TOSHIBA

Optoelectronic
Semiconductors

PHOTO COUPLERS

PHOTO-TRANSISTOR COUPLER
PHOTO-DARLINGTON TRANSISTOR COUPLER
PHOTO-THYRISTOR COUPLER
PHOTO-TRIAC COUPLER
PHOTO-IC COUPLER

DATA BOOK

SUMMER '88 EDITION

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1. General Information

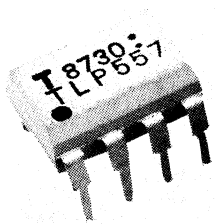
Toshiba is supplying the various type of photocoupler such as Transistor, Darlington Transistor, Thyristor, Triac, IC, Photovaltaic, and Photo MOS FET output in order to control various kind of power.

Photocoupler is optically coupled and electrically isolated device. So one of the important operating parameter in efficiency, which defines the ratio of input current and output current "CTR" in the case of transistor output couplers.

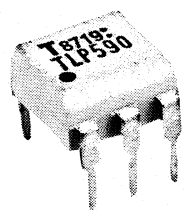
Toshiba achieves the highest CTR coupler in the world by using "White Mold" package technology.

Other parameter is isolation voltage which is AC 5000V rms (1 min.) in Toshiba. Toshiba also has available integrated detector output couplers for data transmission use (Speed up to 10 Mbit/s) and for power control (Up to 15A class power transistor direct drive).

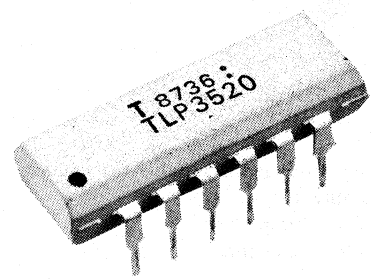
The small package coupler is also available for surface mount.



TLP557



TLP590



TLP3520

2. New Products Digest

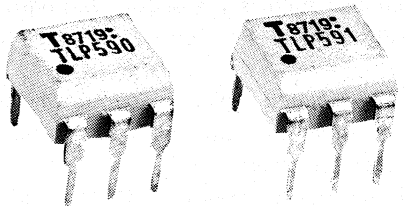
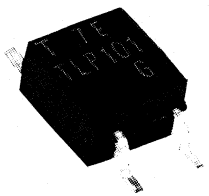


Photo Voltaic Coupler
TLP590/TLP591

TLP590 Photo voltaic coupler can drive directly the gate of power MOS FET transistor.

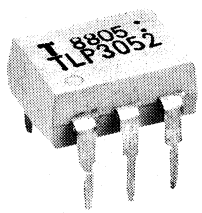
- TLP590 : Non-Internal Shunt Resistor
- TLP591 : Builted-in Shunt Resistor



Mini Flat Photocoupler
TLP101

TLP101 small package is suitable for surface mount assembly use.

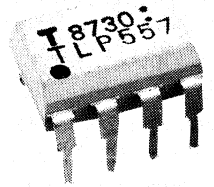
- TLP101 : 1 channel
- TLP101-2 : 2 channel



600V Triac Couplers
TLP3052

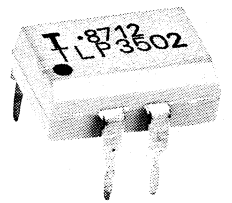
600V Triac Coupler is suitable for 240V AC line power control.

- TLP3051 : I_{FT}=15mA, V_{DRM}=600V
- TLP3052 : I_{FT}=10mA, V_{DRM}=600V

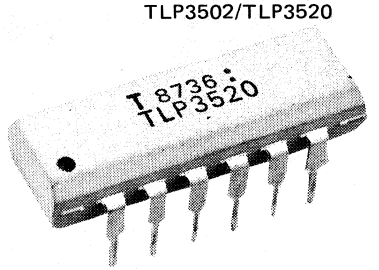


Power Transistor Driver Coupler
TLP557

TLP557 which consists of infrared emitting diode and integrated photo detector is suitable for direct base driving circuit of power transistor up to 20A.



AC Power Photocoupler
TLP3502/TLP3520



AC Power Photocoupler can control 0.5A/1A AC power directly.

- TLP3502 : I_{ON}=0.5A (rms), Non Zero Voltage Crossing, V_{DRM}=400V
- TLP3503 : I_{ON}=0.5A (rms), Zero Voltage Crossing, V_{DRM}=400V
- TLP3520 : I_{ON}=1A (rms), Non Zero Voltage Crossing, V_{DRM}=400V
- TLP3521 : I_{ON}=1A (rms), Zero Voltage Crossing, V_{DRM}=400V

3. Alphanumeric Index

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TLP647G	603
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TLP650	301
TLP651	307
TLP665G	611
TLP665GF	616
TLP665J	617
TLP665JF	621
TLP666G	622
TLP666GF	626
TLP666J	627
TLP666JF	631
TLP675	632
TLP675F	638
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TLP676F	638
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4. Cross Reference

The following Cross-Reference is meant to serve as a guide for existing competitive devices to Toshiba's photocoupler product line.
Toshiba's nearest equivalent devices are selected on the basis of general similarity of electrical characteristics and mechanical configuration. Before using, please compare the detailed specifications of the substitute device to the data sheet of the original.

Code Definitions

A : Direct Replacement
B : Minor Electrical Difference
C : Minor Mechanical Difference
D : Major Electrical Difference
E : Major Mechanical Difference
F : Call TOSHIBA*
G : No Equivalent

*Devices that can be second sourced if volume and pricing warrant.

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PANASONIC 14
NEC 14

SIEMENS

Types	TOSHIBA Types	Code
4N25	4N25	A
4N26	4N26	A
4N27	4N27	A
4N28	4N28	A
4N32	4N32	A
4N33	4N33	A
4N35	4N35	A
4N36	4N36	A
4N37	4N37	A
6N138	6N138	A
6N139	6N139	A
BRT11H	TLP560G	D
BRT11M	TLP560G	D
BRT12H	TLP560J	D
BRT12M	TLP560J	D
BRT21H	TLP561G	D
BRT21M	TLP561G	D
BRT22H	TLP561J	D
BRT22M	TLP561J	D
CNY17-1	TLP535	F
CNY17-2	CNY17-2	C
CNY17-3	CNY17-3	C
CNY17-4	CNY17-4	C
CNY17F-1	TLP732	F
CNY17F-2	TLP732	F
CNY17F-3	TLP732	F
H11AA1	TLP630	A
H11C4	TLP541G	A
H11C5	TLP541G	A
H11C6	TLP541G	A
IL1	TLP631	A
IL2	TLP631(GB)	A
IL5	TLP631	A
IL8	TLP580	E
IL9	TLP581	E
IL10	TLP580(Y)	E
IL11	TLP581(Y)	E
IL30	TLP675	A
IL55	TLP675	D
IL101	6N137	B
IL201	TLP631	F
IL202	TLP631(GB)	F
IL203	TLP631(GB)	F
IL205	TLP101	F
IL206	TLP101	F
IL207	TLP101	F
IL211	TLP101	F
IL212	TLP101	F
IL213	TLP101	F

Types	TOSHIBA Types	Code
IL215	TLP101	F
IL216	TLP101	F
IL217	TLP101	F
IL221	TLP101	G
IL222	TLP101	G
IL223	TLP101	G
IL250	TLP630	A
IL251	TLP630	A
IL252	TLP630(GB)	A
IL256	TLP120	F
IL400	TLP541G	A
IL410	TLP666J	A
IL416	—	G
IL420	TLP665J	A
ILCT6	TLP504A	A
ILD1	TLP504A	A
ILD2	TLP504A(GB)	D
ILD5	TLP504A	D
ILD30	—	G
ILD32	—	G
ILD55	—	G
ILD610-1	—	G
ILD610-2	—	G
ILD610-3	—	G
ILD610-4	—	G
ILQ1	TLP504A-2	A
ILQ2	TLP504A-2(GB)	D
ILQ5	TLP504A-2	D
ILQ30	—	G
ILQ32	—	G
ILQ55	—	G
SFH600-0	TLP731	F
SFH600-1	TLP731	F
SFH600-2	TLP731(GB)	F
SFH600-3	TLP731(GB)	F
SFH601-1	TLP731	F
SFH601-2	TLP731	F
SFH601-3	TLP731(GB)	F
SFH601-4	TLP731(GB)	F
SFH601G-1	TLP731(LF2)	F
SFH601G-2	TLP731(LF2)	F
SFH601G-3	TLP731(LF2)	F
SFH601G-4	TLP731(LF2)	F
SFH609-1	—	G
SFH609-2	—	G
SFH609-3	—	G
SFK610-1	TLP621	F
SFK610-2	TLP621	F
SFK610-3	TLP621(GR)	F

SIEMENS

Types	TOSHIBA Types	Code
SFK610-4	TLP621(GR)	F
SFK611-1	TLP621	F
SFK611-2	TLP621	F
SFK611-3	TLP621(GR)	F
SFK611-4	TLP621(GR)	F

TELEFUNKEN

4N25	4N25	A
4N26	4N26	A
4N27	4N27	A
4N32	4N32	A
4N33	4N33	A
4N35	4N35	A
4N36	4N36	A
4N37	4N37	A
4N38A	4N38A	A
CNR21	—	G
CNY18	—	G
CNY21	TLP580	E
CNY64	TLP580	E
CNY65	TLP580	E
CNY66	—	G
CNY71	TLP630	F
CNY74-2	TLP504A	F
CNY74-4	TLP504A-2	F
CNY75A	TLP731	F
CNY75B	TLP731(GB)	F
CNY75C	TLP731(GB)	F
CNY75G	TLP731(LF2)	F
CQY80N	TLP731	A
CQY80NG	TLP731(LF2)	A
K827P	TLP621-2	F
K847P	TLP621-4	F
K3010P	TLP3010	A
K3010PG	TLP3010(LF2)	A
K3020P	TLP3020	A
K3020PG	TLP3020(LF2)	A
K8013P	—	G
K8031P	—	G

MOTOROLA

4N25	4N25	A
4N25A	4N25A	A
4N26	4N26	A
4N27	4N27	A
4N28	4N28	A
4N29	4N29	A
4N29A	4N29A	A
4N30	4N30	A

Types	TOSHIBA Types	Code
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4N32A	4N32A	A
4N33	4N33	A
4N35	4N35	A
4N36	4N36	A
4N37	4N37	A
4N38	4N38	A
4N38A	4N38A	A
4N39	TLP541G	B
CNY17-1	TLP535	F
CNY17-2	CNY17-2	A
CNY17-3	CNY17-3	A
CNY17-4	CNY17-4	A
H11A1	TLP631	A
H11A2	TLP631	A
H11A3	TLP631	A
H11A4	TLP631	A
H11A5	TLP631	A
H11A520	TLP631	A
H11A550	TLP631	A
H11A5100	TLP631(GB)	A
H11AA1	TLP630	A
H11AA2	TLP630	A
H11AA3	TLP630	A
H11AA4	TLP630(GB)	A
H11B1	TLP571	A
H11B2	TLP575	A
H11B3	TLP575	A
H11B255	TLP575	B
H11C1	TLP541G	A
H11C2	TLP541G	A
H11C3	TLP541G	A
H11D1	TLP335	A
H11D2	TLP335	A
H11D3	TLP335	A
H11D4	TLP335	A
H11G1	TLP371	A
H11G2	TLP371	A
H11G3	TLP572	A
H11J1	TLP665G	A
H11J2	TLP665G	A
H11J3	TLP665G	A
H11J4	TLP665G	A
H11J5	TLP665G	A
H11L1	—	G
H11L2	—	G
H74C1	TLP541G	A
IL1	TLP631	A

MOTOROLA

Types	TOSHIBA Types	Code
IL12	TLP631	A
IL74	TLP631	A
MCA230	TLP575	A
MCA231	TLP575	A
MCA255	TLP575	F
MCS2	TLP541G	A
MCT2	TLP535	A
MCT2E	TLP535	A
MCT26	TLP535	A
MCT271	TLP535	F
MCT272	TLP535(GR)	F
MCT273	TLP535(GR)	F
MCT274	TLP535(BL)	F
MCT275	TLP535(GR)	F
MCT277	TLP535(GB)	F
MCT2200	TLP631	A
MCT2201	TLP631(GB)	A
MOC119	TLP570	A
MOC601A,B	TLP731	A
MOC602A,B	TLP731	A
MOC603A,B	TLP731	A
MOC604A,B	TLP731(GB)	A
MOC622A,B	TLP675	A
MOC623A,B	TLP675	A
MOC624A,B	TLP675	A
MOC625A,B	TLP675	A
MOC626A,B	TLP676	A
MOC627A,B	TLP676	A
MOC628A,B	TLP676	A
MOC629A	TLP676	A
MOC633A,B	TLP665G	A
MOC634A,B	TLP665G	A
MOC635A,B	TLP665G	A
MOC640A,B	TLP666G	A
MOC641A,B	TLP666G	A
MOC1005	TLP631	A
MOC1006	TLP631	A
MOC3002	TLP541G	A
MOC3003	TLP541G	A
MOC3007	TLP541G	A
MOC3009	TLP3009	A
MOC3010	TLP3010	A
MOC3011	TLP3011	A
MOC3012	TLP3012	A
MOC3020	TLP3020	A
MOC3021	TLP3021	A
MOC3022	TLP3022	A
MOC3023	TLP3023	A
MOC3030	TLP3031	A

Types	TOSHIBA Types	Code
MOC3031	TLP3031	A
MOC3032	TLP3032	A
MOC3040	TLP3041	A
MOC3041	TLP3041	A
MOC3060	TLP3061	A
MOC3061	TLP3061	A
MOC3062	TLP3062	A
MOC3063	TLP3063	A
MOC5007	—	G
MOC5008	—	G
MOC5009	—	G
MOC8020	TLP372	A
MOC8021	TLP372	A
MOC8030	TLP372	A
MOC8050	TLP372	A
MOC8100	TLP631(GB)	A
MOC8111	TLP632	A
MOC8112	TLP632	A
MOC8113	TLP632(GB)	A
MOC8204	TLP335	D
MOC8205	TLP335	D
MOC8206	TLP335	D
TIL111	TLP535	A
TIL112	TLP535	A
TIL113	TLP575	A
TIL114	TLP535	A
TIL115	TLP535	A
TIL116	TLP535	A
TIL117	TLP535	A
TIL118	TLP536	A
TIL119	TLP570	A
TIL124	TLP631	A
TIL125	TLP631	A
TIL126	TLP631	A
TIL127	TLP675	A
TIL128	TLP676	A
TIL153	TLP535	A
TIL154	TLP535	A
TIL155	TLP535	A
TIL156	TLP675	A
TIL157	TLP676	A

GENERAL ELECTRIC

4N25	4N25	A
4N25A	4N25A	A
4N26	4N26	A
4N27	4N27	A
4N28	4N28	A
4N29	4N29	A

GENERAL ELECTRIC

Types	TOSHIBA Types	Code
4N29A	4N29A	A
4N30	4N30	A
4N31	4N31	A
4N32	4N32	A
4N32A	4N32A	A
4N33	4N33	A
4N35	4N35	A
4N35	4N35	A
4N36	4N36	A
4N37	4N37	A
4N38	4N38	A
4N38A	4N38A	A
4N39	TPL541G	A
4N40	TPL541G	A
H11A1	TLP535	A
H11A2	TLP535	A
H11A3	TLP535	A
H11A4	TLP535	A
H11A5	TLP535	A
H11A10	TLP535	A
H11A520	TLP631	A
H11A550	TLP631	A
H11A5100	TLP631(GB)	A
H11AA1	TLP630	A
H11AA2	TLP630	A
H11AA3	TLP630	A
H11AA4	TLP630(GB)	A
H11AG1	TLP331	A
H11AG2	TLP331(BV)	A
H11AG3	TLP331(BV)	B
H11AV1	TLP735(GB)	B
H11AV1A	TLP735F(GB)	B
H11AV2	TLP735(GB)	A
H11AV2A	TLP735F(GB)	A
H11AV3	TLP735	A
H11AV3A	TLP735F	A
H11B1	TLP571	A
H11B2	TLP575	A
H11B3	TLP575	A
H11B255	TLP575	B
H11BX522	TLP575	A
H11C1	TLP541G	A
H11C2	TLP541G	A
H11C3	TLP541G	A
H11C4	TLP541G	A
H11C5	TLP541G	A
H11C6	TLP541G	A
H11D1	TLP335	A
H11D2	TLP335	A
H11D3	TLP335	A
H11D4	TLP335	A
H11F1	—	G
H11F2	—	G
H11F3	—	G
H11G1	TLP371	A
H11G2	TLP371	A
H11G3	TLP572	A
H11G45	TLP675	F
H11G46	TLP675	F
H11J1	TLP665G	A
H11J2	TLP665G	A
H11J3	TLP560G	A
H11J4	TLP560G	A
H11J5	TLP560G	A
H11L1	—	G
H11L2	—	G
H11L3	—	G
H74A1	TLP535	A
H74C1	TLP541G	A
H74C2	TLP541G	A
CNY17- I	TLP535	F
CNY17-II	CNY17-1	A
CNY17-III	CNY17-2	A
CNY17-IV	CNY17-3	A
CNY30	TLP541	A
CNY31	—	G
CNY32	TLP621	F
CNY33	TLP335	A
CNY34	TLP541G	A
CNY35	TLP630	A
CNY47	TLP535	F
CNY47A	TLP535	A
CNY48	TLP571	A
CNY51	TLP731(GB)	A
CQY80	TLP631	A
GE3009	TLP3009	A
GE3010	TLP3010	A
GE3011	TLP3011	A
GE3012	TLP3012	A
GE3020	TLP3020	A
GE3021	TLP3021	A
GE3022	TLP3022	A
GE3023	TLP3023	A
GEPS2001	TLP731	A
GFH600- I	TLP731	F
GFH600-II	TLP731(GB)	F
GFH600-III	TLP731(GB)	F
GFH601- I	TLP731	F

GENERAL ELECTRIC

Types	TOSHIBA Types	Code
GFH601-II	TLP731	F
GFH601-III	TLP731(GB)	F
GFH601-IV	TLP731(GB)	F

GENERAL INSTRUMENTS

Types	TOSHIBA Types	Code
4N25	4N25	A
4N26	4N26	A
4N27	4N27	A
4N28	4N28	A
4N29	4N29	A
4N30	4N30	A
4N31	4N31	A
4N32	4N32	A
4N33	4N33	A
4N35	4N35	A
4N36	4N36	A
4N37	4N37	A
6N135	6N135	A
6N136	6N136	A
6N137	6N137	A
6N138	6N138	A
6N139	6N139	A
740L6000	—	G
740L6001	—	G
740L6010	—	G
740L6011	—	G
CNY17-1	TLP535	F
CNY17-2	CNY17-2	A
CNY17-3	CNY17-3	A
CNY17-4	CNY17-4	A
CNY17-1Z	TLP731	F
CNY17-2Z	TLP731	F
CNY17-3Z	TLP731(GB)	F
CNY17-4Z	TLP731(GB)	F
CNY65	TLP580	E
CNX35	TLP631	F
CNX36	TLP631(GB)	A
H11A1/1Z	TLP731	A
H11AA1	TLP630	A
H11AA2	TLP630	A
H11AA3	TLP630	A
H11AA4	TLP630(GB)	A
H11D1/1Z	TLP335	A
H11D2/2Z	TLP335	A
H11D3/3Z	TLP335	A
H11G1	TLP371	A
H11G2	TLP371	A
H11G3	TLP371	A
HCPL2502	TLP551	F
HCPL2503	TLP551	F
HCPL2530	TLP2530	A
HCPL2531	TLP2531	A
HCPL2601	TLP2601	A
HCPL2630	TLP2630	A
HCPL2631	TLP2631	A
MCA11G1	TLP371	A
MCA11G2	TLP371	A
MCA11G3	TLP371	A
MCA230	TLP575	A
MCA231	TLP575	A
MCA255	TLP575	B
MCA2230/Z	TLP675	A
MCA2231/Z	TLP675	A
MCA2255/Z	TLP675	B
MCL2501	TLP551	F
MCL2502	TLP551	F
MCL2503	TLP551	F
MCL2530	TLP2530	A
MCL2531	TLP2531	A
MCL2601	TLP2601	A
MCL2630	TLP2630	A
MCP3009	TLP3009	A
MCP3010	TLP3010	A
MCP3011	TLP3011	A
MCP3011A	TLP3011	A
MCP3012	TLP3012	A
MCP3020/0Z	TLP3020	A
MCP3021/1Z	TLP3021	A
MCP3022/2Z	TLP3022	A
MCP3022A	TLP3022	A
MCP3023	TLP3023	A
MCP3030	TLP3031	A
MCP3031	TLP3031	A
MCP3032	TLP3032	A
MCP3033	TLP3033	A
MCP3040/0Z	TLP3041	A
MCP3041/1Z	TLP3041	A
MCP3042	TLP3042	A
MCP3043	TLP3043	A
MCS2	TLP541G	A
MCS21	TLP541G	A
MCS2400	TLP541G	A
MCS2401	TLP541G	A
MCT2	TLP535	A
MCT2E	TLP535	A
MCT4	—	G
MCT4R	—	G
MCT6	TLP504A	A

GENERAL INSTRUMENTS

Types	TOSHIBA Types	Code
MCT26	TLP535	A
MCT61	TLP504A	A
MCT62	TLP504A(GB)	A
MCT66	TLP504A	A
MCT210	TLP535(BL)	F
MCT270	TLP535	A
MCT271	TLP535	F
MCT272	TLP535(GR)	F
MCT273	TLP535(GR)	F
MCT274	TLP535(BL)	F
MCT275	TLP535(GR)	F
MCT276	TLP535	F
MCT277	TLP535(GB)	A
MCT2200/0Z	TLP731	A
MCT2201/1Z	TLP731(GB)	A
MCT2202/2Z	TLP731	F
MCT5200	TLP535(GB)	F
MCT5201	TLP535(GB)	F
MCT5210	TLP331	A
MCT5211	TLP331(BV)	A
MID400	—	G
GIC5102	TLP521-1	A
GIC5102-2	TLP521-2	A
GIC5102-3	TLP521-3	A
GIC5102-4	TLP521-4	A

HEWLETT PACKARD

6N135	6N135	A
6N136	6N136	A
6N137	6N137	A
6N138	6N138	A
6N139	6N139	A
HCPL-2200	TLP2200	A
HCPL-2300	—	G
HCPL-2400	—	G
HCPL-2502	TLP551	F
HCPL-2503	TLP551	F
HCPL-2530	TLP2530	A
HCPL-2531	TLP2531	A
HCPL-2601	TLP2601	A
HCPL-2630	TLP2630	A
HCPL-2631	TLP2631	A
QCPL-4502	TLP550	F
SL5505	—	G

TRW-OPTRON

3N243	—	G
3N243R	—	G
3N244	—	G
3N244R	—	G
3N245	—	G
3N245R	—	G
4N22A	—	G
4N23A	—	G
4N24A	—	G
4N25	4N25	A
4N26	4N26	A
4N27	4N27	A
4N28	4N28	A
4N29	4N29	A
4N30	4N30	A
4N31	4N31	A
4N32	4N32	A
4N33	4N33	A
4N35	4N35	A
4N36	4N36	A
4N37	4N37	A
4N38	4N38	A
4N38A	4N38A	A
4N45	—	G
4N46	—	G
6N135	6N135	A
6N136	6N136	A
6N137	6N137	A
6N138	6N138	A
6N139	6N139	A
CNY17/ I	TLP535	F
CNY17/II	CNY17-2	A
CNY17/III	CNY17-3	A
CNY17/IV	CMY17-4	A
OPI102	—	G
OPI103	—	G
OPI110	TLP580	E
OPI113	—	G
OPI120	TLP580	E
OPI123	—	G
OPI125	—	G
OPI126	—	G
OPI127	—	G
OPI128	—	G
OPI130	—	G
OPI140	—	G
OPI150	—	G
OPI153	—	G
OPI1264A	TLP580	E
OPI1264B	TLP580	E
OPI1264C	TLP580	E
OPI2100	TLP631(GB)	A

TRW-OPTRON

Types	TOSHIBA Types	Code
OPI2150	TLP535	A
OPI2151	TLP535	A
OPI2152	TLP535	A
OPI2153	TLP535	A
OPI2154	TLP535(GB)	A
OPI2155	TLP535(GB)	A
OPI2156	TLP535(GB)	A
OPI2250	TLP535	A
OPI2251	TLP535	A
OPI2252	TLP535	A
OPI2254	TLP535(GB)	A
OPI2255	TLP535(GB)	A
OPI2500	TLP630	A
OPI2501	TLP630	A
OPI3009	TLP3009	A
OPI3010	TLP3010	A
OPI3011	TLP3011	A
OPI3012	TLP3012	A
OPI3020	TLP3020	A
OPI3021	TLP3021	A
OPI3022	TLP3022	A
OPI3023	TLP3023	A
OPI3030	TLP3031	B
OPI3031	TLP3031	A
OPI3032	TLP3032	A
OPI3033	TLP3033	A
OPI3040	TLP3041	B
OPI3041	TLP3041	A
OPI3042	TLP3042	A
OPI3043	TLP3043	A
OPI3150	TLP575	A
OPI3151	TLP575	A
OPI3152	TLP575	F
OPI3153	TLP575	A
OPI3250	TLP575	A
OPI3251	TLP575	A
OPI3252	TLP575	F
OPI3253	TLP575	A
OPI6000	—	G
OPI6100	—	G
OPI7002	TLP580	E
OPI7010	TLP580	E
OPI7320	—	G
OPI7340	—	G
OPI8012	—	G
OPI8013	—	G
OPI8014	—	G
OPI8015	—	G

TEXAS INSTRUMENTS

Types	TOSHIBA Types	Code
3N261	—	G
3N262	—	G
3N263	—	G
4N22	—	G
4N23	—	G
4N24	—	G
4N25	4N25	A
4N26	4N26	A
4N27	4N27	A
4N28	4N28	A
4N35	4N35	A
4N36	4N36	A
4N37	4N37	A
4N47	—	G
4N48	—	G
4N49	—	G
MCT2	TLP535	A
MCT2E	TLP631	A
TIL102	—	G
TIL103	—	G
TIL107	—	G
TIL108	—	G
TIL111	TLP535	A
TIL112	TLP535	A
TIL113	TLP575	A
TIL114	TLP535	A
TIL115	TLP535	A
TIL116	TLP535	A
TIL117	TLP535	A
TIL118	TLP536	A
TIL119	TLP570	A
TIL119A	TLP570	A
TIL120	—	G
TIL121	—	G
TIL124	TLP631	A
TIL125	TLP631	A
TIL126	TLP631	A
TIL127	TLP675	A
TIL128	TLP676	A
TIL128A	TLP676	A
TIL153	TLP535	A
TIL154	TLP535	A
TIL155	TLP535	A
TIL156	TLP675	A
TIL157	TLP676	A
TIL157A	TLP676	A

SHARP

PC4N25	4N25	A

Types	TOSHIBA Types	Code
PC4N26	4N26	A
PC4N27	4N27	A
PC4N28	4N28	A
PC4N29	4N29	A
PC4N30	4N30	A
PC4N32	4N32	A
PC4N33	4N33	A
PC4N35	4N35	A
PC4N36	4N36	A
PC4N37	4N37	A
PC508	TLP580	E
PC511	TLP580	E
PC702	TLP531	A
PC703	TLP531	A
PC713	TLP531	A
PC714	TLP532	A
PC715	TLP570	B
PC716	TLP570	B
PC723	TLP531	A
PC725	TLP371	A
PC733	TLP630	A
PC733H	TLP330	A
PC801	TLP101	C
PC810	TLP621	A
PC812	TLP621	B
PC813	TLP626	A
PC814	TLP620	A
PC815	TLP523	B
PC816	TLP321	A
PC817	TLP621	A
PC818	TLP621	B
PC818I	TLP621(LF1)	A
PC823	TLP626-2	A
PC824	TLP620-2	A
PC825	TLP523-2	B
PC826	TLP321-2	A
PC827	TLP621-2	A
PC829	TLP504A	B
PC835	TLP523-3	B
PC837	TLP621-3	A
PC843	TLP626-4	A
PC844	TLP620-4	A
PC845	TLP523-4	B
PC846	TLP321-4	A
PC847	TLP621-4	A
PC849	TLP504A-2	B
PC910	TLP552	A
S11MD3	TLP560G	A
S11MD3H	TLP560J	A

Types	TOSHIBA Types	Code
S12MD1	TLP541G	A
S12MD2	—	G
S12MD22	—	G
S12MD3	TLP511GA	A
S13MD1	TLP541G	A
S13MD3	TLP511GA	A
S21MD3	TLP560J	A
S21MD4	TLP561J	A
S22MD1	TLP541J	A
S22MD3	TLP611J	A

PANASONIC

ON3100	TLP535	A
ON3105	TLP580	E
ON3110	TLP536	A
ON3111	TLP521-1	A
ON3112	TLP521-2	A
ON3161	TLP621	A
ON3162	TLP621-2	A
ON3164	TLP621-4	A

NEC

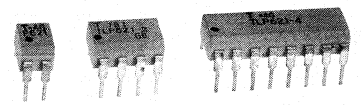
PS2006B	TLP551	A
PS2007B	TLP552	A
PS2016B	TLP550	A
PS2401-1	TLP621	A
PS2403-1	TLP624	A

5. Selection Guide

5–1 4 pin DIP & Multichannel Photocouplers

4 pin DIP & multichannel photocouplers are capable of high-density mounting by incorporating one circuit into a 4 pin DIP small-sized package.

PACKAGE STYLE



11-5B1 11-10C1 11-20A1

Transistor Output & AC input

Type: Single Channel 4 pin DIP	Type: Dual Channel 8 pin DIP	Type: Quad Channel 16 pin DIP	Features	Current Transfer Ratio (CTR): Rank	Min. (%)	Max. (%)	@ I_F (mA)	Low Input CTR: Min. (%)	@ I_F (mA)	Collector Breakdown Voltage $V_{(BR)CEO}$ (V)	Isolation Voltage BVs (Vrms)
TLP521-1	TLP521-2	TLP521-4	High EMR environments High CTR	A	50	600	5	—	—	55	2500
				GB	100	600	5	30	1		
				GR**	100	300	5	30	1		
				BL**	200	600	5	30	1		
TLP621	TLP621-2	TLP621-4	High isolation High CTR	—	50	600	5	—	—	55	5000
				GB	100	600	5	30	1		
				GR**	100	300	5	30	1		
				BL**	200	600	5	30	1		
TLP624	TLP624-2	TLP624-4	Low input current	—	100	—	1	50	0.5	55	5000
				BV	200	—	1	100	0.5		
NEW TLP321	TLP321-2	TLP321-4	High V_{CEO} High CTR	—	50	—	5	—	—	80	5000
				GB	100	—	5	30	1		
—	TLP504A	TLP504A-2	High EMR environments High CTR	—	50	600	5	—	—	55	2500
				GB	100	600	5	30	1		
TLP620	TLP620-2	TLP620-4	AC input	—	50	600	±5	—	±1	55	5000
				GB	100	600	±5	30	±1		
TLP626	TLP626-2	TLP626-4	AC input Low input current	—	100	—	±1	50	±0.5	55	5000
				BV	200	—	±1	100	±0.5		

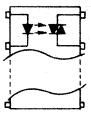
** 4 ch. type is not available with there CTR rankings.

Resistor–Darlington Transistor Output

Type: Single Channel 4 pin DIP	Type: Dual Channel 8 pin DIP	Type: Quad Channel 16 pin DIP	Features	Current Transfer Ratio (CTR): Min. (%)	@ I_F (mA)	@ V_{CE} (V)	Saturation Voltage V_{CE} (sat): Max. (V)	@ I_C (mA)	@ I_F (mA)	Collector Breakdown Voltage $V_{(BR)CEO}$ (V)	Isolation Voltage BVs (Vrms)
TLP523	TLP523-2	TLP523-4	Low input current High CTR	1000	1	1	1.0	50	10	55	2500
TLP627	TLP627-2	TLP627-4	Low input current High V_{CEO}	1000	1	1	1.2	100	10	300	5000

4 pin DIP & Multichannel Photocouplers (continued)

Triac Output

	Type			Features	LED Trigger Current-I_{FT} (V_{TM}=3V) Max. (mA)	dV/dt Typ. (V/μS)	Blocking Voltage V_{DRM} (V)	Isolation Voltage BVs (Vrms)
	Single Channel 4 pin DIP	Dual Channel 8 pin DIP	Quad Channel 16 pin DIP					
	**TLP525G**	**TLP525G-2**	**TLP525G-4**	Low input current	10	500	400	2500

5–2 6 pin DIP Photocouplers

6 pin DIP photocouplers use Toshiba's white epoxy mold, realizing high isolation voltage, sensitivity, and current transfer ratio. VDE recognized products are available for various types.

PACKAGE STYLE

11-7A1 11-7B1 11-9A2

Transistor Output

Type		Features	Current Transfer Ratio (CTR)					Low Input CTR			Collector Breakdown Voltage $V_{(BR)CEO}$ (V)	Isolation Voltage BVs (Vrms)
	No Base Connection		Rank	Min. (%)	Max. (%)	@ I_F (mA)	@ V_{CE} (V)	Min. (%)	@ I_F (mA)	@ V_{CE} (V)		
4N25(SHORT)	–	Direct replacement for JEDEC type	–	20	–	10	10	–	–	–	30	2500
4N25A(SHORT)	–		–	20	–	10	10	–	–	–	30	2500
4N26(SHORT)	–		–	20	–	10	10	–	–	–	30	2500
4N27(SHORT)	–		–	20	–	10	10	–	–	–	30	2500
4N28(SHORT)	–		–	20	–	10	10	–	–	–	30	2500
4N35(SHORT)	–		–	100	–	10	10	–	–	–	30	2500
4N36(SHORT)	–		–	100	–	10	10	–	–	–	30	2500
4N37(SHORT)	–		–	100	–	10	10	–	–	–	30	2500
4N38(SHORT)	–		–	10	–	10	10	–	–	–	80	2500
4N38A(SHORT)	–		–	10	–	10	10	–	–	–	80	2500
CNY17-2	–	Double width of CTR Min/Max Ratio	–	63	125	10	5	–	–	–	70	4400 (VDC)
CNY17-3	–		–	100	200	10	5	–	–	–		
CNY17-4	–		–	160	320	10	5	–	–	–		

6 pin DIP Photocouplers (continued)

Transistor Output

Type		Features	Current Transfer Ratio (CTR)					Low Input CTR			Collector Breakdown Voltage $V_{(BR)CEO}$ (V)	Isolation Voltage BVs (Vrms)
	No Base Connection		Rank	Min. (%)	Max. (%)	@ I_F (mA)	@ V_{CE} (V)	Min. (%)	@ I_F (mA)	@ V_{CE} (V)		
TLP535(SHORT)	—	High CTR	—	50	600	10	10	—	—	—	55	2500
			GB	100	600	10	10	30	1	0.4		
			GR	100	300	10	10	30	1	0.4		
			BL	200	600	10	10	30	1	0.4		
TLP631	TLP632	High isolation	—	50	600	5	5	—	—	—	55	5000
			GB	100	600	5	5	30	1	0.4		
			GR	100	300	5	5	30	1	0.4		
			BL	200	600	5	5	30	1	0.4		
TLP731	TLP732	High isolation Desinged to clear VDE 0806	—	50	600	5	5	—	—	—	55	4000
			GB	100	600	5	5	30	1	0.4		
			GR	100	300	5	5	30	1	0.4		
NEW TLP331	TLP332	Low input current	—	100	—	1	0.5	50	0.5	1.5	55	5000
			BV	200	—	1	0.5	100	0.5	1.5		
NEW TLP735	TLP736	Desinged to clear VDE 0700	—	50	600	5	5	—	—	—	55	5000
			GB	100	600	5	5	30	1	0.4		
☆ TLP335*	TLP336*	High V_{CEO} High isolation	—	25	—	5	5	—	—	—	300	5000

* Scheduled for marketing from the summer of 1988.

AC Input – Transistor Output

Type		Features	Current Transfer Ratio (CTR)					Low Input CTR			Collector Breakdown Voltage $V_{(BR)CEO}$ (V)	Isolation Voltage BVs (Vrms)
	No Base Connection		Rank	Min. (%)	Max. (%)	@ I_F (mA)	@ V_{CE} (V)	Min. (%)	@ I_F (mA)	@ V_{CE} (V)		
TLP630	—	AC input High isolation	—	50	—	± 5	5	—	—	—	55	5000
			GB	100	—	± 5	5	30	±1	0.4		
NEW TLP330	—	AC input 150mA IF Rating	—	25	—	±20	1	—	—	—	55	5000

Darlington Transistor Output

Type		Features	Current Transfer Ratio (CTR)			Saturated CTR			Saturation Voltage V_{CE} (sat)			Collector Breakdown Voltage $V_{(BR)CEO}$ (V)	Isolation Voltage BVs (Vrms)
	No Base Connection		Min. (%)	@ I_F (mA)	@ V_{CE} (V)	Min. (%)	@ I_F (mA)	@ V_{CE} (V)	Max. (V)	@ I_C (mA)	@ I_F (mA)		
4N29(SHORT)	—	Direct replacement for JEDEC type	100	10	10	—	—	—	1.0	2	8	30	2500
4N29A(SHORT)	—		100	10	10	—	—	—	1.0	2	8	30	2500
4N30(SHORT)	—		100	10	10	—	—	—	1.0	2	8	30	2500
4N31(SHORT)	—		50	10	10	—	—	—	1.2	2	8	30	2500
4N32(SHORT)	—		500	10	10	—	—	—	1.0	2	8	30	2500
4N32A(SHORT)	—		500	10	10	—	—	—	1.0	2	8	30	2500
4N33(SHORT)	—		500	10	10	—	—	—	1.0	2	8	30	2500
TLP575(SHORT)		High CTR	200	1	1	—	—	—	1.0	1	1	35	2500
TLP570	TLP571	High CTR	1000	1	1	500	10	1	1.2	100	10	35	2500
—	TLP572	Resistor-Darlington	1000	1	1.2	—	—	—	1.2	100	10	55	2500
NEW TLP371	TLP372	300V High V_{CEO}	1000	1	1	500	10	1	1.2	100	10	300	5000

6 pin DIP Photouplers
Thyristor Output

Type	Features	LED Trigger Current-I_{FT} (R_{GK}=27KΩ) Max. (mA)	Holding Current I_H Typ. (μA)	dV/dt Typ. (V/μs)	Blocking Voltage V_{DRM} (V)	Isolation Voltage BVs (Vrms)
TLP541G	Low I_{FT}	7	200	10	400	2500
TLP741G	Designed to clear VDE 0806	10	200	10	400	4000
TLP741J		10	200	10	600	4000
(NEW) **TLP745G**	Designed to clear VDE 0700	10	200	10	400	5000
(NEW) **TLP745J**		10	200	10	600	5000

Triac Output

Type	With Zero Crossing	Features	LED Trigger Current-I_{FT} Max. (mA)	Zero Crossing Inhibit Voltage (at rated I_{FT}) Max. (V)	dV/dt Typ. (V/μs)	Blocking Voltage V_{DRM} (V)	Isolation Voltage BVs (Vrms)
TLP3009	–	Direct replacement for Industrial Standard Type of MOC3000 MCT3000 Series Designed to clear VDE0806	30	–	500	250	5000
TLP3010	–		15	–	500	250	5000
TLP3011	–		10	–	500	250	5000
TLP3012	–		5	–	500	250	5000
TLP3020	–		30	–	500	400	5000
TLP3021	–		15	–	500	400	5000
TLP3022	–		10	–	500	400	5000
TLP3023	–		5	–	500	400	5000
–	**TLP3031**		15	40	500	250	5000
–	**TLP3032**		10	40	500	250	5000
–	**TLP3033**		5	40	500	250	5000
–	**TLP3041**		15	40	500	400	5000
–	**TLP3042**		10	40	500	400	5000
–	**TLP3043**		5	40	500	400	5000
(NEW) **TLP3051**	–		15	–	500	600	5000
(NEW) **TLP3052**	–		10	–	500	600	5000
–	**TLP3061**		15	50	500	600	5000
–	**TLP3062**		10	50	500	600	5000
–	**TLP3063**		5	50	500	600	5000
TLP560G	–	Low I_{FT}	– 10 IFT7 7 IFT5 5	–	500	400	2500
TLP560J	–		– 10 IFT7 7	–	500	600	2500
–	**TLP561G**		– 10 IFT7 7 IFT5 5	40	500	400	2500
–	**TLP561J**		– 10 IFT7 7	50	500	600	2500
(NEW) –	**TLP766G**	Designed to clear VDE0700	– 10	40	500	400	5000
(NEW) –	**TLP766J**		– 10	50	500	600	5000

5–3 High Speed Photo-IC Photocouplers

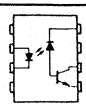
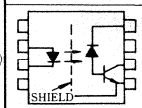
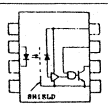
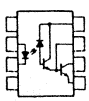
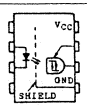
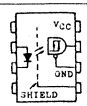
High-speed photocouplers are ideal for use on high-speed interfaces for linking peripheral devices, including various control equipment, measuring instruments, and office equipment.

PACKAGE STYLE

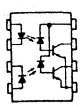
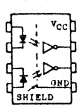
11-10C1

11-10C1

Single – channel

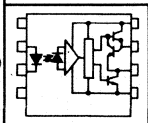
Type		Features	Output Current				Data Rate	Supply Voltage	Isolation Voltage
			Rank	Min. (mA)	@ I_F (mA)	@ V_O (V)	(NRZ) Typ. (bit/S)	Vcc (V)	BVs (Vrms)
	**TLP550**	No base connection Transistor output	–	1.6	16	0.4	1M	15	2500
			0	3.04	16	0.4			
	TLP650	No base connection High isolation	–	1.6	16	0.4	1M	15	5000
			0	3.04	16	0.4			
NEW 	**TLP559**	No base connection With internal shield	–	3.2	16	0.4	1M	15	2500
	6N135	JEDEC Type Transistor output	–	1.12	16	0.4	1M	15	2500
	6N136		–	3.04	16	0.4	1M	15	2500
	TLP651	High isolation Transistor output	–	1.6	16	0.4	1M	15	5000
			0	3.04	16	0.4			
	**6N137**	JEDEC Type High speed No shield	–	13	5	0.6	10M	5	2500
	TLP2601	High CMR High speed	–	13	5	0.6	10M	5	2500
	**6N138**	JEDEC Type Low input current	–	4.8	1.6	0.4	100K	7	2500
	6N139		–	8.0	1.6	0.4	100K	18	2500
			–	2.0	0.5	0.4			
	**TLP558**	3 state output Inverter logic	–	6.4	1.6	0.4	5M	20	2500
			–	-2.4	0	2.4			
	**TLP2200**	3 state output Buffer logic	–	6.4	0	0.5	5M	20	2500
			–	-2.4	1.6	2.4			

Dual – channel

	**TLP2530**	Dual channel of 6N135	–	1.12	16	0.4	1M	15	2500
	TLP2531	Dual channel of 6N136	–	3.04	16	0.4	1M	15	2500
	**TLP2630**	Dual channel of 6N137 No shield	–	13	5	0.6	10M	5	2500
	TLP2631	Dual Channel of TLP2601	–	13	5	0.6	10M	5	2500

High Speed Photocouplers (continued)

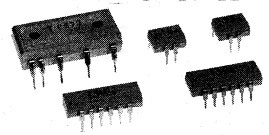
Power Transister Driver

Type		Features	Output Current			Propagation Delay time (Typ.)	Supply Voltage	Isolation Voltage
			Io (Typ.) (A)	@ IF (mA)	Rex (Ω)	(μS)	Vcc (V)	BVs (Vrms)
NEW 	TLP557	Power transistor direct drive High speed	0.25	5	2.7	1	16	2500

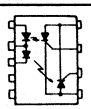
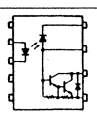
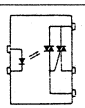
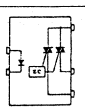
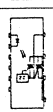
5-4 Photocoupled Relays

Photocoupled relays perform as ideal control elements for load ON / OFF operation from 0.5A to 1A.

PACKAGE STYLE



11-30A1A 11-20A2

Type		Features	LED Trigger Current-IFT		Zerro Crossing Inhibit Voltage Max. (V)	On State Current ION (A)	Off State Voltage VOFF (V)	Isolation Voltage BVs (Vrms)
			Rank	IFT Max. (mA)				
	TLP546G	High power output (1A)	—	10	—	1(rms)	400	2500
	TLP573	High power output (1A)	—	10	—	1(dc)	80	2500
NEW 	TLP3502	0.5 Arms load direct control	—	10	—	0.5(rms)	400	2500
			IFT7	7				
			IFT5	5				
☆	TLP3506*		—	10	—	0.5(rms)	600	2500
NEW 	TLP3503	0.5 Arms load direct control Zero voltage turn-on	—	10	40	0.5(rms)	400	2500
			IFT7	7				
			IFT5	5				
☆	TLP3507*		—	10	50	0.5(rms)	600	2500
NEW	TLP3520	1 Arms load direct control	—	10	—	1(rms)	400	2500
			IFT7	7				
			IFT5	5				
☆	TLP3526*		—	10	—	1(rms)	600	2500
NEW 	TLP3521	1 Arms load direct control Zero voltage turn-on	—	10	40	1(rms)	400	2500
			IFT7	7				
			IFT5	5				
☆	TLP3527*		—	10	50	1(rms)	600	2500

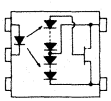
*Scheduled for marketing from the summer of 1988

5–5 Photovoltaic Couplers

This component consists of a solar-cell type photodiode array and an infrared-light-emitting LED.
The photodiode array is formed through the use of Toshiba's independently developed silicon direct-bonding technology to conncet multiple diodes in series.
The photodiode array and infrared-light-emitting LED are optically coupled to each other but electrically isolated from each other.
The electric signal flowing into the infrared-light-emitting LED produces a light signal hitting the photodiode arrays, causing the generation of a photovoltage.
In other words, TTL output current generates an electrically insulated electromotive force. Using this electromotive force to drive a power MOS FET permits the power system to be driven in complete isolation from the control signal system. MOS FETs are conventionally driven by using transistor couplers but that requires an external power supply for the gate drive. Because the photovoltaic coupler generates enough electromotive force, it can drive gates directly with no external power supply.

PACKAGE STYLE

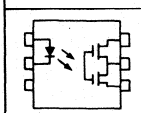
11-7A1

	Type		Features	Short Current I_{SC}			Open Voltage V_{OC} (Typ) (V)	Switching Time ($@I_F$=20mA C_L=1000pF)		Isolation Voltage BVs (Vrms)
				Rank	Min. (μA)	@ I_F (mA)		t_{ON} Typ. (ms)	t_{OFF} Typ. (ms)	
NEW		TLP590	High output voltage	—	3	10	6	0.5	2	2500
				C05	5	10				
NEW		TLP590A	High output current	—	6	10	6	0.2	2	2500
				C10	10	10				
NEW		TLP591	High output voltage Internal shunt resistor	—	6	20	6	0.5	2	2500
				C10	10	20				
NEW		TLP591A	High output current Internal shunt resistor	—	10	20	6	0.5	2	2500
				C20	20	20				
☆		TLP592*	High speed High output current		6	10	6	0.2	0.2	2500

* Scheduled for marketing from the summer of 1988.

5–6 Photo MOS Couplers

Photo MOS couplers are suitable for switching analog signals in weak signal scan circuits of data acquisition systems or telephone circuits of digital exchange systems.

	Type		Features	V_{OFF} (V)	I_{ON} (A)	Ron			IFT (TYP.) (mA)	Switching Time				Isolation Voltage BVs (Vrms)
						TYP (Ω)	@ I_F (mA)	@ I_{ON} (A)		t_{ON} (TYP) (ms)	t_{OFF} (TYP) (ms)	@ I_F (mA)	@ I_{ON} (A)	
☆		TLP595G*	0.2Arms load direct control	400	0.15	12	10	0.1	5	0.2		16	0.1	2500

*Scheduled for marketing from the summer of 1988.

5–7 Mini Flat Photocouplers (SMD Photocouplers)

Mini flat photocouplers, smaller and thinner than DIP package photocouplers, are ideal for use with hybrid IC's.

PACKAGE STYLE

11-5D1

Transistor Output

Type		Features	Current Transter Ratio			Saturation Voltage			Collector Breakdown Voltage V(BR)CEO (V)	Isolation Voltage BVs (Vrms)
			Min. (%)	@ IF (mA)	@ VCE (V)	Max. (V)	@ IC (mA)	@ IF (mA)		
(NEW)	TLP101	High CTR High isolation	50	5	5	0.4	2.4	8	35	4000
☆	TLP124*	Low input current	100	1	0.5	0.4	0.5	1	80	3750
☆	TLP120*	AC input current	— 50	±5	5	0.4	2.4	8	80	3750
			GB 100	±5	5					
☆	TLP126*	AC input Low input current	— 100	±1	0.5	0.4	0.5	1	80	3750
			BV 200	±1	0.5					
☆	TLP131*	High CTR High VCEO	— 50	5	5	0.4	2.4	8	80	3750
			GB 100	5	5					
☆	TLP137*	Low input current	— 100	1	0.5	0.4	0.5	1	80	3750
			BV 200	1	0.5					
☆	TLP130*	AC input current	— 50	±5	5	0.4	2.4	8	80	3750
			GB 100	±5	5					
(NEW)	TLP101-2	Two channels of TLP101	50	5	5	0.4	2.4	8	35	4000

* Scheduled for marketing form Summer 1988.

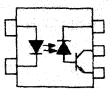
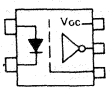
Triac Output

Type		Features	LED Trigger Current-IFT (VTM=3V) Max.(mA)	Zero Crossing Inhibit Voltage (at Rated IFT) Max.(V)	dV/dt Typ. (V/μs)	Blocking Voltage VDRM (V)	Isolation Voltage BVs (Vrms)
☆	TLP160G*	Low IFT	7	—	500	400	2500
☆	TLP160J*	High VDRM	10	—	500	600	2500
☆	TLP161G*	Zero Voltage turn on	7	40	500	400	2500
☆	TLP161J*	High VDRM	10	50	500	600	2500

* Scheduled for marketing from Summer 1988.

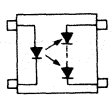
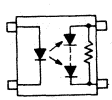
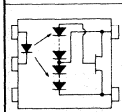
Mini Flat Photocouplers (SMD Photocouplers) (continued)

High Speed Photo-IC Output

	Type		Features	Output Current Min. (mA)	Output Current @ IF (mA)	Data Rate (NRZ) Typ. (bit/s)	Common Mode Rejection Typ. (V/μs)	Supply Voltage VCC (V)	Isolation Voltage BVs (Vrms)
☆		TLP112*	1 Mbps High speed	1.6	16	1M	2000	15	2500
☆		TLP113*	10 Mbps High speed	13	10	10M	200	5	2500
☆		TLP115*	10 Mbps High speed High CMR	13	10	10M	3000	5	2500

* Scheduled for marketing form Summer 1988.

Photovoltaic Couplers

	Type		Features	Short Current ISC Min. (μA)	Short Current @ IF (mA)	Open Voltage VOC (Typ.) (V)	Switching Time (@IF=20mA, CL=1000PF) Ton Typ. (ms)	Switching Time (@IF=20mA, CL=1000PF) Toff Typ. (ms)	Isolation Voltage BVs (Vrms)
☆		TLP190*	High output current	3	10	6	0.5	2.0	2500
☆		TLP191*	High output current Internal shunt resistor	6	20	6	0.5	2.0	2500
☆		TLP192*	High speed High output current	3	10	6	0.5	0.2	2500

* Scheduled for marketing from Summer 1988.

NOTE : 1) Symbol (NEW) : New Products
Symbol ☆ : Under Development

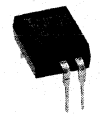
Scheduled marketing start date is indicated under* mark footnote.
Specifications are subject to changes for achieving performance improvement.

2) How to handle CTR, IFT specified products :
For ordering (example)
Use type number of TLP735F(GB) for GB rank of TLP735F
For safety standard certificate application :
Use Toshiba standard type numder such as TLP735F

5–8 VDE Approved Photocouplers

Products conforming to the VDE, West Germany Safety Standards, are listed below. (SELV : Safety Extra Low Voltage application).

PACKAGE STYLE


11-10D1A

11-7B1

11-7B102

11-9A1

11-9A102

Transistor Output

Type		Features	Current Transfer Ratio (CTR)				Low Input CTR			SELV Requirements		Isolation Voltage
Lead Form Style			Rank	Min. (%)	Max. (%)	@ IF (mA)	Min. (%)	@ IF (mA)	@ VCE (V)	Isolation Thickness (mm)	Clearance & Creepage (mm)	BVs (Vrms)
			—	25	—	10	—	—	—	2.0	14.5	5000
TLP580*		0.6" DIP 5pin	O	25	75	10	—	—	—			
TLP581		VDE0700	Y	50	150	10	30	2	0.4			
			GR	100	300	10	30	2	0.4			
TLP731*	TLP731(LF2)*	DIP 6pin	—	50	600	5	—	—	—	0.5	8.2	4000
TLP732	TLP732(LF2)	VDE0806	GB	100	600	5	30	1	0.4			
			GR	100	300	5	30	1	0.4			
TLP735*	TLP735F*	DIP 6pin	—	50	600	5	—	—	—	3 layers Insulation	8.0	5000
TLP736	TLP736F	VDE0700	GB	100	600	5	30	1	0.4			

* No Base internal connection.

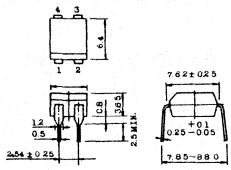
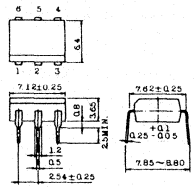
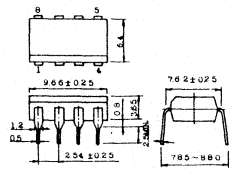
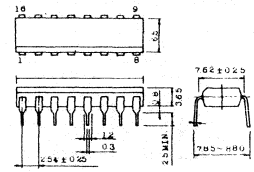
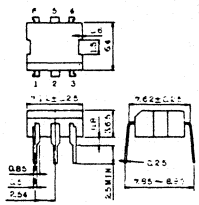
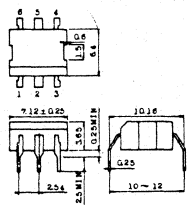
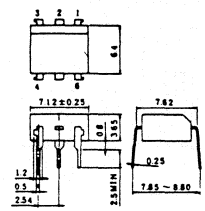
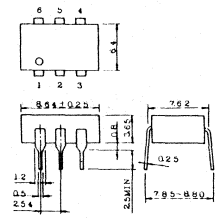
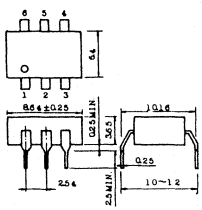
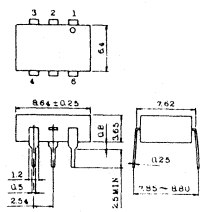
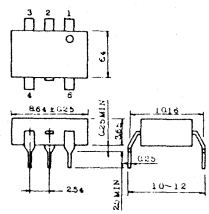
Triac Output

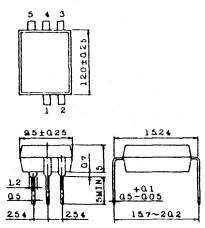
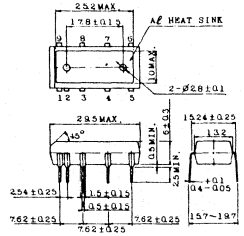
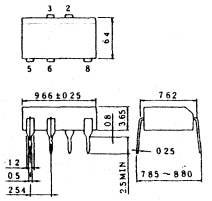
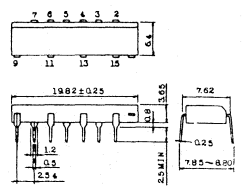
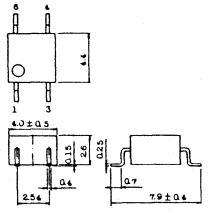
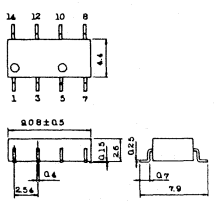
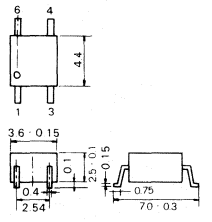
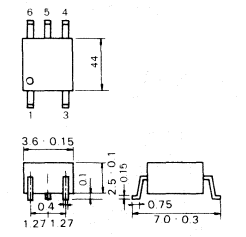
Type		Features	Zero Crossing	LED Trigger Current IFT	dV/dt	Blocking Voltage	SELV Requirements		Isolation Voltage
Lead Form Style				Max. (mA)	(Typ.) (V/μs)	VDRM (V)	Isolation Thickness (mm)	Clearance & Creepage (mm)	BVs (Vrms)
TLP665G	TLP665GF	DIP 6pin	—	10	500	400	0.5	8.0	5000
TLP665J	TLP665JF	VDE0806		10	500	600			
TLP666G	TLP666GF		●	10	500	400			
TLP666J	TLP666JF			10	500	600			
TLP766G	TLP766GF	DIP 6pin	●	10	500	400	3 layers Insulation	8.0	5000
TLP766J	TLP766JF	VDE0700		10	500	600			

Thyristor Output

Type		Features	LED Trigger Current IFT (RGK=27KΩ) (mA)	dV/dt (Typ.) (V/μs)	Blocking Voltage VDRM (V)	SELV Requirements		Isolation Voltage
Lead Form Style						Isolation Thickness (mm)	Clearance & Creepage (mm)	BVs (Vrms)
TLP741G	TLP741G(LF2)	DIP 6pin	10	10	400	0.5	8.2	4000
TLP741J	TLP741J(LF2)	VDE0806	10	10	600			4000
TLP745G	TLP745GF	DIP 6pin	10	10	400	3 layers Insulation	8.0	5000
TLP745J	TLP745JF	VDE0700	10	10	600			5000

■ Package Style

DIP 4 pin (11-5B1)	DIP 6 pin (11-7A1)	DIP 8 pin (11-10C1)	DIP 16 pin (11-20A1)
			
DIP 6 pin (11-7B1)	**DIP 6 pin (LF2) (11-7B102)**	**DIP 5 pin (11-7A4)**	**DIP 6 pin (11-9A1)**
			
DIP 6 pin (LF2) (11-9A102)	**DIP 5 pin (11-9A2)**	**DIP 5 pin (LF2) (11-9A202)**	
			

TLP580 Type (11-10D1A)	TLP546G Type (11-30A1A)	TLP3502 Type	TLP3520 Type (11-20A2)
			
TLP101 Type (11-5D1)	**TLP101-2 Type**	**Mini Flat Package 4 pin**	**Mini Flat Package 5 pin**
			

6. Supplementary Informations

6-1 Current Transfer Ratio (CTR) and Trigger LED Current (IFT) Ranking and Marking

Standard rank classifications are applied for the CTR on transistor-type photocouplers and for I_{FT} on SCR, Triac-type photocouplers. Product indications corresponding to rank names are as shown below. Also, note that the applied rank classifications depends on product types.

6-1-1) CTR Ranking and Rank Code

i)

Rank Name	CTR	CTR Rank Marking
A or None	50% ~ 600%	Blank, Y, Y■, G, G■, B, B■, GB
Y	50% ~ 150%	Y, Y■
GR	100% ~ 300%	G, G■
BL	200% ~ 600%	B, B■
YG	50% ~ 300%	Y, Y■, G, G■
GB	100% ~ 600%	GB, G, G■, B, B■

ii) For TLP521-2, TLP521-3, TLP521-4
TLP520, TLP520-2, TLP520-3, TLP520-4,
TLP620, TLP620-2, TLP620-3, TLP620-4,
TLP621-2, TLP621-3, TLP621-4
TLP530, TLP630, TLP639

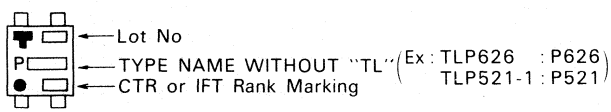
Rank Name	CTR	CTR Rank Marking
A or None	50% ~ 600%	Blank, YG, GB, GR, BL
GB	100% ~ 600%	GB, GR, BL

6-1-2) IFT Ranking and Rank Code

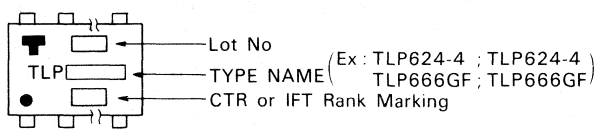
Rank Name	IFT	IFT Rank Marking
None	IFT Max	Blank, T7, T5
IFT7	7mA Max	T7, T5
IFT5	5mA Max	T5

6-1-3) Marking Example

i) 4 pin Type



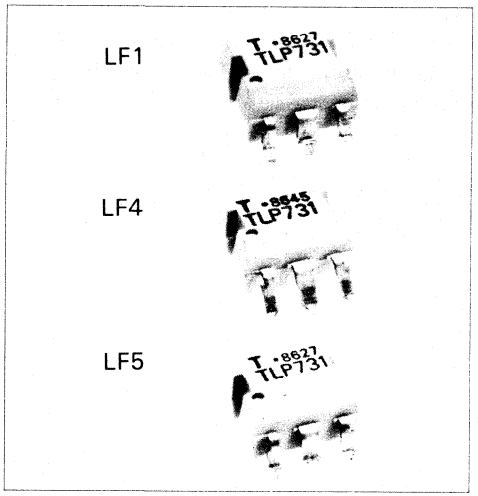
ii) Others

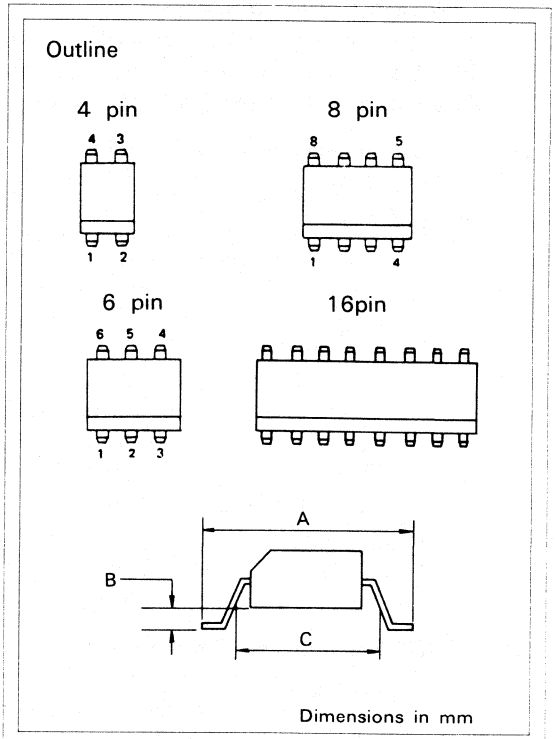


6-2 Standard Lead Forming

6-2-1) SURFACE MOUNT LEAD BEND OPTIONS

(LF1)
(LF4)
(LF5)





○ The photocoupler line-up with lead bending is available for surface mounting.

○ FEATURES

- Surface mountable
- Available for all 4, 6, 8 & 16 pin DIP
- All electrical parameters remain unchanged from standard package

○ ORDERING INFORMATION

To order any standard optocoupler with a surface mount lead bend, add : (LF1) or (LF4) or (LF5) to the standard part number.
Example :
Standard part number : TLP731 (GR)
Surface mount type : TLP731 (GR-LF1) or TLP731 (GR-LF4) or TLP731 (GR-LF5)

Dimension \ Version	(LF1)		(LF4)		(LF5)	
	MIN	MAX	MIN	MAX	MIN	MAX
A		10.0		12.0		10.0
B	(0.35Typ.)					0.2
C	6.4		8.0		6.4	

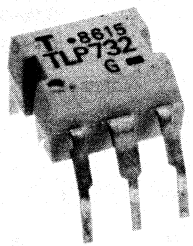
All other package dimensions are the same as each standard package outline

○ SAFETY STANDARD CERTIFICATION

Use TOSHIBA standard part number for safety standard certificate application.
Example:
TLP731(GR-LF1)➡TLP731

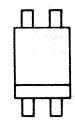
6-2-2) LONG DISTANCE LEAD BEND OPTION
(LF2)

LF2

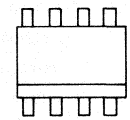


Outline

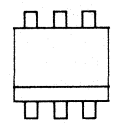
4 pin



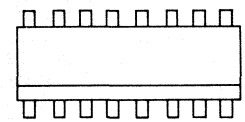
8 pin

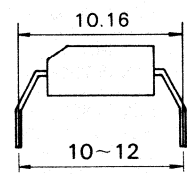


6 pin



16pin





Dimensions in mm

All other package dimensions are the same as each standard package outline

The photocoupler line-up with lead bending is available for long distance clearance.

○ FEATURES

- Long distance clearance
- Available for all 4, 6, 8 & 16 pin DIP
- All electrical parameters remain unchanged from standard package

○ ORDERING INFORMATION

To order any standard optocoupler with a long distance lead bend, add : (LF2) to the standard part number.

Example :

Standard part number : TLP731 (GR)

Long distance type : TLP731 (GR-LF2)

○ SAFETY STANDARD CERTIFICATION

Use TOSHIBA standard part number for safety standard certificate application.

Example;

TLP731(GR-LF2)➡TLP731

6–3 Safety Standard Approved Photocouplers

Toshiba's photocouplers include a full line-up of products recognized by UL (U.S.A.), VDE and TÜV (West Germany), and BSI (U.K.) for required safety standards. In the table below, the contents of applicable standards and construction mechanical ratings are summarized.

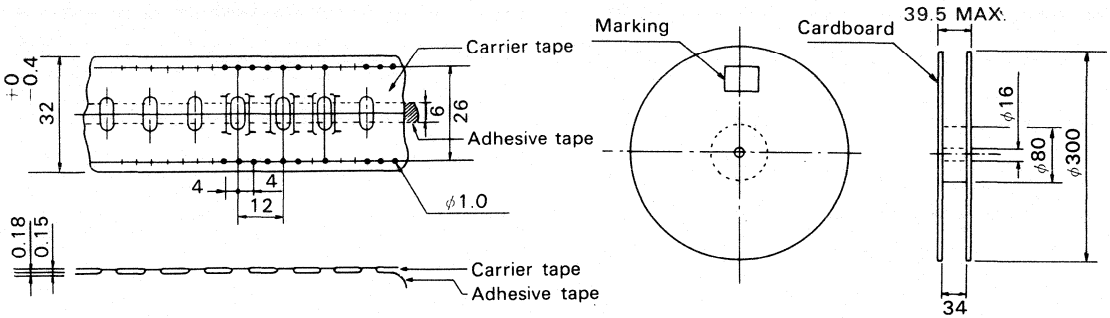
Device Type		4 Pin and Multi-channel			TLP621		
		Transistor Output		TLP580/581		TLP731/732	TLP735F/736F
		Thyristor Output				TLP741G/741J	TLP745GF/745JF
		Triac Output				TLP665G/J* TLP665G/J*	TLP766GF/766JF
Construction Mechanical Ratings		Isolation Creepage Path (mm)		14.5	6.4	8.2/8.0*	8.0
		Isolation Clearance (mm)		14.5	6.4	8.0	8.0
		Isolation Thickness (mm)		2.0	0.4	0.5	(3 layer Insulation)
		Internal Creepage Path (mm)		8.0	–	–	–
		Isolation Voltage		5,000	5,000	4,000/5,000*	5,000
Safety Standard		UL1577 (File No. E67349)	Parts Specification	●	●	●	●
		(UL1414)	Double Protection	–	●	–	●
		DIN 57 883/ VDE 0883/06.80	Parts Specification	●	● (TÜV)	●	●
		DIN IEC65/ VDE 0860/08.81	Home Appliance	●	● (TÜV)	●	●
		DIN IEC380/ VDE 0806/08.81	Office Equipments	●	○	◎**	●
		DIN IEC435/ VDE 0805/08.79	Data Processing Equipments	●	○	◎**	●
● Approved (SELV)		DIN 57 804/ VDE 0804/01.83	Data Processing Equipments	●	○	●	●
◎ SELV satisfied		DIN 57 700T1/ VDE 0700T1/2.81	Home Appliance	●	○	○	●
○ ELV satisfied		DIN IEC601T1/ VDE 0750T1/05.82	Medical Equipments	●	○	◎**	●
		BS415 : 1979	Home Appliance	●	◎	◎	◎
		BS5850 : 1981	Office Equipment	●	○	○	○
		BS6204 : 1982	Telephone Equipments	◎	○	○	○

** : Cleared with lead forming(LF2)

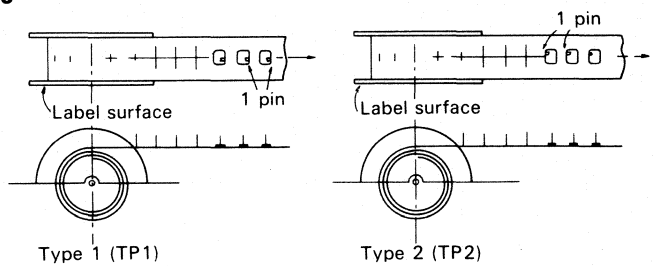
6–4 Photocoupler Taping Specifications

This specification provides the requirements for the radial taping of Mini Flat Photocouplers (TLP101) for use in automatic insertion machine.

6-4-1) Packing Dimension



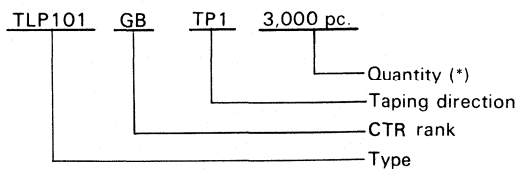
6-4-2) Taping Direction



NOTE : Orientation of 1-pin ID marking is different in the above two types.
(1 reel is wound only in one direction).

3. Standard quantity
   Standard quantity is 1,500 ea. per reel.
4. Markings
   A label with following markings is attached to the reel.
   1. Mounting direction (TP1 or TP2)
   2. Product type
   3. Quantity
   4. Lot No.
5. Ordering method
   When ordering tape products, please specify the product name, taping direction, and quantity in the following manner.

   Example:



(*) : Quantity must be a multiple of 1,500 pieces because one reel contains 1,500 pieces.

7. Data Sheets

7-1 Recommendable Devices

7-1 Recommendable Devices

Type No.	Page
4N25 (Short)	37
4N25A (Short)	37
4N26 (Short)	37
4N27 (Short)	37
4N28 (Short)	37
4N29 (Short)	43
4N29A (Short)	43
4N30 (Short)	43
4N31 (Short)	43
4N32 (Short)	43
4N33 (Short)	43
4N35 (Short)	48
4N36 (Short)	48
4N37 (Short)	48
4N38 (Short)	54
4N38A (Short)	54
6N135	60
6N136	60
6N137	66
6N138	73
6N139	73
CNY17-2	78
CNY17-3	463
CNY17-4	78
TLP101	84
TLP101-2	84
TLP321	91
TLP321-2	91
TLP321-3	463
TLP321-4	91
TLP330	98
TLP331	103
TLP332	103
TLP371	110
TLP372	110
TLP504A	117
TLP504A-2	117
TLP521-1	124
TLP521-2	124
TLP521-3	463
TLP521-4	124
TLP523	131
TLP523-2	131
TLP523-3	463
TLP523-4	131

Type No.	Page
TLP525G	137
TLP525G-2	137
TLP525G-3	463
TLP525G-4	137
TLP535 (Short)	142
TLP535	143
TLP536	143
TLP541G	149
TLP542G	149
TLP546G	154
TLP550	158
TLP557	164
TLP558	170
TLP559	176
TLP560G	182
TLP560J	187
TLP561G	191
TLP561J	195
TLP570	199
TLP571	199
TLP572	206
TLP573	213
TLP575 (Short)	219
TLP575	220
TLP576	220
TLP580	226
TLP581	226
TLP590	234
TLP590A	238
TLP591	242
TLP591A	246
TLP620	250
TLP620-2	250
TLP620-3	463
TLP620-4	250
TLP621	257
TLP621-2	257
TLP621-3	463
TLP621-4	257
TLP624	264
TLP624-2	264
TLP624-3	463
TLP624-4	264
TLP626	271
TLP626-2	271

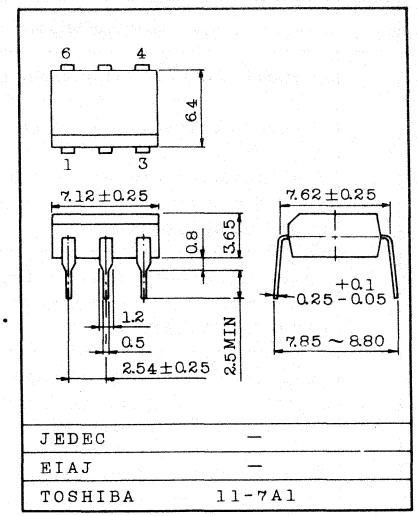
Type No.	Page
TLP626-3	463
TLP626-4	271
TLF627	278
TLP627-2	278
TLP627-3	463
TLP627-4	278
TLP630	285
TLP631	293
TLP632	293
TLP650	301
TLP651	307
TLP731	313
TLP732	313
TLP735	321
TLP735F	329
TLP736	321
TLP736F	329
TLP741G	330
TLP741J	335
TLP745G	340
TLP745GF	345
TLP745J	346
TLP745JF	351
TLP751	352
TLP766G	358
TLP766GF	362
TLP766J	363
TLP766JF	367
TLP2200	368
TLP2530	374
TLP2531	374
TLP2601	381
TLP2630	389
TLP2631	397
TLP3009	405
TLP3010	405
TLP3011	405
TLP3012	405
TLP3020	410
TLP3021	410
TLP3022	410
TLP3023	410
TLP3031	415
TLP3032	415
TLP3033	415
TLP3041	419
TLP3042	419
TLP3043	419
TLP3051	423
TLP3052	423
TLP3061	427
TLP3062	427
TLP3063	427
TLP3502	431
TLP3503	435
TLP3506	439
TLP3507	443
TLP3520	447
TLP3521	451
TLP3526	455
TLP3527	459

4N25(Short),4N25A(Short),4N26(Short) 4N27(Short), 4N28(Short)

GaAs IRED & PHOTO-TRANSISTOR

AC LINE/DIGITAL LOGIC ISOLATOR.
DIGITAL LOGIC/DIGITAL LOGIC ISOLATOR.
TELEPHONE LINE RECEIVER.
TWISTED PAIR LINE RECEIVER.
HIGH FREQUENCY POWER SUPPLY FEEDBACK CONTROL.
RELAY CONTACT MONITOR.

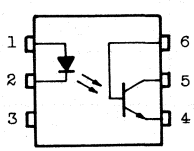
Unit in mm



The TOSHIBA 4N25(Short) through 4N28(Short) consist of a galloum arsenide infrared emitting diode coupled with a silicon phototransistor in a dual in-line package.

- Switching Speeds : 3μs
- DC Current Transfer Ratio : 100%
- Isolation Resistance : $10^{11}\Omega$
- Isolation Voltage : 2500V_{rms} Min.
- UL Recognized : File No. E67349

PIN CONFIGURATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: EMITTER
5: COLLECTOR
6: BASE

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current (Continuous)	I_F	80	mA
	Forward Current Derating	$\Delta I_F/°C$	1.07*	mA/°C
	Peak Forward Current (Note)	I_{PF}	3	A
	Power Dissipation	P_D	150	mW
	Power Dissipation Derating	$\Delta P_D/°C$	2.0*	mW/°C
	Reverse Voltage	V_R	3	V
PHOTO-TRANSISTOR	Collector-Emitter Voltage	BV_{CEO}	30	V
	Collector-Base Voltage	BV_{CBO}	70	V
	Emitter-Collector Voltage	BV_{ECO}	7	V
	Collector Current (Continuous)	I_C	100	mA
	Power Dissipation	P_C	150	mW
	Power Dissipation Derating	$\Delta P_C/°C$	2.0*	mW/°C
COUPLED	Storage Temperature Range	T_{stg}	-55~150	°C
	Operating Temperature Range	T_{opr}	-55~100	°C
	Lead Soldering Temperature (10 sec.)	T_{sold}	260	°C
	Total Package Power Dissipation	P_T	250	mW
	Total Package Power Dissipation Derating	$\Delta P_T/°C$	3.3*	mW/°C

Note : Pulse width 300μs, 2% duty cycle.

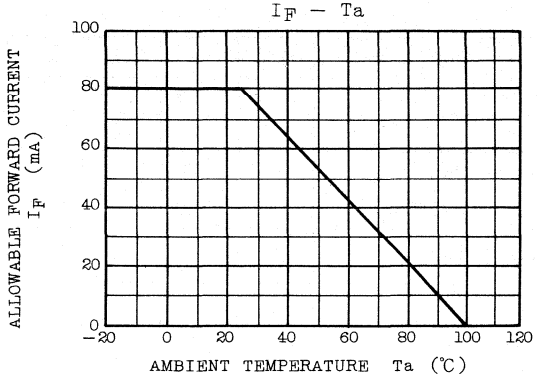
* Above 25°C ambient.

ELECTRICAL CHARACTERISTICS (Ta=25°C)

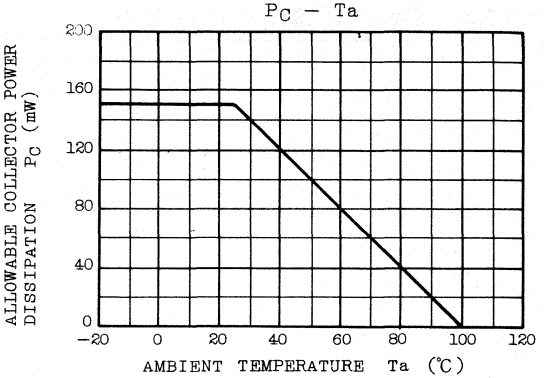
	CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage		V_F	I_F=10mA	–	1.15	1.5	V
	Reverse Current		I_R	V_R=3V	–	–	100	μA
	Capacitance		C_D	V=0, f=1MHz	–	30	–	pF
PHOTO-TRANSISTOR	DC Forward Current Gain		hFE	V_{CE}=5V, I_C=500μA	–	200	–	
	Collector-Emitter Breakdown Voltage		$V_{(BR)CEO}$	I_C=1mA, I_F=0	30	–	–	V
	Collector-Base Breakdown Voltage		$V_{(BR)CBO}$	I_C=100μA	70	–	–	V
	Emitter-Collector Breakdown Voltage		$V_{(BR)ECO}$	I_E=100μA	7	–	–	V
	Collector Dark Current		I_{CEO}	V_{CE}=10V	–	1	50	nA
	Collector Dark Current		I_{CBO}	V_{CB}=10V	–	0.1	20	nA
	Collector-Emitter Capacitance		C_{CE}	V=0, f=1MHz	–	10	–	pF
COUPLED	Current Transfer Ratio		I_C/I_F	I_F=10mA, V_{CE}=10V	20	100	–	%
	Collector-Emitter Saturation Voltage		$V_{CE(SAT)}$	I_F=50mA, I_C=2mA	–	0.1	0.5	V
	Capacitance Input to Output		C_S	V_S=0, f=1MHz	–	0.8	–	pF
	Isolation Resistance		R_S	V_S=500V	–	10^{11}	–	Ω
	Isolation Voltage		BV_S	AC, 1 minute	2500	–	–	V_{rms}
		4N25, 4N25A	BV_S*	AC, Peak	2500	–	–	Vpk
		4N26, 4N27			1500	–	–	
		4N28			500	–	–	
		4N25A		AC, 1 second	1775	–	–	V_{rms}
	Rise/Fall Time		t_r/t_f	V_{CE}=10V, I_C=2mA R_L=100Ω	–	2	–	μs
	Rise/Fall Time		t_r/t_f	V_{CB}=10V, I_{CB}=50μA R_L=100Ω	–	200	–	ns

* JEDEC registered minimum BV_S, however, TOSHIBA specifies a minimum BV_S of 2500V_{rms} 1 minute.

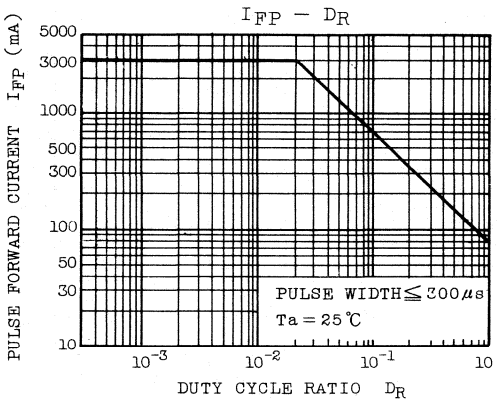
I_F – Ta



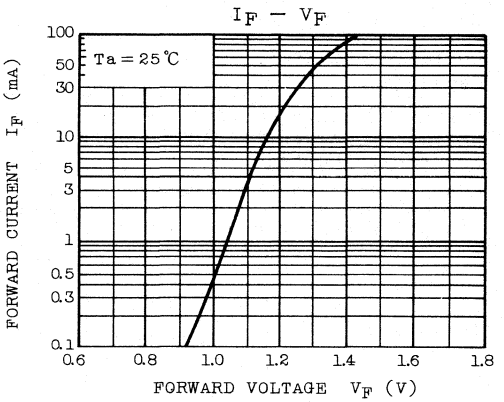
P_C – Ta



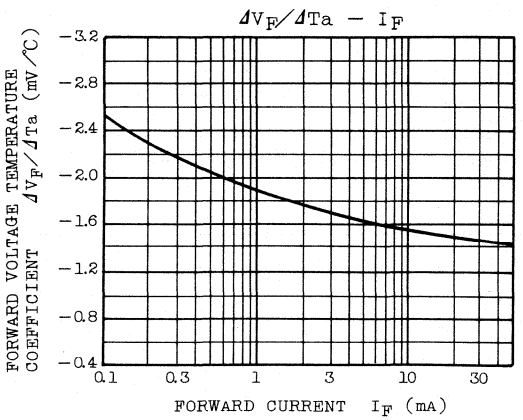
I_{FP} – D_R



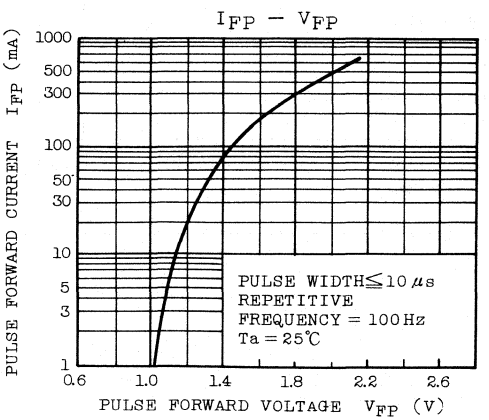
I_F – V_F



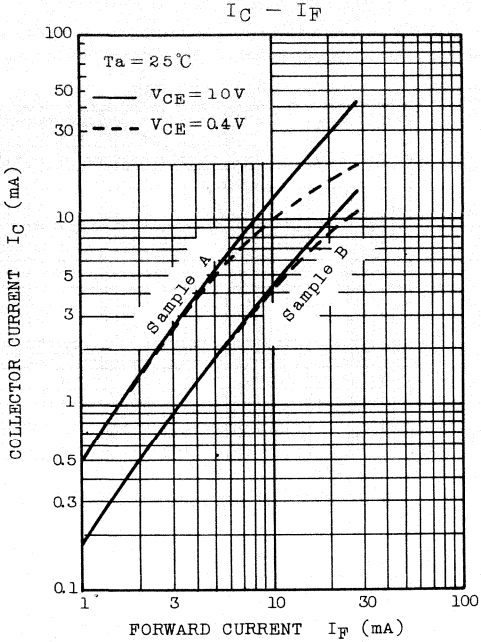
$\Delta V_F/\Delta Ta$ – I_F



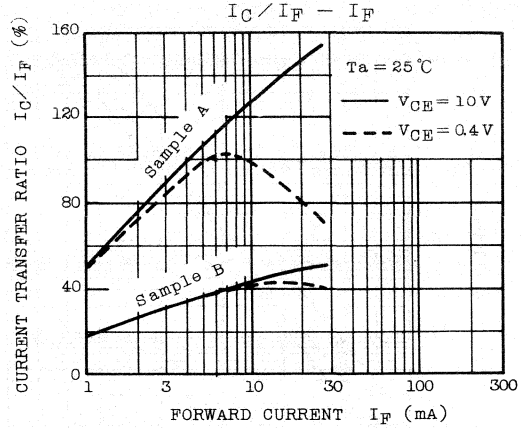
I_{FP} – V_{FP}



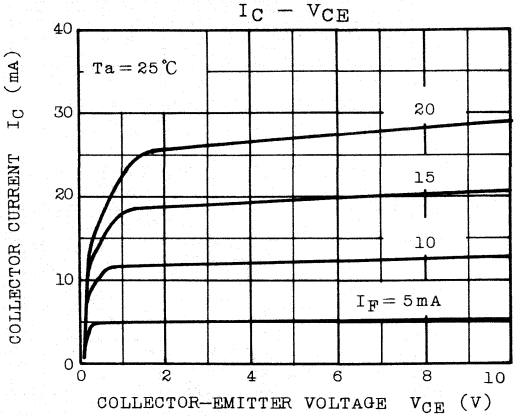
$I_C - I_F$



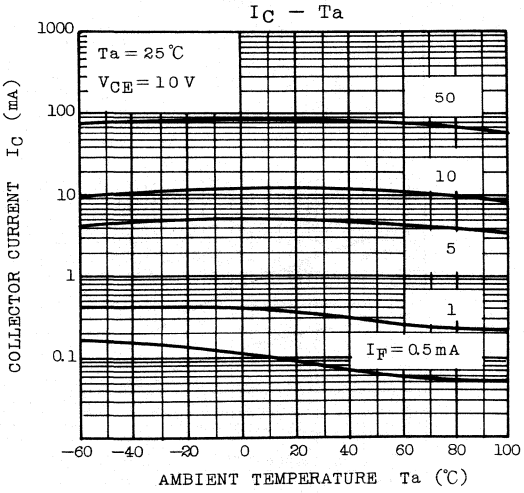
$I_C / I_F - I_F$



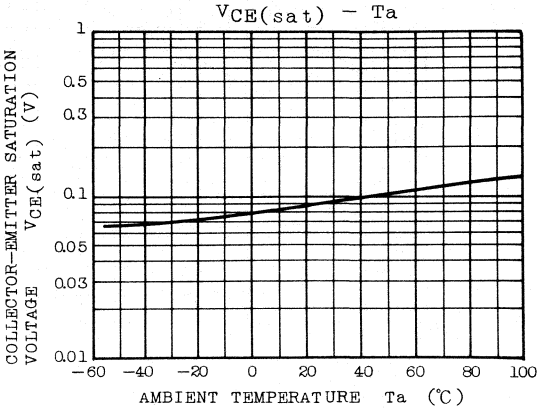
$I_C - V_{CE}$



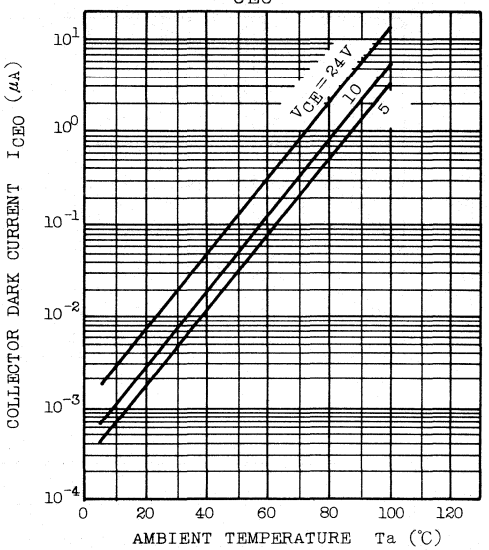
$I_C - Ta$



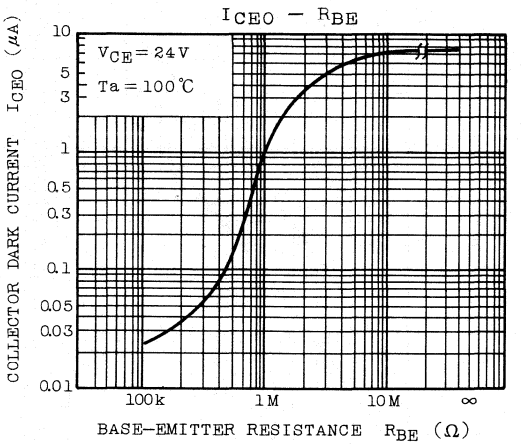
$V_{CE(sat)} - Ta$



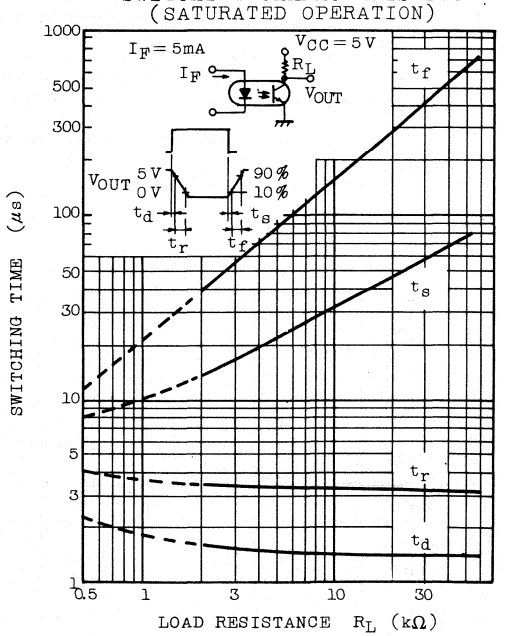
I_{CEO} – Ta



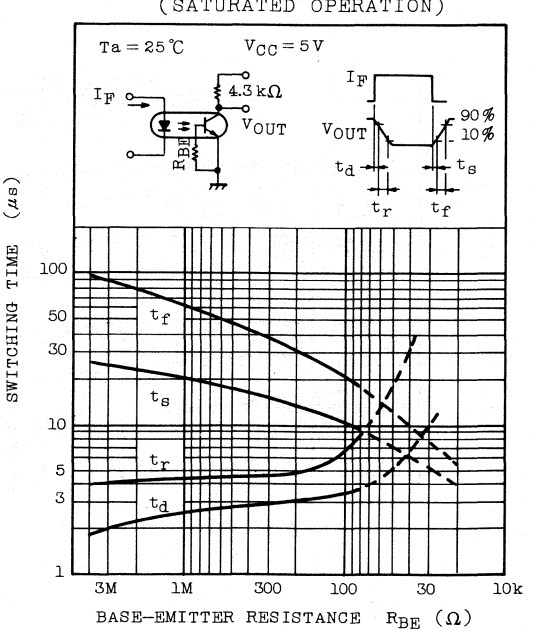
I_{CEO} – R_{BE}



SWITCHING CHARACTERISTICS
(SATURATED OPERATION)



R_{BE} – SWITCHING CHARACTERISTICS
(SATURATED OPERATION)



4N29(Short), 4N29A(Short), 4N30(Short), 4N31(Short)
4N32(Short), 4N32A(Short), 4N33(Short)

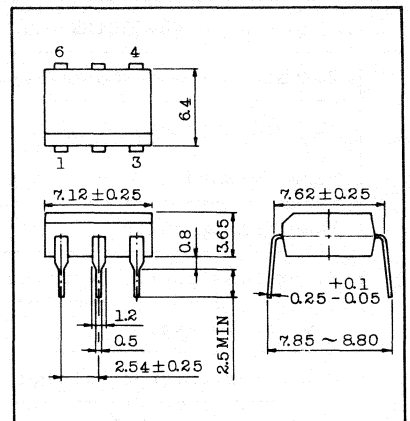
GaAs IRED & PHOTO-TRANSISTOR

AC LINE/DIGITAL LOGIC ISOLATOR.
DIGITAL LOGIC/DIGITAL LOGIC ISOLATOR.
TELEPHONE LINE RECEIVER.
TWISTED PAIR LINE RECEIVER.
RELAY CONTACT MONITOR.

The TOSHIBA 4N29(Short) through 4N33(Short) consist arsenide infrared emitting diode coupled with a silicon photo darlington in a dula in-line package.

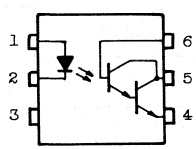
- Switching Time : 100μs
- DC Current Transfer Ratio : 500%
- Isolation Resistance : $10^{11}\Omega$
- Isolation Voltage : $2500V_{rms}$ Min.
- UL Recognized : File No. E67349

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-7A1

PIN CONFIGURATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: EMITTER
5: COLLECTOR
6: BASE

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current (Continuous)	I_F	80	mA
	Forward Current Derating	$\Delta I_F/°C$	1.07*	mA/°C
	Peak Forward Current (Note)	I_{FP}	3	A
	Power Dissipation	P_D	150	mW
	Power Dissipation Derating	$\Delta P_D/°C$	2.0*	mW/°C
	Reverse Voltage	V_R	3	V
PHOTO-DARLINGTON	Collector-Emitter Voltage	BV_{CEO}	30	V
	Collector-Base Voltage	BV_{CBO}	30	V
	Emitter-Collector Voltage	BV_{ECO}	5	V
	Collector Current (Continuous)	I_C	100	mA
	Power Dissipation	P_C	150	mW
	Power Dissipation Derating	$\Delta P_C/°C$	2.0*	mW/°C
COUPLED	Storage Temperature Range	T_{stg}	-55～150	°C
	Operating Temperature Range	T_{opr}	-55～100	°C
	Lead Soldering Temperature	T_{sold}	260	°C
	Total Package Power Dissipation	P_T	250	mW
	Total Package Power Dissipation Derating	$\Delta P_C/°C$	3.3*	mW/°C

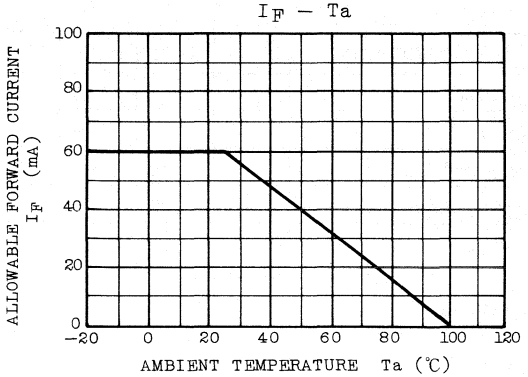
Note : Pulse width 300μs, 2% duty cycle.
* Above 25°C ambient.

ELECTRICAL CHARACTERISTICS (Ta=25°C)

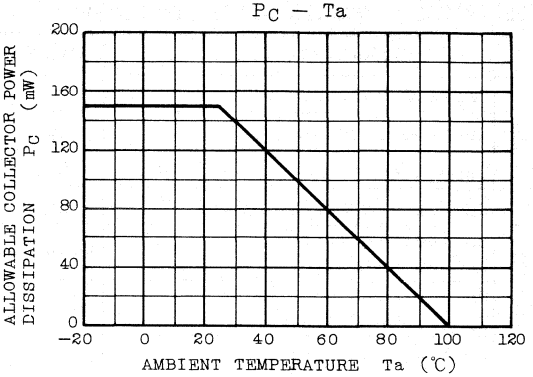
	CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage		V_F	I_F=10mA	-	1.15	1.5	V
	Reverse Current		I_R	V_R=3V	-	-	100	μA
	Capacitance		C_D	V=0, f=1MHz	-	30	-	pF
PHOTO-DARLINGTON	DC Forward Current Gain		h_{FE}	V_{CE}=5, I_C=0.5mA	-	10K	-	
	Collector-Emitter Breakdown Voltage		$V_{(BR)CEO}$	I_C=1mA	30	-	-	V
	Collector-Base Breakdown Voltage		$V_{(BR)CBO}$	I_C=100μA	30	-	-	V
	Emitter-Collector Breakdown Voltage		$V_{(BR)ECO}$	I_E=100μA	5	-	-	V
	Collector Dark Current		I_{CEO}	V_{CE}=10V	-	1.0	100	nA
COUPLED	Collector Output Current	4N32, 4N32A 4N33	I_C	I_F=10mA, V_{CE}=10V	50	-	-	mA
		4N29, 4N29A 4N30			10	-	-	
		4N31			5			
	Collector-Emitter Saturation Voltage	4N29,4N29A,4N30, 4N32,4N32A,4N33	$V_{CE(sat)}$	I_F=8mA, I_C=2mA	-	-	1.0	V
		4N31			-	-	1.2	
	Turn-on Time		t_{on}	I_F=200mA, V_{CC}=10V I_C=50mA	-	-	5	μs
	Turn-off Time	4N29, 4N29A 4N30, 4N31	t_{off}		-	-	40	μs
		4N32, 4N32A 4N33					100	
	Capacitance Input to Output		C_S	V=0, f=1MHz	-	0.8	-	pF
	Isolation Resistance		R_S	V=500V	-	10^{11}	-	Ω
	Isolation Voltage		BV_S	AC, 1 Minute	2500	-	-	V_{rms}
		4N29, 4N29A 4N32, 4N32A	BV_S*	AC, Peak	2500	-	-	Vpk
		4N30, 4N31 4N33			1500	-	-	
		4N29A, 4N32A		AC, 1 second	1775	-	-	V_{rms}

* JEDEC registered minimum BV_S, however, Toshiba specifies a minimum BV_S of 2500V_{rms} 1 minute.

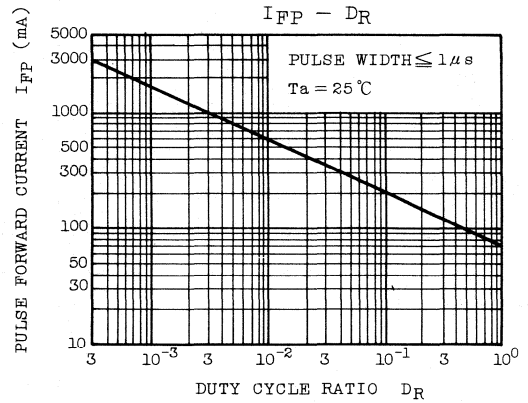
I_F – Ta



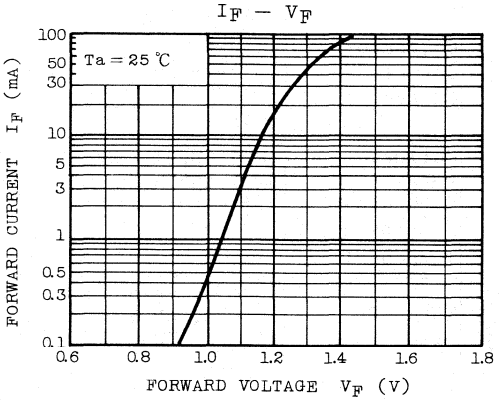
P_C – Ta



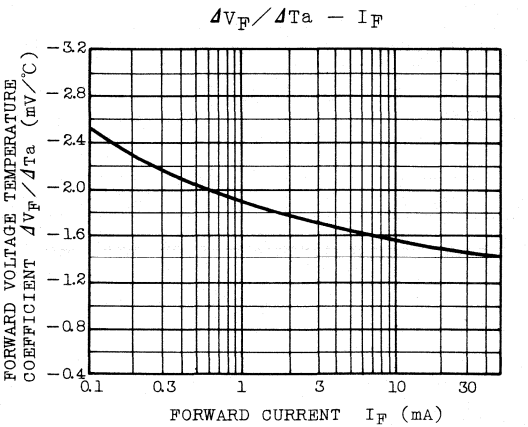
I_{FP} – D_R



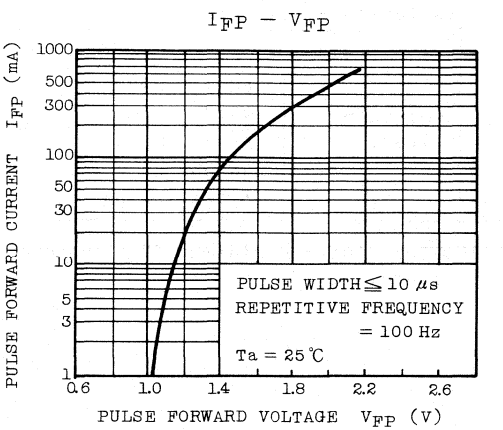
I_F – V_F

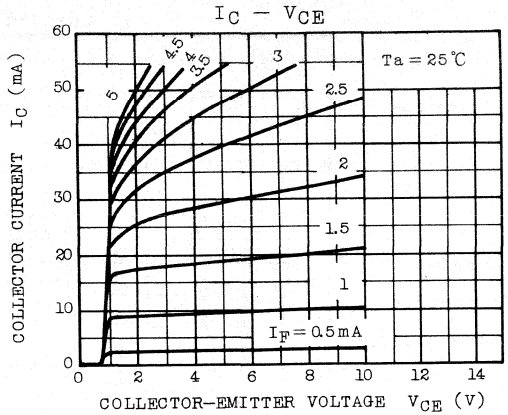


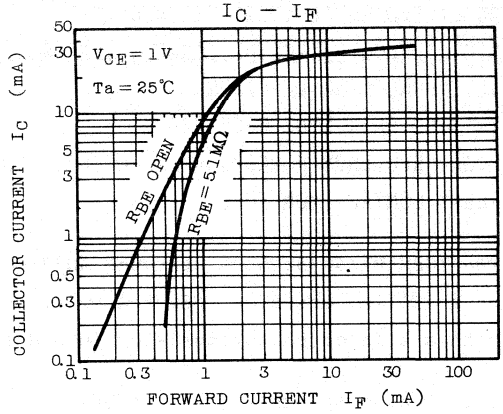
$\Delta V_F / \Delta Ta$ – I_F

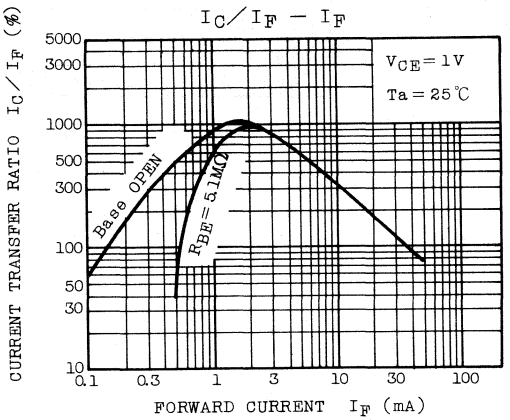


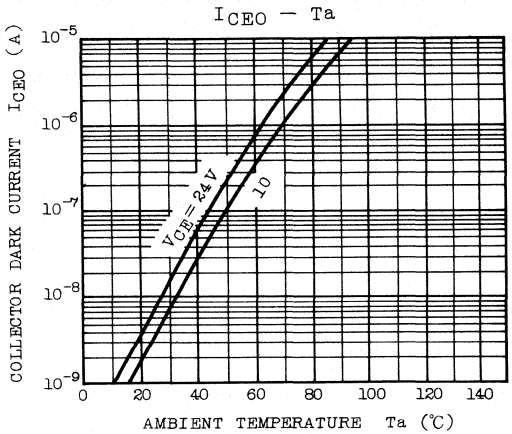
I_{FP} – V_{FP}

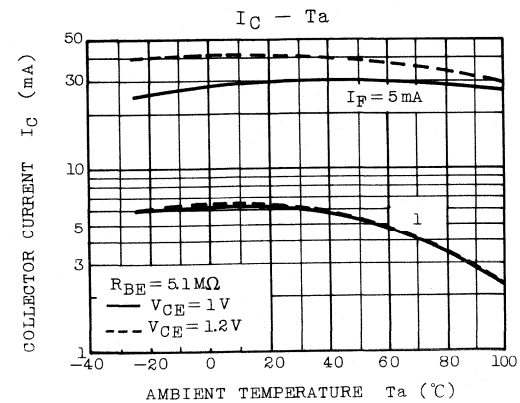


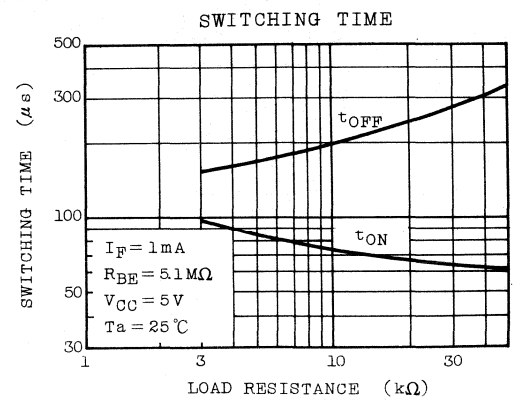

$I_C - V_{CE}$
COLLECTOR CURRENT I_C (mA)
COLLECTOR-EMITTER VOLTAGE V_{CE} (V)
Ta = 25℃
I_F = 0.5mA
5
4.5
4
3.5
3
2.5
2
1.5
1


$I_C - I_F$
COLLECTOR CURRENT I_C (mA)
FORWARD CURRENT I_F (mA)
V_{CE} = 1V
Ta = 25℃
R_{BE} OPEN
R_{BE} = 5.1MΩ


$I_C / I_F - I_F$
CURRENT TRANSFER RATIO I_C / I_F (%)
FORWARD CURRENT I_F (mA)
V_{CE} = 1V
Ta = 25℃
Base OPEN
R_{BE} = 5.1MΩ


$I_{CEO} - Ta$
COLLECTOR DARK CURRENT I_{CEO} (A)
AMBIENT TEMPERATURE Ta (℃)
V_{CE} = 24V
10
1


$I_C - Ta$
COLLECTOR CURRENT I_C (mA)
AMBIENT TEMPERATURE Ta (℃)
I_F = 5mA
1
R_{BE} = 5.1MΩ
V_{CE} = 1V
V_{CE} = 1.2V


SWITCHING TIME
SWITCHING TIME (μs)
LOAD RESISTANCE (kΩ)
t_{OFF}
t_{ON}
I_F = 1mA
R_{BE} = 5.1MΩ
V_{CC} = 5V
Ta = 25℃

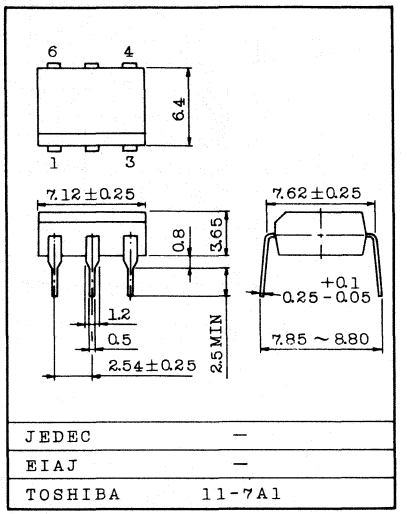
4N35(Short), 4N36(Short), 4N37(Short)

AC LINE/DIGITAL LOGIC ISOLATOR.
DIGITAL LOGIC/DIGITAL LOGIC ISOLATOR.
TELEPHONE LINE RECEIVER.
TWISTED PAIR LINE RECEIVER.
HIGH FREQUENCY POWER SUPPLY FEEDBACK CONTROL.
RELAY CONTACT MONITOR.

The TOSHIBA 4N35(Short) through 4N37(Short) consist of a gallium arsenide infrared emitting diode coupled with a silicon phototransistor in a dual in line package.

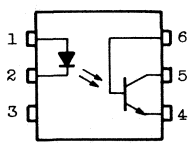
- Switching Speeds : 3μs
- DC Current Transfer Ratio : 100%
- Isolation Resistance : $10^{11}\Omega$
- Isolation Voltage : 2500V_{rms} Min.
- UL Recognized : File No. E67349

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-7A1

PIN CONFIGURATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: EMITTER
5: COLLECTOR
6: BASE

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current (Continuous)		I_F	60	mA
	Forward Current Derating		$\Delta I_F/°C$	0.8*	mA/°C
	Peak Forward Current (Note)		I_{PF}	3	A
	Power Dissipation		P_D	100	mW
	Power Dissipation Derating		$\Delta P_D/°C$	1.33*	mW/°C
	Reverse Voltage		V_R	6	V
PHOTO-TRANSISTOR	Collector-Emitter Voltage		BV_{CEO}	30	V
	Collector-Base Voltage		BV_{CBO}	70	V
	Emitter-Collector Voltage		BV_{ECO}	7	V
	Collector Current (Continuous)		I_C	100	mA
	Power Dissipation		P_C	300	mW
	Power Dissipation Derating		$\Delta P_C/°C$	4.0*	mW/°C
COUPLED	Storage Temperature		T_{stg}	-55 ~ 150	°C
	Operating Temperature		T_{opr}	-55 ~ 100	°C
	Lead Soldering Temperature (at 10 sec.)		T_{sold}	260	°C
	Total Package Power Dissipation		P_T	300	mW
	Total Package Power Dissipation Derating		$\Delta P_T/°C$	3.3*	mW/°C
	Input to Output Isolation Voltage (AC, 1 Minute)		BV_S	2500	V_{rms}
		4N35	BV_S**	2500/3550	V_{rms}/V_{pk}
		4N36		1750/2500	
		4N37		1050/1500	

Note : Pulse width 1μs, 300pps

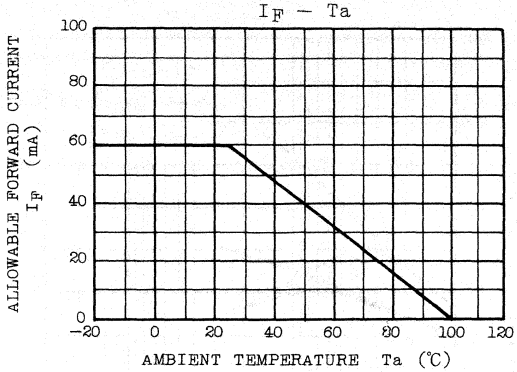
* Above 25°C ambient.

** JEDEC registered maximum BV_S, however, TOSHIBA specifies a maximum BV_S of $2500V_{rms}$, 1 minute.

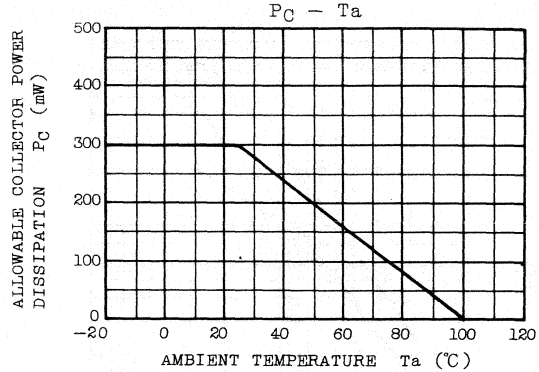
ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage		V_F	I_F=10mA	0.8	1.15	1.5	V
				I_F=10mA, Ta=-55°C	0.9	-	1.7	
				I_F=10mA, Ta=100°C	0.7	-	1.4	
	Reverse Current		I_R	V_R=6V	-	-	10	μA
	Capacitance		C_D	V=0, f=1MHz	-	30	100	pF
PHOTO-TRANSISTOR	DC Forward Current Gain		h_{FE}	V_{CE}=5V, I_C=500μA	-	200	-	
	Collector-Emitter Breakdown Voltage		$V_{(BR)CEO}$	I_C=10mA	30	-	-	V
	Collector-Base Breakdown Voltage		$V_{(BR)CBO}$	I_C=100μA	70	-	-	V
	Emitter-Collector Breakdown Voltage		$V_{(BR)ECO}$	I_E=100μA	7	-	-	V
	Collector Dark Current		I_{CEO}	V_{CE}=10V	-	1	50	nA
	Collector Dark Current		I_{CEO}	V_{CE}=30V Ta=100°C	-	-	500	μA
	Collector-Emitter Capacitance		C_{CE}	V=0, f=1MHz	-	10	-	pF
COUPLED	Current Transfer Ratio		I_C/I_F	I_F=10mA, V_{CE}=10V	100	-	-	%
				I_F=10mA, V_{CE}=10V Ta=-55°C	40	-	-	
				I_F=10mA, V_{CE}=10V Ta=100°C	40	-	-	
	Collector-Emitter Saturation Voltage		$V_{CE(SAT)}$	I_F=10mA, I_C=0.5mA	-	0.1	0.3	V
	Capacitance Input to Output		C_S	V_S=0, f=1MHz	-	0.8	2.5	pF
	Isolation Resistance		R_S	V_S=500V	10^{11}	-	-	Ω
	Input to Output Isolation Current (Pulse Width=8ms)	4N35	I_{IO}	V_{io}=3550Vpk	-	-	100	μA
		4N36		V_{io}=2500Vpk	-	-	100	
		4N37		V_{io}=1500Vpk	-	-	100	
	Turn on Time		t_{on}	V_{CC}=10V, I_C=2mA	-	3	10	μs
	Turn off Time		t_{off}	R_L=100Ω	-	3	10	μs

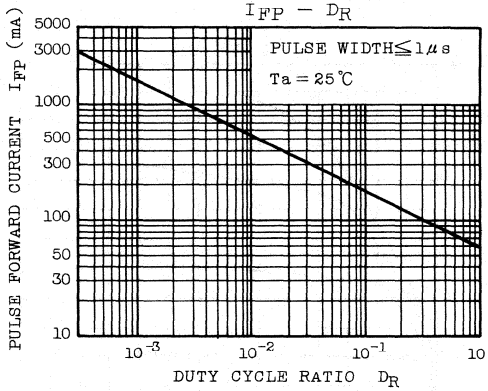
I_F – Ta



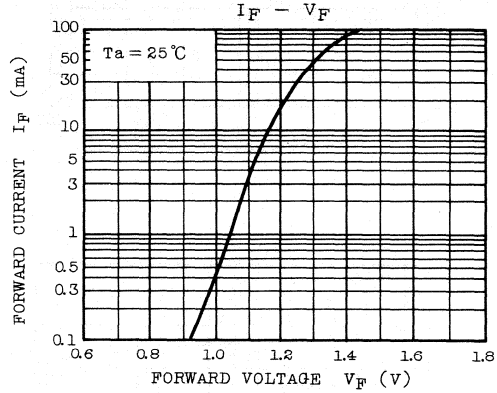
P_C – Ta



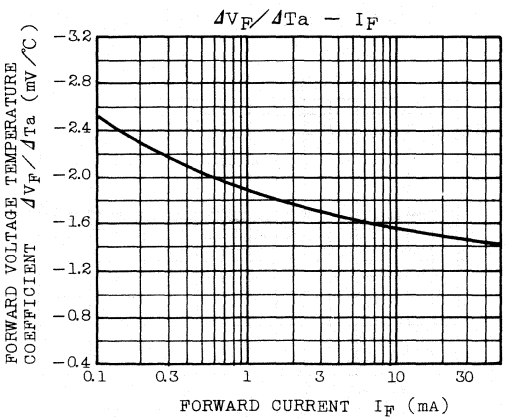
I_{FP} – D_R



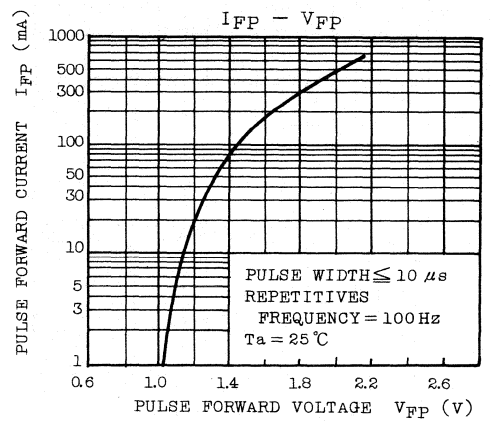
I_F – V_F



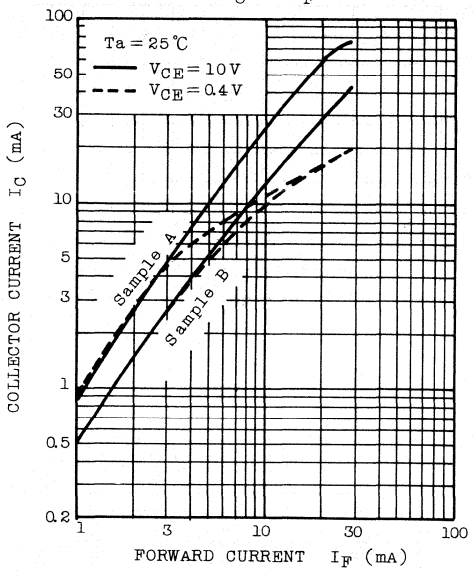
$\Delta V_F / \Delta Ta$ – I_F



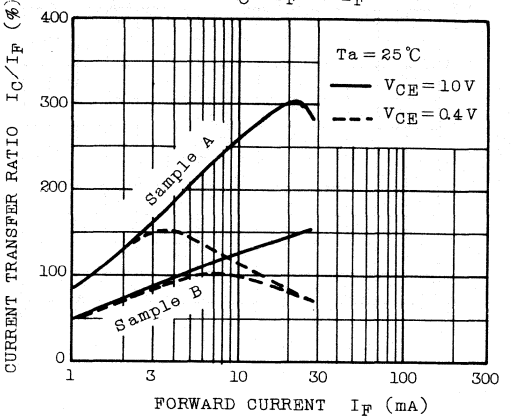
I_{FP} – V_{FP}



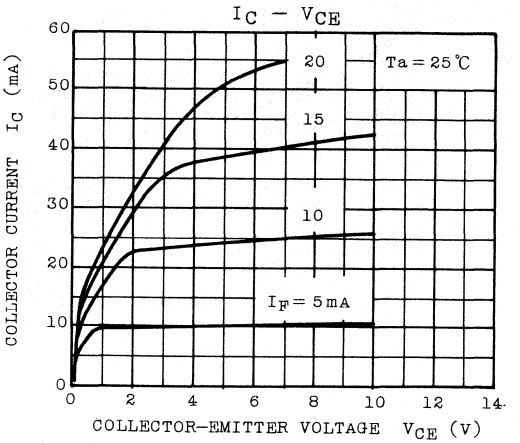
$I_C - I_F$



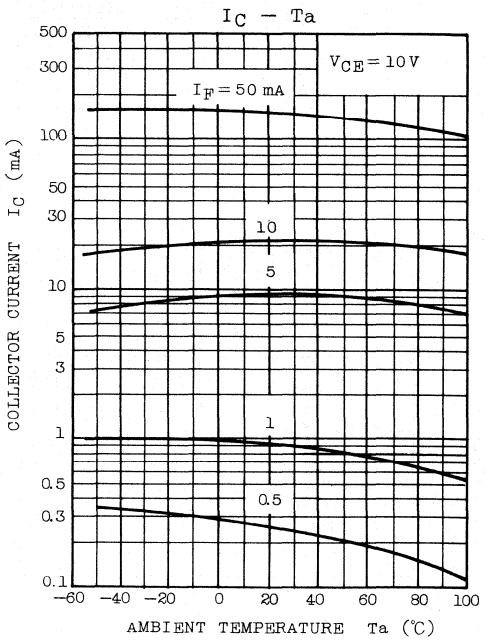
$I_C / I_F - I_F$



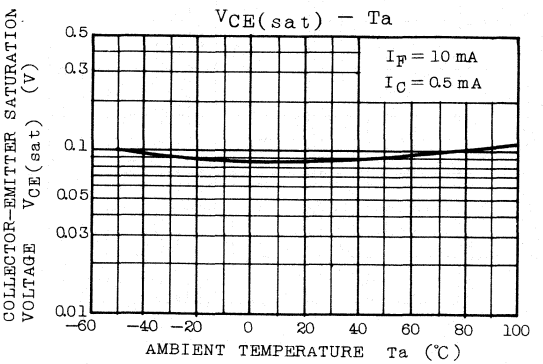
$I_C - V_{CE}$

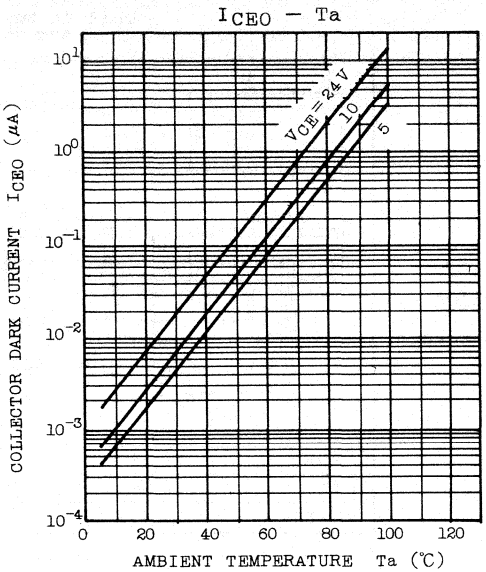


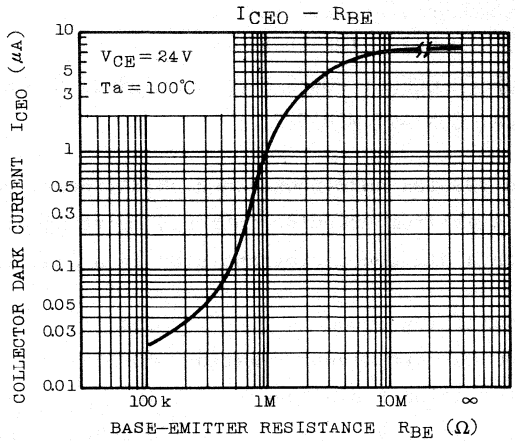
$I_C - Ta$

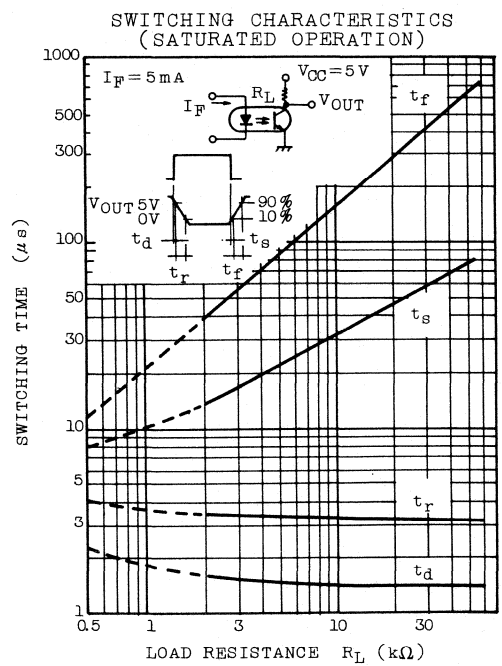


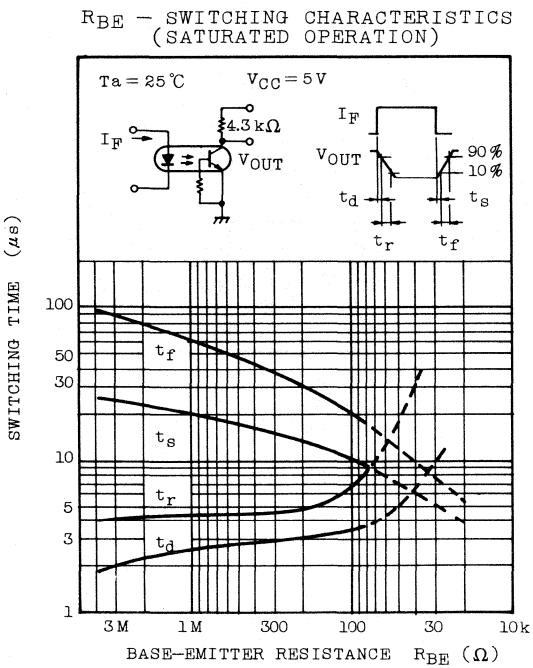
$V_{CE(sat)} - Ta$




I_{CEO} – Ta
COLLECTOR DARK CURRENT I_{CEO} (μA)
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
V_{CE}=24 V
10
5
0
20
40
60
80
100
120
AMBIENT TEMPERATURE Ta (℃)


I_{CEO} – R_{BE}
COLLECTOR DARK CURRENT I_{CEO} (μA)
10
5
3
1
0.5
0.3
0.1
0.05
0.03
0.01
V_{CE}=24 V
Ta=100℃
100 k
1M
10M
∞
BASE-EMITTER RESISTANCE R_{BE} (Ω)

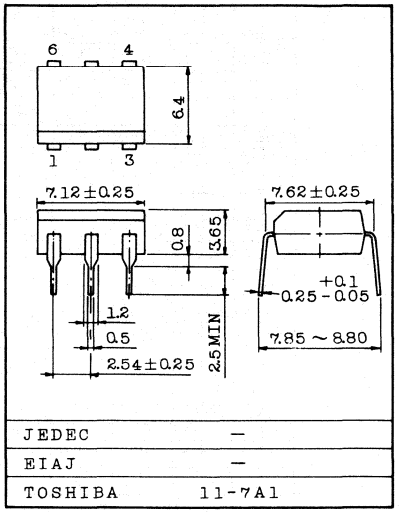

SWITCHING CHARACTERISTICS
(SATURATED OPERATION)
SWITCHING TIME (μs)
1000
500
300
100
50
30
10
5
3
1
I_F=5 mA
V_{CC}=5 V
R_L
I_F
V_{OUT}
V_{OUT} 5V
0V
90%
10%
t_d
t_r
t_s
t_f
0.5
1
3
10
30
LOAD RESISTANCE R_L (kΩ)


R_{BE} – SWITCHING CHARACTERISTICS
(SATURATED OPERATION)
SWITCHING TIME (μs)
Ta=25℃
V_{CC}=5 V
4.3 kΩ
I_F
V_{OUT}
90%
10%
t_d
t_r
t_s
t_f
100
50
30
10
5
3
1
3M
1M
300
100
30
10k
BASE-EMITTER RESISTANCE R_{BE} (Ω)

4N38(Short), 4N38A(Short) GaAs IRED & PHOTO-TRANSISTOR

AC LINE/DIGITAL LOGIC ISOLATOR.
DIGITAL LOGIC/DIGITAL LOGIC ISOLATOR.
TELEPHONE LINE RECEIVER.
TWISTED PAIR LINE RECEIVER.
HIGH FREQUENCY POWER SUPPLY FEEDBACK CONTROL.
RELAY CONTACT MONITOR.

Unit in mm

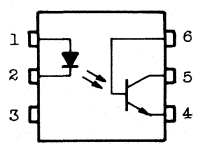


JEDEC	—
EIAJ	—
TOSHIBA	11-7A1

The TOSHIBA 4N38(Short) and 4N38A(Short) consist of a gallium arsenide infrared emitting diode coupled with a silicon phototransistor in a dual in-line package.

- Switching Speeds : 3μs
- DC Current Transfer Ratio : 100%
- Isolation Resistance : $10^{11}\Omega$
- Isolation Voltage : $2500V_{rms}$ Min.
- UL Recognized : File No. E67349

PIN CONFIGURATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: EMITTER
5: COLLECTOR
6: BASE

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current (Continuous)	I_F	80	mA
	Forward Current Derating	$\Delta I_F/°C$	1.07*	mA/°C
	Peak Forward Current (Note)	I_{PF}	3	A
	Power Dissipation	P_D	150	mW
	Power Dissipation Derating	$\Delta P_D/°C$	2.0*	mW/°C
	Reverse Voltage	V_R	3	V
PHOTO-TRANSISTOR	Collector-Emitter Voltage	BV_{CEO}	80	V
	Collector-Base Voltage	BV_{CBO}	80	V
	Emitter-Collector Voltage	BV_{ECO}	7	V
	Collector Current (Continuous)	I_C	100	mA
	Power Dissipation	P_C	150	mW
	Power Dissipation Derating	$\Delta P_C/°C$	2.0*	mW/°C
COUPLED	Storage Temperature	T_{stg}	-55 ~ 150	°C
	Operating Temperature	T_{opr}	-55 ~ 100	°C
	Lead Soldering Temperature (at 10 sec.)	T_{sold}	260	°C
	Total Package Dissipation	P_T	250	mW
	Total Package Power Dissipation Derating	$\Delta P_T/°C$	3.3*	mW/°C

Note : Pulse width 300μs, 2% duty cycle.

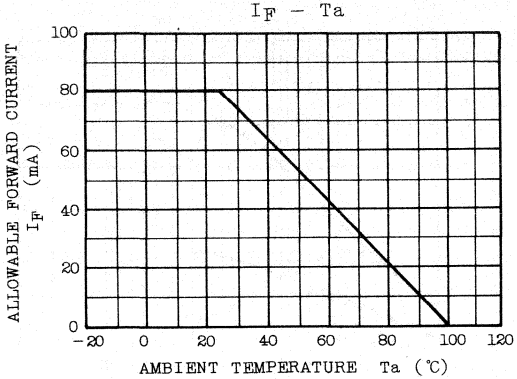
* Above 25°C ambient.

ELECTRICAL CHARACTERISTICS (Ta=25°C)

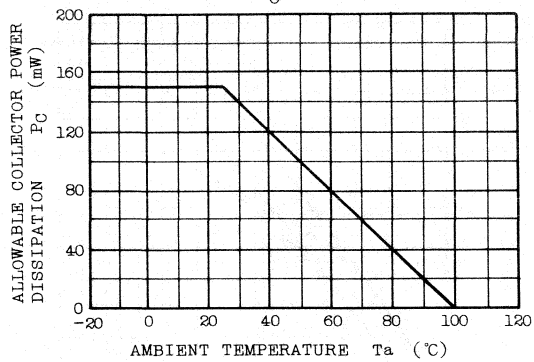
	CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage		V_F	I_F=10mA	-	1.15	1.5	V
	Reverse Current		I_R	V_R=3V	-	-	100	μA
	Capacitance		C_D	V=0, f=1MHz	-	30	-	pF
PHOTO-TRANSISTOR	DC Forward Current Gain		h_{FE}	V_{CE}=5V, I_C=500μA	-	200	-	
	Collector-Emitter Breakdown Voltage		$V_{(BR)CEO}$	I_C=1mA	80	-	-	V
	Collector-Base Breakdown Voltage		$V_{(BR)CBO}$	I_C=100μA	80	-	-	V
	Emitter-Collector Breakdown Voltage		$V_{(BR)ECO}$	I_E=100μA	7	-	-	V
	Collector Dark Current		I_{CEO}	V_{CE}=60V	-	1	50	nA
	Collector Dark Current		I_{CBO}	V_{CB}=60V	-	0.1	20	nA
	Collector-Emitter Capacitance		C_{CE}	V=0, f=1MHz	-	10	-	pF
COUPLED	Current Transfer Ratio		I_C/I_F	I_F=10mA, V_{CE}=10V	10	100	-	%
	Collector-Emitter Saturation Voltage		$V_{CE(sat)}$	I_F=20mA, I_C=4mA	-	-	1.0	V
	Capacitance Input to Output		C_S	V_S=0, f=1MHz	-	0.8	-	pF
	Isolation Resistance		R_S	V_S=500V	-	10^{11}	-	Ω
	Isolation Voltage		BV_S	AC, 1 minute	2500	-	-	V_{rms}
		4N38	BV_S*	AC, Peak	1500	-	-	V_{pk}
		4N38A			2500	-	-	
		4N38A		AC, 1 second	1775	-	-	V_{rms}
	Turn-on Time		t_{on}	V_{CE}=10V, I_C=2mA	-	3	-	μs
	Turn-off Time		t_{off}	R_L=100Ω	-	3	-	

* JEDEC registered minimum BV_S, however, TOSHIBA specifies a minimum BV_S of 2500V_{rms}, 1 minute.

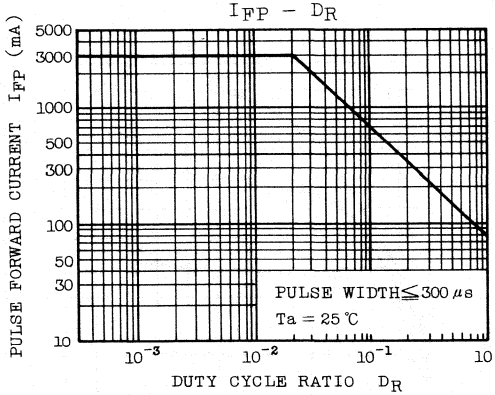
I_F – Ta



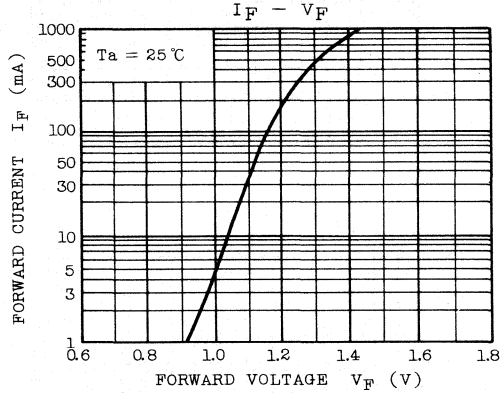
P_C – Ta



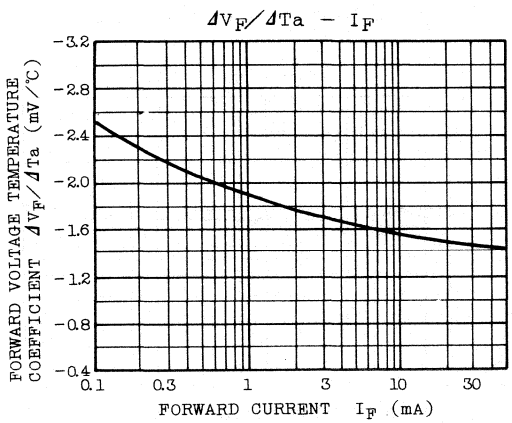
I_{FP} – D_R



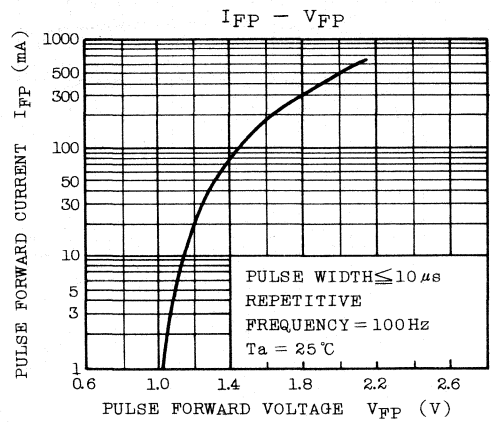
I_F – V_F



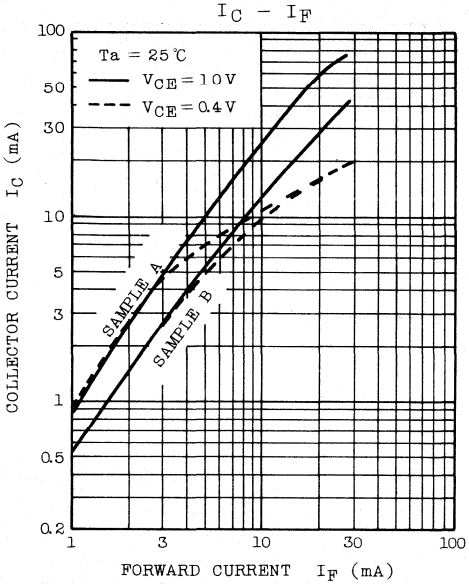
$\Delta V_F / \Delta Ta$ – I_F



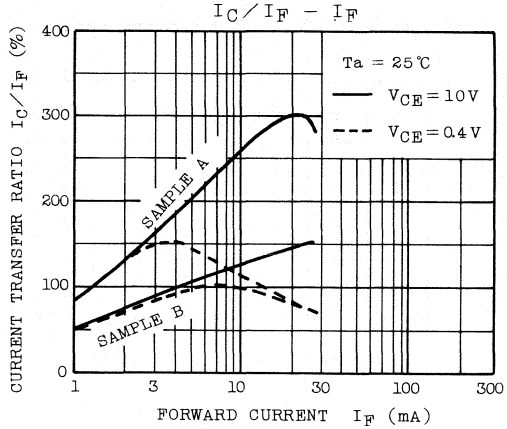
I_{FP} – V_{FP}



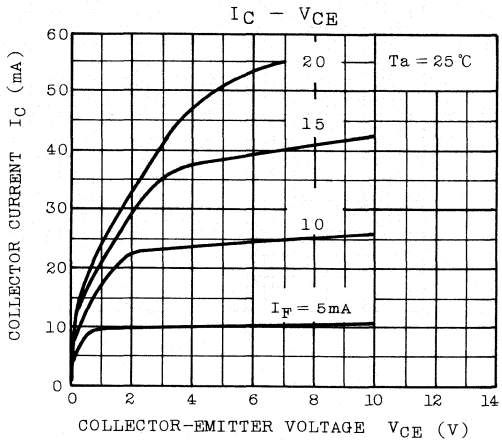
$I_C - I_F$



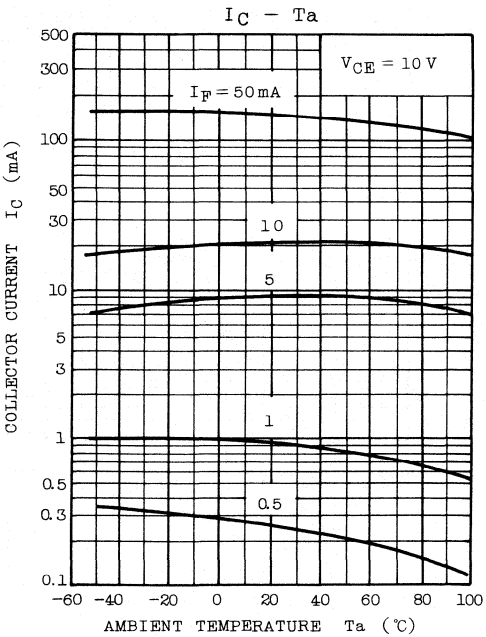
$I_C / I_F - I_F$



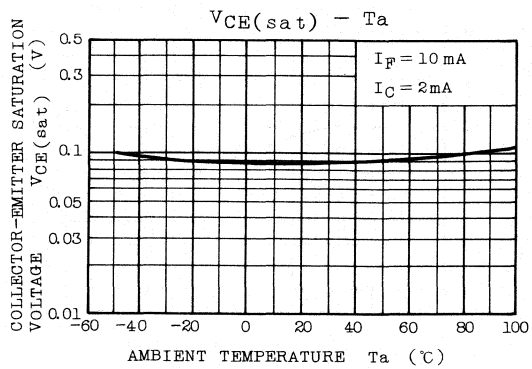
$I_C - V_{CE}$



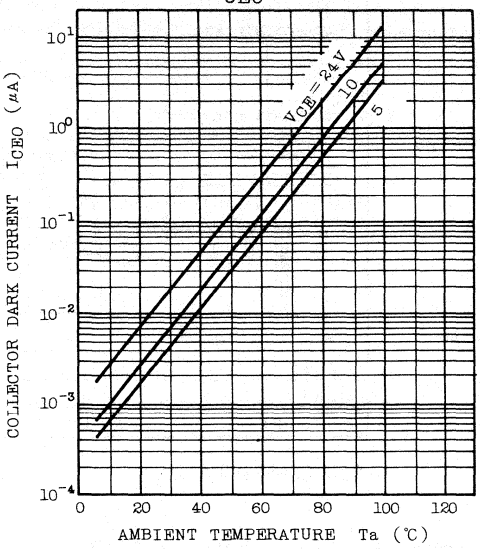
$I_C - Ta$



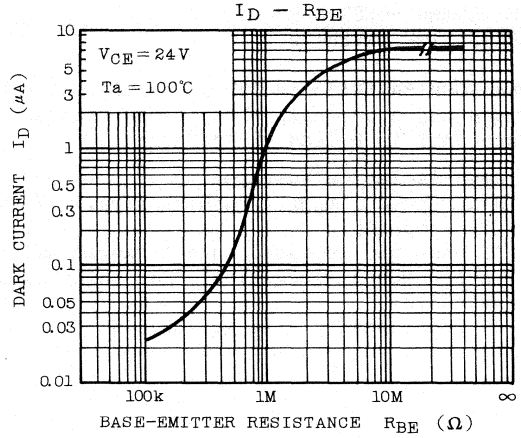
$V_{CE(sat)} - Ta$



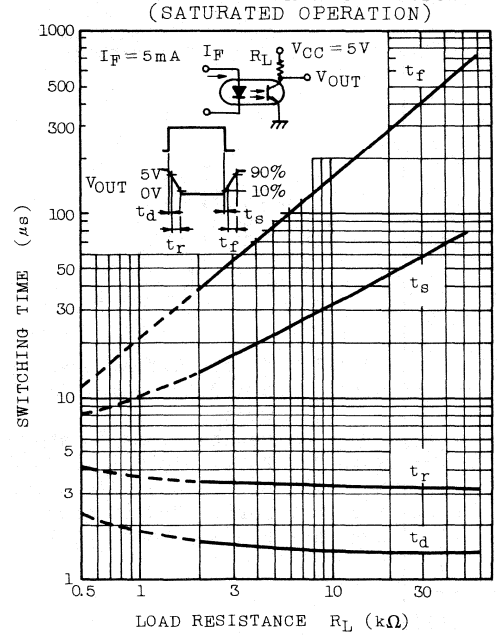
I_{CEO} – Ta



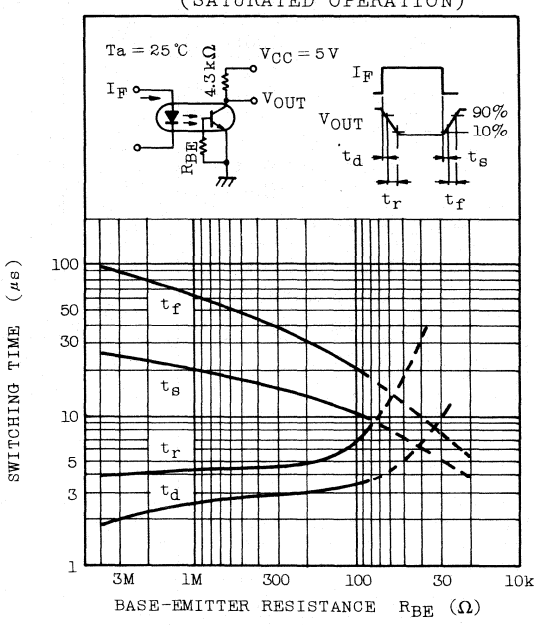
I_D – R_{BE}



SWITCHING CHARACTERISTICS (SATURATED OPERATION)



R_{BE} – SWITCHING CHARACTERISTICS (SATURATED OPERATION)



6N135, 6N136

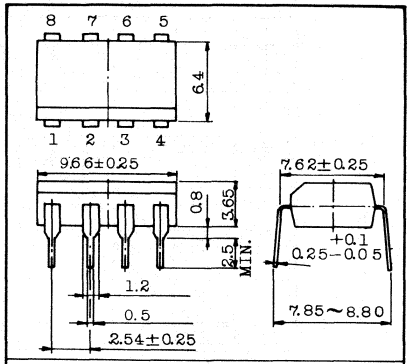
GaAℓAs IRED & PHOTO-IC

DEGITAL LOGIC ISOLATION.
LINE RECEIVER.
POWER SUPPLY CONTROL.
SWITCHING POWER SUPPLY.
TRANSISTOR INVERTER.

The TOSHIBA 6N135 and 6N136 consist of a high emitting diode and a one chip photo diode-transistor.
Each unit is 8-lead DIP package.

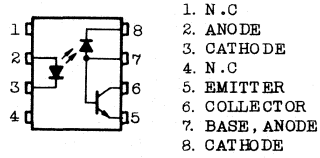
- High Isolation Voltage
- High Speed : t_{pHL}, t_{pLH}=0.5μs(Typ.) (R_L=1.9kΩ)
- TTL Compatible
- If base pin is open, output signal will be noisy by environmental condition. For this base, TLP550 is suitable.
- UL Recognized : File No. E67349

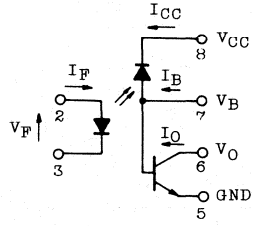
Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11−10C1

PIN CONFIGURATIONS





MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current (Note 1)	I_F	25	mA
	Pulse Forward Current (Note 2)	I_{FP}	50	mA
	Total Pulse Forward Current (Note 3)	I_{FPT}	1	A
	Reverse Voltage	V_R	5	V
	Diode Power Dissipation (Note 4)	P_D	45	mW
DETECTOR	Output Current	I_O	8	mA
	Peak Output Current	I_{OP}	16	mA
	Emitter-Base Reverse Voltage (Pin 5-7)	V_{EB}	5	V
	Supply Voltage	V_{CC}	-0.5~15	V
	Output Voltage	V_O	-0.5~15	V
	Base Current (Pin 7)	I_B	5	mA
	Output Power Dissipation (Note 5)	P_O	100	mW
Operating Temperature Range		T_{opr}	-55~100	°C
Storage Temperature Range		T_{stg}	-55~125	°C
Isolation Voltage (Note 6)		BV_S	2500	V_{rms}

Note 1 : Derate 0.8mA above 70°C.
Note 2 : 50% duty cycle, 1ms pulse width.
Derate 1.6mA/°C above 70°C.
Note 3 : Pulse width 1μs, 300pps.
Note 4 : Derate 0.9mW/°C above 70°C.
Note 5 : Derate 2mW/°C above 70°C.
Note 6 : R.H.=40~60%, AC/1 min.

ELECTRICAL CHARACTERISTICS

OVER RECOMMENDED TEMPERATURE (Ta=0°C ~ 70°C Unless otherwise noted)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	**TYP.	MAX.	UNIT
Current Transfer Ratio	6N135	CTR	I_F=16mA, V_O=0.4V, V_{CC}=4.5V, Ta=25°C (Note 1)	7	18	-	%
	6N136			19	24	-	%
	6N135	CTR	I_F=16mA, V_O=0.5V, V_{CC}=4.5V (Note 1)	5	13	-	%
	6N136			15	21	-	%
Logic Low Output Voltage	6N135	V_{OL}	I_F=16mA, I_O=1.1mA, V_{CC}=4.5V	-	0.1	0.4	V
	6N136		I_F=16mA, I_O=2.4mA, V_{CC}=4.5V	-	0.1	0.4	V
Logic High Output Current		I_{OH}	I_F=0mA, V_O=V_{CC}=5.5V, Ta=25°C	-	3	500	nA
			I_F=0mA, V_O=V_{CC}=15V, Ta=25°C	-	0.1	1	μA
		I_{OH}	I_F=0mA, V_O=V_{CC}=15V	-	-	50	μA
Logic Low Supply Current		I_{CCL}	I_F=16mA, V_O=Open, V_{CC}=15V	-	40	-	μA
Logic High Supply Current		I_{CCH}	I_F=0mA, V_O=Open, V_{CC}=15V, Ta=25°C	-	0.01	1	μA
		I_{CCH}	I_F=0mA, V_O=Open, V_{CC}=15V	-	-	2	μA
Input Forward Voltage		V_F	I_F=16mA, Ta=25°C	-	1.65	1.7	V
Temperature Coefficient of Forward Voltage		$\frac{\Delta V_F}{\Delta Ta}$	I_F=16mA	-	-1.9	-	mV/°C
Input Reverse Breakdown Voltage		BV_R	I_R=10μA, Ta=25°C	5	-	-	V
Input Capacitance		C_{IN}	f=1MHz, V_F=0	-	60	-	pF
Input-Output Insulation Leakage Current		I_{I-O}	45% Relative Humidity, t=5s, V_{I-O}=3000Vdc, Ta=25°C (Note 2)	-	-	1.0	μA
Resistance (Input-Output)		R_{I-O}	V_{I-O}=500Vdc (Note 2)	-	10^{12}	-	Ω
Capacitance (Input-Output)		C_{I-O}	f=1MHz (Note 2)	-	0.6	-	pF
Transistor DC Current Gain		h_{FE}	V_O=5V, I_O=3mA	-	80	-	-

** All typicals at Ta=25°C.

SWITCHING SPECIFICATIONS

(Unless otherwise specified. Ta=25°C, V_{CC}=5V, I_F=16mA)

CHARACTERISTIC		SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Propagation Dealy Time to Logic Low at Output	6N135	t_{pHL}	1	R_L=4.1kΩ	-	0.2	1.5	μs
	6N136			R_L=1.9kΩ	-	0.2	0.8	μs
Propagation Delay Time to Logic High at Output	6N135	t_{pLH}	1	R_L=4.1kΩ	-	1.0	1.5	μs
	6N136			R_L=1.9kΩ	-	0.5	0.8	μs
Common Mode Transient Immunity at Logic High Level Output (Note 3)	6N135	CM_H	2	I_F=0mA, V_{CM}=10V_{p-p} R_L=4.1kΩ	-	1000	-	V/μs
	6N136			I_F=0mA, V_{CM}=10V_{p-p} R_L=1.9kΩ	-	1000	-	V/μs
Common Mode Transient Immunity at Logic Low Level Output (Note 3)	6N135	C_{ML}	2	V_{CM}=10Vp-p, R_L=4.1kΩ I_F=16mA	-	-1000	-	V/μs
	6N136			V_{CM}=10Vp-p, R_L=1.9kΩ I_F=16mA	-	-1000	-	V/μs
Bandwidth (Note 4)		BW	-	R_L=100Ω	-	2	-	MHz

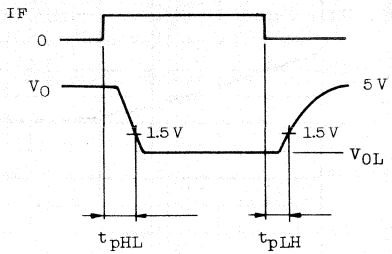
Note 1 : DC CURRENT TRANSFER RATIO is defined as the ratio of output collector current, I_O, to the forward LED input current, I_F, times 100%.

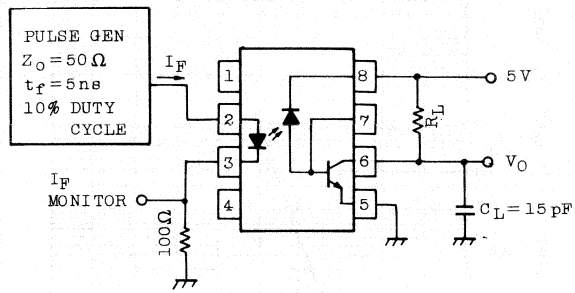
2 : Device considered a two-terminal device: Pins 1,2,3, and 4 shorted together and Pins 5, 6, 7 and 8 shorted together.

3 : Common mode transient immunity in Logic High level is the maximum tolerable (Positive) dVcm/dt on the leading edge of the common mode pulse, Vcm, to assure that the output will remain in a Logic High state (i.e., $V_O > 2.0V$). Common mode transient immunity in Logic Low level is the maximum tolerable (negativ)dVcm/dt on the trailing edge of the common mode pulse signal, Vcm, to assure that the output will remain in a Logic Low state (i.e., $V_O < 0.8V$).

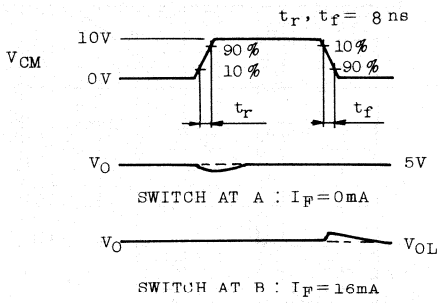
4 : The frequency at which the ac output voltage is 3dB below the low frequency asymptote.

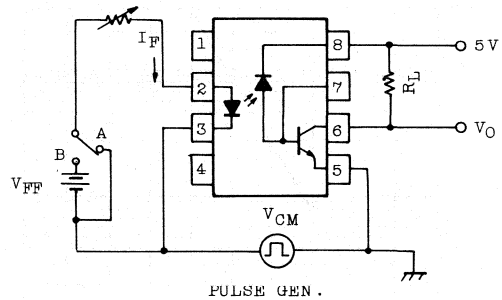
TEST CIRCUIT 1.





TEST CIRCUIT 2.



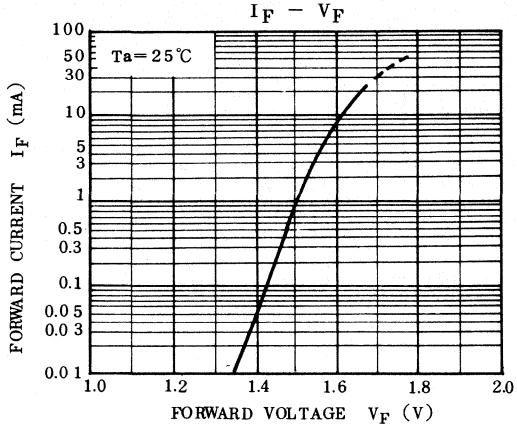


PRECAUTION

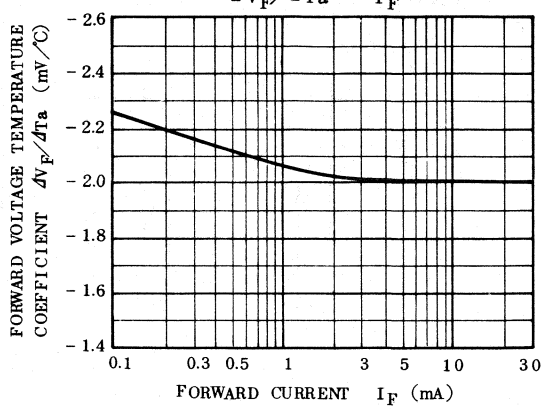
Please be careful of the followings.

1. Soldering temperature: 260°C MAX.
   Soldering time: 10 sec MAX.
   (Soldering portion of lead: up to 2mm from the body of the device)
2. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E

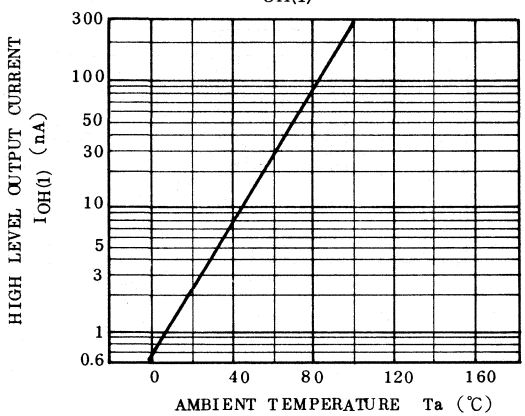
$I_F - V_F$



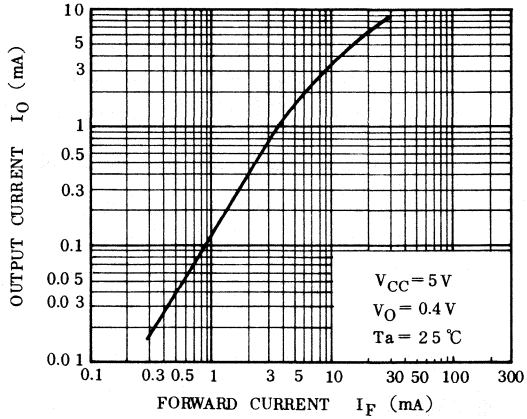
$\Delta V_F / \Delta Ta - I_F$



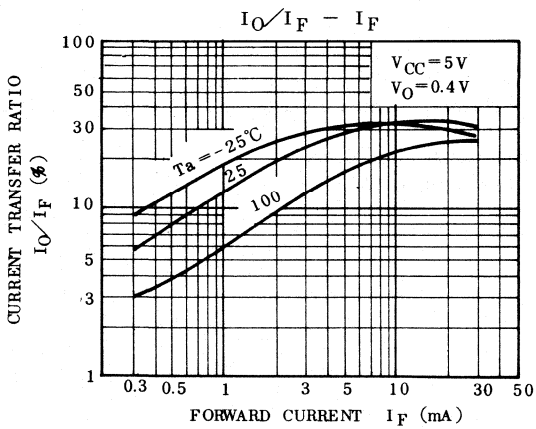
$I_{OH(1)} - Ta$



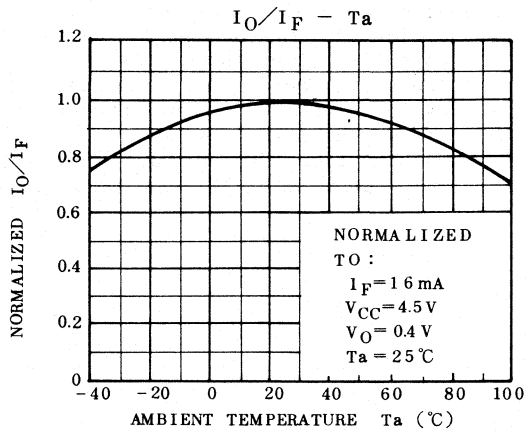
$I_O - I_F$



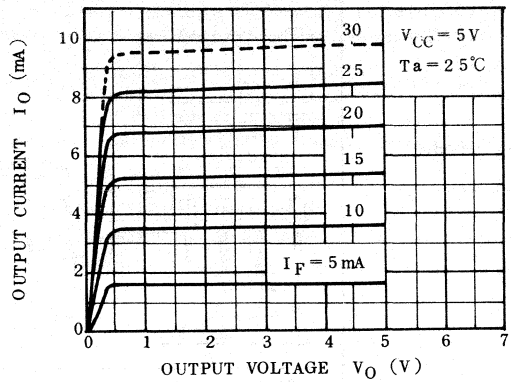
$I_O / I_F - I_F$



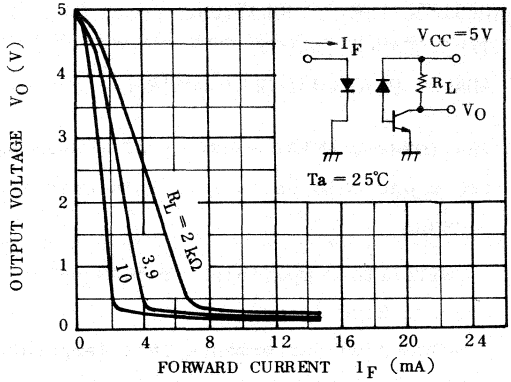
$I_O / I_F - Ta$



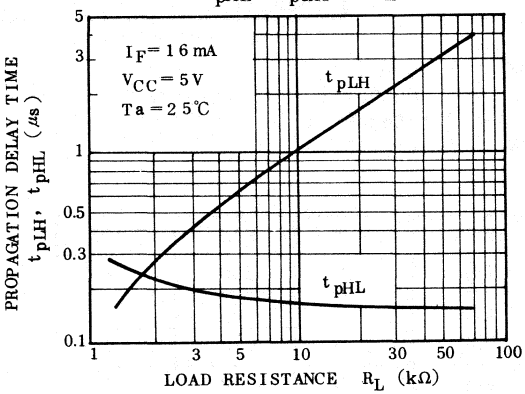
$I_O - V_O$



$V_O - I_F$



t_{pHL}, t_{pLH} – R_L



6N137

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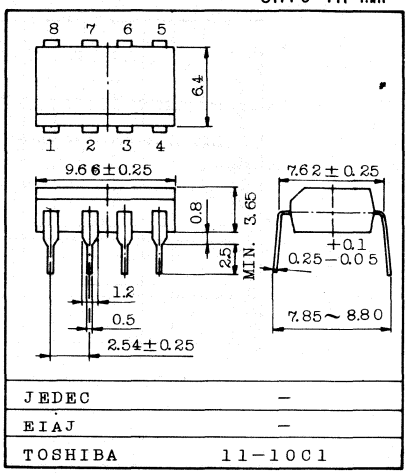
Unit in mm



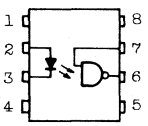
JEDEC	—
EIAJ	—
TOSHIBA	11−10C1

DEGITAL LOGIC ISOLATION.
TELE-COMMUNICATION.
ANALOG DATA EQUIPMENT CONTROL.

The TOSHIBA 6N137 consists of a high emitting diode and a one chip photo IC. This unit is 8-lead DIP package.

- LSTTL/TTL Compatible : 5V Supply
- Ultra High Speed
- Guaranteed Performance Over Temperature.
- High Isolation Voltage : 2500V_{rms}
- UL Recognized : File No. E67349

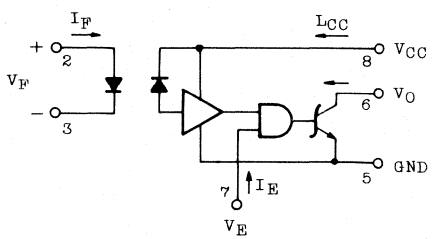
PIN CONFIGURATIONS (TOP VIEW)



1. NO CONNECTION
2. LED ANODE
3. LED CATHODE
4. NO CONNECTION
5. GND
6. OUTPUT (OPEN COLLECTOR)
7. ENABLE
8. V_{CC}

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	MAX.	UNIT
Input Current, Low Level Each Channel	I_{FL}	0	250	μA
Input Current, High Level Each Channel	I_{FH}	7	20	mA
High Level Enable Voltage	V_{EH}	2.0	V_{CC}	V
Low Level Enable Voltage (Output High)	V_{EL}	0	0.8	V
Supply Voltage, Output	V_{CC}	4.5	5.5	V
Fan Out (TTL LOAD)	N	-	8	
Operating Temperature	Ta	0	70	°C



TRUTH TABLE

INPUT	ENABLE	OUTPUT
H	H	L
L	H	H
H	L	H
L	L	H

MAXIMUM RATINGS

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	20	mA
	Pulse Forward Current (Note)	I_{FP}	40	mA
	Reverse Voltage	V_R	5	V
DETECTOR	Output Current	I_O	50	mA
	Output Voltage	V_O	7	V
	Supply Voltage (1 minute Maximum)	V_{CC}	7	V
	Enable Input Voltage (Not to exceed V_{CC} by more than 500mV)	V_{EH}	5.5	V
	Output Collcetor Power Dissipation	P_O	85	mW
Operating Temperature Range		T_{opr}	0 ~ 70	°C
Storage Temperature Range		T_{stg}	-55 ~ 125	°C

Note : 50% duty cycle, 1ms pulse width.

PRECAUTION

Please be careful of the followings.

1. Soldering temperature: 260°C MAX. Soldering time: 10 sec MAX.
   (Soldering portion of lead: up to 2mm from the body of the device)
2. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E
3. A ceramic capacitor (0.1μF) should be connected from pin 8 to pin 5 to stabilize the operation of the high gain linear amplifier. Failure to provide the bypassing may impair the switching property. The total lead length between capacitor and coupler should not exceed 1cm.

ELECTRICAL CHARACTERISTICS

OVER RECOMMENDED TEMPERATURE (Ta=0 ~ 70°C Unless otherwise noted)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	**TYP.	MAX.	UNIT
High Level Output Current	I_{OH}	V_{CC}=5.5V, V_O=5.5V I_F=250μA, V_E=2.0V	-	1	250	μA
Low Level Output Voltage	V_{OL}	V_{CC}=5.5V, I_F=5mA V_{EH}=2.0V I_{OL}(Sinking)=13mA	-	0.4	0.6	V
High Level Enable Current	I_{EH}	V_{CC}=5.5V, V_E=2.0V	-	-1.0	-	mA
Low Level Enable Current	I_{EL}	V_{CC}=5.5V, V_E=0.5V	-	-1.6	-2.0	mA
High Level Supply Current	I_{CCH}	V_{CC}=5.5V, I_F=0, V_E=0.5V	-	7	15	mA
Low Level Supply Current	I_{CCL}	V_{CC}=5.5V, I_F=10mA V_E=0.5V	-	12	18	mA
Input-Output Insulation Leakage Current (Note)	I_{I-O}	45% Relative Humidity, Ta=25°C, t=5s, V_{I-O}=3000Vdc	-	-	1.0	μA
Resistance (Input-Output) (Note)	R_{I-O}	V_{I-O}=500V, Ta=25°C	-	10^{12}	-	Ω
Capacitance (Input-Output) (Note)	C_{I-O}	f=1MHz, Ta=25°C	-	0.6	-	pF
Input Forward Voltage	V_F	I_F=10mA, Ta=25°C	-	1.65	1.75	V
Input Reverse Breakdown Voltage	BV_R	I_R=10μA, Ta=25°C	5	-	-	V
Input Capacitance	C_{IN}	V_F=0, f=1MHz	-	45	-	pF
Current Transfer Ratio	CTR	I_F=5.0mA, R_L=100Ω	-	1000	-	%

** All typical values are at V_{CC}=5V, Ta=25°C

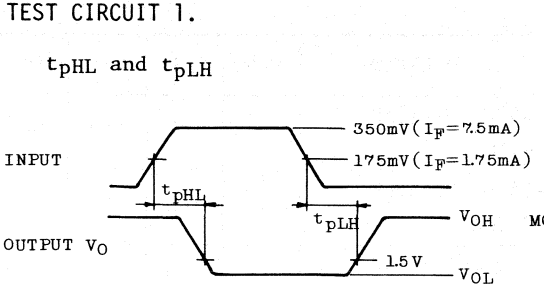
Note : Pins 1,2,3 and 4 shorted together and Pins 5,6,7 and 8 shorted together.

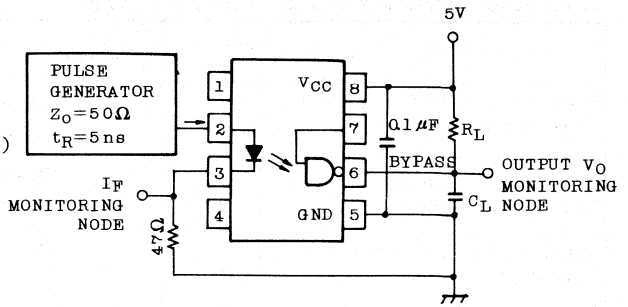
SWITCHING CHARACTERISTICS (Ta=25°C, V_{CC}=5V)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Propagation Delay Time to High Output Level	t_{pLH}	1	R_L=350Ω, C_L=15pF I_F=7.5mA	-	60	75	ns
Propagation Delay Time to Low Output Level	t_{pHL}	1	R_L=350Ω, C_L=15pF I_F=7.5mA	-	60	75	ns
Output Rise-Fall Time (10-90%)	t_r,t_f	-	R_L=350Ω, C_L=15pF I_F=7.5mA	-	30	-	ns
Propagation Delay Time of Enable from V_{EH} to V_{EL}	t_{ELH}	2	R_L=350Ω, C_L=15pF I_F=7.5mA, V_{EH}=3.0V V_{EL}=0.5V	-	25	-	ns
Propagation Dealy Time of Enable from V_{EL} to V_{EH}	t_{EHL}	2	R_L=350Ω, C_L=15pF I_F=7.5mA, V_{EH}=3.0V V_{EL}=0.5V	-	25	-	ns
Common Mode Transient Immunity at Logic High Output Level	CM_H	3	V_{CM}=10V, R_L=350Ω $V_{O(min.)}$=2V I_F=0mA	-	200	-	V/μs
Common Mode Transient Immunity at Logic Low Output Level	CM_L	3	V_{CM}=10V, R_L=350Ω $V_{O(max.)}$=0.8V I_F=5mA	-	-500	-	V/μs

TEST CIRCUIT 1.

t_{pHL} and t_{pLH}

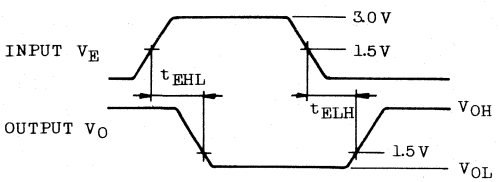


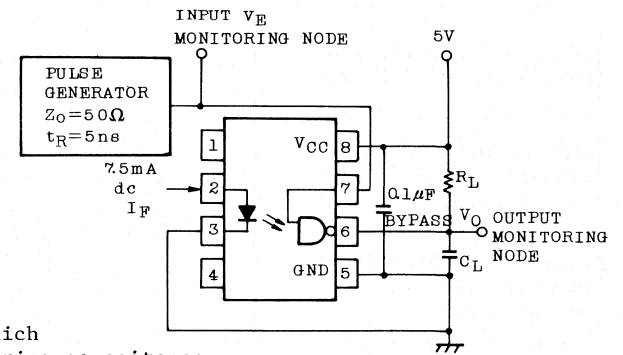


C_L is approximately 15pF which includes probe and stray wiring capacitance.

TEST CIRCUIT 2.

t_{ELH} and t_{EHL}

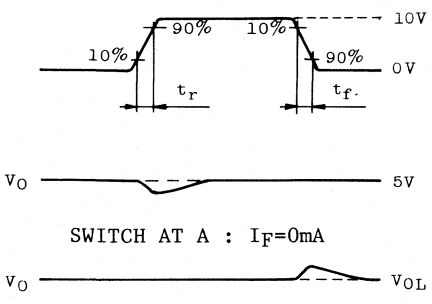


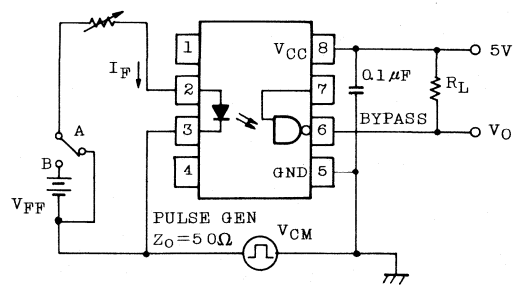


. C_L is approximately 15pF which includes prove and stray wiring capacitance.

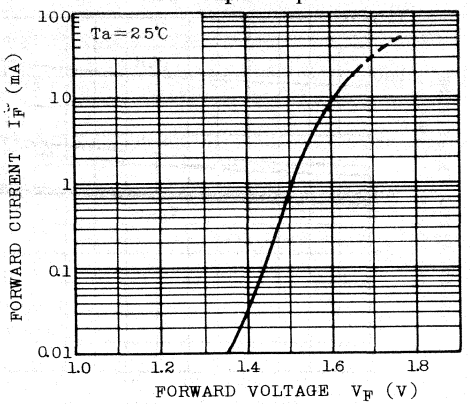
TEST CIRCUIT 3.

Transient Immunity and Typical Waveforms

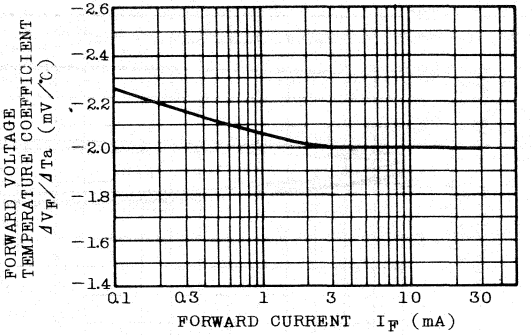




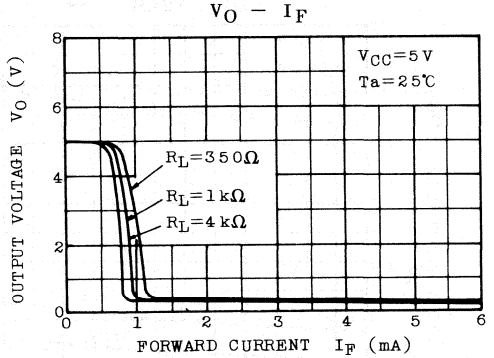
$I_F - V_F$



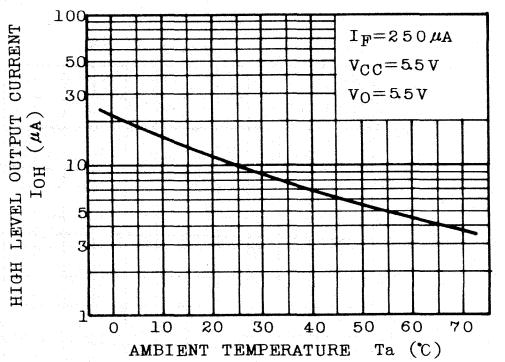
$\Delta T_F/\Delta Ta - I_F$



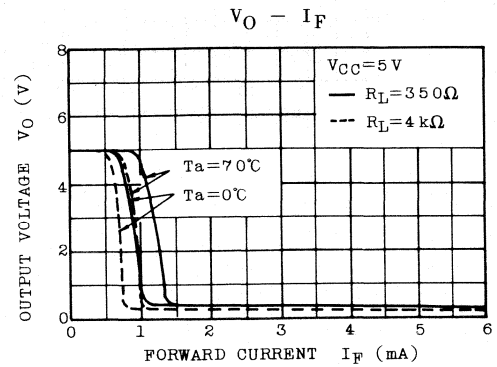
$V_O - I_F$



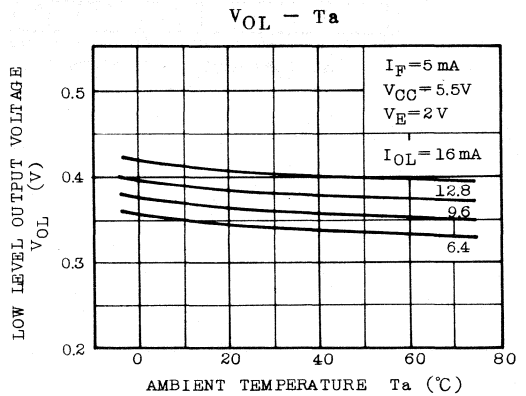
$I_{OH} - Ta$



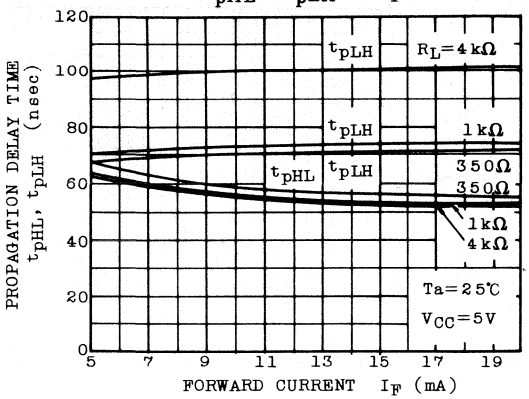
$V_O - I_F$



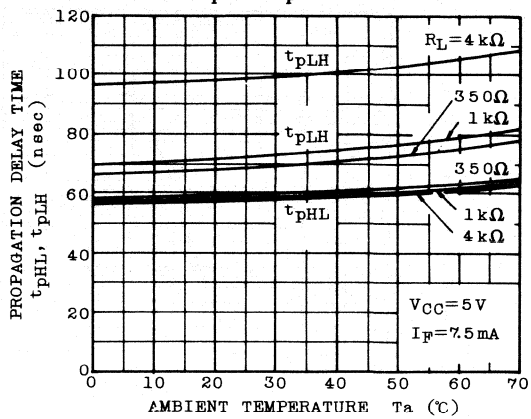
$V_{OL} - Ta$



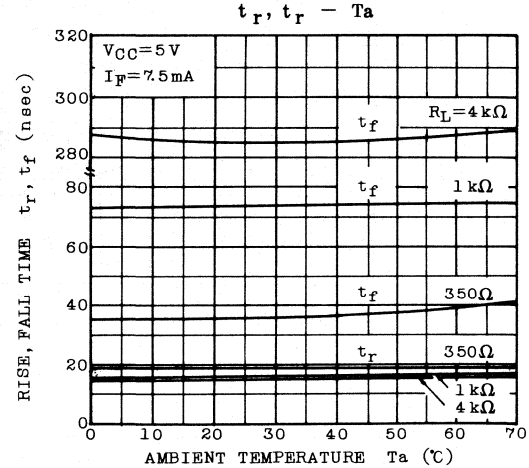
t_{pHL}, t_{pLH} – I_F



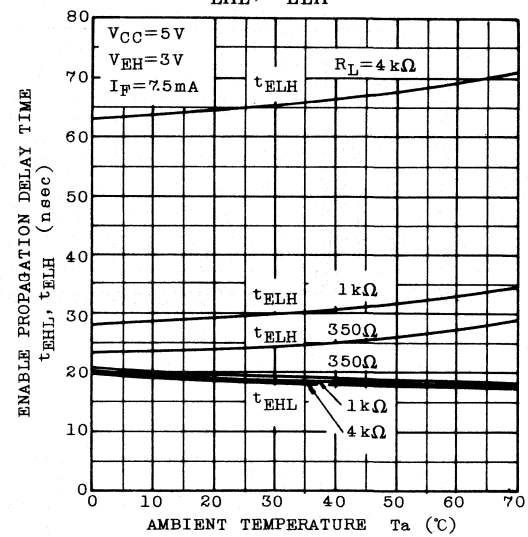
t_{pHL}, t_{pLH} – Ta



t_r, t_r – Ta



t_{EHL}, t_{ELH} – Ta

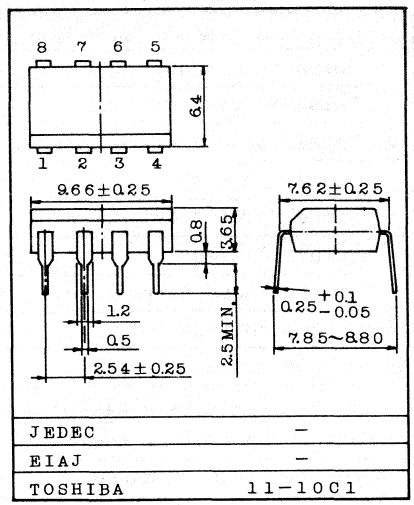


CURRENT LOOP DRIVER.
LOW INPUT CURRENT LINE RECEIVER.
CMOS LOGIC INTERFACE.

The TOSHIBA 6N138 and 6N139 consist of a GaAℓAs infrared emitting diode coupled with a split-Darlington output configuration.
A high speed GaAℓAs IRED manufactured with an unique LPE junction, has the virtue of fast rise and fall time at low drive current.

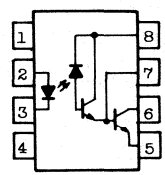
- Isolation Voltage : 2500V_{rms} (Min.)
- Current Transfer Ratio
  : 6N138 - 300% Min. (I_F=1.6mA)
  6N139 - 400% Min. (I_F=0.5mA)
- Switching time : 6N138 - t_{PHL}=10μs Max.
  - t_{PLH}=35μs Max.
  6N139 - t_{PHL}=1μs Max.
  - t_{PLH}=7μs Max.
- UL Recognized : File No. E67349

Unit in mm



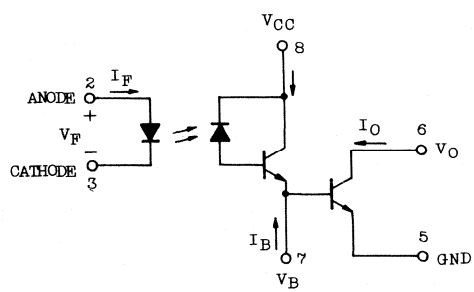
JEDEC	—
EIAJ	—
TOSHIBA	11-10C1

PIN CONFIGURATION (TOP VIEW)



1 : NC
2 : ANODE
3 : CATHODE
4 : NC
5 : GROUND
6 : OUTPUT
7 : OUTPUT BASE
8 : V_{CC}

SCHEMATIC



MAXIMUM RATINGS* (Ta=0°C to +70°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current	(Note 1)	I_F	20	mA
	Pulse Forward Current		I_{FP}*1	40	mA
	Total Pulse Forward Current		I_{FP}*2	1	A
	Reverse Voltage		V_R	5	V
	Diode Power Dissipation	(Note 2)	P_D	35	mW
DETECTOR	Output Current	(Note 3)	I_O	60	mA
	Emitter-Base Reverse Voltage		V_{EB}	0.5	V
	Supply Voltage		V_{CC}*3	-0.5 to 18	V
	Output Voltage		V_O*3	-0.5 to 18	V
	Output Power Dissipation	(Note 4)	P_o	100	mW
Operating Temperature Range			T_{opr}	0 to 70	°C
Storage Temperature Range			T_{stg}	-55 to 125	°C
Lead Solder Temperature (10 sec)		*4	T_{sold}	260	°C
Isolation Voltage (1 min., RH ≦ 60%)			BV_S**	2500	V_{rms}
				3540	Vdc

* JEDEC Registered Data

** Not Registered JEDEC

*1 50% duty cycle, 1ms pulse width

*2 Pulse width 1μs, 300pps

*3 6N138 .... -0.5 to 7V

*4 1.6mm below seating plane

ELECTRICAL CHARACTERISTICS (Ta=0°C to +70°C, Unless otherwise specified)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	*5 TYP.	MAX.	UNIT
Current Transfer Ratio (Note 5,6)	6N139	CTR*	I_F=0.5mA, V_O=0.4V, V_{CC}=4.5V	400	800	-	%
			I_F=1.6mA, V_O=0.4V, V_{CC}=4.5V	500	900	-	
	6N138			300	600	-	
Logic Low Output Voltage (Note 6)	6N139	V_{OL}	I_F=1.6mA, I_O=6.4mA, V_{CC}=4.5V	-	0.1	0.4	V
			I_F=5mA, I_O=15mA, V_{CC}=4.5V	-	0.1	0.4	
			I_F=12mA, I_O=24mA, V_{CC}=4.5V	-	0.2	0.4	
	6N138		I_F=1.6mA, I_O=4.8mA, V_{CC}=4.5V	-	0.1	0.4	
Logic High Output Current (Note 6)	6N139	I_{OH}*	I_F=0mA, V_O=V_{CC}=18V	-	0.05	100	μA
	6N138		I_F=0mA, V_O=V_{CC}=7V	-	0.05	250	
Logic Low Supply Current (Note 6)		I_{CCL}	I_F=1.6mA, V_O=Open, V_{CC}=5V	-	0.2	-	mA
Logic High Supply Current (Note 6)		I_{CCH}	I_F=0mA, V_O=Open, V_{CC}=5V	-	10	-	nA
Input Forward Voltage		V_F*	I_F=1.6mA, Ta=25°C	-	1.65	1.7	V
Input Reverse Breakdown Voltage		BV_R*	I_R=10μA, Ta=25°C	5	-	-	V
Temperature Coefficient of Forward Voltage		$\frac{\Delta V_F}{\Delta Ta}$	I_F=1.6mA	-	-1.9	-	mV/°C
Input Capacitance		C_{IN}	f=1MHz, V_F=0	-	60	-	pF
Input-Output Insulation Leakage Current		I_{I-O}*	45% Relative Humidity, t=5s, V_{I-O}=3000Vdc, Ta=25°C (Note 7)	-	-	1.0	μA
Resistance (Input-Output)		R_{I-O}	V_{I-O}=500Vdc (Note 7)	-	10^{12}	-	Ω
Capacitance (Input-Output)		C_{I-O}	f=1MHz (Note 7)	-	0.6	-	pF

* JEDEC Registered Data.

*5 All typicals at Ta=25°C and V_{CC}=5V, Unless otherwise noted.

SWITCHING SPECIFICATIONS (Ta=25°C, V_{CC}=5V, Unless otherwise specified)

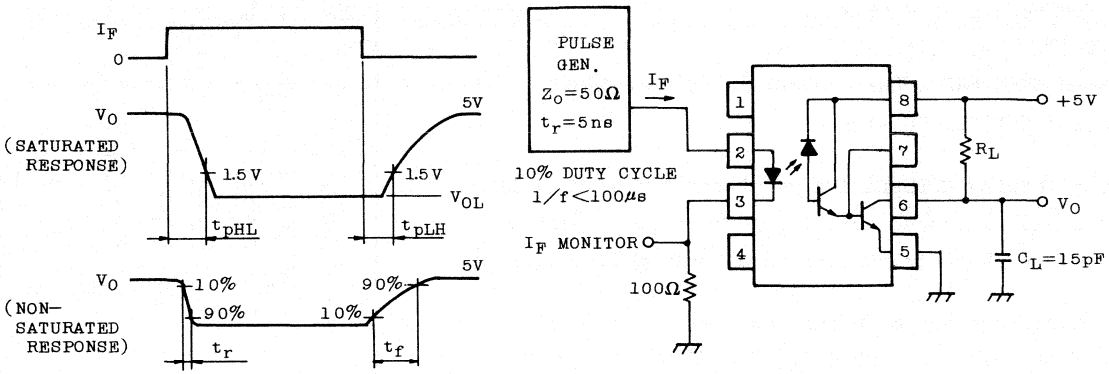
CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Propagation Delay Time to Logic Low at Output (Note 6,8)	6N139	t_{pHL}*	1	I_F=0.5mA, R_L=4.7kΩ	-	5	25	μs
				I_F=12mA, R_L=270Ω	-	0.2	1	
	6N138			I_F=1.6mA, R_L=2.2kΩ	-	1	10	
Propagation Delay Time to Logic High at Output (Note 6,8)	6N139	t_{pLH}*	1	I_F=0.5mA, R_L=4.7kΩ	-	5	60	μs
				I_F=12mA, R_L=270Ω	-	1	7	
	6N138			I_F=1.6mA, R_L=2.2kΩ	-	4	35	
Common Mode Transient Immunity at Logic High Level Output (Note 9)		CM_H	2	I_F=0mA, R_L=2.2kΩ V_{CM}=400Vp-p	-	500	-	V/μs
Common Mode Transient Immunity at Logic Low Level Output (Note 9)		CM_L	2	I_F=1.6mA, R_L=2.2kΩ V_{CM}=400Vp-p	-	-500	-	V/μs

NOTES:

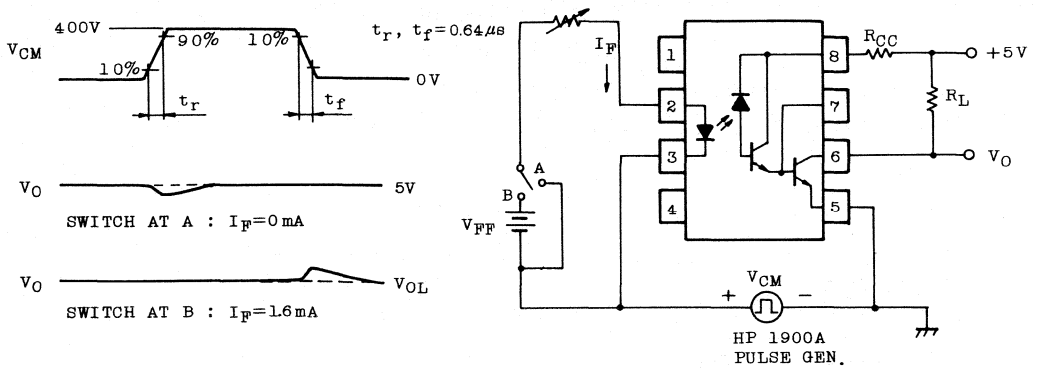
* JEDEC Registered Data.

1. Derate linearly above 50°C free-air temperature at a rate of 0.4mA/°C.
2. Derate linearly above 50°C free-air temperature at a rate of 0.7mW/°C.
3. Derate linearly ablve 25°C free-air temperature at a rate of 0.7mA/°C.
4. Derate linearly ablve 25°C free-air temperature at a rate of 2.0mW/°C.
5. DC CURRENT TRANSFER RATIO is defined as the ratio of output collector current, I_O, to the forward LED input current, I_F, times 100%.
6. Pin 7 Open.
7. Device considered a two-terminal device: Pins 1,2,3, and 4 shorted together and Pins 5,6,7, and 8 shorted together.
8. Use of a resistor between pin 5 and 7 will decrease gain and delay time.
9. Commom mode transient immunity in Logic High level is the maximum tolerable (positive) dV_{CM}/dt on the leading edge of the common mode pulse, V_{CM}, to assure that the output will remain in a Logic High state (i.e., $V_O > 2.0V$).
   Common mode transient immunity in Logic Low level is the maximum tolerable (negative dV_{CM}/dt on the trailing dege of the common mode pulse signal, V_{CM}, to assure that the output will remain in a Logic Low state (i.e., $V_O < 0.8V$)

TEST CIRCUIT 1.



TEST CIRCUIT 2.

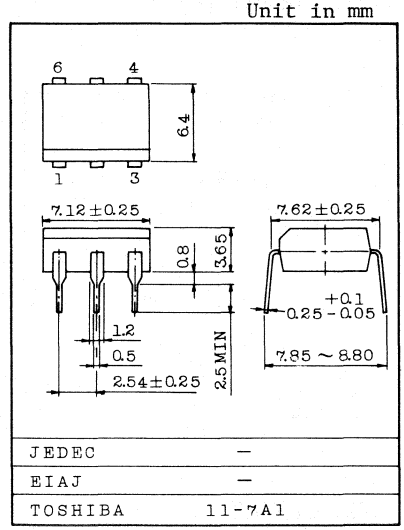


CNY17-2, CNY17-3, CNY17-4

GaAs IRED & PHOTO-TRANSISTOR

AC LINE/DIGITAL LOGIC ISOLATOR.
DIGITAL LOGIC/DIGITAL LOGIC ISOLATOR.
TELEPHONE LINE RECEIVER.
TWISTED PAIR LINE RECEIVER.
HIGH FREQUENCY POWER SUPPLY FEEDBACK CONTROL.
RELAY CONTACT MONITOR.

Unit in mm

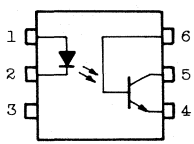


JEDEC	—
EIAJ	—
TOSHIBA	11-7A1

The TOSHIBA Corporation CNY17 consist of a gallium arsenide infrared emitting diode coupled with a silicon photo transistor in a dual in-line package.

- Small Package Size and Low Cost
- Fast Switching Speeds 5μs
- High DC Current Transfer Ratio
  ..... CTR (I_F=10mA, V_{CE}=5V)
  CNY17-2: 63~125%
  CNY17-3: 100~200%
  CNY17-4: 160~320%
- High Isolation Resistance ... $10^{11}\Omega$
- High Isolation Voltage 4400V

PIN CONFIGURATION



1: ANIDE
2: CATHODE
3: NC
4: EMITTER
5: COLLECTOR
6: BASE

MRXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	60	mA
	Forward Current Derating	$\Delta I_F/°C$	0.8*	mA/°C
	Peak Forward Current (Note)	I_{PF}	3	A
	Power Dissipation	P_D	100	mW
	Power Dissipation Derating	$\Delta P_D/°C$	1.33*	mW/°C
	Reverse Voltage	V_R	6	V
PHOTO-TRANSISTOR	Collector-Emitter Voltage	BV_{CEO}	70	V
	Collector-Base Voltage	BV_{CBO}	70	V
	Emitter-Collector Voltage	BV_{ECO}	7	V
	Collector Current	I_C	100	mA
	Power Dissipation	P_C	150	mW
	Power Dissipation Derating	$\Delta P_C/°C$	2.0*	mW/°C
COUPLED	Storage Temperature	T_{stg}	-55~150	°C
	Operating Temperature	T_{opr}	-55~100	°C
	Lead Soldering Temperature (at 10 sec.)	T_{sold}	260	°C
	Total Package Dissipation	P_T	200	mW
	Total Package Power Dissipation Derating	$\Delta P_T/°C$	2.6*	mW/°C

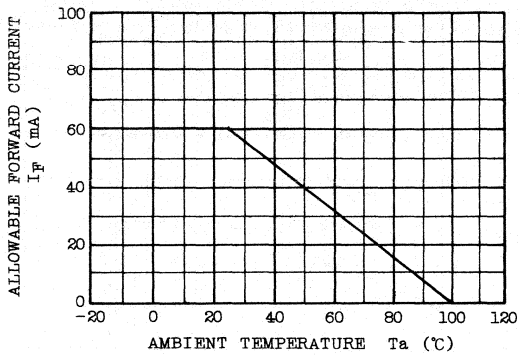
Note : Pulse Width 1μs, 300pps.

* Above 25°C ambient.

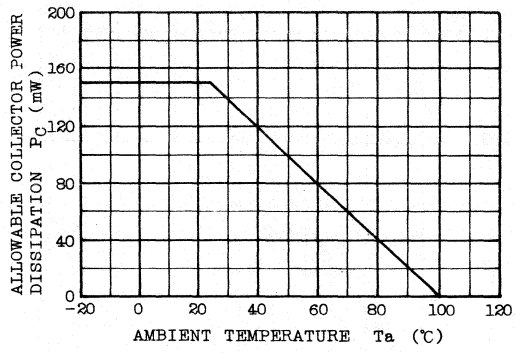
ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage		V_F	I_F=60mA	-	1.35	1.65	V
	Reverse Current		I_R	V_R=3V	-	-	10	μA
	Capacitance		C_D	V=0, f=1MHz	-	30	-	pF
PHOTO-TRANSISTOR	DC Forward Current Gain		h_{FE}	V_{CE}=5, I_C=500μA	100	200	-	
	Collector-Emitter Breakdown Voltage		$V_{(BR)CEO}$	I_C=1mA, I_F=0	70	-	-	V
	Collector-Base Breakdown Voltage		$V_{(BR)CBO}$	I_C=100μA, I_F=0	70	-	-	V
	Emitter-Collector Breakdown Voltage		$V_{(BR)ECO}$	I_E=100μA, I_F=0	7	-	-	V
	Collector Dark Current		I_{CEO}	V_{CE}=10V, I_F=0	-	1	50	nA
	Collector Dark Current		I_{CBO}	V_{CB}=10V, I_F=0	-	0.1	20	nA
	Collector-Emitter Capacitance		C_{CE}	V=0, f=1MHz	-	10	-	pF
COUPLED	Current Transfer Ratio	CNY17-2	CTR	I_F=10mA, V_{CE}=5V	63	-	125	%
		CNY17-3			100	-	200	
		CNY17-4			160	-	320	
	Saturation Voltage		$V_{CE(sat)}$	I_F=10mA, I_C=2.5mA	-	-	0.4	V
	Capacitance Input to Output		C_S	V=0, f=1MHz	-	0.8	-	pF
	Isolation Resistance		R_S	V=500V	-	10^{11}	-	Ω
	DC Isolation Voltage		BV_S	DC 1 minute	4400	-	-	V
	Rise Fall Time		t_r/t_f	V_{CE}=10V, I_C=2mA R_L=100Ω	-	5	10	μs
	Rise/Fall Time Photo Diode		t_r/t_f	V_{CB}=10V, I_{CB}=50μA R_L=100Ω	-	200	-	ns

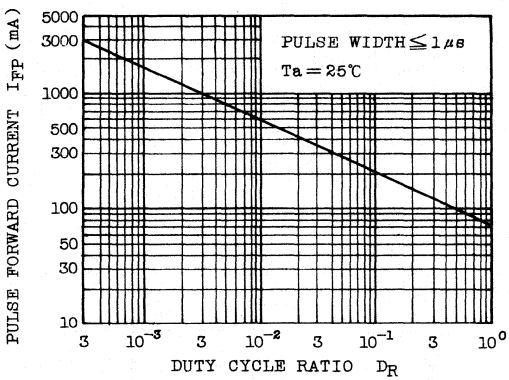
I_F – Ta



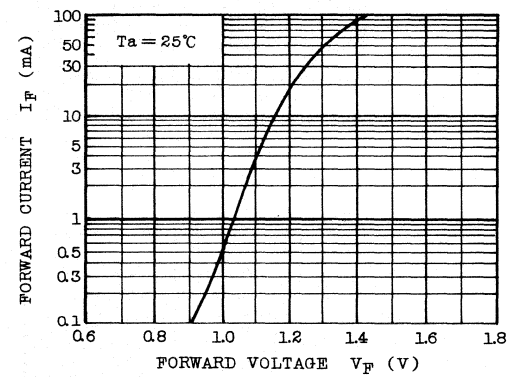
P_C – Ta



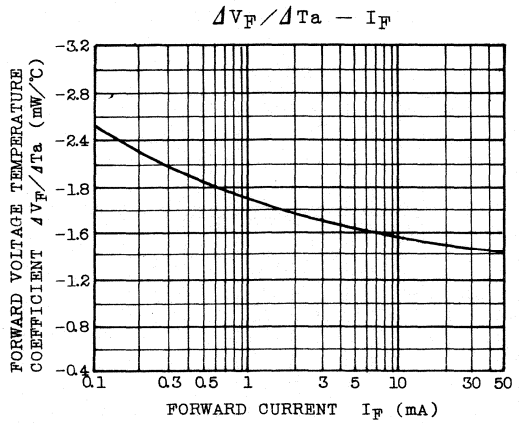
I_{FP} – D_R



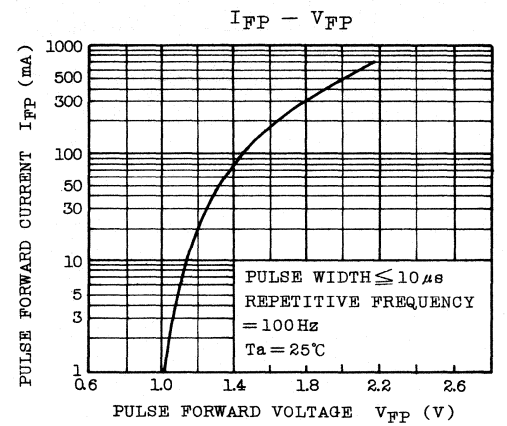
I_F – V_F



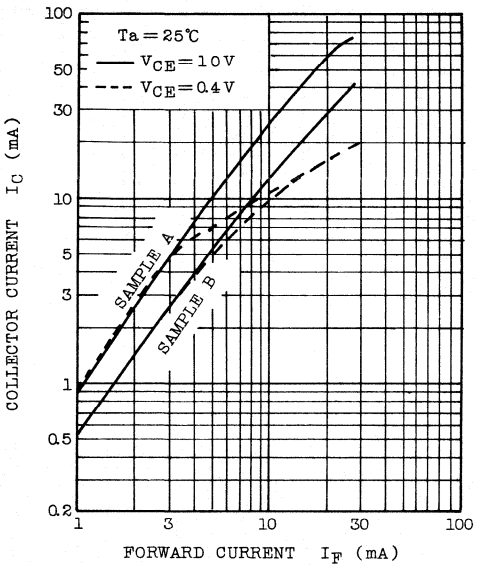
$\Delta V_F / \Delta Ta$ – I_F



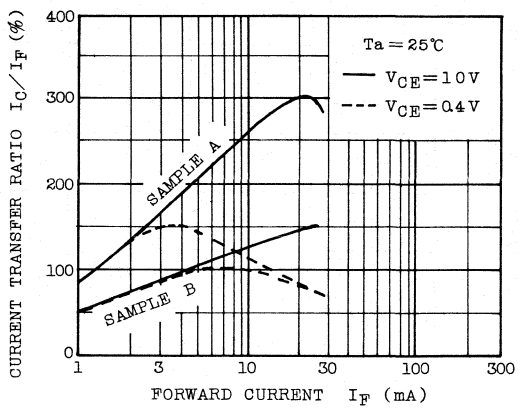
I_{FP} – V_{FP}



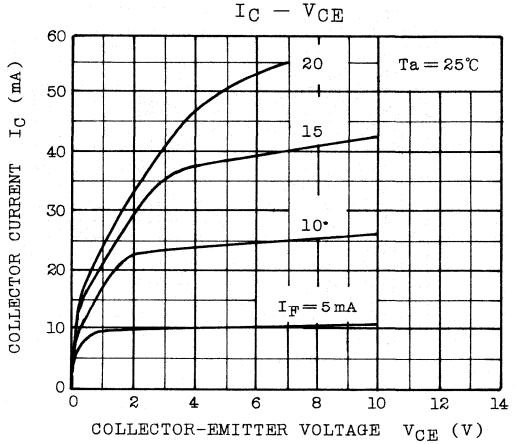
$I_C - I_F$



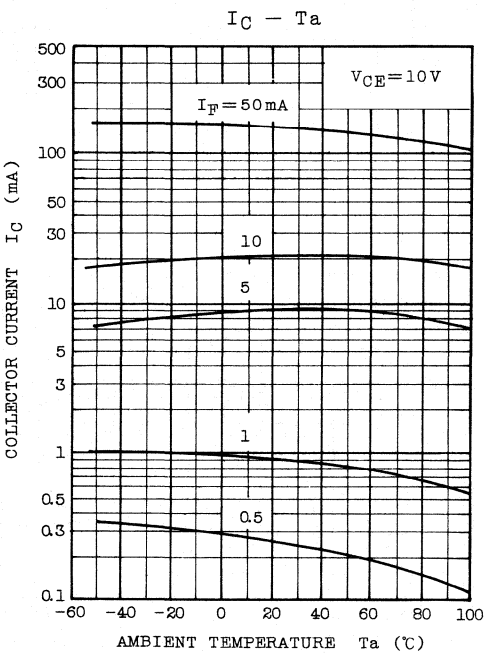
$I_C / I_F - I_F$



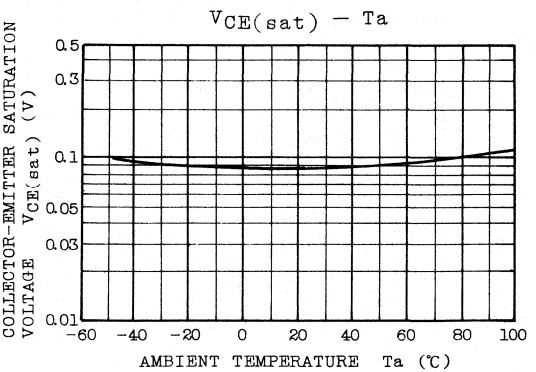
$I_C - V_{CE}$



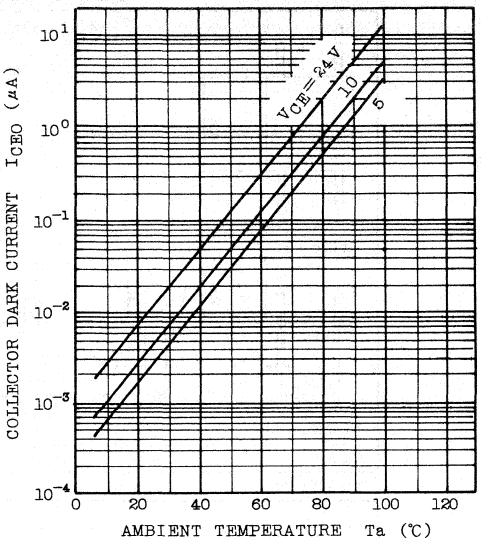
$I_C - Ta$



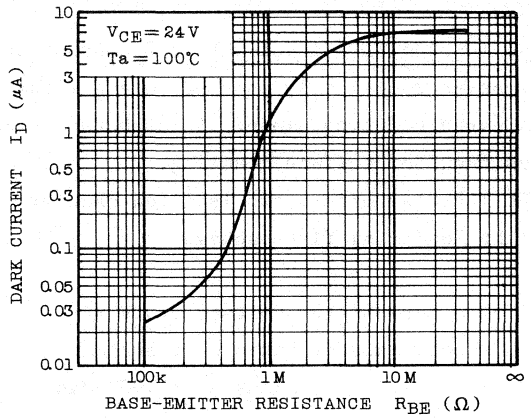
$V_{CE(sat)} - Ta$



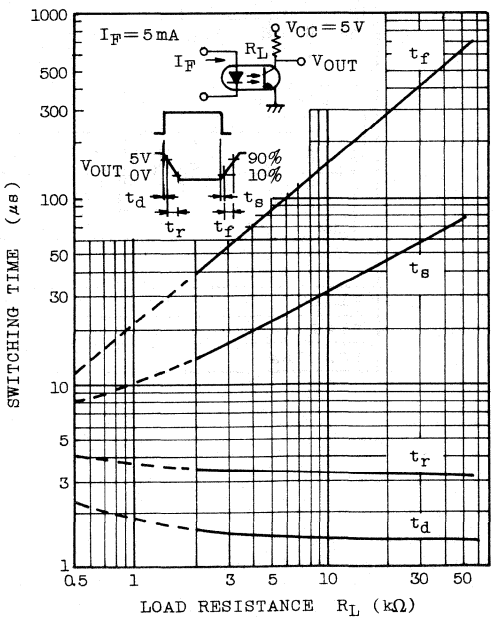
I_{CEO} — Ta



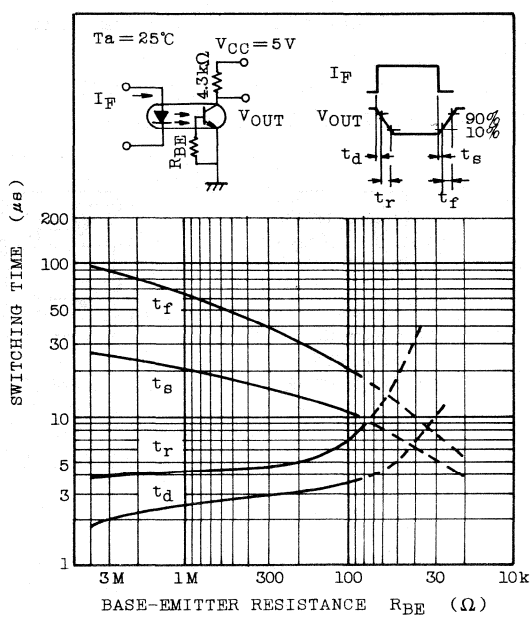
I_D — R_{BE}



SWITCHING CHARACTERISTICS
(SATURATED OPERATION)



R_{BE} — SWITCHING CHARACTERISTICS
(SATURATED OPERATION)



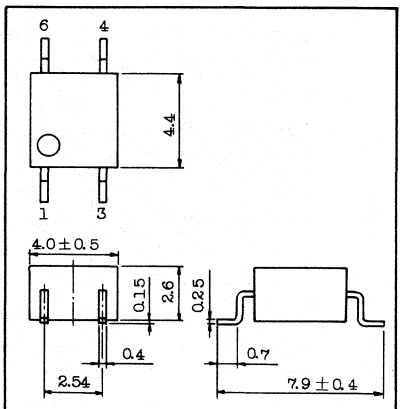
TLP101, TLP101-2

PROGRAMMABLE CONTROLLERS
AC/DC-INPUT MODULE
TELECOMMUNICATION.

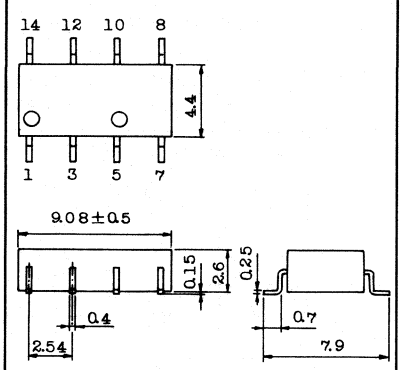
The TOSHIBA TLP101 and TLP101-2 consist of a photo-transistor optically coupled to a gallium arsenide infrared emitting diode. This photocoupler is designed for surface mounting.
The TLP101-2 offers two isolated channels in an eight lead mini flat package.

- Collector-Emitter Voltage : 35V Min.
- Current Transfer Ratio : 50% Min.
  Rank GB : 100% Min.
- Isolation Voltage : 4000Vrms Min.
- Guaranteed Requirements of VDE0883/UL1557
- Climatic Test Class : 30/100/21
- Isolation Creepage Path : 4.0mm Min.
- Isolation Clearance : 4.0mm Min.

Unit in mm

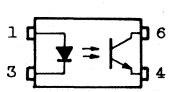


JEDEC	—
EIAJ	—
TOSHIBA	11-5D1

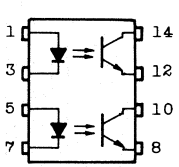


JEDEC	—
EIAJ	—
TOSHIBA	—

PIN CONFIGURATION (TOP VIEW)



1: ANODE
3: CATHODE
4: EMITTER
6: COLLECTOR



1,5 : ANODE
3,7 : CATHODE
8,12: EMITTER
10,14: COLLECTOR

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING		UNIT
			TLP101	TLP101-2	
LED	Forward Current	I_F	70	50	mA
	Forward Current Derating	$\Delta I_F/°C$	-0.7 (Ta≧25°C)	-0.5 (Ta≧25°C)	mA/°C
	Pulse Forward Current	I_{FP}	1 (100μs pulse, 100pps)		A
	Power Dissipation (1 Circuit)	P_D	100	70	mW
	Power Dissipation Derating (Ta ≧ 25°C, 1 Circuit)	$\Delta P_D/°C$	-1.0		mW/°C
	Reverse Voltage	V_R	5		V
	Junction Temperature	T_j	125		°C
DETECTOR	Collector-Emitter Voltage	V_{CEO}	35		V
	Emitter-Collector Voltage	V_{ECO}	5		V
	Collector Current	I_C	50		mA
	Collector Power Dissipation (1 Circuit)	P_C	150	100	mW
	Collector Power Dissipation Derating (Ta ≧ 25°C, 1 Circuit)	$\Delta P_C/°C$	-1.5	-1.0	mW/°C
	Junction Temperature	T_j	125		°C
Storage Temperature Range		T_{stg}	-30∿125		°C
Operating Temperature Range		T_{opr}	-30∿100		°C
Lead Soldering Temperature		T_{sold}	260 (10 sec.)		°C
Total Package Power Dissipation (1 Circuit)		P_T	200	150	mW
Total Package Power Dissipation Derating (Ta≧25°C, 1 Circuit)		$\Delta P_T/°C$	-2.0	-1.5	mW/°C
Isolation Voltage		BV_S	4000 (AC, 1 min., RH≦60%)		V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=0.5mA	35	-	-	V
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	5	-	-	V
	Collector Dark Current	I_{CEO}	V_{CE}=24V	-	10	150	nA
			V_{CE}=24V, Ta=85°C	-	2	-	μA
	Capacitance (Collector to Emitter)	C_{CE}	V=0, f=1MHz	-	10	-	pF

COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Current Transfer Ratio	I_C/I_F	I_F=5mA, V_{CE}=5V	50	-	600	%
		Rank GB	100	-	600	
Saturated CTR	I_C/I_F (sat)	I_F=1mA, V_{CE}=0.4V	-	60	-	%
		Rank GB	30	-	-	
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C=2.4mA, I_F=8mA	-	-	0.4	V
		I_C=0.2mA, I_F=1mA	-	0.2	-	
		Rank GB	-	-	0.4	

ISOLATION CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Capacitance (Input to Output)	CS	VS=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	RS	VS=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BVS	AC, 1 minute	4000	-	-	V_{rms}
		AC, 1 second, in oil	-	5000	-	
		DC, 1 minute, in oil	-	5000	-	Vdc

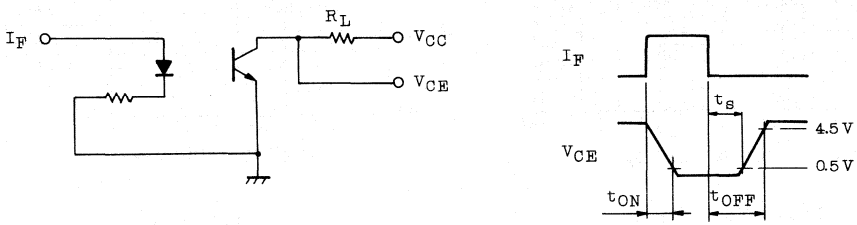
SWITCHING CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Rise Time	t_r	V_{CC}=10V, I_C=2mA R_L=100Ω	-	2	-	μs
Fall Time	t_f		-	3	-	
Turn-on Time	t_{on}		-	4	-	
Turn-off Time	t_{off}		-	3	-	
Turn-on Time	t_{ON}	R_L=1.9kΩ (Fig.1) V_{CC}=5V, I_F=16mA	-	3	-	μs
Storage Time	t_s		-	15	-	
Turn-off Time	t_{OFF}		-	40	-	

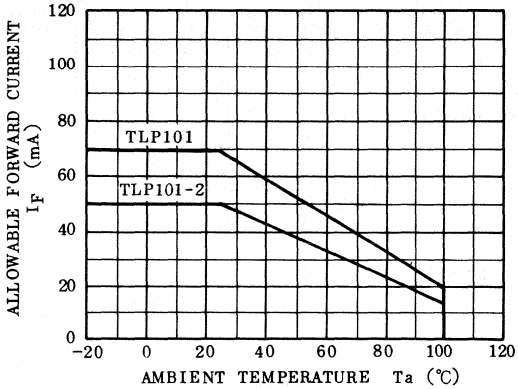
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	-	5	24	V
Forward Current	I_F	-	16	20	mA
Collector Current	I_C	-	1	10	mA
Operating Temperature	T_{opr}	-25	-	85	°C

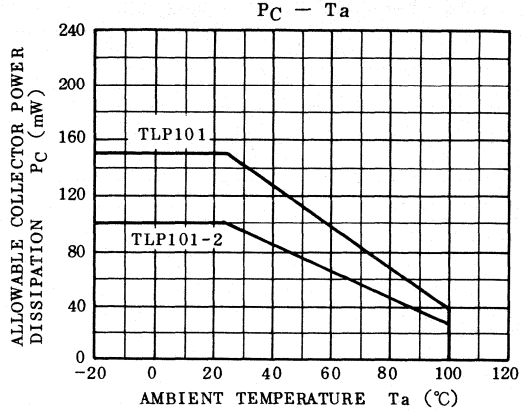
Fig. 1 Switching Time Test Circuit



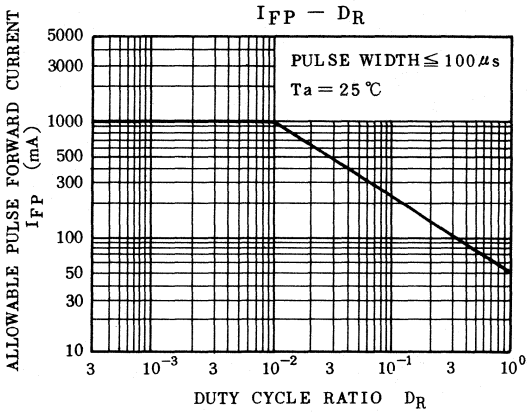
$I_F - Ta$



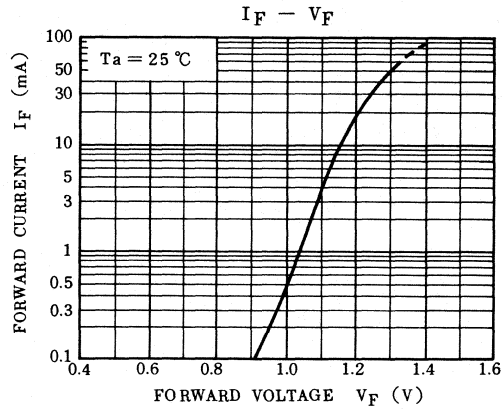
$P_C - Ta$



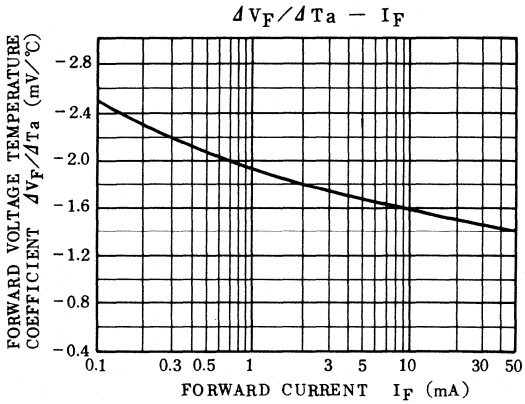
$I_{FP} - D_R$



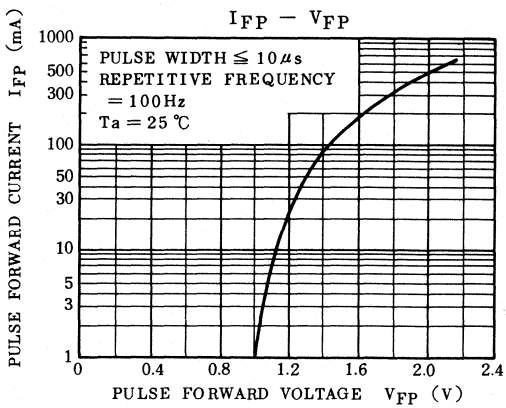
$I_F - V_F$



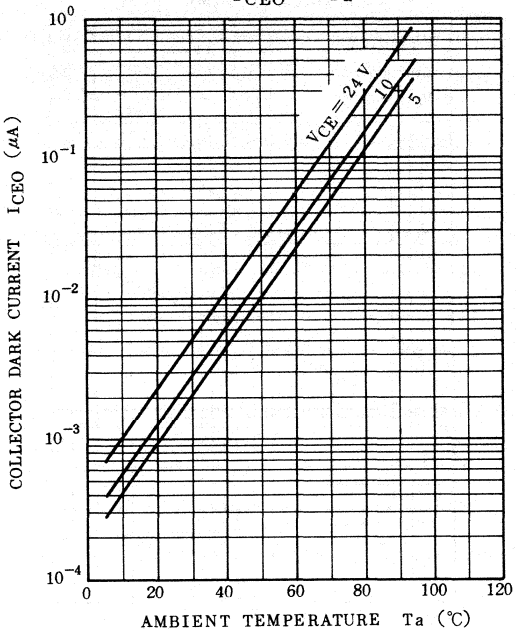
$\Delta V_F / \Delta Ta - I_F$



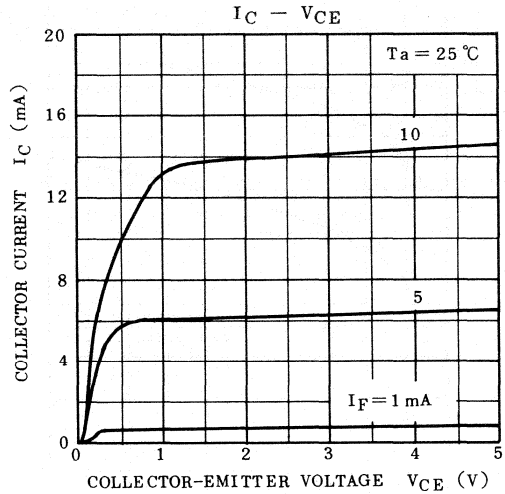
$I_{FP} - V_{FP}$



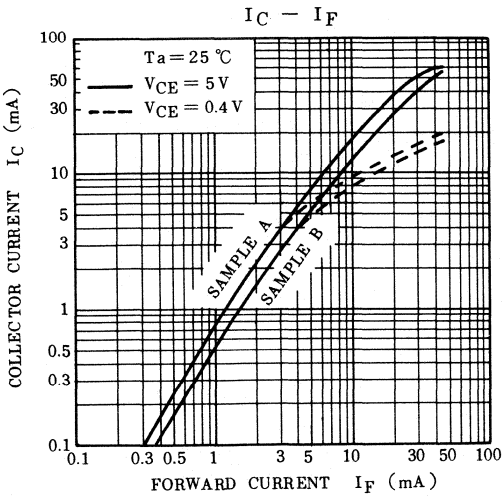
I_{CEO} – Ta



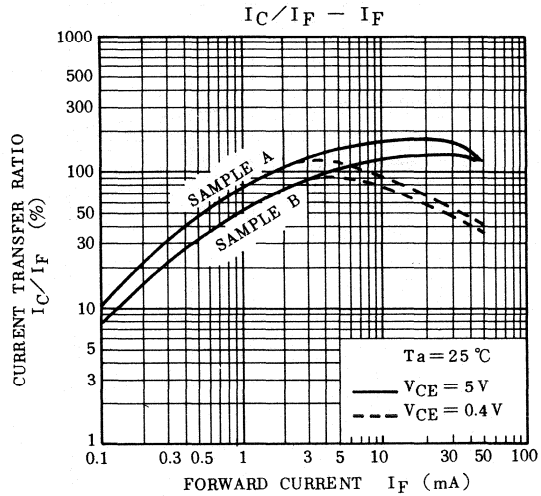
I_C – V_{CE}



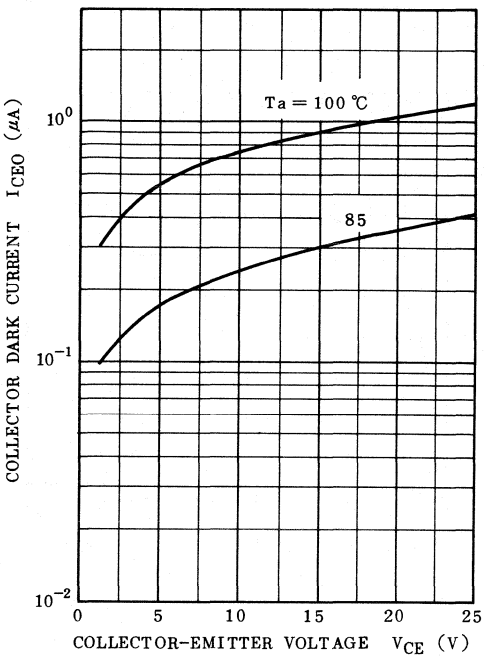
I_C – I_F



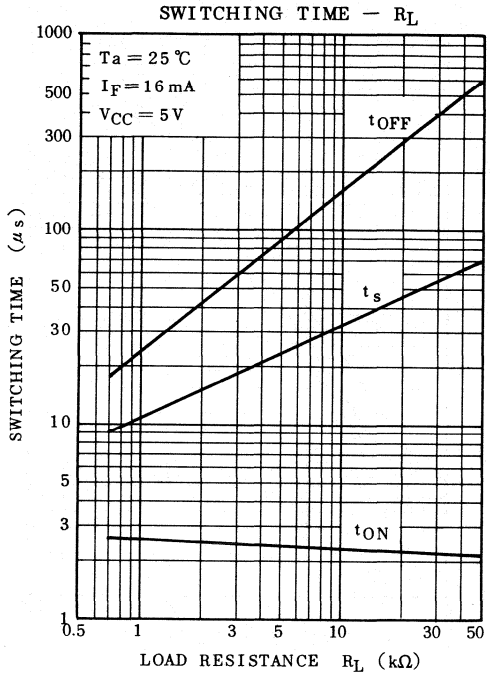
I_C/I_F – I_F



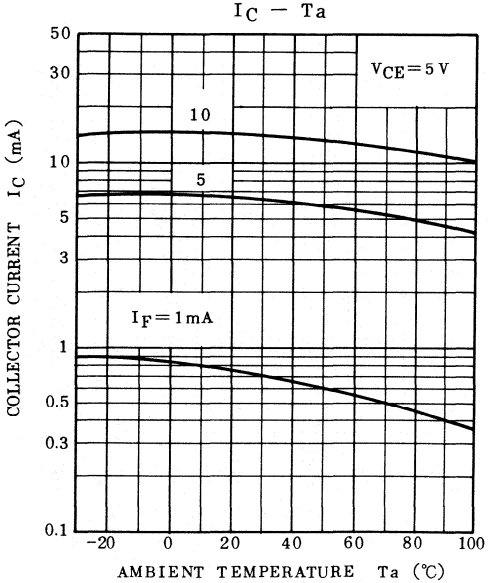
$I_{CEO} - V_{CE}$



SWITCHING TIME — R_L



$I_C - Ta$



TLP321, TLP321-2, TLP321-4

GaAs IRED & PHOTO-TRANSISTOR

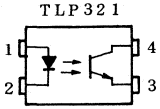
PROGRAMMABLE CONTROLLERS
DC-OUTPUT MODULE
TELECOMUNICATION

The TOSHIBA TLP321, -2 and -4 consist of a photo-transistor optically couled to a gallium arsenide infrared emitting diode.
The TLP321-2 offers two isolated channels in an eight lead plastic DIP package, while the TLP321-4 provides four isolated channels in a sixteen plastic DIP package.
TLP321/-2/-4 have high V_{CEO} Voltage (V_{CEO}=80V).

- Collector-Emitter Voltage : 80V Min.
- Current Transfer Ratio : 50% Min.
  Rank GB : 100% Min.
- Isolation Voltage : 5000Vrms Min.
- UL Recognized : File No. E67349

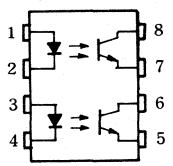
PIN CONFIGURATIONS (TOP VIEW)

TLP321



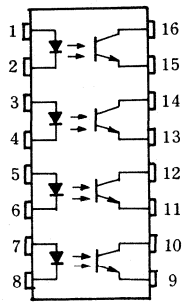
1 : ANODE
2 : CATHODE
3 : EMITTER
4 : COLLECTOR

TLP321-2



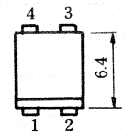
1, 3 : ANODE
2, 4 : CATHODE
5, 7 : EMITTER
6, 8 : COLLECTOR

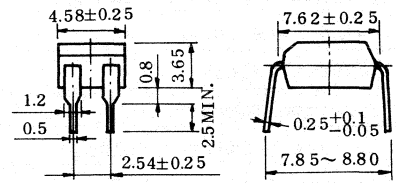
TLP321-4



1, 3, 5, 7 : ANODE
2, 4, 6, 8 : CATHODE
9, 11, 13, 15 : EMITTER
10, 12, 14, 16 : COLLECTOR

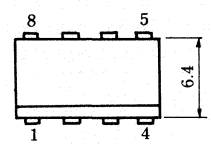
TLP321

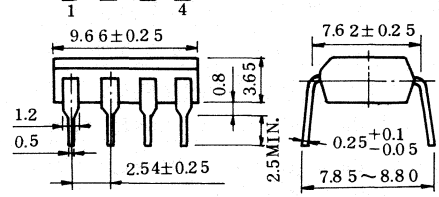




JEDEC	—
EIAJ	—
TOSHIBA	11-5B1

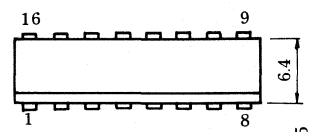
TLP321-2

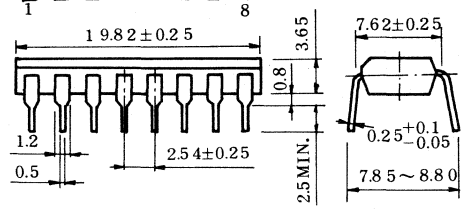




JEDEC	—
EIAJ	—
TOSHIBA	11-10C1

TLP321-4





JEDEC	—
EIAJ	—
TOSHIBA	11-20A1

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING		UNIT
			TLP321-1	TLP321-2,-4	
LED	Forward Current	I_F	60	50	mA
	Forward Current Derating	ΔI_F/°C	-0.7 (Ta≧39°C)	-0.5 (Ta≧25°C)	mA/°C
	Pulse Forward Current	I_{FP}	1 (100μs pulse, 100pps)		A
	Reverse Voltage	V_R	5		V
	Junction Temperature	T_j	125		°C
DETECTOR	Collector-Emitter Voltage	V_{CEO}	80		V
	Emitter-Collector Voltage	V_{ECO}	7		V
	Collector Current	I_C	50		mA
	Collector Power Dissipation (1 Circuit)	P_C	150	100	mW
	Collector Power Dissipation Derating (1 Circuit, Ta≧25°C)	ΔP_C/°C	-1.5	-1.0	mW/°C
	Junction Temperature	T_j	125		°C
Storage Temperature Range		T_{stg}	-55∿125		°C
Operating Temperature Range		T_{opr}	-55∿100		°C
Lead Soldering Temperature		T_{sold}	260 (10 sec.)		°C
Total Package Power Dissipation		P_T	250	150	mW
Total Package Power Dissipation Derating (Ta≧25°C)		ΔP_T/°C	-2.5	-1.5	mW/°C
Isolation Voltage		BV_S	5000 (AC, 1 min., RH≦60%)		V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=0.5mA	80	-	-	V
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	7	-	-	V
	Collector Dard Current	I_{CEO}	V_{CE}=24V	-	10	100	nA
			V_{CE}=24V, T_A=85°C	-	2	50	μA
	Capacitance (Collector to Emitter)	C_{CE}	V=0, f=1MHz	-	10	-	pF

COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTICS	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Current Transfer Ratio	I_C/I_F	I_F=5mA, V_{CE}=5V	50	-	600	%
		Rank GB	100	-	600	
Saturated CTR	I_C/I_F (sat)	I_F=1mA, V_{CE}=0.4V	-	60	-	%
		Rank GB	30	-	-	
Collector-Emitter Staturation Voltage	$V_{CE(sat)}$	I_C=2.4mA, I_F=8mA	-	-	0.4	V
		I_C=0.2mA, I_F=1mA	-	0.2	-	
		Rank GB	-	-	0.4	

ISOLATION CHARACTERISTICS (Ta=25°C)

CHARACTERISTICS	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V, R.H.≦60%	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	5000	-	-	V_{rms}
		AC, 1 second	-	10000	-	
		DC, 1 minute	-	10000	-	V_{dc}

SWITCHING CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Rise Time	t_r	V_{CC}=10V I_C=2mA R_L=100Ω	-	2	-	μs
Fall Time	t_f		-	3	-	
Turn-on Time	t_{on}		-	3	-	
Turn-off Time	t_{off}		-	3	-	
Turn-on Time	t_{ON}	R_L=1.9kΩ(Fig. 1) V_{CC}=5V, I_F=16mA	-	2	-	μs
Storage Time	t_s		-	15	-	
Turn-off Time	t_{OFF}		-	25	-	

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	-	12	48	V
Forward Current	I_F	-	16	20	mA
Collector Current	I_C	-	1	10	mA
Operating Temperature	T_{OPR}	-25	-	85	°C

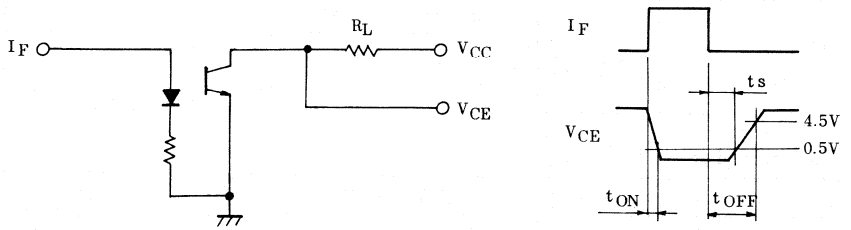
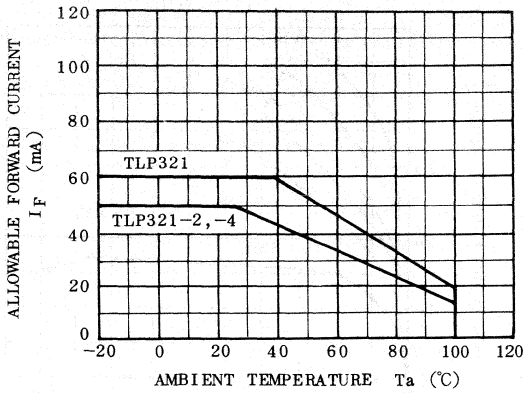
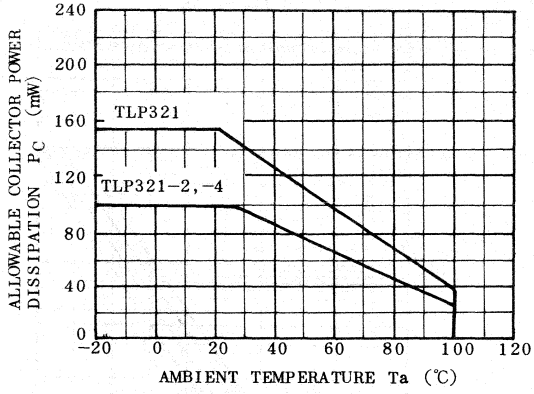


Fig.1 Switching Time Test Circuit

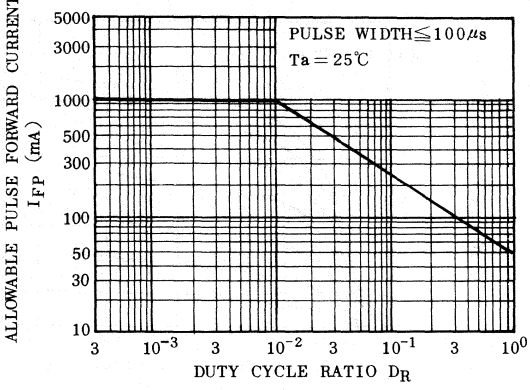
I_F – Ta



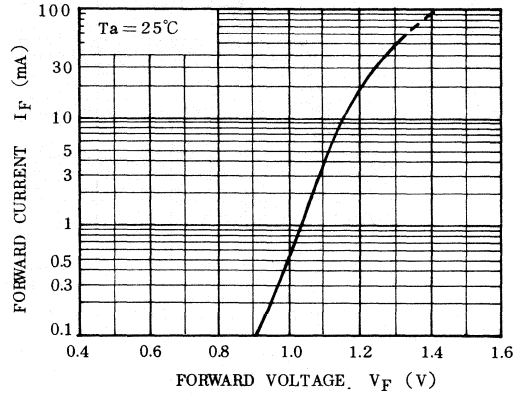
P_C – Ta



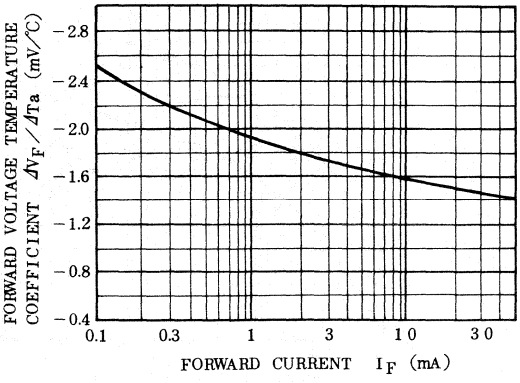
I_{FP} – D_R



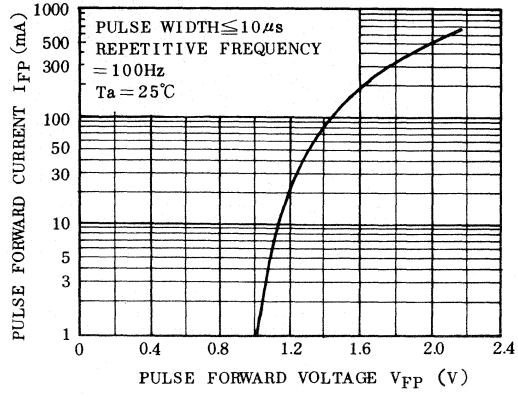
I_F – V_F



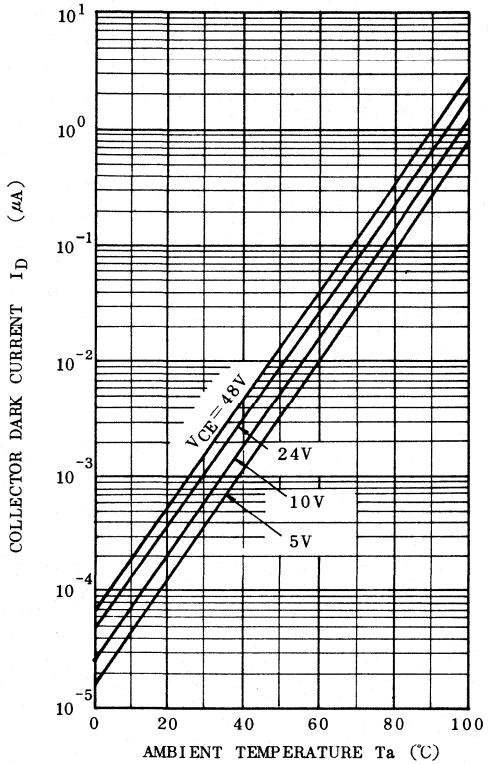
$\Delta V_F / \Delta Ta$ – I_F



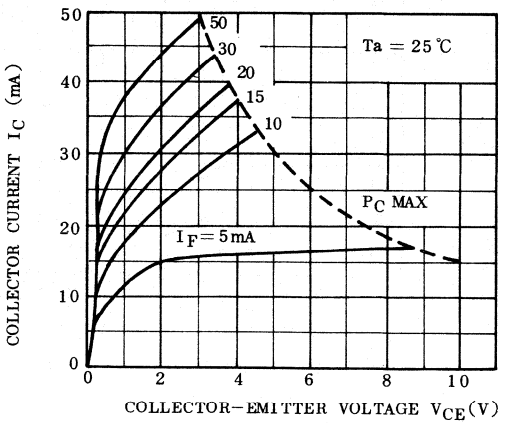
I_{FP} – V_{FP}



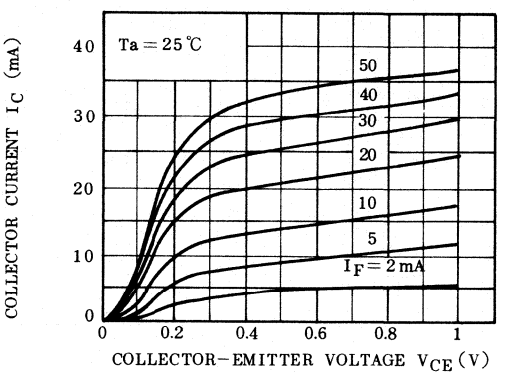
I_D – Ta



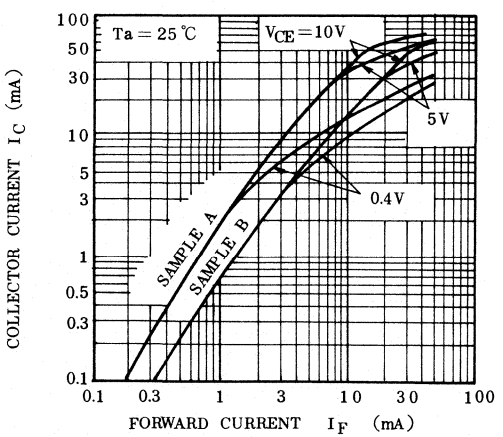
I_C – V_{CE}



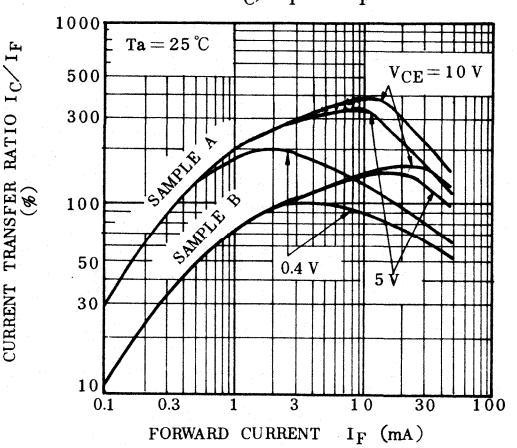
I_C – V_{CE}



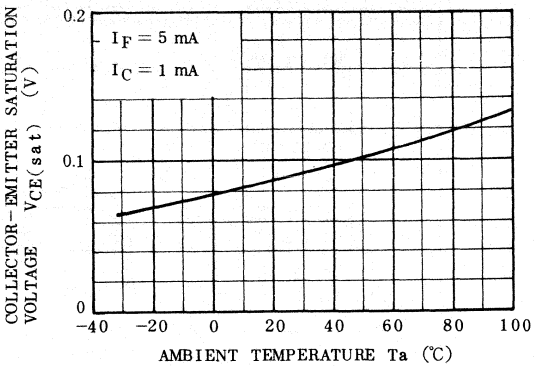
I_C – I_F



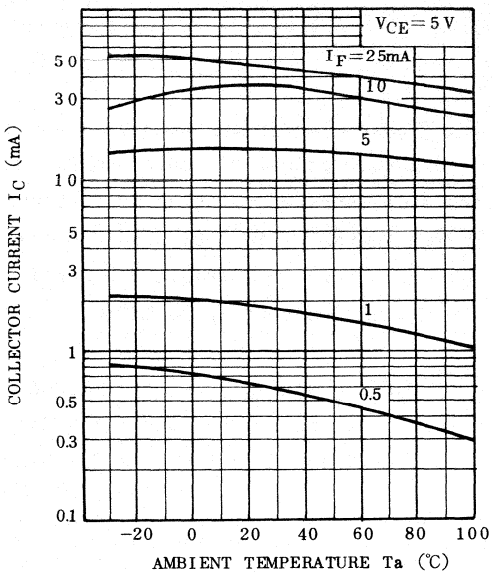
I_C/I_F – I_F



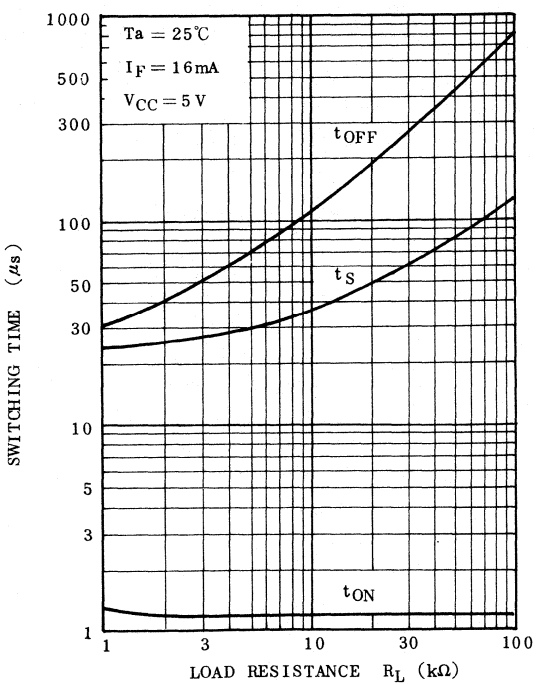
$V_{CE(sat)}$ – Ta



I_C – Ta



SWITCHING TIME – R_L



TLP330

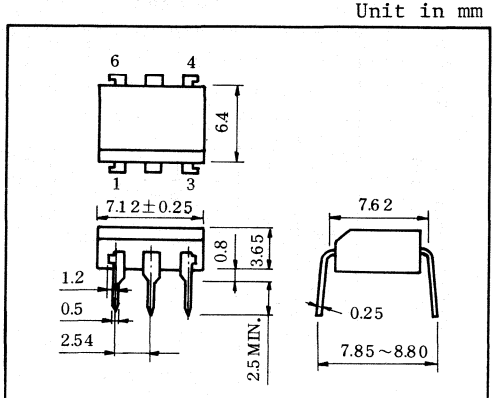
GaAs IRED & PHOTO-TRANSISTOR

PROGRAMMABLE CONTROLLERS.
AC/DC-INPUT MODULE.
TELECOMMUNICATION.

The TOSHIBA TLP330 consists of a photo-transistor optically coupled to two gallium arsenide infrared emitting diode connected inverse parallel in a six lead plastic DIP package. This is suitable for application of AC input current up to 150mA.

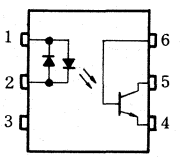
- I_F Maximum Rating : ±150mA
- Collector-Emitter Voltage : 55V Min.
- Current Transfer Ratio : 25% Min. (I_F=±20mA)
- Isolation Voltage : 5000Vrms Min.
- UL Recognized : File No. E67349

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-7A2

PIN CONFIGURATIONS (TOP VIEW)



1 : ANODE, CATHODE
2 : CATHODE, ANODE
3 : NC
4 : EMITTER
5 : COLLECTOR
6 : BASE

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	±150	mA
	Forward Current Derating (Ta≧25°C)	ΔI_F/°C	-1.5	mA/°C
	Peak Forward Current (100μs pulse, 100pps)	I_{FP}	±1	A
	Junction Temperature	T_j	125	°C
DETECTOR	Collector-Emitter Voltage	V_{CEO}	55	V
	Collector-Base Voltage	V_{CBO}	80	V
	Emitter-Collector Voltage	V_{ECO}	7	V
	Emitter-Base Voltage	V_{EBO}	7	V
	Collector Current	I_C	80	mA
	Power Dissipation	P_C	150	mW
	Power Dissipation Derating (Ta≧25°C)	ΔP_C/°C	-1.5	mW/°C
	Junction Temperature	T_j	125	°C
Storage Temperature Range		Tstg	-55∿125	°C
Operating Temperature Range		Topr	-55∿100	°C
Lead Soldering Temperature (10 sec.)		Tsold	260	°C
Total Package Power Dissipation		P_T	250	mW
Total Package Power Dissipation Derating (Ta≧25°C)		ΔP_T/°C	-2.5	mW/°C
Isolation Voltage (AC, 1 min, RH≦60%)		BV_S	5000	V_{RMS}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=±100mA	-	1.4	1.7	V
	Forward Current	I_F	V_F=±0.7V	-	2.5	20	μA
	Capacitance	C_T	V=0, f=1MHz	-	100	-	pF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=0.5mA	55	-	-	V
	Emitter-Collecter Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	7	-	-	V
	Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	I_C=0.1mA	80	-	-	V
	Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	I_E=0.1mA	7	-	-	V
	Collector Dark Current	I_{CEO}	V_{CE}=24V	-	10	100	nA
			V_{CE}=24V, Ta=85°C	-	2	50	μA
	Collector Dark Current	I_{CER}	V_{CE}=24V, Ta=85°C R_{BE}=1MΩ	-	0.5	10	μA
	Collector Dark Current	I_{CBO}	V_{CB}=10V	-	0.1	-	nA
	DC Forward Current Gain	h_{FE}	V_{CE}=5V, I_C=0.5mA	-	400	-	-
	Capacitance (Collector to Emitter)	C_{CE}	V=0, f=1MHz	-	10	-	pF

COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTICS	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Current Transfer Ratio	I_C/I_F	I_F=±20mA V_{CE}=1V	25	-	-	%
	I_C/I_F (high)	I_F=±100mA V_{CE}=1V	20	-	80	%
Base Photo-current	I_{PB}	I_F=±5mA, V_{CB}=5V	-	10	-	μA
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C=2.4mA, I_F=20mA	-	-	0.4	V
		I_C=2.4mA, I_F=±100mA	-	-	0.4	
Off-State Collecter Current	$I_{C(off)}$	V_F=±0.7V, V_{CE}=24V	-	1	10	μA
CTR Symmetry	$I_{C(ratio)}$	$I_C(I_F$=-20mA)/$I_C(I_F$=+20mA)	0.5	1	2	-

ISOLATION CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BVS	AC, 1 minute	5000	-	-	Vrms
		AC, 1 second	-	10000	-	V_{rms}
		DC, 1 minute	-	10000	-	V_{dc}

SWITCHING CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Rise Time	t_r	V_{CC}=10V, I_C=2mA, R_L=100Ω	-	2	-	μs
Fall Time	t_f		-	3	-	
Turn-on Time	t_{on}		-	3	10	
Turn-off Time	t_{off}		-	3	10	
Turn-on Time	t_{ON}	R_L=1.9kΩ (Fig.1), R_{BE}=OPEN, V_{CC}=5V, I_F=±16mA	-	2	-	μs
Storage Time	t_S		-	15	-	
Turn-off Time	t_{OFF}		-	25	-	
Turn-on Time	t_{ON}	R_L=1.9kΩ (Fig.1), R_{BE}=220kΩ, V_{CC}=5V, I_F=±16mA	-	2	-	μs
Storage Time	t_S		-	12	-	
Turn-off Time	t_{OFF}		-	20	-	

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	-	5	24	V
Forward Current	$\pm I_F$	-	20	120	mA
Collector Current	I_C	-	1	10	mA
Operating Temperature	T_{opr}	-25	-	85	°C

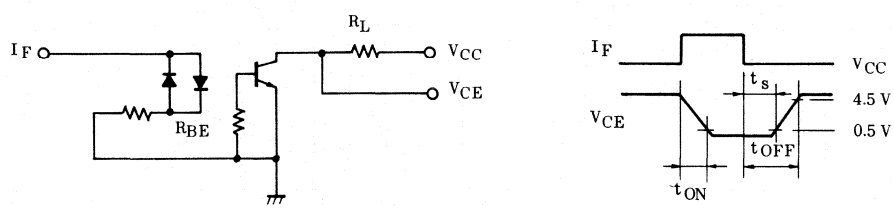
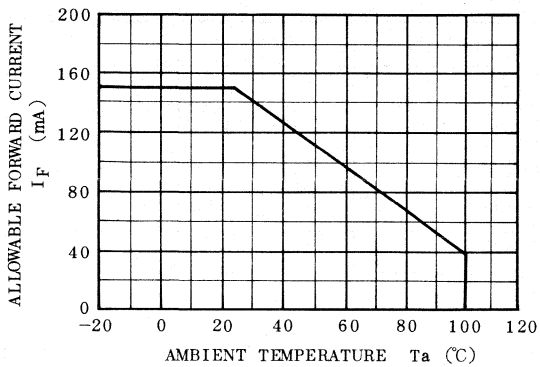
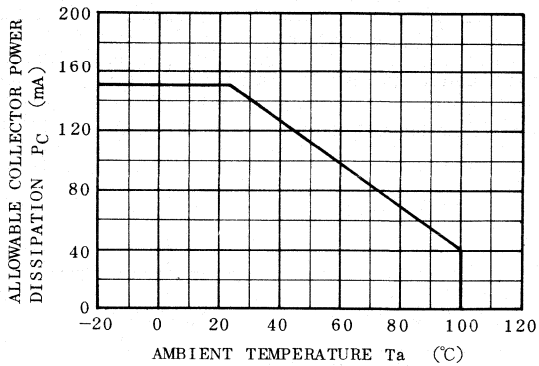


Fig 1 Switching Time Test Circuit

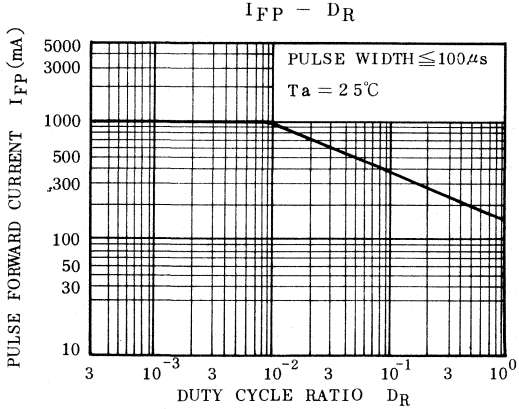
I_F – Ta



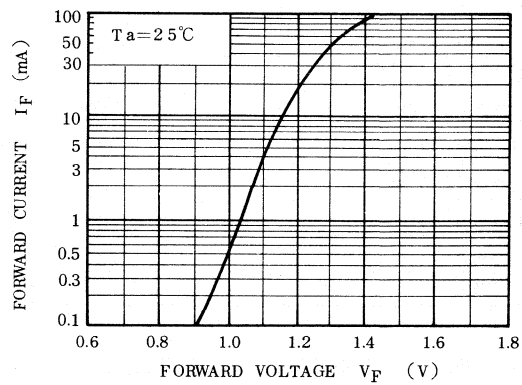
P_C – Ta



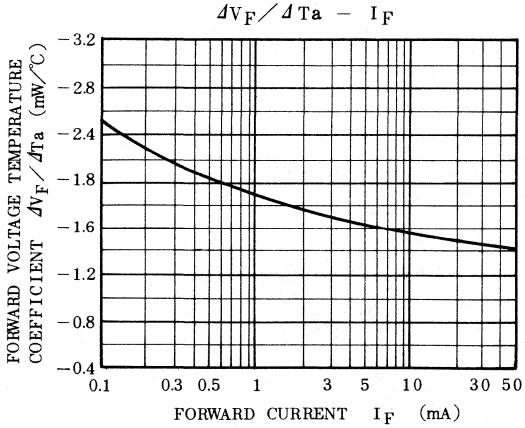
I_{FP} – D_R



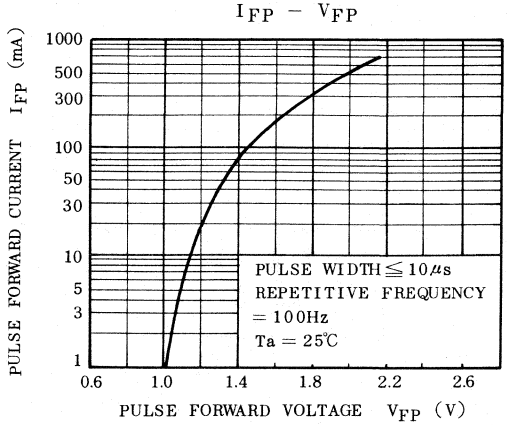
I_F – V_F



$\Delta V_F / \Delta Ta$ – I_F



I_{FP} – V_{FP}



TLP331, TLP332

OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
PROGRAMMABLE CONTROLLERS.
AC/DC-INPUT MODULE.
TELECOMMUNICATION.

The TOSHIBA TLP331 and TLP332 consist of a gallium arsenide infrared emitting diode optically coupled to a photo-transistor in a six lead plastic DIP package. This photocoupler provides the unique feature of high current transfer ratio at both low output voltage and low input current. This makes it ideal for use in low power logic circuits, telecommunications equipment and portable electronics isolation applications.
TLP332 is no-base internal connection for high-EMI environments.

. Collector-Emitter Voltage : 55V Min.

. Current Transfer Ratio

CLASSIFICATION (*)	CURRENT TRANSFER RATIO (Min.)			MARKING OF CLASSIFICATION
	Ta=25°C		Ta=-25∿75°C	
	I_F=1mA V_{CE}=0.5V	I_F=0.5mA V_{CE}=1.5V	I_F=1mA V_{CE}=0.5V	
Rank BV	200%	100%	100%	BV
Standard	100%	50%	50%	BV, Blank

(*) Ex. Standard : TLP331
Rank BV : TLP331 (BV)

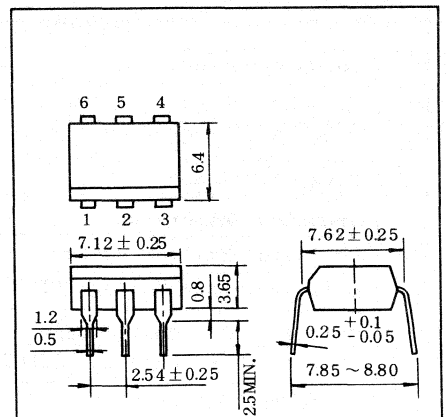
. Isolation Voltage : 5000Vrms Min.

. UL Recognized : File No. E67349

. Note: Application type name for certification test, please use standard product type name, i.e.

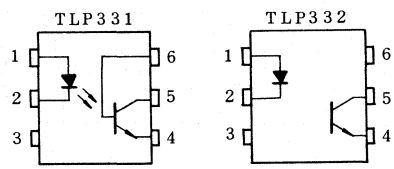
TLP331(BV):TLP331

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-7A1

PIN CONFIGURATIONS (TOP VIEW)



TLP331	TLP332
1 : ANODE	1 : ANODE
2 : CATHODE	2 : CATHODE
3 : NC	3 : NC
4 : EMITTER	4 : EMITTER
5 : COLLECTOR	5 : COLLECTOR
6 : BASE	6 : NC

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	60	mA
	Forward Current Derating (Ta≧39°C)	ΔI_F/°C	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)	I_{FP}	1	A
	Reverse Voltage	V_R	5	V
	Junction Temperature	T_j	125	°C
DETECTOR	Collector-Emitter Voltage	V_{CEO}	55	V
	Collector-Base Voltage (TLP331)	V_{CBO}	80	V
	Emitter-Collector Voltage	V_{ECO}	7	V
	Emitter-Base Voltage (TLP331)	V_{EBO}	7	V
	Collector Current	I_C	50	mA
	Power Dissipation	P_C	150	mW
	Power Dissipation Derating (Ta≧25°C)	ΔP_C/°C	-1.5	mW/°C
	Junction Temperature	T_j	125	°C
Storage Temperature Range		T_{stg}	-55~125	°C
Operating Temperature Range		T_{opr}	-55~100	°C
Lead Soldering Temperature (10 sec.)		T_{sold}	260	°C
Total Package Power Dissipation		P_T	250	mW
Total Package Power Dissipation Derating (Ta≧25°C)		P_T/°C	-2.5	mW/°C
Isolation Voltage (AC, 1 min., RH≦60%)		BVS	5000	V_{rms}

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	-	5	25	V
Forward Current	I_F	-	1.6	25	mA
Collector Current	I_C	-	1	10	mA
Operating Temperature	T_{opr}	-25	-	75	°C

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	CT	V=0, f=1MHz	-	30	-	pF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=0.5mA	55	-	-	V
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	7	-	-	V
	Collector-Base Breakdown Voltage (TLP331)	$V_{(BR)CBO}$	I_C=0.1mA	80	-	-	V
	Emitter-Base Breakdown Voltage (TLP331)	$V_{(BR)EBO}$	I_E=0.1mA	7	-	-	V
	Collector Dark Current	I_{CEO}	V_{CE}=24V	-	10	100	nA
			V_{CE}=24V, Ta=85°C	-	2	50	μA
	Collector Dark Current (TLP331)	I_{CER}	V_{CE}=24V, Ta=85°C R_{BE}=1MΩ	-	0.5	10	μA
	Collector Dark Current (TLP331)	I_{CBO}	V_{CB}=10V	-	0.1	-	nA
	DC Forward Current Gain (TLP331)	h_{FE}	V_{CE}=5V, I_c=0.5mA	-	1000	-	-
	Capacitance (Collector to Emitter)	C_{CE}	V=0, f=1MHz	-	12	-	pF

COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Current Transfer Ratio	I_C/I_F	I_F=1mA, V_{CE}=0.5V	100	-	-	%
		Rank BV	200	-	-	
Low Input CTR	I_C/I_F(low)	I_F=0.5mA, V_{CE}=1.5V	50	-	-	%
		Rank BV	100	-	-	
Base Photo-current (TLP331)	I_{PB}	I_F=1mA, V_{CB}=5V	-	5	-	μA
Collector-Emitter Saturation Voltage	V_{CE}(sat)	I_C=0.5mA I_F=1mA	-	-	0.4	V
		I_C=1mA I_F=1mA	-	0.2	-	
		Rank BV	-	-	0.4	

COUPLED ELECTRICAL CHARACTERISTICS (Ta=-25~75°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Current Transfer Ratio	I_C/I_F	I_F=1mA, V_{CE}=0.5V	50	-	-	%
		Rank BV	100	-	-	
Low Input CTR	I_C/I_F(low)	I_F=0.5mA, V_{CE}=1.5V	-	50	-	%
		Rank BV	-	100	-	

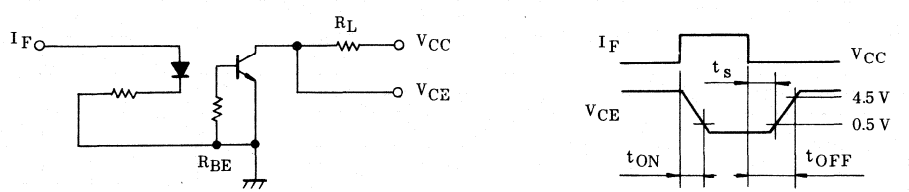
ISOLATION CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V =500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	5000	-	-	V_{rms}
		AC, 1 second	-	10000	-	
		DC, 1 minute	-	10000	-	V_{dc}

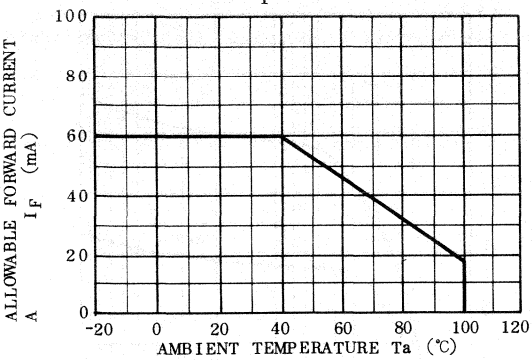
SWITCHING CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Rise Time	t_r	V_{CC}=10V	-	8	-	μs
Fall Time	t_f	I_C=2mA	-	8	-	
Turn-on Time	t_{on}	R_L=100Ω	-	10	-	
Turn-off Time	t_{off}		-	8	-	
Turn-on Time	t_{ON}	R_L=4.7kΩ (Fig.1)	-	10	-	μs
Storage Time	tS	RBE=OPEN	-	50	-	
Turn-off Time	t_{OFF}	V_{CC}=5V, I_F=1.6mA	-	300	-	
Turn-on Time	t_{ON}	R_L=4.7kΩ (Fig.1)	-	12	-	μs
Storage Time	tS	R_{BE}=470kΩ (TLP331)	-	30	-	
Turn-off Time	t_{OFF}	V_{CC}=5V, I_F=1.6mA	-	100	-	

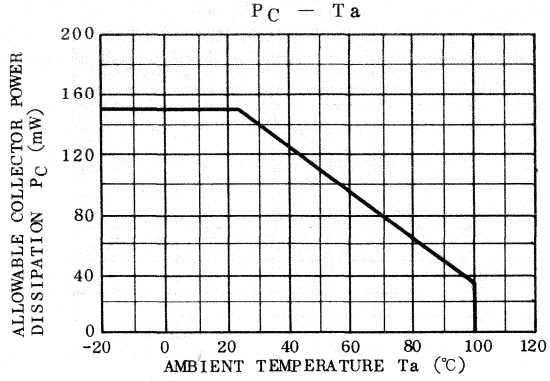
Fig. 1 SWITCHING TIME TEST CIRCUIT



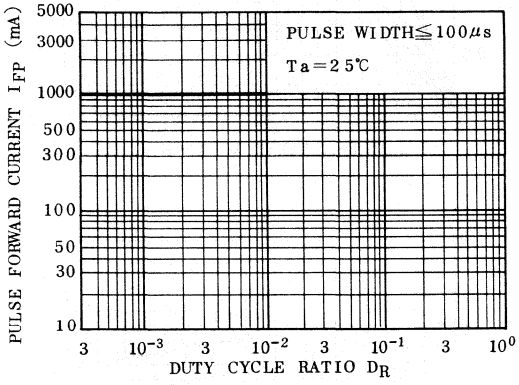
I_F — Ta



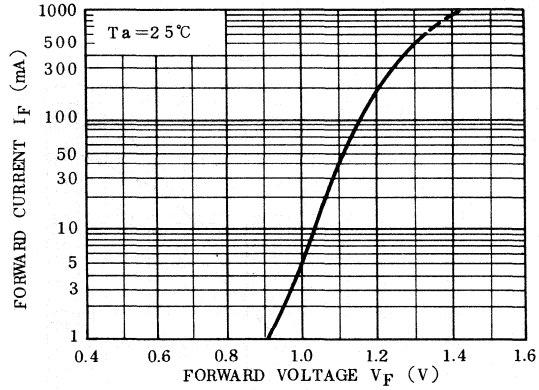
P_C — Ta



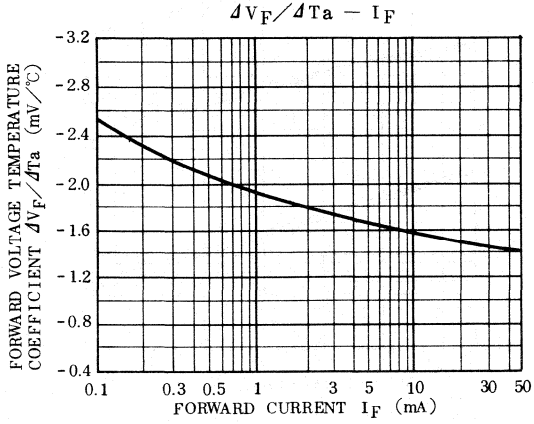
I_{FP} — D_R



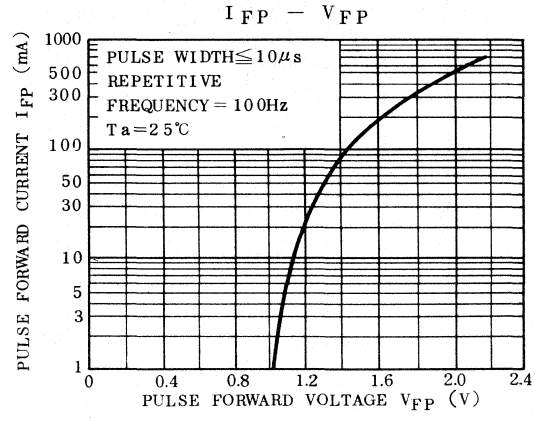
I_F — V_F



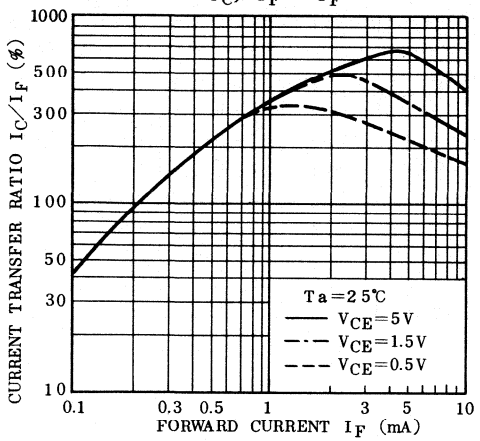
$\Delta V_F/\Delta Ta$ — I_F



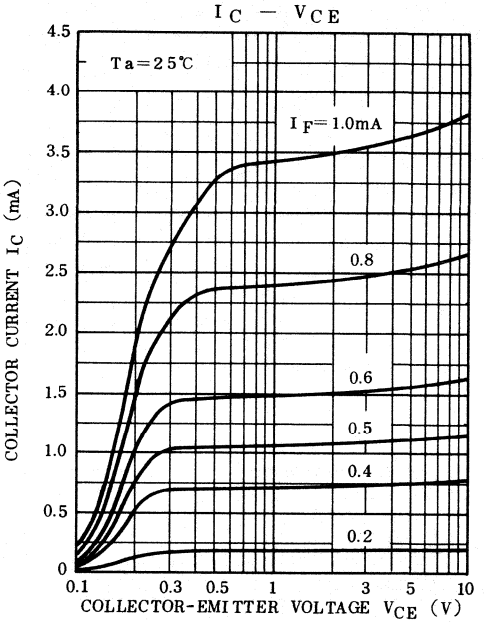
I_{FP} — V_{FP}



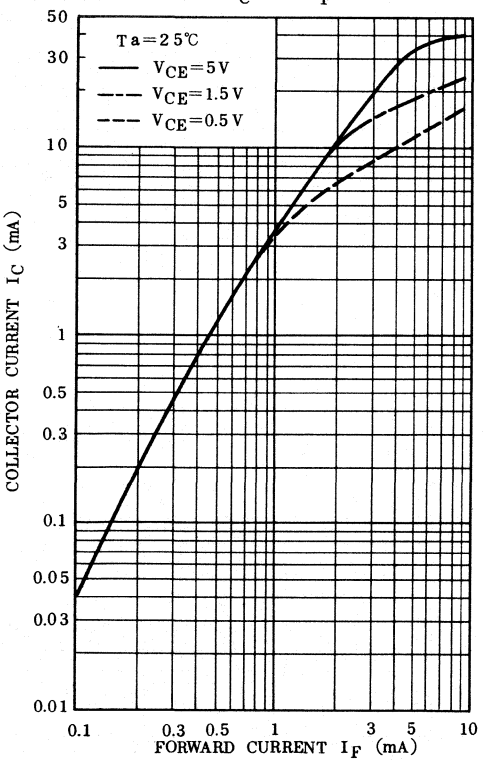
$I_C/I_F - I_F$



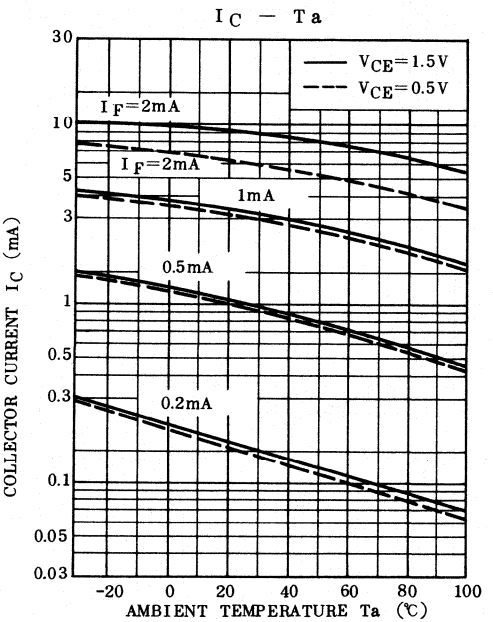
$I_C - V_{CE}$



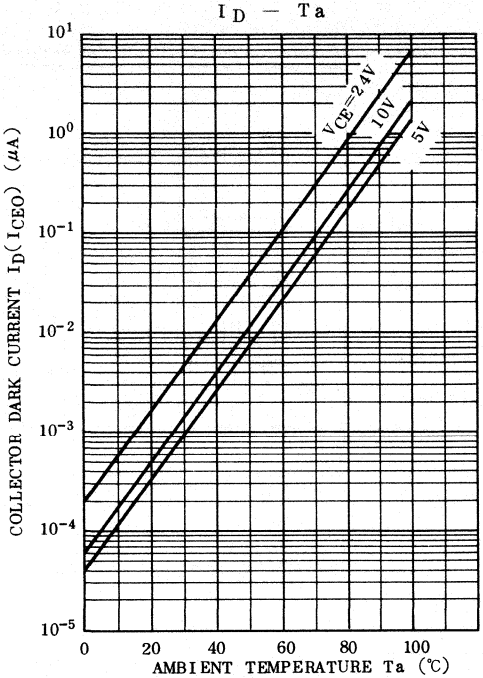
$I_C - I_F$



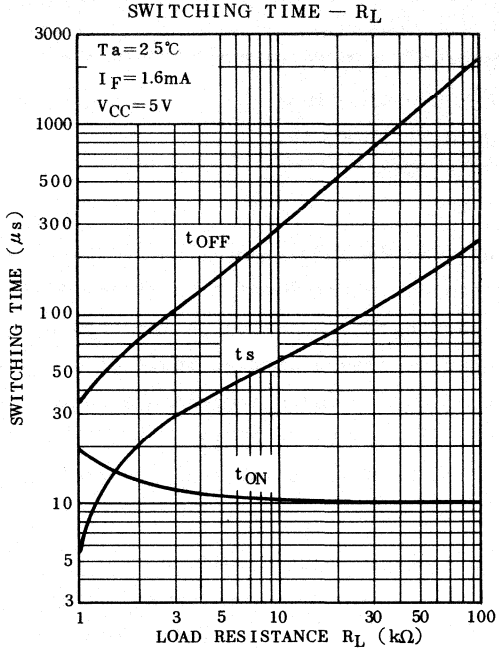
$I_C - Ta$



I_D — Ta



SWITCHING TIME — R_L



TLP371, TLP372

GaAs IRED & PHOTO-TRANSISTOR

OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
TELECOMMUNICATION.
SOLID STATE RELAY.
PROGRAMMABLE CONTROLLERS.

The TOSHIBA TLP371 and TLP372 consist of a gallium arsenide infrared emitting diode optically coupled to a darlington connected photo-transistor which has an integrated base-emitter resistor to optimize switching speed and elevated temperature characteristics in a six lead plastic DIP package.
TLP372 is no-base internal connection for high-EMI environments.

. Collector-Emitter Voltage :

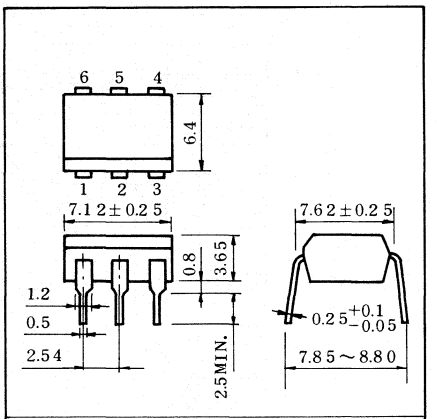
CLASSIFICATION (*)	COLLECTOR-EMITTER VOLTAGE (Min.)	MARKING OF CLASSIFICATION
Standard	300V	Blank
Rank V2	200V	Blank, V2
Rank V1	100V	Blank, V2, V1

(*) Ex. Standard : TLP371
Rank V2 : TLP371(V2)

. Current Transfer Ratio : 1000% Min. (I_F=1mA)
. Isolation Voltage : 5000V_{rms} Min.
. UL Recognized : File No. E67349

. Note: Application type name for certification test, please use standard product type name, i.e.
TLP371(V2): TLP371

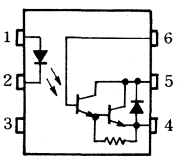
Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-7A1

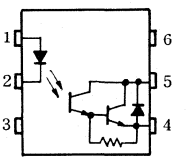
PIN CONFIGURATIONS (TOP VIEW)

TLP371



1 : ANODE
2 : CATHODE
3 : NC
4 : EMITTER
5 : COLLECTOR
6 : BASE

TLP372



1 : ANODE
2 : CATHODE
3 : NC
4 : EMITTER
5 : COLLECTOR
6 : NC

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current		IF	60	mA
	Forward Current Derating (Ta≧39°C)		ΔI_F/°C	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)		I_{FP}	1	A
	Reverse Voltage		V_R	5	V
	Junction Temperature		T_j	125	°C
DETECTOR	Collector-Emitter Voltage		V_{CEO}	300	V
		Rank V2		200	
		Rank V1		100	
	Collector-Base Voltage (TLP371)		V_{CBO}	300	V
		Rank V2		200	
		Rank V1		100	
	Emitter-Collector Voltage		V_{ECO}	0.3	V
	Emitter-Base Voltage (TLP371)		V_{EBO}	7	V
	Collector Current		I_C	150	mA
	Power Dissipation		P_C	300	mW
	Power Dissipation Derating (Ta≧25°C)		ΔP_C/°C	-3.0	mW/°C
	Junction Temperature		T_j	125	°C
Storage Temperature Range			Tstg	-55∿125	°C
Operating Temperature Range			T_{opr}	-55∿100	°C
Lead Soldering Temperature (10 sec.)			Tsold	260	°C
Total Package Power Dissipation			P_T	350	mW
Total Package Power Dissipation Derating (Ta≧25°C)			ΔP_T/°C	-3.5	mW/°C
Isolation Voltage (AC, 1 min., RH≦60%)			BV_S	5000	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=0.1mA	300	-	-	V
			Rank V2	200	-	-	
			Rank V1	100	-	-	
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	0.3	-	-	V
	Collector-Base Breakdown Voltage (TLP371)	$V_{(BR)CBO}$	I_C=0.1mA	300	-	-	V
			Rank V2	200	-	-	
			Rank V1	100	-	-	
	Emitter-Base Breakdown Voltage (TLP371)	$V_{(BR)EBO}$	I_E=0.1mA	7	-	-	V
	Collector Dark Current	I_{CEO}	V_{CE}=200V V_{CE}=150V (V2 Rank) V_{CE}=80V (V1 Rank)	-	10	200	nA
			V_{CE}=200V V_{CE}=150V (V2 Rank) V_{CE}= 80V (V1 Rank) Ta=85°C	-	-	20	μA
	Collector Dark Current (TLP371)	I_{CER}	V_{CE}=200V V_{CE}=150V (V2 Rank) V_{CE}= 80V (V1 Rank) Ta=85°C, R_{BE}=10MΩ	-	0.5	10	μA
	Collector Dark Current (TLP371)	I_{CBO}	V_{CE}=200V V_{CE}=150V (V2 Rank) V_{CE}= 80V (V1 Rank)	-	0.1	-	nA
	DC Forward Current Gain (TLP371)	h_{FE}	V_{CE}=5V, I_C=10mA	-	7000	-	-
	Capacitance (Collector to Emitter)	C_{CE}	V=0, f=1MHz	-	10	-	pF

COUPLED ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Current Transfer Ratio	I_C/I_F	I_F=1mA, V_{CE}=1V	1000	4000	-	%
Saturated CTR	$I_C/I_{F(sat)}$	I_F=10mA, V_{CE}=1V	500	-	-	%
Base Photo-Current (TLP371)	I_{PB}	I_F=1mA, V_{CB}=1V	-	6	-	μA
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C=10mA, I_F=1mA	-	-	1.0	V
		I_C=100mA, I_F=10mA	0.3	-	1.2	

ISOLATION CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	5000	-	-	V_{rms}
		AC, 1 second	-	10000	-	
		DC, 1 minute	-	10000	-	V_{DC}

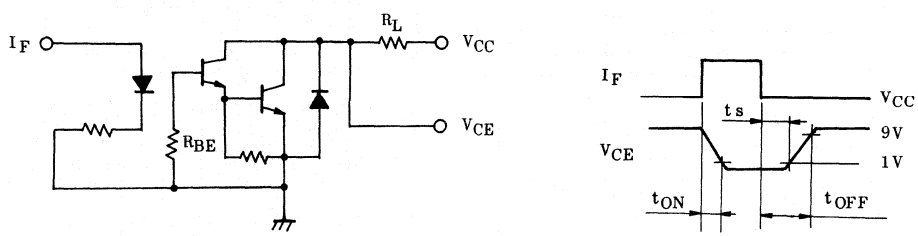
SWITCHING CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Rise Time	t_r	V_{CC}=10V, I_C=10mA, R_L=100Ω	-	40	-	μs
Fall Time	t_f		-	15	-	
Turn-on Time	t_{on}		-	50	-	
Turn-off Time	t_{off}		-	15	-	
Turn-on Time	t_{ON}	R_L=180Ω (Fig.1), R_{BE}=OPEN, V_{CC}=10V, I_F=16mA	-	3	-	μs
Storage Time	t_S		-	45	-	
Turn-off Time	t_{OFF}		-	90	-	
Turn-on Time	t_{ON}	R_L=180Ω (Fig.1), R_{BE}=10MΩ (TLP371), V_{CC}=10V, I_F=16mA	-	5	-	μs
Storage Time	t_S		-	40	-	
Turn-off Time	t_{OFF}		-	80	-	

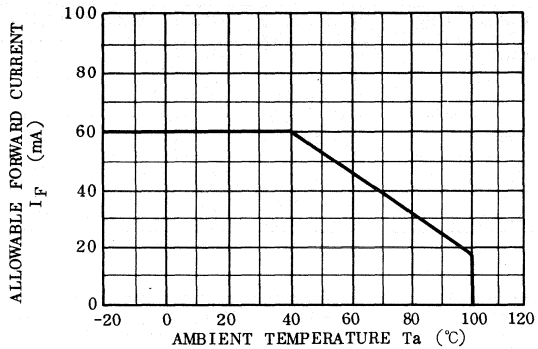
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	VCC	-	-	200	V
Forward Current	IF	-	16	25	mA
Collector Current	I_C	-	-	50	mA
Operating Temperature	T_{opr}	-25	-	85	°C

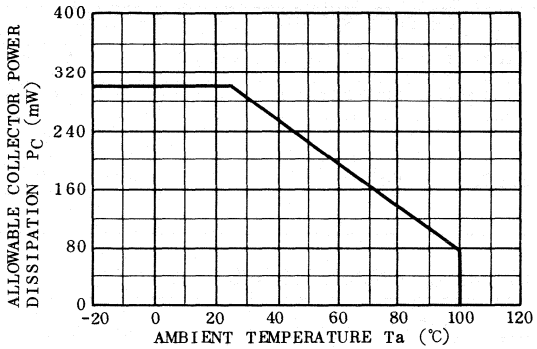
Fig. 1 SWITCHING TIME TEST CIRCUIT



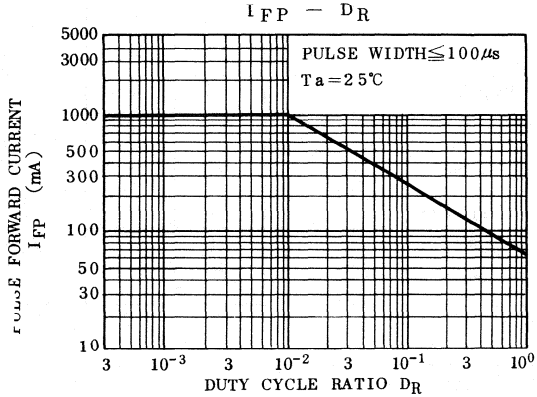
I_F — Ta



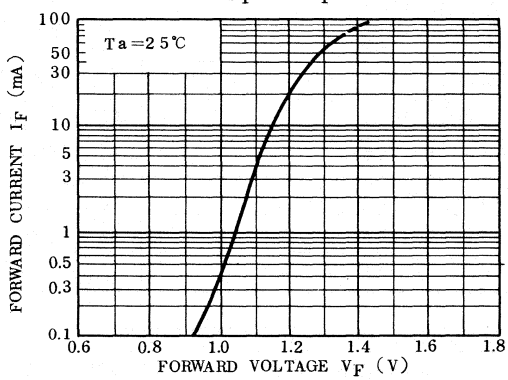
P_C — Ta



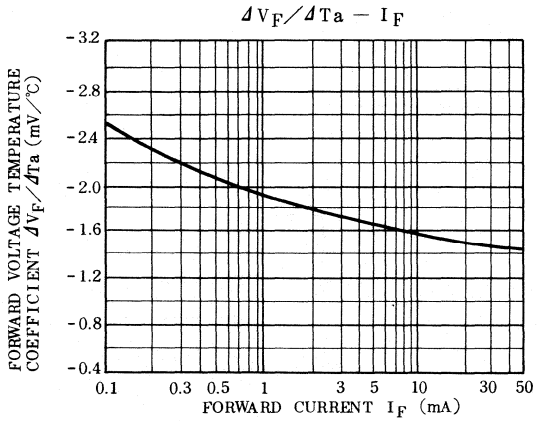
I_{FP} — D_R



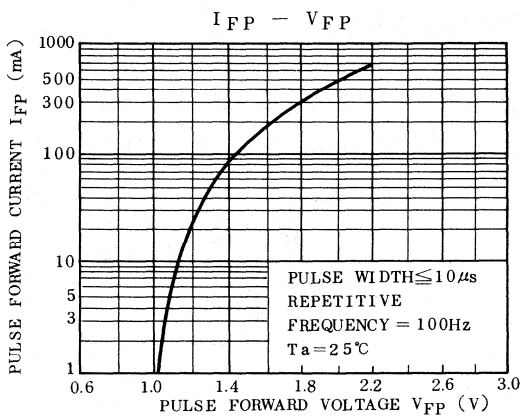
I_F — V_F



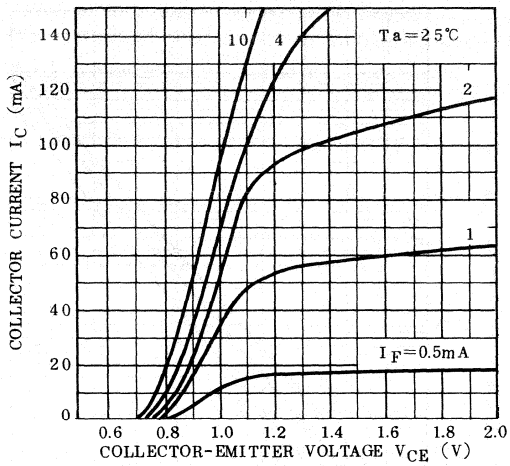
$\Delta V_F/\Delta Ta$ — I_F



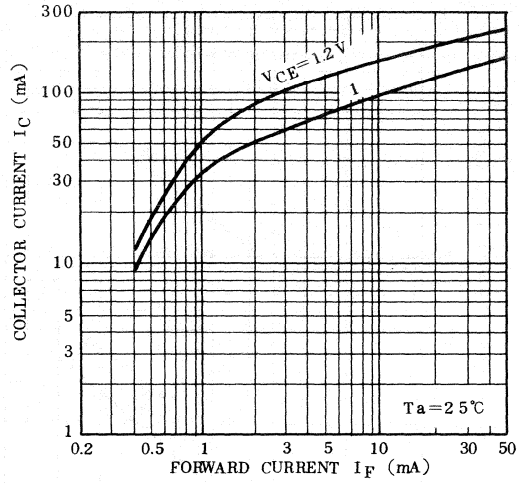
I_{FP} — V_{FP}



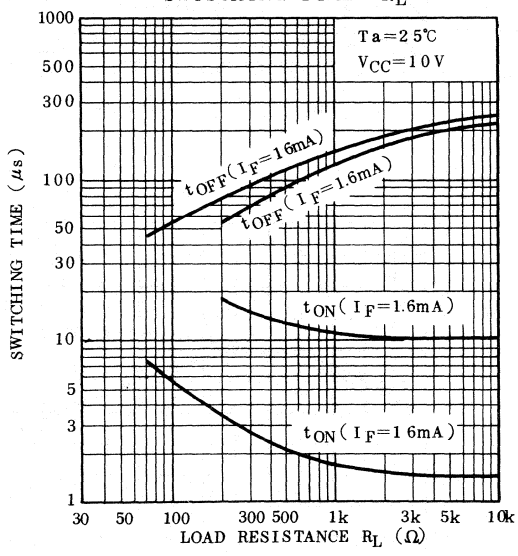
$I_C - V_{CE}$



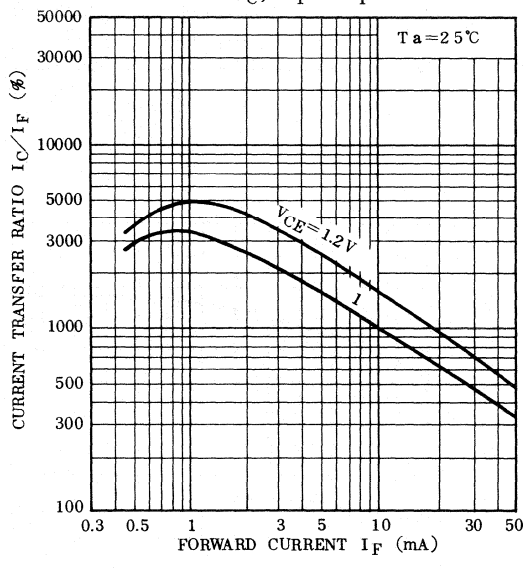
$I_C - I_F$



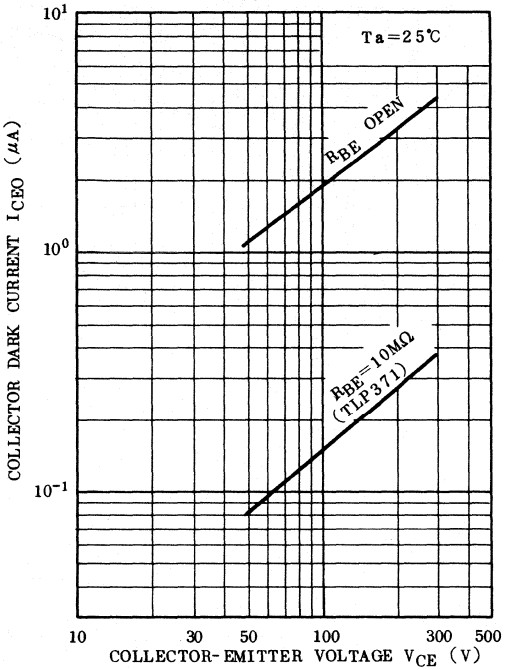
SWITCHING TIME $- R_L$



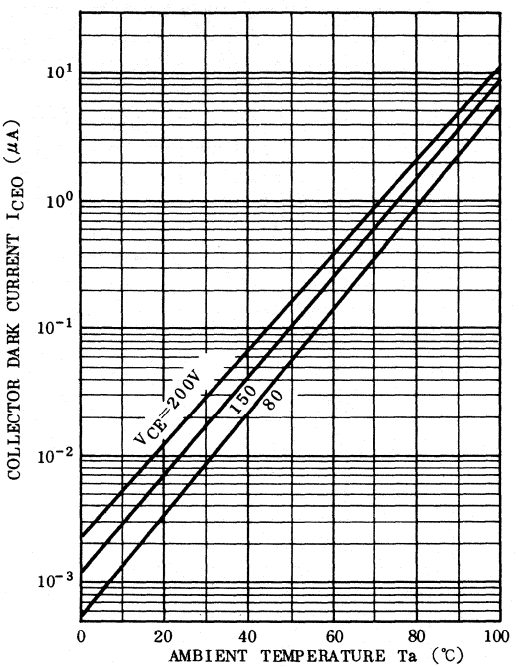
$I_C / I_F - I_F$



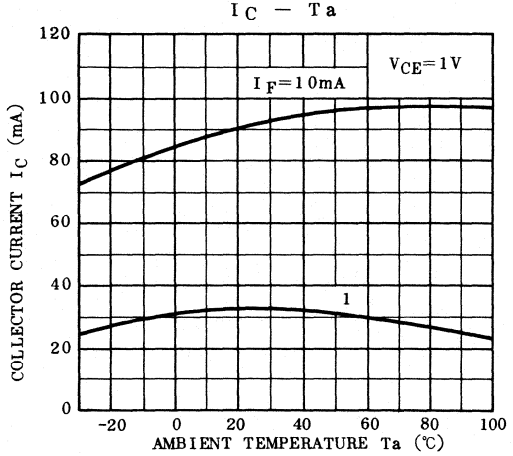
I_{CEO} – V_{CE}



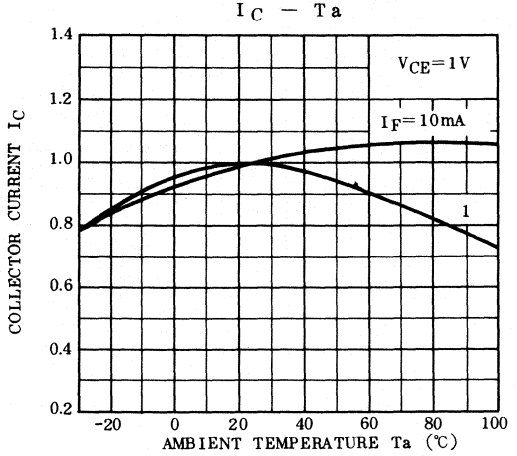
I_{CEO} – Ta



I_C – Ta



I_C – Ta



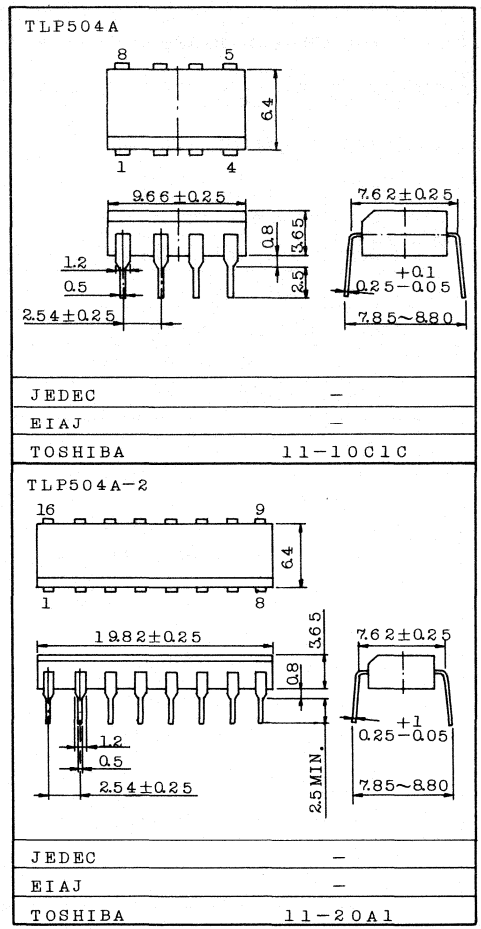
TLP504A, TLP504A-2

PROGRAMMABLE CONTROLLERS
AC/DC-INPUT MODULE
SOLID STATE RELAY

The TOSHIBA TLP504A and TLP504A-2 consist of a photo-transistor optically coupled to a gallium arsenide infrared emitting diode. The TLP504A offers two isolated channels in a eight lead plastic DIP package, while the TLP504A-2 provides four isolated channels in a sixteen plastic DIP package.

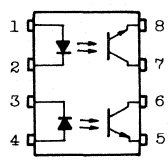
- Collector-Emitter Voltage : 55V Min.
- Current Transfer Ratio : 50% Min.
  Rank GB : 100% Min.
- Isolation Voltage : 2500V_{rms} Min.
- UL Recognized : File No. E67349

Unit in mm



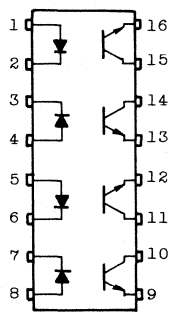
PIN CONFIGURATIONS (TOP VIEW)

TLP504A



1,4 : ANODE
2,3 : CATHODE
5,8 : EMITTER
6,7 : COLLECTOR

TLP504A-2



1,4,5,8 : ANODE
2,3,6,7 : CATHODE
9,12,13,16 : EMITTER
10,11,14,15 : COLLECTOR

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING		UNIT
			TLP504A	TLP504A-2	
LED	Forward Current	I_F	60	50	mA
	Forward Current Derating	$\Delta I_F/°C$	-0.7 (Ta≧39°C)	-0.5 (Ta≧25°C)	mA/°C
	Pulse Forward Current	I_{FP}	1 (100μs pulse, 100pps)		A
	Power Dissipation	P_D	100	70	mW
	Power Dissipation Derating	$\Delta P_D/°C$	-1.0	-0.7	mW/°C
	Reverse Voltage	V_R	5		V
	Junction Temperature	T_j	125		°C
DETECTOR	Collector-Emitter Voltage	V_{CEO}	55		V
	Emitter-Collector Voltage	V_{ECO}	7		V
	Collector Current	I_C	50		mA
	Collector Power Dissipation (1 Circuit)	P_C	150	100	mW
	Collector Power Dissipation Derating (1 Circuit Ta≧25°C)	$\Delta P_C/°C$	-1.5	-1.0	mW/°C
	Junction Temperature	T_j	125		°C
Storage Temperature Range		T_{stg}	-55~150		°C
Operating Temperature Range		T_{opr}	-55~100		°C
Lead Soldering Temperature		T_{sold}	260 (10 sec.)		°C
Total Package Power Dissipation		P_T	250	150	mW
Total Package Power Dissipation Derating (Ta≧25°C)		$\Delta P_T/°C$	-2.5	-1.5	mW/°C
Isolation Voltage		BV_S	2500 (AC, 1 min., RH≦60%)		Vrms

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=0.5mA	55	-	-	V
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	7	-	-	V
	Collector Dark Current	I_{CEO}	V_{CE}=24V	-	10	100	nA
			V_{CE}=24V, Ta=85°C	-	2	50	μA
	Capacitance Collector to Emitter	C_{CE}	V=0, f=1MHz	-	10	-	pF

COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Current Transfer Ratio	I_C/I_F	I_F=5mA, V_{CE}=5V	50	-	600	%
		Rank GB	100	-	600	
Saturated CTR	$I_C/I_{F(sat)}$	I_F=1mA, V_{CE}=0.4V	-	60	-	%
		Rank GB	30	-	-	
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C=2.4mA, I_F=8mA	-	-	0.4	V
		I_C=0.2mA, I_F=1mA	-	0.2	-	
		Rank GB	-	-	0.4	

ISOLATION CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Capacitance Input to Output	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	2500	-	-	V_{rms}
		AC, 1 second	-	5000	-	
		DC, 1 minute	-	5000	-	Vdc

SWITCHING CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Rise Time	t_r	V_{CC}=10V, I_C=2mA R_L=100Ω	-	2	-	μs
Fall Time	t_f		-	3	-	
Turn-on Time	t_{on}		-	3	-	
Turn-off Time	t_{off}		-	3	-	
Turn-on Time	t_{ON}	R_L=1.9kΩ (Fig.1) V_{CC}=5V, I_F=16mA	-	2	-	μs
Storage Time	t_s		-	15	-	
Turn-off Time	t_{OFF}		-	25	-	

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	-	5	24	V
Forward Current	I_F	-	16	20	mA
Collector Current	I_C	-	1	10	mA
Operating Temperature	T_{opr}	-25	-	85	°C

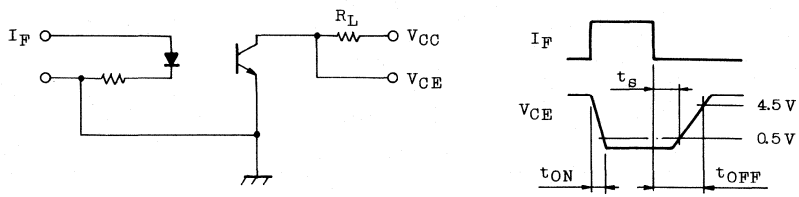
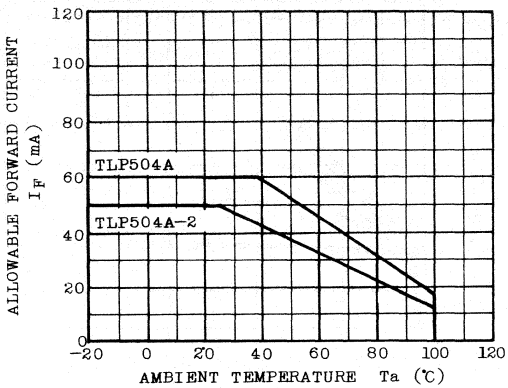
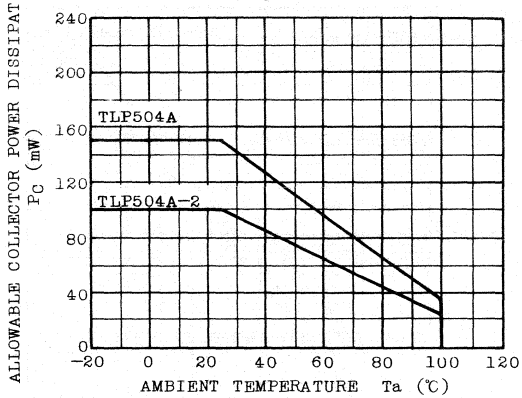


Fig. 1 Switching Time Test Circuit

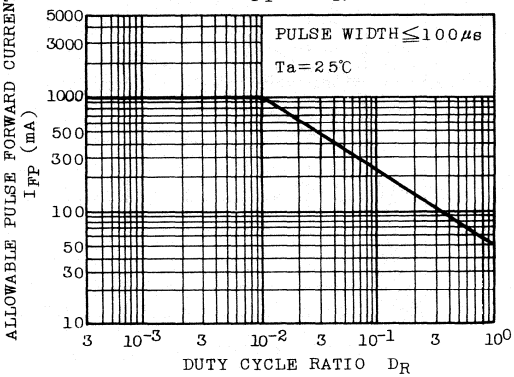
I_F – Ta



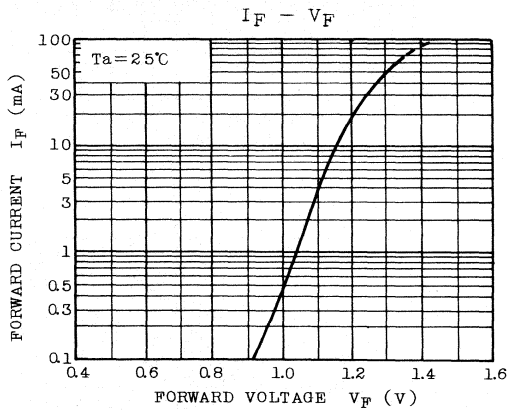
P_C – Ta



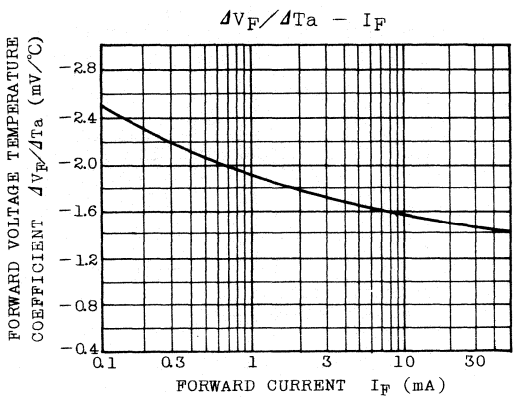
I_{FP} – D_R



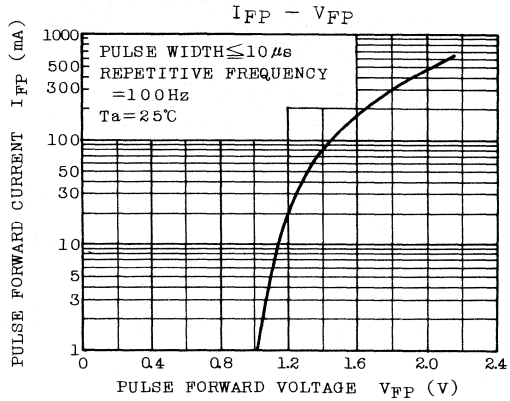
I_F – V_F



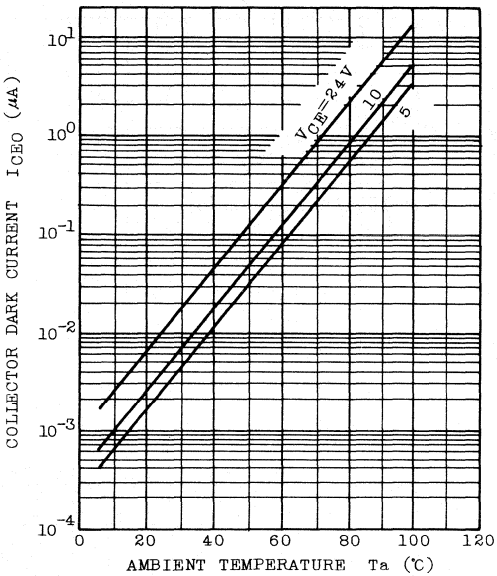
$\Delta V_F / \Delta Ta$ – I_F



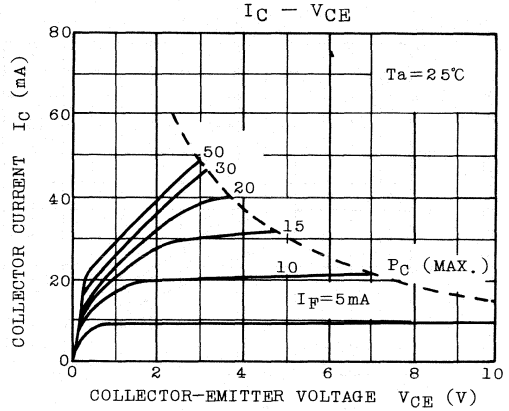
I_{FP} – V_{FP}



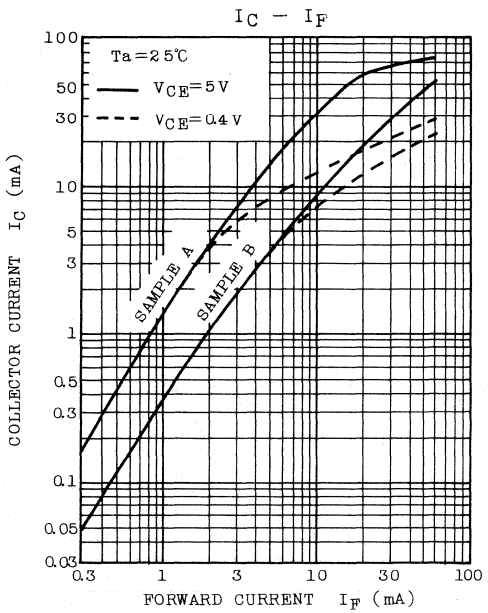
I_{CEO} – Ta



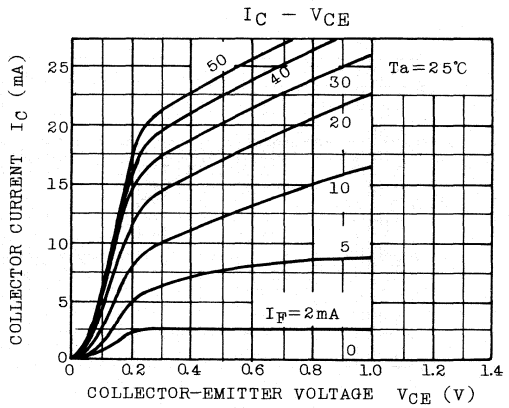
I_C – V_{CE}



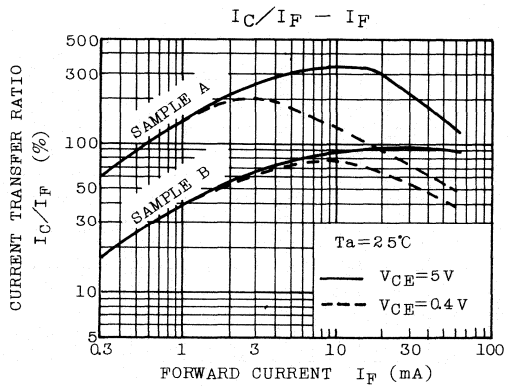
I_C – I_F

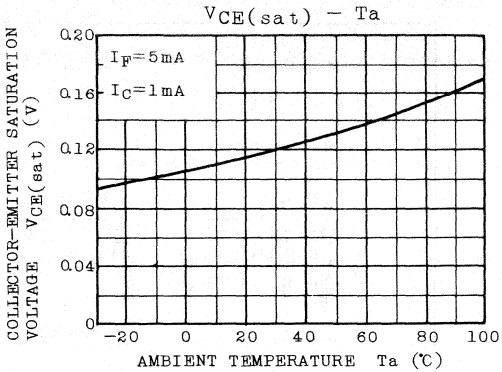


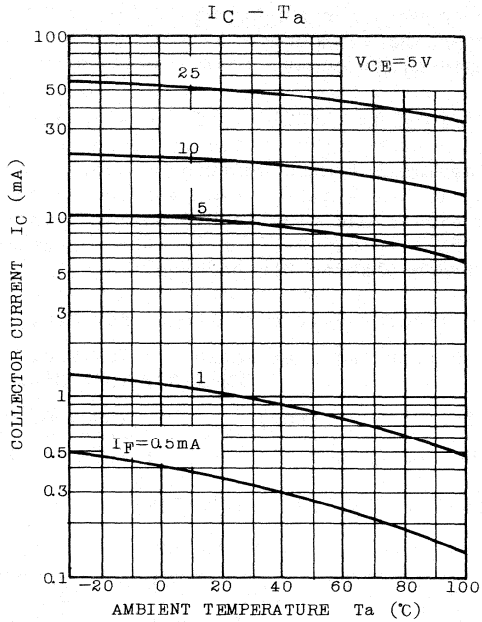
I_C – V_{CE}

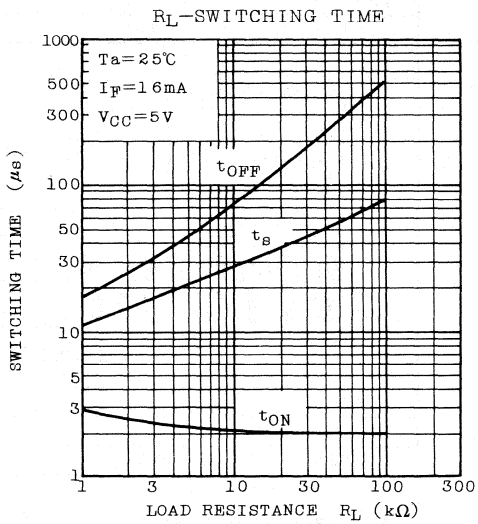


I_C/I_F – I_F




$V_{CE(sat)}$ – Ta
COLLECTOR–EMITTER SATURATION VOLTAGE $V_{CE(sat)}$ (V)
I_F=5mA
I_C=1mA
0.20
0.16
0.12
0.08
0.04
0
–20
0
20
40
60
80
100
AMBIENT TEMPERATURE Ta (℃)


I_C – Ta
COLLECTOR CURRENT I_C (mA)
V_{CE}=5V
25
10
5
1
I_F=0.5mA
100
50
30
10
5
3
1
0.5
0.3
0.1
–20
0
20
40
60
80
100
AMBIENT TEMPERATURE Ta (℃)


R_L–SWITCHING TIME
SWITCHING TIME (μs)
Ta=25℃
I_F=16mA
V_{CC}=5V
t_{OFF}
t_s
t_{ON}
1000
500
300
100
50
30
10
5
3
1
1
3
10
30
100
300
LOAD RESISTANCE R_L (kΩ)

TLP521-1, TLP521-2, TLP521-4

GaAs IRED & PHOTO-TRANSISTOR

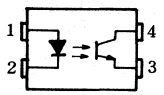
PROGRAMMABLE CONTROLLERS
AC/DC-INPUT MODULE
SOLID STATE RELAY

The TOSHIBA TLP521-1, -2 and -4 consist of a photo-transistor optically couled to a gallium arsenide infrared emitting diode.
The TLP521-2 offers two isolated channels in an eight lead plastic DIP package, while the TLP521-4 provides four isolated channels in a sixteen plastic DIP package.

- Collector-Emitter Voltage: 55V Min.
- Current Transfer Ratio : 50% Min.
  Rank GB: 100% Min.
- Isolation Voltage : 2500Vrms Min.
- UL Recognized : File No. E67349

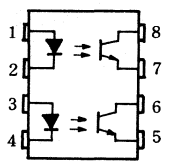
PIN CONFIGURATION (TOP VIEW)

TLP521-1



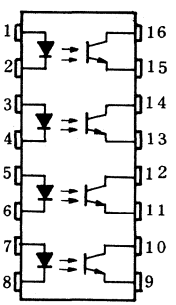
1 : ANODE
2 : CATHODE
3 : EMITTER
4 : COLLECTOR

TLP521-2



1, 3 : ANODE
2, 4 : CATHODE
5, 7 : EMITTER
6, 8 : COLLECTOR

TLP521-4



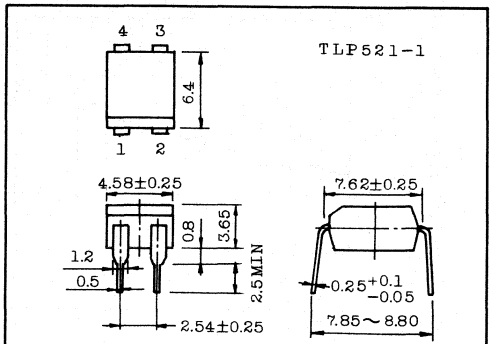
1,3,5,7 : ANODE
2,4,6,8 : CATHODE
9,11,13,15 : EMITTER
10,12,14,16 : COLLECTOR

- Current Transfer Ratio

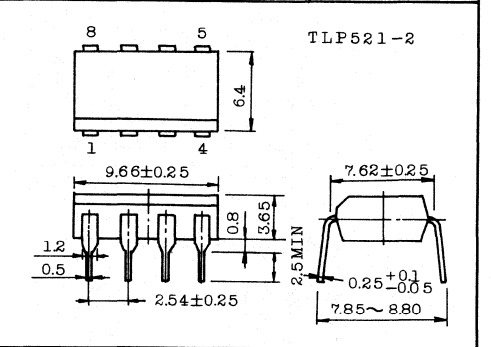
TYPE	CLASSIFICATION *1	CURRENT TRANSFER RATIO (%) (I_C/I_F) I_F=5mA, V_{CE}=5V Ta=25°C	
		MIN.	MAX.
TLP521-1	A	50	600
	Rank Y	50	150
	Rank GR	100	300
	Rank BL	200	600
	Rank GB	100	600
	Rank YG	50	300
TLP521-2	A	50	600
TLP521-4	Rank GB	100	600

*1: Ex. Rank GB : TLP521-1(GB)

Note: Application type name for certification test, please use standard product type name, i.e.
TLP521-1(GB) : TLP521-1
TLP521-2(GB) : TLP521-2



JEDEC	–
EIAJ	–
TOSHIBA	11-5B1



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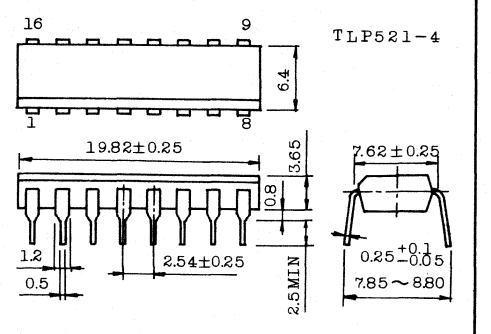
EIAJ	–
TOSHIBA	11-10C1



JEDEC	–
EIAJ	–
TOSHIBA	11-20A1

MAXIMUM RATINGS (ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING		UNIT
			TLP521-1	TLP521-2,4	
LED	Forward Current	I_F	70	50	mA
	Forward Current Derating	ΔI_F/°C	-0.7 (Ta ≧39°C)	-0.5 (Ta ≧25°C)	mA/°C
	Pulse Forward Current	I_{FP}	1 (100μ pulse, 100pps)		A
	Reverse Voltage	V_R	5		V
	Junction Temperature	T_j	125		°C
DETECTOR	Collector-Emitter Voltage	V_{CEO}	55		V
	Emitter-Collector Voltage	V_{ECO}	7		V
	Collector Current	I_C	50		mA
	Collector Power Dissipation (1 Circuit)	P_C	150	100	mW
	Collector Power Dissipation Derating (1 Circuit Ta ≧25°C)	ΔP_C/°C	-1.5	-1.0	mW/°C
	Junction Temperature	T_j	125		°C
Storage Temperature Range		T_{stg}	-55∿125		°C
Operating Temperature Range		T_{opr}	-55∿100		°C
Lead Soldering Temperature		T_{sold}	260 (10 sec.)		°C
Total Package Power Dissipation		P_T	250	150	mW
Total Package Power Dissipation Derating (Ta ≧25°C)		ΔP_T/°C	-2.5	-1.5	mW/°C
Isolation Voltage		BV_S	2500 (AC, 1 min., RH ≦60%)		Vrms

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=0.5mA	55	-	-	V
	Emitter-Collecter Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	7	-	-	V
	Collector Dark Current	I_{CEO}	V_{CE}=24V	-	10	100	nA
			V_{CE}=24V, T_A=85°C	-	2	50	μA
	Capacitance(Collector to Emitter)	C_{CE}	V=0, f=1MHz	-	10	-	pF

COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTICS	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Current Transfer Ratio	I_C/I_F	I_F=5mA, V_{CE}=5V	50	-	600	%
		Rank GB	100	-	600	
Saturated CTR	I_C/I_F (sat)	I_F=1mA, V_{CE}=0.4V	-	60	-	%
		Rank GB	30	-	-	
Collector-Emitter Staturation Voltage	$V_{CE(sat)}$	I_C=2.4mA, I_F=8mA	-	-	0.4	V

ISOLATION CHARACTERISTICS (Ta=25°C)

CHARACTERISTICS	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V, R.H. $\leq$60%	-	10^{11}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	2500	-	-	V_{rms}

SWITCHING CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Rise Time	t_r	V_{CC}=10V I_C=2mA R_L=100Ω	-	2	-	μs
Fall Time	t_f		-	3	-	
Turn-on Time	t_{on}		-	3	-	
Turn-off Time	t_{off}		-	3	-	
Turn-on Time	t_{ON}	R_L=1.9kΩ(Fig. 1) V_{CC}=5V, I_F=16mA	-	2	-	μs
Strage Time	t_s		-	15	-	
Turn-off Time	t_{OFF}		-	25	-	

RECOMMENDED OPERATING CONDITIONS

CHARACTERISITC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	-	5	24	V
Forward Current	I_F	-	16	20	mA
Collector Current	I_C	-	1	10	mA
Operating Temperature	T_{OPR}	-25	-	85	°C

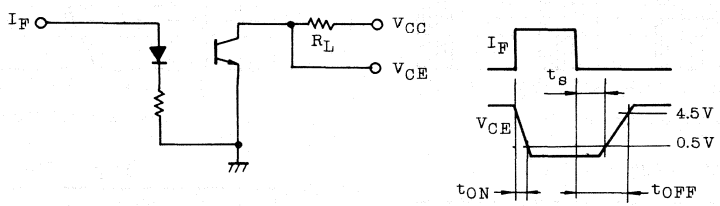
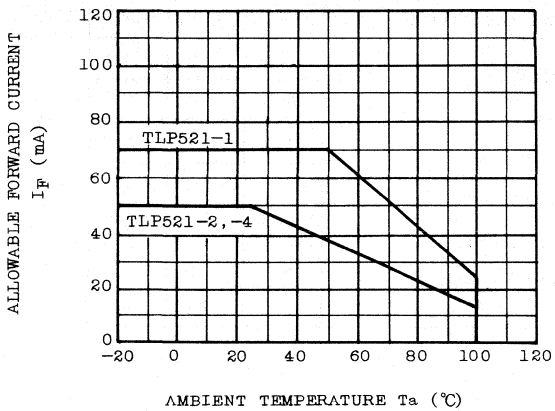
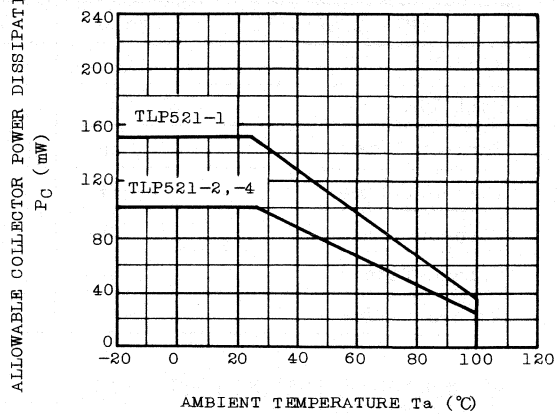


Fig.1 Switching Time Test Circuit

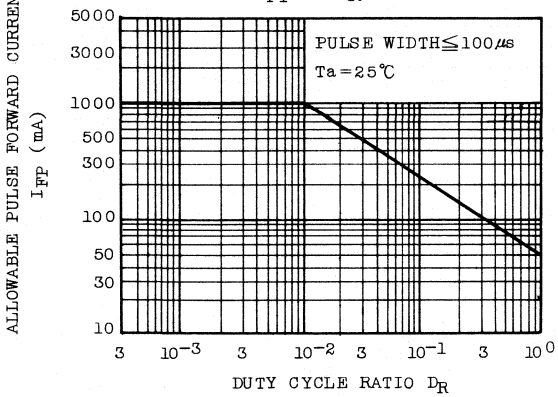
I_F — Ta



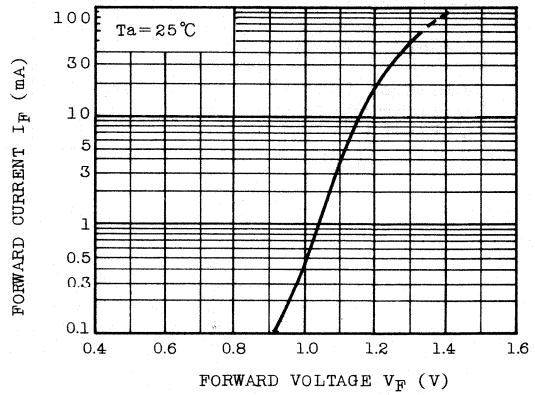
P_C — Ta



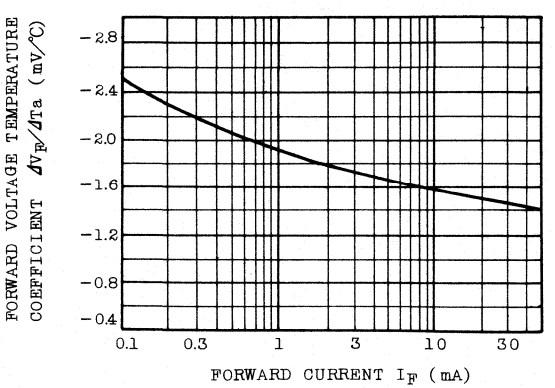
I_{FP} — D_R



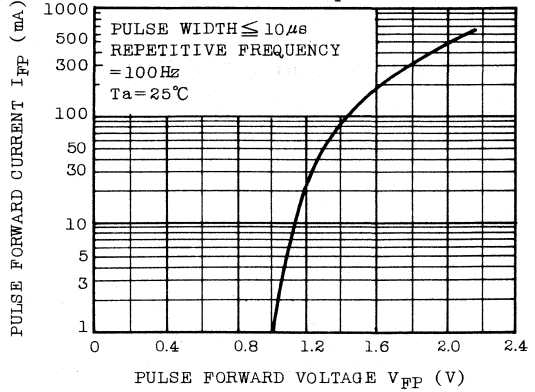
I_F — V_F



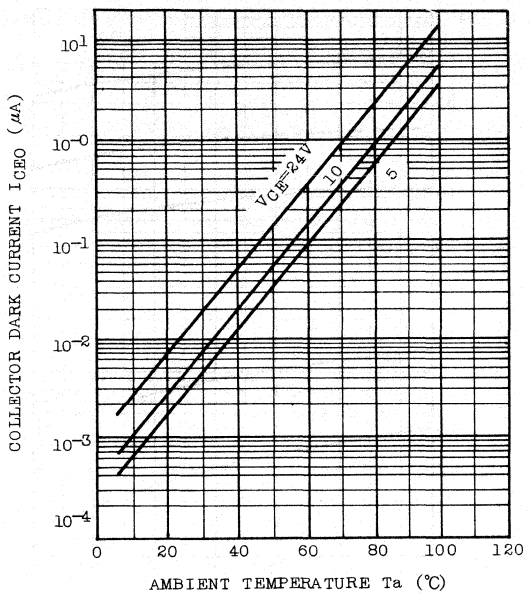
$\Delta V_F / \Delta Ta$ — I_F



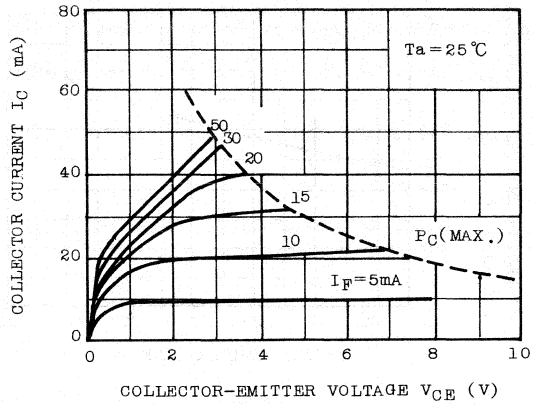
I_{FP} — V_{FP}



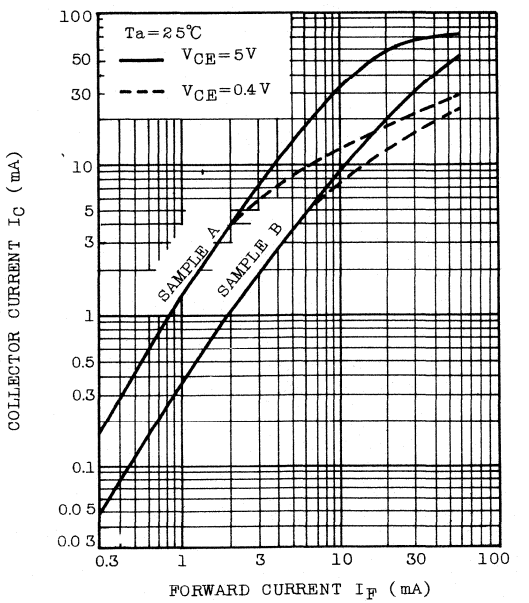
I_{CEO} – Ta



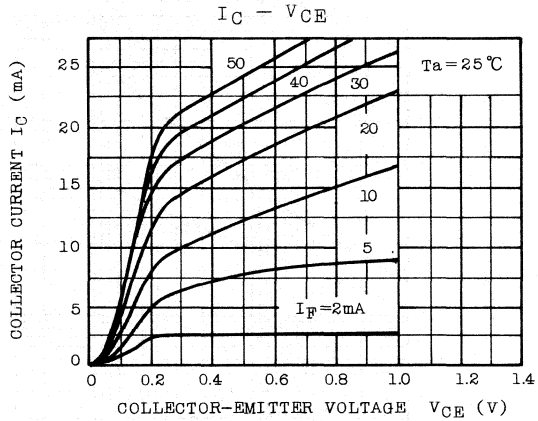
I_C – V_{CE}



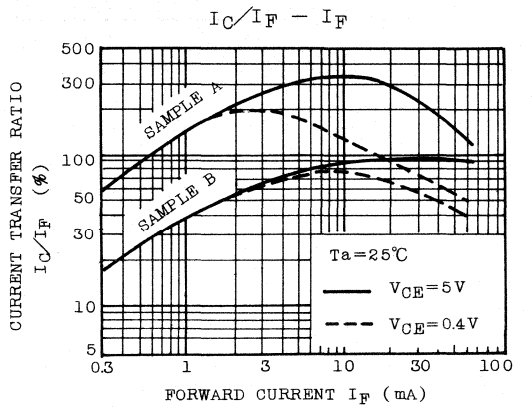
I_C – I_F



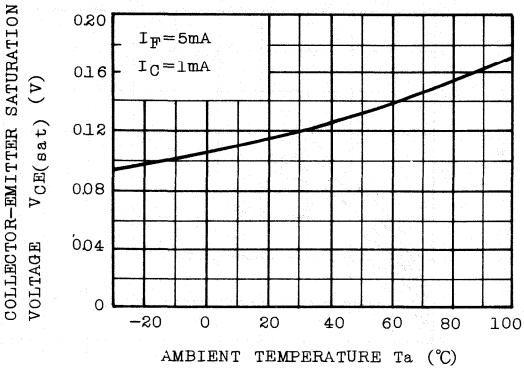
I_C – V_{CE}



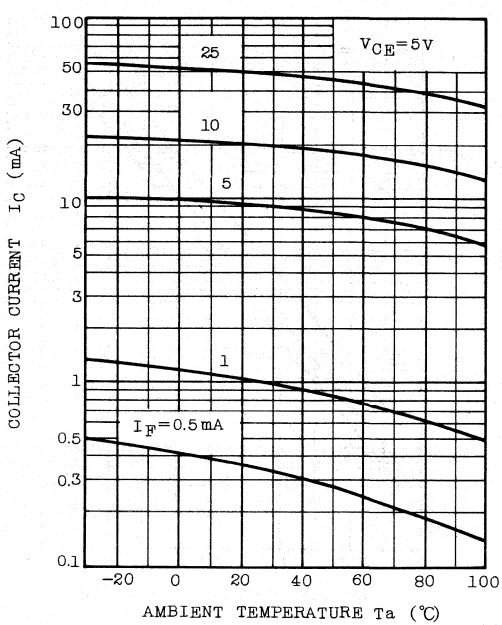
I_C/I_F – I_F



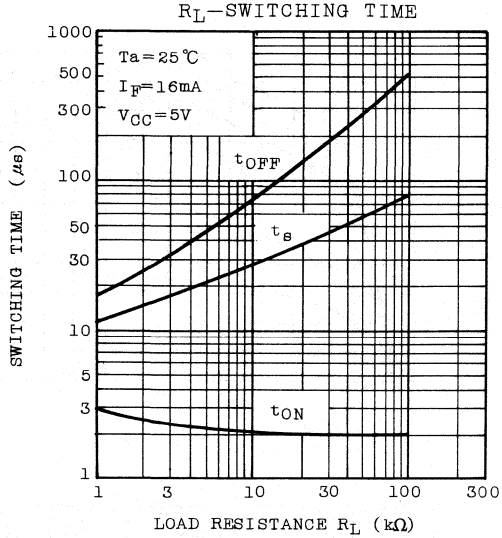
$V_{CE(sat)}$ — Ta



I_C — Ta



R_L—SWITCHING TIME



TLP523, TLP523-2, TLP523-4

GaAs IRED & PHOTO-TRANSISTOR

PROGRAMMABLE CONTROLLERS.

DC-OUTPUT MODULE.

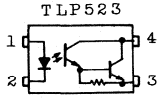
SOLID STATE RELAY.

The TOSHIBA TLP523, -2, and -4 consist of a gallium arsenide infrared emitting diode coupled with a silicon, darlington connected, phototransistor which has an integral base-emitter resistor to optimize switching speed and elevated temperature characteristics.
The TLP523-2 offers two isolated channels in a eight lead plastic DIP package, while the TLP523-4 provide four isolated channels per package.

- Current Transfer Ratio : 500% Min.
  .... (I_F=1mA)
- Isolation Voltage : 2500V_{rms} Min.
- BV_{CEO} : 55V Min.
- Leakage Current : 10μA Max. (Ta=85°C)
- UL Recognized : File No. E67349

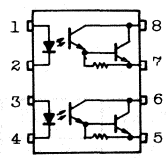
PIN CONFIGURATIONS (TOP VIEW)

TLP523



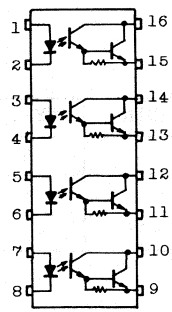
1 : ANODE
2 : CATHODE
3 : EMITTER
4 : COLLECTOR

TLP523-2



1,3 : ANODE
2,4 : CATHODE
5,7 : EMITTER
6,8 : COLLECTOR

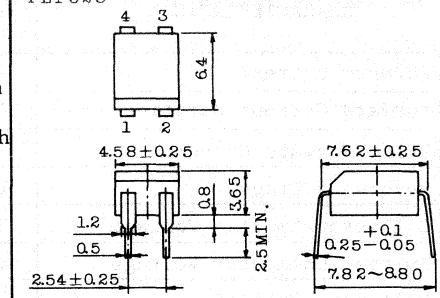
TLP523-4



1, 3, 5, 7 : ANODE
2, 4, 6, 8 : CATHODE
9, 11, 13, 15 : EMITTER
10, 12, 14, 16 : COLLECTOR

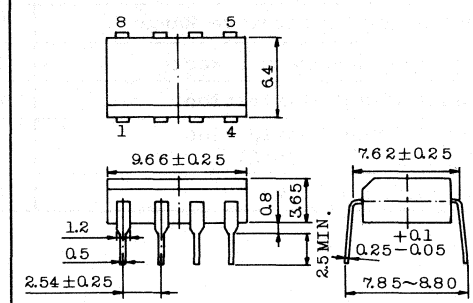
Unit in mm

TLP523



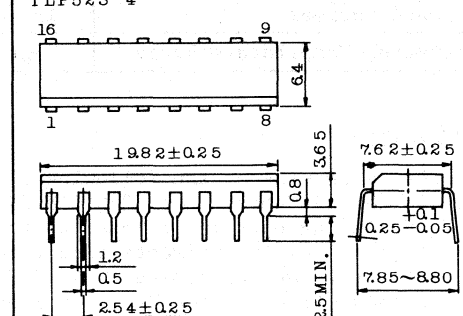
JEDEC	—
EIAJ	—
TOSHIBA	11-5B1

TLP523-2



JEDEC	—
EIAJ	—
TOSHIBA	11-10C1

TLP523-4



JEDEC	—
EIAJ	—
TOSHIBA	11-20A1

TLP523, TLP523-2, TLP523-4

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING		UNIT
			TLP523	TLP523-2 TLP523-4	
LED	Forward Current	I_F	60	50	mA
	Forward Current Derating	ΔI_F/°C	0.7 (Ta≧39°C)	-0.5 (Ta≧25°C)	mA/°C
	Pulse Forward Current	I_{FP}	1 (100μs pulse, 100 pps)		A
	Reverse Voltage	V_R	5		V
DETECTOR	Collector-Emitter Voltage	V_{CEO}	55		V
	Emitter-Collector Voltage	V_{ECO}	0.3		V
	Collector Current	I_C	150		mA
	Collector Power Dissipation (1 Circuit)	P_C	150	100	mW
	Collector Power Dissipation Derating (1 Circuit(Ta≧25°C))	ΔP_C/°C	-1.5	-1.0	mW/°C
Operating Temperature Range		T_{opr}	-55 ~ 100		°C
Storage Temperature Range		T_{stg}	-55 ~ 150		°C
Total Power Dissipation		P_T	250	150	mW
Total Power Dissipation Derating (Ta≧25°C)		ΔP_T/°C	-2.5	-1.5	mW/°C
Isolation Voltage		BVS	2500 (AC, 1 min., RH≦60%)		V_{rms}

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	-	5	24	V
Forward Current	I_F	-	16	20	mA
Operating Temperature Range	T_{opr}	-25	-	85	°C

PRECAUTION

Please be careful of the followings.

1. Soldering temperature: 260°C MAX. Soldering time: 10 sec MAX.
   (Soldering portion of lead: up to 2mm from the body of the device)
2. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E

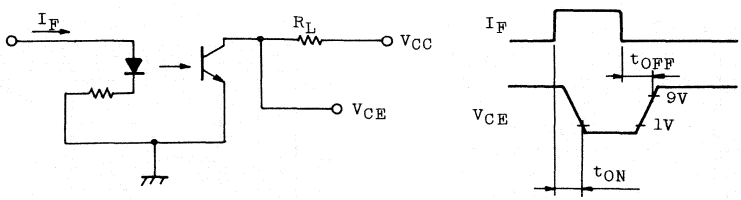
ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=1mA	55	-	-	V
	Collector Dark Current	I_{CEO}	V_{CE}=24V	-	10	200	nA
			V_{CE}=24V, Ta=85°C	-	0.5	10	μA
	Capacitance Collector to Emitter	C_{CE}	V=0, f=1MHz	-	10	-	pF
COUPLED	Current Transfer Ratio	I_C/I_F	I_F=1mA, V_{CE}=1V	500	2000	-	%
	Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C=50mA, I_F=10mA	-	-	1	V
	Capacitance Input to Output	C_S	V_S=0, f=1MHz	-	0.8	-	pF
	Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω

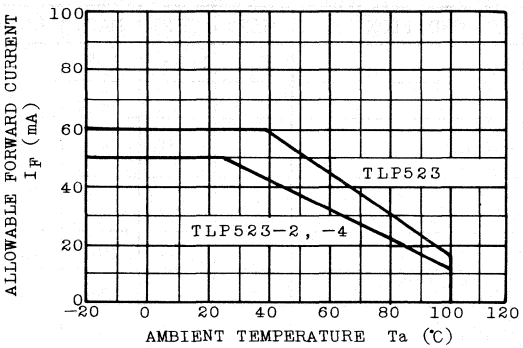
SWITCHING CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Turn-on Time	t_{ON}	V_{CC}=10V, R_L=180Ω	-	3	-	μs
Turn-off Time	t_{OFF}	I_F=16mA	-	80	-	μs

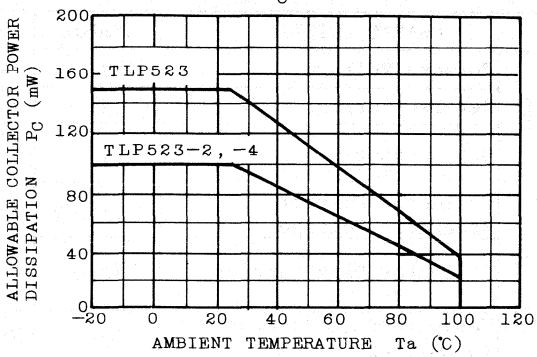
SWITCHING TIME TEST CIRCUIT



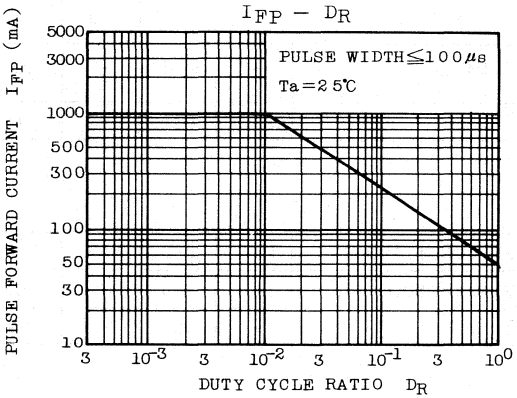
I_F – Ta



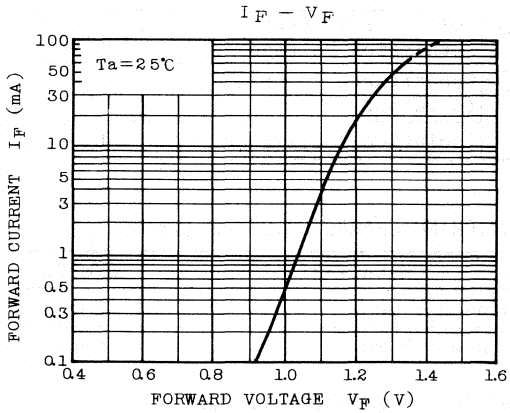
P_C – Ta



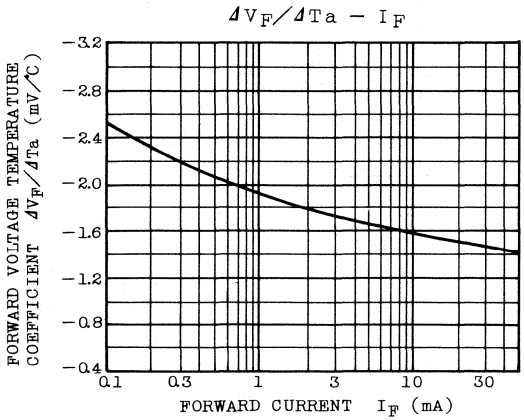
I_{FP} – D_R



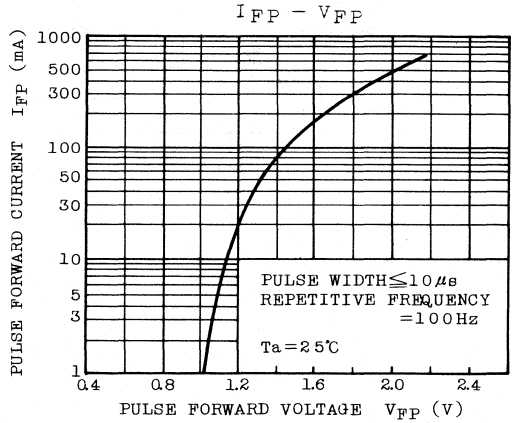
I_F – V_F



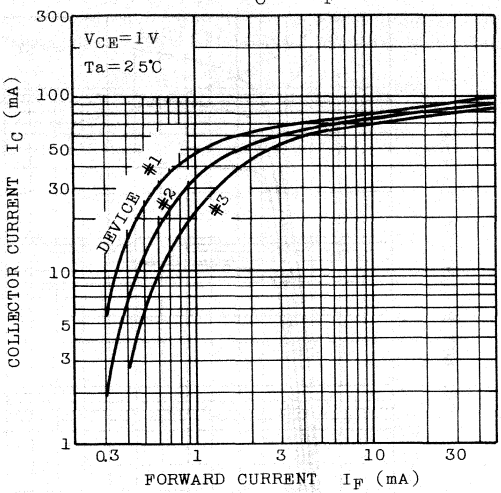
$\Delta V_F / \Delta Ta$ – I_F



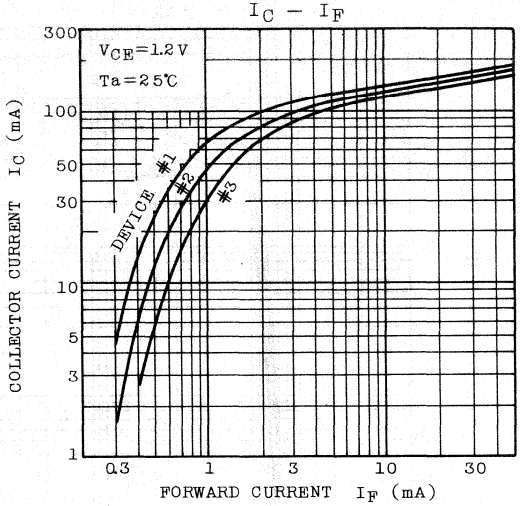
I_{FP} – V_{FP}



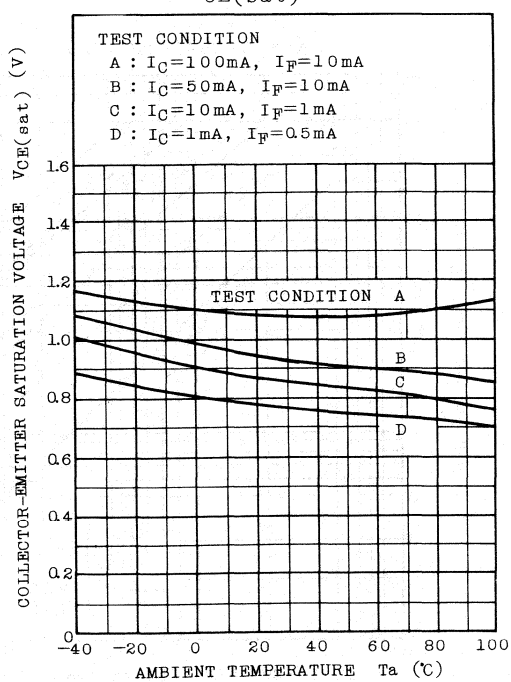
$I_C - I_F$



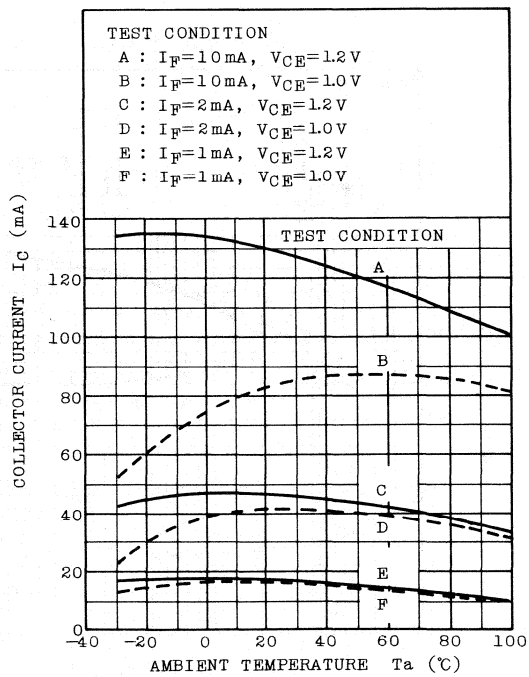
$I_C - I_F$



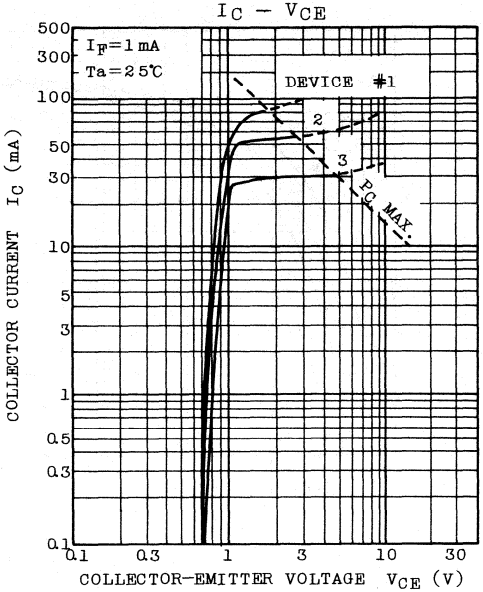
$V_{CE(sat)} - Ta$



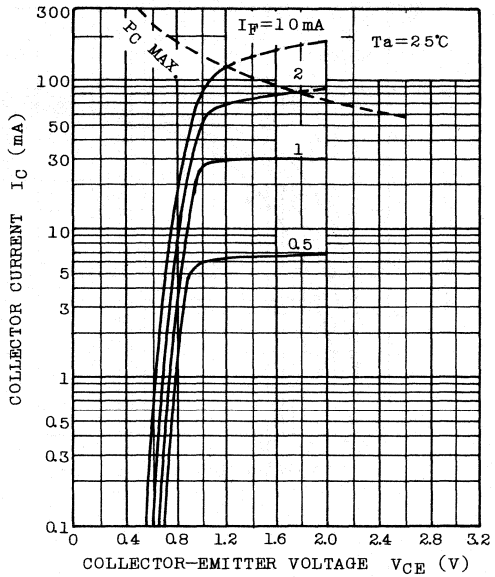
$I_C - Ta$



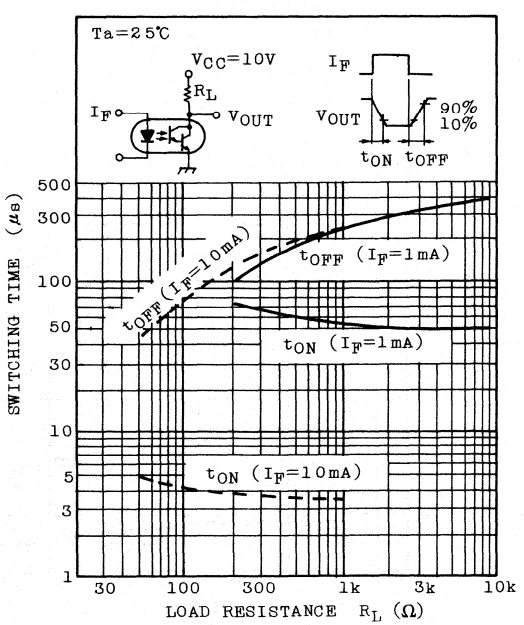
$I_C - V_{CE}$



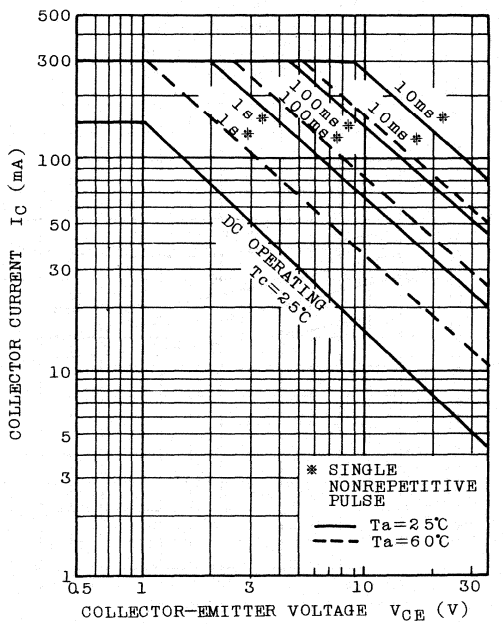
$I_C - V_{CE}$



SWITCHING TIME



SAFE OPERATING AREA



TLP525G, TLP525G-2, TLP525G-4

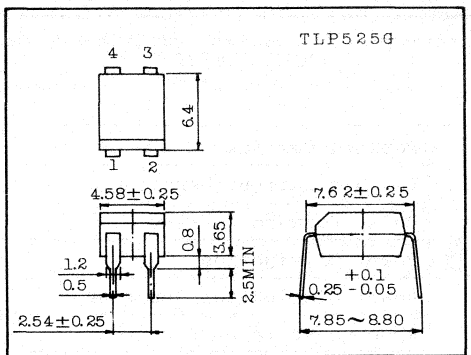
GaAs IRED & PHOTO-TRIAC

TRIAC DRIVE
PROGRAMMABLE CONTROLLERS
AC-OUTPUT MODULE
SOLID STATE RELAY

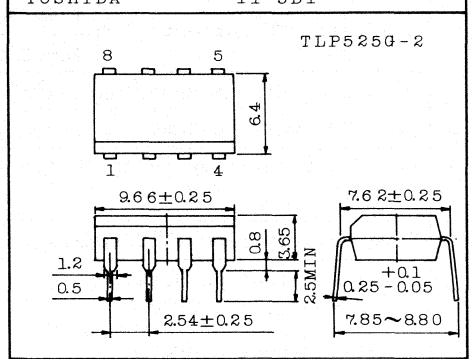
The TOSHIBA TLP525G, -2 and -4 consist of a photo-triac optically coupled to a gallium arsenide infrared emitting diode. The TLP525G-2 offers two isolated channels in an eight lead plastic DIP package, while the TLP525G-4 provides four isolated channels in a sixteen lead plastic DIP package.

- Peak Off-state Voltage : 400V Min.
- Trigger LED Current : 10mA Max.
- Peak On-state Current : 2Apk Max.
- Isolation Voltage : 2500Vrms Min.
- UL Recognized : File No.E67349

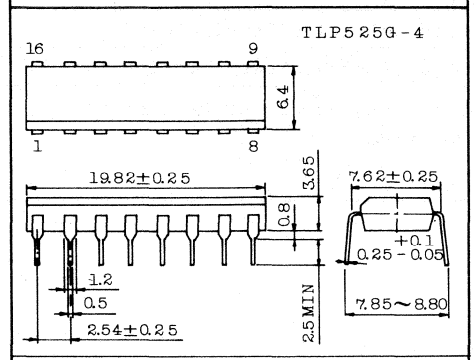
Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-5B1



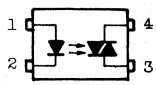
JEDEC	—
EIAJ	—
TOSHIBA	11-10C1



JEDEC	—
EIAJ	—
TOSHIBA	11-20A1

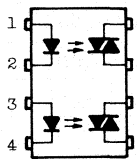
PIN CONFIGURATIONS (TOP VIEW)

TLP525G



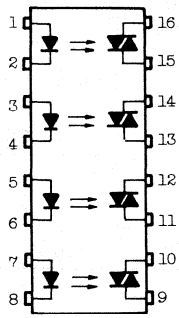
1 : ANODE
2 : CATHODE
3 : TERMINAL 1
4 : TERMINAL 2

TLP525G-2



1,3 : ANODE
2,4 : CATHODE
5,7 : TERMINAL 1
6,8 : TERMINAL 2

TLP525G-4



1,3,5,7 : ANODE
2,4,6,8 : CATHODE
9,11,13,15 : TERMINAL 1
10,12,14,16 : TERMINAL 2

ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING		UNIT
				TLP525G	TLP525G-2 TLP525G-4	
LED	Forward Current		I_F	50	50	mA
	Forward Current Derating		I_F/°C	-0.7(Ta≧53°C)	-0.5(Ta≧25°C)	mA/°C
	Pulse Forward Current		I_{FP}	1 (100μs pulse, 100pps)		A
	Power Dissipation		P_D	100	70	mW
	Power Dissipation Derating		P_D/°C	-1.0(Ta≧25°C)	-0.7(Ta≧25°C)	mW/°C
	Reverse Voltage		V_R	5		V
	Junction Temperature		Tj	125		°C
DETECTOR	Off-State Output Terminal Voltage		V_{DRM}	400		V
	On-State RMS Current	Ta=25°C	$I_{T(RMS)}$	100	80	mA
		Ta=70°C		50	40	
	On-State Current Derating(Ta≧25°C)		I_T/°C	-1.1	-0.9	mA/°C
	Peak On State Current		I_{TP}	2 (100μs pulse, 120pps)		A
	Peak Nonrepetitive Surge Current (P_W=10ms, DC=10%)		I_{TSM}	1.2		A
	Power Dissipation (1 Circuit)		P_D	150	100	mW
	Power Dissipation Derating (1 Circuit, Ta≧25°C)		P_D/°C	-1.5	1.0	mW/°C
	Junction Temperature		Tj	100		°C
Storage Temperature Range			T_{stg}	-55 ~ 150		°C
Operating Temperature Range			T_{opr}	-40 ~ 100		°C
Lead Soldering Temperature			T_{sold}	260 (10 sec.)		°C
Total Package Power Dissipation			P_T	250	150	mW
Total Package Power Dissipation Derating (Ta≧25°C)			P_T/°C	-2.5	-1.5	mW/°C
Isolation Voltage			BV_S	2500 (AC, 1 min., RH≦60%)		V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Peak Off-State Current	I_{DRM}	V_{DRM}=400V	-	10	100	nA
	Peak On-State Voltage	V_{TM}	I_{TM}=100mA	-	1.7	3.0	V
	Holding Current	I_H	-	-	0.2	-	mA
	Critical Rate of Rise of Off-State Voltage	dv/dt	V_{in}=120V_{rms}, Ta=85°C (Figure 1)	-	500	-	V/μs
	Critical Rate of Rise of Commutating Voltage	dv/dt(c)	V_{in}=30V_{rms}, I_T=15mA (Figure 1)	-	0.2	-	V/μs

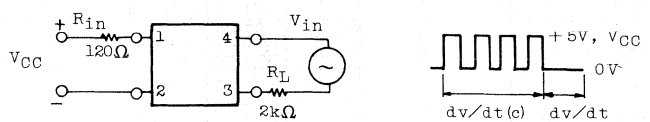
COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_T=3V	-	5	10	mA
Capacitance Input to Output	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	2500	-	-	V_{rms}
		AC, 1 second	-	5000	-	
		DC, 1 minute	-	5000	-	V_{dc}

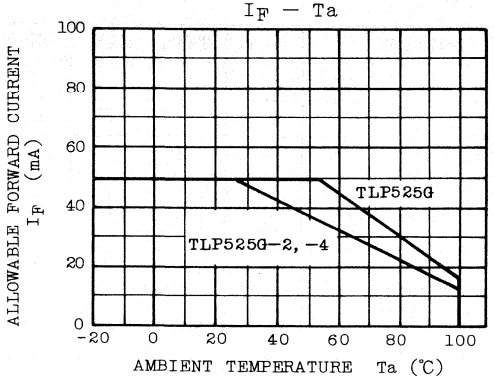
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	120	Vac
Forward Current	I_F	15	20	25	mA
Peak On-State Current	I_{TP}	-	-	1	A
Operating Temperature	Topr	-25	-	85	°C

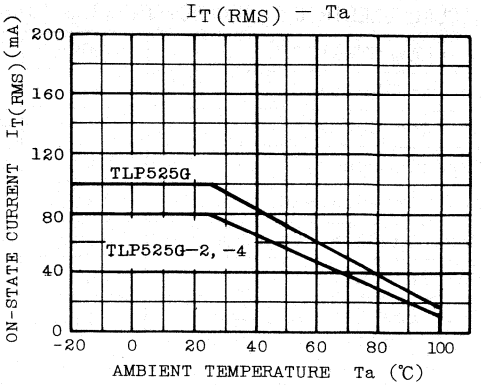
Figure 1 : dv/dt TEST CIRCUIT



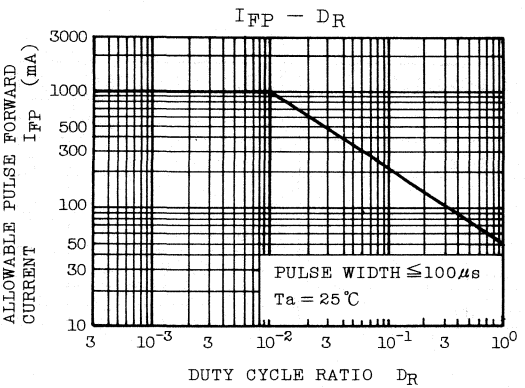
I_F — Ta



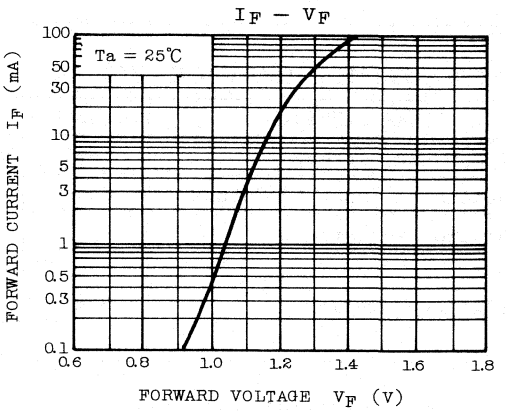
$I_{T(RMS)}$ — Ta



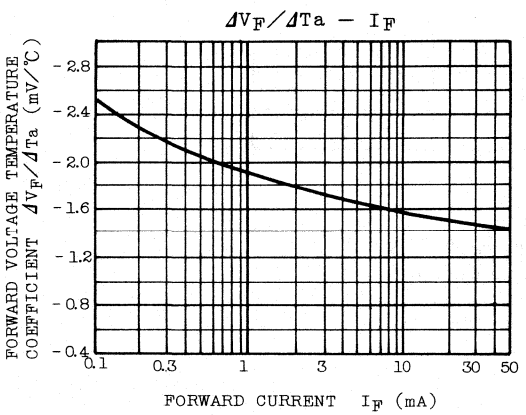
I_{FP} — D_R



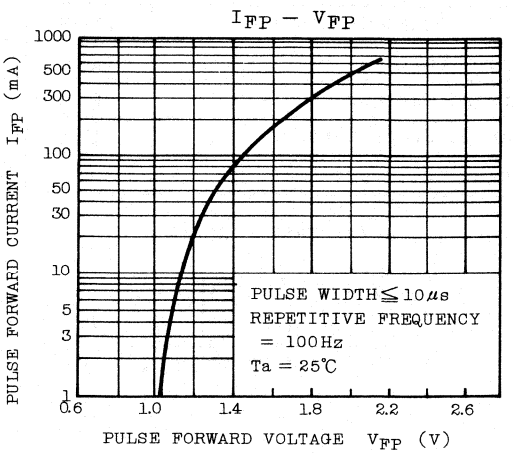
I_F — V_F



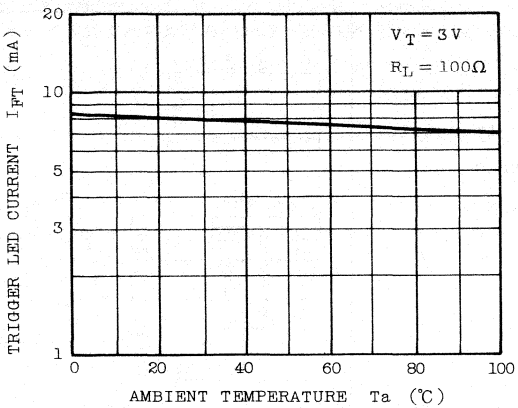
$\Delta V_F / \Delta Ta$ — I_F



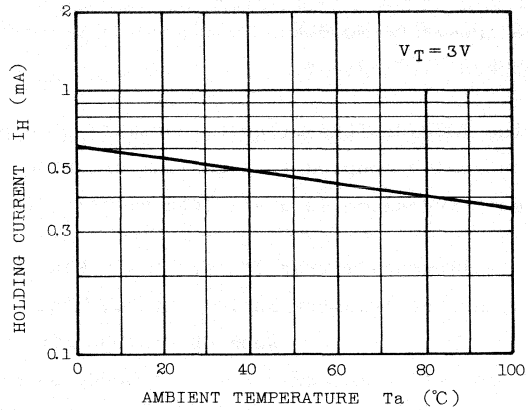
I_{FP} — V_{FP}



I_{FT} – Ta


TRIGGER LED CURRENT I_{FT} (mA)
20
10
5
3
1
0
20
40
60
80
100
AMBIENT TEMPERATURE Ta (°C)
$V_T = 3V$
$R_L = 100\Omega$

I_H – Ta


HOLDING CURRENT I_H (mA)
2
1
0.5
0.3
0.1
0
20
40
60
80
100
AMBIENT TEMPERATURE Ta (°C)
$V_T = 3V$

TLP535(Short)

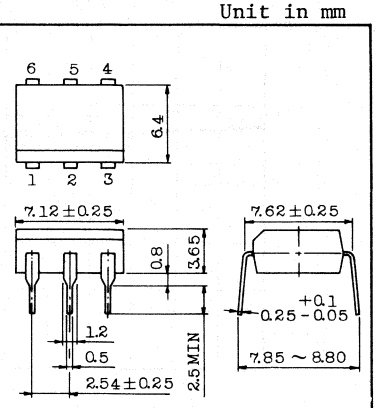
GaAs IRED & PHOTO-TRANSISTOR

PROGRAMMABLE CONTROLLERS.
AC/DC-INPUT MODULE.
SOLID STATE RELAY.

The TOSHIBA TLP535(Short) consists of a photo-transistor optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.

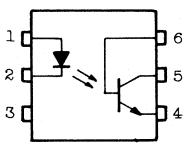
- Collector-Emitter Voltage : 55V Min.
- Current Transfer Ratio : 50% Min.
  Rank GB : 100% Min.
- Isolation Voltage : 5000V_{rms} Min.
- UL Recognezed : File No. E67349

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-7A1

PIN CONFIGURATIONS (TOP VIEW)



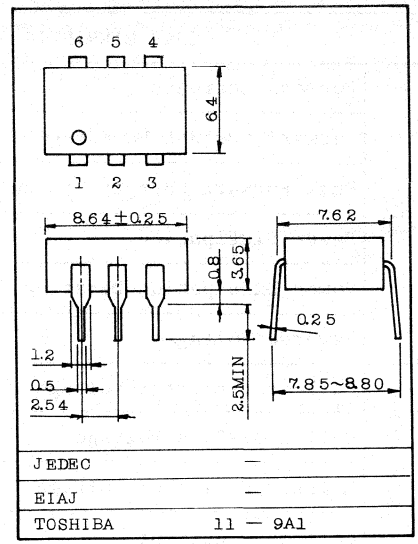
1: ANODE
2: CATHODE
3: NC
4: EMITTER
5: COLLECTOR
6: BASE

TLP535, TLP536

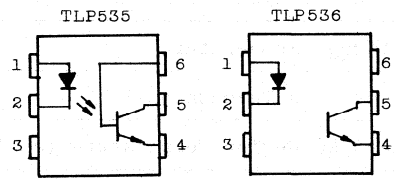
PROGRAMMABLE CONTROLLERS
AC/DC-INPUT MODULE
SOLID STATE RELAY

The TOSHIBA TLP535 and TLP536 consist of a photo-transistor optically coupled to a gallium arsenide infrated emitting diode in a six lead plastic DIP package.
TLP536 is no-base internal connection for high-EMI environments.

- Collector-Emitter Voltage: 55V Min.
- Current Transfer Ratio : 50% Min.
  Rank GB : 100% Min.
- Isolation Voltage : 2500Vrms Min.
- UL Recognized : File No. E67349



PIN CONFIGURATION (TOP VIEW)



TLP535	TLP536
1. ANODE	1. ANODE
2. CATHODE	2. CATHODE
3. NC	3. NC
4. EMITTER	4. EMITTER
5. COLLECTOR	5. COLLECTOR
6. BASE	6. NC

ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	60	mA
	Forward Current Derating	$\Delta I_F/°C$	0.8*	mA/°C
	Peak Forward Current (Note)	I_{PF}	3	A
	Power Dissipation	P_D	100	mW
	Power Dissipation Derating	$\Delta P_D/°C$	1.33*	mW/°C
	Reverse Voltage	V_R	3	V
PHOTO-TRANSISTOR	Collector-Emitter Voltage	BV_{CEO}	35	V
	Collector-Base Voltage	BV_{CBO}	70	V
	Emitter-Collector Voltage	BV_{ECO}	7	V
	Collector Current	I_C	100	mA
	Power Dissipation	P_C	150	mW
	Power Dissipation Derating	$\Delta P_C/°C$	2.0*	mW/°C
COUPLED	Storage Temperature	T_{stg}	-55 ~ 150	°C
	Operating Temperature	T_{opr}	-55 ~ 100	°C
	Lead Soldering Temperature (at 10 sec.)	T_{sold}	260	°C
	Total Package Dissipation	P_T	200	mW
	Total Package Power Dissipation Derating	$\Delta P_T/°C$	2.6*	mW/°C

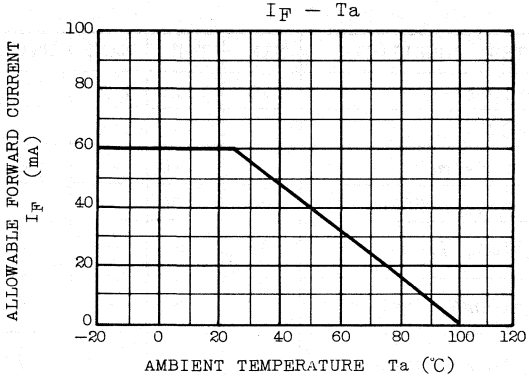
Note : Pulse width 1μs, 300 pps.

* Above 25°C ambient.

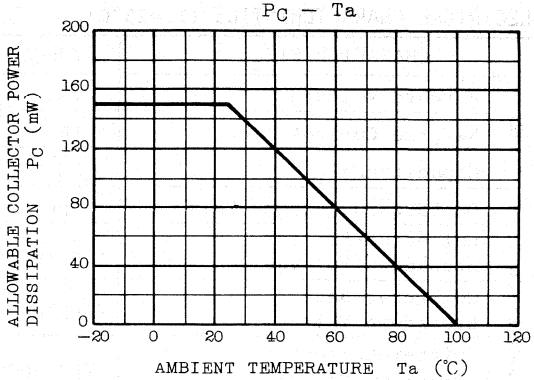
ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=3V	-	-	100	μA
	Capacitance	C_D	V=0, f=1MHz	-	30	-	pF
PHOTO-TRANSISTOR	DC Forward Current Gain	h_{FE}	V_{CE}=5, I_C=500μA	100	200	-	
	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=1mA, I_F=0	35	-	-	V
	Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	I_C=100μA, I_F=0	70	-	-	V
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=100μA, I_F=0	7	-	-	V
	Collector Dark Current	I_{CEO}	V_{CE}=10V, I_F=0	-	1	50	nA
	Collector Dark Current	I_{CBO}	V_{CB}=10V, I_F=0	-	0.1	20	nA
	Collector-Emitter Capacitance	C_{CE}	V=0, f=1MHz	-	10	-	pF
COUPLED	Current Transfer Ratio	I_C/I_F	I_F=10mA, V_{CE}=10V, Rank GR	50	-	600	%
				100	-	300	
			Rank BL	200	-	600	
			Rank GB	100	-	600	
	Saturation Voltage	$V_{CE(SAT)}$	I_F=10mA, I_C=2mA	-	0.1	0.3	V
	Capacitance Input to Output	C_S	V=0, f=1MHz	-	0.8	-	pF
	Isolation Resistance	R_S	V=500V	-	10^{11}	-	Ω
	AC Isolation Voltage	BV_S	AC 1 minute	2500	-	-	V_{RMS}
	Peak Isolation Voltage	BV_S	Peak	3550	-	-	V
	Rise Fall Time	t_r/t_f	V_{CE}=10V, I_C=2mA, R_L=100Ω	-	5	-	μs
	Rise/Fall Time Photo Diode	t_r/t_f	V_{CB}=10V, I_{CB}=50μA, R_L=100Ω	-	200	-	ns
	Turn-on Time	t_{on}	V_{CC}=5V, R_L=1.9kΩ	-	2	-	μs
	Storage Time	t_s	I_F=16mA	-	12	-	
	Turn-off Time	t_{off}	R_{BE}=220kΩ	-	20	-	

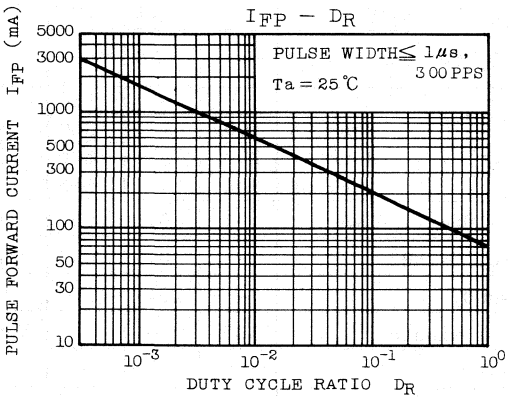
I_F – Ta



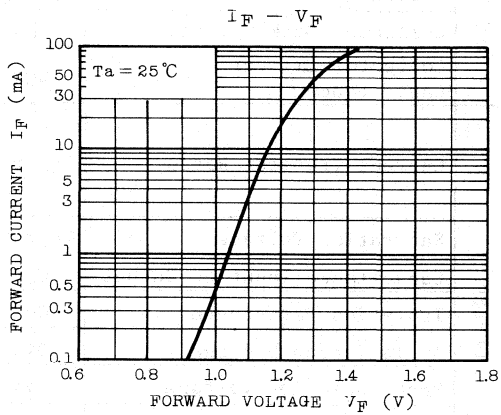
P_C – Ta



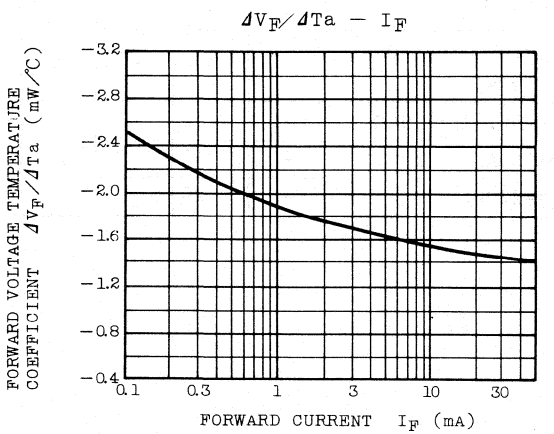
I_{FP} – D_R



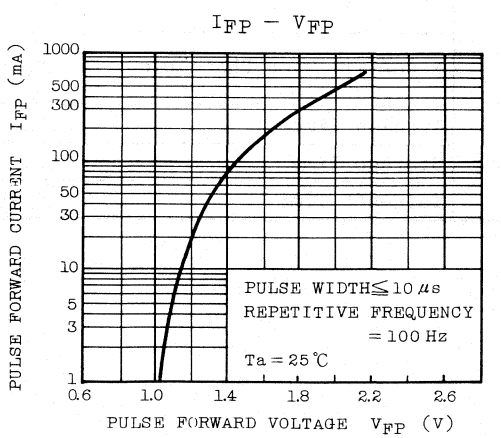
I_F – V_F



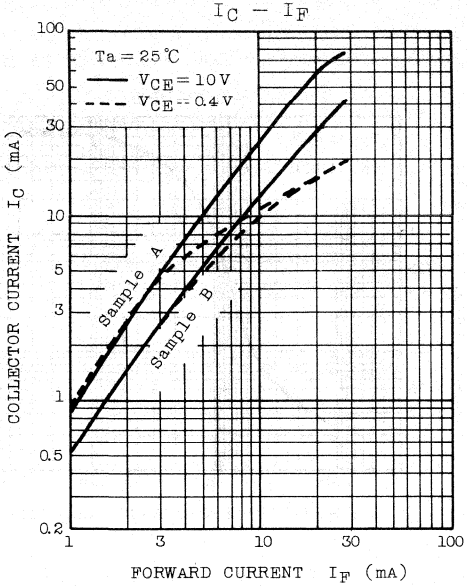
$\Delta V_F / \Delta Ta$ – I_F



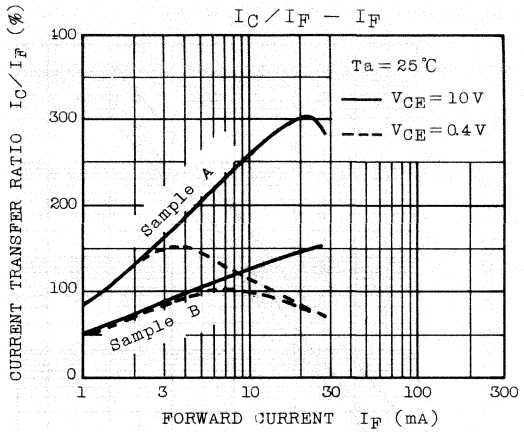
I_{FP} – V_{FP}



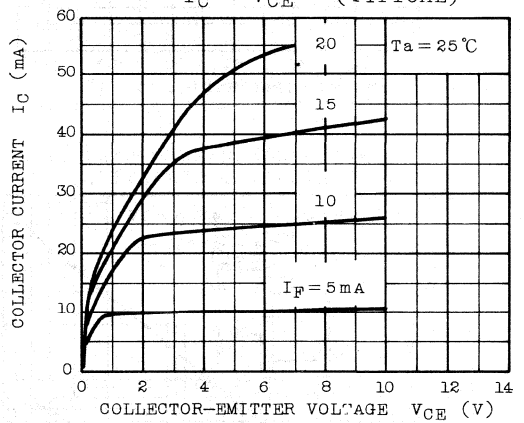
$I_C - I_F$



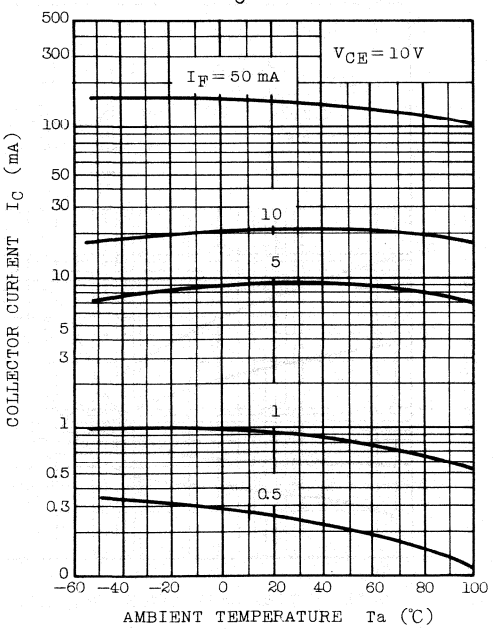
$I_C / I_F - I_F$



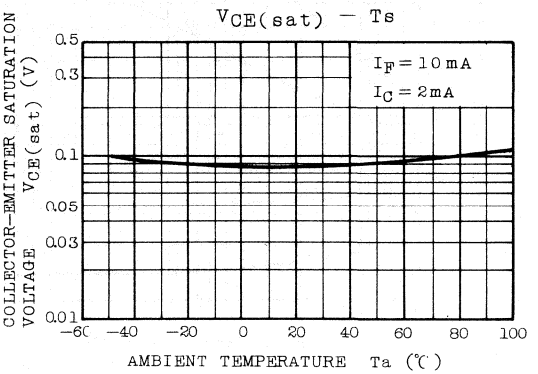
$I_C - V_{CE}$ (TYPICAL)



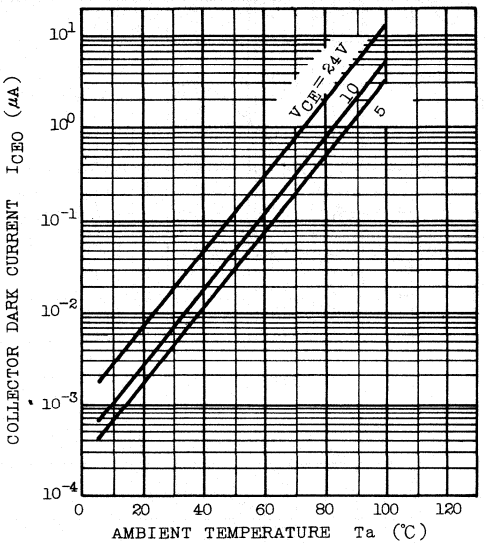
$I_C - Ta$



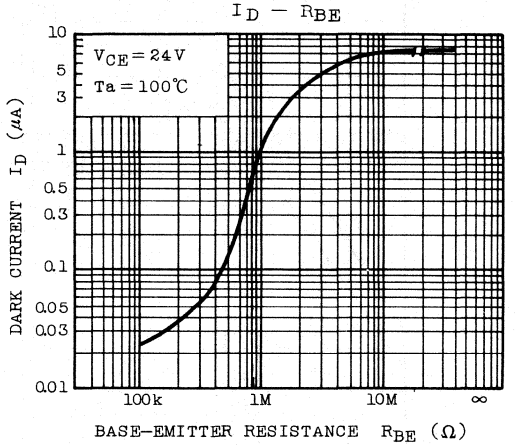
$V_{CE(sat)} - Ts$



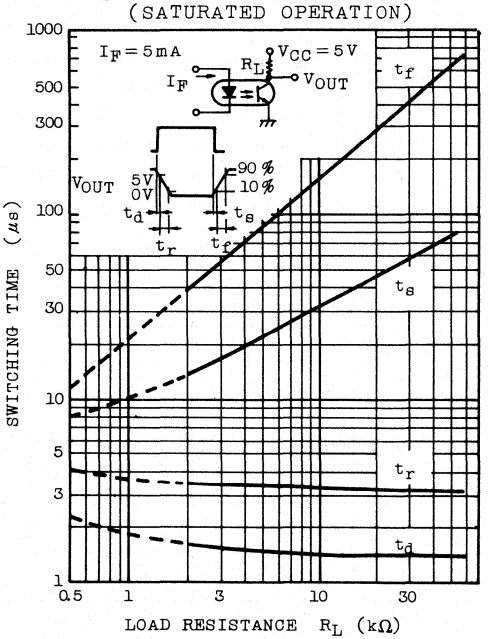
I_{CEO} — Ta



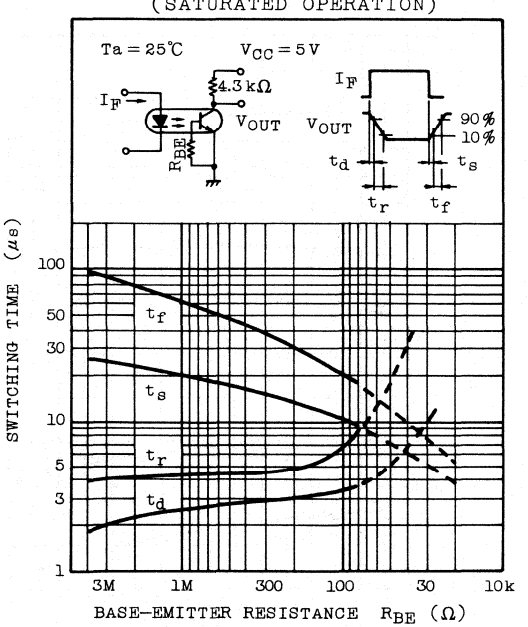
I_D — R_{BE}



SWITCHING CHARACTERISTICS
(SATURATED OPERATION)



R_{BE} — SWITCHING CHARACTERISTICS
(SATURATED OPERATION)



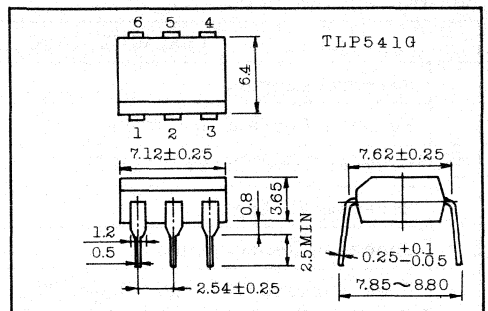
TLP541G, TLP542G

PROGRAMMABLE CONTROLLERS.
AC-OUTPUT MODULE.
SOLID STATE RELAY.

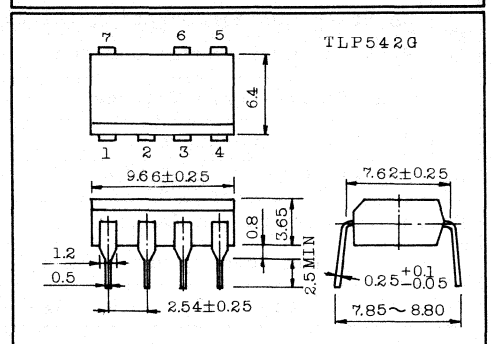
The TOSHIBA TLP541G consists of a photo-thyristor optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.
The TOSHIBA TLP542G consists of a photo-thyristor optically coupled to a gallium arsenide infrared emitting diode in a seven lead plastic DIP package.

- Peak Off-State Voltage: 400V Min.
- Trigger LED Current : 7mA Max.
- On-State Current : 150mA Max.
- Isolation Voltage : 2500Vrms Min.
- UL Recognized : File No. E67349

Unit in mm

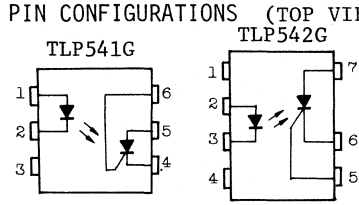


JEDEC	–
EIAJ	–
TOSHIBA	11-7A1



JEDEC	–
EIAJ	–
TOSHIBA	11-10C1

PIN CONFIGURATIONS (TOP VIEW)



TLP541G	TLP542G
1: ANODE	1: NC
2: CATHODE	2: ANODE
3: NC	3: CATHODE
4: CATHODE	4: NC
5: ANODE	5: GATE
6: GATE	6: CATHODE
	7: ANODE

MAXIMUM RATING (Ta=25°C)

	CHARACTERISTIC	SQMBOL	RATING	UNIT
LED	Forward Current	I_F	70	mA
	Forward Current Derating (Ta≧25°C)	ΔI_F/°C	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)	I_{FP}	1	A
	Reverse Voltage	V_R	5	V
	Junction Temperature	T_j	125	°C
DETECTOR	Peak Forward Voltage (R_{GK}=27KΩ)	V_{DRM}	400	V
	Peak Reverse Voltage (R_{GK}=27KΩ)	V_{RRM}	400	V
	On-State Current	$I_{T(RMS)}$	150	mA
	On-State Current Derating (Ta≧25°C)	ΔI_T/°C	-2.0	mA/°C
	Peak One Cycle Surge Current	I_{TSM}	2	A
	Peak Reverse Gate Voltage	V_{GM}	-5	V
	Junction Temperature	T_j	100	°C
Storage Temperature Range		T_{stg}	-55∿125	°C
Operating Temperature Range		T_{opr}	-30∿100	°C
Lead Soldering Temperature (10sec.)		T_{sold}	260	°C
Isolation Voltage (AC, 1 min, RH≦60%)		BV_S	2500	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA		1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V		-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz		-	30	-	pF
DETECTOR	Off-State Current	I_{DRM}	V_{AK}=400V, R_{GK}=27kΩ	Ta=25°C	-	10	5000	nA
				Ta=100°C	-	1	100	μA
	Reverse Current	I_{RRM}	V_{KA}=400V, R_{GK}=27kΩ	Ta=25°C	-	10	5000	nA
				Ta=100°C	-	1	100	μA
	On-State Voltage	V_{TM}	I_{TM}=100mA		-	0.9	1.3	V
	Holding Current	I_H	R_{GK}=27kΩ		-	0.2	1	mA
	Off-State dv/dt	dv/dt	V_{AK}=280V, R_{GK}=27kΩ		5	10	-	V/μs
	Capacitance	C_j	V=0, f=1MHz Anode to Gate Gate to Cathode		- -	20 350	- -	pF

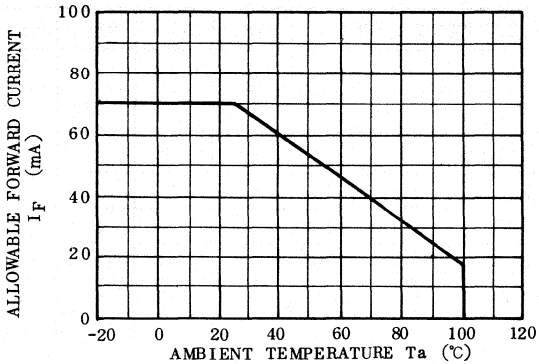
COUPLED CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_{AK}=6V, R_{GK}=27k	1	4	7	mA
Turn-on Time	t_{on}	I_F=50mA R_{GK}=27kΩ	-	10	-	μs
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V, R.H.≤60%	-	10^{11}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	2500	-	-	V_{rms}

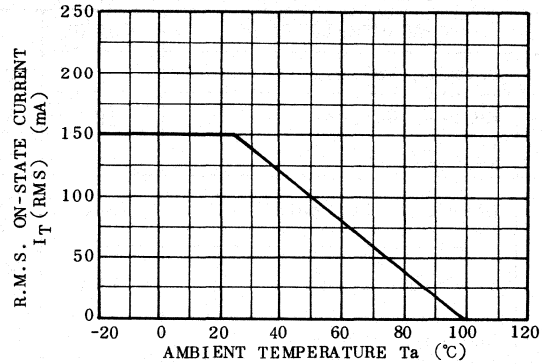
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	120	V_{ac}
Forward Current	I_F	10	16	25	mA
Operating Temperature	T_{opr}	-30	-	85	°C
Gate to Cathode Resistance	R_{GK}	-	27	33	kΩ
Gate to Cathode Capacity	C_{GK}	-	0.01	0.1	μF

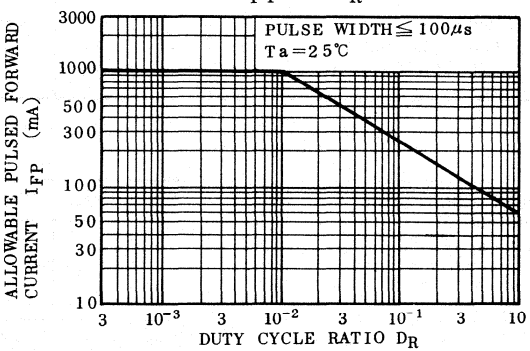
I_F — Ta



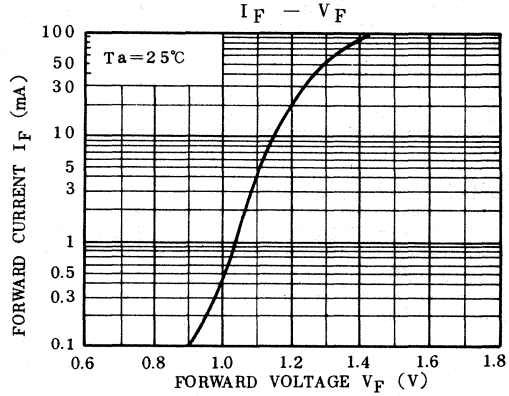
I_T(RMS) — Ta



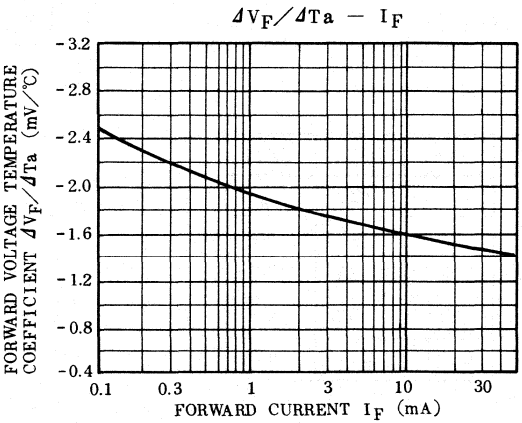
I_{FP} — D_R



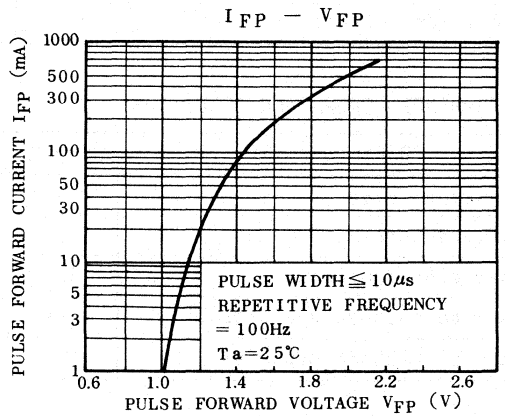
I_F — V_F



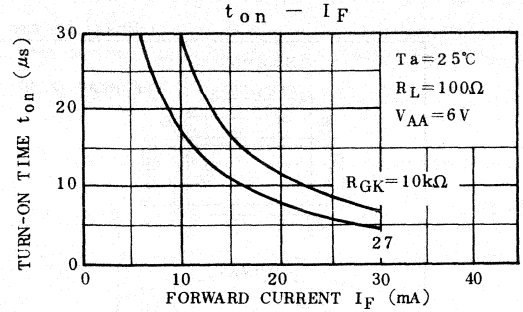
$\Delta V_F / \Delta Ta$ — I_F



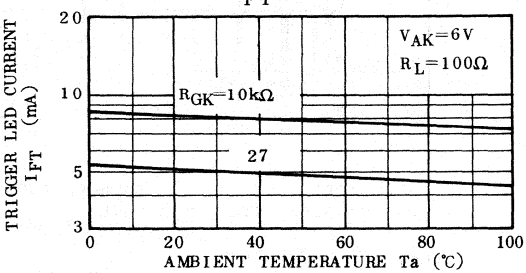
I_{FP} — V_{FP}



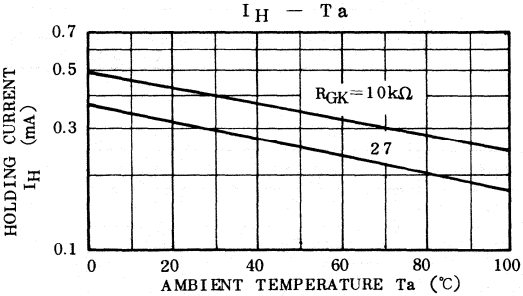
t_{on} — I_F



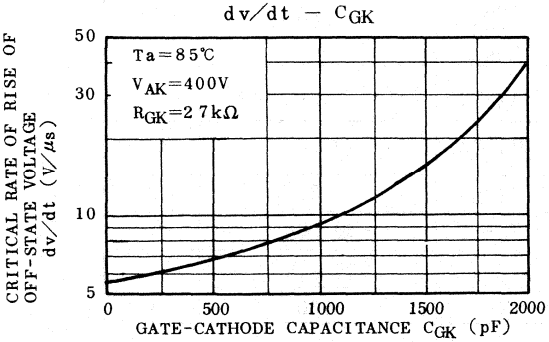
I_{FT} — Ta



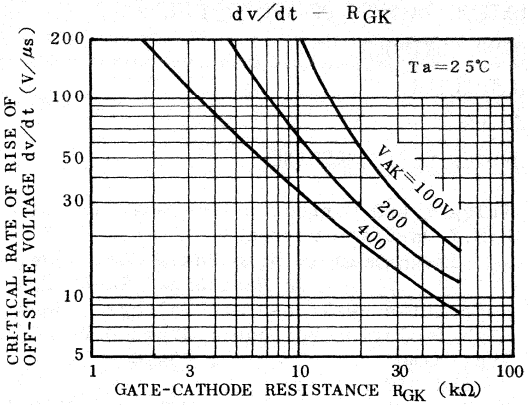
I_H — Ta



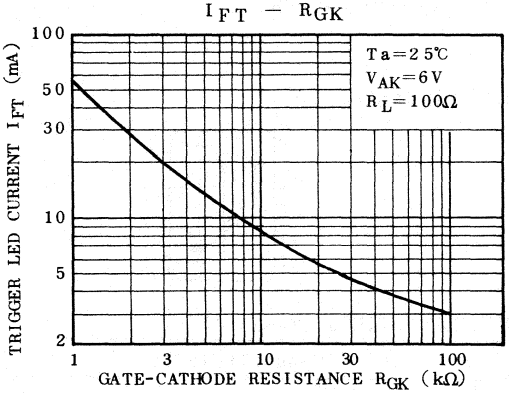
dv/dt — C_{GK}



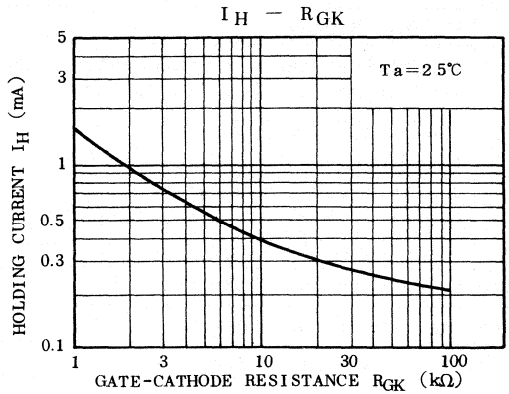
dv/dt — R_{GK}



I_{FT} — R_{GK}



I_H — R_{GK}



TLP546G

GaAs IRED & PHOTO-THYRISTOR × 2

CONTROL 1A(RMS) OF 120V_{AC} LINE.

MOTOR CONTROLS.

CONTROLLER.

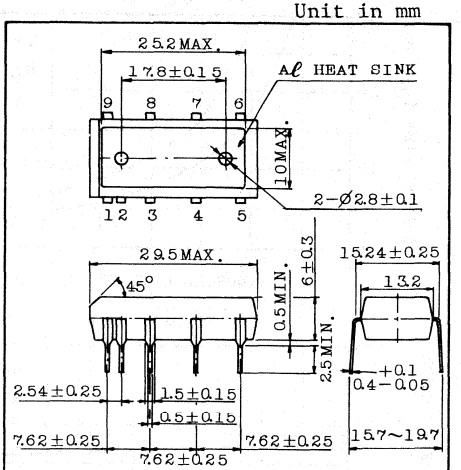
COPIER.

HOME ELECTRIC MACHINE.

- Trigger LED Current : I_{FT}=10mA(Max.) (R_{GK}=15kΩ)
- R.M.S On-State Current
  : $I_{T(RMS)}$=1A (Single Phase Full Wave, No Heat Sink, Ta=40°C)
- Repetitive Peak On-State Voltage : V_{DRM}=400V
- High Isolation Voltage : BV_S=2500V AC/1 min.
- Type Name : P546G
- 9-Lead DIP Package
- UL Recognized : File No. E67349

(Note) Type designation P546G is identical to TLP546G.

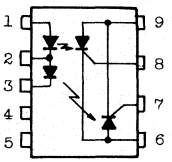
Unit in mm



1.	ANODE	6.	CATHODE, ANODE
2.	CATHODE, ANODE	7,8.	GATE
3.	CATHODE	9.	ANODE, CATHODE
4,5.	NO CONNECTION		

JEDEC	—
EIAJ	—
TOSHIBA	11-30A1A

PIN CONFIGURATIONS



MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Forward Current Derating (Ta ≧ 25°C)	$\Delta I_F/°C$	-0.55	mA/°C
	Reverse Voltage	V_R	5	V
DETECTOR	Repetitive Peak Off-State Voltage and Repetitive Peak Reverse Voltage	V_{DRM} and V_{RRM}	400	V
	R.M.S On-State Current (Single Phase Full Wave Ta=40°C)	$I_{T(RMS)}$	1 (No Heat Sink)	A
	On-State Current Derating (Single Phase Full Wave Ta=40°C)	$\Delta I_T/°C$	-0.04	A/°C
	Peak One Cycle Surge On-State Current	I_{TSM}	20	A
Operating Temperature Range		T_{opr}	-30 ~ 80	°C
Storage Temperature Range		T_{stg}	-55 ~ 125	°C
Isolation Voltage (Note)		BV_S	2500	V

Note : AC/1 min. R.H.=40 ~ 60%

ELECTRICAL CHARACTERISTICS (Ta=25°C)

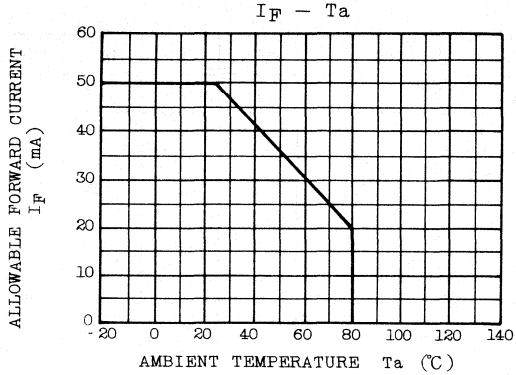
	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=30mA (1 LED)	1.10	1.24	1.40	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
DETECTOR	Repetitive Peak Off-State Voltage and Repetitive Peak Reverse Voltage	I_{DRM} and I_{RRM}	V_{DRM}=Rated, Ta=80°C R_{GK}=15kΩ	-	-	100	μA
	Peak On-State Voltage	V_{TM}	I_{TM}=2A, I_F=15mA	-	-	1.6	V
	Holding Current	I_H	R_L=100Ω, R_{GK}=15kΩ	-	0.5	-	mA
	Critical Rate of Rise of Off-State Voltage	dv/dt	V_{DRM}=2/3 Rated P_{GK}=15kΩ	5	-	-	V/μs
SOUPLED	Trigger LED Current	I_{FT}	V_D=6V, R_L=100Ω R_{GK}=15kΩ	-	6	10	mA
	Isolation Resistance	R_S	R.H.=40 ~ 60%, V=1kV	-	10^{11}	-	Ω

PRECAUTION

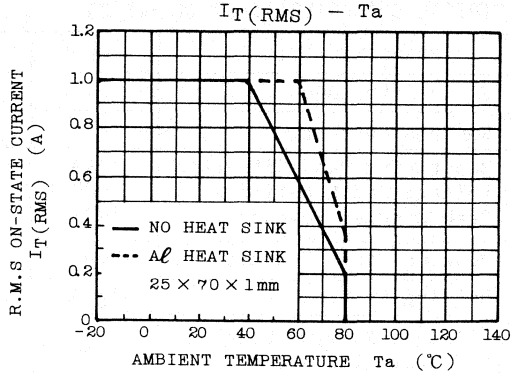
Please be careful of the followings.

1. Soldering temperature: 260°C MAX.
   Soldering time: 10 sec MAX.
   (Soldering portion of lead: up to 2mm from the body of the device)
2. Avoide using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E

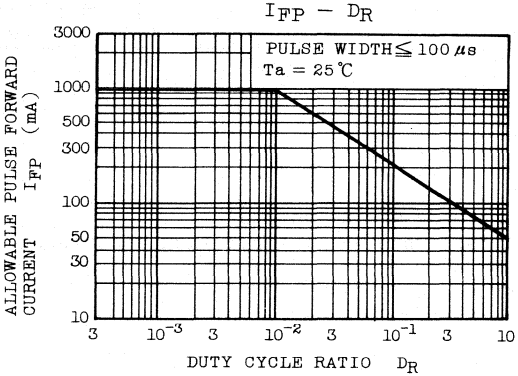
I_F – Ta



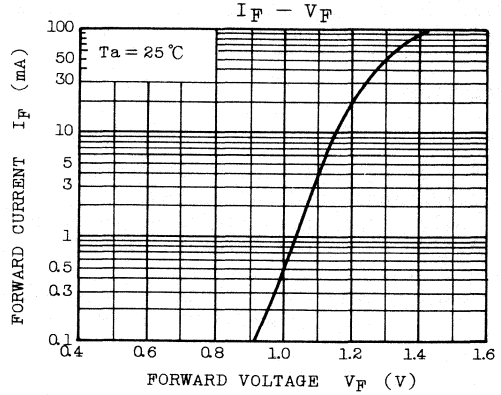
$I_{T(RMS)}$ – Ta



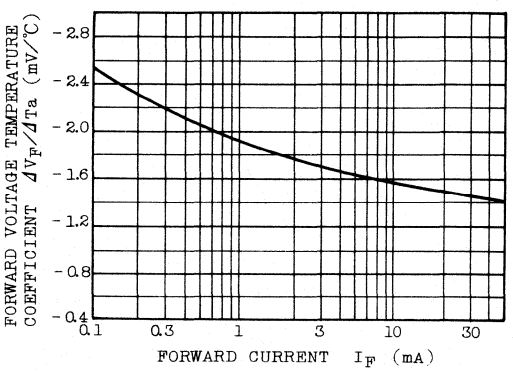
I_{FP} – D_R



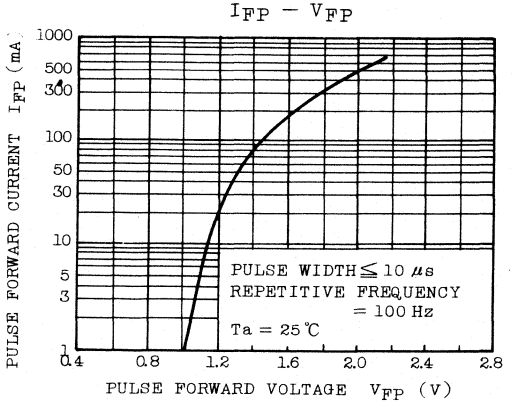
I_F – V_F



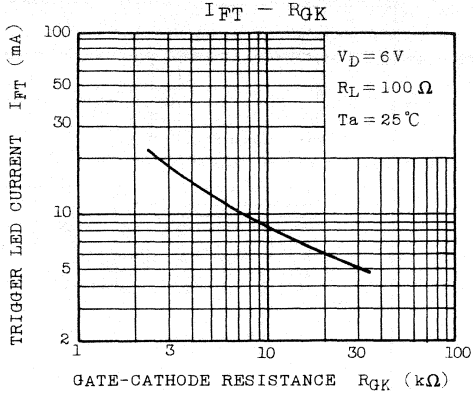
$\Delta V_F/\Delta Ta$ – I_F



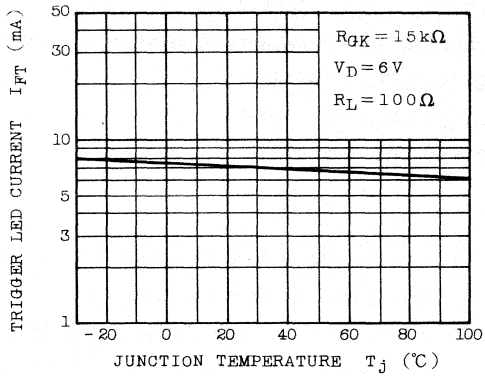
I_{FP} – V_{FP}



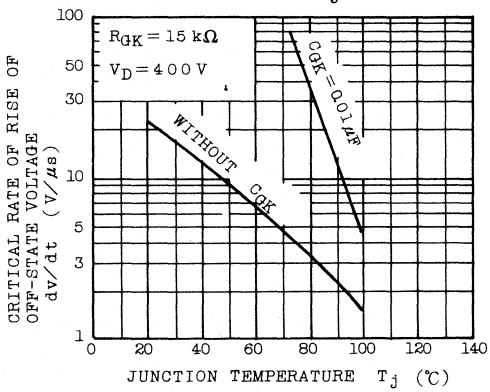
I_{FT} – R_{GK}



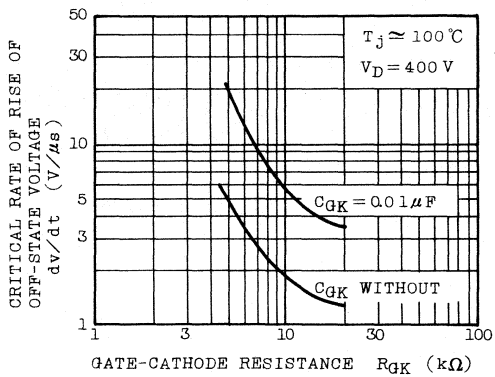
I_{FT} – T_j



dv/dt – T_j



dv/dt – R_{GK}



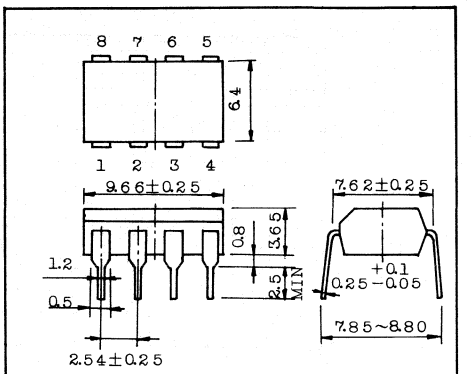
TLP550

INFRED LED + PHOTO IC

DEGITAL LOGIC ISOLATION.
LINE RECEIVER FEEDBACK CONTROL.
POWER SUPPLY CONTROL.
SWITCHING POWER SUPPLY.
TRANSISTOR INVERTOR.

TLP550 constructs a high emitting diode and a one chip photo diode-transistor.
TLP550 has no base connection, and is suitable for application at noisy environmental condition.
This unit is 8-lead DIP package.

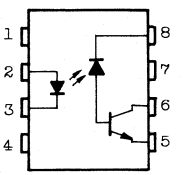
. Isolation Voltage : 2500Vrms Min.
. Switching Speed : t_{pHL}, t_{pLH}=0.5μs(Typ.)
(R_L=1.9kΩ)
. TTL Compatible
. UL Recognized : File No. E67349



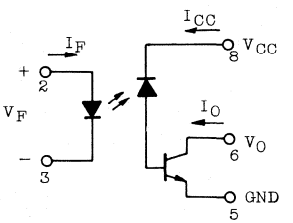
1. N.C
2. ANODE
3. CATHODE
4. N.C
5. EMITTER
6. COLLECTOR
7. N.C
8. CATHODE

JEDEC	—
EIAJ	—
TOSHIBA	11−10C1E

PIN CONFIGURATIONS (TOP VIEW)



SCHEMATIC



MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current	(Note 1)	I_F	25	mA
	Pulse Forward Current	(Note 2)	I_{FP}	50	
	Peak Transient Forward Current	(Note 3)	I_{FPT}	1	A
	Reverse Voltage		V_R	5	V
	Diode Power Dissipation	(Note 4)	P_D	45	mW
DETECTOR	Output Current		I_O	8	mA
	Peak Output Current		I_{OP}	16	
	Supply Voltage		V_{CC}	-0.5 ∿ 15	V
	Output Voltage		V_O	-0.5 ∿ 15	
	Output Power Dissipation	(Note 5)	P_o	100	mW
Operating Temperature Range			T_{opr}	-55 ∿ 100	°C
Storage Temperature Range			T_{stg}	-55 ∿ 125	°C
Lead Solder Temperature (10 sec.)			T_{sold}	260	°C
Isolation Voltage (AC, 1 min., R.H=40 ∿ 60%, Note 6)			BV_S	2500	V_{rms}

Note 1 : Derate 0.8mA above 70°C.

Note 2 : 50% duty cycle, 1ms pulse width.
Derate 1.6mA/°C above 70°C.

Note 3 : Pulse width 1μs, 300pps.

Note 4 : Derate 0.9mW/°C above 70°C.

Note 5 : Derate 2mW/°C above 70°C.

ELECTRICAL CHARACTERISTICS (Ta=25°C)

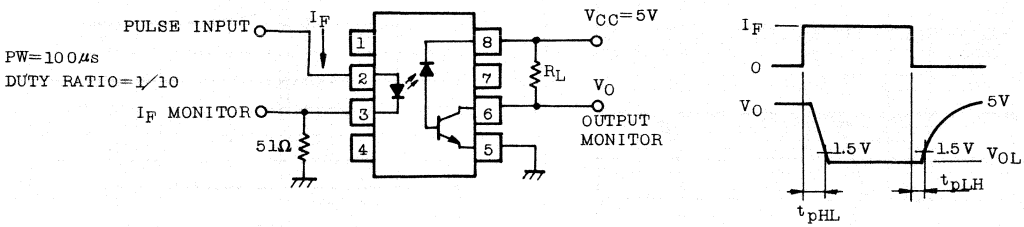
	CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=16mA		1.45	1.65	1.85	V
	Forward Voltage Temperature Coefficient	$\Delta V_F/\Delta Ta$	I_F=16mA		-	-2	-	mV/°C
	Reverse Current	I_R	V_R=5V		-	-	10	μA
	Capacitance Between Terminals	C_T	V_F=0, f=1MHz		-	60	-	pF
DETECTOR	High Level Output Current	$I_{OH(1)}$	I_F=0mA, V_{CC}=V_O=5.5V		-	3	500	nA
		$I_{OH(2)}$	I_F=0mA, V_{CC}=V_O=15V		-	-	5	μA
		I_{OH}	I_F=0mA, V_{CC}=V_O=15V, Ta=70°C		-	-	50	μA
	High Level Supply Voltage	I_{CCH}	I_F=0mA, V_{CC}=15V		-	0.01	1	μA
COUPLED	Current Transfer Ratio	I_O/I_F	I_F=16mA, V_{CC}=4.5V, V_O=0.4V	Ta=25°C	10	30	-	%
				Ta=25°C, rank:0	19	30	-	
				Ta=0 ~ 70°C	5	-	-	
				Ta=0 ~ 70°C, rank:0	15	-	-	
	Low Level Output Voltage	V_{OL}	I_F=16mA, V_{CC}=4.5V, I_O=1.1mA (rank 0: I_O=2.4mA)		-	-	0.4	V
	Isolation Resistance	R_S	R.H.=40 ~ 60%, V=1kV DC (Note 6)		-	10^{12}	-	Ω
	Stray Capacitance Between Input to Output	C_S	V=0, f=1MHz		-	0.8	-	pF

SWITCHING CHARACTERISTICS (Ta=25°C)

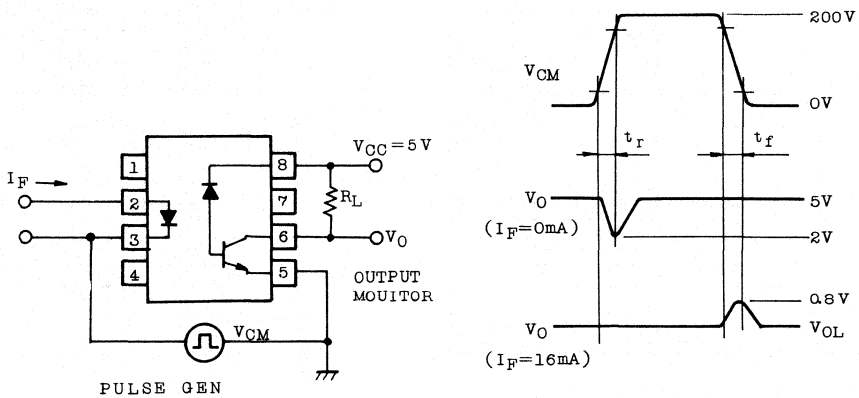
	CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
	Propagation Delay Time (H → L)	t_{pHL}	I_F=0 → 16mA, V_{CC}=5V, R_L=4.1kΩ		-	0.3	0.8	μs
			(Note 7)	rank 0: R_L=1.9kΩ	-	0.5	0.8	
	Propagation Delay Time (L → H)	t_{pLH}	I_F=16 → 0mA, V_{CC}=5V, R_L=4.1kΩ		-	1.0	2.0	
			(Note 7)	rank 0: R_L=1.9kΩ	-	0.6	1.2	
	Common Mode Transient Imunity at High Output Level	C_{MH}	I_F=0mA, V_{CM}=200Vp-p, R_L=4.1kΩ (rank 0: R_L=1.9kΩ) (Note 8)		-	1500	-	V/μs
	Common Mode Transient Imunity at Low Output Level	C_{ML}	I_F=16mA, V_{CM}=200Vp-p, R_L=4.1kΩ (rank 0: R_L=1.9kΩ) (Note 8)		-	-1500	-	

Note 6. Device considered a two-terminal device : Pins 1, 2, 3 and 4 shorted together and Pin 5, 6, 7 and 8 shorted together.

Note 7. Switching time test circuit.



Note 8. Common mode transient immunity test circuit.



Z_O=50Ω

$$CM_H=\frac{160(V)}{t_r(\mu s)},\quad CM_L=\frac{160(V)}{t_f(\mu s)}$$

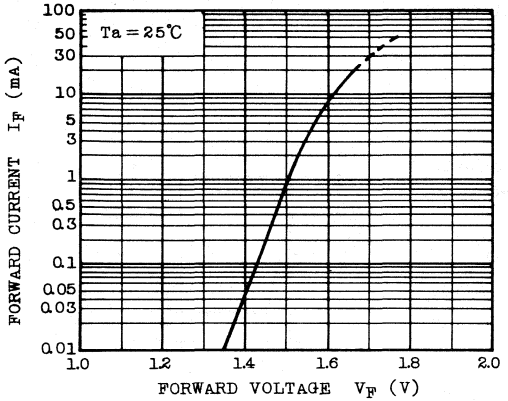
Note 9. Maximum electrostatic discharge voltage for any pins: 100V(C=200pF, R=0)

PRECAUTION

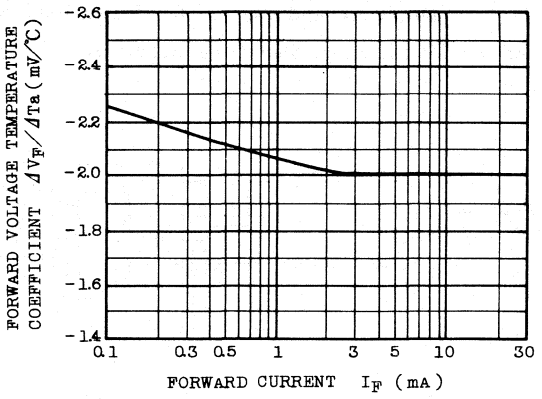
Please be careful of the followings.

1. Soldering temperature: 260°C MAX. Soldering time: 10 sec MAX.
   (Soldering portion of lead: up to 2mm from the body of the device)
2. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   ∘ Freon TE or TF ∘ Dai-Fron Solvents S3 or S3-E

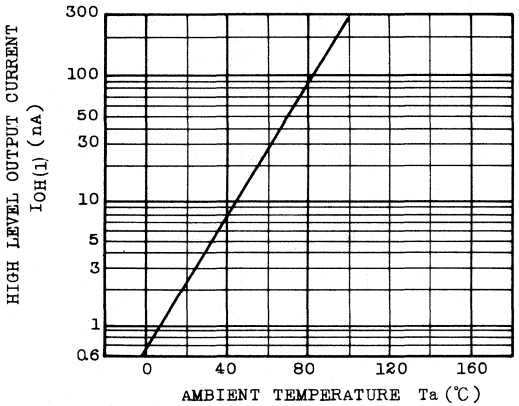
$I_F - V_F$



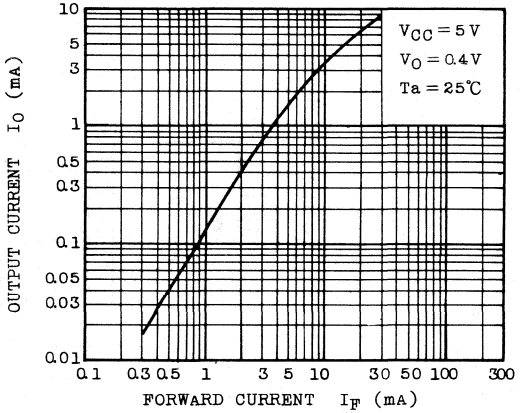
$\Delta V_F / \Delta Ta - I_F$



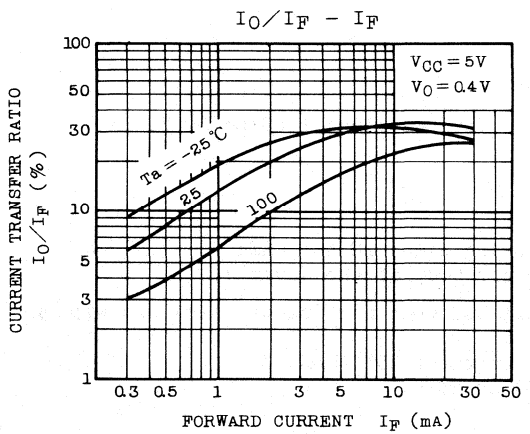
$I_{OH(1)} - Ta$



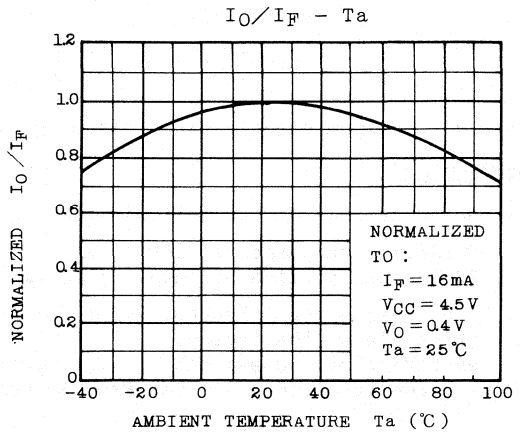
$I_O - I_F$



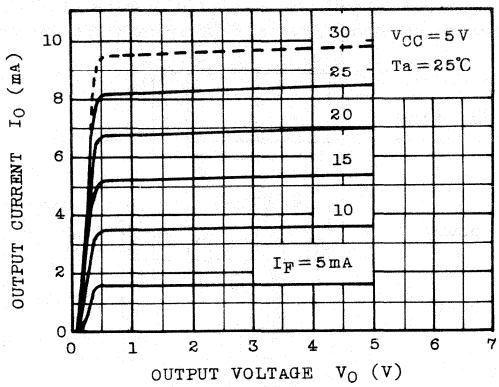
$I_O / I_F - I_F$



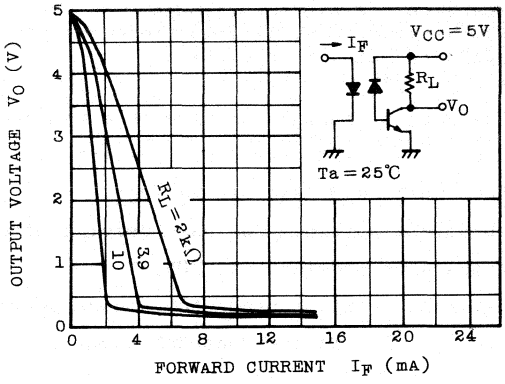
$I_O / I_F - Ta$



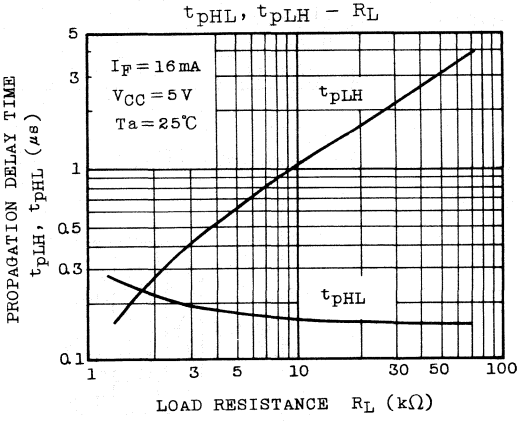
$I_O - V_O$



$V_O - I_F$



$t_{pHL}, t_{pLH} - R_L$



TLP557

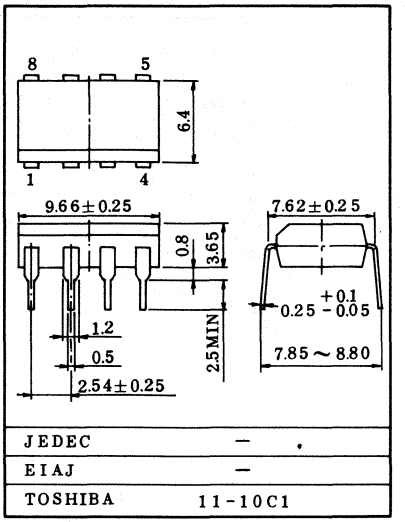
GaAℓAs IRED & PHOTO-IC

TRANSISTOR INVERTOR
INVERTER FOR AIR CONDITIONOR
POWER TRANSISTOR BASE DRIVE

The Toshiba TLP557 consists of a GaAℓAs light emitting diode and a integrated photodetector.
This unit is 8-lead DIP package.
TLP557 is suitable for base driving circuit of power transistor module up to 20A.
External resistor needs to connect between pin 6 and pin 7. This is for constant current driving.

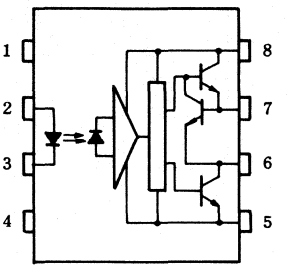
- Input Threshold Current : I_F=5mA (Max.)
- Guaranteed Performance Temperature Range: -30~70°C
- Supply Voltage : 16V (Max.)
- Output Current : ±0.3A (Max.)
- Switching Time (t_{pLH}/t_{pHL}) : 5μs (Max.)
- Isolation Voltage : 2500V_{rms} (Min.)
- UL Recognized : File No. E67349

Unit in mm



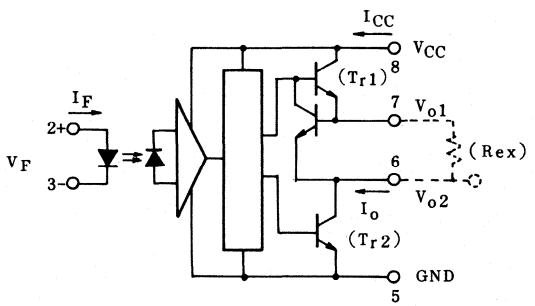
JEDEC	—
EIAJ	—
TOSHIBA	11-10C1

PIN CONFIGURATION (TOP VIEW)



1 : NC
2 : ANODE
3 : CATHODE
4 : NC
5 : GND
6 : V_{o2} (OUTPUT)
7 : V_{o1} (Rex TERMINAL)
8 : V_{CC}

SCHEMATIC



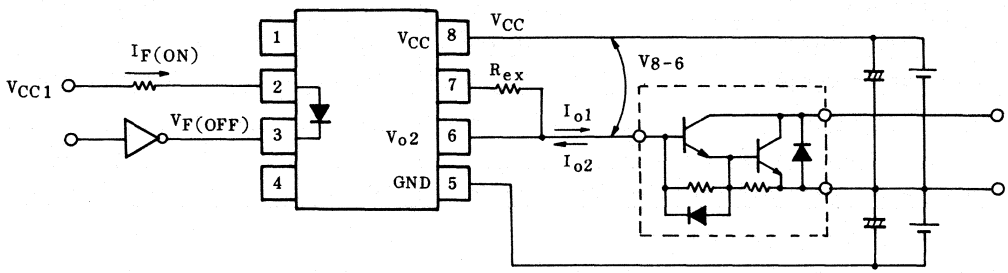
TRUTH TABLE

		Tr1	Tr2
Input LED	ON	ON	OFF
	OFF	OFF	ON

RECOMMENDED OPERATING CONDITION

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Input Current ON	$I_{F(ON)}$	7	8	20	mA
Input Voltage OFF	$V_{F(OFF)}$	0	-	0.8	V
Supply Voltage	V_{CC}	5	6	13	V
I_{B1} Drive Current	I_{O1}	-	0.15	0.25	A
I_{B2} Drive Current	I_{O2}	-	-	0.5	A
External Resistance	Rex	2.7	4.3	-	Ω
V_{CC}-V_{O2}(Pin 8 - Pin 6) ON Voltage	V_{8-6}	2.3	3 (I_{O1}=0.15A)	2.5 (I_{O1}=0.25A)	V
Operating Temperature	Topr	-30	25	70	°C

(Rex is for constant current driving)



ABSOLUTE MAXIMUM RATINGS

	CHARACTERISTICS	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	25	mA
	Peak Transient Forward Current (Note 1)	I_{FPT}	1	A
	Reverse Voltage	V_R	5	V
	Junction Temperature	(Tj)	125	°C
DETECTOR	Output Current (f < 5kHz, Duty < 50%)	I_O	+0.32/-0.32	A
	Peak Output Current (P_W < 10μs, f < 5kHz)	I_{OP}	+2/-0.5	A
	Output Voltage	V_O	16	V
	Supply Voltage	V_{CC}	16	V
	O_1 Terminal to O_2 Terminal (Pin 7-Pin 6) Voltage	V_{1-2}	1.5	V
	O_2 Terminal to O_1 Terminal (Pin 6-Pin 7) Voltage	V_{2-1}	5	V
	Power Dissipation (Note 2)	P_O	0.5	W
	Junction Temperature	(Tj)	125	°C
Total Package Power Dissipation (Note 3)		P_{OT}	0.55	W
Operating Temperature Range		Topr	-30~70	°C
Storage Temperature Range		Tstg	-55~125	°C
Lead Solder Temperature (10 sec.)		Tsol	260	°C
Isolation Voltage(AC,1min.,R.H ≤ 60%,Ta=25°C) (Note 4)		BVs	2500	Vrms

Note 1 : Pulse width $P_W \leq 1\mu s$, 300pps

Note 2 : $\triangle P_O/°C = -6.7mW/°C$ (Ta > 50°C)

Note 3 : $\triangle P_{OT}/°C = -7.4mW/°C$ (Ta > 50°C)

Note 4 : Device considerd a two terminal device : pins 1,2,3 and 4 shorted together, and pins 5,6,7 and 8 shorted together.

ELECTRICAL CHARACTERISTICS (Ta=-30~70°C, Unless otherwise specified)

CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.*	MAX.	UNIT	TEST CIR-CUIT
Input Forward Voltage	V_F	I_F=5mA, Ta=25°C		-	1.55	1.7	V	
Temperature Coefficient of Forward Voltage	$\Delta V_F/\Delta Ta$	I_F=5mA		-	-2.0	-	mV/°C	
Input Reverse Current	I_R	V_R=5V, Ta=25°C		-	-	10	μA	
Input Capacitance	CT	V=0, f=1MHz, Ta=25°C		-	-	250	pF	
O_1 Output Leakage Current	I_{O1L}	V_{CC}=16V, V_{O1}=0, V_F=0.8V		-	0.01	200	μA	1
O_2 Output Leakage Current	I_{O2L}	V_{CC}=16V, V_{O2}=16V, I_F=5mA		-	0.2	200	μA	2
O_1 Output Current	I_O	V_{8-6}=2.3V, Rex=2.7Ω, I_F=5mA, Ta=25°C	V_{CC}=6V	0.22	0.27	0.32	A	3
			V_{CC}=16V	0.22	0.27	0.32		
O_2 High Level Output Voltage	V_{OH}	V_{CC}=6V, Rex=2.7Ω, I_F=5mA		3.5	5.5	-	V	4
O_2 Low Level Output Voltage	V_{OL}	V_F=0.8V, Rex=2.7Ω, I_O=0.25A, Ta=25°C	V_{CC}=6V	-	0.2	0.4	V	5
			V_{CC}=16V	-	0.2	0.4		
		V_F=0.8V, Rex=2.7Ω, I_O=0.5A(*1), Ta=25°C	V_{CC}=6V	-	0.4	-	V	
			V_{CC}=16V	-	0.4	-		
High Level Supply Current	I_{CCH}	V_{CC}=6V, I_F=5mA, Rex=2.7Ω, Ta=25°C		-	3.8	10	mA	
		V_{CC}=6V, I_F=5mA, Rex=2.7Ω		-	-	13		
		V_{CC}=16V, I_F=5mA, Rex=2.7Ω		-	5.2	17		
Low Level Supply Current	I_{CCL}	V_{CC}=6V, I_F=0mA, Rex=2.7Ω, Ta=25°C		-	11	17	mA	
		V_{CC}=6V, I_F=0mA, Rex=2.7Ω		-	-	22		
		V_{CC}=16V, I_F=0mA, Rex=2.7Ω		-	13	25		
"Output L→H" Threshold Input Current	I_{FLH}	Rex=2.7Ω, I_O=0.25A, V_{O2}>3V	V_{CC}=6V	-	2.5	5	mA	
			V_{CC}=16V	-	-	5		
"Output H→L" Threshold Input Voltage	V_{FHL}	Rex=2.7Ω, I_O=0.25A, V_{O2}<0.4V	V_{CC}=6V	0.8	-	-	V	
			V_{CC}=16V	0.8	-	-		
Input Current Hysterisis	I_{HYS}	V_{CC}=6V, Rex=2.7Ω, Ta=25°C		-	0.05	-	mA	
Supply Voltage	V_{CC}			5	-	16	V	
Capacitance (Input-Output)	Cs	Vs=0, f=1MHz, Ta=25°C		-	1.0	2.0	pF	
Resistance (Input-Output)	Rs	Vs=500V, Ta=25°C		5×10^{10}	10^{12}	-	Ω	

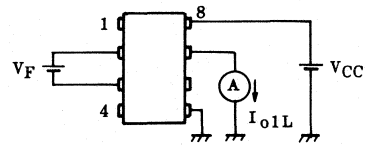
* All typical values are at Ta=25°C (*1): Duration of I_O time ≤100μs

SWITCHING CHARACTERISTICS (Ta=-30~70°C Unless otherwise specified)

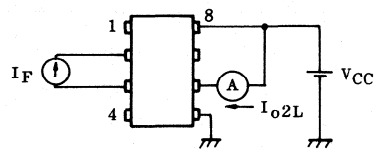
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.*	MAX.	UNIT	TEST CIR-CUIT
Propagation Delay Time, L→H	t_{pLH}	V_{CC}=6V, I_F=8mA	-	1	5	μs	6
Propagation Delay Time, H→L	t_{pHL}	Rex=2.7Ω	-	1	5	μs	
Output Rise Time	t_r	f=5kHz, Duty=10%	-	0.05	-	μs	
Output Fall Time	t_f		-	0.05	-	μs	
Common Mode Transient Immunity at High Level Output	C_{MH}	V_{CM}=600V, I_F=8mA V_{CC}=6V, Rex=270Ω R=1kΩ, Ta=25°C	-	-2000	-	V/μs	7
Common Mode Transient Immunity at Low Level Output	C_{ML}	V_{CM}=600V, I_F=0mA V_{CC}=6V, Rex=270Ω R=1kΩ, Ta=25°C	-	2000	-	V/μs	7

* All typical values are at Ta=25°C.

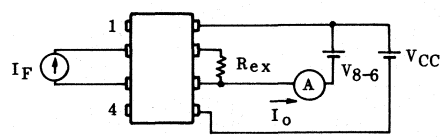
TEST CIRCUIT 1 : I_{O1L}



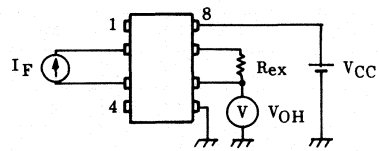
TEST CIRCUIT 2 : I_{O2L}



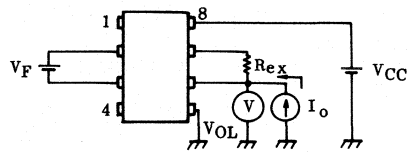
TEST CIRCUIT 3 : I_O



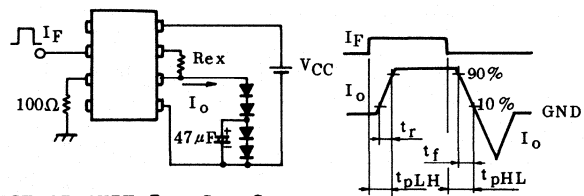
TEST CIRCUIT 4 : V_{OH}



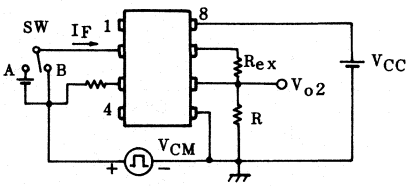
TEST CIRCUIT 5 : V_{OL}

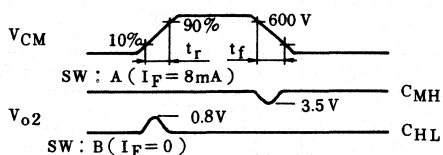


TEST CIRCUIT 6 : t_{pLH}, t_{pHL}, t_r, t_f



TEST CIRCUIT 7 : C_{MH}, C_{ML}



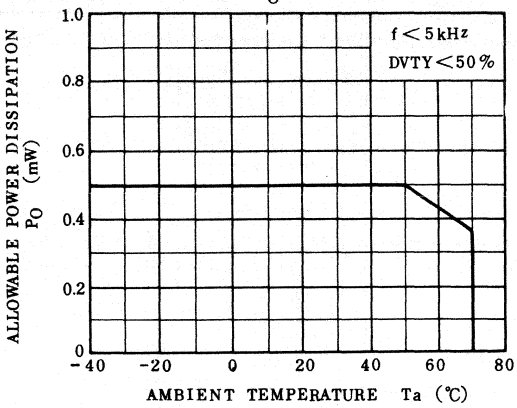


$$C_{ML} = \frac{480\ (V)}{t_r\ (\mu s)}$$

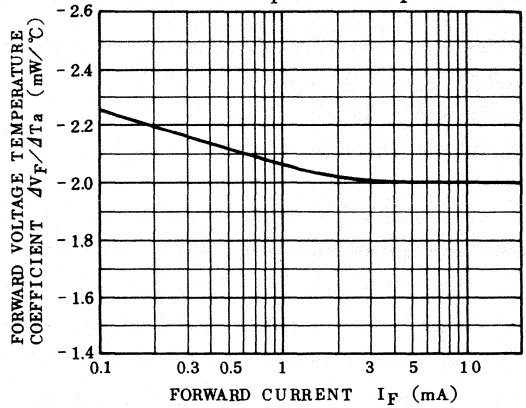
$$C_{MH} = \frac{480\ (V)}{t_f\ (\mu s)}$$

C_{ML}(C_{MH}) is the maximum rate of rise (fall) of the common mode voltage that can be sustained with the output voltage in the low (high) state.

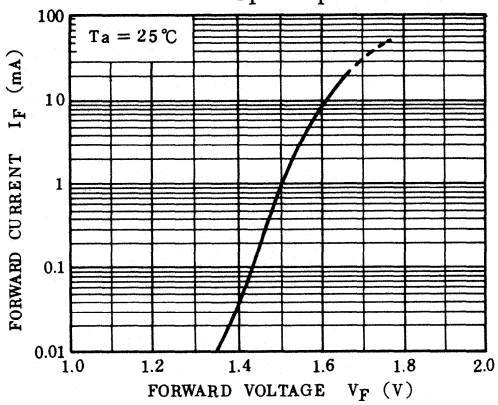
P_O – Ta



$\Delta V_F / \Delta Ta$ – I_F



I_F – V_F



TLP558

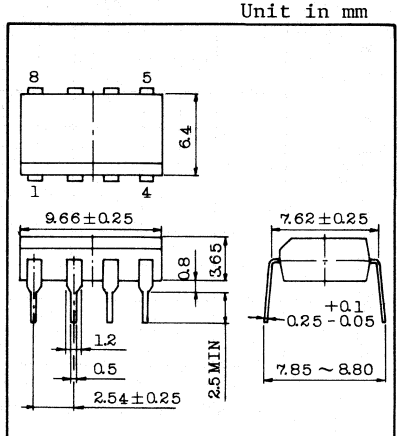
GaAℓAs IRED & PHOTO-IC

ISOLATED BUSS DRIVER
HIGH SPEED LINE RECEIVER
MICROPROCESSOR SYSTEM INTERFACES
MOS FET GATE DRIVER
TRANSISTOR INVERTER

The Toshiba TLP558 consists of a GaAℓAs light emitting diode and integrated high gain, high speed photodetector. This unit is 8-lead DIP package.
The detector has a three state output stage that provides source drive and sink drive, and built-in Schmitt trigger. The detector IC has an internal shield that provides a guaranteed common mode transient immunity of 1000V/μs. TLP558 is inveter logic type. For buffer logic type, TLP555 is in line-up.

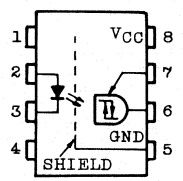
- Input Current : I_F=1.6mA
- Power Supply Voltage : V_{CC}=4.5~20V
- Switching Speed : t_{pHL}, t_{pLH}=400ns Max.
- Common Mode Transient Immunity : ±1000V/μs Min.
- Guaranteed Performance Over Temp. : -25~85°C
- Isolation Voltage : 2500V_{rms} Min.
- UL Recognized : File No. E67349

Unit in mm



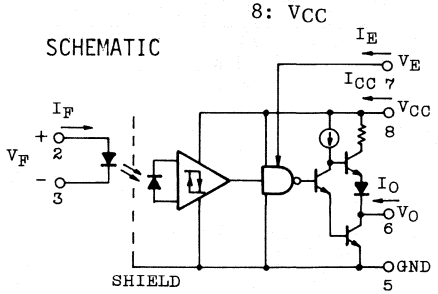
JEDEC	—
EIAJ	—
TOSHIBA	11-10C1

PIN CONFIGURATION (TOP VIEW)



1: NC
2: ANODE
3: CATHODE
4: NC
5: GND
6: V_O (OUTPUT)
7: V_E (ENABLE)
8: V_{CC}

SCHEMATIC



TRUTH TABLE (Positive Logic)

INPUT	ENABLE	OUTPUT
H	H	L
L	H	H
H	L	Z
L	L	Z

A 0.1μF bypass capcitor must be connected between pin 8 and 5 (See note 9).

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Input Current, ON	$I_{F(ON)}$	2*	-	5	mA
Input Voltage, OFF	$V_{F(OFF)}$	0	-	0.8	V
Supply Voltage	V_{CC}	4.5	-	20	V
Enable Voltage High	V_{EH}	2.0	-	20	V
Enable Voltage Low	V_{EL}	0	-	0.8	V
Fan Out (TTL Load)	N	-	-	4	
Operating Temperature	Topr	-25	-	85	°C

* 2mA condition permits at least 20% CTR degradation guardband.
Initial switching threshold is 1.6mA or less.

ABSOLUTE MAXIMUM RATINGS (No Derating Required up to 85°C unless otherwise noted)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current		I_F	10	mA
	Peak Transient Forward Current	(Note 1)	I_{FPT}	1	A
	Reverce Voltage		V_R	5	V
DETECTOR	Output Current		I_O	40/-25	mA
	Peak Output Current	(Note 2)	I_{OP}	80/-50	mA
	Output Voltage		V_O	-0.5~20	V
	Supply Voltage		V_{CC}	-0.5~20	V
	Three State Enable Voltage		V_E	-0.5~20	V
	Output Power Dissipation	(Note 3)	P_O	100	mW
	Total Package Power Dissipation	(Note 4)	P_T	200	mW
Operating Temperature Range			Topr	-40~85	°C
Storage Temperature Range			Tstg	-55~125	°C
Lead Solder Temperature (10 sec.)**			Tsold	260	°C
Isolation Voltage(AC, 1min., R.H ≤60%,Ta=25°C)		(Note 5)	BV_S	2500	Vrms

Note 1 : Pulse Width ≤1μs, 300pps.

Note 2 : Pulse Width ≤5μs, Duty Ratio ≤0.025.

Note 3 : Derate 1.8mW/°C above 70°C ambient temperature.

Note 4 : Derate 3.6mW/°C above 70°C ambient temperature.

Note 5 : Device considered a tow terminal device : pins 1,2,3 and 4 shorted together, and pins, 5,6,7 and 8 shorted together.

** 1.6mm below seating plane.

ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, Ta=-25~85°C, V_{CC}=4.5~20V)

CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.*	MAX.	UNIT
Input Forward Voltage	V_F	I_F=5mA, Ta=25°C		-	1.55	1.7	V
Temperature Coefficient of Forward Voltage	$\Delta V_F/\Delta Ta$	I_F=5mA		-	-2.0	-	mV/°C
Input Reverse Current	I_R	V_R=5V, Ta=25°C		-	-	10	μA
Input Capacitance	C_T	V_F=0V, f=1MHz, Ta=25°C		-	45	-	pF
Output Leakage Current ($V_O > V_{CC}$)	I_{OHH}	V_F=0V	V_O=V_E=5.5V	-	-	100	μA
		V_{CC}=4.5V	V_O=V_E=20V	-	0.01	500	
Logic Low Output Voltage	V_{OL}	I_{OL}=6.4mA, I_F=1.6mA V_E=2V		-	0.4	0.5	V
Logic High Output Voltage	V_{OH}	I_{OH}=-2.6mA, V_F=0.8V V_E=2V		2.4	3.3	-	V
Logic Low Enable Current	I_{EL}	V_E=0.4V		-	-0.13	-0.32	mA
Logic High Enable Current	I_{EH}	V_E=2.7V		-	-	20	μA
		V_E=5.5V		-	-	100	
		V_E=20V		-	0.01	250	
Logic Low Enable Voltage	V_{EL}			-	-	0.8	V
Logic High Enable Voltage	V_{EH}			2.0	-	-	V
Logic Low Supply Current	I_{CCL}	I_F=5mA	V_{CC}=V_E=5.5V	-	4.0	6.0	mA
			V_{CC}=V_E=20V	-	4.6	7.5	
Logic High Supply Current	I_{CCH}	V_F=0V	V_{CC}=V_E=5.5V	-	4.2	6.0	mA
			V_{CC}=V_E=20V	-	4.7	7.5	
High Impedance State Output Current	I_{OZL}	V_F=0V, V_E=0.8V	V_O=0.4V	-	0.01	-20	μA
	I_{OZH}	I_F=5mA V_E=0.8V	V_O=2.4V	-	-	20	
			V_O=5.5V	-	-	100	
			V_O=20V	-	1	500	
Logic Low Short Circuit Output Current (Note 6)	I_{OSL}	I_F=5mA	V_O=V_{CC}=5.5V	25	55	-	mA
		V_E=2V	V_O=V_{CC}=20V	40	80	-	
Logic High Short Circuit Output Current (Note 6)	I_{OSH}	V_F=0V, V_O=GND	V_{CC}=5.5V	-10	-25	-	mA
		V_E=2V	V_{CC}=20V	-25	-60	-	
Input Current Logic Low Output	I_{FL}	V_E=2V, I_O=6.4mA, V_O<0.4V		-	0.4	1.6	mA
Input Voltage Logic High Output	V_{FH}	V_E=2V, I_O=-2.6mA, V_O>2.4V		0.8	-	-	V

* All typical values are at Ta=25°C, V_{CC}=5V, $I_{F(ON)}$=3mA unless otherwise specified.

ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, Ta=-25~85°C, V_{CC}=4.5~20V)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.*	MAX.	UNIT
Input Current Hysteresis	I_{HYS}	$V_{CC}=V_E=5V$	-	0.05	-	mA
Input-Output Insulation Leakage Current	I_S	$V_S=3000V_{DC}$, R.H≤60% Ta=25°C, t=5sec. (Note 5)	-	-	100	μA
Resistance (Input-Output)	R_S	$V_S=500V_{DC}$, R.H≤60% Ta=25°C (Note 5)	-	10^{12}	-	Ω
Capacitance (Input-Output)	C_S	$V_S=0V$, f=1MHz, Ta=25°C (Note 5)	-	1.0	-	pF

* All typical values are at Ta=25°C, V_{CC}=5V, $I_{F(ON)}$=3mA unless otherwise specified.

SWITCHING CHARACTERISTICS

Unless otherwise specified, V_{CC}=4.5~20V, Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.*	MAX.	UNIT
Propagation Delay Time to Logic High Output (Note 7)	t_{pLH}	1	I_F=3→0mA	-	250	400	ns
Propagation Delay Time to Logic Low Output Level (Note 7)	t_{pHL}		I_F=0→3mA	-	270	400	ns
Output Rise Time (10-90%)	t_r		I_F=3→0mA	-	35	75	ns
Output Fall Time (90-10%)	t_f		I_F=0→3mA	-	20	75	ns
Output Enable Time to Logic High	t_{pZH}	2	V_E=0→3V	-		-	ns
Output Enable Time to Logic Low	t_{pZL}		V_E=0→3V	-		-	ns
Output Disable Time from Logic High	t_{pHZ}		V_E=3→0V	-		-	ns
Output Disable Time from Logic Low	t_{pLZ}		V_E=3→0V	-		-	ns
Common Mode Transient Immunity at Logic High Output (Note 8)	CM_H		I_F=0mA, V_{CM}=50V $V_{O(Min)}$=2V	1000		-	V/μs
Common Mode Transient Immunity Logic Low Output (Note 8)	CM_L		I_F=1.6mA, V_{CM}=50V $V_{O(Max)}$=0.8V	-1000		-	V/μs

* All typical values are at Ta=25°C, V_{CC}=5V

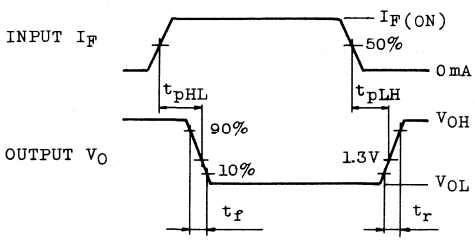
Note 6 : Duration of output short circuit time should not exceed 10ms.

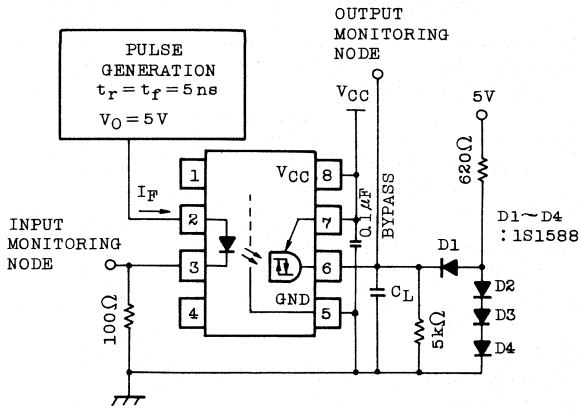
Note 7 : The t_{pLH} propagation delay is measured from the 50% point on the trailing edge of the input pulse to the 1.3V point on the leading edge of the output pulse.
The t_{pHL} propagation delay is measured from the 50% point on the leading edge of the input pulse to the 1.3V point on the trailing edge of the output pulse.

Note 8 : CM_L is the maximum rate of fall of the common mode voltage that can be sustained with the output voltage in the logic low state ($V_O < 0.8V$).
CM_H is the maximum rate of rise of the common mode voltage that can be sustained with the output voltage in the logic state ($V_O > 2.0V$).

Note 9 : A ceramic capacitor (0.1μF) should be connected from pin 8 to pin 5 to stabilize the operation of the high gain linear amplifier. Failure to provide the bypassing may impair the switching property. The total lead length between capacitor and coupler should not exceed 1cm.

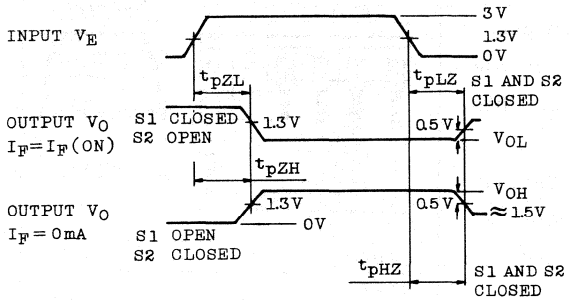
TEST CIRCUIT 1: t_{pLH}, t_{pHL}, t_r and t_f

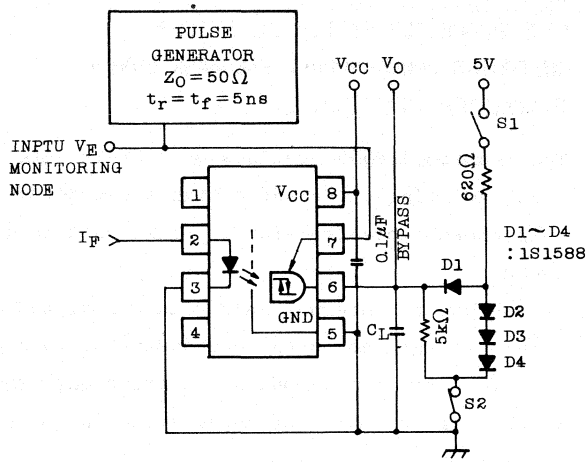




C_L is approximately 15pF which includes probe and stray wiring capacitance.

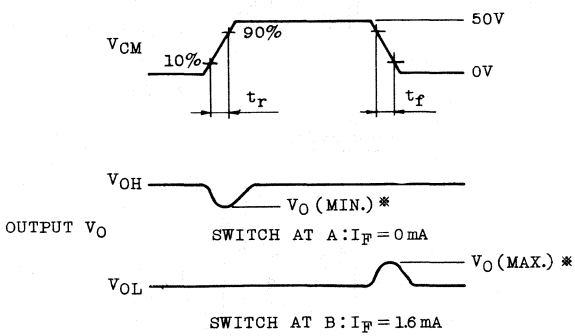
TEST CIRCUIT 2: t_{pHZ}, t_{pZH}, t_{pLZ} and t_{pZL}

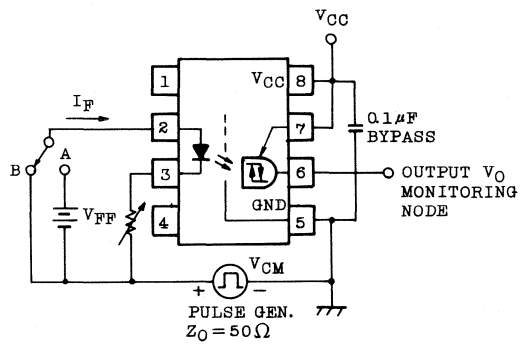




C_L is approxiamtely 15pF which includes probe and stray wiring capacitance.

TEST CIRCUIT 3: Common Mode Transient Immunity





TLP559

GaAs IRED & PHOTO-TRIAC

TENTATIVE DATA

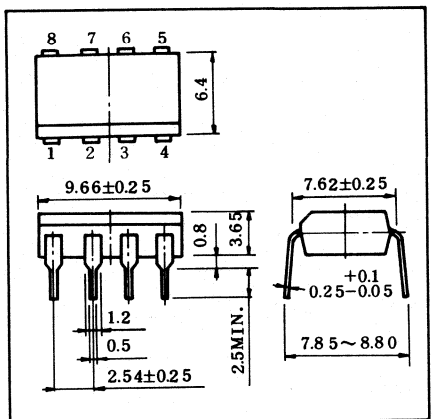
DIGITAL LOGIC GROUND ISOLATION.
LINE RECEIVER.
MICROPROCESSOR SYSTEM INTERFACES.
SWITCHING POWER SUPPLY FEEDBACK CONTROL.
TRANSISTOR INVERTOR.

The Toshiba TLP559 consists of a GaAℓAs high-output light emitting diode and a high speed detector of one chip photo diode-transistor. This unit is 8-lead DIP package.

TLP559 has no internal base connection, and a Faraday shield integrated on the photodetector chip provides an effective common mode noise transient immunity. So this is suitable for application in noisy environmental condition.

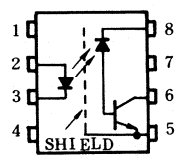
- Isolation Voltage : 2500Vrms Min.
- Switching Speed : t_pHL=0.3μs(Typ.)
  t_pLH=0.5μs(Typ.)(R_L=1.9kΩ)
- TTL Compatible
- UL Recognized : File No. E67349

Unit in mm



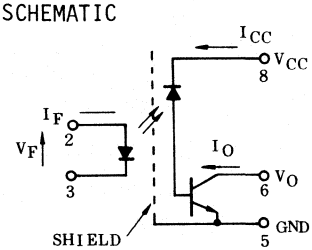
JEDEC	—
EIAJ	—
TOSHIBA	11-10C1

PIN CONFIGURATION (TOP VIEW)



1 : N.C.
2 : ANODE
3 : CATHODE
4 : N.C.
5 : EMITTER
6 : COLLECTOR
7 : N.C.
8 : V_{CC}

SCHEMATIC



MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current	(Note 1)	I_F	25	mA
	Pulse Forward Current	(Note 2)	I_{FP}	50	mA
	Peak Transient Forward Current	(Note 3)	I_{FPT}	1	A
	Reverse Voltage		V_R	5	V
	Diode Power Dissipation	(Note 4)	P_D	45	mW
DETECTOR	Output Current		I_O	8	mA
	Peak Output Current		I_{OP}	16	mA
	Output Voltage		V_O	-0.5∿15	V
	Supply Voltage		V_{CC}	-0.5∿15	V
	Output Power Dissipation	(Note 5)	P_o	100	mW
Operating Temperature Range			T_{opr}	-55∿100	°C
Storage Temperature Range			T_{stg}	-55∿125	°C
Lead Solder Temperature (10 sec.)		(Note 6)	T_{sol}	260	°C
Isolation Voltage (AC, 1min., R.H≦60%)		(Note 7)	BV_S	2500	Vrms

Note 1 : Derate 0.8mA above 70°C.

Note 2 : 50% duty cycle, 1ms pulse width.
Derate 1.6mA/°C above 70°C.

Note 3 : Pulse width≦1μs, 300pps.

Note 4 : Derate 0.9mW/°C above 70°C.

Note 5 : Derate 2mW/°C above 70°C.

Note 6 : Soldering portion of lead : up to 2mm from the body of the device.

Note 7 : Device considered a two terminal device : Pins 1,2,3 and 4 shorted together and pins 5,6,7 and 8 shorted together.

ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=16mA	-	1.65	1.85	V
	Forward Voltage Temperature Coefficient	$\Delta V_F/\Delta Ta$	I_F=16mA	-	-2	-	mV/°C
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance Between Terminal	C_T	V_F=0, f=1MHz	-	45	-	pF
DETECTOR	High Level Output Current	$I_{OH(1)}$	I_F=0mA, V_{CC}=V_O=5.5V	-	3	500	nA
		$I_{OH(2)}$	I_F=0mA, V_{CC}=V_O=15V	-	-	5	μA
		I_{OH}	I_F=0mA, V_{CC}=V_O=15V Ta=70°C	-	-	50	
	High Level Supply Voltage	I_{CCH}	I_F=0mA, V_{CC}=15V	-	0.01	1	μA
COUPLED	Current Transfer Ratio	I_O/I_F	I_F=16mA V_{CC}=4.5V V_O=0.4V	20	40	-	%
	Low Level Output Voltage	V_{OL}	I_F=16mA, V_{CC}=4.5V I_O=2.4mA	-	-	0.4	V
	Resistance (Input-Output)	R_S	R.H.≤60%, V_S=500V_{DC} (Note 7)	5×10^{10}	10^{12}	-	Ω
	Capacitance (Input-Output)	C_S	V_S=0, f=1MHz (Note 7)	-	0.8	-	pF

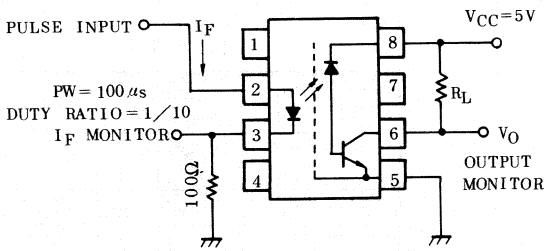
SWITCHING CHARACTERISTICS (Ta=25°C, V_{CC}=5V)

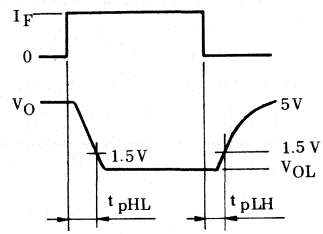
CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Propagation Delay Time (H→L)	t_pHL	1	I_F=0→16mA, V_{CC}=5V, R_L=1.9kΩ	-	0.2	0.8	μs
Propagation Delay Time (L→H)	t_pLH		I_F=16→0mA, V_{CC}=5V, R_L=1.9kΩ	-	0.3	0.8	μs
Common Mode Transient Immunity at Logic High Output (Note 8)	CM_H	2	I_F=0mA, V_{CM}=400V_{p-p} R_L=4.1kΩ	2000	10000	-	V/μs
Common Mode Transient Immunity at Logic Low Output (Note 8)	CM_L		I_F=16mA, V_{CM}=400V_{p-p} R_L=4.1kΩ	-2000	-10000	-	V/μs

Note 8 : CM_L is the maximum rate of fall of the common mode voltage that can be sustained with the output voltage in the logic low state (V_O<0.8V). CM_H is the maximum rate of rise of the common mode voltage that can be sustained with the output voltage in the logic high state (V_O>2.0V).

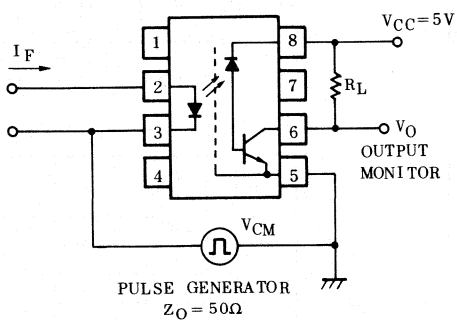
Note 9 : Maximum electrostatic discharge voltage for any pins : 100V(C=200pF, R=0).

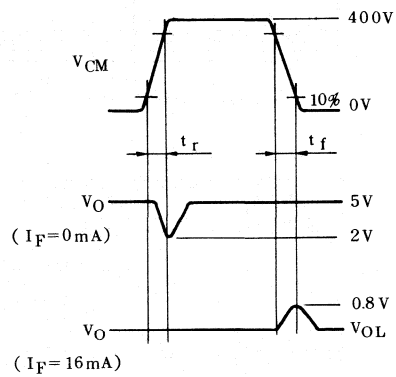
TEST CIRCUIT 1: Switching Time Test Circuit





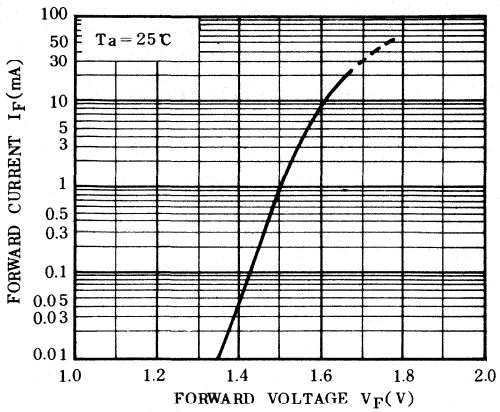
TEST CIRCUIT 2: Common Mode Noise Immunity Test Circuit



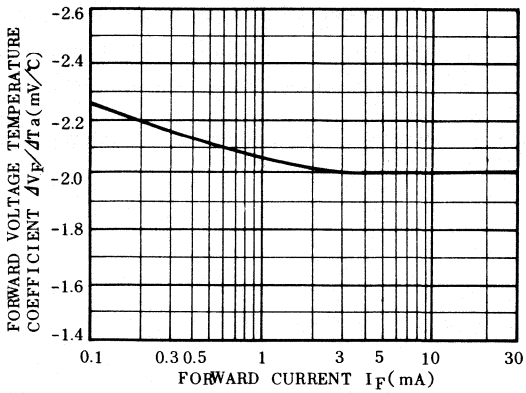


$$CM_H = \frac{320(V)}{t_r(\mu s)}, \quad CM_L = \frac{320(V)}{t_f(\mu s)}$$

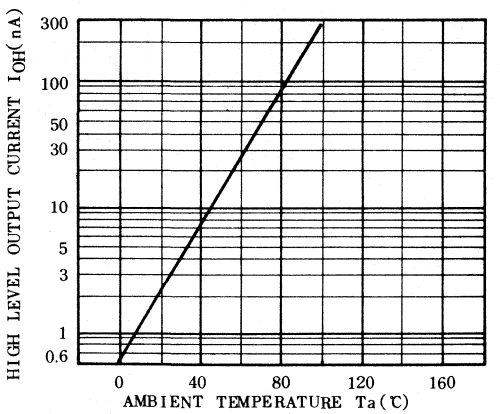
$I_F - V_F$



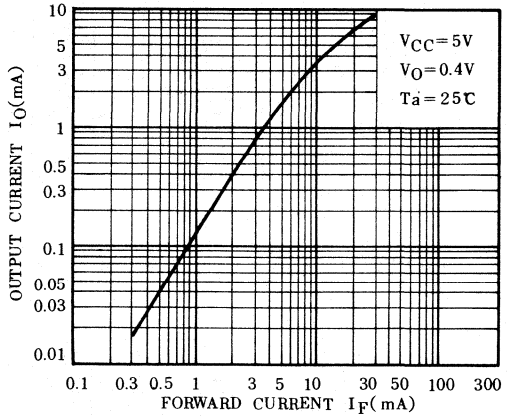
$\Delta V_F / \Delta Ta - I_F$



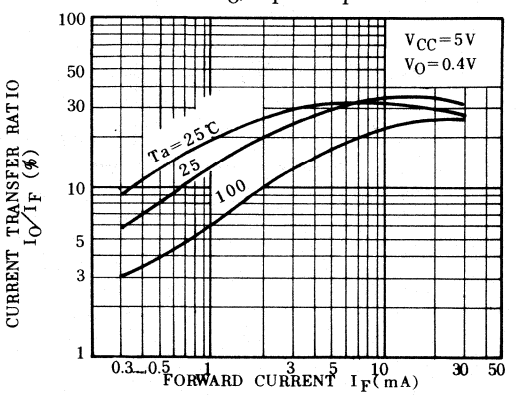
$I_{OH(1)} - Ta$



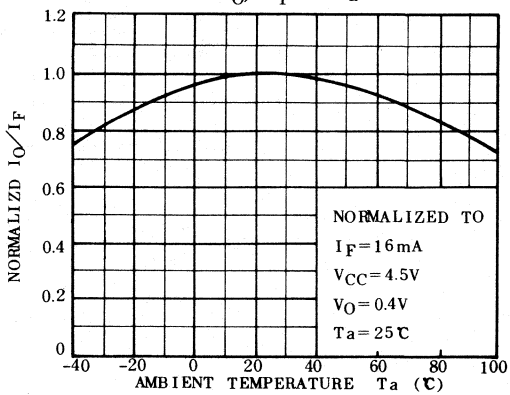
$I_O - I_F$



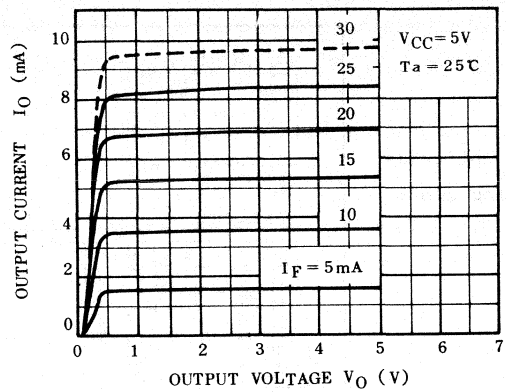
$I_O / I_F - I_F$



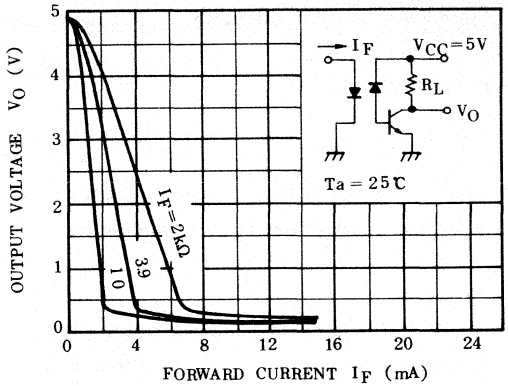
$I_O / I_F - Ta$



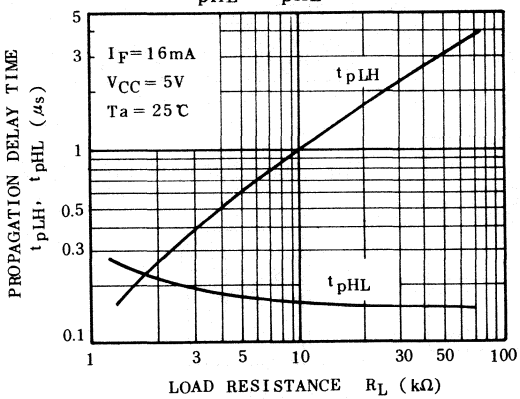
$I_O - V_O$



$V_O - I_F$



t_{pHL}, $t_{pHL} - R_L$



TLP560G

GaAs IRED & PHOTO-TRIAC

TRIAC DRIVER
PROGRAMMABLE CONTROLLERS
AC-OUTPUT MODULE
SOLID STATE RELAY

The TOSHIBA TLP560G consists of a photo-triac optically coupled to a gallium arsenide infreared emitting diode in a six lead plastic DIP package.

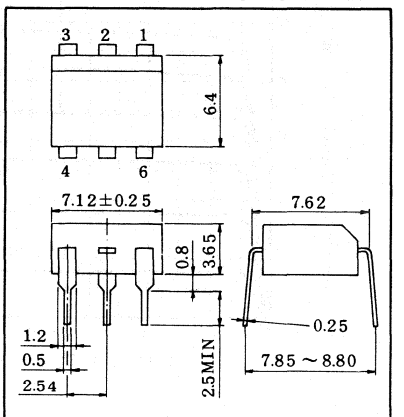
- Peak Off-State Voltage : 400V Min.
- On-State Current : 100mA Max.
- Isolation Voltage : 2500V_{rms} Min.
- UL Recognized : File No. E67349
- Isolation Operating Voltage
  : 250Vac or 300Vdc for Isolation Groupe C*1
- Trigger LED Current

CLASSIFICATION*	TRIGGER LED CURRENT (mA) V_T=6V, Ta=25°C		MARKING OF CLASSIFICATION
	MIN.	MAX.	
(IFT5)	-	5	T5
(IFT7)	-	7	T5,T7
Standard	-	10	T5,T7,Blank

* Ex. : (IFT5); TLP560G(IFT5)

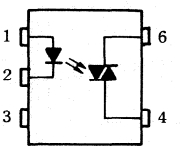
- Note: Application type name for certification test, please use standard product type name, i.e.
  TLP560G(IFT5): TLP560G

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-7A3

PIN CONFIGURATION (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: TERMINAL 1
6: TERMINAL 2

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current		I_F	50	mA
	Forward Current Derating (Ta ≧ 53°C)		ΔI_F/°C	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)		I_{FP}	1	A
	Reverse Voltage		V_R	5	V
	Junction Temperature		T_j	125	°C
DETECTOR	Off-State Output Terminal Voltage		V_{DRM}	400	V
	On-State RMS Current	Ta=25°C	$I_{T(RMS)}$	100	mA
		Ta=70°C		50	
	On-State Current Derating (Ta ≧ 25°C)		ΔI_T/°C	-1.1	mA/°C
	Peak On-State Current (100μs pulse, 120pps)		I_{TP}	2	A
	Peak Nonrepetitive Surge Current (P_W=10ms, DC=10%)		I_{TSM}	1.2	A
	Junction Temperature		T_j	100	°C
Storage Temperature Range			T_{stg}	-55∿125	°C
Operating Temperature Range			T_{opr}	-40∿100	°C
Lead Soldering Temperature (10 sec.)			T_{sold}	260	°C
Isolation Voltage (AC, 1 min., RH ≦ 60%)			BV_S	2500	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	10	-	pF
DETECTOR	Peak Off-State Current	I_{DRM}	V_{DRM}=400V	-	10	100	nA
	Peak On-State Voltage	V_{TM}	I_{TM}=100mA	-	1.7	3.0	V
	Holding Current	I_H	-	-	0.2	-	mA
	Critical Rate of Rise of Off-State Voltage	dv/dt	Vin=120Vrms, Ta=85°C (Fig. 1)	200	500	-	V/μs
	Critical Rate of Rise of Commutating Voltage	dv/dt(c)	I_T=15mA, Vin=30Vrms (Fig. 1)	-	0.2	-	V/μs

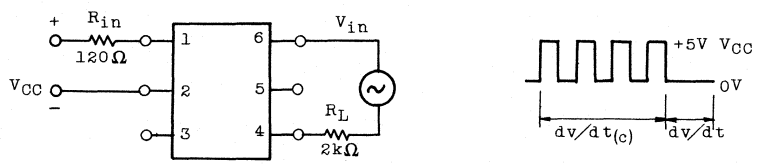
COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_T=3V	-	5	10	mA
Capacitance(Input to Output)	C_S	VS=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	VS=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	2500	-	-	V_{rms}
		AC, 1 second	-	5000	-	
		DC, 1 minute	-	5000	-	V_{dc}

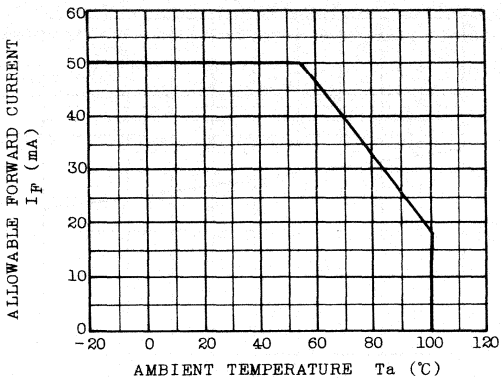
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	120	V_{ac}
Forward Current	I_F	15	20	25	mA
Peak On-State Current	I_{TP}	-	-	1	A
Operating Temperature	T_{opr}	-25	-	85	°C

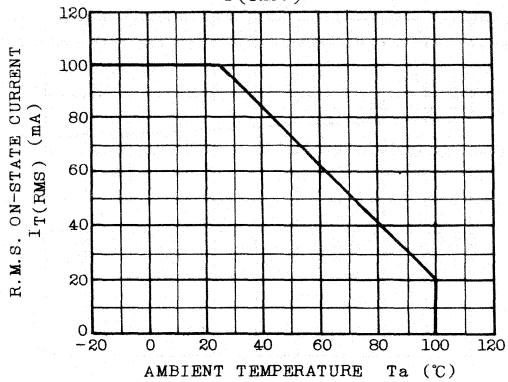
Fig.1 : dv/dt TEST CIRCUIT



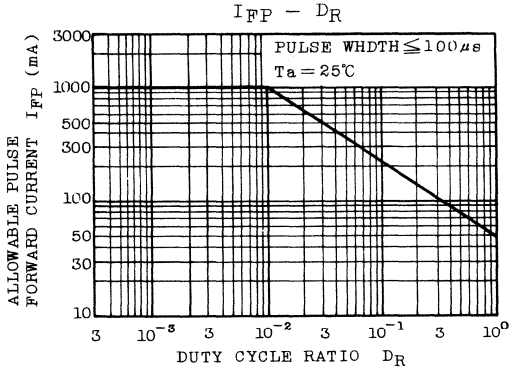
I_F – Ta



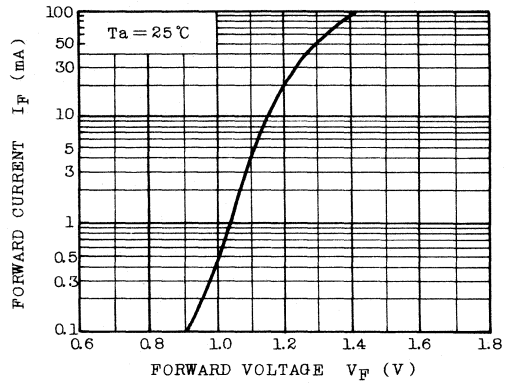
$I_{T(RMS)}$ – Ta



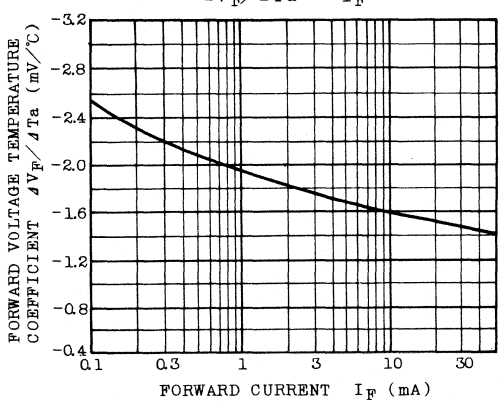
I_{FP} – D_R



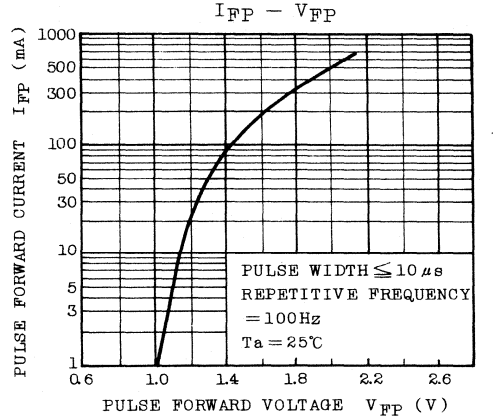
I_F – V_F



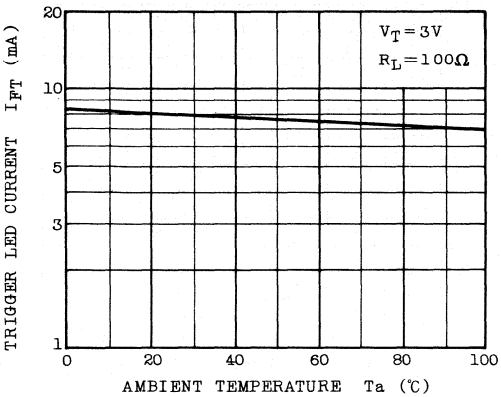
$\Delta V_F/\Delta Ta$ – I_F



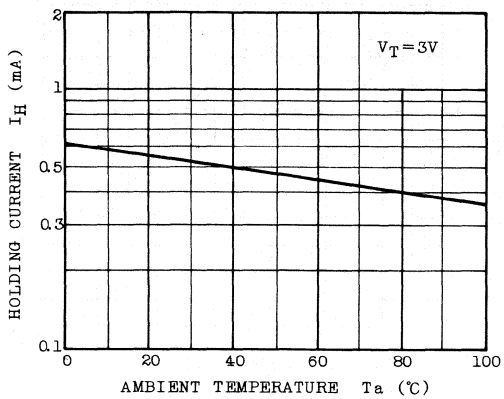
I_{FP} – V_{FP}



I_{FT} – Ta


V_T = 3V
R_L = 100Ω
TRIGGER LED CURRENT I_{FT} (mA)
20
10
5
3
1
0
20
40
60
80
100
AMBIENT TEMPERATURE Ta (°C)

I_H – Ta

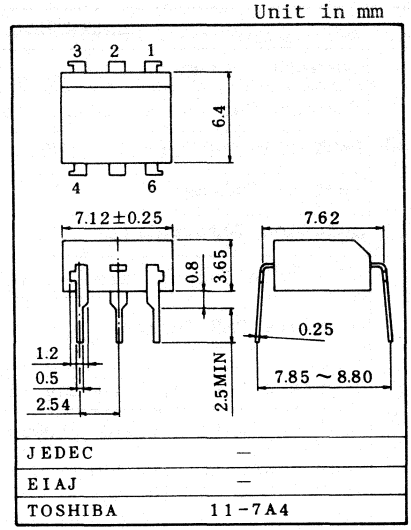

V_T = 3V
HOLDING CURRENT I_H (mA)
2
1
0.5
0.3
0.1
0
20
40
60
80
100
AMBIENT TEMPERATURE Ta (°C)

TLP560J

TRIAC DRIVER.
PROGRAMMABLE CONTROLLERS.
AC-OUTPUT MODULE.
SOLID STATE RELAY.

The TOSHIBA TLP560J consists of a photo-triac optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.

Unit in mm



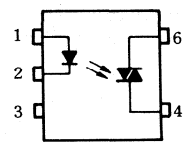
- Peak Off-State Voltage : 600V Min.
- On-State Current : 100mA Max.
- Isolation Voltage : 2500Vrms Min.
- UL Recognized : File No. E67349
- Isolation Operating Voltage
  : 250Vac or 300Vdc for Isolation Groupe C*1
- Trigger LED Current

CLASSIFICATION*	TRIGGER LED CURRENT (mA) V_T=6V, Ta=25°C		MARKING OF CLASSIFICATION
	MIN.	MAX.	
(IFT7)	-	7	T7
Standard	-	10	T7, Blank

* Ex. (IFT7) ; TLP560J (IFT7)

- Note: Application type name for certification test, please use standard product type name, i.e.
  TLP560J(IFT7) : TLP560J

PIN CONFIGURATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: TERMINAL 1
6: TERMINAL 2

*; : According to VDE0110, table 4.

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current		I_F	50	mA
	Forward Current Derating (Ta ≧ 53°C)		ΔI_F/°C	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)		I_{FP}	1	A
	Reverse Voltage		V_R	5	V
	Junction Temperature		T_j	125	°C
DETECTOR	Off-State Output Terminal Voltage		V_{DRM}	600	V
	On-State RMS Current	Ta=25°C	$I_{T(RMS)}$	100	mA
		Ta=70°C		50	
	On-State Current Derating (Ta ≧ 25°C)		ΔI_T/°C	-1.1	mA/°C
	Peak On-State Current (100μs pulse, 120pps)		I_{TP}	2	A
	Peak Nonrepetitive Surge Current (P_W=10ms, DC=10%)		I_{TSM}	1.2	A
	Junction Temperature		T_j	100	°C
Storage Temperature Range			T_{stg}	-55~125	°C
Operating Temperature Range			T_{opr}	-40~100	°C
Lead Soldering Temperature (10 sec.)			T_{sold}	260	°C
Isolation Voltage (AC, 1 min., RH ≦ 60%)			BV_S	2500	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	10	-	pF
DETECTOR	Peak Off-State Current	I_{DRM}	V_{DRM}=600V	-	10	100	nA
	Peak On-State Voltage	V_{TM}	I_{TM}=100mA	-	1.7	3.0	V
	Holding Current	I_H	-	-	1.0	-	mA
	Critical Rate of Rise of Off-State Voltage	dv/dt	V_{in}=240V_{rms}, Ta=85°C (Fig.1)	-	500	-	V/μs
	Critical Rate of Rise of Commutating Voltage	dv/dt(c)	I_T=15mA, V_{in}=60V_{rms} (Fig.1)	-	0.2	-	V/μs

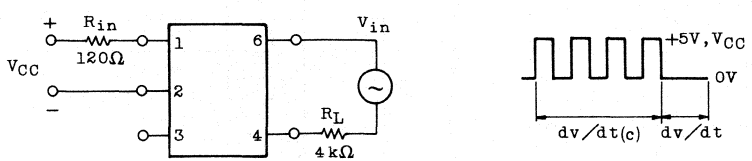
COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_T=6V, R_L=100Ω	-	5	10	mA
Capacitance(Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	2500	-	-	V_{rms}
		AC, 1 second	-	5000	-	
		DC, 1 minute	-	5000	-	Vdc

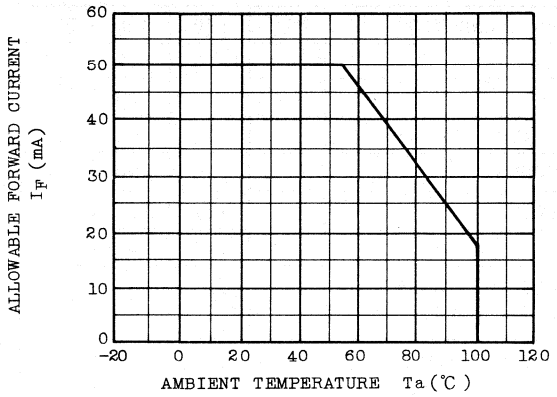
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	240	Vac
Forward Current	I_F	15	20	25	mA
Peak On-State Current	I_{TP}	-	-	1	A
Operating Temperature	Topr	-25	-	85	°C

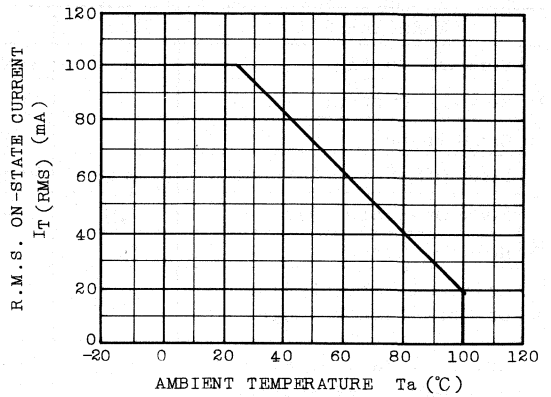
Fig. 1 dv/dt TEST CIRCUIT



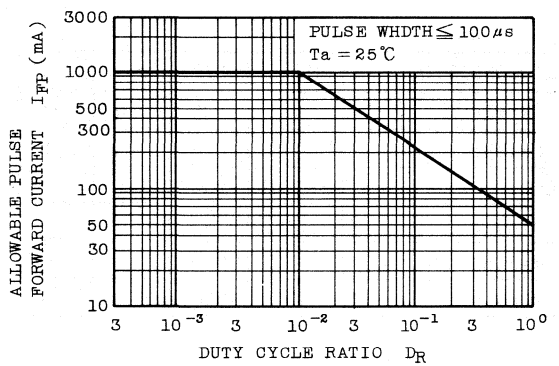
I_F – Ta



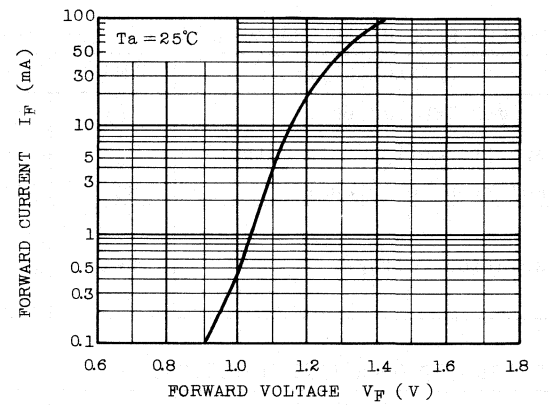
$I_{T(RMS)}$ – Ta



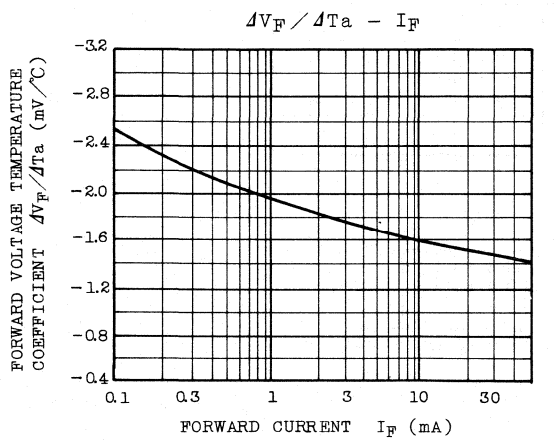
I_{FP} – D_R



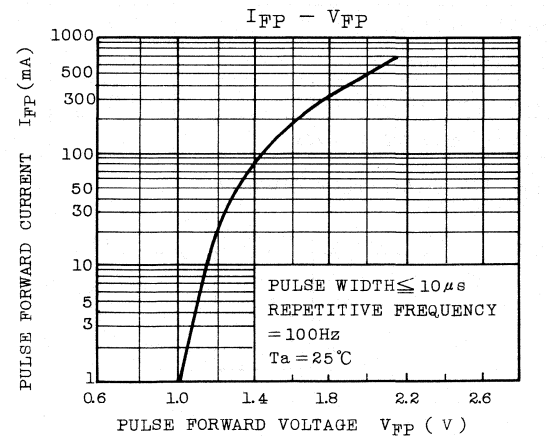
I_F – V_F



$\Delta V_F / \Delta Ta$ – I_F



I_{FP} – V_{FP}



TRIAC DRIVER
PROGRAMMABLE CONTROLLERS
AC-OUTPUT MODULE
SOLID STATE RELAY

The TOSHIBA TLP561G consists of a zero voltage crossing turn-on photo-triac optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.

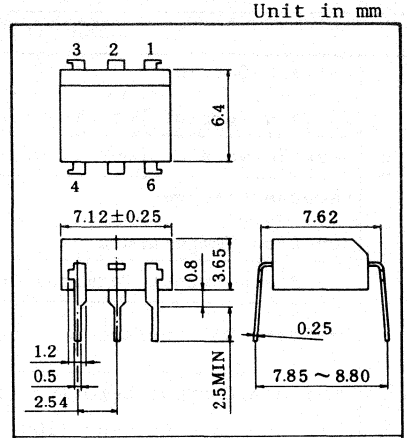
- Peak Off-State Voltage : 400V Min.
- On-State Current : 100mA Max.
- Isolation Voltage : 2500V_{rms} Min.
- UL Recognized : File No. E67349
- Isolation Operating Voltage
  : 250Vac or 300Vdc for Isolation Groupe C*1
- Trigger LED Current

CLASSIFICATION*	TRIGGER LED CURRENT (mA) V_T=6V, Ta=25°C		MARKING OF CLASSIFICATION
	MIN.	MAX.	
(IFT5)	-	5	T5
(IFT7)	-	7	T5, T7
Standard	-	10	T5, T7, Blank

* Ex. (IFT5); TLP561G (IFT5)

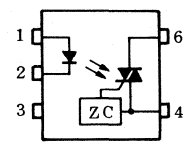
- Note: Application type name for certification test, please use standard product type name, i.e.
  TLP561G (IFT5): TLP561G

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-7A4

PIN CONFIGURATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: TERMINAL 1
6: TERMINAL 2

*1 : According to VDE0110, table 4.

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current		I_F	50	mA
	Forward Current Derating (Ta≧53°C)		$\Delta I_F/°C$	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)		I_{FP}	1	A
	Reverse Voltage		V_R	5	V
	Junction Temperature		T_j	125	°C
DETECTOR	Off-State Output Terminal Voltage		V_{DRM}	400	V
	On-State RMS Current	Ta=25°C	$I_{T(RMS)}$	100	mA
		Ta=70°C		50	
	On-State Current Derating (Ta≧25°C)		$\Delta I_T/°C$	-1.1	mA/°C
	Peak On-State Current (100μs pulse, 120pps)		I_{TP}	2	A
	Peak Nonrepectitive Surge Current (P_W=10ms, DC=10%)		I_{TSM}	1.2	A
	Junction Temperature		T_j	100	°C
Storage Temperature Range			T_{stg}	-55∿125	°C
Operating Temperature Range			T_{opr}	-40∿100	°C
Lead Soldering Temperature (10 sec.)			T_{sold}	260	°C
Isolation Voltage (AC, 1 min., RH≦60%)			BV_S	2500	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	10	-	pF
DETECTOR	Peak Off-State Current	I_{DRM}	V_{DRM}=400V	-	10	100	nA
	Peak On-State Voltage	V_{TM}	I_{TM}=100mA	-	1.7	3.0	V
	Holding Current	I_H	-	-	0.2	-	mA
	Critical Rate of Rise of Off-State Voltage	dv/dt	V_{in}=120Vrms, Ta=85°C (Fig.1)	200	500	-	V/μs
	Critical Rate of Rise of Commutating Voltage	dv/dt(c)	V_{in}=30Vrms, I_T=15mA (Fig.1)	-	0.2	-	V/μs

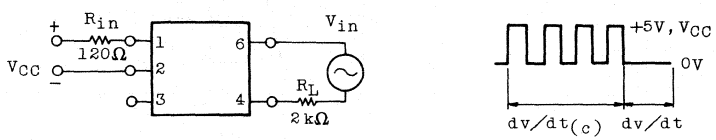
COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_T=3V, R_L=100Ω	-	5	10	mA
Inhibit Voltage	V_{IH}	I_F=Rated I_{FT}	-	-	40	V
Leakage in Inhibited State	I_{IH}	I_F=Rated I_{FT} V_T=Rated V_{DRM}	-	100	300	μA
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	2500	-	-	Vrms
		AC, 1 second	-	5000	-	
		DC, 1 minute	-	5000	-	Vdc

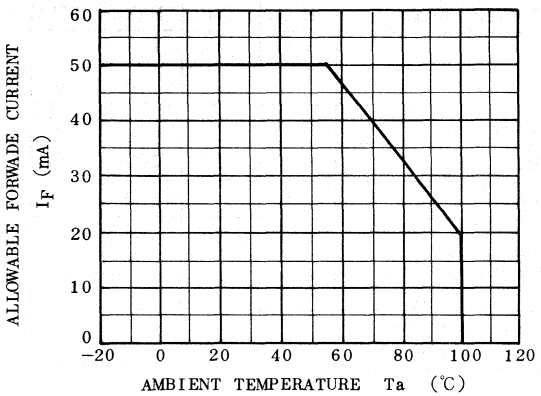
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	120	Vac
Forward Current	I_F	15	20	25	mA
Peak On-State Current	I_{TP}	-	-	1	A
Operating Temperature	Topr	-25	-	85	°C

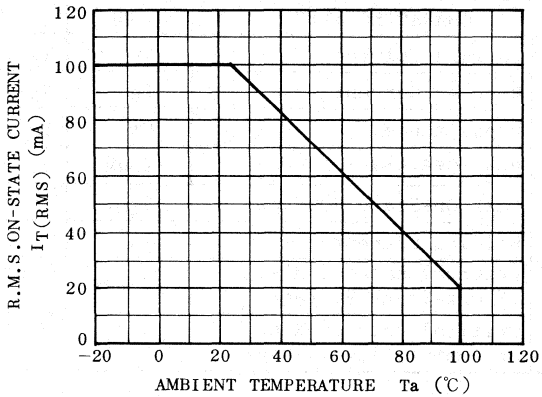
Fig. 1 dv/dt TEST CIRCUIT



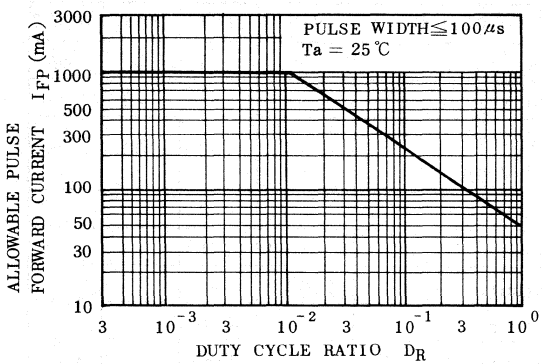
I_F – Ta



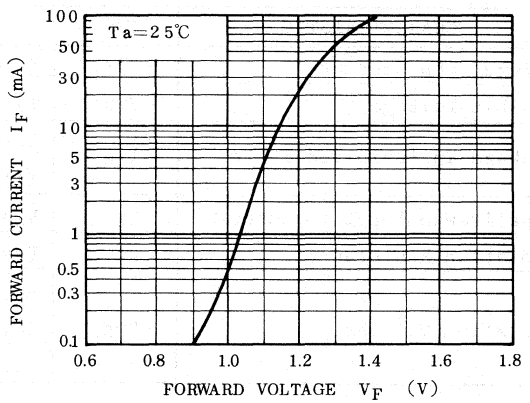
$I_{T(RMS)}$ – Ta



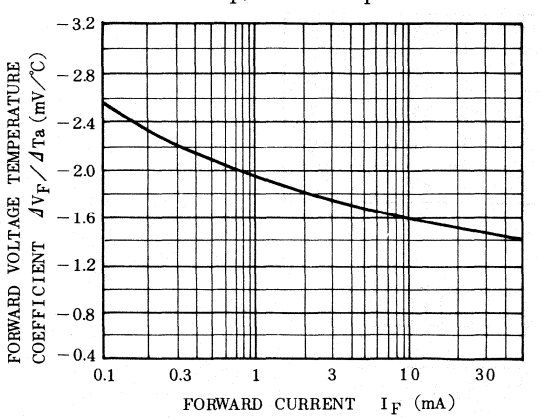
I_{FP} – D_R



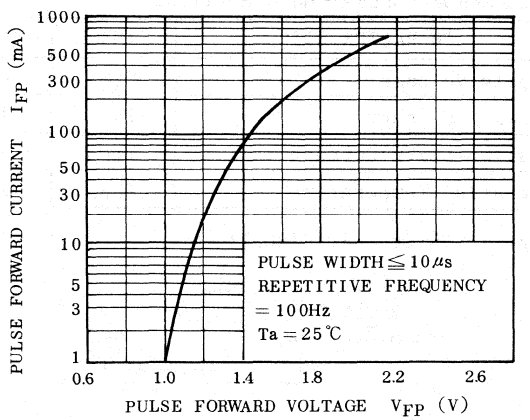
I_F – V_F



$\Delta V_F / \Delta Ta$ – I_F



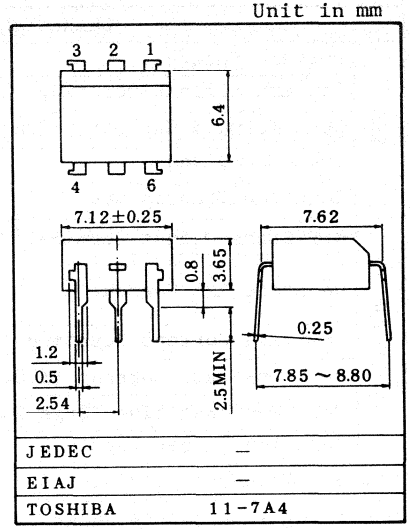
I_{FP} – V_{FP}



TRIAC DRIVER.
PROGRAMMABLE CONTROLLERS.
AC-OUTPUT MODULE.
SOLID STATE RELAY.

The TOSHIBA TLP561J consists of a zero voltage crossing turn-on photo-triac optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-7A4

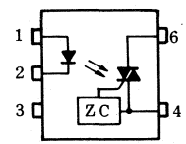
- Peak Off-State Voltage : 600V Min.
- On-State Current : 100mA Max.
- Isolation Voltage : 2500Vrms Min.
- UL Recognized : File No. E67349
- Isolation Operating Voltage
  : 250Vac or 300Vdc for Isolation Groupe C*1
- Trigger LED Current

CLASSIFICATION*	TRIGGER LED CURRENT (mA) V_T=6V, Ta=25°C		MARKING OF CLASSIFICATION
	MIN.	MAX.	
(IFT7)	-	7	T7
Standard	-	10	T7, Blank

* Ex. (IFT7) ; TLP561J (IFT7)

- Note: Application type name for certification test, please use standard product type name, i.e.
  TLP561J (IFT7) : TLP561J

PIN CONFIGURATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: TERMINAL 1
6: TERMINAL 2

*1 : According to VDE0110, table 4.

MUXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current		I_F	50	mA
	Forward Current Derating (Ta ≧53°C)		ΔI_F/°C	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)		I_{FP}	1	A
	Reverse Voltage		V_R	5	V
	Junction Temperature		T_j	125	°C
DETECTOR	Off-State Output Terminal Voltage		V_{DRM}	600	V
	On-State RMS Current	Ta=25°C	$I_{T(RMS)}$	100	mA
		Ta=70°C		50	
	On-State Current Derating (Ta ≧ 25°C)		ΔI_T/°C	-1.1	mA/°C
	Peak On-State Current (100μs pulse, 120pps)		I_{TP}	2	A
	Peak Nonrepetitive Surge Current (P_W=10ms, DC=10%)		I_{TSM}	1.2	A
	Junction Temperature		T_j	100	°C
Storage Temperature Range			T_{stg}	-55∿125	°C
Operating Temperature Range			T_{opr}	-40∿100	°C
Lead Soldering Temperature (10 sec.)			T_{sold}	260	°C
Isolation Voltage (AC, 1 min., RH ≦60%)			BV_S	2500	V_{rms}

INDIVIDUAL ELECTREICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	10	-	pF
DETECTOR	Peak Off-State Current	I_{DRM}	V_{DRM}=600V	-	10	100	nA
	Peak On-State Voltage	V_{TM}	I_{TM}=100mA	-	1.7	3.0	V
	Holding Current	I_H	-	-	0.2	-	mA
	Critical Rate of Rise of Off-State Voltage	dv/dt	V_{in}=240Vrms, Ta=85°C (Fig.1)	200	500	-	V/μs
	Critical Rate of Rise of Commutating Voltage	dv/dt(c)	V_{in}=60Vrms, I_T=15mA (Fig.1)	-	0.2	-	V/μs

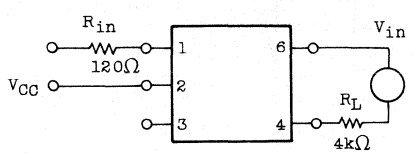
COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

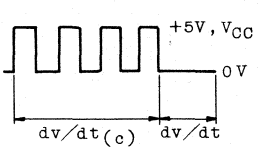
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_T=6V, R_L=100Ω	-	5	10	mA
Inhibit Voltage	V_{IH}	I_F=Rated I_{FT}	-	-	50	V
Leakage in Inhibited State	I_{IH}	I_F=Rated I_{FT} V_T=Rated V_{DRM}	-	200	600	μA
Capacitance(Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BVS	AC, 1 minute	2500	-	-	Vrms
		AC, 1 second	-	5000	-	
		DC, 1 minute	-	5000	-	Vdc

RECOMMENDED OPERATING CONDITIONS

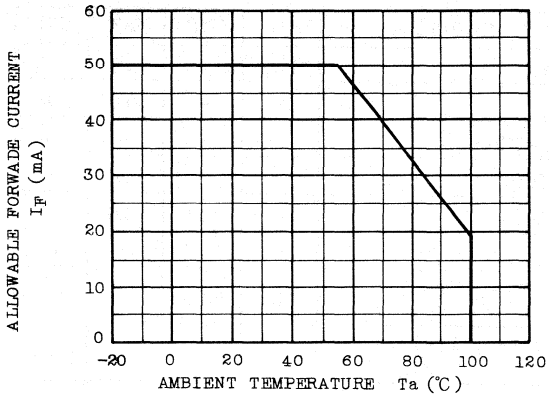
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	240	Vac
Forward Current	I_F	15	20	25	mA
Peak On-State Current	I_{TP}	-	-	1	A
Operating Temperature	Topr	-25	-	85	°C

Fig. 1 dv/dt TEST CIRCUIT

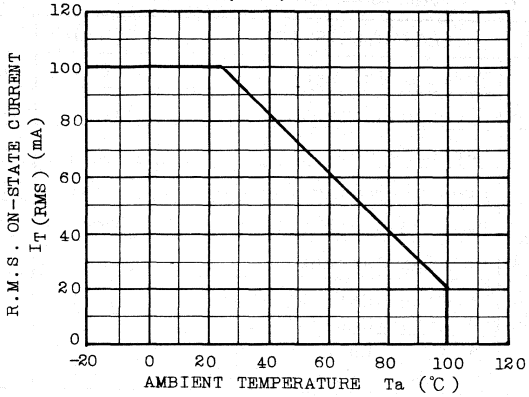




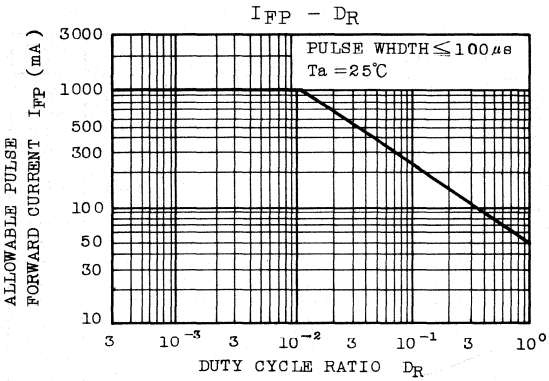
I_F – Ta



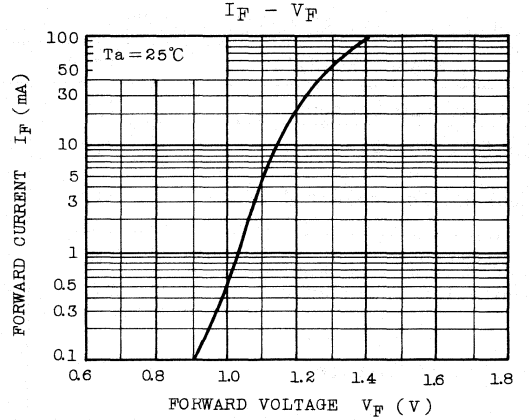
$I_{T(RMS)}$ – Ta



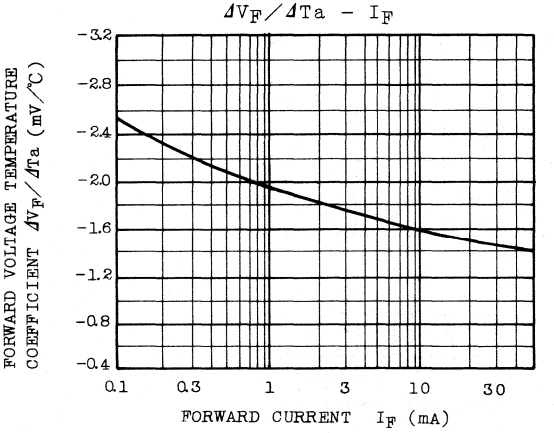
I_{FP} – D_R



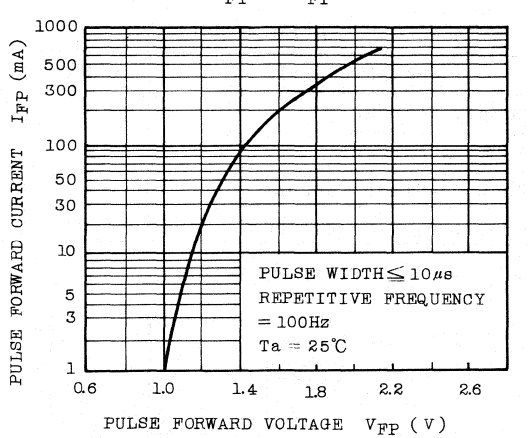
I_F – V_F



$\Delta V_F / \Delta Ta$ – I_F



I_{FP} – V_{FP}



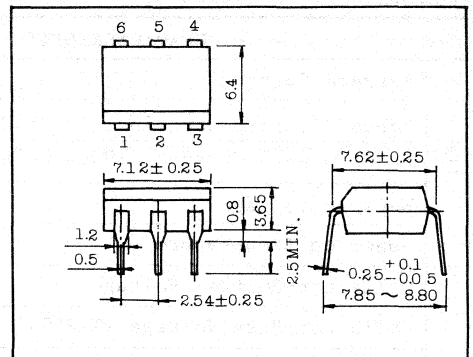
TLP570, TLP571

PROGRAMMABLE CONTROLLERS
AC/DC-INPUT MODULE
SOLID STATE RELAY

The TOSHIBA TLP570 and TLP571 consist of a darlington connected photo-transistor optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.
TLP570 is no-base internal connection for high-EMI environments.

- Collector-Emitter Voltage: 35V Min.
- Current Transfer Ratio : 1000% Min.
- Isolation Voltage : 2500Vrms Min.
- UL Recognized : File No. E67349

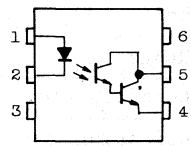
Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-7A1

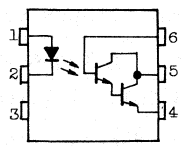
PIN CONFIGURATIONS (TOP VIEW)

TLP570



1: ANODE
2: CATHODE
3: NC
4: EMITTER
5: COLLECTOR
6: NC

TLP571



1: ANODE
2: CATHODE
3: NC
4: EMITTER
5: COLLECTOR
6: BASE

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIT	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	70	MA
	Forward Curent Derating (Ta≧25°C)	ΔI_F/°C	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)	I_{FP}	1	A
	Reverse Voltage	V_R	5	V
	Junction Temperature	T_j	125	°C
DETECTOR	Collector-Emitter Voltage	V_{CEO}	35	V
	Collector-Base Voltage (TLP571)	V_{CBO}	80	V
	Emitter-Collector Voltage	V_{ECO}	7	V
	Emitter-Base Voltage (TLP571)	V_{EBO}	7	V
	Collector Current	I_C	150	mA
	Power Dissipation	P_C	150	mW
	Power Dissipation Derating (Ta≧25°C)	ΔP_C/°C	-1.5	mW/°C
	Junction Temperature	T_j	125	°C
Storage Temperature Range		T_{stg}	-55∿125	°C
Operating Temperature Range		T_{opr}	-55∿100	°C
Lead Soldering Temperature (10 sec.)		T_{sold}	260	°C
Total Package Power Dissipation		P_T	250	MW
Total Package Power Dissipation Derating (Ta≧25°C)		ΔP_T/°C	-2.5	mW/°C
Isolation Voltage (AC, 1 min, RH≦6%)		BV_S	2500	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=1mA	35	-	-	V
	Emitter-Collectoe Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	7	-	-	V
	Collector-Base Breakdown Voltage. (TLP571)	$V_{(BR)CBO}$	I_C=0.1mA	80	-	-	V
	Emitter-Base Breakdown Voltage (TLP571)	$V_{(BR)EBO}$	I_E=0.1mA	7	-	-	V
	Collector Dark Current	I_{CEO}	V_{CE}=24V	-	10	200	nA
			V_{CE}=24V, Ta=85°C	-	-	300	μA
	Collector Dark Current (TLP571)	I_{CER}	V_{CE}=24V, Ta=85°C R_{BE}=10MΩ	-	0.5	10	μA
	Collector Dark Current (TLP571)	I_{CBO}	V_{CB}=10V	-	0.01	-	nA
	DC Forward Current Gain (TLP571)	h_{FE}	V_{CE}=5V, I_C=10mA	-	50K	-	-
	Capacitance (Collecter to Emitter)	C_{CE}	V=0, f=1MHz	-	10	-	pF

COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Current Transfer Ratio	I_C/I_F	I_F=1mA, V_{CE}=1V	1000	2000	-	%
Saturated CTR	$I_C/I_{F(sat)}$	I_F=10mA, V_{CE}=1V	500	-	-	%
Base Photo-Current (TLP571)	I_{PB}	I_F=1mA, V_{CB}=1V	-	2	-	μA
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C=10mA, I_F=1mA	-	-	1.0	V
		I_C=100mA, I_F=10mA	0.3	-	1.2	

ISOLATION CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V, R.H.≦60%	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	2500	-	-	Vrms
		AC, 1 second	-	5000	-	
		DC, 1 minute	-	5000	-	Vdc

SWITCHING CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Rise Time	t_r	V_{CC}=10V, I_C=10mA, R_L=100Ω	-	40	-	μs
Fall Time	t_f		-	30	-	
Turn-on Time	t_{on}		-	45	-	
Turn-off Time	t_{off}		-	35	-	
Turn-on Time	t_{ON}	R_L=180Ω (Fig.1)	-	5	-	μs
Storage Time	t_S	R_{BE}=OPEN	-	20	-	
Turn-off Time	t_{OFF}	V_{CC}=10V, I_F=10mA	-	100	-	
Turn-on Time	t_{ON}	R_L=180Ω (Fig.1)	-	5	-	μs
Storage Time	t_S	R_{BE}=10M (TLP571)	-	15	-	
Turn-off Time	t_{OFF}	V_{CC}=10V, I_F=10mA	-	60	-	

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	-	5	24	V
Forward Current	I_F	-	16	25	mA
Collector Current	I_C	-	-	50	mA
Operating Temperature	Topr	-25	-	85	°C

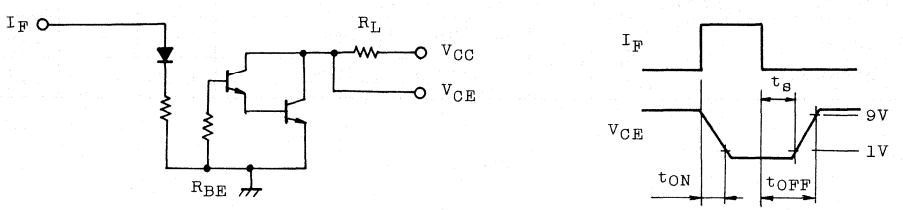
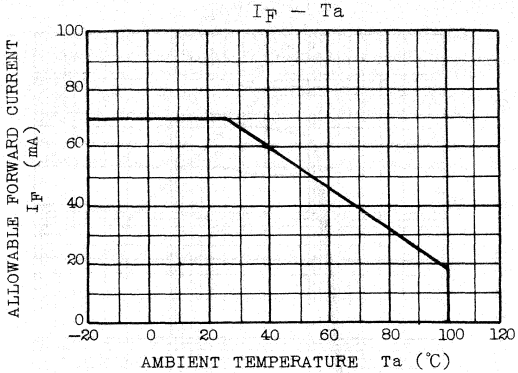
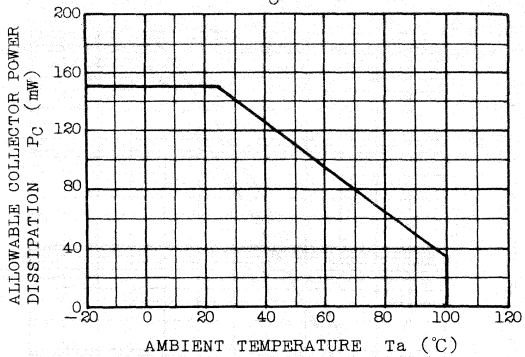


Fig.1 Switching Time Test Circuit

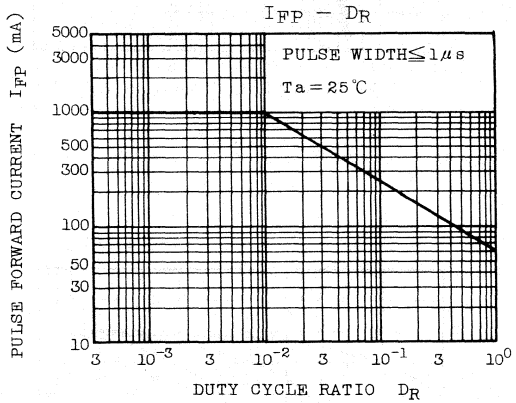
I_F – Ta

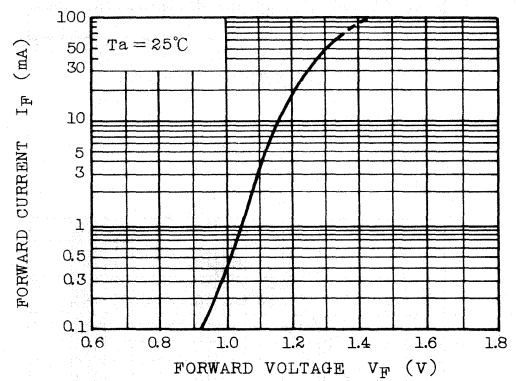


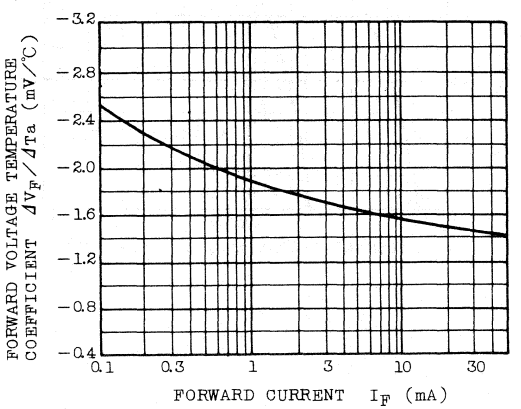
P_C – Ta

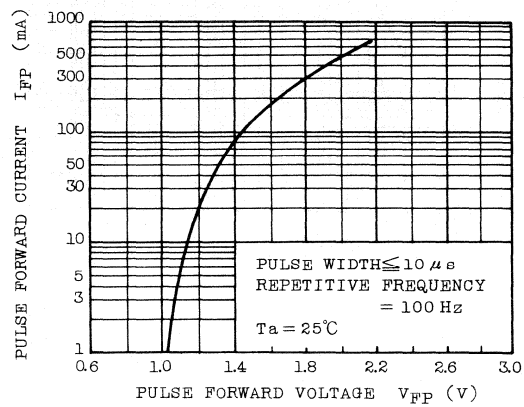


I_{FP} – D_R

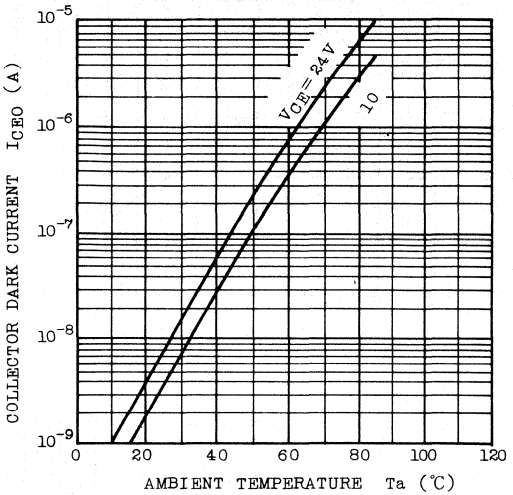




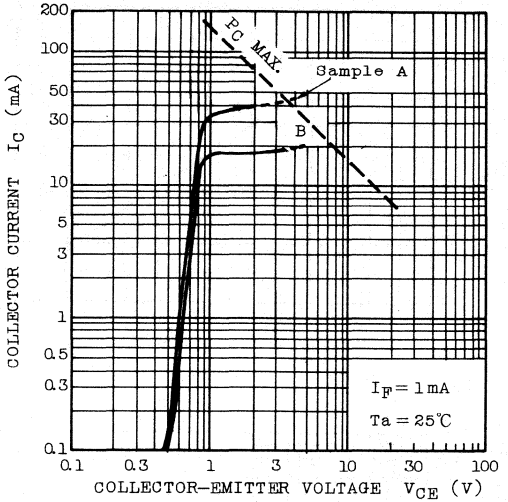




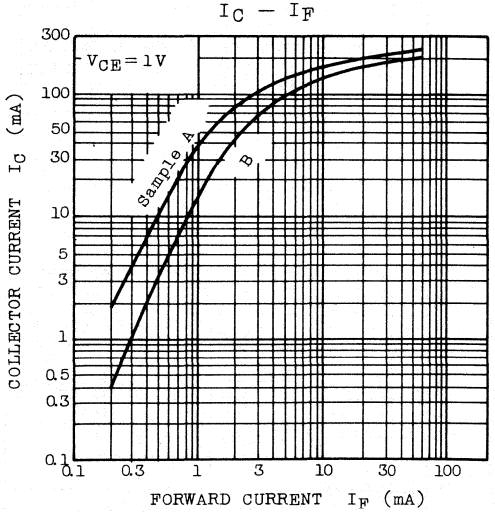
I_{CEO} – Ta



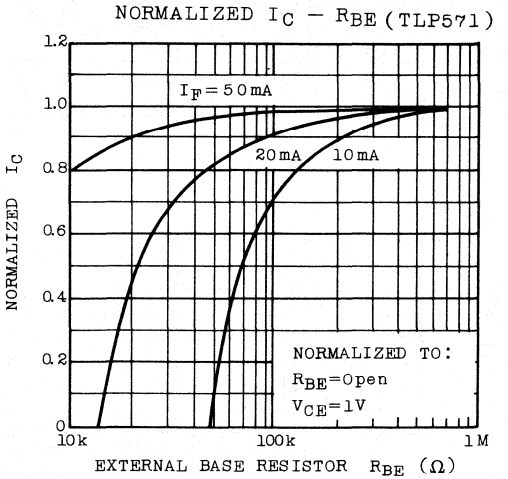
I_C – V_{CE}



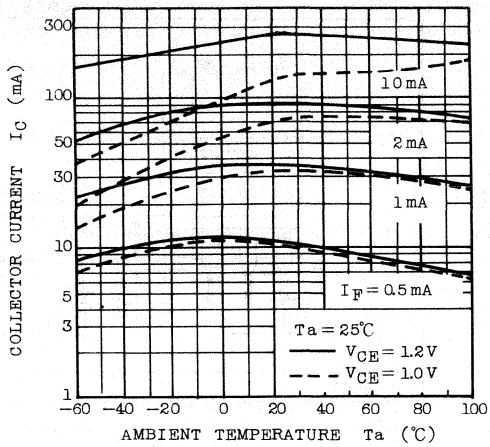
I_C – I_F



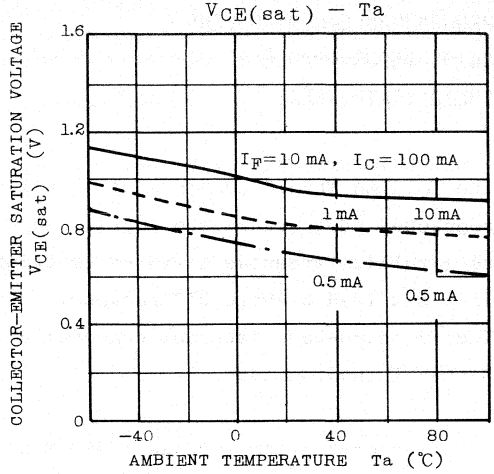
NORMALIZED I_C – R_{BE} (TLP571)



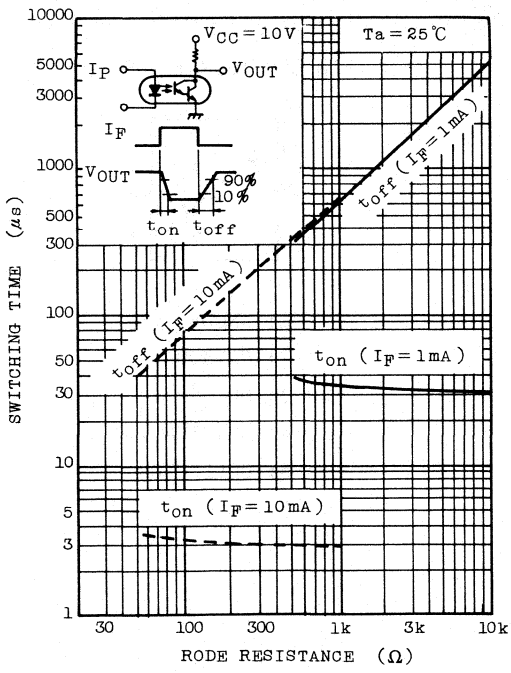
I_C – Ta



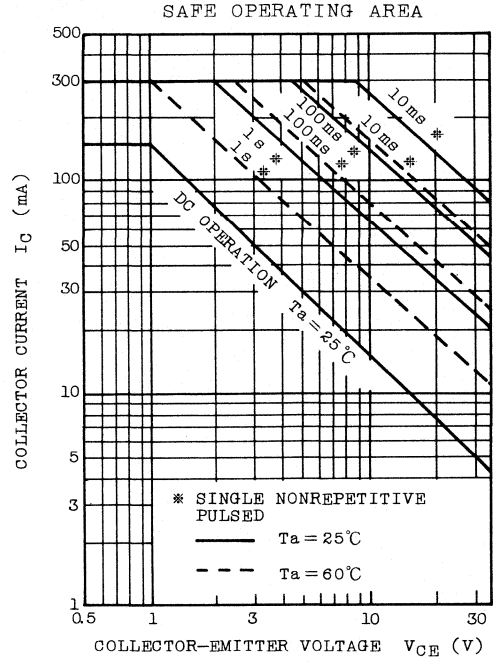
$V_{CE(sat)}$ – Ta



SWITCHING TIME



SAFE OPERATING AREA



TPL572

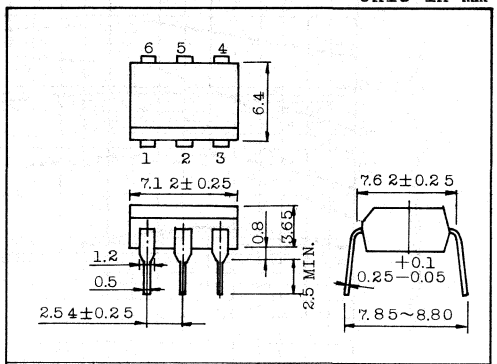
GaAs IRED & PHOTO-TRANSISTOR

PROGRAMMABLE CONTROLLERS
AC/DC-INPUT MODULE
SOLID STATE RELAY

The TOSHIBA TLP572 consists of a darlington connected photo-transistor optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.
TLP572 is no-base internal connection for high-EMI environments.

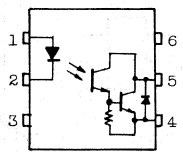
- Collector-Emitter Voltage : 55V Min.
- Current Transfer Ratio : 1000% Min.
- Isolation Voltage : 2500Vrms Min.
- UL Recognized : File No. E67349

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-7A1

PIN CONFIGURATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: EMITTER
5: COLLECTOR
6: NC

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Forward Current Derating (Ta ≧ 53°C)	I_F/°C	-0.7	mA°C
	Peak Forward Current (100μs pulse, 100pps)	I_{FP}	1	A
	Reverse Voltage	V_R	5	V
	Junction Temperature	T_j	125	°C
DETECTOR	Collector-Emitter Voltage	V_{CEO}	55	V
	Emitter-Collector Voltage	V_{ECO}	0.3	V
	Collector Current	I_C	150/-10	mA
	Power Dissipation	P_C	150	mW
	Power Dissipation Derating (Ta ≧ 25°C)	P_C/°C	-1.5	mW/°C
	Junction Temperature	T_j	125	°C
Storage Temperature Range		T_{stg}	-55 ∿ 125	°C
Operating Temperature Range		T_{opr}	-30 ∿ 85	°C
Lead Soldering Temperature		T_{sold}	260	°C
Total Package Power Dissipation		P_T	200	mW
Total Package Power Dissipation Derating (Ta ≧ 25°C)		P_D/°C	-2.6	mW/°C
Isolation Voltage (AC, 1min., RH ≦ 60%)		BV_S	2500	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
LED	Reverse Current	I_R	V_R=5V	-	-	10	μA
LED	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=1mA	55	-	-	V
DETECTOR	Emitter-Collecter Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	0.3	-	-	V
DETECTOR	Collector Dark Current	I_{CEO}	V_{CE}=24V	-	10	200	nA
			V_{CE}=24V, Ta=85°C	-	0.5	10	μA
DETECTOR	Capacitance (Collecter to Emitter)	C_{CE}	V=0, f=1MHZ	-	10	-	pF

COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTI	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Current Transfer Ratio	I_C/I_F	I_F=1mA, V_{CE}=1.2V	1000	2000	-	%
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C=100mA, I_F=10mA	0.3	-	1.2	V

ISOLATION CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V, R.H.≤60%	-	10^{11}	-	Ω
AC Isolation Voltage	BV_S	AC, 1 minute	2500	-	-	V_{rms}

SWITCHING CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Rise Time	t_r	V_{CC}=10V, I_C=10mA R_L=100Ω	-		-	μs
Fall Time	t_f		-		-	
Turn-on Time	t_{on}		-		-	
Turn-off Time	t_{off}		-		-	
Turn-on Time	t_{ON}	R_L=180 (Fig.1) V_{CC}=10V, I_F=10mA	-	3	-	μs
Storage Time	t_s		-	-	-	
Turn-off Time	t_{OFF}		-	80	-	

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	-	12	24	V
Forward Current	I_F	-	-	25	mA
Collector Current	I_C	-	-	40	mA
Operating Temperature	T_{opr}	-30	-	85	°C

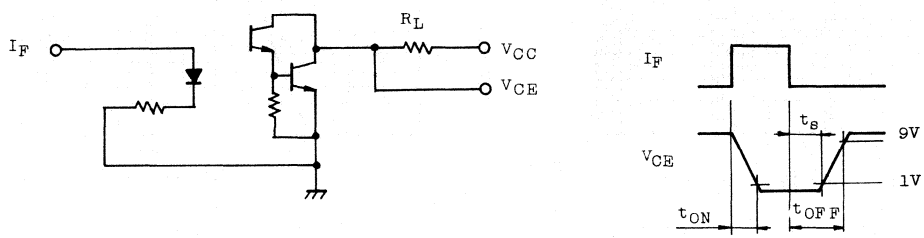
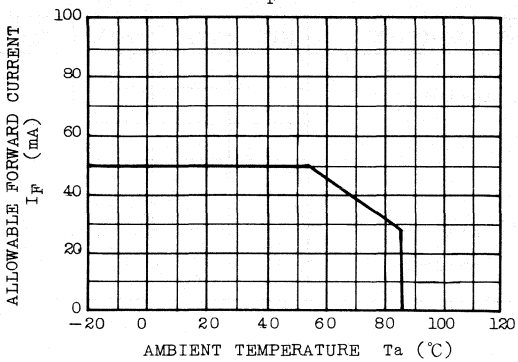
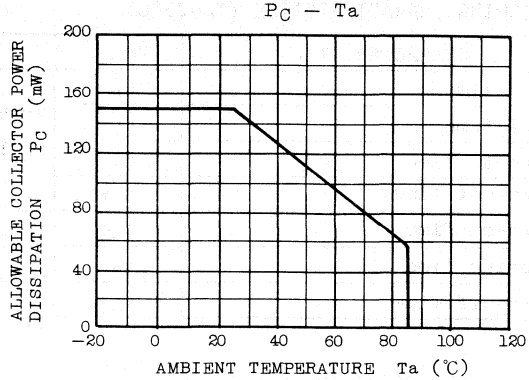


Fig. 1 Switching Time Test Circuit

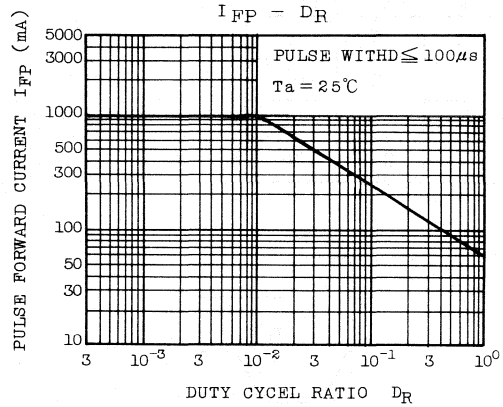
I_F – Ta



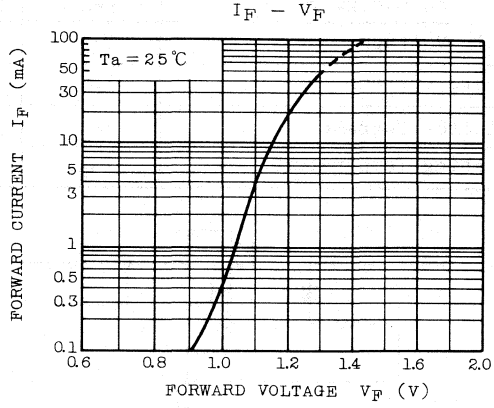
P_C – Ta



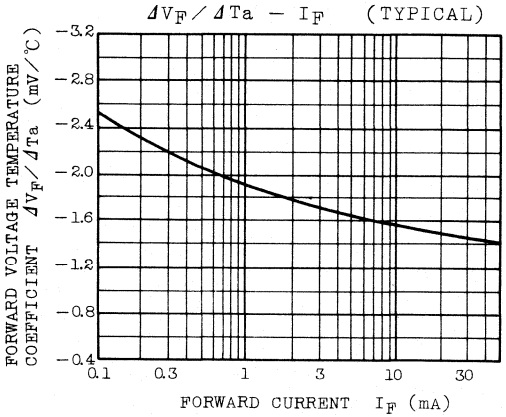
I_{FP} – D_R



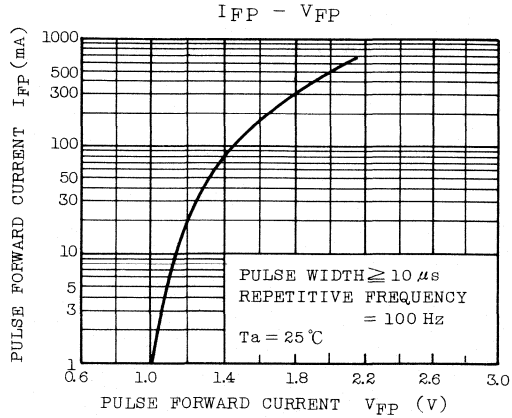
I_F – V_F



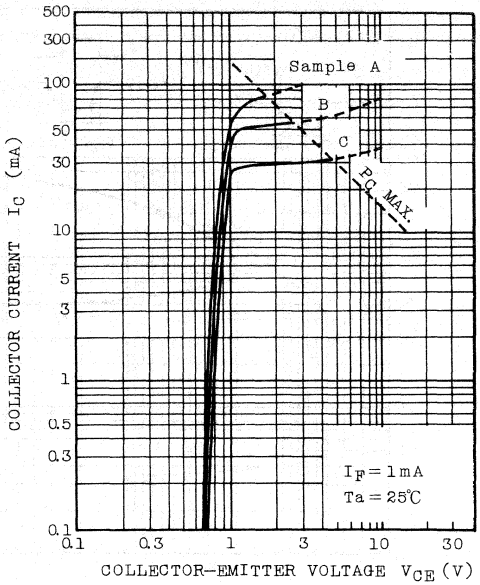
$\Delta V_F / \Delta Ta$ – I_F (TYPICAL)



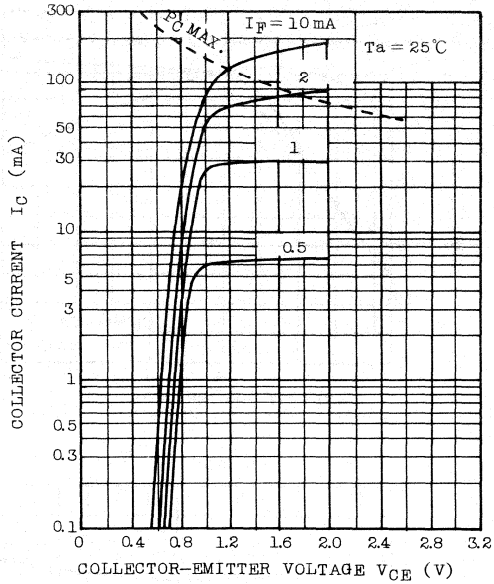
I_{FP} – V_{FP}



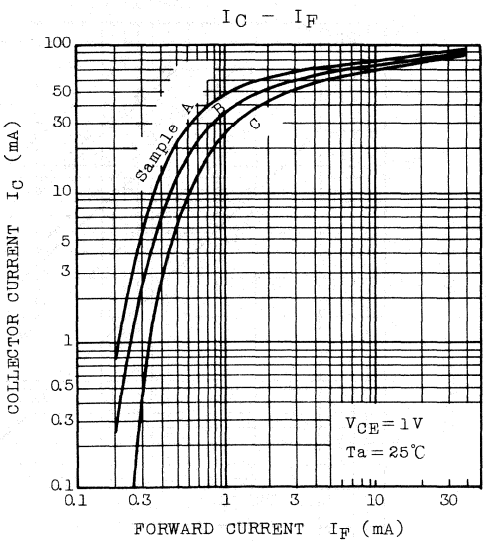
$I_C - V_{CE}$



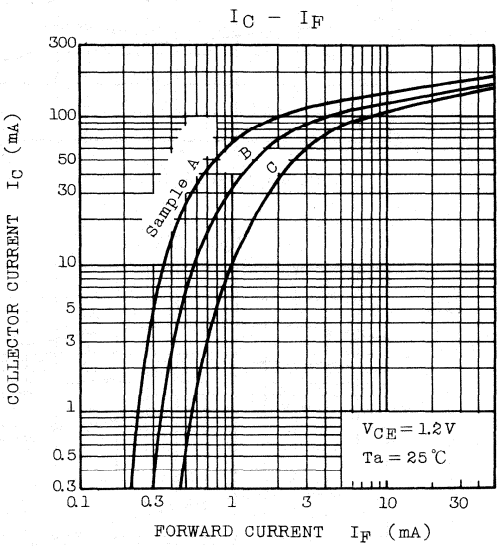
$I_C - V_{CE}$



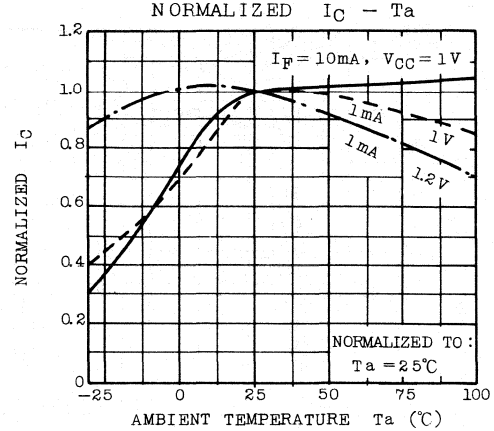
$I_C - I_F$



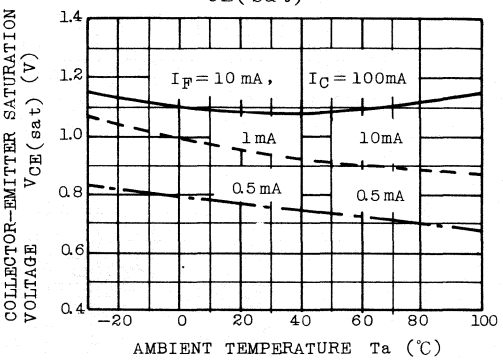
$I_C - I_F$



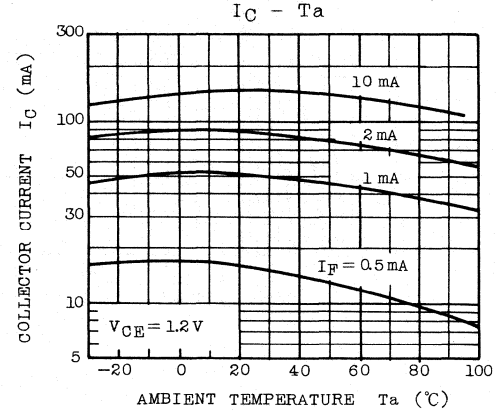
NORMALIZED I_C – Ta



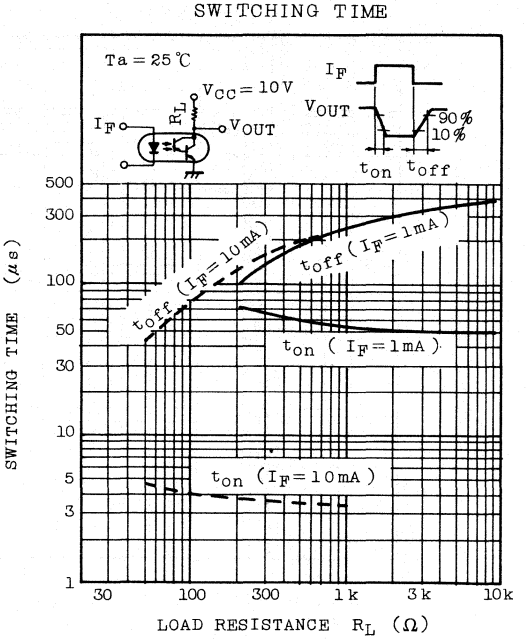
$V_{CE(sat)}$ – Ta



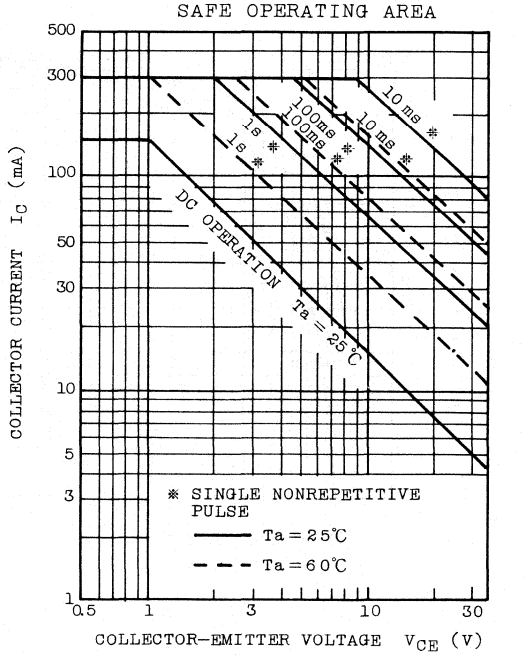
I_C – Ta



SWITCHING TIME



SAFE OPERATING AREA

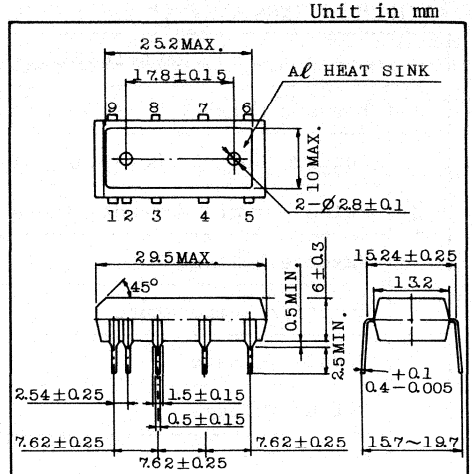


MOTOR CONTROL
CONTROLLER
COPY MACHINE
NC MACHINE
PULSE MOTOR DRIVE
POWER TRANSISTOR DRIVE

TLP573 can control DC 1A, this unit is a 9-LEAD DIP package.

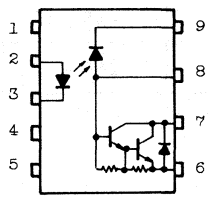
. High Output Current
  : I_O=1A, @I_F=12mA, V_O=1.5V, V_{CC}=5V
  : $I_O \leqq$1mA, @V_O=5V, I_F=1.5mA
. High Output Voltage
  : V_O(V_{CEO})=60V, V_{CC} (photo-diode)=60V
. High Isolation Voltage : BV_S=2500V AC/1min.
. Type Name : P573 or TLP573

Unit in mm



1,4,5 : NC	6 : EMITTER
2 : ANOD	7 : COLLECTOR
3,9 : CATHOD	8 : BASE, ANOD
JEDEC	—
EIAJ	—
TOSHIBA	11-30A1B

PIN CONFIGURATIONS (TOP VIEW)



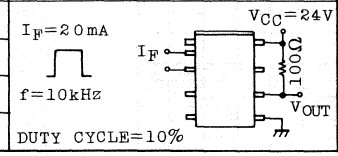
MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	60	mA
	Foreard Current Derating (Ta≧50°C)	ΔI_F/°C	-1.2	mA/°C
	Pulse Forward Current (Note 1)	I_{FP}	1	A
	Reverse Voltage	V_R	5	V
	Junction Temperature	T_j	100	°C
DETECTOR	Supply Voltage	V_{CC}	-0.5～60	V
	Output Voltage	V_O	-0.5～60	V
	Output Current	I_O	1	A
	Emitter-Base Reverse Voltage	V_{EBO}	5	V
	Base Current	I_B	0.2	A
	Output Power Dissipation	P_O	1.3	W
	Output Power Dissipation Derating (Ta≧25°C)	ΔP_O/°C	18	mW/°C
	Junction Temperature	T_j	100	°C
Isolation Voltage (Note 2)		BVS	2500	V_{rms}
Operating Temperature Range		T_{opr}	-30～80	°C
Storage Temperature Range		T_{stg}	-55～125	°C
Lead Temperature . Time		T_{sol}	260 . 3	°C.sec

Note 1 : Pulse width≦100μs, Repetitive frequency=100Hz

2 : AC/1min., R.H=40～60%

ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage		V_F	I_F=30mA	1.10	1.24	1.40	V
	Reverse Current		I_R	V_R=5V	-	-	10	μA
	Terminal Between Capacitance		C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	High Level Output Current		I_{OH}	I_F=0mA, V_{CC}=V_O=60V	-	-	1	μA
	Photo Diose Reverse Current		I_{CCH}	I_F=0mA, V_{CC}=60V	-	-	200	nA
	DC Current Gain		h_{FE}	V_{CE}=1.5V, I_O=1A	-	5000	-	
	Emitter Cut-off Current		I_{EBO}	V_{FB}=5V, I_O=0	-	-	10	mA
COUPLED	Trigger Current 1		$I_{F1(ON)}$	V_O=1.5V, V_{CC}=5V, I_O=1A	-	6	12	mA
	Trigger Current 2		$I_{F2(ON)}$	V_O=V_{CC}=1.5V, I_O=1A	-	9	20	mA
	Non-Trigger Current		$I_{F(OFF)}$	V_O=1.5V, V_{CC}=5V, I_O=1mA	1.5	3.5	-	mA
	Current Transfer Ratio		I_O/I_F	V_O=1.5V, V_{CC}=5V, I_O=1A	8200	-	-	%
	Low Level Output Voltage 1		V_{OL1}	V_{CC}=5V, I_O=1A, I_F=15mA	-	1.3	1.5	V
	Low Level Output Voltage 2		V_{OL2}	V_{CC}=V_{OL2}, I_O=1A, I_F=20mA	-	1.3	1.5	V
	Switching Time	Delay Time	t_d		-	0.6	-	μs
		Rise Time	t_r		-	0.6	-	μs
		Storage	t_s		-	4	-	μs
		Fall Time	t_f		-	2	-	μs

RECOMMENDED OPERATING CONDITIONS (Ta=-30～55°C)

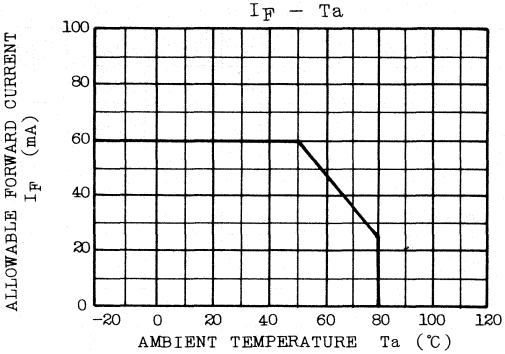
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Trigger Current 1	$I_{F1(ON)}$	18	20	40	mA
Trigger Current 2	$I_{F2(ON)}$	25	30	40	mA
Non-Trigger Current	$I_{F(OFF)}$	0	-	1	mA
Output Low Level Current	I_{OL}	-	-	0.55	A
Supply Voltage	V_{CC}	3	24	30	V
Output High Level Voltage	V_{OH}	-	24	30	V

PRECAUTION

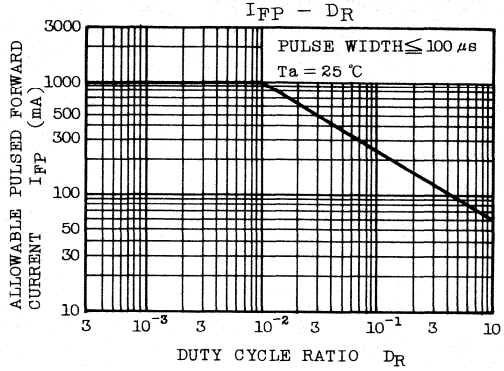
Please be careful of the followings.

. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
  Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
  o Freon TE or TF o Dai-Fron Solvents S3 or S3-E

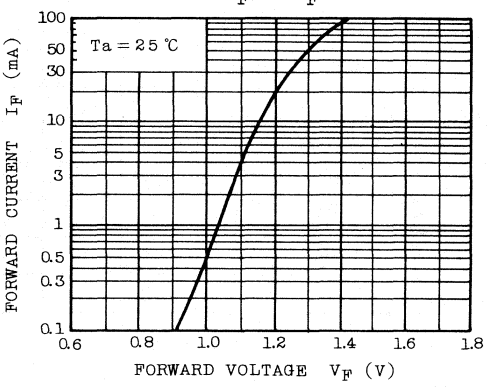
I_F – Ta



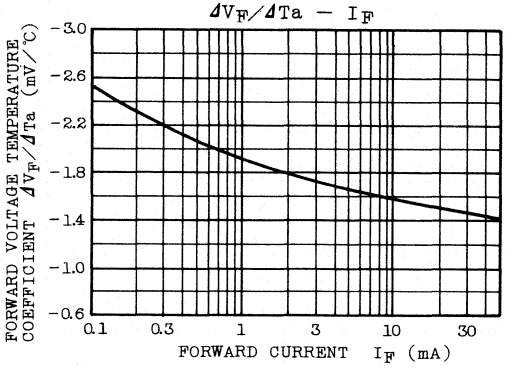
I_{FP} – D_R



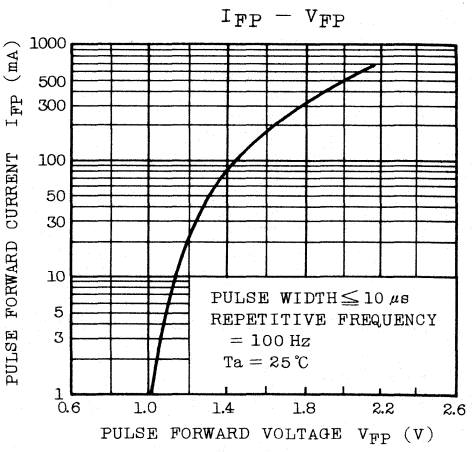
I_F – V_F



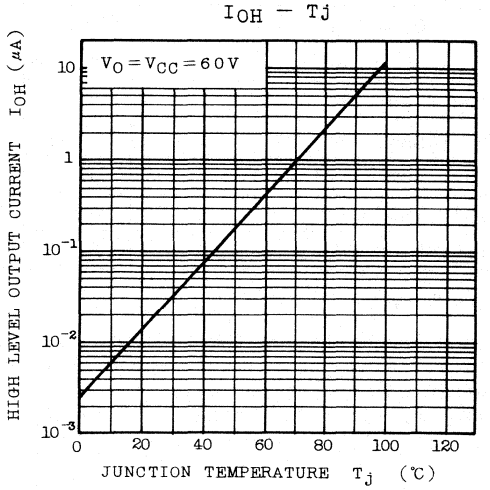
$\Delta V_F/\Delta Ta$ – I_F



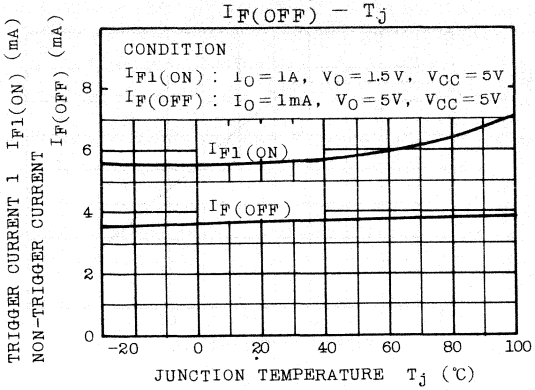
I_{FP} – V_{FP}



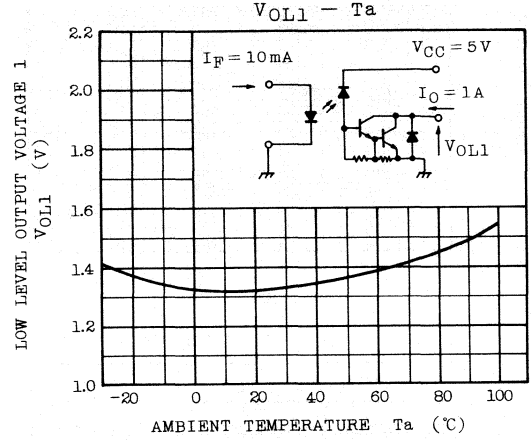
I_{OH} – Tj



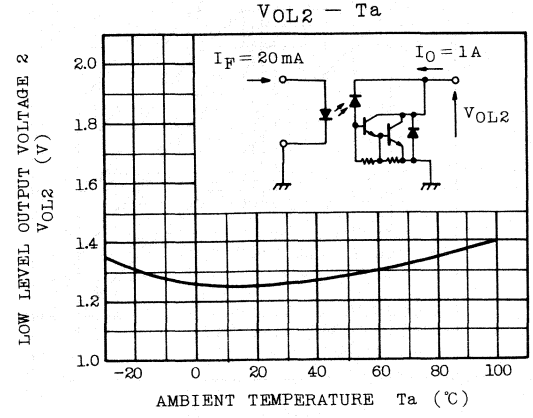
$I_{F1(ON)}$ — T_j
$I_{F(OFF)}$ — T_j



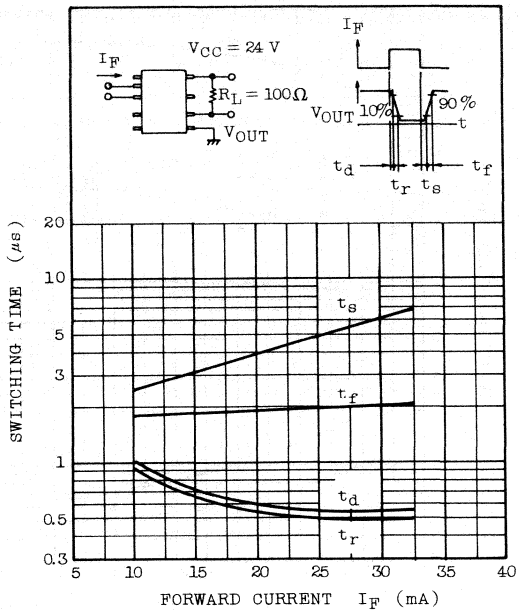
V_{OL1} — Ta



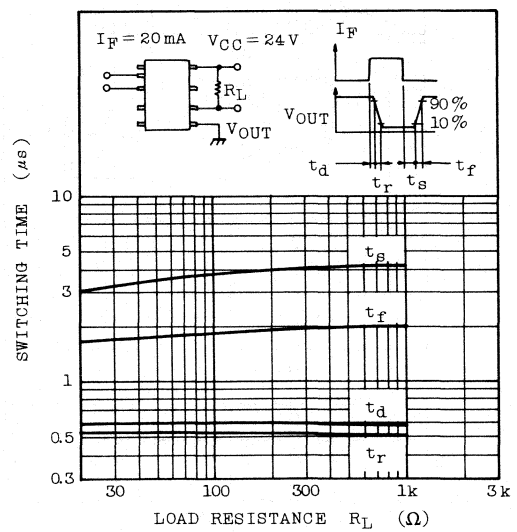
V_{OL2} — Ta



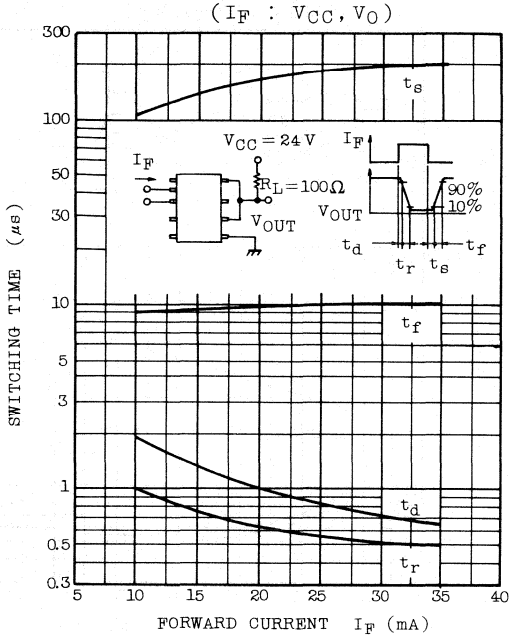
SWITCHING CHARACTERISTICS
(I_F : V_{CC}, V_O)



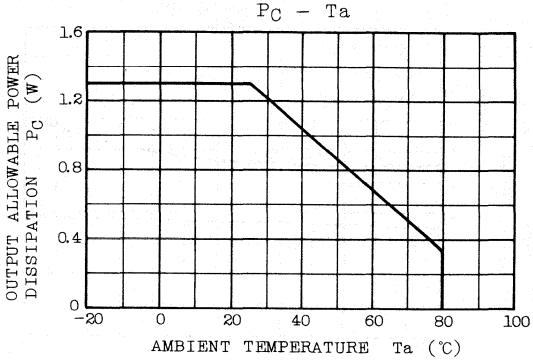
SWITCHING CHARACTERISTICS
(R_L : V_{CC}, V_O)



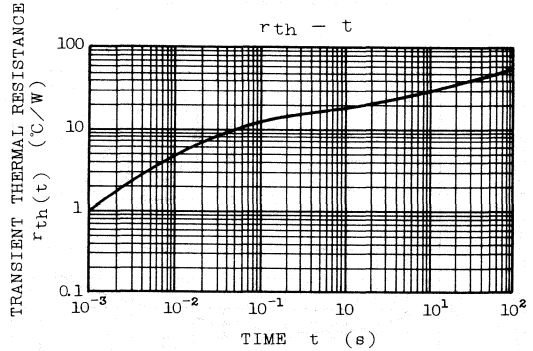
SWITCHING CHARACTERISTICS
(I_F : V_{CC}, V_O)



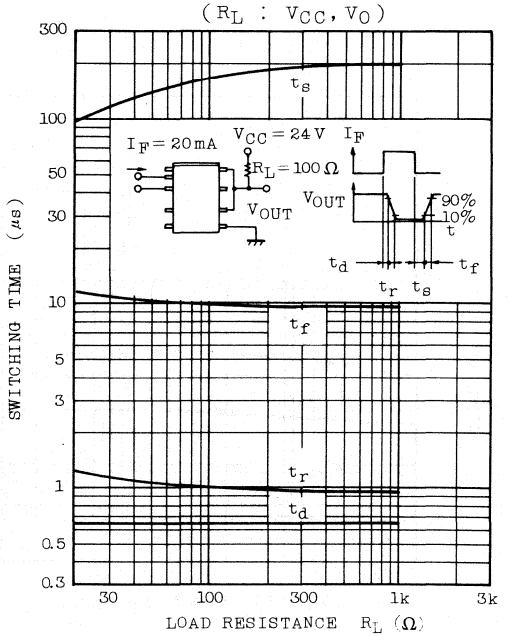
P_C – Ta



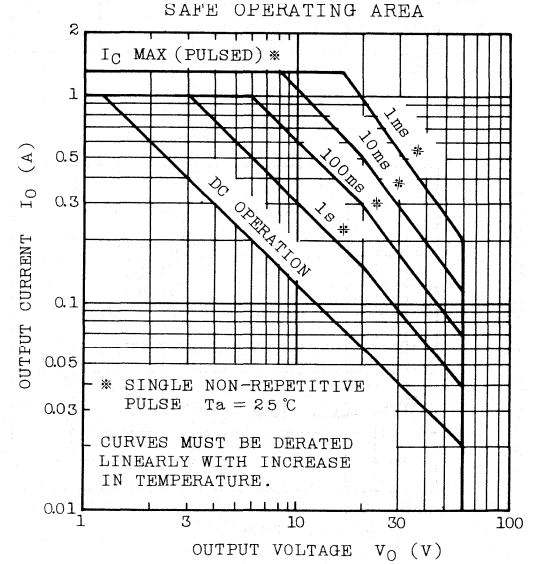
r_{th} – t



SWITCHING CHARACTERISTICS
(R_L : V_{CC}, V_O)



SAFE OPERATING AREA



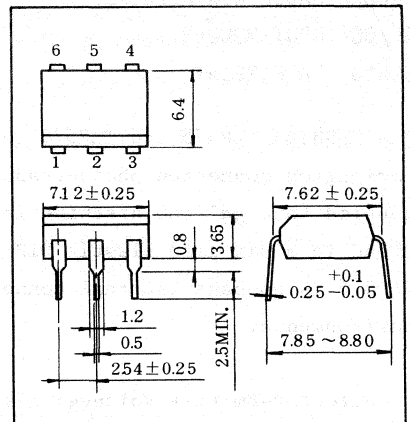
TLP575(Short)

PROGRAMMABLE CONTROLLERS.
AC/DC-INPUT MODULE.
SOLID STATE RELAY.

The TOSHIBA TLP575 (Short) consists of a darlington connected photo-transistor optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.

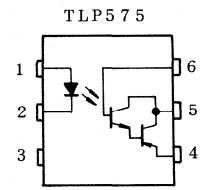
- Collector-Emitter Voltage : 35V Min.
- Current Transfer Ratio : 200% Min.
- Isolation Voltage : 2500Vrms Min.
- UL Recognized : File No. E67349

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11−7A1

PIN CONFIGURATION (TOP VIEW)



1 : ANODE
2 : CATHODE
3 : NC
4 : EMITTER
5 : COLLECTOR
6 : BASE

TLP575, TLP576

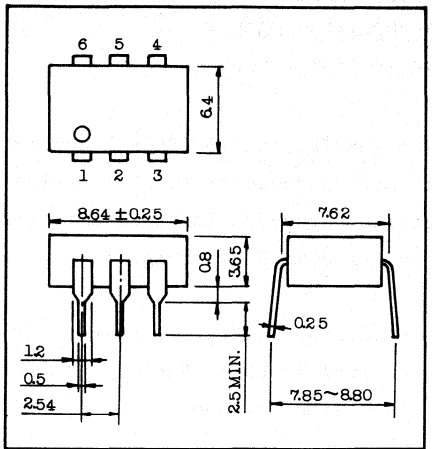
GaAs IRED & PHOTO-TRANSISTOR

PROGRAMMABLE CONTROLLERS.
AC/DC-INPUT MODULE.
SOLID STATE RELAY.

The TOSHIBA TLP575 and TLP576 consist of a darlington connected photo-transistor optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.
TLP576 is no-base internal connection for high-EMI environments.

- Collector-Emitter Voltage: 35V Min.
- Current Transfer Ratio : 200% Min.
- Isolation Voltage : 2500Vrms Min.
- UL Recognized : File No. E67349

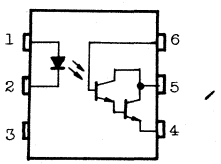
Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-9A1

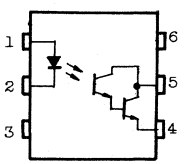
PIN CONFIGURATIONS (TOP VIEW)

TLP575



1: ANODE
2: CATHODE
3: NC
4: EMITTER
5: COLLECTOR
6: BASE

TLP576



1: ANODE
2: CATHODE
3: NC
4: EMITTER
5: COLLECTOR
6: NC

MAXIMUM RATINGS (Ta = 25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	60	mA
	Forward Current Derating (Ta ≧ 39°C)	ΔI_F/°C	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)	I_{FP}	1	A
	Power Dissipation	P_D	100	mW
	Power Dissipation Derating (Ta ≧ 25°C)	ΔP_D/°C	-1.0	mW/°C
	Reverse Voltage	V_R	5	V
	Junction Temperature	T_j	125	°C
DETECTOR	Collector-Emitter Voltage	V_{CEO}	35	V
	Collector-Base Voltage (TLP575)	V_{CBO}	60	V
	Emitter-Collector Voltage	V_{ECO}	7	V
	Emitter-Base Voltage (TLP575)	V_{EBO}	7	V
	Collector Current	I_C	50	mA
	Power Dissipation	P_C	150	mW
	Power Dissipation Derating (Ta ≧ 25°C)	ΔP_C/°C	-1.5	mW/°C
	Junction Temperature	T_j	125	°C
Storage Temperature Range		T_{stg}	-55 ∿ 150	°C
Operating Temperature Range		T_{opr}	-55 ∿ 100	°C
Lead Soldering Temperature (10 sec.)		T_{sold}	260	°C
Total Package Power Dissipation		P_T	250	mW
Total Package Power Dissipation Derating (Ta ≧ 25°C)		ΔP_T/°C	-2.5	mW/°C
Isolation Voltage (AC, 1 min, RH ≦ 6%)		BV_S	2500	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta = 25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	PF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=1mA	35	-	-	V
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	7	-	-	
	Collector-Base Breakdown Voltage (TLP575)	$V_{(BR)CBO}$	I_C=0.1mA	35	-	-	
	Emitter-Base Breakdown Voltage (TLP575)	$V_{(BR)EBO}$	I_E=0.1mA	7	-	-	
	Collector Dark Current	I_{CEO}	V_{CE}=10V	-	1.0	100	nA
			V_{CE}=10V, Ta=85°C	-	-	-	μA
	Collector Dark Current (TLP575)	I_{CER}	V_{CE}=10V, Ta=85°C R_{BE}=10MΩ	-	0.5	10	μA
	Collector Dark Current (TLP575)	I_{CBO}	V_{CB}=10V	-	0.01	-	nA
	DC Forward Current Gain (TLP575)	h_{FE}	V_{CE}=5V, I_C=10mA	-	10K	-	-
	Capacitance Collecter to Emitter	C_{CE}	V=0, f=1MHz	-	10	-	PF

COUPLED ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Current Transfer Ratio	I_C/I_F	I_F=1mA, V_{CE}=1V	200	-	-	%
Saturated CTR	I_C/I_F(sat)	I_F=10mA, V_{CE}=1V	-	-	-	%
Base Photo-Current (TLP575)	I_{PB}	I_F=1mA, V_{CB}=1V	-	2	-	μA
Collector-Emitter Saturation Voltage	V_{CE}(sat)	I_C=1mA, I_F=1mA	-	-	1.0	V
		I_C=10mA, I_F=10mA	-	-	-	

ISOLATION CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Capacitance Input to Output	C_S	V_S=0, f=1MHz	-	0.8	-	PF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	2500	-	-	V_{rms}
		AC, 1 second	-	5000	-	
		DC, 1 minute	-	5000	-	V_{dc}

SWITCHING CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Rise Time	t_r	V_{CC}=10V, I_C=2mA, R_L=100Ω	-		-	μs
Fall Time	t_f		-		-	
Turn-on Time	t_{on}		-		-	
Turn-off Time	t_{off}		-		-	
Turn-on Time	t_{ON}	R_L=4.7KΩ (Fig.1), R_{BE}=OPEN, V_{CC}=10V, I_F=1mA	-		-	μs
Storage Time	t_S		-		-	
Turn-off Time	t_{OFF}		-		-	
Turn-on Time	t_{ON}	R_L=4.7KΩ (Fig.1), R_{BE}=5.1MΩ (TLP575), V_{CC}=10V, I_F=1mA	-		-	μs
Storage Time	t_S		-		-	
Turn-off Time	t_{OFF}		-		-	

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	-	5	24	V
Forward Current	I_F	-	1.6	25	mA
Collector Current	I_C	-	-	10	mA
Operating Temperature	T_{opr}	-25	-	85	°C

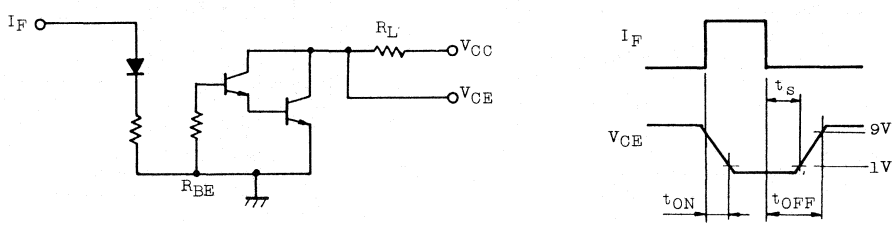
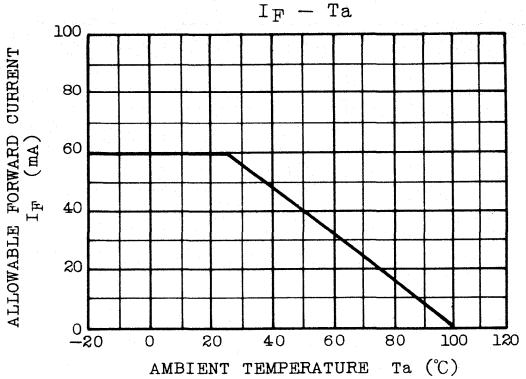
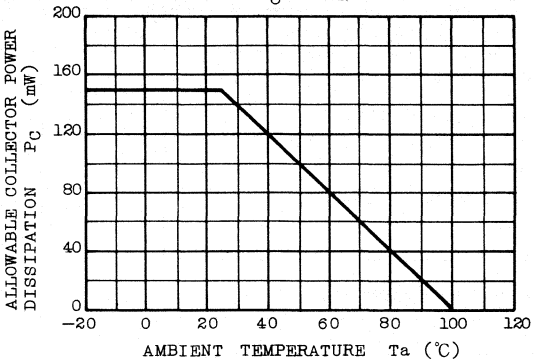


Fig.1 Switching Time Test Circuit

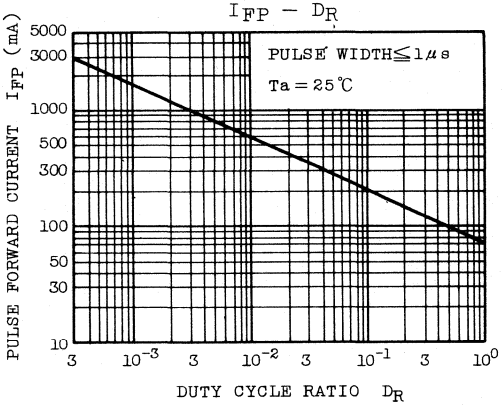
I_F – Ta



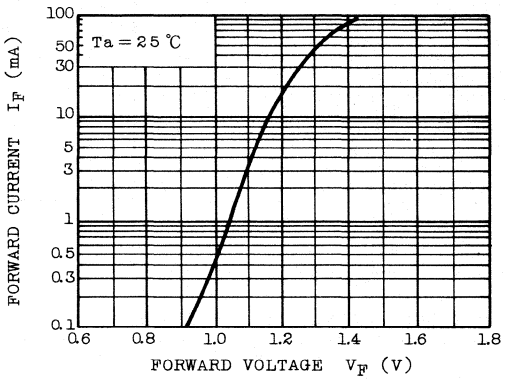
P_C – Ta



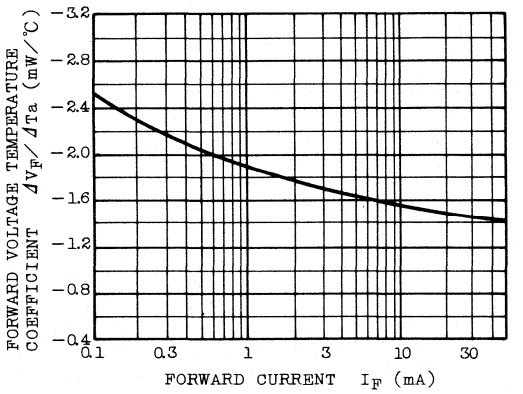
I_{FP} – D_R



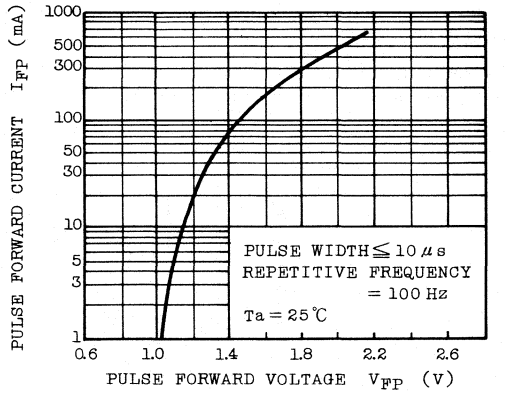
I_F – V_F



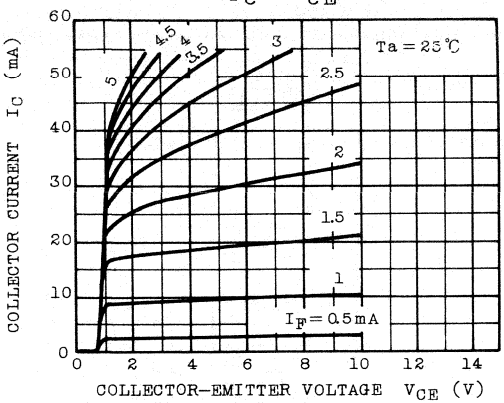
$\Delta V_F / \Delta Ta$ – I_F



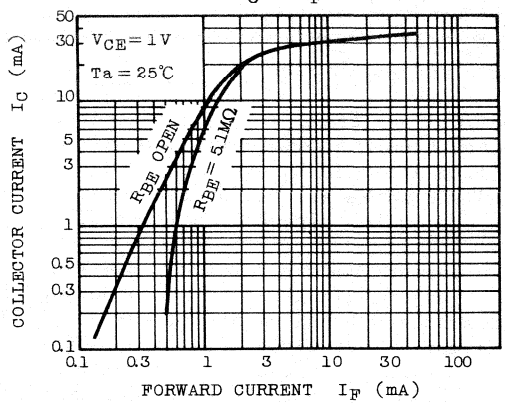
I_{FP} – V_{FP}



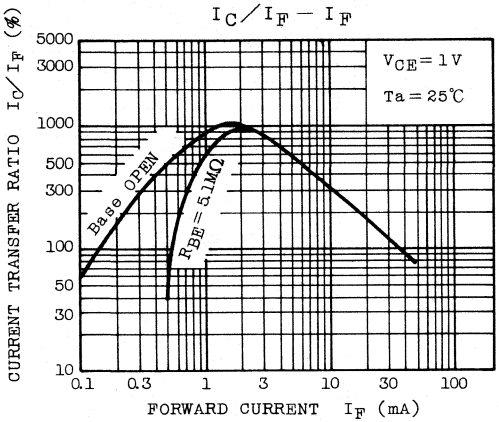
$I_C - V_{CE}$



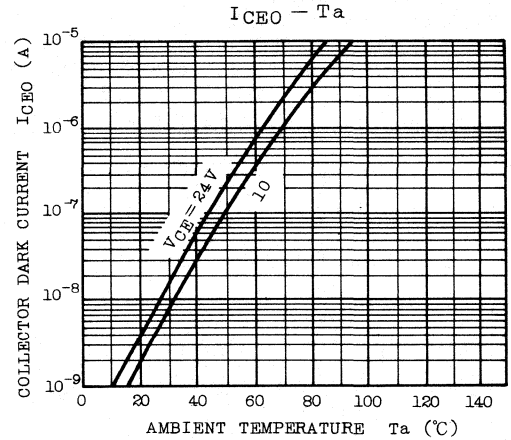
$I_C - I_F$



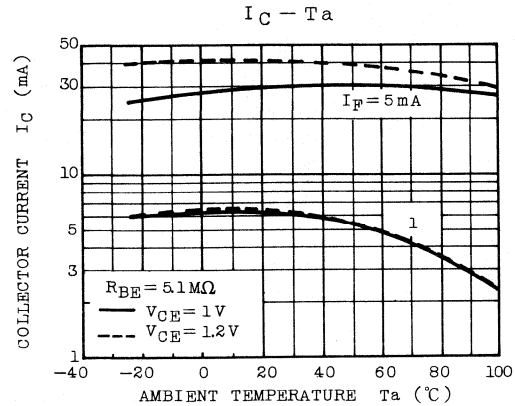
$I_C / I_F - I_F$



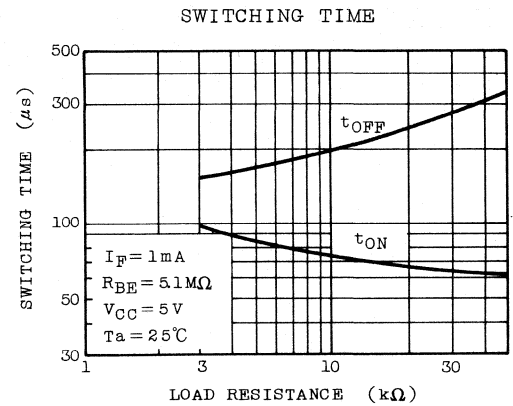
$I_{CEO} - Ta$



$I_C - Ta$



SWITCHING TIME



TLP580, TLP581

GaAℓAs IRED & PHOTO-TRANSISTOR

OFFICE MACHINE
HOUSEHOLD USE EQUIPMENT
SOLID STATE RELAY
SWITCHING POWER SUPPLY

The TOSRIBA TLP580 and TLP581 consist of a photo-transistor optically coupled to an aluminum gallium arsenide infrared emitting diode in a five lead VDE package. TLP580 is no-base internal connection for high-EMI environments.

- Collector-Emitter Voltage : 35V Min.
- Isolation Voltage : $5000V_{rms}$ Min.
- Guaranteed Requirements of VDE0730/BS5850
- Climatic Test Class : 55/150/21
- Isolation Thickness : 2mm Min.
- Isolation Creepage Path : 14.5mm Min.
- Isolation Clearance : 14.5mm Min.
- Isolation Operating Voltage
  : $750V_{ac}$ or $900V_{dc}$ for Isolation Group C*1
- Creeping Current Resistance : Group I*2
- UL Recognized : File No. E67349
- VDE Approved : Certificate No. 37411

*1 : According to VDE0110, table 4

*2 : According to VDE0110, table 3

- Current Transfer Ratio:

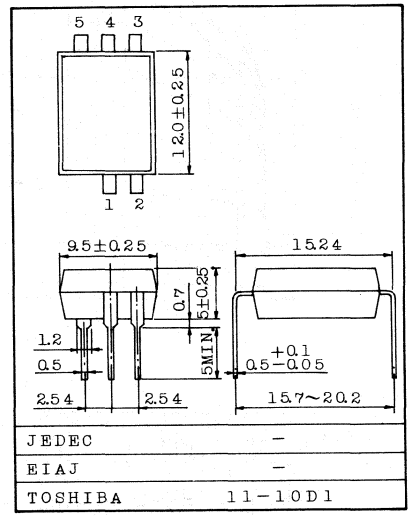
CLASSIFICATION *1	CURRENT TRANSFER RATIO (I_C/I_F) I_F=10mA, V_{CE}=5V Ta=25°C		MARKING OF CLASSIFICATION
	MIN.	MAX.	
(None)	25	-	BLANK Y,Y",G,G",O,O"
Rank O	25	75	O,O"
Rank Y	50	150	Y,Y"
Rank GR	100	300	G,G"

*1 : Ex. Rank Y : TLP580(Y)

- Note: Application type name for certification test, please use standard product type name, i.e.

  TLP580(Y) : TLP580

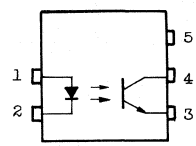
Unit in mm



JEDEC	-
EIAJ	-
TOSHIBA	11-10D1

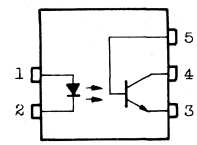
PIN CONFIGURATIONS (TOP VIEW)

TLP580



1 : ANODE
2 : CATHODE
3 : EMITTER
4 : COLLECTOR
5 : NC

TLP581



1 : ANODE
2 : CATHODE
3 : EMITTER
4 : COLLECTOR
5 : BASE

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Forward Current Derating (Ta≧25°C)	$\Delta I_F/°C$	-0.5	mA/°C
	Peak Forward Current (100μs pulse, 100pps)	I_{FP}	1	A
	Power Dissipation	P_D	100	mW
	Power Dissipation Derating (Ta≧25°C)	$\Delta P_D/°C$	-1.0	mW/°C
	Reverse Voltage	V_R	5	V
	Junction Temperature	T_j	125	°C
DETECTOR	Collector-Emitter Voltage	V_{CEO}	35	V
	Collector-Base Voltage (TLP581)	V_{CBO}	50	V
	Emitter-Collector Voltage	V_{ECO}	5	V
	Emitter-Base Voltage (TLP581)	V_{EBO}	5	V
	Collector Current	I_C	50	mA
	Power Dissipation	P_C	150	mW
	Power Dissipation Derating (Ta≧25°C)	$\Delta P_C/°C$	-1.5	mW/°C
	Junction Temperature	T_j	125	°C
Storage Temperature Range		T_{stg}	-55～125	°C
Operating Temperature Range		T_{opr}	-55～100	°C
Lead Soldering Temperature (10 sec.)		T_{sold}	260	°C
Total Package Power Dissipation		P_T	250	mW
Total Package Power Dissipation Derating (Ta≧25°C)		$\Delta P_T/°C$	-2.5	mW/°C
Isolation Voltage (AC, 1 min., RH≦60%)		BV_S	5000	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	-	1.65	1.8	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	45	-	pF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=0.5mA	35	-	-	V
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	5	-	-	V
	Collector-Base Breakdown Voltage (TLP581)	$V_{(BR)CBO}$	I_C=0.1mA	50	-	-	V
	Emitter-Base Breakdown Voltage (TLP581)	$V_{(BR)EBO}$	I_E=0.1mA	5	-	-	V
	Collector Dark Current	I_{CEO}	V_{CE}=24V	-	10	100	nA
			V_{CE}=24V, Ta=85°C	-	2	50	μA
	Collector Dark Current (TLP581)	I_{CER}	V_{CE}=24V, Ta=85°C, R_{BE}=1MΩ	-	0.5	10	μA
	Collector Dark Current (TLP581)	I_{CBO}	V_{CB}=10V	-	0.1	-	nA
	DC Forward Current Gain (TLP581)	h_{FE}	V_{CE}=5V, I_C=0.5mA	-	500	-	-
	Capacitance Collector to Emitter	C_{CE}	V=0, f=1MHz	-	15	-	pF

COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIT	SYMBOL	TEST TONDITION	MIN.	TYP.	MAX.	UNIT
Current Transfer Ratio	I_C/I_F	I_F=10mA, V_{CE}=5V	25	60	-	%
		Rank O	25	-	75	
		Rank Y	50	-	150	
		Rank GR	100	-	300	
Saturation CTR	I_C/I_F(sat)	I_F=2mA, V_{CE}=0.4V	-	45	-	%
		Rank Y, GR	30	-	-	
Base Photo-Current (TLP581)	I_{PB}	I_F=10mA, V_{CB}=10V	-	5	-	μA
Collector-Emitter Saturation Voltage	V_{CE}(sat)	I_C=2.4mA, I_F=10mA	-	-	0.4	V

ISOLATION CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Capacitance(Input to Output)	C_S	V_S=0, f=1MHz	-	0.3	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	5000	-	-	V_{rms}
		AC, 1 second	-	15000	-	
		DC, 1 minute	-	15000	-	V_{dc}

SWITCHING CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Rise Time	t_r	V_{CC}=10V, I_C=2mA, R_L=100Ω	-	4	-	μs
Fall Time	t_f		-	5	-	
Turn-on Time	t_{on}		-	5	-	
Turn-off Time	t_{off}		-	5	-	
Turn-on Time	t_{ON}	R_L=2.7kΩ (Fig.1), R_{BE}=OPEN, V_{CC}=5V, I_F=16mA	-	10	-	μs
Storage Time	t_S		-	30	-	
Turn-off Time	t_{OFF}		-	100	-	
Turn-on Time	t_{ON}	R_L=2.7kΩ (Fig.1), R_{BE}=1MΩ (TLP581), V_{CC}=5V, I_F=16mA	-	10	-	μs
Storage Time	t_S		-	25	-	
Turn-off Time	t_{OFF}		-	75	-	

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	-	-	24	V
Forward Current	I_F	-	16	25	mA
Collector Current	I_C	-	1	10	mA
Operating Temperature	Topr	-25	-	85	°C

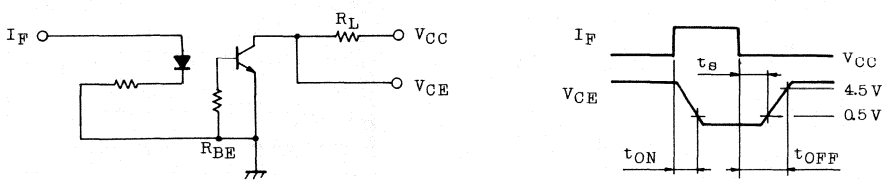
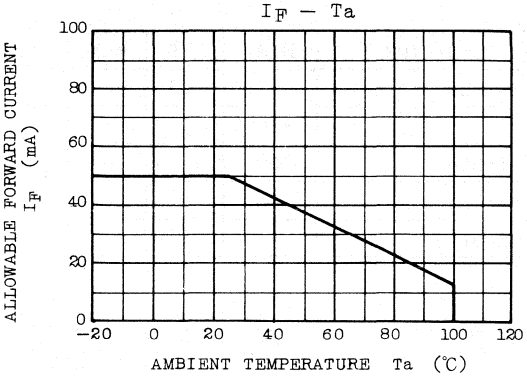
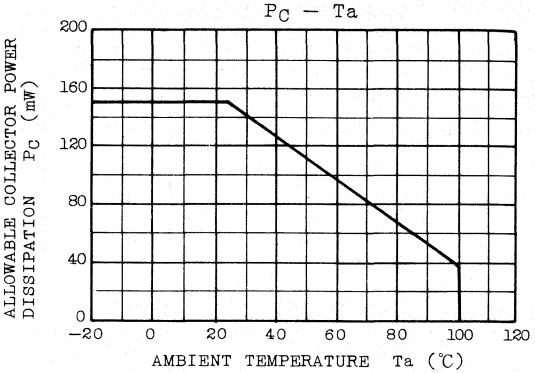


Fig. 1 Switching Time Test Circuit

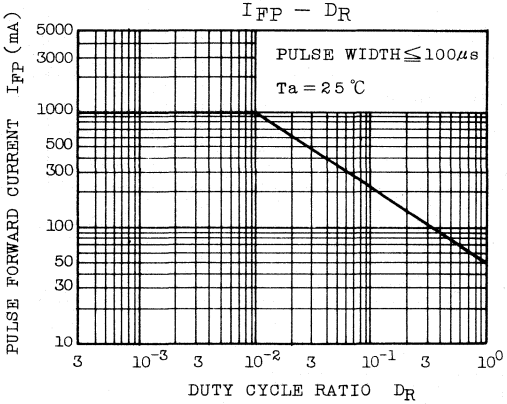
I_F – Ta



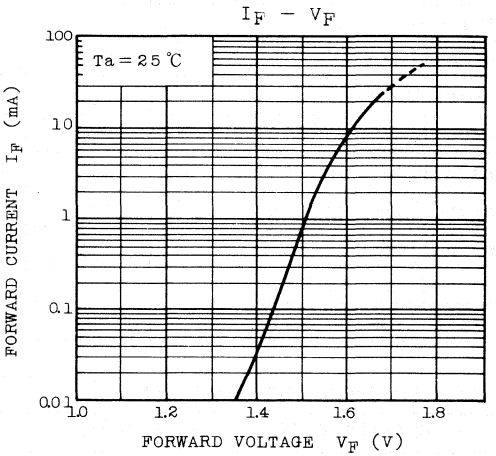
P_C – Ta



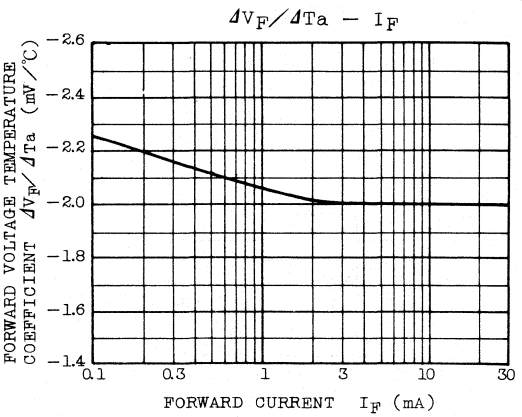
I_{FP} – D_R



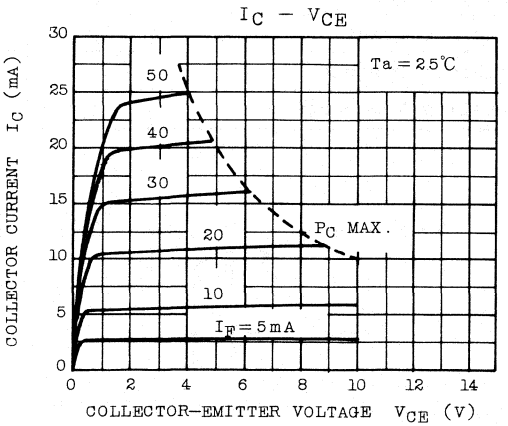
I_F – V_F



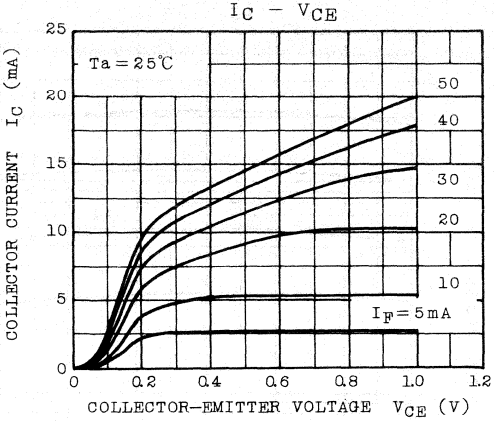
$\Delta V_F / \Delta Ta$ – I_F



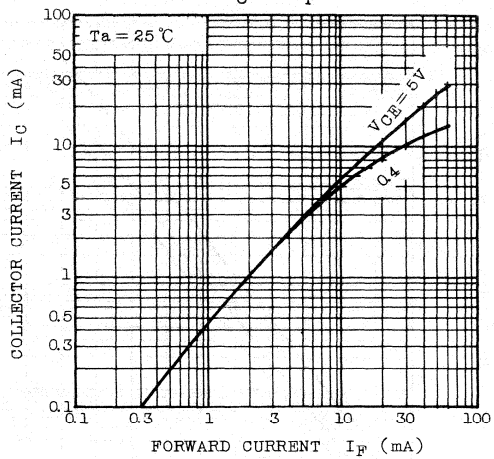
I_C – V_{CE}



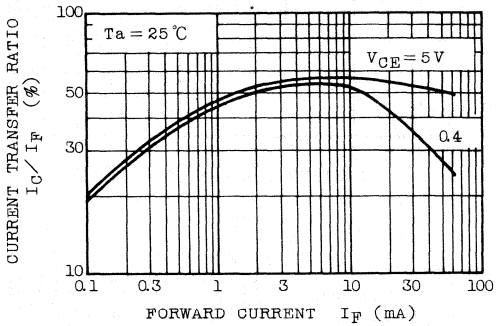
$I_C - V_{CE}$



$I_C - I_F$

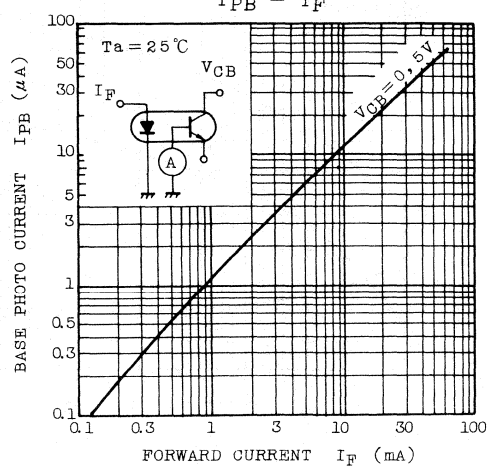


$I_C / I_F - I_F$



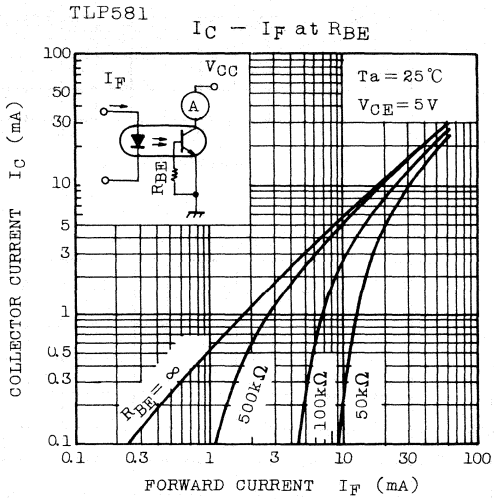
TLP581

$I_{PB} - I_F$

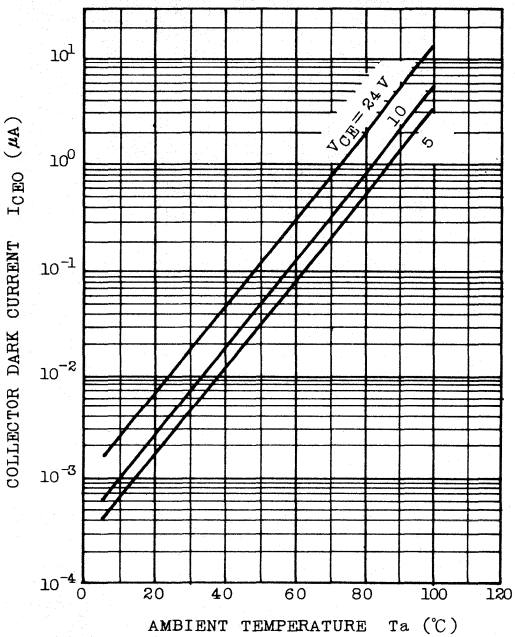


TLP581

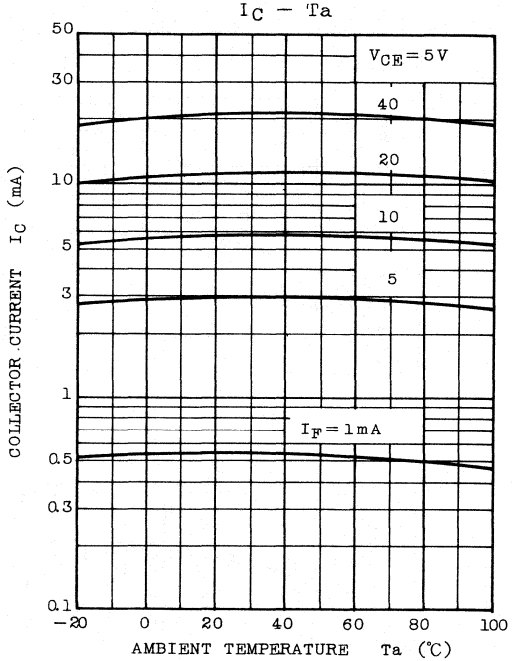
$I_C - I_F$ at R_{BE}



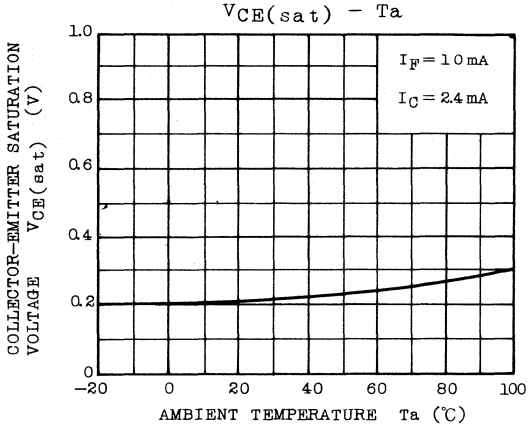
I_{CEO} – Ta



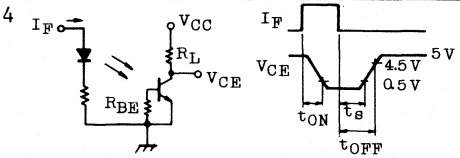
I_C – Ta



$V_{CE(sat)}$ – Ta

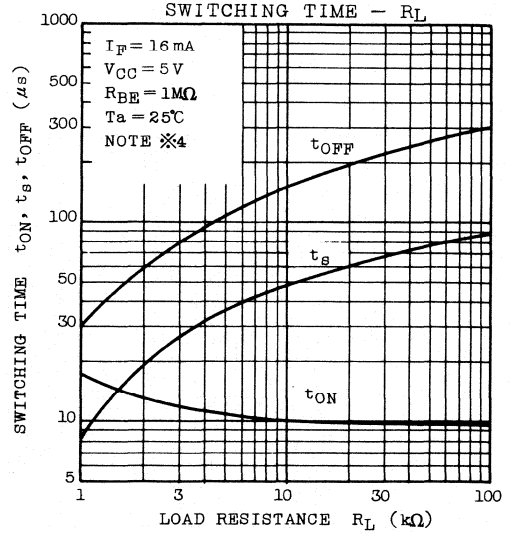


NOTE. * 4

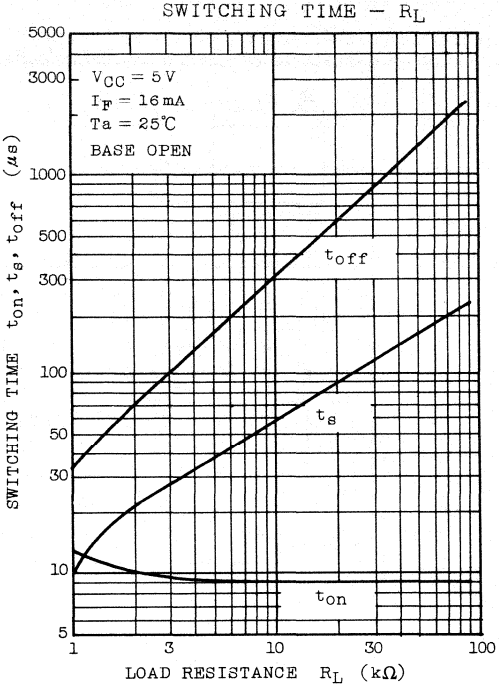


TLP581

SWITCHING TIME – R_L



SWITCHING TIME — R_L



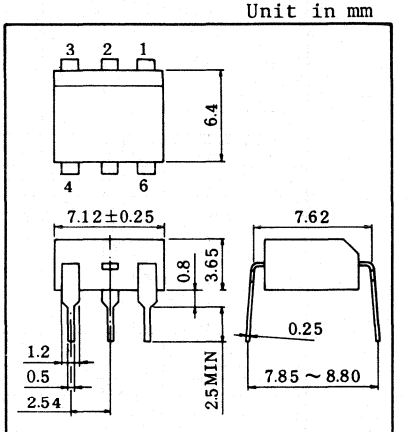
TLP590

GaAs IRED & PHOTO-DIODE ARRAY

TELECOMMUNICATION
PROGRAMMABLE CONTROLLERS.
MOS GATE DRIVER
MOS FET GATE DRIVER

The TOSHIBA TLP590 consists of a galium arsenide infrared emitting diode optically coupled to a series connected photo-diode array in a six lead plastic DIP package.
TLP590 is suitable for MOS FET Gate Driver.

Unit in mm



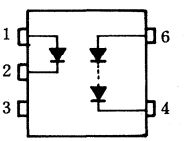
JEDEC	—
EIAJ	—
TOSHIBA	11-7A3

SHORT CURRENT

TYPE NAME	CLASSIFICATION	SHORT CURRENT (Min.)	SHORT CURRENT IF	MARKING OF CLASSIFICATION
TLP590	C05	5μA	10mA	05
	Standard	3μA		05 Blank

Note: Application type name for certification test, please use standard product type name, i.e.
TLP590(C05) : TLP590

PIN CONFIGURATION
(TOP VIEW)



1. ANODE
2. CATHODE
3. NC
4. CATHODE
6. ANODE

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Forward Current Derating (Ta≧53°C)	ΔI_F/°C	-0.7	mA/°C
	Pulse Forward Current (100μs pulse 100pps)	I_{FP}	1	A
	Reverse Voltage	V_R	5	V
	Junction Temperature	Tj	125	°C
DETECTOR	Forward Current	I_{FD}	50	μA
	Reverse Voltage	V_{RD}	10	V
	Junction Temperature	Tj	125	°C
Storage Temperature Range		T_{stg}	-55~125	°C
Operating Temperature Range		T_{opr}	-55~100	°C
Lead Soldering Temperature (10sec.)		T_{sold}	260	°C
Isolation Voltage (AC 1 min., RH≦60%)		BVS	2500	Vrms

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward Current	I_F	-	20	25	mA
Operating Temperature	T_{opr}	-25	-	85	°C

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Forward Voltage	V_{FD}	I_F=10μA	-	7	-	V
	Reverse Current	I_{RD}	V_R=10V	-	1	-	nA
	Capacitance Collector to Emitter	C_{TD}	V=0, f=1MHz	-	-	-	pF

COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Open Voltage	V_{OC}	I_F=10mA	5	7.3	-	V
Short Current	I_{SC}	I_F=10mA	3	6.0	-	μA

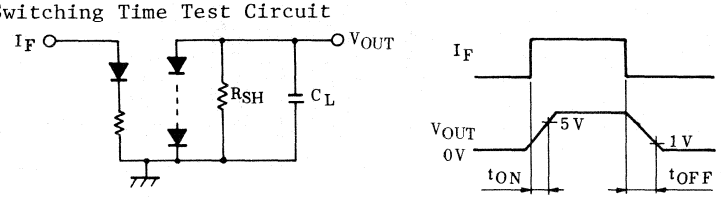
ISOLATION CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Capacitance Input to Output	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BVS	AC, 1 minute	2500	-	-	Vrms
		AC, 1 second in oil	-	5000	-	
		DC, 1 minute in oil	-	5000	-	Vdc

SWITCHING CHARACTERISTICS (Ta=25°C)

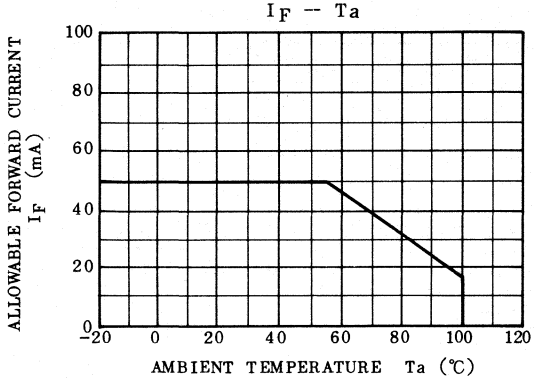
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Turn-on Time	t_{on}	I_F=20mA, R_{SH}=1MΩ	-	0.5	-	ms
Turn-off Time	t_{off}	C_L=1000pF (Fig.1)	-	2	-	ms

Fig. 1 Switching Time Test Circuit

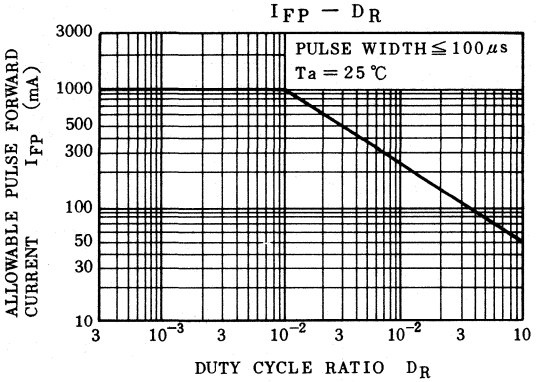


RSH : External Shunt Resistance

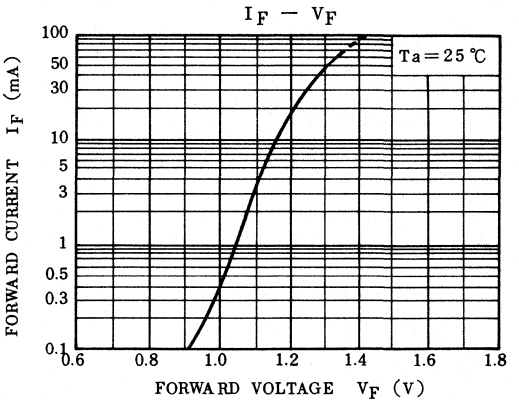
I_F – Ta



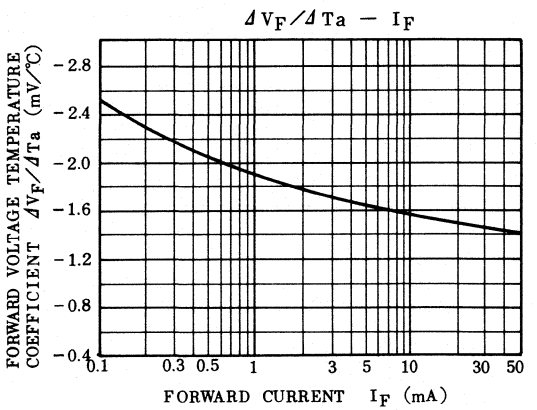
I_{FP} – D_R



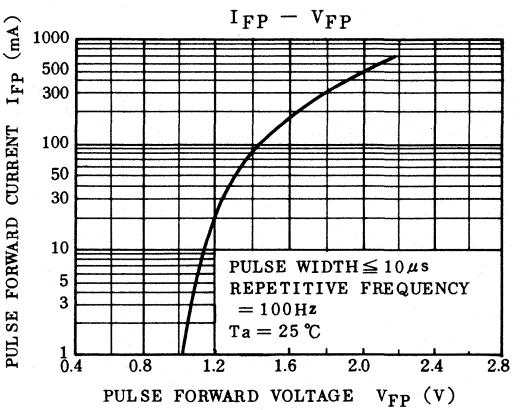
I_F – V_F



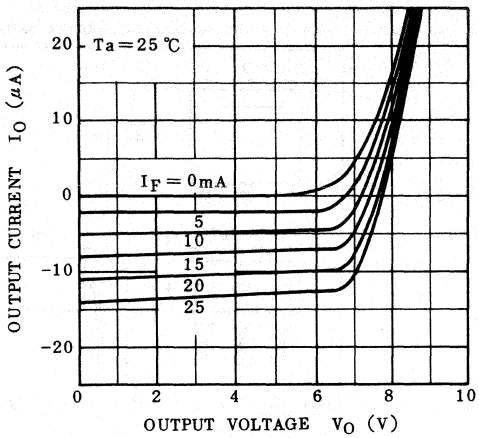
$\Delta V_F / \Delta Ta$ – I_F



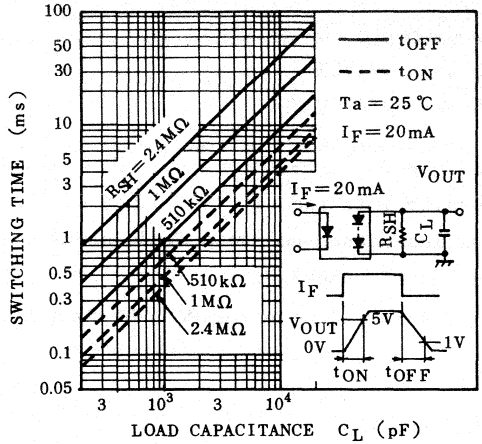
I_{FP} – V_{FP}



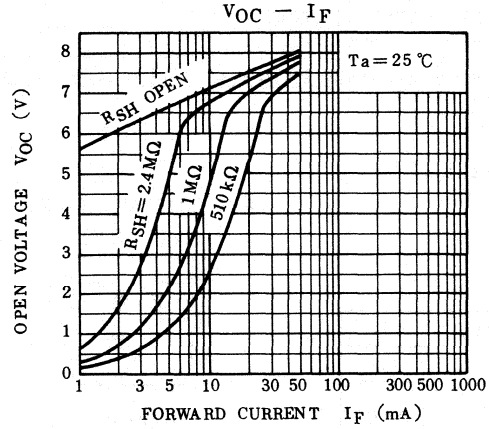
$I_O - V_O$



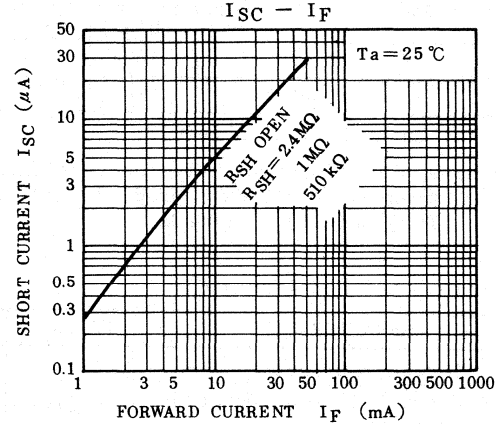
SWITCHING TIME



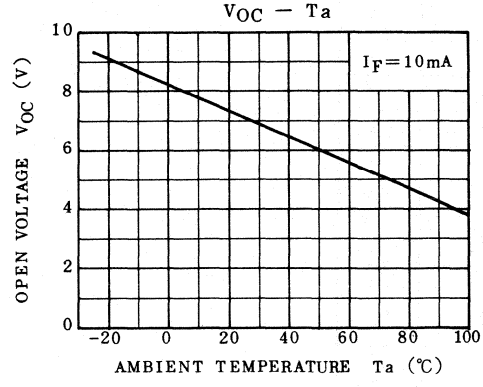
$V_{OC} - I_F$



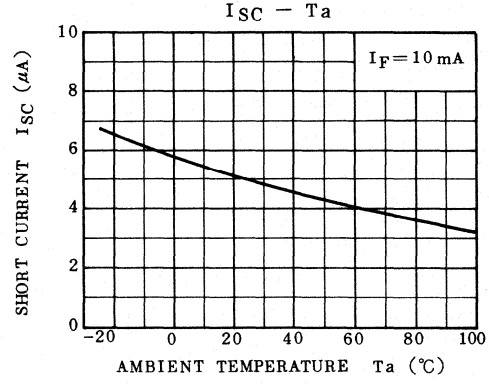
$I_{SC} - I_F$



$V_{OC} - Ta$



$I_{SC} - Ta$



TLP590A

GaAℓAs IRED & PHOTO-DIODE ARRAY

TELECOMMUNICATION TENTATIVE DATA

PROGRAMMABLE CONTROLLERS.

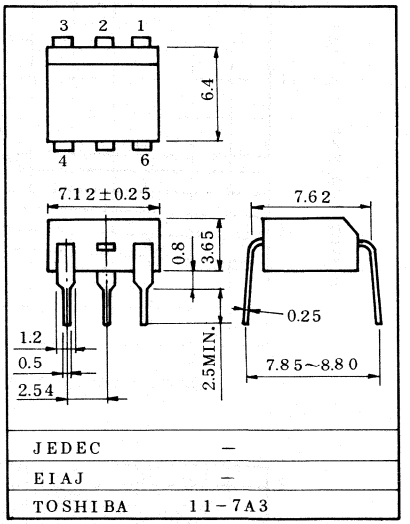
MOS GATE DRIVER

MOS FET GATE DRIVER

The TOSHIBA TLP590A consists of an aluminum galium arsenide infrared emitting diode optically coupled to a series connected photo-diode array in a six lead plastic DIP package.

TLP590A is suitable for MOS FET Gate Driver.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-7A3

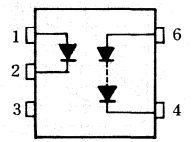
SHORT CURRENT

TYPE NAME	CLASSIFICATION*	SHORT CURRENT I_{SC} (Min.)	SHORT CURRENT I_{SC} @I_F	MARKING OF CLASSIFICATION
TLP590A	C10	10μA	10mA	10
	Standard	6μA		10, Blank

*: Ex. Rank C10 : TLP590A(C10)

Note: Application type name for certification test, please use standard product type name, i.e. TLP590A(C10) : TLP590A

PIN CONFIGURATION (TOP VIEW)



1. ANODE
2. CATHODE
3. NC
4. CATHODE
5. ANODE

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Forward Current Derating (Ta≧53°C)	ΔI_F/°C	-0.7	mA/°C
	Pulse Forward Current (100μs pulse, 100pps)	I_{FP}	1	A
	Reverse Voltage	V_R	5	V
	Junction Temperature	T_j	125	°C
DETECTOR	Forward Current	I_{FD}	50	μA
	Reverse Voltage	V_{RD}	10	V
	Junction Temperature	T_j	125	°C
Storage Temperature Range		T_{stg}	-55~125	°C
Operating Temperature Range		T_{opr}	-55~100	°C
Lead Soldering Temperature (10sec.)		T_{sold}	260	°C
Isolation Voltage (AC 1 min., RH≦60%)		BVS	2500	V_{rms}

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward Current	I_F	-	20	25	mA
Operating Temperature	T_{opr}	-25	-	85	°C

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.15	1.3	1.45	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	17	-	pF
DETECTOR	Forward Voltage	V_{FD}	I_{FD}=10μA	-	7	-	V
	Reverse Current	I_{RD}	V_{RD}=10V	-	1	-	nA
	Capacitance (Collector to Emitter)	C_{TD}	V=0, f=1MHz	-	-	-	pF

COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Open Voltage	V_{OC}	I_F=10mA	6	8.2	-	V
Short Current	I_{SC}	I_F=10mA	6	12	-	μA

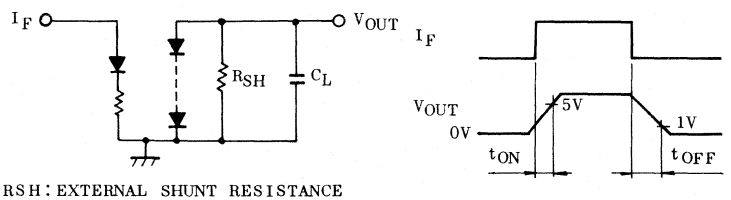
ISOLATION CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BVS	AC, 1 minute	2500	-	-	V_{rms}
		AC, 1 second	-	5000	-	
		DC, 1 minute	-	5000	-	V_{dc}

SWITCHING CHARACTERISTICS (Ta=25°C)

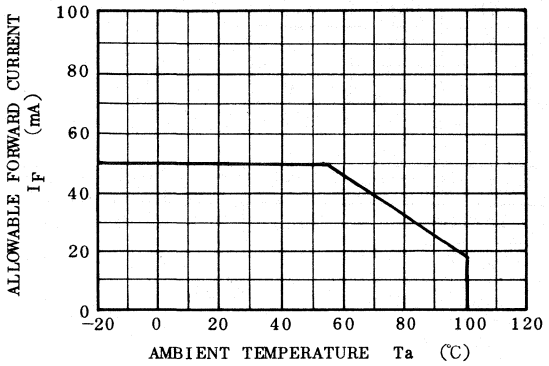
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Turn-on Time	t_{on}	I_F=20mA, R_{SH}=1MΩ	-	0.2	-	ms
Turn-off Time	t_{off}	C_L=1000pF (Fig.1)	-	2	-	ms

Fig. 1 Switching Time Test Circuit

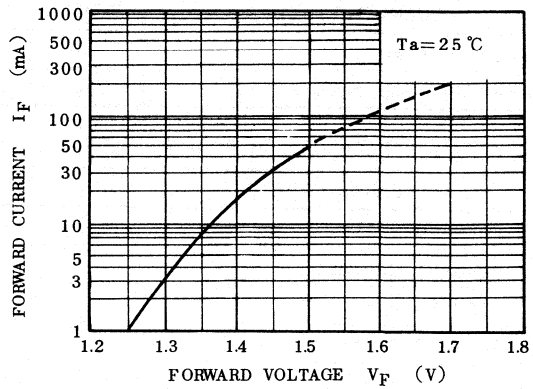


RSH: EXTERNAL SHUNT RESISTANCE

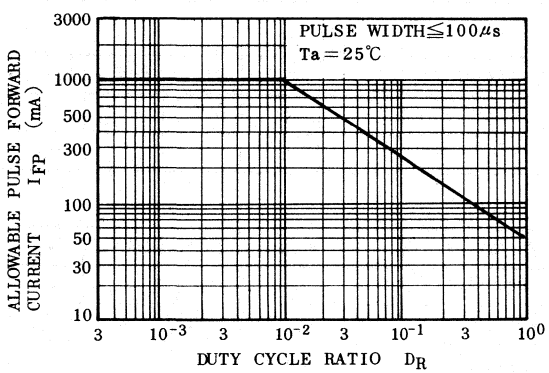
I_F – Ta



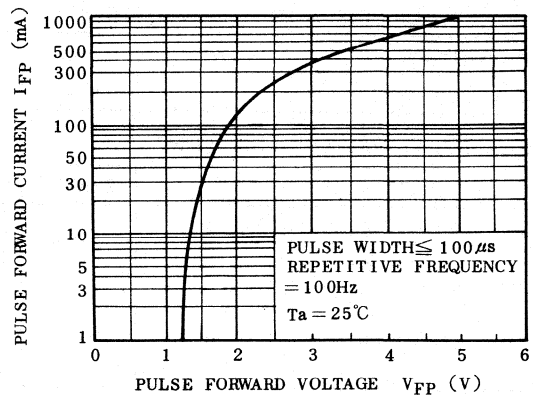
I_F – V_F



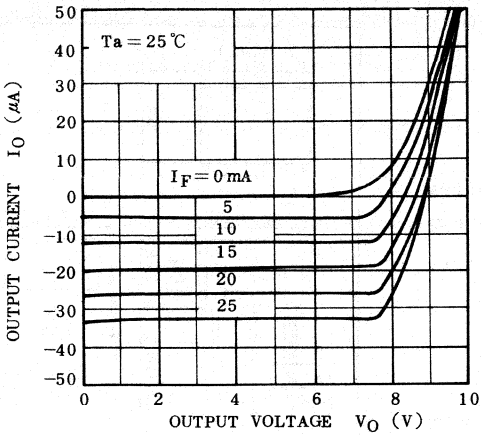
I_{FP} – D_R



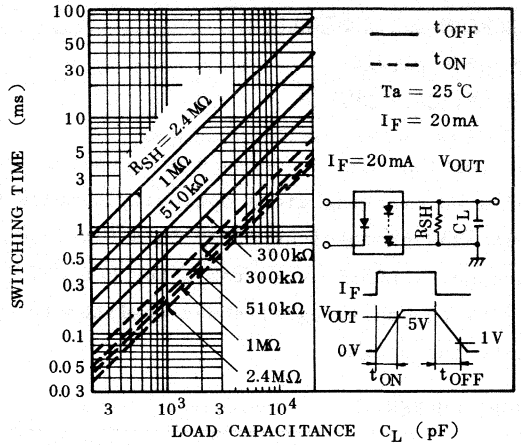
I_{FP} – V_{FP}



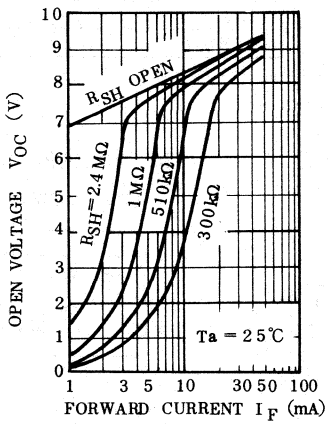
$I_O - V_O$



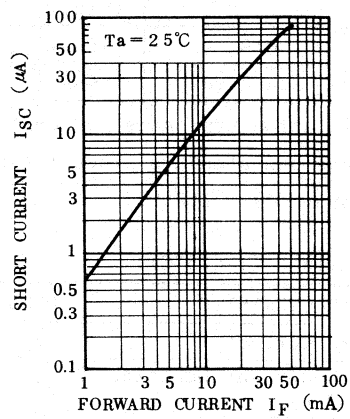
SWITCHING TIME



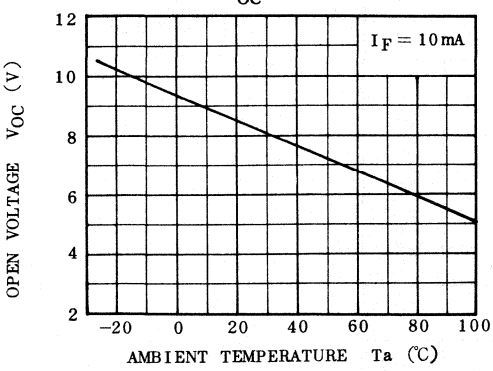
$V_{OC} - I_F$



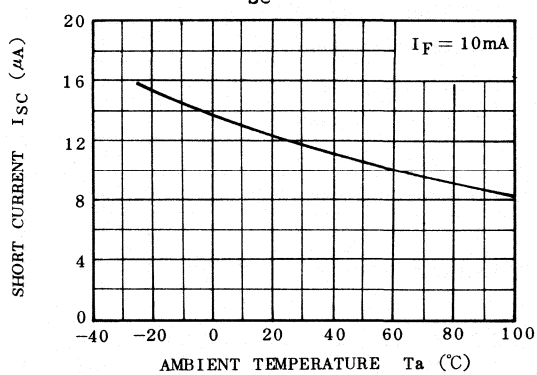
$I_{SC} - I_F$



$V_{OC} - Ta$



$I_{SC} - Ta$



TLP591

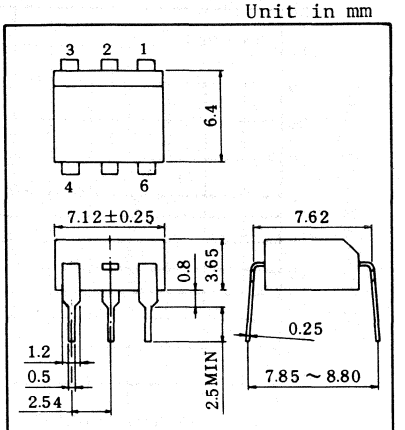
GaAs IRED & PHOTO-DIODE ARRAY

TENTATIVE DATA

TELECOMMUNICATION
PROGRAMMABLE CONTROLLERS.
MOS GATE DRIVER
MOS FET GATE DRIVER

The TOSHIBA TLP591 consists of a galium arsenide infrared emitting diode optically coupled to a series connected photo-diode array in a six lead plastic DIP package. TLP591 is suitable for MOS FET Gate Driver. TLP591 has an integral shunt resistor to optimize switching speed.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-7A3

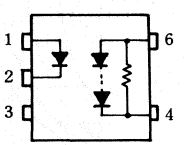
SHORT CURRENT

TYPE NAME	CLASSIFICATION	SHORT CURRENT (Min.)	SHORT CURRENT I_F	MARKING OF CLASSIFICATION
TLP591	C10	10μA	20mA	10
	Standard	6μA		10 blank

Note: Application type name for certification test, please use standard product type name, i.e. TLP590(C05) : TLP590

PIN CONFIGURATION

(TOP VIEW)



1. ANODE
2. CATHODE
3. NC
4. CATHODE
6. ANODE

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Forward Current Derating (Ta ≧ 53°C)	$\Delta I_F/°C$	-0.7	mA/°C
	Pulse Forward Current (100μs pulse, 100pps)	I_{FP}	1	A
	Reverse Voltage	V_R	5	V
	Junction Temperature	Tj	125	°C
DETECTOR	Forward Current	I_{FD}	50	μA
	Reverse Voltage	V_{RD}	10	V
	Junction Temperature	Tj	125	°C
Storage Temperature		Tstg	-55~125	°C
Operating Temperature Range		Topr	-55~100	°C
Lead Soldering Temperature (10sec.)		Tsold	260	°C
Isolation Voltage (AC, 1 min., RH ≦ 60%)		BVS	2500	V_{rms}

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward Current	I_F	-	20	25	mA
Operating Temperature	Topr	-25	-	85	°C

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Forward Voltage	V_{FD}	I_{FD}=10μA	-	7	-	V
	Reverse Current	I_{RD}	V_{RD}=10V	-	7	-	μA
	Capacitance Collector to Emitter	C_{TD}	V=0, f=1MHz	-	-	-	pF

COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Open Voltage	V_{OC}	I_F=20mA	5	7.6	-	V
Short Current	I_{SC}	I_F=20mA	6	12	-	μA

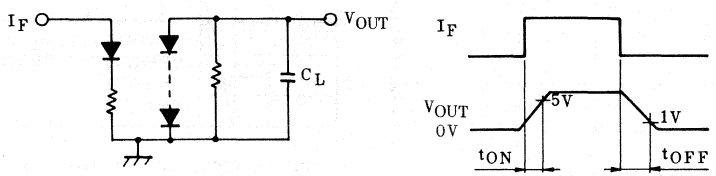
ISOLATION CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Capacitance Input to Output	Cs	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	Rs	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BVS	AC, 1 minute	2500	-	-	V_{rms}
		AC, 1 second in oil	-	5000		
		DC, 1 minute in oil	-	5000	-	V_{dc}

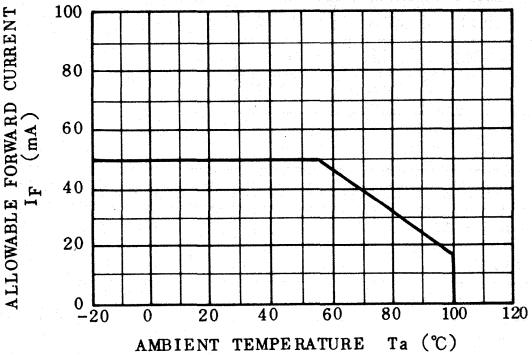
SWITCHING CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Turn-on Time	ton	I_F=20mA, C_L=1000pF	-	0.5	-	ms
Turn-off Time	toff	(Fig.1)	-	2	-	ms

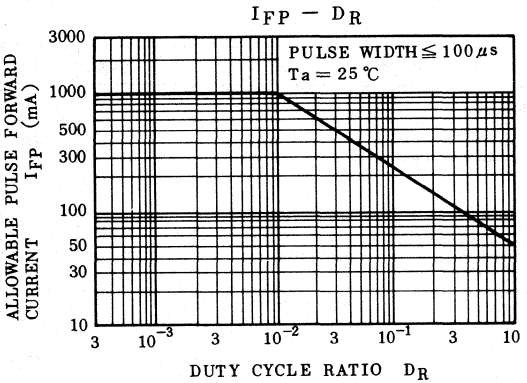
Fig. 1 Switching Time Test Circuit



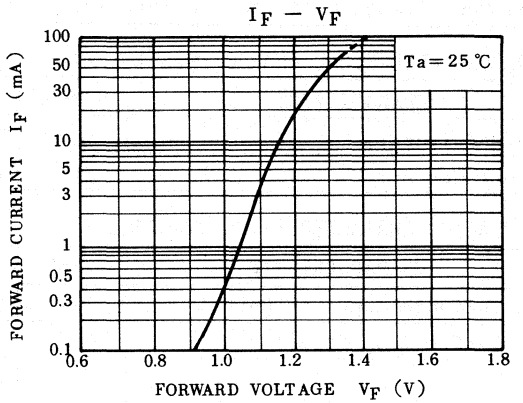
I_F — Ta



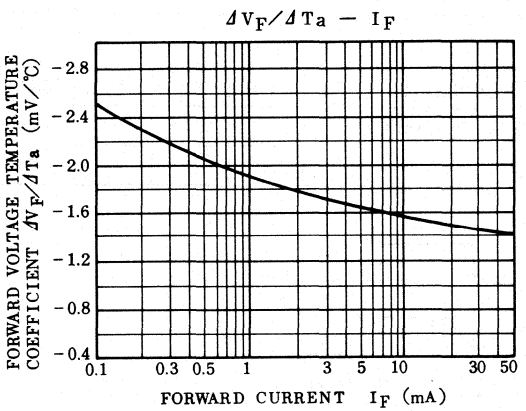
I_{FP} — D_R



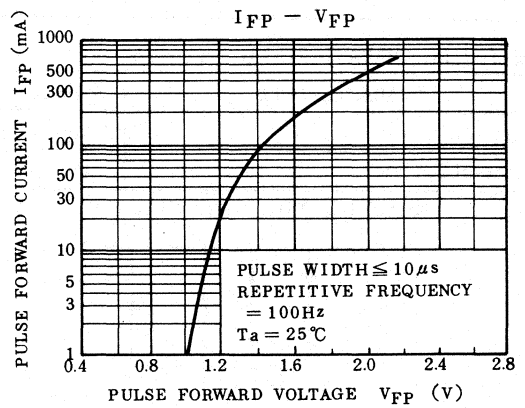
I_F — V_F



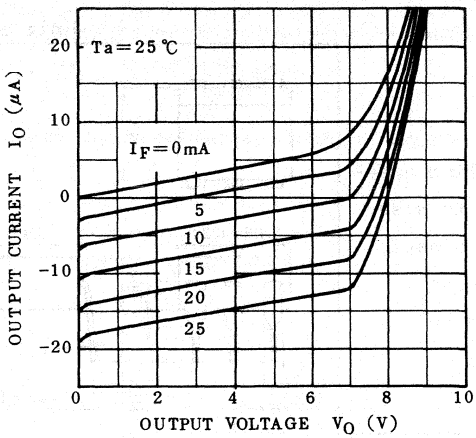
$\Delta V_F/\Delta Ta$ — I_F



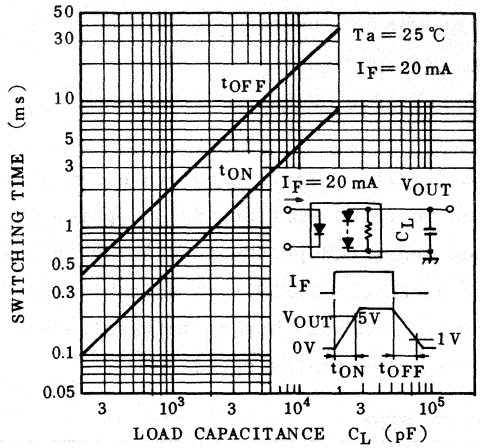
I_{FP} — V_{FP}



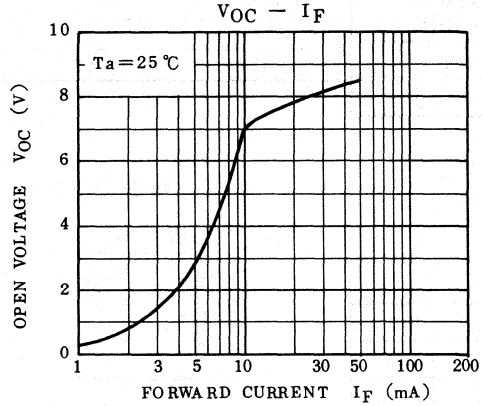
$I_O - V_O$



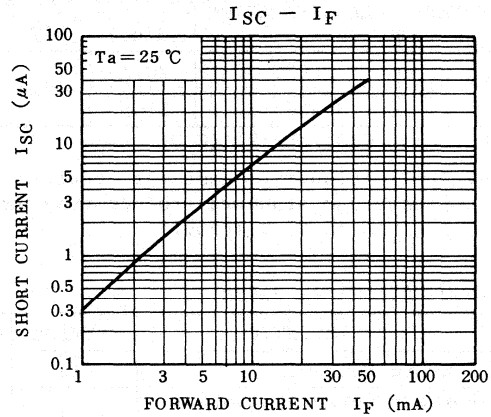
SWITCHING TIME



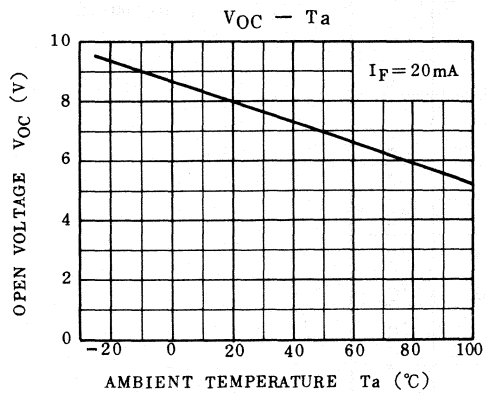
$V_{OC} - I_F$



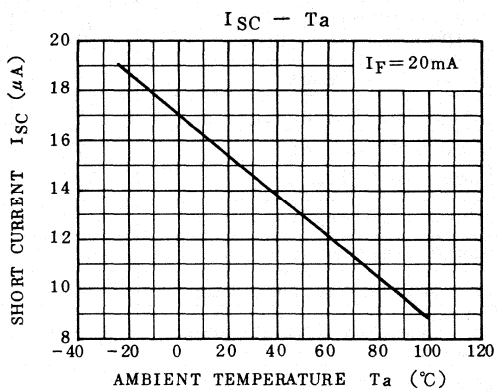
$I_{SC} - I_F$



$V_{OC} - Ta$



$I_{SC} - Ta$



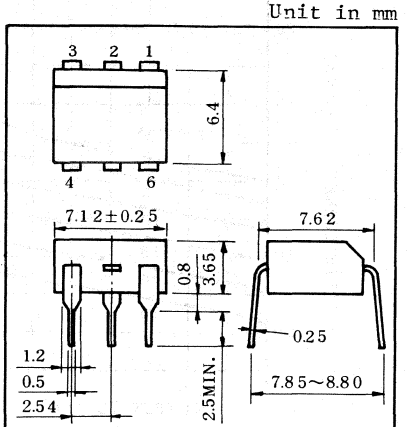
TLP591A

GaAℓAs IRED & PHOTO-DIODE ARRAY

TELECOMMUNICATION TENTATIVE DATA
PROGRAMMABLE CONTROLLERS.
MOS GATE DRIVER
MOS FET GATE DRIVER

The TOSHIBA TLP591A consists of an aluminum galium arsenide infrared emitting diode optically coupled to a series connected photo-diode array in a six lead plastic DIP package. TLP591A is suitable for MOS FET Gate Driver. TLP591A has an integral shunt resistor to optimize switching speed.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-7A3

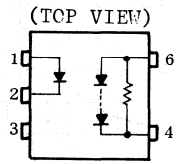
SHORT CURRENT

TYPE NAME	CLASSIFICATION*	SHORT CURRENT I_{SC} (Min.)	SHORT CURRENT I_{SC} @I_F	MARKING OF CLASSIFICATION
TLP591A	C20	20μA	20mA	20
	Standard	12μA		20, blank

*: Ex. Rank C20: TLP591A(C20)

Note: Application type name for certification test, please use standard product type name, i.e. TLP591A (C10) : TLP591A

PIN CONFIGUPATION



1. ANODE
2. CATHODE
3. NC
4. CATHODE
6. ANODE

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Forward Current Derating (Ta≧53°C)	ΔI_F/°C	-0.7	mA/°C
	Pulse Forward Current (100μs pulse, 100pps)	I_{FP}	1	A
	Reverse Voltage	V_R	5	V
	Junction Temperature	T_j	125	°C
DETECTOR	Forward Current	I_{FD}	50	μA
	Reverse Voltage	V_{RD}	10	V
	Junction Temperature	T_j	125	°C
Storage Temperature Range		T_{stg}	-55∿125	°C
Operating Temperature Range		T_{opr}	-55∿100	°C
Lead Soldering Temperature (10sec.)		T_{sold}	260	°C
Isolation Voltage (AC, 1 min., RH≦60%)		BVS	2500	Vrms

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward Current	I_F	-	20	25	mA
Operating Temperature	T_{opr}	-25	-	85	°C

INDIVIDUAL ELECTRICAL CHARACTERISTICS (ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.15	1.3	1.45	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	17	-	pF
DETECTOR	Forward Voltage	V_{FD}	I_{FD}=10μA	-	7	-	V
	Reverse Current	I_{RD}	V_{RD}=10V	-	7	-	μA
	Capacitance (Collector to Emitter)	C_{TD}	V=0, f=1MHz	-	-	-	pF

COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Open Voltage	V_{OC}	I_F=20mA	6	8.1	-	V
Short Current	I_{SC}	I_F=20mA	12	30	-	μA

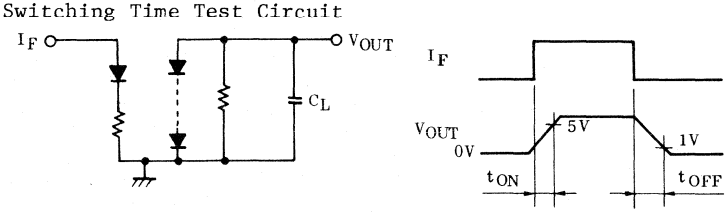
ISOLATION CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Capacitance (Input to Output)	Cs	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	Rs	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BVS	AC, 1 minute	2500	-	-	V_{rms}
		AC, 1 second	-	5000		
		AC, 1 minute	-	5000	-	V_{dc}

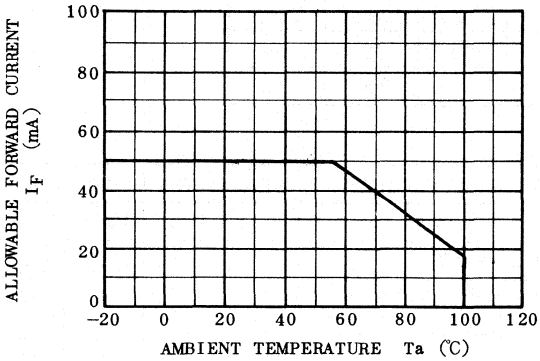
SWITCHING CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Turn-on Time	t_{on}	I_F=20mA, C_L=1000pF	-	0.2	-	ms
Turn-off Time	t_{off}	(Fig. 1)	-	2	-	ms

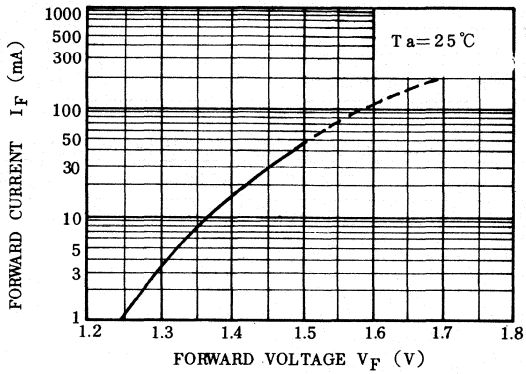
Fig. 1 Switching Time Test Circuit



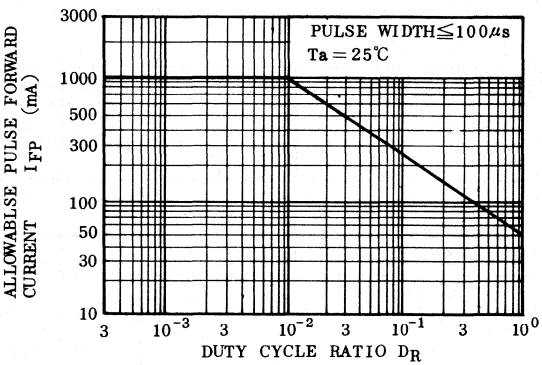
I_F – Ta



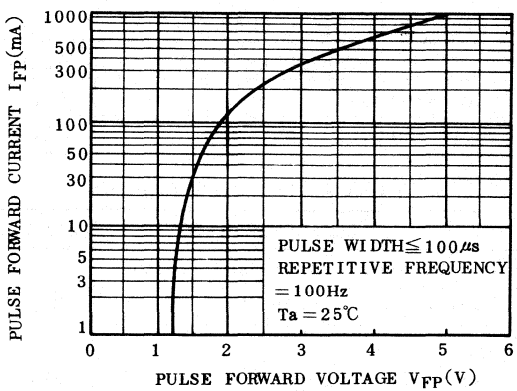
I_F – V_F



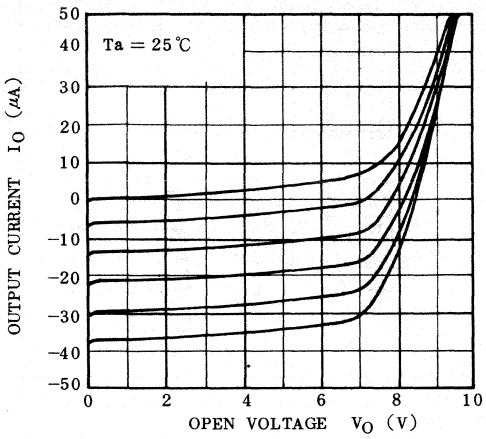
I_{FP} – D_R



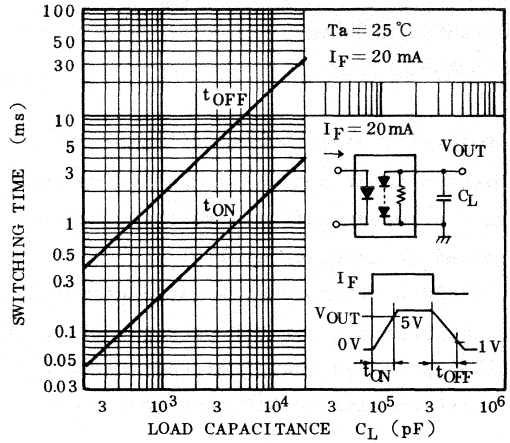
I_{FP} – V_{FP}



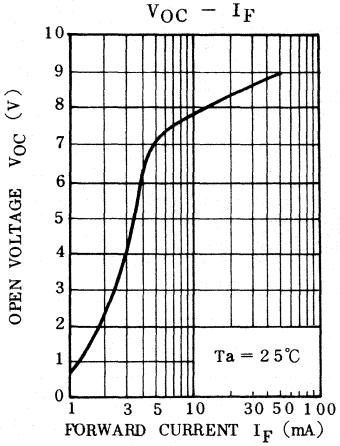
$I_O - V_O$



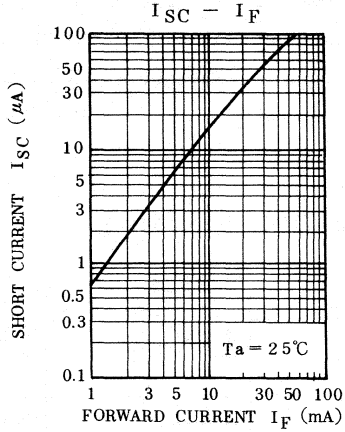
SWITCHING TIME



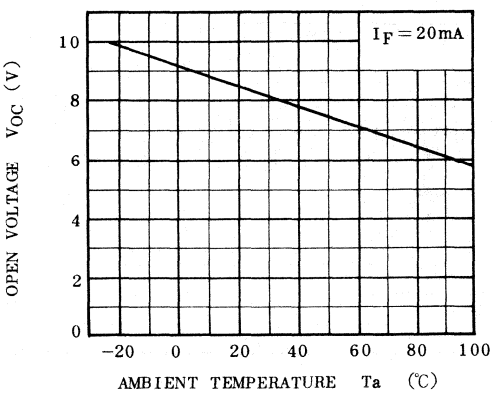
$V_{OC} - I_F$



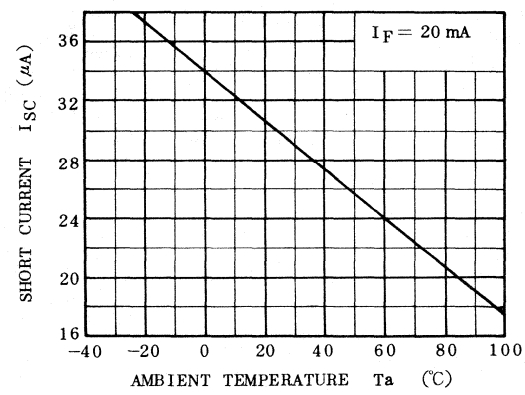
$I_{SC} - I_F$



$V_{OC} - Ta$



$I_{SC} - Ta$



TLP620, TLP620-2, TLP620-4

GaAs IRED & PHOTO-TRANSISTOR

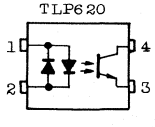
PROGRAMMABLE CONTROLLERS
AC/DC-INPUT MODULE
TELECOMMUNICATION

The TOSHIBA TLP620, -2 and -4 consists of a photo-transistor optically coupled to two gallium arsenide infrared emitting diode connected in inverse parallel.
The TLP620-2 offers two isolated channels in an eight lead plastic DIP package, while the TLP620-4 provides four isolated channels in a sixteen plastic DIP package.

- Collector-Emitter Voltage : 55V Min.
- Current Transfer Ratio : 50% Min.
  Rank GB : 100% Min.
- Isolation Voltage : 5000Vrms Min.
- UL Recognized : File No. E67349

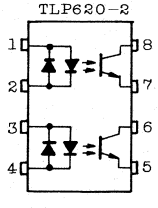
PIN CONFIGURATIONS (TOP VIEW)

TLP620



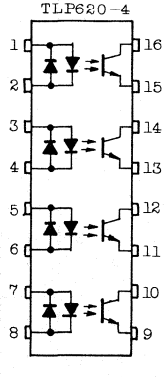
1 : ANODE
CATHODE
2 : CATHODE
ANODE
3 : EMITTER
4 : COLLECTOR

TLP620-2



1,3 : ANODE
CATHODE
2,4 : CATHODE
ANODE
5,7 : EMITTER
6,8 : COLLECTOR

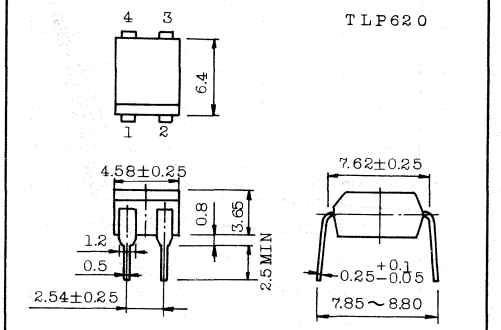
TLP620-4



1,3,5,7 : ANODE
CATHODE
2,4,6,8 : CATHODE
ANODE
9,11,13,15 : EMITTER
10,12,14,16 : COLLECTOR

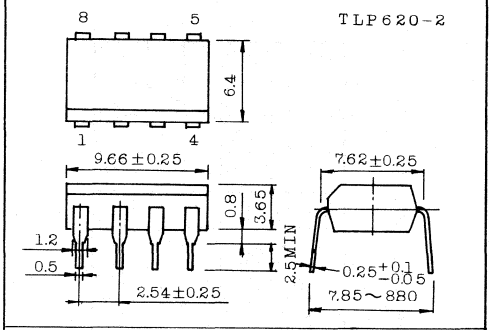
Unit ni mm

TLP620



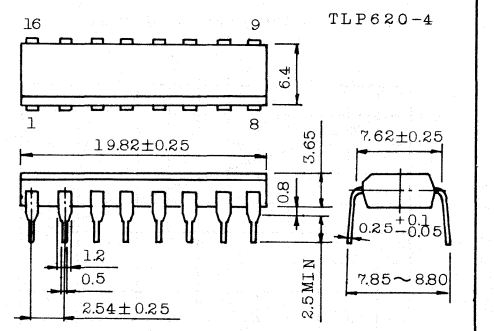
JEDEC	–
EIAJ	–
TOSHIBA	11-5B1

TLP620-2



JEDEC	–
EIAJ	–
TOSHIBA	11-10C1

TLP620-4



JEDEC	–
EIAJ	–
TOSHIBA	11-20A1

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING		UNIT
			TLP620	TLP620-2,4	
LED	Forward Current	$I_{F(RMS)}$	60	50	mA
	Forward Current Derating	$\Delta I_F/°C$	-0.7 (Ta ≧ 39°C)	-0.5 (Ta ≧ 25°C)	mA/°C
	Pulse Forward Current	I_{FP}	1 (100μs pulse, 100pps)		A
	Power Dissipation (1 Circuit)	P_D	100	70	mW
	Power Dissipation Derating	$\Delta P_D/°C$	-1.0	-0.7	mW/°C
	Junction Temperature	T_j	125		°C
DETECTOR	Collector-Emitter Voltage	V_{CEO}	55		V
	Emitter-Collector Voltage	V_{ECO}	7		V
	Collector Current	I_C	50		mA
	Collector Power Dissipation (1 Circuit)	P_C	150	100	mW
	Collector Power Dissipation Derating (Ta ≧ 25°C, 1 Circuit)	$\Delta P_C/°C$	-1.5	-1.0	mW/°C
	Junction Temperature	T_j	125		°C
Storage Temperature Range		T_{stg}	-55 ∿ 150		°C
Operating Temperature Range		T_{opr}	-55 ∿ 100		°C
Lead Soldering Temperature		T_{sold}	260 (10 sec.)		°C
Total Package Power Dissipation		P_T	250	150	mW
Total Package Power Dissipation Derating (Ta ≧ 25°C, 1 Circuit)		$\Delta P_T/°C$	-2.5	-1.5	mW/°C
Isolation Voltage		BV_S	5000 (AC, 1 min., RH ≦ 60%)		V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=±10mA	1.0	1.15	1.3	V
	Forward Current	I_F	V_F=±0.7V	-	2.5	20	μA
	Capacitance	C_T	V=0, f=1MHz	-	60	-	pF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=0.5mA	55	-	-	V
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	7	-	-	V
	Collector Dark Current	I_{CEO}	V_{CE}=24V	-	10	100	nA
			V_{CE}=24V, Ta=85°C	-	2	50	μA
	Capacitance (Collector to Emitter)	C_{CE}	V=0, f=1MHz	-	10	-	pF

COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTICA	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Current Transfer Ratio	I_C/I_F	I_F=±5mA, V_{CE}=5V	50	-	600	%
		Rank GB	100	-	600	
Saturated CTR	$I_C/I_{F(sat)}$	I_F=±1mA, V_{CE}=0.4V	-	60	-	%
		Rank GB	30	-	-	
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C=2.4mA, I_F=±8mA	-	-	0.4	V
		I_C=0.2mA, I_F=±1mA	-	0.2	-	
		Rank GB	-	-	0.4	
Off-State Collector Current	$I_{C(off)}$	V_F=±0.7V, V_{CE}=24V	-	1	10	μA
CTR Symmetry	$I_{C(ratio)}$	$I_C(I_F$=-5mA)/$I_C(I_F$=+5mA)	0.33	1	3	-

ISOLATION CHARACTERISTICS (Ta=25°C)

CHARACTERISTICA	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Capacitance Input to Output	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	5000	-	-	V_{rms}
		AC, 1 second	-	10000	-	
		DC, 1 minute	-	10000	-	V_{dc}

SWITCHING CHARACTERISTICS (Ta=25°C)

CHARACTERISTICS	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Rise Time	t_r	V_{CC} = 10 V	-	2	-	μs
Fall Time	t_f	I_C = 2 mA	-	3	-	
Turn-on Time	t_{on}	R_L = 100 Ω	-	3	-	
Turn-off Time	t_{off}		-	3	-	
Turn-on Time	t_{ON}	R_L = 1.9 kΩ(Fig.1)	-	2	-	μs
Strage Time	t_s	V_{CC} = 5 V, I_F = ±16 mA	-	15	-	
Turn-off Time	t_{OFF}		-	25	-	

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	-	5	24	V
Forward Current	$I_{F(RMS)}$	-	16	20	mA
Collector Current	I_C	-	1	10	mA
Operating Temperature	T_{opr}	-25	-	85	°C

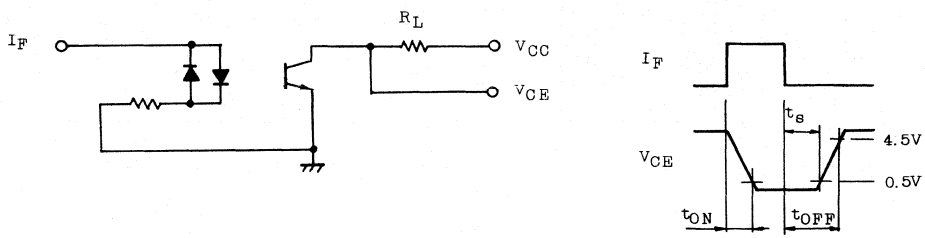
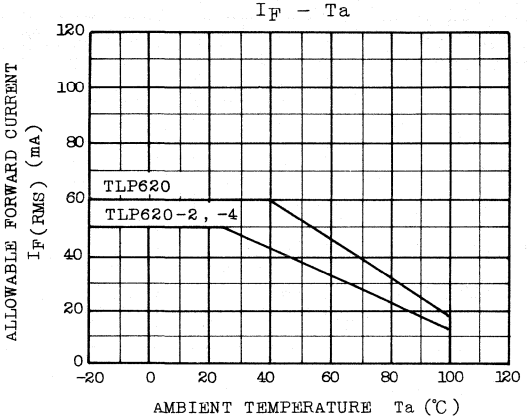
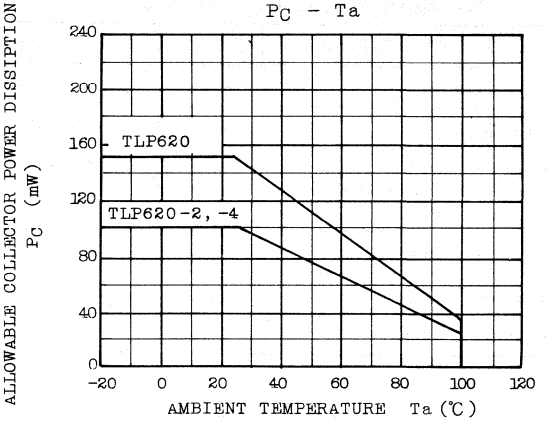


Fig. 1 Switching Time Test Circuit

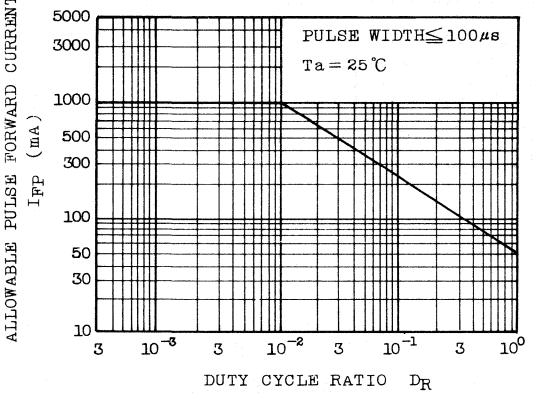
I_F – Ta



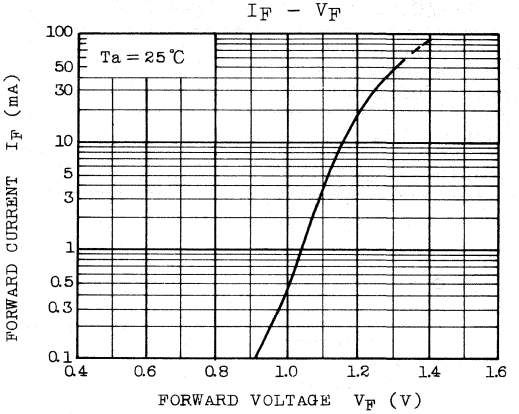
P_C – Ta



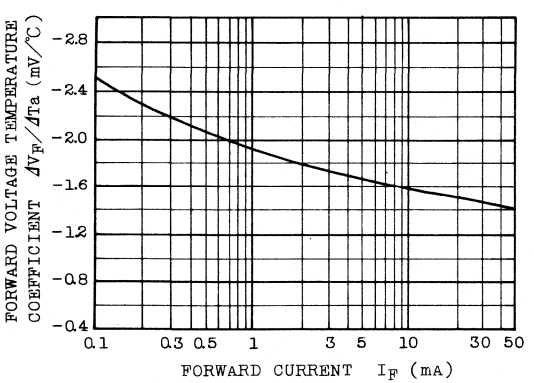
I_{FP} – D_R



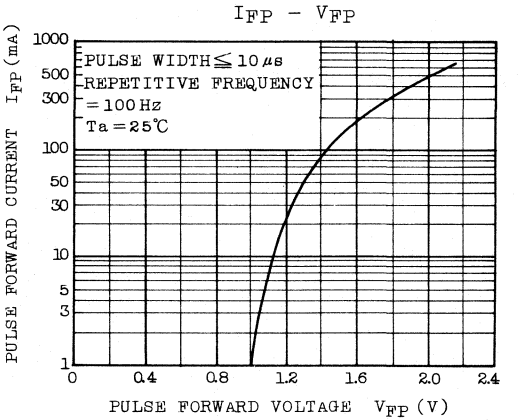
I_F – V_F



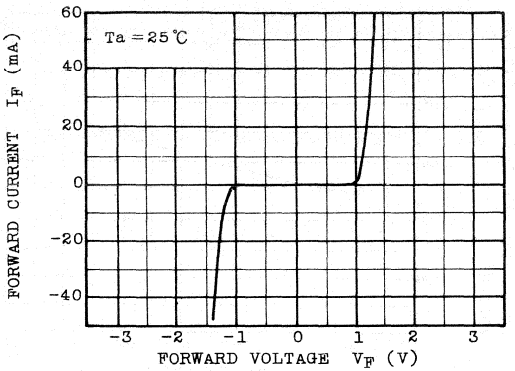
$\Delta V_F / \Delta Ta$ – I_F



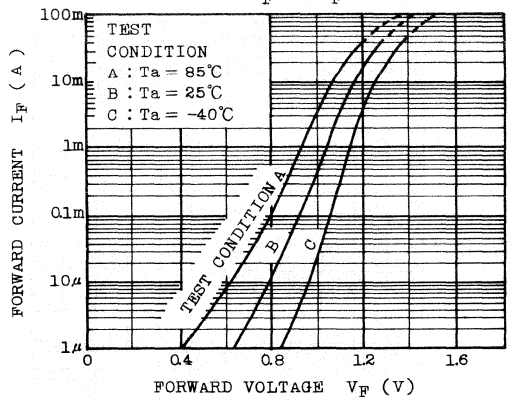
I_{FP} – V_{FP}



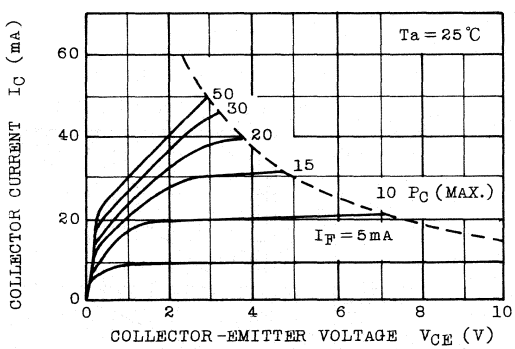
$V_F - I_F$



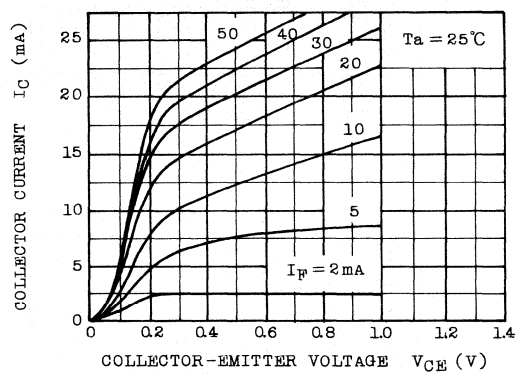
$I_F - V_F$



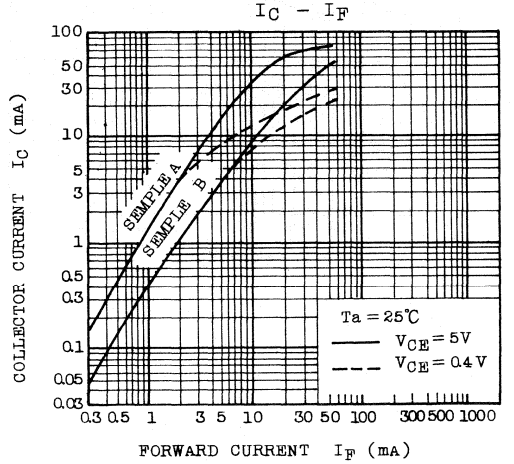
$I_C - V_{CE}$



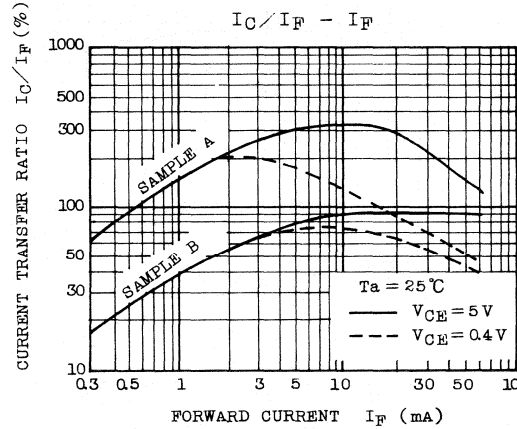
$I_C - V_{CE}$



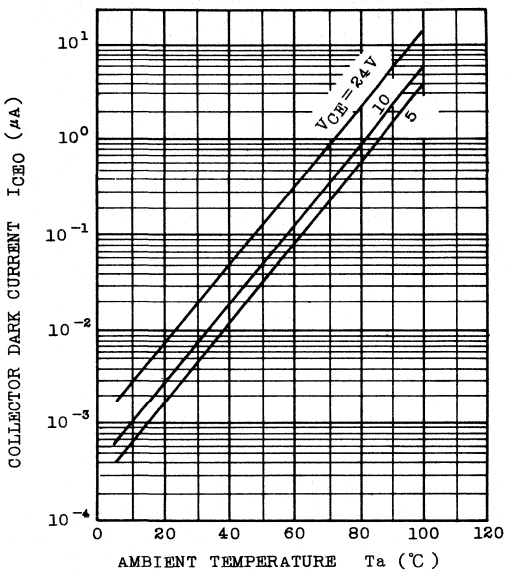
$I_C - I_F$



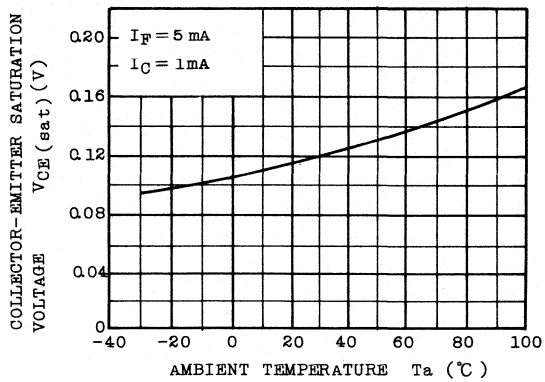
$I_C / I_F - I_F$



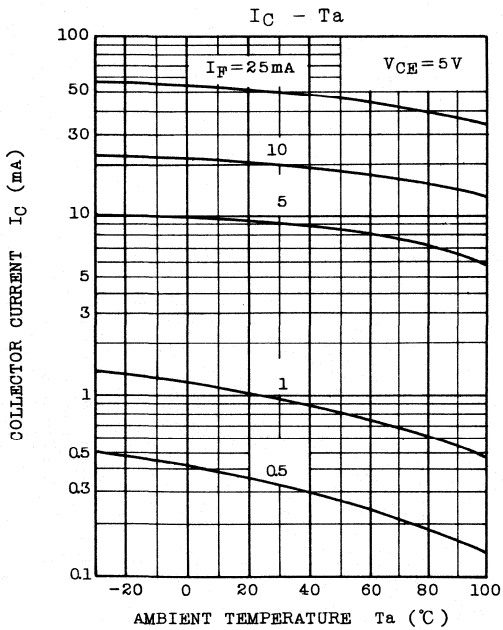
I_{CEO} – Ta



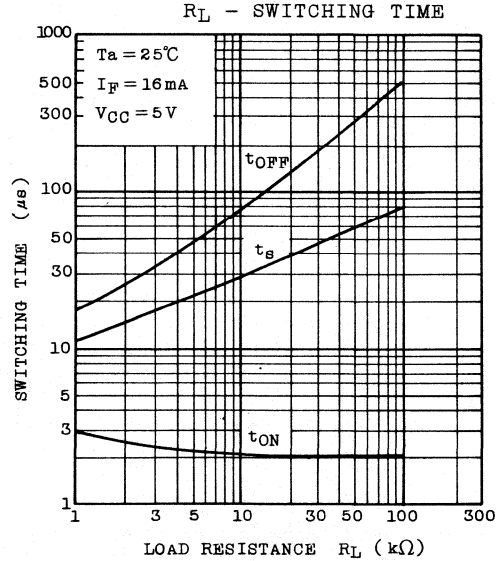
$V_{CE(sat)}$ – Ta



I_C – Ta



R_L – SWITCHING TIME



TLP621, TLP621-2, TLP621-4

GaAs IRED & PHOTO-TRANSISTOR

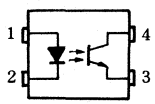
PROGRAMMABLE CONTROLLER
AC/DC-INPUT MODULE
SOLID STATE RELAY

The TOSHIBA TLP621, -2 and -4 consists of a photo-transistor optically coupled to a gallium arsenide infrared emitting diode.
The TLP621-2 offers two isolated channels in an eight lead plastic DIP package, which the TLP621-4 provides four isolated channels in a sixteen plastic DIP package.

- Collector-Emitter Voltage : 55V Min.
- Current Transfer Ratio : 50% Min.
  Rank GB : 100% Min.
- Isolation Voltage : 5000Vrms Min.
- UL Recognized : File No. E67349

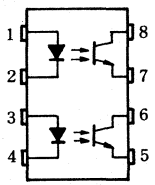
PIN CONFIGURATIONS (TOP VIEW)

TLP621



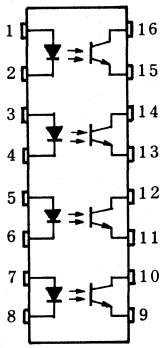
1 : ANODE
2 : CATHODE
3 : EMITTER
4 : COLLDCTOR

TLP621-2



1, 3 : ANODE
2, 4 : CATHODE
5, 7 : EMITTER
6, 8 : COLLECTOR

TLP621-4



1, 3, 5, 7 : ANODE
2, 4, 6, 8 : CATHODE
9, 11, 13, 15 : EMITTER
10, 12, 14, 16 : COLLECTOR

- Current Transfer Ratio

TYPE	CLASSIFICATION *1	CURRENT TRANSFER RATIO (%) (I_C/I_F) I_F=5mA, V_{CE}=5V Ta=25°C MIN.	MAX.	MARKING OF CLASSIFICATION
TLP621	(None)	50	600	BLANK,Y,Y*,G,G*,B,B*,GB
	Rank Y	50	150	Y,Y*
	Rank GR	100	300	G,G*
	Rank BL	200	600	B,B*
	Rank GB	100	600	G,G*,B,B*,GB
TLP621-2	(None)	50	600	BLANK,GR,BL,GB
TLP621-4	Rank GB	100	600	GR,BL,GB

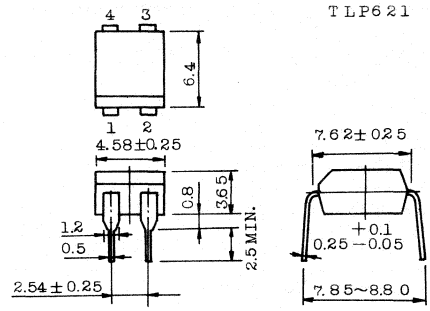
*1 : Ex. Rank GB : TLP621(GB)

Note: Application type name for certification test, please use standard product type name, i.e.

TLP621(GB) : TLP621
TLP621-2(GB): TLP621-2

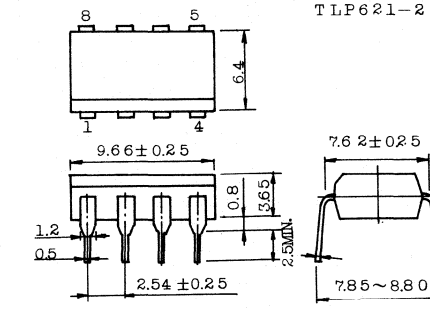
Unit in mm

TLP621



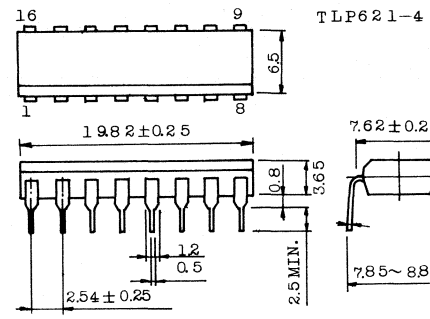
JEDEC	—
EIAJ	—
TOSHIBA	11-5B1

TLP621-2



JEDEC	—
EIAJ	—
TOSHIBA	11-10C1

TLP621-4



JEDEC	—
EIAJ	—
TOSHIBA	11-20A1

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC		SYMBOL	RATING		UNIT
			TLP621	TLP621-2,4	
LED	Forward Current	I_F	60	50	mA
	Forward Current Detating	$\Delta I_F/°C$	-0.7 (Ta ≧ 39°C)	-0.5 (Ta ≧ 25°C)	mA/°C
	Pulse Forwsrd Current	I_{FP}	1 (100μs pulse, 100pps)		A
	Power Dissipation	P_D	100	70	mW
	Power Dissipation Derating	$\Delta P_D/°C$	-1.0	-0.7	mW/°C
	Reverse Voltage	V_R	5		V
	Junction Temperature	T_j	125		°C
DETECTOR	Collector-Emitter Voltage	V_{CEO}	55		V
	Emitter-Collector Votlage	V_{ECO}	7		V
	Collector Current	I_C	50		mA
	Collector Power Dissipation (1 Circuit)	P_C	150	100	mW
	Collector Power Dissipation Derating (1 Circuit Ta ≧ 25°C)	$\Delta P_C/°C$	-1.5	-1.0	mW/°C
	Junction Temperature	T_j	125		°C
Storage Temperature Range		T_{stg}	-55 ∿ 150		°C
Operating Temperature Range		T_{opr}	-55 ∿ 100		°C
Lead Soldering Temperature		T_{sold}	260 (10 sec.)		°C
Total Package Power Dissipation		P_T	250	150	mW
Total Package Power Dissipation Derating (Ta ≧ 25°C)		$\Delta P_T/°C$	-2.5	-1.5	mW/°C
Isolation Voltage		BV_S	5000 (AC, 1 min., RH ≦ 60%)		V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=0.5mA	55	-	-	V
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	7	-	-	V
	Collector Dark Current	I_{CEO}	V_{CE}=24V	-	10	100	nA
			V_{CE}=24V, T_A=85°C	-	2	50	μA
	Capacitance(Collector to Emitter)	C_{CE}	V=0, f=1MHz	-	10	-	pF

COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTICS	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Current Transfer Ratio	I_C/I_F	I_F=5mA, V_{CE}=5V	50	-	600	%
		Rank GB	100	-	600	
Saturated CTR	I_C/I_F (sat)	I_F=1mA, V_{CE}=0.4V	-	60	-	%
		Rank GB	30	-	-	
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C=2.4mA, I_F=8mA	-	-	0.4	V
		I_C=0.2mA, I_F=1mA	-	0.2	-	
		Rank GB	-	-	0.4	

ISOLATION CHARACTERISTICS (Ta=25°C)

CHARACTERISTICS	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Capacitance(Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	5000	-	-	V_{rms}
		AC, 1 second	-	10000	-	
		DC, 1 minute	-	10000	-	V_{dc}

SWITCHING CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Rise Time	t_r	V_{CC}=10V	-	2	-	μs
Fall Time	t_f	I_C=2 mA	-	3	-	
Tunr-on Time	t_{on}	R_L=100Ω	-	3	-	
Turn-off Time	t_{off}		-	3	-	
Turn-on Time	t_{ON}	R_L=1.9kΩ(Fig.1)	-	2	-	μs
Strage Time	t_s	V_{CC}=5V, I_F=16mA	-	15	-	
Turn-off Time	t_{OFF}		-	25	-	

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	-	5	24	V
Forward Current	I_F	-	16	20	mA
Collector Current	I_C	-	1	10	mA
Operating Temperature	T_{opr}	-25	-	85	°C

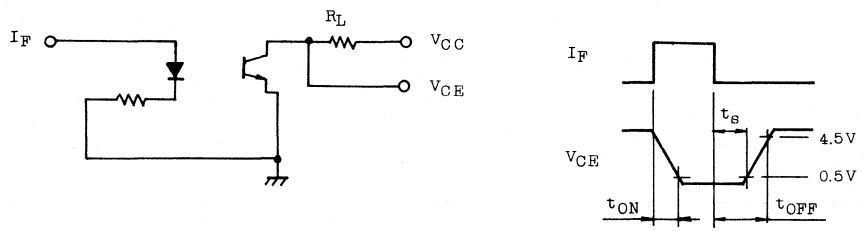
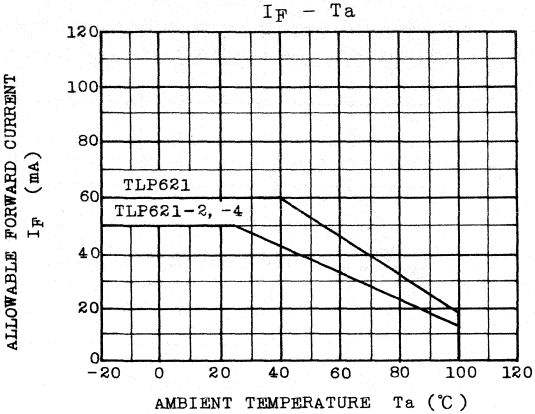
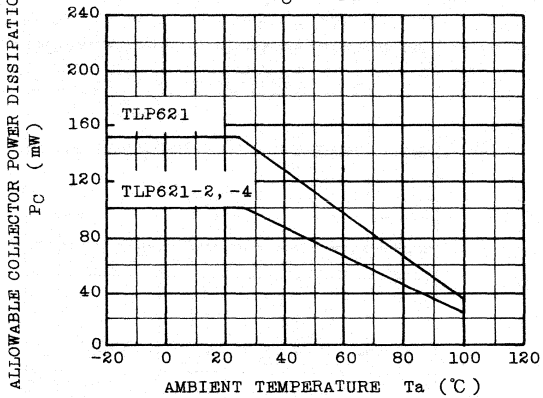


Fig. 1 Switching Time Test Circuit.

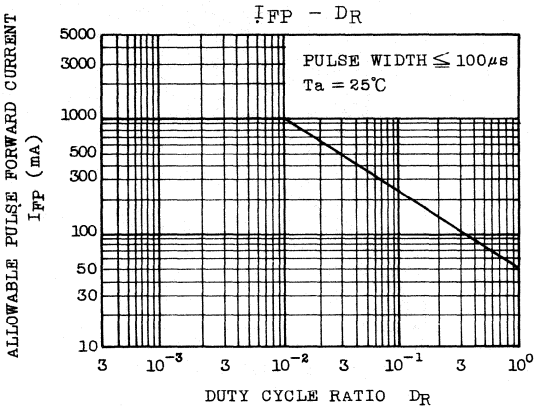
I_F – Ta



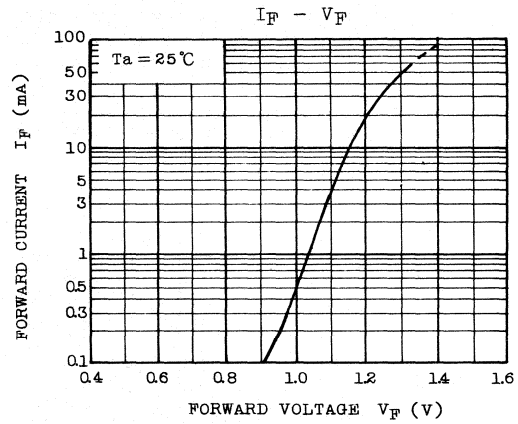
P_C – Ta



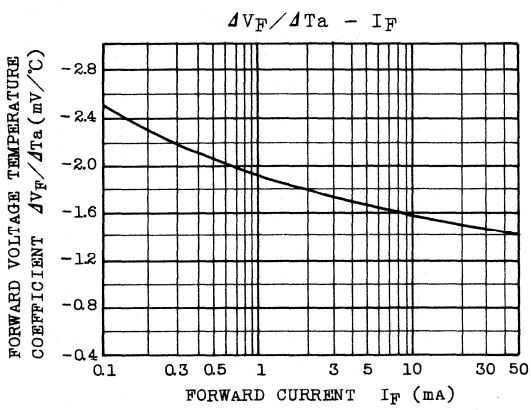
I_{FP} – D_R



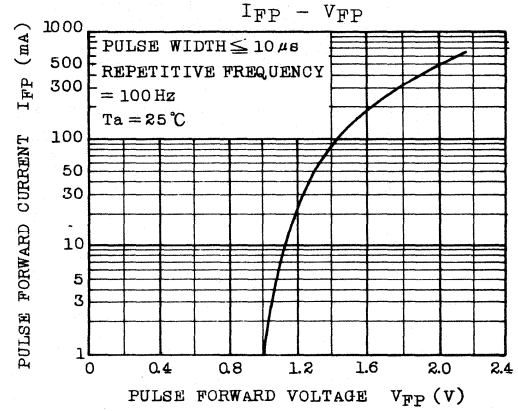
I_F – V_F



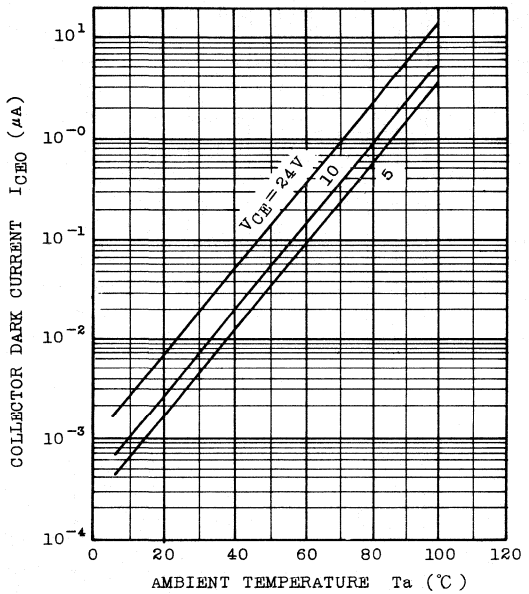
$\Delta V_F / \Delta Ta$ – I_F



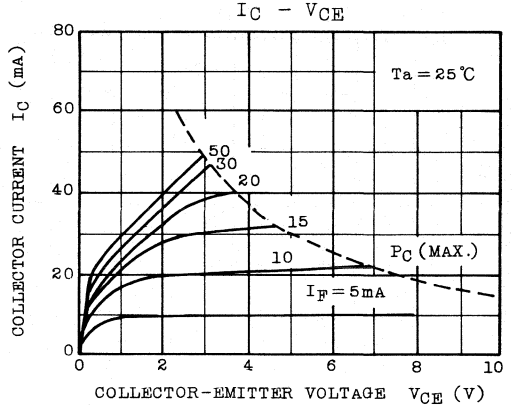
I_{FP} – V_{FP}



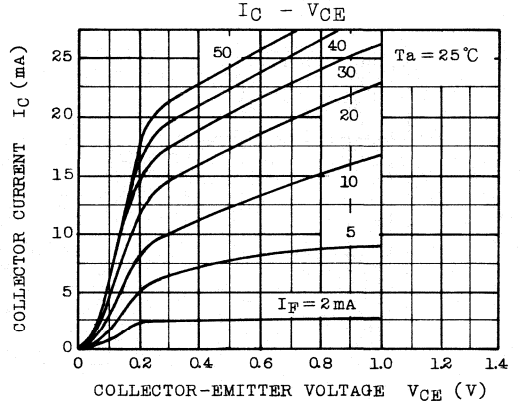
I_{CEO} – Ta



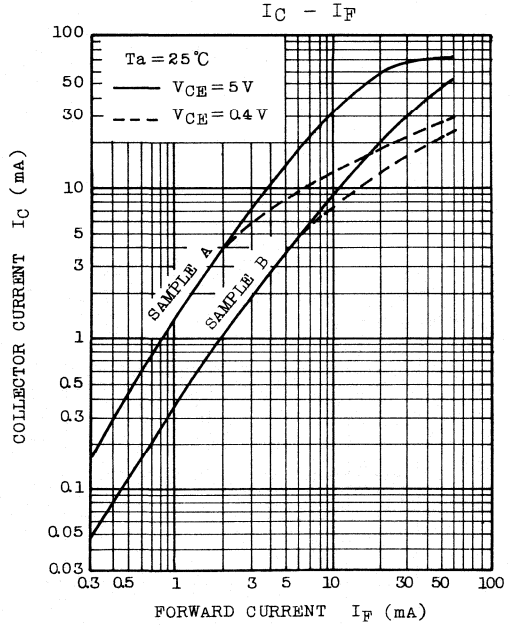
I_C – V_{CE}



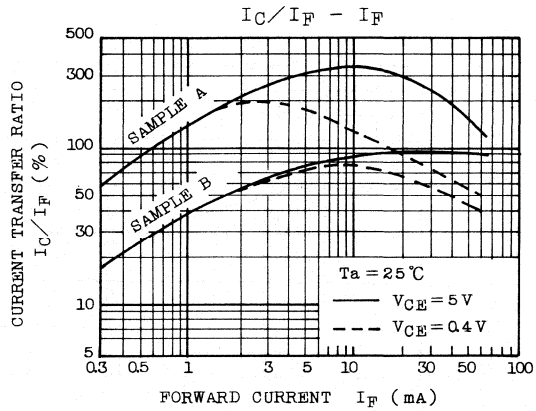
I_C – V_{CE}



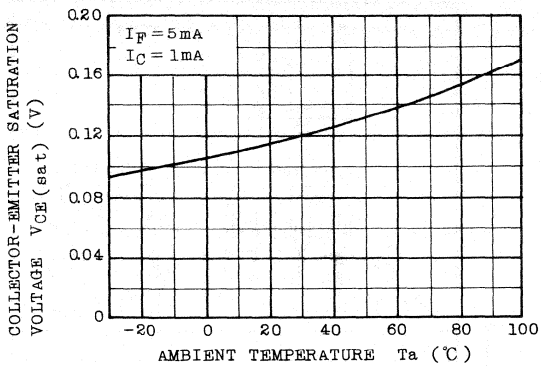
I_C – I_F



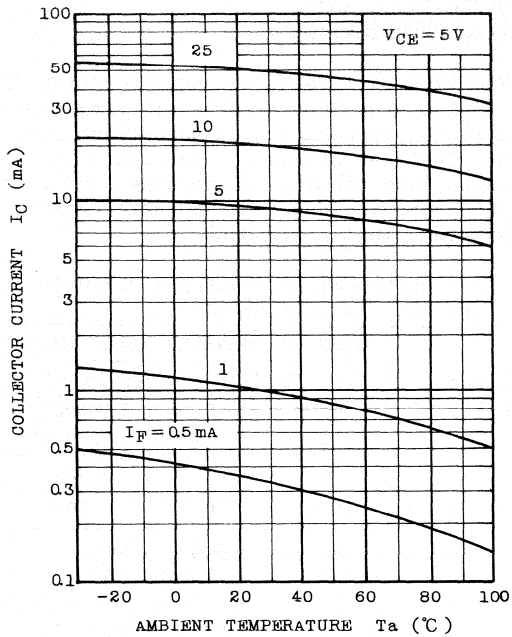
I_C/I_F – I_F



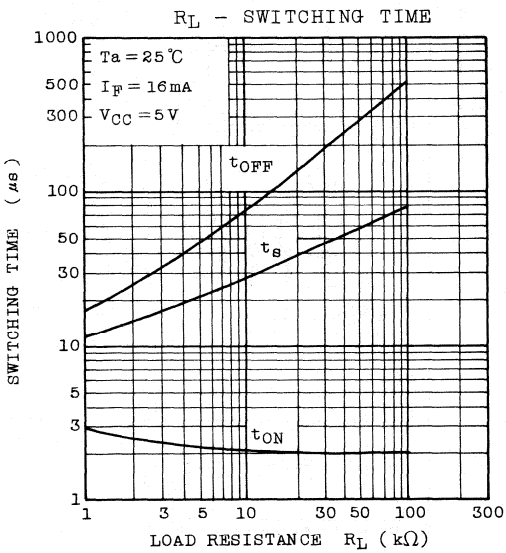
$V_{CE(sat)}$ – Ta



I_C – Ta



R_L – SWITCHING TIME



TLP624, TLP624-2, TLP624-4

GaAs IRED & PHOTO-TRANSISTOR

PROGRAMMABLE CONTROLLERS
AC/DC-INPUT MODULE
TELECOMMUNICATION

The TOSHIBA TLP624, -2 and -4 consist of a gallium arsenide infrared emitting diode optically coupled to a photo-transistor. The TLP624-2 offers two isolated channels in an eight lead plastic DIP package, while the TLP624-4 provides four isolated channels in a sixteen plastic DIP package.

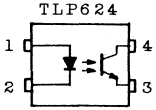
- Collector-Emitter Voltage: 55V Min.
- Current Transfer Ratio

CLASSIFICATION	CURRENT TRANSFER RATIO (Min.)			MARKING OF CLASSIFICATION
	Ta=25°C		Ta=25 ∿ 75°C	
	I_F=1mA V_{CE}=0.5V	I_F=0.5mA V_{CE}=1.5V	I_F=1mA V_{CE}=0.5V	
Rank BV	200%	100%	100%	BV
Standard	100%	50%	50%	BV, Blank

- Isolation Voltage: 5000V_{rms} Min.
- UL Recognized : File No. E67349
- Note: Application type name for certification test, please use standard product type name, i.e.
  TLP624(BV) : TLP624
  TLP624-2(BV): TLP624-2

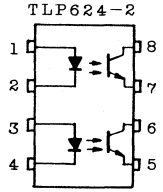
PIN CONFIGURATIONS (TOP VIEW)

TLP624



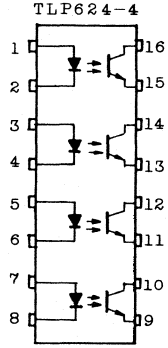
1: ANODE
2: CATHODE
3: EMITTER
4: COLLECTOR

TLP624-2



1,3: ANODE
2,4: CATHODE
5,7: EMITTER
6,8: COLLECTOR

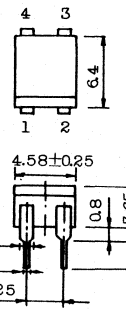
TLP624-4



1,3,5,7: ANODE
2,4,6,8: CATHODE
9,11,13,15: EMITTER
10,12,14,16: COLLECTOR

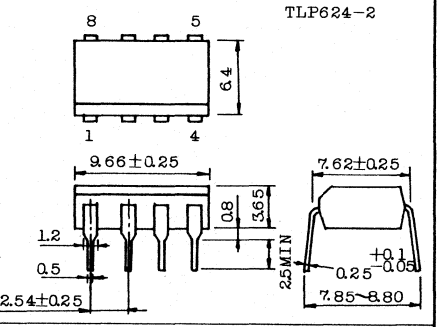
Unit in mm

TLP624



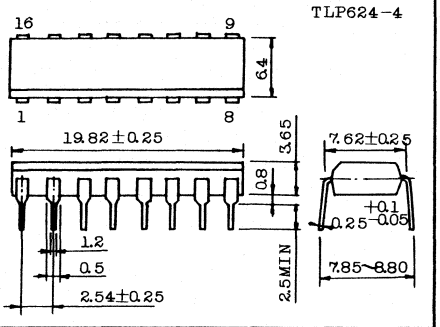
JEDEC	—
EIJA	—
TOSHIBA	11-5B1

TLP624-2



JEDEC	—
EIAJ	—
TOSHIBA	11-10C1

TLP624-4



JEDEC	—
EIAJ	—
TOSHIBA	11-20A1

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING		UNIT
			TLP624	TLP624-2 TLP624-4	
LED	Forward Current	I_F	60	50	mA
	Forward Current Detating	$\Delta I_F/°C$	-0.7 (Ta≧39°C)	-0.5 (Ta≧25°C)	mA/°C
	Pulse Forward Current	I_{FP}	1 (100μs pulse, 100pps)		A
	Power Dissipation (1 Circuit)	P_D	100	70	mW
	Power Dissipation Derating (Ta≧25°C, 1 Circuit)	$\Delta P_D/°C$	-1.0	-0.7	mW/°C
	Reverse Voltage	V_R	5		V
	Junction Temperature	T_j	125		°C
DETECTOR	Collector-Emitter Voltage	V_{CEO}	55		V
	Emitter-Collector Voltage	V_{ECO}	7		V
	Collector Current	I_C	50		mA
	Collector Power Dissipation (1 Circuit)	P_C	150	100	mW
	Collector Power Dissipation Derating (Ta≧25°C, 1 Circuit)	$\Delta P_C/°C$	-1.5	-1.0	mW/°C
	Junction Temperature	T_j	125		°C
Storage Temperature Range		T_{stg}	-55~150		°C
Operating Temperature Range		T_{opr}	-55~100		°C
Lead Soldering Temperature		T_{sold}	260 (10 sec.)		°C
Total Package Power Dissipation (1 Circuit)		P_T	250	150	mW
Total Package Power Dissipation Derating (Ta≧25°C, 1 Circuit)		$\Delta P_T/°C$	-2.5	-1.5	mW/°C
Isolation Voltage		BVS	5000 (AC, 1 min., RH≦60%)		V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=0.5mA	55	-	-	V
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	7	-	-	V
	Collector Dark Current	I_{CEO}	V_{CE}=24V	-	10	100	nA
			V_{CE}=24V, Ta=85°C	-	2	50	μA
	Capacitance Collector to Emitter	C_{CE}	V=0, f=1MHz	-	12	-	pF

COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Current Transfer Ratio	I_C/I_F	I_F=1mA, V_{CE}=0.5V	100	-	-	%
		Rank BV	200	-	-	
Low Input CTR	I_C/I_F (low)	I_F=0.5mA, V_{CE}=1.5V	50	-	-	%
		Rank BV	100	-	-	
Collector-Emitter Saturation Voltage	V_{CE} (sat)	I_C=0.5mA, I_F=1mA	-	-	0.4	V
		I_C=1mA, I_F=1mA	-	0.2	-	
		Rank BV	-	-	0.4	

COUPLED ELECTRICAL CHARACTERISTICS (Ta=-25 ∿ 75°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Current Transfer Ratio	I_C/I_F	I_F=1mA, V_{CE}=0.5V	50	-	-	%
		Rank BV	100	-	-	
Low Input CTR	I_C/I_F (low)	I_F=0.5mA, V_{CE}=1.5V	-	50	-	%
		Rank BV	-	100	-	

ISOLATION CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Capacitance Input to Output	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	5000	-	-	V_{rms}
		AC, 1 second	-	10000	-	
		DC, 1 minute	-	10000	-	V_{dc}

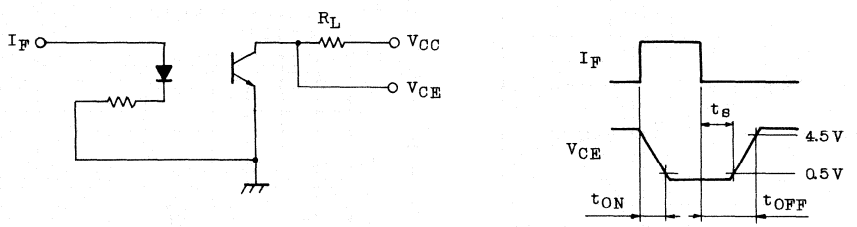
SWITCHING CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Rise Time	t_r	V_{CC}=10V, I_C=2mA R_L=100Ω	-	8	-	μs
Fall Time	t_f		-	8	-	
Turn-on Time	t_{on}		-	10	-	
Turn-off Time	t_{off}		-	8	-	
Turn-on Time	t_{ON}	R_L=4.7kΩ (Fig.1) V_{CC}=5V, I_F=1.6mA	-	10	-	μs
Storage Time	t_s		-	50	-	
Turn-off Time	t_{OFF}		-	300	-	

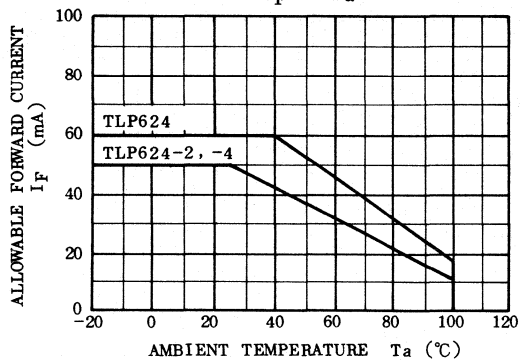
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	-	5	24	V
Forward Current	I_F	-	1.6	20	mA
Collector Current	I_C	-	1	10	mA
Operating Temperature	T_{opr}	-25	-	75	°C

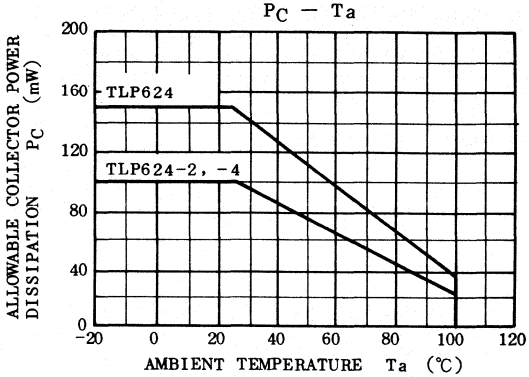
Fig. 1 SWITCHING TIME TEST CIRCUIT



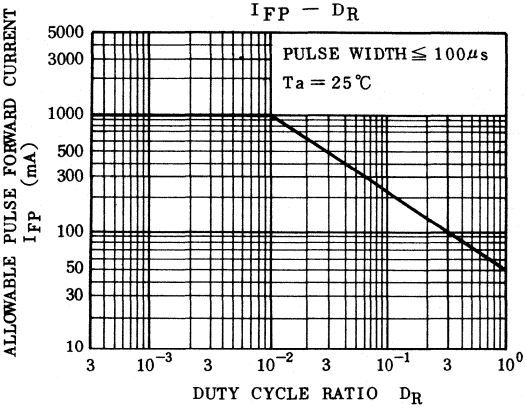
I_F – Ta



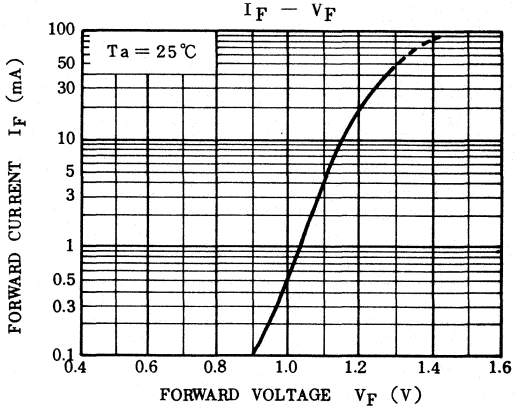
P_C – Ta



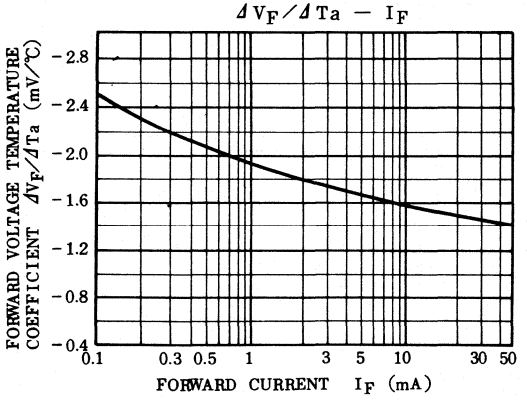
I_{FP} – D_R



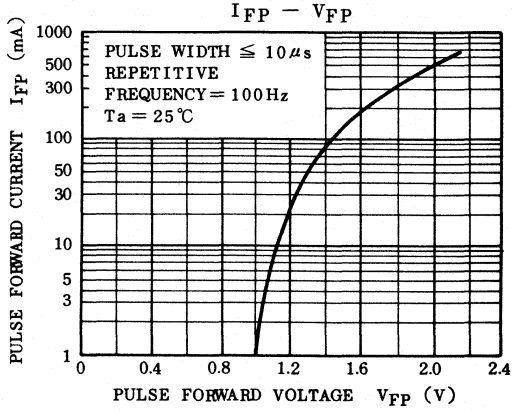
I_F – V_F



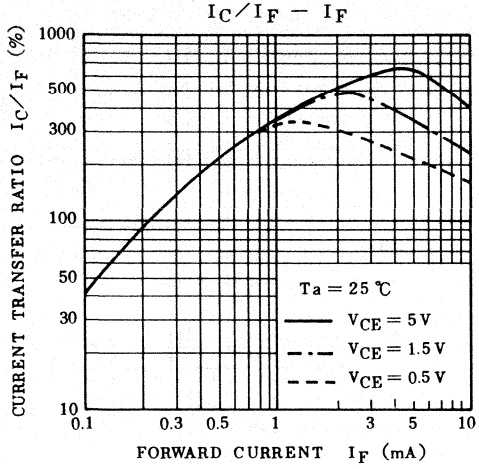
$\Delta V_F / \Delta Ta$ – I_F



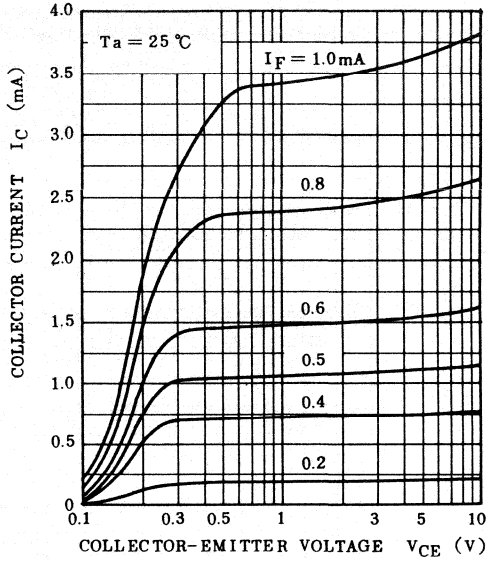
I_{FP} – V_{FP}



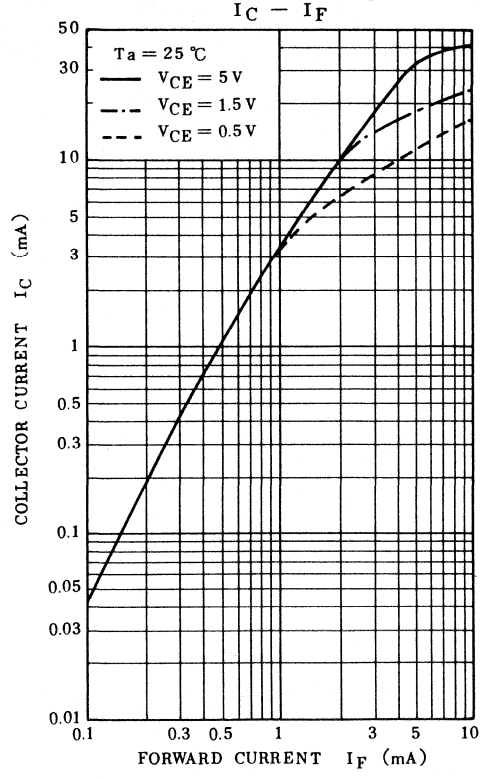
$I_C / I_F - I_F$



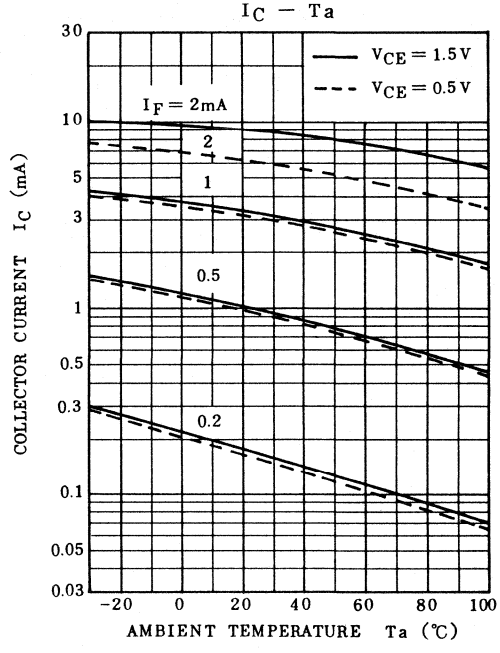
$I_C - V_{CE}$

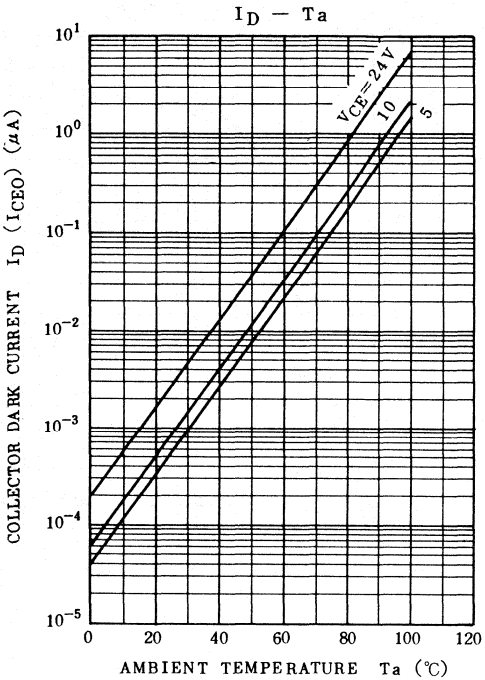


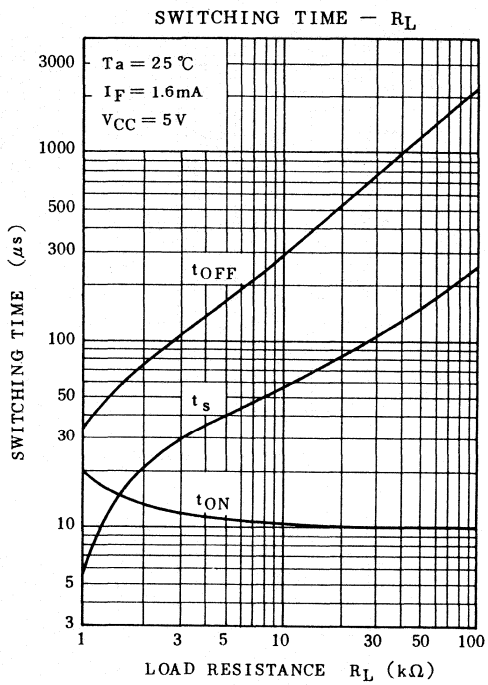
$I_C - I_F$



$I_C - Ta$




I_D – Ta
COLLECTOR DARK CURRENT I_D (I_{CEO}) (μA)
10^1
10^0
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
V_{CE} = 24 V
10
5
0
20
40
60
80
100
120
AMBIENT TEMPERATURE Ta (℃)


SWITCHING TIME – R_L
Ta = 25 ℃
I_F = 1.6mA
V_{CC} = 5 V
SWITCHING TIME (μs)
3000
1000
500
300
100
50
30
10
5
3
t_{OFF}
t_s
t_{ON}
1
3
5
10
30
50
100
LOAD RESISTANCE R_L (kΩ)

TLP626, TLP626-2, TLP626-4

GaAs IRED & PHOTO-TRANSISTOR

PROGRAMMABLE CONTROLLERS
AC/DC-INPUT MODULE
TELECOMMUNICATION

The TOSHIBA TLP626, -2 and -4 consist of two gallium arsenide infreared emitting diodes connected in inverse parallel, optically coupled to a photo-transistor.
The TLP626-2 offers two isolated channels in an eight lead plastic DIP package, while the TLP 626-4 provides four isolated channels in a sixteen plastic DIP package.

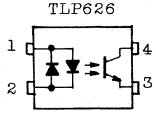
- Collector-Emitter Voltage: 55V Min.
- Current Transfer Ratio

CLASSIFICATION	CURRENT TRANSFER RATIO (Min.)			MARKING OF CLASSIFICATION
	Ta=25°C		Ta=-25 ∿75°C	
	I_F=±1mA V_{CE}=0.5V	I_F=±0.5mA V_{CE}=1.5V	I_F=±1mA V_{CE}=0.5V	
Rank BV	200%	100%	100%	BV
Standard	100%	50%	50%	BV, Blank

- Isolation Voltage: 500V_{rms} Min.
- UL Recognized : File No. E67349
- Note: Application type name for certification test, please use standard product type name, i.e.
  TLP626(BV): TLP626

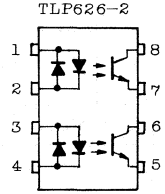
PIN CONFIGURATIONS (TOP VIEW)

TLP626



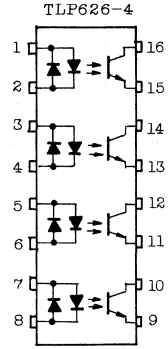
1: ANODE
CATHODE
2: CATHODE
ANODE
3: EMITTER
4: COLLECTOR

TLP626-2



1,3: ANODE
CATHODE
2,4: CATHODE
ANODE
5,7: EMITTER
6,8: COLLECTOR

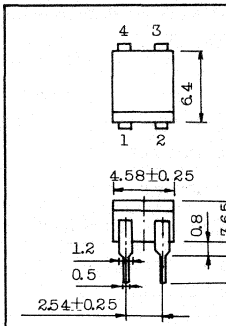
TLP626-4



1,3,5,7: ANODE, CATHODE
2,4,6,8: CATHODE, ANODE
9,11,13,15: EMITTER
10,12,14,16: COLLECTOR

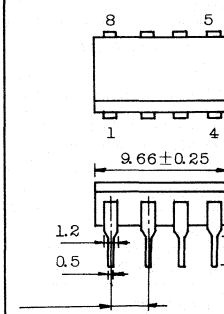
Unit in mm

TLP626



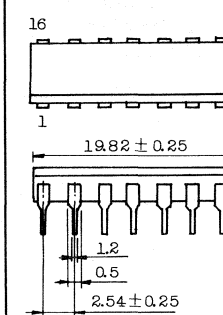
JEDEC	—
EIAJ	—
TOSHIBA	11-5B1

TLP626-2



JEDEC	—
EIAJ	—
TOSHIBA	11-10C1

TLP626-4



JEDEC	—
EIAJ	—
TOSHIBA	11-20A1

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING		UNIT
			TLP626	TLP626-2 TLP626-4	
LED	Forward Current	$I_{F(RMS)}$	60	50	mA
	Forward Current Derating	ΔI_F/°C	-0.7 (Ta≧39°C)	-0.5 (Ta≧25°C)	mA/°C
	Pulse Forward Current	I_{FP}	1 (100μs pulse, 100pps)		A
	Power Dissipation (1 Circuit)	P_D	100	70	mW
	Power Dissipation Derating (Ta≧25°C, 1 Circuit)	ΔP_D/°C	-1.0	-0.7	mW/°C
	Junction Temperature	T_j	125		°C
DETECTOR	Collector-Emitter Voltage	V_{CEO}	55		V
	Emitter-Collector Voltage	V_{ECO}	7		V
	Collector Current	I_C	50		mA
	Collector Power Dissipation (1 Circuit)	P_C	150	100	mW
	Collector Power Dissipation Derating (Ta≧25°C, 1 Circuit)	ΔP_C/°C	-1.5	-1.0	mW/°C
	Junction Temperature	T_j	125		°C
Storage Temperature Range		T_{stg}	-55~150		°C
Operating Temperature Range		T_{opr}	-55~100		°C
Lead Soldering Temperature		T_{sold}	260 (10 sec.)		°C
Total Package Power Dissipation (1 Circuit)		P_T	250	150	mW
Total Package Power Dissipation Derating (Ta≧25°C, 1 Circuit)		ΔP_T/°C	-2.5	-1.5	mW/°C
Isolation Voltage		BV_S	5000 (AC, 1 min., RH≦60%)		V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISITC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=±10mA	1.0	1.15	1.3	V
	Forward Current	I_F	V_F=±0.7V	-	2.5	20	μA
	Capacitance	C_T	V=0, f=1MHz	-	60	-	pF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=0.5mA	55	-	-	V
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	7	-	-	V
	Collector Dark Current	I_{CEO}	V_{CE}=24V	-	10	100	nA
			V_{CE}=24V, Ta=85°C	-	2	50	μA
	Capacitance Collector to Emitter	C_{CE}	V=0, f=1MHz	-	12	-	pF

COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Current Transfer Ratio	I_C/I_F	I_F=±1mA, V_{CE}=0.5V	100	-	-	%
		Rank BV	200	-	-	
Low Input CTR	I_C/I_F(low)	I_F=±0.5mA, V_{CE}=1.5V	50	-	-	%
		Rank BV	100	-	-	
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C=0.5mA, I_F=±1mA	-	-	0.4	V
		I_C=1mA, I_F=±1mA	-	0.2	-	
		Rank BV	-	-	0.4	
Off-State Collector Current	$I_{C(off)}$	V_F=±0.7V, V_{CE}=24V	-	1	10	μA
CTR Symmetry	$I_{C(ratio)}$	$I_C(I_F$=-1mA)/$I_C(I_F$=1mA)	0.5	-	2	-

COUPLED ELECTRICAL CHARACTERISTICS (Ta=-25 ∿ 75°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Current Transfer Ratio	I_C/I_F	I_F= 1mA, V_{CE}=0.5V	50	-	-	%
		Rank BV	100	-	-	
Low Input CTR	I_C/I_F(low)	I_F= 0.5mA, V_{CE}=1.5V	-	50	-	%
		Rank BV	-	100	-	

ISOLATION CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Capacitacne Input to Output	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	5000	-	-	V_{rms}
		AC, 1 second	-	10000	-	
		DC, 1 minute	-	10000	-	V_{dc}

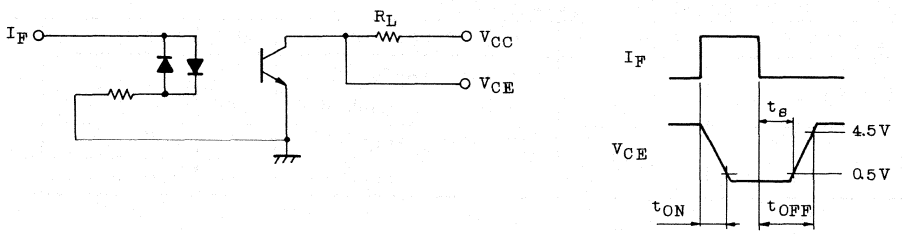
SWITCHING CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Rise Time	t_r	V_{CC}=10V, I_C=2mA R_L=100Ω	-	8	-	μs
Fall Time	t_f		-	8	-	
Turn-on Time	t_{on}		-	10	-	
Turn-off Time	t_{off}		-	8	-	
Turn-on Time	t_{ON}	R_L=4.7kΩ (Fig.1) V_{CC}=5V, I_F=±1.6mA	-	10	-	μs
Storage Time	t_s		-	50	-	
Turn-off Time	t_{OFF}		-	300	-	

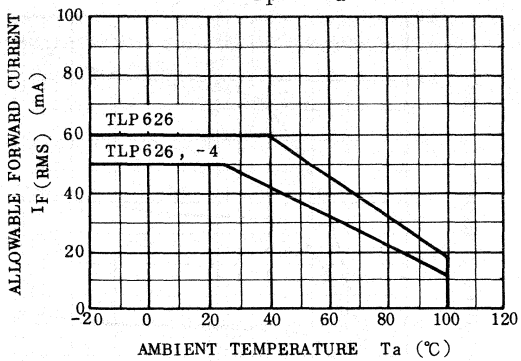
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	-	5	24	V
Forward Current	$I_{F(RMS)}$	-	1.6	20	mA
Collector Current	I_C	-	1	10	mA
Operating Temperature	T_{opr}	-25	-	75	°C

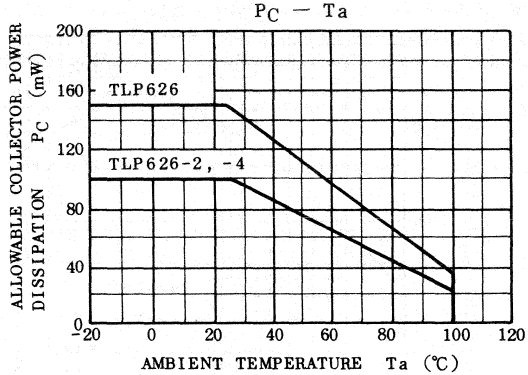
Fig. 1 SWITCHING TIME TEST CIRCUIT



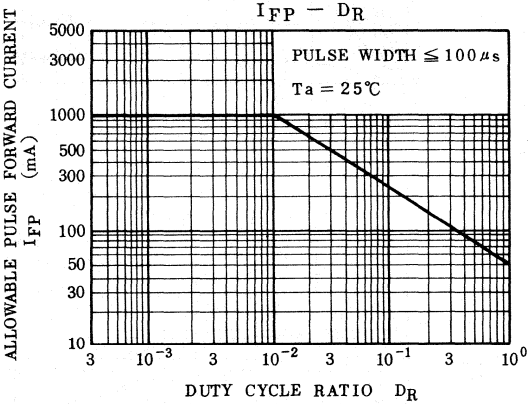
I_F — Ta



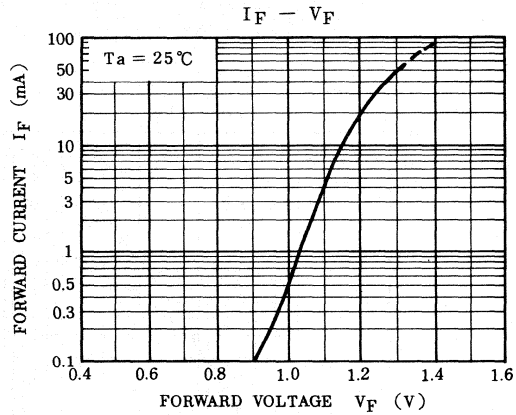
P_C — Ta



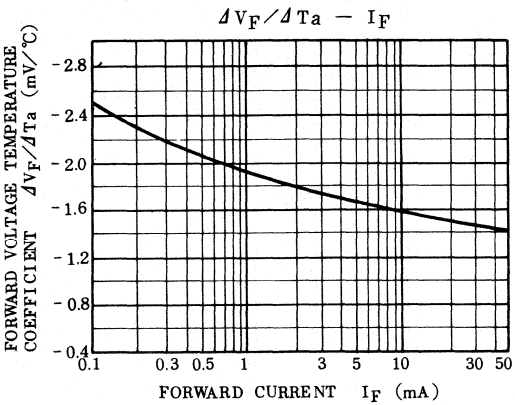
I_{FP} — D_R



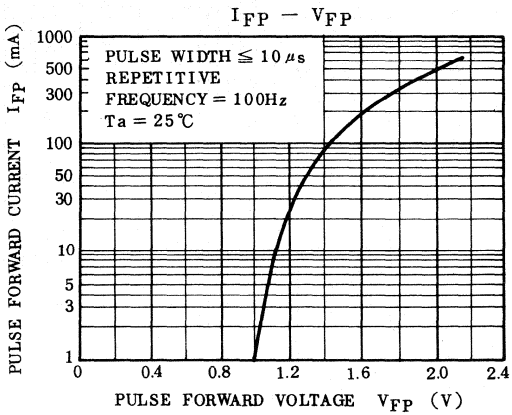
I_F — V_F



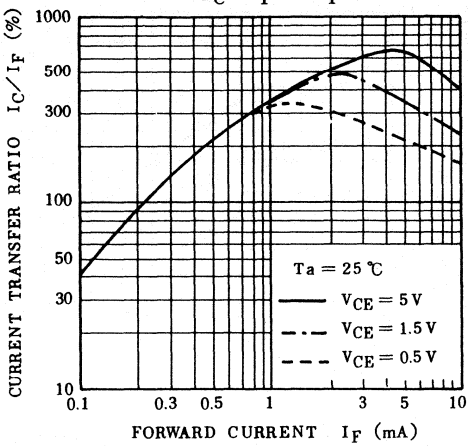
$\Delta V_F / \Delta Ta$ — I_F



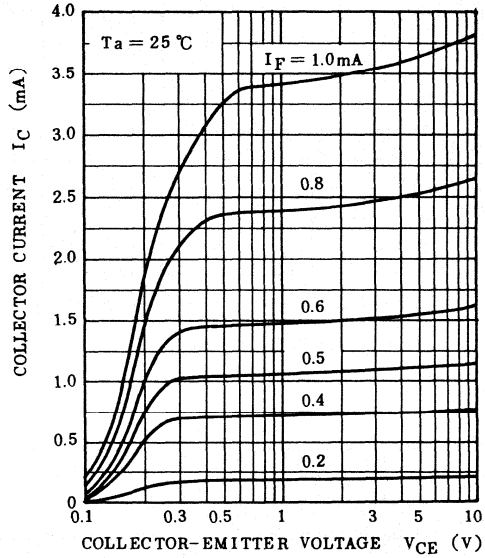
I_{FP} — V_{FP}



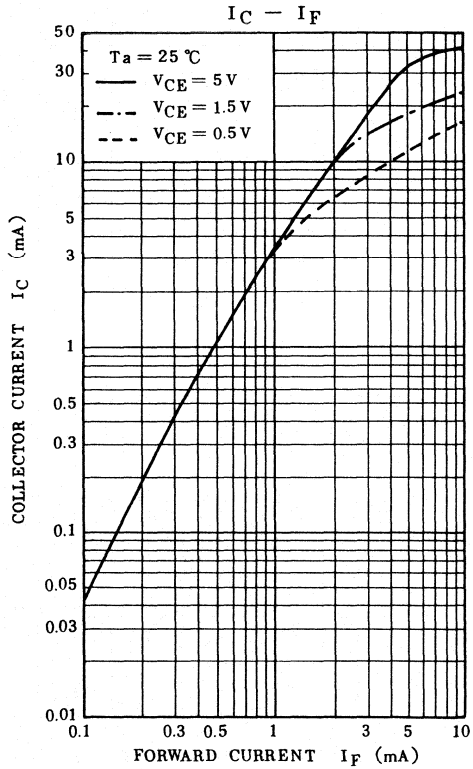
$I_C / I_F - I_F$



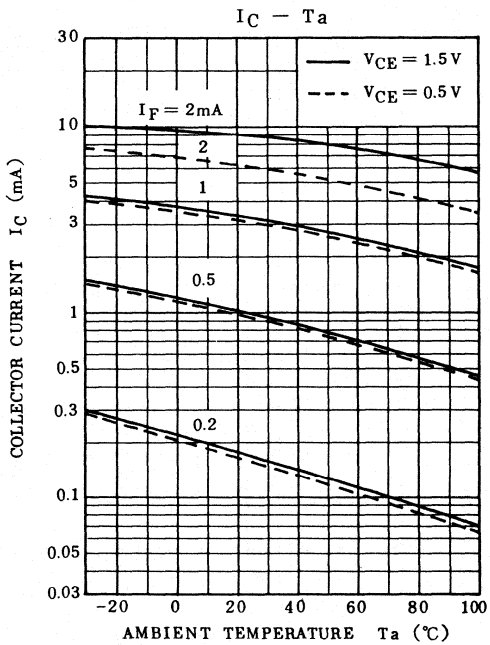
$I_C - V_{CE}$

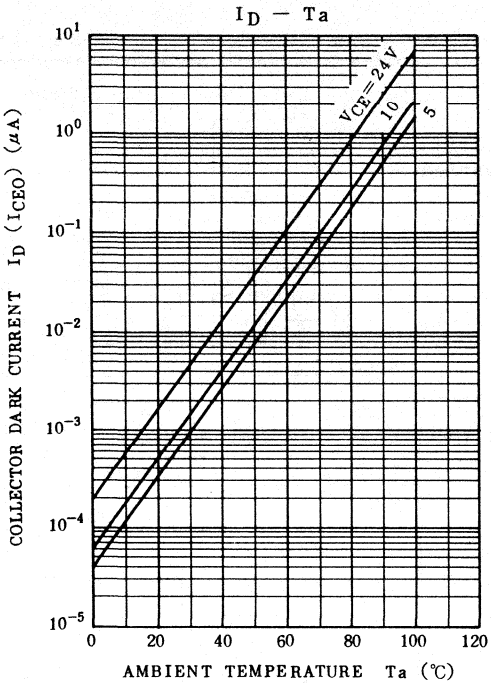


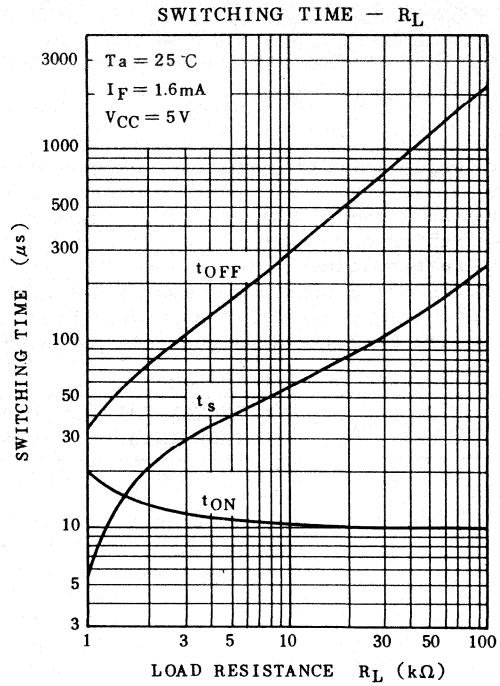
$I_C - I_F$



$I_C - Ta$




I_D — Ta
COLLECTOR DARK CURRENT I_D (I_{CEO}) (μA)
10^1
10^0
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
V_{CE} = 24 V
10
5
0
20
40
60
80
100
120
AMBIENT TEMPERATURE Ta (℃)


SWITCHING TIME — R_L
Ta = 25 ℃
I_F = 1.6mA
V_{CC} = 5 V
SWITCHING TIME (μs)
3000
1000
500
300
100
50
30
10
5
3
t_{OFF}
t_s
t_{ON}
1
3
5
10
30
50
100
LOAD RESISTANCE R_L (kΩ)

TLP627, TLP627-2, TLP627-4

GaAs IRED & PHOTO-TRANSISTOR

PROGRAMMABLE CONTROLLERS.

DC-OUTPUT MODULE.

TELECOMMUNICATION.

The TOSHIBA TLP627, -2, and -4 consist of a gallium arsenide infreared emitting diode optically coupled to a darlington connected phototransistor which has an integral base-emitter resistor to optimize switching speed and elevated temperature characteristics.
The TLP627-2 offers two isolated channels in a eight lead plastic DIP package, while the TLP627-4 provide four isolated channels per package.

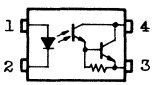
. Collector-Emitter Voltage

CLASSIFICATION	COLLECTOR-EMITTER VOLTAGE (Min.)	MARKING OF CLASSIFICATION
Standard	300V	Blank
Rank V2	200V	Blank, V2
Rank V1	100V	Blank, V2,V1

. Current Transfer Ratio : 1000% Min.
. Isolation Voltage : 5000V_{rms} Min.
. UL Recognized : File No. E67349
. Note: Application type name for certification test, please use standard product type name, i.e.
TLP627(V2) : TLP627
TLP627-2(V2) : TLP627-2

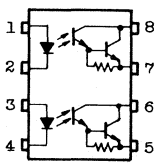
PIN CONFIGURATIONS (TOP VIEW)

TLP627



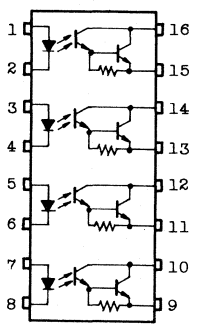
1: ANODE
2: CATHODE
3: EMITTER
4: COLLECTOR

TLP627-2



1,3: ANODE
2,4: CATHODE
5,7: EMITTER
6,8: COLLECTOR

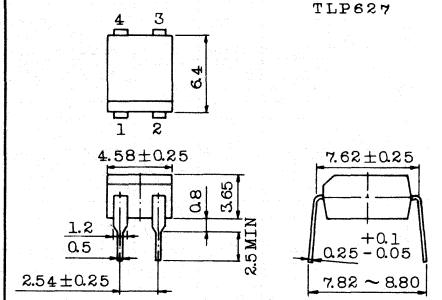
TLP627-4



1,3,5,7 : ANODE
2,4,6,8 : CATHODE
9,11,13,15 : EMITTER
10,12,14,16: COLLECTOR

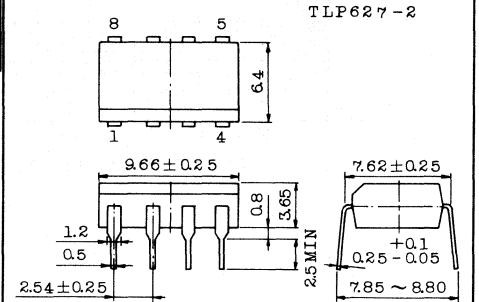
Unit in mm

TLP627



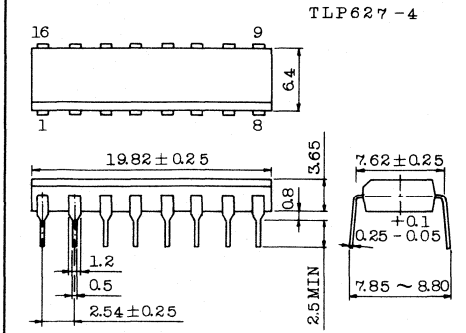
JEDEC	—
EIAJ	—
TOSHIBA	11-5B1

TLP627-2



JEDEC	—
EIAJ	—
TOSHIBA	11-10C1

TLP627-4



JEDEC	—
EIAJ	—
TOSHIBA	11-20A1

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING		UNIT
			TLP627	TLP627-2 TLP627-4	
LED	Forward Current	I_F	60	50	mA
	Forward Current Detating	$\Delta I_F/°C$	-0.7 (Ta≧39°C)	-0.5 (Ta≧25°C)	mA/°C
	Pulse Forward Current	I_{FP}	1 (100μs pulse, 100pps)		A
	Power Dissipation (1 Circuit)	P_D	100	70	mW
	Power Dissipation Derating (Ta≧25°C, 1 Circuit)	$\Delta P_D/°C$	-1.0	-0.7	mW/°C
	Reverse Voltage	V_R	5		V
	Junction Temperature	T_j	125		°C
DETECTOR	Collector-Emitter Voltage	V_{CEO}	300		V
			200 (Rank V2)		
			100 (Rank V1)		
	Emitter-Collector Voltage	V_{ECO}	0.3		V
	Collector Current	I_C	150		mA
	Collector Power Dissipation (1 Circuit)	P_C	150	100	mW
	Collector Power Dissipation Derating (Ta≧25°C, 1 Circuit)	$\Delta P_C/°C$	-1.5	-1.0	mW/°C
	Junction Temperature	T_j	125		°C
Storage Temperature Range		T_{stg}	-55~150		°C
Operating Temperature Range		T_{opr}	-55~100		°C
Lead Soldering Temperature		T_{sold}	260 (10 sec.)		°C
Total Package Power Dissipation (1 Circuit)		P_T	250	150	mW
Total Package Power Dissipation Derating (Ta≧25°C, 1 Circuit)		$\Delta P_T/°C$	-2.5	-1.5	mW/°C
Isolation Voltage		BV_S	5000 (AC, 1 min., RH≦60%)		V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=0.1mA Rank V2	300	-	-	V
			I_C=0.1mA Rank V2	200	-	-	
			I_C=0.1mA Rank V1	100	-	-	
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	0.3	-	-	V
	Collector Dark Current	I_{CEO}	V_{CE}=200V V_{CE}=150V (Rank V2) V_{CE}=80V (Rank V1)	-	10	200	nA
			V_{CE}=200V V_{CE}=150V (Rank V2) V_{CE}=80V (Rank V1) Ta=85°C	-	-	20	μA
	Capacitacne Collector to Emitter	C_{CE}	V=0, f=1MHz	-	10	-	pF

COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Current Transfer Ratio	I_C/I_F	I_F=1mA, V_{CE}=1V	1000	4000	-	%
Saturated CTR	$I_C/I_{F(sat)}$	I_F=10mA, V_{CE}=1V	500	-	-	%
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C=10mA, I_F=1mA	-	-	1.0	V
		I_C=100mA, I_F=10mA	0.3	-	1.2	

ISOLATION CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Capacitacne Input to Output	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	5000	-	-	V_{rms}
		AC, 1 second	-	10000	-	
		DC, 1 minute	-	10000	-	V_{dc}

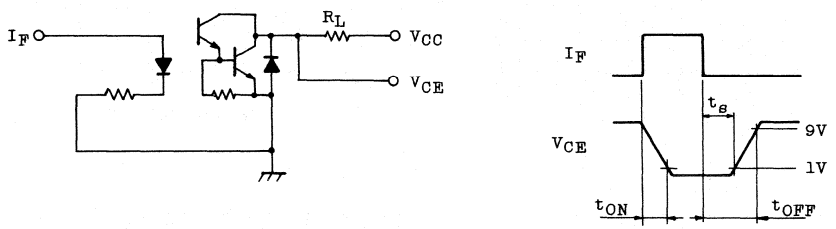
SWITCHING CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Rise Time	t_r	V_{CC}=10V, I_C=10mA R_L=100Ω	-	40	-	μs
Fall Time	tf		-	15	-	
Turn-on Time	t_{on}		-	50	-	
Turn-off Time	t_{off}		-	15	-	
Turn-on Time	t_{ON}	R_L=180kΩ (Fig.1) V_{CC}=10V, I_F=16mA	-	5	-	μs
Strage Time	t_s		-	40	-	
Turn-off Time	t_{OFF}		-	80	-	

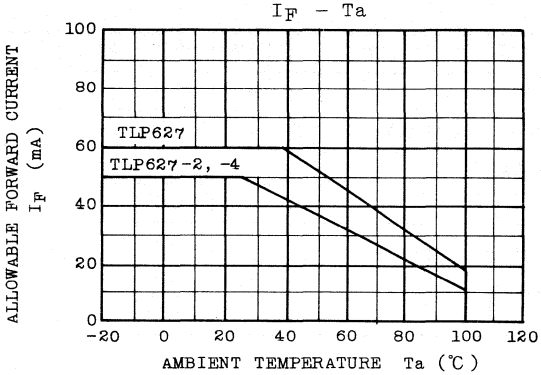
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	-	-	200	V
Forward Current	I_F	-	16	20	mA
Collector Current	I_C	-	-	50	mA
Operating Temperature	T_{opr}	-25	-	85	°C

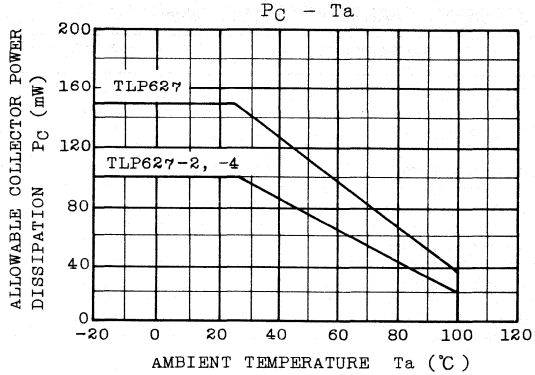
Fig. 1 SWITCHING TIME TEST CIRCUIT



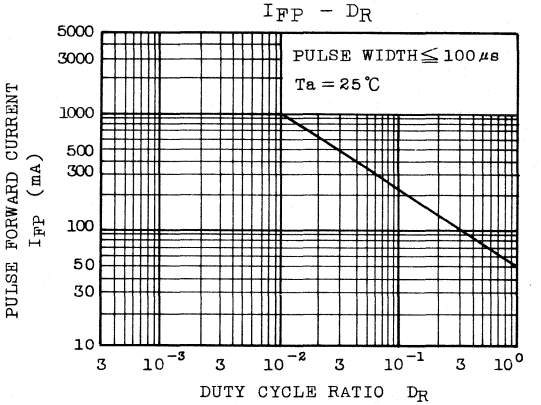
I_F – Ta



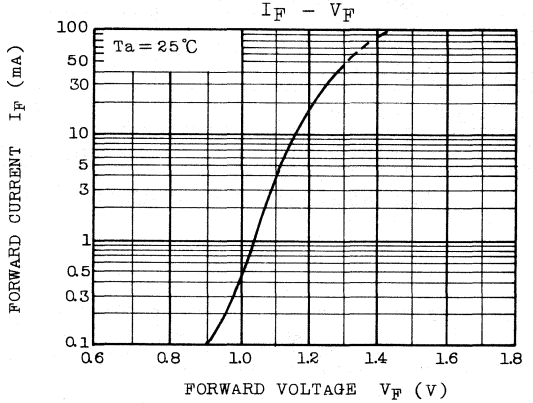
P_C – Ta



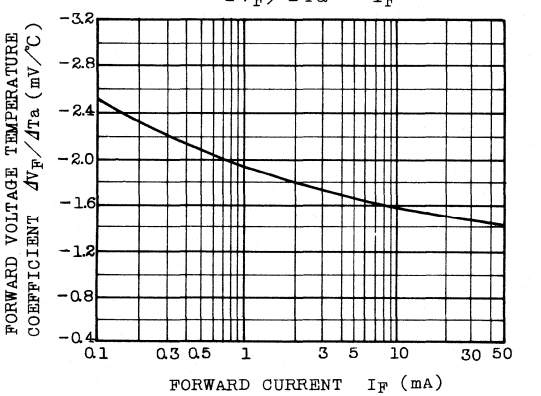
I_{FP} – D_R



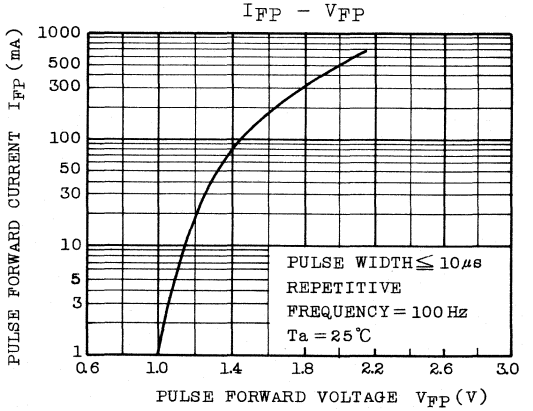
I_F – V_F



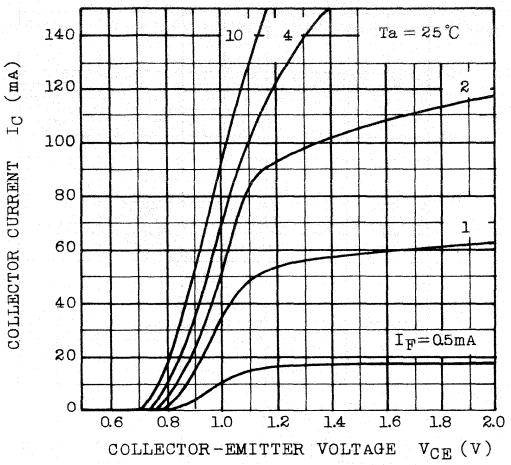
$\Delta V_F / \Delta Ta$ – I_F



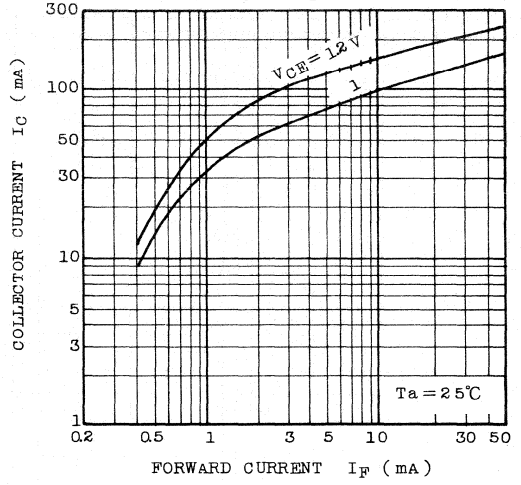
I_{FP} – V_{FP}



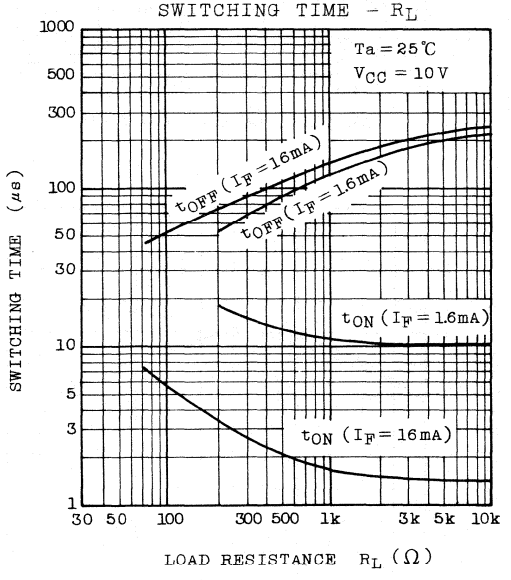
$I_C - V_{CE}$



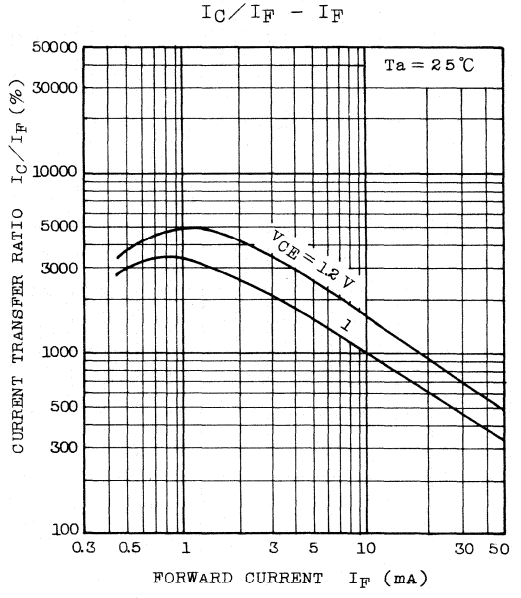
$I_C - I_F$



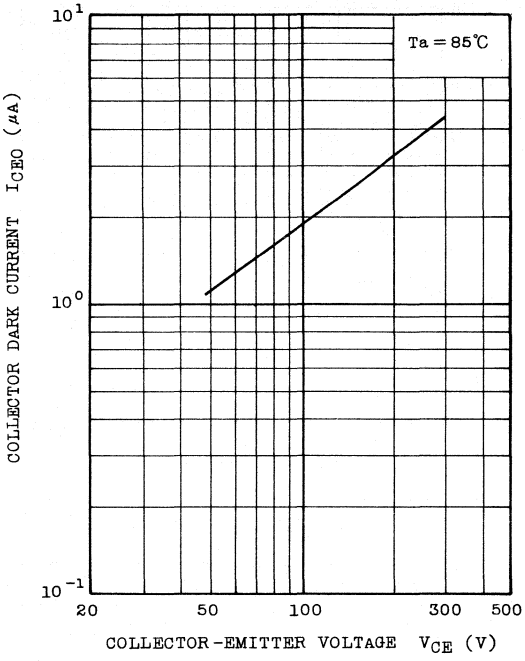
SWITCHING TIME - R_L



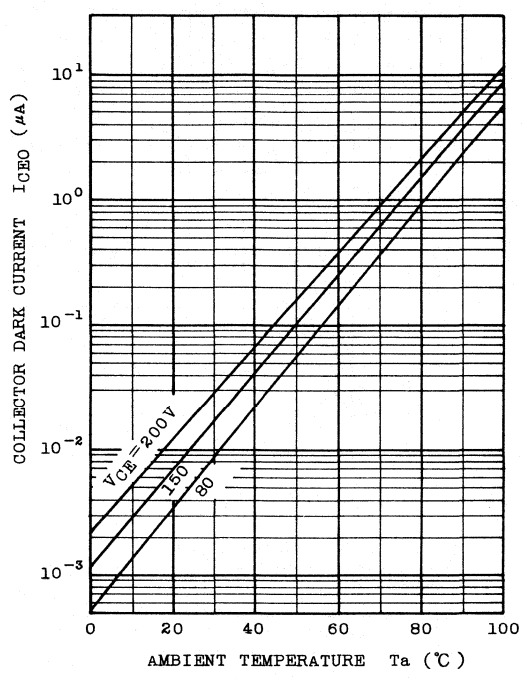
$I_C / I_F - I_F$



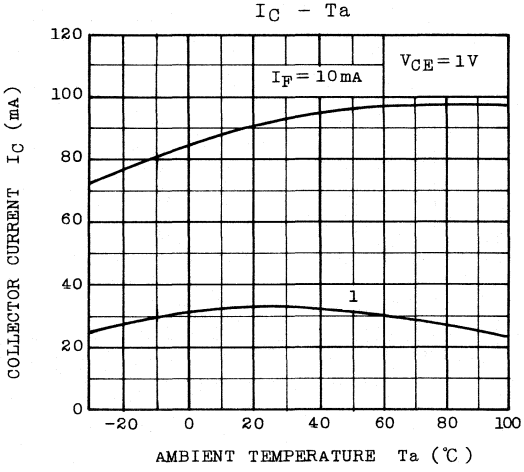
I_{CEO} – V_{CE}



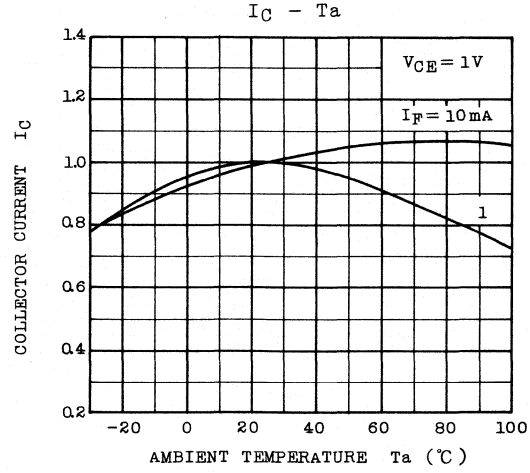
I_{CEO} – Ta



I_C – Ta



I_C – Ta

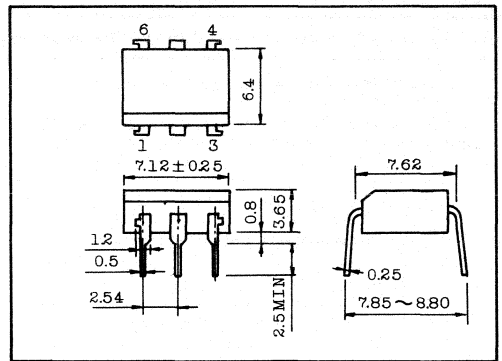


PROGRAMMABLE CONTROLLERS
AC/DC-INPUT MODULE
TELECOMMUNICATION

The TOSHIBA TLP630 consists of a photo-transistor optically coupled to two gallium arsenide infrared emitting diode connected inverse parallel in a six lead plastic DIP package.

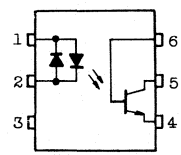
- Collector-Emitter Voltage : 55V Min.
- Current Transfer Ratio : 50% Min.
  Rank GB : 100% Min.
- Isolation Voltage : 5000Vrms Min.
- UL Recognized : File No. E67349

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-7A2

PIN CONFIGURATIONS (TOP VIEW)



1: ANODE, CATHODE
2: CATHODE, ANODE
3: NC
4: EMITTER
5: COLLECTOR
6: BASE

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	$I_{F(RMS)}$	60	mA
	Forward Current Derating (Ta≧39°C)	I_F/°C	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)	I_{FP}	±1	A
	Junction Temperature	T_j	125	°C
DETECTOR	Collector-Emitter Voltage	V_{CEO}	55	V
	Collector-Base Voltage	V_{CBO}	80	V
	Emitter-Collector Voltage	V_{ECO}	7	V
	Emitter-Base Voltage	V_{EBO}	7	V
	Collector Current	I_C	50	mA
	Power Dissipation	P_C	150	mW
	Power Dissipation Derating (Ta≧25°C)	P_C/°C	-1.5	mW/°C
	Junction Temperature	T_j	125	°C
Storage Temperature Range		T_{stg}	-55∿125	°C
Operating Temperature Range		T_{opr}	-55∿100	°C
Lead Soldering Temperature (10 sec.)		Tsold	260	°C
Total Package Power Dissipation		P_T	250	mW
Total Package Power Dissipation Derating (Ta≧25°C)		ΔP_T/°C	-2.5	mW/°C
Isolation Voltage (AC,1 min, RH≦60%)		BV_S	5000	V_{RMS}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIT	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=±10mA	1.0	1.15	1.3	V
	Capacitance	C_T	V=0, f=1MHz	-	60	-	pF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=0.5mA	55	-	-	V
	Emitter-Collecter Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	7	-	-	V
	Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	I_C=0.1mA	80	-	-	V
	Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	I_E=0.1mA	7	-	-	V
	Collector Dark Current	I_{CEO}	V_{CE}=24V	-	10	100	nA
			V_{CE}=24V, Ta=85°C	-	2	50	μA
	Collector Dark Current	I_{CBO}	V_{CB}=10V	-	0.1	-	nA
	Capacitance (Collector to Emitter)	C_{CE}	V=0, f=1MHz	-	10	-	pF

COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTITS	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Current Transfer Ratio	I_C/I_F	I_F=±5mA, V_{CE}=5V Rank GB	50	-	600	%
			100	-	600	
Saturated CTR	$I_C/I_{F(sat)}$	I_F=±1mA, V_{CE}=0.4V Rank GB	-	60	-	%
			30	-	-	
Base Photo-current	I_{PB}	I_F=±5mA, V_{CB}=5V	-	10	-	μA
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C=2.4mA, I_F=±8mA	-	-	0.4	
Off-State Collecter Crrent	$I_{C(off)}$	V_F=±0.7V, V_{CE}=24V	-	1	10	μA
CTR Symmetry	$I_{C(ratio)}$	$I_C(I_F$=-5mA)/$I_C(I_F$=+5mA)	0.33	1	3	-

ISOLATION CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V, R.H.≤60%	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	5000	-	-	V_{rms}
		AC, 1 second	-	10000	-	V_{rms}
		DC, 1 minute	-	10000	-	V_{dc}

SWITCHING CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Rise Time	t_r	V_{CC}=10V, I_C=2mA, R_L=100Ω	-	2	-	μs
Fall Time	t_f		-	3	-	
Turn-on Time	t_{on}		-	3	-	
Turn-off Time	t_{off}		-	3	-	
Turn-on Time	t_{ON}	R_L=1.9kΩ (Fig.1)	-	2	-	μs
Storage Time	t_S	R_{BE}=OPEN	-	15	-	
Turn-off Time	t_{OFF}	V_{CC}=5V, I_F=±16mA	-	25	-	
Turn-on Time	t_{ON}	R_L=1.9kΩ (Fig.1)	-	2	-	μs
Storage Time	t_S	R_{BE}=220kΩ	-	12	-	
Turn-off Time	t_{OFF}	V_{CC}=5V, I_F=±16mA	-	20	-	

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	-	5	24	V
Forward Current	$I_{F(RMS)}$	-	16	25	mA
Collector Current	I_C	-	1	10	mA
Operating Temperature	T_{opr}	-25	-	85	°C

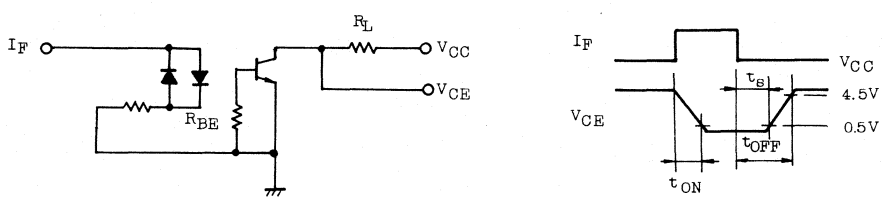
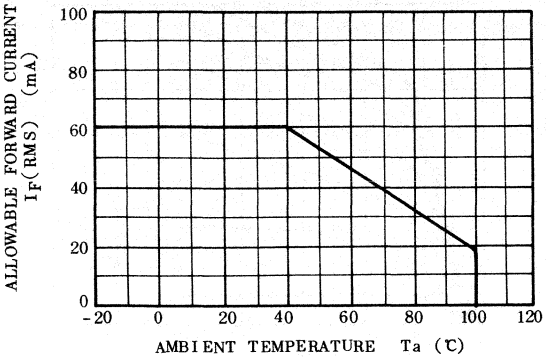
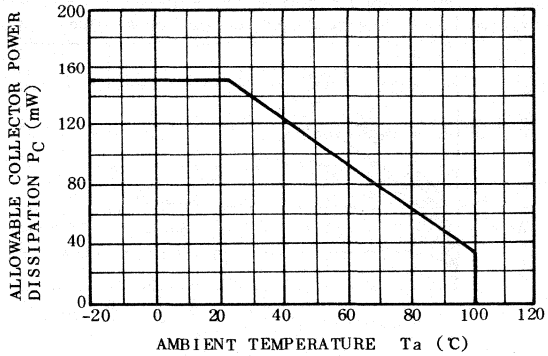


Fig 1 Switching Time Test Circuit

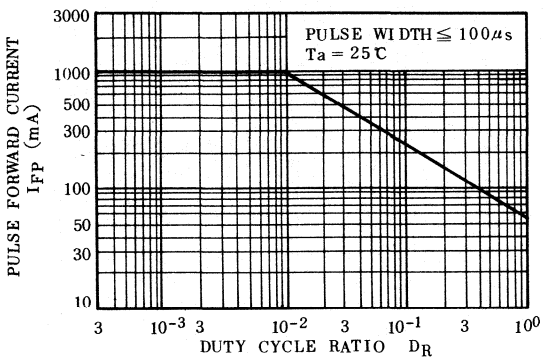
I_F (RMS) — Ta



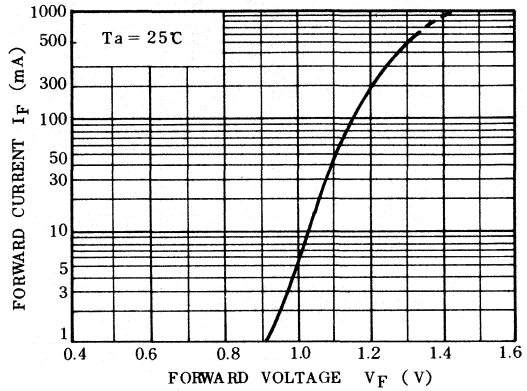
P_C — Ta



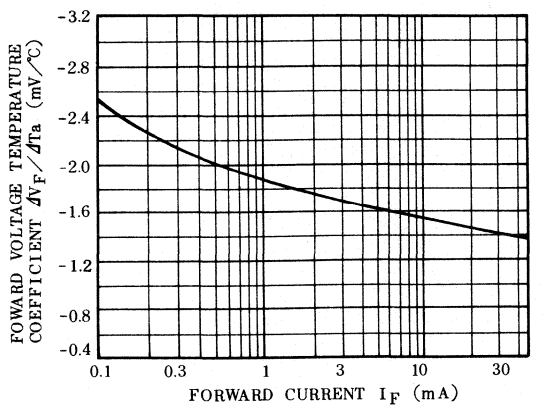
I_{FP} — D_R



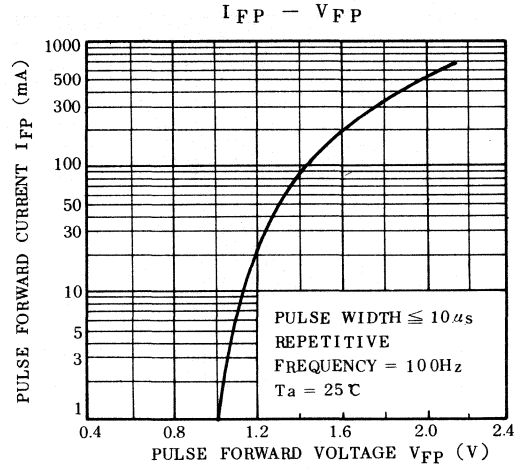
I_F — V_F



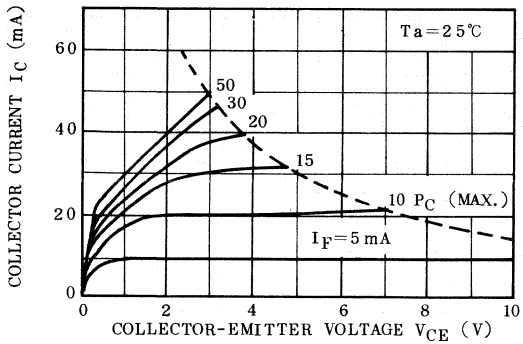
$\Delta V_F / \Delta Ta$ — I_F



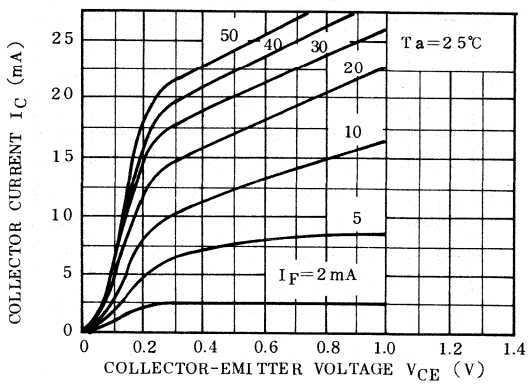
I_{FP} — V_{FP}



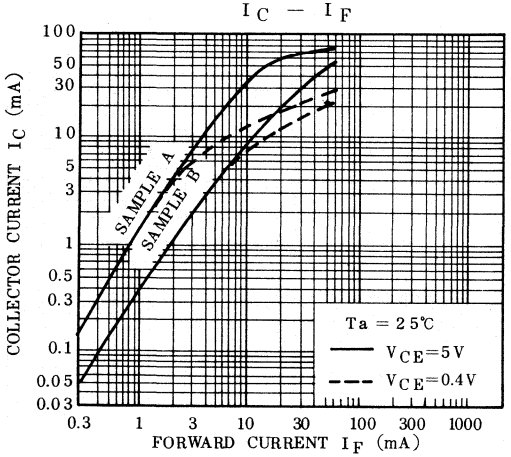
$I_C - V_{CE}$



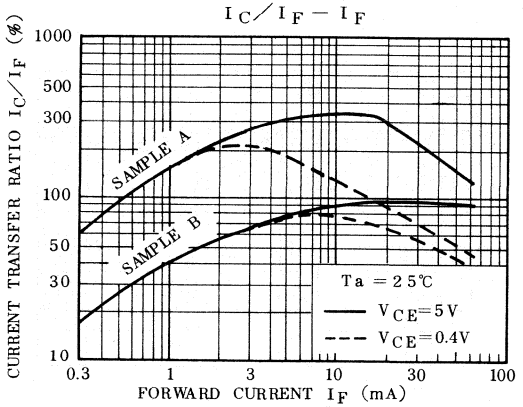
$I_C - V_{CE}$



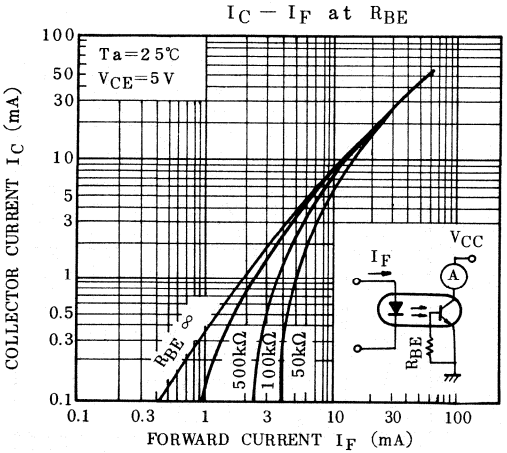
$I_C - I_F$



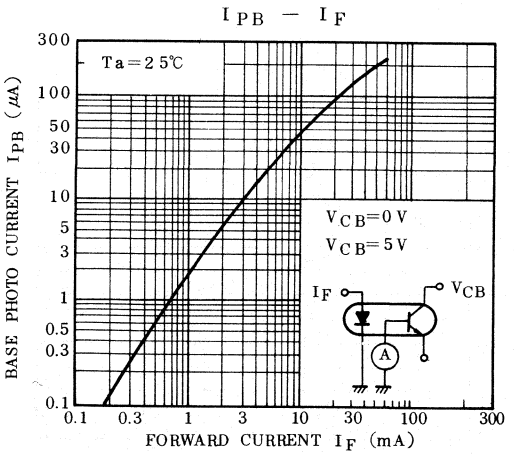
$I_C / I_F - I_F$



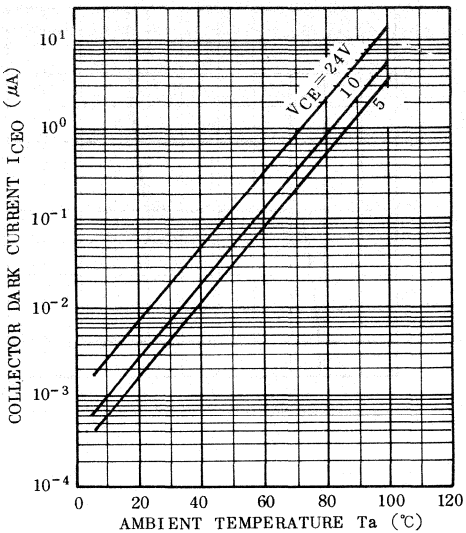
$I_C - I_F$ at R_{BE}



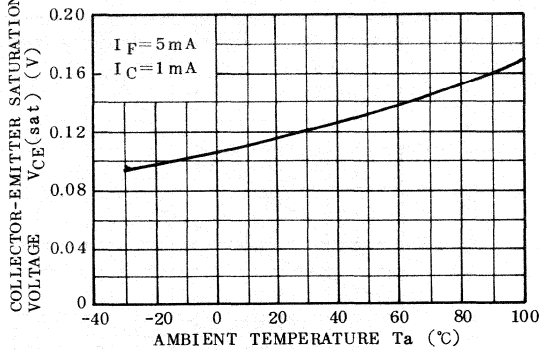
$I_{PB} - I_F$



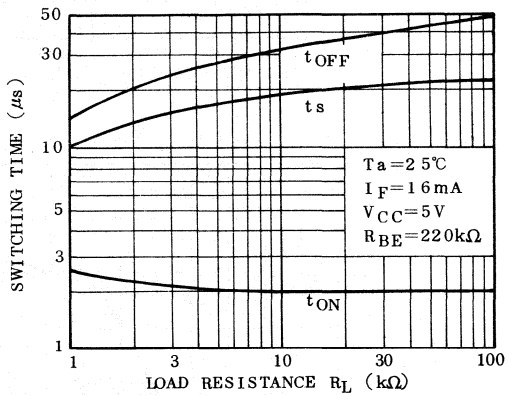
I_{CEO} — Ta



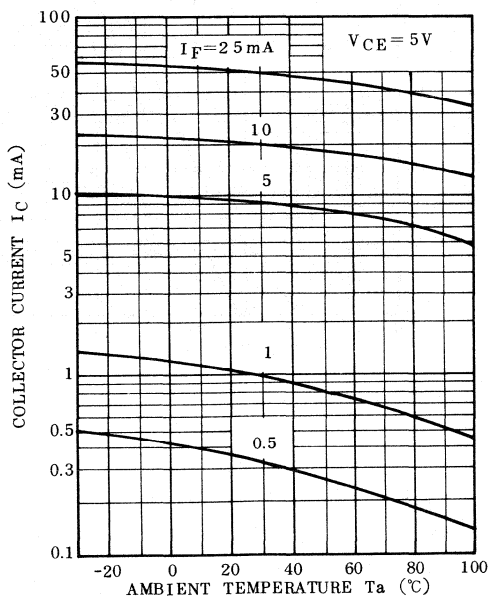
$V_{CE}(sat)$ — Ta



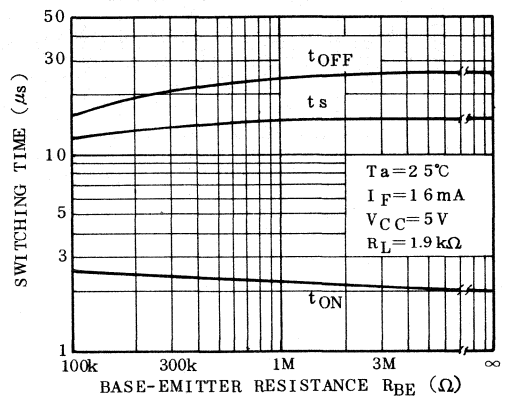
SWITCHING TIME — R_L



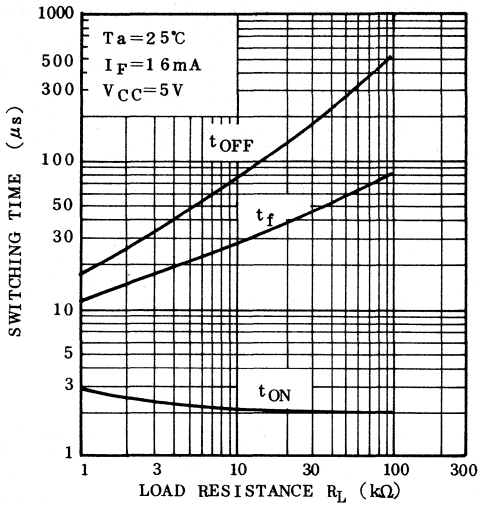
I_C — Ta



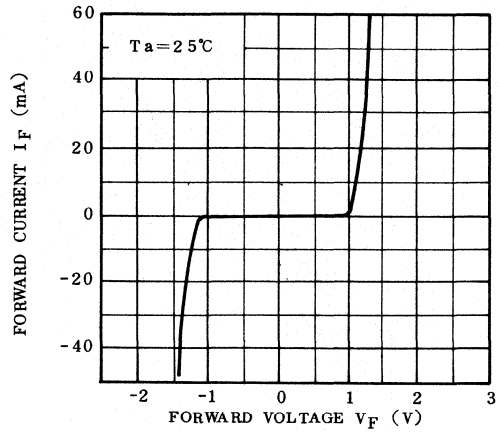
R_{BE} — SWITCHING TIME



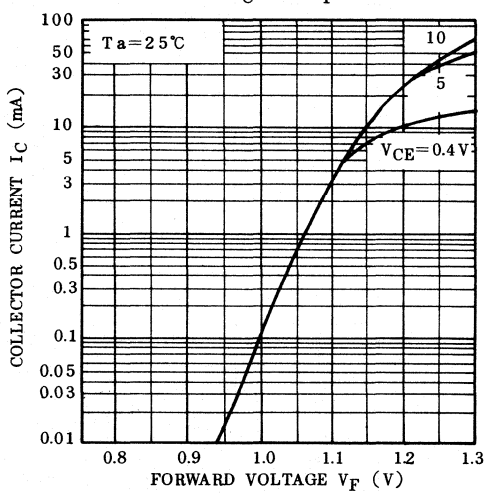
R_L — SWITCHING TIME



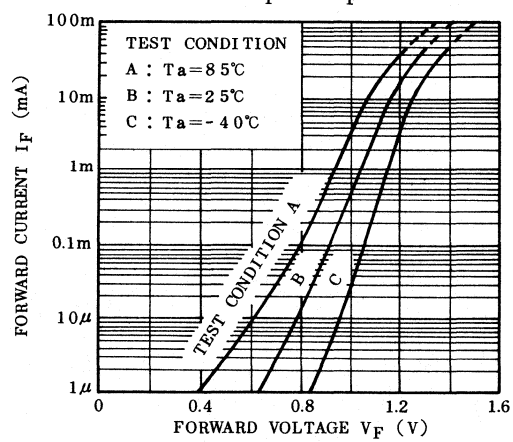
V_F — I_F



I_C — V_F



I_F — V_F



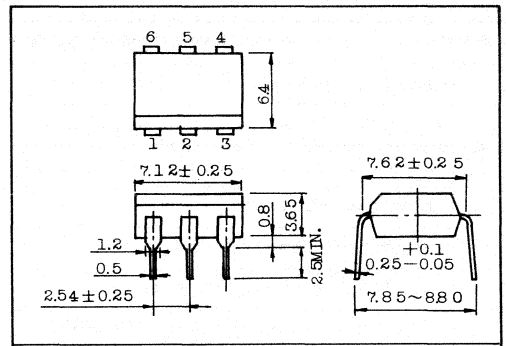
TLP631, TLP632

PROGRAMMABLE CONTROLLERS
AC/DC-INPUT MODULE
SOLID STATE RELAY

The TOSHIBA TLP631 and TLP632 consist of a photo-transistor optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.
TLP632 is no-base internal connection for high-EMI environments.

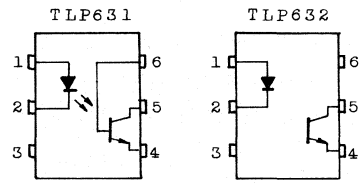
- collector-Emitter Voltage : 55V Min.
- Current Transfer Ratio : 50% Min.
  Rank GB : 100% Min.
- Isolation Voltage : 5000Vrms Min,
- UL Recognized : File No. E67349

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11−7A1

PIN CONFIGURATIONS (TOP VIEW)



TLP631	TLP632
1. ANODE	1. ANODE
2. CATHODE	2. CATHODE
3. NC	3. NC
4. EMITTER	4. EMITTER
5. COLLECTOR	5. COLLECTOR
6. BASE	6. NC

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	60	mA
	Forward Current Derating (Ta≧39°C)	ΔIF/°C	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)	I_{FP}	1	A
	Reverse Voltage	V_R	5	V
	Junction Temperature	T_j	125	°C
DETECTOR	Collection-Emitter Voltage	V_{CED}	55	V
	Collector-Base Voltage (TLP631)	V_{CBO}	80	V
	Emitter-Collector Voltage	V_{ECO}	7	V
	Emitter-Base Voltage (TLP631)	V_{EBO}	7	V
	Collector Current	I_C	50	mA
	Power Dissipation	P_C	150	mW
	Power Dissipation Derating (Ta≧25°C)	ΔP_C/°C	-1.5	mW/°C
	Junction Temperature	T_j	125	°C
Storage Temperature Range		T_{stg}	-55∿125	°C
Operating Temperature Range		T_{opr}	-55∿100	°C
Lead Soldering Temperature (10 sec.)		T_{sold}	260	°C
Total Package Power Dissipation		P_T	250	mW
Total Package Power Dissipatioo Derating (Ta≧25°C)		ΔP_T/°C	-2.5	mW/°C
Isolation Voltage (AC, 1 min, RH≦60%)		BV_S	5000	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=0.5mA	55	-	-	V
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	7	-	-	V
	Collector-Base Breakdown Voltage (TLP631)	$V_{(BR)CBO}$	I_C=0.1mA	80	-	-	V
	Emitter-Base Breakdown Voltage (TLP631)	$V_{(BR)EBO}$	I_E=0.1mA	7	-	-	V
	Collector Dark Current	I_{CEO}	V_{CE}=24V	-	10	100	nA
			V_{CE}=24V, Ta=85°C	-	2	50	μA
	Capacitance (Collector to Emitter	C_{CE}	V=0, f=1MHz	-	10	-	pF

COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Current Transfer Ratio	I_C/I_F	I_F=5mA, V_{CE}=5V	50	-	600	%
		Rank GB	100	-	600	
Saturated CTR	I_C/I_F (sat)	I_F=1mA, V_{CE}=0.4V	-	60	-	%
		Rank GB	-	-	-	
Collector-Emitter Saturation Voltage	V_{CE}(sat)	I_C=2.4mA, I_F=8mA	-	-	0.4	V

ISOLATION CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V, R.H≤60%	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	5000	-	-	Vrms

SWITCHING CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Rise Time	t_r	V_{CC}=10V, I_C=2mA, R_L=100Ω	-	2	-	μs
Fall Time	t_f		-	3	-	
Turn-on Time	t_{on}		-	3	-	
Turn-off Time	t_{off}		-	3	-	
Turn-on Time	t_{ON}	R_L=1.9kΩ (Fig.1), R_{BE}=OPEN, V_{CC}=5V, I_F=16mA	-	2	-	μs
Storage Time	t_S		-	15	-	
Turn-off Time	t_{OFF}		-	25	-	
Turn-on Time	t_{ON}	R_L=1.9kΩ (Fig.1), R_{BE}=220kΩ (TLP631), V_{CC}=5V, I_F=16mA	-	2	-	μs
Storage Time	t_S		-	12	-	
Turn-off Time	t_{OFF}		-	20	-	

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	-	5	24	V
Forward Current	I_F	-	16	25	mA
Collector Current	I_C	-	1	10	mA
Operating Temperature	Topr	-25	-	85	°C

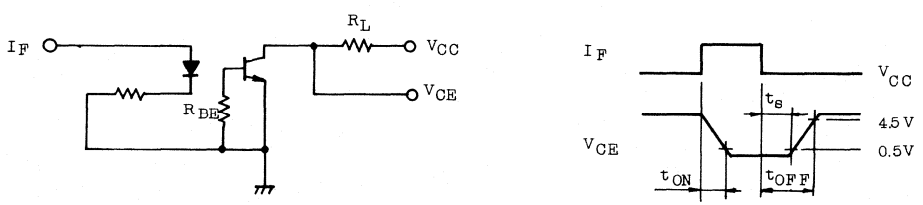
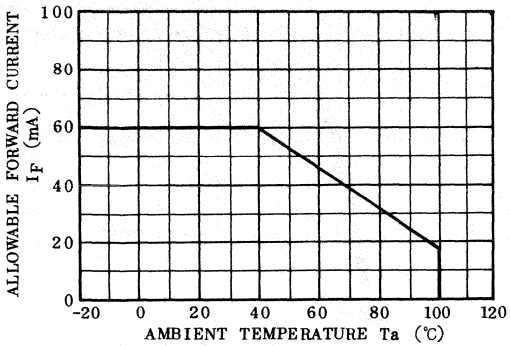
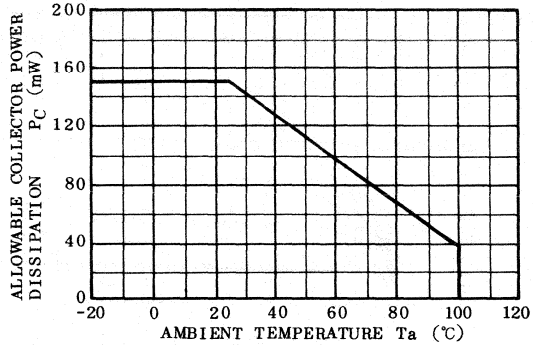


Fig. 1 Switching Time Test Circuit

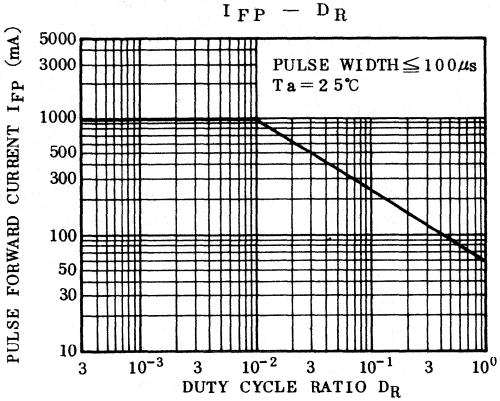
I_F — Ta



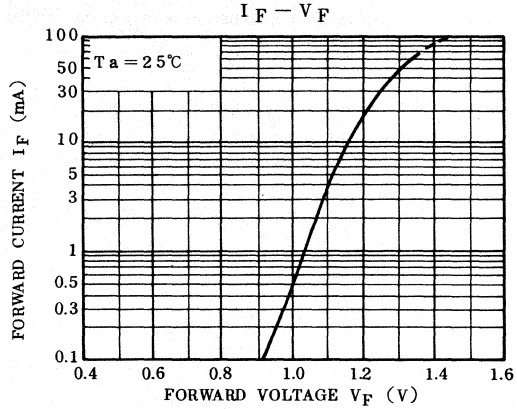
P_C — Ta



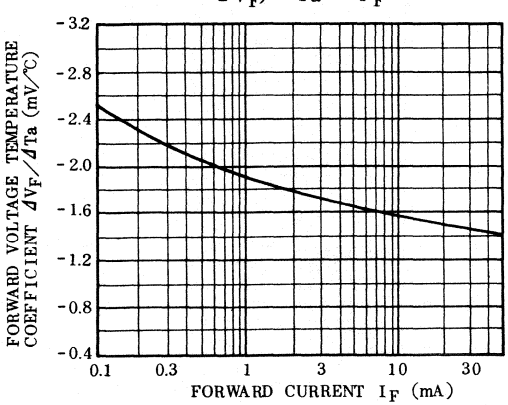
I_{FP} — D_R



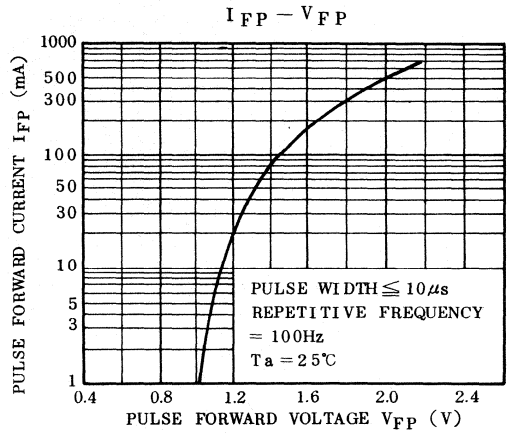
I_F — V_F



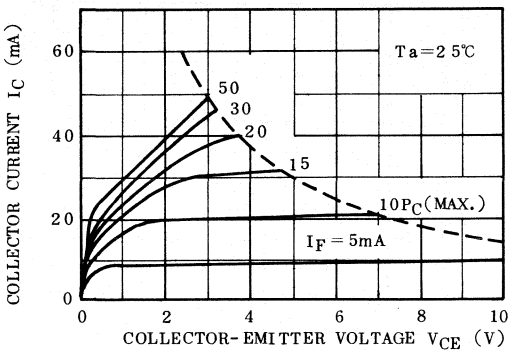
$\Delta V_F / \Delta Ta$ — I_F



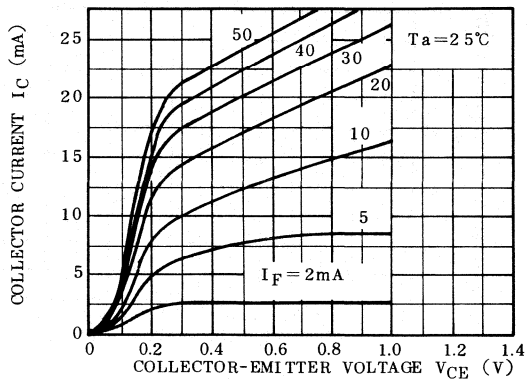
I_{FP} — V_{FP}



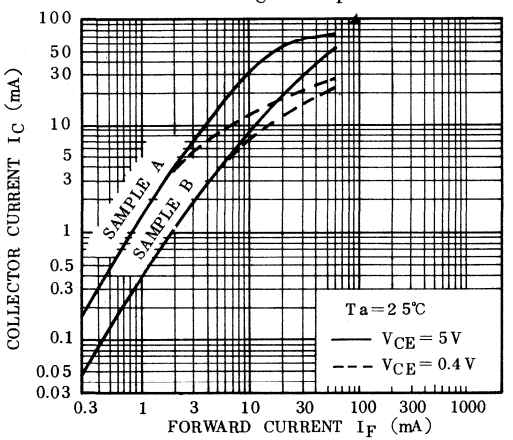
$I_C - V_{CE}$



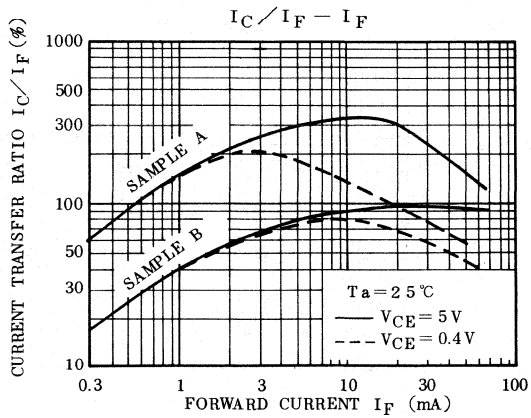
$I_C - V_{CE}$



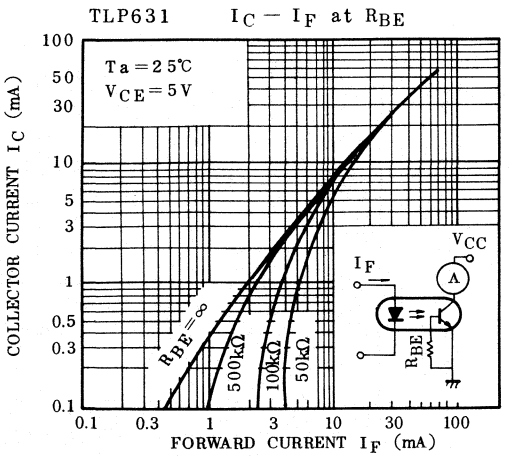
$I_C - I_F$



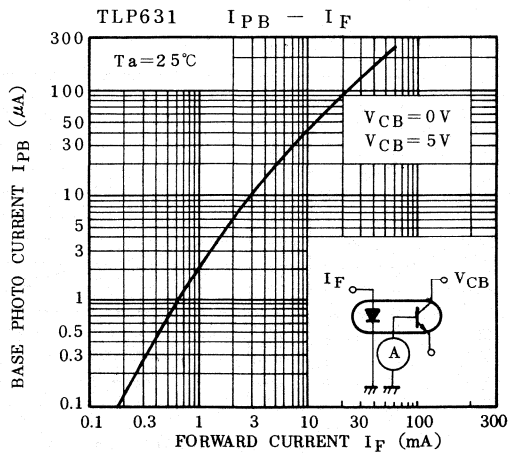
$I_C / I_F - I_F$



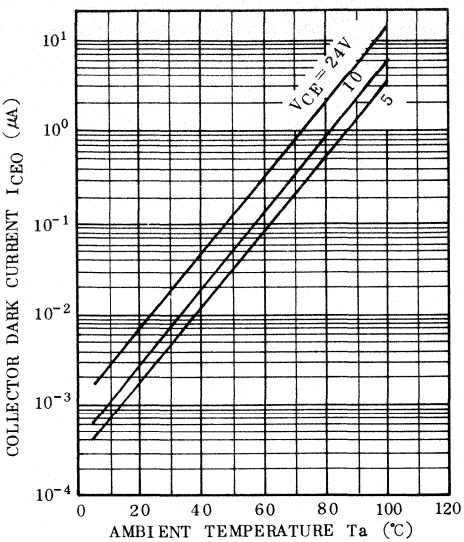
TLP631 $I_C - I_F$ at R_{BE}



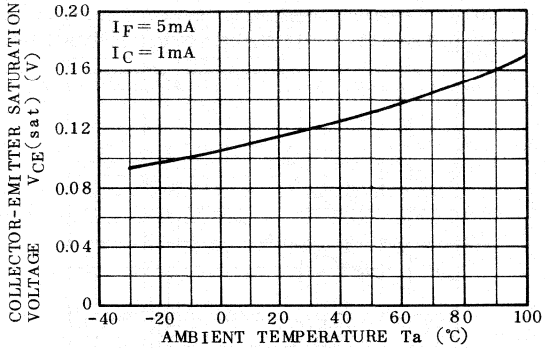
TLP631 $I_{PB} - I_F$



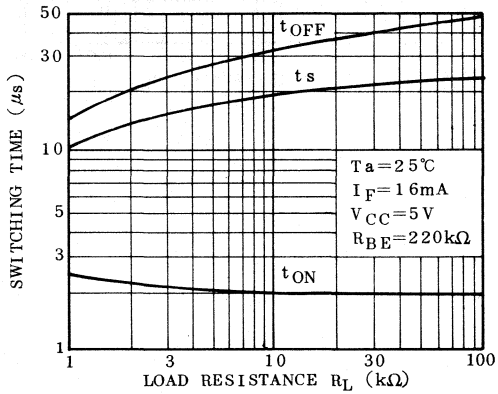
I_{CEO} — Ta



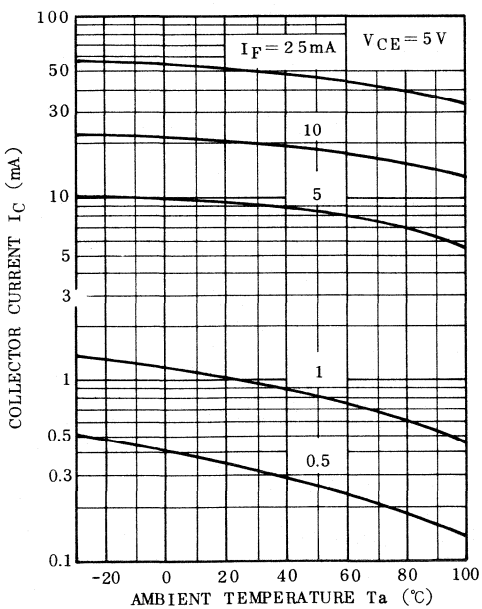
V_{CE} (sat) — Ta



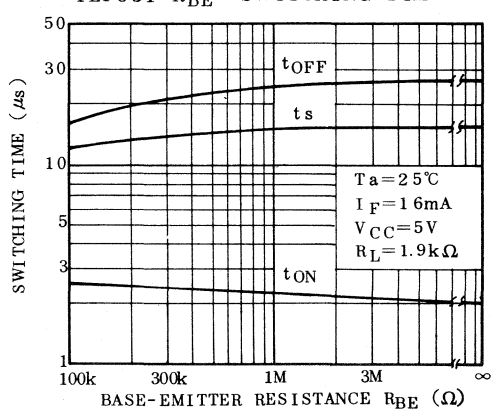
TLP631 SWITCHING TIME — R_L



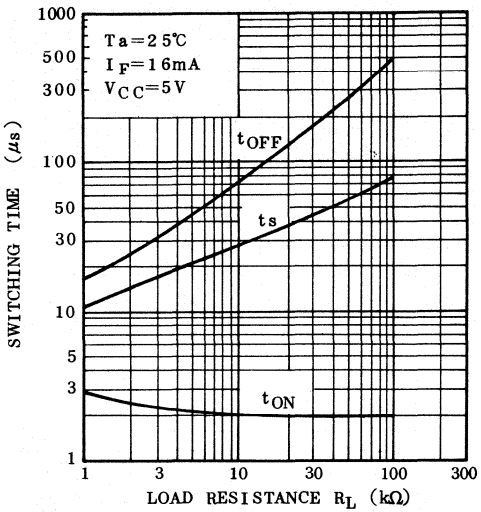
I_C — Ta



TLP631 R_{BE} — SWITCHING TIME



R_L — SWITCHING TIME

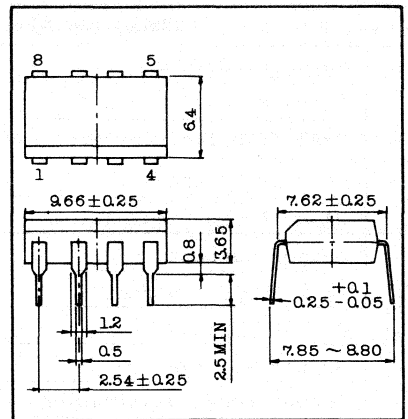


DIGITAL LOGIC GROUND ISOLATION.
LINE RECEIVER.
MICROPROCESSOR SYSTEM INTERFACES.
SWITCHING POWER SUPPLY FEEDBACK CONTROL.
TRANSISTOR INVERTOR.

The Toshiba TLP650 consists of a GaAℓAs high-output light emitting diode and a high speed detector of one chip photo diode-transistor. This unit is 8-lead DIP package.
TLP650 has no internal base connection, and is suitable for application in noisy enviromental condition.

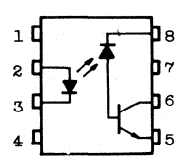
- Isolation Voltage : 5000V_{rms} Min.
- Switching Speed : t_{pHL}=0.3μs(Typ.)
  t_{pLH}=0.5μs(Typ.)(R_L=1.9kΩ)
- TTL Compatible
- UL Recognized : File No. E67349

Unit in mm



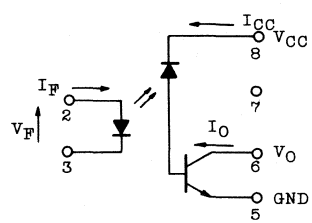
JEDEC	—
EIAJ	—
TOSHIBA	11-10C1

PIN CONFIGURATION (TOP VIEW)



1: NC
2: ANODE
3: CATHODE
4: NC
5: EMITTER
6: COLLECTOR
7: NC
8: V_{CC}

SCHEMATIC



MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current	(Note 1)	I_F	25	mA
	Pulse Forward Current	(Note 2)	I_{FP}	50	mA
	Peak Transient Forward Current	(Note 3)	I_{FPT}	1	A
	Reverse Voltage		V_R	5	V
	Diode Power Dissipation	(Note 4)	P_D	45	mW
DETECTOR	Output Current		I_O	8	mA
	Peak Output Current		I_{OP}	16	mA
	Output Voltage		V_O	-0.5~15	V
	Supply Voltage		V_{CC}	-0.5~15	V
	Output Power Dissipation	(Note 5)	P_o	100	mW
Operating Temperature Range			T_{opr}	-55~100	°C
Storage Temperature Range			T_{stg}	-55~125	°C
Lead Solder Temperature (10 sec.)		(Note 6)	T_{sol}	260	°C
Isolation Voltage(AC, 1min., R.H≤60%)		(Note 7)	BV_S	5000	V_{rms}

Note 1 : Derate 0.8mA above 70°C.

Note 2 : 50% duty cycle, 1ms pulse width.
Derate 1.6mA/°C above 70°C.

Note 3 : Pulse width≦1μs, 300pps.

Note 4 : Derate 0.9mW/°C above 70°C.

Note 5 : Derate 2mW/°C above 70°C.

Note 6 : Soldering portion of lead : up to 2mm from the body of the device.

Note 7 : Device considered a two terminal device : Pins 1,2,3 and 4 shorted together and pins 5,6,7 and 8 shorted together.

ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=16mA	-	1.65	1.85	V
	Forward Voltage Temperature Coefficient	$\Delta V_F/\Delta Ta$	I_F=16mA	-	-2	-	mV/°C
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance Between Terminal	C_T	V_F=0, f=1MHz	-	45	-	pF
DETECTOR	High Level Output Current	I_{OH}(1)	I_F=0mA, V_{CC}=V_O=5.5V	-	3	500	nA
		I_{OH}(2)	I_F=0mA, V_{CC}=V_O=15V	-	-	5	μA
		I_{OH}	I_F=0mA, V_{CC}=V_O=15V Ta=70°C	-	-	250	
	High Level Supply Voltage	I_{CCH}	I_F=0mA, V_{CC}=15V	-	0.01	1	μA
COUPLED	Current Transfer Ratio	I_O/I_F	I_F=16mA, V_{CC}=4.5V, V_O=0.4V, Ta=25°C	10	30	-	%
			Rank:O	19	30	-	
			Ta=0~70°C	5	-	-	
			Rank:O	15	-	-	
	Low Level Output Voltage	V_{OL}	I_F=16mA, V_{CC}=4.5V, I_O=1.1mA(Rank O:I_O=2.4mA)	-	-	0.4	V
	Isolation Resistance	R_S	R.H. ≤60%, V_S=500V_{DC} (Note 7)	-	10^{12}	-	Ω
	Capacitance Between Input to Output	C_S	V_S=0, f=1MHz (Note 7)	-	0.8	-	pF

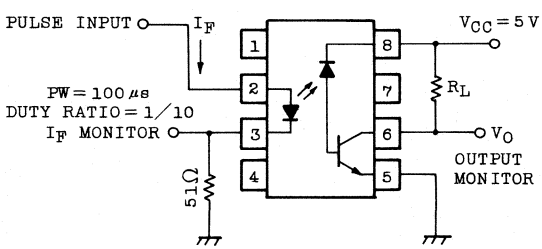
SWITCHING CHARACTERISTICS (Ta=25°C, V_{CC}=5V)

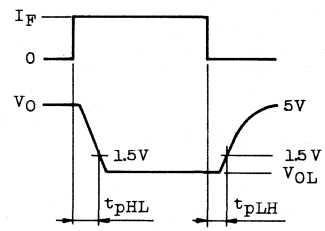
CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Propagation Delay Time (H→L)	t_{pHL}	1	I_F=0→16mA, V_{CC}=5V, R_L=4.1kΩ	-	0.2	0.8	μs
			Rank O:R_L=1.9kΩ	-	0.3	0.8	
Propagation Delay Time (L→H)	t_{pLH}		I_F=16→0mA, V_{CC}=5V, R_L=4.1kΩ	-	1.0	2.0	μs
			Rank O:R_L=1.9kΩ	-	0.5	1.2	
Common Mode Transient Immunity at Logic High Output (Note 8)	CM_H	2	I_F=0mA, V_{CM}=200Vp-p, R_L=4.1kΩ (Rank O:R_L=1.9kΩ)	-	1500	-	V/μs
Common Mode Transient Immunity at Logic Low Output (Note 8)	CM_L		I_F=16mA, V_{CM}=200Vp-p, R_L=4.1kΩ (Rank O:R_L=1.9kΩ)	-	-1500	-	V/μs

Note 8 : CM_L is the maximum rate of fall of the common mode voltage that can be sustained with the output voltage in the logic low state ($V_O < 0.8V$). CM_H is the maximum rate of rise of the common mode voltage that can be sustained with the output voltage in the logic high state ($V_O > 2.0V$)

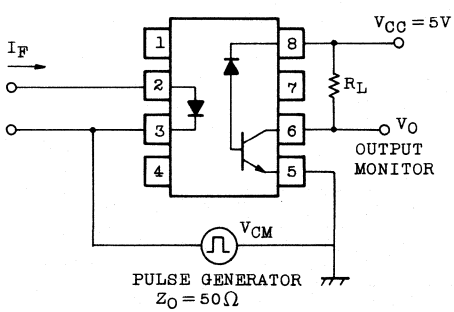
Note 9 : Maximum electrostatic discharge voltage for any pins : 100V(C=200pF, R=0).

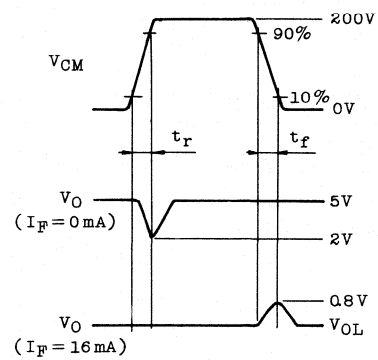
TEST CIRCUIT 1: Switching Time Test Circuit





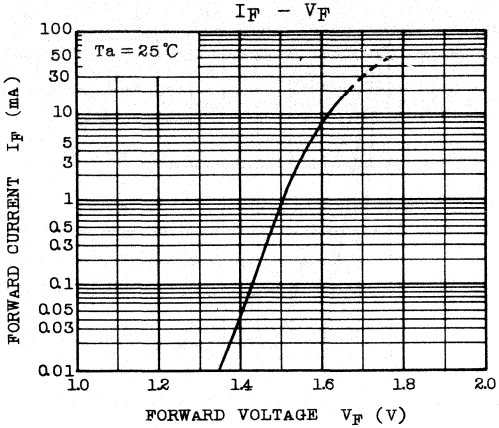
TEST CIRCUIT 2: Common Mode Noise Immunity Test Circuit



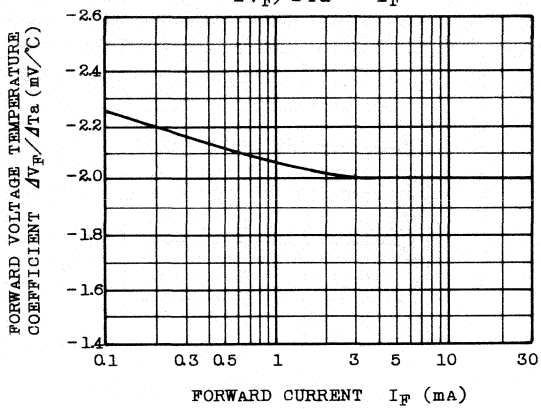


$$CM_H = \frac{160\,(V)}{t_r\,(\mu s)}\,,\quad CM_L = \frac{160\,(V)}{t_f\,(\mu s)}$$

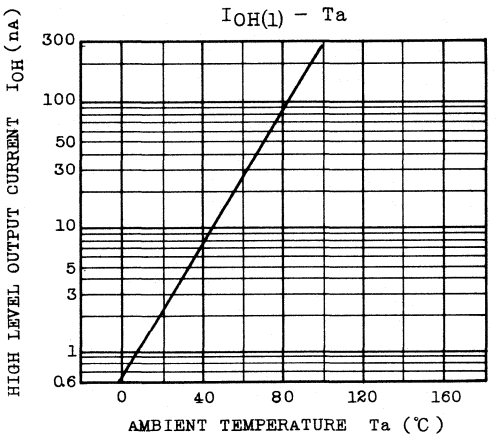
$I_F - V_F$



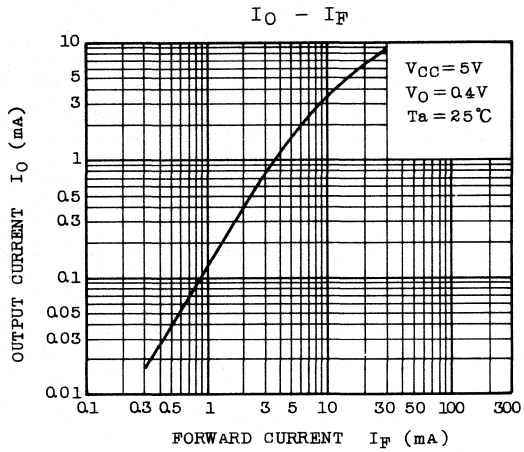
$\Delta V_F/\Delta Ta - I_F$



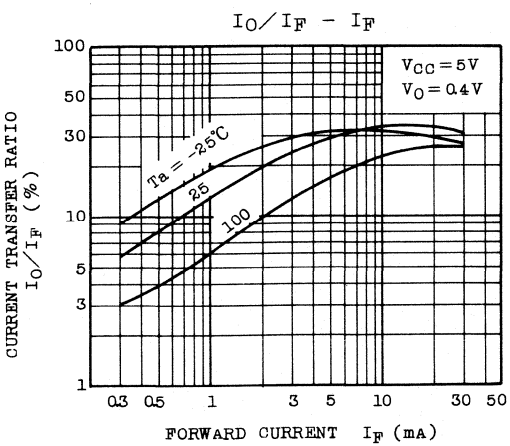
$I_{OH(1)} - Ta$



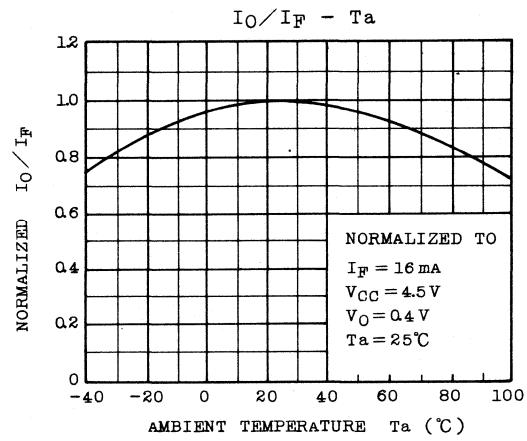
$I_O - I_F$



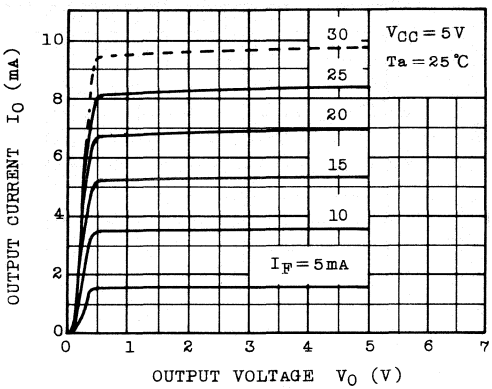
$I_O/I_F - I_F$



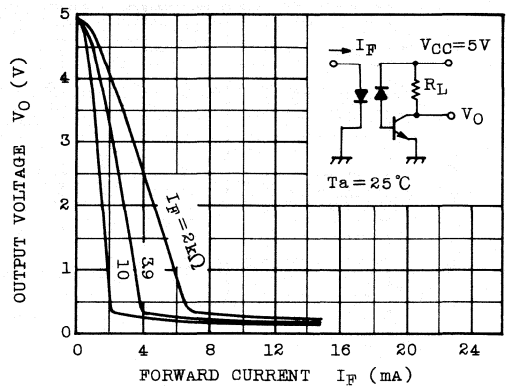
$I_O/I_F - Ta$



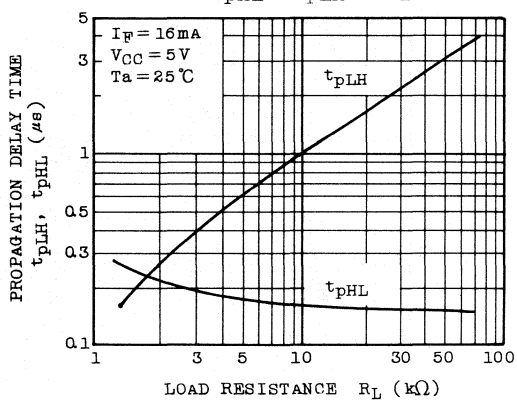
$I_O - V_O$



$V_O - I_F$



t_{pHL}, t_{pLH} - R_L

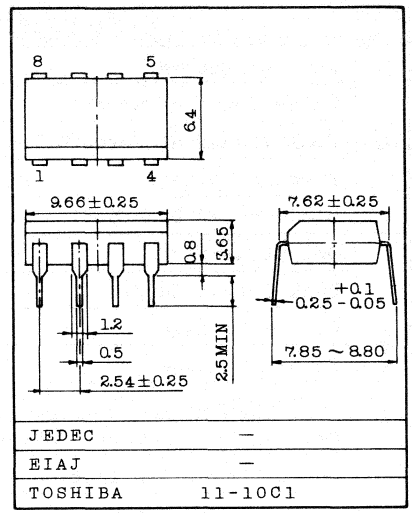


DIGITAL LOGIC GROUND ISOLATION.
LINE RECEIVER.
MICROPROCESSOR SYSTEM INTERFACES.
SWITCHING POWER SUPPLY FEEDBACK CONTROL.
ANALOG SIGNAL ISOLATION.

The Toshiba TLP651 consists of a GaAℓAs high-output light emitting diode and a high speed detector of one chip photo diode-transistor. This unit is 8-lead DIP package.
TLP651 has internal base connection. This base pin should be used for analog application or enable operation. If base pin is open, output signal will be noisy by enviromental condition. For this case, TLP650 is suitable.

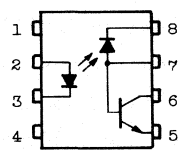
- Isolation Voltage : 5000V_{rms} Min.
- Switching Speed : t_{pHL}=0.3μs(Typ.)
  t_{pLH}=0.5μs(Typ.)
  (R_L=1.9kΩ)
- TTL Compatible
- UL Recognized : File No. E67349

Unit in mm



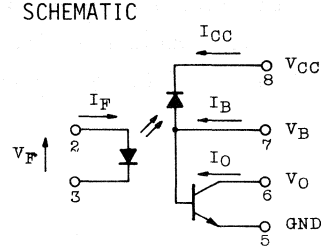
JEDEC	—
EIAJ	—
TOSHIBA	11-10C1

PIN CONFIGURATION (TOP VIEW)



1: NC
2: ANODE
3: CATHODE
4: NC
5: EMITTER
6: COLLECTOR
7: BASE
8: V_{CC}

SCHEMATIC



MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current	(Note 1)	I_F	25	mA
	Pulse Forward Current	(Note 2)	I_{FP}	50	mA
	Peak Transient Forward Current	(Note 3)	I_{FPT}	1	A
	Reverse Voltage		V_R	5	V
	Diode Power Dissipation	(Note 4)	P_D	45	mW
DETECTOR	Output Current		I_O	8	mA
	Peak Output Current		I_{OP}	16	mA
	Output Voltage		V_O	-0.5~15	V
	Supply Voltage		V_{CC}	-0.5~15	V
	Base Current		I_B	5	mA
	Emitter-Base Reverse Voltage		V_{EB}	5	V
	Output Power Dissipation	(Note 5)	P_O	100	mW
Operating Temperature Range			T_{opr}	-55~100	°C
Storage Temperature Range			T_{stg}	-55~125	°C
Lead Solder Temperature (10 sec.)		(Note 6)	T_{sol}	260	°C
Isolation Voltage (AC, 1 min., R.H≤60%)		(Note 7)	BV_S	5000	V_{rms}

Note 1 : Derate 0.8mA above 70°C

Note 2 : 50% duty cycle, 1ms pulse width.
Derate 1.6mA/°C above 70°C.

Note 3 : Pulse width≦1μs, 300pps.

Note 4 : Derate 0.9mW/°C above 70°C.

Note 5 : Derate 2mW/°C above 70°C.

Note 6 : Soldering portion of lead : up to 2mm from the body of the device.

Note 7 : Device considered a two terminal device : Pins 1,2,3 and 4 shorted together and pins 5,6,7 and 8 shorted together.

ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=16mA		-	1.65	1.85	V
	Forward Voltage Temperature Coefficient	$\Delta V_F/\Delta Ta$	I_F=16mA		-	-2	-	mV/°C
	Reverse Current	I_R	V_R=5V		-	-	10	μA
	Capacitance Between Terminal	C_T	V_F=0, f=1MHz		-	45	-	pF
DETECTOR	High Level Output Current	I_{OH}(1)	I_F=0mA, V_{CC}=V_O=5.5V		-	3	500	nA
		I_{OH}(2)	I_F=0mA, V_{CC}=V_O=15V		-	-	5	μA
		I_{OH}	I_F=0mA, V_{CC}=V_O=15V Ta=70°C		-	-	250	
	High Level Supply Voltage	I_{CCH}	I_F=0mA, V_{CC}=15V		-	0.01	1	μA
COUPLED	Current Transfer Ratio	I_O/I_F	I_F=16mA, V_{CC}=4.5V, V_O=0.4V	Ta=25°C	10	30	-	%
				Rank:0	19	30	-	
				Ta=0~70°C	5	-	-	
				Rank:0	15	-	-	
	Low Level Output Voltage	V_{OL}	I_F=16mA, V_{CC}=4.5V I_O=1.1mA(rank 0:I_O=2.4mA)		-	-	0.4	V
	Isolation Resistance	R_S	R.H.≤60%, V_S=500V_{DC} (Note 7)		-	10^{12}	-	Ω
	Capacitance Between Input to Output	C_S	V_S=0, f=1MHz (Note 7)		-	0.8	-	pF

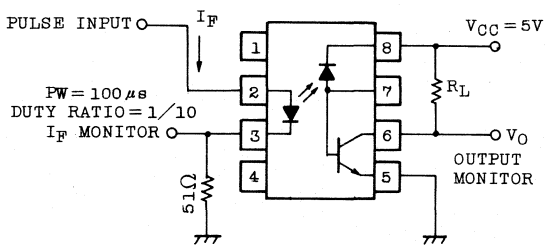
SWITCHING CHARACTERISTICS (Ta=25°C, V_{CC}=5V)

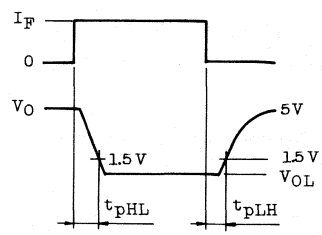
CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Propagation Delay Time (H→L)	t_{pHL}	1	I_F=0→16mA, V_{CC}=5V, R_L=4.1kΩ		-	0.2	0.8	μs
				Rank 0:R_L=1.9kΩ	-	0.3	0.8	
Propagation Delay Time (L→H)	t_{pLH}		I_F=16→0mA, V_{CC}=5V, R_L=4.1kΩ		-	1.0	2.0	μs
				Rank 0:R_L=1.9kΩ	-	0.5	1.2	
Common Mode Transient Immunity at Logic High Output (Note 8)	CM_H	2	I_F=0mA, V_{CM}=200Vp-p R_L=4.1kΩ (Rank 0:R_L=1.9kΩ)		-	400	-	V/μs
Common Mode Transient Immunity at Logic Low Output (Note 8)	CM_L		I_F=16mA, V_{CM}=200Vp-p R_L=4.1kΩ (Rank 0:R_L=1.9kΩ)		-	-1000	-	V/μs

Note 8 : CM_L is the maximum rate of fall of the common mode voltage that can be sustained with the output voltage in the logic low state (V_O <0.8V). CM_H is the maximum rate of rise of the common mode voltage that can be sustained with the output voltage in the logic high state (V_O >2.0V).

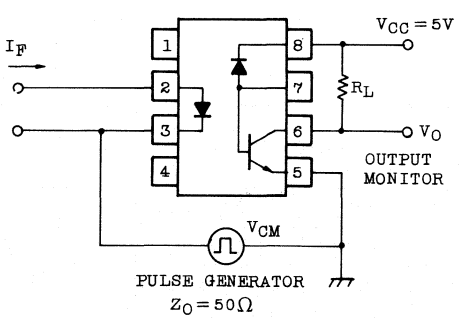
Note 9 : Maximum electrostatic discharge voltage for any pins : 100V(C=200pF, R=0).

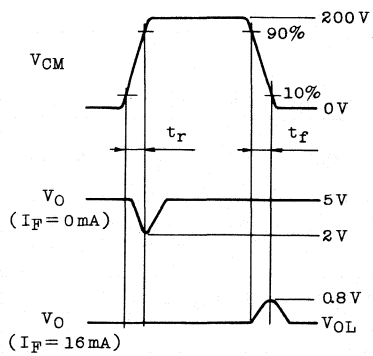
TEST CIRCUIT 1: Switching Time Test Circuit





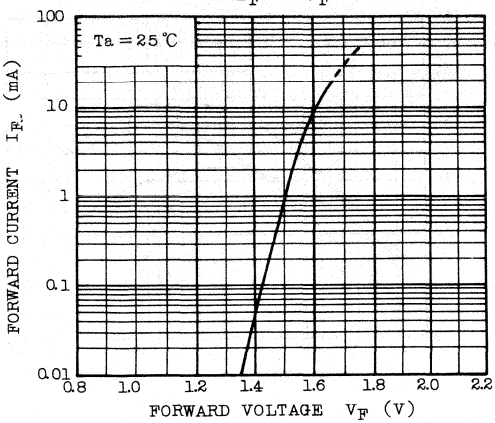
TEST CIRCUIT 2: Common Mode Noise Immunity Test Circuit



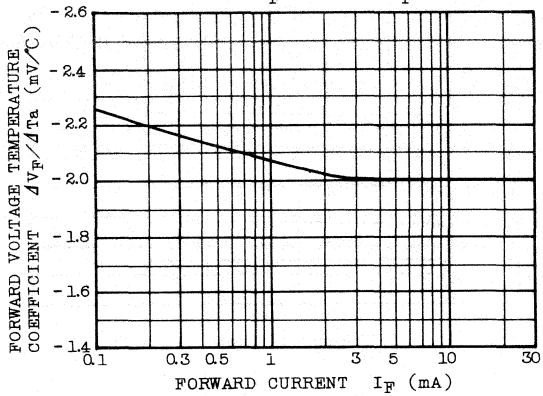


$$CM_H = \frac{160\,(V)}{t_r\,(\mu s)}\ ,\quad CM_L = \frac{160\,(V)}{t_f\,(\mu s)}$$

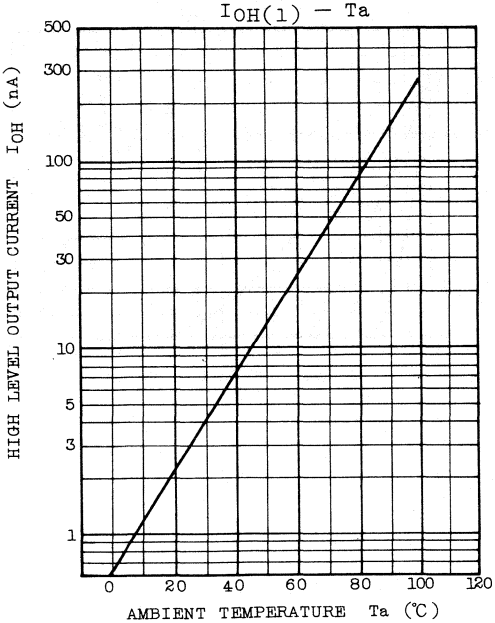
$I_F - V_F$



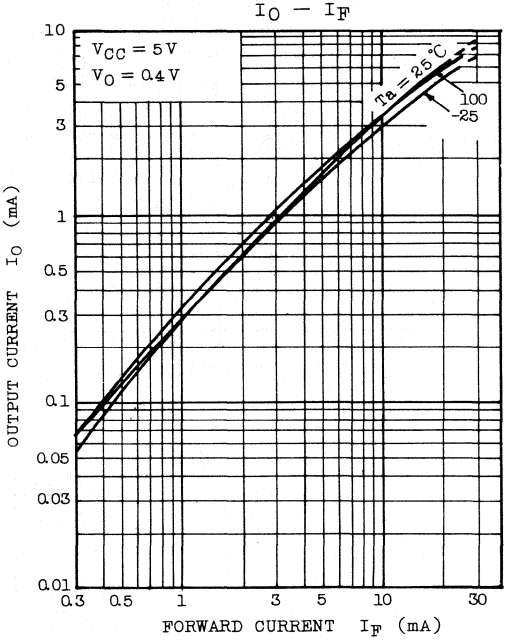
$\Delta V_F / \Delta Ta - I_F$



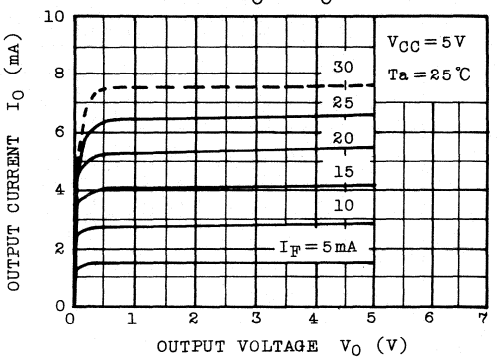
$I_{OH(1)} - Ta$



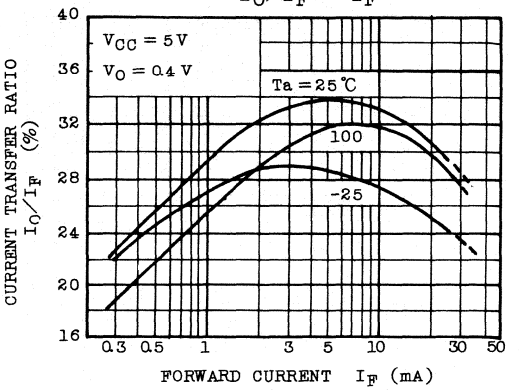
$I_O - I_F$



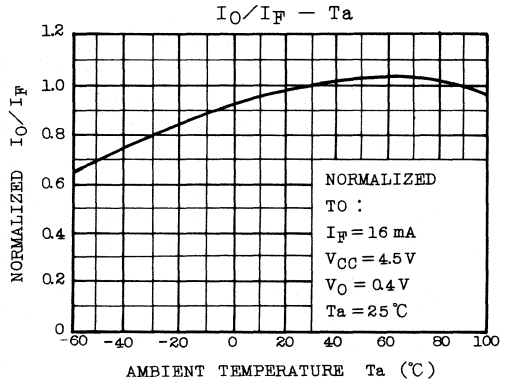
$I_O - V_O$



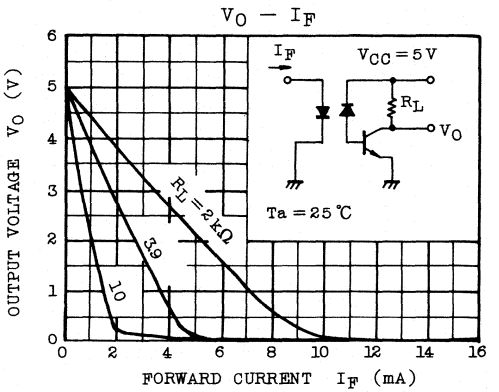
$I_O/I_F - I_F$



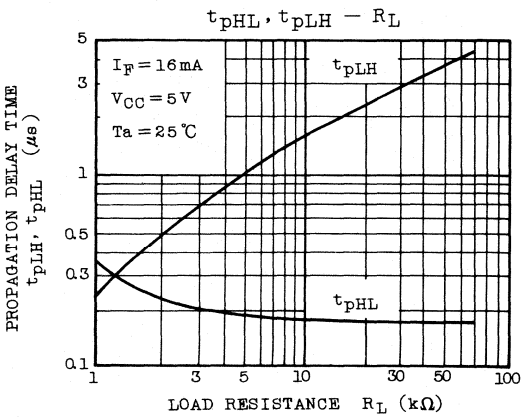
I_O/I_F — Ta



$V_O - I_F$



$t_{pHL}, t_{pLH} - R_L$



TLP731, TLP732

PRELIMINARY DATA

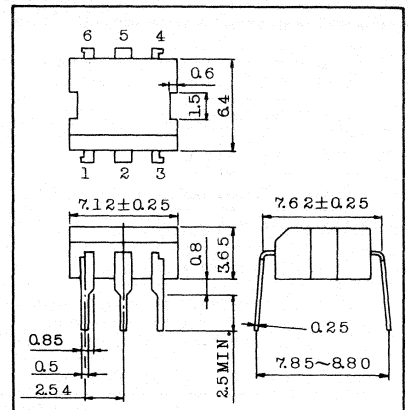
OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
SOLID STATE RELAY.
SWITCHING POWER SUPPLY.

The TOSHIBA TLP731 and TLP732 consist of a photo-transistor optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.
TLP732 is no-base internal connection for high-EMI environments.

- Collector-Emitter Voltage : 55V Min.
- Current Transfer Ratio : 50% Min.
  Rank GB : 100% Min.
- Isolation Voltage : 4000V_{rms} Min.
- Guaranteed Requirements of IEC380/VDE0806
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.2mm Min.
- Isolation Clearance : 7.6mm Min.
- Isolation Operating Voltage
  : 500V_{ac} or 600V_{dc} for Isolation Group C*1
- Creeping Current Resistance : Group I*2
- TÜV Approved for DIN57883/VDE0883/6.80

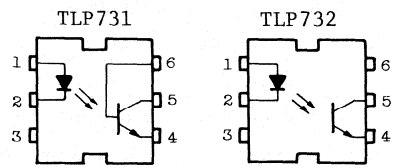
*1 : According to VDE0110, table 4
*2 : According to VDE0110, table 3

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-7B1

PIN CONFIGURATIONS (TOP VIEW)



TLP731	TLP732
1: ANODE	1: ANODE
2: CATHODE	2: CATHODE
3: NC	3: NC
4: EMITTER	4: EMITTER
5: COLLECTOR	5: COLLECTOR
6: BASE	6: NC

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	60	mA
	Forward Current Derating (Ta ≧39°C)	$\Delta I_F/°C$	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)	I_{FP}	1	A
	Power Dissipation	P_D	100	mW
	Power Dissipation Derating (Ta ≧25°C)	$\Delta P_D/°C$	-1.0	mW/°C
	Reverse Voltage	V_R	5	V
	Junction Temperature	T_j	125	°C
DETECTOR	Collector-Emitter Voltage	V_{CEO}	55	V
	Collector-Base Voltage (TLP731)	V_{CBO}	80	V
	Emitter-Collector Voltage	V_{ECO}	7	V
	Emitter-Base Voltage (TLP731)	V_{EBO}	7	V
	Collector Current	I_C	50	mA
	Power Dissipation	P_C	150	mW
	Power Dissipation Derating (Ta ≧25°C)	$\Delta P_C/°C$	-1.5	mW/°C
	Junction Temperature	T_j	125	°C
Storage Temperature Range		T_{stg}	-55 ~ 150	°C
Operating Temperature Range		T_{opr}	-55 ~ 100	°C
Lead Soldering Temperature (10 sec.)		T_{sold}	260	°C
Total Package Power Dissipation		P_T	250	mW
Total Package Power Dissipation Derating (Ta ≧25°C)		$\Delta P_T/°C$	-2.5	mW/°C
Isolation Voltage (AC, 1 min, RH ≦60%)		BVS	4000	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=0.5mA	55	-	-	V
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	7	-	-	V
	Collector-Base Breakdown Voltage (TLP731)	$V_{(BR)CBO}$	I_C=0.1mA	80	-	-	V
	Emitter-Base Breakdown Voltage (TLP731)	$V_{(BR)EBO}$	I_E=0.1mA	7	-	-	V
	Collector Dark Current	I_{CEO}	V_{CE}=24V	-	10	100	nA
			V_{CE}=24V, Ta=85°C	-	2	50	μA
	Collector Dark Current (TLP731)	I_{CER}	V_{CE}=24V, Ta=85°C, R_{BE}=1MΩ	-	0.5	10	μA
	Collector Dark Current (TLP731)	I_{CBO}	V_{CB}=10V	-	0.1	-	nA
	DC Forward Current Gain (TLP731)	h_{FE}	V_{CE}=5V, I_C=0.5mA	-	400	-	-
	Capacitance Collector to Emitter	C_{CE}	V=0, f=1MHz	-	10	-	pF

COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Current Transfer Ratio	I_C/I_F	I_F=5mA, V_{CE}=5V	50	-	600	%
		Rank GB	100	-	600	
Saturated CTR	$I_C/I_{F(sat)}$	I_F=1mA, V_{CE}=0.4V	-	60	-	%
		Rank GB	30	-	-	
Base Photo-Current (TLP731)	I_{PB}	I_F=5mA, V_{CB}=5V	-	10	-	μA
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C=2.4mA, I_F=8mA	-	-	0.4	V
		I_C=0.2mA, I_F=1mA	-	0.2	-	V
		Rank GB	-	-	0.4	

ISOLATION CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Capacitance Input to Output	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	4000	-	-	V_{rms}
		AC, 1 second	-	10000	-	
		DC, 1 minute	-	10000	-	V_{dc}

SWITCHING CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Rise Time	t_r	V_{CC}=10V, I_C=2mA, R_L=100Ω	-	2	-	μs
Fall Time	t_f		-	3	-	
Turn-on Time	t_{on}		-	3	10	
Turn-off Time	t_{off}		-	3	10	
Turn-on Time	t_{ON}	R_L=1.9kΩ (Fig.1), R_{BE}=OPEN, V_{CC}=5V, I_F=16mA	-	2	-	μs
Storage Time	t_S		-	15	-	
Turn-off Time	t_{OFF}		-	25	-	
Turn-on Time	t_{ON}	R_L=1.9kΩ (Fig.1), R_{BE}=220kΩ (TLP731), V_{CC}=5V, I_F=16mA	-	2	-	μs
Storage Time	t_S		-	12	-	
Turn-off Time	t_{OFF}		-	20	-	

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	-	5	24	V
Forward Current	I_F	-	16	25	mA
Collector Current	I_C	-	1	10	mA
Operating Temperature	T_{opr}	-25	-	85	°C

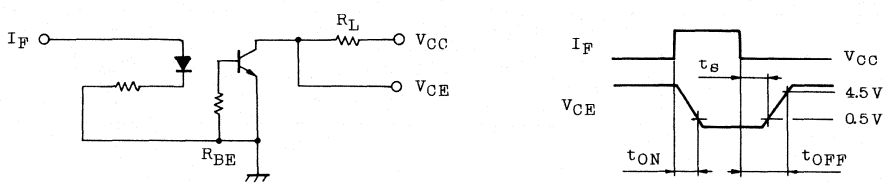
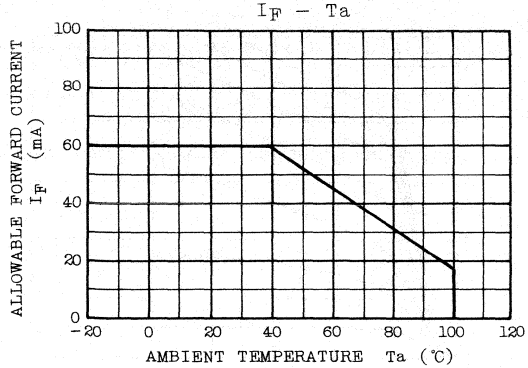
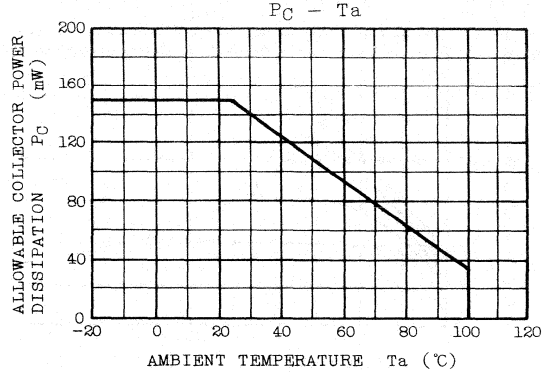


Fig. 1 Switching Time Test Circuit

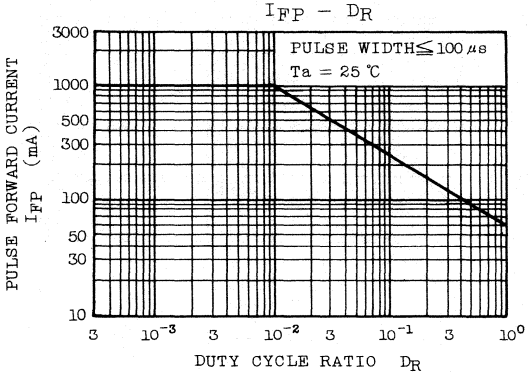
I_F – Ta



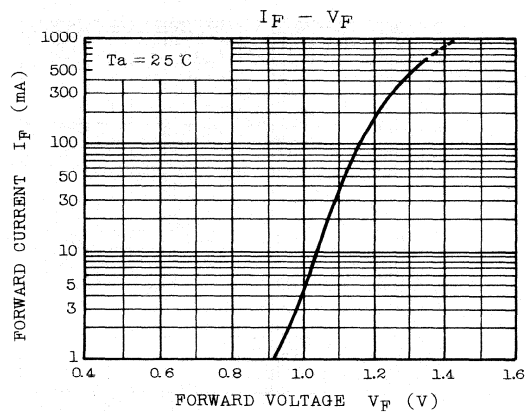
P_C – Ta



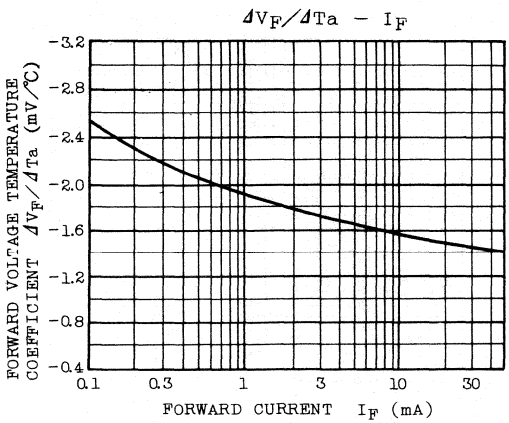
I_{FP} – D_R



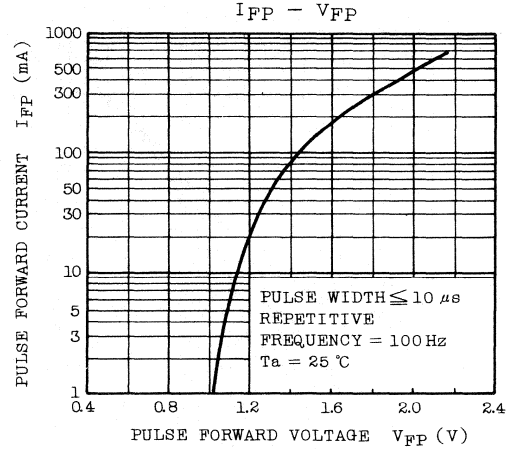
I_F – V_F



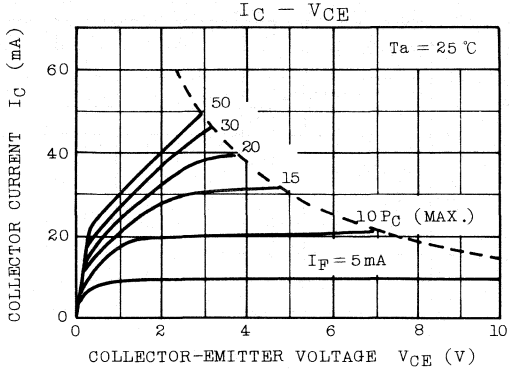
$\Delta V_F/\Delta Ta$ – I_F



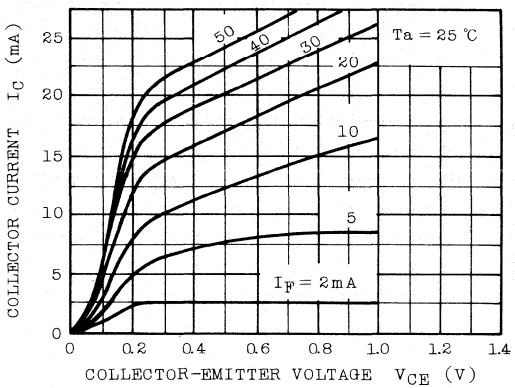
I_{FP} – V_{FP}



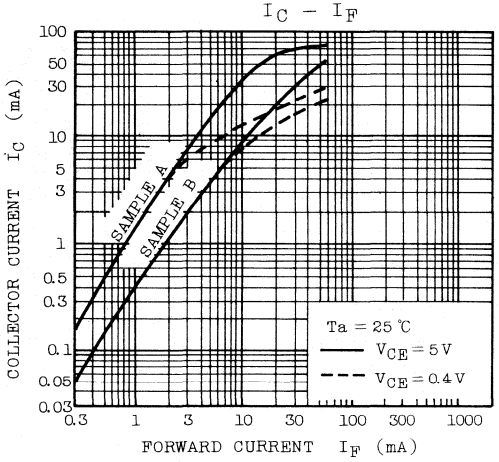
$I_C - V_{CE}$



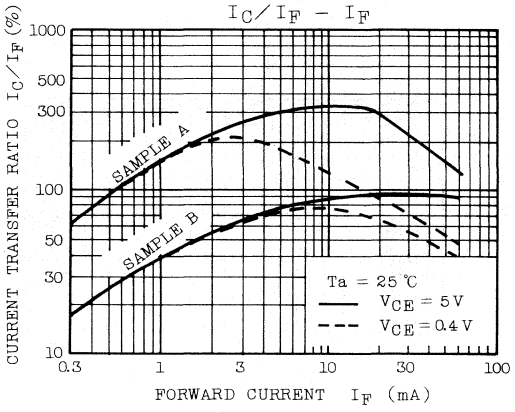
$I_C - V_{CE}$



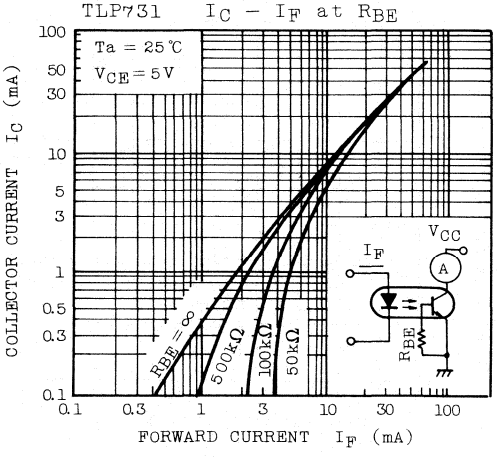
$I_C - I_F$



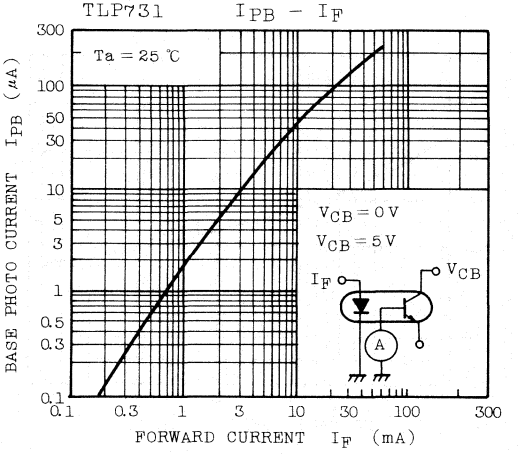
$I_C / I_F - I_F$



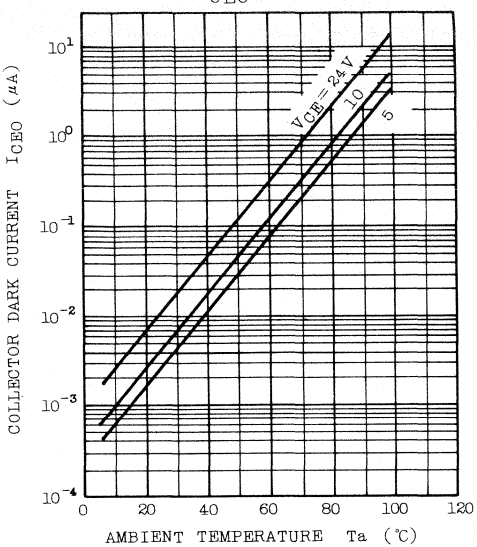
TLP731 $I_C - I_F$ at R_{BE}



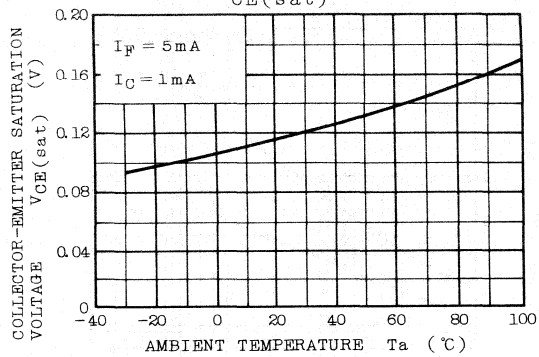
TLP731 $I_{PB} - I_F$



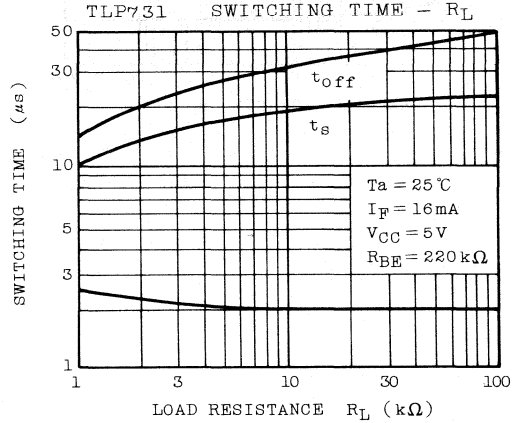
I_{CEO} – Ta



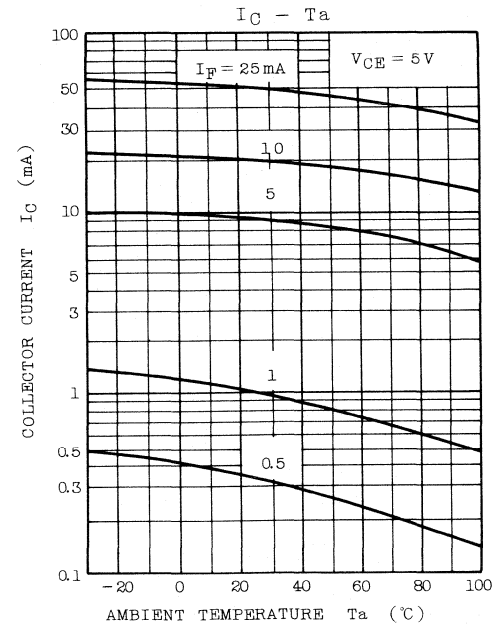
$V_{CE(sat)}$ – Ta



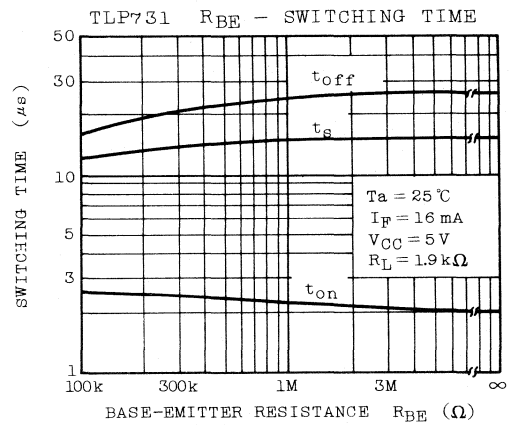
TLP731 SWITCHING TIME – R_L



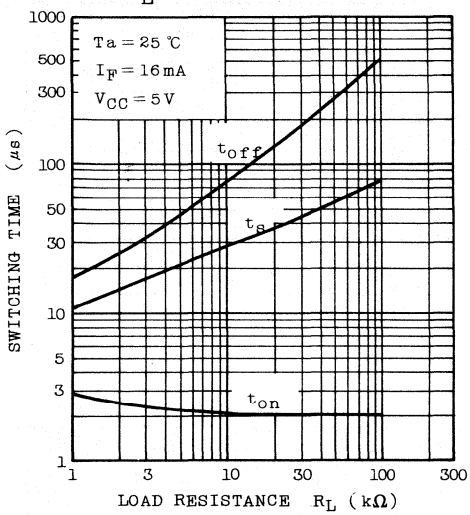
I_C – Ta



TLP731 R_{BE} – SWITCHING TIME



R_L — SWITCHING TIME



TLP735, TLP736

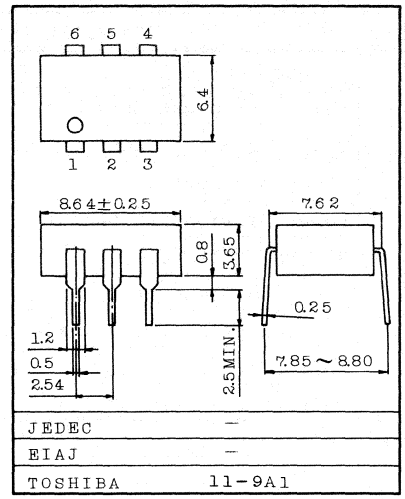
OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
SOLID STATE RELAY.
SWITCHING POWER SUPPLY.

The TOSHIBA TLP735 and TLP736 consist of a photo-transistor optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.
TLP736 is no-base internal connection for high-EMI environments.

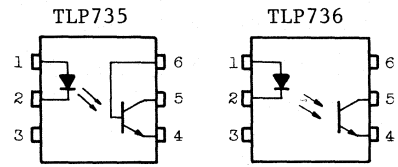
- Collector-Emitter Voltage : 55V Min.
- Current Transfer Ratio : 50% Min.
  Rank GB : 100% Min.
- Isolation Voltage : 5000V_{rms} Min.
- Guaranteed Requirements of IEC380/VDE0806 VDE0700T1
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.0mm Min.
- Isolation Clearance : 7.3mm Min.
- Isolation Operating Voltage
  : 500V_{ac} or 600V_{dc} for Isolation Group C*1
- Creeping Current Resistance : Group I*2

*1 : According to VDE0110, table 4
*2 : According to VDE0110, table 3

Unit in mm



PIN CONFIGURATIONS (TOP VIEW)



TLP735	TLP736
1: ANODE	1: ANODE
2: CATHODE	2: CATHODE
3: NC	3: NC
4: EMITTER	4: EMITTER
5: COLLECTOR	5: COLLECTOR
6: BASE	6: NC

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	60	mA
	Forward Current Derating (Ta≧39°C)	$\Delta I_F/°C$	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)	I_{FP}	1	A
	Power Dissipation	P_D	100	mW
	Power Dissipation Derating (Ta≧25°C)	$\Delta P_D/°C$	-1.0	mW/°C
	Reverse Voltage	V_R	5	V
	Junction Temperature	T_j	125	°C
DETECTOR	Collector-Emitter Voltage	V_{CEO}	55	V
	Collector-Base Voltage (TLP735)	V_{CBO}	80	V
	Emitter-Collector Voltage	V_{ECO}	7	V
	Emitter-Base Voltage (TLP735)	V_{EBO}	7	V
	Collector Current	I_C	50	mA
	Power Dissipation	P_C	150	mW
	Power Dissipation Derating (Ta≧25°C)	$\Delta P_C/°C$	-1.5	mW/°C
	Junction Temperature	T_j	125	°C
Storage Temperature Range		T_{stg}	-55~150	°C
Operating Temperature Range		T_{opr}	-55~100	°C
Lead Soldering Temperature (10 sec.)		T_{sold}	260	°C
Total Package Power Dissipation		P_T	250	mW
Total Package Power Dissipation Derating (Ta≧25°C)		$\Delta P_T/°C$	-2.5	mW/°C
Isolation Voltage (AC, 1 min., RH≦60%)		BV_S	5000	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=0.5mA	55	-	-	V
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	7	-	-	V
	Collector-Base Breakdown Voltage (TLP735)	$V_{(BR)CBO}$	I_C=0.1mA	80	-	-	V
	Emitter-Base Breakdown Voltage (TLP735)	$V_{(BR)EBO}$	I_E=0.1mA	7	-	-	V
	Collector Dark Current	I_{CEO}	V_{CE}=24V	-	10	100	nA
			V_{CE}=24V, Ta=85°C	-	2	50	μA
	Collector Dark Current (TLP735)	I_{CER}	V_{CE}=24V, Ta=85°C, R_{BE}=1MΩ	-	0.5	10	μA
	Collector Dark Current (TLP735)	I_{CBO}	V_{CB}=10V	-	0.1	-	nA
	DC Forward Current Gain (TLP735)	h_{FE}	V_{CE}=5V, I_C=0.5mA	-	400	-	-
	Capacitance(Collector to Emitter)	C_{CE}	V=0, f=1MHz	-	10	-	pF

COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Current Transfer Ratio	I_C/I_F	I_F=5mA, V_{CE}=5V	50	-	600	%
		Rank GB	100	-	600	
Saturated CTR	$I_C/I_{F(sat)}$	I_F=1mA, V_{CE}=0.4V	-	60	-	%
		Rank GB	30	-	-	
Base Photo-Current (TLP735)	I_{PB}	I_F=5mA, V_{CB}=5V	-	10	-	μA
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C=2.4mA, I_F=8mA	-	-	0.4	V
		I_C=0.2mA, I_F=1mA	-	0.2	-	
		Rank GB	-	-	0.4	

ISOLATION CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Capacitance(Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	5000	-	-	V_{rms}
		AC, 1 second	-	10000	-	
		DC, 1 minute	-	10000	-	V_{dc}

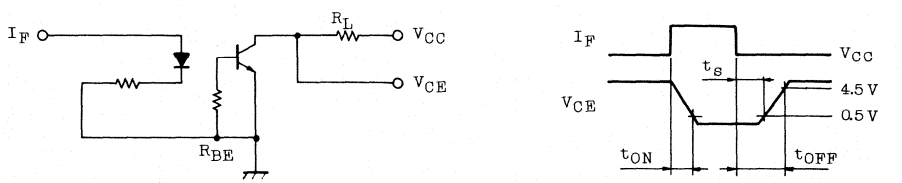
SWITCHING CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Rise Time	t_r	V_{CC}=10V, I_C=2mA, R_L=100Ω	-	2	-	μs
Fall Time	t_f		-	3	-	
Turn-on Time	t_{on}		-	3	10	
Turn-off Time	t_{off}		-	3	10	
Turn-on Time	t_{ON}	R_L=1.9kΩ (Fig. 1), R_{BE}=OPEN, V_{CC}=5V, I_F=16mA	-	2	-	μs
Storage Time	t_S		-	15	-	
Turn-off Time	t_{OFF}		-	25	-	
Turn-on Time	t_{ON}	R_L=1.9kΩ (Fig. 1), R_{BE}=220kΩ (TLP735), V_{CC}=5V, I_F=16mA	-	2	-	μs
Storage Time	t_S		-	12	-	
Turn-off Time	t_{OFF}		-	20	-	

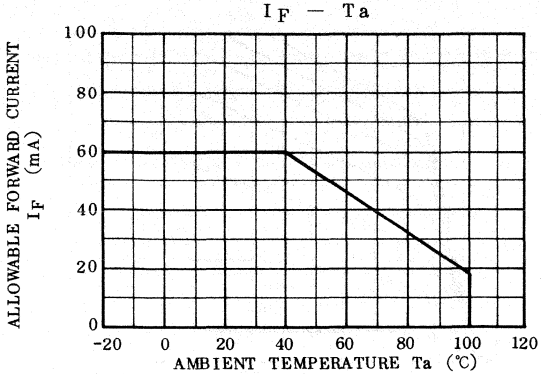
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	-	5	24	V
Forward Current	I_F	-	16	25	mA
Collector Current	I_C	-	1	10	mA
Operating Temperature	Topr	-25	-	85	°C

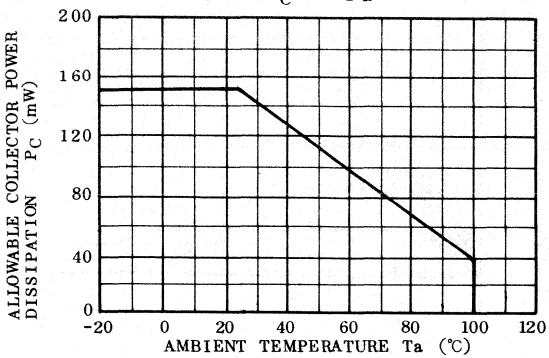
Fig. 1 SWITCHING TIME TEST CIRCUIT



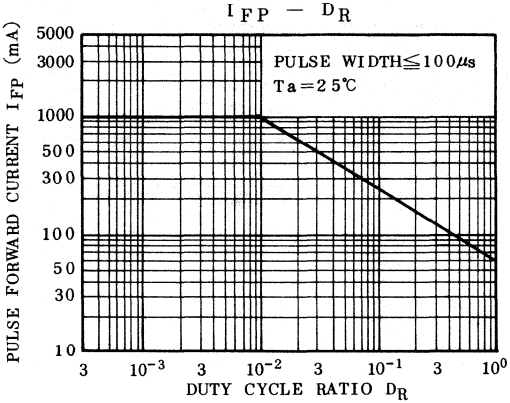
I_F — Ta



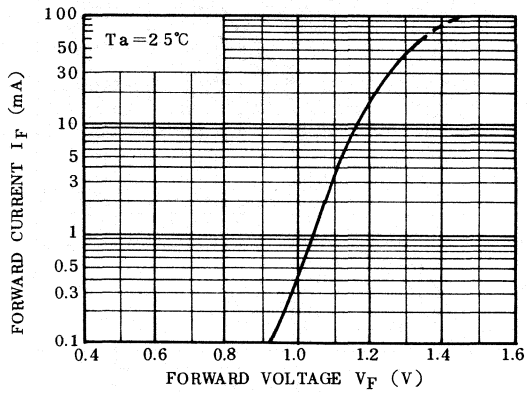
P_C — Ta



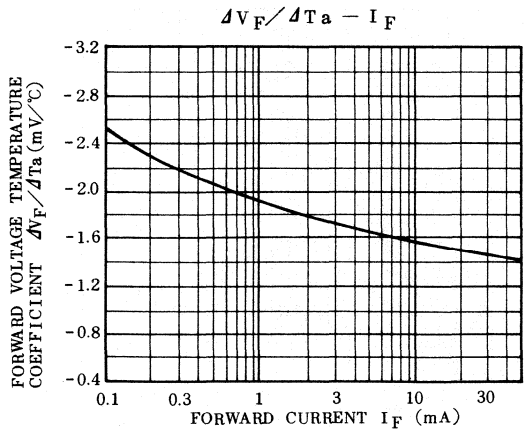
I_{FP} — D_R



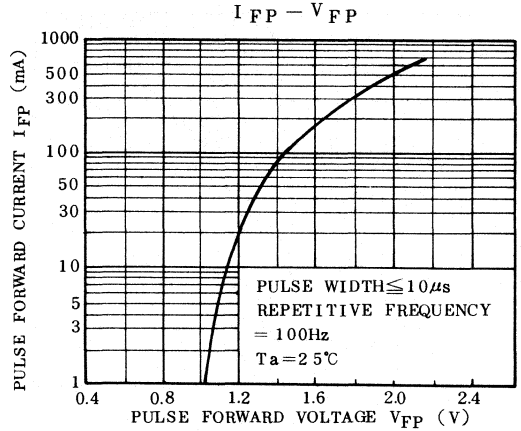
I_F — V_F



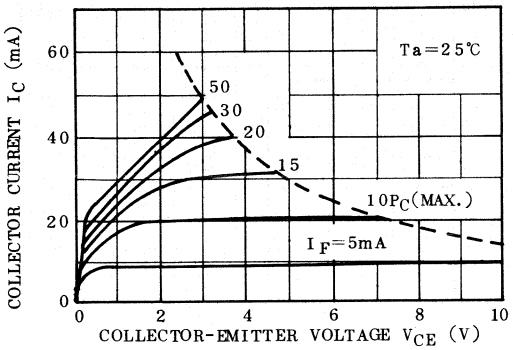
$\Delta V_F / \Delta Ta$ — I_F



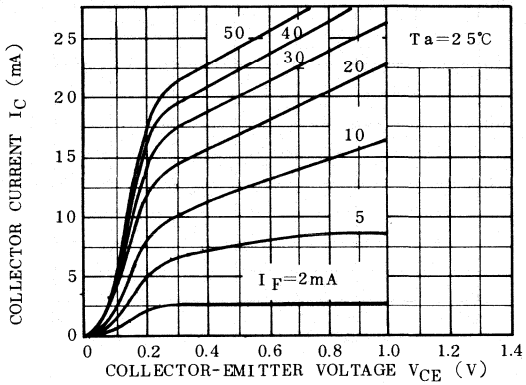
I_{FP} — V_{FP}



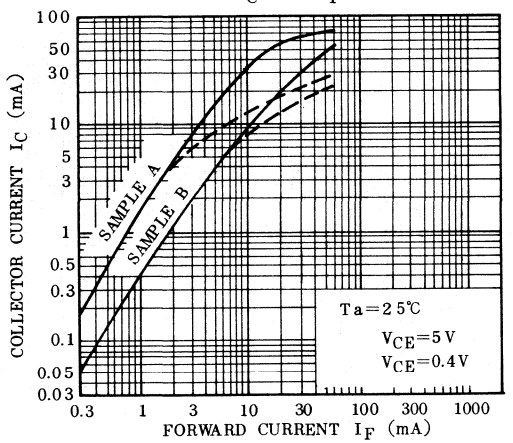
$I_C - V_{CE}$



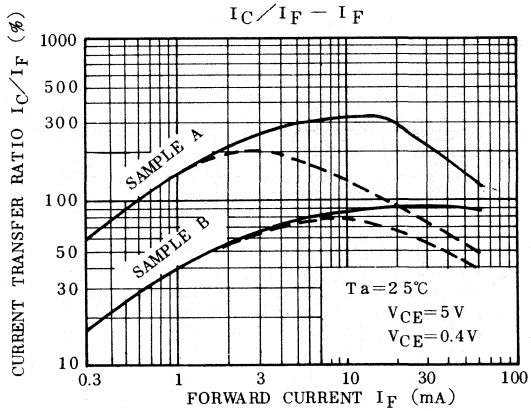
$I_C - V_{CE}$



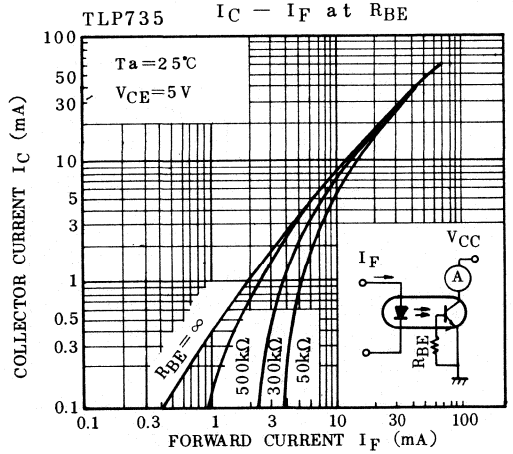
$I_C - I_F$



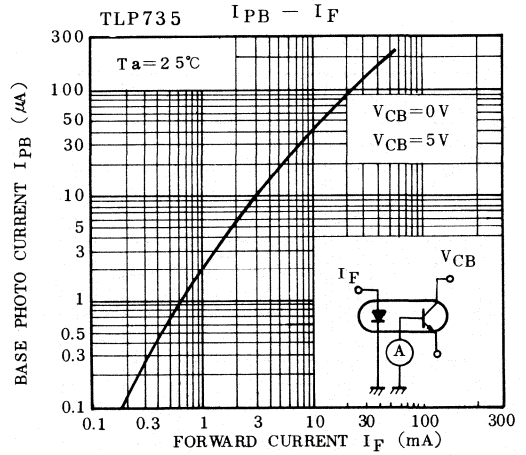
$I_C / I_F - I_F$



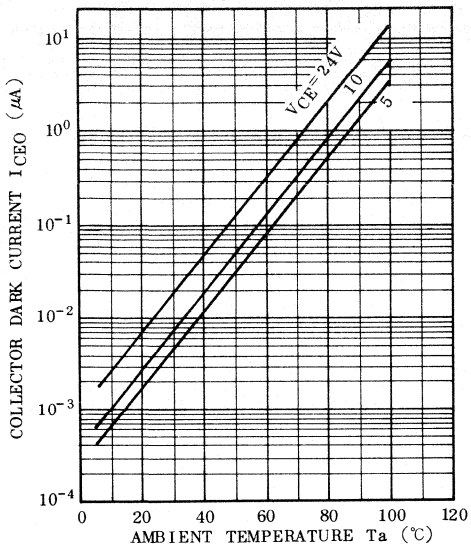
TLP735 $I_C - I_F$ at R_{BE}



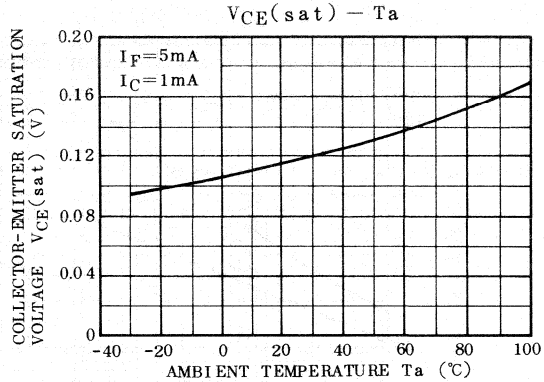
TLP735 $I_{PB} - I_F$



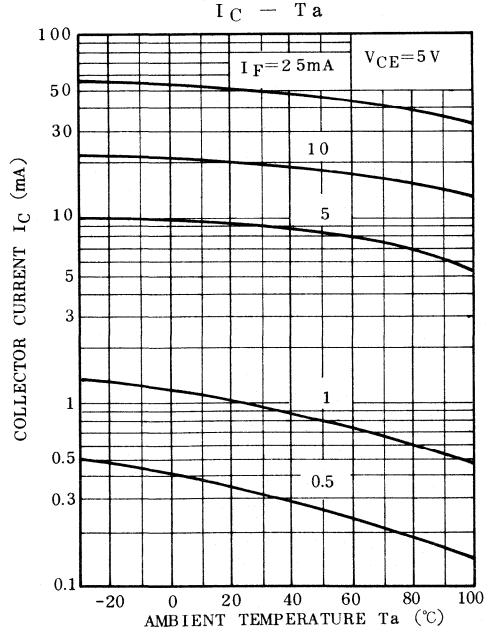
I_{CEO} — Ta



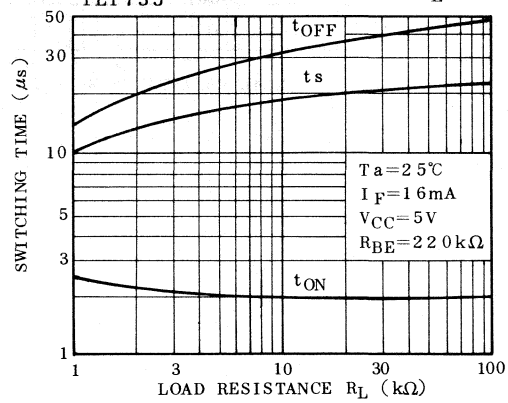
$V_{CE}(sat)$ — Ta



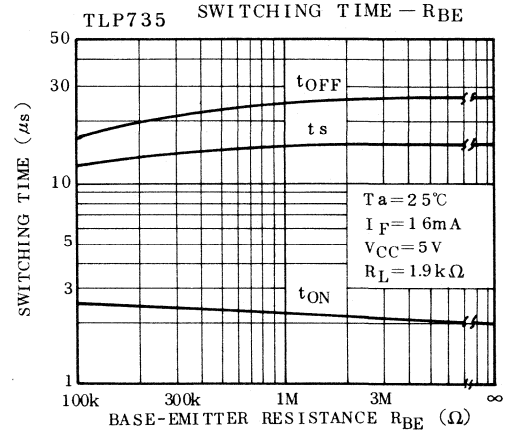
I_C — Ta



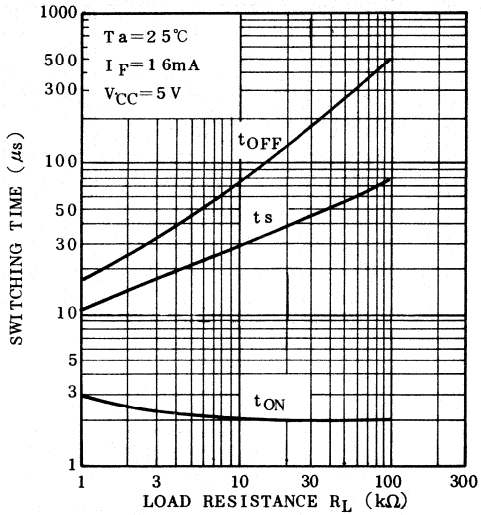
TLP735 SWITCHING TIME — R_L



TLP735 SWITCHING TIME — R_{BE}



SWITGHING TIME — R_L



TLP735F, TLP736F

OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
SOLID STATE RELAY.
SWITCHING POWER SUPPLY.

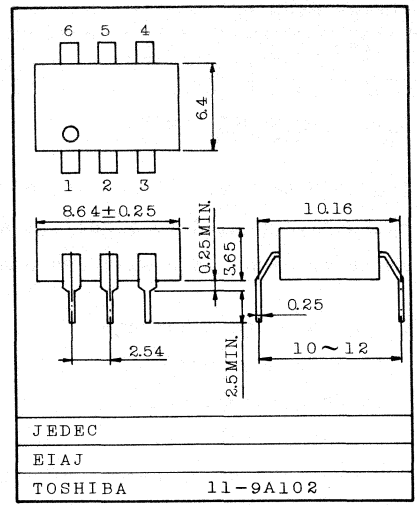
The TOSHIBA TLP735F and TLP736F consist of a photo-transistor optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.
TLP736F is no-base internal connection for high-EMI environments.
All parameters are tested to the specification of TLP735 and TLP736. (both condition and limits)

- Collector-Emitter Voltage : 55V Min.
- Current Transfer Ratio : 50% Min.
  Rank GB : 100% Min.
- Isolation Voltage : 5000V_{rms} Min.
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.0mm Min.
- Isolation Clearance : 8.0mm Min.
- Isolation Operating Voltage
  : 500V_{ac} or 600V_{dc} for Isolation Group C*1
- Creeping Current Resistance : Group I*2
- Guaranteed Requirements of Safety Standards as Follows:

  DIN 57 883/VDE0883/6.80
  DIN 57 804/VDE0804/1.83
  DIN IEC65/VDE0860/8.81
  DIN IEC380/VDE0806/8.81
  DIN IEC435/VDE0805/Draft Nov.84
  DIN IEC601T1/VDE0750T1/5.82
  DIN 57 700T1/VDE0700T1/2.81

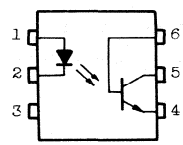
*1 : According to VDE0110, table 4
*2 : According to VDE0110, table 3

Unit in mm



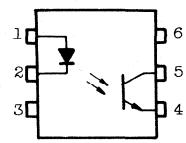
PIN CONFIGURATIONS (TOP VIEW)

TLP735F



1: ANODE
2: CATHODE
3: NC
4: EMITTER
5: COLLECTOR
6: BASE

TLP736F



1: ANODE
2: CATHODE
3: NC
4: EMITTER
5: COLLECTOR
6: NC

TLP741G

GaAs IRED & PHOTO-THYRISTOR

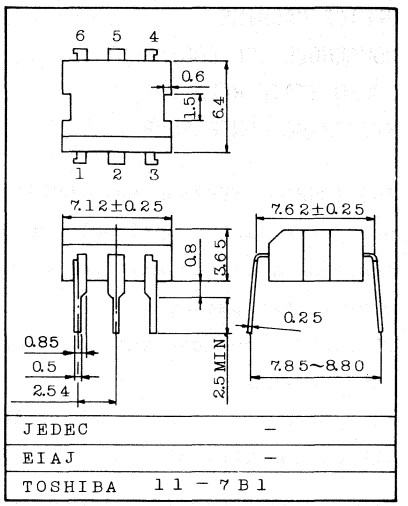
OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
SOLID STATE RELAY.
SWITCHING POWER SUPPLY.

The TOSHIBA TLP741G consists of a photo-thyristor optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.

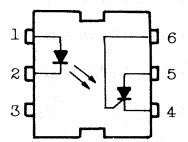
- Peak Off-State Voltage : 400V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 150mA Max.
- Isolation Voltage : 4000V_{rms} Min.
- Guaranteed Requirements of IEC380/VDE0806
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.2mm Min.
- Isolation Clearance : 7.6mm Min.
- Isolation Operating Voltage
  : 500Vac or 600Vdc for Isolation Group C.*1
- Creeping Current Resistance : Group I*2
- TÜV Approved for DIN57883/VDE0883/6.80

*1 : According to VDE0110, table 4
*2 : According to VDE0110, table 3

Unit in mm



PIN CONFIGURATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: CATHODE
5: ANODE
6: GATE

MAXIMUM RATING (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	60	mA
	Forward Current Derating (Ta≧39°C)	$\Delta I_F/°C$	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)	I_{FP}	1	A
	Power Dissipation	P_D	100	mW
	Power Dissipation Derating (Ta≧25°C)	$\Delta P_D/°C$	-1.0	mW/°C
	Reverse Voltage	V_R	5	V
	Junction Temperature	Tj	125	°C
DETECTOR	Peak Forward Voltage (R_{GK}=27KΩ)	V_{DRM}	400	V
	Peak Reverse Voltage (R_{GK}=27KΩ)	V_{RRM}	400	V
	On-State Current	$I_{T(RMS)}$	150	mA
	On-State Current Derating (Ta≧25°C)	$\Delta I_T/°C$	-2.0	mA/°C
	Peak On-State Current (100μs pulse, 120pps)	I_{TP}	3	A
	Peak One Cycle Surge Current	I_{TSM}	2	A
	Peak Reverse Gate Voltage	V_{GM}	5	V
	Power Dissipation	P_D	150	mW
	Power Dissipation Derating (Ta≧25°C)	$\Delta P_D/°C$	-2.0	mW/°C
	Junction Temperature	Tj	100	°C
Storage Temperature Range		Tstg	-55~150	°C
Operating Temperature Range		Topr	-55~100	°C
Lead Soldering Temperature (10sec.)		Tsold	260	°C
Total Package Power Dissipation		P_T	250	mW
Total Package Power Dissipation Derating (Ta≧25°C)		$\Delta P_T/°C$	-3.3	mW/°C
Isolation Voltage (AC, 1 min, RH≦60%)		BVS	4000	Vrms

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA		1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V		-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz		-	30	-	pF
DETECTOR	Off-State Current	I_{DRM}	V_{AK}=400V, R_{GK}=27kΩ	Ta=25°C	-	10	5000	nA
				Ta=100°C	-	1	100	μA
	Reverse Current	I_{RRM}	V_{KA}=400V, R_{GK}=27kΩ	Ta=25°C	-	10	5000	nA
				Ta=100°C	-	1	100	μA
	On-State Voltage	V_{TM}	I_{TM}=100mA		-	0.9	1.3	V
	Holding Current	I_H	R_{GK}=27kΩ		-	0.2	-	mA
	Off-State dv/dt	dv/dt	V_D=280V, R_{GK}=27kΩ		5	10	-	V/μs
	Capacitance	C_j	V=0, f=1MHz					
			Anode to Gate		-	20	-	pF
			Gate to Cathode		-	350	-	

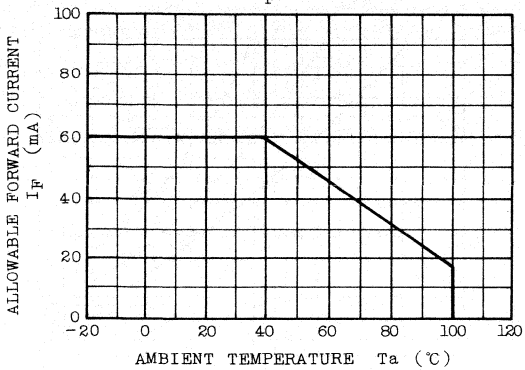
COUPLED CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_{AK}=6V, R_{GK}=27kΩ	-	4	10	mA
Turn-on Time	t_{on}	I_F=30mA, V_{AA}=50V, R_{GK}=27kΩ	-	10	-	μs
Coupled dv/dt	dv/dt	V_S=500V, R_{GK}=27kΩ	500	-	-	V/μs
Capacitance Input to Output	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	4000	-	-	V_{rms}
		AC, 1 second	-	10000	-	
		DC, 1 minute	-	10000	-	Vdc

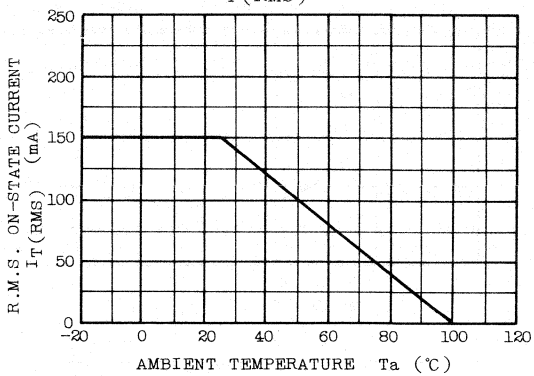
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	120	Vac
Forward Current	I_F	15	20	25	mA
Operating Temperature	Topr	-25	-	85	°C
Gate to Cathode Resistance	R_{GK}	-	27	33	kΩ
Gate to Cathode Capacity	C_{GK}	-	0.01	0.1	μF

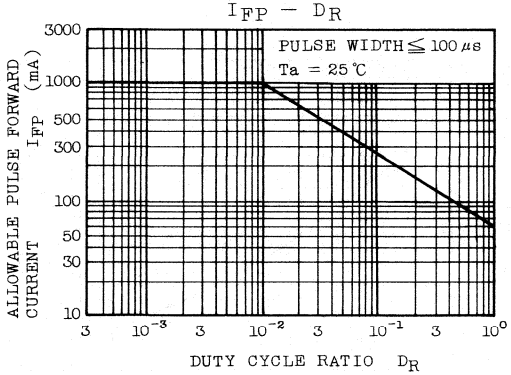
I_F – Ta



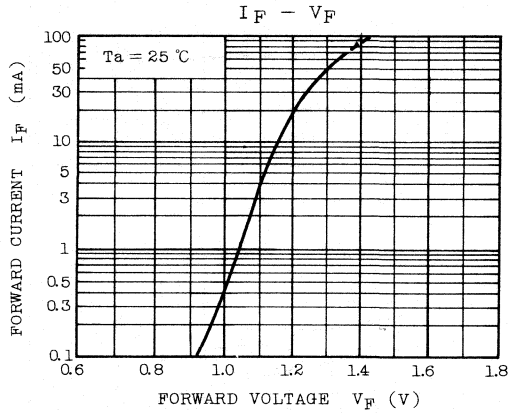
$I_{T(RMS)}$ – Ta



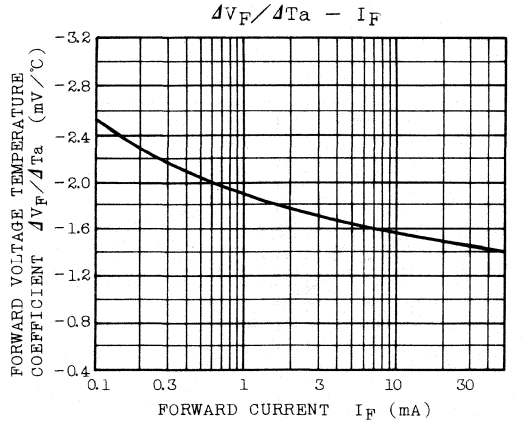
I_{FP} – D_R



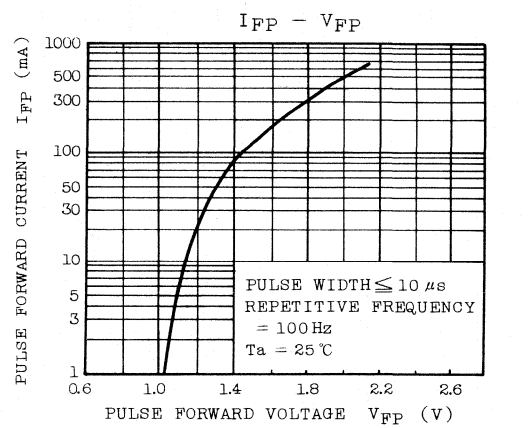
I_F – V_F



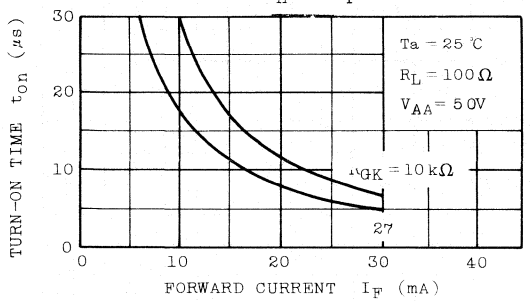
$\Delta V_F / \Delta Ta$ – I_F



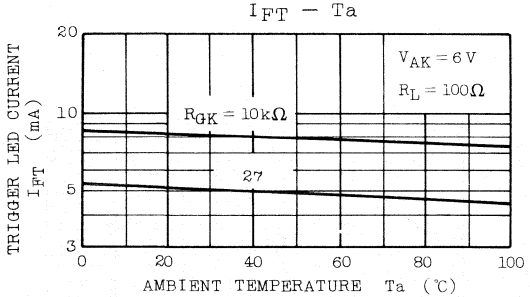
I_{FP} – V_{FP}



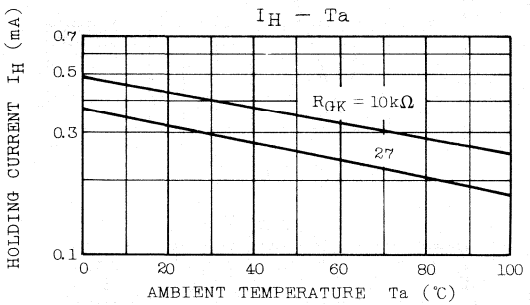
t_{on} – I_F



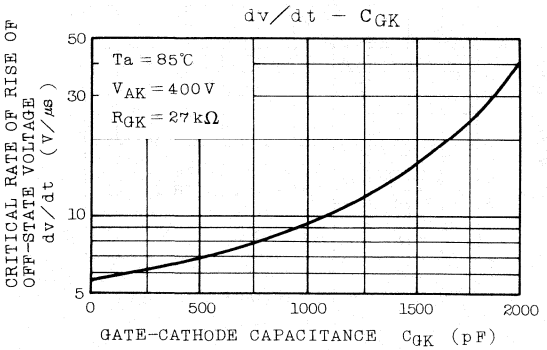
I_{FT} – Ta



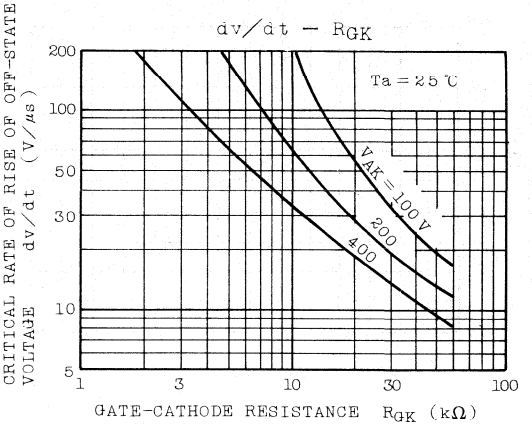
I_H – Ta



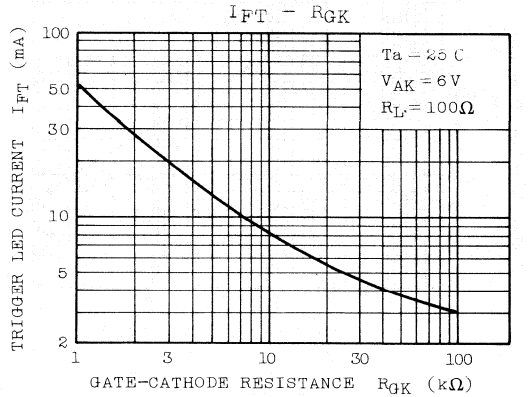
dv/dt – C_{GK}



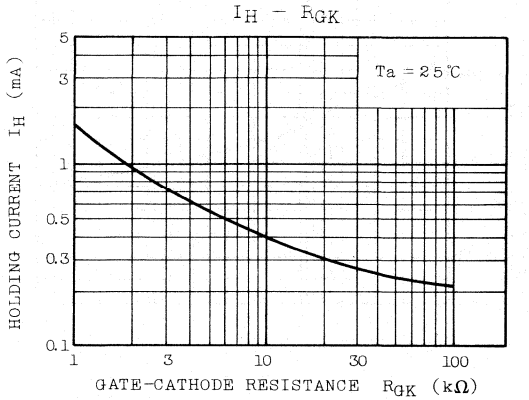
dv/dt – R_{GK}



I_{FT} – R_{GK}



I_H – R_{GK}



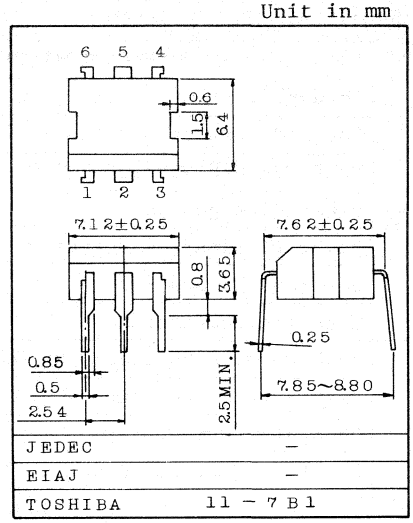
OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
SOLID STATE RELAY.
SWITCHING POWER SUPPLY.

The TOSHIBA TLP741J consists of a photo-thyristor optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.

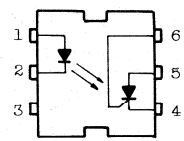
- Peak Off-State Voltage : 600V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 150mA Max.
- Isolation Voltage : 4000V_{rms} Min.
- Guaranteed Requirements of IEC380/VDE0806
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.2mm Min.
- Isolation Clearance : 7.6mm Min.
- Isolation Operating Voltage
  : 500Vac or 600Vdc for Isolation Group C*1
- Creeping Current Resistance : Group I*2
- TÜV Approved for DIN57883/VDE0883/6.80

*1 : According to VDE0110, table 4
*2 : According to VDE0110, table 3

Unit in mm



PIN CONFIGURATIONS (TOP VIEW)



1. ANODE
2. CATHODE
3. NC
4. CATHODE
5. ANODE
6. GATE

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	60	mA
	Forward Current Derating (Ta≧39°C)	ΔI_F/°C	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)	I_{FP}	1	A
	Power Dissipation	P_D	100	mW
	Power Dissipation Derating (Ta≧25°C)	ΔP_D/°C	-1.0	mW/°C
	Reverse Voltage	V_R	5	V
	Junction Temperature	T_j	125	°C
DETECTOR	Peak Forward Voltage (R_{GK}=27kΩ)	V_{DRM}	600	V
	Peak Reverse Voltage (R_{GK}=27kΩ)	V_{RRM}	600	V
	On-State Current	$I_{T(RMS)}$	150	mA
	On-State Current Derating (Ta≧25°C)	ΔI_T/°C	-2.0	mA/°C
	Peak On-State Current (100μs pulse, 120pps)	I_{TP}	3	A
	Peak One Cycle Surge Current	I_{TSM}	2	A
	Peak Reverse Gate Voltage	V_{GM}	5	V
	Power Dissipation	P_D	150	mW
	Power Dissipation Derating (Ta≧25°C)	ΔP_D/°C	-2.0	mW/°C
	Junction Temperature	T_j	100	°C
Storage Temperature Range		T_{stg}	-55～150	°C
Operating Temperature Range		T_{opr}	-55～100	°C
Lead Soldering Temperature (10 sec.)		T_{sold}	260	°C
Total Package Power Dissipation		P_T	250	mW
Total Package Power Dissipation Derating (Ta≧25°C)		ΔP_T/°C	-3.3	mW/°C
Isolation Voltage (AC, 1 min. RH≦60%)		BV_S	4000	Vrms

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta = 25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA		1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V		-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz		-	30	-	pF
DETECTOR	Off-State Current	I_{DRM}	V_{AK}=600V, R_{GK}=27kΩ	Ta=25°C	-	10	5000	nA
				Ta=85°C	-	1	150	μA
	Reverse Current	I_{RRM}	V_{KA}=600V, R_{GK}=27kΩ	Ta=25°C	-	10	5000	nA
				Ta=85°C	-	1	150	μA
	On-State Voltage	V_{TM}	I_{TM}=100mA		-	0.9	1.3	V
	Holding Current	I_H	R_{GK}=27kΩ		-	0.2	-	mA
	Off-State dv/dt	dv/dt	V_D=420V, R_{GK}=27kΩ		-	10	-	V/μs
	Capacitance	C_j	V=0, f=1MHz Anode to Gate		-	20	-	pF
			Gate to Cathode		-	350	-	

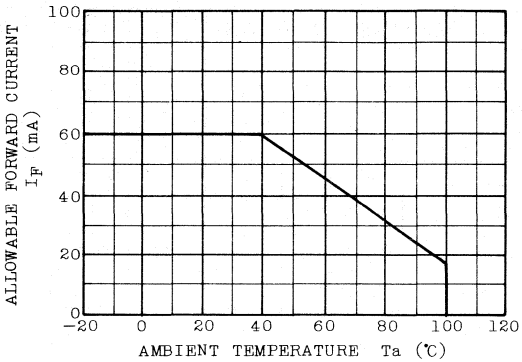
COUPLED CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_{AK}=6V, R_{GK}=27kΩ	-	5	10	mA
Turn-on Time	t_{on}	I_F=30mA, V_{AA}=50V, R_{GK}=27kΩ	-	10	-	μs
Coupled dv/dt	dv/dt	V_S=500V, R_{GK}=27kΩ	500	-	-	V/μs
Capacitance Input to Output	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	4000	-	-	V_{rms}
		AC, 1 second	-	10000	-	
		DC, 1 minute	-	10000	-	Vdc

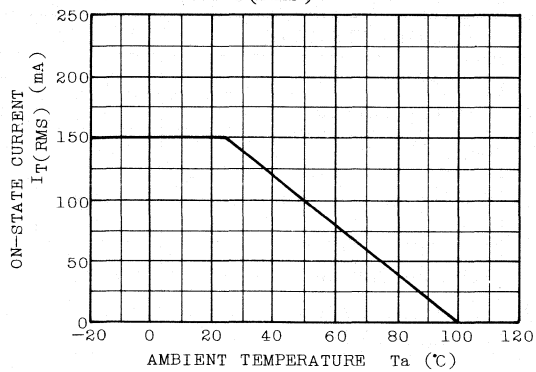
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	240	Vac
Forward Current	I_F	15	20	25	mA
Operating Temperature	Topr	-25	-	85	°C
Gate to Cathode Resistance	R_{GK}	-	10	27	kΩ
Gate to Cathode Capacity	C_{GK}	-	0.01	0.1	μF

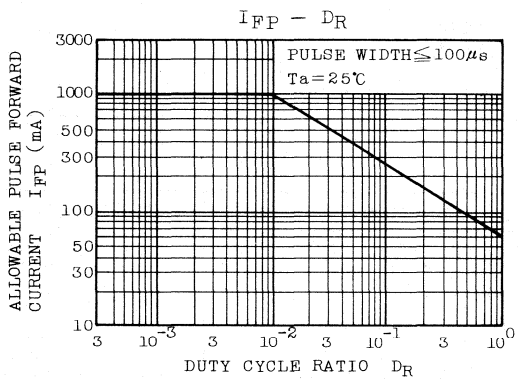
I_F – Ta



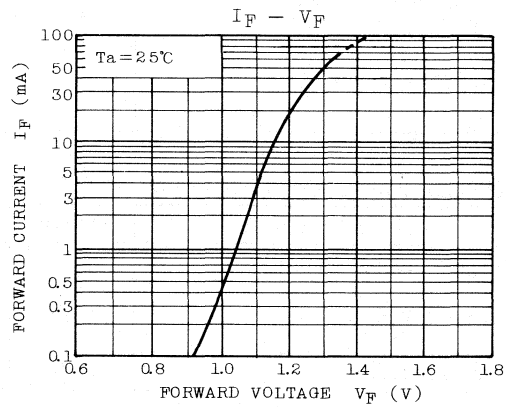
$I_{T(RMS)}$ – Ta



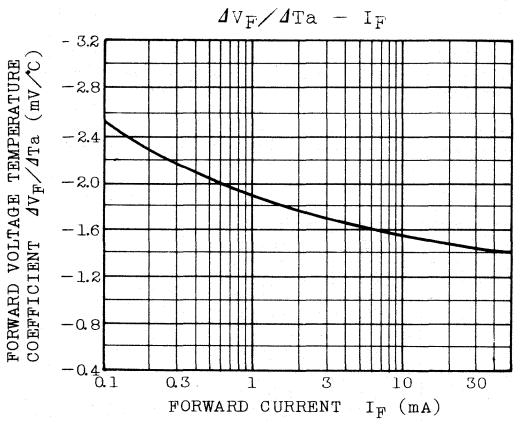
I_{FP} – D_R



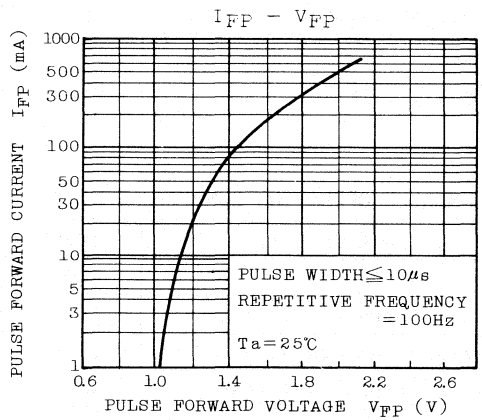
I_F – V_F



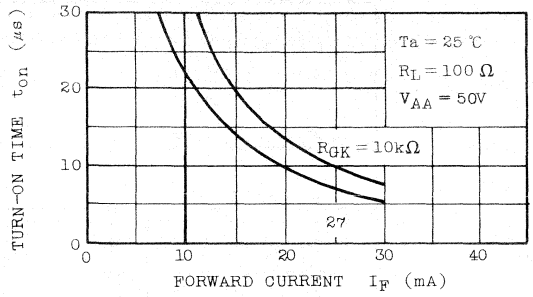
$\Delta V_F / \Delta Ta$ – I_F



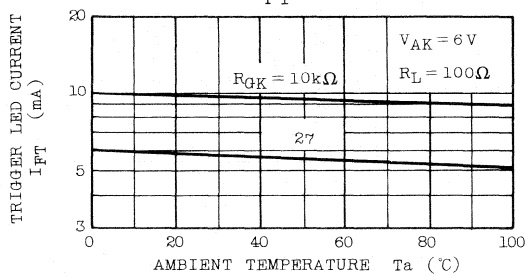
I_{FP} – V_{FP}



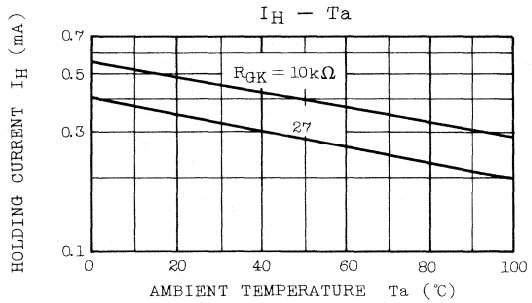
t_{on} – I_F



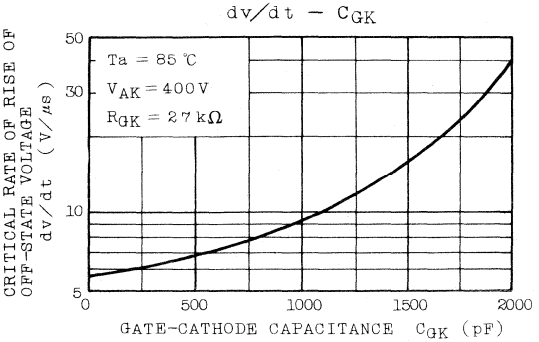
I_{FT} – Ta



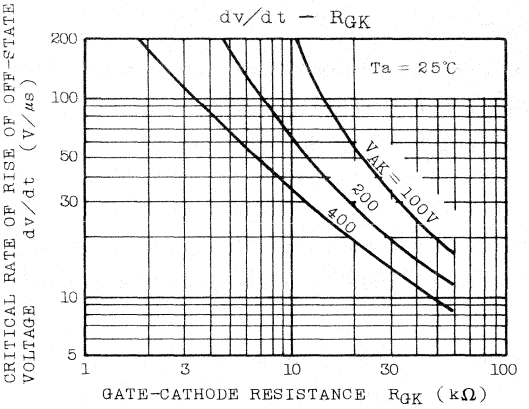
I_H – Ta



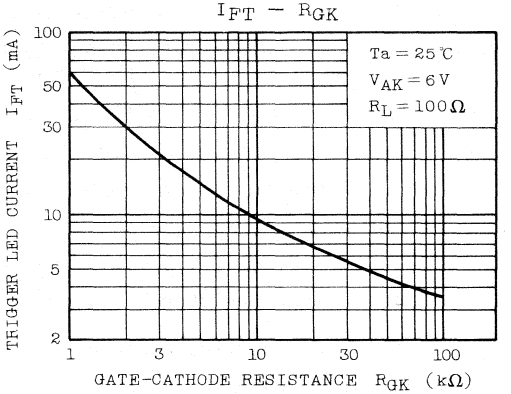
dv/dt – C_{GK}



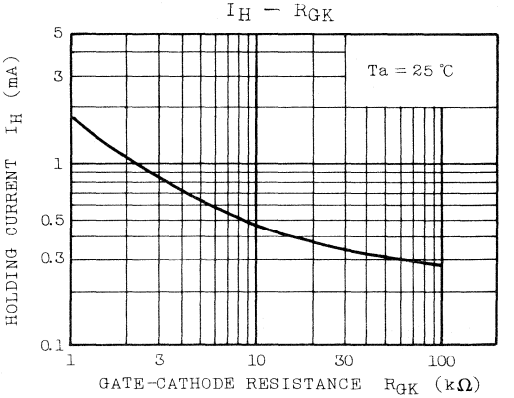
dv/dt – R_{GK}



I_{FT} – R_{GK}



I_H – R_{GK}



TLP745G

GaAs IRED & PHOTO-THYRISTOR

OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
SOLID STATE RELAY.
SWITCHING POWER SUPPLY.

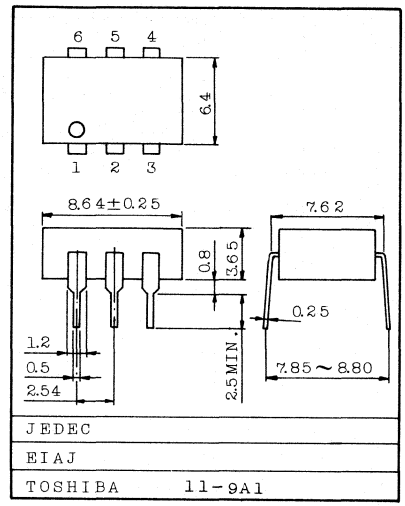
The TOSHIBA TLP745G consists of a photo-thyristor optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.

- Peak Off-State Voltage : 400V Min.
- Trigger LED Current : 10mA Max.
- Isolation Voltage : 150mA Max.
- Isolation Voltage : 5000Vrms Min.
- Guaranteed Requirements of IEC380/VDE0806 VDE0700T1
- Climatic Test Class : 55/150/21
- Isolation Creepage Path: 8.00mm Min.
- Isolation Clearance : 7.3mm Min.
- Isolation Operating Voltage
  : $500V_{ac}$ or $600V_{dc}$ for Isolation Group C*1
- Creepting Current Resistance : Group I*2

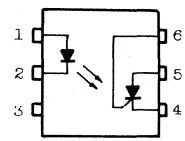
*1: According to VDE0110, table 4

*2: According to VDE0110, table 3

Unit in mm



PIN CONFIGURATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: CATHODE
5: ANODE
6: GATE

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	60	mA
	Forward Current Derating (Ta≧39°C)	$\Delta I_F/°C$	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)	I_{FP}	1	A
	Power Dissipation	P_D	100	mW
	Power Dissipation Derating (Ta≧25°C)	$\Delta P_D/°C$	-1.0	mW/°C
	Reverse Voltage	V_R	5	V
	Junction Temperature	T_j	125	°C
DETECTOR	Peak Forward Voltage (R_{GK}=27kΩ)	V_{DRM}	400	V
	Peak Reverse Voltage (R_{GK}=27kΩ)	V_{RRM}	400	V
	On-State Current	$I_{T(RMS)}$	150	mA
	On-State Current Derating (Ta≧25°C)	$\Delta I_T/°C$	-2.0	mA/°C
	Peak On-State Current (100μs pulse, 120pps)	I_{TP}	3	A
	Peak One Cycle Surge Current	I_{TSM}	2	A
	Peak Reverse Gate Voltage	V_{GM}	5	V
	Power Dissipation	P_D	150	mW
	Power Dissipation Derating (Ta≧25°C)	$\Delta P_D/°C$	-2.0	mW/°C
	Junction Temperature	T_j	100	°C
Storage Temperature Range		T_{stg}	-55~150	°C
Operating Temperature Range		T_{opr}	-55~100	°C
Lead Soldering Temperature (10sec.)		T_{sold}	260	°C
Total Package Power Dissipation		P_T	250	mW
Total Package Power Dissipation Derating (Ta≧25°C)		$\Delta P_T/°C$	-3.3	mW/°C
Isolation Voltage (AC, 1 min., RH≦60%)		BVS	5000	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA		1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V		-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz		-	30	-	pF
DETECTOR	Off-State Current	I_{DRM}	V_{AK}=400V, R_{GK}=27kΩ	Ta=25°C	-	10	5000	nA
				Ta=100°C	-	1	100	μA
	Reverse Current	I_{RRM}	V_{KA}=400V, R_{GK}=27kΩ	Ta=25°C	-	10	5000	nA
				Ta=100°C	-	1	100	μA
	On-State Voltage	V_{TM}	I_{TM}=100mA		-	0.9	1.3	V
	Holding Current	I_H	R_{GK}=27kΩ		-	0.2	-	mA
	Off-State dv/dt	dv/dt	V_D=280V, R_{GK}=27kΩ		5	10	-	V/μs
	Capacitance	C_j	V=0, f=1MHz Anode to Gate		-	20	-	pF
			Gate to Cathode		-	350	-	

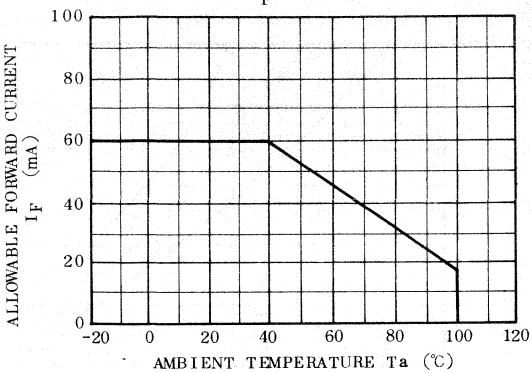
COUPLED CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_{AK}=6V, R_{GK}=27kΩ	-	4	10	mA
Turn-on Time	t_{on}	I_F=30mA, V_{AA}=50V R_{GK}=27kΩ	-	10	-	μs
Coupled dv/dt	dv/dt	V_S=500V, R_{GK}=27kΩ	500	-	-	V/μs
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	5000	-	-	V_{rms}
		AC, 1 second	-	10000	-	
		DC, 1 minute	-	10000	-	V_{dc}

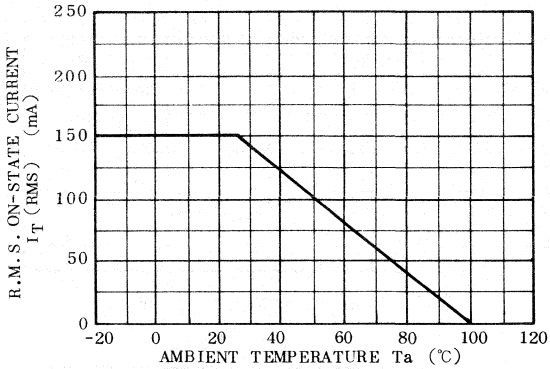
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	120	V_{ac}
Forward Current	I_F	15	20	25	mA
Operating Temperature	T_{opr}	-25	-	85	°C
Gate to Cathode Resistance	R_{GK}	-	27	33	kΩ
Gate to Cathode Capacity	C_{GK}	-	0.01	0.1	μF

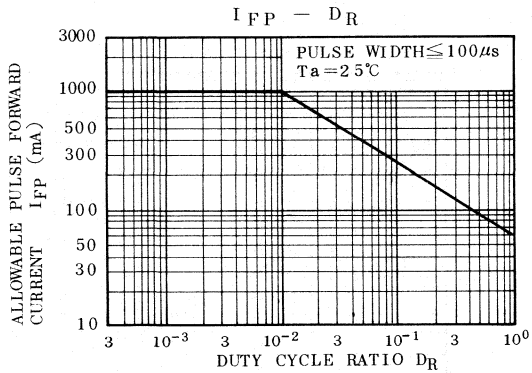
I_F — Ta



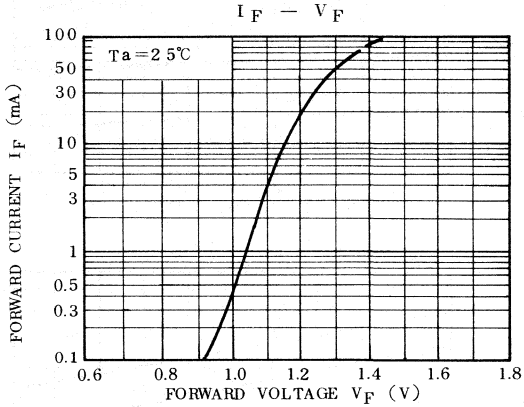
$I_{T(RMS)}$ — Ta



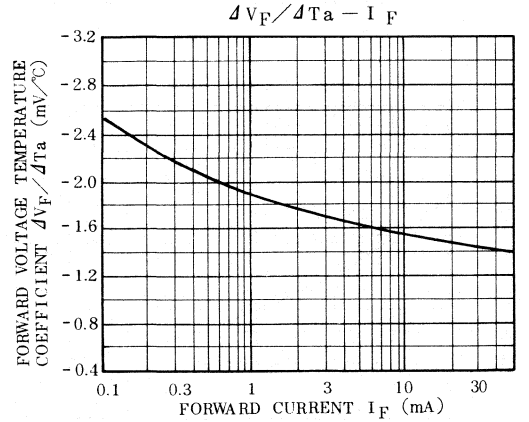
I_{FP} — D_R



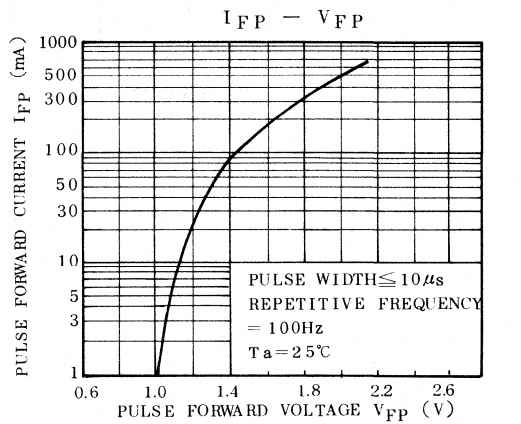
I_F — V_F



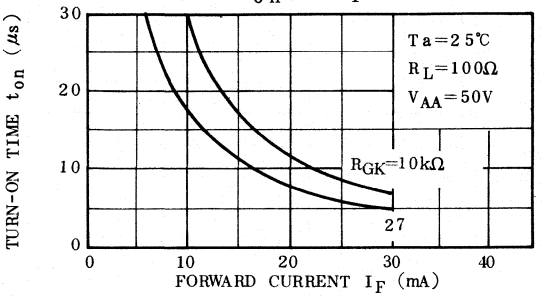
$\Delta V_F / \Delta Ta$ — I_F



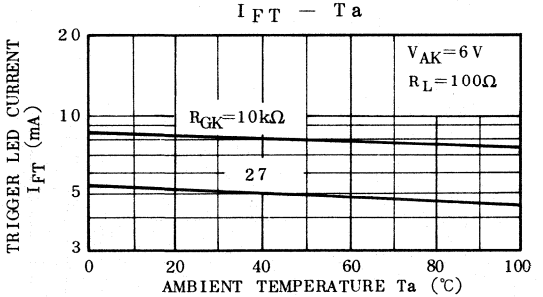
I_{FP} — V_{FP}



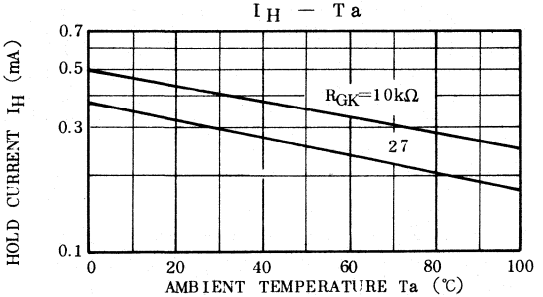
t_{on} — I_F



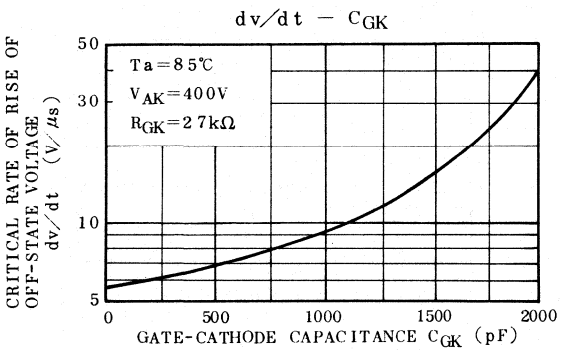
I_{FT} — Ta



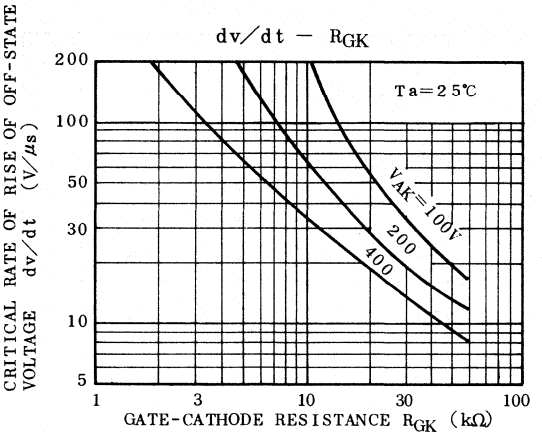
I_H — Ta



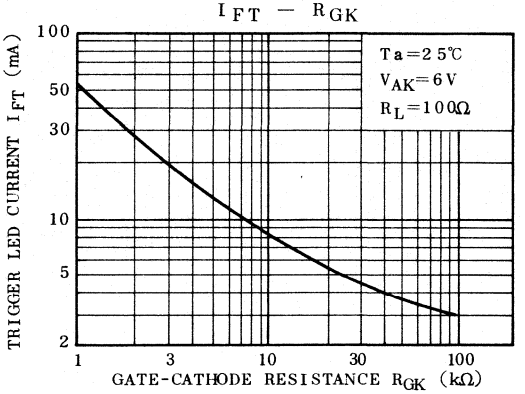
dv/dt — C_{GK}



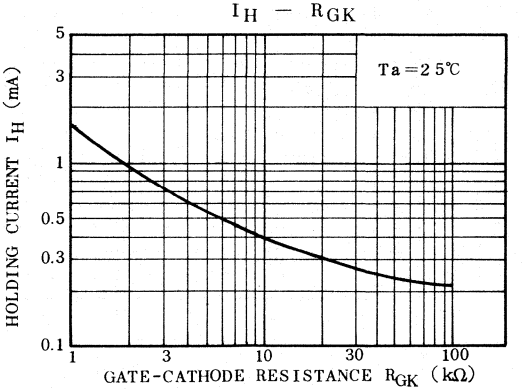
dv/dt — R_{GK}



I_{FT} — R_{GK}



I_H — R_{GK}



OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
SOLID STATE RELAY.
SWITCHING POWER SUPPLY.

The TOSHIBA TLP745GF consists of a photo-thyristor optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package. All parameters are tested to the specification of TLP745G. (both condition and limits)

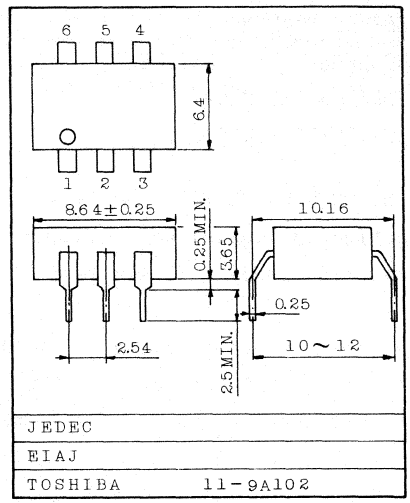
- Peak Off-State Voltage : 400V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 150mA Max.
- Isolation Voltage : 5000V_{rms} Min.
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.0mm Min.
- Isolation Clearance : 8.0mm Min.
- Isolation Operating Voltage
  : 500V_{ac} or 600V_{dc} for Isolation Group C*1
- Creeping Current Resistance : Group I*2
- Guaranteed Requirements of Safety Standards as Follows:

  DIN 57 883/VDE0883/6.80
  DIN 57 804/VDE0804/1.83
  DIN IEC65/VDE0860/8.81
  DIN IEC380/VDE0806/8.81
  DIN IEC435/VDE0805/Draft Nov.84
  DIN IEC601T1/VDE0750T1/5.82
  DIN 57 700T1/VDE0700T1/2.81

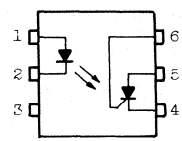
*1 : According to VDE0110, table 4

*2 : According to VDE0110, table 3

Unit in mm



PIN CONFIGURATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: CATHODE
5: ANODE
6: GATE

TLP745J

GaAs IRED & PHOTO-THYRISTOR

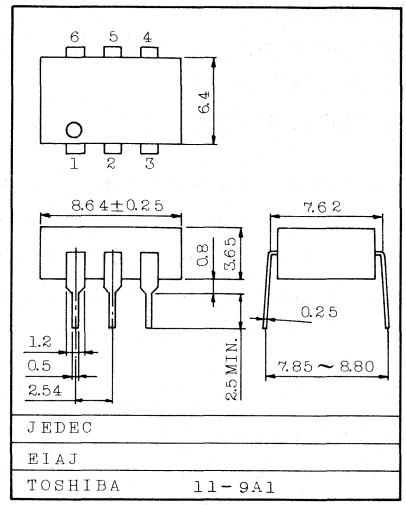
OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
SOLID STATE RELAY.
SWITCHING POWER SUPPLY.

The TOSHIBA TLP745J consists of a photo-thyristor optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.

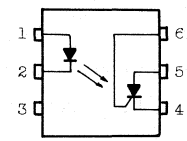
- Peak Off-State Voltage : 6000V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 150mA Max.
- Isolation Voltage : 5000Vrms Min.
- Guaranteed Requirements of IEC380/VDE0806
  VDE0700IT1
- Climatic Test Class : 55/150/21
- Isolation Creepage Path: 8.0mm Min.
- Isolation Clearance : 7.3mm Min.
- Isolation Operating Voltage
  : 500Vac or 600Vdc for Isolation Group C*1
- Creeping Current Resistance: Group I*2

*1: According to VDE0110, table 4
*2: According to VDE0110, table 3

Unit in mm



PIN CONFIGURATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: CATHODE
5: ANODE
6: GATE

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	60	mA
	Forward Current Derating (Ta≧39°C)	$\Delta I_F/°C$	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)	I_{FP}	1	A
	Power Dissipation	P_D	100	mW
	Power Dissipation Derating (Ta≧25°C)	$\Delta P_D/°C$	-1.0	mW/°C
	Reverse Voltage	V_R	5	V
	Junction Temperature	T_j	125	°C
DETECTOR	Peak Forward Voltage (R_{GK}=27kΩ)	V_{DRM}	600	V
	Peak Reverse Voltage (R_{GK}=27kΩ)	V_{RRM}	600	V
	On-State Current	$I_{T(RMS)}$	150	mA
	On-State Current Derating (Ta≧25°C)	$\Delta I_T/°C$	-2.0	mA/°C
	Peak On-State Current (100μs pulse, 120pps)	I_{TP}	3	A
	Peak One Cycle Surge Current	I_{TSM}	2	A
	Peak Reverse Gate Voltage	V_{GM}	5	V
	Power Dissipation	P_D	150	mW
	Power Dissipation Derating (Ta≧25°C)	$\Delta P_D/°C$	-2.0	mW/°C
	Junction Temperature	T_j	100	°C
Storage Temperature Range		T_{stg}	-55~150	°C
Operating Temperature Range		Topr	-55~100	°C
Lead Soldering Temperature (10 sec.)		Tsold	260	°C
Total Package Power Dissipation		P_T	250	mW
Total Package Power Dissipation Derating (Ta≧25°C)		$\Delta P_T/°C$	-3.3	mW/°C
Isolation Voltage (AC, 1 min., RH≦60%)		BVS	5000	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA		1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V		-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz		-	30	-	pF
DETECTOR	Off-State Current	I_{DRM}	V_{AK}=600V, R_{GK}=27kΩ	Ta=25°C	-	10	5000	nA
				Ta=85°C	-	1	150	μA
	Reverse Current	I_{RRM}	V_{KA}=600V, R_{GK}=27kΩ	Ta=25°C	-	10	5000	nA
				Ta=85°C	-	1	150	μA
	On-State Voltage	V_{TM}	I_{TM}=100mA		-	0.9	1.3	V
	Holding Current	I_H	R_{GK}=27kΩ		-	0.2	-	mA
	Off-State dv/dt	dv/dt	V_D=420V, R_{GK}=27kΩ		-	10	-	V/μs
	Capacitance	C_j	V=0, f=1MHz					
			Anode to Gate		-	20	-	pF
			Gate to Cathode		-	350	-	

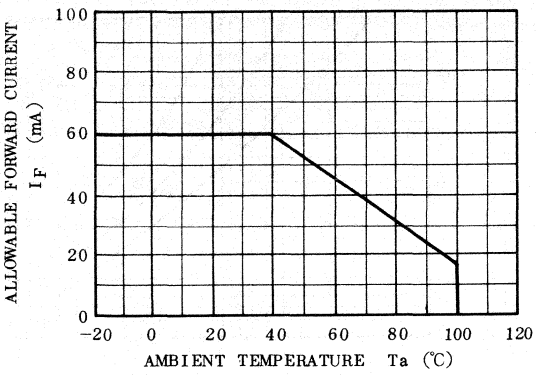
COUPLDE CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_{AK}=6V, R_{GK}=27kΩ	-	5	10	mA
Turn-on Time	t_{on}	I_F=30mA, V_{AA}=50V, R_{GK}=27kΩ	-	10	-	μs
Coupled dv/dt	dv/dt	V_S=500V, R_{GK}=27kΩ	500	-	-	V/μs
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	5000	-	-	V_{rms}
		AC, 1 second	-	10000	-	
		DC, 1 minute	-	10000	-	V_{dc}

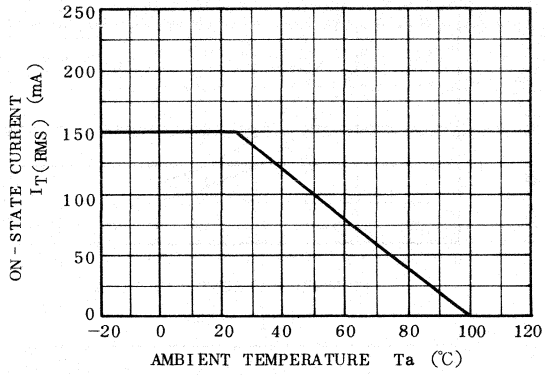
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	240	V_{ac}
Forward Current	I_F	15	20	25	mA
Operating Temperature	Topr	-25	-	85	°C
Gate to Cathode Resistance	R_{GK}	-	10	27	kΩ
Gate to Cathode Capacity	C_{GK}	-	0.01	0.1	μF

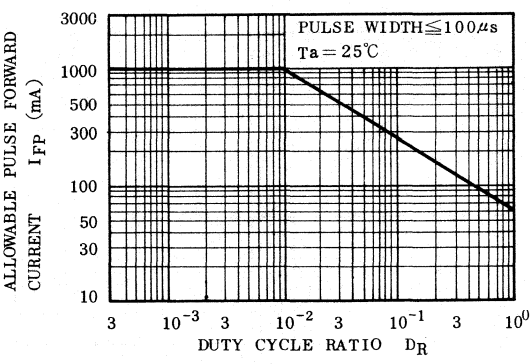
I_F – Ta



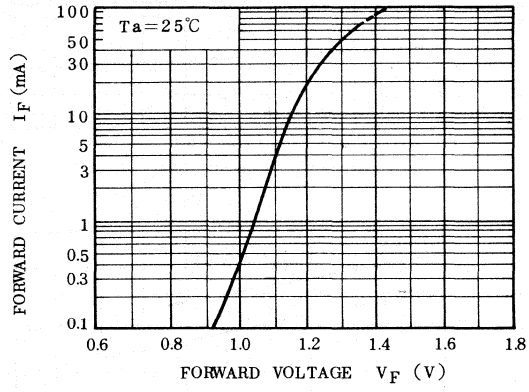
$I_{T(RMS)}$ – Ta



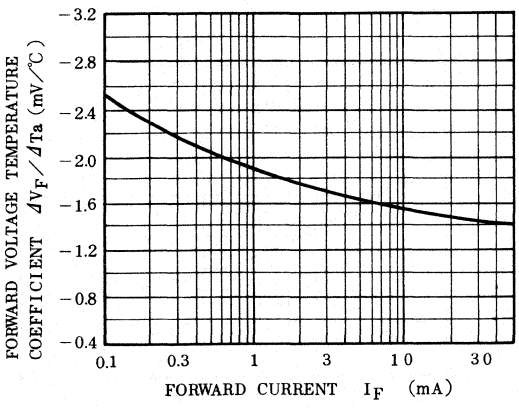
I_{FP} – D_R



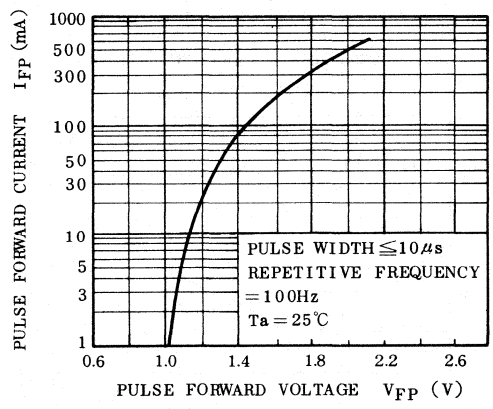
I_F – V_F



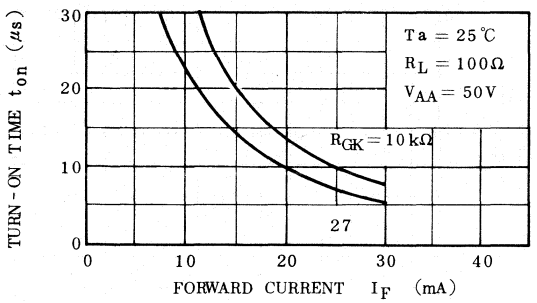
$\Delta V_F / \Delta Ta$ – I_F



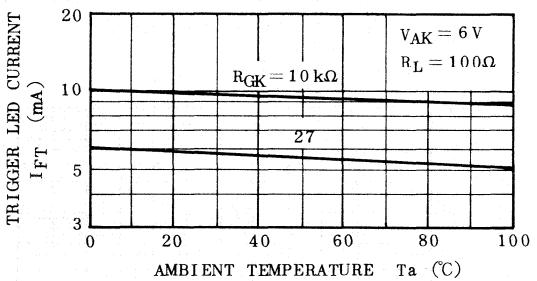
I_{FP} – V_{FP}



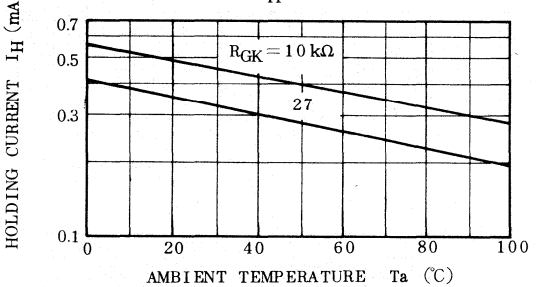
t_{on} – I_F



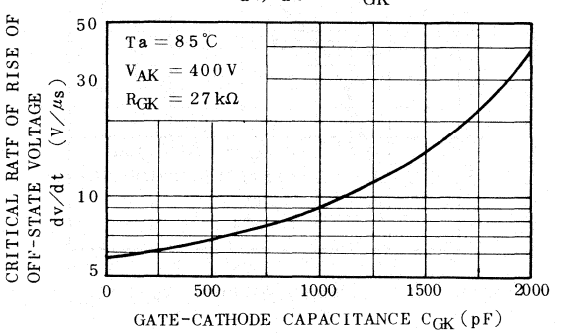
I_{FT} – Ta



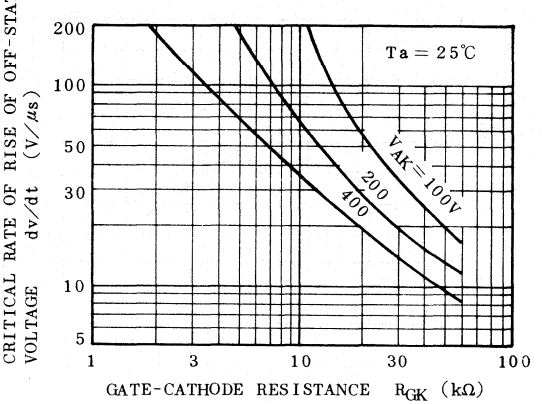
I_H – Ta



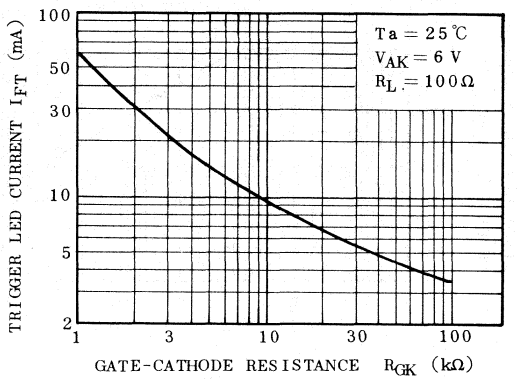
dv/dt – C_{GK}



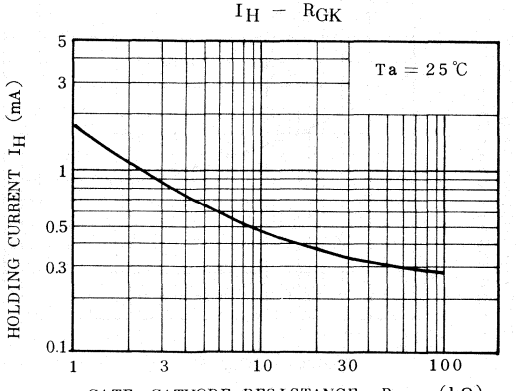
dv/dt – R_{GK}



I_{FT} – R_{GK}



I_H – R_{GK}



OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
SOLID STATE RELAY.
SWITCHING POWER SUPPLY.

The TOSHIBA TLP745JF consists of a photo-thyristor optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package. All parameters are rested to the specification of TLP545J. (both condition and limits)

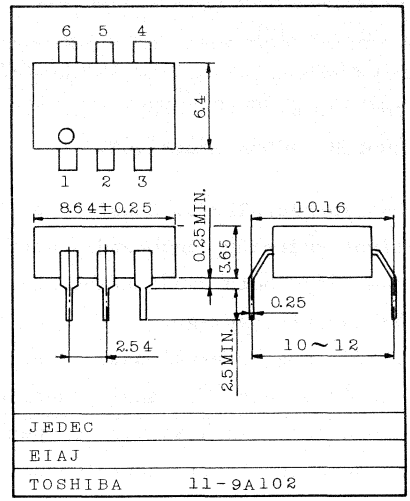
- Peak Off-State Voltage : 600V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 150mA Max.
- Isolation Voltage : 5000V_{rms} Min.
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.0mm Min.
- Isolation Clearance : 8.0mm Min.
- Isolation Operating Voltage
  : 500V_{ac} or 600V_{dc} for Isolation Group C*1
- Creeping Current Resistance : Group I*2
- Guaranteed Requirements of Safety Standards as Follows:

  DIN 57 883/VDE0883/6.80
  DIN 57 804/VDE0804/1.83
  DIN IEC65/VDE0860/8.81
  DIN IEC380/FED0806/8.81
  DIN IEC435/VDE0805/Draft Nov.84
  DIN IEC601T1/VDE0750T1/5.82
  DIN 57 700T1/VDE0700T1/2.81

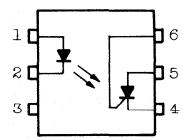
*1 : Accrding to VDE0110, table 4

*2 : Accrding to VDE0110, table 3

Unit in mm



PIN CONFIGURATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: CATHODE
5: ANODE
6: GATE

TLP751

GaAℓAs IRED & PHOTO-IC

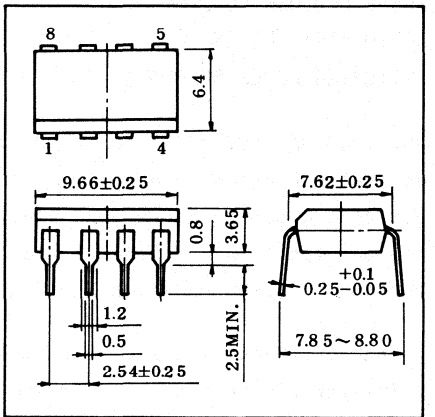
DIGITAL LOGIC GROUND ISOLATION.
LINE RECEIVER.
MICROPROCESSOR SYSTEM INTERFACES.
SWITCHING POWER SUPPLY FEEDBACK CONTROL.
ANALOG SIGNAL ISOLATION.

The Toshiba TLP751 Consists of GaAℓAs high-output light emitting diode and a high speed detector of one chip photo diode-transistor. This unit is 8-lead DIP package.
TLP751 has internal base connection. This base pin should be used for analog application or enable operation. If base pin is open, output signal will be noisy by environmental condition. For this case, TLP650 is suitable.

- Isolation Voltage : 5000Vrms Min.
- Switching Speed : tpHL=0.3μs(Typ.)
  tpLH=0.5μs(Typ.)
  (R_L=1.9kΩ)
- TTL Compatible
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 6.4mm Min.
- Isolation Clearance : 6.4mm Min.
- Isolation Operating Voltage
  : 500V_{ac} or 600V_{dc} for Isolation Group B*1
  380V_{ac} or 450V_{dc} for Isolation Group C*1
- Creeping Current Resistance : Group I*2
- Guaranteed Requirements of DIN IEC65/VDE0860/8.81

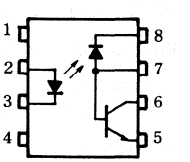
*1 : According to VDE0110, table 4
*2 : According to VDE0110, table 3

Unit in mm



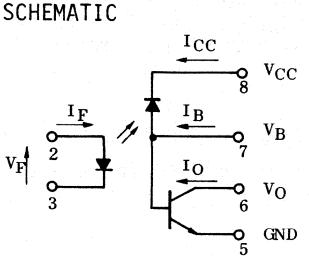
JEDEC	—
EIAJ	—
TOSHIBA	11-10C1

PIN CONFIGURATION (TOP VIEW)



1 : NC
2 : ANODE
3 : CATHODE
4 : NC
5 : EMITTER
6 : COLLECTOR
7 : BASE
8 : V_{CC}

SCHEMATIC



MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current	(Note 1)	I_F	25	mA
	Pulse Forward Current	(Note 2)	I_{FP}	50	mA
	Peak Transient Forward Current	(Note 3)	I_{FPT}	1	A
	Reverse Voltage		V_R	5	V
	Diode Power Dissipation	(Note 4)	P_D	45	mW
DETECTOR	Output Current		I_O	8	mA
	Peak Output Current		I_{OP}	16	mA
	Output Voltage		V_O	-0.5∿15	V
	Supply Voltage		V_{CC}	-0.5∿15	V
	Base Current		I_B	5	mA
	Emitter-Base Reverse Voltage		V_{EB}	5	V
	Output Power Dissipation	(Note 5)	P_o	100	mW
Operating Temperature Range			T_{opr}	-55∿100	°C
Storage Temperature Range			T_{stg}	-55∿125	°C
Lead Solder Temperature (10 sec.)		(Note 6)	T_{sol}	260	°C
Isolation Voltage (AC, 1 min., R.H≦60%)		(Note 7)	BV_S	5000	Vrms

Note 1 : Derate 0.8mA above 70°C

Note 2 : 50% duty cycle, 1ms pulse width.
Derate 1.6mA/°C above 70°C.

Note 3 : Pulse width≦1μs, 300pps.

Note 4 : Derate 0.9mW/°C above 70°C

Note 5 : Derate 2mW/°C above 70°C.

Note 6 : Soldering portion of lead : up to 2mm from the body of the device.

Note 7 : Device considered a two terminal device : Pins 1, 2, 3 and 4 shorted together and pins 5, 6, 7 and 8 shorted together.

ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=16mA	-	1.65	1.85	V
	Forward Voltage Temperature Coefficient	$\Delta V_F / \Delta Ta$	I =16mA	-	-2	-	mV/°C
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance Between Terminal	C_T	V_F=0, f=1MHz	-	45	-	pF
DETECTOR	High Level Output Current	$I_{OH(1)}$	I_F=0mA, V_{CC}=V_O=5.5V	-	3	500	nA
		$I_{OH(2)}$	I_F=0mA, V_{CC}=V_O=15V	-	-	5	μA
		I_{OH}	I_F=0mA, V_{CC}=V_O=15V Ta=70°C	-	-	50	
	High Level Supply Voltage	I_{CCH}	I_F=0mA, V_{CC}=15V	-	0.01	1	μA
COUPLED	Current Transfer Ratio	I_O/I_F	I_F=16mA V_{CC}=4.5V V_O=0.4V	4	-	-	%
	Low Level Output Voltage	V_{OL}	I_F=16mA, V_{CC}=4.5V I_O=1.1mA	-	-	0.4	V
	Resistance (Input-Output)	R_S	R.H.≦60%, V_S=500V_{DC} (Note 7)	5×10^{10}	10^{12}	-	Ω
	Capacitance (Input-Output)	C_S	V_S=0, f=1MHz (Note 7)	-	0.8	-	pF

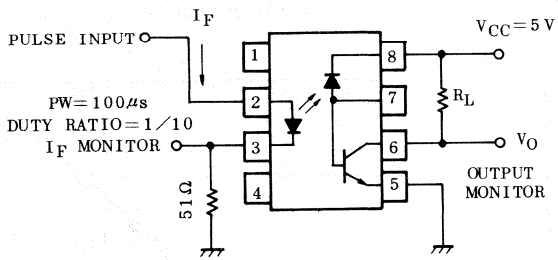
SWITCHING CHARACTERISTICS (Ta=25°C, V_{CC}=5V)

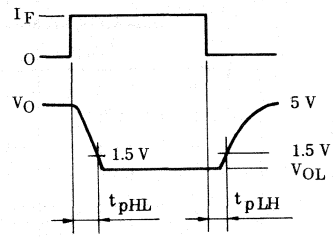
CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Propagation Delay Time (H→L)	t_pHL	1	I_F=0→16mA, V_{CC}=5V, R_L=4.1kΩ	-	0.2	-	μs
Propagation Delay Time (L→H)	t_pLH		I_F=16→0mA, V_{CC}=5V, R_L=4.1kΩ	-	1.0	-	μs
Common Mode Transient Immunity at Logic High Output (Note 8)	CM_H	2	I_F=0mA, V_{CM}=200V_{p-p} R_L=4.1kΩ	-	400	-	V/μs
Common Mode Transient Immunity at Logic Low Output (Note 8)	CM_L		I_F=16mA, V_{CM}=200V_{p-p} R_L=4.1kΩ	-	-1000	-	V/μs

Note 8 : CM_L is the maximun rate of fall of the common mode voltage that can be sustained with the output voltage in the logic low state (V_O<0.8V).
CM_H is the maximun rate of rise of the common mode voltage that can be sustained with the output voltage in the logic high state (V_O>2.0V).

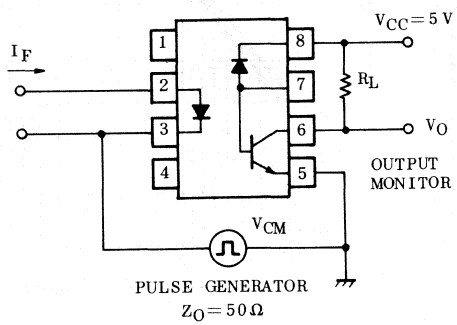
Note 9 : Maximum electrostatic discharge voltage for any pins : 100V(C=200pF, R=0).

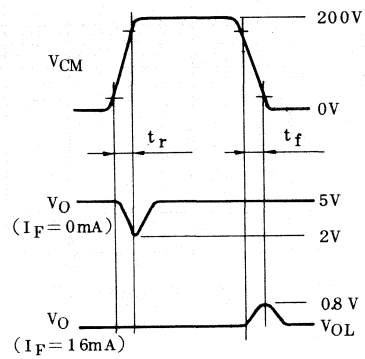
TEST CIRCUIT 1: Switching Time Test Circuit





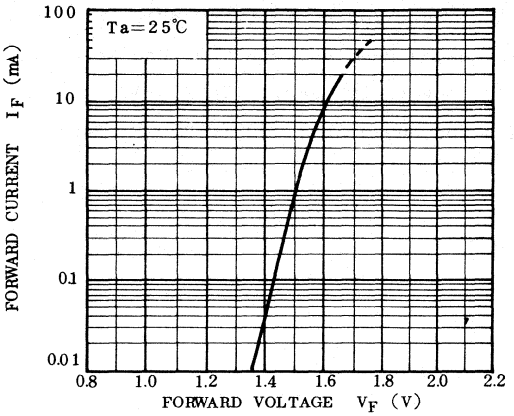
TEST CIRCUIT 2: Common Mode Noise Immunity Test Circuit



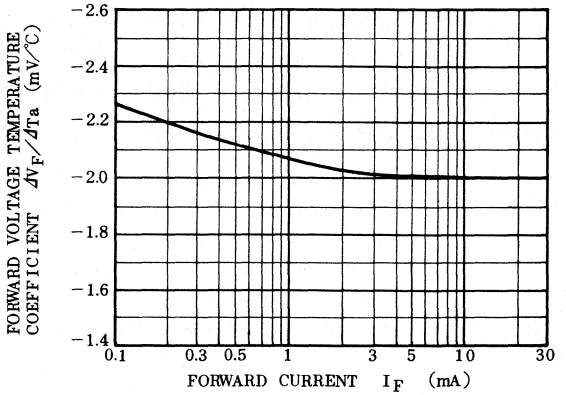


$$CM_H = \frac{160(V)}{t_r(\mu s)}, \quad CM_L = \frac{160(V)}{t_f(\mu s)}$$

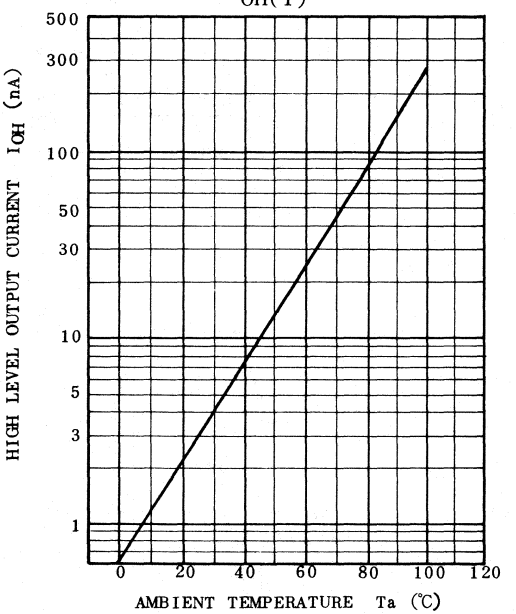
$I_F - V_F$



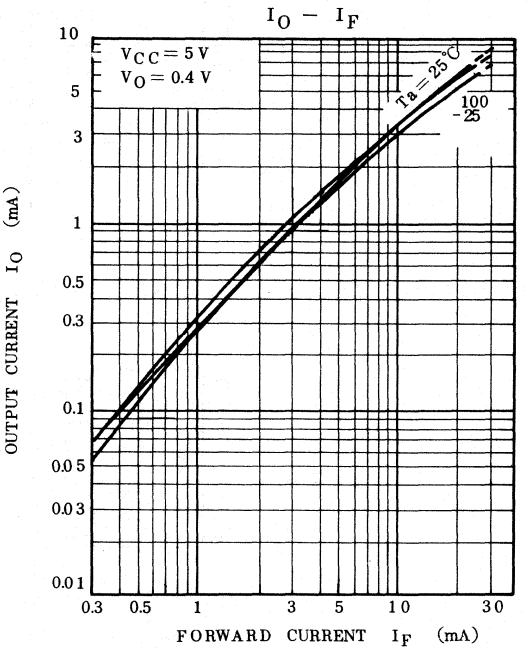
$\Delta V_F / \Delta Ta - I_F$



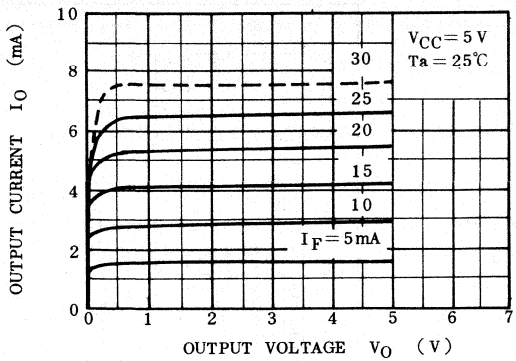
$I_{OH(1)} - Ta$



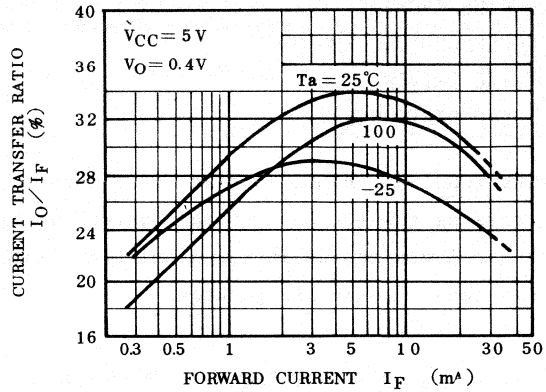
$I_O - I_F$



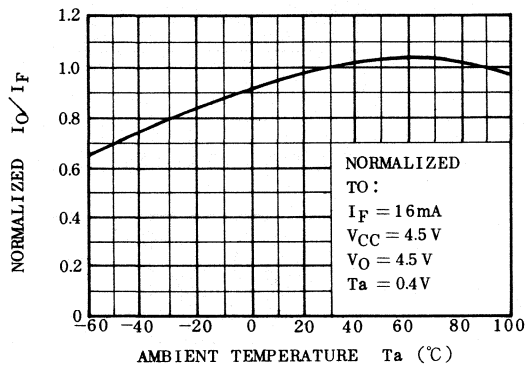
$I_O - V_O$



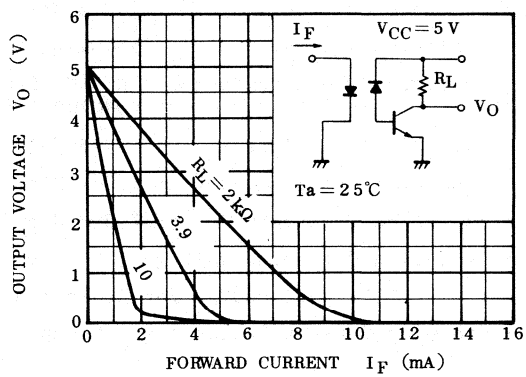
$I_O / I_F - I_F$



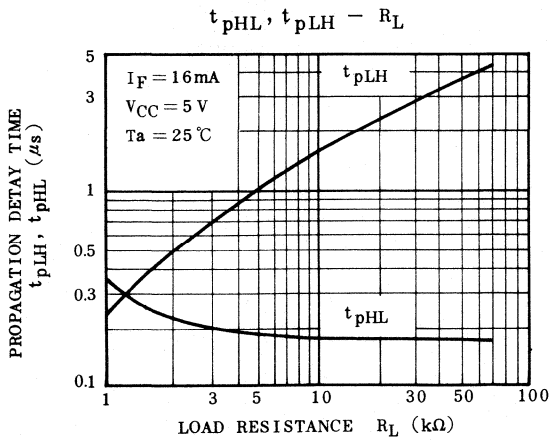
I_O / I_F - Ta



$V_O - I_F$



$t_{pHL}, t_{pLH} - R_L$



TLP766G

GaAs IRED & PHOTO-TRIAC

TENTATIVE DATA

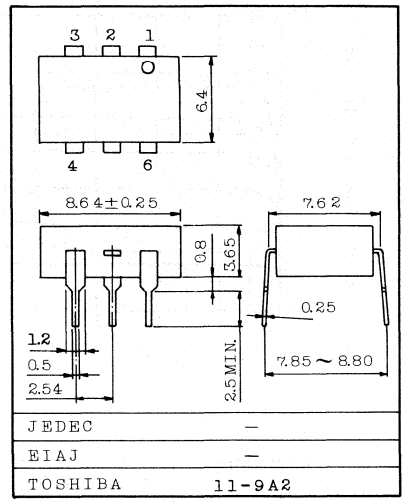
OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
TRIAC DRIVER.
SOLID STATE RELAY.

The TOSHIBA TLP766G consists of a zero voltage crossing turn-on photo-triac optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.

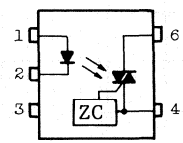
- Peak Off-State Voltage : 400V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 100mA Max.
- Isolation Voltage : 5000V_{rms} Min.
- Guaranteed Requirements of IEC380/VDE0806 VDE0700T1
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.0mm Min.
- Isolation Clearance : 7.3mm Min.
- Isolation Operating Voltage
  : 500V_{ac} or 600V_{dc} for Isolation Group C*1
- Creeping Current Resistance : Group 1*2

*1 : According to VDE0110, table 4.
*2 : According to VDE0110, table 3.

Unit in mm



PIN CONFIGURATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: TERMINAL 1
6: TERMINAL 2

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current		I_F	50	mA
	Forward Current Derating (Ta≧53°C)		$\Delta I_F/°C$	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)		I_{FP}	1	A
	Power Dissipation		P_D	100	mW
	Power Dissipation Derating (Ta≧25°C)		$\Delta P_D/°C$	-1.0	mW/°C
	Reverse Voltage		V_R	5	V
	Junction Temperature		T_j	125	°C
DETECTOR	Off-State Output Terminal Voltage		V_{DRM}	400	V
	On-State RMS Current	Ta=25°C	$I_{T(RMS)}$	100	mA
		Ta=70°C		50	
	On-State Current Derating (Ta≧25°C)		$\Delta I_T/°C$	-1.1	mA/°C
	Peak On-State Current (100μs pulse, 120pps)		I_{TP}	2	A
	Peak Nonrepetitive Surge Current (P_W=10ms, DC=10%)		I_{TSM}	1.2	A
	Power Dissipation		P_D	300	mW
	Power Dissipation Derating (Ta≧25°C)		$\Delta P_D/°C$	-4.0	mW/°C
	Junction Temperature		T_j	100	°C
Storage Temperature Range			T_{stg}	-55~150	°C
Operating Temperature Range			T_{opr}	-40~100	°C
Lead Soldering Temperature (10 sec.)			T_{sold}	260	°C
Total Package Power Dissipation			P_T	330	mW
Total Package Power Dissipation Derating (Ta≧25°C)			$\Delta P_T/°C$	-4.4	mW/°C
Isolation Voltage (AC, 1 min., RH≦60%)			BV_S	5000	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	CT	V=0, f=1MHz	-	10	-	pF
DETECTOR	Peak Off-State Current	I_{DRM}	V_{DRM}=400	-	10	100	nA
	Peak On-State Voltage	V_{TM}	I_{TM}=100mA	-	1.7	3.0	V
	Holding Current	I_H	-	-	0.2	-	mA
	Critical Rate of Rise of Off-State Voltage	dv/dt	V_{in}=120V_{rms}, Ta=85°C (Fig. 1)	200	500	-	V/μs
	Critical Rate of Rise of Commutating Voltage	$dv/dt_{(c)}$	V_{in}=30V_{rms}, I_T=15mA (Fig. 1)	-	0.2	-	V/μs

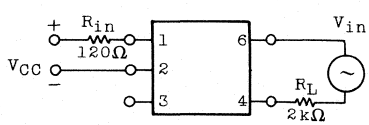
COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

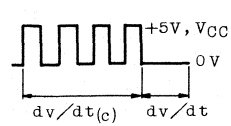
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_T=3V, R_L=100Ω	-	5	10	mA
Inhibit Voltage	V_{IH}	I_F=Rated I_{FT}	-	-	40	V
Leakage in Inhibited State	I_{IH}	I_F=Rated I_{FT} V_T=Rated V_{DRM}	-	100	300	μA
Capacitance (Input to Output)	CS	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	RS	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BVS	AC, 1 minute	5000	-	-	V_{rms}
		AC, 1 second	-	10000	-	
		DC, 1 minute	-	10000	-	Vdc

RECOMMENDED OPERATING CONDITIONS

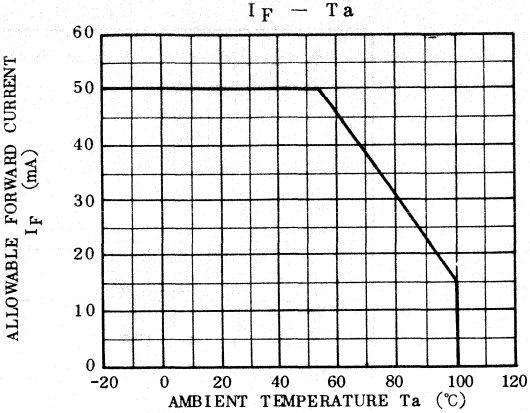
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	120	Vac
Forward Current	I_F	15	20	25	mA
Peak On-State Current	I_{TP}	-	-	1	A
Operating Temperature	Topr	-25	-	85	°C

Fig. 1 dv/dt TEST CIRCUIT

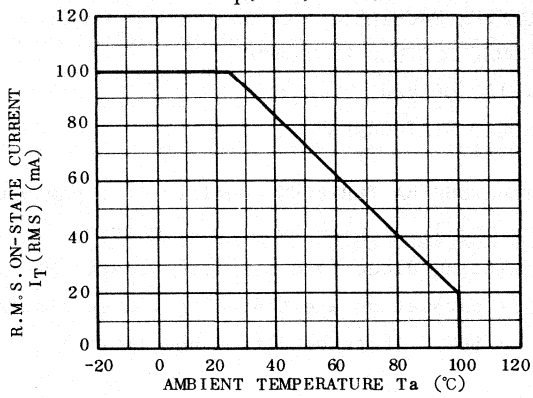




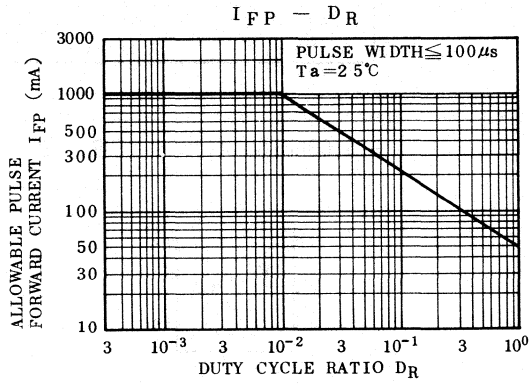
I_F — Ta



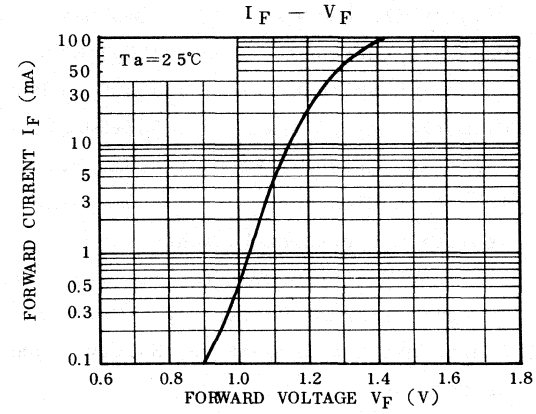
I_T(RMS) — Ta



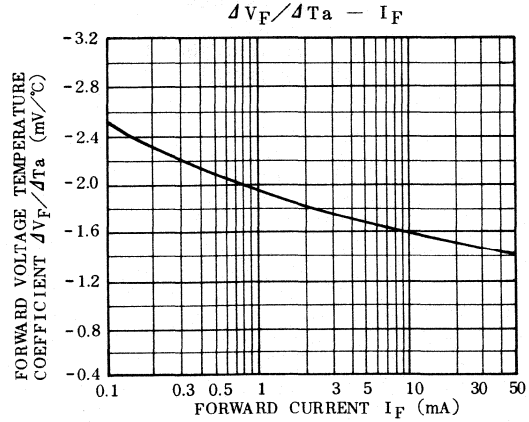
I_{FP} — D_R



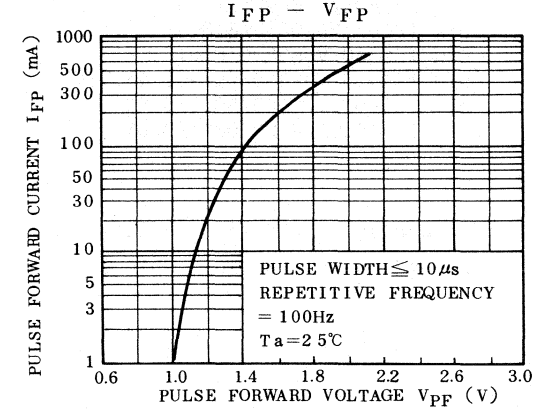
I_F — V_F



$\Delta V_F/\Delta Ta$ — I_F



I_{FP} — V_{FP}



TLP766GF

GaAs IRED & PHOTO-TRIAC

TENTATIVE DATA

OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
TRIAC DRIVER.
SOLID STATE RELAY.

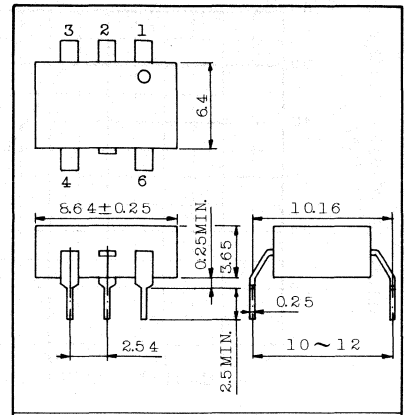
The TOSHIBA TLP766FG consists of a photo-triac optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package. All parameters are tested to the specification of TLP766G. (both condition and limits)

- Peak Off-State Voltage : 400V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 100mA Max.
- Isolation Voltage : 5000V_{rms} Min.
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.0mm Min.
- Isolation Clearance : 8.0mm Min.
- Isolation Operating Voltage
  : 500V_{ac} or 600V_{dc} for Isolation Group C*1
- Creeping Current Resistance : Group I*2
- Guaranteed Requirements of Safety Standards as Follows:

  DIN 57 883/VDE0883/6.80
  DIN 57 804/VDE0804/1.83
  DIN IEC65/VDE0860/8.81
  DIN IEC380/VDE0806/8.81
  DIN IEC435/VDE0805/Draft Nov.84
  DIN IEC601T1/VDE0750T1/5.82
  DIN 57 700T1/VDE0700T1/2.81

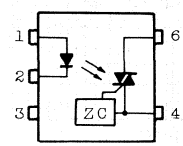
*1 : According to VDE0110, table 4
*2 : According to VDE0110, table 3

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-9A202

PIN CONFIGURATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: TERMINAL 1
6: TERMINAL 2

OFFICE MACHINE
HOUSEHOLD USE EQUIPMENT
TRIAC DRIVER
SOLID STATE RELAY

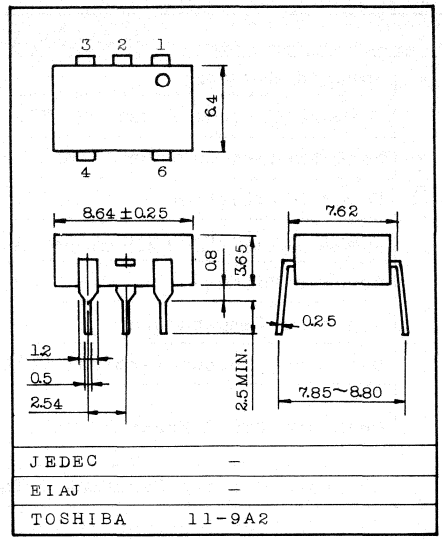
The TOSHIBA TLP766J consists of a zero voltage crossing turn-on photo-triac optically coupled to a gallium arsenide infrared emitting diode in a siz lead plastic DIP package.

- Peak Off-State Voltage : 600V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 100mA Max.
- Isolation Voltage : 5000Vrms Min.
- Guaranteed Requirements of IEC380/VDE0806 VDE700T1
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.0mm Min.
- Isolation Clearance : 7.3mm Min.
- Isolation Operating Voltage
  : $500V_{ac}$ or $600V_{dc}$ for Isolation Group C*1
- Creeping Current Resistance: Group I*2

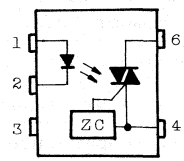
*1: According to VDE0110, table 4.

*2: According to VDE0110, table 3.

Unit in mm



PIN CONFIGURATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: TERMINAL 1
6: TERMINAL 2

MAXIMUM RATINGS (Ta = 25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current		I_F	50	mA
	Forward Current Derating (Ta ≧ 53°C)		ΔI_F/°C	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)		I_{FP}	1	A
	Power Dissipation		P_D	100	mW
	Power Dissipation Derating (Ta ≧ 25°C)		ΔP_D/°C	-1.0	mW/°C
	Reverse Voltage		V_R	5	V
	Junction Temperature		T_j	125	°C
DETECTOR	Off-State Output Terminal Voltage		V_{DRM}	600	V
	On-State RMS Current	Ta=25°C	$I_{T(RMS)}$	100	mA
		Ta=70°C		50	
	On-State Current Derating (Ta ≧ 25°C)		ΔI_T/°C	-1.1	mA/°C
	Peak On-State Current (100μs pulse, 120pps)		I_{TP}	2	A
	Peak Nonrepetitive Surge Current (Pw=10ms, DC=10%)		I_{TSM}	1.2	A
	Power Dissipation		P_D	300	mW
	Power Dissipation Derating (Ta ≧ 25°C)		ΔP_D/°C	-4.0	mW/°C
	Junction Temperature		T_j	100	°C
Storage Temperature Range			T_{stg}	-55 ~ 150	°C
Operating Temperature Range			T_{opr}	-40 ~ 100	°C
Lead Soldering Temperature (10 sec.)			T_{sold}	260	°C
Total Package Power Dissipation			P_T	330	mW
Total Package Power Dissipation Derating (Ta ≧ 25°C)			ΔP_T/°C	-4.4	mW/°C
Isolation Voltage (AC, 1 min., RH ≦ 60%)			BV_S	5000	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta = 25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	10	-	pF
DETECTOR	Peak Off-State Current	I_{DRM}	V_{DRM}=400	-	10	100	nA
	Peak On-State Voltage	V_{TM}	I_{TM}=100mA	-	1.7	3.0	V
	Holding Current	I_H	-	-	0.2	-	mA
	Critical Rate of Rise of Off-State Voltage	dv/dt	Vin=240Vrms, Ta=85°C (Fig. 1)	200	500	-	V/μs
	Critical Rate of Rise of Commutating Voltage	dv/dt(c)	Vin=60Vrms, I_T=15mA (Fig. 1)	-	0.2	-	V/μs

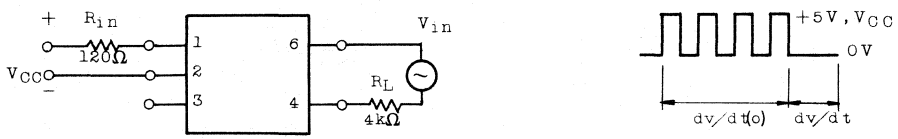
COUPLED ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_T=6V, R_L=100Ω	-	5	10	mA
Inhibit Voltage	V_{IH}	I_F=Rated I_{FT}	-	-	50	V
Leakage in Inhibited State	I_{IH}	I_F=Rated I_{FT} V_T=Rated V_{DRM}	-	100	300	μA
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	5000	-	-	V_{rms}
		AC, 1 second	-	10000	-	
		DC, 1 minute	-	10000	-	Vdc

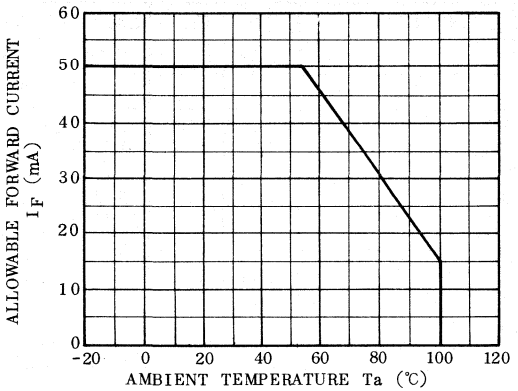
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	240	Vac
Forward Current	I_F	15	20	25	mA
Peak On-State Current	I_{TP}	-	-	1	A
Operating Temperature	Topr	-25	-	85	°C

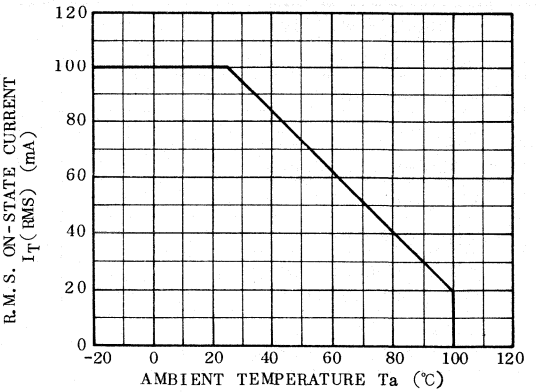
Fig. 1 dv/dt TEST CIRCUIT



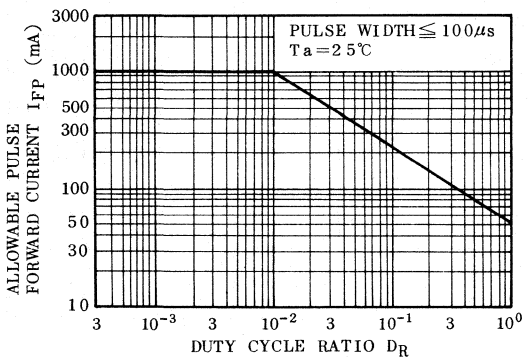
I_F — Ta



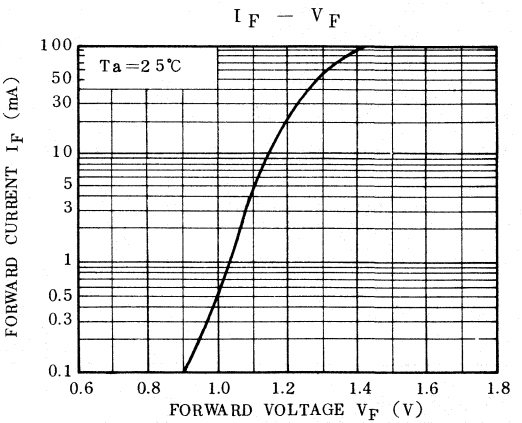
I_T(RMS) — Ta



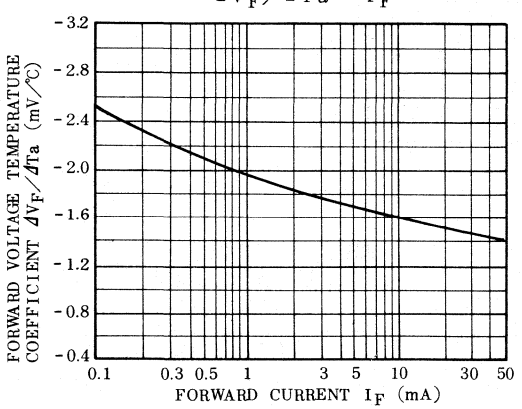
I_{FP} — D_R



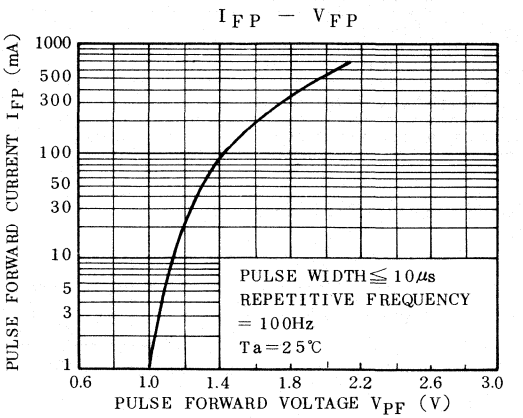
I_F — V_F



$\Delta V_F / \Delta Ta$ — I_F



I_{FP} — V_{FP}



OFFICE MACHINE
HOUSEHOLD USE EQUIPMENT
TRIAC DRIVER
SOLID STATE RELAY

The TOSHIBA TLP766JF consists of a photo-triac optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package. All parameters are tested to the specification of TLP766J. (both condition and limits)

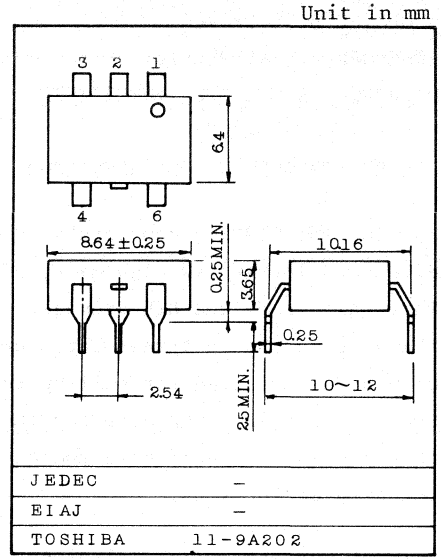
- Peak Off-State Voltage : 600V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 100mA Max.
- Isolation Voltage : 5000V_{rms} Min.
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.0mm Min.
- Isolation Clearance : 8.0mm Min.
- Isolation Operating Voltage
  : 500V_{ac} or 600V_{dc} for Isolation Group C*1
- Creeping Current Resistance : Group I*2
- Guaranteed Requirements of Safety Standards as Foolows:

  DIN 57 883/VDE0883/6.80
  DIN 57 804/VDE0804/1.83
  DIN IEC65/VDE0860/8.81
  DIN IEC380/VDE0806/8.81
  DIN IEC435/VDE0805/Draft Nov.84
  DIN IEC601T1/VDE0750T1/5.82
  DIN 57 700T1/VDE0700T1/2.81

*1: According to VDE0100, table 4

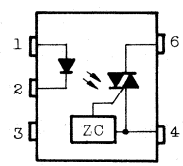
*2: According to VDE0110, table 3

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-9A202

PIN CONFIGURATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: TERMINAL 1
6: TERMINAL 2

TLP2200

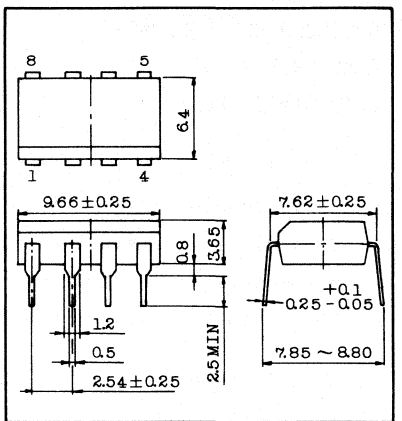
GaAℓAs IRED & PHOTO-IC

ISOLATED BUSS DRIVER
HIGH SPEED LINE RECEIVER
MICROPOCESSOR SYSTEM INTERFACES
MOS FET GATE DRIVER
DIRECT REPLACEMENT FOR HCPL-2200

The Toshiba TLP2200 consists of a GaAℓAs light emitting diode and integrated high gain, high speed photodetector. This unit is 8-lead DIP package.
The detector has a three state output stage that eliminates the need for pull-up resistor, and built-in Schmitt trigger. The detector IC has an internal shield that provides a guaranteed common mode transient immunity of 1000V/μs.

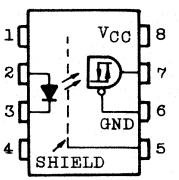
- Input Current : I_F=1.6mA
- Power Supply Voltage : V_{CC}=4.5~20V
- Switching Speed : 2.5 MBd Guaranteed
- Common Mode Transient Immunity : ±1000V/μs Min.
- Guaranteed Performance Over Temp. : 0~85°C
- Isolation Voltage : 2500V_{rms} Min.
- UL Recognized : File No. E67349

Unit in mm



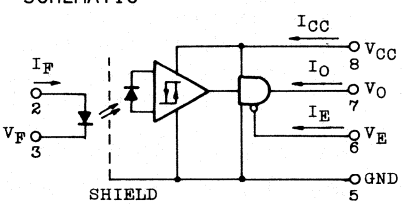
JEDEC	—
EIAJ	—
TOSHIBA	11-10C1

PIN CONFIGURATION (TOP VIEW)



1: NC
2: ANODE
3: CATHODE
4: NC
5: GND
6: V_E (ENABLE)
7: V_O (OUTPUT)
8: V_{CC}

SCHEMATIC



TRUTH TABLE (Positive Logic)

INPUT	ENABLE	OUTPUT
H	H	Z
L	H	Z
H	L	H
L	L	L

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Input Current, ON	I_F(ON)	1.6	-	5	mA
Input Current, OFF	I_F(OFF)	0	-	0.1	mA
Supply Voltage	V_{CC}	4.5	-	20	V
Enable Voltage High	V_{EH}	2.0	-	20	V
Enable Voltage Low	V_{EL}	0	-	0.8	V
Fan Out (TTL Load)	N	-	-	4	
Operating Temperature	T_{opr}	0	-	85	°C

ABSOLUTE MAXIMUM RATINGS (No Derating Required up to 70°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current	I_F	10	mA
	Peak Transient Forward Current (Note 1)	I_{FPT}	1	A
	Reverce Voltage	V_R	5	V
DETECTOR	Output Current	I_O	25	mA
	Supply Voltage	V_{CC}	-0.5~20	V
	Output Voltage	V_O	-0.5~20	V
	Three State Enable Voltage	V_E	-0.5~20	V
	Total Package Power Dissipation (Note 2)	P_T	210	mW
Operating Temperature Range		Topr	-40~85	°C
Storage Temperature Range		Tstg	-55~125	°C
Lead Solder Temperature (10 sec.)**		Tsold	260	°C
Isolation Voltage(AC 1min.,R.H≤60%, Ta=25°C)(Note 3)		BVs	2500	Vrms

Note 1 : Pulse width 1μs, 300pps.

Note 2 : Derate 4.5mW/°C above 70°C ambient temperature.

Note 3 : Device considered a two terminal device: pins 1,2,3 and 4 shorted together, and pins 5,6,7 and 8 shorted together.

** 1.6mm below seating plane.

ELECTRICAL CHARACTERISTICS Unless otherwise specified, Ta=0~85°C, V_{CC}=4.5~20V, $I_{F(ON)}$=1.6~5mA, $I_{F(OFF)}$=0~0.1mA, V_{EL}=0~0.8V, V_{EH}=2.0~20V

CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.*	MAX.	UNIT
Output Leakage Current ($V_O > V_{CC}$)	I_{OHH}	I_F=5mA	V_O=5.5V	-	-	100	μA
		V_{CC}=4.5V	V_O=20V	-	2	500	
Logic Low Output Voltage	V_{OL}	I_{OL}=6.4mA (4 TTL Load)		-	0.32	0.5	V
Logic High Output Voltage	V_{OH}	I_{OH}=-2.6mA		2.4	3.4	-	V
Logic Low Enable Current	I_{EL}	V_E=0.4V		-	-0.13	-0.32	mA
Logic High Enable Current	I_{EH}	V_E=2.7V		-	-	20	μA
		V_E=5.5V		-	-	100	
		V_E=20V		-	0.01	250	
Logic Low Enable Voltage	V_{EL}			-	-	0.8	V
Logic High Enable Voltage	V_{EH}			2.0	-	-	V
Logic Low Supply Current	I_{CCL}	I_F=0mA	V_{CC}=5.5V	-	5	6.0	mA
		V_E=Don't Care	V_{CC}=20V	-	5.6	7.5	
Logic High Supply Current	I_{CCH}	I_F=5mA	V_{CC}=5.5V	-	2.5	4.5	mA
		V_E=Don't Care	V_{CC}=20V	-	2.8	6.0	
High Impedance State Output Current	I_{OZL}	I_F=5mA, V_E=2V	V_O=0.4V	-	1	-20	μA
	I_{OZH}	I_F=0mA, V_E=2V	V_O=2.4V	-	-	20	
			V_O=5.5V	-	-	100	
			V_O=20V	-	0.01	500	
Logic Low Short Circuit Output Current (Note 4)	I_{OSL}	I_F=0mA	V_O=V_{CC}=5.5V	25	55	-	mA
			V_O=V_{CC}=20V	40	80	-	
Logic High Short Circuit Output Current (Note 4)	I_{OSH}	I_F=5mA	V_{CC}=5.5V	-10	-25	-	mA
		V_O=GND	V_{CC}=20V	-25	-60	-	
Input Current Hysteresis	I_{HYS}	V_{CC}=5V		-	0.05	-	mA
Input Forward Voltage	V_F	I_F=5mA, Ta=25°C		-	1.55	1.7	V
Temperature Coefficient of Forward Voltage	$\Delta V_F/\Delta Ta$	I_F=5mA		-	-2.0	-	mV/°C
Input Reverse Breakdown Voltage	BVR	I_R=10μA, Ta=25°C		5	-	-	V
Input Capacitance	C_{IN}	V_F=0V, f=1MHz, Ta=25°C		-	45	-	pF
Input-Output Insulation Leakage Current	I_{I-O}	V_{I-O}=3000V_{DC}, t=5sec Relative Humidity=45% Ta=25°C (Note 3)		-	-	1	μA
Resistance (Input-Output)	R_{I-O}	V_{I-O}=500V_{DC} (Note 3)		-	10^{12}	-	Ω
Capacitance (Input-Output)	C_{I-O}	V_{I-O}=0V, f=1MHz (Note 3)		-	0.6	-	pF

* All typical values are at Ta=25°C, V_{CC}=5V, $I_{F(ON)}$=3mA unless otherwise specified.

SWITCHING CHARACTERISTICS

(Unless otherwise specified, Ta=0~85°C, V_{CC}=4.5~20V, $I_{F(ON)}$=1.6~5mA, $I_{F(OFF)}$=0~0.1mA)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.*	MAX.	UNIT
Propagation Delay Time to Logic High Output Level (Note 5)	t_{pLH}	1	Without peaking capacitor C_1	-	235	-	ns
			With peaking capacitor C_1	-	-	400	
Propagation Delay Time to Logic Low Output Level (Note 5)	t_{pHL}		Without peaking capacitor C_1	-	250	-	ns
			With peaking capacitor C_1	-	-	400	
Output Rise Time (10-90%)	t_r			-	35	-	ns
Output Fall Time (90-10%)	t_f			-	20	-	ns
Output Enable Time to Logic High	t_{pZH}	2		-		-	ns
Output Enable Time to Logic Low	t_{pZL}			-		-	ns
Output Disable Time from Logic High	t_{pHZ}			-		-	ns
Output Disable Time from Logic Low	t_{pLZ}			-		-	ns
Common Mode Transient Immunity at Logic High Output (Note 6)	CM_H	3	I_F=1.6mA, V_{CM}=50V Ta=25°C	-1000		-	V/μs
Common Mode Transient Immunity at Logic Low Output (Note 6)	CM_L		I_F=0mA, V_{CM}=50V Ta=25°C	1000		-	V/μs

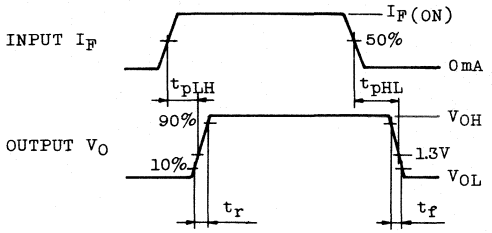
* All typical values are at Ta=25°C, V_{CC}=5V, $I_{F(ON)}$=3mA unless otherwise specified.

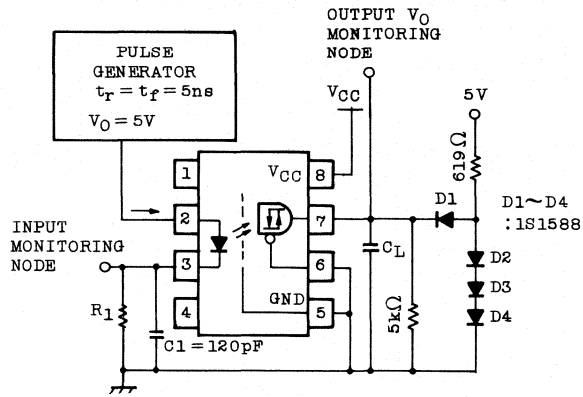
Note 4 : Duration of output short circuit time should not exceed 10ms.

Note 5 : The t_{pLH} propagation delay is measured from the 50% point on the leading edge of the input pulse to the 1.3V point on the leading edge of the output pulse. The t_{pHL} propagation delay is measured from the 50% point on the trailing edge of the input pulse to the 1.3V point on the trailing edge of the output pulse.

Note 6 : CM_L is the maximum rate of rise of the common mode voltage that can be sustained with the output voltage in the logic low state (V_O<0.8V). CM_H is the maximum rate of fall of the common mode voltage that can be sustained with the output voltage in the logic high state (V_O>2.0V).

TEST CIRCUIT 1 t_{pLH}, t_{pLH}, t_r and t_f

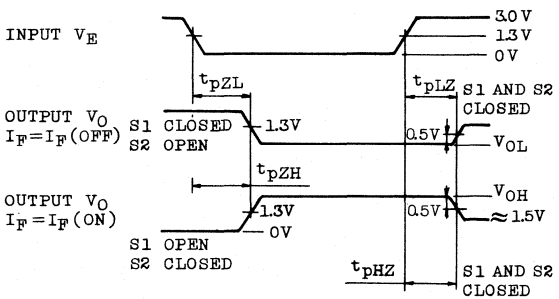


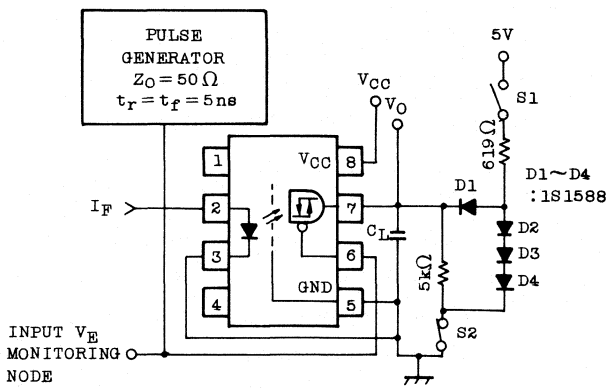


R_1	2.15k	1.1k	681
$I_{F(ON)}$	1.6mA	3mA	5mA

C_1 is peaking capacitor. The probe and jig capacitances are include in C_1. C_L is approximately 15pF which includes probe and stray wiring capacitance.

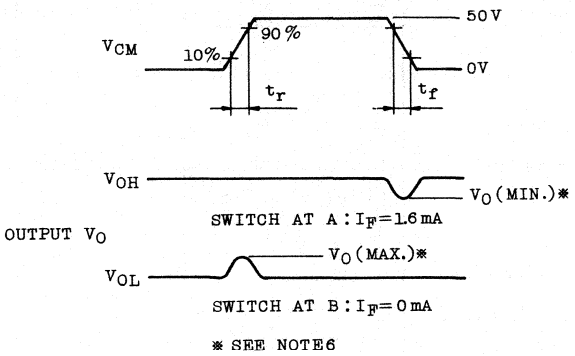
TEST CIRCUIT 2 t_{pHZ}, t_{pZH}, t_{pLZ} and t_{pZL}

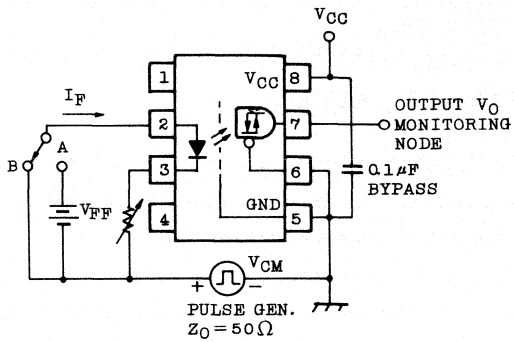




C_L is approximately 15pF which includes probe and stray wiring capacitance.

TEST CIRCUIT 3 Common Mode Transient Immunity





TLP2530, TLP2531

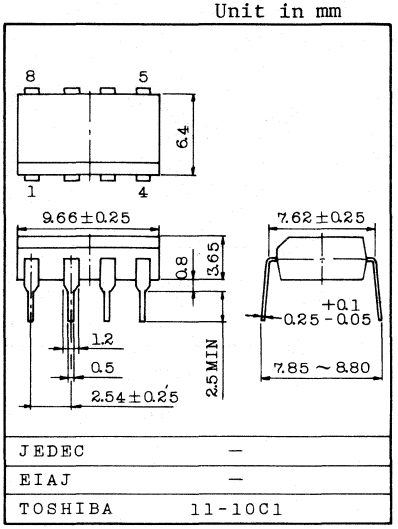
GaAℓAs IRED & PHOTO-IC

DEGITAL LOGIC ISOLATION.
LINE RECEIVER.
POWER SUPPLY CONTROL.
SWITCHING POWER SUPPLY.
TRANSISTOR INVERTER.

The TOSHIBA TLP2530 and TLP2531 dual photocouplers consist of a pair of GaAℓAs light emitting diode and integrated photodetector.
This unit is 8-lead DIP package.
Separate connection for the photodiode bias and output transistor collectors improve the speed up to a hundred times that of a conventional phototransistor coupler by reducing the base-collector capacitance.

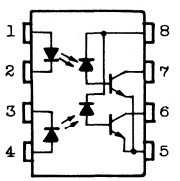
- TTL Compatibel
- Switching Speed : $t_{pHL}, t_{pLH}=0.3\mu s$(Typ.) (@ $R_L=1.9k\Omega$)
- Guaranteed Performance Over Temp. : 0~70°C
- Isolation Voltage : $2500V_{rms}$ Min.

Unit in mm



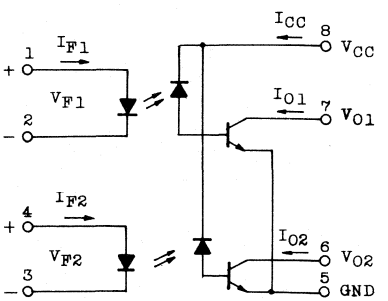
JEDEC	—
EIAJ	—
TOSHIBA	11-10C1

PIN CONFIGURATION (TOP VIEW)



1: ANODE.1
2: CATHODE.1
3: CATHODE.2
4: ANODE.2
5: GND
6: V_{O2}(OUTPUT 2)
7: V_{O1}(OUTPUT 1)
8: V_{CC}

SCHEMATIC



RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	0	-	12	V
Forward Current, Each Channel	I_F	-	16	25	mA
Operating Temperature	T_{opr}	-25	-	85	°C

ABSOLUTE MAXIMUM RATINGS

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current (Each channel, Note 1)	I_F	25	mA
	Pulse Forward Current (Each channel, Note 2)	I_{FP}	50	mA
	Total Pulse Forward Current (Each channel, Note 3)	I_{FPT}	1	A
	Reverse Voltage (Each channel)	V_R	5	V
	Diode Power Dissipation (Each channel, Note 4)	P_D	45	mW
DETECTOR	Output Current (Each channel)	I_O	8	mA
	Peak Output Current (Each channel)	I_{OP}	16	mA
	Supply Voltage	V_{CC}	-0.5~15	V
	Output Voltage (Each channel)	V_O	-0.5~15	V
	Output Power Dissipation (Each channel, Note 5)	P_O	35	mW
Operating Temperature Range		T_{opr}	-55~100	°C
Storage Temperature Range		T_{stg}	-55~125	°C
Lead Solder Temperature (10 sec.)**		T_{sold}	260	°C
Isolation Voltage (AC, 1 min., R.H≦60%, Note 7)		BV_S	2500	Vrms

Note 1 : Derate 0.8mA above 70°C.

Note 2 : 50% duty cycle, 1ms pulse width. Derate 1.6mA/°C above 70°C.

Note 3 : Pulse width 1μs, 300pps.

Note 4 : Derate 0.9mW/°C above 70°C.

Note 5 : Derate 1mW/°C above 70°C.

** 1.6mm below seating plane.

ELECTRICAL CHARACTERISTICS

OVER RECOMMENDED TEMPERATURE (Ta=0°C~70°C, Unless otherwise noted)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.**	MAX.	UNIT
Current Transfer Ratio (Each Channel)	TLP2530	CTR	I_F=16mA, V_O=0.4V, V_{CC}=4.5V, Ta=25°C (Note 6)	7	30	-	%
	TLP2531			19	30	-	
	TLP2530	CTR	I_F=16mA, V_O=0.5V, V_{CC}=4.5V (Note 6)	5	-	-	%
	TLP2531			15	-	-	
Logic Low Output Voltage (Each Channel)	TLP2530	V_{OL}	I_F=16mA, I_O=1.1mA, V_{CC}=4.5V	-	0.1	0.4	V
	TLP2531		I_F=16mA, I_O=2.4mA, V_{CC}=4.5V	-	0.1	0.4	V
Logic High Output Current (Each Channel)		I_{OH}	I_F=0mA, V_O=V_{CC}=5.5V, Ta=25°C	-	3	500	nA
			I_F=0mA, V_O=V_{CC}=15V	-	-	50	μA
Logic Low Supply Current		I_{CCL}	I_{F1}=I_{F2}=16mA, V_{O1}=V_{O2}=Open, V_{CC}=15V	-	160	-	μA
Logic High Supply Current		I_{CCH}	I_{F1}=I_{F2}=0mA, V_{O1}=V_{O2}=Open, V_{CC}=15V	-	0.05	4	μA
Input Forward Voltage (Each Channel)		V_F	I_F=16mA, Ta=25°C	-	1.65	1.7	V
Temperature Coefficent of Forward Voltage (Each Channel)		$\frac{\Delta V_F}{\Delta Ta}$	I_F=16mA	-	-2	-	mV/°C
Input Reverse Breakdown Voltage (Each Channel)		BV_R	I_R=10μA, Ta=25°C	5	-	-	V
Input Capacitance (Each Channel)		C_{IN}	f=1MHz, V_F=0	-	60	-	pF
Input-Output Insulation Leakage Current		I_{I-O}	Relative Humidity=45%, t=5s, V_{I-O}=3000Vdc, Ta=25°C (Note 7)	-	-	1.0	μA
Resistance (Input-Output)		R_{I-O}	V_{I-O}=500Vdc (Note 7)	-	10^{12}	-	Ω
Capacitacne (Input-Output)		C_{I-O}	f=1MHz (Note 7)	-	0.6	-	pF
Input-Input Leakage Current		I_{I-I}	Relative Humidity=45%, t=5s, V_{I-I}=500V (Note 8)	-	0.005	-	μA
Resistance (Input-Input)		R_{I-I}	V_{I-I}=500Vdc (Note 8)	-	10^{11}	-	Ω
Capacitance (Input-Input)		C_{I-I}	f=1MHz (Note 8)	-	0.25	-	pF

** All typicals at Ta=25°C.

SWITCHING SPECIFICATIONS

(Unless otherwise specified, Ta=25°C, V_{CC}=5V, I_F=16mA)

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Propagation Delay Time to Logic Low at Output (Each Channel)	TLP2530	t_{pHL}	1	R_L=4.1kΩ	-	0.3	1.5	μs
	TLP2531			R_L=1.9kΩ	-	0.2	0.8	
Propagation Delay Time to Logic High at Output (Each Channel)	TLP2530	t_{pLH}	1	R_L=4.1kΩ	-	0.5	1.5	μs
	TLP2531			R_L=1.9kΩ	-	0.3	0.8	
Common Mode Transient Immunity at Logic High Level Output (Each Channel, Note 9)	TLP2530	C_{MH}	2	I_F=0mA, V_{CM}=400Vp-p R_L=4.1kΩ	-	1000	-	V/μs
	TLP2531			I_F=0mA, V_{CM}=400Vp-p R_L=1.9kΩ	-	1000	-	
Common Mode Transient Immunity at Logic Low Level Output(Each Channel, Note 9)	TLP2530	C_{ML}	2	V_{CM}=400Vp-p R_L=4.1kΩ, I_F=16mA	-	-1000	-	V/μs
	TLP2531			V_{CM}=400Vp-p R_L=1.9kΩ, I_F=16mA	-	-1000	-	
Bandwidth (Each Channel, Note 10)		BW	3	R_L=100Ω	-	2	-	MHz

Note 6 : DC CURRENT TRANSFER RATIO is defined as the ratio of output collector current, I_O, to the forward LED input current, I_F, times 100%.

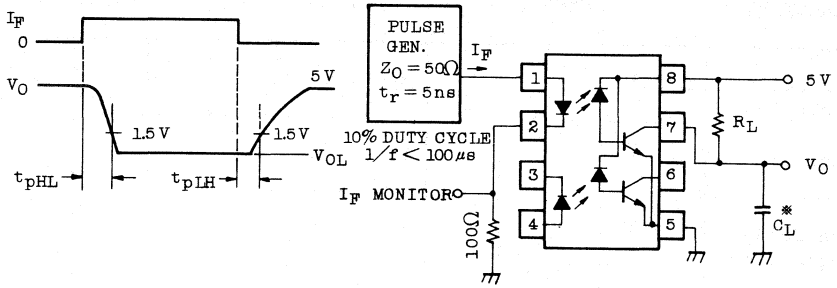
Note 7 : Device considered a two-terminal device: Pins 1,2,3, and 4 shorted together and Pins 5,6,7 and 8 shorted together.

Note 8 : Measured between pins 1 and 2 shorted together, and pins 3 and 4 shorted togeter.

Note 9 : Common mode transient immunity in Logic High level is the maximum tolerable (Positive) dVcm/dt on the leading edge of the common mode pulse, Vcm, to assure that the output will remain in a Logic High state (i.e., V_O>2.0V).
Common mode transient immunity in Logic Low level is the maximum tolerable (negativ) dVcm/dt on the trailing edge of the common mode pulse signal, Vcm, to assure that the output will remain in a Logic Low state (i.e., V_O<0.8V).

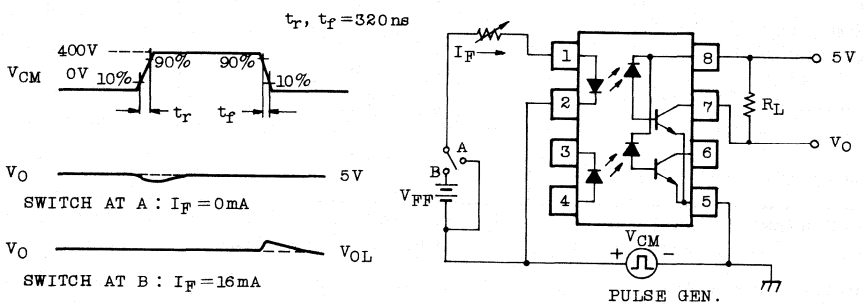
Note 10: The frequency at which the ac output voltage is 3dB below the low frequency asymptote.

TEST CIRCUIT 1 : SWITCHING TIME, t_{pHL}, t_{pLH}

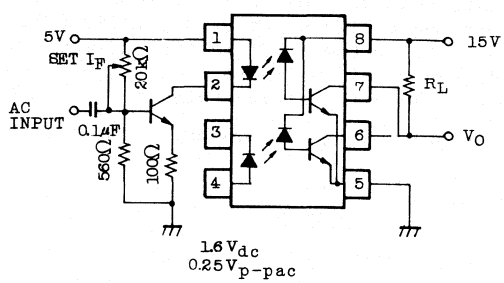


*C_L is appoxinately 15pF which includes probe and stray wiring capacitance.

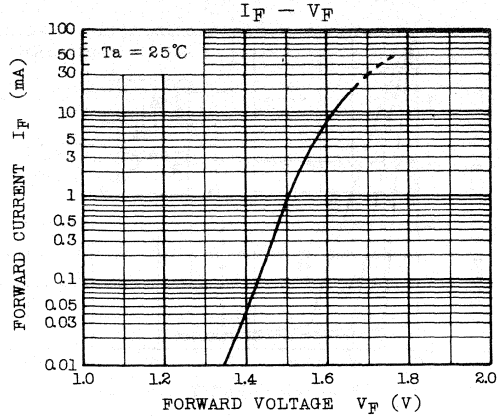
TEST CIRCUIT 2 : TRANSIENT IMMUNITY AND TYPICAL WAVEFORM



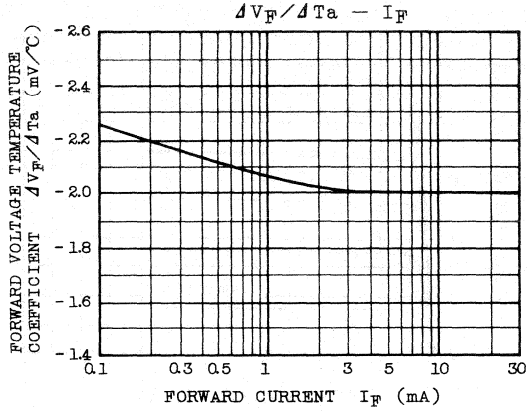
TEST CIRCUIT 3 : FREQUENCY RESPONCE



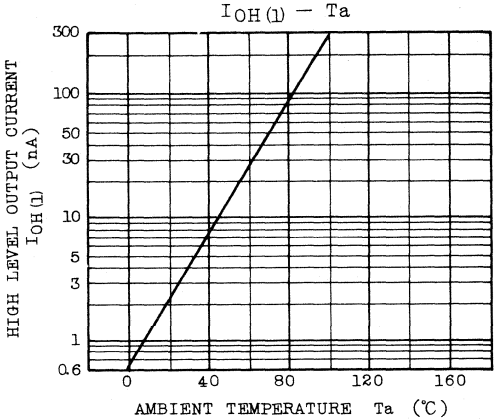
$I_F - V_F$



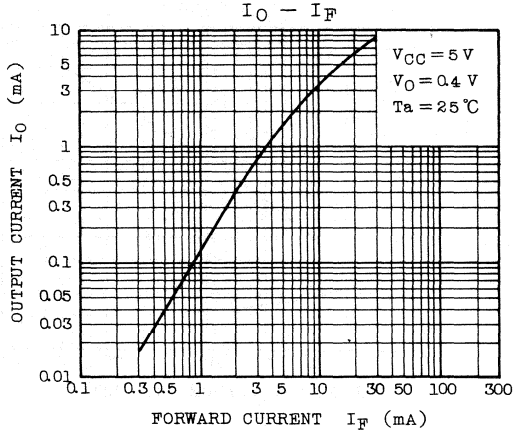
$\Delta V_F / \Delta Ta - I_F$



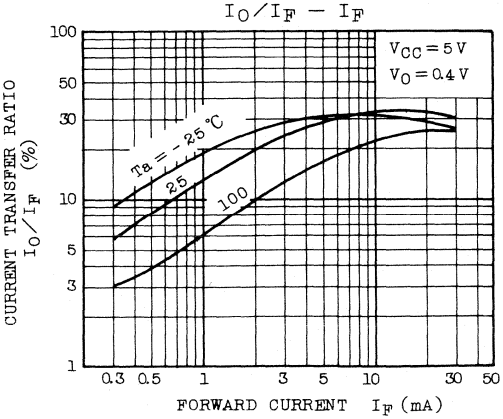
$I_{OH(1)} - Ta$



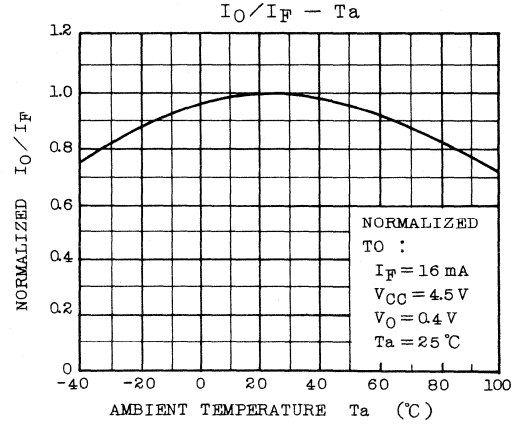
$I_O - I_F$



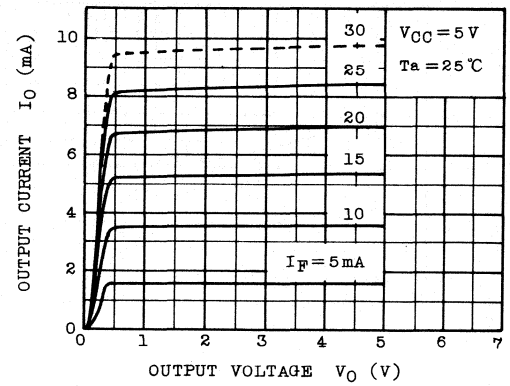
$I_O / I_F - I_F$



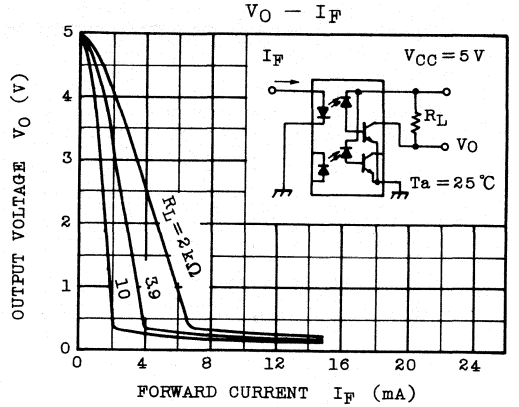
$I_O / I_F - Ta$



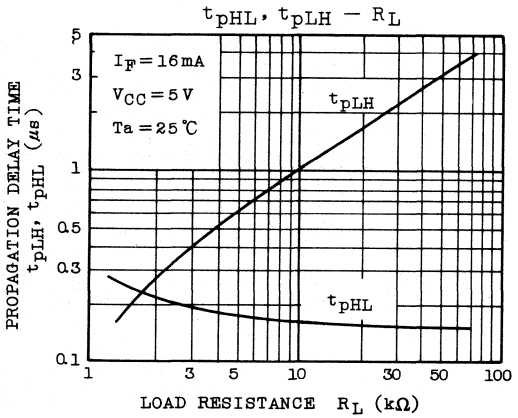
$I_O - V_O$



$V_O - I_F$



$t_{pHL}, t_{pLH} - R_L$

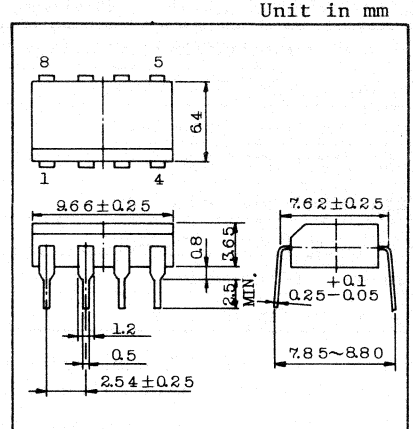


ISOLATED LINE RECEIVER
SIMPLEX/MULTIPLEX DATA TRANSMISSION
COMPUTER-PERIPHERAL INTERFACE
MICROPROCESSOR SYSTEM INTERFACE
DIGITAL ISOLATION FOR A/D, D/A CONVERSION
DIRECT REPLACEMENT FOR HCPL-2601

The TOSHIBA TLP2601 is a photocoupler which combines a GaAℓAs IRED as the emitter and an integrated high gain, high speed photodetector.
The output of the detector circuit is an open collector, Schottky clamped transistor.
A Faraday shield integrated on the photodetector chip reduces the effects of capacitive coupling between the input LED emitter and the high gain stages of the detector. This provides an effective common mode transient immunity of 1000V/μs.

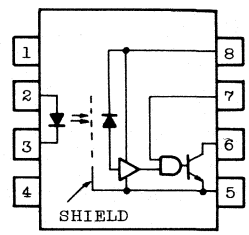
- Input Current Thresholds : I_F=5mA Max.
- Isolation Voltage : 2500V_{rms} Min.
- Switching Speed : 10MBd
- Common Mode Transient Immunity : 1000V/μs Min.
- Guaranteed Performance Over Temp. : 0°C ~ 70°C
- UL Recognized : File No. E67349

Unit in mm

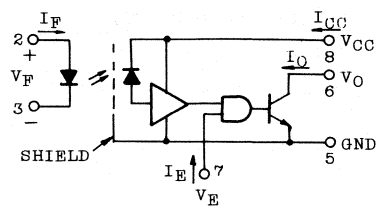


JEDEC	—
EIAJ	—
TOSHIBA	11-10C1

PIN CONFIGURATION (TOP VIEW)



SCHEMATIC



A 0.01 to 0.1μF bypass capacitor must be connected between pins 8 and 5 (See Note 1).

TRUTH TABLE
(Positive Logic)

INPUT	ENABLE	OUTPUT
H	H	L
L	H	H
H	L	H
L	L	H

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Input Current, Low Level	I_{FL}	0	-	250	μA
Input Current, High Level	I_{FH}	6.3 *	-	20	mA
Supply Voltage, Output	V_{CC}	4.5	-	5.5	V
High Level Enable Voltage	V_{EH}	2.0	-	V_{CC}	V
Low Level Enable Voltage	V_{EL}	0	-	0.8	V
Fan Out (TTL Load)	N	-	-	8	
Operating Temperature	T_{opr}	0	-	70	°C

* 6.3mA is a guard banded value which allows for at least 20% CTR degradation. Initial input current threshold value is 5.0mA or less.

MAXIMUM RATINGS (No derating Required)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	20	mA
	Reverse Voltage	V_R	5	V
DETECTOR	Output Current	I_O	25	mA
	Output Voltage	V_O	7	V
	Supply Voltage (1 Minute Maximum)	V_{CC}	7	V
	Enable Input Voltage (Not to exceed V_{CC} by more than 500mV)	V_E	5.5	V
	Output Collector Power Dissipation	P_O	40	mW
Operating Temperature Range		T_{opr}	0 ~ 70	°C
Storage Temperature Range		T_{stg}	-55 ~ 125	°C
Lead Solder Temperature (10 sec.)**		T_{sold}	260	°C
Isolation Voltage (R.H ≦ 60%, AC/1 min., Note 10)		BV_S	2500	V_{rms}
			3540	V_{dc}

** 1.6mm below seating plane.

ELECTRICAL CHARACTERISTICS (Ta=0°C ~ 70°C Unless Otherwise Noted)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.*	MAX.	UNIT
High Level Output Current	I_{OH}	V_{CC}=5.5V, V_O=5.5V I_F=250μA, V_E=2.0V	-	1	250	μA
Low Level Output Voltage	V_{OL}	V_{CC}=5.5V, I_F=5mA V_E=2.0V I_{OL}(Sinking)=13mA	-	0.4	0.6	V
High Level Supply Current	I_{CCH}	V_{CC}=5.5V, I_F=0 V_E=0.5V	-	7	15	mA
Low Level Supply Current	I_{CCL}	V_{CC}=5.5V, I_F=10mA V_E=0.5V	-	12	19	mA
Low Level Enable Current	I_{EL}	V_{CC}=5.5V, V_E=0.5V	-	-1.6	-2.0	mA
High Level Enable Current	I_{EH}	V_{CC}=5.5V, V_E=2.0V	-	-1	-	mA
High Level Enable Voltage	V_{EH}	Note 11	2.0	-	-	V
Low Level Enable Voltage	V_{EL}		-	-	0.8	
Input Forward Voltage	V_F	I_F=10mA, Ta=25°C	-	1.65	1.75	V
Input Reverse Breakdown Voltage	BV_R	I_R=10μA, Ta=25°C	5	-	-	V
Input Capacitance	C_{IN}	V_F=0, f=1MHz	-	45	-	pF
Input Diode Temperature Coefficient	$\frac{\Delta V_F}{\Delta T_A}$	I_F=10mA	-	-2.0	-	mV/°C
Input-Output Insulation Leakage Current	I_{I-O}	Relative Humidity=45% Ta=25°C, t=5second V_{I-O}=3000Vdc, Note 10	-	-	1	μA
Resistance (Input-Output)	R_{I-O}	V_{I-O}=500V, Note 10	-	10^{12}	-	Ω
Capacitance (Input-Output)	C_{I-O}	f=1MHz, Note 10	-	0.6	-	pF

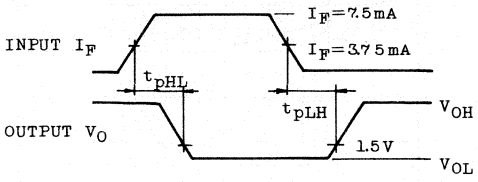
* All typical values are at V_{CC}=5V, Ta=25°C.

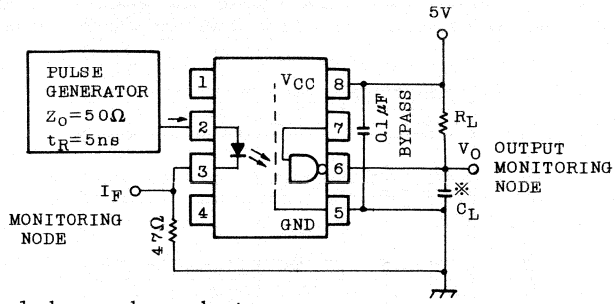
SWITCHING CHARACTERISTICS (Ta=25°C, V_{CC}=5V)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Propagation Delay Time to High Output Level	t_{pLH}	1	R_L=350Ω, C_L=15pF I_F=7.5mA Note 2,3,4 & 5	-	60	75	ns
Propagation Delay Time to Low Output Level	t_{pHL}			-	60	75	ns
Output Rise Time (10-90%)	t_r			-	30	-	ns
Output Fall Time (90-10%)	t_f			-	30	-	ns
Propagation Delay Time of Enable from V_{EH} to V_{EL}	t_{ELH}	2	R_L=350Ω, C_L=15pF I_F=7.5mA, V_{EH}=3.0V V_{EL}=0.5V Note 6 & 7	-	25	-	ns
Propagation Delay Time of Enable from V_{EL} to V_{EH}	t_{EHL}			-	25	-	ns
Common Mode Transient Immunity at High Output Level	CM_H	3	V_{CM}=400V, R_L=350Ω V_O(min.)=2V, I_F=0mA Note 9	1000	10000	-	V/μs
Common Mode Transient Immunity at Low Output Level	CM_L		V_{CM}=400V, R_L=350Ω V_O(max.)=0.8V I_F=7.5mA Note 8	-1000	-10000	-	V/μs

TEST CIRCUIT 1.

t_{pHL} and t_{pLH}

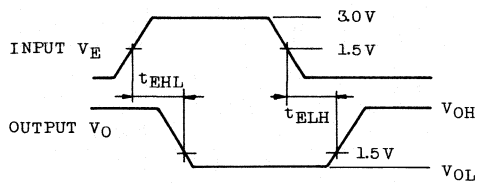


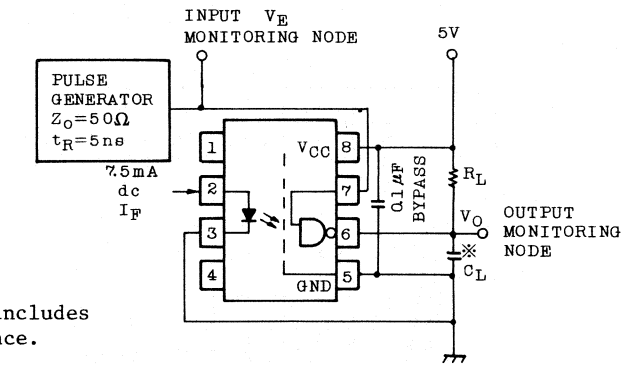


※ C_L is approximately 15pF which includes probe and stray wiring capacitance.

TEST CIRCUIT 2.

t_{ELH} and t_{EHL}

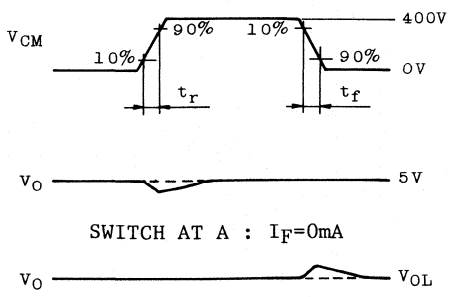


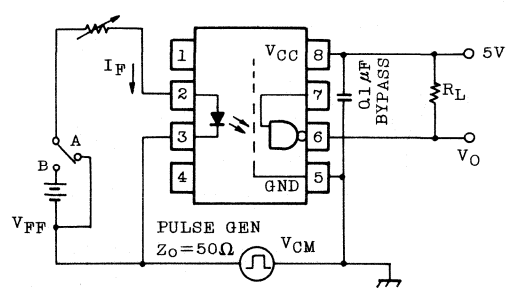


※ C_L is approximately 15pF which includes probe and stray wiring capacitance.

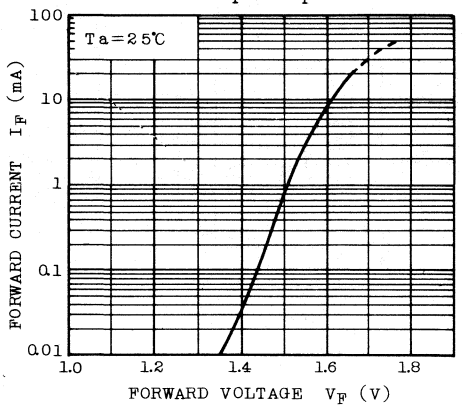
TEST CIRCUIT 3.

Transient Immunity and Typical Waveforms.

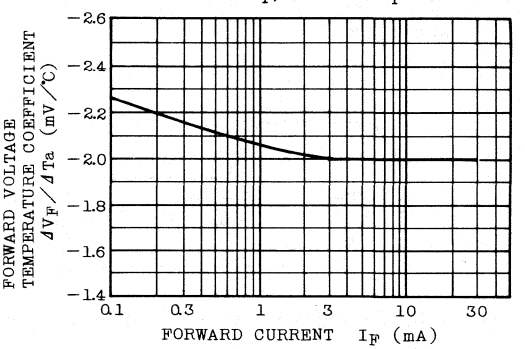




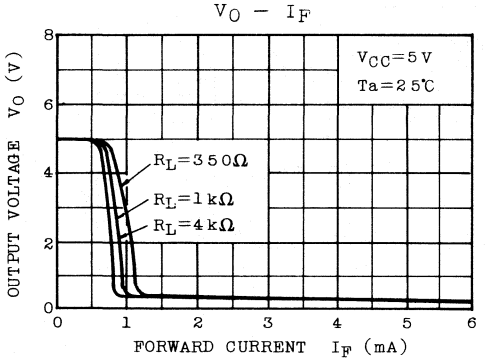
$I_F - V_F$



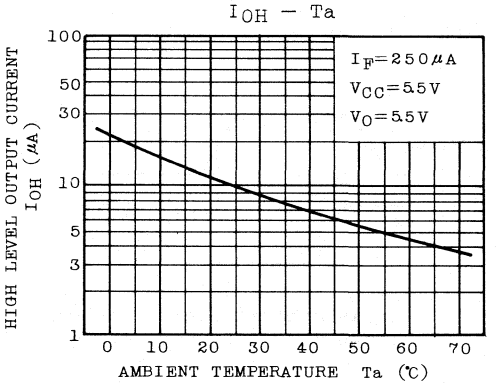
$\Delta V_F / \Delta Ta - I_F$



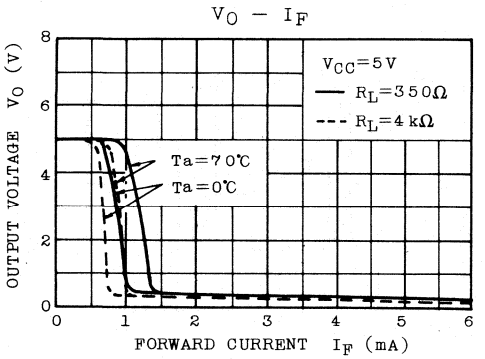
$V_O - I_F$



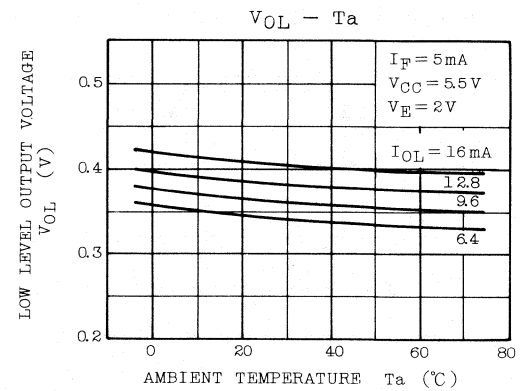
$I_{OH} - Ta$



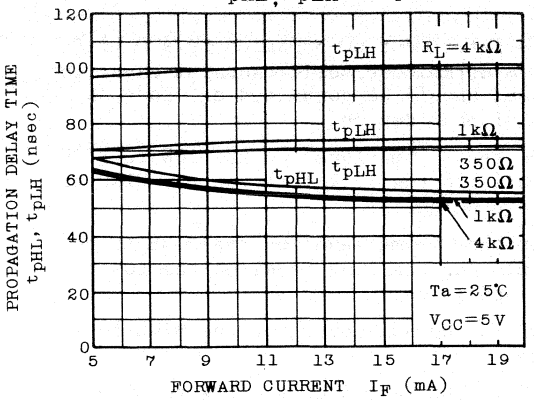
$V_O - I_F$



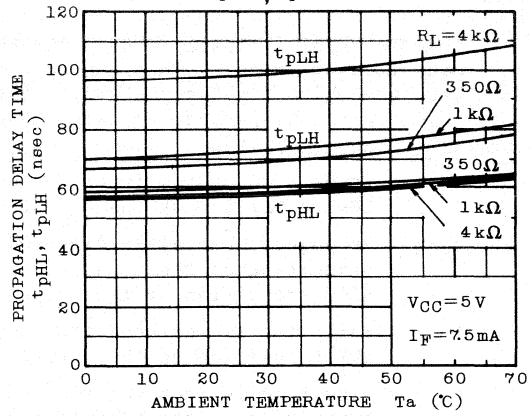
$V_{OL} - Ta$



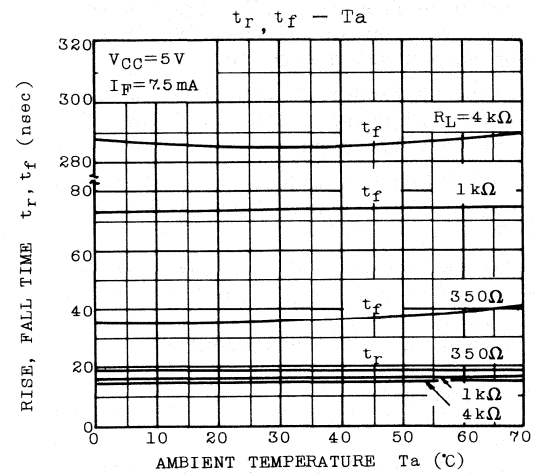
$t_{pHL}, t_{pLH} - I_F$



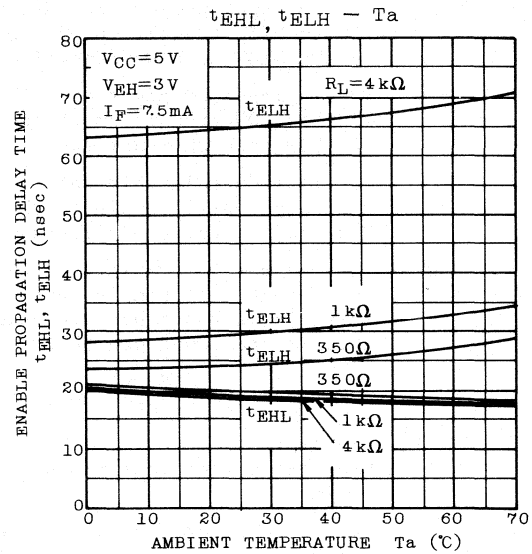
$t_{pHL}, t_{pLH} - Ta$



$t_r, t_f - Ta$



$t_{EHL}, t_{ELH} - Ta$



NOTES

1. The V_{CC} supply voltage to each TLP2601 isolator must be bypassed by a 0.01μF capacitor or larger. This can be either a ceramic or solid tantalum capacitor with good high frequency characteristic and should be connected as close as possible to the package V_{CC} and GND pins of each device.

2. t_{pHL} · Propagation delay is measured from the 3.75mA level on the LOW to HIGH transition of the input current pulse to the 1.5V level on the HIGH to LOW transition of the output voltage pulse.

3. t_{pLH} · Propagation delay is measured from the 3.75mA level on the HIGH to LOW transition of the input current pulse to the 1.5V level on the LOW to HIGH transition of the output voltage pulse.

4. t_f · Fall time is measured from the 10% to the 90% levels of the HIGH to LOW transition on the output pulse.

5. t_r · Rise time is measured from the 90% to 10% levels of the LOW to HIGH transition on the output pulse.

6. t_{EHL} · Enable input propagation delay is measured from the 1.5V level on the LOW to HIGH transition of the input voltage pulse to the 1.5V level on the HIGH to LOW transition of the output voltage pulse.

7. t_{ELH} · Enable input propagation delay is measured from the 1.5V level on the HIGH to LOW transition of the input voltage pulse to the 1.5V level on the LOW to HIGH transition of the output voltage pulse.

8. CM_L · The maximum tolerable rate of fall of the common mode voltage to ensure the output will remain in the low output state (i.e., $V_{OUT} < 0.8V$). Measured in volts per microsecond (V/μs).

9. CM_H · The maximum tolerable rate of rise of the common mode voltage to ensure the output will remain in the high state (i.e., $V_{OUT} > 2.0V$). Measured in volts per microsecond (V/μs). Volts/microsecond can be translated to sinusoidial voltages:

$$V/\mu s = \frac{(dV_{CM})}{dt}_{Max.} = f_{CM}\, V_{CM}\ (p.p.)$$

Example:
V_{CM}=318Vpp when f_{CM}=1MHz using CM_L and CM_H=1000V/μs data sheet specified minimum.

10. · Device considered a two-terminal device: Pins 1,2,3 and 4 shorted together, and Pins 5,6,7 and 8 shorted together.

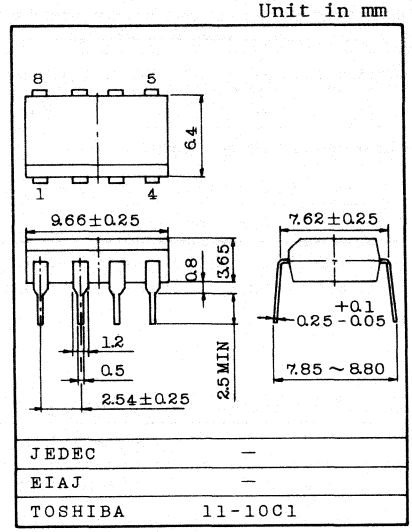
11. Enable Input · No pull up resistor required as the device has an internal pull up resistor.

DEGITAL LOGIC ISOLATION.
TELE-COMMUNICATION.
ANALOG DATA EQUIPMENT CONTROL.
MICROPROCESSOR SYSTEM INTERFACE.

The TOSHIBA TLP2630 dual photocoupler consists of a pair of GaAℓAs light emitting diode and integrated high gain, high speed photodetector.
The output of the detector circuit is an open collector, Schottky clamped transistor. This unit is 8-lead DIP package.

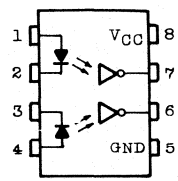
- Input Current Threshold : I_F=5mA Max.
- LSTTL/TTL Compatible : 5V Supply
- Switching Speed : 10MBd (Typ.)
- Guaranteed Performance Over Temperature : 0~70°C
- Isolation Voltage : 2500V_{rms} Min.

Unit in mm



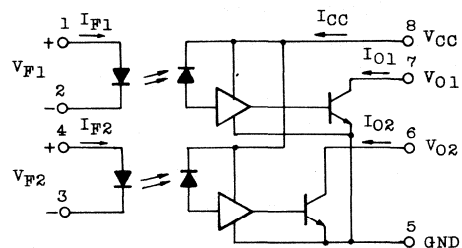
JEDEC	—
EIAJ	—
TOSHIBA	11-10C1

PIN CONFIGURATION (TOP VIEW)



1: ANODE.1
2: CATHODE.1
3: CATHODE.2
4: ANODE.2
5: GND
6: V_{O2}(OUTPUT 2)
7: V_{O1}(OUTPUT 1)
8: V_{CC}

SCHEMATIC



TRUTH TABLE

(Positive Logic)

INPUT	OUTPUT
H	L
L	H

A 0.01 to 0.1μF bypass capacitor must connected between pins 8 and 5 (See Note 1).

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Input Current, Low Level, Each Channel	I_{FL}	0	-	250	μA
Input Current, High Level, Each Channel	I_{FH}	6.3*	-	15	mA
Supply Voltage, Output	V_{CC}	4.5	5	5.5	V
Fan Out (TTL Load, Each Channel)	N	-	-	8	
Operating Temperature	T_{opr}	0	-	70	°C

* 6.3mA is a guard banded value which allows for at least 20% CTR degradation. Initial input current threshold value is 5.0mA or less.

MAXIMUM RATINGS (No derating required up to 70°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current (Each Channel)	I_F	15	mA
	Pulse Forward Current (Each Channel)*	I_{FP}	30	mA
	Reverse Voltage (Each Channel)	V_R	5	V
DETECTOR	Output Current (Each Channel)	I_O	16	mA
	Output Voltage (Each Channel)	V_O	7	V
	Supply Voltage (1 Minute Maximum)	V_{CC}	7	V
	Output Collector Power Dissipation (Each Channel)	P_O	60	mW
Operating Temperature Range		T_{opr}	0~70	°C
Storage Temperature Range		T_{stg}	-55~125	°C
Lead Solder Temperature (10 sec.)**		T_{sold}	260	°C
Isolation Voltage (AC, 1 min., R.H≦60%, Note 8)		BV_S	2500	V_{rms}

* $t \leq 1$ msec Duration.

** 1.6mm below seating plane.

ELECTRICAL CHARACTERISTICS (Ta=0°C~70°C, Unless otherwise noted)

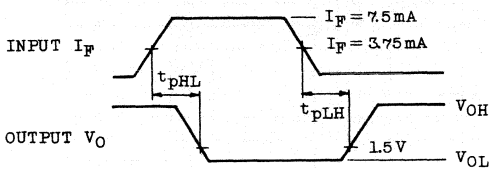
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.*	MAX.	UNIT
High Level Output Current (Each Channel)	I_{OH}	V_{CC}=5.5V, V_O=5.5V I_F=250μA	-	1	250	μA
Low Level Output Voltage (Each Channel)	V_{OL}	V_{CC}=5.5V, I_F=5mA I_{OL}(Sinking)=13mA	-	0.4	0.6	V
High Level Supply Current (Both Channels)	I_{CCH}	V_{CC}=5.5V, I_F=0	-	14	30	mA
Low Level Supply Current (Both Channels)	I_{CCL}	V_{CC}=5.5V, I_F=10mA	-	24	36	mA
Current Transfer Ratio (Each Channel)	CTR	I_F=5mA, R_L=100Ω	-	1000	-	%
Input Forward Voltage (Each Channel)	V_F	I_F=10mA, Ta=25°C	-	1.65	1.75	V
Input Reverse Breakdown Voltage (Each Channel)	BV_R	I_R=10μA, Ta=25°C	5	-	-	V
Input Capacitance (Each Channel)	C_{IN}	V_F=0, f=1MHz	-	45	-	pF
Input Diode Temperature Coefficient (Each Channel)	$\frac{\Delta V_F}{\Delta Ta}$	I_F=10mA	-	-2.0	-	mV/°C
Input-Output Insulation Leakage Current	I_{I-O}	Relative Humidity=45% Ta=25°C, t=5second V_{I-O}=3000V_{dc} (Note 8)	-	-	1	μA
Resistance (Input-Output)	R_{I-O}	V_{I-O}=500V (Note 8)	-	10^{12}	-	Ω
Capacitance (Input-Output)	C_{I-O}	f=1MHz (Note 8)	-	0.6	-	pF
Input-Input Leakage Current	I_{I-I}	Relative Humidity=45% t=5s, V_{I-I}=500V(Note 9)	-	0.005	-	μA
Resistance (Input-Input)	R_{I-I}	V_{I-I}=500V (Note 9)	-	10^{11}	-	Ω
Capacitance (Input-Input)	C_{I-I}	f=1MHz (Note 9)	-	0.25	-	pF

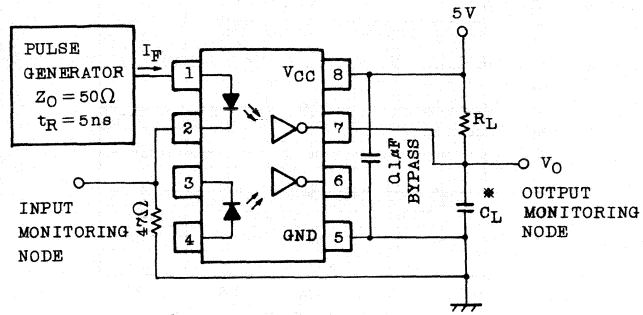
* All typical values are at V_{CC}=5V, Ta=25°C.

SWITCHING CHARACTERISTICS (Ta=25°C, V_{CC}=5V)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Propagation Delay Time to High Output Level	t_{pLH}	1	R_L=350Ω, C_L=15pF I_F=7.5mA (Each Channel, Note 2,3,4 & 5)	-	60	75	ns
Propagation Delay Time to Low Output Level	t_{pHL}			-	60	75	ns
Output Rise Time (10-90%)	t_r			-	30	-	ns
Output Fall Time (90-10%)	t_f			-	30	-	ns
Common Mode Transient Immunity at High Output Level	CM_H	2	V_{CM}=200V, R_L=350Ω V_O(min.)=2V, I_F=0mA (Each Channel, Note 7)	-	200	-	V/μs
Common Mode Transient Immunity at Low Output Level	CM_L		V_{CM}=200V, R_L=350Ω V_O(max.)=0.8V I_F=7.5mA (Each Channel, Note 6)	-	-500	-	V/μs

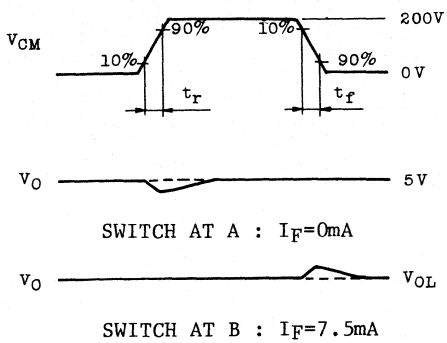
TEST CIRCUIT 1. t_{pHL} and t_{pLH}

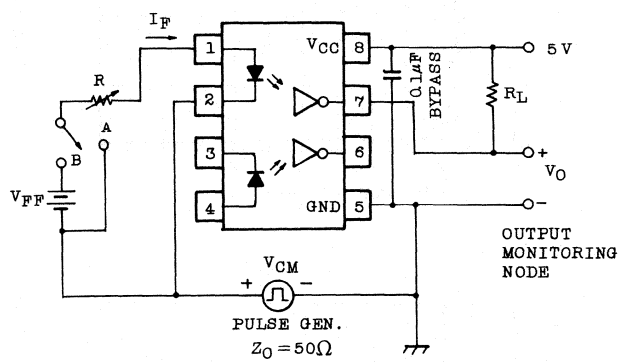




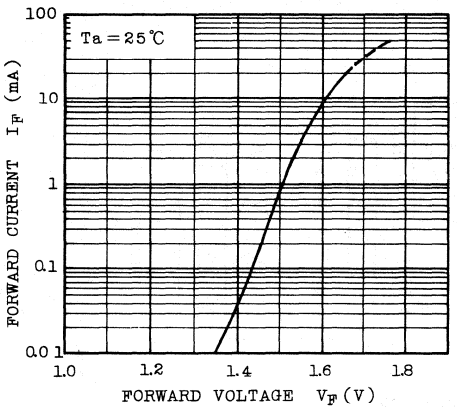
* C_L is approximately 15pF which includes probe and stray wiring capacitance.

TEST CIRCUIT 2. Transient Immunity and Typical Waveforms.

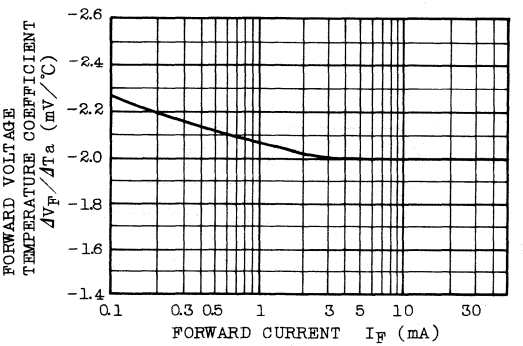




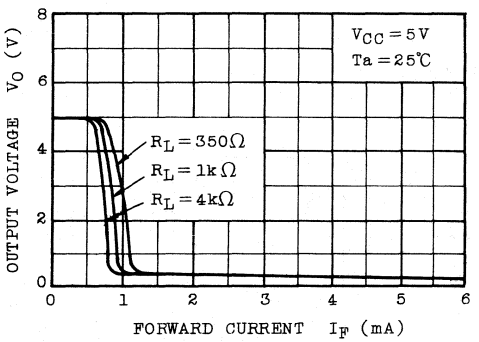
$I_F - V_F$



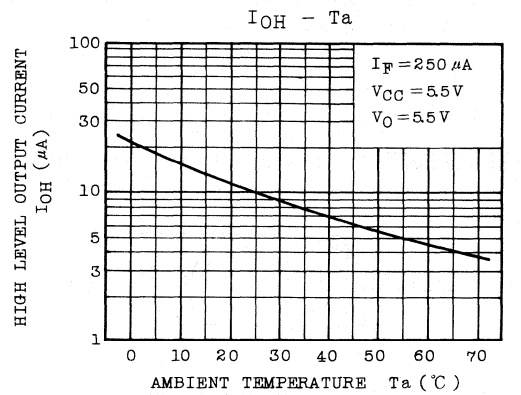
$\Delta V_F / \Delta Ta - I_F$



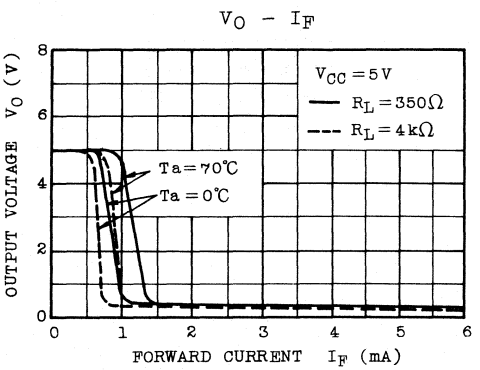
$V_O - I_F$



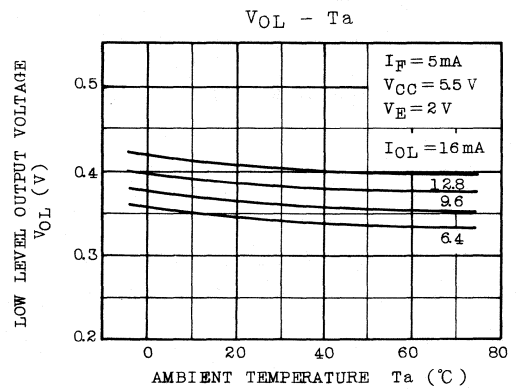
$I_{OH} - Ta$



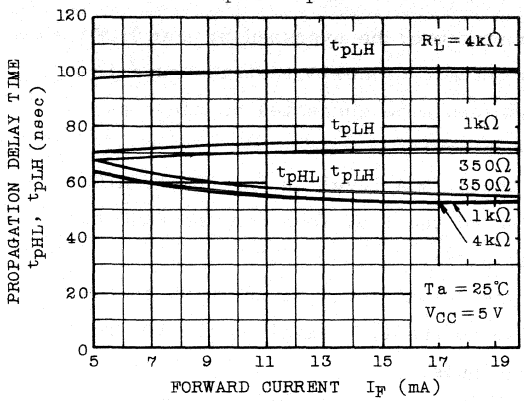
$V_O - I_F$



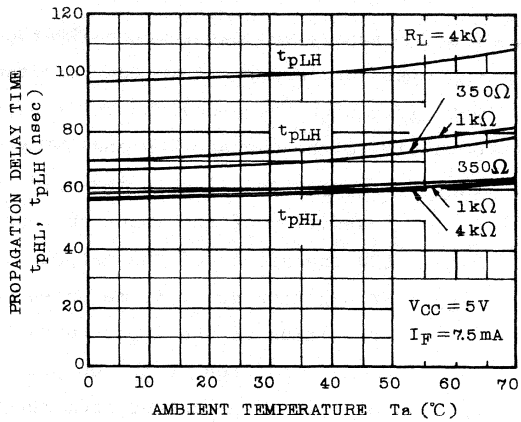
$V_{OL} - Ta$



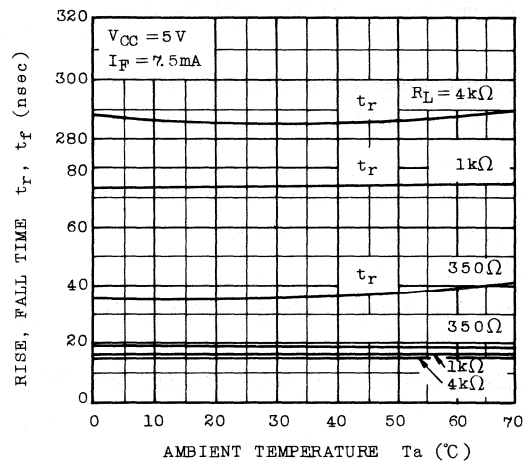
t_{pHL}, t_{pLH} – I_F



t_{pHL}, t_{pLH} – Ta



t_r, t_f – Ta

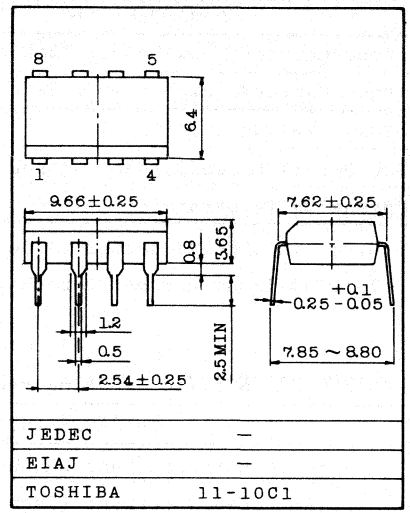


NOTES

1. The V_{CC} supply voltage to each TLP2630 isolator must be bypassed by a 0.01μF capacitro or larger. This can be either a ceramic or solid tantalum capacitor with good high frequency characteristic and should be connected as close as possible to the package V_{CC} and GND pins each device.
2. t_{pHL} · Propagation delay is measured from the 3.75mA level on the LOW to HIGH transition of the input current pulse to the 1.5V level on the HIGH to LOW transition of the output voltage pulse.
3. t_{pLH} · Propagation delay is measured from the 3.75mA level on the HIGH to LOW transition of the input current pulse to the 1.5V level on the LOW to HIGH transition of the output voltage pulse.
4. t_f · Fall time is measured from the 90% to the 10% levels of the HIGH to LOW transition on the output pulse.
5. t_r · Rise time is measured from the 10% to 90% levels of the LOW to HIGH transiton on the output pulse.
6. CM_L · The maximum tolerable rate of fall of the common mode voltage to ensure the output will remain in the low output state (i.e., $V_{OUT} < 0.8V$). Measured in volts per microsecond (V/μs).
7. CM_H · The maximum tolerable rate of rise of the common mode voltage to ensure the output will remain in the high state (i.e., $V_{OUT} > 2.0V$). Measured in volts per microsecond (V/μs).
8. Device considered a two-terminal device: Pins 1,2,3 and 4 shorted together, and Pins 5,6,7 and 8 shorted together.
9. Measured between pins 1 and 2 shorted together, and pins 3 and 4 shorted together.

ISOLATED LINE RECEIVER.
SIMPLEX/MULTIPLEX DATA TRANSMISSION.
COMPUTER-PERIPHERAL INTERFACE.
MICROPROCESSOR SYSTEM INTERFACE.
DIGITAL ISOLATION FOR A/D, D/A CONVERSION.

Unit in mm



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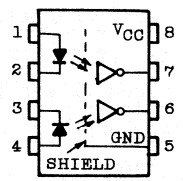
EIAJ	—
TOSHIBA	11-10C1

The TOSHIBA TLP2631 dual photocupler consists of a pair of GaAℓAs light emitting diode and integrated high gain, high speed photodetector.
This unit is 8-lead DIP package.
The output of the detector circuit is an open collector, Schottky clamped transistor.
A Faraday shield integrated on the photodetector chip reduces the effects of capacitive coupling between the input LED emitter and the high gain stages of the detector. This provides an effective common mode transient immunity of 1000V/μs.

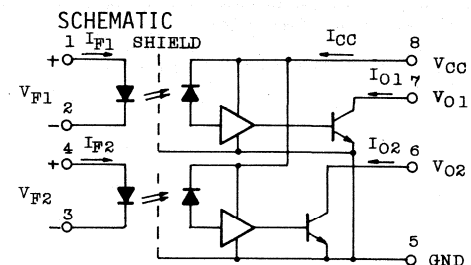
- Input Current Thresholds : I_F=5mA Max.
- Switching Speed : 10MBd (Typ.)
- Common Mode Transient Immunity : 1000V/μs Min.
- Guaranteed Performance Over Temp. : 0°C~70°C
- Isolation Voltage : 2500V_{rms} Min.

PIN CONFIGURATION (TOP VIEW)



1: ANODE.1
2: CATHODE.1
3: CATHODE.2
4: ANODE.2
5: GND
6: V_{O2}(OUTPUT 2)
7: V_{O1}(OUTPUT 1)
8: V_{CC}

SCHEMATIC



TRUTH TABLE

(Positive Logic)

INPUT	OUTPUT
H	L
L	H

A 0.01 to 0.1μF bupass capacitor must connected between pins 8 and 5 (See Note 1)

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Input Current, Low Level, Each Channel	I_{FL}	0	-	250	μA
Input Current, High Level, Each Channel	I_{FH}	6.3*	-	15	mA
Supply Voltage, Output	V_{CC}	4.5	5	5.5	V
Fan Out (TTL Load), Each Channel	N	-	-	8	
Operating Temperature	T_{opr}	0	-	70	°C

* 6.3mA is a guard banded value which allows for at least 20% CTR degradation. Initial input current threshold value is 5.0mA or less.

MAXIMUM RATINGS (No derating required up to 70°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current (Each Channel)	I_F	15	mA
	Pulse Forward Current (Each Channel)*	I_{FP}	30	mA
	Reverse Voltage (Each Channel)	V_R	5	V
DETECTOR	Output Current (Each Channel)	I_O	16	mA
	Output Voltage (Each Channel)	V_O	7	V
	Supply Voltage (1 Minute Maximum)	V_{CC}	7	V
	Output Collector Power Dissipation (Each Channel)	P_O	40	mW
Operating Temperature Range		T_{opr}	0~70	°C
Storage Temperature Range		T_{stg}	-55~125	°C
Lead Solder Temperature (10 sec.)**		T_{sold}	260	°C
Isolation Voltage (AC 1 min., R.H≦60%, Note 8)		BV_S	2500	V_{rms}

* $t \leq 1$ msec Duration.

** 1.6mm below seating plane.

ELECTRICAL CHARACTERISTICS (Ta=0°C~70°C, Unless otherwise noted)

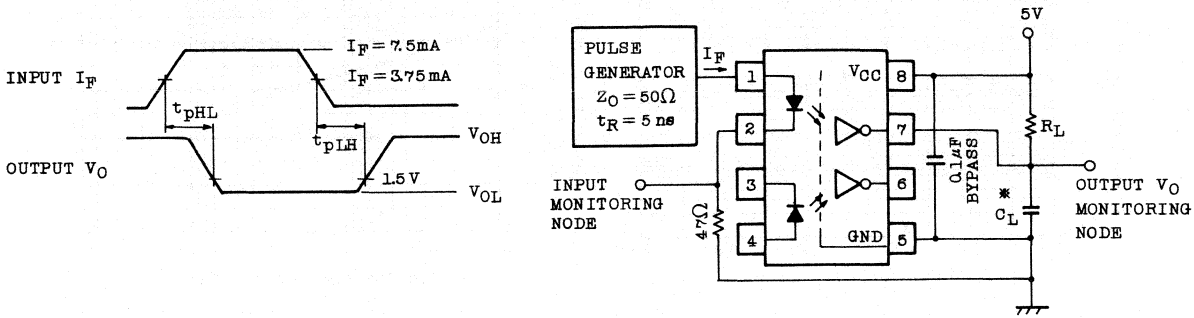
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.*	MAX.	UNIT
High Level Output Current (Each Channel)	I_{OH}	V_{CC}=5.5V, V_O=5.5V I_F=250μA	-	1	250	μA
Low Level Output Voltage (Each Channel)	V_{OL}	V_{CC}=5.5V, I_F=5mA I_{OL}(Sinking)=13mA	-	0.4	0.6	V
High Level Supply Current (Both Channels)	I_{CCH}	V_{CC}=5.5V, I_F=0	-	14	30	mA
Low Level Supply Current (Both Channel)	I_{CCL}	V_{CC}=5.5V, I_F=10mA	-	24	38	mA
Input Forward Voltage (Each Channel)	V_F	I_F=10mA, Ta=25°C	-	1.65	1.75	V
Input Reverse Breakdown Voltage (Each Channel)	BV_R	I_R=10μA, Ta=25°C	5	-	-	V
Input Capacitance (Each Channel)	C_{IN}	V_F=0, f=1MHz	-	45	-	pF
Input Diode Temperature Coefficient (Each Channel)	$\frac{\Delta V_F}{\Delta Ta}$	I_F=10mA	-	-2.0	-	mV/°C
Input-Output Insulation Leakage Current	I_{I-O}	Relative Humidity=45% Ta=25°C, t=5second V_{I-O}=3000V_{dc} (Note 8)	-	-	1	μA
Resistance (Input-Output)	R_{I-O}	V_{I-O}=500V (Note 8)	-	10^{12}	-	Ω
Capacitance (Input-Output)	C_{I-O}	f=1MHz (Note 8)	-	0.6	-	pF
Input-Input Leakage Current	I_{I-I}	Relative Humidity=45% t=5s, V_{I-I}=500V(Note 9)	-	0.005	-	μA
Resistance (Input-Input)	R_{I-I}	V_{I-I}=500V (Note 9)	-	10^{11}	-	Ω
Capacitance (Input-Input)	C_{I-I}	f=1MHz (Note 9)	-	0.25	-	pF

* All typical values are at V_{CC}=5V, Ta=25°C.

SWITCHING CHARACTERISTICS (Ta=25°C, V_{CC}=5V)

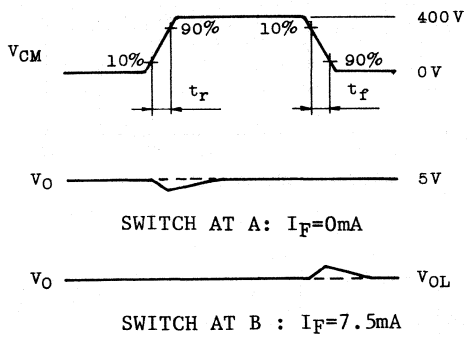
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Propagation Delay Time to High Output Level	t_{pLH}	1	R_L=350Ω, C_L=15pF I_F=7.5mA (Each Channel, Note 2,3,4 & 5)	-	60	75	ns
Propagation Delay Time to Low Output Level	t_{pHL}			-	60	75	ns
Output Rise Time (10-90%)	t_r			-	30	-	ns
Output Fall Time (90-10%)	t_f			-	30	-	ns
Common Mode Transient Immunity at High Output Level	CM_H	2	V_{CM}=400V, R_L=350Ω V_O(min.)=2V, I_F=0mA (Each Channel, Note 7)	1000	10000	-	V/μs
Common Mode Transient Immunity at Low Output Level	CM_L		V_{CM}=400V, R_L=350Ω V_O(max.)=0.8V I_F=7.5mA, (Each Channel, Note 6)	-1000	-10000	-	V/μs

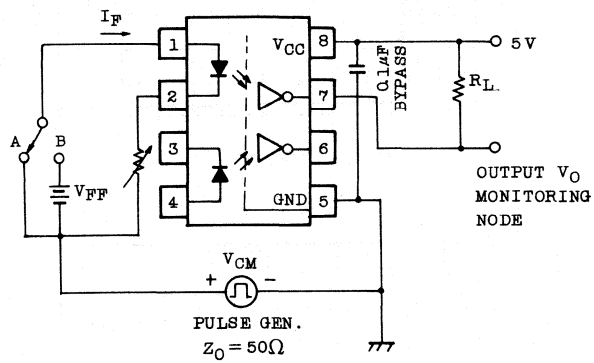
TEST CIRCUIT 1. t_{pHL} and t_{pLH}



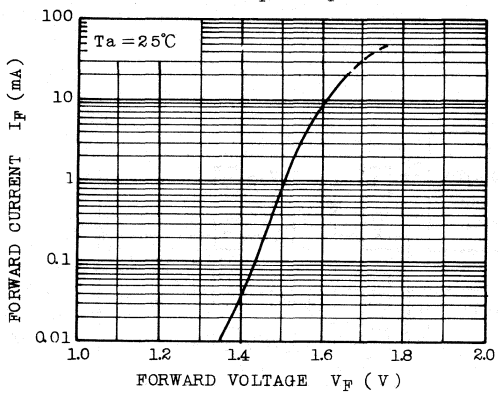
*C_L is approximately 15pF which includes probe and stray wiring capacitance.

TEST CIRCUIT 2. Transient Immunity and Typical Waveforms.

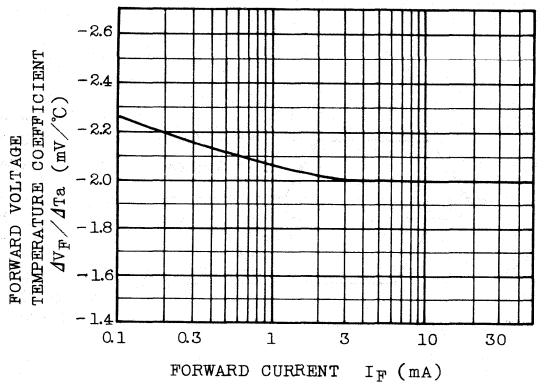




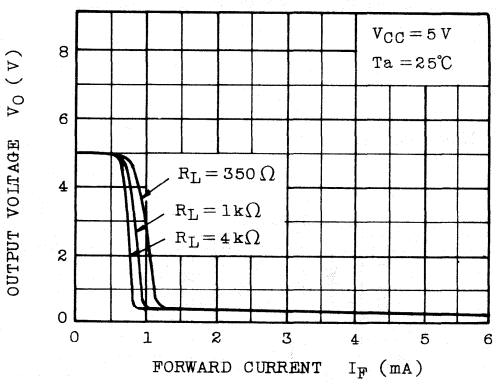
$I_F - V_F$



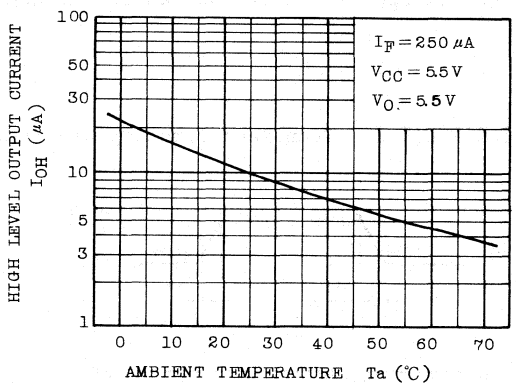
$\Delta V_F / \Delta Ta - I_F$



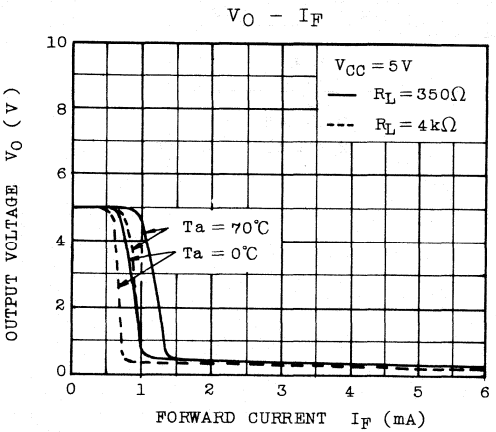
$V_O - I_F$



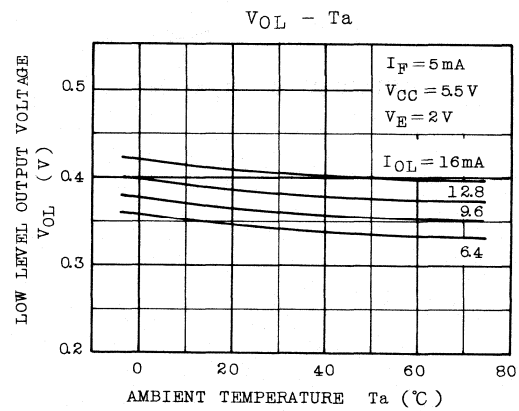
$I_{OH} - Ta$



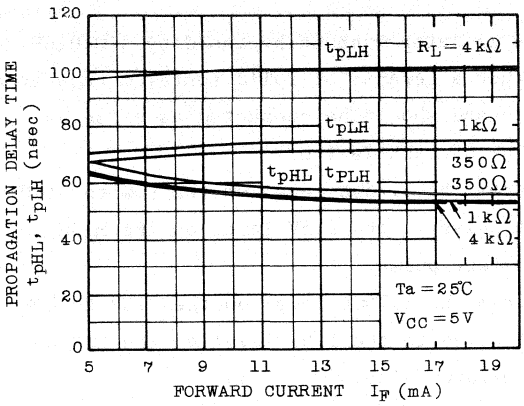
$V_O - I_F$



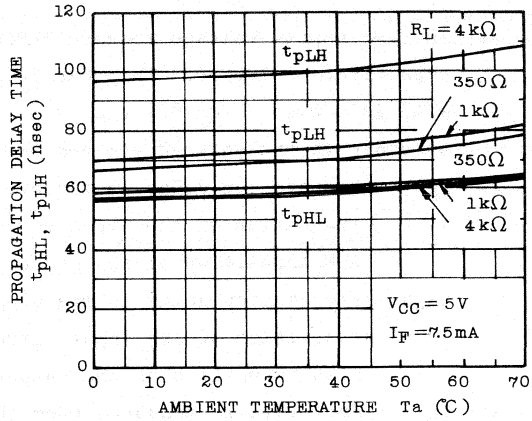
$V_{OL} - Ta$



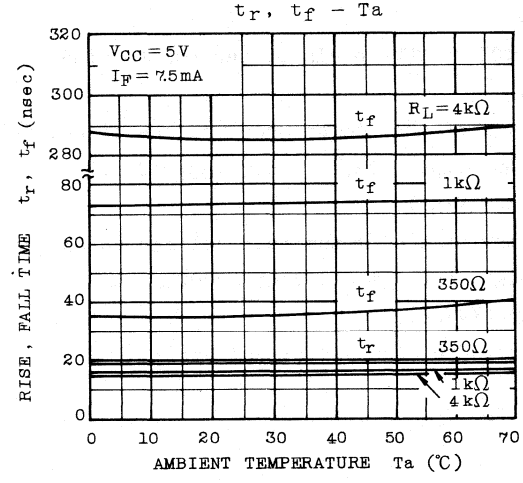
t_{pHL}, T_{pLH} – I_F



t_{pHL}, t_{pLH} – Ta



t_r, t_f – Ta



NOTES

1. The V_{CC} supply voltage to each TLP2631 isolator must be bypassed by a 0.01μF capactitor or larger. This can be either a ceramic or solid tantalum capacitor with good high frequency characteristic and should be connected as close as possible to the package V_{CC} and GND pins of each device.
2. t_{pHL} · Propagation delay is measured from the 3.75mA level on the LOW to HIGH transition of the input current pulse to the 1.5V level on the HIGH to LOW transition of the output voltage pulse.
3. t_{pLH} · Propagation delay is measured from the 3.75mA level on the HIGH to LOW transition of the input current pulse to the 1.5V level on the LOW to HIGH transition of the output voltage pulse.
4. t_f · Fall time is measured from the 90% to the 10% levels of the HIGH to LOW transition on the output pulse.
5. t_r · Rise time is measured from the 10% to 90% levels of the LOW to HIGH transition on the output pulse.
6. CM_L · The maximum tolerable rate of fall of the common mode voltage to ensure the output will remain in the low output state (i.e., $V_{OUT} < 0.8V$). Measured in volts per microsecond (V/μs).
7. CM_H · The maximum tolerable rate of rise of the common mode voltage to ensure the output will remain in the high state (i.e., $V_{OUT} > 2.0V$). Measured in volts per microsecond (V/μs).
   Volts/microsecond can be translated to sinusoidial voltages:

$$V/\mu s = \frac{(dVCM)}{dt} \text{ Max.} = f_{CM}\ V_{CM}\ (p.p.)$$

   Example:
   V_{CM}=319Vpp when f_{CM}=1MHz using CM_L amd CM_H=1000V/μs data sheet specified minimum.
8. Device considered a two-terminal device: Pins 1,2,3 and 4 shorted together, and Pins 5,6,7 and 8 shorted together.
9. Measured between pins 1 and 2 shorted together, and pins 3 and 4 shorted togeter.

TLP3009, TLP3010, TLP3011, TLP3012

GaAs IRED & PHOTO-TRIAC

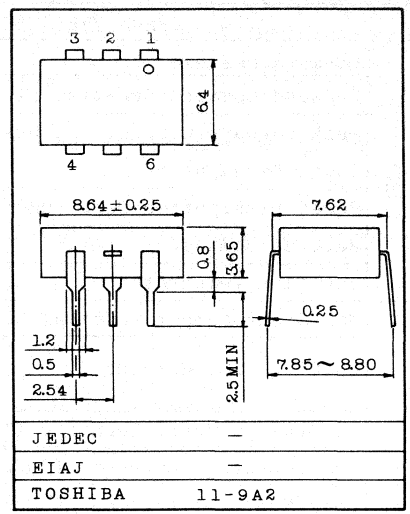
OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
TRIAC DRIVER.
SOLID STATE RELAY.

The TOSHIBA TLP3009, TLP3010, TLP3011 and TLP3012 consist of a photo-triac optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.

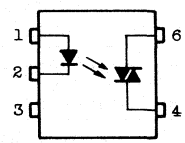
- Peak Off-State Voltage : 250V Min.
- Trigger LED Current : 30mA Max.(TLP3009)
  15mA Max.(TLP3010)
  10mA Max.(TLP3011)
  5mA Max.(TLP3012)
- On-State Current : 100mA Max.
- Isolation Voltage : 5000V_{rms} Min.
- Guaranteed Requirements of IEC380/VDE0806
- Climatic Test Class : 55/150/21
- Isolation Creepage Path: 8.0mm Min.
- Isolation Clearance : 7.3mm Min.
- Isolation Operating Voltage
  : 500V_{ac} or 600V_{dc} for Isolation Group C*1
- Creeping Current Resistance : Group I*2

*1 : According to VDE0110, table 4.
*2 : According to VDE0110, table 3.

Unit in mm



PIN CONFIGURATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: TERMINAL 1
6: TERMINAL 2

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current		I_F	50	mA
	Forward Current Derating (Ta≧53°C)		$\Delta I_F/°C$	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)		I_{FP}	1	A
	Power Dissipation		P_D	100	mW
	Power Dissipation Derating (Ta≧25°C)		$\Delta P_D/°C$	-1.0	mW/°C
	Reverse Voltage		V_R	5	V
	Junction Temperature		T_j	125	°C
DETECTOR	Off-State Output Terminal Voltage		V_{DRM}	250	V
	On-State RMS Current	Ta=25°C	$I_{T(RMS)}$	100	mA
		Ta=70°C		50	
	On-State Current Derating (Ta≧25°C)		$\Delta I_T/°C$	-1.1	mA/°C
	Peak On-State Current (100μs pulse, 120pps)		I_{TP}	2	A
	Peak Nonrepetitive Surge Current (P_W=10ms, DC=10%)		I_{TSM}	1.2	A
	Total Power Dissipation		P_D	300	mW
	Total Power Dissipation Derating (Ta≧25°C)		$\Delta P_D/°C$	-4.0	mW/°C
	Junction Temperature		T_j	100	°C
Storage Temperature Range			T_{stg}	-55~150	°C
Operating Temperature Range			T_{opr}	-40~100	°C
Lead Soldering Temperature (10 sec.)			T_{sold}	260	°C
Total Package Power Dissipation			P_T	330	mW
Total Package Power Dissipation Derating (Ta≧25°C)			$\Delta P_T/°C$	-4.4	mW/°C
Isolation Voltage (AC, 1 min., RH≦60%)			BV_S	5000	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	10	-	pF
DETECTOR	Peak Off-State Current	I_{DRM}	V_{DRM}=250V	-	10	100	nA
	Peak On-State Voltage	V_{TM}	I_{TM}=100mA	-	1.7	3.0	V
	Holding Current	I_H	-	-	0.2	-	mA
	Critical Rate of Rise of Off-State Voltage	dv/dt	V_{in}=120V_{rms}, Ta=85°C (Fig. 1)	200	500	-	V/μs
	Critical Rate of Rise of Commutating Voltage	dv/dt(c)	I_T=15mA, V_{in}=30V_{rms} (Fig. 1)	-	0.2	-	V/μs

COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

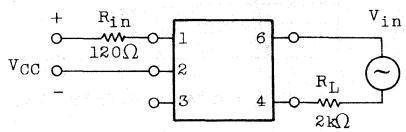
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	TLP3009	I_{FT}	V_T=3V	-	-	30	mA
	TLP3010			-	-	15	
	TLP3011			-	5	10	
	TLP3012			-	-	5	
Capacitance Input to Output		C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance		R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage		BV_S	AC, 1 minute	5000	-	-	V_{rms}
			AC, 1 second	-	10000	-	
			DC, 1 minute	-	10000	-	V_{dc}

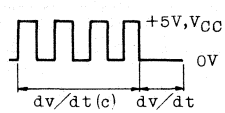
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltate	V_{AC}	-	-	120	Vac
Forward Current	I_F *	15	20	25	mA
Peak On-State Current	I_{TP}	-	-	1	A
Operating Temperature	T_{opr}	-25	-	85	°C

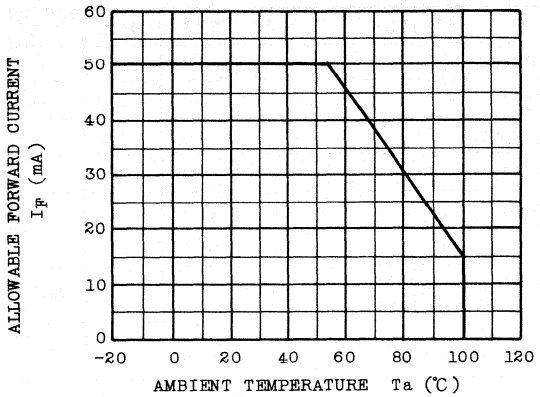
* In the case of TLP3011.

Fig. 1 dv/dt TEST CIRCUIT

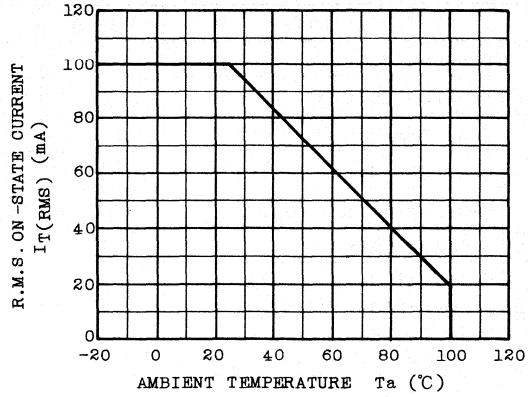




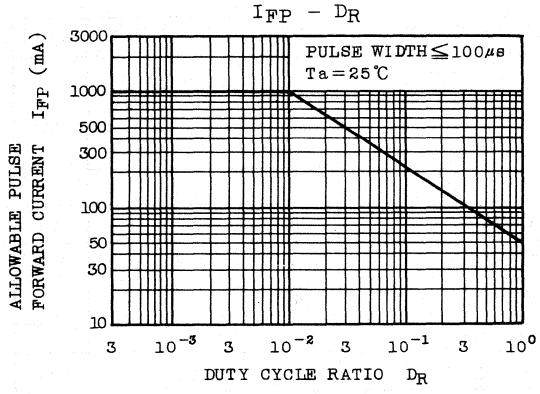
I_F – Ta



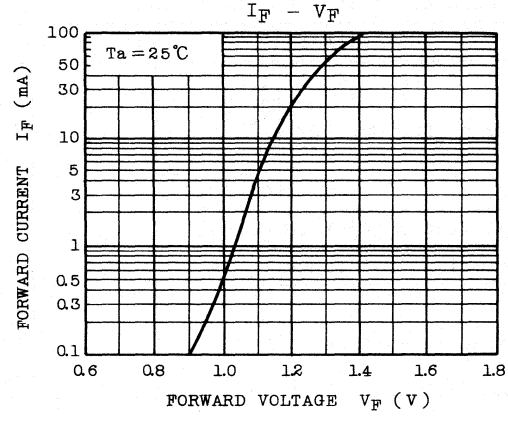
$I_{T(RMS)}$ – Ta



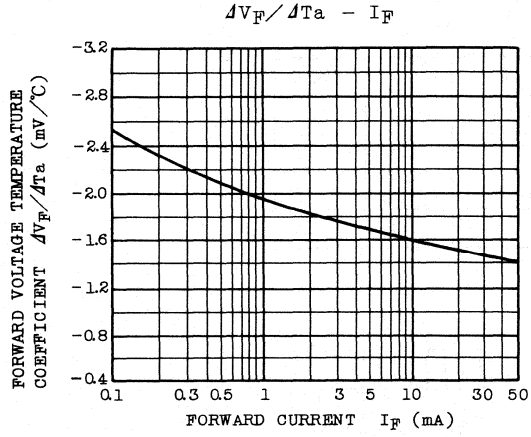
I_{FP} – D_R



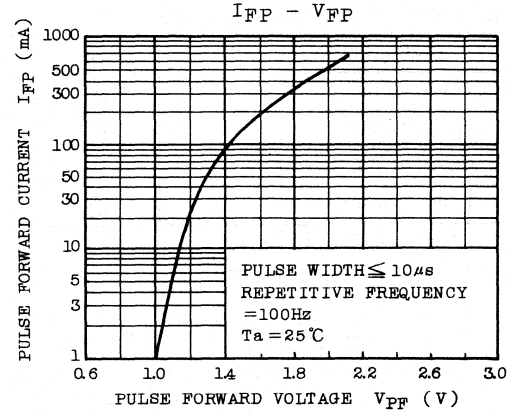
I_F – V_F



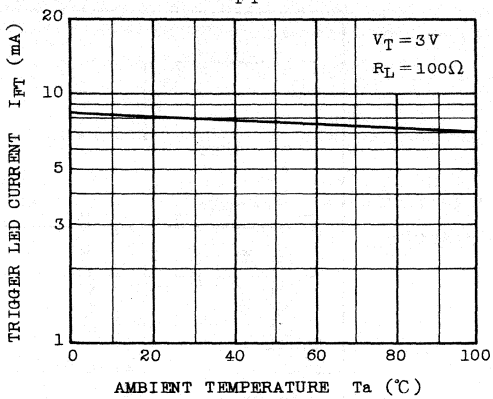
$\Delta V_F / \Delta Ta$ – I_F



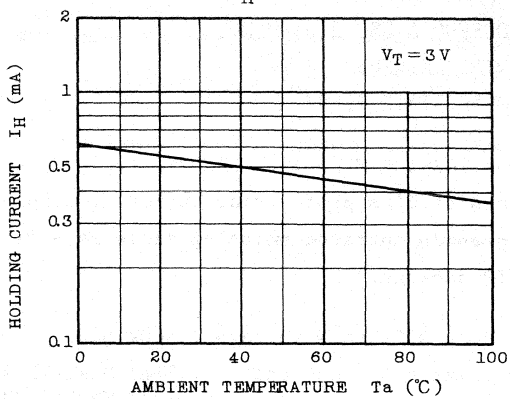
I_{FP} – V_{FP}



I_{FT} – Ta


TRIGGER LED CURRENT I_{FT} (mA)
20
10
5
3
1
0
20
40
60
80
100
$V_T = 3V$
$R_L = 100\Omega$
AMBIENT TEMPERATURE Ta (°C)

I_H – Ta


HOLDING CURRENT I_H (mA)
2
1
0.5
0.3
0.1
0
20
40
60
80
100
$V_T = 3V$
AMBIENT TEMPERATURE Ta (°C)

TLP3020, TLP3021, TLP3022, TLP3023

GaAs IRED & PHOTO-TRIAC

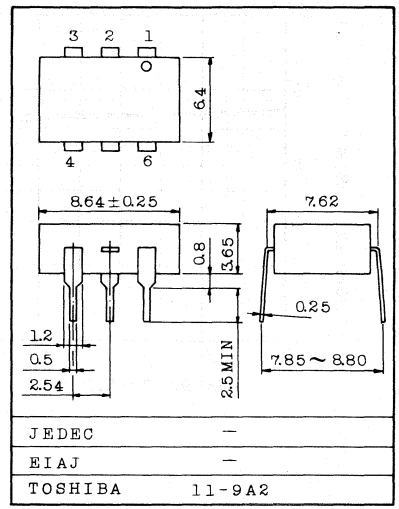
OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
TRIAC DRIVER.
SOLID STATE RELAY.

The TOSHIBA TLP3020, TLP3021, TLP3022 and TLP3023 consist of a photo-triac optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.

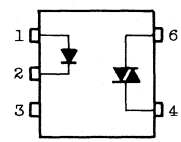
- Peak Off-State Voltage : 400V Min.
- Trigger LED Current : 30mA Max.(TLP3020)
  15mA Max.(TLP3021)
  10mA Max.(TLP3022)
  5mA Max.(TLP3023)
- On-State Current : 100mA Max.
- Isolation Voltage : 5000V_{rms} Min.
- Guaranteed Requirements of IEC380/VDE0806
- Climatic Test Class : 55/150/21
- Isolation Creepage Path: 8.0mm Min.
- Isolation Clearance : 7.3mm Min.
- Isolation Operating Voltage
  : 500V_{ac} or 600V_{dc} for Isolation Group C*1
- Creeping Current Resistance : Group I*2

*1 : According to VDE0110, table 4.
*2 : According to VDE0110, table 3.

Unit in mm



PIN CONFIGUTATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: TERMINAL 1
6: TERMINAL 2

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current		I_F	50	mA
	Forward Current Derating (Ta≧53°C)		$\Delta I_F/°C$	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)		I_{FP}	1	A
	Power Dissipation		P_D	100	mW
	Power Dissipation Derating (Ta≧25°C)		$\Delta P_D/°C$	-1.0	mW/°C
	Reverse Voltage		V_R	5	V
	Junction Temperature		T_j	125	°C
DETECTOR	Off-State Output Terminal Voltage		V_{DRM}	400	V
	On-State RMS Current	Ta=25°C	$I_{T(RMS)}$	100	mA
		Ta=70°C		50	
	On-State Current Derating (Ta≧25°C)		$\Delta I_T/°C$	-1.1	mA/°C
	Peak On-State Current (100μs Pulse, 120pps)		I_{TP}	2	A
	Peak Nonrepetitive Surge Current (P_W=10ms, DC=10%)		I_{TSM}	1.2	A
	Total Power Dissipation		P_D	300	mW
	Total Power Dissipation Derating (Ta≧25°C)		$\Delta P_D/°C$	-4.0	mW/°C
	Junction Temperature		T_j	100	°C
Storage Temperature Range			T_{stg}	-55~150	°C
Operating Temperature Range			T_{opr}	-40~100	°C
Lead Soldering Temperature (10 sec.)			T_{sold}	260	°C
Total Package Power Dissipation			P_T	330	mW
Total Package Power Dissipation Derating (Ta≧25°C)			$\Delta P_T/°C$	-4.4	mW/°C
Isolation Voltage (AC, 1 min., RH≦60%)			BV_S	5000	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitcance	C_T	V=0, f=1MHz	-	10	-	pF
DETECTOR	Peak Off-State Current	I_{DRM}	V_{DRM}=400V	-	10	100	nA
	Peak On-State Voltage	V_{TM}	I_{TM}=100mA	-	1.7	3.0	V
	Holding Current	I_H	-	-	0.2	-	mA
	Critical Rate of Rise of Off-State Voltage	dv/dt	V_{in}=120V_{rms}, Ta=85°C (Fig. 1)	200	500	-	V/μs
	Critical Rate of Rise of Commutating Voltage	dv/dt(c)	I_T=15mA, V_{in}=30V_{rms} (Fig. 1)	-	0.2	-	V/μs

COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

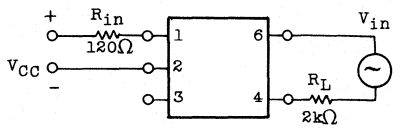
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	TLP3020	I_{FT}	V_T=3V	-	-	30	mA
	TLP3021			-	-	15	
	TLP3022			-	5	10	
	TLP3023			-	-	5	
Capacitance Input to Output		C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance		R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage		BV_S	AC, 1 minute	5000	-	-	V_{rms}
			AC, 1 second	-	10000	-	
			DC, 1 minute	-	10000	-	V_{dc}

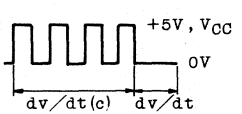
RCOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	120	Vac
Forward Current	I_F *	15	20	25	mA
Peak On-State Current	I_{TP}	-	-	1	A
Operating Temperature	T_{opr}	-25	-	85	°C

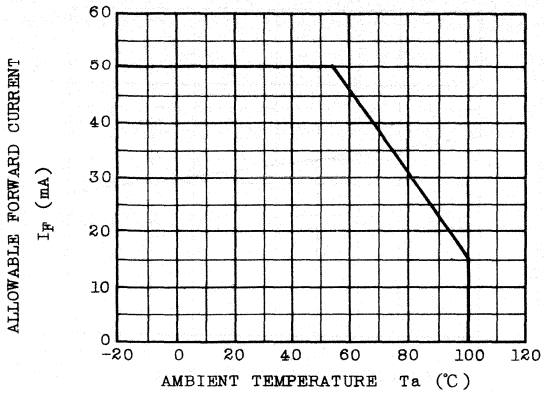
* In the case of TLP3022.

Fig. 1 dv/dt TEST CIRCUIT

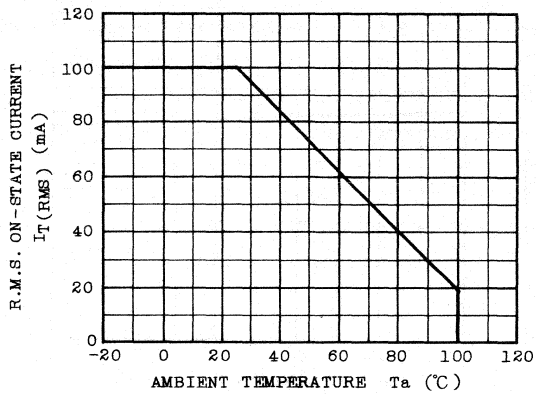




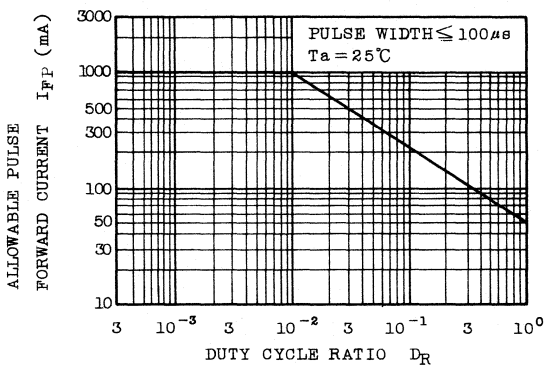
I_F – Ta



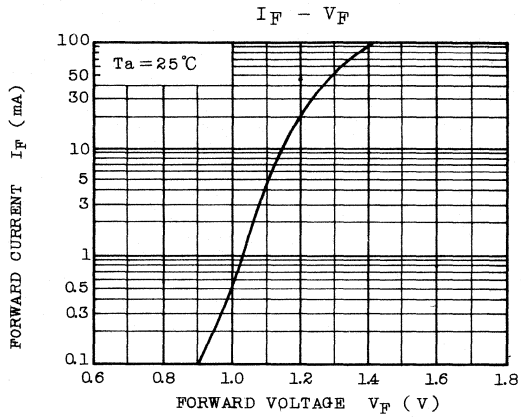
$I_{T(RMS)}$ – Ta



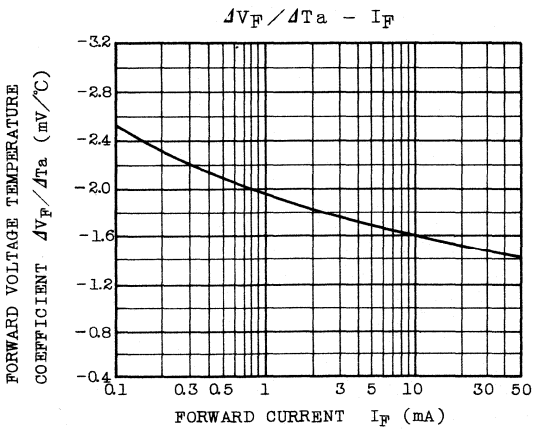
I_{FP} – D_R



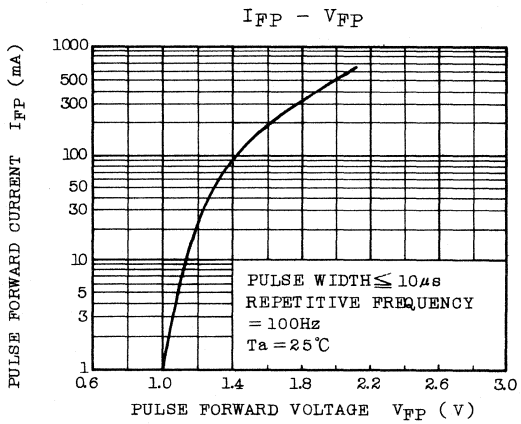
I_F – V_F



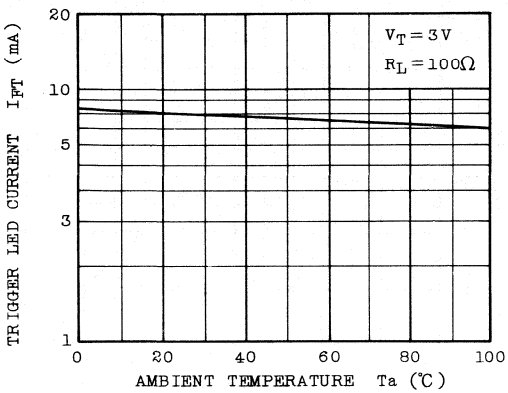
$\Delta V_F / \Delta Ta$ – I_F



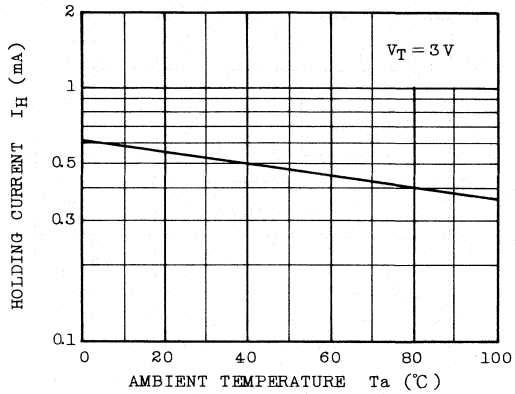
I_{FP} – V_{FP}



I_{FT} – Ta


TRIGGER LED CURRENT I_{FT} (mA)
20
10
5
3
1
0
20
40
60
80
100
AMBIENT TEMPERATURE Ta (°C)
$V_T = 3V$
$R_L = 100\Omega$

I_H – Ta


HOLDING CURRENT I_H (mA)
2
1
0.5
0.3
0.1
0
20
40
60
80
100
AMBIENT TEMPERATURE Ta (°C)
$V_T = 3V$

TLP3031, TLP3032, TLP3033

GaAs IRED & PHOTO-TRIAC

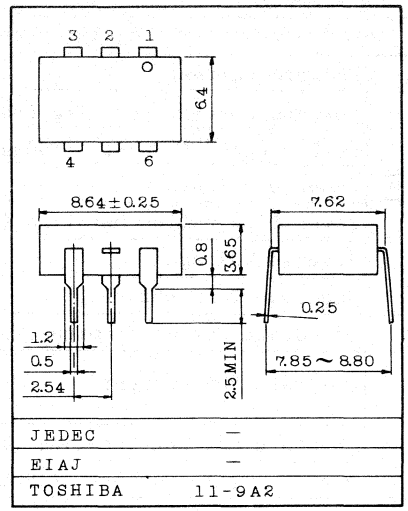
OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
TRIAC DRIVER.
SOLID STATE RELAY.

The TOSHIBA TLP3031, TLP3032 and TLP3033 consist of a zero voltage crossing turn-on photo-triac optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.

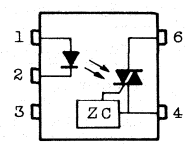
- Peak Off-State Voltage : 250V Min.
- Trigger LED Current : 15mA Max.(TLP3031)
  10mA Max.(TLP3032)
  5mA Max.(TLP3033)
- On-State Current : 100mA Max.
- Isolation Voltage : 5000V_{rms} Min.
- Guaranteed Requirements of IEC380/VDE0806
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.0mm Min.
- Isolation Clearance : 7.3mm Min.
- Isolation Operating Voltage
  : 500V_{ac} or 600Vdc for Isolation Group C*1
- Creeping Current Resistance : Group I*2

*1 : According to VDE0110, table 4.
*2 : According to VDE0110, table 3.

Unit in mm



PIN CONFIGURATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: TERMINAL 1
6: TERMINAL 2

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current		I_F	50	mA
	Forward Current Derating (Ta≧53°C)		$\Delta I_F/°C$	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)		I_{FP}	1	A
	Power Dissipation		P_D	100	mW
	Power Dissipation Derating (Ta≧25°C)		$\Delta P_D/°C$	-1.0	mW/°C
	Reverse Voltage		V_R	5	V
	Junction Temperature		T_j	125	°C
DETECTOR	Off-State Output Terminal Voltage		V_{DRM}	250	V
	On-State RMS Current	Ta=25°C	$I_{T(RMS)}$	100	mA
		Ta=70°C		50	
	On-State Current Derating (Ta≧25°C)		$\Delta I_T/°C$	-1.1	mA/°C
	Peak On-State Current (100μs pulse, 120pps)		I_{TP}	2	A
	Peak Nonrepetitive Surge Current (P_W=10ms, DC=10%)		I_{TSM}	1.2	A
	Power Dissipation		P_D	300	mW
	Power Dissipation Derating (Ta≧25°C)		$\Delta P_D/°C$	-4.0	mW/°C
	Junction Temperature		T_j	100	°C
Storage Temperature Range			T_{stg}	-55~150	°C
Operating Temperature Range			T_{opr}	-40~100	°C
Lead Soldering Temperature (10 sec.)			T_{sold}	260	°C
Total Package Power Dissipation			P_T	330	mW
Total Package Power Dissipation Derating (Ta≧25°C)			$\Delta P_T/°C$	-4.4	mW/°C
Isolation Voltage (AC, 1 min., RH≦60%)			BV_S	5000	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	10	-	pF
DETECTOR	Peak Off-State Current	I_{DRM}	V_{DRM}=250V	-	10	100	nA
	Peak On-State Voltage	V_{TM}	I_{TM}=100mA	-	1.7	3.0	V
	Holding Current	I_H	-	-	0.2	-	mA
	Critical Rate of Rise of Off-State Voltage	dv/dt	V_{in}=120V_{rms}, Ta=85°C (Fig. 1)	200	500	-	V/μs
	Critical Rate of Rise of Commutating Voltage	dv/dt(c)	V_{in}=30V_{rms}, I_T=15mA (Fig. 1)	-	0.2	-	V/μs

COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

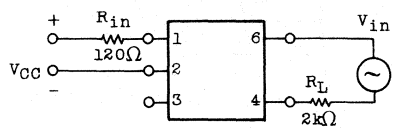
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	TLP3031	I_{FT}	V_T=3V	-	-	15	mA
	TLP3032			-	5	10	
	TLP3033			-	-	5	
Inhibit Voltage		V_{IH}	I_F=Rated I_{FT}	-	-	40	V
Leakage in Inhibited State		I_{IH}	I_F=Rated I_{FT}, V_T=Rated V_{DRM}	-	100	300	μA
Capacitance Input to Output		C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance		R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage		BV_S	AC, 1 minute	5000	-	-	V_{rms}
			AC, 1 second	-	10000	-	
			DC, 1 minute	-	10000	-	Vdc

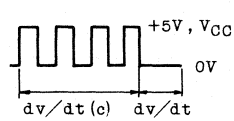
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	120	Vac
Forward Current	I_F *	15	20	25	mA
Peak On-State Current	I_{TP}	-	-	1	A
Operating Temperature	Topr	-25	-	85	°C

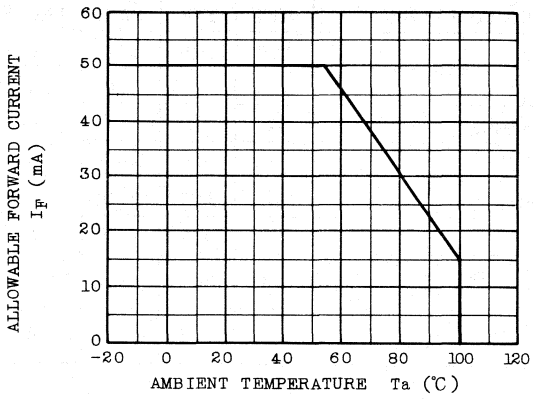
* In the case of TLP3032.

Fig. 1 dv/dt TEST CIRCUIT

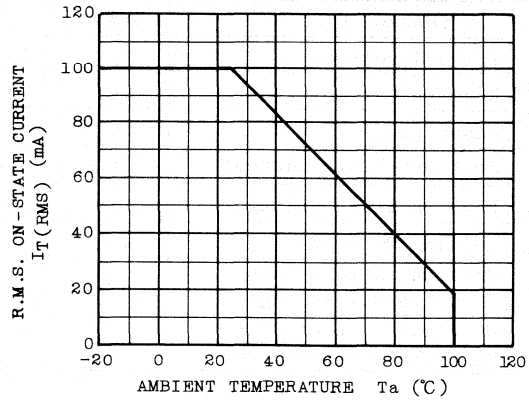




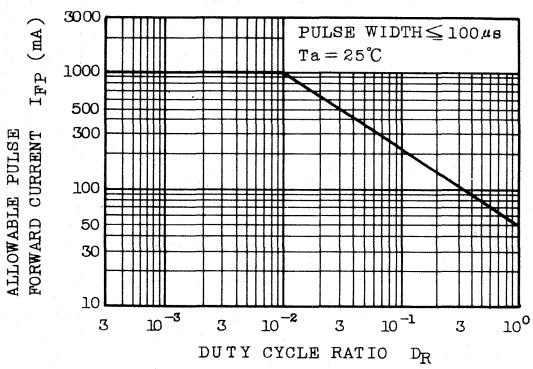
I_F – Ta



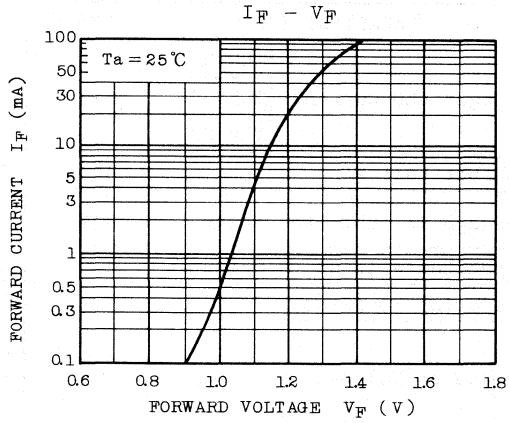
$I_{T(RMS)}$ – Ta



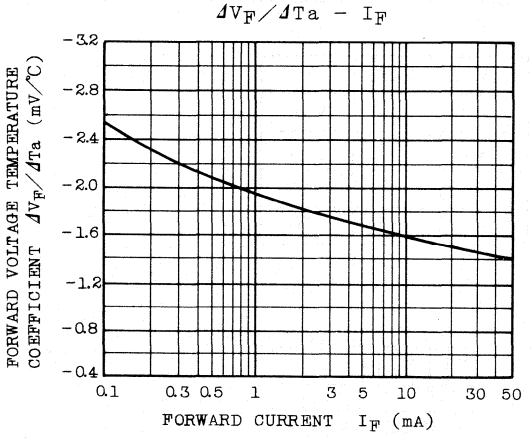
I_{FP} – D_R



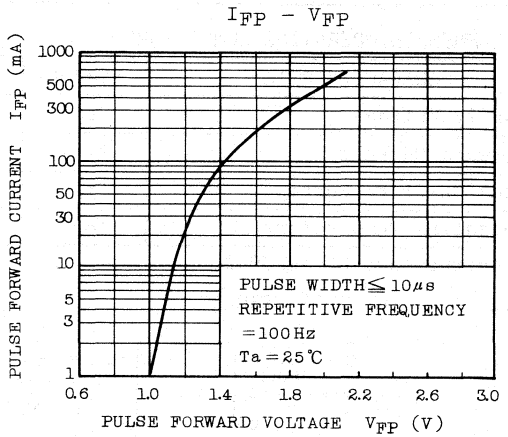
I_F – V_F



$\Delta V_F / \Delta Ta$ – I_F



I_{FP} – V_{FP}



TLP3041, TLP3042, TLP3043

GaAs IRED & PHOTO-TRIAC

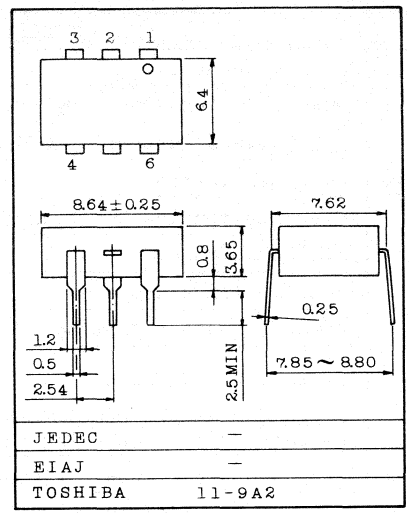
OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
TRIAC DRIVER.
SOLID STATE RELAY.

The TOSHIBA TLP3041, TLP3042 and TLP3043 consist of a zero voltage crossing turn-on photo-triac optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.

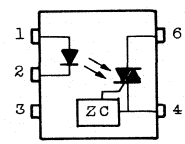
- Peak Off-State Voltage : 400V Min.
- Trigger LED Current : 15mA Max.(TLP3041)
  10mA Max.(TLP3042)
  5mA Max.(TLP3043)
- On-State Current : 100mA Max.
- Isolation Voltage : 5000V_{rms} Min.
- Guaranteeed Requirements of IEC380/VDE0806
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.0mm Min.
- Isolation Clearance : 7.3mm Min.
- Isolation Operating Voltage
  : 500V_{ac} or 600V_{dc} for Isolation Group C*1
- Creeping Current Resistance : Group I*2

*1 : According to VDE0110, table 4.
*2 : According to VDE0110, table 3.

Unit in mm



PIN CONFIGURATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: TERMINAL 1
6: TERMINAL 2

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current		I_F	50	mA
	Forward Current Derating (Ta≧53°C)		$\Delta I_F/°C$	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)		I_{FP}	1	A
	Power Dissipation		P_D	100	mW
	Power Dissipation Derating (Ta≧25°C)		$\Delta P_D/°C$	-1.0	mW/°C
	Reverse Voltage		V_R	5	V
	Junction Temperature		T_j	125	°C
DETECTOR	Off-State Output Terminal Voltage		V_{DRM}	400	V
	On-State RMS Current	Ta=25°C	$I_{T(RMS)}$	100	mA
		Ta=70°C		50	
	On-State Current Derating (Ta≧25°C)		$\Delta I_T/°C$	-1.1	mA/°C
	Peak On-State Current (100μs pulse, 120pps)		I_{TP}	2	A
	Peak Nonrepetitive Surge Current (P_W=10ms, DC=10%)		I_{TSM}	1.2	A
	Power Dissipation		P_D	300	mW
	Power Dissipation Derating (Ta≧25°C)		$\Delta P_D/°C$	-4.0	mW/°C
	Junction Temperature		T_j	100	°C
Storage Temperature Range			T_{stg}	-55~150	°C
Operating Temperature Range			T_{opr}	-40~100	°C
Lead Soldering Temperature (10 sec.)			T_{sold}	260	°C
Total Package Power Dissipation			P_T	330	mW
Total Package Power Dissipation Derating (Ta≧25°C)			$\Delta P_T/°C$	-4.4	mW/°C
Isolation Voltage (AC, 1 min., RH≦60%)			BV_S	5000	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f-1MHz	-	10	-	pF
DETECTOR	Peak Off-State Current	I_{DRM}	V_{DRM}=400V	-	10	100	nA
	Peak On-State Voltage	V_{TM}	I_{TM}=100mA	-	1.7	3.0	V
	Holding Current	I_H	-	-	0.2	-	mA
	Critical Rate of Rise of Off-State Voltage	dv/dt	V_{in}=120V_{rms}, Ta=85°C (Fig. 1)	200	500	-	V/μs
	Critical Rate of Rise of Commutating Voltage	dv/dt(c)	V_{in}=30V_{rms}, I_T=15mA (Fig. 1)	-	0.2	-	V/μs

COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

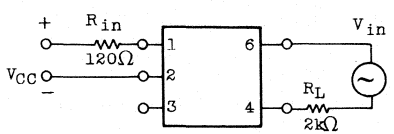
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	TLP3041	I_{FT}	V_T=3V	-	-	15	mA
	TLP3042			-	5	10	
	TLP3043			-	-	5	
Inhibit Voltage		V_{IH}	I_F=Rated I_{FT}	-	-	40	V
Leakage in Inhibited State		I_{IH}	I_F=Rated I_{FT}, V_T=Rated V_{DRM}	-	100	300	μA
Capacitance Input to Output		C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance		R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage		BVS	AC, 1 minute	5000	-	-	Vrms
			AC, 1 second	-	10000	-	
			DC, 1 minute	-	10000	-	Vdc

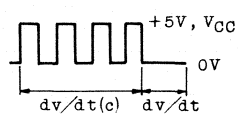
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	120	Vac
Forward Current	I_F *	15	20	25	mA
Peak On-State Current	I_{TP}	-	-	1	A
Operating Temperature	Topr	-25	-	85	°C

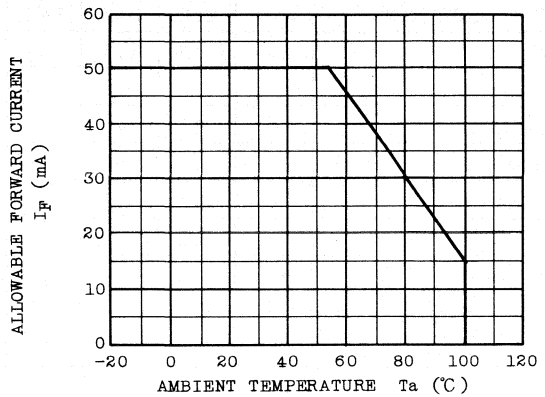
* In the case of TLP3042.

Fig. 1 dv/dt TEST CIRCUIT

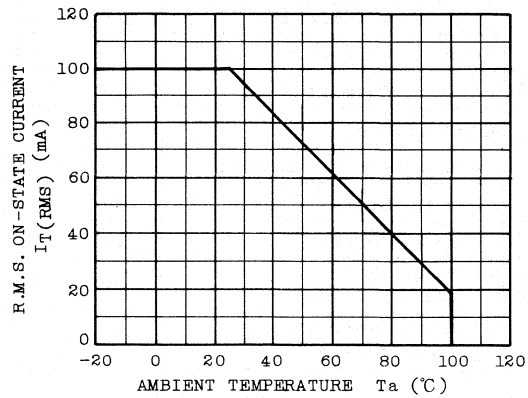




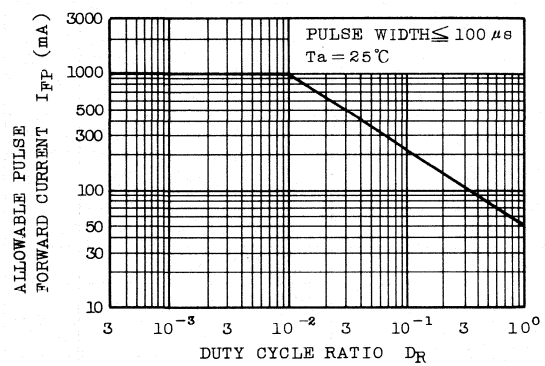
I_F – Ta



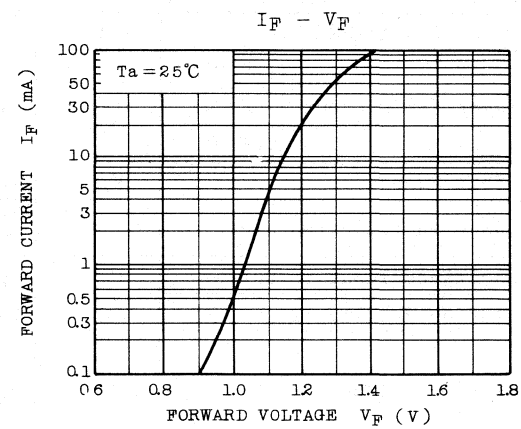
$I_{T(RMS)}$ – Ta



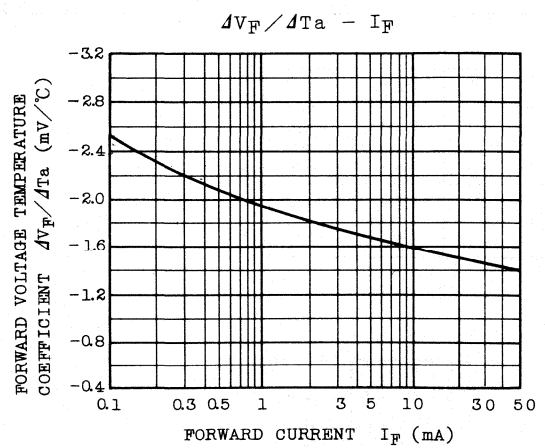
I_{FP} – D_R



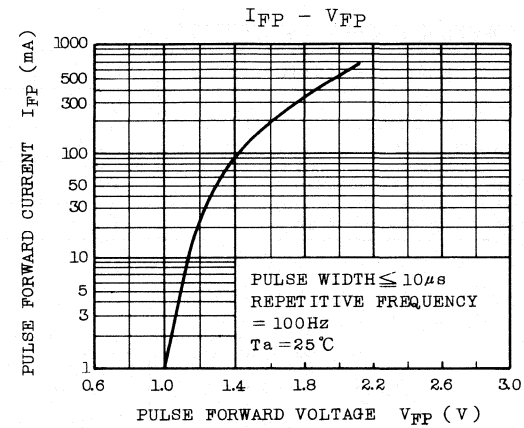
I_F – V_F



$\Delta V_F / \Delta Ta$ – I_F



I_{FP} – V_{FP}



TLP3051, TLP3052

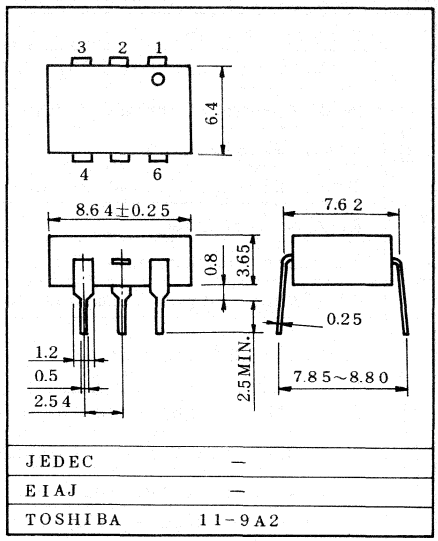
OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
TRIAC DRIVER.
SOLID STATE RELAY.

The TOSHIBA TLP3051 and TLP3052 consist of a photo-triac optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.

- Peak Off-State Voltage : 600V Min.
- Trigger LED Current : 15mA Max. (TLP3051)
  10mA Max. (TLP3052)
- On-State Current : 100mA Max.
- Isolation Voltage : 5000V_{rms} Min.
- Guaranteed Requirements of IEC380/VDE0806
- Climatic Test Class : 55/150/21
- Isolation Creepage Path: 8.0mm Min.
- Isolation Clearance : 7.2mm Min.
- Isolation Operating Voltage
  : 500V_{ac} or 600V_{dc} for Isolation Group C*1
- Creeping Current Resistance : Group I*2

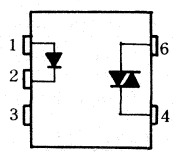
*1 : According to VDE0110, table 4.
*2 : According to VDE0110, table 3.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-9A2

PIN CONFIGURATIONS (TOP VIEW)



1 : ANODE
2 : CATHODE
3 : NC
4 : TERMINAL 1
6 : TERMINAL 2

MAXIMUM RATINGS

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current		I_F	50	mA
	Forward Current Derating (Ta≧53°C)		ΔI_F/°C	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)		I_{FP}	1	A
	Power Dissipation		P_D	100	mW
	Power Dissipation Derating (Ta≧25°C)		ΔP_D/°C	-1.0	mW/°C
	Reverse Voltage		V_R	5	V
	Junction Temperature		T_j	125	°C
DETECTOR	Off-State Output Terminal Voltage		V_{DRM}	600	V
	On-State RMS Current	Ta=25°C	$I_{T(RMS)}$	100	mA
		Ta=70°C		50	
	On-State Current Derating (Ta≧25°C)		ΔI_T/°C	-1.1	mA/°C
	Peak On-State Current (100μs Pulse, 120pps)		I_{TP}	2	A
	Peak Nonrepetitive Surge Current (Pw=10ms, DC=10%)		I_{TSM}	1.2	A
	Total Power Dissipation		P_D	300	mW
	Total Power Dissipation Derating (Ta≧25°C)		ΔP_D/°C	-4.0	mW/°C
	Junction Temperature		T_j	100	°C
Storage Temperature Range			T_{stg}	-55∿150	°C
Operating Temperature Range			T_{opr}	-40∿100	°C
Lead Soldering Temperature (10 sec.)			T_{sold}	260	°C
Total Package Power Dissipation			P_T	330	mW
Total Package Power Dissipation Derating (Ta≧25°C)			ΔP_T/°C	-4.4	mW/°C
Isolation Voltage (AC, 1 min., RH≦60%)			BV_S	5000	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Peak Off-State Current	I_{DRM}	V_{DRM}=600V	-	10	1000	nA
	Peak On-State Voltage	V_{TM}	I_{TM}=100mA	-	1.7	3.0	V
	Holding Current	I_H	-	-	1.0	-	mA
	Critical Rate of Rise of Off-State Voltage	dv/dt	V_{in}=240V_{rms}, Ta=85°C (Fig. 1)	-	500	-	V/μs
	Critical Rate of Rise of Commutating Voltage	dv/dt(c)	I_T=15mA, V_{in}=60V_{rms} (Fig. 1)	-	0.2	-	V/μs

COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

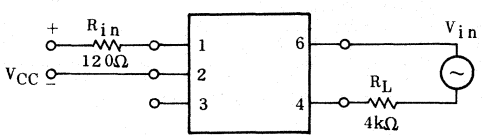
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	TLP3051	I_{FT}	V_T=6V	-	-	15	mA
	TLP3052			-	5	10	
Capacitance(Input to Output)		C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance		R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage		BVS	AC, 1 minute	5000	-	-	V_{rms}
			AC, 1 second	-	10000	-	
			DC, 1 minute	-	10000	-	V_{dc}

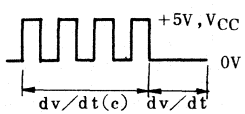
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	240	V_{ac}
Forward Current	I_F *	15	20	25	mA
Peak On-State Current	I_{TP}	-	-	1	A
Operating Temperature	T_{opr}	-25	-	85	°C

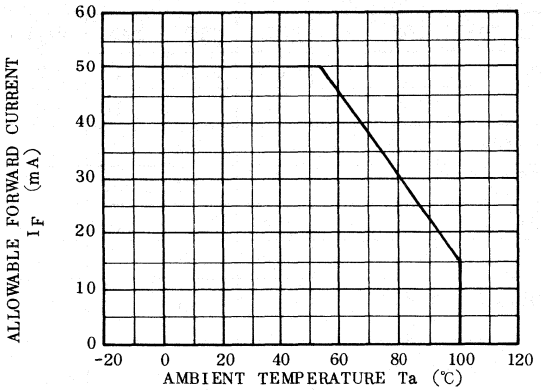
* In the case of TLP3052.

Fig. 1 dv/dt TEST CIRCUIT

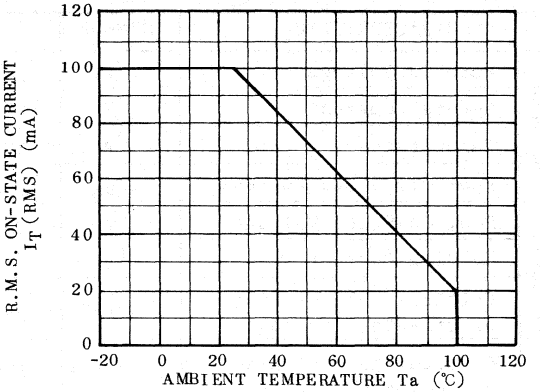




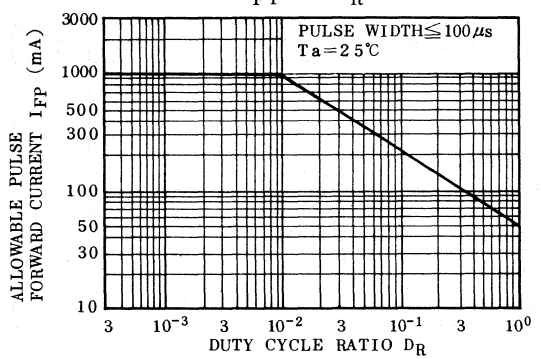
I_F — Ta



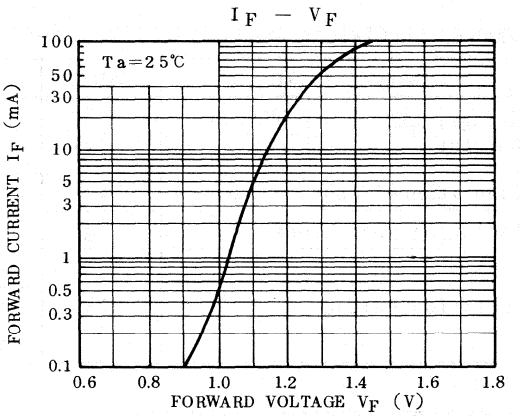
I_T(RMS) — Ta



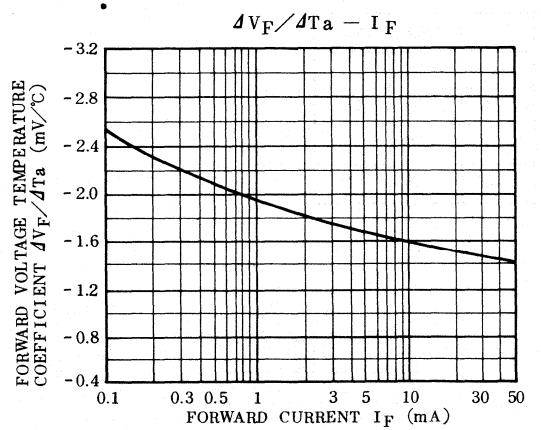
I_{FP} — D_R



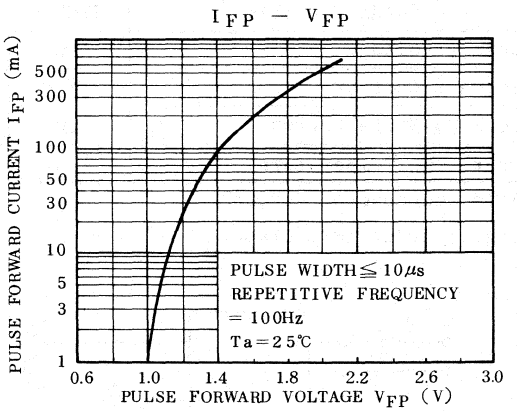
I_F — V_F



$\Delta V_F / \Delta Ta$ — I_F



I_{FP} — V_{FP}



TLP3061, TLP3062, TLP3063

GaAs IRED & PHOTO-TRIAC

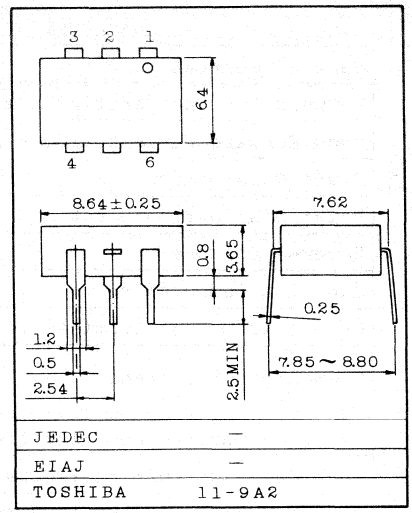
OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
TRIAC DRIVER.
SOLID STATE RELAY.

The TOSHIBA TLP3061, TLP3062 and TLP3063 consist of a zero voltage crossing turn-on photo-triac optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.

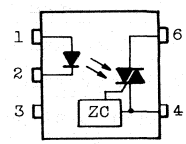
- Peak Off-State Voltage : 600V Min.
- Trigger LED Current : 15mA Max. (TLP3061)
  10mA Max. (TLP3062)
  5mA Max. (TLP3063)
- On-State Current : 100mA Max.
- Isolation Voltage : 5000V_{rms} Min.
- Guaranteed Requirements of IEC380/VDE0806
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.0mm Min.
- Isolation Clearance : 7.3mm Min.
- Isolation Operating Voltage
  : 500V_{ac} or 600V_{dc} for Isolation Group C*1
- Creeping Current Resistance : Group I*2

*1 : According to VDE0110, table 4.
*2 : According to VDE0110, table 3.

Unit in mm



PIN CONFIGURATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: TERMINAL 1
6: TERMINAL 2

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current		I_F	50	mA
	Forward Current Derating (Ta≧53°C)		$\Delta I_F/°C$	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)		I_{FP}	1	A
	Power Dissipation		P_D	100	mW
	Power Dissipation Derating (Ta≧25°C)		$\Delta P_D/°C$	-1.0	mW/°C
	Reverse Voltage		V_R	5	V
	Junction Temperature		T_j	125	°C
DETECTOR	Off-State Output Terminal Voltage		V_{DRM}	600	V
	On-State RMS Current	Ta=25°C	$\Delta I_{T(RMS)}$	100	mA
		Ta=70°C		50	
	On-State Current Derating (Ta≧25°C)		$I_T/°C$	-1.1	mA/°C
	Peak On-State Current (100μs pulse, 120pps)		I_{TP}	2	A
	Peak Nonrepetitive Surge Current (P_W=10ms, DC=10%)		I_{TSM}	1.2	A
	Power Dissipation		P_D	300	mW
	Power Dissipation Derating (Ta≧25°C)		$\Delta P_D/°C$	-4.0	mW/°C
	Junction Temperature		T_j	100	°C
Storage Temperature Range			T_{stg}	-55~150	°C
Operating Temperature Range			T_{opr}	-40~100	°C
Lead Soldering Temperature (10 sec.)			T_{sold}	260	°C
Total Package Power Dissipation			P_T	330	mW
Total Package Power Dissipation Derating (Ta≧25°C)			$\Delta P_T/°C$	-4.4	mW/°C
Isolation Voltage (AC, 1 min., RH≦60%)			BV_S	5000	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	10	-	pF
DETECTOR	Peak Off-State Current	I_{DRM}	V_{DRM}=600V	-	10	100	nA
	Peak On-State Voltage	V_{TM}	I_{TM}=100mA	-	1.7	3.0	V
	Holding Current	I_H	-	-	0.2	-	mA
	Critical Rate of Rise of Off-State Voltage	dv/dt	V_{in}=240V_{rms} Ta=85°C (Fig.1)	200	500	-	V/μs
	Critical Rate of Rise of Commutating Voltage	dv/dt(c)	V_{in}=60V_{rms} I_T=15mA (Fig.1)	-	0.2	-	V/μs

COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

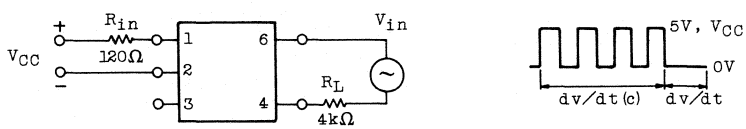
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	TLP3061	I_{FT}	V_T=6V	-	-	15	mA
	TLP3062			-	5	10	
	TLP3063			-	-	5	
Inhibit Voltage		V_{IH}	I_F=Rated I_{FT}	-	-	50	V
Leakage in Inhibited State		I_{IH}	I_F=Rated I_{FT} V_T=Rated V_{DRM}	-	100	300	μA
Capacitance Input to Output		C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance		R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage		BV_S	AC, 1 minute	5000	-	-	V_{rms}
			AC, 1 second	-	10000	-	
			DC, 1 minute	-	10000	-	V_{dc}

RECOMMENDED OPERATING CONDITIONS

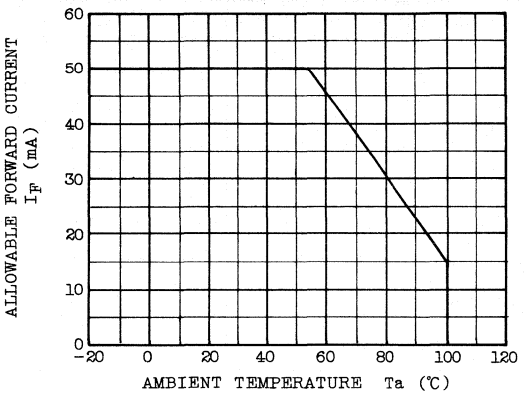
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	240	V_{ac}
Forward Current	I_F *	15	20	25	mA
Peak On-State Current	I_{TP}	-	-	1	A
Operating Temperature	T_{opr}	-25	-	85	°C

* In the case of TLP3062

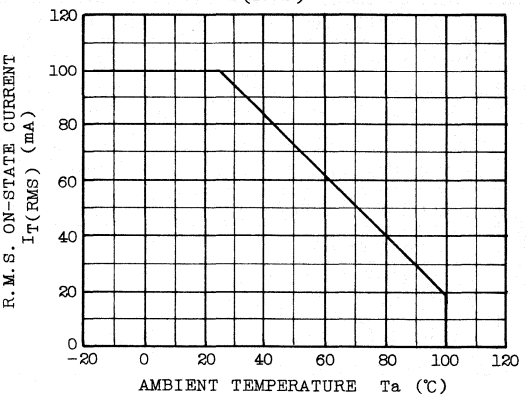
Fig. 1 dv/dt TEST CIRCUIT



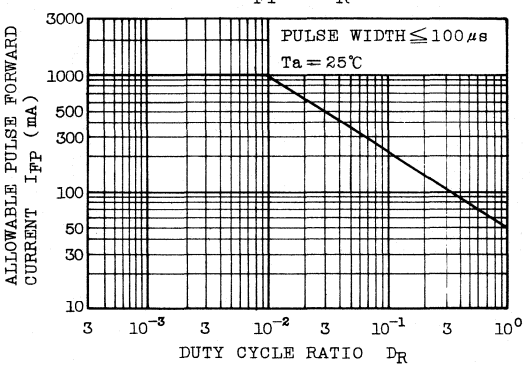
I_F — Ta



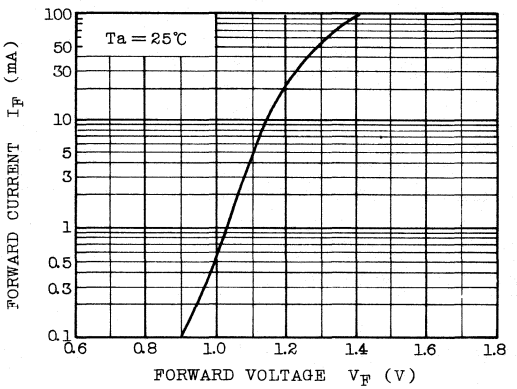
$I_{T(RMS)}$ — Ta



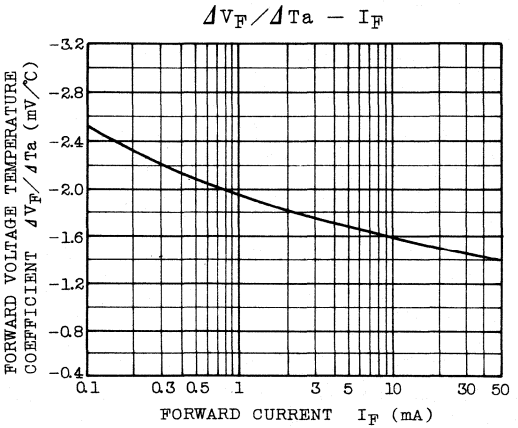
I_{FP} — D_R



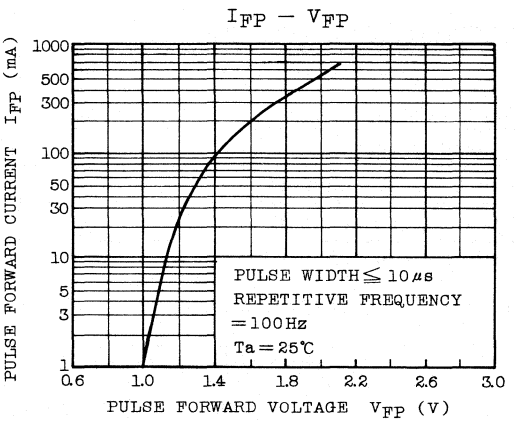
I_F — V_F



$\Delta V_F / \Delta Ta$ — I_F



I_{FP} — V_{FP}



TRICA DRIVER
PROGRAMMABLE CONTROLLERS
AC-OUTPUT MODULE
SOLID STATE RELAY

The TOSHIBA TLP3502 consists of a photo-triac optically coupled to a gallium arsenide infrared emitting diode in a 8 lead plastic DIP package.

- Peak Off-State Voltage : 400V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 0.5Arms Max.
- Isolation Voltage : 2500V_{rms} Min.
- UL Recognized : File No. E67349

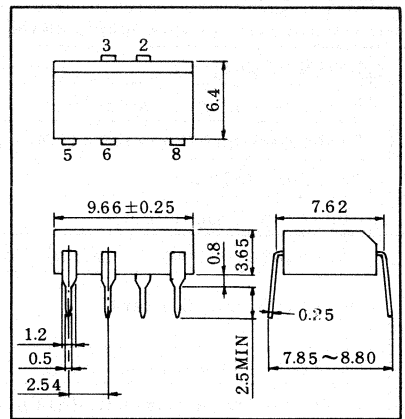
. Trigger LED Current

CLASSIFICATION*	TRIGGER LED CURRENT (mA) V_T=6V, Ta=25°C		MARKING OF CLASSIFICATION
	MIN.	MAX.	
(IFT5)	-	5	T5
(IFT7)	-	7	T5,T7
Standard	-	10	T5,T7,Blank

* Ex. (IFT5) ; TLP3502 (IFT5)

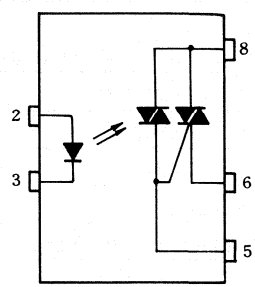
. Note: Application type name for certification test, please use standard product type name, i.e.
TLP3502 (IFT5) : TLP3502

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	

PIN CONFIGURATION (TOP VIEW)



2: ANODE
3: CATHODE
5: TRIAC GATE
6: TRIAC T1
8: TRIAC T2

TLP3502

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current		I_F	50	mA
	Forward Current Derating (Ta≧53°C)		$\Delta I_F/°C$	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)		I_{FP}	1	A
	Reverse Voltage		V_R	5	V
	Junction Temperature		Tj	125	°C
DETECTOR	Off-State Output Terminal Voltage		V_{DRM}	400	V
	On-State RMS Current	Ta=40°C	$I_{T(RMS)}$	0.5	A
		Ta=60°C		0.35	
	On-State Current Derating (Ta≧40°C)		$\Delta I_T/°C$	-7.2	mA/°C
	Peak On-State Current (100μs pulse, 120pps)		I_{TP}	-	A
	Peak Nonrepetitive Surge Current (50Hz, Peak)		I_{TSM}	5	A
	Junction Temperature		Tj	110	°C
Storage Temperature Range			Tstg	-40~125	°C
Operating Temperature Range			Topr	-20~80	°C
Lead Soldering Temperature (10sec.)			Tsold	260	°C
Isolation Voltage (AC, 1 min., RH≦60%)			BVS	2500	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Peak Off-State Current	I_{DRM}	V_{DRM}=400V, Ta=110°C	-	-	100	μA
	Peak On-State Voltage	V_{TM}	I_{TM}=0.75A	-	-	3.0	V
	Holding Current	I_H	-	-	-	25	mA
	Critical Rate of Rise of Off-State Voltage	dv/dt	V_{in}=120V_{rms} (Fig.1)	200	500	-	V/μs
	Critical Rate of Rise of Commutating Voltage	dv/dt(c)	V_{in}=120V_{rms} I_T=0.5A$_{rms}$ (Fig.1)	-	5	-	V/μs

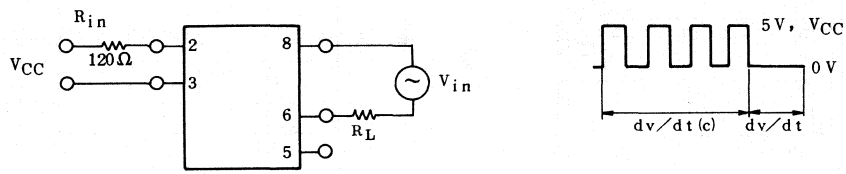
COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_T=6V	-	-	10	mA
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	1.5	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	2500	-	-	V_{rms}
		AC, 1 second	-	5000	-	
		DC, 1 minute	-	5000	-	Vdc

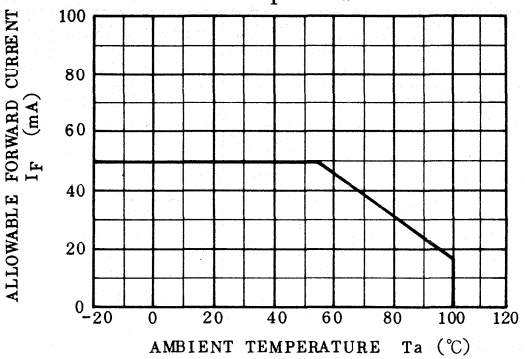
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	120	Vac
Forward Current	I_F	15	20	25	mA
Peak On-State Current	I_{TP}	-	-	-	A
Operating Temperature	Topr	-20	-	80	°C

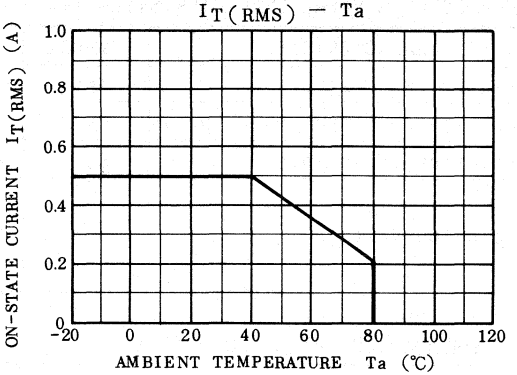
Fig.1 : dv/dt TEST CIRCUIT



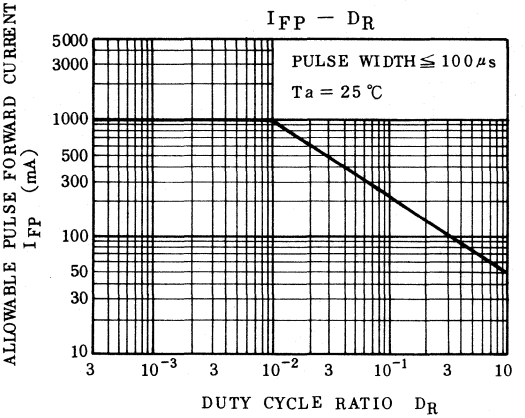
I_F — Ta



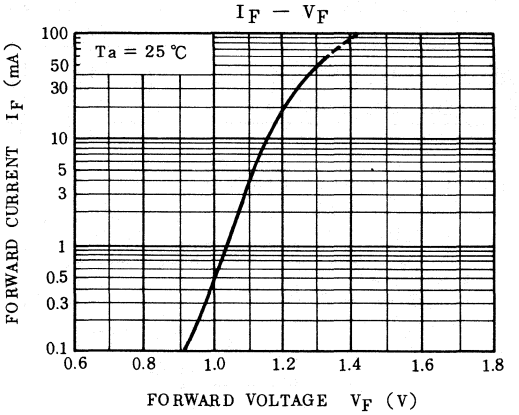
$I_{T(RMS)}$ — Ta



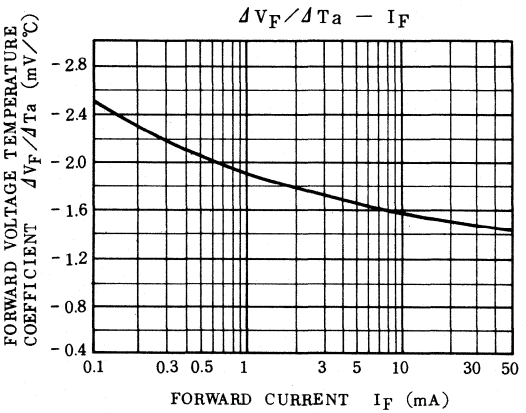
I_{FP} — D_R



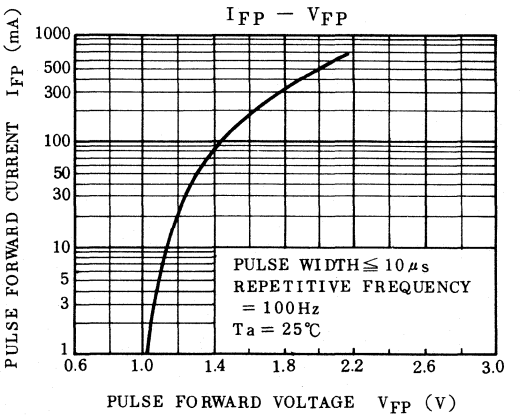
I_F — V_F



$\Delta V_F / \Delta Ta$ — I_F



I_{FP} — V_{FP}



TRICA DRIVER
PROGRAMMABLE CONTROLLERS
AC-OUTPUT MODULE
SOLID STATE RELAY

The TOSHIBA TLP3503 consists of a zero voltage crossing turn-on photo-triac optically coupled to a gallium arsenide infreared emitting diode in a 8 lead plastic DIP package.

- Peak Off-State Voltage : 400V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 0.5A_{rms} Max.
- Isolation Voltage : 2500V_{rms} Min.
- UL Recognized : File No.E67349

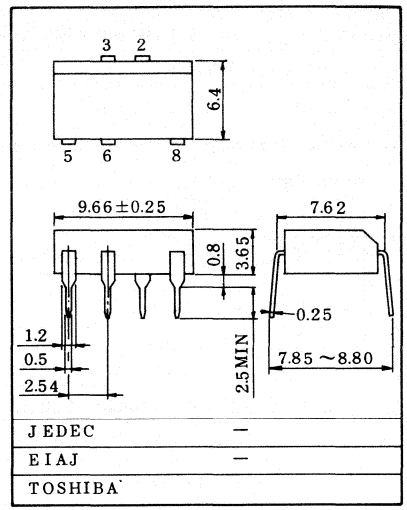
. Trigger LED Current

CLASSI-FICATION*	TRIGGER LED CURREN (mA) V_T=6V, Ta=25°C		MARKING OF CLASSI-FICATION
	MIN.	MAX.	
(IFT5)	-	5	T5
(IFT7)	-	7	T5,T7
Standard	-	10	T5,T7,Blank

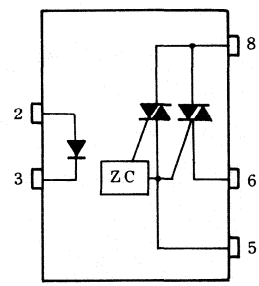
* Ex. : (IFT5) ; TLP3503 (IFT5)

. Note: Application type name for certification test please use standard product type name, i.e.
TLP3503 (IFT5) : TLP3503

Unit it mm



PIN CONFIGURATIONS (TOP VIEW)



2: ANODE
3: CATHODE
5: TRIAC GATE
6: TRIAC T1
8: TRIAC T2

TLP3506

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current		I_F	50	mA
	Forward Current Derating (Ta≧53°C)		ΔI_F/°C	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)		I_{FP}	1	A
	Reverse Voltage		V_R	5	V
	Junction Temperature		Tj	125	°C
DETECTOR	Off-State Output Terminal Voltage		V_{DRM}	400	V
	On-State RMS Current	Ta=40°C	$I_{T(RMS)}$	0.5	A
		Ta=60°C		0.35	
	On-State Current Derating (Ta≧40°C)		ΔI_T/°C	-7.2	mA/°C
	Peak On-State Current (100μs pulse, 120pps)		I_{TP}	-	A
	Peak Nonrepetitive Surge Current (50Hz, Peak)		I_{TSM}	5	A
	Junction Temperature		Tj	110	°C
Storage Temperature Range			Tstg	-40~125	°C
Operating Temperature Range			Topr	-20~80	°C
Lead Soldering Temperature (10sec.)			Tsold	260	°C
Isolation Voltage (AC, 1 min., RH≦60%)			BV_S	2500	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Peak Off-State Current	I_{DRM}	V_{DRM}=400V, Ta=110°C	-	-	100	μA
	Peak On-State Voltage	V_{TM}	I_{TM}=0.75A	-	-	3.0	V
	Holding Current	I_H	R_L=100Ω	-	-	25	mA
	Critical Rate of Rise of Off-State Voltage	dv/dt	V_{in}=120V_{rms} (Fig.1)	200	500	-	V/μs
	Critical Rate of Rise of Commutating Voltage	dv/dt(c)	V_{in}=120V_{rms} I_T=0.5A_{rms} (Fig.1)	-	5	-	V/μs

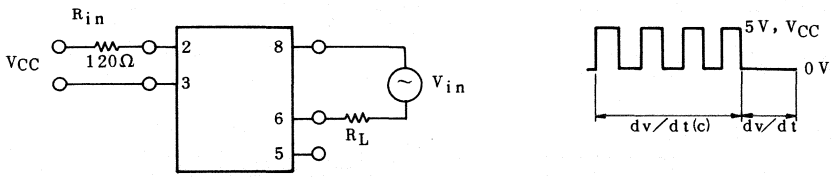
COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_T=6V	-	-	10	mA
Inhibit Voltage	V_{IH}	I_F=Rated I_{FT}	-	-	50	V
Leakage in Inhibited State	I_{IH}	I_F=Rated I_{FT} V_T=Rated V_{DRM}	-	200	-	μA
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	1.5	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	2500	-	-	Vrms
		AC, 1 second	-	5000	-	
		DC, 1 minute	-	5000	-	Vdc

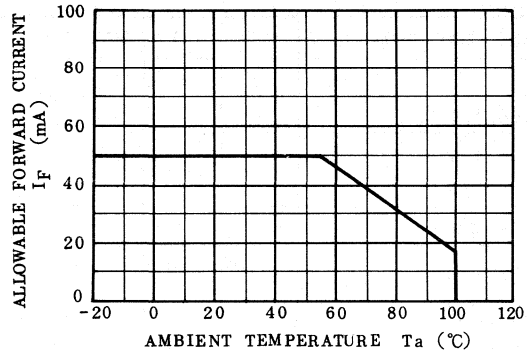
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	120	Vac
Forward Current	I_F	15	20	25	mA
Peak On-State Current	I_{TP}	-	-	-	A
Operating Temperature	Topr	-20	-	80	°C

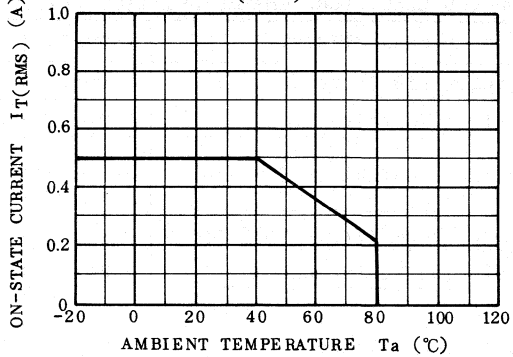
Fig.1 : dv/dt TEST CIRCUIT



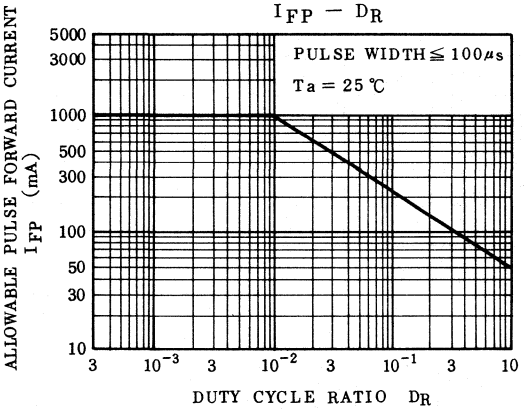
I_F — Ta



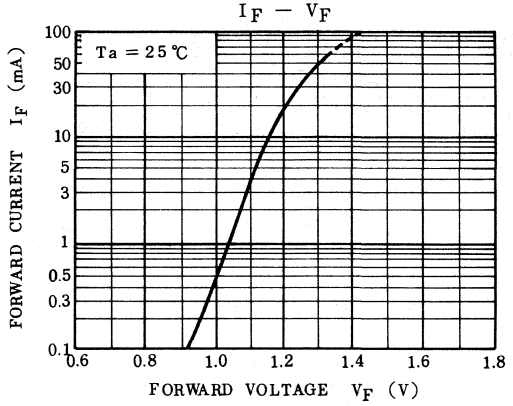
$I_{T(RMS)}$ — Ta



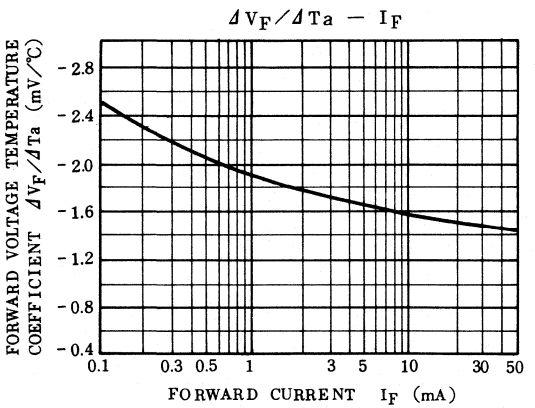
I_{FP} — D_R



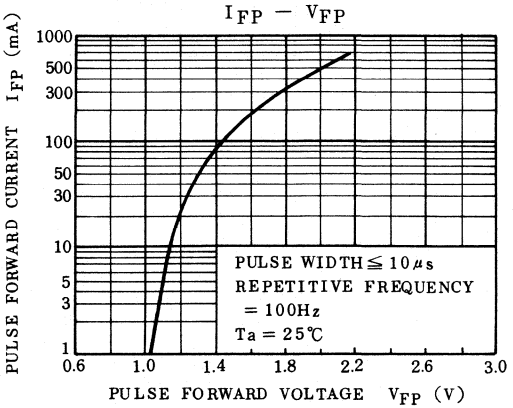
I_F — V_F



$\Delta V_F / \Delta Ta$ — I_F



I_{FP} — V_{FP}

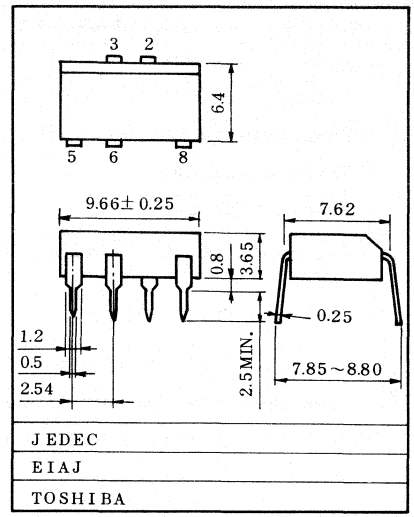


TRIAC DRIVER
PROGRAMMABLE CONTROLLERS
AC-OUTPUT MODULE
SOLID STATE RELAY

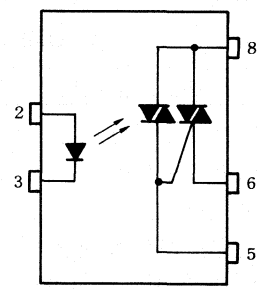
The TOSHIBA TLP3506 consists of a photo-triac optically coupled to a gallium arsenide infrared emitting diode in a 8 lead plastic DIP package.

- Peak Off-State Voltage : 600V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 0.5Arms Max.
- Isolation Voltage : 25000Vrms Min.

Unit in mm



PIN CONFIGURATION (TOP VIEW)



2 : ANODE
3 : CATHODE
5 : TRIAC GATE
6 : TRIAC T1
8 : TRIAC T2

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current		I_F	50	mA
	Forward Current Derating (Ta≧53°C)		ΔI_F/°C	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)		I_{FP}	1	A
	Reverse Voltage		V_R	5	V
	Junction Temperature		T_j	125	°C
DETECTOR	Off-State Output Terminal Voltage		V_{DRM}	600	V
	On-State RMS Current	Ta=40°C	I_T(RMS)	0.5	A
		Ta=60°C		0.35	
	On-State Current Derating (Ta≧40°C)		ΔI_T/°C	-7.2	mA/°C
	Peak On-State Current (100μs pulse, 120pps)		I_{TP}	-	A
	Peak Nonrepetitive Surge Current (50Hz, Peak)		I_{TSM}	5	A
	Junction Temperature		T_j	110	°C
Storage Temperature Range			T_{stg}	-40∿125	°C
Operating Temperature Range			T_{opr}	-20∿80	°C
Lead Soldering Temperature (10sec.)			Tsold	260	°C
Isolation Voltage (AC, 1 min., RH≦60%)			BV_S	2500	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Peak Off-State Current	I_{DRM}	V_{DRM}=600V, Ta=110°C	-	-	100	μA
	Peak On-State Voltage	V_{TM}	I_{TM}=0.75A	-	-	3.0	V
	Holding Current	I_H	-	-	-	25	mA
	Critical Rate of Rise of Off-State Voltage	dv/dt	V_{in}=240V_{rms} (Fig.1)	-	500	-	V/μs
	Critical Rate of Rise of Commutating Voltage	dv/dt(c)	V_{in}=240V_{rms} I_T=0.5A_{rms} (Fig.1)	-	5	-	V/μs

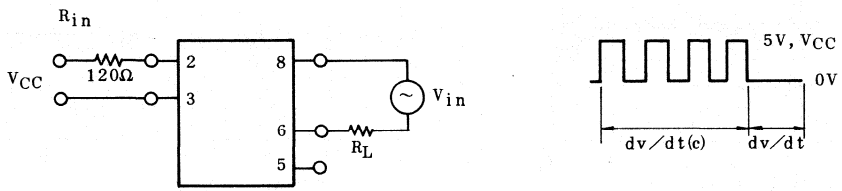
COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_T=6V	-	-	10	mA
Capacitance (Input to Output)	C_S	V_S=0. f=1MHz	-	1.5	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	2500	-	-	Vrms
		AC, 1 second	-	5000	-	
		DC, 1 minute	-	5000	-	Vdc

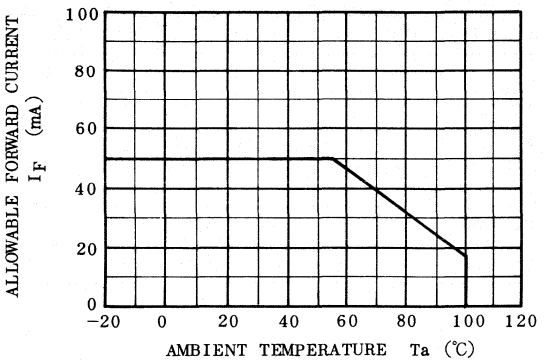
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	240	Vac
Forward Current	I_F	15	20	25	mA
Peak On-State Current	I_{TP}	-	-	-	A
Operating Temperature	T_{opr}	-20	-	80	°C

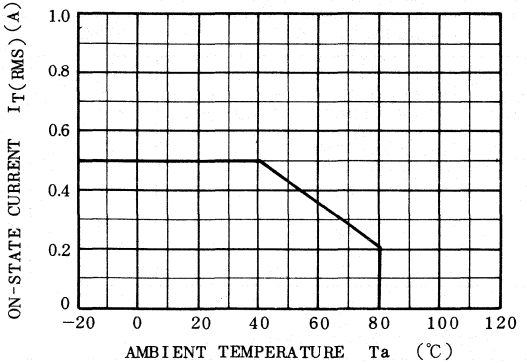
Fig.1 : dv/dt TEST CIRCUIT



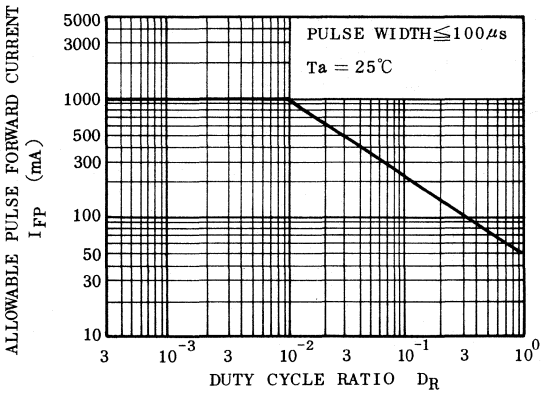
I_F – Ta



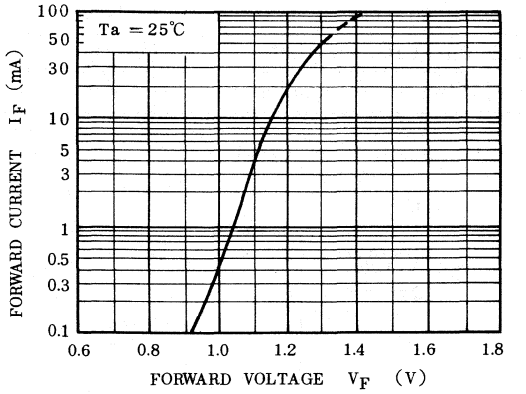
$I_{T(RMS)}$ – Ta



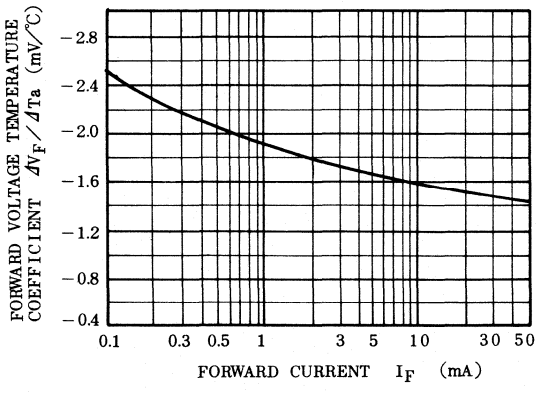
I_{FP} – D_R



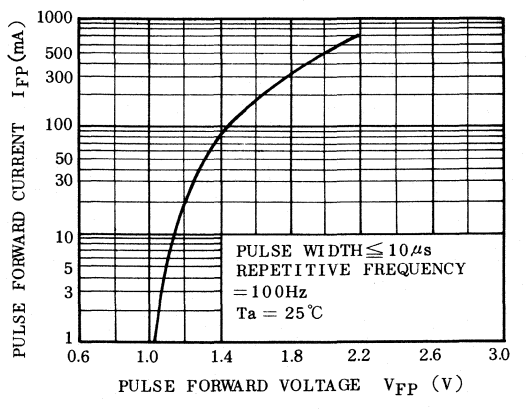
I_F – V_F



$\Delta V_F / \Delta Ta$ – I_F



I_{FP} – V_{FP}



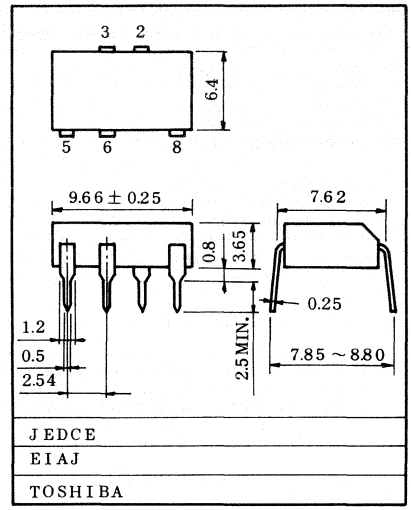
TLP3507

TRIAC DRIVER
PROGRAMMABLE CONTROLLERS
AC-OUTPUT MODULE
SOLID STATE RELAY

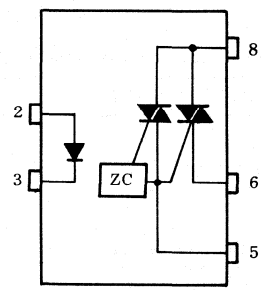
The TOSHIBA TLP3507 consists of a zero voltage crossing turn-on photo-triac optically coupled to a gallium arsenide infrared emitting diode in a 8 lead plastic DIP package.

- Peak Off-State Voltage : 600V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 0.5Arms Max.
- Isolation Voltage : 2500Vrms Min.

Unit in mm



PIN CONFIGURATIONS (TOP VIEW)



2 : ANODE
3 : CATHODE
5 : TRIAC GATE
6 : TRIAC T1
8 : TRIAC T2

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current		ΔI_F	50	mA
	Forward Current Derating (Ta≧53°C)		I_F/°C	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)		I_{FP}	1	A
	Reverse Voltage		V_R	5	V
	Junction Temperature		T_j	125	°C
DETECTOR	Off-State Output Terminal Voltage		V_{DRM}	600	V
	On-State RMS Current	Ta=40°C	$I_{T(RMS)}$	0.5	A
		Ta=60°C		0.35	
	On-State Current Derating (Ta≧40°C)		ΔI_T/°C	-7.2	mA/°C
	Peak On-State Current (100μs pulse, 120pps)		I_{TP}	-	A
	Peak Nonrepetitive Surge Current (50Hz, Peak)		I_{TSM}	5	A
	Junction Temperature		T_j	110	°C
Storage Temperature Range			T_{stg}	-40∿125	°C
Operating Temperature Range			T_{opr}	-20∿80	°C
Lead Soldering Temperature (10sec.)			T_{sold}	260	°C
Isolation Voltage (AC, 1 min., RH≦60%)			BV_S	2500	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Peak Off-State Current	I_{DRM}	V_{DRM}=600V, Ta=110°C	-	-	100	μA
	Peak On-State Voltage	V_{TM}	I_{TM}=0.75A	-	-	3.0	V
	Holding Current	I_H	R_L=100Ω	-	-	25	mA
	Critical Rate of Rise of Off-State Voltage	dv/dt	V_{in}=240V_{rms} (Fig.1)	-	500	-	V/μs
	Critical Rate of Rise of Commutating Voltage	dv/dt(c)	V_{in}=240V_{rms} I_T=0.5A_{rms} (Fig.1)	-	5	-	V/μs

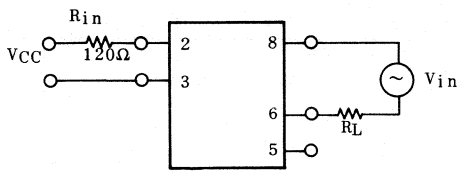
COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

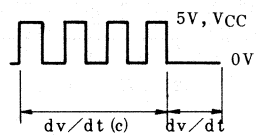
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_T=6V	-	-	10	mA
Inhibit Voltage	V_{IH}	I_F=Rated I_{FT}	-	-	50	V
Leakage in Inhibited State	I_{IH}	I_F=Rated I_{FT} V_T=Rated V_{DRM}	-	200	-	μA
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	1.5	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	2500	-	-	Vrms
		AC, 1 second	-	5000	-	
		DC, 1 minute	-	5000	-	Vdc

RECOMMENDED OPERATING CONDITIONS

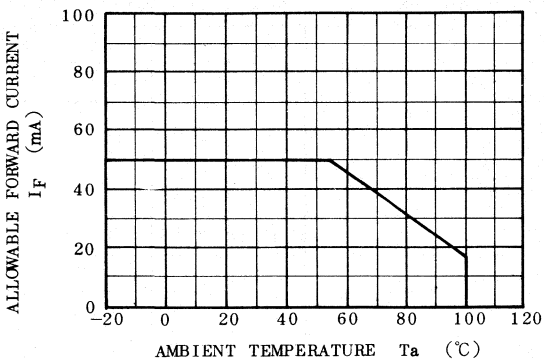
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	240	Vac
Forward Current	I_F	15	20	25	mA
Peak On-State Current	I_{TP}	-	-	-	A
Operating Temperature	T_{opr}	-20	-	80	°C

Fig.1 : dv/dt TEST CIRCUIT

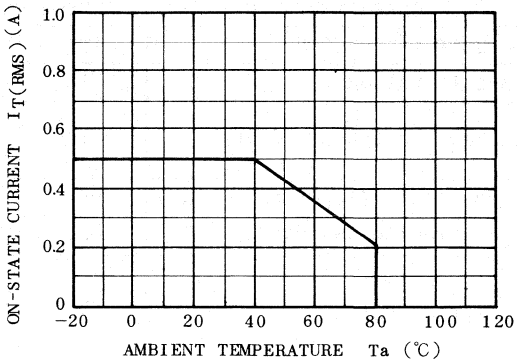




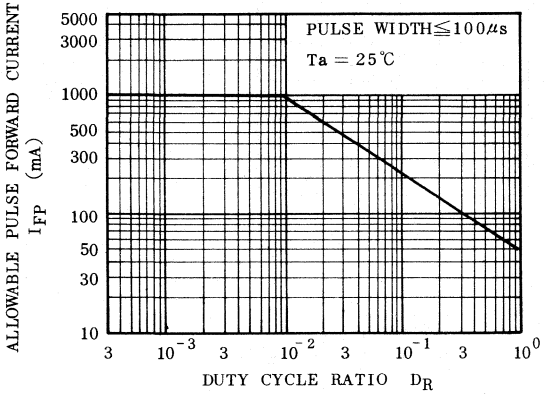
I_F – Ta



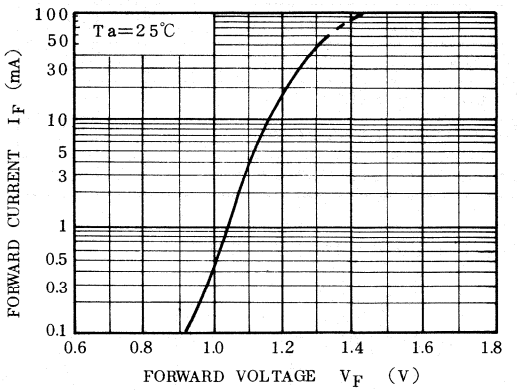
$I_{T(RMS)}$ – Ta



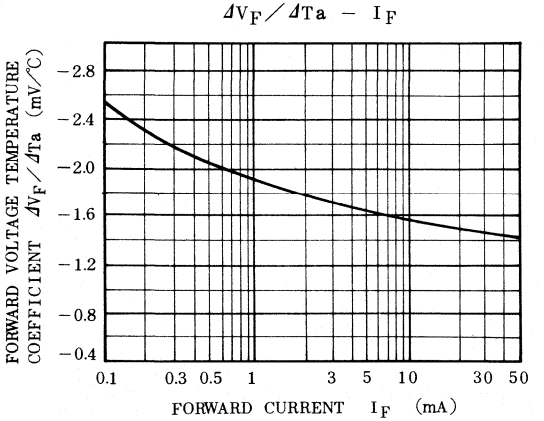
I_{FP} – D_R



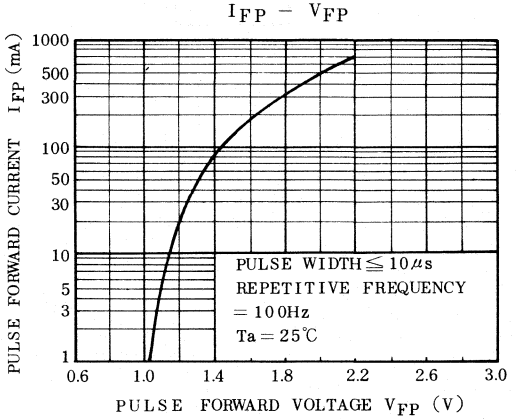
I_F – V_F



$\Delta V_F / \Delta Ta$ – I_F



I_{FP} – V_{FP}



TRIAC DRIVER
PROGRAMMABLE CONTROLLERS
AC-OUTPUT MODULE
SOLID STATE RELAY

The TOSHIBA TLP3520 consists of a photo-triac optically coupled to a gallium arsenide infrared emitting diode in a 16 lead plastic DIP package.

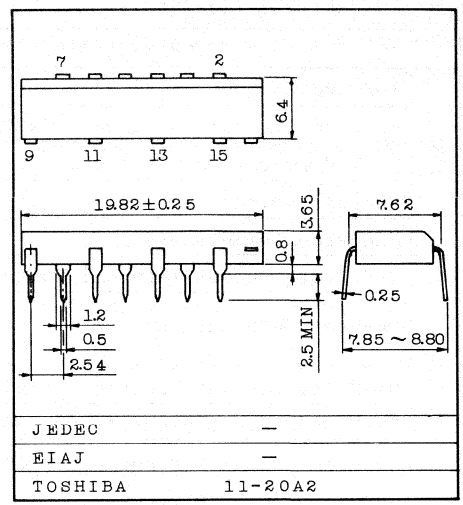
- Peak Off-State Voltage : 400V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 1.0A_{rms} Max.
- Isolation Voltage : 2500V_{rms} Min.
- UL Recognized : File No.E67349
- Trigger LED Current

CLASSIFICATION*	TRIGGER LED CURRENT (mA) V_T=6V, Ta=25°C		MARKING OF CLASSIFICATION
	MIN.	MAX.	
(IFT5)	-	5	T5
(IFT7)	-	7	T5,T7
Standard	-	10	T5,T7,Blank

* Ex. : (IFT5) ; TLP3520 (IFT5)

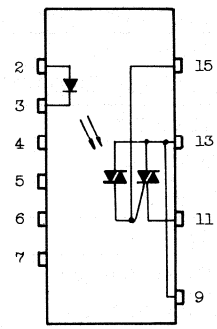
- Note: Application type name for certification test, please use standard product type name, i.e.
  TLP3520 (IFT5) : TLP3520

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-20A2

PIN CONFIGURATION (TOP VIEW)



2: ANODE
3: CATHODE
4,5,6,7: NC
9,13: TRIAC T2
11: TRIAC T1
15: TRIAC GATE

TLP3520

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current		I_F	50	mA
	Forward Current Derating (Ta≧53°C)		$\Delta I_F/°C$	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)		I_{FP}	1	A
	Reverse Voltage		V_R	5	V
	Junction Temperature		Tj	125	°C
DETECTOR	Off-State Output Terminal Voltage		V_{DRM}	400	V
	On-State RMS Current	Ta=40°C	$I_{T(RMS)}$	1.0	A
		Ta=60°C		0.7	
	On-State Current Derating (Ta≧40°C)		$\Delta I_T/°C$	-14.3	mA/°C
	Peak On-State Current (100μs pulse, 120pps)		I_{TP}	-	A
	Peak Nonrepetitive Surge Current (50Hz, Peak)		I_{TSM}	10	A
	Junction Temperature		Tj	110	°C
Storage Temperature Range			Tstg	-40~125	°C
Operating Temperature Range			Topr	-20~80	°C
Lead Soldering Temperature (10sec.)			Tsold	260	°C
Isolation Voltage (AC, 1 min., RH≦60%)			BVS	2500	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	CT	V=0, f=1MHz	-	30	-	pF
DETECTOR	Peak Off-State Current	I_{DRM}	V_{DRM}=400V, Ta=110°C	-	-	100	μA
	Peak On-State Voltage	V_{TM}	I_{TM}=1.5A	-	-	3.0	V
	Holding Current	I_H	R_L=100Ω	-	-	25	mA
	Critical Rate of Rise of Off-State Voltage	dv/dt	V_{in}=120V_{rms} (Fig. 1)	200	500	-	V/μs
	Critical Rate of Rise of Commutating Voltage	dv/dt(c)	V_{in}=120V_{rms}, I_T=1.0A_{rms} (Fig. 1)	-	5	-	V/μs

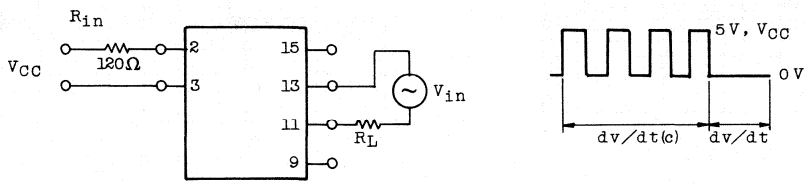
COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_T=6V	-	-	10	mA
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	1.5	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	2500	-	-	V_{rms}
		AC, 1 second	-	5000	-	
		DC, 1 minute	-	5000	-	V_{dc}

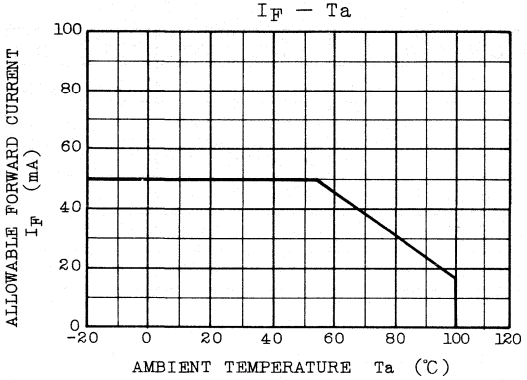
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	120	V_{ac}
Forward Current	I_F	15	20	25	mA
Peak On-State Current	I_{TP}	-	-	-	A
Operating Temperature	T_{opr}	-20	-	80	°C

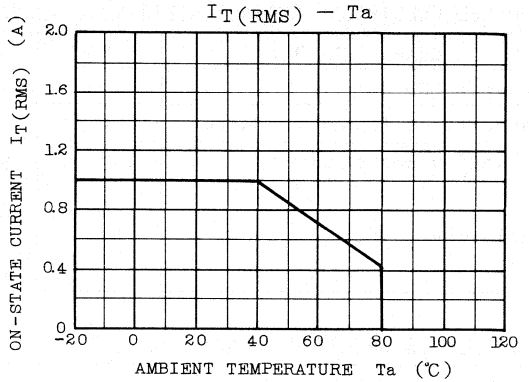
Fig.1 : dv/dt TEST CIRCUIT



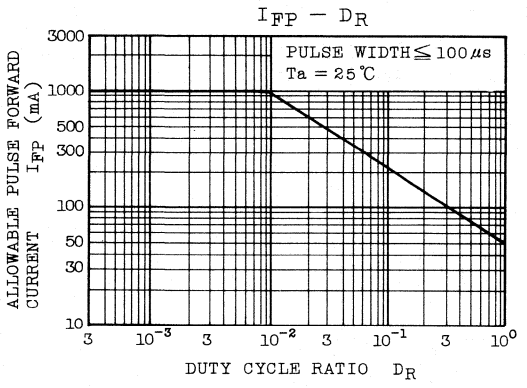
I_F — Ta



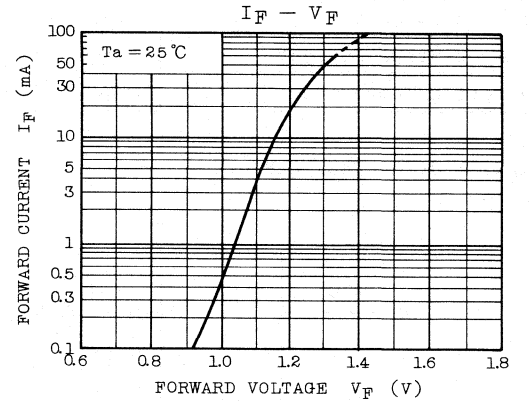
$I_{T(RMS)}$ — Ta



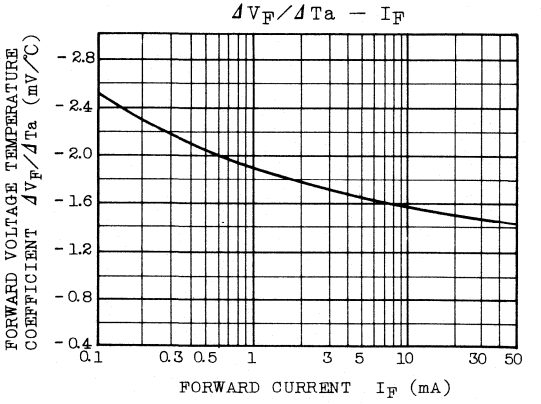
I_{FP} — D_R



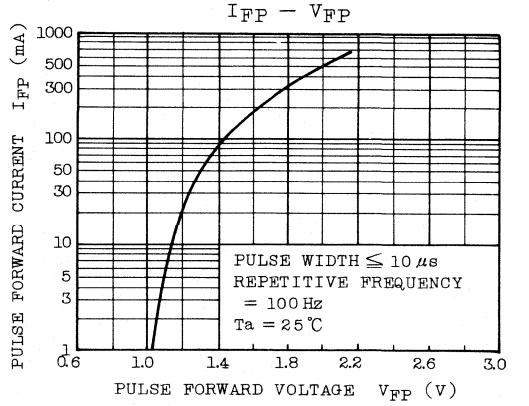
I_F — V_F



$\Delta V_F / \Delta Ta$ — I_F



I_{FP} — V_{FP}

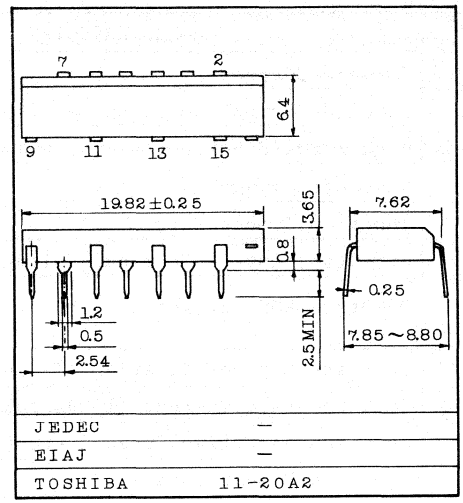


TRIAC DRIVER
PROGRAMMABLE CONTROLLERS
AC-OUTPUT MODULE
SOLID STATE RELAY

The TOSHIBA TLP3521 consists of a zero voltage crossing turn-on photo-triac optically coupled to a gallium arsenide infrared emitting diode in a 16 lead plastic DIP package.

- Peak Off-State Voltage : 400V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 1.0Arms Max.
- Isolation Voltage : 2500Vrms Min.
- UL Recognized : File No.E67349

Unit in mm



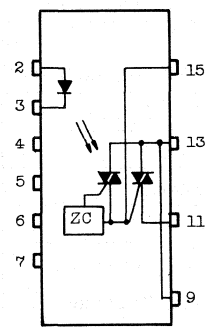
- Trigger LED Current

CLASSIFICATION*	TRIGGER LED CURRENT (mA) V_T=6V, Ta=25°C		MARKING OF CLASSIFICATION
	MIN.	MAX.	
(IFT5)	-	5	T5
(IFT7)	-	7	T5,T7
Standard	-	10	T5,T7,Blank

* Ex. : (IFT5) ; TLP3521 (IFT5)

- Note: Application type name for certification test, please use standard product type name, i.e.
  TLP3521 (IFT5) : TLP3521

PIN CONFIGURATIONS (TOP VIEW)



2: ANODE
3: CATHODE
4,5,6,7: NC
9,13: TRIAC T2
11: TRIAC T1
15: TRIAC GATE

TLP3521

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current		I_F	50	mA
	Forward Current Derating (Ta≧53°C)		$\Delta I_F/°C$	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)		I_{FP}	1	A
	Reverse Voltage		V_R	5	V
	Junction Temperature		Tj	125	°C
DETECTOR	Off-State Output Terminal Voltage		V_{DRM}	400	V
	On-State RMS Current	Ta=40°C	$I_{T(RMS)}$	1.0	A
		Ta=60°C		0.7	
	On-State Current Derating (Ta≧40°C)		$\Delta I_T/°C$	-14.3	mA/°C
	Peak On-State Current (100μs pulse, 120pps)		I_{TP}	-	A
	Peak Nonrepetitive Surge Current (50Hz, Peak)		I_{TSM}	10	A
	Junction Temperature		Tj	110	°C
Storage Temperature Range			T_{stg}	-40~125	°C
Operating Temperature Range			T_{opr}	-20~80	°C
Lead Soldering Temperature (10sec.)			T_{sold}	260	°C
Isolation Voltage (AC, 1 min., RH≦60%)			BVS	2500	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Peak Off-State Current	I_{DRM}	V_{DRM}=400V, Ta=110°C	-	-	100	μA
	Peak On-State Voltage	V_{TM}	I_{TM}=1.5A	-	-	3.0	V
	Holding Current	I_H	R_L=100Ω	-	-	25	mA
	Critical Rate of Rise of Off-State Voltage	dv/dt	V_{in}=120V_{rms} (Fig.1)	200	500	-	V/μs
	Critical Rate of Rise of Commutating Voltage	dv/dt(c)	V_{in}=120V_{rms}, I_T=1.0A_{rms} (Fig.1)	-	5	-	V/μs

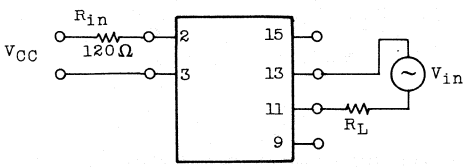
COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

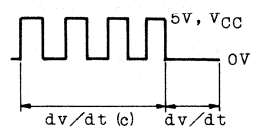
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_T=6V	-	-	10	mA
Inhibit Voltage	V_{IH}	I_F=Rated I_{FT}	-	-	50	V
Leakage in Inhibited State	I_{IH}	I_F=Rated I_{FT} V_T=Rated V_{DRM}	-	200	-	μA
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	1.5	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	2500	-	-	V_{rms}
		AC, 1 second	-	5000	-	
		DC, 1 minute	-	5000	-	Vdc

RECOMMENDED OPERATING CONDITIONS

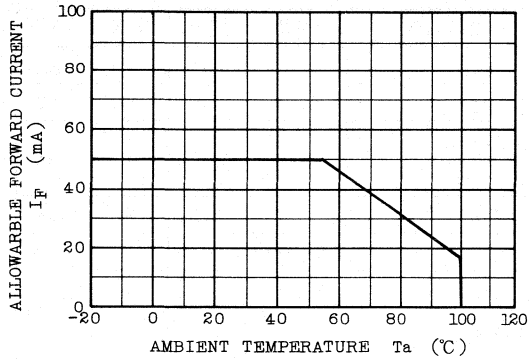
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	120	Vac
Forward Current	I_F	15	20	25	mA
Peak On-State Current	I_{TP}	-	-	-	A
Operating Temperature	Topr	-20	-	80	°C

Fig. 1 dv/dt TEST CIRCUIT

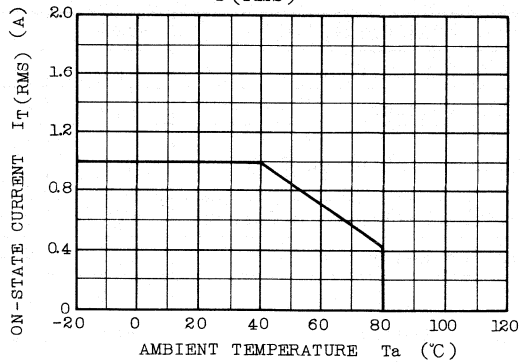




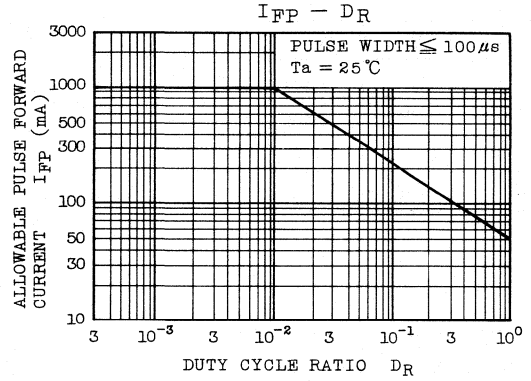
I_F — Ta



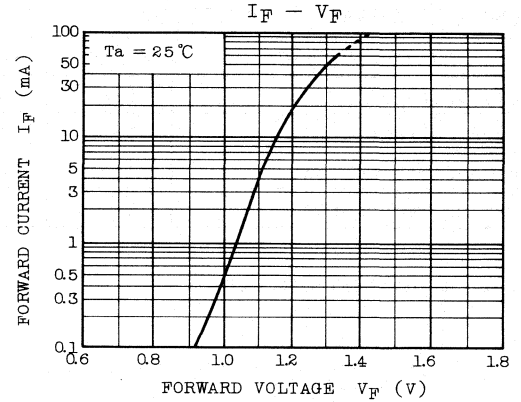
$I_{T(RMS)}$ — Ta



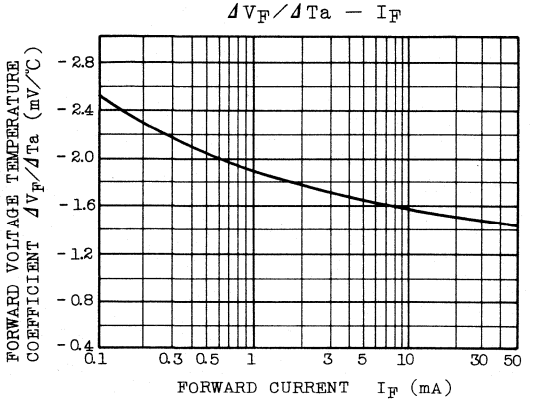
I_{FP} — D_R



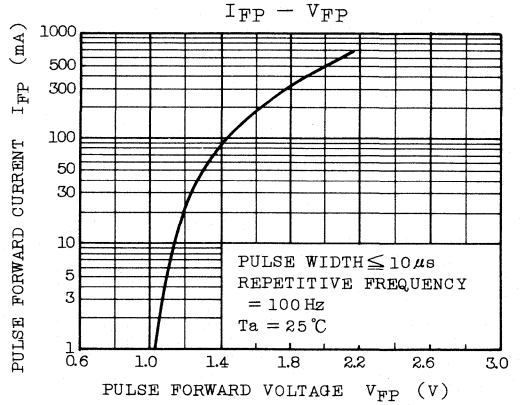
I_F — V_F



$\Delta V_F / \Delta Ta$ — I_F



I_{FP} — V_{FP}

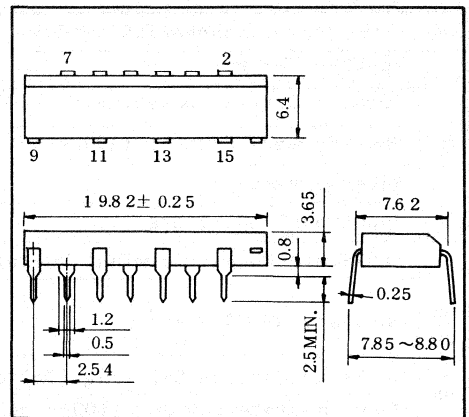


TRIAC DRIVER
PROGRAMMABLE CONTROLLERS
AC-OUTPUT MODULE
SOLID STATE RELAY

The TOSHIBA TLP3526 consists of a photo-triac optically coupled to a gallium arsenide infrared emitting diode in a 16 lead plastic DIP package.

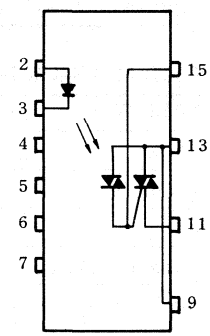
- Peak Off-State Voltage : 600V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 1.0Arms Max.
- Isolation Voltage : 2500Vrms Min.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-20A2

PIN CONFIGURATION (TOP VIEW)



2 : ANODE
3 : CATHODE
4, 5, 6, 7 : NC
9, 13 : TRIAC T2
11 : TRIAC T1
15 : TRIAC GATE

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current		I_F	50	mA
	Forward Current Derating (Ta≧53°C)		ΔI_F/°C	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)		I_{FP}	1	A
	Reverse Voltage		V_R	5	V
	Junction Temperature		T_j	125	°C
DETECTOR	Off-State Output Terminal Voltage		V_{DRM}	600	V
	On-State RMS Current	Ta=40°C	$I_{T(RMS)}$	1.0	A
		Ta=60°C		0.7	
	On-State Current Derating (Ta≧40°C)		ΔI_T/°C	-14.3	mA/°C
	Peak On-State Current (100μs pulse, 120pps)		I_{TP}	-	A
	Peak Nonrepetitive Surge Current (50Hz, Peak)		I_{TSM}	10	A
	Junction Temperature		T_j	110	°C
Storage Temperature Range			T_{stg}	-40∿125	°C
Operating Temperature Range			T_{opr}	-20∿80	°C
Lead Soldering Temperature (10sec.)			T_{sold}	260	°C
Isolation Voltage (AC, 1 min., RH≦60%)			BV_S	2500	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Peak Off-State Current	I_{DRM}	V_{DRM}=600V, Ta=110°C	-	-	100	μA
	Peak On-State Voltage	VTM	I_{TM}=1.5A	-	-	3.0	V
	Holding Current	I_H	R_L=100Ω	-	-	25	mA
	Critical Rate of Rise of Off-State Voltage	dv/dt	V_{in}=240V_{rms} (Fig. 1)	-	500	-	V/μs
	Critical Rate of Rise of Commutating Voltage	dv/dt(c)	V_{in}=240V_{rms}, I_T=1.0A_{rms} (Fig. 1)	-	5	-	V/μs

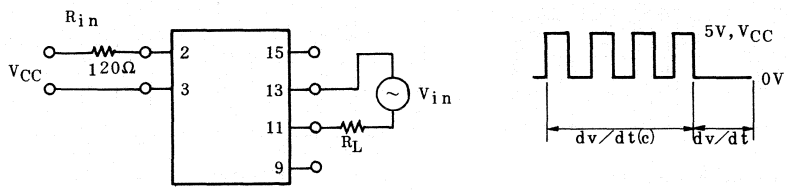
COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_T=6V	-	-	10	mA
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	1.5	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	2500	-	-	V_{rms}
		AC, 1 second	-	5000	-	
		DC, 1 minute	-	5000	-	Vdc

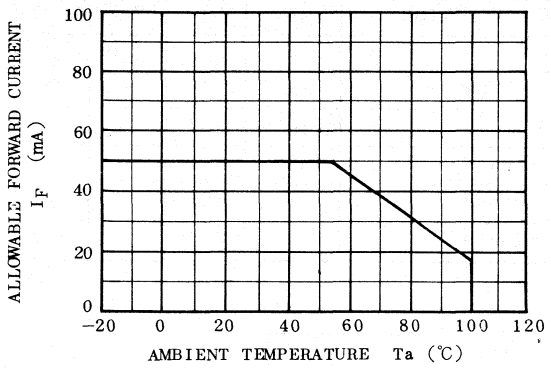
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	240	Vac
Forward Current	I_F	15	20	25	mA
Peak On-State Current	I_{TP}	-	-	-	A
Operating Temperature	T_{opr}	-20	-	80	°C

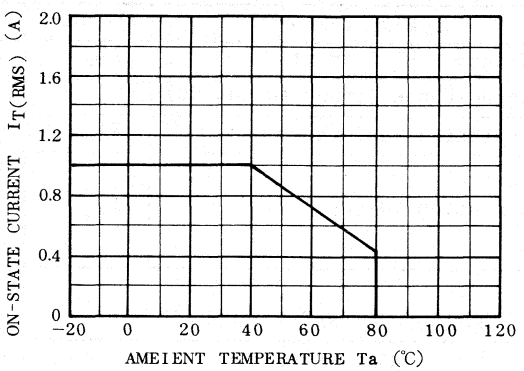
Fig.1 : dv/dt TEST CIRCUIT



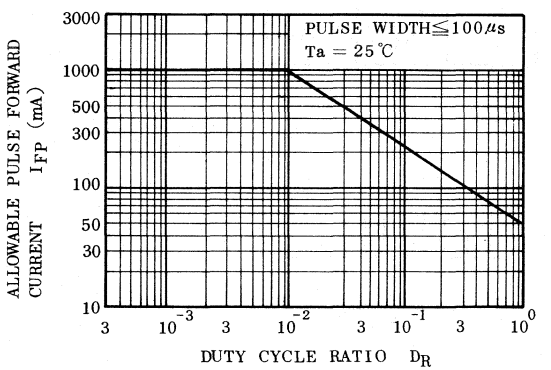
I_F – Ta



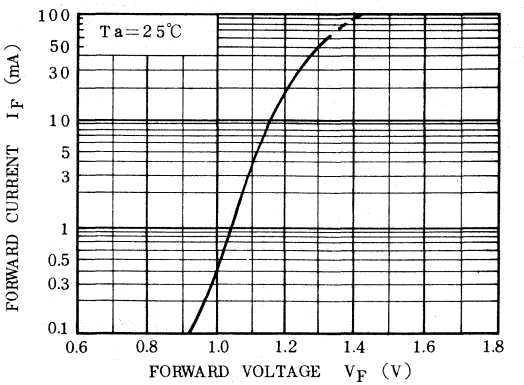
$I_{T(RMS)}$ – Ta



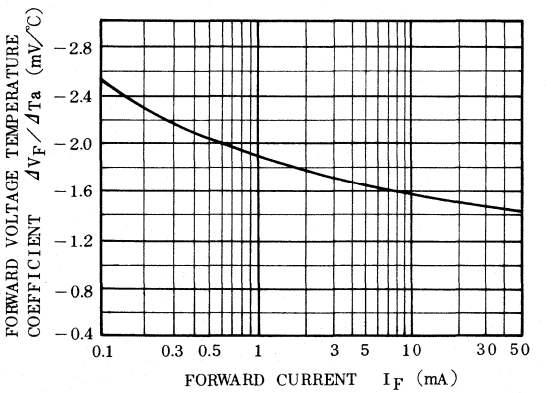
I_{FP} – D_R



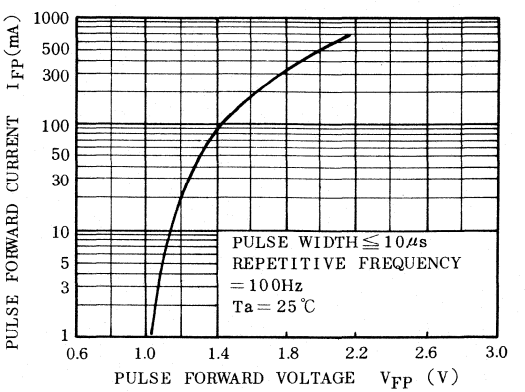
I_F – V_F



$\Delta V_F / \Delta Ta$ – I_F



I_{FP} – V_{FP}

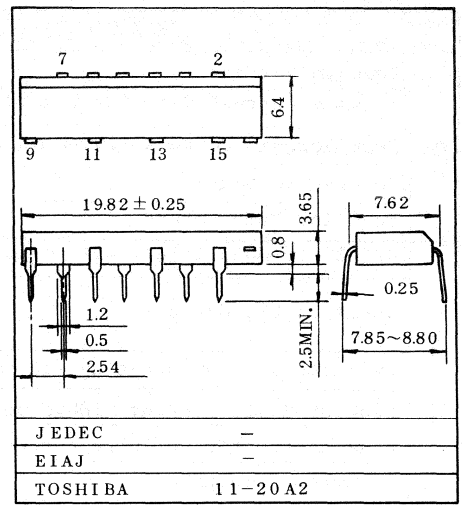


TRIAC DRIVER
PROGRAMMABLE CONTROLLERS
AC-OUTPUT MODULE
SOLID STATE RELAY

The TOSHIBA TLP3527 consists of a zero voltage crossing turn-on photo-triac optically coupled to a gallium arsenide infrared emitting diode in a 16 lead plastic DIP package.

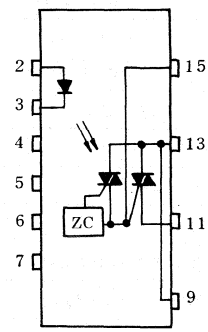
- Peak Off-State Voltage : 600V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 1.0Arms Max.
- Isolation Voltage : 2500Vrms Min.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-20A2

PIN CONFIGURATIONS (TOP VIEW)



2 : ANODE
3 : CATHODE
4, 5, 6, 7 : NC
9, 13 : TRIAC T2
11 : TRIAC T1
15 : TRIAC GATE

TLP3527

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current		I_F	50	mA
	Forward Current Derating (Ta≧53°C)		$\Delta I_F/°C$	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)		I_{FP}	1	A
	Reverse Voltage		V_R	5	V
	Junction Temperature		T_j	125	°C
DETECTOR	Off-State Output Terminal Voltage		V_{DRM}	600	V
	On-State RMS Current	Ta=40°C	$I_{T(RMS)}$	1.0	A
		Ta=60°C		0.7	
	On-State Current Derating (Ta≧40°C)		$\Delta I_T/°C$	-14.3	mA/°C
	Peak On-State Current (100μs pulse, 120pps)		I_{TP}	-	A
	Peak Nonrepetitive Surge Current (50Hz, Peak)		I_{TSM}	10	A
	Junction Temperature		Tj	110	°C
Storage Temperature Range			T_{stg}	-40∿125	°C
Operating Temperature Range			T_{opr}	-20∿80	°C
Lead Soldering Temperature (10sec.)			T_{sold}	260	°C
Isolation Voltage (AC, 1 min., RH≦60%)			BV_S	2500	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Peak Off-State Current	I_{DRM}	V_{DRM}=600V, Ta=110°C	-	-	100	μA
	Peak On-State Voltage	V_{TM}	I_{TM}=1.5A	-	-	3.0	V
	Holding Current	I_H	R_L=100Ω	-	-	25	mA
	Critical Rate of Rise of Off-State Voltage	dv/dt	Vin=240V_{rms} (Fig.1)	-	500	-	V/μs
	Critical Rate of Rise of Commutating Voltage	dv/dt(c)	V_{in}=240V_{rms}, I_T=1.0A_{rms} (Fig.1)	-	5	-	V/μs

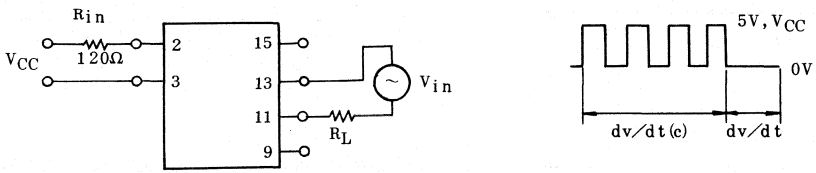
COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_T=6V	-	-	10	mA
Inhibit Voltage	V_{IH}	I_F=Rated I_{FT}	-	-	50	V
Leakage in Inhibited State	I_{IH}	I_F=Rated I_{FT} V_T=Rated V_{DRM}	-	200	-	μA
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	1.5	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	2500	-	-	Vrms
		AC, 1 second	-	5000	-	
		DC, 1 minute	-	5000	-	Vdc

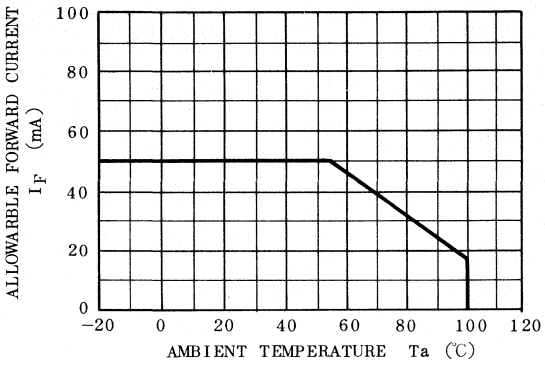
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	240	Vac
Forward Current	I_F	15	20	25	mA
Peak On-State Current	I_{TP}	-	-	-	A
Operating Temperature	T_{opr}	-20	-	80	°C

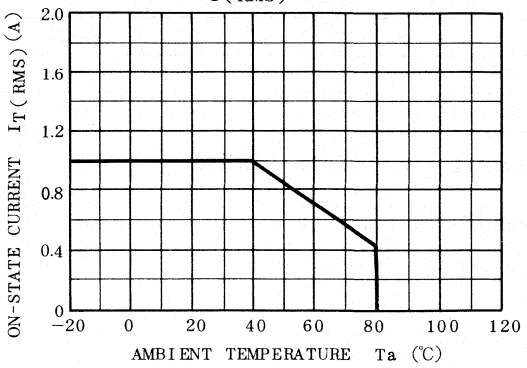
Fig. 1 dv/dt TEST CIRCUIT



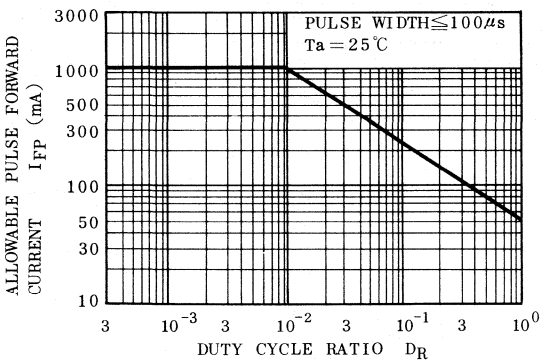
I_F – Ta



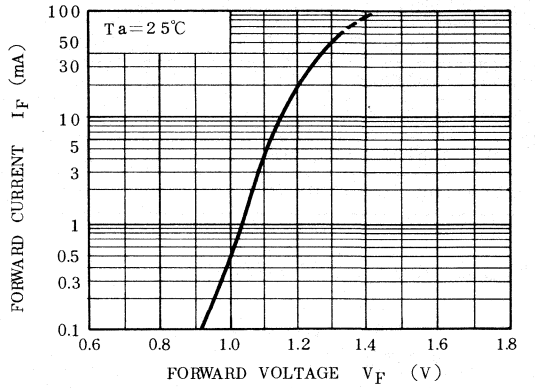
$I_{T(RMS)}$ – Ta



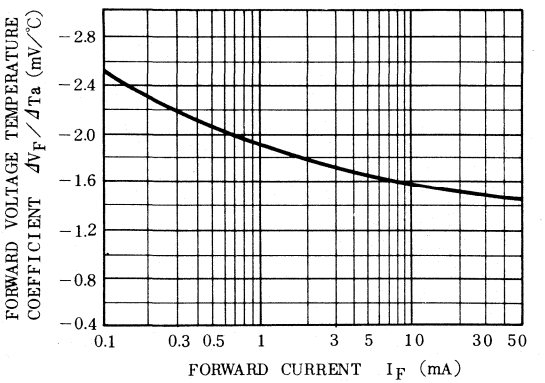
I_{FP} – D_R



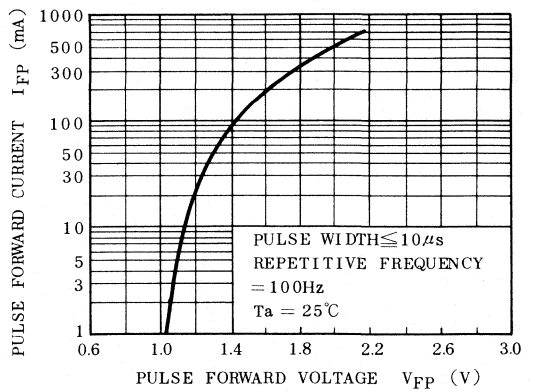
I_F – V_F



$\Delta V_F / \Delta Ta$ – I_F



I_{FP} – V_{FP}

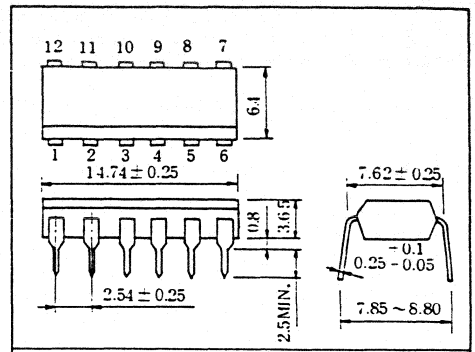


12PIN DIP 3 CHANNELS TYPE

Unit in mm

SOLID STATE RELAY.
I/O MODULE.
DATA INTERFACE.
THREE-PHASE MOTOR CONTROL.

The TOSHIBA 3 channels type series consist of 3 channels of 4 pin DIP photocouplers in a twelve plastic DIP package.



JEDEC	—
EIAJ	—
TOSHIBA	11-15A1

Type Name	Isolation Voltage	Feature	Pin Configulation
TLP321-3	5000V AC/1	Transistor Output	Fig. 2
TLP520-3	2500V AC/1	AC Input	Fig. 1
TLP523-3	" "	Darlington Output	Fig. 3
TLP525G-3	" "	Triac Output	Fig. 4
TLP620-3	5000V "	AC Input	Fig. 1
TLP621-3	" "	Transistor Output	Fig. 2
TLP624-3	" "	Low Input Current	Fig. 2
TLP626-3	" "	AC Input & Low Input Current	Fig. 1
TLP627-3	" "	300V Darlington Output	Fig. 3

. All electrical parameters are same as 2 channel of each types.
(Example) TLP520-3 → TLP520-2

. UL Recognized UL File No. E67349 (Use Type name for safety standard certificate application)

. PIN configuration

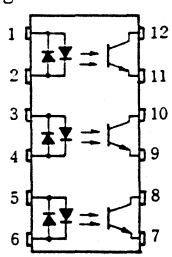


Fig 1

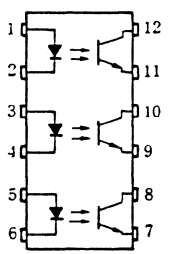


Fig 2

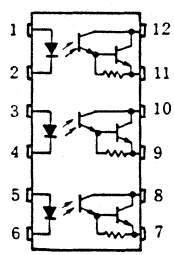


Fig 3

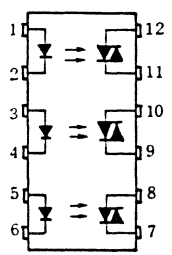


Fig 4

7. Data Sheets

7.2 Production Devices

7.2 Production Devices

The following devices are in production. However, these devices are not recommended for new designs.

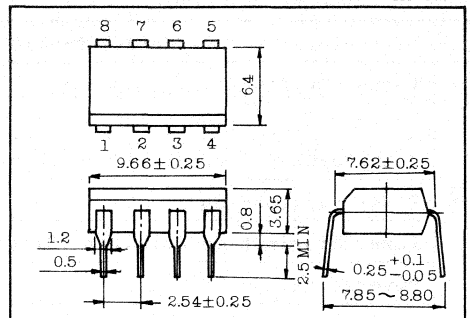
Type No.	Page
TLP511GA	467
TLP512	472
TLP513	478
TLP520	484
TLP520-2	484
TLP520-3	463
TLP520-4	484
TLP531	491
TLP532	491
TLP543J	499
TLP545J	499
TLP548G	504
TLP548J	509
TLP551	514
TLP552	520
TLP553	527
TLP554	532
TLP555	539
TLP576	220
TLP611J	545
TLP633	550
TLP634	550
TLP635	555
TLP635F	563
TLP636	555
TLP636F	563
TLP637	564
TLP637F	571
TLP638	564
TLP638F	571
TLP639	572
TLP639F	580
TLP641G	581
TLP641J	586
TLP645G	591
TLP645GF	596
TLP645J	597
TLP645JF	602
TLP647G	603
TLP647J	607
TLP665G	611
TLP665GF	616
TLP665J	617
TLP665JF	621
TLP666G	622
TLP666GF	626
TLP666J	627
TLP666JF	631
TLP675	632
TLP675F	638
TLP676	632
TLP676F	638
TLP677	639
TLP677F	646
TLP678	639
TLP678F	646

PROGRAMMABLE CONTROLLERS
AC-OUTPUT MODULE
SOLID STATE RELAY

The TOSHIBA TLP511GA consists of a photo-thyristor connected inverse parallel optically coupled to a gallium arsenide infrared emitting diode in an eight lead plastic DIP package.

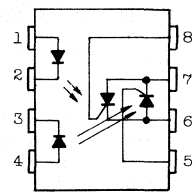
- Peak Off-State Voltage: 400V Min.
- Trigger LED Current : 7mA Max.
- On-State Current : 200mA Max.
- Isolation Voltage : 2500Vrms Min.
- UL Recognized : File No. E67349

Unit in mm



JEDEC	–
EIAJ	–
TOSHIBA	11-10C1

PIN CONFIGURATION (TOP VIEW)



1, 4: ANODE
2, 3: CATHODE
5, 8: GATE
6: CATHODE, ANODE
7: ANODE, CATHODE

MAXIMUM RATING (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Forward Current Derating (Ta≧25°C)	$\Delta I_F/°C$	-0.5	mA/°C
	Peak Forward Current (100μs pulse, 100pps)	I_{FP}	1	A
	Power Dissipation	P_D	100	mW
	Power Dissipation Derating (Ta≧25°C)	$\Delta P_D/°C$	-1.0	mW/°C
	Reverse Voltage	V_R	5	V
	Junction Temperature	T_j	125	°C
DETECTOR	Peak Forward Voltage (R_{GK}=27KΩ)	V_{DRM}	400	V
	Peak Reverse Voltage (R_{GK}=27KΩ)	V_{RRM}	400	V
	On-State Current	$I_{T(RMS)}$	200	mA
	On-State Current Derating (Ta≧25°C)	$\Delta I_T/°C$	-2.7	mA/°C
	Peak On-State Current (100μs pulse, 120pps)	I_{TP}	3	A
	Peak One Cycle Surge Current	I_{TSM}	2	A
	Peak Reverse Gate Voltage	V_{GM}	5	V
	Power Dissipation	P_D	200	mW
	Power Dissipation Derating (Ta≧25°C)	$\Delta P_D/°C$	-2.7	mW/°C
	Junction Temperature	T_j	100	°C
Storage Temperature Range		T_{stg}	-55∿150	°C
Operating Temperature Range		T_{opr}	-55∿100	°C
Lead Soldering Temperature (10sec.)		T_{sold}	260	°C
Total Package Power Dissipation		P_T	300	mW
Total Package Power Dissipation Derating (Ta≧25°C)		$\Delta P_T/°C$	-4.0	mW/°C
Isolation Voltage (AC, 1 min, RH≦60%)		BV_S	2500	Vrms

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA		1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V		-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz		-	30	-	pF
DETECTOR	Off-State Current	I_{DRM}	V_{AK}=400V, R_{GK}=27kΩ	Ta=25°C	-	10	5000	nA
				Ta=100°C	-	1	100	μA
	Reverse Current	I_{RRM}	V_{KA}=400V, R_{GK}=27kΩ	Ta=25°C	-	10	5000	nA
				Ta=100°C	-	1	100	μA
	On-State Voltage	V_{TM}	I_{TM}=100mA		-	0.9	1.3	V
	Holding Current	I_H	R_{GK}=27kΩ		-	0.2	-	mA
	Off-State dv/dt	dv/dt	V_{AK}=280V, R_{GK}=27kΩ		5	10	-	V/μs
	Capacitance	C_j	V=0, f=1MHz Anode to Gate Gate to Cathode		- -	20 350	- -	pF

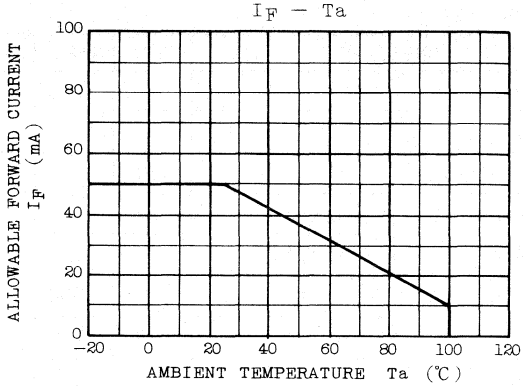
COUPLED CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_{AK}=6V, R_{GK}=27kΩ	1	4	7	mA
Turn-on Time	t_{on}	I_F=30mA, V_{AA}=50V, R_{GK}=27kΩ	-	10	-	μs
Coupled dv/dt	dv/dt	V_S=500V, R_{GK}=27kΩ	500	-	-	V/μs
Capacitance Input to Output	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	2500	-	-	V_{rms}
		AC, 1 second	-	5000	-	
		DC, 1 minute	-	5000	-	Vdc

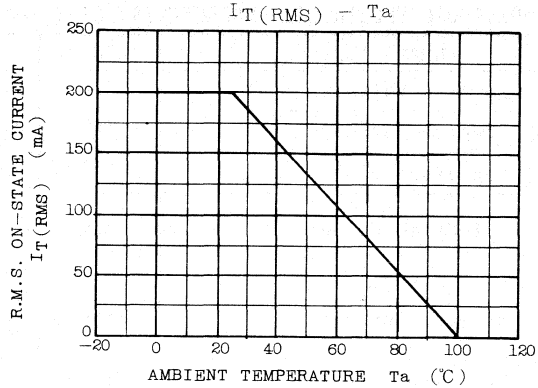
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	120	Vac
Forward Current	I_F	14	16	25	mA
Operating Temperature	Topr	-25	-	85	°C
Gate to Cathode Resistance	R_{GK}	-	27	33	kΩ
Gate to Cathode Capacity	C_{GK}	-	0.01	0.1	μF

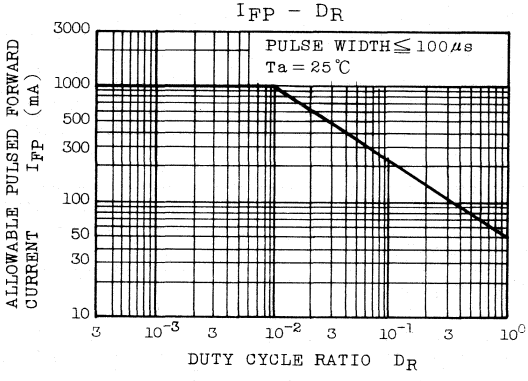
I_F – Ta



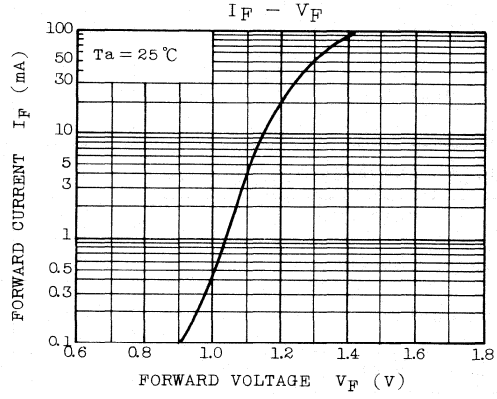
$I_{T(RMS)}$ – Ta



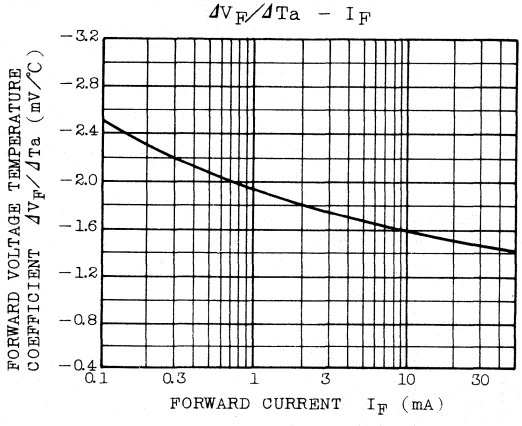
I_{FP} – D_R



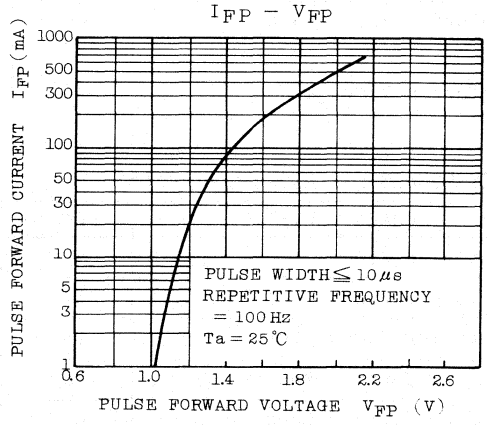
I_F – V_F



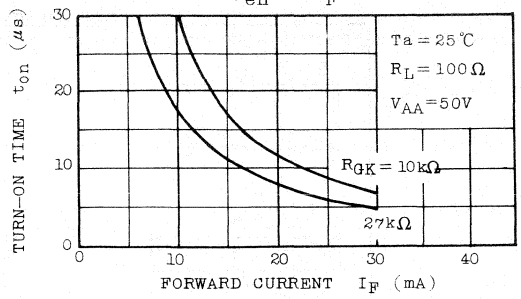
$\Delta V_F/\Delta Ta$ – I_F



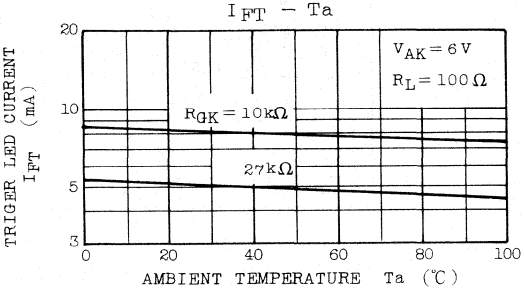
I_{FP} – V_{FP}



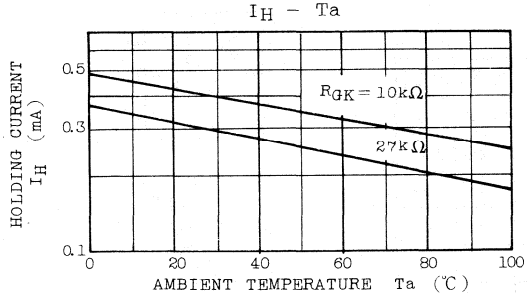
t_{en} – I_F



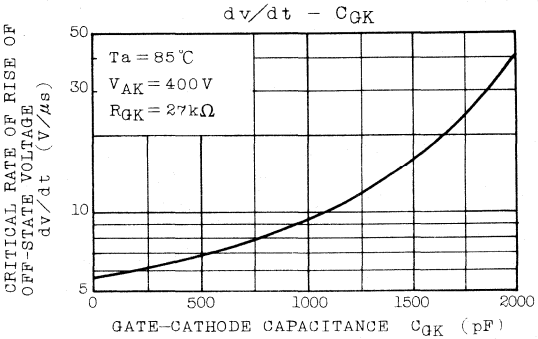
I_{FT} – Ta



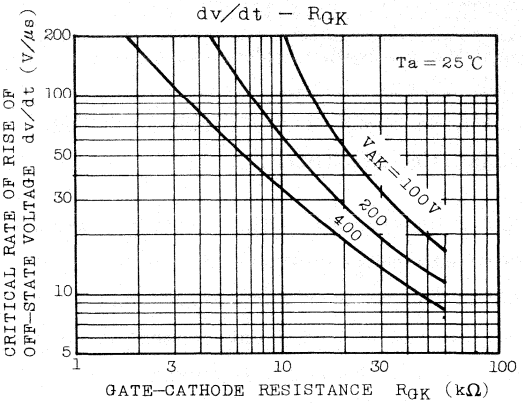
I_H – Ta



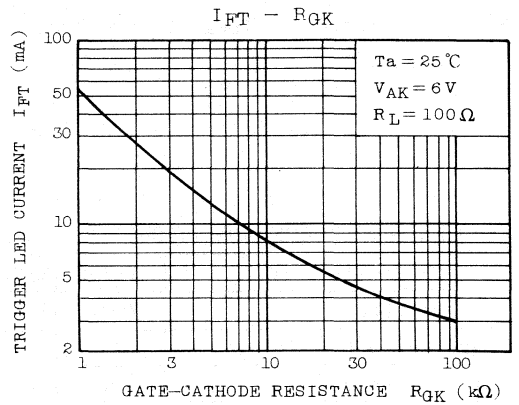
dv/dt – C_{GK}



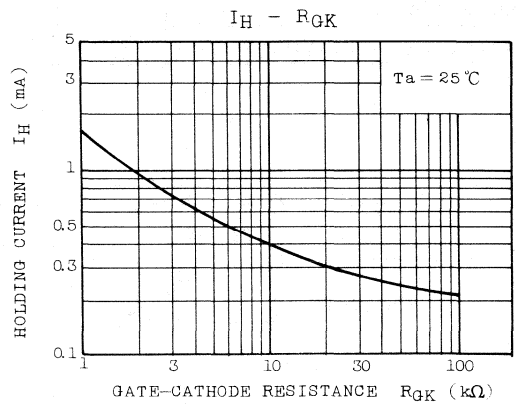
dv/dt – R_{GK}



I_{FT} – R_{GK}



I_H – R_{GK}



TLP512

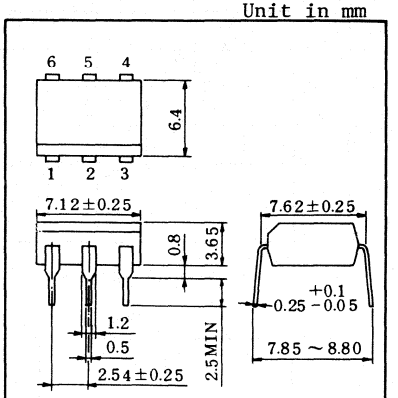
GaAℓAs IRED & PHOTO-IC

DEGITAL LOGIC ISOLATION.
ISOLATED LINE RECEIVER.
POWER SUPPLY CONTROL.
SWITCHING POWER SUPPLY FEEDBACK CONTROL.
TRANSISTOR INVERTOR.

TLP512 constructs a high emitting diode and a one chip photo diode-transistor.
TLP512 has no base connection, and is suitable for application at noisy environmental condition.
This unit is 6-lead DIP package.

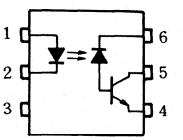
. Isolation Voltage : 2500V_{rms}(Min.)
. Switching Speed : t_{pHL}, t_{pLH}=0.8μs(Max.)(R_L=1.9kΩ)
. TTL Compatible

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-7A1

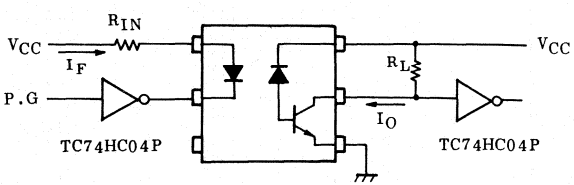
PIN CONFIGURATIONS (TOP VIEW)



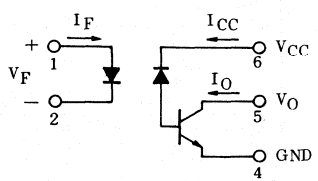
1: ANODE
2: CATHODE
3: NC
4: EMITTER(GND)
5: COLLECTOR(Output)
6: V_{CC}

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	4.5	5	15	V
Forward Current	I_F	16	16	20	mA
Input Resistance	R_{IN}	-	200	-	Ω
I_O × DTa ×Dtime		-	1.8	-	mA
Load Resistance	R_L	-	2.7	-	kΩ
Operating Temperature Range	T_{opr}	-25	25	85	°C



SCHEMATIC



MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current	(Note 1)	I_F	25	mA
	Pulse Forward Current	(Note 2)	I_{FP}	50	mA
	Peak Transient Forward Current	(Note 3)	I_{FPT}	1	A
	Reverse Voltage		V_R	5	V
	Diode Power Dissipation	(Note 4)	P_D	45	mW
DETECTOR	Output Current		I_O	8	mA
	Peak Output Current		I_{OP}	16	mA
	Supply Voltage		V_{CC}	-0.5~15	V
	Output Voltage		V_O	-0.5~15	V
	Output Power Dissipation	(Note 5)	P_O	100	mW
Operating Temperature Range			T_{opr}	-55~100	°C
Storage Temperature Range			T_{stg}	-55~125	°C
Lead Solder Temperature (10 sec.)		(Note 6)	Tsold	260	°C
Isolation Voltage (AC, 1 min., R.H≦60%, Note 7)			BV_S	2500	Vrms

Note 1 : Derate 0.8mA/°C above 70°C.

Note 2 : 50% duty cycle, 1ms pulse width.
Derate 1.6mA/°C above 70°C.

Note 3 : Pulse width≦1μs, 300pps.

Note 4 : Derate 0.9mW/°C above 70°C.

Note 5 : Derate 2mW/°C above 70°C.

Note 6 : Soldering portion of lead : up to 2mm from the body of the device.

ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=16mA	-	1.65	1.85	V
	Forward Voltage Temperature Coefficient	$\Delta V_F/\Delta Ta$	I_F=16mA	-	-2	-	mV/°C
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance Between Terminals	C_T	V_F=0, f=1MHz	-	60	-	pF
DETECTOR	High Level Output Current	$I_{OH(1)}$	I_F=0mA, V_{CC}=V_O=5.5V	-	3	500	nA
		$I_{OH(2)}$	I_F=0mA, V_{CC}=V_O=15V	-	-	5	μA
		I_{OH}	I_F=0mA, V_{CC}=V_O=15V Ta=70°C	-	-	50	
	High Level Supply Voltage	I_{CCH}	I_F=0mA, V_{CC}=15V	-	0.01	1	μA
COUPLED	Current Transfer Ratio	I_O/I_F	I_F=16mA, V_{CC}=4.5V V_O=0.4V	20	-	-	%
	Low Level Output Voltage	V_{OL}	I_F=16mA, V_{CC}=4.5V I_O=2.4mA	-	-	0.4	V
	Isolation Resistance	R_S	R.H.≦60% V_S=500V DC (Note 7)	5×10^{10}	10^{12}	-	Ω
	Stray Capacitance Between Input to Output	C_S	V_S=0, f=1MHz (Note 7)	-	0.8	-	pF

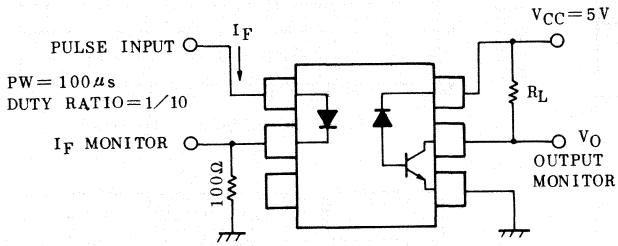
SWITCHING CHARACTERISTICS (Ta=25°C)

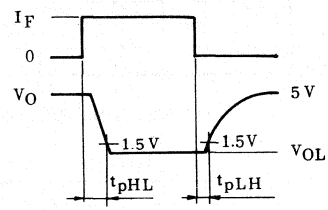
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Propagation Delay Time (H→L)	t_{pHL}	1	I_F=0→16mA V_{CC}=5V, R_L=1.9kΩ	-	-	0.8	μs
Propagation Delay Time (L→H)	t_{pLH}	1	I_F=16→0mA V_{CC}=5V, R_L=1.9kΩ	-	-	0.8	μs
Common Mode Transient Imunity at High Output Level	C_{MH}	2	I_F=0mA, V_{CM}=200Vp-p R_L=1.9kΩ	-	-1500	-	V/μs
Common Mode Transient Imunity at Low Output Level	C_{ML}	2	I_F=16mA, V_{CM}=200Vp-p R_L=1.9kΩ	-	-1500	-	V/μs

Note 7 : Device considered a two-terminal device : Pins 1, 2, and 3 shorted together and Pin 4,5 and 6 shorted together.

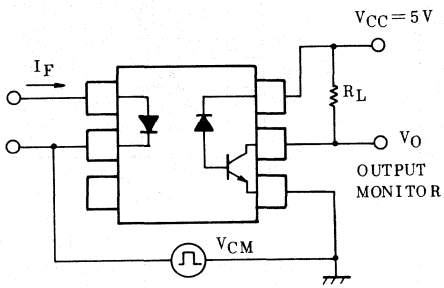
Note 8 : Maximum electrostatic discharge voltage for any pins : 100V (C=200pF, R=0)

TEST CIRCUIT 1 : Switching Time Test Circuit



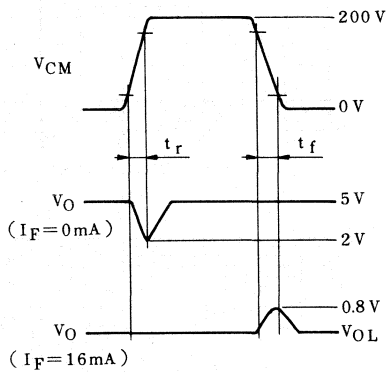


TEST CIRCUIT 2 : Common Mode Transient Immunity Test Circuit



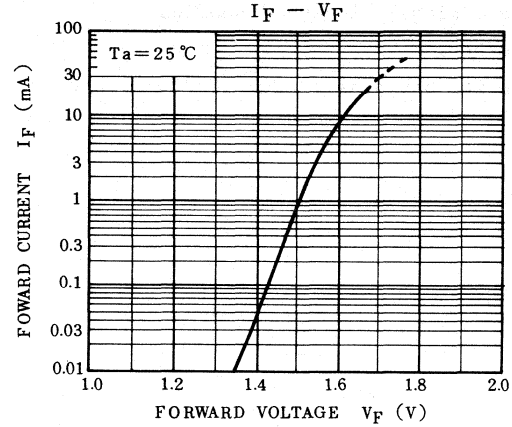
PULSE GEN

$Z_O = 50\,\Omega$

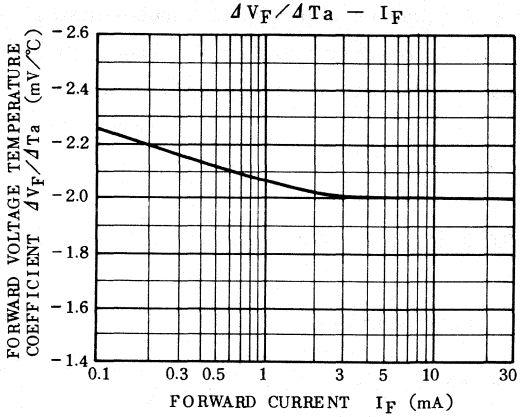


$$CM_H = \frac{160\ (V)}{t_r\ (\mu s)} \qquad CM_L = \frac{160\ (V)}{t_f\ (\mu s)}$$

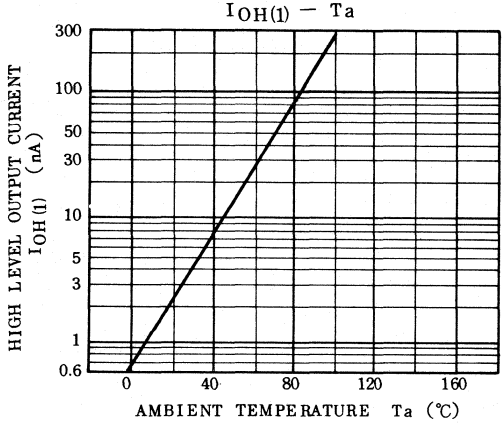
$I_F - V_F$



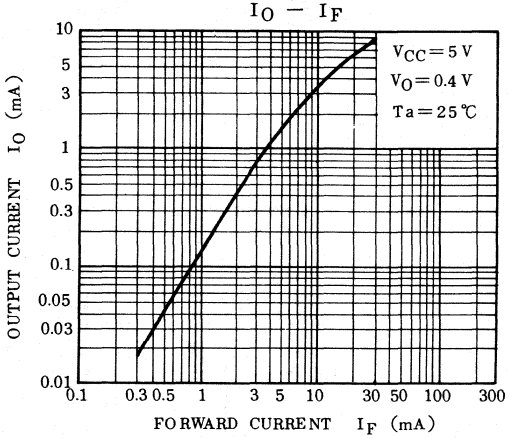
$\Delta V_F / \Delta Ta - I_F$



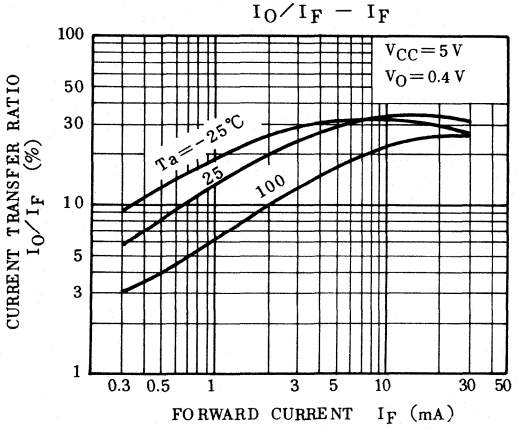
$I_{OH(1)} - Ta$



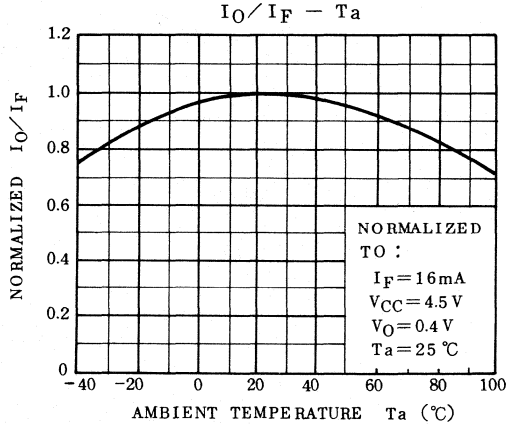
$I_O - I_F$



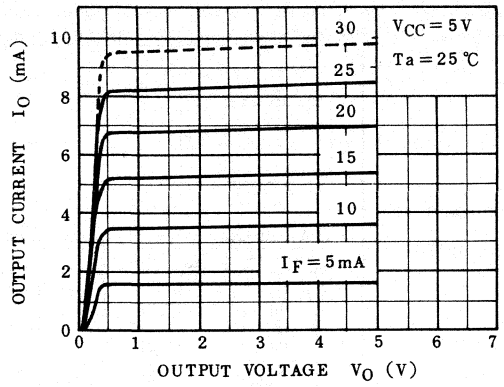
$I_O / I_F - I_F$



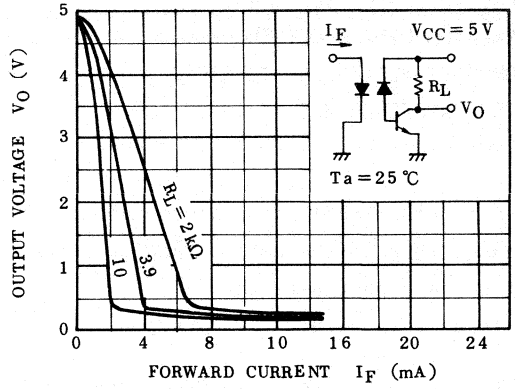
$I_O / I_F - Ta$



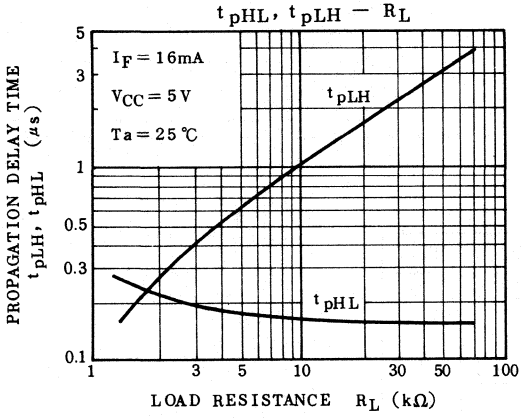
$I_O - V_O$



$V_O - I_F$



$t_{pHL}, t_{pLH} - R_L$



TLP513

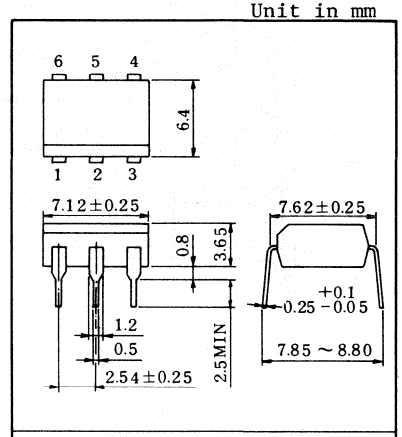
GaAℓAs IRED & PHOTO-IC

DEGITAL LOGIC ISOLATION.
ISOLATED LINE RECEIVER.
COMPUTER-PERIPHERAL INTERFACE.
MICROPROCESSOR SYSTEM INTERFACE.

The TOSHIBA TLP513 is a photocoupler which combines a GaAℓAs IRED as the emitter and an integrated high gain, high speed photodetector.
This unit is 6-lead DIP package.

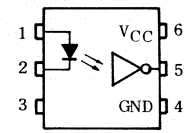
. Isolation Voltage : 2500V_{rms} Min.
. Switching Speed : tpHL, tpLH=60ns(Typ.)
@ R_L=350Ω
. TTL Compatible : V_{CC}=5V

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-7A1

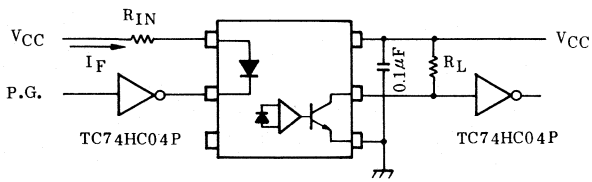
PIN CONFIGURATIONS (TIP VIEW)



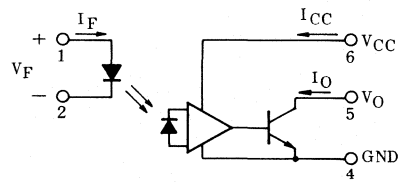
1: ANODE
2: CATHODE
3: NC
4: GND
5: OUTPUT(OPEN COLLECTOR)
6: V_{CC}

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	MAX.	UNIT
Supply Voltage	V_{CC}	4.5	5.5	V
Forward Current	I_F	6.3	20	mA
Input Resistance	R_{IN}	390 (Typ.)		Ω
Load Resistance	R_L	0.35	1	kΩ
Operating Temperature Range	Topr	0	70	°C



SCHEMATIC



TRUTH TABLE (Positive Logic)

INPUT	OUTPUT
H	L
L	H

A 0.1μF bypass capacitor must be connected between pin 6 and 4 (See Note 5).

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current		I_F	20	mA
	Pulse Forward Current	(Note 1)	I_{FP}	40	mA
	Peak Transient Forward Current	(Note 2)	I_{FPT}	1	A
	Reverse Voltage		V_R	5	V
	Diode Power Dissipation		P_D	40	mW
DETECTOR	Output Current		I_O	25	mA
	Output Voltage		V_O	7	V
	Supply Voltage (1 Minute Maximum)		V_{CC}	7	V
	Output Power Dissipation		P_o	40	mW
Operating Temperature Range			T_{opr}	-40~85	°C
Storage Temperature Range			T_{stg}	-55~125	°C
Lead Solder Temperature (10 sec.)		(Note 3)	T_{sold}	260	°C
Isolation Voltage (AC, 1 min., TH≦60%, Note 4)			BVS	2500	Vrms

Note 1 : 50% duty cycle, 1ms pulse width.

Note 2 : Pulse width ≦1μs, 300pps.

Note 3 : Soldering portion of lead : up to 2mm from the body of the device.

ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, Ta=0~70°C, V_{CC}=4.5~5.5V, V_{FL}≦1.0V)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=10mA, Ta=25°C	-	1.65	1.80	V
Forward Voltage Temperature Coefficient	V_F/ Ta	I_F=10mA	-	-2	-	mV/°C
Reverse Current	I_R	V_R=5V, Ta=25°C	-	-	10	μA
Capacitance Between Terminals	C_T	V_F=0, f=1MHz, Ta=25°C	-	45	-	pF
High Level Output Current	I_{OH}	V_F=1.0, V_O=5.5V	-	-	250	μA
		V_F=1.0, V_O=5.5V, Ta=25°C	-	0.5	10	
Low Level Output Voltage	V_{CL}	I_F=5mA I_{OL}=13mA(Sinking)	-	0.4	0.6	V
"H Level Output → L Level Output" Input Current	I_{FH}	I_{OL}=13mA(Sinking) V_{OL}=0.6V	-	-	5	mA
High Level Supply Current	I_{CCH}	V_{CC}=5.5V, I_F=0	-	7	15	mA
Low Level Supply Current	I_{CCL}	V_{CC}=5.5V, I_F=10mA	-	12	18	mA
Input-Output Insulation Leakage Current	I_S	V_S=3540V, t=5s Ta=25°C (Note 4)	-	-	100	μA
Isolation Resistance	R_S	R.H.≦60%, V_S=500V DC Ta=25°C (Note 4)	5×10^{10}	10^{12}	-	Ω
Stray Capacitance Between Input to Output	C_S	V_S=0, f=1MHz Ta=25°C (Note 4)	-	0.6	-	pF

* All typical values are V_{CC}=5V, Ta=25°C

SWITCHING CHARACTERISTICS (V_{CC}=5V, Ta=25°C)

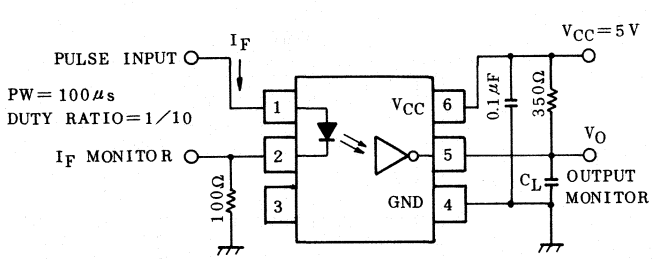
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Propagation Delay Time (H→L)	t_{pHL}	1	I_F=0→7.5mA C_L=15pF, R_L=350Ω	-	-	120	ns
Propagation Delay Time (L→H)	t_{pLH}	1	I_F=7.5→0mA C_L=15pF, R_L=350Ω	-	-	120	ns
Output Rise-Fall Time (10-90%)	tr,tf	2	R_L=350 , C_L=15pF I_F=0⇄7.5mA	-	30	-	ns
Common Mode Transient Imunity at High Output Level	C_{MH}	2	I_F=0mA, V_{CM}=200Vp-p $V_{O(MIN)}$=2V, R_L=350Ω	-	200	-	V/μs
Common Mode Transient Imunity at Low Output Level	C_{ML}	2	I_F=16mA, V_{CM}=200Vp-p $V_{O(MAX)}$=0.8V, R_L=350Ω	-	-500	-	V/μs

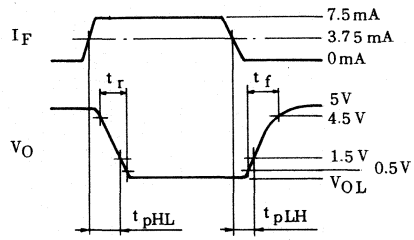
Note 4 : Device considered a two-terminal device : Pins 1, 2, and 3 shorted together and Pin 4,5 and 6 shorted together.

Note 5 : The V_{CC} supply voltage to each TLP513 isolator must be bypassed by 0.1μF capacitor. This can be either a ceramic or solid tantalum capacitor with good high frequency characteristic and should be connected as close as possible to package V_{CC} and GND pins of each device.

Note 6 : Maximum electrostatic discharge voltage for any pins : 180V (C=200pF, R=0)

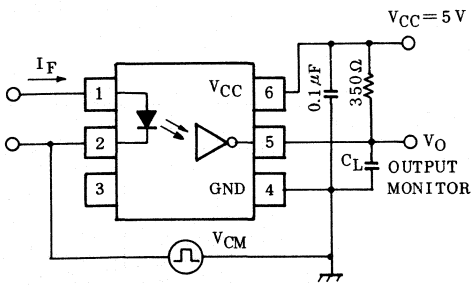
TEST CIRCUIT 1 : Switching Time Test Circuit





C_L is approximately 15pF which includes probe and stray wiring capacitance.

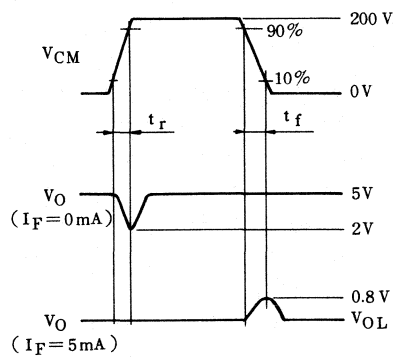
TEST CIRCUIT 2 : Common Mode Transient Immunity Test Circuit



PULSE GEN

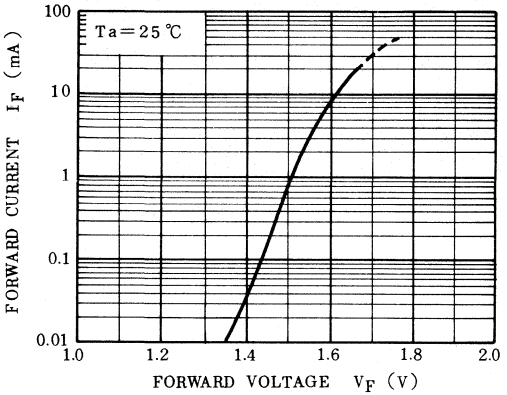
$Z_O = 50\,\Omega$

$CM_H = \frac{160\ (V)}{t_r\ (\mu s)}$, $CM_L = \frac{160\ (V)}{t_f\ (\mu s)}$

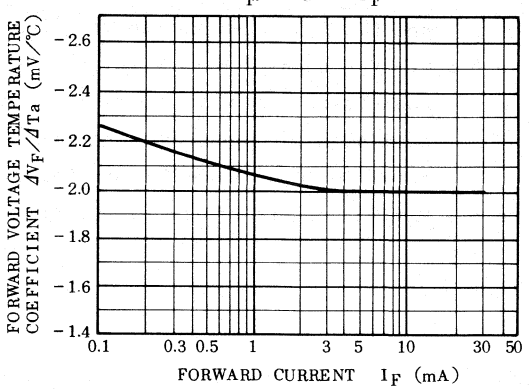


C_L is approximately 15pF which includes probe and stray wiring capacitance.

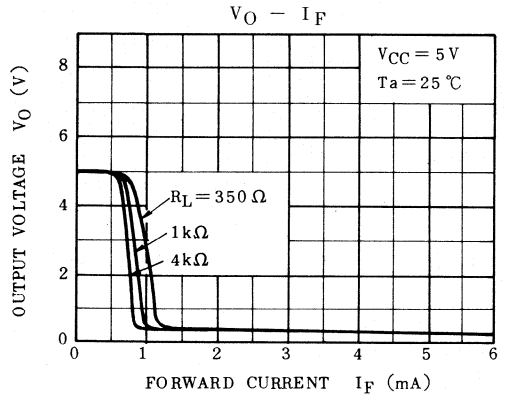
$I_F - V_F$



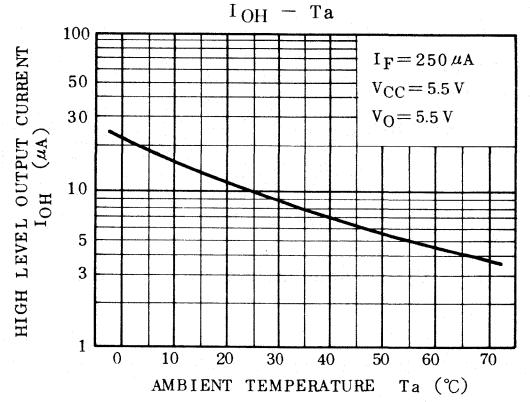
$\Delta V_F / \Delta Ta - I_F$



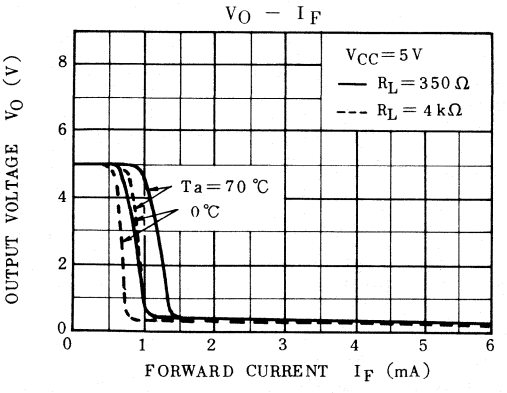
$V_O - I_F$



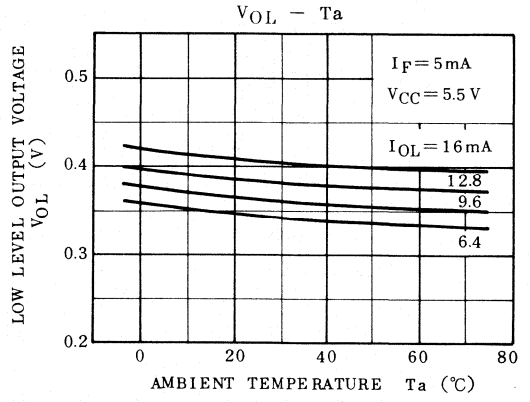
$I_{OH} - Ta$



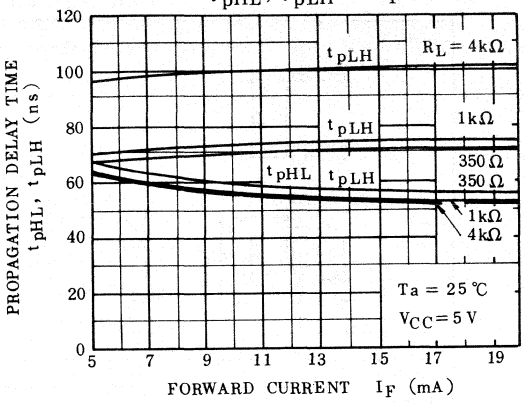
$V_O - I_F$



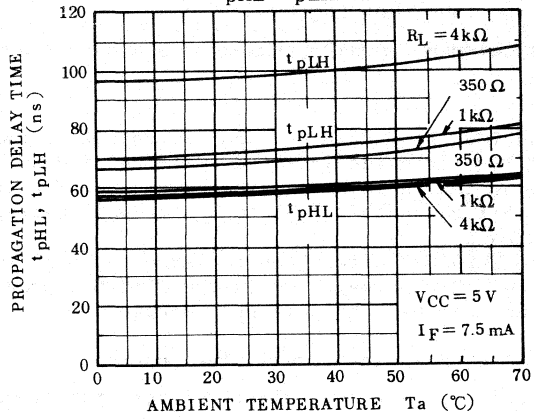
$V_{OL} - Ta$



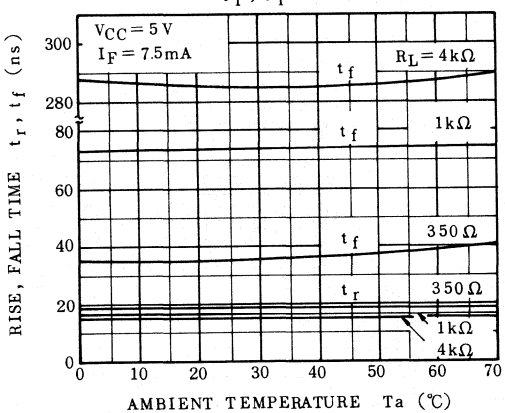
$t_{pHL}, t_{pLH} - I_F$



$t_{pHL}, t_{pLH} - Ta$



$t_r, t_f - Ta$



TLP520, TLP520-2, TLP520-4

GaAs IRED & PHOTO-TRANSISTOR

AC/DC-INPUT MODULES

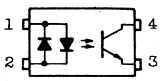
PROGRAMMABLE CONTROLLERS

The TOSHIBA TLP520, -2 and -4 consist of two gallium arsenide infrared emitting diodes connected in inverse parallel and coupled with a silicon photo-transistor in a dual in-line package.
The TLP520-2 offers two isolated channels in a single DIP package, while the TLP520-4 provides four isolated channels per package.

- AC or Polarity Insensitive Inputs
- Built-in Reverse Polarity Input Protection
- Isolation Voltage ..... 2500V_{rms} Min.
- Current Transfer Ratio ..... 50% Min.
- BV_{CEO} : 55V Min.
- UL Recognized : File No. E67349

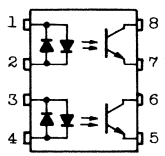
PIN CONFIGURATIONS (TOP VIEW)

TLP520



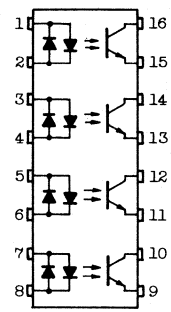
1 : ANODE
CATHODE
2 : CATHODE
ANODE
3 : EMITTER
4 : COLLECTOR

TLP520-2



1,3 : ANODE
CATHODE
2,4 : CATHODE
ANODE
5,7 : EMITTER
6,8 : COLLECTOR

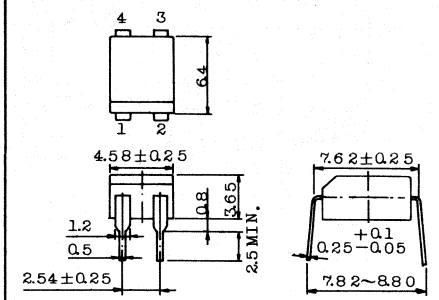
TLP520-4



1,3,5,7 : ANODE
CATHODE
2,4,6,8 : CATHODE
ANODE
9,11,13,15 : EMITTER
10,12,14,16 : COLLECTOR

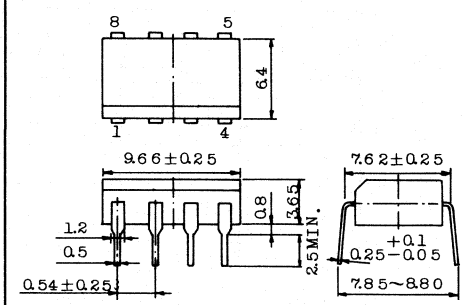
Unit in mm

TLP520



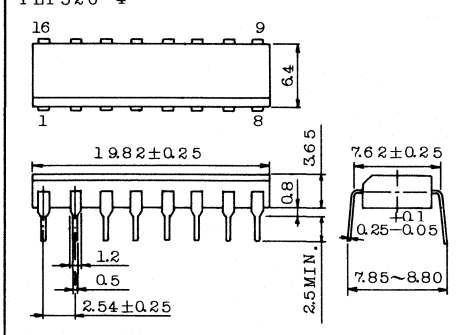
JEDEC	—
EIAJ	—
TOSHIBA	11−5B1

TLP520-2



JEDEC	—
EIAJ	—
TOSHIBA	11−10C1

TLP520-4



JEDEC	—
EIAJ	—
TOSHIBA	11−20A1

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING		UNIT
			TLP520	TLP520-2,TLP520-4	
LED	Forward Current	$I_{F(RMS)}$	60	50	mA
LED	Forward Current Derating	$\Delta I_F/°C$	-0.7 (Ta≧39°C)	-0.5 (Ta≧25°C)	mA/°C
LED	Pulse Forward Current	I_{FP}	±1 (100μs pulse, 100 pps)		A
DETECTOR	Collector-Emitter Voltage	V_{CEO}	55		V
DETECTOR	Emitter-Collector Voltage	V_{ECO}	7		V
DETECTOR	Collector Current	I_C	50		mA
DETECTOR	Collector Power Dissipation (1 Circuit)	P_C	150	100	mW
DETECTOR	Collector Power Dissipation Derating (1 Circuit) (Ta≧25°C)	$\Delta P_C/°C$	-1.5	-1.0	mW/°C
Operating Temperature Range		T_{opr}	-55~100		°C
Storage Temperature Range		T_{stg}	-55~125		°C
Total Power Dissipation		P_T	250	150	mW
Total Power Dissipation Derating (Ta≧25°C)		$\Delta P_T/°C$	-2.5	-1.5	mW/°C
Isolation Voltage		BV_S	2500 (AC, 1 min., RH≦60%)		V_{rms}

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	-	5	24	V
Forward Current	I_F	-	16	20	mA
Operating Temperature Range	T_{opr}	-25	-	85	°C

PRECAUTION

Please be careful of the followings.

1. Soldering temperature: 260°C MAX. Soldering time: 10 sec MAX.
   (Soldering portion of lead: up to 2mm from the body of the device)
2. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E

ELECTRICAL CHARACTERISTICS (Ta=25°C)

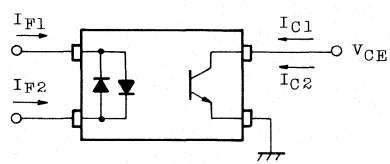
	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=±10mA	1.0	1.15	1.3	V
	Forward Current	I_F	V_F=±0.7V	-	2.5	20	μA
	Capacitance	C_T	V=0, f=1MHz	-	60	-	pF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=0.5mA	55	-	-	V
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	7	-	-	V
	Collector Dark Current	I_{CEO}	V_{CE}=24V	-	10	100	nA
			V_{CE}=24V, Ta=85°C	-	2	50	μA
	Capacitance Collector to Emitter	C_{CE}	V_{CE}=0, f=1MHz	-	10	-	pF
COUPLED	Current Transfer Ratio (Note 1)	I_C/I_F	I_F=±5mA, V_{CE}=5V	50	200	600	%
			I_F=±1mA, V_{CE}=0.4V	-	100	-	
	Off-State Collector Current	$I_{C(OFF)}$	V_F=±0.7V, V_{CE}=24V	-	1	10	μA
	Saturation Voltage	$V_{CE(sat)}$	I_F=8mA, I_C=2.4mA	-	-	0.4	V
	Capacitance Input to Output	C_S	V=0, f=1MHz	-	0.8	-	pF
	Isolation Resistance	R_S	V=500V	5×10^{10}	10^{14}	-	Ω
	Rise and Fall Time	t_r, t_f	V_{CE}=10V, R_L=100Ω, I_C=2mA	-	2,3	-	μs
	CTR Symmetry (Note 2)	$I_{C(Ratio)}$	I_F=5mA, V_{CE}=5V	0.33	1	3	-

Note 1 : CTR rank

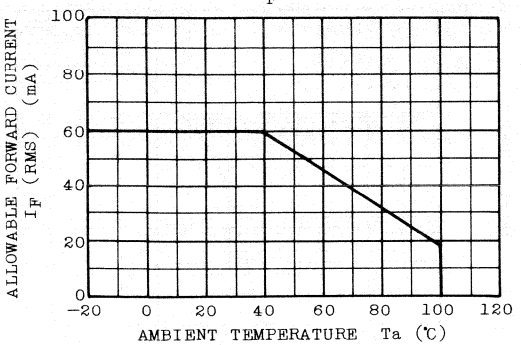
2 : $I_{C(Ratio)}$

$$= \frac{I_{C2}(I_F=-5mA,\ V_{CE}=5V)}{I_{C1}(I_F=+5mA,\ V_{CE}=5V)}$$

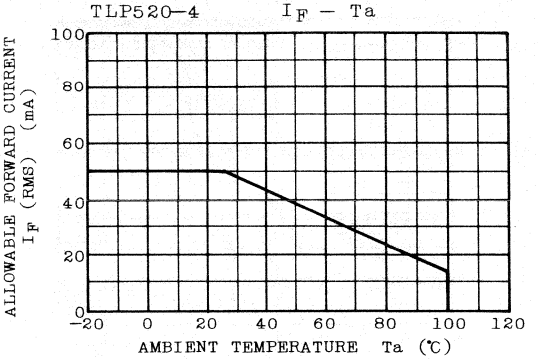
RANK NAME	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Rank GB	I_F=±5mA, V_{CE}=5V	100	-	600	%
	I_F=±1mA, V_{CE}=0.4V	30	-	-	



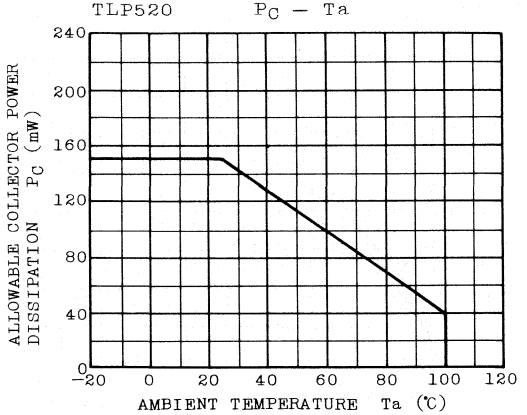
TLP520 I_F – Ta



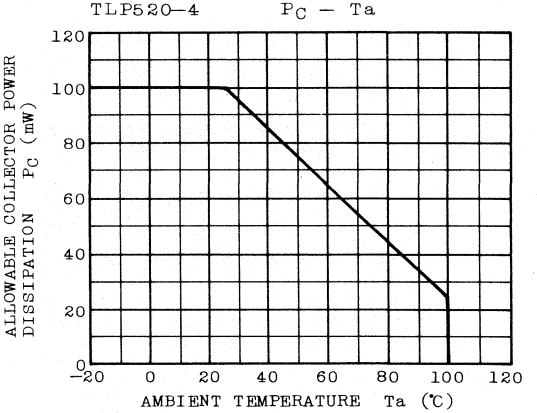
TLP520-2
TLP520-4 I_F – Ta



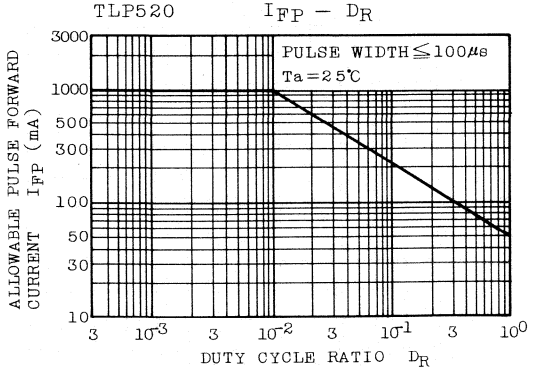
TLP520 P_C – Ta



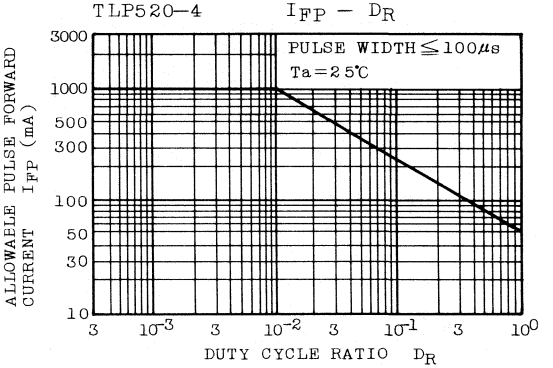
TLP520-2
TLP520-4 P_C – Ta



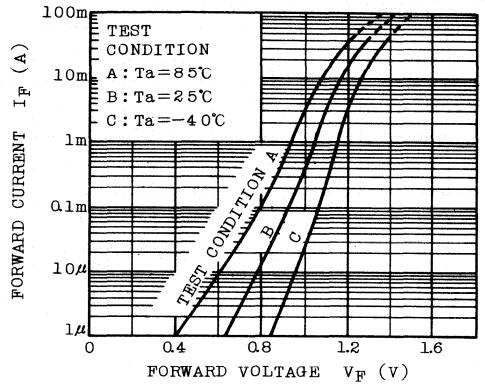
TLP520 I_{FP} – D_R



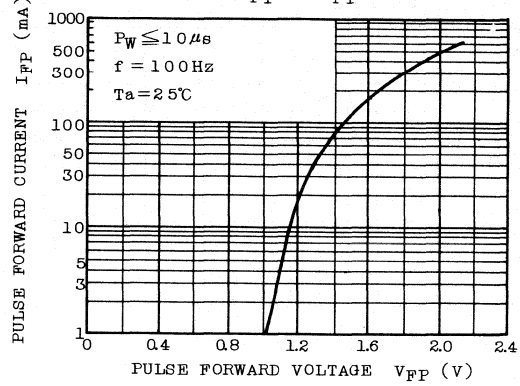
TLP520-2
TLP520-4 I_{FP} – D_R



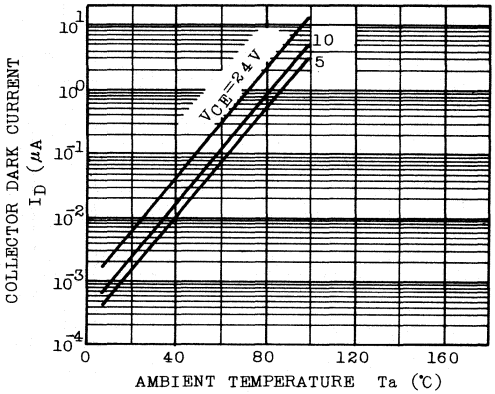
$I_F - V_F$



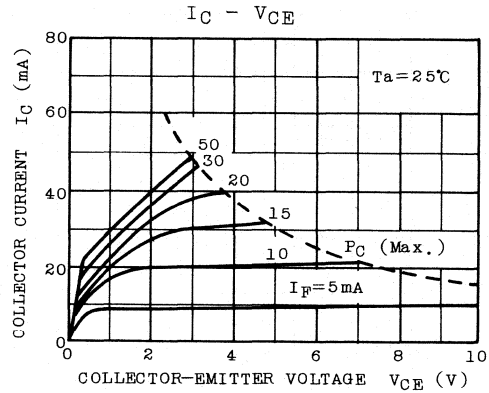
$I_{FP} - V_{FP}$



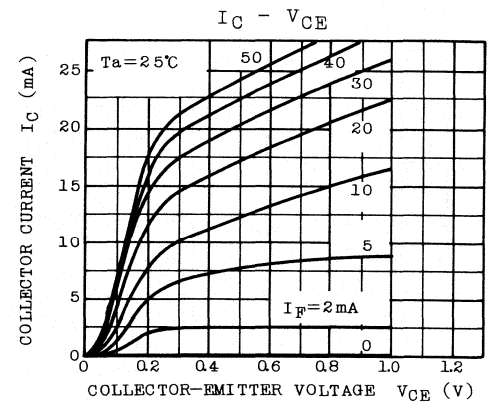
$I_D - Ta$



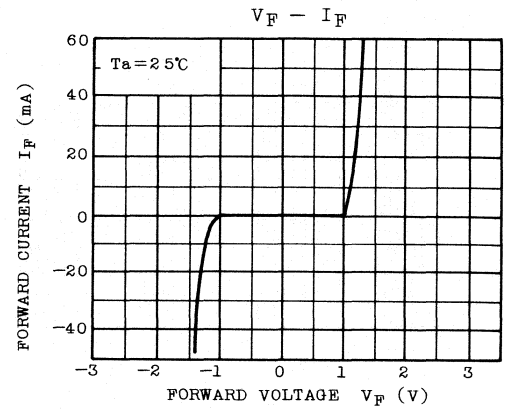
$I_C - V_{CE}$



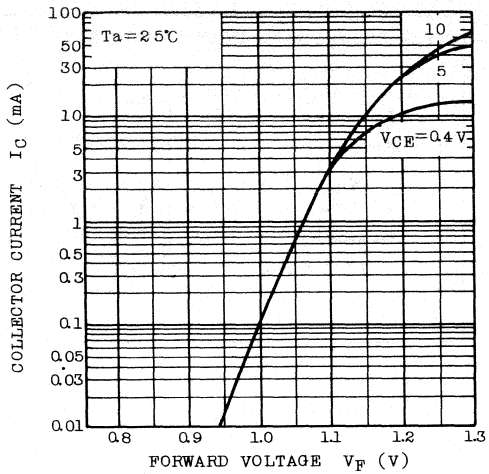
$I_C - V_{CE}$



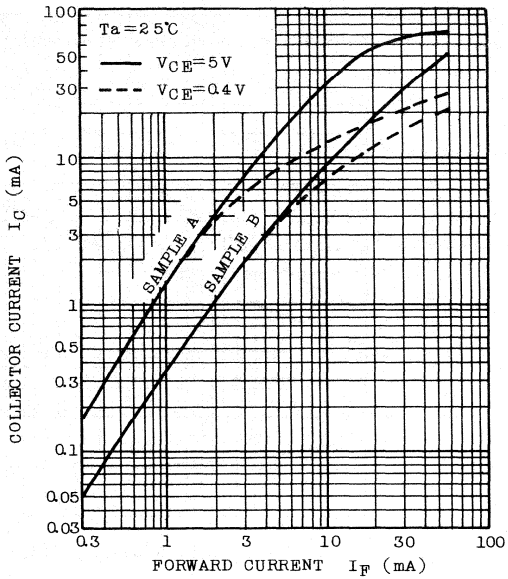
$V_F - I_F$



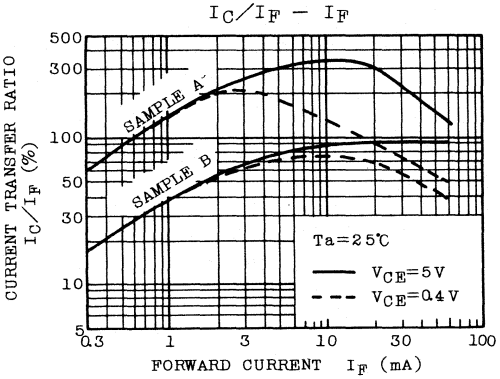
$I_C - V_F$



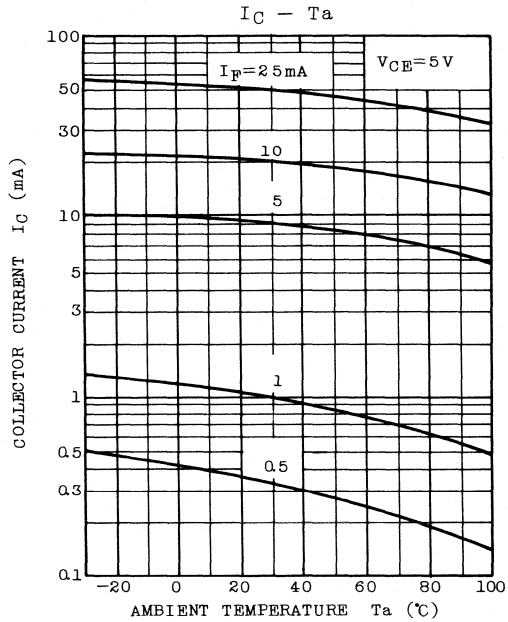
$I_C - I_F$



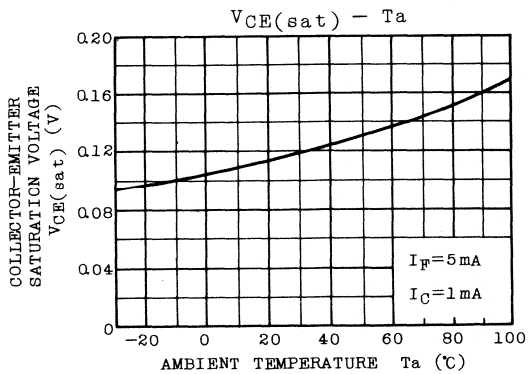
$I_C/I_F - I_F$



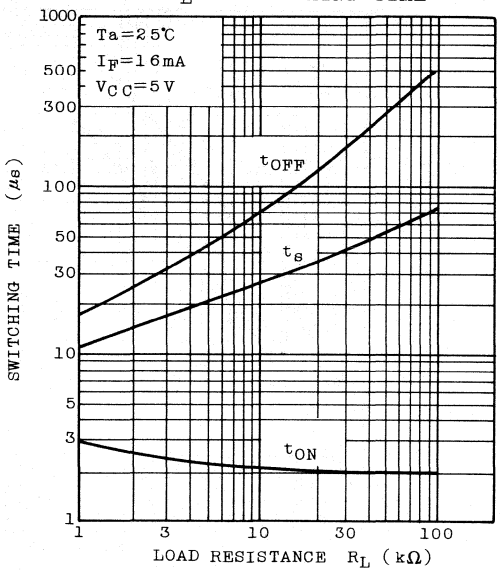
$I_C - Ta$



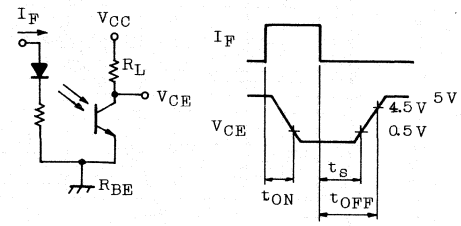
$V_{CE(sat)} - Ta$



R_L - SWITCHING TIME



t_{on}, t_{off}, t_s TEST CONDITION



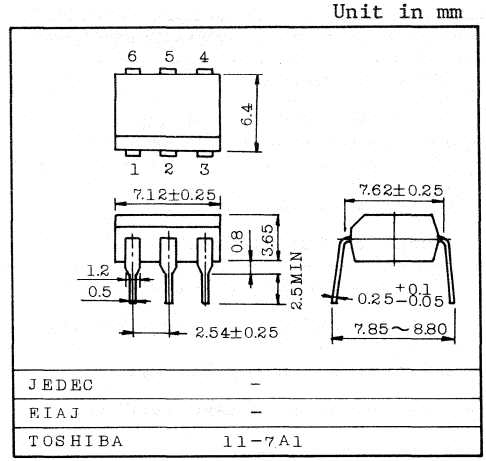
TLP531, TLP532

PROGRAMMABLE CONTROLLERS
AC/DC-INPUT MODULE
SOLID STATE RELAY

The TOSHIBA TLP531 and TLP532 consist of a photo-transistor optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.
TLP532 is no-base internal connection for high-EMI environments.

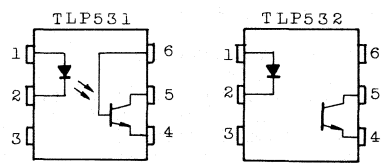
- Collector-Emitter Voltage: 55V Min.
- Current Transfer Ratio : 50% Min.
  Rank GB: 100% Min.
- Isolation Voltage : 2500Vrms Min.
- UL Recognized : File No. E67349

Unit in mm



JEDEC	–
EIAJ	–
TOSHIBA	11-7A1

PIN CONFIGURATION (TOP VIEW)



TLP531	TLP532
1. ANODE	1. ANODE
2. CATHODE	2. CATHODE
3. NC	3. NC
4. EMITTER	4. EMITTER
5. COLLECTOR	5. COLLECTOR
6. BASE	6. NC

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	70	mA
	Forward Current Derating (Ta ≧ 50°C)	ΔI_F/°C	0.93	mA/°C
	Peak Forward Current (100μs pulse, 100pps)	I_{FP}	1	A
	Reverse Voltage	V_R	5	V
	Junction Temeprature	T_j	125	°C
DETECTOR	Collector-Emitter Voltage	V_{CEO}	55	V
	Collector-Base Voltage (TLP531)	V_{CBO}	80	V
	Emitter-Collector Voltage	V_{ECO}	7	V
	Emitter-Base Voltage (TLP531)	V_{EBO}	7	V
	Collector Current	I_C	50	mA
	Power Dissipation	P_C	150	mW
	Power Dissipation Derating (Ta ≧ 25°C)	ΔP_C/°C	-1.5	mW/°C
	Junction Temperature	T_j	125	°C
Storage Temperature Range		T_{stg}	-55∿125	°C
Operating Temperature Range		T_{opr}	-55∿100	°C
Lead Soldering Temperature (10 sec.)		T_{sold}	260	°C
Total Package Power Dissipation		P_T	250	mW
Total Package Power Dissipation Derating (Ta ≧ 25°C)		ΔP_T/°C	-2.5	mW/°C
Isolation Voltage (AC, 1 min, RH ≦ 60%)		BV_S	2500	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=0.5mA	55	-	-	V
	Emitter-Collecter Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	7	-	-	V
	Collector-Base Breakdown Voltage (TLP531)	$V_{(BR)CBO}$	I_C=0.1mA	80	-	-	V
	Emitter-Base Breakdown Voltage (TLP531)	$V_{(BR)EBO}$	I_E=0.1mA	7	-	-	V
	Collector Dark Current	I_{CEO}	V_{CE}=24V	-	10	100	nA
			V_{CE}=24V, T_A=85°C	-	2	50	μA
	Capacitance (Collector to Emitter)	C_{CE}	V=0, f=1MHz	-	10	-	pF

CHARACTERISTICS	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Current Transfer Ratio	I_C/I_F	I_F=5mA, V_{CE}=5V	50	200	600	%
		Rank Y	50	-	150	
		Rank YG	50	-	300	
		Rank GR	100	-	300	
		Rank GB	100	-	600	
		Rank BL	200	-	600	
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C=2.4mA, I_F=8mA	-	-	0.4	V

ISOLATION CHARACTERISTICS (Ta=25°C)

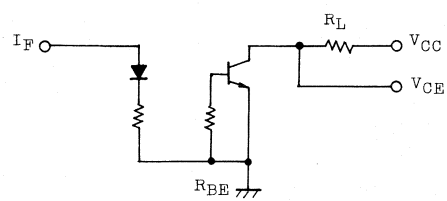
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Capacitance(Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	PF
Isolation Resistance	R_S	V_S=500V, R.H.≤60%	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	2500	-	-	V_{rms}

SWITCHING CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Rise Time	t_r	V_{CC}=10V, I_C=2mA, R_L=100Ω	-	2	-	μs
Fall Time	t_f		-	3	-	
Turn-on Time	t_{on}		-	3	-	
Turn-off Time	t_{off}		-	3	-	
Turn-on Time	t_{ON}	R_L=1.9kΩ (Fig.1)	-	2	-	μs
Storage Time	t_S	R_{BE}=OPEN	-	15	-	
Turn-off Time	t_{OFF}	V_{CC}=5V, I_F=16mA	-	25	-	
Turn-on Time	t_{ON}	R_L=1.9kΩ (Fig.1)	-	2	-	μs
Storage Time	t_S	R_{BE}=220kΩ (TLP531)	-	12	-	
Turn-off Time	t_{OFF}	V_{CC}=5V, I_F=16mA	-	20	-	

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	-	5	24	V
Forward Current	I_F	-	16	25	mA
Collector Current	I_C	-	1	10	mA
Operating Temperature	Topr	-25	-	85	°C



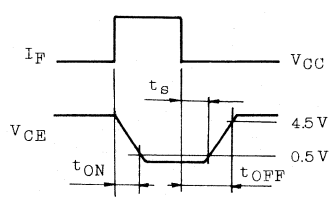
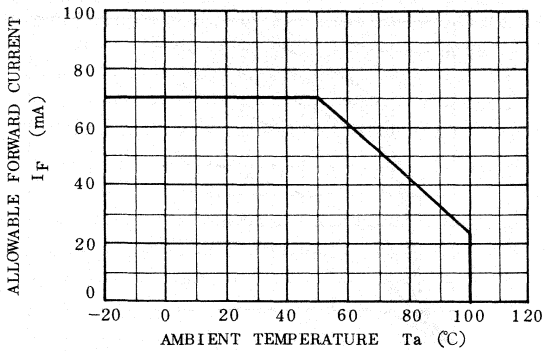
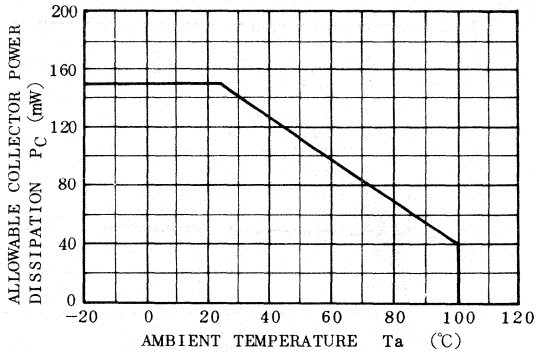


Fig. 1 Switching Time Test Circuit

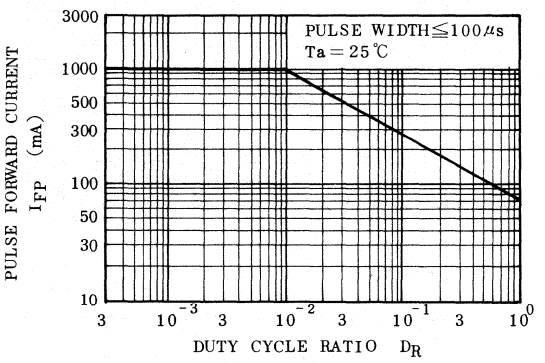
I_F – Ta



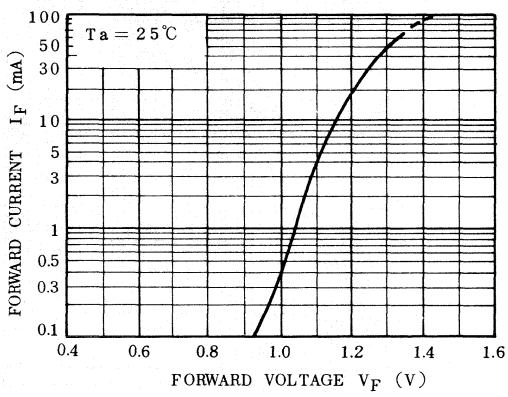
P_C – Ta



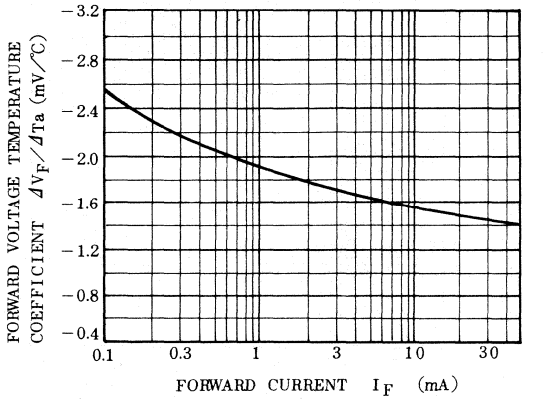
I_{FP} – D_R



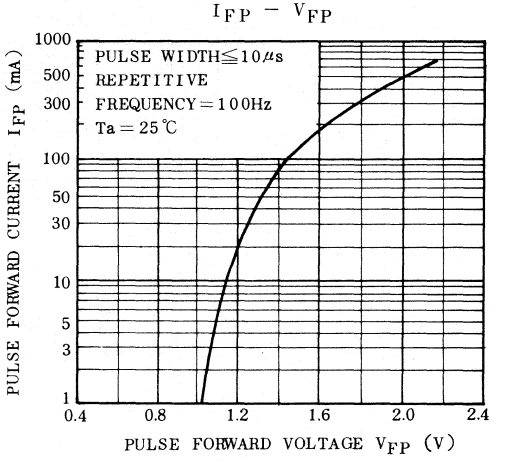
I_F – V_F



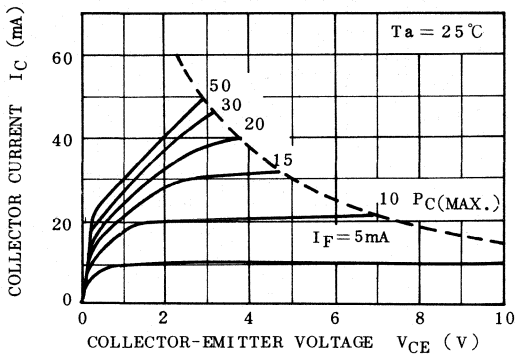
$\Delta V_F / \Delta Ta$ – I_F



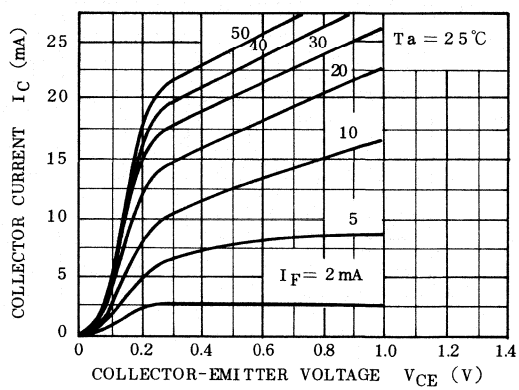
I_{FP} – V_{FP}



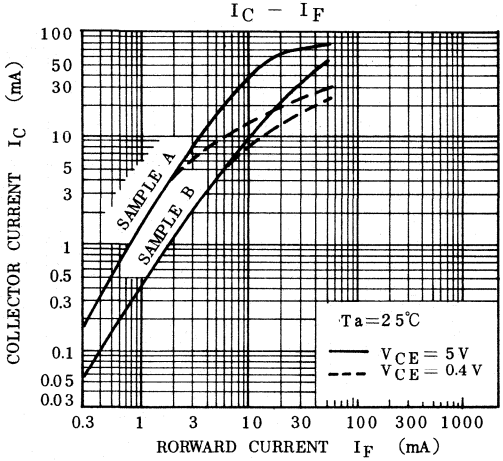
$I_C - V_{CE}$



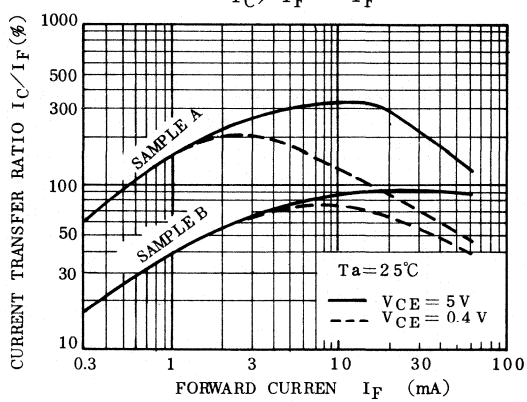
$I_C - V_{CE}$



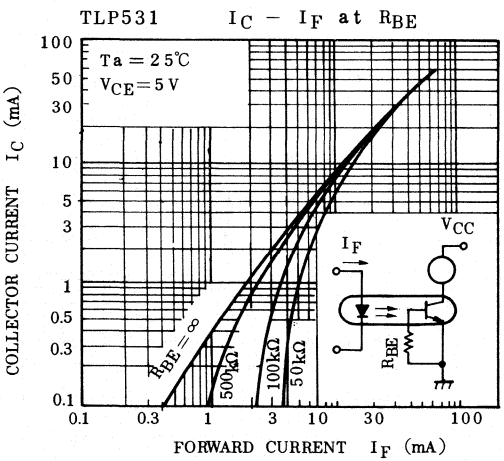
$I_C - I_F$



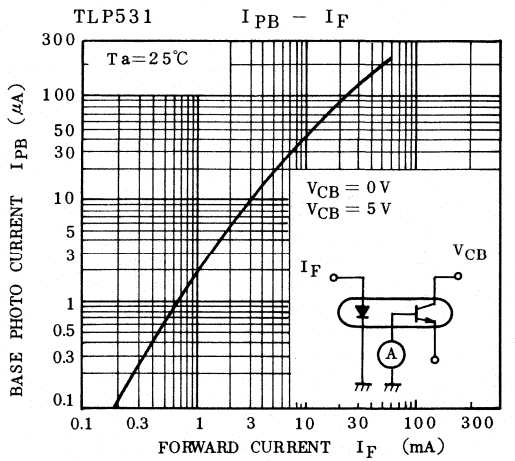
$I_C / I_F - I_F$



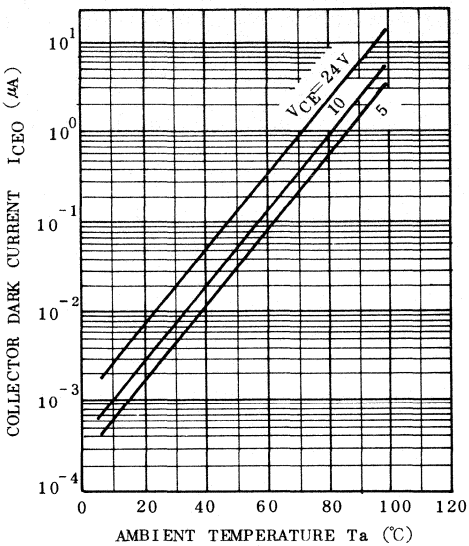
TLP531 $I_C - I_F$ at R_{BE}



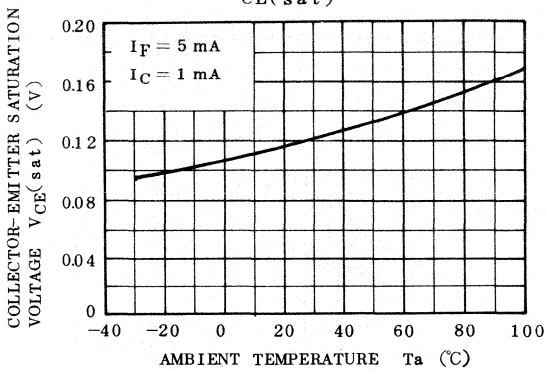
TLP531 $I_{PB} - I_F$



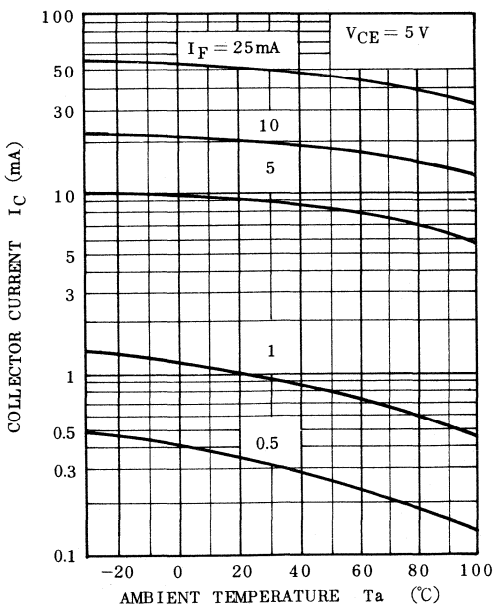
I_{CEO} – Ta



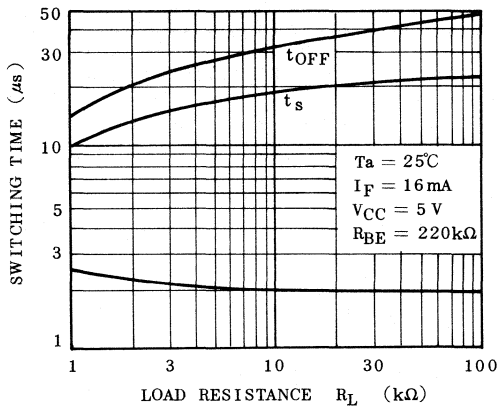
$V_{CE(sat)}$ – Ta



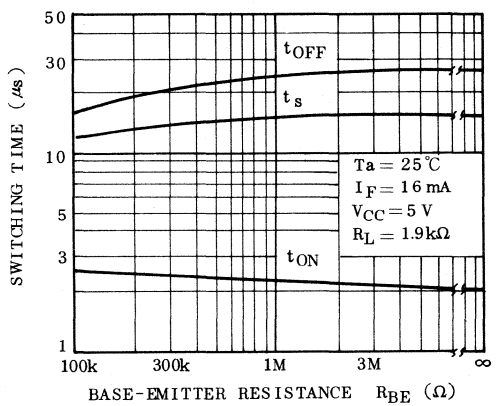
I_C – Ta



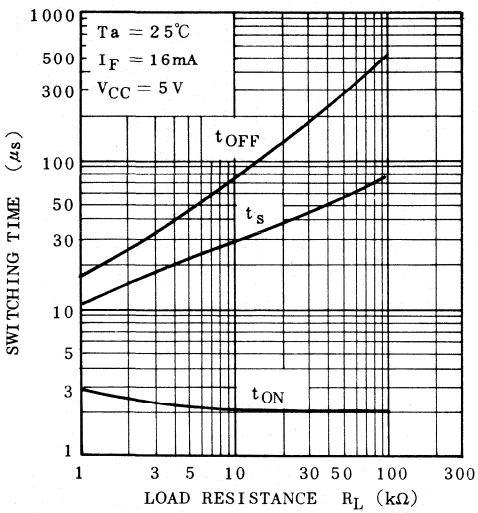
TLP531 SWITCHING TIME – R_L



TLP531 R_{BE} – SWITCHING TIME



R_L – SWITCHING TIME



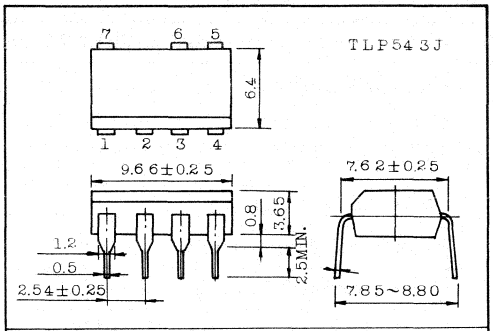
TLP543J, TLP545J

PROGRAMMABLE CONTROLLERS.
AC-OUTPUT MODULE.
SOLID STATE RELAY.

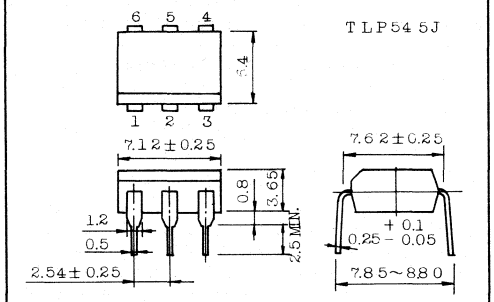
The TOSHIBA TLP543J consists of a phot-thyristor optically coupled to a gallium arsenide infrared emitting diode in a seven lead plastic DIP package.
The TOSHIBA TLP545J consists of a photo-thyristor optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.

- Peak Off-State Voltage : 600V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 150mA Max.
- Isolation Voltage : 2500Vrms Min.
- UL Recognized : File No. E67349

Unit in mm

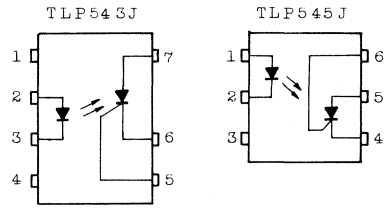


JEDEC	—
EIAJ	—
TOSHIBA	11-10C1



JEDEC	—
EIAJ	—
TOSHIBA	11-7A1

PIN CONFIGURATIONS (TOP VIEW)



TLP543J
1: NC
2: ANODE
3: CATHODE
4: NC
5: GATE
6: CATHODE
7: ANODE

TLP545J
1: ANODE
2: CATHODE
3: NC
4: CATHODE
5: ANODE
6: GATE

MAXIMUM RATING (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	70	mA
	Forward Current Derating (Ta≧25°C)	$\Delta I_F/°C$	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)	I_{FP}	1	A
	Reverse Voltage	V_R	5	V
	Junction Temperature	T_j	125	°C
DETECTOR	Peak Forward Voltage (R_{GK}=27KΩ)	V_{DRM}	600	V
	Peak Reverse Voltage (R_{GK}=27KΩ)	V_{RRM}	600	V
	On-State Current	$I_{T(RMS)}$	150	mA
	On-State Current Derating (Ta≧25°C)	$\Delta I_T/°C$	-2.0	mA/°C
	Peak One Cycle Surge Current	I_{TSM}	2	A
	Peak Reverse Gate Voltage	V_{GM}	-5	V
	Junction Temperature	T_j	100	°C
Storage Temperature Range		T_{stg}	-55∿125	°C
Operating Temperature Range		T_{opr}	-30∿100	°C
Lead Soldering Temperature (10sec.)		T_{sold}	260	°C
Isolation Voltage (AC, 1 min. RH≦60%)		BV_S	2500	V_{rms}

INDIVIDUAL ELECTIRCAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST TONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Off-State Current	I_{DRM}	V_{AK}=600V, R_{GK}=27kΩ, Ta=25°C	-	10	5000	nA
	Reverse Current	I_{RRM}	V_{KA}=600V, R_{GK}=27kΩ, Ta=25°C	-	10	5000	nA
	On-State Voltage	V_{TM}	I_{TM}=100mA	-	0.9	1.3	V
	Holding Current	I_H	R_{GK}=27kΩ	-	0.2	-	mA
	Off-State dv/dt	dv/dt	V_{AK}=420V, R_{GK}=27kΩ	-	10	-	V/μs
	Capaictance	C_j	V=0, f=1MHz Anode to Gate Gate to Cathode	- -	20 350	- -	pF

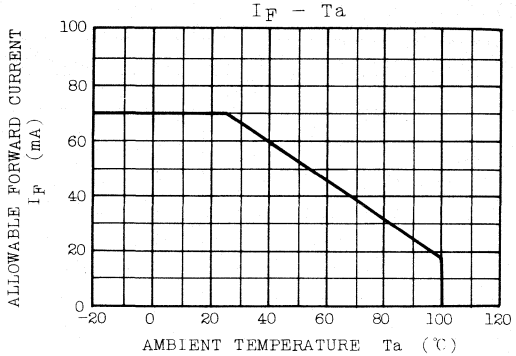
COUPLED CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_{AK}=6V, R_{GK}=27kΩ	-	5	10	mA
Turn-on Time	t_{on}	I_F=50mA, R_{GK}=27kΩ	-	10	-	μs
Cpacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V, R.H.≤60%	-	10^{11}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	2500	-	-	Vrms

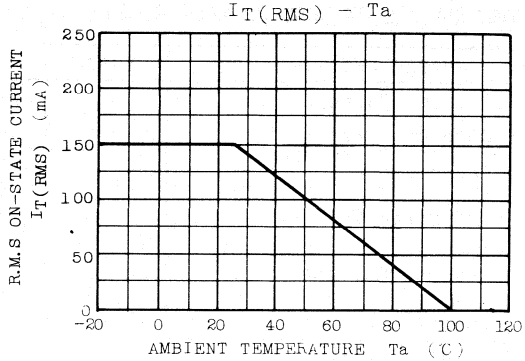
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	240	Vac
Forward Current	I_F	15	20	25	mA
Operating Temperature	T_{opr}	-30	-	85	°C
Gate to Cathode Resistance	R_{GK}	-	10	27	kΩ
Gate to Cathode Capacity	C_{GK}	-	0.01	0.1	μF

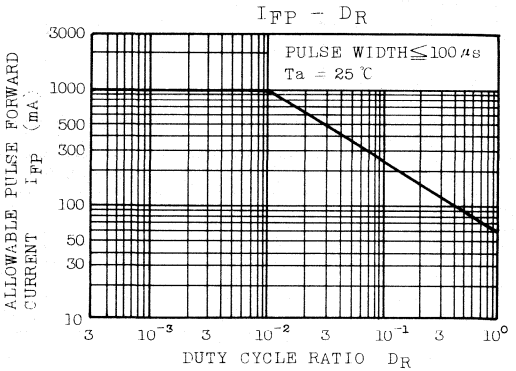
I_F – Ta



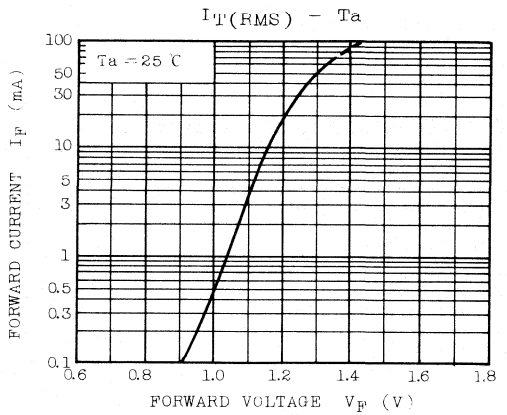
$I_{T(RMS)}$ – Ta



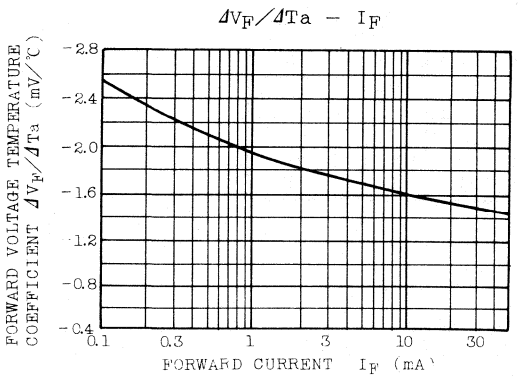
I_{FP} – D_R



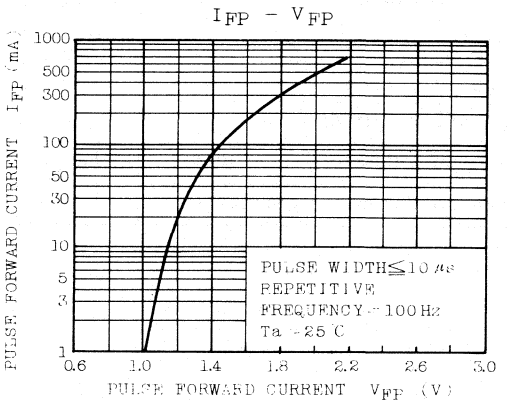
$I_{T(RMS)}$ – Ta



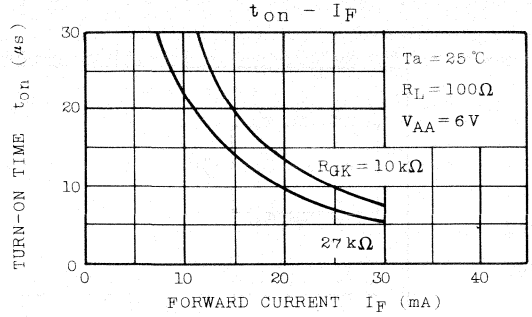
$\Delta V_F / \Delta Ta$ – I_F



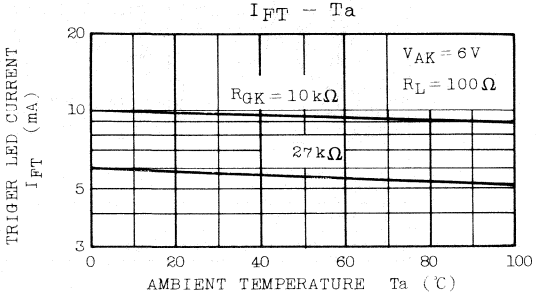
I_{FP} – V_{FP}



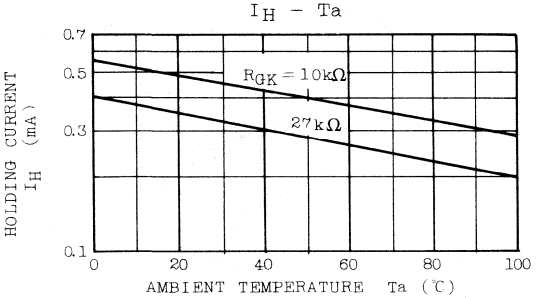
t_{on} – I_F



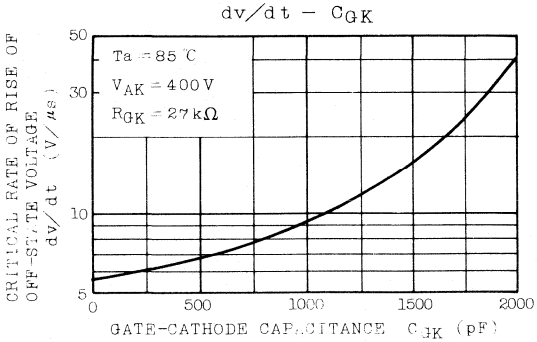
I_{FT} – Ta



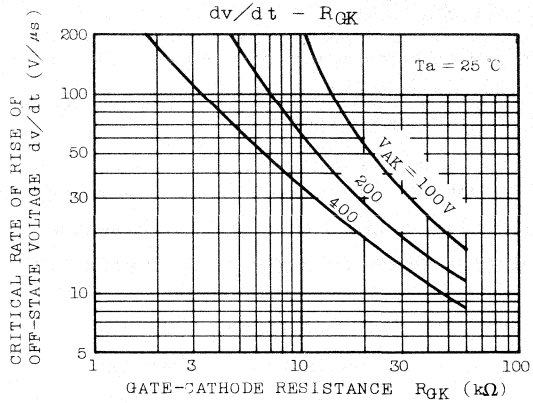
I_H – Ta



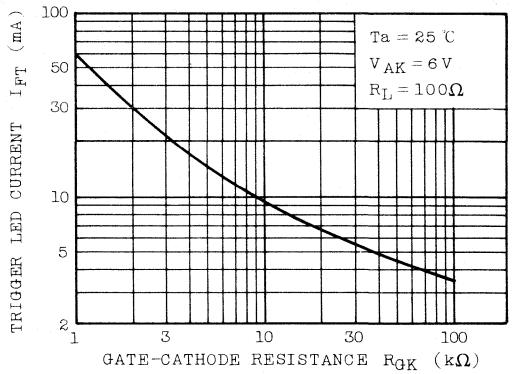
dv/dt – C_{GK}



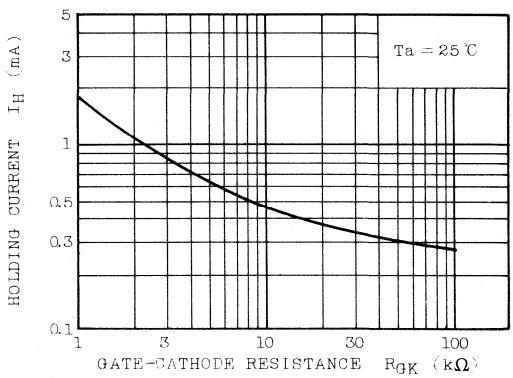
dv/dt – R_{GK}



I_{FT} – R_{GK}



I_H – R_{GK}



TLP548G

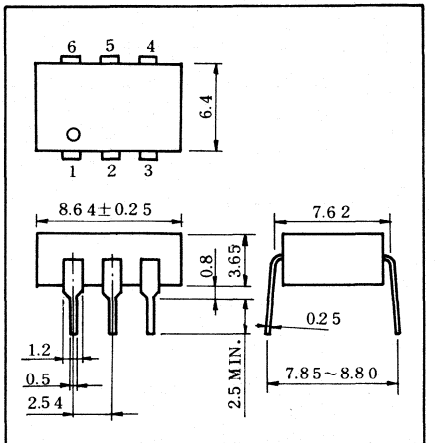
GaAs IRED & PHOTO-THYRISTOR

OFFICE MACHINE.
HOUSEHOLE USE EQUIPMENT.
SOLID STATE RELAY.
SWITCHING POWER SUPPLY.

The TOSHIBA TLP548G consists of a photo-thyristor optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.

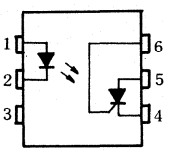
- Peak Off-State Voltage : 400V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 150mA Max.
- Isolation Voltage : 2500Vrms Min.
- UL Recognized : File No. E67349

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-9A1

PIN CONFIGURATIONS (TOP VIEW)



1 : ANODE
2 : CATHODE
3 : NC
4 : CATHODE
5 : ANODE
6 : GATE

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	60	mA
	Forward Current Derating (Ta≧39°C)	ΔI_F/°C	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)	I_{FP}	1	A
	Power Dissipation	P_D	100	mW
	Power Dissipation Derating (Ta≧25°C)	ΔP_D/°C	-1.0	mW/°C
	Reverse Voltage	V_R	5	V
	Junction Temperature	T_j	125	°C
DETECTOR	Peak Forward Voltage (R_{GK}=27kΩ)	V_{DRM}	400	V
	Peak Reverse Voltage (R_{GK}=27kΩ)	V_{RRM}	400	V
	On-State Current	$I_{T(RMS)}$	150	mA
	On-State Current Derating (Ta≧25°C)	ΔI_T/°C	-2.0	mA/°C
	Peak On-State Current (100μs pulse, 120pps)	I_{TP}	3	A
	Peak One Cycle Surge Current	I_{TSM}	2	A
	Peak Reverse Gate Voltage	V_{GM}	5	V
	Power Dissipation	P_D	150	mW
	Power Dissipation Derating (Ta≧25°C)	ΔP_D/°C	-2.0	mW/°C
	Junction Temperature	T_j	100	°C
Storage Temperature Range		T_{stg}	-55∿150	°C
Operating Temperature Range		T_{opr}	-55∿100	°C
Lead Soldering Temperature (10 sec.)		T_{sold}	260	°C
Total Package Power Dissipation		P_T	250	mW
Total Package Power Dissipation Derating (Ta≧25°C)		ΔP_T/°C	-3.3	mW/°C
Isolation Voltage (AC, 1 min., RH≦60%)		BV_S	2500	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA		1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V		-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz		-	30	-	pF
DETECTOR	Off-State Current	I_{DRM}	V_{AK}=400V, R_{GK}=27kΩ	Ta=25°C	-	10	5000	nA
				Ta=100°C	-	1	100	μA
	Reverse Current	I_{RRM}	V_{KA}=400V, R_{GK}=27kΩ	Ta=25°C	-	10	5000	nA
				Ta=100°C	-	1	100	μA
	On-State Voltage	V_{TM}	I_{TM}=100mA		-	0.9	1.3	V
	Holding Current	I_H	R_{GK}=27kΩ		-	0.2	-	mA
	Off-State dv/dt	dv/dt	V_D=280V, R_{GK}=27kΩ		5	10	-	v/μs
	Capacitance	C_j	V=0, f=1MHz Anode to Gate Gate to Cathode		- -	20 350	- -	pF

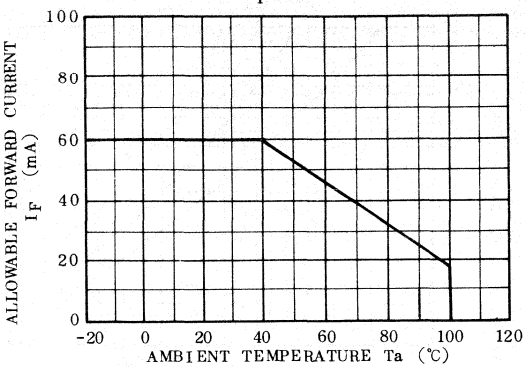
COUPLED CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_{AK}=6V, R_{GK}=27kΩ	-	4	10	mA
Turn-on Time	t_{on}	I_F=30mA, V_{AA}=50V, R_{GK}=27kΩ	-	10	-	μs
Coupled dv/dt	dv/dt	V_S=500V, R_{GK}=27kΩ	500	-	-	V/μs
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	2500	-	-	V_{rms}
		AC, 1 second	-	5000	-	
		DC, 1 minute	-	5000	-	V_{dc}

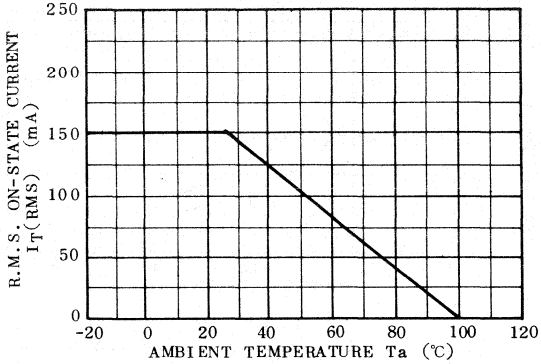
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	120	V_{ac}
Forward Current	I_F	15	20	25	mA
Operating Temperature	T_{opr}	-25	-	85	°C
Gate to Cathode Resistance	R_{GK}	-	27	33	kΩ
Gate to Cathode Capacity	C_{GK}	-	0.01	0.1	μF

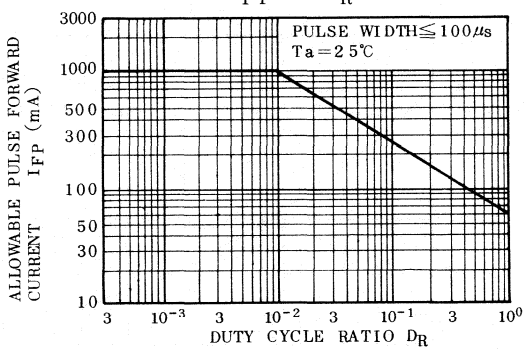
I_F — Ta



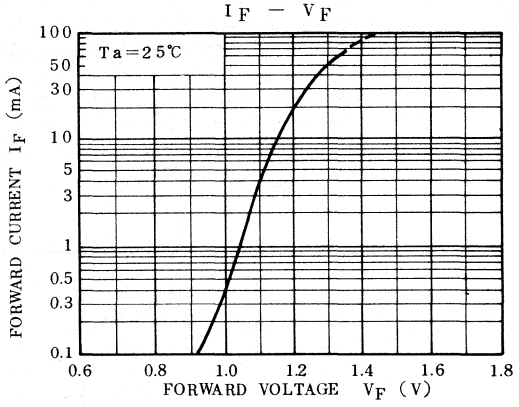
I_T(RMS) — Ta



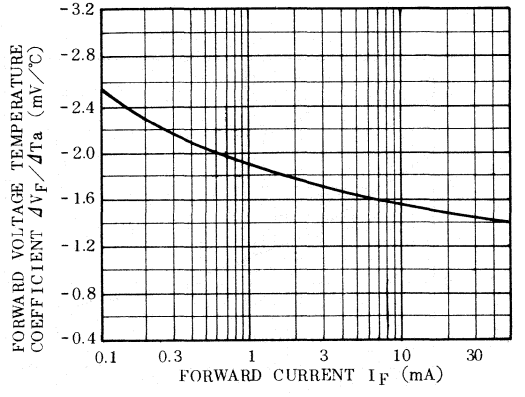
I_{FP} — D_R



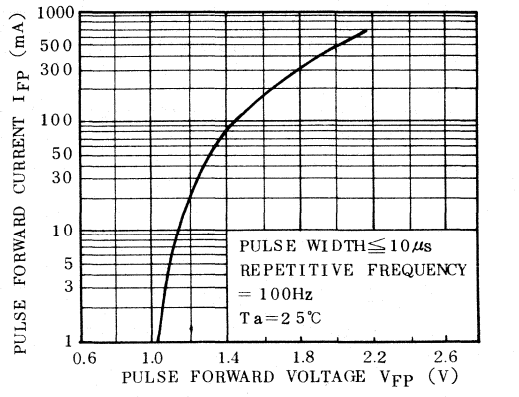
I_F — V_F



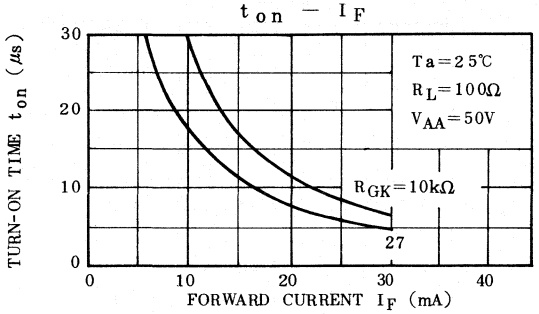
$\Delta V_F/\Delta Ta$ — I_F



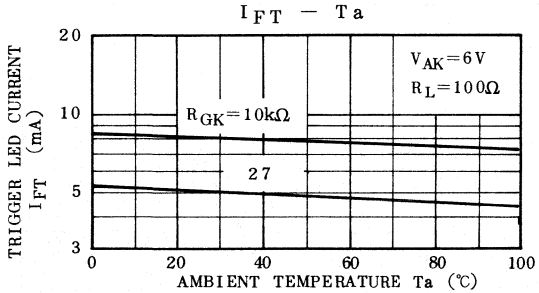
I_{FP} — V_{FP}



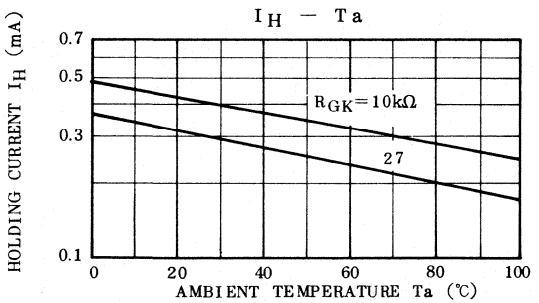
t_{on} — I_F



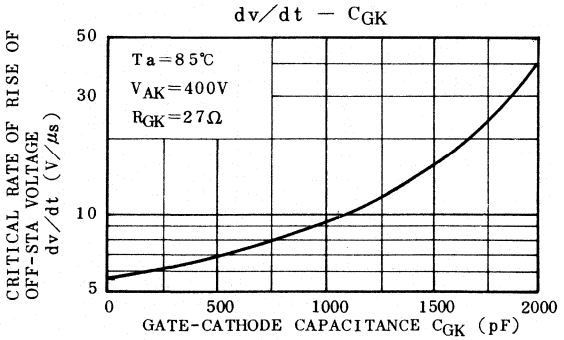
I_{FT} — Ta



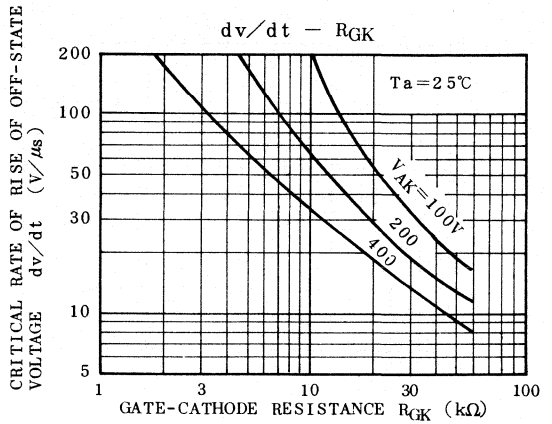
I_H — Ta



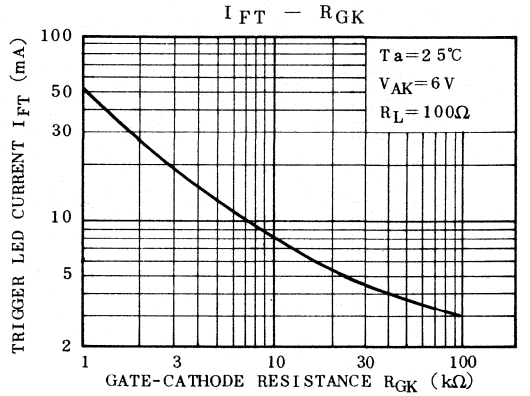
dv/dt — C_{GK}



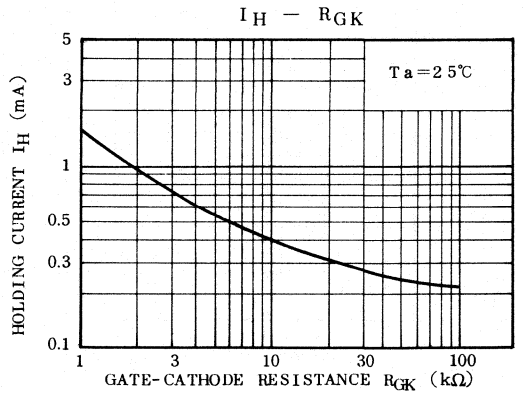
dv/dt — R_{GK}



I_{FT} — R_{GK}



I_H — R_{GK}

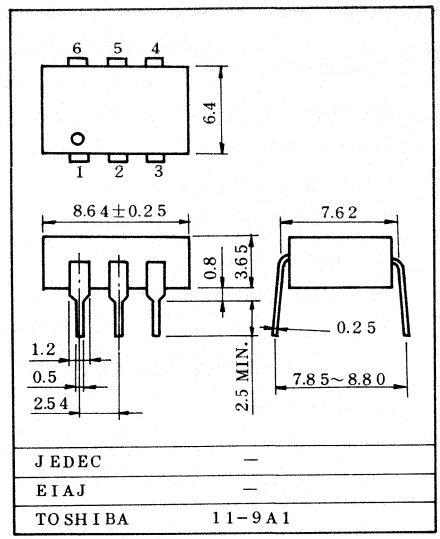


OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
SOLID STATE RELAY.
SWITCHING POWER SUPPLY.

The TOSHIBA TLP548J consists of a photo-thyristor optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.

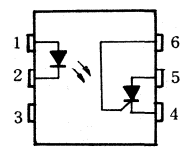
- Peak Off-State Voltage : 600V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 150mA Max.
- Isolation Voltage : 2500Vrms Min.
- UL Recognized : File No. E67349

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-9A1

PIN CONFIGURATIONS (TOP VIEW)



1 : ANODE
2 : CATHODE
3 : NC
4 : CATHODE
5 : ANODE
6 : GATE

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	60	mA
	Forward Current Derating (Ta ≧ 39°C)	ΔI_F/°C	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)	I_{FP}	1	A
	Power Dissipation	P_D	100	mW
	Power Dissipation Derating (Ta ≧ 25°C)	ΔPD/°C	-1.0	mW/°C
	Reverse Voltage	V_R	5	V
	Junction Temperature	T_j	125	°C
DETECTOR	Peak Forward Voltage (R_{GK}=27kΩ)	V_{DRM}	600	V
	Peak Reverse Voltage (R_{GK}=27kΩ)	V_{RRM}	600	V
	On-State Current	$I_{T(RMS)}$	150	mA
	On-State Current Derating (Ta≧25°C)	ΔI_T/°C	-2.0	mA/°C
	Peak On-State Current (100μs pulse, 120pps)	I_{TP}	3	A
	Peak One Cycle Surge Current	I_{TSM}	2	A
	Peak Reverse Gate Voltage	V_{GM}	5	V
	Power Dissipation	P_D	150	mW
	Power Dissipation Derating (Ta ≧ 25°C)	ΔP_D/°C	-2.0	mW/°C
	Junction Temperature	T_j	100	°C
Storage Temperature Range		T_{stg}	-55∿150	°C
Operating Temperature Range		T_{opr}	-55∿100	°C
Lead Soldering Temperature (10 sec.)		T_{sold}	260	°C
Total Packaging Power Dissipation		P_T	250	mW
Total Package Power Dissipation Derating (Ta≧25°C)		ΔP_T/°C	-3.3	mW/°C
Isolation Voltage (AC, 1 min., RH≦60%)		BV_S	2500	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA		1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V		-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz		-	30	-	P_F
DETECTOR	Off-State Current	I_{DRM}	V_{AK}=600V	Ta=25°C	-	10	5000	nA
			R_{GK}=27kΩ	Ta=85°C	-	1	150	μA
	Reverse Current	I_{RRM}	V_{KA}=600V	Ta=25°C	-	10	5000	nA
			R_{GK}=27kΩ	Ta=85°C	-	1	150	μA
	On-State Voltage	V_{TM}	I_{TM}=100mA		-	0.9	1.3	V
	Holding Current	I_H	R_{GK}=27kΩ		-	0.2	-	mA
	Off-State dv/dt	dv/dt	V_D=420V, R_{GK}=27kΩ		-	10	-	V/μs
	Capacitance	Cj	V=0, f=1MHz Anode to Gate Gate to Cathode		- -	20 350	- -	pF

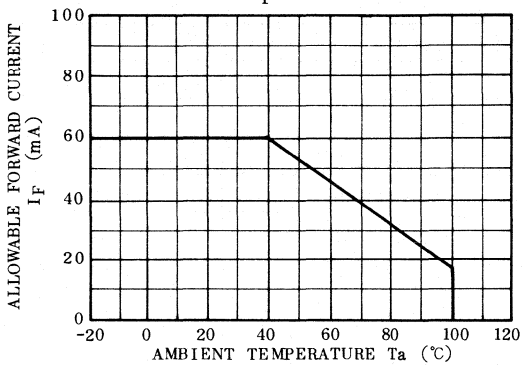
COUPLED CHARACTERISTICS (Ta=25°C)

CHARACTERISTICS	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_{AK}=6V, R_{GK}=27kΩ	-	5	10	mA
Turn-on Time	t_{on}	I_F=30mA, V_{AA}=50V R_{GK}=27kΩ	-	10	-	μs
Coupled dv/dt	dv/dt	V_S=500V, R_{GK}=27kΩ	500	-	-	V/μs
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	2500	-	-	V_{rms}
		AC, 1 second	-	5000	-	
		DC, 1 minute	-	5000	-	Vdc

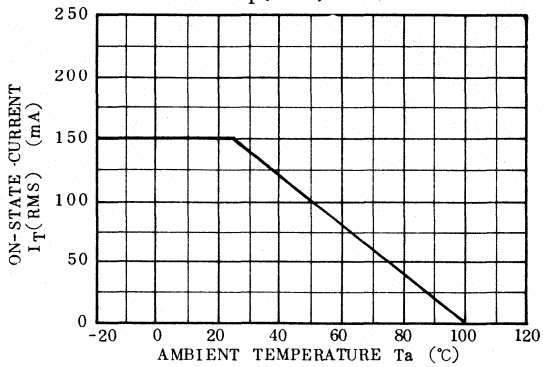
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	240	V_{ac}
Forward Current	I_F	15	20	25	mA
Operating Temperature	T_{opr}	-25	-	85	°C
Gate to Cathode Resistance	R_{GK}	-	10	27	kΩ
Gate to Cathode Capacity	C_{GK}	-	0.01	0.1	μF

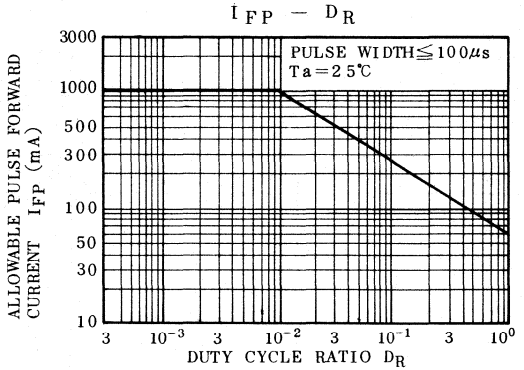
I_F — Ta



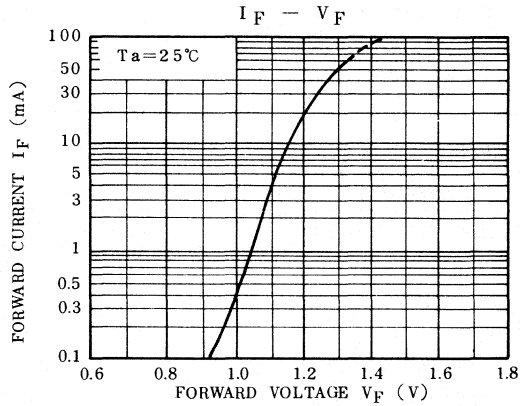
I_T(RMS) — Ta



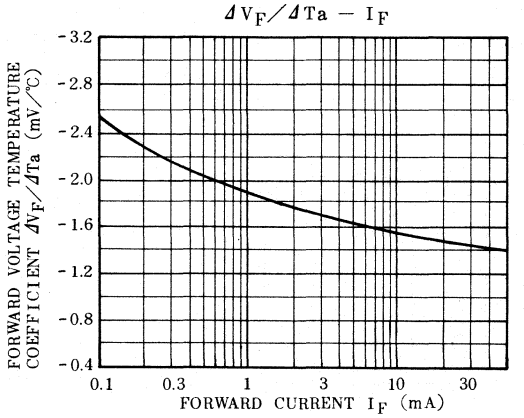
I_{FP} — D_R



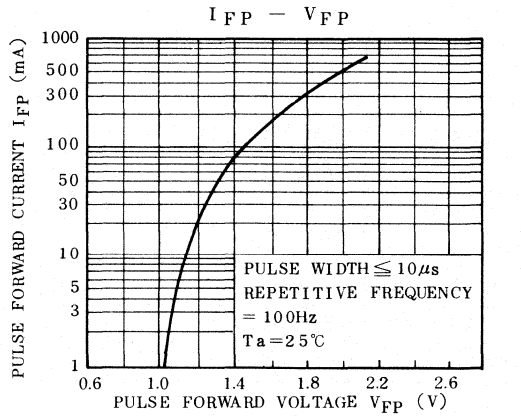
I_F — V_F



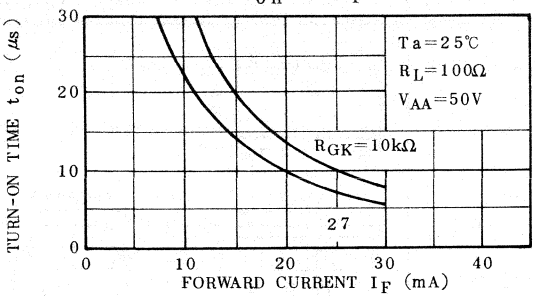
$\Delta V_F / \Delta Ta$ — I_F



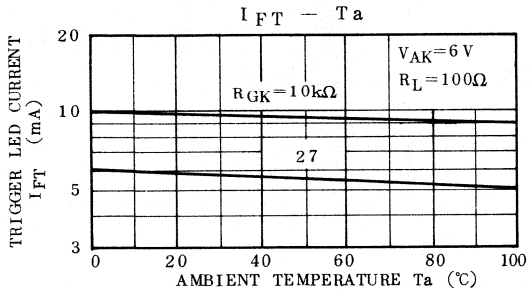
I_{FP} — V_{FP}



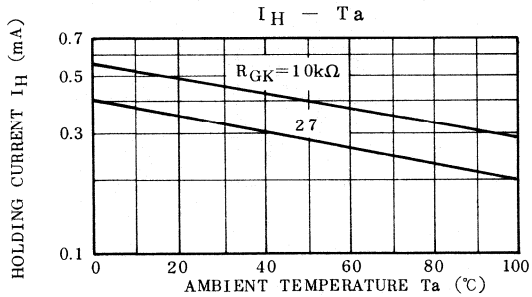
t_{on} — I_F



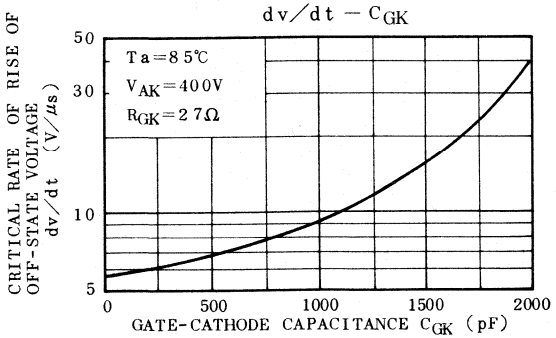
I_{FT} — Ta



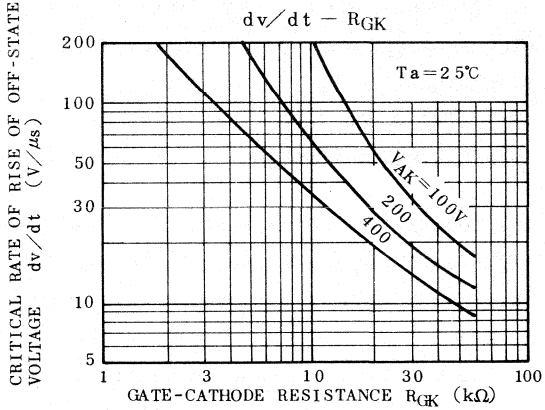
I_H — Ta



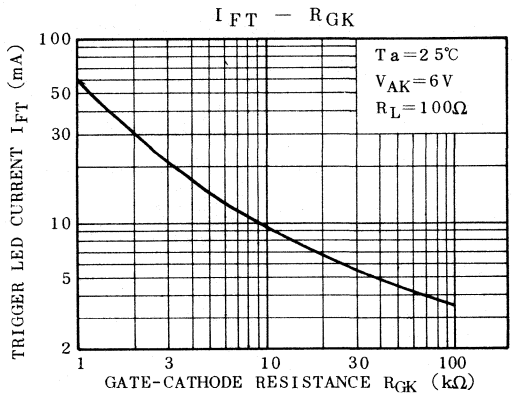
dv/dt — C_{GK}



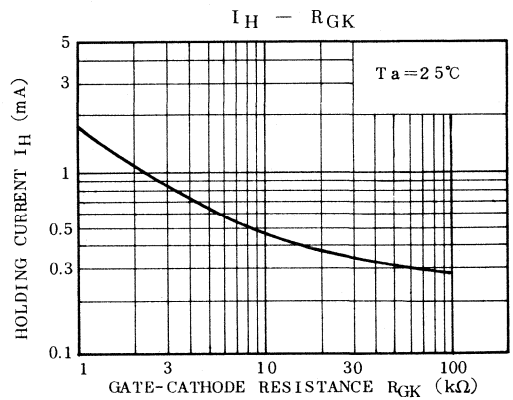
dv/dt — R_{GK}



I_{FT} — R_{GK}



I_H — R_{GK}



TLP551

GaAℓAs IRED & PHOTO-IC

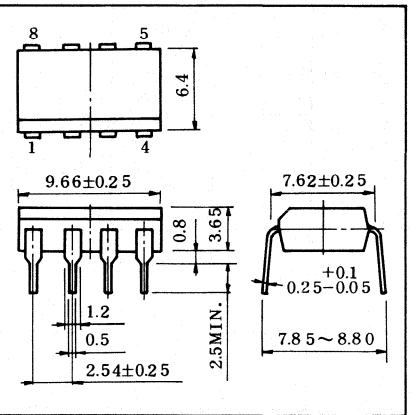
DIGITAL LOGIC GROUND ISOLATION.
LINE RECEIVER.
MICROPROCESSOR SYSTEM INTERFACES.
SWITCHING POWER SUPPLY FEEDBACK CONTROL.
ANALOG SIGNAL ISOLATION.

The Toshiba TLP551 consists of a GaAℓAs high-output light emitting diode and a high speed detector of one chip photo diode-transistor. This unit is 8-lead DIP package.

TLP551 has internal base connection. This base pin should be used for analog application or enable operation. If base pin is open, output signal will be noisy by environmental condition. For this case, TLP550 is suitable.

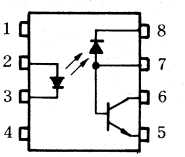
- Isolation Voltage : 2500Vrms Min.
- Switching Speed : tpHL=0.3μs(Typ.)
  tpLH=0.5μs(Typ.)
  (R_L=1.9kΩ)
- TTL Compatible
- UL Recognized : File No. E67349

Unit in mm



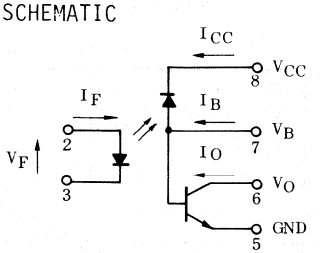
JEDEC	—
EIAJ	—
TOSHIBA	11-10C1

PIN CONFIGURATION (TOP VIEW)



1 : NC
2 : ANODE
3 : CATHODE
4 : NC
5 : EMITTER
6 : COLLECTOR
7 : BASE
8 : V_{CC}

SCHEMATIC



MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current	(Note 1)	I_F	25	mA
	Pulse Forward Current	(Note 2)	I_{FP}	50	mA
	Peak Transient Forward Current	(Note 3)	I_{FPT}	1	A
	Reverse Voltage		V_R	5	V
	Diode Power Dissipation	(Note 4)	P_D	45	mW
DETECTOR	Output Current		I_O	8	mA
	Peak Output Current		I_{OP}	16	mA
	Output Voltage		V_O	-0.5∿15	V
	Supply Voltage		V_{CC}	-0.5∿15	V
	Base Current		I_B	5	mA
	Emitter-Base Reverse Voltage		V_{EB}	5	V
	Output Power Dissipation	(Note 5)	P_O	100	mW
Operating Temperature Range			T_{opr}	-55∿100	°C
Storage Temperature Range			T_{stg}	-55∿125	°C
Lead Solder Temperature (10 sec.)		(Note 6)	T_{sol}	260	°C
Isolation Voltage (AC, 1 min., R.H≦60%)		(Note 7)	BVS	2500	Vrms

Note 1 : Derate 0.8mA above 70°C

Note 2 : 50% duty cycle, 1ms pulse width.
Derate 1.6mA/°C above 70°C

Note 3 : Pulse width≦1μs, 390pps.

Note 4 : Derate 0.9mW/°C above 70°C

Note 5 : Derate 2mW/°C above 70°C

Note 6 : Soldering portion of lead : up to 2mm from the body of the device.

Note 7 : Device considered a two terminal device : Pins 1, 2, 3 and 4 shorted together and pins 5, 6, 7 and 8 shorted together.

ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=16mA		1.45	1.65	1.85	V
	Forward Voltage Temperature Coefficient	$\Delta V_F/\Delta Ta$	I_F=16mA		-	-2	-	mV/°C
	Reverse Current	I_R	V_R=5V		-	-	10	μA
	Capacitance between Terminal	C_T	V_F=0, f=1MHz		-	45	-	pF
DETECTOR	High Level Output Current	I_{OH}(1)	I_F=0mA, V_{CC}=V_O=5.5V		-	3	500	nA
		I_{OH}(2)	I_F=0mA, V_{CC}=V_O=15V		-	-	5	μA
		I_{OH}	I_F=0mA, V_{CC}=V_O=15V Ta=70°C		-	-	50	μA
	High Level Supply Voltage	I_{CCH}	I_F=0mA, V_{CC}=15V		-	0.01	1	μA
COUPLED	Current Transfer Ratio	I_O/I_F	I_F=16mA, V_{CC}=4.5V, V_O=0.4V	Ta=25°C	10	30	-	%
				Rank:0	19	30	-	
				Ta=0~70°C	5	-	-	
				Rank:0	15	-	-	
	Low Level Output Voltage	V_{OL}	I_F=16mA, V_{CC}=4.5V I_O=1.1mA (rank 0: I_O=2.4mA)		-	-	0.4	V
	Resistance (Input - Output)	R_S	R.H.≦60%, V_S=500V_{DC} (Note 7)		-	10^{12}	-	Ω
	Capacitance (Input - Output)	C_S	V_S=0, f=1MHz (Note 7)		-	0.8	-	pF

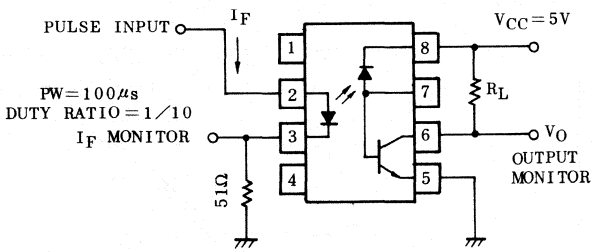
SWITCHING CHARACTERISTICS (Ta=25°C, V_{CC}=5V)

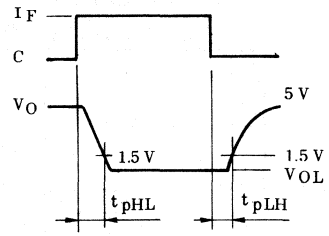
CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Propagation Delay Time (H→L)	t_{pHL}	1	I_F=0→16mA, V_{CC}=5V, R_L=4.1kΩ		-	0.2	0.8	μs
				Rank 0: R_L=1.9kΩ	-	0.3	0.8	
Propagation Delay Time (L→H)	t_{pLH}		I_F=16→0mA, V_{CC}=5V, R_L=4.1kΩ		-	1.0	2.0	μs
				Rand 0: R_L=1.9kΩ	-	0.5	1.2	
Common Mode Transient Immunity at Logic High Output (Note 8)	CM_H	2	I_F=0mA, V_{CM}=200Vp-p R_L=4.1kΩ (Rank 0: R_L=1.9kΩ)		-	400	-	V/μs
Common Mode Transient Immunity at Logic Low Output (Note 8)	CM_L		I_F=16mA, V_{CM}=200Vp-p R_L=4.1kΩ (Rank 0: R_L=1.9kΩ)		-	-1000	-	V/μs

Note 8 : CM_L is the maximum rate of fall of the common mode voltage that can be sustained with the output voltage in the logic low state (V_O<0.8V).
CM_H is the maximum rate of rise of the common mode voltage that can be sustained with the output voltage in the logic high state (V_O>2.0V).

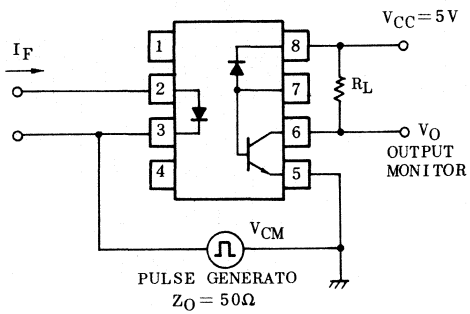
Note 9 : Maximum electrostatic discharge voltage for any pins : 100V (C=200pF, R=0).

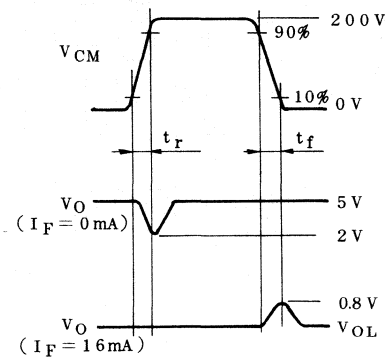
TEST CIRCUIT 1: Switching Time Test Circuit





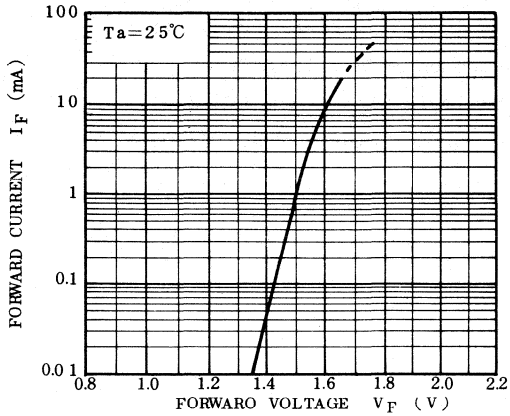
TEST CIRCUIT 2: Common Mode Noise Immunity Test Circuit



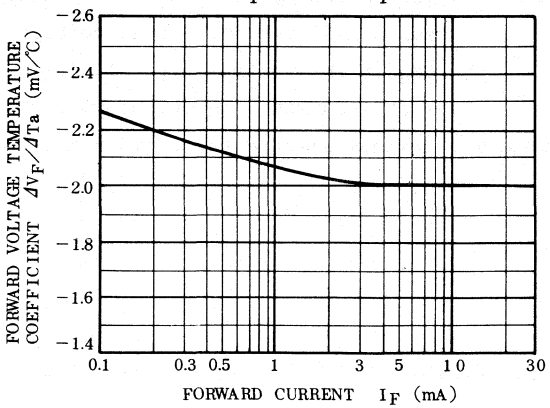


$$CM_H = \frac{160(V)}{t_r(\mu s)} \quad , \quad CM_L = \frac{160(V)}{t_f(\mu s)}$$

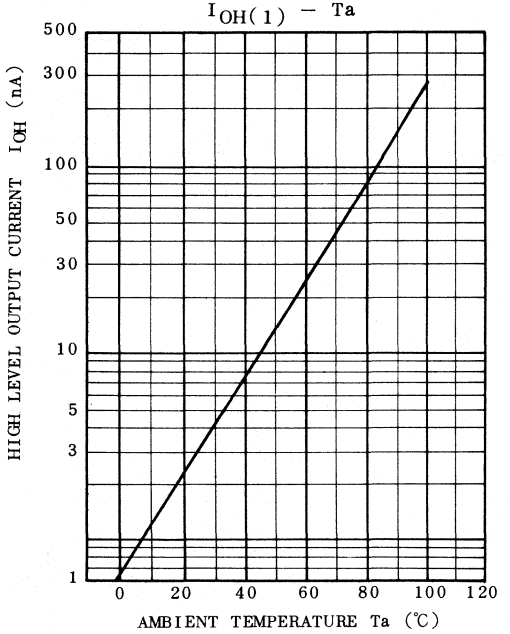
$I_F - V_F$



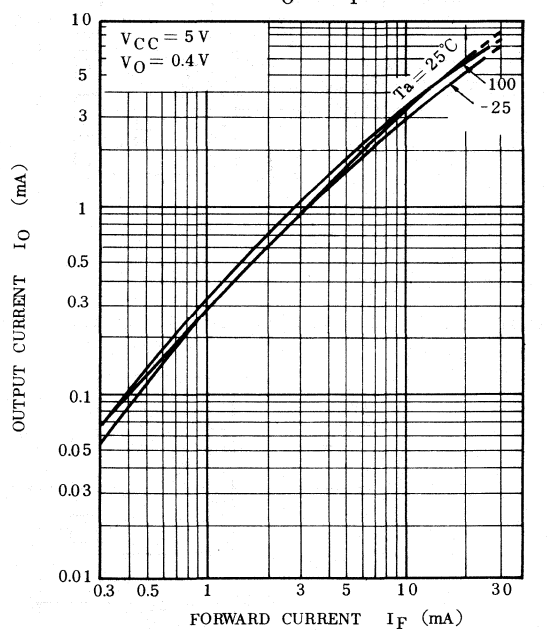
$\Delta V_F / \Delta Ta - I_F$



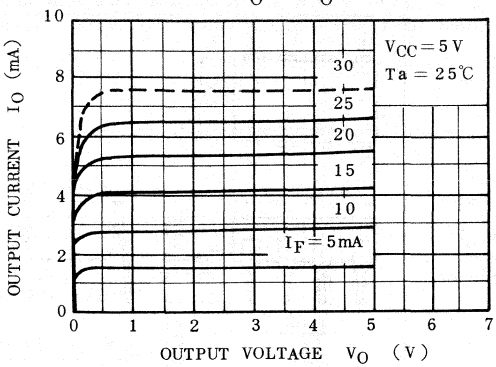
$I_{OH(1)} - Ta$



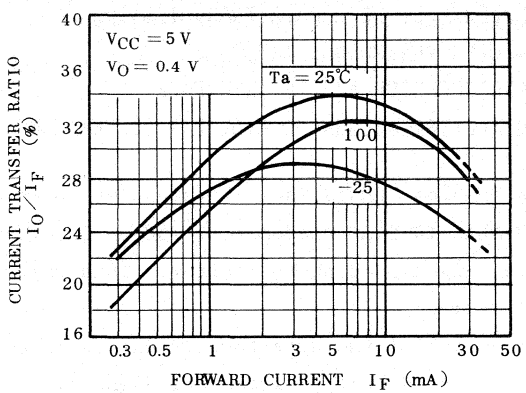
$I_O - I_F$



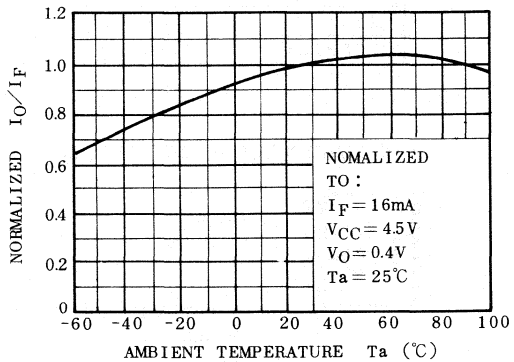
$I_O - V_O$



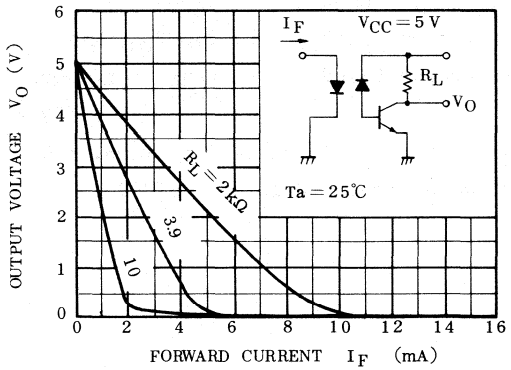
$I_O / I_F - I_F$



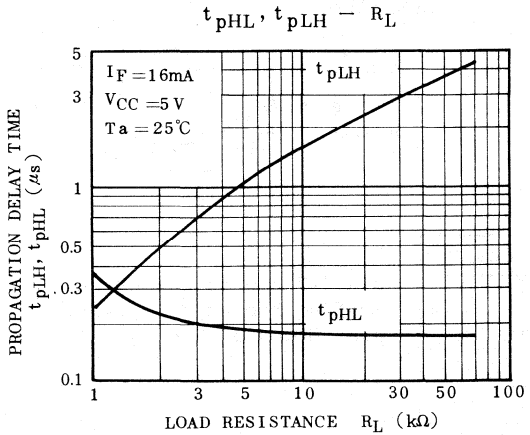
$I_O / I_F - Ta$



$V_O - I_F$



$t_{pHL}, t_{pLH} - R_L$



TLP552

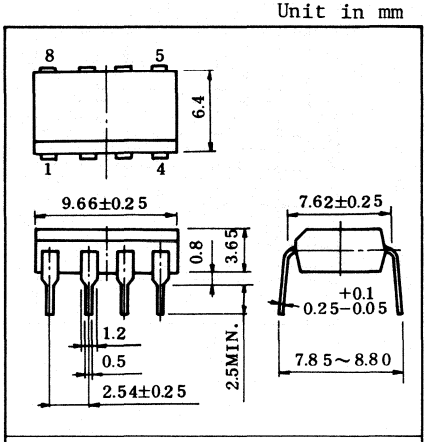
GaAℓAs IRED & PHOTO-IC

ISOLATED LINE RECEIVER
SIMPLEX/MULTIPLEX DATA TRANSMISSION
COMPUTER-PERIPHERAL INTERFACE
MICROPROCESSOR SYSTEM INTERFACE
DIGITAL ISOLATION FOR A/D, D/A CONVERSION

The Toshiba TLP552 is a photocoupler which combines a GaAℓAs IRED as the emitter and an integrated high gain, high speed photodetector. This unit is 8-lead DIP package.
The output of the detector circuit is an open collector, Schottky clamped transistor.

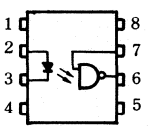
- TTL/LSTTL Compatible : V_{CC}=5V
- Isolation Voltage : 2500V_{rms} Min.
- Switching Speed : t_{pHL}, t_{pLH}=60ns(Typ.) (@R_L=350Ω)
- Guaranteed Performance Over Temp. : 0°C∿70°C
- UL Recognized : File No. E67349

Unit in mm



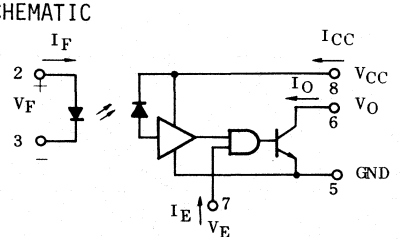
JEDEC	—
EIAJ	—
TOSHIBA	11-10C1

PIN CONFIGURATION (TOP VIEW)



1. : NC
2. : ANODE
3. : CATHODE
4. : NC
5. : GND
6. : OUTPUT(OPEN COLLECTOR)
7. : ENABLE
8. : V_{CC}

SCHEMATIC



TRUTH TABLE
(Positive Logic)

INPUT	ENABLE	OUTPUT
H	H	L
L	H	H
H	L	H
L	L	H

A 0.1μF bypass capacitor must be connected between pins 8 and 5 (See Note 3).

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Input Current, Low Level	I_{FL}	0	-	250	μA
Input Current, High Level	I_{FH}	7	-	20	mA
Supply Voltage, Output	V_{CC}	4.5	-	5.5	V
High Level Enable Voltage	V_{EH}	2.0	-	V_{CC}	V
Low level Enable Voltage	V_{EL}	0	-	0.8	V
Fan Out (TTL Load)	N	-	-	8	
Operating Temperature	T_{opr}	0	-	70	°C

MAXIMUM RATING (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	20	mA
	Pulse Forward Current (Note 1)	I_{FP}	40	mA
	Peak Transient Forward Current (Note 2)	I_{FPT}	0.5	A
	Reverse Voltage	V_R	5	V
	Diode Power Dissipation	P_D	40	mW
DETECTOR	Output Current	I_O	50	mA
	Output Voltage	V_O	7	V
	Supply Voltage (1 Minute Maximum)	V_{CC}	7	V
	Enable Input Voltage (Not to exceed V_{CC} by more than 500mV)	V_E	5.5	V
	Output Collector Power Dissipation	P_O	85	mW
Operating Temperature Range		T_{opr}	0∿70	°C
Storage Temperature Range		T_{stg}	-55∿125	°C
Lead Solder Temperature (10 sec.)**		T_{sold}	260	°C
Isolation Voltage (R.H.≦60%, AC/1 min., Note 4)		BV_S	2500	V_{rms}

**Soldering portion of lead : up to 2mm from the body of the device.

Note 1 : 50% duty cycle, 1ms pulse width.

Note 2 : Pulse width≦1μs, 300pps.

ELECTRICAL CHARACTERISTICS

(For $0°C \leq Ta \leq 70°C$, unless otherwise specified.)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.*	MAX.	UNIT
Input Forward Voltage	V_F	I_F=10mA, Ta=25°C	-	1.65	1.8	V
Input Diode Temperature Coefficient	$\frac{\Delta V_F}{\Delta T_A}$	I_F=10mA	-	-2.0	-	mV/°C
Input Reverse Current	I_R	V_R=5V, Ta=25°C	-	-	10	μA
Input Capacitance	C_T	V_F=0V, f=1MHz	-	45	-	pF
High Level Output Current	I_{OH}	V_{CC}=5.5V, V_O=5.5V I_F=250μA, V_E=2.0V	-	10	250	μA
Low Level Output Voltage	V_{OL}	V_{CC}=5.5V, I_F=5mA V_{EH}=2.0V I_{OL}=(Sinking)=13mA	-	0.4	0.6	V
High Level Enable Current	I_{EH}	V_{CC}=5.5V, V_E=2.0V	-	-0.1	-	mA
Low Level Enable Current	I_{EL}	V_{CC}=5.5V, V_E=0.5V	-	-1.6	-2.0	mA
High Level Supply Current	I_{CCH}	V_{CC}=5.5V, I_F=0 V_E=0.5V	-	7	15	mA
Low Level Supply Current	I_{CCL}	V_{CC}=5.5V, I_F=10mA V_E=0.5V	-	12	18	mA
Current Transfer Ratio	CTR	I_F=5.0mA, R_L=100Ω V_{CC}=5V, Ta=25°C	-	1000	-	%
Resistance (Input-Output)	R_S	V_S=500V, R.H. ≤ 60% Ta=25°C (Note 4)	-	10^{12}	-	Ω
Capacitance (Input-Output)	C_S	f=1MHz, V_S=0, Ta=25°C (Note 4)	-	0.6	-	pF

* All typical values are at V_{CC}=5V, Ta=25°C.

SWITCHING CHARACTERISTICS (Ta=25°C, V_{CC}=5V)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Propagation Delay Time to High Output Level (L→H)	t_{pLH}	1	R_L=350Ω, C_L=15pF I_F=7.5mA	-	60	120	ns
Propagation Delay Time to Low Output Level (H→L)	t_{pHL}		R_L=350Ω, C_L=15pF I_F=7.5mA	-	60	120	ns
Output Rise Fall Time (10-90%)	tr,tf		R_L=350Ω, C_L=15pF I_F=7.5mA	-	30	-	ns
Propagation Delay Time of Enable from V_{EH} to V_{EL}	t_{ELH}	2	R_L=350Ω, C_L=15pF I_F=7.5mA, V_{EH}=3.0V	-	25	-	ns
Propagation Delay Time of Enable from V_{EL} to V_{EH}	t_{EHL}		R_L=350Ω, C_L=15pF I_F=7.5mA, V_{EH}=3.0V	-	25	-	ns
Common Mode Transient Immunity at Logic High Output Level	CM_H	3	V_{CM}=200V, R_L=350Ω V_O(min.)=2V, I_F=0mA (Note 6)	-	200	-	V/μs
Common Mode Transient Immunity at Logic Low Output Level	CM_L		V_{CM}=200V, R_L=350Ω V_O=(max.)=0.8V I_F=5mA (Note 6)	-	-500	-	V/μs

Note 3 : A ceramic capacitor (0.1μF) should be connected from pin 8 and pin 5 to stabilize the operation of the high gain linear amplifier. Failure to provide the bypassing may impair the switching properties. The total lead length between capacitor and coupler should not exceed 1cm.

Note 4 : Device considered a two-terminal device: Pins 1, 2, 3 and 4 shorted together, and Pins 5, 6, 7 and 8 shorted together.

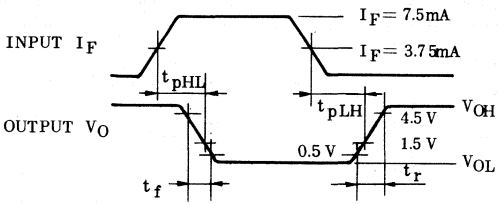
Note 5 : Enable Input: No pull up resistor required as the device has an internal pull up resistor.

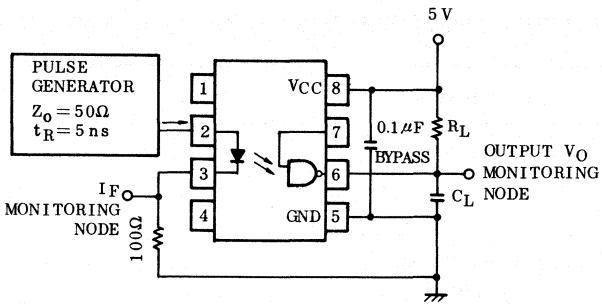
Note 6 : CM_L: The maximum tolerable rate of fall of the common mode voltage to ensure the output will remain in the low output state (i.e., V_{OUT}<0.8V). Measured in volts per microsecond (V/μs)
CM_H: The maximum tolerable rate of rise of the common mode voltage to ensure the output will remain in the high state (i.e., V_{OUT}>2.0V) Measured in volts per microsecond (V/μs).

Note 7 : Maximum electrostatic discharge voltage for any pins: 180V (C=200pF, R=0)

TEST CIRCUIT 1.

t_{pHL} and t_{pLH}

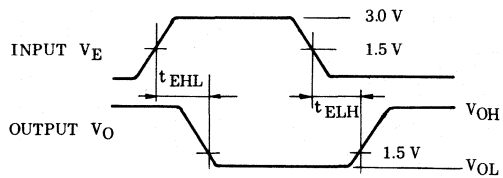


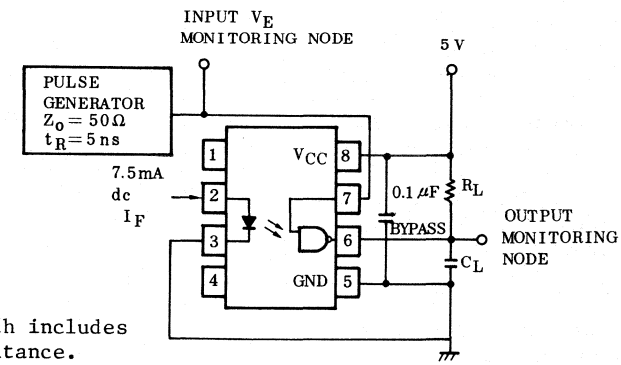


- C_L is approximately 15pF which includes probe and stray wiring capacitance.

TEST CIRCUIT 2.

t_{ELH} and t_{EHL}

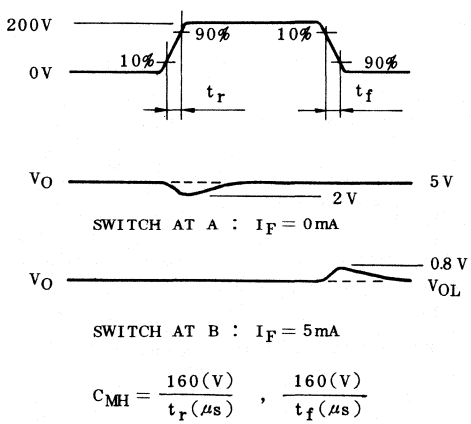


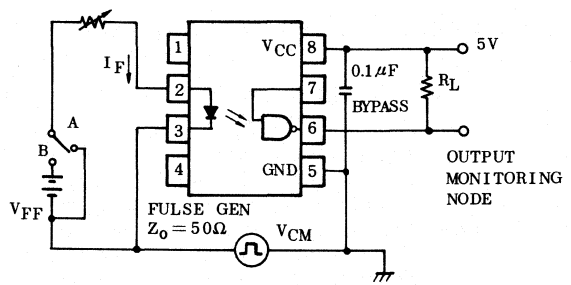


- C_L is approximately 15pF which includes probe and stray wiring capacitance.

TEST CIRCUIT 3.

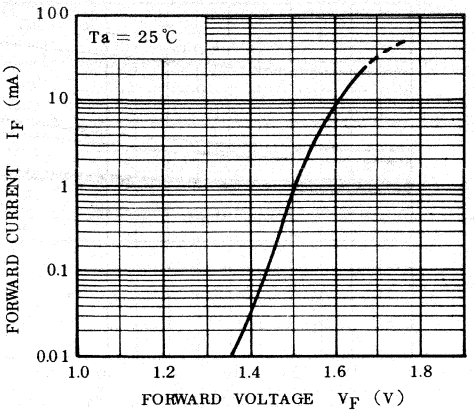
Transient Immunity and Typical Waveforms.



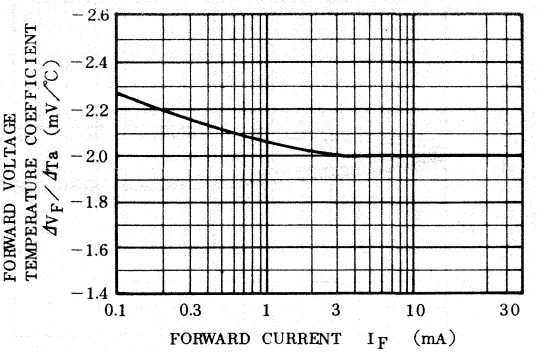


$$C_{MH} = \frac{160(V)}{t_r(\mu s)} \quad , \quad \frac{160(V)}{t_f(\mu s)}$$

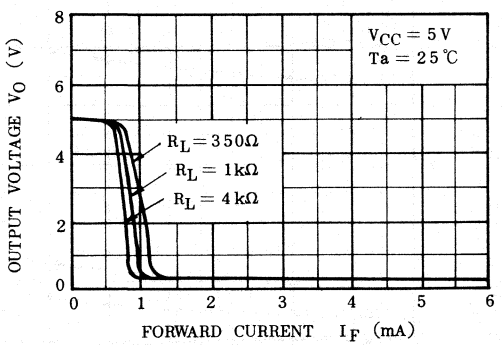
$I_F - V_F$



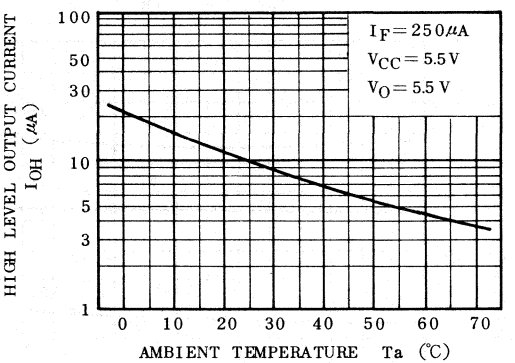
$\Delta V_F / \Delta Ta - I_F$



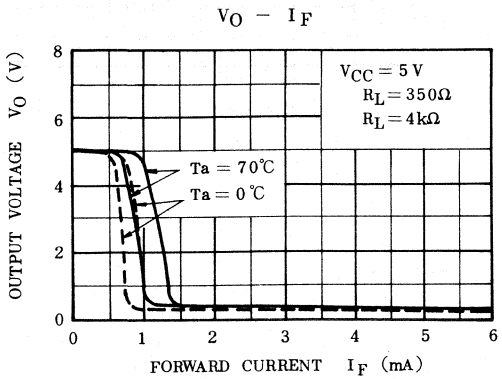
$V_O - I_F$



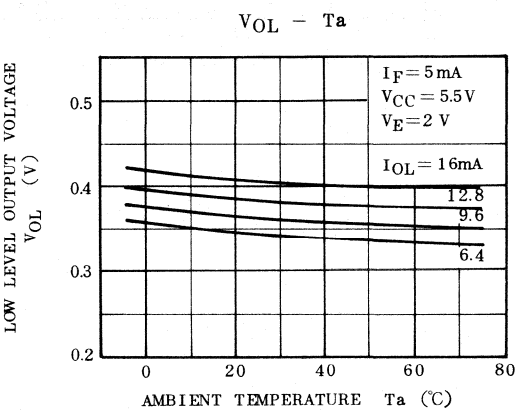
$I_{OH} - Ta$



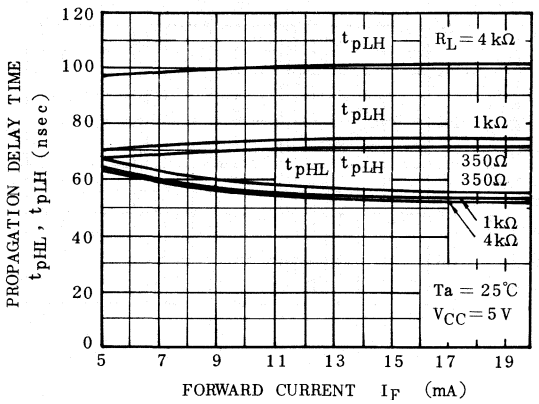
$V_O - I_F$



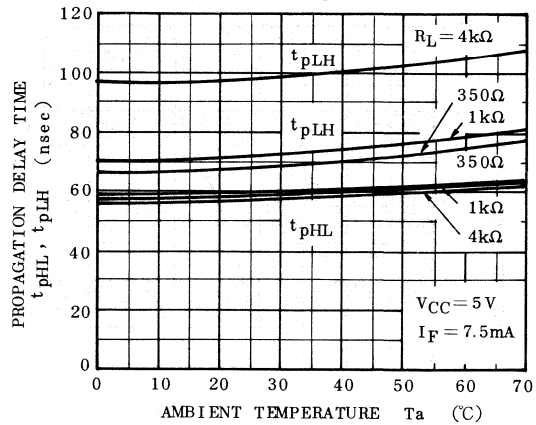
$V_{OL} - Ta$



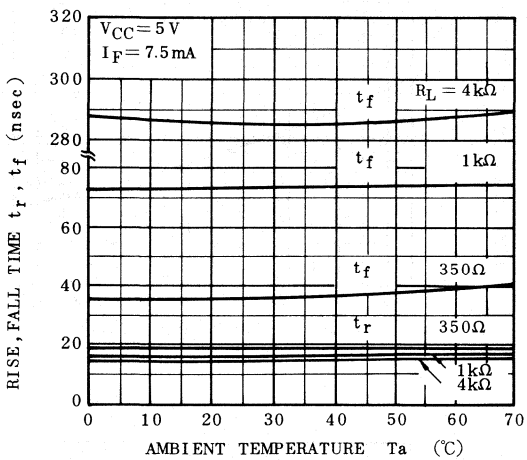
t_{pHL} , t_{pLH} – I_F



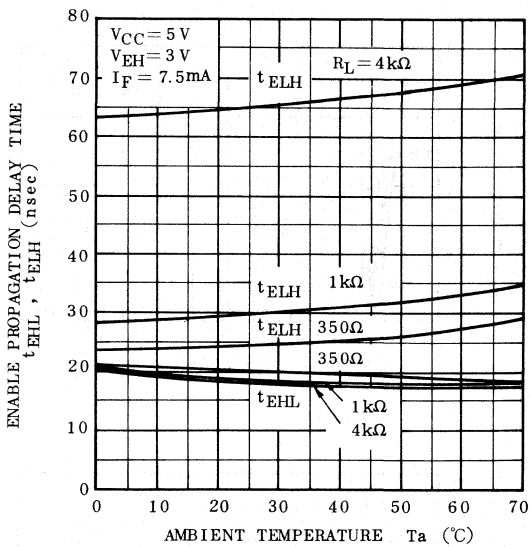
t_{pHL} , t_{pLH} – Ta



t_r , t_f – Ta



t_{EHL} , t_{ELH} – Ta

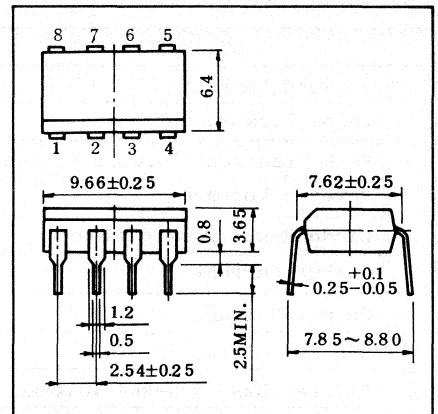


CURRENT LOOP DRIVER.
LOW INPUT CURRENT LINE RECEIVER.
CMOS LOGIC INTERFACE.
TELEPHONE RING DETECTOR.
MICROPROCESSOR SYSTEM INTERFACE.

The TOSHIBA TLP553 consists of a GaAℓAs infrared emitting diode and a split-Darlington output configuration photodetector.
A high speed GaAℓAs LED and an integrated high gain photo-detector provide extremely high current transfer ratio. So TLP553 is suitable for use in CMOS, LSTTL or other high speed, low power applications.

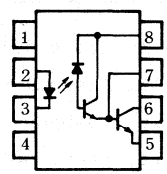
- Isolation Voltage : 2500Vrms (Min.)
- Current Transfer Ratio: 400% Min. (I_F=0.5mA)
- Switching time : t_{PHL}=2μs (Typ.)
  t_{PLH}=4μs (Typ.)
  @R_L=4.7kΩ, I_F=0.5mA
- Performance guaranteed over temperature : 0°C∿7°C
- UL recognized : File No. E67349

Unit in mm



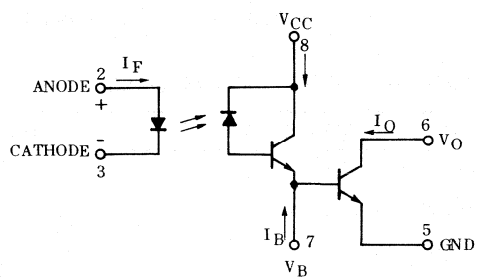
JEDEC	—
EIAJ	—
TOSHIBA	11-10C1

PIN CONFIGURATION (TOP VIEW)



1 : N.C.
2 : ANODE
3 : CATHODE
4 : N.C.
5 : GROUND
6 : OUTPUT
7 : OUTPUT BASE
8 : V_{CC}

SCHEMATIC



MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current	(Note 1)	I_F	20	mA
	Pulse Forward Current	(Note 2)	I_{FP}	40	mA
	Peak Transient Forward Current	(Note 3)	I_{FP}	1	A
	Reverse Voltage		V_R	5	V
	Diode Power Dissipation	(Note 4)	P_D	35	mW
DETECTOR	Output Current	(Note 5)	I_O	60	mA
	Output Voltage		V_O	-0.5 to 18	V
	Supply Voltage		V_{CC}	-0.5 to 18	V
	Emitter-Base Reverse Voltage		V_{EB}	0.5	V
	Output Power Dissipation	(Note 6)	P_o	100	mW
Operating Temperature Range			T_{opr}	-40 to 85	°C
Storage Temperature Range			T_{stg}	-55 to 125	°C
Lead Solder Temperature (10 sec.)		(Note 7)	T_{sold}	260	°C
Isolation Voltage (AC, 1 min., RH $\leq$ 60%)		(Note 8)	BV_S	2500	V_{rms}

Note 1 Derate linearly above 50°C free-air temperature at a rate of 0.27mA/°C.

Note 2 50% duty cycle, 1ms pulse width

Note 3 Pulse width 1μs, 300pps

Note 4 Derate linearly above 50°C free-air temperature at a rate of 0.47mW/°C.

Note 5 Derate linearly above 25°C free-air temperature at a rate of 0.6mA/°C.

Note 6 Derate linearly above 25°C free-air temperature at a rate of 1mW/°C.

Note 7 Soldering portion of lead : up to 2mm from body of the device.

Note 8 Device considered a two-terminal device: Pins 1,2,3, and 4 shorted together and Pins 5,6,7, and 8 shorted together.

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	-	-	16	V
Forward Current	I_F	-	-	15	mA
Output Current	I_O	-	-	30	mA
Operating Temperature	T_{opr}	0	-	70	°C

ELECTRICAL CHARACTERISTICS (Ta=0°C to +70°C, Unless otherwise specified)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.*	MAX.	UNIT
Input Forward Voltage	V_F	I_F=1.6mA, Ta=25°C	-	1.55	1.7	V
Temperature Coefficient of Forward Voltage	$\frac{\Delta V_F}{\Delta Ta}$	I_F=1.6mA	-	-1.9	-	mV/°C
Reverce Current	I_R	V_R=5V, Ta=25°C	-	-	10	μA
Input Capacitance	C_{IN}	f=1MHz, V_F=0	-	45	-	pF
Logic High Output Current	I_{OH}	V_F=0.8V, V_O=V_{CC}=18V	-	0.1	100	μA
Logic High Supply Current	I_{CCH}	I_F=0mA, V_O=Open V_{CC}=5V	-	10	-	nA
Logic Low Supply Current	I_{CCL}	I_F=1.6mA, V_O=Open V_{CC}=5V	-	0.3	-	mA
Current Transfer Ratio	I_O/I_F	I_F=0.5mA, V_O=0.4V V_{CC}=4.5V	400	1000	-	%
		I_F=1.6mA, V_O=0.4V V_{CC}=4.5V	500	900	-	
Logic Low Output Voltage (Note 6)	V_{OL}	I_F=1.6mA, I_O=6.4mA V_{CC}=4.5V	-	0.1	0.4	V
		I_F=5mA, I_O=15mA V_{CC}=4.5V	-	0.1	0.4	
		I_F=12mA, I_O=24mA V_{CC}=4.5V	-	0.2	0.4	
Input-Output Insulation Leakage Current	I_S	R.H.≦60% t=5s, V_S = 3000Vdc Ta=25°C (Note 8)	-	-	100	μA
Resistance (Input-Output)	R_S	Ta=25°C, R.H.<60% V_S=500Vdc (Note 8)	-	10^{12}	-	Ω
Capacitance (Input-Output)	C_S	f=1MHz, V_S=0 Ta=25°C (Note 8)	-	0.6	-	pF

* All typicals at Ta=25°C and V_{CC}=5V, Unless otherwise noted.

SWITCHING SPECIFICATIONS (Ta=25°C, V_{CC}=5V, Unless otherwise specified)

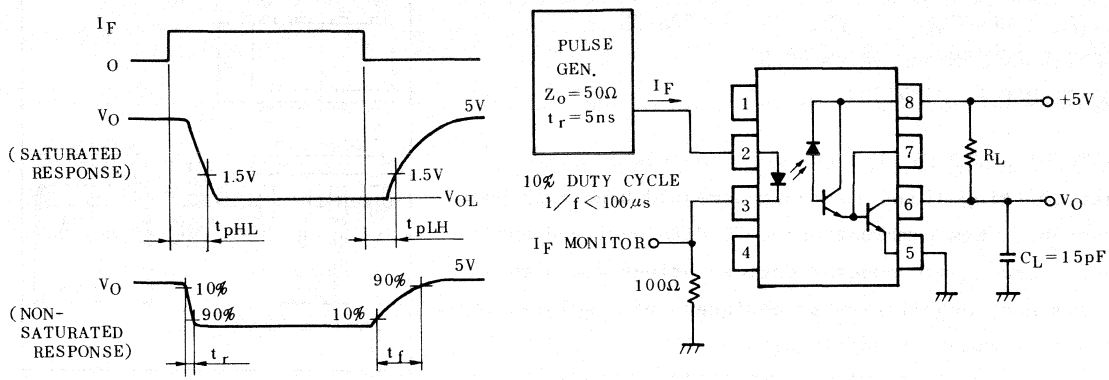
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Propagation Delay Time to Logic Low at Output (H→L) (Note 9, 10)	t_{pHL}	1	I_F=0.5mA, R_L=4.7kΩ	-	2	25	μs
			I_F=12mA, R_L=270Ω	-	0.3	1	
			I_F=1.6mA, R_L=2.2kΩ	-	-	-	
Propagation Delay Time to Logic High at Output (L→H) (Note 9, 10)	t_{pLH}	1	I_F=0.5mA, R_L=4.7kΩ	-	4	60	μs
			I_F=12mA, R_L=270Ω	-	1	7	
			I_F=1.6mA, R_L=2.2kΩ	-	-	-	
Common Mode Transient Immunity at Logic High Level Output (Note 11)	CM_H	2	I_F=0mA, R_L=2.2kΩ V_{CM}=400V_{p-p}	-	500	-	V/μs
Common Mode Transient Immunity at Logic Low Level Output (Note 11)	CM_L	2	I_F=1.6mA, R_L=2.2kΩ V_{CM}=400V_{p-p}	-	-500	-	V/μs

Note 9 Pin 7 Open.

Note 10 Use of a resistor between pin 5 and 7 will decrease gain and delay time.

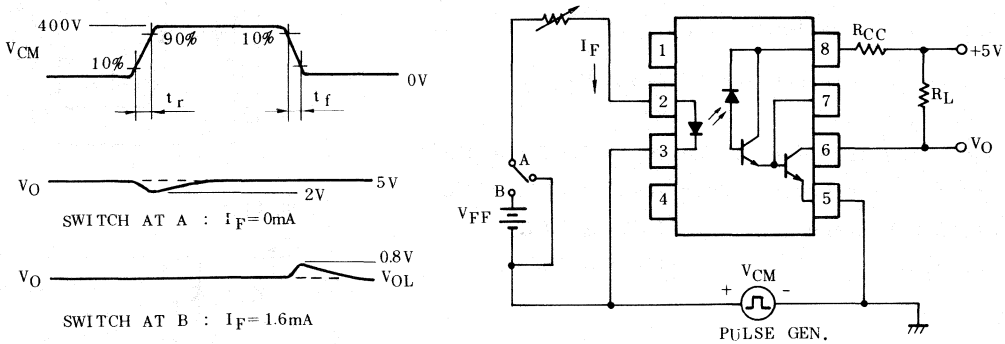
Note 11 Common mode transient immunity in Logic High level is the maximum tolerable (positive) dV_{CM}/dt on the leading edge of the common mode pulse, V_{CM}, to assure that the output will remain in a Logic High state (i.e., V_O>2.0V). Common mode transient immunity in Logic Low level is the maximum tolerable (negative) dV_{CM}/dt on the trailing edge of the common mode pulse signal, V_{CM}, to assure that the output will remain in a Logic Low state (i.e., V_O<0.8V).

TEST CIRCUIT 1. Switching Time Test Circuit



C_L is approximately 15pF which includes probe and stray wiring capacitance.

TEST CIRCUIT 2. Common Mode Noise Immunity Test Circuit



$$C_{MH} = \frac{320V}{t_r(\mu s)} \quad , \quad C_{ML} = \frac{320V}{t_f(\mu s)}$$

TLP554

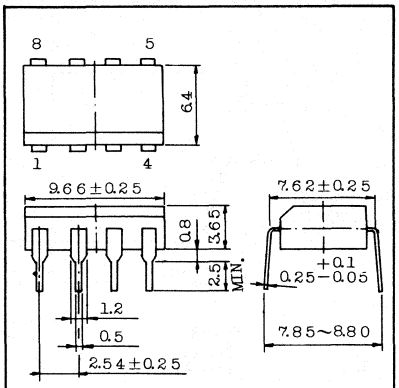
GaAℓAs IRED & PHOTO-IC

HIGH SPEED, LONG DISTANCE ISOLATED LINE RECEIVER
MICROPROCESSOR SYSTEM INTERFACES
DIGITAL ISOLATION FOR A/D, D/A CONVERSION
COMPUTER-PERIPHERAL INTERFACES
GROUND LOOP ELIMINATION

The TOSHIBA TLP554 photocoupler combines a GaAℓAs light emitting diode with an integrated high gain photo-detector. This combination of TOSHIBA designed and manufactured semiconductor devices brings new high performance capabilities to designers of isolated logic and data communication circuits.
The new low current, high speed GaAℓAs emitter manufactured with an unique LPE junction, has the virtue of fast rise and fall time at low drive currents.
The output of the shielded integrated detector circuit is an open collector shottly clamped transistor. The shield, which shunts capacitively coupled common mode noise to ground, provides a guaranteed transient immunity specification of 1000V/μs.

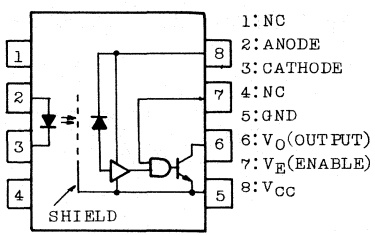
- Input Current Thresholds : I_F=5mA Max.
- Switching Speed : 5MBd
- Common Mode Transient Immunity : ±1000V/μs Min.
- Guaranteed Performance Over Temp. : 0°C ~ 70°C
- Isolation Voltage : 2500V_{rms} Min.
- UL Recognized : File No. E67349

Unit in mm

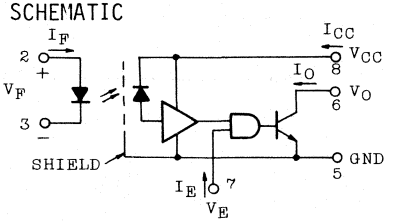


JEDEC	—
EIAJ	—
TOSHIBA	11-10C1

PIN CONFIGURATION (TOP VIEW)



SCHEMATIC



TRUTH TABLE
(Positive Logic)

INPUT	ENABLE	OUTPUT
H	H	L
L	H	H
H	L	H
L	L	H

A 0.1μF bypass capacitor must connected between pins 8 and 5 (See Note 1).

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Input Voltage, Low Level	V_{FL}	-3	0	1.0	V
Input Current, High Level	I_{FH}	6.3*	-	20	mA
Supply Voltage, Output	V_{CC}	4.5	5	5.5	V
High Level Enable Voltage	V_{EH}	2.0	-	V_{CC}	V
Low Level Enable Voltage	V_{EL}	0	-	0.8	V
Fan Out (TTL Load)	N	-	-	8	
Operating Temperature	T_{opr}	-40	-	85	°C

* 6.3mA is guard banded value which allows for at least 20% CTR degradation. Initial input current threshold value is 5mA or less.

MAXIMUM RATINGS

CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current	I_F	20	mA
	Reverse Voltage	V_R	5	V
DETECTOR	Output Current	I_O	25	mA
	Output Voltage	V_O	-0.5∿7	V
	Supply Voltage (1 Minute Maximum)	V_{CC}	7	V
	Enable Input Voltege (Not to exceed V_{CC} by more than 500mV)	V_E	5.5	V
	Output Collector Power Dissipation	P_O	40	mW
Operating Temperature Range		T_{opr}	-40∿85	°C
Storage Temperature Range		T_{stg}	-55∿125	°C
Lead Solder Temperature (10 sec.)**		T_{sold}	260	°C
Isolation Voltage (R.H≦60%, AC/1 min., Note 3)		BV_S	2500	V_{rms}

** Soldering portion of lead : up to 2mm from the body of the device.

ELECTRICAL CHARACTERISTICS

(For $0°C \leqq Ta \leqq 70°C$, $4.5V \leqq V_{CC} \leqq 5.5V$, $V_{FL} \leqq 1.0V$, unless otherwise specified.)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.*	MAX.	UNIT
Input Forward Voltage	V_F	I_F=10mA, Ta=25°C	-	1.65	1.8	V
Input Diode Temperature Coefficient	$\frac{\Delta V_F}{\Delta T_A}$	I_F=10mA	-	-2.0	-	mV/°C
Input Reverse Current	I_R	V_R=5V, Ta=25°C	-	-	10	μA
Input Capacitance	C_T	V_F=0V, f=1MHz	-	45	-	pF
High Level Output Current	I_{OH}	V_F=1.0V, V_O=5.5V V_E=2.0V	-	10	250	μA
		V_F=1.0V, V_O=5.5V Ta=25°C, V_E=2.0V	-	0.5	10	
Low Level Output Voltage	V_{OL}	I_F=5mA, V_E=2.0V I_{OL}(Sinking)=13mA	-	0.4	0.6	V
Input Current Logic Low Output Level	I_{FH}	I_{OL}(Sinking)=13mA V_E=2.0V, V_{OL}=0.6V	-	-	5	mA
High Level Supply Current	I_{CCH}	I_F=0mA, V_{CC}=5.5V V_E=0.5V	-	7	15	mA
Low Level Supply Current	I_{CCL}	I_F=10mA, V_{CC}=5.5V V_E=0.5V	-	12	19	mA
Low Level Enable Current	I_{EL}	V_{CC}=5.5V, V_E=0.5V	-	-1.6	-2.0	mA
High Level Enable Current	I_{EH}	V_{CC}=5.5V, V_E=2.0V	-	-1	-	mA
High Level Enable Voltage	V_{EH}		2.0	-	-	V
Low Level Enable Voltage	V_{EL}		-	-	0.8	V
Input-Output Leakage Current	I_S	V_S=3540V DC, R.H.≦60% Ta=25°C, t=5 second (Note. 3)	-	-	100	μA
Resistance (Input-Output)	R_S	V_S=500V, R.H.≦60%, Ta=25°C (Note.3)	-	10^{12}	-	Ω
Capacitance (Input-Output)	C_S	f=1MHz, V_S=0, Ta=25°C (Note.3)	-	0.6	-	pF

* All typical values are at V_{CC}=5V, Ta=25°C.

SWITCHING CHARACTERISTICS (Ta=25°C, V_{CC}=5V)

CHARACTERISTICS	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Propagation Delay Time to High Output Level (L→H)	t_{pLH}	1	R_L=350Ω, C_L=15pF I_F=7.5mA	-	60	120	ns
Propagation Delay Time to Low Output Level (H→L)	t_{pHL}			-	60	120	ns
Output Rise Time (10-90%)	t_r		R_L=350Ω, C_L=15pF I_F=7.5mA	-	30	-	ns
Output Fall Time (90-10%)	t_f			-	30	-	ns
Propagation Delay Time of Enable from V_{EH} to V_{EL}	t_{ELH}	2	R_L=350Ω, C_L=15pF I_F=7.5mA, V_{EH}=3.0V	-	25	-	ns
Propagation Delay Time of Enable from V_{EL} to V_{EH}	t_{EHL}			-	25	-	ns
Common Mode Transient Immunity at Logic High Output Level	CM_H	3	V_{CM}=400V, R_L=350Ω $V_{O(min.)}$=2V, I_F=0mA (Note 2)	1000	1000	-	V/μs
Common Mode Transient Immunity at Logic Low Output Level	CM_L		V_{CM}=400V, R_L=350Ω $V_{O(max.)}$=0.8V I_F=7.5mA (Note 2)	-1000	-1000	-	V/μs

Note 1. The V_{CC} supply voltage to each TLP554 isolator must be bypassed by a 0.1μF capacitor to stabilize the operation of the high gain amplifier. This can be either a ceramic or solid tantalum capacitor with good high frequency characteristic and should be connected as close as possible to the package V_{CC} and GND pins of each device.

Note 2. CM_L • The maximum tolerable rate of fall of the common mode voltage to ensure the output will remain in the low output state (i.e., V_{OUT}<0.8V). Measured in volts per microsecond (V/μs).

CM_H • The maximum tolerable rate of rise of the common mode voltage to ensure the output will remain in the high state (i.e., V_{OUT}>2.0V). Measured in volts per microsecond (V/μs).

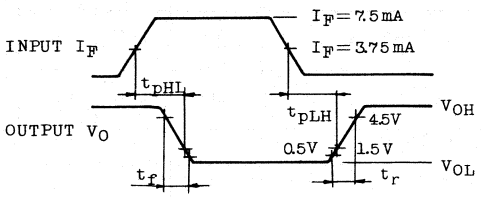
Note 3. Device considered a two-terminal device: Pins 1,2,3 and 4 shorted together, and Pins 5,6,7 and 8 shorted together.

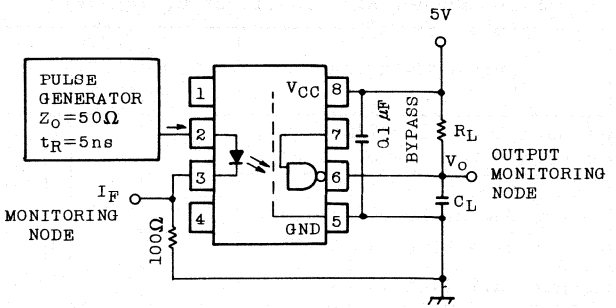
Note 4. Enable Input • No pull up resistor required as the device has an internal pull up resistor.

Note 5. Maximum electrostatic discharge voltage for any pins: 180V (c=200pF, R=0)

TEST CIRCUIT 1.

t_{pHL} and t_{pLH}

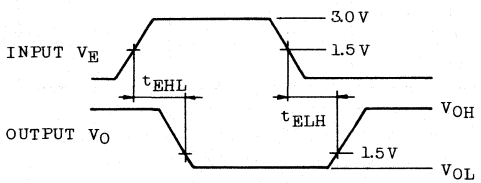


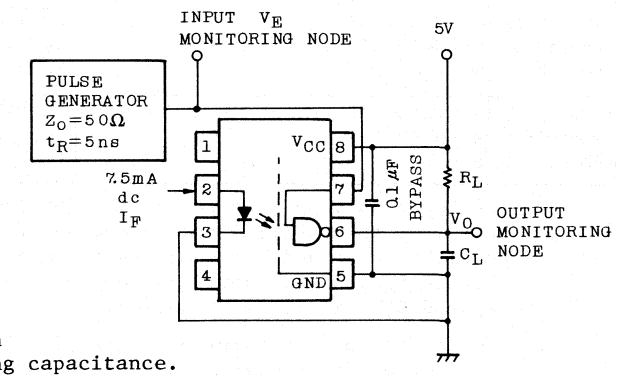


· C_L is approximately 15pF which includes probe and stray wiring capacitance.

TEST CIRCUIT 2.

t_{ELH} and t_{EHL}

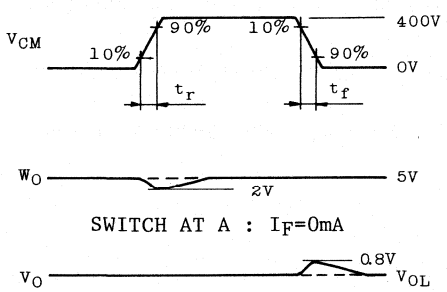




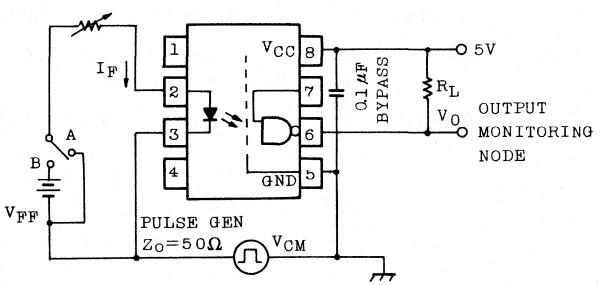
· C_L is approximately 15pF which includes probe and stray wiring capacitance.

TEST CIRCUIT 3.

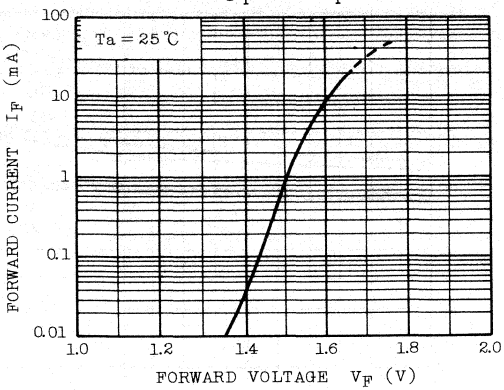
Transient Immunity and Typical Waveforms.



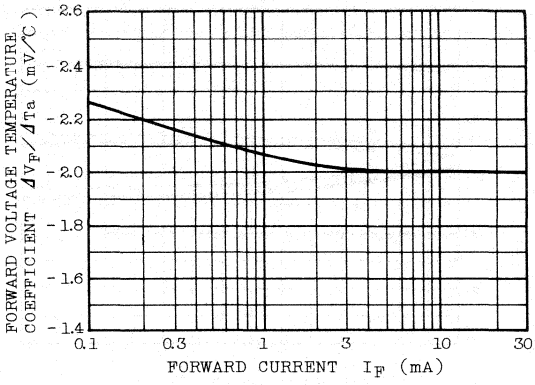
$$C_{MH}=\frac{320(V)}{t_r(\mu s)},\quad C_{ML}=\frac{320(V)}{t_f(\mu s)}$$



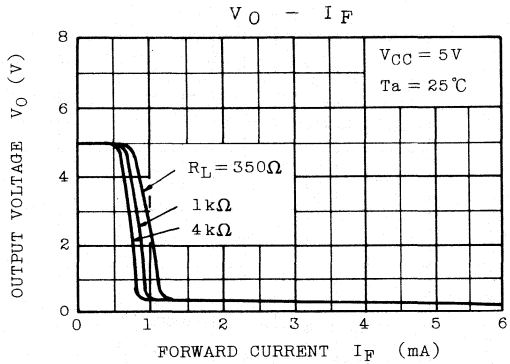
$I_F - V_F$



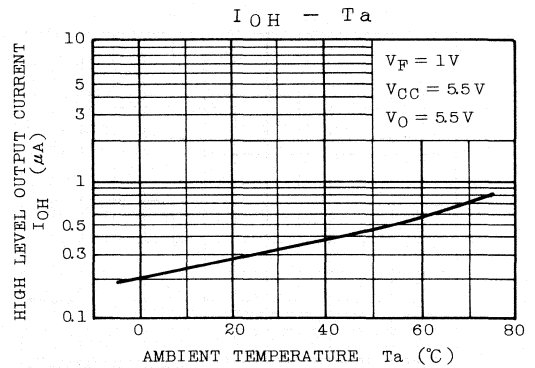
$\Delta V_F / Ta - I_F$



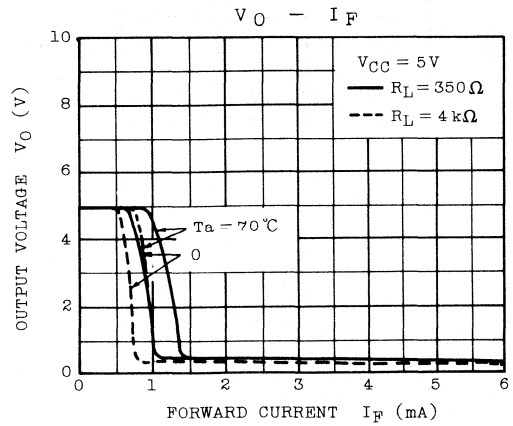
$V_O - I_F$



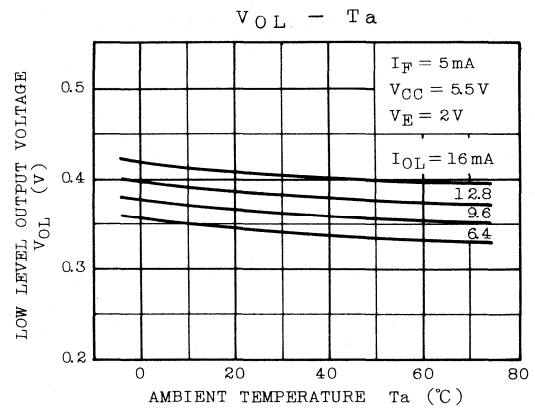
$I_{OH} - Ta$

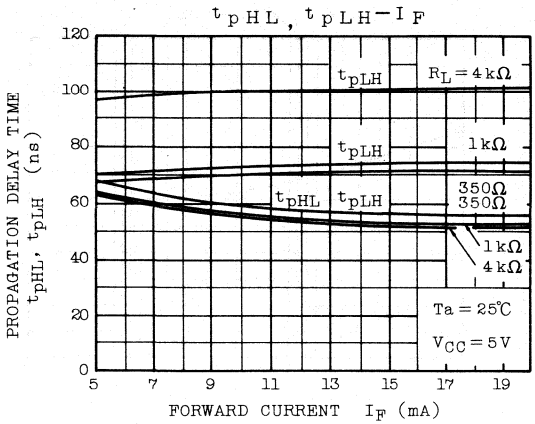


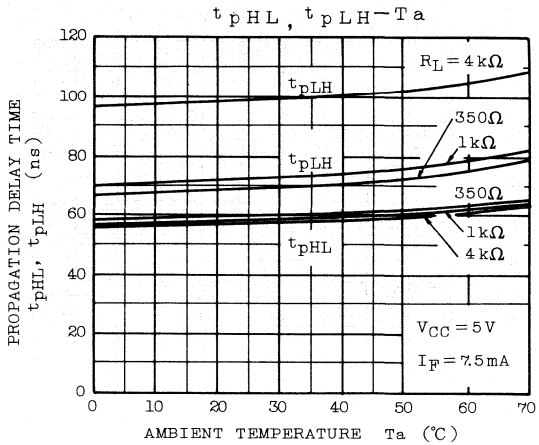
$V_O - I_F$

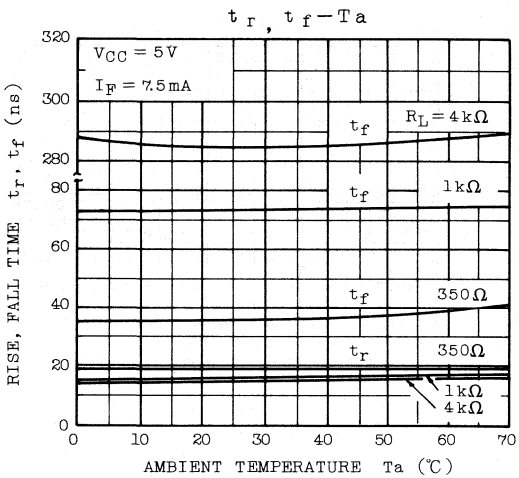


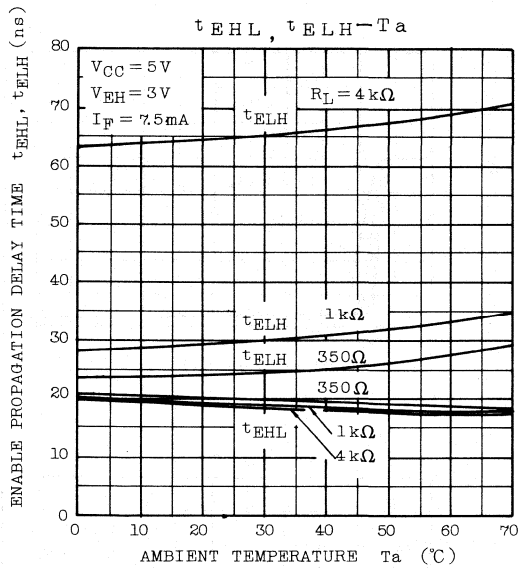
$V_{OL} - Ta$




t_{pHL}, t_{pLH} – I_F
PROPAGATION DELAY TIME t_{pHL}, t_{pLH} (ns)
FORWARD CURRENT I_F (mA)
t_{pLH}
$R_L = 4k\Omega$
1kΩ
350Ω
t_{pHL}
4kΩ
Ta = 25℃
V_{CC} = 5V


t_{pHL}, t_{pLH} – Ta
PROPAGATION DELAY TIME t_{pHL}, t_{pLH} (ns)
AMBIENT TEMPERATURE Ta (℃)
$R_L = 4k\Omega$
t_{pLH}
350Ω
1kΩ
t_{pHL}
4kΩ
V_{CC} = 5V
I_F = 7.5mA


t_r, t_f – Ta
RISE, FALL TIME t_r, t_f (ns)
AMBIENT TEMPERATURE Ta (℃)
V_{CC} = 5V
I_F = 7.5mA
t_f
$R_L = 4k\Omega$
1kΩ
350Ω
t_r
4kΩ

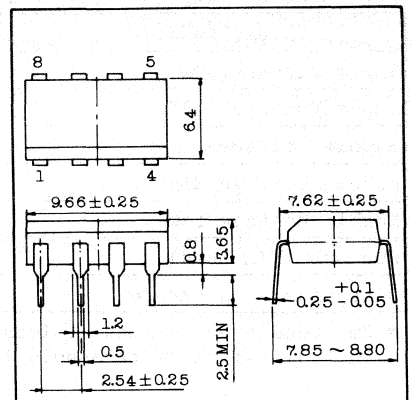

t_{EHL}, t_{ELH} – Ta
ENABLE PROPAGATION DELAY TIME t_{EHL}, t_{ELH} (ns)
AMBIENT TEMPERATURE Ta (℃)
V_{CC} = 5V
V_{EH} = 3V
I_F = 7.5mA
t_{ELH}
$R_L = 4k\Omega$
1kΩ
350Ω
t_{EHL}
4kΩ

ISOLATED BUSS DRIVER
HIGH SPEED LINE RECEIVER
MICROPROCESSOR SYSTEM INTERFACES
MOS FET GATE DRIVER
TRANSISTOR INVERTER

The Toshiba TLP555 consists of a GaAℓAs light emitting diode and integrated high gain, high speed photodetector. This unit is 8-lead DIP package.
The detector has a three state output stage that provides source drive and sink drive, and built-in Schmitt trigger. The detector IC has an internal shield that provides a guaranteed common mode transient immunity of 1000V/μs. TLP555 is buffer logic type. For inverter logic type, TLP558 is in line-up.

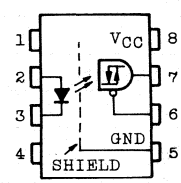
- Input Current : I_F=1.6mA
- Power Supply Voltage : V_{CC}=4.5~20V
- Switching Speed : t_{pHL}, t_{pLH}=400ns Max.
- Common Mode Transient Immunity : ±1000V/μs Min.
- Guaranteed Performance Over Temp. : -25~85°C
- Isolation Voltage : 2500Vrms Min.
- UL Recognized : File No. E67349

Unit in mm



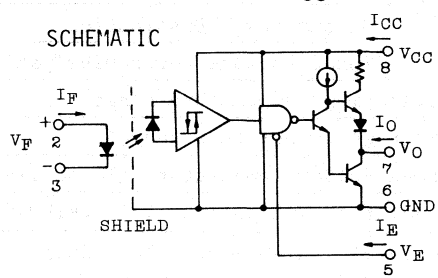
JEDEC	—
EIAJ	—
TOSHIBA	11-10C1

PIN CONFIGURATION (TOP VIEW)



1: NC
2: ANODE
3: CATHODE
4: NC
5: GND
6: V_E (ENABLE)
7: V_O (OUTPUT)
8: V_{CC}

SCHEMATIC



TRUTH TABLE (Positive Logic)

INPUT	ENABLE	OUTPUT
H	H	Z
L	H	Z
H	L	H
L	L	L

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Input Current, ON	$I_{F(ON)}$	2*	-	5	mA
Input Voltage, OFF	$V_{F(OFF)}$	0	-	0.8	V
Supply Voltage	V_{CC}	4.5	-	20	V
Enable Voltage High	V_{EH}	2.0	-	20	V
Enable Voltage Low	V_{EL}	0	-	0.8	V
Fan Out (TTL Load)	N			4	
Operating Temperature	T_{opr}	-25	-	85	°C

* 2mA condition permits at least 20% CTR degradation guardband.
Initial switching threshold is 1.6mA or less.

ABSOLUTE MAXIMUM RATINGS (No Derating Required up to 85°C unless otherwise noted)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current		I_F	10	mA
	Peak Transient Forward Current	(Note 1)	I_{FPT}	1	A
	Revere Voltage		V_R	5	V
DETECTOR	Output Current		I_O	40/-25	mA
	Peak Output Current	(Note 2)	I_{OP}	80/-50	mA
	Output Voltage		V_O	-0.5~20	V
	Supply Voltage		V_{CC}	-0.5~20	V
	Three State Enable Voltage		V_E	-0.5~20	V
	Output Power Dissipation	(Note 3)	P_O	100	mW
	Total Package Power Dissipation	(Note 4)	P_T	200	mW
Operating Temperature Range			T_{opr}	-40~85	°C
Storage Temperature Range			T_{stg}	-55~125	°C
Lead Solder Temperature (10 sec.)**			T_{sold}	260	°C
Isolation Voltage(AC, 1min.,R.H≤60%,Ta=25°C)		(Note 5)	BV_S	2500	V_{rms}

Note 1 : Pulse Width ≤ 1μs, 300pps

Note 2 : Pulse Width ≤ 5μs, Duty Ratio ≤ 0.025

Note 3 : Derate 1.8mW/°C above 70°C ambient temperature.

Note 4 : Derate 3.6mW/°C above 70°C ambient temperature.

Note 5 : Device considered a tow terminal device : pins 1,2,3 and 4 shorted together, and pins 5,6,7 and 8 shorted together.

** 1.6mm below seating plane.

ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, Ta=-25~85°C, V_{CC}=4.5~20V)

CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.*	MAX.	UNIT
Input Forward Voltage	V_F	I_F=5mA, Ta=25°C		-	1.55	1.7	V
Temperature Coefficient of Forward Voltage	$\Delta V_F/\Delta Ta$	I_F=5mA		-	-2.0	-	mV/°C
Input Reverse Current	I_R	V_R=5V, Ta=25°C		-	-	10	μA
Input Capacitance	C_T	V_F=0V, f=1MHz, Ta=25°C		-	45	-	pF
Output Leakage Current ($V_O > V_{CC}$)	I_{OHH}	I_F=5mA, V_{CC}=4.5V	V_O=5.5V	-	-	100	μA
		V_E=GND	V_O=20V	-	2	500	
Logic Low Output Voltage	V_{OL}	I_{OL}=6.4mA, V_F=0.8V V_E=0.8V		-	0.4	0.5	V
Logic High Ouptut Voltage	V_{OH}	I_{OH}=-2.6mA, I_F=1.6mA V_E=0.8V		2.4	3.3	-	V
Logic Low Enable Current	I_{EL}	V_E=0.4V		-	-0.13	-0.32	mA
Logic High Enable Current	I_{EH}	V_E=2.7V		-	-	20	μA
		V_E=5.5V		-	-	100	
		V_E=20V		-	0.01	250	
Logic Low Enable Voltage	V_{EL}			-	-	0.8	V
Logic High Enable Voltage	V_{EH}			2.0	-	-	V
Logic Low Supply Current	I_{CCL}	V_F=0V	V_{CC}=5.5V	-	5	6.0	mA
		V_E=GND	V_{CC}=20V	-	5.6	7.5	
Logic High Supply Current	I_{CCH}	I_F=5mA	V_{CC}=5.5V	-	2.5	4.5	mA
		V_E=GND	V_{CC}=20V	-	2.8	6.0	
High Impedance State Output Current	I_{OZL}	I_F=5mA, V_E=2V	V_O=0.4V	-	1	-20	μA
	I_{OZH}	V_F=0V V_E=2V	V_O=2.4V	-	-	20	
			V_O=5.5V	-	-	100	
			V_O=20V	-	0.01	500	
Logic Low Short Circuit Output Current (Note 6)	I_{OSL}	V_F=0V	V_O=V_{CC}=5.5V	25	55	-	mA
		V_E=0.8V	V_O=V_{CC}=20V	40	80	-	
Logic High Short Circuit Output Current (Note 6)	I_{OSH}	I_F=5mA, V_O=GND	V_{CC}=5.5V	-10	-25	-	mA
		V_E=0.8V	V_{CC}=20V	-25	-60	-	
Input Current Logic High Output	I_{FH}	V_E=0.8V, I_O=-2.6mA V_O>2.4V		-	0.4	1.6	mA
Input Voltage Logic Low Output	V_{FL}	V_E=0.8V, I_O=6.4mA V_O<0.4V		0.8	-	-	V

* All typical values are at Ta=25°C, V_{CC}=5V, $I_{F(ON)}$=3mA unless otherwise specified.

ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, Ta=-25~85°C, V_{CC}=4.5~20V)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.*	MAX.	UNIT
Input Current Hysteresis	I_{HYS}	V_{CC}=5V, V_E=GND	-	0.05	-	mA
Input-Output Insulation Leakage Current	I_S	V_S=3000V_{DC}, R.H. ≤ 60% Ta=25°C, t=5sec. (Note 5)	-	-	100	μA
Resistance (Input-Output)	R_S	V_S=500V_{DC}, R.H ≤ 60% Ta=25°C (Note 5)	-	10^{12}	-	Ω
Capacitance (Input-Output)	C_S	V_S=0V, f=1MHz, Ta=25°C (Note 5)	-	1.0	-	pF

* All typical values are at Ta=25°C, V_{CC}=5V, $I_{F(ON)}$=3mA unless otherwise specified.

SWITCHING CHARACTERISTICS

(Unless otherwise specified, V_{CC}=4.5~20V, Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.*	MAX.	UNIT
Propagation Delay Time to Logic High Output Level (Note 7)	t_{pLH}	1	I_F=0→3mA	-	235	400	ns
Propagation Delay Time to Logic Low Output Level (Note 7)	t_{pHL}		I_F=3→0mA	-	250	400	ns
Output Rise Time (10-90%)	t_r		I_F=0→3mA	-	35	75	ns
Output Fall Time (90-10%)	t_f		I_F=3→0mA	-	20	75	ns
Output Enable Time to Logic High	t_{pZH}	2	V_E=3→0V	-		-	ns
Output Enable Time to Logic Low	t_{pZL}		V_E=3→0V	-		-	ns
Output Disable Time from Logic High	t_{pHZ}		V_E=0→3V	-		-	ns
Output Disable Time from Logic Low	t_{pLZ}		V_E=0→3V	-		-	ns
Common Mode Transient Immunity at Logic High Output (Note 8)	CM_H	3	I_F=1.6mA, V_{CM}=50V $V_{O(Min)}$=2V	-1000		-	V/μs
Common Mode Transient Immunity Logic Low Output (Note 8)	CM_L		I_F=0mA, V_{CM}=50V $V_{O(Max)}$=0.8V	1000		-	V/μs

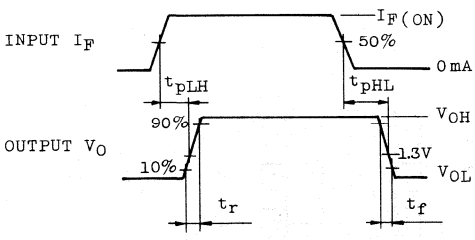
* All typical values are at Ta=25°C, V_{CC}=5V

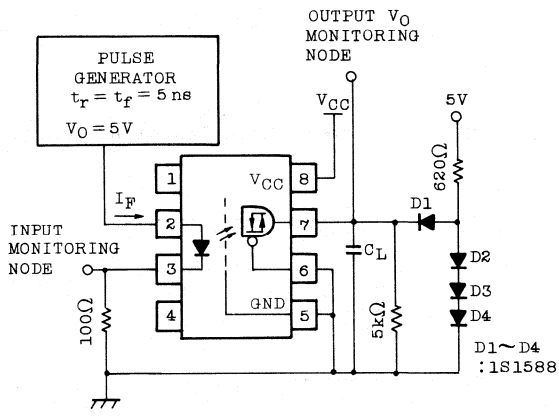
Note 6 : Duration of output short circuit time should not exceed 10ms.

Note 7 : The t_{pLH} propagation delay is measured from the 50% point on the leading edge of the input pulse to the 1.3V point on the leading edge of the output pulse. The t_{pHL} propagation delay is measured from the 50% point on the trailing edge of the input pulse to the 1.3V point on the trailing edge of the output pulse.

Note 8 : CM_L is the maximum rate of rise of the common mode voltage that can be sustained with the output voltage in the logic low state ($V_O < 0.8V$). CM_H is the maximum rate of fall of the common mode voltage that can be sustained with the output voltage in the logic high state ($V_O > 2.0V$).

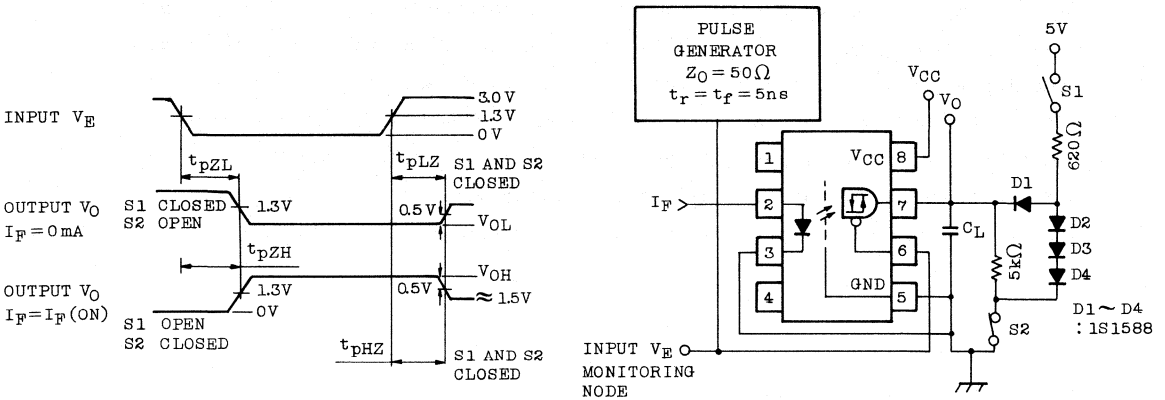
TEST CIRCUIT 1: t_{pLH}, t_{pHL}, t_r and t_f





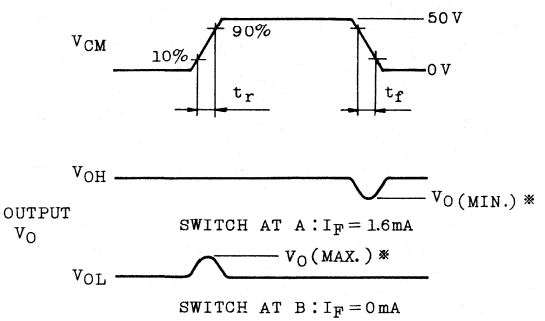
C_L is approximately 15pF which includes probe and stray wiring capacitance.

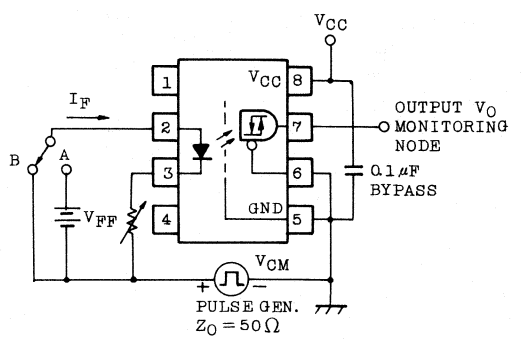
TEST CIRCUIT 2: t_{pHZ}, t_{pZH}, t_{pLZ} and t_{pZL}



C_L is approximately 15pF which includes probe and stray wiring capacitance.

TEST CIRCUIT 3: Common Mode Transient Immunity





PROGRAMMABLE CONTROLLERS

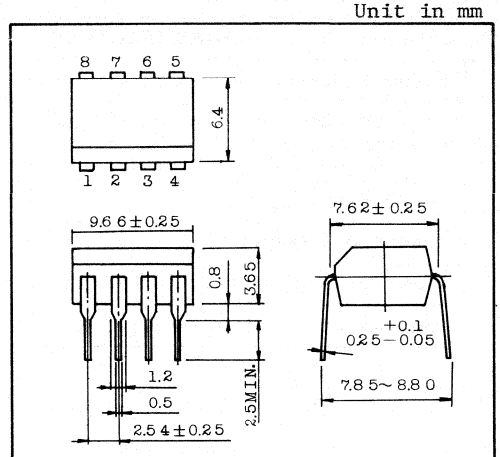
AC-OUTPUT MODULE

SOLID STATE RELAY

The TOSHIBA TLP611J consists of a photo-thyristor connected inverse parallel optically coupled to a gallium arsenide infrared emitting diode in an eight lead plastic DIP package.

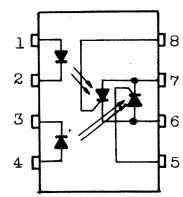
- Peak Off-State Voltage : 600V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 200mA Max.
- Isolation Voltage : 5000Vrms Min.
- UL Recognized : File No. E67349

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-10C1

PIN CONFIGURATION (TOP VIEW)



1, 4: ANODE

2, 3: CATHODE

5, 8: GATE

6: CATHODE, ANODE

7: ANODE, CATHODE

MAXIMUM RATING (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Forward Current Derating (Ta≧25°C)	$\Delta I_F/°C$	-0.5	mA/°C
	Peak Forward Current (100μs pulse, 100pps)	I_{FP}	1	A
	Reverse Voltage	V_R	5	V
	Junction Temperature	T_j	125	°C
DETECTOR	Peak Forward Voltage (R_{GK}=27KΩ)	V_{DRM}	600	V
	Peak Reverse Voltage (R_{GK}=27KΩ)	V_{RRM}	600	V
	On-State Current	I_T	200	mA
	On-State Current Derating (Ta≧25°C)	$\Delta I_T/°C$	-2.67	mA/°C
	Peak One Cycle Surge Current	I_{TSM}	2	A
	Peak Reverse Gate Voltage	V_{GM}	-5	V
	Junction Temperature	T_j	100	°C
Storage Temperature Range		T_{stg}	-55∿125	°C
Operating Temperature Range		T_{opr}	-30∿100	°C
Lead Soldering Temperature (10sec.)		T_{sold}	260	°C
Isolation Voltage (AC, 1 min, RH≦60%)		BV_S	5000	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA		1.0	1.15	1.3	V
LED	Reverse Current	I_R	V_R=5V		-	-	10	μA
LED	Capacitance	C_T	V=0, f=1MHz		-	30	-	pF
DETECTOR	Off-State Current	I_{DRM}	V_{AK}=600V	R_{GK}=27kΩ, Ta=25°C	-	10	5000	nA
				R_{GK}=10kΩ, Ta=85°C	-	2	300	μA
DETECTOR	Reverse Current	I_{RRM}	V_{KA}=600V	R_{GK}=27kΩ, Ta=25°C	-	10	5000	nA
				R_{GK}=10kΩ, Ta=85°C	-	2	300	μA
DETECTOR	On-State Voltage	V_{TM}	I_{TM}=100mA		-	0.9	1.3	V
DETECTOR	Holding Current	I_H	R_{GK}=27kΩ		-	0.2	-	mA
DETECTOR	Off-State dv/dt	dv/dt	V_{AK}=420V, R_{GK}=27kΩ		5	10	-	V/μs
DETECTOR	Capacitance	C_j	V=0, f=1MHz	Anode to Gate	-	20	-	pF
				Gate to Cathode	-	350	-	

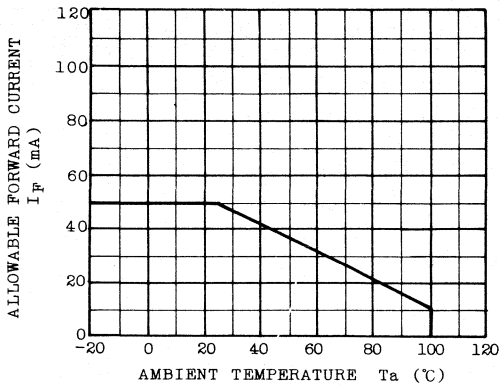
COUPLED CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	V_{AK}=6V, R_{GK}=27k	1	5	10	mA
Turn-on Time	t_{on}	I_F=50mA, R_{GK}=27k	-	10	-	μs
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	-	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	5000	-	-	Vrms

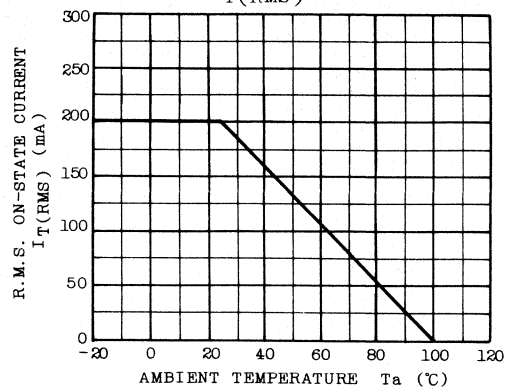
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	240	Vac
Forward Current	I_F	20	25	30	mA
Operating Temperature	T_{opr}	-30	-	85	°C
Gage to Cathode Resistance	R_{GK}	-	10	27	kΩ
Gate to Cathode Capacity	C_{GK}	-	0.01	0.1	μF

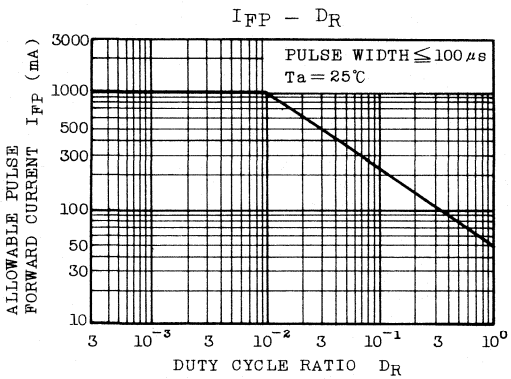
I_F – Ta



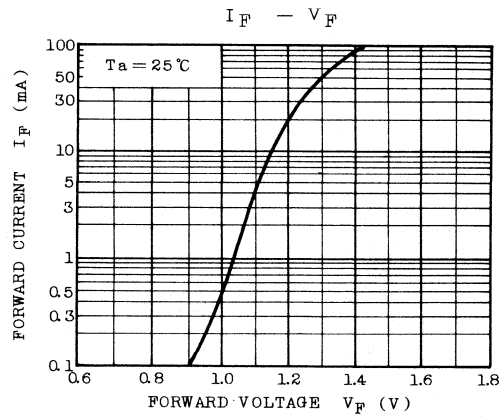
$I_{T(RMS)}$ – Ta



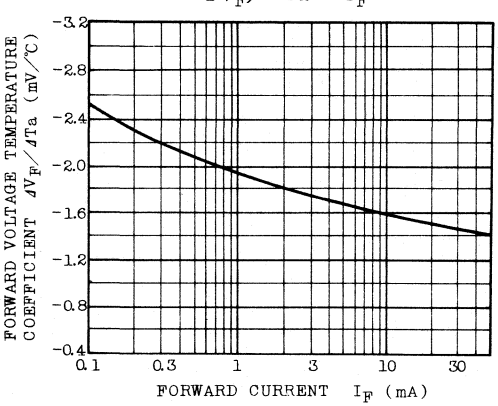
I_{FP} – D_R



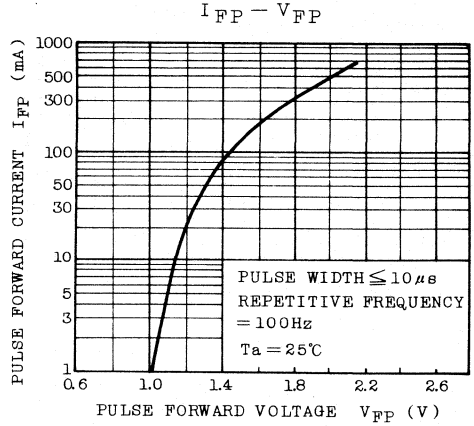
I_F – V_F



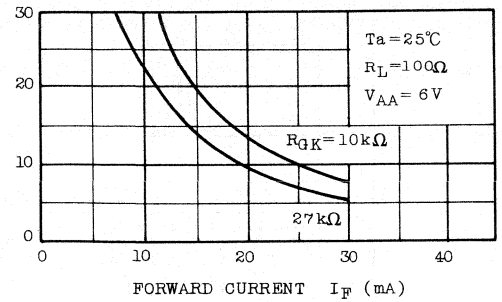
$\Delta V_F / \Delta Ta$ – I_F



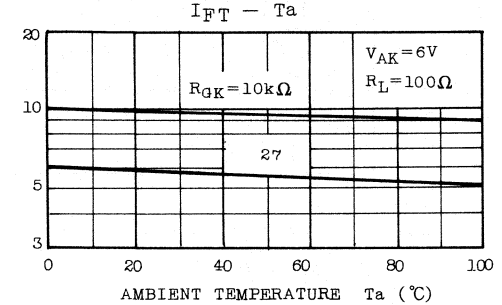
I_{FP} – V_{FP}



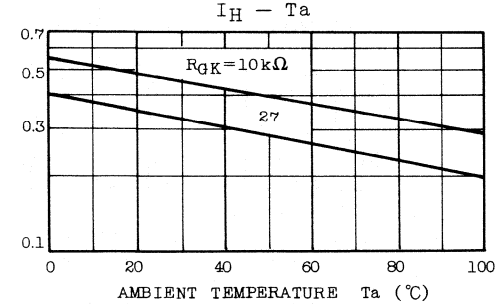
t_{ON} – I_F



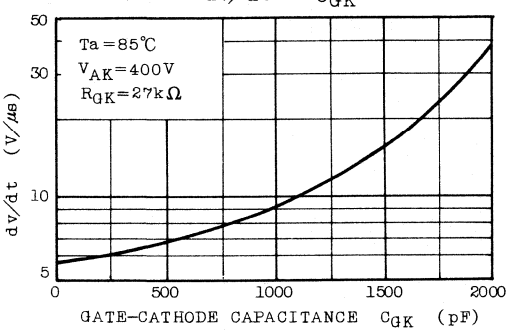
I_{FT} – Ta



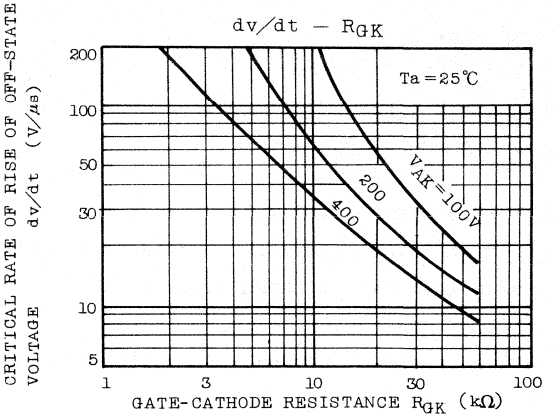
I_H – Ta



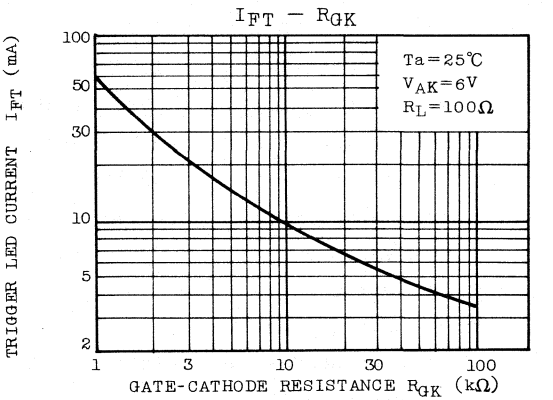
dv/dt – C_{GK}



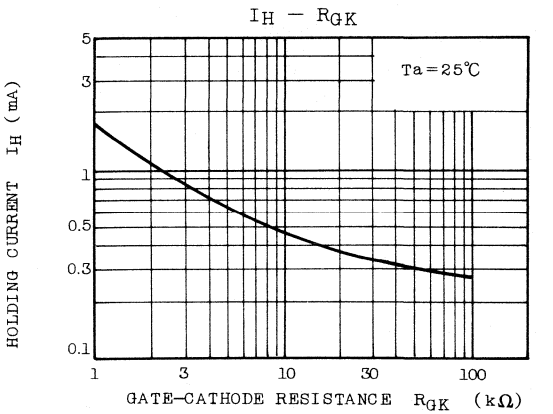
dv/dt – R_{GK}



I_{FT} – R_{GK}



I_H – R_{GK}



TLP633, TLP634

GaAs IRED & PHOTO-TRANSISTOR

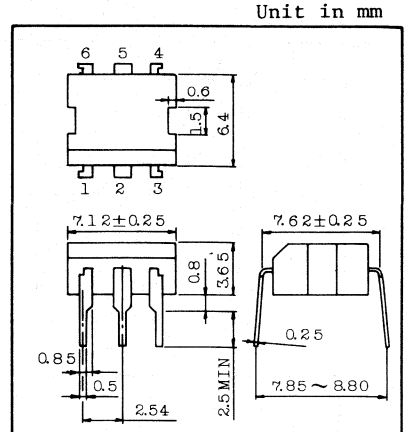
OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
SOLID STATE RELAY.
SWITCHING POWER SUPPLY.

The TOSHIBA TLP633 and TLP634 consist of a photo-transistor optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.
TLP634 is no-base internal connection for high-EMI environments.

- Collector-Emitter Voltage : 55V Min.
- Current Transfer Ratio : 50% Min.
  Rank GB : 100% Min.
- Isolation Voltage : 4000V_{rms} Min.
- Guaranteed Requirements of IEC380/VDE0806
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.2mm Min.
- Isolation Clearance : 7.6mm Min.
- Internal Creepage Path : 4.0mm Min.
- Isolation Operating Voltage
  : 500V_{ac} or 600V_{dc} for Isolation Group C *1
- Creeping Current Resistance : Group I *2
- VDE Approved : Certificate No.39408

*1 : According to VDE0110, table 4
*2 : According to VDE0110, table 3

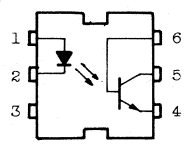
Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-7B1

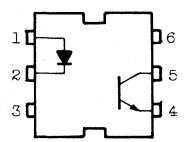
PIN CONFIGURATIONS (TOP VIEW)

TLP633



1. ANODE
2. CATHODE
3. NC
4. EMITTER
5. COLLECTOR
6. BASE

TLP634



1. ANODE
2. CATHODE
3. NC
4. EMITTER
5. COLLECTOR
6. NC

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	60	mA
	Forward Current Derating (Ta≧39°C)	$\Delta I_F/°C$	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)	I_{FP}	1	A
	Power Dissipation	P_D	100	mW
	Power Dissipation Derating (Ta≧25°C)	$\Delta P_D/°C$	-1.0	mW/°C
	Reverse Voltage	V_R	5	V
	Junction Temperature	T_j	125	°C
DETECTOR	Collector-Emitter Voltage	V_{CEO}	55	V
	Collector-Base Voltage (TLP633)	V_{CBO}	80	V
	Emitter-Collector Voltage	V_{ECO}	7	V
	Emitter-Base Voltage (TLP633)	V_{EBO}	7	V
	Collector Current	I_C	50	mA
	Power Dissipation	P_C	150	mW
	Power Dissipation Derating (Ta≧25°C)	$\Delta P_C/°C$	-1.5	mW/°C
	Junction Temperature	T_j	125	°C
Storage Temperature Range		Tstg	-55 ~ 150	°C
Operating Temperature Range		Topr	-55 ~ 100	°C
Lead Soldering Temperature (10 sec.)		Tsold	260	°C
Total Package Power Dissipation		P_T	250	mW
Total Package Power Dissipation Derating (Ta≧25°C)		$\Delta P_T/°C$	-2.5	mW/°C
Isolation Voltage (AC, 1 min, RH≦60%)		BVS	4000	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=0.5mA	55	-	-	V
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	7	-	-	V
	Collector-Base Breakdown Voltage (TLP633)	$V_{(BR)CBO}$	I_C=0.1mA	80	-	-	V
	Emitter-Base Breakdown Voltage (TLP633)	$V_{(BR)EBO}$	I_E=0.1mA	7	-	-	V
	Collector Dark Current	I_{CEO}	V_{CE}=24V	-	10	100	nA
			V_{CE}=24V, Ta=85°C	-	2	50	μA
	Collector Dark Current (TLP633)	I_{CER}	V_{CE}=24V, Ta=85°C R_{BE}=1MΩ	-	0.5	10	μA
	Collector Dark Current (TLP633)	I_{CBO}	V_{CB}=10V	-	0.1	-	nA
	DC Forward Current (TLP633)	h_{FE}	V_{CE}=5V, I_C=0.5mA	-	400	-	-
	Capacitance Collector to Emitter	C_{CE}	V=0, f=1MHz	-	10	-	pF

COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Current Transfer Ratio	I_C/I_F	I_F=5mA, V_{CE}=5V	50	-	600	%
		Rank GB	100	-	600	
Saturated CTR	$I_C/I_{F(sat)}$	I_F=1mA, V_{CE}=0.4V	-	60	-	%
		Rank GB	30	-	-	
Base Photo-Current	I_{PB}	I_F=5mA, V_{CB}=5V	-	10	-	μA
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C=2.4mA, I_F=8mA	-	-	0.4	V
		I_C=0.2mA, I_F=1mA	-	0.2	-	
		Rank GB	-	-	0.4	

ISOLATION CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Capacitance(Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	4000	-	-	V_{rms}
		AC, 1 second	-	10000	-	
		DC, 1 minute	-	10000	-	V_{dc}

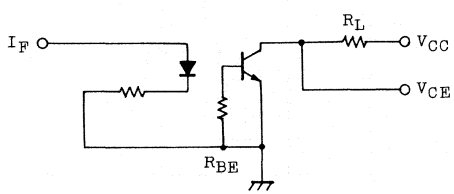
SWITCHING CHARACTERISTICS (Ta=25°C)

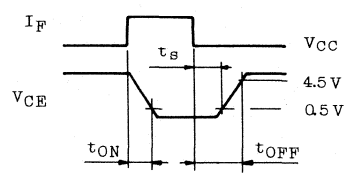
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Rise Time	t_r	V_{CC}=10V, I_C=2mA R_L=100Ω	-	2	-	μs
Fall Time	t_f		-	3	-	
Turn-on Time	t_{on}		-	3	10	
Turn-off Time	t_{off}		-	3	10	
Turn-on Time	t_{ON}	R_L=1.9kΩ (Fig.1)	-	2	-	μs
Storage Time	t_S	R_{BE}=OPEN	-	15	-	
Turn-off Time	t_{OFF}	V_{CC}=5V, I_F=16mA	-	25	-	
Turn-on Time	t_{ON}	R_L=1.9kΩ (Fig.1)	-	2	-	μs
Storage Time	t_S	R_{BE}=220kΩ (TLP633)	-	12	-	
Turn-off Time	t_{OFF}	V_{CC}=5V, I_F=16mA	-	20	-	

RECOMMENDED OPERATING CONDITIONS

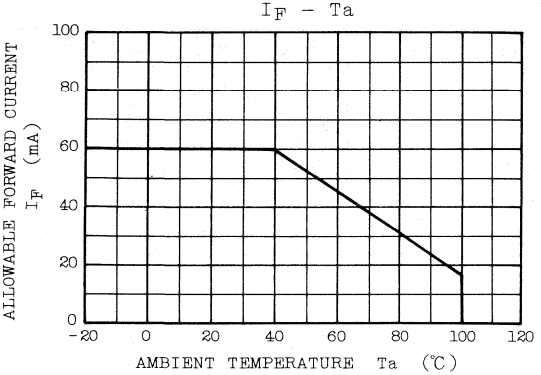
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	-	5	24	V
Forward Current	I_F	-	16	25	mA
Collector Current	I_C	-	1	10	mA
Operating Temperature	T_{opr}	-25	-	85	°C

Fig. 1 SWITCHING TIME TEST CIRCUIT

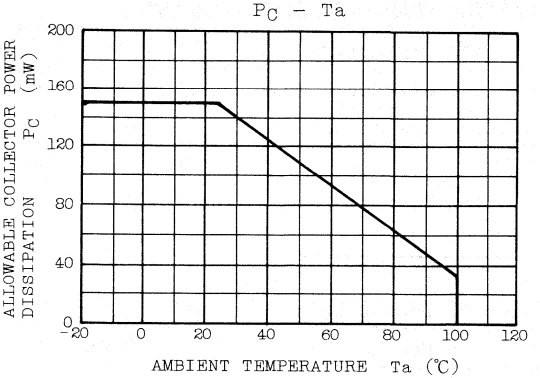




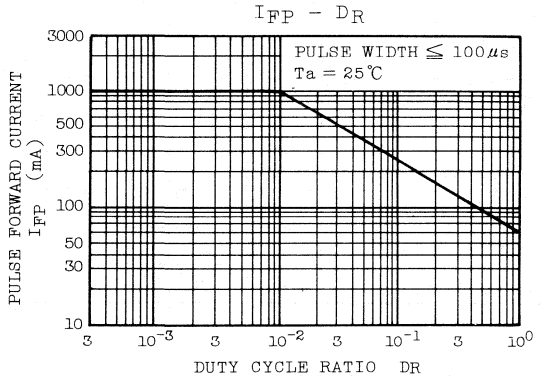
I_F – Ta



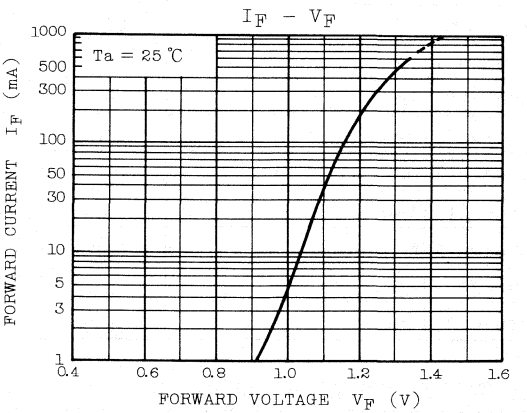
P_C – Ta



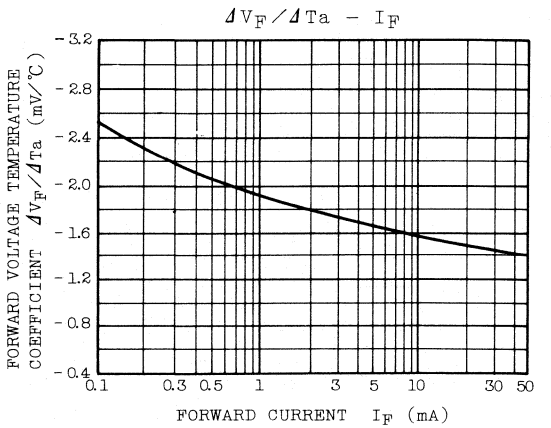
I_{FP} – D_R



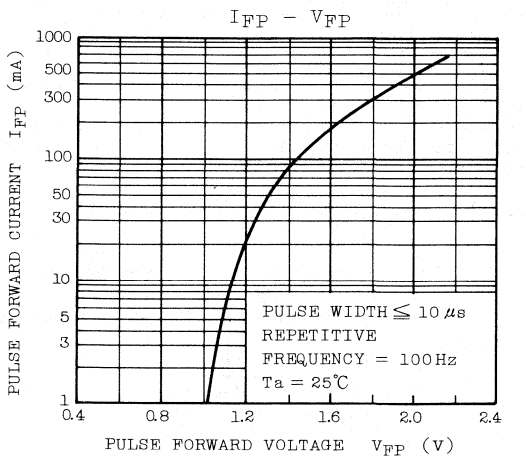
I_F – V_F



$\Delta V_F / \Delta Ta$ – I_F



I_{FP} – V_{FP}



TLP635, TLP636

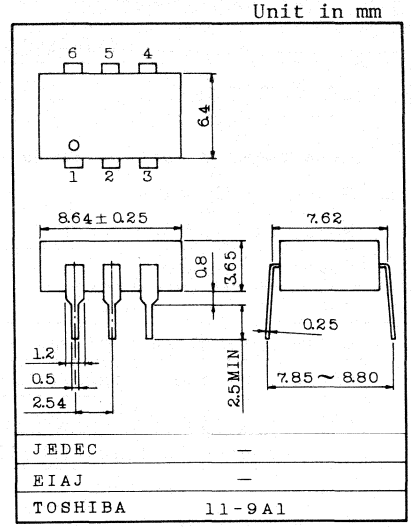
OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
SOLID STATE RELAY.
SWITCHING POWER SUPPLY.

The TOSHIBA TLP635 and TLP636 consist of a photo-transistor optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.
TLP636 is no-base internal connection for high-EMI environments.

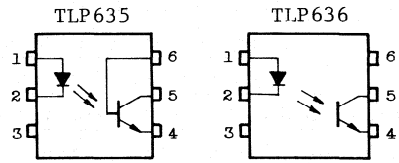
- Collector-Emitter Voltage : 80V Min.
- Current Transfer Ratio : 50% Min.
  Rank GB : 100% Min.
- Isolation Voltage : 5000Vrms Min.
- Guaranteed Requirements of IEC380/VDE0806
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.0mm Min.
- Isolation Clearance : 7.3mm Min.
- Isolation Operating Voltage
  : 500Vac or 600Vdc for Isolation Group C *1
- Creeping Current Resistance : Group I *2

*1 : According to VDE0110, table 4
*2 : According to VDE0110, table 3

Unit in mm



PIN CONFIGURATIONS (TOP VIEW)



TLP635	TLP636
1: Anode	1: ANODE
2: CATHODE	2: CATHODE
3: NC	3: NC
4: EMITTER	4: EMITTER
5: COLLECTOR	5: COLLECTOR
6: BASE	6: NC

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	60	mA
	Forward Current Derating (Ta≧39°C)	$\Delta I_F/°C$	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)	I_{FP}	1	A
	Power Dissipation	P_D	100	mW
	Power Dissipation Derating (Ta≧25°C)	$\Delta P_D/°C$	-1.0	mW/°C
	Reverse Voltage	V_R	5	V
	Junction Temperature	T_j	125	°C
DETECTOR	Collector-Emitter Voltage	V_{CEO}	80	V
	Collector-Base Voltage (TLP635)	V_{CBO}	80	V
	Emitter-Collector Voltage	V_{ECO}	7	V
	Emitter-Base Voltage (TLP635)	V_{EBO}	7	V
	Collector Current	I_C	50	mA
	Power Dissipation	P_C	150	mW
	Power Dissipation Derating (Ta≧25°C)	$\Delta P_C/°C$	-1.5	mW/°C
	Junction Temperature	T_j	125	°C
Storage Temperature Range		T_{stg}	-55~150	°C
Operating Temperature Range		T_{opr}	-55~100	°C
Lead Soldering Temperature (10 sec.)		T_{sold}	260	°C
Total Package Power Dissipation		P_T	250	mW
Total Package Power Dissipation Derating (Ta≧25°C)		$\Delta P_T/°C$	-2.5	mW/°C
Isolation Voltage (AC, 1 min., RH≦60%)		BV_S	5000	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=0.5mA	30	-	-	V
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	7	-	-	V
	Collector-Base Breakdown Voltage (TLP635)	$V_{(BR)CBO}$	I_C=0.1mA	80	-	-	V
	Emitter-Base Breakdown Voltage (TLP635)	$V_{(BR)EBO}$	I_E=0.1mA	7	-	-	V
	Collector Dark Current	I_{CEO}	V_{CE}=24V	-	10	100	nA
			V_{CE}=24V, Ta=85°C	-	2	50	μA
	Collector Dark Current (TLP635)	I_{CER}	V_{CE}=24V, Ta=85°C R_{BE}=1MΩ	-	0.5	10	μA
	Collector Dark Current (TLP635)	I_{CBO}	V_{CB}=10V	-	0.1	-	nA
	DC Forward Current Gain (TLP635)	h_{FE}	V_{CE}=5V, I_C=0.5mA	-	400	-	-
	Capacitance (Collector to Emitter)	C_{CE}	V=0, f=1MHz	-	10	-	pF

COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Current Transfer Ratio	I_C/I_F	I_F=5mA, V_{CE}=5V	50	-	600	%
		Rank GB	100	-	600	
Saturated CTR	$I_C/I_{F(sat)}$	I_F=1mA, V_{CE}=0.4V	-	60	-	%
		Rank GB	30	-	-	
Base Photo-Current (TLP635)	I_{PB}	I_F=5mA, V_{CB}=5V	-	10	-	μA
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C=2.4mA, I_F=8mA	-	-	0.4	V
		I_C=0.2mA, I_F=1mA	-	0.2	-	
		Rank GB	-	-	0.4	

ISOLATION CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	5000	-	-	V_{rms}
		AC, 1 second	-	10000	-	
		DC, 1 minute	-	10000	-	V_{dc}

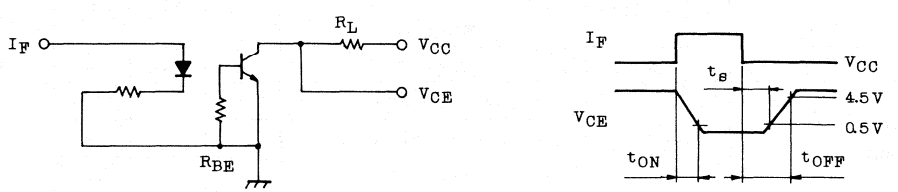
SWITCHING CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Rise Time	t_r	V_{CC}=10V, I_C=2mA, R_L=100Ω	-	2	-	μs
Fall Time	t_f		-	3	-	
Turn-on Time	t_{on}		-	3	10	
Turn-off Time	t_{off}		-	3	10	
Turn-on Time	t_{ON}	R_L=1.9kΩ (Fig.1)	-	2	-	μs
Storage Time	t_S	R_{BE}=OPEN	-	15	-	
Turn-off Time	t_{OFF}	V_{CC}=5V, I_F=16mA	-	25	-	
Turn-on Time	t_{ON}	R_L=1.9kΩ (Fig.1)	-	2	-	μs
Storage Time	t_S	R_{BE}=220kΩ (TLP635)	-	12	-	
Turn-off Time	t_{OFF}	V_{CC}=5V, I_F=16mA	-	20	-	

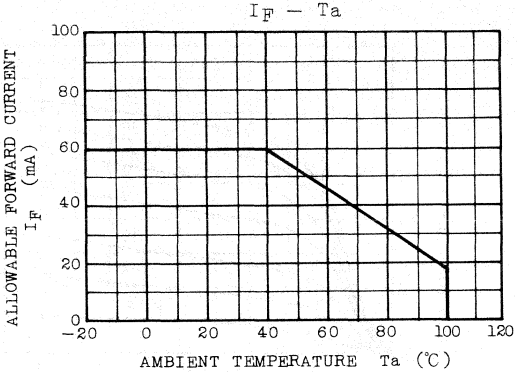
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	-	5	24	V
Forward Current	I_F	-	16	25	mA
Collector Current	I_C	-	1	10	mA
Operating Temperature	T_{opr}	-25	-	85	°C

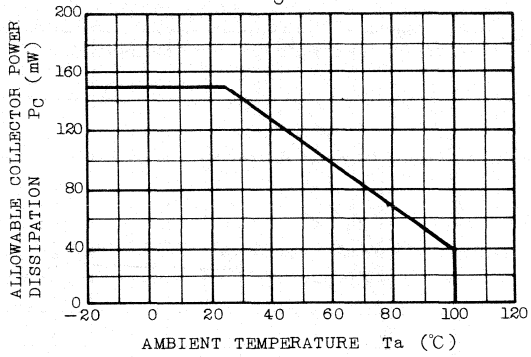
Fig. 1 SWITCHING TIME TEST CIRCUIT



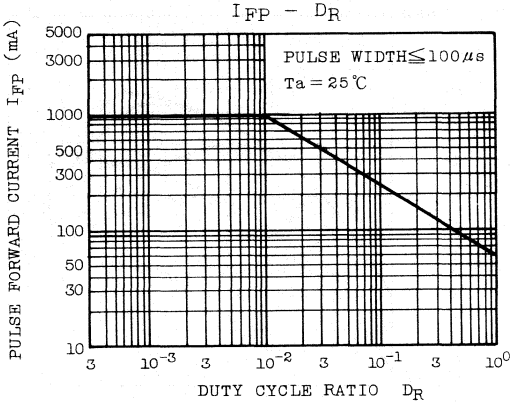
I_F – Ta



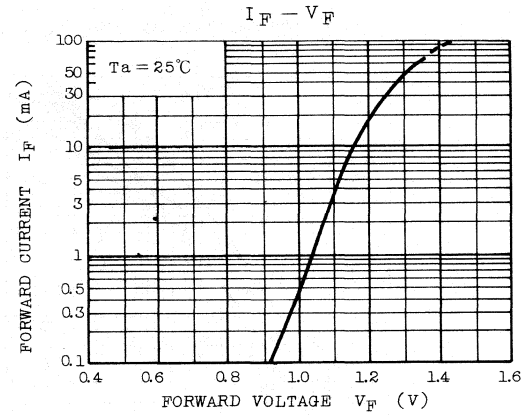
P_C – Ta



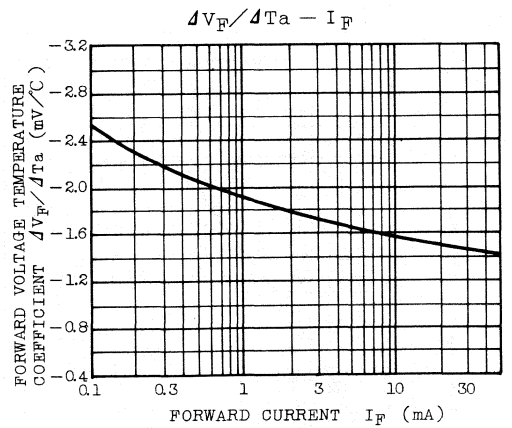
I_{FP} – D_R



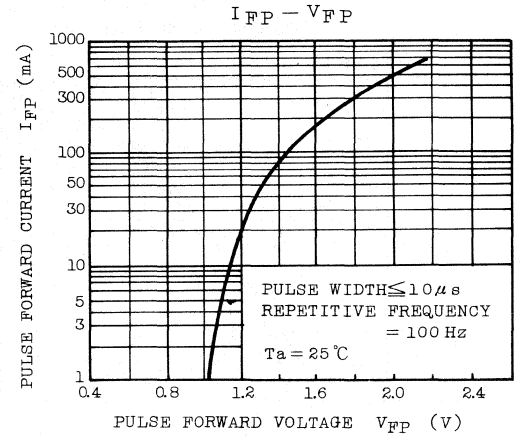
I_F – V_F



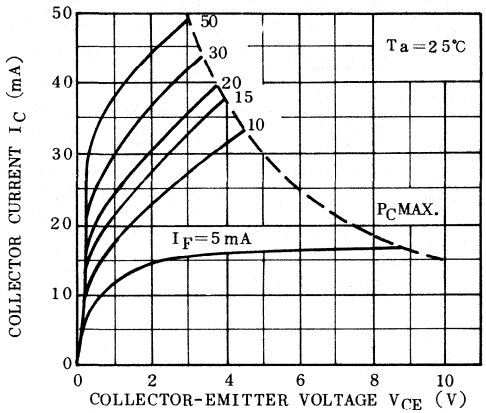
$\Delta V_F / \Delta Ta$ – I_F



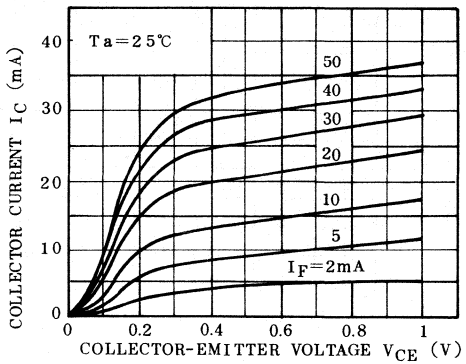
I_{FP} – V_{FP}



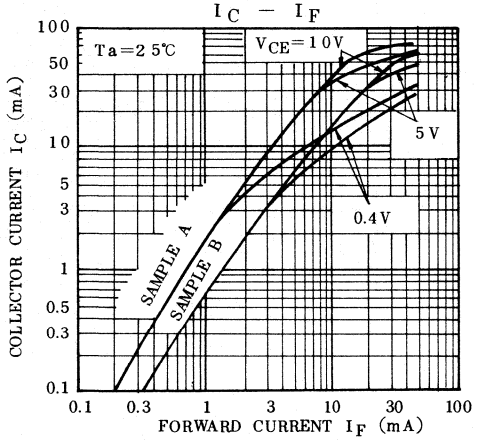
$I_C - V_{CE}$



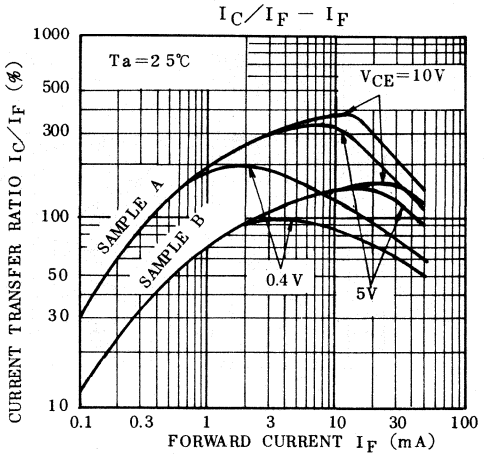
$I_C - V_{CE}$



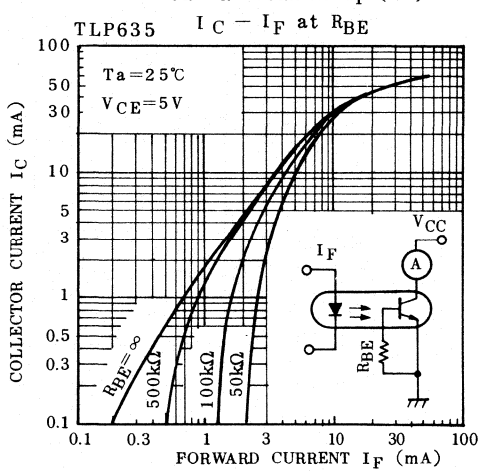
$I_C - I_F$



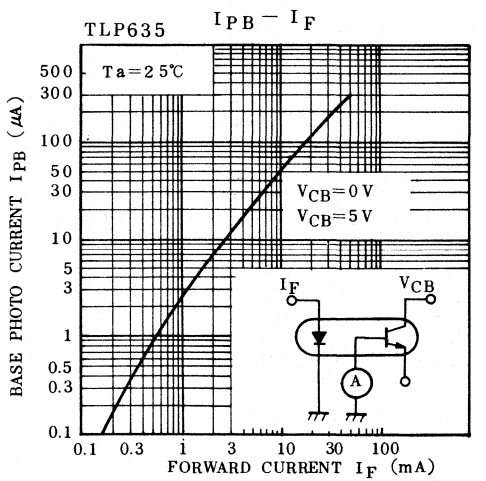
$I_C/I_F - I_F$



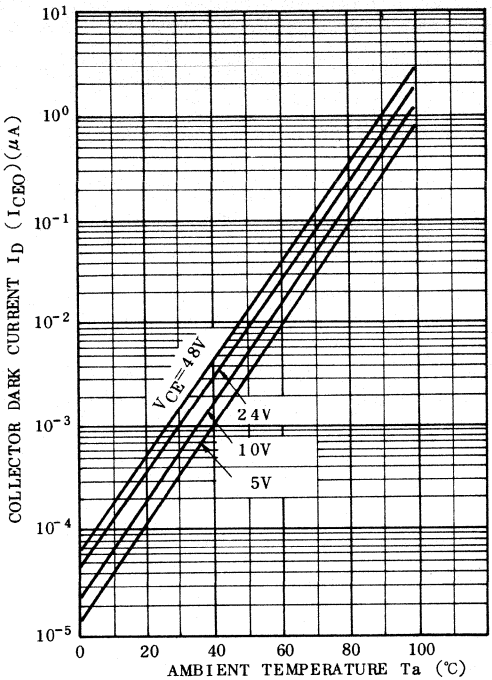
TLP635 $I_C - I_F$ at R_{BE}



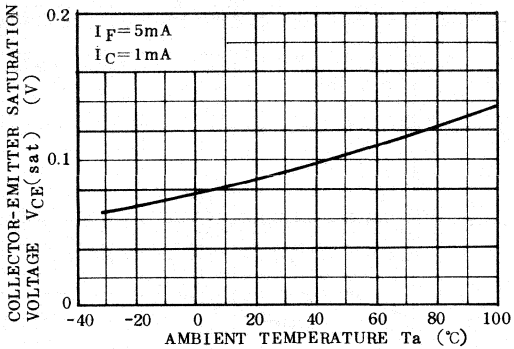
TLP635 $I_{PB} - I_F$



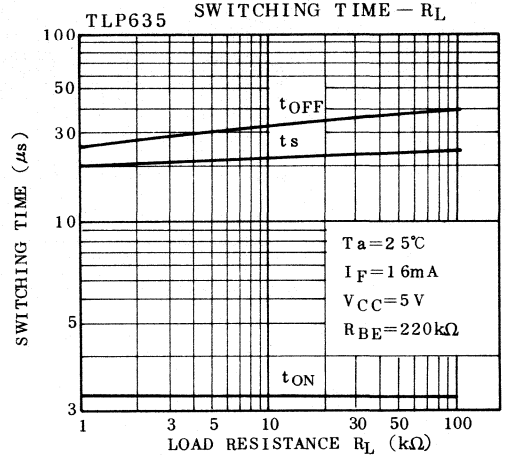
I_D — Ta



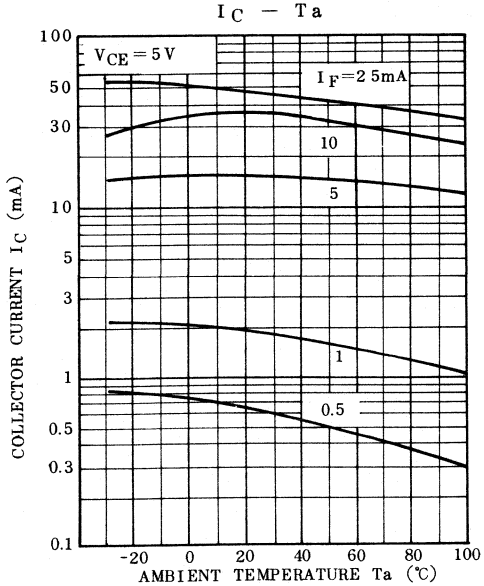
$V_{CE}(sat)$ — Ta



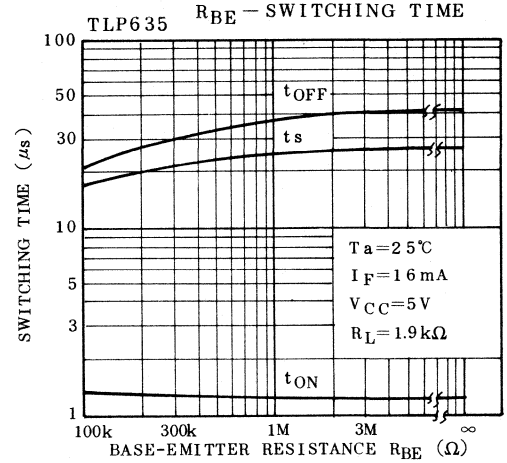
TLP635 SWITCHING TIME — R_L



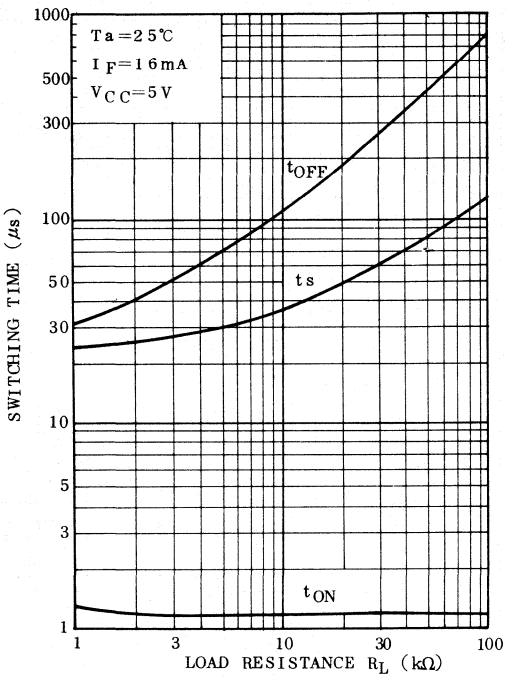
I_C — Ta



TLP635 R_{BE} — SWITCHING TIME



SWITCHING TIME — R_L



TLP635F, TLP636F

OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
SOLID STATE RELAY.
SWITCHING POWER SUPPLY.

The TOSHIBA TLP635F and TLP636F consist of a photo-transistor optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.

TLP636F is no-base internal connection for high-EMI environments.

All parameters are tested to the specification of TLP635 and TLP636. (both condition and limits)

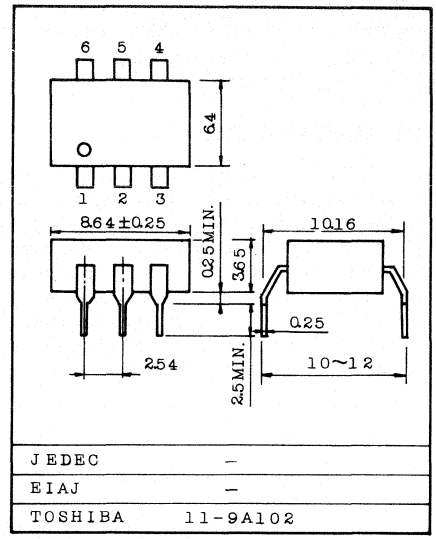
- Collector-Emitter Voltage : 55V Min.
- Current Transfer Ratio : 50% Min.
  Rank GB : 100% Min.
- Isolation Voltage : 5000V_{rms} Min.
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.0mm Min.
- Isolation Clearance : 8.0mm Min.
- Isolation Operating Voltage
  : 500V_{ac} or 600V_{dc} for Isolation Group C*1
- Creeping Current Resistance: Group I*2
- Guaranteed Requirements of Safety Standards as Follows:

  DIN 57 883/VDE0883/6.80
  DIN 57 804/VDE0804/1.83
  DIN IEC65/VDE0860/8.81
  DIN IEC380/VDE0806/8.81
  DIN IEC435/VDE0805/Draft Nov.84
  DIN IEC601T1/VDE0750T1/5.82

*1 : According to VDE0110, table 4

*2 : According to VDE0110, table 3

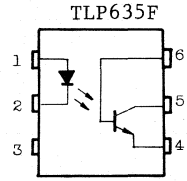
Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-9A102

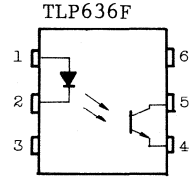
PIN CONFIGURATIONS (TOP VIEW)

TLP635F



1: ANODE
2: CATHOD
3: NC
4: EMITTER
5: COLLECTOR
6: BASE

TLP636F



1: ANODE
2: CATHODE
3: NC
4: EMITTER
5: COLLECTOR
6: NC

TLP637, TLP638

GaAs IRED & PHOTO-TRANSISTOR

OFFICE MACHINE.

HOUSEHOLD USE EQUIPMENT.

PROGRAMMABLE CONTROLLERS.

AC/DC-INPUT MODULE.

TELECOMMUNICATION.

The TOSHIBA TLP637 and TLP638 consist of a gallium arsenide infrared emitting diode optically coupled to a photo-transistor in a six lead plastic DIP package. This photocupler provides the unique feature of high current transfer ratio at both low output voltage and low input current. This makes it ideal for use in low power logic circuits, telecommunications equipment and portable electronics isolation applications.
TLP638 is no-base internal connection for high-EMI encironments.

. Collector-Emitter Voltage : 55V Min.

. Current Transfer Ratio

CLASSIFICATION	CURRENT TRANSFER RATIO(Min.)			MARKING OF CLASSIFICATION
	Ta=25°C		Ta=−25 ∿ 75°C	
	I_F=1mA V_{CE}=0.5V	I_F=0.5mA V_{CE}=1.5V	I_F=1mA V_{CE}=0.5V	
Rank BV	200%	100%	100%	BV
Standard	100%	50%	50%	BV, Blank

. Isolation Voltage : $5000V_{rms}$ Min.

. Guaranteed Requirements of IEC380/VDE0806

. Climatic Test Class : 55/150/21

. Isolation Creepage Path : 8.0mm Min.

. Isolation Clearance : 7.3mm Min.

. Isolation Operating Voltage

: $500V_{ac}$ or $600V_{dc}$ dor Isolation Group C*1

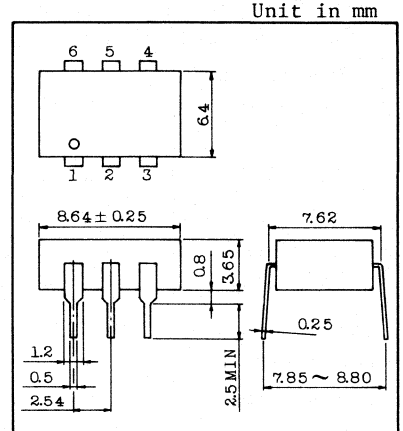
. Creeping Current Resistance : Group I*2

. Note: Application type name for certification test, please use standard product type name, i.e.

TLP637(BV) : TLP637

*1 : According to VED0110, table 4
*2 : According to VDE0110, table 3

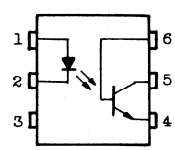
Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-9A1

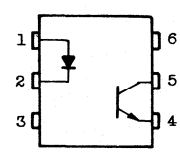
PIN CONFIGURATIONS (TOP VIEW)

TLP637



1: ANODE
2: CATHOCE
3: NC
4: EMITTER
5: COLLECTOR
6: BASE

TLP638



1: ANODE
2: CATHODE
3: NC
4: EMITTER
5: COLLECTOR
6: NC

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	60	mA
	Forward Current Derating (Ta≧39°C)	ΔI_F/°C	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)	I_{FP}	1	A
	Power Dissipation	P_D	100	mW
	Power Dissipation Derating (Ta≧25°C)	ΔP_D/°C	-1.0	mW/°C
	Reverse Voltage	V_R	5	V
	Junction Temperature	T_j	125	°C
DETECTOR	Collector-Emitter Voltage	V_{CEO}	55	V
	Collector-Base Voltage (TLP637)	V_{CBO}	80	V
	Emitter-Collector Voltage	V_{ECO}	7	V
	Emitter-Base Voltage (TLP637)	V_{EBO}	7	V
	Collector Current	I_C	50	mA
	Power Dissipation	P_C	150	mW
	Power Dissipation Derating (Ta≧25°C)	ΔP_C/°C	-1.5	mW/°C
	Junction Temperature	T_j	125	°C
Storage Temperature Range		T_{stg}	-55~150	°C
Operating Temperature Range		T_{opr}	-55~100	°C
Lead Soldering Temperature (10 sec.)		T_{sold}	260	°C
Total Package Power Dissipation		P_T	250	mW
Total Package Power Dissipation Derating (Ta≧25°C)		ΔP_T/°C	-2.5	mW/°C
Isolation Voltage (AC, 1 min., RH≦60%)		BV_S	5000	V_{rms}

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	-	5	24	V
Forward Current	I_F	-	1.6	25	mA
Collector Current	I_C	-	1	10	mA
Operating Temperature	T_{opr}	-25	-	75	°C

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=0.5mA	55	-	-	V
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	7	-	-	V
	Cotlector-Base Breakdown Voltage (TLP637)	$V_{(BR)CBO}$	I_C=0.1mA	80	-	-	V
	Emitter-Base Breakdown Voltage (TLP637)	$V_{(BR)EBO}$	I_E=0.1mA	7	-	-	V
	Collector Dark Current	I_{CEO}	V_{CE}=24V	-	10	100	nA
			V_{CE}=24V, Ta=85°C	-	2	50	μA
	Collector Dark Current (TLP637)	I_{CER}	V_{CE}=24V, Ta=85°C R_{BE}=1MΩ	-	0.5	10	μA
	Collector Dark Current (TLP637)	I_{CBO}	V_{CB}=10V	-	0.1	-	nA
	DC Forward Current Gain (TLP637)	h_{FE}	V_{CE}=5V, I_C=0.5mA	-	1000	-	-
	Capacitance Collector to Emitter	C_{CE}	V=0, f=1MHz	-	12	-	pF

COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Current Transfer Ratio	I_C/I_F	I_F=1mA, V_{CE}=0.5V	100	-	-	%
		Rank BV	200	-	-	
Low Input CTR	$I_C/I_{F(low)}$	I_F=0.5mA, V_{CE}=1.5V	50	-	-	%
		Rank BV	100	-	-	
Base Photo-current (TLP637)	I_{PB}	I_F=1mA, V_{CB}=5V	-	5	-	μA
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C=0.5mA, I_F=1mA	-	-	0.4	V
		I_C=1mA, I_F=1mA	-	0.2	-	
		Rank BV	-	-	0.4	

COUPLED ELECTRICAL CHARACTERISTICS (Ta=-25~75°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Current Transfer Ratio	I_C/I_F	I_F=1mA, V_{CE}=0.5V	50	-	-	%
		Rank BV	100	-	-	
Low Input CTR	$I_C/I_{F(low)}$	I_F=0.2mA, V_{CE}=1.5V	-	50	-	%
		Rank BV	-	100	-	

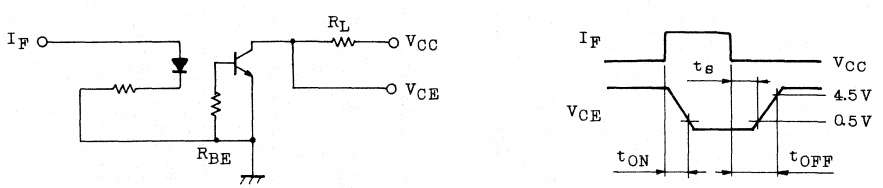
ISOLATION CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Capacitance Input to Output	CS	VS=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BVS	AC, 1 minute	5000	-	-	V_{rms}
		AC, 1 second	-	10000	-	
		DC, 1 minute	-	10000	-	V_{dc}

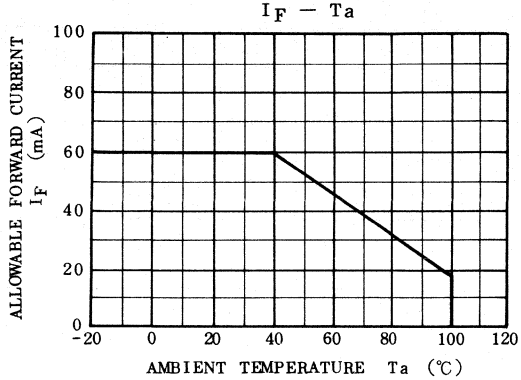
SWITCHING CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Rise Time	t_r	V_{CC}=10V, I_C=2mA, R_L=100Ω	-	8	-	μs
Fall Time	t_f		-	8	-	
Turn-on Time	t_{on}		-	10	-	
Turn-off Time	t_{off}		-	8	-	
Turn-on Time	t_{ON}	R_L=4.7kΩ (Fig.1), R_{BE}=OPEN, V_{CC}=5V, I_F=1.6mA	-	10	-	μs
Storage Time	t_S		-	50	-	
Turn-off Time	t_{OFF}		-	300	-	
Turn-on Time	t_{ON}	R_L=4.7kΩ (Fig.1), R_{BE}=470kΩ (TLP637), V_{CC}=5V, I_F=1.6mA	-	12	-	μs
Storage Time	t_S		-	30	-	
Turn-off Time	t_{OFF}		-	100	-	

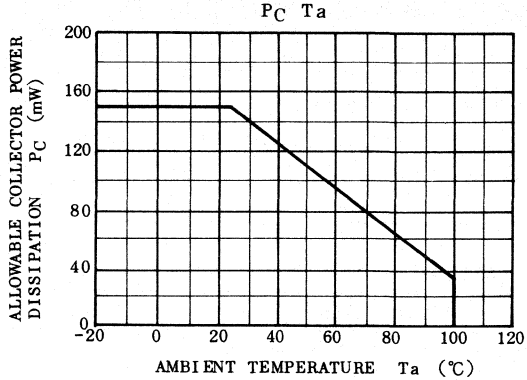
Fig. 1 SWITCHING TIME TEST CIRCUIT



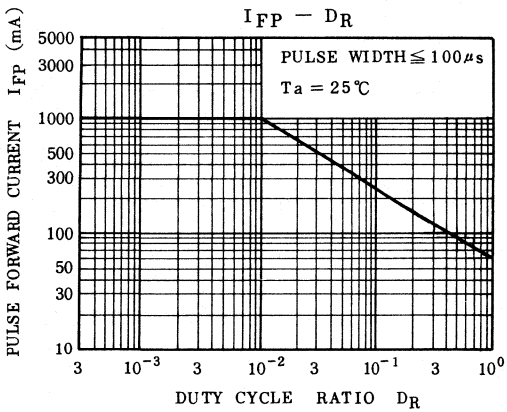
I_F — Ta



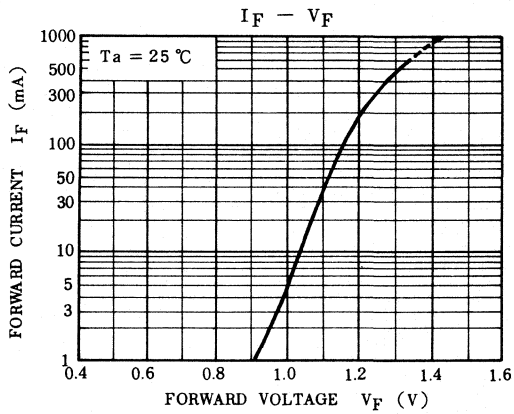
P_C Ta



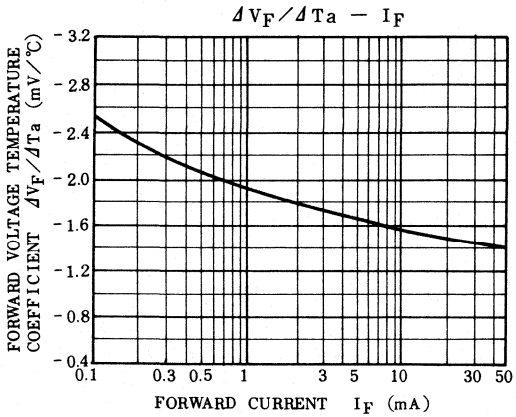
I_{FP} — D_R



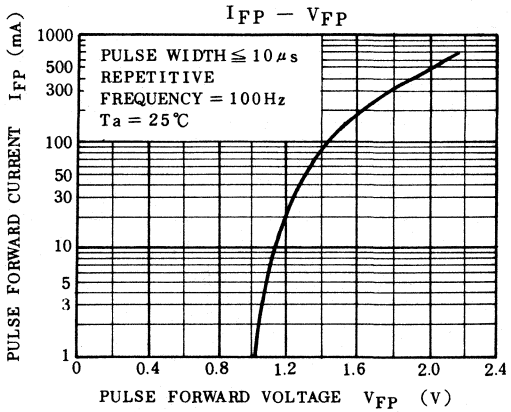
I_F — V_F



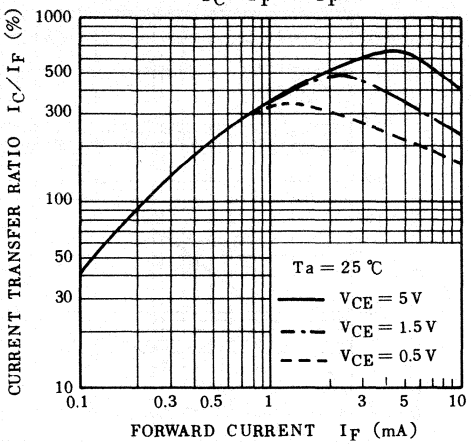
$\Delta V_F / \Delta Ta$ — I_F



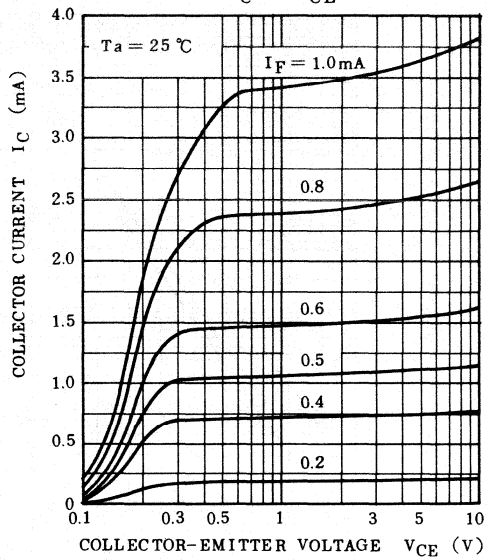
I_{FP} — V_{FP}



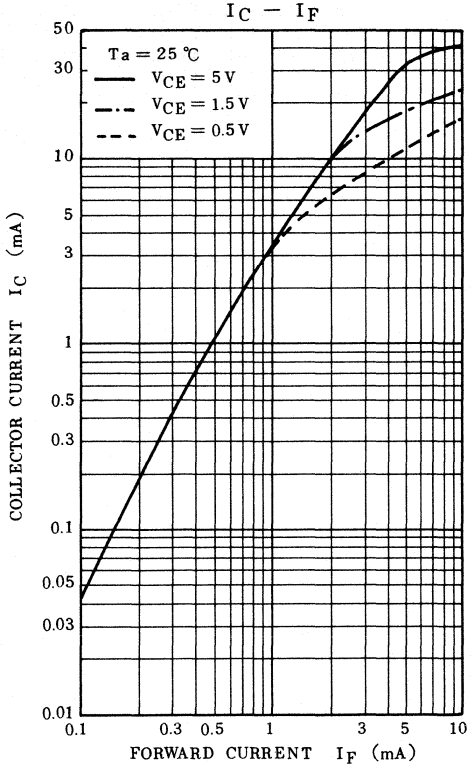
$I_C / I_F - I_F$



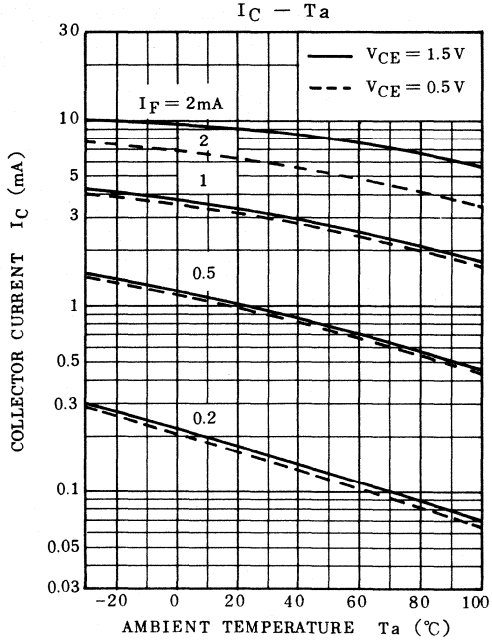
$I_C - V_{CE}$

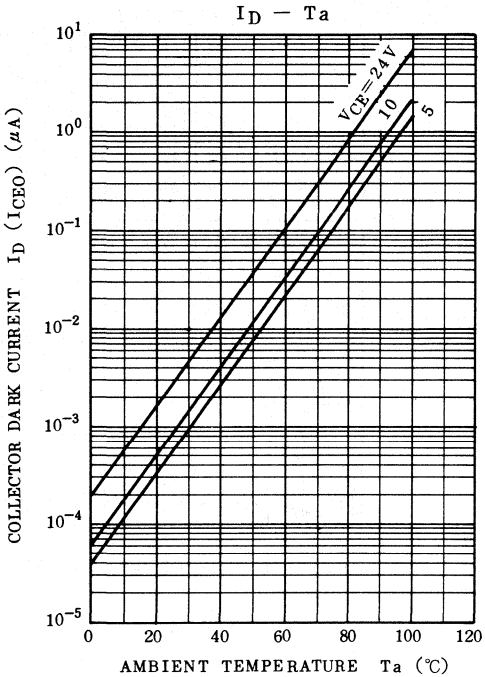


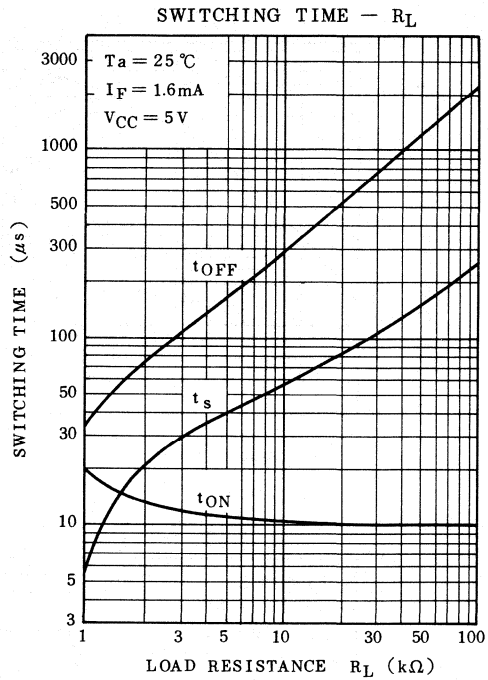
$I_C - I_F$



$I_C - Ta$




I_D — Ta
COLLECTOR DARK CURRENT I_D (I_{CEO}) (μA)
10^1
10^0
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
V_{CE}=24 V
10
5
0
20
40
60
80
100
120
AMBIENT TEMPERATURE Ta (℃)


SWITCHING TIME — R_L
Ta = 25 ℃
I_F = 1.6mA
V_{CC} = 5 V
SWITCHING TIME (μs)
3000
1000
500
300
100
50
30
10
5
3
t_{OFF}
t_s
t_{ON}
1
3
5
10
30
50
100
LOAD RESISTANCE R_L (kΩ)

TLP637F, TLP638F

OFFICE MACHINE
HOUSEHOLD USE EQUIPMENT
ROGRAMMABLE CONTROLLERS
AC/DC-INPUT MODULE
TELECOMMUNICATION

The TOSHIBA TLP637F and TLP638F consist of a gallium arsenide infrared emitting diode optically coupled to a photo-transistor in a six lead plastic DIP package. This photocoupler provides the unique feature of high current transfer ratio at both low output voltage and low input current. This makes it ideal for use in low power logic circuits, telecommunications equipment and portable electronics isolation applications.
TLP638F is no-base internal connection for high-EMI environments.
All parameters are tested to the specification of TLP637 and TLP638. (both condition and limits)

- Colector-Emitter Voltage : 55V Min.
- Current Transfer Ratio

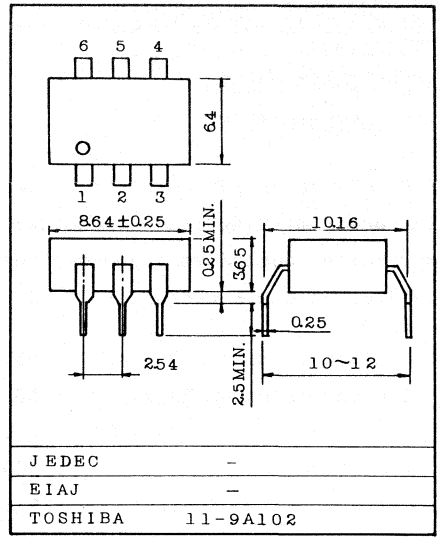
Classification	Current Transfer Ratio (Min.)			Making of classification
	Ta=25°C		Ta=-25 ∿ 75°C	
	I_F=1mA V_{CE}=0.5	I_F=0.5mA V_{CE}=1.5V	I_F=1mA V_{CE}=0.5V	
Rank BV	200%	100%	100%	BV
Standard	100%	50%	50%	BV, Blank

- Isolation Voltage : 5000 rms Min.
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.0mm Min.
- Isolation Clearance : 8.0mm Min.
- Isolation Operating Voltage
  : $500V_{ac}$ or $600V_{dc}$ for Isolation Group C*1
- Creeping Current Resistance : Group I*2
- Guaranteed Requirements of Safety Standards as Follows:
  DIN 57 883/VDE0833/6.80
  DIN 57 804/VDE0804/1.83
  DIN IEC65/VED0860/8.81
  DIN IEC380/VDE0806/8.81
  DIN IEC435/VDE0805/Draft Nov.84
  DIN IEC601T1/VDE0750T1/5.82

Note : Application type name for certification test, please use standard product type name, i.e.
TLP637F (BV) ; TLP637F

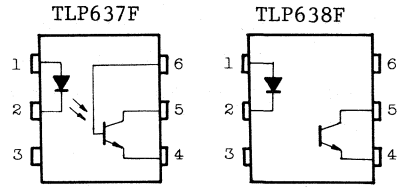
*1 : According to VDE0110, table 4
*2 : According to VDE0110, table 3

Unit in mm



JEDEC	–
EIAJ	–
TOSHIBA	11-9A102

PIN CONFIGURATION (TOP VIEW)



TLP637F	TLP638F
1: ANODE	1: ANODE
2: CATHODE	2: CATHODE
3: NC	3: NC
4: EMITTER	4: EMITTER
5: COLLECTOR	5: COLLECTOR
6: BASE	6: NC

TLP639

GaAs IRED & PHOTO-TRANSISTOR

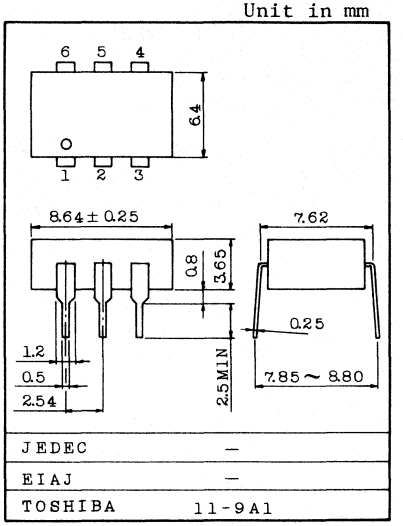
OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
PROGRAMMABLE CONTROLLERS.
AC/DC-INPUT MODULE.
TELECOMMUNICATION.

The TOSHIBA TLP639 consists of two gallium arsenide infrared emitting diode connected inverse parallel, optically coupled to a photo-transistor in a six lead plastic DIP package.

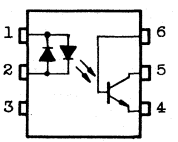
- Collector-Emitter Voltage : 55V Min.
- Current Transfer Ratio : 50% Min.
  Rank GB : 100% Min.
- Isolation Voltage : 5000V_{rms} Min.
- Guaranteed Requirements of IEC380/VDE0806
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.0mm Min.
- Isolation Clearance : 7.3mm Min.
- Isolation Operating Voltage
  : 500V_{ac} or 600V_{dc} for Isolation Group C.*1
- Creeping Current Resistance : Group I.*2

*1 : According to VDE0110, table 4
*2 : According to VED0110, table 3

Unit in mm



PIN COFIGURATIONS (TOP VIEW)



1: ANODE, CATHODE
2: CATHODE, ANODE
3: NC
4: EMITTER
5: COLLECTOR
6: BASE

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	$I_{F(RMS)}$	60	mA
	Forward Current Derating (Ta≧39°C)	$\Delta I_F/°C$	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)	I_{FP}	1	A
	Power Dissipation	P_D	100	mW
	Power Dissipation Derating (Ta≧25°C)	$\Delta P_D/°C$	-1.0	mW/°C
	Junction Temperature	T_j	125	°C
DETECTOR	Collector-Emitter Voltage	V_{CEO}	55	V
	Collector-Base Voltage	V_{CBO}	80	V
	Emitter-Collector Voltage	V_{ECO}	7	V
	Emitter-Base Voltage	V_{EBO}	7	V
	Collector Current	I_C	50	mA
	Power Dissipation	P_C	150	mW
	Power Dissipation Derating (Ta≧25°C)	$\Delta P_C/°C$	-1.5	mW/°C
	Junction Temperature	T_j	125	°C
Storage Temperature Range		T_{stg}	-55~150	°C
Operating Tmeperature Range		T_{opr}	-55~100	°C
Lead Soldering Temperature (10 sec.)		Tsold	260	°C
Total Package Power Dissipation		P_T	250	mW
Total Package Power Dissipation Derating (Ta≧25°C)		$\Delta P_T/°C$	-2.5	mW/°C
Isolation Voltage (AC, 1 min., RH≦60%)		BV_S	5000	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=±10mA	1.0	1.15	1.3	V
	Forward Current	I_F	V_F=±0.7V	-	2.5	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	60	-	pF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=0.5mA	55	-	-	V
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	7	-	-	V
	Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	I_C=0.1mA	80	-	-	V
	Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	I_E=0.1mA	7	-	-	V
	Collector Dark Current	I_{CEO}	V_{CE}=24V	-	10	100	nA
			V_{CE}=24V, Ta=85°C	-	2	50	μA
	Collector Dark Current	I_{CER}	V_{CE}=24V, Ta=85°C R_{BE}=1MΩ	-	0.5	10	μA
	Collector Dark Current	I_{CBO}	V_{CB}=10V	-	0.1	-	nA
	DC Forward Current Gain	h_{FE}	V_{CE}=5V, I_C=0.5mA	-	400	-	-
	Capacitance Collector to Emitter	C_{CE}	V=0, f=1MHz	-	10	-	pF

COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Current Transfer Ratio	I_C/I_F	I_F=±5mA, V_{CE}=5V	50	-	600	%
		Rank GB	100	-	600	
Saturated CTR	$I_C/I_{F(sat)}$	I_F=±1mA, V_{CE}=0.4V	-	60	-	%
		Rank GB	30	-	-	
Base Photo-current	I_{PB}	I_F=±5mA, V_{CB}=5V	-	10	-	μA
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C=2.4mA, I_F=±8mA	-	-	0.4	V
		I_C=0.2mA, I_F=±1mA	-	0.2	-	
		Rank GB	-	-	0.4	
Off-State Collector Current	$I_{C(off)}$	V_F=±0.7V, V_{CE}=24V	-	1	10	μA
CRT Symmetry	$I_{C(ratio)}$	$I_C(I_F$=-5mA)/$I_C(I_F$=5mA)	0.5	-	2	-

ISOLATION CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Capacitance Input to Output	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	5000	-	-	Vrms
		AC, 1 second	-	10000	-	
		DC, 1 minute	-	10000	-	Vdc

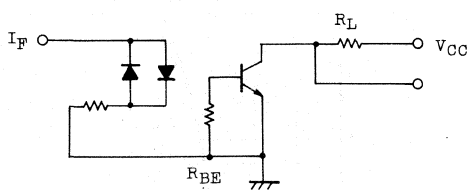
SWITCHING CHARACTERISTICS (Ta=25°C)

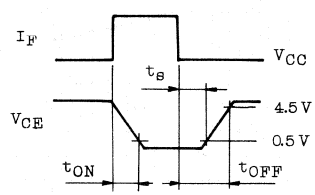
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Rise Time	t_r	V_{CC}=10V, I_C=2mA, R_L=100Ω	-	2	-	μs
Fall Time	t_f		-	3	-	
Turn-on Time	t_{on}		-	3	10	
Turn-off Time	t_{off}		-	3	10	
Turn-on Time	t_{ON}	R_L=1.9kΩ (Fig.1)	-	2	-	μs
Storage Time	t_S	R_{BE}=OPEN	-	15	-	
Turn-off Time	t_{OFF}	V_{CC}=5V, I_F=±16mA	-	25	-	
Turn-on Time	t_{ON}	R_L=1.9kΩ (Fig.1)	-	2	-	μs
Storage Time	t_S	R_{BE}=220kΩ	-	12	-	
Turn-off Time	t_{OFF}	V_{CC}=5V, I_F=±16mA	-	20	-	

RECOMMENDED OPERATING CONDITIONS

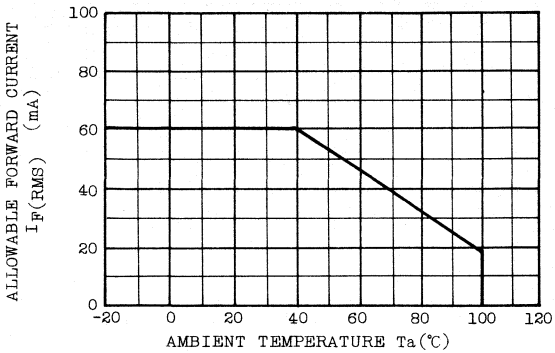
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	-	5	24	A
Forward Current	$I_{F(RMS)}$	-	16	25	mA
Collector Current	I_C	-	1	10	mA
Operating Temperature	T_{opr}	-25	-	85	°C

Fig. 1 SWITCHING TIME TEST CIRCUIT

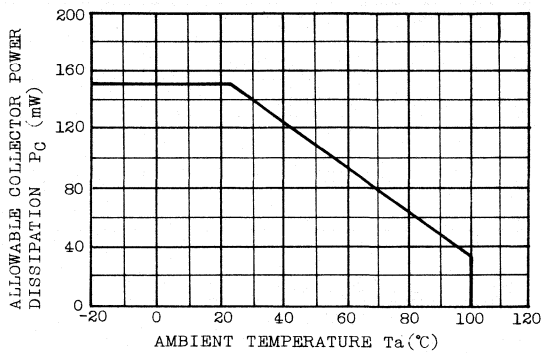




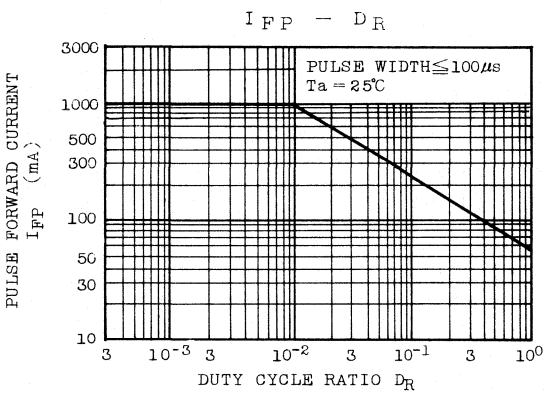
$I_{F(RMS)}$ — Ta



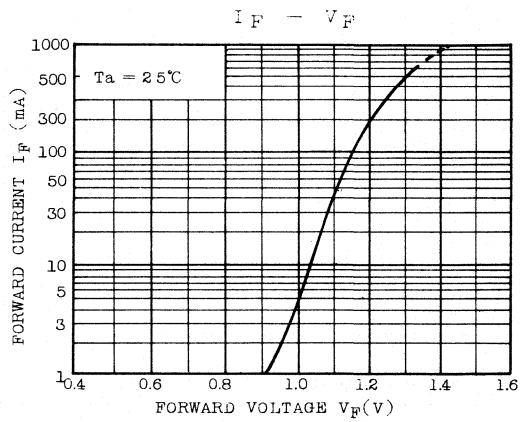
P_C — Ta



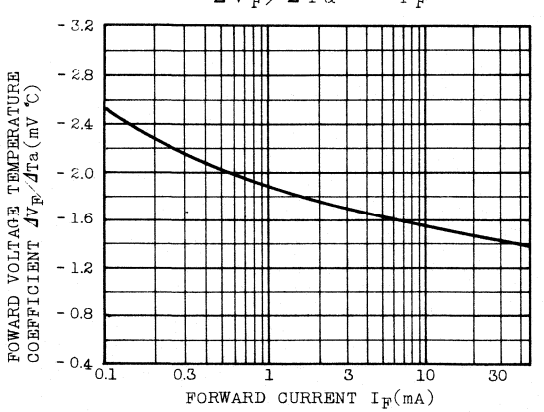
I_{FP} — D_R



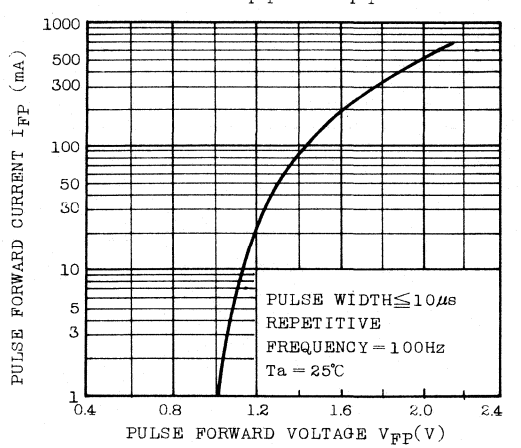
I_F — V_F



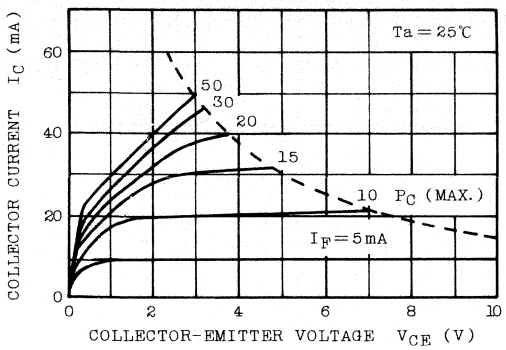
$\Delta V_F/\Delta Ta$ — I_F



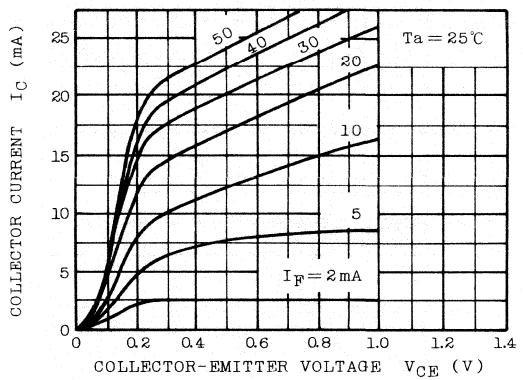
I_{FP} — V_{FP}



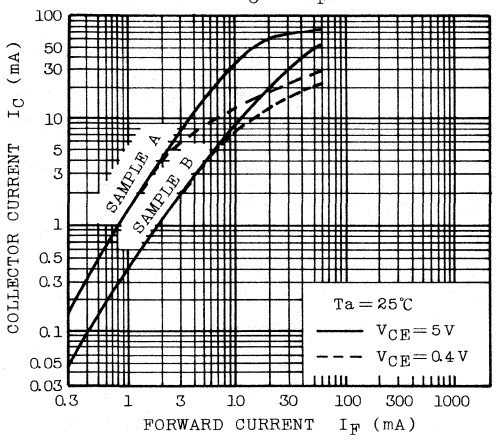
$I_C - V_{CE}$



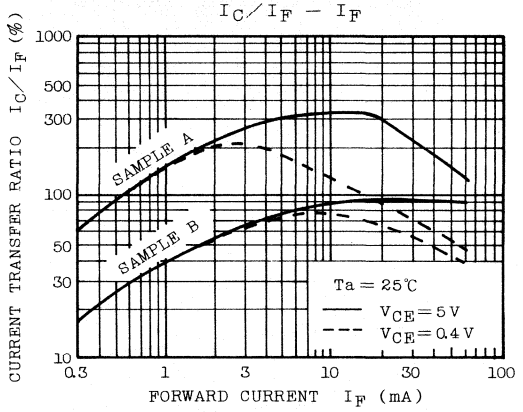
$I_C - V_{CE}$



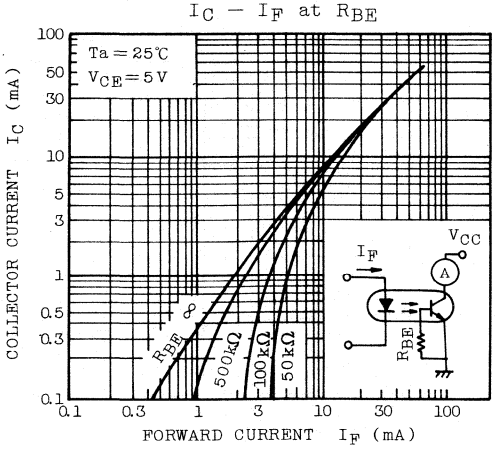
$I_C - I_F$



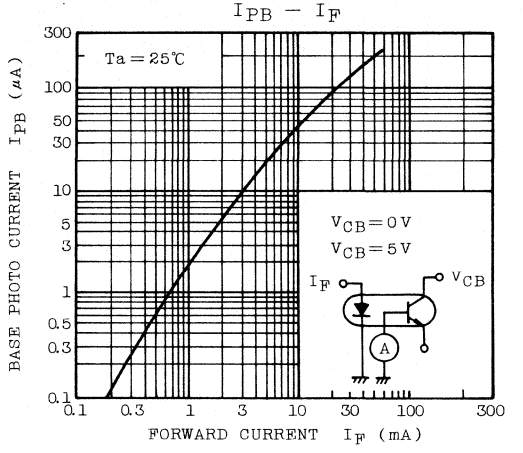
$I_C / I_F - I_F$



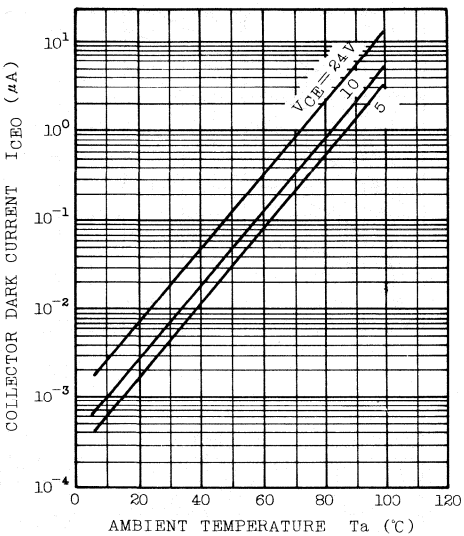
$I_C - I_F$ at R_{BE}



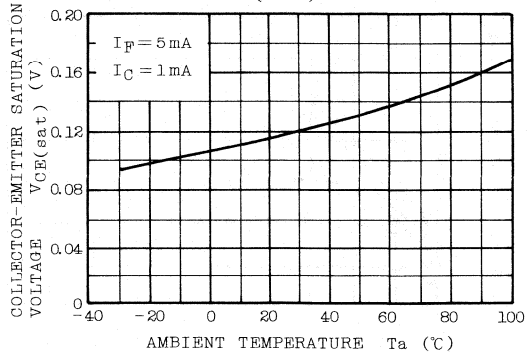
$I_{PB} - I_F$



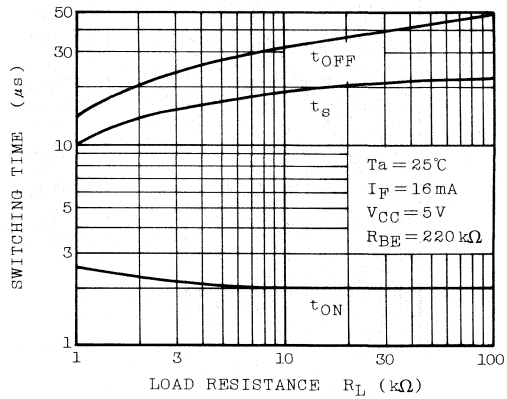
I_{CEO} — Ta



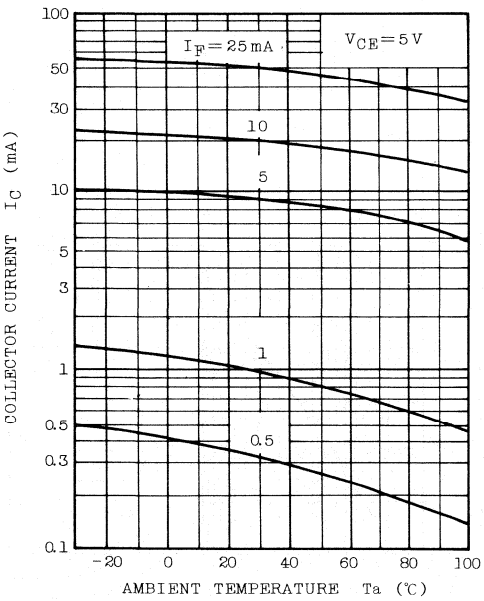
$V_{CE(sat)}$ — Ta



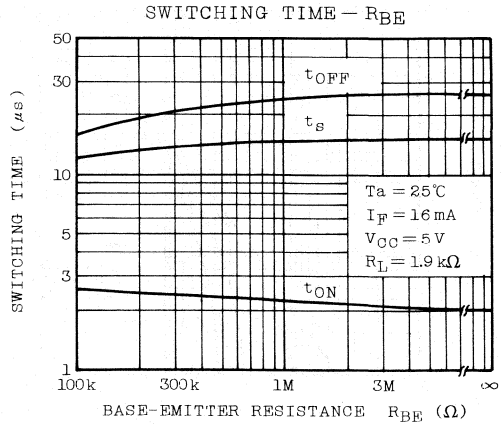
SWITCHING TIME — R_L



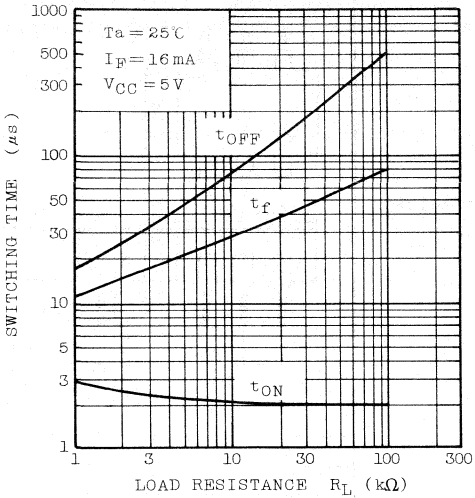
I_C — Ta



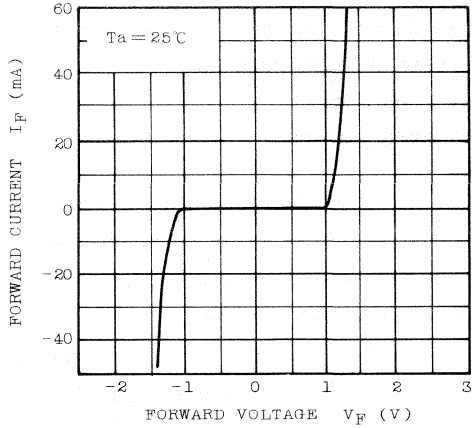
SWITCHING TIME — R_{BE}



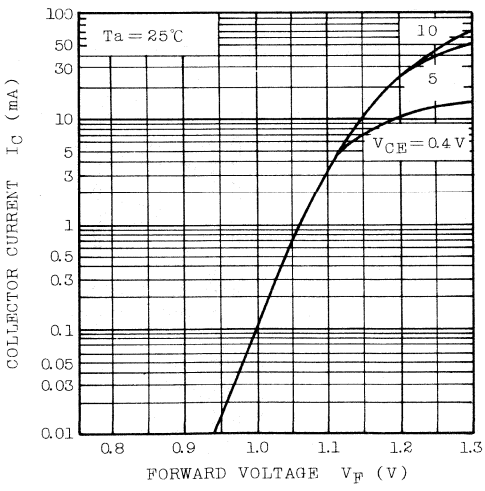
SWITCHING TIME — R_L (TYPICAL)



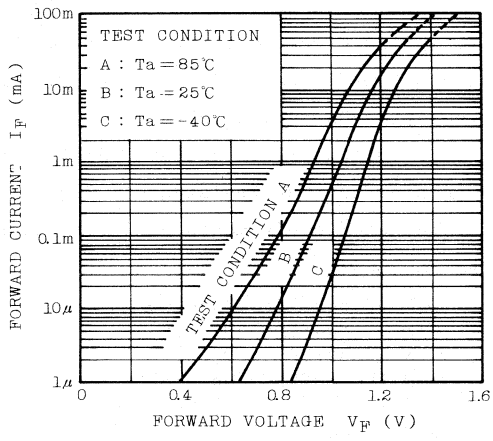
I_F — V_F



I_C — V_F



I_F — V_F



TLP639F

GaAs IRED & PHOTO-TRANSISTOR

OFFICE MACHINE
HOUSEHOLD USE EQUIPMENT
PROGRAMMABLE CONTROLLERS
AC/DC-INPUT MODULE
TELECOMMUNICATION

The TOSHIBA TLP639F consists of two gallium arsenide infrared emitting diode connected inverse parallel, optically coupled to a photo-transistor in a six lead plastic DIP package.
All parameters are tested to the specification of TLP639. (both condition and limits)

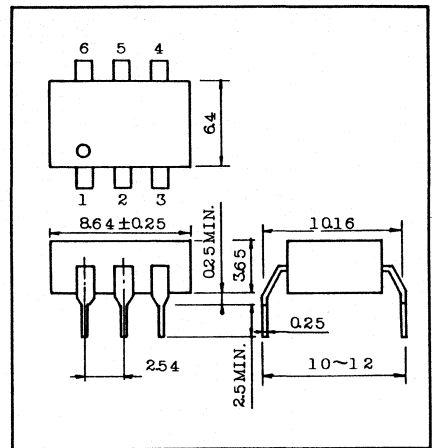
- Collector-Emitter Voltage : 55V Min.
- Current Transfer Ratio : 50% Min.
  Rank GB : 100% Min.
- Isolation Voltage : 5000V_{rms} Min.
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.0mm Min.
- Isolation Clearance : 8.0mm Min.
- Isolation Operating Voltage
  : 500V_{ac} or 600V_{dc} for Isolation Group C*1
- Creeping Current Resistance : Group I*2
- Guaranteed Requirements of Safety Standards as Follows:

  DIN 57 883/VDE0883/6.80
  DIN 57 804/VDE0804/1.83
  DIN IEC65/VDE0860/8.81
  DIN IEC380/VDE0806/8.81
  DIN IEC435/VDE0805/Draft Nov.84
  DIN IEC601T1/VDE0750T1/5.82

*1 : According to VDE0110, table 4

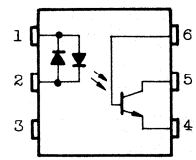
*2 : According to VDE0110, table 3

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-9A102

PIN CONFIGURATIONS (TOP VIEW)



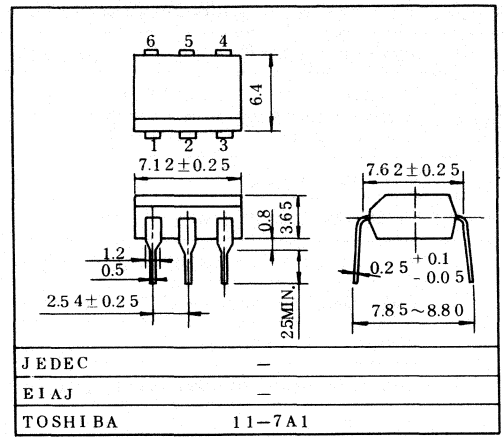
1: ANODE, CATHODE
2: CATHODE, ANODE
3: NC
4: EMITTER
5: COLLECTOR
6: BASE

PROGRAMMABLE CONTROLLERS.
AC-OUTPUT MODULE.
SOLID STATE RELAY.

The TOSHIBA TLP641G consists of a photo-thyristor optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.

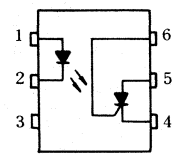
- Peak Off-State Voltage : 400V Min.
- Trigger LED Current : 7mA Max.
- On-State Current : 150mA Max.
- Isolation Voltage : 5000Vrms Min.
- UL Recognized : File No.E67349

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-7A1

PIN CONFIGURATIONS (TOP VIEW)



1 : ANODE
2 : CATHODE
3 : N.C.
4 : CATHODE
5 : ANODE
6 : GATE

MAXIMUM RATING (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Forward Current Derating (Ta ≧53°C)	ΔI_F/°C	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)	I_{FP}	1	A
	Reverse Voltage	V_R	5	V
	Junction Temperature	T_j	125	°C
DETECTOR	Peak Forward Voltage (R_{GK}=27KΩ)	V_{DRM}	400	V
	Peak Reverse Voltage (R_{GK}=27KΩ)	V_{RRM}	400	V
	On-State Current	$I_{T(RMS)}$	150	mA
	On-State Current Derating (Ta ≧25°C)	ΔI_T/°C	-2.0	mA/°C
	Peak One Cycle Surge Current	I_{TSM}	2	A
	Peak Reverse Gate Voltage	V_{GM}	-5	V
	Junction Temperature	T_j	100	°C
Storage Temperature Range		T_{stg}	-55∿125	°C
Operating Temperature Range		T_{opr}	-30∿100	°C
Lead Soldering Temperature (10sec.)		T_{sold}	260	°C
Isolation Voltage (AC, 1 min, RH ≦60%)		BV_S	5000	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA		1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V		-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz		-	30	-	pF
DETECTOR	Off-State Current	I_{DRM}	V_{AK}=400V, R_{GK}=27kΩ	Ta=25°C	-	10	5000	nA
				Ta=100°C	-	1	100	μA
	Reverse Current	I_{RRM}	V_{KA}=400V, R_{GK}=27kΩ	Ta=25°C	-	10	5000	nA
				Ta=100°C	-	1	100	μA
	On-State Voltage	V_{TM}	I_{TM}=100mA		-	0.9	1.3	V
	Holding Current	I_H	R_{GK}=27kΩ		-	0.2	1	mA
	Off-State dv/dt	dv/dt	V_{AK}=280V, R_{GK}=27kΩ		5	10	-	V/μs
	Capacitance	C_j	V=0, f=1MHz Anode to Gate Gate to Cathode		- -	20 350	- -	pF

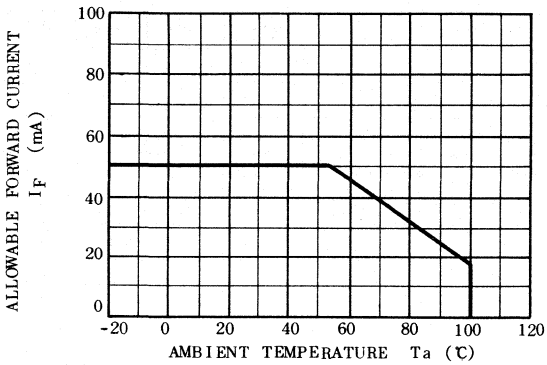
COUPLED CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_{AK}=6V, R_{GK}=27kΩ	1	4	7	mA
Turn-on Time	t_{on}	I_F=50mA R_{GK}=27kΩ	-	10	-	μs
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	RS	V_S=500V, R.H.≤60%	$5x10^{10}$	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	5000	-	-	V_{rms}

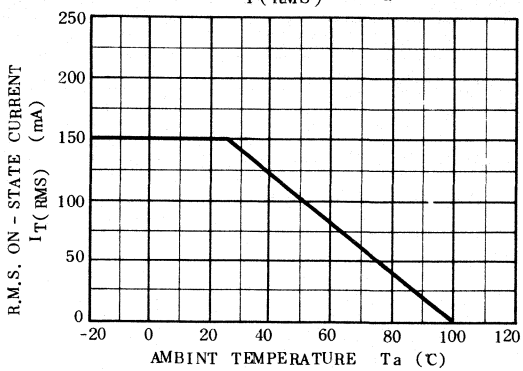
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	120	Vac
Forward Current	I_F	10	16	25	mA
Operating Temperature	T_{opr}	-30	-	85	°C
Gate to Cathode Resistance	R_{GK}	-	27	33	kΩ
Gate to Cathode Capacity	C_{GK}	-	0.01	0.1	μF

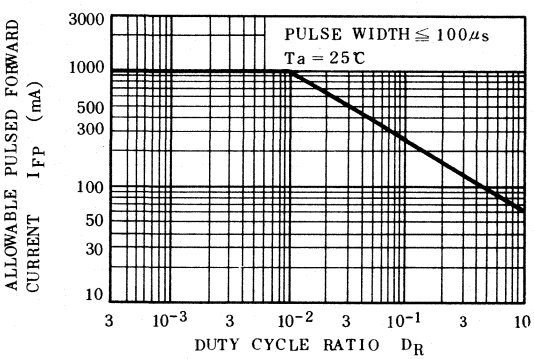
I_F – Ta



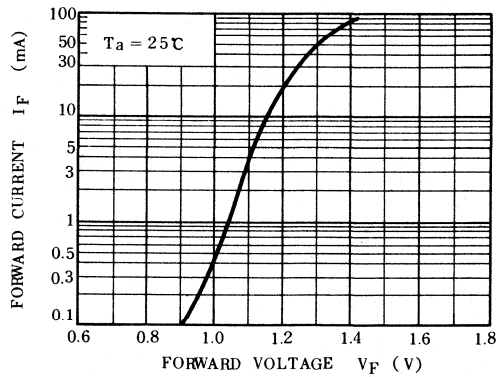
$I_{T(RMS)}$ – Ta



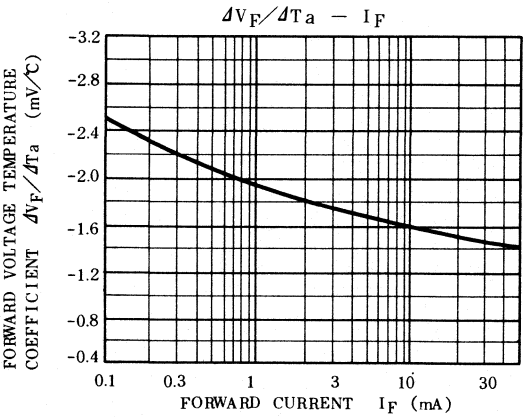
I_{FP} – D_R



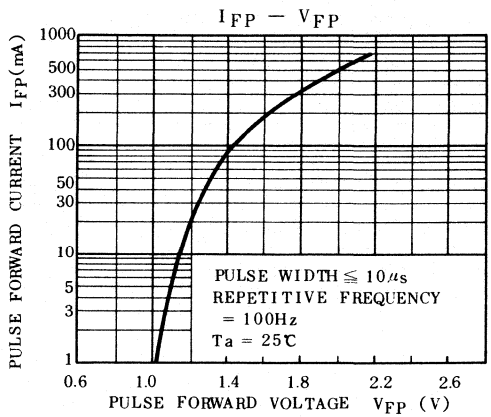
I_F – V_F



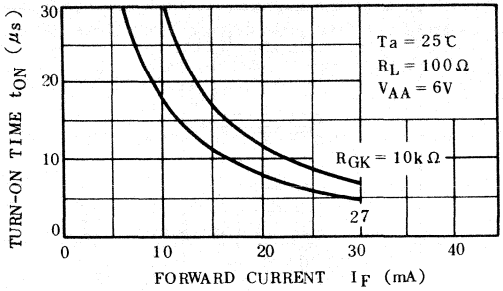
$\Delta V_F/\Delta Ta$ – I_F



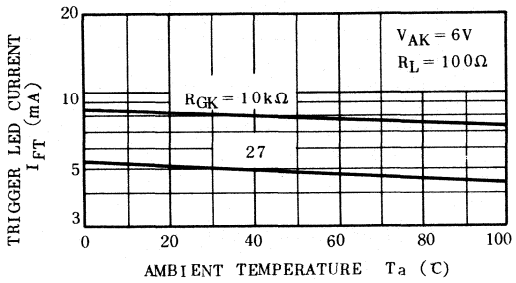
I_{FP} – V_{FP}



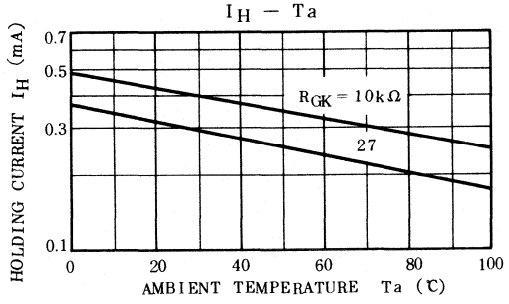
t_{ON} – I_F



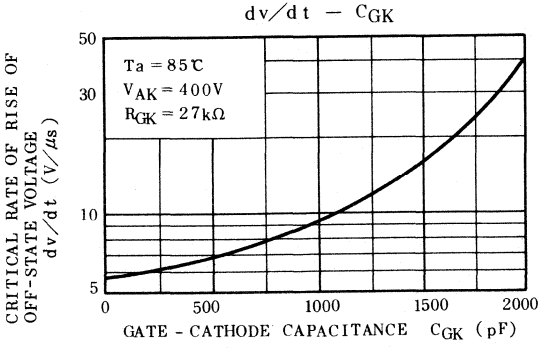
I_{FT} – Ta



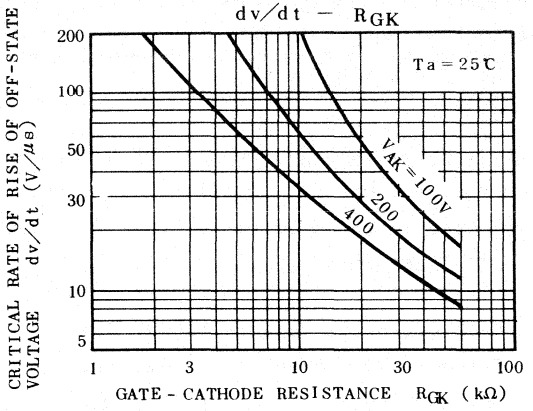
I_H – Ta



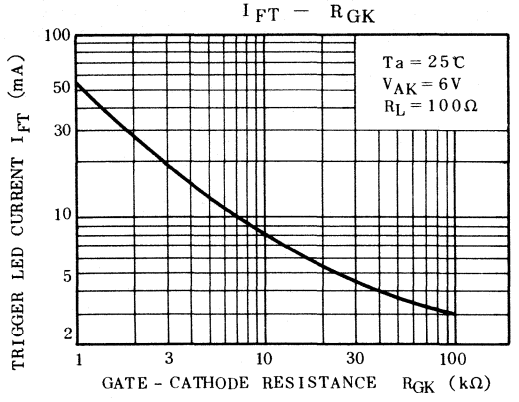
dv/dt – C_{GK}



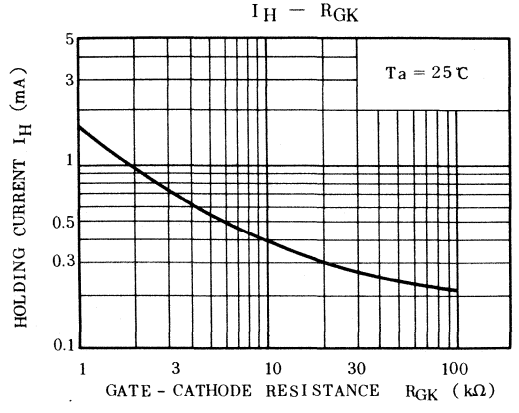
dv/dt – R_{GK}



I_{FT} – R_{GK}



I_H – R_{GK}



TLP641J

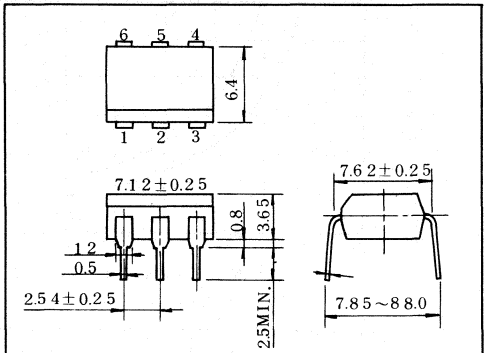
GaAs IRED & PHOTO-THYRISTOR

PROGRAMMABLE CONTROLLERS.
AC-OUTPUT MODULE.
SOLID STATE RELAY.

The TOSHIBA TLP641J consists of a photo-thyristor optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.

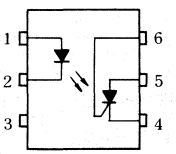
- Peak Off-State Voltage : 600V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 150mA Max.
- Isolation Voltage : 5000Vrms Min.
- UL Recognized : File No. E67349

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-7A1

PIN CONFIGURATION (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: CATHODE
5: ANODE
6: GATE

MAXIMUM RATING (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Forward Current Derating (Ta ≧53°C)	ΔI_F/°C	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)	I_{FP}	1	A
	Reverse Voltage	V_R	5	V
	Junction Temperature	T_j	125	°C
DETECTOR	Peak Forward Voltage (R_{GK}=27KΩ)	V_{DRM}	600	V
	Peak Reverse Voltage (R_{GK}=27KΩ)	V_{RRM}	600	V
	On-State Current	$I_{T(RMS)}$	150	mA
	On-State Current Derating (Ta ≧25°C)	ΔI_T/°C	-2.0	mA/°C
	Peak One Cycle Surge Current	I_{TSM}	2	A
	Peak Reverse Gate Voltage	V_{GM}	-5	V
	Junction Temperature	T_j	100	°C
Storage Temperature Range		T_{stg}	-55∿125	°C
Operating Temperature Range		T_{opr}	-30∿100	°C
Lead Soldering Temperature (10sec.)		T_{sold}	260	°C
Isolation Voltage (AC, 1 min, RH≦60%)		BV_S	5000	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA		1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V		-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz		-	30	-	pF
DETECTOR	Off-State Current	I_{DRM}	V_{AK}=600V	R_{GK}=27kΩ, Ta=25°C	-	10	5000	nA
				R_{GK}=10kΩ, Ta=85°C	-	1	150	μA
	Reverse Current	I_{RRM}	V_{KA}=600V	R_{GK}=27kΩ, Ta=25°C	-	10	5000	nA
				R_{GK}=10kΩ, Ta=85°C	-	1	150	μA
	On-State Voltage	V_{TM}	I_{TM}=100mA		-	0.9	1.3	V
	Holding Current	I_H	R_{GK}=27kΩ		-	0.2	-	mA
	Off-State dv/dt	dv/dt	V_{AK}=420V, R_{GK}=27kΩ		5	10	-	V/μs
	Capacitance	C_j	V=0, f=1MHz Anode to Gate Gate to Cathode		- -	20 350	- -	pF

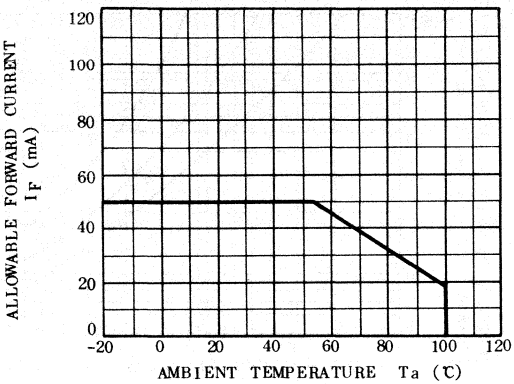
COUPLED CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_{AK}=6V, R_{GK}=27kΩ	1	5	10	mA
Turn-on Time	t_{on}	I_F=50mA R_{GK}=27kΩ	-	10	-	μs
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V =500V, R.H.≤60%	-	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	5000	-	-	V_{rms}

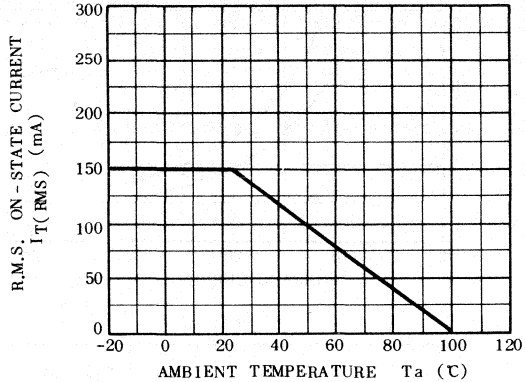
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	240	Vac
Forward Current	I_F	20	25	30	mA
Operating Temperature	Topr	-30	-	85	°C
Gate to Cathode Resistance	R_{GK}	-	10	27	kΩ
Gate to Cathode Capacity	C_{GK}	-	0.01	0.1	μF

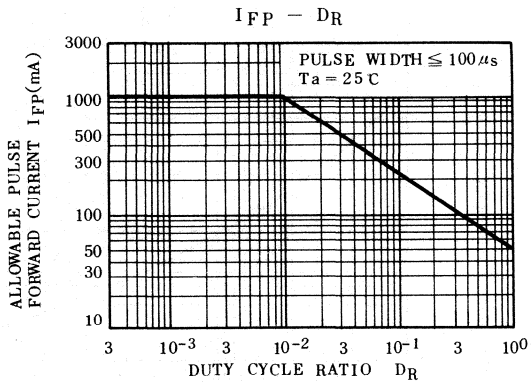
I_F – Ta

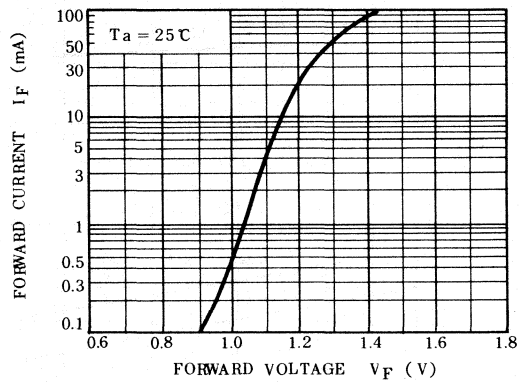


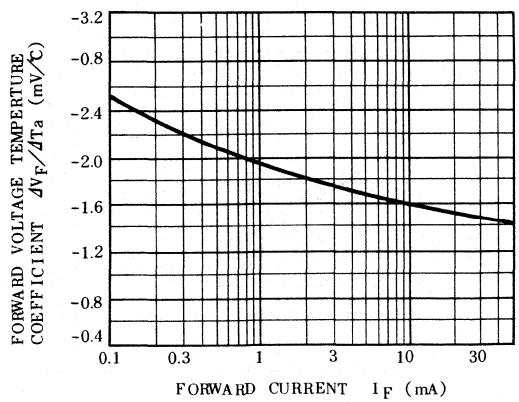
$I_{T(RMS)}$ – Ta

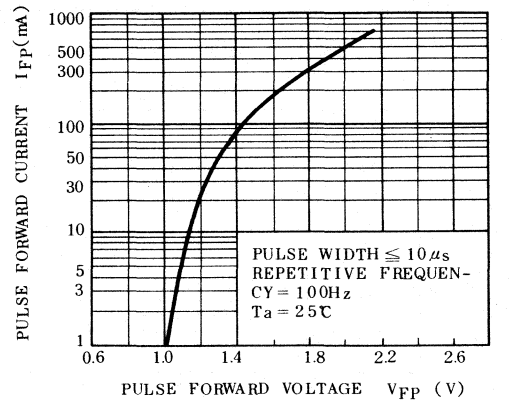


I_{FP} – D_R

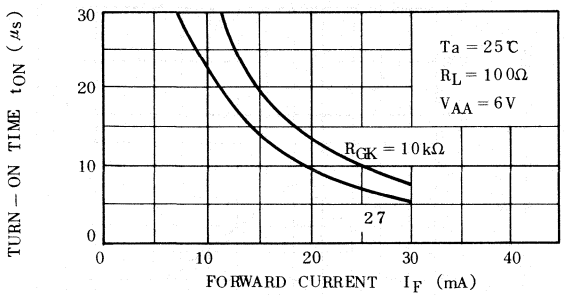




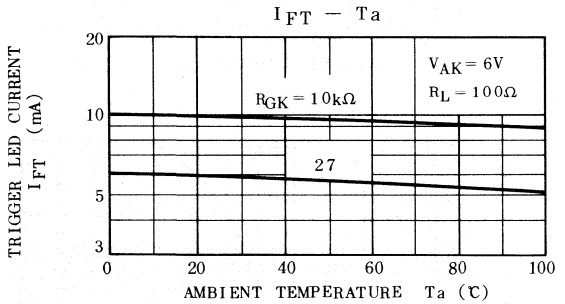




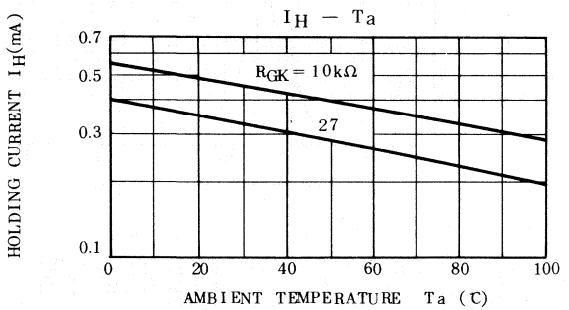
t_{ON} — I_F



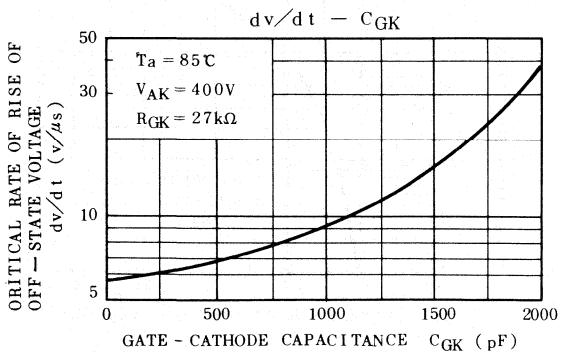
I_{FT} — Ta



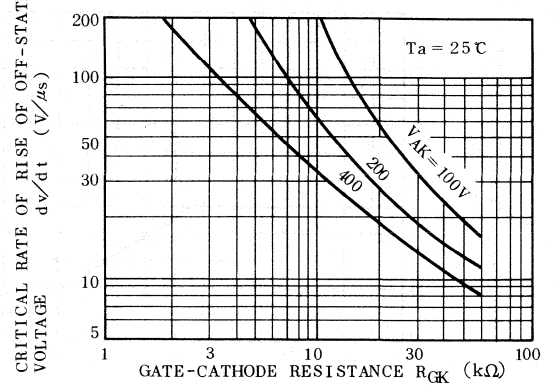
I_H — Ta



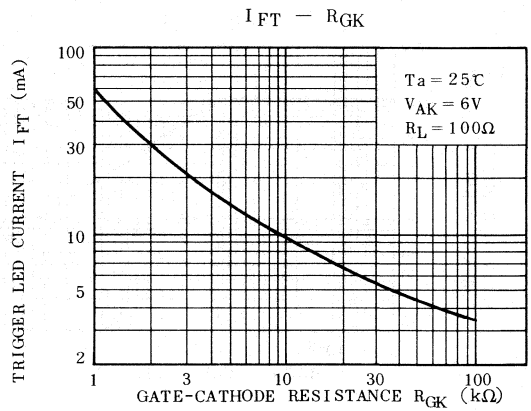
dv/dt — C_{GK}



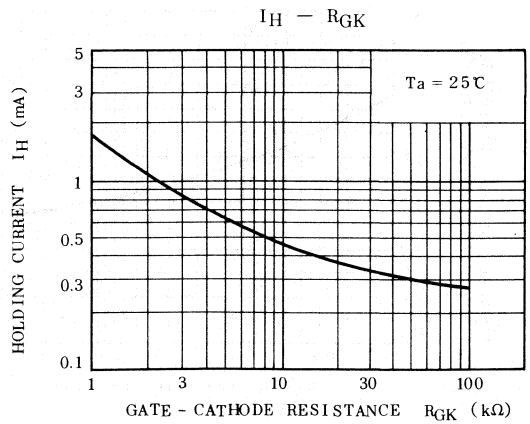
dv/dt — R_{GK}



I_{FT} — R_{GK}



I_H — R_{GK}



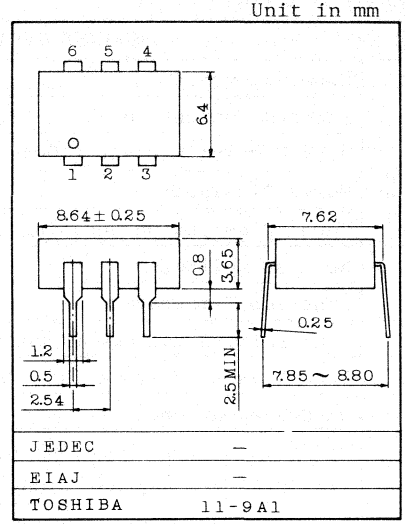
OFFICE MACHINE.
HOUSEHOLE USE EQUIPMENT.
SOLID STATE RELAY.
SWITCHING POWER SUPPLY.

The TOSHIBA TLP645G consists of a photo-thyristor optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.

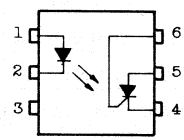
- Peak Off-State Voltage : 400V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 150mA Max.
- Isolation Voltage : 5000V_{rms} Min.
- Guaranteed Requirements of IEC380/VDE0806
- Climatic Test Class : 55/150/21
- Isolation Creepage Path: 8.0mm Min.
- Isolation Clearance : 7.3mm Min.
- Isolation Operating Voltage
  : 500V_{ac} or 600V_{dc} for Isolation Group C. *1
- Creeping Current Resistance : Group I *2

*1 : According to VDE0110, table 4
*2 : According to VDE0110, table 3

Unit in mm



PIN CONFIGURATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: CATHODE
5: ANODE
6: GATE

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISITC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	60	mA
	Forward Current Derating (Ta≧39°C)	ΔI_F/°C	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)	I_{FP}	1	A
	Power Dissipation	P_D	100	mW
	Power Dissipation Derating (Ta≧25°C)	ΔP_D/°C	-1.0	mW/°C
	Reverse Voltage	V_R	5	V
	Junction Temperature	T_j	125	°C
DETECTOR	Peak Forward Voltage (R_{GK}=27kΩ)	V_{DRM}	400	V
	Peak Reverse Voltage (R_{GK}=27kΩ)	V_{RRM}	400	V
	On-State Current	$I_{T(RMS)}$	150	mA
	On-State Current Derating (Ta≧25°C)	ΔI_T/°C	-2.0	mA/°C
	Peak On-State Current (100μs pulse, 120pps)	I_{TP}	3	A
	Peak One Cycle Surge Current	I_{TSM}	2	A
	Peak Reverse Gate Voltage	V_{GM}	5	V
	Power Dissipation	P_D	150	mW
	Power Dissipation Derating (Ta≧25°C)	ΔP_D/°C	-2.0	mW/°C
	Junction Temperature	T_j	100	°C
Storage Temperature Range		T_{stg}	-55~150	°C
Operating Temperature Range		T_{opr}	-55~100	°C
Lead Soldering Temperature (10 sec.)		T_{sold}	260	°C
Total Package Power Dissipation		P_T	250	mW
Total Package Power Dissipation Derating (Ta≧25°C)		ΔP_T/°C	-3.3	mW/°C
Isolation Voltage (AC, 1 min., RH≦60%)		BVS	5000	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA		1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V		-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz		-	30	-	pF
DETECTOR	Off-State Current	I_{DRM}	V_{AK}=400V, R_{GK}=27kΩ	Ta=25°C	-	10	5000	nA
				Ta=100°C	-	1	100	μA
	Reverse Current	I_{RRM}	V_{KA}=400V, R_{GK}=27kΩ	Ta=25°C	-	10	5000	nA
				Ta=100°C	-	1	100	μA
	On-State Voltage	V_{TM}	I_{TM}=100mA		-	0.9	1.3	V
	Holding Current	I_H	R_{GK}=27kΩ		-	0.2	-	mA
	Off-State dv/dt	dv/dt	V_D=280V, R_{GK}=27kΩ		5	10	-	V/μs
	Capacitance	C_j	V=0, f=1MHz					
			Anode to Gate		-	20	-	pF
			Gate to Cathode		-	350	-	

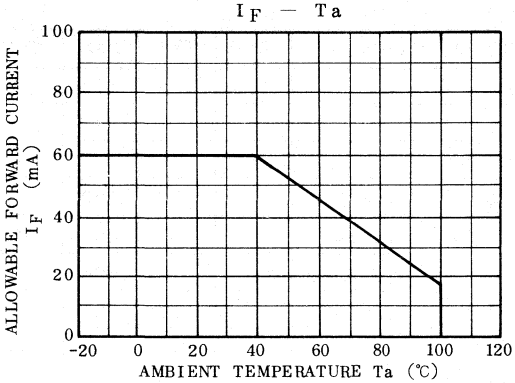
COUPLED CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_{AK}=6V, R_{GK}=27kΩ	-	4	10	mA
Turn-on Time	t_{on}	I_F=30mA, V_{AA}=50V, R_{GK}=27kΩ	-	10	-	μs
Coupled dv/dt	dv/dt	V_S=500V, R_{GK}=27kΩ	500	-	-	V/μs
Capacitacne (Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	5000	-	-	V_{rms}
		AC, 1 second	-	10000	-	
		DC, 1 minute	-	10000	-	V_{dc}

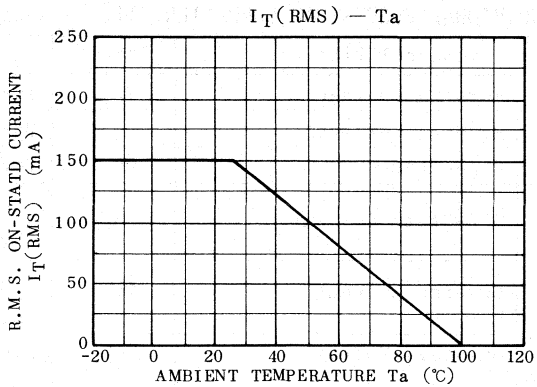
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	120	V_{ac}
Forward Current	I_F	15	20	25	mA
Operating Temperature	Topr	-25	-	85	°C
Gate to Cathode Resistance	R_{GK}	-	27	33	kΩ
Gate to Cathode Capacity	C_{GK}	-	0.01	0.1	μF

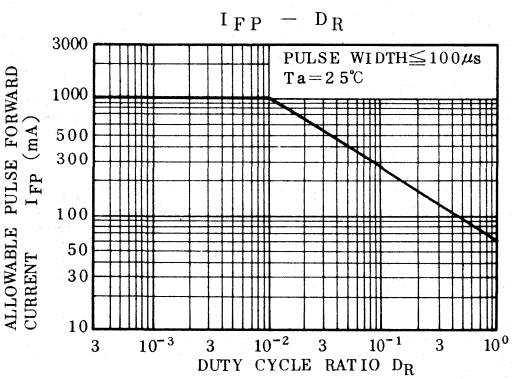
I_F — Ta



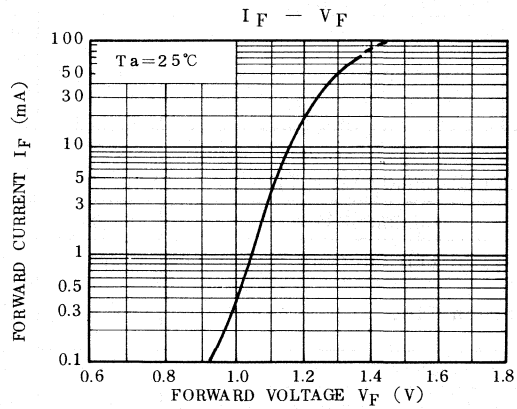
I_T(RMS) — Ta



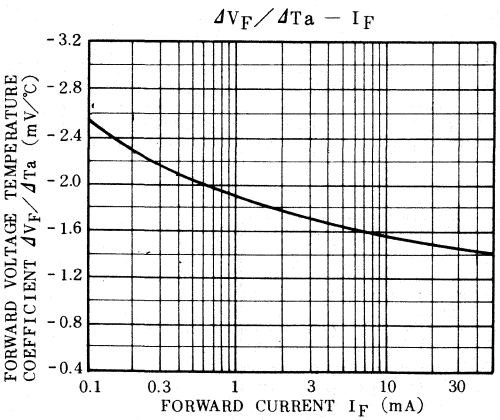
I_{FP} — D_R



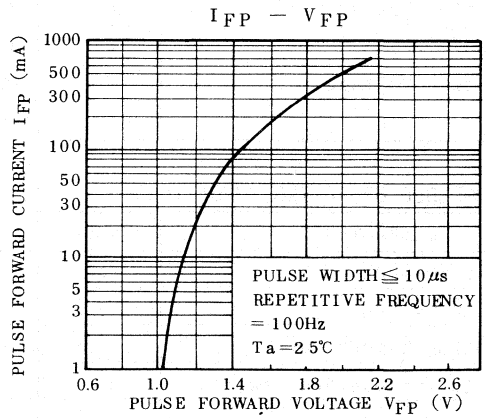
I_F — V_F



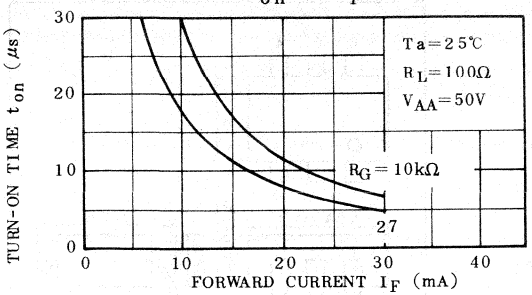
$\Delta V_F / \Delta Ta$ — I_F



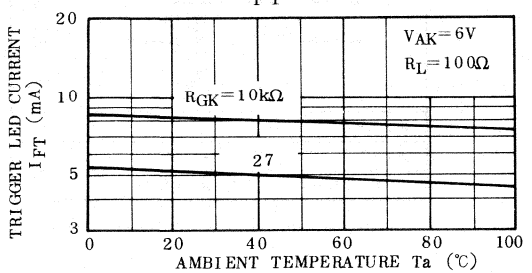
I_{FP} — V_{FP}



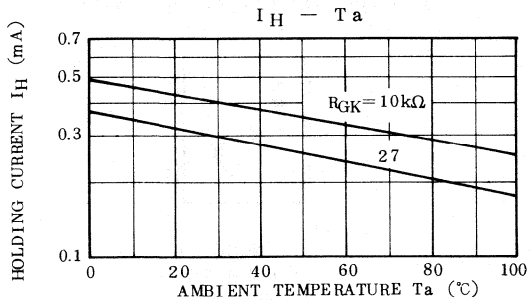
t_{on} – I_F



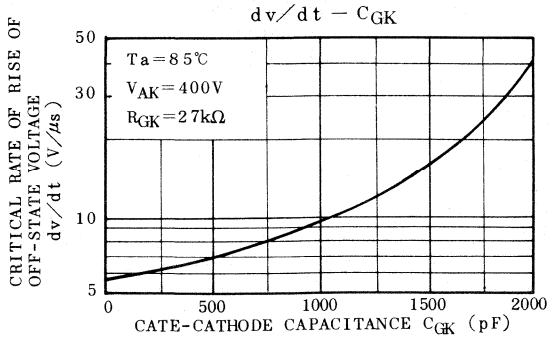
I_{FT} – Ta



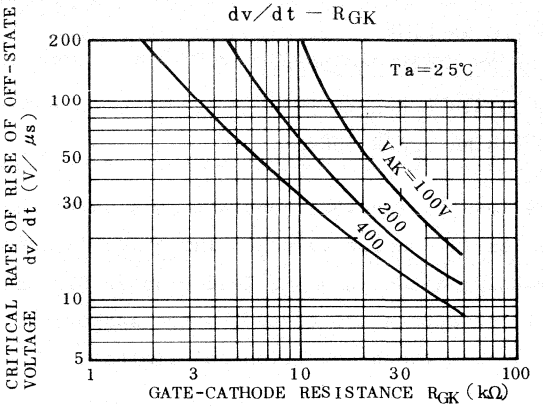
I_H – Ta



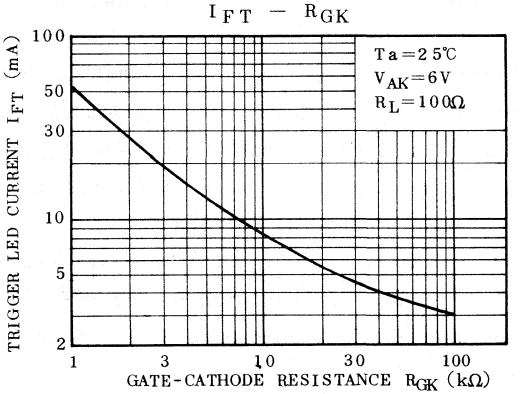
dv/dt – C_{GK}



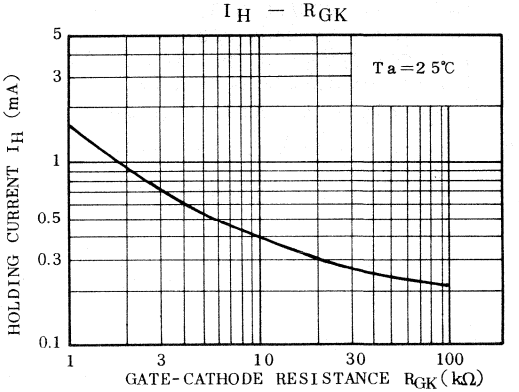
dv/dt – R_{GK}



I_{FT} – R_{GK}



I_H – R_{GK}



TLP645GF

GaAs IRED & PHOTO-THYRISTOR

OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
SOLID STATE RELAY.
SWITCHING POWER SUPPLY.

The TOSHIBA TLP645GF consists of a photo-thyristor optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package. All parameters are tested to the specification of TLP645G. (both condition and limits)

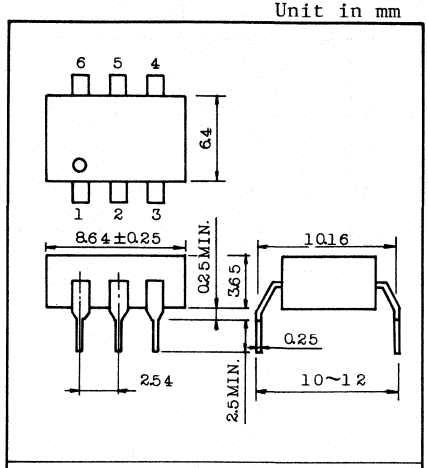
- Peak Off-State Voltage : 400V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 150mA Max.
- Isolation Voltage : 5000V_{rms} Min.
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.0mm Min.
- Isolation Clearance : 8.0mm Min.
- Isolation Operating Voltage
  : 500V_{ac} ro 600V_{dc} for Insolation Group C*1
- Creeping Current Resistance: Group*2
- Guaranteed Requirements of Safety Standards as rollows:

  DIN 57 883/VDE0883/6.80
  DIN 57 804/VDE0804/1.83
  DIN IEC65/VDE0860/8.81
  DIN IEC380/VDE0806/8.81
  DIN IEC435/VDE0805/Draft Nov. 84
  DIN IEC601T1/VDE0750T1/5.82

*1 : According to VDE0110, table 4

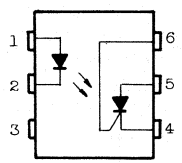
*2 : According to VDE0110, table 3

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-9A102

PIN CONFIGURATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: CATHODE
5: ANODE
6: GATE

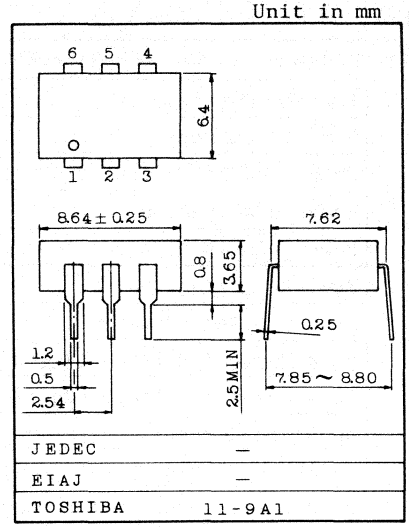
OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
SOLID STATE RELAY.
SWITCHING POWER SUPPLY.

The TOSHIBA TLP645J consists of a photo-thyristor optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.

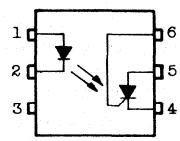
- Peak Off-State Voltage : 600V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 150mA Max.
- Isolation Voltage : 5000V_{rms} Min.
- Guaranteed Requirements of IEC380/VDE0806
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.0mm Min.
- Isolation Clearance : 7.3mm Min.
- Isolation Operating Voltage
  : 500V_{ac} or 600V_{dc} for Isolation Group C*1
- Creeping Current Resistance : Group I*2

*1 : According to VDE0110, table 4
*2 : According to VDE0110, table 3

Unit in mm



PIN CONFIGURATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: CATHODE
5: ANODE
6: GATE

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	60	mA
	Forward Current Derating (Ta≧39°C)	ΔI_F/°C	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)	I_{FP}	1	A
	Power Dissipation	P_D	100	mW
	Power Dissipation Derating (Ta≧25°C)	ΔP_D/°C	-1.0	mW/°C
	Reverse Voltage	V_R	5	V
	Junction Temperature	T_j	125	°C
DETECTOR	Peak Forward Voltage (R_{GK}=27kΩ)	V_{DRM}	600	V
	Peak Reverse Voltage (R_{GK}=27kΩ)	V_{RRM}	600	V
	On-State Current	$I_{T(RMS)}$	150	mA
	On-State Current Derating (Ta≧25°C)	ΔI_T/°C	-2.0	mA/°C
	Peak On-State Current (100μs pulse, 120pps)	I_{TP}	3	A
	Peak One Cycle Surge Current	I_{TSM}	2	A
	Peak Reverse Gate Voltage	V_{GM}	5	V
	Power Dissipation	P_D	150	mW
	Power Dissipation Derating (Ta≧25°C)	ΔP_D/°C	-2.0	mW/°C
	Junction Temperature	T_j	100	°C
Storage Temperature Range		T_{stg}	-55~150	°C
Operating Temperature Range		T_{opr}	-55~100	°C
Lead Soldering Temperature (10 sec.)		T_{sold}	260	°C
Total Package Power Dissipation		P_T	250	mW
Total Package Power Dissipation Derating (Ta≧25°C)		ΔP_T/°C	-3.3	mW/°C
Isolation Voltage (AC, 1 min., RH≦60%)		BV_S	5000	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA		1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V		-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz		-	30	-	pF
DETECTOR	Off-State Current	I_{DRM}	V_{AK}=600V	Ta=25°C	-	10	5000	nA
			R_{GK}=27kΩ	Ta=85°C	-	1	150	μA
	Reverse Current	I_{RRM}	V_{KA}=600V	Ta=25°C	-	10	5000	nA
			R_{GK}=27kΩ	Ta=85°C	-	1	150	μA
	On-State Voltage	V_{TM}	I_{TM}=100mA		-	0.9	1.3	V
	Holding Current	I_H	R_{GK}=27kΩ		-	0.2	-	mA
	Off-State dv/dt	dv/dt	V_D=420V, R_{GK}=27kΩ		-	10	-	V/μs
	Capacitance	Cj	V=0, f=1MHz					
			Anode to Gate		-	20	-	pF
			Gate to Cathode		-	350	-	

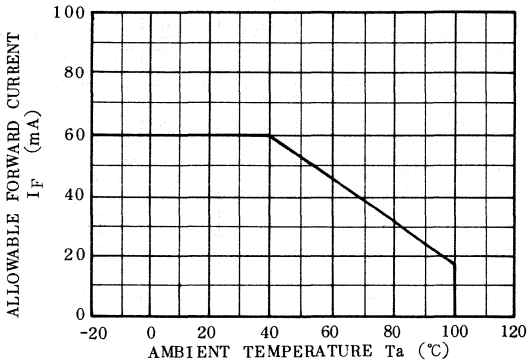
COUPLED CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_{AK}=6V, R_{GK}=27kΩ	-	5	10	mA
Turn-on Time	t_{on}	I_F=30mA, V_{AA}=50V R_{GK}=27kΩ	-	10	-	μs
Coupled dv/dt	dv/dt	V_S=500V, R_{GK}=27kΩ	500	-	-	V/μs
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	5000	-	-	V_{rms}
		AC, 1 second	-	10000	-	
		DC, 1 minute	-	10000	-	V_{dc}

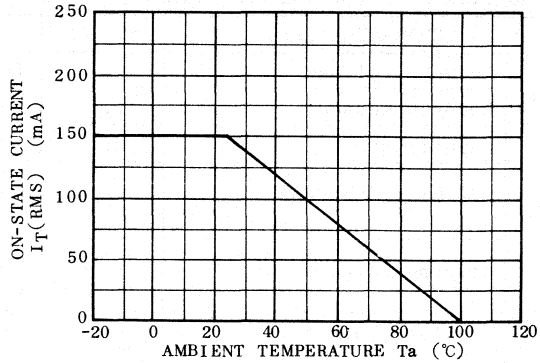
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	240	V_{ac}
Forward Current	I_F	15	20	25	mA
Operating Temperature	T_{opr}	-25	-	85	°C
Gate to Cathode Resistance	R_{GK}	-	10	27	kΩ
Gate to Cathode Capacity	C_{GK}	-	0.01	0.1	μF

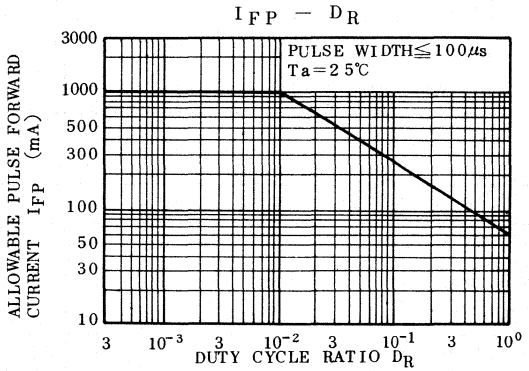
I_F — Ta



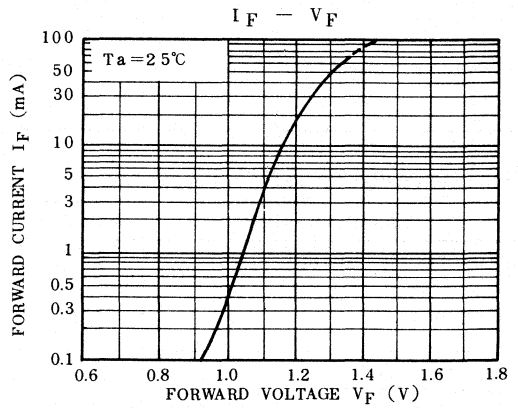
$I_{T(RMS)}$ — Ta



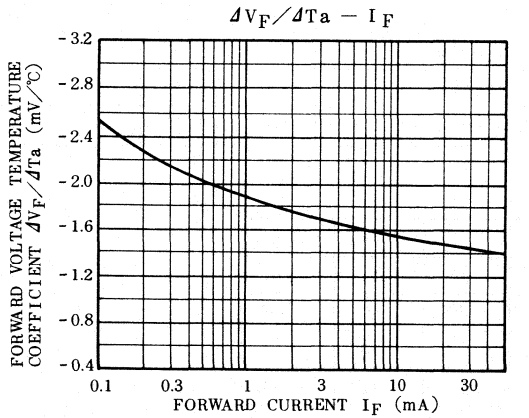
I_{FP} — D_R



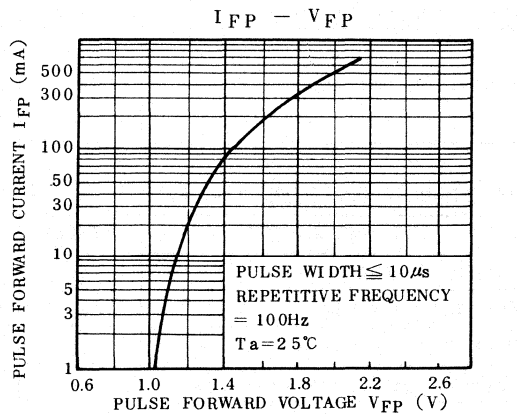
I_F — V_F

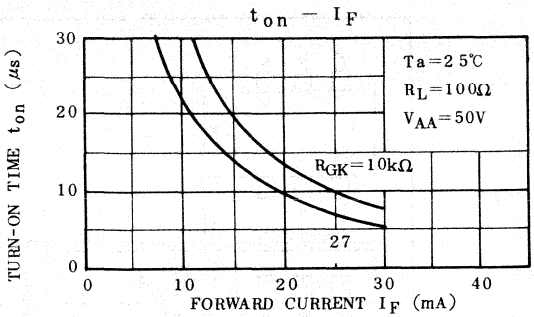


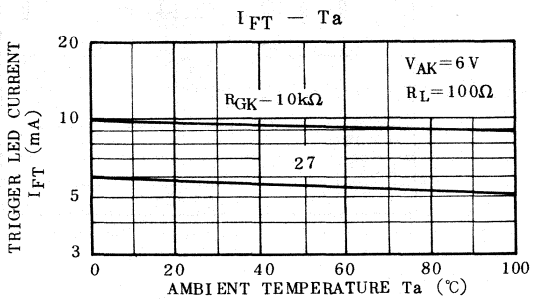
$\Delta V_F / \Delta Ta$ — I_F

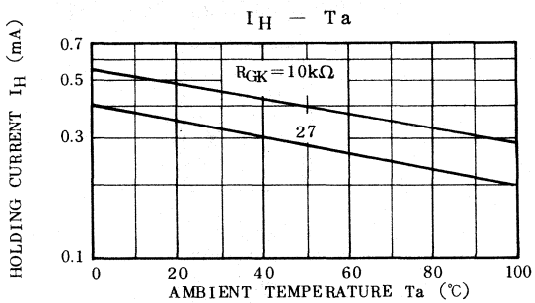


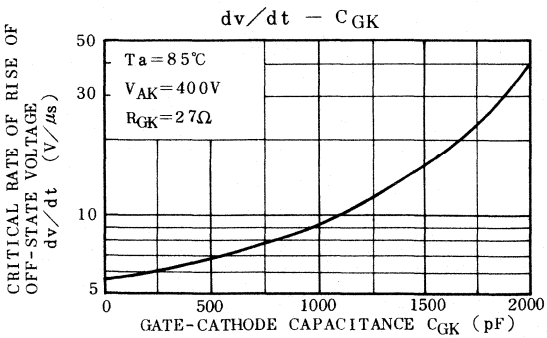
I_{FP} — V_{FP}

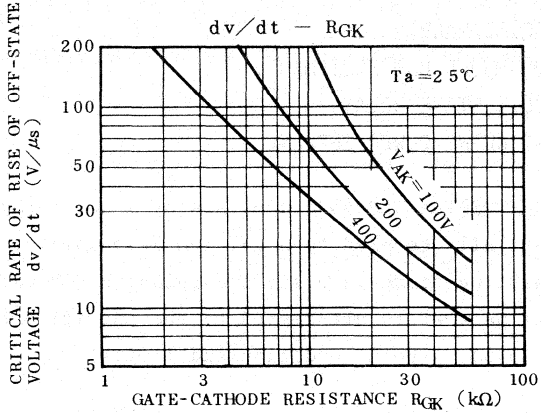


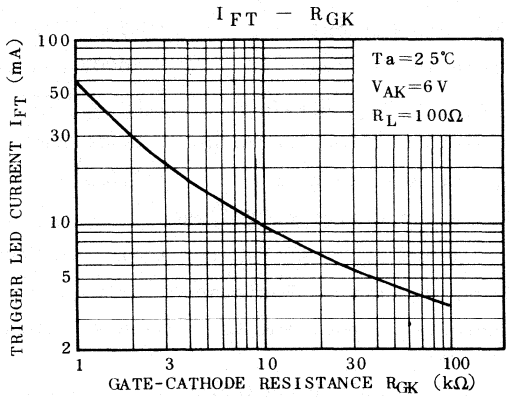

t_{on} – I_F
Ta=25℃
R_L=100Ω
V_{AA}=50V
R_{GK}=10kΩ
27
TURN-ON TIME t_{on} (μs)
FORWARD CURRENT I_F (mA)

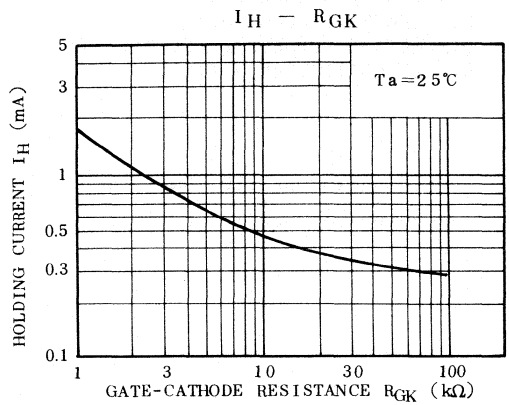

I_{FT} – Ta
V_{AK}=6V
R_L=100Ω
R_{GK}=10kΩ
27
TRIGGER LED CURRENT I_{FT} (mA)
AMBIENT TEMPERATURE Ta (℃)


I_H – Ta
R_{GK}=10kΩ
27
HOLDING CURRENT I_H (mA)
AMBIENT TEMPERATURE Ta (℃)


dv/dt – C_{GK}
Ta=85℃
V_{AK}=400V
R_{GK}=27Ω
CRITICAL RATE OF RISE OF OFF-STATE VOLTAGE dv/dt (V/μs)
GATE-CATHODE CAPACITANCE C_{GK} (pF)


dv/dt – R_{GK}
Ta=25℃
V_{AK}=100V
200
400
CRITICAL RATE OF RISE OF OFF-STATE VOLTAGE dv/dt (V/μs)
GATE-CATHODE RESISTANCE R_{GK} (kΩ)


I_{FT} – R_{GK}
Ta=25℃
V_{AK}=6V
R_L=100Ω
TRIGGER LED CURRENT I_{FT} (mA)
GATE-CATHODE RESISTANCE R_{GK} (kΩ)


I_H – R_{GK}
Ta=25℃
HOLDING CURRENT I_H (mA)
GATE-CATHODE RESISTANCE R_{GK} (kΩ)

TLP645JF

GaAs IRED & PHOTO-THYRISTOR

OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
SOLID STATE RELAY.
SWITCHING POWER SUPPLY.

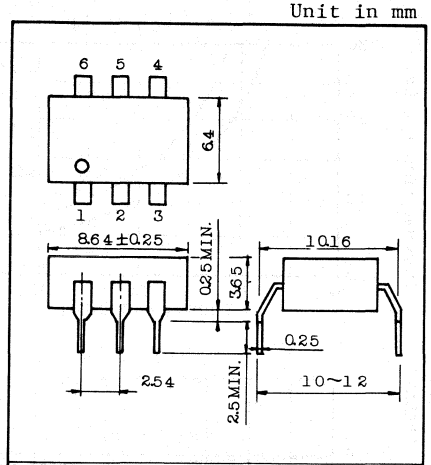
The TOSHIBA TLP645JF consists of a photo-thyristor optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package. All parameters are tested to the specification of TLP645J. (both condition and limits)

- Peak Off-State Voltage : 600V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 150mA Max.
- Isolation Voltage : 5000V_{rms} Min.
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.0mm Min.
- Isolation Clearance : 8.0mm Min.
- Isolation Operating Voltage
  : 500V_{ac} or 600V_{dc} for Isolation Group C*1
- Creeping Current Resistance: Group 1*2
- Guaranteed Requirements of Safety Standards as Follows:

  DIN 57 883/VDE0883/6.80
  DIN 57 804/VDE0804/1.83
  DIN IEC65/VDE0860/8.81
  DIN IEC380/FED0806/8.81
  DIN IEC435/VDE0805/Draft Nov.84
  DIN IEC601T1/VDE0750T1/5.82

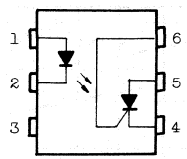
*1 : According to VDE0110, table 4
*2 : According to VDE0110, table 3

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-9A102

PIN CONFIGURATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: CATHODE
5: ANODE
6: GATE

OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
SOLID STATE RELAY.
SWITCHING POWER SUPPLY.

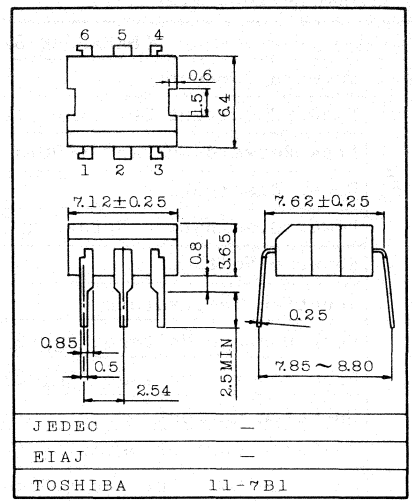
The TOSHIBA TLP647G consists of a photo-thyristor optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.

- Peak Off-State Voltage : 400V Min.
- Trigger LED Current : 15mA Max.
- On-State Current : 150mA Max.
- Isolation Voltage : 4000V_{rms} Min.
- Guaranteed Requirements of IEC380/VDE0806
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.2mm Min.
- Isolation Clearance : 7.6mm Min.
- Internal Creepage Path : 4.0mm Min.
- Isolation Operating Voltage
  : 500V_{ac} or 600V_{dc} for Isolation Group C.*1
- Creeping Current Resistance : Group I.*2
- VDE Approved: Certificate No.39408

*1 : According to VDE0110, table 4

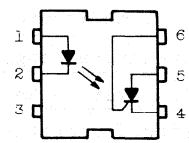
*2 : According to VDE0110, table 3

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-7B1

PIN CONFIGURATIONS (TOP VIEW)



1. ANODE
2. CATHODE
3. NC
4. CATHODE
5. ANODE
6. GATE

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	60	mA
	Forward Current Derating (Ta≧39°C)	$\Delta I_F/°C$	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)	I_{FP}	1	A
	Power Dissipation	P_D	100	mW
	Power Dissipation Derating (Ta≧25°C)	$\Delta P_D/°C$	-1.0	mW/°C
	Reverse Voltage	V_R	5	V
	Junction Temperature	T_j	125	°C
DETECTOR	Peak Forward Voltage (R_{GK}=27kΩ)	V_{DRM}	400	V
	Peak Reverse Voltage (R_{GK}=27kΩ)	V_{RRM}	400	V
	On-State Current	$I_{T(RMS)}$	150	mA
	On-State Current Derating (Ta≧25°C)	$\Delta I_T/°C$	-2.0	mA/°C
	Peak On-State Current (100μs, pulse, 120pps)	I_{TP}	3	A
	Peak One Cycle Surge Current	I_{TSM}	2	A
	Peak Reverse Gate Voltage	V_{GM}	5	V
	Power Dissipation	P_D	150	mW
	Power Dissipation Derating (Ta≧25°C)	$\Delta P_D/°C$	-2.0	mW/°C
	Junction Temperature	T_j	100	°C
Storage Temperature Range		T_{stg}	-55~150	°C
Operating Temperature Range		T_{opr}	-55~100	°C
Lead Soldering Temperature (10 sec.)		T_{sold}	260	°C
Total Package Power Dissipation		P_T	250	mW
Total Package Power Dissipation Derating (Ta≧25°C)		$\Delta P_T/°C$	-3.3	mW/°C
Isolation Voltage (AC, 1 min., RH≦60%)		BV_S	4000	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA		1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V		-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz		-	30	-	pF
DETECTOR	Off-State Current	I_{DRM}	V_{AK}=400V, R_{GK}=27kΩ	Ta=25°C	-	10	5000	nA
				Ta=100°C	-	1	100	μA
	Reverse Current	I_{RRM}	V_{KA}=400V, R_{GK}=27kΩ	Ta=25°C	-	10	5000	nA
				Ta=100°C	-	1	100	μA
	On-State Voltage	V_{TM}	I_{TM}=100mA		-	0.9	1.3	V
	Holding Current	I_H	R_{GK}=27kΩ		-	0.2	-	mA
	Off-State dv/dt	dv/dt	V_{AK}=280V, R_{GK}=27kΩ		5	10	-	V/μs
	Capacitance	C_j	V=0, f=1MHz					
			Anode to Gate		-	20	-	pF
			Gate to Cathode		-	350	-	

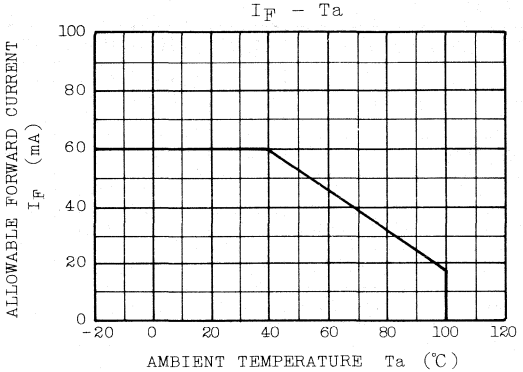
COUPLED CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_{AK}=6V, R_{GK}=27kΩ	-	-	15	mA
Turn-on Time	t_{on}	I_F=30mA, V_{AA}=50V, R_{GK}=27kΩ	-	10	-	μs
Coupled dv/dt	dv/dt	V_S=500V, R_{GK}=27kΩ	500	-	-	V/μs
Capacitance(Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	4000	-	-	V_{rms}
		AC, 1 second	-	10000	-	
		DC, 1 minute	-	10000	-	V_{dc}

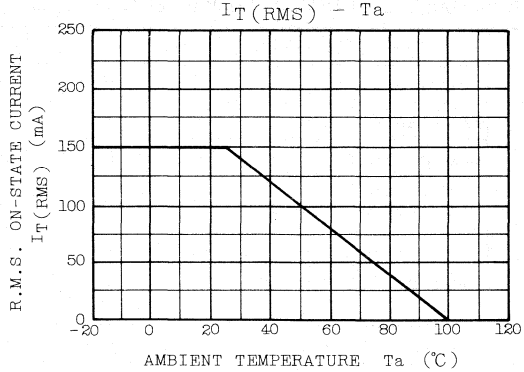
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	120	V_{ac}
Forward Current	I_F	20	-	25	mA
Operating Temperature	T_{opr}	-25	-	85	°C
Gate to Cathode Resistance	R_{GK}	-	27	33	kΩ
Gate to Cathode Capacity	C_{GK}	-	0.01	0.1	μF

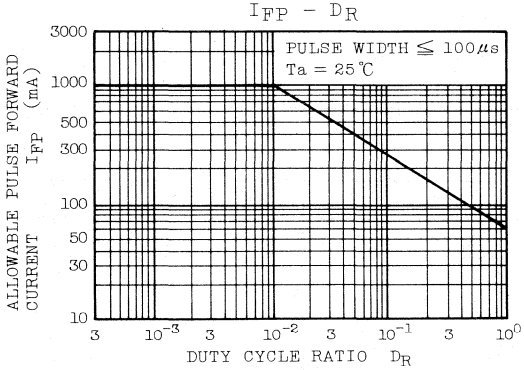
I_F – Ta



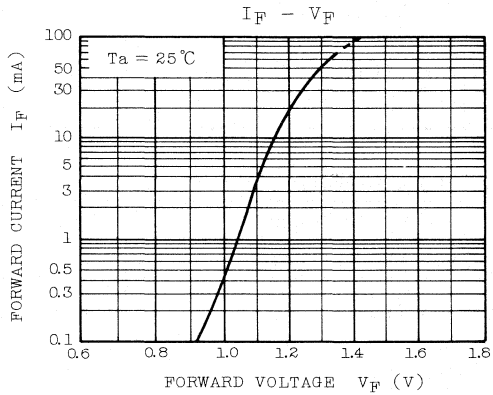
$I_{T(RMS)}$ – Ta



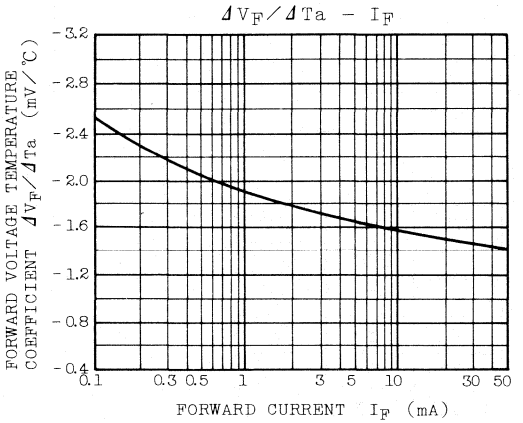
I_{FP} – D_R



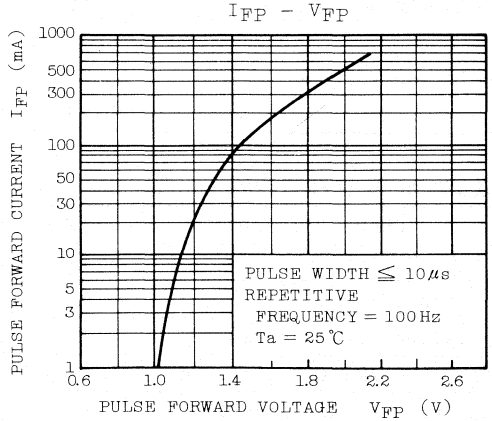
I_F – V_F



$\Delta V_F / \Delta Ta$ – I_F



I_{FP} – V_{FP}



OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
SOLID STATE RELAY.
SWITCHING POWER SUPPLY.

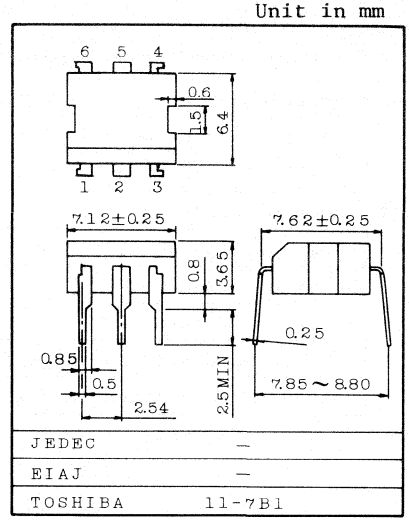
The TOSHIBA TLP647J consists of a photo-thyristor optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.

- Peak Off-State Voltage : 600V Min.
- Trigger LED Current : 15mA Max.
- On-State Current : 150mA Max.
- Isolation Voltage : 4000V_{rms} Min.
- Guaranteed Requirements of IEC380/VDE0806
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.2mm Min.
- Isolation Clearance : 7.6mm Min.
- Internal Creepage Path : 4.0mm Min.
- Isolation Operating Voltage
  : 500V_{ac} or 600V_{dc} for Isolation Group C*1
- Creeping Current Resistance : Group I*2
- VDE Approved : Certificate No.39408

*1 : According to VDE0110, table 4

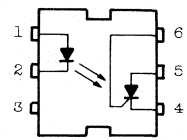
*2 : According to VDE0110, table 3

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-7B1

PIN CONFIGURATIONS (TOP VIEW)



1. ANODE
2. CATHODE
3. NC
4. CATHODE
5. ANODE
6. GATE

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	60	mA
	Forward Current Derating (Ta≧39°C)	$\Delta I_F/°C$	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)	I_{FP}	1	A
	Power Dissipation	P_D	100	mW
	Power Dissipation Derating (Ta≧25°C)	$\Delta P_D/°C$	-1.0	mW/°C
	Reverse Voltage	V_R	5	V
	Junction Temperature	T_j	125	°C
DETECTOR	Peak Forward Voltage (R_{GK}=27kΩ)	V_{DRM}	600	V
	Peak Reverse Voltage (R_{GK}=27kΩ)	V_{RRM}	600	V
	On-State Current	$I_{T(RMS)}$	150	mA
	On-State Current Derating (Ta≧25°C)	$\Delta I_T/°C$	-2.0	mA/°C
	Peak On-State Current (100μs pulse, 120pps)	I_{TP}	3	A
	Peak One Cycle Surge Current	I_{TSM}	2	A
	Peak Reverse Gate Voltage	V_{GM}	5	V
	Power Dissipation	P_D	150	mW
	Power Dissipation Derating (Ta≧25°C)	$\Delta P_D/°C$	-2.0	mW/°C
	Junction Temperature	T_j	100	°C
Storage Temperature Range		T_{stg}	-55 ~ 150	°C
Operating Temperature Range		T_{opr}	-55 ~ 100	°C
Lead Soldering Temperature (10 sec.)		T_{sold}	260	°C
Total Package Power Dissipation		P_T	250	mW
Total Package Power Dissipation Derating (Ta≧25°C)		$\Delta P_T/°C$	-3.3	mW/°C
Isolation Voltage (AC, 1 min., RH≦60%)		BV_S	4000	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA		1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V		-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz		-	30	-	pF
DETECTOR	Off-State Current	I_{DRM}	V_{AK}=600V	Ta=25°C	-	10	5000	nA
			R_{GK}=27kΩ	Ta=85°C	-	1	150	μA
	Reverse Current	I_{RRM}	V_{KA}=600V	Ta=25°C	-	10	5000	nA
			R_{GK}=27kΩ	Ta=85°C	-	1	150	μA
	On-State Voltage	V_{TM}	I_{TM}=100mA		-	0.9	1.3	V
	Holding Current	I_H	R_{GK}=27kΩ		-	0.2	-	mA
	Off-State dv/dt	dv/dt	V_{AK}=420V, R_{GK}=27kΩ		-	10	-	V/μs
	Capacitance	C_j	V=0, f=1MHz Anode to Gate		-	20	-	pF
			Gate to Cathode		-	350	-	

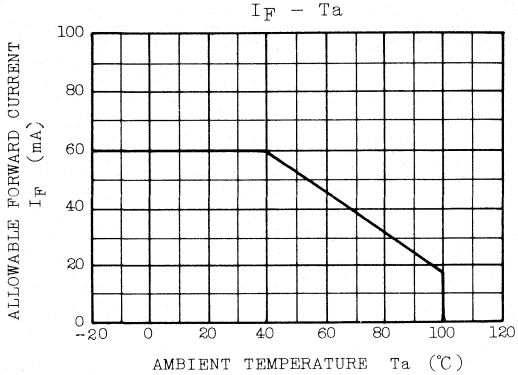
COUPLED CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_{AK}=6V, R_{GK}=27kΩ	-	-	15	mA
Turn-on Time	t_{on}	I_F=30mA, V_{AA}=50V R_{GK}=27kΩ	-	10	-	μs
Coupled dv/dt	dv/dt	V_S=500V, R_{GK}=27kΩ	500	-	-	V/μs
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	4000	-	-	V_{rms}
		AC, 1 second	-	10000	-	
		DC, 1 minute	-	10000	-	V_{dc}

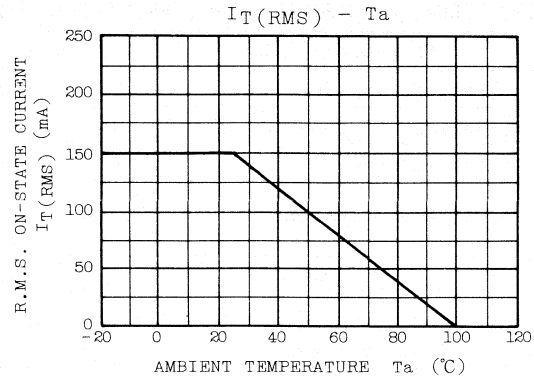
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	240	V_{ac}
Forward Current	I_F	20	-	25	mA
Operating Temperature	T_{opr}	-25	-	85	°C
Gate to Cathode Resistance	R_{GK}	-	10	27	kΩ
Gate to Cathode Capacity	C_{GK}	-	0.01	0.1	μF

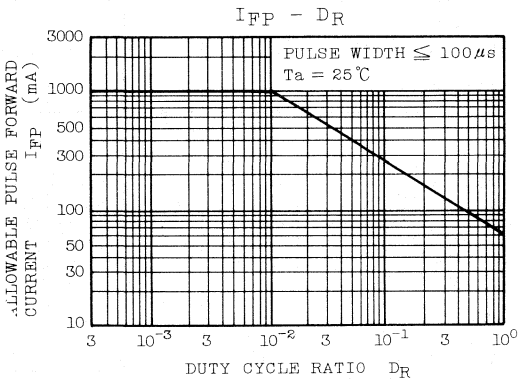
I_F – Ta



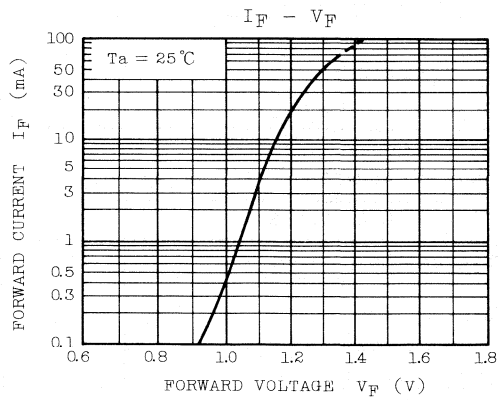
$I_{T(RMS)}$ – Ta



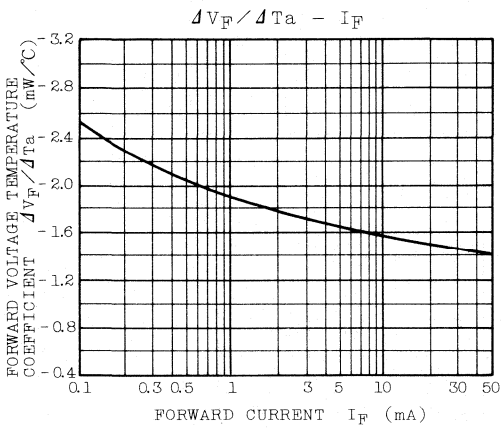
I_{FP} – D_R



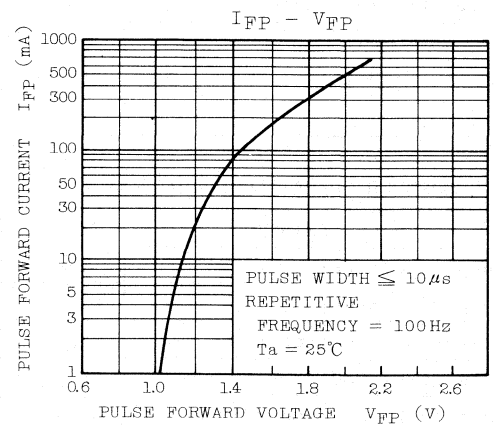
I_F – V_F



$\Delta V_F / \Delta Ta$ – I_F



I_{FP} – V_{FP}



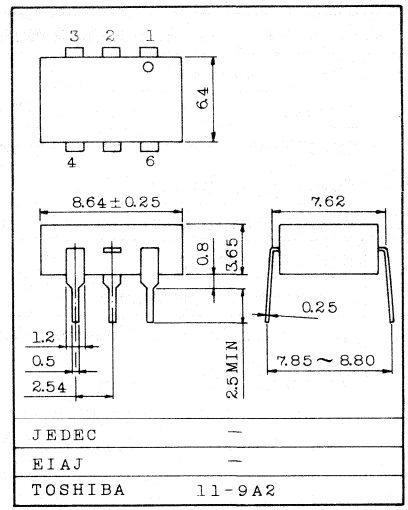
OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
TRIAC DRIVER.
SOLID STATE RELAY.

The TOSHIBA TLP665G consists of a photo-triac optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.

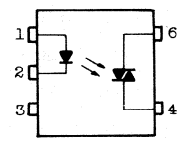
- Peak Off-State Voltage : 400V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 100mA Max.
- Isolation Voltage : 5000V_{rms} Min.
- Guaranteed Requirements of IEC380/VDE0806
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.0mm Min.
- Isolation Clearance : 7.3mm Min.
- Isolation Operating Voltage
  : 500V_{ac} or 600Vdc for Isolation Group C*1
- Creeping Current Resistance : Group I*2

*1 : According to VDE0110, table 4
*@ : According to VDE0110, table 3

Unit in mm



PIN CONFIGURATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: TERMINAL 1
6: TERMINAL 2

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current		I_F	50	mA
	Forward Current Derating (Ta≧53°C)		$\Delta I_F/°C$	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)		I_{FP}	1	A
	Power Dissipation		P_D	100	mW
	Power Dissipation Derating (Ta≧25°C)		$\Delta P_D/°C$	-1.0	mW/°C
	Reverse Voltage		V_R	5	V
	Junction Temperature		T_j	125	°C
DETECTOR	Off-State Output Terminal Voltage		V_{DRM}	400	V
	On-State RMS Current	Ta=25°C	$I_{T(RMS)}$	100	mA
		Ta=70°C		50	
	On-State Current Derating (Ta≧25°C)		$\Delta I_T/°C$	-1.1	mA/°C
	Peak On-State Current (100μs pulse, 120pps)		I_{TP}	2	A
	Peak Nonrepetitive Surge Current (P_W=10ms, DC=10%)		I_{TSM}	1.2	A
	Total Power Dissipation		P_D	300	mW
	Total Power Dissipation Derating (Ta≧25°C)		$\Delta P_D/°C$	-4.0	mW/°C
	Junction Temperature		T_j	100	°C
Storage Temperature Range			T_{stg}	-55~150	°C
Operating Temperature Range			T_{opr}	-40~100	°C
Lead Soldering Temperature (10 sec.)			T_{sold}	260	°C
Total Package Power Dissipation			P_T	330	mW
Total Package Power Dissipation Derating (Ta≧25°C)			$\Delta P_T/°C$	-4.4	mW/°C
Isolation Voltage (AC, 1 min., RH≦60%)			BV_S	5000	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	10	-	pF
DETECTOR	Peak Off-State Current	I_{DRM}	V_{DRM}=400V	-	10	100	nA
	Peak On-State Voltage	V_{TM}	I_{TM}=100mA	-	1.7	3.0	V
	Holding Current	I_H	-	-	0.2	-	mA
	Critical Rate of Rise of Off-State Voltage	dv/dt	V_{in}=120V_{rms}, Ta=85°C (Fig.1)	200	500	-	V/μs
	Critical Rate of Rise of Commutating Voltage	dv/dt(c)	I_T=15mA, V_{in}=30V_{rms} (Fig.1)	-	0.2	-	V/μs

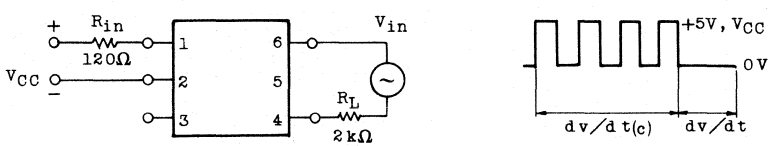
COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_T=3V	-	5	10	mA
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	5000	-	-	V_{rms}
		AC, 1 second	-	10000	-	
		DC, 1 minute	-	10000	-	Vdc

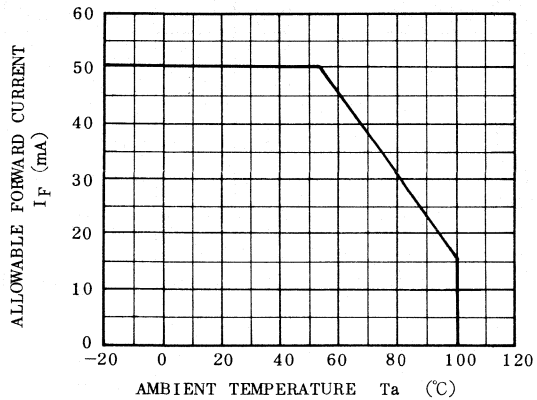
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	120	Vac
Forward Current	I_F	15	20	25	mA
Peak On-State Current	I_{TP}	-	-	1	A
Operating Temperature	T_{opr}	-25	-	85	°C

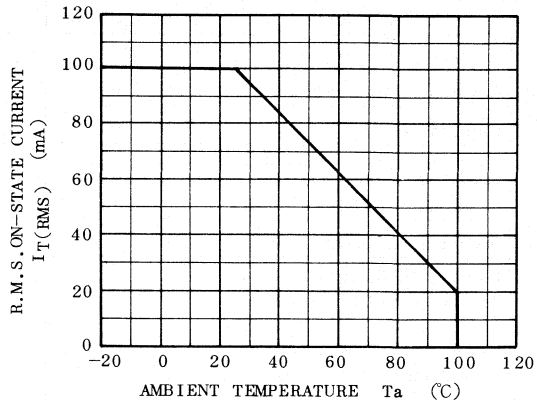
Fig. 1 dv/dt TEST CIRCUIT



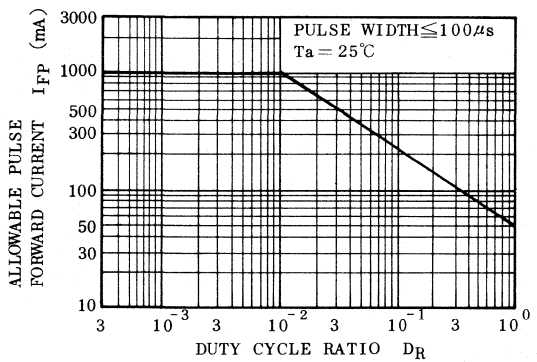
I_F – Ta



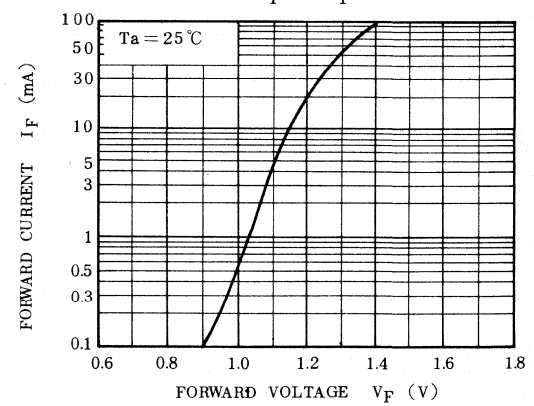
$I_{T(RMS)}$ – Ta



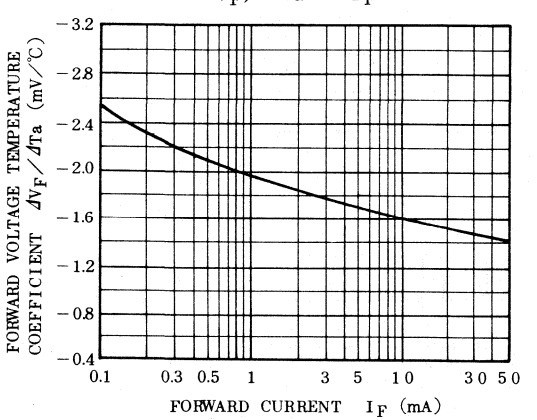
I_{FP} – D_R



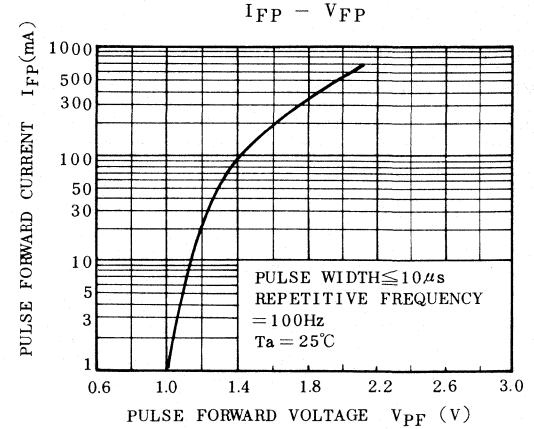
I_F – V_F



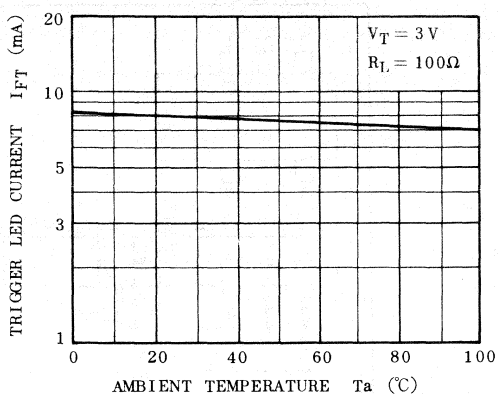
$\Delta V_F / \Delta Ta$ – I_F



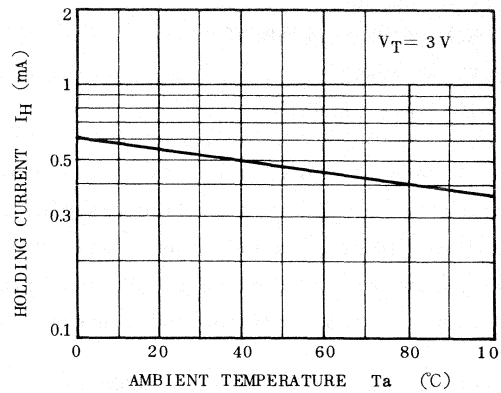
I_{FP} – V_{FP}



I_{FT} – Ta


TRIGGER LED CURRENT I_{FT} (mA)
20
10
5
3
1
0
20
40
60
80
100
AMBIENT TEMPERATURE Ta (℃)
V_T = 3 V
R_L = 100Ω

I_H – Ta


HOLDING CURRENT I_H (mA)
2
1
0.5
0.3
0.1
0
20
40
60
80
100
AMBIENT TEMPERATURE Ta (℃)
V_T = 3 V

TLP665GF

GaAs IRED & PHOTO-TRIAC

OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
TRIAC DRIVER.
SOLID STATE RELAY.

The TOSHIBA TLP665GF consists of a photo-triac optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package. All parameters are tested to the specification of TLP665G. (both condition and limits)

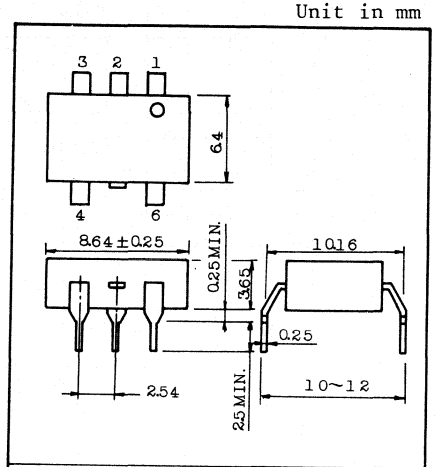
- Peak Off-State Voltage : 400V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 100mA Max.
- Isolation Voltage : 5000Vrms Min.
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.0mm Min.
- Isolation Clearance : 8.0mm Min.
- Isolation Operating Voltage
  : $500V_{ac}$ or $600V_{dc}$ for Isolation Group C*1
- Creeping Current Resistance : Group I*2
- Guaranteed Requirements of Safety Standards as Follows:

  DIN 57 883/VDE0883/6.80
  DIN 57 804/VDE0804/1.83
  DIN IEC65/VDE0860/8.81
  DIN IEC380/VDE0806/8.81
  DIN IEC435/VDE0805/Draft Nov.84
  DIN IEC601T1/VDE0750T1/5.82

*1 : According to VDE0110, table 4

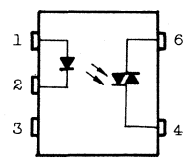
*2 : According to VDE0110, table 3

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-9A202

PIN CONFIGURATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: TERMINAL 1
6: TERMINAL 2

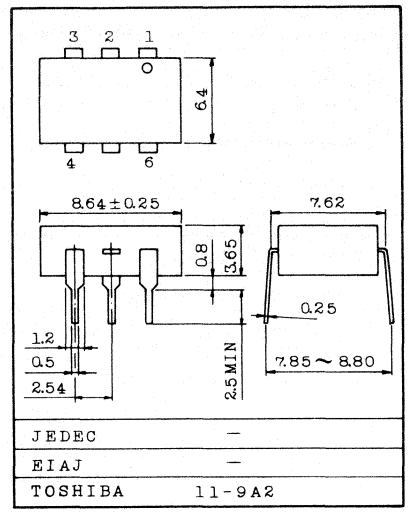
OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
TRIAC DRIVER.
SOLID STATE RELAY.

The TOSHIBA TLP665J consists of a photo-triac optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP packge.

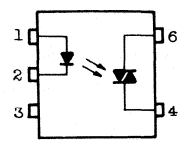
- Peak Off-State Voltage : 600V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 100mA Max.
- Isolation Voltage : 5000V_{rms} Min.
- Guaranteed Requirements of IEC380/VDE0806
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.0mm Min.
- Isolation Clearance : 7.3mm Min.
- Isolation Operating Voltage
  : 500V_{ac} or 600V_{dc} for Isolation Group C*1
- Creeping Current Resistance : Group I*2

*1 : According to VDE0110, table 4
*2 : According to VDE0110, table 3

Unit in mm



PIN CONFIGURATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: TERMINAL 1
6: TERMINAL 2

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current		I_F	50	mA
	Forward Current Derating (Ta≧53°C)		$\Delta I_F/°C$	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)		I_{FP}	1	A
	Power Dissipation		P_D	100	mW
	Power Dissipation Derating (Ta≧25°C)		$\Delta P_D/°C$	-1.0	mW/°C
	Reverse Voltage		V_R	5	V
	Junction Temperature		T_j	125	°C
DETECTOR	Off-State Output Terminal Voltage		V_{DRM}	600	V
	On-State RMS Current	Ta=25°C	$I_{T(RMS)}$	100	mA
		Ta=70°C		50	
	On-State Current Derating (Ta≧25°C)		$\Delta I_T/°C$	-1.1	mA/°C
	Peak On-State Current (100μs pulse, 120pps)		I_{TP}	2	A
	Peak Nonrepetitive Surge Current (P_W=10ms, DC=10%)		I_{TSM}	1.2	A
	Total Power Dissipation		P_D	300	mW
	Total Power Dissipation Derating (Ta≧25°C)		$\Delta P_D/°C$	-4.0	mW/°C
	Junction Temperature		T_j	100	°C
Storage Temperature Range			T_{stg}	-55~150	°C
Operating Temperature Range			Topr	-40~100	°C
Lead Soldering Temperature (10 sec.)			Tsold	260	°C
Total Package Power Dissipation			P_T	330	mW
Total Package Power Dissipation Derating (Ta≧25°C)			$\Delta P_T/°C$	-4.4	mW/°C
Isolation Voltage (AC, 1 min., RH≦60%)			BV_S	5000	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	10	-	pF
DETECTOR	Peak Off-State Current	I_{DRM}	V_{DRM}=600V	-	10	100	nA
	Peak On-State Voltage	V_{TM}	I_{TM}=100mA	-	1.7	3.0	V
	Holding Current	I_H	-	-	0.2	-	mA
	Critical Rate of Rise of Off-State Voltage	dv/dt	V_{in}=120V_{rms}, Ta=85°C (Fig.1)	-	500	-	V/μs
	Critical Rate of Rise of Commutating Voltage	dv/dt(c)	V_{in}=60V_{rms}, I_T=15mA (Fig.1)	-	0.2	-	V/μs

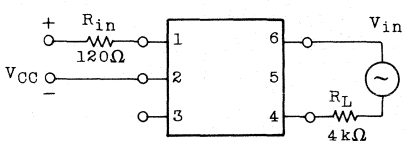
COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

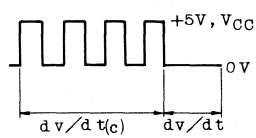
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_T=6V	-	5	10	mA
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	5000	-	-	V_{rms}
		AC, 1 second	-	10000	-	
		DC, 1 minute	-	10000	-	V_{dc}

RECOMMENDED OPERATING CONDITIONS

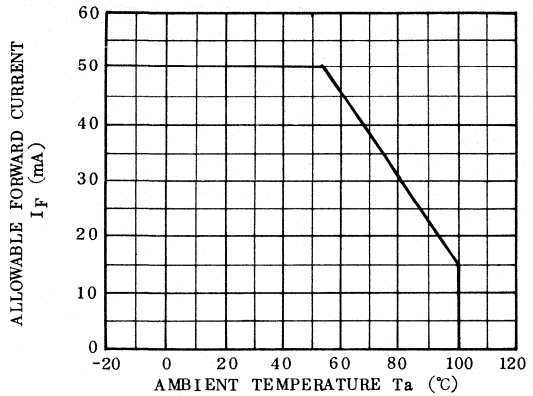
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	240	Vac
Forward Current	I_F	15	20	25	mA
Peak On-State Current	I_{TP}	-	-	1	A
Operating Temperature	T_{opr}	-25	-	85	°C

Fig. 1 dv/dt TEST CIRCUIT

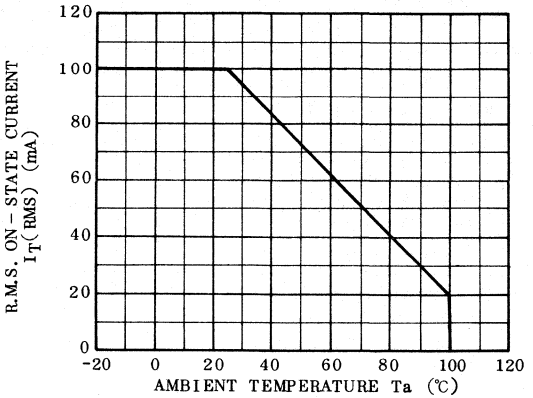




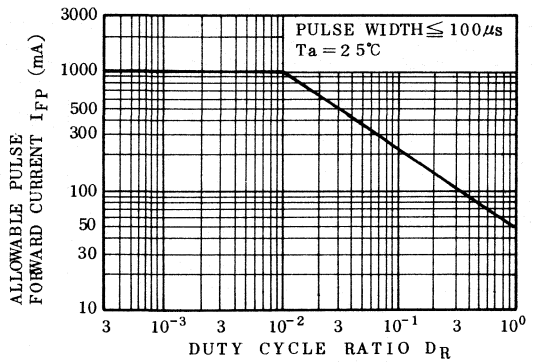
I_F — Ta



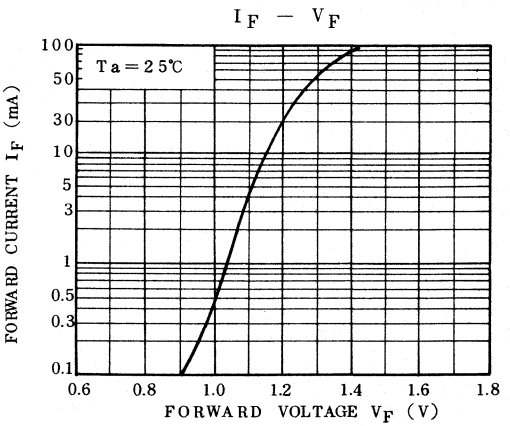
I_T (RMS) — Ta



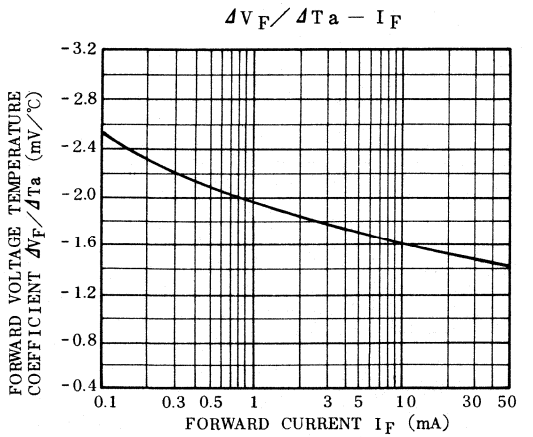
I_{FP} — D_R



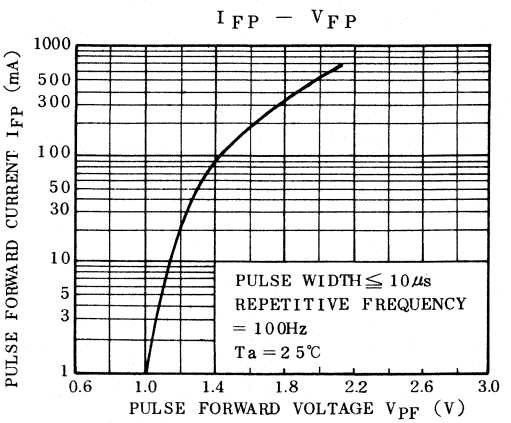
I_F — V_F



$\Delta V_F / \Delta Ta$ — I_F



I_{FP} — V_{FP}



OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
TRIAC DRIVER.
SOLID STATE RELAY.

The TOSHIBA TLP665JF consists of a photo-triac optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package. All parameters are tested to the specification of TLP665J. (both condition and limits)

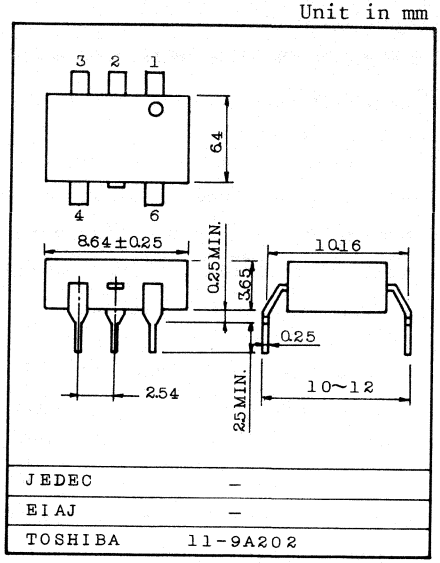
- Peak Off-State Voltage : 600V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 100mA Max.
- Isolation Voltage : 5000V_{rms} Min.
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.0mm Min.
- Isolation Clearance : 8.0mm Min.
- Isolation Operating Voltage
  : 500V_{ac} or 600V_{dc} for Isolation Group C*1
- Creeping Current Resistance : Group I*2
- Guaranteed Requirements of Safety Standards as Follows:

  DIN 57 883/VDE0883/6.80
  DIN 57 804/VDE0804/1.83
  DIN IEC65/VDE0860/8.81
  DIN IEC380/VDE0806/8.81
  DIN IEC435/VDE0805/Draft Nov.84
  DIN IEC601T1/VDE0750T1/5.82

*1 : According to VDE0110, table 4

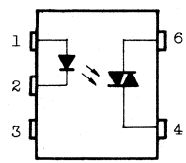
*2 : According to VDE0110, table 3

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-9A202

PIN CONFIGURATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: TERMINAL 1
6: TERMINAL 2

TLP666G

GaAs IRED & PHOTO-TRIAC

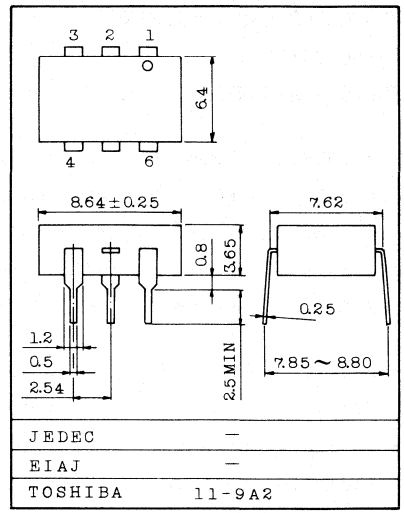
OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
TRIAC DRIVER.
SOLID STATE RELAY.

The TOSHIBA TLP666G consists of a zero voltage crossing turn-on photo-triac optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.

- Peak Off-State Voltage : 400V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 100mA Max.
- Isolation Voltage : 5000V_{rms} Min.
- Guaranteed Requirements of IEC380/VDE0806
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.0mm Min.
- Isolation Clearance : 7.3mm Min.
- Isolation Operating Voltage
  : 500V_{ac} or 600V_{dc} for Isolation Group C*1
- Creeping Current Resistance : Group I*2

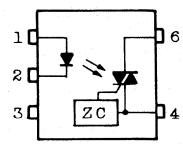
*1 : According to VDE0110, table 4
*2 : According to VDE0110, table 3

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-9A2

PIN CONFIGURATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: TERMINAL 1
6: TERMINAL 2

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current		I_F	50	mA
	Forward Current Derating (Ta≧53°C)		$\Delta I_F/°C$	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)		I_{FP}	1	A
	Power Dissipation		P_D	100	mW
	Power Dissipation Derating (Ta≧25°C)		$\Delta P_D/°C$	-1.0	mW/°C
	Reverse Voltage		V_R	5	V
	Junction Temperature		T_j	125	°C
DETECTOR	Off-State Output Terminal Voltage		V_{DRM}	400	V
	On-State RMS Current	Ta=25°C	$I_{T(RMS)}$	100	mA
		Ta=70°C		50	
	On-State Current Derating (Ta≧25°C)		$\Delta I_T/°C$	-1.1	mA/°C
	Peak On-State Current (100μs pulse, 120pps)		I_{TP}	2	A
	Peak Nonrepetitive Surge Current (P_W=10ms, DC=10%)		I_{TSM}	1.2	A
	Power Dissipation		P_D	300	mW
	Power Dissipation Derating (Ta≧25°C)		$\Delta P_D/°C$	-4.0	mW/°C
	Junction Temperature		T_j	100	°C
Storage Temperature Range			T_{stg}	-55~150	°C
Operating Temperature Range			T_{opr}	-40~100	°C
Lead Soldering Temperature (10 sec.)			T_{sold}	260	°C
Total Package Power Dissipation			P_T	330	mW
Total Package Power Dissipation Derating (Ta≧25°C)			$\Delta P_T/°C$	-4.4	mW/°C
Isolation Voltage (AC, 1 min., RH≦60%)			BVS	5000	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	10	-	pF
DETECTOR	Peak Off-State Current	I_{DRM}	V_{DRM}=400V	-	10	100	nA
	Peak On-State Voltage	V_{TM}	I_{TM}=100mA	-	1.7	3.0	V
	Holding Current	I_H	-	-	0.2	-	mA
	Critical Rate of Rise of Off-State Voltage	dv/dt	V_{in}=120Vrms, Ta=85°C (Fig.1)	200	500	-	V/μs
	Critical Rate of Rise of Commutating Voltage	dv/dt(c)	V_{in}=30Vrms, I_T=15mA (Fig.1)	-	0.2	-	V/μs

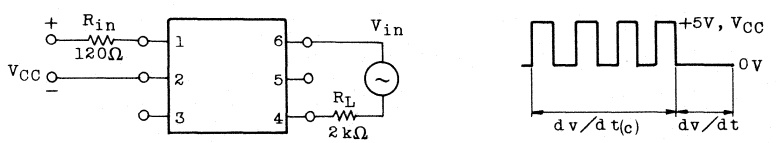
COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_T=3V	-	5	10	mA
Inhibit Voltage	V_{IH}	I_F=Rated I_{FT}	-	-	40	V
Leakage in Inhibited State	I_{IH}	I_F=Rated I_{FT} V_T=Rated V_{DRM}	-	100	300	μA
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	5000	-	-	Vrms
		AC, 1 second	-	10000	-	
		DC, 1 minute	-	10000	-	Vdc

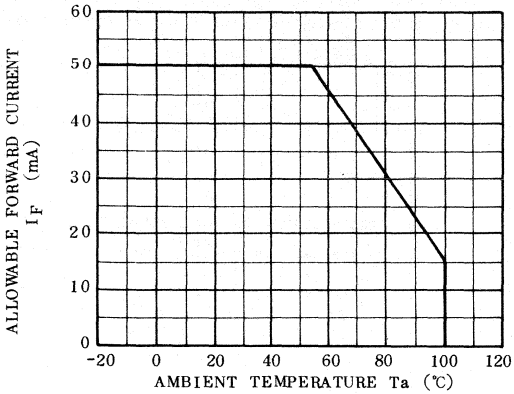
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	120	Vac
Forward Current	I_F	15	20	25	mA
Peak On-State Current	I_{TP}	-	-	1	A
Operating Temperature	Topr	-25	-	85	°C

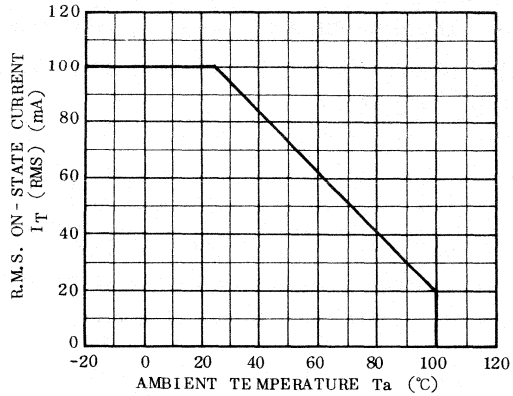
Fig. 1 dv/dt TEST CIRCUIT



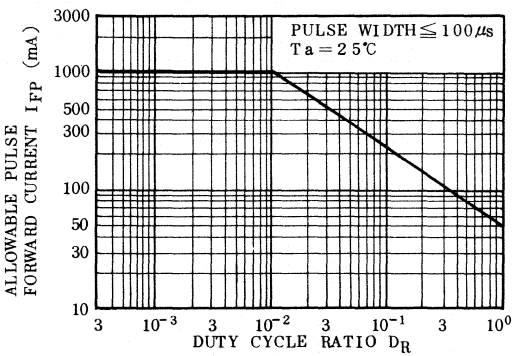
I_F — Ta



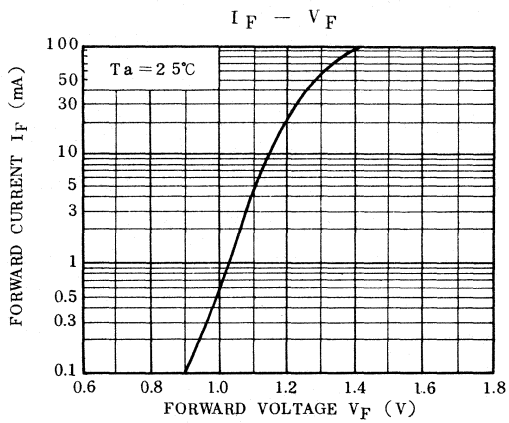
I_T(RMS) — Ta



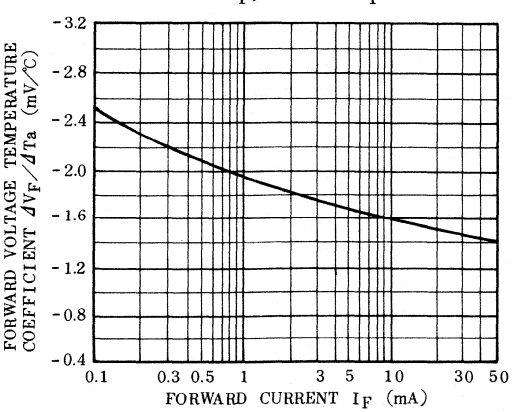
I_{FP} — D_R



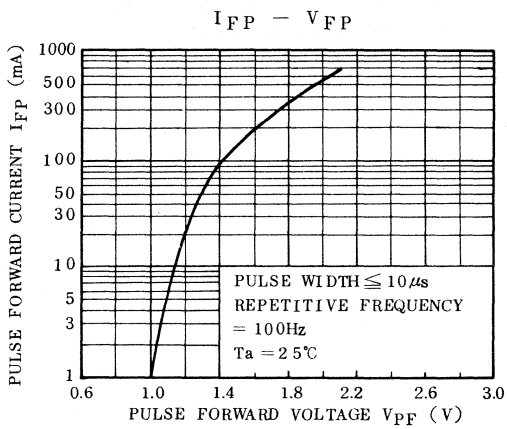
I_F — V_F



$\Delta V_F / \Delta Ta$ — I_F



I_{FP} — V_{FP}



TLP666GF

GaAs IRED & PHOTO-TRIAC

OFFICE MACHINE
HOUSEHOLD USE EQUIPMENT
TRIAC DRIVER
SOLID STATE RELAY

The TOSHIBA TLP666FG consists of a photo-triac optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package. All parameters are tested to the specification of TLP666G. (both condition and limits)

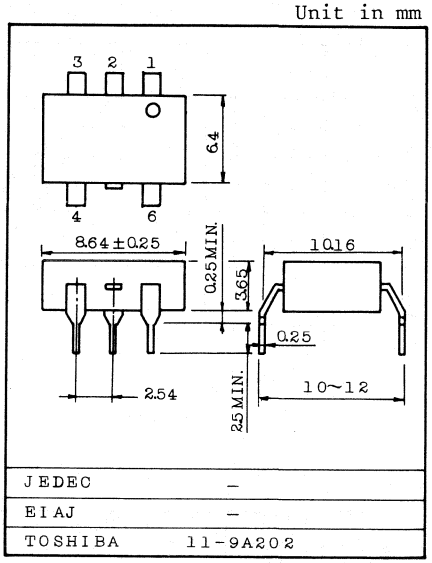
- Peak Off-State Voltage : 400V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 100mA Max.
- Isolation Voltage : $5000V_{rms}$ Min.
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.0mm Min.
- Isolation Clearance : 8.0mm Min.
- Isolation Operating Voltage
  : $500V_{ac}$ or $600V_{dc}$ for Isolation Group C*1
- Creeping Current Resistance : Group I*2
- Guaranteed Requirements of Safety Standards as Follows:

  DIN 57 883/VDE0883/6.80
  DIN 57 804/VDE0804/1.83
  DIN IEC65/VDE0860/8.81
  DIN IEC380/VDE0806/8.81
  DIN IEC435/VDE0805/Draft Nov.84
  DIN IEC601T1/VDE0750T1/5.82

*1 : According to VDE0110, table 4

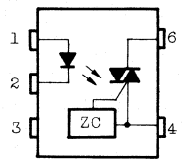
*2 : According to VDE0110, table 3

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-9A202

PIN CONFIGURATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: TERMINAL 1
6: TERMINAL 2

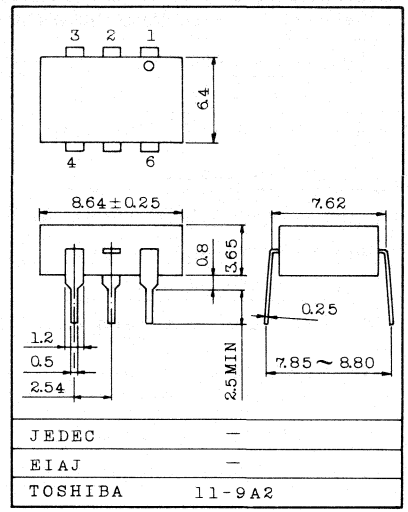
OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
TRIAC DRIVER.
SOLID STATE RELAY.

The TOSHIBA TLP666J consists of a zero voltage crossing turn-on photo-triac optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.

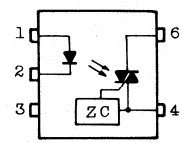
- Peak Off-State Voltage : 600V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 100mA Max.
- Isolation Voltage : 5000V_{rms} Min.
- Guaranteed Requirements of IEC380/VDE0806
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.0mm Min.
- Isolation Clearance : 7.3mm Min.
- Isolation Operating Voltage
  : 500V_{ac} or 600V_{dc} for Isolation Group C*1
- Creeping Current Resistance : Group I*2

*1 : According to VDE0110, table 4
*2 : According to VDE0110, table 3

Unit in mm



PIN CONFIGURATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: TERMINAL 1
6: TERMINAL 2

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current		I_F	50	mA
	Forward Current Derating (Ta≧53°C)		ΔI_F/°C	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)		I_{FP}	1	A
	Power Dissipation		P_D	100	mW
	Power Dissipation Derating (Ta≧25°C)		ΔP_D/°C	-1.0	mW/°C
	Reverse Voltage		V_R	5	V
	Junction Temperature		T_j	125	°C
DETECTOR	Off-State Output Terminal Voltage		V_{DRM}	600	V
	On-State RMS Current	Ta=25°C	$I_{T(RMS)}$	100	mA
		Ta=70°C		50	
	On-State Current Derating (Ta≧25°C)		ΔI_T/°C	-1.1	mA/°C
	Peak On-State Current (100μs pulse, 120pps)		I_{TP}	2	A
	Peak Nonrepetitive Surge Current (P_W=10ms, DC=10%)		I_{TSM}	1.2	A
	Power Dissipation		P_D	300	mW
	Power Dissipation Derating (Ta≧25°C)		ΔP_D/°C	-4.0	mW/°C
	Junction Temperature		T_j	100	°C
Storage Temperature Range			T_{stg}	-55~150	°C
Operating Temperature Range			Topr	-40~100	°C
Lead Soldering Temperature (10 sec.)			T_{sold}	260	°C
Total Package Power Dissipation			P_T	330	mW
Total Package Power Dissipation Derating (Ta≧25°C)			ΔP_T/°C	-4.4	mW/°C
Isolation Voltage (AC, 1 min., RH≦60%)			BV_S	5000	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	10	-	pF
DETECTOR	Peak Off-State Current	I_{DRM}	V_{DRM}=400V	-	10	100	nA
	Peak On-State Voltage	V_{TM}	I_{TM}=100mA	-	1.7	3.0	V
	Holding Current	I_H	-	-	0.2	-	mA
	Critical Rate of Rise of Off-State Voltage	dv/dt	V_{in}=240V_{rms}, Ta=85°C (Fig.1)	200	500	-	V/μs
	Critical Rate of Rise of Commutating Voltage	dv/dt(c)	V_{in}=60V_{rms}, I_T=15mA (Fig.1)	-	0.2	-	V/μs

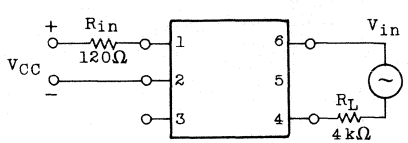
COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

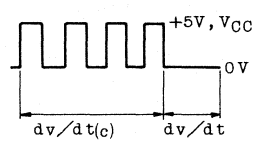
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Trigger LED Current	I_{FT}	V_T=6V	-	5	10	mA
Inhibit Voltage	V_{IH}	I_F=Rated I_{FT}	-	-	50	V
Leakage in Inhibited State	I_{IH}	I_F=Rated I_{FT} V_T=Rated V_{DRM}	-	100	300	μA
Capacitacne(Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	5000	-	-	V_{rms}
		AC, 1 second	-	10000	-	
		DC, 1 minute	-	10000	-	Vdc

RECOMMENDED OPERATING CONDITIONS

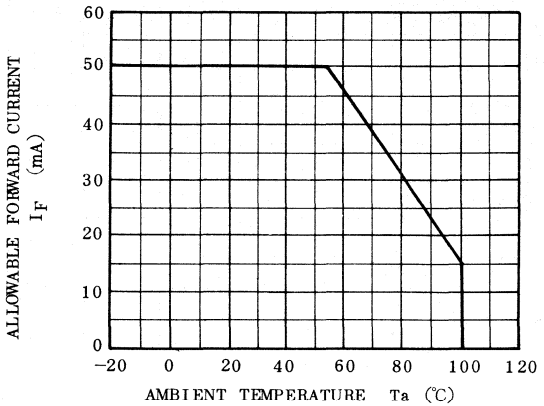
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	240	Vac
Forward Current	I_F	15	20	25	mA
Peak On-State Current	I_{TP}	-	-	1	A
Operating Temperature	T_{opr}	-25	-	85	°C

Fig. 1 dv/dt TEST CIRCUIT

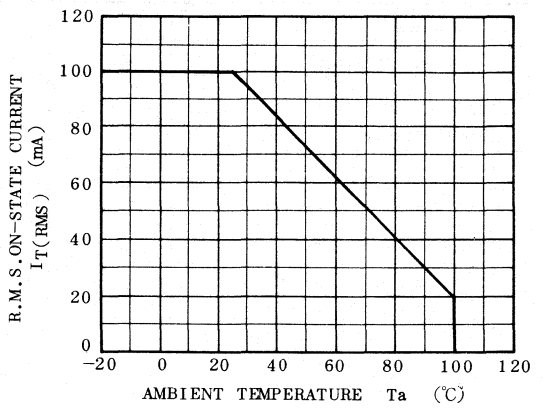




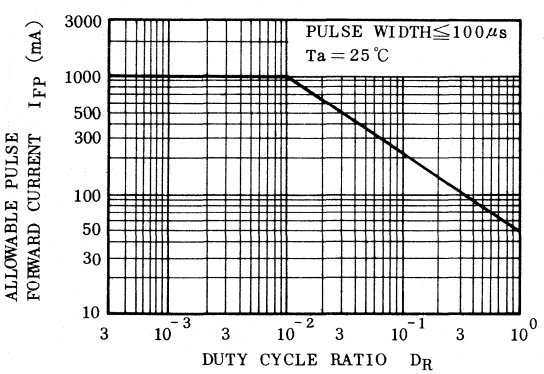
I_F – Ta



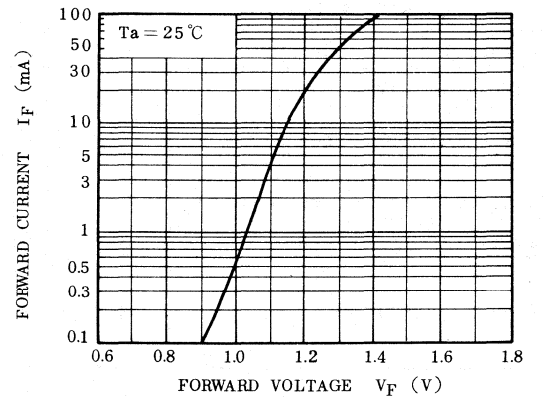
$I_{T(RMS)}$ – Ta



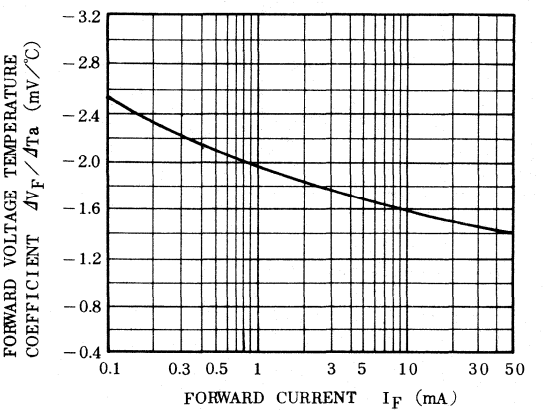
I_{FP} – D_R



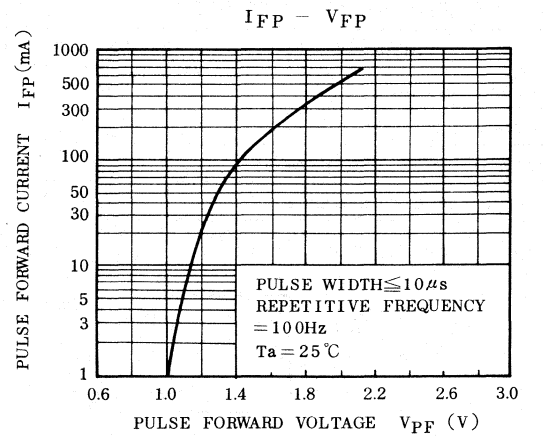
I_F – V_F



$\Delta V_F / \Delta Ta$ – I_F



I_{FP} – V_{FP}



OFFICE MACHINE

HOUSEHOLD USE EQUIPMENT

TRIAC DRIVER

SOLID STATE RELAY

The TOSHIBA TLP666JF consists of a photo-triac optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package. All parameters are tested to the specification of TLP666J. (both condition and limits)

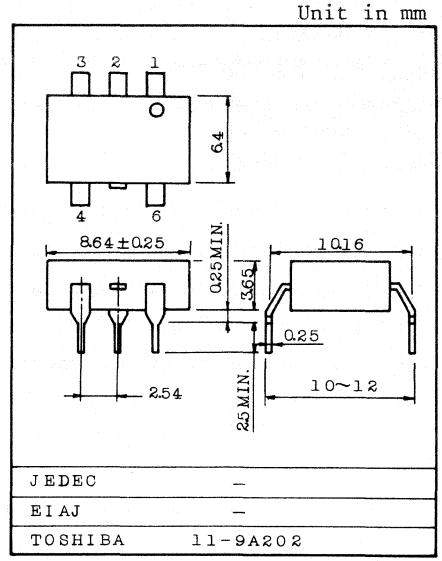
- Peak Off-State Voltage : 600V Min.
- Trigger LED Current : 10mA Max.
- On-State Current : 100mA Max.
- Isolation Voltage : 5000V_{rms} Min.
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.0mm Min.
- Isolation Clearance : 8.0mm Min.
- Isolation Operating Voltage
  : 500V_{ac} or 600V_{dc} for Isolation Group C*1
- Creeping Current Resistance : Group I*2
- Guaranteed Requirements of Safety Standards as Follows:

  DIN 57 883/VDE0883/6.80
  DIN 57 804/VDE0804/1.83
  DIN IEC65/VDE0860/8.81
  DIN IEC380/VDE0806/8.81
  DIN IEC435/VDE0805/Draft Nov.84
  DIN IEC601T1/VDE0750T1/5.82

*1 : According to VDE0110, table 4

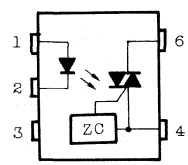
*2 : According to VDE0110, table 3

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-9A202

PIN CONFIGURATIONS (TOP VIEW)



1: ANODE
2: CATHODE
3: NC
4: TERMINAL 1
6: TERMINAL 2

TLP675, TLP676

GaAs IRED & PHOTO-TRANSISTOR

OFFICE MACHINE.

HOUSEHOLD USE EQUIPMENT.

PROGRAMMABLE CONTROLLERS
AC/DC-INPUT MODULE
SOLID STATE RELAY

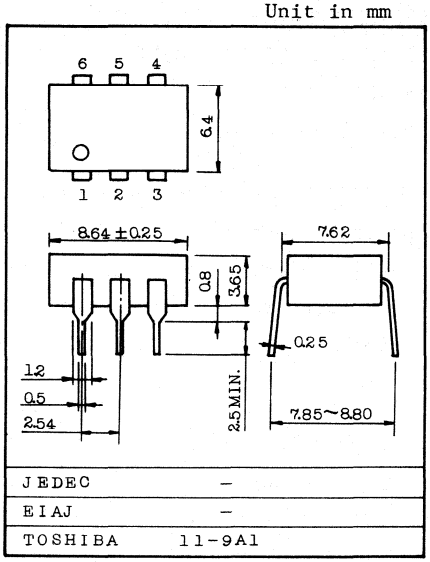
The TOSHIBA TLP675 and TLP676 consists of a darlington connected photo-transistor optically coupled to a gallium arsenide infrared emitting diode in a six lead plastic DIP package.
TLP676 is no-base internal connection for high-EMI environments.

- Collector-Emitter Voltape: 35V Min.
- Current Transfer Ratio : 500% Min.
- Isolation Voltage : 5000V_{rms} Min.
- Guranteed Requirements of IEC380/VDE0806

- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8,0mm Min.
- Isolation Clearance : 7.3mm Min.
- Isolation Operating Voltage
  : 500V_{ac} or 600V_{dc} for Isolation Group C*1
- Creeping Current Resistance : Group I*2

* 1 : According to VDE0110, table 4
* 2 : According to VDE0110, table 3

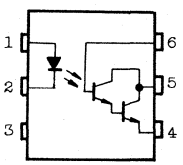
Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-9A1

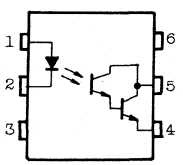
PIN COFIGURATIONS (TOP VIEW)

TLP675



1: ANODE
2: CATHODE
3: NC
4: EMITTER
5: COLLECTOR
6: BASE

TLP676



1: ANODE
2: CATHODE
3: NC
4: EMITTER
5: COLLECTOR
6: NC

MAXIMUM RATINGS (Ta = 25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	60	mA
	Forward Current Derating (Ta ≧ 39°C)	ΔI_F/°C	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)	I_{FP}	1	A
	Power Dissipation	P_D	100	mW
	Power Dissipation Derating (Ta ≧ 25°C)	ΔP_D/°C	-1.0	mW/°C
	Reverse Voltage	V_R	5	V
	Junction Temperature	T_j	125	°C
DETECTOR	Collector-Emitter Voltage	V_{CEO}	35	V
	Collector-Base Voltage (TLP675)	V_{CBO}	60	V
	Emitter-Collector Voltage	V_{ECO}	7	V
	Emitter-Base Voltage (TLP675)	V_{EBO}	7	V
	Collector Current	I_C	50	mA
	Power Dissipation	P_C	150	mW
	Power Dissipation Derating (Ta ≧ 25°C)	ΔP_C/°C	-1.5	mW/°C
	Junction Temperature	T_j	125	°C
Storage Temperature Range		T_{stg}	-55 ∿ 150	°C
Operating Temperature Range		T_{opr}	-55 ∿ 100	°C
Lead Soldering Temperature (10 sec.)		T_{sold}	260	°C
Total Package Power Dissipation		P_T	250	mW
Total Package Power Dissipation Derating (Ta ≧ 25°C)		ΔP_T/°C	-2.5	mW/°C
Isolation Voltage (AC, 1 min, RH ≦ 6%)		BV_S	2500	V_{rms}

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta = 25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=1mA	35	-	-	V
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	7	-	-	
	Collector-Base Breakdown Voltage (TLP675)	$V_{(BR)CBO}$	I_C=0.1mA	60	-	-	
	Emitter-Base Breakdown Voltage (TLP675)	$V_{(BR)EBO}$	I_E=0.1mA	7	-	-	
	Collector Dark Current	I_{CEO}	V_{CE}=24V	-	10	200	nA
			V_{CE}=24V, Ta=85°C	-	-	300	μA
	Collector Dark Current (TLP675)	I_{CER}	V_{CE}=24V, Ta=85°C R_{BE}=10MΩ	-	0.5	10	μA
	Collector Dark Current (TLP675)	I_{CBO}	V_{CB}=10V	-	0.01	-	nA
	DC Forward Current Gain (TLP675)	h_{FE}	V_{CE}=5V, I_C=10mA	-	50K	-	-
	Capacitance (Collecter to Emitter)	C_{CE}	V=0, f=1MHz	-	10	-	pF

COUPLED ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Current Transfer Ratio	I_C/I_F	I_F=1mA, V_{CE}=1V	500	2000	-	%
Saturated CTR	I_C/I_F(sat)	I_F=10mA, V_{CE}=1V	500	-	-	
Base Photo-Current (TLP675)	I_{PB}	I_F=1mA, V_{CB}=1V	-	2	-	μA
Collector-Emitter Saturation Voltage	V_{CE}(sat)	I_C= 5mA, I_F=1mA	-	-	1.0	V
		I_C=50mA, I_F=10mA	-	-	-	

ISOLATION CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Capacitance (Input to Output)	C_S	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	R_S	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BV_S	AC, 1 minute	2500	-	-	Vrms
		AC, 1 second	-	5000	-	
		DC, 1 minute	-	5000	-	Vdc

SWITCHING CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Rise Time	t_r	V_{CC}=10V, I_C=10mA, R_L=100Ω	-	40	-	μs
Fall Time	t_f		-	30	-	
Turn-on Time	t_{ON}		-	45	-	
Turn-off Time	t_{OFF}		-	35	-	
Turn-on Time	t_{ON}	R_L=180Ω (Fig.1), R_{BE}=OPEN, V_{CC}=10V, I_F=10mA	-	5	-	μs
Storage Time	t_S		-	20	-	
Turn-off Time	t_{OFF}		-	100	-	
Turn-on Time	t_{ON}	R_L=180Ω (Fig.1), R_{BE}=10M (TLP675), V_{CC}=10V, I_F=10mA	-	5	-	μs
Storage Time	t_S		-	15	-	
Turn-off Time	t_{OFF}		-	60	-	

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	-	5	24	V
Forward Current	I_F	-	16	25	mA
Collector Current	I_C	-	-	50	mA
Operating Temperature	T_{opr}	-25	-	85	°C

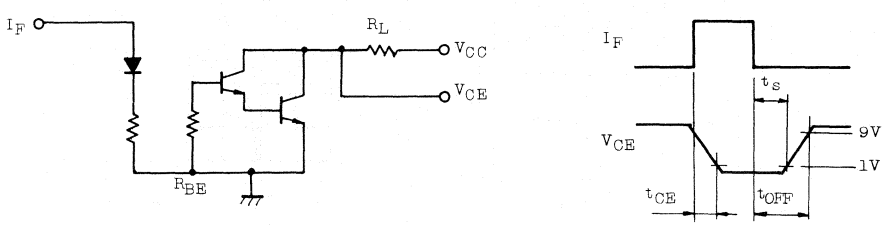
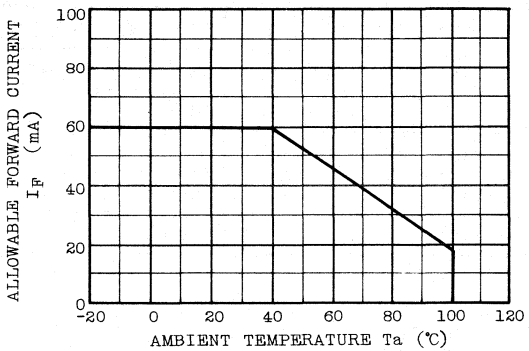
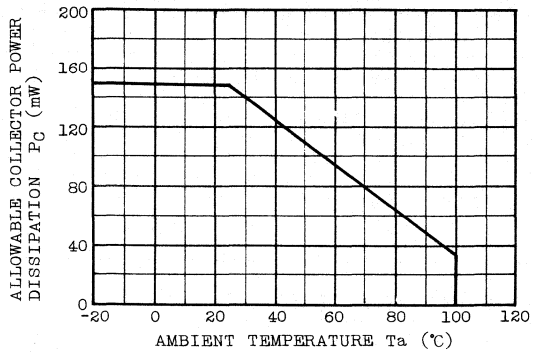


Fig.1 Switching Time Test Circuit

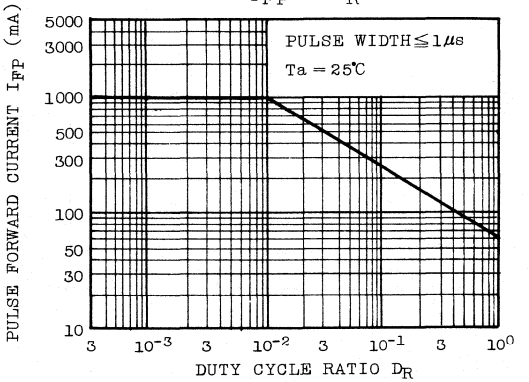
I_F — Ta



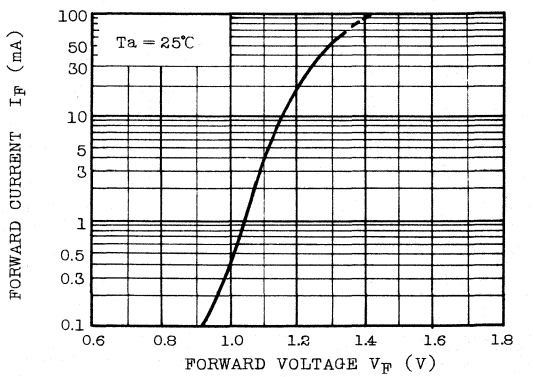
P_C — Ta



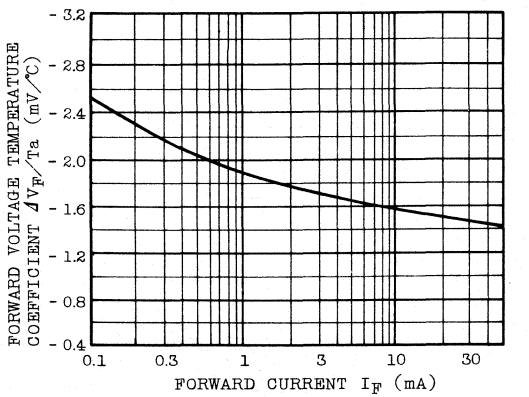
I_{FP} — D_R



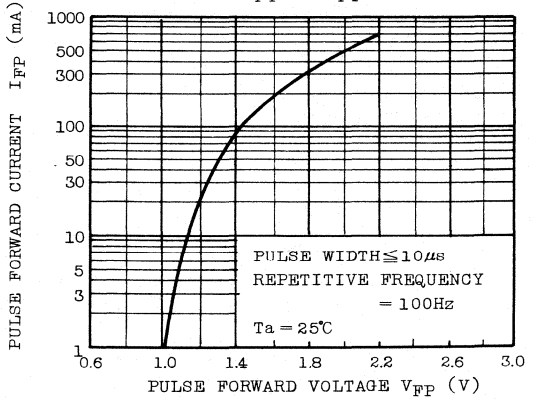
I_F — V_F



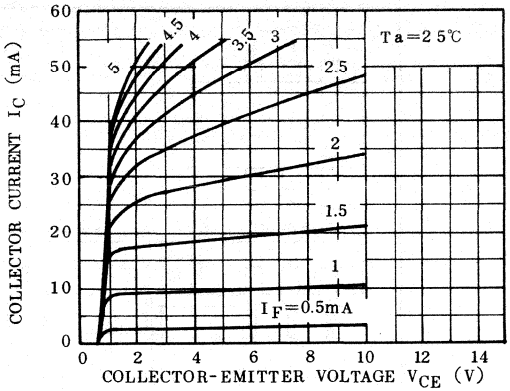
$\Delta V_F / \Delta Ta$ — I_F



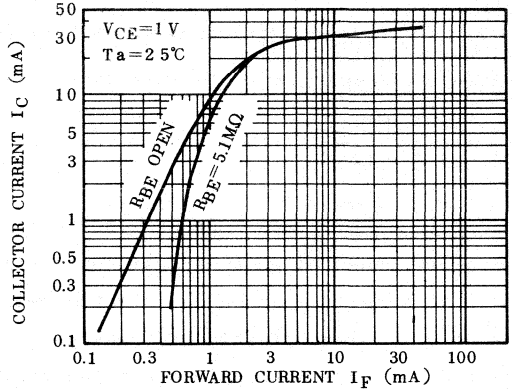
I_{FP} — V_{FP}



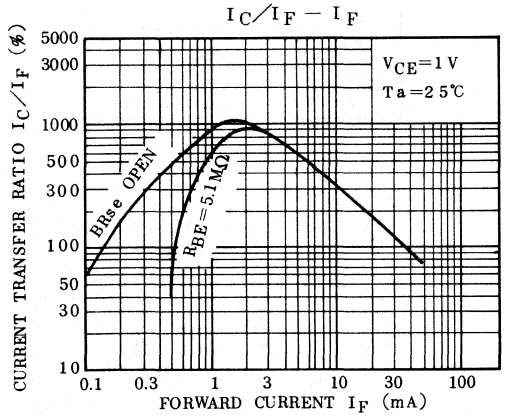
$I_C - V_{CE}$



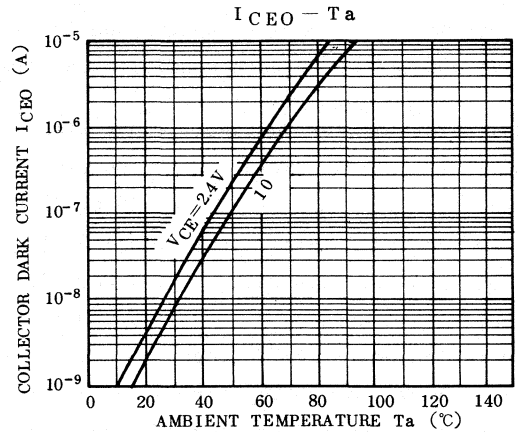
$I_C - I_F$



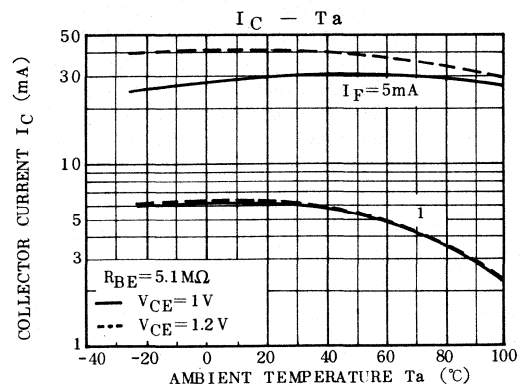
$I_C/I_F - I_F$



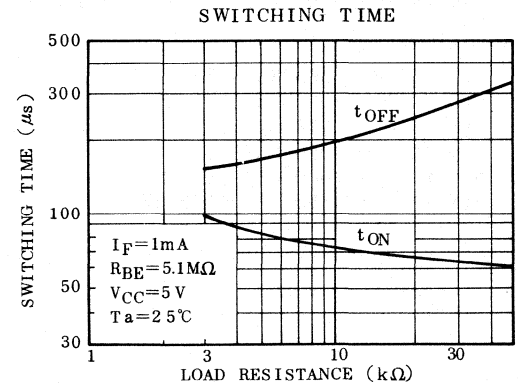
$I_{CEO} - Ta$



$I_C - Ta$



SWITCHING TIME



TLP675F, TLP676F

GaAs IRED & PHOTO-TRANSISTOR

OFFICE MACHINE.
HOUSEHOLD USE EQUIPMENT.
PROGRAMMABLE CONTROLLERS.
AC/DC-INPUT MODULE.
SOLID STATE RELAY.

The TOSHIBA TLP675F and TLP676F consist of a darlington connected photo-transistor optically coupled to a gallium arsenide infrared emitting diode in a sic lead plastic DIP package.
TLP676F is no-base internal connection for high-EMI environments.
All parameters are tested to the specification of TLP675 and TLP676. (both condition and limits)

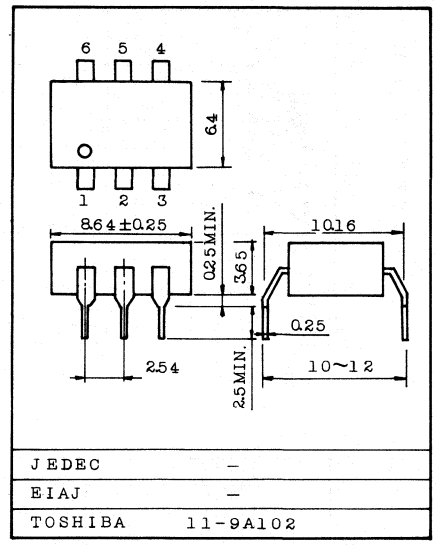
- Collector-Emitter Voltage : 35V Min.
- Current Transfer Ratio : 500 Min.
- Isolation Voltage : 5000V_{rms} Min.
- Climatic Test Class : 5/150/21
- Isolation Creepage Path : 8.0mm Min.
- Isolation Clearance : 8.0 Min.
- Isolation Operating Voltage
  : 500V_{ac} or 600V_{dc} for Isolation Group C*1
- Creeping Current Resistance : Group I*2
- Guaranteed Requirements of Safety Standards as Follows:

  DIN 57 883/VDE0883/6.80
  DIN 57 804/VDE0804/1.83
  DIN IEC65/VDE0860/8.81
  DIN IEC380/VDE0806/8.81
  DIN IEC435/VDE0805/Draft Nov.84
  DIN IEC601T1/VDE0750T1/5.82

*1 : According to VDE0110, table 4

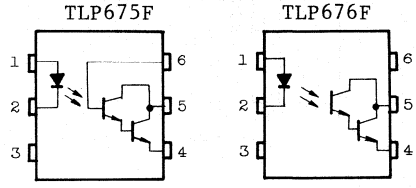
*2 : According to VDE0110, table 3

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-9A102

PIN CONFIGURATIONS (TOP VIEW)



TLP675F	TLP676F
1: ANODE	1: ANODE
2: CATHODE	2: CATHODE
3: NC	3: NC
4: EMITTER	4: EMITTER
5: COLLECTOR	5: COLLECTOR
6: BASE	6: NC

TLP677, TLP678

OFFICE MACHINE.

HOUSEHOLD USE EQUIPMENT.

SOLID STATE RELAY.

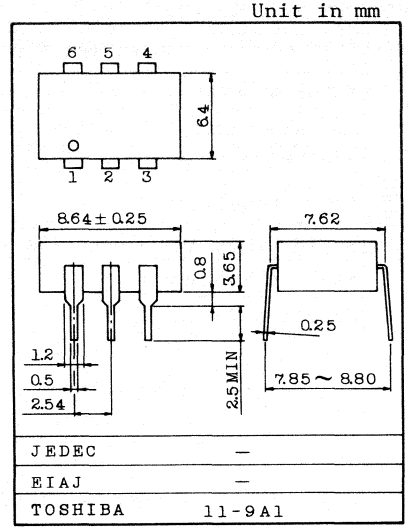
SWITCHING POWER SUPPLY.

The TOSHIBA TLP677 and TLP678 consist of a gallium arsenide infrared emitting diode optically coupled to a darlington connected photo-transistor which has an integral base-emitter resistor to optimize swiching speed and elevated temperature characteristics in a six lead plastic DIP package.
TLP678 is no-base internal connection for high-EMI environments.

Collector-Emitter Voltage :

CLASSIFICATION	COLLECTOR-EMITTER VOLTAGE (Min.)	MARKING OF CLASSIFICATION
Standard	300V	Blank
Rank V2	200V	Blank,V2
Rank V1	100V	Blank,V2,V1

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-9A1

- Current Transfer Ratio : 1000% Min.
- Isolation Voltage : 5000V_{rms} Min.
- Guaranteed Requirements of IEC380/VDE0806
- Climatic Test Class : 55/150/21
- Isolation Creepage Path : 8.0mm Min.
- Isolation Clearance : 7.3mm Min.
- Isolation Operating Voltage
  : 500V_{ac} ro 600V_{dc} for Isolation Group C*1
- Creeping Current Resistance : Group I*2

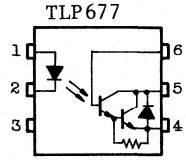
- Note: Application type name for certification test, please use standard product type name, i.e.
  TLP677(V2) : TLP677

*1 : According to VDE0110, table 4

*2 : According to VDE0110, table 3

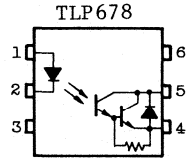
PIN CONFIGURATIONS (TOP VIEW)

TLP677



1: ANODE
2: CATHODE
3: NC
4: EMITTER
5: COLLECTOR
6: BASE

TLP678



1: ANODE
2: CATHODE
3: NC
4: EMITTER
5: COLLECTOR
6: NC

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current		I_F	60	mA
	Forward Current Derating (Ta≧39°C)		ΔI_F/°C	-0.7	mA/°C
	Peak Forward Current (100μs pulse, 100pps)		I_{FP}	1	A
	Power Dissipation		P_D	100	mW
	Power Dissipation Derating (Ta≧25°C)		ΔP_D/°C	-1.0	mW/°C
	Reverse Voltage		V_R	5	V
	Junction Temperature		Tj	125	°C
DETECTOR	Collector-Emitter Voltage	Rank V2	V_{CEO}	300	V
		Rank V1		200	
				100	
	Collector-Base Voltage (TLP677)	Rank V2	V_{CBO}	300	V
		Rank V1		200	
				100	
	Emitter-Collector Voltage		V_{ECO}	0.3	V
	Emitter-Base Voltage (TLP677)		V_{EBO}	7	V
	Collector Current		I_C	150	mA
	Power Dissipation		P_C	300	mW
	Power Dissipation Derating (Ta≧25°C)		ΔP_C/°C	-3.0	mW/°C
	Junction Temperature		Tj	125	°C
Storage Temperature Range			Tstg	-55~150	°C
Operating Temperature Range			Topr	-55~100	°C
Lead Soldering Temperature (10 sec.)			Tsold	260	°C
Total Package Power Dissipation			P_T	350	mW
Total Package Power Dissipation Derating (Ta≧25°C)			ΔP_T/°C	-3.5	mW/°C
Isolation Voltage (AC, 1 min., RH≦60%)			BVS	5000	Vrms

INDIVIDUAL ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=0.1mA Rank V2	300	-	-	V
			Rank V2	200	-	-	
			Rank V1	100	-	-	
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	0.3	-	-	V
	Collector-Base Breakdown Voltage (TLP677)	$V_{(BR)CBO}$	I_C=0.1mA Rank V2	300	-	-	V
			Rank V2	200	-	-	
			Rank V1	100	-	-	
	Emitter-Base Breakdown Voltage (TLP677)	$V_{(BR)EBO}$	I_E=0.1mA	7	-	-	V
	Collector Dark Current	I_{CEO}	V_{CE}=200V*	-	10	200	nA
			V_{CE}=200V*, Ta=85°C	-	-	20	μA
	Collector Dark Current (TLP677)	I_{CER}	V_{CE}=200V*, Ta=85°C, R_{BE}=10MΩ	-	0.5	10	μA
	Collector Dark Current (TLP677)	I_{CBO}	V_{CB}=200V*	-	0.1	-	nA
	DC Forward Current Gain (TLP677)	h_{FE}	V_{CE}=5V, I_C=10mA	-	7000	-	-
	Capacitance Collector to Emitter	C_{CE}	V=0, f=1MHz	-	10	-	pF

* Rank V2: 150V, Rank V1: 80V

COUPLED ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Current Transfer Ratio	I_C/I_F	I_F=1mA, V_{CE}=1V	1000	4000	-	%
Saturated CTR	$I_C/I_{F(sat)}$	I_F=10mA, V_{CE}=1V	500	-	-	%
Base Photo-Current (TLP677)	I_{PB}	I_F=1mA, V_{CB}=1V	-	6	-	μA
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C=10mA, I_F=1mA	-	-	1.0	V
		I_C=100mA, I_F=10mA	0.3	-	1.2	

ISOLATION CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Capacitance Input to Output	CS	V_S=0, f=1MHz	-	0.8	-	pF
Isolation Resistance	RS	V_S=500V	5×10^{10}	10^{14}	-	Ω
Isolation Voltage	BVS	AC, 1 minute	5000	-	-	V_{rms}
		AC, 1 second	-	10000	-	
		DC, 1 minute	-	10000	-	V_{DC}

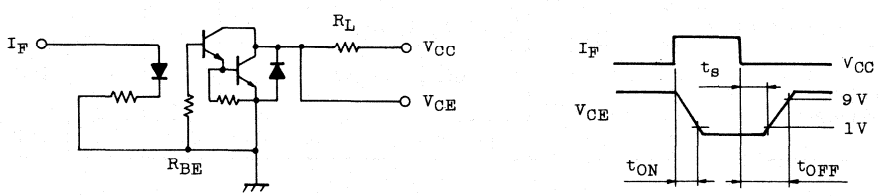
SWITCHING CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Rise Time	t_r	V_{CC}=10V, I_C=10mA, R_L=100Ω	-	40	-	μs
Fall Time	t_f		-	15	-	
Turn-on Time	t_{on}		-	50	-	
Turn-off Time	t_{off}		-	15	-	
Turn-on Time	t_{ON}	R_L=180Ω (Fig.1), R_{BE}=OPEN, V_{CC}=10V, I_F=16mA	-	3	-	μs
Storage Time	t_S		-	45	-	
Turn-off Time	t_{OFF}		-	90	-	
Turn-on Time	t_{ON}	R_L=180Ω (Fig.1), R_{BE}=10MΩ (TLP677), V_{CC}=10V, I_F=16mA	-	5	-	μs
Storage Time	t_S		-	40	-	
Turn-off Time	t_{OFF}		-	80	-	

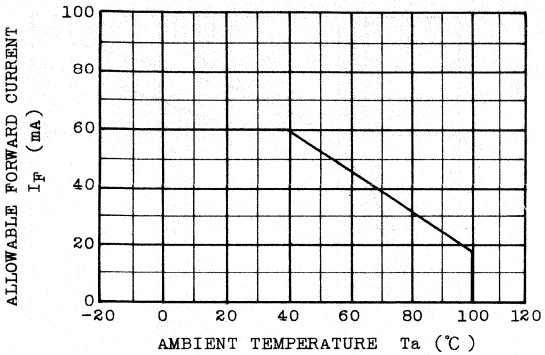
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	-	-	200	V
Forward Current	I_F	-	16	25	mA
Collector Current	I_C	-	-	50	mA
Operating Temperature	Topr	-25	-	85	°C

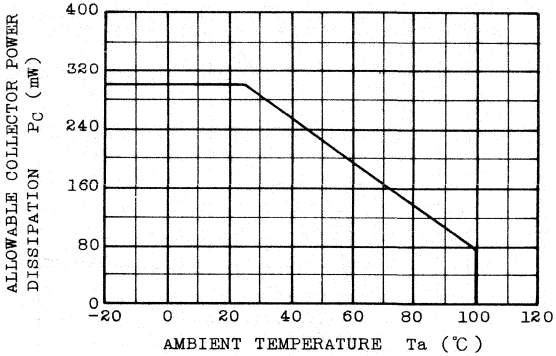
Fig. 1 SWITCHING TIME TEST CIRCUIT



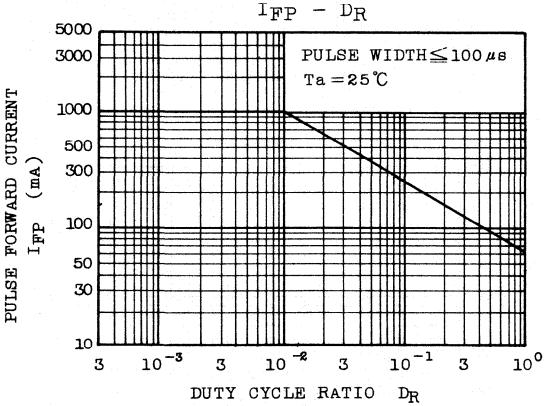
I_F – Ta



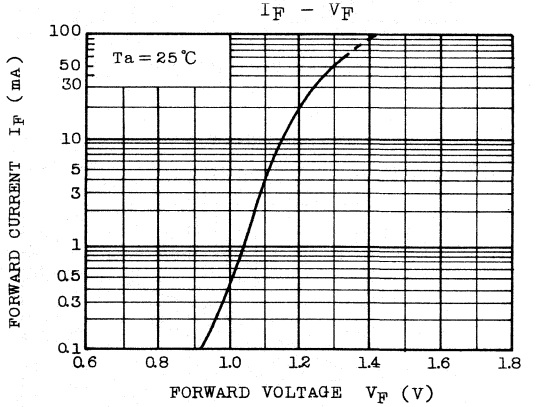
P_C – Ta



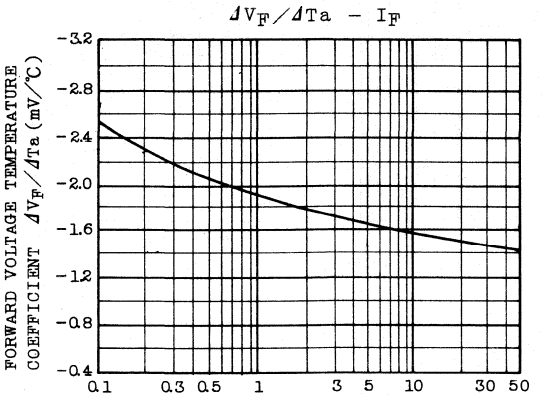
I_{FP} – D_R



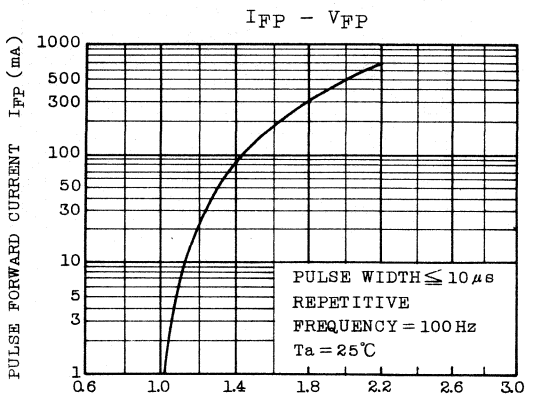
I_F – V_F



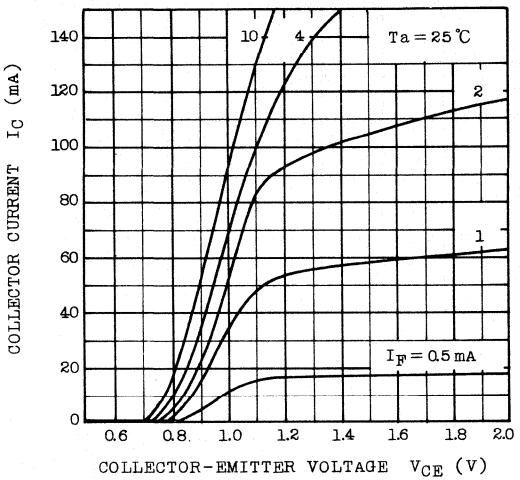
$\Delta V_F / \Delta Ta$ – I_F



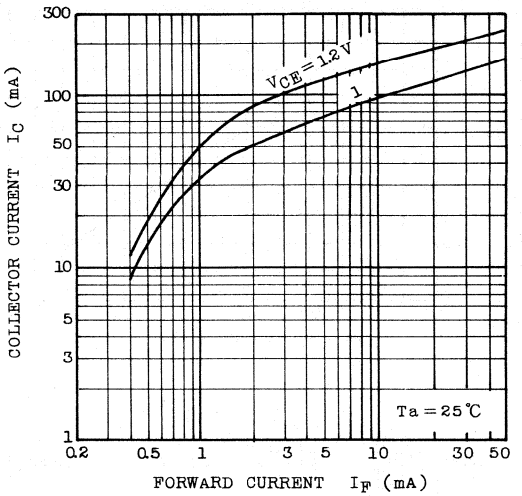
I_{FP} – V_{FP}



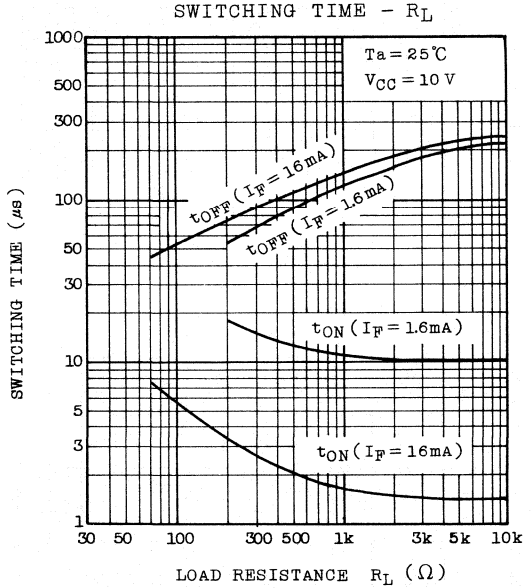
$I_C - V_{CE}$



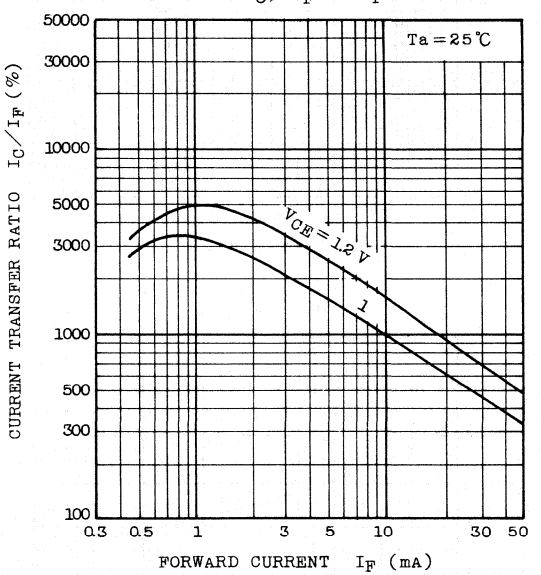
$I_C - I_F$



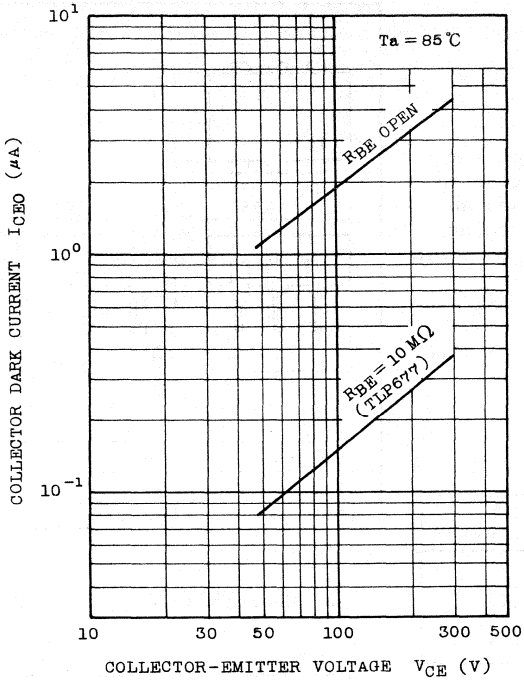
SWITCHING TIME - R_L



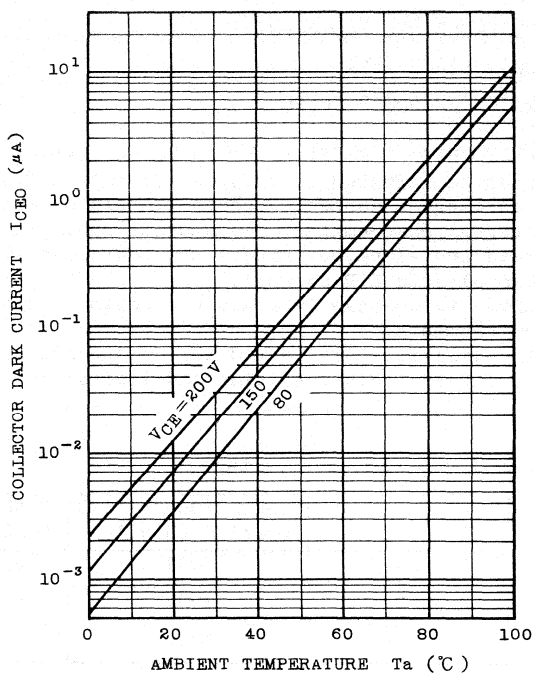
$I_C / I_F - I_F$



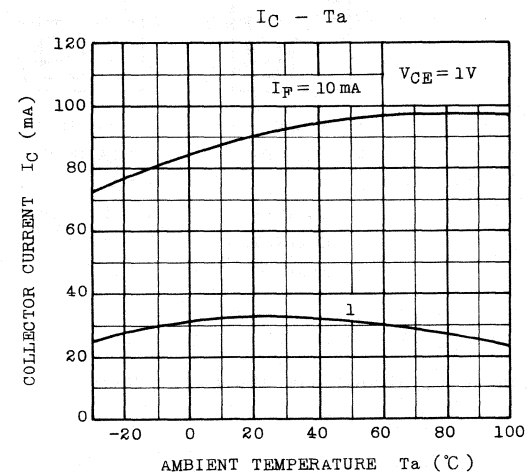
I_{CEO} – V_{CE}



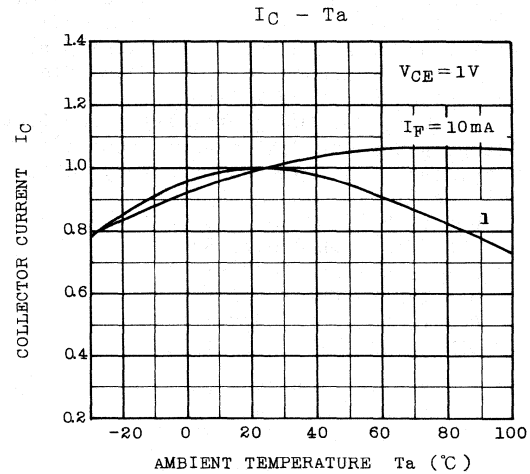
I_{CEO} – Ta



I_C – Ta



I_C – Ta



TLP677F, TLP678F

GaAs IRED & PHOTO-TRANSISTOR

OFFICE MACHINE.

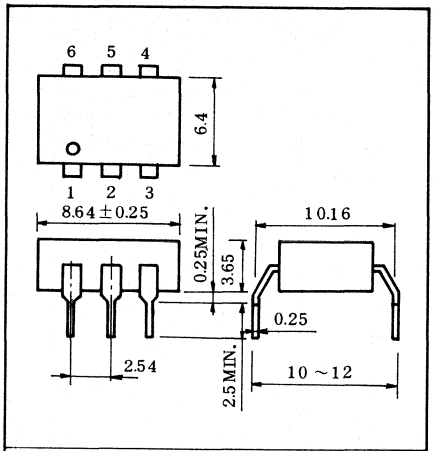
HOUSEHOLD USE EQUIPMENT.

SOLID STATE RELAY.

SWITCHING POWER SUPPLY.

The TOSHIBA TLP677F and TLP678F consist of a gallium arsenide infrared emitting diode optically coupled to a darlington connected photo-transistor which has an integral base-emitter resistor to optimize switching speed and elevated temperature characteristics in a six lead plastic DIP package.
TLP678 is no-base internal connection for high-EMI environments.
All parameters are tested to the specification of TLP677 and TLP678 (both condition and limits)

Unit in mm



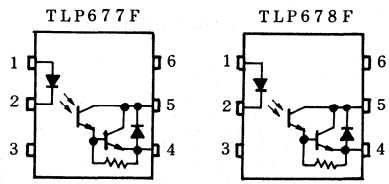
JEDEC	—
EIAJ	—
TOSHIBA	11-9A102

. Collector-Emitter Voltage:

CLASSIFICATION	COLLECTOR-EMITTER VOLTAGE (Min.)	MARKING OF CLASSIFICATION
Standard	300V	Blank
Rank V2	200V	Blank,V2
Rank V1	100V	Blank,V2,V1

. Current Transfer Ratio : 1000% Min.
. Isolation Voltage : 5000 rms Min.
. Climatic Test Class : 55/150/21
. Isolation Creepage Path : 8.0mm Min.
. Isolation Clearance : 8.0mm Min.
. Isolation Operating Voltage
: $500V_{ac}$ or $600V_{dc}$ for Isolation Group C*1
. Creeping Current Resistance: Group I*2
. Guaranteed Requirements of Safety Standards as Follows:
DIN 57 883/VDE0833/6.80
DIN 57 804/VDE0804/1.83
DIN IEC65/VDE0860/8.81
DIN IEC380/VDE0806/8.81
DIN IEC435/VDE0805/Draft Nov.84
DIN IEC601T1/VDE0750T1/5.82

PIN CONFIGURATIONS (TOP VIEW)



TLP677F	TLP678F
1 : ANODE	1 : ANODE
2 : CATHODE	2 : CATHODE
3 : NC	3 : NC
4 : EMITTER	4 : EMITTER
5 : COLLECTOR	5 : COLLECTOR
6 : BASE	6 : NC

Note : Application type name for certification test, please use standard product type name, i.e.
TLP677F (V2) ; TLP677F

*1 : According to VDE0110, table 4
*2 : According to VDE0110, table 3

8. Application Note

8-1 Outline of Photocouplers

8-1-1 Description of Photocouplers for General Purposes

■ **Structure and Basic Characteristics**

Demand for photocouplers entered a real growth period around 1977. The background for this is the increasing application in signal transmission between CPU and peripheral devices caused by the popularization of microprocessors and in isolation interface between logic circuits and power line load circuits.

Traditionally, for these applications, relays or transformers have been used. Photocouplers not ohly replace these devices, but also have merits such as elimination of impedance mismatching, improvement in isolation capability between input and outputs and ease of noise cutoff. Moreover, while circuit consist of more LSIs and microcomputers, additional merits of occupying area reduction on the printed circuit board and maintenance-free operation based on reliability improvement increase the demand rapidly.

With this background, metalsealed tubular photocoupler TLP501 was developed in 1972, then, TLP503 (DIP, 6-pin) and TLP504 (DIP, 8-pin, 2ch), and photo-thyristor couplers TLP505G and TLP506G were commercialized. In 1978, new package material "White epoxy resin" was developed in Toshiba, then made higher isolation voltage, higher sensitivity, and higher current transfer ratio. Recently, however, as the large-scale control by microcomputers, become popular in the sequence controllers, photocouplers used for I/O interface has increased markedly. Accordingly, to increase the number of units mountable per printed circuit board, multichannel photo couplers are also developed.

In this paragraph, the structure and basic characteristics for these units will be described.

■ Structure

Fig. 8-1 shows TLP521-1 structure. As shown in the cross-sectional structure in Fig. 8-2, an infrared light emitting diode chip and a photo-transistor chip are individually die bonded on the separated lead frames. Each electrode is bonded with 25μ diameter Au wire by thermal compressive wire bonding, so the light-emitting and the light-receiving lead frames face each other on their optical centers axis. Further, transparent silicone resin is inserted into the chips facing gap to obtain optical coupling and electrical isolation. At the same time, white epoxy resin is used for transfer molding.

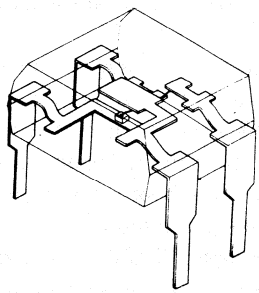


Fig. 8-1 TLP521-1 structure

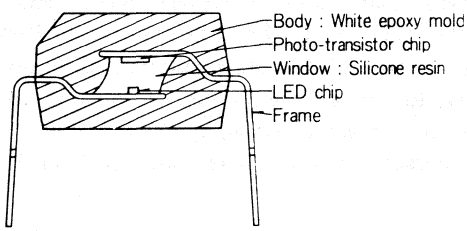


Fig. 8-2 Cross section of TLP521-1

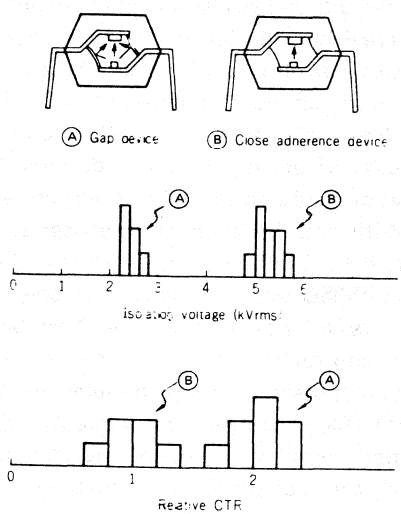


Fig. 8-3 Isolation voltage vs. CTR

The infrared light-emitting diode is an Si-doped liquid phase epitaxial GaAs diode and is mounted with its P-side up. The light-receiving chip is an Si NPN epitaxial planner photo-transistor. (In TLP645G, PNPN epitaxial planner photo-thyristor is used.)

■ Basic Characteristics

○ Isolation Voltage

If the isolation distance between the input and the output is wide, the isolation voltage becomes high. On the other hand, as the quantity of light reaching at photo detector decreases exponentially, the current-transfer-ratio goes down. Also, even if wide isolation distance is permissible, the package size becomes large, and does not meet to the market needs of small DIP package. As a solution to this problem, transparent silicone resin is used between the input and output to maintain the required isolation voltage. The isolation voltage of transparent silicone resin as a light guide is about 17 kV/mm, regardless of the kinds used. Normally 2.5 kVrms minimum isolation voltage have to be guaranteed. So the center of breakdown voltage distribution is at 6 kVrms to keep enough margin. The distance between the input and output conductors is designed at about 0.4 mm. Also, to increases the creepage spark voltage at the interface between the transparent silicon and molding resin, materials with strong mutual adhesion are used, where no air gap is formed at the interface after transfer molding.

However, as Model B in Fig. 8-3 shows, good adhesion lowers light reflectivity at the resin interface, reducing the quantity of light reaching at photo detector, and resulting in an undesired effect of lowering the current-transfer-ratio. Consequently, selection of resin used as an optical guide is important from the viewpoint of product design, as it greatly influences the isolation voltage and current-transfer-ratio, which are basic characteristics of a photocoupler, and is related to reliability, as will be described later.

The isolation voltage distribution of new photocouplers has a average of about 6 kVrms as shown in Fig. 8-4 , achieving the initial goal. Figure 8-5 shows the impulsed isolation voltage distribution, which is considered important in connection with lightning surge in electric systems.

○ Current Transfer Ratio (CTR)

To meet the market needs for high isolation voltage of 2.5 kVrms minimum, transparent silicone resin with strong interface adhesion is used for an optical guide. Accordingly, CTR is reduced considerably. However, white epoxy molding improve the interface reflectivity has made CTR two to three times higher, as compared with the traditional black-molded device (TLP503), and maintains CTR of typically 200% (minimum 50%).

■ Important Points in Applications

When using photocouplers, it is necessary to pay attention to the following:

① CTR degradation; When used for a long time (10 years) CTR will be down to −10%, compared with the initial value. It is recommended, however, to have a design margin by considering this as about −30 to −50%.

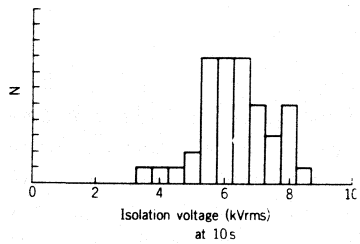


Fig. 8-4 Isolation voltage distribution

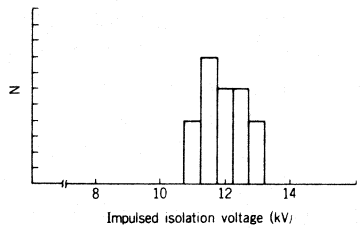


Fig. 8-5 Impulsed isolation voltage distribution

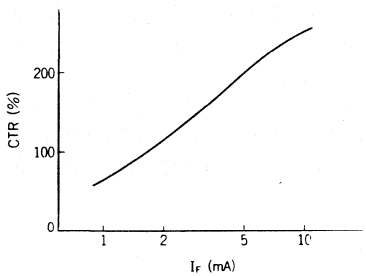


Fig. 8-6 IF vs. CTR

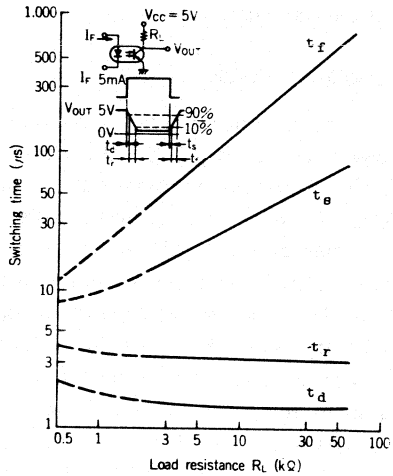


Fig. 8-7 Switching time vs. RL

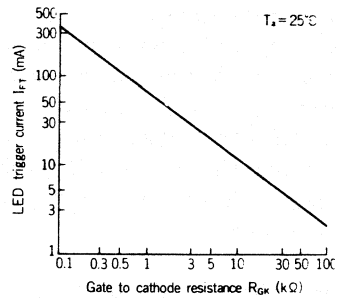


Fig. 8-8 IFT vs. RGK

② CTR input current dependency: When used with low input current, CTR drops, as shown in Fig. 8-6 . In designing circuit, this effect should be considered.

③ CTR ambient temperature dependency: At high temperatures, the decrease in light emission efficiency is more dominant than the increase in hFE, resulting in reducing CTR. Attention should be paid to this effect.

④ Switching time. When the light-receiving photo-transistor is used in a saturated switching mode, the switching time must be considered. Of photo-transistor's switching characteristics, turn-off (tf) is the longest and is represented approximately by $tf \sim 2.2\ C_{ob}.hFE.R_L$. Here, C_{ob} is the collector-to-base capacitance, hFE is DC current gain and R_L is the load resistance. Switching time is shown in Fig. 8.7.

■ Photo-thyristor Coupler I_{FT} Characteristic

The photo-thyristor itself is highly sensitive to light. However, as gate-to-cathode resistance (R_{GK}) is connected to bypass the charging current i = C.dV/dt, photo current Iλ partly flows through P_{GK} and reduces the trigger sensitivity (I_{FT}) by LED. Figure 8-8 shows the R_{GK} dependency for I_{FT}.

Also, for I_{FT} ambient temperature dependency, at low temperatures the decrease in the photo-thyristor gate sensitivity is more dominant than the increase in light emission efficiency, I_{FT} sensitivity becomes poor at low temperatures. Typical effect of R_{GK} on dV/dt and temperature effect on I_{FT} are illustrated in Fig. 8-9, Fig. 8-10.

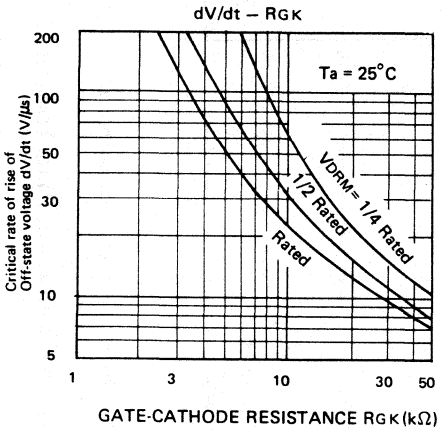


Fig. 8-9 Typical effect R_{GK} on dt/df

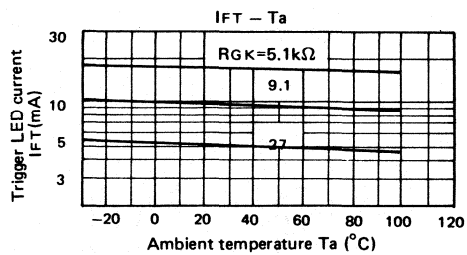
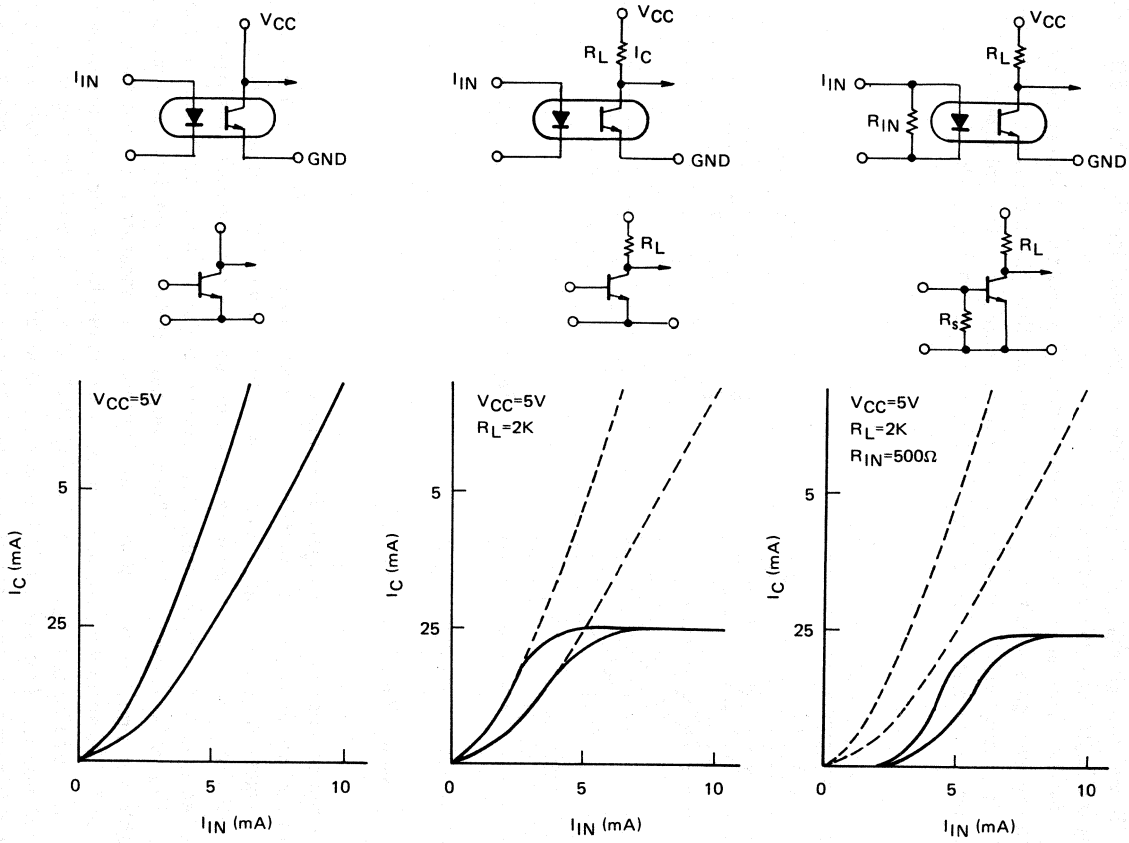


Fig. 8-10 Typical effect temperature on I_{FT}

■ Examples of Application to Signal Transmission

Products which have high sensitivity and high current transfer ratio are effective as an interface for signal transmission. Generally, transmission lines may subject to all kinds of noises and it is therefore necessary to take countermeasures against these noises at receiving side. Photo transistor couplers are normally in such design as shown by (b) of Fig. 8-11 in many cases. Photo couplers in this design, however, are actually unfavorable for signal transmission. This is because no measure has been taken against differential noises although there is no problem for same phase noises because of isolation characteristics of photo couplers. (c) in Fig. 8-11 is an example of the circuit for erasing differential noises. This circuit is the same as that of general transistors with a resistor inserted between the base and the emitter. It can be seen from the graph that a high CTR product is able to bring the cut-off area and saturation area more close each other than a low CTR product. It is possible to design threshold level with a sufficient margin and, this circuit is recommended.



(a) Characteristic of Photo Coupler (b) Characteristic with Load Connected (c) Characteristic for Transmission

Fig. 8-11 Load Characteristics of Photo Transistor Coupler

8-1-2 High-Power Photo Thyristor Coupler

Photo couplers are being used for transmitting signals between circuits in different ground level or for noise cut in a data transmission line. A photo thyristor coupler is capable of directly opening or closing an AC line by input side LED ON-OFF, while electrically separating input side LED from output side photo thyristor.

Recently, the photo thyristor coupler is rapidly expanding its demands as a gate trigger switch to open or close an AC load for a main triac due to increasing solid-state utilization, not only in industrial use control equipment but also for home electrical appliances (electronic cooker, air-conditioner, automatic washing machine etc.) as well as copier, vending machine etc., all resulting from microcomputer's widespread use open or close capability increase, trigger sensitivity improvement, isolation voltage increase etc., are required from the market as the demand for thyristor coupler increase. In response to these requirements, Toshiba has commercialized a high-power photo thyristor coupler, Model TLP546G, aiming at DIP-type lead relay (switching capability is nearly 1Arms) solid-state formation. Its construction, electrical characteristics and applications will be discribed.

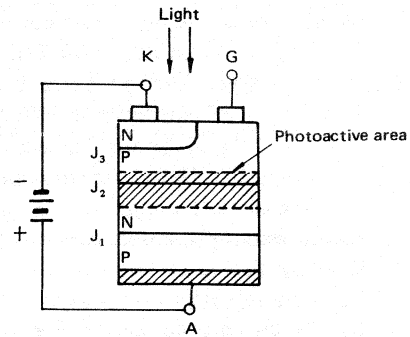


Fig. 8-12 Photo thyristor structure

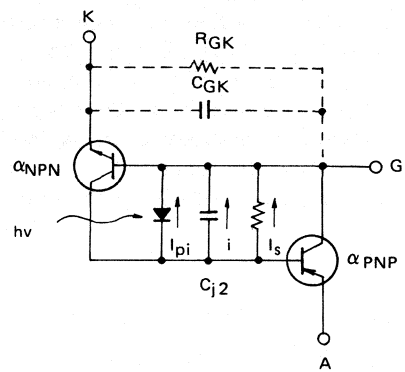


Fig. 8-13 Photo thyristor equivalent circuit

■ **Photo Thyristor**

A photo thyristor, having a PNPN construction similar to ordinary thyristors, is made up of two different transistor types (PNP and NPN) with central junction J_2 commonly used for a collector. This construction is outlined in Fig. 8-12. A simplified equivalent circuit is shown in Fig. 8-13.

When a photo thyristor is operated with a forward bias voltage between its anode and cathode, central junction J_2 functions as a reverse biased photo diode. This bias enables gate current flow. Photo thyristor's anode current I_A in the equivalent circuit shown in Fig. 8-13 is expressed by Eq. (1).

$$I_A = \frac{I_S + I_{P\lambda}}{1 - (\alpha_{PNP} + \alpha_{NPN})} \quad (1)$$

where, α_{PNP}: Positive hole current ratio that reaches a collector over these injected by an emitter in the PNP section.

α_{NPN}: Electron current ratio that reaches a collector over these injected by an emitter in the NPN section.

I_S: Saturated leakage current at a reverse biased J_2 junction.

$I_{P\lambda}$: Photo current appearing at a J_2 junction due to an incidental light.

Transistor's α_{PNP} and α_{NPN} increase as its emitter current increases. When $I_{P\lambda}$ flow by inputed light, anode current I_A increases, due to gain factor in a regeneration feedback loop consisting of two different types of transistors (PNP and NPN). With the increase in I_A current, α_{PNP} and α_{NPN} further increase until α_{PNP} plus α_{NPN} reaches a value equal to 1 when I_A becomes infinite, firing the photo thyristor.

■ Device Structure

Aluminum Plate Internal Structure

The TLP546G, consisting of two photo thyristors connected in a reverse parallel connection, and two infrared light emitting diode, facing each photo thyristor. Aluminum plate is buried up inside a resin body as a heat sink. The internal structure and pin connection is shown in Fig. 8-14.

Transparent silicone is filled into the gap between infrared light emitting diode and photo thyristor, to be a light guide. Its surrounding areas are further molded with adhesive white epoxy resin, which makes double structure. Moreover, aluminum plate are completely separated from individual input and output leads. Thus high-voltage isoration, 2.5 kVrms (for one minute duration) is maintained.

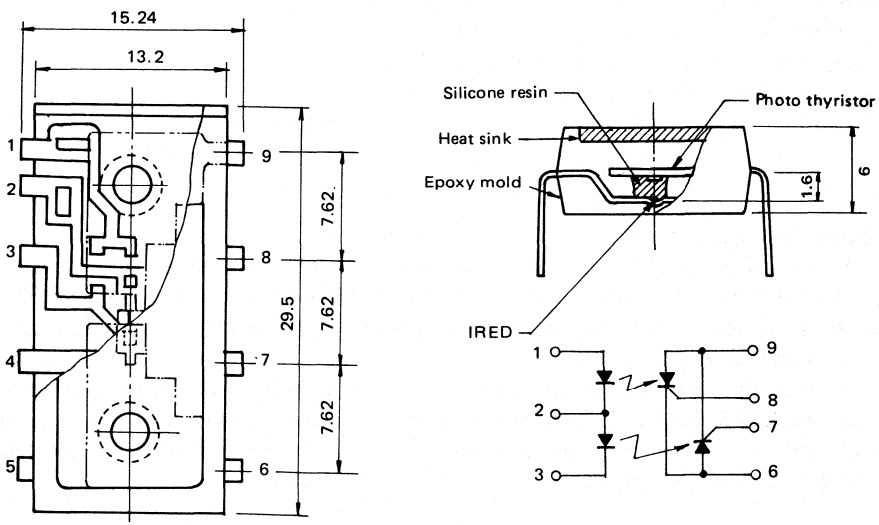


Fig. 8-14 TLP546G structure

When the TLP546G is operated at 40°C environment temperature with rated condition, photo thyristor chip temperature increases to nearly 100°C. In order to emit this heat energy into the ambient environment efficiently, the output side frame is designed to be as large as possible, and the gap between aluminum plate and the output side frame is designed to be as small as possible. Furthermore, small convex and concave are applied on the aluminum plate so as to increase contact area with the atmosphere for heat emission effect improvement.

Outline View

In order to make easy mounting on a print circuit board, DIP-type 0.1 inch pin pitch was selected, as shown in Fig. 8-14. On the photo thyristor side, as the pin pitch is 7.62 mm. The wider pad spaces on the print circuit board is available to keep enough "OFF" voltage.

■ Maximum Ratings and Electrical Characteristics

Maximum Ratings

When Operating point exceed the maximum rating, even a few seconds, not only are electrical characteristics and reliabilities lost but also the devices break down in the worst case, so adequately careful design is necessary. Table 8.1 shows the TLP546G maximum ratings. If the operating points are over maximum rating or, derating is insufficient, trigger sensitivity (trigger LED current, I_{FT}) may be degraded, or off-state voltage may be decreased.

Table 8-1 TLP546G Maximum Ratings (Ta = 25°C)

	Characteristics	Symbol	Rating	Unit
LED	Forward current*	I_F	50	mA
LED	Reverse voltage	V_R	5	V
Detector	Repetitive peak off-state voltage	V_{RRM} and V_{DRM}	400	V
Detector	On-state current (rms)**	I_T (rms)	1 (non-heatsink)	A
Detector	Peak one cycle Surge on-state current	I_{TSM}	20	A
Operating Temperature		$T_{opr.}$	−30~ 80	°C
Storage Temperature		$T_{stg.}$	−30~125	°C

Note:

* Derate linearly above 25°C free-air temperature at a rate of 0.55 mA/°C.

** Derate linearly above 40°C free-air temperature at a rate of 40 mA (rms)/°C.

Table 8-2 TLP546G Electrical Characteristics (Ta = 25°C)

	Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
LED	Forward voltage	V_F	I_F = 30 mA	–	–	1.40	V
	Reverse current	I_R	V_R = 5V	–	–	10	μA
Detector	Repetitive peak off-state current	I_{DRM}	V_{DRM} = rated, T_a = 80°C	–	–	100	μA
	On-state voltage	V_{TM}	I_{TM} = 2A, I_F = 15 mA	–	–	2	V
	Holding current	I_H	R_L = 100Ω, R_{GK} = 15 kΩ	–	0.5	–	mA
	Critical rise rate of off-state voltage	dV/dt	V_{DRM} = 2/3 rated, R_{GK}= 15 kΩ	5	–	–	V/μs
Coupler	LED trigger current	I_{FT}	V_D = 6V, R_L =100Ω, R_{GK} = 15kΩ	–	7	10	mA
	Isolation resistance	R_S	R. H. = 40~60%, V=1,000V DC	–	10^{11}	–	Ω
	Isolation voltage	BV_S	AC 1 minute, R.H. 40~60%	2,500	–	–	V

Electrical Characteristics

The TLP546G electrical characteristics are shown in Table 8-2. As important electrical characteristics, dv/dt and I_{FT} are described.

○ dv/dt

When a steep forward bias voltage is applied to photo thyristor's anode and cathode point, there is a case where the photo thyristor turns on, even though this voltage is within its breakover voltage and the trigger LED current is zero. This is due to the fact that, when the device is in a forward biased state, a central junction J_2 shown in Fig. 8-12 is reverse biased, forming a depletion layer capacitor C_{J_2} wherein displacement current, *i*, flows in as forward biased voltage applied varies. This displacement current, *i*, is expressed by the following formula (2).

$$J = Cj_2 V^{k} \cdot \frac{dV}{dT}^{1} \quad (2)$$

V; Applied Voltage
K; 2~3

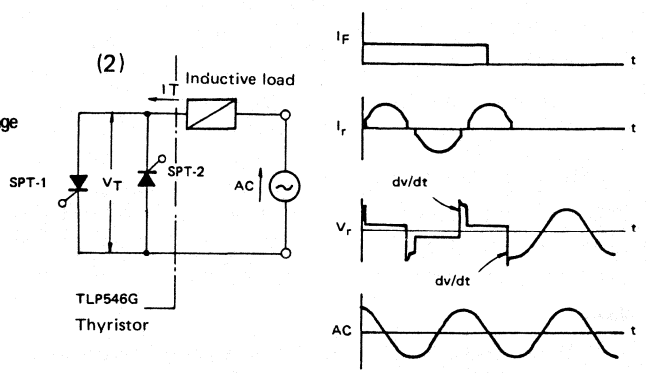


Fig. 8-15 Inductive lead connection and each waveforms

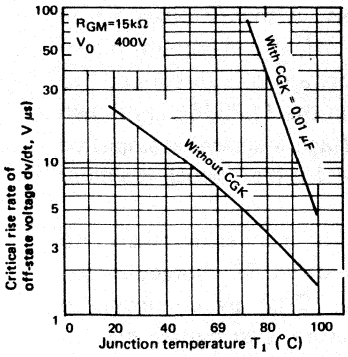


Fig. 8-16 dv/dt vs. T_J

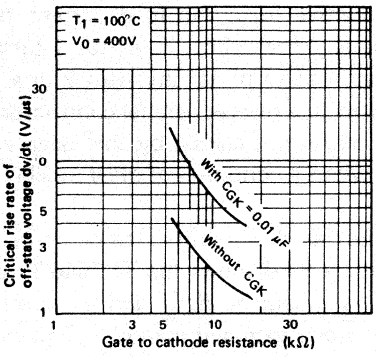


Fig. 8-17 dv/dt vs. R_{GK}

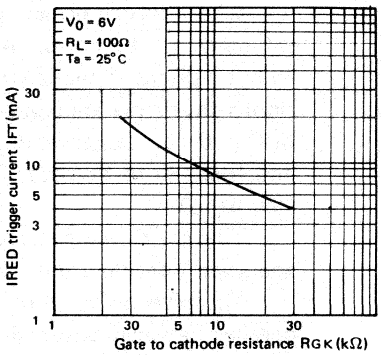


Fig. 8-18 I_{FT} vs R_{GK}

Table 8-3 Application examples

Application	Examples
Motor Control	Sequence controller, automatic vending machine, ECR, sewing machine, air-conditioner, automatic door, automatic
Light Control	Fluorescent lamp dimmer, stage lighting advertisement lighting, traffic signal, game machine
Temperature control	Copier, panel heater, electronic
To Prevent Disasters	Fire alarm, gas alarm, circuit breaker, various indicators

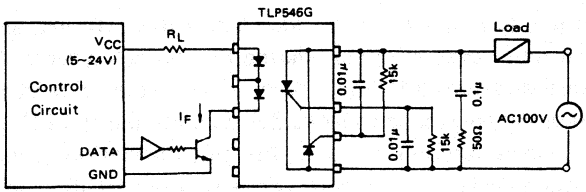


Fig. 8-19 TLP546G application

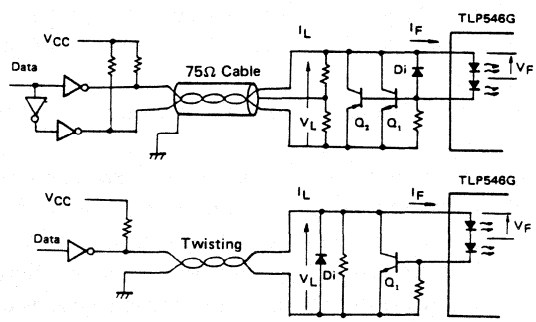


Fig. 8-20 Logic systems interface application

When switching an inductive load, the load current flows with $\pi/2$ phase lag in reference to the power source. When photo thyristor 1 turns off, the maximum power source voltage is suddenly applied to photo thyristor 2 in a forward bias direction, two photo thyristors are connected in a reverse parallel connection in the TLP546G, as shown in Fig. 8-15. Displacement current, i, caused by this steep voltage increase, is amplified and fires photo thyristor 2 when a condition of αPNP+αNPN $\geqq$ 1 is met, which is similar step to $I_{p\lambda}$.

The dv/dt value decreases as the junction temperature rises, it must be taken into adequate consideration. Figure 8-16 shows the TLP546G's dv/dt vs. Tj, characteristics.

To solve dv/dt trouble, a resistance R_{GK} and a capacitor C_{GK} are connected in parallel between photo thyristor's gate and cathode. This measure is to bypass the displacement current, i, shown in Fig. 8-13 into a cathode for suppressing α increase. The connecting effect of R_{GK} and C_{GK} in the TLP546G are shown in Fig. 8-16 and 8-17.

○ Trigger LED current

A photo current $I_{p\lambda}$ produced by a forward current I_F fires a thyristor by the previously mentioned turn-on process. This minimum required forward current is defined at trigger LED current I_{FT}. The I_{FT} increases with R_{GK} connection. This is because a part of $I_{p\lambda}$ leaks into the photo thyristor's cathode. The TLP546G's I_{FT} vs. R_{GK} characteristics are shown in Fig. 8-18.

■ TLP546G Application Examples

The TLP546G can be used to connect the control circuit which consist of microcomputer, various IC and a small motor operating at 100 V AC, heater solenoid, relay, lamp etc. Table 8-3 shows application example. Also, Fig. 8-19 shows a typical circuit example.

Although trigger LED current I_{FT} at R_{GK} = 15 kΩ, is less than 10 mA, an I_F = 20 mA is recommended, as two times over drive considering the device's yearly degradation, environment temperature and turn-off time. Also, when cable or twisted pair wire is used for AC power remote control, erroneous behavior or input LED breakdown happen, because external noise vary line current. For this prevention, a protection circuit for input LED becomes necessary to suppress drive currrent. This example is shown in Fig. 8-20. A characteristic chart for input LED's bias condition is shown in Fig. 8-21 for a case where a current I_L from a line driver shown in Fig. 8-20, varies both positively and negatively. This chart is divided into the following four operational regions.

① Non-triggered region: No forward bias current flows before I_L reaches a constant value.
② Triggered region: Necessary forward bias current flow for firing.
③ Forward bias current protection region: Excessive I_L is absorbed by a transistor Q_1 and I_F is kept within rating values.
④ Reverse bias voltage protection region: Reverse bias current is absorbed by diode D_1 and transistor Q_2 and LED's reverse bias is kept within rating values.

TLP546G has the function of "Non-contact point" in the DIP type lead relay, and also keep high reliability. So it is considered to be the simplest solid-state relay regarding the shape, load switching capability.

The high-power thyristor coupler will continue to expand its application range together as microcomputer become popular, covering not only industrial use equipment but also home electrical appliances.

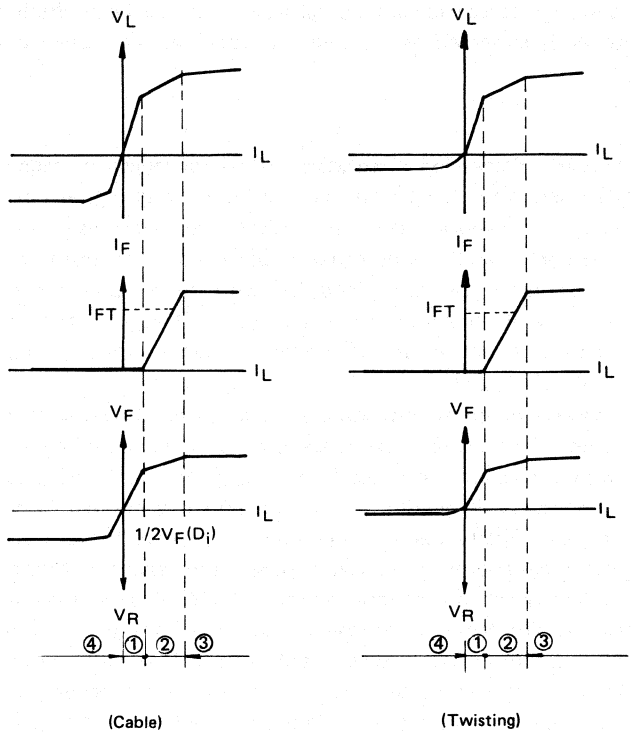


Fig. 8-21 Connection characteristics

8-1-3 High-Speed Photo Coupler (6N137)

Recently, with the advancement of office automation, various applied products using CPU for office and industrial uses are produced and high speed processings through digital control are increasingly demanded. With such a background necessity for high-speed response which cannot be realized by conventional photo transistor couplers has been increased for interfaces among various systems.

In designing the high-speed photo coupler **6N137**, which has been newly developed by Toshiba, materials for high-speed response light emitting diode have been carefully selected and photo-electric IC that can be connected to TTL has been designed with extreme care so that this photo coupler has same construction as that of our conventional photo couplers. As a result isolation performance of this newly developed photo coupler can be guaranteed at 2.5 kV rms which is the same level as that of Toshiba's white mold coupler and high response speed of approx. 70 ns has been obtained. Extensive use of this photo coupler is expected as a popular product of high-speed photo coupler in the future.

■ **Preface**

In recent years, degree of integration of microprocessors, memories, etc. has been greatly improved and also, logic analyzers for supporting digital circuit designing which is becoming highly precise have become extensively used. As a result, products for industrial and office use have been rapidly progressed. In particular, computers which are the intensive systems of semiconductor products, coupled with arrival of the office automation age, are expected to grow at an annual rate of 30%. Further, industrial electronic equipment have become highly efficient, multi-functioned and large scaled as a result of active use of microprocessors, memories, etc.

With the improvement of individual systems to higher level of efficiency, interfaces which are capable of accurately exchange data at high speed have become demanded. However, the system design is troubled by various problems existing on transmission lines. For instance, if offset voltage due to ground loop is generated, loop current may flow between systems and finally damage equipment. To solve these problems use of optical fibers for long distances and photo couplers for short distances is effective.

Photo couplers which are generally used for digital data transmission at present are photo transistor output type. Response frequency of these photo couplers, if they are reasonably designed, will be DC ~ several tens kbit/S. However, as reduction of data transmission waiting time between systems is desired and when loop process between circuits is performed at high speed, adjustment of timing resulted from propagation delay of a photo coupler becomes necessary.

Thus, it has become not possible to ignore propagation time of data or command between systems or circuits. When a photo transistor coupler is operated at marginal high speed and connected to a logic IC at the rear stage, it also becomes necessary to design a discrete circuit which match with the rear stage. Further, a careful design with conditions under adverse environment considered is demanded for automation systems which are used in production line. (process controller, NC equipment, robot, etc.).

Existing photo couplers which is capable of high speed processing are in most simple construction of GaAs LED and photo diode. However, as output photo current is as low as several tens μA, it is necessary to design a high gain and high speed amplifier. It is considered that a wide application of this type of photo couplers in high speed signal circuits had been delayed for this reason.

In order to respond the above market needs, Toshiba has newly developed the high-speed photo coupler 6N137 which connected a light emitting element of high speed response and a logic output type light detective IC. Selection of the device, its structure, basic characteristics and application of this high-speed photo coupler 6N137 are described here.

■ I/O Component Elements and its Internal Structure

In designing the construction of a photo coupler, it is necessary to examine response characteristics of light emitting diode and light detector individually.

Light emitting diode has different characteristics according to external quantum efficiency attributable to their materials and pulse response characteristics as shown in Table 8-4. The material of emitting diode which is generally used is a Si doped GaAs, LED by the liquid phase grown method with wavelength λ = 9,400 Å. It has an extremely large light emitting output and external quantum efficiency of about 5 ~ 10%. However, this GaAs LED has a defect of low pulse response speed of about 500 ns and it cannot be used for the high-speed photo coupler.

Table 8-4: Response Characteristics of LED

Material	I_F = 7.5mA Response Time (ns)	External Quantum Efficiency (%)
GaAs	500	8
GaAsP	40	0.2
GaAlAs	50	3
GaP	300	3

According to this reason, a light emitting diode that has response characteristics suited to the high-speed photo coupler is a GaAsP LED but its external quantum efficiency is lower than GaAs LED by about 1 ~ 2 digits. Therefore, it is necessary to design a distance to be short between light emitting diode and detector so that transmission efficiency between light emitting diode and detector is improved. However, such construction remarkably reduces isolation voltage between input and output, which is the most important item of the photo coupler. As this counterplan, the following methods are adopted. One method is to insert an insulation film such as teflon which is sufficiently transparent to emitting wavelength of LED between input and output as shown in Fig. 8-22. Another method is to close fit LED and a detector with a thin spacer which has high isolation strength (a glass sheet, etc.) inserted between them as shown in Fig. 8-23. By these counterplan, the internal creeping distance between conductors including input/output leads which are discharging routes is extended.

However,these manufacturing methods are more complicated than that of conventional photo couplers and require a new assembly technique. Furthermore, there is some danger that because of a short distance between the light emitting diode and detector, the variance of coupling characteristics will increase. In view of above, Toshiba has concluded that

a GaAlAs LED which has high external quantum efficiency is optimum for the high-speed photo coupler, although. Its response characteristics are somewhat worse than GaAsP LED.

As GaAlAs LED has larger photo output than that of GaAsP LED, sufficient coupling efficiency is obtained between the emitting diode and detector and it is possible to design a photo coupler with a wider distance between the emitting diode and detector. For this reason, we have become to consider only high sensitivity. Then, the high speed photo coupler **6N137** has been designed in the same structure as in conventional photo couplers.

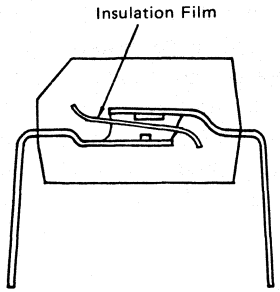


Fig. 8-22 Isolation method with insulation film

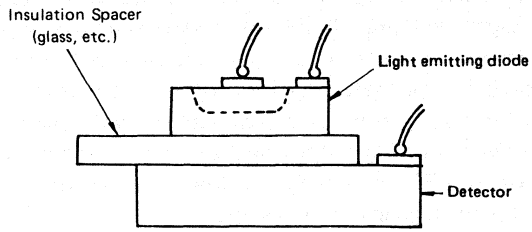


Fig. 8-23 Isolation method with galss sheet

When a PIN photo diode is assembled using a GaAlAs LED as a light emitting diode, output current in such a structure as shown in Fig. 8-24 is no more than several tens μA. As output current of currently available photo transistor is also about several mA, sufficient output cannot be obtained. For response characteristics between the input and output, it is necessary for the photo transistor coupler to enlarge the junction surface between the collector and base, which is its light receiving section in order to increase light detective sensitivity. For this reason, its junction capacity is amplified and made large due to mirror effect. Therefore, response speed becomes inevitably slow and even when an applicable load circuit is designed, maximum response speed will become about 100 kbit/s.

There is also a method to separate a photo diode and a transistor for amplyfication but sufficient high-speed cannot be expected because of capacity between the collector and base of a transistor for amplification. So, the light detector of the 6N137 has been made of monolithic IC type which consists of a PIN photo diode with a high gain high-speed linear amplification circuit and a Schottky transistor to its final stage for open collector output.

The cross section of the 6N137 using the above-stated emitting diode and detector is shown in Fig. 8-24 and its pin configuration in Fig. 8-25. A GaAlAs LED and Si light detector have been die bonded and wire bonded to independent lead drames, respectively. And the lead frames of the LED and light detector are placed to face each other and the optical centers of the elements agree each other, with transparent silicon resin filled between the facing elements and white epoxy resin transfer molded. Thus, it is possible not only to make the structure simple but also to improve positioning accuracy of the light emitting diode and detector as well as to minimize distribution of coupling characteristics.

■ Basic Characteristics of High-Speed Photocoupler (6N137)

• Isolation characteristics

The **6N137** has employed a structure similar to that of Toshiba's conventional photo coupler TLP521 Series. And materials which have excellent mutual adhesiveness as white mold resin for external coating and clear silicon resin for internal coating have been selected. Consequently the isolation voltage between input and output of the **6N137**, which is the basic characteristics of photo coupler, can be guaranteed at 2.5 kVrms (peak 3.550V).

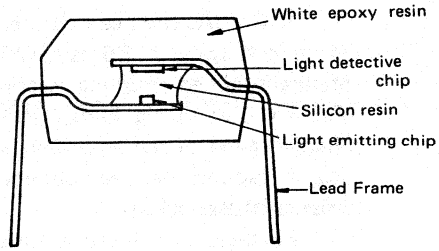


Fig. 8-24 Cross Section of 6N137

Further, on an output IC photo coupler, as the amplifier gain after transfering photo signal to electric signal has been designed at high level, it is necessary to pay attention to common mode noise applied between input and output. As the **6N137** has been designed with the wider internal distance between input and output, it acts advantageous against noise as shown in Fig. 8-26 and Fig. 8-27.

The upper state in Fig. 2-63 is output waveform of a photo coupler with a distance shortened by method of a film inserted, the middle stage is output waveform of the **6N137** and the lower stage is waveform of common mode noise. If noise of about 10V/25ns (≈400V/us) is applied between input and output when the input LED is OFF, the output terminal cannot be kept at OFF state and is instantaneously at ON state. On the **6N137**, noise can be reduced at about 1/3.

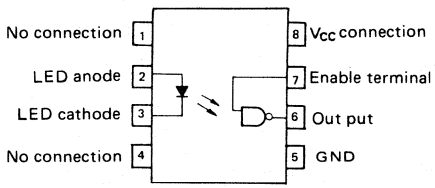


Fig. 8-25 Pin Configuration of 6N137

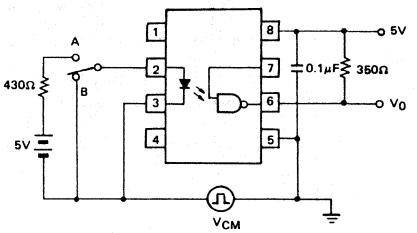
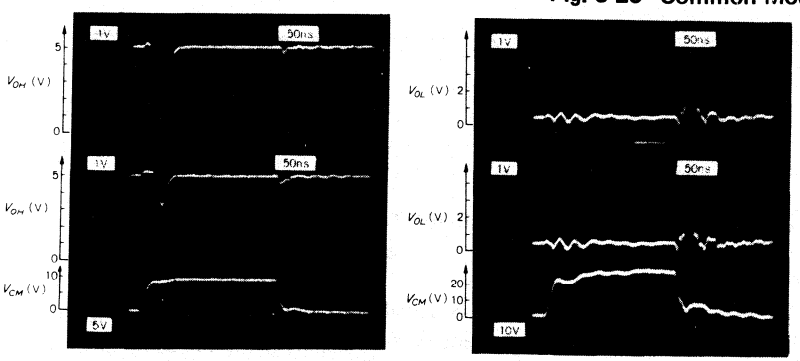


Fig. 8-26 Common Mode Noise Measuring



(a) Connection A
(CMH: High Output Level)

(b) Connection B
(CML: Low Output Level)

Upper Stage:
Output noise waveform of film type system
Middle Stage:
Output noise waveform of 6N137
Lower Stage:
Common mode noise

Fig. 8-27 Common Mode Noise

Then, when the output IC is placed in ON state by applying power to the input LED, the output begins momentarily to OFF. There are also some differences as shown in Fig. 8-28.

- **Response characteristics**

A GaAlAs has been selected as a light emitting **diode.** As shown in Fig. 8-28, t_{PHL} ~ 75 ns and t_{PLH} ~ 65 ns have been obtained, which are nearly satisfactory values for the originally aimed coupling response characteristics with CMOS and TTL. The measuring circuit is shown in Fig. 8-29. Further, the **6N137** has been designed to suppress temperature Change speed of the amplifiers speed. And almost flat temperature dependence characteristics of response has been obtained as shown in Fig. 8-30. This is one of the excellent characteristics of the **6N137.**

Further, this response time changes depending upon input current I_F and load resistance R_L but not much change is observed because of effect of the output Schottky transistor.

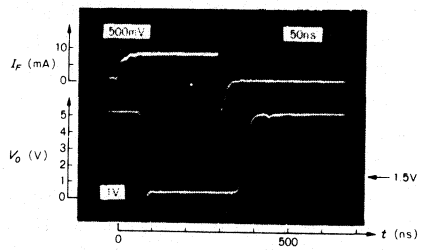


Fig. 8-28 Switching Operation Waveform

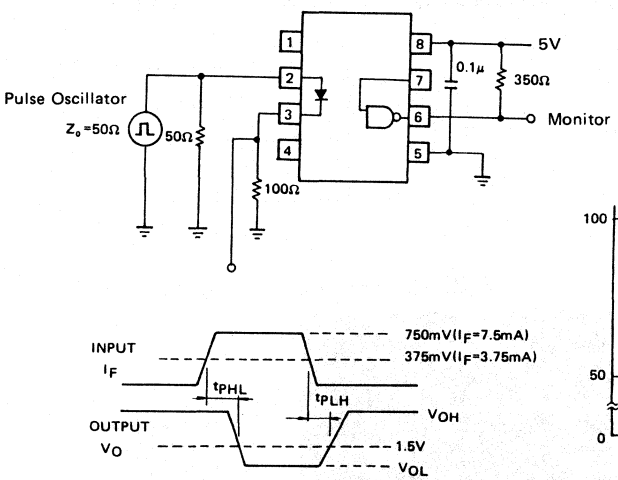


Fig. 8-29 t_{PHL}, t_{PLH} Measuring Circuit

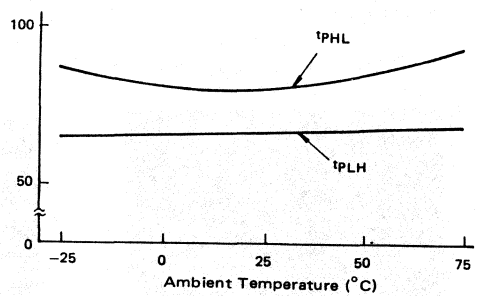


Fig. 8-30 Temperature Dependency of Switching Speed

- **Input driving current**

As gain is obtained by the linear amplifier, it is possible to take low level output current I_{OL} by more than 13 mA at LED driving current I_F = 5 mA, which is the same level of the general use TLP521 Series. This has ability to connect about 8 standard TTLs. LED can be directly driven by TTL and its output can drive TTL. The important characteristics of the **6N137** are described as following.

(1) Output low level voltage:
$V_{OL} \leqq 0.6V$ (I_F = 5 mA, I_{OL} = 16 mA, V_{CC} = 5.5V, Ta = 0 ~ 70°C, C = 0.1 μF)

(2) Output high level current:
$I_{OH} \leqq 250\ \mu A$ (I_F = 250 μA, $V_{CC} = V_O$ = 5.5V, Ta = 0 ~ 70°C, C = 0.1 μF)

C = 0.1 μF in the above conditional items is required for stabilizing power supply Vcc. If frequency impedance of the power supply is high, the linear amplifier which is contained in **6N137** may become unstable and speed, low level voltage of above-stated output may not be obtained properly. Low inductive bypass capacitance (ceramic capacitance) is desirable for a condenser of 0.1 μF.

Effect of load resistance is shown in Fig. 8-31. When load resistance is increased, input LED current can be somewhat reduced but there is almost no difference. From the output low level voltage standard of the above (1) including temperature dependence characteristics, I_F = 7 ~ 15 mA is set as the recommended value. Further, if switching speed is considered to be important, load resistance should be set at $R_L = 350\Omega$.

- **Enable Terminal**

Pin 7 in Fig. 8-25 is the enable terminal. When voltage of 0.8V or less is applied to this terminal, output voltage is kept at high level and becomes independent of input LED signal.

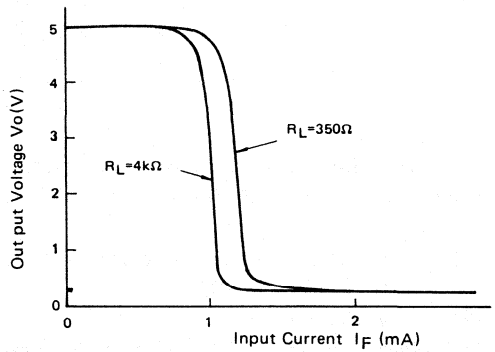


Fig. 8-31 I_F vs Vo Characteristics

■ **Application of High-Speed Photocoupler (6N137)**

In transmitting digital signals, there is the possibility of generating ground loop or ground shift. When a photo coupler is used, ground loop current can be sharply reduced and even when some large noises are applied, internal damages can be prevented by the photo coupler. As an example of application, the basic circuit when the **6N137** is used as a line receiver is described here.

In terminating a transmission line, the following 3 items become important:

(1) Setting of LED forward current I_F that can be properly ON/OFF.
(2) Adjustment of delay time difference t_{PLH} and t_{PHL} between sending signal and receiving signal.
(3) Load matching to reduce reflection on a low loss and high-speed line 50m or less.

Here, a design example of line termination that completely satisfies (1) and nearly satisfies (3) of the above design items is performed on a circuit shown in Fig. 8-32.

The design conditions are as follows:

(1) Characteristic impedance: $Z_O = 75\ \Omega$
(2) Photo coupler's forward current: $V_F = 1.7V$ at $I_F \fallingdotseq 10$ mA
(3) Input current for output ON: $I_{FT} = 10$ mA
(4) Matching with characteristic impedance at $I_F = I_{FT}$
(5) **Set a sum of line resistance and impedance at line driver side (Ro) at 25Ω.**
(6) Open voltage of source line
Application voltage E_0 assumed to be 3 V.

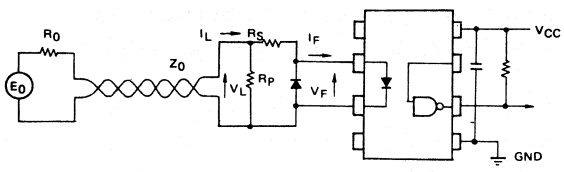


Fig. 8.32 Application to Line Termination

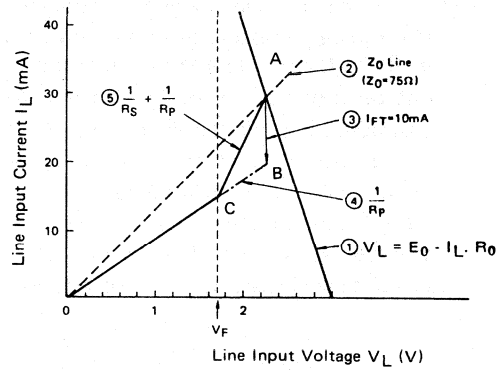


Fig. 8.33 Line Termination Design Graph

With the above conditions, obtain resistance values R_P and R_S which have been set for the line termination. Perform the design in order of numbers in circles in Fig. 8.33.

(1) Draw a characteristic curve at line input ON state:
$$V_L = E_O - I_L \cdot R_O$$
(2) Draw Z_O line.
(3) Removing $I_{FT} = 10$ mA from the intersecting point A of the termination ON line and the Z_O line, obtain Point B.
(4) Connect Point B and the original point. As this slope indicates current flowing to R_P,

$$R_P = \frac{2.25\ (V)}{20\ (mA)} = 112\ (\Omega)$$

(5) Connect Point C and Point A. As this slope indicates current flowing to R_P and R_S,

$$\frac{1}{R_S} + \frac{1}{R_P} = \frac{14.9\ (mA)}{2.25 - 1.7\ (V)} \quad \therefore R_S = 28\Omega$$

From standard resistance values, $R_P = 120\ \Omega$ and $R_S = 27\ \Omega$.

Reflection coefficient according to this calculation method is positive before input LED is ON. Therefore, when a photo coupler is OFF, a reflection accompanying vibration may be caused on a transmission line, however, this vibration is normally at low level and it is possible to design the most simple termination.

8-2 How to Use Photocouplers

8-2-1 LED Control Circuit

DC drive

An example of controlling LED drive current by switching on and off the power supply, is shown in Fig. 8-34.

In this case, resister R is

$$R = \frac{V_{IN} - V_F}{I_F}$$

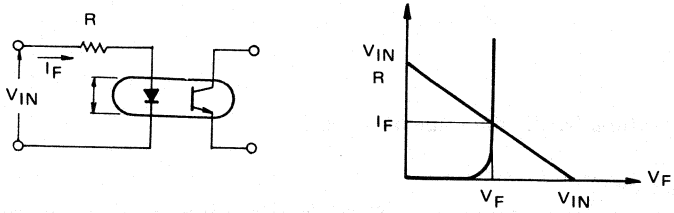


Fig. 8-34 Simple drive circuit for an LED

For example, when I_F = 10 mA, $V_{F(MAX)}$ = 1.35V, and V_{IN} = 5V

$$R = \frac{5 - 1.35}{10\ \text{mA}} = 365\Omega$$

Therefore, it should be at R = 360Ω. Assuming that V_F = 0.9V due to its fluctuation or temperature dependence, the value of I_F is 11.4 mA.

Reverse voltage protection

When a reverse surge voltage is applied on a light emitting diode, a Si diode (for example, 1S1588) should be connected in reverse parallel with the light emitting diode so that the reverse surge voltage bypasses the LED.

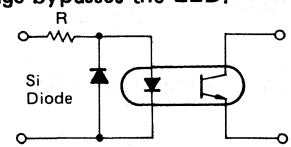


Fig. 8-35 Protection from reverse voltage by silicon diode

Threshold voltage

When the input voltage is not absolutely zero or some unnecessary steady current flow is in a data transmission line, the threshold voltage of LED should be raised up to a certain level by connecting a resistor in parallel with the light emitting diode. (Fig. 8-36)

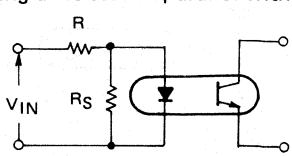


Fig. 8-36 Threshold voltage

If the forward voltage of LED which is in the zero-light-emission V_T, the off-level input voltage $V_{IN(OFF)}$, and the off-level input current $I_{IN(OFF)}$ are given by

$$V_{IN\ (off)} = V_T + R\frac{V_T}{R_S}$$

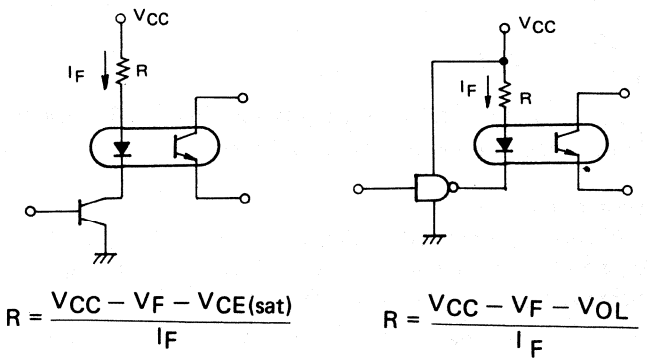
$$= \left(1 + \frac{R}{R_S}\right) V_T$$

$$I_{IN(off)} = \frac{V_T}{R_S}$$

In the case of the Toshiba-IRED, the value of V_T is 0.5V.

Driving by transistor or IC

In Fig. 8-37 are shown examples of LED driving circuits by using transistor or IC.



$$R = \frac{V_{CC} - V_F - V_{CE(sat)}}{I_F} \qquad R = \frac{V_{CC} - V_F - V_{OL}}{I_F}$$

Fig. 8-37 Driving by transistor or IC

AC drive

In this case, a rectifying bridge is used as shown in Fig. 8-38.

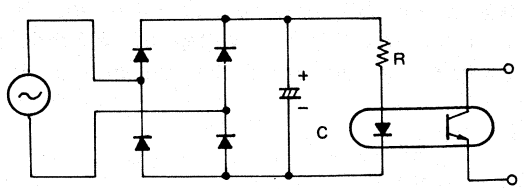


Fig. 8-38 AC drive

8-2-2 Phototransistor Coupler Output Circuit

(1) Base terminal

The transistor action of an output photo transistor, is achieved by receiving a light signal from LED. Then the base terminal of the transistor is not necessary in general so that devices are used without the base terminal. However, the base-terminal is used in the case of forward current threshold action, and improvement of the dark current, linearity, and switching speed of photocouplers.

○ **Improvement of dark current**

The dark current of an output phototransistor increases exponentially with respect to temperature. When we use the circuit in Fig. 8-39 and the output voltage level is decreased by this effect, certainly it is possible to transfer wrong signals to the next stage. Adding a resistor between the base and emitter terminal to pass the leakage current at the collector-base junction(I_{CBO}) to R_{BE} makes it possible to decrease both the dark current and the wrong effect to the next stage. In Fig.8-40 is shown an example of I_D-R_{BE} characteristics. (See the respective data in detail)

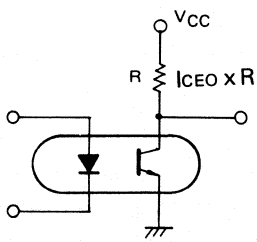


Fig. 8-39 Basic circuit

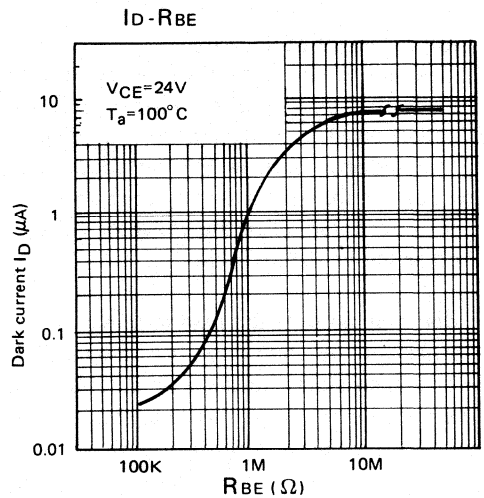


Fig. 8-40 Dark current vs. R_{BE}

- **Forward current threshold action**

Fig. 8-41 shows the relationship between the forward current IF of LED and the collector current I_C of phototransistor. If the resistor R_{BE} is added between base and emitter, the photocurrent I_{PB} is bypassed through R_{BE} and the collector current cannot flow until the $V_{BE\ (on)}$ voltage appears, as shown in Fig. 8-42. For example, when R_{BE} = 0.2 MΩ, collector current $I_C < 0.1$ mA at I_F = 1 mA, the collector current decreases to one tenth of its value in case of $R_{BE} = \infty$. This shows that the forward current threshold action is possible by adding a suitable value of R_{BE}. This is effective in preventing spurious noise signals appearing at the input side.

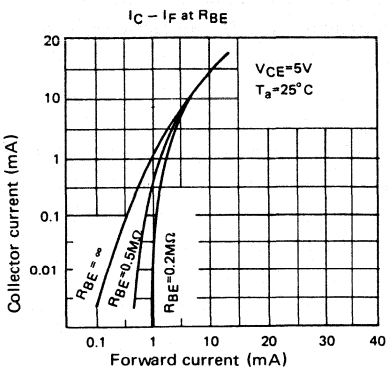


Fig. 8-41 Collector current vs. forward current

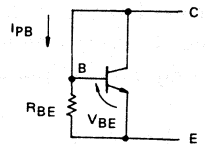


Fig. 8-42

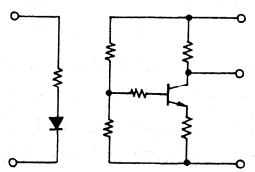


Fig. 8-43 Bleeder Method

- **Improvement of linearity**

The collector current of a phototransistor is large because the photo-current I_{PB} is amplified by h_{FE} of a transistor. However, the collector current is unstable due to the fluctuation of h_{FE} depend on I_{PB}, V_{CE}, and temperature. Generally, for linear application, the collector voltage is set at about half of the supply voltage, however, the transistor action point is shifted for the above reason.

In order to stabilize the collector voltage, it is better to use DC biasing by the bleeder method as shown in Fig. 8-43.

(2) Common noise at the base terminal

When a photocoupler with a base terminal is used, the base terminal acts like an antenna in the open state and picks up a noise. In particular, when a high pulse voltage is applied between the input and output, the induction noise from the base lead terminal and the noise from the capacitance between the input and output are added together to act as an input signal. In this case, adding a capacitance (C_{BE}) between the base and emitter is able to absorb the transitional noise from the base terminal and prevents the error action. However, care must be taken regarding the slowering of response time (examples is shown in Fig. 8-44)

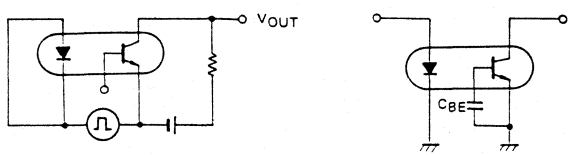


Fig. 8-44 Common noise absorption by C BE

8-2-3 Photo Tyristor Coupler Output Circuit

In transmitting electric signals between circuits having different grounds potential, isolation transformers (pulse transformers), lead relays have been widely used until now. However, for such problems as service life, reliability, space factor, easiness for mounting to circuit board and mounting density, photo couplers have become generally employed.

In the field of industrial control equipment, with the advancement of equipment automation and realization of central control, application of photo couplers has been further expanded. In this field, as a result of wide use of microcomputer, photo couplers are used in interfaces between CPU and I/O cards as presented by sequence controllers, and in interface between microcomputer and power device in such household electric equipment as electric oven, air conditioner and in such office machines as copier.

Especially, a photo thyristor coupler, when used as a power TRIAC gas trigger device, has more merits than a pule transformer and small lead relay which have been used until now.

For instance, when a pulse transformer is used, sufficient trigger pulse width enough to ignite a power TRIAC or a trigger circuit for generating trigger pulses continuously for more than 1 ms is necessary and this makes the circuit to be more expensive.

From this viewpoint, when a photo thyristor coupler is used as an ON/OFF switch of a gate circuit, power can be simply controlled only by driving input side LEDs by TTL gate. Furthermore, in the mechanical contact switching of a lead relay, phase control is not possible as response speed is slow and when operating frequency is high, its life can be adversely affected. In this point, a photo thyristor coupler is superior to conventional pulse transformers and lead relays.

With this background, recently a photo thyristor coupler has been made available in many kinds and its range of application is more and more expanding. The fundamental characteristics, precautions in use and application circuits of these photo thyristor couplers are described here.

Turn-On Mechanism of Photo Thyristor

There are several important turn-on mechanisms of photo thyristors. The first one is the mechanism by gate current I_G which is normally applied to ordinary thyristors.

The second one is the mechanism to ignite a photo thyristor by a light from a light emitting diode, which is applied to a photo thyristor coupler.

The third one is the turn-ON/OFF mechanism through increase of leakage current I_{CO}. ICO increases by about 2 times per 8°C at high ambient temperature and a photo thyristor is turned ON/OFF in αPNP + αPNP→1. Further, if voltage between the anode and cathode rushes into the avalanche break down state by exceeding break over voltage V_{BO} of a device, a photo thyristor is turned ON by this avalanche current, which is however undesirable.

The final one is the turn-on by dv/dt. If a rapid forward voltage rise (dv/dt) is applied between the anode and cathode of a photo thyristor, the thyristor may be ignited even when that voltage applied is less than break over voltage V_{BO} of the photo thyristor and furthermore, LED current is shut off.

When a device is in forward voltage blocking state, the center junction j_2 shown in Fig. 8-12 is reverse biased and the junction capacity C_{j2} in Fig. 8-45 is generated. If forward voltage changes rapidly, charging current i_{j2} flows to C_{j2}. because of this charg-

ing current i_{j2}, electron is injected through J_1 and J_2, respectively, thus igniting a photo thyristor as in the turn-on mechanism by the above-stated $I_{P\lambda}$ (I_F). This injected current is expressed by the following equation:

$$i_{j2} = C_{j2} \times V^{1/K} \times dv/dt$$

$K = 2 \sim 3$

V : Applied voltage

Further a critical value of dv/dt immediately before a photo thyristor is turned off is called dv/dt capability or build-up rate of critical off voltage and expressed in V/us. As current gains of two transistors increase as a result of rise of the junction temperature T_j, dv/dt capability is reduced as shown in the graph of Fig. 8-46. This may further increase transient voltage when the power switch is turned on and mulfunction at time of commutation of inductive load and therefore, it is necessary to take measure described later.

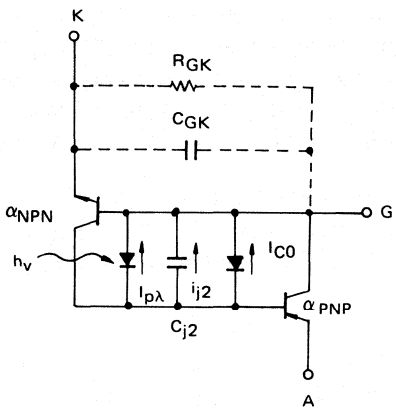


Fig. 8-45 Equivalent Circuit of Photo Thyristor

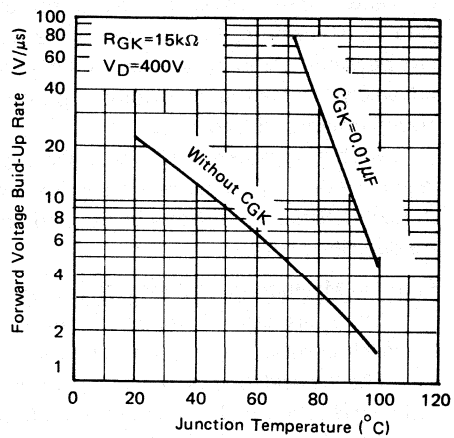


Fig. 8-46 dv/dt vs Junction Temperature

Basic Circuit and Erroneous Ignition Preventive Measure

Generation of dv/dt closely relates to transient voltage when the switch is turned on or off. Mechanisms for generating transient voltage applied to the photo thyristor circuit are shown in Fig. 8-47 and 8-48.

When ON/OFF of an AC circuit by a photo thyristor, the thyristor is positively turned off at an interval of 1/2 cycle. In case of resistance load, when current becomes zero, voltage also becomes zero and voltage build-up immediately after commutation shows a gentle sine wave of supply voltage.

However, in such a photo thyristor circuit of reverse parallel connection with a inductive load as shown in Fig. 8-49, immediately after current of SPT-1 drops below holding current and SPT-1 is turned off, a peak value of supply voltage is rapidly applied in the forward direction of SPT-2. If this forward voltage build-up rate dv/dt is too large, V_{BO} drops due to charging current by the junction capacity C_{j2} of the photo thyristor, and finally erroneous ignition and malfunction of the circuit and system will be caused.

So, in order to positively turn off SPT-2 (not to allow turn-off by dv/dt), it is considered as counterplan to capacitance C_1 insert to erase overshoot by load inductance (L) and insert R_1 as a resistor for limiting surge (di/dt) from a capacitor when the photo thyristor is ignited. Generally, when R_1 = 100 Ω and C_1 = 0.1 μF are used in an actual inductive circuit, it is possible to suppress dv/dt at time of commutation to about 1 ~ 1.5V/μs. The waveform of dv/dt at this example is shown in Fig. 8-51.

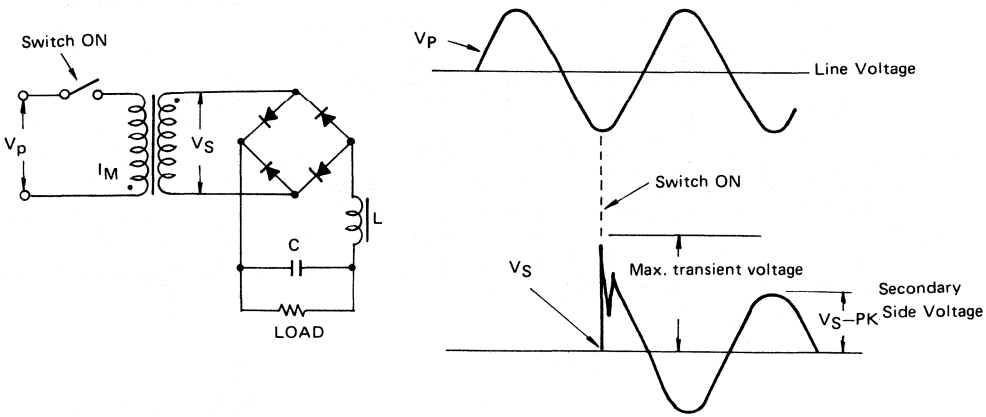


Fig. 8-47 Generation of Transient Voltage When Power Switch of Transformer Primary Side is ON

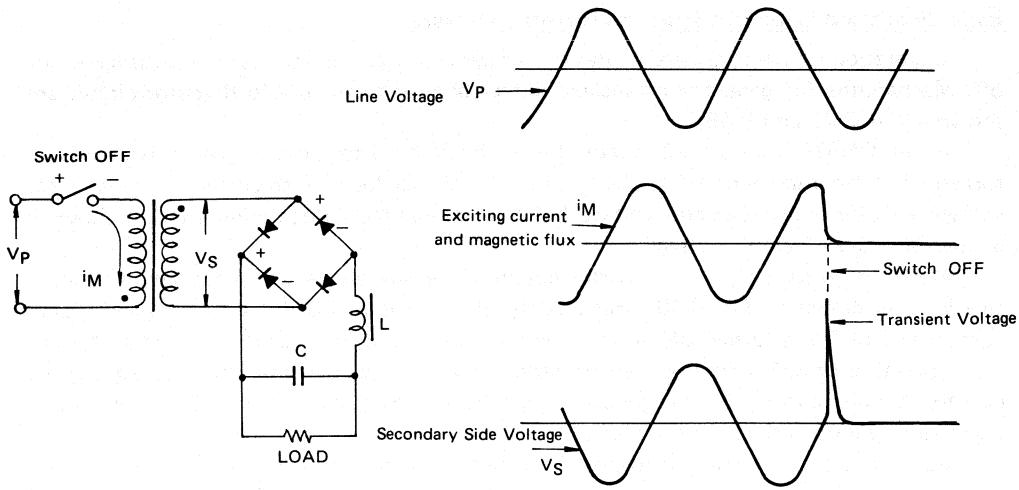


Fig. 8-48 Generation of Transient Voltage when Power Switch of Transformer Primary Side is OFF

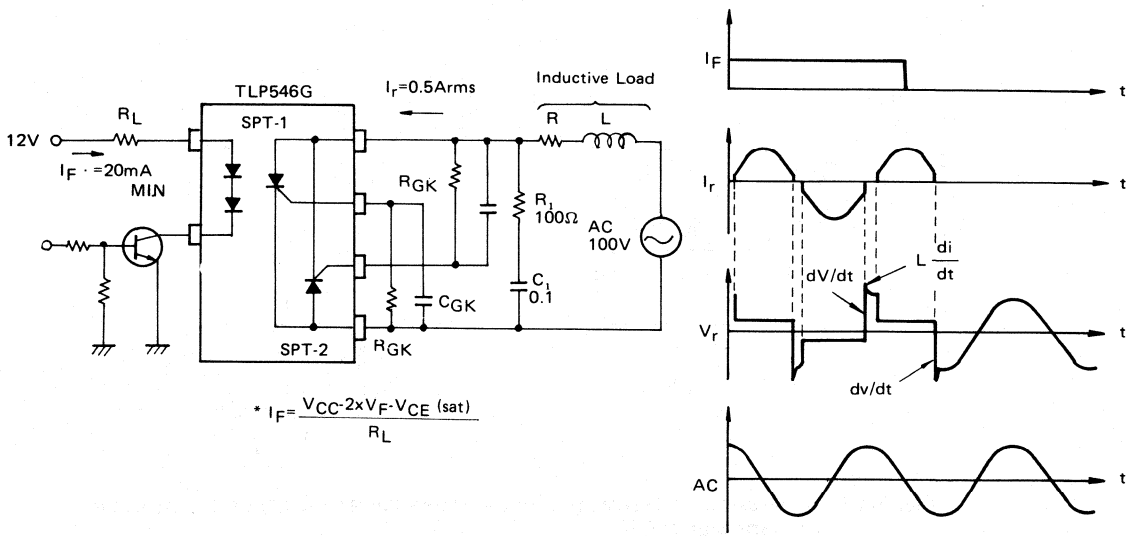


Fig. 8-49 Control of Inductive Load by Photo Thyristor of Parallel Connection

It is necessary to keep dv/dt of a photo thyristor at about 2 V/μs when operated at high ambient temperature Ta = 100°C. From the characteristic curve shown in Fig. 8-46, C_{GK} = 0.01 μF and R_{GK} = 15 kΩ are optimum. As dv/dt vs T_j characteristic differs depending upon used devices it is necessary to refer to the technical data of manufacturers.

Fig. 8-50 shows an example of a circuit using reverse parallely connected small size photo thyristor coupler (I_T = 0.1 ~ 0.2 Arms). In this case photo thyristor couplers works as the main triac photo trigger devices, when several ampere ~ several tens ampere load current is turned ON/OFF.

C_{GK} shown in Fig. 8-50 increases dv/dt capability, maintaining high gate sensitivity for DC and low frequency trigger signals. By bypassing displacement current of C_{j2} dur to dv/dt to the cathode by C_{GK} in the equivalent circuit in Fig. 8-45, the regeneration feedback gain of the photo thyristor can be suppressed, and it will prevent erroneus ignition.

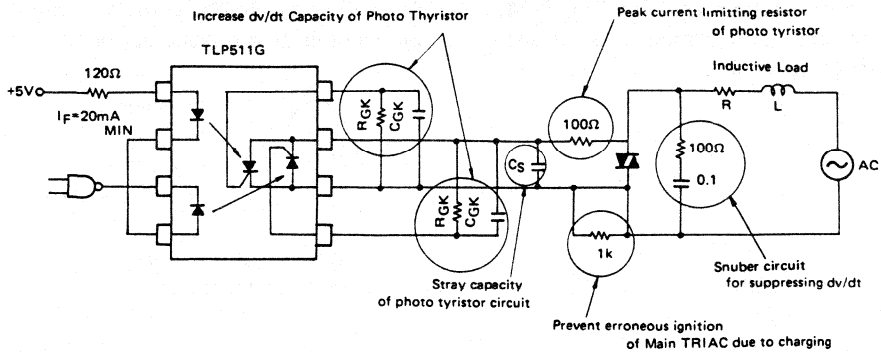


Fig. 8-50 Use of Photo Thyristor of Parallel Connection as TRIAC trigger element

An representative example of characteristics of the relation between C_{GK} and dv/dt capability is shown in Fig. 8-52. In case of photo thyristor couplers available in the market, C_{GK} = 0.001 ~ 0.1 μF is used. Further, as a matter of course, if C_{GK} is set up, the turn-on time t_{ON} becomes longer. Normally, $t_{ON} \cong 20 \sim 30$ μs at C_{GK} = 0.01 μF and over drive factor I_F/I_{FT} = 1.5.

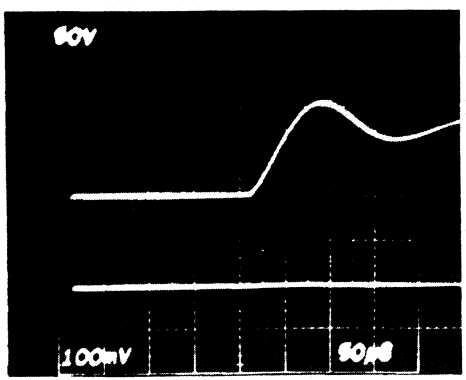


Fig. 8-51 dv/dt Suppression Effect by Snuber Circuit of R=100Ω, C=0.1μF at Time of Comutation

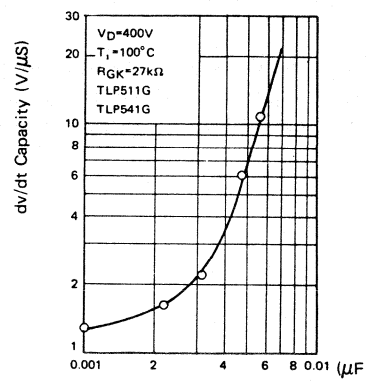


Fig. 8-52 C_{GK} Dependency of dv/dt Capacity

The gate sensitivity of a photo thyristor has been designed high (I_{GT} = 5 ~ 30 μF) so that it is turned ON by minute photo current $I_{P\lambda}$ and therefore, the thyristor is apt to be erroneously ignited by leakage current I_{CO} generated at high temperature operation. So, to assure stable operation, R_{GK} is inserted to bypass I_{CO} to cathode as shown in Fig. 8-50.

Further, as R_{GK} also bypasses gate current i_{j2} by dv/dt, dv/dt capability also increases.

However, as $I_{P\lambda}$ obtained by light energy from LED is bypassed to the cathode, contribution rate as gate current drops and I_{FT} (minimum current of LED required for igniting a photo thyristor) becomes large. And if R_{GK} is too small, LED cannot be triggered. Representative characteristics of this I_{FT} vs R_{GK} are shown in Fig. 8-53.

When full-wave rectification is performed by a diode bridge and its switching is made by photo thyristors, one set of photo thyristor couplers is sufficient enough and it will be expected to be economical. In Fig. 8-54, a simple solid relay which consists of photo thyristor couplers and a main triac is shown as an example of the basic application of photo thyristor couplers.

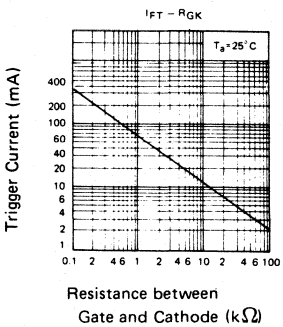


Fig. 8-53 R_{GK} Dependency of I_{FT}

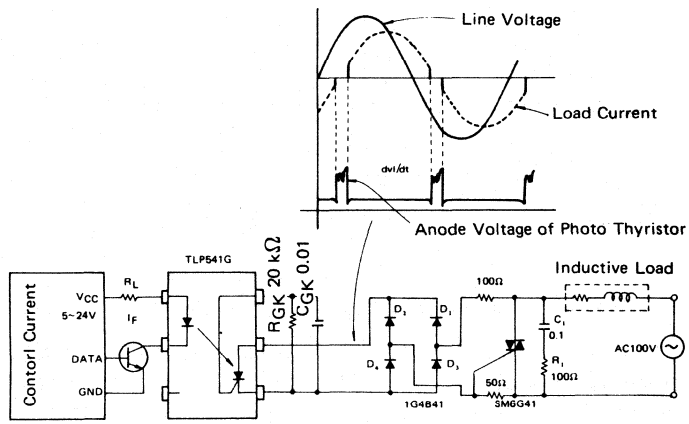


Fig. 8-54 Application of Photo Thyristor Coupler

This circuit is generally used for motor control and various load switching. As anode current of a photo thyristor drops below holding current (I_F = 0.2 mA) and is turned off when the main TRIAC is ignited, the photo thyristor itself does not almost need the power.

8-2-4 Interface Circuit between TTLs using Photo-transistor Coupler

A circuit using a DIP 4 pin photo coupler as an interface between TTLs is shown in Fig. 8-55. In order to assure positive ON/OFF operation of TTL, LED current I_F should be set to satisfy I_{OL} which is decided by R_C and I_{IL}.

Example of Design Specifications

Operating temperature:	0 ∿ 70°C
Data speed:	5 k bits/sec
Supply voltage:	V_{CC} = 5V ± 5%
Operating life:	20 years (170,000 hours)
System working ratio:	50%

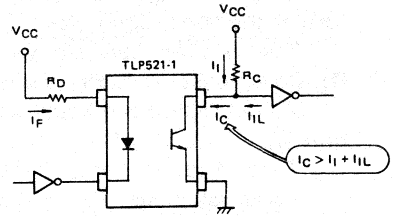


Fig. 8-55 Interface Circuit between TTLs using 4 pin photo coupler

Specifications for products required for designing are shown in Table 8-5.

Table 8-5: Principal Characteristics of TLP521-1

Item	Symbol	Test condition (Ta = 25°C)		min	typ	max	Unit
Forward Voltage	V_F	I_F = 10 mA		1.0	1.15	1.3	V
Collector and Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C = 0.5 mA		35			V
Emitter and Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E = 0.1 mA		5			V
Collector Dark Current	I_{CEO}	I_F = 0, V_{CE} = 24 V		—	10	100	μA
		I_F = 0, V_{CE} = 24 V, Ta = 85°C		—	2	50	μA
Current Transfer Ratio	CTR (I_C/I_F)	I_F = 5 mA, V_{CE} = 5 V	A rank	50	—	600	
			GB rank	100	—	600	
			GR rank	100	—	300	
			BL rank	200	—	600	
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_F = 5 mA, I_C = 1 mA		—	0.1	0.4	V

▼ **Setting of R_C (max)**

Set R_C (max) by switching time and dark current I_{CEO} (max) at max. operating temperature of the photo coumpler.

The relation between switching time and R_L (load resistance), R_C is shown as following.

As data speed is 5 kbits/sec, total switching time is

$T = tr + td + tf + ts \leqq 200\ \mu s$

Load resistance R_L is obtained from the switching time (saturation operation) characteristic in Fig. 8-56 so that T becomes 100 μs, considering device distribution in order to secure $T \leqq 200\ \mu s$. From this graph, $R_L = 4.7\ k\Omega$ is obtained. Here, R_L can be expressed by parallel resistance of the standard TTL input resistance P_{IN} and R_C. (Fig. 8-57)

$$R_L = R_C // P_{IN}$$

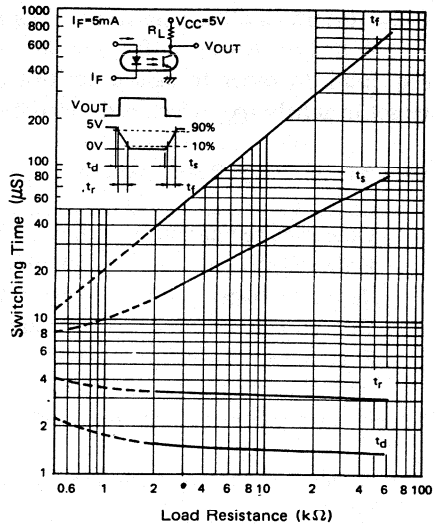


Fig. 8-56 Load Resistance vs Switching Time

As $R_L = 4.7\ k\Omega > R_{IN} = 4\ k\Omega$, R_C may be indefinite ($R_C = \infty$) but R_C (max) against dark current $I_{CEO(max)}$ is limited.

The relation between I_{CEO} (max) and R_C (max) is shown below.

$$R_{C(max)} = \frac{V_{CC(min)} - V_{IH}}{I_{CEO(max)} + I_{IH}}$$

Then, I_{CEO} (max) at Ta = 70°C is estimated. Temperature dependency of I_{CEO} (typ) with a parameter of V_{CE} = 5V/10V/24V is shown in Fig. 8-58.

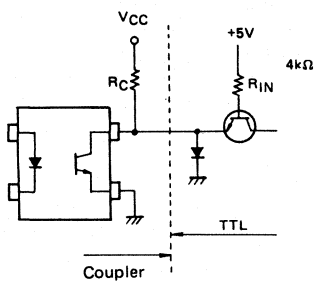


Fig. 8-57 R_L **can be expressed by** R_{IN} **and** R_C

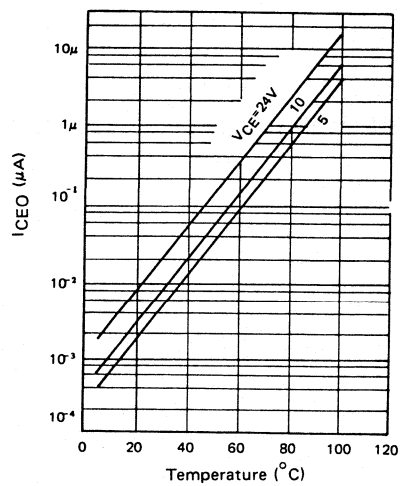


Fig. 8-58 I_{CEO} **vs Temperature**

In the case of the TLP521-1, $I_{CEO\ (max)}$ = 50 μA at Ta = 85°C and V_{CE} = 24V and therefore, taking V_{CE} dependency and Ta dependency into consideration from Fig. 8-58, $I_{CEO\ (max)}$ at Ta = 70°C and V_E = 5V is estimated.

V_{CE} dependency: $I_{CEO(typ)}$ is 1/4 times at V_{CE} = 24V to 5V

Ta dependency: $I_{CEO(typ)}$ is 1/4 times at Ta = 85°C to 70°C

Therefore, $I_{CEO(max)}$ at Ta = 70°C and V_{CE} = 5V is estimated to be,

$$I_{CEO} = 50\,\mu A \times \frac{1}{4} \times \frac{1}{4} = 3.1\,\mu A$$

Accordingly, $R_{C\ (max)}$ will be obrained as following

$$R_{C(max)} = \frac{4.75V - 2V}{3.1\,\mu A + 40\,\mu A} = 64\ k\Omega$$

▼ Setting of Forward Current I_F

Maximum forward current I_F is I_F = 16 mA from $I_F \leqq I_{OL}$ and maximum allowable value of I_F is 50 mA from Fig. 8-59. However, it should be kept as small as possible as CTR degradation increases with the increase of forward current. Fig. 8-60 shows degradation of CTR. In order to expect the continuous operating life of approx. 100,000 hours, forward current should be set at I_F = 10 mA ± 50%.

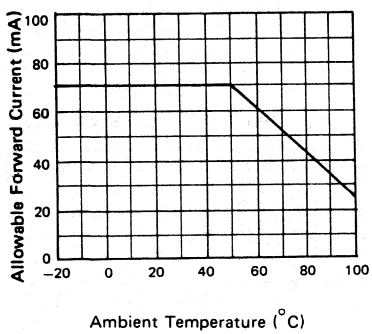


Fig. 8-59 Ambient Temperature vs. Allowable Forward Current (TLP521-1)

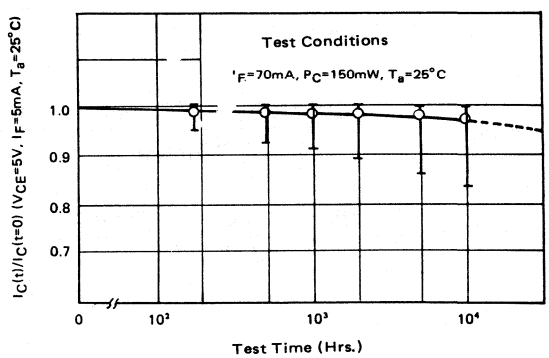


Fig. 8-60 Life Test Data (CTR degradation)

▼ Setting of I_F Limiting Resistance R_D

Forward Current (typ.) is expressed by the following formula:

$$I_F = \frac{V_{CC} - V_{F(typ)} - V_{OL}}{R_{D(typ)}}$$

where $V_{F(typ)}$ is obtained from a technical data.
then, $V_{F(typ)}$ = 1.15V (at I_F = 10 mA)

Therefore, R_D is given as following.

$$R_D = \frac{5V - 1.15V - 0.4V}{10\,mA}$$

$$= 345\Omega$$

Therefore, R_D = 330Ω ± 5% will be optimum.

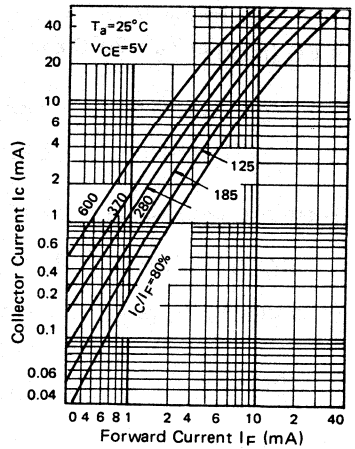


Fig. 8-61 I_C vs I_F by parameter I_C/I_F

When $I_{F(min)}$ and $I_{F(max)}$ should be checked to make sure,

$$I_{F(min)} = \frac{V_{CC(min)} - V_F\ (max) - V_{OL}}{R_{D(max)}}$$

$$= \frac{4.75V - 1.3V - 0.4V}{314\Omega}$$

$$= 9.7\ mA$$

$$I_{F(max)} = \frac{V_{CC(max)} - V_{F(min)} - V_{OL}}{R_{D(min)}}$$

$$= \frac{5.25V - 1.0V - 0.4V}{347}$$

$$= 11.1\ mA$$

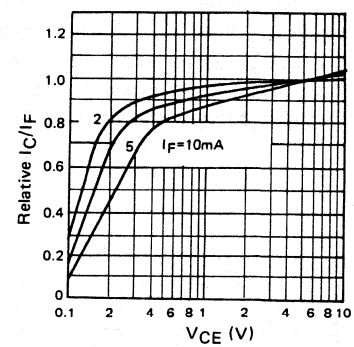


Fig. 8-62 I_C/I_F vs. V_{CE}

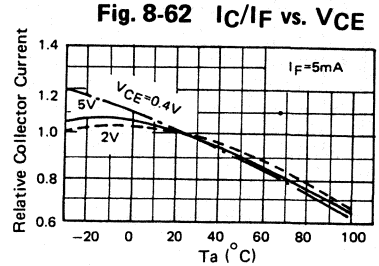


Fig. 8-63 Collector Current vs. Ta

▼ Setting of Pull-Up Resistance R_C

When a value of collector current I_C in the worst case is assumed to be min I_C, it can be expressed by the following relation:

$$R_C = \frac{V_{CC(max)} - V_{OL}}{\min I_C - I_{IL}}$$

$$\min I_C = I_{C(min)} \times D_{IF} \times D_t \times D_{VCE} \times D_{Ta}$$

where,

D_t : I_C degradation rate after certain time has passed.

D_{IF} : I_C change rate at I_F setting for catalog conditions.

D_{VCE} : I_C drop rate under $V_{CE(sat)}$ condition.

D_{Ta} : I_C fluctuation rate within operating temperature T_{OPR}.

These values are obtained from technical data.

In the case of the TLP521-1:

From Fig. 8-60, D_t = 0.5 (t = 17 x 10^5, H_R x 50% working ratio)

From Fig. 8-61, D_{IF} = 2.5 (I_F = 10 mA)

From Fig. 8-62, D_{VCE} = 0.8 (V_{CE} = 0.4V)

From Fig. 8-63, D_{Ta} = 0.75 (Ta = 70°C)

On the other hand, as $I_{C(min)}$ = 2.5 mA (I_F = 5 mA x $I_C/I_{F(min)}$ = 50%),

min I_C = 2.5 mA x 2.5 x 0.5 x 0.8 x 0.75 = 1.8 mA

However, if based on these data, the following formula can not be formed

$$\min I_C - I_{IL} > \frac{V_{CC(max)} - V_{OL}}{R_{C(max)}}$$

Therefore, a photo coupler with higher CTR should be selected. In the case of the TLP521-1 (GB), as $I_{C(min)}$ is guaranteed to be 5 mA, min I_C will become 3.6 mA. Accordingly, $R_{C(min)}$ can be obtained as following:

$$R_{C(min)} = \frac{5.24 - 0.4}{3.6 - 1.6} = 2.4\ k\Omega$$

In other words, R_C can be set from 2.4 kΩ to 64 kΩ but it is also need to consider the switching speed, required by a system and the certainty of logical ON/OFF. If the switching speed is attached to be important, R_C should be set to be near to $R_{C(min)}$. On the other hand, if the certainty of ON/OFF operation (this may be taken as the operating life) is considered as important, a value close to $R_{C(max)}$ should be selected. In this case, since Dt is assumed to be 0.5, the switching speed should be considered to be important. So, Rc is obtained as 4.7 kΩ.

8-2-5 TRIAC Drive Circuit Using Photo Coupler

Such electronic equipment as electronic oven, copier, auto-door, etc. have become controlled by microcomputer recently and interface between power circuit and microcomputer logic becomes more and more important. In this paragraph, a triac drive circuit which has especially wide applications as a power circuit is explained.

(1) Drive by Photo Darlington Coupler

Gate trigger current I_{GT} of 3 ~ 16A class TRIAC is necessary 20 ~ 50 mA. Accordingly, I_G = 40 ~ 50 mA is necessary as gate current and therefore, a photo Darlington coupler with high CTR is used. An example of this circuit is shown in Fig. 8-64.

Example of Design Specifications

Operating temperature:	−30 ~ 85°C
Switching capability	100V, $3A_{RMS}$
Supply voltage:	V_{CC} = 5V ±5%
Operating life:	20 years (170,000 hours)
System working ratio:	50%

First, the TLP570 is used in this example.

<Design Procedures>

▼ Setting of Forward Current I_F

In the same manner as in the above mentioned TTL interface, I_F is set to be 10 mA and therefore, R_D = 330Ω and $I_{F(min)}$ = 9.7 mA ≒ 10 mA are obtained.

▼ Setting of R_C

The minI_C (the minimum value) of the TLP570 is 42 mA when $I_{C(min)}$ is 100 mA (I_F = 10 mA, V_{CE} = 1.2V) and variable factors are assumed as following:

D_t = 0.6

D_{IF} = 1

D_{Ta} = 0.7

Therefore, R_C is calculated as following:

$$R_C = \frac{V_Z - V_{CE(sat)}}{\min I_C} = \frac{6.8\ V - 1.2\ V}{42\ mA} = 133\ \Omega$$

Therefore, R_C = 130 Ω (1/4W) is optimum.

▼ Setting of Other Constants

R_Z is given by the following equation:

$$R_Z = \frac{V_{AC} - V_Z - V_{F(D_1)}}{I_Z}$$

By substituting I_Z = 20 mA and V_F = 1V into this formula, R_Z = 4.6 kΩ is obtained. Power consumption of R_Z is $I_Z^2 R$ = 1.8W. Therefore, R_Z = 4.7 kΩ (3W) is optimum.

47Ω, 0.1μF between T_1 - T_2 is snubber circuit to surge absorption.

(2) 400V/8A TRIAC Drive Circuit

In the case of a 8A class TRIAC, gate trigger current I_G is as high as 50 mA and therefore, I_G = 100mA is required. So, the circuit shown in Fig. 8-65 is better.

The design procedures are briefly described below.

- As I_F = 10 mA, R_D = 330Ω
- As I_G = 100 mA, R_E = 33Ω
- As I_C = 10 mA, R_C = 470Ω

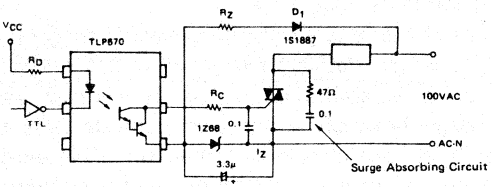


Fig. 8-64 3A TRIAC Drive Circuit

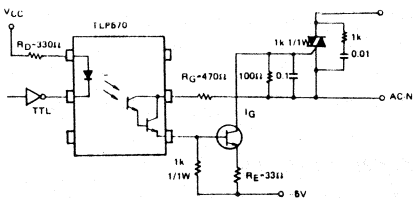


Fig. 8-65 8A TRIAC Drive Circuit

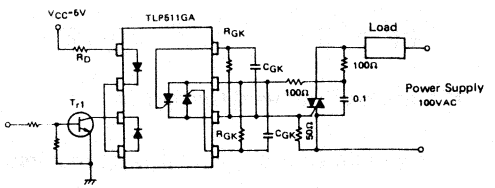


Fig. 8-66 Thyristor Coupler TRIAC Drive Circuit

(3) Drive by Reverse Parallel Thyristor Coupler

The TRIAC driving through a unidirectional conducting thyristor coupler with a bridge rectifier circuit has been principally described until this paragraph. When reverse parallel thyristor couplers are used, following merits can be derived:

① A bridge rectifier circuit can be eliminated, thus reducing number of components and simplifying circuits

② As independent photo thyristors are reverse parallelly connected and either one is always non-conductive for half cycle, commutating dv/dt of photo couplers does not exist intrinsically.

An example of the circuit using reverse parallel thyristor couplers is shown in Fig. 8-66.

Example of Design Specifications

Operating temperature:	−30 ~ 85°C
dv/dt capability:	10V/μs min.
Operating life:	20 years (170,000 hours)
System working ratio:	50%

In this example, the TLP511GA Photo Coupler is used.

Design Procedures

▼ Setting of R_{GK}, C_{GK}

As trigger energy of photo-electric trigger is extremely less than that of current trigger, R_{GK} is set at relatively high level as 10 k ~ 33 kΩ and therefore, gate sensitivity increases and dv/dt capability decreases. In this case, even when no trigger gate input is applied, if voltage between anode and cathode rises to exceed a certain critical value (dv/dt capability), the circuit is turned on. This dv/dt capacity is in reverse strongly depends proportional to gate sensitivity. And it depends on R_{GK}, C_{GK} and Ta strongly as shown by (a), (b) and (c) in Fig. 8-67. From Fig. 8-67, R_{GK} and C_{GK} which satisfy dv/dt ≧ 10 V/us of the design specifications are set as follows:

$$R_{GK} = 27\ k\Omega\ ,\quad C_{GK} = 0.01\ \mu F$$

▼ Setting of Forward Current I_F

Minimum LED current $I_{F(min)}$ required for trigger is given by

$$I_{F(min)} = I_{FT(max)} \times D_{Ta} \times D_{RGK} \times D_t \times D_{ON}$$

where,

$I_{FT(max)}$: I_F value, required for turn-on (7 mA from technical data)

D_{Ta} : 1.2 from temperature characteristics of I_{FT}.

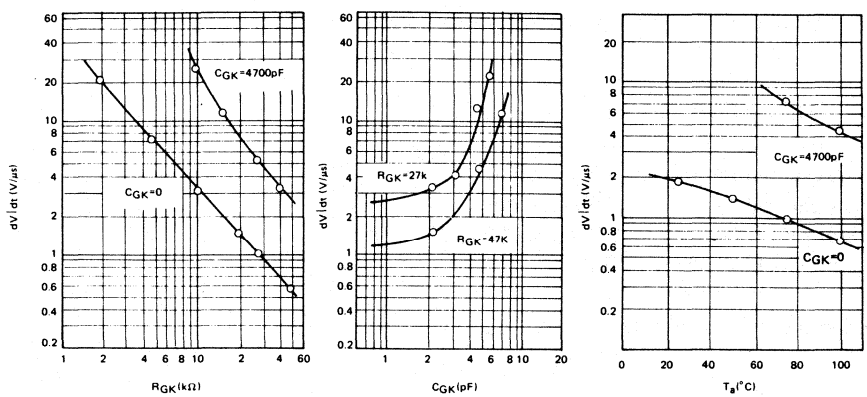
D_{RGK} : Ratio 1 which is obtained from R_{GK} dependence characteristics of I_{FT}

D_t : 1.3, from I_{FT} degradation

D_{ON} : 2, Overdrive factor

Therefore, $I_{F(min)}$ = 20 mA is obtained. But the direct driving by TTL is impossible, so Tr_1 is used as a LED driver.

From $R_D = \dfrac{V_{CC} - 2V_F - V_{CE(sat)}}{I_{F(min)}}$, R_D = 120 Ω ± 5% is optimum.



(a) dv/dt vs. R_{GK} (T_a=100°C)

(b) dv/dt vs. R_{GK} (T_a=100°C)

(c) dv/dt vs. Ta (R_{GK}=27kΩ)

Fig. 8-67 Thyristor Coupler Characteristics

8-2-6 AC Switching Circuit Using Thyristor Coupler

In this paragraph, as the basic circuit of a solid state relay (SSR), Fig. 8-68 is shown. In this circuit, the methods for selecting R_{GK} and C_{GK} and deciding control current (forward current I_F) are described as following.

Example of Design Specifications

Operating temperature:	T_{opr}	= 0 to 70°C
Supply voltage:	V_{CC}	= 5V ± 5%
Resistance variation:	±5%	
Operating life:	170,000 hours (about 20 years)	
System working ratio:	50%	

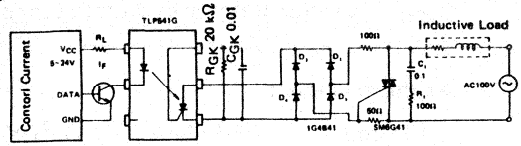


Fig. 8-68 Example of SSR Circuit

▼ Selection of Components

In the circuit shown in Fig. 8-68, the TLP541G is used as the photo thyristor coupler.

However, as the TLP541G is of unidirectional conduction type, the 1G41B is used as a rectifying bridge.

In order to turn ON/OFF 100V, 2A load, the SM6G14 is used as a main TRIAC. Further a circuit with R = 100Ω and C = 0.1 μF is adequate for a snubber circuit. R = 50Ω which is set up between G and T_2 of the TRIAC is to bypass charging current by capacitance of a diode bridge or photo thyristor.

▼ Setting of R_{GK}, C_{GK}

As load is inductive, dv/dt capacity should be designed to be large as a measure against the above-stated problems. When the SM6G14 is turned on, as no power flows through the TLP541G, power loss is less and T_j rise due to self-power dissipation is not so much. Therefore, the maximum junction temperature of the photo thyristor is considered to be maximum ambient temperature plus the heat spread from LED side. LED forward current I_F is limited to be $I_F \leqq 30$ mA from the relation of a longer life as described later and even when this heat generation is added, the junction temperature of thyristor coupler, $T_{j(SCR)}$ will be below about 80°C.

With effect of the snubber circuit taken into consideration, dv/dt = 2 ~ 3V/μs is kept at $T_{j(SCR)}$ = 80°C and V_{DRM} = 280V which is twice of maximum supply voltage.

To give a margin to dv/dt, R_{GK} = 27 kΩ, C_{GK} = 0.01 μF are considered to be adequate from the characteristic curve in Fig. 8-52. C_{GK} can be increased to a level where no trouble due to long turn-on time of the thyristor coupler is generated.

▼ Setting of Forward Current

Minimum forward current I_F for turning on a photo thyristor is defined to be trigger LED current I_{FT}. I_F which is required here is obtained from the following formula:

$$I_F = I_{FT(max)} \times D_{Ta} \times D_{RGK} \times D_t \times D_{ton}$$

where,

$I_{FT(max)}$: I_{FT} which is initially guaranteed in technical data

D_{Ta} : A relative value of temperature dependency of I_{FT} within a range of 1.1~1.2 times

D_{RGK} : A relative value of R_{GK} dependency of I_{FT}.
No correction is necessary as R_{GK} = 27 kΩ which is the same as measuring condition of manufacturer.

D_t : Compensation factor of I_{FT} degradation. It is necessary to confirm with manufacturer. Fig. 8-69 is referred to here.

D_{ton} : Overdrive factor to shorten turn-on time. In this case, estimated at $D_{ton} = 1.2$

As the examples:

$I_{FT(max)}$ = 7mA at Ta = 25°C, R_{GK} = 27 kΩ

D_{RGK} = 1 at R_{GK} = 27 kΩ

D_t = 1.3 at 8.5×10^4 Hrs (working ratio 50%)

D_{ton} = 1.5

Therefore, minimum required value of I_F is given as following.

$I_{F(min)} \cong 16$ (mA)

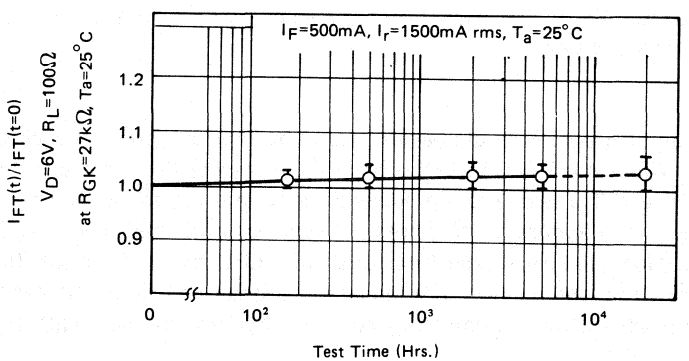


Fig. 8-69 Life Test Results of LED Trigger Current I_{FT} (TLP541G)

Zero-Cross Switch Circuit

When a switch is turned on, current suddenly changes and, the radio frequency interference (RFI) is generated by rush current, or transient voltage.

To minimize RFI there is a method to make a switching around the zero cross point of AC voltage. This is called the zero voltage switching or zero-cross switching.

Fig. 8-70 shows an example of the zero-cross switch constructed using the photo thyristor coupler TLP541. In this circuit, the photo thyristor is turned ON only when voltage between T_1 and T_2 of TRIAC is around zero voltage and TRIAC is triggered.

In this zero-cross system voltage between $T_1 \sim T_2$ is divided by resistors R_1 and R_2 and transistor T_{r1} is saturated by this divided voltage. That is, as photo current Ip of the photo thyristor flows from the gate through T_{r1} and shorted to the cathode when voltage is other than zero, the photo thyristor is not turned ON even when V_{IN} is applied.

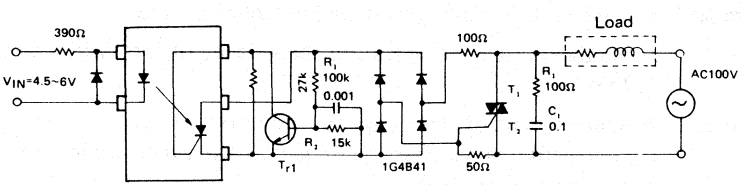


Fig. 8-70 Zero Cross SSR Circuit

Power Control of Magnetron for Microwave Oven

Fig. 8-71 shows an example of power control circuit of an microwave oven. This circuit consist of a phase shift circuit using Uni Junction Transistor 2SH21. The LED trigger phase of the TLP511G is delayed from line voltage by about 90°. Thus, delay in current rise generated by inductive load of main thyristor SM16G14 is reduced and oscillation of magnetron is stabilized.

The trigger circuit operates at duty ratio set in the timer circuit and power of the microwave oven is controlled by oscillation ON/OFF of the magnetron.

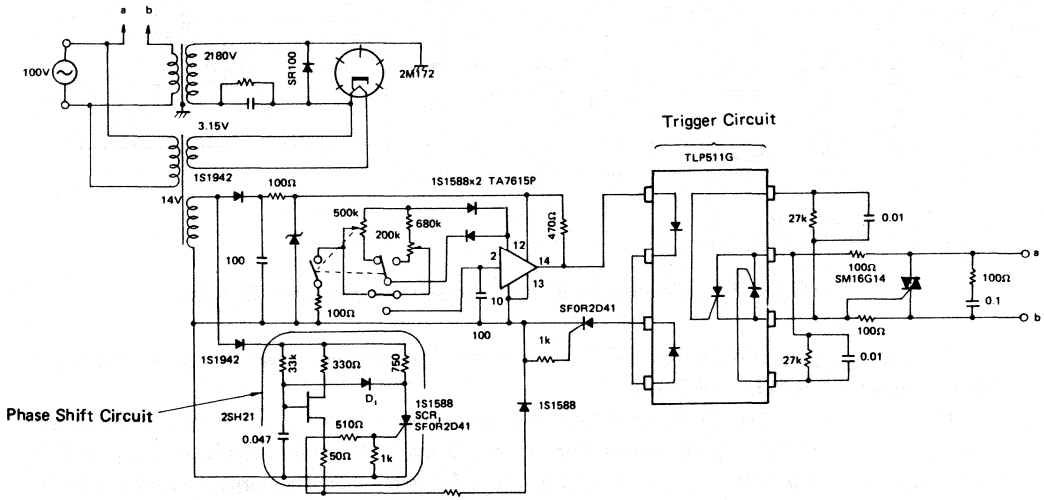


Fig. 8-71 Power Control Circuit of Electronic Oven

Driving of Motor in Normal and Reverse Directions

Fig. 8-72 shows the driving circuit of a reversible motor in the normal/reverse direction with high power photo thyristor couplers applied. Recently, photo thyristors are available in the market, of which power capability reach to ON/OFF load current of about 1 Arms. In this circuit, the TLP546G drives a motor of 4W output. The TLP546G has an aluminium radiating plate of 2 ~ 3 cm^2 embeded in DIP mold and is able to turn ON/OFF 1 Arms at ambient temperature Ta = 40°C.

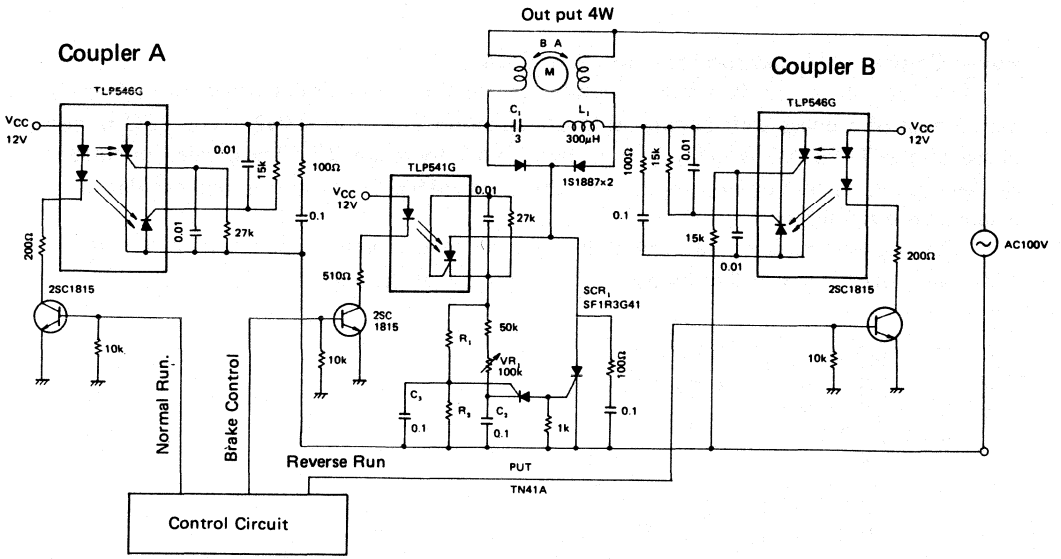


Fig. 8-72 Reversible Motor Normal/Reverse Drive Circuit

Inductive L_1 shown in Fig. 8-72 is necessary for suppressing surge current from C_1 and should be set at 200 ~ 500 μH.

Control signal for switching driving of the photo couplers from direction A to direction B or vice versa requires a pause time more than 1/2 cycle. In other words, if Coupler B is turned ON when Coupler A has not been turned OFF, excessive discharge current suddenly flows from C_1 to both Couplers A and B and devices are completely broken. Fig. 8-73 shows discharge current from C_1 when a 5Ω resistor is inserted for L_1 and its peak value has reached 45A.

For braking, the TLP546G is operated. When the TLP546G is turned ON, PUT is operated to turn OFF SCR_1 at a certain phase difference. When DC component is applied, the reversible motor is braked. As discharge surge current is also generated from C_1 at this time, it is indispensable to insert L_1.

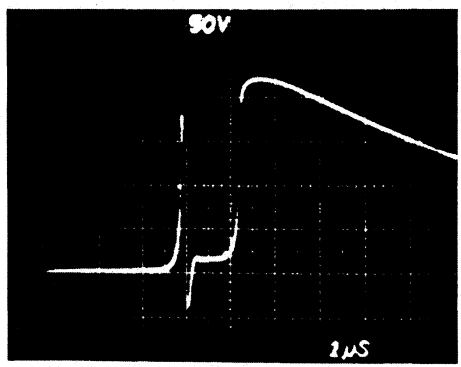
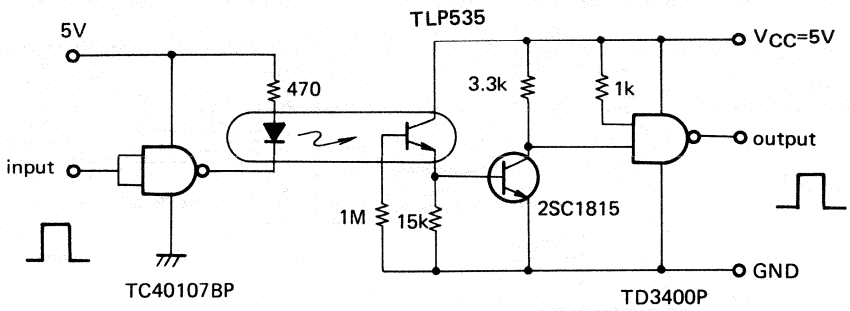


Fig. 8-73 Discharge Surge Current from Condenser C_1 (Voltage Drop of 5Ω Resistor)

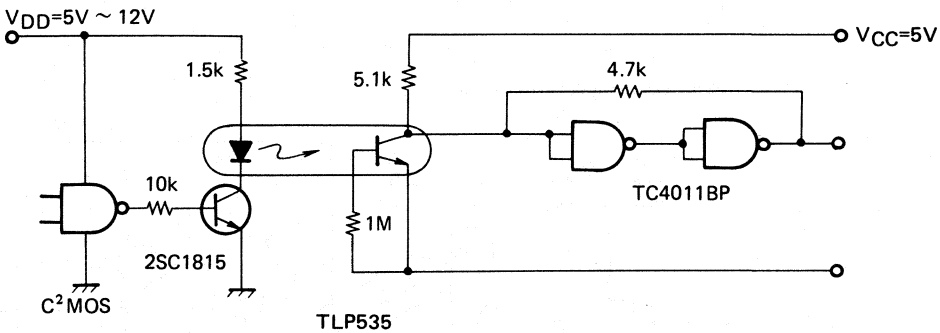
8-3 Examples of Application Circuit

8-3-1 General Interface

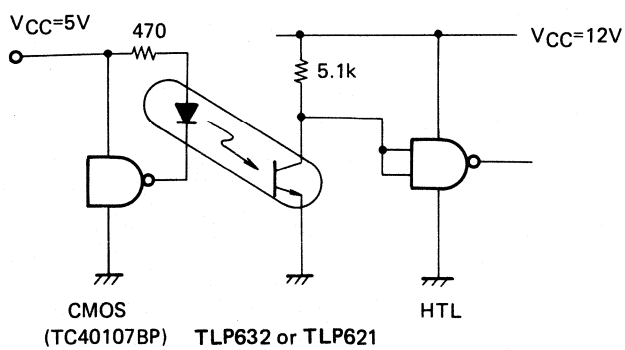
(1) Interface between systems



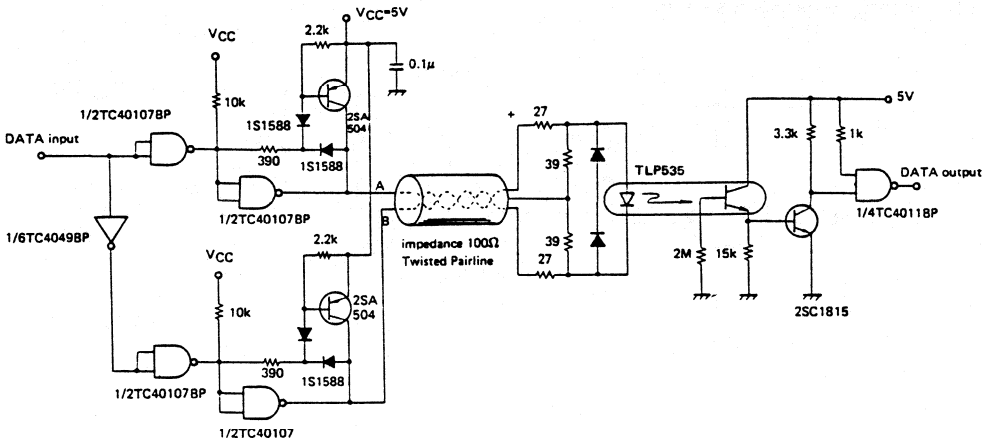
(2) Interface between systems having schmitt circuit



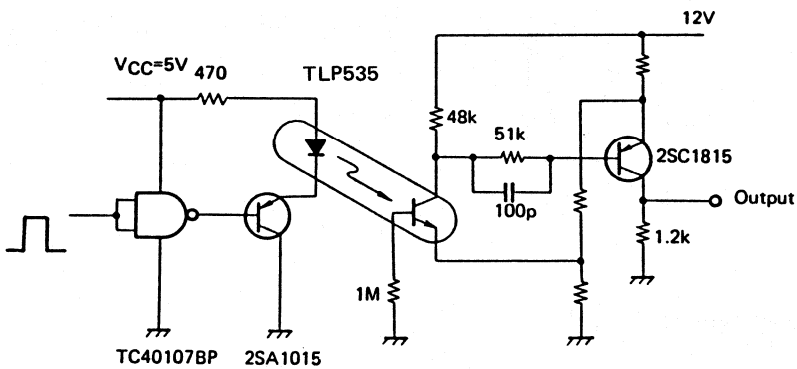
(3) Interface between TTL, HTL



(4) Line driver and line receiver system

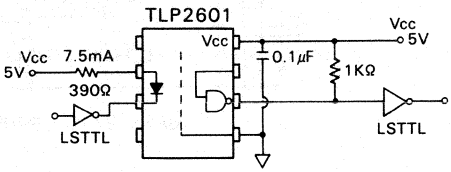


(5) Optical coupling schmitt trigger



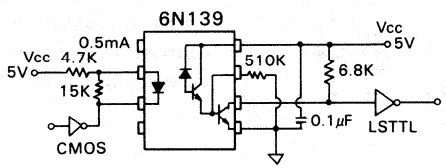
8-3-2 Digital Data Interface Applications

High Speed



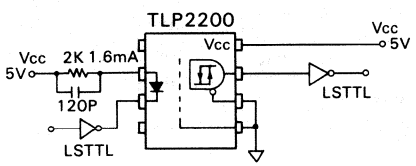
By using high-speed type TLP2601, high-speed data transmission is possible up to approximately 5MHz.
f(Typ.) : 5MHz

(1) Low Input Current Drive



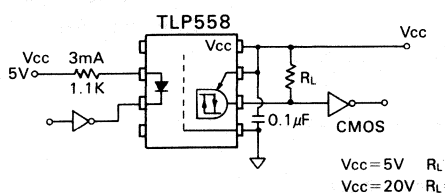
Use of high-CTR (current transfer ratio) 6N139 enables operation by low input current and direct driving with CMOS.
f(Typ.) : 50kHz

(2) Pull-up Resistor Free



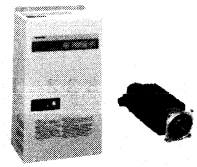
When 3-state output TLP2200 is used, the next-step logic gate can be operated without using a pull-up resistor.
f(Typ.) : 1MHz

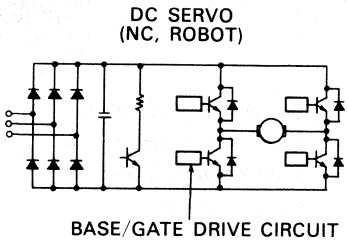
(3) Vcc Range Free

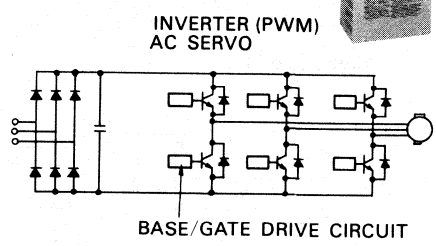


By using TLP558 with wide-range Vcc, CMOS logic gates and other components can be operated with high Vcc.
f(Typ) : 1MHz

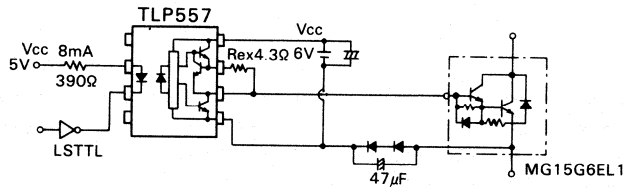
8-3-3 Inverter, AC/DC Servo Applications





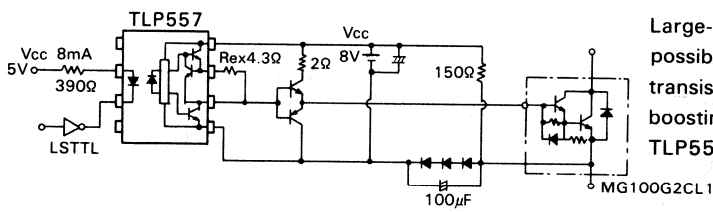


(1) 15A Class G-TR (GIANT TRANSISTOR) Module Base Drive



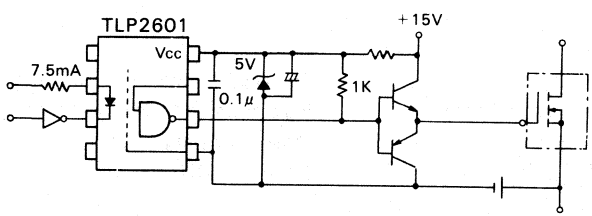
External resistor Rex is connected between pins 6 and 7. This resistor causes the drive base current to become constant and enables a stabilized G-TR drive.

(2) 100A Class G-TR Module Base Drive



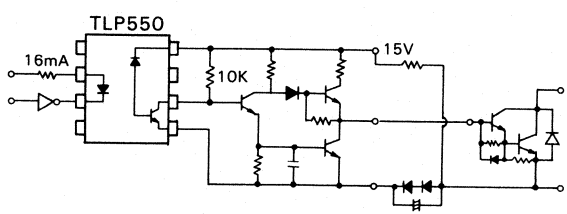
Large-capacity G-TR drive is possible by using two transistors to achieve 1-step boosting of output current of TLP557.

(3) High Speed Switching Power MOS Gate Drive

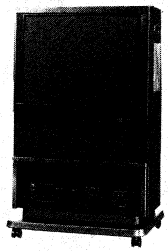


This is a gate drive circuit of power MOS employing high-CMR, high-speed TLP2601.

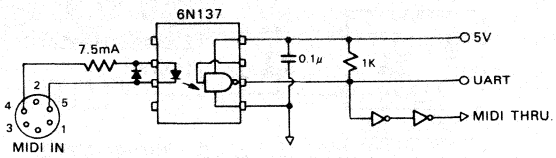
(4) High Speed Switching Transistor Module Base Drive



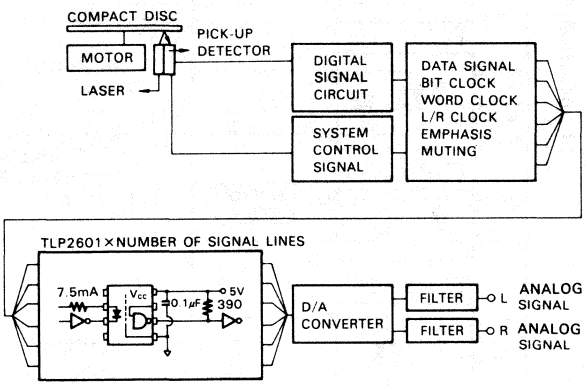
8-3-4 Audio & TV



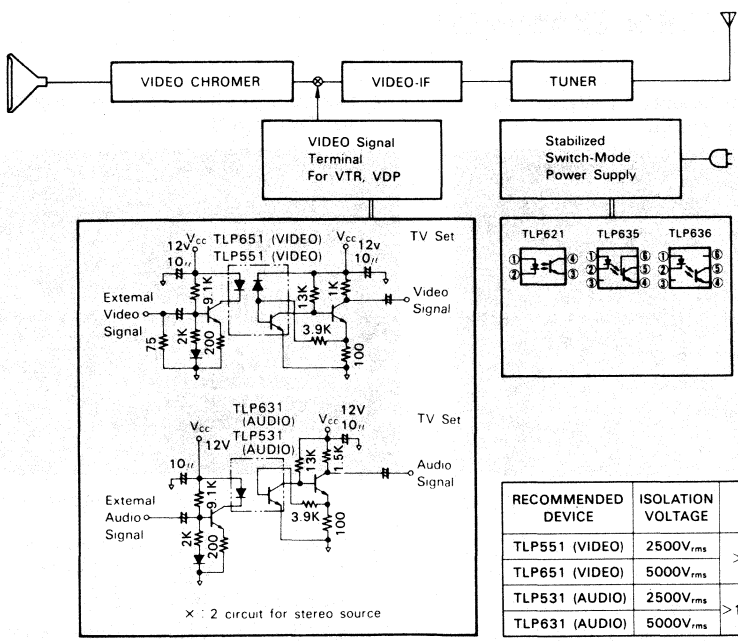
(1) Application for "MIDI" Interface of Electronic Music Instrument



(2) Application for Compact Disc Player



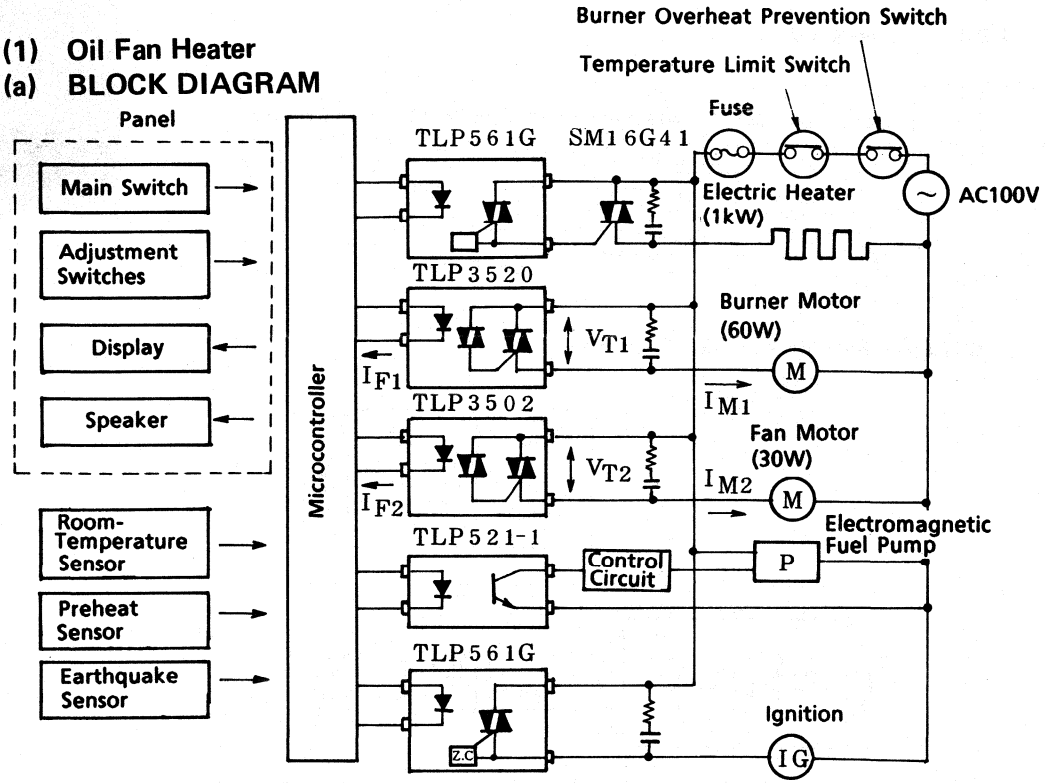
(3) Application for TV Terminal Isolation From Home Computer & VCR



RECOMMENDED DEVICE	ISOLATION VOLTAGE	BAND WIDTH	VOLTAGE GAIN
TLP551 (VIDEO)	2500V_{rms}	>4.5MHz	0.5–2
TLP651 (VIDEO)	5000V_{rms}		
TLP531 (AUDIO)	2500V_{rms}	>100kHz	0.7–2
TLP631 (AUDIO)	5000V_{rms}		

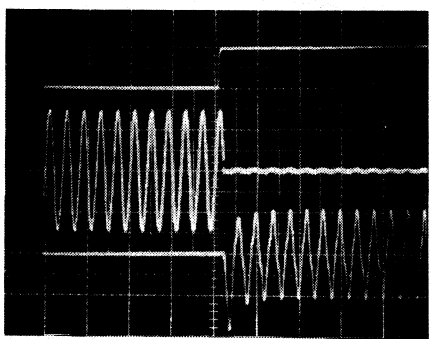
(1) Oil Fan Heater

(a) BLOCK DIAGRAM



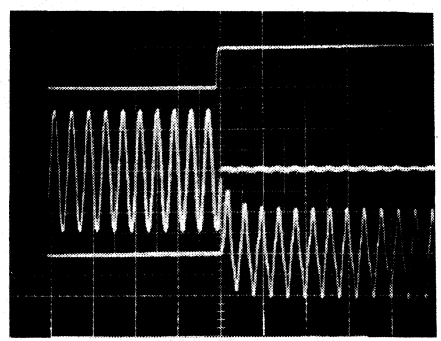
(b) WAVEFORM EXAMPLES

1. Example of Operating Waveform for Burnner Motor



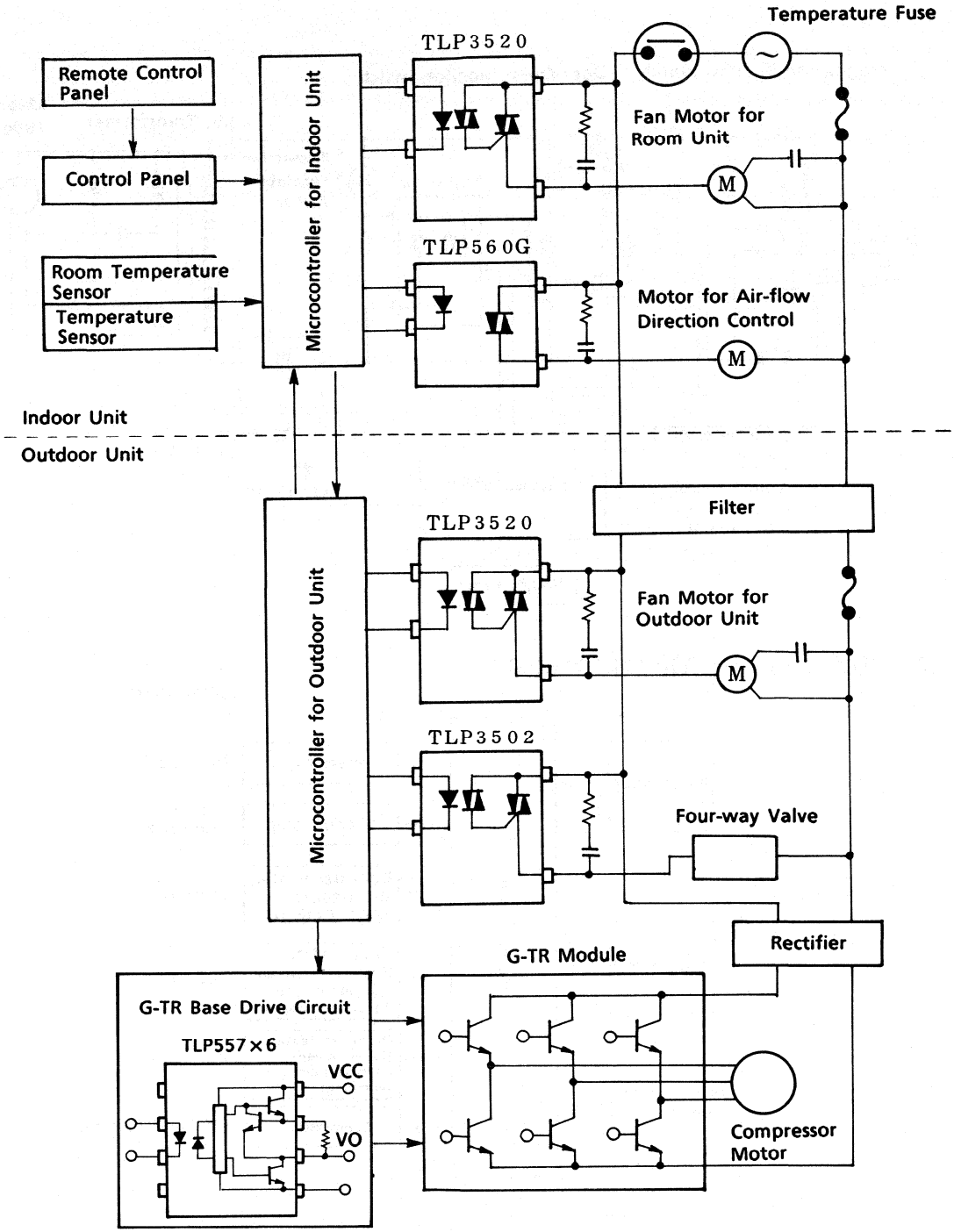
Top : I_{F1} 15mA/div
Medium : V_{T1} 100V/div
Bottom : I_{M1} 1A/div
Horizon : time 50ms/div

2. Example of Operating Waveform for Fan Motor

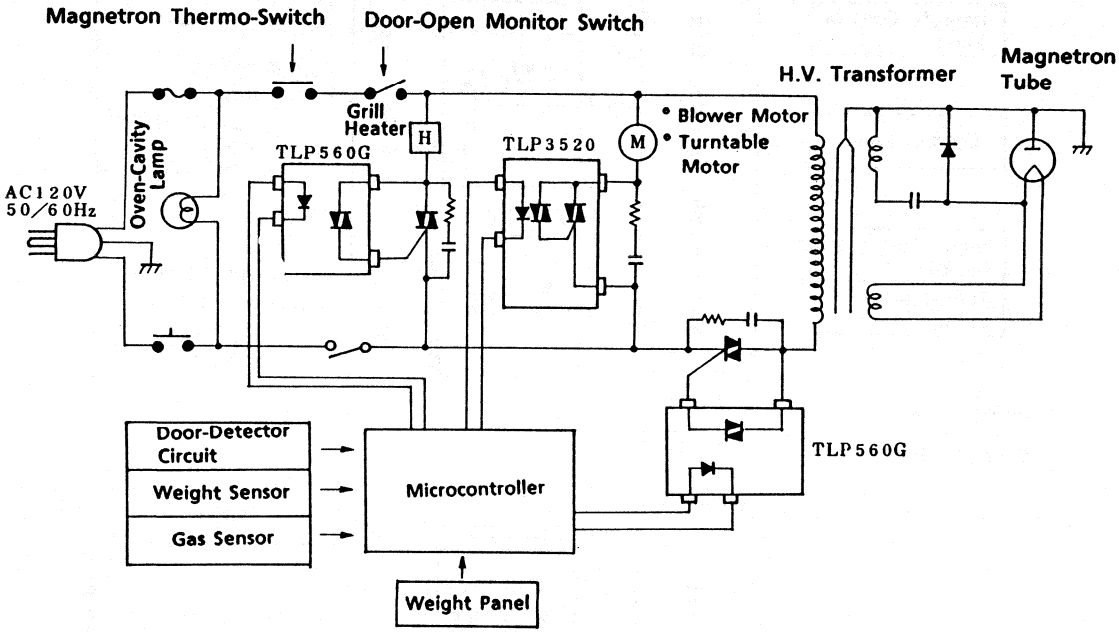


Top : I_{F2} 15mA/div
Medium : V_{T2} 100V/div
Bottom : I_{M2} 0.5A/div
Horizon : time 50ms/div

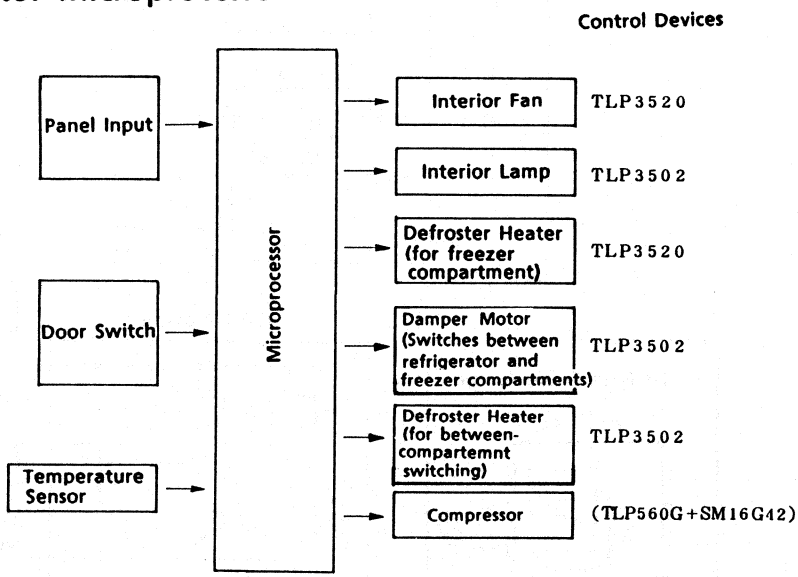
(2) Inverter Air Conditioner



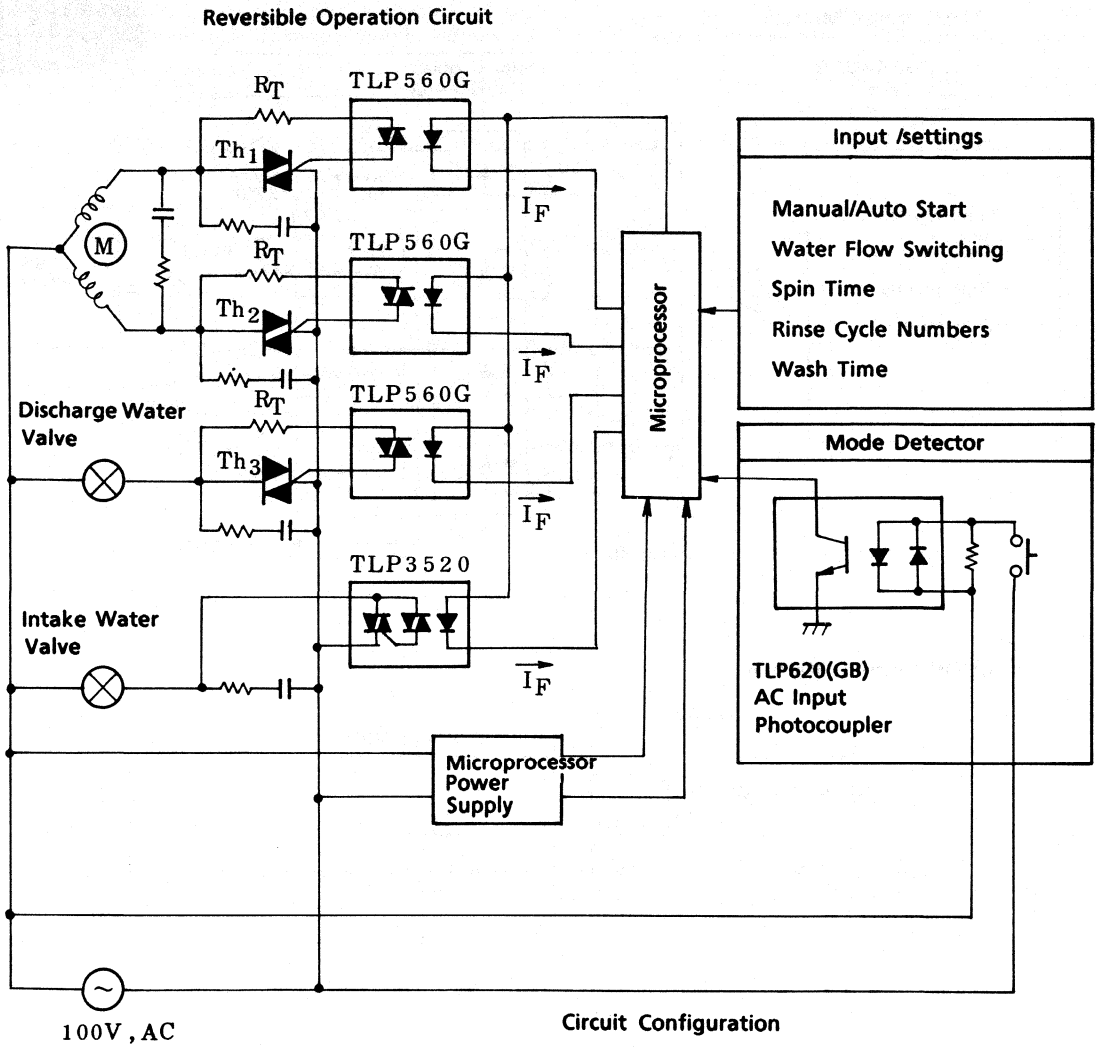
(3) Oven Grill Range



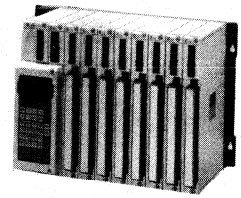
(4) Refrigerator Microprocessor



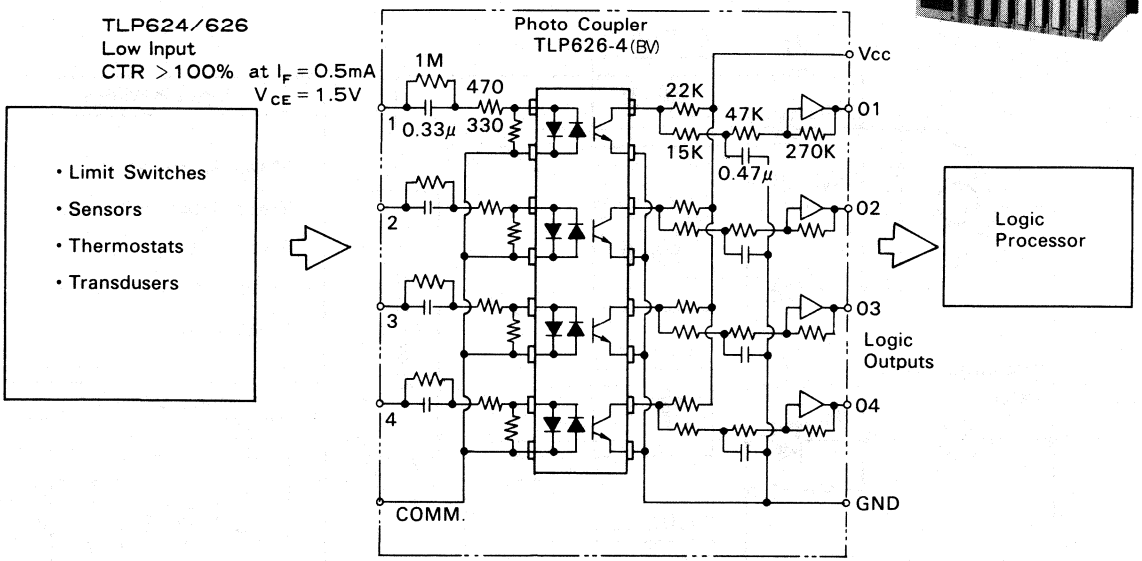
(5) Automatic Washing Machines



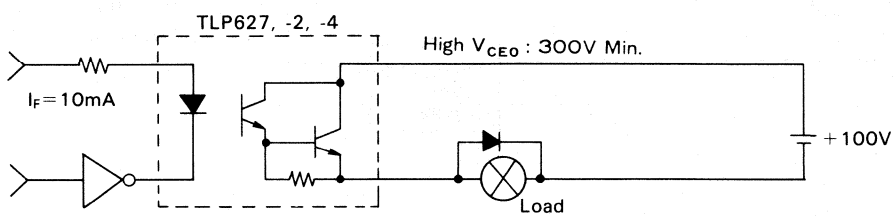
8-3-6 Programmable Controller
(Low Input Photocouplers and High V_{CEO} Photocouplers)

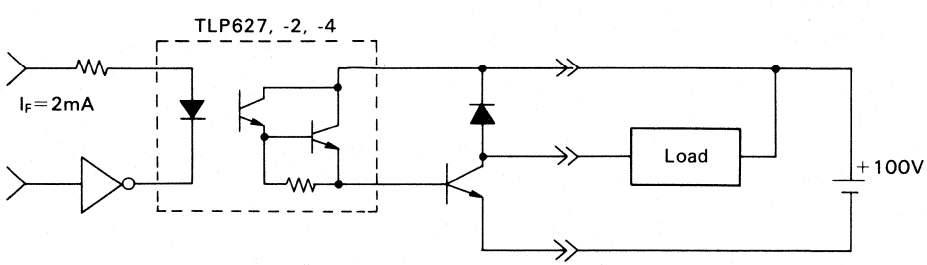


(1)AC Input Module

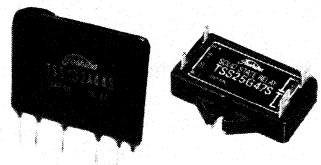


(2)DC Output Module

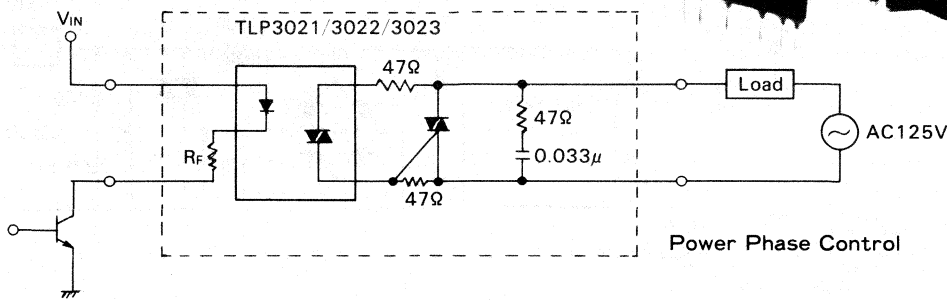




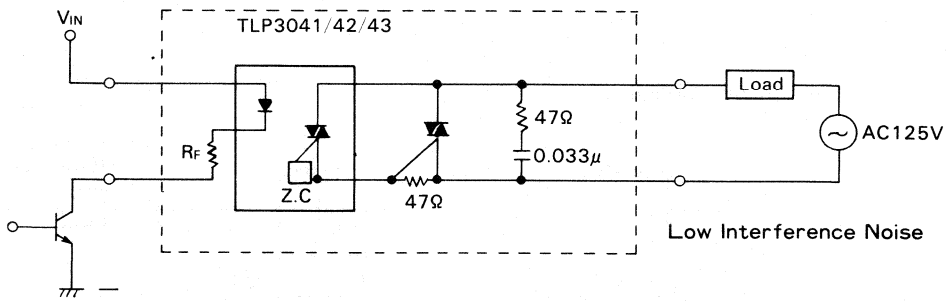
8-3-7 Solid State Relay



(1) Non Zero Crossing Type



(2) Zero Crossing Type

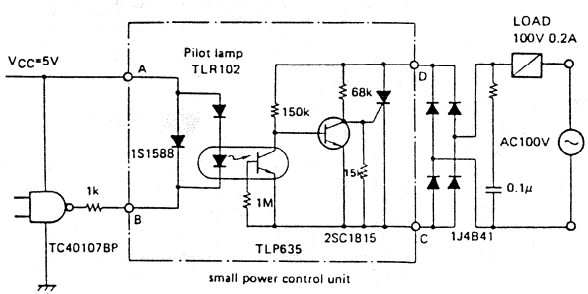


Recommended R_F Value

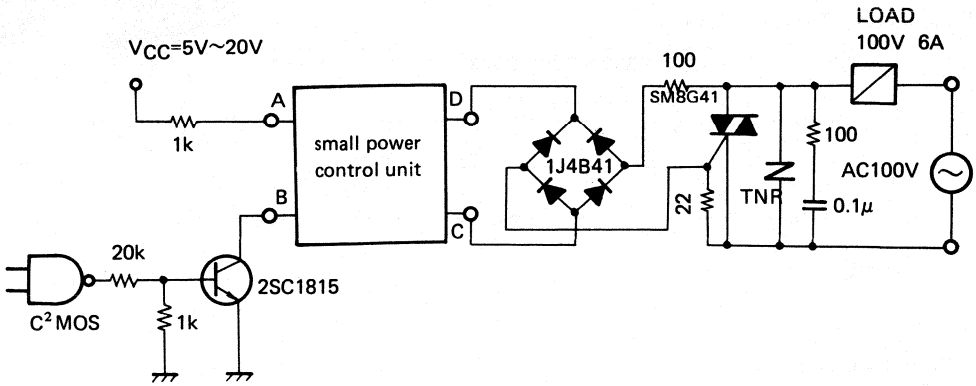
Type	Recommended R_F (Power Rating (W))		
	@ V_{IN} = 5V	@ V_{IN} = 12V	@ V_{IN} = 32V
TLP3021 **TLP3041**	120Ω (1/2)	390Ω (1/2)	1.2KΩ (2)
TLP3022 **TLP3042**	180Ω (1/4)	560Ω (1/2)	1.8KΩ (1)
TLP3023 **TLP3043**	360Ω (1/8)	1.2KΩ (1/4)	3.6KΩ (1/2)

(3) Power Control Circuit

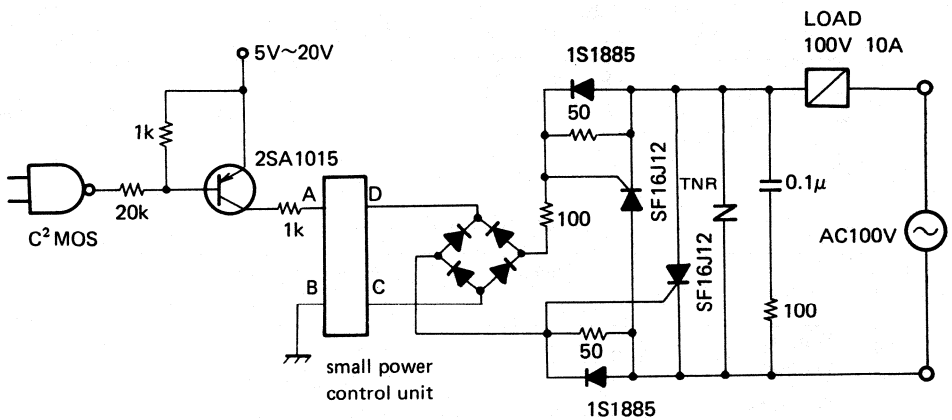
(a) Small power control (by C^2 MOS)



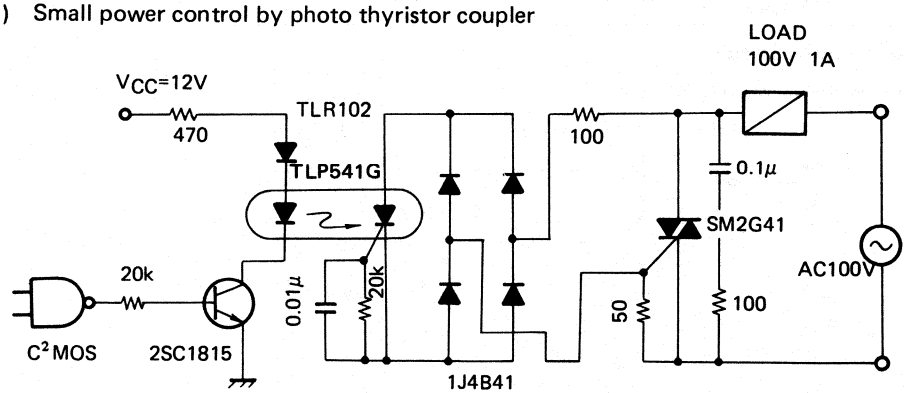
(b) Medium power control (by C^2MOS)



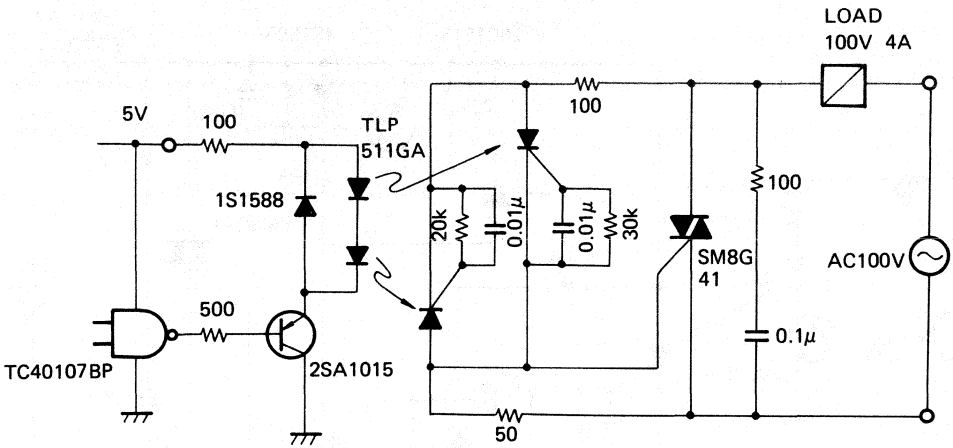
(c) Medium power control



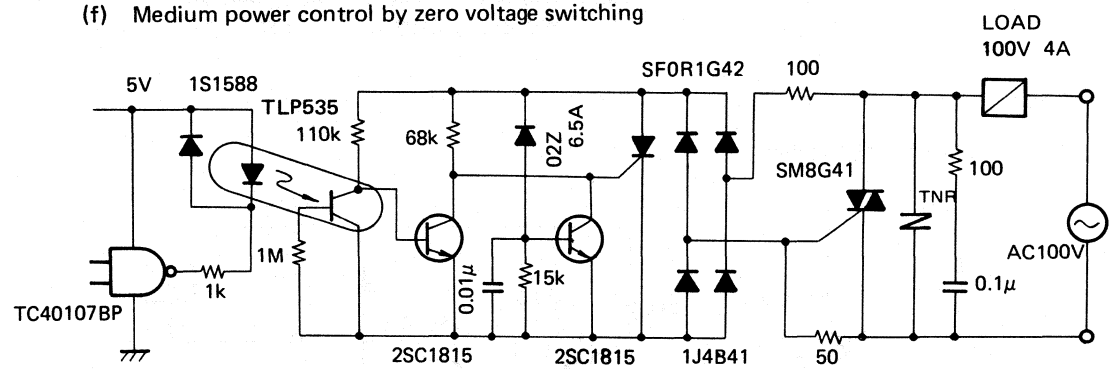
(d) Small power control by photo thyristor coupler



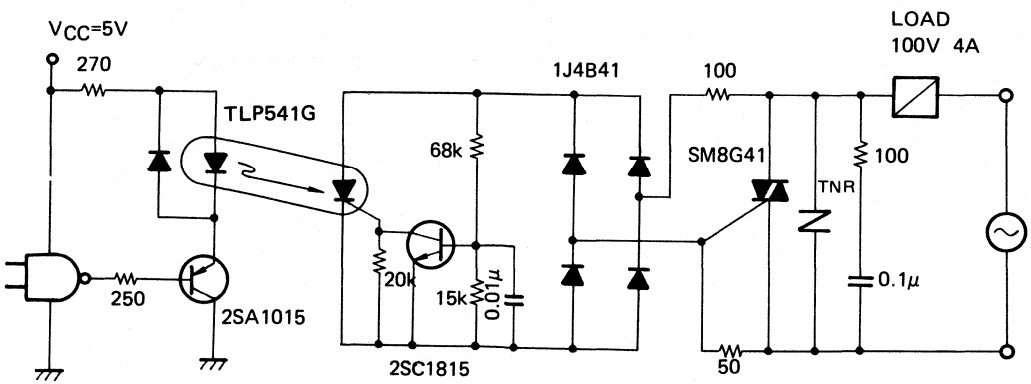
(e) Medium power control by photo triac coupler



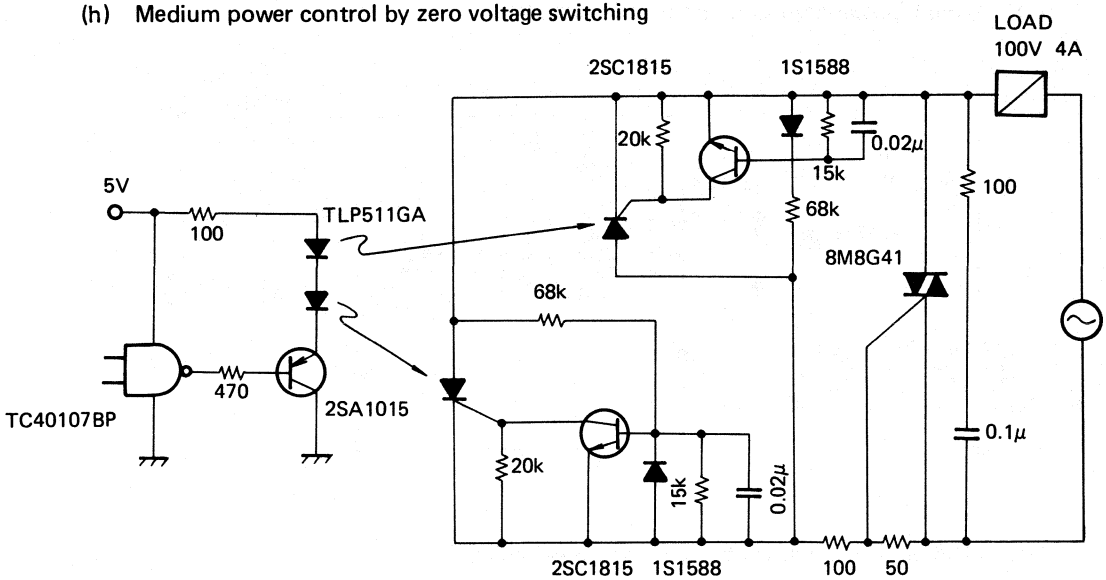
(f) Medium power control by zero voltage switching



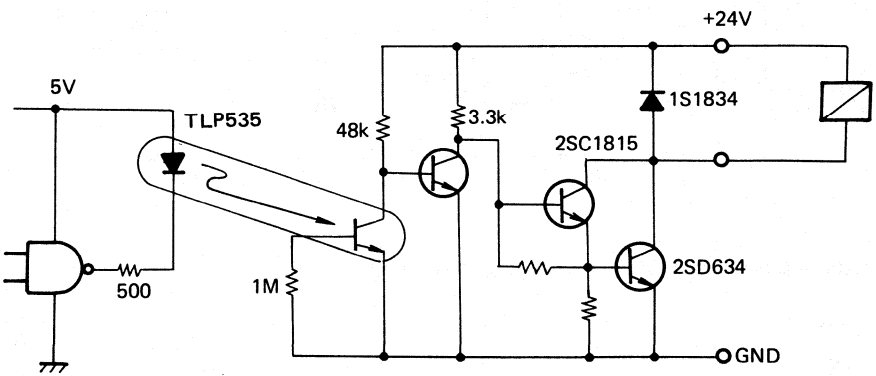
(g) Medium power control by zero voltage switching



(h) Medium power control by zero voltage switching

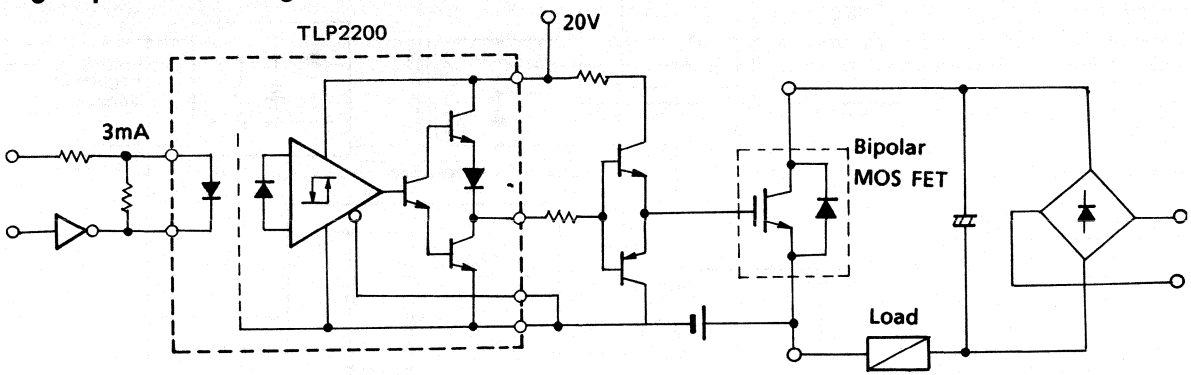


(i) DC. solid state relay

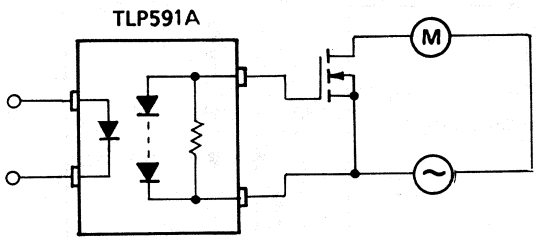


Power & Motor Control

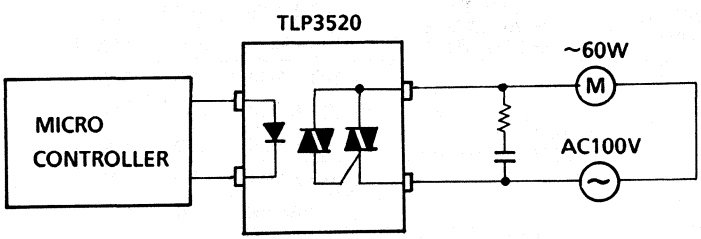
(1) High Speed Switching MOS Gate Drive



(2) MOS Gate Drive Using Photo Voltaic Coupler

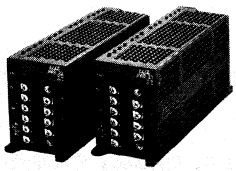


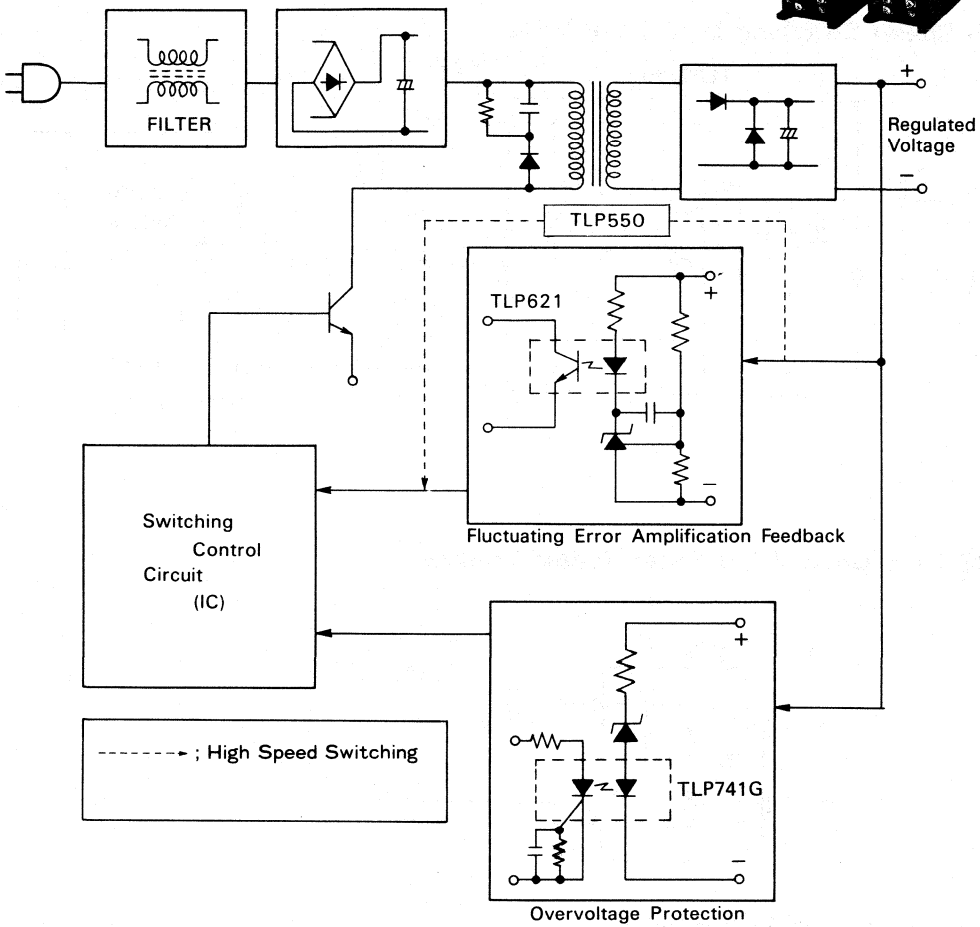
(3) Photocoupled Relay Control



8-3-9 Switching Power Supply

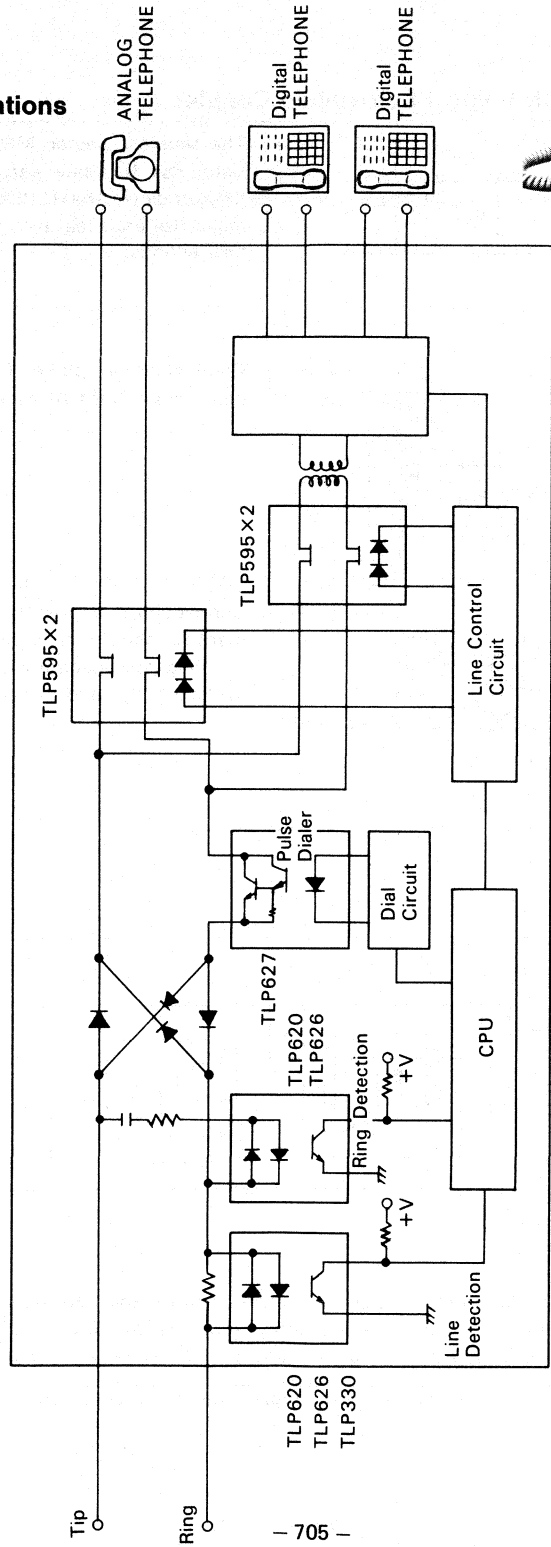
For CTR Classified Transistor Photocouplers, SCR and Triac Photocouplers



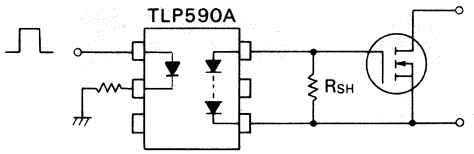


RECOMMENDED DEVICES	ISOLATION VOLTAGE	SAFETY STANDARDS RECOGNITION	CTR (I_C/I_F) RANK (%)		
			RANK	MIN.	MAX.
TLP621	5000 V_{rms}	UL1577 IEC65/VDE0860	NO RANK	50	600
			(GB)RANK	100	600
			(BL)RANK	200	600
			(GR)RANK	100	300
			(Y)RANK	50	150
TLP731	5000 V_{rms}	UL1577 IEC380/VDE0806 IEC65/VDE0860	NO RANK	50	600
TLP732			(GB)RANK	100	600
TLP580	5000 V_{rms}	UL1577 IEC380/VDE0806 IEC65/VDE0860 BS415/BS5850	NO RANK	25	—
TLP581			(O)RANK	25	75
			(Y)RANK	50	150
TLP550	2500 V_{rms}	UL1577	(O)RANK	19	—

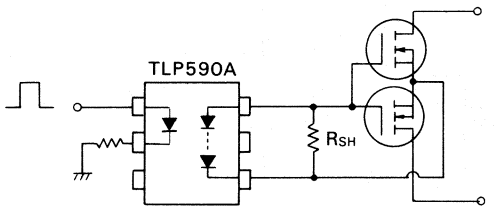
8-3-10 Telecommunications



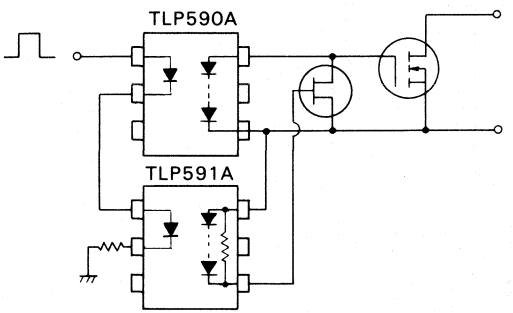
8-3-11 MOS FET Switch Using Photovoltaic Coupler



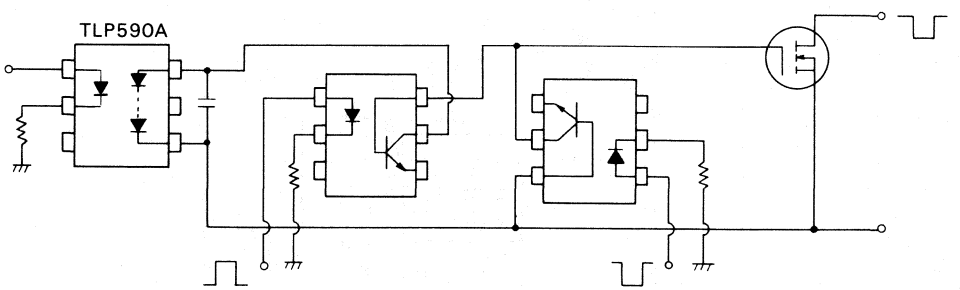
The simplest power MOS FET drive circuit. Resistor R_{SH} for gate capacitor discharge reduces turn-off time. The TLP591's built-in resistors make R_{SH} unnecessary. (t_{ON} and t_{OFF} are several milliseconds)



Connecting a power MOS FET to source common allows both AC and DC drive.



Connecting a depression-type FET as a replacement for shunt resistor R_{SH} allows rapid discharging of gate capacitor charge and high-speed switching. (t_{ON} and t_{OFF} are about one millisecond)

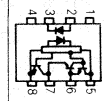
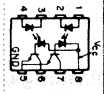


Using photovoltaic-output photocoupler as a power source and alternately driving the externally-attached photocouplers charges and discharges the MOS FET gate. This circuit provides higher-speed switching. (t_{ON} and t_{OFF} are several microseconds)

NOTE(Information) : The Patents Concerning these applications are retained by General Electric.

8-3-12 Application Table of High Speed Photo-IC Photocouplers

(TYPICAL DATA)

	TLP2601	6N137	TLP558	TLP2200	6N138 6N139	6N135 6N136 TLP651	TLP550 TLP650	TLP559	TLP557
									
Dual Type	TLP2631	TLP2630					TLP2530 TLP2531		
									
Output	Open Collector		3 State/Totem Pole		Open Collector	Open Collector			−0.25 0.5A
Speed	10M bps		5M bps		0.3M bps	1M bps			1μs
Input Current IF	5mA		1.6mA		0.5mA	16mA			5mA
Supply Voltage Vcc	5V		4.5~20V		<18V	<15V			<16V
Supply Current Icc	12mA(24mA for Dual Type)		5mA		0.1mA	0.1mA(0.2mA for Dual Type)			10mA
Common Mode Nois Rejection	○	—	○		—	—	○	○	○
Application	• NC machines • Industrial robots • High-speed digital signal interfaces • Computer terminal devices • Various industrial control equipment	• Electronic musical instruments • Compact Desk players • High-speed digital signal interfaces • Computer terminal devices	• Computer data bus drivers • High-speed digital signal interfaces • High-speed gate drives for power MOS elements • Various industrial control equipment		• CMOS direct drive is possible • Current loop receiver driver • Telephone ring detector • Computer terminal devices	• TV units • Transmission of analog signals such as video signals • Digital signal interfaces	• General-purpose inverters • Inverter-incorporated air-conditioning equipment • NC machines • Switching power supply units		• General-purpose inverters • Inverter-incorporated air-conditioning equipment • G-TR base drives

9. Reliability

9.1 General

In recent years, as the application fields for photo couplers expand, more discussions are being made on reliability.

For reliability improvement, it is insufficient to perform strinct process management and to have reliability tests such as life test and environmental tests. It is necessary to perform a failure mechanisms for conventional transistors and diodes, tent to suffer from the following failure modes.

(a) Defective bonding between GaAs LED chip and light-detective chip.

Because of the double structure consisting of transparent silicone resin and molding resin, the difference in thermal expansion and contraction between these materials exerts a periodic force on bonding wire, causing wire breakage.

(b) CTR variation

CTR variation caused by the peeling off of the interface between GaAs LED chip and encapsulation (transparent silicone for optical guide) and of the molding resin interface.

(c) I_{CEO}, I_{DRM} increase

Water invades through the interface between the lead frame and molding resin, and cause an increase in dark current. Most of above factors are parastic causes due to the double-structured package comprising the light-emitting and light-receiving elements, and important points in designing a photo-couplers.

Our photocouplers developed, have received, based on these factors, sufficient investigation with respect to proper materials, structure and assembling method.

Accordingly, temperature resistance and moisture resistance characteristics have been especially improved.

The evaluation results for reliability tests are shown as follows.

9-2 Quality control of production process and quality assurance

Quality control flow chart is shown in Table 9-3.

Quality assurance of shipping products are performed based on the lot quality assurance level shown in Table 9-1.

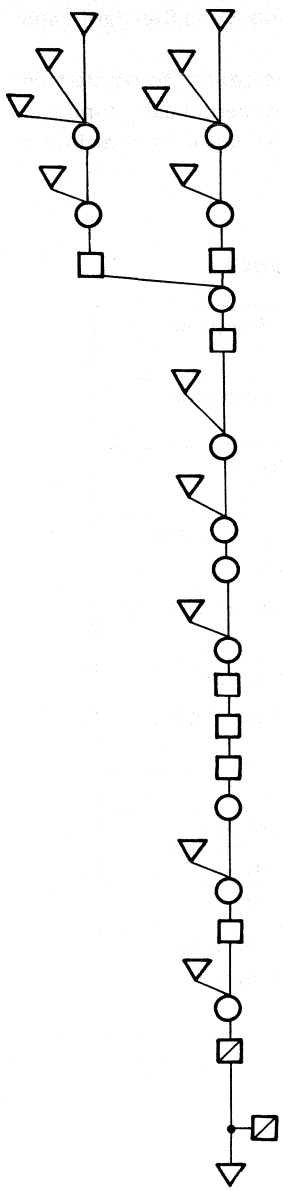
Table 9-1 Lot Quality Assurance Level of Photocoupter

Items		LTPD	Notes
Electrical characteristics	Catastrophic	1.5%	
	Major	5%	
	Minor	10%	
Lot life inspection		20%/168 HRS	

Table 9-2 MIL–S–19500 Inspection Table

Max. Percent Defective (LTPD) or λ	50	30	20	15	10	7	5	3	2	1.5	1	0.7	0.5	0.3	0.2	0.15	0.1
Acceptance Number (a) (r=a+1)	Minimum Sample Sizes																
0	5 (1.03)	8 (0.64)	11 (0.46)	15 (0.34)	22 (0.23)	32 (0.16)	45 (0.11)	76 (0.07)	116 (0.04)	153 (0.03)	231 (0.02)	328 (0.02)	461 (0.01)	767 (0.007)	1152 (0.005)	1534 (0.003)	2303 (0.002)
1	8 (4.4)	13 (2.7)	18 (2.0)	25 (1.4)	38 (0.94)	55 (0.65)	77 (0.46)	129 (0.28)	195 (0.18)	258 (0.14)	390 (0.09)	555 (0.06)	778 (0.045)	1290 (0.027)	1946 (0.018)	2592 (0.013)	3891 (0.009)
2	11 (7.4)	18 (4.5)	25 (3.4)	34 (2.24)	52 (1.6)	75 (1.1)	105 (0.78)	176 (0.47)	266 (0.31)	354 (0.23)	533 (0.15)	759 (0.11)	1065 (0.080)	1773 (0.045)	2662 (0.031)	3547 (0.022)	5323 (0.015)
3	13 (10.5)	22 (6.2)	32 (4.4)	43 (3.2)	65 (2.1)	94 (1.5)	132 (1.0)	221 (0.62)	333 (0.41)	444 (0.31)	668 (0.20)	953 (0.14)	1337 (0.10)	2226 (0.062)	3341 (0.041)	4452 (0.031)	6681 (0.018)
4	16 (12.3)	27 (7.4)	38 (5.0)	52 (3.9)	78 (2.6)	113 (1.8)	158 (1.3)	265 (0.75)	398 (0.50)	531 (0.37)	798 (0.25)	1140 (0.17)	1599 (0.12)	2663 (0.074)	3997 (0.040)	5327 (0.037)	7994 (0.025)
5	19 (13.8)	31 (8.3)	45 (6.0)	60 (4.4)	91 (2.9)	131 (2.0)	184 (1.4)	308 (0.85)	462 (0.57)	617 (0.42)	927 (0.28)	1323 (0.20)	1855 (0.14)	3090 (0.085)	4638 (0.056)	6181 (0.042)	9275 (0.028)
6	21 (15.6)	35 (9.4)	51 (6.6)	68 (4.9)	104 (3.2)	149 (2.2)	209 (1.6)	349 (0.94)	528 (0.62)	700 (0.47)	1054 (0.31)	1503 (0.22)	2107 (0.155)	3509 (0.093)	5267 (0.062)	7019 (0.047)	10533 (0.031)
7	24 (16.6)	39 (10.2)	57 (7.2)	77 (5.3)	116 (3.5)	166 (2.4)	234 (1.7)	390 (1.0)	589 (0.67)	783 (0.51)	1178 (0.34)	1680 (0.24)	2355 (0.17)	3922 (0.101)	5886 (0.067)	7845 (0.051)	11771 (0.034)
8	26 (18.1)	43 (10.9)	63 (7.7)	85 (5.6)	128 (3.7)	184 (2.6)	258 (1.8)	431 (1.1)	648 (0.72)	864 (0.54)	1300 (0.36)	1854 (0.25)	2599 (0.18)	4329 (0.108)	6498 (0.072)	8660 (0.054)	12995 (0.036)
9	28 (19.4)	47 (11.5)	69 (8.1)	93 (6.0)	140 (3.9)	201 (2.7)	282 (1.9)	471 (1.2)	709 (0.77)	945 (0.58)	1421 (0.38)	2027 (0.27)	2842 (0.19)	4733 (0.114)	7103 (0.077)	9468 (0.057)	14206 (0.038)
10	31 (19.9)	51 (12.1)	75 (8.4)	100 (6.3)	152 (4.1)	218 (2.9)	306 (2.0)	511 (1.2)	770 (0.80)	1025 (0.60)	1541 (0.40)	2199 (0.28)	3082 (0.20)	5133 (0.120)	7704 (0.080)	10268 (0.060)	15407 (0.040)
11	33 (21.0)	54 (12.8)	83 (8.3)	111 (6.2)	166 (4.2)	238 (2.9)	332 (2.1)	555 (1.2)	832 (0.83)	1109 (0.62)	1604 (0.42)	2378 (0.29)	3323 (0.21)	5546 (0.12)	8319 (0.083)	11092 (0.062)	15638 (0.042)
12	36 (21.4)	59 (13.0)	89 (8.6)	119 (6.5)	178 (4.3)	254 (3.0)	356 (2.2)	594 (1.3)	890 (0.86)	1187 (0.65)	1781 (0.43)	2544 (0.3)	3562 (0.22)	5936 (0.13)	8904 (0.086)	11872 (0.065)	17808 (0.043)
13	38 (22.3)	63 (13.4)	95 (8.9)	126 (6.7)	190 (4.5)	271 (3.1)	379 (2.26)	632 (1.3)	948 (0.89)	1264 (0.67)	1896 (0.44)	2709 (0.31)	3793 (0.22)	6321 (0.134)	9482 (0.089)	12643 (0.067)	18964 (0.045)
14	40 (23.1)	67 (13.8)	101 (9.2)	134 (6.9)	201 (4.6)	288 (3.2)	404 (2.3)	672 (1.4)	1007 (0.92)	1343 (0.69)	2015 (0.46)	2878 (0.32)	4029 (0.23)	6716 (0.138)	10073 (0.092)	13431 (0.069)	20146 (0.046)
15	43 (23.3)	71 (14.1)	107 (9.4)	142 (7.1)	213 (4.7)	305 (3.3)	426 (2.36)	711 (1.41)	1066 (0.94)	1422 (0.71)	2133 (0.47)	3046 (0.33)	4265 (0.235)	7108 (0.141)	10662 (0.094)	14216 (0.070)	21324 (0.047)
16	45 (24.1)	74 (14.6)	112 (9.7)	150 (7.2)	225 (4.8)	321 (3.37)	450 (2.41)	750 (1.44)	1124 (0.96)	1499 (0.72)	2249 (0.48)	3212 (0.337)	4497 (0.241)	7496 (0.144)	11244 (0.096)	14992 (0.072)	22487 (0.048)
17	47 (24.7)	79 (14.7)	118 (9.86)	158 (7.36)	236 (4.93)	338 (3.44)	473 (2.46)	788 (1.48)	1182 (0.98)	1576 (0.74)	2364 (0.49)	3377 (0.344)	4728 (0.246)	7880 (0.148)	11819 (0.098)	15759 (0.074)	23630 (0.049)
18	50 (24.9)	83 (15.0)	124 (10.0)	165 (7.54)	248 (5.02)	354 (3.51)	496 (2.51)	826 (1.51)	1239 (1.0)	1652 (0.75)	2478 (0.50)	3540 (0.351)	4956 (0.251)	8200 (0.151)	12390 (0.100)	16520 (0.075)	24780 (0.050)
19	52 (25.5)	86 (15.4)	130 (10.2)	173 (7.76)	259 (5.12)	370 (3.58)	518 (2.56)	864 (1.53)	1296 (1.02)	1728 (0.77)	2591 (0.52)	3702 (0.358)	5183 (0.256)	8638 (0.153)	12957 (0.102)	17276 (0.077)	25914 (0.051)
20	54 (26.1)	90 (15.6)	135 (10.4)	180 (7.82)	271 (5.19)	386 (3.65)	541 (2.60)	902 (1.56)	1353 (1.04)	1803 (0.78)	2705 (0.52)	3864 (0.364)	5410 (0.260)	9017 (0.156)	13526 (0.104)	18034 (0.078)	27061 (0.052)
25	65 (27.0)	109 (16.1)	163 (10.8)	217 (8.08)	326 (5.38)	466 (3.76)	652 (2.69)	1086 (1.61)	1629 (1.08)	2173 (0.807)	3259 (0.538)	4656 (0.376)	6518 (0.269)	10863 (0.161)	16295 (0.108)	21726 (0.081)	32589 (0.054)

Table 9-3 Manufacturing process flow chart of photocoupler

PROCESS FLOW CHART		NOTE
[LED] [Detector] 	Chips	Oxide thickness, breakdown voltage, etc. are inspected to confirm lot quality.
	Frame	
	Mount Material	
	Die Mount	Strength of die attachment, and visual inspection
	Bonding wire	
	Bonding	Temperature, Bond Strength
	Visual Pre-Coupling	Mount & Bond Appearance
	Coupling	Strength of bonding, shape, wire touch etc. are inspected
	Visual Pre-Mold	
	Encap. Material (Silicone)	
	Encap.	
	Mold Material (Epoxy resin)	
	Mold	Temperature
	Lead Cut, Bending	
	Plating Material	
	Plating	
	Test	Electrical Test
	Stabilization Bake	
	Temperature cycling	
	Dicing	
	Marking Material	
	Marking	
	Final Electrical Test	
	Packing Material	
	Packing	
	Lot Quality Assurance	Appearance
	Test	Life Test Electrical Test
	Reliability Test	Life Test Mechanical Test
	Ship	

9-3 Reliability Tests

Reliability Test Procedures

Typical test procedures published as standard test procedures are listed in Table 9-4. Toshiba has selected the procedures listed in Table 9-5, as its standard in conformance with EIAJ (Electronic Industries Association of Japan), JIS (Japanese Industrial Standard), and MIL Standards.

Furthermore, dependent on the construction and usage of the device, an accelerated life test, compounded stress test, step stress test, etc. are conducted periodically time and again. This serves to upgrade reliability level, and helps in the making of a contributes towards formulating a reliability assessment.

Table 9-4 Reliability Test Specifications and Standards

JISC5003	General Test Procedure of Failure Rate for Electronic Components
JISC5020	General Rules for Environmental Testing Method for Electronic Components
JISC5700	General Rules for Reliability Assured Electronic Components
JISC7021	Environmental Testing Methods and Endurance Testing Methods for Discrete Semiconductor Devices
EIAJ-SD-121	Environmental and Mechanical Test Methods for Discrete Semiconductor Devices
EIAJ-IC-121	Test Methods for Reliability of Integrated Circuits
MIL-STD-202	Test Methods for Electronic and Electrical Component parts
MIL-STD-750	Test Methods for Semiconductor Devices
MIL-STD-883	Test Methods and Procedures for Microelectronics
MIL-S-19500	Semiconductor Devices. General specification for
MIL-M-38510	Microcircuit General specification for
IEC Publication 147	Essential ratings and characteristics of semiconductor devices and general principles of measuring methods Part-4, Part-5

Table 9-5 Reliability Tests

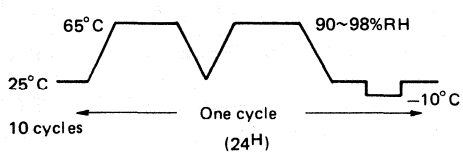
	Item	Description and Test Conditions	Standard
Life Test	Steady state operation	Electrical (voltage and current) and thermal stresses are applied continuously for a long period of time, and the durability of the product is determined. Normal testing temp is: For discrete semi conductor devices. T_a=25°C For integrated circuit. T_a=Topr. Max.	MIL-STD-750: 1026 MIL-STD-883: 1005 JIS C7021: B-1 EIAJ IC-121: B-1
	High temperature storage	When stored for a long time at a high temperature, durability against the heat is determined. Normal testing temp. is hled the same as the maximum storage temperature (Tstg. Max).	MIL-STD-750: 1031 MIL-STD-883: 1008 JIS C7021: B-10 EIAJ IC-121: B-3
	High temp. high humidity storage	When stored for a long time at a high temperature and high humidity, durability is determined. Normal testing conditions are T_a=60°C, RH=90%	MIL-STD-202E: 1038 JIS C7021: B-11 EIAJ IC-121: B-5
	Low temperature storage	When stored for a long time at a low temperature, durability is determined. Normal testing temp. is the same as minimum storage temperature (Tstg. Min)	JIS C7021: B-12 EIAJ IC-121: B-4
Environmental Test	Soldering heat	Durability of the device against heat received during soldering is determined. Normal testing conditions: To be dipped 10 secs. at 260°C.	MIL-STD-750: 2031 JIS C7021: A-1 EIAJ IC-121: A-11
	Temperature cycling	Durability when exposed to hot and cold conditions is determined. Tstg. Min — 25°C — Tstg. Max — 25°C (30 mins) (5 mins) (30 mins) (5 mins) One cycle 5 cycles	MIL-STD-750: 1051 MIL-STD-883: 1010 JIS C7021: A-4 EIAJ IC-121: A-4
	Thermal shock	Durability is assessed when the device is suddenly exposed to severe changes. 100°C — 0°C is regarded as "one" cycle, and five cycles are required when testing. Also if Tstg. Max. is below 100°C, testing is done at this temperature.	MIL-STD-750: 1056 MIL-STD-883: 1011 JIS C7021: A-3 EIAJ IC-121: A-5
	Moisture resistance	Durability is assessed when device is exposed to high temp. and high humidity conditions.  	MIL-STD-202: 106 MIL-STD-883: 1004 JIS C7021: A-5 EIAJ IC-121: A-2

Table 9-6 Reliability Tests (Cont'd)

	Item	Description and Test Conditions	Standard
Mechanical Test	Vibration	Durability is determined againt vibrations received during transportation or usage of the device. The test is performed with a variable frequency of vibration, or that with a fixed frequency. Normally a varying frequency vibration (from 100 to 2000 Hz) is used.	MIL-STD-750: 2046 2056 MIL-STD-883: 2005 2007 JIS C7021: A-10 EIAJ IC-121: A-13
	Shock	Durability resulting from structural and mechanical reasons is determined. Testing conditions will differ with construction. For molded plastic type devices, a shock of 1500G acceleration, and 0.5 ms duration is applied.	MIL-STD-750: 2016 MIL-STD-883: 2002 JIS C7021: A-7 EIAJ IC-121: A-9
	Constant acceleration	Durability against constant acceleration stresses is determined. Test conditions will differ with construction. For molded plastic type devices normally a constant acceleration of 20000G is applied.	MIL-STD-750: 2006 MIL-STD-883: 2001 JIS C7021: A-9 EIAJ IC-121: A-8
	Drop	Determine structural and mechanical durability of the device. Testing conditions: Drop from a height of 75 cm on an oak board. (Not applicable to devices encased in ceramic.)	JIS C7021: A-8 EIAJ IC-121: A-15
	Terminal strength	Determine whether the strength of the terminal area is sufficient to withstand stresses from is mounted circuit board or during usage of the device. Testing conditions: This will differ according to shape and type of terminal arrangement, and cross section of the pins. Normal test conditions call for suspending a 250 gr, weight, bending to a 90° bend, and straightening.	MIL-STD-750: 2036 MIL-STD-883: 2004 JIS C7021: A-11 EIAJ IC-121: A-12
	Solderability	Determine whether terminal area permits easy application of solder. Normal testing conditions: With the solder heated to 230°C, solder within 5 seconds.	MIL-STD-750: 2026 MIL-STD-883: 2003 JIS C7021: A-2 EIAJ IC-121: A-10
	Seal	Determine-air-tightness of the encapsulation. Use a tracer gas for detecting fine leaks. And bubbles to detect large leaks. This test applies to devices with encapsulated in a metal or a ceramic case.	MIL-STD-750: 1071 MIL-STD-883: 1014 JIS C7021: A-6 EIAJ IC-121: A-6
	Salt atmosphere	Determine corrosion resisting properties against a salt containing atmosphere. Normal testing conditions: At a room temp. of 35°C spray with a 5% salt solution for 24 hours.	MIL-STD-750: 1041 MIL-STD-883: 1009 JIS C7021: A-12 EIAJ IC-121: A-3

Failure Criteria

Table 9-7 shows Failure Criteria for Main Characteristics of Photocouplers

Table 9-7 Failure Criteria of Photocouplers

Test Item	Symbol	Limits
Isolation Voltage	BVs	2500 V_{RMS}, 1 minute
LED Forward Voltage	V_F	USL x 1.1
LED Reverse Current	I_R	USL x 2
Collector Breakdown Voltage	V_{CEO}	LSL x 0.9
Collector Dark Current	I_{CEO}	USL x 2
DC Current Transfer Ratio	CTR	Initial Data x 0.8
Saturation Voltage Collector to Emitter	VCE(SAT)	USL x 1.1
SCR Off-State Voltage	V_{DRM} V_{RRM}	LSL x 0.9
SCR Off-State Current	I_{DRM} I_{RRM}	USL x 2
SCR Input Current to Trigger	I_{FT}	Initial Data x 0.8
SCR On-State Voltage	V_{TM}	USL x 1.1

LSL; Lower Specification Limit

USL; Upper Specification Limit

Test Results

(a) Life and environmental tests

Test Results of Photocouplers are summarized from Table 9-9 to Table 9-14, which are separated to Photo Transistor family, Photo Darlington family, Photo Thyristor family, Double Molding family and Power output family.

Type name of each family are shown in Table 9-8.

Table 9-9 shows evaluation results for temperature cycling test (TCT), thermal shock test (TST) and pressure cooker test (PCT). From these, the following comments can be made.

(1) In both TCT and TST for temperature resistance, no defective units were detected up to 1000 cycles.

(2) In the test concerning moisture resistance, PCT; 24 hrs, 85°C/85% R.H; 1000 hrs. produced absolutely no defective unit and good results were obtained. In these tests, the main evaluation itemsin each step are CTR (or I_{FT}), isolation voltage, dark current, LED's reverse current.

(b) Electrical endurance tests

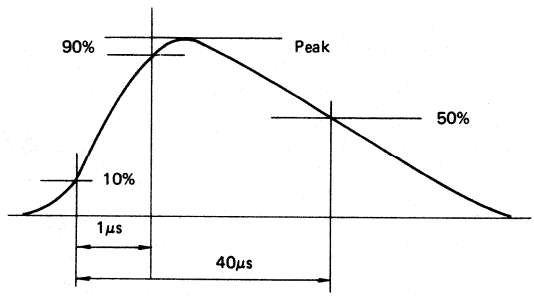
Impulse Surge Isolation Voltage

Definition:

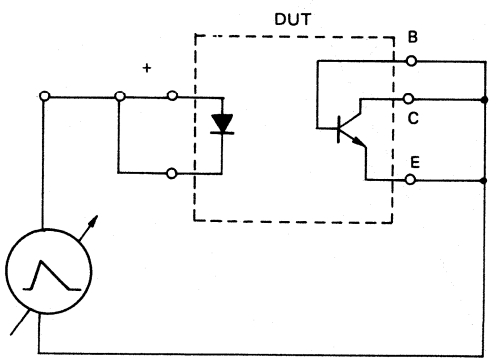
This rating is used to protect one-time transient over-voltage generated from thundering.

Test Condition

Impulse surge waveform is shown as follows.



Impulse Surge Isolation voltage is measured as illustrated below.



Test Results

Impulse Surge Isolation Breakdown Voltage (Peak value) test results are shown in Fig. 3-1.

Fig. 9-1 Impulse surge isolation test results

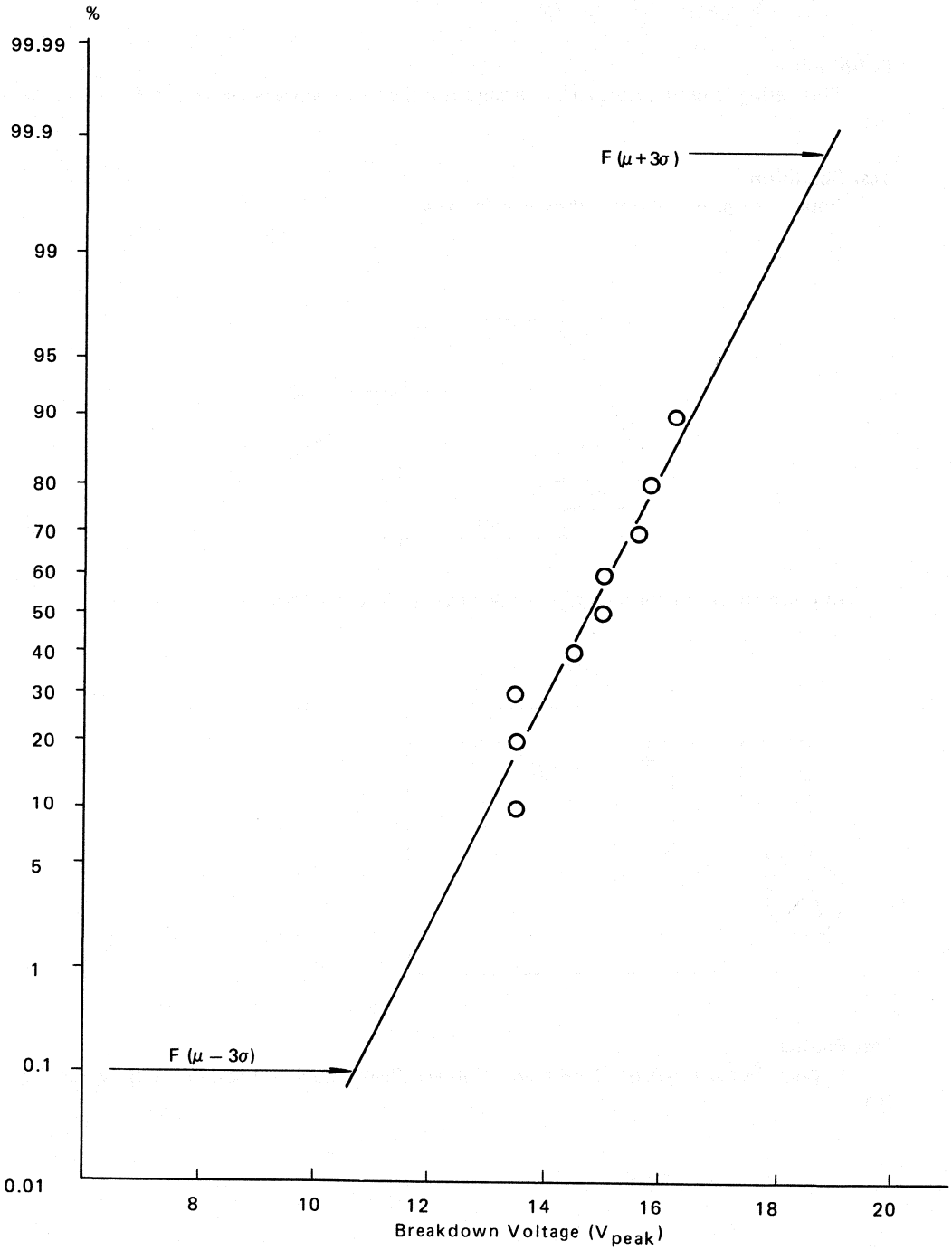


Table 9-8 Type name of each family

Family	Type name
Photo transistor Output	TLP521-1, 2, 3, 4 TLP535, TLP535 4N25, 25A, 4N26, 4N27, 4N28 4N35, 4N36, 4N37, 4N38, 4N38A
Photo darlington Output	TLP575, TLP576 4N29, 4N29A, 4N30 4N31, 4N32, 4N32A, 4N33
Photo thyristor Output	TLP645G, 645J
DC Power Output	TLP573
AC Power Output	TLP546G

Table 9-9 Reliability Test Data for Photocouplers

Test		OLD TYPE Photo Transistor Family (TLP508)		Photo Transistor Family		Photo Thyristor Family	
		Sample size	Failures	Sample size	Failures	Sample size	Failure
TCT	Cycles						
	100	320	0	500	0	320	0
	300	320	0	500	0	320	0
	500	317	* 3	500	0	320	0
	1000	311	* 6	500	0	320	0
TST	Cycles						
	20	100	0	100	0	100	0
	50	100	0	100	0	100	0
	100	100	0	100	0	100	0
PCT	Hours						
	24	100	0	250	0	250	0
	48	100	** 1	250	0	250	0
	96	100	** 7	250	0	250	0
	144	100	**32	250	** 9	250	**11

* Wire Break IN mid span

** I_D or I_{DRM} Over limit

Conditions; TCT (Temperature Cycling Test)
−55°C to 125°C, 30 minutes per temperature and 5 minutes transfer time.

TST (Thermal Shock Test)
100°C to 0°C in required at 5 minutes per temperature and 5 second transfer time.

PCT (Pressure Cooker Test)
Ta = 121°C, R.H. = 100% (2 atm)

Table 9-10 Test Results of Photo Transistor Output Family

Test Items	Test Conditions	Sample Size	Test Duration	Total Component Hours	Failures
Steady State Operation	Ta = 25°C I_F = 70 mA P_C = 150 mW	300	1000 Hrs.	300,000	0
High Temp. Operation	Ta = 85°C I_F = 40 mA P_C = 60 mW	90	1000 Hrs.	90,000	0
High Temp. Storage	Ta = 125°C	300	1000 Hrs.	300,000	0
High Temp. Reverse bias	Ta = 100°C V_{CE} = 24V	300	1000 Hrs.	300,000	0
High Temp. High Humidity Storage	Ta = 85°C R.H = 85%	300	1000 Hrs.	300,000	0
High Temp. High Humidity Operation	Ta = 85°C R.H.=85% I_F = 40 mA P_C = 60 mW	90	1000 Hrs.	90,000	0
Soldering Heat	TSOL = 300°C	500	10 Sec.	–	0
Soldering Heat Stress (300°C/10 sec.) +Temp. Cycling	MIL-STD-883B T MIN = –55°C T MAX = 125°C	500	1000 Cycles	–	0
Thermal Shock	MIL-STD-883B	100	100 Cycles	–	0
Moisture Resistance	MIL-STD-883B	100	10 Cycles	–	0
Solderbility	TSOL = 230°C	100	1 sec. 1 time	–	0
Pressure Cooker	Ta = 121°C R.H = 100% (2 atm)	250	96 H	–	0

Table 9-11 Test Results of Photo Darlington Output Family

Test Items	Test Conditions	Sample Size	Test Duration	Total Component Hours	Failures
Steady State Operation	Ta = 25°C I_F = 70 mA P_C = 150 mW	120	1000 Hrs.	120,000	0
High Temp. Operation	Ta = 85°C I_F = 40 mA P_C = 60 mW	–	–	–	–
High Temp. Storage	Ta = 125°C	120	1000 Hrs.	120,000	0
High Temp. Reverse bias	Ta = 100°C V_{CE} = 24V	120	1000 Hrs.	120,000	0
High Temp. High Humidity Storage	Ta = 85°C R.H = 85%	120	1000 Hrs.	120,000	0
High Temp. High Humidity Operation	Ta = 85°C R.H=85% I_F = 40 mA P_C = 60 mW	–	–	–	–
Soldering Heat	TSOL = 300°C	300	10 Sec.	–	–
Soldering Heat Stress (300°C/10 sec.) + Temp. Cycling	MIL-STD-883B T MIN = –55°C T MAX = 125°C	300	500 Cycles	–	0
Thermal Shock	MIL-STD-883B	60	100 Cycles	–	0
Moisture Resistance	MIL-STD-883B	60	10 Cycles	–	0
Solderbility	TSOL = 230°C	60	1 sec. 1 time	–	0
Pressure Cooker	Ta = 121°C R.H = 100% (2 atm)	100	96H	–	0

Table 9-12 Test Results of Photo Thyristor Output Family

Test Items	Test Conditions	Sample Size	Test Duration	Total Component Hours	Failure
Steady State Operation	Ta = 25°C I_F = 70 mA I_T = 150 mA RMS	300	1000 Hrs.	300,000	0
High Temp. Operation	Ta = 85°C I_F = 25 mA I_T = 30 mA RMS	90	1000 Hrs.	90,000	0
High Temp. Storage	Ta = 125°C	300	1000 Hrs.	300,000	0
High Temp. Blocking	Ta = 100°C V_{DM} = 400V	300	1000 Hrs.	300,000	0
High Temp. High Humidity Storage	Ta = 85°C R.H = 85%	300	1000 Hrs.	300,000	0
High Temp. High Humidity Operation	–	–	–	–	–
Soldering Heat	TSOL = 300°C	320	10 Sec.	–	0
Soldering Heat Stress (300°C/10 sec.) + Temp. Cycling	MIL-STD-883B T MIN = –55°C T MAX = 125°C	320	1000 Cycles	–	0
Thermal Shock	MIL-STD-883B	100	100 Cycles	–	0
Moisture Resistance	MIL-STD-883B	100	10 Cycles	–	0
Solderbility	TSOL = 230°C	100	1 sec. 1 time	–	0
Pressure Cooker	Ta = 121°C R.H = 100% (2 atm)	250	96 H	–	0

Table 9-13 Test Results of V_{DC}–Power Output Family

Test Items	Test Conditions	Sample Size	Test Duration	Total Component Hours	Failures
Steady State Operation	Ta = 25°C I_F = 60 mA P_C = 1.3W	60	1000 Hrs.	60,000	0
High Temp. Operation	Ta = 80°C I_F = 25mA P_C = 0.3W	60	1000 Hrs.	60,000	0
High Temp. Storage	Ta = 125°C	60	1000 Hrs.	60,000	0
High Temp. Reverse bias	Ta = 100°C V_{CE} = 48V	60	1000 Hrs.	60,000	0
High Temp. High Humidity Storage	Ta = 85°C R.H = 85%	60	1000 Hrs.	60,000	0
High Temp. High Humidity Operation	–	–	–	–	–
Soldering Heat	TSOL = 300°C	200	10 sec.	–	0
Soldering Heat Stress (300°C/10 sec. + Temp. Cycling	MIL-STD-883B Ta MIN = –55°C Ta MAX = 125°C	200	200 Cycles	–	0
Thermal Shock	MIL-STD-883B	60	100 Cycles	–	0
Moisture Resistance	MIL-STD-883B	60	10 Cycles	–	0
Solderbility	TSOL = 230°C	60	1 sec. 1 time	–	0
Pressure Cooker	Ta = 121°C R.H = 100% (2 atm)	100	96 H	–	0

Table 9-14 Test Results of AC-Power Output Family

Test Items	Test Conditions	Sample Size	Test Duration	Total Component Hours	Failures
Steady State Operation	Ta = 25°C I_F = 50 mA I_T = 1A RMS	60	1000 Hrs.	60,000	0
High Temp. Operation	Ta = 80°C I_F = 20mA P_I = 0.2A RMS	60	1000 Hrs.	60,000	0
High Temp. Storage	Ta = 125°C	60	1000 Hrs.	60,000	0
High Temp. Reverse bias	Ta = 100°C V_{DU} = 400V	60	1000 Hrs.	60,000	0
High Temp. High Humidity Storage	Ta = 85°C R.H = 85%	60	1000 Hrs.	60,000	0
High Temp. High Humidity Operation	–	–	–	–	0
Soldering Heat	TSOL = 300°C	200	10 sec.	–	0
Soldering Heat Stress (300°C/10 sec.) + Temp. Cycling	MIL-STD-883B Ta MIN = –55°C Ta MAX = 125°C	200	200 Cycles	–	0
Thermal Shock	MIL-STD-883B	60	100 Cycles	–	0
Moisture Resistance	MIL-STD-883B	60	10 Cycles	–	0
Solderbility	TSOL = 230°C	60	1 sec. 1 time	–	0
Pressure Cooker	Ta = 121°C R.H = 100% (2 atm)	250	96 H	–	0

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