FEB. 1989

Hitachi

Optodevice

DATA BOOK

ADE-408-001 C
(5-6C)

HITACHI

Hitachi Optodevice Data Book

HITACHI

ADE-408-001C

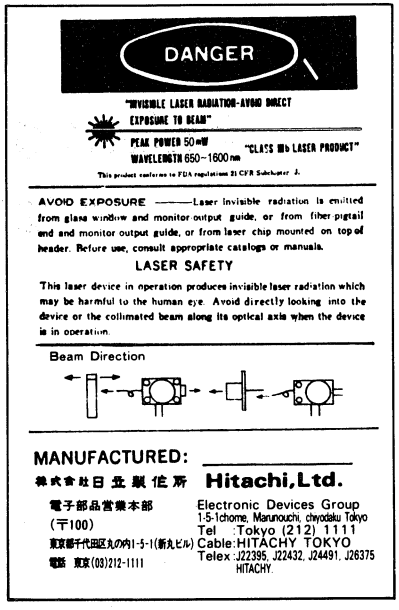
Introduction

With the rapid progress that has been made in recent years, optoelectronic semiconductor applications have become commonplace in such optical systems as transmission equipment, information terminals, video/audio disc players, measurement equipment, medical apparatuses, and much more. Hitachi, for its part, has contributed to optimization of these systems by developing superior optoelectronic semiconductors that demonstrate compact size, light weight, low power consumption, high collimating efficiency, excellent monochromaticity, and high speed direct modulation capability. This data book contains product lineups, operational features as well as device characteristics, application hints, and data sheets for Hitachi laser diodes (LDs), infrared emitting diodes (IREDs) and photodiodes.

Safety Considerations

Be sure to avoid direct exposure of human eyes to high power laser beams emitted from laser diodes. Even though barely visible to the human eye, they can be quite harmful. In particular, avoid looking directly into a laser diode or collimated beam along its optical axis when the diode is activated. One simple way to determine the optical path is to use a phosphor plate or infrared sensitive camera.

Hitachi certifies compliance with US Safety Regulations (21 CFR Subchapter J) on laser products, as stipulated by the U.S. Department of Health and Human Services. The Hitachi products shown here correspond to the category "CLASS IIIb LASER PRODUCT" in this regulation.


DANGER

"INVISIBLE LASER RADIATION-AVOID DIRECT EXPOSURE TO BEAM"

PEAK POWER 50mW
WAVELENGTH 650~1600nm
"CLASS IIIb LASER PRODUCT"

This product conforms to FDA regulations 21 CFR Subchapter J.

AVOID EXPOSURE ——Laser invisible radiation is emitted from glass window and monitor output guide, or from fiber pigtail end and monitor output guide, or from laser chip mounted on top of header. Before use, consult appropriate catalogs or manuals.

LASER SAFETY

This laser device in operation produces invisible laser radiation which may be harmful to the human eye. Avoid directly looking into the device or the collimated beam along its optical axis when the device is in operation.

Beam Direction

MANUFACTURED:
株式会社日立製作所 Hitachi, Ltd.
電子部品営業本部
(〒100)
東京都千代田区丸の内1-5-1(新丸ビル)
電話 東京(03)212-1111

Electronic Devices Group
1-5-1chome, Marunouchi, chiyodaku Tokyo
Tel :Tokyo (212) 1111
Cable:HITACHY TOKYO
Telex:J22395, J22432, J24491, J26375 HITACHY.

NOTICE:

1. Hitachi, Ltd. reserves the right to make changes in its products without notice in order to improve reliability, function or design.
2. Information furnished herein by Hitachi, Ltd. has been carefully checked and is believed to be accurate and reliable. However, no responsibility is assumed by Hitachi, Ltd. for any damages by the use of information, products, or circuits described herein ; nor for any infringements of patents or other rights of any party which may result from its use.
3. No license is granted by implication or otherwise under any patents or other rights of any third party or Hitachi, Ltd.
4. MEDICAL APPLICATIONS : Hitachi's products are not authorized for use in MEDICAL APPLICATIONS, including, but not limited to, use in life support devices without the written consent of the appropriate officer of Hitachi's sales company. Buyers of Hitachi's products are requested to notify Hitachi's sales offices when planning to use the products in MEDICAL APPLICATIONS.

Product Lineup

Product Descriptions

Laser Diodes

Infrared Emitting Diodes

Photodiodes

Guide to Discontinued Devices

Contents

Product Lineup

Part no. 3
Product lineup 4
Main characteristics 10
Package variations 14

Product Descriptions

I. Operation principles 21
II. Chip structures 24
III. Symbols and definitions 34
IV. Fundamental characteristics 40
V. Handling instructions 74
VI. Reliability 81
VII. In Purchasing Hitachi Optodevices 85

Data Sheets

—Laser diodes—

HL6711G	InGaAlP LD	89
HL7801E	GaAlAs LD	90
HL7802E	GaAlAs LD	92
HL7802G	GaAlAs LD	94
HL7806G	GaAlAs LD	96
HL7806MG	GaAlAs LD	99
HL7831G	GaAlAs LD	102
HL7831HG	GaAlAs LD	105
HL7832G	GaAlAs LD	108
HL7832HG	GaAlAs LD	111
HL7836G	GaAlAs LD	114
HL7836MG	GaAlAs LD	117
HL7838G	GaAlAs LD	120
HLP1400	GaAlAs LD	123
HL8311E	GaAlAs LD	125
HL8311G	GaAlAs LD	127
HL8312E	GaAlAs LD	129
HL8312G	GaAlAs LD	131
HL8314E	GaAlAs LD	133
HL8314G	GaAlAs LD	135
HL8315E	GaAlAs LD	138
HL8318E	GaAlAs LD	141
HL8318G	GaAlAs LD	144
HL8351E	GaAlAs LD	147
HL1221A	InGaAsP LD	149
HL1221AC	InGaAsP LD	152
HLP5400	InGaAsP LD	155
HL1321AC	InGaAsP LD	158
HL1321FG	InGaAsP LD	161
HL1321BF	InGaAsP LD	164
HL1321DL	InGaAsP LD	168
HL1322A	InGaAsP LD	172
HL1322AC	InGaAsP LD	175
HL1323DM	InGaAsP LD	178
HL1323TR	InGaAsP LD	181
HL1341A	InGaAsP DFB LD	184
HL1341AC	InGaAsP DFB LD	188
HL1341FG	InGaAsP DFB LD	192
HL1341BF	InGaAsP DFB LD	197
HL1341DL	InGaAsP DFB LD	203
HL1361A	InGaAsP DFB LD	209
HL1361AC	InGaAsP DFB LD	210
HL1521A	InGaAsP LD	211
HL1521AC	InGaAsP LD	214
HL1521FG	InGaAsP LD	217
HL1541A	InGaAsP DFB LD	220
HL1541AC	InGaAsP DFB LD	224

HL1541FG InGaAsP DFB LD 228
HL1541BF InGaAsP DFB LD 234
HL1541DL InGaAsP DFB LD 240
HL1541DM InGaAsP DFB LD 246
HL1561A InGaAsP DFB LD 251
HL1561AC InGaAsP DFB LD 255
HL1561BF InGaAsP DFB LD 259

—Infrared emitting diodes—

HLP20R GaAlAs IRED 263
HLP30R GaAlAs IRED 263
HLP40R GaAlAs IRED 263
HLP20RG GaAlAs IRED 266
HLP30RG GaAlAs IRED 266
HLP40RG GaAlAs IRED 266
HE7601SG GaAlAs IRED 269
HE8403R GaAlAs IRED 270
HE8403SG GaAlAs IRED 272
HE8403ML GaAlAs IRED 274
HE8403TR GaAlAs IRED 276
HE8404SG GaAlAs IRED 278
HE8805VG GaAlAs IRED 279
HE8806VG GaAlAs IRED 281
HE8807SG GaAlAs IRED 283
HE8807SL GaAlAs IRED 285
HE8807CL GaAlAs IRED 287
HE8810MA GaAlAs IRED 288
HE8811 GaAlAs IRED 289
HE8812SG GaAlAs IRED 291
HE1301R InGaAsP IRED 292
HE1301SG InGaAsP IRED 294
HE1301ML InGaAsP IRED 296
HE1301TR InGaAsP IRED 298

—Photodiodes—

HR8101 Si PIN Photodiode 303
HR8102 Si PIN Photodiode 305
HR8202TG Si Avalanche Photodiode 307
HR1103TG InGaAs PIN Photodiode 309
HR1103CX InGaAs PIN Photodiode 312
HR1103TR InGaAs PIN Photodiode 315
HR1104TG InGaAs PIN Photodiode 318
HR1104CX InGaAs PIN Photodiode 321
HR1105TG InGaAs PIN Photodiode 324
HR1106LG InGaAs PIN Photodiode 327
HR1201TG InGaAs Avalanche Photodiode 329
HR1201CX InGaAs Avalanche Photodiode 332

Guide to Products to be Discontinued

Products to be discontinued 337

Product Lineup

Part no.

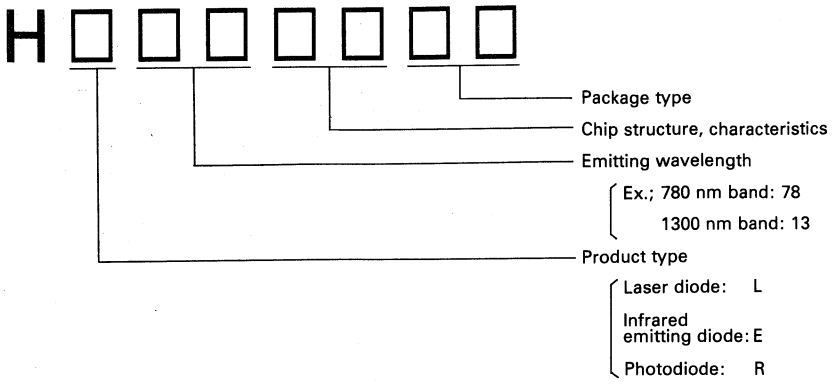
Product lineup

Main characteristics

Package variations

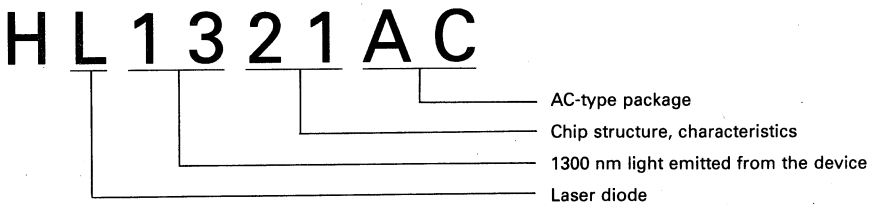
Part no.

1. Hitachi optoelectronic device part nos. indicate the following:

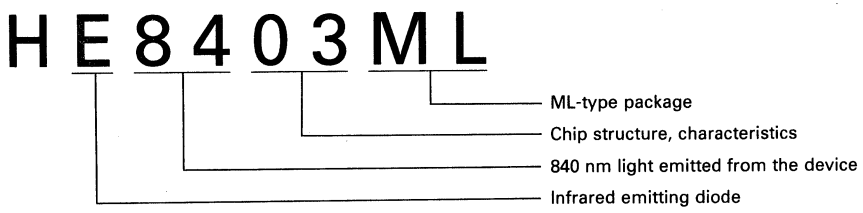


2. Sample part nos. are given below.

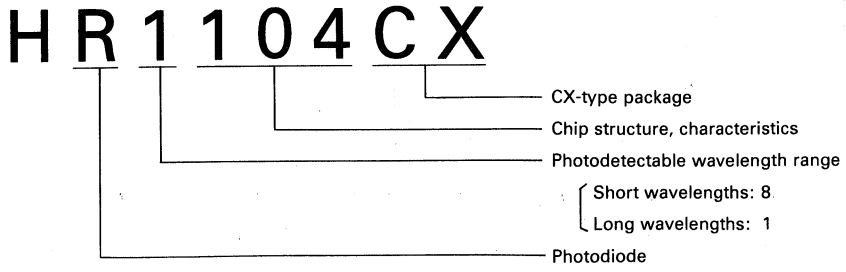
(1) Laser diode example



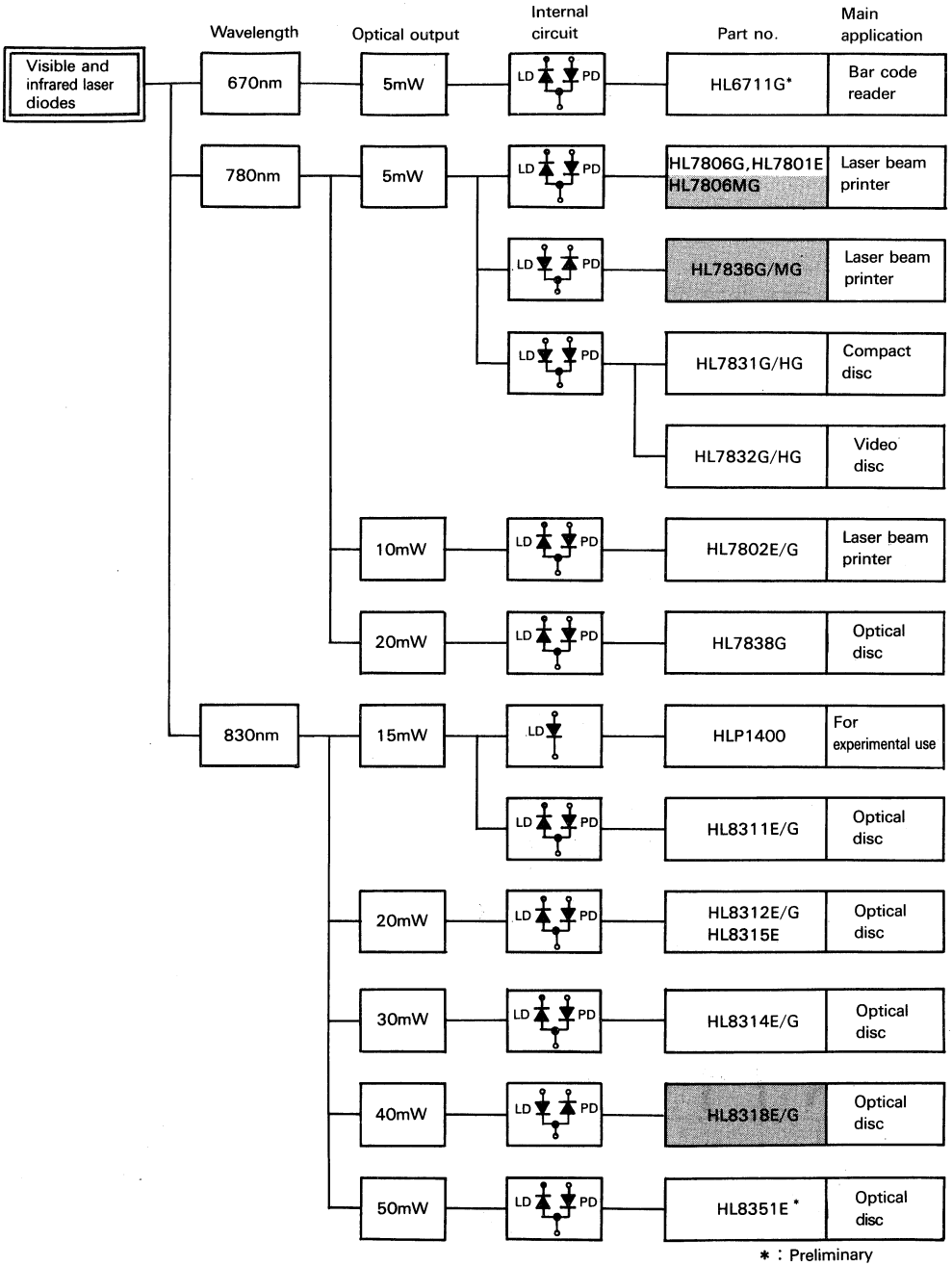
(2) Infrared emitting diode example



(3) Photodiode example

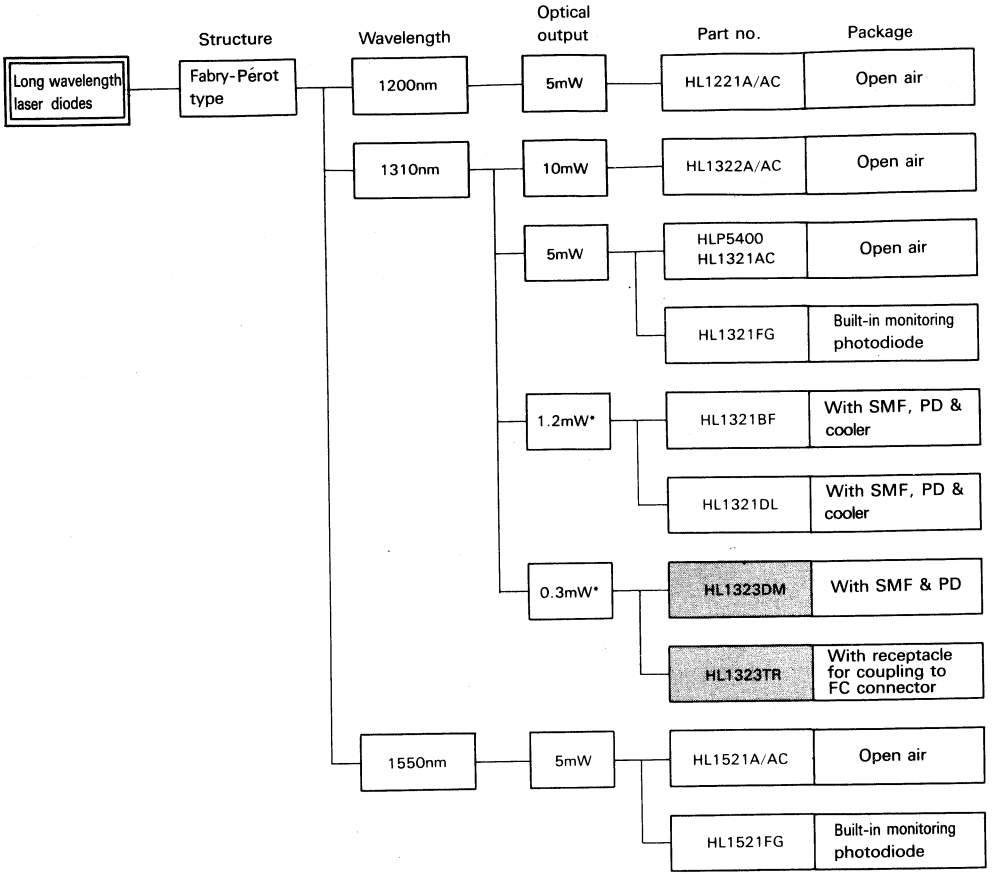


Product lineup



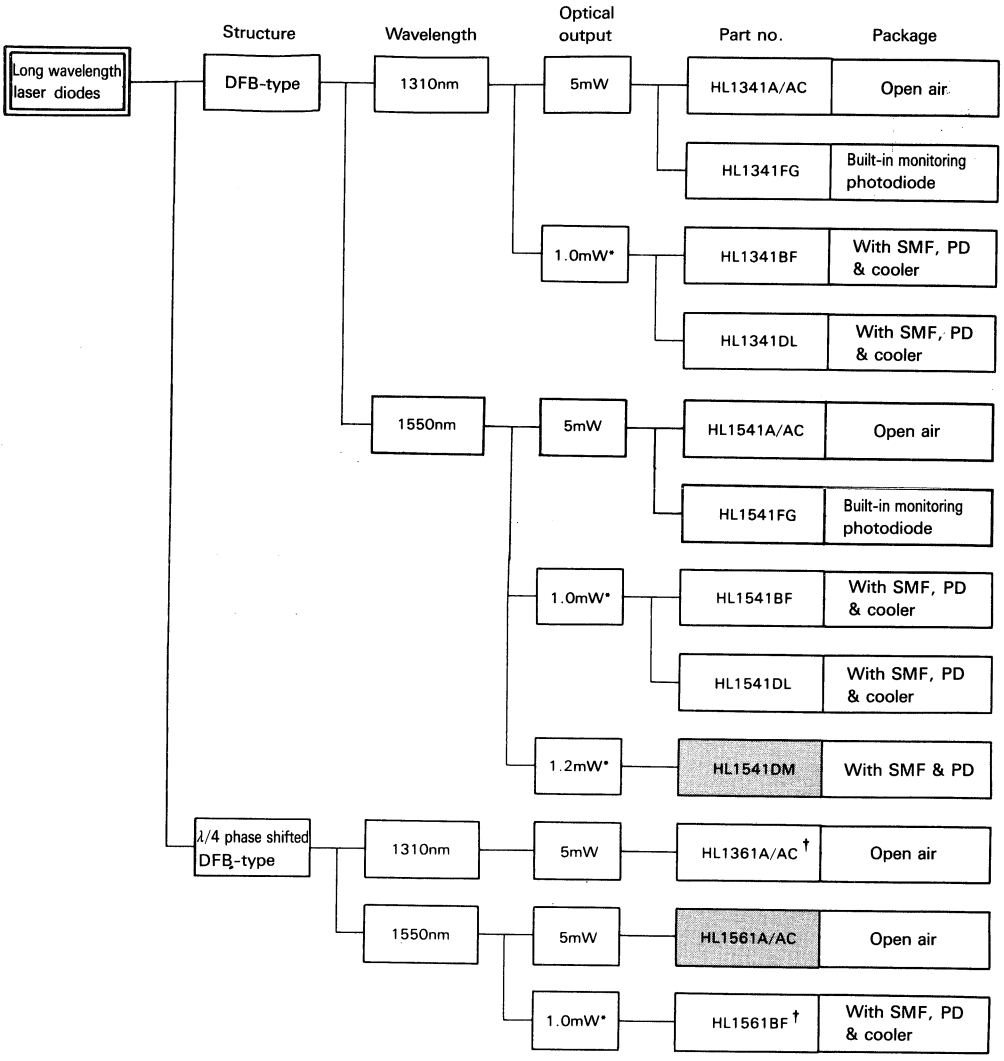
* : Preliminary
: New product

HITACHI



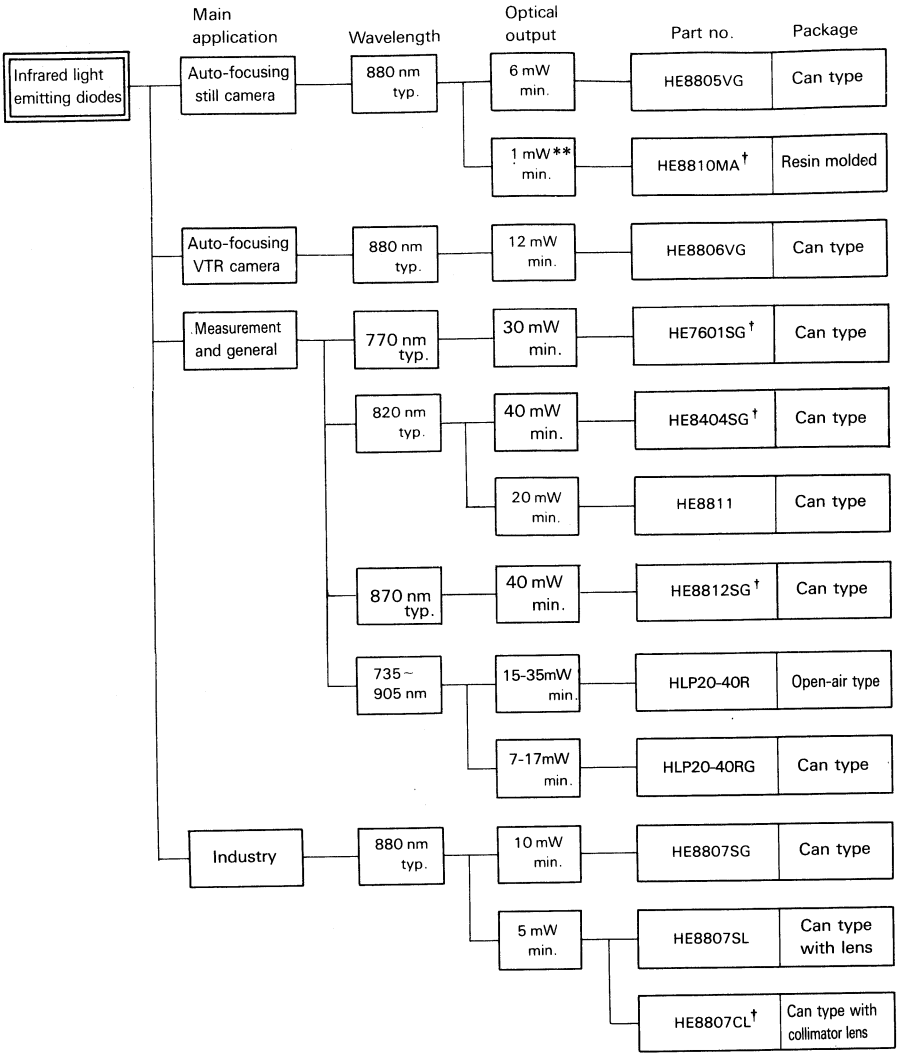
* : Fiber optical output
SMF : Single mode fiber
▭ : New product

Product lineup



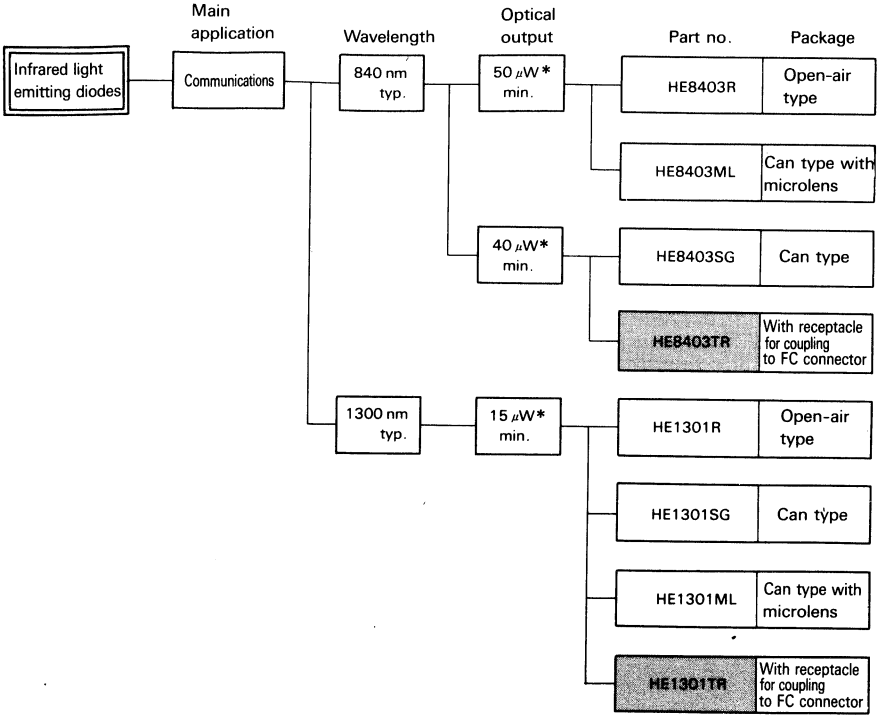
† : Under development
* : Fiber optical output
SMF : Single mode fiber
▒ : New product

HITACHI



† : Under development
* : Fiber optical output
** : Value at NA=0.25

Product lineup



† : Under development
* : Fiber optical output
** : Value at NA=0.25
▒ : New product

HITACHI

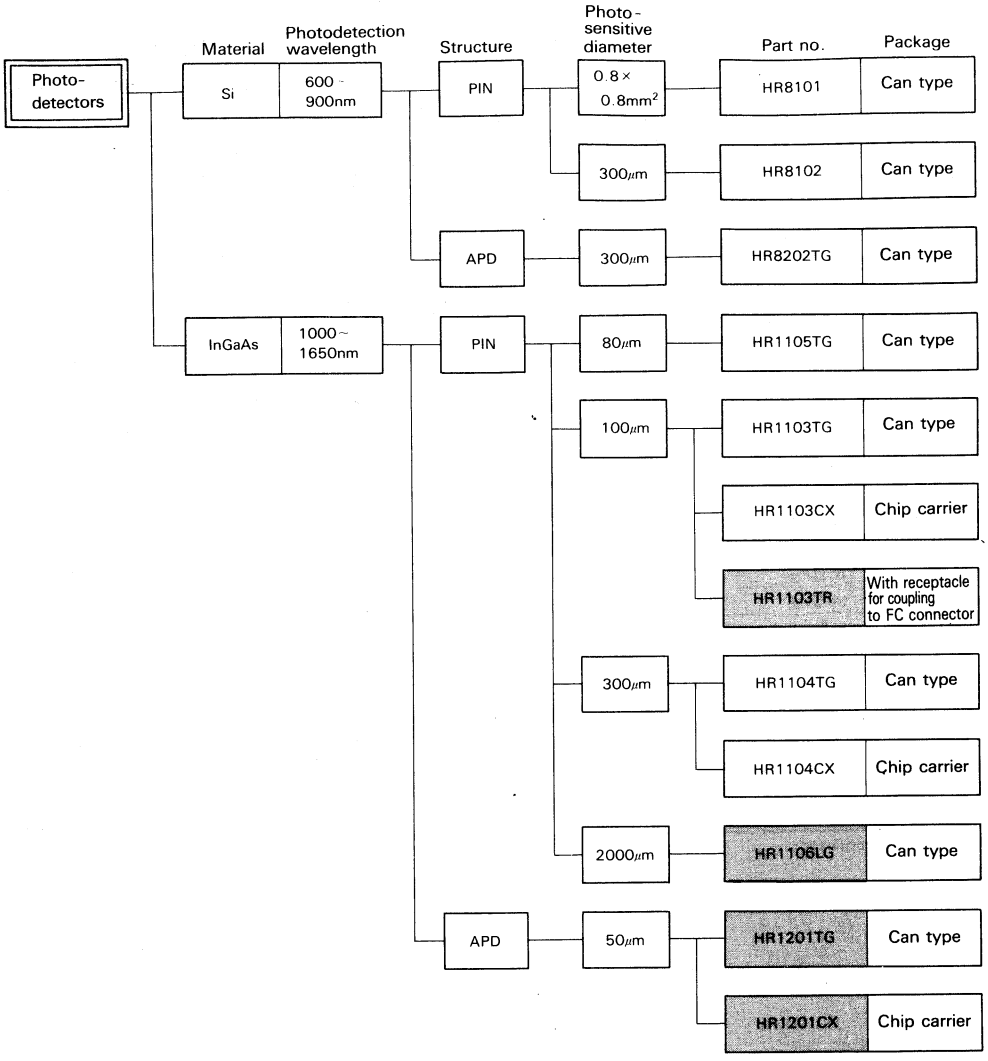


Photo-detectors
Material
Photodetection wavelength
Structure
Photo-sensitive diameter
Part no.
Package
Si
600 ~ 900nm
PIN
0.8 × 0.8mm²
HR8101
Can type
300μm
HR8102
Can type
APD
300μm
HR8202TG
Can type
InGaAs
1000 ~ 1650nm
PIN
80μm
HR1105TG
Can type
100μm
HR1103TG
Can type
HR1103CX
Chip carrier
HR1103TR
With receptacle for coupling to FC connector
300μm
HR1104TG
Can type
HR1104CX
Chip carrier
2000μm
HR1106LG
Can type
APD
50μm
HR1201TG
Can type
HR1201CX
Chip carrier

: New product

Main characteristics

Laser diodes ($T_C = 25°C$)

Part no.		Absolute maximum ratings: Optical output power, P_O (mW)	Reverse voltage, $V_{R(LD)}$ (V)	Operating temp., T_{opr} (°C)	Storage temp., T_{stg} (°C)	Optical and electrical characteristics: Lasing wavelength, λ_p (nm) min.	typ.	max.	Beam divergence, $\theta_{//} \times \theta_{\perp}$ (deg.) typ.	Test condition P_o (mW)	Reference page
HL6711 series	HL6711G+	5	2	−10 to +50	−40 to +85	660	670	680	8×30	5	89
HL7801 series	HL7801E	5	2	−10 to +60	−40 to +80	760	780	800	15×30	3	90
HL7802 series	HL7802E	10	2	−10 to +50	−40 to +80	770	785	800	11×30	10	92
	HL7802G										94
HL7806 series	HL7806G	5	2	−10 to +60	−40 to +85	775	785	795	14×27	5	96
	HL7806MG										99
HL7831 series	HL7831G	5	2	−10 to +60	−40 to +85	770	785	795	13×35	3	102
	HL7831HG								11×35		105
HL7832 series	HL7832G	5	2	−10 to +60	−40 to +85	770	785	795	13×35	3	108
	HL7832HG								11×35	5	111
HL7836 series	HL7836G	5	2	−10 to +60	−40 to +85	770	785	795	11×27	5	114
	HL7836MG										117
HL7838 series	HL7838G	20	2	−10 to +60	−40 to +80	770	780	795	10×26	20	120
HL8311 series	HLP1400	15	2	0 to +60	0 to +80	800	830	850	10×25	10	123
	HL8311E			−10 to +60	−40 to +80						125
	HL8311G										127
HL8312 series	HL8312E	20	2	−10 to +50	−40 to +80	810	830	850	10×25	10	129
	HL8312G										131
HL8314 series	HL8314E	30	2	−10 to +50	−40 to +80	810	830	850	10×25	30	133
	HL8314G										135
HL8315 series	HL8315E	20	2	−10 to +50	−40 to +80	800	830	850	10×25	10	138
HL8318 series	HL8318E	40	2	−10 to +60	−40 to +85	810	830	850	11×25	40	141
	HL8318G										144
HL8351 series	HL8351E+	50	2	−10 to +60	−40 to +85	810	830	850	9×27	50	147

+ Preliminary specifications
New product

(Continued)

Laser diodes ($T_C = 25°C$)

Part no.		Absolute maximum ratings: Optical output power, P_O (mW)	Reverse voltage, $V_{R(LD)}$ (V)	Operating temp., T_{opr} (°C)	Storage temp., T_{stg} (°C)	Optical and electrical characteristics: Lasing wavelength, λ_p (nm) min.	typ.	max.	Beam divergence, $\theta_{//} \times \theta_{\perp}$ (deg.) typ.	Test condition P_O (mW)	Reference page
HL1221 series	HL1221A	5	2	0 to +50	0 to +60	1170	1200	1230	30×40	3	149
	HL1221AC										152
HL1321 series	HLP5400	5	2	0 to +50	0 to +60	1270	1300	1330	30×40	3	155
	HL1321AC	5	2	0 to +60	0 to +80	1270	1300	1330	30×40	3	158
	HL1321FG	5	2	0 to +60	−40 to +80	1290	1310	1330	30×40	3	161
	HL1321BF	1.2*	2	0 to +60	−40 to +70	1290	1310	1330		1.0*	164
	HL1321DL	1.2*	2	0 to +60	−40 to +70	1290	1310	1330		1.0*	168
HL1322 series	HL1322A	10	2	0 to +60	0 to +80	1290	1310	1330	30×40	6	172
	HL1322AC										175
HL1323 series	HL1323DM	0.3*	2	0 to +65	−20 to +70	1260	1300	1340		0.15*	178
	HL1323TR			0 to +60	−40 to +80	1290	1310	1330		0.1*	181
HL1341 series	HL1341A	5	2	0 to +60	0 to +80	1290	1310	1330	30×40	3	184
	HL1341AC				0 to +80						188
	HL1341FG				−40 to +80						192
	HL1341BF	1.2*	2		−40 to +70					0.5*	197
	HL1341DL				−40 to +70						203
HL1361 series	HL1361A++	5	2	0 to +60	0 to +80	1290	1310	1330	30×40	3	209
	HL1361AC++										210
HL1521 series	HL1521A	5	2	0 to +60	0 to +80	1530	1550	1570	30×40	3	211
	HL1521AC										214
	HL1521FG				−40 to +80						217
HL1541 series	HL1541A	5	2	0 to +60	0 to +80	1530	1550	1570	30×40	3	220
	HL1541AC				0 to +80						224
	HL1541FG				−40 to +80						228
	HL1541BF	1.0*	2		−40 to +70					0.5*	234
	HL1541DL				−40 to +70						240
	HL1541DM	1.2*		0 to +50	−40 to +60						246
HL1561 series	HL1561A	5	2	0 to +60	0 to +80	1530	1550	1570	30×40	3	251
	HL1561AC										255
	HL1561BF++	1.0*			−40 to +70					0.5*	259

+ Preliminary specifications ++ Under development * Fiber optical output power, P_f ▣ New product

Infrared emitting diodes ($T_C = 25°C$)

Part no.		Absolute maximum ratings: Reverse voltage, V_R (V)	Operating temp., T_{opr} (°C)	Storage temp., T_{stg} (°C)	Optical and electrical characteristics: Optical output power, P_O (mW) min.	Peak wave-length*, λ_p (nm) A	B	C	D	Spectral width, $\Delta\lambda$ (nm) typ.	Test condition I_F (mA)	Capaci-tance, C_t (pF) typ.	Test condition	Reference page
HLP series	HLP20R	3	−20 to +40	−40 to +60	15	○				30	200	30	V_R = 0 V f = 1 MHz	263
	HLP30R				25	○	○	○	○					
	HLP40R				35	○	○	○	○					
	HLP20RG	3	−20 to +60	−40 to +80	7	○				30	200	30	V_R = 0 V f = 1 MHz	266
	HLP30RG				12	○	○	○	○					
	HLP40RG				17	○	○	○	○					
HE7601SG+		3	−20 to +60	−40 to +90	30	740 to 800				50	200	30	V_R = 0 V f = 1 MHz	269
HE8403R		3	−20 to +40	−40 to +60	50μ**	800 to 900				50	100	10		270
HE8403SG		3	−20 to +60	−40 to +90	40μ**	800 to 900				50	100	10		272
HE8403ML		3	−20 to +60	−40 to +90	50μ**	800 to 900				50	100	10		274
HE8403TR		3	−20 to +85	−40 to +100	40μ**	800 to 900				50	100	10		276
HE8404SG+		3	−20 to +60	−40 to +90	40	790 to +850				50	200	30		278
HE8805VG		3	−20 to +60	−40 to +90	6	800 to 900				30	150	10		279
HE8806VG		3	−20 to +60	−40 to +90	12	800 to 900				30	150	10		281
HE8807SG		3	−20 to +80	−40 to +100	10	800 to 900				30	150	10		283
HE8807SL		3	−20 to +80	−40 to +100	5	800 to 900				30	150	10		285
HE8807CL +		3	−20 to +80	−40 to +100	5	800 to 900				30	150	10		287
HE8810MA +		3	−20 to +60	−40 to +90	1.0***	800 to 900				30	150	10		288
HE8811		3	−20 to +60	−40 to +90	20	780 to 900				50	150	10		289
HE8812SG+		3	−20 to +60	−40 to +90	40	840 to 900				30	200	30		291
HE1301R		1.0	−20 to +40	−40 to +60	15μ**	1260 to 1340				140	100	30		292
HE1301SG		1.0	−20 to +60	−40 to +90	15μ**	1260 to 1340				140	100	30		294
HE1301ML		1.0	−20 to +60	−40 to +90	15μ**	1260 to 1340				140	100	30		296
HE1301TR		1.0	−20 to +85	−40 to +100	15μ**	1260 to 1340				140	100	30		298

+ Under development * HLP series grouped with peak wavelength ** Fiber optical output power , P_f , *** NA=0.25(pF) ☐ New product

Grade	λ_p (nm) min.	typ.	max.
A	735	760	785
B	775	800	825
C	815	840	865
D	855	880	905

Photodiodes ($T_C = 25°C$)

Part no.	Absolute maximum ratings: Photo-detection dia., ϕ (μm)	Reverse voltage, V_R (V)	Operating temp., T_{opr} (°C)	Storage temp., T_{stg} (°C)	Optical and electrical characteristics: Dark current, I_{DARK} (nA) typ.	Test condition V_R (V)	Capacitance, C_t (pF) typ.	Test condition	Sensitivity, S (mA/mW) min.	Test condition	Reference page
HR8101	0.8×0.8mm²	100	−40 to +80	−45 to +100	2	10	10	V_R = 10 V f = 1 MHz	0.4	V_R = 10 V λ_p = 830 nm	303
HR8102	300	100	−40 to +80	−45 to +100	0.5	10	1.5		0.4		305
HR8202TG	300		−40 to +80	−45 to +100	0.5	0.9V_B	1.5	V_R = 100 V f = 1 MHz	0.46	M = 1 λ_p = 830 mm	307
HR1103TG	100	20	−40 to +80	−45 to +100	1	5	1.0	V_R = 5 V f = 1 MHz	0.9 typ.	V_R = 5 V λ_p = 1550 nm	309
HR1103CX	100	20	−40 to +80	−40 to +100	1	5	1.2		0.9 typ.		312
HR1103TR	100	20	−40 to +85	−45 to +100	1	5	1.0		0.85 typ.		315
HR1104TG	300	20	−40 to +80	−45 to +100	10	5	5	V_R = 5 V f = 1 MHz	0.9 typ.	V_R = 5 V λ_p = 1550 nm	318
HR1104CX	300	20	−40 to +80	−40 to +100	10	5	6		0.9 typ.		321
HR1105TG	80	20	−40 to +80	−45 to +100	1	5	0.8		0.9 typ.		324
HR1106LG	2000	2	−40 to +85	−45 to +100	1	1	150	V_R = 1 V f = 1 MHz	0.9 typ.	V_R = 1 V λ_p = 1550 nm	327
HR1201TG	50		−40 to +80	−45 to +100	2	0.9V_B	0.5	V_R = 0.9 V_B f = 1 MHz	0.9 typ.	V_R = 0.9 V_B λ_p = 1550 nm	329
HR1201CX	50		−40 to +80	−45 to +100	2	0.9 V_B	0.7		0.9 typ.		332

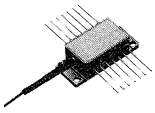
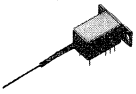
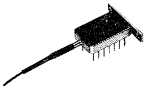
New product

Package variations

Laser Diodes

	Packages	Features	Applicable products
Open-air type	 A-type	• For experimental use • For module assembly	HLP1400, HL1221A, HLP5400, HL1322A, HL1341A, HL1361A, HL1521A, HL1541A, HL1561A
	 AC-type	• For module assembly • Chip carrier stem	HL1221AC, HL1321AC, HL1322AC, HL1341AC, HL1361AC, HL1521AC, HL1541AC, HL1561AC
Hermetically-sealed type	 E-type	• With built-in monitor-photodiode • Three leads	HL7801E, HL7802E, HL8311E, HL8312E, HL8314E, HL8315E, HL8318E, HL8351E
	 G-type	• With built-in monitor-photodiode • Three leads	HL6711G, HL7802G, HL7806G, HL7831G, HL7832G, HL7836G, HL7838G, HL8311G, HL8312G, HL8314G, HL8318G
	 FG-type	• With buil-in monitor-photodiode • Four leads	HL1321FG, HL1341FG, HL1521FG, HL1541FG

(Continued)

	Packages	Features	Applicable products
Hermetically-sealed type	 MG-type	• Compact size • With built-in monitor-photodiode • Three leads	HL7806MG, HL7836MG
	 HG-type	• Compact size • Slanted window • With built-in monitor-photodiode • Three leads	HL7831HG, HL7832HG
Fiber-pigtail type	 BF-type	• For high frequency • Butterfly-type package • With single-mode fiber • With built-in cooler • With built-in monitor-photodiode	HL1321BF, HL1341BF, HL1541BF, HL1561BF
	 DL-type	• Dual-in-line type package • With single-mode fiber • With built-in cooler • With built-in monitor-photodiode	HL1321DL, HL1341DL, HL1541DL
	 DM-type	• With single-mode fiber • With built-in monitor-photodiode	HL1323DM, HL1541DM
Receptacle type	 TR-type	• With receptacle • For coupling FC-connector	HL1323TR

Infrared emitting diodes

	Packages	Features	Applicable products
Open-air type	 R-type	• For experimental use • For module assembly	HLP20R, HLP30R, HLP40R, HE8403R, HE1301R
Hermetically-sealed type	 RG-type	• Flat glass window • Longer cap than SG-type's	HLP20RG, HLP30RG, HLP40RG
	 SG-type	• Flat glass window	HE7601SG, HE8403SG, HE8404SG HE8807SG, HE8811,HE8812SG, HE1301SG
	 VG-type	• Flat glass window	HE8805VG, HE8806VG
	 ML-type	• With microball lens	HE8403ML, HE1301ML
	 SL-type	• With lens cap	HE8807SL
	 CL-type	• Lens cap to collimate beam	HE8807CL

Packages	Features	Applicable products
 MA-type	• Resin molded	HE8810MA
Receptacle type  TR-type	• With receptacle • For coupling FC-connector	HE8403TR, HE1301TR

Photodiodes

	Packages	Features	Applicable products
Open-air type	 CX-type	• For module assembly • Chip carrier stem	HR1103CX, HR1104CX, HR1201CX
Hermetically-sealed type	 QG-type	• Flat glass window • Two leads	HR8101
	 TG-type	• Flat glass window • Three leads	HR8102, HR8202TG, HR1103TG, HR1104TG, HR1105TG, HR1201TG
	 LG-type	• Flat glass window • Two leads	HR1106LG
Receptacle type	 TR-type	• With receptacle • For coupling to FC-connector	HR1103TR

Product Descriptions

I. Operation principles
II. Chip structures
III. Symbols and definitions
IV. Fundamental characteristics
V. Handling instructions
VI. Reliability
VII. In Purchasing Hitachi Optodevices

I. Operation principles

1. Operation principles of LDs, IREDs and photodiodes

1.1 Emitting principles

Each electron in atoms and molecules has a specific discrete energy level, as shown in Fig. I-1. The transition of electrons between different energy levels is sometimes accompanied by light absorption or emission of the wavelength, λ, expressed as:

$$\lambda = \frac{C}{f_0} = \frac{C}{|E_2 - E_1|/h} = \frac{1.2398}{|E_2 - E_1|}$$

C: Light velocity
E_1: Energy level before transition
E_2: Energy level after transition
h: Planck constant (6.625×10^{-34} joul. sec.)
f_0: Emission frequency

There are three types of electron transitions, as shown in Fig. I-2.

Firstly, Fig. I-2 (a) shows what is known as resonant absorption. An electron transits from the stable low energy level, E_0, to the higher energy level, E_1, through absorbing light.

Secondly, Fig. I-2 (b) shows spontaneous emission. An electron transits from the high energy level, E_1, to the stabler low energy level, E_0. At the time, the energy balance of $|E_1 - E_0|$ is released in the form of light. Since each electron in the level, E_1, transits independently, light is emitted at random and out of phase. Such light is referred to as incoherent light and one of the typical characteristics of spontaneous emission. The light from IRED is of such spontaneous emission light.

Under thermal equilibrium, probability of electrons to exist in the lower level, E_0, is higher than that in the higher energy level, E_1. Therefore, electron transition to higher energy level ($E_0 \rightarrow E_1$) by absorbing light is more likely to occur than light emission as shown in Fig. I-2 (a). In order to emit light, electrons must exist in E_1 with high probability, which is referred to as inversed population.

Thirdly, Fig. I-2 (c) shows stimulated emission. The electrons in the higher energy level, E_1, are forcibly transferred to the lower energy level, E_0, by incident light. The light generated this time is referred to as stimulated emission light. Its phase is the same as that of incident light, because the stimulated emission light is emitted with resonating to the incident light. Such stimulated emission light is referred to as the coherent light.

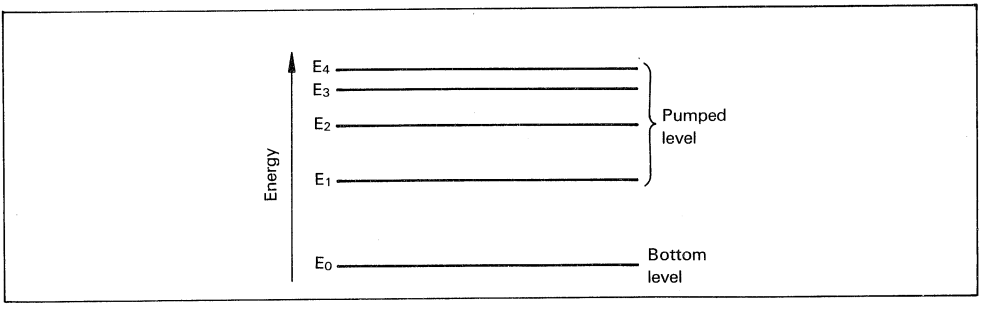


Figure I-1. Energy Level

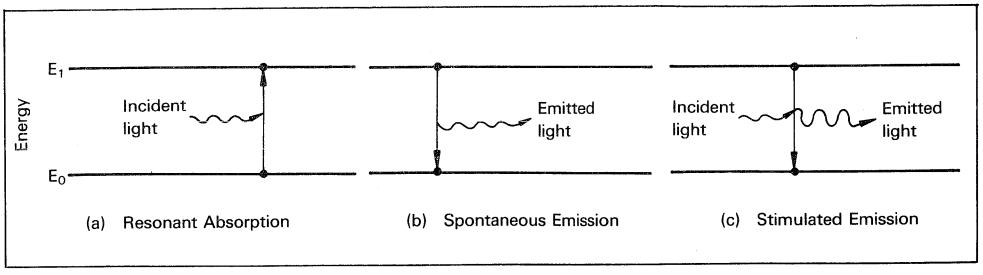


Figure I-2. Transition Process

Similarly to the electric circuit, laser oscillation requires the feedback function in addition to the gain which exceeds the loss. Laser beam is oscillated by amplification of stimulated emission and positive feedback with mirrors.

Figure I-3 shows a Fabry-Pérot resonator which is the most fundamental optical resonator.

The structure of an LD, in principle, is the same as shown in Fig. I-3, which has the both surfaces of the chip with reflection mirrors by cleaving.

The light heading to the reflection mirror among incident spontaneous emission light, is amplified by stimulated emission and comes back to the initial position after reflection. This process accompanies the loss by passing through or diffraction of light at the reflection mirrors and scattering or absorption in the cavity. When the loss is higher than the amplification gain, the light attenuates. Injected current strengthens amplification gain in an LD and at the condition that the gain and the loss are balanced, initial light intensity becomes equal to that of returned. This condition is referred as threshold. A laser oscillates above the threshold when the gain increases enough.

Injection pumping is mainly taking place at the p-n junction in a semiconductor laser diode. A semiconductor crystal can obtain higher gain than a gas laser (HeNe for example) due to the higher density of atoms available with a cavity. Therefore, a laser can oscillate with such a short resonant cavity of 300 μm and low reflectivity of 30%.

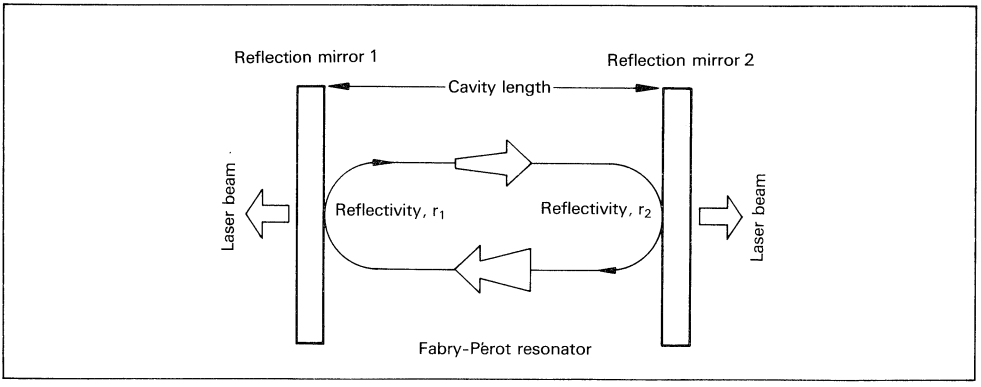


Figure I-3. Fundamental Structure of Fabry-Pérot Resonator

1.2 Photo-detection principles

Photodiodes make use of a photovoltaic effect resulting from application of voltage to both ends of a p-n junction at the time light exposes the junction. Under reverse-voltage conditions at the p-n junction, a depletion region is generated to which an electric field has been applied (see Fig. I-4). Incident light with the same energy as the bandgap energy is absorbed in the depletion region. This absorption of light produces electron-hole pairs. The electrons and holes then drift, under electric field action, in opposite directions across the depletion region. Electrons move forward to the cathode electrode, and holes move to the anode. As a result, a current flows through the load resister, and light signals are converted to electric signals. Carriers produced in the depletion region move at high speeds due to acceleration by the electric field. Carriers generated in the diffusion region, however, move slowly due to diffusion in accordance with the concentration gradient.

In optical fiber or information terminal equipment systems, a high-speed response and high quantum efficiency are essential photodiode capabilities. Accordingly, Hitachi has been employing PIN structures for photodiodes to achieve higher quantum efficiency and reduce junction capacitance for a faster response. "PIN" signifies a structural configuration whereby an intrinsic layer with high resistance is sandwiched between p-type and n-type semiconductors. The electric field is applied to the intrinsic region, and most incident light is absorbed in this region, producing a great many electron-hole pairs.

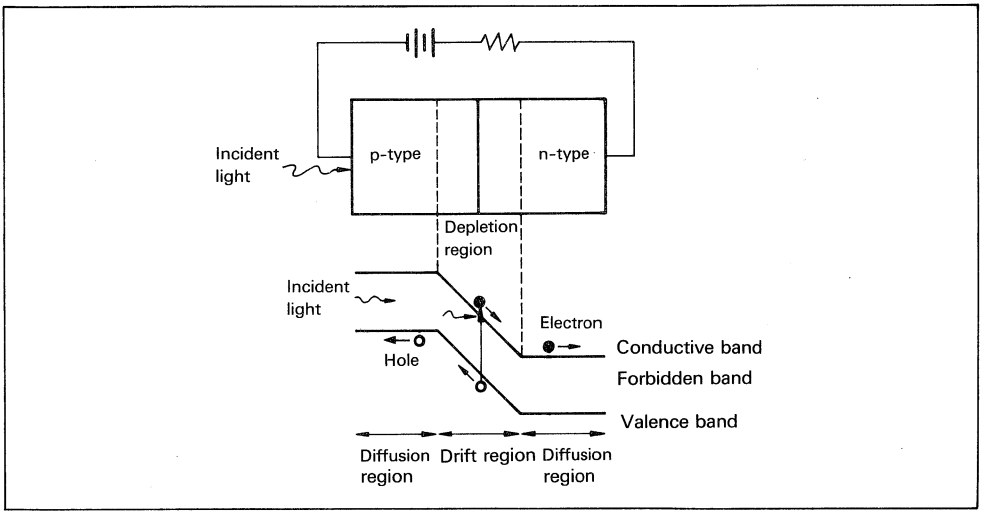


Figure I-4. Photo-detection Principles

II. Chip structures

1. LD structures

1.1 GaAlAs LD structure

The p-type active layer is processed first in which stimulated emission enforces optical amplification (Fig. II-1 (a)). The p-n junction is made here to inject minority carriers (the p-n heterojunction). With forward current applied to the junction, electrons in n-type region are injected into p-type region. With a p-type semiconductor of wide band gap on the other side of p-n junction (heteroisolation junction), the injected carriers are much confined within the p-type active layer. This carrier confinement makes population inversion easily and the light emission intensity is then increased.

The active layer of the GaAlAs LD is made of GaAs or $Ga_{1-y}Al_yAs$ (Fig. II-2). The thickness of the layer is 0.05 to 0.2 μm. p-type $Ga_{1-x}Al_xAs$ and n-type $Ga_{1-x}Al_xAs$ ($x > y$) sandwich the active layer (x and y here are the mixture ratio of aluminum). When x is 0.3, the band gap of the sandwich layers is 1.8 eV and there is balance of 0.4 eV against 1.4 eV of GaAs. When forward bias is applied here, the heterobarrier confines carriers within the 0.05 to 0.2 μm active layer, carrier population is inverted and the gain increases. The refractive index of GaAs is higher by some percents than that of $Ga_{1-x}Al_xAs$, which confines the generated light within the GaAs active layer. The light penetrating into Al_xAs layer is not absorbed because of its wide band gap. So laser oscillates effectively there (Fig. II-1). The thinner GaAs layer can do with less threshold current density for laser oscillation. At present, the threshold current density of as low as 1 to 2 kA/cm^2 is achieved, which realizes the continuous oscillation (CW) stably at room temperature.

1.2 Lasing modes of GaAlAs LD

Under the laser oscillation, the light standing wave forms with wavefront parallel to mirror facets while light is traveling back and forth within the laser cavity. This standing wave consists of longitudinal mode and transverse mode (Fig. II-3). Longitudinal mode expresses the condition in the direction of cavity length (z direction). Transverse

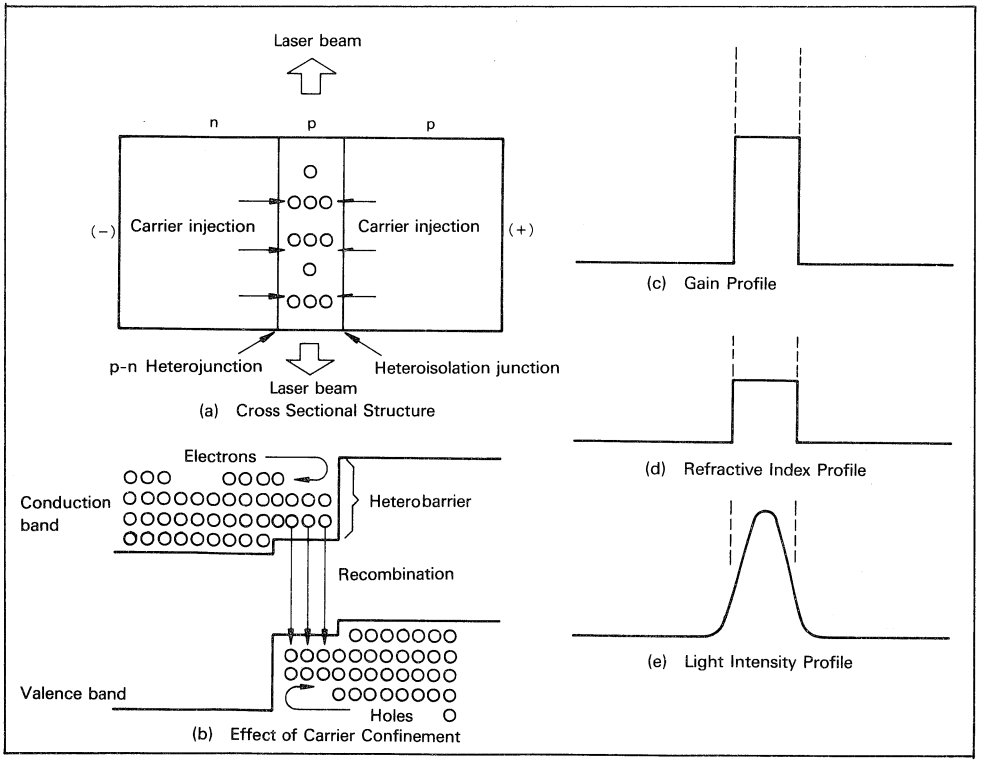


Figure II-1. Operation Principles of Double-heterojunction LD

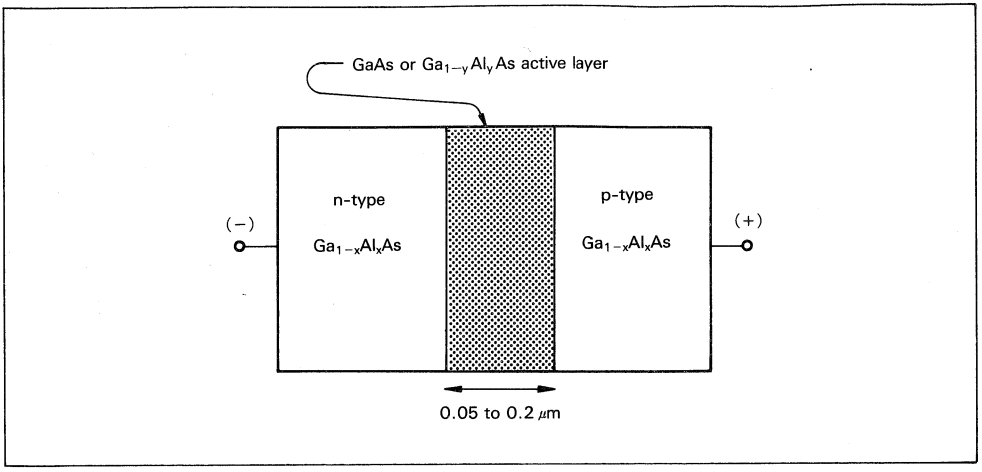


Figure II-2. GaAlAs DH Structure LD

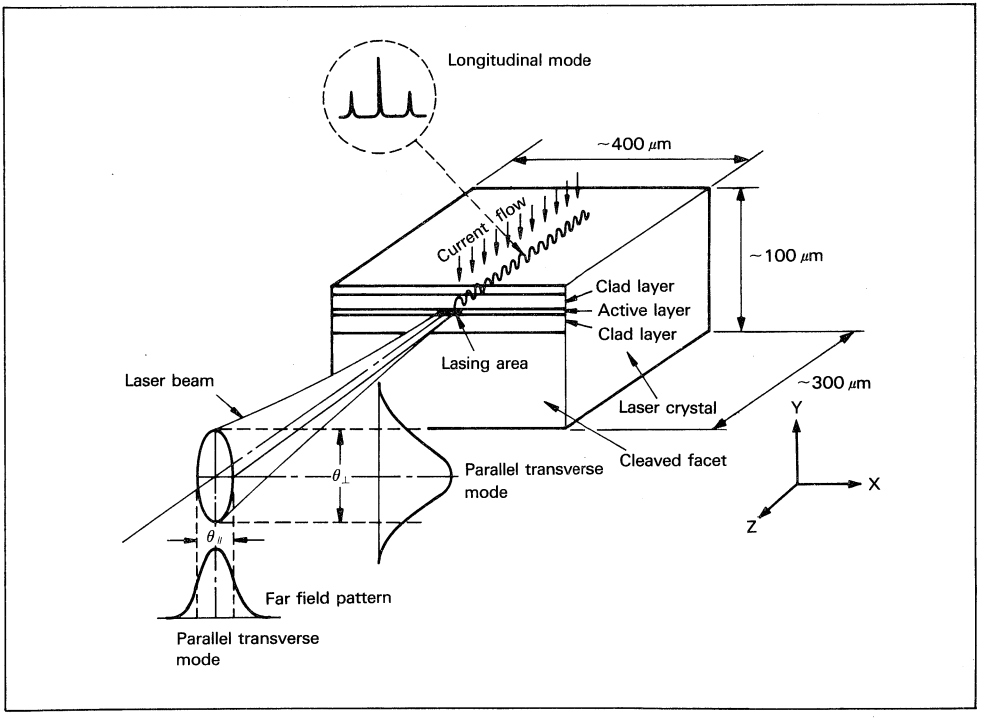


Figure II-3. Lasing Mode of LD

mode expresses the condition of the perpendicular axis to the cavity length direction. And the transverse mode is devided into perpendicular transverse mode which is perpendicular to the active layer and parallel transverse mode which is parallel to the layer.

Longitudinal mode

Figure II-4 shows that a standing wave of the half wavelength multiplied by an integer, q, forms in the direction of laser cavity length (z direction). When the refractive index of the medium is n and the wavelength in the vacuum is λ, the wavelength of light λ' is expressed as:

$$\lambda' = \lambda / n$$

So the half wavelength is expressed as:

$$\frac{1}{2}\lambda' = \frac{\lambda}{2n}$$

As described at the beginning, since the half wavelength multiplied by an integer, q, equals to the cavity length, L:

$$q \cdot \frac{\lambda}{2n} = L$$

For a semiconductor laser diode, when λ is 850 nm, n is 3.5 and L is 300 μm, q is about 2500. This q is referred as a mode number.

When a mode number, q, changes by 1, the wavelength change, $\Delta\lambda$, is expressed as:

$$|\Delta\lambda| = 0.34 \text{ nm}$$

Since a cavity length is incomparably longer than a wavelength, cavity resonance can take place at multiple wavelengths. The particular wavelength area where the cavity gain becomes maximum will then be chosen to have a stable standing wave.

In a semiconductor laser diode, when the temperature changes, the band gap energy changes then the wavelength where the maximum gain is achieved changes. As for the GaAlAs DH structure laser, this temperature coefficient is about 0.25 nm/deg. So the temperature rise makes the oscillation wavelength jump upward at intervals of $\Delta\lambda$ ($\approx$ 0.34 nm). The same phenomenon takes place because of temperature rise in the active layer when the injection current increases for the higher optical output power under the continuous operation (CW).

Perpendicular transverse mode

In a GaAlAs laser diode, the active layer is sandwiched by heterojunction (Fig. II-5). Light is confined within the active layer because of the higher refractive index here than that of sandwiching layer GaAlAs, although it is a matter of some percents. The amount of light confined here depends on the thickness of the active layer. A thicker layer confines more light. On the other hand, light penetrates into the sandwiching layers in case of a too thin layer. The width of laser beam divergence depends on the thickness of an active layer and when it is 0.3 to 0.4 μm, the width becomes narrowest. At this width, the radiation angle of laser beam emitted from the cleaved facet becomes widest (Fig. II-6). In general, in a semiconductor laser, the radiation angle of laser beam out of the device becomes very wide because the laser beam profile width in the device is the same as or less than the lasing wavelength. This is very the different characteristic from that of a conventional gas laser or solid state laser.

Parallel transverse mode

Waveguide must be formed by some means because there is nothing to guide light in the active layer in parallel to the junction. When the current injection is limited to a narrow enough region with a full cavity length, laser oscillation can then take place in the region (Fig. II-3). Figure II-7 shows the basic stripe structure which can limit current pass only.

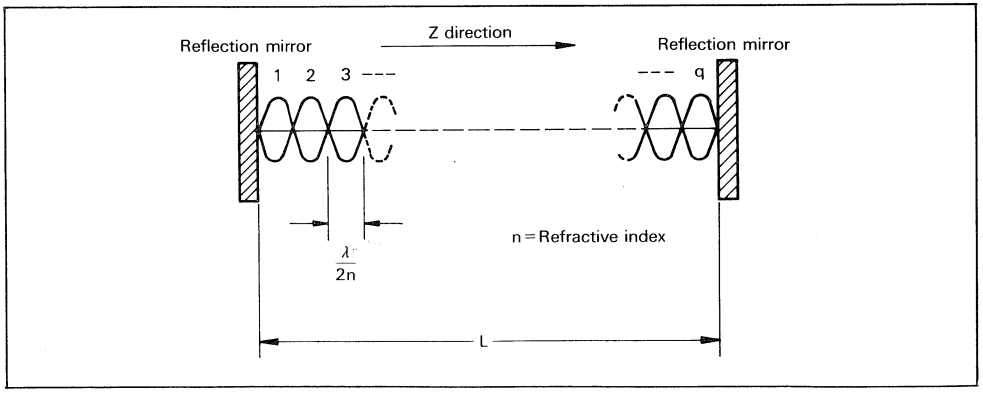


Figure II-4. Longitudinal Mode of LD

In order to control the transverse mode more effectively, the refractive index profile or the optical loss profile should be built in structurally to the stripe structure additionally. Figure II-8 shows examples of this structure.

Figure II-8 (a) describes a CSP (channeled substrate planar) laser. Outside of the channel fabricated in the base, the light penetrated from the active layer reaches the base and suppresses the lasing due to absorption loss. Figure II-8 (b) describes a BH (buried heterostructure) laser. In the both directions of perpendicular and parallel, the double-heterostructure is made.

These structural waveguides stabilize the single fundamental transverse mode. All of Hitachi LDs have the stable single transverse mode. A GaAlAs laser diode is described above.

HL7801, HL7806, HL8311, HL8312 and HL8314 series employ basically the same material; GaAlAs. HL1321 series employ InGaAsP in an active layer and InP in sandwiching layers, and the fundamental lasing principle and the lasing mode are the same as the former. The structure of DFB (distributed feedback) LD to realize dynamic single mode is shown in Fig. II-9.

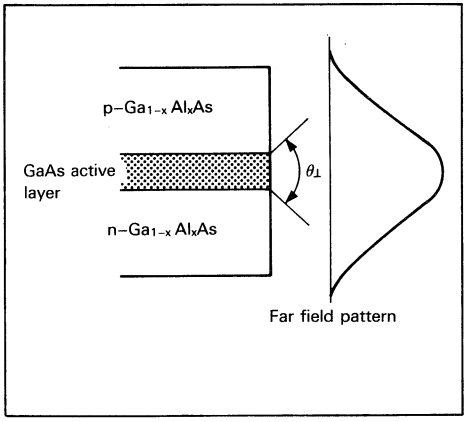


Figure II-5. Perpendicular Transverse Mode

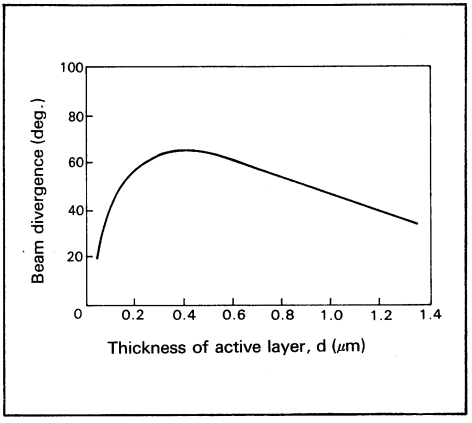


Figure II-6. Thickness of Active Layer vs. Beam Divergence

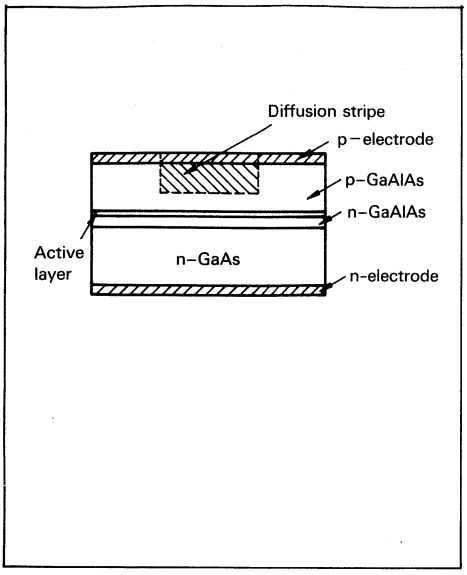


Figure II-7. Basic Stripe LD

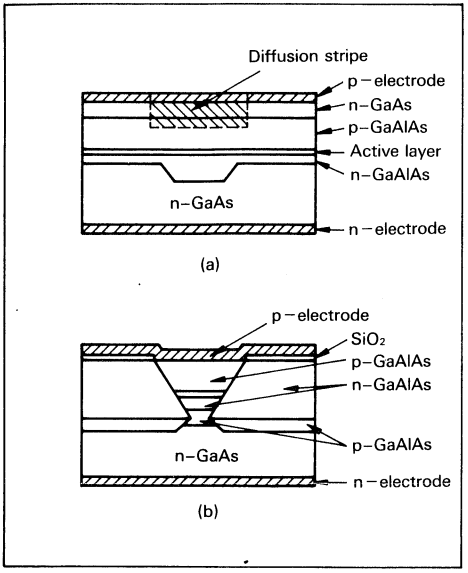


Figure II-8. Stripe Lasers with Built-in Waveguide

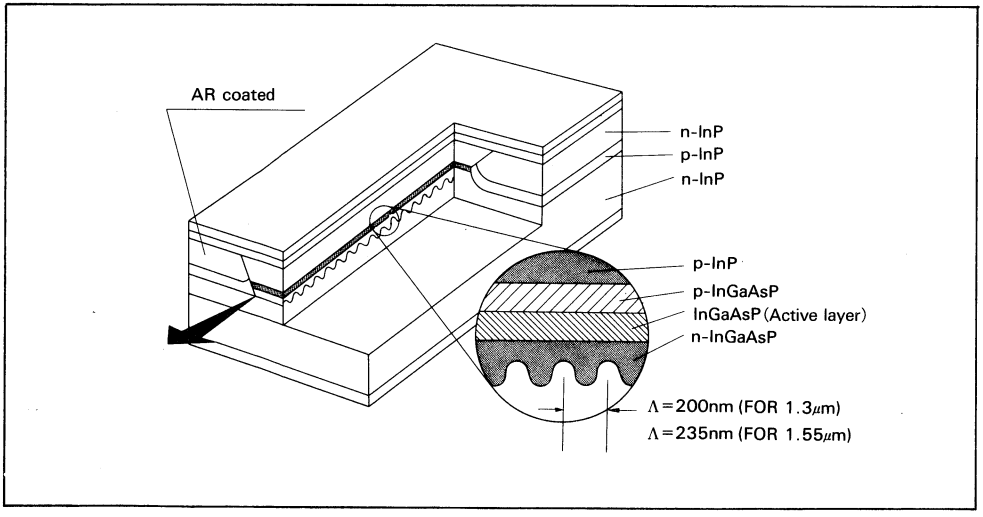


Figure II-9. DFB-LD Structure

2. IRED structures

2.1 Heterostructure

The p-n junction barrier of the diode confines the injected current to the active layer. The heterojunction (Fig. II-10 (a)) consists of p-type and n-type whose band gap energy are different from each other. This heterojunction structure increases the confinement effect and realizes high power output with high speed. Practically, $Ga_{1-x}Al_xAs$ is used, controlled band gap energy by changing the mixture ratio, x.

Hitachi IREDs are devided into two structures: SH (Single Hetero) structure which has only one heterojunction and DH (Double Hetero) structure which has two heterojunctions (Fig. II-10 (b)) and realizes high power output with high speed. Table II-1 shows the structure of each type number.

High efficiency of current-light conversion is achieved, using GaAs crystal which is a direct transition type material. Hitachi shapes the chip surface hemispherically to best utilize the emitted light out of a chip (Fig. II-11).

Table II-1. Hitachi IRED Structures

Part no.	Structure
HLP series	SH
HE8805VG	SH
HE8806VG	SH
HE8807 series	SH
HE7601SG	DH
HE8404SG	DH
HE8812SG	DH
HE8811	DH
HE8403 series	DH
HE1301 series	DH

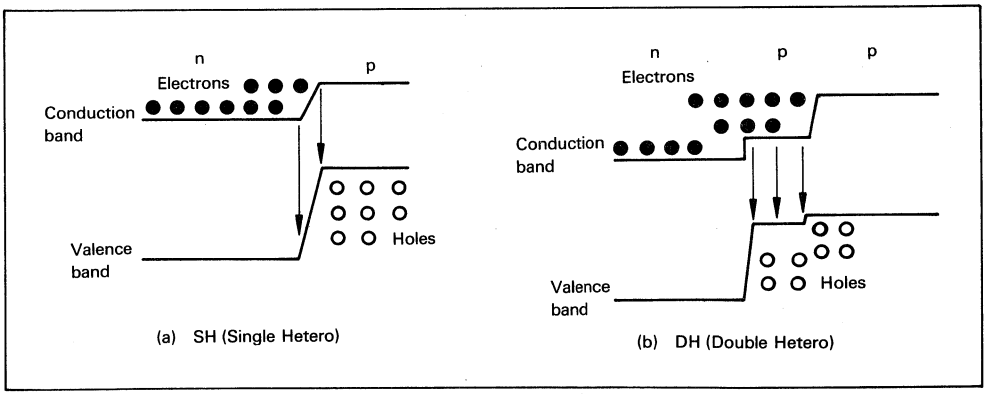


Figure II-10. Junction Structure

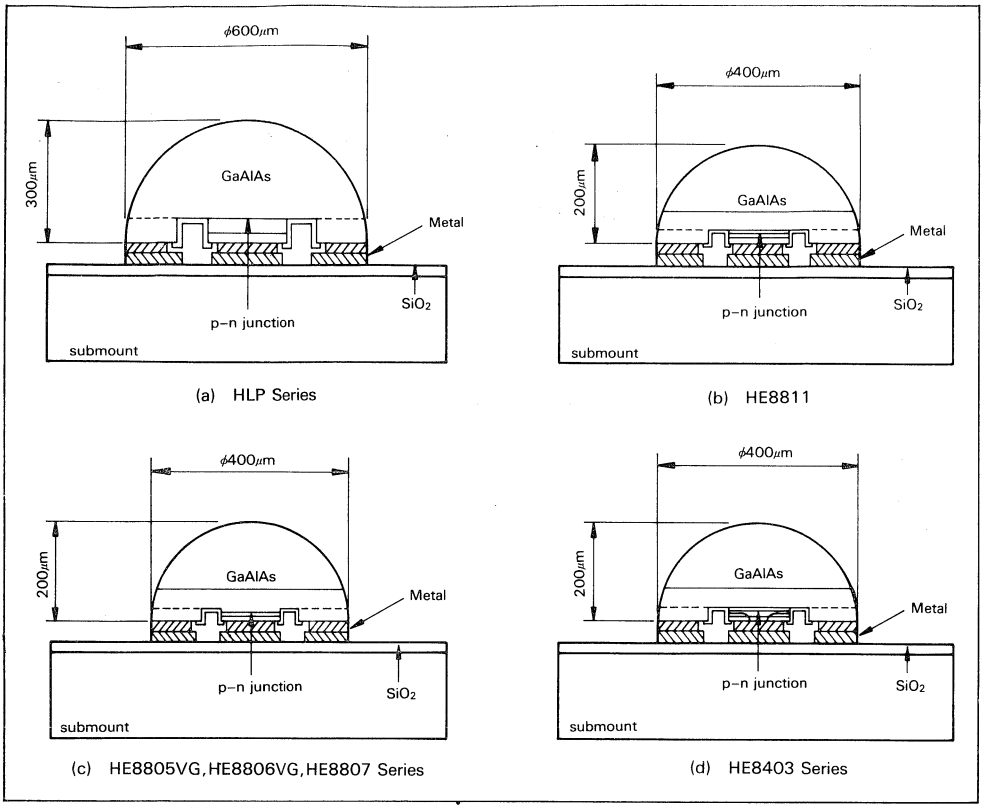


Figure II-11. IRED Structures

2.2 Dome shaped chip

Refraction at the outer surface of the dome must be taken into account when considering light emission. Since the refractive index of GaAlAs is about 3.4, light projected to the surface of a flat-shaped chip is unable to pass out at angles above 17 degrees and is reflected inside the chip, as shown in Fig. II-12. Therefore, by making the chip dome-shaped, light from the center of the chip will hit the surface perpendicularly no matter what the angle and will almost all emit from the chip, as shown in Fig. II-13. Also, the chip is designed so that the light emitting area is sizable in relation to overall chip diameter: about 25% for high output IREDs and 7.5% for high speed ones. As a result, light hitting around the dome periphery is refracted forward which increases the amount of utilizable light.

Table II-2. Dome Diameter and Junction Diameter of Each Part Number

Part no.	Dome Dia. (μm)	Junction Dia. (μm)
HLP series	600	160
HE7601SG	600	160
HE8404SG	600	160
HE8812SG	600	160
HE8805VG	400	100
HE8806VG	400	100
HE8807 series	400	100
HE8811	400	100
HE8403 series	400	30
HE1301 series	400	30

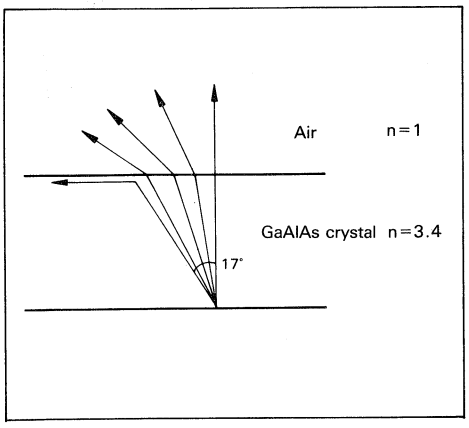


Figure II-12. Light Refraction at Boundary Layer

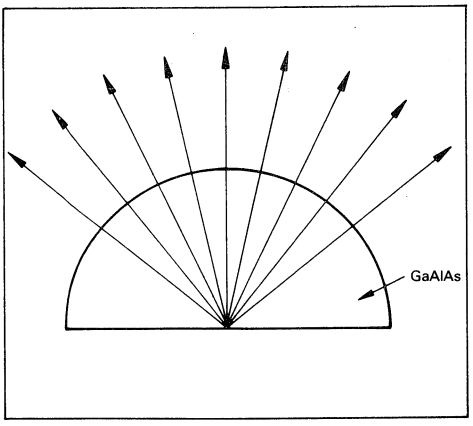


Figure II-13. Hemispherical Shaped Light Radiation

3. Photodiode structures

3.1 Si PIN photodiodes

PIN photodiodes are characterized by high quantum efficiency and a high-speed response under low voltage operations. To operate photodiodes at low voltages, it is necessary that impurities in the intrinsic layer be limited to the greatest extent possible, thus leading to a wide depletion region and a high light-absorption coefficient.

Hitachi Si PIN photodiodes achieve their depletion regions with less than a 5 V bias voltage. This is brought about Hitachi's high-purity epitaxy processes. A cross-section of Hitachi Si PIN photodiodes is illustrated in Fig. II-14.

These photodiodes are sensitive over wavelength ranges from 450 nm to 1000 nm, and quantum efficiency at 830 nm is as high as about 70%. Figure II-15 shows frequency response under conditions of 830 nm incident light, 50Ω load resistance and use of a network analyzer. As can be seen in this figure, a cut-off frequency of more than 300 MHz can be obtained at a 5 V bias voltage.

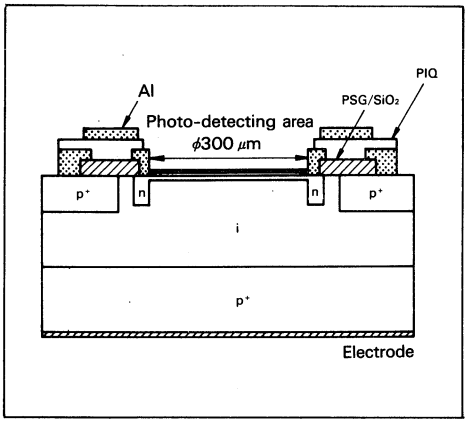


Figure II-14. Si PIN Photodiode Structure

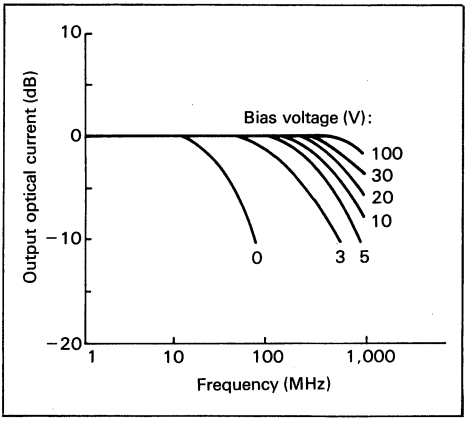


Figure II-15. Frequency Response for Si PIN Photodiode

3.2 InGaAs/ InP PIN photodiodes

To optimize InP compound semiconductors for photodiode use, a unique light absorption structure is employed to gain high quantum efficiency. This is necessary because the absorption coefficient of InP compounds is so large for light of greater than band gap energy.

Electron hole pairs also recombine and are annihilated easily when there are defects at the chip surface.

Hitachi InGaAs/ InP photodiodes make use of a planar structure (Fig. II-16). In them, incident light is absorbed into the InGaAs layer through the InP diffusion layer.

The absorption edge of the InP has a wavelength of about 900 nm. Light with longer wavelengths can pass through the InP layer to the InGaAs layer.

Quantum efficiency is about 80% at 1300 nm when the spectrally sensitive region is set at 1000 nm to 1650 nm.

Frequency response is flat up to around 1 GHz. Thus, this area is suitable for signal detection use in high-speed fiberoptic transmission systems.

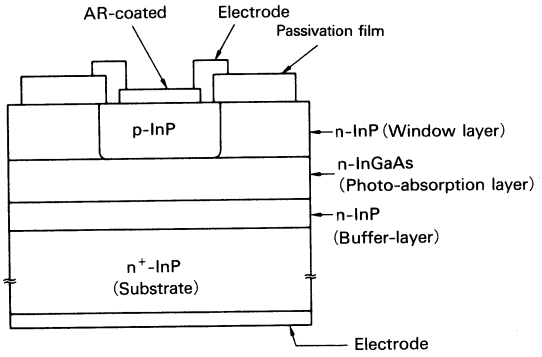


Figure II-16. InGaAs/ InP PIN Photodiode Structure

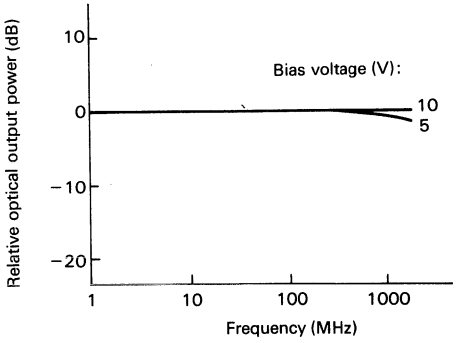


Figure II-17. Frequency Response for InGaAs/ InP PIN Photodiode

III. Symbols and definitions

1. The absolute maximum ratings

The absolute maximum ratings specified in this data book are the values which should not be exceeded under any condition. They are defined at the case temperature, T_C, of 25°C unless otherwise specified.

The absolute maximum ratings of laser diodes (LDs), infrared emitting diodes (IREDs) and photodiodes are defined individually as follows.

Table III-1. Absolute Maximum Ratings

Items	Applicable devices: LDs	IREDs	Photo-diodes	Definitions
Optical output power, P_O, P_f	○			Maximum tolerable output power under CW operation. The value with no kink phenomenon in light vs. current characteristics (Fig. III-1). The power of device with fiber pigtail is shown as fiber optical output power, P_f.
Forward current, I_F		○	○	Maximum tolerable current under CW operation.
Reverse current, I_R			○	Maximum permissable photocurrent when prescribed reverse voltage, V_R (but not exceed breakdown voltage, V_B), and incident light are applied.
Reverse voltage, V_R	○	○	○	Maximum tolerable reverse bias applied to a device. For the LDs with of built-in photodiode, the reverse voltages of photodiode, $V_{R(PD)}$, and of LD, $V_{R(LD)}$, are specified respectively.
Tolerable power dissipation, P_d		○		Maximum tolerable power dissipation of diode under CW operation.
Operating temperature, T_{opr}	○	○	○	Case temperature range under which a device can safely operate. This value differs according to package type, open air vs. hermetic type.
Storage temperature, T_{stg}	○	○	○	Ambient temperature range under which a device can be safely stored. This value also differs according to package type.

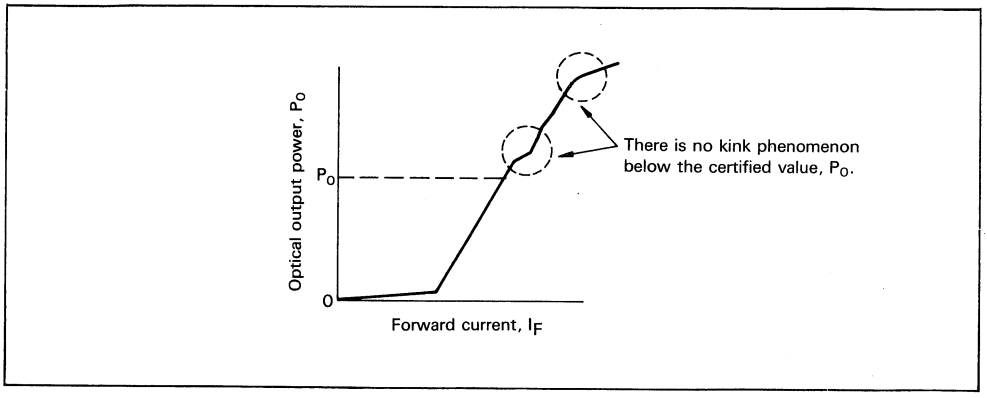


Figure III-1. Light vs. Current Characteristics

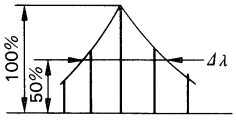
2. Optical and electrical characteristics

The limit values and the typical values of optical and electrical characteristics are described in this data book as much as possible for user's convenience at the application to electrical circuits and optics.

The definitions of optical and electrical characteristics are listed below.

Table III-2. LD Optical and Electrical Characteristics

Items	Definitions
Optical output power, P_O, P_f	Optical output power under the specified forward current, I_F or the value of kink-free region. The power of device with fiber pigtail is shown as fiber optical output power, P_f.
Monitor power, P_m	Optical output power from the rear side of a chip at the specified forward current, I_F, or optical output power, P_O.
Threshold current, I_{th}	Forward current at which a diode starts to lase (Fig. III-2). Practically, this value is specified as the crossing point of x axis and the extension of line B, where "A" is spontaneous emission region and "B" lasing region.
Lasing wavelength, λ_p	Maximum intensity wavelength in a spectral distribution (Fig. III-3).
Beam divergence parallel to the junction, $\theta_{//}$ Beam divergence perpendicular to the junction, $\theta_{\perp}$	Divergence of light beam emitted from a laser diode is described in Fig. III-4 (a). $\theta_{//}$ is the full angle at a half of the peak intensity in the parallel profile (Fig. III-4 (b)). $\theta_{\perp}$ is the full angle at a half of the peak intensity in the perpendicular profile (Fig. III-4 (c)).
Slope efficiency, η	Optical output power increment per unit drive current in lasing region (B region) of Fig. III-2.
Monitor current, I_S	Current of photodiode operated at the specified optical output power, P_O or P_f. It applies only to a device with built-in photodiode.
Dark current, I_{DARK}	Leakage current of photodiode when the specified reverse voltage is applied without any light input to a photodiode chip.
Rise time, t_r Fall time, t_f	Rise time, t_r, is time required for light intensity to rise from 10 to 90% of maximum output power when drive current is switched on. Fall time, t_f, is time required for light intensity to fall from 90 to 10% of maximum output power when current is switched off. (Fig. III-5)
Spectral width, $\Delta\lambda$	Full width at half maximum when the spectrum pattern has been approximated to envelop.



(Continued)

Table III-2. LD Optical and Electrical Characteristics

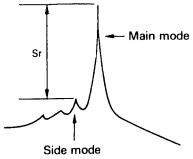
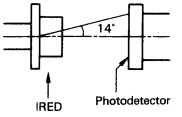
Items	Definitions
Capacitance, C_t	Junction capacitance when specified reverse bias voltage is applied.
Side-mode suppression ratio, Sr	These are parameters for evaluating laser diode spectral shape. Particularly with regard to single longitudinal mode generation like the distributed feedback (DFB) laser, indicates the ratio between the highest spectral intensity (called main mode) and the second highest spectral intensity (called side mode). 
Cooling capacity, ΔT Cooler current, I_C Cooler voltage, V_c Thermister resistance, R_{TM}	These are parameters used to evaluate the thermal characteristics of laser diode modules with built-in Peltier effect (cooling) elements. ΔT indicates, for cooler current, I_C, and cooler voltage, V_c, the cooling capacity as a temperature difference ($\Delta T = T_{LD} - T_C$). (Here T_{LD} is the temperature at the laser diode chip and T_C is the temperature of the module's case). R_{TM} indicates the resistance of the built in thermistor.

Table III-3. IRED Optical and Elecrrical Characteristics

Items	Definitions
Optical output power, P_O, P_f	Total optical output power emitted from chip at specified forward current (Fig. III-6). The power of device used in fiberoptic transmission is shown as fiber optical output power, P_f.
Forward optical output power, P_F	Indicates forward optical output power emitted from chip for prescribed forward current, I_f. This measurement is carried out with NA = 0.25, as shown in the figure below. 
Peak wavelength, λ_p Spectral width, $\Delta\lambda$	Maximum intensity wavelength in a spectral distribution (Fig. III-7). Wavelength width at half the peak intensity of the peak wavelength (Fig. III-7). This differs according to junction structure, single vs. double heterojunction structure.
Beam divergence, θ_H	Full angle at a half of maximum peak intensity.
Forward voltage, V_F	Forward voltage at specified forward current input.
Reverse current, I_R	Leakage current when specified reverse voltage is applied.
Capacitance, C_t	Junction capacitance when specified reverse bias voltage is applied.
Rise time, t_r Fall time, t_f	Rise time, t_r, is time required for light intensity to rise from 10 to 90% of maximum output power when current is switched on. Fall time, t_f, is time required for light intensity to fall from 90 to 10% of maximum power when current is switched off (Fig. III-5).

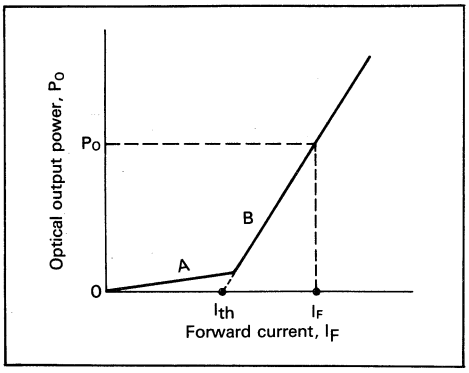


Figure III-2. Light vs. Current Characteristics

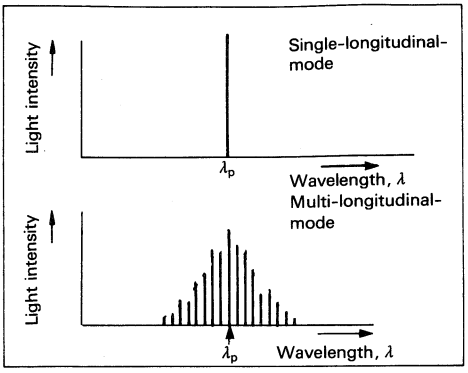


Figure III-3. Lasing Spectrum

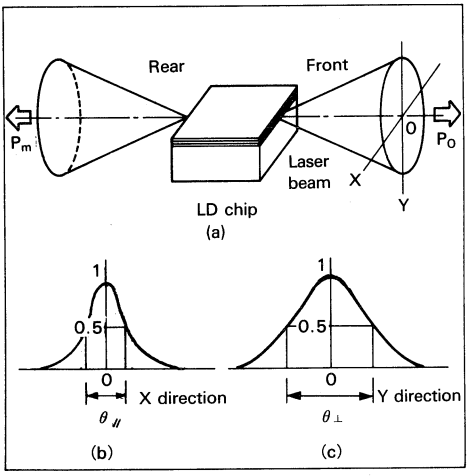


Figure III-4. Beam Divergence

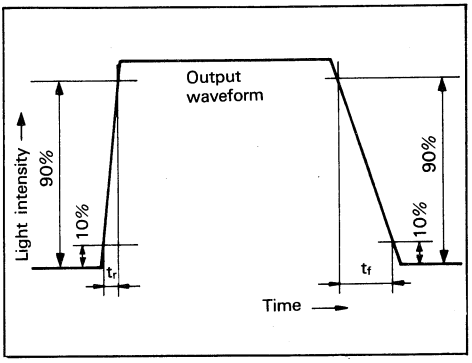


Figure III-5. Definition of Rise & Fall Time

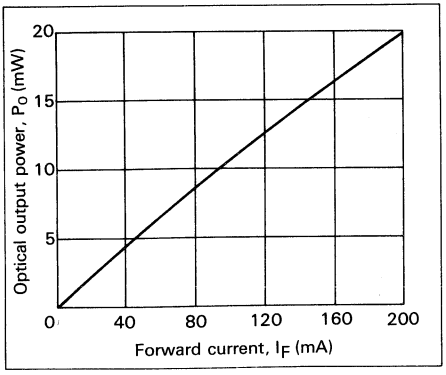


Figure III-6. Light vs. Current Characteristics

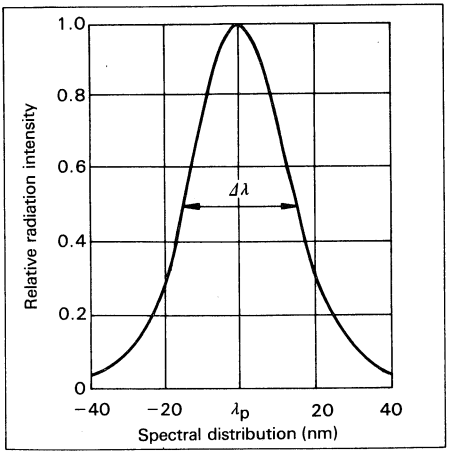


Figure III-7. Spectral Characteristics for HLP30RG

Table III-4. Photodiode Optical and Electrical Characteristics

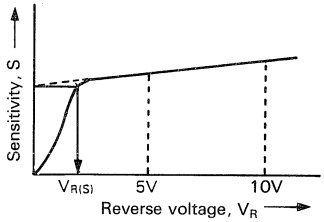
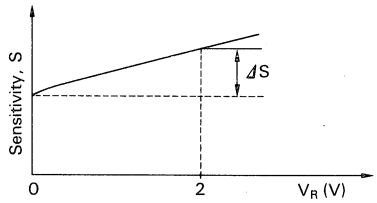
Items	Definitions
Dark current, I_{DARK}	Leakage current of photodiode when the specified reverse voltage is applied without any light input to photodiode chip.
Capacitance, C_t	Junction capacitance when specified reverse voltage is applied.
Sensitivity, S	Photovoltaic current increment per unit light power input.
Rise time, t_r Fall time, t_f	Rise time, t_r, is time required for light intensity to rise from 10 to 90% of maximum output power when drive current is switched on. Fall time, t_f, is time required for light intensity to fall from 90 to 10% of maximum output power when current is switched off. (Fig. III-5)
Photosensitivity saturation voltage, $V_{R(S)}$	Reverse voltage value corresponding to the point where the straight line connecting $V_R = 5$ V and $V_R = 10$ V crosses the S axis. 
Amount of sensitivity change, ΔS	Amount of variation of photosensitivity with impressed reverse voltage V_R is defined below.  $\Delta S = \frac{S(V_R = 2V) - S(V_R = 0)}{S(V_R = 2V)} \times 100\%$ This section applies to PDs, which have large sensitive area, for measurement use.

Table III-5. APD Optical and Electrical Characteristics

Items	Definitions
Breakdown voltage, V_B	The reverse voltage when the specified leak current is applied with out any light input to photodiode chip.
Multiplication factor, M	Defined as ratio of number of carrier which reached the electrode according to avalanche phenomenon to number of carrier generated by just light input. Defined the V_R as V_I at the turning point of I_{ph} curve (Fig. III-8) $M = \frac{I_{ph} - I_{DARK}}{I_{phI} - I_{DARKI}}$ thus M = 1 when $V_R = V_I$
Maximum multiplicaption factor, Mm	Maximum multiplication factor for V_R.
Multiplicated dark current, I_{DM}	Dark current for $V_R = V_I$ (thus making M = 1).
Cut-off frequency, f_C	Frequency at which output power becomes −3dB of output power at the standard frequency.
Excess noise factor, F, X	Multiplied shot noise parameter for avalanche photodiode. Excess noise factor F defined as $F = M^X$

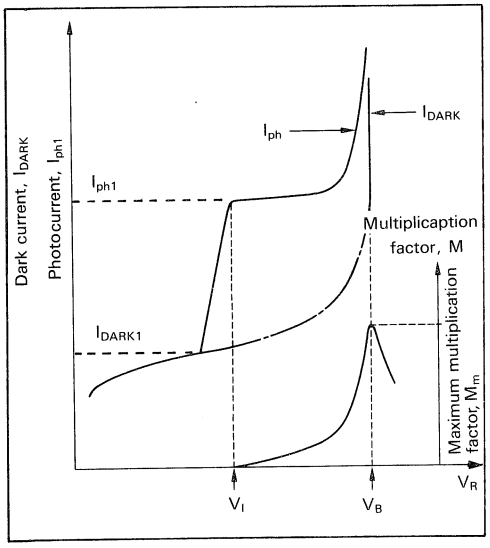


Figure III-8. Definition of APD Symbols

Ⅳ. Fundamental characteristics

1. LD fundamental characteristics

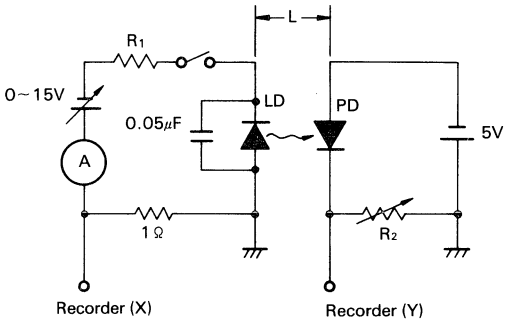
1.1 Light vs. current characteristics under CW operation

One of the fundamental parameters of LDs is optical-output-power vs. forward-current (light vs. current) characteristic. Figure IV-1 shows a measuring setup for light vs. current characteristic under CW operation.

The photodetector with proper response and effective photosensitive area is first required for measuring LD's optical characteristics.

The measuring setup for light vs. current characteristics under CW operation is shown in Fig. IV-1.

A photocell of more than 20 mm dia. is recommended which is provided with enough photosensitive area to take-in full light power without a lens. The suitable distance between a photocell and an LD chip is 5 to 10 mm. Since photovoltaic sensitivity varies with devices, each photocell must be calibrated with a standard cell and R_2 must be adjusted accordingly before this setup is actually used. A device must be mounted on a copper or aluminum heat radiator of about 30 × 40 × 2 mm^3 especially for CW testing. Because the heat generated from a chip itself degrades the device characteristics and life time.



PD : Large area Si-solar cell for short-wavelength range LD
: Large area Ge-photodiode for long-wavelength range LD
R_1 = 10 to 50 Ω for short-wavelength range LD
= 100 to 300 Ω for long-wavelength range LD
R_2 ≃ 20 Ω for 10 mV output at 1 mW optical power
L ≃ 10 mm for short-wavelength range LD
≃ 6 mm for long-wavelength range LD

Figure IV-1. Measuring Setup for Light vs. Current Characteristics under CW Operation

Light vs. current characteristics and dL/dI vs. I characteristics for the HL1322A are shown in Figs. IV-2 and IV-3 respectively.

Temperature dependencies of I_{th} and η for the HL1322A are shown in Figs. IV-4 and IV-5 respectively.

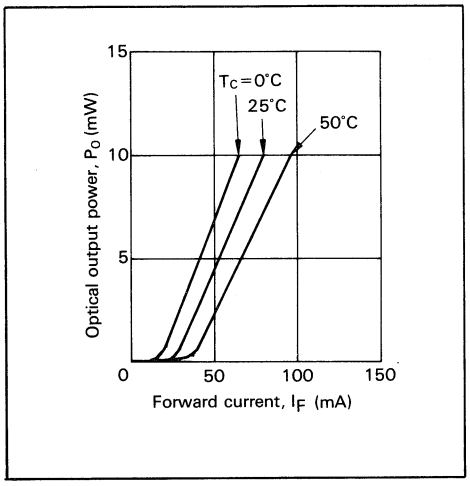


Figure IV-2. Light vs. Current Characteristics for HL1322A

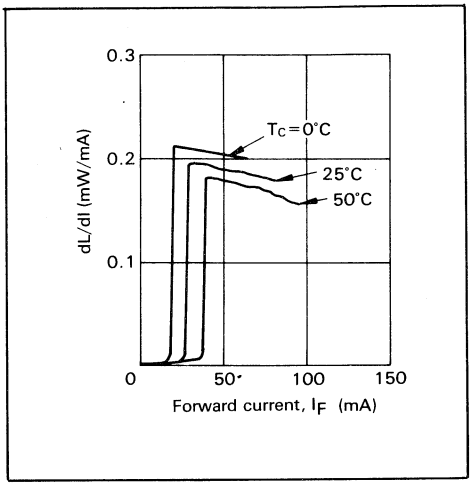


Figure IV-3. dL/dI vs. I Characteristics for HL1322A

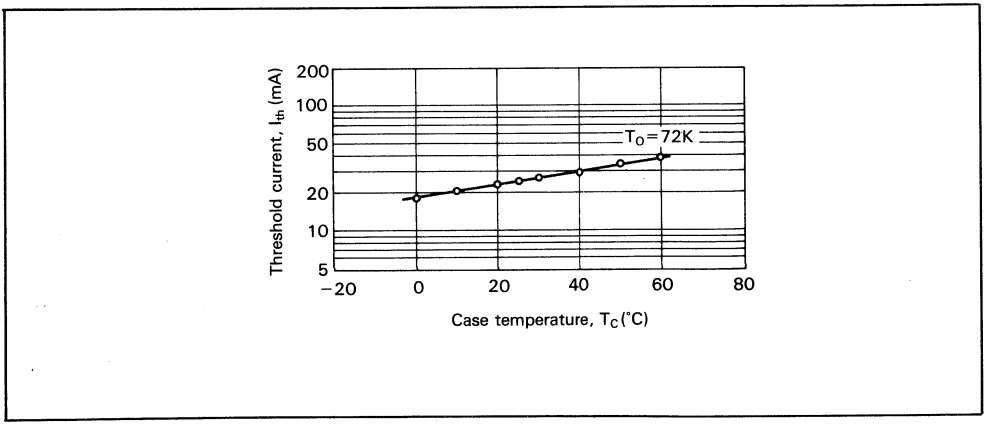


Figure IV-4. Temperature Dependency of I_{th} for HL1322A

1.2 Light vs. current characteristics under pulse operation

A measuring setup example for light-current characteristics under low frequency up to several 10 kHz with low duty (about 1%) pulse operation is shown in Fig. IV-6, which employs a PIN photodiode as a photodetector. Sampling measurement of photovoltaic current should be made when it becomes stabilized.

Figure IV-7 shows pulse light vs. current characteristics for the HL1322A.

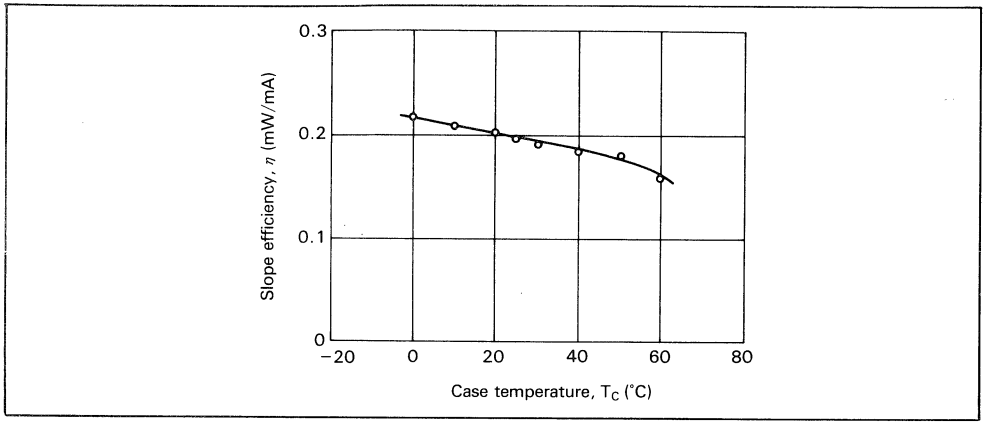


Figure IV-5. Temperature Dependency of η for HL1322A

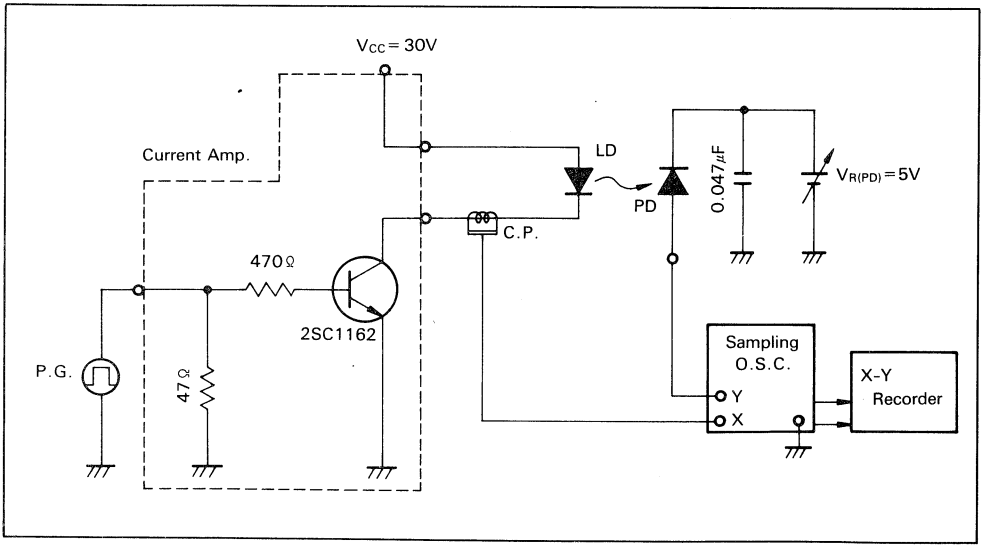


Figure IV-6. Measuring Setup for Light vs. Current Characteristics under Low-frequency Pulse Operation

1.3 Lasing spectrum

Lasing spectrum (longitudinal mode) is one of LD fundamental characteristics. Spectrum at modulation is an important factor of LDs for transmission use; particularly, spectral width, $\Delta\lambda$, is important for Fabry-Pérot LDs and side-mode suppression ratio for DFB (distributed feedback) LDs. Temperature dependency and optical-output dependency of spectrum should also be taken into consideration. A measuring setup for spectrum at modulation is shown in Fig. IV-8.

For high frequency modulation, the same precautions described in "1.5 Pulse Response Characteristics" must be observed. If the fiber pierces a portion of the human body, it can cause injury, so appropriate care must be exercised in its handling.

Figure IV-9 shows temperature dependency of lasing spectrum for the HL1322A, Fabry-Pérot LD. The temperature coefficient of wavelength is about 0.3 nm/°C.

Optical-output-power dependency of lasing spectrum for the HL1322A is shown in Fig. IV-10.

Figure IV-11 shows modulation dependency of spectral width, $\Delta\lambda$. The higher bit rate is, the larger $\Delta\lambda$ becomes.

Figure IV-12 shows the dependency of the generated spectrum on temperature. The generated wavelength vs temperature dependence of the DFB-LD, at 0.09 nm/°C, is small relative to that of the FP-LD.

Figure IV-13 shows the dependency of optical output power of the generated spectrum on temperature. At currents above the threshold current (I_{th}), single mode is generated, but the generated wavelength exhibits almost no dependence upon optical output power.

Figure IV-14 shows the generated spectrum for modulation. When modulating, the side mode suppression ratio Sr is stable even in comparison with CW operation, and exhibits characteristics optimized for use in gigabit band transmission.

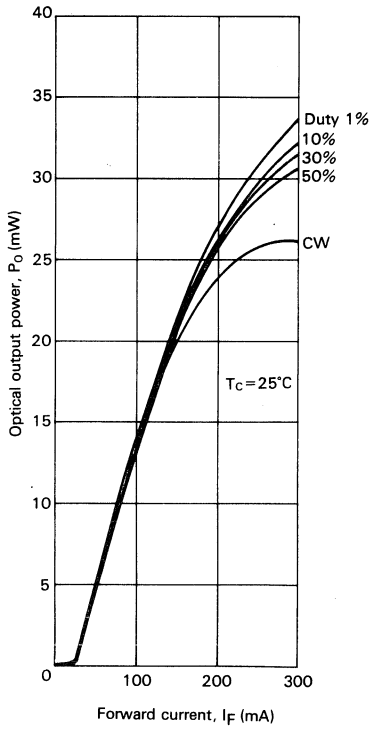
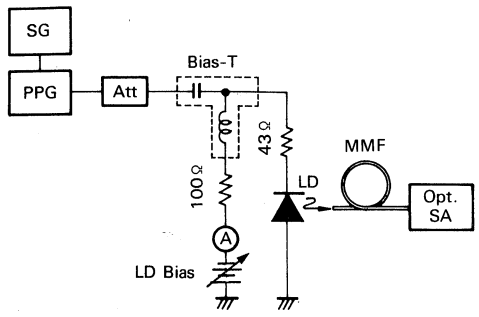


Figure IV-7. Pulse Light vs. Current Characteristics for HL1322A



SG; Signal generator
PPG; Pulse pattern generator
Opt. SA; Optical spectrum analyzer
Bias-T; Bias unit
MMF; Multi mode fiber (1 m)
Att; Attenuator

Figure IV-8. Measuring Setup for Spectrum under Modulation

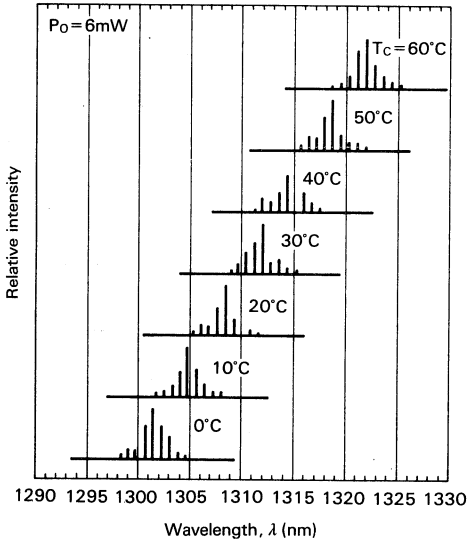


Figure IV-9. Temperature Dependency of Wavelength for HL1322A

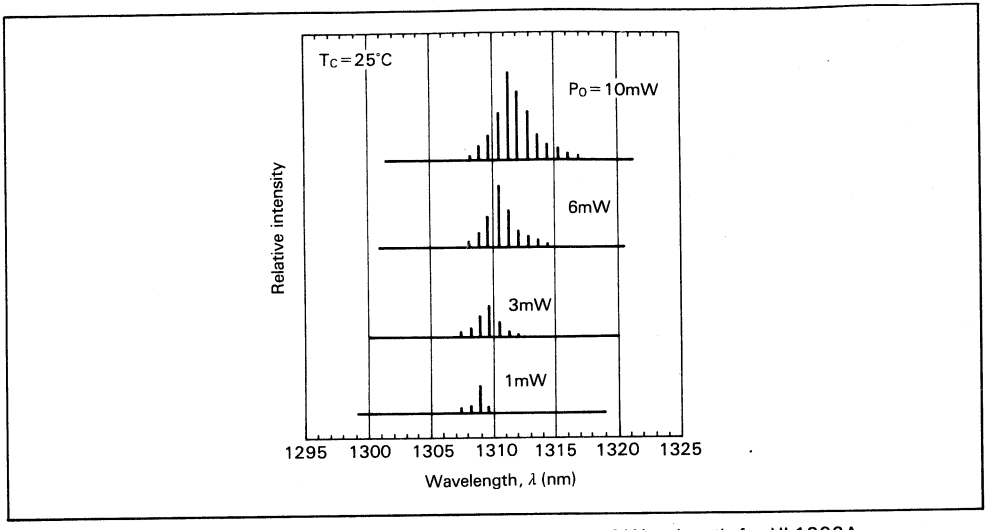


Figure IV-10. Optical-output-power Dependency of Wavelength for HL1322A

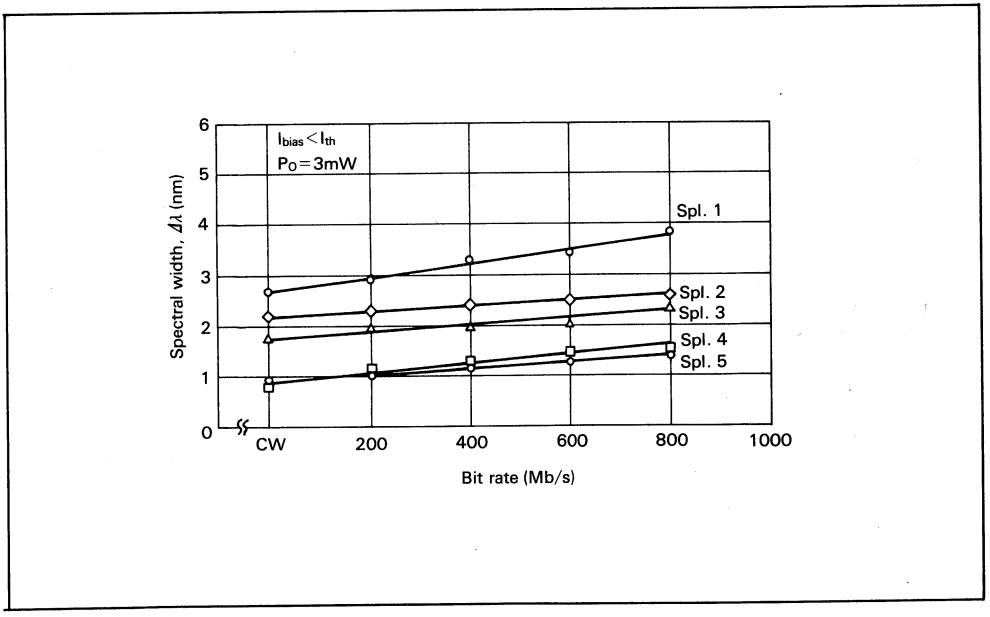


Figure IV-11. Spectral Width vs. Transmission Bit Rate for HL1322A

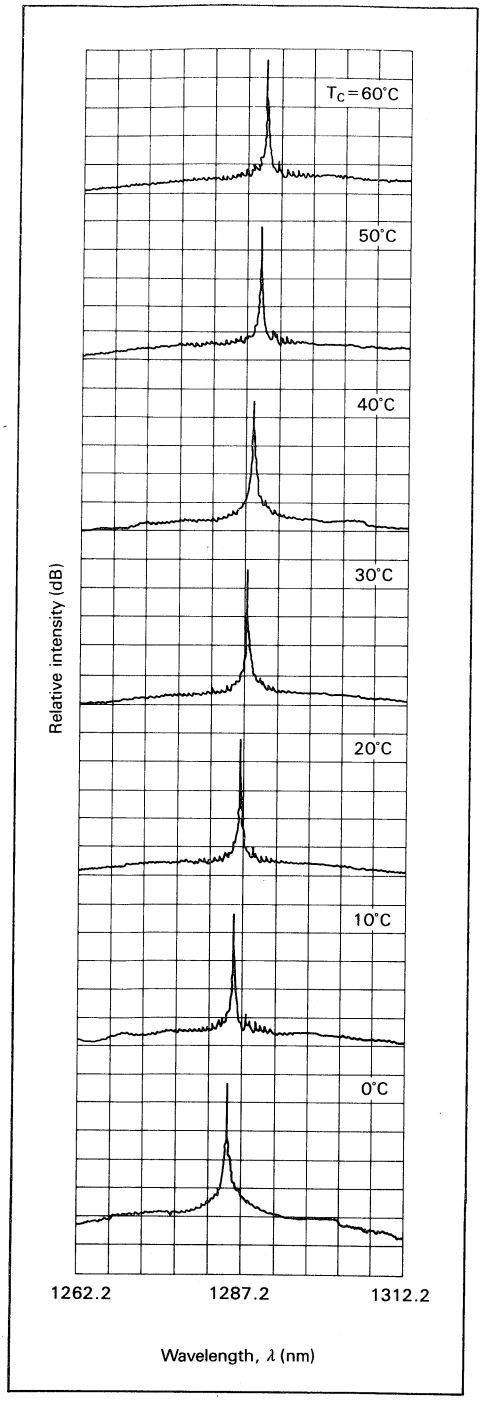


Figure IV-12. Temperature Dependence of Spectrum for HL134IA

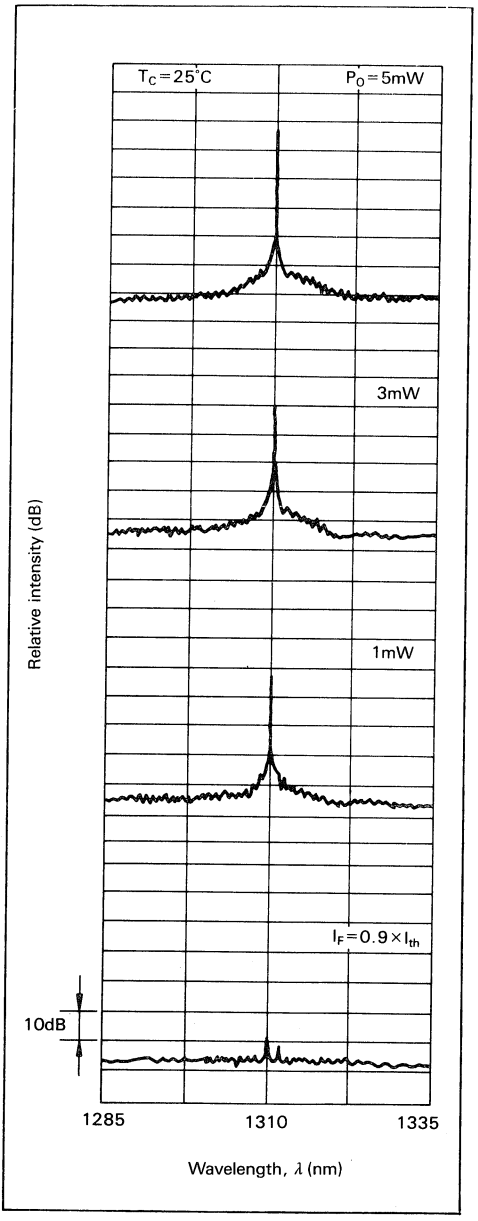


Figure IV-13. Optical Output Power Dependence of Spectrum for HL1341A

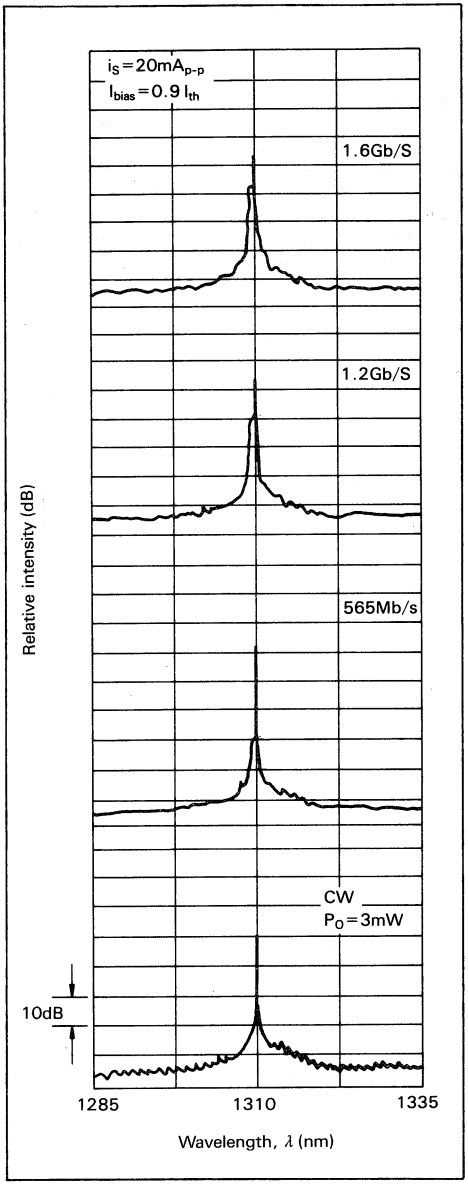


Figure IV-14. Frequency Dependence of Spectrum for HL1341A

1.4 Far field pattern (FFP)

FFP is the light intensity profile measured in two directions as function of angle: parallel and perpendicular to a device (the active layer of an LD and arbitrary for IRED). The measuring setup for FFP is shown in Fig. IV-15, which employs the same drive circuit as that for light vs. current characteristics measurement under CW operation. Use a PIN photodiode with small photosensitive area or an APD as a photodetector. The distance between the detector and an LD is about 10 cm. Set the emitting point of LD at the center of the turn table. Use of a potentiometer is effective to translate the rotation angle to voltage.

FFP of HL7836 series is shown in Fig. IV-16 for various power output.

They lase at stable transverse fundamental mode, namely with single peak in FFP approximated to the gaussian curve. FFP grows its height proportionally to optical output power and has no peak point steering or no light distribution width change within the maximum ratings.

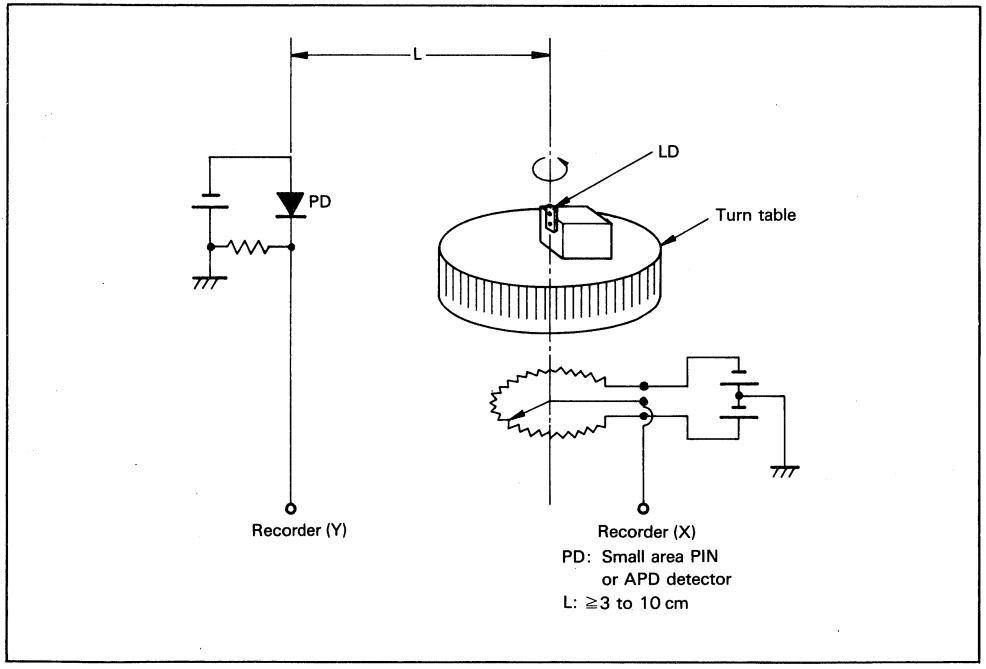


Figure IV-15. Measuring Setup for Far Field Pattern

1.5 Pulse-response characteristics

A measuring setup for pulse-response characteristics is shown in Fig. IV-17. Pulse signals are generated with a PPG. A fast-pulse-response PIN photodiode or APD (avalanche photodiode) is suitable for this setup.

When operating the LD in pulse mode, if the DC bias falls below the threshold current, a delay will develop between the drive current pulse and the optical output pulse. The exact value of the delay depends upon the bias point and the temperature. An example is given in Fig. IV-18.

Precautions for Measurements.

(1) Select a lens for light emitted from the LD with NA and magnification which concentrates adequate light on the active optical surface of the PD.
(2) Cut the lead of the LD as short as possible, and solder to a 50Ω strip.
(3) For the LD impedance, because the LD gives rise to dispersion, select a ship resistance for which the LD impedance and chip resistance are 50Ω (approx. 43Ω is optimal).
(4) Because this is a GHz order measurement, the cable must be kept as short as possible, and all connections should be verified sound.

For the pulse response characteristic, the rise and fall time characteristics, and the eye pattern of the digital transmission must be evaluated.

Figure IV-19 shows an example of eye patterns for the HL1322A. As seen from this figure, the HL1322A responds enough up to 1.4 Gb/s.

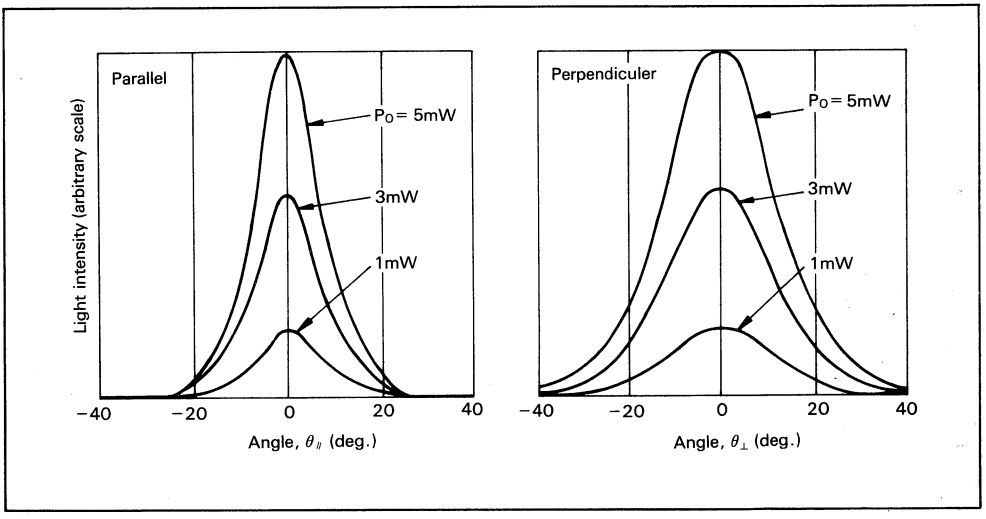


Figure IV-16. Optical-output-power Dependency of Far Field Pattern for HL7836 Series

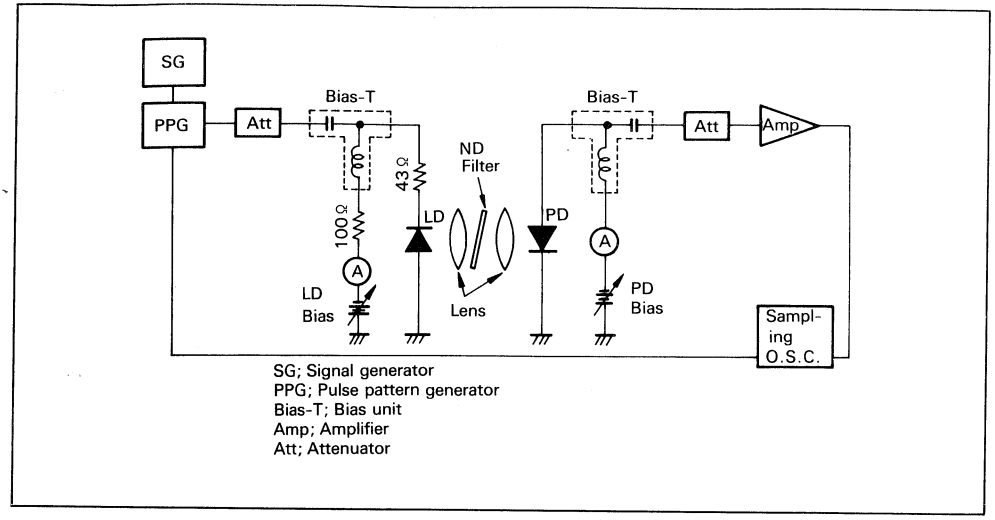


Figure IV-17. Measuring Setup for Pulse-response Characteristics

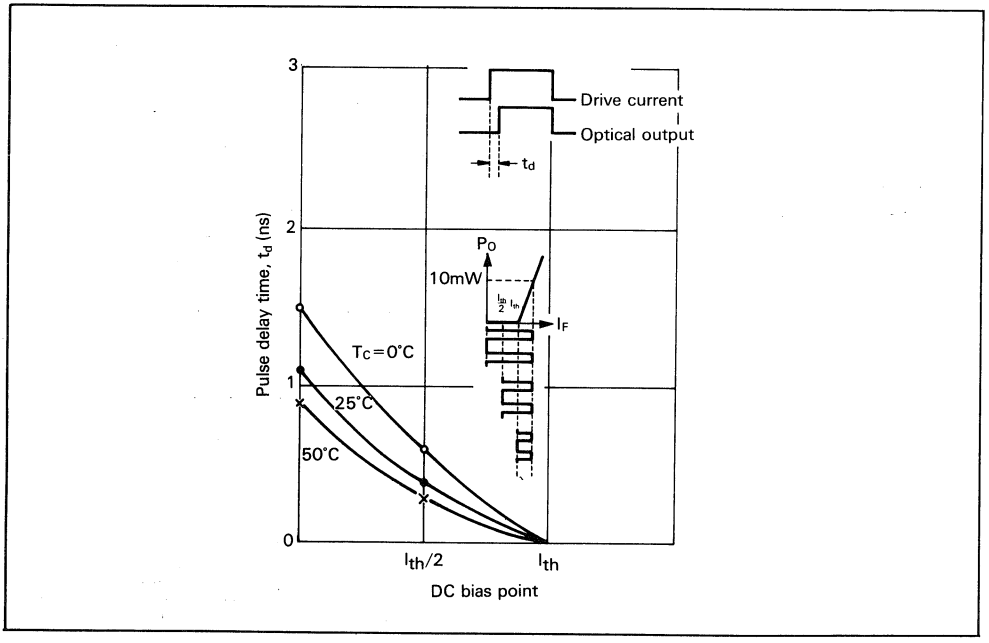


Figure IV-18. Bias Point Dependency of Pulse Delay Time for HL7836 series

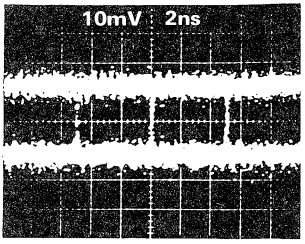
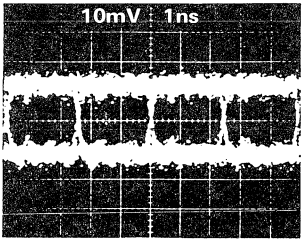
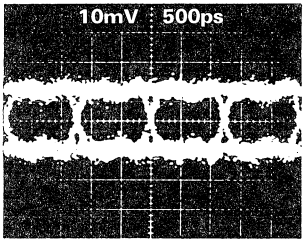
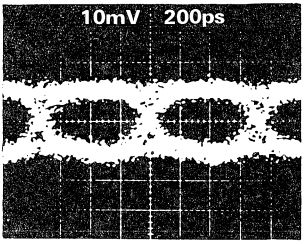
Transmission speed	Eye patterns for HL1322A
200 Mb/s	
400 Mb/s	
800 Mb/s	
1400 Mb/s	

Figure IV-19. Eye-pattern Characteristics at Pulse Modulation for HL1322A

1.6 Frequency characteristics

A measuring setup for frequency characteristics is shown in Fig. IV-20. A measurement example of frequency for the HL1322A is shown in Fig. IV-21.

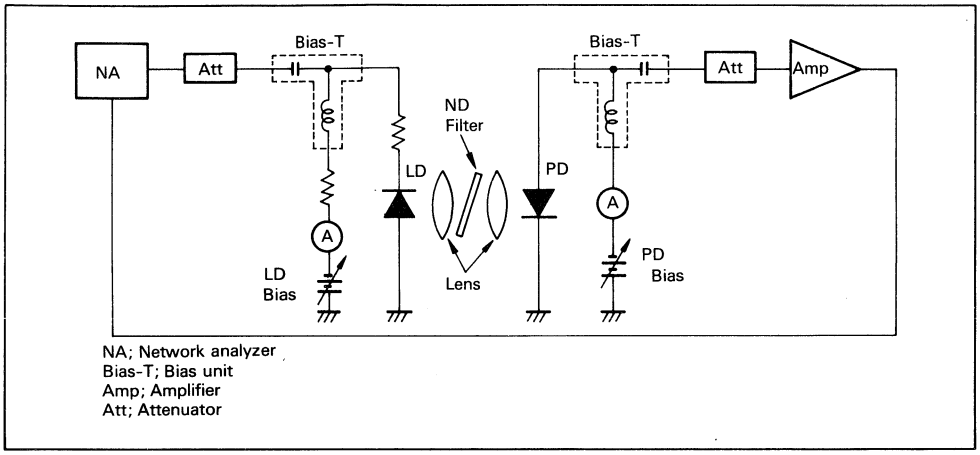


Figure IV-20. Measuring Setup for Frequency-response Characteristics

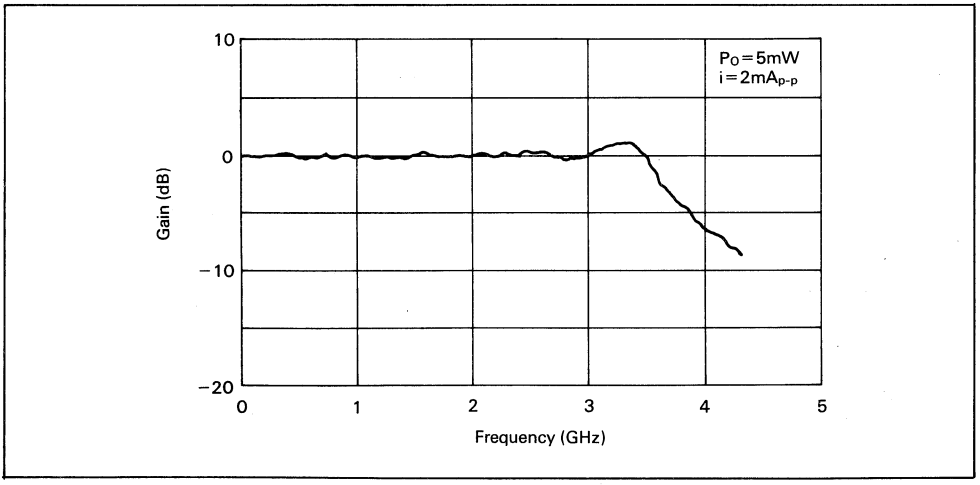


Figure IV-21. Frequency Characteristic for HL1322A

1.7 Mode hopping noise

A measuring setup for LD noise is shown in Fig. IV-22. Set the frequency range to be measured as suitable for each device application.

Measurement should be carried out after getting rid of external noise. For measurement under temperature below the room temperature, take care not to cut off the optical path due to condensation. Measurement in dry air or dry nitrogen is recommended.

Figure IV-23 shows an example of noise vs. case temperature.

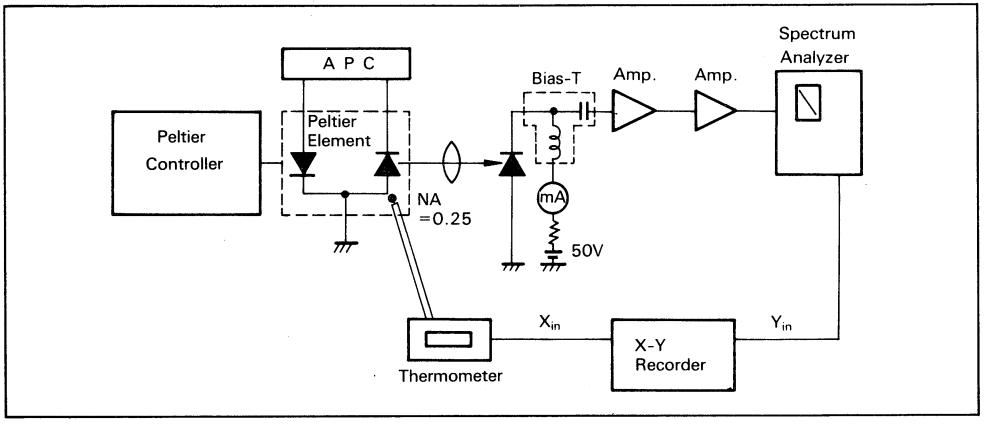


Figure IV-22. Measuring Setup for Noise

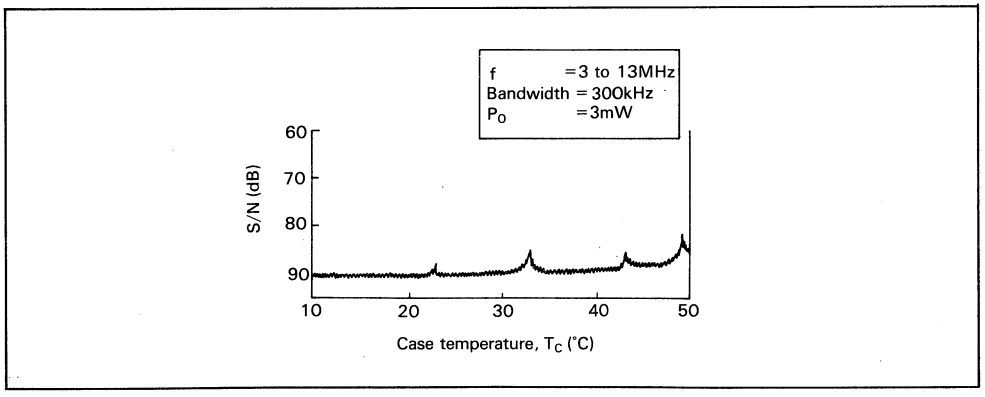


Figure IV-23. Noise Measurement Example

1.8 Polarization ratio of LDs

The measuring setup for polarization ratio is shown in Fig. IV-24. An objective lens collimates the light emitted from an LD to form parallel beam. In this case, use of an infrared phosphor plate is helpful to detect light. Choose the measurement equipment with appropriate aperture and photosensitive area not to disturb the parallel beam input. Polarization ratio is calculated with the maximum and minimum values of a power meter while turning a polarization prism.

Polarization phenomenon of an LD is illustrated in Fig. IV-25. Electric field oscillates in parallel to the active layer, and magnetic field in perpendicular.

Polarization ratio depends on optical output power and numerical aperture. The polarization ratio vs. power output for the HL7806 series and HL8311 series are shown in Fig. IV-26 (a) and (b) respectively. Polarization ratio is larger when optical output power is higher or NA (numerical aperture) of an objective lens is smaller.

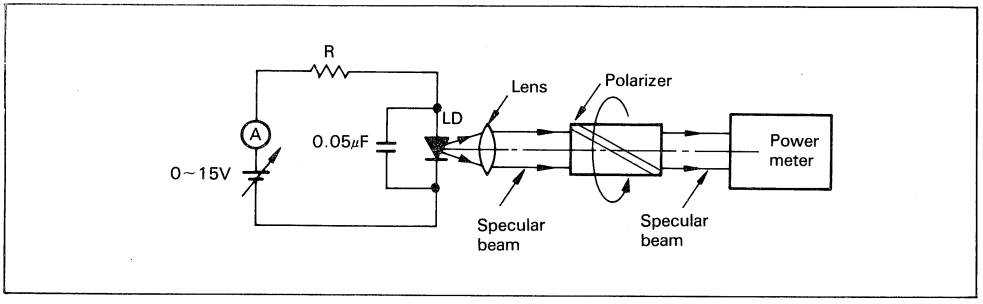


Figure IV-24. Measuring Setup for Polarization Ratio

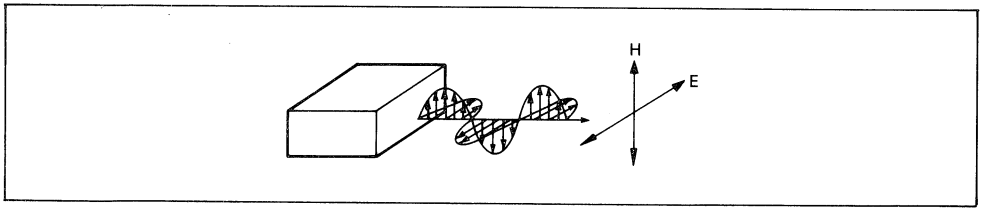


Figure IV-25. Polarization Ratio of LD

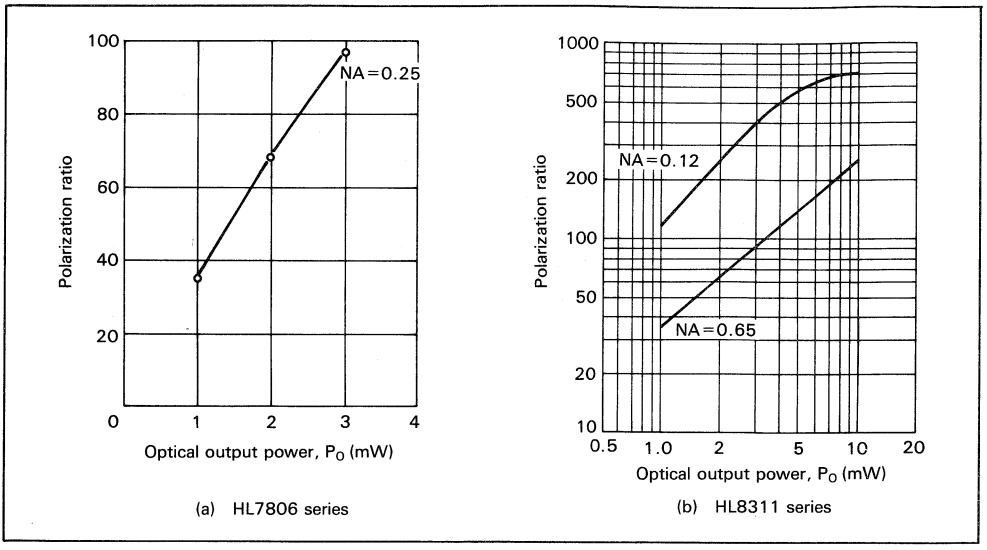


Figure IV-26. Optical-output-power Dependency of Polarization Ratio

2. IRED fundamental characteristics

2.1 Optical output power

Optical output-power measuring method under CW operation

An optical cone is used for measuring optical output power under CW operation. The optical cone gathers all light from the IRED and leads it to a photocell (see Fig. IV-27). Photocells should be calibrated beforehand against a standard cell, since their photovoltaic current will vary from cell to cell. Since under CW operation, optical output will fluctuate significantly during the measurement due to heat generated by the chip, a copper or aluminum heat radiator of larger than 30 × 40 × 2 mm^3 should be attached to IREDs before testing. An example of the optical output-power measuring setup is shown in Fig. IV-28.

Optical output-power measuring method under pulse operation

An example of the measuring setup for optical output-power under low pulse operation (some kHz to some 10 kHz) is illustrated in Fig. IV-29. The light vs. current characteristics of the HLP30RGD are shown in Fig. IV-30.

Under pulse operation, light vs. current linearity and peak values of optical output power are more favorable than under CW operation, because of lower average current and less temperature increase at the junction. However, attention should be given not to exceed maximum ratings during operation, measuring or mounting.

A measurement setup example for high-speed pulse response is given in Fig. IV-31. It is recommended that a high-speed PIN photodiode or avalanche photodiode able to respond to a several GHz order be used as the photodetector in this measurement. Figure IV-32 shows a measurement example of high-speed response characteristics.

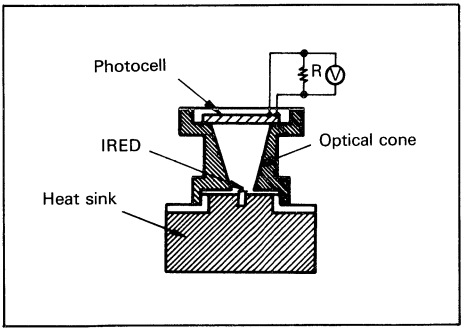


Figure IV-27. Optical Output-power Measuring Method under CW Operation

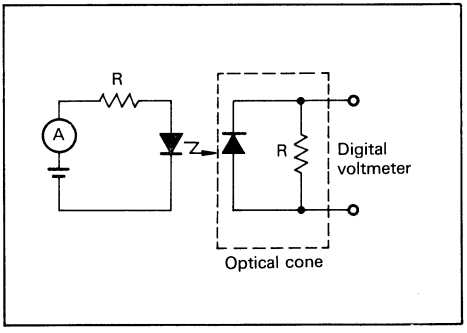


Figure IV-28. Measuring Setup for Optical Output Power under CW Operation

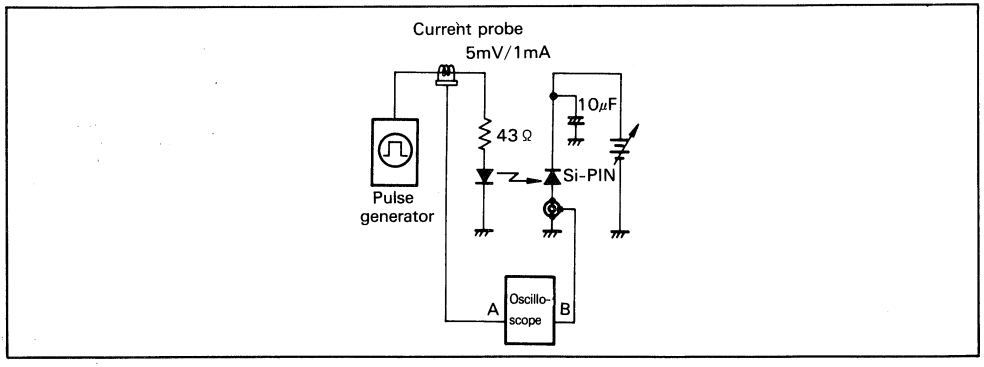


Figure IV-29. Measuring Setup for Light vs. Current Characteristics under Low Frequency Pulse Operation

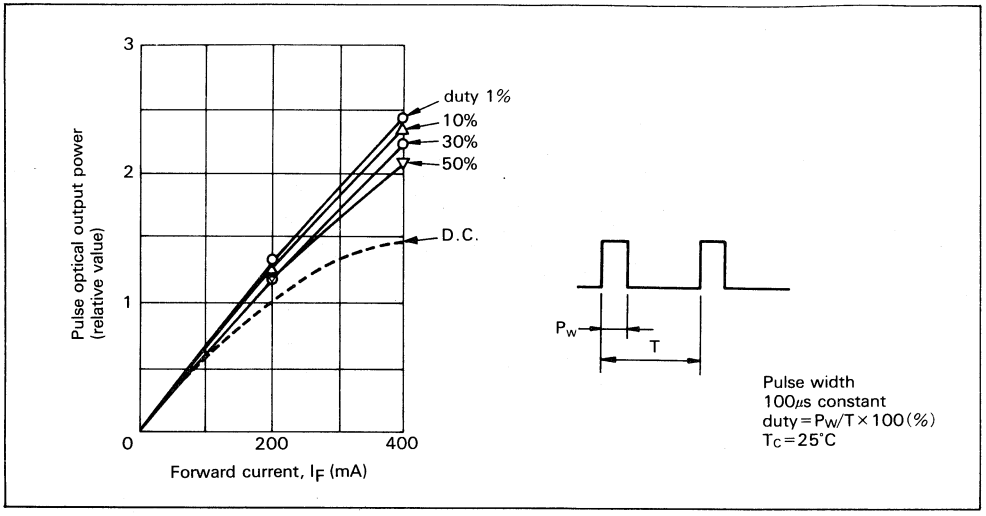


Figure IV-30. Light vs. Current Characteristics for HLP30RGD

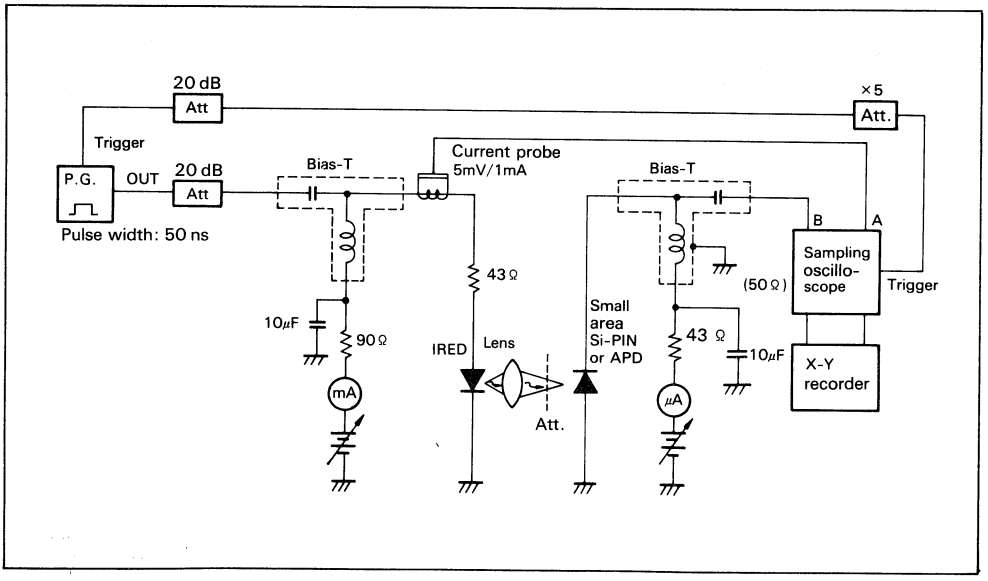


Figure IV-31. Measuring Setup for Fast Pulse Response Characteristics

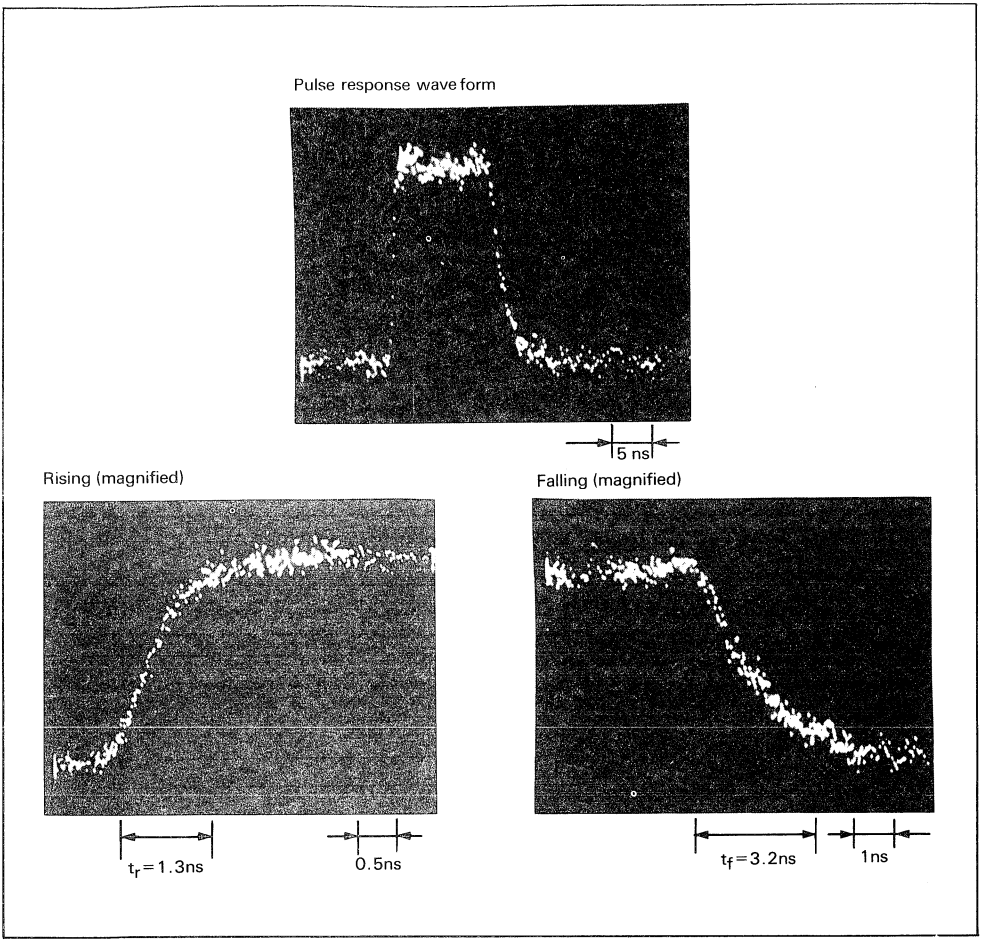


Figure IV-32. High-speed Response Example for HE1301SG

Optical output-power measuring method for fiber-ends

Figure IV-33 shows the measuring method for optical output-power at fiber-ends under CW operation.

Figure IV-34 shows an example of the light vs. current characteristics for the HE1301R.

The main methods for coupling fiber to an IRED are the direct coupling method and parabolic-rod-lens coupling. The former is suitable for measuring fiber-end optical output power in R-type (open-air type) packages, and the latter in SG-types (hermetic-seal, glass-window types). This will be explained in more detail in Section 2.7, "Optical fiber coupling efficiency."

Temperature dependency of optical output power

Optical output power from IREDs fluctuates along with temperature change in the p-n junction. Figure IV-35 gives a measurement example of optical output fluctuation when IRED case temperature was varied. Temperature coefficients of optical output power are −0.8%/°C (typ.) for the HE8805, HE8806, HE8807 and HLP series, −0.5%/°C (typ.) for the HE8811 and HE8403 series and −0.4%/°C (typ.) for the HE1301 series.

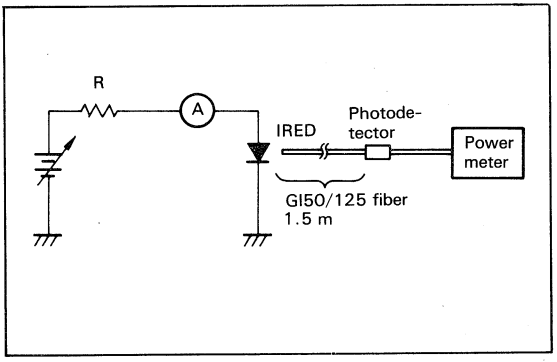


Figure IV-33. Measuring Setup for Optical Output-power at Fiber-ends

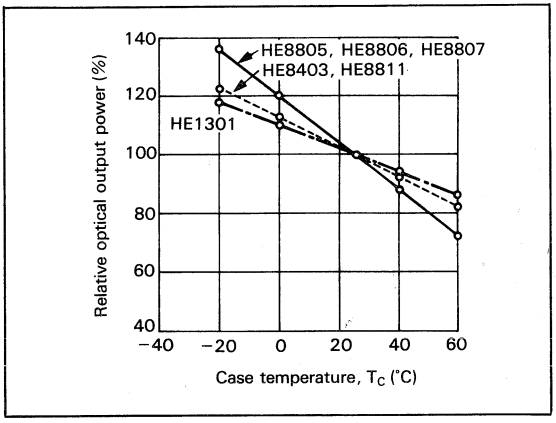


Figure IV-35. Temperature Dependency of Optical Output Power

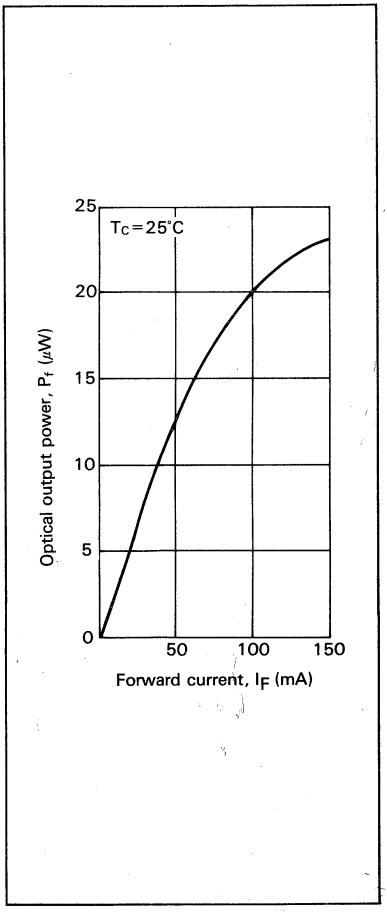


Figure IV-34. Light vs. Current Characteristics for HE1301R

2.2 Emitting wavelength

Spectral distribution measuring method

A spectroscope is normally used to measure the spectrum of the emitted wavelength. To draw light emitted from the IRED into the spectroscope, either a bundle fiber is used or light is coupled with a condenser lens. Figure IV-36 shows the measuring method using a bundle fiber.

Temperature dependency of wavelength

In the same way as with optical output power, temperature changes cause the wavelength distribution to fluctuate. Therefore, sufficient attention should be paid to releasing heat from the device. Figure IV-37 shows temperature dependency of the wavelength for the HE8807 series.

As shown in Fig. IV-38, the peak wavelength becomes longer, spectral width wider and optical output power lower when the temperature rises.

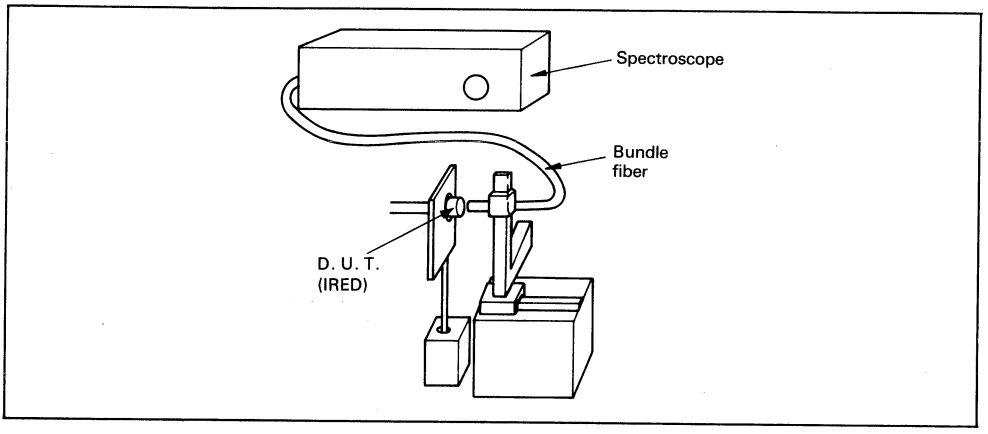


Figure IV-36. Spectral Distribution Measuring Method

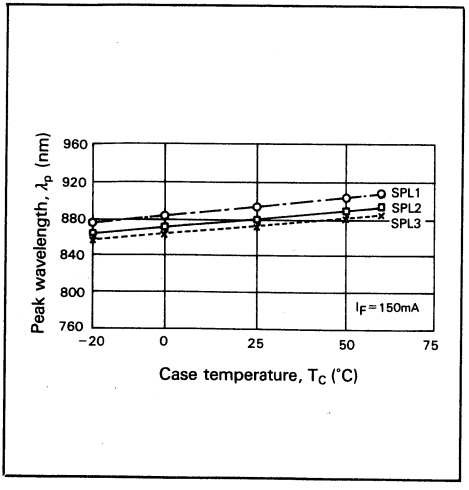


Figure IV-37. Temperature Dependency of Wavelength for HE8807 series

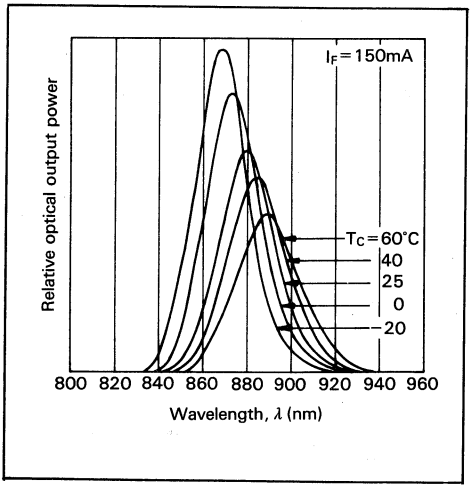


Figure IV-38. Temperature Dependency of Optical Output Power for HE8807 series

2.3 Far field pattern (FFP)

An FFP is the light intensity profile used to obtain the relation between the angle and optical output by placing a photodetector far enough distance away that the size of the IRED emitting area can be neglected. Figure IV-39 illustrates the FFP measuring method. It employs the same driving circuit as the measuring setup for light-current characteristics under CW operation. It uses a PIN photodiode or an avalanche photodiode (APD) with a minute sectional area as its photodetector. The IRED is fixed so that emitting area is aligned with the center of the turntable. Light intensity input into the photodetector is measured by rotating the turntable, and the relation between the light intensity and the turning angles is obtained.

Since the chip surface of Hitachi IREDs is dome-shaped, uniform optical output is maintained at each angle. However, devices in RG and SG packages have different light intensity profiles than those in R packages due to interference or reflection from their sidewalls. FFP measurement examples are shown in Fig. IV-40.

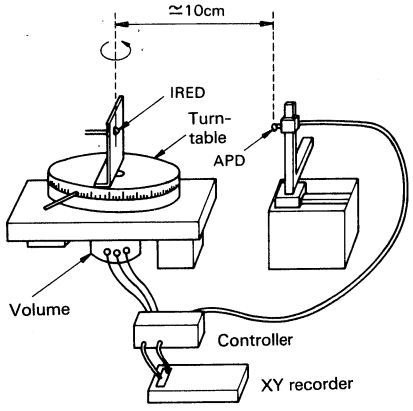


Figure IV-39. FFP Measuring Method

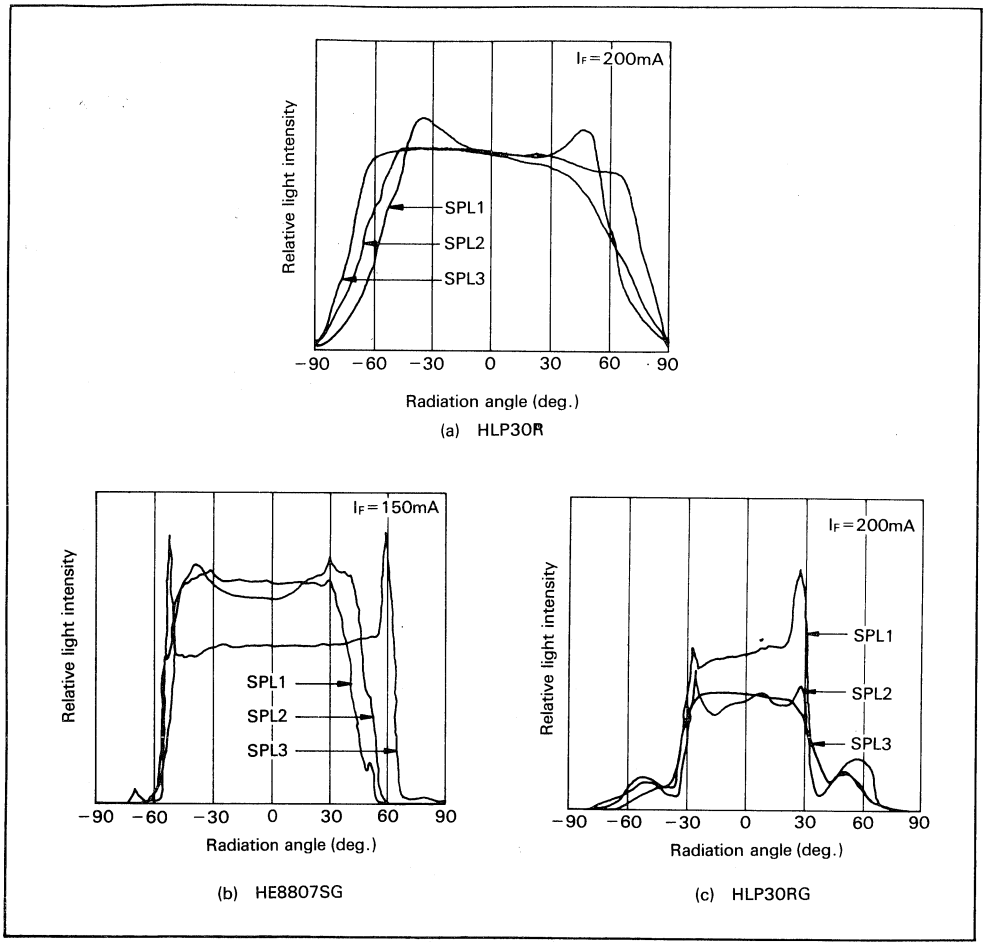


Figure IV-40. FFP Examples

2.4 Near field pattern (NFP)

An NFP can be observed with an infrared camera by operating the IRED under continuous waves (CW) and collimating the emitted light to a parallel beam with a lens (see Fig. IV-41). The amount of incident light into the infrared camera should be controlled with an optical attenuator, since too much incident light causes halation.

The emitting area is magnified from the upper surface of the IRED chip and observed wider than actual size, due to the lens effect of the dome-shaped GaAlAs crystal layer. At this time, the apparent diameter (effective diameter) will differ according to chip structure. Effective diameter is defined as half of the peak light intensity of the NFP, as shown in Fig. IV-42. The effective diameters are 520 μm (typ.) for the HLP series of 600 μm dome (chip) diameter and 360 μm (typ.) for the HE8807 and HE8811 of 400 μm dome diameter. And 150 μm for current confinement types such as the HE8403 and HE1301 series. Figure IV-43 shows a measurement example of effective diameters for the HE8807.

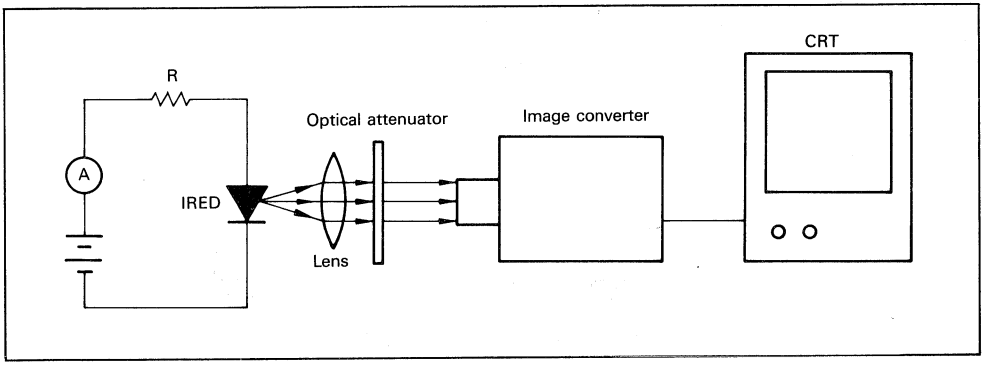


Figure IV-41. NFP Measuring Method

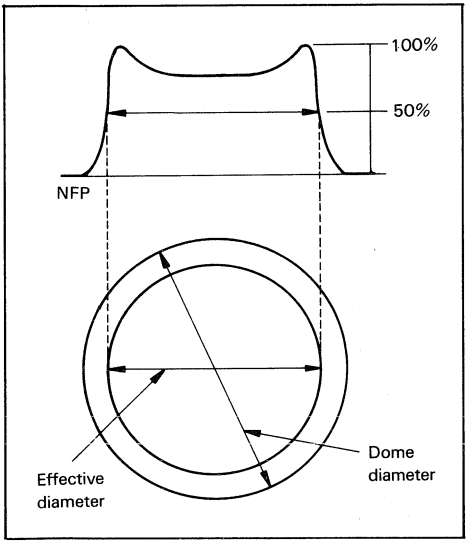


Figure IV-42. Effective Diameter and NFP

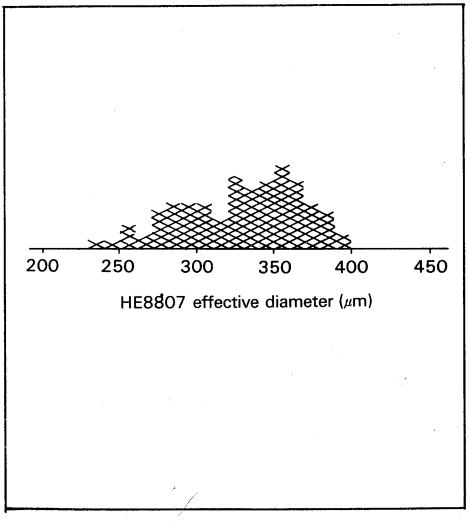


Figure IV-43. Effective Diameter Examples for HE8807

2.5 Current destruction

Sufficient care should be taken when switching on the power or carrying out pulse operation to not create an excessive current flow that may destroy the IRED. Measurement values of current destruction are shown in Fig. IV-44. IREDs should be operated at value below half this destruction current and in a region where the light-output-current characteristic is not saturated.

A serial protection resistor, R_s, should be inserted in the drive circuit for CW operation to prevent excessive current flow (see Fig. IV-45). When using a constant voltage supply, the supply voltage, V_{CC}, should be set as high as possible to avoid current fluctuation due to forward voltage variation from device to device and temperature changes. When using a constant current supply, be careful to set the resistance value, R_S, high enough that excessive current does not flow before the current limitter starts functioning after the power source is switched on.

Figure IV-46 shows a destructive-current measurement example when forward or reverse excessive current (surge current) is applied to the IRED.

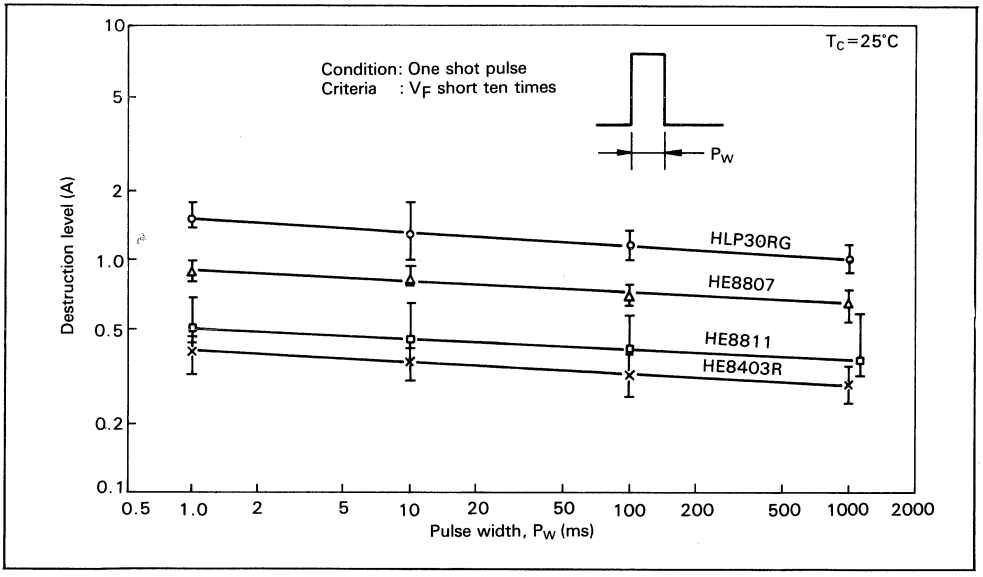
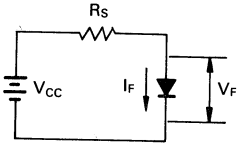


Figure IV-44. Destructive Current



a) When using constant voltage supply

$$R_S = \frac{V_{CC} - V_F}{I_F} \quad (\Omega)$$

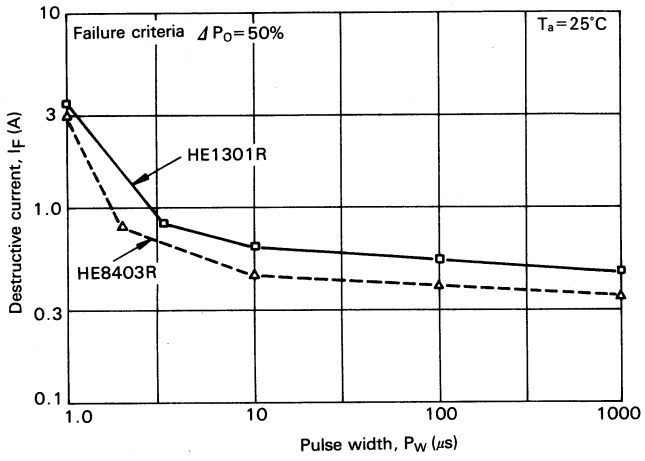
V_{CC} : Supply voltage (V)
V_F : Forward voltage (V)
I_F : Forward current (A)

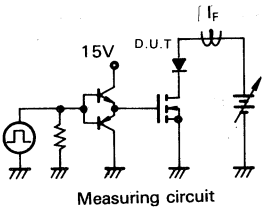
b) When using constant current supply

$$R_S = \frac{V_{CO} - V_F}{I_F \text{ max.}}$$

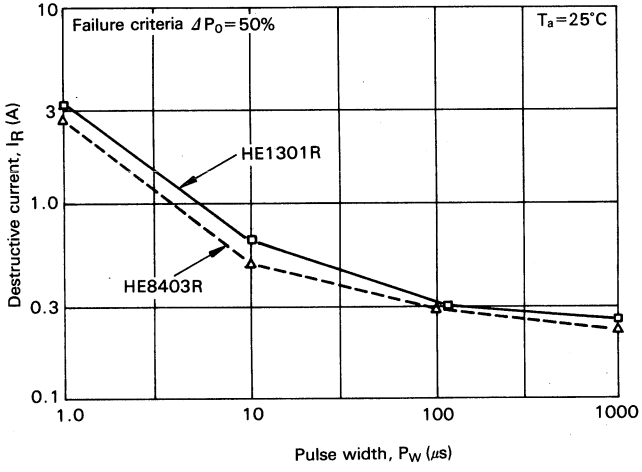
V_{CO} : Unloaded supply voltage (V)
V_F : Forward voltage (V)
I_F max : Forward current maximum rating (A)

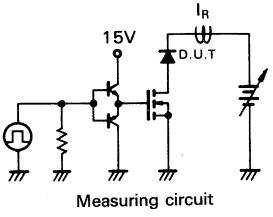
Figure IV-45. Power Supply for CW Operation





(a) Forward current applied





(b) Reverse current applied

Figure IV-46. Durability against One-pulse Surge

2.6 Transient thermal resistance

The life time of IREDs depends heavily on their junction temperature. Adequate heat release should be designed. Figure IV-47 shows examples of transient thermal resistance characteristics.

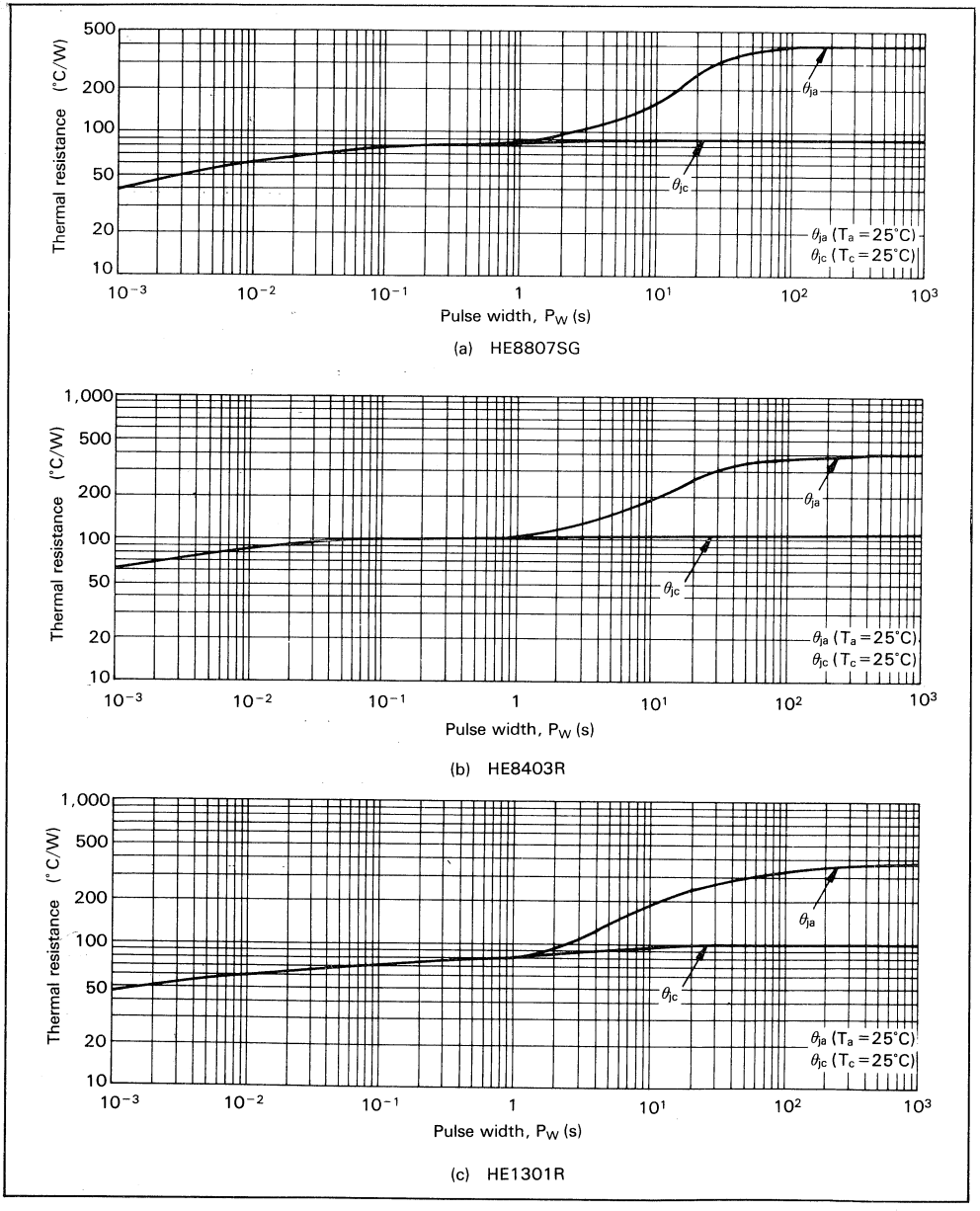


Figure IV-47. Transient Thermal Resistance Examples

2.7 Optical fiber coupling efficiency

Figure IV-48 shows the coupling efficiency when connecting various types of optical fiber with IREDs. Figure IV-49 shows changes of light input into optical fiber when varying the distance from the chip surface to the fiber tip. The reduction rate of optical fiber output is about 12 to 24%/ 100 μm at distance Z. Figure IV-50 shows the fiber coupling reproducibility of HE8403TR which accommodates fibers with standard connectors. Reproducibility shows good performance within an output variation of ± 0.5 dB.

The fiber can either be processed or a lens used to obtain larger optical output. Optical output can be increased as much as 1.2 times by using fibers with tips made hemispherical through an electric discharge process.

By using a parabolic-rod or similar lens (see Fig. IV-51), almost the same fiber output can be obtained as with direct coupling method (see Fig. IV-52) even when some distance separates the chip surface and the fiber tip. Therefore, SG-type devices with caps are expected to realize about the same fiber output as the R-types. Figure IV-53 shows the relation between the fiber output of IRED chips in R packages measured through the direct coupling method and that of IRED chips in capped SG packages measured through the parabolic-rod-lens coupling method.

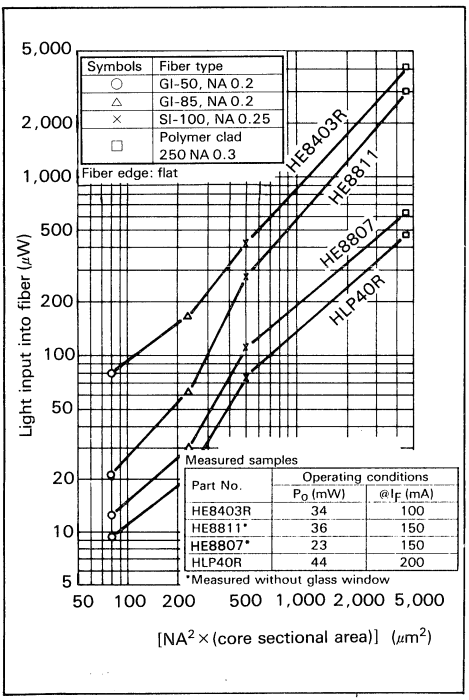


Figure IV-48. Optical Fiber Coupling Efficiency

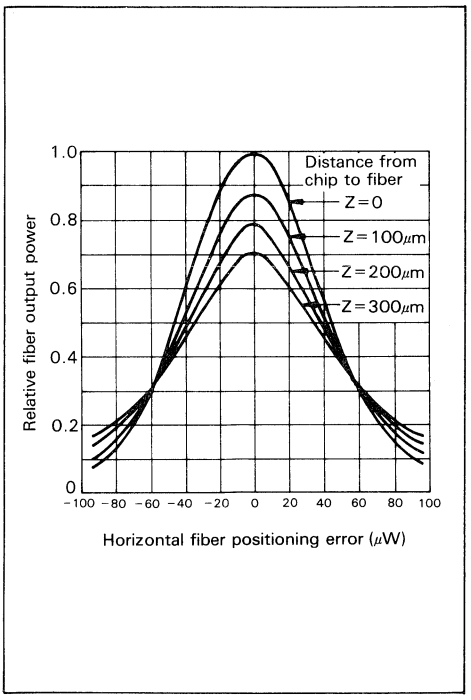


Figure IV-49. Fiber Output Deviation due to Fiber Positioning Error with HE8403R

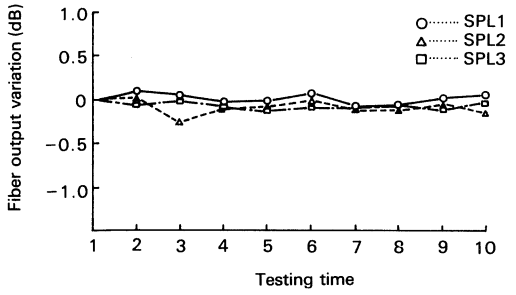


Figure IV-50. Fiber Connecting Reproducibility for HE8403TR

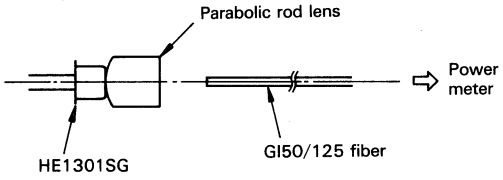


Figure IV-51. Parabolic Rod-lens Coupling Method

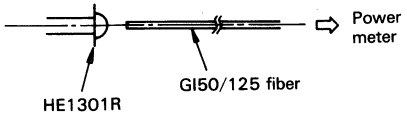


Figure IV-52. Direct Coupling Method

2.8 Precision of chip position

In most practical applications, the optical output of an IRED is condensed by placing a lens over its face. At that time, it is important to adjust relative position of the light source and the center of the lens to a point where no practical problem arises. Figure IV-54 gives the amount of chip position offset to the center of the stem, as useful data for designing this type of optical system. Figure IV-55 shows the distances between glass window of the cap and the chip.

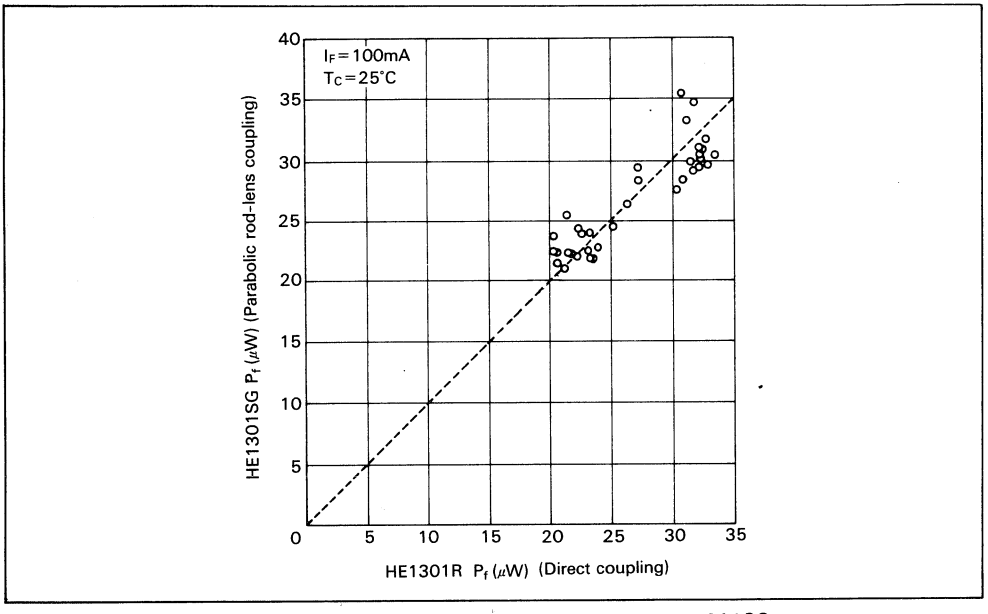


Figure IV-53. Fiber Output Comparison for HE1301R and HE1301SG

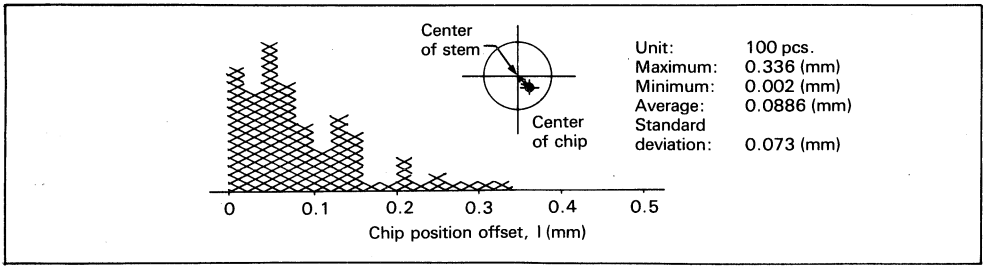
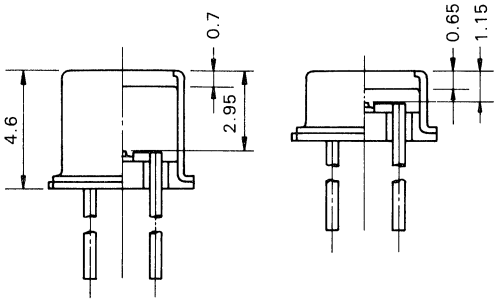


Figure IV-54. Chip Position Offset Examples



(a) RG-type (b) SG-type

(Unit : mm)

Figure IV-55. Distances between Glass Window of Cap and Chip

3. Photodiode fundamental characteristics

3.1 Photo-detection sensitivity (S)

An example is given in Fig. IV-56 of a method for measuring photo-detection sensitivity. A laser beam of specified wavelength is input from an LD into an optical fiber. The optical axis is adjusted so that the light quantity is maximum at the photodiode surface. The APC circuit is then adjusted so that there is a specified level, P_{in}, of optical input power into the photodiode. It is necessary at this time to adjust the position of the photodiode so as not to change the saturation current, I_S. The photo-detection sensitivity, S, can then be calculated using the formula:

$$S = I_S/P_{in} \ (mA/mW)$$

When measuring spectral sensitivity characteristics, values calculated for spectral sensitivity are usually compared against wavelengths. Here, several wavelengths that have issued from monochromatic light sources and have the same spectral width are usually employed.

Figure IV-57 shows the relation between saturation current, I_S, and reverse voltage, V_R, for Si PIN and InGaAs/InP PIN photodiodes. Spectral sensitivity characteristics are listed in the individual product data sheets.

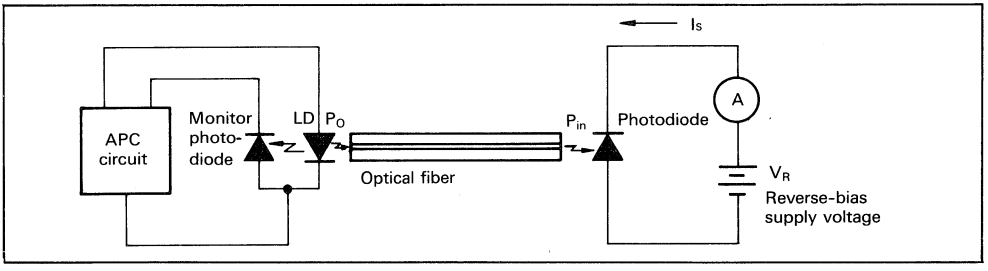


Figure IV-56. System for Measuring Photo-detecting Sensitivity

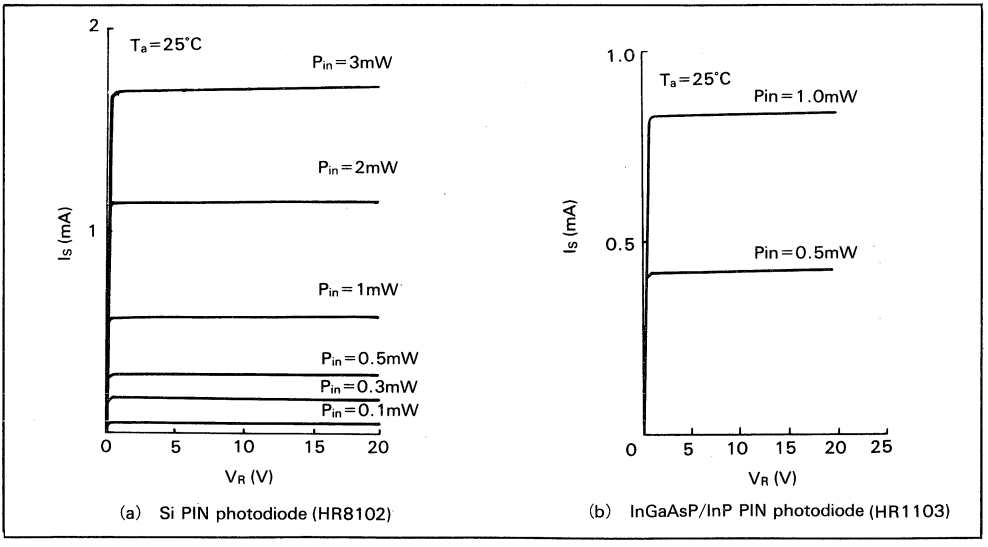


Figure IV-57. Relationship between Saturation Current and Voltage

3.2 Photo-detection response characteristics

Photo-detection response can be observed by measuring rise time, t_r, and fall time, t_f, for a photodiode output-current pulse when a pulse is input into the photodiode (Fig. IV-58). A measurement setup example is presented in Fig. IV-59. A high-speed response capability is required for precise measurement of photodiode response when a monochromatic light source, LD, is employed. Optical power output from an LD is focused using a lens, and the axis of the LD and the photodiode is adjusted so the focused spot is within the photo-detection area of the photodiode. LD optical output power is then set by adjusting the pulse generator so that a specified volume of light is incident on the photodiode. A photo-detection response example is shown in Fig. IV-60.

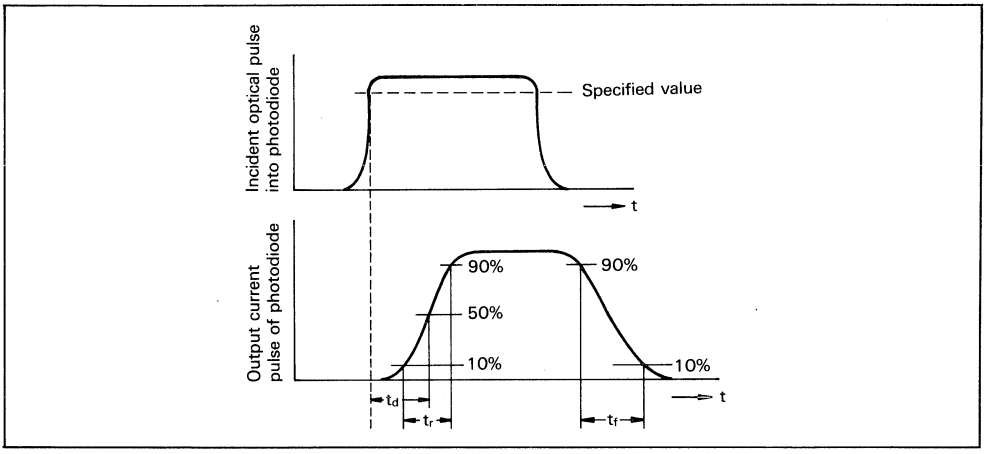


Figure IV-58. Definition of Photo-detection Response Time

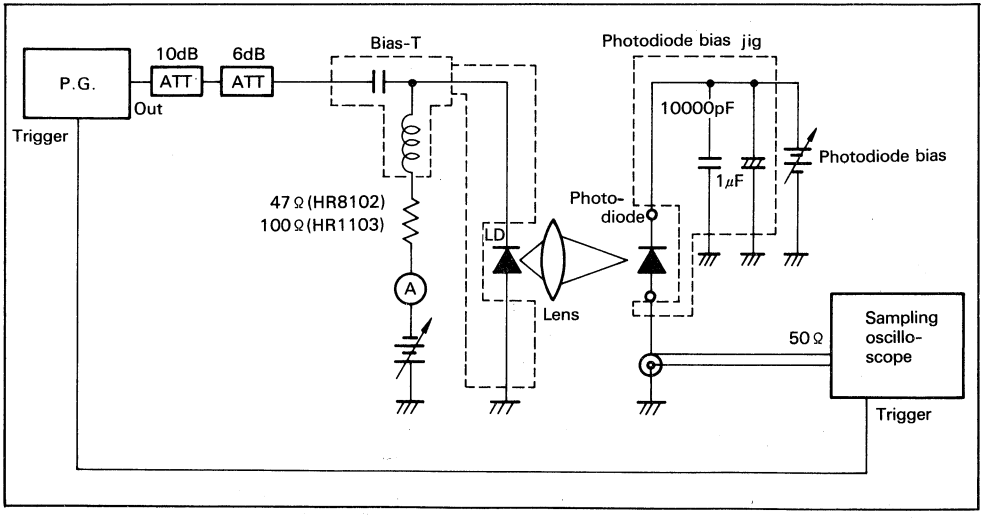


Figure IV-59. Measuring Setup for Photo-detection Response

3.3 Frequency response

Figure IV-61 shows the frequency response characteristics of Si PIN PD (HR8101, HR8102). These values were measured using a network analyzer, with injected light at 830 nm and a 50Ω load. Notice in particular that, even with a 5V bias, the cutoff frequency is greater than 300 MHz.

The frequency response characteristic of InGaAs PD (HR1103) with multi-layer heterozygous structure, is shown in Fig. IV-62. As is clear from the figure, the frequency response is flat up to the 1 GHz region, making it ideally suited for a signal detector in a high speed optical fiber transmission system.

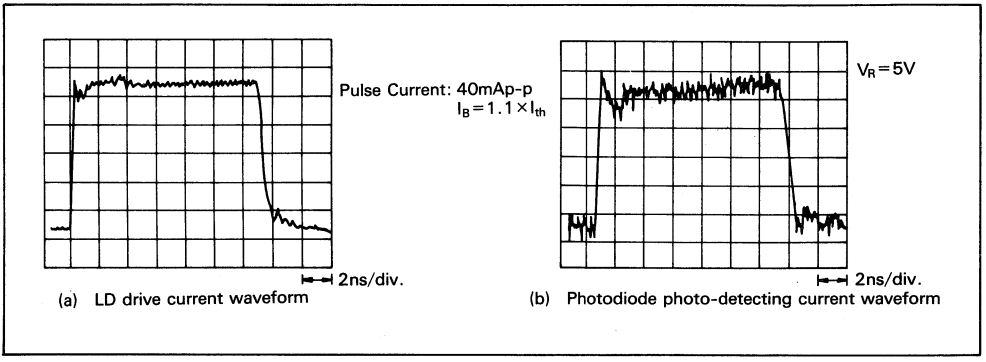


Figure IV-60. Photo-detecting Response Wave for InGaAs/InP PIN Photodiode (HR1103)

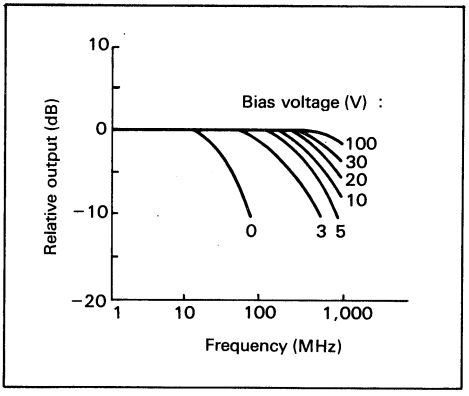


Figure IV-61. Frequency Response Characteristic of Si PIN PD.

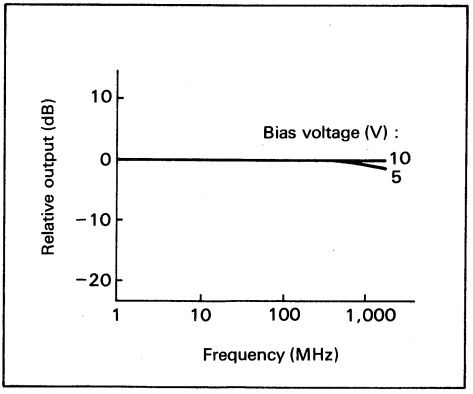


Figure IV-62. Frequency Response Characteristic of InGaAs/InP PIN PD.

V. Handling instructions

Suitable handling precautions during device measurement and system design must be taken as described below for high performance of a device with high reliability.

1. The absolute maximum ratings

Be careful never to exceed, even momentarily, the absolute maximum ratings specified in the data sheets herein.

Pay particular attention to the following points.

(1) It is possible for diodes to be damaged by spike current, generated when switching the power ON or OFF or when adjusting its output voltage. Before activating diodes, check the transient state of the power supply to assure that it does not exceed the maximum voltage rating.
(2) Operate the diodes under the maximum optical output power rating in order to prevent mirror facet damage and resultant loss in reliability.

2. Surge energy

Electrostatic discharge and electric spike input which may damage the diodes should be prevented. The main causes of undesirable surge energy are static electricity on the human body, shipping containers made of unsuitable materials, abnormal pulses generated from test equipment, and voltage leakage from soldering irons.

Precautions below should be taken when using diodes.

(1) The human body should be grounded through a high resistance of 500 kΩ to 1 MΩ while handling diodes in order to prevent diode destruction due to static electricity contained in the body and clothes.
(2) Soldering irons should be grounded to prevent voltage leakage from transferring to the diodes.
(3) Suitable materials should be chosen for shipping containers and jigs so that they will not become charged with static electricity by rubbing during transportation. Use of electroconductive materials or aluminum foil is effective.

3. Storage

(1) Store diodes in temperature of between 5 and 30°C and relative humidity of below 40%. Lower values of both are preferable. Avoid sharp drops in temperature in order to prevent condensation. It is recommended to store diodes in an atmosphere of dry nitrogen with a dew point of −40°C.
(2) Assure that the storage atmosphere is void of dust and gases harmful to diodes.
(3) Use a storage case which can not easily be charged with static electricity.

4. Safety considerations

Even though barely visible to the human eye, laser beams can be harmful to the eye. Do not look at the beam through lenses when the diode is activated. When aligning the optical axis of a laser beam and an external optical system, use an ITV camera (e.g. a silicon-vidicon type) which can detect infrared rays to observe the laser beam.

5. LD-package handling

5.1 A- and AC-types

A-type is designed for experimental use and AC-type for module assembly. An LD chip is mounted on a submount on a heat sink and the mirror facets are exposed to the air. Special care is required as follows:

(1) Never touch the bonding wire on the upper part of a device.
(2) Prevent mechanical contact to an LD chip, because the stress peels off the chip from the heat sink or deteriorates the device properties such as beam divergence, far field pattern and reliability.
(3) Cleanest atmosphere is strongly desired to handle a device, to keep mirror facets free from dust and scratch, because a light emitting source is extremely small. As a result, this precaution prevents degradation of optical output power and far field pattern.
(4) Hold the copper heat sink in handling a device. Do not drop the device or give any other mechanical shock.
(5) Do not process or deform a heat sink.
(6) Use a good thermal radiator to mount a device on. The temperature of an LD chip rises highly owing to the high current density unless a good heat sinking is provided. As a result, this precaution prevents lower optical output power and device deterioration. Notice the following cautions in using a thermal radiator.
   (i) Never use silicone grease because it creeps up and adheres to the mirror facets, resulting in a degradation of optical output performance.
   (ii) Use a copper or an aluminum plate as a thermal radiator. The radiator should be larger than 30 × 40 × 2 mm^3.
   (iii) Polish up the thermal radiator surface to have a good thermal conductivity with the device heat sink. Finish the radiator surface to keep bump, twist or bend below 0.05 mm.
   (iv) Chamfer all screw holes. The diameters of the chamfered holes should be smaller than that of a screw cap.
   (v) When mounting a device to a radiator, do not allow the device to be turned by screwing down or the chip to contact the thermal radiator.

(7) Soldering:
Notice the following precautions when soldering the electrode ribbon of a device to the circuit.
(i) Do not exceed the heat sink temperature of 80°C and finish process within 30 seconds, because a low melting point solder is used for chip mounting.
(ii) Use the fine tipped soldering iron commercially available or a common soldering iron with the copper coil around the tip. At the time, earth the tip of the iron. A battery operation type is best to use.
(iii) Do not allow the solder to flow into the pad of bonding wire.
(iv) Do not allow the scattered flux to adhere to the mirror facets.
(v) Do not wash out flux after soldering, because it contaminates the mirror facets.

(8) Hermetic seal:
Hermetically seal a device to extend its life time.

These packages should be hermetically sealed on mounting on systems.

5.2 BF-, DL-, DM- and TR-types

These packages are designed for fiberoptic communications. DL- and BF-types contain a PD for power monitoring as well as a TE cooler. DM-type contains a monitor. Both are provided with a single mode fiber. The TR-type package design allows connection of an FC connector, and contains a built-in LD as well as a PD. The LD, PD, and TE cooler are all hermetically sealed. Pay attention to the following precautions in handling these devices.

(1) Excessive force to optical fiber disconnects the fiber at a moment or deforms it partially. Do not pull, crook or twist the fiber because it deteriorates fiber characteristics. Do not bend the optical fiber within 30 mm radius.
(2) Do not apply excessive stress between the package and the optical fiber, to prevent a fiber from breaking, falling out and reducing optical output power. Lift both of the package and the optical fiber at the same time not to bend the fiber bottom.
(3) Do not apply excessive stress by bending or pulling the pins, because it deteriorates hermeticity.
(4) Do not process or deform a package.
(5) Processing the optical fiber:
Do not contaminate or damage the tip of an optical fiber to prevent the loss of optical output power or of coupling efficiency. Follow the instructions below in processing the fiber tip.
(i) Remove the appropriate length of the nylon jacket from the fiber tip with a proper stripper.
(ii) Remove the fiber coating remedy from the peeled fiber with aceton.
(iii) Scratch the cutting point of the fiber with a diamond cutter.
(iv) Hold the fiber tip with a pair of tweezers and bend to snap, then expose the clean surface. When the surface of the fiber cannot be snapped flatly, try again (Fig. V-1). Take enough care when processing a fiber, because the extremely thin core of fiber may easily pierce human skin.
(6) Mounting a device on a thermal radiator:
Use an LD with a thermal radiator.
(i) When screw mounting a device on a radiator, torque should be 1 to 2 kg·cm. Too small torque may result in excessive thermal resistance and excessive torque may damage the diode on the other hand.
(ii) Use a screw of 2 mm dia.
Use a spring washer and apply lock paint to tapping holes or nuts to prevent turning or relaxation of the screw.
(iii) For other considerations, follow the instructions described in the previous section 5.1 (6).
(7) TR Package
Make certain that dirt and dust do not enter the TR package sleeve. For the HL1323TR, dirt or dust which has penetrated the sleeve may be wiped off the glass surface.
(8) Soldering:
Follow the instructions described in the previous section 5.1 (7).

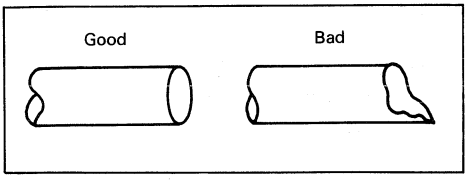


Figure V-1. Processed Fiber-tip Examples

5.3 E-, G-, FG- MG- and HG-types

(1) Take care not to touch the window glass directly. Contamination and scratches on the window surface will result in decreased optical power output and distorted far field patterns. Contamination can usually be wiped off using a cotton swab with ethanol.

(2) Do not squeeze the cap tightly, as it will cause the window glass to crack and package hermeticity to deteriorate.

(3) Do not bend the bottom of the lead wire, as it will cause the glass area to crack and the hermeticity to deteriorate.

(4) Do not cut or process packages.

(5) Mounting a diode on a thermal radiator:
Laser diodes must be mounted on thermal radiators. For higher reliability, it is necessary to minimize mechanical stress to the packages and achieve sufficient heat sinking. Attention should be paid to the followings when mounting diodes on thermal radiators.

(i) Use a copper or aluminum plate for the thermal radiator. The plate should be larger than 30 × 40 × 2 mm^3.

(ii) To give it good thermal conductivity, polish the thermal radiator surface so it will lie flat with the diode heat sink. Finish the radiator surface to keep bumps, twists or bends below 0.05 mm.

(iii) Chamfer all screws. The diameter of chamfered holes should not be larger than that of the screw heads.

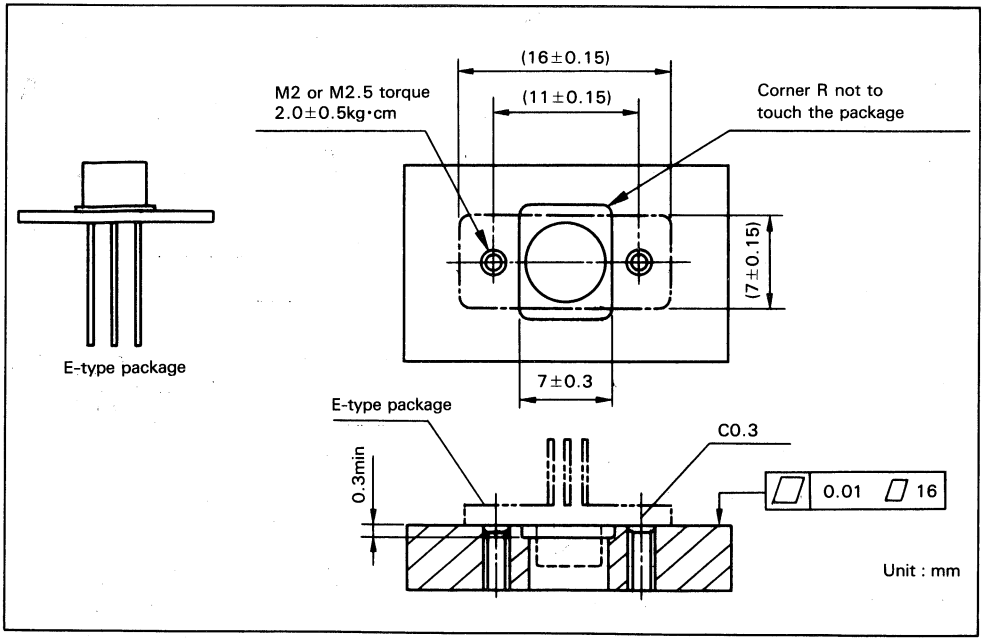
(iv) When screw mounting diodes on radiators, torque should be applied at 2.0 ± 0.5 kg·cm. Insufficient torque may result in excessive thermal resistance, where excessive torque may damage the diodes.

(v) Use screws with diameters of 2 or 2.5 mm for the E-type package. Use spring washers and apply lock paint.
When the cap-side of the stem-surface of an E-package is to be mounted on a heat sink, pay careful attention to the following points in order to reduce stress on the glass cap. (See the figure below).
- The mounting surface must be finished to a flatness of better than 0.01 mm over the area where contact is made.
- To prevent flexing of the stem, furnish a recess of 7 mm center width and at least 0.3 mm depth.
- Make certain that no burrs or external matter are present on the mounting surface.

(vi) Do not solder packages to thermal radiators, as this may result in excessive temperature to the assemblies inside the packages or loss of package hermeticity.

(vii) When mounting the diodes, do not touch or hit them against the caps, in order to prevent the window glass from becoming contaminated or cracked.

(viii) Do not use heat sink grease, as it may contaminate the window glass.

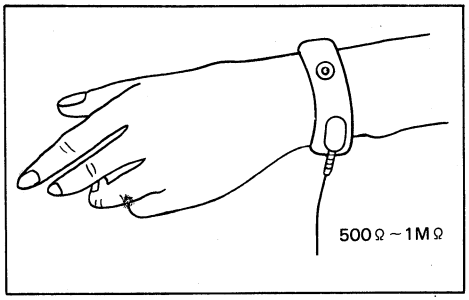


6. Advice for beginners

(1) Avoiding surge energy:
Laser diodes are easily destroyed by static electricity. To prevent electrostatic discharge, pay attention to the following precautions as well as Table V-1 when handling diodes and designing application circuits.

(i) Set the electric potential of the work bench to be the same as that of the power supply ground line.

(ii) Ground the operator's body by wearing a wrist band, and connect it to the same potential as the power supply ground line.



(iii) Do not operate equipment which may generate high frequency surge energy near diodes. The lead wires of drive circuits pick up surge electricity which may destroy diodes in the induced electric field.

(2) Operating laser diodes:

(i) Mount a diode on a thermal radiator. The radiator size depends on operating time and output power. When there is no condition set, use a relatively large radiator ($50 \times 50 \times 2$ mm^3) of copper or aluminum.

(ii) The drive circuits preferred are ones with APC (automatic power control) function. However, a simple constant current source is recommended when merely testing performance, because adjustment miscalculation can result when circuits are too complex, leading to destruction of the diodes.

(iii) Before connecting a laser diode to the power supply in the ON-state as shown in Fig. V-3, set the output level at minimum. Also, before disconnecting a laser diode from the power supply, set the output voltage at minimum. After disconnecting, turn off the main switch.

(3) LD drive circuit:
The optical output power from an LD is affected easily by the fluctuation of ambient temperature. APC (automatic power control) function is generally recommended for a drive circuit to achieve stable operation. The function to monitor beam and feed it back to drive current is useful to achieve constant optical output power against temperature change.

Table V-1. Ways to Prevent Surge Destruction of LDs (Examples)

Items	Check points	Specification examples
Human body	Ground operator's body.	Place a non-metallic, carbon band with a resistance of 500 Ω to 1M Ω on his wrist.
	Commonly ground the measuring and inspecting equipment and the work bench.	Should be carried out in shielded rooms as well.
	Control the ground level.	Under 10 Ω
Power supply	Distribute power from main power supply through noise filter to each measuring and testing unit.	
	Insert noise filter in each power supply unit.	Organize with capacitors and resistors.
	Keep the main power supply in the on-state, and switch the power on and off using an external switch.	
	Set up sequence control for turning the power supply off during electric outages.	
	Eliminate relay chattering.	
	To prevent chattering, avoid turning on and off of switch in APC circuit or relay.	
Working conditions	Temporarily stop work when the power supply for lights or other equipment connected to the same power line is turned on or off.	
	Conduct diode packing and measuring while performing ion blowing or in a weak minus ion atmosphere.	
	Select the right soldering iron.	Battery operated soldering iron.
Jigs and other considerations	Make carrier jigs and packing cases conductive.	Particularly the cases.
	Place conductive mats on the working floor.	Under 300 Ω
	Control room temperature and humidity.	Humidity should be 50±10%.
	Make short circuits between diode leads.	
	Do not use sticky volume knobs.	Periodically replace with new ones.
	Eliminate ripples from power supply.	Battery operated power supply.

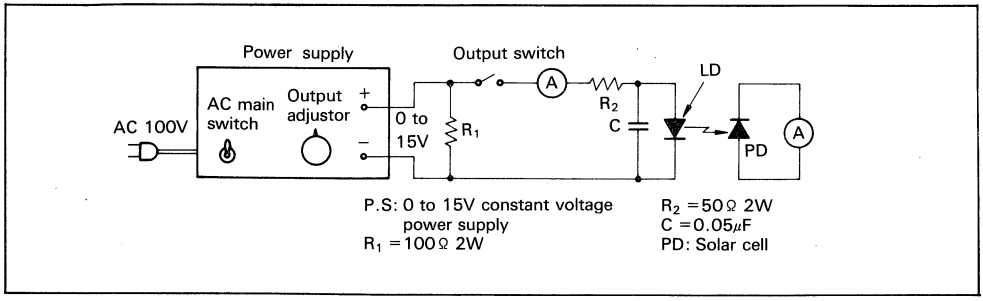


Figure V-3. Simple Drive Circuit

7. IRED-package handling

7.1 R-type (Open-air type)

An IRED chip on R-type package is exposed to the air for the convenience of coupling to the fiber or external optics. The following particular care must be taken for the open-air type package.

(1) Never touch the extremely thin gold bonding wire which is bare.
(2) Never apply mechanical stress to an IRED chip, or it peels off the chip from a diode base and deteriorates the properties and reliability. Also do not contaminate the chip surface, because it deteriorates optical properties and output power.
(3) Do not process or deform a diode base.
(4) Mounting a device on a thermal radiator:
An IRED must be mounted on a thermal radiator to reduce the temperature rise because it is usually driven at high current density. Without a radiator, specified optical output power cannot be obtained and the device may be degraded due to the chip temperature rise. When mounting a device on a radiator, follow the instructions below.
  (i) The appropriate size of a thermal radiator differs with operating conditions, but a large plate than 20 × 30 × 2 mm^3 of copper or aluminum is usually recommended.
  (ii) Polish up the thermal radiator surface to have a good thermal conductivity with the device heat sink. Finish the radiator surface to keep bump, twist or bend below 0.05 mm.
  (iii) Use of silicone grease is absolutely prohibited as described in the previous section 5.1(6) for A-type LD heat sink.
(5) Soldering:
  (i) Use a low melting point (below 200°C) solder.
  (ii) Soldering should be done in 10 seconds and at below 260°C.
  (iii) Do not allow the scattered flux to adhere to the chip surface.
(6) Hermetic seal:
Hermetically seal a device to extend its life time.

7.2 RG-, SG-, VG-, ML- and SL-types (Hermetically sealed)

These packages are well moisture-proof and easy to handle because of the hermetic seal. Pay attention to the following precautions in handling a device.

(1) Keep the glass surface of a device clean to have uniform optical output available.
(2) Do not process or deform a package. Especially do not nip the cap hard or bend the bottom of a lead wire forcibly, or it cracks the glass area and deteriorates the hermeticity.
(3) Mounting a device on a thermal radiator:
Use of a thermal radiator is recommended for higher reliability. Do not apply silicone grease to the contact area of the thermal radiator even for effective heat sinking, because it creeps up and adheres to the window glass as temperature increase, resulting in a degradation of optical properties and output power. For further details, see the previous section 7.1 (4).
(4) Soldering:
  (i) Soldering point must be away by 1.5 mm or more from the bottom of lead wires.
  (ii) Use a low melting point (below 200°C) solder.
  (iii) Soldering should be done in 10 seconds and at below 260°C.

8. Photodiode package handling

8.1 QG-, TG- and LG-types (Hermetically sealed)

These hermetically sealed packages are moisture-proof and easy to handle. Nevertheless, be careful to observe the following when handling them.

(1) Keep the glass surface of QG, TG or LG type devices clean to assure uniform optical input.
(2) Do not process the packages or change their shape. Be especially careful not to apply heavy stress to the glass surface, pinch the cap hard, bend the bottom of the lead wires forcibly, or apply stress to the bottom of the stem since this may degrade the hermetic integrity of the package.
(3) Soldering:
See item 7.2 (4).

8.2 CX-type (Chip-carrier)

This package has been designed for use in optical module assemblies. A photodiode chip is attached to a ceramic carrier stem, where it is left exposed to the air. With this package type, particular care must be taken in the following areas.

(1) Storage:
  (i) Store the photodiode in a dry, particle-free box, or in a nitrogen atmosphere between +20 and +30°C, where the dew point is below −30°C. Maintain these same conditions when storing the package unsealed during processing. The storage period recommendations in Table V-2 are meant to assure maximum product quality.
  (ii) Use storage containers which are not subject to buildups of static electricity.
(2) Handling and assembly conditions:
  (i) Never touch the chip bonding wire.
  (ii) Keep the chip photodetector area clean.
  (iii) Be careful not to scratch the chip surface, or crack or break the device when imple-

menting the CX type in your system. The soldering conditions given in Table V-3 should be maintained if optical and electrical characteristics and reliability are not to degrade.

(iv) This device should be hermetically sealed when it is finally mounted. The sealing process should be carried out within an atmosphere composed of an inactive gas such as nitrogen.
Results of hermetic-seal helium leak tests should be below 10^{-8} atm.cc/sec.

(v) Be sure to ground the worker's body and equipment when he or she handles the device.

Table V-2. Recommended Storage Period

Conditions	Storage period
Unopened, in Hitachi's packing case	Less than three months
Stored under the above conditions after opening the packing case	Less than one month

Table V-3. Recommended Soldering Conditions

Temperature	Time	Atmosphere
230 °C	Within 30 sec.	Inactive gas such as nitrogen

VI. Reliability

This section covers points which particularly affect the operating life of light emitting devices, and provides some examples which should be studied before proceeding with your system design.

1. Characteristic Drift

When optical emission devices such as the LD or IRED are operated in the forward mode, crystal defects (point defects and dislocations) propagate in the active region of the crystal.

These crystal defects cause optical emission characteristics (optical output power, threshold current, etc.) to drift, and ultimately lead to the end of the device's useful operating life. Figure VI-1 shows an example of drift in the optical output power vs current characteristic of an LD. From t_1 to t_4, the threshold current increases and the slope efficiency declines. The end of useful operating life is defined as the point where the operating current becomes 1.5 times of its initial value.

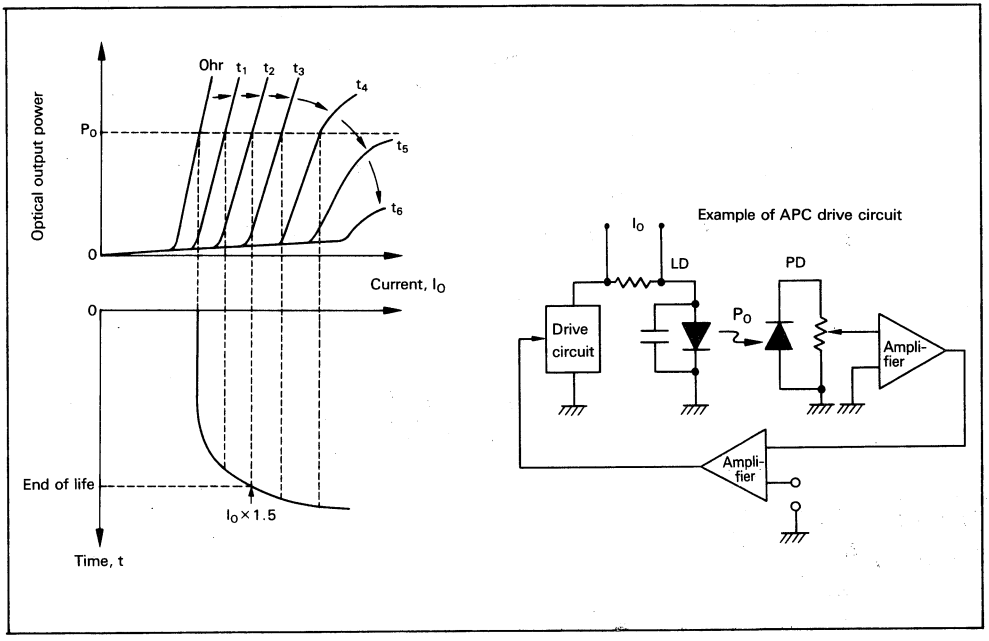


Figure VI-1. Example of Drift in LD Optical Output Power vs Current Characteristic

2. Derating

LD and IRED have a strong temperature dependence of lifetime. Thus, the expected operating life shows an exponential decrease with operating temperature. Derating should be employed to keep the rise of junction temperature as small as possible. (See Figure VI-2, and VI-3). Figure VI-4 shows the dependence of operating life on optical output power. Please note that this decrease in operating life occurs even at threshold current bias.

Figure VI-5 shows operating current dependence of IRED lifetime. In particular, when operated in open air at high current, the operating life is drastically affected by the rise in junction temperature due to heat generated by the device. Careful attention must be paid to carrying away excess heat.

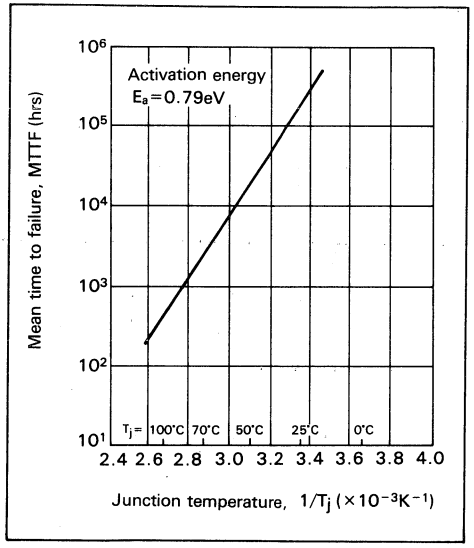


Figure VI-2. LD Mean Time to Failure vs Junction Temperature (Example)

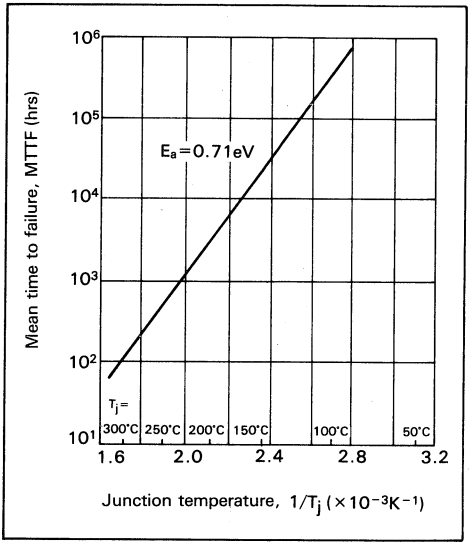


Figure VI-3. IRED Mean Time to Failure vs Junction Temperature (Example)

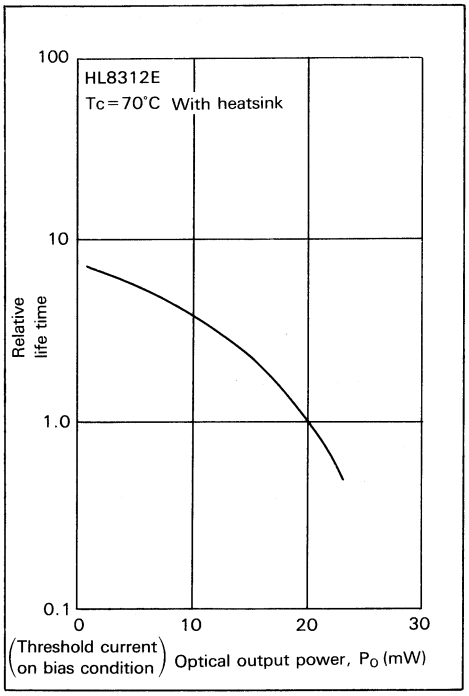


Figure VI-4. LD Operating Life vs Optical Output Power (Example)

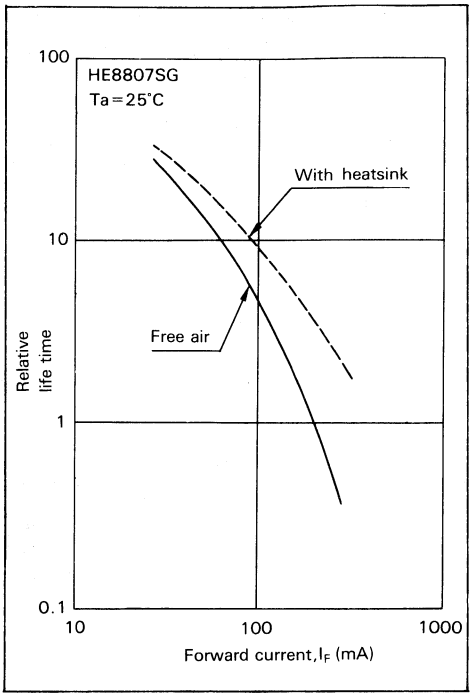


Figure VI-5. IRED Operating Life vs Forward Current (Example)

3. Estimation for Useful Operating Life

The operating life of light emitting devices exhibits the typical wear failure distribution, and thus is generally approximated by the lognormal distribution. Figure VI-6 shows an example distribution for LD operating life. When the temperature derating and optical output power derating discussed in the previous section are also considered, the actual expected operating life under given operating conditions can be estimated.

4. Standard Devices Graded by Expected Life

Hitachi classifies IREDs of standard-specifications by life levels and applications as shown in VI-1. For special requests or further details, please see your Hitachi representative.

Table VI-1. Lifetime and Application for Standard-Specification IREDs

Applications	Expected life time	Operating conditions	Criteria	Applicable products
Auto-focusing still camera	10 hrs.	I_F = 200 mA	F(t) = 0.1%, $\Delta P_0 \leqq 30\%$	HE8805VG
Auto-focusing VTR camera	200 hrs.	I_F = 250 mA f = 10 kHz, duty 25%	F(t) = 0.1%, $\Delta P_0 \leqq 30\%$	HE8806VG
Measurement or general use	1,000 hrs.	$T_j \leqq P_0$ 100°C	F(t) = 0.1%, $\Delta P_0 \leqq 30\%$	HLP series, HE8811
Industrial use	10,000 hrs.	$T_j \leqq$ 100°C	F(t) = 1%, $\Delta P_0 \leqq 50\%$	HE8807 series
Communications use	24,000 hrs.	$T_j \leqq$ 100°C	F(t) = 1%, $\Delta P_0 \leqq 50\%$	HE8403 series, HE1301 series

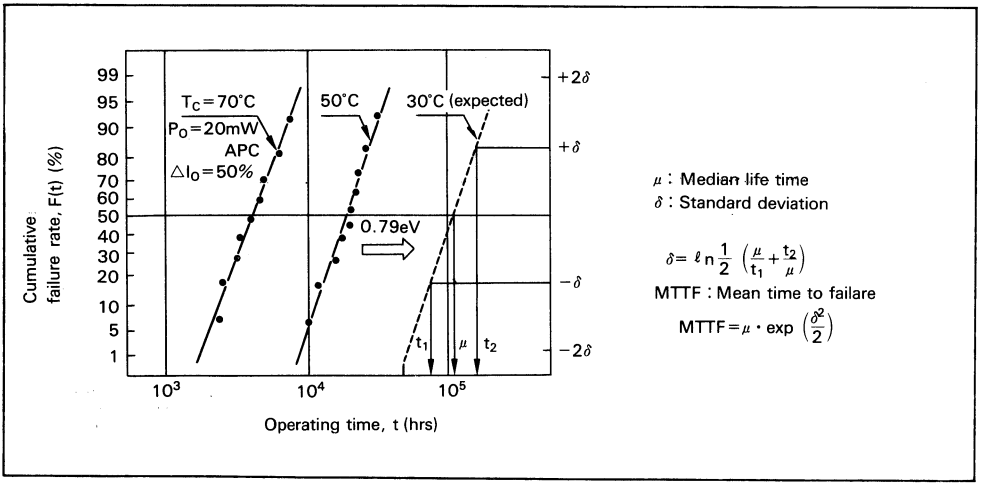


Figure VI-6. Distribution of Expected LD Life (Example)

VII. In Purchasing Hitachi Optodevices

1. Accompanying Data

If measurement data for ordered parts is desired, please mention this to your Hitachi representative.

2. Price and Delivery

For information on price and delivery, please discuss with your Hitachi representative.

Data Sheets

Laser Diodes

Product Lineup

Chips	Packages										
	A	AC	E	G	MG	HG	FG	TR	DM	BF	DL
HL6711				HL6711G*							
HL7801			HL7801E								
HL7802			HL7802E	HL7802G							
HL7806				HL7806G	HL7806MG						
HL7831				HL7831G		HL7831HG					
HL7832				HL7832G		HL7832HG					
HL7836				HL7836G	HL7836MG						
HL7838				HL7838G							
HL8311	HLP1400		HL8311E	HL8311G							
HL8312/ HL8315			HL8312E HL8315E	HL8312G							
HL8314			HL8314E	HL8314G							
HL8318			HL8318E	HL8318G							
HL8351			HL8351E*								
HL1221	HL1221A	HL1221AC									
HL1321	HLP5400	HL1321AC					HL1321FG			HL1321BF	HL1321DL
HL1322	HL1322A	HL1322AC									
HL1323								HL1323TR	HL1323DM		
HL1341	HL1341A	HL1341AC					HL1341FG			HL1341BF	HL1341DL
HL1361	HL1361A	HL1361AC									
HL1521	HL1521A	HL1521AC					HL1521FG				
HL1541	HL1541A	HL1541AC					HL1541FG		HL1541DM	HL1541BF	HL1541DL
HL1561	HL1561A	HL1561AC								HL1561BF	

New product

Under development

* Preliminary

HL6711G

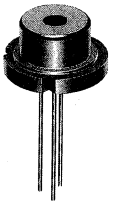
—Preliminary—
InGaAlP LD

Features

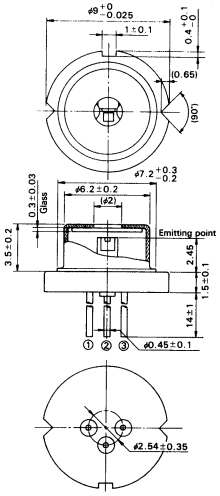
- Visible light output: λ_p = 670 nm typ.
- Threshold currents: I_{th} = 80 mA typ.
- Built-in photodiode for monitoring laser output

Applications

- Bar code readers
- Measurement or control equipment
- Various other types of optical equipment



Package Dimensions



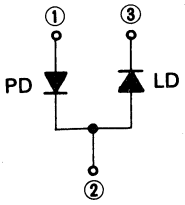
Notes: Optical path: 2.55 mm
Refraction index of window glass: 1.46 – 1.53

1. Photodiode anode
2. Common (Case)
3. Laser diode cathode

(Unit: mm)

G-type

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +50	°C
Storage temperature	T_{stg}	−40 to +85	°C

Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		80	95	mA	
Optical output power	P_O	5			mW	Kink free
Slope efficiency	η	0.4	0.7	0.8	mW/mA	$\frac{3(\text{mW})}{I\,(5\text{ mW}) - I\,(2\text{ mW})}$
Lasing wavelength	λ_p	660	670	680	nm	P_O = 5 mW
Beam divergence parallel to the junction	$\theta_{//}$	6	8	10	deg.	P_O = 5 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$	20	30	40	deg.	P_O = 5 mW
Monitor current	I_S	30	100	150	μA	$V_{R(PD)}$ = 5 V, P_O = 5mW

HL7801E

GaAlAs LD

Description

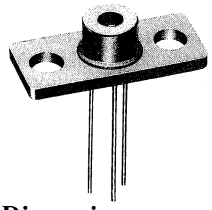
HL7801E is a 0.78 μm GaAlAs laser diode with double heterojunction structure.

It is suitable as a light source in laser beam printers, laser levelers and various other types of optical equipment.

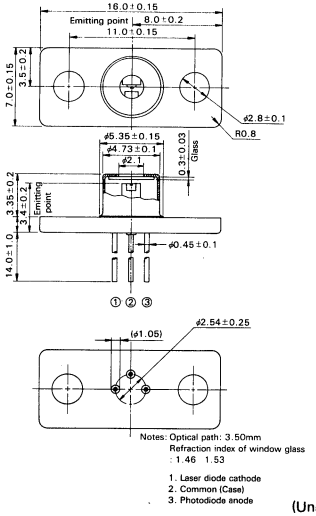
A screw-on type package facilitates the adjustment of optical components. Hermetic sealing of the package achieves high reliability.

Features

- Visible light output: λ_p = 760–800 nm
- Built-in photodiode for monitoring laser output
- Low astigmatism: As = 2 μm typ.
- Small beam ellipticity:
  $\theta_{//}$ = 15 deg., $\theta_{\perp}$ = 30 deg. typ.
- Single longitudinal mode

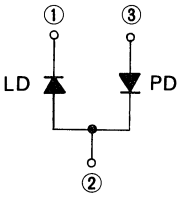


Package Dimensions



E-type

Internal Circuit



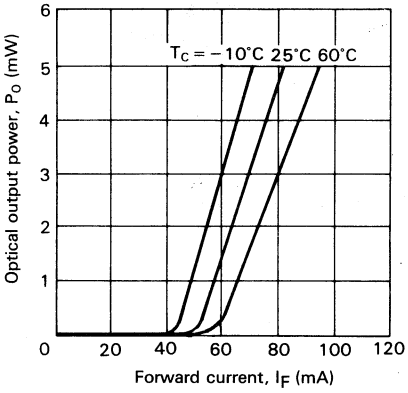
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +60	°C
Storage temperature	T_{stg}	−40 to +80	°C

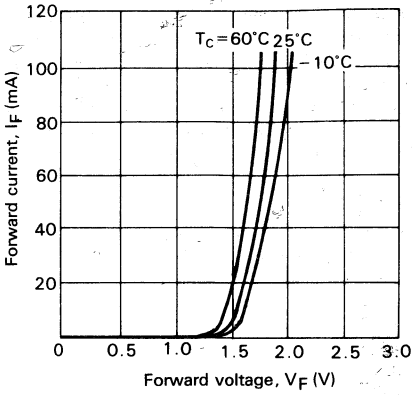
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		50	90	mA	
Optical output power	P_O	5			mW	Kink free
Slope efficiency	η	0.13	0.25		mW/mA	$\frac{3(mW)}{I(4\ mW) - I(1\ mW)}$
Lasing wavelength	λ_p	760	780	800	nm	P_O = 3 mW
Beam divergence parallel to the junction	$\theta_{//}$	10	15	20	deg.	P_O = 3 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$	20	30	40	deg.	P_O = 3 mW
Monitor current	I_S	0.1	0.3		mA	P_O = 3 mW

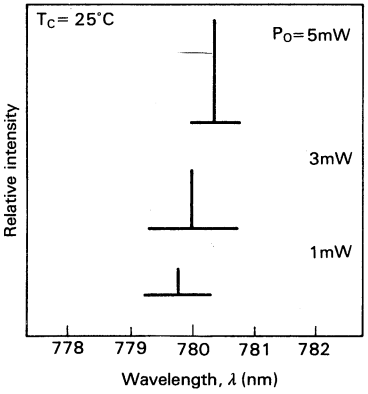
Optical Output Power vs. Forward Current



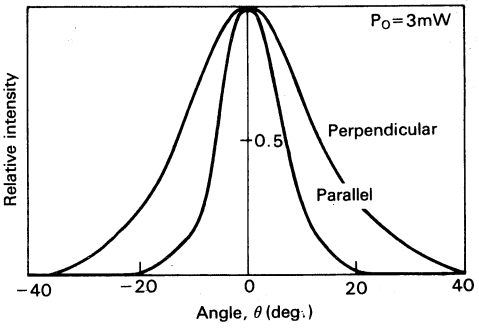
Forward Current vs. Forward Voltage



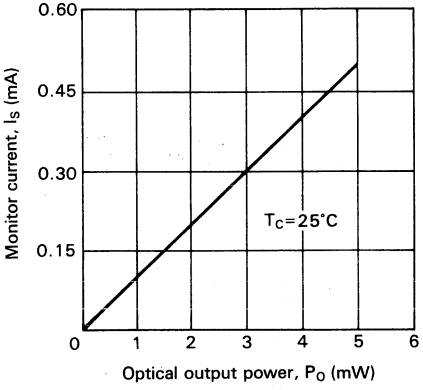
Lasing Spectrum



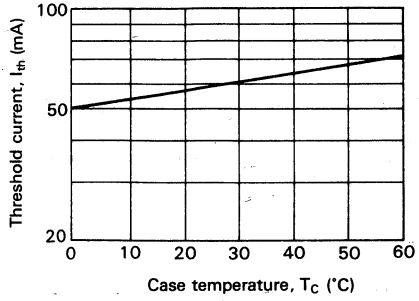
Far Field Pattern



Monitor Current vs. Optical Output Power



Threshold Current vs. Case Temperature



HL7802E

GaAlAs LD

Description

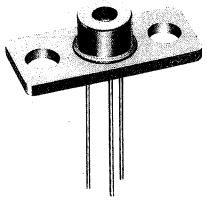
HL7802E is a high-power 0.78 μm GaAlAs laser diode with double heterojunction structure.

It is suitable as a light source in laser beam printers, laser levelers and various other types of optical equipment.

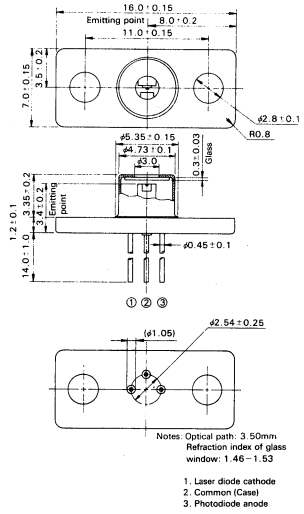
A screw-on type package facilitates the adjustment of optical components. Hermetic sealing of the package achieves high reliability.

Features

- Visible light output: $\lambda_p = 770-795$ nm
- Built-in photodiode for monitoring laser output
- Single longitudinal mode



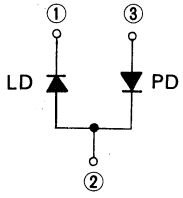
Package Dimensions



(Unit: mm)

E-type

Internal Circuit



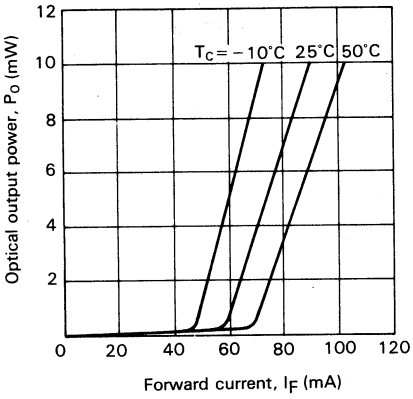
Absolute Maximum Ratings ($T_C = 25°C$)

Items	Symbols	Values	Units
Optical output power	P_O	10	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +50	°C
Storage temperature	T_{stg}	−40 to +80	°C

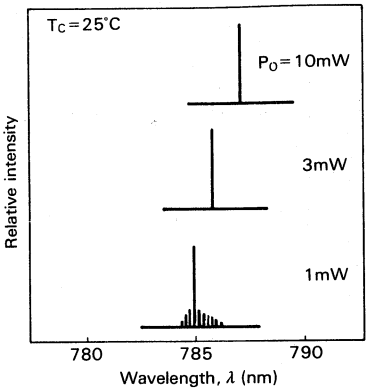
Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		50	90	mA	
Optical output power	P_O	10			mW	Kink free
Slope efficiency	η	0.13	0.25	—	mW/mA	$\frac{6(mW)}{I\ (8\ mW) - I\ (2\ mW)}$
Lasing wavelength	λ_p	770	785	795	nm	$P_O = 10$ mW
Beam divergence parallel to the junction	$\theta_{//}$	7	11	15	deg.	$P_O = 10$ mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$	20	30	35	deg.	$P_O = 10$ mW
Monitor current	I_S	0.35			mA	$V_{R(PD)} = 5$ V, $P_O = 10$ mW

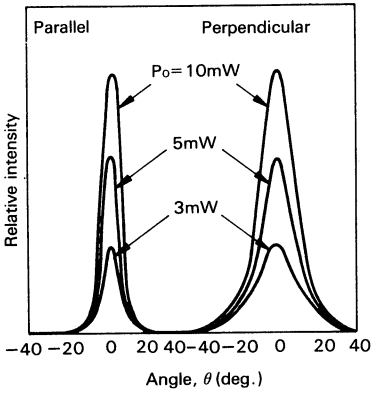
Optical Output Power vs. Forward Current



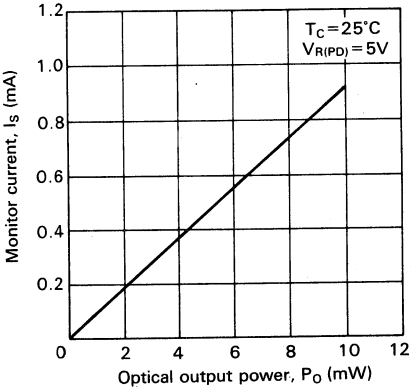
Lasing Spectrum



Far Field Pattern



Monitor Current vs. Optical Output Power



HL7802G

GaAlAs LD

Description

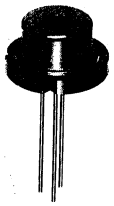
HL7802G is a high-power 0.78 μm GaAlAs laser diode with double heterojunction structure.

It is suitable as a light source in laser beam printers, laser levelers and various other types of optical equipment.

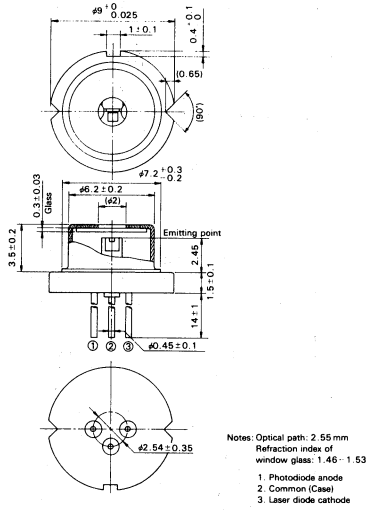
Hermetic sealing of the package achieves high reliability.

Features

- Visible light output: λ_p = 770–795 nm
- Built-in photodiode for monitoring laser output
- Single longitudinal mode

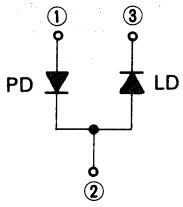


Package Dimensions



G-type

Internal Circuit



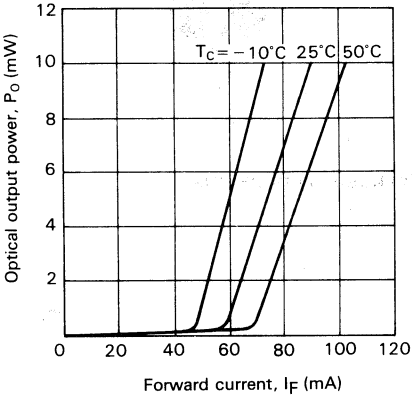
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	10	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +50	°C
Storage temperature	T_{stg}	−40 to +80	°C

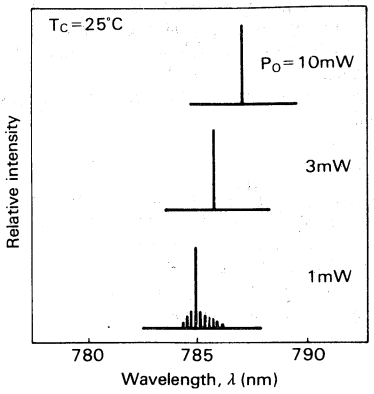
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		50	90	mA	
Optical output power	P_O	10			mW	Kink free
Slope efficiency	η	0.13	0.25		mW/mA	$\frac{6(mW)}{I\ (8\ mW) - I\ (2\ mW)}$
Lasing wavelength	λ_p	770	785	795	nm	P_O = 10 mW
Beam divergence parallel to the junction	$\theta_{//}$	7	11	15	deg.	P_O = 10 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$	20	30	35	deg.	P_O = 10 mW
Monitor current	I_S	0.35			mA	$V_{R(PD)}$ = 5 V, P_O = 10 mW

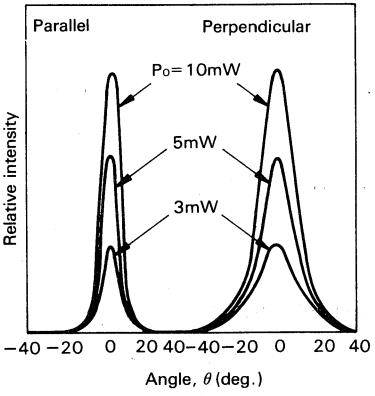
Optical Output Power vs. Forward Current



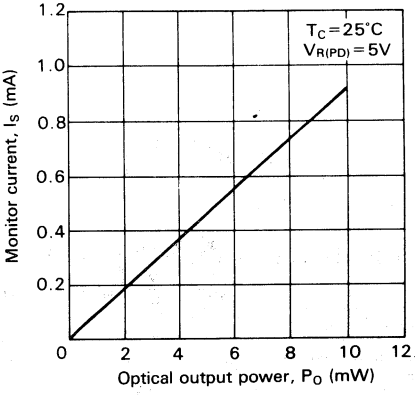
Lasing Spectrum



Far Field Pattern



Monitor Current vs. Optical Output Power



HL7806G

GaAlAs LD

Description

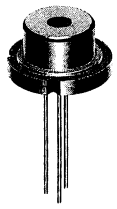
HL7806G is a 0.78 μm GaAlAs laser diode with double heterojunction structure.

It is suitable as a light source in laser beam printers, laser levelers and various other types of optical equipment.

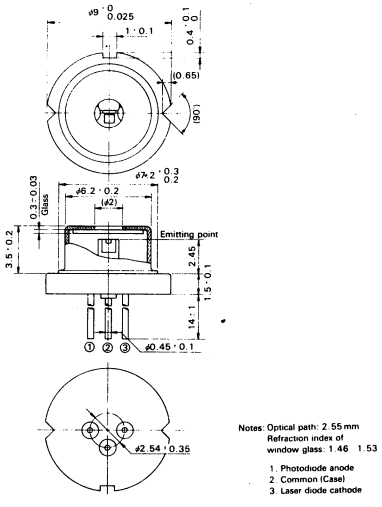
Hermetic sealing of the package achieves high reliability.

Features

- Visible light output: λ_p = 775–795 nm
- Built-in photodiode for monitoring laser output
- Low astigmatism: As = 2 μm typ.
- Small beam ellipticity:
  $\theta_{//}$ = 14 deg., $\theta_{\perp}$ = 27 deg. typ.
- Single longitudinal mode



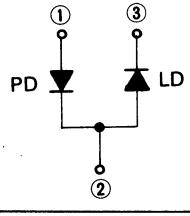
Package Dimensions



(Unit: mm)

G-type

Internal Circuit



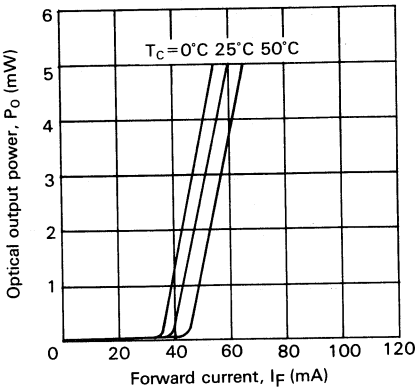
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +60	°C
Storage temperature	T_{stg}	−40 to +85	°C

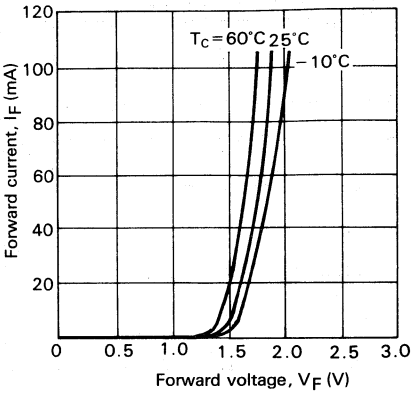
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		40	70	mA	
Optical output power	P_O	5			mW	Kink free
Slope efficiency	η	0.15	0.25		mW/mA	$\frac{3(mW)}{I\ (4\ mW) - I\ (1\ mW)}$
Lasing wavelength	λ_p	775	785	795	nm	P_O = 5 mW
Beam divergence parallel to the junction	$\theta_{//}$	8	14	20	deg.	P_O = 5 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$	20	27	45	deg.	P_O = 5 mW
Monitor current	I_S	0.35	1.0	1.65	mA	$V_{R(PD)}$ = 5 V, P_O = 5±0.05 mW

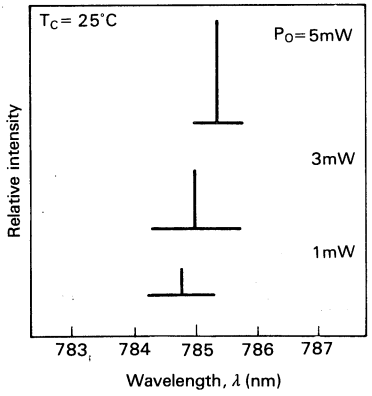
Optical Output Power vs. Forward Current



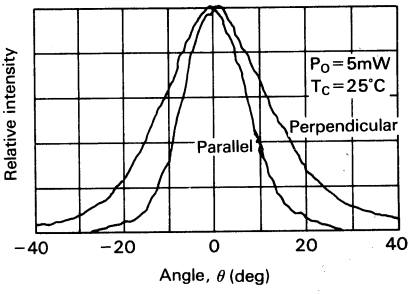
Forward Current vs. Forward Voltage



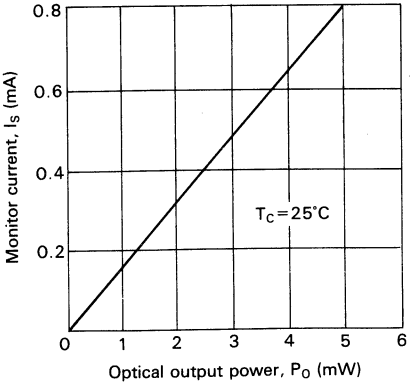
Lasing Spectrum



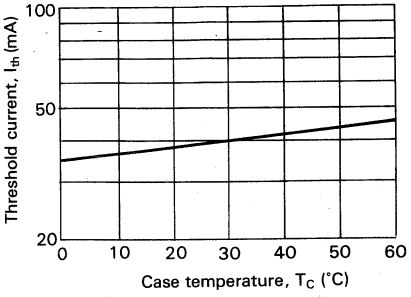
Far Field Pattern



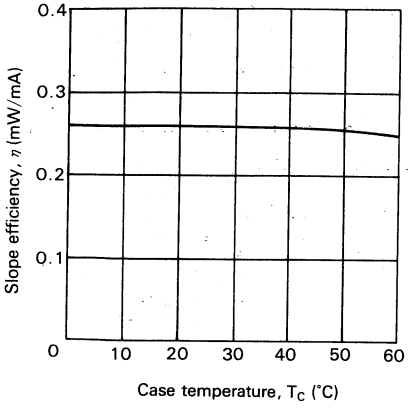
Monitor Current vs. Optical Output Power



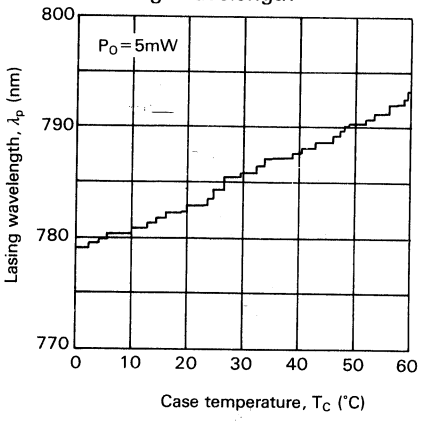
Threshold Current vs. Case Temperature



Temperature Dependence of Slope Efficiency



Temperature Dependence of Lasing Wavelength



Description

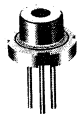
HL7806MG is a 0.78 μm GaAlAs laser diode with double heterojunction structure.

It is suitable as a light source in laser beam printers, laser levelers and various other types of optical equipment.

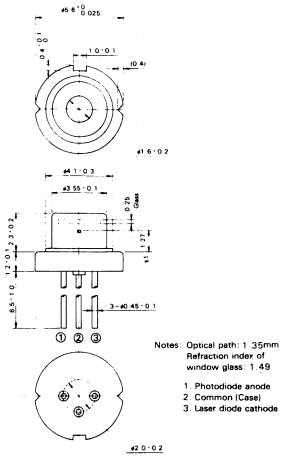
Hermetic sealing of the package achieves high reliability. The package capacity is five times as small as G-type's.

Features

- Visible light output: λ_p = 775–795 nm
- Built-in photodiode for monitoring laser output
- Low astigmatism: As = 2 μm typ.
- Small beam ellipticity:
  $\theta_{//}$ = 14 deg., $\theta_{\perp}$ = 27 deg. typ.
- Single longitudinal mode

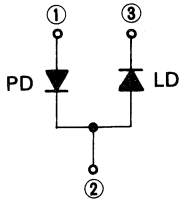


Package Dimensions



MG-type (Unit: mm)

Internal Circuit



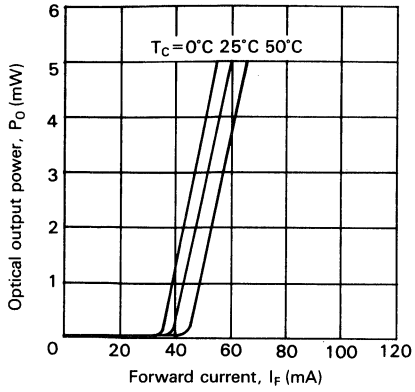
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +60	°C
Storage temperature	T_{stg}	−40 to +85	°C

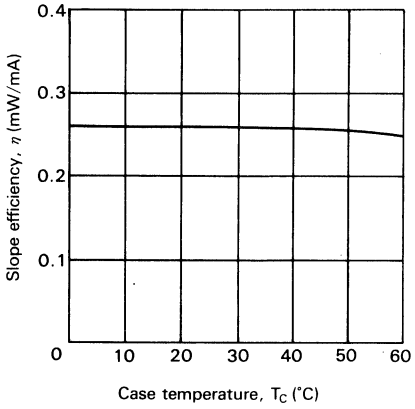
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		40	70	mA	
Optical output power	P_O	5			mW	Kink free
Slope efficiency	η	0.15	0.25		mW/mA	$\frac{3(mW)}{I(4\ mW) - I(1\ mW)}$
Lasing wavelength	λ_p	775	785	795	nm	P_O = 5 mW
Beam divergence parallel to the junction	$\theta_{//}$	8	14	20	deg.	P_O = 5 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$	20	27	45	deg.	P_O = 5 mW
Monitor current	I_S	0.2	0.5	0.8	mA	$V_{R(PD)}$ = 5 V, P_O = 5±0.05 mW

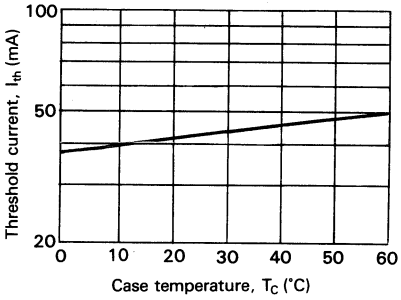
Optical Output Power vs. Forward Current



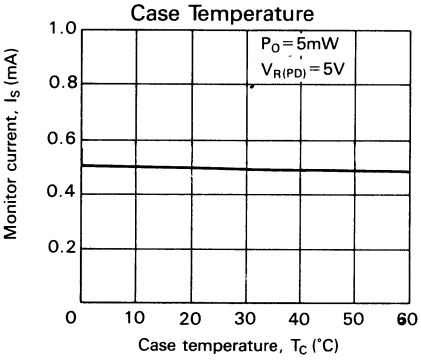
Temperature Dependence of Slope Efficiency



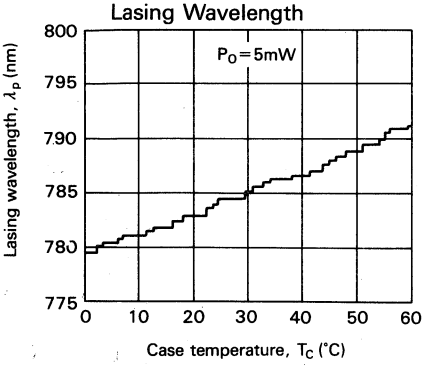
Threshold Current vs. Case Temperature



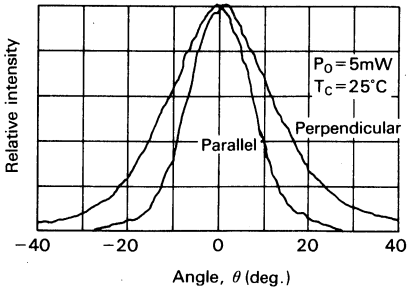
Monitor Current vs. Case Temperature



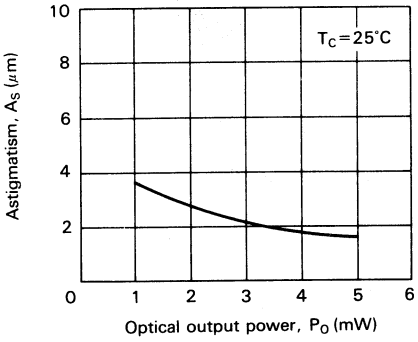
Temperature Dependence of Lasing Wavelength



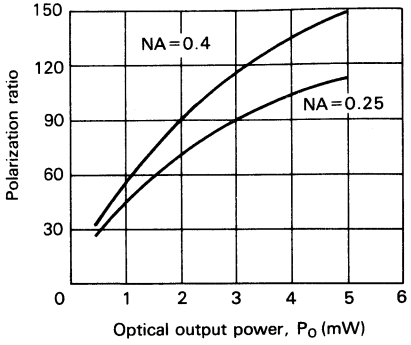
Far Field Pattern



Optical Output Power Dependence of Astigmatism



Optical Output Power Dependence of Polarization Ratio



HL7831G

GaAlAs LD

Description

HL7831G is a 0.78 μm GaAlAs laser diode with double heterojunction structure.

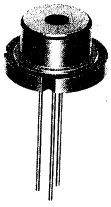
It is suitable as a light source in compact disc and optical video disc players and various other types of optical equipment.

MOCVD technology is employed to precisely analyze and optimize device conditions in order to realize a low noise level.

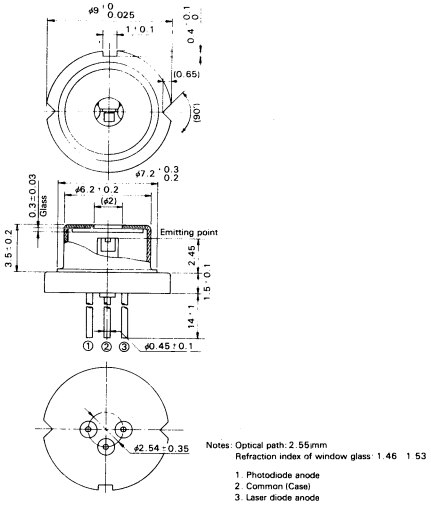
Hermetic sealing of the package achieves high reliability.

Features

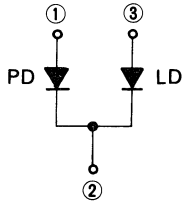
- Visible light output: λ_p = 770–795 nm
- Built-in photodiode for monitoring laser output
- Multiple longitudinal mode
- Low noise: S/N = 60 dB min.



Package Dimensions



Internal Circuit



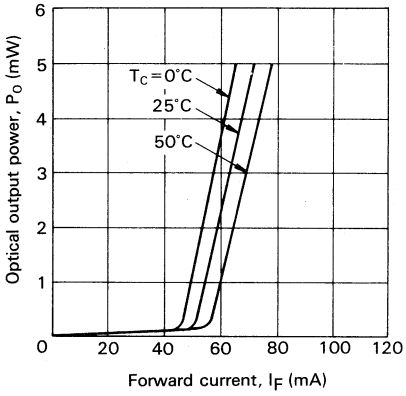
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +60	°C
Storage temperature	T_{stg}	−40 to +85	°C

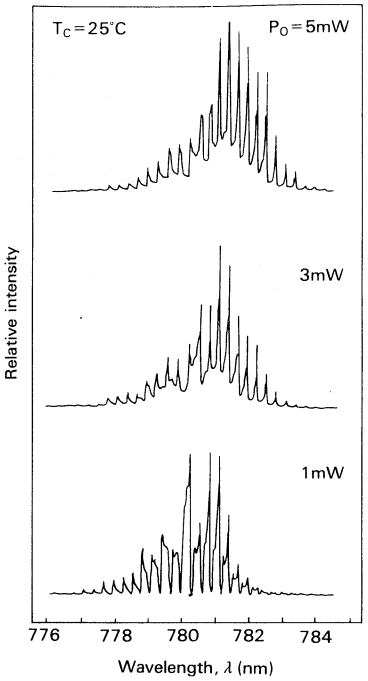
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		50	80	mA	
Optical output power	P_O	5			mW	Kink free
Slope efficiency	η	0.1	0.25	0.6	mW/mA	$\frac{3(mW)}{I\ (4\ mW) - I\ (1\ mW)}$
Lasing wavelength	λ_p	770	785	795	nm	P_O = 3 mW
Beam divergence parallel to the junction	$\theta_{//}$	9	13	16	deg.	P_O = 3 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$	20	35	48	deg.	P_O = 3 mW
Monitor current	I_S	0.3	1.0	1.6	mA	$V_{R(PD)}$ = 5 V, P_O = 3±0.03 mW
Noise	S/N	60			dB	P_O = 3 mW, f = 750 kHz, Δf = 30 kHz

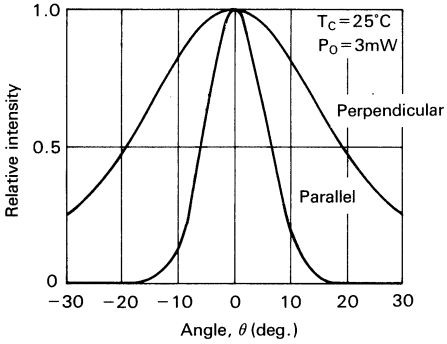
Optical Output Power vs. Forward Current



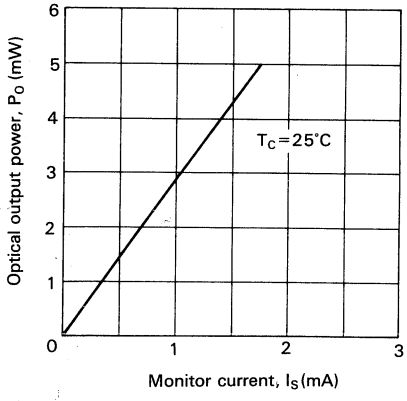
Lasing Spectrum



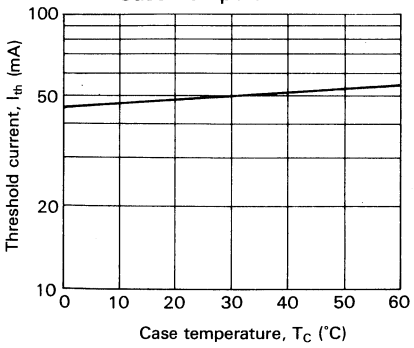
Far Field Pattern



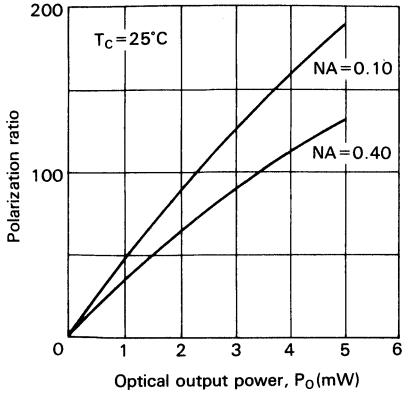
Optical Output Power vs. Monitor Current



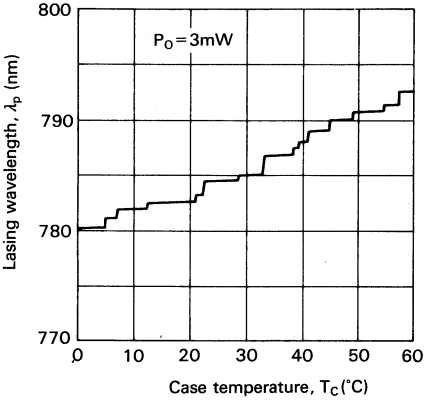
Threshold Current vs. Case Temperature



Optical Output Power Dependence of Polarization Ratio



Temperature Dependence of Lasing Wavelength



Description

HL7831HG is a 0.78 μm GaAlAs laser diode with double heterojunction structure.

It is suitable as a light source in compact disc and optical video disc players and various other types of optical equipment.

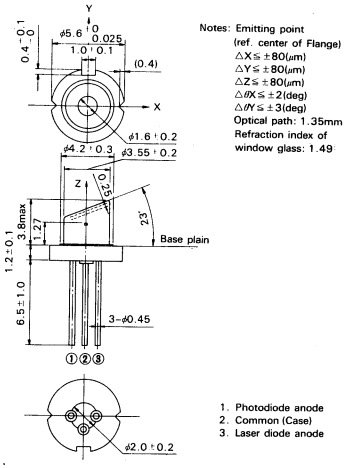
MOCVD technology is employed to precisely analyze and optimize device conditions in order to realize a low noise level.

Hermetic sealing of the package achieves high reliability. The package capacity is five times as small as G-type's. Astigmatism is minimized with a slanted glass window of cap.

Features

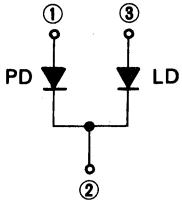
- Visible light output: λ_p = 770–795 nm
- Built-in photodiode for monitoring laser output
- Multiple longitudinal mode
- Low noise: S/N = 60 dB min.
- Low astigmatism: | As | ≦ 10 μm

Package Dimensions



HG-type (Unit: mm)

Internal Circuit



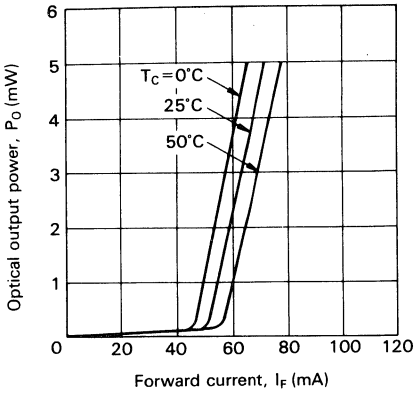
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +60	°C
Storage temperature	T_{stg}	−40 to +85	°C

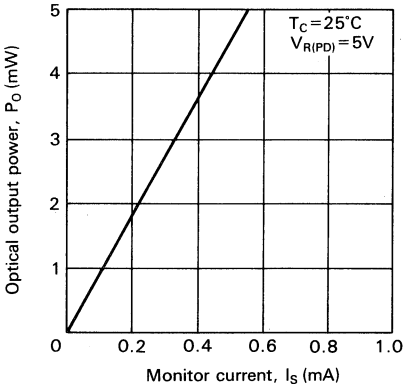
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		50	80	mA	
Optical output power	P_O	5			mW	Kink free
Slope efficiency	η	0.1	0.25	0.6	mW/mA	$\frac{3(\text{mW})}{I\,(4\text{ mW}) - I\,(1\text{ mW})}$
Lasing wavelength	λ_p	770	785	795	nm	P_O = 3 mW
Beam divergence parallel to the junction	$\theta_{//}$	9	11	16	deg.	P_O = 3 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$	20	35	48	deg.	P_O = 3 mW
Monitor current	I_S	0.15		0.6	mA	$V_{R(PD)}$ = 5 V, P_O = 5±0.05 mW
Noise	S/N	60			dB	P_O = 3 mW, f = 750 kHz, Δf = 30 kHz

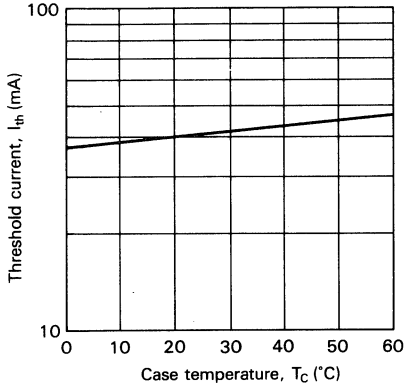
Optical Output Power vs. Forward Current



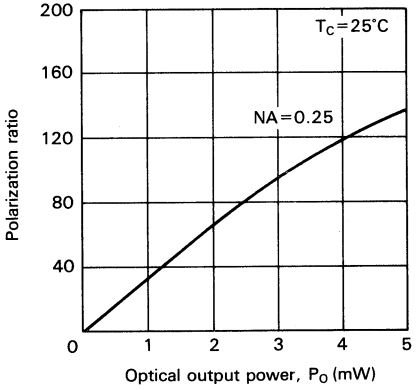
Optical Output Power vs. Monitor Current



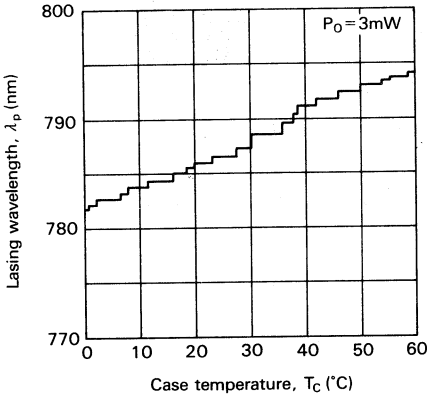
Threshold Current vs. Case Temperature



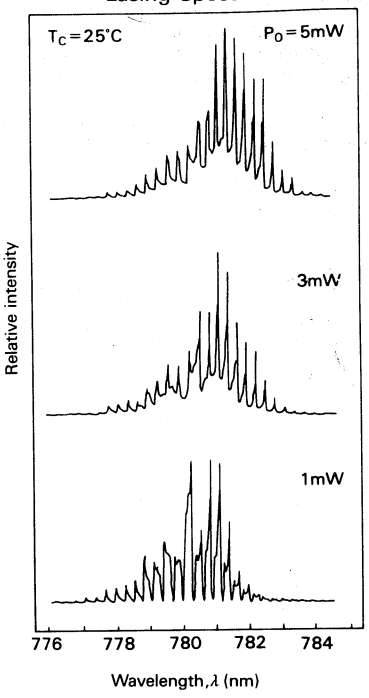
Optical Output Power Dependence of Polarization Ratio



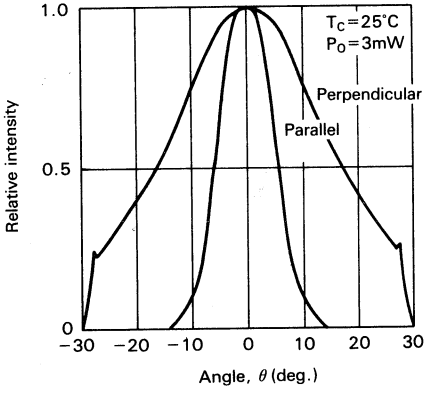
Temperature Dependence of Lasing Wavelength



Lasing Spectrum



Far Field Pattern



HL7832G

GaAlAs LD

Description

HL7832G is a 0.78 μm GaAlAs laser diode with double heterojunction structure.

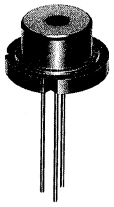
It is suitable as a light source in optical video disc players and various other types of optical equipment.

MOCVD technology is employed to precisely analyze and optimize device conditions in order to realize a low noise level.

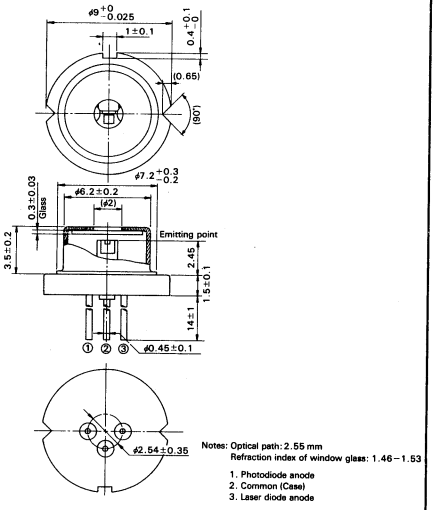
Hermetic sealing of the package achieves high reliability.

Features

- Visible light output: λ_p = 770–795 nm
- Built-in photodiode for monitoring laser output
- Multiple longitudinal mode
- Low noise: S/N = 80 dB min.

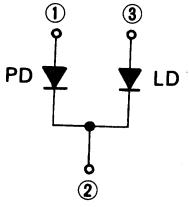


Package Dimensions



Internal Circuit

G-type



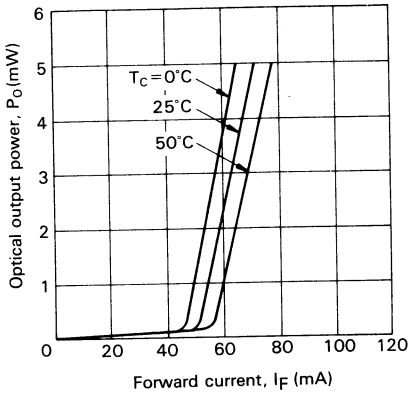
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +60	°C
Storage temperature	T_{stg}	−40 to +85	°C

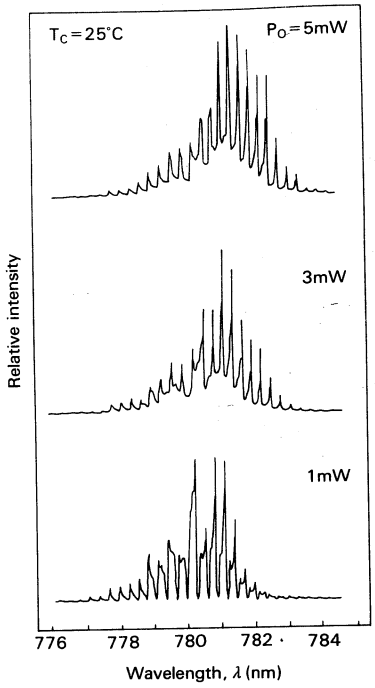
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		50	80	mA	
Optical output power	P_O	5			mW	Kink free
Slope efficiency	η	0.1	0.25	0.6	mW/mA	$\frac{3(\text{mW})}{I\,(4\text{ mW}) - I\,(1\text{ mW})}$
Lasing wavelength	λ_p	770	785	795	nm	P_O = 3 mW
Beam divergence parallel to the junction	$\theta_{//}$	8	13	14	deg.	P_O = 3 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$	25	35	48	deg.	P_O = 3 mW
Monitor current	I_S	0.3	1.0	1.6	mA	$V_{R(PD)}$ = 5 V, P_O = 3±0.03 mW
Noise	S/N	80			dB	P_O = 3 mW, f = 8 MHz, Δf = 100 kHz

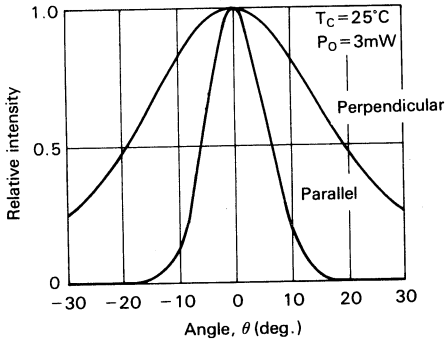
Optical Output Power vs. Forward Current



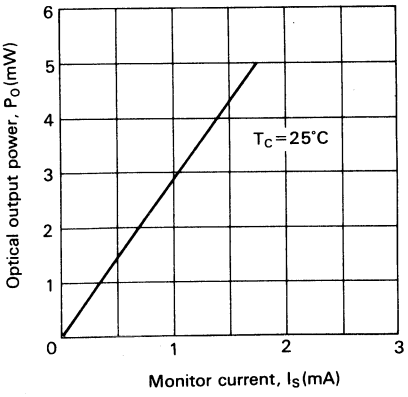
Lasing Spectrum



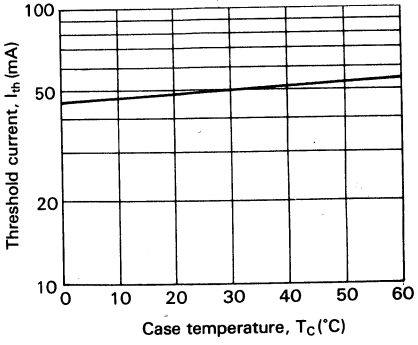
Far Field Pattern



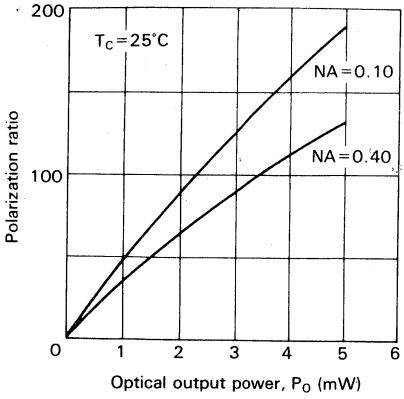
Optical Output Power vs. Monitor Current



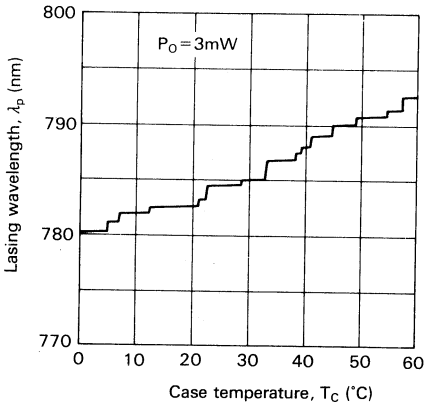
Threshold Current vs. Case Temperature



Optical Output Power Dependence of Polarization Ratio



Temperature Dependence of Lasing Wavelength



HL7832HG

GaAlAs LD

Description

HL7832HG is a 0.78 μm GaAlAs laser diode with double heterojunction structure.

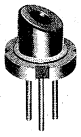
It is suitable as a light source in optical video disc players and various other types of optical equipment.

MOCVD technology is employed to precisely analyze and optimize device conditions in order to realize a low noise level.

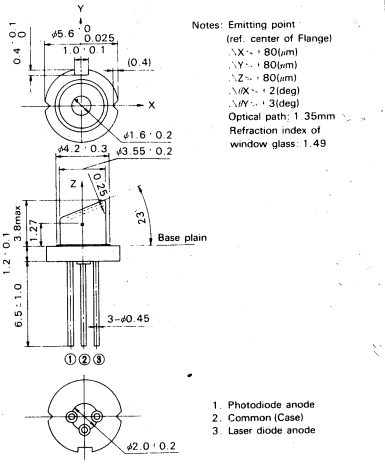
Hermetic sealing of the package achieves high reliability. The package capacity is five times as small as G-type's. Astigmatism is minimized with slanted glass window of cap.

Features

- Visible light output: λ_p = 770–795 nm
- Built-in photodiode for monitoring laser output
- Multiple longitudinal mode
- Low noise: S/N = 80 dB min.
- Low astigmatism: | As | ≦ 10 μm

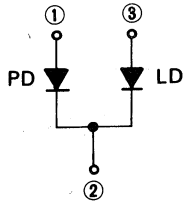


Package Dimensions



HG-type

Internal Circuit



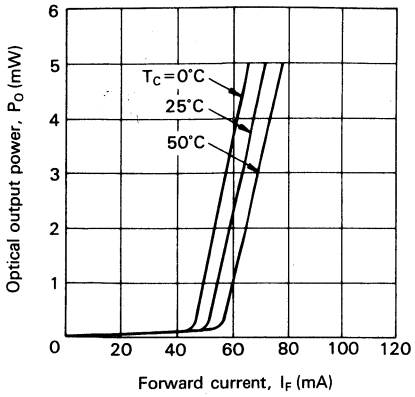
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +60	°C
Storage temperature	T_{stg}	−40 to +85	°C

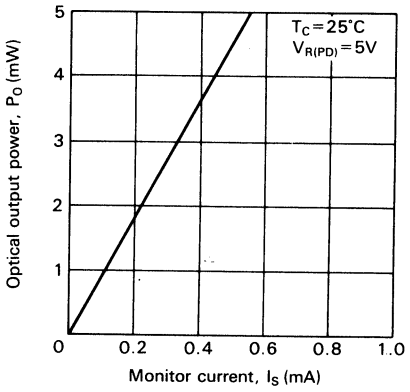
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		50	80	mA	
Optical output power	P_O	5			mW	Kink free
Slope efficiency	η	0.1	0.25	0.6	mW/mA	$\frac{3(mW)}{I(4\ mW) - I(1\ mW)}$
Lasing wavelength	λ_p	770	785	795	nm	P_O = 5 mW
Beam divergence parallel to the junction	$\theta_{//}$	8	11	14	deg.	P_O = 5 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$	25	35	48	deg.	P_O = 5 mW
Monitor current	I_S	0.25		1.0	mA	$V_{R(PD)}$ = 5 V, P_O = 5±0.05 mW
Noise	S/N	80			dB	P_O = 5 mW, f = 8 MHz, Δf = 30 kHz

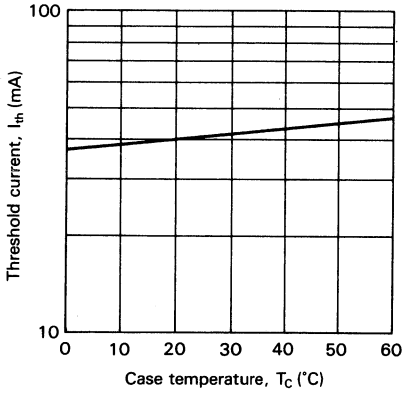
Optical Output Power vs. Forward Current



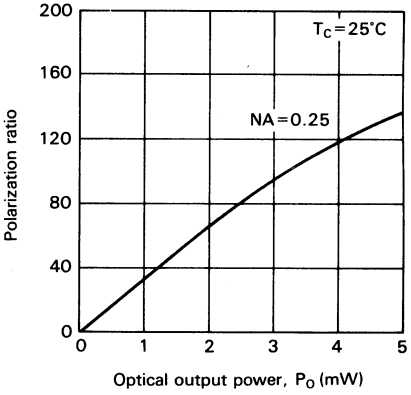
Optical Output Power vs. Monitor Current



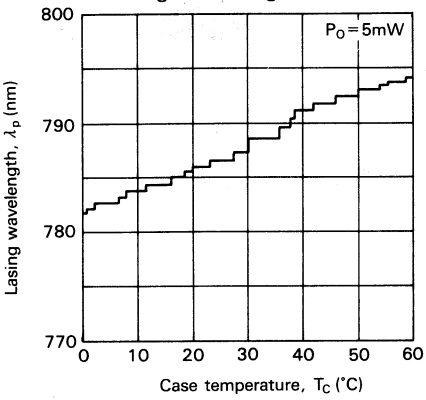
Threshold Current vs. Case Temperature



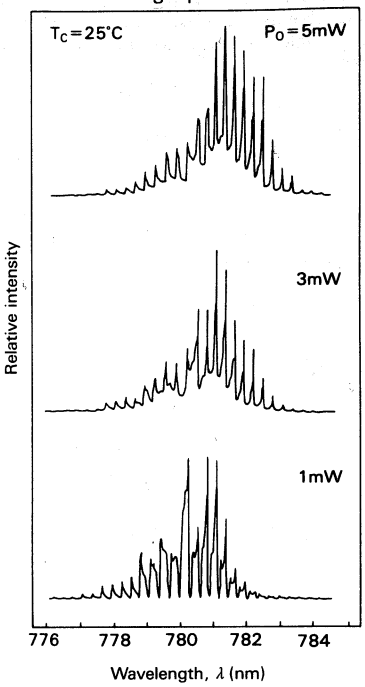
Optical Output Power Dependence of Polarization Ratio



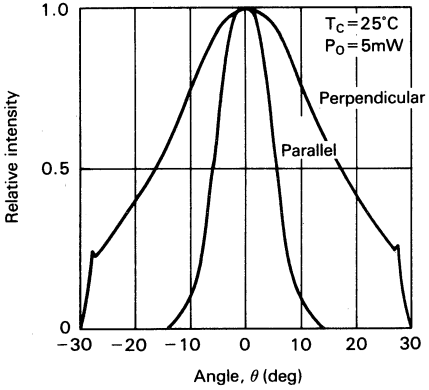
Temperature Dependence of Lasing Wavelength



Lasing Spectrum



Far Field Pattern



HL7836G

GaAlAs LD

Description

HL7836G is a 0.78 μm GaAlAs laser diode with double heterojunction structure.

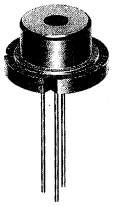
It is suitable as a light source in laser beam printers, laser levelers and various other types of optical equipment.

Single positive power supply is available for LD and PD.

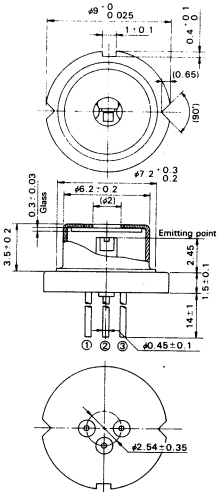
Hermetic sealing of the package achieves high reliability.

Features

- Visible light output: λ_p = 770–795 nm
- Built-in photodiode for monitoring laser output
- Low astigmatism: As = 3 μm typ.
- Single longitudinal mode



Package Dimensions



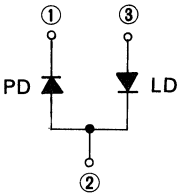
Notes: Optical path: 2.55 mm
Refraction index of window glass: 1.46–1.53

1. Photodiode cathode
2. Common (Case)
3. Laser diode anode

(Unit: mm)

G-type

Internal Circuit



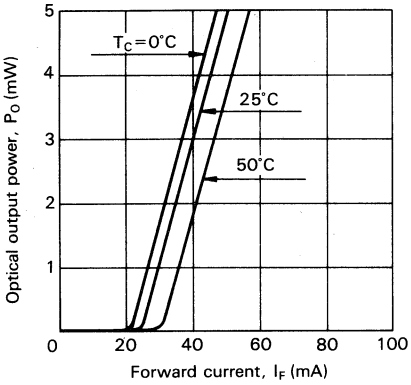
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +60	°C
Storage temperature	T_{stg}	−40 to +85	°C

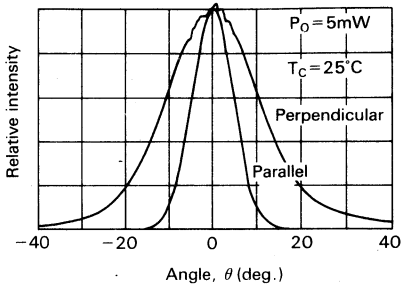
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}	20		60	mA	
Optical output power	P_O	5			mW	Kink free
Slope efficiency	η	0.1	0.25	0.45	mW/mA	$\frac{3(mW)}{I\ (4\ mW) - I\ (1\ mW)}$
Lasing wavelength	λ_p	770	785	795	nm	P_O = 5 mW
Beam divergence parallel to the junction	$\theta_{//}$	8	11	16	deg.	P_O = 5 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$	20	27	35	deg.	P_O = 3 mW
Monitor current	I_S	0.25	1.0	1.65	mA	$V_{R(PD)}$ = 5 V, P_O = 5±0.05 mW

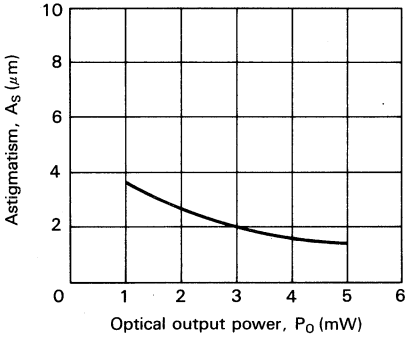
Optical Output Power vs. Forward Current



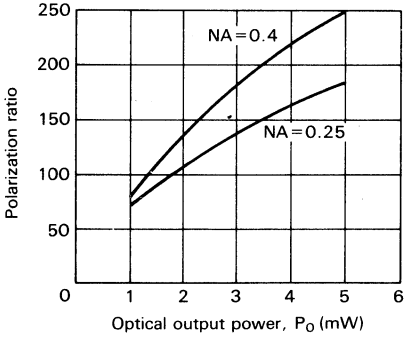
Far Field Pattern



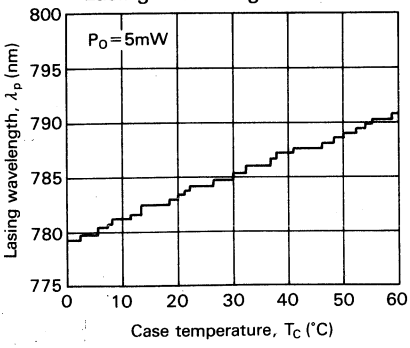
Optical Output Power Dependence of Astigmatism



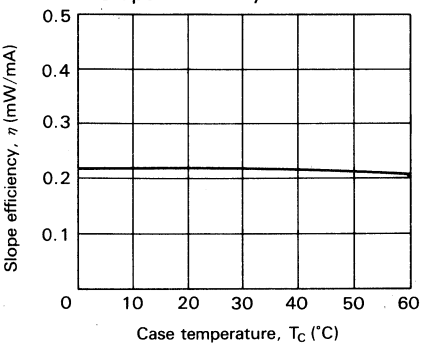
Optical Output Power Dependence of Polarization Ratio



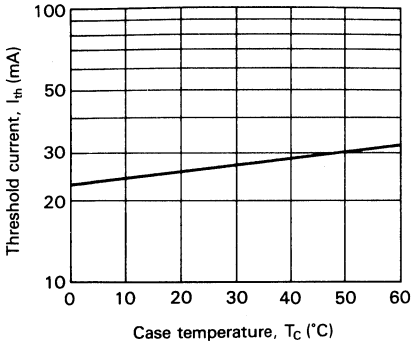
Temperature Dependence of Lasing Wavelength



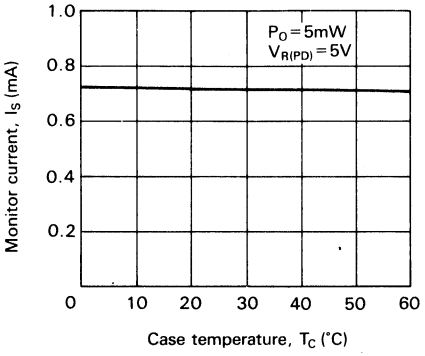
Temperature Dependence of Slope Efficiency



Threshold Current vs.
Case Temperature



Monitor Current vs.
Case Temperature



HL7836MG

GaAlAs LD

Description

HL7836MG is a 0.78 μm GaAlAs laser diode with double heterojunction structure.

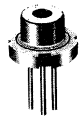
It is suitable as a light source in laser beam printers, laser levelers and various other types of optical equipment.

Single positive power supply is available for LD and PD.

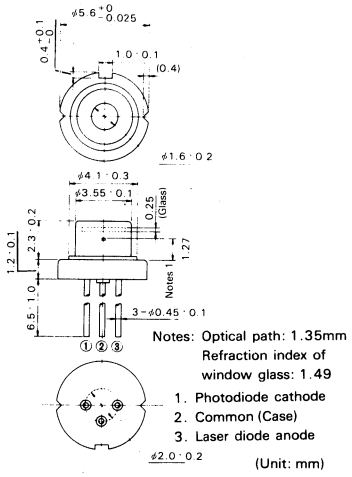
Hermetic sealing of the package achieves high reliability. The package capacity is five times as small as G-type's.

Features

- Visible light output: λ_p = 770–795 nm
- Built-in photodiode for monitoring laser output
- Low astigmatism: As = 3 μm typ.
- Single longitudinal mode

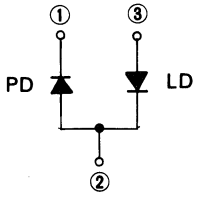


Package Dimensions



MG-type

Internal Circuit



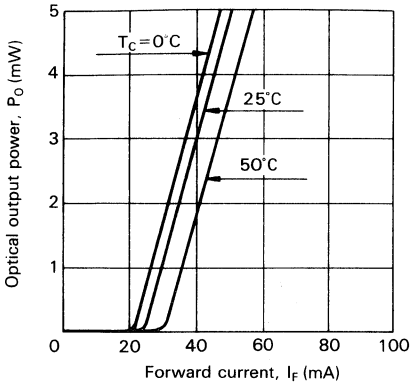
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +60	°C
Storage temperature	T_{stg}	−40 to +85	°C

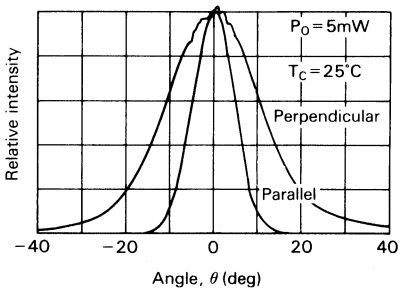
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}	20		60	mA	
Optical output power	P_O	5			mW	Kink free
Slope efficiency	η	0.1	0.25	0.45	mW/mA	$\frac{3(mW)}{I\ (4\ mW) - I\ (1\ mW)}$
Lasing wavelength	λ_p	770	785	795	nm	P_O = 5 mW
Beam divergence parallel to the junction	$\theta_{//}$	8	11	16	deg.	P_O = 5 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$	20	27	35	deg.	P_O = 5 mW
Monitor current	I_S	0.25	0.6	1.0	mA	$V_{R(PD)}$ = 5 V, P_O = 5±0.05 mW

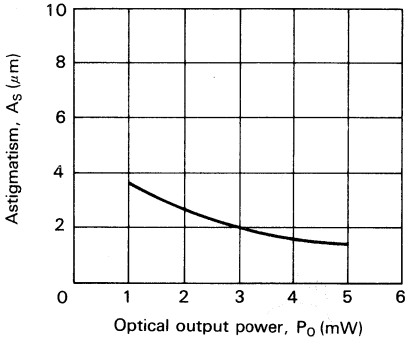
Optical Output Power vs. Forward Current



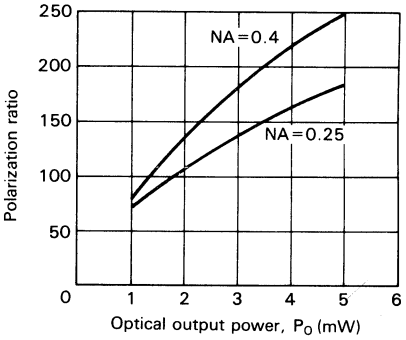
Far Field Pattern



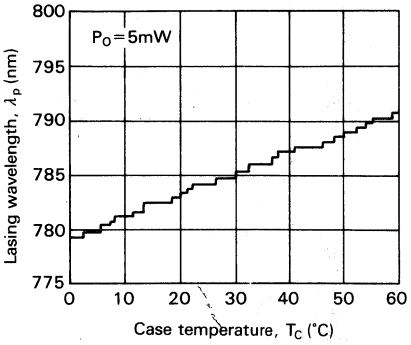
Optical Output Power Dependence of Astigmatism



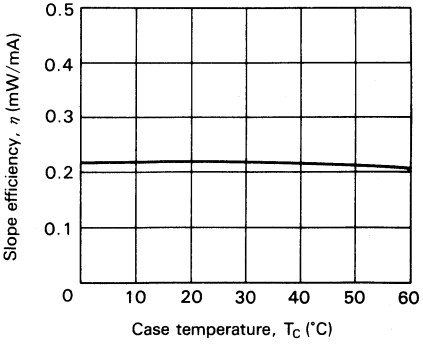
Optical Output Power Dependence of Polarization Ratio



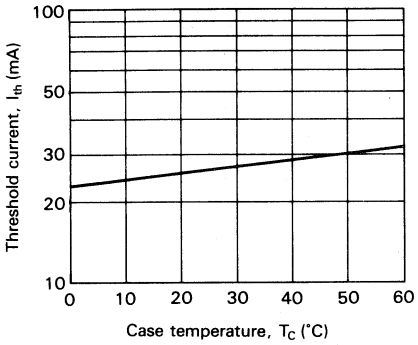
Temperature Dependence of Lasing Wavelength



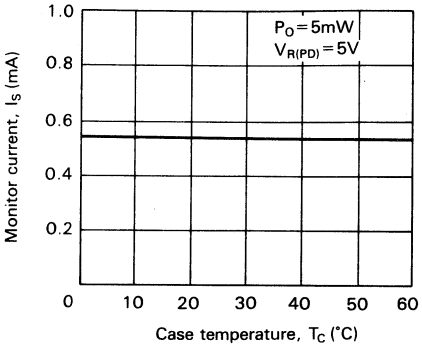
Temperature Dependence of Slope Efficiency



Threshold Current vs.
Case Temperature



Monitor Current vs.
Case Temperature



Description

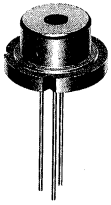
HL7838G is a high-power 0.78 μm GaAlAs laser diode with double heterojunction structure.

It is suitable as a light source in laser beam printers, laser levelers, optical disc memories and various other types of optical equipment.

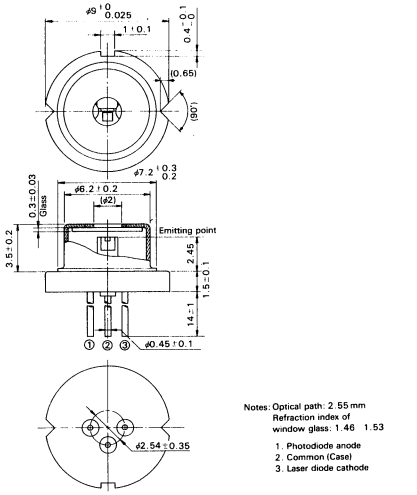
Hermetic sealing of the package achieves high reliability.

Features

- Visible light output: λ_p = 770–795 nm
- 20 mW (CW), 30 mW (pulse) operation at room temperature
- Built-in photodiode for monitoring laser output
- Single longitudinal mode



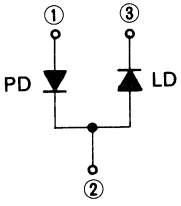
Package Dimensions



G-type

(Unit: mm)

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

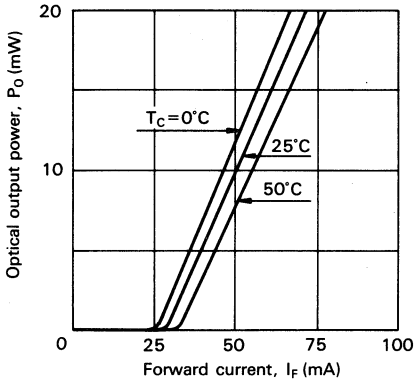
Items	Symbols	Values	Units
Optical output power	P_O	20	mW
Pulse optical output power	$P_{O(pulse)}$	30*	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +60	°C
Storage temperature	T_{stg}	−40 to +80	°C

*PW ≦ 1 μs, duty 50%

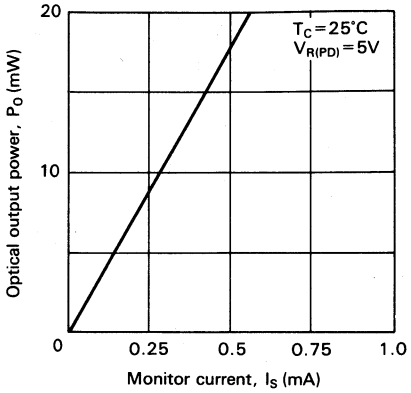
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}	20		70	mA	
Optical output power	P_O	20			mW	Kink free
Slope efficiency	η	0.3	0.45		mW/mA	$\frac{12(mW)}{I(16\ mW) - I(4\ mW)}$
Lasing wavelength	λ_p	770	780	795	nm	P_O = 20 mW
Beam divergence parallel to the junction	$\theta_{//}$	8	10	14	deg.	P_O = 20 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$	20	26	35	deg.	P_O = 20 mW
Monitor current	I_S	30			μA	$V_{R(PD)}$ = 5 V, P_O = 2 mW

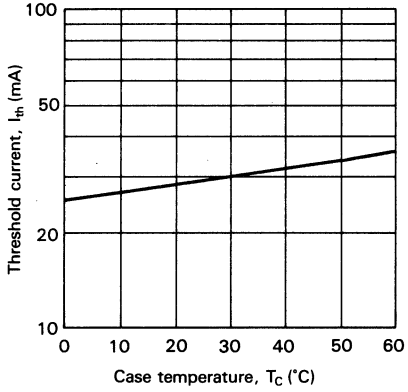
Optical Output Power vs. Forward Current



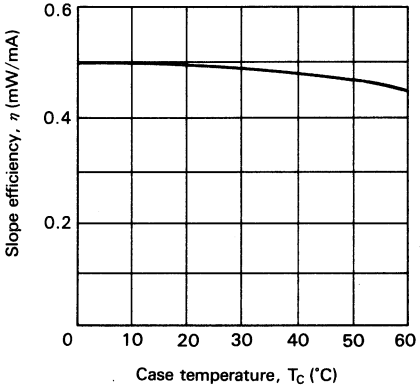
Optical Output Power vs. Monitor Current



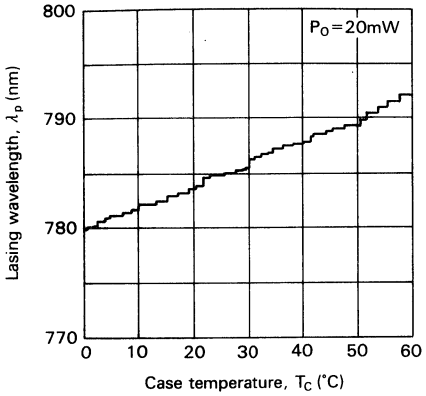
Threshold Current vs. Case Temperature



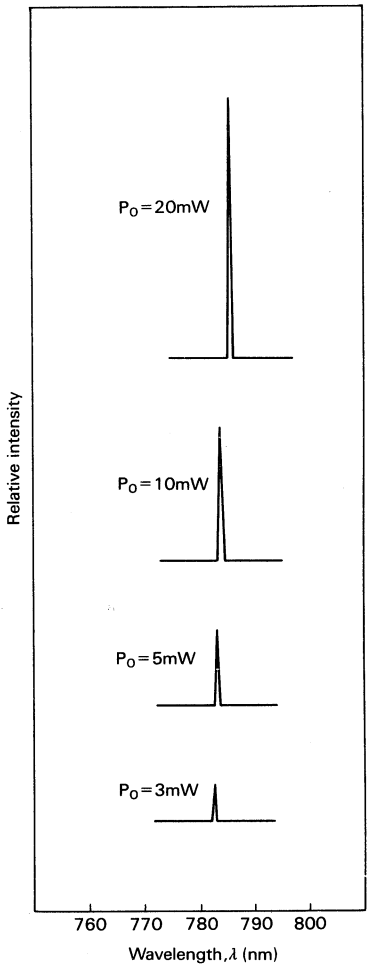
Temperature Dependence of Slope Efficiency



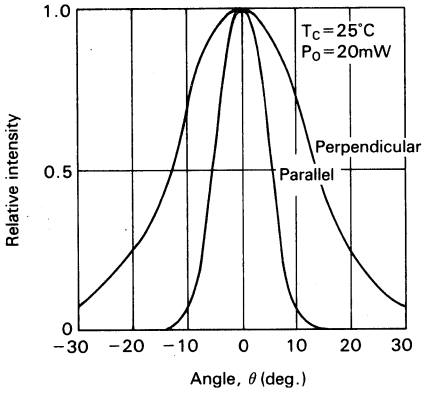
Temperature Dependence of Lasing Wavelength



Lasing Spectrum



Far Field Pattern



HLP1400

GaAlAs LD

Description

HLP1400 is a 0.8 μm GaAlAs laser diode with double heterojunction structure.

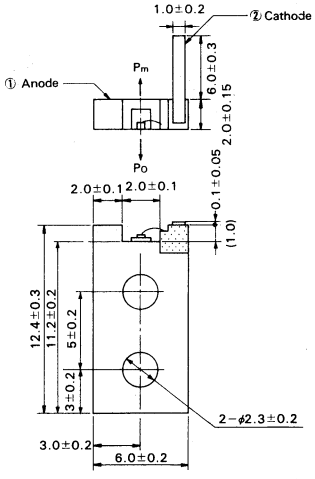
It is suitable as a light source in fiberoptic communications, optical disc memories or various other types of optical equipment.

The package is convenient for system testing because the laser chip is mounted on its stem. This device should be hermetically sealed before mounting on a system.

Features

- Infrared light output: λ_p = 800–850 nm
- 15 mW CW operation at room temperature
- Single longitudinal mode

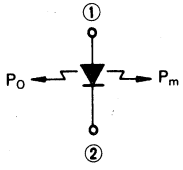
Package Dimensions



(Unit: mm)

A-type

Internal Circuit



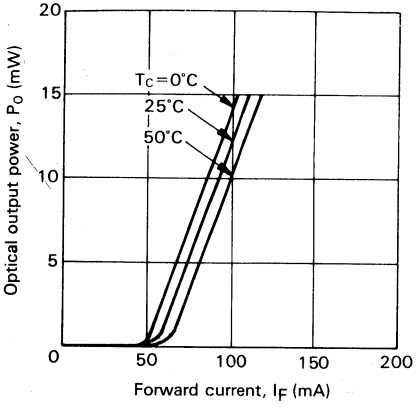
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	15	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	0 to +80	°C

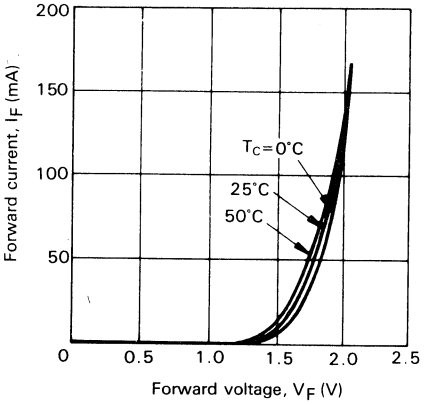
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		60	90	mA	
Optical output power	P_O	15			mW	Kink free
		4	5		mW	$I_F = I_{th}$ + 25 mA
Monitor power	P_m	2			mW	$I_F = I_{th}$ + 25 mA
Lasing wavelength	λ_p	800	830	850	nm	P_O = 10 mW
Beam divergence parallel to the junction	$\theta_{//}$		10		deg.	P_O = 10 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$		25		deg.	P_O = 10 mW

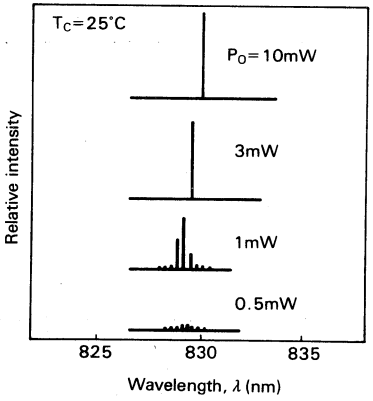
Optical Output Power vs. Forward Current



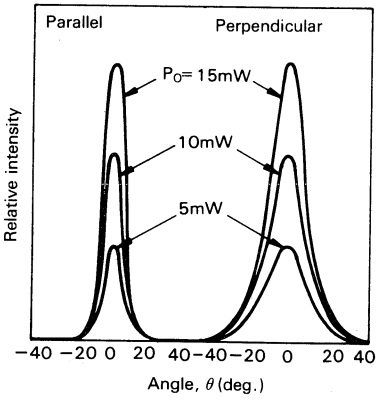
Forward Current vs. Forward Voltage



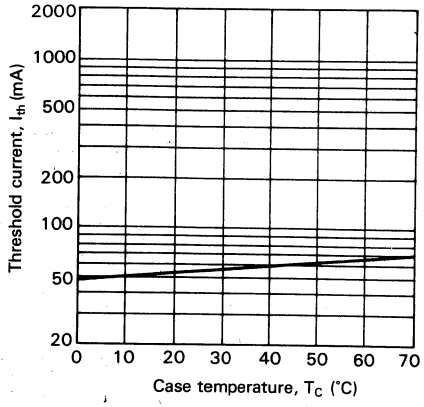
Lasing Spectrum



Far Field Pattern



Threshold Current vs. Case Temperature



HL8311E

GaAlAs LD

Description

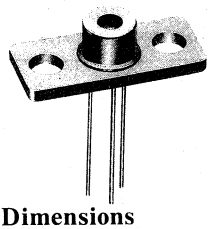
HL8311E is a 0.8 μm GaAlAs laser diode with double heterojunction structure.

It is suitable as a light source in optical disc memories and various other types of optical equipment.

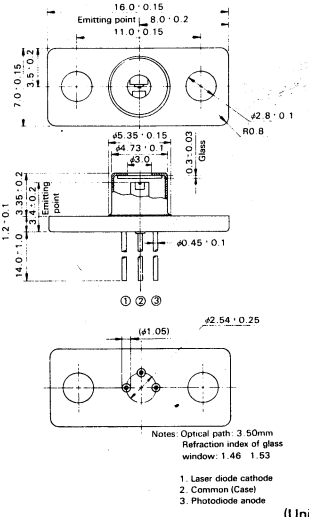
A screw-on type package facilitates the adjustment of optical components. Hermetic sealing of the package achieves high reliability.

Features

- Infrared light output: λ_p = 800–850 nm
- 15 mW CW operation at room temperature
- Built-in photodiode for monitoring laser output
- Single longitudinal mode

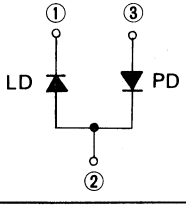


Package Dimensions



E-type

Internal Circuit



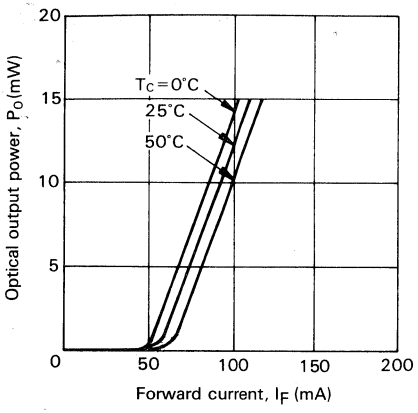
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	15	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +60	°C
Storage temperature	T_{stg}	−40 to +80	°C

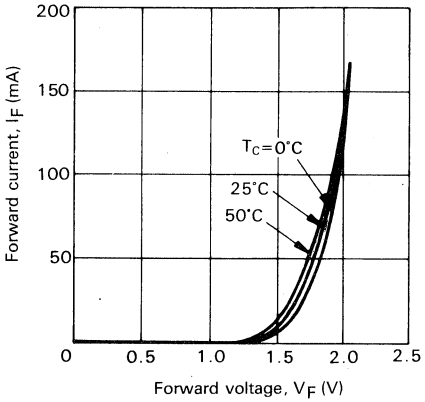
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		60	90	mA	
Optical output power	P_O	15			mW	Kink free
Slope efficiency	η	0.16	0.28		mW/mA	$\frac{8(mW)}{I\ (12\ mW) - I\ (4\ mW)}$
Lasing wavelength	λ_p	800	830	850	nm	P_O = 10 mW
Beam divergence parallel to the junction	$\theta_{//}$	8	11	14	deg.	P_O = 10 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$	18	25	35	deg.	P_O = 10 mW
Monitor current	I_S	0.2		3.0	mA	$V_{R(PD)}$ = 5 V, P_O = 10 mW

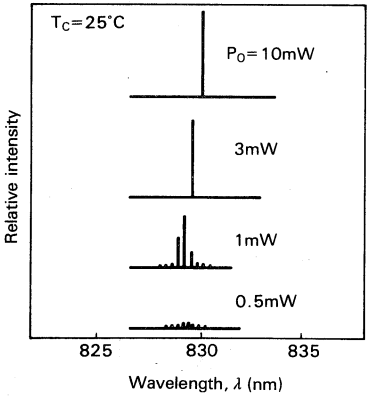
Optical Output Power vs. Forward Current



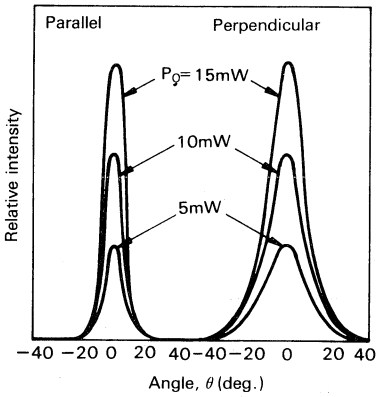
Forward Current vs. Forward Voltage



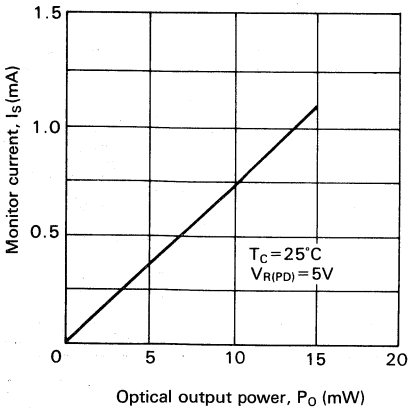
Lasing Spectrum



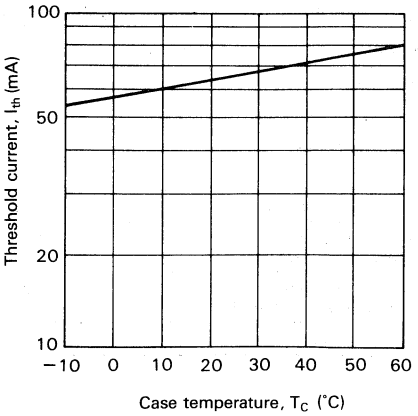
Far Field Pattern



Monitor Current vs. Optical Output Power



Threshold Current vs. Case Temperature



HL8311G

GaAlAs LD

Description

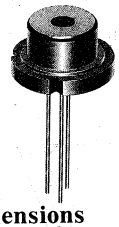
HL8311G is a 0.8 μm GaAlAs laser diode with double heterojunction structure.

It is suitable as a light source in optical disc memories and various other types of optical equipment.

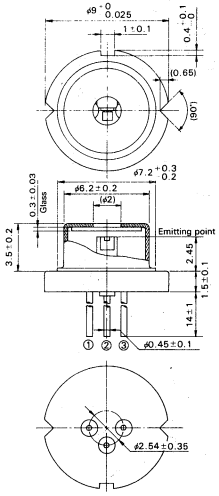
Hermetic sealing of the package achieves high reliability.

Features

- Infrared light output: λ_p = 800 – 850 nm
- 15 mW CW operation at room temperature
- Built-in photodiode for monitoring laser output
- Single longitudinal mode



Package Dimensions



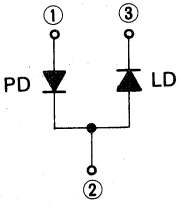
Notes: Optical path: 2.55 mm
Refraction index of window glass: 1.46 – 1.53

1. Photodiode anode
2. Common (Case)
3. Laser diode cathode

(Unit: mm)

G-type

Internal Circuit



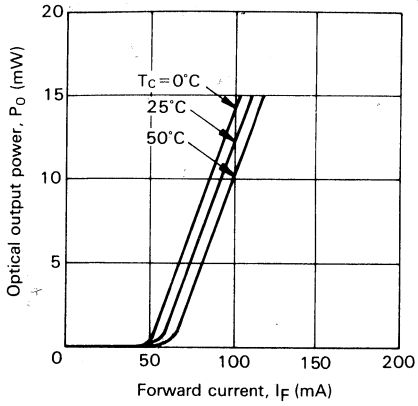
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	15	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +60	°C
Storage temperature	T_{stg}	−40 to +80	°C

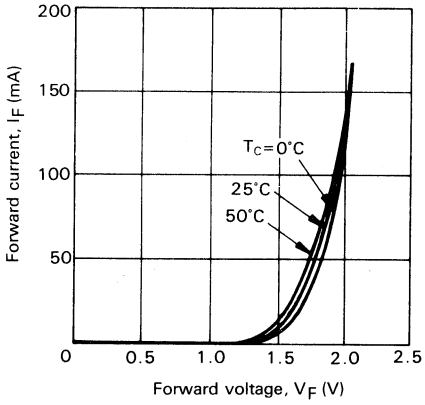
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		60	90	mA	
Optical output power	P_O	15			mW	Kink free
Slope efficiency	η	0.16	0.28		mW/mA	$\frac{8(\text{mW})}{I\ (12\ \text{mW}) - I\ (4\ \text{mW})}$
Lasing wavelength	λ_p	800	830	850	nm	P_O = 10 mW
Beam divergence parallel to the junction	$\theta_{//}$	8	11	14	deg.	P_O = 10 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$	18	25	35	deg.	P_O = 10 mW
Monitor current	I_S	0.2		3.0	mA	$V_{R(PD)}$ = 5 V, P_O = 10 mW

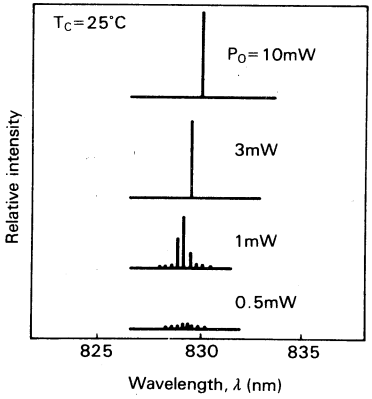
Optical Output Power vs. Forward Current



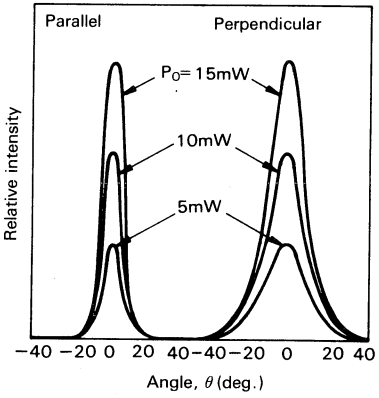
Forward Current vs. Forward Voltage



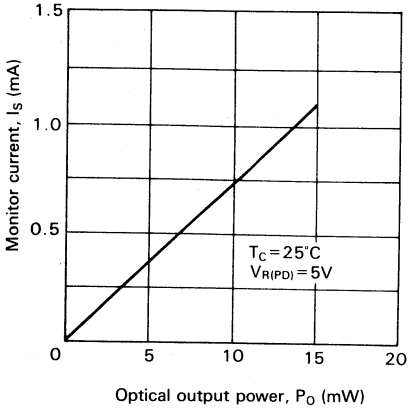
Lasing Spectrum



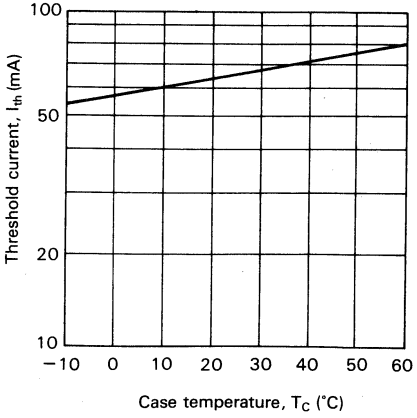
Far Field Pattern



Monitor Current vs. Optical Output Power



Threshold Current vs. Case Temperature



HL8312E

GaAlAs LD

Description

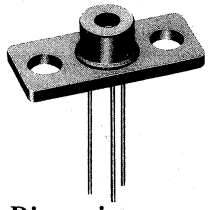
HL8312E is a high-power 0.8 μm GaAlAs laser diode with double heterojunction structure.

It is suitable as a light source in optical disc memories and various other types of optical equipment.

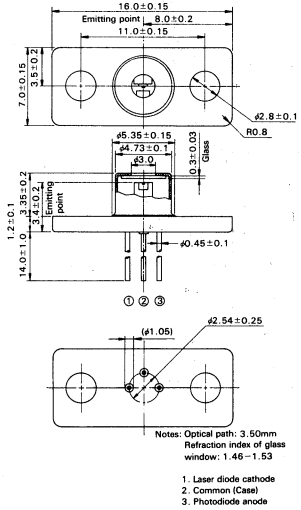
A screw-on type package facilitates the adjustment of optical components. Hermetic sealing of the package achieves high reliability.

Features

- Infrared light output: λ_p = 810−850 nm
- 20 mW CW operation at room temperature
- Built-in photodiode for monitoring laser output
- Single longitudinal mode

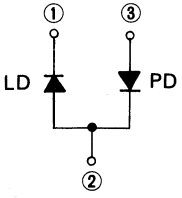


Package Dimensions



E-type (Unit: mm)

Internal Circuit



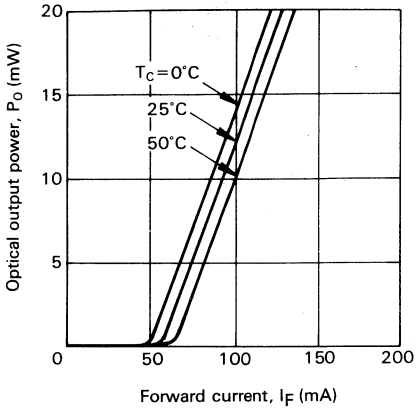
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	20	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +50	°C
Storage temperature	T_{stg}	−40 to +80	°C

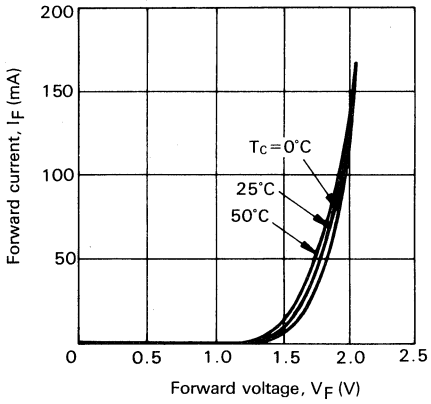
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		60	90	mA	
Optical output power	P_O	20			mW	Kink free
Slope efficiency	η	0.16	0.28		mW/mA	$\frac{12(mW)}{I\ (16\ mW) - I\ (4\ mW)}$
Lasing wavelength	λ_p	810	830	850	nm	P_O = 10 mW
Beam divergence parallel to the junction	$\theta_{//}$	8	11	14	deg.	P_O = 10 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$	18	25	35	deg.	P_O = 10 mW
Monitor current	I_S	0.2		3.0	mA	$V_{R(PD)}$ = 5 V, P_O = 10 mW

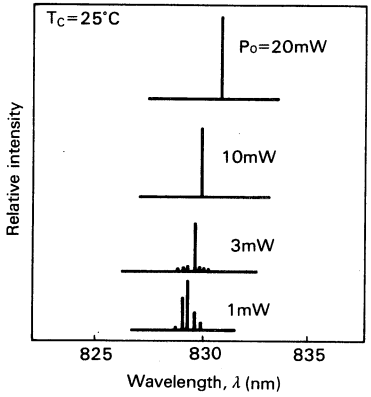
Optical Output Power vs. Forward Current



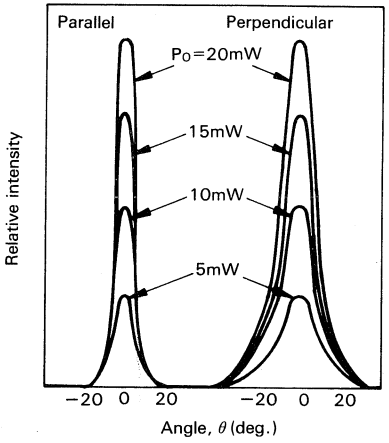
Forward Current vs. Forward Voltage



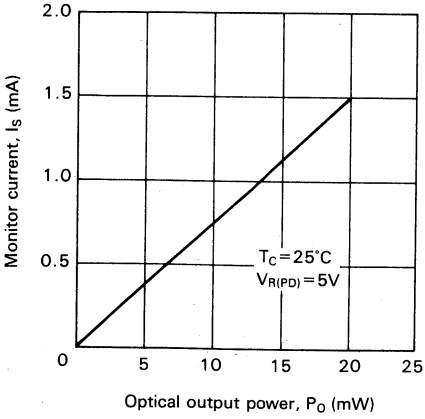
Lasing Spectrum



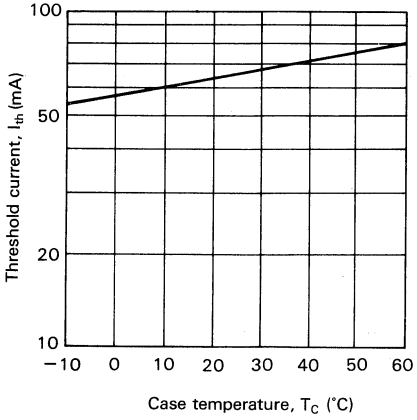
Far Field Pattern



Monitor Current vs. Optical Output Power



Threshold Current vs. Case Temperature



HL8312G

GaAlAs LD

Description

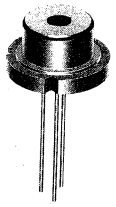
HL8312G is a high-power 0.8 μm GaAlAs laser diode with double heterojunction structure.

It is suitable as a light source in optical disc memories and various other types of optical equipment.

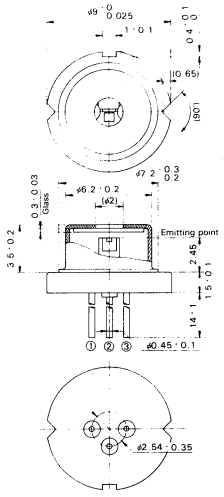
Hermetic sealing of the package achieves high reliability.

Features

- Infrared light output: λ_p = 810–850 nm
- 20 mW CW operation at room temperature
- Built-in photodiode for monitoring laser output
- Single longitudinal mode

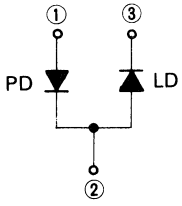


Package Dimensions



G-type

Internal Circuit



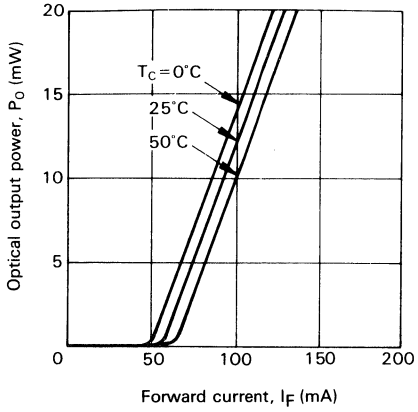
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	20	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +50	°C
Storage temperature	T_{stg}	−40 to +80	°C

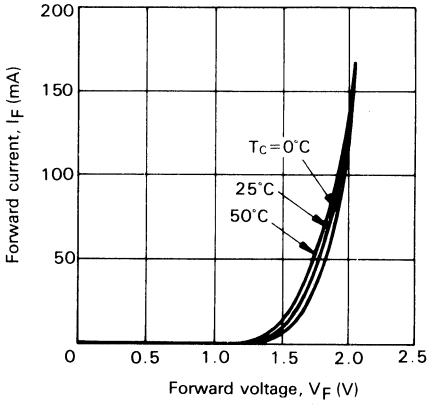
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		60	90	mA	
Optical output power	P_O	20			mW	Kink free
Slope efficiency	η	0.16	0.28		mW/mA	$\frac{12(\text{mW})}{I\,(16\text{ mW}) - I\,(4\text{ mW})}$
Lasing wavelength	λ_p	810	830	850	nm	P_O = 10 mW
Beam divergence parallel to the junction	$\theta_{//}$	8	11	14	deg.	P_O = 10 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$	18	25	35	deg.	P_O = 10 mW
Monitor current	I_S	0.2		3.0	mA	$V_{R(PD)}$ = 5 V, P_O = 10 mW

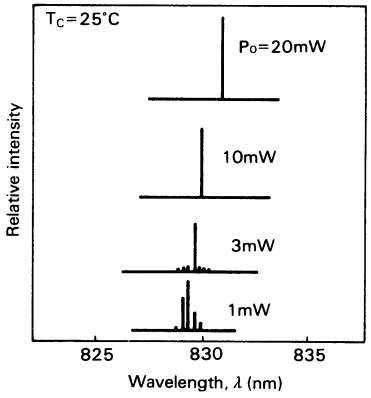
Optical Output Power vs. Forward Current



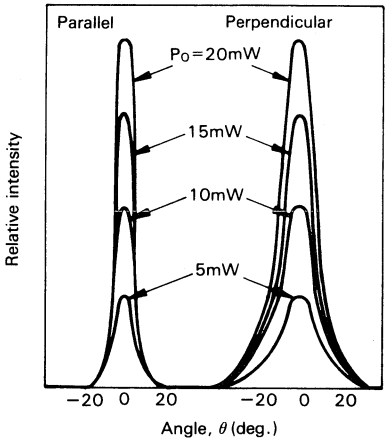
Forward Current vs. Forward Voltage



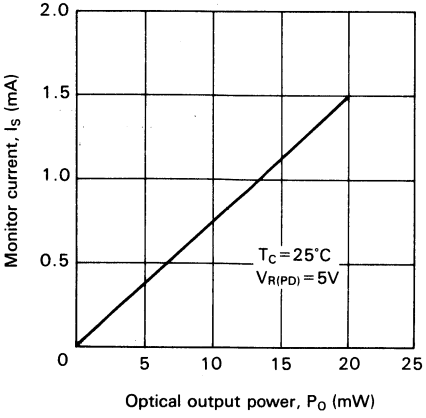
Lasing Spectrum



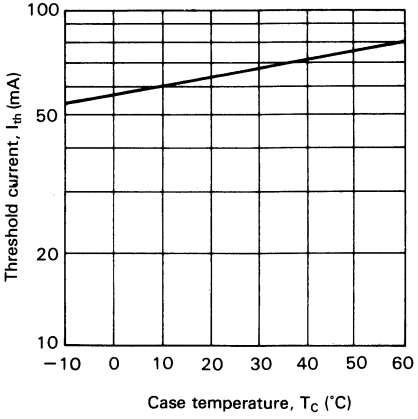
Far Field Pattern



Monitor Current vs. Optical Output Power



Threshold Current vs. Case Temperature



HL8314E

GaAlAs LD

Description

HL8314E is a high-power 0.8 μm GaAlAs laser diode with double heterojunction structure.

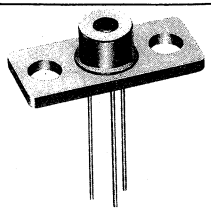
It is suitable as a light source in optical disc memories and various other types of optical equipment.

High power output is obtained through non-symmetrical coating technology for chip mirror facets.

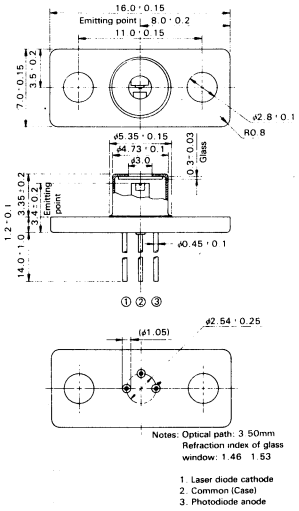
A screw-on type package facilitates the adjustment of optical components. Hermetic sealing of the package achieves high reliability.

Features

- Infrared light output: λ_p = 810–850 nm
- 30 mW CW operation at room temperature
- Built-in photodiode for monitoring laser output
- Single longitudinal mode

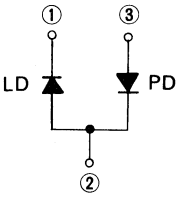


Package Dimensions



E-type (Unit: mm)

Internal Circuit



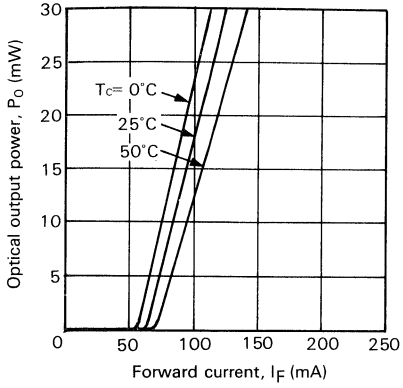
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	30	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +50	°C
Storage temperature	T_{stg}	−40 to +80	°C

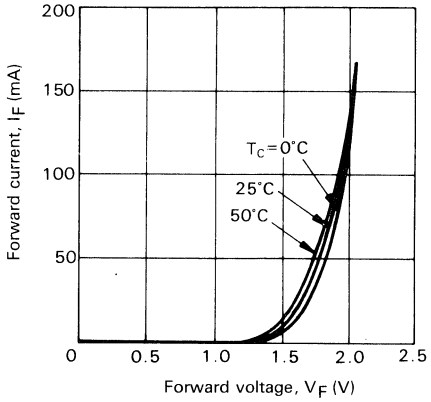
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		60	90	mA	
Optical output power	P_O	30			mW	Kink free
Slope efficiency	η	0.3	0.5		mW/mA	$\frac{18(mW)}{I\ (24\ mW) - I\ (6\ mW)}$
Lasing wavelength	λ_p	810	830	850	nm	P_O = 30 mW
Beam divergence parallel to the junction	$\theta_{//}$	8	11	14	deg.	P_O = 30 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$	18	25	32	deg.	P_O = 30 mW
Monitor current	I_S	20			μA	$V_{R(PD)}$ = 5 V, P_O = 3mW

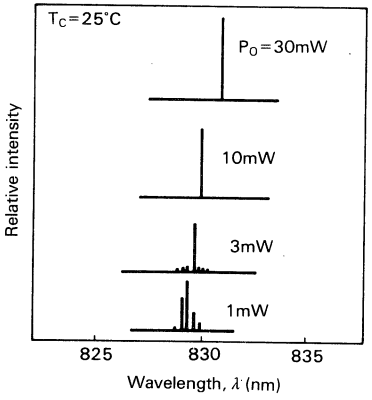
Optical Output Power vs. Forward Current



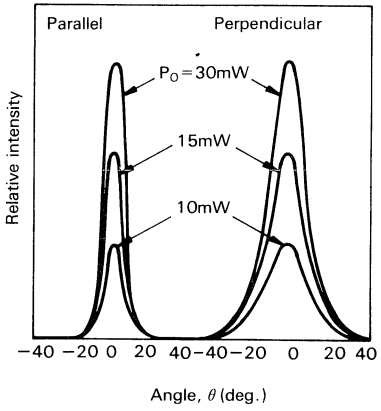
Forward Current vs. Forward Voltage



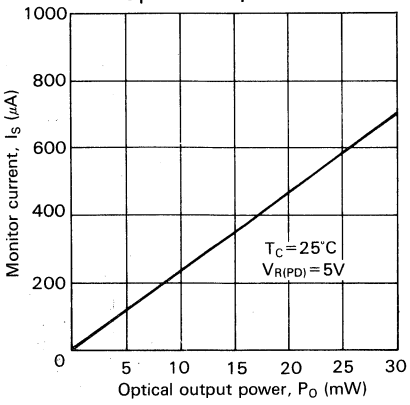
Lasing Spectrum



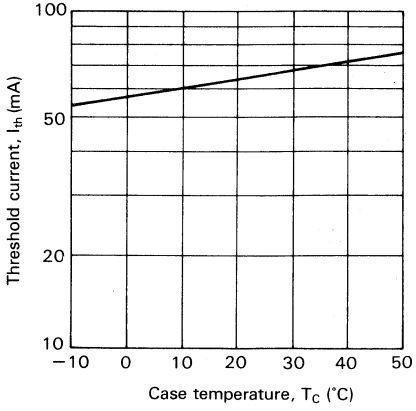
Far Field Pattern



Monitor Current vs. Optical Output Power



Threshold Current vs. Case Temperature



Description

HL8314G is a high-power 0.8 μm GaAlAs laser diode with double heterojunction structure.

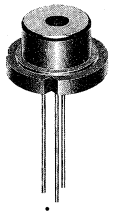
It is suitable as a light source in optical disc memories and various other types of optical equipment.

High power output is obtained through non-symmetrical coating technology for chip mirror facets.

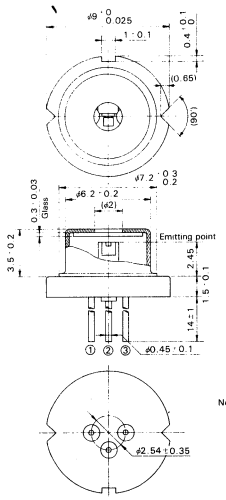
Hermetic sealing of the package achieves high reliability.

Features

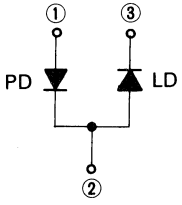
- Infrared light output: λ_p = 810–850 nm
- 30 mW CW operation at room temperature
- Built-in photodiode for monitoring laser output
- Single longitudinal mode



Package Dimensions



Internal Circuit



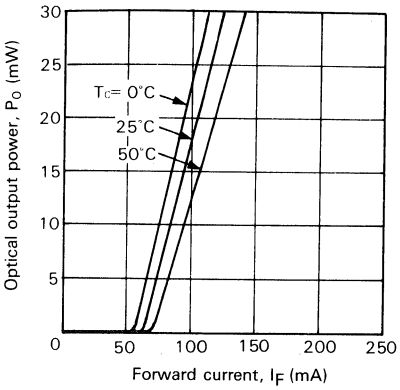
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	30	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +50	°C
Storage temperature	T_{stg}	−40 to +80	°C

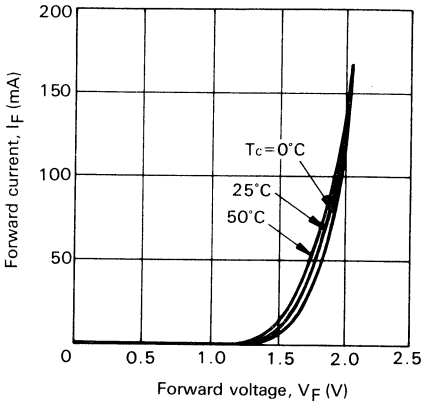
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		60	90	mA	
Optical output power	P_O	30			mW	Kink free
Slope efficiency	η	0.3	0.5		mW/mA	$\frac{18(mW)}{I\ (24\ mW) - I\ (6\ mW)}$
Lasing wavelength	λ_p	810	830	850	nm	P_O = 30 mW
Beam divergence parallel to the junction	$\theta_{//}$	8	11	14	deg.	P_O = 30 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$	18	25	32	deg.	P_O = 30 mW
Monitor current	I_S	20			μA	$V_{R(PD)}$ = 5 V, P_O = 3 mW

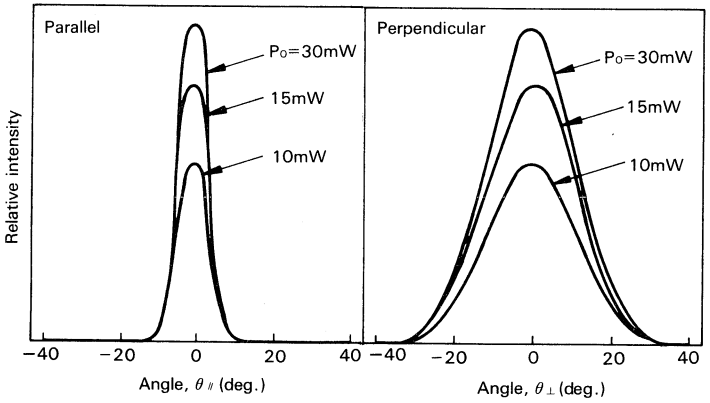
Optical Output Power vs. Forward Current



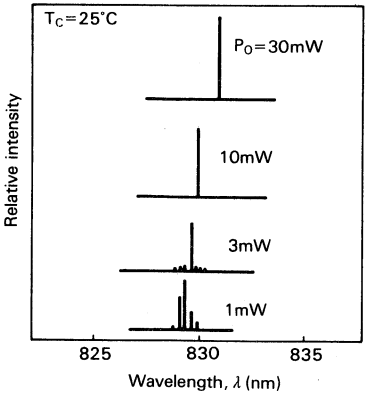
Forward Current vs. Forward Voltage



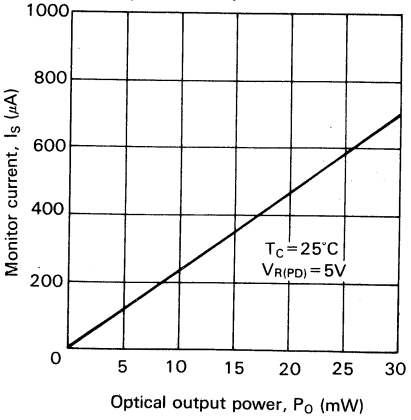
Far Field Pattern



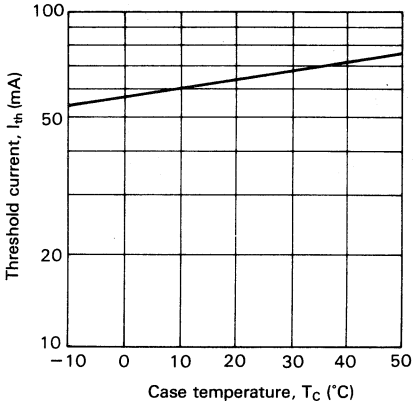
Lasing Spectrum



Monitor Current vs. Optical Output Power



Threshold Current vs.
Case Temperature



HL8315E

GaAlAs LD

Description

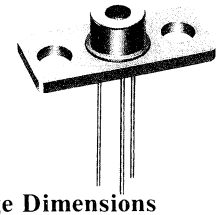
HL8315E is a high-power 0.8 μm GaAlAs laser diode with double heterojunction structure.

It is suitable as a light source in optical disc memories and various other types of optical equipment.

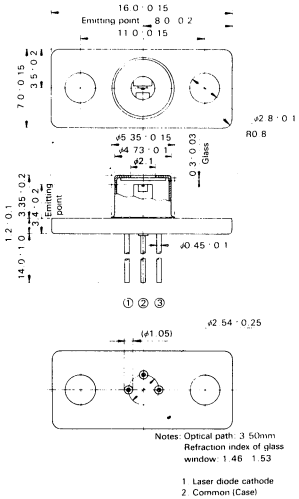
A screw-on type package facilitates the adjustment of optical components. Hermetic sealing of the package achieves high reliability.

Features

- Infrared light output: λ_p = 800–850 nm
- 20 mW CW operation at room temperature
- Built-in photodiode for monitoring laser output
- Fast pulse response of photodiode: t_r, t_f = 50 ns typ.
- Single longitudinal mode



Package Dimensions



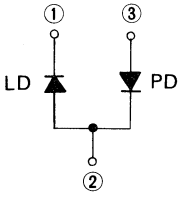
Notes: Optical path: 3.50mm
Refraction index of glass window: 1.46 1.53

1. Laser diode cathode
2. Common (Case)
3. Photodiode anode

(Unit: mm)

E-type

Internal Circuit



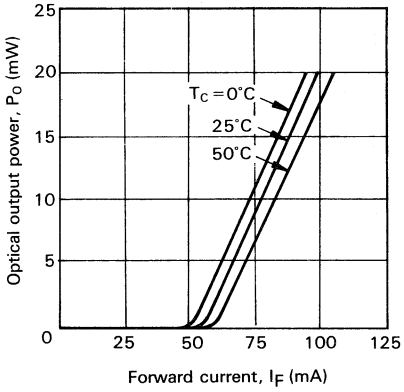
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	20	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +50	°C
Storage temperature	T_{stg}	−40 to +80	°C

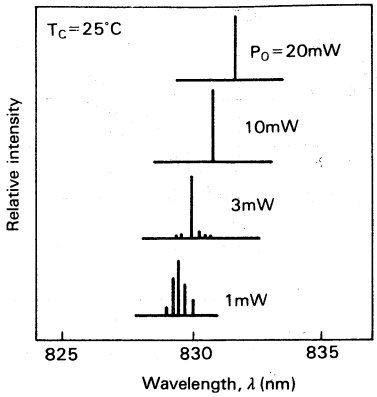
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		60	90	mA	
Optical output power	P_O	20			mW	Kink free
Slope efficiency	η	0.16	0.3		mW/mA	$\frac{12(\text{mW})}{I\ (16\ \text{mW}) - I\ (4\ \text{mW})}$
Lasing wavelength	λ_p	800	830	850	nm	P_O = 10 mW
Beam divergence parallel to the junction	$\theta_{//}$	7	11	15	deg.	P_O = 10 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$	19	25	35	deg.	P_O = 10 mW
Monitor current	I_S	1.0		3.5	mA	$V_{R(PD)}$ = 5 V, P_O = 10 mW

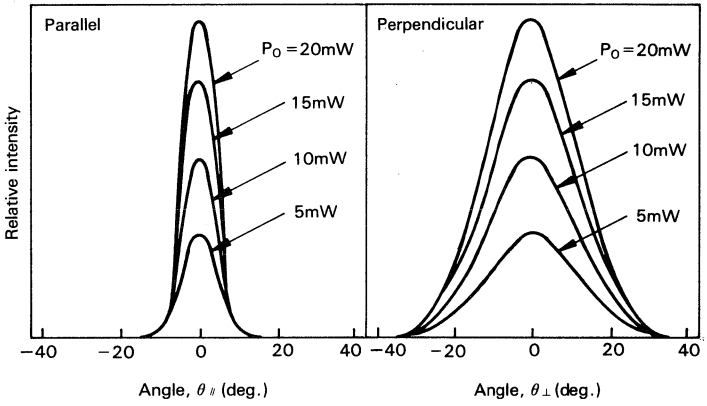
Optical Output Power vs. Forward Current



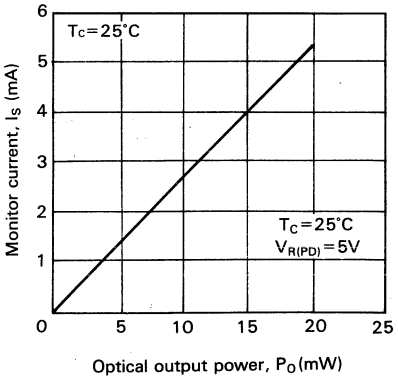
Lasing Spectrum



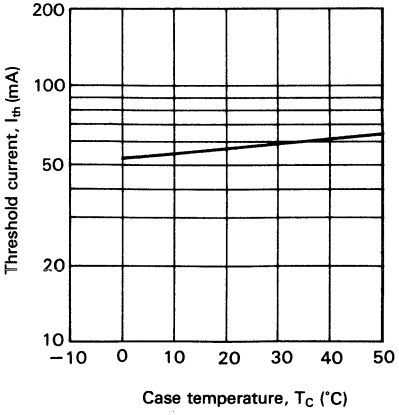
Far Field Pattern



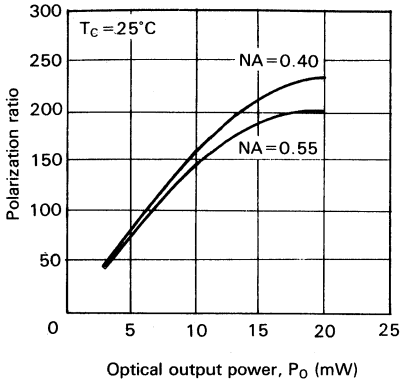
Monitor Current vs. Optical Output Power



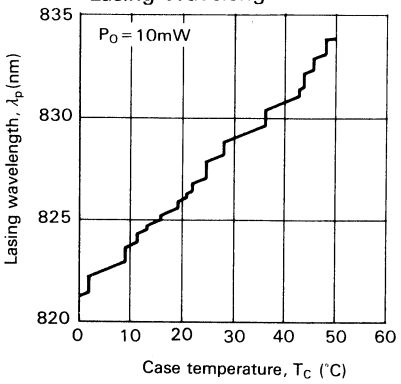
Threshold Current vs. Case Temperature



Optical Output Power Dependence of Polarization Ratio



Temperature Dependence of Lasing Wavelength



HL8318E

GaAlAs LD

Description

HL8318E is a high-power 0.8 μm GaAlAs laser diode with double heterojunction structure.

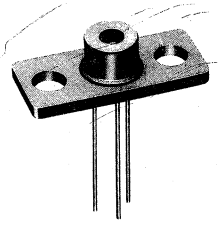
It is suitable as a light source in optical disc memories and various other types of optical equipment.

Single positive power supply is available for LD and PD.

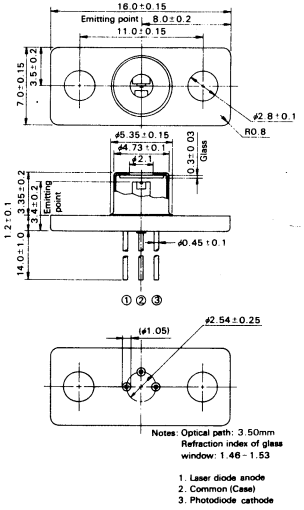
A screw-on type package facilitates the adjustment of optical components. Hermetic sealing of the package achieves high reliability.

Features

- Infrared light output: λ_p = 810–850 nm
- 40 mW (CW), 50 mW (pulse) operation at room temperature
- Built-in photodiode for monitoring laser output
- Single longitudinal mode

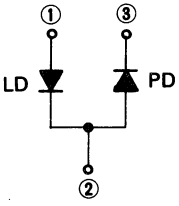


Package Dimensions



E-type (Unit: mm)

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

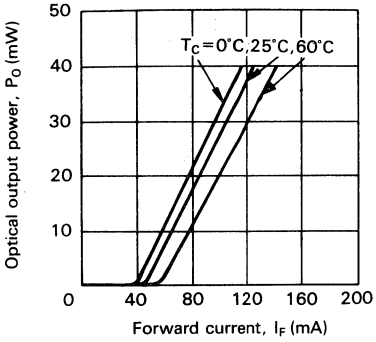
Items	Symbols	Values	Units
Optical output power	P_O	40	mW
Pulse optical output power	$P_{O(pulse)}$	50*	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +60	°C
Storage temperature	T_{stg}	−40 to +85	°C

*PW ≦ 1 μs, duty 50%

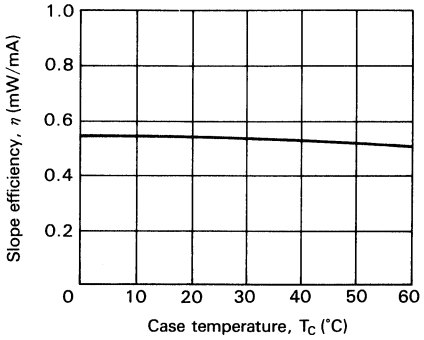
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		40	70	mA	
Optical output power	P_O	40			mW	Kink free
Slope efficiency	η	0.4	0.5	0.9	mW/mA	$\frac{24(mW)}{I\ (32\ mW) - I\ (8\ mW)}$
Lasing wavelength	λ_p	810	830	850	nm	P_O = 40 mW
Beam divergence parallel to the junction	$\theta_{//}$	8	11	14	deg.	P_O = 40 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$	18	25	32	deg.	P_O = 40 mW
Monitor current	I_S	40	100	240	μA	$V_{R(PD)}$ = 5 V, P_O = 4mW

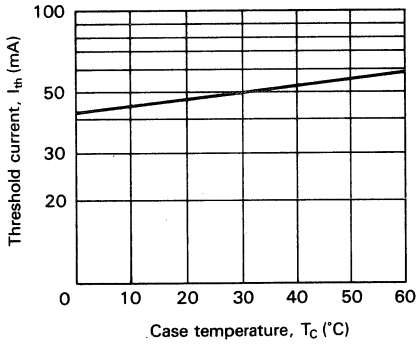
Optical Output Power vs. Forward Current



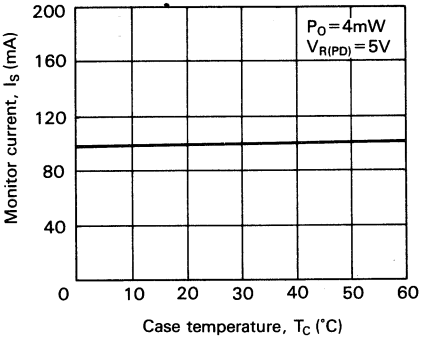
Temperature Dependence of Slope Efficiency



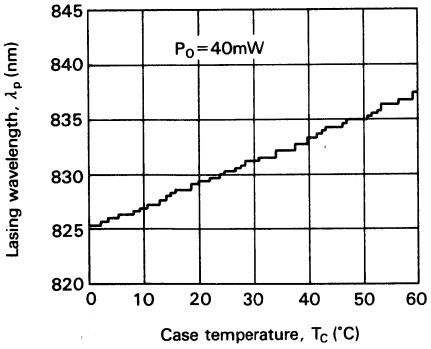
Threshold Current vs. Case Temperature



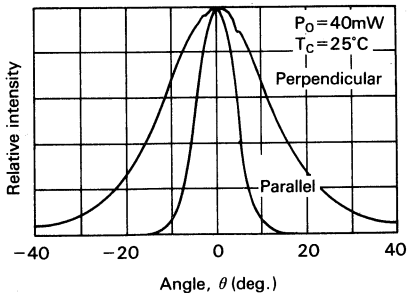
Monitor Current vs. Case Temperature



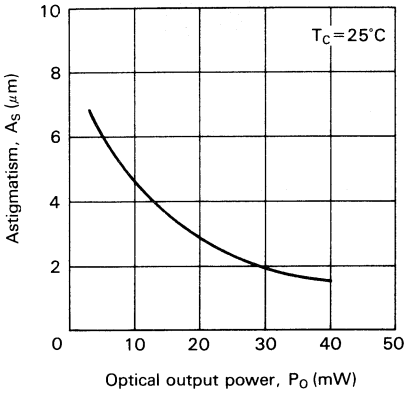
Temperature Dependence of Lasing Wavelength



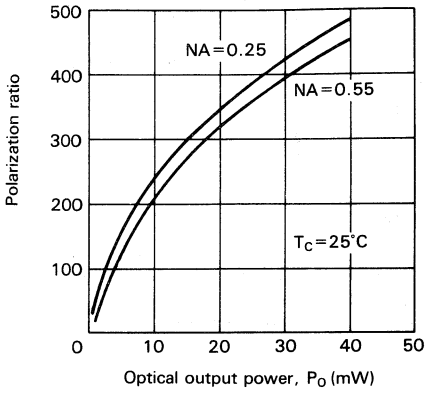
Far Field Pattern



Optical Output Power Dependence of Astigmatism



Optical Output Power Dependence of Polarization Ratio



HL8318G

GaAlAs LD

Description

HL8318G is a high-power 0.8 μm GaAlAs laser diode with double heterojunction structure.

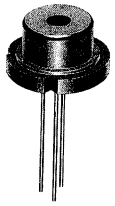
It is suitable as a light source in optical disc memories and various other types of optical equipment.

Single positive power supply is available for LD and PD.

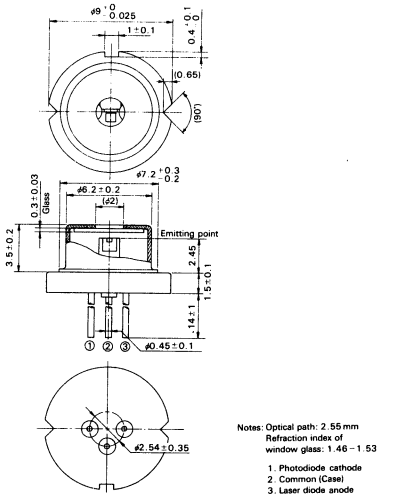
Hermetic sealing of the package achieves high reliability.

Features

- Infrared light output: λ_p = 810–850 nm
- 40 mW (CW), 50 mW (pulse) operation at room temperature
- Built-in photodiode for monitoring laser output
- Single longitudinal mode

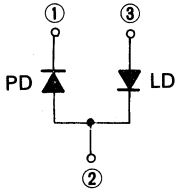


Package Dimensions



G-type

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

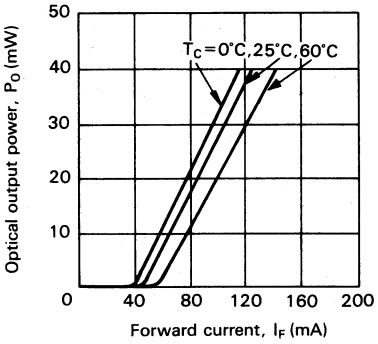
Items	Symbols	Values	Units
Optical output power	P_O	40	mW
Pulse optical output power	$P_{O(pulse)}$	50*	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +60	°C
Storage temperature	T_{stg}	−40 to +85	°C

*PW ≦ 1 μs, duty 50%

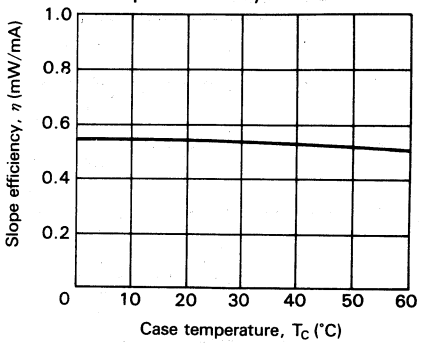
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		40	70	mA	
Optical output power	P_O	40			mW	Kink free
Slope efficiency	η	0.4	0.5	0.9	mW/mA	$\frac{24(mW)}{I\ (32\ mW) - I\ (8\ mW)}$
Lasing wavelength	λ_p	810	830	850	nm	P_O = 40 mW
Beam divergence parallel to the junction	$\theta_{//}$	8	11	14	deg.	P_O = 40 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$	18	25	32	deg.	P_O = 40 mW
Monitor current	I_S	40	100	240	μA	$V_{R(PD)}$ = 5 V, P_O = 4mW

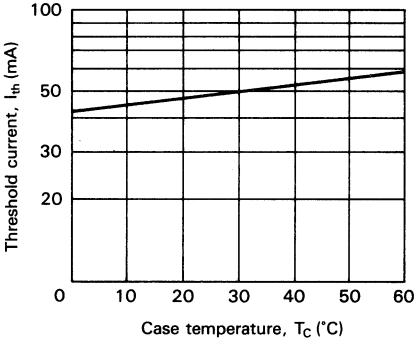
Optical Output Power vs. Forward Current



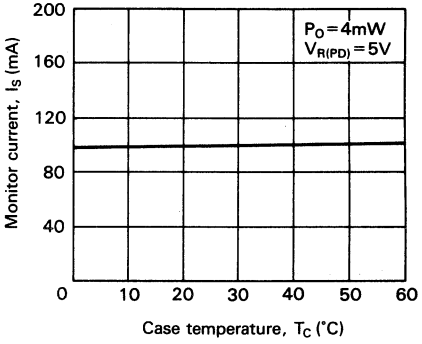
Temperature Dependence of Slope Efficiency



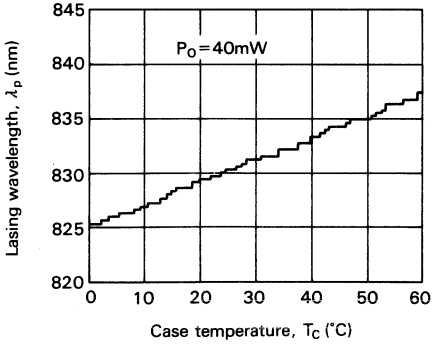
Threshold Current vs. Case Temperature



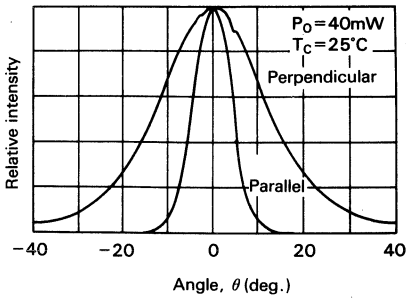
Monitor Current vs. Case Temperature



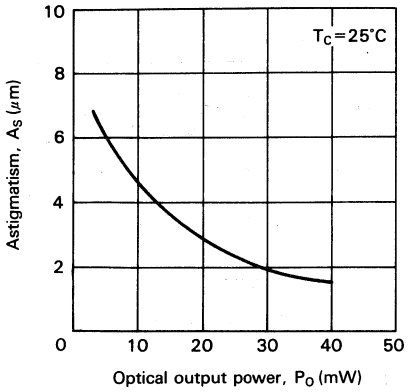
Temperature Dependence of Lasing Wavelength



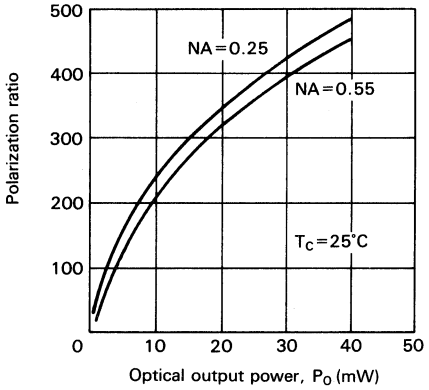
Far Field Pattern



Optical Output Power Dependence of Astigmatism



Optical Output Power Dependence of Polarization Ratio



HL8351E

—Preliminary—
GaAlAs LD

Description

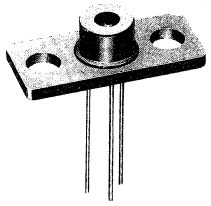
HL8351E is a high-power 0.8 μm GaAlAs laser diode with multi-quantum well (MQW) structure.

It is suitable as a light source in optical disc memories and various other types of optical equipment.

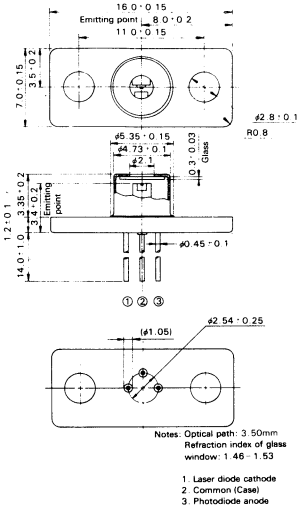
A screw-on type package facilitates the adjustment of optical components. Hermetic sealing of the package achieves high reliability.

Features

- Infrared light output: λ_p = 810–850 nm
- 50 mW CW operation at room temperature
- Built-in photodiode for monitoring laser output
- Single longitudinal mode

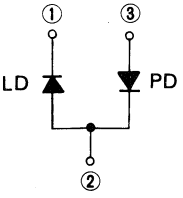


Package Dimensions



E-type (Unit: mm)

Internal Circuit



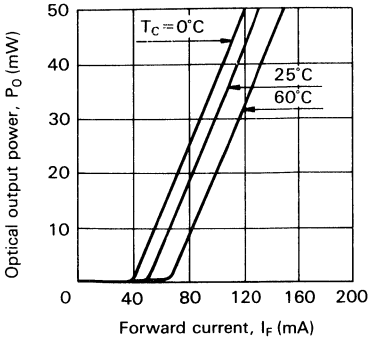
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	50	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +60	°C
Storage temperature	T_{stg}	−40 to +85	°C

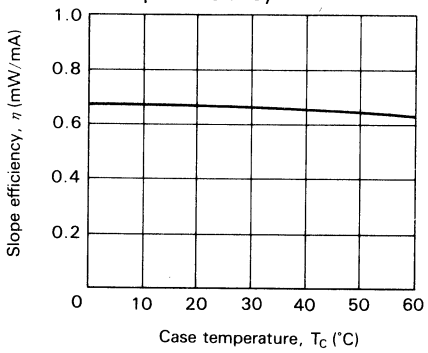
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		40	70	mA	
Optical output power	P_O	50			mW	Kink free
Slope efficiency	η	0.4	0.7	0.9	mW/mA	$\frac{40(mW)}{I\ (45\ mW) - I\ (5\ mW)}$
Lasing wavelength	λ_p	810	830	850	nm	P_O = 50 mW
Beam divergence parallel to the junction	$\theta_{//}$	7	9	13	deg.	P_O = 50 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$	20	27	35	deg.	P_O = 50 mW
Monitor current	I_S	30			μA	$V_{R(PD)}$ = 5 V, P_O = 5mW

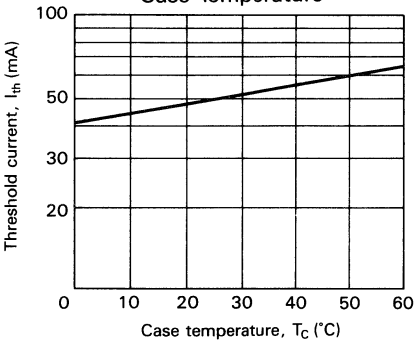
Optical Output Power vs. Forward Current



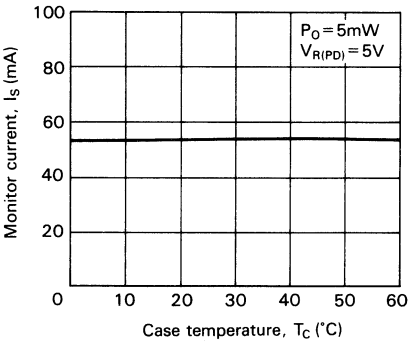
Temperature Dependence of Slope Efficiency



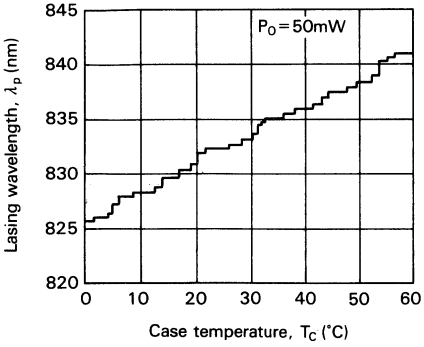
Threshold Current vs. Case Temperature



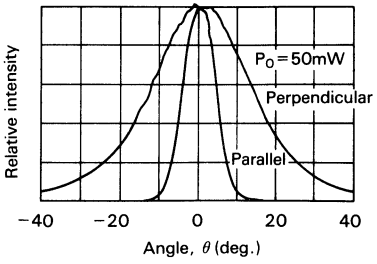
Temperature Dependence of Monitor Current



Temperature Dependence of Lasing Wavelength



Far Field Pattern



HL1221A

InGaAsP LD

Description

HL1221A is a 1.2 μm InGaAsP laser diode with double heterojunction structure.

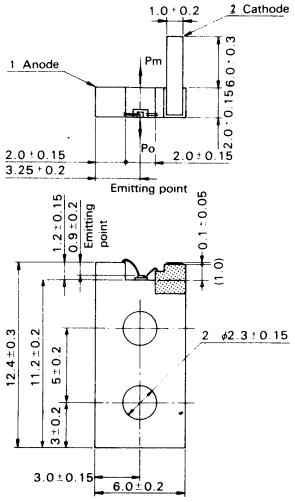
It is suitable as a light source in fiberoptic communications and various other types of optical equipment.

The package is convenient for system testing because the laser chip is mounted on its stem. This device should be hermetically sealed before mounting on a system.

Features

- Long wavelength light output: λ_p = 1170–1230 nm
- 5 mW CW operation at room temperature
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns

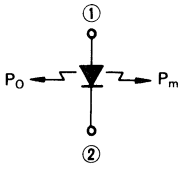
Package Dimensions



A-type

(Unit: mm)

Internal Circuit



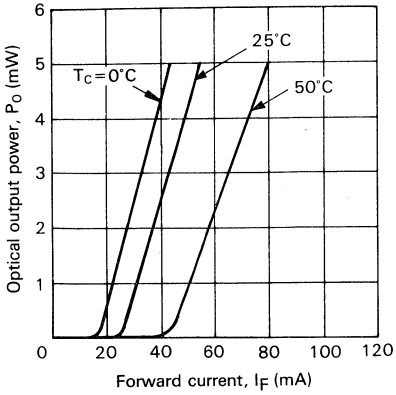
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +50	°C
Storage temperature	T_{stg}	0 to +60	°C

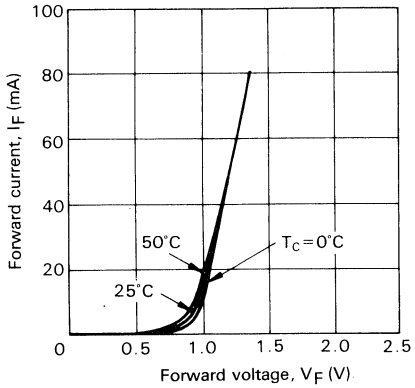
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	80	mA	
Optical output power	P_O	5			mW	Kink free
		1.5	3.0		mW	$I_F = I_{th}$ + 20 mA
Monitor power	P_m	1			mW	$I_F = I_{th}$ + 20 mA
Lasing wavelength	λ_p	1170	1200	1230	nm	P_O = 3 mW
Spectral width	$\Delta\lambda$		2		nm	P_O = 3 mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	P_O = 3 mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	P_O = 3 mW, FWHM
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

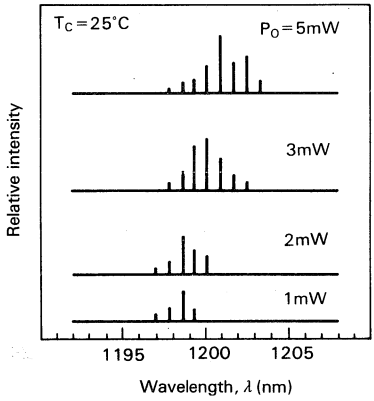
Optical Output Power vs. Forward Current



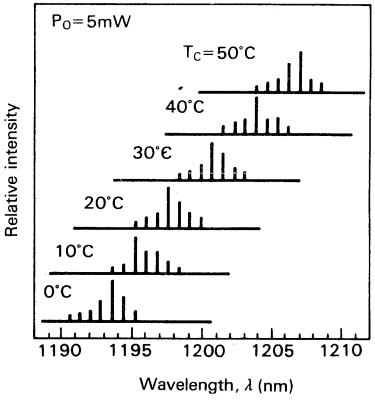
Forward Current vs. Forward Voltage



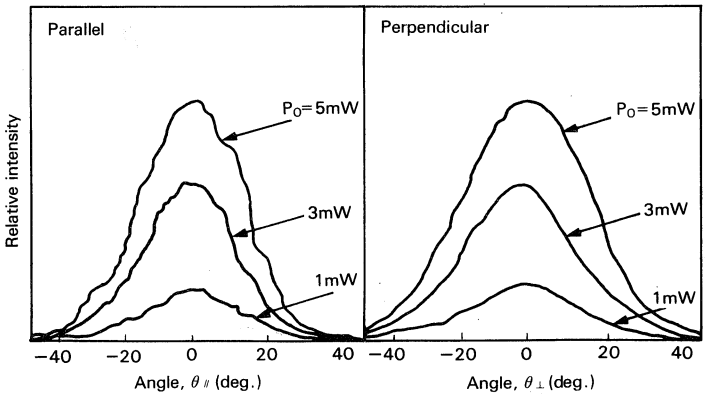
Lasing Spectrum



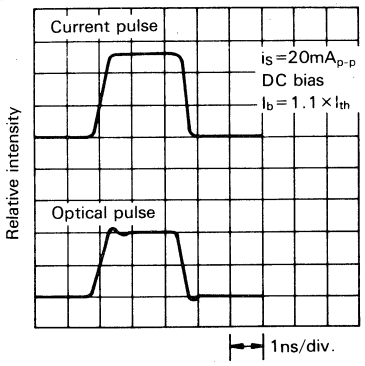
Temperature Dependence of Lasing Spectrum



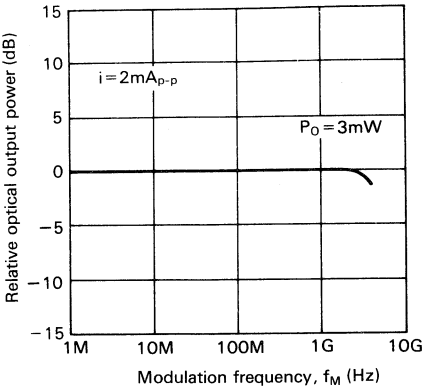
Far Field Pattern



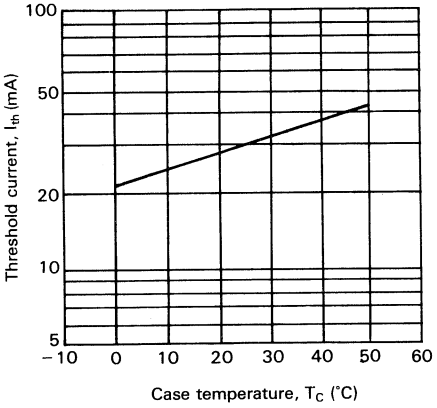
Pulse Response



Frequency Response



Threshold Current vs. Case Temperature



HL1221AC

InGaAsP LD

Description

HL1221AC is a 1.2 μm InGaAsP laser diode with double heterojunction structure.

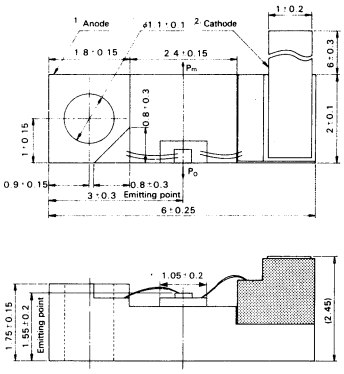
It is suitable as a light source in fiberoptic communications and various other types of optical equipment.

The package is compact to facilitate module assembly.

Features

- Long wavelength light output: $\lambda_p = 1170 - 1230$ nm
- 5 mW CW operation at room temperature
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns

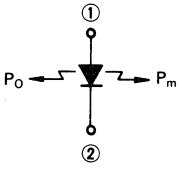
Package Dimensions



(Unit: mm)

AC-type

Internal Circuit



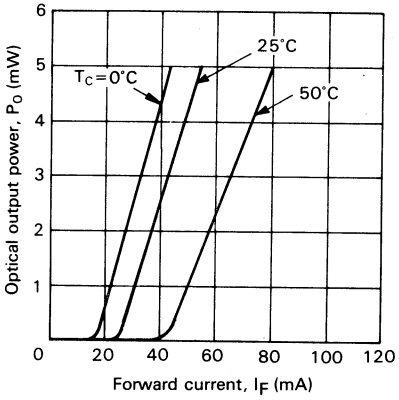
Absolute Maximum Ratings ($T_C = 25°C$)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +50	°C
Storage temperature	T_{stg}	0 to +60	°C

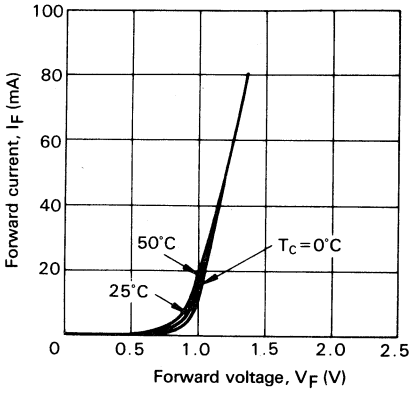
Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	80	mA	
Optical output power	P_O	5			mW	Kink free
		1.5	3.0		mW	$I_F = I_{th} + 20$ mA
Monitor power	P_m	1			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1170	1200	1230	nm	$P_O = 3$ mW
Spectral width	$\Delta\lambda$		2		nm	$P_O = 3$ mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	$P_O = 3$ mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	$P_O = 3$ mW, FWHM
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

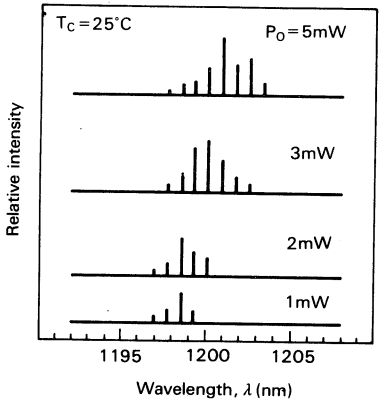
Optical Output Power vs. Forward Current



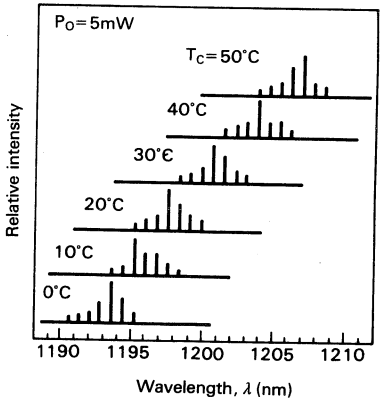
Forward Current vs. Forward Voltage



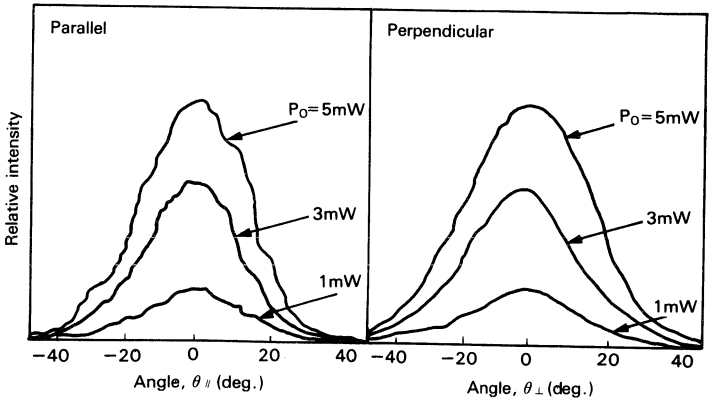
Lasing Spectrum



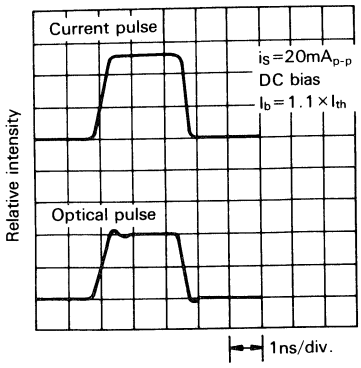
Temperature Dependence of Lasing Spectrum



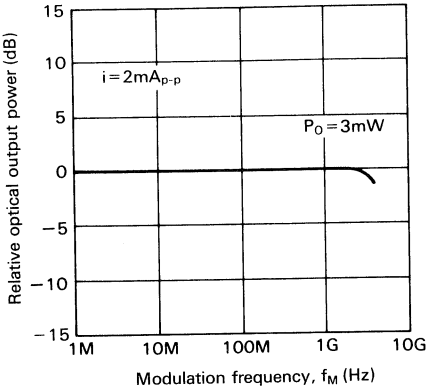
Far Field Pattern



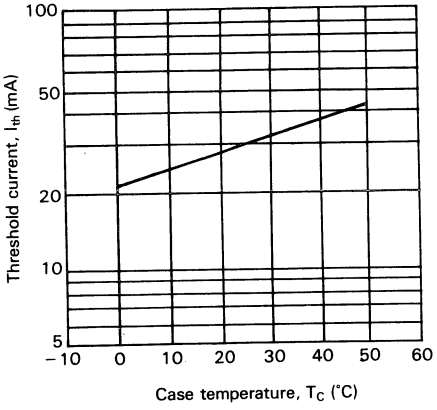
Pulse Response



Frequency Response



Threshold Current vs. Case Temperature



HLP5400

InGaAsP LD

Description

HLP5400 is a 1.3 μm InGaAsP laser diode with double heterojunction structure.

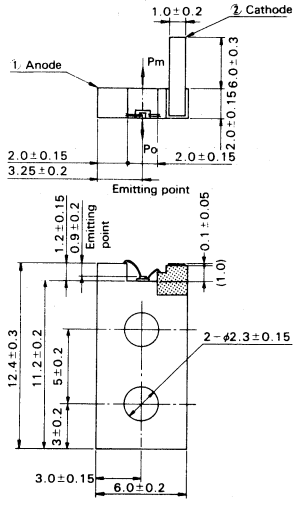
It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications and various other types of optical equipment.

The package is convenient for system testing because the laser chip is mounted on its stem. This device should be hermetically sealed before mounting on a system.

Features

- Long wavelength light output: $\lambda_p = 1270-1330$ nm
- 5 mW CW operation at room temperature
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns

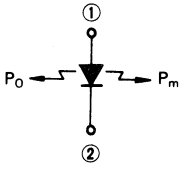
Package Dimensions



(Unit: mm)

A-type

Internal Circuit



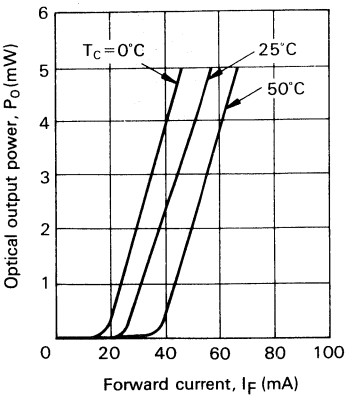
Absolute Maximum Ratings ($T_C = 25°C$)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +50	°C
Storage temperature	T_{stg}	0 to +60	°C

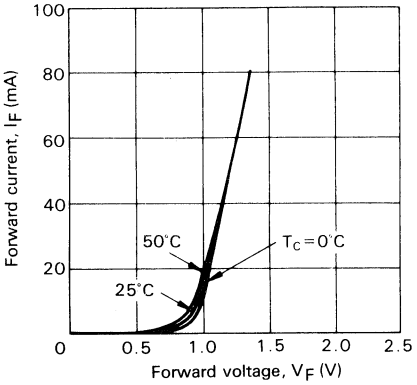
Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	80	mA	
Optical output power	P_O	5			mW	Kink free
		1.5	3.0		mW	$I_F = I_{th} + 20$ mA
Monitor power	P_m	1			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1270	1300	1330	nm	$P_O = 3$ mW
Spectral width	$\Delta\lambda$		2		nm	$P_O = 3$ mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	$P_O = 3$ mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	$P_O = 3$ mW, FWHM
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

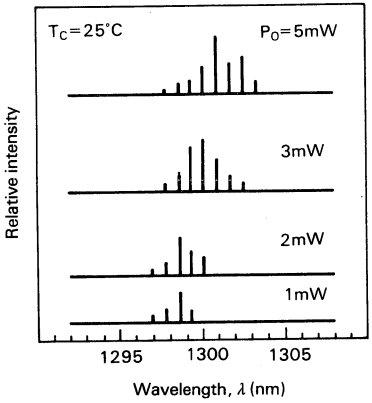
Optical Output Power vs. Forward Current



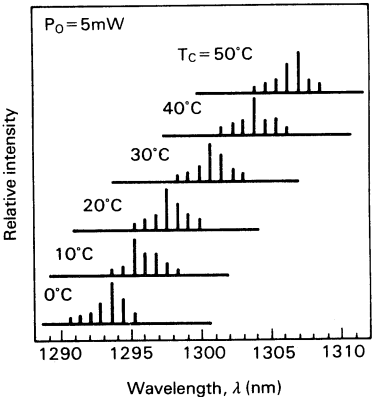
Forward Current vs. Forward Voltage



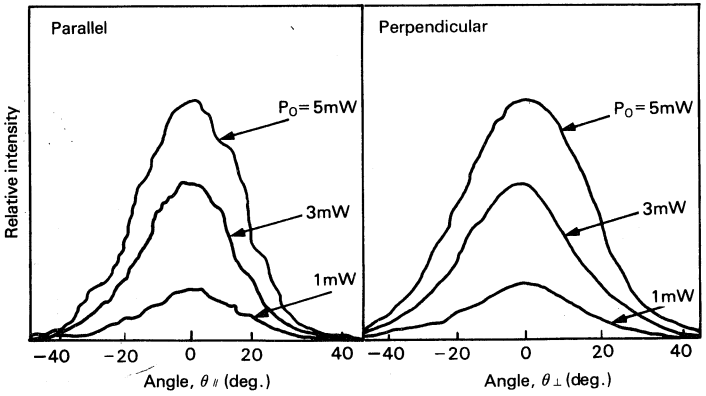
Lasing Spectrum



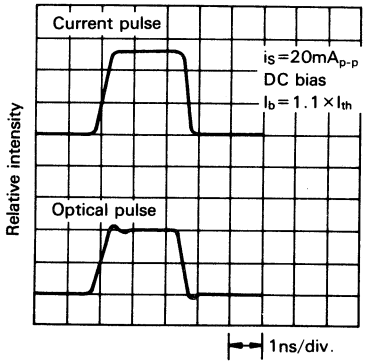
Temperature Dependence of Lasing Spectrum



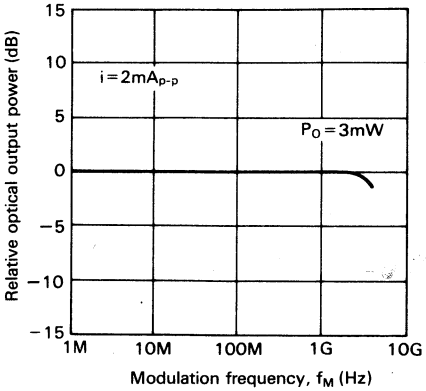
Far Field Pattern



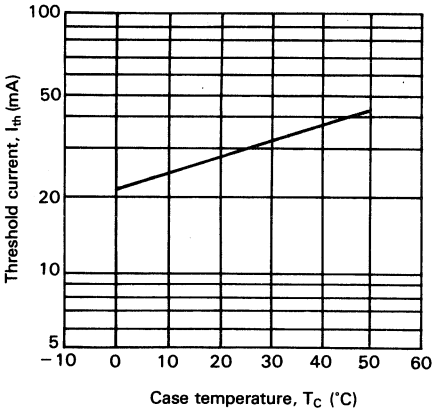
Pulse Response



Frequency Response



Threshold Current vs. Case Temperature



HL1321AC

InGaAsP LD

Description

HL1321AC is a 1.3 μm InGaAsP laser diode with double heterojunction structure.

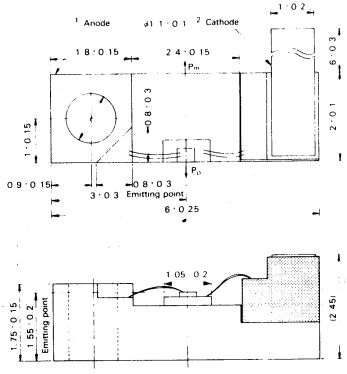
It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications and various other types of optical equipment.

The package is compact to facilitate module assembly.

Features

- Long wavelength light output: $\lambda_p = 1270-1330$ nm
- 5 mW CW operation at room temperature
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns

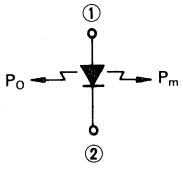
Package Dimensions



(Unit: mm)

AC-type

Internal Circuit



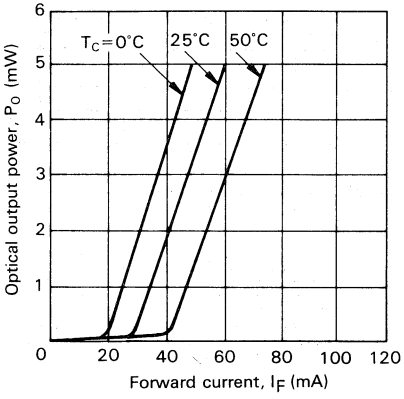
Absolute Maximum Ratings ($T_C = 25°C$)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	0 to +80	°C

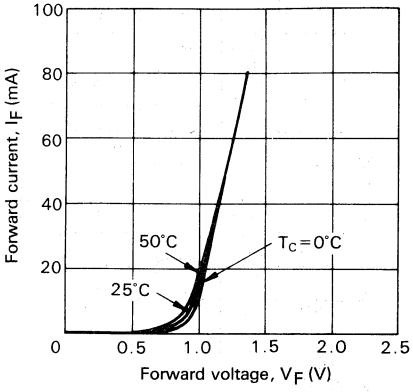
Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	50	mA	
Optical output power	P_O	5			mW	Kink free
		1.5	3.0		mW	$I_F = I_{th} + 20$ mA
Monitor power	P_m	1.0			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1270	1300	1330	nm	$P_O = 3$ mW
Spectral width	$\Delta\lambda$		2		nm	$P_O = 3$ mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	$P_O = 3$ mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	$P_O = 3$ mW, FWHM
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

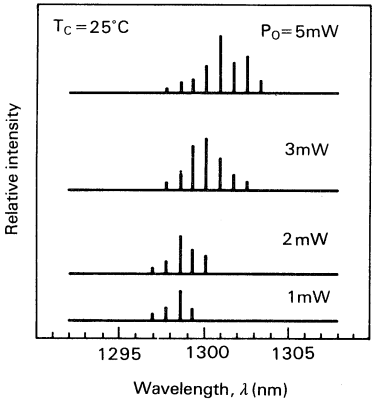
Optical Output Power vs. Forward Current



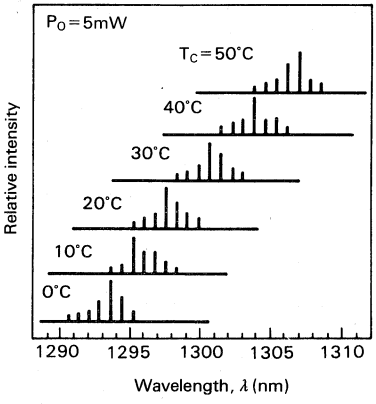
Forward Current vs. Forward Voltage



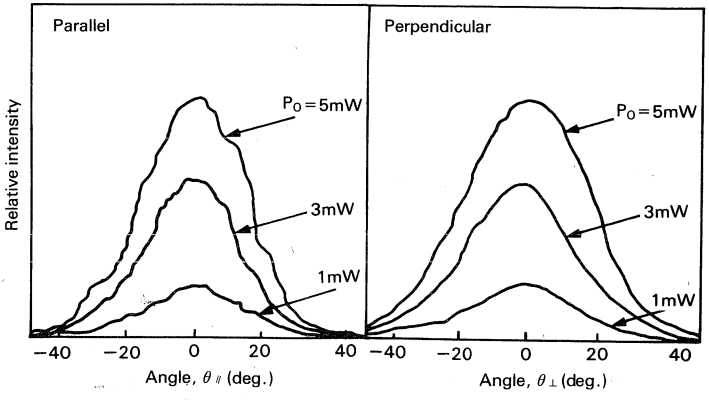
Lasing Spectrum



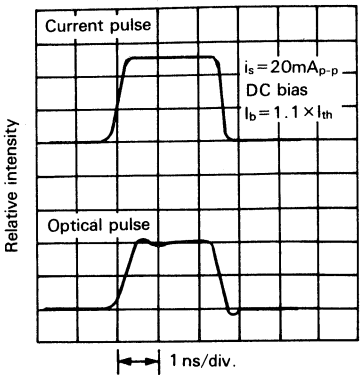
Temperature Dependence of Lasing Spectrum



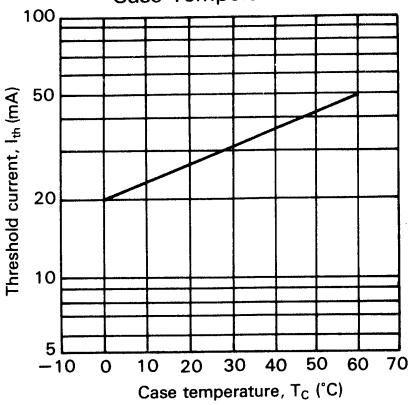
Far Field Pattern



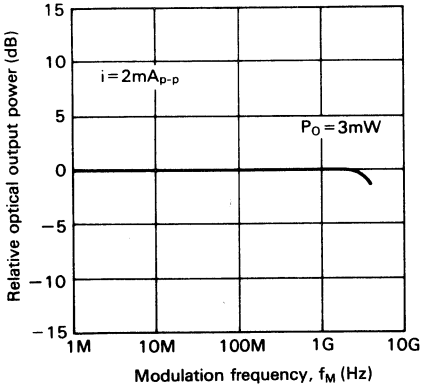
Pulse Response



Threshold Current vs. Case Temperature



Frequency Response



HL1321FG

InGaAsP LD

Description

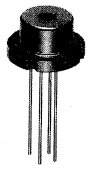
HL1321FG is a 1.3 μm InGaAsP laser diode with double heterojunction structure.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications equipment.

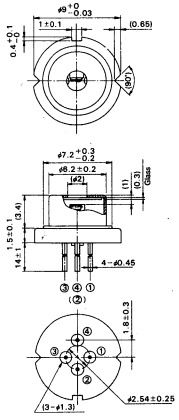
The laser beam is output through the glass window in the package cap. Monitoring current is output from a built-in photodiode.

Features

- Long wavelength light output: λ_p = 1290 – 1330 nm
- 5 mW CW operation at room temperature
- Built-in photodiode for monitoring laser output
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns



Package Dimensions



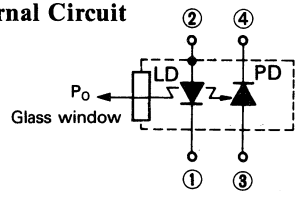
Notes: Optical path: 2.55 mm
Refraction index of window glass: 1.46 – 1.53

1. Laser diode cathode
2. Laser diode anode (Case)
3. Photodiode anode
4. Photodiode cathode

FG-type

(Unit: mm)

Internal Circuit



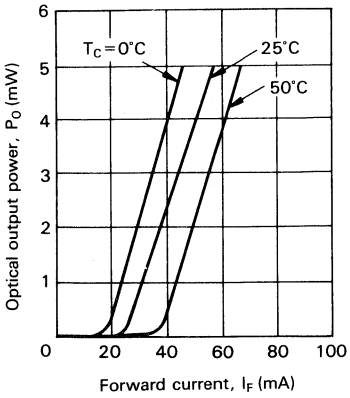
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	15	V
Photodiode forward current	$I_{F(PD)}$	1	mA
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	−40 to +80	°C

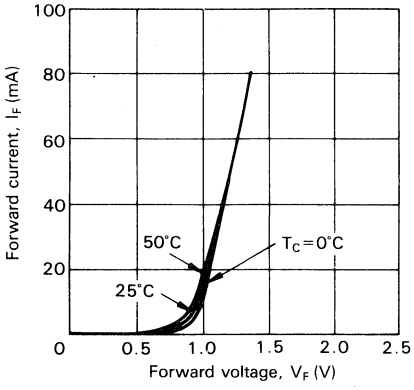
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	50	mA	
Optical output power	P_O	5			mW	Kink free
		1.5	3.0		mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1290	1310	1330	nm	P_O = 3 mW
Spectral width	$\Delta\lambda$		2		nm	P_O = 3 mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	P_O = 3 mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	P_O = 3 mW, FWHM
Photodiode dark current	I_{DARK}			350	nA	$V_{R(PD)}$ = 5 V
Monitor current	I_S	100			μA	$V_{R(PD)}$ = 5 V, P_O = 3 mW
Photodiode capacitance	C_t		10	20	pF	$V_{R(PD)}$ = 5 V, f = 1 MHz
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Rise time	t_r			0.5	ns	P_O = 3 mW, $I_{bias} = I_{th}$, 10 to 90%
Fall time	t_f			0.5	ns	P_O = 3 mW, $I_{bias} = I_{th}$, 90 to 10%

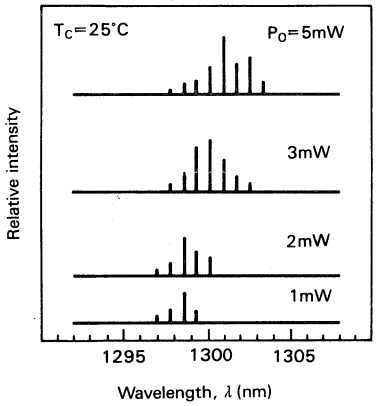
Optical Output Power vs. Forward Current



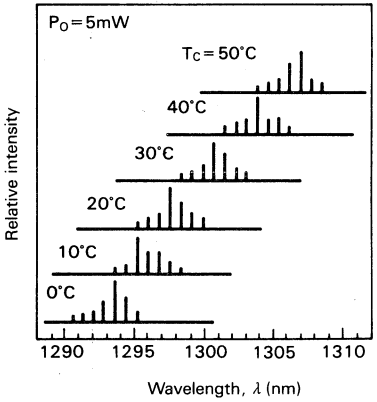
Forward Current vs. Forward Voltage



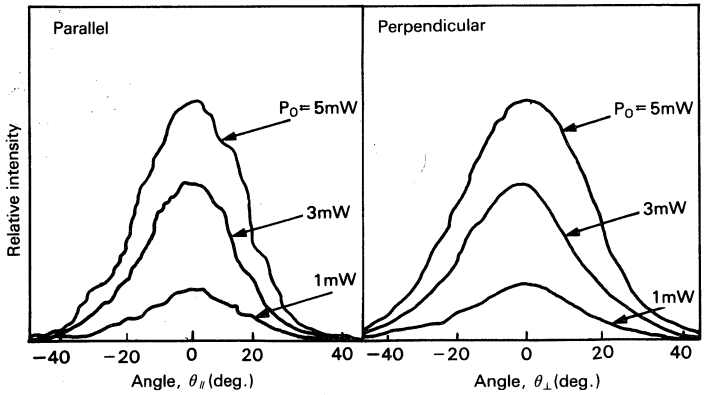
Lasing Spectrum



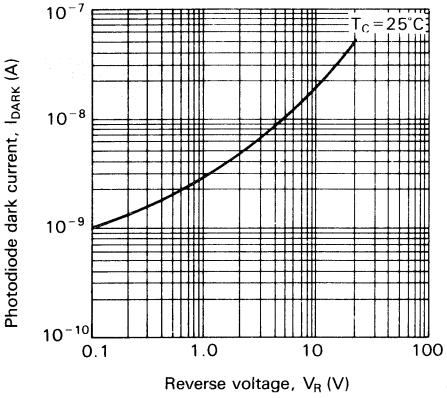
Temperature Dependence of Lasing Spectrum



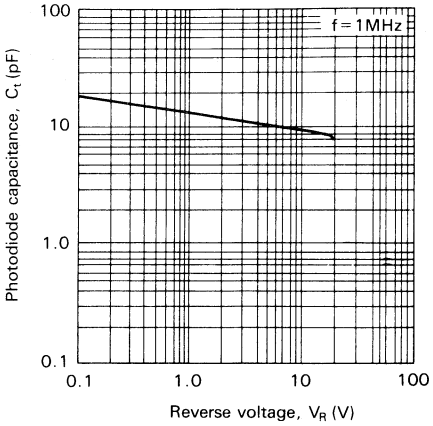
Far Field Pattern



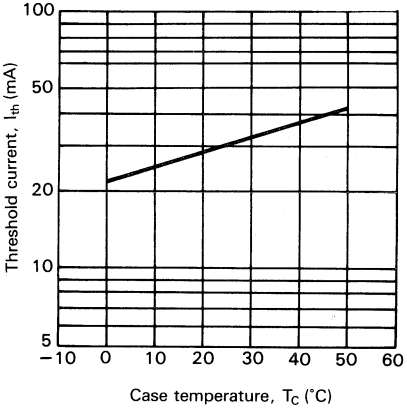
Photodiode Dark Current vs. Reverse Voltage



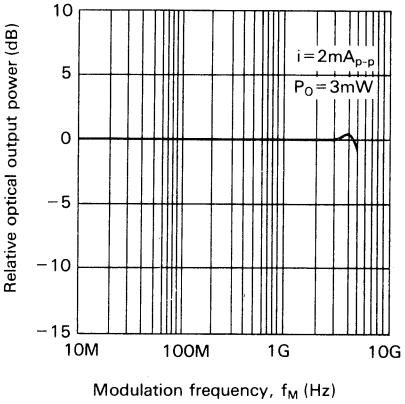
Photodiode Capacitance vs. Reverse Voltage



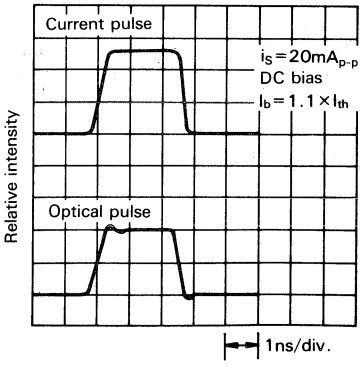
Threshold Current vs. Case Temperature



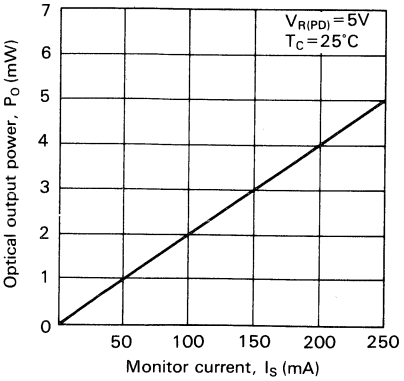
Frequency Response of Laser Diode



Pulse Response of Laser Diode



Optical Cutput Power vs. Monitor Current



HL1321BF

InGaAsP LD

Description

HL1321BF is a laser-diode module in a 14-pin butterfly-type package with a built-in thermoelectronic controller and connected single mode fiber.

It is suitable as a light source in high-speed modulated, high-bit-rate, long-distance fiberoptic communications equipment.

The built-in thermoelectronic controller functions to keep the laser chip operation at a constant temperature.

—Fiber specifications—

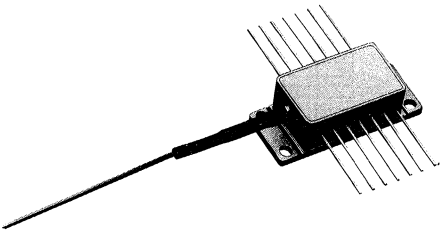
Mode field diameter	: 10.0 ±1.0 μm
λ_c	: 1.10–1.20 μm
Core diameter	: 10 μm
Outer diameter	: 125 μm
Jacket diameter	: 900 μm
Fiber length	: More than 500 mm

Features

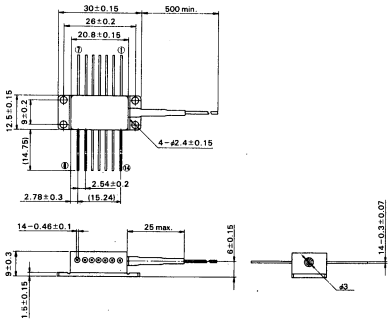
- Long wavelength light output: λ_p = 1290–1330 nm
- 1.2 mW CW and pulse operation at room temperature
- High-speed modulation (1.8 Gb/s)
- Stabilized operation with built-in thermoelectronic controller

Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Fiber optical output power	P_f	1.2	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	15	V
Photodiode forward current	$I_{F(PD)}$	1	mA
Cooler current	I_C	1.4	A
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	−40 to +70	°C



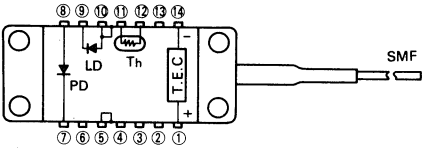
Package Dimensions



(Unit: mm)

BF-type

Pin Connection (Bottom view)



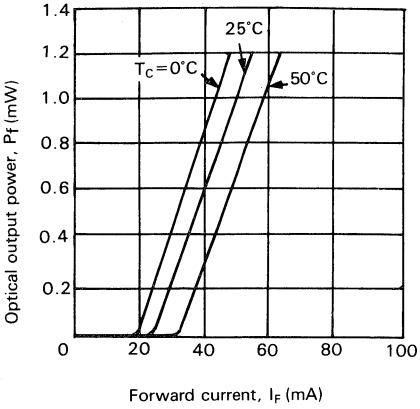
LD; Laser diode
PD; Photodiode
Th; Thermistor
T. E. C. ; T. E. cooler
SMF; Single-mode fiber

① T. E. C. anode
② N. C.
③ N. C.
④ N. C.
⑤ Case
⑥ N. C.
⑦ PD cathode
⑧ PD anode
⑨ LD cathode
⑩ LD anode (case)
⑪ Thermistor
⑫ Thermistor
⑬ N. C.
⑭ T. E. C. cathode

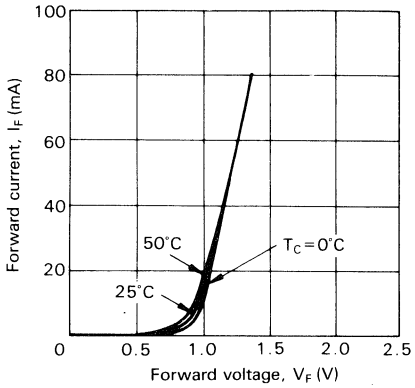
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	50	mA	
Fiber optical output power	P_f	1.2			mW	Kink free
		0.6			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1290	1310	1330	nm	P_f = 1.0 mW
Spectral width	$\Delta\lambda$		2		nm	P_f = 1.0 mW
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	
Photodiode dark current	I_{DARK}			350	nA	$V_{R(PD)}$ = 5 V
Monitor current	I_S	300			µA	$V_{R(PD)}$ = 5 V, P_f = 1.0 mW
Photodiode capacitance	C_t		10	20	pF	$V_{R(PD)}$ = 5 V, f = 1 MHz
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Cooling capacity	ΔT	40			°C	P_f = 1.0 mW
Cooler current	I_C			1.4	A	ΔT = 40°C
Cooler voltage	V_C			1.8	V	ΔT = 40°C
Thermistor resistance	R_{TM}		10		kΩ	

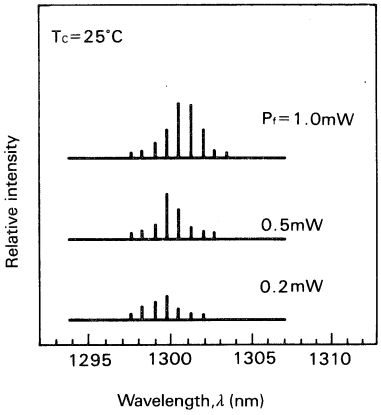
Optical Output Power vs. Forward Current



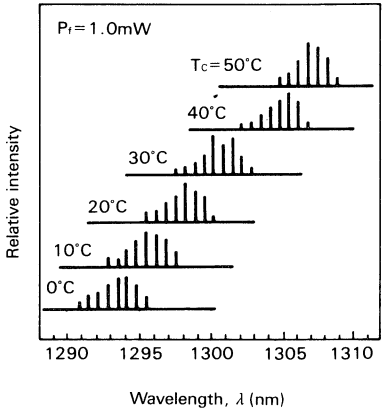
Forward Current vs. Forward Voltage



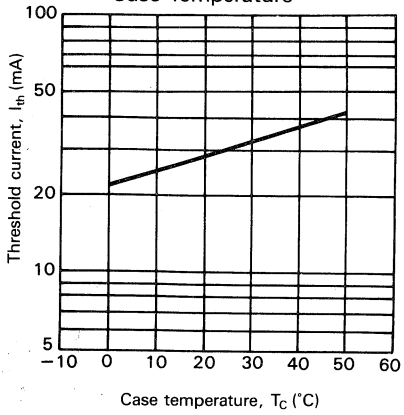
Lasing Spectrum



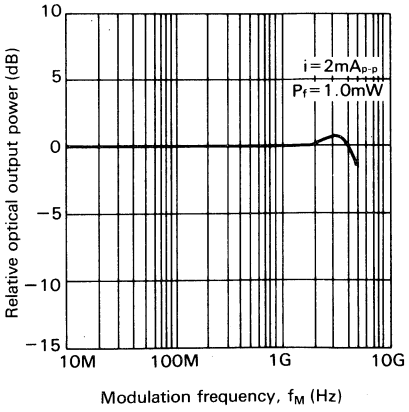
Temperature Dependence of Lasing Spectrum



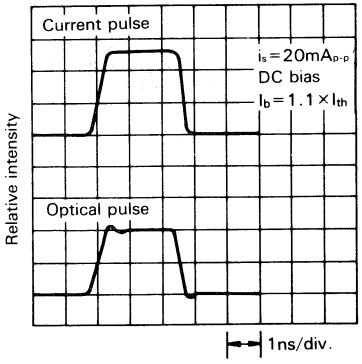
Threshold Current vs. Case Temperature



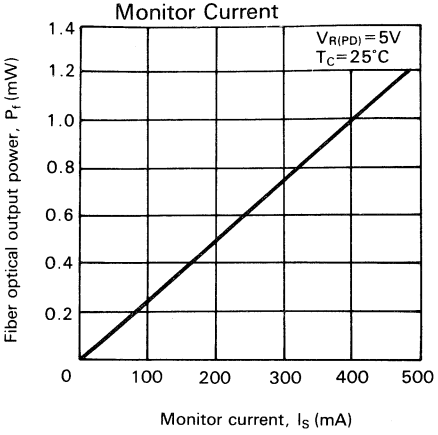
Frequency Response of Laser Diode



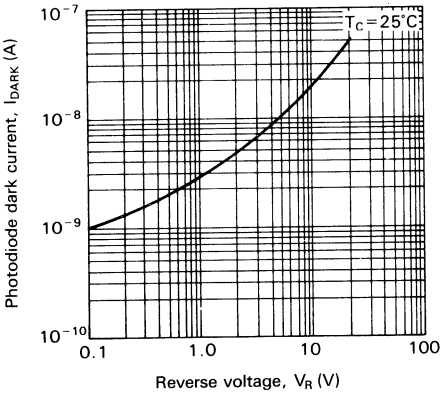
Pulse Response of Laser Diode



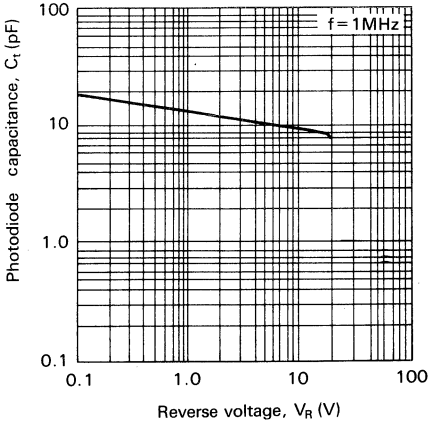
Optical Output Power vs. Monitor Current



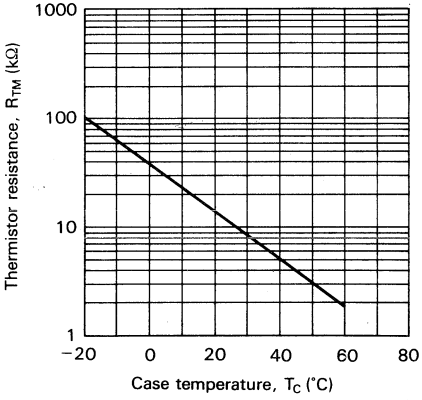
Photodiode Dark Current vs. Reverse Voltage



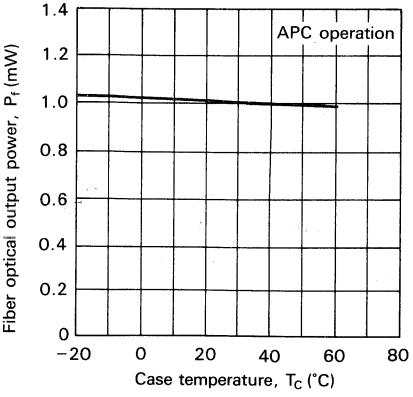
Photodiode Capacitance vs. Reverse Voltage



Thermistor Resistance vs. Case Temperature



Tracking Characteristics



HL1321DL

InGaAsP LD

Description

HL1321DL is a laser-diode module in a 14-pin dual-in-line type package with a built-in thermoelectronic controller and connected single-mode fiber.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications equipment.

The built-in thermoelectronic controller functions to keep the laser chip operation at a constant temperature.

—Fiber specifications—

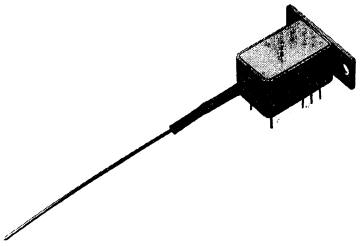
Mode field diameter	: 10.0 ±1.0 μm
λ_c	: 1.10—1.20 μm
Core diameter	: 10 μm
Outer diameter	: 125 μm
Jacket diameter	: 900 μm
Fiber length	: More than 500 mm

Features

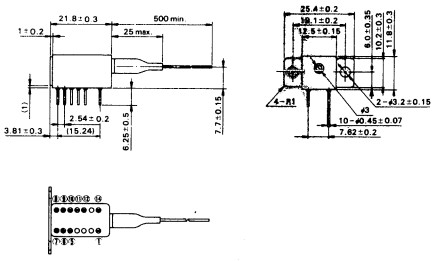
- Long wavelength light output: λ_p = 1290—1330 nm
- 1.2 mW CW and pulse operation at room temperature
- High-speed modulation (800 Mb/s)
- Stabilized operation with built-in thermoelectronic controller

Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Fiber optical output power	P_f	1.2	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	15	V
Photodiode forward current	$I_{F(PD)}$	1	mA
Cooler current	I_C	1.4	A
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	—40 to +70	°C



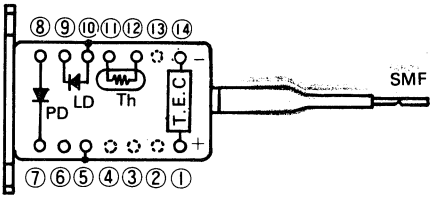
Package Dimensions



(Unit: mm)

DL-type

Pin Connection (Bottom view)



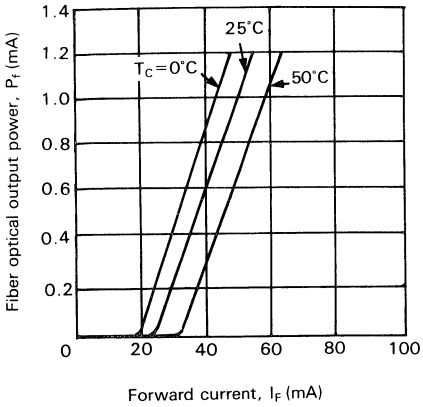
LD; Laser diode
PD; Photodiode
Th; Thermistor
T. E. C. ; T. E. cooler
SMF; Single-mode fiber

① T. E. C. anode
② —
③ —
④ —
⑤ Case
⑥ N. C.
⑦ PD cathode
⑧ PD anode
⑨ LD cathode
⑩ LD anode (case)
⑪ Thermistor
⑫ Thermistor
⑬ —
⑭ T. E. C. cathode

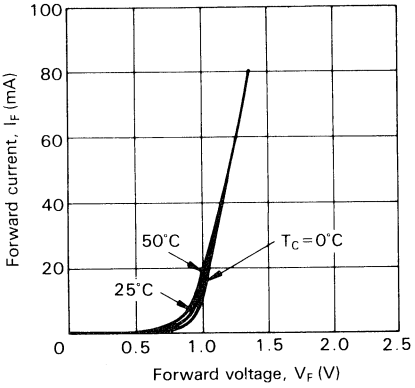
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	50	mA	
Fiber optical output power	P_f	1.2			mW	Kink free
		0.6			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1290	1310	1330	nm	P_f = 1.0 mW
Spectral width	$\Delta\lambda$		2		nm	P_f = 1.0 mW
Rise time	t_r			0.5	ns	P_f = 1.0 mW, $I_{bias} = I_{th}$, 10 to 90%
Fall time	t_f			0.5	ns	P_f = 1.0 mW, $I_{bias} = I_{th}$, 90 to 10%
Photodiode dark current	I_{DARK}			350	nA	$V_{R(PD)}$ = 5 V
Monitor current	I_S	300			μA	$V_{R(PD)}$ = 5 V, P_f = 1.0 mW
Photodiode capacitance	C_t		10	20	pF	$V_{R(PD)}$ = 5 V, f = 1 MHz
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Cooling capacity	ΔT	40			°C	P_f = 1.0 mW
Cooler current	I_C			1.4	A	ΔT = 40°C
Cooler voltage	V_C			1.8	V	ΔT = 40°C
Thermistor resistance	R_{TM}		10		kΩ	

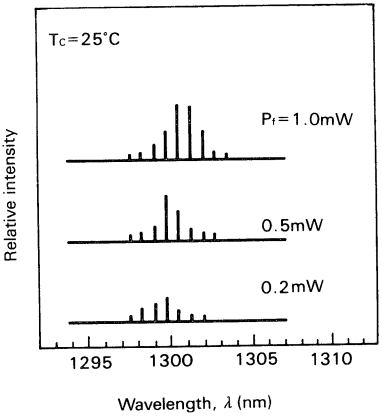
Optical Output Power vs. Forward Current



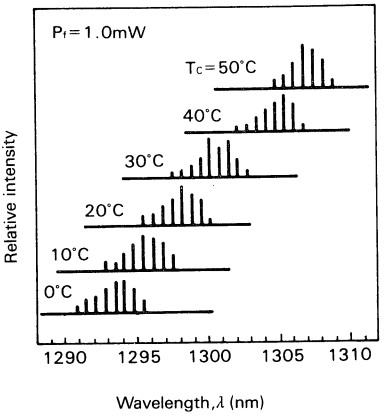
Forward Current vs. Forward Voltage



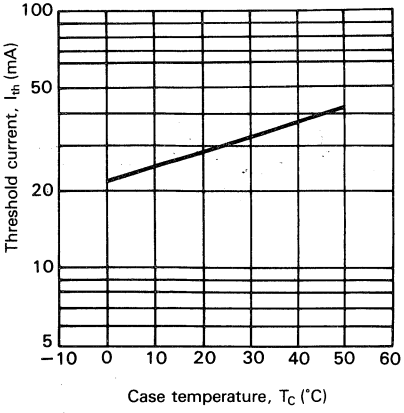
Lasing Spectrum



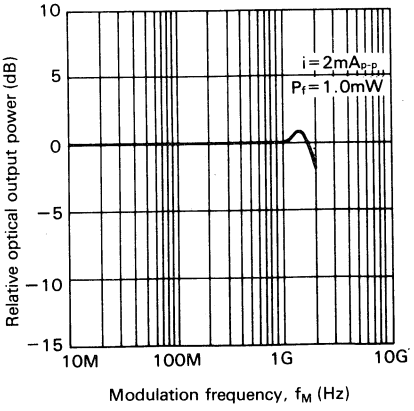
Temperature Dependence of Lasing Spectrum



Threshold Current vs. Case Temperature

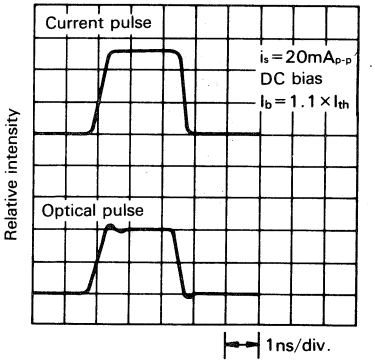


Frequency Response of Laser Diode

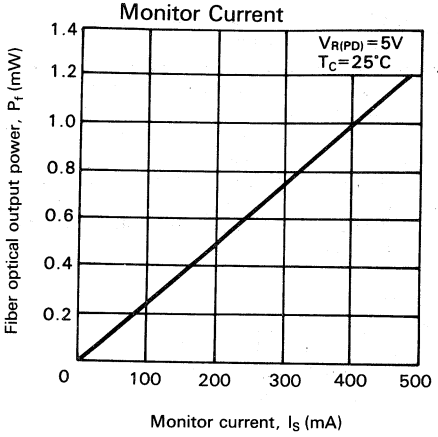


HITACHI

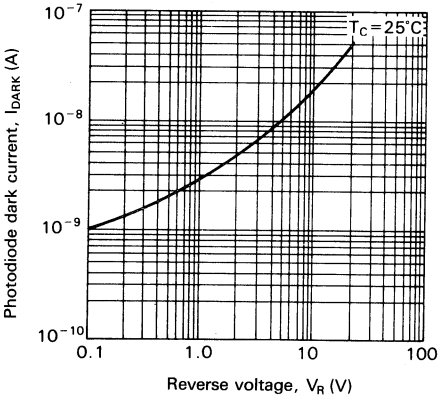
Pulse Response of Laser Diode



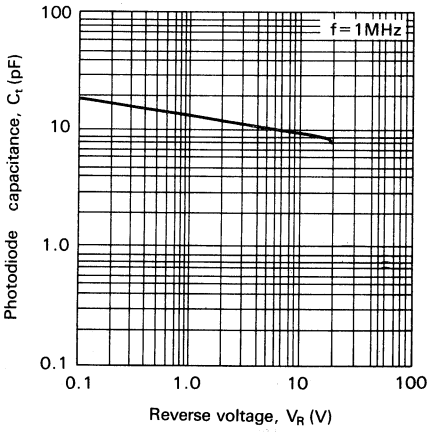
Optical Output Power vs. Monitor Current



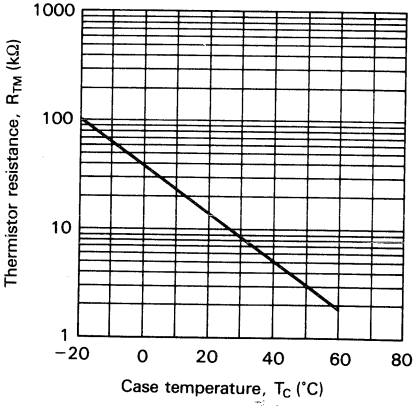
Photodiode Dark Current vs. Reverse Voltage



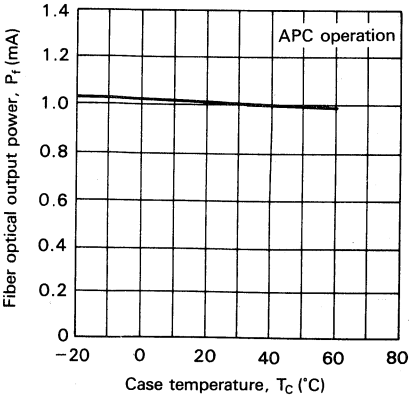
Photodiode Capacitance vs. Reverse Voltage



Thermistor Resistance vs. Case Temperature



Tracking Characteristics



HL1322A

InGaAsP LD

Description

HL1322A is a high-power 1.3 μm InGaAsP laser diode with double heterojunction structure.

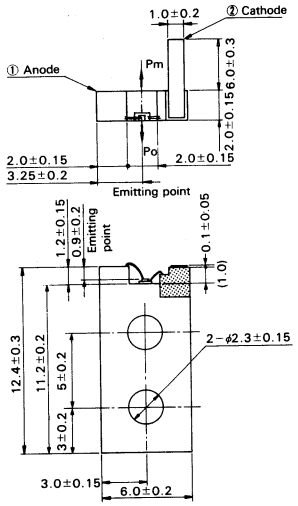
It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications and various other types of optical equipment. The HL1322A emits higher optical power than HLP5400 and HL1321AC.

The package is convenient for system testing because the laser chip is mounted on its stem. This device should be hermetically sealed before mounting on a system.

Features

- Long wavelength light output: λ_p = 1290–1330 nm
- 10 mW CW operation at room temperature
- Fast pulse response: t_r, t_f ≦ 0.5 ns

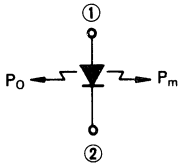
Package Dimensions



(Unit: mm)

A-type

Internal Circuit



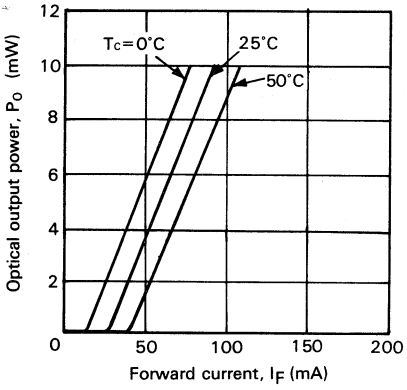
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	10	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	0 to +80	°C

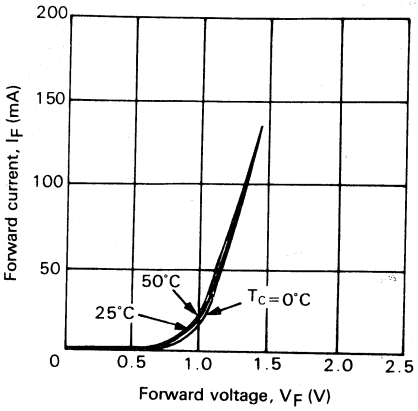
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	50	mA	
Optical output power	P_O	10			mW	Kink free
		4			mW	$I_F = I_{th}$ + 40 mA
Monitor power	P_m	2			mW	$I_F = I_{th}$ + 40 mA
Lasing wavelength	λ_p	1290	1310	1330	nm	P_O = 6 mW
Spectral width	$\Delta\lambda$			5	nm	P_O = 6 mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	P_O = 6 mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	P_O = 6 mW, FWHM
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

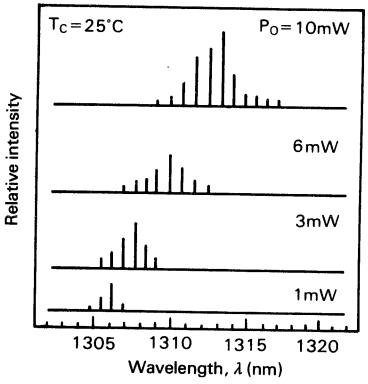
Optical Output Power vs. Forward Current



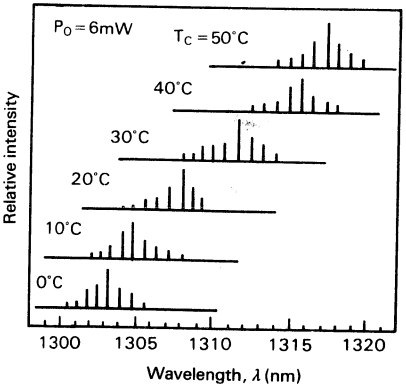
Forward Current vs. Forward Voltage



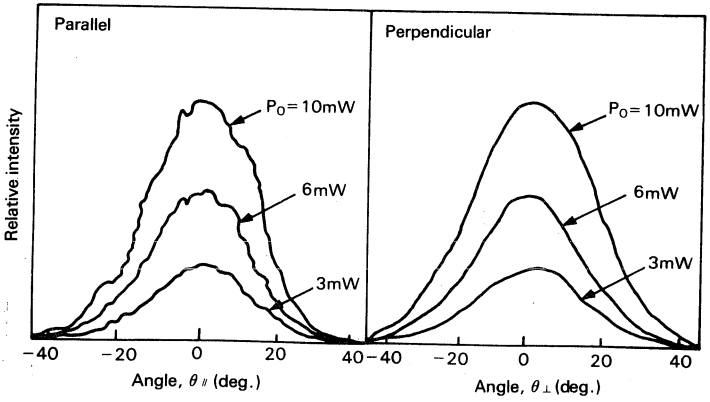
Lasing Spectrum



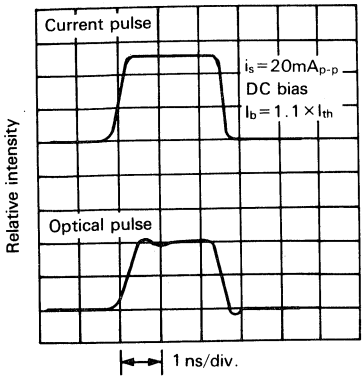
Temperature Dependence of Lasing Spectrum



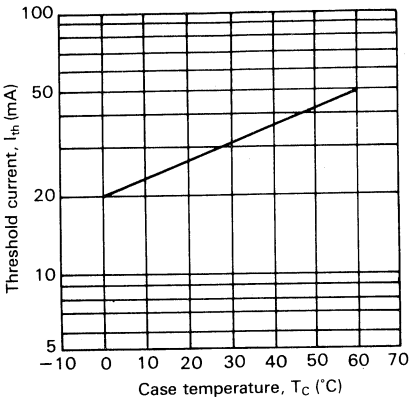
Far Field Pattern



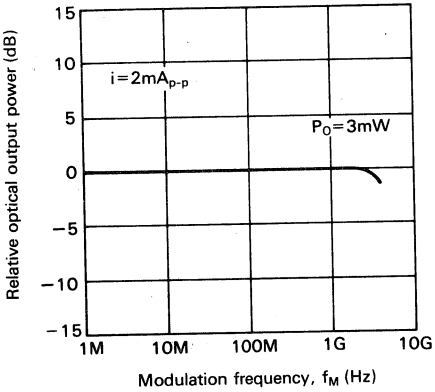
Pulse Response



Threshold Current vs. Case Temperature



Frequency Response of Laser Diode



HL1322AC

InGaAsP LD

Description

HL1322AC is a high-power 1.3 μm InGaAsP laser diode with double heterojunction structure.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications and various other types of optical equipment.

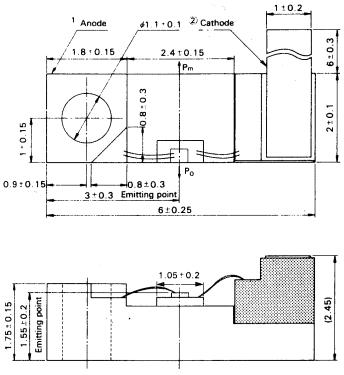
The HL1322AC emits higher optical power than HLP5400 and HL1321AC.

The package is compact to facilitate module assembly.

Features

- Long wavelength light output: λ_p = 1290 – 1330 nm
- 10 mW CW operation at room temperature
- Fast pulse response: t_r, t_f ≦ 0.5 ns

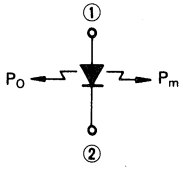
Package Dimensions



(Unit: mm)

AC-type

Internal Circuit



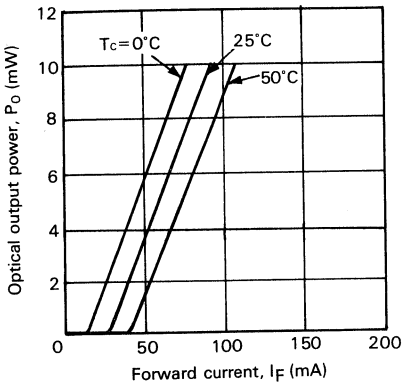
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	10	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	0 to +80	°C

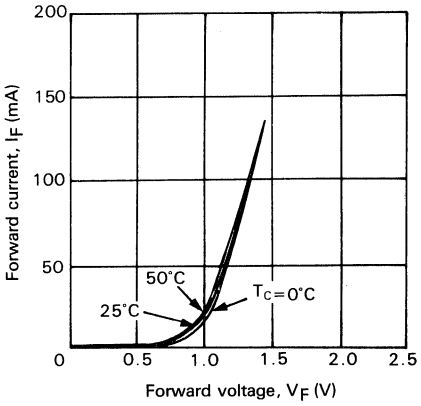
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	50	mA	
Optical output power	P_O	10			mW	Kink free
		4			mW	$I_F = I_{th}$ + 40 mA
Monitor power	P_m	2			mW	$I_F = I_{th}$ + 40 mA
Lasing wavelength	λ_p	1290	1310	1330	nm	P_O = 6 mW
Spectral width	$\Delta\lambda$			5	nm	P_O = 6 mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	P_O = 6 mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	P_O = 6 mW, FWHM
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

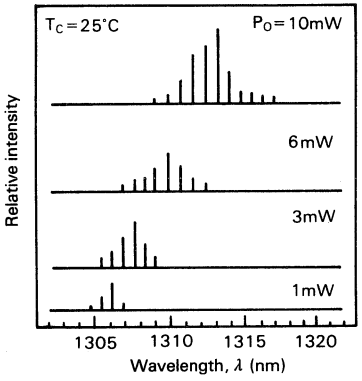
Optical Output Power vs. Forward Current



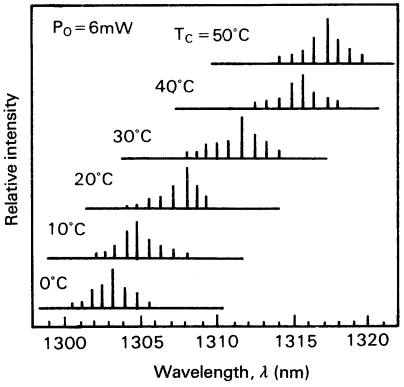
Forward Current vs. Forward Voltage



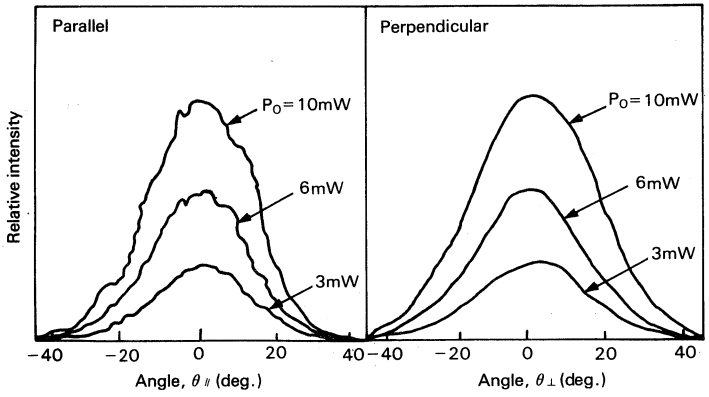
Lasing Spectrum



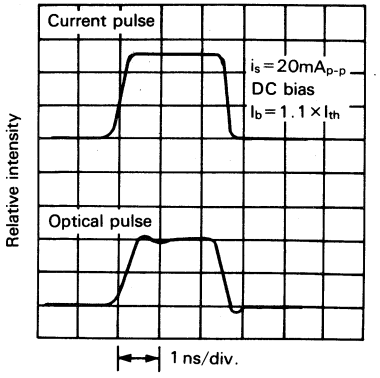
Temperature Dependence of Lasing Spectrum



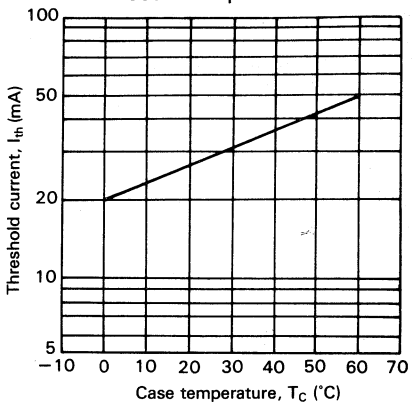
Far Field Pattern



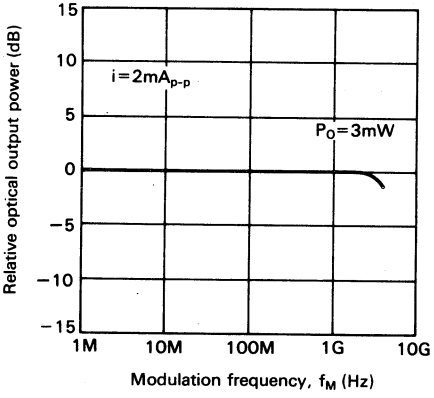
Pulse Response



Threshold Current vs. Case Temperature



Frequency Response of Laser Diode



HL1323DM

InGaAsP LD

Description

HL1323DM is a 1.3 μm InGaAsP laser diode with double heterojunction structure.

It is suitable as a light source in short- to intermediate-distance fiberoptic communications systems, e.g. LAN, CATV and LJN.

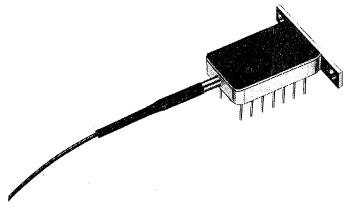
The laser beam comes out from the connected single-mode fiber; monitoring current by a built-in photodiode.

—Fiber specifications—

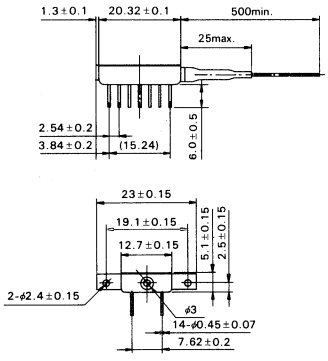
Mode field diameter	: 10.0 ±1.0 μm
Cutoff wavelength	: 1.10—1.20 μm
Core diameter	: 10 μm
Outer diameter	: 125 μm
Jacket diameter	: 900 μm
Fiber length	: More than 500 mm

Features

- Long wavelength light output: λ_p = 1260—1340 nm
- 0.3 mW CW and pulse operation at room temperature
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns
- Built-in photodiode for monitoring laser output
- Package with thinner-height

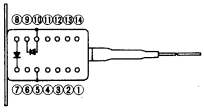


Package Dimensions



DM-type (Unit: mm)

Pin Connection (Bottom view)



① N.C.
② N.C.
③ N.C.
④ N.C.
⑤ Case
⑥ N.C.
⑦ FD Cathode
⑧ PD Anode
⑨ LD Cathode
⑩ LD Anode (Case)
⑪ N.C.
⑫ N.C.
⑬ N.C.
⑭ N.C.

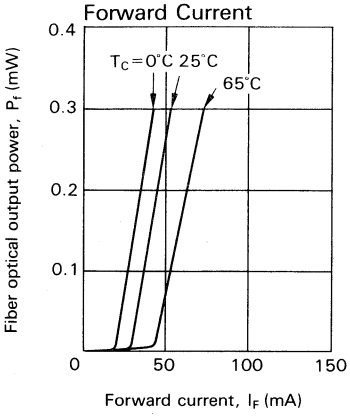
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Fiber optical output power	P_f	0.3	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	15	V
Photodiode forward current	$I_{F(PD)}$	1	mA
Operating temperature	T_{opr}	0 to +65	°C
Storage temperature	T_{stg}	−20 to +70	°C

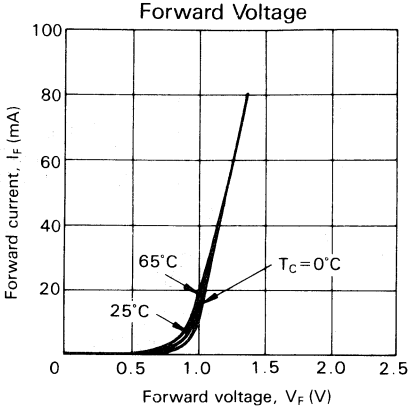
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	50	mA	
Fiber optical output power	P_f	0.3			mW	Kink free
		0.14			mW	$I_F = I_{th}$ + 20 mA
Lasing wavelength	λ_p	1260	1300	1340	nm	P_f = 0.15 mW
Spectral width	$\Delta\lambda$		2		nm	P_f = 0.3 mW
Rise time	t_r			0.5	ns	P_f = 0.15 mW, $I_{bias} = I_{th}$, 10 to 90%
Fall time	t_f			0.5	ns	P_f = 0.15 mW, $I_{bias} = I_{th}$, 90 to 10%
Photodiode dark current	I_{DARK}			350	nA	$V_{R(PD)}$ = 5 V
Monitor current	I_S	100			μA	$V_{R(PD)}$ = 5 V, P_f = 0.15 mW
Photodiode capacitance	C_t		10	20	pF	$V_{R(PD)}$ = 5 V, f = 1 MHz

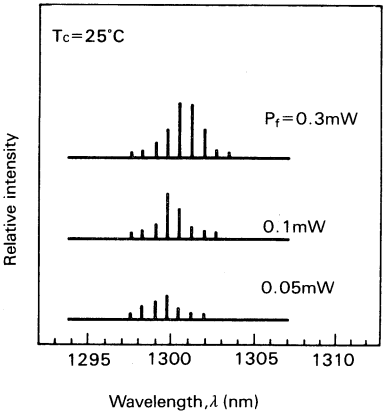
Optical Output Power vs. Forward Current



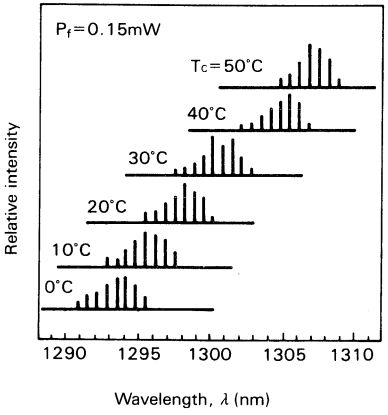
Forward Current vs. Forward Voltage



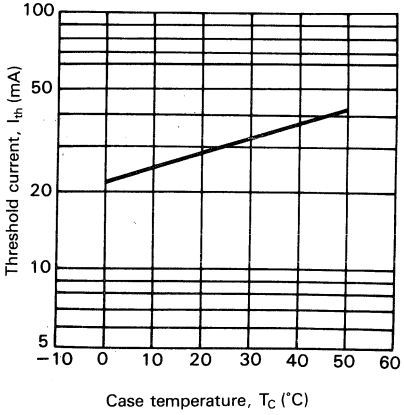
Lasing Spectrum



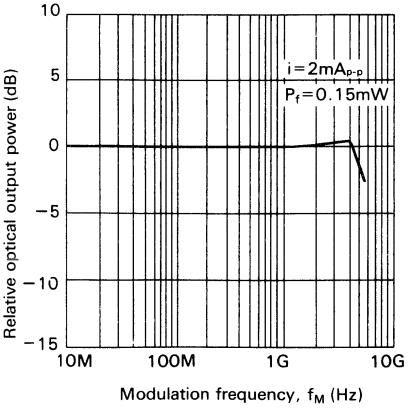
Temperature Dependence of Lasing Spectrum



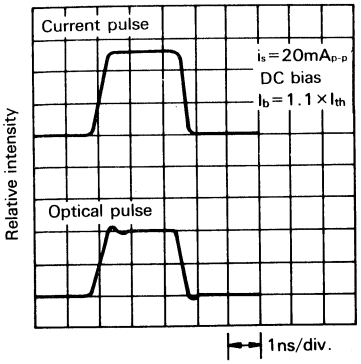
Threshold Current vs. Case Temperature



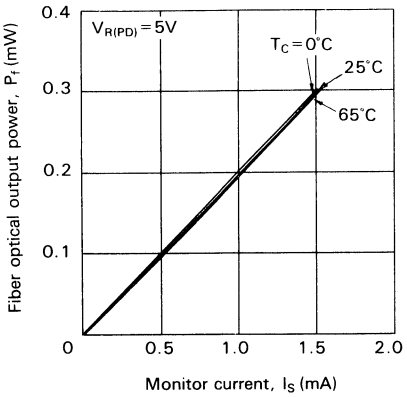
Frequency Response of Laser Diode



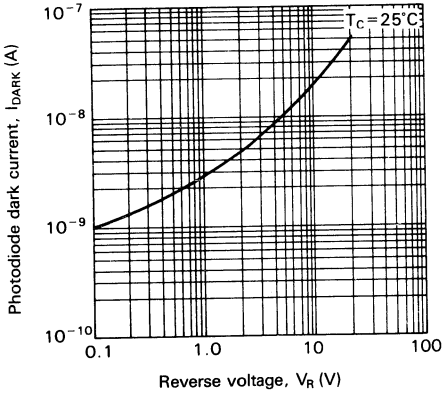
Pulse Response of Laser Diode



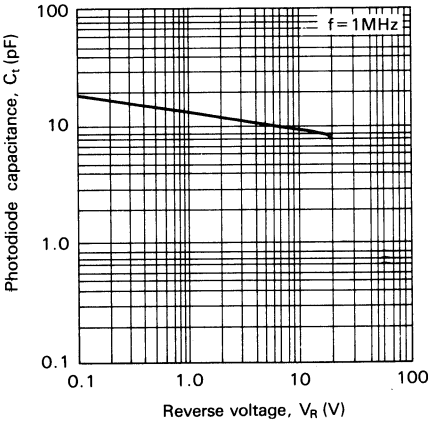
Optical Output Power vs. Monitor Current



Photodiode Dark Current vs. Reverse Voltage



Photodiode Capacitance vs. Reverse Voltage



HL1323TR

InGaAsP LD

Description

HL1323TR is a 1.3 μm InGaAsP laser diode with double heterojunction structure.

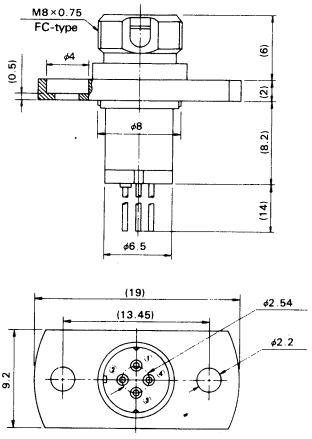
It is suitable as a light source in short- to intermediate-distance fiberoptic communications systems, e.g. LAN, CATV and LJN.

The package with receptacle is suited for easy connecting with FC-PC type connector.

Features

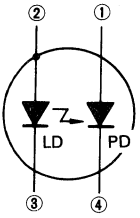
- Long wavelength light output: $\lambda_p = 1290-1330$ nm
- $P_f \geqq 1.0$ mW (connecting with multi-mode fiber)
  $P_f \geqq 0.3$ mW (connecting with single-mode fiber)
- High-speed modulation (BR $\leqq$ 1 Gb/s)
- Built-in photodiode for monitoring laser output
- Wide operating temperature range: $T_{opr} = 0-+60°C$

Package Dimensions



TR-type (Unit: mm)

Internal Circuit



① PD anode
② LD anode
③ LD cathode
④ PD cathode

Absolute Maximum Ratings ($T_C = 25°C$)

Items	Symbols	Values	Units
Fiber optical output power	P_f	0.3*	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	15	V
Photodiode forward current	$I_{F(PD)}$	1	mA
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	−40 to +80	°C

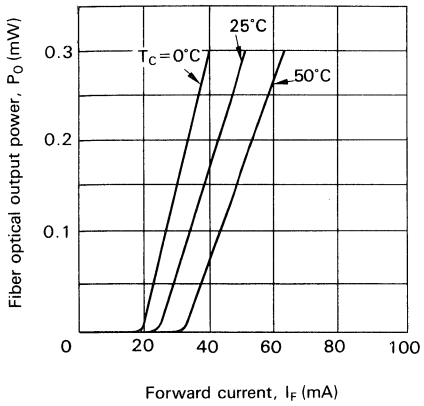
* At SI10/125 FC-PC connector end

Optical and Electrical Characteristics ($T_C = 25°C$)

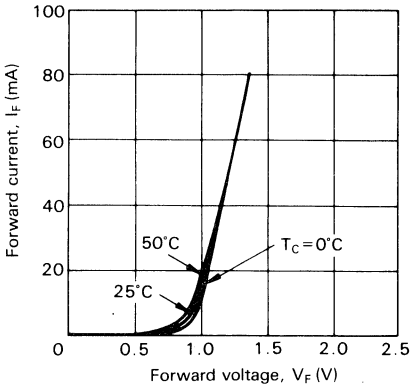
Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	50	mA	
Fiber optical output power	P_f	0.3*			mW	Kink free
		0.1*	0.2*		mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1290	1310	1330	nm	$P_f = 0.1$ mW
Spectral width	$\Delta\lambda$		2		nm	$P_f = 0.1$ mW
Rise time	t_r			0.5	ns	$P_f = 0.1$ mW, $I_{bias} = I_{th}$, 10 to 90%
Fall time	t_f			0.5	ns	$P_f = 0.1$ mW, $I_{bias} = I_{th}$, 90 to 10%
Photodiode dark current	I_{DARK}			350	nA	$V_{R(PD)} = 5$ V
Monitor current	I_S	50			μA	$V_{R(PD)} = 5$ V, $P_f = 0.1$ mW
Photodiode capacitance	C_t		10	20	pF	$V_{R(PD)} = 5$ V, f = 1 MHz

* At SI10/125 FC-PC connector end

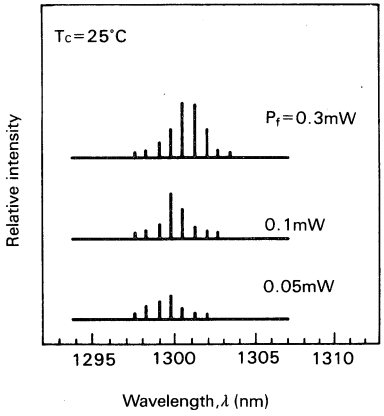
Optical Output Power vs. Forward Current



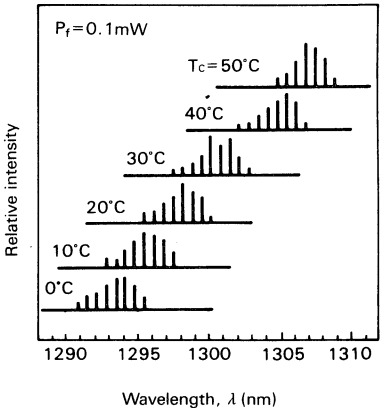
Forward Current vs. Forward Voltage



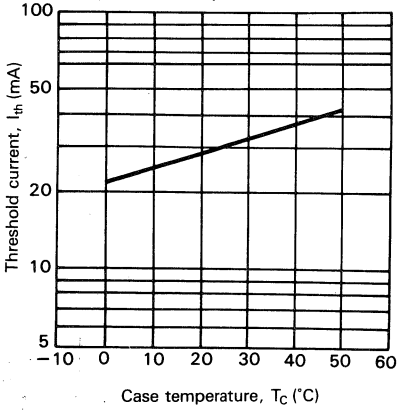
Lasing Spectrum



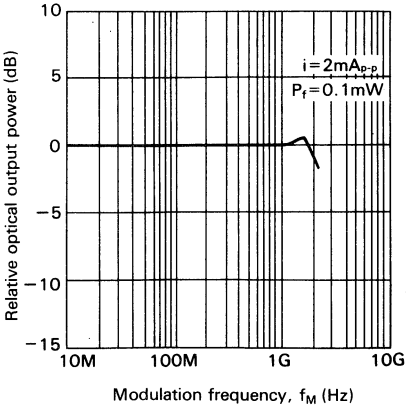
Temperature Dependence of Lasing Spectrum



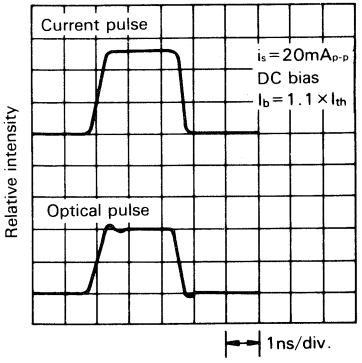
Threshold Current vs. Case Temperature



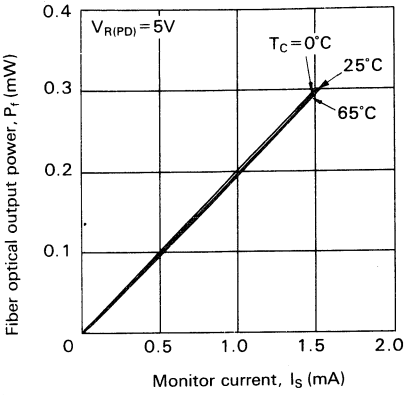
Frequency Response of Laser Diode



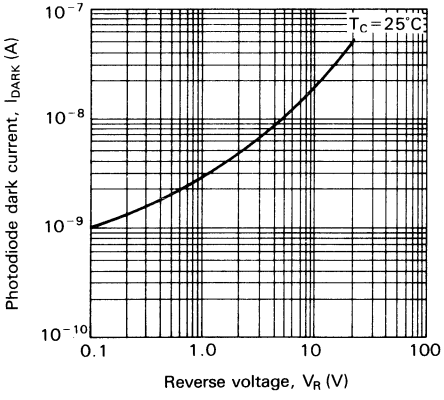
Pulse Response of Laser Diode



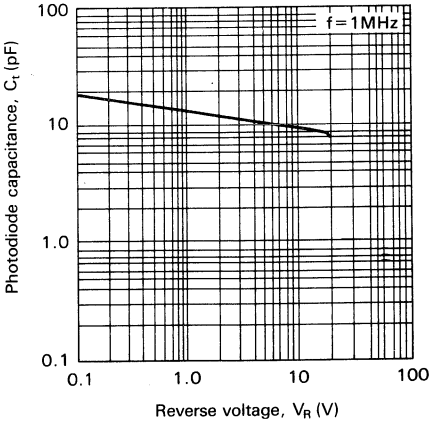
Optical Output Power vs. Monitor Current



Photodiode Dark Current vs. Reverse Voltage



Photodiode Capacitance vs. Reverse Voltage



HL1341A

InGaAsP LD

Description

HL1341A is a 1.3 μm InGaAsP distributed-feedback (DFB) laser diode with buried hetero-structure.

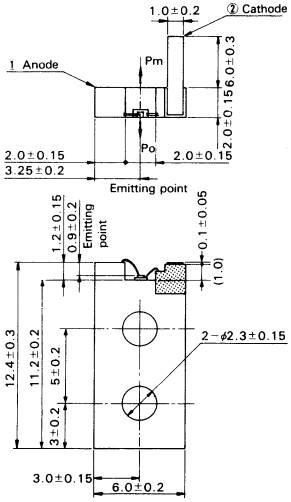
It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications and various other types of optical equipment.

The package is convenient for system testing because the laser chip is mounted on its stem. This device should be hermetically sealed before mounting on a system.

Features

- Long wavelength light output: λ_p = 1290–1330 nm
- 5 mW CW operation at room temperature
- Dynamic single longitudinal mode: S_r = 35 dB typ.
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns

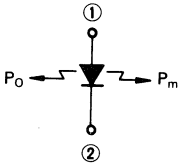
Package Dimensions



(Unit: mm)

A-type

Internal Circuit



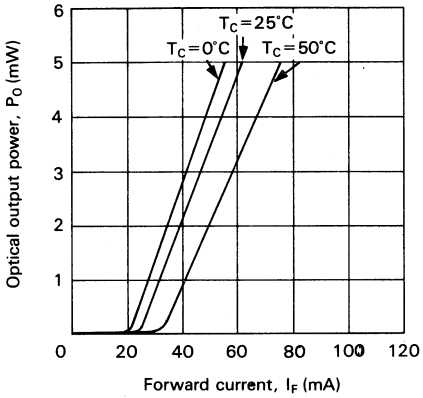
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	0 to +80	°C

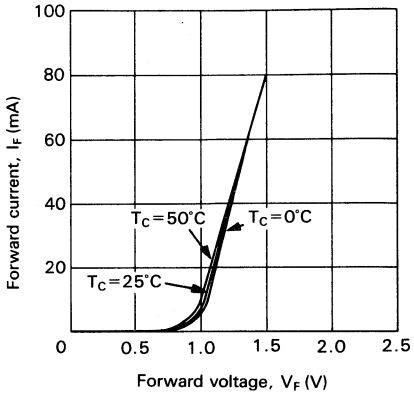
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		25	50	mA	
Optical output power	P_O	5			mW	Kink free
		2.5			mW	$I_F = I_{th}$ + 20 mA
Monitor power	P_m	1.0			mW	$I_F = I_{th}$ + 20 mA
Lasing wavelength	λ_p	1290	1310	1330	nm	P_O = 3 mW
Side-mode suppression ratio	S_r	30	35		dB	P_O = 3 mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	P_O = 3 mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	P_O = 3 mW, FWHM
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

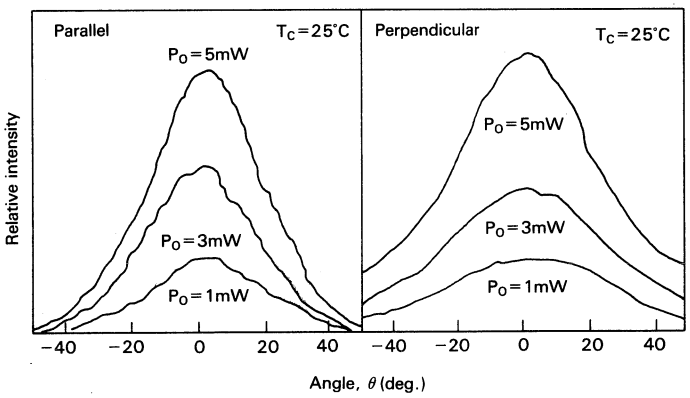
Optical Output Power vs. Forward Current



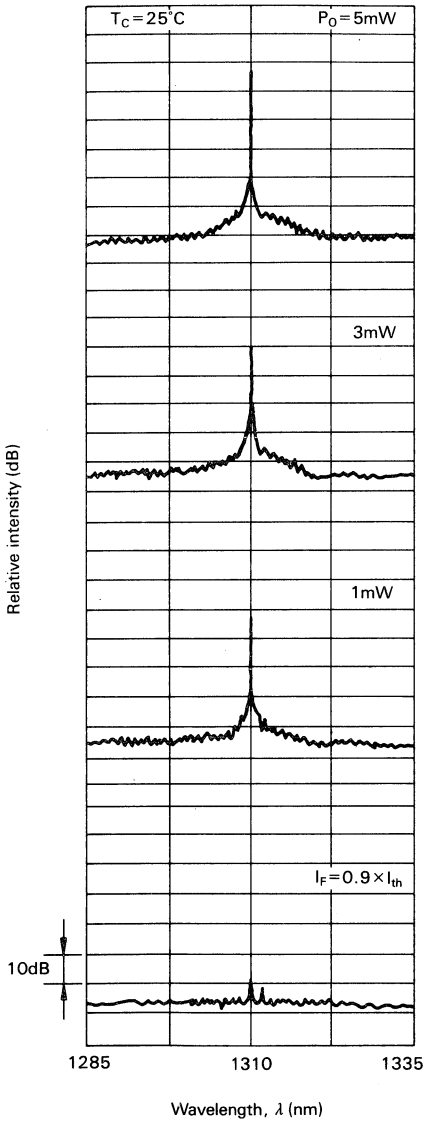
Forward Current vs. Forward Voltage



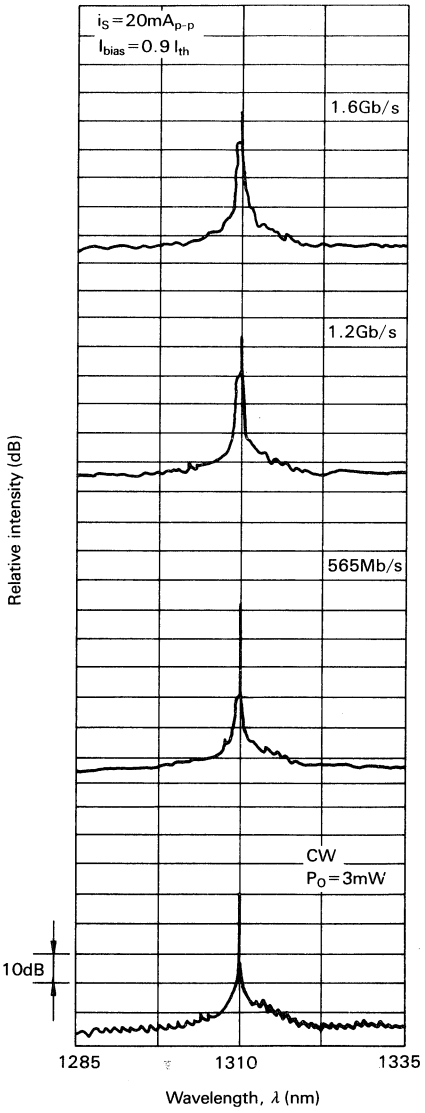
Far Field Pattern



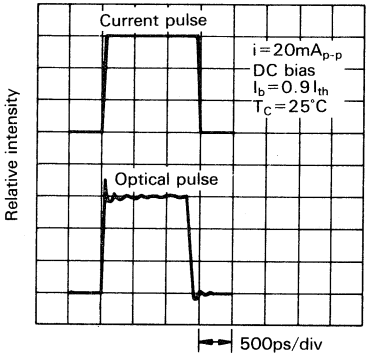
Output Power Dependence of Lasing Spectrum



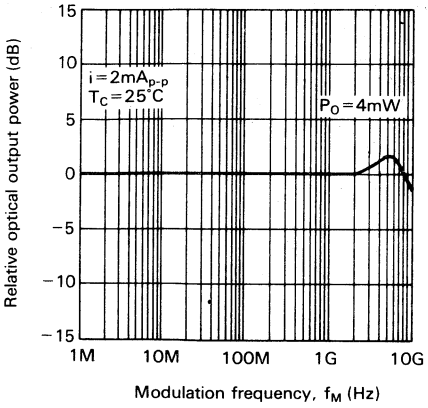
Frequency Dependence of Lasing Spectrum



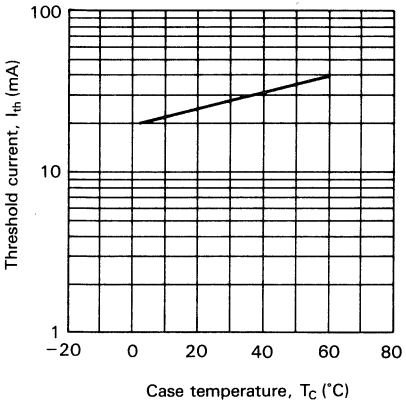
Pulse Response of Laser Diode



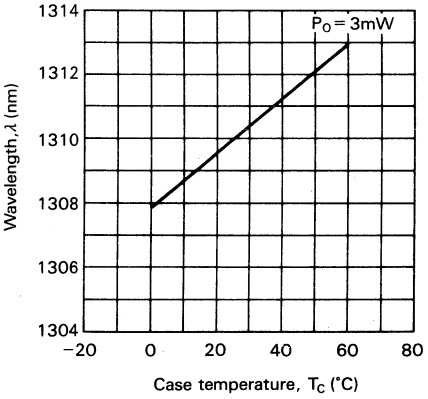
Frequency Response of Laser Diode



Threshold Current vs. Case Temperature



Temperature Dependence of Lasing Wavelength



Description

HL1341AC is a 1.3 μm InGaAsP distributed-feedback (DFB) laser diode with buried heterostructure.

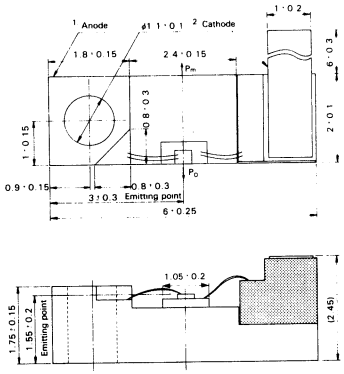
It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications and various other types of optical equipment.

The package is compact to facilitate module assembly.

Features

- Long wavelength light output: $\lambda_p = 1290-1330$ nm
- 5 mW CW operation at room temperature
- Dynamic single longitudinal mode: $S_r = 35$ dB typ.
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns

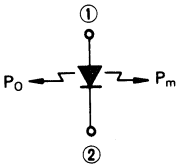
Package Dimensions



(Unit: mm)

AC-type

Internal Circuit



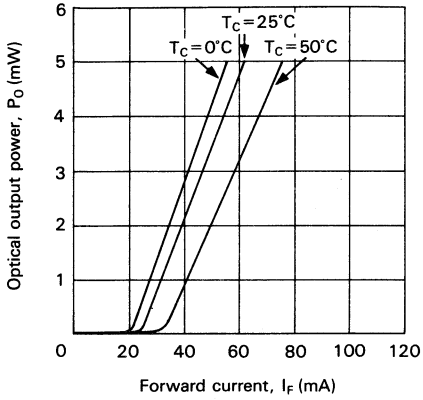
Absolute Maximum Ratings ($T_C = 25°C$)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	0 to +80	°C

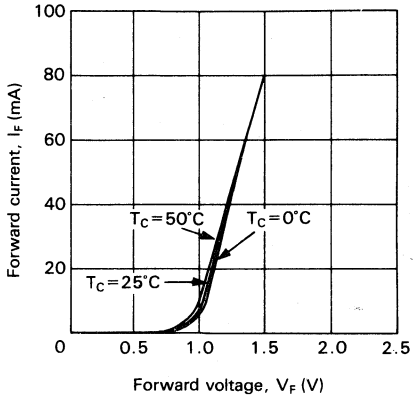
Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		25	50	mA	
Optical output power	P_O	5			mW	Kink free
		2.5			mW	$I_F = I_{th} + 20$ mA
Monitor power	P_m	1.0			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1290	1310	1330	nm	$P_O = 3$ mW
Side-mode suppression ratio	S_r	30	35		dB	$P_O = 3$ mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	$P_O = 3$ mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	$P_O = 3$ mW, FWHM
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

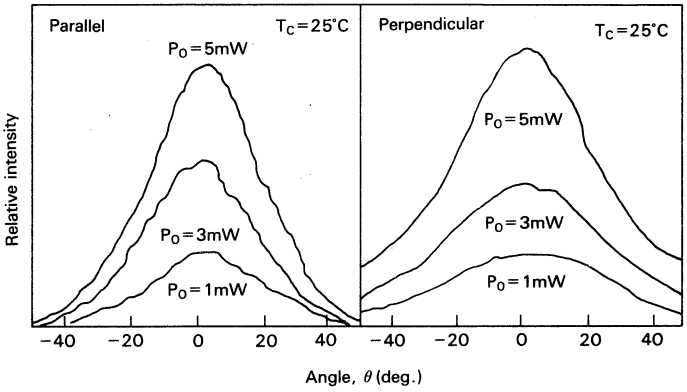
Optical Output Power vs. Forward Current



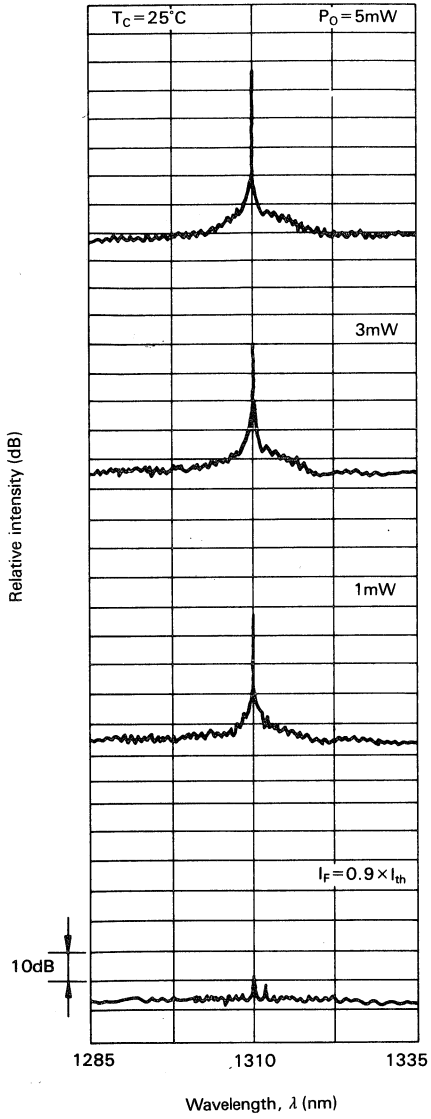
Forward Current vs. Forward Voltage



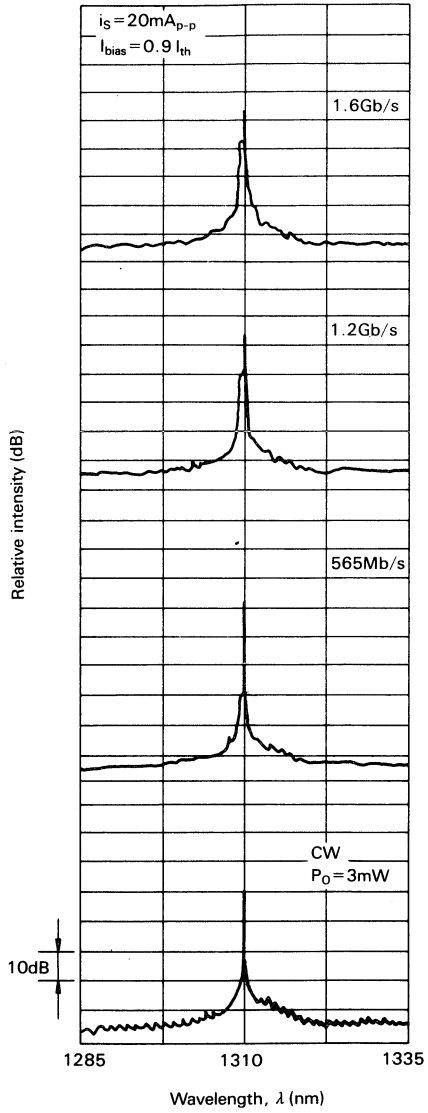
Far Field Pattern



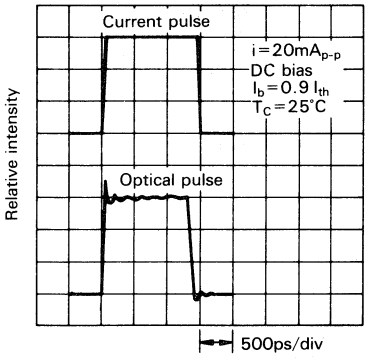
Output Power Dependence of Lasing Spectrum



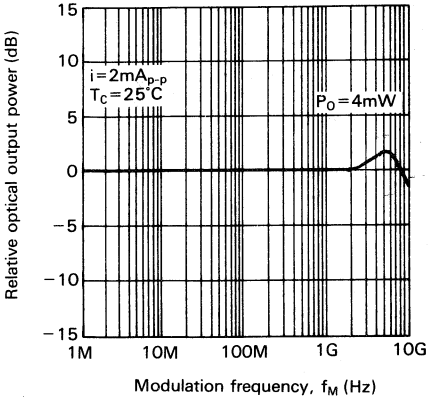
Frequency Dependence of Lasing Spectrum



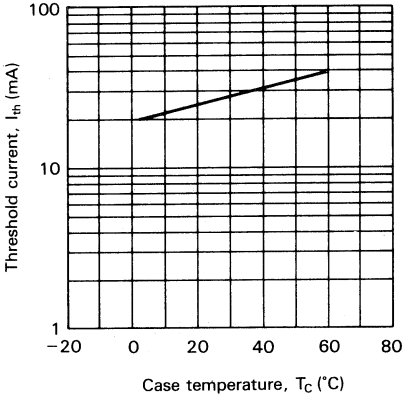
Pulse Response of Laser Diode



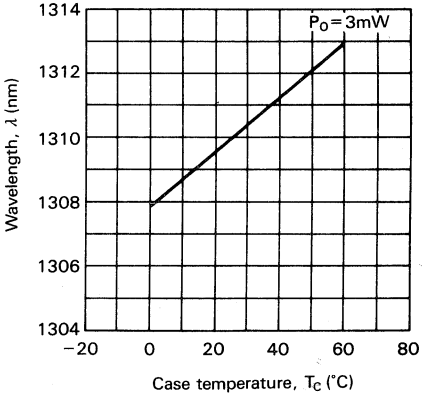
Frequency Response of Laser Diode



Threshold Current vs. Case Temperature



Temperature Dependence of Lasing Wavelength



HL1341FG

InGaAsP LD

Description

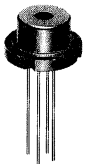
HL1341FG is a 1.3 μm InGaAsP distributed-feedback (DFB) laser diode with buried heterostructure.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications and various other types of optical equipment.

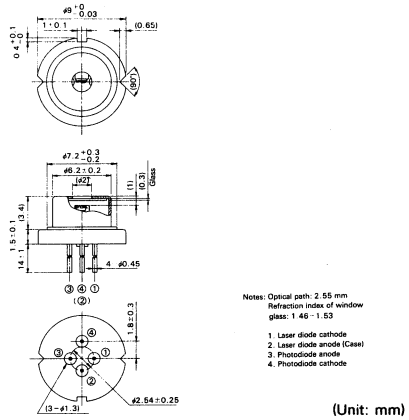
The laser beam is output through the glass window in the package cap. Monitoring current is output from a built-in photodiode.

Features

- Long wavelength light output: λ_p = 1290–1330 nm
- 5 mW CW operation at room temperature
- Dynamic single longitudinal mode: S_r = 35 dB typ.
- Built-in photodiode for monitoring laser output
- Fast pulse response: t_r, $t_f \leqq$ 0.5 ns

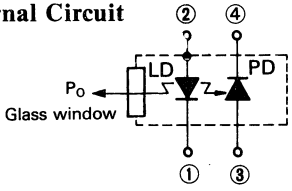


Package Dimensions



FG-type

Internal Circuit



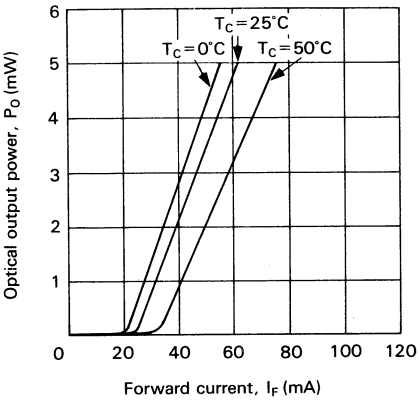
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	15	V
Photodiode forward current	$I_{F(PD)}$	1	mA
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	−40 to +80	°C

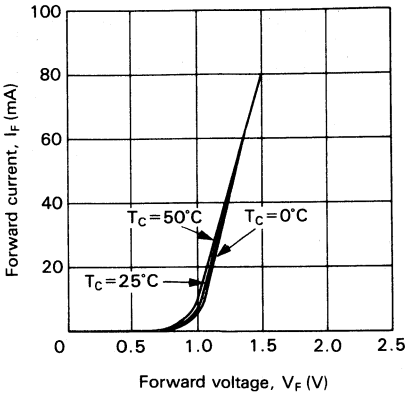
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		25	50	mA	
Optical output power	P_O	5			mW	Kink free
		2.5			mW	$I_F = I_{th}$ + 20 mA
Lasing wavelength	λ_p	1290	1310	1330	nm	P_O = 3 mW
Side-mode suppression ratio	S_r	30	35		dB	P_O = 3 mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	P_O = 3 mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	P_O = 3 mW, FWHM
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	
Photodiode dark current	I_{DARK}			350	nA	$V_{R(PD)}$ = 5 V
Monitor current	I_S	50			μA	$V_{R(PD)}$ = 5 V, P_O = 3 mW
Photodiode capacitance	C_t		10	20	pF	$V_{R(PD)}$ = 5 V, f = 1 MHz
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	

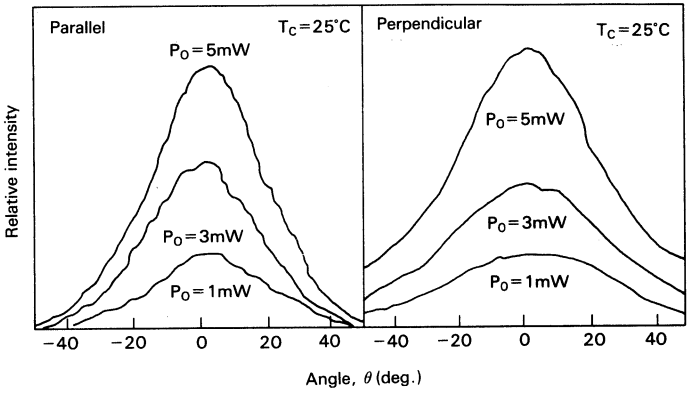
Optical Output Power vs. Forward Current



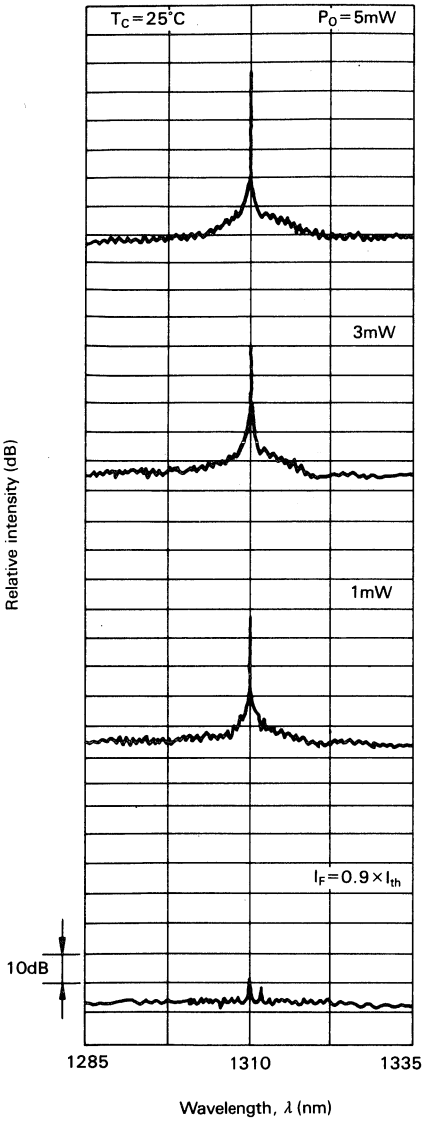
Forward Current vs. Forward Voltage



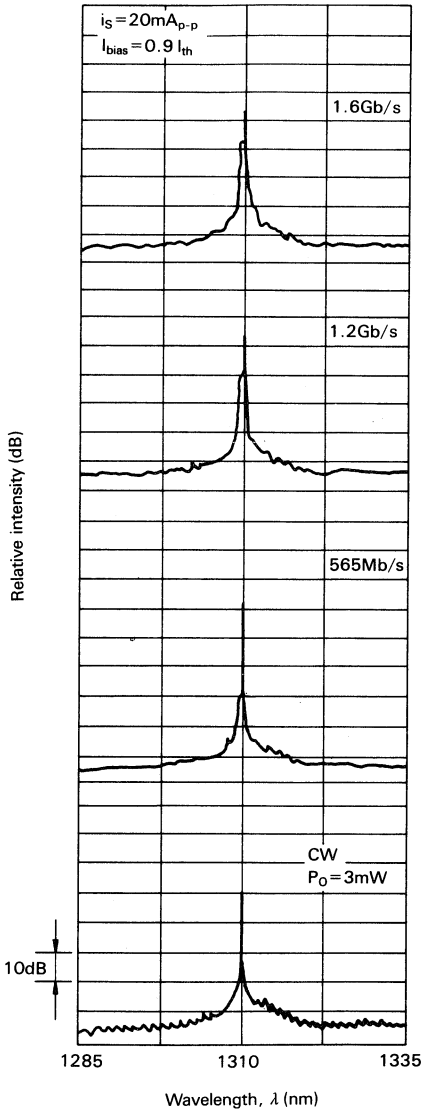
Far Field Pattern



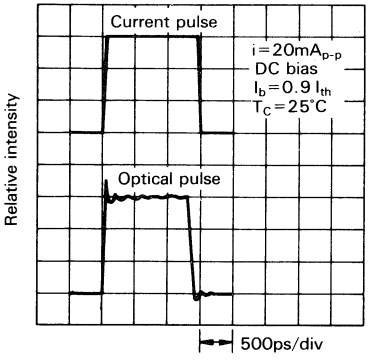
Output Power Dependence of Lasing Spectrum



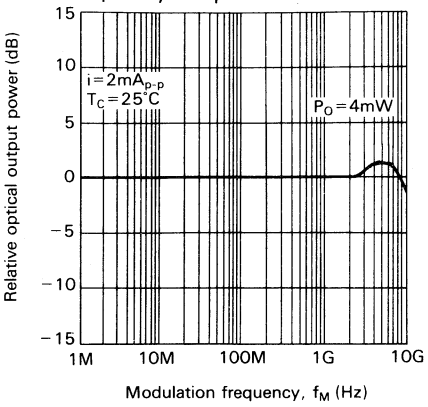
Frequency Dependence of Lasing Spectrum



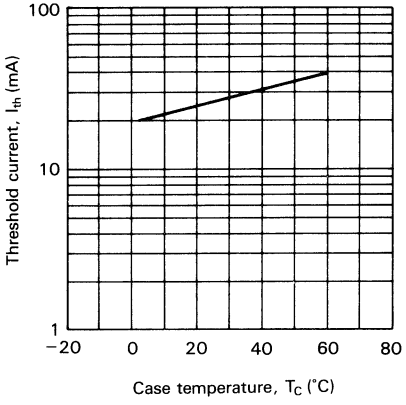
Pulse Response of Laser Diode



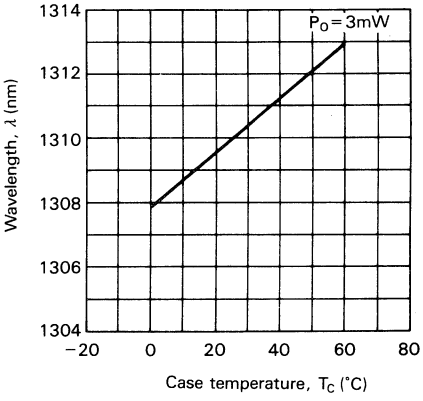
Frequency Response of Laser Diode



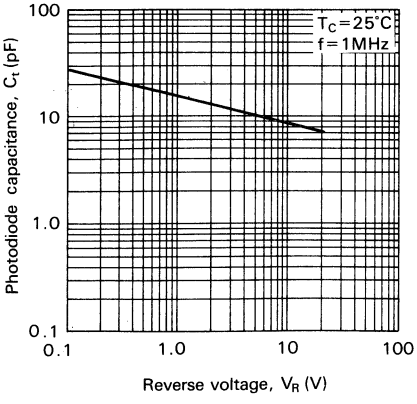
Threshold Current vs. Case Temperature



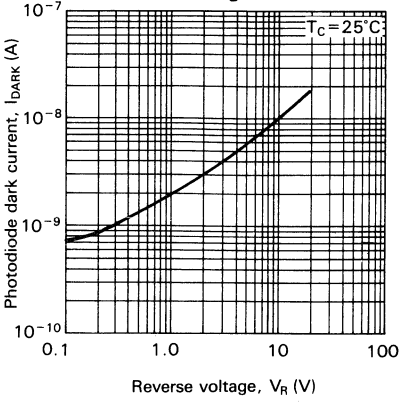
Temperature Dependence of Lasing Wavelength



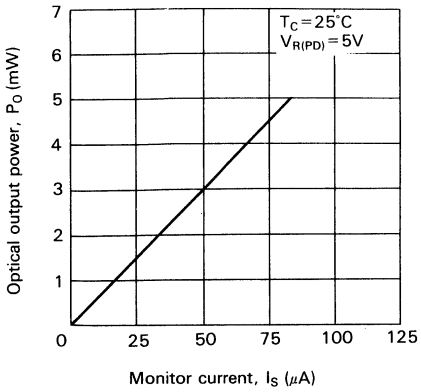
Photodiode Capacitance vs. Reverse Voltage



Photodiode Dark Current vs. Reverse Voltage



Optical Output Power vs.
Monitor Current



HL1341BF

InGaAsP LD

Description

HL1341BF is a DFB laser diode module in a 14-pin butterfly-type package with a built-in thermoelectronic controller and connected single-mode fiber.

It is suitable as a light source in high-speed modulated, high-bit-rate, long-distance fiberoptic communications equipment.

The built-in thermoelectronic controller functions to keep the laser chip operation at a constant temperature.

—Fiber specifications—

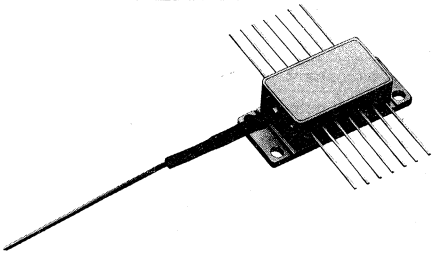
Mode field diameter	: 10.0 ± 1.0 μm
Cutoff wavelength	: 1.10—1.20 μm
Core diameter	: 10 μm
Outer diameter	: 125 μm
Jacket diameter	: 900 μm
Fiber length	: More than 500 mm

Features

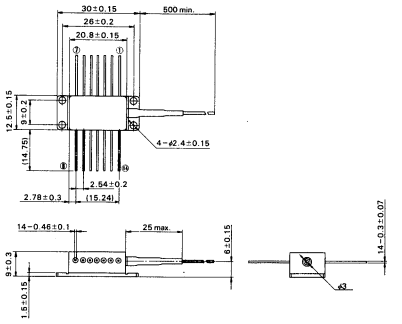
- Long wavelength light output: λ_p = 1290—1330 nm
- 1.0 mW CW and pulse operation at room temperature
- Dynamic single longitudinal mode: S_r = 35 dB typ.
- High-speed modulation (1.8 Gb/s)
- Stabilized operation with built-in thermoelectronic controller

Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Fiber optical output power	P_f	1.0	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	15	V
Photodiode forward current	$I_{F(PD)}$	1	mA
Cooler current	I_C	1.4	A
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	−40 to +70	°C



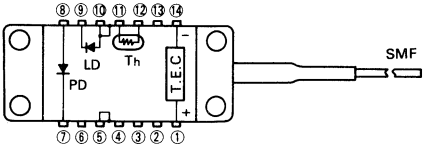
Package Dimensions



(Unit: mm)

BF-type

Pin Connection (Bottom view)



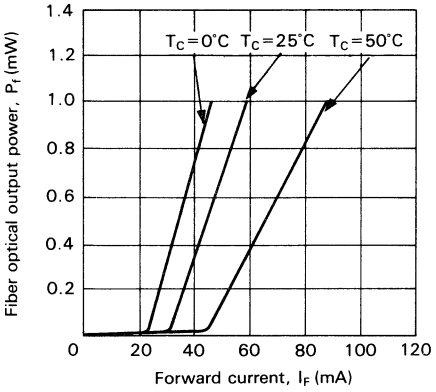
LD; Laser diode
PD; Photodiode
Th; Thermistor
T. E. C. ; T. E. cooler
SMF; Single-mode fiber

① T. E. C. anode
② N. C.
③ N. C.
④ N. C.
⑤ Case
⑥ N. C.
⑦ PD cathode
⑧ PD anode
⑨ LD cathode
⑩ LD anode (case)
⑪ Thermistor
⑫ Thermistor
⑬ N. C.
⑭ T. E. C. cathode

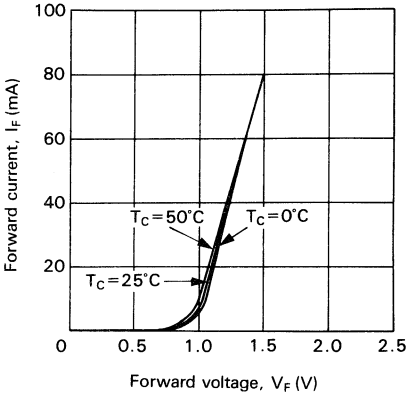
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	50	mA	
Fiber optical output power	P_f	1.0			mW	Kink free
		0.5			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1290	1310	1330	nm	P_f = 0.5 mW
Side-mode suppression ratio	S_r	30	35		dB	P_f = 0.5 mW, CW
Rise time	t_r		0.2		ns	$I_{bias} = I_{th}$, 10 to 90%
Fall time	t_f		0.3		ns	$I_{bias} = I_{th}$, 90 to 10%
Photodiode dark current	I_{DARK}			350	nA	$V_{R(PD)}$ = 5 V
Monitor current	I_S	0.3			mA	$V_{R(PD)}$ = 5 V, P_f = 0.5 mW
Photodiode capacitance	C_t		10	20	pF	$V_{R(PD)}$ = 5 V, f = 1 MHz
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Cooling capacity	ΔT	40			°C	T_C = 60°C, P_f = 0.5 mW
Cooler current	I_C			1.4	A	ΔT = 40°C
Cooler voltage	V_C			1.8	V	ΔT = 40°C
Thermistor resistance	R_{TM}		10		kΩ	

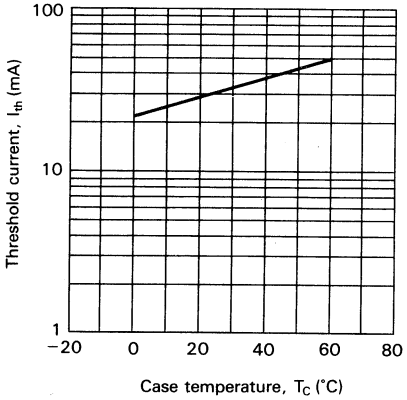
Optical Output Power vs. Forward Current



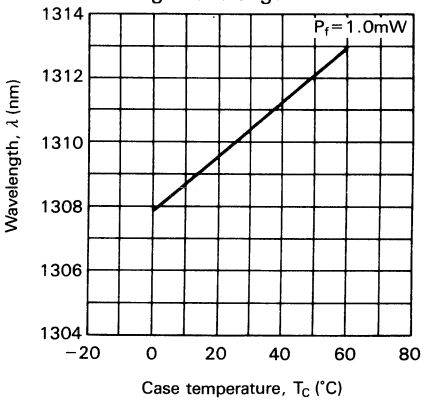
Forward Current vs. Forward Voltage



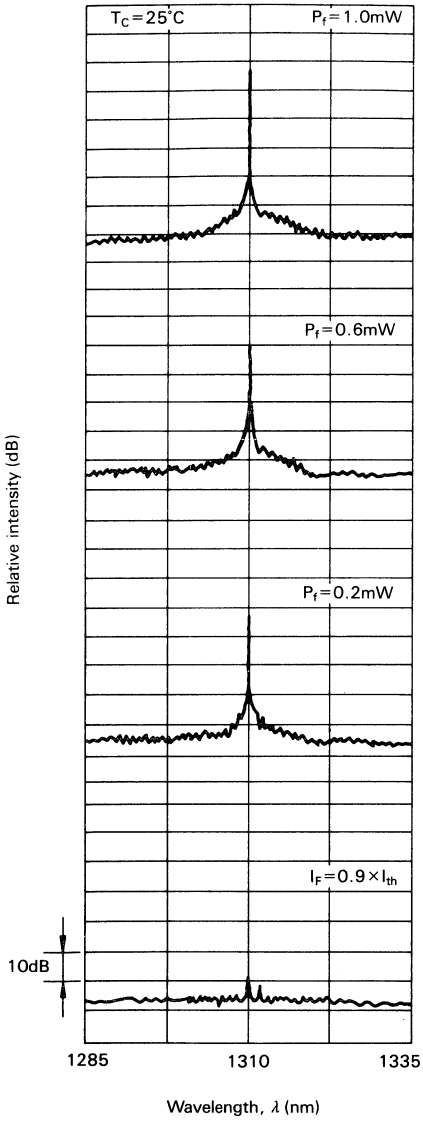
Threshold Current vs. Case Temperature



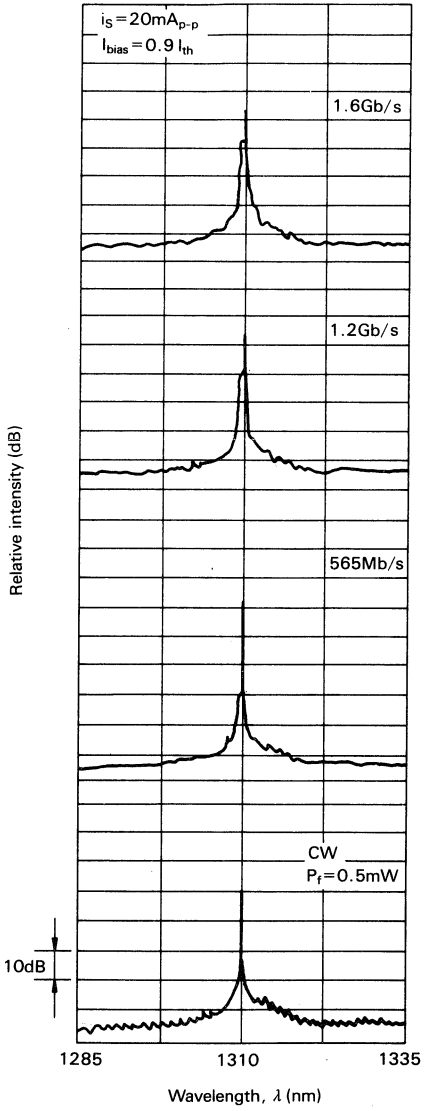
Temperature Dependence of Lasing Wavelength



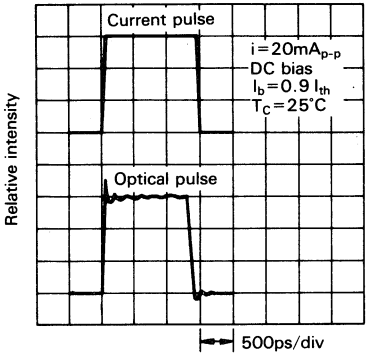
Output Power Dependence of Lasing Spectrum



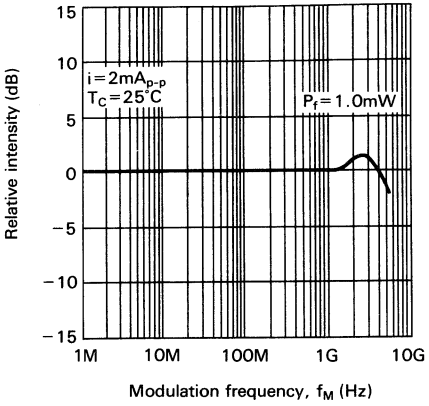
Frequency Dependence of Lasing Spectrum



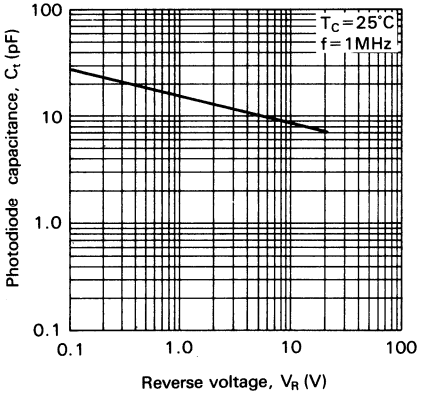
Pulse Response of Laser Diode



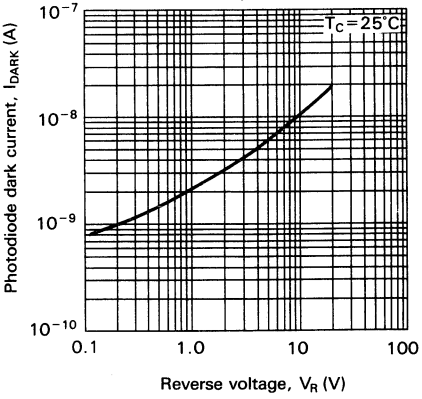
Frequency Response of Laser Diode



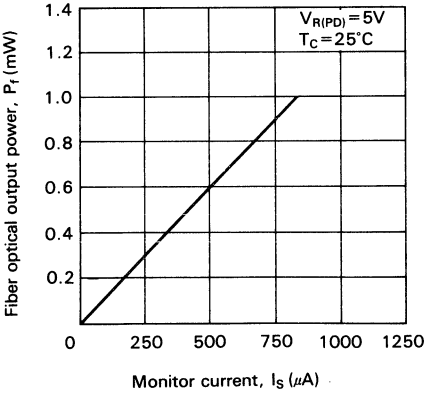
Photodiode Capacitance vs. Reverse Voltage



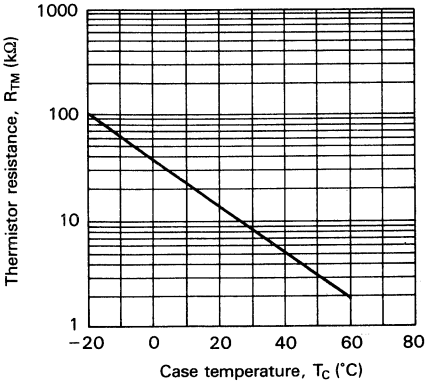
Photodiode Dark Current vs. Reverse Voltage



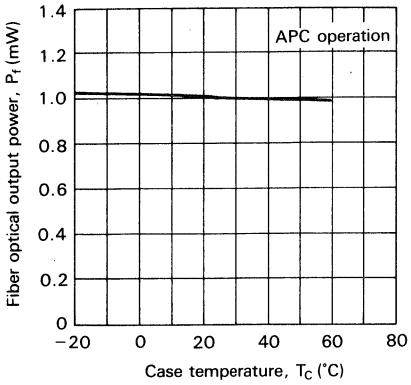
Optical Output Power vs. Monitor Current



Thermistor Resistance vs. Case Temperature



Tracking Characteristics



HL1341DL

InGaAsP LD

Description

HL1341DL is a DFB laser diode module in a 14-pin dual-in-line type package with a built-in thermoelectronic controller and connected single-mode fiber.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications equipment.

The built-in thermoelectronic controller functions to keep the laser chip operation at a constant temperature.

—Fiber specifications—

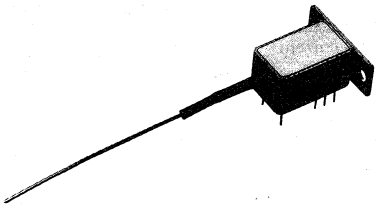
Mode field diameter	: 10.0 ± 1.0 μm
Cutoff wavelength	: 1.10—1.20 μm
Core diameter	: 10 μm
Outer diameter	: 125 μm
Jacket diameter	: 900 μm
Fiber length	: More than 500 mm

Features

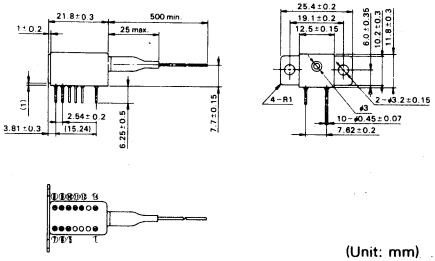
- Long wavelength light output: λ_p = 1290—1330 nm
- 1.0 mW CW and pulse operation at room temperature
- Dynamic single longitudinal mode: S_r = 35 dB typ.
- High-speed modulation (800 Mb/s)
- Stabilized operation with built-in thermoelectronic controller

Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Fiber optical output power	P_f	1.0	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	15	V
Photodiode forward current	$I_{F(PD)}$	1	mA
Cooler current	I_C	1.4	A
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	−40 to +70	°C



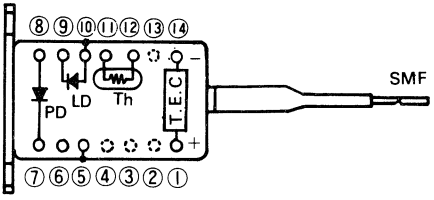
Package Dimensions



(Unit: mm)

DL-type

Pin Connection (Bottom view)



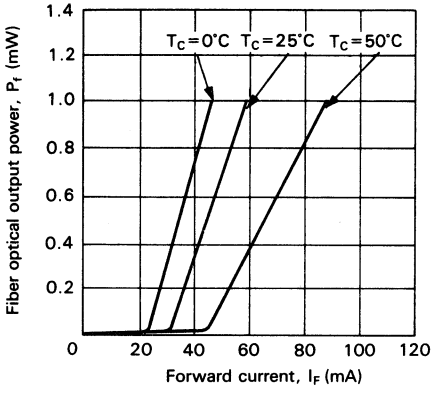
LD; Laser diode
PD; Photodiode
Th; Thermistor
T. E. C. ; T. E. cooler
SMF; Single-mode fiber

① T. E. C. anode
② —
③ —
④ —
⑤ Case
⑥ N. C.
⑦ PD cathode
⑧ PD anode
⑨ LD cathode
⑩ LD anode (case)
⑪ Thermistor
⑫ Thermistor
⑬ —
⑭ T. E. C. cathode

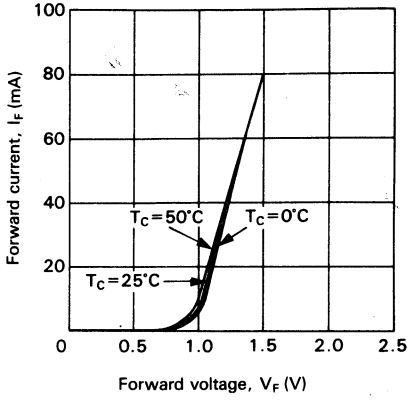
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	50	mA	
Fiber optical output power	P_f	1.0			mW	Kink free
		0.5			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1290	1310	1330	nm	P_f = 0.5 mW
Side-mode suppression ratio	S_r	30	35		dB	P_f = 0.5 mW, CW
Rise time	t_r		0.2		ns	$I_{bias} = I_{th}$, 10 to 90%
Fall time	t_f		0.3		ns	$I_{bias} = I_{th}$, 90 to 10%
Photodiode dark current	I_{DARK}			350	nA	$V_{R(PD)}$ = 5 V
Monitor current	I_S	0.3			mA	$V_{R(PD)}$ = 5 V, P_f = 0.5 mW
Photodiode capacitance	C_t		10	20	pF	$V_{R(PD)}$ = 5 V, f = 1 MHz
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Cooling capacity	ΔT	40			°C	T_C = 60°C, P_f = 0.5 mW
Cooler current	I_C			1.4	A	ΔT = 40°C
Cooler voltage	V_C			1.8	V	ΔT = 40°C
Thermistor resistance	R_{TM}		10		kΩ	

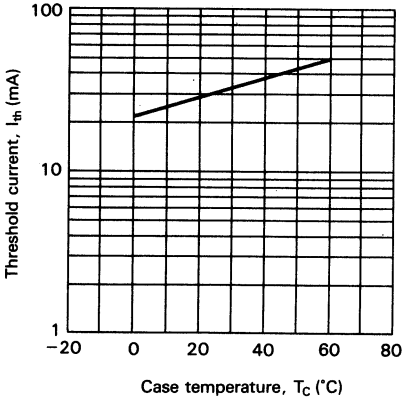
Optical Output Power vs. Forward Current



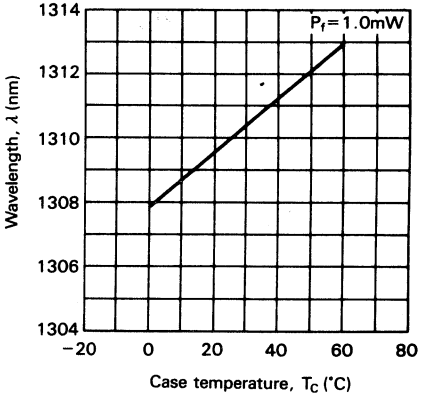
Forward Current vs. Forward Voltage



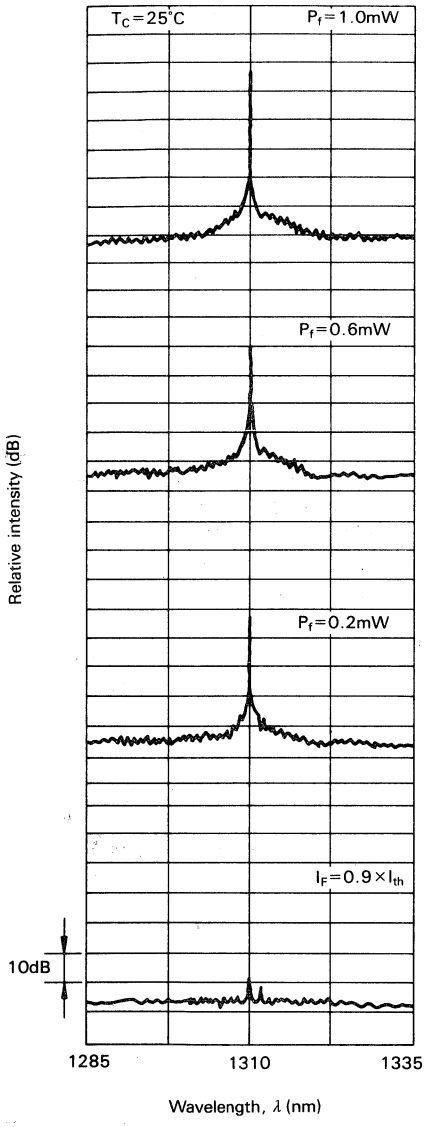
Threshold Current vs. Case Temperature



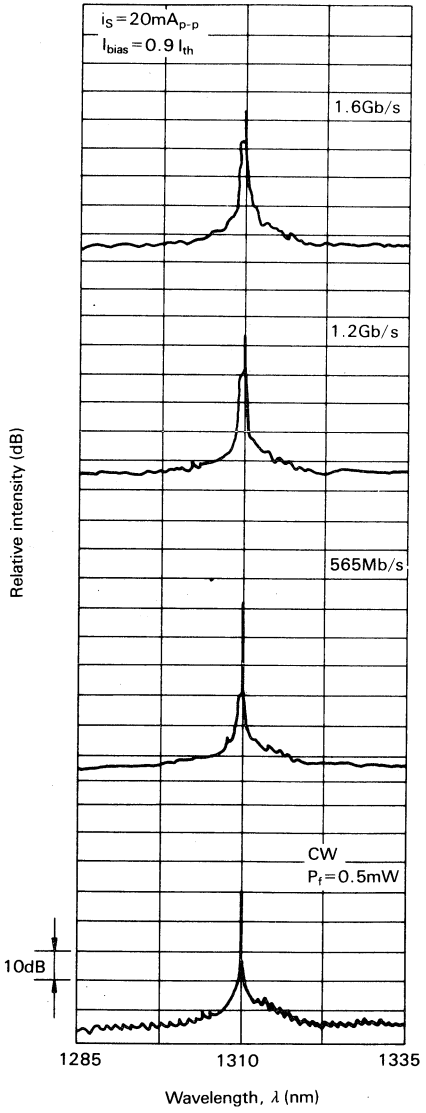
Temperature Dependence of Lasing Wavelength



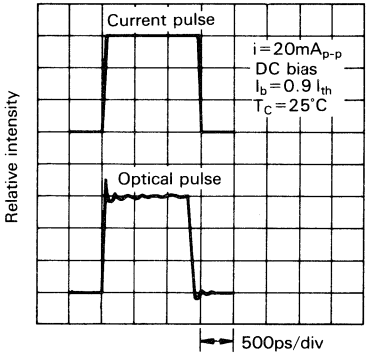
Output Power Dependence of Lasing Spectrum



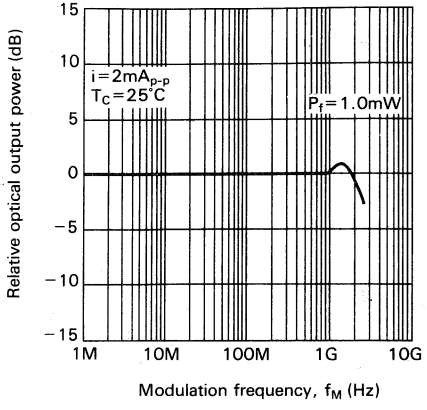
Frequency Dependence of Lasing Spectrum



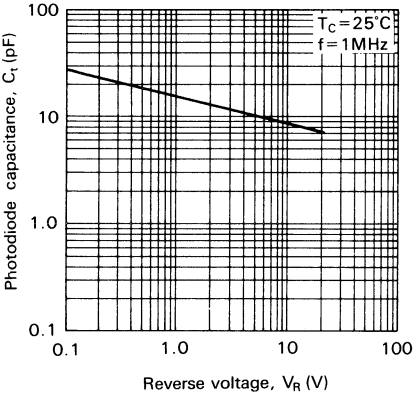
Pulse Response of Laser Diode



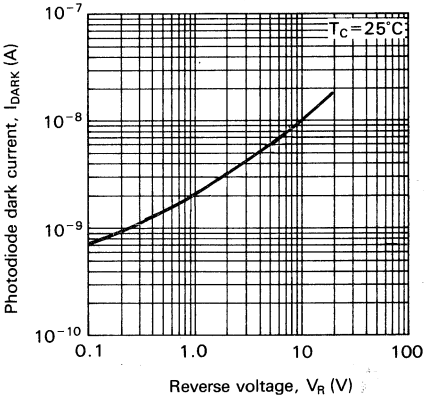
Frequency Response of Laser Diode



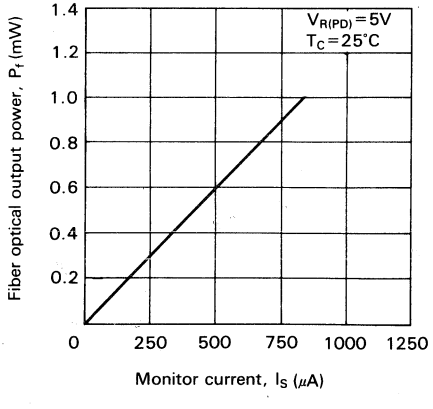
Photodiode Capacitance vs. Reverse Voltage



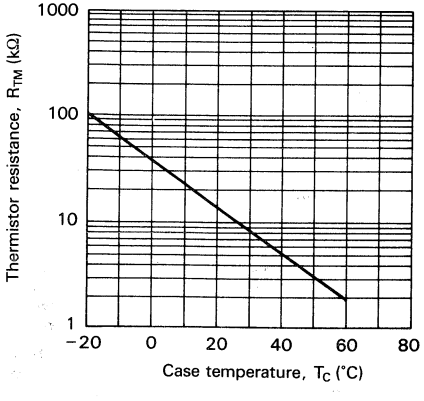
Photodiode Dark Current vs. Reverse Voltage



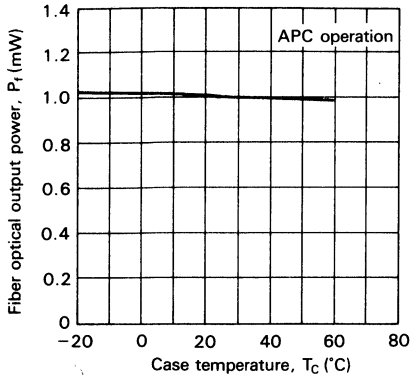
Optical Output Power vs. Monitor Current



Thermistor Resistance vs. Case Temperature



Tracking Characteristics



HL1361A

—Under development—
InGaAsP LD

Description

HL1361A is a 1.3 μm InGaAsP distributed-feedback (DFB) laser diode with $\lambda/4$ phase shifted.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications and various other types of optical equipment.

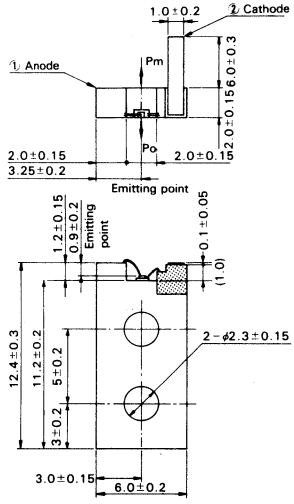
Direct photo-exposure technology is employed to have fine phase-shifted grating.

The package is convenient for system testing because the laser chip is mounted on its stem. This device should be hermetically sealed before mounting on a system.

Features

- Long wavelength light output: λ_p = 1290–1330 nm
- 5 mW CW operation at room temperature
- Dynamic single longitudinal mode: S_r = 38 dB typ.
- Fast pulse response: t_r = 0.15 ns, t_f = 0.2 ns typ.
- High-speed modulation (2.4 Gb/s)

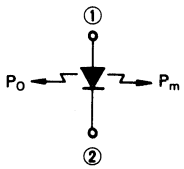
Package Dimensions



(Unit: mm)

A-type

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	0 to +80	°C

Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		25	50	mA	
Optical output power	P_O	5			mW	Kink free
		2.5			mW	$I_F = I_{th}$ + 20 mA
Monitor power	P_m	1.0			mW	$I_F = I_{th}$ + 20 mA
Lasing wavelength	λ_p	1290	1310	1330	nm	P_O = 3 mW
Side-mode suppression ratio	S_r	30	38		dB	P_O = 3 mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	P_O = 3 mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	P_O = 3 mW, FWHM
Rise time	t_r		0.15		ns	$I_{bias} = I_{th}$, 10 to 90%
Fall time	t_f		0.2		ns	$I_{bias} = I_{th}$, 90 to 10%

HL1361AC

—Under development—
InGaAsP LD

Description

HL1361AC is a 1.3 μm InGaAsP distributed-feedback (DFB) laser diode with $\lambda/4$ phase shifted.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications and various other types of optical equipment.

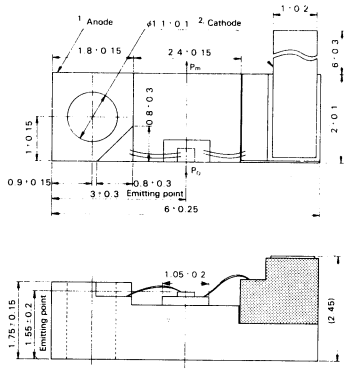
Direct photo-exposure technology is employed to have fine phase-shifted grating.

The package is compact to facilitate module assembly.

Features

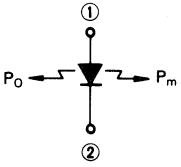
- Long wavelength light output: $\lambda_p = 1290-1330$ nm
- 5 mW CW operation at room temperature
- Dynamic single longitudinal mode: $S_r = 38$ dB typ.
- Fast pulse response: $t_r = 0.15$ ns, $t_f = 0.2$ ns typ.
- High-speed modulation (2.4 Gb/s)

Package Dimensions



AC-type

Internal Circuit



Absolute Maximum Ratings ($T_C = 25°C$)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	0 to +80	°C

Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		25	50	mA	
Optical output power	P_O	5			mW	Kink free
		2.5			mW	$I_F = I_{th} + 20$ mA
Monitor power	P_m	1.0			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1290	1310	1330	nm	$P_O = 3$ mW
Side-mode suppression ratio	S_r	30	38		dB	$P_O = 3$ mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	$P_O = 3$ mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	$P_O = 3$ mW, FWHM
Rise time	t_r		0.15		ns	$I_{bias} = I_{th}$, 10 to 90%
Fall time	t_f		0.2		ns	$I_{bias} = I_{th}$, 90 to 10%

HL1521A

InGaAsP LD

Description

HL1521A is a 1.55 μm InGaAsP laser diode with double heterojunction structure.

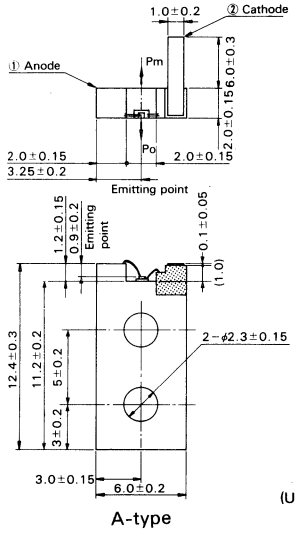
It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications and various other types of optical equipment.

The package is convenient for system testing because the laser chip is mounted on its stem. This device should be hermetically sealed before mounting on a system.

Features

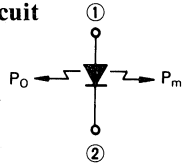
- Long wavelength light output: λ_p = 1530–1570 nm
- 5 mW CW operation at room temperature
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns

Package Dimensions



A-type

Internal Circuit



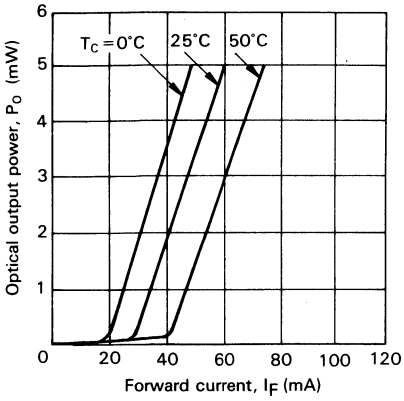
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	0 to +80	°C

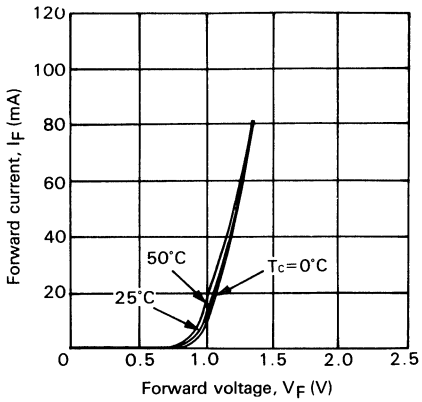
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	50	mA	
Optical output power	P_O	5			mW	Kink free
		2.0			mW	$I_F = I_{th}$ + 20 mA
Monitor power	P_m	0.45			mW	$I_F = I_{th}$ + 20 mA
Lasing wavelength	λ_p	1530	1550	1570	nm	P_O = 3 mW
Spectral width	$\Delta\lambda$		2		nm	P_O = 3 mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	P_O = 3 mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	P_O = 3 mW, FWHM
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

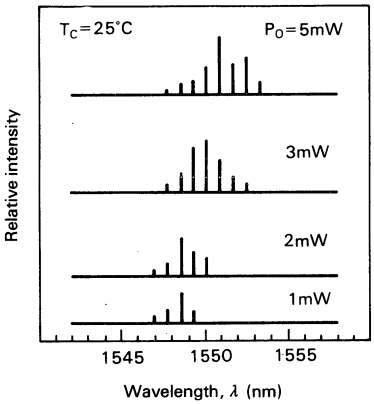
Optical Output Power vs. Forward Current



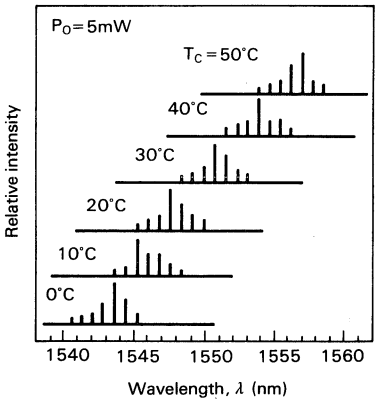
Forward Current vs. Forward Voltage



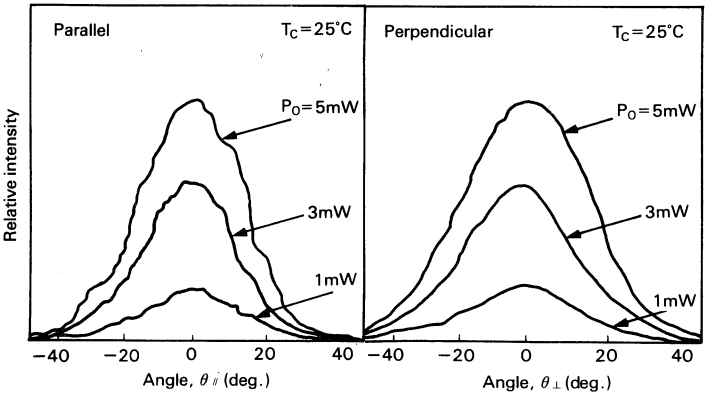
Lasing Spectrum



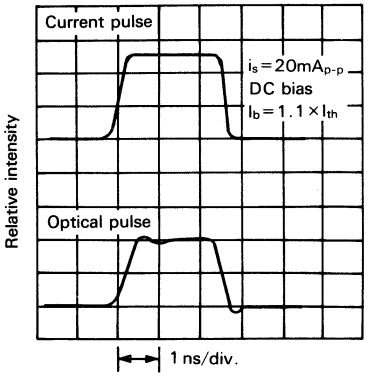
Temperature Dependence of Lasing Spectrum



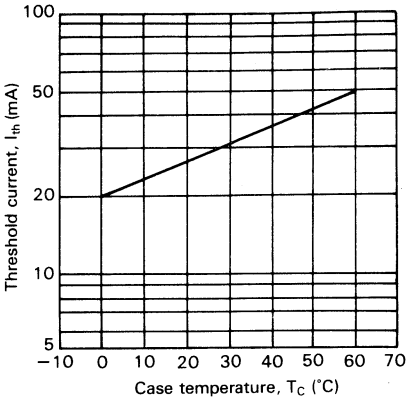
Far Field Pattern



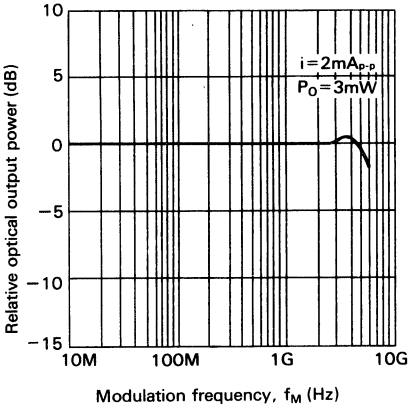
Pulse Response



Threshold Current vs. Case Temperature



Frequency Response of Laser Diode



HL1521AC

InGaAsP LD

Description

HL1521AC is a 1.55 μm InGaAsP laser diode with double heterojunction structure.

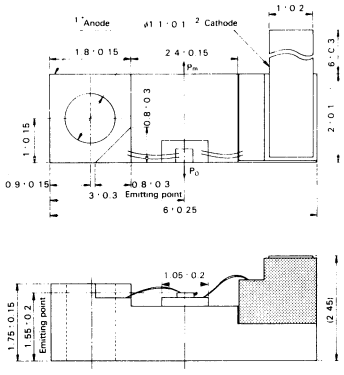
It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications and various other types of optical equipment.

The package is compact to facilitate module assembly.

Features

- Long wavelength light output: $\lambda_p = 1530-1570$ nm
- 5 mW CW operation at room temperature
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns

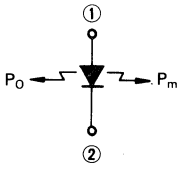
Package Dimensions



(Unit: mm)

AC-type

Internal Circuit



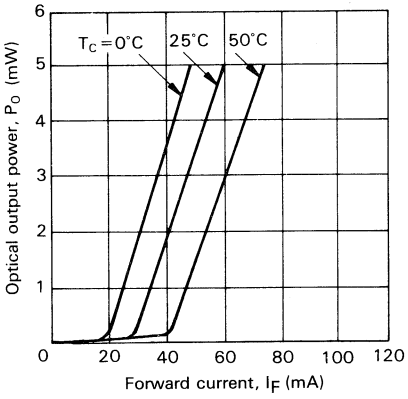
Absolute Maximum Ratings ($T_C = 25°C$)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	0 to +80	°C

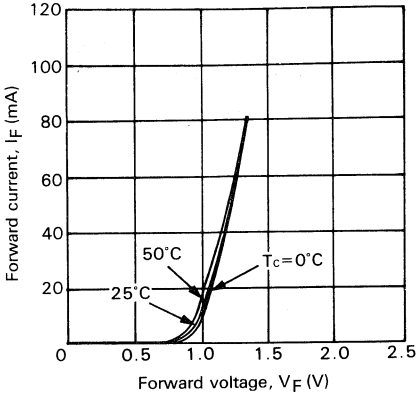
Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	50	mA	
Optical output power	P_O	5			mW	Kink free
		2.0			mW	$I_F = I_{th} + 20$ mA
Monitor power	P_m	0.45			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1530	1550	1570	nm	$P_O = 3$ mW
Spectral width	$\Delta\lambda$		2		nm	$P_O = 3$ mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	$P_O = 3$ mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	$P_O = 3$ mW, FWHM
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

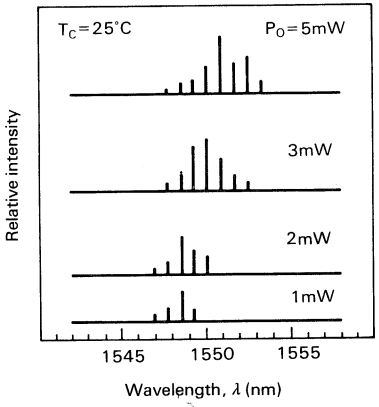
Optical Output Power vs. Forward Current



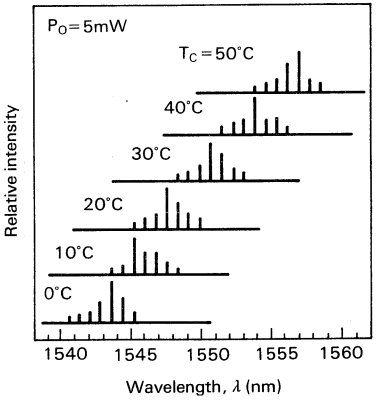
Forward Current vs. Forward Voltage



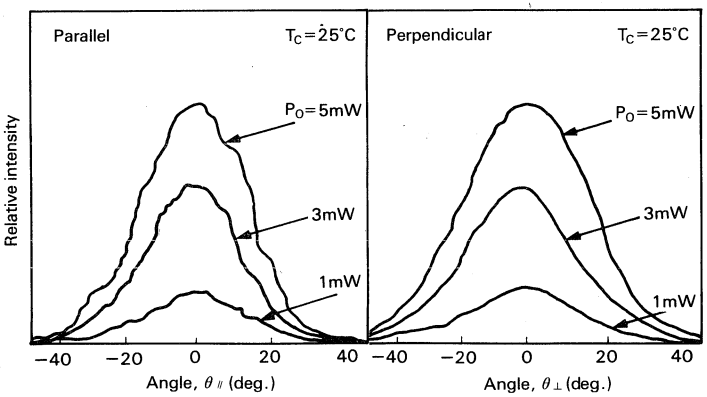
Lasing Spectrum



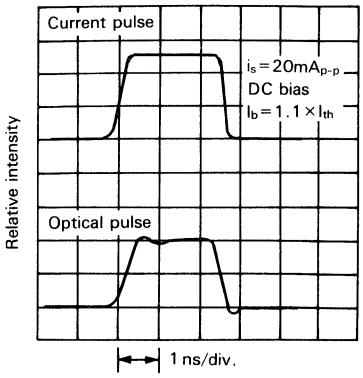
Temperature Dependence of Lasing Spectrum



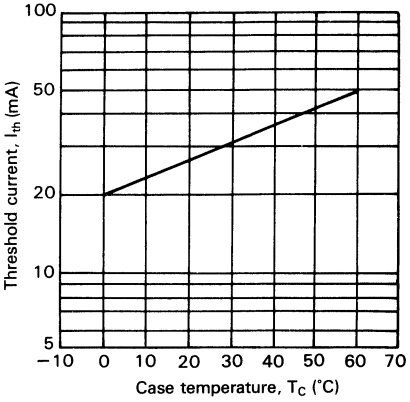
Far Field Pattern



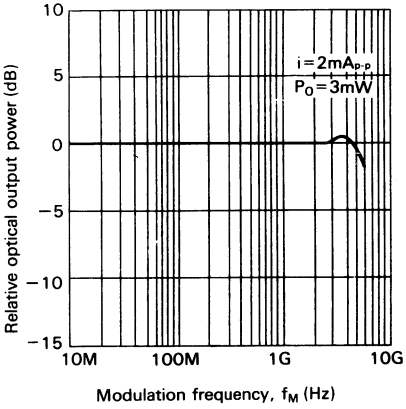
Pulse Response



Threshold Current vs. Case Temperature



Frequency Response of Laser Diode



HL1521FG

InGaAsP LD

Description

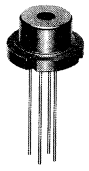
HL1521FG is a 1.55 μm InGaAsP laser diode with buried heterostructure.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications and various other types of optical equipment.

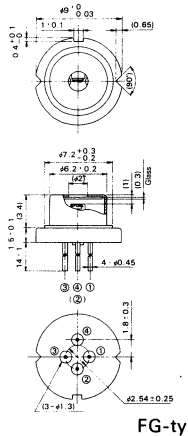
The laser beam is output through the glass window in the package cap. Monitoring current is output from a built-in photodiode.

Features

- Long wavelength light output: $\lambda_p = 1530-1570$ nm
- 5 mW CW operation at room temperature
- Built-in photodiode for monitoring laser output
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns



Package Dimensions



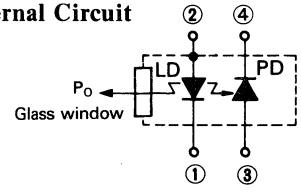
Notes: Optical path: 2.55 mm
Refraction index of window glass: 1.46 - 1.53

① Laser diode cathode
② Laser diode anode (Case)
③ Photodiode anode
④ Photodiode cathode

(Unit: mm)

FG-type

Internal Circuit



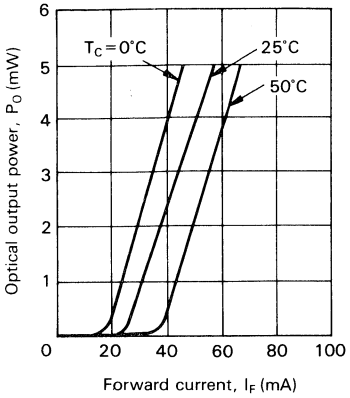
Absolute Maximum Ratings ($T_C = 25°C$)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	15	V
Photodiode forward current	$I_{F(PD)}$	1	mA
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	−40 to +80	°C

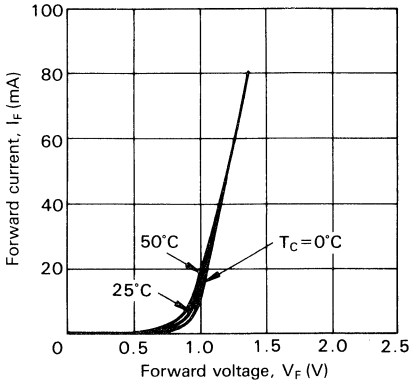
Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	50	mA	
Optical output power	P_O	5			mW	Kink free
		1.5			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1530	1550	1570	nm	$P_O = 3$ mW
Spectral width	$\Delta\lambda$		2		nm	$P_O = 3$ mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	$P_O = 3$ mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	$P_O = 3$ mW, FWHM
Photodiode dark current	I_{DARK}			350	nA	$V_{R(PD)} = 5$ V
Monitor current	I_S	50			μA	$V_{R(PD)} = 5$ V, $P_O = 3$ mW
Photodiode capacitance	C_t		10	20	pF	$V_{R(PD)} = 5$ V, f = 1 MHz
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Rise time	t_r			0.5	ns	$I_{bias} = I_{th}$, 10 to 90%
Fall time	t_f			0.5	ns	$I_{bias} = I_{th}$, 90 to 10%

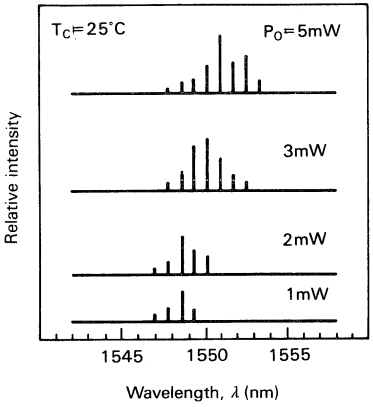
Optical Output Power vs. Forward Current



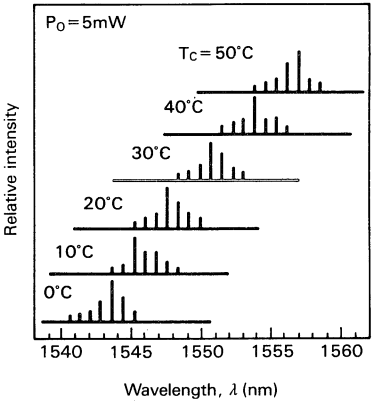
Forward Current vs. Forward Voltage



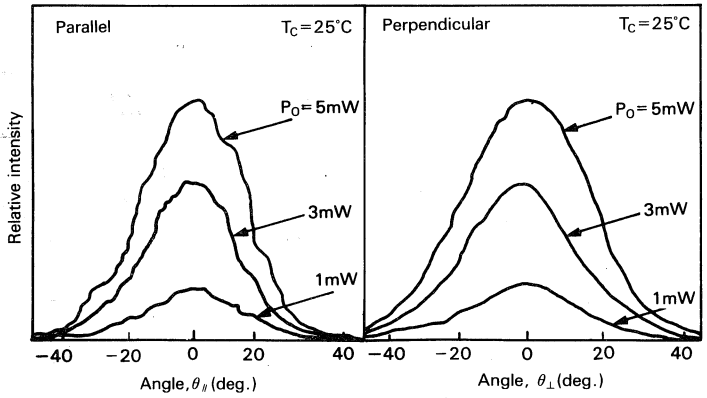
Lasing Spectrum



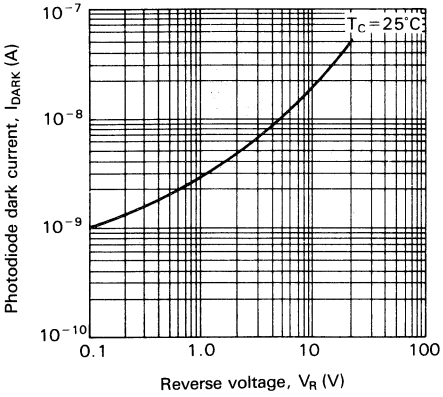
Temperature Dependence of Lasing Spectrum



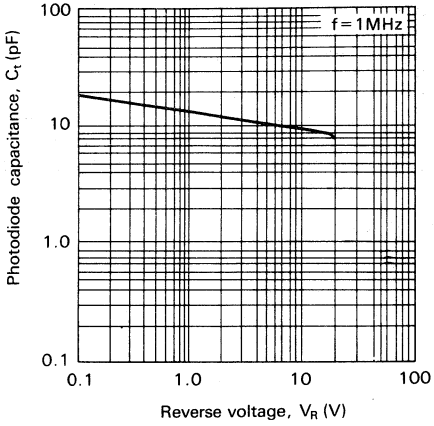
Far Field Pattern



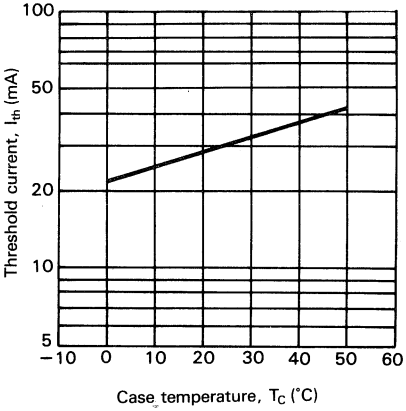
Photodiode Dark Current vs. Reverse Voltage



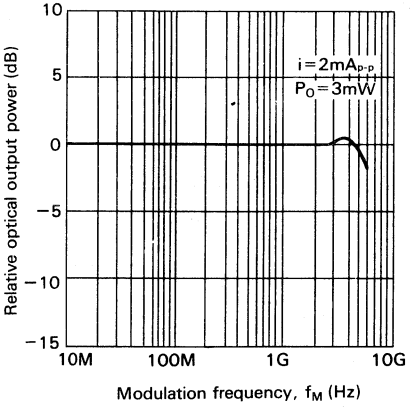
Photodiode Capacitance vs. Reverse Voltage



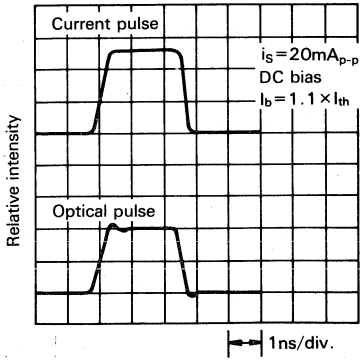
Threshold Current vs. Case Temperature



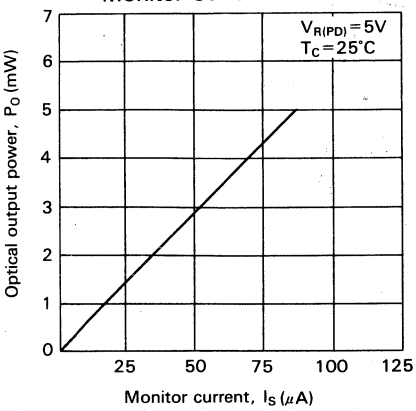
Frequency Response of Laser Diode



Pulse Response of Laser Diode



Optical Output Power vs. Monitor Current



Description

HL1541A is a 1.55 μm InGaAsP distributed-feedback (DFB) laser diode with buried hetero-structure.

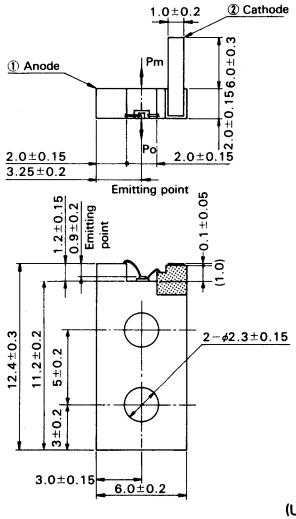
It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications and various other types of optical equipment.

The package is convenient for system testing because the laser chip is mounted on its stem. This device should be hermetically sealed before mounting on a system.

Features

- Long wavelength light output: λ_p = 1530–1570 nm
- 5 mW CW operation at room temperature
- Dynamic single longitudinal mode: S_r = 35 dB typ.
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns

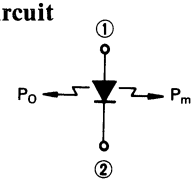
Package Dimensions



(Unit: mm)

A-type

Internal Circuit



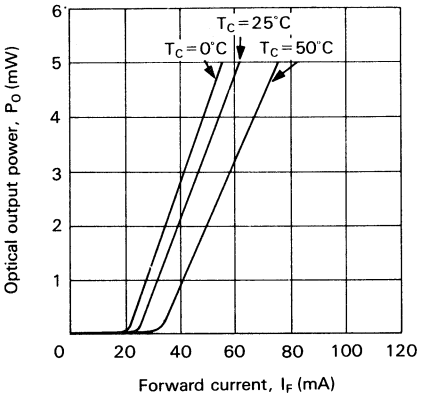
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	0 to +80	°C

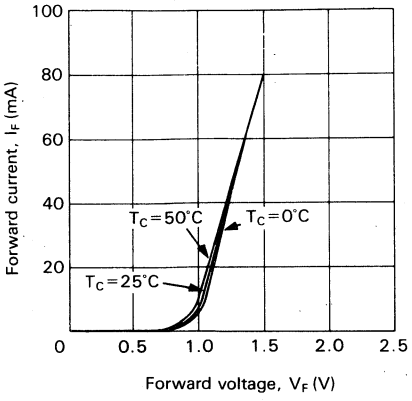
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		25	50	mA	
Optical output power	P_O	5			mW	Kink free
		1.5			mW	$I_F = I_{th}$ + 20 mA
Monitor power	P_m	0.5			mW	$I_F = I_{th}$ + 20 mA
Lasing wavelength	λ_p	1530	1550	1570	nm	P_O = 3 mW
Side-mode suppression ratio	S_r	30	35		dB	P_O = 3 mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	P_O = 3 mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	P_O = 3 mW, FWHM
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

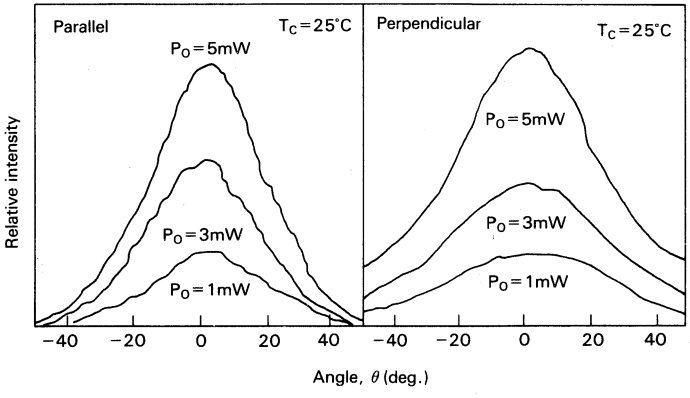
Optical Output Power vs. Forward Current



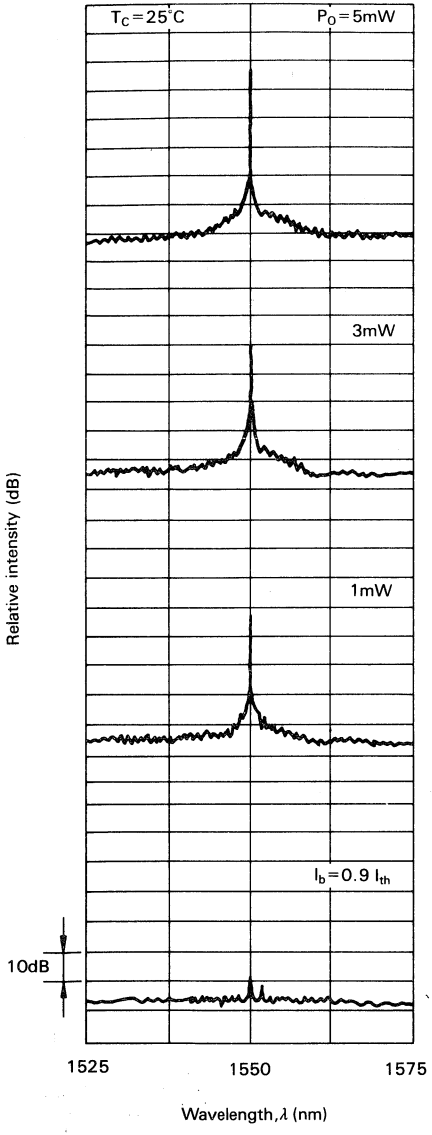
Forward Current vs. Forward Voltage



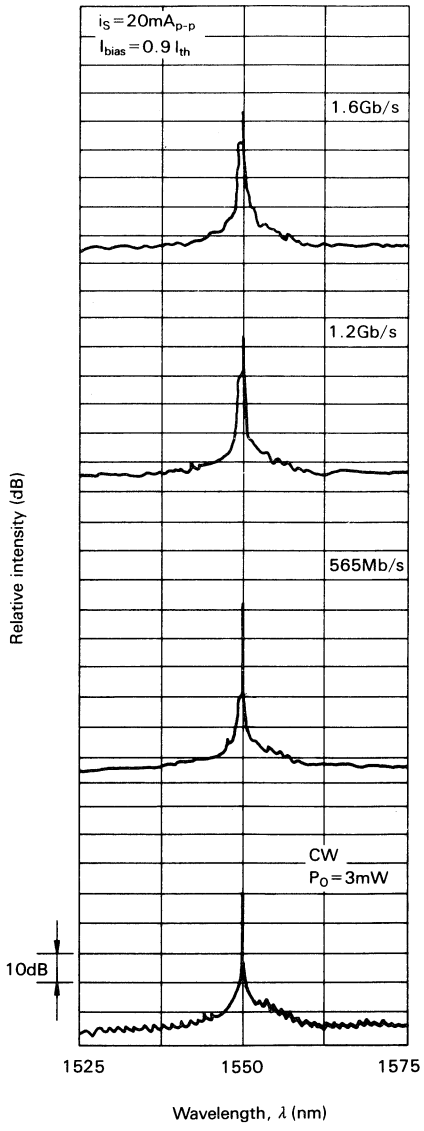
Far Field Pattern



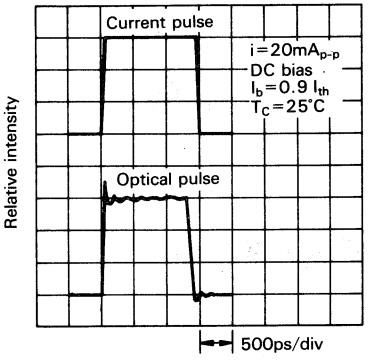
Output Power Dependence of Lasing Spectrum



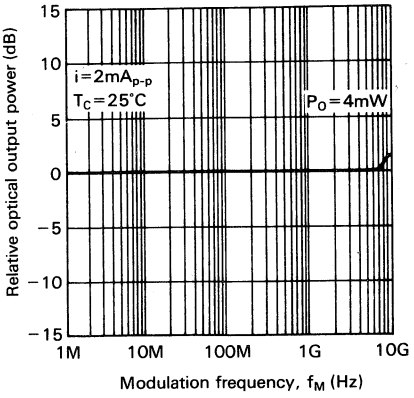
Frequency Dependence of Lasing Spectrum



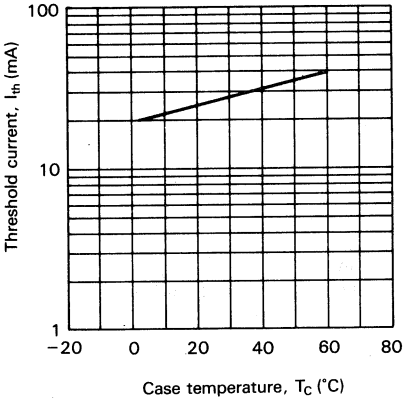
Pulse Response of Laser Diode



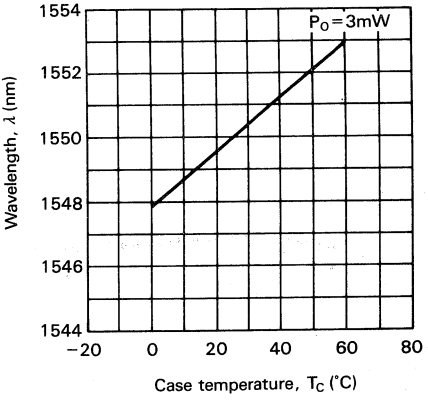
Frequency Response of Laser Diode



Threshold Current vs. Case Temperature



Temperature Dependence of Lasing Wavelength



HL1541AC

InGaAsP LD

Description

HL1541AC is a 1.55 μm InGaAsP distributed-feedback (DFB) laser diode with buried hetero-structure.

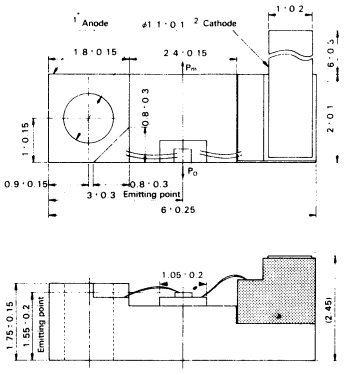
It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications and various other types of optical equipment.

The package is compact to facilitate module assembly.

Features

- Long wavelength light output: $\lambda_p = 1530-1570$ nm
- 5 mW CW operation at room temperature
- Dynamic single longitudinal mode: $S_r = 35$ dB typ.
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns

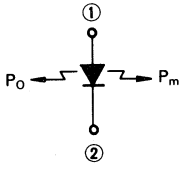
Package Dimensions



(Unit: mm)

AC-type

Internal Circuit



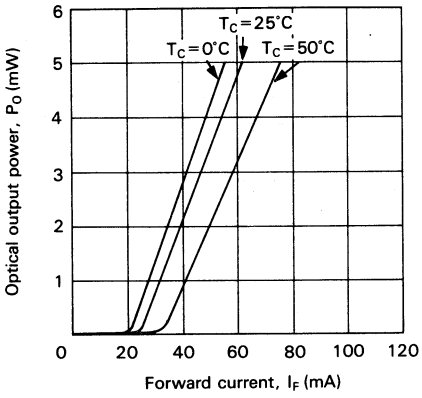
Absolute Maximum Ratings ($T_C = 25°C$)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	0 to +80	°C

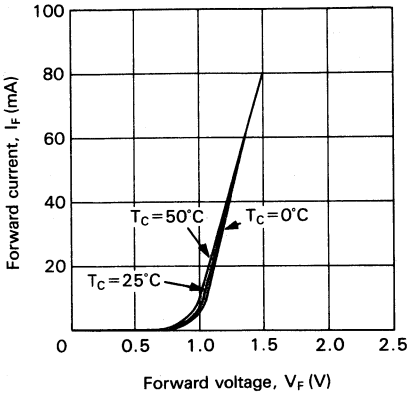
Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		25	50	mA	
Optical output power	P_O	5			mW	Kink free
		1.5			mW	$I_F = I_{th} + 20$ mA
Monitor power	P_m	0.5			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1530	1550	1570	nm	$P_O = 3$ mW
Side-mode suppression ratio	S_r	30	35		dB	$P_O = 3$ mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	$P_O = 3$ mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	$P_O = 3$ mW, FWHM
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

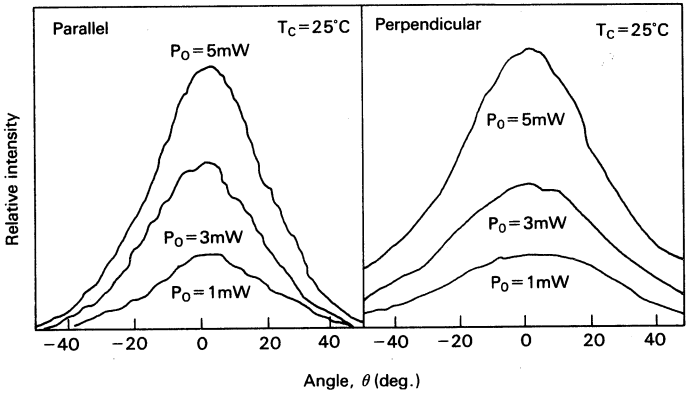
Optical Output Power vs. Forward Current



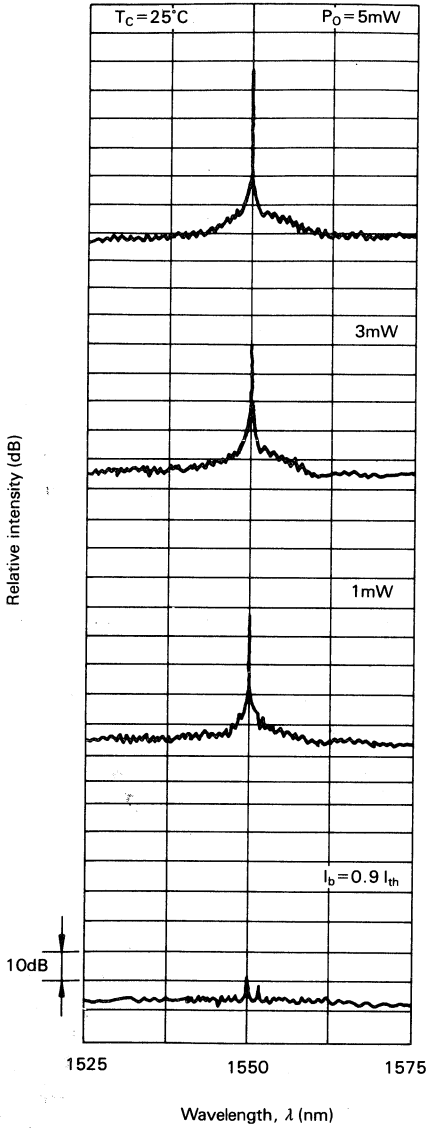
Forward Current vs. Forward Voltage



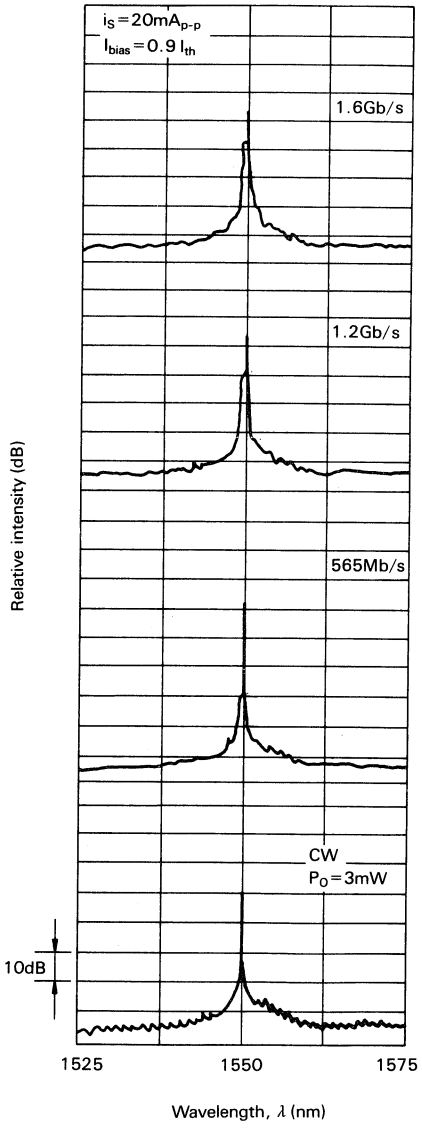
Far Field Pattern



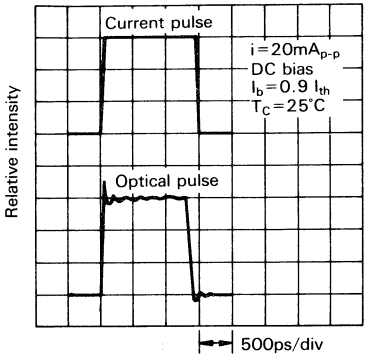
Output Power Dependence of Lasing Spectrum



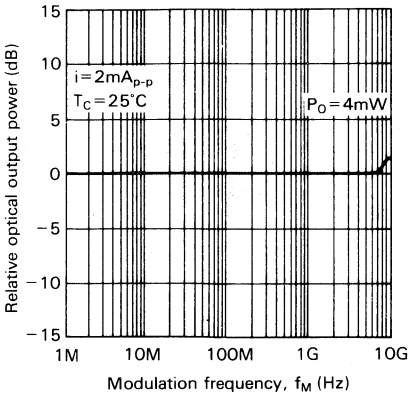
Frequency Dependence of Lasing Spectrum



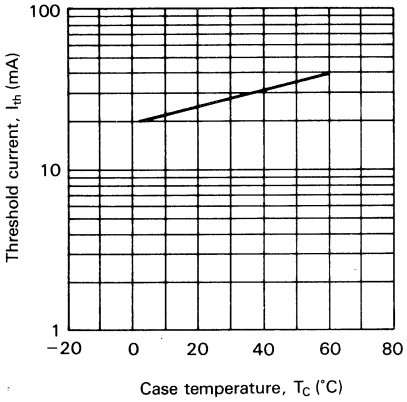
Pulse Response of Laser Diode



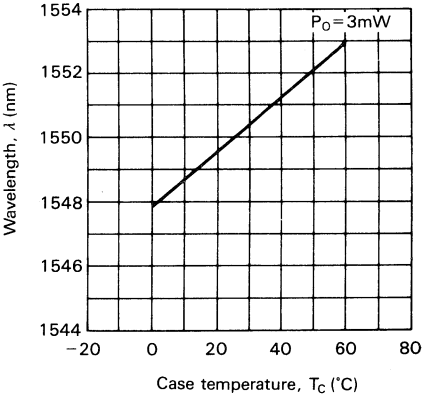
Frequency Response of Laser Diode



Threshold Current vs. Case Temperature



Temperature Dependence of Lasing Wavelength



HL1541FG

InGaAsP LD

Description

HL1541FG is a 1.55 μm InGaAsP distributed-feedback (DFB) laser diode with buried hetero-structure.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications and various other types of optical equipment.

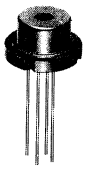
The laser beam is output through the glass window in the package. Monitoring current is output from a built-in photodiode.

Features

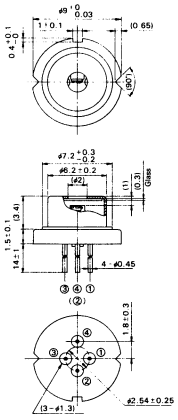
- Long wavelength light output: λ_p = 1530–1570 nm
- 5 mW CW operation at room temperature
- Dynamic single longitudinal mode: S_r = 35 dB typ.
- Built-in photodiode for monitoring laser output
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns

Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	15	V
Photodiode forward current	$I_{F(PD)}$	1	mA
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	−40 to +80	°C



Package Dimensions



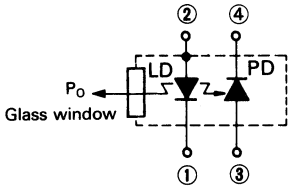
Notes: Optical path: 2.55 mm
Refraction index of window glass: 1.46 - 1.53

① Laser diode cathode
② Laser diode anode (Case)
③ Photodiode anode
④ Photodiode cathode

FG-type

(Unit: mm)

Internal Circuit

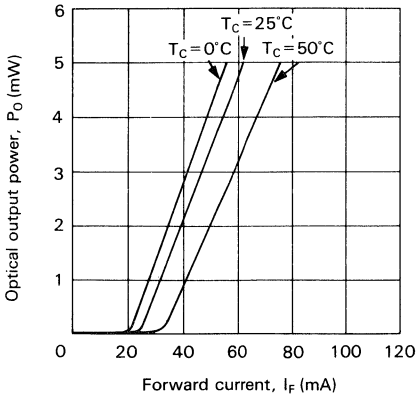


HITACHI

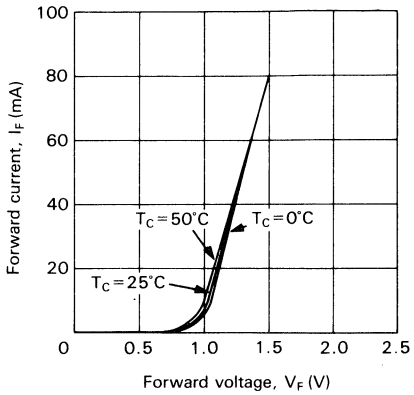
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		25	50	mA	
Optical output power	P_O	5			mW	Kink free
		1.5	3.0		mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1530	1550	1570	nm	$P_O = 3$ mW
Side-mode suppression ratio	S_r	30	35		dB	$P_O = 3$ mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	$P_O = 3$ mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	$P_O = 3$ mW, FWHM
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	
Photodiode dark current	I_{DARK}			350	nA	$V_{R(PD)} = 5$ V
Monitor current	I_S	50			μA	$V_{R(PD)} = 5$ V, $P_O = 3$ mW
Photodiode capacitance	C_t		10	20	pF	$V_{R(PD)} = 5$ V, f = 1 MHz
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	

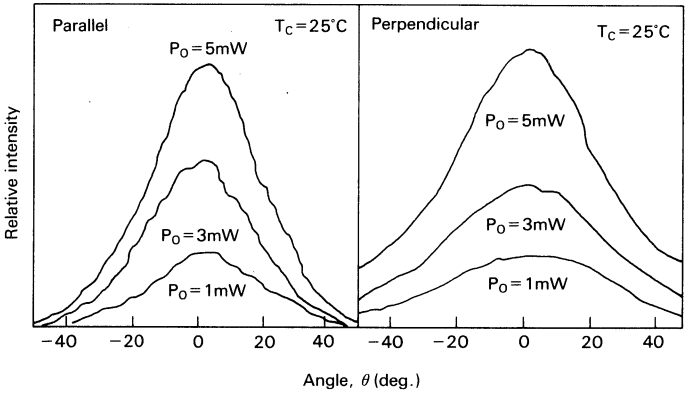
Optical Output Power vs. Forward Current



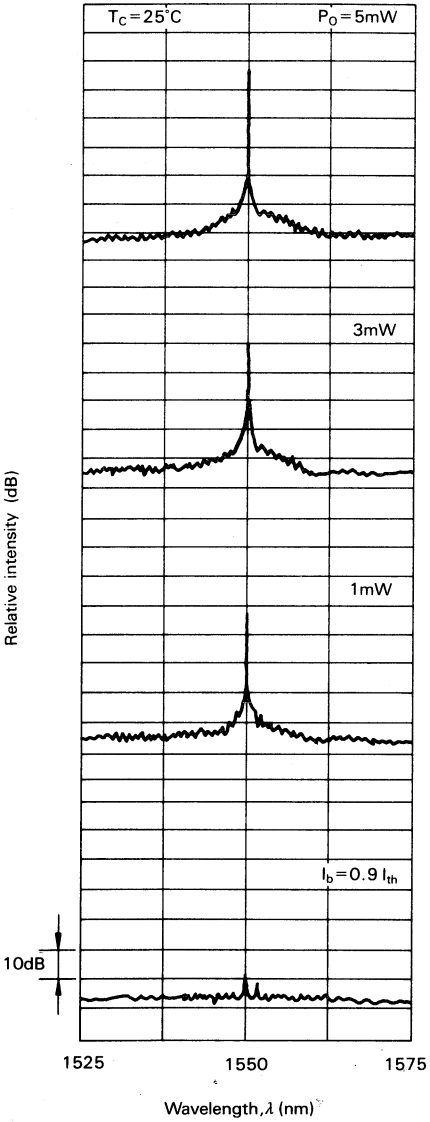
Forward Current vs. Forward Voltage



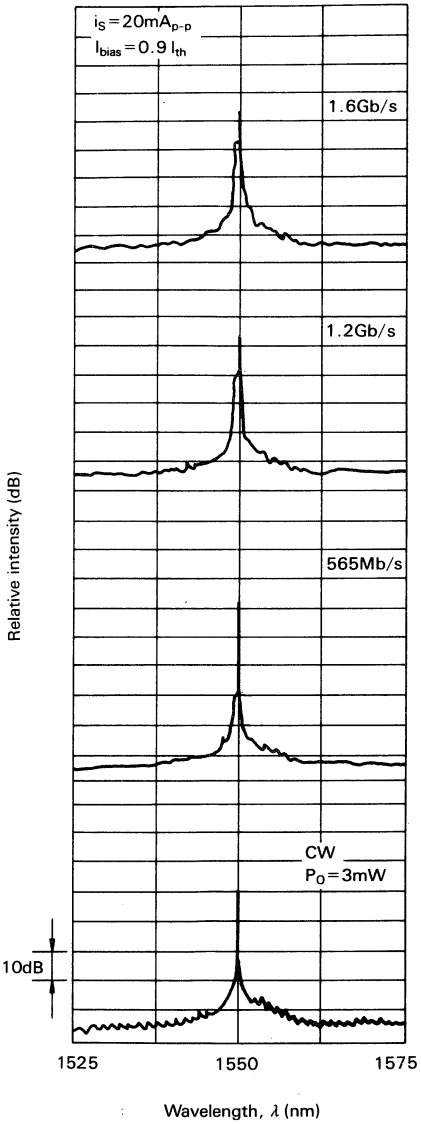
Far Field Pattern



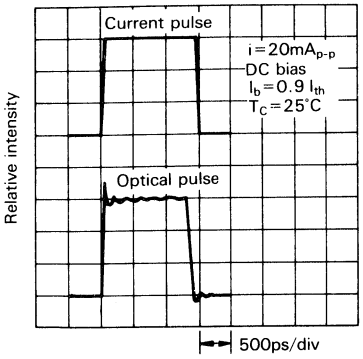
Output Power Dependence of Lasing Spectrum



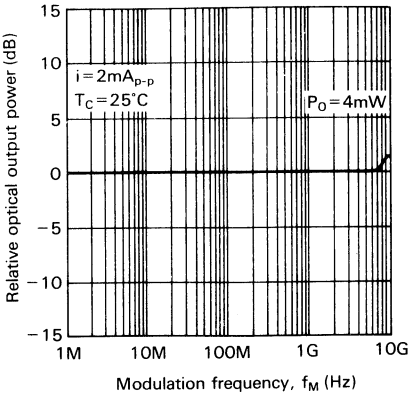
Frequency Dependence of Lasing Spectrum



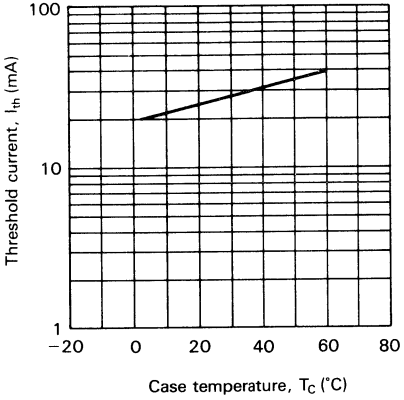
Pulse Response of Laser Diode



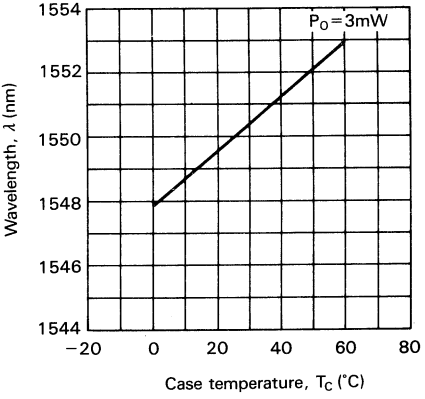
Frequency Response of Laser Diode



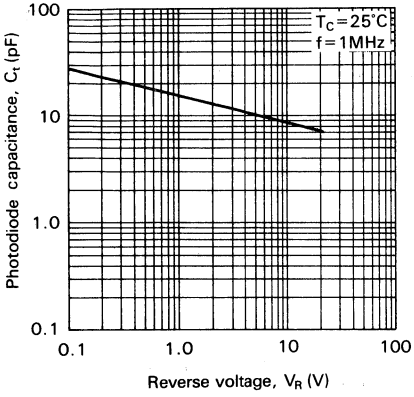
Threshold Current vs. Case Temperature



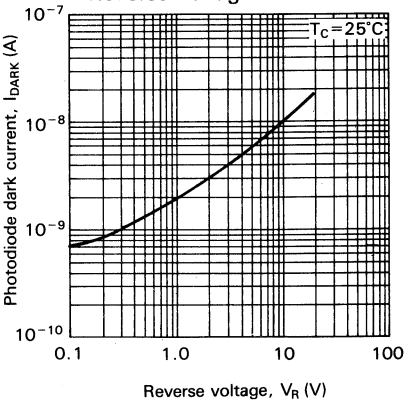
Temperature Dependence of Lasing Wavelength



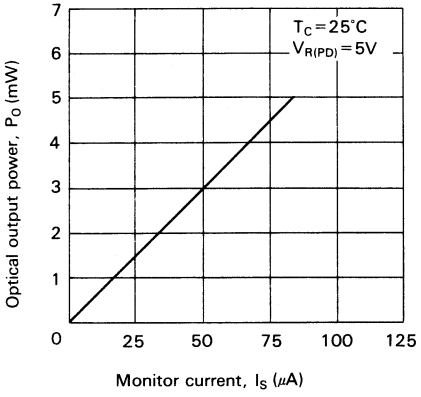
Photodiode Capacitance vs. Reverse Voltage



Photodiode Dark Current vs. Reverse Voltage



Optical Output Power vs.
Monitor Current



HL1541BF

InGaAsP LD

Description

HL1541BF is a DFB laser diode module in a 14-pin butterfly-type package with a built-in thermoelectronic controller and connected single mode fiber.

It is suitable as a light source in high-speed modulated, high-bit-rate, long-distance fiberoptic communications equipment.

The built-in thermoelectronic controller functions to keep the laser chip operation at a constant temperature.

—Fiber specifications—

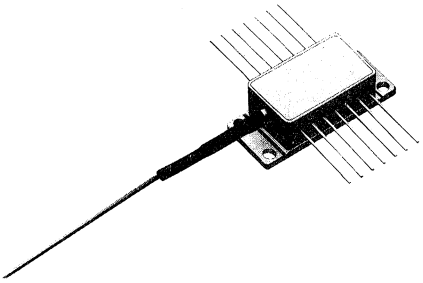
Mode field diameter	: 10.0 ± 1.0 μm
Cutoff wavelength	: 1.10—1.20 μm
Core diameter	: 10 μm
Outer diameter	: 125 μm
Jacket diameter	: 900 μm
Fiber length	: More than 500 mm

Features

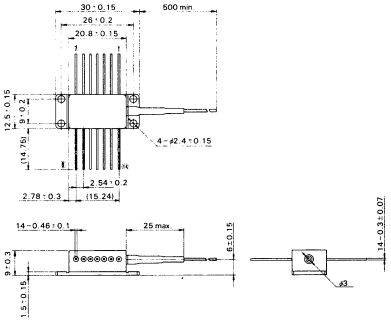
- Long wavelength light output: λ_p = 1530—1570 nm
- 1.0 mW CW and pulse operation at room temperature
- Dynamic single longitudinal mode: S_r = 35 dB typ.
- High-speed modulation (1.8 Gb/s)
- Stabilized operation with built-in thermoelectronic controller

Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Fiber optical output power	P_f	1.0	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	15	V
Photodiode forward current	$I_{F(PD)}$	1	mA
Cooler current	I_C	1.4	A
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	−40 to +70	°C



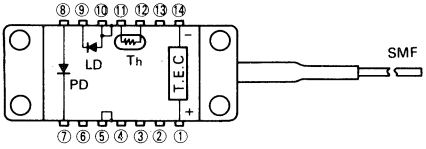
Package Dimensions



(Unit: mm)

BF-type

Pin Connection (Bottom view)



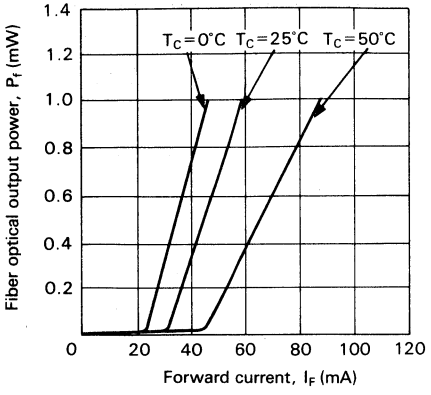
LD; Laser diode
PD; Photodiode
Th; Thermistor
T. E. C. ; T. E. cooler
SMF; Single-mode fiber

① T. E. C. anode
② N. C.
③ N. C.
④ N. C.
⑤ Case
⑥ N. C.
⑦ PD cathode
⑧ PD anode
⑨ LD cathode
⑩ LD anode (case)
⑪ Thermistor
⑫ Thermistor
⑬ N. C.
⑭ T. E. C. cathode

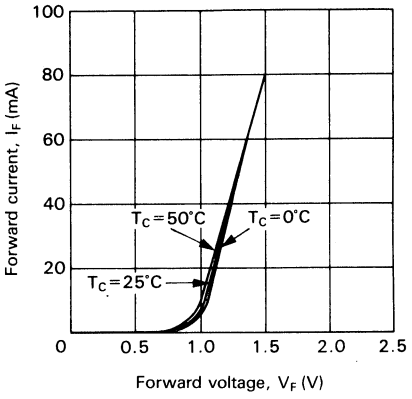
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	50	mA	
Fiber optical output power	P_f	1.0			mW	Kink free
		0.3			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1530	1550	1570	nm	P_f = 0.5 mW
Side-mode suppression ratio	S_r	30	35		dB	P_f = 0.5 mW, CW
Rise time	t_r		0.2		ns	$I_{bias} = I_{th}$, 10 to 90%
Fall time	t_f		0.3		ns	$I_{bias} = I_{th}$, 90 to 10%
Photodiode dark current	I_{DARK}			350	nA	$V_{R(PD)}$ = 5 V
Monitor current	I_S	0.3			mA	$V_{R(PD)}$ = 5 V, P_f = 0.5 mW
Photodiode capacitance	C_t		10	20	pF	$V_{R(PD)}$ = 5 V, f = 1 MHz
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Cooling capacity	ΔT	40			°C	T_C = 60°C, P_f = 0.5 mW
Cooler current	I_C			1.4	A	ΔT = 40°C
Cooler voltage	V_C			1.8	V	ΔT = 40°C
Thermistor resistance	R_{TM}		10		kΩ	

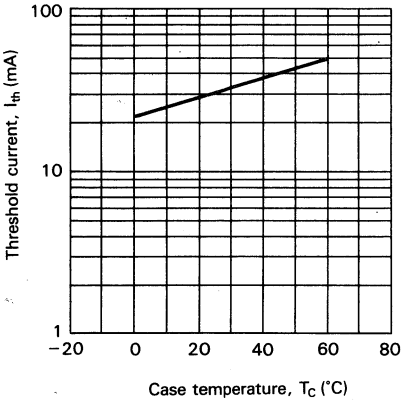
Optical Output Power vs. Forward Current



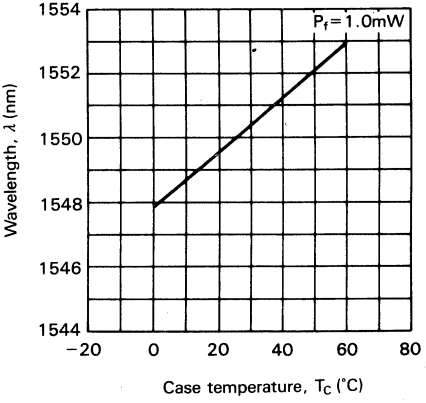
Forward Current vs. Forward Voltage



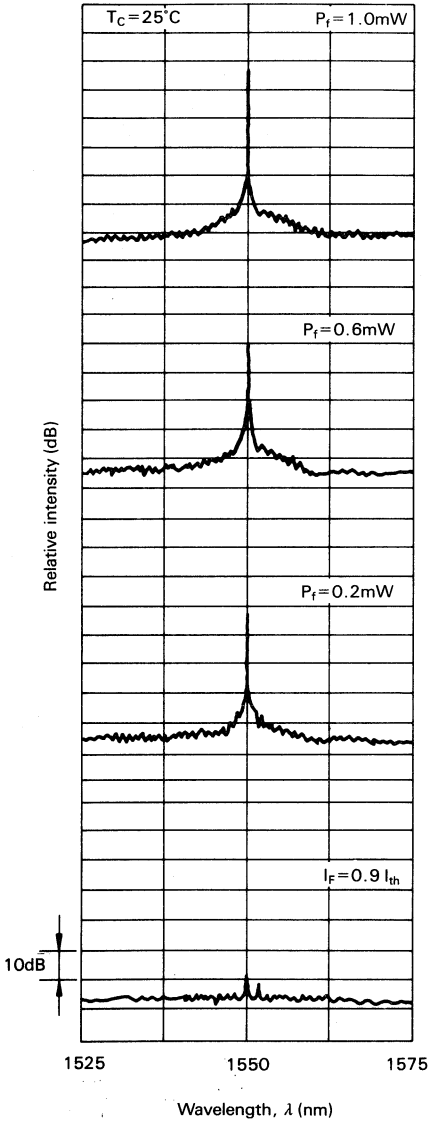
Threshold Current vs. Case Temperature



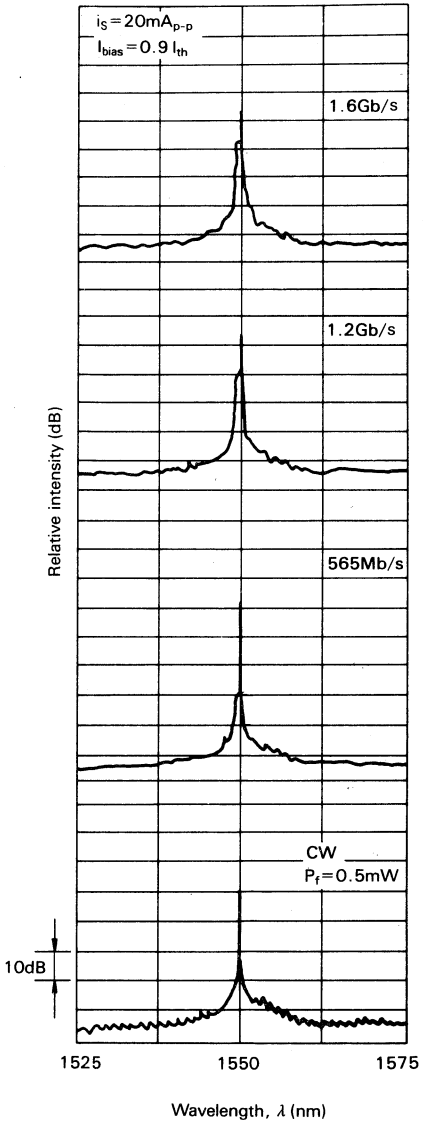
Temperature Dependence of Lasing Wavelength



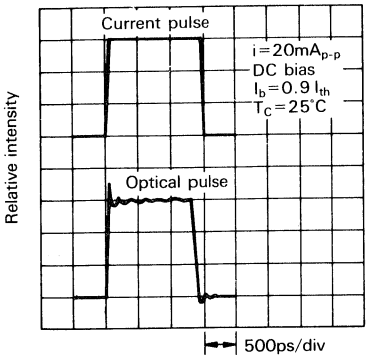
Output Power Dependence of Lasing Spectrum



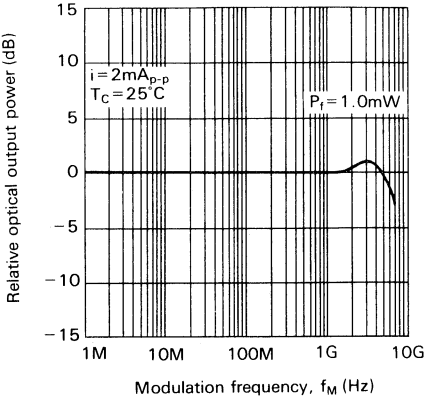
Frequency Dependence of Lasing Spectrum



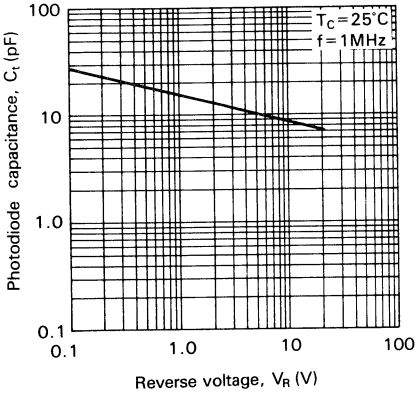
Pulse Response of Laser Diode



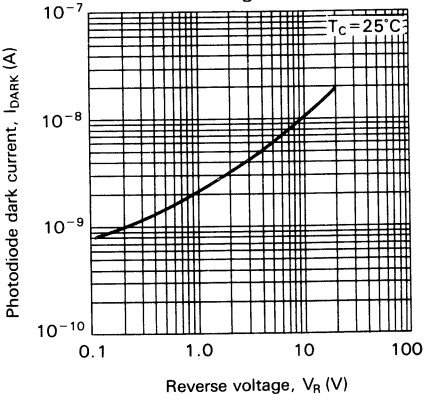
Frequency Response of Laser Diode



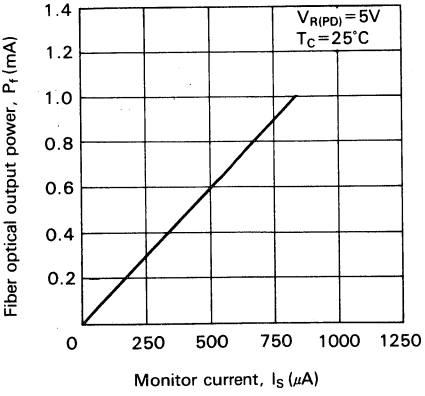
Photodiode Capacitance vs. Reverse Voltage



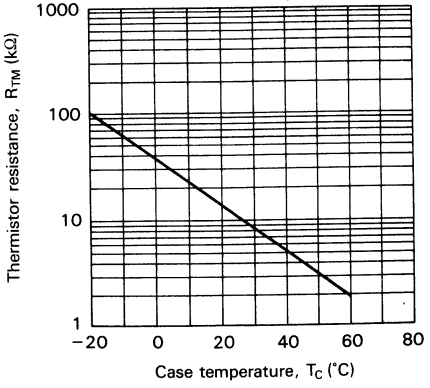
Photodiode Dark Current vs. Reverse Voltage



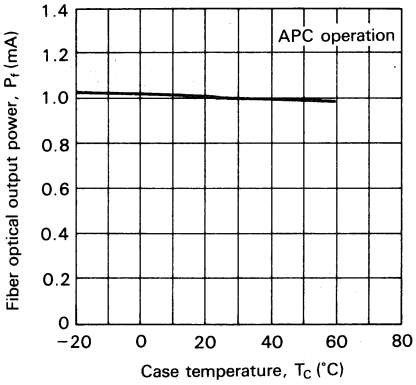
Optical Output Power vs. Monitor Current



Thermistor Resistance vs. Case Temperature



Tracking Characteristics



HL1541DL

InGaAsP LD

Description

HL1541DL is a DFB laser diode module in a 14-pin dual-in-line type package with a built-in thermoelectronic controller and connected single mode fiber.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications equipment.

The built-in thermoelectronic controller functions to keep the laser chip operation at a constant temperature.

—Fiber specifications—

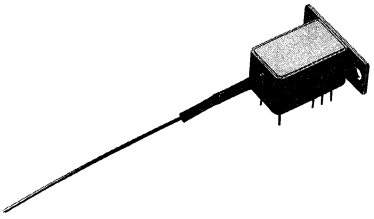
Mode field diameter	: 10.0 ± 1.0 μm
Cutoff wavelength	: 1.10—1.20 μm
Core diameter	: 10 μm
Outer diameter	: 125 μm
Jacket diameter	: 900 μm
Fiber length	: More than 500 mm

Features

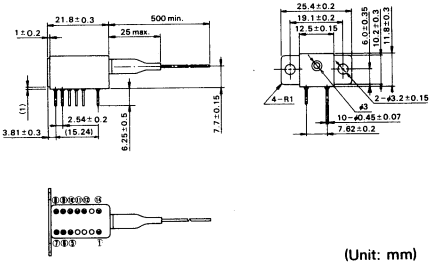
- Long wavelength light output: λ_p = 1530—1570 nm
- 1.0 mW CW and pulse operation at room temperature
- Dynamic single longitudinal mode: S_r = 35 dB typ.
- High-speed modulation (800 Mb/s)
- Stabilized operation with built-in thermoelectronic controller

Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Fiber optical output power	P_f	1.0	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	15	V
Photodiode forward current	$I_{F(PD)}$	1	mA
Cooler current	I_C	1.4	A
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	−40 to +70	°C



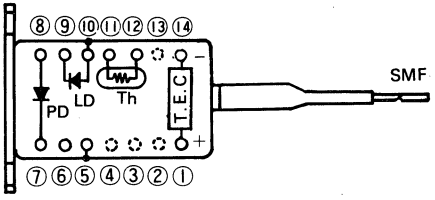
Package Dimensions



(Unit: mm)

DL-type

Pin Connection (Bottom view)



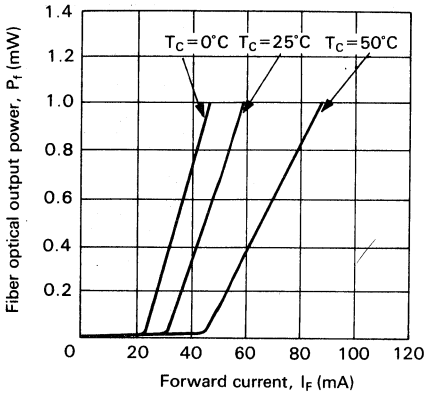
LD; Laser diode
PD; Photodiode
Th; Thermistor
T. E. C. ; T. E. cooler
SMF; Single-mode fiber

① T. E. C. anode
② —
③ —
④ —
⑤ Case
⑥ N. C.
⑦ PD cathode
⑧ PD anode
⑨ LD cathode
⑩ LD anode (case)
⑪ Thermistor
⑫ Thermistor
⑬ —
⑭ T. E. C. cathode

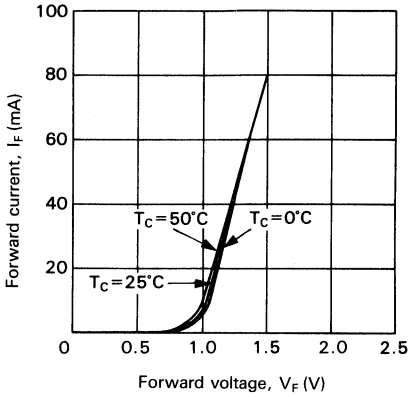
Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	50	mA	
Fiberoptical output power	P_f	1.0			mW	Kink free
		0.3			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1530	1550	1570	nm	$P_f = 0.5$ mW
Side-mode suppression ratio	S_r	30	35		dB	$P_f = 0.5$ mW, CW
Rise time	t_r		0.2		ns	$I_{bias} = I_{th}$, 10 to 90%
Fall time	t_f		0.3		ns	$I_{bias} = I_{th}$, 90 to 10%
Photodiode dark current	I_{DARK}			350	nA	$V_{R(PD)} = 5$ V
Monitor current	I_S	0.3			mA	$V_{R(PD)} = 5$ V, $P_f = 0.5$ mW
Photodiode capacitance	C_t		10	20	pF	$V_{R(PD)} = 5$ V, f = 1 MHz
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Cooling capacity	ΔT	40			°C	$T_C = 60°C$, $P_f = 0.5$ mW
Cooler current	I_C			1.4	A	$\Delta T = 40°C$
Cooler voltage	V_C			1.8	V	$\Delta T = 40°C$
Thermistor resistance	R_{TM}		10		kΩ	

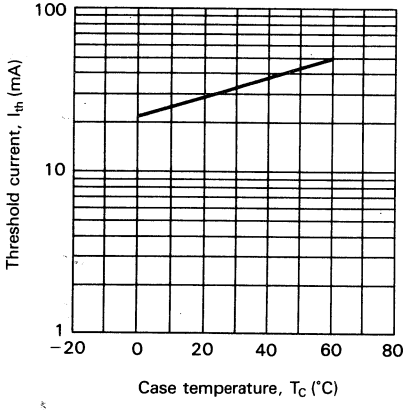
Optical Output Power vs. Forward Current



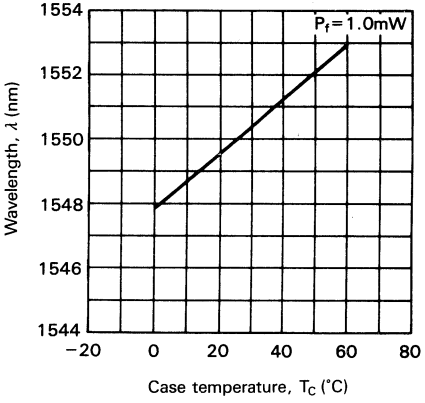
Forward Current vs. Forward Voltage



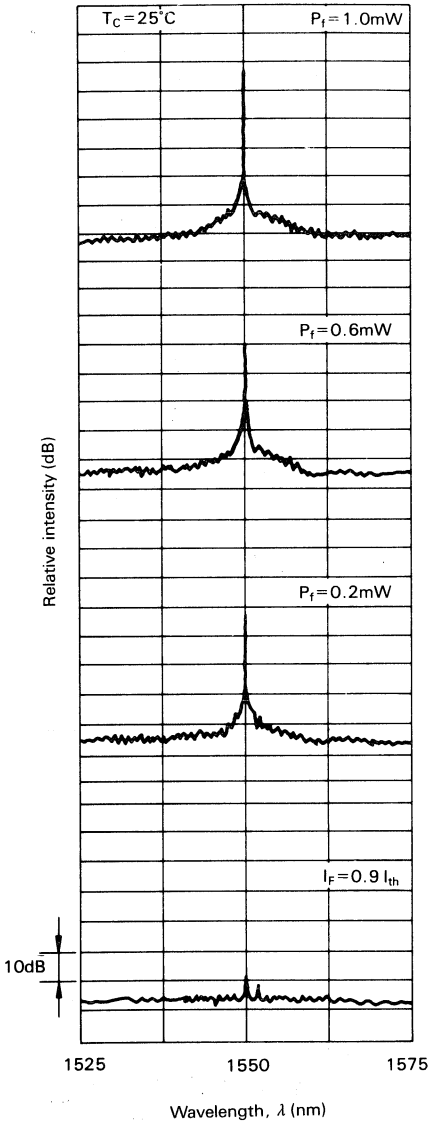
Threshold Current vs. Case Temperature



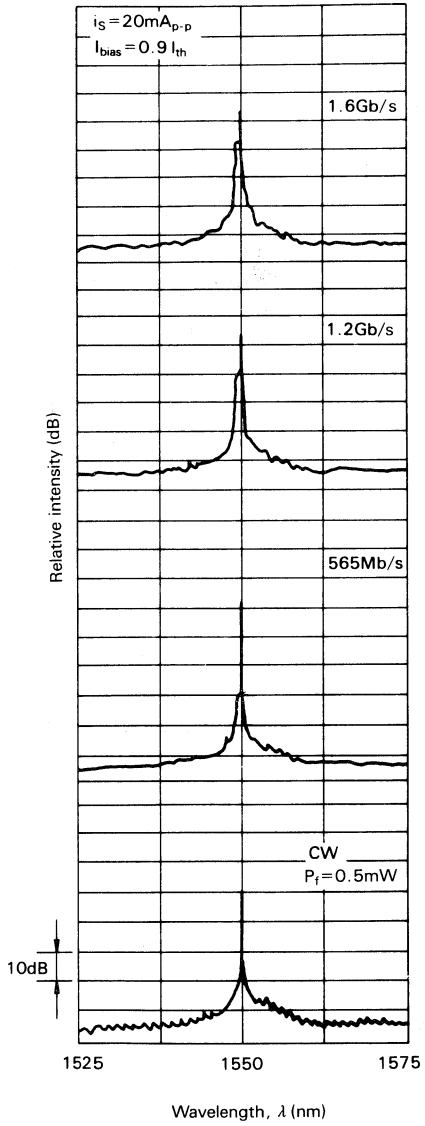
Temperature Dependence of Lasing Wavelength



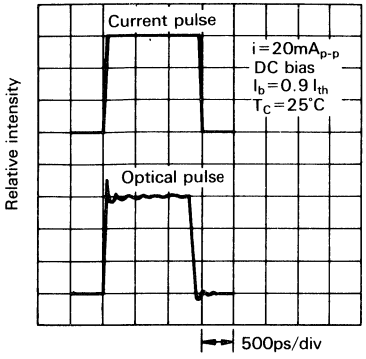
Output Power Dependence of Lasing Spectrum



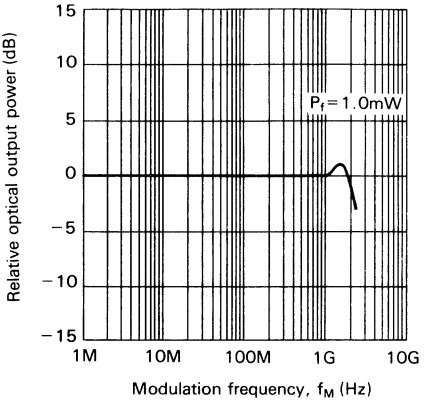
Frequency Dependence of Lasing Spectrum



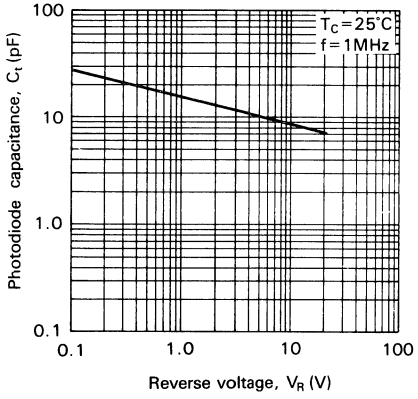
Pulse Response of Laser Diode



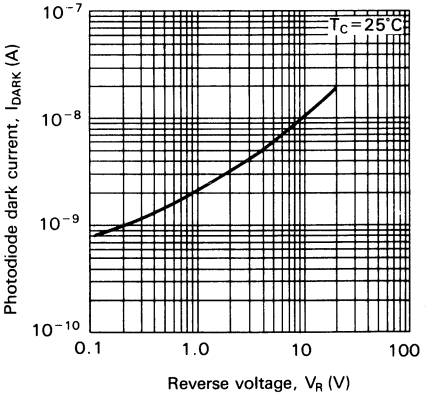
Frequency Response of Laser Diode



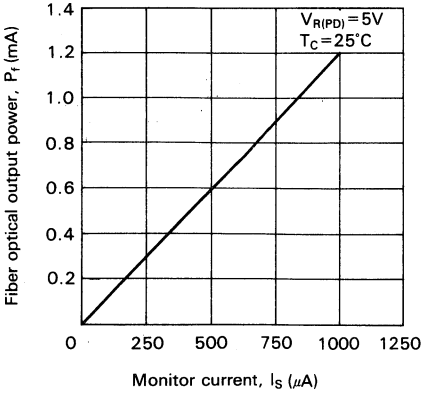
Photodiode Capacitance vs. Reverse Voltage



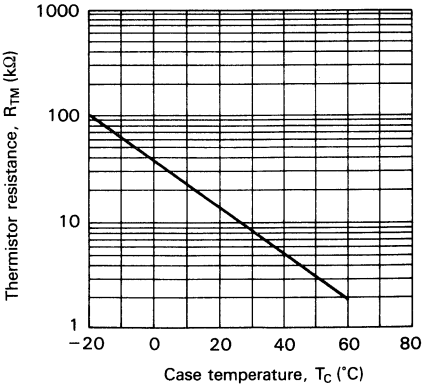
Photodiode Dark Current vs. Reverse Voltage



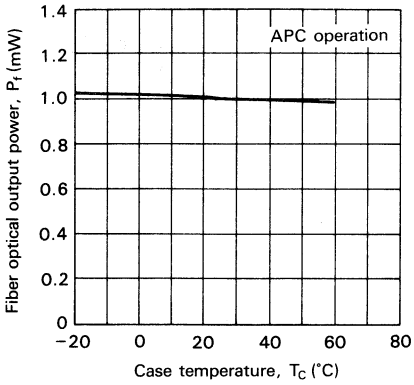
Optical Output Power vs. Monitor Current



Thermistor Resistance vs. Case Temperature



Tracking Characteristics



HL1541DM

InGaAsP LD

Description

HL1541DM is a 1.55 μm InGaAsP distributed feedback (DFB) laser diode with buried heterostructure.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications equipment.

The laser beam comes out from the connected single-mode fiber; monitoring current by a built-in photodiode.

—Fiber specifications—

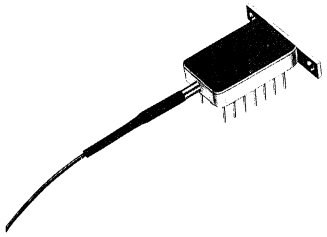
Mode field diameter	: 10.0 ± 1.0 μm
Cutoff wavelength	: 1.10—1.20 μm
Core diameter	: 10 μm
Outer diameter	: 125 μm
Jacket diameter	: 900 μm
Fiber length	: More than 500 mm

Features

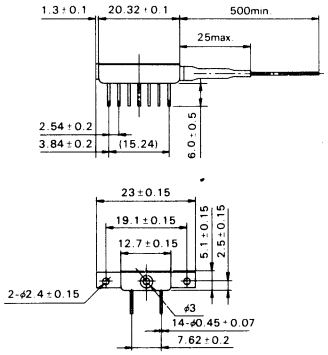
- Long wavelength light output: λ_p = 1530—1570 nm
- 1.2 mW CW and pulse operation at room temperature
- Dynamic single longitudinal mode: S_r = 35 dB typ.
- Fast pulse response: t_r = 0.2 ns, t_f = 0.3 ns typ.
- Built-in photodiode for monitoring laser output
- Package with thinner height

Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Fiber optical output power	P_f	1.2	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	15	V
Photodiode forward current	$I_{F(PD)}$	1	mA
Operating temperature	T_{opr}	0 to +50	°C
Storage temperature	T_{stg}	−40 to +60	°C

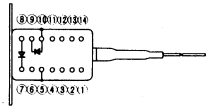


Package Dimensions



DM-type (Unit : mm)

Pin Connection (Bottom view)

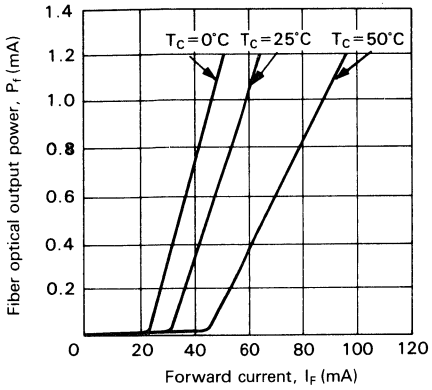


(1) N.C.
(2) N.C.
(3) N.C.
(4) N.C.
(5) Case
(6) N.C.
(7) PD Cathode
(8) PD Anode
(9) LD Cathode
(10) LD Anode (Case)
(11) N.C.
(12) N.C.
(13) N.C.
(14) N.C.

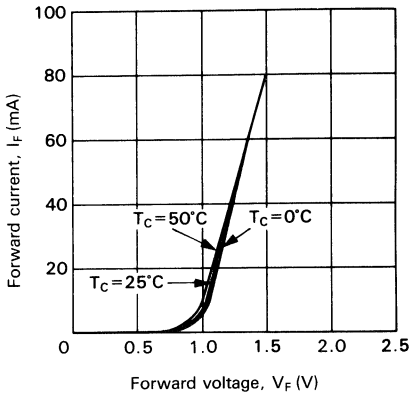
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	50	mA	
Fiber optical output power	P_f	1.2			mW	Kink free
		0.3			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1530	1550	1570	nm	$P_f = 0.5$ mW
Side-mode suppression ratio	S_r	30	35		dB	$P_f = 0.5$ mW, CW
Rise time	t_r		0.2		ns	$I_{bias} = I_{th}$, 10 to 90%
Fall time	t_f		0.3		ns	$I_{bias} = I_{th}$, 90 to 10%
Photodiode dark current	I_{DARK}			350	nA	$V_{R(PD)} = 5$ V
Monitor current	I_S	0.15			mA	$V_{R(PD)} = 5$ V, $P_f = 0.5$ mW
Photodiode capacitance	C_t		10	20	pF	$V_{R(PD)} = 5$ V, f = 1 MHz
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	

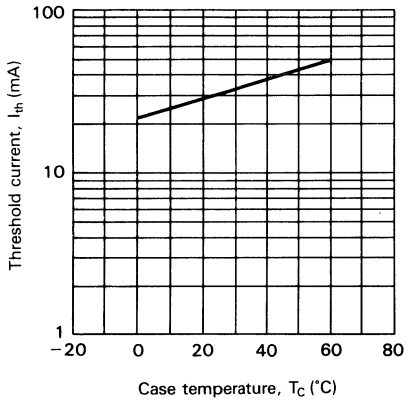
Optical Output Power vs. Forward Current



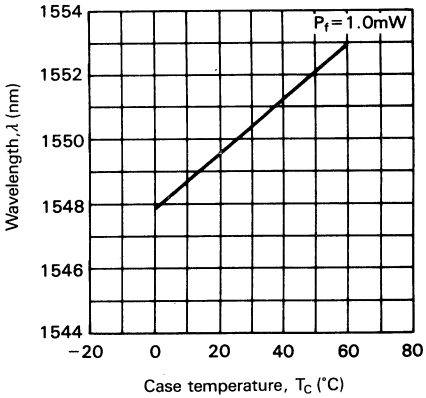
Forward Current vs. Forward Voltage



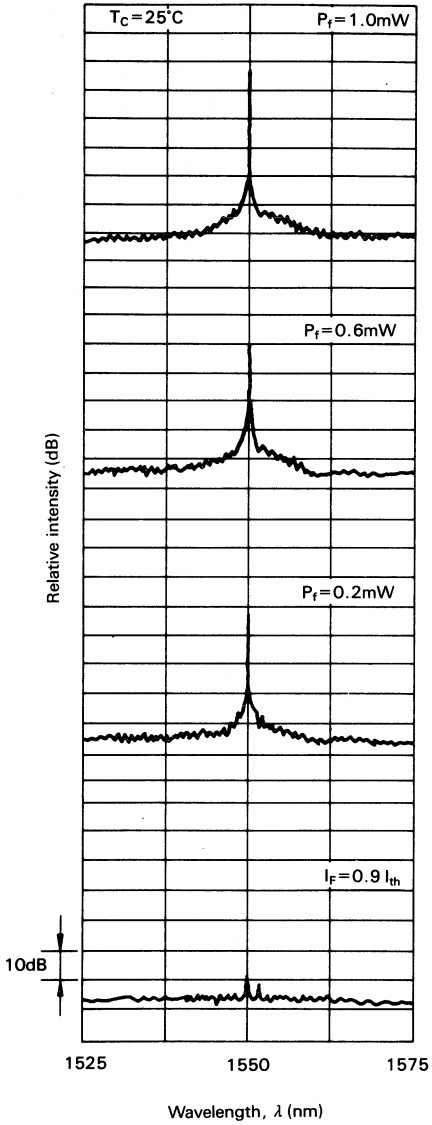
Threshold Current vs. Case Temperature



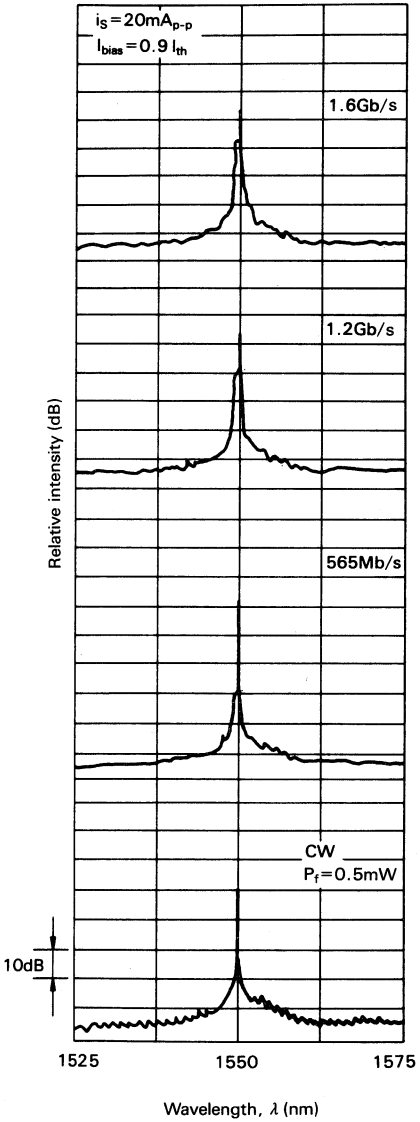
Temperature Dependence of Lasing Wavelength



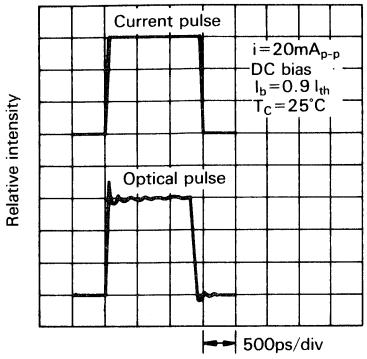
Output Power Dependence of Lasing Spectrum



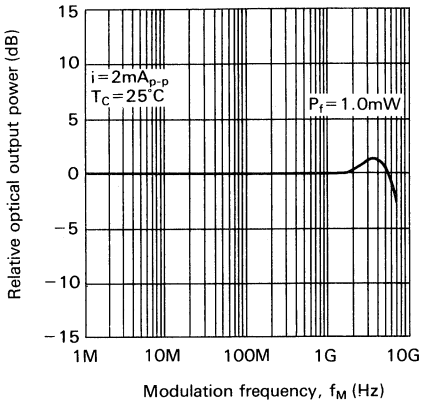
Frequency Dependence of Lasing Spectrum



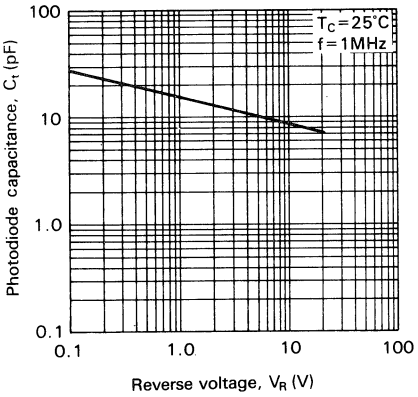
Pulse Response of Laser Diode



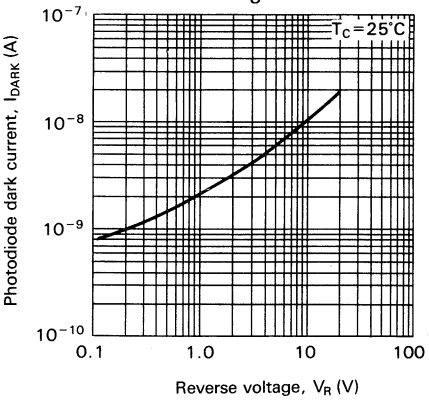
Frequency Response of Laser Diode



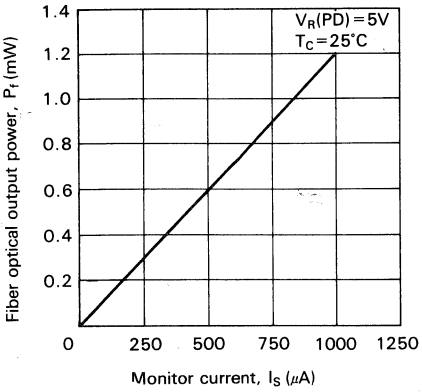
Photodiode Capacitance vs. Reverse Voltage



Photodiode Dark Current vs. Reverse Voltage



Optical Output Power vs. Monitor Current



Description

HL1561A is a 1.55 μm InGaAsP distributed-feedback (DFB) laser diode with λ/4 phase shifted.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications and various other types of optical equipment.

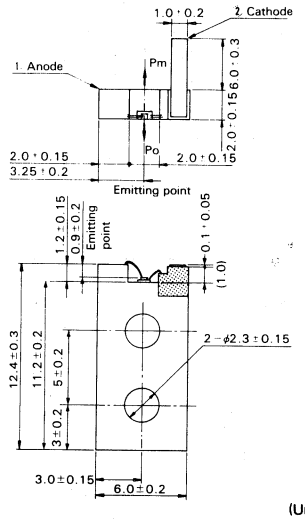
Direct photo-exposure technology is employed to have fine phase-shifted grating.

The package is convenient for system testing because the laser chip is mounted on its stem. This device should be hermetically sealed before mounting on a system.

Features

- Long wavelength light output: $\lambda_p = 1530-1570$ nm
- 5 mW CW operation at room temperature
- Dynamic single longitudinal mode: $S_r = 38$ dB typ.
- Fast pulse response: $t_r = 0.15$ ns, $t_f = 0.2$ ns typ.
- High-speed modulation (2.4 Gb/s)

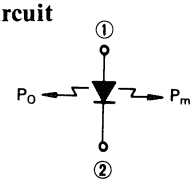
Package Dimensions



(Unit: mm)

A-type

Internal Circuit



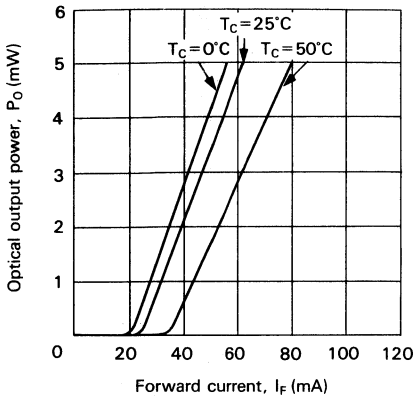
Absolute Maximum Ratings ($T_C = 25°C$)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	0 to +80	°C

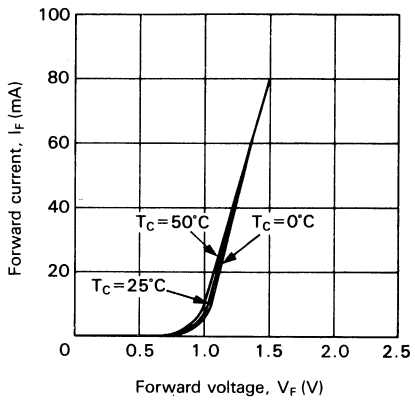
Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		25	50	mA	
Optical output power	P_O	5			mW	Kink free
		1.5			mW	$I_F = I_{th} + 20$ mA
Monitor power	P_m	0.6			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1530	1550	1570	nm	$P_O = 3$ mW
Side-mode suppression ratio	S_r	30	38		dB	$P_O = 3$ mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	$P_O = 3$ mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	$P_O = 3$ mW, FWHM
Rise time	t_r		0.15		ns	10 to 90%
Fall time	t_f		0.2		ns	90 to 10%

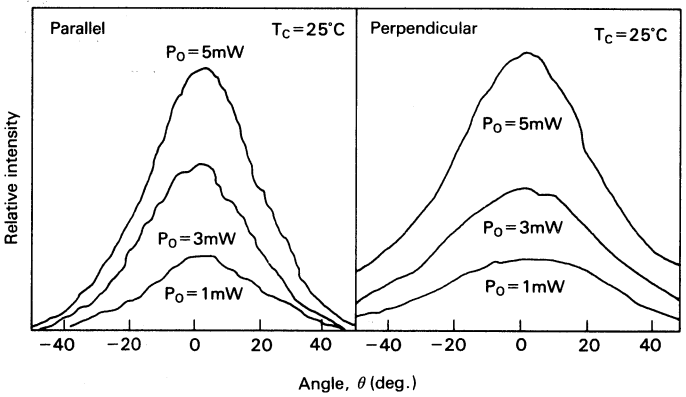
Optical Output Power vs. Forward Current



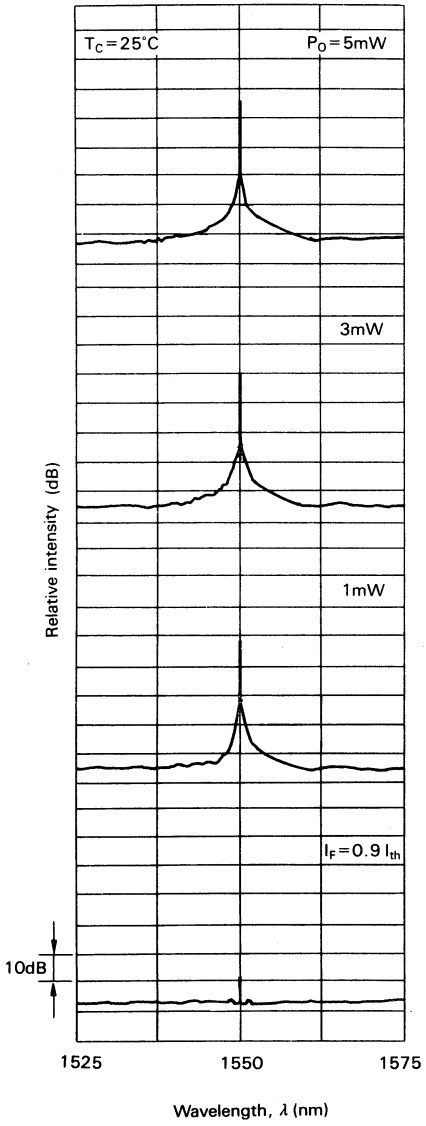
Forward Current vs. Forward Voltage



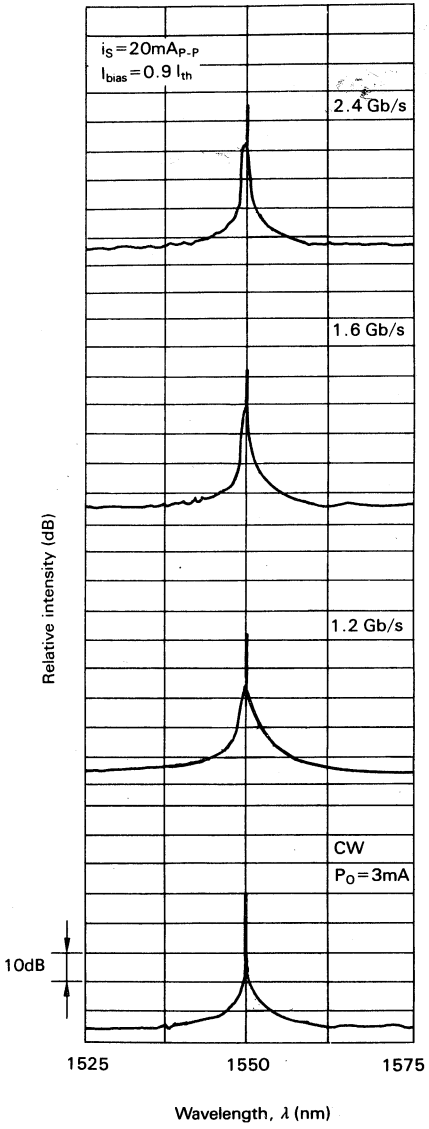
Far Field Pattern



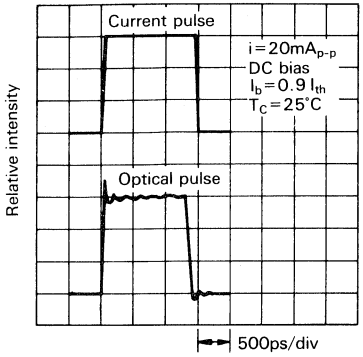
Output Power Dependence of Lasing Spectrum



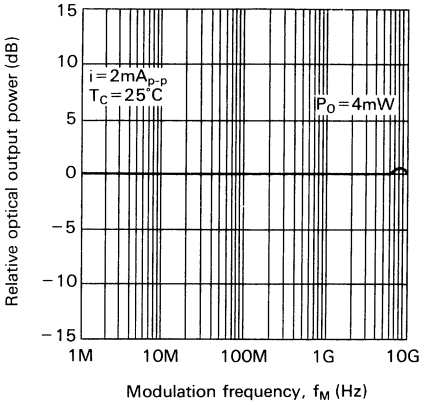
Frequency Dependence of Lasing Spectrum



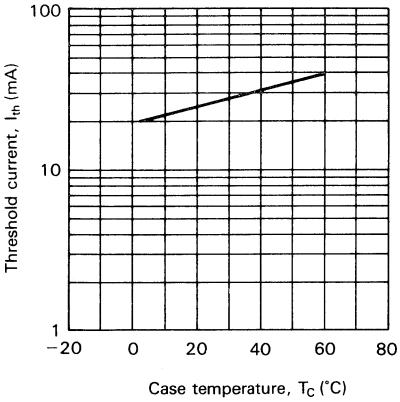
Pulse Response of Laser Diode



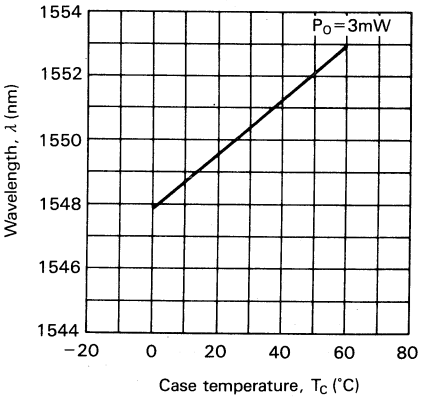
Frequency Response of Laser Diode



Threshold Current vs. Case Temperature



Temperature Dependence of Lasing Wavelength



HL1561AC

InGaAsP LD

Description

HL1561AC is a 1.55 μm InGaAsP distributed-feedback (DFB) laser diode with $\lambda/4$ phase shifted.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications and various other types of optical equipment.

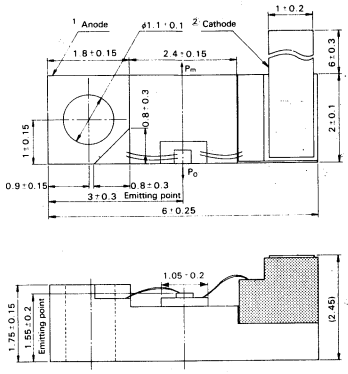
Direct photo-exposure technology is employed to have fine phase-shifted grating.

The package is compact to facilitate module assembly.

Features

- Long wavelength light output: $\lambda_p = 1530-1570$ nm
- 5 mW CW operation at room temperature
- Dynamic single longitudinal mode: $S_r = 38$ dB typ.
- Fast pulse response: $t_r = 0.15$ ns, $t_f = 0.2$ ns typ.
- High-speed modulation (2.4 Gb/s)

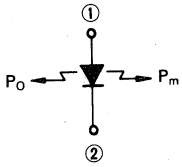
Package Dimensions



(Unit: mm)

AC-type

Internal Circuit



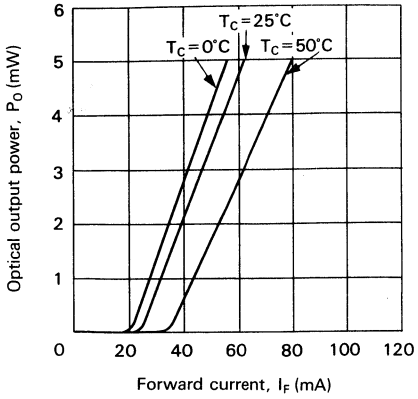
Absolute Maximum Ratings ($T_C = 25°C$)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	0 to +80	°C

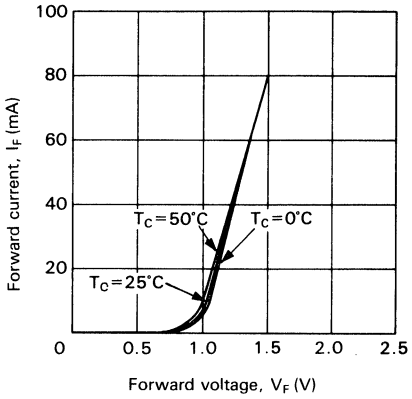
Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		25	50	mA	
Optical output power	P_O	5			mW	Kink free
		1.5			mW	$I_F = I_{th} + 20$ mA
Monitor power	P_m	0.6			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1530	1570	1570	nm	$P_O = 3$ mW
Side-mode suppression ratio	S_r	30	38		dB	$P_O = 3$ mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	$P_O = 3$ mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	$P_O = 3$ mW, FWHM
Rise time	t_r		0.15		ns	10 to 90%
Fall time	t_f		0.2		ns	90 to 10%

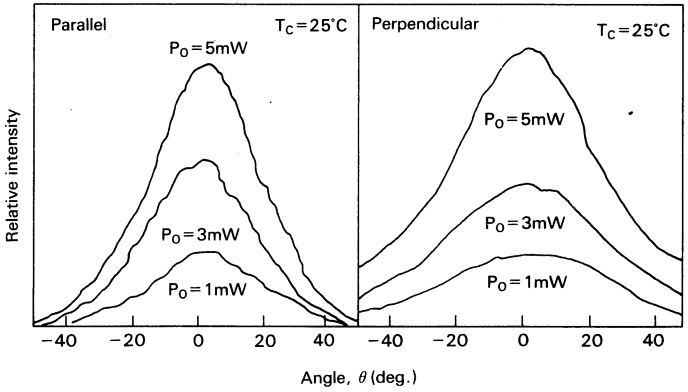
Optical Output Power vs. Forward Current



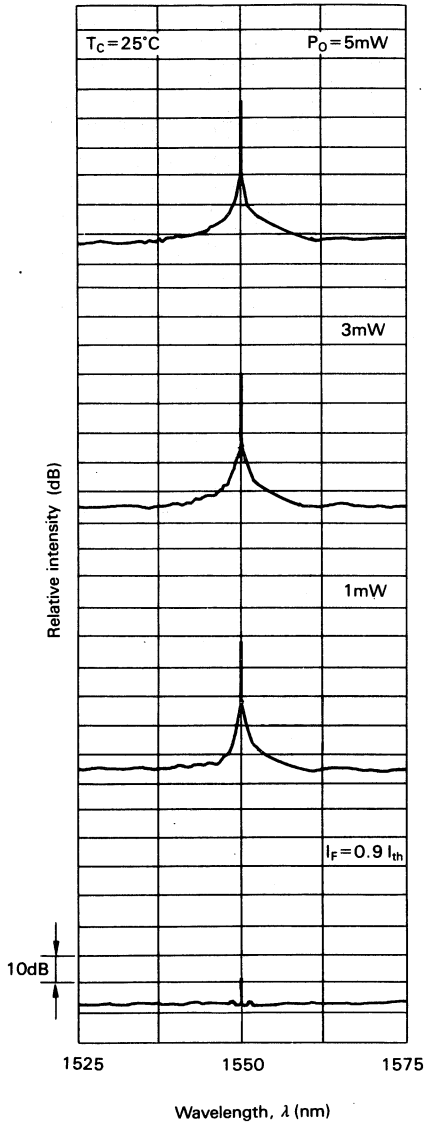
Forward Current vs. Forward Voltage



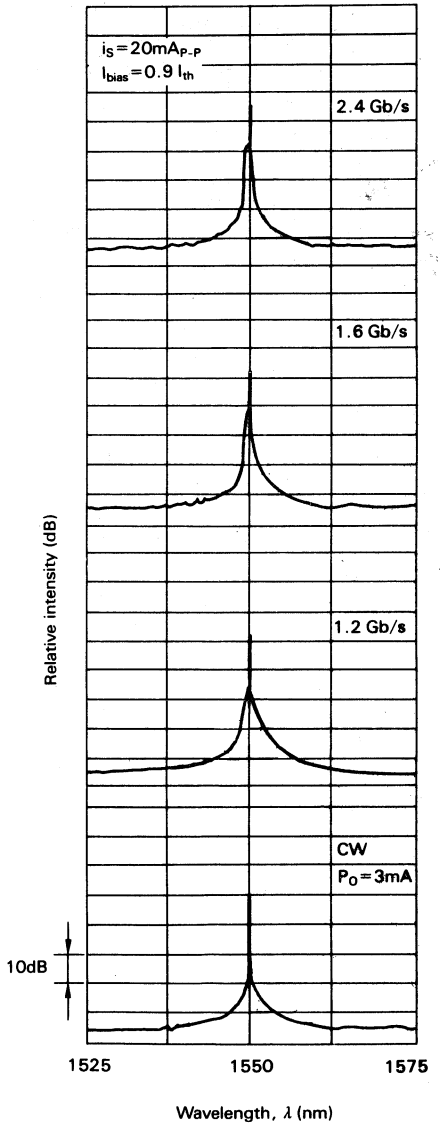
Far Field Pattern



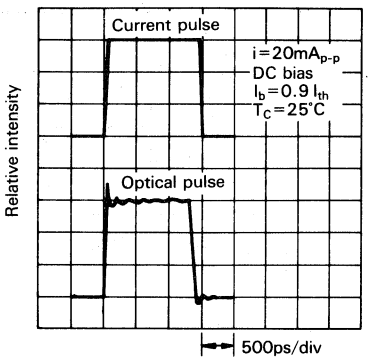
Output Power Dependence of Lasing Spectrum



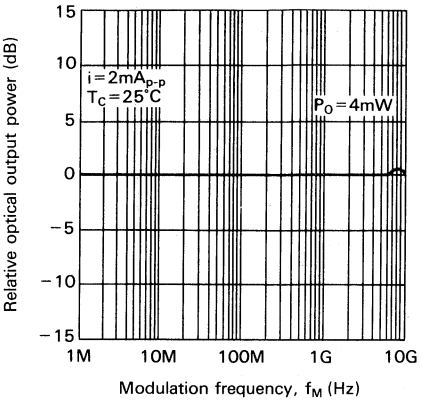
Frequency Dependence of Lasing Spectrum



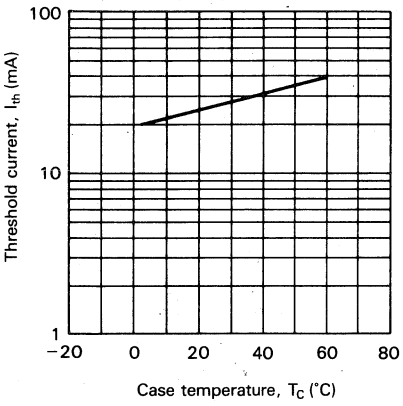
Pulse Response of Laser Diode



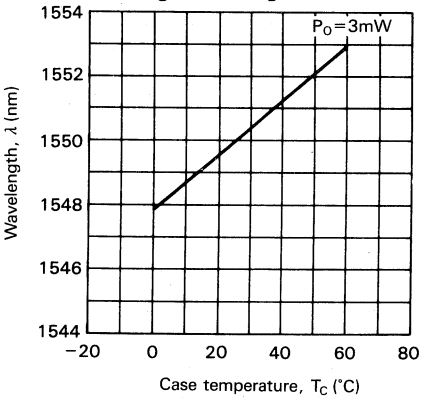
Frequency Response of Laser Diode



Threshold Current vs. Case Temperature



Temperature Dependence of Lasing Wavelength



HL1561BF

—Under development—
InGaAsP LD

Description

HL1561BF is a λ/4 phase shifted DFB laser diode module in a 14-pin butterfly-type package with a built-in thermoelectronic controller and connected single mode fiber.

It is suitable as a light source in high-speed modulated, high-bit-rate, long-distance fiberoptic communications equipment.

The built-in thermoelectronic controller functions to keep the laser chip operation at a constant temperature.

—Fiber specifications—

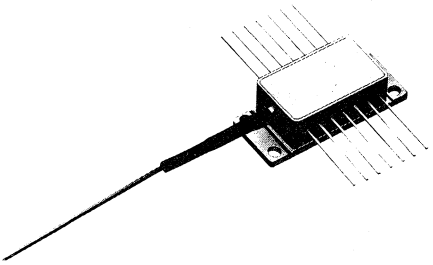
Mode field diameter	: 10.0 ± 1.0 μm
Cutoff wavelength	: 1.10—1.20 μm
Core diameter	: 10 μm
Outer diameter	: 125 μm
Jacket diameter	: 900 μm
Fiber length	: More than 500 mm

Features

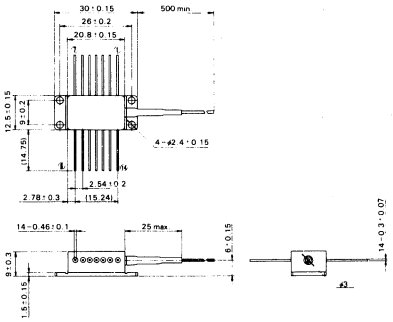
- Long wavelength light output: λ_p = 1530—1570 nm
- 1.0 mW CW and pulse operation at room temperature
- Dynamic single longitudinal mode: S_r = 38 dB typ.
- High-speed modulation (2.4 Gb/s)
- Stabilized operation with built-in thermoelectronic controller

Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Fiber optical output power	P_f	1.0	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	15	V
Photodiode forward current	$I_{F(PD)}$	1	mA
Cooler current	I_C	1.4	A
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	—40 to +70	°C



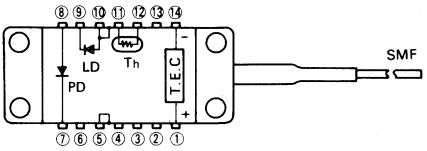
Package Dimensions



(Unit: mm)

BF-type

Pin Connection (Bottom view)



LD; Laser diode
PD; Photodiode
Th; Thermistor
T. E. C. ; T. E. cooler
SMF; Single-mode fiber

① T. E. C. anode
② N. C.
③ N. C.
④ N. C.
⑤ Case
⑥ N. C.
⑦ PD cathode
⑧ PD anode
⑨ LD cathode
⑩ LD anode (case)
⑪ Thermistor
⑫ Thermistor
⑬ N. C.
⑭ T. E. C. cathode

Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	50	mA	
Fiberoptical output power	P_f	1.0			mW	Kink free
		0.3			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1530	1550	1570	nm	P_f = 0.5 mW
Side-mode suppression ratio	S_r	30	38		dB	P_f = 0.5 mW, CW
Rise time	t_r		0.15		ns	$I_{bias} = I_{th}$, 10 to 90%
Fall time	t_f		0.2		ns	$I_{bias} = I_{th}$, 90 to 10%
Photodiode dark current	I_{DARK}			150	nA	$V_{R(PD)}$ = 5 V
Monitor current	I_S	0.3			mA	$V_{R(PD)}$ = 5 V, P_f = 0.5 mW
Photodiode capacitance	C_t		10	20	pF	$V_{R(PD)}$ = 5 V, f = 1 MHz
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Cooling capacity	ΔT	40			°C	T_C = 60°C, P_f = 0.5 mW
Cooler current	I_C			1.4	A	ΔT = 40°C
Cooler voltage	V_C			1.8	V	ΔT = 40°C
Thermistor resistance	R_{TM}		10		kΩ	

Infrared Emitting Diodes

Product Lineup

	Packages								
Chips	**R**	**RG**	**SG**	**VG**	**MA**	**ML**	**SL**	**CL**	**TR**
HLP30	HLP20R –HLP40R	HLP20RG –HLP40RG							
HE7601			HE7601SG						
HE8403	HE8403R		HE8403SG			HE8403ML			HE8403TR
HE8404			HE8404SG						
HE8805				HE8805VG					
HE8806				HE8806VG					
HE8807			HE8807SG				HE8807SL	HE8807CL	
HE8810					HE8810MA				
HE8811			HE8811						
HE8812			HE8812SG						
HE1301	HE1301R		HE1301SG			HE1301ML			HE1301TR

New product
Under development

HLP20R, HLP30R, HLP40R

GaAlAs IRED

Description

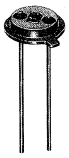
HLP20R, HLP30R and HLP40R are GaAlAs infrared emitting diodes with single heterojunction structure.

They offer a wide range of wavelength and output power, and are suitable for various types of optical equipment.

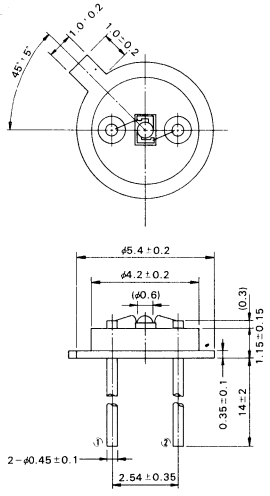
The package should be hermetically sealed before mounting on a system.

Features

- High efficiency
- Selection from a wide range of wavelength and output power
- Narrow spectral width



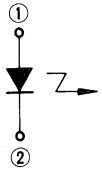
Package Dimensions



(Unit: mm)

R-type

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Forward current	I_F	250	mA
		230*	mA
Reverse voltage	V_R	3	V
Tolerable power dissipation	P_d	600	mW
Operating temperature	T_{opr}	−20 to +40**°C	
Storage temperature	T_{stg}	−40 to +60**°C	

* Value for devices with λ_p from 735 nm to 785 nm.
** Value for conditions without condensation.

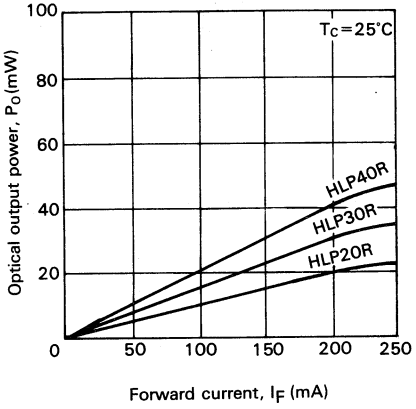
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Optical output power	P_O		**		mW	I_F = 200 mA
Peak wavelength	λ_p		**		nm	I_F = 200 mA
Spectral width	$\Delta\lambda$		30	60	nm	I_F = 200 mA
Beam divergence	θ_H		180		deg.	I_F = 200 mA
Forward voltage	V_F		1.7	2.3	V	I_F = 200 mA
			2.0*	2.6*	V	I_F = 200 mA
Reverse current	I_R			30	µA	V_R = 3 V
Capacitance	C_t		30		pF	V_R = 0 V, f = 1 MHz
Rise time	t_r		12		ns	I_F = 50 mA
			20*		ns	I_F = 50 mA
Fall time	t_f		12		ns	I_F = 50 mA
			20*		ns	I_F = 50 mA

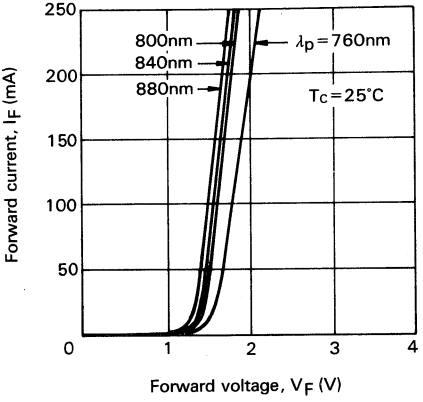
* Value for devices with λ_p from 735 nm to 785 nm.
** HLP20R-HLP40R are grouped with λ_p and P_O as follows.

	λ_p (nm)			P_O (mW)		
Grades	min.	typ.	max.	15 (min.)	25 (min.)	35 (min.)
A	735	760	785	HLP20R	HLP30R	HLP40R
B	775	800	825		HLP30R	HLP40R
C	815	840	865		HLP30R	HLP40R
D	855	880	905		HLP30R	HLP40R

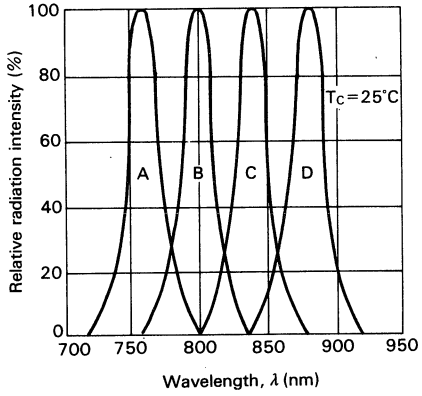
Optical Output Power vs. Forward Current



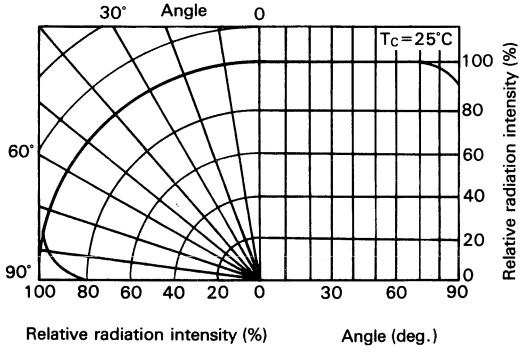
Forward Current vs. Forward Voltage



Emission Spectra of Standard Products



Radiation Pattern



HLP20RG, HLP30RG, HLP40RG GaAlAs IRED

Description

HLP20RG, HLP30RG and HLP40RG are GaAlAs infrared emitting diodes with single heterojunction structure.

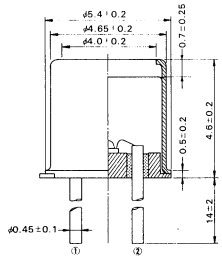
They offer a wide range of wavelength and output power, and are suitable for various types of optical equipment.

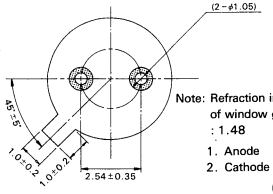
Hermetic sealing of the package achieves high reliability.

Features

- High efficiency
- Selection from a wide range of wavelength and output power
- Narrow spectral width

Package Dimensions





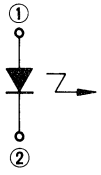
Note: Refraction index of window glass : 1.48

1. Anode
2. Cathode

(Unit: mm)

RG-type

Internal Circuit



Absolute Maximum Ratings ($T_C = 25°C$)

Items	Symbols	Values	Units
Forward current	I_F	250	mA
		230*	mA
Reverse voltage	V_R	3	V
Tolerable power dissipation	P_d	600	mW
Operating temperature	T_{opr}	−20 to +60	°C
Storage temperature	T_{stg}	−40 to +80	°C

* Value for devices with λ_p from 735 nm to 785 nm.

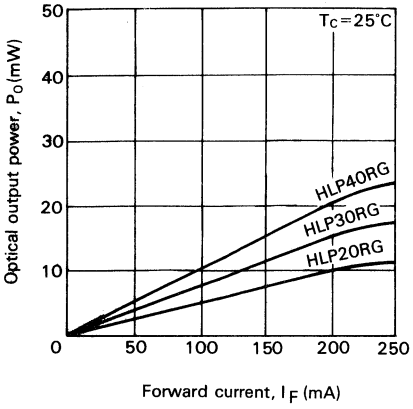
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Optical output power	P_O		**		mW	I_F = 200 mA
Peak wavelength	λ_p		**		nm	I_F = 200 mA
Spectral width	$\Delta\lambda$		30	60	nm	I_F = 200 mA
Beam divergence	θ_H		120		deg.	I_F = 200 mA
Forward voltage	V_F		1.7	2.3	V	I_F = 200 mA
			2.0*	2.6*	V	I_F = 200 mA
Reverse current	I_R			30	μA	V_R = 3 V
Capacitance	C_t		30		pF	V_R = 0 V, f = 1 MHz
Rise time	t_r		12		ns	I_F = 50 mA
			20*		ns	I_F = 50 mA
Fall time	t_f		12		ns	I_F = 50 mA
			20*		ns	I_F = 50 mA

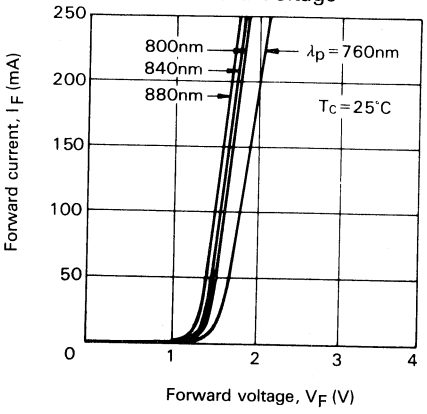
* Value for devices with λ_p from 735 nm to 785 nm.
** HLP20RG-HLP40RG are grouped with λ_p and P_O as follows.

	λ_p (nm)			P_O (mW)		
Grades	min.	typ.	max.	7 (min.)	12 (min.)	17 (min.)
A	735	760	785	HLP20RG	HLP30RG	HLP40RG
B	775	800	825		HLP30RG	HLP40RG
C	815	840	865		HLP30RG	HLP40RG
D	855	880	905		HLP30RG	HLP40RG

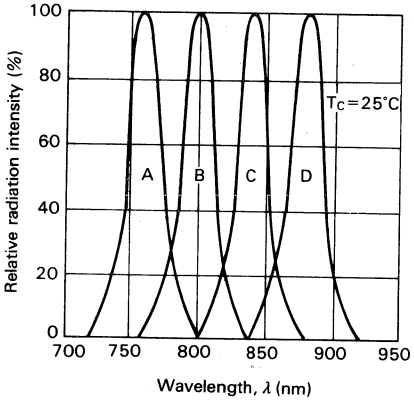
Optical Output Power vs. Forward Current



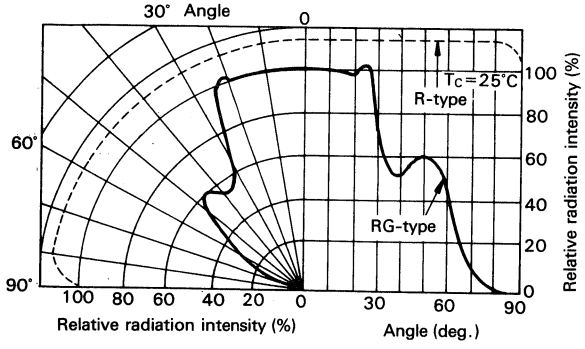
Forward Current vs. Forward Voltage



Emission Spectra of Standard Products



Radiation Pattern



HE7601SG

—Under development—
GaAlAs IRED

Description

HE7601SG is a 0.77 μm GaAlAs infrared emitting diode with double heterojunction structure. High brightness output, high power output and high speed response can be obtained.

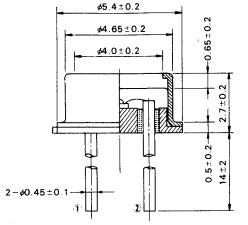
It is suitable as a light source in optical controlling equipment and sensors.

Hermetic sealing of the package achieves high reliability.

Features

- High power output: $P_o \geqq 30$ mW
- Fast pulse response: $t_r = 5$ns, $t_f = 7$ns typ.

Package Dimensions

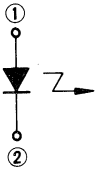


Note: Refraction index of window glass: 1.48
1. Anode
2. Cathode

(Unit: mm)

SG-type

Internal Circuit



Absolute Maximum Ratings ($T_C = 25$°C)

Items	Symbols	Values	Units
Forward current	I_F	250	mA
Reverse voltage	V_R	3	V
Operating temperature	T_{opr}	−20 to +60	°C
Storage temperature	T_{stg}	−40 to +90	°C

Optical and Electrical Characteristics ($T_C = 25$°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Optical output power	P_O	30			mW	$I_F = 200$ mA
Peak wavelength	λ_p	740	770	800	nm	$I_F = 200$ mA
Spectral width	$\Delta\lambda$		50		nm	$I_F = 200$ mA
Forward voltage	V_F			2.5	V	$I_F = 200$ mA
Reverse current	I_R			100	µA	$V_R = 3$ V
Capacitance	C_t		30		pF	$V_R = 0$ V, f = 1 MHz
Rise time	t_r		5		ns	$I_F = 50$ mA
Fall time	t_f		7		ns	$I_F = 50$ mA

HE8403R

GaAlAs IRED

Description

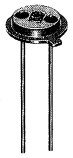
HE8403R is a 0.8 μm GaAlAs infrared emitting diode with double heterojunction structure, which provides high speed response.

Optical fiber can be close to the chip, achieving high coupling efficiency; suitable as a light source in fiberoptic communications equipment.

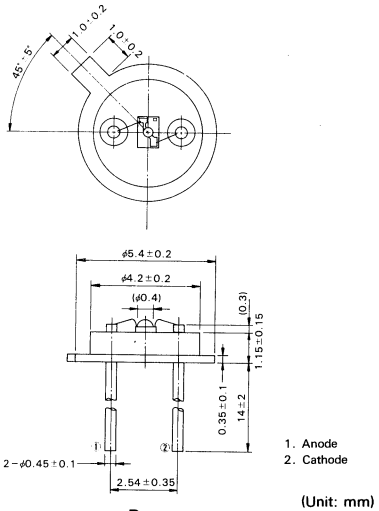
The package should be hermetically sealed before mounting on a system.

Features

- High efficiency and high brightness output
- High frequency response
- Excellent light-current linearity

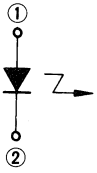


Package Dimensions



R-type

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Forward current	I_F	150	mA
Reverse voltage	V_R	3	V
Tolerable power dissipation	P_d	350	mW
Operating temperature	T_{opr}	−20 to +40*	°C
Storage temperature	T_{stg}	−40 to +60*	°C

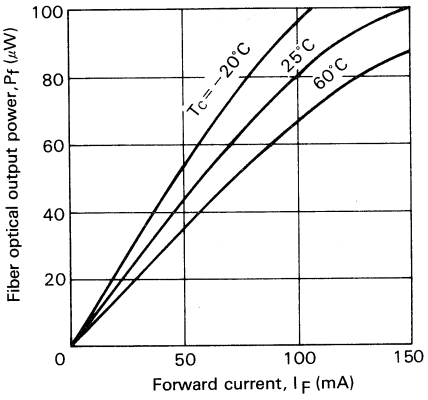
* Value for conditions without condensation.

Optical and Electrical Characteristics (T_C = 25°C)

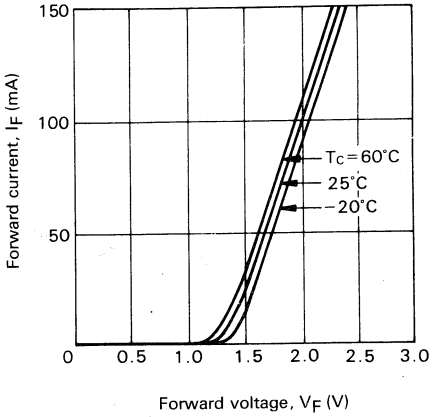
Items	Symbols	min.	typ.	max.	Units	Test conditions
Fiber optical output power	P_f*	50	80		μW	I_F = 100 mA
Peak wavelength	λ_p	800	840	900	nm	I_F = 100 mA
Spectral width	$\Delta\lambda$		50		nm	I_F = 100 mA
Forward voltage	V_F			2.5	V	I_F = 100 mA
Reverse current	I_R			100	μA	V_R = 3 V
Capacitance	C_t		10		pF	V_R = 0 V, f = 1 MHz
Rise time	t_r		5		ns	I_F = 50 mA
Fall time	t_f		7		ns	I_F = 50 mA

* At GI 50/125 fiber end.

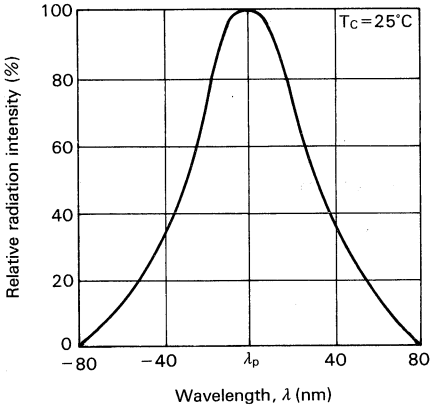
Optical Output Power vs. Forward Current



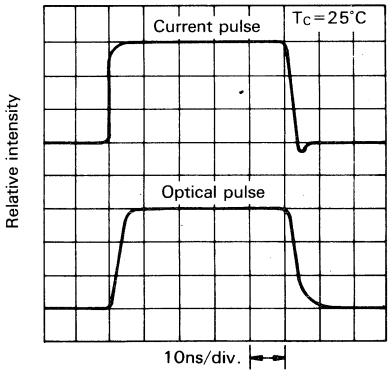
Forward Current vs. Forward Voltage



Spectral Distribution



Pulse Response



HE8403SG

GaAlAs IRED

Description

HE8403SG is a 0.8 μm GaAlAs infrared emitting diode with double heterojunction structure, which provides high speed response.

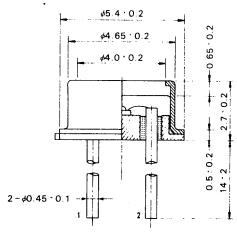
High coupling efficiency can be realized using a rod lens; suitable as a light source in fiberoptic communications equipment.

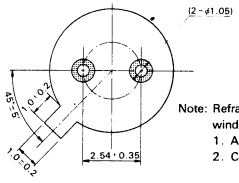
Hermetic sealing of the package achieves high reliability.

Features

- High efficiency and high brightness output
- High frequency response
- Excellent light-current linearity

Package Dimensions



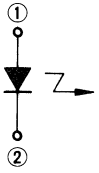


Note: Refraction index of window glass: 1.48
1. Anode
2. Cathode

(Unit: mm)

SG-type

Internal Circuit



Absolute Maximum Ratings ($T_C = 25°C$)

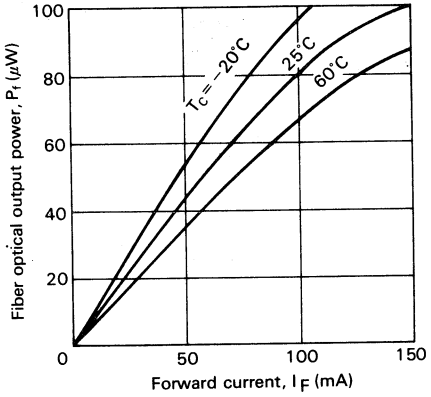
Items	Symbols	Values	Units
Forward current	I_F	150	mA
Reverse voltage	V_R	3	V
Tolerable power dissipation	P_d	350	mW
Operating temperature	T_{opr}	−20 to +60	°C
Storage temperature	T_{stg}	−40 to +90	°C

Optical and Electrical Characteristics ($T_C = 25°C$)

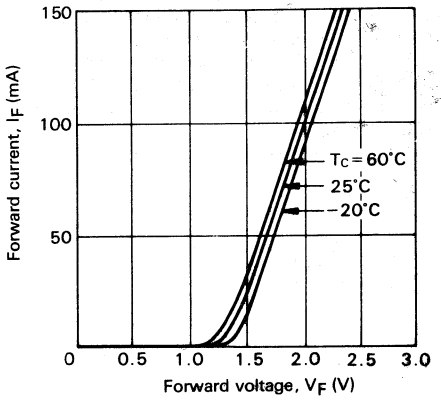
Items	Symbols	min.	typ.	max.	Units	Test conditions
Fiber optical output power	P_f*	40	80		μW	$I_F = 100$ mA
Peak wavelength	λ_p	800	840	900	nm	$I_F = 100$ mA
Spectral width	$\Delta\lambda$		50		nm	$I_F = 100$ mA
Forward voltage	V_F			2.5	V	$I_F = 100$ mA
Reverse current	I_R			100	μA	$V_R = 3$ V
Capacitance	C_t		10		pF	$V_R = 0$ V, f = 1 MHz
Rise time	t_r		5		ns	$I_F = 50$ mA
Fall time	t_f		7		ns	$I_F = 50$ mA

* At GI 50/125 fiber end through rod lens.

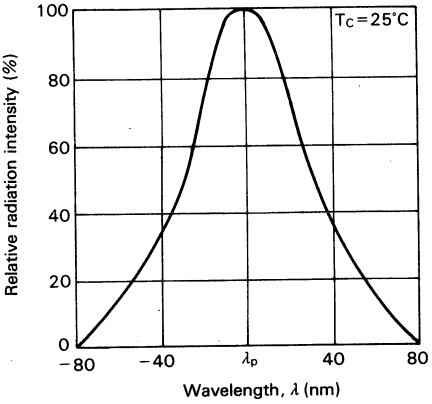
Optical Output Power vs. Forward Current



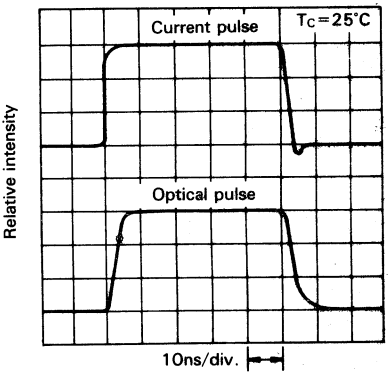
Forward Current vs. Forward Voltage



Spectral Distribution



Pulse Response



HE8403ML

GaAlAs IRED

Description

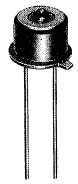
HE8403ML is a 0.8 μm GaAlAs infrared emitting diode with double heterojunction structure, which provides high speed response.

Optical output from the chip is directed to the optical fiber efficiently through the microlens in the cap; suitable as a light source in fiberoptic communications equipment.

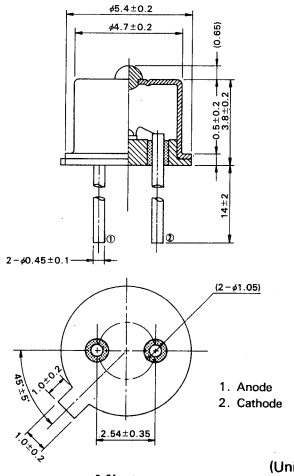
Hermetic sealing of the package achieves high reliability.

Features

- High efficiency and high brightness output
- High frequency response
- Excellent light-current linearity



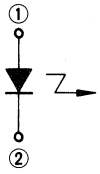
Package Dimensions



ML-type

(Unit: mm)

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

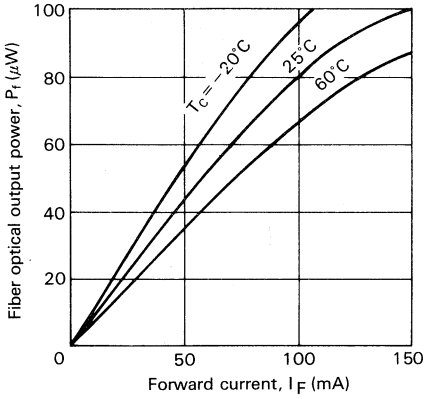
Items	Symbols	Values	Units
Forward current	I_F	150	mA
Reverse voltage	V_R	3	V
Tolerable power dissipation	P_d	350	mW
Operating temperature	T_{opr}	−20 to +60	°C
Storage temperature	T_{stg}	−40 to +90	°C

Optical and Electrical Characteristics (T_C = 25°C)

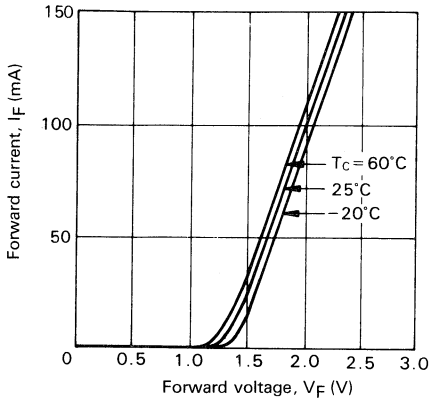
Items	Symbols	min.	typ.	max.	Units	Test conditions
Fiber optical output power	P_f*	50	80		μW	I_F = 100 mA
Peak wavelength	λ_p	800	840	900	nm	I_F = 100 mA
Spectral width	$\Delta\lambda$		50		nm	I_F = 100 mA
Forward voltage	V_F			2.5	V	I_F = 100 mA
Reverse current	I_R			100	μA	V_R = 3 V
Capacitance	C_t		10		pF	V_R = 0 V, f = 1 MHz
Rise time	t_r		5		ns	I_F = 50 mA
Fall time	t_f		7		ns	I_F = 50 mA

* At GI 50/125 fiber end.

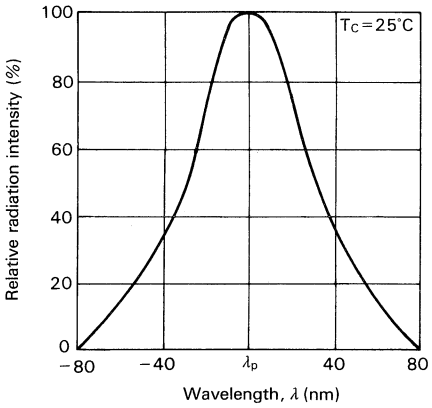
Optical Output Power vs. Forward Current



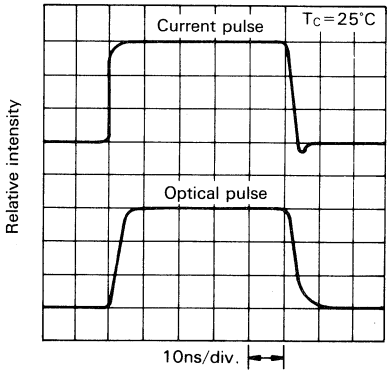
Forward Current vs. Forward Voltage



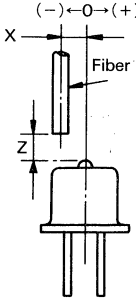
Spectral Distribution

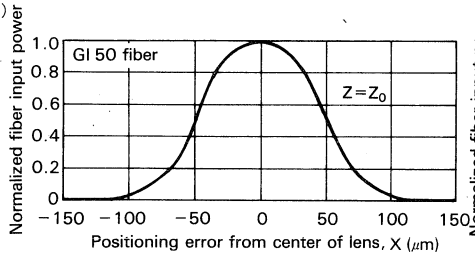


Pulse Response



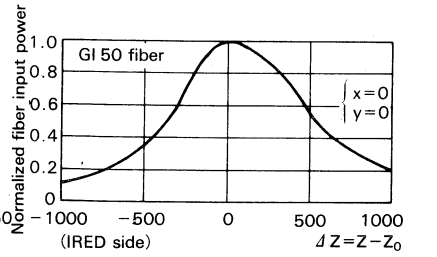
Coupling Characteristics





Fiber input deviation due to lateral fiber positioning error

Z_0: Focal point of lens



Positioning error from focal point of lens, Δ Z (μm)

Fiber input deviation due to horizontal fiber positioning error

HE8403TR

GaAlAs IRED

Description

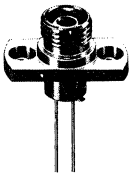
HE8403TR is a 0.8 μm GaAlAs infrared emitting diode with double heterojunction structure, which provides high speed response.

The package with a receptacle is easily connected with FC-type connector; suitable as a light source in fiberoptic communications equipment.

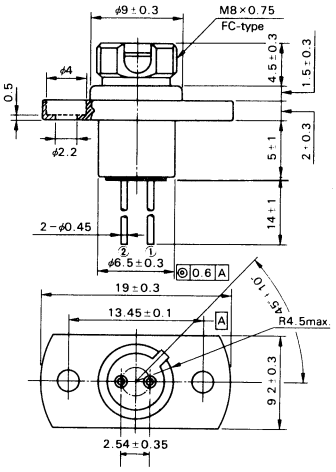
Hermetic sealing of the package achieves high reliability.

Features

- High efficiency and high brightness output
- High frequency response
- Wide operating-temperature range: T_{opr} = −20 to +85°C



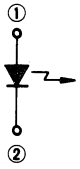
Package Dimensions



1. Anode
2. Cathode

TR-type (Unit : mm)

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

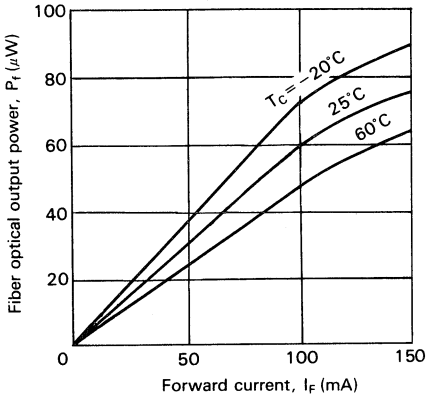
Items	Symbols	Values	Units
Forward current	I_F	150	mA
Reverse voltage	V_R	3	V
Tolerable power dissipation	P_d	350	mW
Operating temperature	T_{opr}	−20 to +85	°C
Storage temperature	T_{stg}	−40 to +100	°C

Optical and Electrical Characteristics (T_C = 25°C)

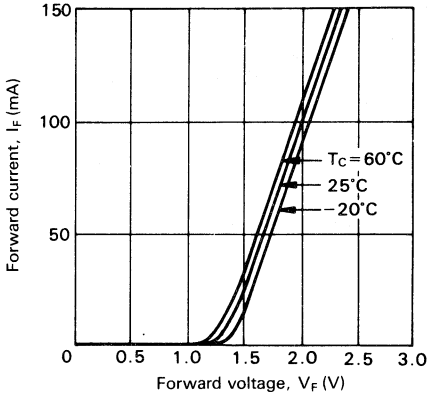
Items	Symbols	min.	typ.	max.	Units	Test conditions
Fiber optical output power	P_f*	40	60		μW	I_F = 100 mA
Peak wavelength	λ_p	800	840	900	nm	I_F = 100 mA
Spectral width	$\Delta\lambda$		50		nm	I_F = 100 mA
Forward voltage	V_F			2.5	V	I_F = 100 mA
Capacitance	C_t		10		pF	V_R = 0 V, f = 1 MHz
Rise time	t_r		5		ns	I_F = 50 mA
Fall time	t_f		7		ns	I_F = 50 mA

* At GI 50/125 fiber end.

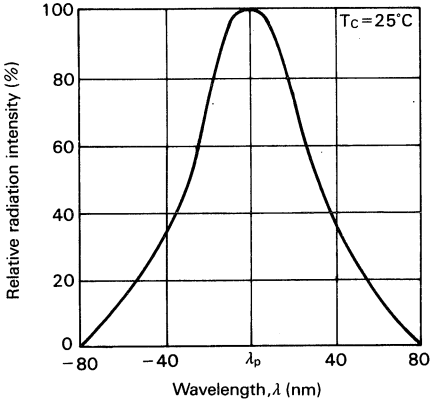
Optical Output Power vs. Forward Current



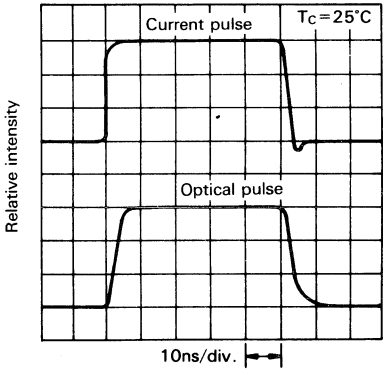
Forward Current vs. Forward Voltage



Spectral Distribution



Pulse Response



HE8404SG

—Under development—
GaAlAs IRED

Description

HE8404SG is a 0.82 μm GaAlAs infrared emitting diode with double heterojunction structure. High brightness output, high power output and high speed response can be obtained.

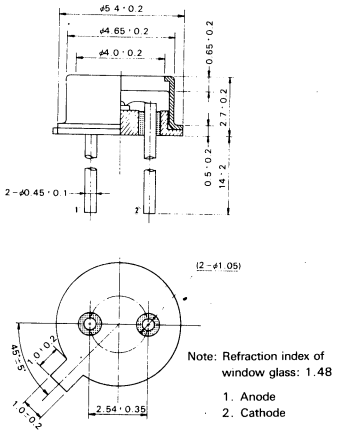
It is suitable as a light source in optical controlling equipment and sensors.

Hermetic sealing of the package achieves high reliability.

Features

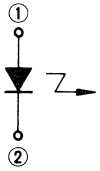
- High power output: $P_o \geqq 40$ mW
- Fast pulse response: $t_r = 5$ns, $t_f = 7$ns typ.

Package Dimensions



SG-type

Internal Circuit



Absolute Maximum Ratings ($T_C = 25$°C)

Items	Symbols	Values	Units
Forward current	I_F	250	mA
Reverse voltage	V_R	3	V
Operating temperature	T_{opr}	−20 to +60	°C
Storage temperature	T_{stg}	−40 to +90	°C

Optical and Electrical Characteristics ($T_C = 25$°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Optical output power	P_0	40			mW	$I_F = 200$ mA
Peak wavelength	λ_p	790	820	850	nm	$I_F = 200$ mA
Spectral width	$\Delta\lambda$		50		nm	$I_F = 200$ mA
Forward voltage	V_F			2.5	V	$I_F = 200$ mA
Reverse current	I_R			100	µA	$V_R = 3$ V
Capacitance	C_t		30		pF	$V_R = 0$ V, f = 1 MHz
Rise time	t_r		5		ns	$I_F = 50$ mA
Fall time	t_f		7		ns	$I_F = 50$ mA

HE8805VG

GaAlAs IRED

Description

HE8805VG is a 0.8 μm GaAlAs infrared emitting diode with single heterojunction structure.

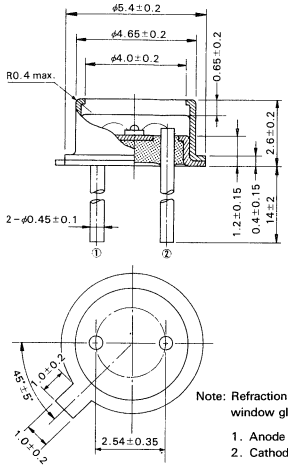
It is suitable as a light source in autofocusing still cameras.

Hermetic sealing of the package achieves high reliability.

Features

- High efficiency and high power output
- Narrow spectral width
- Wide radiant directionality

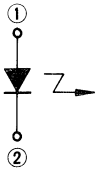
Package Dimensions



VG-type

(Unit: mm)

Internal Circuit



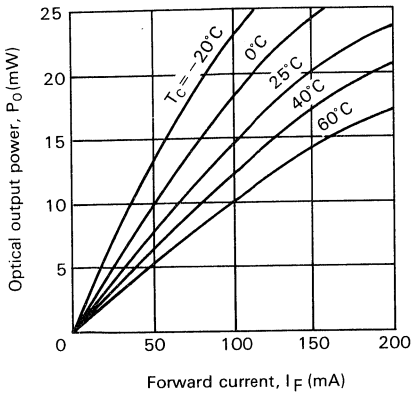
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Forward current	I_F	200	mA
Reverse voltage	V_R	3	V
Tolerable power dissipation	P_d	300	mW
Operating temperature	T_{opr}	−20 to +60	°C
Storage temperature	T_{stg}	−40 to +90	°C

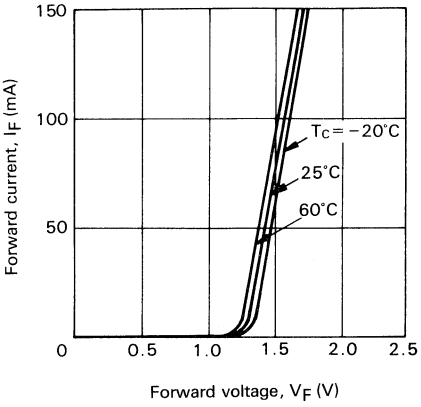
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Optical output power	P_O	6			mW	I_F = 150 mA
Peak wavelength	λ_p	800	880	900	nm	I_F = 150 mA
Spectral width	$\Delta\lambda$		30	60	nm	I_F = 150 mA
Forward voltage	V_F		1.7	2.3	V	I_F = 150 mA
Reverse current	I_R			100	µA	V_R = 3 V
Capacitance	C_t		10		pF	V_R = 0 V, f = 1 MHz
Rise time	t_r		20		ns	I_F = 50 mA
Fall time	t_f		20		ns	I_F = 50 mA

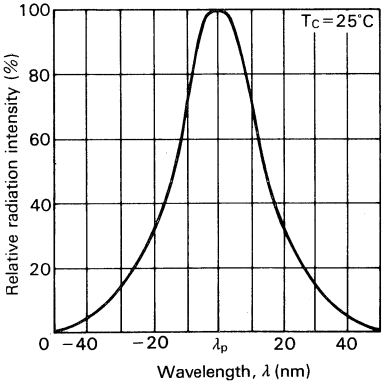
Optical Output Power vs. Forward Current



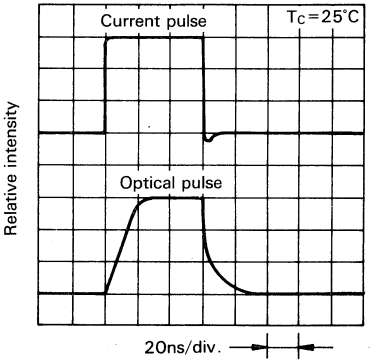
Forward Current vs. Forward Voltage



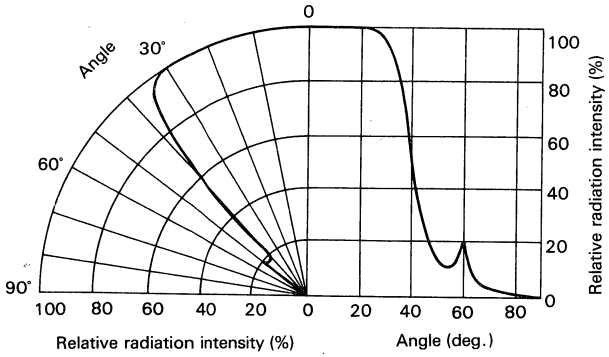
Spectral Distribution



Pulse Response



Radiation Pattern



HE8806VG

GaAlAs IRED

Description

HE8806VG is a 0.8 μm GaAlAs infrared emitting diode with single heterojunction structure.

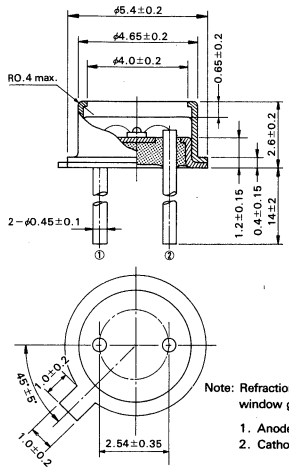
It is suitable as a light source in autofocusing VTR cameras.

Hermetic sealing of the package achieves high reliability.

Features

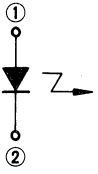
- High efficiency and high power output
- Narrow spectral width
- Wide radiant directionality

Package Dimensions



VG-type

Internal Circuit



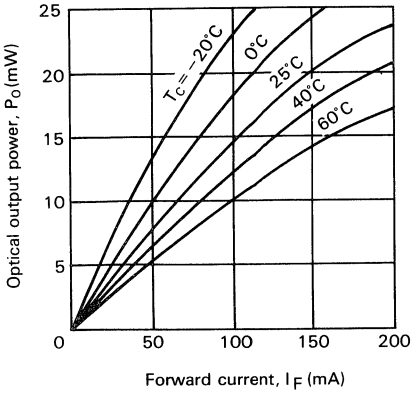
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Forward current	I_F	200	mA
Reverse voltage	V_R	3	V
Tolerable power dissipation	P_d	300	mW
Operating temperature	T_{opr}	−20 to +60	°C
Storage temperature	T_{stg}	−40 to +90	°C

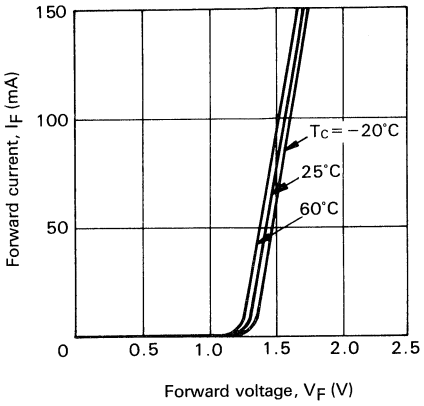
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Optical output power	P_O	12			mW	I_F = 150 mA
Peak wavelength	λ_p	800	880	900	nm	I_F = 150 mA
Spectral width	$\Delta\lambda$		30	60	nm	I_F = 150 mA
Forward voltage	V_F		1.7	2.3	V	I_F = 150 mA
Reverse current	i_R			100	µA	V_R = 3 V
Capacitance	C_t		10		pF	V_R = 0 V, f = 1 MHz
Rise time	t_r		20		ns	I_F = 50 mA
Fall time	t_f		20		ns	I_F = 50 mA

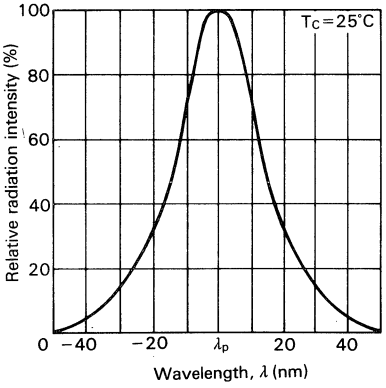
Optical Output Power vs. Forward Current



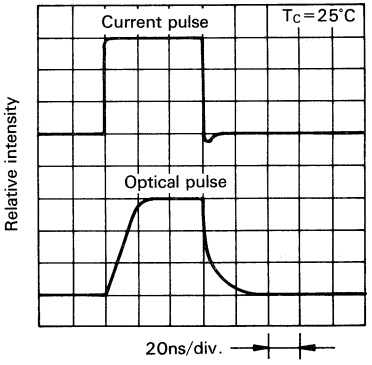
Forward Current vs. Forward Voltage



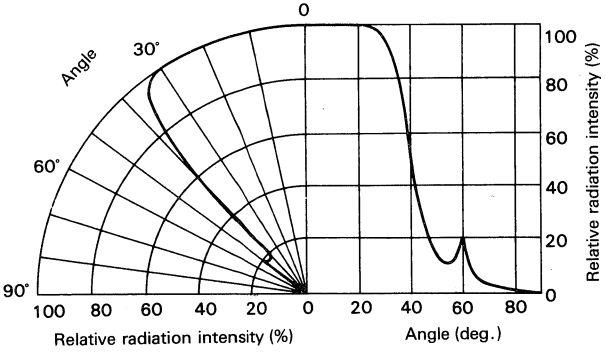
Spectral Distribution



Pulse Response



Radiation Pattern



HE8807SG

GaAlAs IRED

Description

HE8807SG is a 0.8 μm GaAlAs infrared emitting diode with single heterojunction structure.

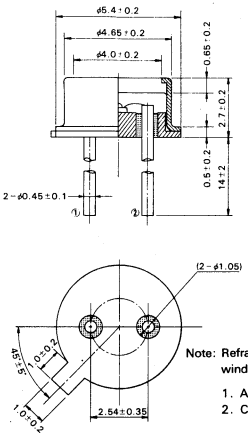
Radiant directionality is wide and radiant intensity is high; suitable as a light source in encoders and sensors.

Hermetic sealing of the package achieves high reliability.

Features

- High efficiency and high power output
- Narrow spectral width
- Wide radiant directionality
- High reliability

Package Dimensions



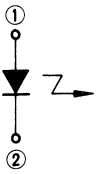
Note: Refraction index of window glass: 1.48

1. Anode
2. Cathode

(Unit: mm)

SG-type

Internal Circuit



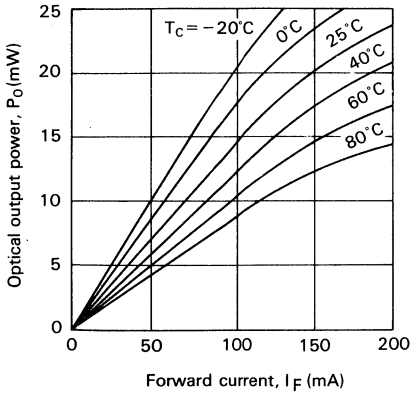
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Forward current	I_F	200	mA
Reverse voltage	V_R	3	V
Tolerable power dissipation	P_d	350	mW
Operating temperature	T_{opr}	−20 to +80	°C
Storage temperature	T_{stg}	−40 to +100	°C

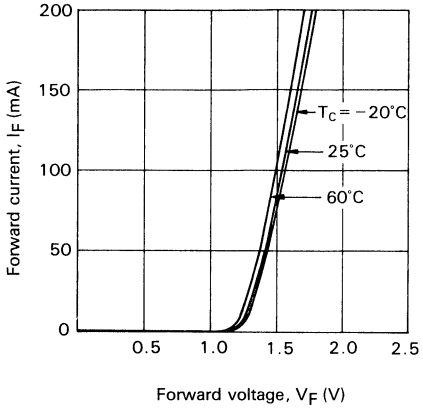
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Optical output power	P_O	10	20		mW	I_F = 150 mA
Peak wavelength	λ_p	800	880	900	nm	I_F = 150 mA
Spectral width	$\Delta\lambda$		30	60	nm	I_F = 150 mA
Forward voltage	V_F		1.7	2.3	V	I_F = 150 mA
Reverse current	I_R			100	µA	V_R = 3 V
Capacitance	C_t		10		pF	V_R = 0 V, f = 1 MHz
Rise time	t_r		20		ns	I_F = 50 mA
Fall time	t_f		20		ns	I_F = 50 mA

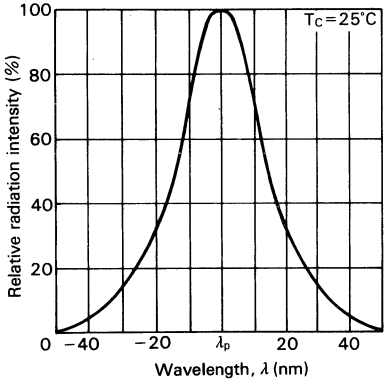
Optical Output Power vs. Forward Current



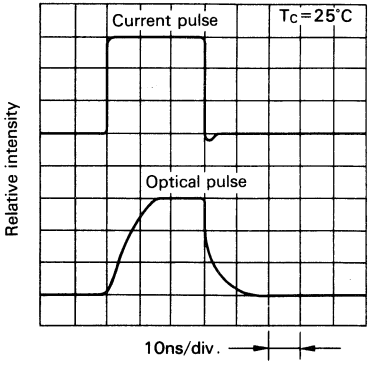
Forward Current vs. Forward Voltage



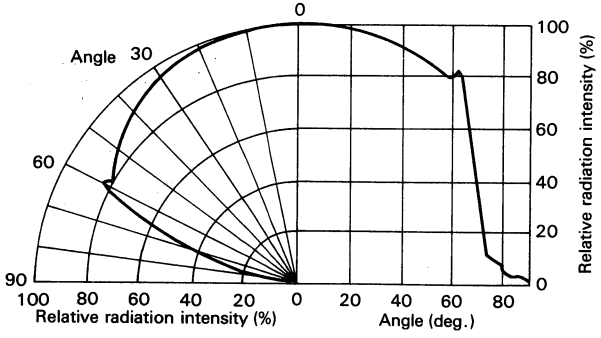
Spectral Distribution



Pulse Response



Radiation Pattern



HE8807SL

GaAlAs IRED

Description

HE8807SL is a 0.8 μm GaAlAs infrared emitting diode with single heterojunction structure.

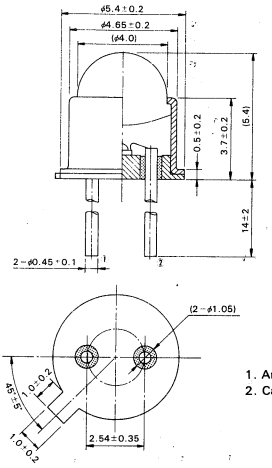
Radiant directionality is narrow and radiant intensity is high; suitable as a light source in encoders and sensors.

The package is hermetically sealed with the cap and lens, achieving high reliability.

Features

- High efficiency and high power output
- Narrow spectral width
- Narrow radiant directionality

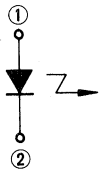
Package Dimensions



(Unit: mm)

SL-type

Internal Circuit



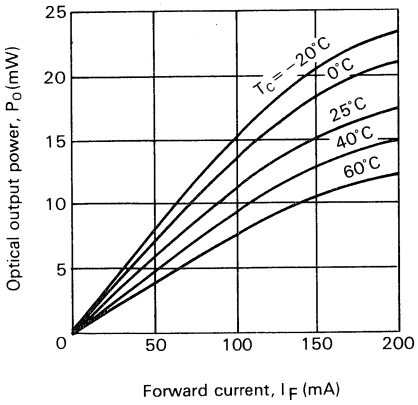
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Forward current	I_F	200	mA
Reverse voltage	V_R	3	V
Tolerable power dissipation	P_d	350	mW
Operating temperature	T_{opr}	−20 to +80	°C
Storage temperature	T_{stg}	−40 to +100	°C

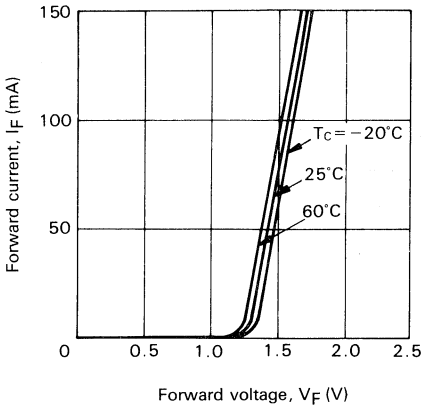
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Optical output power	P_O	5	15		mW	I_F = 150 mA
Peak wavelength	λ_p	800	880	900	nm	I_F = 150 mA
Spectral width	$\Delta\lambda$		30	60	nm	I_F = 150 mA
Forward voltage	V_F		1.7	2.3	V	I_F = 150 mA
Reverse current	I_R			100	µA	V_R = 3 V
Capacitance	C_t		10		pF	V_R = 0 V, f = 1 MHz
Rise time	t_r		20		ns	I_F = 50 mA
Fall time	t_f		20		ns	I_F = 50 mA

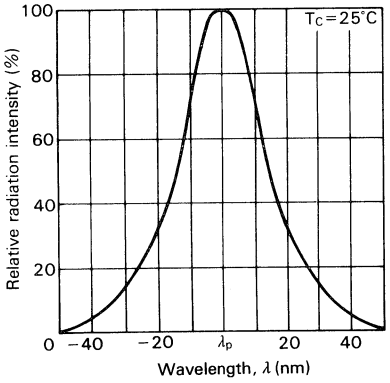
Optical Output Power vs. Forward Current



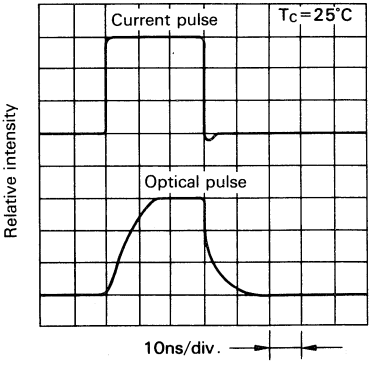
Forward Current vs. Forward Voltage



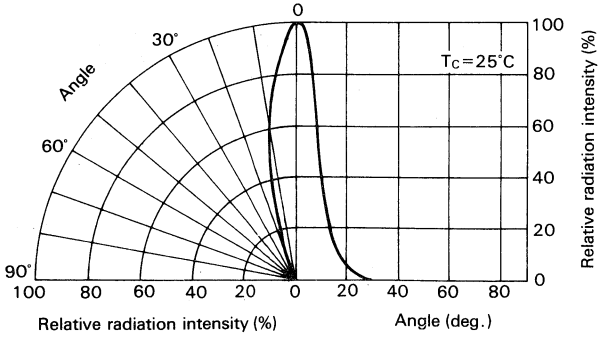
Spectral Distribution



Pulse Response



Radiation Pattern



HE8807CL

—Under development—
GaAlAs IRED

Description

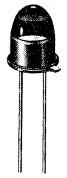
HE8807CL is a 0.8 μm GaAlAs infrared emitting diode with single heterojunction structure.

Collimated light beam can be obtained by the package with lens; suitable as a light source in encoders and sensors.

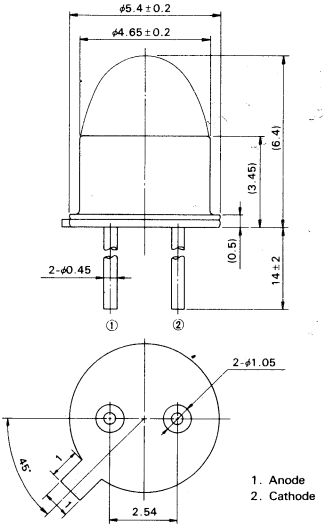
The package is hermetically sealed with the cap and lens, achieving high reliability.

Features

- High efficiency and high power output
- Narrow spectral width
- Collimated light beam

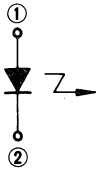


Package Dimensions



CL-type (Unit : mm)

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Forward current	I_F	200	mA
Reverse voltage	V_R	3	V
Tolerable power dissipation	P_d	350	mW
Operating temperature	T_{opr}	−20 to +80	°C
Storage temperature	T_{stg}	−40 to +100	°C

Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Optical output power	P_O	5	10		mW	I_F = 150 mA
Peak wavelength	λ_p	800	880	900	nm	I_F = 150 mA
Spectral width	$\Delta\lambda$		30	60	nm	I_F = 150 mA
Forward voltage	V_F		1.7	2.3	V	I_F = 150 mA
Reverse current	I_R			100	μA	V_R = 3 V
Capacitance	C_t		10		pF	V_R = 0 V, f = 1 MHz
Rise time	t_r		20		ns	I_F = 50 mA
Fall time	t_f		20		ns	I_F = 50 mA

HE8810MA

—Under development—
GaAlAs IRED

Description

HE8810MA is a 0.8 μm GaAlAs infrared emitting diode with single heterojunction structure.

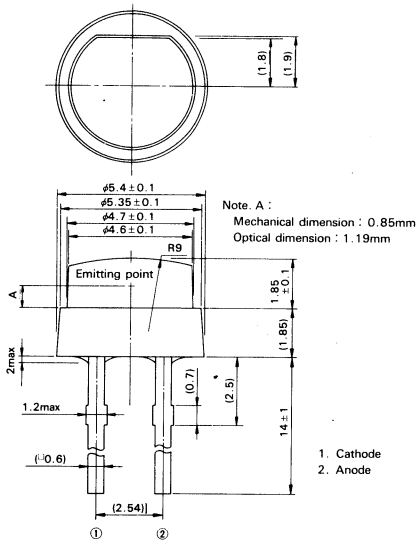
It is suitable as a light source in autofocusing still cameras.

The package is transparent resin molded.

Features

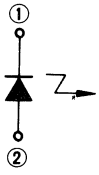
- High efficiency and high power output
- Narrow spectral width

Package Dimensions



MA-type (Unit : mm)

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Forward current	I_F	150	mA
Reverse voltage	V_R	3	V
Tolerable power dissipation	P_d	300	mW
Operating temperature	T_{opr}	−20 to +60	°C
Storage temperature	T_{stg}	−40 to +90	°C

Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Optical output power	P_F	1	1.5		mW	I_F = 150 mA, NA = 0.25
Peak wavelength	λ_p	800	880	900	nm	I_F = 150 mA
Spectral width	$\Delta\lambda$		30	60	nm	I_F = 150 mA
Forward voltage	V_F		1.7	2.3	V	I_F = 150 mA
Reverse current	I_R			100	μA	V_R = 3 V
Capacitance	C_t		10		pF	V_R = 0 V, f = 1 MHz
Rise time	t_r		20		ns	I_F = 50 mA
Fall time	t_f		20		ns	I_F = 50 mA

HE8811 GaAlAs IRED

Description

HE8811 is a 0.8 μm GaAlAs infrared emitting diode with double heterojunction structure. High brightness output, high power output and high speed response can be obtained.

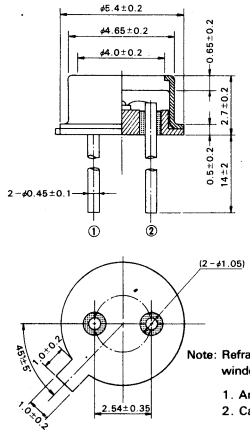
It is suitable as a light source in measuring and beam communications equipment.

Hermetic sealing of the package achieves high reliability.

Features

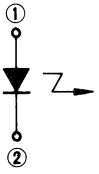
- High frequency response
- High power output, high efficiency and high brightness output
- Wide radiant directionality

Package Dimensions



SG-type

Internal Circuit



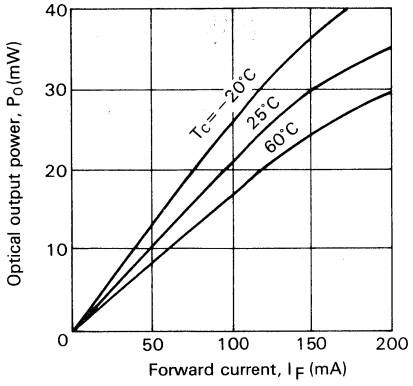
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Forward current	I_F	200	mA
Reverse voltage	V_R	3	V
Tolerable power dissipation	P_d	400	mW
Operating temperature	T_{opr}	−20 to +60	°C
Storage temperature	T_{stg}	−40 to +90	°C

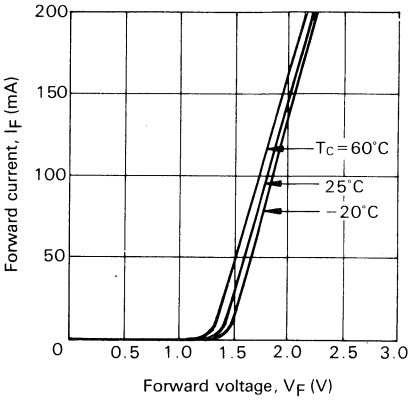
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Optical output power	P_O	20	30		mW	I_F = 150 mA
Peak wavelength	λ_p	780	820	900	nm	I_F = 150 mA
Spectral width	$\Delta\lambda$		50		nm	I_F = 150 mA
Forward voltage	V_F			2.5	V	I_F = 150 mA
Reverse current	I_R			100	µA	V_R = 3 V
Capacitance	C_t		10		pF	V_R = 0 V, f = 1 MHz
Rise time	t_r		5		ns	I_F = 50 mA
Fall time	t_f		7		ns	I_F = 50 mA

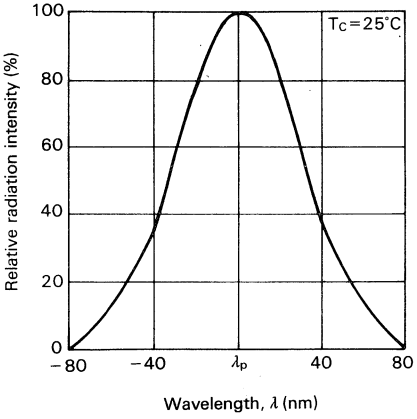
Optical Output Power vs. Forward Current



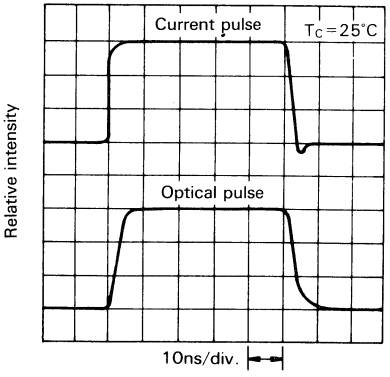
Forward Current vs. Forward Voltage



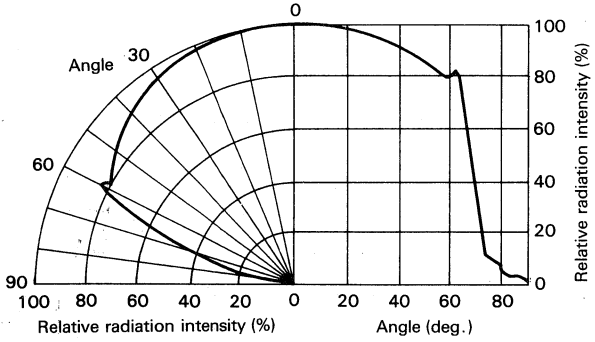
Spectral Distribution



Pulse Response



Radiation Pattern



HE8812SG

—Under development—
GaAlAs IRED

Description

HE8812SG is a 0.87 μm GaAlAs infrared emitting diode with double heterojunction structure. High brightness output, high power output and high speed response can be obtained.

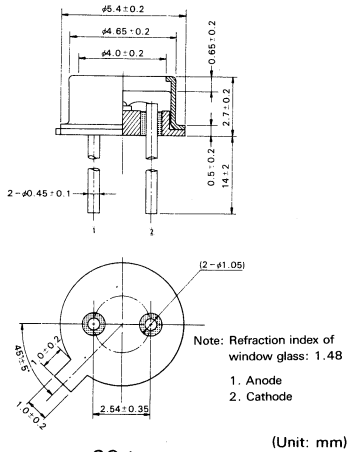
It is suitable as a light source in optical controlling equipment and sensors.

Hermetic sealing of the package achieves high reliability.

Features

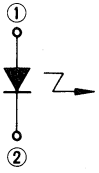
- High power output: $P_O \geqq 40$ mW
- Fast pulse response: $t_r = 5$ns, $t_f = 7$ns typ.

Package Dimensions



SG-type

Internal Circuit



Absolute Maximum Ratings ($T_C = 25$°C)

Items	Symbols	Values	Units
Forward current	I_F	250	mA
Reverse voltage	V_R	3	V
Operating temperature	T_{opr}	−20 to +60	°C
Storage temperature	T_{stg}	−40 to +90	°C

Optical and Electrical Characteristics ($T_C = 25$°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Optical output power	P_O	40			mW	$I_F = 200$ mA
Peak wavelength	λ_p	840	870	900	nm	$I_F = 200$ mA
Spectral width	$\Delta\lambda$		50		nm	$I_F = 200$ mA
Forward voltage	V_F			2.5	V	$I_F = 200$ mA
Reverse current	I_R			100	µA	$V_R = 3$ V
Capacitance	C_t		30		pF	$V_R = 0$ V, f = 1 MHz
Rise time	t_r		5		ns	$I_F = 50$ mA
Fall time	t_f		7		ns	$I_F = 50$ mA

HE1301R

InGaAsP IRED

Description

HE1301R is a 1.3 μm InGaAsP infrared emitting diode with double heterojunction structure, which provides high speed response.

It is suitable as a light source in high-speed digital link (up to 200 Mb/s) of fiberoptic communications equipment.

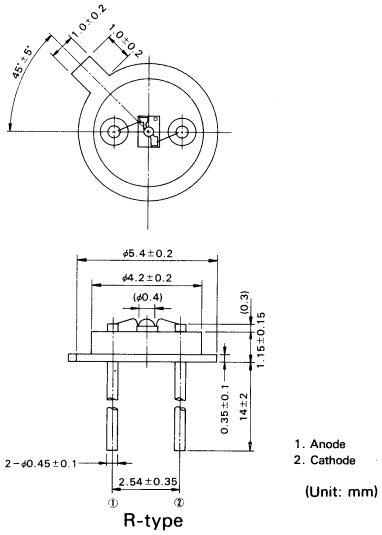
Optical fiber can be close to the chip, achieving high coupling efficiency.

The package should be hermetically sealed before mounting on a system.

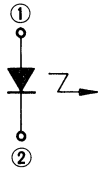
Features

- High power output
- High efficiency and high brightness output
- Fast pulse response

Package Dimensions



Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Forward current	I_F	150	mA
Reverse voltage	V_R	1.0	V
Tolerable power dissipation	P_d	300	mW
Operating temperature	T_{opr}	−20 to +40*	°C
Storage temperature	T_{stg}	−40 to +60*	°C

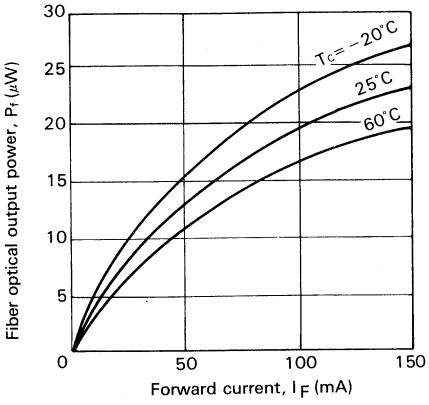
* Value for conditions without condensation.

Optical and Electrical Characteristics (T_C = 25°C)

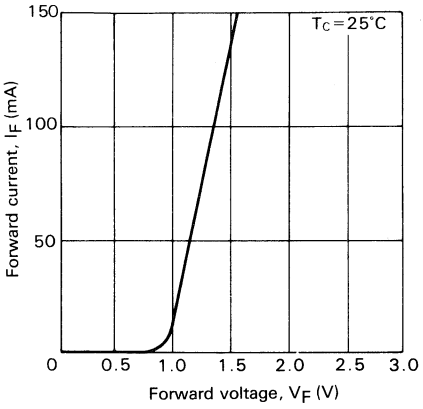
Items	Symbols	min.	typ.	max.	Units	Test conditions
Fiber optical output power	P_f*	15			μW	I_F = 100 mA
Peak wavelength	λ_p	1260	1300	1340	nm	I_F = 100 mA
Spectral width	$\Delta\lambda$		140		nm	I_F = 100 mA
Forward voltage	V_F		1.5	2.0	V	I_F = 100 mA
Capacitance	C_t		30		pF	V_R = 0 V, f = 1 MHz
Rise time	t_r		1.5		ns	I_F = 100 mA
Fall time	t_f		4.0		ns	I_F = 100 mA

* At GI 50/125 fiber end.

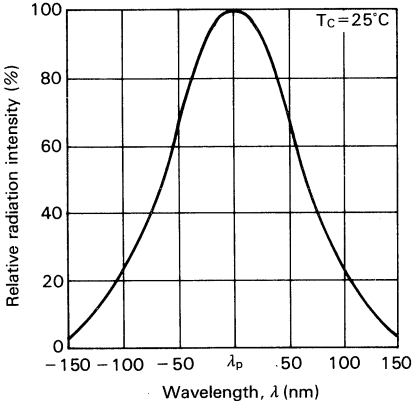
Optical Output Power vs. Forward Current



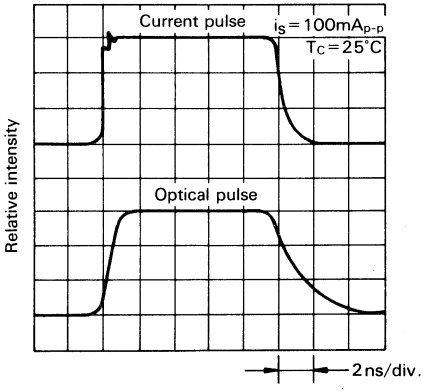
Forward Current vs. Forward Voltage



Spectral Distribution



Pulse Response



HE1301SG

InGaAsP IRED

Description

HE1301SG is a 1.3 μm InGaAsP infrared emitting diode with double heterojunction structure, which provides high speed response.

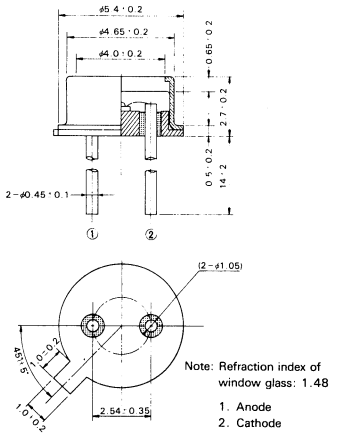
High coupling efficiency can be realized using a rod lens; suitable as a light source in fiberoptic communications equipment.

Hermetic sealing of the package achieves high reliability.

Features

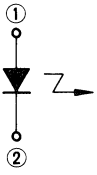
- High power output
- High efficiency and high brightness output
- Fast pulse response

Package Dimensions



SG-type

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

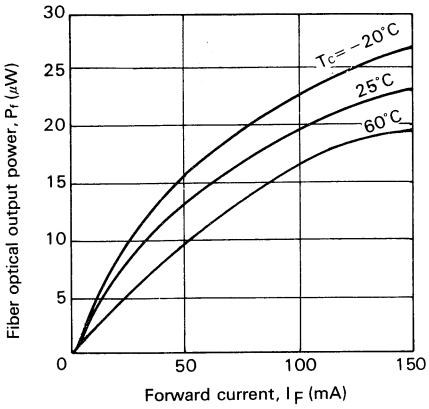
Items	Symbols	Values	Units
Forward current	I_F	150	mA
Reverse voltage	V_R	1.0	V
Tolerable power dissipation	P_d	300	mW
Operating temperature	T_{opr}	−20 to +60	°C
Storage temperature	T_{stg}	−40 to +90	°C

Optical and Electrical Characteristics (T_C = 25°C)

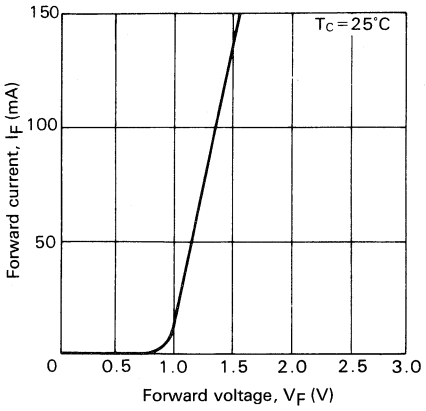
Items	Symbols	min.	typ.	max.	Units	Test conditions
Fiber optical output power	P_f*	15			μW	I_F = 100 mA
Peak wavelength	λ_p	1260	1300	1340	nm	I_F = 100 mA
Spectral width	$\Delta\lambda$		140		nm	I_F = 100 mA
Forward voltage	V_F		1.5	2.0	V	I_F = 100 mA
Capacitance	C_t		30		pF	V_R = 0 V, f = 1 MHz
Rise time	t_r		1.5		ns	I_F = 100 mA
Fall time	t_f		4.0		ns	I_F = 100 mA

* At GI 50/125 fiber end.

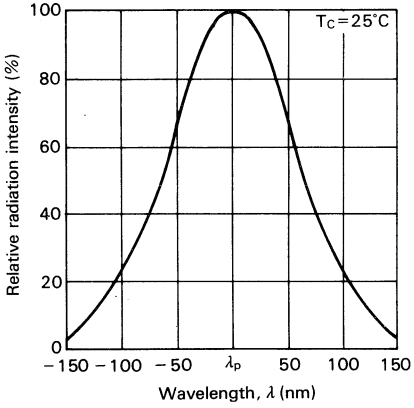
Optical Output Power vs. Forward Current



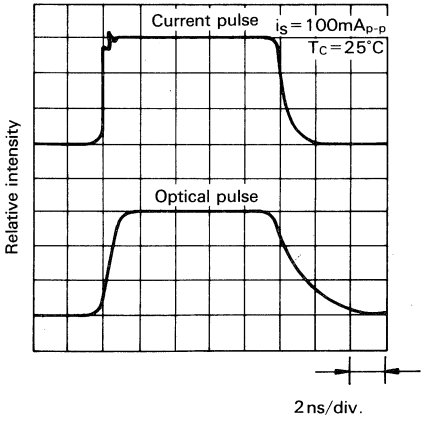
Forward Current vs. Forward Voltage



Spectral Distribution



Pulse Response



HE1301ML

InGaAsP IRED

Description

HE1301ML is a 1.3 μm InGaAsP infrared emitting diode with double heterojunction structure, which provides high speed response.

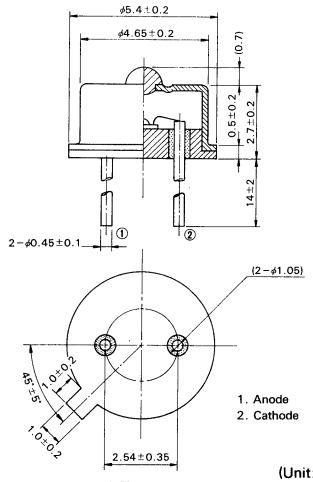
Optical output from the chip is directed to the optical fiber efficiently through the microlens in the cap; suitable as a light source in fiberoptic communications equipment.

Hermetic sealing of the package achieves high reliability.

Features

- High power output
- High efficiency and high brightness output
- Fast pulse response

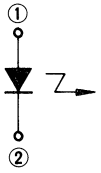
Package Dimensions



(Unit: mm)

ML-type

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

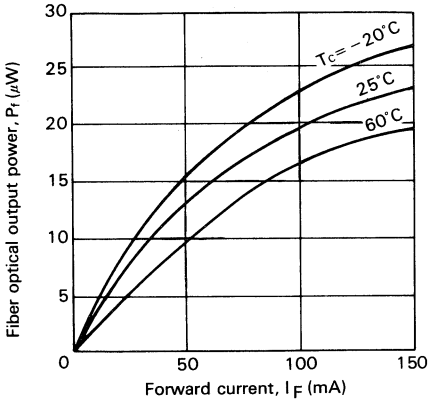
Items	Symbols	Values	Units
Forward current	I_F	150	mA
Reverse voltage	V_R	1.0	V
Tolerable power dissipation	P_d	300	mW
Operating temperature	T_{opr}	−20 to +60	°C
Storage temperature	T_{stg}	−40 to +90	°C

Optical and Electrical Characteristics (T_C = 25°C)

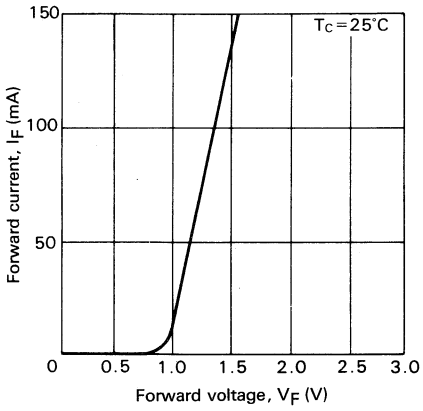
Items	Symbols	min.	typ.	max.	Units	Test conditions
Fiber optical output power	P_f*	15			μW	I_F = 100 mA
Peak wavelength	λ_p	1260	1300	1340	nm	I_F = 100 mA
Spectral width	$\Delta\lambda$		140		nm	I_F = 100 mA
Forward voltage	V_F		1.5	2.0	V	I_F = 100 mA
Capacitance	C_t		30		pF	V_R = 0 V, f = 1 MHz
Rise time	t_r		1.5		ns	I_F = 100 mA
Fall time	t_f		4.0		ns	I_F = 100 mA

* At GI 50/125 fiber end.

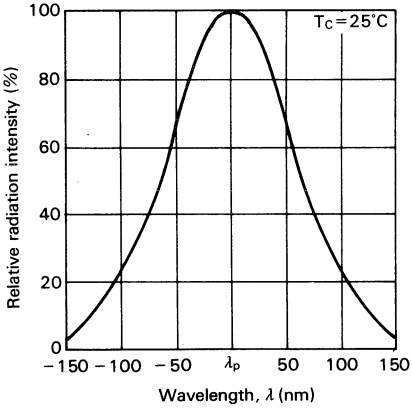
Optical Output Power vs. Forward Current



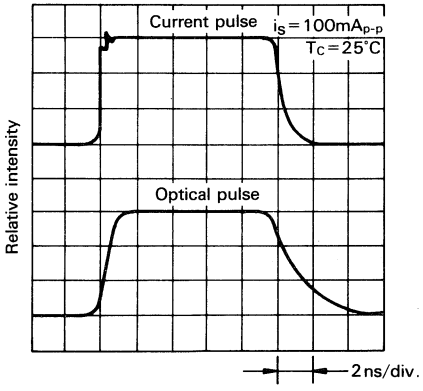
Forward Current vs. Forward Voltage



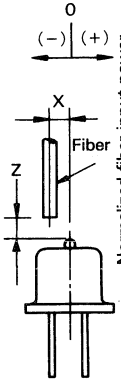
Spectral Distribution

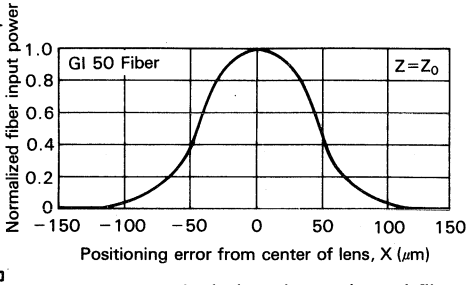


Pulse Response



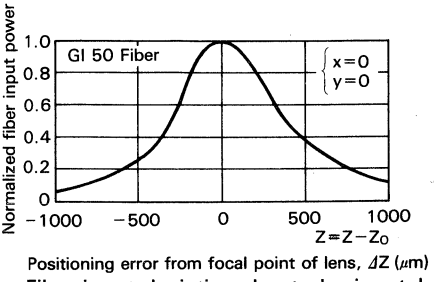
Coupling Characteristics





Fiber input deviation due to lateral fiber positioning error

Z_0: Focal point of lens



Fiber input deviation due to horizontal fiber positioning error

HE1301TR

InGaAsP IRED

Description

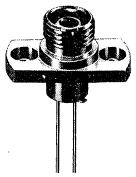
HE1301TR is a 1.3 μm InGaAsP infrared emitting diode with double heterojunction structure, which provides high speed response.

The package with a receptacle is easily connected with FC-type connector; suitable as a light source in fiberoptic communications equipment.

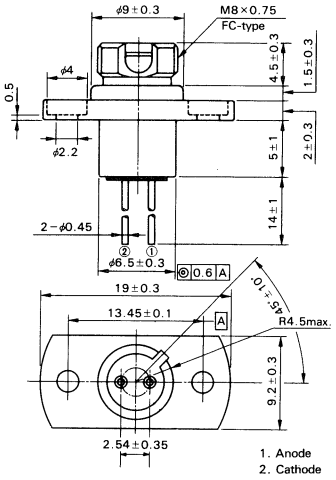
Hermetic sealing of the package achieves high reliability.

Features

- High efficiency and high brightness output
- Fast pulse response
- Wide operating-temperature range: T_{opr} = −20 to +85°C

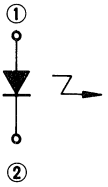


Package Dimensions



TR-type (Unit : mm)

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

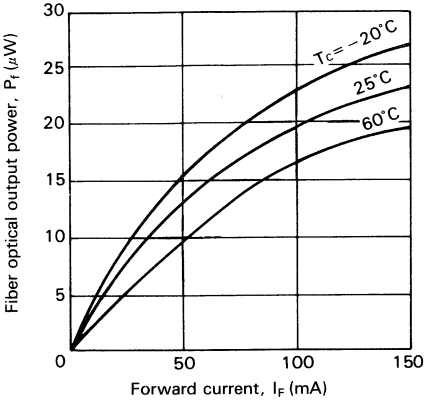
Items	Symbols	Values	Units
Forward current	I_F	150	mA
Reverse voltage	V_R	1.0	V
Tolerable power dissipation	P_d	300	mW
Operating temperature	T_{opr}	−20 to +85	°C
Storage temperature	T_{stg}	−40 to +100	°C

Optical and Electrical Characteristics (T_C = 25°C)

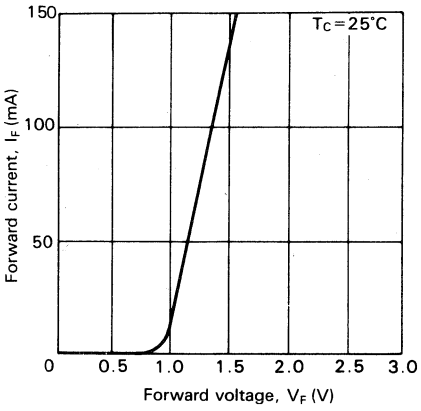
Items	Symbols	min.	typ.	max.	Units	Test conditions
Fiber optical output power	P_f*	15	20		μW	I_F = 100 mA
Peak wavelength	λ_p	1260	1300	1340	nm	I_F = 100 mA
Spectral width	$\Delta\lambda$		140		nm	I_F = 100 mA
Forward voltage	V_F		1.5	2.0	V	I_F = 100 mA
Capacitance	C_t		30		pF	V_R = 0 V, f = 1 MHz
Rise time	t_r		1.5		ns	I_F = 100 mA
Fall time	t_f		4.0		ns	I_F = 100 mA

* At GI 50/125 fiber end.

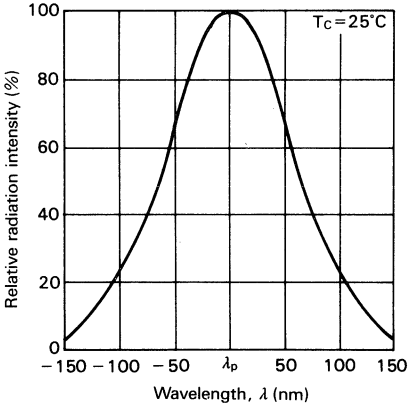
Optical Output Power vs. Forward Current



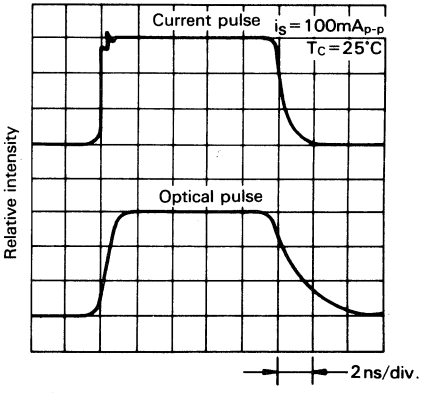
Forward Current vs. Forward Voltage



Spectral Distribution



Pulse Response



Photodiodes

Product Lineup

	Packages				
Chips	**QG**	**TG**	**LG**	**CX**	**TR**
HR8101	HR8101				
HR8102		HR8102			
HR8202		HR8202TG			
HR1103		HR1103TG		HR1103CX	HR1103TR
HR1104		HR1104TG		HR1104CX	
HR1105		HR1105TG			
HR1106			HR1106LG		
HR1201		HR1201TG		HR1201CX	

New product

HR8101

Si PIN Photodiode

Description

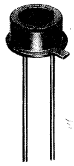
HR8101 is a Si PIN photodiode for detecting 0.6–0.9 μm light.

It is suitable as an optical monitor in measuring and fiberoptic communications and various other types of optical equipment.

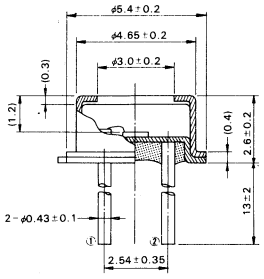
Hermetic sealing of the package achieves high reliability.

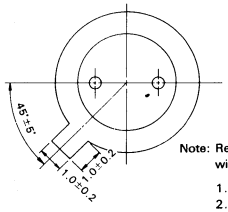
Features

- High speed pulse response: t_r, t_f = 30 ns typ.
- Photodetectable area: 0.8 × 0.8 mm□



Package Dimensions





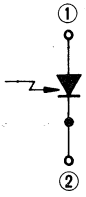
Note: Refraction index of window glass: 1.48

1. Anode
2. Cathode (Case)

(Unit: mm)

QG-type

Internal Circuit



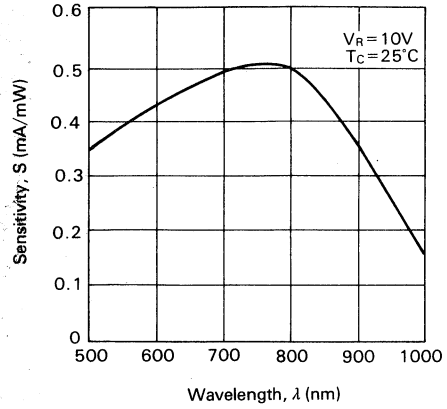
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Reverse voltage	V_R	100	V
Forward current	I_F	100	mA
Operating temperature	T_{opr}	−40 to +80	°C
Storage temperature	T_{stg}	−45 to +100	°C

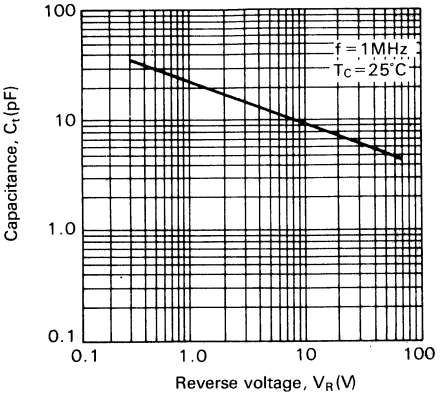
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Dark current	I_{DARK}		2	10	nA	V_R = 10 V
Capacitance	C_t		10	15	pF	V_R = 10 V, f = 1 MHz
Sensitivity	S	0.4			mA/mW	V_R = 10 V, λ_p = 830 nm
Rise time	t_r		30		ns	V_R = 10 V, λ_p = 830 nm R_L = 50 Ω
Fall time	t_f		30		ns	V_R = 10 V, λ_p = 830 nm R_L = 50 Ω

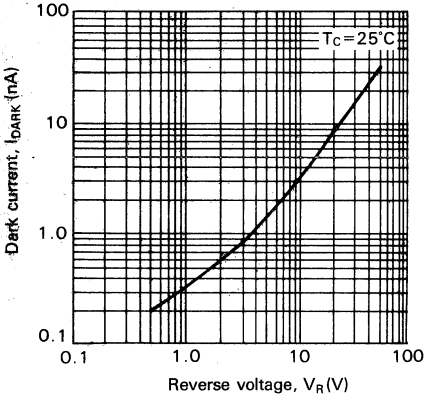
Sensitivity vs. Wavelength



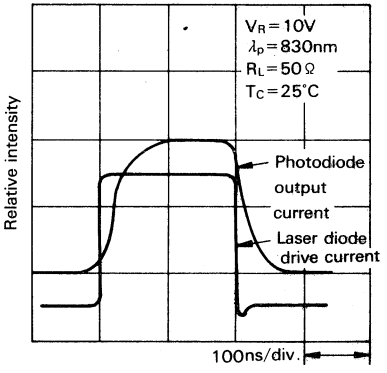
Capacitance vs. Reverse Voltage



Dark Current vs. Reverse Voltage



Pulse Response



HR8102

Si PIN Photodiode

Description

HR8102 is a Si PIN photodiode for detecting 0.6–0.9 μm light.

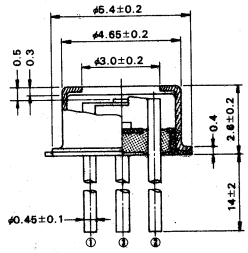
Its high speed pulse response makes it especially suitable as an optical signal detector in high-bit-rate fiberoptic communications equipment.

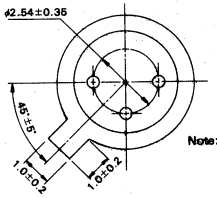
Hermetic sealing of the package achieves high reliability.

Features

- High sensitivity to wide wavelength range
- High speed pulse response: t_r, t_f = 1 ns typ.
- 5 V of low voltage operation
- Photodetectable area: 300 μm dia.

Package Dimensions





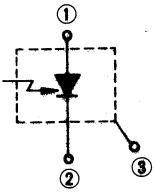
Note: Refraction index of window glass: 1.48

1. Anode
2. Cathode
3. Case

(Unit: mm)

TG-type

Internal Circuit



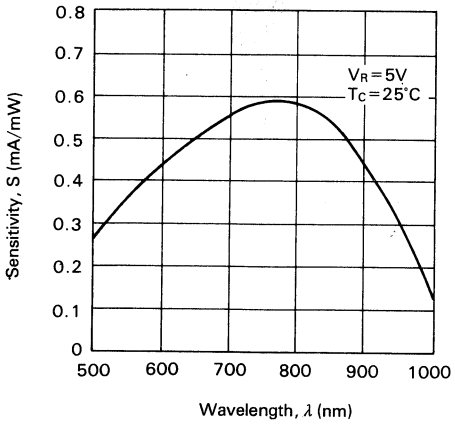
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Reverse voltage	V_R	100	V
Forward current	I_F	100	mA
Operating temperature	T_{opr}	−40 to +80	°C
Storage temperature	T_{stg}	−45 to +100	°C

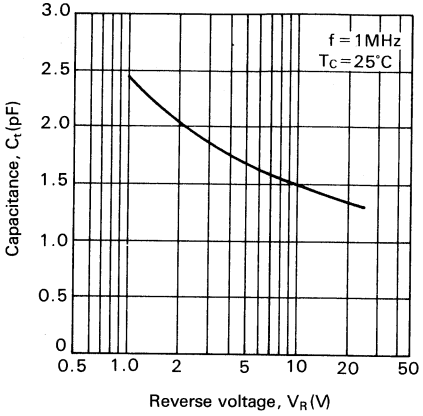
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Dark current	I_{DARK}		0.5	3	nA	V_R = 10 V
Capacitance	C_t		1.5	3	pF	V_R = 10 V, f = 1 MHz
Sensitivity	S	0.4			mA/mW	V_R = 10 V, λ_p = 830 nm
Rise time	t_r		1.0		ns	V_R = 10 V, λ_p = 830 nm R_L = 50 Ω
Fall time	t_f		1.0		ns	V_R = 10 V, λ_p = 830 nm R_L = 50 Ω

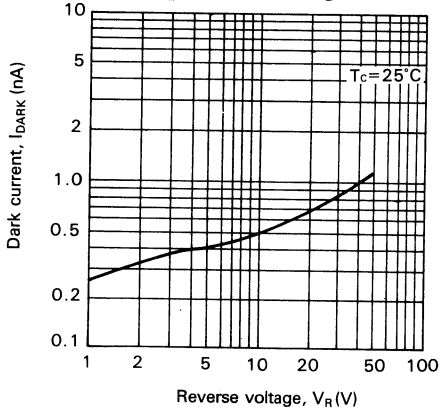
Sensitivity vs. Wavelength



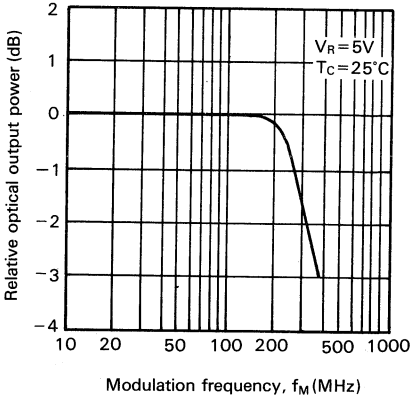
Capacitance vs. Reverse Voltage



Dark Current vs. Reverse Voltage



Frequency Response



HR8202TG

Si Avalanche Photodiode

Description

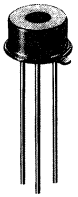
HR8202TG is a Si avalanche photodiode for detecting 0.6 – 0.9 μm light.

Its high frequency characteristics make it especially suitable as an optical signal detector in analog fiberoptic communications equipment.

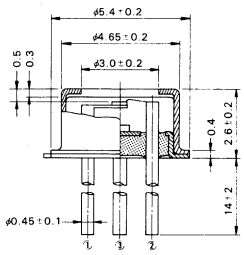
Hermetic sealing of the package achieves high reliability.

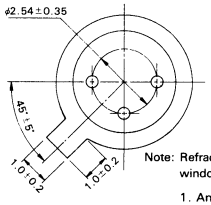
Features

- High quantum efficiency: More than 70%
- High speed response : More than 300 MHz
- Low dark current : Less than 3 nA
- Low operation voltage : Less than 200 V
- Photodetectable area : 300 μm dia.



Package Dimensions





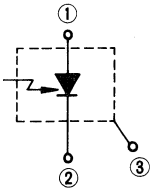
Note: Refraction index of window glass: 1.48

1. Anode
2. Cathode
3. Case

(Unit: mm)

TG-type

Internal Circuit



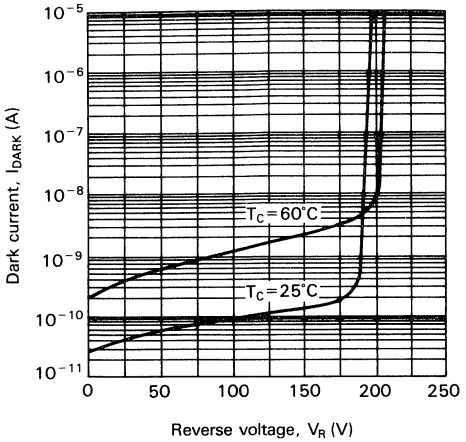
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Forward current	I_F	100	mA
Reverse current	I_R	200	µA
Operating temperature	T_{opr}	−40 to +80	°C
Storage temperature	T_{stg}	−45 to +100	°C

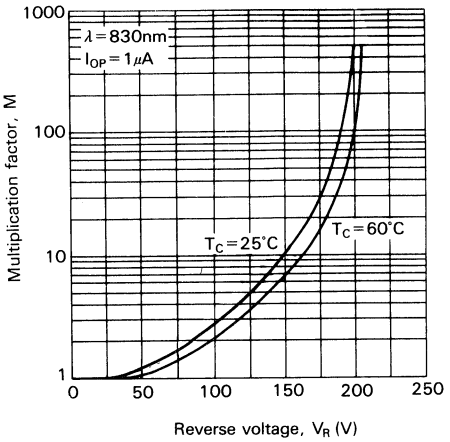
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Dark current	I_{DARK}		0.5	3	nA	V_R = 0.9 V_B
Capacitance	C_t		1.5		pF	V_R = 100 V, f = 1 MHz
Sensitivity	S	0.46	0.52		mA/mW	λ_p = 830 nm, M = 1
Quantum efficiency	η	70	78		%	λ_p = 830 nm, M = 1
Breakdown voltage	V_B	150	180	220	V	I_{DARK} = 100 µA
Cut-off frequency	f_c		600		MHz	λ_p = 830 nm, R_L = 50Ω, M = 10
Excessive noise factor	F		2			λ_p = 830 nm, M = 10
	x		0.3			f = 10 MHz, B = 300 kHz
Multiplication factor	M	30				V_R = 0.9 V_B, λ_p = 830 nm

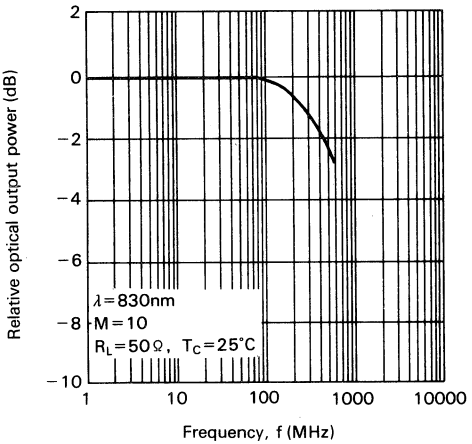
Dark Current vs. Reverse Voltage



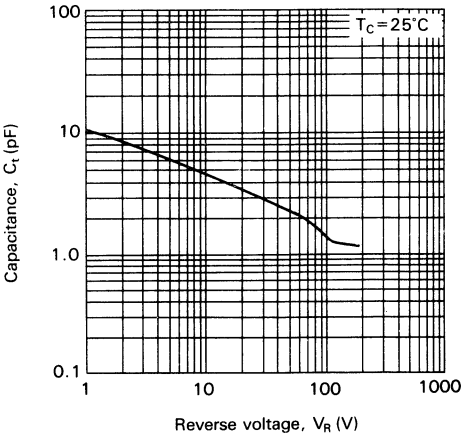
Multiplication Factor vs. Reverse Voltage



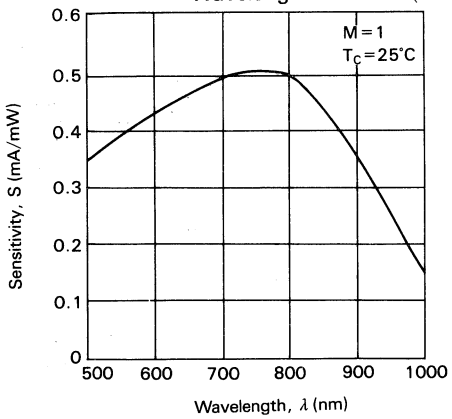
Frequency Response



Capacitance vs. Reverse Voltage



Sensitivity vs. Wavelength



HR1103TG

InGaAs PIN Photodiode

Description

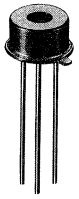
HR1103TG is an InGaAs PIN photodiode for detecting 1.0 – 1.65 μm light.

Its high speed pulse response makes it suitable as an optical signal detector in high-bit-rate fiber-optic communications equipment.

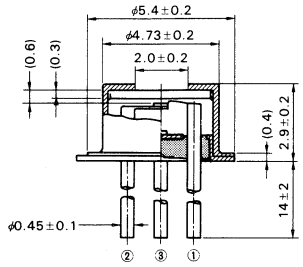
Hermetic sealing of the package achieves high reliability.

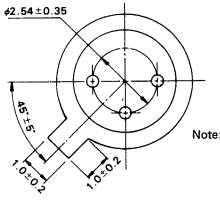
Features

- Fast pulse response : t_r, t_f = 0.5 ns typ.
- High sensitivity : S = 0.9 mA/mW typ. (λ_p = 1550 nm)
- Low dark current : I_{DARK} = 1 nA typ.
- Small capacitance : C_t = 1.0 pF typ.
- Photodetectable area : 100 μm dia.



Package Dimensions





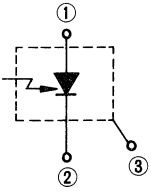
Note: Refraction index of window glass: 1.48

1. Anode
2. Cathode
3. Case

(Unit: mm)

TG-type

Internal Circuit



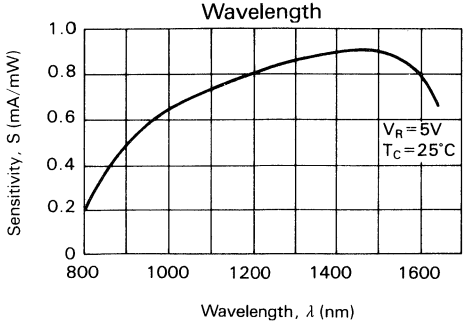
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Reverse voltage	V_R	20	V
Forward current	I_F	1.0	mA
Reverse current	I_R	500	µA
Operating temperature	T_{opr}	−40 to +80	°C
Storage temperature	T_{stg}	−45 to +100	°C

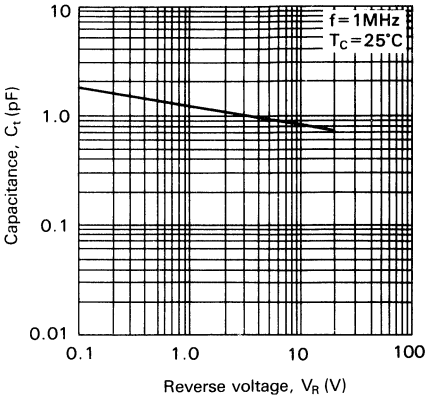
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Dark current	I_{DARK}		1	20	nA	V_R = 5 V
Capacitance	C_t		1.0	1.5	pF	V_R = 5 V, f = 1 MHz
Sensitivity	S_1	0.73	0.85		mA/mW	V_R = 5 V, λ_p = 1300 nm
	S_2		0.9		mA/mW	V_R = 5 V, λ_p = 1550 nm
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Rise time	t_r		0.5		ns	V_R = 5 V, λ_p = 1300 nm, R_L = 50 Ω
Fall time	t_f		0.5		ns	V_R = 5 V, λ_p = 1300 nm, R_L = 50 Ω

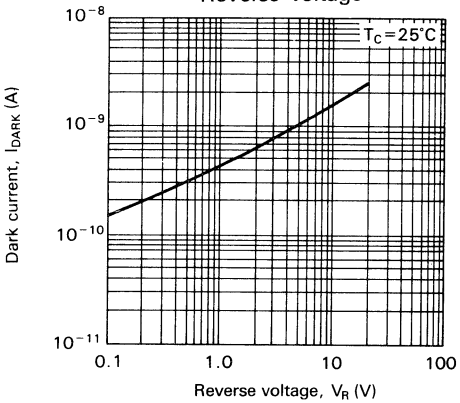
Sensitivity vs. Wavelength



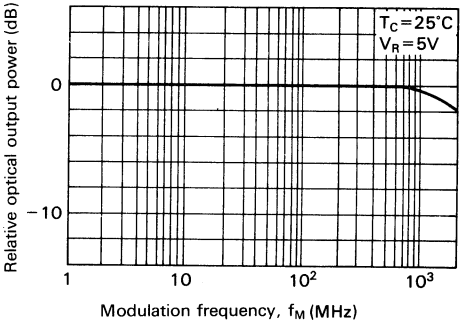
Capacitance vs. Reverse Voltage



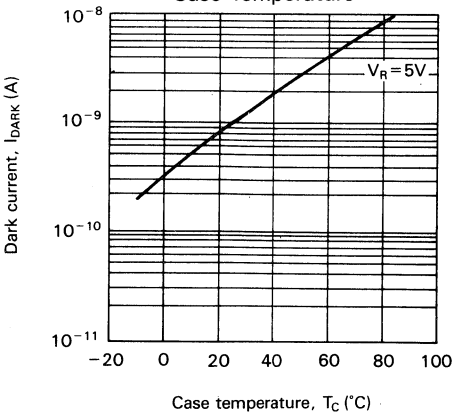
Dark Current vs. Reverse Voltage



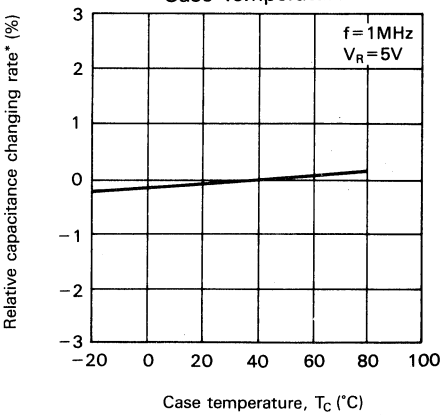
Frequency Response



Dark Current vs. Case Temperature

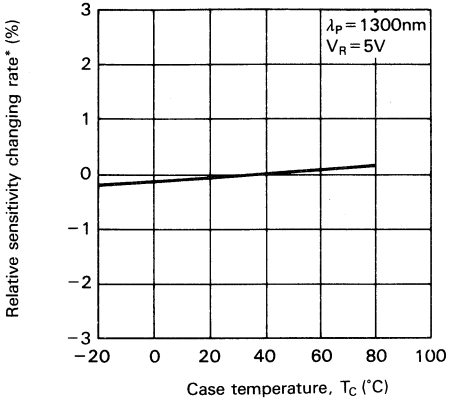


Capacitance vs. Case Temperature



(* Between terminal pins at T_C=25°C)

Sensitivity vs.
Case Temperature



(* At T_C = 25°C)

HR1103CX

InGaAs PIN Photodiode

Description

HR1103CX is an InGaAs PIN photodiode for detecting 1.0–1.65 μm light.

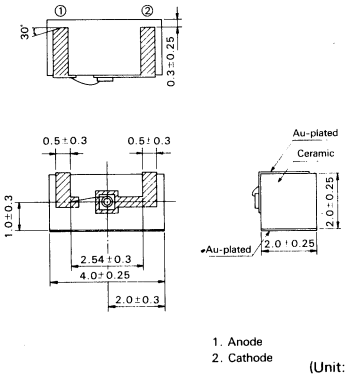
Its high speed pulse response makes it suitable as an optical signal detector in high-bit-rate fiber-optic communications equipment.

The package is compact for ease in module assembly.

Features

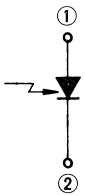
- Fast pulse response : t_r, t_f = 0.5 ns typ.
- High sensitivity : S = 0.9 mA/mW typ. (λ_p = 1550 nm)
- Low dark current : I_{DARK} = 1 nA typ.
- Small capacitance : C_t = 1.2 pF typ.
- Photodetectable area : 100 μm dia.

Package Dimensions



CX-type

Internal Circuit

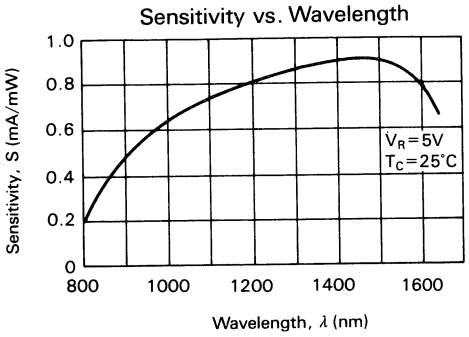


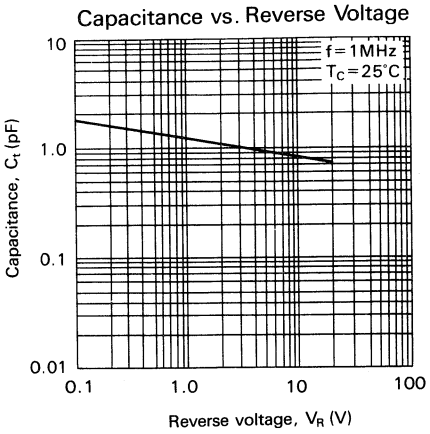
Absolute Maximum Ratings (T_C = 25°C)

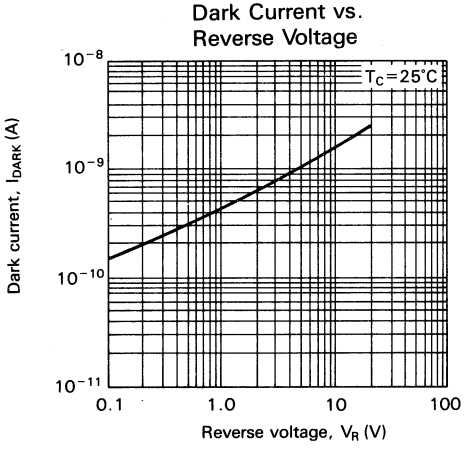
Items	Symbols	Values	Units
Reverse voltage	V_R	20	V
Forward current	I_F	1.0	mA
Reverse current	I_R	500	μA
Operating temperature	T_{opr}	−40 to +80	°C
Storage temperature	T_{stg}	−40 to +100	°C

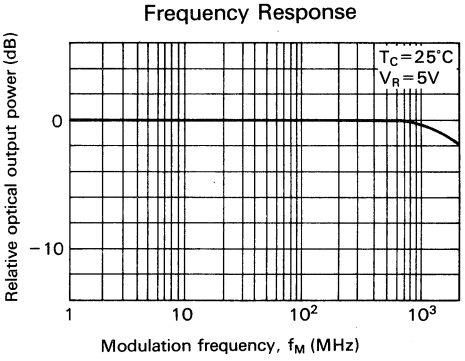
Optical and Electrical Characteristics (T_C = 25°C)

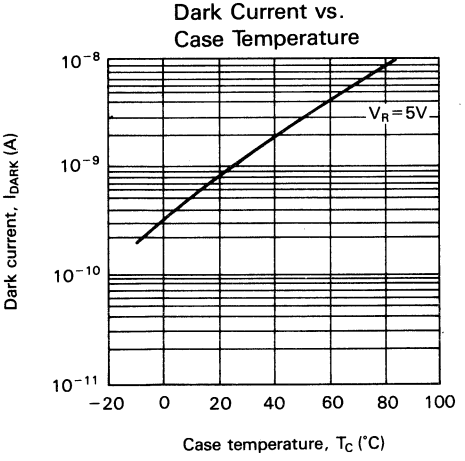
Items	Symbols	min.	typ.	max.	Units	Test conditions
Dark current	I_{DARK}		1	50	nA	V_R = 5 V
Capacitance	C_t		1.2		pF	V_R = 5 V, f = 1 MHz
Sensitivity	S_1	0.73	0.85		mA/mW	V_R = 5 V, λ_p = 1300 nm
	S_2		0.9		mA/mW	V_R = 5 V, λ_p = 1550 nm
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Rise time	t_r		0.5		ns	V_R = 5 V, λ_p = 1300 nm, R_L = 50 Ω
Fall time	t_f		0.5		ns	V_R = 5 V, λ_p = 1300 nm, R_L = 50 Ω

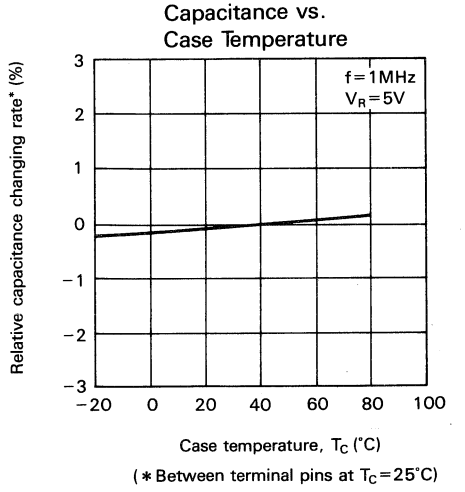






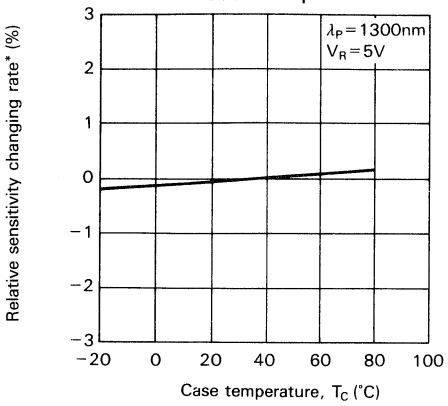






(* Between terminal pins at T_C=25°C)

Sensitivity vs.
Case Temperature



(* At T_C=25°C)

HR1103TR

InGaAs PIN PD

Description

HR1103TR is an InGaAs PIN photodiode for detecting 1.0–1.65 μm light.

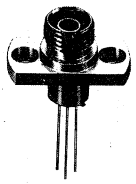
Its high speed pulse response makes it suitable as an optical signal detector in high-bit-rate fiber-optic communications equipment.

This package, with a receptacle, is easily connected to fiber with FC-type connector.

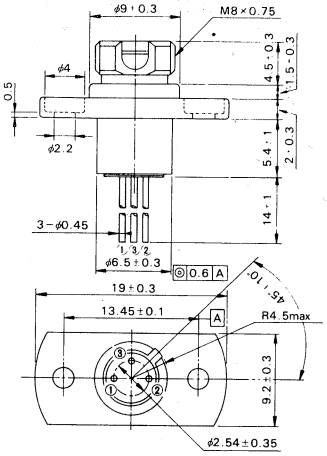
Hermetic sealing of the package achieves high reliability.

Features

- High sensitivity : S ≧ 0.6 mA/mW (λ_p = 1300 nm)
- Fast pulse response : t_r, t_f = 0.5 ns typ.
- Wide operating-temperature range : T_{opr} = −20 to +85°C
- Photodetectable area : 100 μm dia.

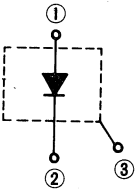


Package Dimensions



TR-type (Unit : mm)

Internal Circuit



① Anode
② Cathode
③ Case

Absolute Maximum Ratings (T_C = 25°C)

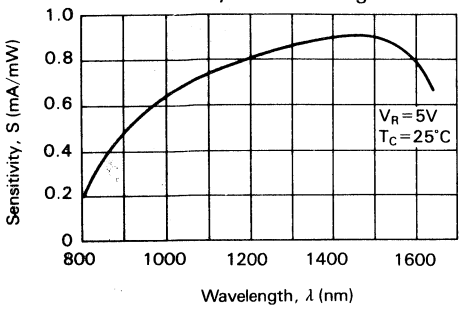
Items	Symbols	Values	Units
Reverse voltage	V_R	20	V
Forward current	I_F	1.0	mA
Reverse current	I_R	500	µA
Operating temperature	T_{opr}	−40 to +85	°C
Storage temperature	T_{stg}	−45 to +100	°C

Optical and Electrical Characteristics (T_C = 25°C)

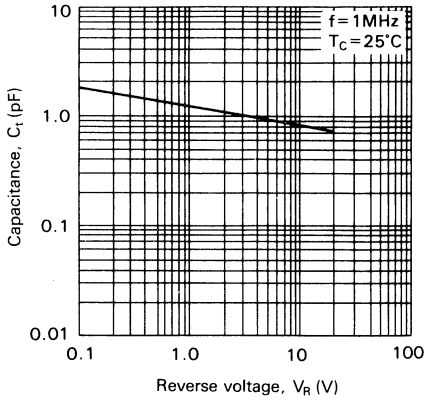
Items	Symbols	min.	typ.	max.	Units	Test conditions
Dark current	I_{DARK}		1	20	nA	V_R = 5 V
Capacitance	C_t		1.0	1.5	pF	V_R = 5 V, f = 1 MHz
Sensitivity	S_1*	0.6		0.7	mA/mW	V_R = 5 V, λ_p = 1300 nm
	S_2*		0.85		mA/mW	V_R = 5 V, λ_p = 1550 nm
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Rise time	t_r		0.5		ns	V_R = 5 V, λ_p = 1300 nm, R_L = 50 Ω
Fall time	t_f		0.5		ns	V_R = 5 V, λ_p = 1300 nm, R_L = 50 Ω

* At GI50/125 fiber

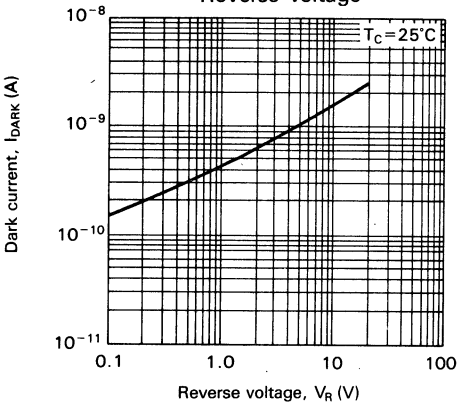
Sensitivity vs. Wavelength



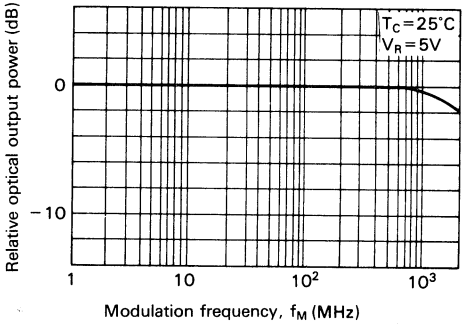
Capacitance vs. Reverse Voltage



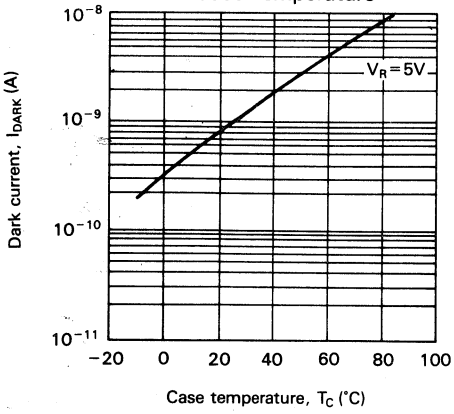
Dark Current vs. Reverse Voltage



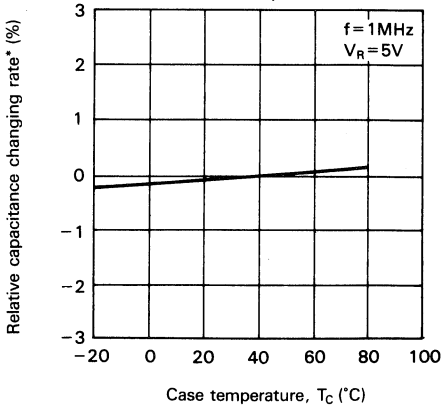
Frequency Response



Dark Current vs. Case Temperature

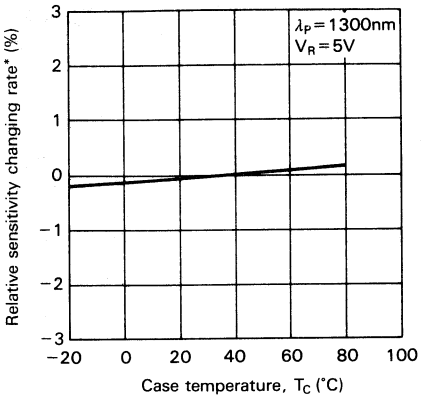


Capacitance vs. Case Temperature



(* Between terminal pins at T_C=25°C)

Sensitivity vs.
Case Temperature



(*At T_C=25°C)

HR1104TG

InGaAs PIN Photodiode

Description

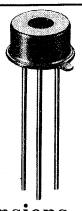
HR1104TG is an InGaAs PIN photodiode for detecting 1.0–1.65 μm light.

It is suitable as an optical monitor in high-bit-rate fiberoptic communications equipment.

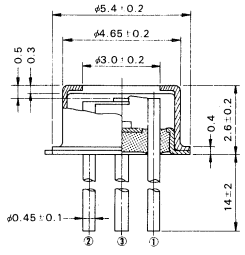
Hermetic sealing of the package achieves high reliability.

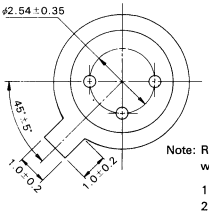
Features

- Fast pulse response : t_r, t_f = 1.0 ns typ.
- High sensitivity : S = 0.9 mA/mW typ. (λ_p = 1550 nm)
- Low dark current : I_{DARK} = 5 nA typ.
- Small capacitance : C_t = 5 pF typ.
- Photodetectable area : 300 μm dia.



Package Dimensions





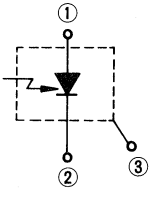
Note: Refraction index of window glass: 1.48

1. Anode
2. Cathode
3. Case

(Unit: mm)

TG-type

Internal Circuit



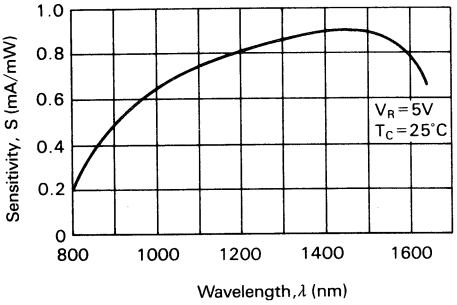
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Reverse voltage	V_R	20	V
Forward current	I_F	1.0	mA
Reverse current	I_R	500	μA
Operating temperature	T_{opr}	−40 to +80	°C
Storage temperature	T_{stg}	−45 to +100	°C

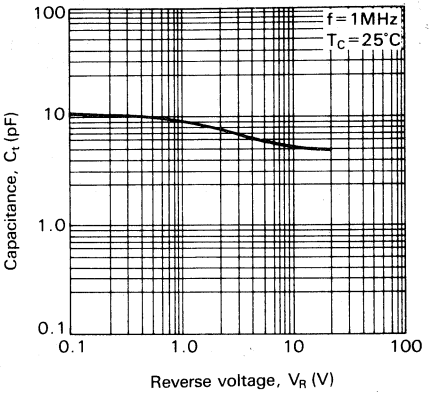
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Dark current	I_{DARK}		10	30	nA	V_R = 5 V
Capacitance	C_t		5	10	pF	V_R = 5 V, f = 1 MHz
Sensitivity	S_1	0.73	0.85		mA/mW	V_R = 5 V, λ_p = 1300 nm
	S_2		0.9		mA/mW	V_R = 5 V, λ_p = 1550 nm
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Rise time	t_r		1.0		ns	V_R = 5 V, λ_p = 1300 nm R_L = 50 Ω
Fall time	t_f		1.0		ns	V_R = 5 V, λ_p = 1300 nm R_L = 50 Ω

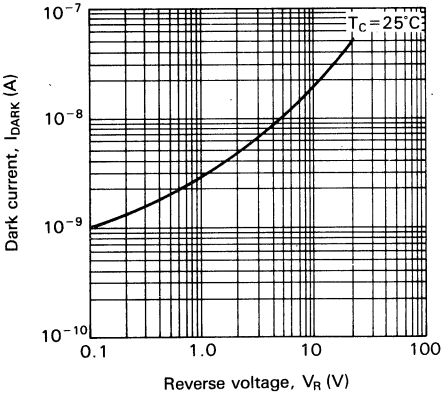
Sensitivity vs. Wavelength



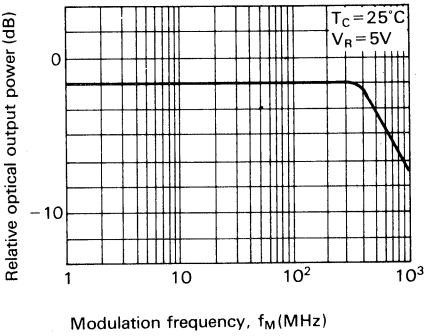
Capacitance vs. Reverse Voltage



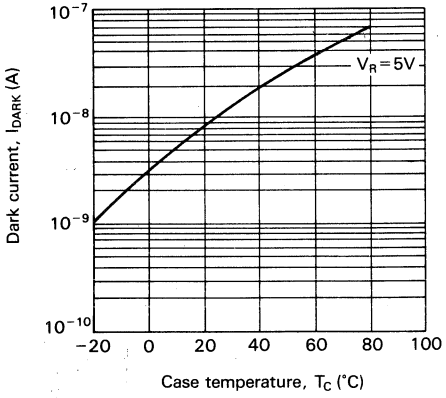
Dark Current vs. Reverse Voltage



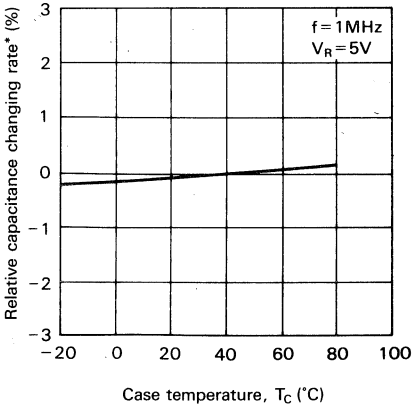
Frequency Response



Dark Current vs. Case Temperature

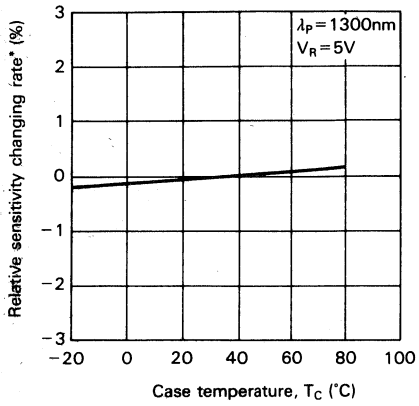


Capacitance vs. Case Temperature



(* Between terminal pins at T_C=25°C)

Sensitivity vs.
Case Temperature



(*At T_C=25°C)

HR1104CX

InGaAs PIN Photodiode

Description

HR1104CX is an InGaAs PIN photodiode for detecting 1.0–1.65 μm light.

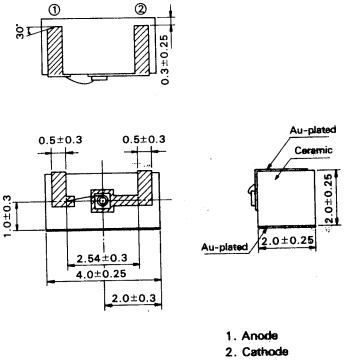
It is suitable as an optical monitor in high-bit-rate fiberoptic communications equipment.

The package is compact for ease in module assembly.

Features

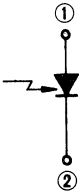
- Fast pulse response : t_r, t_f = 1.0 ns typ.
- High sensitivity : S = 0.9 mA/mW typ. (λ_p = 1550 nm)
- Low dark current : I_{DARK} = 5 nA typ.
- Small capacitance : C_t = 6 pF typ.
- Photodetectable area : 300 μm dia.

Package Dimensions



CX-type

Internal Circuit



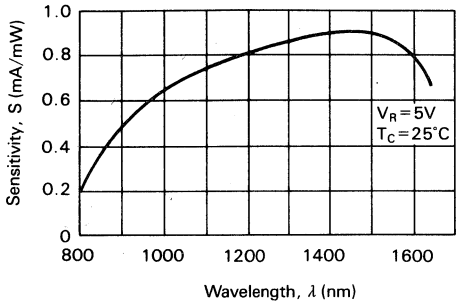
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Reverse voltage	V_R	20	V
Forward current	I_F	1.0	mA
Reverse current	I_R	500	µA
Operating temperature	T_{opr}	−40 to +80	°C
Storage temperature	T_{stg}	−40 to +100	°C

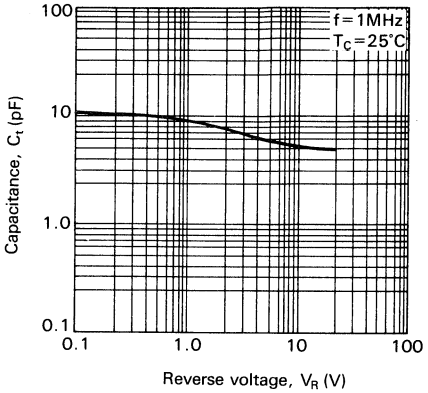
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Dark current	I_{DARK}		10	30	nA	V_R = 5 V
Capacitance	C_t		6		pF	V_R = 5 V, f = 1 MHz
Sensitivity	S_1	0.73	0.85		mA/mW	V_R = 5 V, λ_p = 1300 nm
	S_2		0.9		mA/mW	V_R = 5 V, λ_p = 1550 nm
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Rise time	t_r		1.0		ns	V_R = 5 V, λ_p = 1300 nm, R_L = 50 Ω
Fall time	t_f		1.0		ns	V_R = 5 V, λ_p = 1300 nm, R_L = 50 Ω

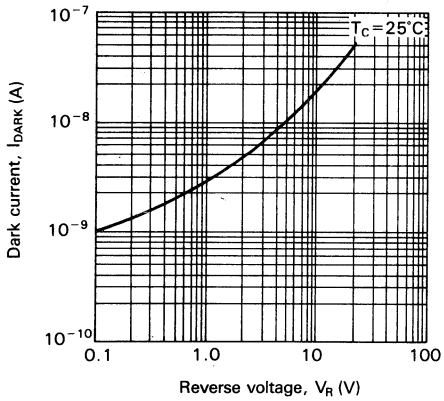
Sensitivity vs. Wavelength



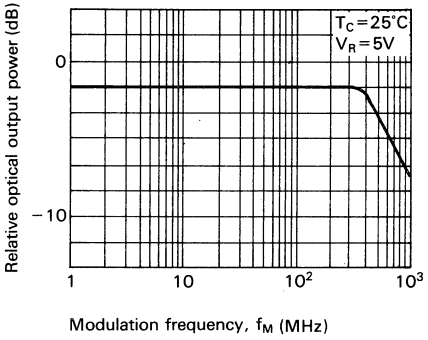
Capacitance vs. Reverse Voltage



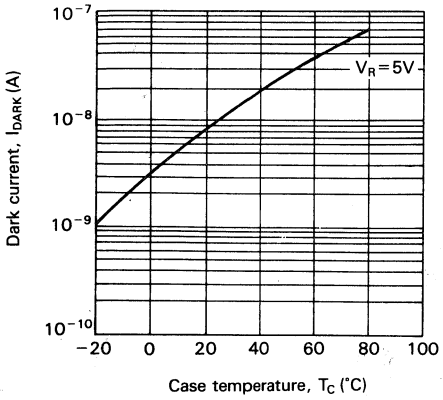
Dark Current vs. Reverse Voltage



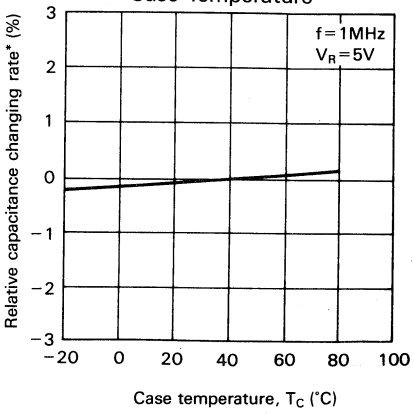
Frequency Response



Dark Current vs. Case Temperature

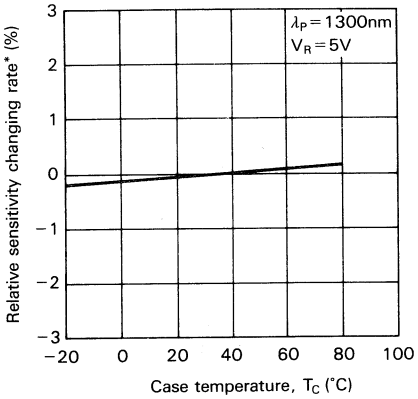


Capacitance vs. Case Temperature



(* Between terminal pins at T_C=25°C)

Sensitivity vs.
Case Temperature



(* At T_C = 25°C)

HR1105TG

InGaAs PIN Photodiode

Description

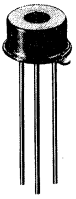
HR1105TG is an InGaAs PIN photodiode for detecting 1.0–1.65 μm light.

Its high speed pulse response makes it suitable as an optical signal detector in high-bit-rate fiber-optic communications equipment.

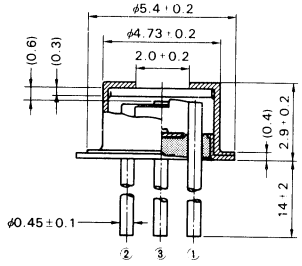
Hermetic sealing of the package achieves high reliability.

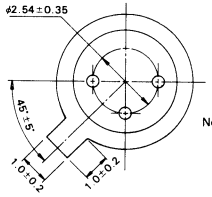
Features

- Fast pulse response : t_r, t_f = 0.3 ns typ.
- High sensitivity : S = 0.9 mA/mW typ. (λ_p = 1550 nm)
- Low dark current : I_{DARK} = 1 nA typ.
- Small capacitance : C_t = 0.8 pF typ.
- Photodetectable area : 80 μm dia.



Package Dimensions





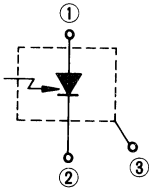
Note: Refraction index of window glass: 1.48

1. Anode
2. Cathode
3. Case

(Unit: mm)

TG-type

Internal Circuit



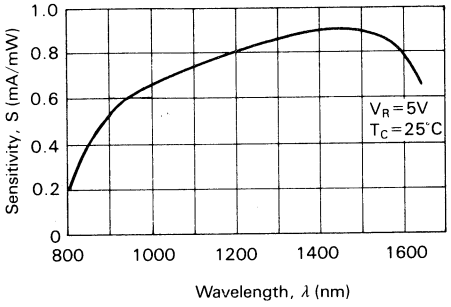
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Reverse voltage	V_R	20	V
Forward current	I_F	1.0	mA
Reverse current	I_R	500	μA
Operating temperature	T_{opr}	−40 to +80	°C
Storage temperature	T_{stg}	−45 to +100	°C

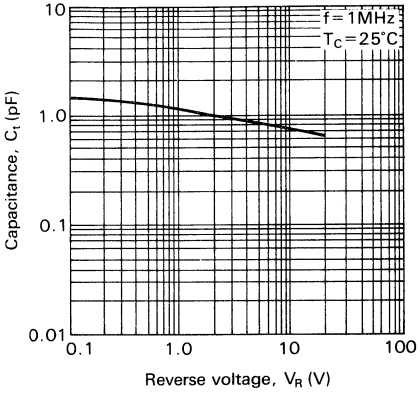
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Dark current	I_{DARK}		1.0	10	nA	V_R = 5 V
Capacitance	C_t		0.8	1.2	pF	V_R = 5 V, f = 1 MHz
Sensitivity	S_1	0.73	0.85		mA/mW	V_R = 5 V, λ_p = 1300 nm
	S_2		0.9		mA/mW	V_R = 5 V, λ_p = 1550 nm
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Rise time	t_r		0.3		ns	V_R = 5 V, λ_p = 1300 nm, R_L = 50 Ω
Fall time	t_f		0.3		ns	V_R = 5 V, λ_p = 1300 nm, R_L = 50 Ω

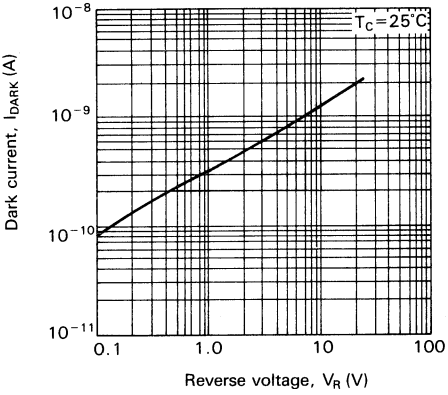
Sensitivity vs. Wavelength



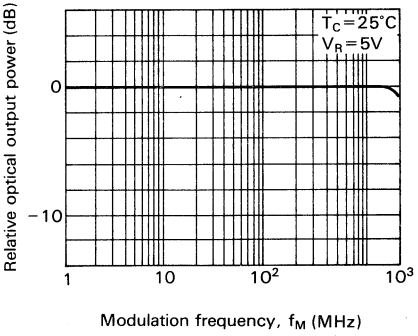
Capacitance vs. Reverse Voltage



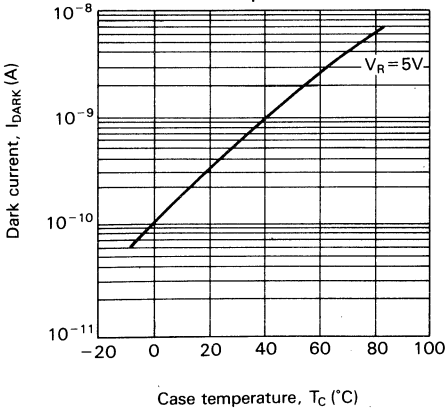
Dark Current vs. Reverse Voltage



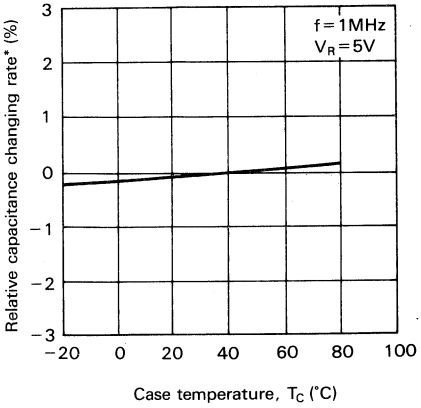
Frequency Response



Dark Current vs. Case Temperature

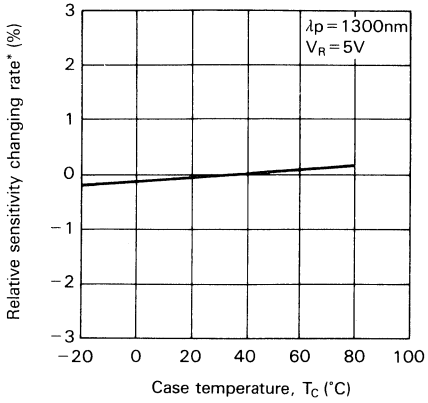


Capacitance vs. Case Temperature



(*Between terminal pins at T_C=25°C)

Sensitivity vs.
Case Temperature



(* At T_C = 25°C)

HR1106LG INGaAs PIN Photodiode

Description

HR1106LG is an InGaAs PIN photodiode for detecting 1.0−1.65 μm light.

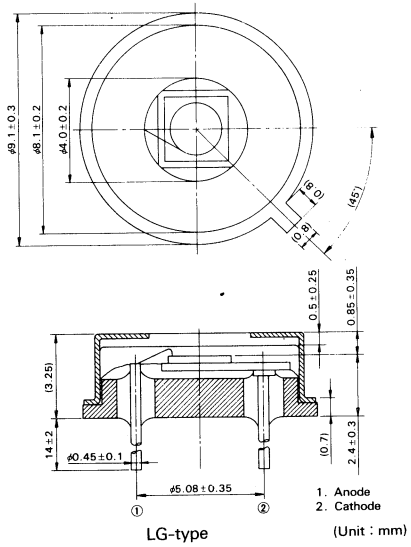
It is suitable as an optical detector in optical communications, optical power meter and optical measuring equipment.

Hermetic sealing of the package achieves high reliability.

Features

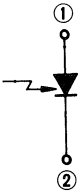
- High sensitivity : S = 0.9 mA/mW typ. (λ_p = 1550 nm)
- Low dark current : I_{DARK} = 1 μA typ.
- Small capacitance : C_t = 150 pF typ.
- Photodetectable area : 2 mm dia.

Package Dimensions



LG-type

Internal Circuit



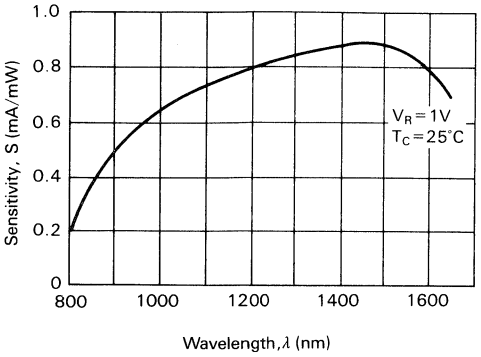
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Reverse voltage	V_R	2	V
Forward current	I_F	20	mA
Reverse current	I_R	10	µA
Operating temperature	T_{opr}	−40 to +85	°C
Storage temperature	T_{stg}	−45 to +100	°C

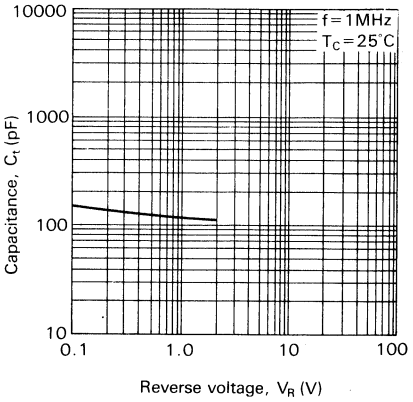
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Dark current	I_{DARK}		1	5	µA	V_R = 1 V
Capacitance	C_t		150		pF	V_R = 1 V, f = 1 MHz
Sensitivity	S_1	0.7	0.8		mA/mW	V_R = 1 V, λ_p = 1300 nm
	S_2		0.9		mA/mW	V_R = 1 V, λ_p = 1550 nm
Amount of sensitivity change	ΔS			5	%	Pin = 1 mW, V_R = 0 to 2 V

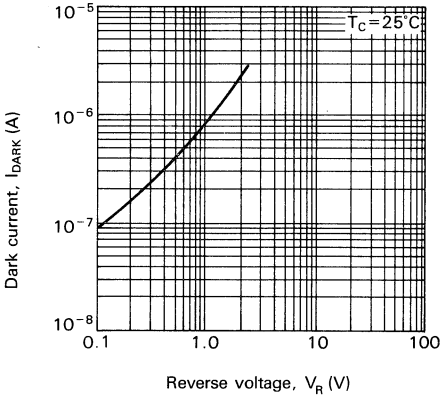
Sensitivity vs. Wavelength



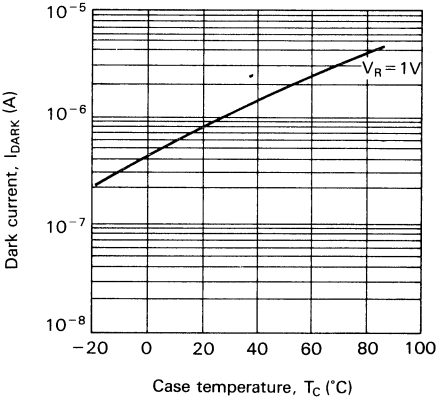
Capacitance vs. Reverse Voltage



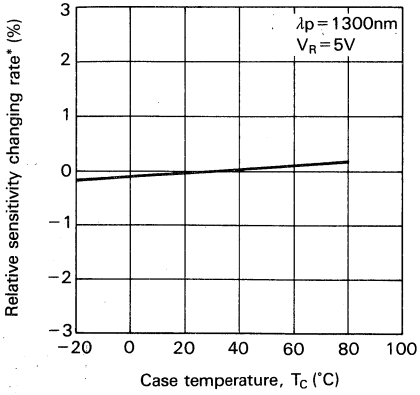
Capacitance vs. Reverse Voltage



Dark Current vs. Case Temperature



Sensitivity vs. Case Temperature



(*At T_C=25°C)

HR1201TG InGaAs Avalanche Photodiode

Description

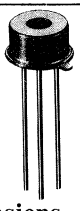
HR1201TG is an InGaAs avalanche photodiode for detecting 1.0 – 1.65 μm light.

Its high speed pulse response makes it suitable as an optical signal detector in high-bit-rate fiber-optic communications equipment.

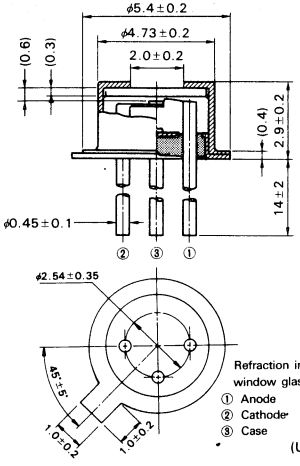
Hermetic sealing of the package achieves high reliability.

Features

- High sensitivity : S = 0.9 mA/mW typ. (λ_p = 1550 nm)
- Low dark current : I_{DARK} = 2 nA typ.
- Small capacitance : C_t = 0.5 pF typ.
- Photodetectable area : 50 μm dia.
- High multiplication ratio : M = 40 typ.
- High cut-off frequency : $f_c \cdot G$ = 30 typ.

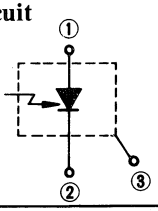


Package Dimensions



TG-type

Internal Circuit



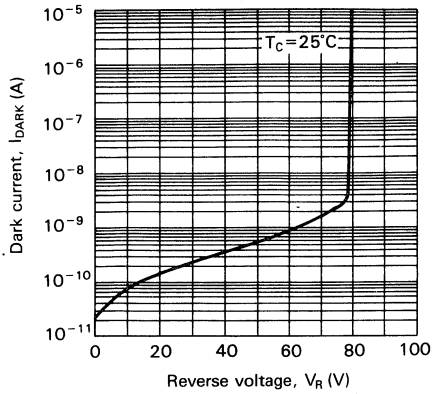
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Forward current	I_F	10	mA
Reverse current	I_R	500	μA
Operating temperature	T_{opr}	−40 to +80	°C
Storage temperature	T_{stg}	−45 to +100	°C

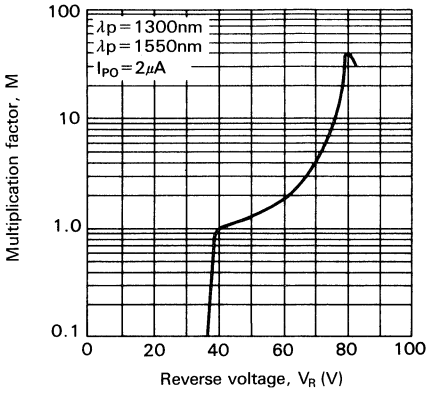
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Dark current	I_{DARK}		2	50	nA	$V_R = 0.9\ V_B$
Multiplicated dark current	I_{DM}		0.5	5	nA	M = 1
Capacitance	C_t		0.5	0.8	pF	f = 1 MHz, $V_R = 0.9\ V_B$
Sensitivity	S_1	0.73	0.85		mA/mW	λ_p = 1300 nm
	S_2		0.9		mA/mW	λ_p = 1550 nm
Breakdown voltage	V_B	60	80	100	V	I_{DARK} = 100 μA
Cut-off frequency	f_c	1			GHz	M = 5; λ_p = 1300 nm, R_L = 50 Ω, Output: 500 kHz −3 dB
		1				M = 10
			1			M = 30
Excess noise factor	F		5			λ_p = 1300 nm, M = 10, f = 100 MHz, B = 10 MHz, I_{PO} = 2 μA
	x		0.7			
Maximum multiplication factor	M_m	30	40			λ_p = 1300 nm, I_{PO} = 2 μA

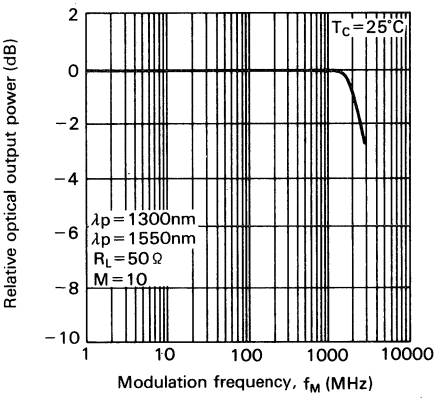
Dark Current vs. Reverse Voltage



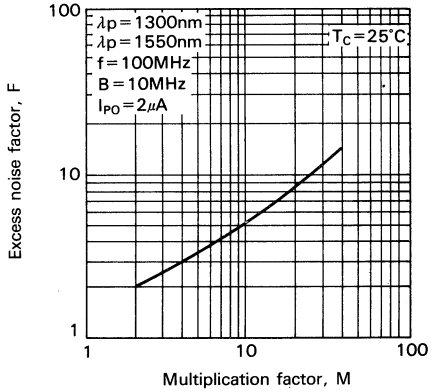
Multiplication Factor vs. Reverse Voltage



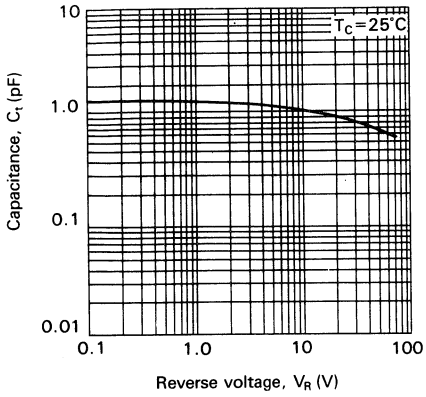
Frequency Response



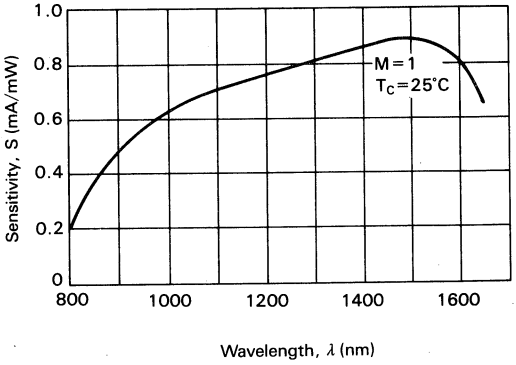
Excess Noise Factor vs. Multiplication Factor



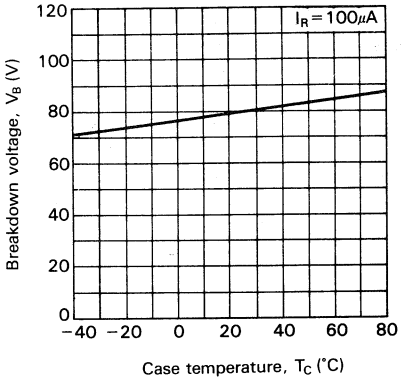
Capacitance vs. Reverse Voltage



Sensitivity vs. Wavelength



Break Down Voltage vs.
Case Temperature



HR1201CX InGaAs Avalanche Photodiode

Description

HR1201CX is an InGaAs avalanche photodiode for detecting 1.0–1.65 μm light.

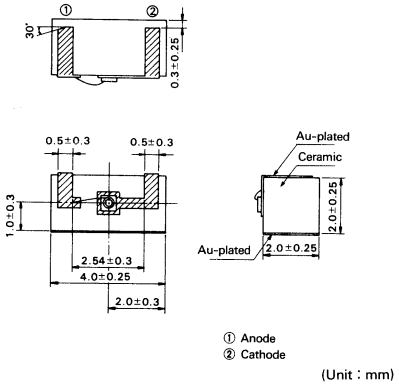
Its high speed pulse response makes it suitable as an optical signal detector in high-bit-rate fiber-optic communications equipment.

The package is compact for ease in module assembly.

Features

- High sensitivity : S = 0.9 mA/mW typ. (λ_p = 1550 nm)
- Low dark current : I_{DARK} = 2 nA typ.
- Small capacitance : C_t = 0.7 pF typ.
- Photodetectable area : 50 μm dia.
- High multiplication ratio : M = 40 typ.
- High cut-off frequency : $f_c \cdot G$ = 30 typ.

Package Dimensions



CX-type

Internal Circuit

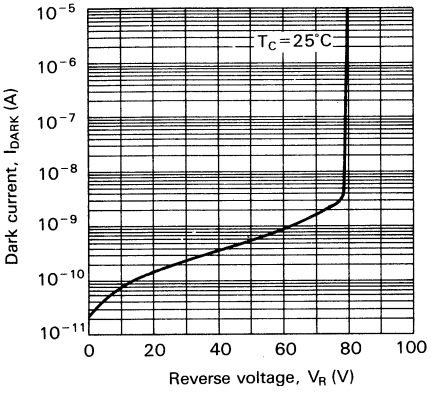
Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Forward current	I_F	10	mA
Reverse current	I_R	500	µA
Operating temperature	T_{opr}	−40 to +80	°C
Storage temperature	T_{stg}	−45 to +100	°C

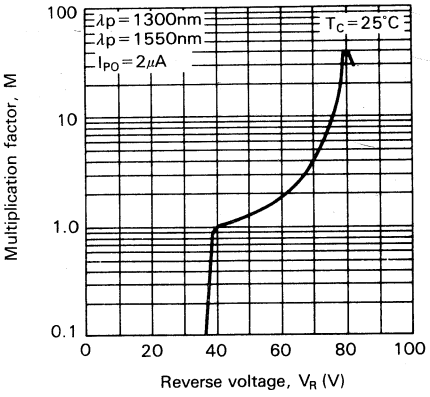
Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Dark current	I_{DARK}		2	50	nA	$V_R = 0.9\ V_B$
Multiplicated dark current	I_{DM}		0.5	5	nA	M = 1
Capacitance	C_t		0.7	1.0	pF	f = 1 MHz, $V_R = 0.9\ V_B$
Sensitivity	S_1	0.73	0.85		mA/mW	λ_p = 1300 nm
	S_2		0.9		mA/mW	λ_p = 1550 nm
Breakdown voltage	V_B	60	80	100	V	I_{DARK} = 100 µA
Cut-off frequency	f_c	1			GHz	M = 5 λ_p = 1300 nm, R_L = 50 Ω, Output: 500 kHz −3 dB
		1				M = 10
			1			M = 30
Excess noise factor	F		5			λ_p = 1300 nm, M = 10, f = 100 MHz, B = 10 MHz, I_{PO} = 2 µA
	x		0.7			
Maximum multiplication factor	M_m	30	40			λ_p = 1300 nm, I_{PO} = 2 µA

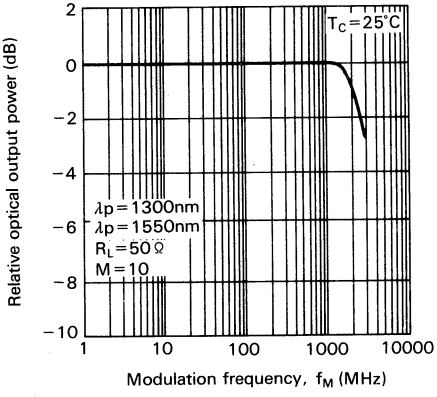
Dark Current vs. Reverse Voltage



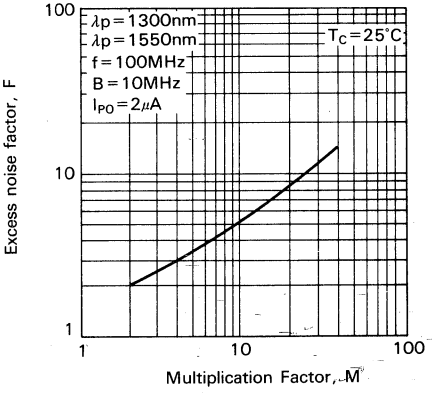
Multiplication Factor vs. Reverse Voltage



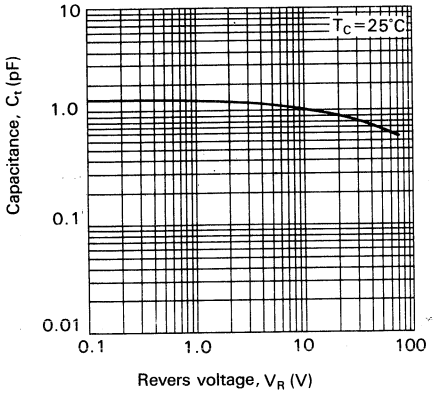
Frequency Response



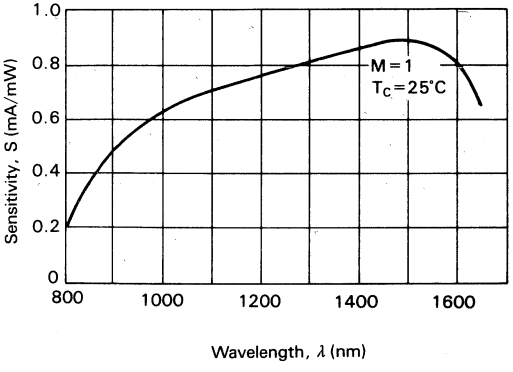
Excess Noise Factor vs. Multiplication Factor



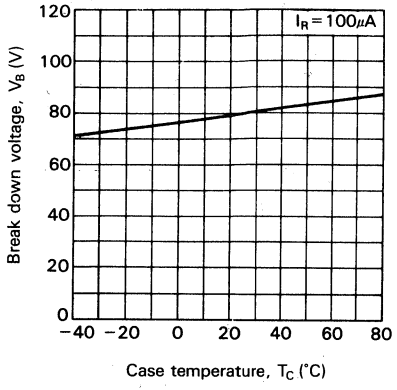
Capacitance vs. Reverse Voltage



Sensitivity vs. Wavelength



Break Down Voltage vs.
Case Temperature



Guide to Discontinued Devices

Products to be discontinued

Part No.	Package	Replacements	Remarks
HL7801G	G (Mod)	HL7806G	Cap size different
HLP1500	B (500)	None	
HLP1600	C (600)	None	
HL1221B	B (500)	None	
HL1221C	C (600)	None	
HLP5500	B (500)	HL1321DL	Built-in PD & TE cooler, SMF
		HL1323DM	Built-in PD, SMF, Smaller Po
HLP5600	C (600)	None	
HL1321P/ HL1321SP	P/SP	HL1321DL	Built-in PD & TE cooler, SMF
		HL1323DM	Built-in PD, SMF, Smaller Po
HLP50R/RG HLP60R/RG	R/RG	HE7601SG* HE8404SG* HE8812SG*	600 µm dia. DH structure
HE8402F	F	HE8403TR	With receptacle
HE8801	SG	HE8807SG	Life level improved
HE1302ML	ML	HE1301ML	
HR1101	TG	HR1103TG	100 µm dia. InGaAs PIN
HR1102	TG	HR1104TG	300 µm dia. InGaAs PIN
HR1102CX	CX	HR1104CX	300 µm dia. InGaAs PIN

SMF: Single-mode fiber * Under development

HL7801G

GaAlAs LD

Description

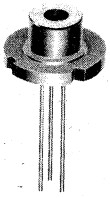
HL7801G is a 0.78 μm GaAlAs laser diode with double heterojunction structure.

It is suitable as a light source in laser beam printers, laser levelers and various other types of optical equipment.

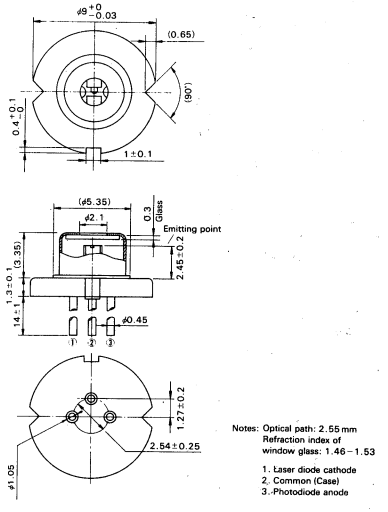
Hermetic sealing of the package achieves high reliability.

Features

- Visible light output: λ_p = 760–800 nm
- Built-in photodiode for monitoring laser output
- Low astigmatism: As = 2 μm typ.
- Small beam ellipticity:
  $\theta_{//}$ = 15 deg., $\theta_{\perp}$ = 30 deg. typ.
- Single longitudinal mode



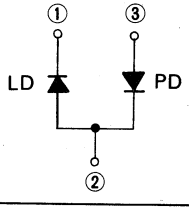
Package Dimensions



(Unit: mm)

G-type

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Laser diode reverse voltage	$V_{R(LD)}$	2	V
Photodiode reverse voltage	$V_{R(PD)}$	30	V
Operating temperature	T_{opr}	−10 to +60	°C
Storage temperature	T_{stg}	−40 to +80	°C

Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		50	90	mA	
Optical output power	P_O	5			mW	Kink free
Slope efficiency	η	0.13	0.25		mW/mA	$\frac{3(mW)}{I\ (4\ mW) - I\ (1\ mW)}$
Lasing wavelength	λ_p	760	780	800	nm	P_O = 3 mW
Beam divergence parallel to the junction	$\theta_{//}$	10	15	20	deg.	P_O = 3 mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$	20	30	40	deg.	P_O = 3 mW
Monitor current	I_S	0.1	0.3		mA	P_O = 3 mW

HLP1500

GaAlAs LD

Description

HLP1500 is a 0.8 μm GaAlAs laser diode with double heterojunction structure.

It is suitable as a light source in fiberoptic communications equipment.

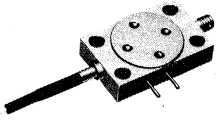
The laser beam is output from the connected optical fiber. Monitoring power is output from the glass rod as optical output power.

—Fiber specifications—

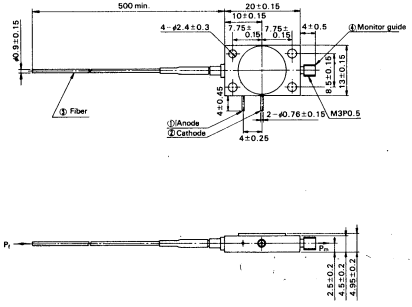
Numerical aperture	: 0.2
Core diameter	: 50 μm
Outer diameter	: 125 μm
Jacket diameter	: 900 μm
Refraction index profile	: GI type
Fiber length	: More than 500 mm

Features

- Infrared light output: λ_p = 800–850 nm
- 6 mW CW operation at room temperature
- Single longitudinal mode
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns



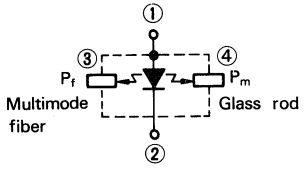
Package Dimensions



(Unit: mm)

B-type

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Fiber optical output power	P_f	6	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	−40 to +70	°C

Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		60	90	mA	
Fiber optical output power	P_f	6			mW	Kink free
		2	3		mW	$I_F = I_{th}$ + 25 mA
Monitor power	P_m	0.5			mW	$I_F = I_{th}$ + 25 mA
Lasing wavelength	λ_p	800	830	850	nm	P_f = 4 mW
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

HLP1600

GaAlAs LD

Description

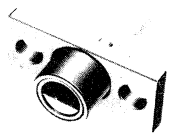
HLP1600 is a 0.8 μm GaAlAs laser diode with double heterojunction structure.

It is suitable as a light source in fiberoptic communications, optical disc memories or various other types of optical equipment.

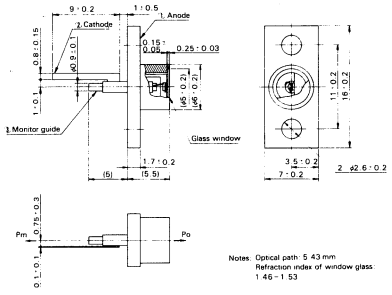
Monitoring power is output from the glass rod as optical output power.

Features

- Infrared light output: $\lambda_p = 800-850$ nm
- 15 mW CW operation at room temperature
- Single longitudinal mode
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns



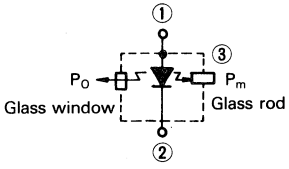
Package Dimensions



C-type

(Unit: mm)

Internal Circuit



Absolute Maximum Ratings ($T_C = 25°C$)

Items	Symbols	Values	Units
Optical output power	P_O	15	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +60	°C
Storage temperature	T_{stg}	−40 to +80	°C

Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		60	90	mA	
Optical output power	P_O	15			mW	Kink free
		4	5		mW	$I_F = I_{th} + 25$ mA
Monitor power	P_m	0.2			mW	$I_F = I_{th} + 25$ mA
Lasing wavelength	λ_p	800	830	850	nm	$P_O = 10$ mW
Beam divergence parallel to the junction	$\theta_{//}$		10		deg.	$P_O = 10$ mW
Beam divergence perpendicular to the junction	$\theta_{\perp}$		25		deg.	$P_O = 10$ mW
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

HL1221B

InGaAsP LD

Description

HL1221B is a 1.2 μm InGaAsP laser diode with double heterojunction structure.

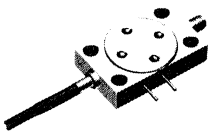
It is suitable as a light source in fiberoptic communications equipment.

The laser beam is output from the connected optical fiber. Monitoring power is output from the glass rod as optical output power.

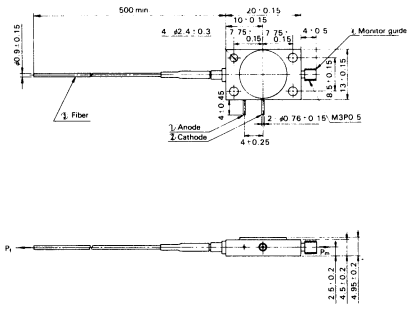
—Fiber specifications—	
Numerical aperture	: 0.2
Core diameter	: 50 μm
Outer diameter	: 125 μm
Jacket diameter	: 900 μm
Refraction index profile	: GI type
Fiber length	: More than 500 mm

Features

- Long wavelength light output: λ_p = 1170–1230 nm
- 1.2 mW CW operation at room temperature
- Fast pulse response: t_r, t_f ≦ 0.5 ns

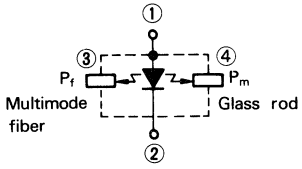


Package Dimensions



B-type

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Fiber optical output power	P_f	1.2	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +50	°C
Storage temperature	T_{stg}	−40 to +60	°C

Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	80	mA	
Fiber optical output power	P_f	1.2			mW	Kink free
		0.4	0.7		mW	$I_F = I_{th}$ + 20 mA
Monitor power	P_m	0.05			mW	$I_F = I_{th}$ + 20 mA
Lasing wavelength	λ_p	1170	1200	1230	nm	P_f = 0.5 mW
Spectral width	$\Delta\lambda$		2		nm	P_f = 0.5 mW
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

HL1221C

InGaAsP LD

Description

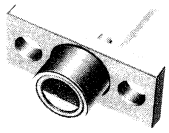
HL1221C is a 1.2 μm InGaAsP laser diode with double heterojunction structure.

It is suitable as a light source in fiberoptic communications and various other types of optical equipment.

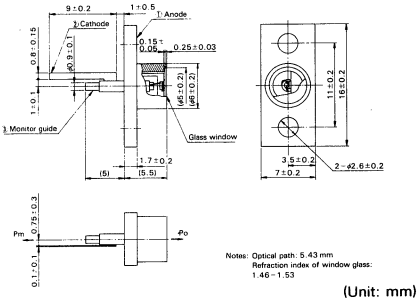
Monitoring power is output from the glass rod as optical output power.

Features

- Long wavelength light output: $\lambda_p = 1170-1230$ nm
- 5 mW CW operation at room temperature
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns

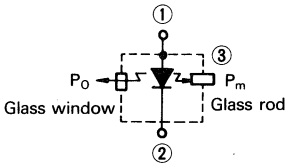


Package Dimensions



C-type

Internal Circuit



Absolute Maximum Ratings ($T_C = 25°C$)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +50	°C
Storage temperature	T_{stg}	−40 to +60	°C

Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	80	mA	
Optical output power	P_O	5			mW	Kink free
		1.5	3.0		mW	$I_F = I_{th} + 20$ mA
Monitor power	P_m	0.5			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1170	1200	1230	nm	$P_O = 3$ mW
Spectral width	$\Delta\lambda$		2		nm	$P_O = 3$ mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	$P_O = 3$ mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	$P_O = 3$ mW, FWHM
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

HLP5500

InGaAsP LD

Description

HLP5500 is a 1.3 μm InGaAsP laser diode with double heterojunction structure.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications equipment.

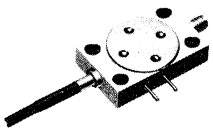
The laser beam is output from the connected optical fiber. Monitoring power is output from the glass rod as optical output power.

—Fiber specifications—

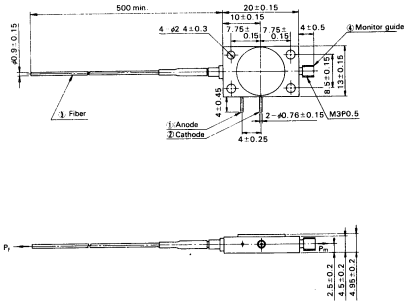
Numerical aperture	: 0.2
Core diameter	: 50 μm
Outer diameter	: 125 μm
Jacket diameter	: 900 μm
Refraction index profile	: GI type
Fiber length	: More than 500 mm

Features

- Long wavelength light output: λ_p = 1270–1330 nm
- 1.2 mW CW operation at room temperature
- Fast pulse response: t_r, t_f ≦ 0.5 ns



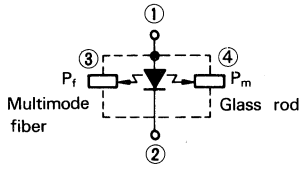
Package Dimensions



(Unit: mm)

B-type

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Fiber optical output power	P_f	1.2	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +50	°C
Storage temperature	T_{stg}	−40 to +60	°C

Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	80	mA	
Fiber optical output power	P_f	1.2			mW	Kink free
		0.4	0.7		mW	$I_F = I_{th}$ + 20 mA
Monitor power	P_m	0.05			mW	$I_F = I_{th}$ + 20 mA
Lasing wavelength	λ_p	1270	1300	1330	nm	P_f = 0.5 mW
Spectral width	$\Delta\lambda$		2		nm	P_f = 0.5 mW
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

HLP5600

InGaAsP LD

Description

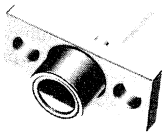
HLP5600 is a 1.3 μm InGaAsP laser diode with double heterojunction structure.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications and various other types of optical equipment.

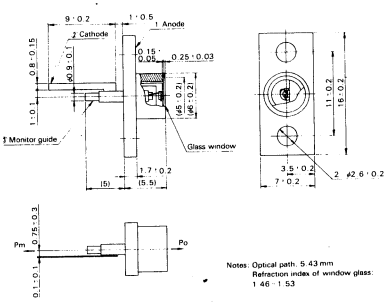
Monitoring power is output from the glass rod as optical output power.

Features

- Long wavelength light output: $\lambda_p = 1270-1330$ nm
- 5 mW CW operation at room temperature
- Fast pulse response: $t_r, t_f \leqq 0.5$ ns



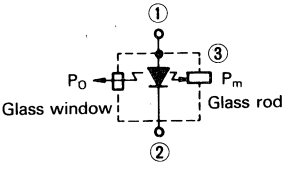
Package Dimensions



(Unit: mm)

C-type

Internal Circuit



Absolute Maximum Ratings ($T_C = 25°C$)

Items	Symbols	Values	Units
Optical output power	P_O	5	mW
Reverse voltage	V_R	2	V
Operating temperature	T_{opr}	0 to +50	°C
Storage temperature	T_{stg}	−40 to +60	°C

Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	80	mA	
Optical output power	P_O	5			mW	Kink free
		1.5	3.0		mW	$I_F = I_{th} + 20$ mA
Monitor power	P_m	0.5			mW	$I_F = I_{th} + 20$ mA
Lasing wavelength	λ_p	1270	1300	1330	nm	$P_O = 3$ mW
Spectral width	$\Delta\lambda$		2		nm	$P_O = 3$ mW
Beam divergence parallel to the junction	$\theta_{//}$		30		deg.	$P_O = 3$ mW, FWHM
Beam divergence perpendicular to the junction	$\theta_{\perp}$		40		deg.	$P_O = 3$ mW, FWHM
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

HL1321P

InGaAsP LD

Description

HL1321P is a 1.3 μm InGaAsP laser diode with double heterojunction structure.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications equipment.

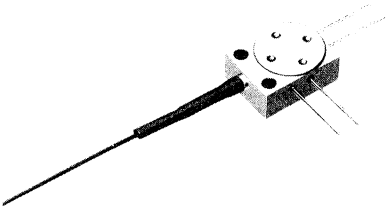
The laser beam is output from the connected multimode fiber. Monitoring current is output from a built-in photodiode.

—Fiber specifications—

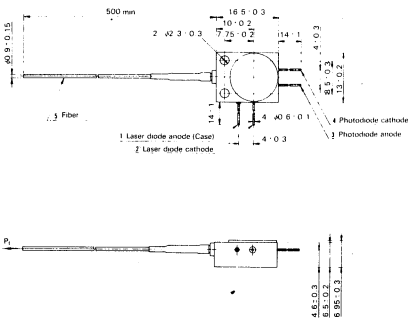
Numerical aperture	: 0.2
Core diameter	: 50 μm
Outer diameter	: 125 μm
Jacket diameter	: 900 μm
Refraction index profile	: GI type
Fiber length	: More than 500 mm

Features

- Long wavelength light output: λ_p = 1270–1330 nm
- 1.2 mW CW operation at room temperature
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns
- Built-in photodiode for monitoring laser output



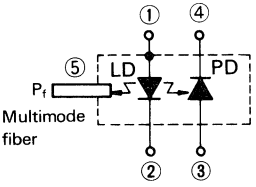
Package Dimensions



(Unit: mm)

P-type

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Fiber optical output power	P_f	1.2	mW
Laser diode reverse voltage	$V_{R(LD)}$	2.0	V
Photodiode reverse voltage	$V_{R(PD)}$	20	V
Photodiode forward current	$I_{F(PD)}$	1.0	mA
Operating temperature	T_{opr}	0 to +50	°C
Storage temperature	T_{stg}	−40 to +60	°C

Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	50	mA	
Fiber optical output power	P_f	1.2			mW	Kink free
		0.7			mW	$I_F = I_{th}$ + 20 mA
Lasing wavelength	λ_p	1270	1300	1330	nm	P_f = 0.5 mW
Spectral width	$\Delta\lambda$		2		nm	P_f = 0.5 mW
Photodiode dark current	I_{DARK}			150	nA	$V_{R(PD)}$ = 5 V
Monitor current	I_S	70			µA	$V_{R(PD)}$ = 5 V, P_f = 1.0 mW
Photodiode capacitance	C_t		3.0	4.0	pF	$V_{R(PD)}$ = 5 V, f = 1 MHz
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

HL1321SP

InGaAsP LD

Description

HL1321SP is a 1.3 μm InGaAsP laser diode with double heterojunction structure.

It is suitable as a light source in high-bit-rate, long-distance fiberoptic communications equipment.

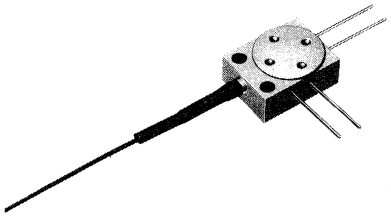
The laser beam is output from the connected single mode fiber. Monitoring current is output from a built-in photodiode.

—Fiber specifications—

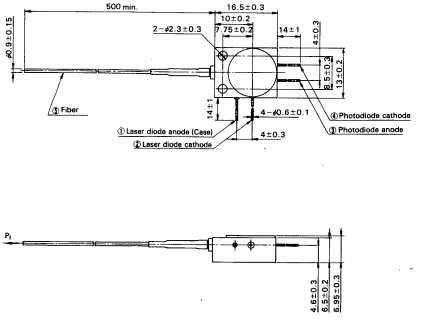
Spot size	: 5 μm
λ_c	: 1.10—1.28 μm
Core diameter	: 10 μm
Outer diameter	: 125 μm
Jacket diameter	: 900 μm
Fiber length	: More than 500 mm

Features

- Long wavelength light output: λ_p = 1270—1330 nm
- 1.2 mW CW operation at room temperature
- Fast pulse response: t_r, $t_f \leqq 0.5$ ns
- Built-in photodiode for monitoring laser output



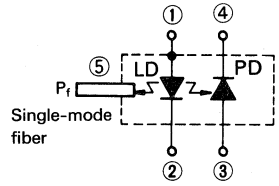
Package Dimensions



(Unit: mm)

SP-type

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Fiber optical output power	P_f	1.2	mW
Laser diode reverse voltage	$V_{R(LD)}$	2.0	V
Photodiode reverse voltage	$V_{R(PD)}$	20	V
Photodiode forward current	$I_{F(PD)}$	1.0	mA
Operating temperature	T_{opr}	0 to +50	°C
Storage temperature	T_{stg}	−40 to +60	°C

Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Threshold current	I_{th}		30	50	mA	
Fiber optical output power	P_f	1.2			mW	Kink free
		0.6			mW	$I_F = I_{th}$ + 20 mA
Lasing wavelength	λ_p	1270	1300	1330	nm	P_f = 1.0 mW
Spectral width	$\Delta\lambda$		2		nm	P_f = 0.5 mW
Photodiode dark current	I_{DARK}			150	nA	$V_{R(PD)}$ = 5 V
Monitor current	I_S	140			µA	$V_{R(PD)}$ = 5 V, P_f = 1.0 mW
Photodiode capacitance	C_t		3.0	4.0	pF	$V_{R(PD)}$ = 5 V, f = 1 MHz
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Rise time	t_r			0.5	ns	
Fall time	t_f			0.5	ns	

HLP50R, HLP60R

GaAlAs IRED

Description

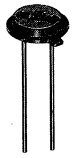
HLP50R and HLP60R are GaAlAs infrared emitting diodes with single heterojunction structure.

They offer a wide range of wavelength and output power, and are suitable for various types of optical equipment.

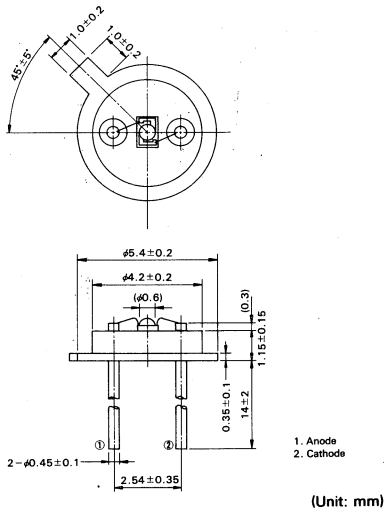
The package should be hermetically sealed before mounting on a system.

Features

- High efficiency
- Selection from a wide range of wavelength and output power
- Narrow spectral width

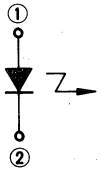


Package Dimensions



R-type

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Forward current	I_F	250	mA
		230*	mA
Reverse voltage	V_R	3	V
Tolerable power dissipation	P_d	600	mW
Operating temperature	T_{opr}	−20 to +40**°C	
Storage temperature	T_{stg}	−40 to +60**°C	

* Value for devices with λ_p from 735 nm to 785 nm.
** Value for conditions without condensation.

Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Optical output power	P_O		**		mW	$I_F = 200$ mA
Peak wavelength	λ_p		**		nm	$I_F = 200$ mA
Spectral width	$\Delta\lambda$		30	60	nm	$I_F = 200$ mA
Beam divergence	θ_H		180		deg.	$I_F = 200$ mA
Forward voltage	V_F		1.7	2.3	V	$I_F = 200$ mA
			2.0*	2.6*	V	$I_F = 200$ mA
Reverse current	I_R			30	μA	$V_R = 3$ V
Capacitance	C_t		30		pF	$V_R = 0$ V, f = 1 MHz
Rise time	t_r		12		ns	$I_F = 50$ mA
			20*		ns	$I_F = 50$ mA
Fall time	t_f		12		ns	$I_F = 50$ mA
			20*		ns	$I_F = 50$ mA

* Value for devices with λ_p from 735 nm to 785 nm.
** HLP50R, HLP60R are grouped with λ_p and P_O as follows.

	λ_p (nm)			P_O (mW)	
Grades	min.	typ.	max.	45 (min.)	55 (min.)
B	775	800	825	HLP50R	HLP60R
C	815	840	865	HLP50R	HLP60R
D	855	880	905	HLP50R	HLP60R

HLP50RG, HLP60RG

GaAlAs IRED

Description

HLP50RG and HLP60RG are GaAlAs infrared emitting diodes with single heterojunction structure.

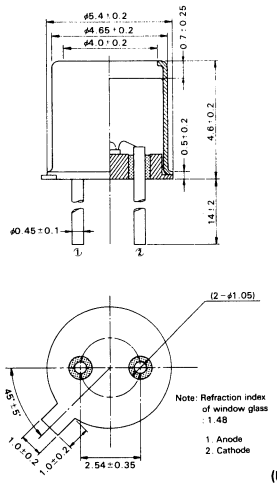
They offer a wide range of wavelength and output power, and are suitable for various types of optical equipment.

Hermetic sealing of the package achieves high reliability.

Features

- High efficiency
- Selection from a wide range of wavelength and output power
- Narrow spectral width

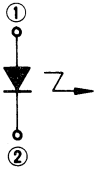
Package Dimensions



(Unit: mm)

RG-type

Internal Circuit



Absolute Maximum Ratings ($T_C = 25°C$)

Items	Symbols	Values	Units
Forward current	I_F	250	mA
		230*	mA
Reverse voltage	V_R	3	V
Tolerable power dissipation	P_d	600	mW
Operating temperature	T_{opr}	−20 to +40	°C
Storage temperature	T_{stg}	−40 to +60	°C

* Value for devices with λ_p from 735 nm to 785 nm.

HITACHI

Optical and Electrical Characteristics ($T_C = 25°C$)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Optical output power	P_O		**		mW	$I_F = 200$ mA
Peak wavelength	λ_p		**		nm	$I_F = 200$ mA
Spectral width	$\Delta\lambda$		30	60	nm	$I_F = 200$ mA
Beam divergence	θ_H		120		deg.	$I_F = 200$ mA
Forward voltage	V_F		1.7	2.3	V	$I_F = 200$ mA
			2.0*	2.6*	V	$I_F = 200$ mA
Reverse current	I_R			30	μA	$V_R = 3$ V
Capacitance	C_t		30		pF	$V_R = 0$ V, f = 1 MHz
Rise time	t_r		12		ns	$I_F = 50$ mA
			20*		ns	$I_F = 50$ mA
Fall time	t_f		12		ns	$I_F = 50$ mA
			20*		ns	$I_F = 50$ mA

* Value for devices with λ_p from 735 nm to 785 nm.
** HLP50RG, HLP60RG are grouped with λ_p and P_O as follows.

	λ_p (nm)			P_O (mW)	
Grades	min.	typ.	max.	22 (min.)	27 (min.)
B	775	800	825	HLP50RG	HLP60RG
C	815	840	865	HLP50RG	HLP60RG
D	855	880	905	HLP50RG	HLP60RG

HE8402F

GaAlAs IRED

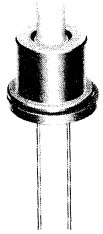
Description

HE8402F is a 0.8 μm GaAlAs infrared emitting diode with double heterojunction structure, which provides high speed response.

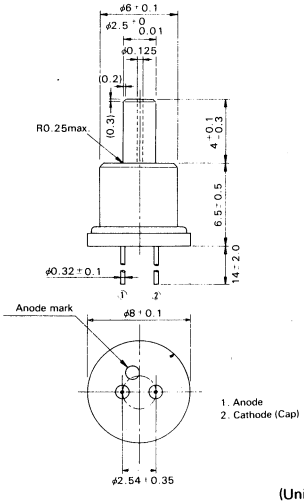
The package can be easily connected to optical fiber, and is suitable as a light source in fiberoptic communications equipment.

Features

- Optical fiber rod (50 μm of core dia., GI) included in ferrule (2.5 mm dia.)
- Ease in fiber coupling
- High frequency response
- Excellent light-current linearity



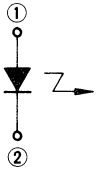
Package Dimensions



(Unit: mm)

F-type

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Forward current	I_F	150	mA
Reverse voltage	V_R	3	V
Tolerable power dissipation	P_d	350	mW
Operating temperature	T_{opr}	−20 to +60	°C
Storage temperature	T_{stg}	−40 to +90	°C

Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Fiber optical output power	P_f*	40	60		μW	I_F = 100 mA
Peak wavelength	λ_p	800	840	900	nm	I_F = 100 mA
Spectral width	$\Delta\lambda$		50		nm	I_F = 100 mA
Forward voltage	V_F			2.5	V	I_F = 100 mA
Reverse current	I_R			100	μA	V_R = 3 V
Capacitance	C_t		10		pF	V_R = 0 V, f = 1 MHz
Rise time	t_r		5		ns	I_F = 50 mA
Fall time	t_f		7		ns	I_F = 50 mA

* At GI 50/125 fiber end.

HE8801

GaAlAs IRED

Description

HE8801 is a 0.8 μm GaAlAs infrared emitting diode with single heterojunction structure.

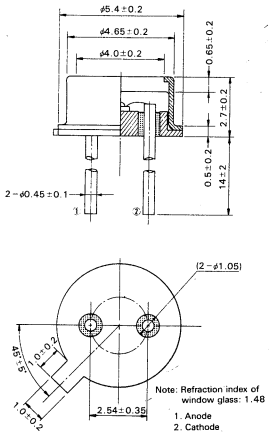
Wide radiant directionality makes it suitable as a light source in various types of optical equipment.

Hermetic sealing of the package achieves high reliability.

Features

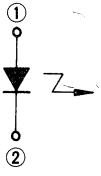
- High efficiency and high power output
- Narrow spectral width
- Wide radiant directionality

Package Dimensions



SG-type

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Forward current	I_F	200	mA
Reverse voltage	V_R	3	V
Tolerable power dissipation	P_d	400	mW
Operating temperature	T_{opr}	−20 to +60	°C
Storage temperature	T_{stg}	−40 to +90	°C

Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Optical output power	P_O	6	20		mW	I_F = 150 mA
Peak wavelength	λ_p	800	880	900	nm	I_F = 150 mA
Spectral width	$\Delta\lambda$		30	60	nm	I_F = 150 mA
Forward voltage	V_F		1.7	2.3	V	I_F = 150 mA
Reverse current	I_R			100	µA	V_R = 3 V
Capacitance	C_t		10		pF	V_R = 0 V, f = 1 MHz
Rise time	t_r		12		ns	I_F = 50 mA
Fall time	t_f		12		ns	I_F = 50 mA

HE1302ML

InGaAsP IRED

Description

HE1302ML is a high-power 1.3 μm InGaAsP infrared emitting diode with double heterojunction structure, which provides high speed response.

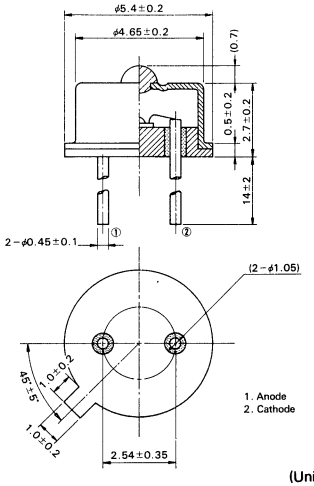
Optical output from the chip is directed to the optical fiber efficiently through the microlens in the cap; suitable as a light source in fiberoptic communications equipment.

Hermetic sealing of the package achieves high reliability.

Features

- High power output
- High efficiency and high brightness output
- Fast pulse response

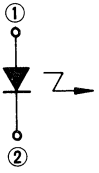
Package Dimensions



(Unit: mm)

ML-type

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Forward current	I_F	150	mA
Reverse voltage	V_R	1.0	V
Tolerable power dissipation	P_d	300	mW
Operating temperature	T_{opr}	−20 to +60	°C
Storage temperature	T_{stg}	−40 to +90	°C

Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Fiber optical output power	P_f*	30			μW	I_F = 100 mA
Peak wavelength	λ_p	1260	1300	1340	nm	I_F = 100 mA
Spectral width	$\Delta\lambda$		140		nm	I_F = 100 mA
Forward voltage	V_F		1.5	2.0	V	I_F = 100 mA
Capacitance	C_t		30		pF	V_R = 0 V, f = 1 MHz
Rise time	t_r		1.5		ns	I_F = 100 mA
Fall time	t_f		4.0		ns	I_F = 100 mA

* At GI 50/125 fiber end.

HR1101 InGaAsP PIN Photodiode

Description

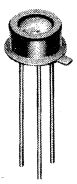
HR1101 is an InGaAsP PIN photodiode for detecting 1.0 – 1.5 μm light.

Its high-speed pulse response makes it especially suitable as a light signal detector in high-bit-rate fiberoptic communications equipment.

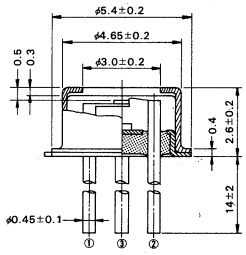
Hermetic sealing of the package achieves high reliability.

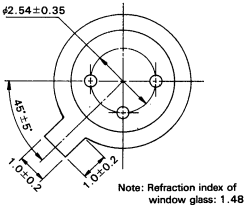
Features

- Fast pulse response : t_r, t_f = 0.5 ns typ.
- High sensitivity : S ≧ 0.45 mA/mW
- Low dark current : I_{DARK} = 7 nA typ.
- Small capacitance : C_t = 2.0 pF typ.
- Photodetectable area : 100 μm dia.



Package Dimensions





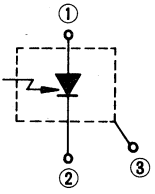
Note: Refraction index of window glass: 1.48

1. Anode
2. Cathode
3. Case

(Unit: mm)

TG-type

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Reverse voltage	V_R	20	V
Forward current	I_F	1.0	mA
Operating temperature	T_{opr}	−40 to +80	°C
Storage temperature	T_{stg}	−45 to +100	°C

Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Dark current	I_{DARK}		7	200	nA	V_R = 10 V
Capacitance	C_t		2.0	3.0	pF	V_R = 10 V, f = 1 MHz
Sensitivity	S	0.45	0.7		mA/mW	V_R = 10 V, λ_p = 1300 nm P_{in} = 1.0 mW
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Rise time	t_r		0.5		ns	V_R = 10 V, λ_p = 1300 nm R_L = 50 Ω
Fall time	t_f		0.5		ns	V_R = 10 V, λ_p = 1300 nm R_L = 50 Ω

HR1102 InGaAsP PIN Photodiode

Description

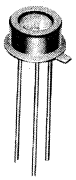
HR1102 is an InGaAsP PIN photodiode for detecting 1.0 – 1.5 μm light.

It is suitable as an optical monitor in high-bit-rate fiberoptic communications equipment.

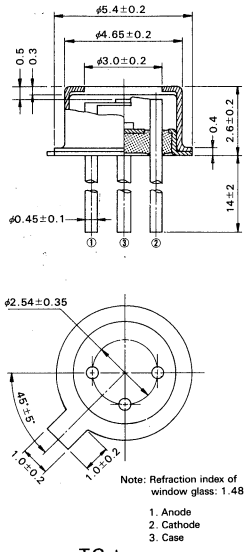
Hermetic sealing of the package achieves high reliability.

Features

- High sensitivity : S ≧ 0.45 mA/mW
- Low dark current : I_{DARK} = 20 nA typ.
- Photodetectable area : 300 μm dia.



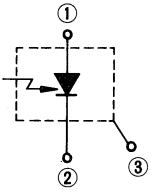
Package Dimensions



(Unit: mm)

TG-type

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Reverse voltage	V_R	15	V
Forward current	I_F	1.0	mA
Operating temperature	T_{opr}	−40 to +80	°C
Storage temperature	T_{stg}	−45 to +100	°C

Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Dark current	I_{DARK}		20	500	nA	V_R = 10 V
Capacitance	C_t		9	15	pF	V_R = 10 V, f = 1 MHz
Sensitivity	S	0.45	0.7		mA/mW	V_R = 10 V, λ_p = 1300 nm P_{in} = 1.0 mW
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Rise time	t_r		1.2		ns	V_R = 10 V, λ_p = 1300 nm R_L = 50 Ω
Fall time	t_f		1.2		ns	V_R = 10 V, λ_p = 1300 nm R_L = 50 Ω

HR1102CX

InGaAsP PIN Photodiode

Description

HR1102CX is an InGaAsP PIN photodiode for detecting 1.0 – 1.5 μm light.

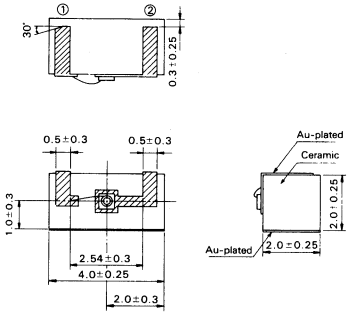
It is suitable as an optical monitor in high-bit-rate fiberoptic communications equipment.

The package is compact for ease in module assembly.

Features

- High sensitivity : S ≧ 0.6 mA/mW
- Low dark current : I_{DARK} = 20 nA typ.
- Photodetectable area : 300 μm dia.

Package Dimensions

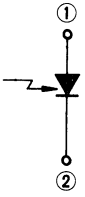


1. Anode
2. Cathode

(Unit: mm)

CX-type

Internal Circuit



Absolute Maximum Ratings (T_C = 25°C)

Items	Symbols	Values	Units
Reverse voltage	V_R	15	V
Forward current	I_F	1.0	mA
Operating temperature	T_{opr}	−40 to +80	°C
Storage temperature	T_{stg}	−40 to +100	°C

Optical and Electrical Characteristics (T_C = 25°C)

Items	Symbols	min.	typ.	max.	Units	Test conditions
Dark current	I_{DARK}		20	100	nA	V_R = 10 V
Capacitance	C_t		10		pF	V_R = 10 V, f = 1 MHz
Sensitivity	S	0.6	0.7		mA/mW	V_R = 10 V, λ_p = 1300 nm P_{in} = 1.0 mW
Photosensitivity saturation voltage	$V_{R(S)}$			2	V	
Rise time	t_r		1.2		ns	V_R = 10 V, λ_p = 1300 nm R_L = 50 Ω
Fall time	t_f		1.2		ns	V_R = 10 V, λ_p = 1300 nm R_L = 50 Ω

Hitachi Optodevice

Publication Date: 1st Edition, April 1983
4th Edition, February 1989

Published by: Semiconductor and IC Div.
Hitachi, Ltd.

Edited by: Application Engineering Dept.
Hitachi Microcomputer Engineering, Ltd.

HITACHI EUROPEAN SALES LOCATIONS

Hitachi Europe GmbH
Electronic Components Division

Headquarter:
Hans-Pinsel-Str. 10A
D-8013 Haar bei München
Tel.: (0 89) 46 14-0; Telex: 5 22 593 hitc d
Telefax: (0 89) 46 31 51

Sales Offices:
North Germany / Benelux
Am Seestern 18; Postfach 11 05 36
D-4000 Düsseldorf 11
Tel.: (02 11) 52 83-0; Teletext: 2 114 096 HIEC D
Telefax: (02 11) 52 83-779

Central Germany
Fabrikstraße 17; D-7024 Filderstadt
Tel.: (07 11) 77 20 11
Teletex: 71 11 410 HITECS
Telefax: (07 11) 7 77 51 16

South Germany
Hans-Pinsel-Str. 10A
D-8013 Haar bei München
Tel.: (0 89) 46 14-0; Telex: 5 22 593 hitc d
Telefax: (0 89) 46 31 51

Italy
Via L. Rizzo 8; I-20151 Milano
Tel.: (02) 33 40 41 80; Telex: 32 33 77 hitec i
Telefax: (02) 33 40 41 52

Via Pescosolido 154; I-00158 Roma
Tel.: (06) 4 51 01 46, -1 47
Telefax: (06) 4 51 01 48

Spain
Sucursal en Espana
c/Buganvilla, 5; E-28036 Madrid
Tel.: 00 34/1/7 67 27 82, 7 67 27 92
Telefax: 00 34/1/3 83 85 11

France
Immeuble «Les Gémeaux»
2 Rue Antoine Etex; F-94020 Créteil
Tel.: (1) 43 39 45 00; Telex: 2 62 246
Telefax: (1) 43 39 84 93

Nissei Sangyo GmbH
Headquarters & Germany
Gustav-Heinemann-Ring 121; D-8000 München 83
Tel.: (0 89) 6 78 28-0; Telex: 5 29 963 nism d
Telefax: (0 89) 6 70 31 02 oder 6 70 43 52

Berlin
Bayreuther Str. 4; 1000 Berlin 30
Tel.: (0 30) 24 80 81; Telex: 18 36 70
Telefax: (0 30) 2 13 96 95

France
Nissei Sangyo S.A.R.L.
2, Rue Louis Armand; Tour Objectiv 5F
F-92700 Asnières
Tel.: (1) 47 93 67 10; Telefax: (1) 47 93 00 60

Spain
Nissei Sangyo France (S.A.R.L.)
Barcelona Office
Gran Via Carlos III, 98
Planta 1-4
Edificios Trade
E-09028 Barcelona
Tel.: (3) 330-97 53/98 05; Telefax (3) 339-09 95