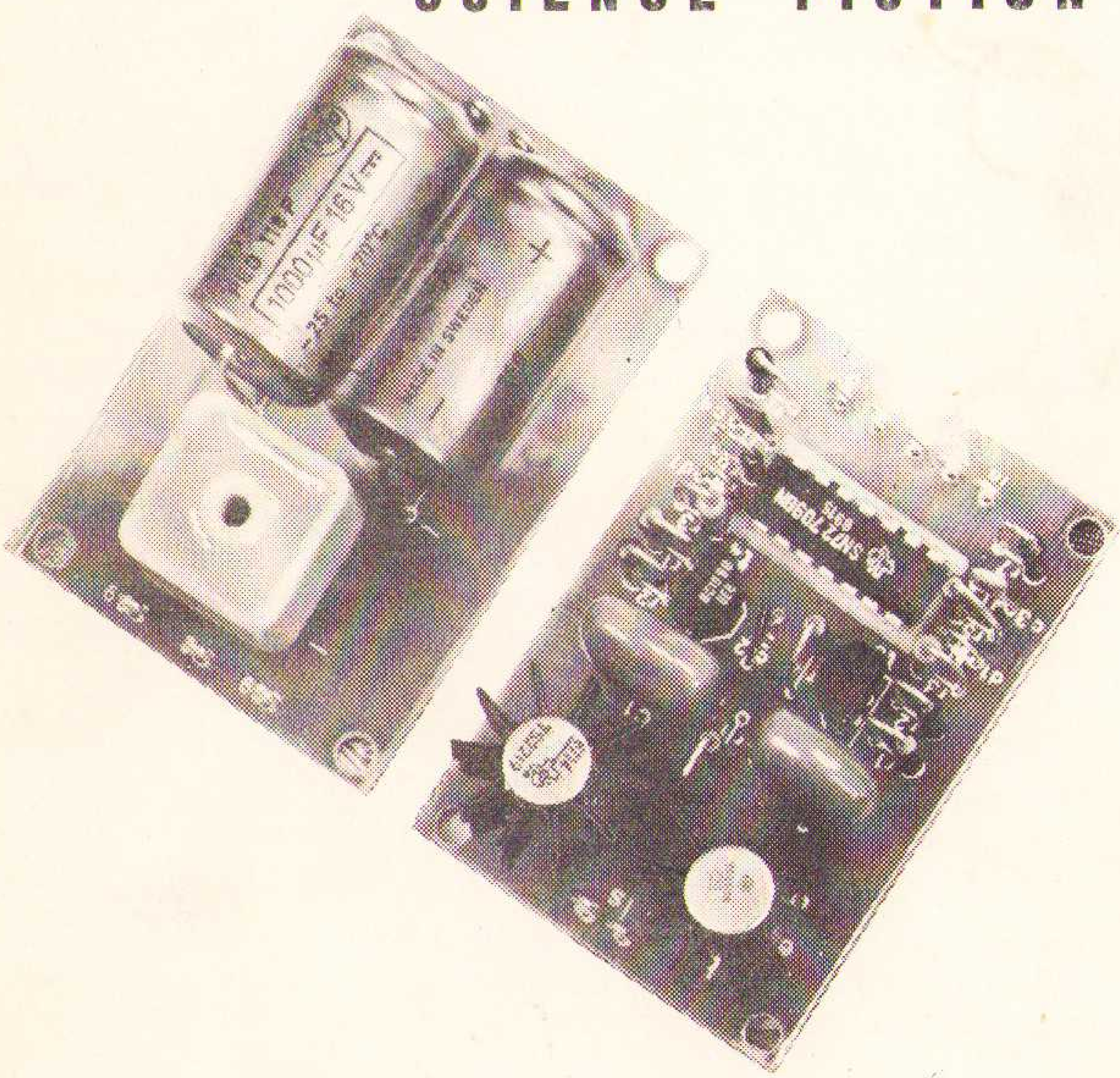
TECHNISCHE DOCUMENTATIE 1969
DEEL 5·6 MEI·JUNI

<u>in dit nummer onder andere:</u>
correctie Technische documentatie deel 1 en 2.
laagspanningsvoeding voor de digitale bouwstenen.
een thyristor ontsteking voor de bromfiets.
enkele schakelingen van de science fiction amplifier.
de triacs W1520A en W1540A.
een nieuwe spanningsregelaar.
een tweetal geintegreerde powerversterkers PA230 en PA237.
toepassingen van de opgenomen halfgeleiders.

SCIENCE FICTION AMPLIFIER



Van Dam Elektronica, Snellemanstraat 10-11, Rotterdam-noord
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Postorders en correspondentie aan: Postbus 3149 te Rotterdam.

Van Dam Elektronica, Reguliersgracht 105, Amsterdam, Telefoon: 020-248967.

PRIJS *f* 3,50

Technische documentatie 1969 deel 5 en 6 (dubbelnummer).

Abonnementsprijs *f* 10,40 per jaar incl. 4% B.T.W.

OMSLAGFOTO: De SCIENCE FICTION AMPLIFIER met de voeding. Afgebeeld zijn een eindversterker in mono-uitvoering en de voeding excl. trafo voor een stereo-uitvoering. Deze versterker met regel- en voorversterkers treft U aan op pagina 7 van deze documentatie.

LEVERINGSVOORWAARDEN:
Voor onze leveringsvoorwaarden zie technische documentatie 1969 deel 1 blz. 2.

VERHUIZINGEN:

Bij verhuizing dient direct na het verschijnen van de nieuwste uitgave hiervan opgave worden gedaan aan onze administratie. Hierbij kunnen alleen adreswijzigingen in behandeling worden genomen als het op de enveloppe vermelde nummer is opgenomen op Uw adreskaart; zonder dit nummer worden wijzigingen BESLIST NIET in behandeling genomen en aan U retour gezonden. Correspondentie te richten aan: Van Dam Elektronica, Postbus 3149 te Rotterdam-noord.

PRIJSNOTERINGEN:

Alle door ons uitgegeven prijslijsten kunnen onderhevig zijn aan veranderingen; veranderingen zijn derhalve strikt voorbehouden. Alle prijsnoteringen zijn incl. 12% B.T.W.; voor de netto- of 'BTW'-schone prijs geldt een omrekenfactor 0,8929. Wij behouden ons strikt het recht voor produkten uit ons verkoopprogramma te onttrekken.

Na de technische documentatie deel 4 betreffende de Görler en transistorgegevens, treft U in dit dubbelnummer enkele nieuwe onderdelenpakketten aan en een uitvoerige beschrijving van enkele interessante geïntegreerde schakelingen.

De besproken produkten zijn inmiddels aan ons verkoopprogramma toegevoegd; prijzen zijn op de achterzijde van deze documentatie opgenomen.

Ook onze volgende documentatie zal een dubbelnummer zijn; de verwachte verschijningsdatum is 2e helft van juli.

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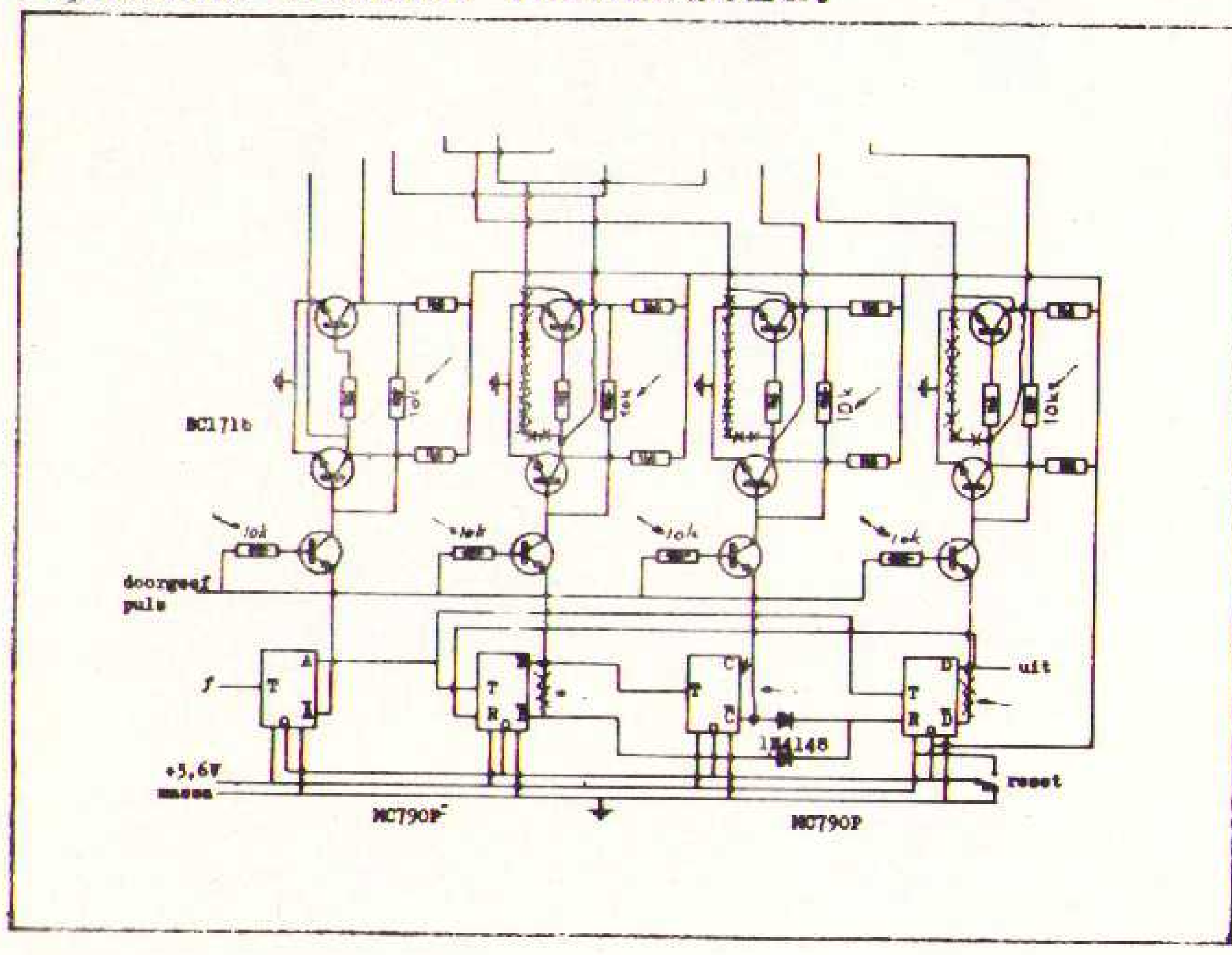
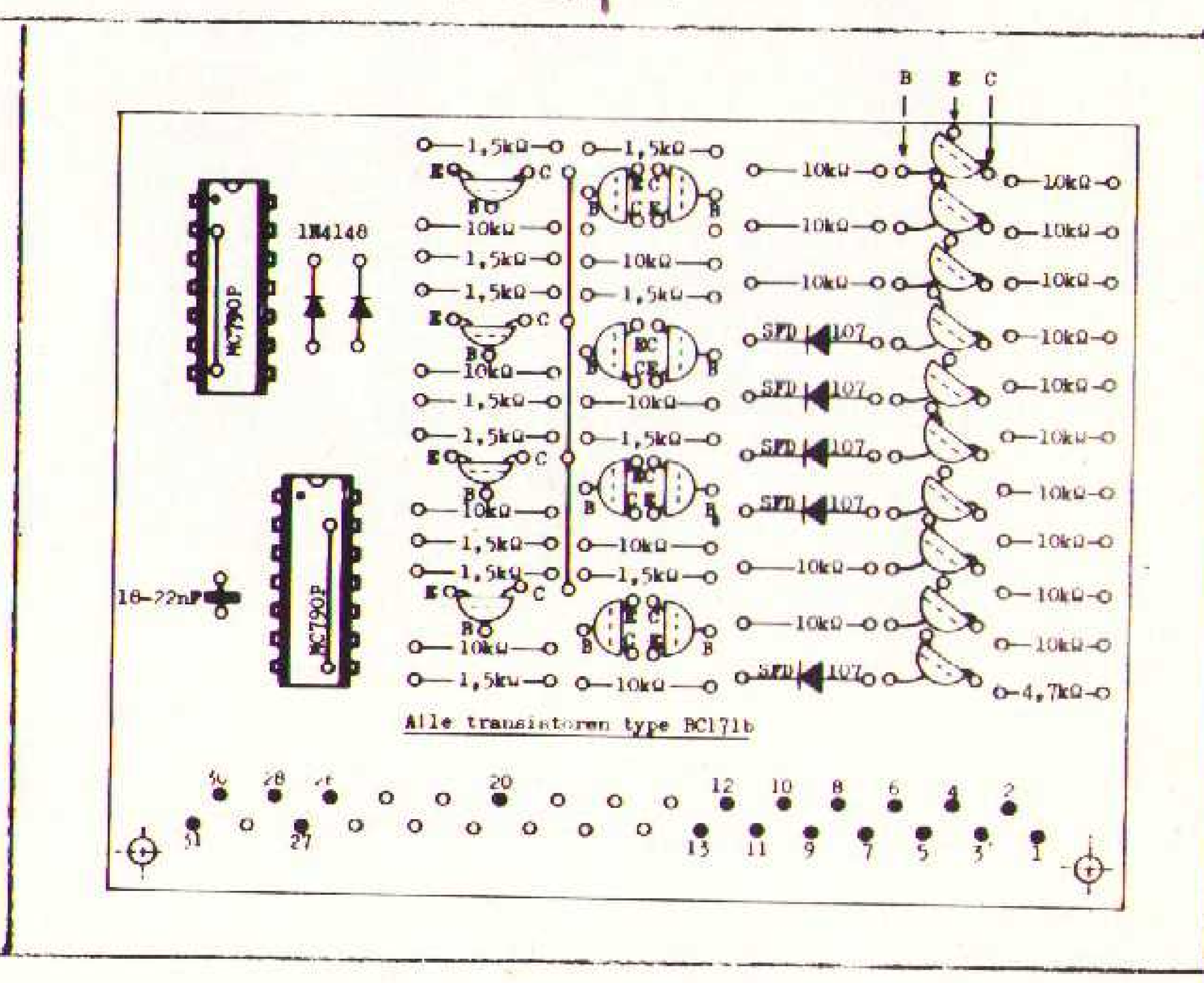
Verandering digitale teller met buffergeheugen (T.D. 1969 deel 1, blz. 10).

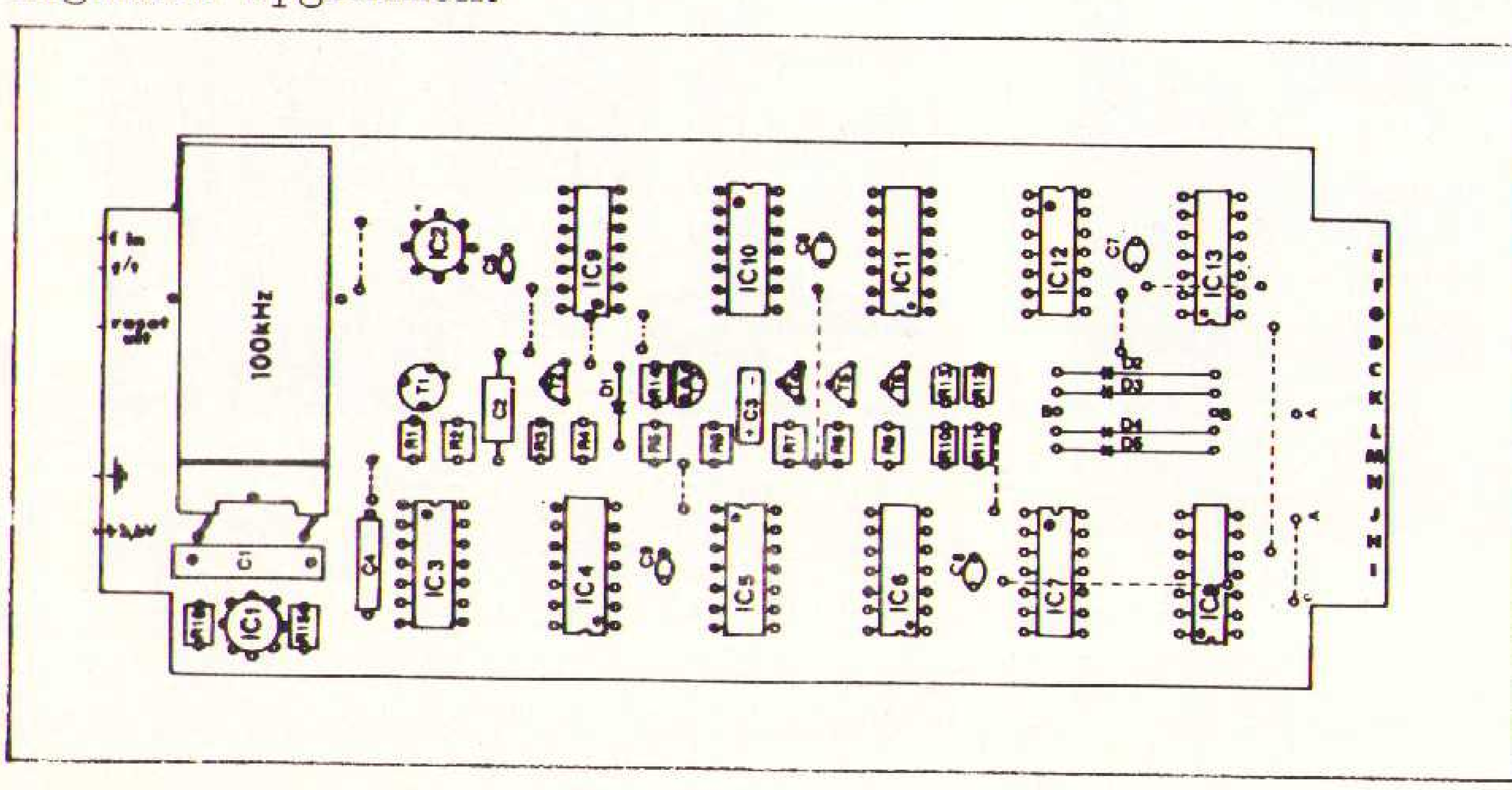
In verband met een kleine specificatie-verandering in de MC790P ten aanzien van de toelaatbare, van buiten het IC komende, uitgangsstroom ('verzadigingsstroom') hebben wij één van de door ons uitgebrachte digitale tellers moeten aanpassen. Hierin zijn de basis- en collector-weerstanden van 4,7*kΩ veranderd in 10kΩ. Bij het uitschakelen van het geheugen, waarbij de doorgeefpuls aan +3,6V moet komen, dient in serie met aansluiting 20 op de connector een weerstand van 270-390Ω worden opgenomen. Deze weerstand zit in de binnenkort uitkomende tijdbasis verwerkt. Bovendien hebben wij de print van voormoende teller iets veranderd; de uitgangen van de IC's $\bar{B}$, C en $\bar{D}$ gaan nu niet meer naar het geheugen; hiervoor worden nu B, $\bar{C}$ en D gebruikt, waarbij de uitgangen van de geheugenschakeling eveneens werden verwisseld.

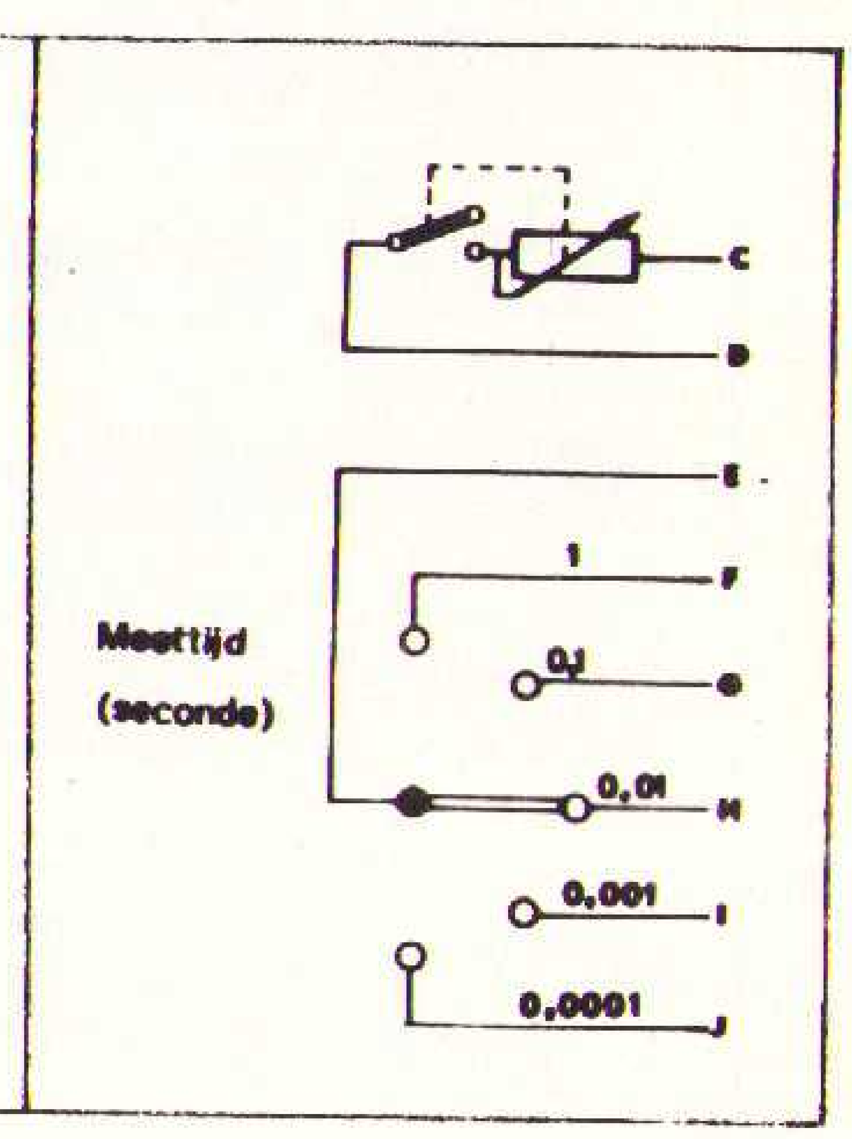
* resp. 1k5





Tevens is door een zetfout de tekening van de tijdeenheid niet geheel tot zijn recht gekomen (TD 1969 deel 1 blz. 11). In onderstaande tekeningen wordt deze nogmaals opgenomen.





Correctie Technische Documentatie deel 2.

Blz. 11: onderdelenlijst 25/40 watt eindversterker: C11 i.p.v. 10nF moet worden gebruikt: 0,1µF 200volt metaal papier.
Blz. 11: onderdelenlijst 25 watt eindversterker: T3: ..... BFX41 i.p.v. BFY56.
Blz. 11: onderdelenlijst 25 watt eindversterker: T4: ..... BFY56 i.p.v. BFX41.
Blz. 20 1ste kolom: stereo 2x25 watt incl. montagematerialen totaal *f* 255,- i.p.v. *f* 225,00.

Wij adviseren U de betrokken documentaties aan te passen teneinde eventuele latere moeilijkheden te voorkomen. Wij zullen alles in het werk stellen om in de toekomst deze vergissingen uit te sluiten.

MET INGANG VAN 1 JUNI 1969 ZIJN WIJ 'sMAANDAGS DE GEHELE DAG

G E S L O T E N !!!!!!!!

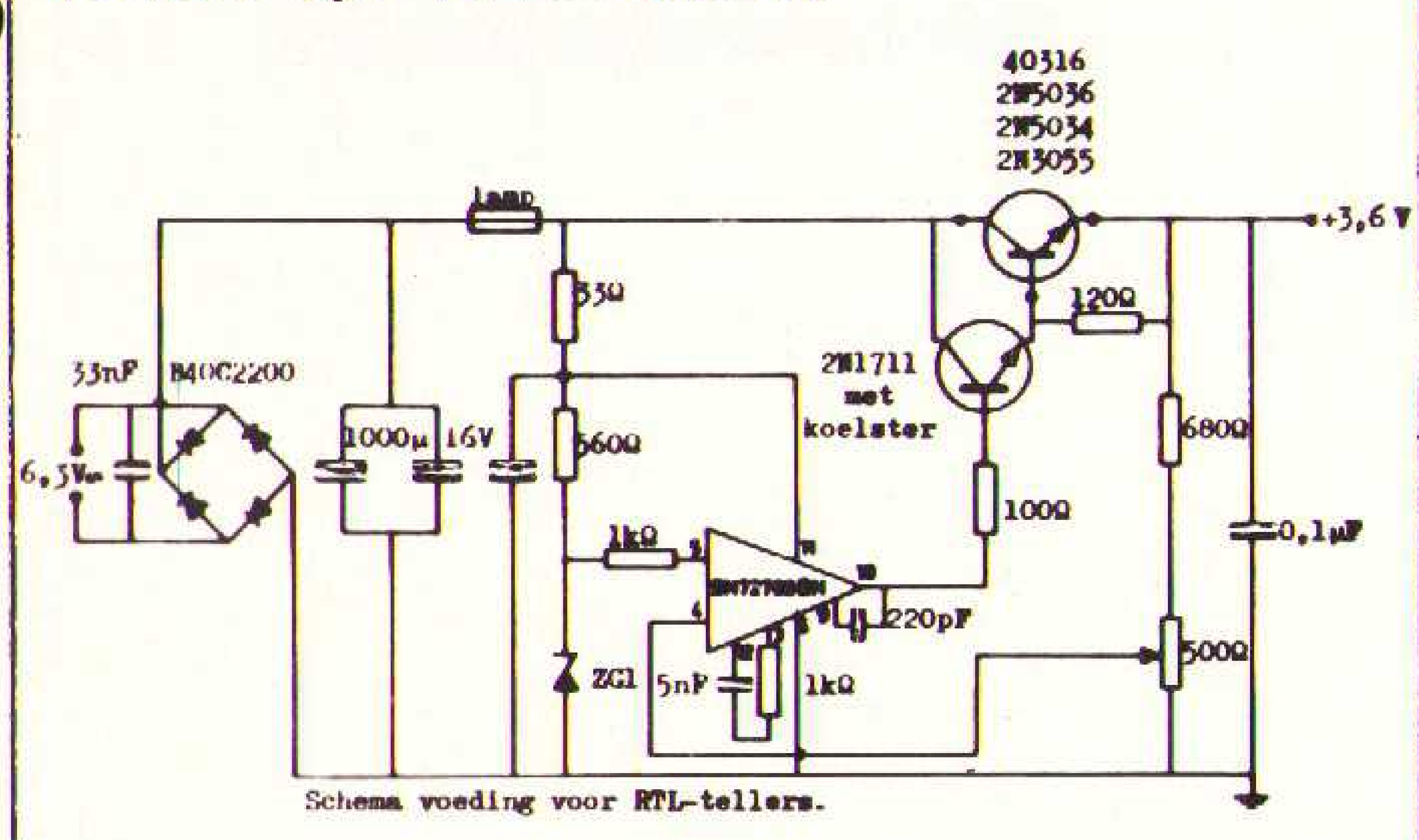
DIGITALE BOUWSTENEN (zie ook technische documentatie deel 1, januari 1969).

VOEDING VOOR RTL-GEÏNTEGREERDE SCHAKELINGEN MET DE SN 72709 BN.

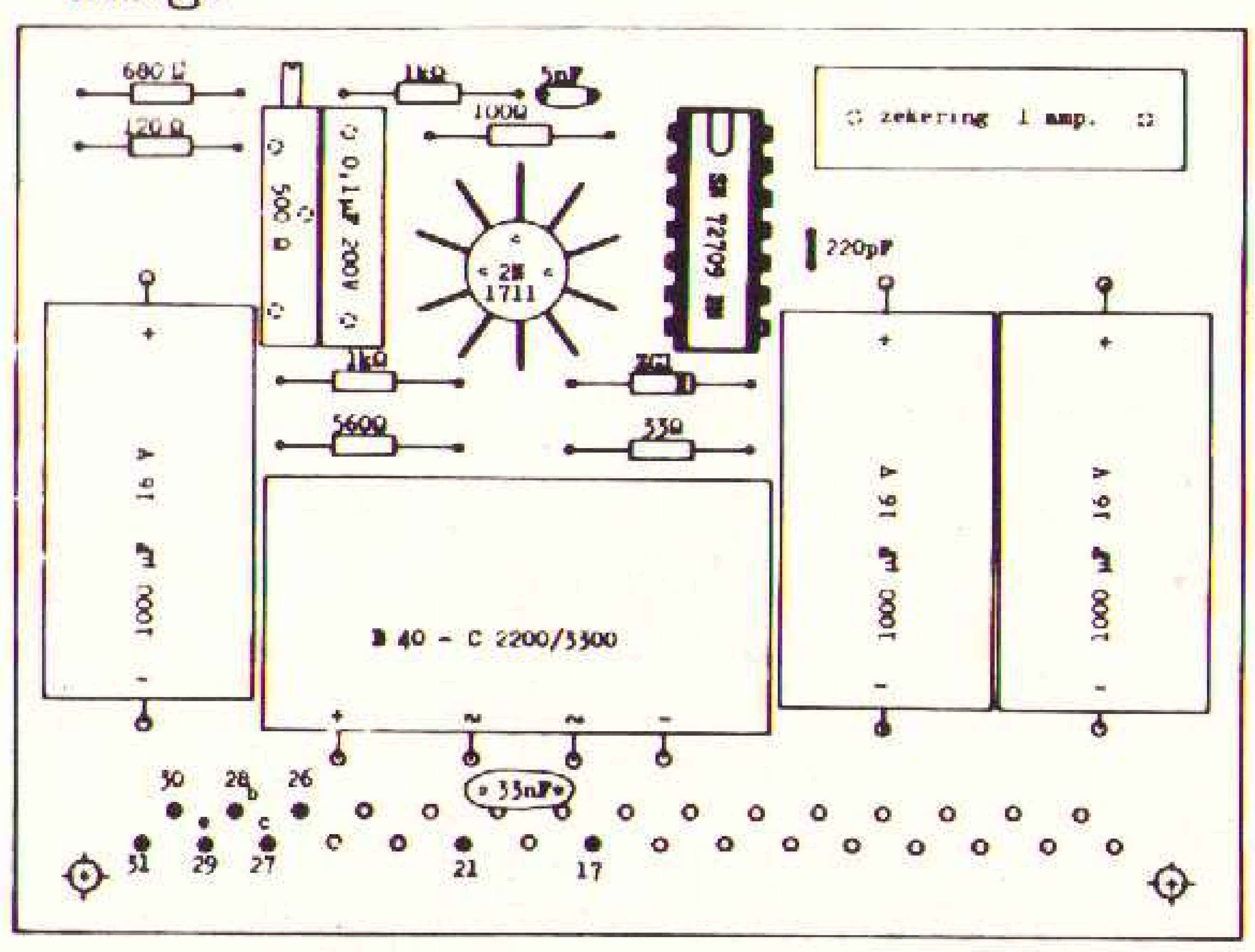
Bij de ontwikkeling van onderstaande voeding is ervan uitgegaan, dat de rimpelspanning op de uitgang minimaal klein moet zijn; gezien de lage voedingsspanning en grote stroomafname is dit met discrete componenten geen eenvoudige opgave. De operationele versterker SN72709BN, waarvan de specificaties e.d. zijn opgenomen in onze technische documentatie nummer 3 (blz. 9), kan ook op deze plaats goede diensten bewijzen. De verkregen specificaties bij een stroomafname van 0,5A zijn:

uitgangsspanning: 3,6 volt (regelbereik van 3 tot 5,5 volt).
rimpelspanning: kleiner dan 20mV.
inwendige weerstand circa 200mΩ.
maximale uitgangsstroom: circa 1,2 ampère (de zekering wordt dan 1,6A).
De instelling van de uitgangsspanning dient in onbelaste toestand plaats te vinden. Na inregeling (hetgeen geschiedt met een professionele draadgewonden potmeter van fabr. Amphenol) kan de voeding belast worden en nageregeld worden. De power-transistor dient een koelopp. te bezitten van circa 10cm^2 bij 1 ampère uitgangsstroom; desgewenst kan hiervoor het chassis worden gebruikt. Bij het onderdelenpakket is de koelplaat en de connector niet inbegrepen.

schema 3,6 volt voeding



onderdelenopstelling 3,6 volt voeding.



Aansluitingen:
punt 17 en 21 gaan naar de 6,3 tot 10 volt wikkeling van de trafo.
punt 26 en/of 31 gaan naar massa.
punt 27 gaat naar de collector van de powertransistor.
punt 28 gaat naar de basis van de powertransistor.
punt 29 gaat naar de emitter van de powertransistor.
punt 30 gaat naar de +3,6 volt aansluitingen van de diverse printen.

Opmerking:
Wij wijzen U er met nadruk op, dat de zenerdiode ZG1 moet worden gemonteerd als staat aangegeven. Dit in tegenstelling tot de andere spanningswaarden uit de ZG-reeks. (Zie hiervoor het in TD 1969 deel 4 opgenomen datasheet).

 wijzigingen voorbehouden.

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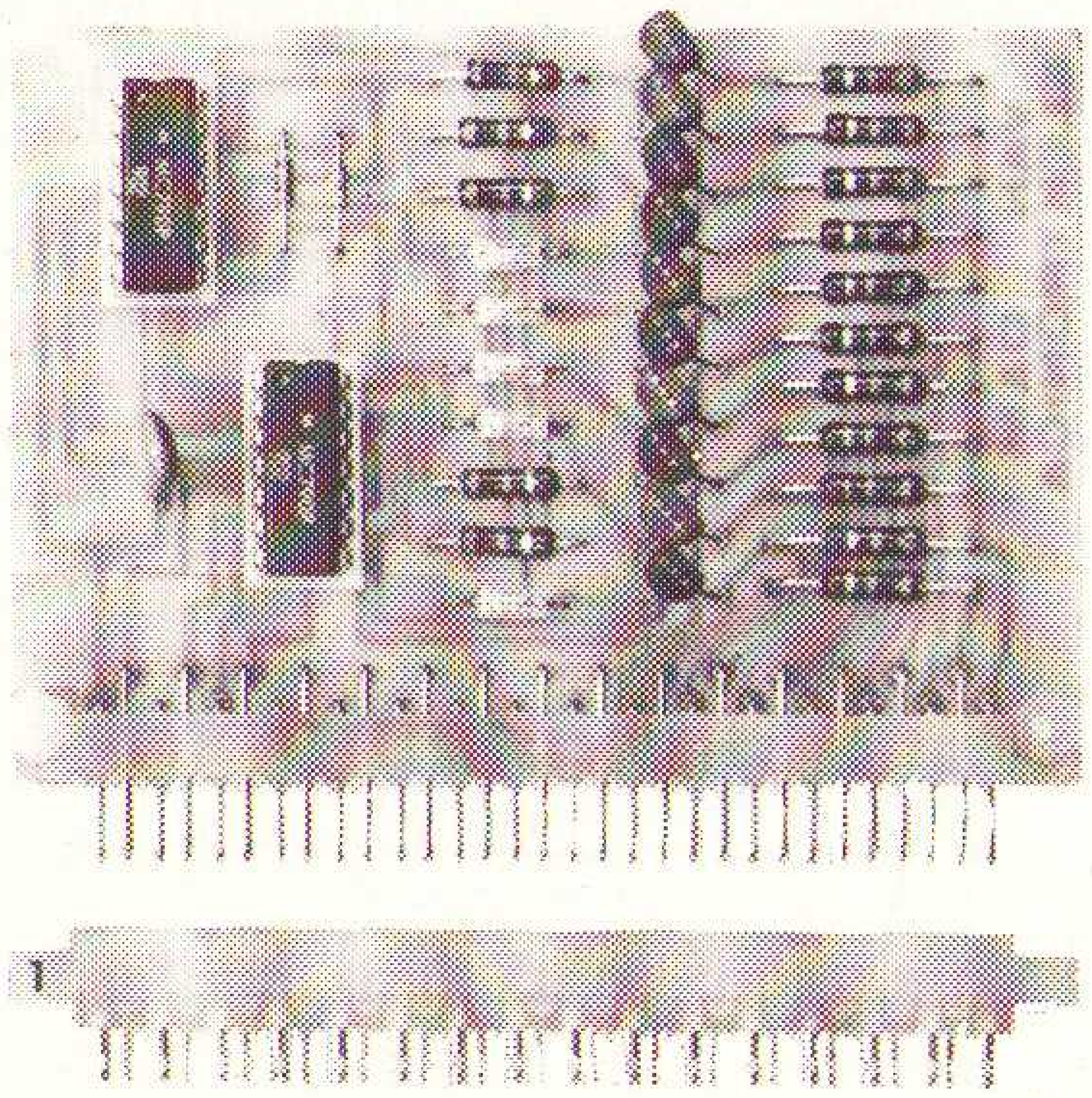

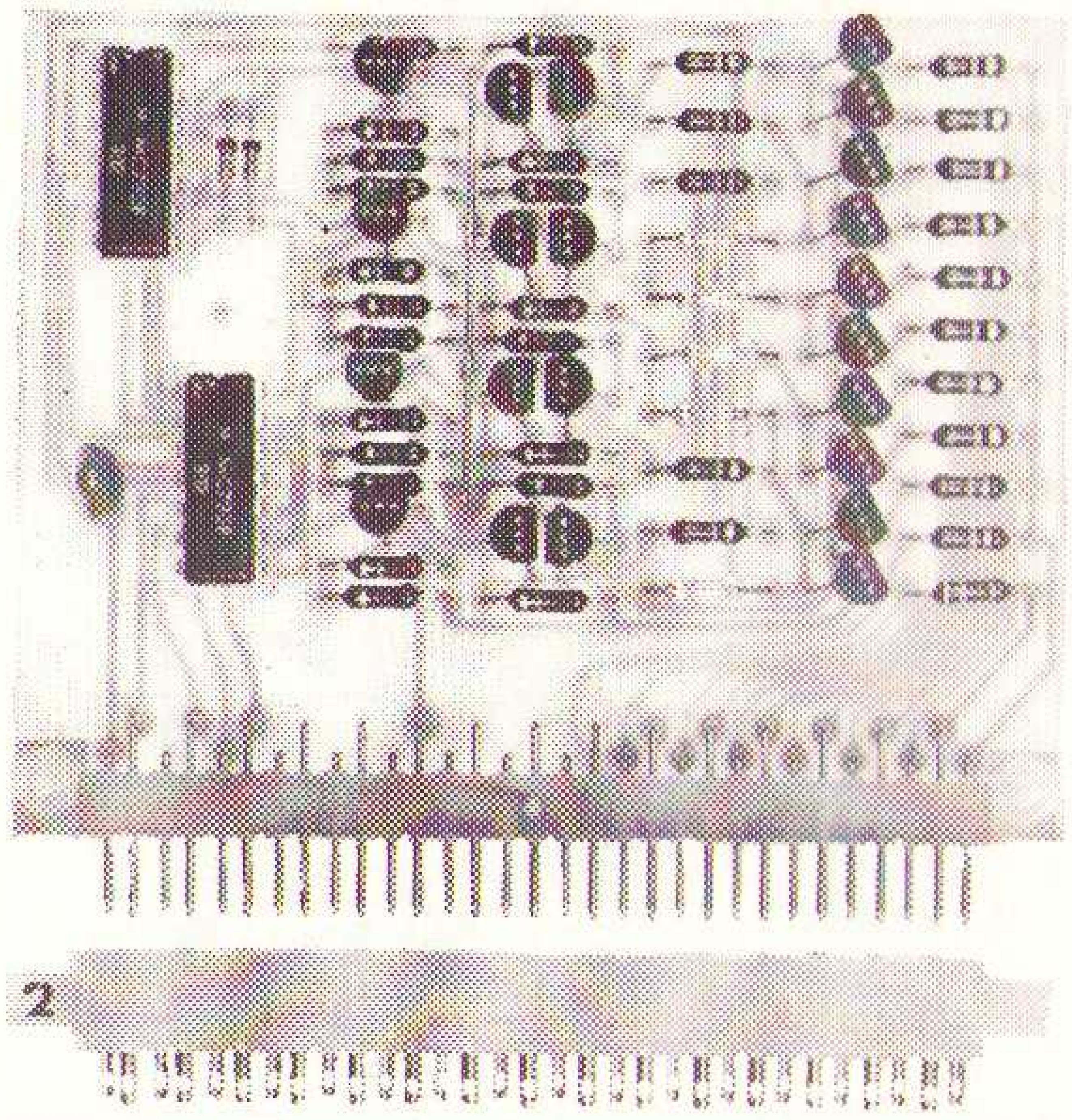

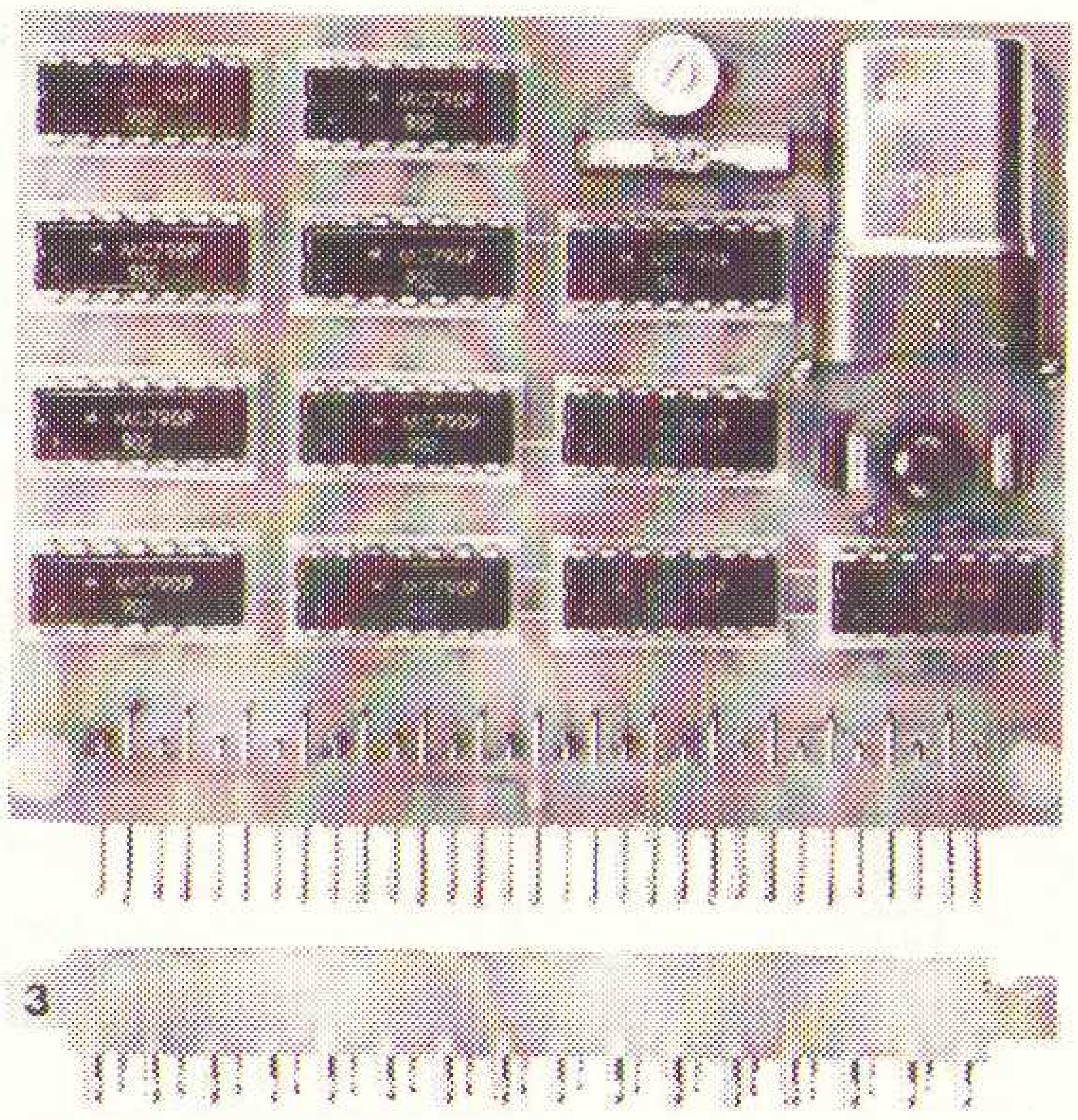

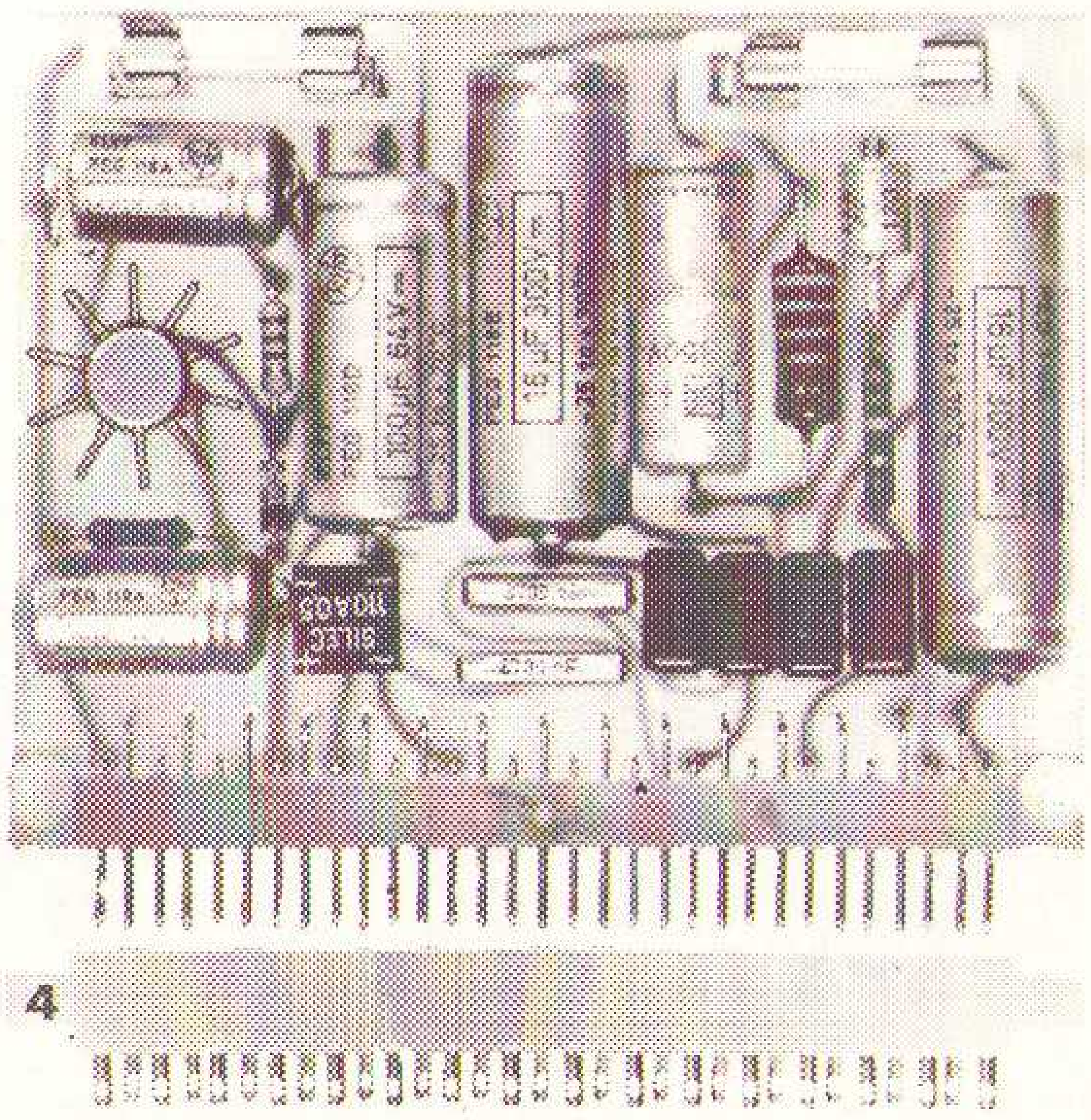

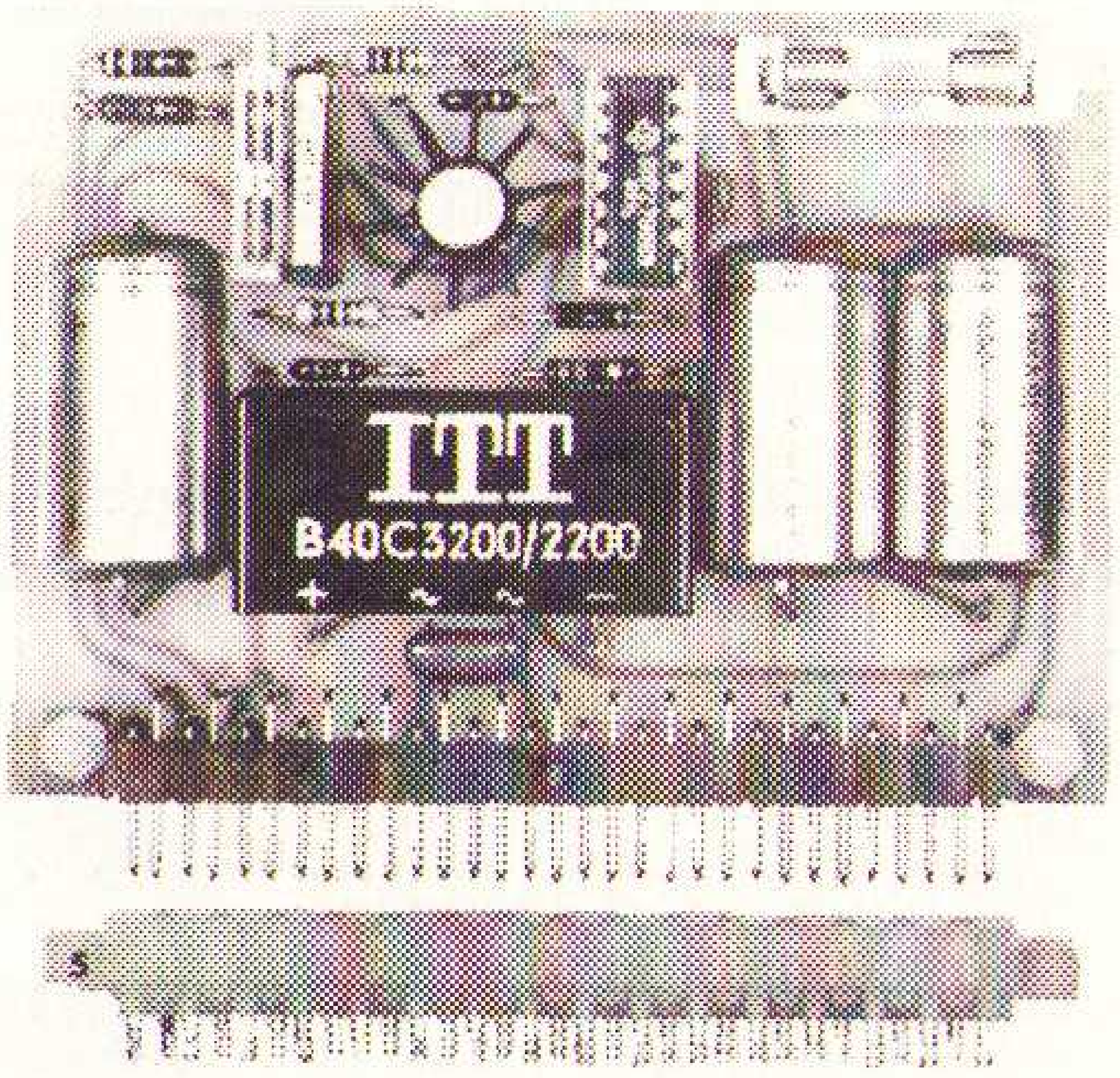

Omschrijving foto's digitale bouwstenen.

1. 1 MHz. teller met uitsturing.
2. 10 MHz. teller met geheugen.
3. Oscillator en 6 tiendelers.
4. Voeding hoogspanning (120/33V).
5. Laagspanningsvoeding met opamp type SN 72709 BN (beschreven op pag. 5)

De opgenomen bouwstenen zijn besproken in onze Technische Documentatie 1969, deel 1 (januari).

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Snellemanstraat 10-11
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Reguliersgracht 105.

THYRISTOR ONTSTEKING VOOR DE BROMFIETS

Sinds enkele jaren worden in verscheidene vakbladen thyristor ontstekingen voor de auto gepubliceerd; voor de bromfiets brengt een dergelijke ontsteking ook verscheidene voordelen met zich mee. Sinds kort is onderstaande ontsteking voor dit doel aan ons verkoopprogramma toegevoegd. Het bouwpakket bestaat uit alle elektronische componenten, een print en een kastje. De bobine en de trafo is derhalve niet inbegrepen.

aansluitingen ontsteking

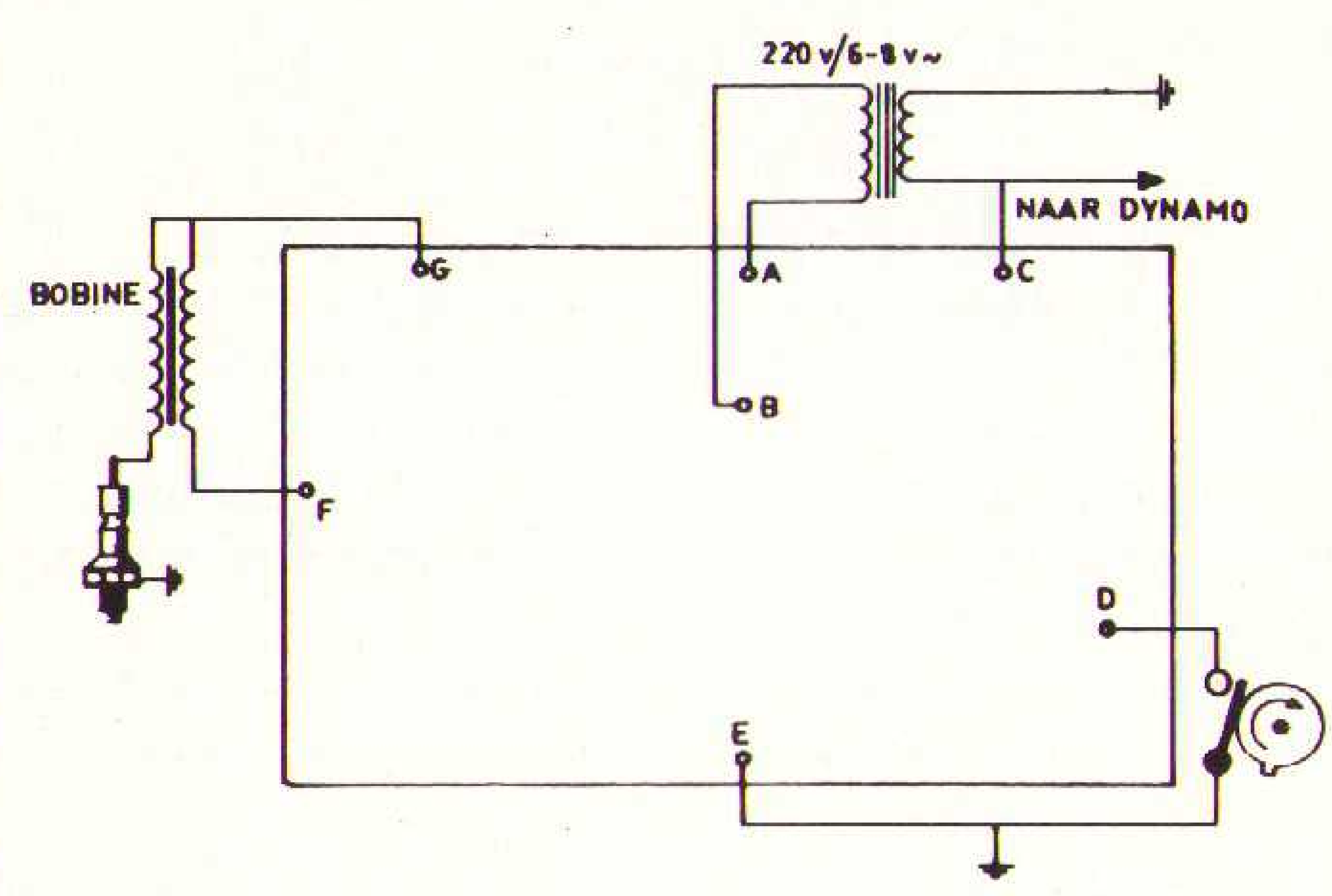
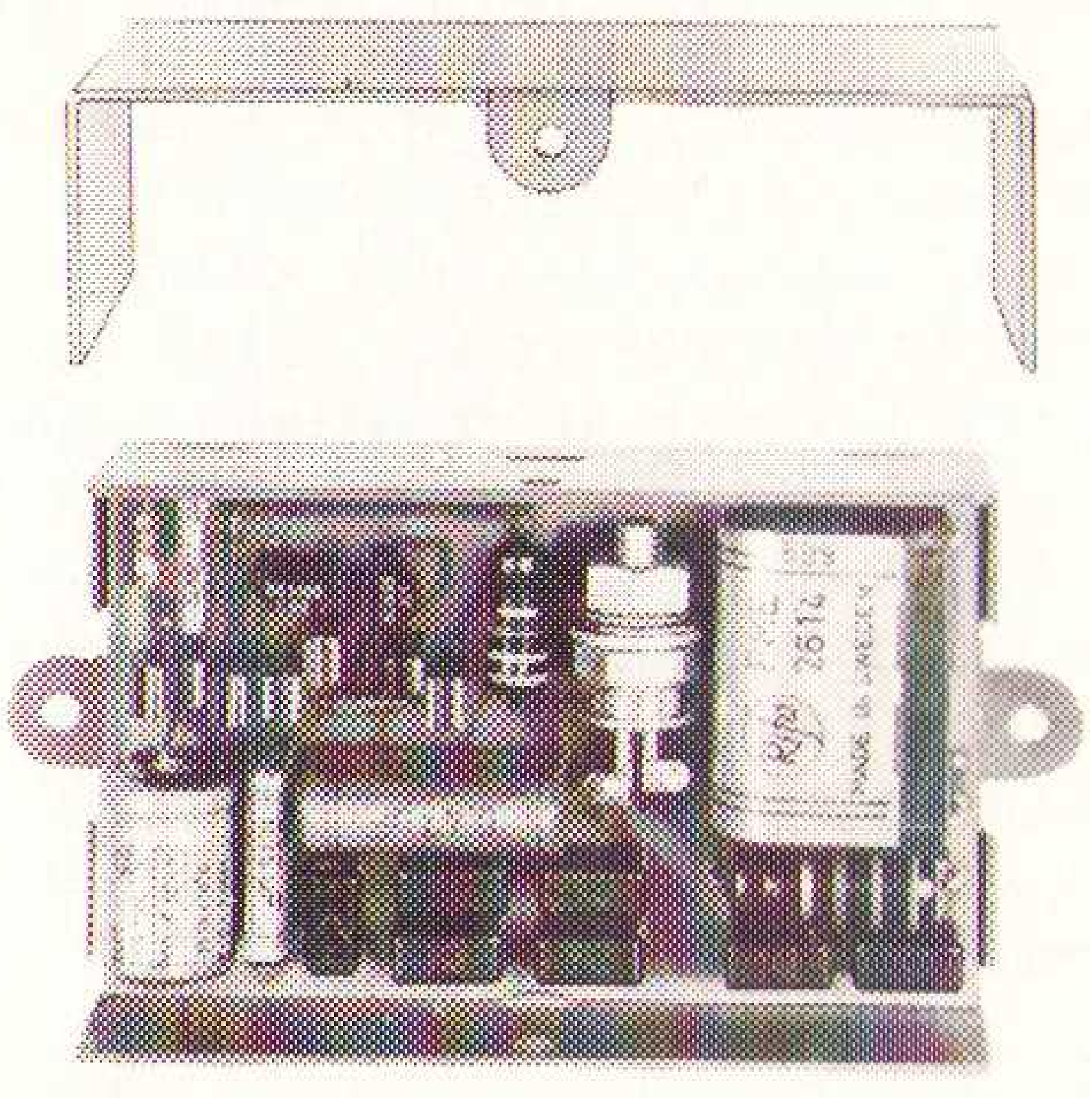


foto gemonteerde ontsteking

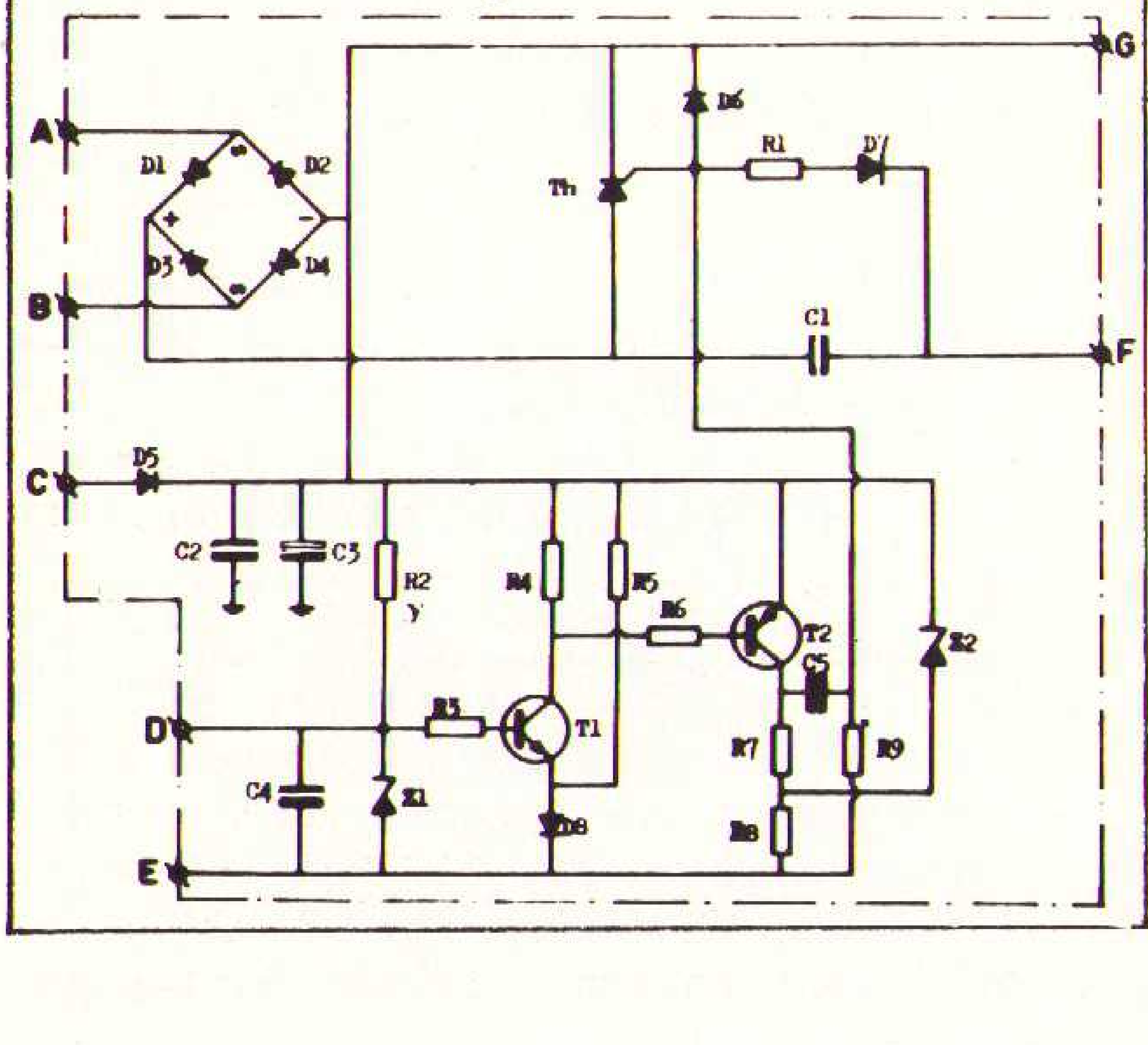


Onderdelenlijst:

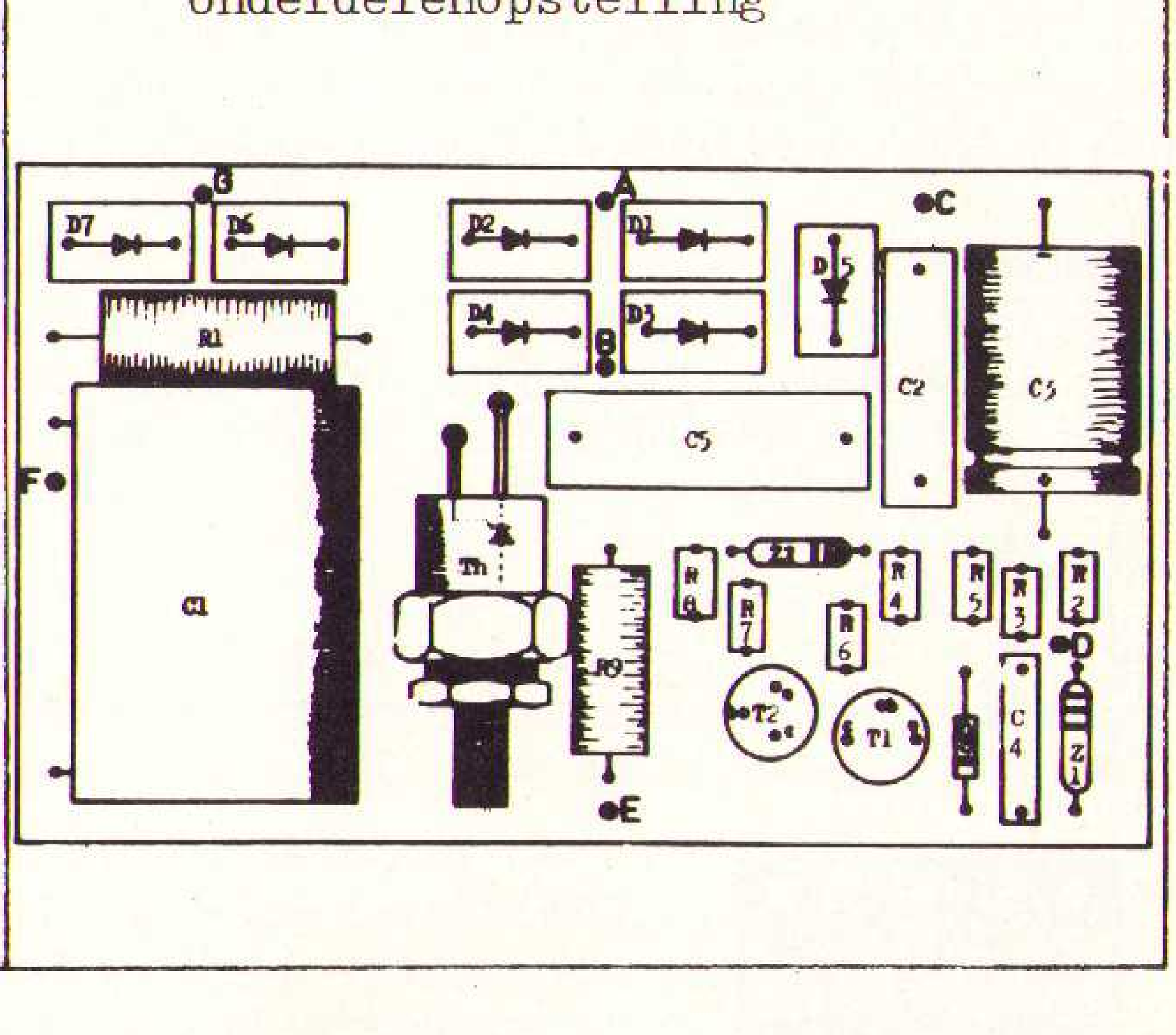
D1, D2, D3, D4, D7	ESK 1/12
D5, D6	ESK 1/02 of 1/06
C1	1µF 400 volt Rifa miniprint metaal-papier.
C2	0,15µF 200 volt, miniprint metaal-papier.
C3	100µF 40 volt Rifa type PEG118C.
C4	1,5nF miniprint of styroflex.
C5	0,47µF 200 volt, miniprint metaal-papier.
R1	3,3kΩ 1 watt 5%.
R2, R5	10kΩ ¼ watt 5%, UBT printuitvoering.
R3, R7	1 kΩ ¼ watt 5%, UBT printuitvoering.
R4	4,7kΩ ¼ watt 5%, UBT printuitvoering.
R6	5,6kΩ ¼ watt 5%, UBT printuitvoering.
R8	470 Ω ¼ watt 5%, UBT printuitvoering.
R9	470 Ω ½ watt 5%.
Th	Thyristor MCR2305/6 of 2N4172.
D8	1N4148 of 1N914.
T1	BC107b, BC147b, BC171b.
T2	BC251b, BC159b, BC154, 2N3964.
Z1	Zenerdiode FZ4,7 of ZG4,7.
Z2	Zenerdiode FZ7,5 of ZG7,5.

Verder wordt bij het bouwpakket een kastje, print en vulstukjes voor de transistoren geleverd. De bobine en de gloeistroomtrafo zijn niet in het pakket inbegrepen.

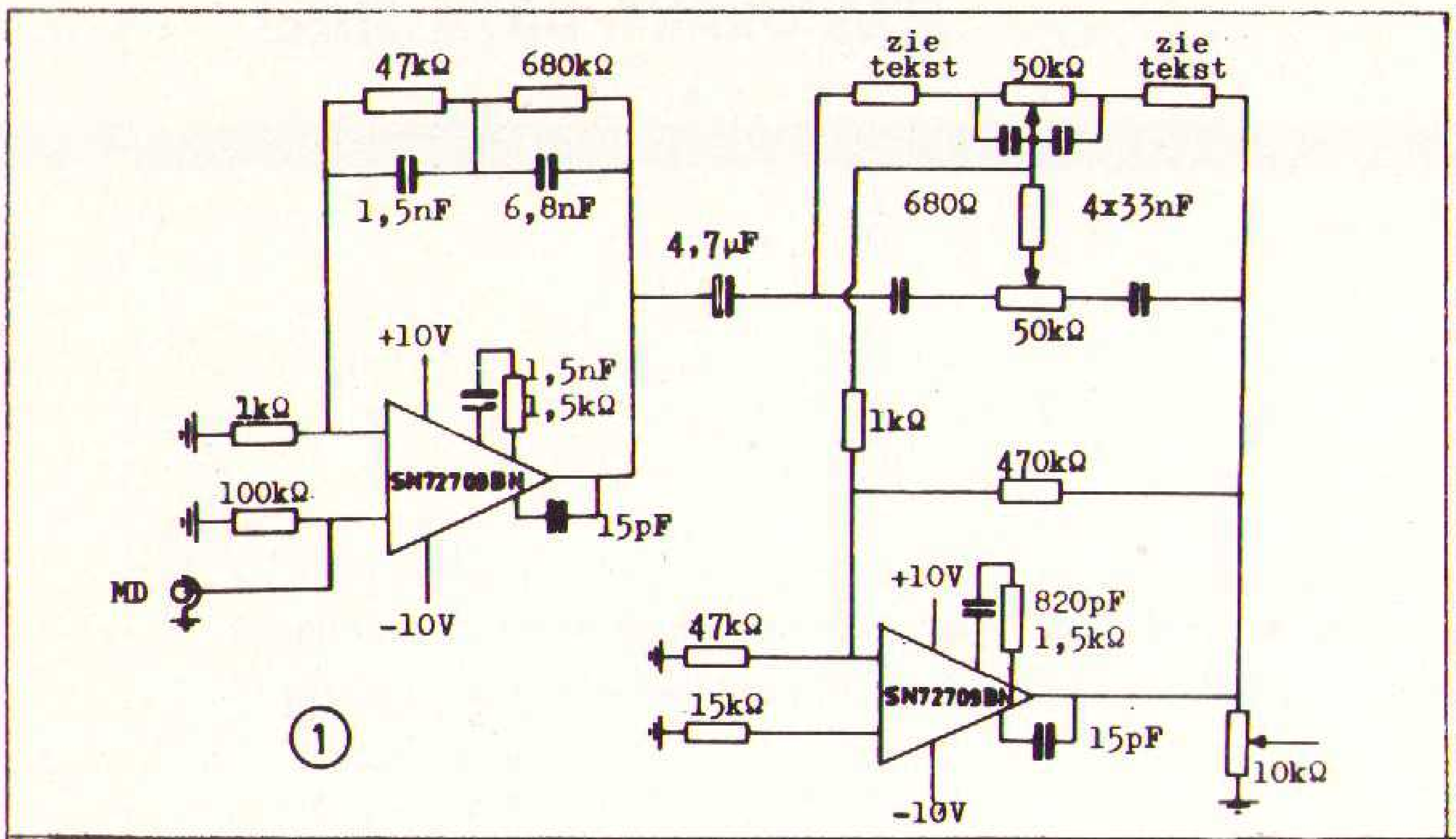
schema ontsteking

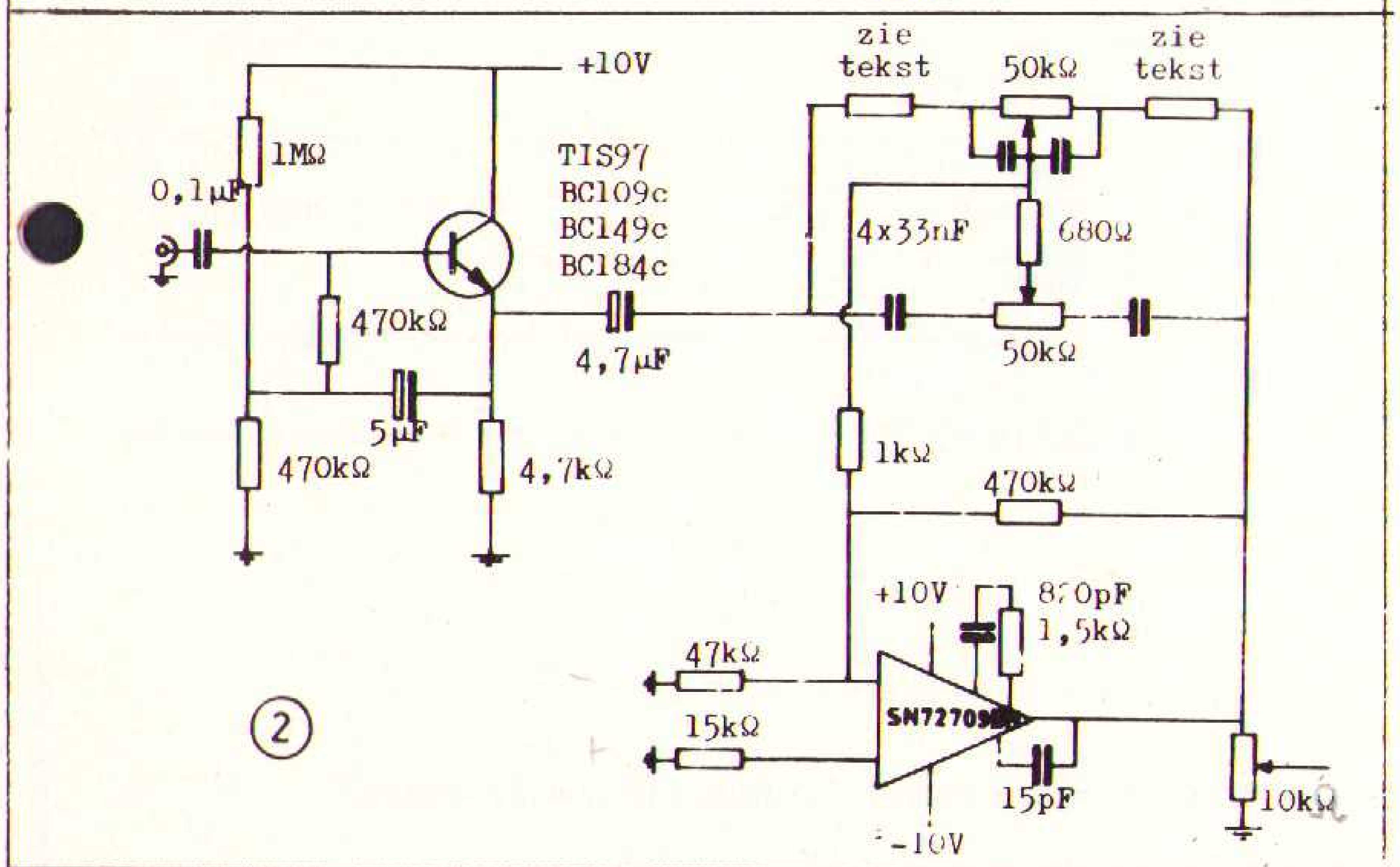


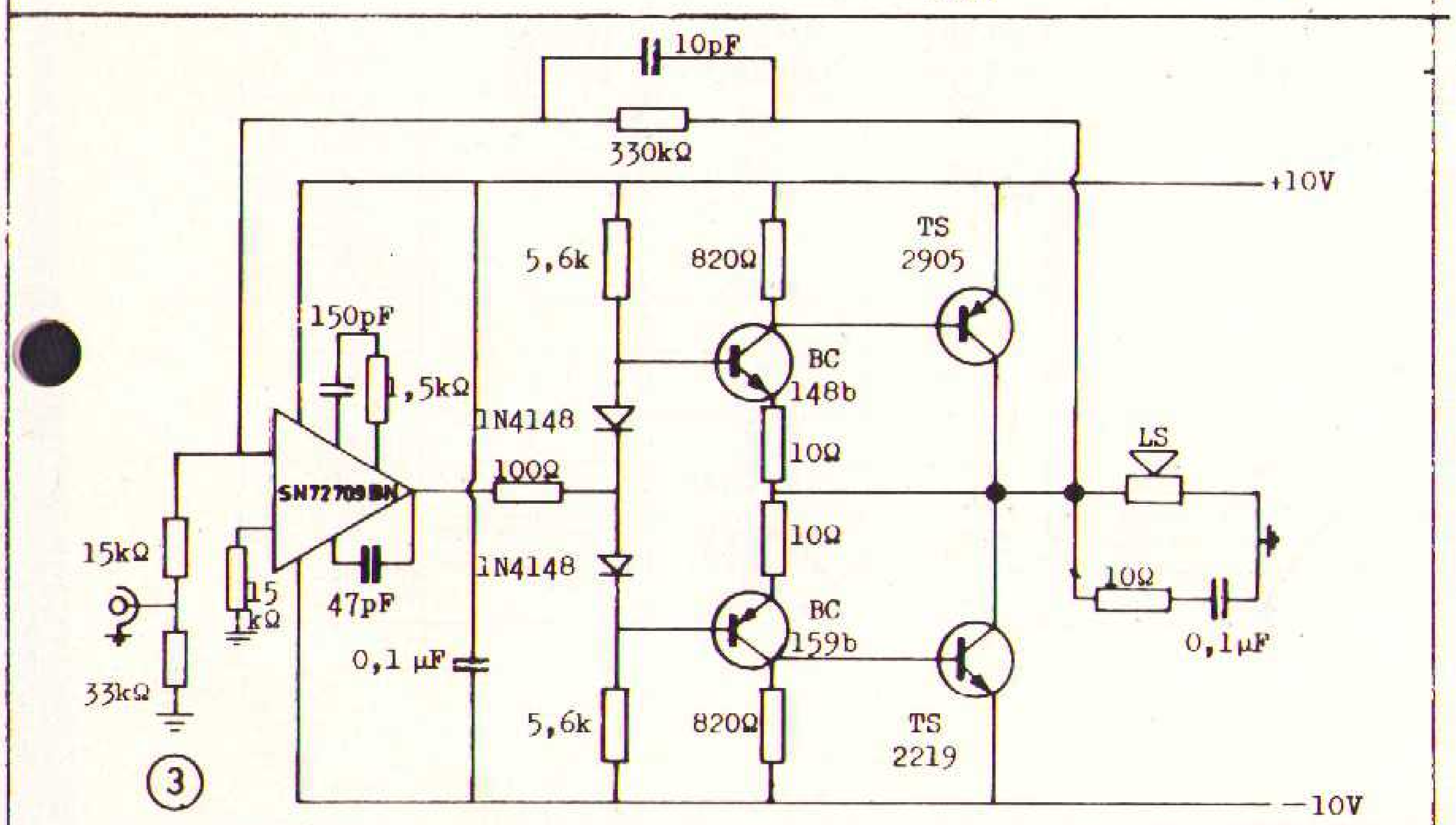
onderdelenopstelling

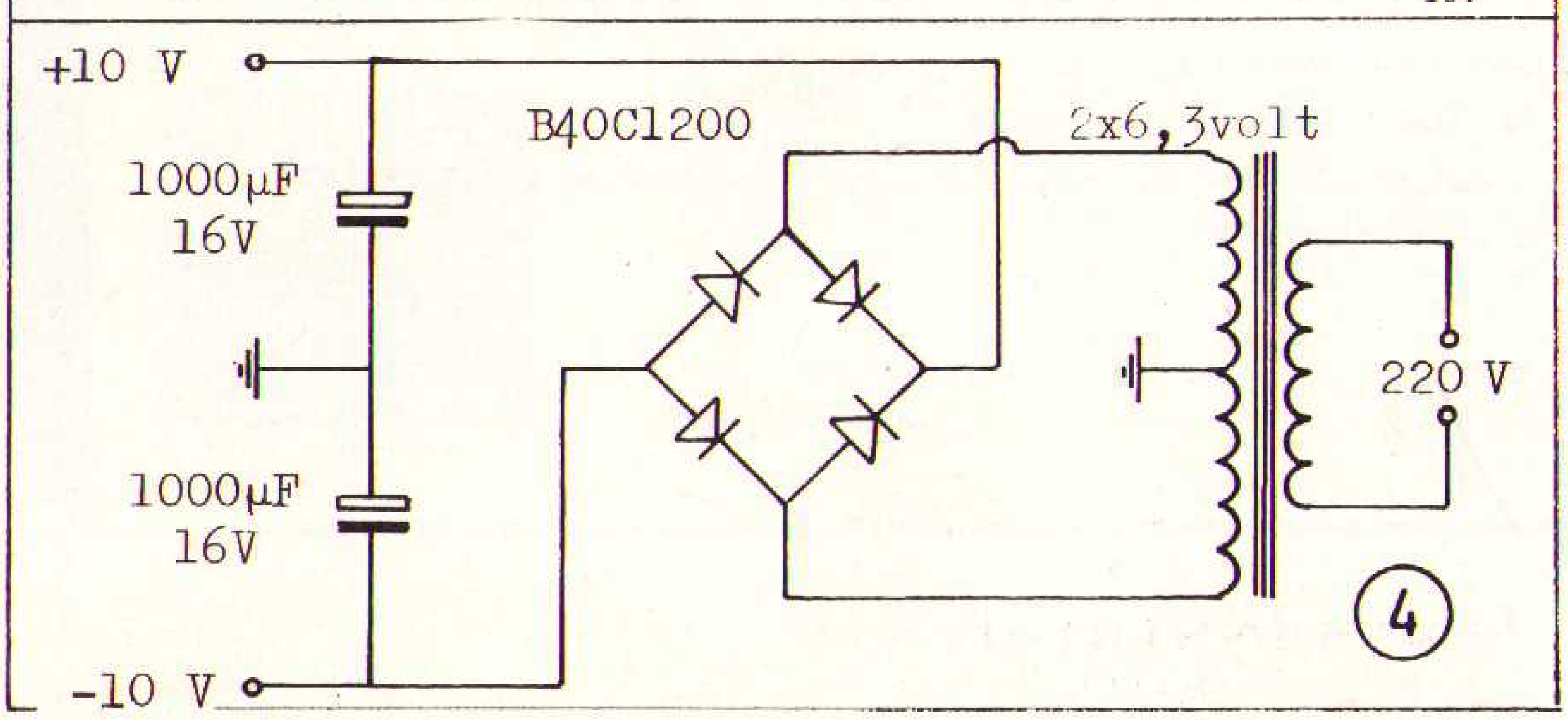


SCIENCE FICTION AMPLIFIER









De op deze pagina opgenomen tekeningen hebben betrekking op een serie ontwerpen van Van Dam Elektronica-Rotterdam. Deze reeks gaat bestaan uit versterkerbouwstenen van verscheidene vermogens. Door het grote toepassingsgebied van de operationele versterker type SN 72709 BN, waarvan de gegevens en aansluitingen zijn opgenomen in Technische documentatie deel 3, zult U deze in de komende schakelingen op dit gebied ook aantreffen. Deze nieuwste technische ontwikkelingen maken het mogelijk met een minimum aan componenten een versterker samen te stellen, welke zéér weinig koppelcondensatoren of -elco's bevat.

figuur 1.
Toonregelversterker voor MD-element.

Correctie: volgens R.I.A.A.
Toonregeling:
laag +18db tot -18dB bij toepassing van 5,6kΩ weerstanden.
laag +12dB tot -12dB bij toepassing van 6,8kΩ weerstanden.
hoog +18dB tot -18dB.

figuur 2.
Toonregelversterker voor kristalelement of radio.
Toonregeling: als figuur 1.

figuur 3.
3 watt eindversterker.
luidspreker 5-8Ω.
vermogen gemeten bij 5Ω.

figuur 4.
Voeding voor bovenstaande units.

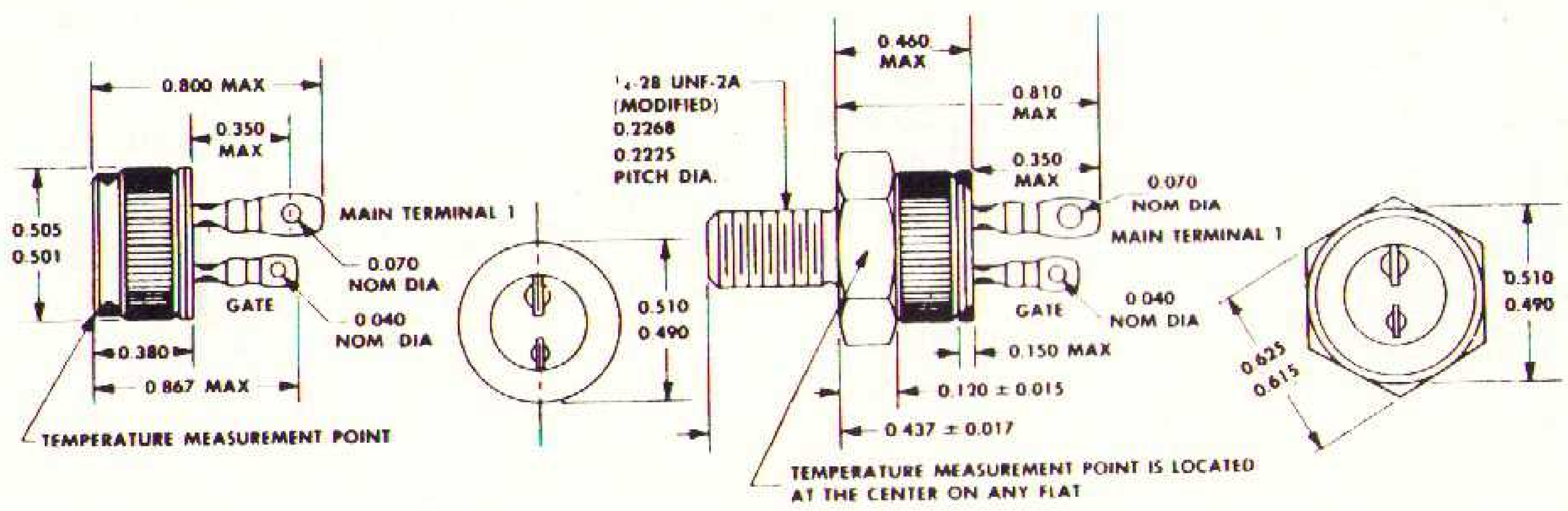
Door toepassing van operationele versterkers is een positieve en negatieve spanning noodzakelijk. Deze kan worden onttrokken uit een trafo 220V/2x6,3V. Met een bruggelijkrichter wordt de pos. en neg. spanning samengesteld en afgevlakt met twee elco's van 1000µF 16 V (Rifa Peg 118F).

WT20, WT22 TRIAC TEMPORARY DATA SHEET

WT22D = W1520A

description

The WT20 and WT22 series of devices are bidirectional triode thyristors (triacs). These devices are designed to trigger from a blocking state to a conducting state by either polarity of gate signal for either polarity of applied voltage.



WT20 WT22

absolute maximum ratings over operating case temperature range (unless otherwise noted)

	WT20B WT22B	WT20D WT22D	WT20E WT22E	UNIT
Continuous Off-State Voltage, V_D (See Note 1)	200	400	500	V
Repetitive Peak Off-State Voltage, V_{DRM} (See Note 1)	200	400	500	V
Full Cycle ms On-State Current at (or below) 75°C Case Temperature $I_{(rms)}$, (See Note 2)		6		A
Peak On-State Surge Current IT_{sm} (See Note 3)		50		A
Peak Gate Power Dissipation P_{GM} (Pulse Width $\leq$ 200 μs)		5		W
Average Gate Power Dissipation $P_{G(av)}$ (See Note 4)		0.5		W
Operating Case Temperature Range		–40 to 100		°C
Storage Temperature Range		–40 to 125		°C
Terminal Temperature 1/16 Inch from Case for 10 Seconds		230		°C

NOTES: 1. These values apply bidirectionally when the resistance between the gate and Main Terminal 1, $R_G \leq \infty$.

2. This value applies for 60-Hz full-sine-wave operation with resistive load. Above 75°C derate according to figure 1.

3. This value applies for one 60-Hz full sine wave when the device is operating at (or below) the rated value of on-state current. Surge may be repeated after the device has returned to original thermal equilibrium. During the surge, gate control may be lost.

4. This value applies for a maximum averaging time of 16.6 ms.

electrical characteristics

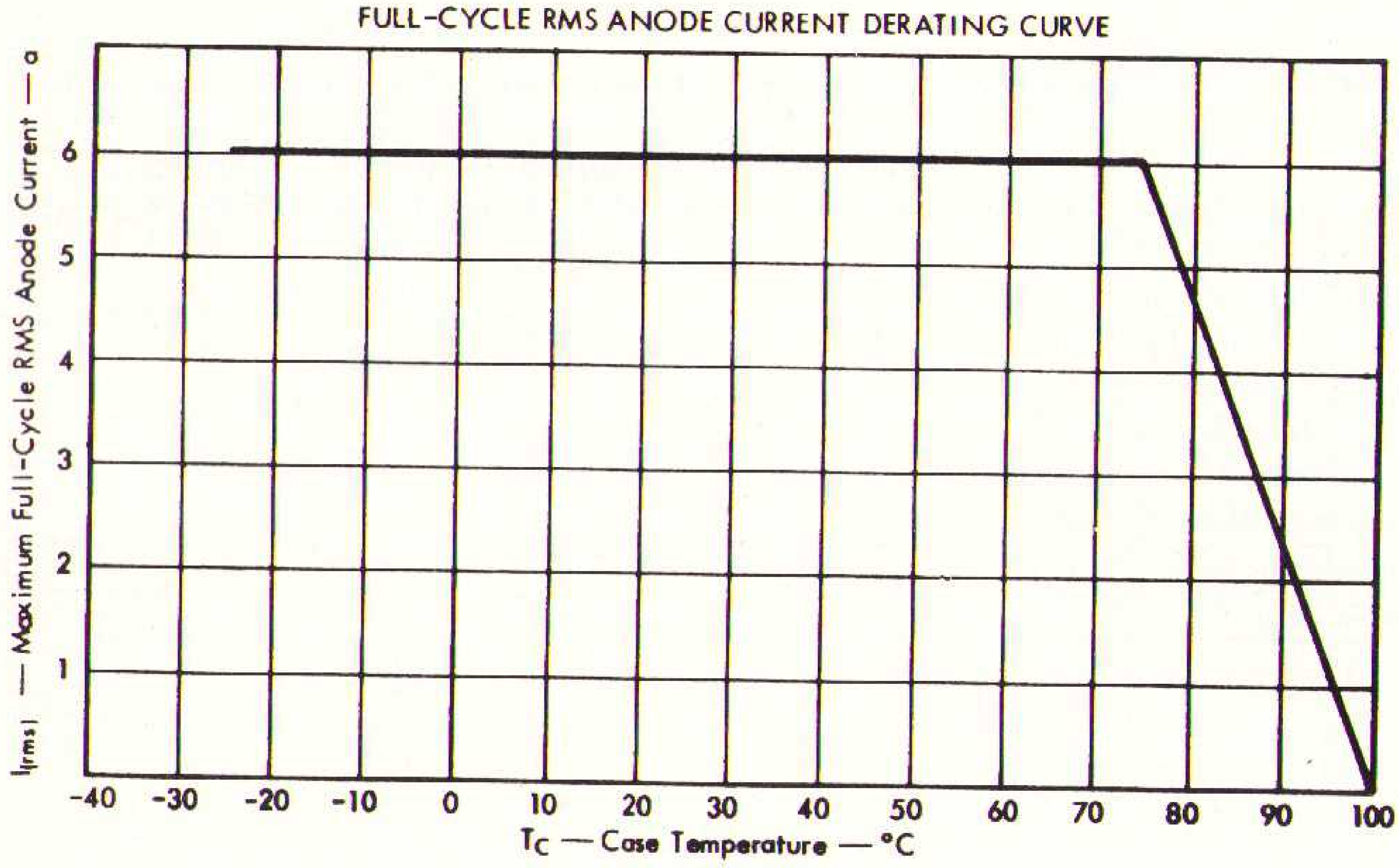
	PARAMETER	TEST CONDITIONS	TYPE	TYP	MAX	UNIT
I_{DRM}	Repetitive Peak Off-State Current	$V_{DRM} = \pm 200$ V, $I_G = 0$, $T_C = 100°C$	WT20B, WT22B		±1	mA
		$V_{DRM} = \pm 400$ V, $I_G = 0$, $T_C = 100°C$	WT20D, WT22D			
		$V_{DRM} = \pm 500$ V, $I_G = 0$, $T_C = 100°C$	WT20E, WT22E			
I_{GTM}	Peak Gate Trigger Current	$V_{supply} = +12$ V†, $R_L = 12\,\Omega$ $t_{p(g)} \geq 20\,\mu s$ $T_C = 25°C$	ALL		+50	mA
		$V_{supply} = +12$ V†, $R_L = 12\,\Omega$ $t_{p(g)} \geq 20\,\mu s$ $T_C = 25°C$			−50	
		$V_{supply} = -12$ V†, $R_L = 12\,\Omega$ $t_{p(g)} \geq 20\,\mu s$ $T_C = 25°C$			−50	
		$V_{supply} = -12$ V†, $R_L = 12\,\Omega$ $t_{p(g)} \geq 20\,\mu s$ $T_C = 25°C$		+100		
V_{GTM}	Peak Gate Trigger Voltage	$V_{supply} = +12$ V†, $R_L = 12\,\Omega$ $t_{p(g)} \geq 20\,\mu s$ $T_C = 25°C$	ALL		+3	V
		$V_{supply} = +12$ V†, $R_L = 12\,\Omega$ $t_{p(g)} \geq 20\,\mu s$ $T_C = 25°C$			−3	
		$V_{supply} = -12$ V†, $R_L = 12\,\Omega$ $t_{p(g)} \geq 20\,\mu s$ $T_C = 25°C$			−3	
		$V_{supply} = -12$ V†, $R_L = 12\,\Omega$ $t_{p(g)} \geq 20\,\mu s$ $T_C = 25°C$		+3		
dV/dt	Critical Rate of Rise of Off-State Voltage	$V_{DRM} = \pm 200$ V, $I_G = 0$, $T_C = 100°C$	WT20B, WT22B	100		V/μs
		$V_{DRM} = \pm 400$ V, $I_G = 0$, $T_C = 100°C$	WT20D, WT22D	100		
		$V_{DRM} = \pm 500$ V, $I_G = 0$, $T_C = 100°C$	WT20E, WT22E	100		
V_{TM}	Peak On-State Voltage	$I_{TM} = \pm 8.5$ A, See Note 5 $T_C = 25°C$	ALL		±1.83	V

†The supply voltage is called positive when it causes Main Terminal 2 to be positive with respect to Main Terminal 1.

NOTES: 5. The initial instantaneous value is measured using the pulse techniques. $t_p \leq 300\,\mu s$ duty cycle $\leq 1\%$.

THERMAL INFORMATION

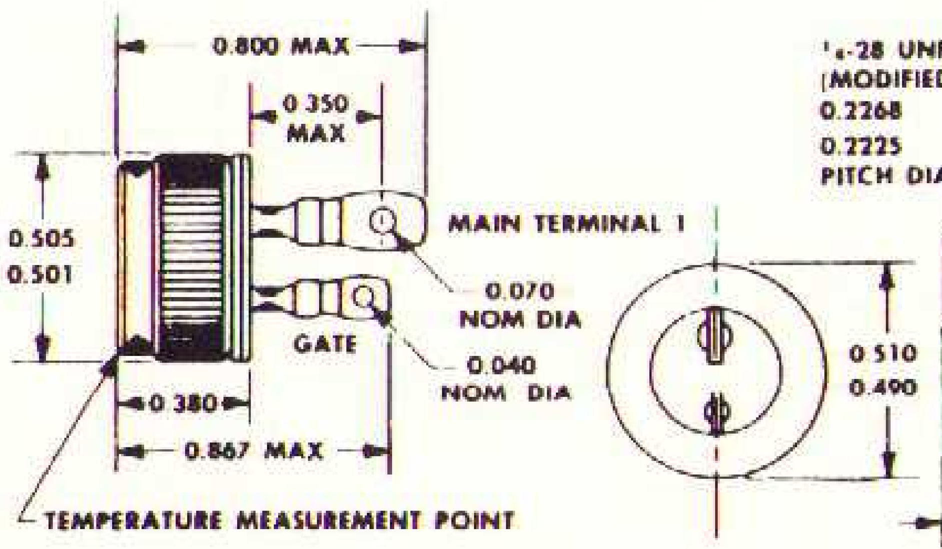
FULL-CYCLE RMS ANODE CURRENT DERATING CURVE



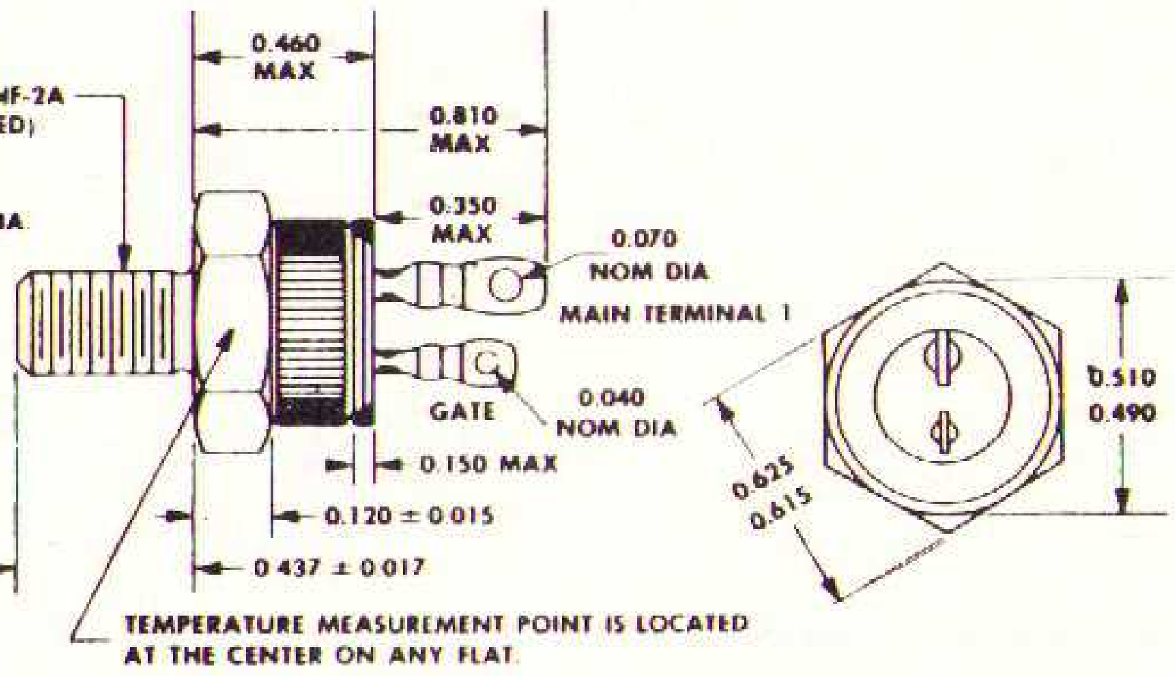
WT32D = W1540A

description

The WT30 and WT32 series of devices are bidirectional triode thyristors (triacs). These devices are designed to trigger from a blocking state to a conducting state by either polarity of gate signal for either polarity of applied voltage.



WT30



WT32

absolute maximum ratings over operating case temperature range (unless otherwise noted)

	WT30B WT32B	WT30D WT32D	WT30E WT32E	UNIT
Continuous Off-State Voltage, V_D (See Note 1)	200	400	500	V
Repetitive Peak Off-State Voltage, V_{DRM} (See Note 1)	200	400	500	V
Full Cycle ms On-State Current at (or below) 75°C Case Temperature $I_{(rms)}$, (See Note 2)		10		A
Peak On-State Surge Current IT_{sm} (See Note 3)		80		A
Peak Gate Power Dissipation P_{GM} (Pulse Width $\leq 200\ \mu s$)		5		W
Average Gate Power Dissipation $P_{G(av)}$ (See Note 4)		0.5		W
Operating Case Temperature Range		–40 to 100		°C
Storage Temperature Range		–40 to 125		°C
Terminal Temperature 1/16 Inch from Case for 10 Seconds		230		°C

NOTES: 1. These values apply bidirectionally when the resistance between the gate and Main Terminal 1, $R_G \leq \infty$.

2. This value applies for 60-Hz full-sine-wave operation with resistive load. Above 75°C derate according to figure 1.

3. This value applies for one 60-Hz full sine wave when the device is operating at (or below) the rated value of on-state current. Surge may be repeated after the device has returned to original thermal equilibriûm. During the surge, gate control may be lost.

4. This value applies for a maximum averaging time of 16.6 ms.

PRELIMINARY DATA SHEET:
Supplementary data will be published at a later date.

TEXAS INSTRUMENTS
LIMITED
MANTON LANE BEDFORD ENGLAND
TELEPHONE BEDFORD 67466 · CABLES TEXINLIM BEDFORD · TELEX 82178

electrical characteristics

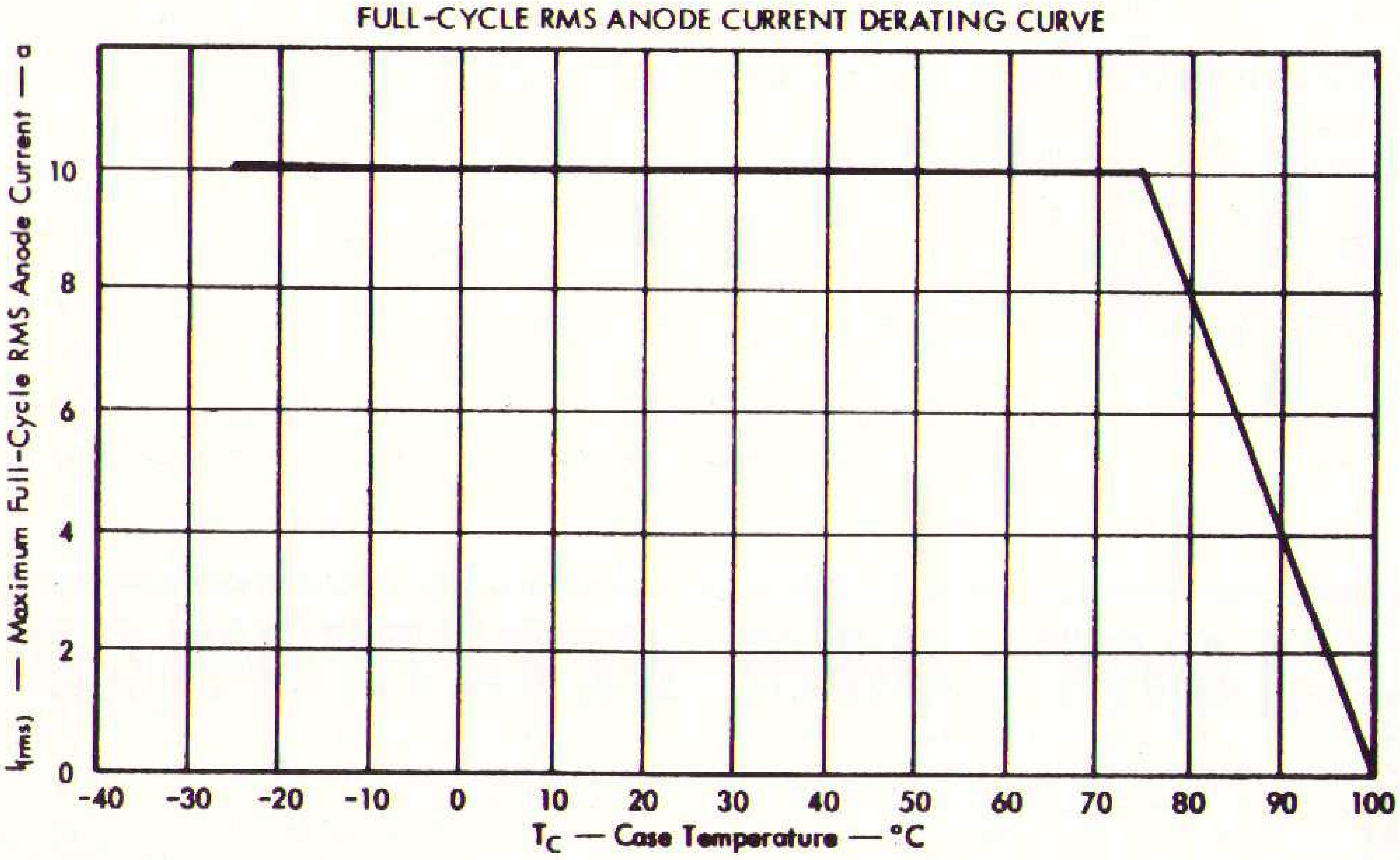
PARAMETER		TEST CONDITIONS	TYPE	TYP	MAX	UNIT
I_{DRM}	Repetitive Peak Off-State Current	$V_{DRM} = \pm 200$ V, $I_G = 0$, $T_C = 100°C$	WT30B, WT32B		±1	mA
		$V_{DRM} = \pm 400$ V, $I_G = 0$, $T_C = 100°C$	WT30D, WT32D			
		$V_{DRM} = \pm 500$ V, $I_G = 0$, $T_C = 100°C$	WT30E, WT32E			
I_{GTM}	Peak Gate Trigger Current	$V_{supply} = +12$ V†, $R_L = 12\,\Omega$ $t_{p(g)} \geq 20\,\mu s$ $T_C = 25°C$	ALL		+50	mA
		$V_{supply} = +12$ V†, $R_L = 12\,\Omega$ $t_{p(g)} \geq 20\,\mu s$ $T_C = 25°C$			−50	
		$V_{supply} = -12$ V†, $R_L = 12\,\Omega$ $t_{p(g)} \geq 20\,\mu s$ $T_C = 25°C$			−50	
		$V_{supply} = -12$ V†, $R_L = 12\,\Omega$ $t_{p(g)} \geq 20\,\mu s$ $T_C = 25°C$		+100		
V_{GTM}	Peak Gate Trigger Voltage	$V_{supply} = +12$ V†, $R_L = 12\,\Omega$ $t_{p(g)} \geq 20\,\mu s$ $T_C = 25°C$	ALL		+3	V
		$V_{supply} = +12$ V†, $R_L = 12\,\Omega$ $t_{p(g)} \geq 20\,\mu s$ $T_C = 25°C$			−3	
		$V_{supply} = -12$ V†, $R_L = 12\,\Omega$ $t_{p(g)} \geq 20\,\mu s$ $T_C = 25°C$			−3	
		$V_{supply} = -12$ V†, $R_L = 12\,\Omega$ $t_{p(g)} \geq 20\,\mu s$ $T_C = 25°C$		+3		
dV/dt	Critical Rate of Rise of Off-State Voltage	$V_{DRM} = \pm 200$ V, $I_G = 0$, $T_C = 100°C$	WT30B, WT32B	100		V/µs
		$V_{DRM} = \pm 400$ V, $I_G = 0$, $T_C = 100°C$	WT30D, WT32D	100		
		$V_{DRM} = \pm 500$ V, $I_G = 0$, $T_C = 100°C$	WT30E, WT32E	100		
V_{TM}	Peak On-State Voltage	$I_{TM} = \pm 14$ A, See Note 5 $T_C = 25°C$	ALL		±1.65	V

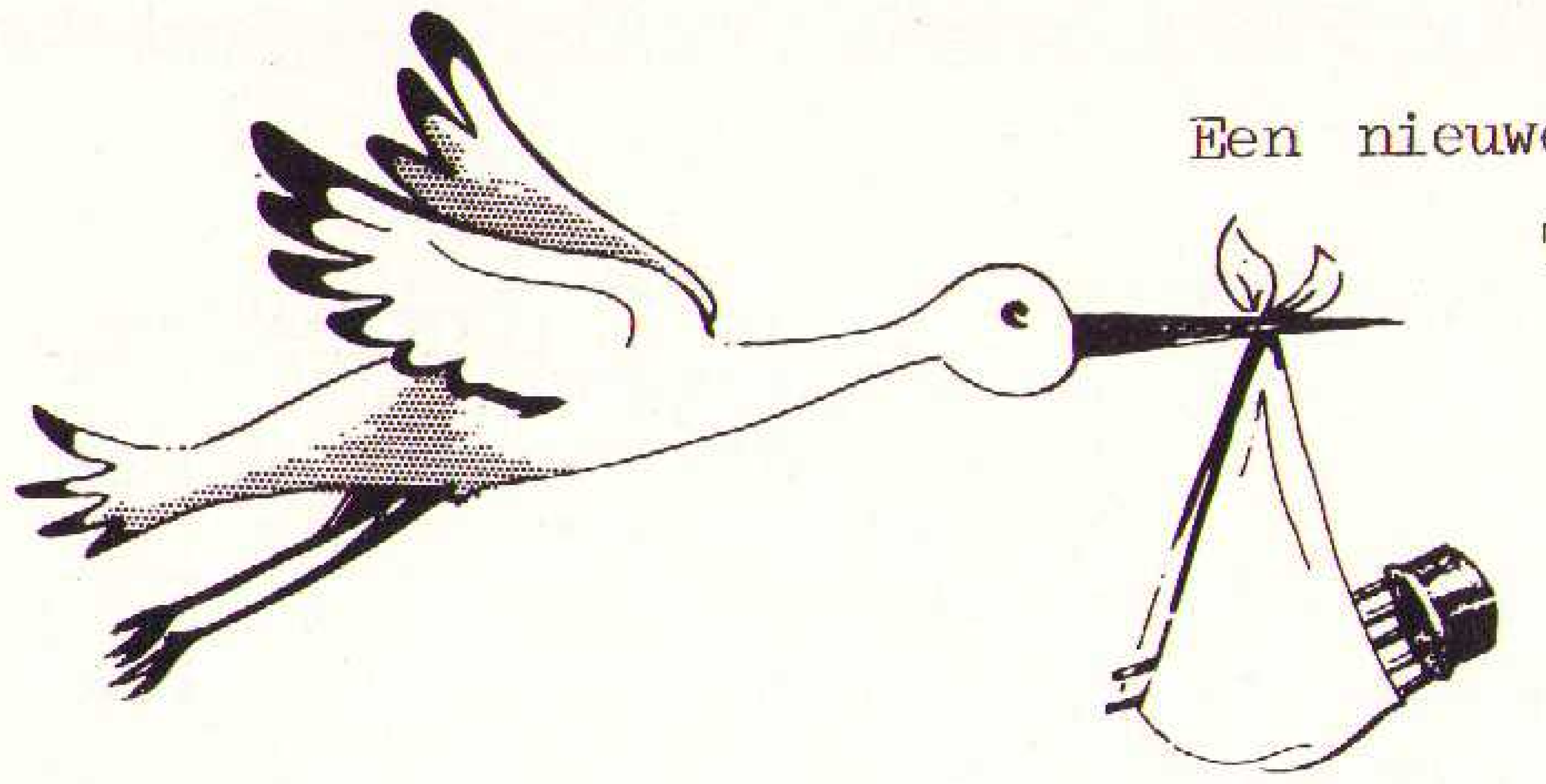
†The supply voltage is called positive when it causes Main Terminal 2 to be positive with respect to Main Terminal 1.

NOTES: 5. The initial instantaneous value is measured using the pulse techniques. $t_p \leq 300\,\mu s$ duty cycle $\leq 1\%$.

THERMAL INFORMATION

FULL-CYCLE RMS ANODE CURRENT DERATING CURVE





Een nieuwe spanningsregelaar van Motorola

TYPE MC 1460 G

Er doen zich vaak gevallen voor, waar de nauwkeurigheid en algemene kwaliteit van de voeding van groot belang zijn voor de goede werking van de gevoede schakeling.

Verscheidene vooraanstaande halfgeleiderfabrikanten zijn voor de oplossing van dergelijke problemen, begonnen met de ontwikkeling en produktie van volledige geïntegreerde spanningsregelaars; Motorola heeft voor dit doel onlangs de MC1460/61 en MC1560/61 uitgebracht.

Deze nieuwe geïntegreerde schakelingen zijn op pagina 13 t/m 22 met uitgebreide technische gegevens en toepassingsschakelingen nader toegelicht. Enkele van de meest belangrijke eigenschappen van het type MC1460G (welke inmiddels aan ons leveringsprogramma is toegevoegd) zijn:

Ingangsspanning tussen 9 volt dc en 20 volt dc.

Uitgangsspanning tussen 2,5 volt en 17 volt.

Rimpelspanning gemiddeld 150µvolt.

Verloop uitgangsspanning: circa 0,002% per °C.

Uitgangsstroom: 1-200mA.

Stabiliteit t.o.v. spanningsverandering ingang: max. 0,03%/Vin.

Uitgangsweerstand gemiddeld 25mΩ.

Kortsluitstroom bij kortsluitweerstand van 2,7Ω: 80-300µA.

Ook de prijs is aantrekkelijk: de MC 1460G kost *f* 27,20 incl. BTW.

MOTOROLA Semiconductors
BOX 20912 • PHOENIX, ARIZONA 85036

MC1560, MC1561
MC1460, MC1461

MONOLITHIC VOLTAGE REGULATOR

. . . designed to deliver continuous load current up to 500 mA without use of an external power transistor.

- Electronic "Shut-Down" Control and Short-Circuit Protection
- Excellent Load Regulation (Low Output Impedance = 20 milliohms typ from dc to 100 kHz)
- High Power Capability: To 17.5 Watts
- Excellent Transient Response and Temperature Stability
- High Ripple Rejection = 0.002 %/V typ
- Single External Transistor Can Boost Load Current to Greater than 10 Amperes
- Input Voltages to 40 Volts (MC1561)

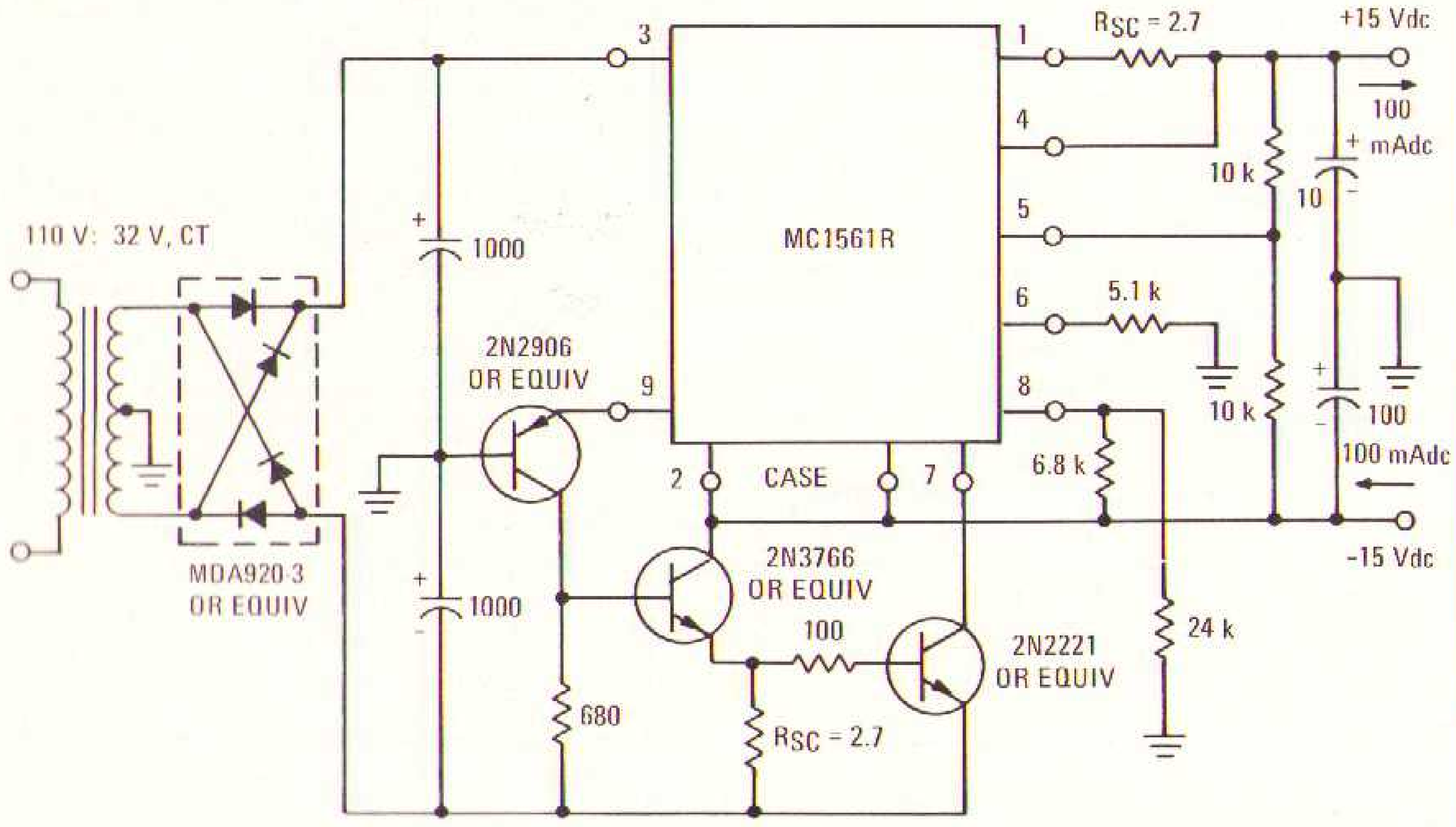
POSITIVE-POWER-SUPPLY VOLTAGE REGULATOR INTEGRATED CIRCUIT

EPITAXIAL PASSIVATED

APRIL 1969 – DS 9104 R1

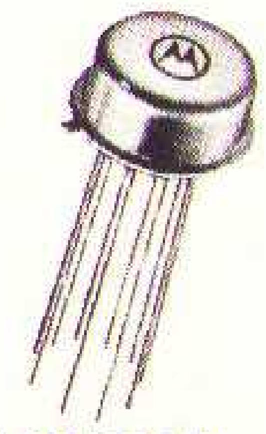
TYPICAL APPLICATION

A ±15 Vdc COMPLEMENTARY TRACKING POWER SUPPLY WITH CURRENT LIMITING

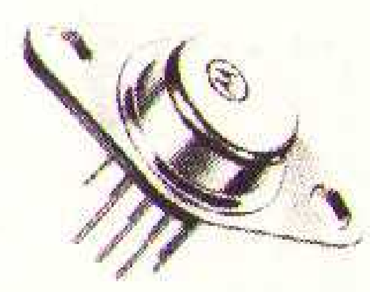


RESISTANCE IS EXPRESSED IN OHMS, CAPACITANCE IN MICROFARADS.

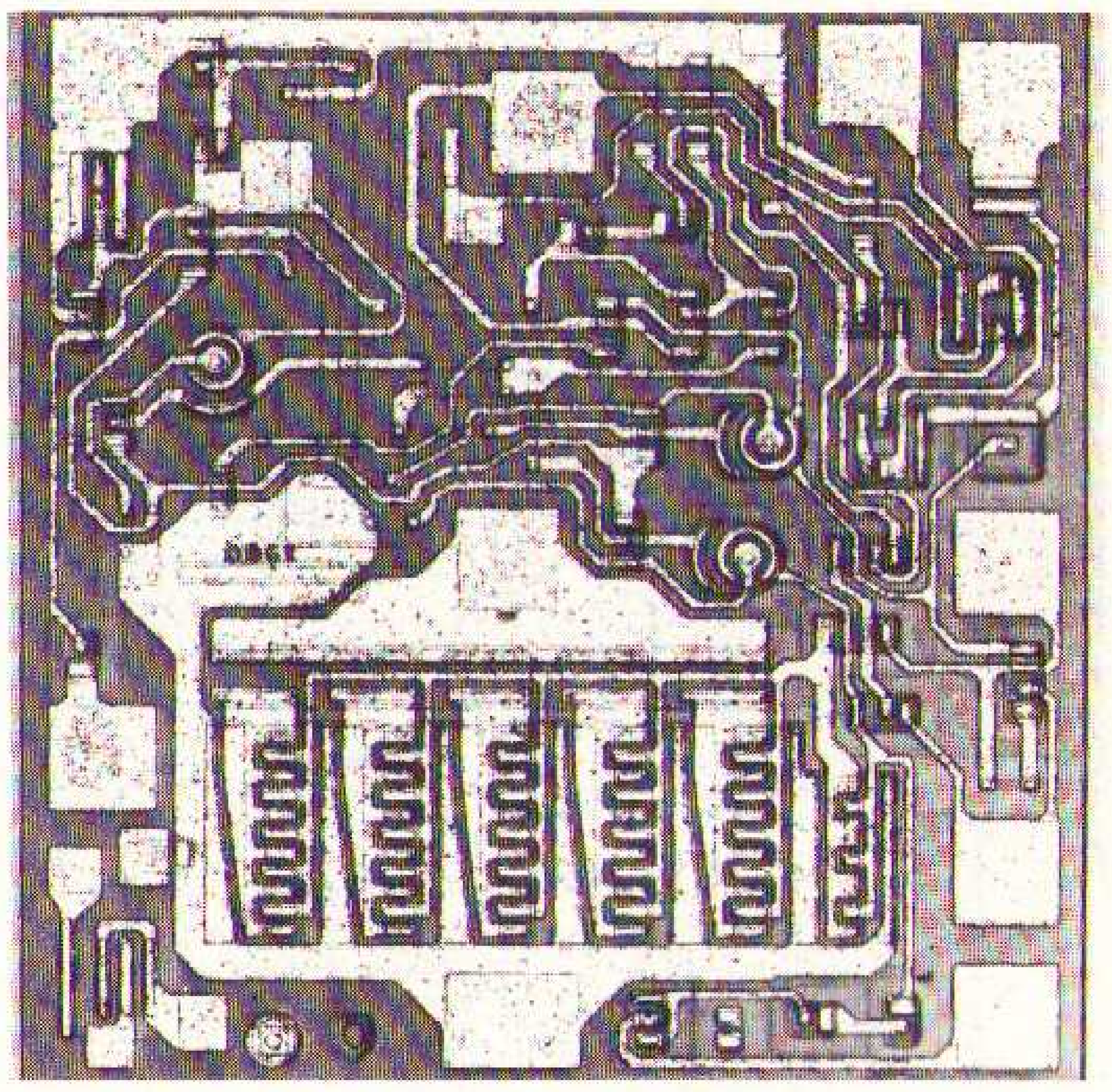
FOR OTHER TYPICAL APPLICATIONS, SEE FIGURES 16 THRU 29



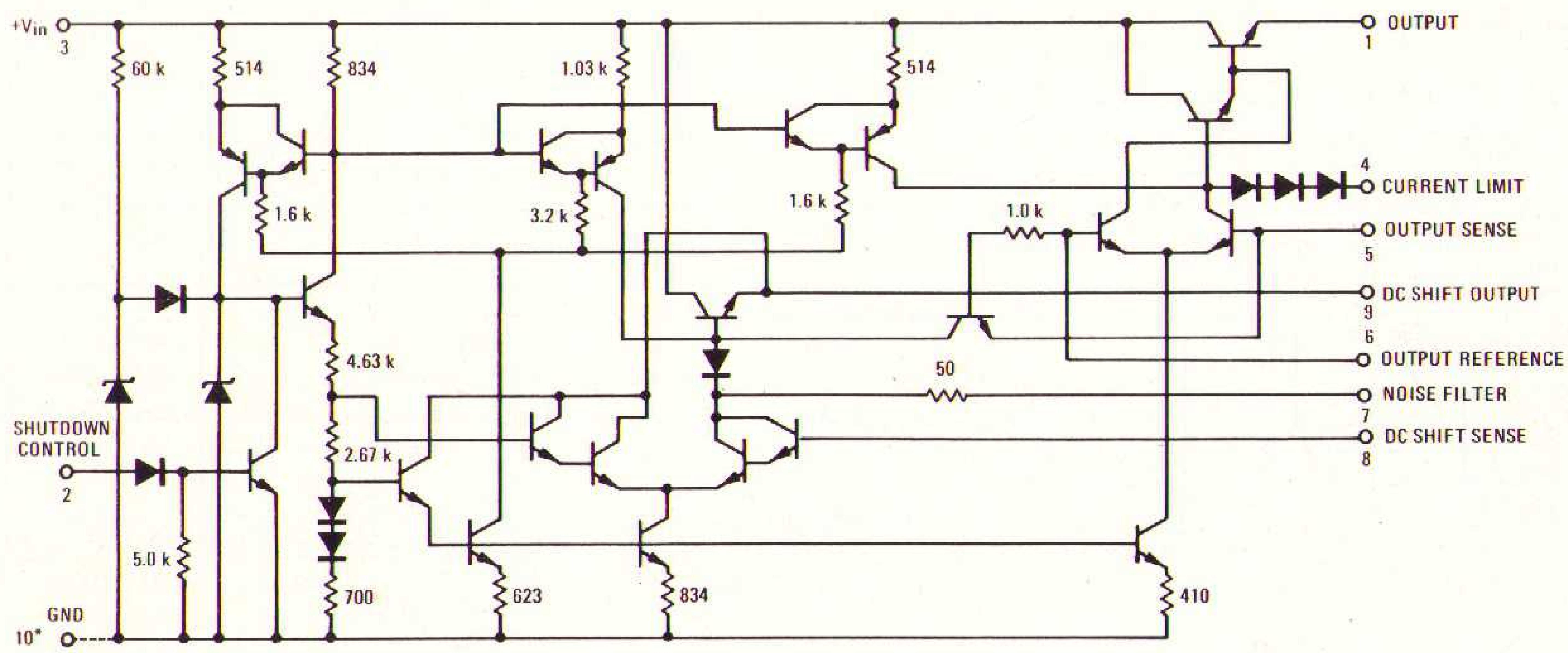
CASE 71A
G Suffix



CASE 614
R Suffix



CIRCUIT SCHEMATIC



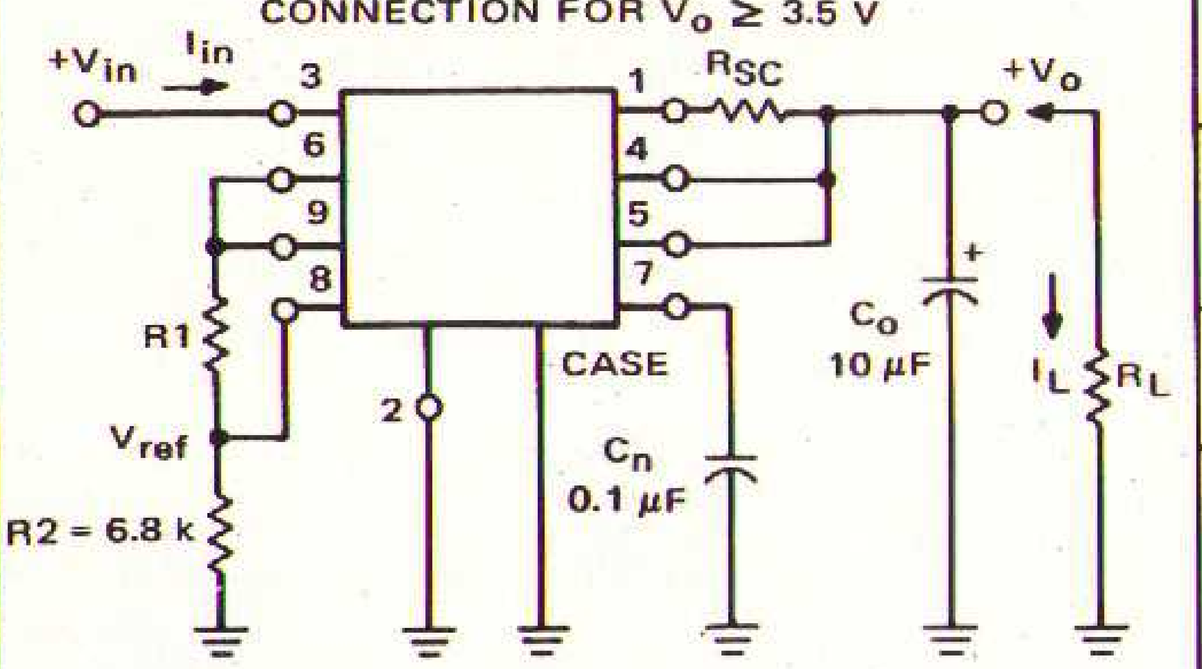
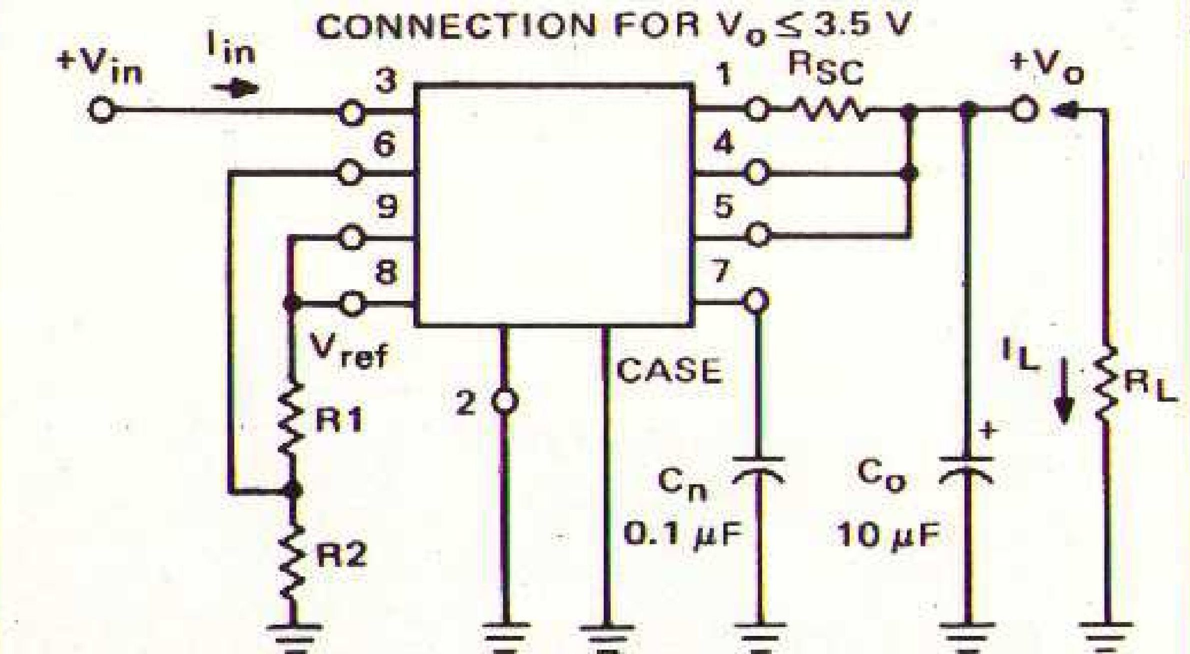
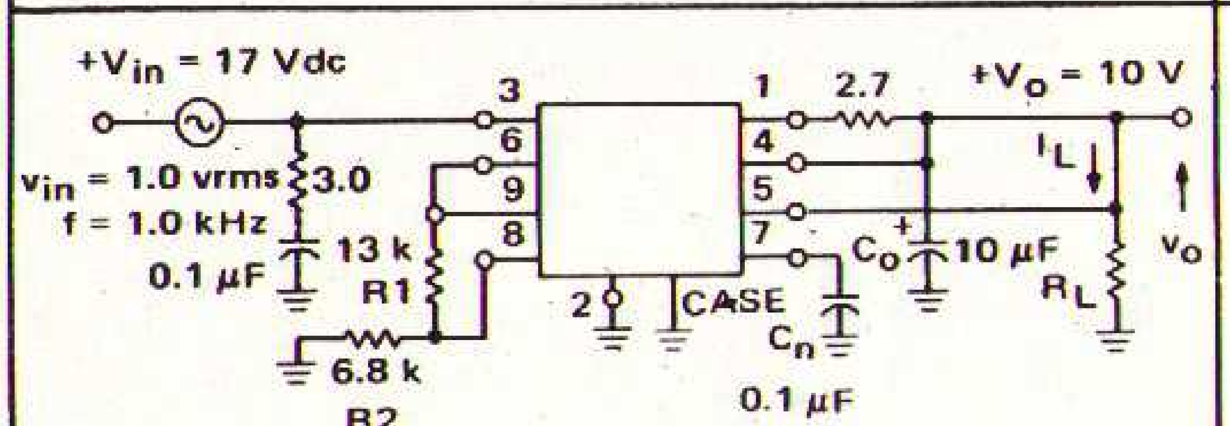
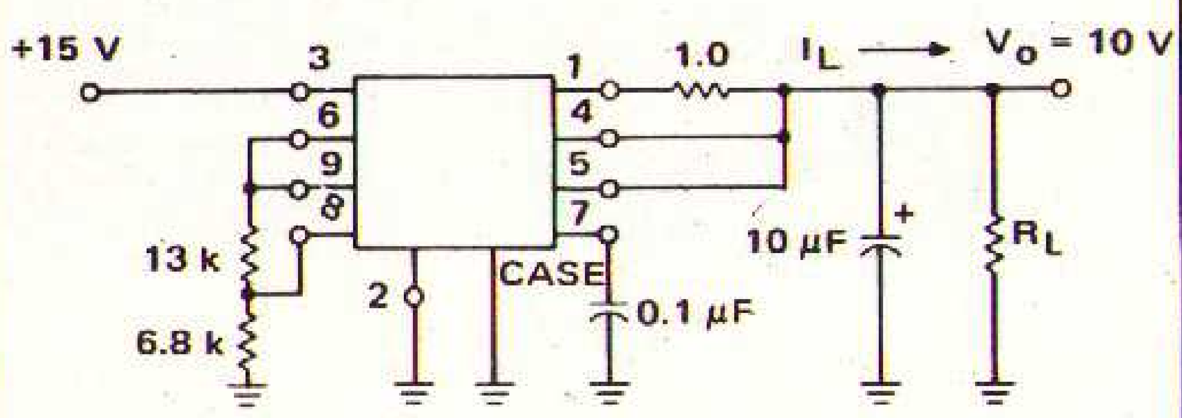
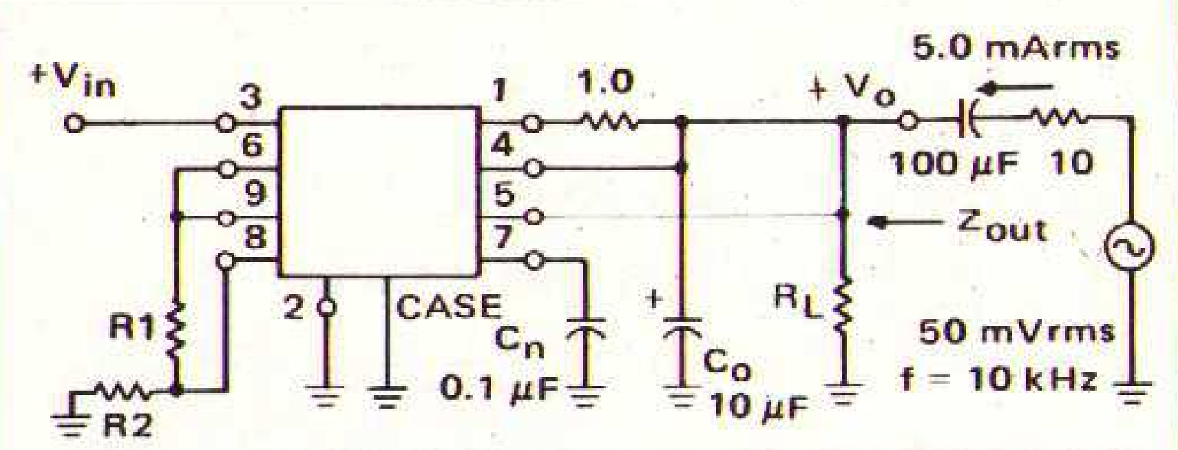
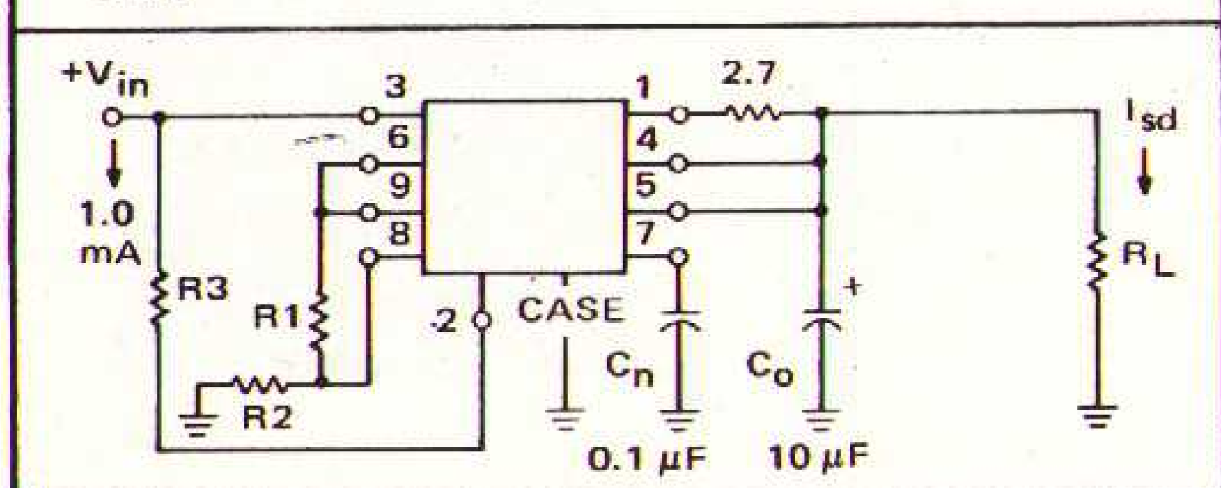
*Pin 10 is case and ground on "G" package, only case is ground on "R" package.

INTEGRATED VOLTAGE REGULATOR

MC1560 • MC1561 MC1460 • MC1461

ELECTRICAL CHARACTERISTICS

(T_C = 25°C unless otherwise noted) Load Current = 100 mA for "R" Package and = 10 mA for "G" Package, unless otherwise noted.

Characteristic Definitions (linear operation)	Characteristic	Symbol	Min	Typ	Max	Units
(R_{SC} = 2.7 ohms unless otherwise noted) CONNECTION FOR $V_o \geq 3.5$ V  Select R1 to give desired V_o: R1 ≈ (2 V_o − 7) kΩ	Input Voltage (See Note 1) (0 to +75°C) MC1460 (−55°C to +125°C) MC1560 (0 to +75°C) MC1461 (−55°C to +125°C) MC1561	V_{in}	 9.0 8.5 9.0 8.5	 – – – –	 20 20 35 40	Vdc
	Output Voltage Range MC1460, MC1560 MC1461 MC1561	V_o	2.5 2.5 2.5	– – –	17 32 37	Vdc
	Reference Voltage (Pin 8 to ground)	V_{ref}	3.2	3.5	3.8	Vdc
	Minimum Input-Output Voltage Differential (See Note 2) (R_{SC} = 0) MC1460, MC1461 MC1560, MC1561	V_{in}-V_o	 – –	 2.1 2.1	 3.0 2.7	Vdc
CONNECTION FOR $V_o \leq 3.5$ V  Select R2 to give desired V_o: R2 ≈ (2 V_o) kΩ Select R1: R1 ≈ (7.0 kΩ − R2) kΩ	Bias Current (I_L = 1.0 mAdc, R_2 = 6.8 kΩ, $I_B = I_{in} - I_L$) MC1460, MC1461 MC1560, MC1561	I_B	 – –	 5.0 4.0	 12 9.0	mAdc
	Output Noise (C_n = 0.1 µF, f = 10 Hz to 5.0 MHz)	v_n	–	0.150	–	mVrms
	Temperature Coefficient of Output Voltage (See Note 3) (0 to +75°C) MC1460, MC1461 (−55° to +125°C) MC1560, MC1561	TCV_o	 – –	 ±0.002 ±0.002	 – –	%/°C
	Operating Load Current Range ($R_{SC} \leq$ 0.3 ohms) R Package ($R_{SC} \leq$ 2.0 ohms) G Package	I_L	 1.0 1.0	 – –	 500 200	mAdc
	Input Regulation (% change in output voltage per 1-volt change in input voltage) MC1460, MC1461 MC1560, MC1561 $Reg_{in} = \frac{v_{o\,rms}(100)}{V_o} \Big/ v_{in\,rms}$ (See Note 4)	Reg_{in}	– –	0.003 0.002	0.030 0.015	%/V_{in}
	Load Regulation T_J = Constant (1.0 mA ≤ I_L ≤ 20 mA) MC1460 MC1560 MC1461 MC1561	Reg_{load}	 – – – –	 0.5 0.3 0.7 0.4	 2.0 1.2 2.4 1.6	mV
	T_C = 25°C (See Note 5) (1.0 mA ≤ I_L ≤ 50 mA) R Package G Package		 – –	 0.005 0.01	 0.05 0.13	% V_o
	Output Impedance (See Note 6) (R_{SC} = 1.0 ohms, f = 10 kHz, V_{in} = 14 Vdc) MC1460 MC1560 (I_L = 25 mAdc for G Package) MC1461 MC1561	Z_{out}	– – – –	25 15 35 20	100 60 120 80	milli-ohms
	Shutdown Current (V_{in} = 20 Vdc) MC1460 MC1560 (V_{in} = 35 Vdc) MC1461 MC1561 $R_3 \approx \frac{V_{in} - 1.4}{1.0\ \text{mA}}$	I_{sd}	 – – – –	 80 20 140 70	 300 50 500 150	µAdc

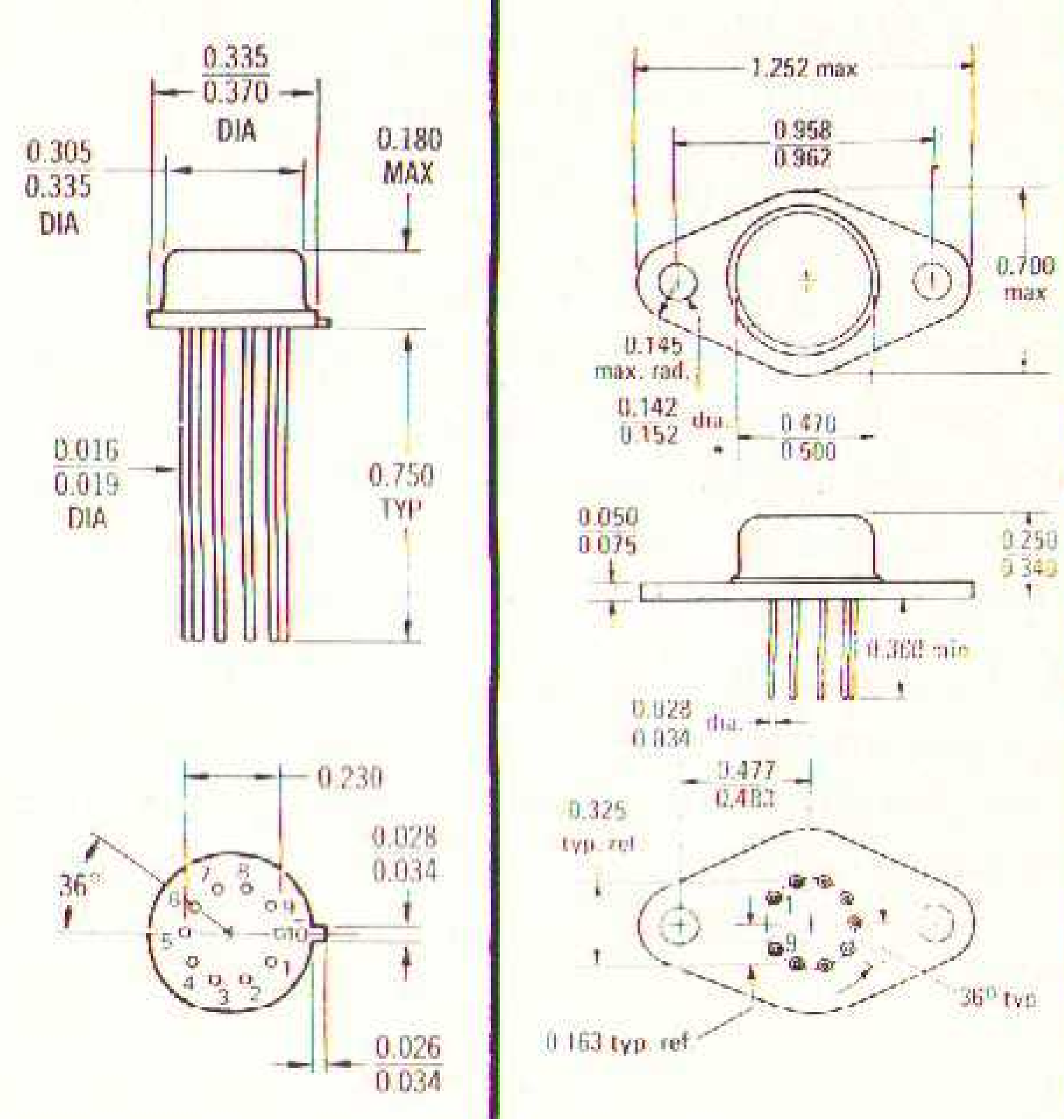
INTEGRATED VOLTAGE REGULATOR

MAXIMUM RATINGS (T_C = +25°C unless otherwise noted)

Rating		Symbol	Value		Unit
Input Voltage	MC1460, MC1560 MC1461 MC1561	V_{in}	20 35 40		Vdc
			G Package	R Package	
Load Current		I_L	250	600	mA
Current, Pin 2 Current, Pin 9		$I_{pin\ 2}$ $I_{pin\ 9}$	10 5.0	10 5.0	mA
Power Dissipation and Thermal Characteristics					
T_A = 25°C		P_D	0.68	3.0	Watts
Derate above T_A = 25°C		$1/\theta_{JA}$	5.44	24	mW/°C
Thermal Resistance, Junction to Air		θ_{JA}	184	41.6	°C/W
T_C = 25°C		P_D	1.8	17.5*	Watts
Derate above T_C = 25°C		$1/\theta_{JC}$	14.4	140	mW/°C
Thermal Resistance, Junction to Case		θ_{JC}	69.4	7.15	°C/W
Operating and Storage Junction Temperature Range		T_J, T_{stg}	-65 to +150		°C

*The MC1460R and MC1560R are limited to 12 watts maximum by the voltage and current maximum ratings.

G Suffix R Suffix



Pin 10 electrically connected to case

Case is ground terminal

OPERATING TEMPERATURE RANGE

Ambient Temperature	MC1460, MC1461 MC1560, MC1561	T_A	0 to +75 -55 to +125	°C

Note 1. "Minimum Input Voltage" is the minimum "total instantaneous input voltage" required to properly bias the internal zener reference diode. For output voltages greater than approximately 5.5 Vdc the minimum "total instantaneous input voltage" must increase to the extent that it will always exceed the output voltage by at least the "input-output voltage differential"

Note 2. This parameter states that the MC1560/1561 and MC1460/1461 will regulate properly with the input-output voltage differential ($V_{in} - V_o$) as low as 2.7 Vdc and 3.0 Vdc respectively. Typical units will regulate properly with (V_{in} V_o) as low as 2.1 Vdc as shown in the typical column.

Note 3. "Temperature Coefficient of Output Voltage" is defined as:

$$\text{MC1560, MC1561} \quad TC_{V_o} = \frac{\pm(V_{o\,max} - V_{o\,min})(100)}{(180^\circ C)(V_o @ 25^\circ C)} = \%/^\circ C$$

$$\text{MC1460, MC1461} \quad TC_{V_o} = \frac{\pm(V_{o\,max} - V_{o\,min})(100)}{(75^\circ C)(V_o @ 25^\circ C)} = \%/^\circ C$$

The output-voltage adjusting resistors (R1 and R2) must have matched temperature characteristics in order to maintain a constant ratio independent of temperature.

Note 4. The input signal can be introduced by use of a transformer which will allow the output of an audio oscillator to be coupled in series with the dc input to the regulator. (The large ac input impedance of the regulator will not load the oscillator.) A 24 V, 1.0 ampere filament transformer with the audio oscillator connected to the 110 V primary winding is satisfactory for this test. $v_{in} \approx 1.0$ Vrms.

Note 5. Load regulation is specified for small ($\leq$+17°C) changes in junction temperature. Temperature drift effect must be taken into account separately for conditions of high junction temperature changes due to the thermal feedback that exists on the monolithic chip.

$$\text{Load Regulation} = \frac{V_O|_{I_L = 1.0\,mA} - V_O|_{I_L = 50\,mA}}{V_O|_{I_L = 1.0\,mA}} \times 100$$

Note 6. The resulting low level output signal (v_o) will require the use of a tuned voltmeter to obtain a reading. Special care should be used to insure that the measurement technique does not include connection resistance, wire resistance, and wire lead inductance (i.e., measure close to the case). Note that No. 22 AWG hook-up wire has approximately 4.0 milliohms/in. dc resistance and an inductive reactance of approximately 10 milliohms/in. at 100 kHz. Avoid use of alligator clips or banana plug-jack combination.

GENERAL OPERATING INFORMATION

There is a general tendency to consider a voltage regulator as simply a dc circuit and to prepare breadboard construction accordingly. The excellent high-frequency performance and fast response capability of this integrated-circuit regulator, however, makes extra breadboarding care worthwhile when compared with the limited performance achieved in other regulators when low-frequency transistors are used in the feedback amplifier. Due to the use of VHF transistors in the integrated circuit, some VHF care (short, well-dressed leads) must be exercised in the construction and wiring of circuits ("printed-circuit" boards provide an excellent component interconnection technique).

The circuit must be grounded by a low-inductance connection to the case of the "R" package, or to pin 10 of the "G" package.

A series RC "de-Q'ing" circuit (a 2.7 Ω 1/4 W composition resistor and a 0.01 to 0.1 μF disc ceramic capacitor) can solve most local VHF parasitic problems resulting from poor hook-up technique which for some reason cannot be avoided. Thus a VHF tank circuit that may result from the high-Q inductive reactance of non-tantalum electrolytic output capacitors (C_o) can be shunted by the low impedance RC "de-Q'ing" circuit. In addition, parasitic instabilities due to large input-lead reactance to pin 3 can also be solved with a similar network in place of an electrolytic capacitor from pin 3 to ground, (see dotted components shown in Figures 1 and 2). Further, in NPN current boost circuits using a high-frequency boosting transistor, placing this network from the collector of the external transistor to ground will prevent a local HF instability of the boost transistor that may result from unavoidable line length of the collector lead (see Figure 18).

The "Shut-Down Control", Pin 2, can be actuated for all possible output voltages and any values of C_o and C_n with no damage to the circuit. The standard logic levels of RTL, DTL, or TTL can be used (see Figure 20). This control can be used to eliminate power consumption by circuit loads which can be put in a "standby" mode, as an ac and dc "squelch" control for communications circuits, and as a dissipation control to protect the regulator under sustained output short-circuiting (see Figures 21 and 25). As the magnitude of the input-threshold voltage at Pin 2 depends directly upon the junction temperature of the IC chip, a fixed dc voltage at Pin 2 will cause automatic shut-down for high junction temperatures (see Figure 23, a and b). This will protect the chip, independent of the heat sinking used, the ambient temperature, or the input or output voltage levels.

Due to the small value of input current at Pin 8, the external resistors, R1 and R2, can be selected with little regard to their parallel resistance. Further, no match to a diffused-resistor temperature coefficient is required; but R1 and R2 should have the same temperature coefficient to keep their ratio independent of temperature.

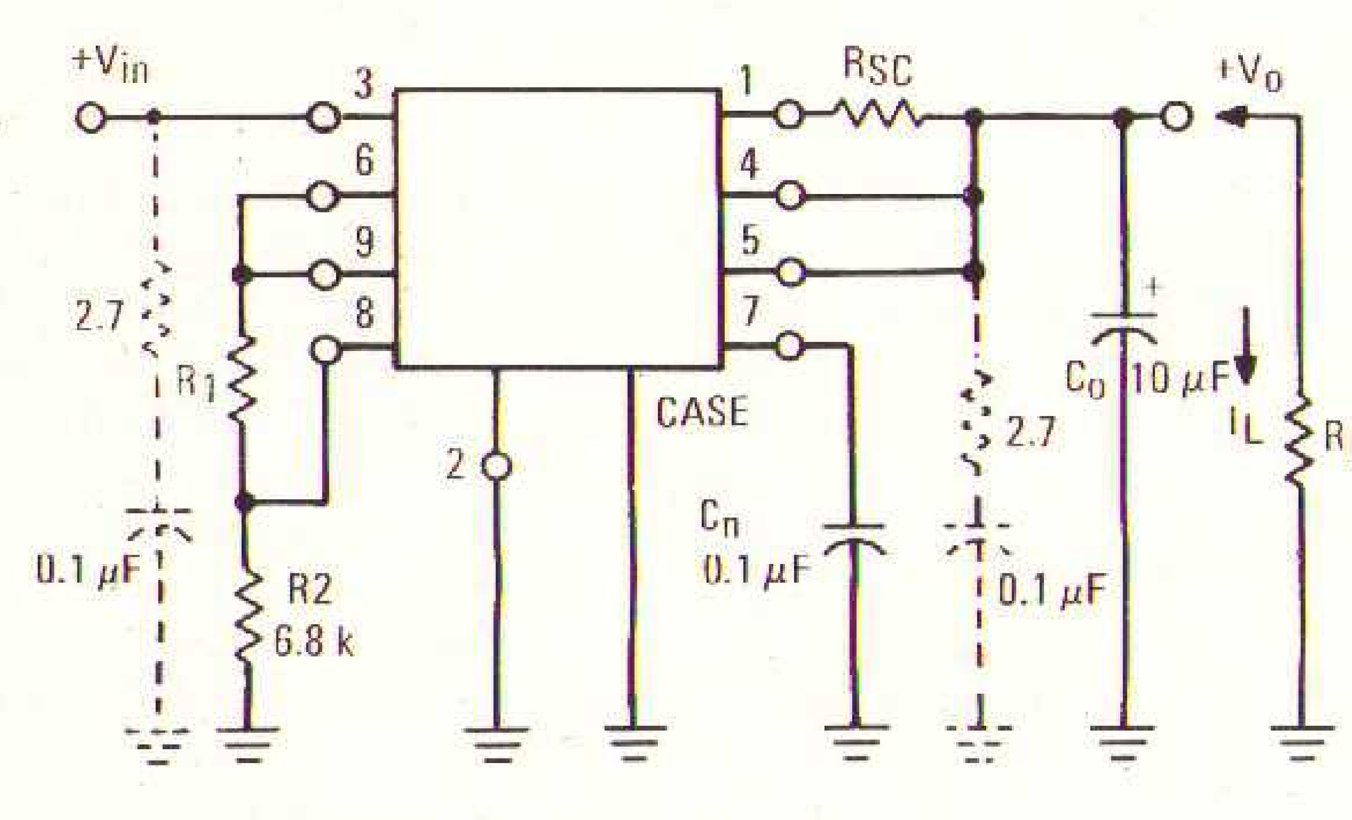
C_n values in excess of 0.1 μF are rarely needed to reduce noise. In cases where more output noise can be tolerated, a smaller capacitor can be used (C_n min. $\approx$ 0.001 μF).

The connection to Pin 5 can be made by a separate lead directly to the load. Thus "remote sensing" can be achieved and undesired impedances (including that of a milliammeter used to measure I_L) can be greatly reduced in their effect on Z_{out}. A 10-ohm resistor placed from pin 1 to pin 5 (close to the IC) will eliminate undesirable lead-inductance effects.

Short-circuit current-limiting is achieved by selecting a value for R_{SC} which will threshold the internal diode string when the desired maximum load current flows (see Figure 5). If the device dissipation and dc safe area limits (Figure 15) are not exceeded, it can be continuously short-circuited at the output without damage.

TYPICAL CONNECTIONS

FIGURE 1 – CONNECTION FOR Vo ≥ 3.5 V



Select R1 to give desired V_0:

$R1 \approx (2\,V_0 - 7.0)$ kΩ

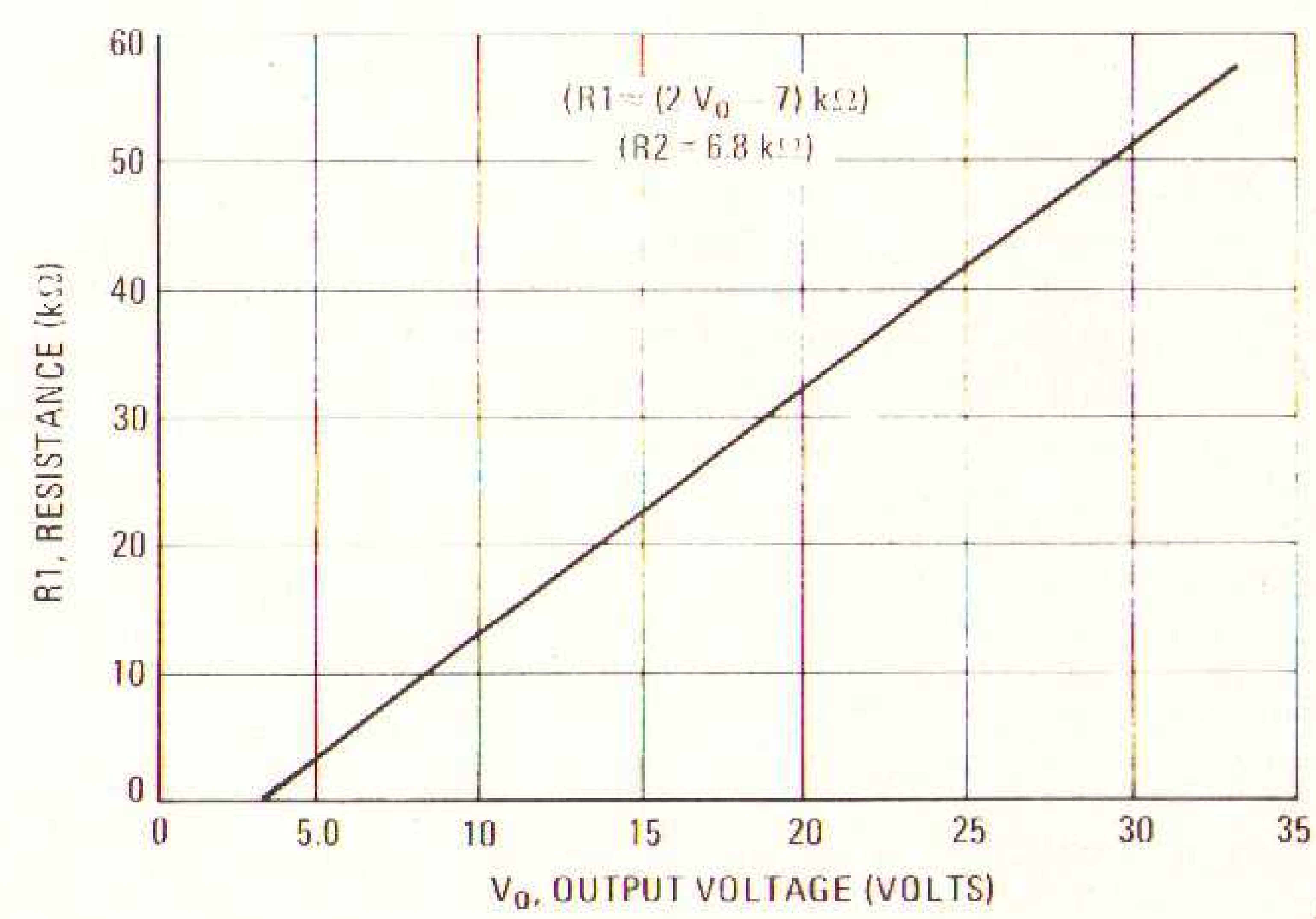
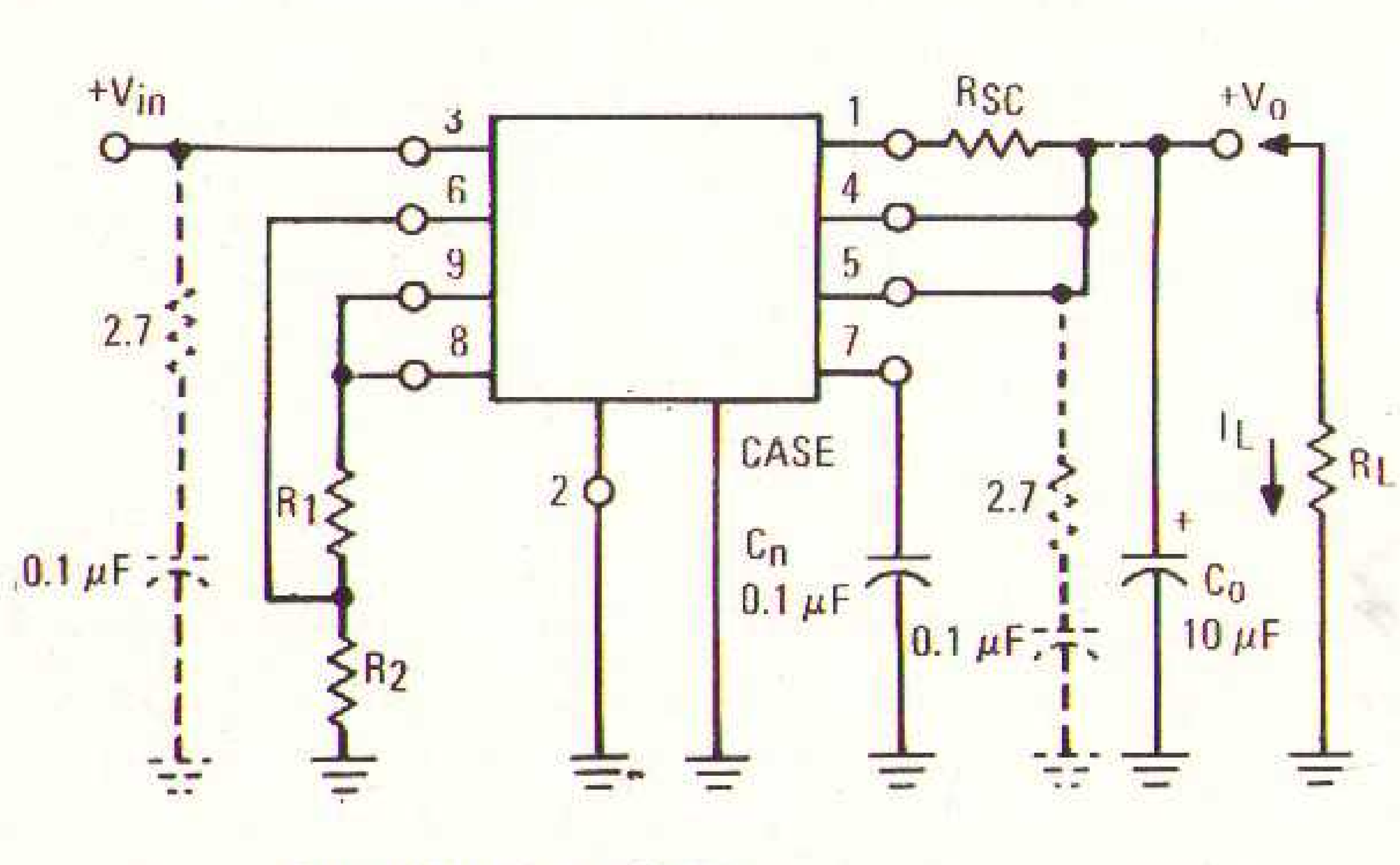


FIGURE 2 – CONNECTION FOR Vo ≤ +3.5 V

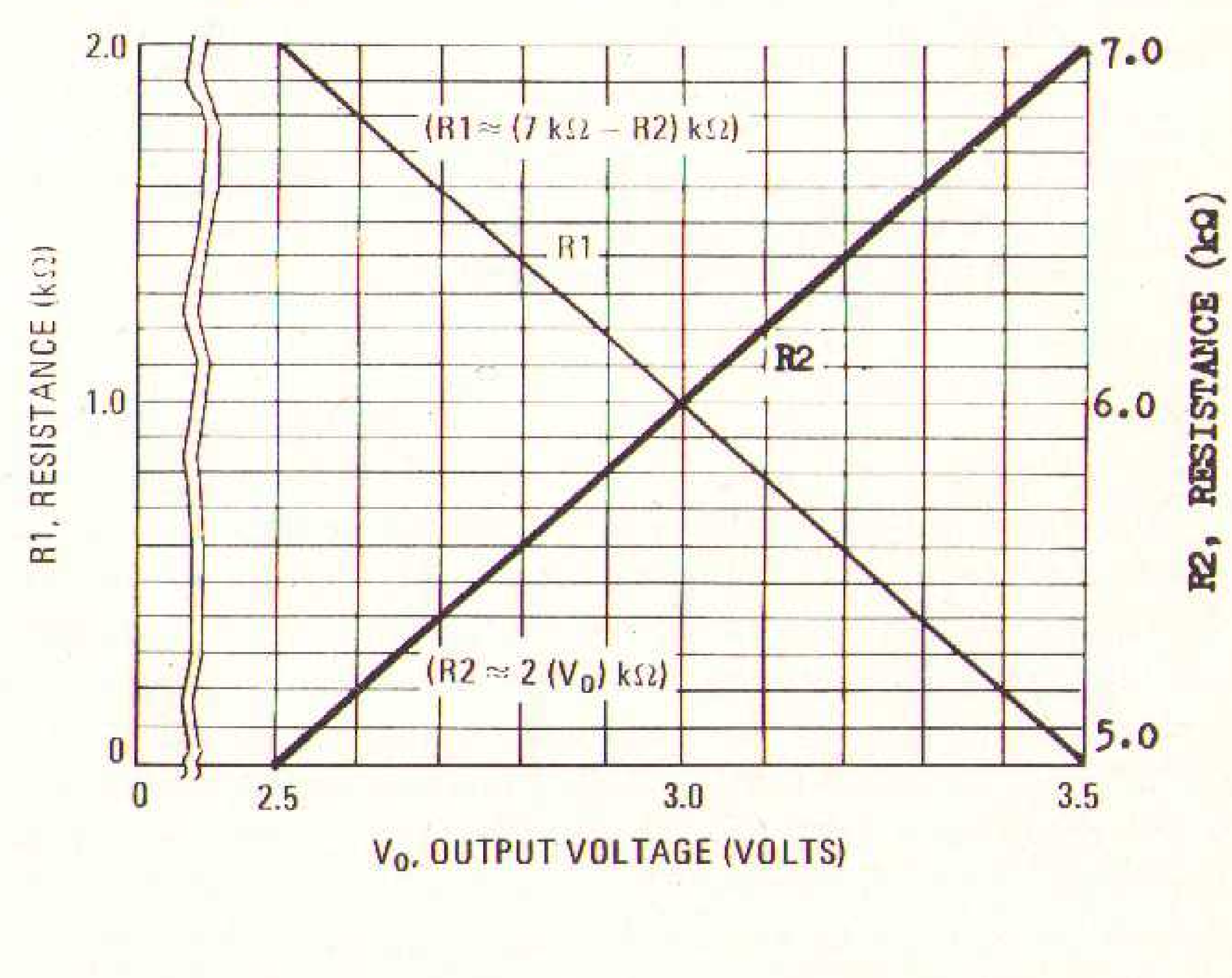


Select R2 to give desired V_0:

$R2 \approx (2\,V_0)$ kΩ

Select R1:

$R1 \approx 7.0$ kΩ $-$ R2



INTEGRATED VOLTAGE REGULATOR

TYPICAL CHARACTERISTICS

Unless otherwise stated: $C_n = 0.1\ \mu F$, $C_O = 10\ \mu F$, $V_{O\ nom} = +5.0$ Vdc, $V_{in\ nom} = +9.0$ Vdc, $T_C = +25^oC$, $I_L > 200$ mA for "R" Package only.

FIGURE 3 – INPUT TRANSIENT RESPONSE

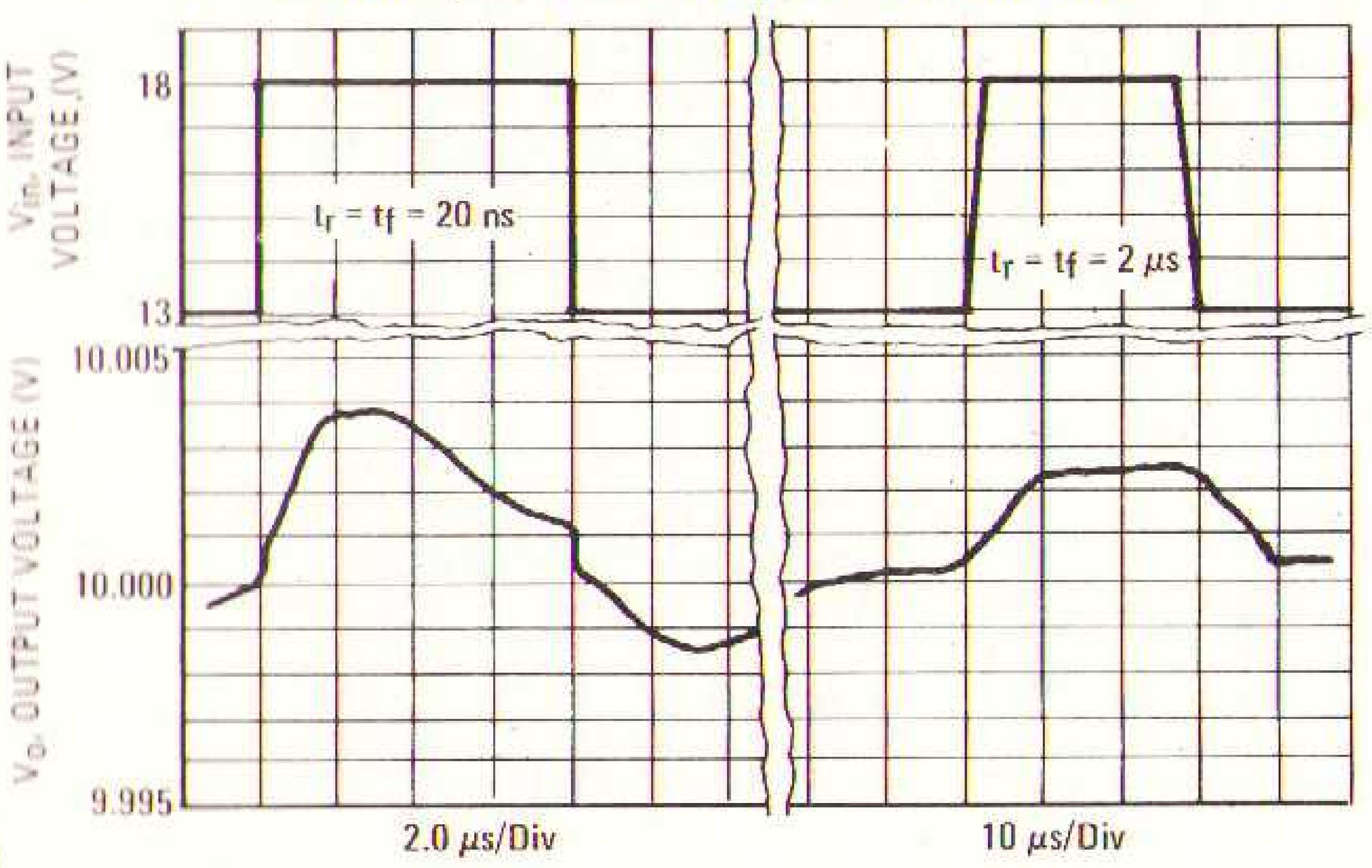


FIGURE 4 – LOAD TRANSIENT RESPONSE

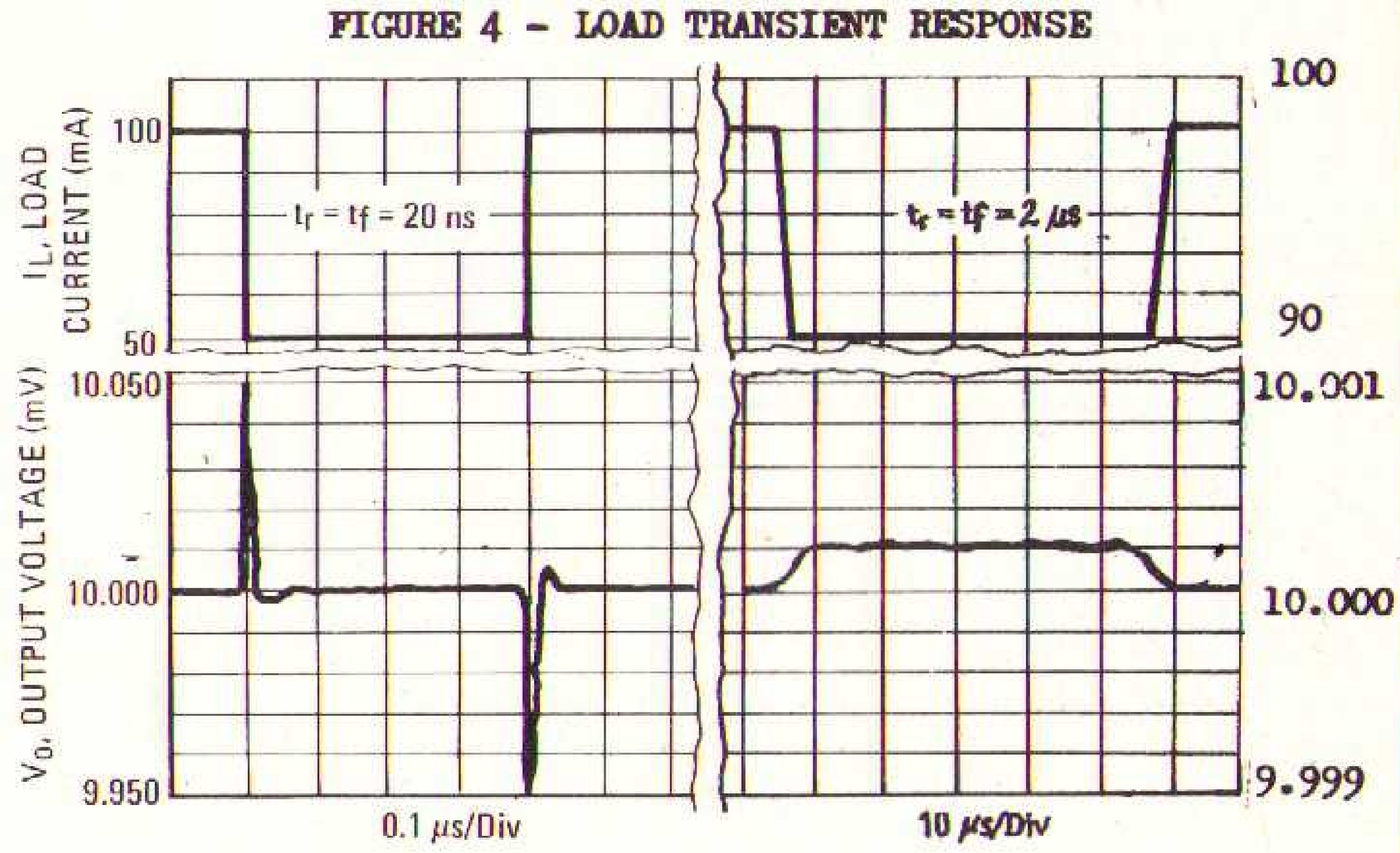


FIGURE 5 – SHORT-CIRCUIT CURRENT versus R_{SC}

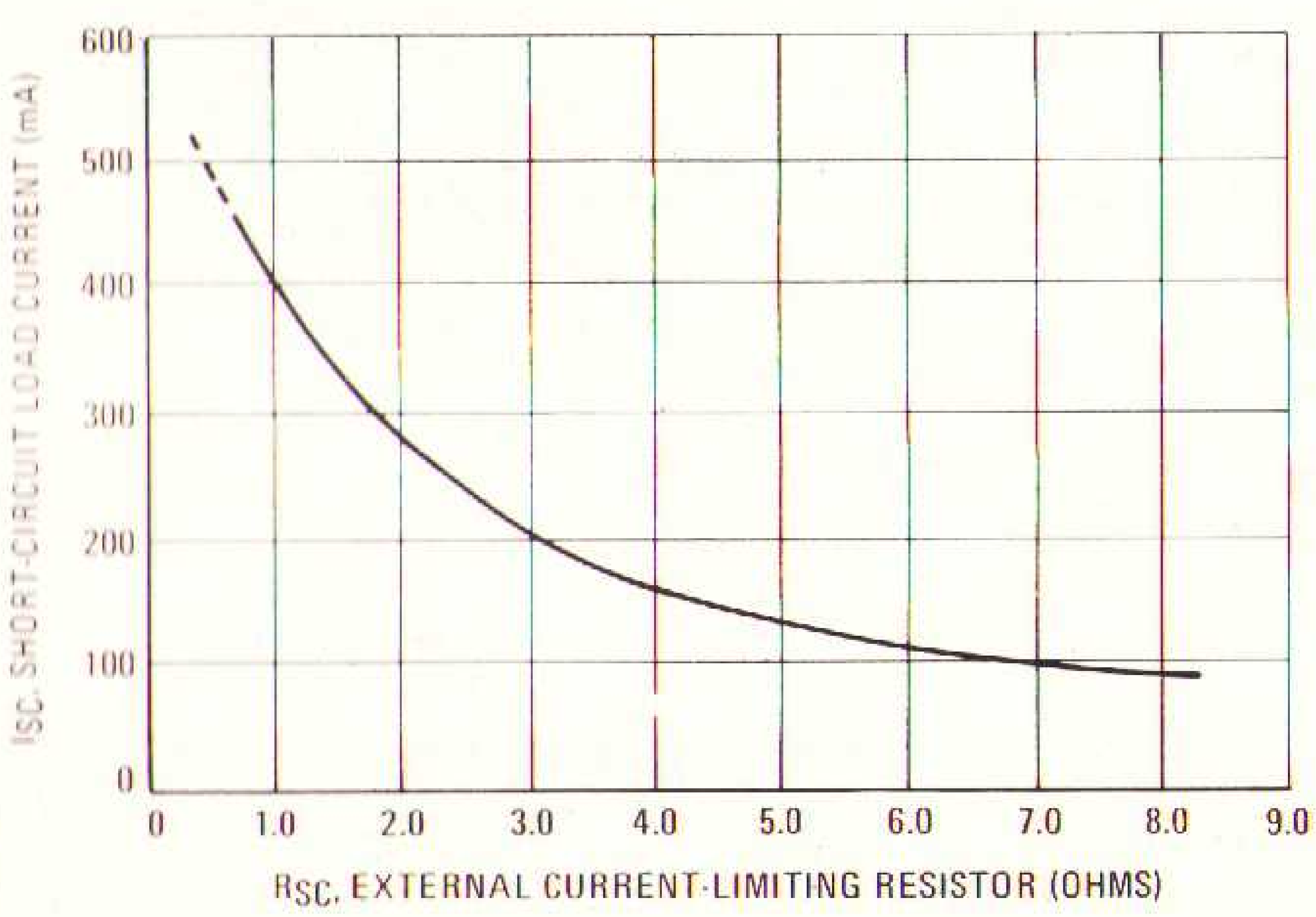


FIGURE 6 – CURRENT-LIMITING CHARACTERISTICS

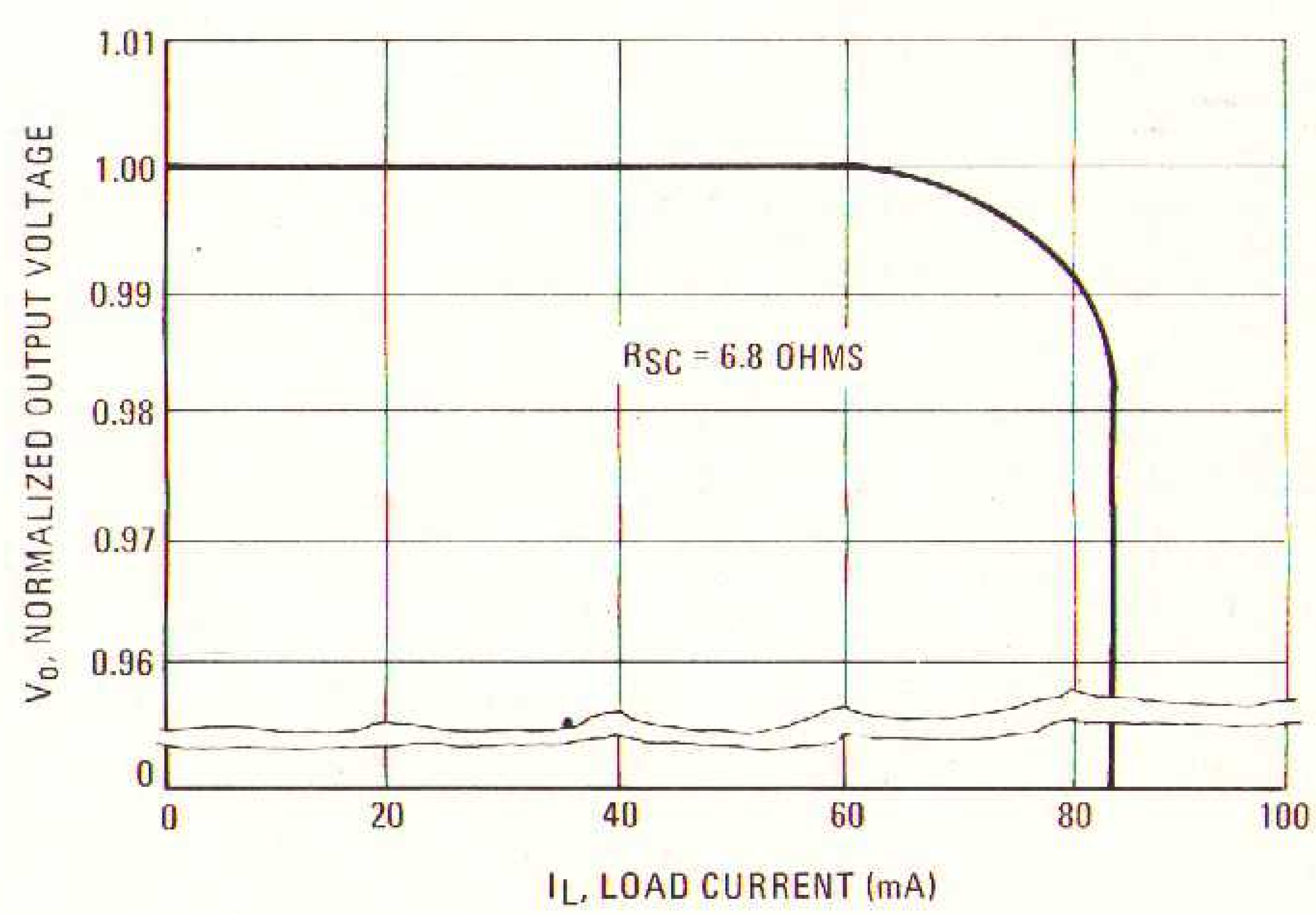


FIGURE 7 – FREQUENCY-DEPENDENCE OF OUTPUT IMPEDANCE

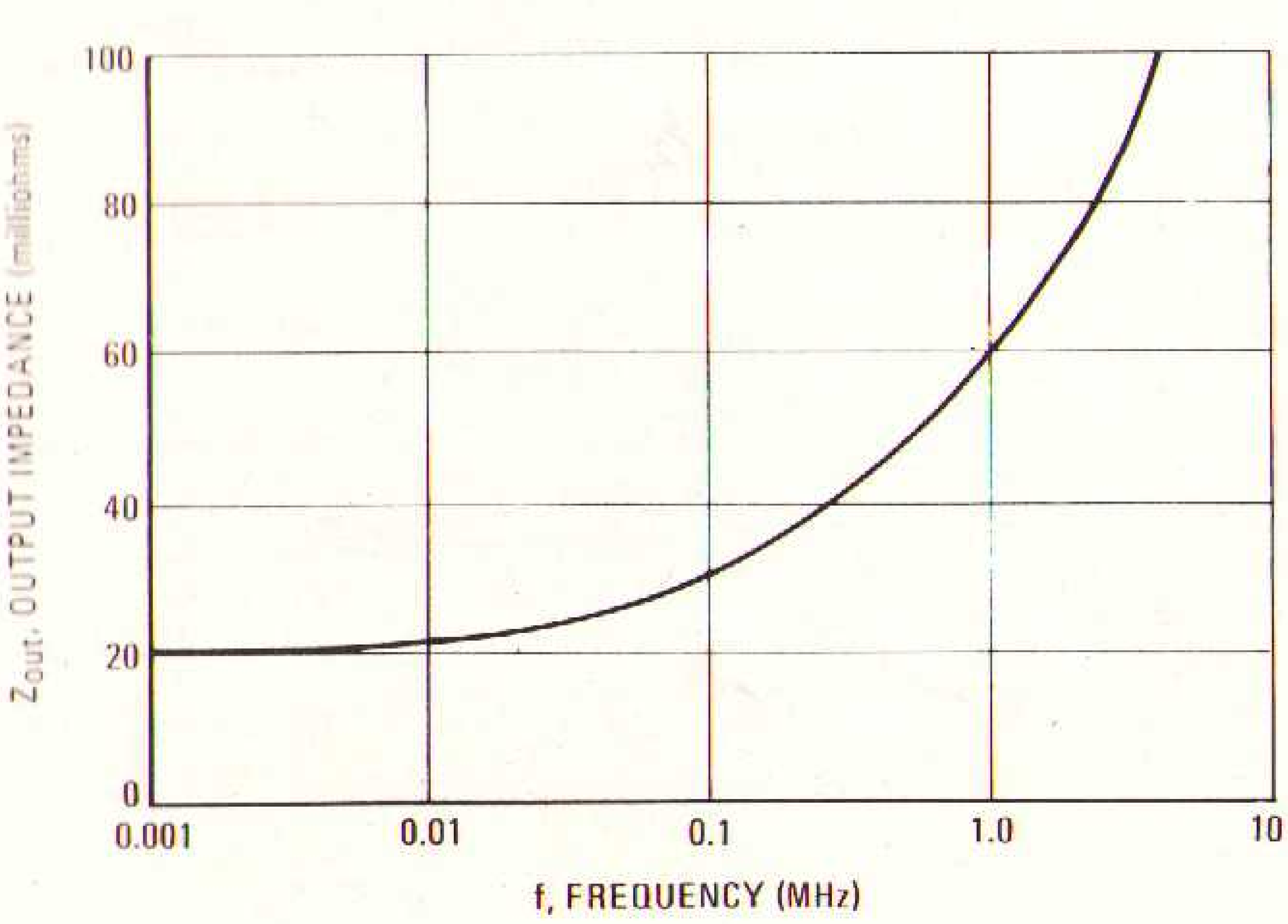
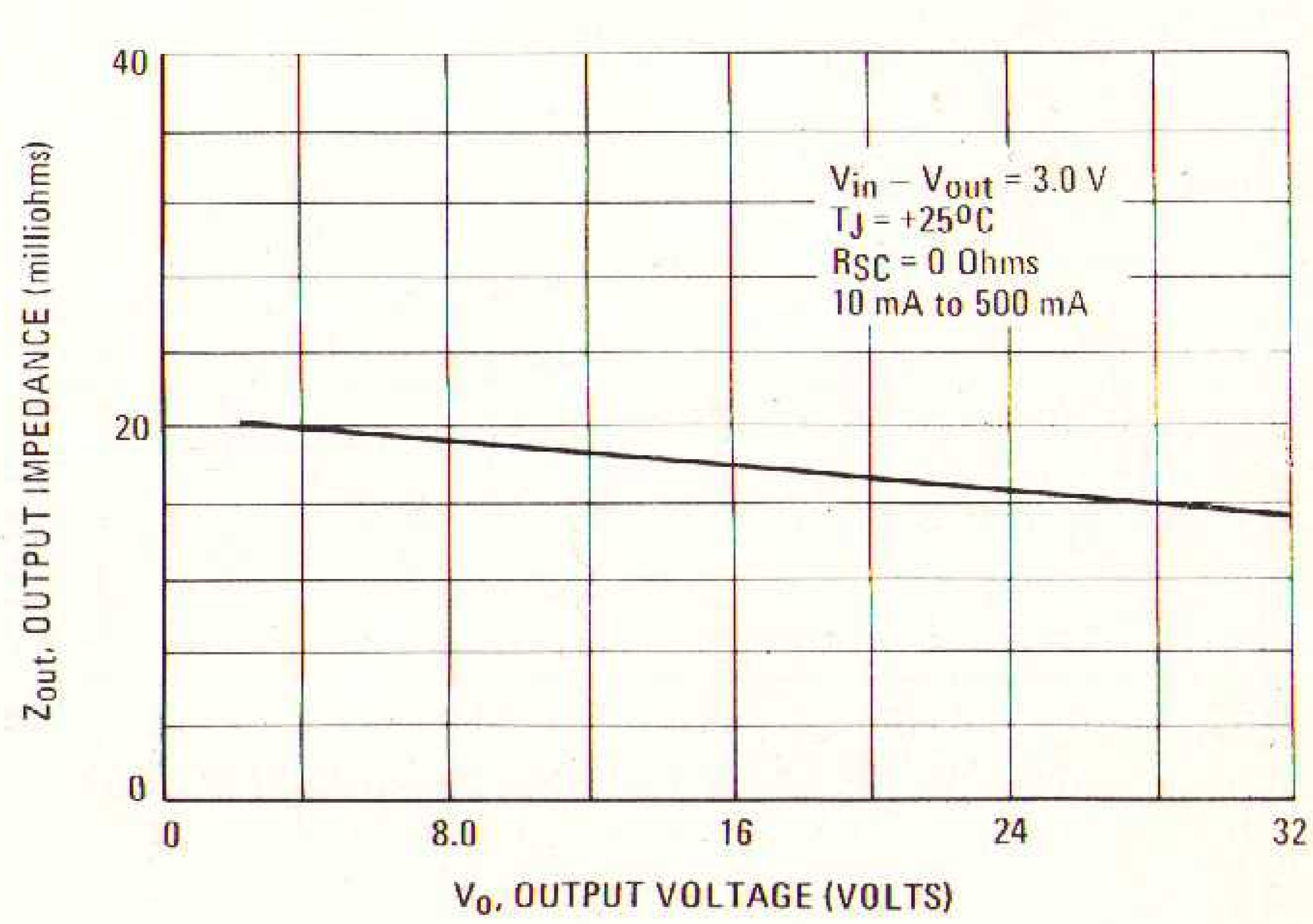


FIGURE 8 – DEPENDENCE OF OUTPUT IMPEDANCE ON OUTPUT VOLTAGE



TYPICAL CHARACTERISTICS (continued)

Unless otherwise stated: $C_n = 0.1\ \mu F$, $C_o = 10\ \mu F$, $V_{o\ nom} = +5.0$ Vdc, $V_{in\ nom} = +9.0$ Vdc, $T_C = +25^oC$, $I_L > 200$ mA for "R" Package only.

FIGURE 9 – OUTPUT IMPEDANCE versus R_{SC}

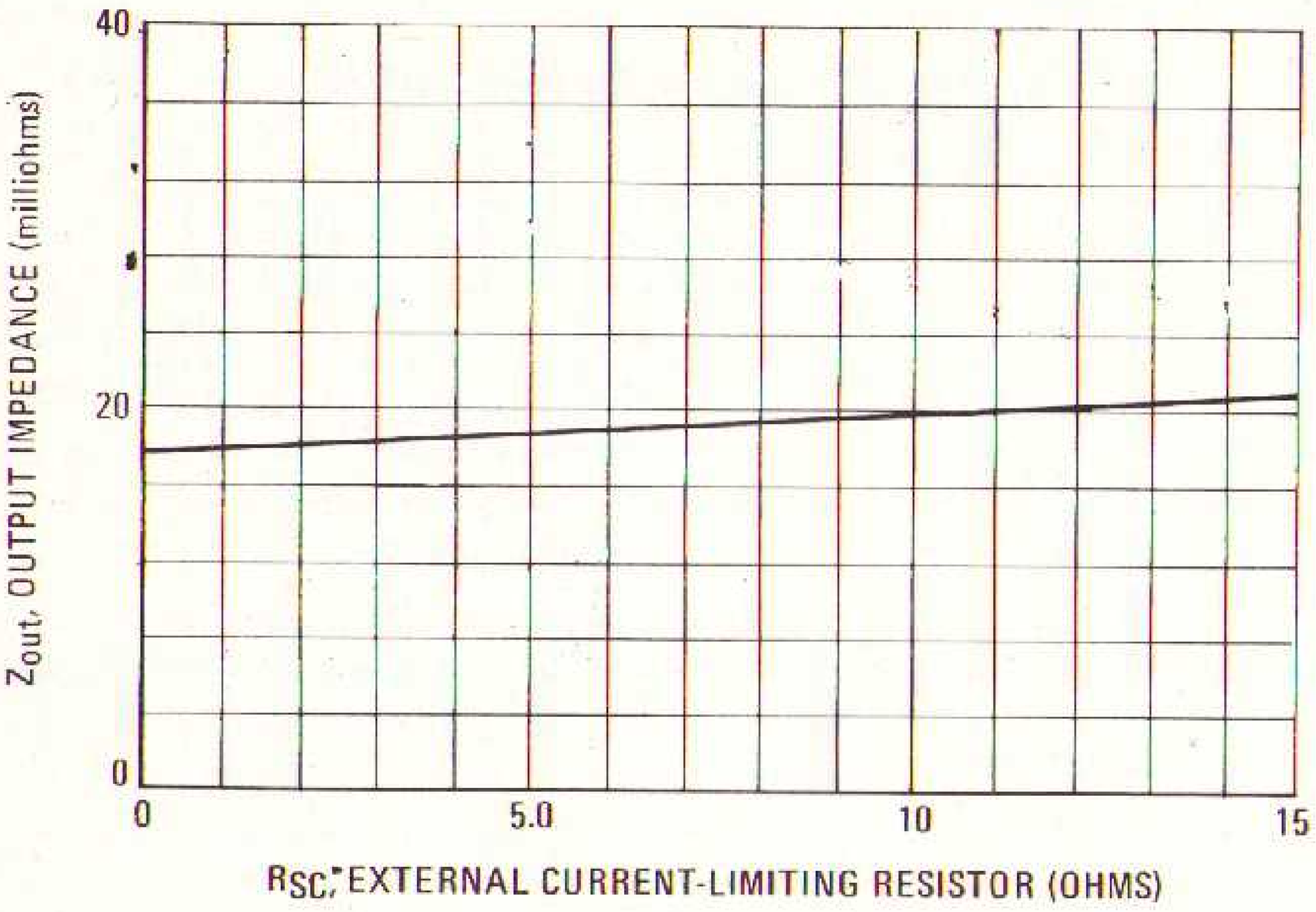


FIGURE 10 – FREQUENCY-DEPENDENCE OF INPUT REGULATION

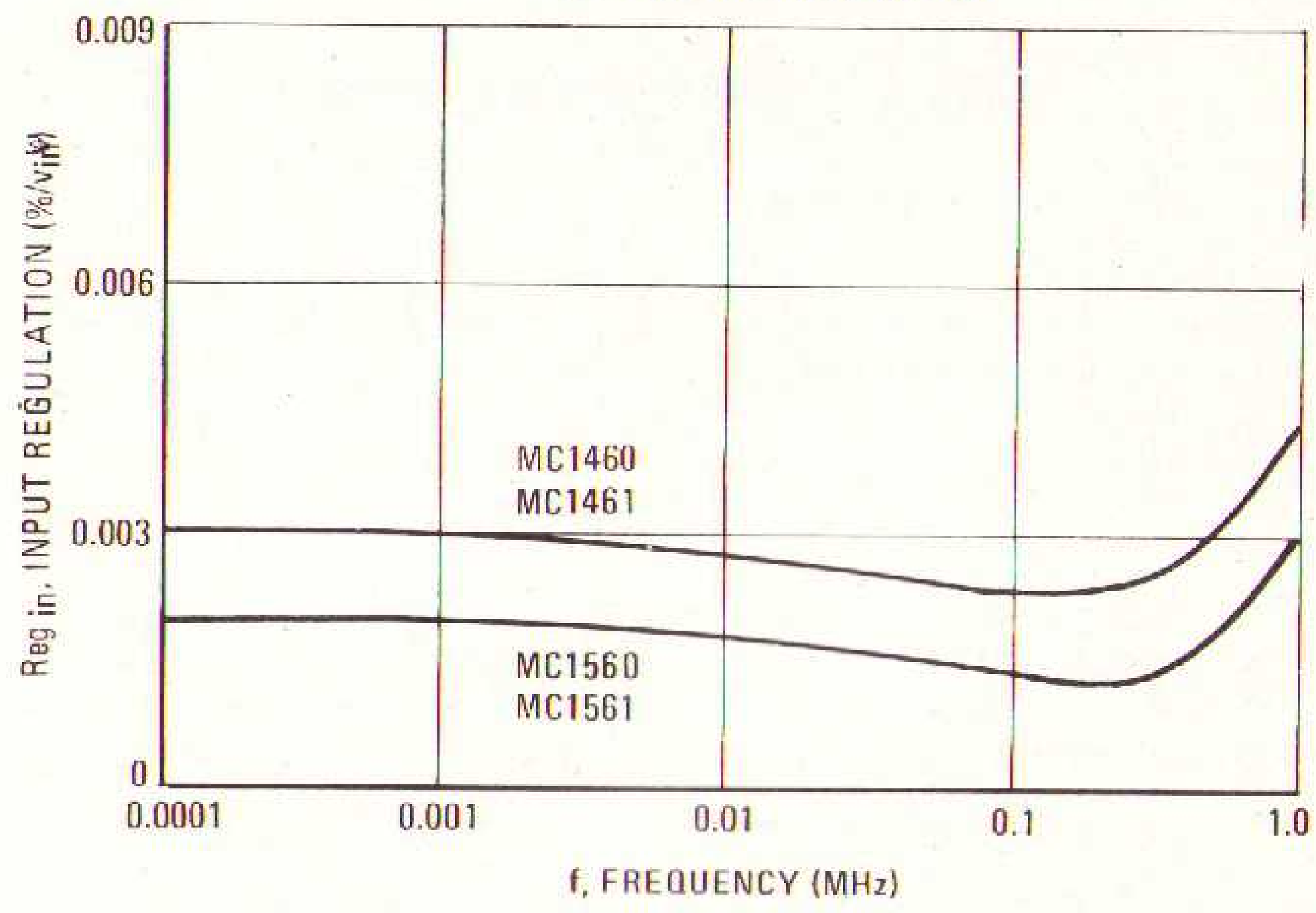


FIGURE 11 – BIAS CURRENT versus INPUT VOLTAGE

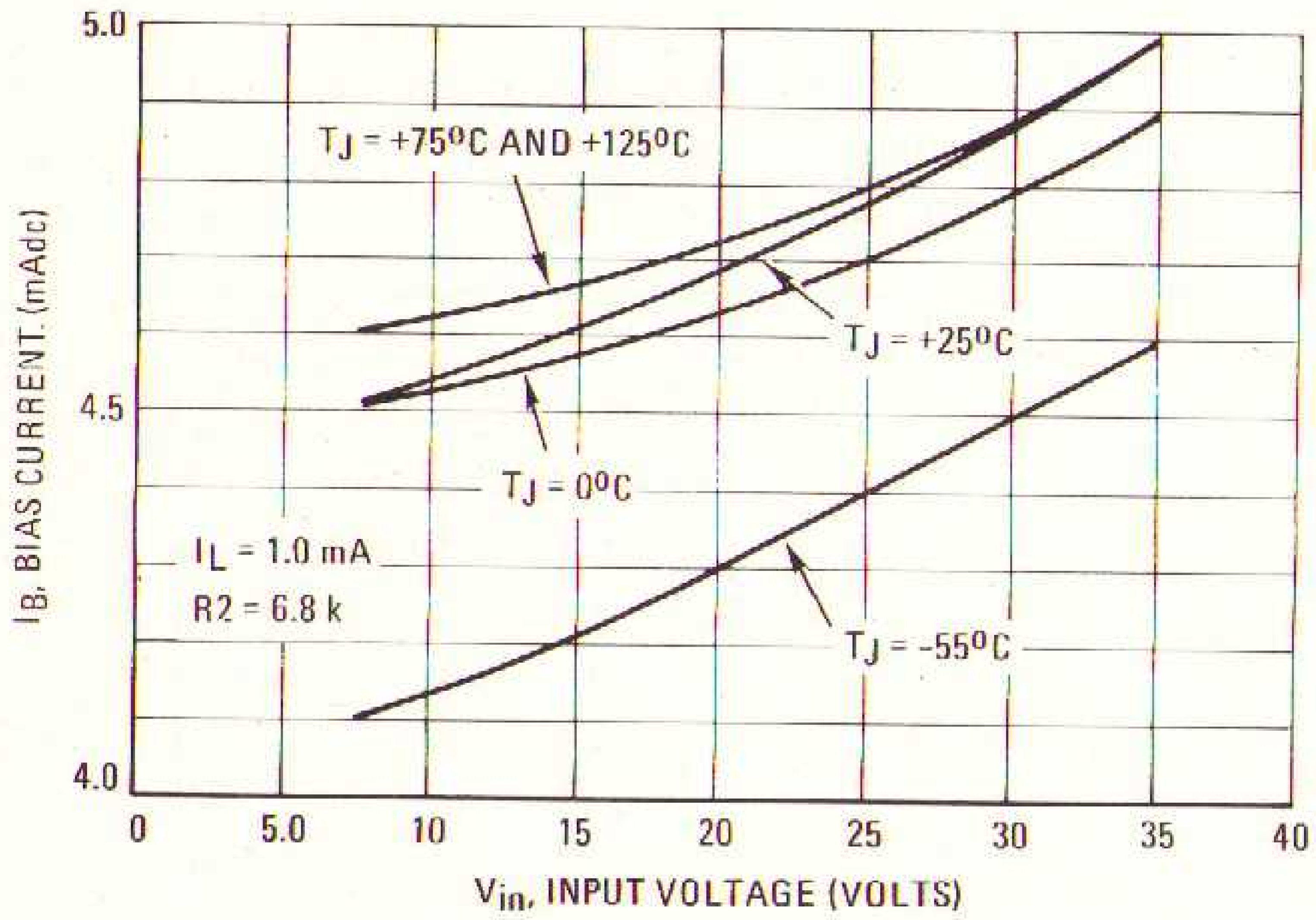


FIGURE 12 – EFFECT OF LOAD CURRENT ON INPUT-OUTPUT VOLTAGE DIFFERENTIAL

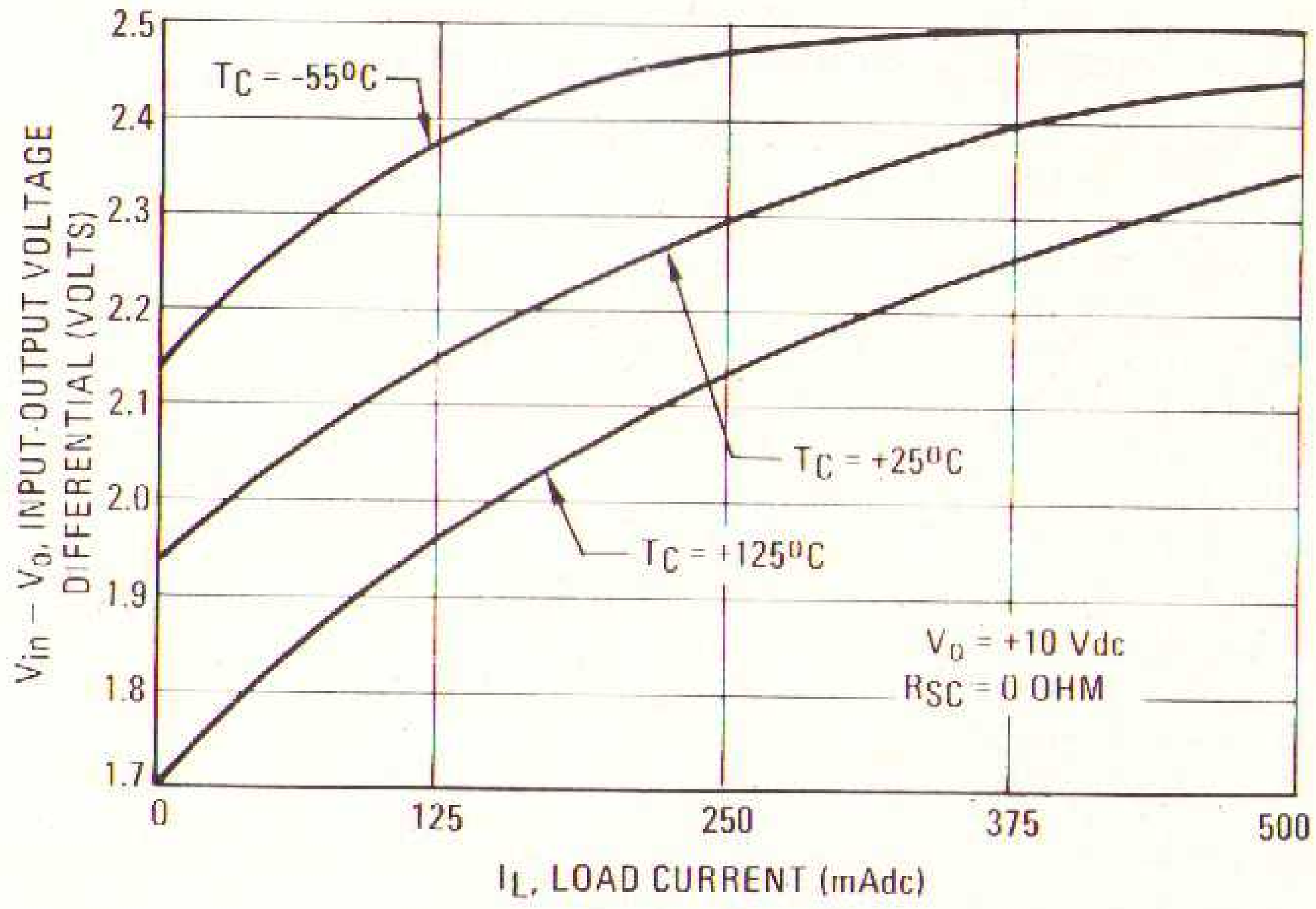


FIGURE 13 – EFFECT OF INPUT-OUTPUT VOLTAGE DIFFERENTIAL ON INPUT REGULATION

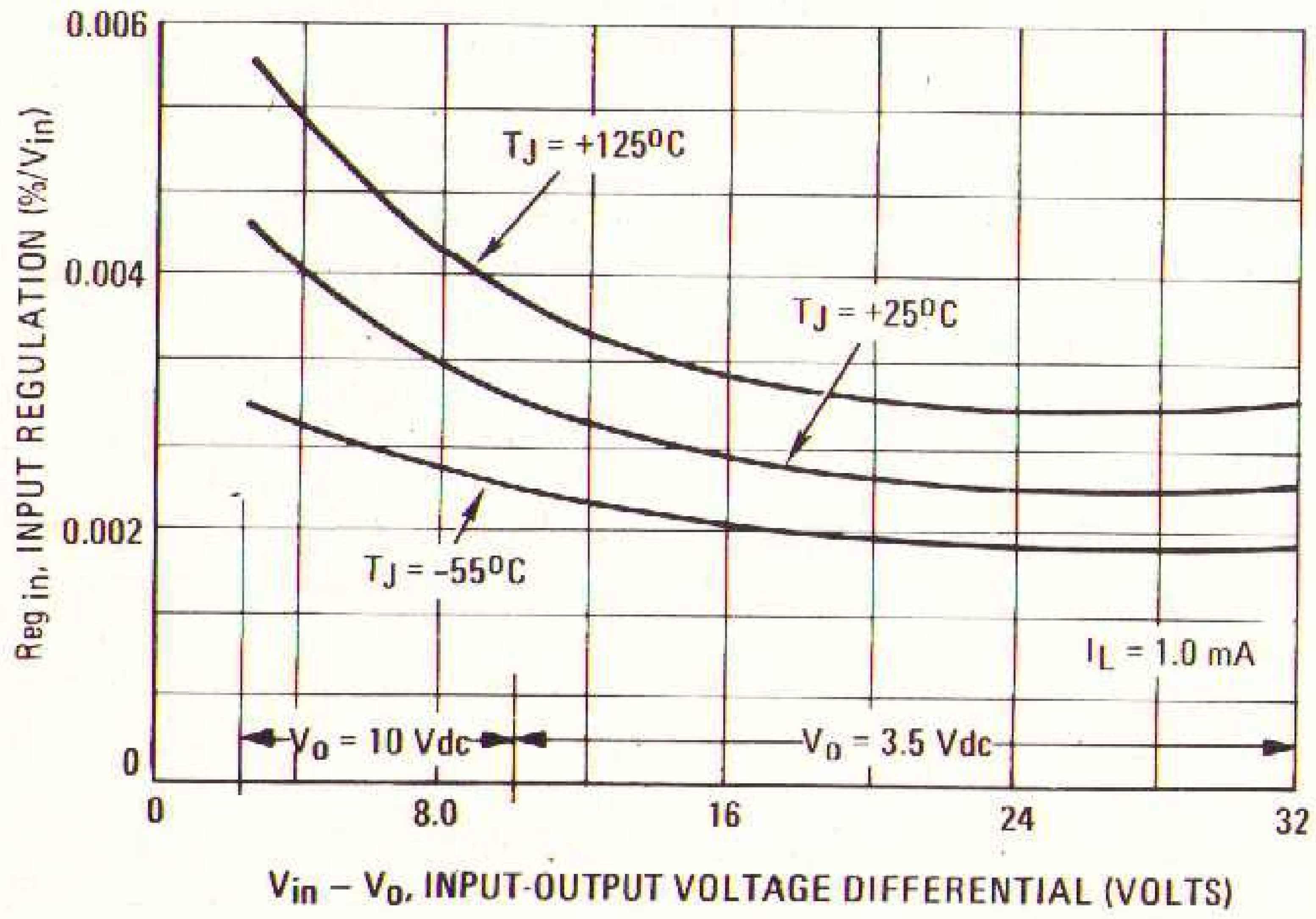
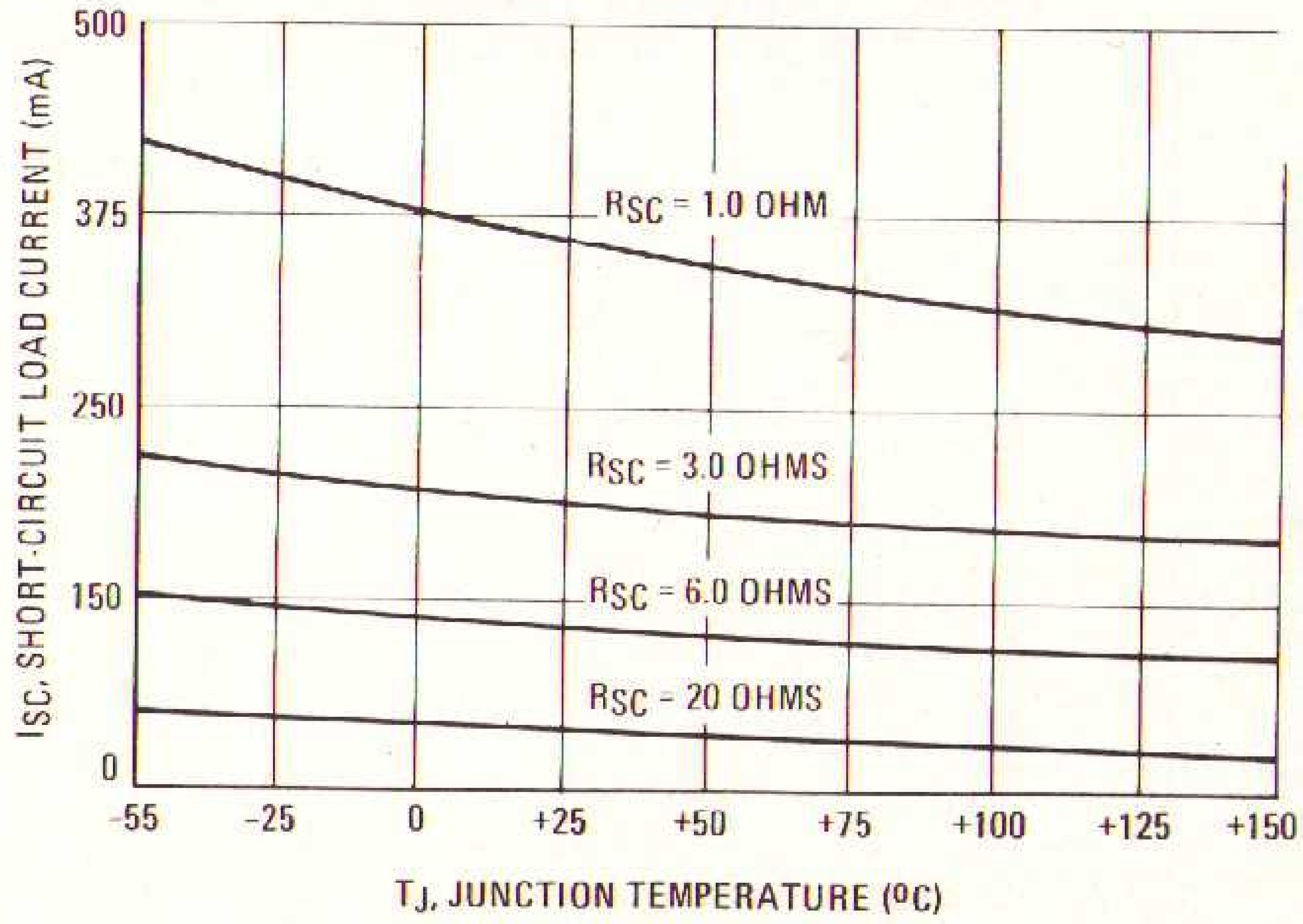


FIGURE 14 – TEMPERATURE DEPENDENCE OF SHORT-CIRCUIT LOAD CURRENT



TYPICAL CHARACTERISTICS (continued)

FIGURE 15a – DC SAFE OPERATING AREA ("G" PACKAGE)

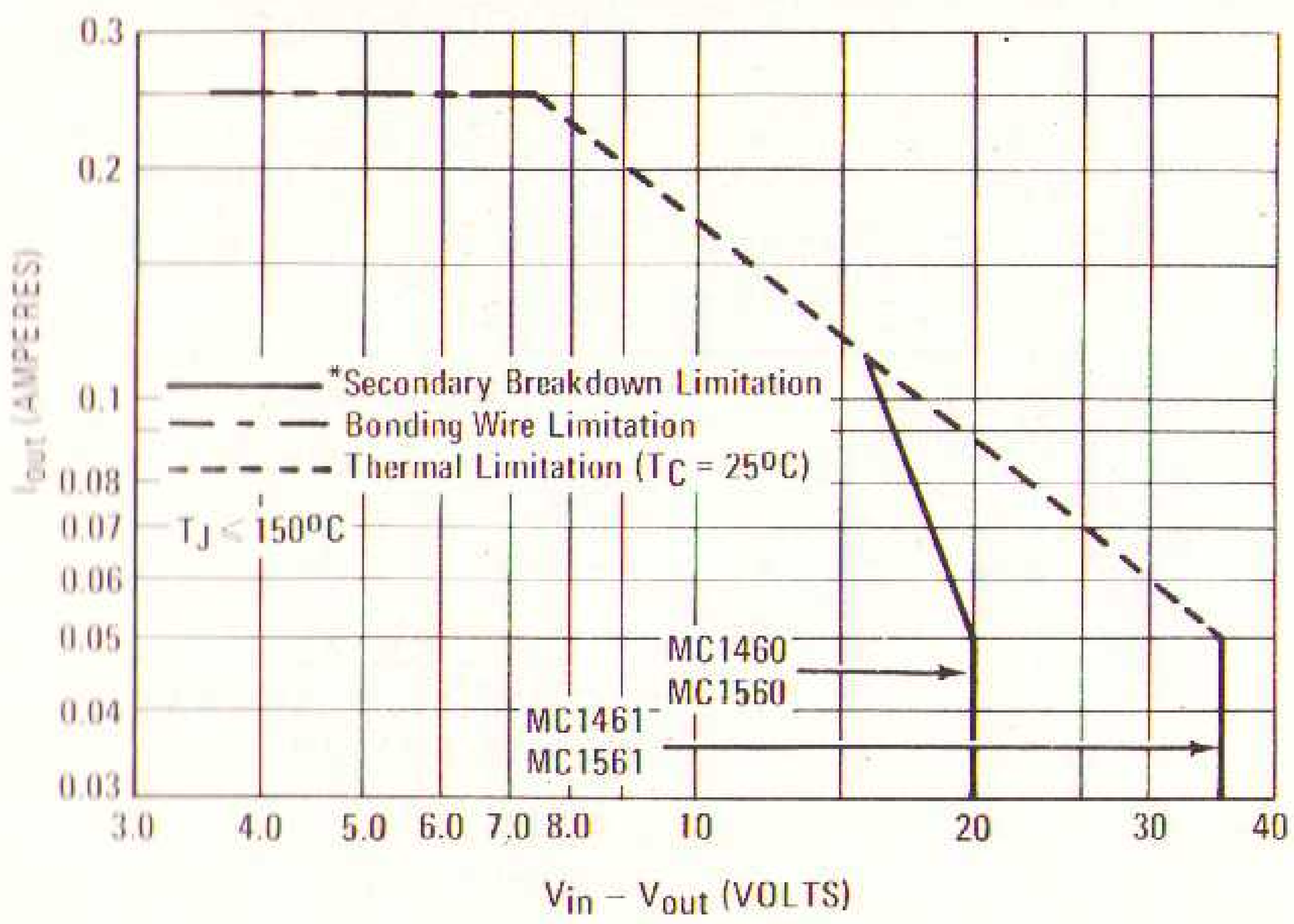
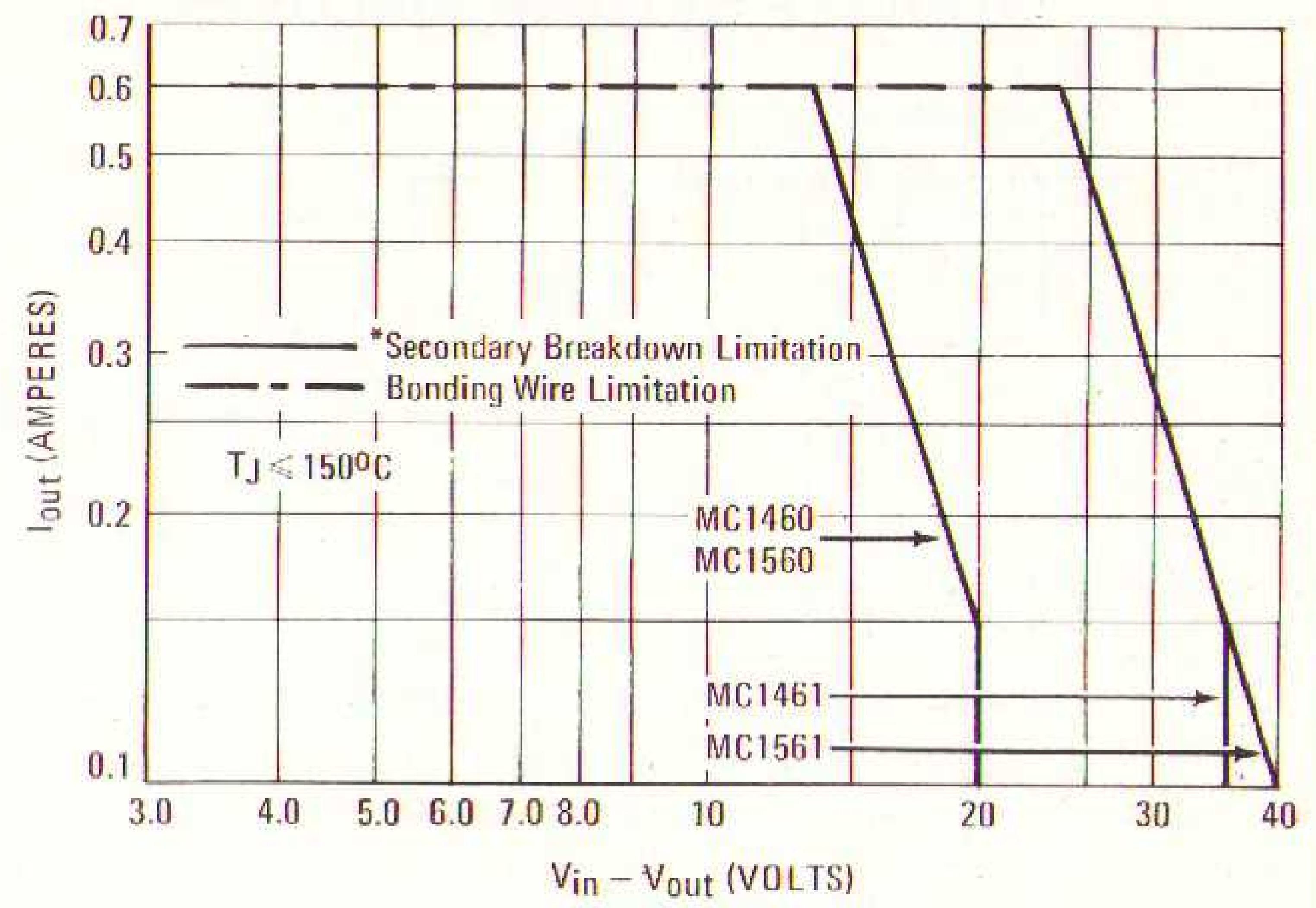


FIGURE 15b – DC SAFE OPERATING AREA ("R" PACKAGE)



*See Application Note AN-415 for an explanation of safe area and second breakdown.

TYPICAL APPLICATIONS

FIGURE 16 – A LABORATORY SUPPLY, 0 TO 25V

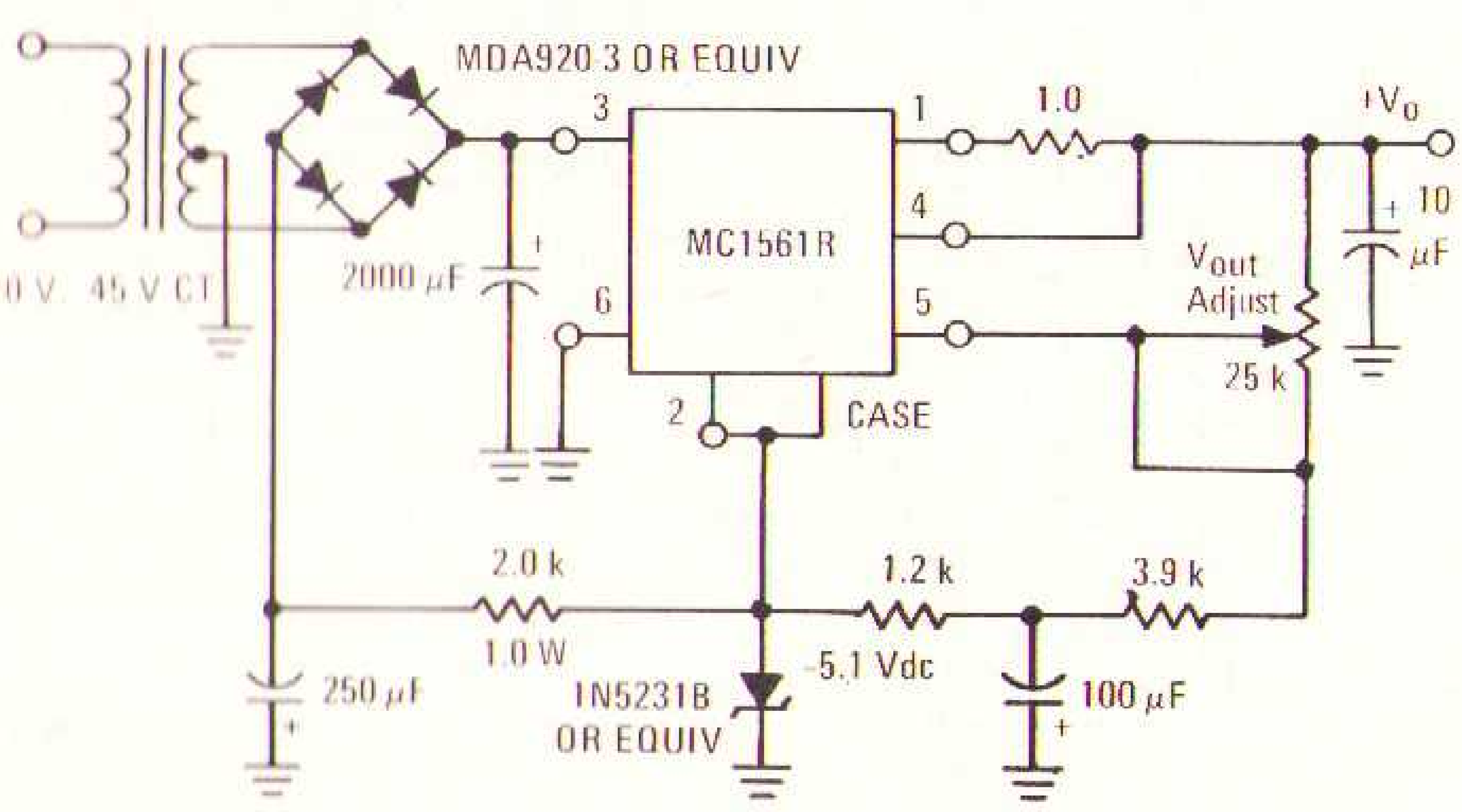


FIGURE 17 – PROVIDING TWO REGULATED OUTPUT VOLTAGES

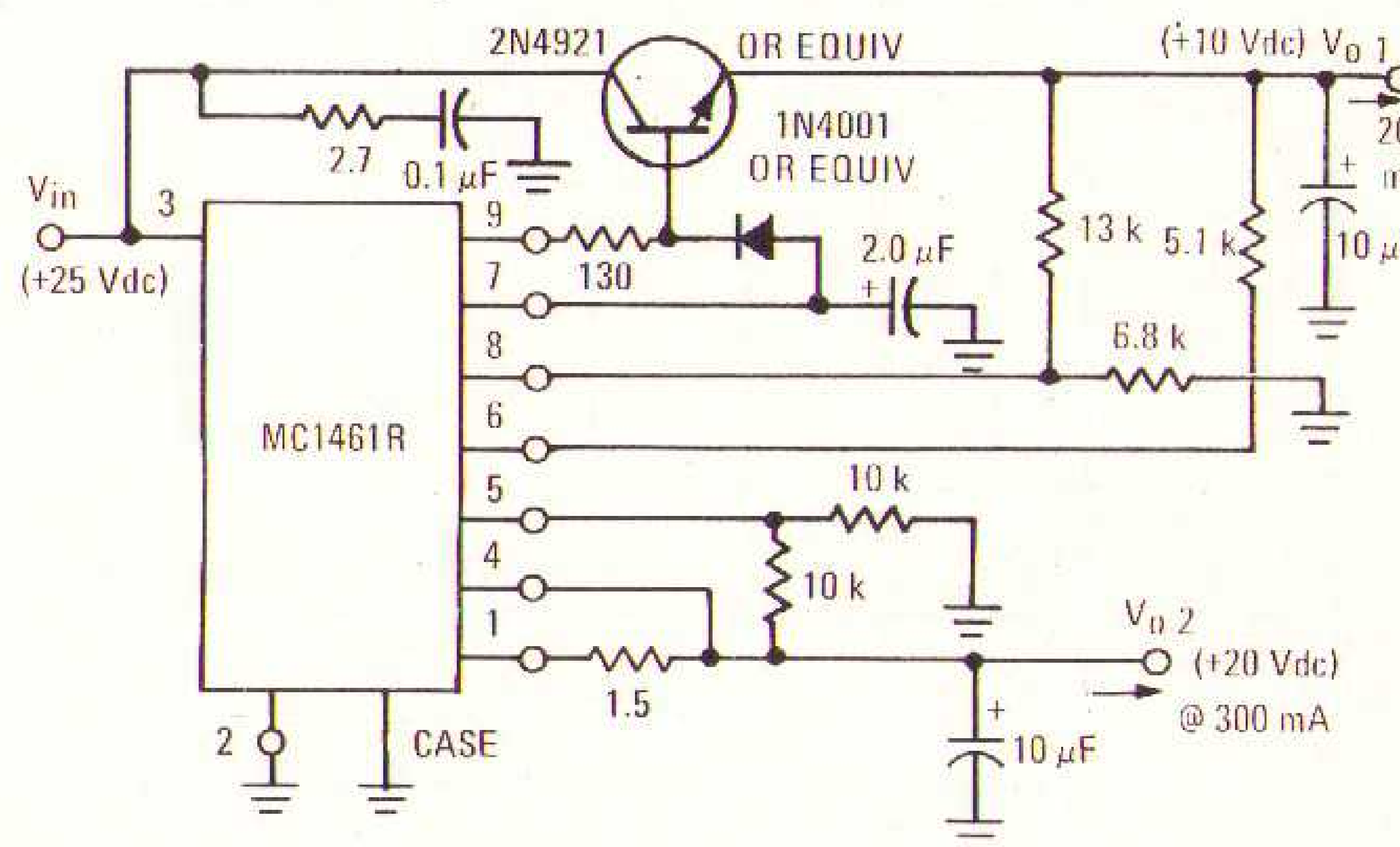
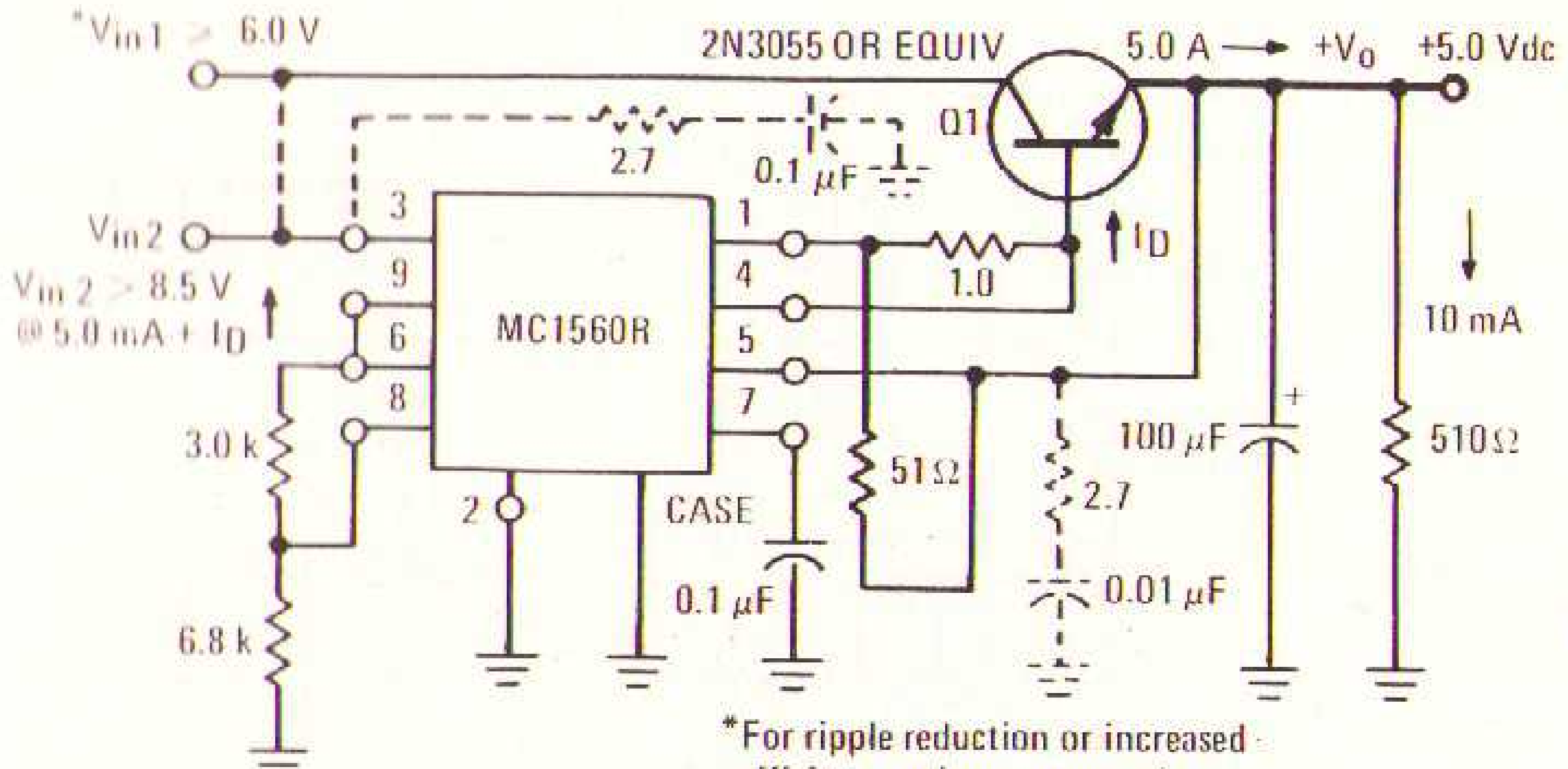
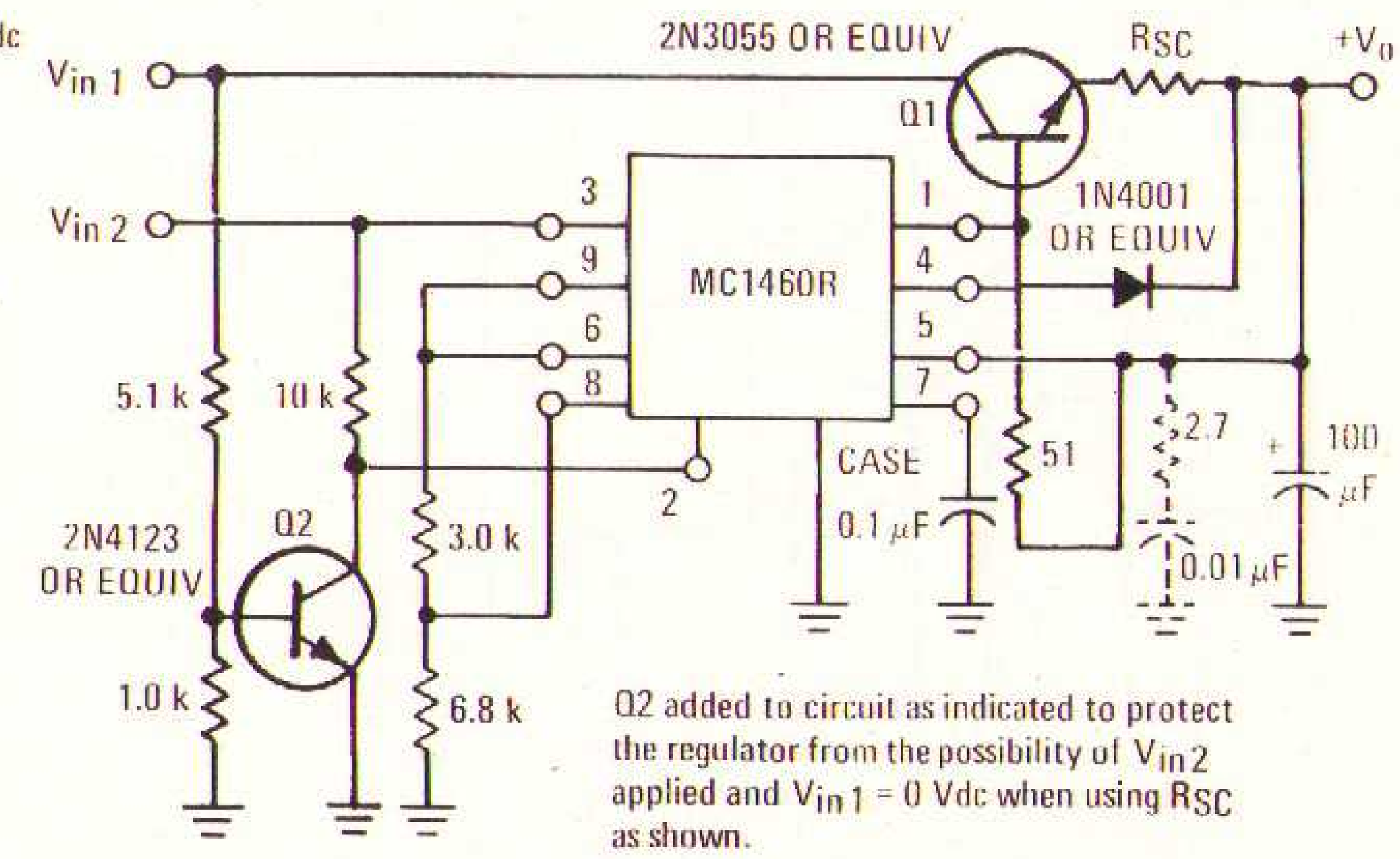


FIGURE 18 – NPN CURRENT BOOST CIRCUITS



*For ripple reduction or increased efficiency at low output voltages, the collector of Q1 can tie to a separate low-voltage supply as shown.



Q2 added to circuit as indicated to protect the regulator from the possibility of $V_{in\,2}$ applied and $V_{in\,1}$ = 0 Vdc when using R_{SC} as shown.

TYPICAL APPLICATIONS (continued)

FIGURE 19 – PNP CURRENT BOOST CIRCUIT

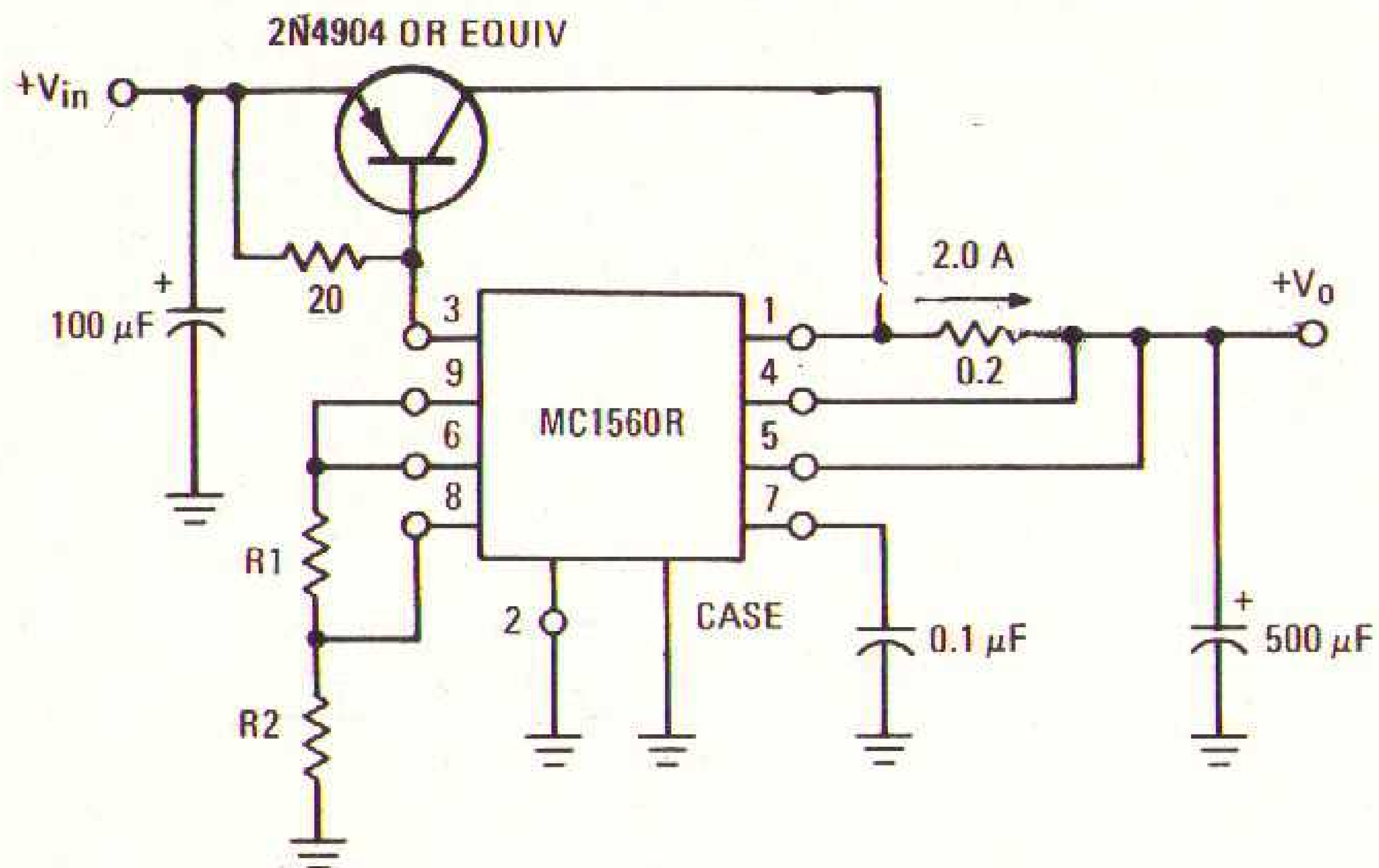
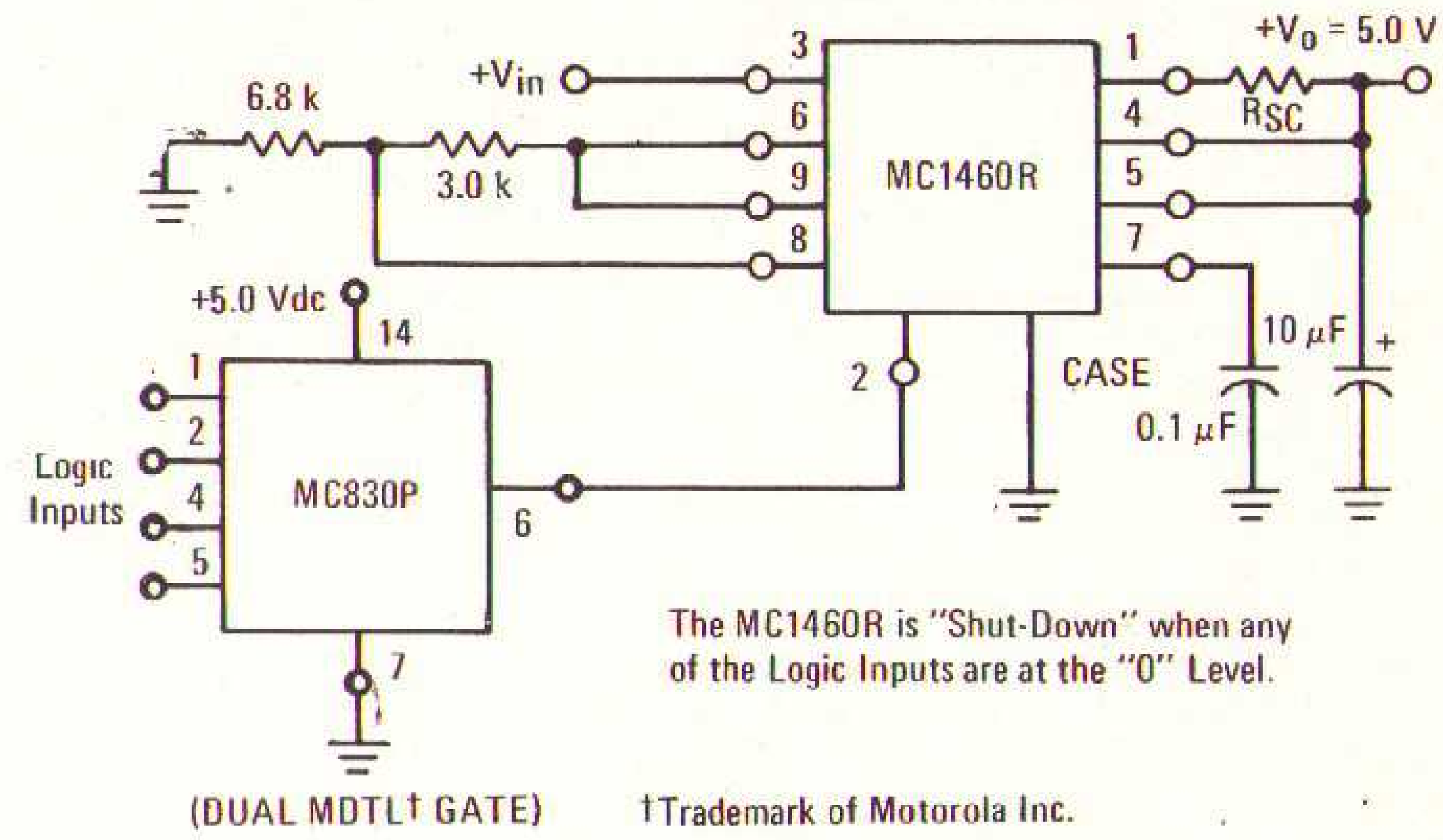


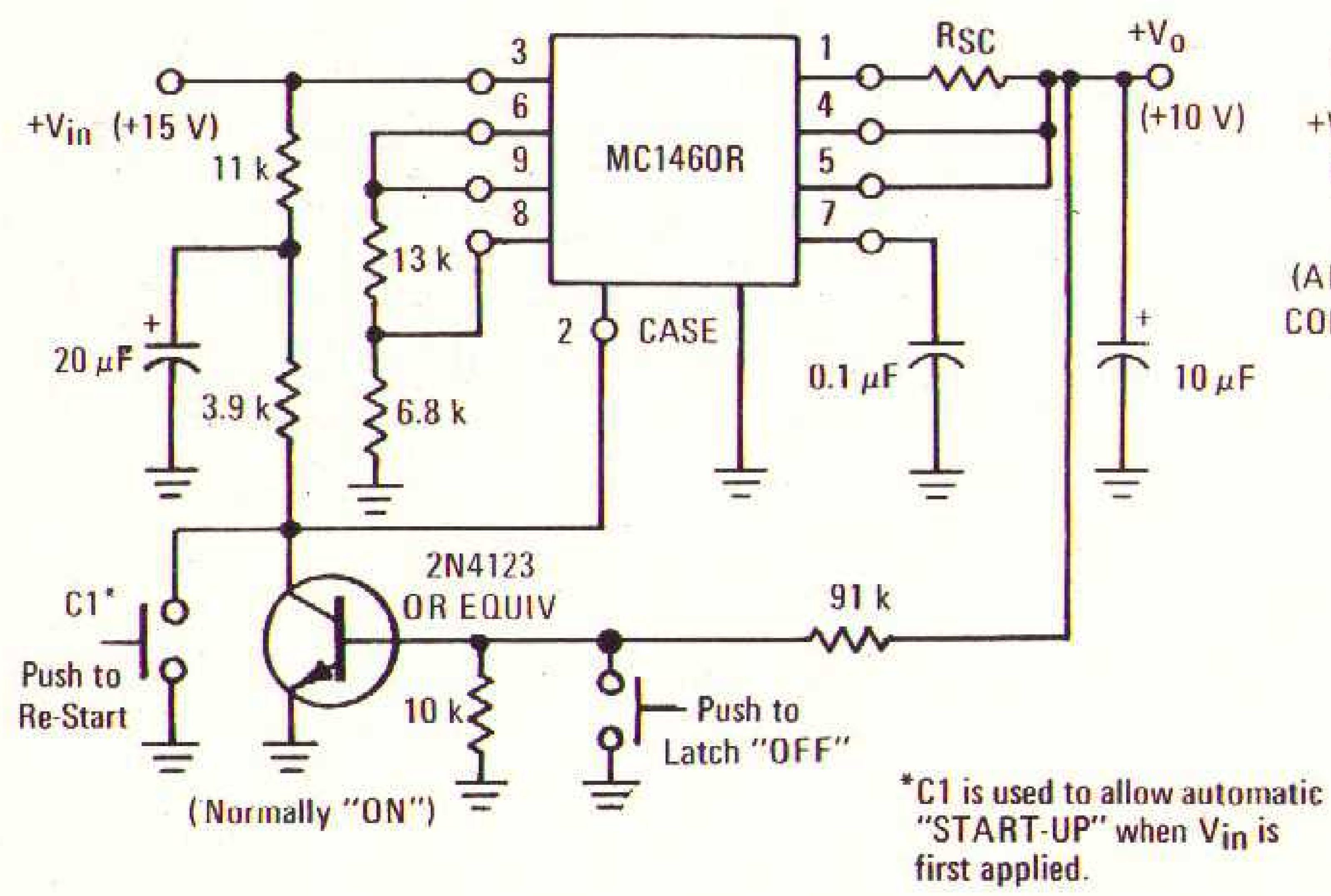
FIGURE 20 – ELECTRONIC SHUT-DOWN USING A MDTL GATE



The MC1460R is "Shut-Down" when any of the Logic Inputs are at the "0" Level.

†Trademark of Motorola Inc.

FIGURE 21 – AUTOMATIC LATCH INTO SHUT-DOWN WHEN OUTPUT IS SHORT-CIRCUITED WITH MANUAL RE-START



*C1 is used to allow automatic "START-UP" when V_{in} is first applied.

FIGURE 22 – SCR "CROWBAR" OVER-VOLTAGE PROTECTION

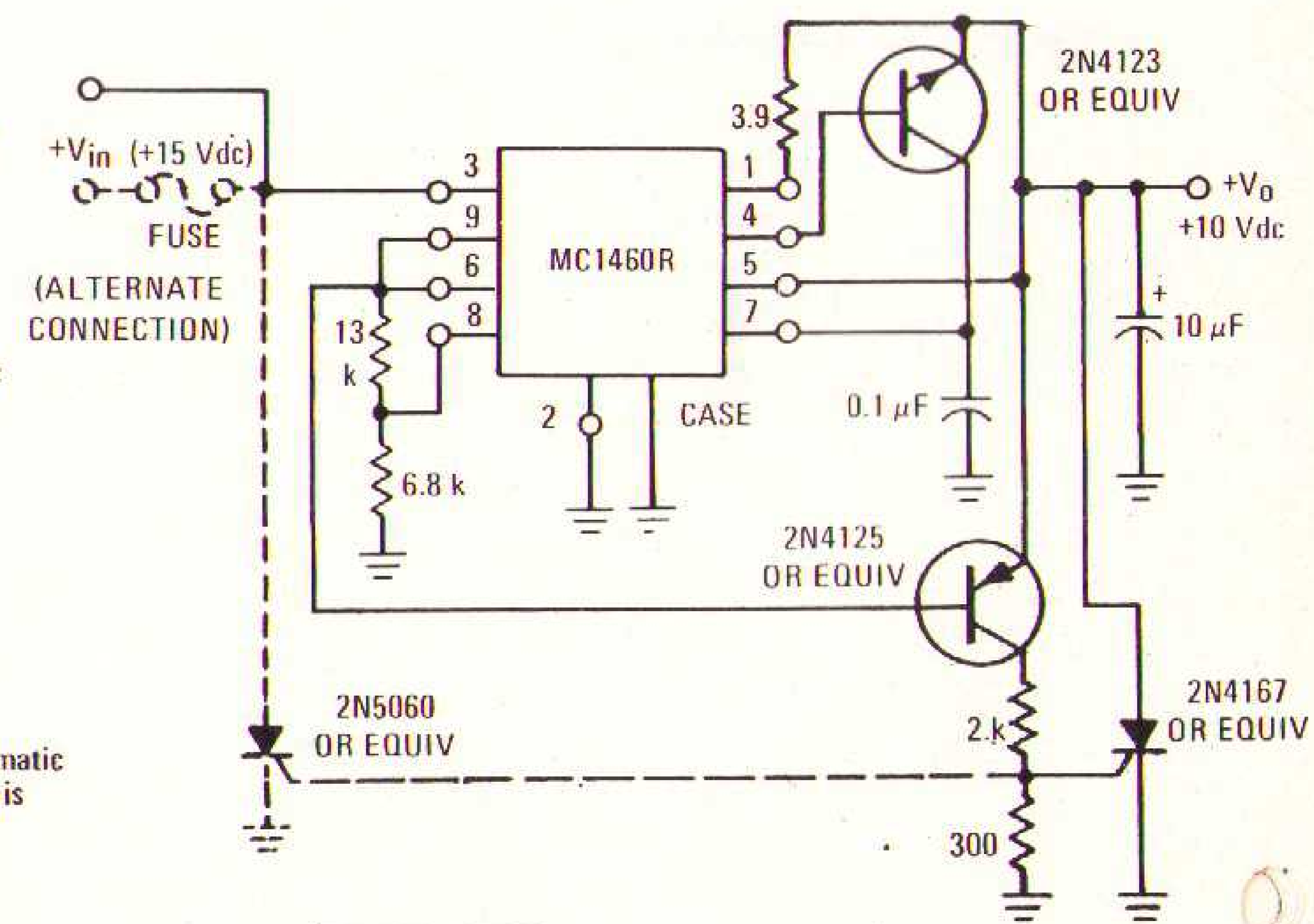
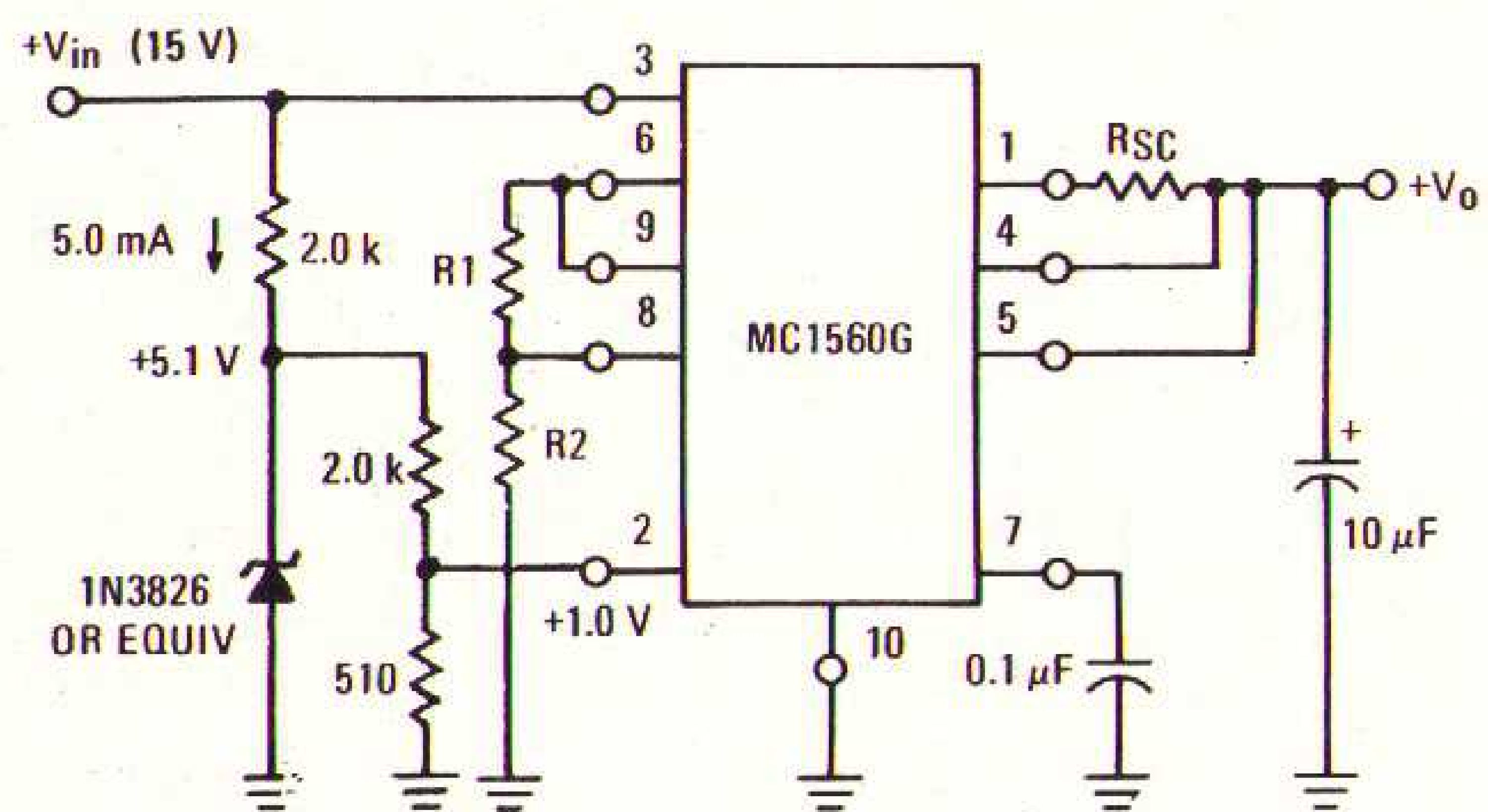


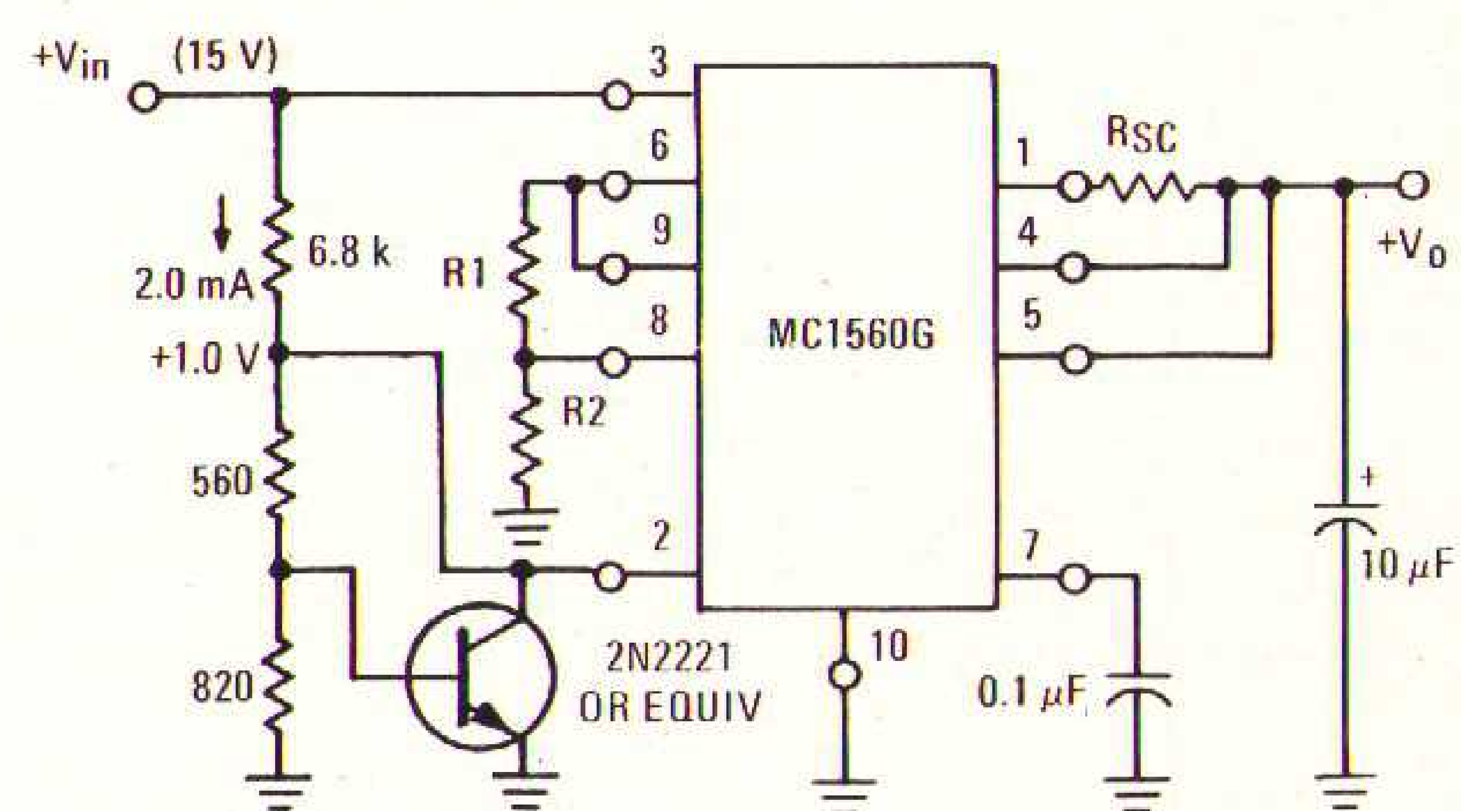
FIGURE 23 – LIMITING MAXIMUM-JUNCTION TEMPERATURE

FIGURE a. – USING A ZERO TC REFERENCE

FIG. b – USING A T_A REFERENCE

$V_{pin\ 2}$ (for shut-down) $\approx 1.38 - 3.4 \times 10^{-3}\ (T_J - 25^oC)$





TYPICAL APPLICATIONS (continued)

FIGURE 24 – THERMAL SHUTDOWN WHEN USING EXTERNAL PASS TRANSISTOR

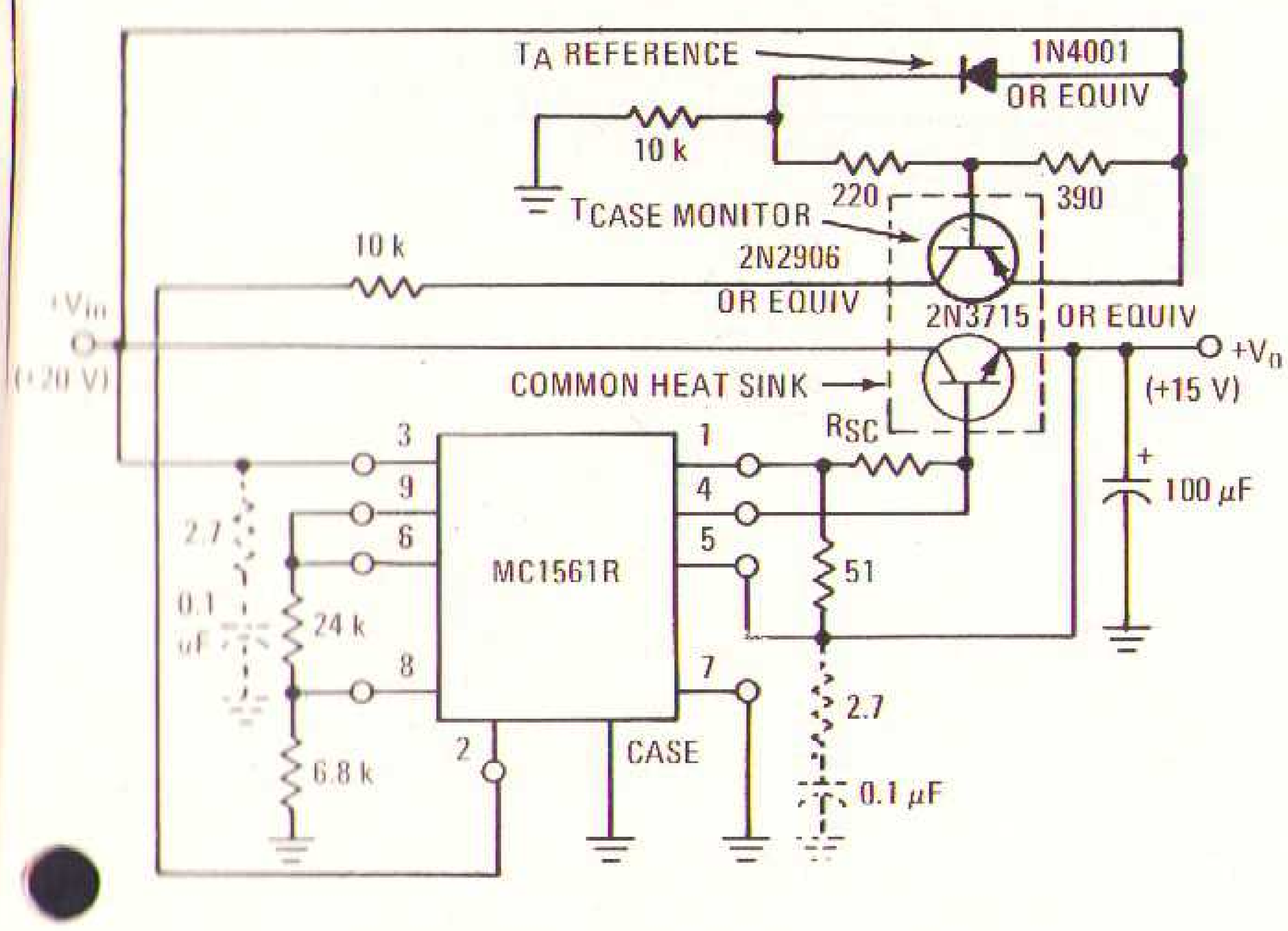


FIGURE 25 – LOW DUTY CYCLE SHORT CIRCUIT PROTECTION WITH AUTOMATIC RESET

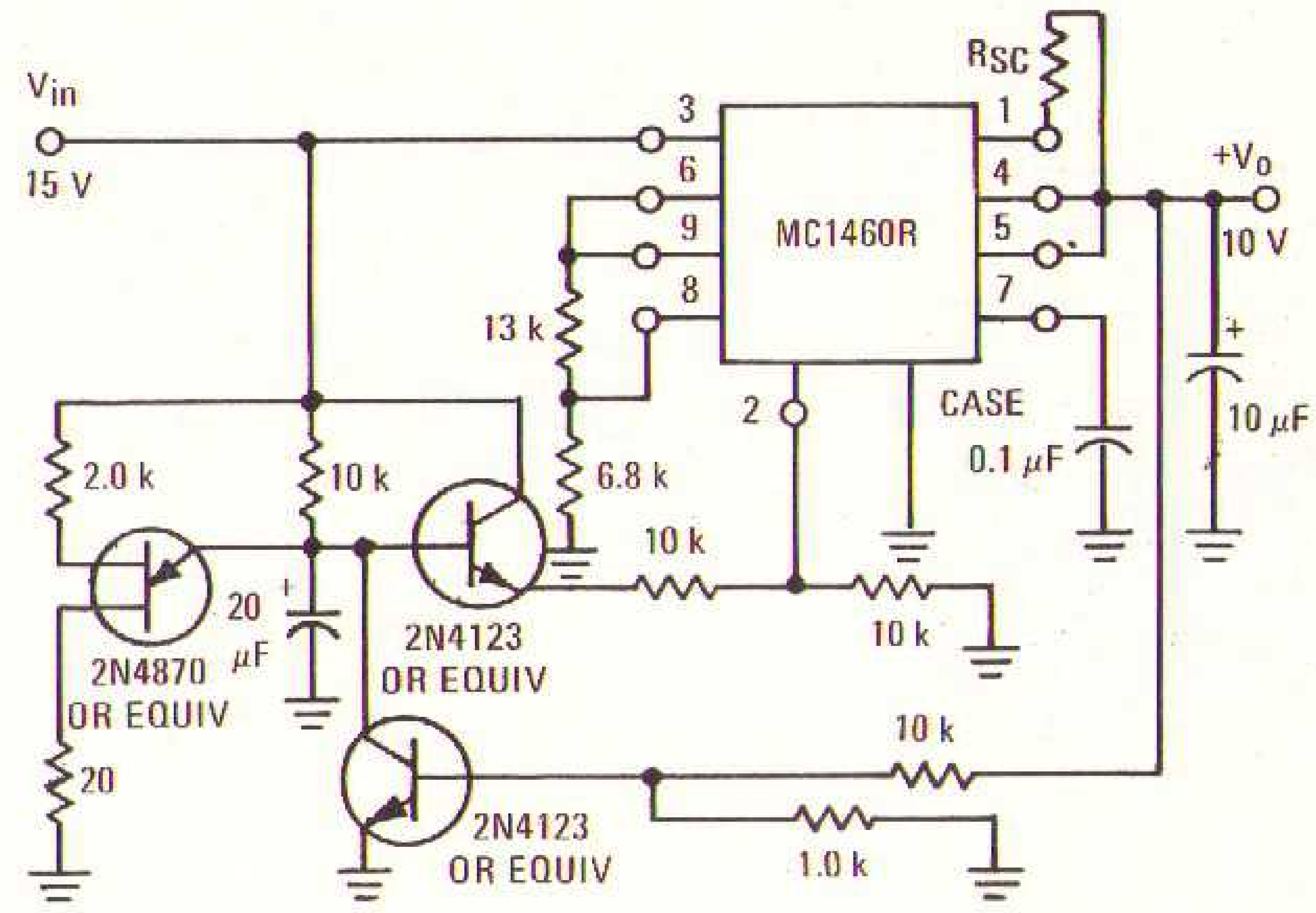


FIGURE 26 – CONNECTION FOR A NEGATIVE OUTPUT VOLTAGE

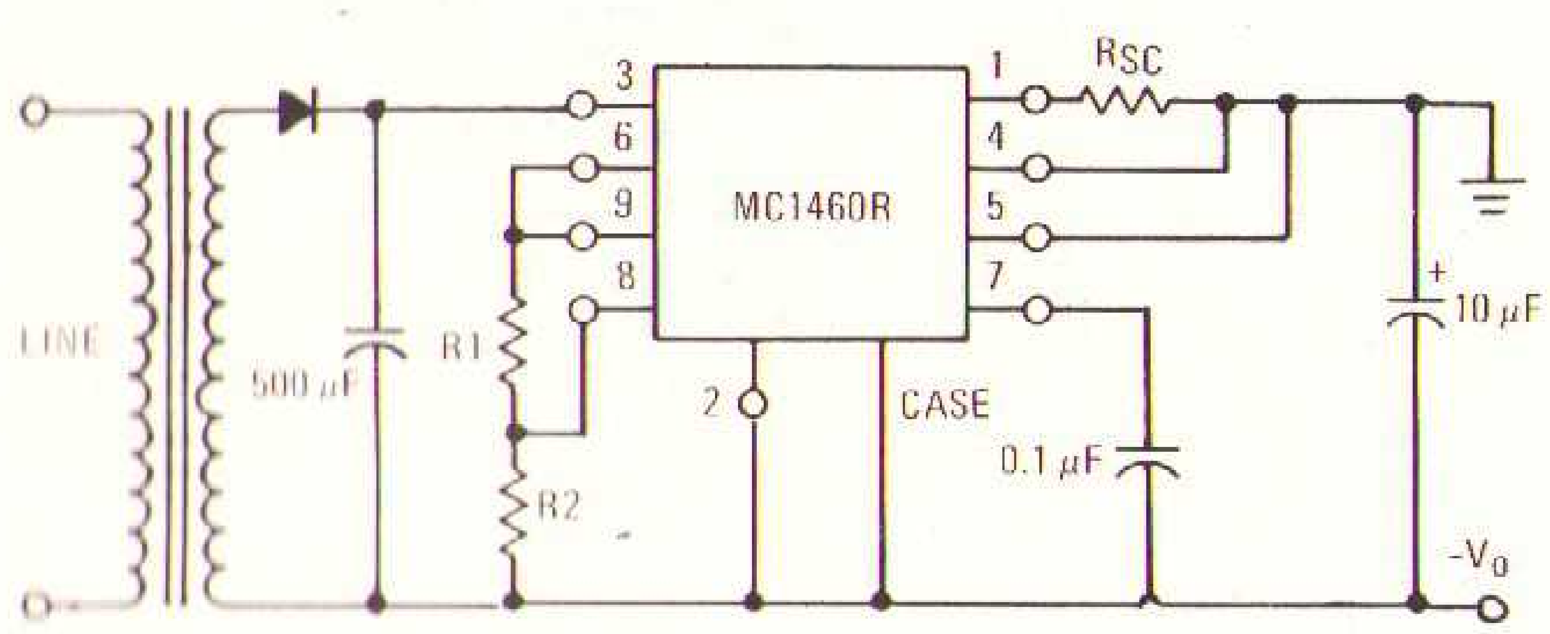


FIGURE 27 – DIGITALLY CONTROLLED 3-TERMINAL NEGATIVE REGULATOR

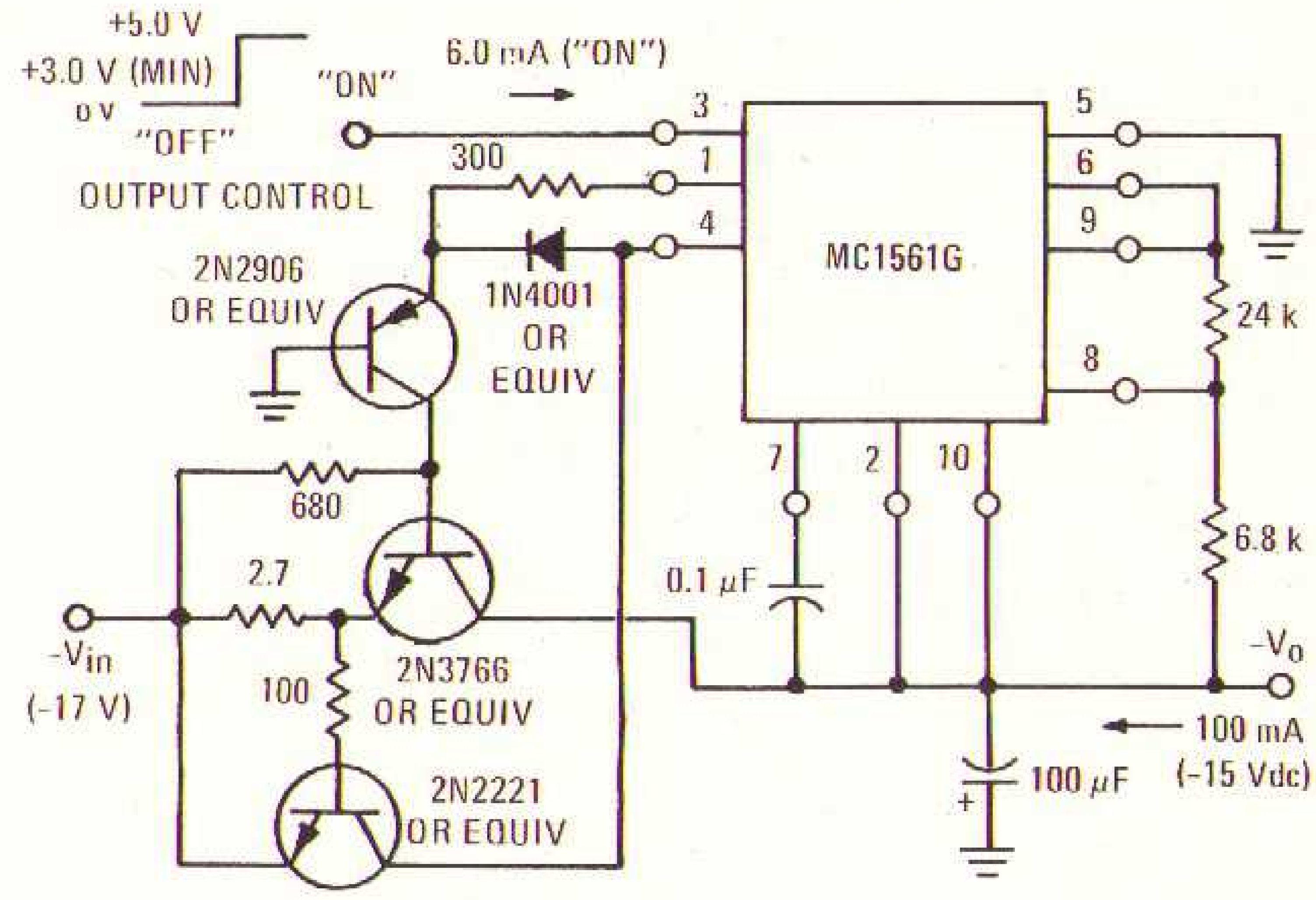


FIGURE 28 – A ZERO TC ADJUSTABLE "ZENER" REFERENCE

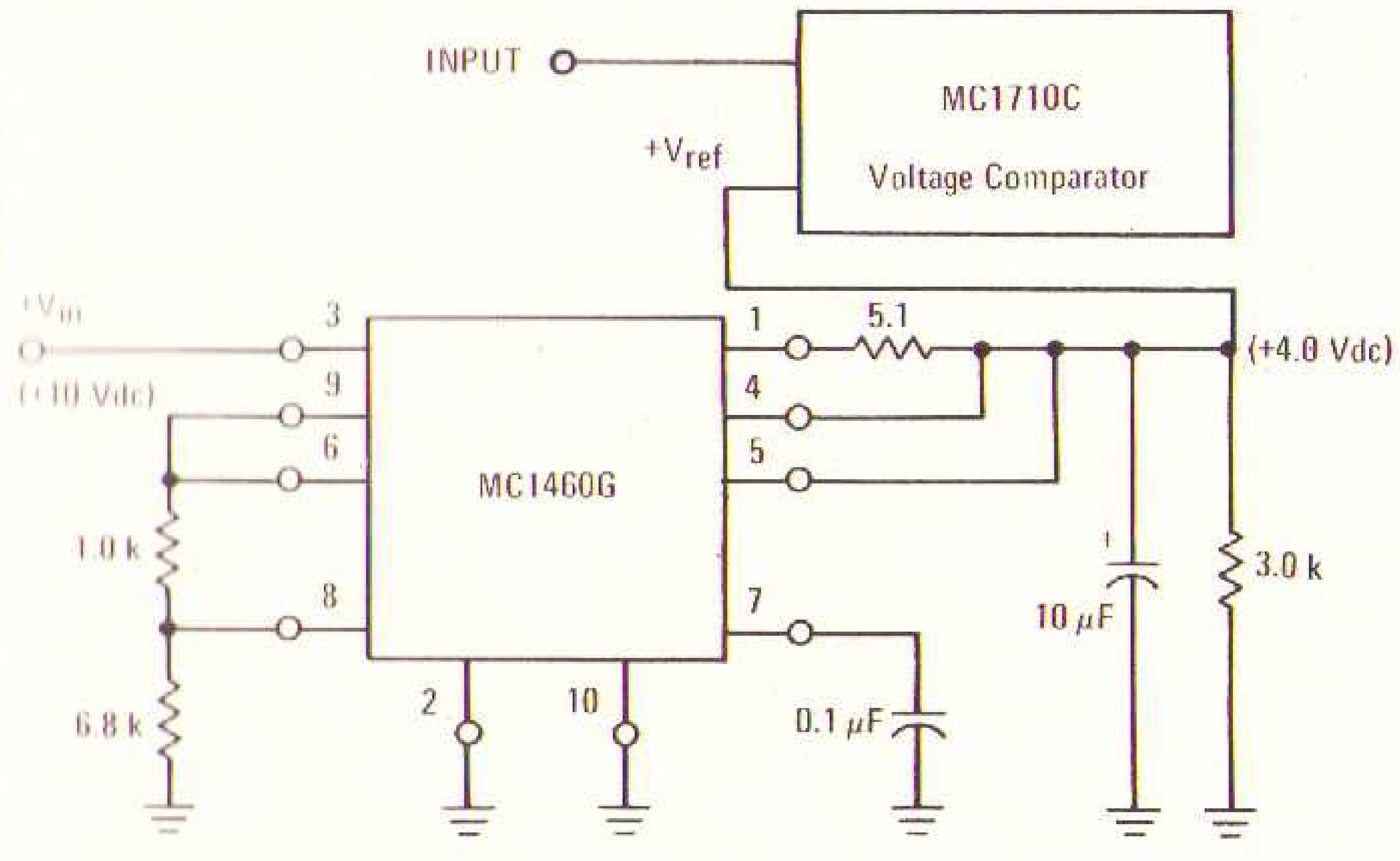
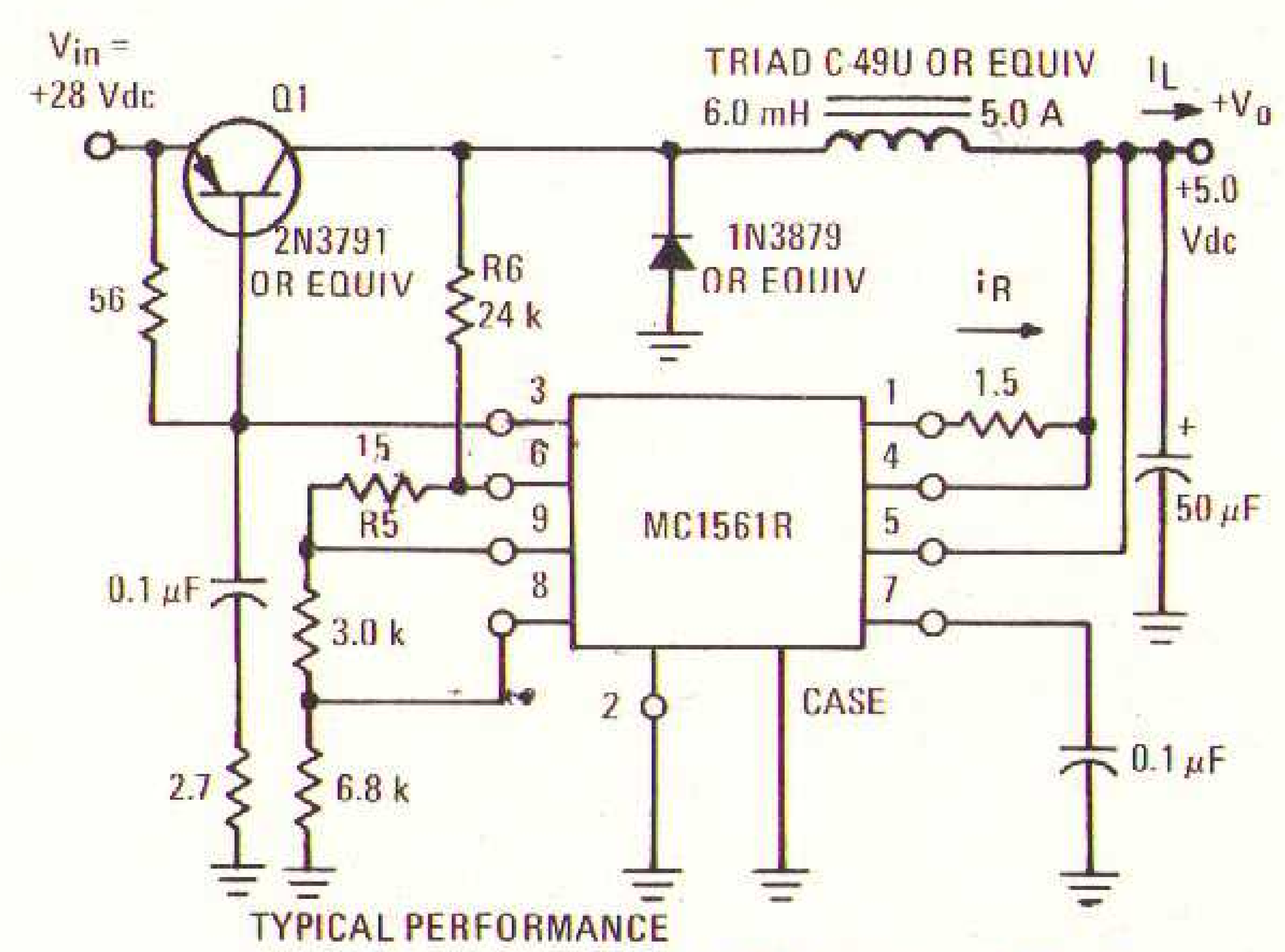


FIGURE 29 – A SWITCHING REGULATOR



TYPICAL PERFORMANCE
For an I_L change from 50 mA to 5.0 A, V_o changes 50 mV.
For a V_{in} change from 10 V to 30 V, V_o changes 22 mV.
Ripple < 60 mV_{p-p}

INTEGRATED VOLTAGE REGULATOR

THERMAL CHARACTERISTICS

FIGURE 30 – THERMAL RESPONSE, "G" PACKAGE

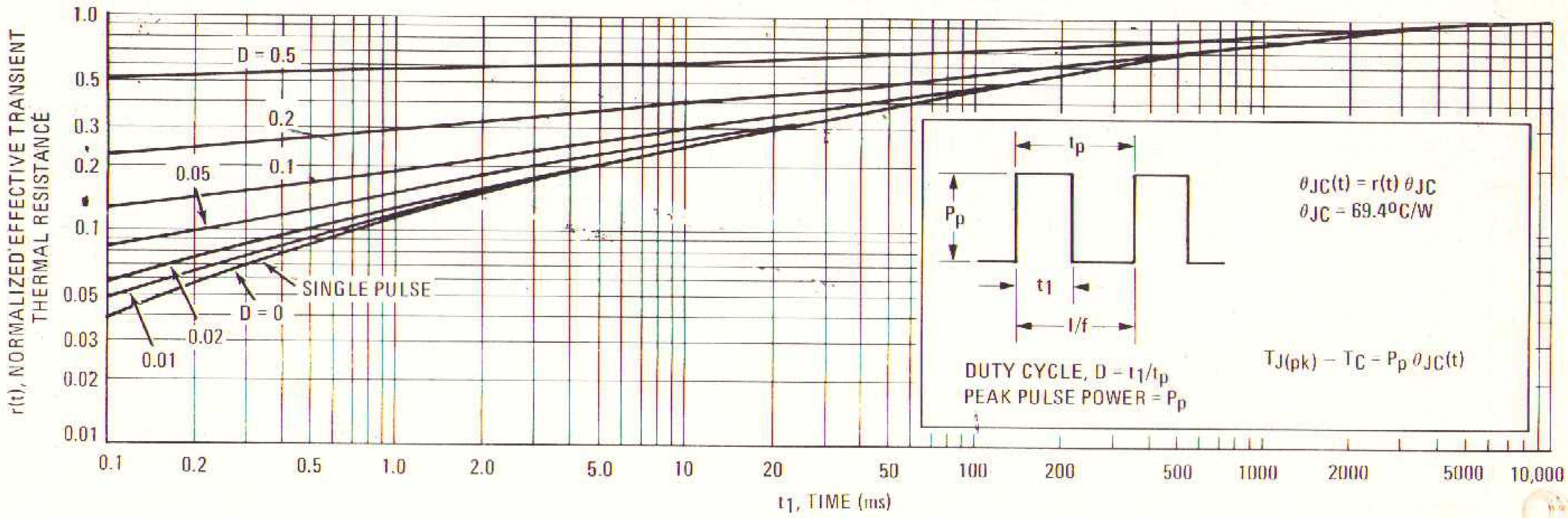
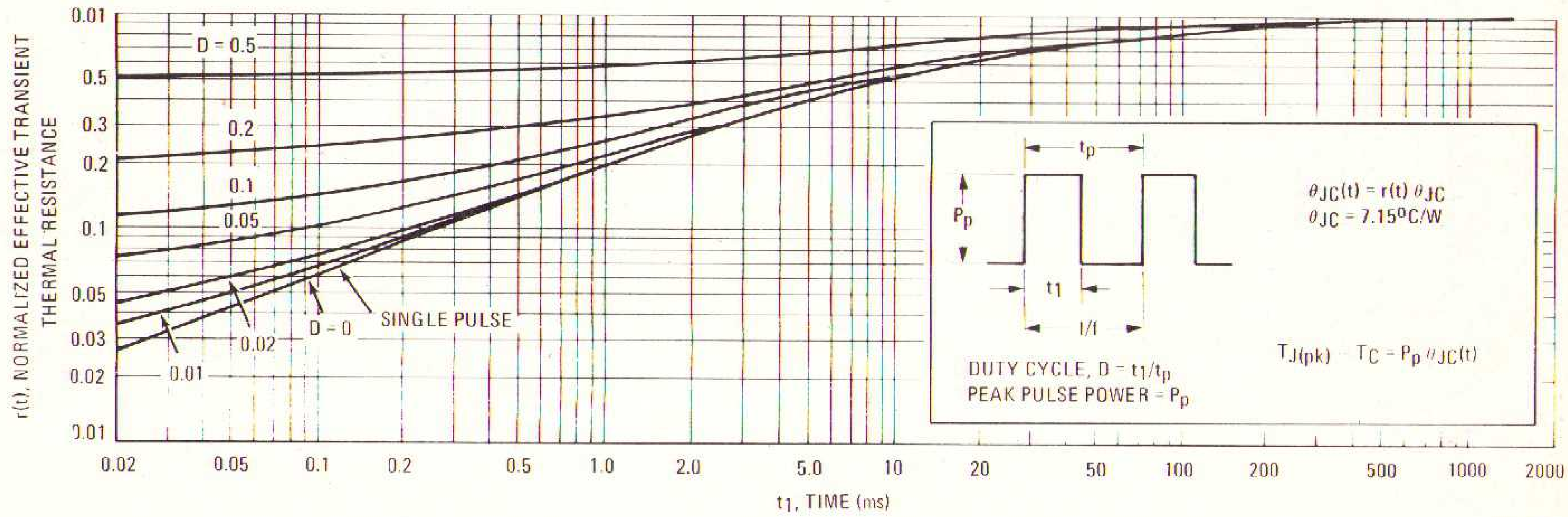


FIGURE 31 – THERMAL RESPONSE, "R" PACKAGE



DISIGN NOTE: Use of Transient Thermal Resistance Data.

Example:

The thermal response curves can be used to predict the maximum junction temperature of the IC Regulator used in the Switching Regulator of Figure 29.

Given

$V_{in} = 28$ V
$V_o = 5.0$ V
$f \cong 6.5$ kHz
$T_C = 50^oC$
$\theta_{JC} = 7.15^oC$/Watt ("R" package)
$I_R \cong 275$ mA Peak Current

The Peak Voltage across the MC1561R, V_R, is:

$V_R = V_{in} - V_{BE(Q1)} - V_o$ and $V_{BE(Q1)} \approx 1.0$ V

$V_R \approx 28 - 1.0 - 5.0 = 22$ V

$P_p = I_R \times V_R = (0.275\ A)\ (22\ V) = 6.05$ Watts

Neglecting the Series Drop in the Regulator

$V_o \cong V_{in} \times D$

$D \cong \frac{V_o}{V_{in}} = 5/28 = 0.18$

$t_p = 1/f = \frac{1}{6.5\ kHz} = 154\ \mu s$

$t_1 = D\ t_p = (0.18)\ (154)\ \mu s = 27.7\ \mu s$

From Figure 31

$r(t) = 0.2$

$\theta_{JC}(t) = r(t)\ \theta_{JC} = (0.2)(7.15) = 1.43^oC$/Watts

$T_{J(pk)} = \theta_{JC}(t)\ P_p + T_C$

$T_{J(pk)} = (1.43)\ (6.05) + 50^o = 58.7^oC$

Note: $T_{J(pk)}$ must not exceed 150^oC.

ELECTRONIC INNOVATIONS IN ACTION
SEMICONDUCTORS

Integrated Circuit
Low Level Amplifier

PA230

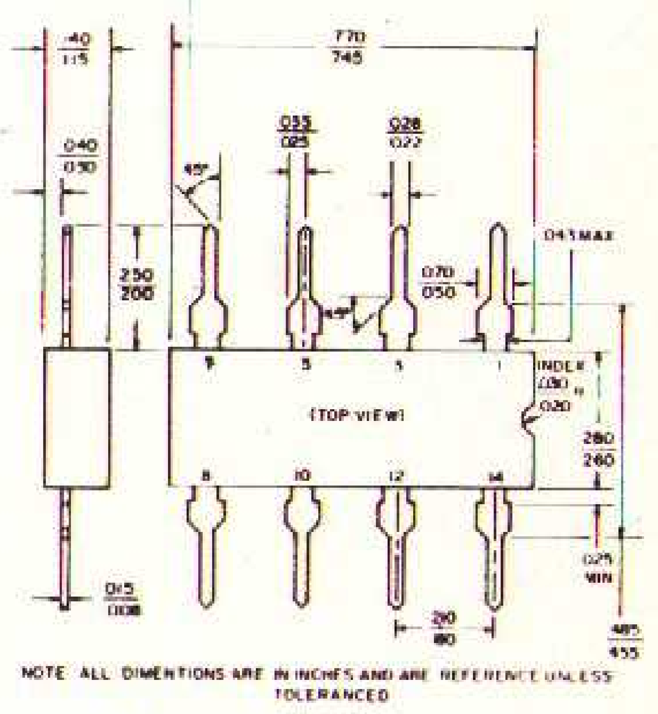
The General Electric PA230 is a monolithic integrated circuit designed and specified as a low level amplifier. This device features an expanded operating temperature range, output short circuit protection, high voltage gain, and low noise. Applications within consumer-industrial products include audio preamplifiers and general purpose small signal amplifiers.

Features:
1. −55°C to +110°C Operating Temperature
2. +12 Volts Supply
3. 10 V_{P-P} Output
4. Short Circuit Protection
5. Dual-in-line Package

Applications:
1. General Purpose DC Amplifier
2. Audio Preamplifier

absolute maximum ratings: (25°C) (unless otherwise specified)

Supply Voltage (Pin 3 to 8)	V_{CC}	14	Volts
Operating Temperature	T_A	−55°C to +110°C	
Storage Temperature	T_{STG}	−65°C to +150°C	
Package Dissipation (Free Air at 25°C) (Derate 8 mW/°C increase in ambient temperature above 25°C.)	P_T	800	mW

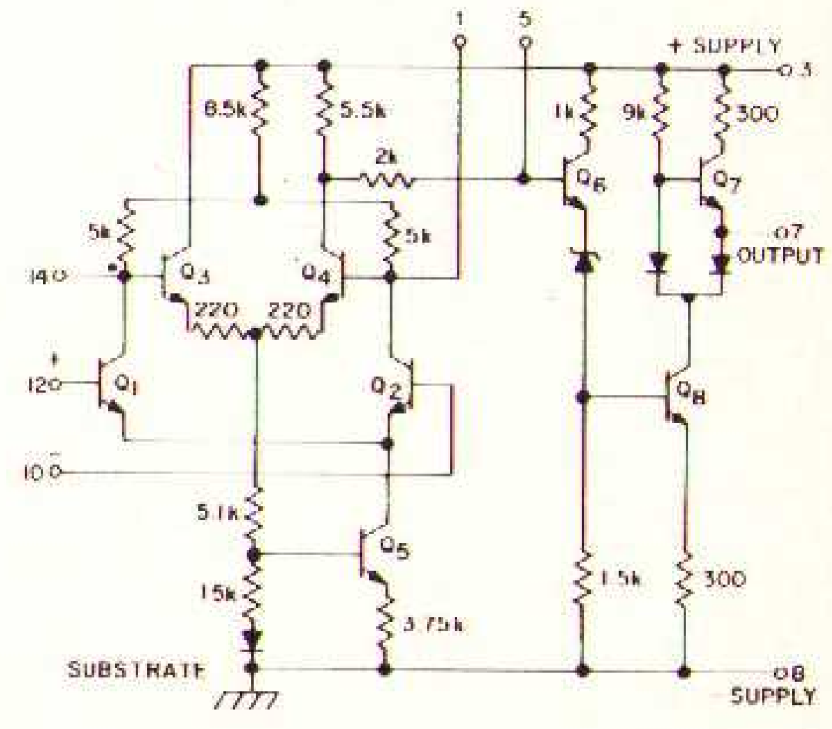


PACKAGE OUTLINE

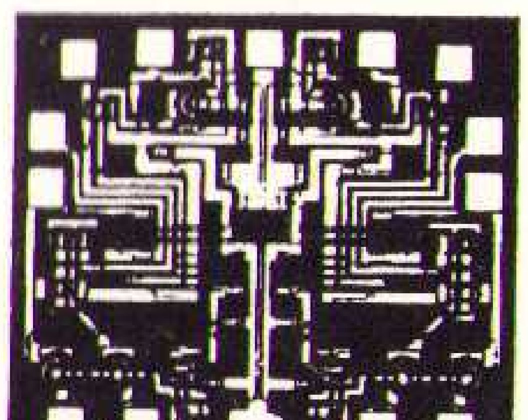
electrical characteristics: V_{CC} = +12 Volts (25°C)

(unless otherwise specified)

	Min.	Typ.	Max.	
Open Loop Voltage Gain	4	7	12	k
Supply Current		3	5	mA
Input Unbalance Voltage		2.0	10	mV
Input Bias Current		2		μA
Input Noise Voltage (R_g = 600 Ohms, BW = 30 Hz to 20 kHz)		2		μV
Open Loop Bandwidth (3 dB down)		0.5		MHz
Input Resistance	15	35		kOhms
Output Resistance		100	200	Ohms
Output Voltage Swing (R_L = 6 kOhms)	9	10		V_{P-P}
Distortion (Open Loop at 1 kHz)		1	3	%
(Closed Loop Gain of 200 at 1 kHz)		.05		%



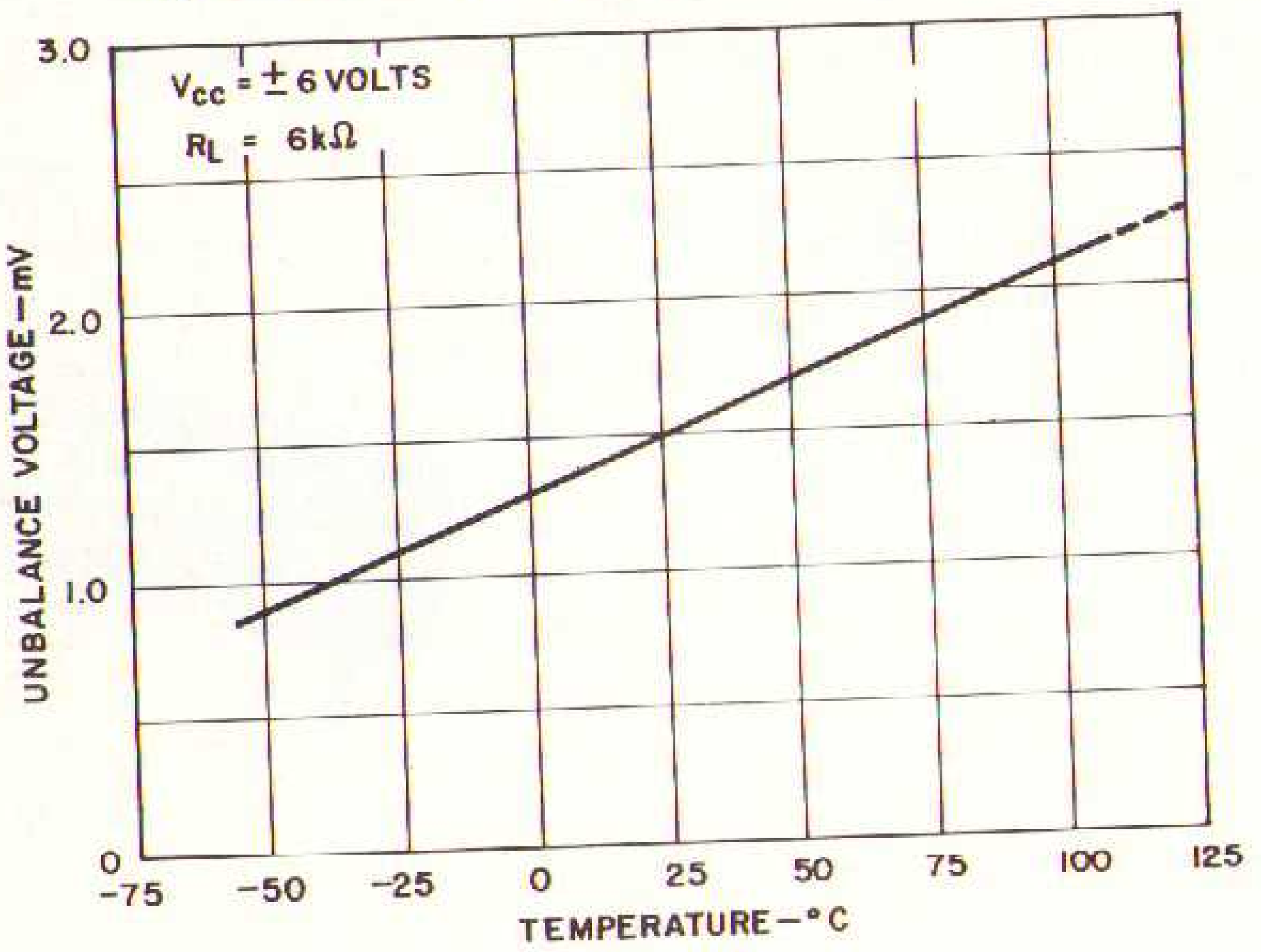
CIRCUIT DIAGRAM



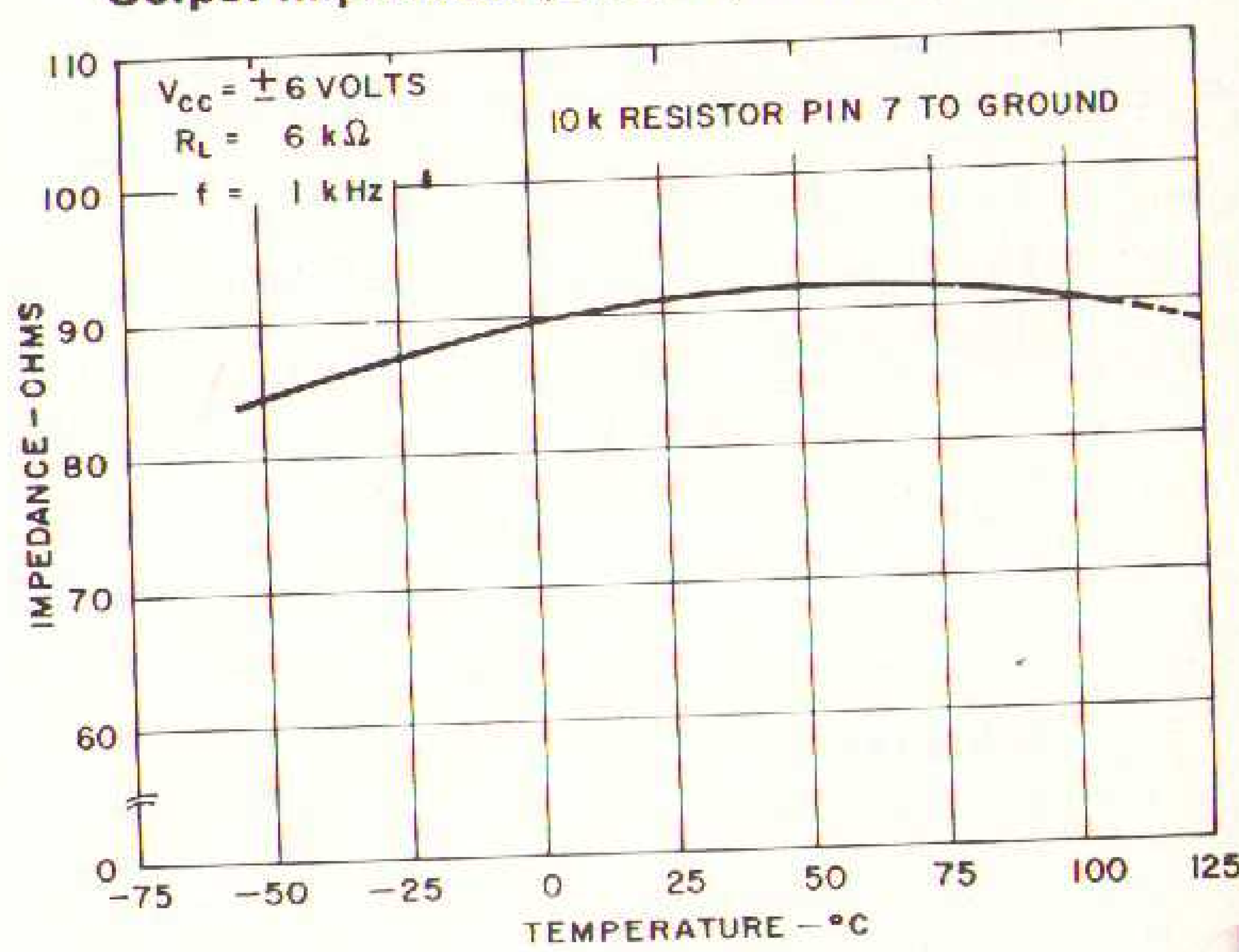
Van Dam Elektronica, Snellemanstraat 10-11, Rotterdam-noord
Telefoon: 010-240812-243497, administratie: 010 - 245516
Postgiro: 295550. Bank:AMRO-bank, Middellandstraat, Rotterdam.
Postorders en correspondentie aan: Postbus 3149 te Rotterdam.

Van Dam Elektronica, Reguliersgracht 105, Amsterdam, Telefoon: 020-248967.

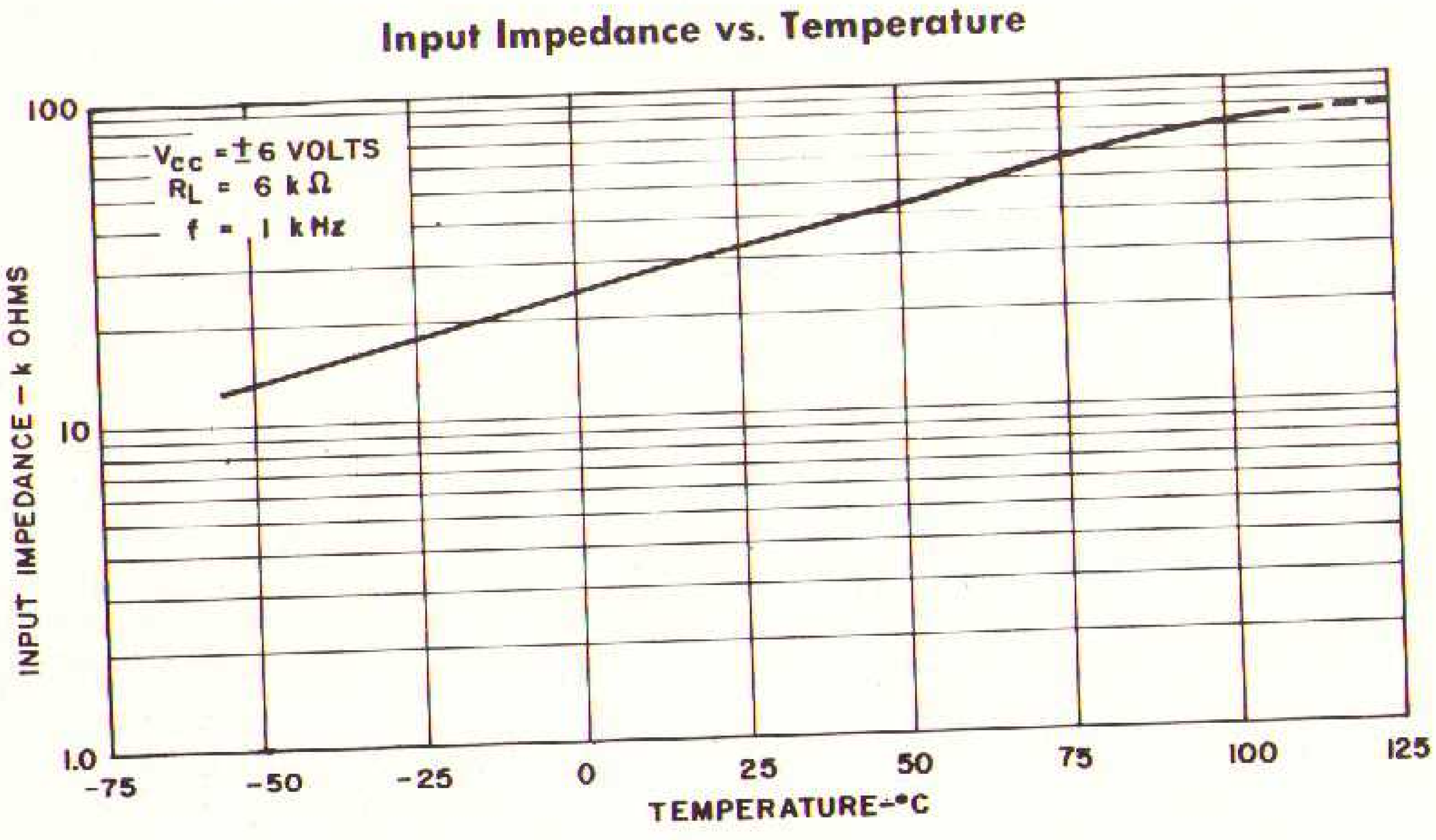
Input Unbalance Voltage vs. Temperature



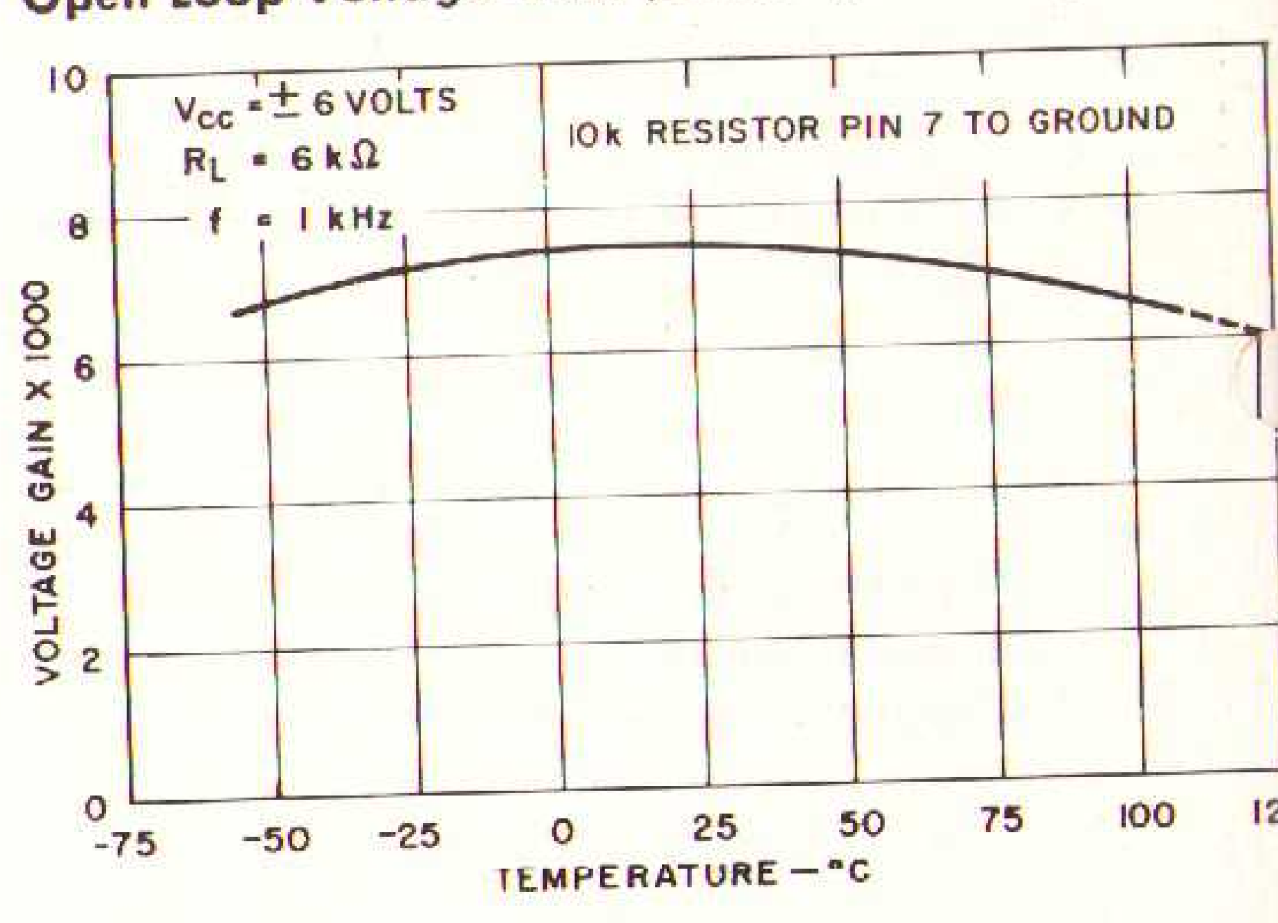
Output Impedance (Class A) vs. Temperature



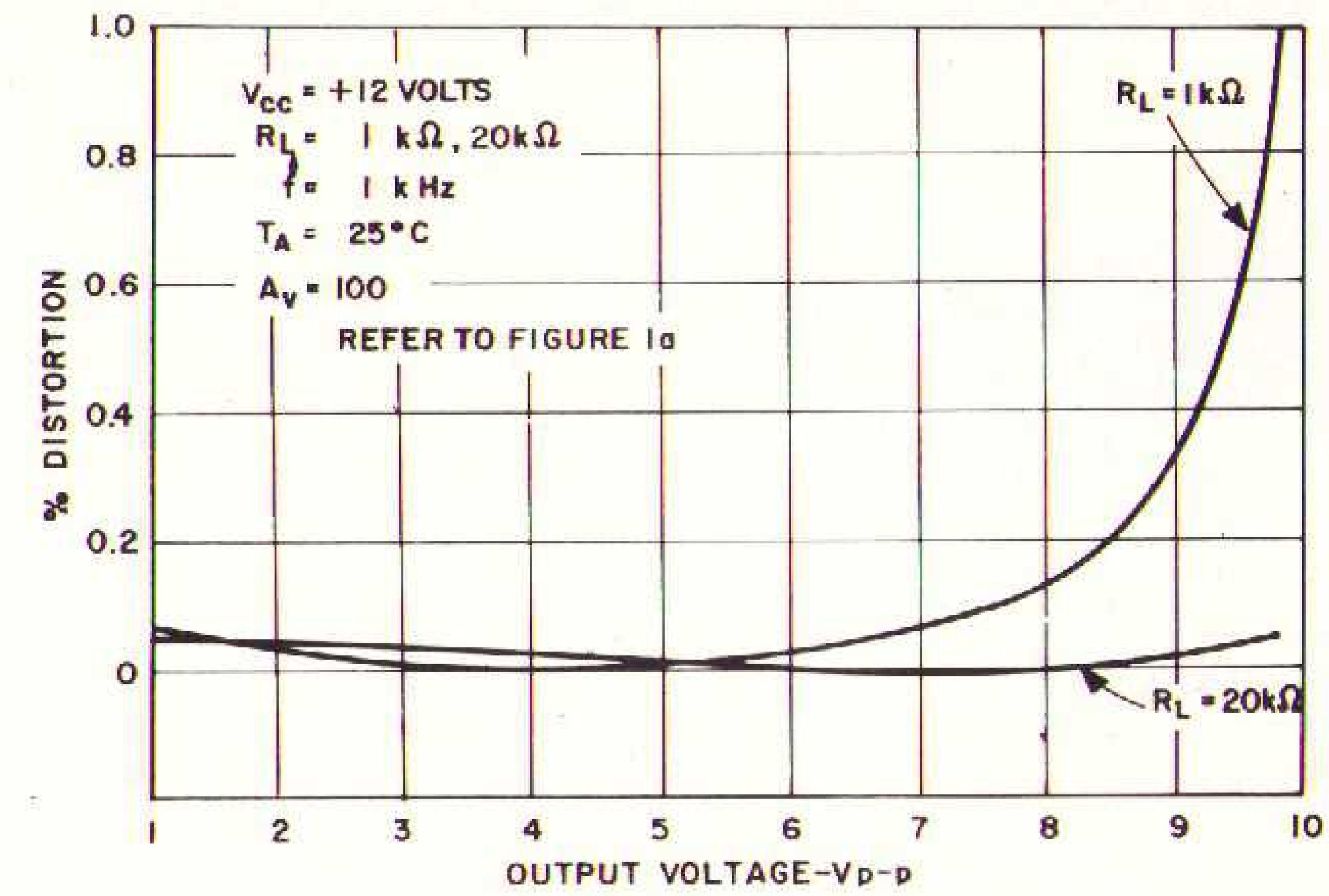
Input Impedance vs. Temperature



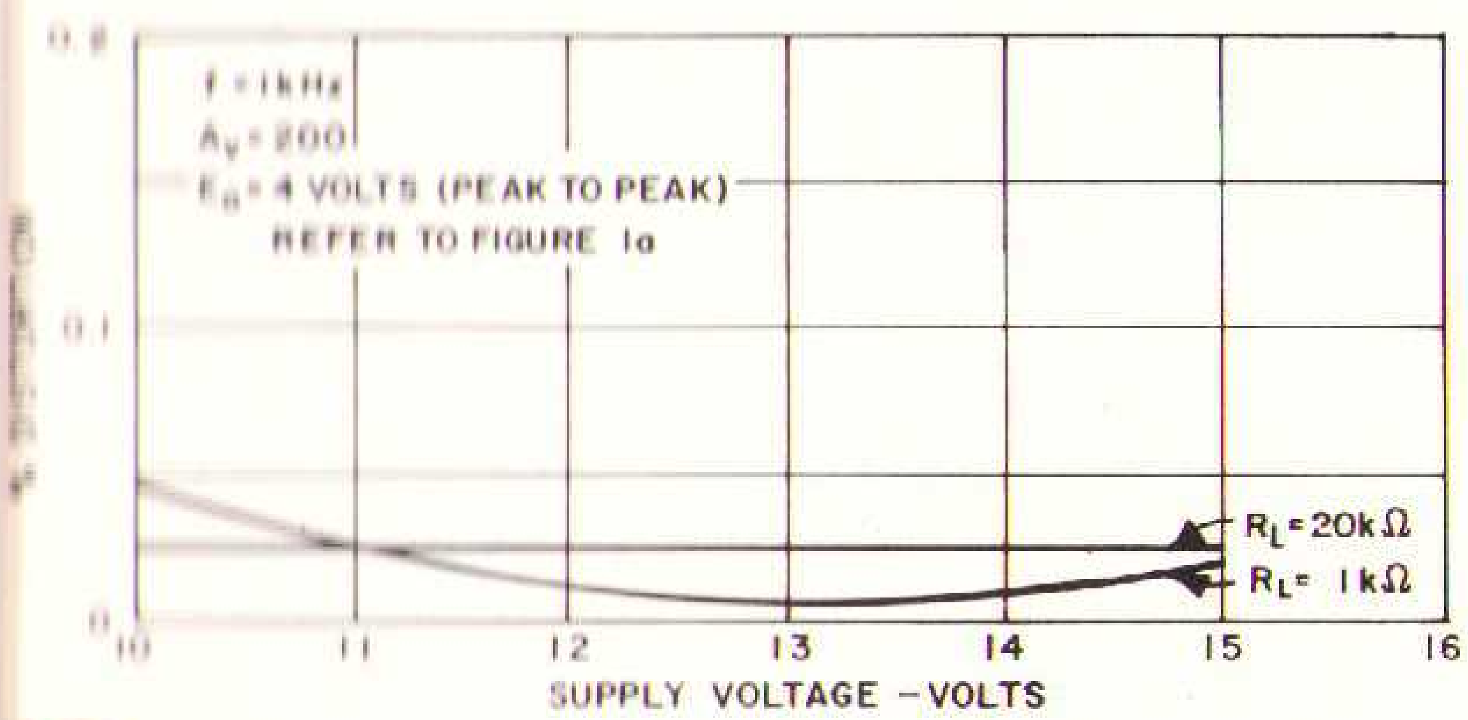
Open Loop Voltage Gain (Class A) vs. Temperature



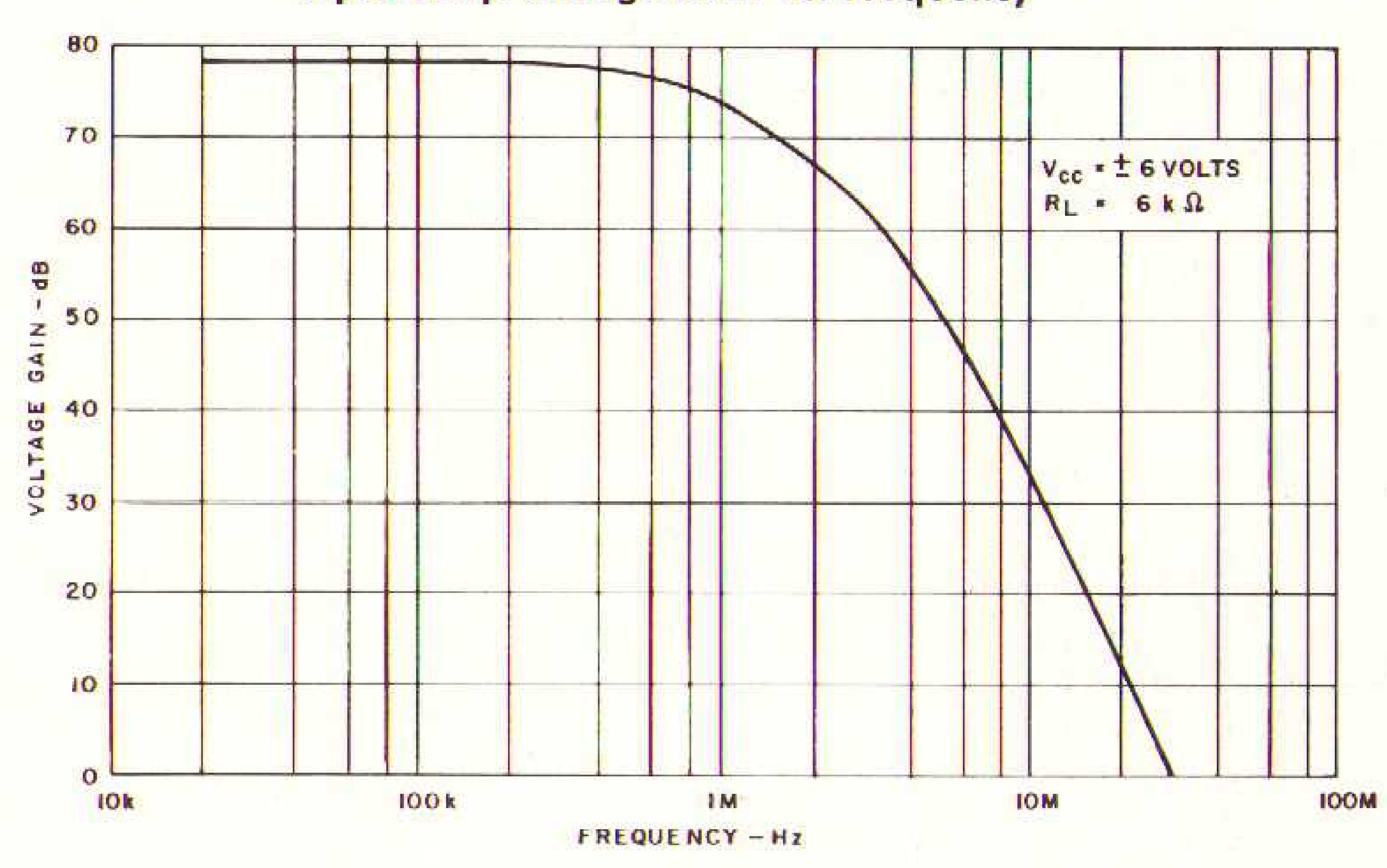
Total Harmonic Distortion vs. Output Voltage (P-P)



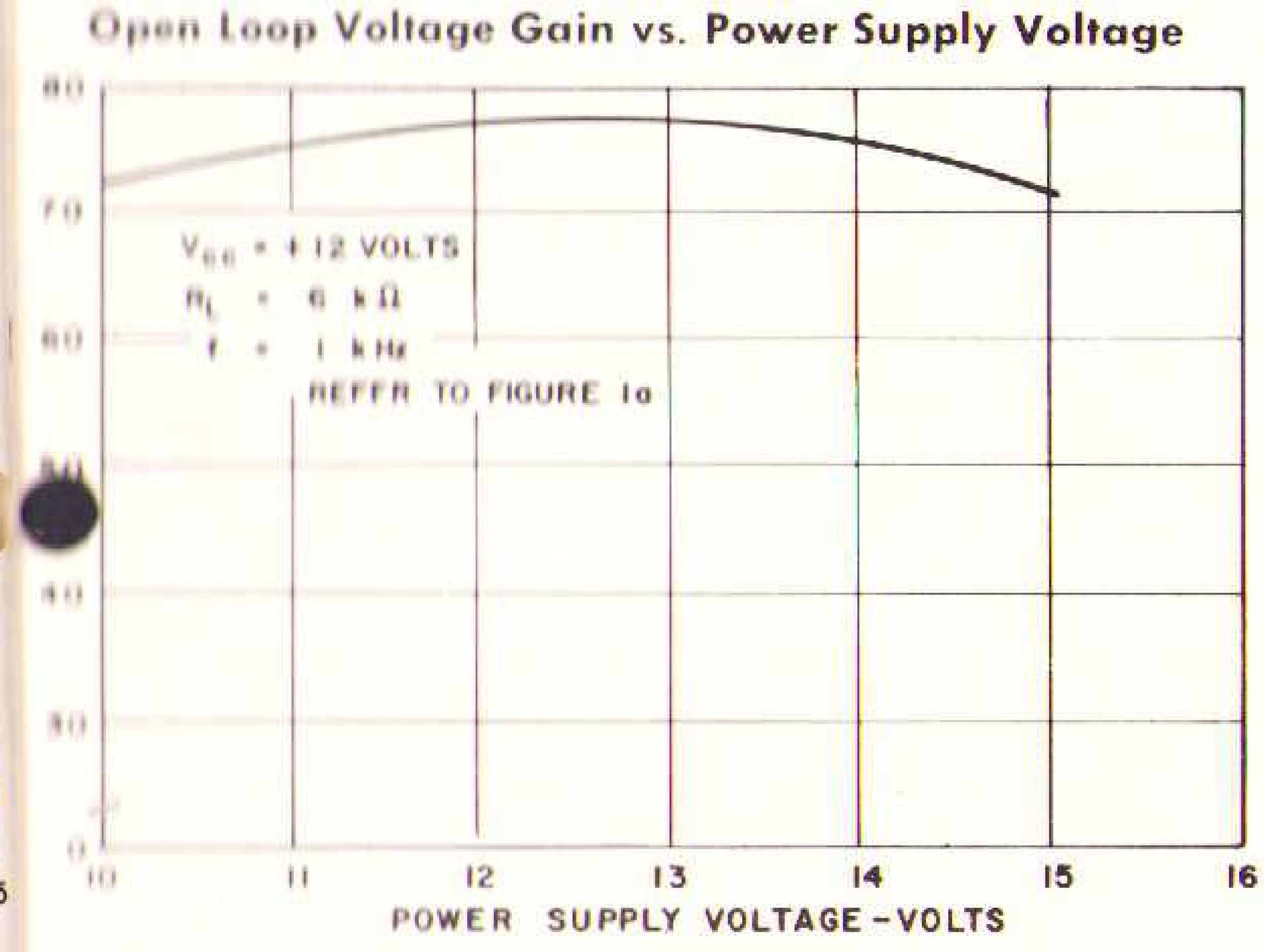
Total Harmonic Distortion vs. Power Supply Voltage



Open Loop Voltage Gain vs. Frequency



Open Loop Voltage Gain vs. Power Supply Voltage



DESIGN NOTES

The PA230 is a general purpose preamplifier that may be adapted to meet specific circuit requirements. Figure 1a indicates a multipurpose circuit whose gain and band pass characteristic may be set by the external components. A generalized frequency response is shown in Figure 1b, and Table I indicates one possible combination of external components that may be used to give an amplifier gain of 100 and a band pass of 30 Hz to 30 kHz.

A tape compensated network is shown in Figure 2a with its frequency response indicated in 2b. The tape equalization break point is set at 1 kHz; however, it may be adjusted by increasing or decreasing the 470 pF capacitor in Figure 2a.

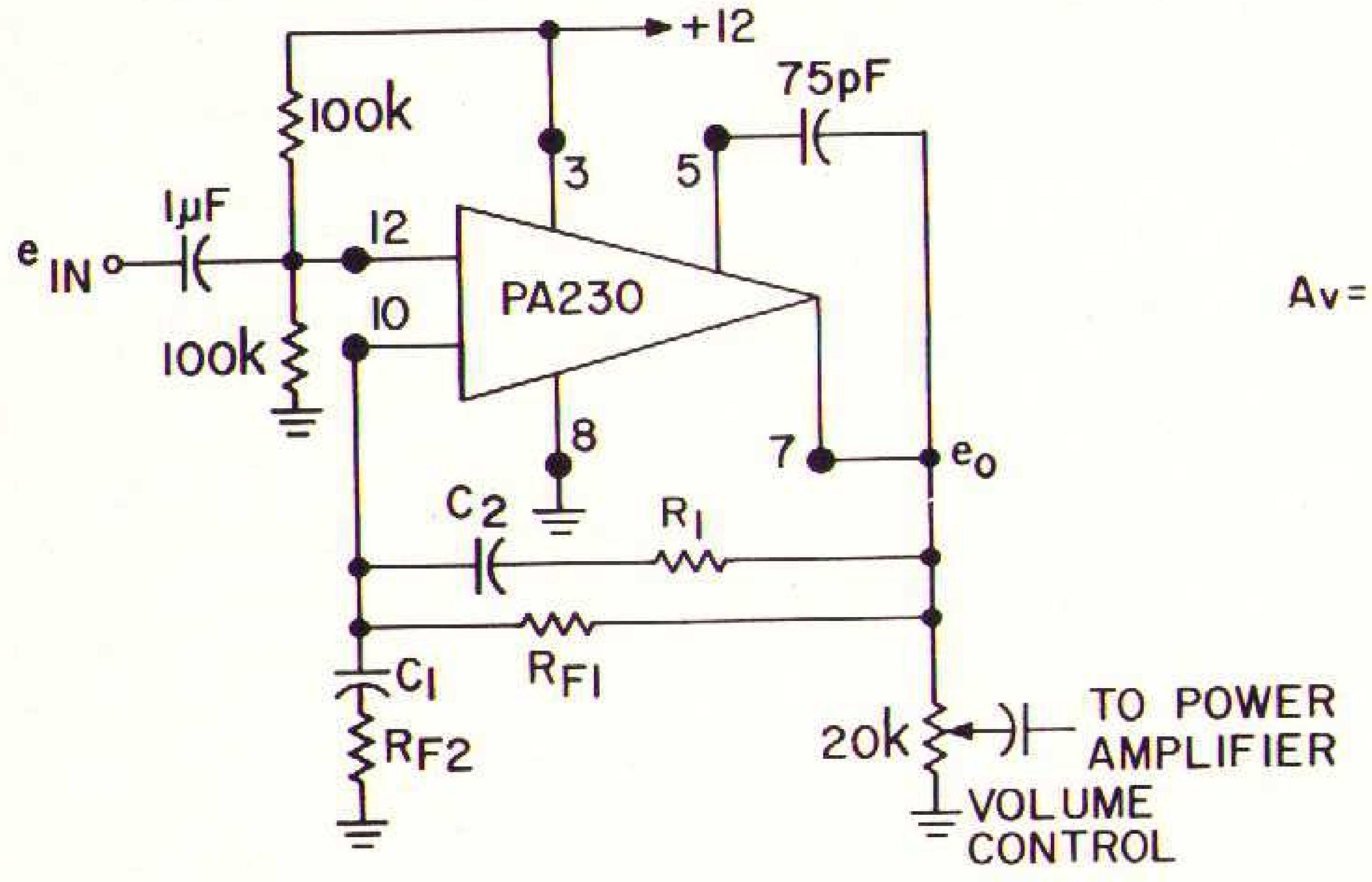
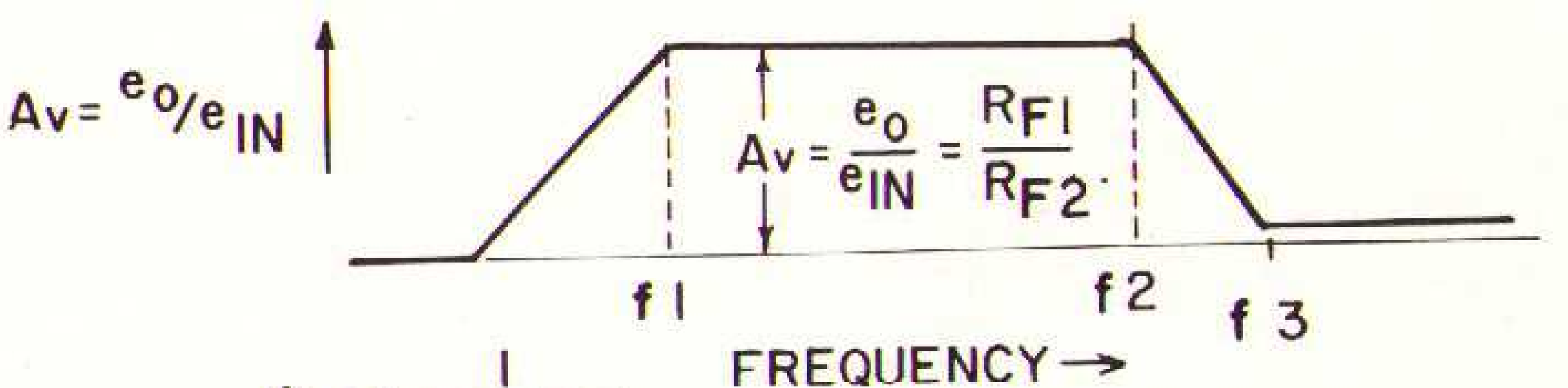


Figure 1a.



$f_1 = \frac{1}{2\pi R_{F2} C_1}$

$f_2 = \frac{1}{2\pi C_2 R_{F1}}$

$f_3 = \frac{1}{2\pi C_2 R_1}$

Figure 1b.

Table I

R_{F1}	R_{F2}	C_1	C_2	R_1	AV	f_1	f_2	f_3
51k	510	10 μF	100 pF	10k	100	30 Hz	30 kHz	150 kHz

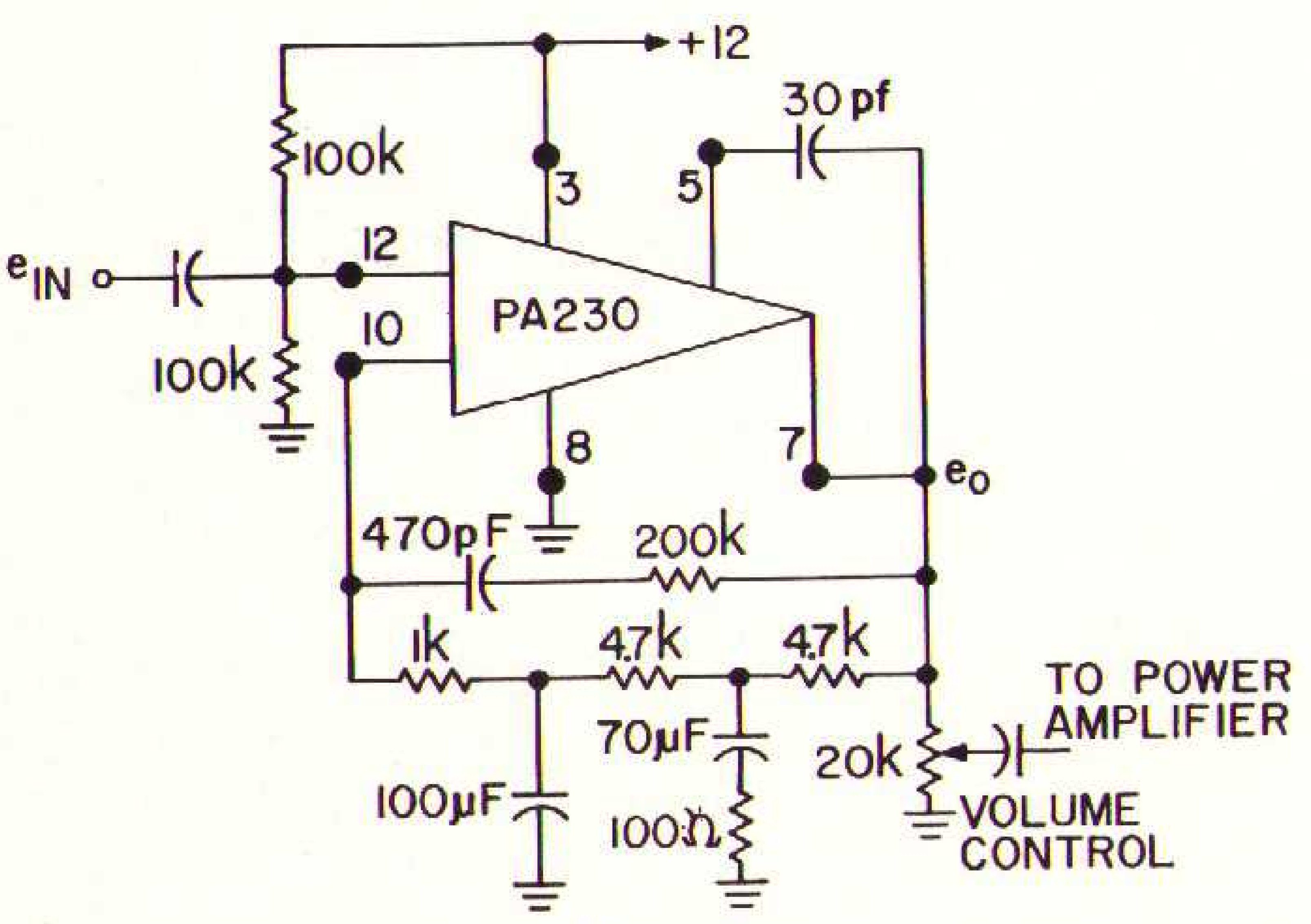


Figure 2a.

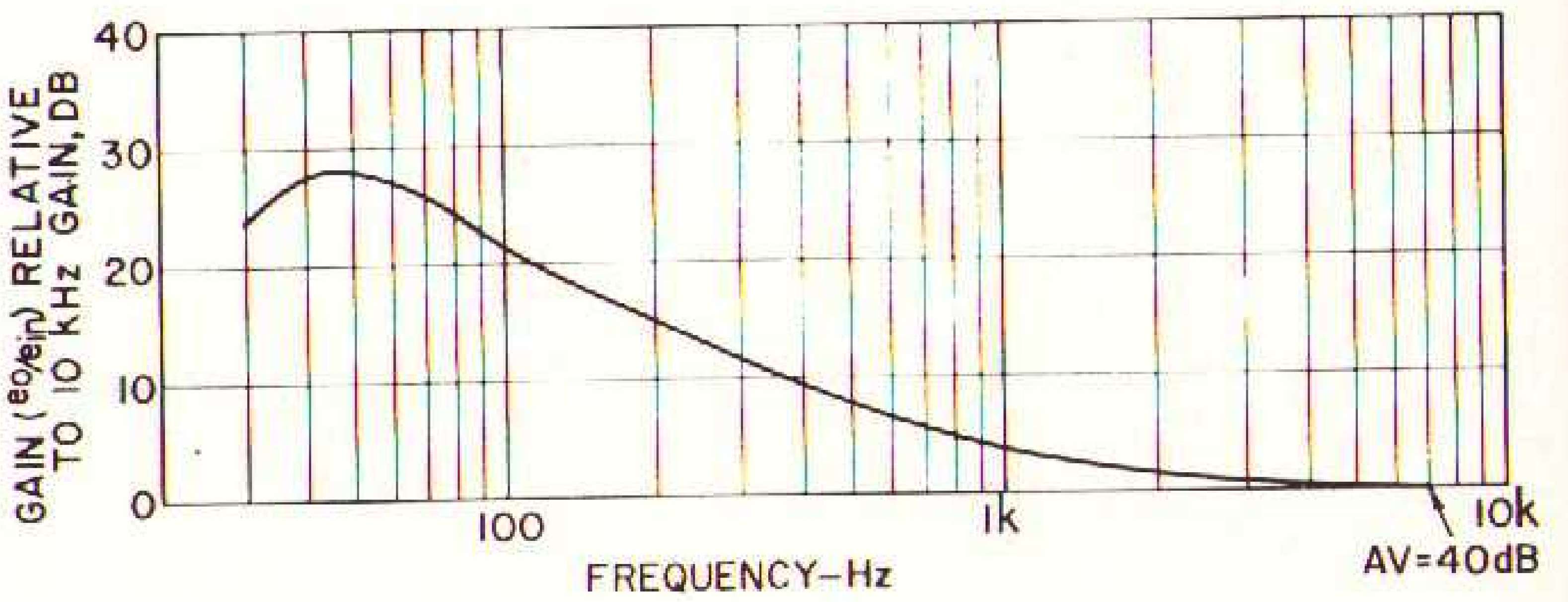


Figure 2b.

ELECTRONIC INNOVATIONS IN ACTION
SEMICONDUCTORS

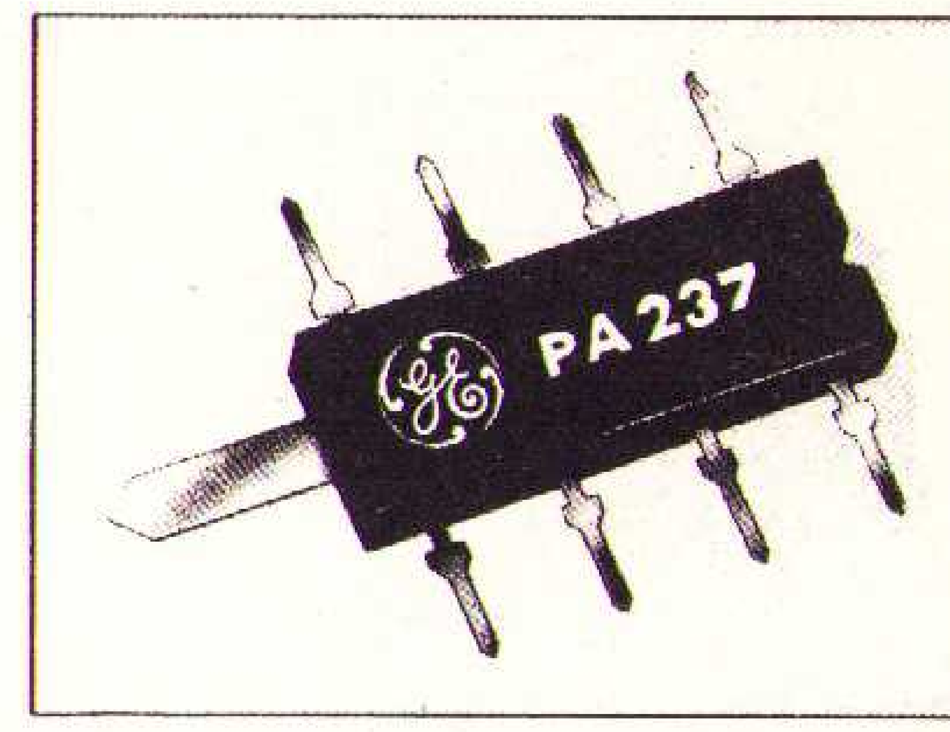
Integrated Circuit
2 Watt Audio Amplifier

85.23 4/68
Supersedes 85.23 8/67

PA237

Including Application Notes

The General Electric PA237 is a monolithic audio amplifier designed to deliver 2 watts of continuous power to a 16-ohm load. It can, however, be operated from a wide variety of supply voltages and load impedances, thereby providing user versatility. Housed in an 8-lead plastic dual-in-line package, the PA237 has an attached tab for heat transfer to a printed circuit board. In addition to many audio applications, the PA237 may also be utilized for several voltage regulator and servo amplifier uses.

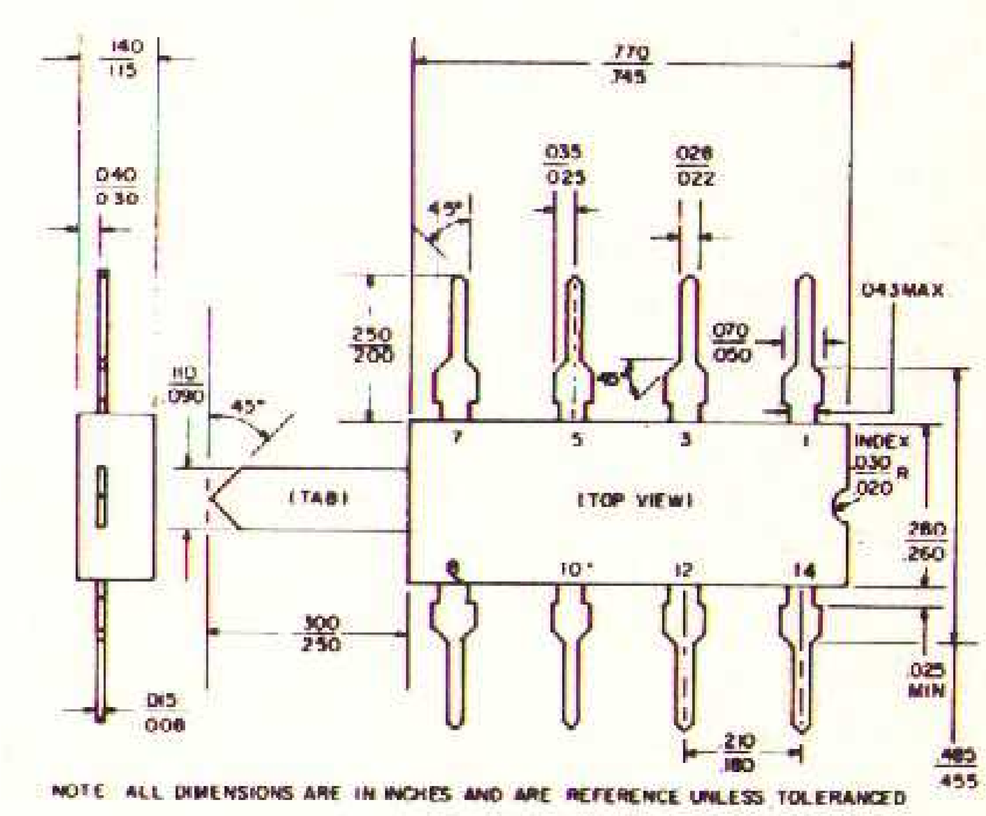


Features:

1. 2 watts output
2. 9 to 27 volts power supply range
3. Dual-in-line package
4. 8 m V sensitivity
5. −55°C to +125°C operating temperature

Applications:

1. Phonographs
2. Tape players/recorders
3. Dictating equipment
4. TV and FM receivers
5. Movie projectors
6. Voltage regulators



Package Outline

maximum ratings: (25°C)

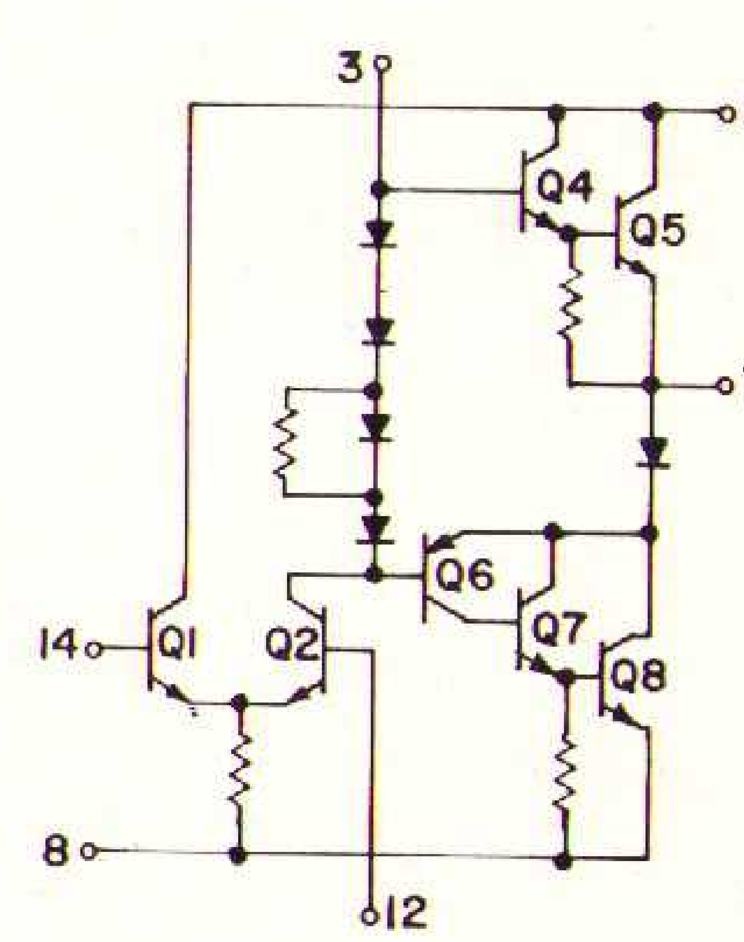
Supply Voltage	27	Volts
Output Current	1.0	Amp
Package Dissipation (Tab at 50°C)	2.25	Watts
(Derate 30 mW/°C above 50°C)		
(Ambient at 25°C)	0.8	Watt
(Derate 8 mW/°C above 25°C)		
Temperature		
Storage	-65 to 150°C	
Operating	-55 to 125°C	

Note: Tab is connected to substrate and should be externally connected to the circuit ground at pin 8.

electrical characteristics: (25°C) (24V supply in Test Circuit)

	Min.	Typ.	Max.	
Audio Power Output (continuous)				
(<5% total harmonic distortion)	2.0			Watts
Input Voltage for P_o = 2 watts*				
(R_6 = 0)		8		mV
(R_6 = 6.8k)		120	140	mV
Efficiency (P_o = 2 watts)		52		%
Distortion at 1 kHz*				
(2 watts P_o)		1.0	5	%
(0.05 watts P_o)		0.5	2	%
Output Quiescent Voltage* (pin 7)		12.5		V
Quiescent Current	3		15	mA
Frequency Response*				
(± 3 dB at P_o = 1w)		30 to 100k		Hz
Noise Output Level				
Relative to 2 watts output (Input open, BW = 30 Hz to 100kHz)		−75		dB
Input Impedance*		40k		ohms
Output Impedance*		0.85		ohms

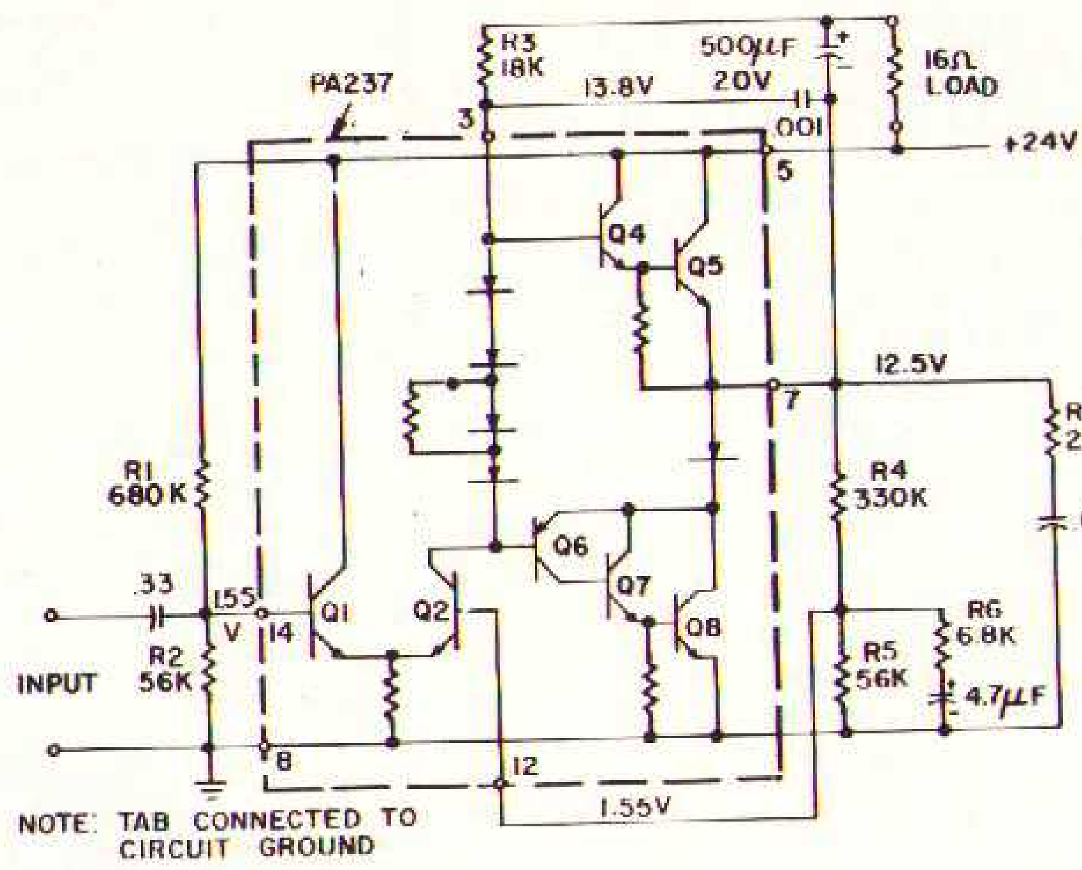
*Performance is determined by external components used in the test circuit.



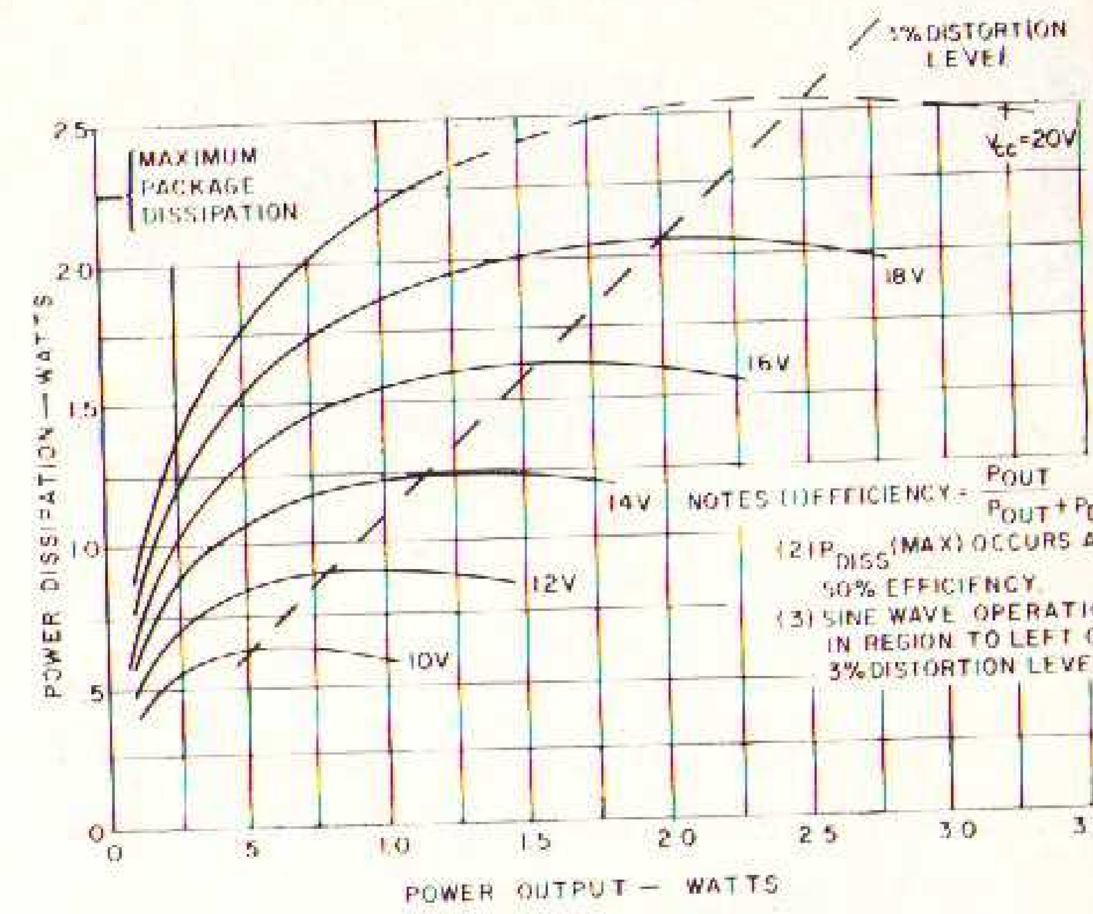
Circuit Diagram

GENERAL ELECTRIC

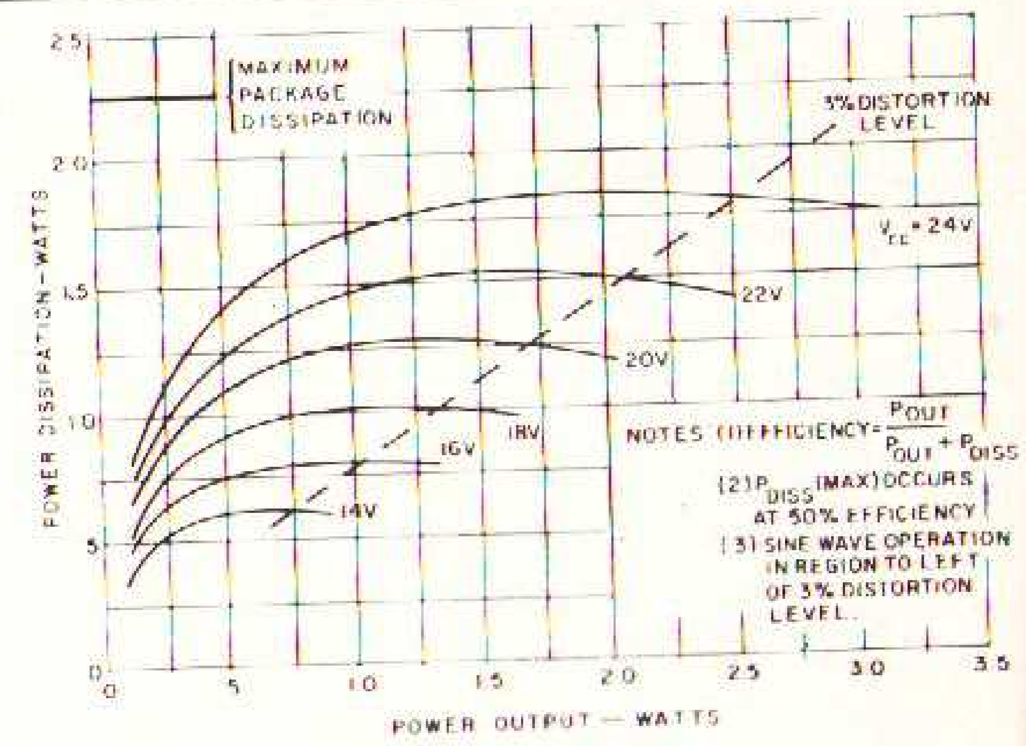
Test Circuit



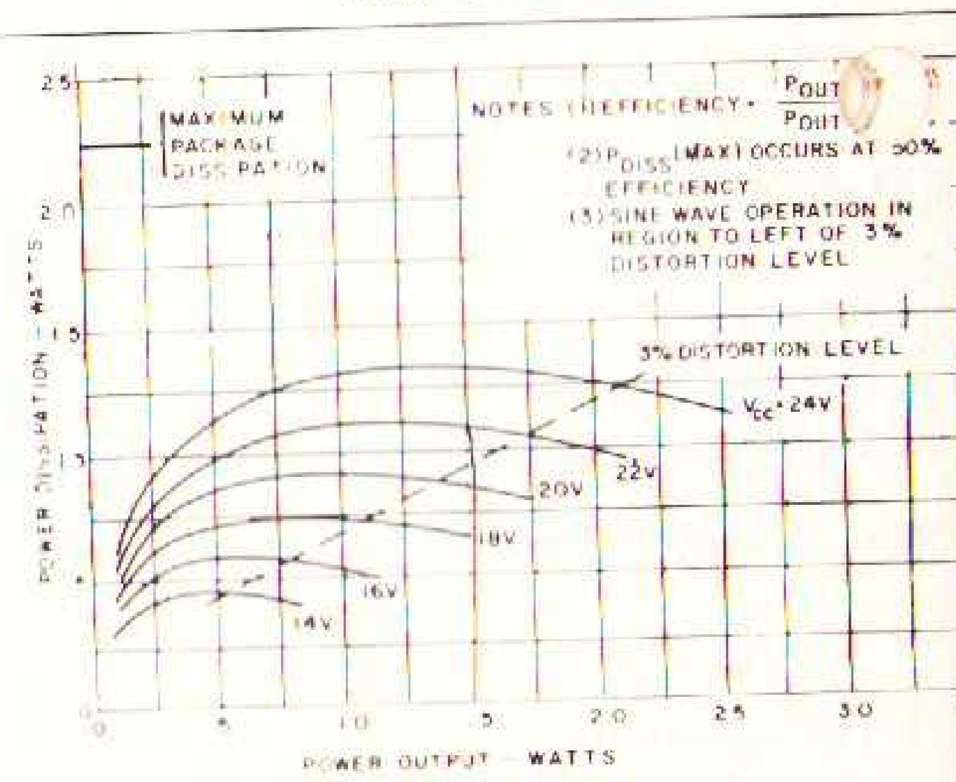
Internal Dissipation vs. Power Output Delivered to an 8-ohm Load



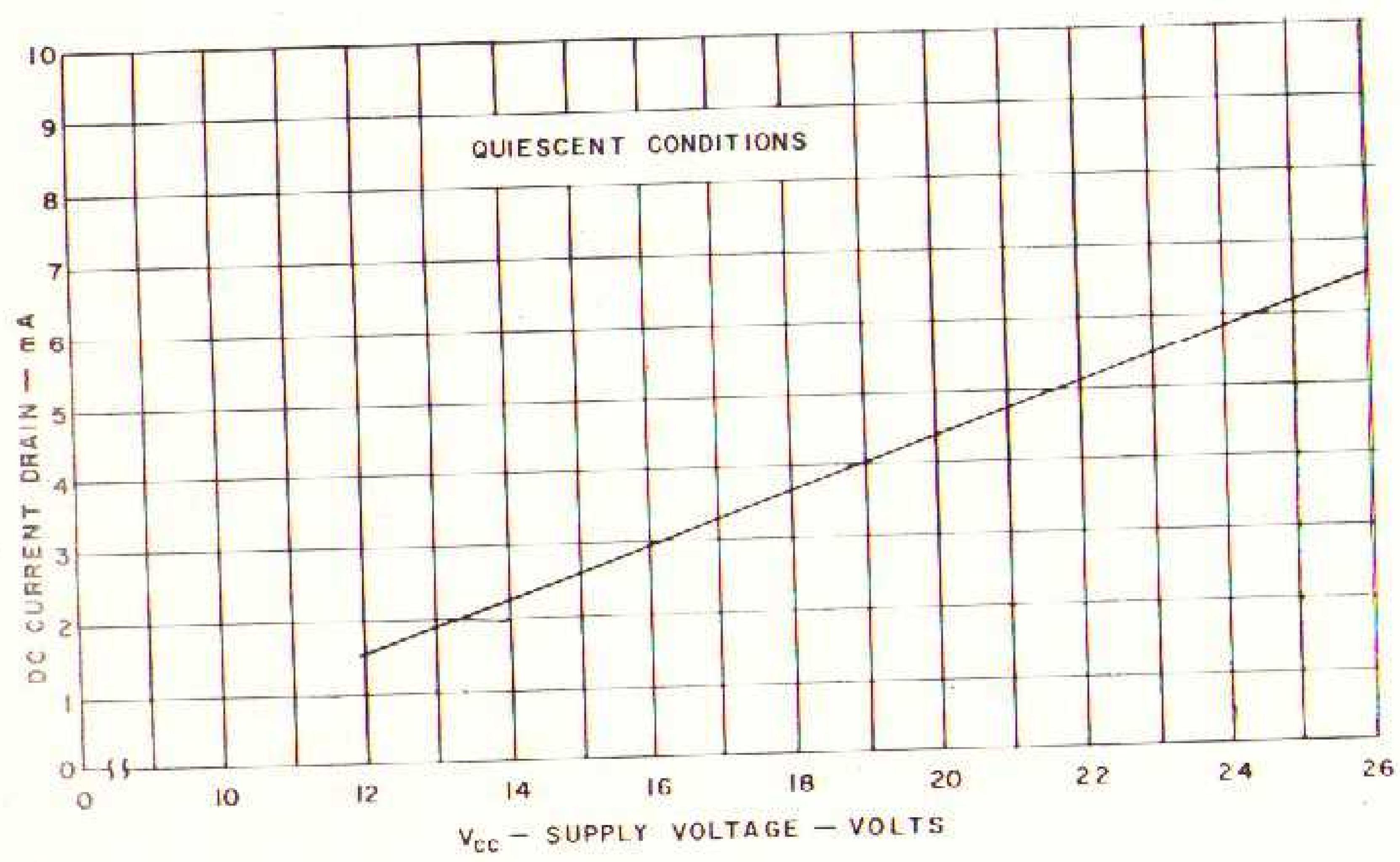
Internal Dissipation vs. Power Output Delivered to a 16 ohm Load



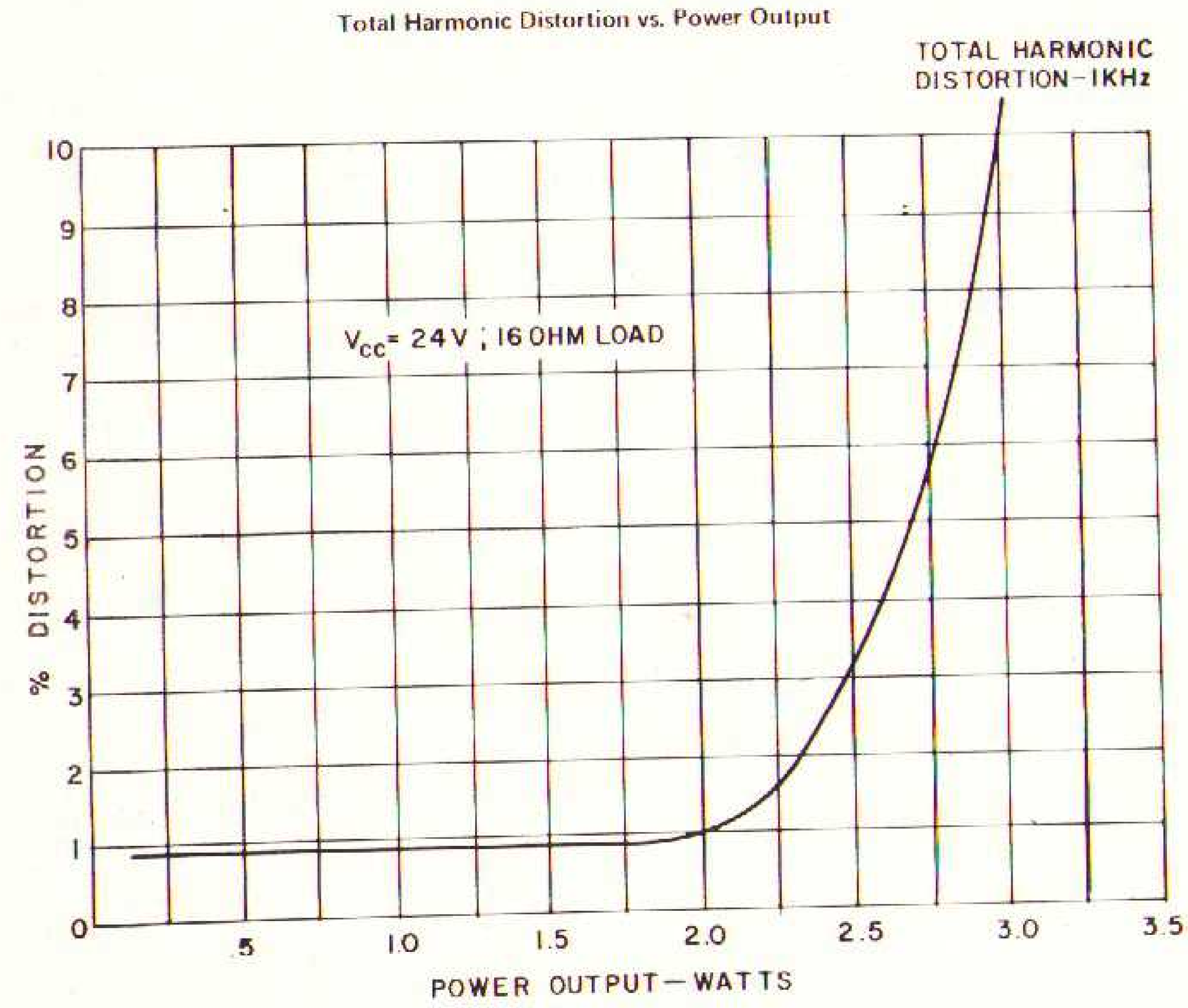
Internal Dissipation vs. Power Output Delivered to a 22 ohm Load

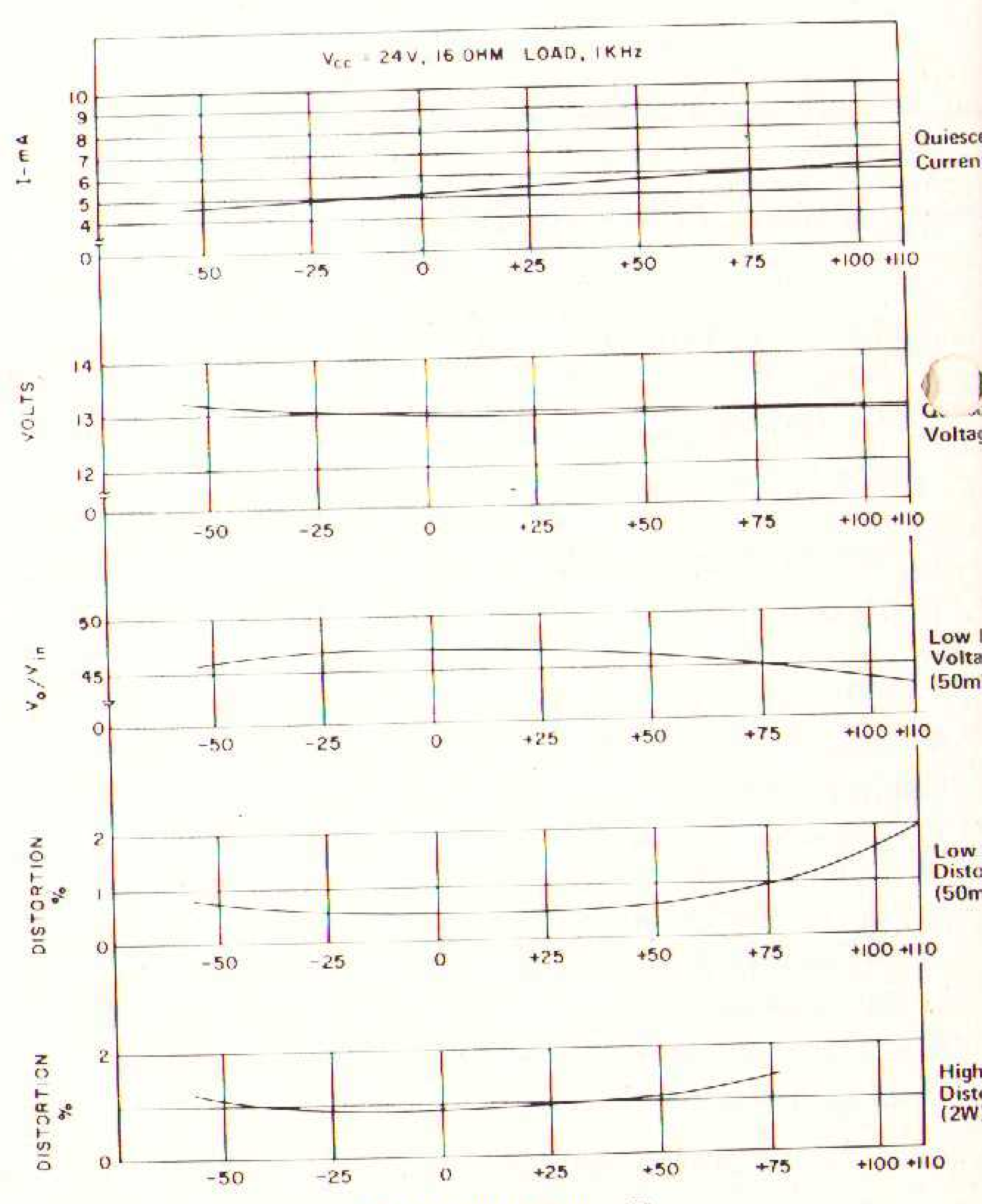


DC Current Drain vs. Supply Voltage

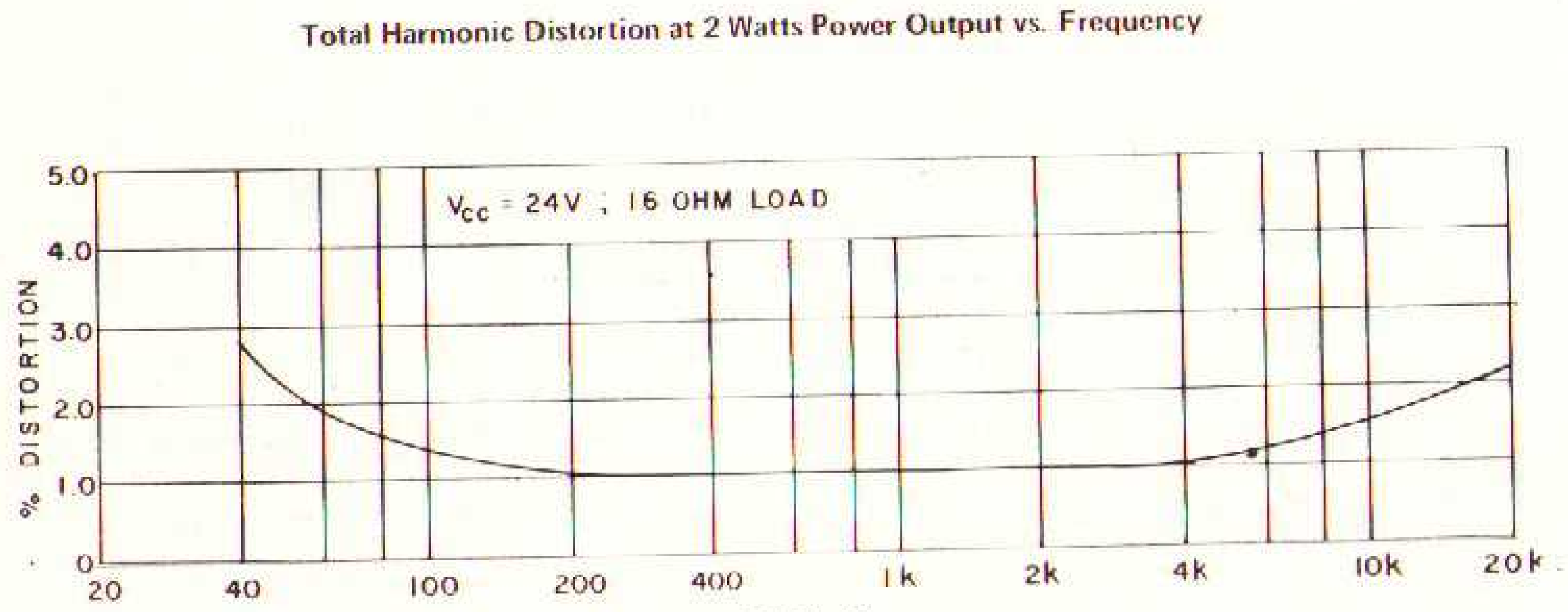


Total Harmonic Distortion vs. Power Output





Total Harmonic Distortion at 2 Watts Power Output vs. Frequency



MONOLITHIC INTEGRATED CIRCUIT POWER AMPLIFIER

by
J. E. Byerly
Application Engineering
Syracuse, New York

The General Electric PA237 is a silicon monolithic audio amplifier designed for versatile performance to meet a wide variety of applications. Some of these applications include phonograph, tape player, AM-FM-TV audio, intercom, servo-amplifiers,and industrial uses.

The broad application of this amplifier is made possible through its ability to operate over a wide range of supply voltage and bias conditions. Different forms of feedback may be applied to the amplifier to allow adjustment of stability, input and output impedance,and amplifier sensitivity. Both AC and DC feedback is employed to provide excellent stability with frequency and temperature.

Figure 1 shows the schematic diagram of the silicon monolithic chip.

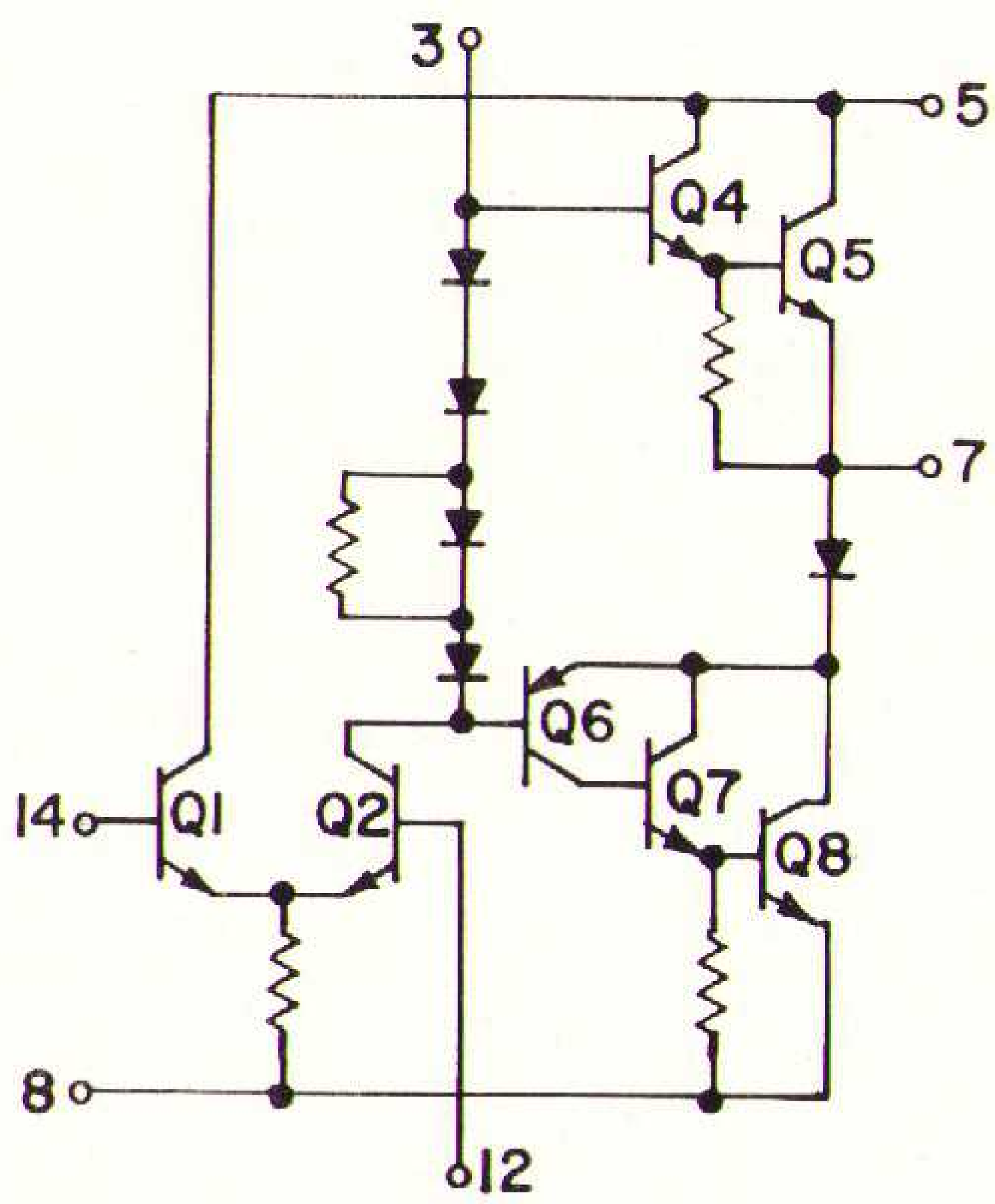
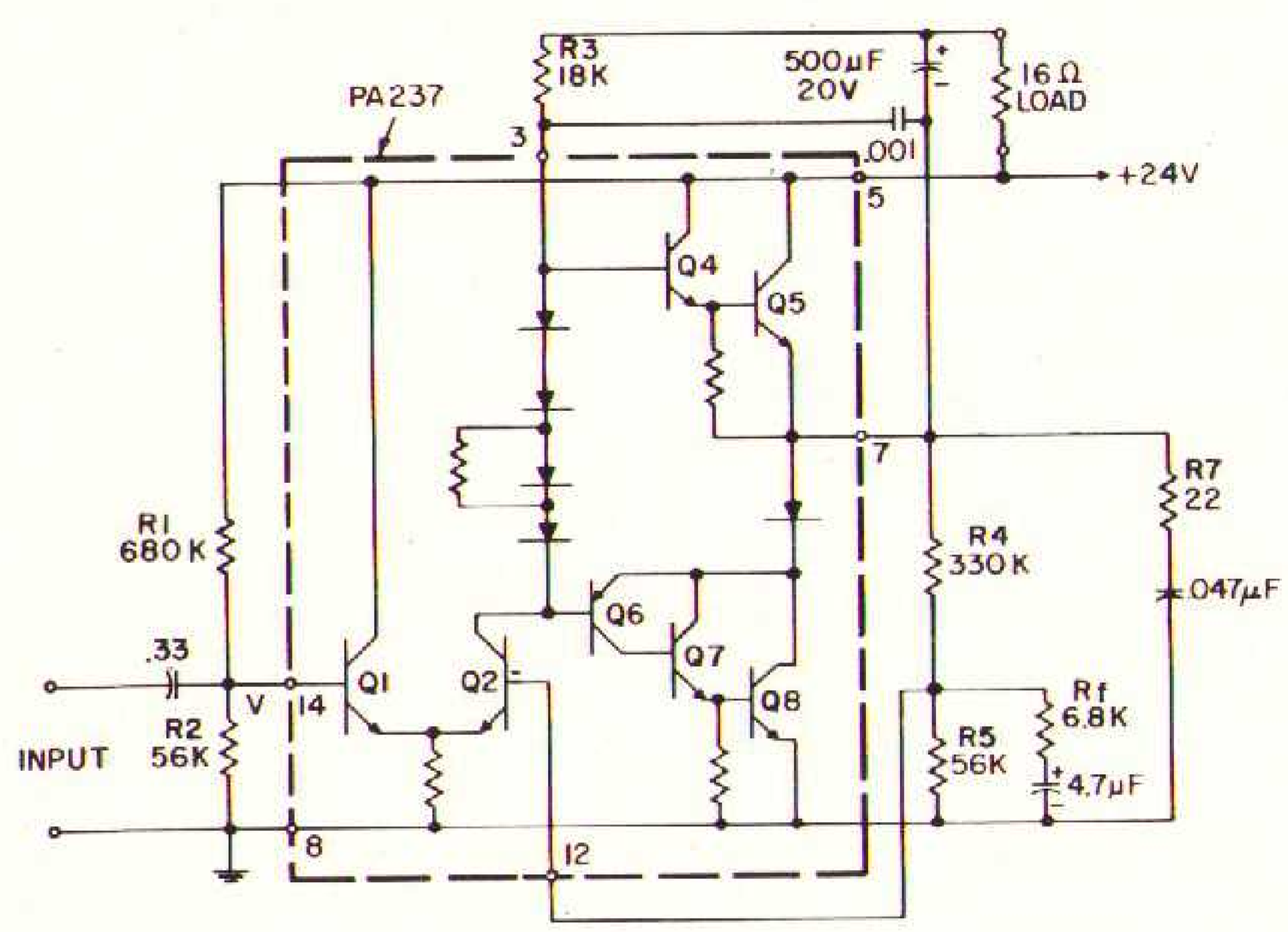


Figure 1 - Monolithic Chip

The output is a quasi-complementary push-pull circuit consisting of transistors Q_4, Q_5, Q_6, Q_7 and Q_8. The darlington configuration enables the driving circuit to operate at low current levels and therefore provides good sensitivity and noise characteristics. The driving circuit consists of transistors Q_1 and Q_2 in differential amplifier configuration. This provides good bias stability against variations of h_{FE} and temperature.* The biasing network is external to the chip to provide overall user economy and allow maximum versatility of application. The PA237 can be biased into Class A, Class A-B or Class B operation. Many biasing arrangements may be employed, including current source biasing, various degrees of voltage source biasing, common mode biasing, etc. The standby idle current is established by the current in the diode chain regulator. Increasing the diode current moves the amplifier toward Class A operation. The center point voltage (pin 7) is established by the voltage drop across the load (R_3) in series with the diode string (pin 3) (see Figure 2). Thus, by properly choosing this resistor value and diode current, one can obtain the center point voltage and output idle current of one's choice.

The operating voltage is 9 to 27 volts for the standard PA237. Higher voltage devices are avail le upon special order. The output has over 1 ampere peak capability which enables the amplifier to drive low impedance loads.



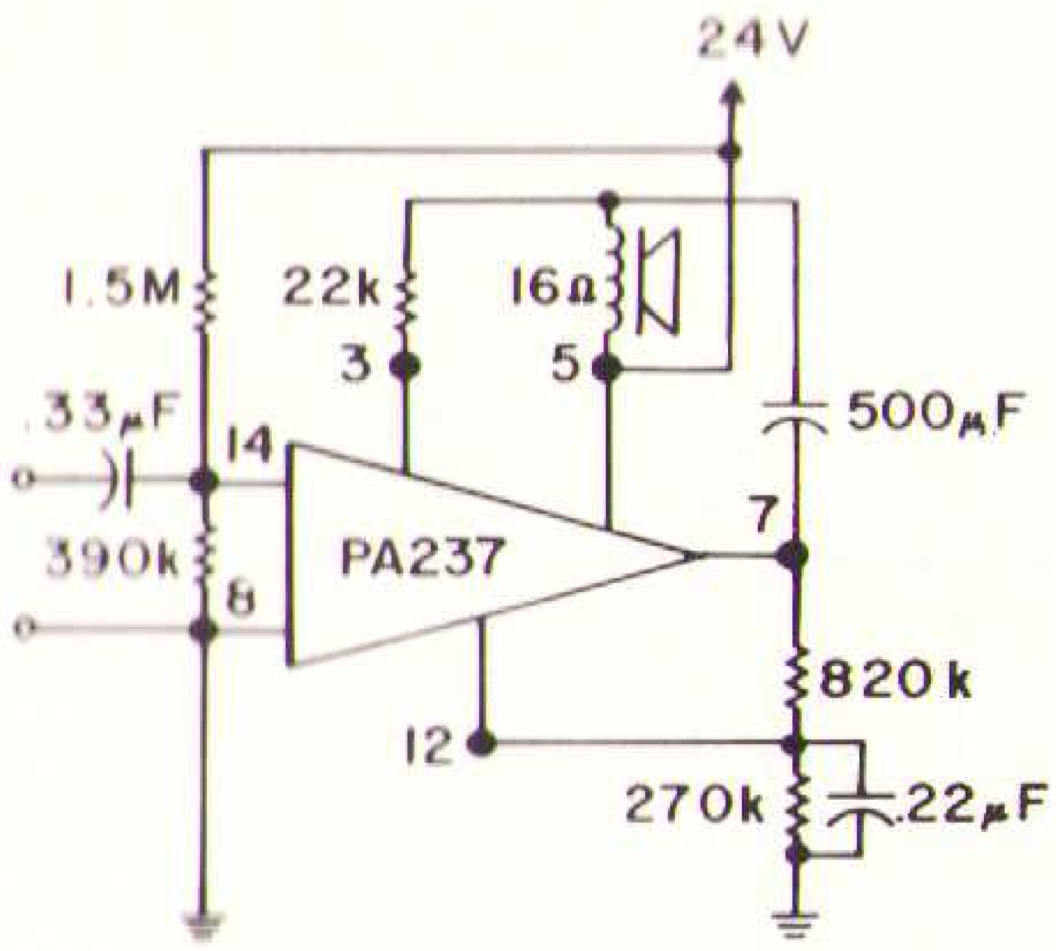
R_f	0	1KΩ	5KΩ	10KΩ
Sens. at 2W	8.0mV	22mV	86mV	150mV
THD at 2W	5.2%	2.9%	1.7%	1.5%
Z(in)	20KΩ	35KΩ	40KΩ	40KΩ
Freq. Resp. -3dB	80-24 kHz	35-50 kHz	18-100 kHz	17-110 kHz

Figure 2 - PA237 Test Circuit

Figure 2 shows the amplifier test circuit with voltage source biasing, high and low frequency roll-of bootstrapping, negative DC feedback, and negative AC feedback loop closure. The amplifier is biased into Class A-B operation. The sensitivity is 120mV for 2W output or a voltage gain > 45. The input impedance is 40KΩ and the output impedance 0.85Ω. Noise output is 75dB below 2W. The ratio of R_4 to R_f determines the amount of AC feedback closure. Setting the 6.8KΩ feedback resistor (R_f) to other values enables the sensitivity, input impedance and distortion to vary as seen on the chart accompanying Figure 2. Making this feedback resistor the volume control may be advantageous in that as the output level is decreased by increasing the negative A.C. feedback, the distortion decreases. This is particularly desirable for lowering crossover distortion at low levels in that it is at low levels where crossover becomes a significant portion of the total distortion

*For more detailed explanation of circuit configuration refer to Publication Number 90.73.

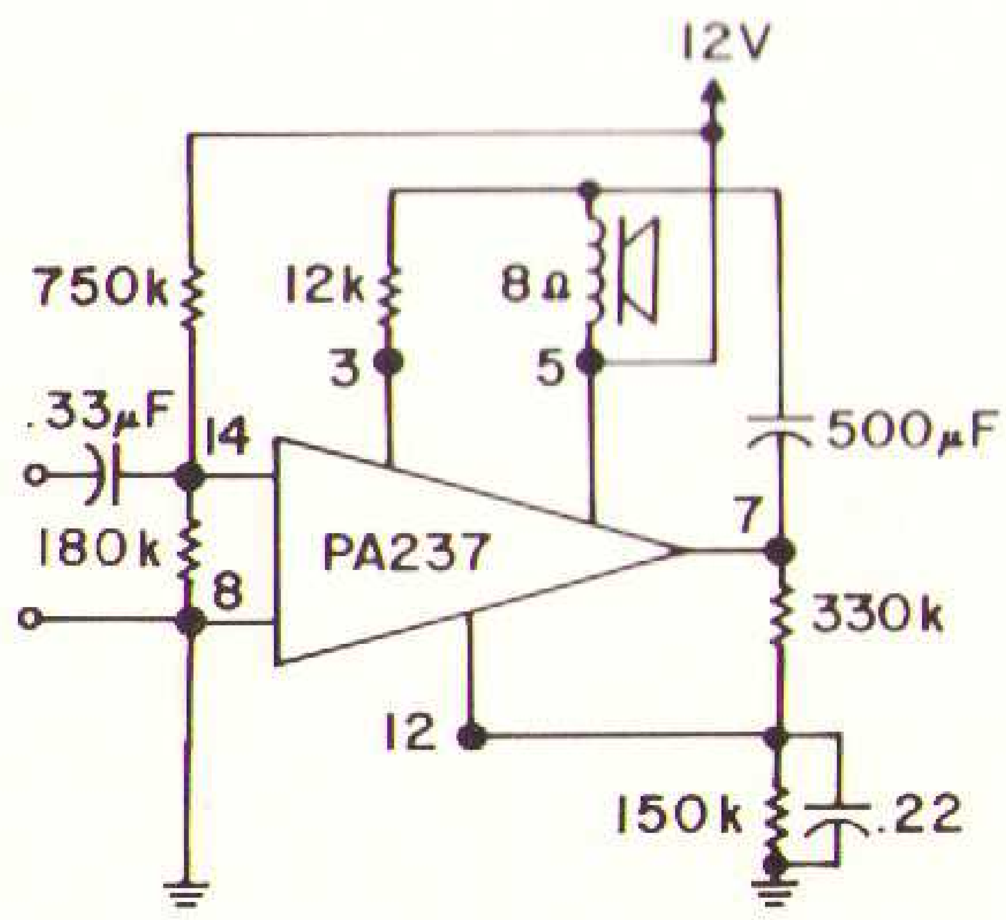
igure 3 - 24V Open Loop Configuration



igure 3 shows the PA237 in a 24V-16Ω open loop application. It has a sensitivity of 5mV for 2W tput or a voltage gain of $>$ 1100. The input impedance is $>$ 15KΩ. This sensitivity enables the mplifier to be driven directly from a diode detector or magnetic phono cartridge.

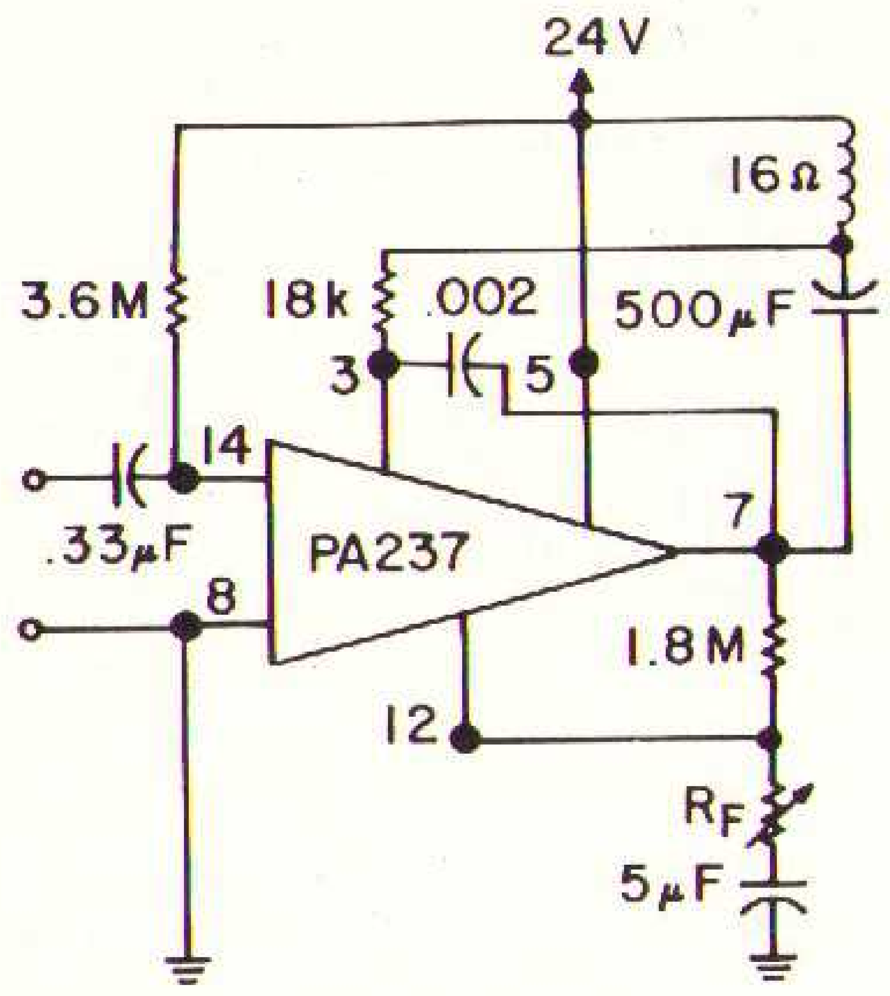
The same configuration can be used at other combinations of voltage and load impedance simply by changing the values of the biasing resistors. Figure 4 shows such a change for 12V and 8Ω operation.

Figure 4 - 12V Open Loop Configuration



Seven millivolts drives the amplifier to 3/4W output for a voltage gain of 350 at 3.5% T.H.D. Maximum power out is 1W at 10% T.H.D. The input impedance is 15KΩ.

The number of external components can be reduced where the application does not require all the protective elements that were included in Figure 2. The configuration of Figure 5 employs current source biasing, adjustable loop closure, and low frequency roll-off for a total external component count of four resistors and two capacitors. (The current gain (h_{FE}) of the differential amplifier



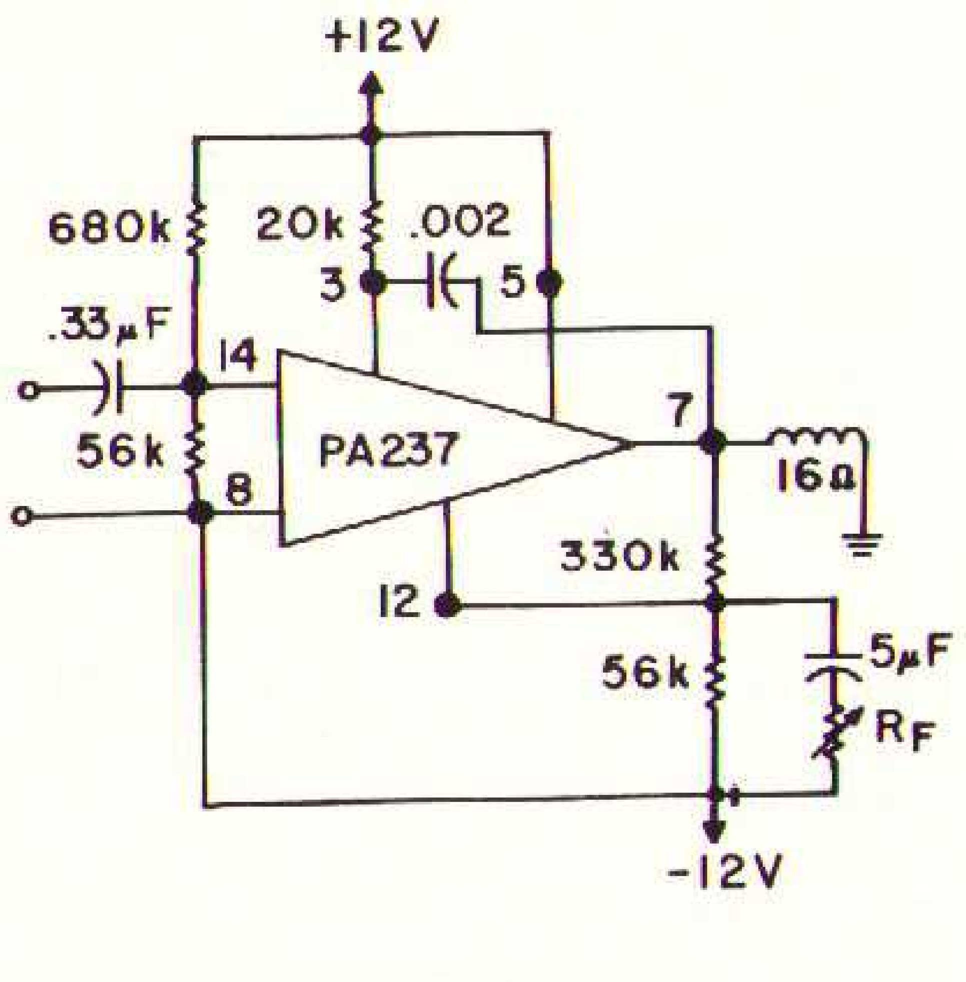
R_f	0	1KΩ	5KΩ	10KΩ
Sens. at 2W	5mV	11mV	26mV	40mV
THD at 2W	5.0%	4.5%	3.5%	1.8%
Z(in)	24KΩ	50KΩ	80KΩ	100KΩ
Freq. Resp. -3dB	60-19 kHz	40-29 kHz	20-41 kHz	10-50 kHz

Figure 5 - Current Source Bias Configuration

transistors (Q_1 and Q_2) must be known to enable one to choose the current source resistor values.)

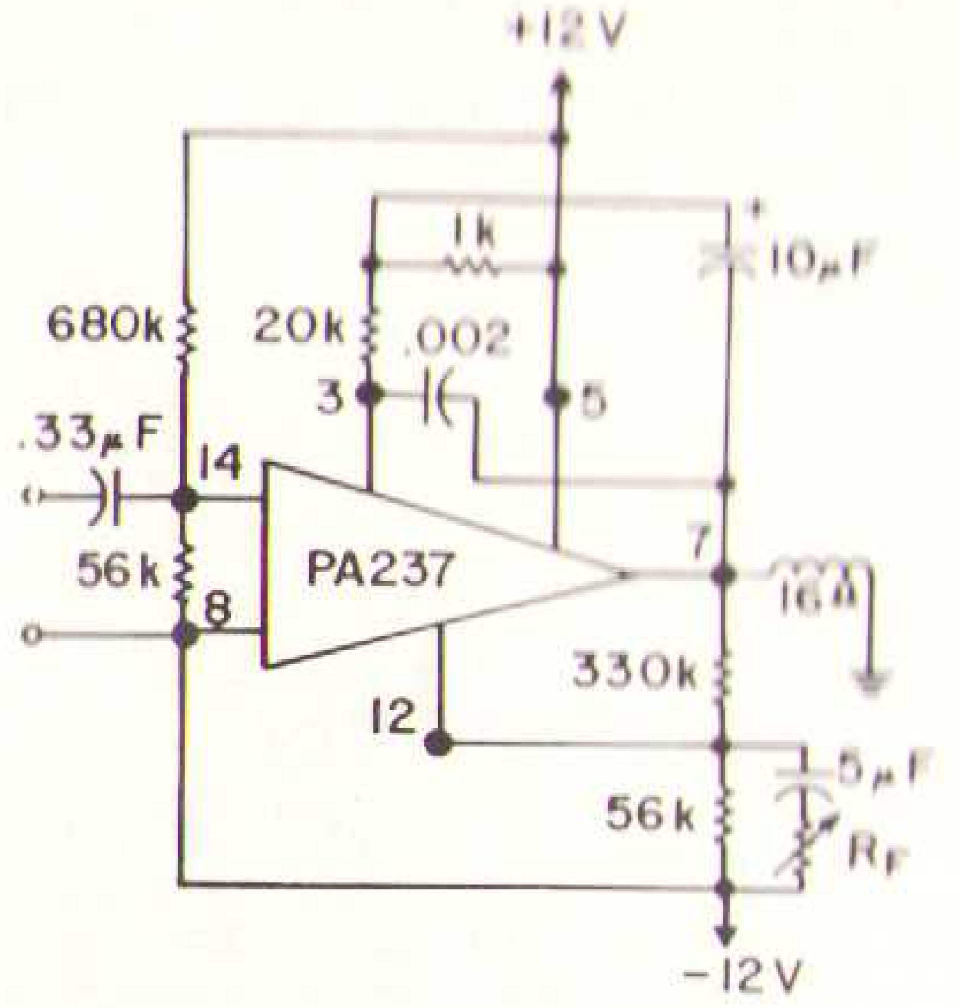
Figure 5 shows the configuration for 24V and 16Ω Class A-B operation. The accompanying chart shows the amplifier performance for different degrees of loop closure.

The large output coupling capacitor can be eliminated by using two supplies when available. Figure 6a shows such a configuration employing voltage source biasing. The same circuit but with the addition of load bootstrapping is shown in Figure 6b.



R_f	0	1KΩ	5KΩ	10KΩ
Sens. at 2W	40mV	80mV	150mV	220mV
THD at 2W	4.5%	3.2%	2.5%	2.2%
Z(in)	15KΩ	20KΩ	30KΩ	35KΩ
Freq. Resp. -3dB	10-75 kHz	12-90 kHz	9-100 kHz	8-130 kHz

Figure 6a - Dual Supply Configuration

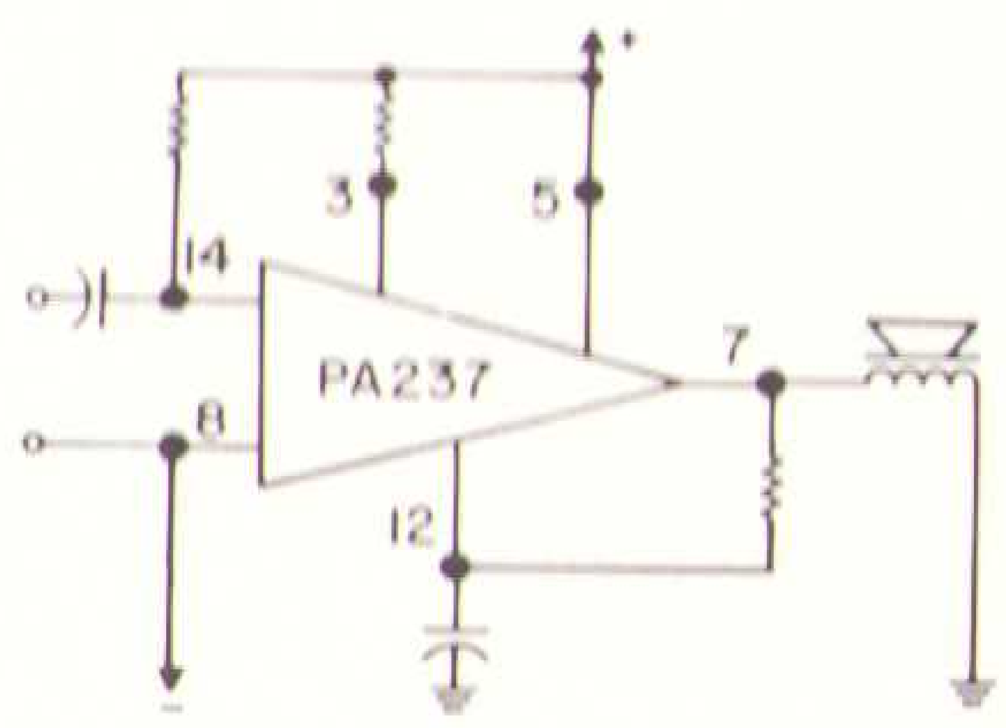


Rf	0	1KΩ	5KΩ	10KΩ
Sens. at 2W	10mV	23mV	85mV	140mV
THD at 2W	7.5%	4.5%	2.0%	1.5%
Z(in)	24KΩ	20KΩ	35KΩ	40KΩ
Freq. Resp. -3dB	50-20 kHz	25-40 kHz	12-80 kHz	10-95 kHz

Figure 6b - Dual Supply Configuration with Load Bootstrapping

The circuit in Figure 7 employs a minimum number of external components when some of the performance of the other circuits can be sacrificed.

Figure 7 - Minimum External Component Configuration



For operation from high source impedance transducers such as ceramic and crystal phono cartridges the amplifier input impedance may be increased by the methods shown in the following circuit configurations.

Figure 8 - Bootstrapped Input Configuration

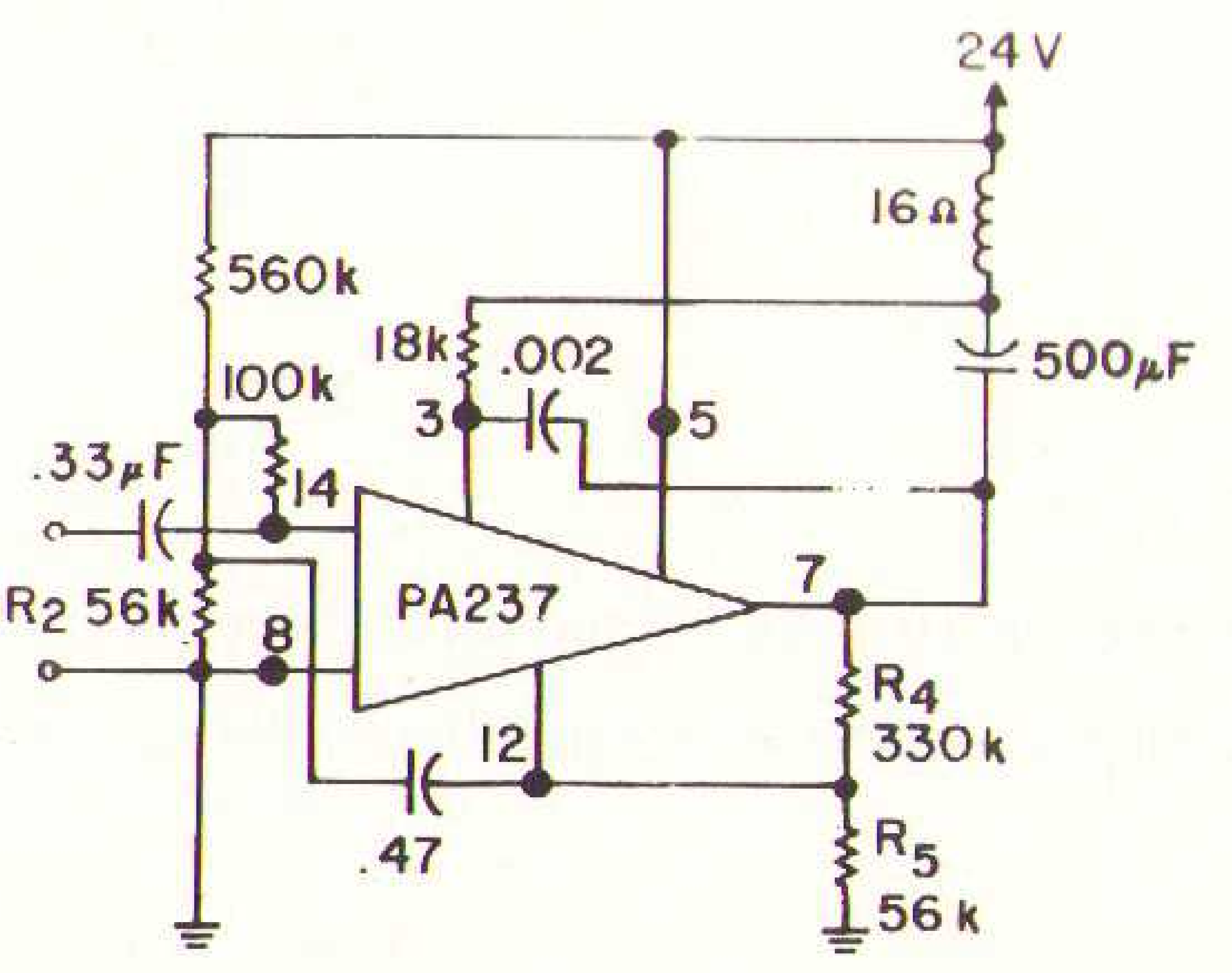
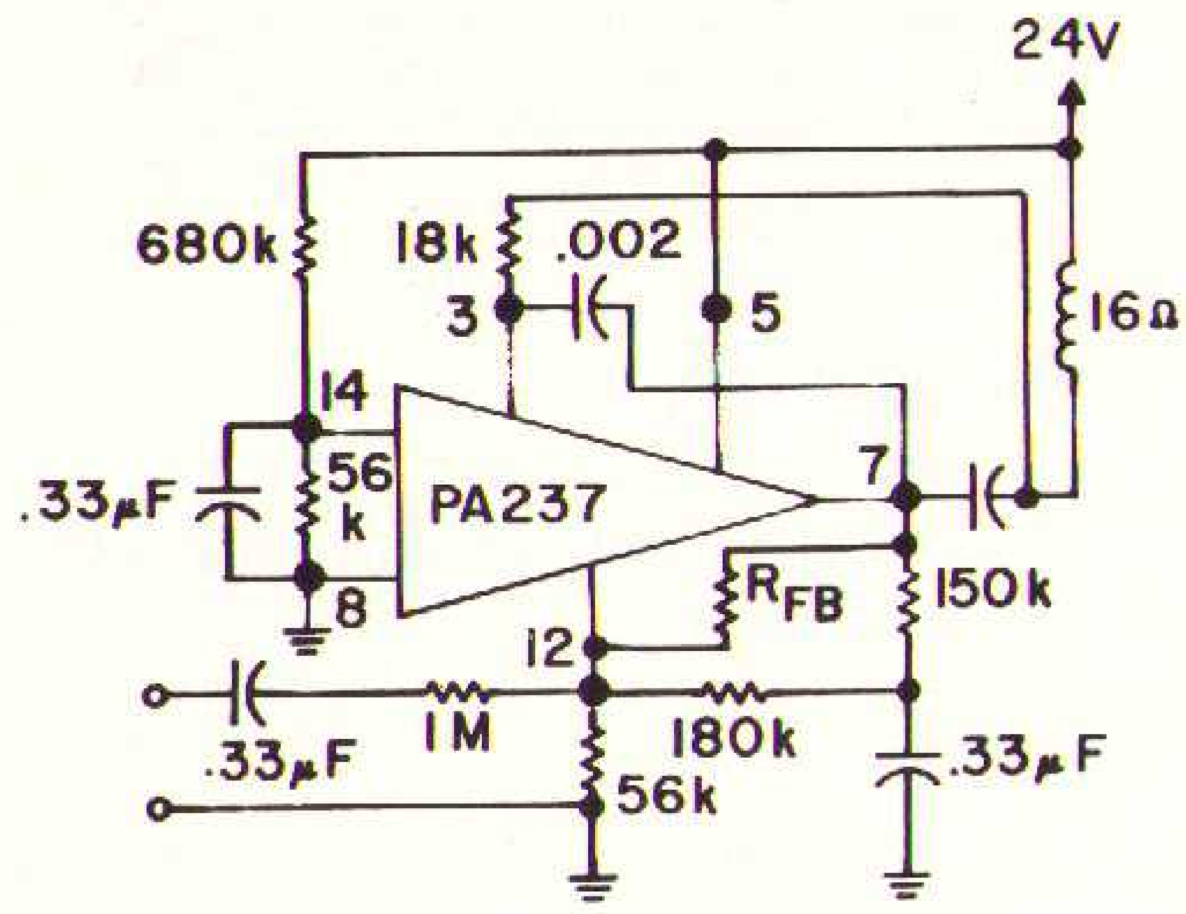


Figure 8 shows the PA237 with additional input bootstrapping to increase input impedance. The ratio of the parallel combination of resistors R_2 and R_5 to R_4 determines the amount of AC feedback closure. One can adjust the loop gain by choosing the biasing resistors so that the parallel combination of R_2 and R_5 result in the desired loop closure. Another method is to place an AC shunt consisting of a capacitor and the desired resistor value across R_5.



R_{FB}	∞	10MΩ	5MΩ
Sens. at 2W	650mV	1.1V	1.9V
THD at 2W	3.0%	1.8%	1.25%
Z(in)	1MΩ	1MΩ	1MΩ
Freq. Resp. -3dB	150-10 kHz	80-21 kHz	50-34 kHz

Figure 9 - Voltage Ratio Feedback Configuration

For operation with crystal phono cartridges or other high impedance sources, the circuit of Figure 9 may be considered using voltage ratio feedback. The accompanying chart shows the circuit performance for different degrees of feedback closure.

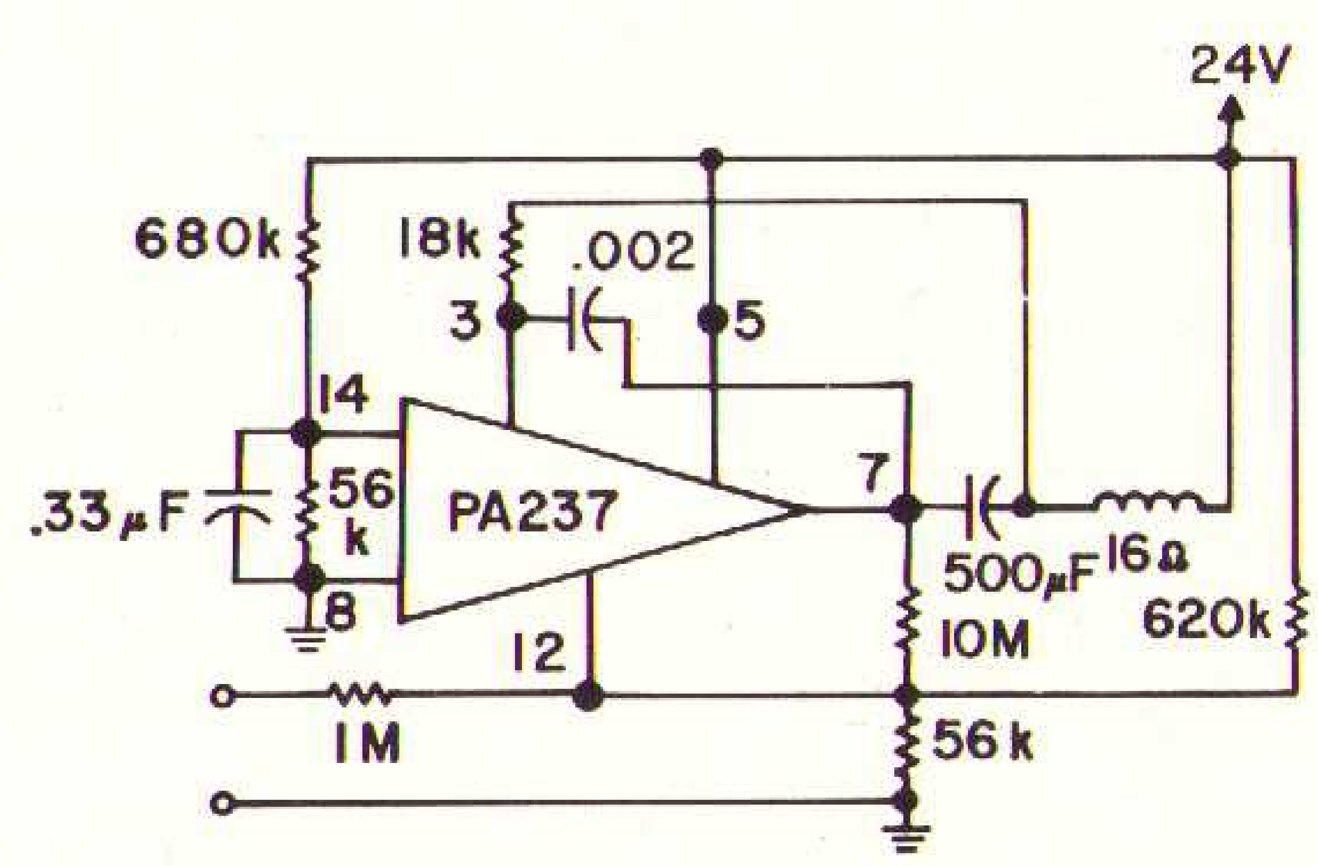


Figure 10

The circuit of Figure 10 may be used in place of that of Figure 9 saving a resistor and capacitor where the degree of negative DC feedback of the circuit in Figure 9 is not required.

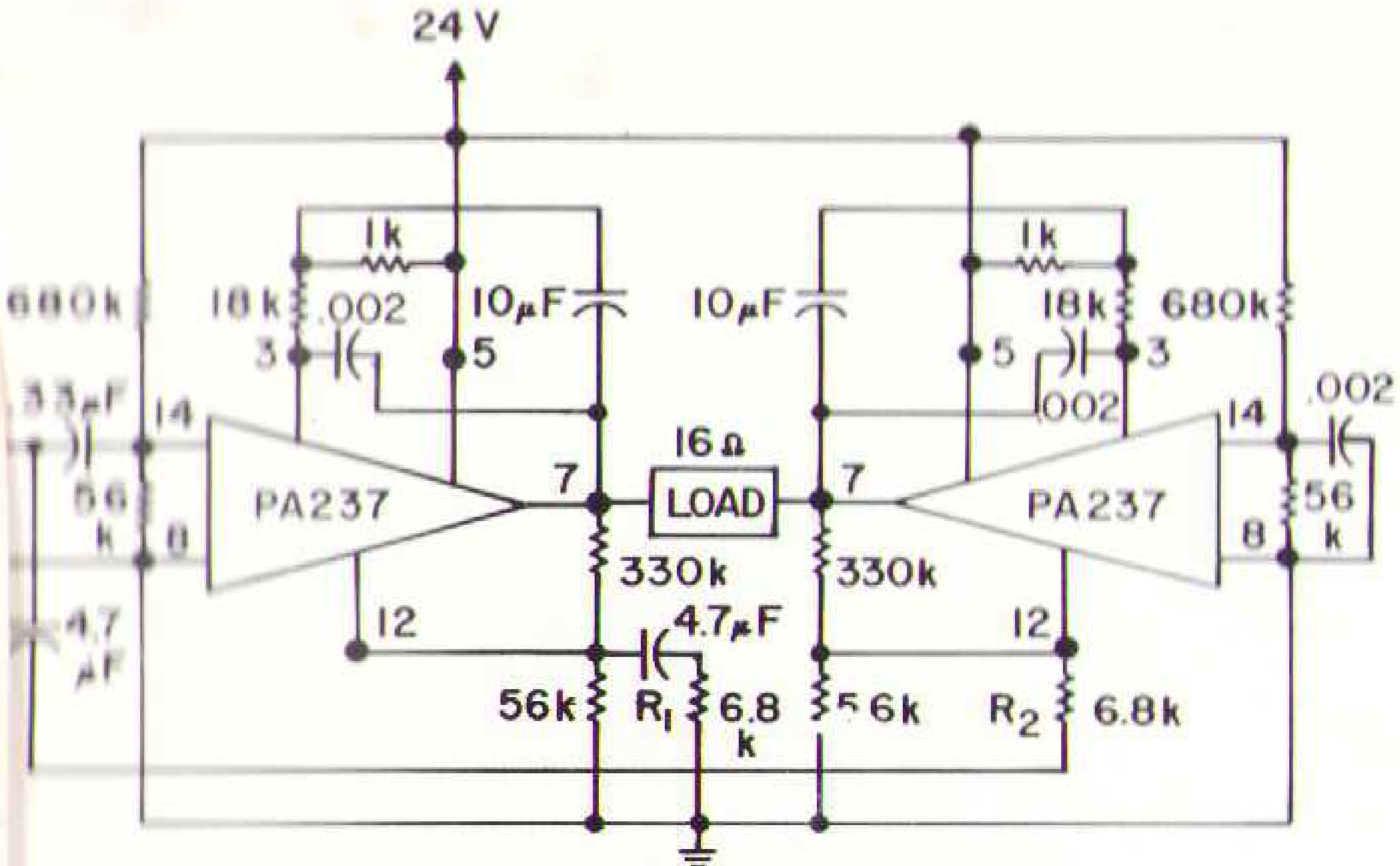


Figure 11 -

Bootstrapped Bridge Configuration

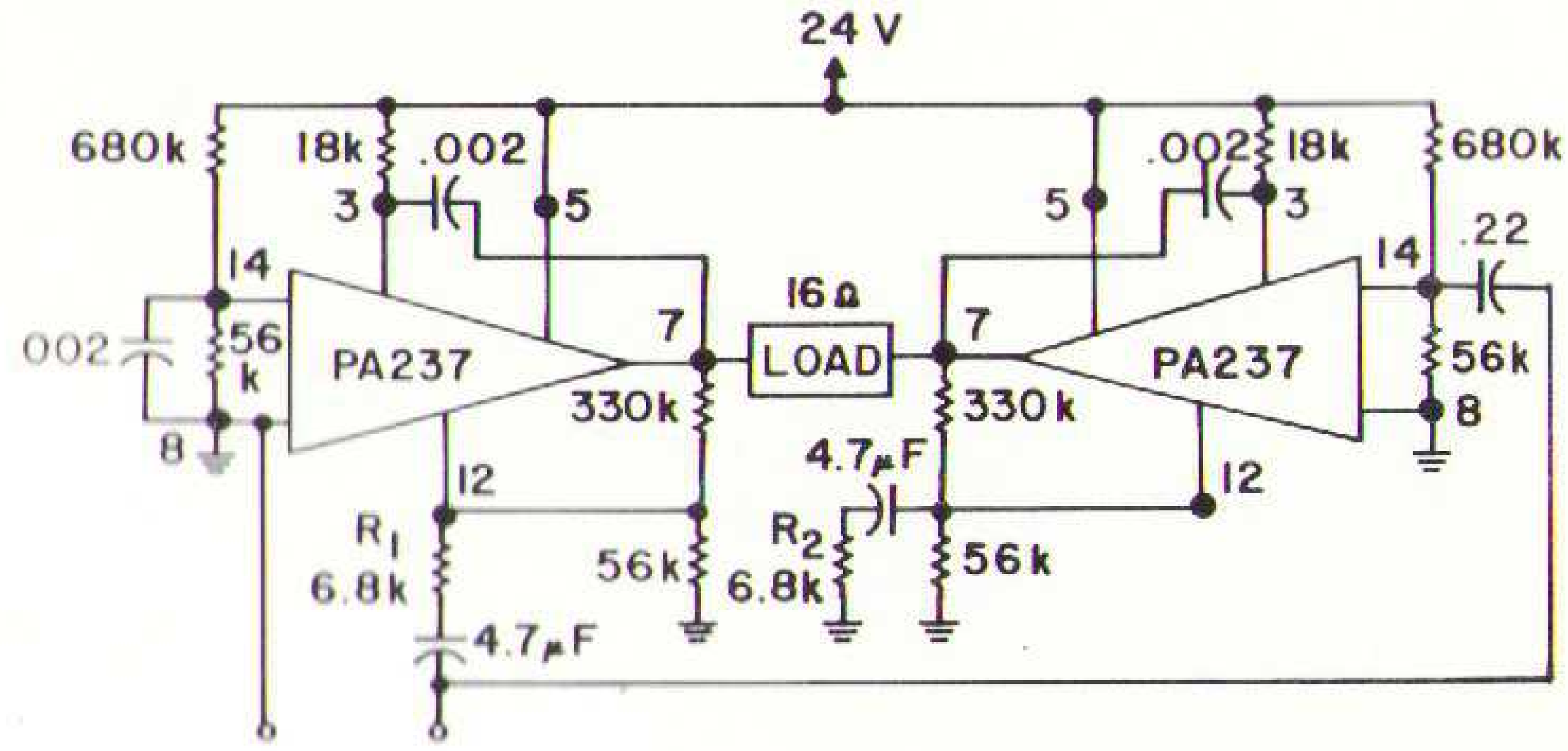
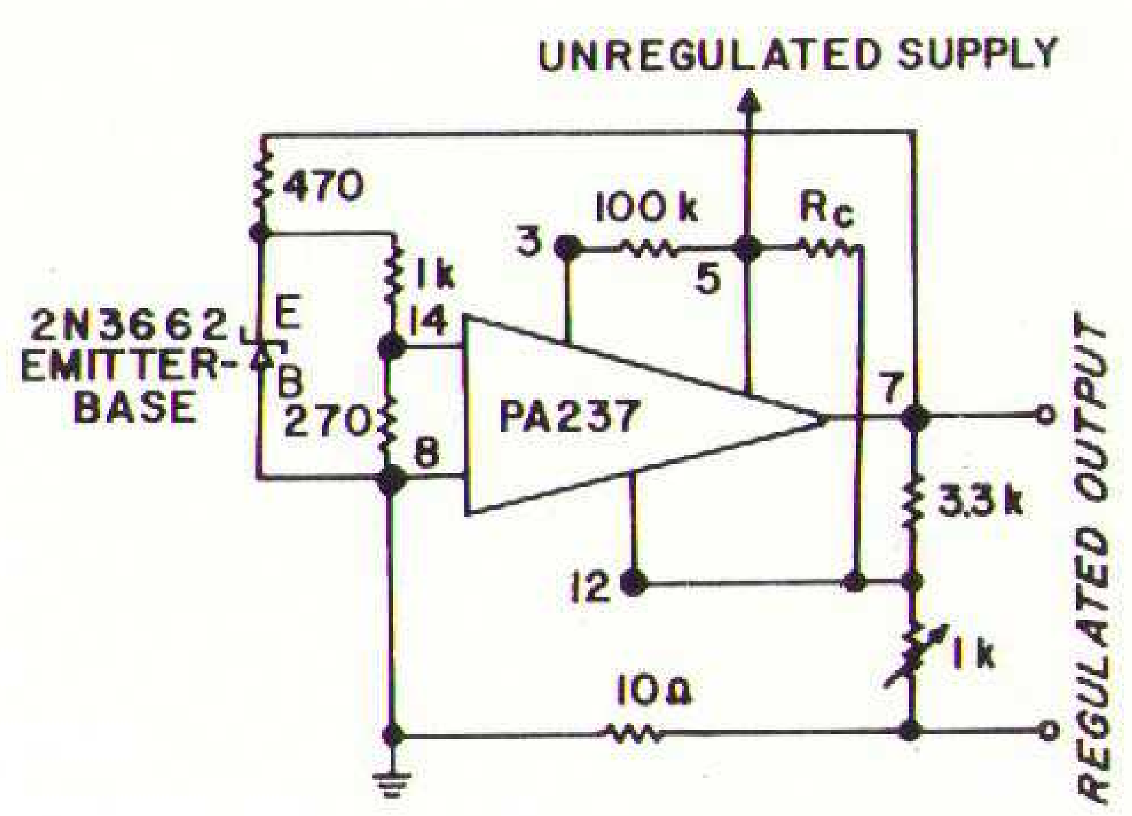


Figure 12 -

Bridge Configuration without Bootstrapping

For higher power applications, the PA237 may be used in a bridge configuration thereby doubling the available power output. Figures 11 and 12 show two bridge circuits, one with load bootstrapping and one without. Resistors R_1 and R_2 are adjusted for the desired amplifier sensitivity and input impedance. Of course, the various biasing configurations previously discussed for the single amplifier are applicable to the bridge circuits also.

The PA237 may also be used as a voltage regulator as is shown in Figure 13. The current capability is limited by the difference between input voltage and regulated voltage so that the VI product does not exceed the power rating of the 237. Short circuit protection is provided by the resistor in the ground return path. An alternate method of current limiting which provides a sharper cutoff is to use a transistor to shunt the reference diode at the desired current. The accompanying chart shows the performance of the circuit of Figure 13 for various regulator output voltages versus unregulated input voltage.



Unregulated Input Voltage	15	20	25	30*	35*	40*	
							Compensating Resistor
Regulated Output Voltage	9.9	10.0	10.0	10.0	10.0	10.0	R_C = 100KΩ
	11.7	12.0	12.0	12.0	12.0	12.0	R_C = 70KΩ
		14.8	15.0	15.0	15.0	15.0	R_C = 50KΩ
		16.5	17.0	17.0	17.0	17.0	R_C = 40KΩ
			19.9	20.1	20.1	20.1	R_C = 30KΩ
			22.4	22.6	22.5	22.5	R_C = 20KΩ

Figure 13 - Voltage Regulator

*Utilizes selected high voltage PA237's

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