Ordering number:ENN919D

Monolithic Linear IC

LA4192

1 to 2.3W 2-Channel of Power Amplifier

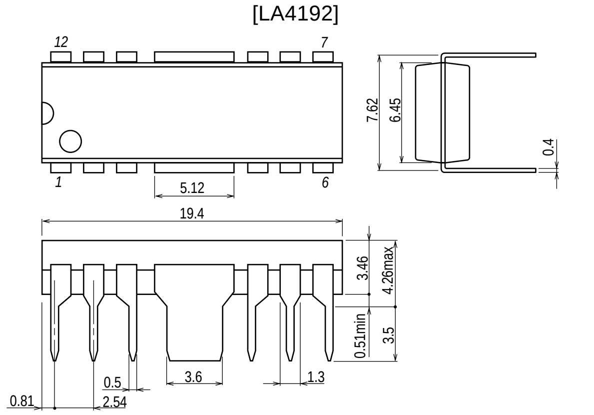
Features

- Has two channels that can be used for either stereo or bridge amplifier.
- High outputs : LA4192 provides 2.3W per channel for 2 channel stereo connected at V_{CC}=9V, R_L=4Ω, or 4.7W bridge amplifier (for R_L=8Ω).
- Voltage gain is variable by externally connected feedback resistors :
  For 2-channel : R_{NF}=27Ω, VG=50dB
  Bridge amplifier connected : R_{NF}=51Ω, VG=51dB
- Switching distortions in higher frequencies have been held low.
- The built-in muting circuit keeps noises caused by turning power on and off at low levels.
- The built-in ripple filter provides good ripple rejection factors.
- Excels in channel separation.

Package Dimensions

unit:mm

3022A-DIP12F



Specifications

Absolute Maximum Ratings at Ta = 25˚C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{CC} max	With signals	11	V
		With no signal	15	V
Allowable power dissipation	Pd max	With P-plate (See Pd – Ta diagram)	4	W
Operating temperature	Topr		–20 to +75	˚C
Storage temperature	Tstg		–55 to +150	˚C

Recommended Operating Conditions at Ta = 25˚C

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	V_{CC}		9	V
Load resistance	R_L	2-channel	4 to 8	Ω
		Bridge	8	Ω

Note : Basically, this package dissipates heat by using the copper foil section of the printed circuit board, but because power dissipation Pd can be increased by power voltages and load conditions, it is recommended that a heat sink be used in conjunction with the printed circuit board.

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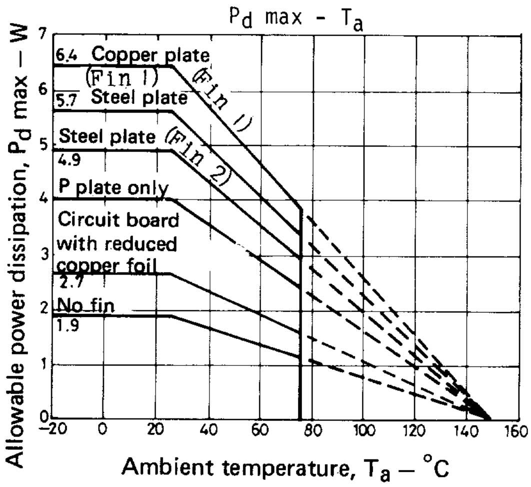
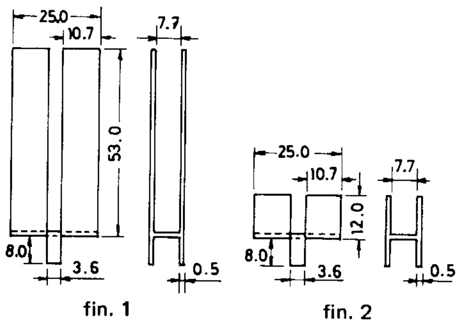
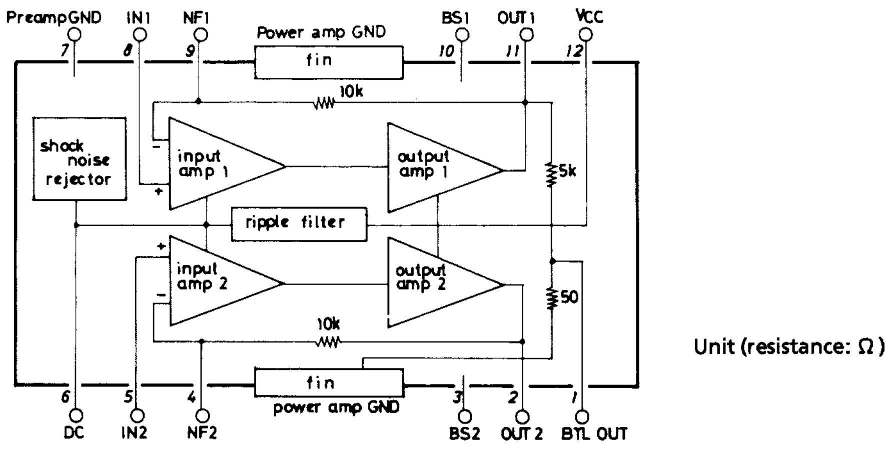
Operating Characteristics at Ta = 25˚C, V_{CC}=9V, f=1kHz, Rg=600Ω, R_L=4Ω, ( ) denotes values for 8Ω, in the specified test circuit

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Quiescent current	I_{CCO}	For 2 channels 6V		35	55	mA
		For 2 channels 7.5V		40		mA
Voltage gain	VG	Closed loop, R_{NF}=27Ω, V_{IN}=–51dBm, 2-channel	48	50	52	dB
		Closed loop, R_{NF}=27Ω, V_{IN}=–51dBm, Bridge	49	51	53	dB
Voltage gain imbalance	∆VG	2-channel			2	dB
Output power	P_O	THD=10%, 2-channel	1.7	2.3		W
		THD=10%, 2-channel		(1.3)		
		THD=10%, Bridge		(4.7)		W
Total harmonic distortion	THD	P_O=250mW, 2-channel		0.5	2.0	%
Input resistance	r_i		21	30		kΩ
Output noise voltage	V_{NO}	Rg=0, 2-channel		0.5	1.3	mV
		Rg=10kΩ, 2-channel		0.8	2.5	mV
Ripple rejection	R_r	Rg=0, V_R=150mV, 2-channel		46		dB
Channel separation	CH sep	Rg=10kW, v_o=0dBm, 2-channel	40	55		dB



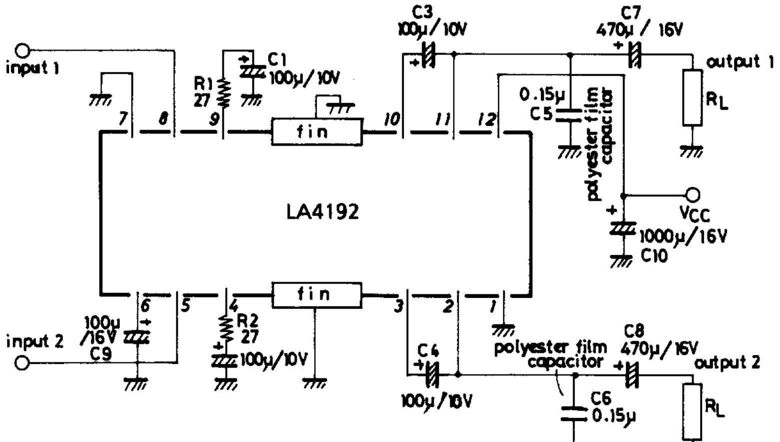


Equivalent Circuit Block Diagram

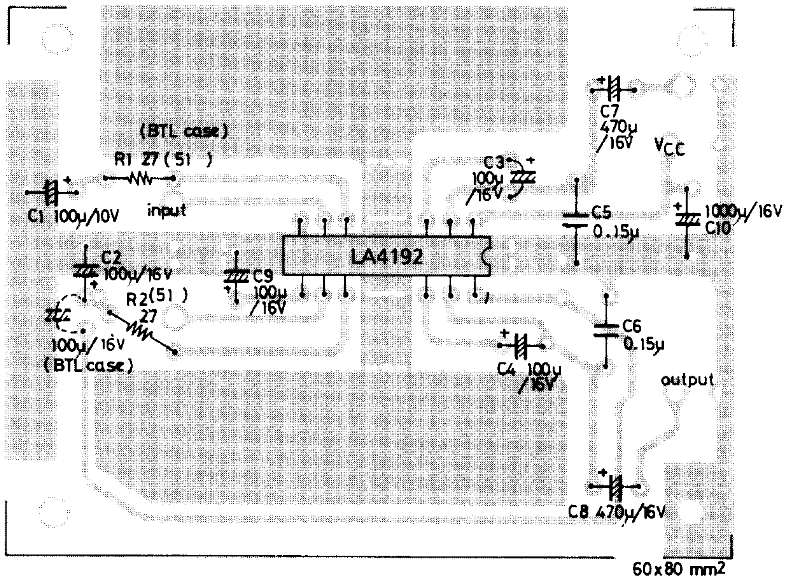


Sample Application Circuit 1 : For 2-channel

Unit (resistance: Ω, capacitance: F)



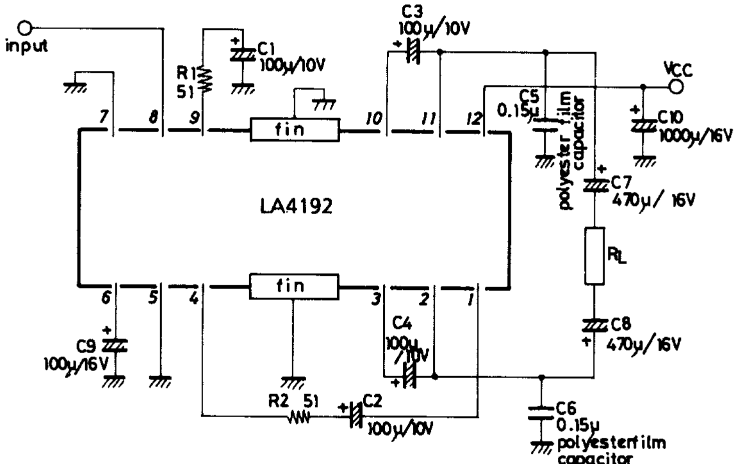
VG=50dB



Sample printed pattern for 2 channel and bridge amp. (copper foil side)

Sample Application Circuit 2 : Bridge amplifier connected

Unit (resistance: Ω, capacitance: F)



VG=51dB

Externally connected components and comments

C1 (C2) : Feedback capacitor : The lower cut-off frequency is given by the following formula :

$$f_L=\frac{1}{2\pi C1R_f}$$

f_L : Lower cut-off frequency
R_f : Feedback resistance

This requires careful review, because, together with decoupling capacitor, it affects the starting time.

R1 (R2) : Feedback resistor : Voltage gain is determined by ratio to the built-in resistor. Use ±5%-tolerance resistors to enhance balance of voltage gains for the two channels.

C3 (C4) : Bootstrap capacitor : Capacitance affects output in the low-frequency range ; employment of small-value capacitance causes reduced outputs in lower frequencies. Employ at least 47μF.

C5 (C6) : De-oscillating capacitor : Use a mylar capacitor that excels in temperature and frequency characteristics. If an aluminum electrolytic or a ceramic capacitor is used, it may cause oscillation.

C7 (C8) : Output capacitor : The lower cut-off frequency is given by the following formula :

$$f_L=\frac{1}{2\pi C7R_L}$$

f_L : Lower cut-off frequency
R_L : Load resistance

To obtain equivalent low-frequency characteristics for 2-channel operation with bridge amplifier connected, double the capacitance.

C9 : Decoupling capacitor : Though this is an arm of the ripple filter, rejection effects saturate at a certain value so that excessively large values do not serve any further purpose. It is employed for a time constant of the muting circuit, so it affects the starting time.

C10 : Power supply capacitor.

Concerning application circuits

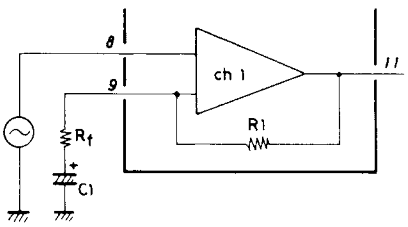
1. Voltage gain adjustments

♦ 2-channel

Voltage gain is determined by resistor R1 (R2) and an externally connected feedback resistor R_f in accordance with the following formula :

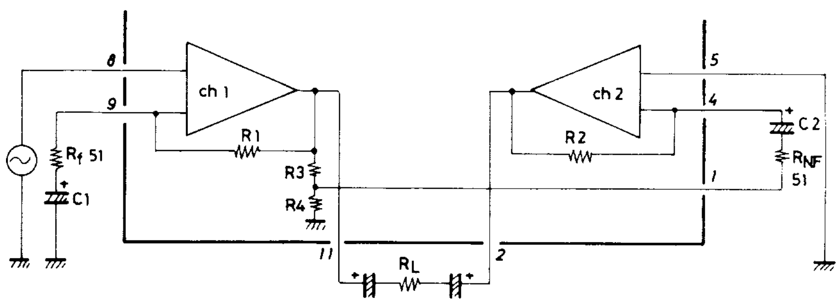
$$VG=20\log\frac{R1\ (R2)}{R_f}\ [dB]$$

By suitable selection of the externally connected resistor Rf, any voltage gain can be obtained. It is preferable, however, that the voltage gain is chosen in the range of 45dB to 50dB. Incidentally, R1 (R2) =10kΩ typ.



♦ Bridge Amplifier.

Unit (resistance: Ω)



A bridge amplifier connection is structured as shown above. Ch-1 functions as a non-inverting amplifier and Ch-2 as an inverting amplifier. For input to ch-2, output of ch-1 is divided by resistors R3 and R4 and is led out at pin 1 as bridge amplifier output. Attenuation of ch-1 output is R3/R4, while amplification of ch-2/ (R_{NF}+R4), and due to designation for R3 : 5kΩ typ., and R4 : 50Ω typ., ch-1 output attenuation and ch-2 amplification become equal by designating R_{NF}=51Ω. When obtained at ch-2, output is the same output as ch-1 but opposite in phase. Accordingly, the overall voltage gain exhibited is 6dB above ch-1 gain, and is approximately given by the following formula.

Continued on next page.

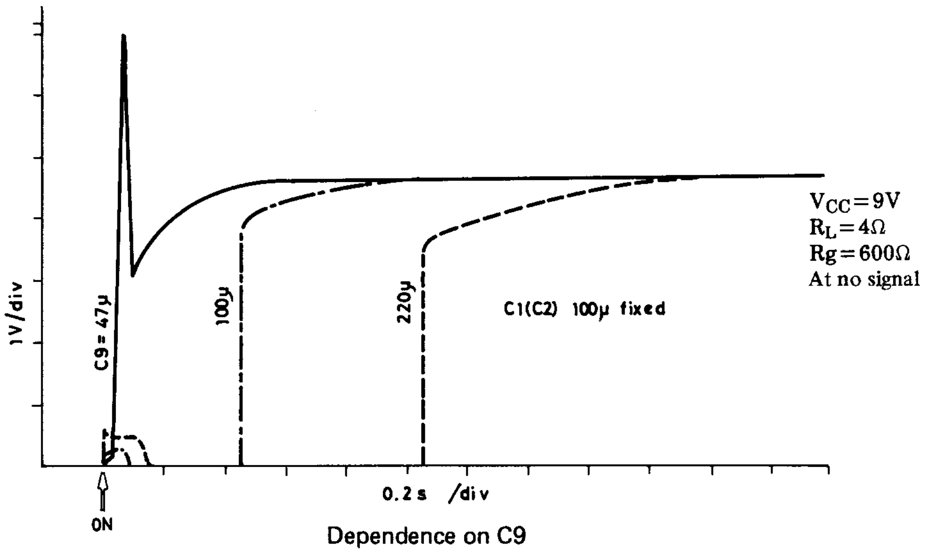
Continued from preceding page.

$$VG=20 \log \frac{R1}{R_f} +6 \text{ [dB]}$$

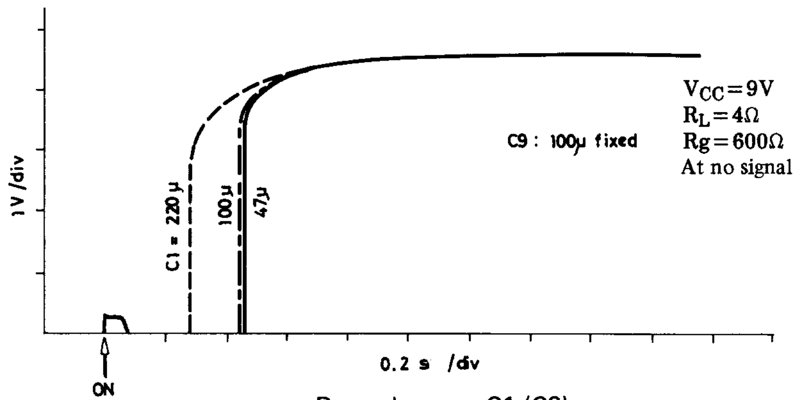
If designated for Rf=27Ω, VG=56dB will be obtained which is excessive ; it is recommended that R_{NF}=51Ω be designated when bridge amplifier is connected.

2. Crosstalk
   As LA4192 is used at a voltage gain around 50dB, feedback is shallow. It is recommended that the bridge amplifier output pin (pin 1) be grounded when used for 2-channel.

3. Starting time
   A built-in muting circuit suppresses shock noise when power is turned on. It utilizes time constant of C9 (decoupling capacitor), and built-in charging circuits for C1 and C2 (NF capacitors). The starting time depends on capacitances of C1 (C2) and C9 as shown below :



Dependence on C9



Dependence on C1 (C2)

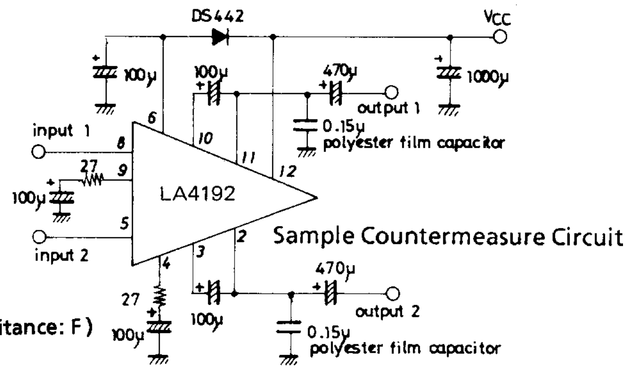
4. Cautions for use of the IC
   1. When used close to the maximum ratings, even a slight variation in conditions can cause the maximum ratings to be surpassed. This leads to breakdown failures. Be sure to provide for sufficient margins to cover variations in power voltages. Use the IC in a range that never exceeds the maximum ratings.
   2. Inter-pin shortcircuits
      Turning the power on with inter-pin shortcircuits causes breakage or deterioration, so that when mounting the IC on a circuit board, carefully inspect to avoid inter-pin shorts caused by soldering, before turning the power on.
   3. Short-circuited loads
      When used for a prolonged period with a shorted load, breakage or deterioration can result. Under no circumstance should loads be left shorted.
   4. When used in a radio or radio-cassette recorder, maintain a sufficient distance between the IC and a bar antenna.
   5. In making a circuit board, refer to the sample printed pattern.

• Caution for LA4192 in sets

When LA4192 is used in a set and driven by AC mains, switching the motor on as shwon below, causes instantaneous lowering of the power supply voltage, depending on the transformer regulation and other conditions.

Ripple noises are sometimes generated in the speakers or headphones. The following can be used to prevent such problems.

1. Connect a diode (a rectifier diode with an average rectified current I_O=100 to 200mA) across pins 6 and 12 of LA4192, and have pin 6 potential closely follow power supply voltage variations. In a steady state, this diode will be cut off.
2. Use large enough capacitance capacitors for the power supply to suppress supply votage variations caused when the motor is switched on.



Sample Countermeasure Circuit

Unit (resistance: Ω, capacitance: F)

• Heat sink design

As the package is basically heat-dissipated by utilizing a copper foil section of the printed circuit board, the area of copper foil in the vicinity of the IC heat dissipating plate should be made as broad in area as possible when designing the printed circuit board. For the sample printed pattern shown earlier, providing copper coil where indicated by the broken lines will considerably enhance heat sinking. Power consumption (Pd) can be increased depending on power supply voltage and load conditions. Use of a heat sink in conjunction with the printed circuit board is recommended. Described below are formulas to provide guidelines for Pd (for 2 channels) under various conditions of usage. For AC power supplies, it is preferable to take actual measurements at the transformer of sets. For bridge amplifier, simply use 1/2 of employed loads in computations.

1) DC power supply

$$\text{Pd max}=\frac{V_{CC}^2}{\pi^2 R_L}+I_{CCO}\cdot V_{CC}\ \text{(for 2 channels)} \quad \text{.......... (1)}$$

2) AC power supply

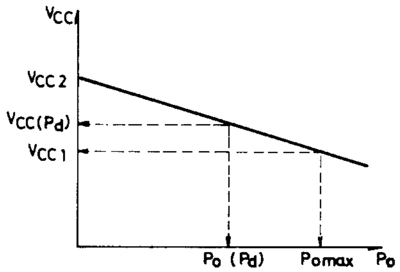
$V_{CC}2$: Power supply voltage at no signal

V_{CC} (Pd) : Power supply voltage at P_d max

$V_{CC}1$: Power supply voltage at maximum output

r : Voltage regulation $\frac{V_{CC}2-V_{CC}1}{V_{CC}1}$

I_{CCO} : Quiescent current



Power supply voltage variation

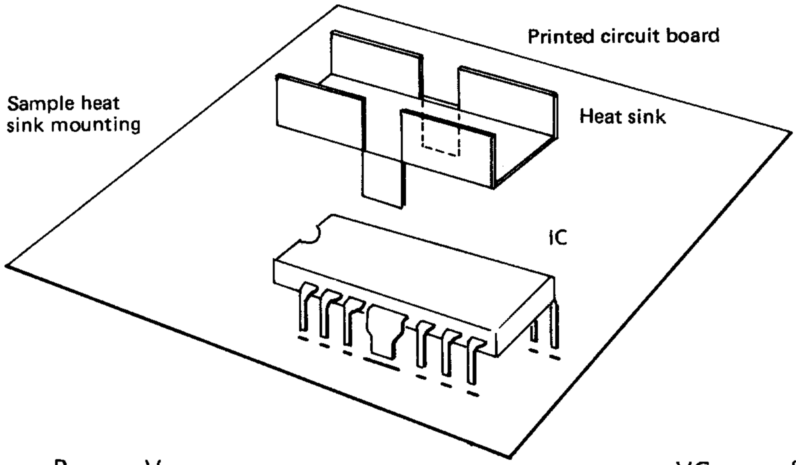
$$P_d\ \text{max}=\frac{V_{CC}(Pd)^2}{\pi^2 R_L}+I_{CCO}\cdot V_{CC}\ \text{(Pd) (for 2 channels)} \quad \text{.......... (2)}$$

where

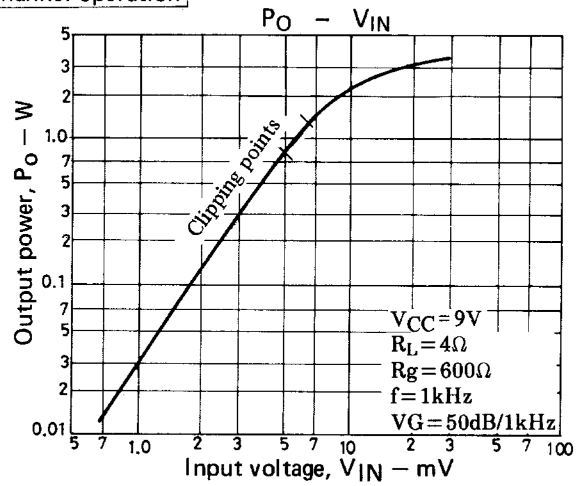
$$V_{CC}\ (Pd)=\frac{(1+r)\,V_{CC}1}{1+\frac{r\cdot V_{CC}1}{\sqrt{2}\cdot\pi\cdot R_L}\times\sqrt{\frac{R_L}{P_O\ \text{max}}}}$$

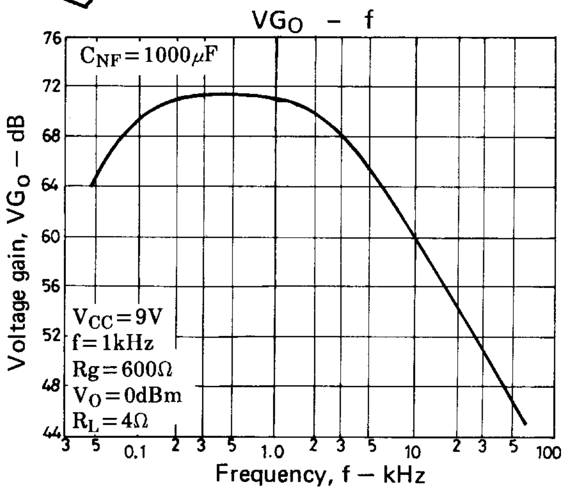
Sample heat sink mounting

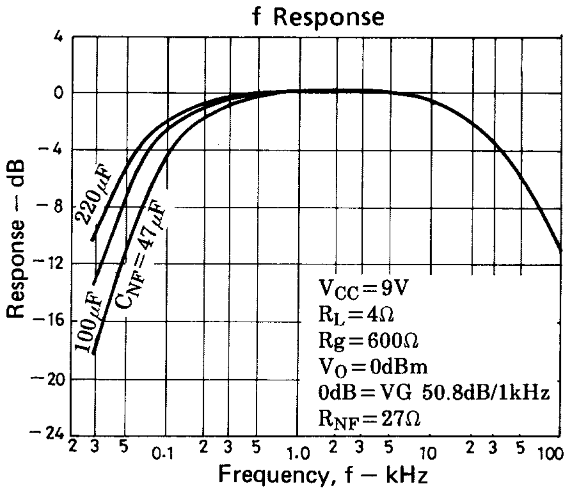
Prepare a heat sink as shown on the next page. It is configured to be able to dissipate heat both from the IC plastic surface and its fins. Solder it on to the printed circuit board. Refer to the Pd – Ta characteristics for size of heat sink. Solderable copper or steel are preferable. Silicone grease is recommended for application to the IC plastic surface to lower its thermal resistance with the heat sink.

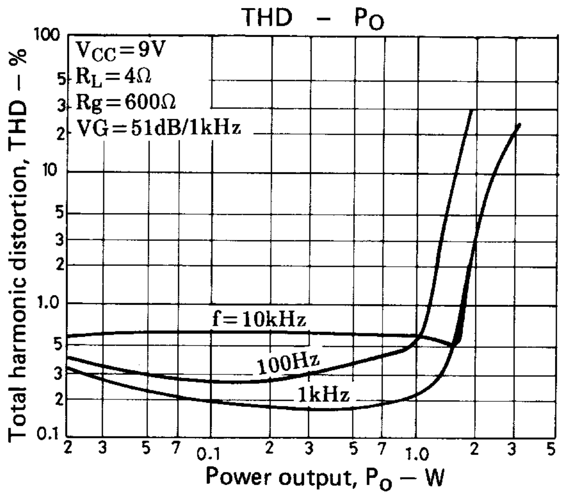


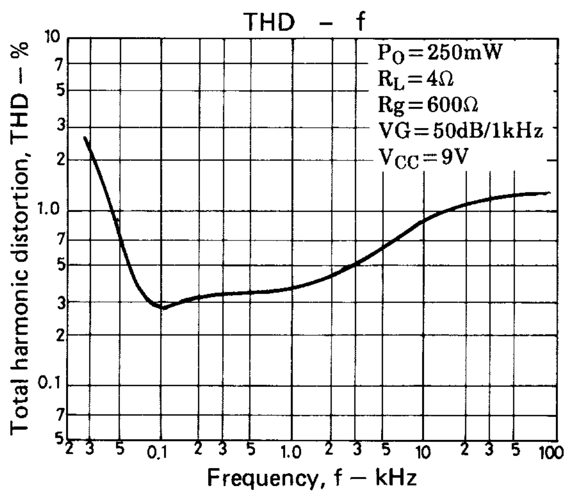
2 channel operation

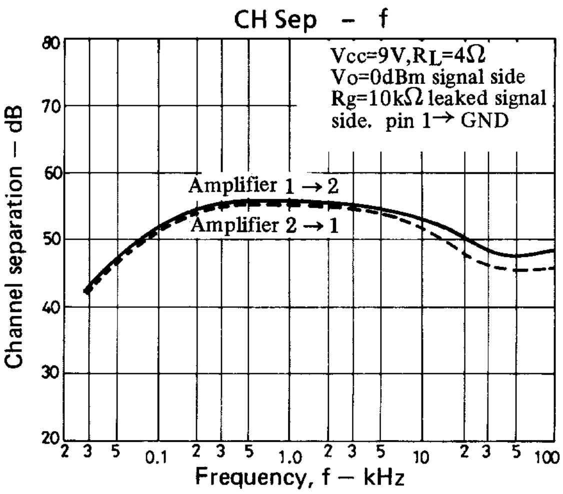




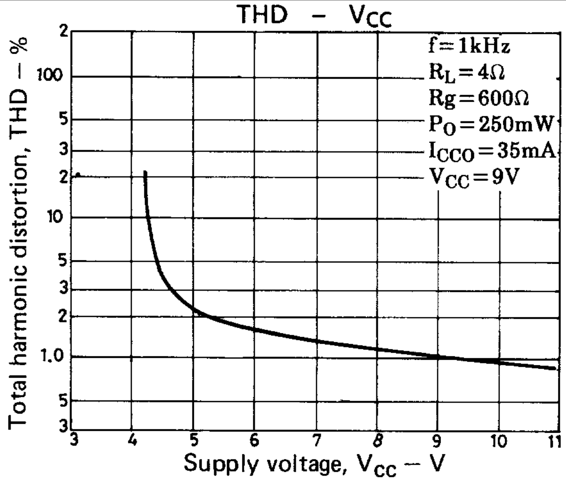




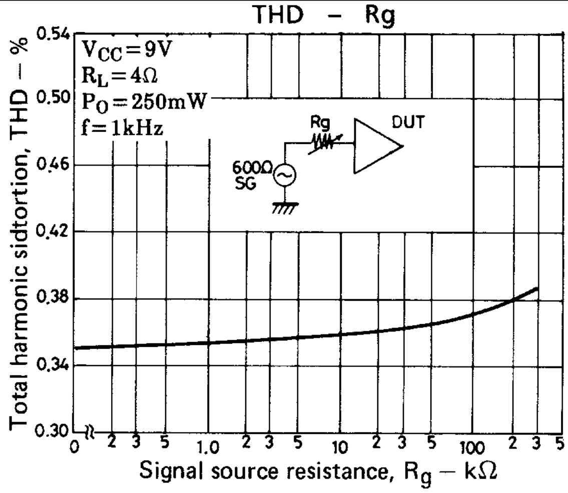




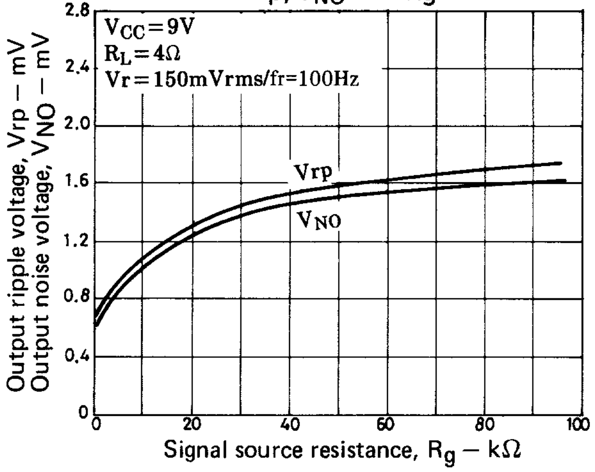
THD – V_{CC}



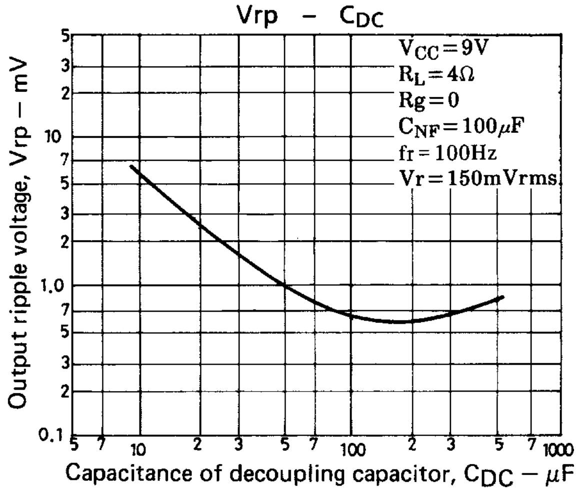
THD – Rg



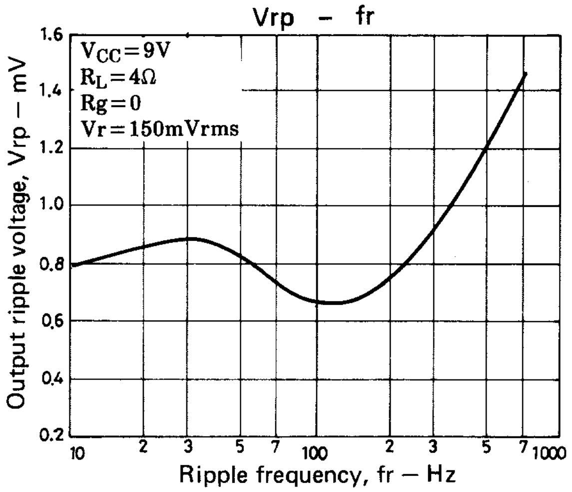
Vrp, V_{NO} – Rg



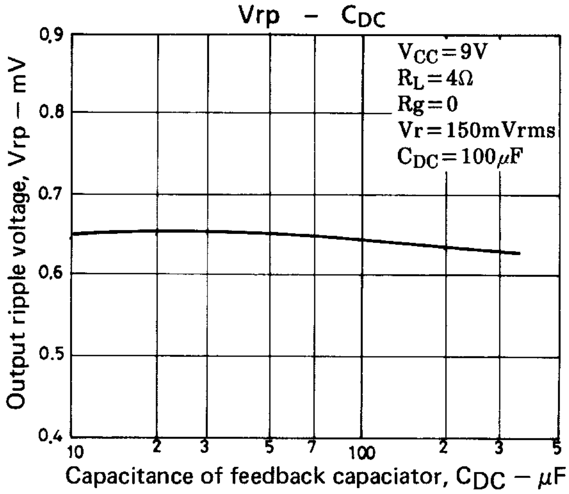
Vrp – C_{DC}



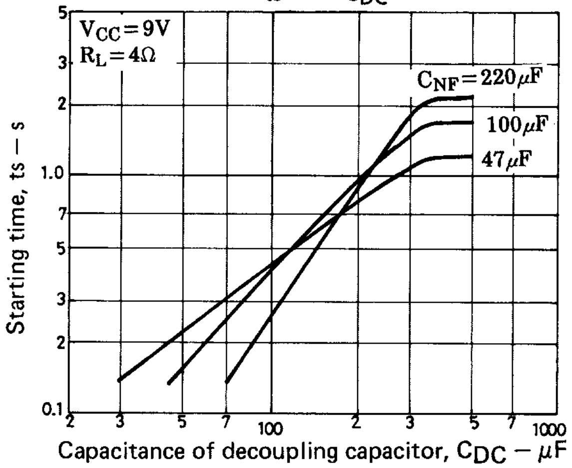
Vrp – fr



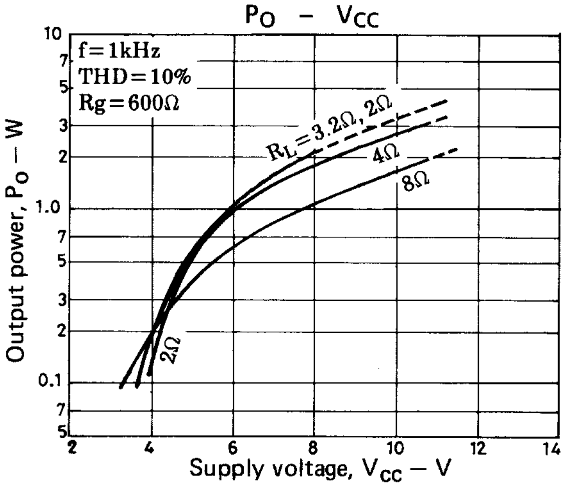
Vrp – C_{DC}

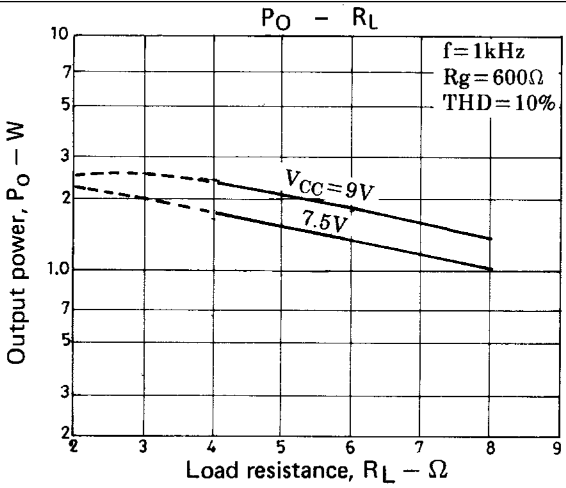


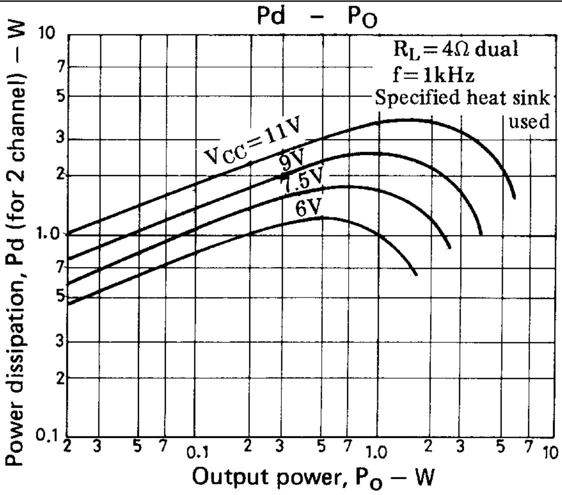
ts – C_{DC}

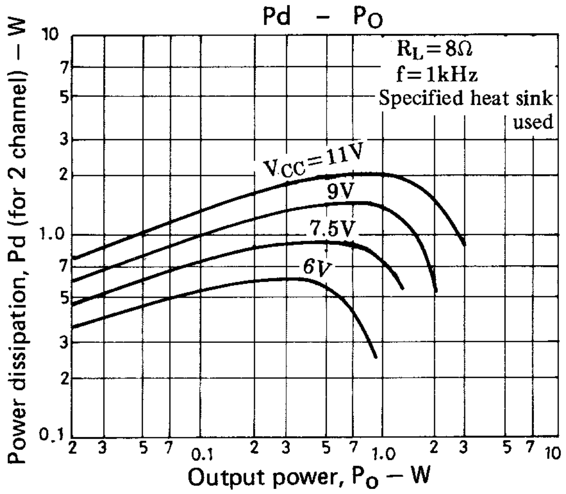


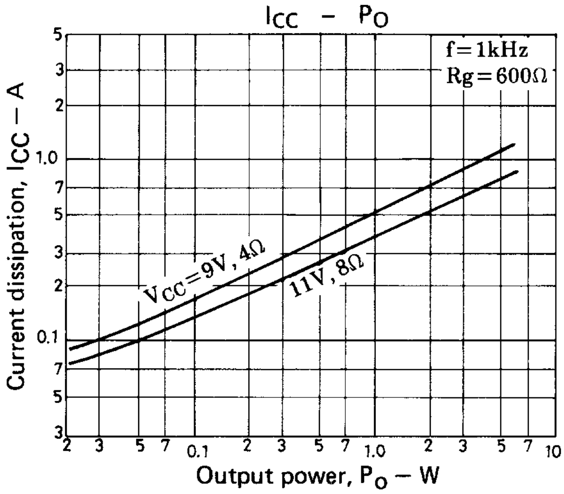
P_O – V_{CC}

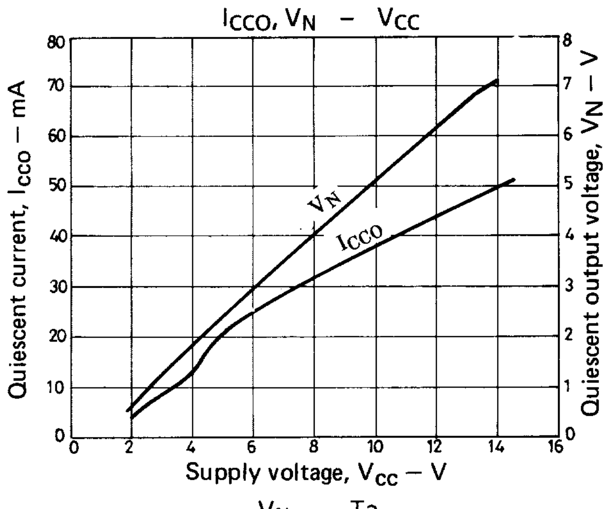


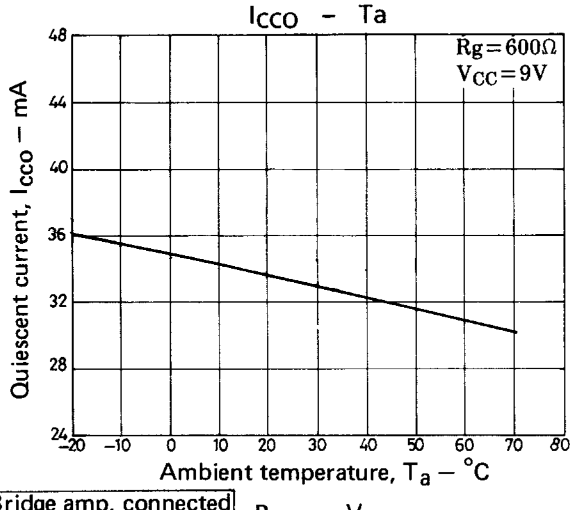


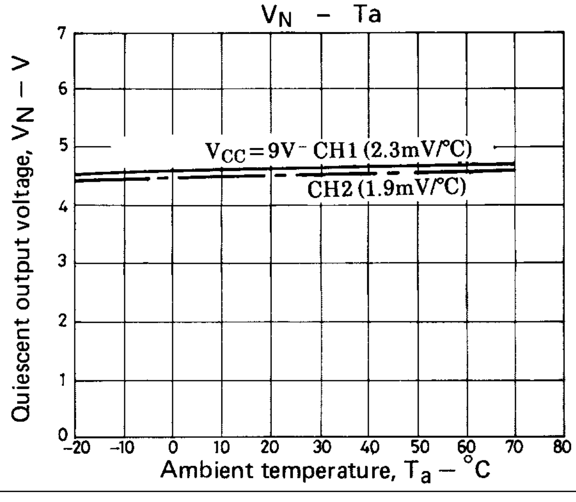




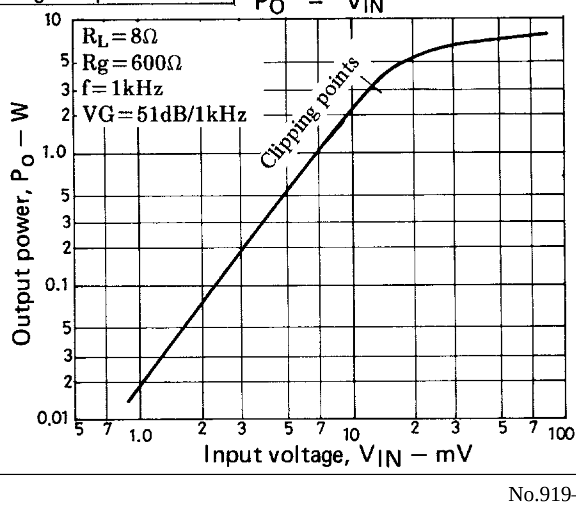




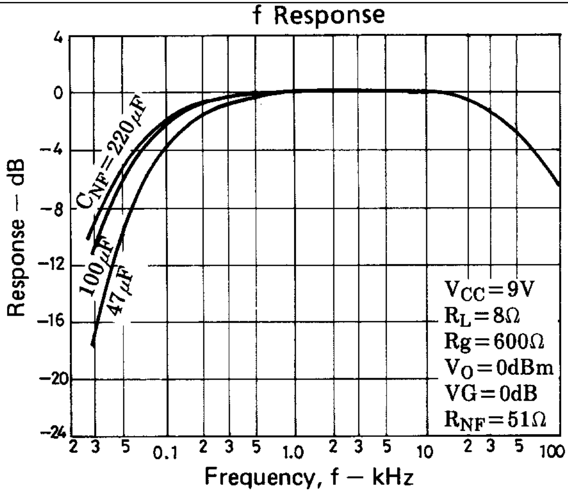




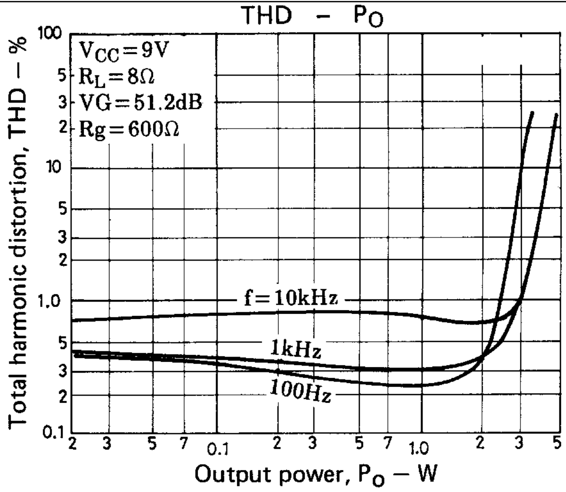
Bridge amp. connected



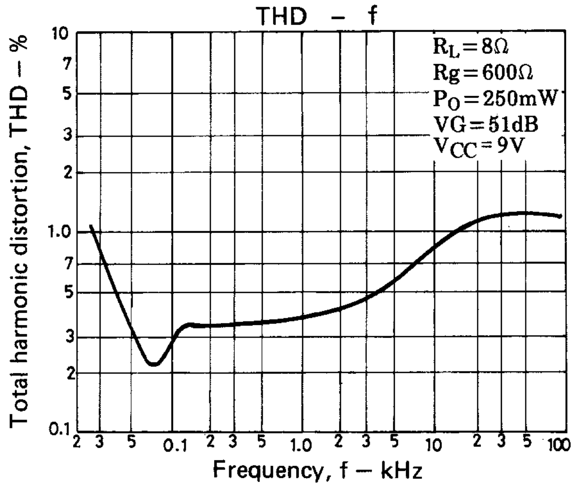
f Response



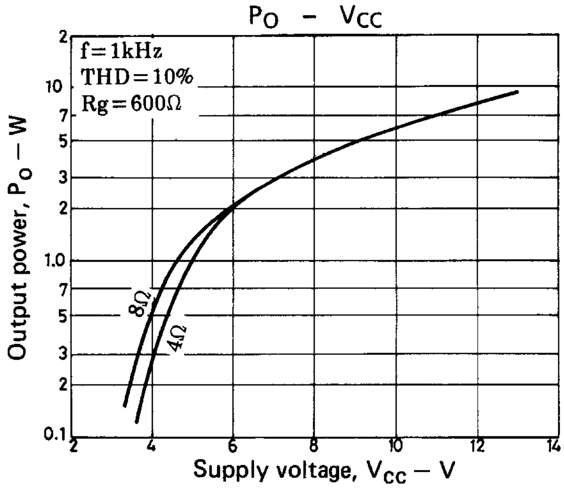
THD – P_O



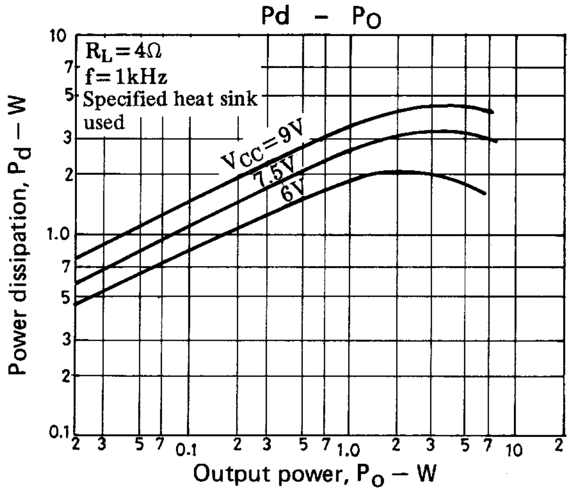
THD – f



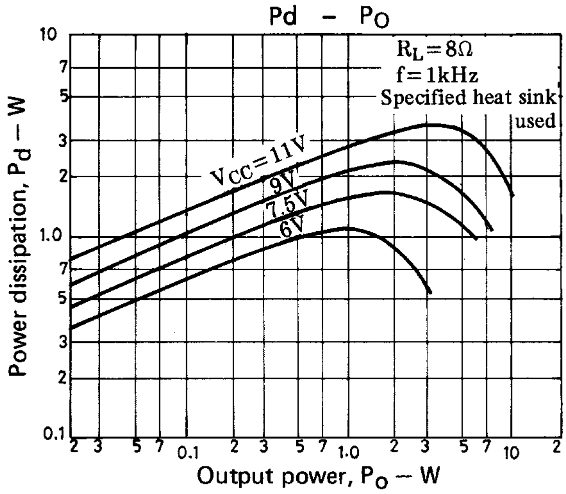
P_O – V_{CC}



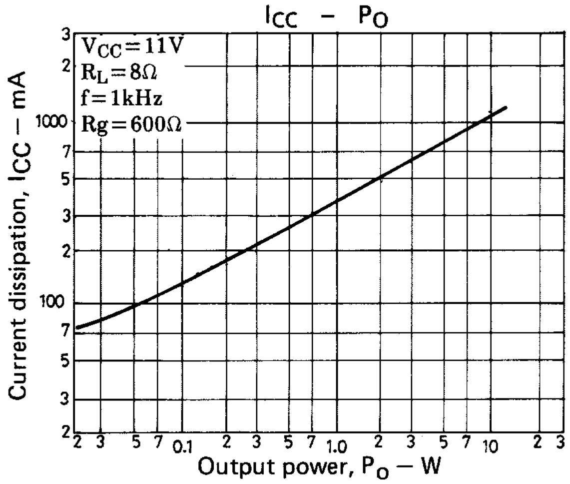
Pd – P_O



Pd – P_O



I_{CC} – P_O



This catalog provides information as of February, 2000. Specifications and information herein are subject to change without notice.