



LA4192

1 to 2.3W 2-Channel of Power Amplifier

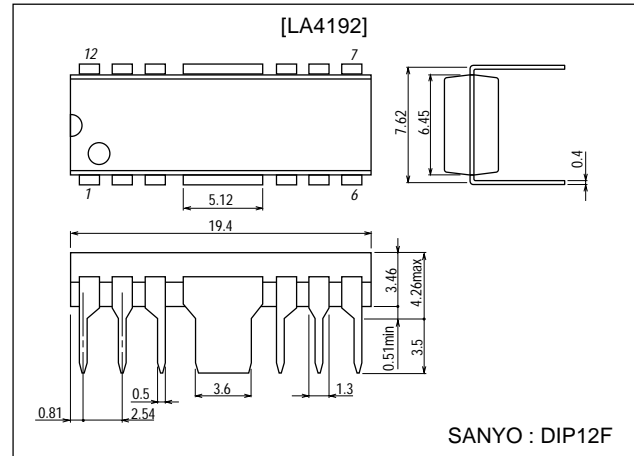
Features

- 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 $V_{CC}=9V$, $R_L=4\Omega$, or 4.7W bridge amplifier (for $R_L=8\Omega$).
- Voltage gain is variable by externally connected feedback resistors :
For 2-channel : $R_{NF}=27\Omega$, $VG=50dB$
Bridge amplifier connected : $R_{NF}=51\Omega$, $VG=51dB$
- 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 $T_a = 25^\circ C$

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{CC} max	With signals	11	V
		With no signal	15	V
Allowable power dissipation	P_d max	With P-plate (See $P_d - T_a$ diagram)	4	W
Operating temperature	T_{opr}		-20 to +75	$^\circ C$
Storage temperature	T_{stg}		-55 to +150	$^\circ C$

Recommended Operating Conditions at $T_a = 25^\circ C$

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 P_d 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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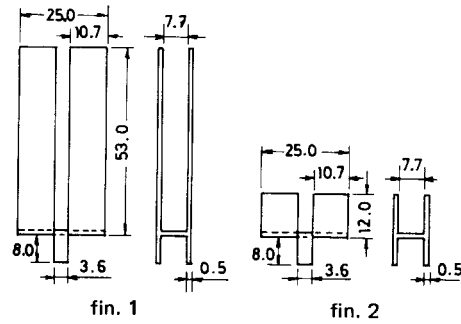
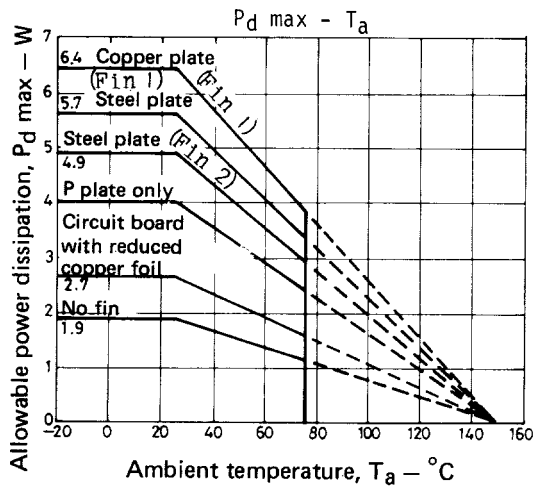
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21500TH (KT)/71093TS/O207KI/2146KI/4195MW, TS No.919-1/11

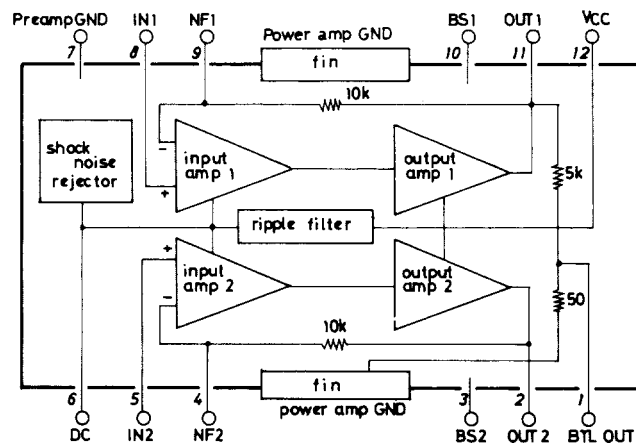
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Operating Characteristics at $T_a = 25^\circ\text{C}$, $V_{CC}=9\text{V}$, $f=1\text{kHz}$, $R_g=600\Omega$, $R_L=4\Omega$, () denotes values for 8Ω , in the specified test circuit

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, $R_{NF}=27\Omega$, $V_{IN}=-51\text{dBm}$, 2-channel	48	50	52	dB
		Closed loop, $R_{NF}=27\Omega$, $V_{IN}=-51\text{dBm}$, Bridge	49	51	53	dB
Voltage gain imbalance	ΔVG	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	$P_O=250\text{mW}$, 2-channel		0.5	2.0	%
Input resistance	r_i		21	30		k Ω
Output noise voltage	V_{NO}	$R_g=0$, 2-channel		0.5	1.3	mV
		$R_g=10\text{k}\Omega$, 2-channel		0.8	2.5	mV
Ripple rejection	R_r	$R_g=0$, $V_R=150\text{mV}$, 2-channel		46		dB
Channel separation	CH sep	$R_g=10\text{k}\Omega$, $v_o=0\text{dBm}$, 2-channel	40	55		dB



Equivalent Circuit Block Diagram

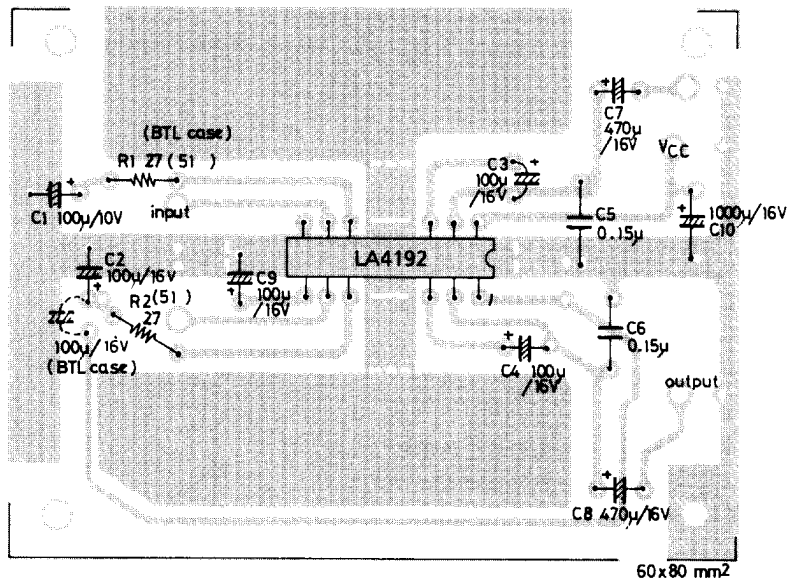
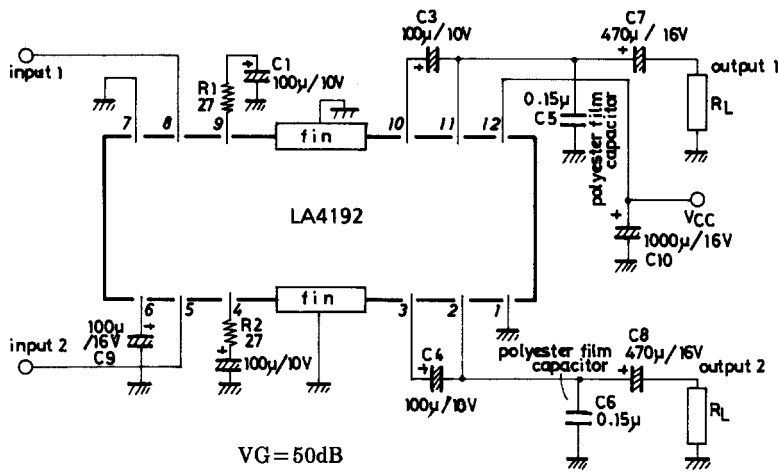


Unit (resistance: Ω)

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Sample Application Circuit 1 : For 2-channel

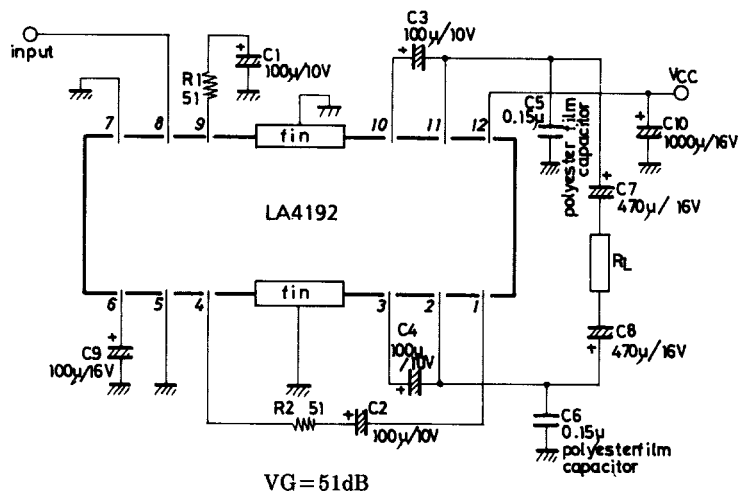
Unit (resistance: Ω , capacitance: F)



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

Sample Application Circuit 2 : Bridge amplifier connected

Unit (resistance: Ω , capacitance: F)



Externally connected components and comments

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

$$f_L = \frac{1}{2\pi C1 R_f} \quad \begin{array}{l} f_L : \text{Lower cut-off frequency} \\ R_f : \text{Feedback resistance} \end{array}$$

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 $\pm 5\%$ -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 $47\mu\text{F}$.

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 :

$$f_L = \frac{1}{2\pi C7 R_L} \quad \begin{array}{l} f_L : \text{Lower cut-off frequency} \\ R_L : \text{Load resistance} \end{array}$$

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

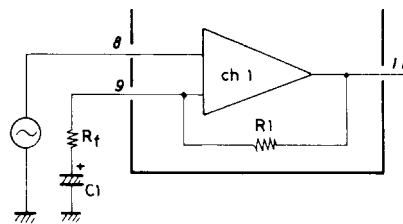
1. Voltage gain adjustments

◆ 2-channel

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

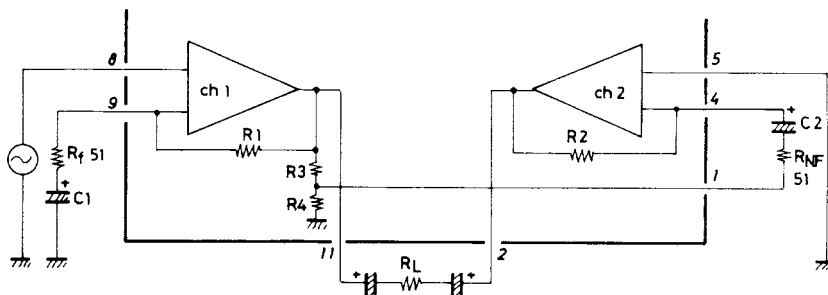
$$VG = 20 \log \frac{R1 (R2)}{R_f} \text{ [dB]}$$

By suitable selection of the externally connected resistor R_f , 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) = 10k Ω 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 : 5k Ω typ., and R4 : 50 Ω typ., ch-1 output attenuation and ch-2 amplification become equal by designating $R_{NF}=51\Omega$. 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.

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

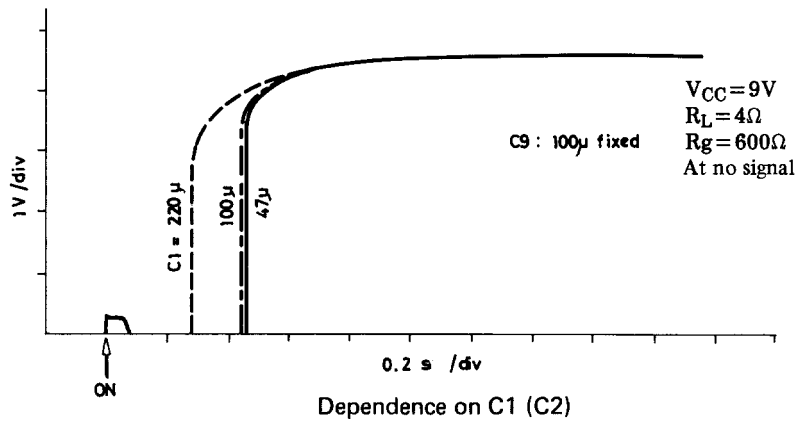
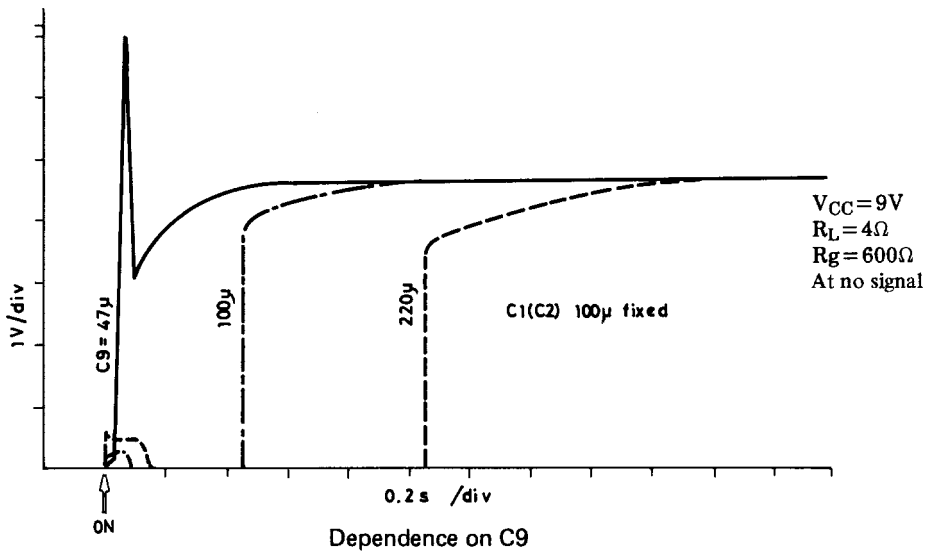
If designated for $R_f=27\Omega$, $VG=56\text{dB}$ will be obtained which is excessive ; it is recommended that $R_{NF}=51\Omega$ be designated when bridge amplifier is connected.

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 :



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.

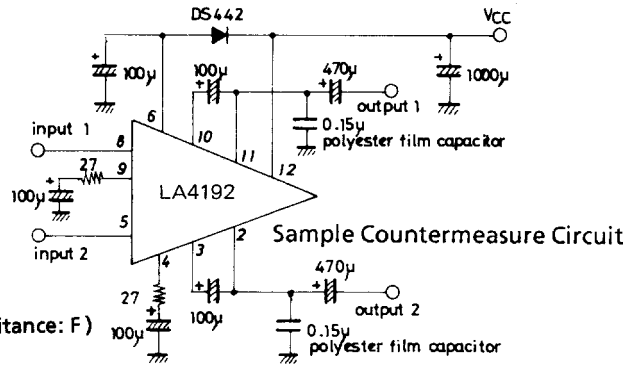
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• Caution for LA4192 in sets

When LA4192 is used in a set and driven by AC mains, switching the motor on as shown 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 voltage variations caused when the motor is switched on.



Unit (resistance: Ω , capacitance: F)

• Heat sink design

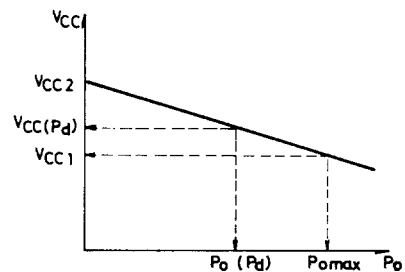
As the package is basically heat-dissipated by utilizing a copper foil section of the printed circuit board, the area of copper foil in the vicinity of the IC heat dissipating plate should be made as broad in area as possible when designing the printed circuit board. For the sample printed pattern shown earlier, providing copper coil where indicated by the broken lines will considerably enhance heat sinking. Power consumption (P_d) 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 P_d (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

$$P_d \text{ max} = \frac{V_{CC2}^2}{\pi^2 R_L} + I_{CC0} \cdot V_{CC} \text{ (for 2 channels) } \dots\dots\dots (1)$$

2) AC power supply

- V_{CC2} : Power supply voltage at no signal
- $V_{CC} (P_d)$: Power supply voltage at P_d max
- V_{CC1} : Power supply voltage at maximum output
- r : Voltage regulation $\frac{V_{CC2} - V_{CC1}}{V_{CC1}}$
- I_{CC0} : Quiescent current



Power supply voltage variation

$$P_d \text{ max} = \frac{V_{CC(Pd)}^2}{\pi^2 R_L} + I_{CC0} \cdot V_{CC} (P_d) \text{ (for 2 channels) } \dots\dots\dots (2)$$

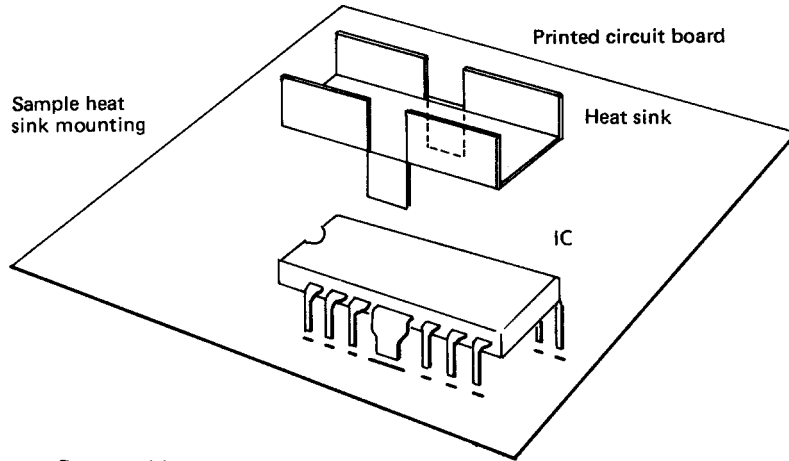
where

$$V_{CC} (P_d) = \frac{(1+r) V_{CC1}}{1 + \frac{r \cdot V_{CC1}}{\sqrt{2} \cdot \pi \cdot R_L} \times \sqrt{\frac{R_L}{P_{O \text{ max}}}}}$$

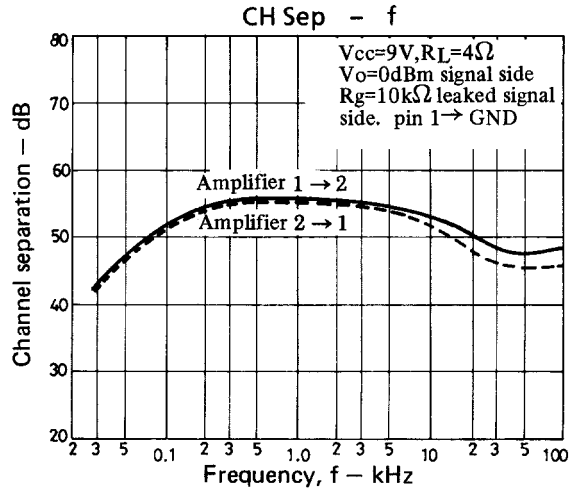
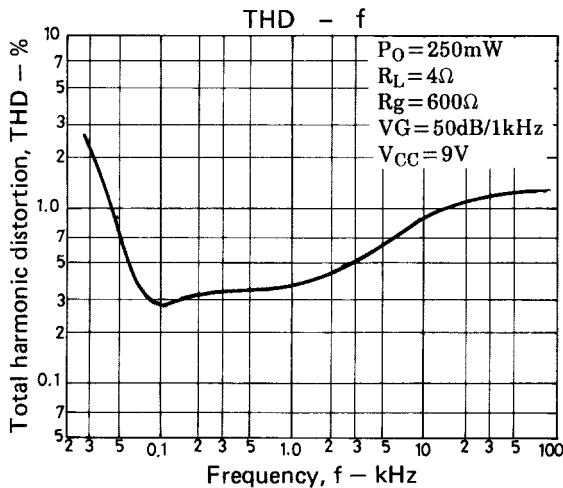
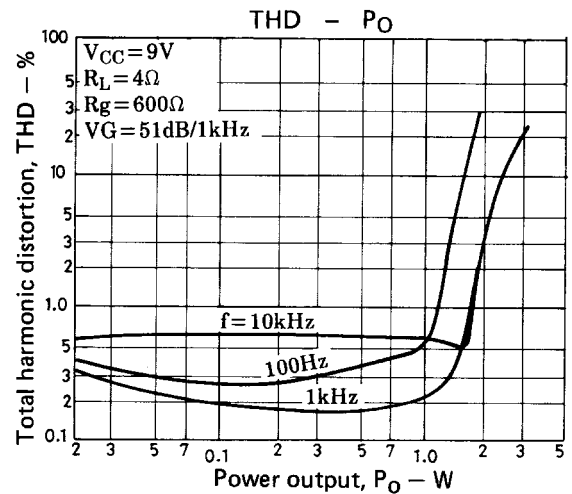
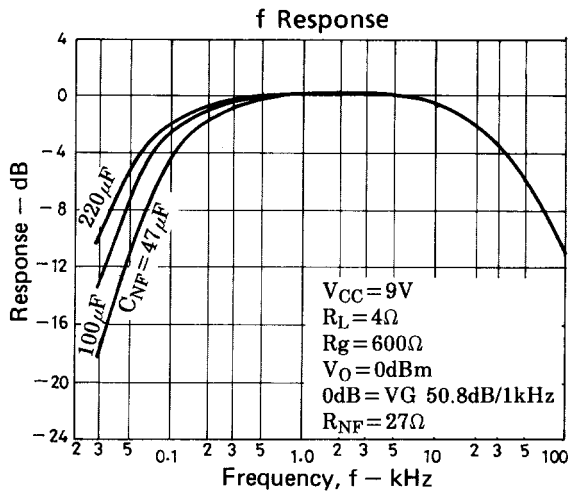
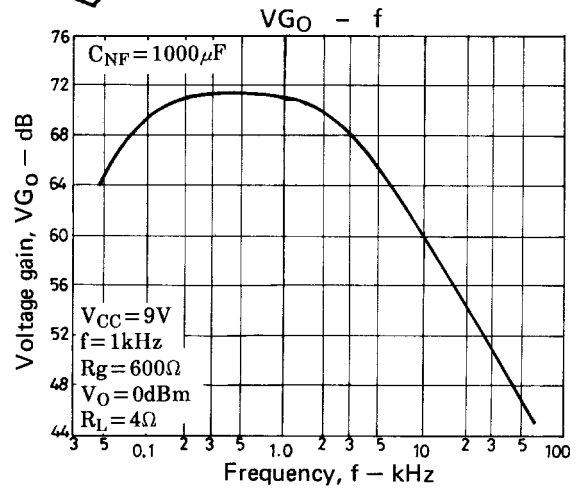
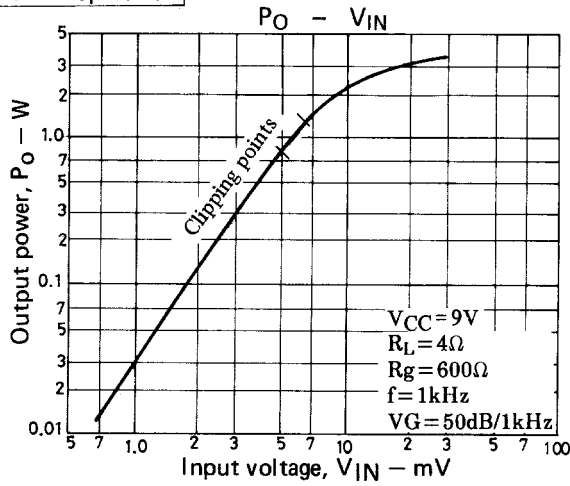
Sample heat sink mounting

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 $P_d - T_a$ 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.

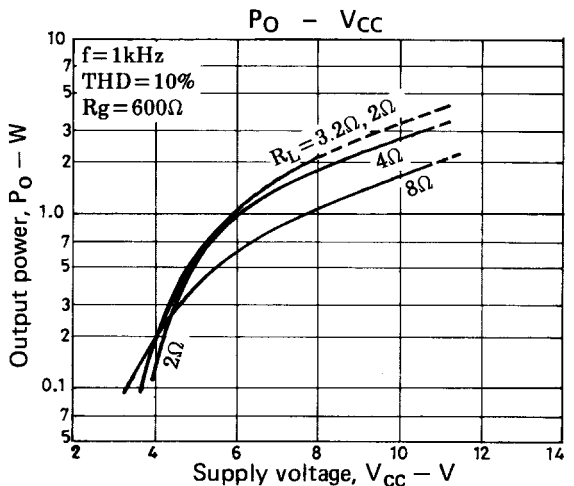
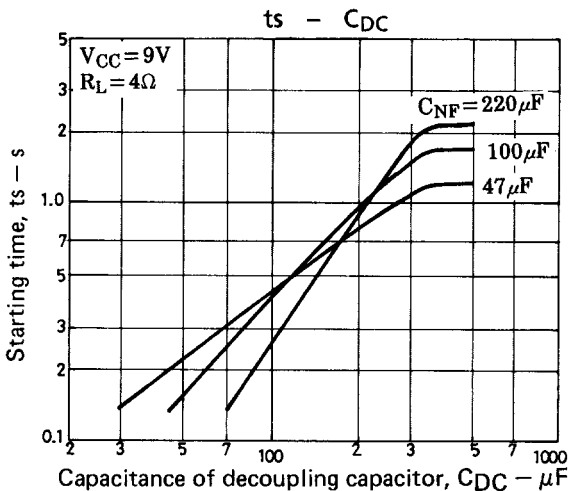
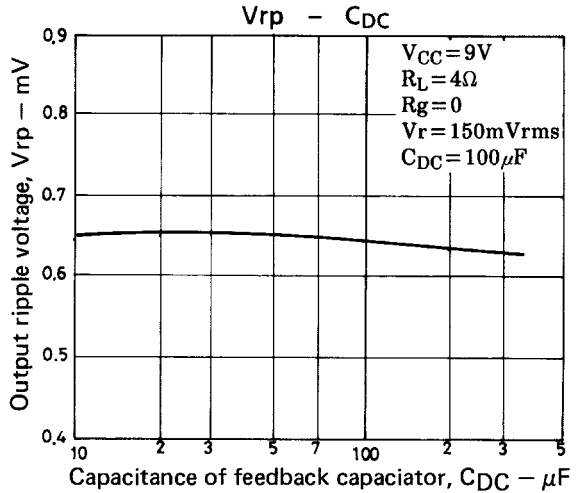
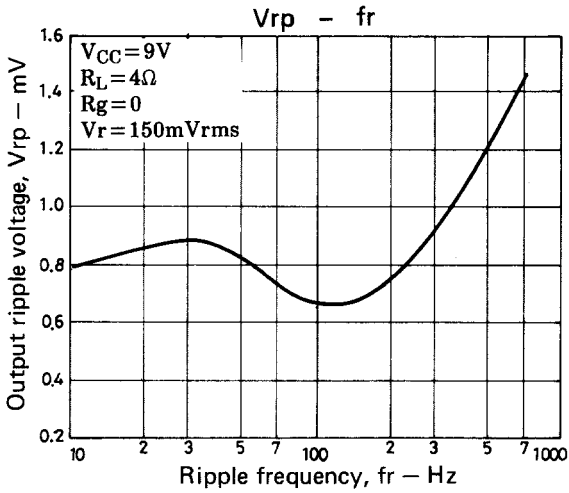
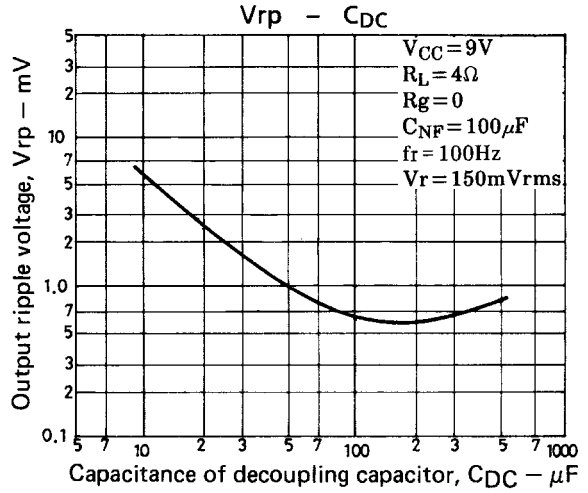
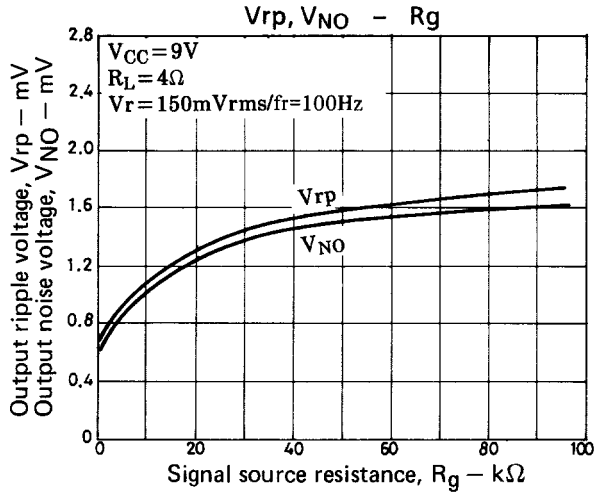
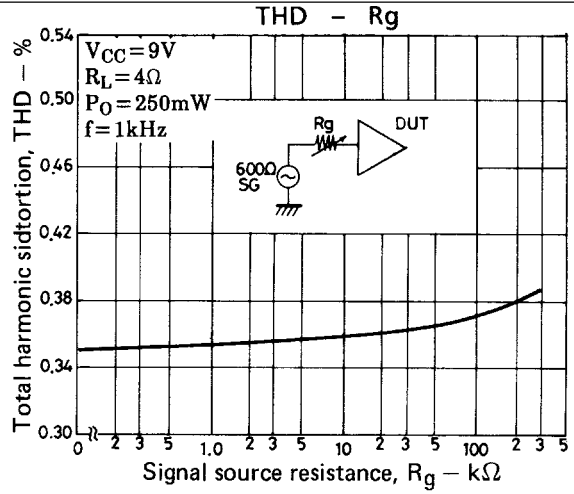
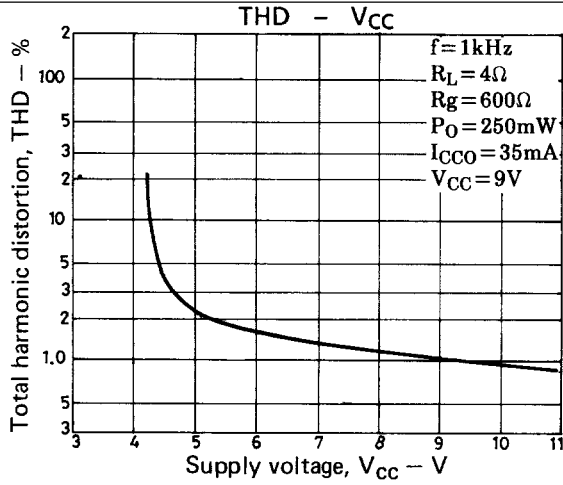
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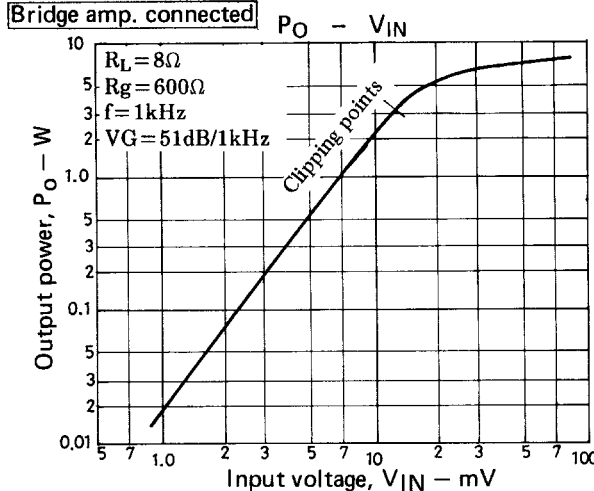
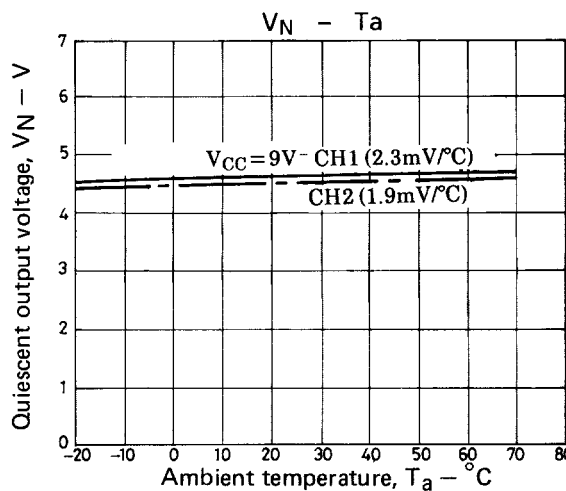
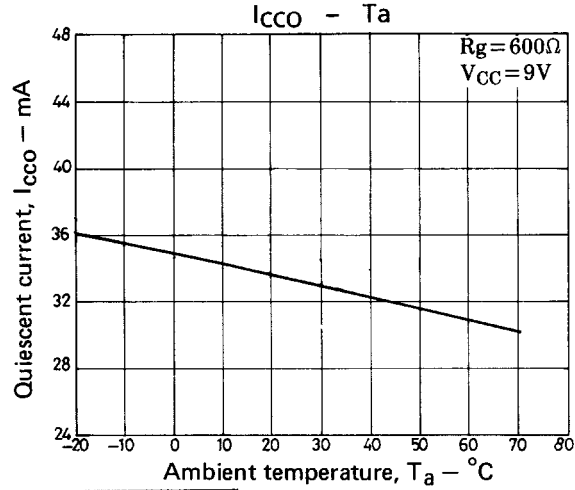
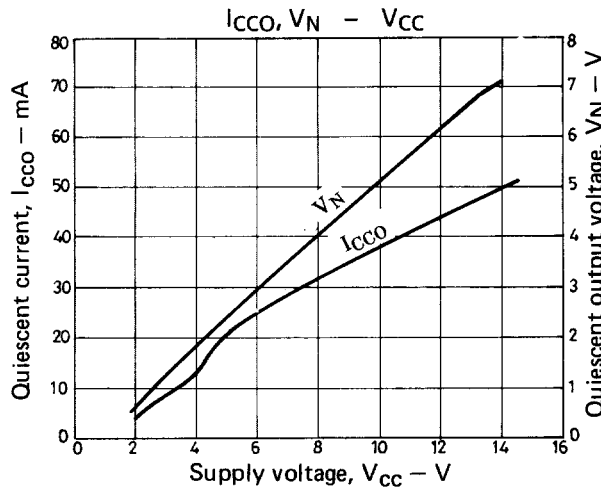
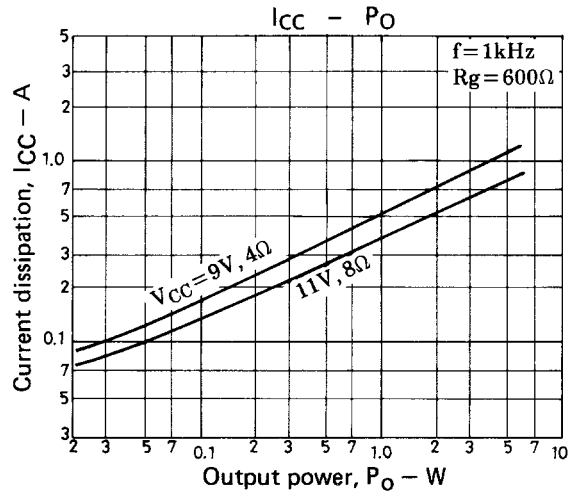
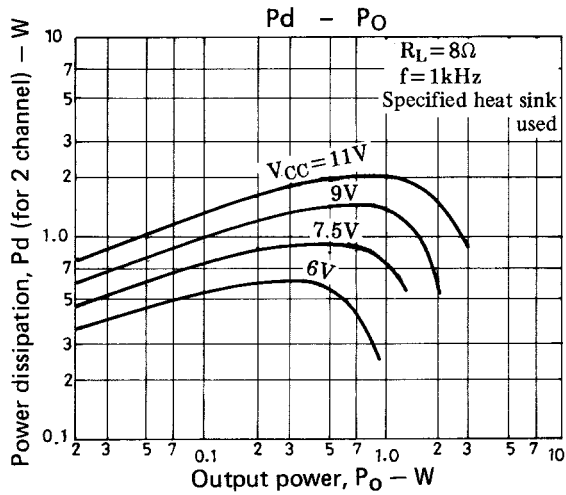
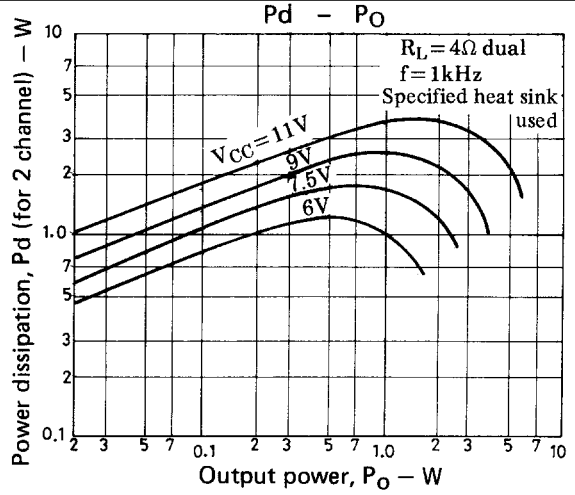
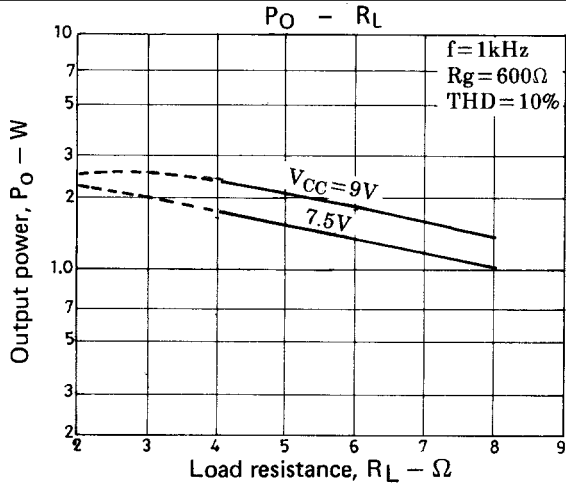
2 channel operation



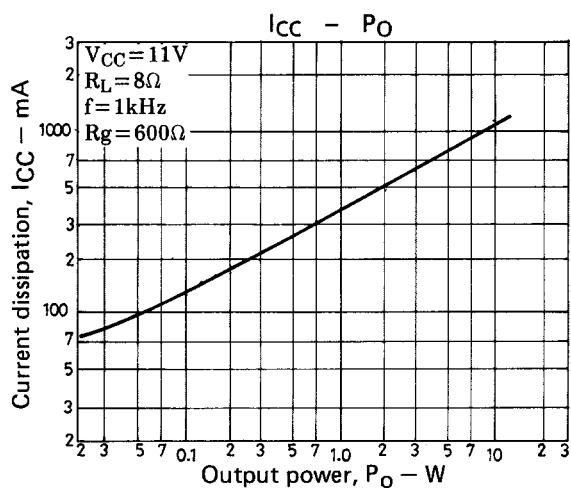
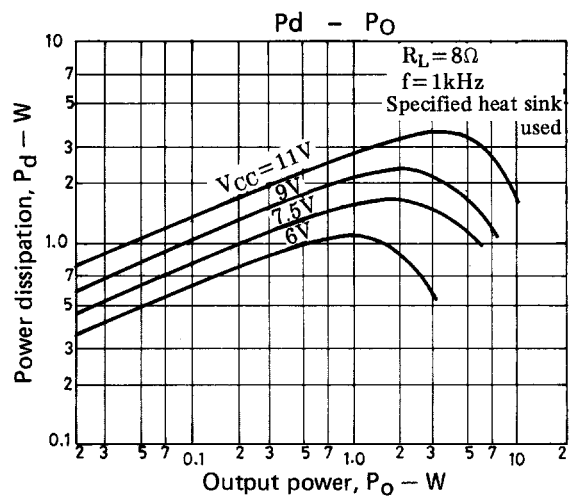
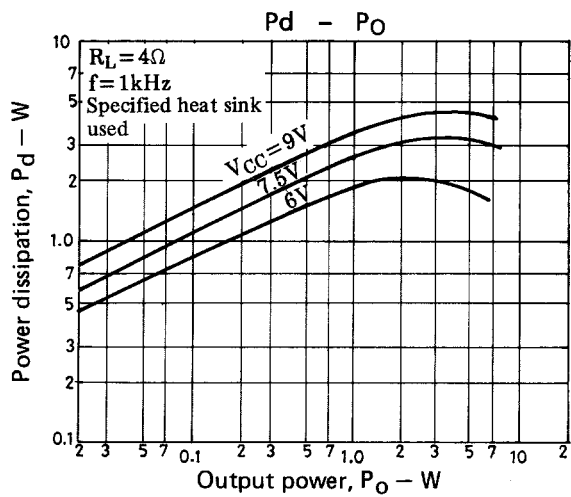
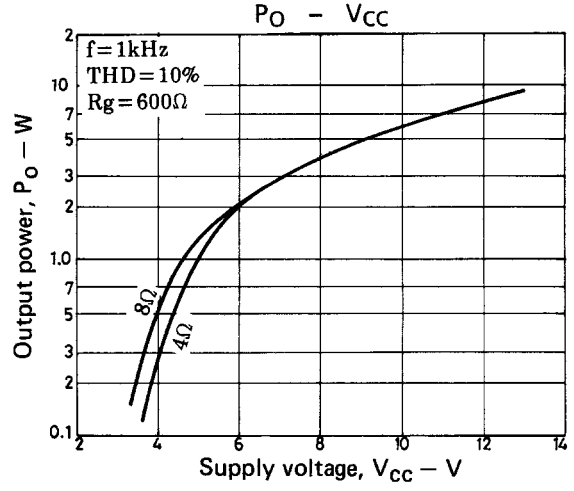
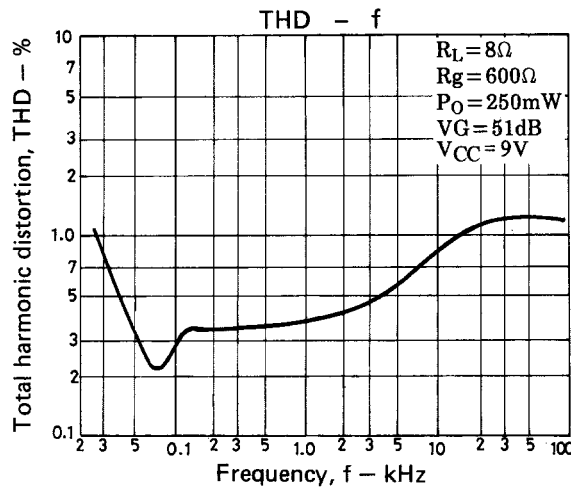
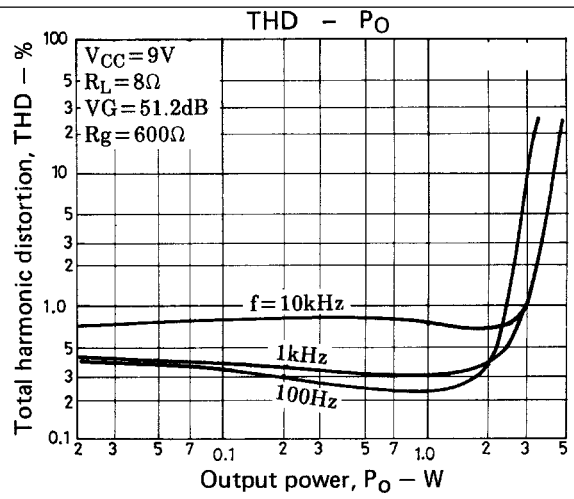
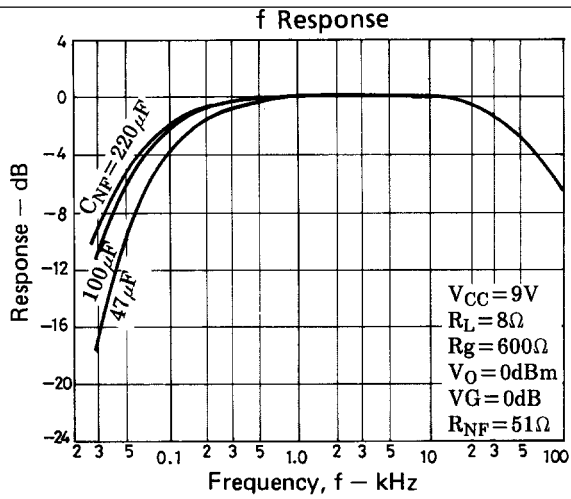
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