Ordering number:ENN4898

Thick Film Hybrid IC

STK401-140

2ch AF Power Amplifier (Split Power Supply) (120W + 120W min, THD = 0.4%)

Overview

A major feature of Sanyo thick-film power amplifier ICs is that all ICs within a given product series are pin compatible. This allows users to construct a product line of amplifiers with differing power output capacities using the same PCB design by simply changing the hybrid IC used. Sanyo has now developed a new series that expands this intra-series pin compatibility to also provide compatibility between certain series. Adoption of the ICs in this new series also allows the development of both two- and three-channel amplifiers on the same PCB. Furthermore, this new series supports 3 and 6 Ω drive to handle the recent trend toward lower impedance speakers.

Features

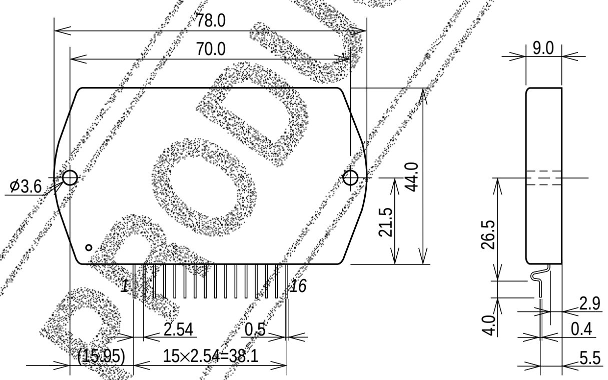
- Pin compatibility
  STK400-000 series (three channels/single package)
  ↓
  STK401-000 series (two channels/single package)
- Support for output load impedances of 3 or 6 Ω
- New pin assignment
  The new pin assignment groups the input, output, and power supply systems into separate blocks. This minimizes characteristic degradation due to problems with the PCB pattern layout.
- Minimal number of required external components
  The bootstrap resistor and capacitor required in earlier series are no longer necessary.

Package Dimensions

unit:mm

4029

[STK401-140]



SANYO : SIP16

Specifications

Maximum Ratings at Ta = 25˚C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{CC} max		±74	V
Thermal resistance	θ j-c	Per power transistor	1.0	˚C/W
Junction temperature	Tj		150	˚C
Operating substrate temperature	Tc		125	˚C
Storage temperature	Tstg		–30 to +125	˚C
Available time for load short-circuit	t_s	V_{CC}=±51V, R_L=6Ω, f=50Hz, P_O=120W	0.5	s

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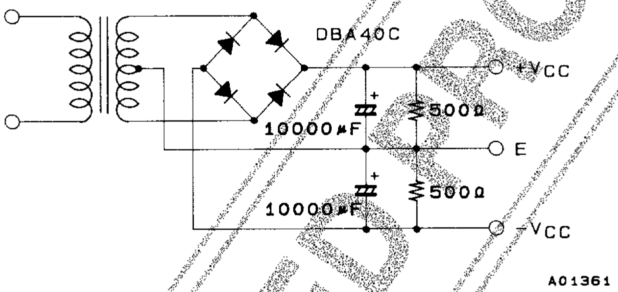
Operating Characteristics at Ta = 25˚C, R_L=6Ω, Rg=600Ω, VG=40dB, and with a noninductive load (R_L)

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Quiescent current	I_{CCO}	V_{CC}=±61V	20	60	100	mA
Output power	P_O	V_{CC}=±51V, f=20Hz to 20kHz, THD=0.4%	120	140		W
Total harmonic distortion	THD1	V_{CC}=±51V, f=20Hz to 20kHz, P_O=1.0W			0.4	%
	THD2	V_{CC}=±51V, f=1kHz, P_O=30W		0.02		%
Frequency characteristics	f_L, f_H	V_{CC}=±51V, P_O=1.0W, $^{+0}_{-3}$ dB		20 to 50k		Hz
Input impedance	r_i	V_{CC}=±51V, f=1kHz, P_O=1.0W		55		kΩ
Output noise voltage	V_{NO}	V_{CC}=±61V, Rg=10kΩ			1.2	mVrms
Neutral voltage	V_N	V_{CC}=±61V	–70	0	+70	mV

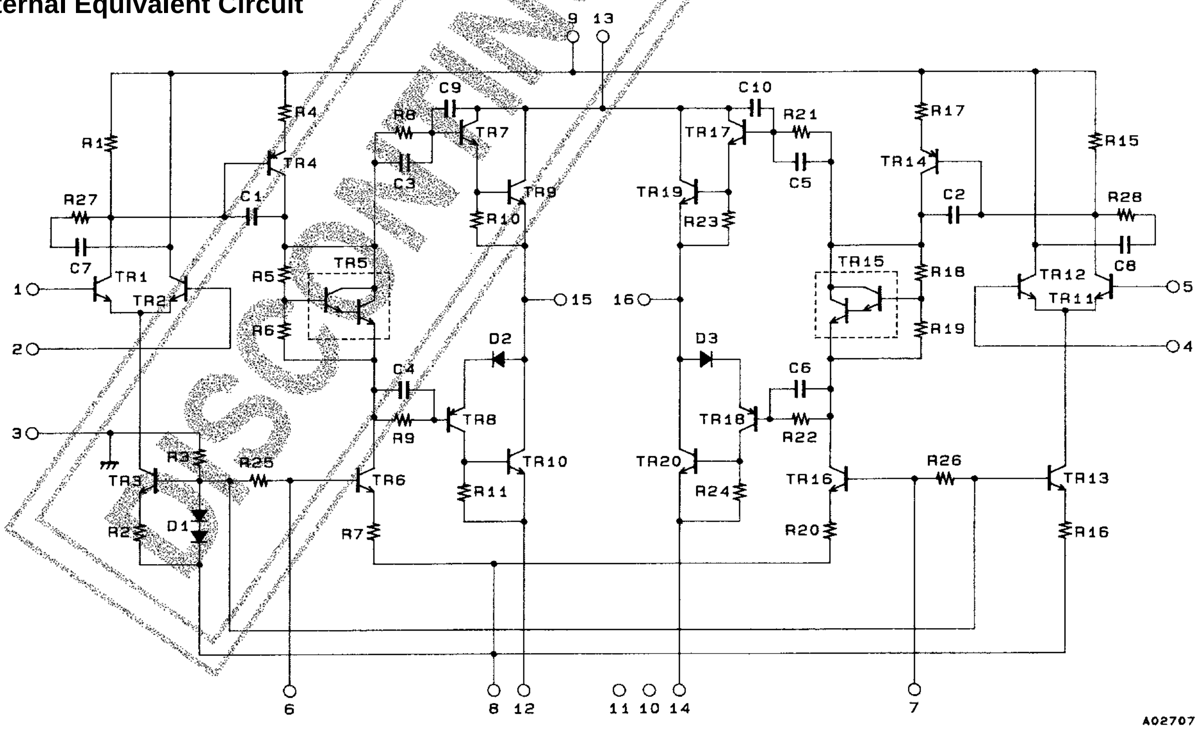
Note.

1. Use a rated power supply for the test unless otherwise noted.
2. Use the specified transformer power supply shown in the figure when measuring the available time for load shorted and the output noise voltage.
3. The output noise voltage is the peak value measured with an averaging rms scale volt meter (VTVM). A 50 Hz AC stabilized power supply should be used to eliminate the effects fo AC primary line flicker noise when an AC power supply is used.

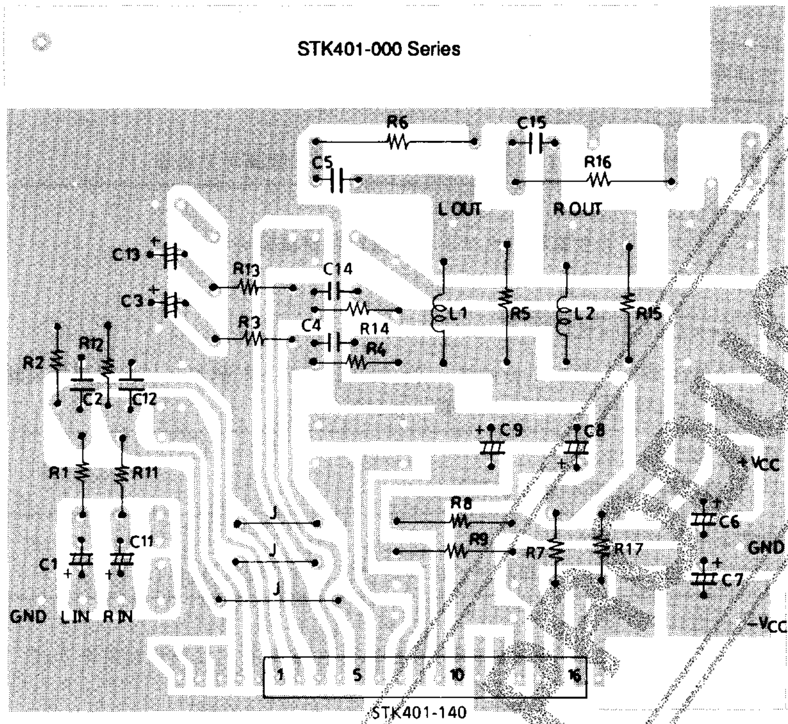


Specified Transformer Power Supply (MG-250 equivalent)

Internal Equivalent Circuit

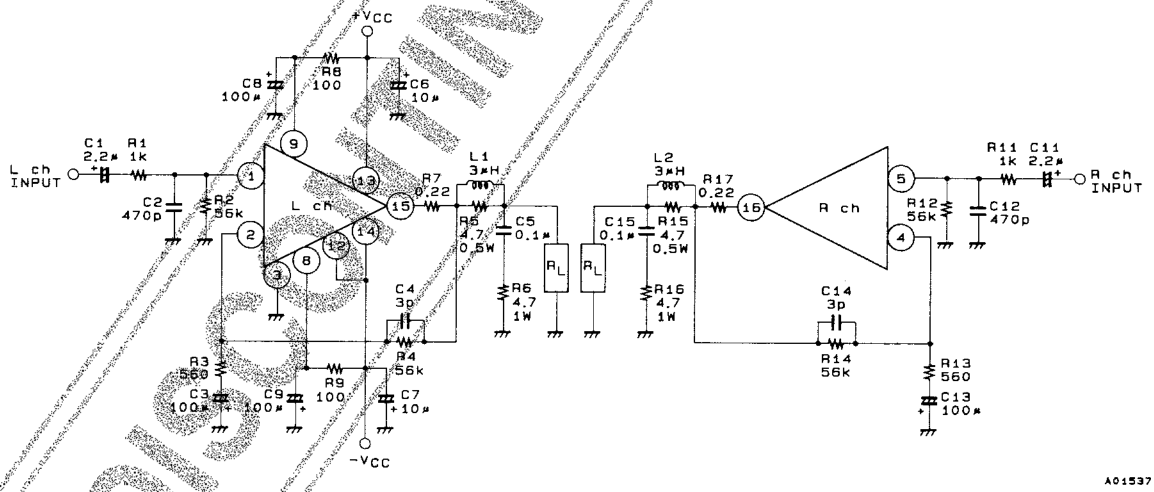


Sample PCB Pattern used with either Two- or Three-Channel Amplifiers



Copper (Cu) foil surface
Pin 1 in the STK401-000 series corresponds to pin 6 in the STK400-000 series.

Sample Application Circuit



Units (resistance: Ω, capacitance: F)

External Component Descriptions

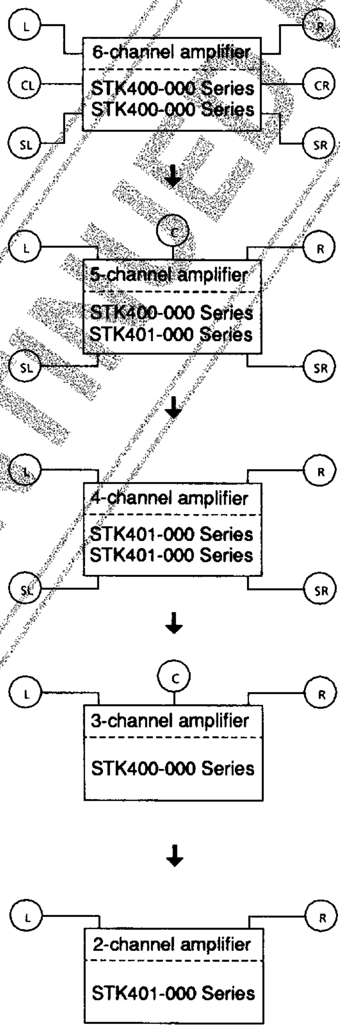
Item	Function
C1, C11	Input coupling capacitors. Used to block the DC component. Reducing the reactance value of these capacitors can reduce output noise, since output noise is exacerbated due to the 1/f noise signal source resistance dependencies if these capacitors have a large reactances at low frequencies. The impulse noise that occurs when power is first applied can be reduced by increasing the values of C1 and C11, and reducing the values of the NF side C3 and C13.
C2, C12	Input filter capacitors. High band noise can be reduced by the filters formed by these capacitors and R1 and R11.
C3, C13	NF capacitors. These capacitors determine the low band cutoff frequency. $f_L = \frac{1}{2\pi \times C3\ (13) \times R3\ (13)}$ Voltage gain can be acquired up to the low band by increasing the value of these capacitors. However, since this increases the impulse noise that occurs when power is applied, limit the values of these capacitors to what is actually required.
C4, C14	Oscillation prevention capacitors. These capacitors increase stability at large outputs and high temperatures.
C5, C15	Oscillation prevention capacitors. The use of Mylar capacitors with superlative temperature and frequency characteristics is recommended.
C6, C7	Oscillation prevention capacitors. Insert these capacitors as close as possible to the IC power supply pins. They lower the power supply impedance and provide stable IC operation. Electrolytic capacitors are recommended.
C8, C9	Decoupling capacitors. The time constant circuits formed in conjunction with R8 and R9 reduce the impulse noise that occurs when power is applied and remove ripple components that enter from the power supply line.
R1, R11	Input filter resistors.
R2, R12	Input bias resistors. These resistors bias the input pins to 0V. The input impedance is largely determined by these resistors.
R3, R13 R4, R14	These resistors determine the voltage gain (VG). A voltage gain of 40dBm, achieved by setting R3 and R13 to 560Ω and R4 and R14 to 56kΩ, is recommended. It is desirable that R3 and R13 be used to change the voltage gain. If R4 and R14 are uesd to change the voltage gain, set R4=R2 and R14=R12 for V_N balance stability.
R5, R15	Oscillation prevention resistors.
R6, R16	Oscillation prevention resistors. The power dissipated by these resistors depends on the signal frequency as follws. $P\ R6\ (16) = \left(\frac{V_{CC}\ max / \sqrt{2}}{1/2\pi\ fC5\ (15) \times R6\ (16)} \right)^2 \times R6\ (16)$ where f is the upper limit of the output signal frequency.
R7, R17	Output resistors. These resistors increase the resistance to load shorting during high output.
R8, R9	Ripple filter resistors. The P_O max, ripple rejection, and impulse noise at power on are changed by these values. These resitors are the pre-drive transistor limit resistors in the load short state and the peak current when C8 and C9 are charged flows through these resistors. Therfore, the power sissipated in these resistors requires consideration when determining their values.
L1, L2	Oscillation prevention coils. These inductors correct phase shifting due to capacitive loads and increase circuit stability.

Series Configuration

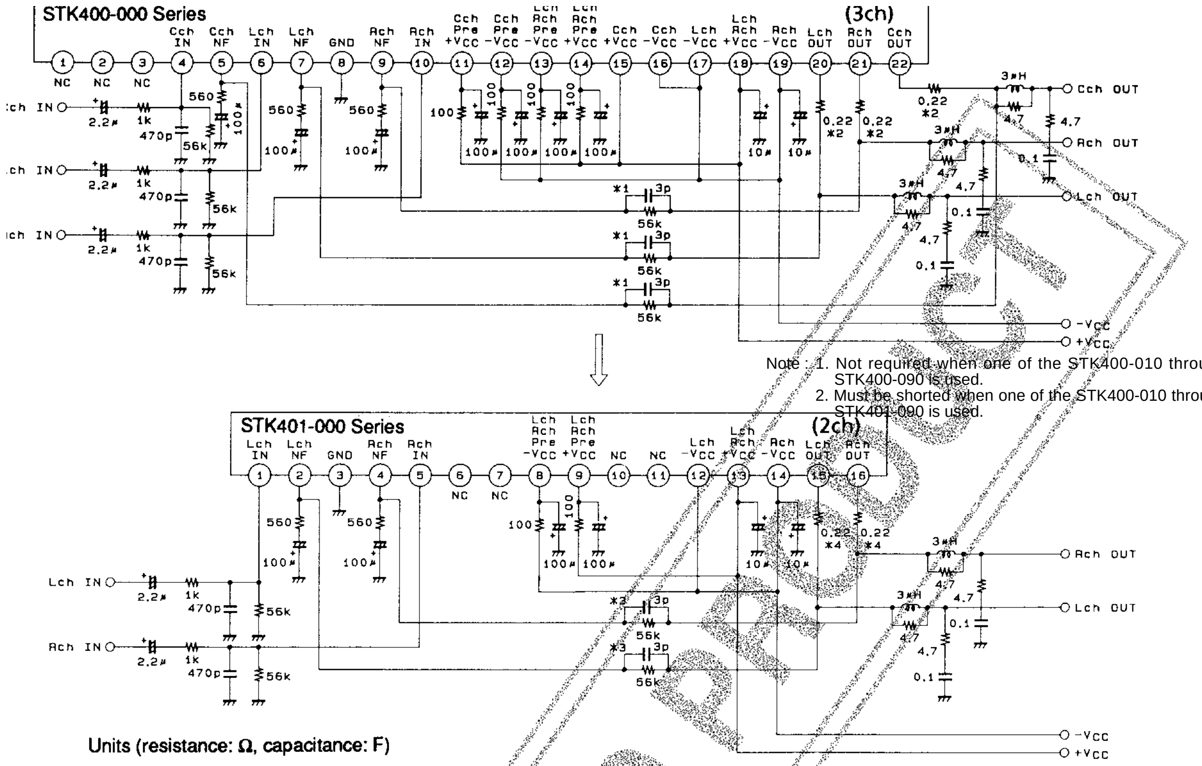
3-channel amplifiers type No.	Rated output	2-channel amplifiers type No.	Rated output	THD [%] f=20Hz to 20kHz	Power supply voltage [V]			
					V_{CC} max1	V_{CC} max2	$V_{CC}1$	$V_{CC}2$
STK400-010	10W × 3	STK401-010	10W × 2	0.4	–	±26	±17.5	±14
STK400-020	15W × 3	STK401-020	15W × 2		–	±29	±20	±16
STK400-030	20W × 3	STK401-030	20W × 2		–	±34	±23	±19
STK400-040	25W × 3	STK401-040	25W × 2		–	±36	±25	±21
STK400-050	30W × 3	STK401-050	30W × 2		–	±39	±26	±22
STK400-060	35W × 3	STK401-060	35W × 2		–	±41	±28	±23
STK400-070	40W × 3	STK401-070	40W × 2		–	±44	±30	±24
STK400-080	45W × 3	STK401-080	45W × 2		–	±45	±31	±25
STK400-090	50W × 3	STK401-090	50W × 2		–	±47	±32	±26
STK400-100	60W × 3	STK401-100	60W × 2		–	±51	±35	±27
STK400-110	70W × 3	STK401-110	70W × 2		±56.0	–	±38	–
–	–	STK401-120	80W × 2		±61.0	–	±42	–
–	–	STK401-130	100W × 2		±65.0	–	±45	–
–	–	STK401-140	120W × 2		±74.0	–	±51	–

Note : V_{CC} max1 When R_L=6Ω
V_{CC} max2 When R_L=between 3 and 6Ω
$V_{CC}1$ When R_L=6Ω
$V_{CC}2$ When R_L=3Ω

End Product Series Design Example Using the Same PCB



External Circuit Diagram



Note : 1. Not required when one of the STK400-010 through STK400-090 is used.
2. Must be shorted when one of the STK400-010 through STK401-090 is used.

Units (resistance: Ω, capacitance: F)

Note : 1. Not required when one of the STK401-010 through STK401-090 is used.
2. Must be shorted when one of the STK401-010 through STK401-090 is used.

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Thermal Design Example

The thermal resistance θc-a of the required heat sink for a total case-internal power dissipation Pd for the STK401-140 can be derived as follows :

Condition 1 : The IC case temperature Tc must not exceed 125°C.
Pd×θc-a+Ta<125°C .... (1)
Ta : Set guaranteed ambient temperature

Condition 2 : The individual power transistor junction temperatures must not exceed 150°C.
Pd×θc-a+Pd/N×θj-c+Ta<150°C .... (2)
N : Nunber of power transistors
θj-c : Thermal resistance per power transistor

However, the power dissipated by the power transistors (Pd) is divided evenly among the N transistors.
Solving equations (1) and (2) for θc-a gives :
θc-a< (125–Ta)/Pd .... (1)’
θc-a< (150–Ta)/Pd–θj-c/N .... (2)’

A value that satisfies these two equations will be the required heat sink thermal resistance.
The required heat sink thermal resistance can be derived from formulas (1)’ and (2)’ once the following specifications have been determined.

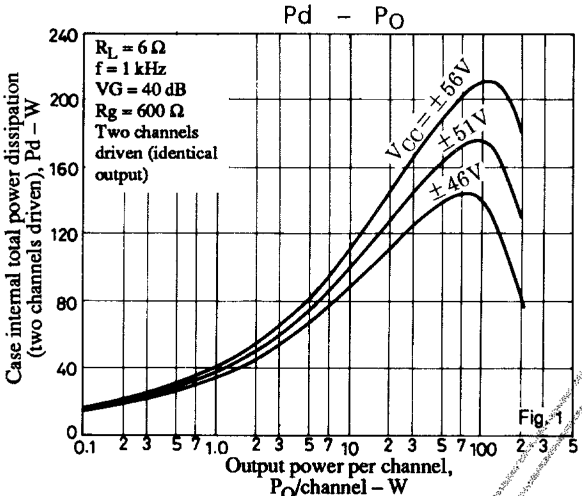
- Power supply voltage : V_{CC}
- Load resistance : R_L
- Guaranteed ambient temperature : Ta

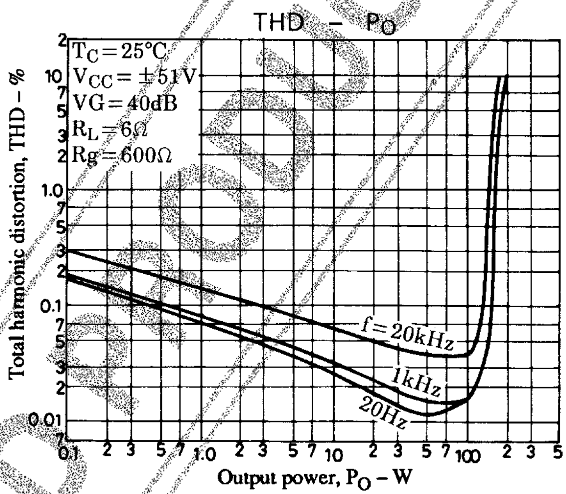
When the STK401-140 V_{CC} is ±51V and R_L is 6Ω, the case-internal total power dissipation for a continuous sine wave signal will have a maximum value of 177W, as shown in Figure 1.
One tenth of the P_O max for this kind of continuous signal is generally used as an estimate of power dissipation for actual music signals, although this may vary somewhat depending on safety standards.
Pd=107W (When 1/10 P_O max is 12W)

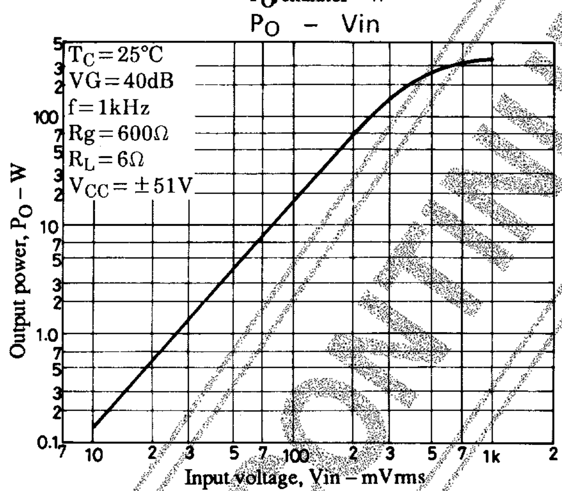
The STK401-140 has four power transistors and the thermal resistance per transistor is 1.0°C/W. If the guaranteed ambient temperature Ta is 50°C then the required heat sink thermal resistance can be calculated as follows.

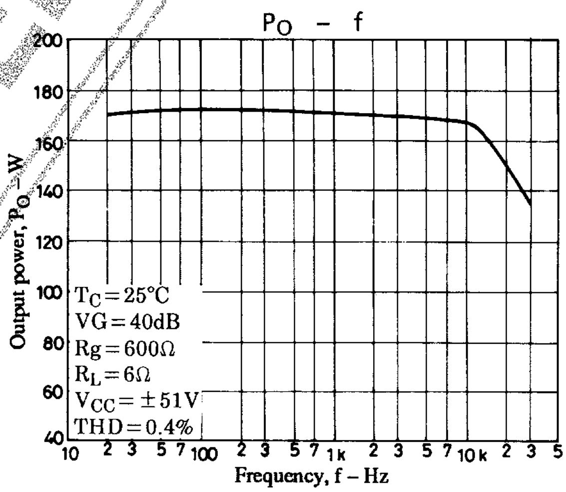
From formula (1)' : θc-a $< (125–50)/107$
< 0.70
From formula (2)' : θc-a $< (150–50)/107–1.0/4$
< 0.68

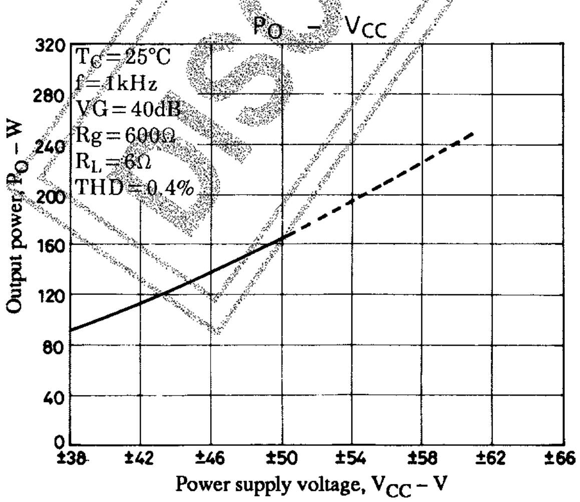
Therefore the value 0.68C/W, which satisfies both of these formulas, is the required heat sink thermal resistance. Note that this thermal design example assumes a rated power supply and the actual thermal design must be confirmed in the end product itself.

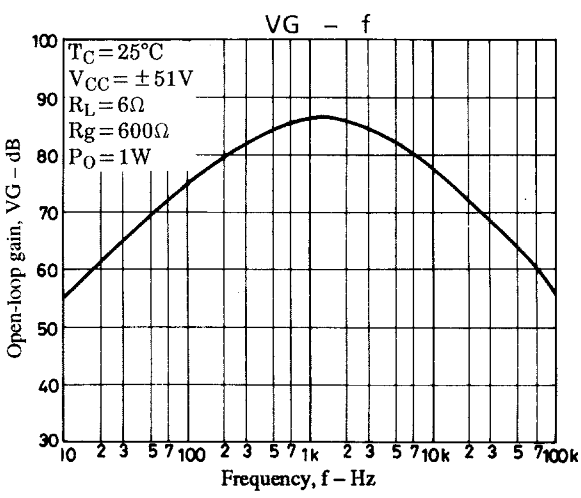


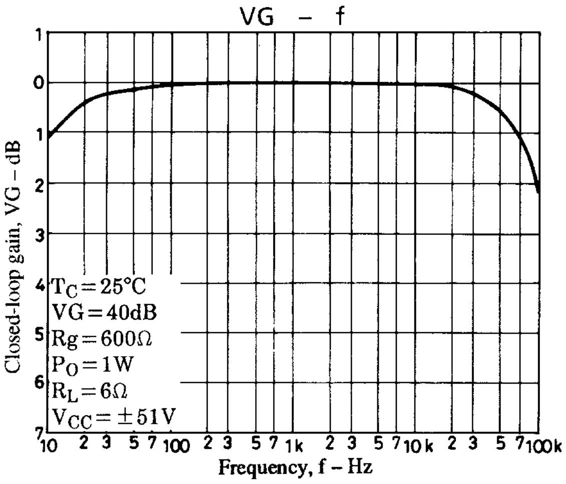


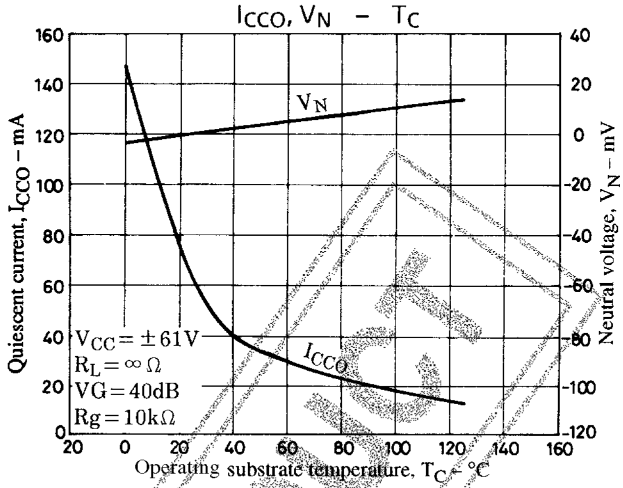


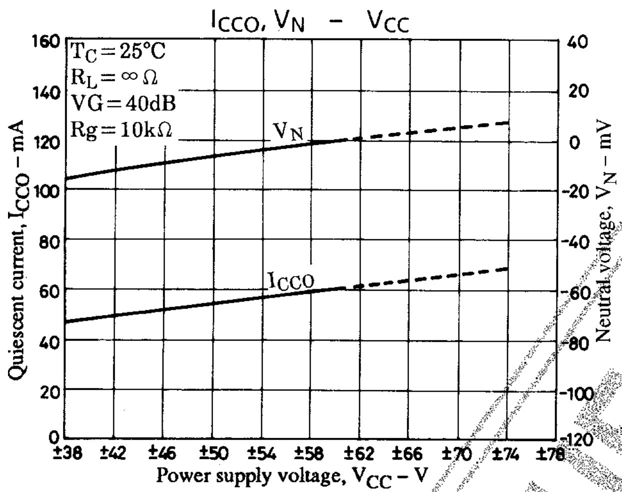












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