Ordering number: EN 5704

Thick Film Hybrid IC

STK400-060

AF Power Amplifier (Split Power Supply) (35W+35W+35W, THD = 0.4%)

Overview

The STK400-060 is a 3-channel AF power amplifier IC supporting multichannel speakers. One package includes 35W×3ch for Lch, Rch and Cch. It is pin compatible with both 3-channel output devices (STK400-*00 series) and 2-channel output devices (STK401-*00 series). The output load impedance is 6/3Ω.

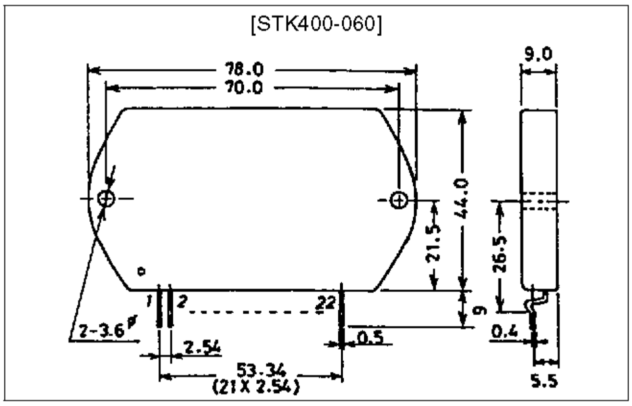
Features

- New series combining 3-channel output devices (STK400-*00 series) and 2-channel output devices (STK401-*00 series) with the same pin compatibility.
- Output load impedance is 6/3Ω.
- Pin assignment is grouped into individual blocks of inputs, outputs and supply lines, minimizing the adverse effects of pattern layout on operating characteristics.
- Minimum nmber of external components required.

Package Dimensions

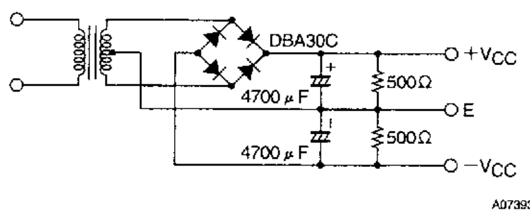
unit: mm

4086A



Specified Transformer Power Supply

(RP-25 or Equivalent)



Specifications

Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{CC} max		±41	V
Thermal resistance	θj-c	Per power transistor	1.8	°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} = ±28V, R_L = 6Ω, f = 50Hz, P_O = 35W	1	s

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

Parameter	Symbol	Conditions	min	typ	max	Unit
Output power	$P_O(1)$	V_{CC} = ±28V, f = 20Hz to 20kHz, THD = 0.4%	35	40	–	W
	$P_O(2)$	V_{CC} = ±23V, f = 1kHz, THD = 1.0%, R_L = 3Ω	35	40	–	W
Total harmonic distortion	THD(1)	V_{CC} = ±28V, f = 20Hz to 20kHz, P_O = 1.0W	–	–	0.4	%
	THD(2)	V_{CC} = ±28V, f = 1kHz, P_O = 5.0W	–	0.01	–	%

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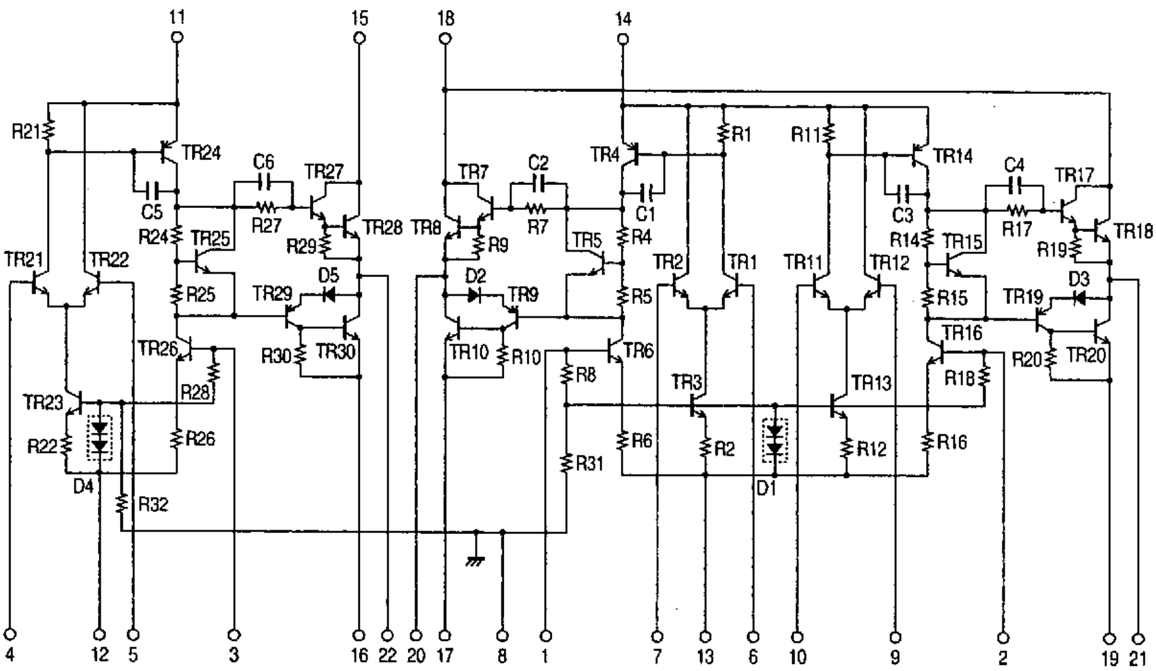
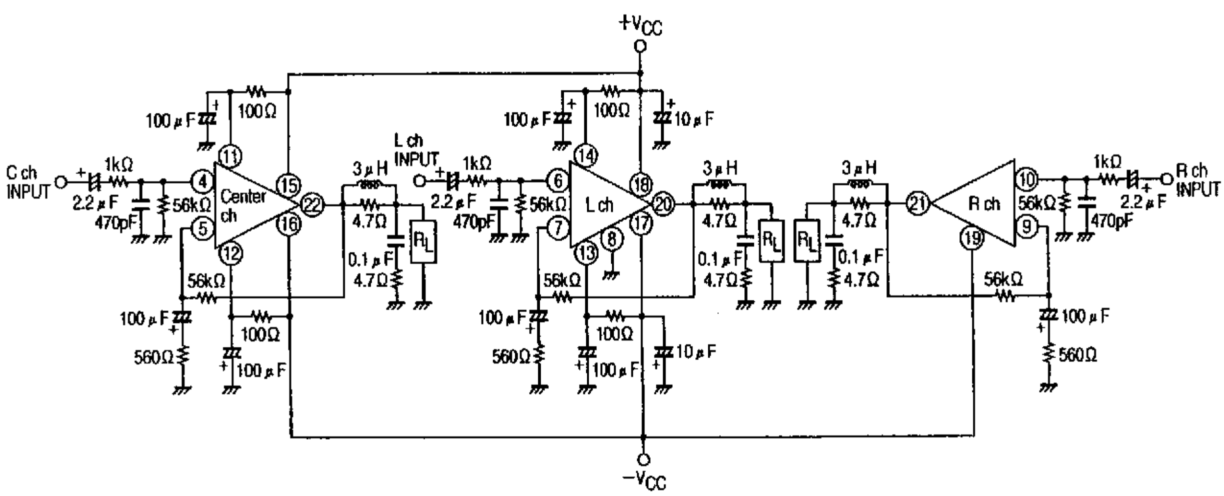
Parameter	Symbol	Conditions	min	typ	max	Unit
Frequency response	f_L, f_H	V_{CC} = ±28V, P_O = 1.0W, $^{+0}_{-3}$dB	–	20 to 50k	–	Hz
Input impedance	r_i	V_{CC} = ±28V, f = 1kHz, P_O = 1.0W	–	55	–	kΩ
Output noise voltage	V_{NO}	V_{CC} = ±34V, Rg = 10kΩ	–	–	1.2	mVrms
Quiescent current	I_{CCO}	V_{CC} = ±34V	30	90	150	mA
Neutral voltage	V_N	V_{CC} = ±34V	–70	0	+70	mV

Notes.
All tests are conducted using a constant-voltage regulated power supply unless otherwise specified.
Available time for load short-circuit and output noise voltage are measured using the transformer power supply specified on page 1.
The output noise voltage is the peak value of an average-reading meter with an rms value scale (VTVM). A regulated AC supply (50Hz) should be used to eliminate the effects of AC primary line flicker noise.

Equivalent Circuit



Sample Application Circuit



Series Configuration

The products are serialized according to the number of channels, the output capacity, and the distortion ratio. These include the products under development: for details, please contact your Sanyo sales representative.

STK400-000, STK400-200 series (3-channel equal output)					STK401-000, STK401-200 series (2-channel)					Supply voltage [V]			
Type No.	THD [%]	Type No.	THD [%]	Rated output	Type No.	THD [%]	Type No.	THD [%]	Rated output	V_{CC} max1	V_{CC} max2	$V_{CC}1$	$V_{CC}2$
STK400-010		STK400-210		10W × 3	STK401-010		STK401-210		10W × 2	–	±26.0	±17.5	±14.0
STK400-020		STK400-220		15W × 3	STK401-020		STK401-220		15W × 2	–	±29.0	±20.0	±16.0
STK400-030		STK400-230		20W × 3	STK401-030		STK401-230		20W × 2	–	±34.0	±23.0	±19.0
STK400-040		STK400-240		25W × 3	STK401-040		STK401-240		25W × 2	–	±36.0	±25.0	±21.0
STK400-050		STK400-250		30W × 3	STK401-050		STK401-250		30W × 2	–	±39.0	±26.0	±22.0
STK400-060		STK400-260		35W × 3	STK401-060		STK401-260		35W × 2	–	±41.0	±28.0	±23.0
STK400-070	0.4	STK400-270	0.08	40W × 3	STK401-070	0.4	STK401-270	0.08	40W × 2	–	±44.0	±30.0	±24.0
STK400-080		STK400-280		45W × 3	STK401-080		STK401-280		45W × 2	–	±45.0	±31.0	±25.0
STK400-090		STK400-290		50W × 3	STK401-090		STK401-290		50W × 2	–	±47.0	±32.0	±26.0
STK400-100		STK400-300		60W × 3	STK401-100		STK401-300		60W × 2	–	±51.0	±35.0	±27.0
STK400-110		STK400-310		70W × 3	STK401-110		STK401-310		70W × 2	±56.0	–	±38.0	–
–		–		–	STK401-120		STK401-320		80W × 2	±61.0	–	±42.0	–
–		–		–	STK401-130		STK401-330		100W × 2	±65.0	–	±45.0	–
–		–		–	STK401-140		STK401-340		120W × 2	±74.0	–	±51.0	–

STK400-400, STK400-600 series (3-channel different output)						Supply voltage [V]			
Type No.	THD [%]	Type No.	THD [%]	Rated output		V_{CC} max1	V_{CC} max2	$V_{CC}1$	$V_{CC}2$
STK400-450		STK400-650		Cch	30W	–	±39.0	±26.0	±22.0
				L, Rch	15W	–	±29.0	±20.0	±16.0
STK400-460		STK400-660		Cch	35W	–	±41.0	±28.0	±23.0
				L, Rch	15W	–	±29.0	±20.0	±16.0
STK400-470		STK400-670		Cch	40W	–	±44.0	±30.0	±24.0
				L, Rch	20W	–	±34.0	±23.0	±19.0
STK400-480		STK400-680		Cch	45W	–	±45.0	±31.0	±25.0
				L, Rch	20W	–	±34.0	±23.0	±19.0
STK400-490	0.4	STK400-690	0.08	Cch	50W	–	±47.0	±32.0	±26.0
				L, Rch	25W	–	±36.0	±25.0	±21.0
STK400-500		STK400-700		Cch	60W	–	±51.0	±35.0	±27.0
				L, Rch	30W	–	±39.0	±26.0	±22.0
STK400-510		STK400-710		Cch	70W	±56.0	–	±38.0	–
				L, Rch	35W	–	±41.0	±28.0	±23.0
STK400-520		STK400-720		Cch	80W	±61.0	–	±42.0	–
				L, Rch	40W	–	±44.0	±30.0	±24.0
STK400-530		STK400-730		Cch	100W	±65.0	–	±45.0	–
				L, Rch	50W	–	±47.0	±32.0	±26.0

V_{CC} max1 (R_L = 6Ω), V_{CC} max2 (R_L = 3 to 6Ω), $V_{CC}1$ (R_L = 6Ω), $V_{CC}2$ (R_L = 3Ω)

Heatsink Design Considerations

The heatsink thermal resistance, θc-a, required to cover the hybrid IC's total power dissipation, Pd, is determined as follows:

Condition 1: Hybrid IC's substrate temperature not to exceed 125°C.

$Pd \times \theta c\text{-}a + Ta < 125°C$ .... (1)

where Ta is the guaranteed maximum ambient temperature.

Condition 2: Power transistor junction temperature, Tj, not to exceed 150°C.

$Pd \times \theta c\text{-}a + Pd/N \times \theta j\text{-}c + Ta < 150°C$ .... (2)

where N is the number of power transistors and θj-c is the thermal resistance per power transistor. Note that the power dissipated per transistor is the total, Pd, divided evenly among the N power transistors.

Expressions (1) and (2) can be rewritten making θc-a the subject.

$\theta c\text{-}a < (125 - Ta)/Pd$ .... (1)′

$\theta c\text{-}a < (150 - Ta)/Pd - \theta j\text{-}c/N$ .... (2)′

The heatsink required must have a thermal resistance that simultaneously satisfies both expressions.

The heatsink thermal resistance can be determined from (1)′ and (2)′ once the following parameters have been defined.

- Supply voltage : V_{CC}
- Load resistance : R_L
- Guaranteed maximum ambient temperature : Ta

The total device power dissipation when hybrid IC's V_{CC} = ±28V and R_L = 6Ω, for a continuous sine wave signal, is a maximum of 81W, as is in Pd-P_O graph.

When estimating the power dissipation for an actual audio signal input, the rule of thumb is to select Pd corresponding to 1/10 P_O max (within safe limits) for a continuous sine wave input. For example,

Pd = 49.2W (for 1/10 P_O max = 3.5W)

The hybrid IC has 6 power transistors, and the thermal resistance per transistor, θj-c, is 1.8°C/W. If the guaranteed maximum ambient temperature, Ta, is 50°C, then the required heatsink thermal resistance, θc-a, is:

From expression (1)′: $\theta c\text{-}a < (125 - 50)/49.2 < 1.52$

From expression (2)′: $\theta c\text{-}a < (150 - 50)/49.2 - 1.8/6 < 1.73$

Therefore, to satisfy both expressions, the required heatsink must have a thermal resistance less than 1.52°C/W.

Similarly, when hybrid IC's V_{CC} = ±23V and R_L = 3Ω:

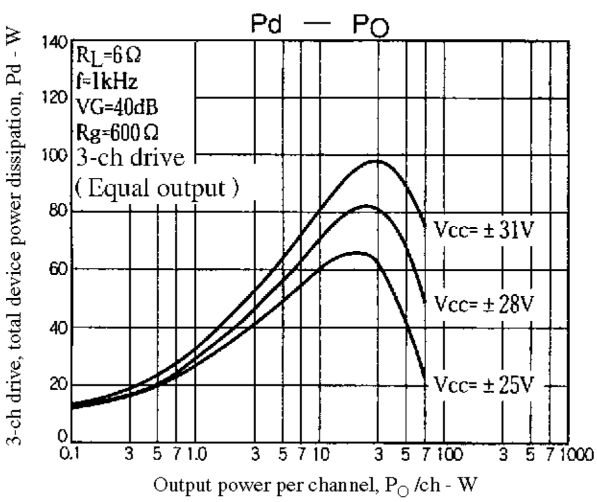
Pd = 58W (for 1/10 P_O max = 3.5W)

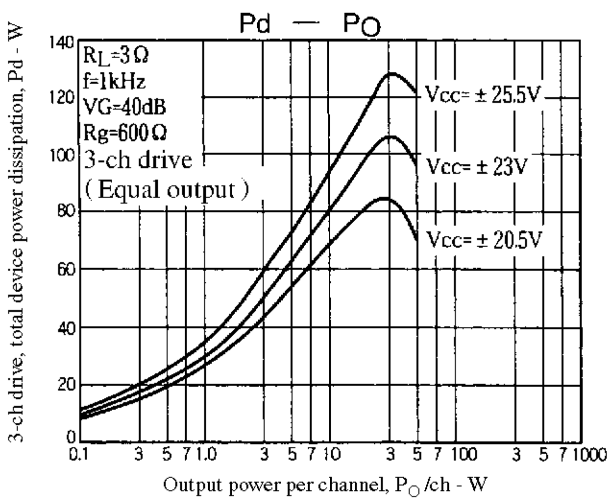
From expression (1)′: $\theta c\text{-}a < (125 - 50)/58 < 1.29$

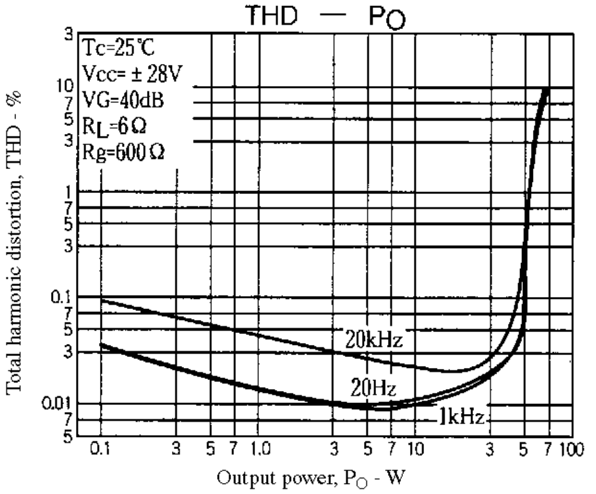
From expression (2)′: $\theta c\text{-}a < (150 - 50)/58 - 1.8/6 < 1.42$

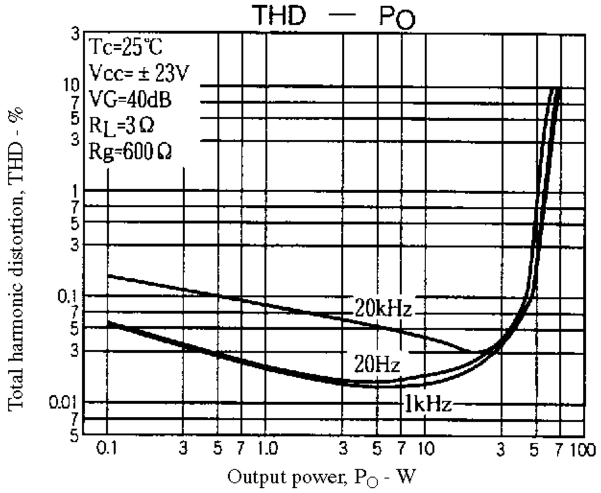
Therefore, to satisfy both expressions, the required heatsink must have a thermal resistance less than 1.29°C/W.

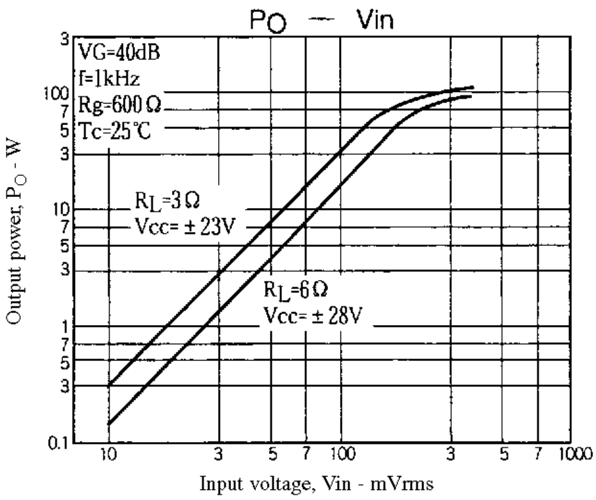
This heatsink design example is based on a constant-voltage supply, and should be verified within your specific set environment.

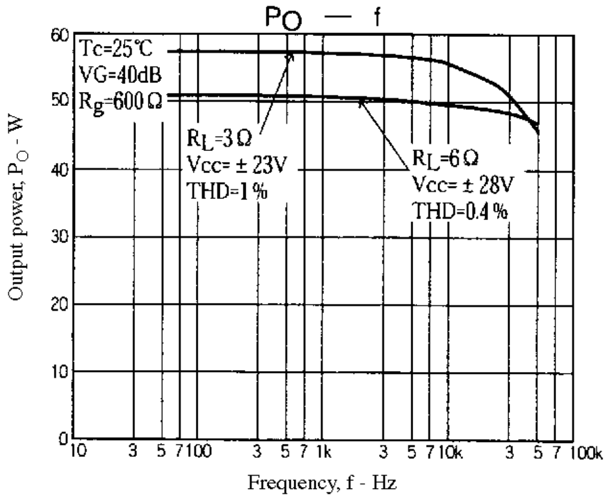


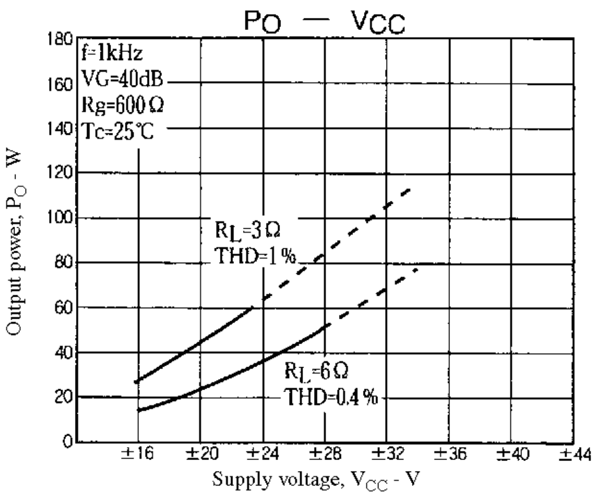


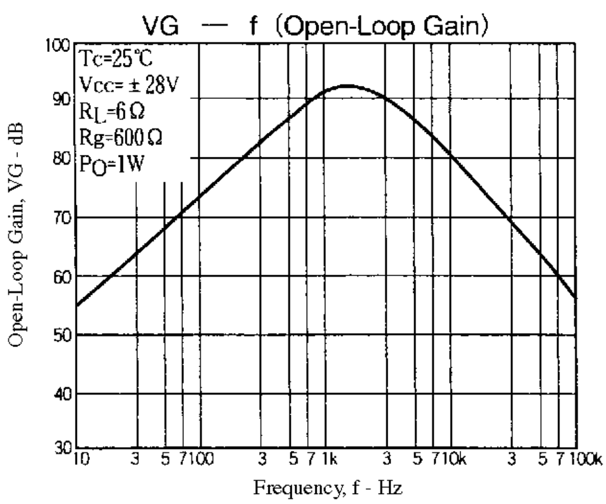

THD — PO
Tc=25℃
Vcc=±28V
VG=40dB
RL=6Ω
Rg=600Ω
20kHz
20Hz
1kHz
Total harmonic distortion, THD - %
Output power, PO - W

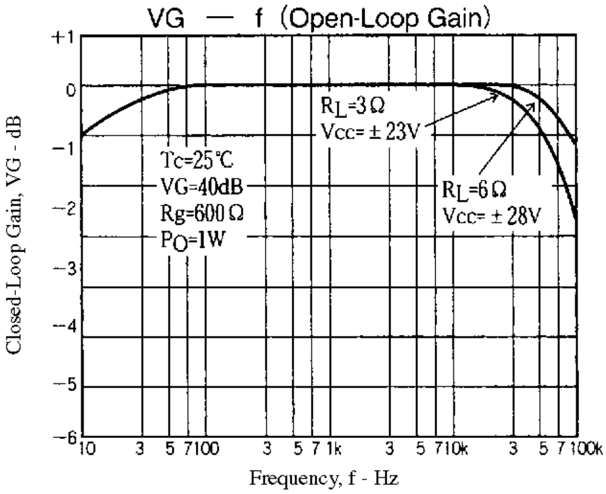

THD — PO
Tc=25℃
Vcc=±23V
VG=40dB
RL=3Ω
Rg=600Ω
20kHz
20Hz
1kHz
Total harmonic distortion, THD - %
Output power, PO - W

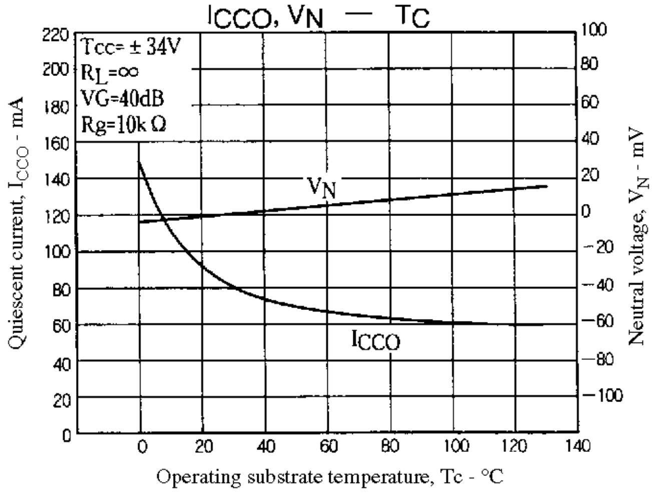

PO — Vin
VG=40dB
f=1kHz
Rg=600Ω
Tc=25℃
RL=3Ω
Vcc=±23V
RL=6Ω
Vcc=±28V
Output power, PO - W
Input voltage, Vin - mVrms

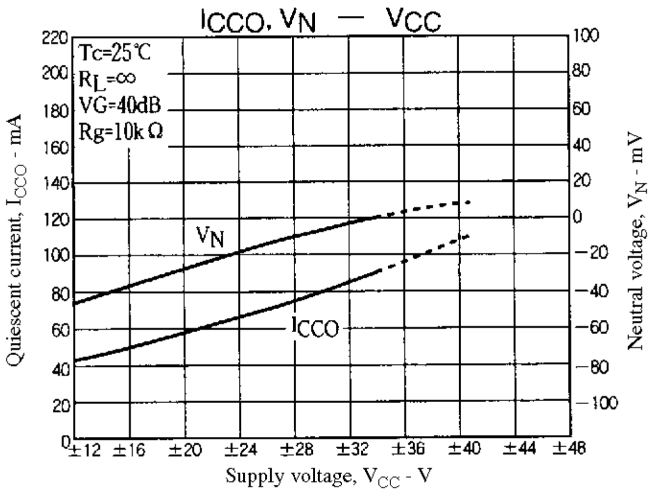

PO — f
Tc=25℃
VG=40dB
Rg=600Ω
RL=3Ω
Vcc=±23V
THD=1%
RL=6Ω
Vcc=±28V
THD=0.4%
Output power, PO - W
Frequency, f - Hz


PO — VCC
f=1kHz
VG=40dB
Rg=600Ω
Tc=25℃
RL=3Ω
THD=1%
RL=6Ω
THD=0.4%
Output power, PO - W
Supply voltage, VCC - V


VG — f (Open-Loop Gain)
Tc=25℃
Vcc=±28V
RL=6Ω
Rg=600Ω
PO=1W
Open-Loop Gain, VG - dB
Frequency, f - Hz


VG — f (Open-Loop Gain)
Closed-Loop Gain, VG - dB
Frequency, f - Hz
Tc=25℃
VG=40dB
Rg=600Ω
PO=1W
RL=3Ω
Vcc=±23V
RL=6Ω
Vcc=±28V
+1
0
−1
−2
−3
−4
−5
−6
10 3 5 7 100 3 5 7 1k 3 5 7 10k 3 5 7 100k


ICCO, VN — TC
Quiescent current, ICCO - mA
Neutral voltage, VN - mV
Operating substrate temperature, Tc - °C
Tcc=±34V
RL=∞
VG=40dB
Rg=10kΩ
VN
ICCO
0 20 40 60 80 100 120 140 160 180 200 220
100 80 60 40 20 0 −20 −40 −60 −80 −100
0 20 40 60 80 100 120 140


ICCO, VN — VCC
Quiescent current, ICCO - mA
Neutral voltage, VN - mV
Supply voltage, VCC - V
Tc=25℃
RL=∞
VG=40dB
Rg=10kΩ
VN
ICCO
0 20 40 60 80 100 120 140 160 180 200 220
100 80 60 40 20 0 −20 −40 −60 −80 −100
±12 ±16 ±20 ±24 ±28 ±32 ±36 ±40 ±44 ±48