Ordering number:ENN5247

Thick Film Hybrid IC

STK400-490

3ch AF Power Amplifier (Split Power Supply) (25W + 50W + 25W, THD = 0.4%)

Overview

The STK400-490 is an audio power amplifier IC for multi-channel speaker applications. It comprises two 25W channels (left and right) and a 50W channel (center) in a single package. It is fully pin compatible with the 3-channel output devices (STK400-×00 series) and 2-channel output devices (STK401-×00 series). In addition, it supports 6/3Ω output load impedance.

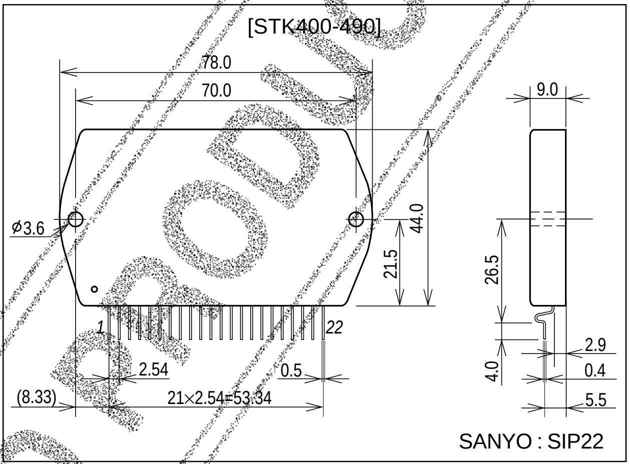
Features

- Pin compatible with the 3-channel output devices (STK400-×00 series) and 2-channel output devices (STK401-×00 series)
- Output load impedance R_L=6/3Ω supported
- Pin configuration grouped into individual blocks of inputs, outputs and supply lines to minimize the adverse effects of pattern layout on operating characteristics.
- Few external components

Package Dimensions

unit:mm

4086A



Specifications

Maximum Ratings at Ta = 25˚C

Parameter	Channel	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	L, R	V_{CC} max1		±36	V
	C	V_{CC} max2		±47	V
Thermal resistance	L, R	θ j-c1	Per power transistor	2.1	˚C/W
	C	θ j-c2	Per power transistor	1.7	˚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	L, R	t_s1	V_{CC}=±25V, R_L=6Ω, f=50Hz, P_O=25W	1	s
	C	t_s2	V_{CC}=±32V, R_L=6Ω, f=50Hz, P_O=50W	1	s

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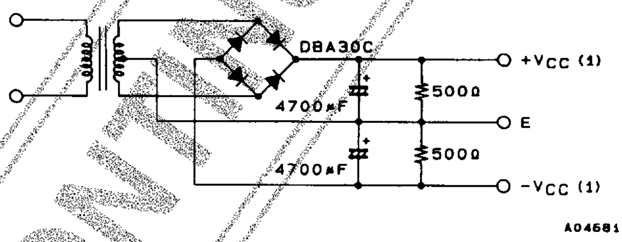
Operating Characteristics at Ta = 25˚C, R_L=6Ω (noninductive load), Rg=600Ω, VG=40dB

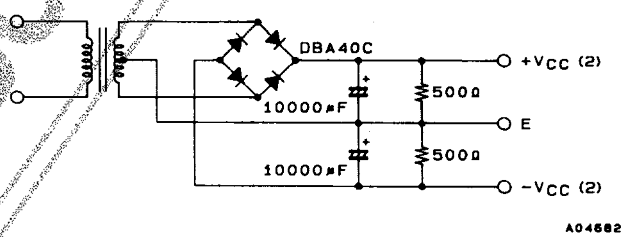
Parameter	Channel	Symbol	Conditions	Ratings			Unit
				min	typ	max	
Output power	L, R	P_O1	V_{CC}=±25V, f=20Hz to 20kHz, THD=0.4%	25	30		W
	C	P_O2	V_{CC}=±32V, f=20Hz to 20kHz, THD=0.4%	50	55		W
	L, R	P_O3	V_{CC}=±21V, f=1kHz, THD=1.0%, R_L=3Ω	25	30		W
	C	P_O4	V_{CC}=±26V, f=1kHz, THD=1.0%, R_L=3Ω	50	55		W
Total harmonic distortion	L, R	THD1	V_{CC}=±25V, f=20Hz to 20kHz, P_O=1.0W			0.4	%
			V_{CC}=±25V, f=1kHz, P_O=5.0W		0.02		%
	C	THD2	V_{CC}=±32V, f=20Hz to 20kHz, P_O=1.0W			0.4	%
			V_{CC}=±32V, f=1kHz, P_O=5.0W		0.01		%
Frequency response	L, R	f_L, f_H1	V_{CC}=±25V, P_O=1.0W, $^{+0}_{-3}$dB		20 to 50k		Hz
	C	f_L, f_H2	V_{CC}=±32V, P_O=1.0W, $^{+0}_{-3}$dB		20 to 50k		Hz
Input impedance	L, R	r_i1	V_{CC}=±25V, f=1kHz, P_O=1.0W		55		kΩ
	C	r_i2	V_{CC}=±32V, f=1kHz, P_O=1.0W		55		kΩ
Output noise voltage	L, R	$V_{NO}1$	V_{CC}=±30V, Rg=10kΩ			1.2	mVrms
	C	$V_{NO}2$	V_{CC}=±39V, Rg=10kΩ			1.2	mVrms
Quiescent current	L, R	$I_{CCO}1$	V_{CC}=±30V	20	60	100	mA
	C	$I_{CCO}2$	V_{CC}=±39V	10	30	50	mA
Neutral voltage	L, R	V_N1	V_{CC}=±30V	–70	0	+70	mV
	C	V_N2	V_{CC}=±39V	–70	0	+70	mV

Note.
All tests are measured using a constant-voltage supply unless otherwise specified.
Available time for load short-circuit and output noise voltage are measured using the transformer supply specified below.
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.

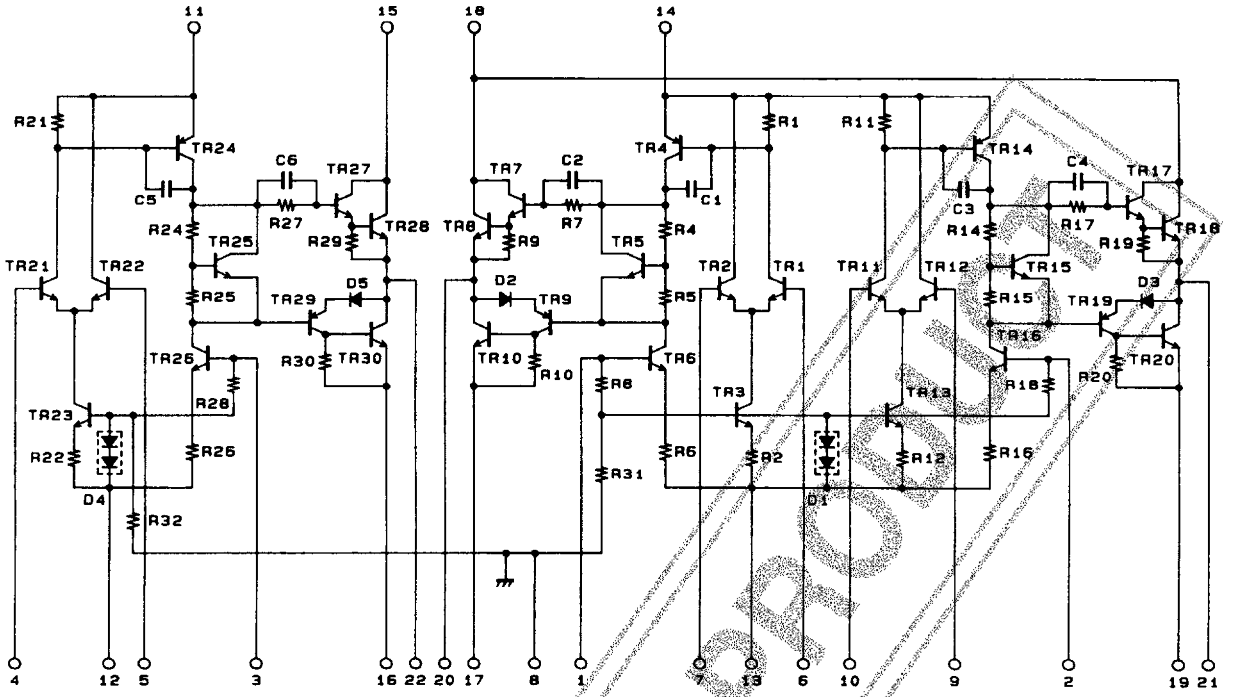
Specified Transformer Supplies
(L, R ch : RP-25 or Equivalent)



(C ch : MG-200 or Equivalent)



Equivalent Circuit



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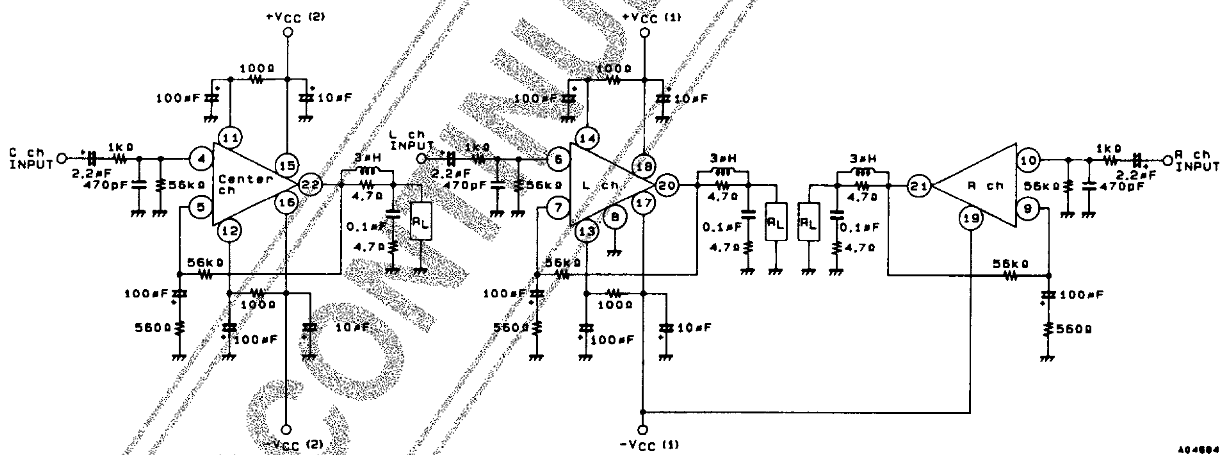
Sample Application Circuit



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Series Configuration

These devices form a series of pin-compatible devices with different number of output channels, output ratings and total harmonic distortion. Some of these devices are under development. Contact your Sanyo sales representative if you requiere more detailed information.

STK400-000, STK400-200 series (3-channel, same output rating)					STK401-000, STK401-200 series (2-channel)					Supply voltage [V]1			
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	0.4	STK400-210	0.08	10W×3	STK401-010	0.4	STK401-210	0.08	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		STK400-270		40W×3	STK401-070		STK401-270		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 ratings)						Supply voltage [V]1			
Type No.	THD [%]	Type No.	THD [%]	Rated output		V_{CC} max1	V_{CC} max2	$V_{CC}1$	$V_{CC}2$
STK400-450	0.4	STK400-650	0.08	Cch	30W	-	±39.0	±26.0	±22.0
				Lch, Rch	15W	-	±29.0	±20.0	±16.0
STK400-460		STK400-660		Cch	35W	-	±41.0	±28.0	±23.0
				Lch, Rch	15W	-	±29.0	±20.0	±16.0
STK400-470		STK400-670		Cch	40W	-	±44.0	±30.0	±24.0
				Lch, Rch	20W	-	±34.0	±23.0	±19.0
STK400-480		STK400-680		Cch	45W	-	±45.0	±31.0	±25.0
				Lch, Rch	20W	-	±34.0	±23.0	±19.0
STK400-490		STK400-690		Cch	50W	-	±47.0	±32.0	±26.0
				Lch, Rch	25W	-	±36.0	±25.0	±21.0
STK400-500		STK400-700		Cch	60W	-	±51.0	±35.0	±27.0
				Lch, Rch	30W	-	±39.0	±26.0	±22.0
STK400-510		STK400-710		Cch	70W	±56.0	-	±38.0	-
				Lch, Rch	35W	-	±41.0	±28.0	±23.0
STK400-520		STK400-720		Cch	80W	±61.0	-	±42.0	-
				Lch, Rch	40W	-	±44.0	±30.0	±24.0
STK400-530		STK400-730		Cch	100W	±65.0	-	±45.0	-
				Lch, Rch	50W	-	±47.0	±32.0	±26.0

1. 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 dissipate the STK400-490 device total power dissipation, Pd, is determined as follows :

Condition 1: IC substrate temperature not to exceed 125°C
Pd (total)×θc-a+Ta<125°C .... (1)
Pd (total)=Pd (L)+Pd (R)+Pd (C)

Where Ta is the guaranteed maximum ambient temperature, Pd (total) is the total power dissipation, Pd (L) is the left-channel power dissipation, Pd (R) is the right-channel power dissipation and Pd (C) is the center-channel power dissipation.

Condition 2: Power transistor junction temperature, Tj, not to exceed 150°C
Pd (total)×θc-a+[Pd (L)+Pd (R)]/N
×θj-c+Ta<150°C .... (2)

Pd (total)×θc-a+Pd (C)/N'
×θj-c'+Ta<150°C .... (3)

where N is the left and right-channel number of power transistors, N' is the center-channel number of power transistors, θj-c is the left and right-channel power transistor thermal resistance per transistor, and θj-c' is the center-channel power transistor thermal resistance per transisttor. Note that the power dissipated per transistor is the total, Pd, devided evenly among the N power transistors.

Expressions (1), (2) and (3) can be rewritten making θc-a the subject.

θc-a< (125–Ta)/Pd (total) .... (1)'

θc-a< (150–Ta)/Pd (total)–[Pd (L)+Pd (R)]
×θj-c/[Pd (total)×N] .... (2)'

θc-a< (150–Ta)/Pd (total)–Pd (C)×
θj-c'/[Pd (total)×N'] .... (3)'

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

The heatsink thermal resistance can be determined from (1)', (2)' and (3)' 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 STK400-490 V_{CC} (1)=±25V, V_{CC} (2)=±32V and R_L=6Ω, for a continuous sine wave signal, is a maximum of 42.5W (left+righ channels) and 34.3W (center channel), as shown in the "Pd–P_O" characteristics graphs.

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 (L)+Pd (R)=25W [for (1/10) × P_O max=2.5W]
Pd (C)=21.6W [for (1/10) × P_O max=5W]
Pd (total)=Pd (L)+Pd (R)+Pd (C)=46.6W

The STK400-490 has 4 left + right-channel power transistors (N), 2 center-channel power transistors (N'), left + right-channel thermal resistance per transistor (θj-c) is 2.1°C/W, and center-channel thermal resistance per transistor (θj-c') is 1.7°C/W. If the guaranteed maximum ambient temperature, Ta, is 50°C, then the required heatsink thermal resistance, θc-a, is :

From expression (1)' :
θc-a < (125–50)/46.6
< 1.60
From expression (2)' :
θc-a < (150–50)/46.6–25×2.1/(46.6×4)
< 1.86
From expression (3)' :
θc-a < (150–50)/46.6–21.6×1.7/(46.6×2)
< 1.75

Therefore, to satisfy all three expressions, the required heatsink must have a thermal resistance less than 1.6°C/W.

Similarly, when STK400-490 V_{CC} (1)=±21V, V_{CC} (2)=±26V and R_L=3Ω,

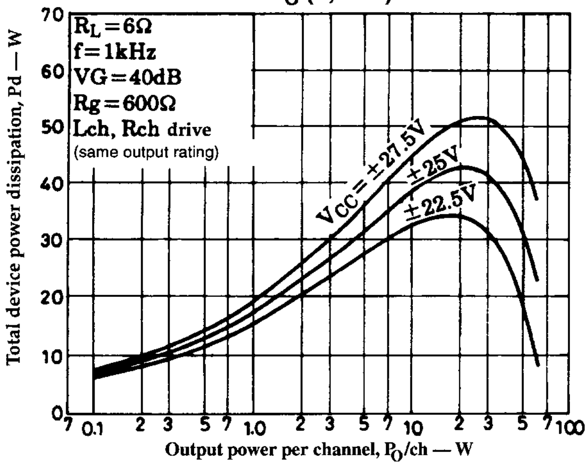
Pd (L)+Pd (R)=30W [for (1/10) × P_O max=2.5W]
Pd (C)=25.5W [for (1/10) × P_O max=5W]
Pd (total)=Pd (L)+Pd (R)+Pd (C)=55.5W

From expression (1)' :
θc-a < (125–50)/55.5
< 1.35
From expression (2)' :
θc-a < (150–50)/55.5–30×2.1/(55.5×4)
< 1.51
From expression (3)' :
θc-a < (150–50)/55.5–25.5×1.7/(55.5×2)
< 1.41

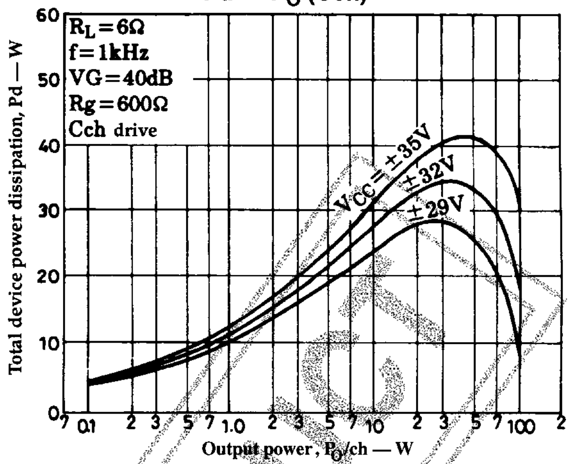
Therefore, to satisfy all three expressions, the required heatsink must have a thermal resistance less than 1.35°C/W.

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

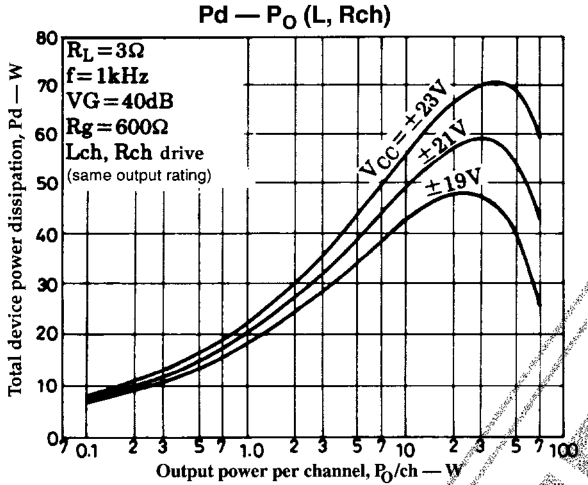
Pd — P_O (L, Rch)



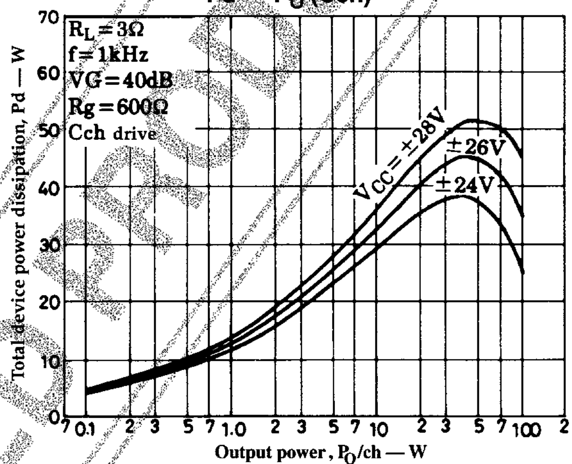
Pd — P_O (Cch)



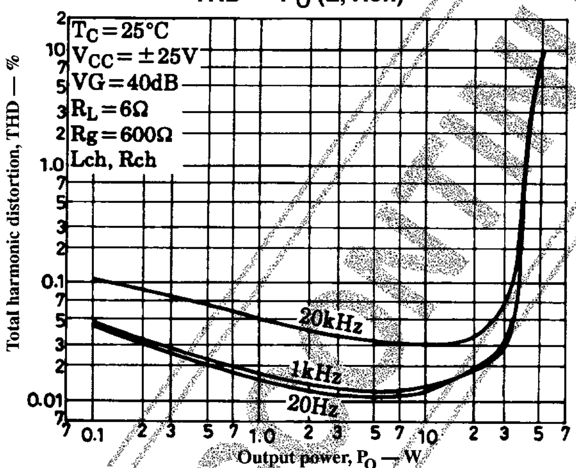
Pd — P_O (L, Rch)



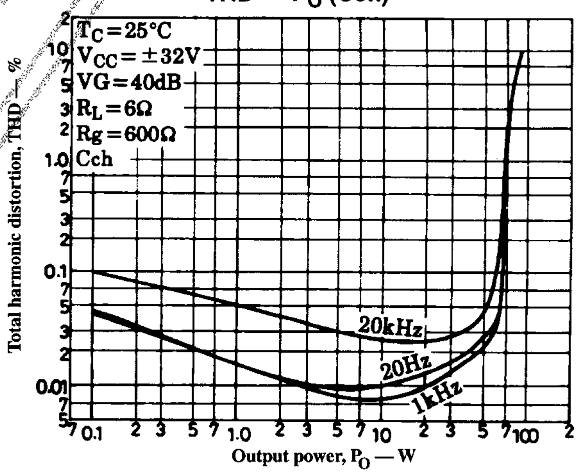
Pd — P_O (Cch)



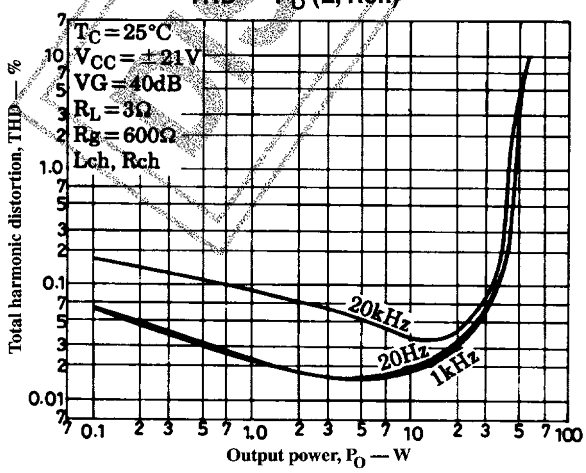
THD — P_O (L, Rch)



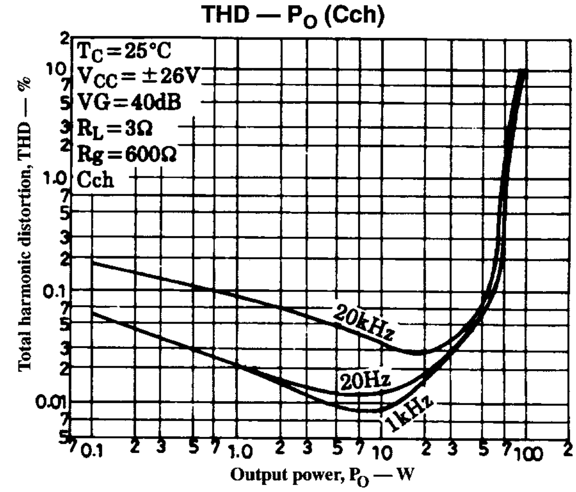
THD — P_O (Cch)



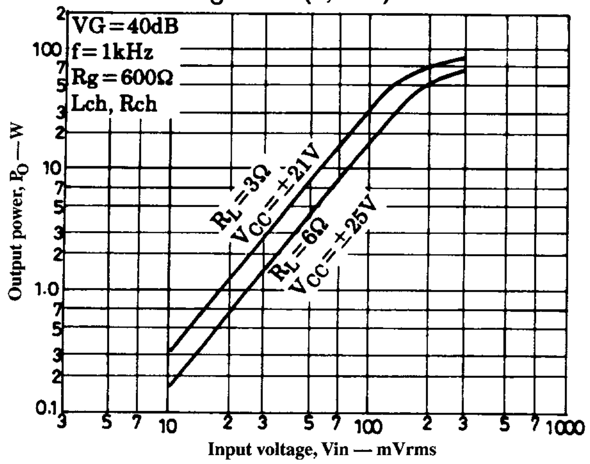
THD — P_O (L, Rch)



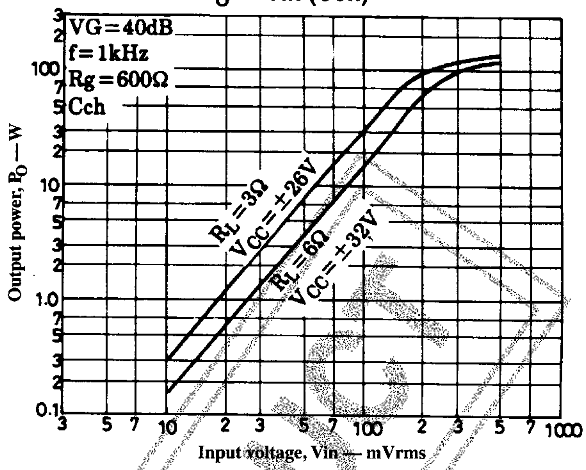
THD — P_O (Cch)



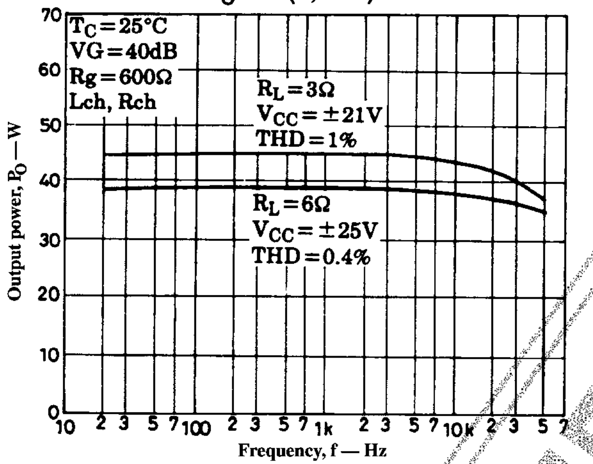
P_O — Vin (L, Rch)



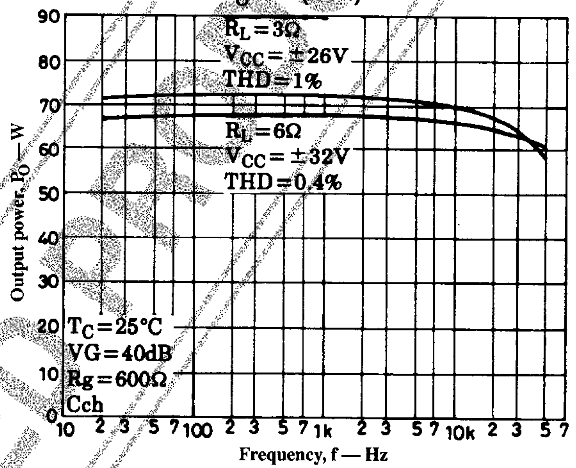
P_O — Vin (Cch)



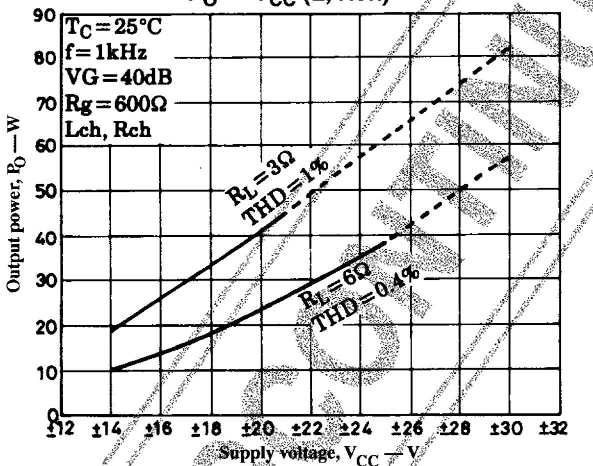
P_O — f (L, Rch)



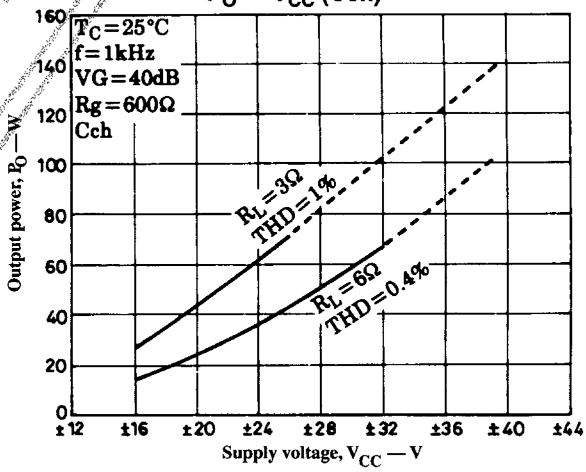
P_O — f (Cch)



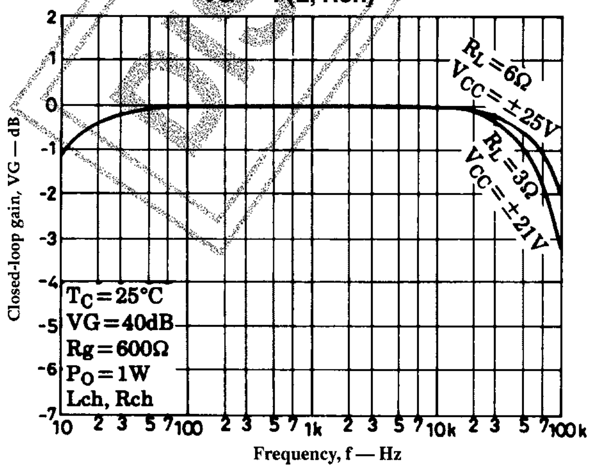
P_O — V_{CC} (L, Rch)



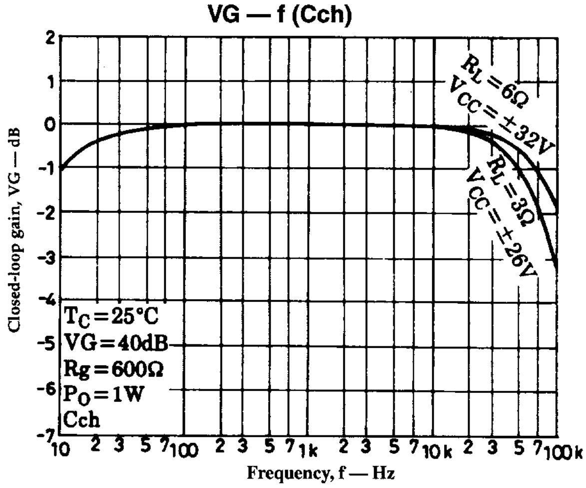
P_O — V_{CC} (Cch)



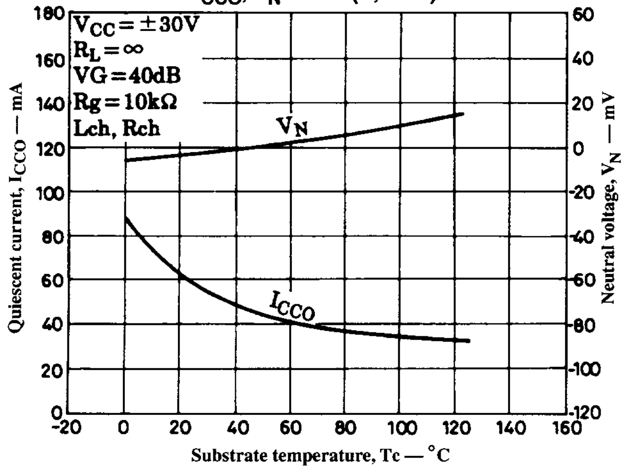
VG — f (L, Rch)



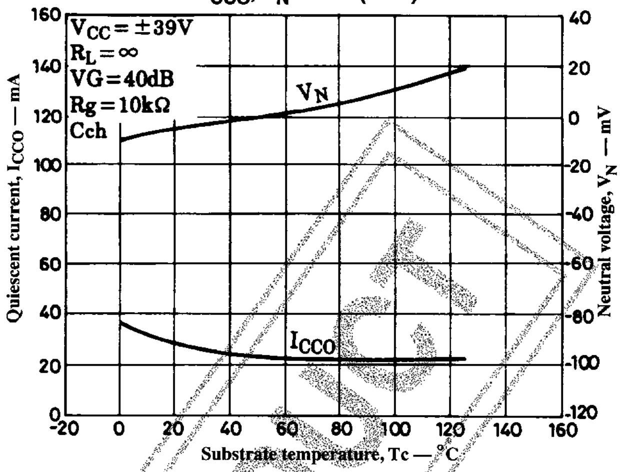
VG — f (Cch)



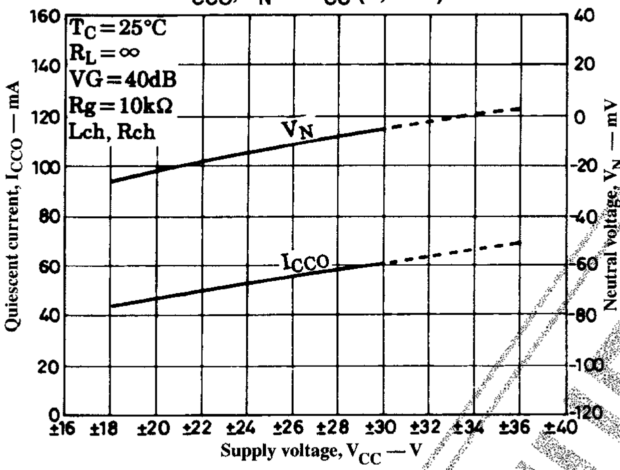
I_{CCO}, V_N — Tc (L, Rch)



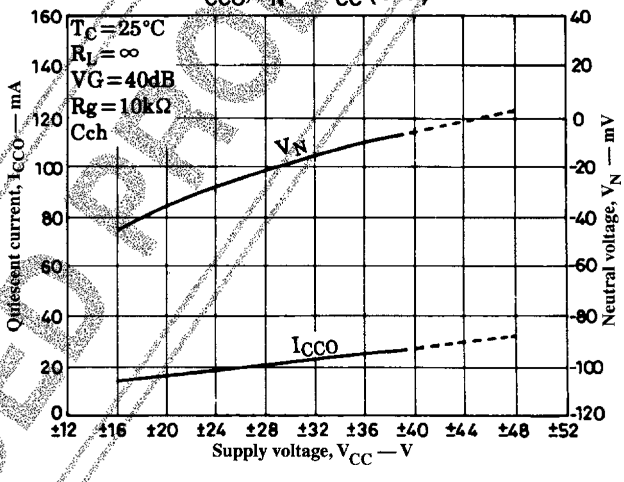
I_{CCO}, V_N — Tc (Cch)



I_{CCO}, V_N — V_{CC} (L, Rch)



I_{CCO}, V_N — V_{CC} (Cch)



This catalog provides information as of September, 1999. Specifications and information herein are subject to change without notice.