



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

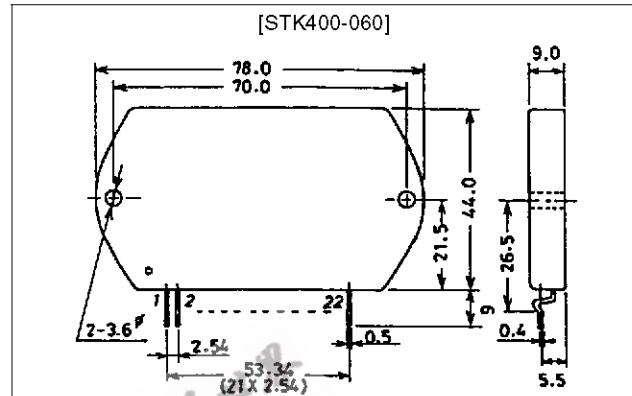
### Features

- 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 number of external components required.

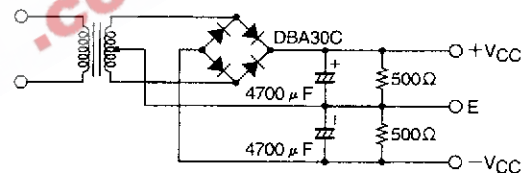
### Package Dimensions

unit: mm

4086A



### Specified Transformer Power Supply (RP-25 or Equivalent)



A07393

### Specifications

Maximum Ratings at  $T_a = 25^\circ\text{C}$ 

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	$V_{CC \text{ max}}$		±41	V
Thermal resistance	$\theta_{j-c}$	Per power transistor	1.8	$^\circ\text{C}/\text{W}$
Junction temperature	$T_j$		150	$^\circ\text{C}$
Operating substrate temperature	$T_c$		125	$^\circ\text{C}$
Storage temperature	$T_{stg}$		-30 to +125	$^\circ\text{C}$
Available time for load short-circuit	$t_s$	$V_{CC} = \pm 28\text{V}$ , $R_L = 6\Omega$ , $f = 50\text{Hz}$ , $P_O = 35\text{W}$	1	s

Operating Characteristics at  $T_a = 25^\circ\text{C}$ ,  $R_L = 6\Omega$  (noninductive load),  $R_g = 600\Omega$ ,  $V_G = 40\text{dB}$ 

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

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

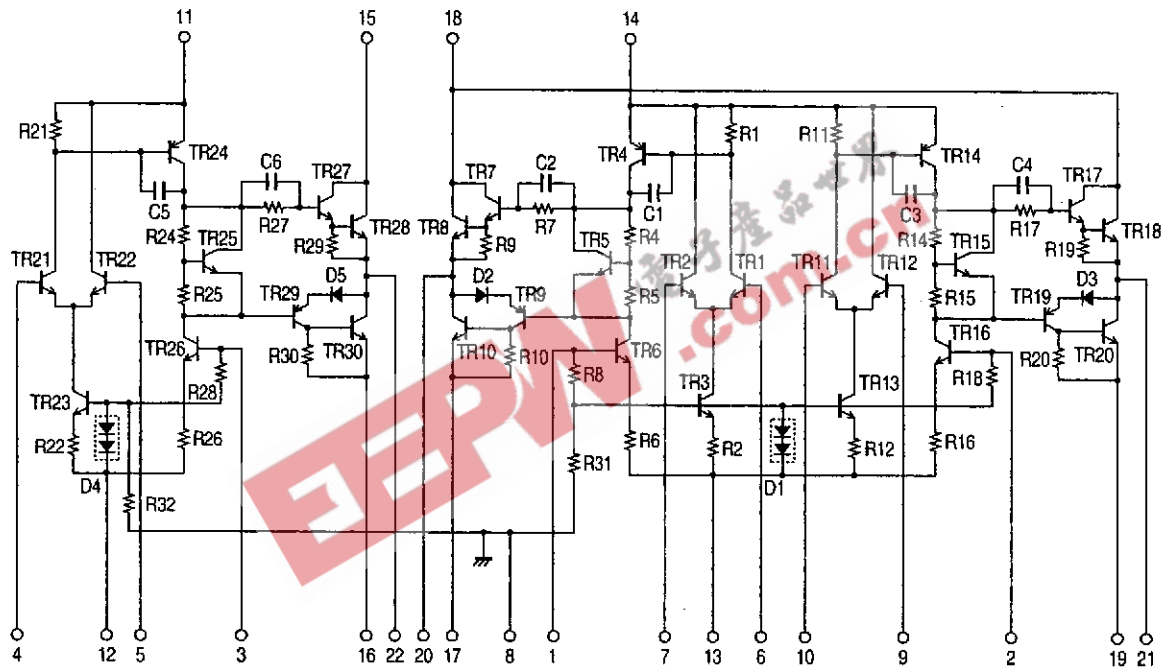
Notes.

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



## STK400-060

### 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 <sub>CC</sub> max1	V <sub>CC</sub> max2	V <sub>CC</sub> 1	V <sub>CC</sub> 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)					Supply voltage [V]				
Type No.	THD [%]	Type No.	THD [%]	Rated output	V <sub>CC</sub> max1	V <sub>CC</sub> max2	V <sub>CC</sub> 1	V <sub>CC</sub> 2	
STK400-450	0.4	STK400-650	0.08	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		STK400-690		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<sub>CC</sub> max1 (R<sub>L</sub> = 6Ω), V<sub>CC</sub> max2 (R<sub>L</sub> = 3 to 6Ω), V<sub>CC</sub>1 (R<sub>L</sub> = 6Ω), V<sub>CC</sub>2 (R<sub>L</sub> = 3Ω)

### Heatsink Design Considerations

The heatsink thermal resistance,  $\theta_{c-a}$ , required to cover the hybrid IC's total power dissipation,  $P_d$ , is determined as follows:

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

$$P_d \times \theta_{c-a} + T_a < 125^\circ\text{C} \dots\dots\dots (1)$$

where  $T_a$  is the guaranteed maximum ambient temperature.

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

$$P_d \times \theta_{c-a} + P_d/N \times \theta_{j-c} + T_a < 150^\circ\text{C} \dots\dots\dots (2)$$

where  $N$  is the number of power transistors and  $\theta_{j-c}$  is the thermal resistance per power transistor. Note that the power dissipated per transistor is the total,  $P_d$ , divided evenly among the  $N$  power transistors.

Expressions (1) and (2) can be rewritten making  $\theta_{c-a}$  the subject.

$$\theta_{c-a} < (125 - T_a)/P_d \dots\dots\dots (1)'$$

$$\theta_{c-a} < (150 - T_a)/P_d - \theta_{j-c}/N \dots\dots\dots (2)'$$

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 :  $T_a$

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

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

$$P_d = 49.2\text{W (for } 1/10 P_O \text{ max} = 3.5\text{W)}$$

The hybrid IC has 6 power transistors, and the thermal resistance per transistor,  $\theta_{j-c}$ , is 1.8°C/W. If the guaranteed maximum ambient temperature,  $T_a$ , is 50°C, then the required heatsink thermal resistance,  $\theta_{c-a}$ , is:

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

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

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

Similarly, when hybrid IC's  $V_{CC} = \pm 23\text{V}$  and  $R_L = 3\Omega$ :

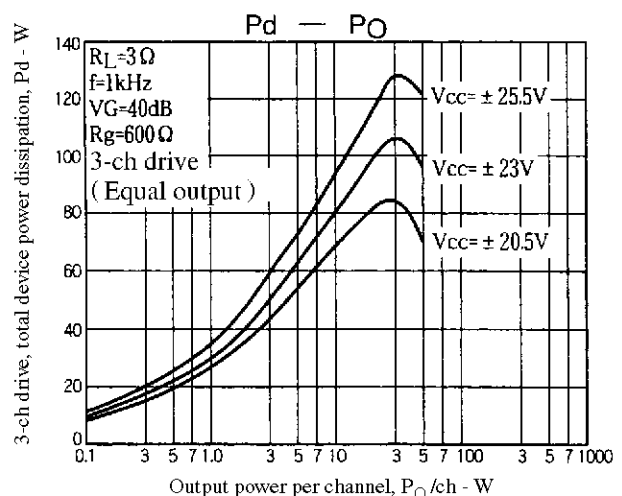
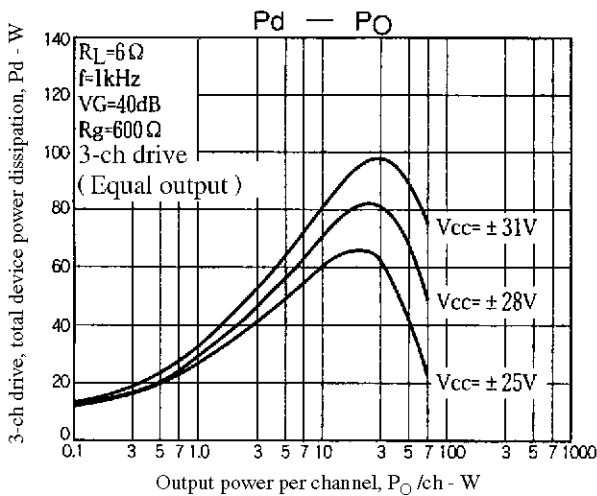
$$P_d = 58\text{W (for } 1/10 P_O \text{ max} = 3.5\text{W)}$$

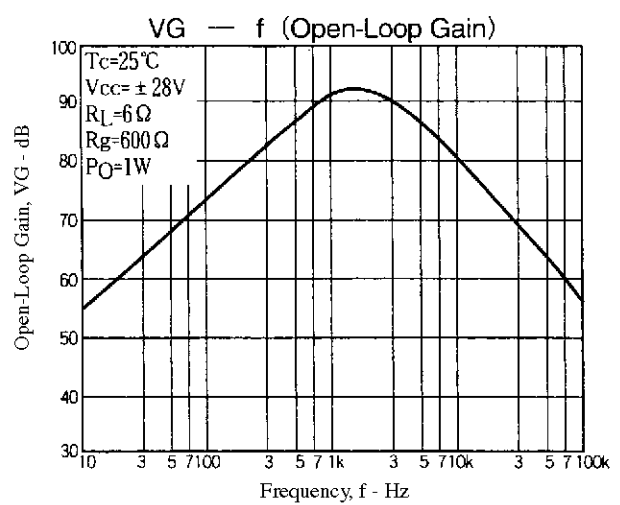
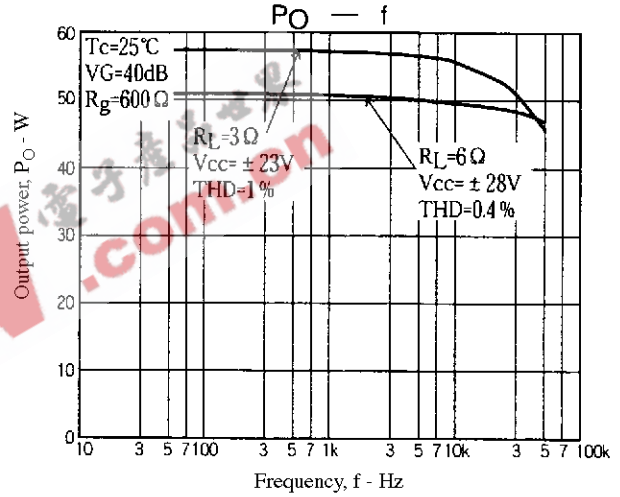
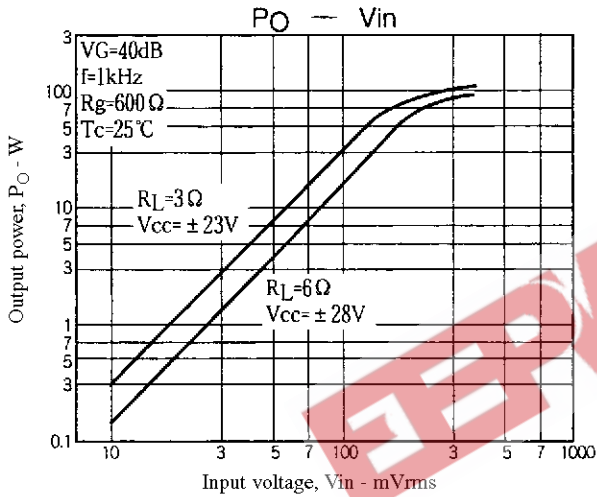
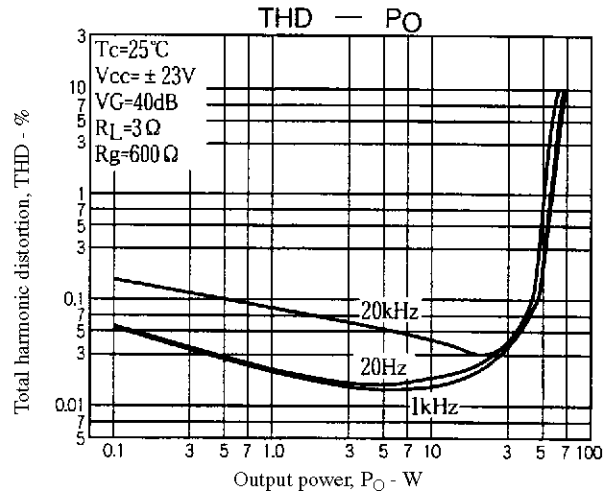
$$\text{From expression (1)'}: \theta_{c-a} < (125 - 50)/58 < 1.29$$

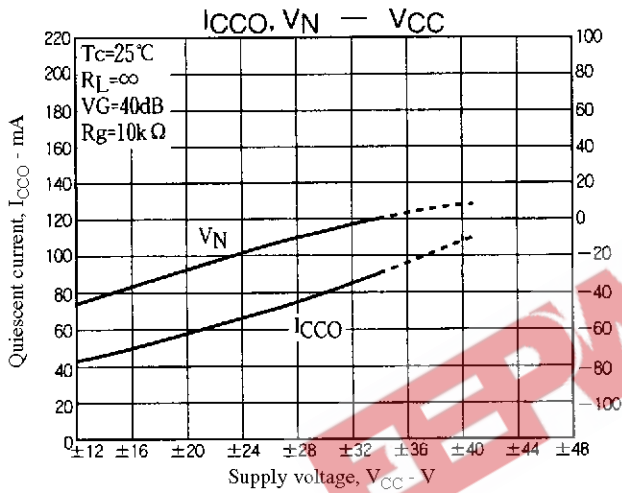
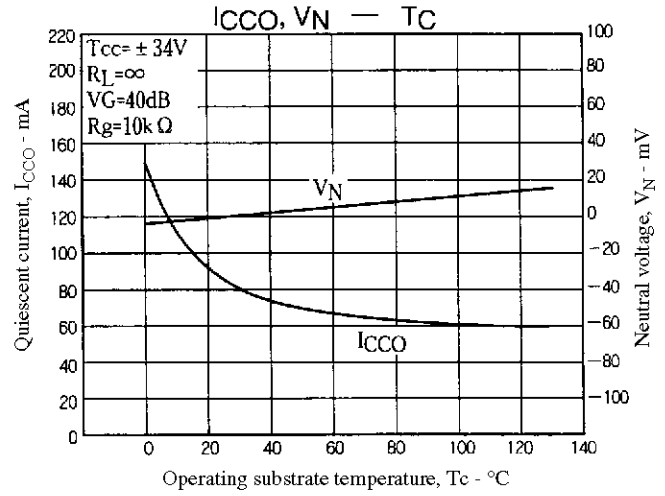
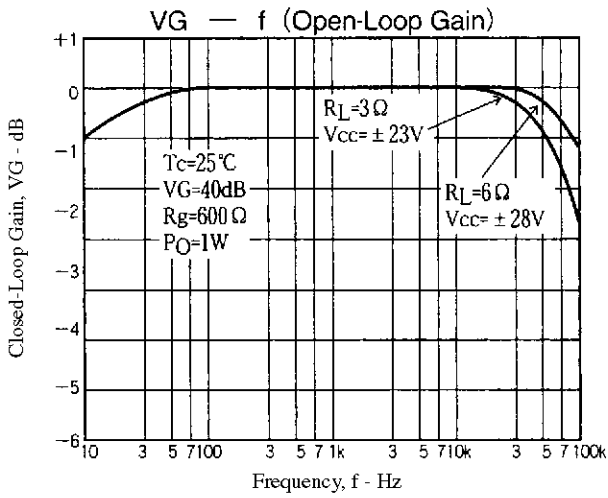
$$\text{From expression (2)'}: \theta_{c-a} < (150 - 50)/58 - 1.8/6 < 1.42$$

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.







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