



**STK400-030**

**AF Power Amplifier (Split Power Supply)  
(20W+20W+20W, THD = 0.4%)**

**Overview**

The STK400-030 is a 3-channel AF power amplifier IC supporting multichannel speakers. One package includes 20W×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.

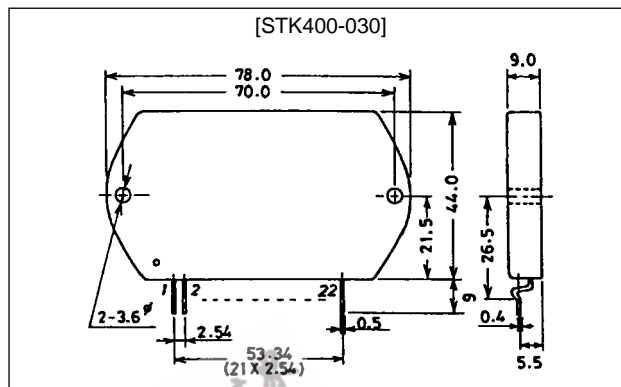
**Features**

- 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.

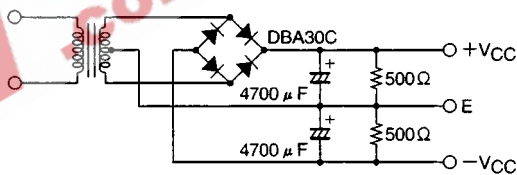
**Package Dimensions**

unit: mm

**4086A**



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



A07379

**Specifications**

**Maximum Ratings** at Ta = 25°C

| Parameter                             | Symbol              | Conditions  | Ratings     | Unit |
|---------------------------------------|---------------------|---|-------------|------|
| Maximum supply voltage                | V <sub>CC</sub> max |   | ±34         | V    |
| Thermal resistance                    | θ <sub>j-c</sub>    | Per power transistor  | 2.1         | °C/W |
| Junction temperature                  | T <sub>j</sub>      |   | 150         | °C   |
| Operating substrate temperature       | T <sub>c</sub>      |   | 125         | °C   |
| Storage temperature                   | T <sub>stg</sub>    |   | -30 to +125 | °C   |
| Available time for load short-circuit | t <sub>s</sub>      | V <sub>CC</sub> = ±23V, R <sub>L</sub> = 6Ω, f = 50Hz, P <sub>O</sub> = 20W | 1           | s    |

**Operating Characteristics** at Ta = 25°C, R<sub>L</sub> = 6Ω (noninductive load), R<sub>g</sub> = 600Ω, V<sub>G</sub> = 40dB

| Parameter                 | Symbol             | Conditions  | min | typ  | max | Unit |
|---------------------------|--------------------|---|-----|------|-----|------|
| Output power              | P <sub>O</sub> (1) | V <sub>CC</sub> = ±23V, f = 20Hz to 20kHz, THD = 0.4%             | 20  | 25   | -   | W    |
|                           | P <sub>O</sub> (2) | V <sub>CC</sub> = ±19V, f = 1kHz, THD = 1.0%, R <sub>L</sub> = 3Ω | 20  | 25   | -   | W    |
| Total harmonic distortion | THD(1)             | V <sub>CC</sub> = ±23V, f = 20Hz to 20kHz, P <sub>O</sub> = 1.0W  | -   | -    | 0.4 | %    |
|                           | THD(2)             | V <sub>CC</sub> = ±23V, f = 1kHz, P <sub>O</sub> = 5.0W           | -   | 0.02 | -   | %    |

| Parameter            | Symbol     | Conditions                                 | min | typ       | max | Unit      |
|----------------------|------------|--|-----|-----------|-----|-----------|
| Frequency response   | $f_L, f_H$ | $V_{CC} = \pm 23V, P_O = 1.0W, +0_{-3} dB$ | -   | 20 to 50k | -   | Hz        |
| Input impedance      | $r_i$      | $V_{CC} = \pm 23V, f = 1kHz, P_O = 1.0W$   | -   | 55        | -   | $k\Omega$ |
| Output noise voltage | $V_{NO}$   | $V_{CC} = \pm 28V, R_g = 10k\Omega$        | -   | -         | 1.2 | mVrms     |
| Quiescent current    | $I_{CCO}$  | $V_{CC} = \pm 28V$                         | 30  | 90        | 150 | mA        |
| Neutral voltage      | $V_N$      | $V_{CC} = \pm 28V$                         | -70 | 0         | +70 | mV        |

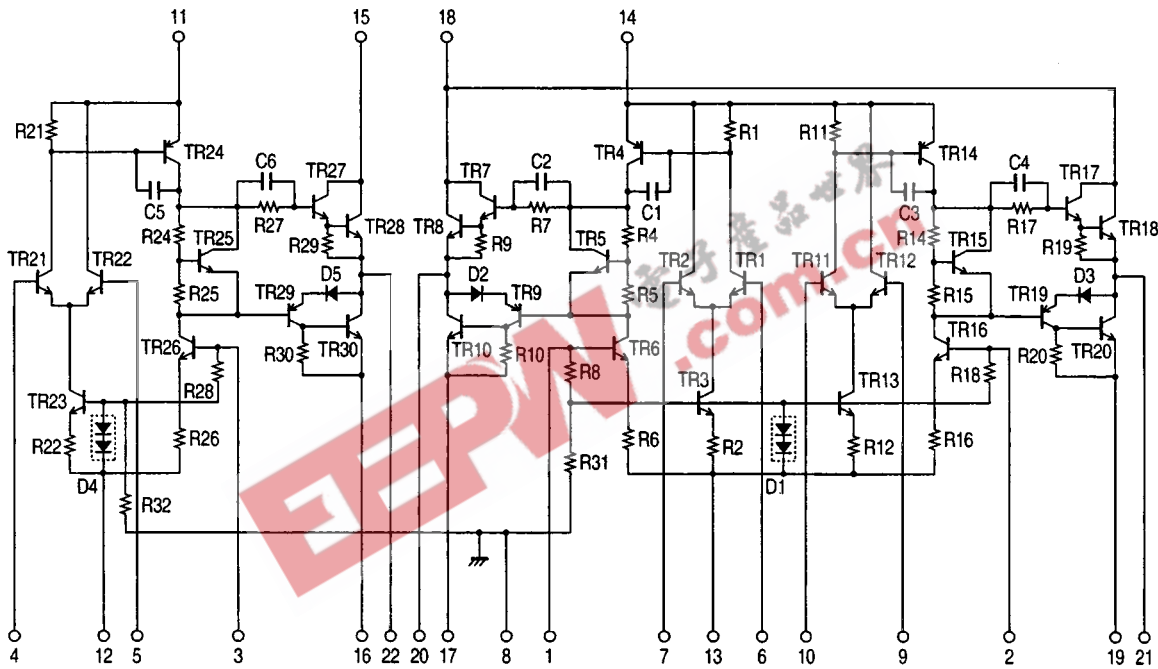
Notes.

All tests are conducted using a constant-voltage regulated power supply unless otherwise specified.

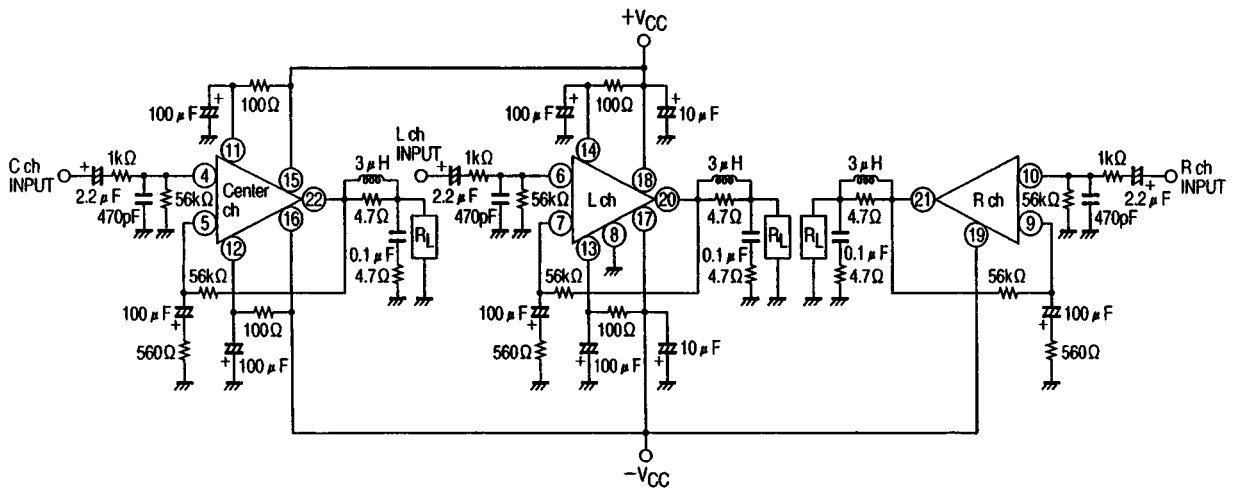
Available time for load shorted and output noise voltage are measured using the transformer power supply specified on page 1.

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<br>(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  $V_{CC} = \pm 23\text{V}$  and  $R_L = 6\Omega$ , for a continuous sine wave signal, is a maximum of 55W, 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,

$$P_d = 31\text{W (for } 1/10 P_O \text{ max} = 2\text{W)}$$

The hybrid IC has 6 power transistors, and the thermal resistance per transistor,  $\theta_{j-c}$ , is 2.1°C/W. If the guaranteed maximum ambient temperature,  $T_a$ , is 50°C, then the required heatsink thermal resistance,  $\theta_{c-a}$ , is:

$$\text{From expression (1)'}: \theta_{c-a} < (125 - 50)/31 < 2.41$$

$$\text{From expression (2)'}: \theta_{c-a} < (150 - 50)/31 - 2.1/6 < 2.87$$

Therefore, to satisfy both expressions, the required heatsink must have a thermal resistance less than 2.41°C/W.

Similarly, when hybrid IC's  $V_{CC} = \pm 19\text{V}$  and  $R_L = 3\Omega$ :

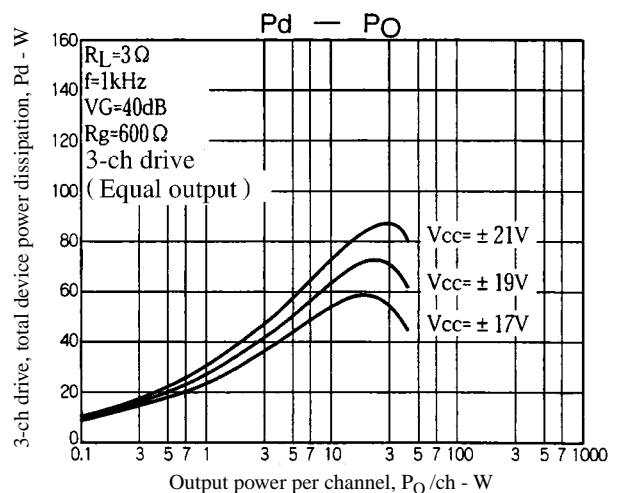
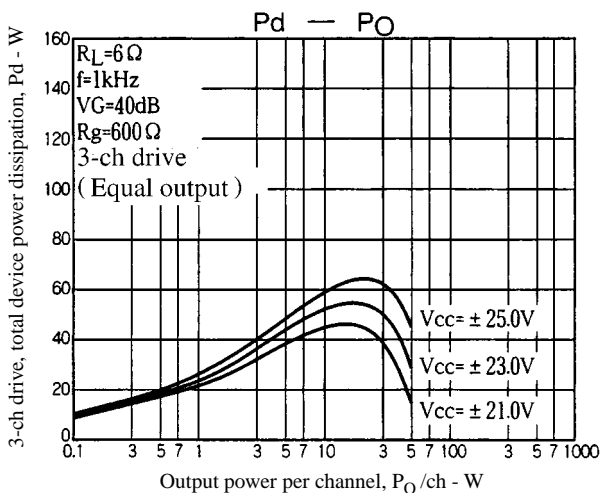
$$P_d = 36\text{W (for } 1/10 P_O \text{ max} = 2\text{W)}$$

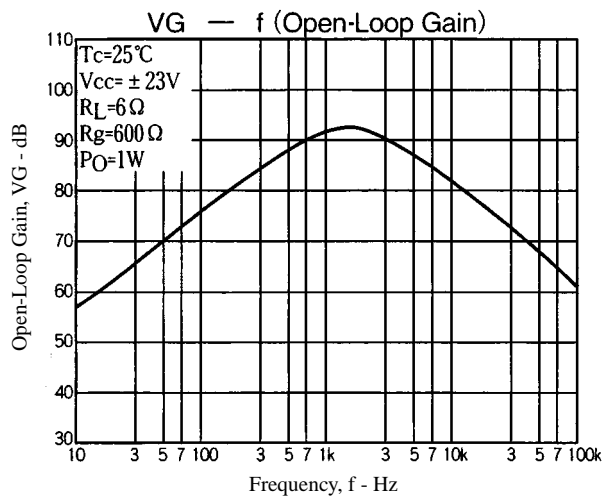
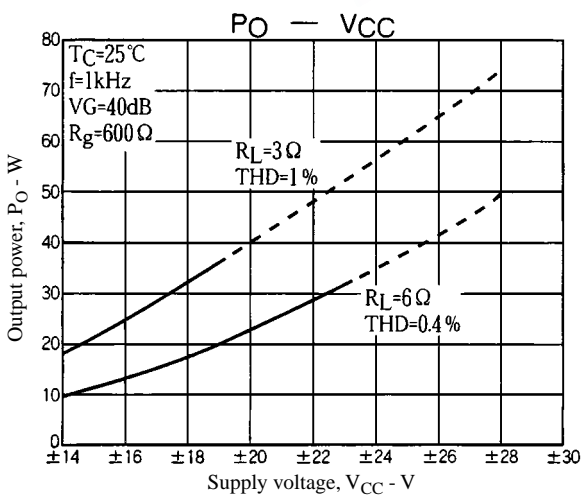
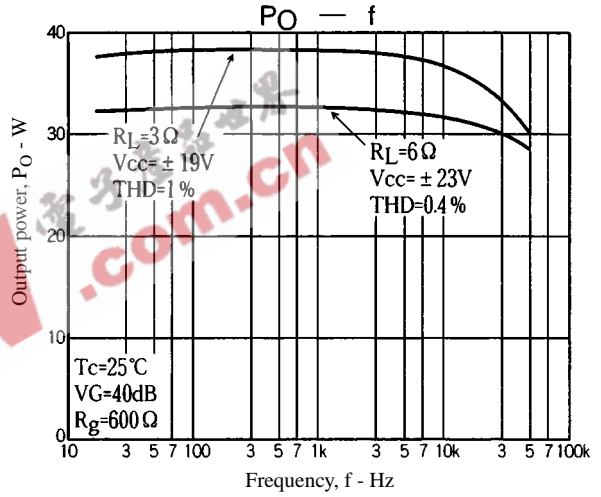
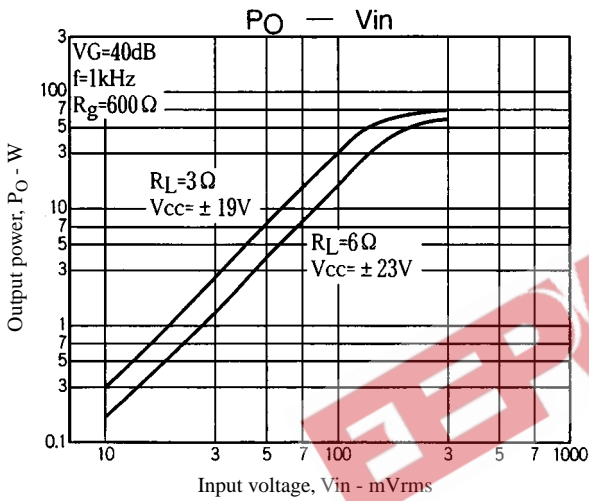
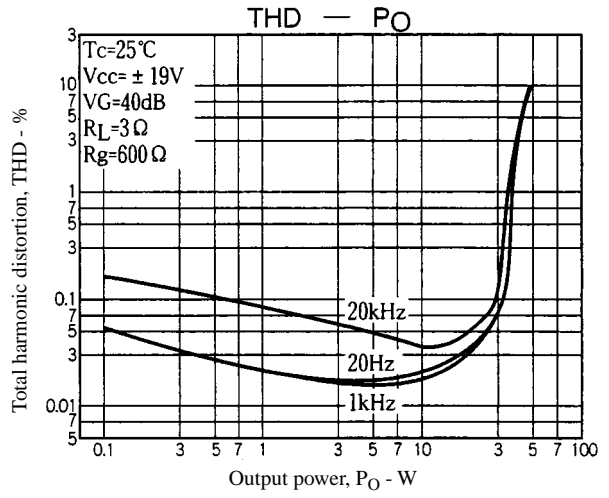
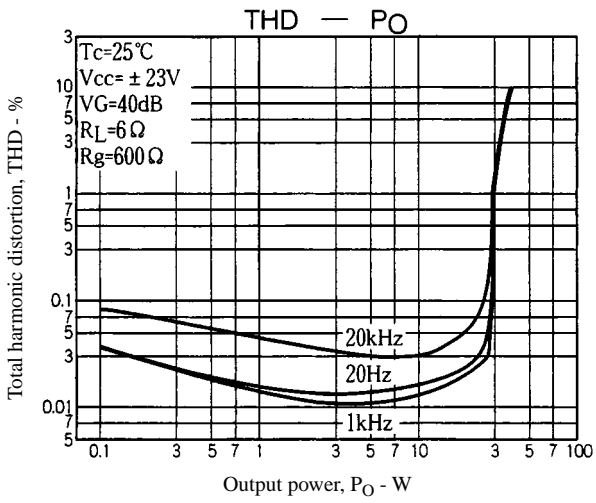
$$\text{From expression (1)'}: \theta_{c-a} < (125 - 50)/36 < 2.08$$

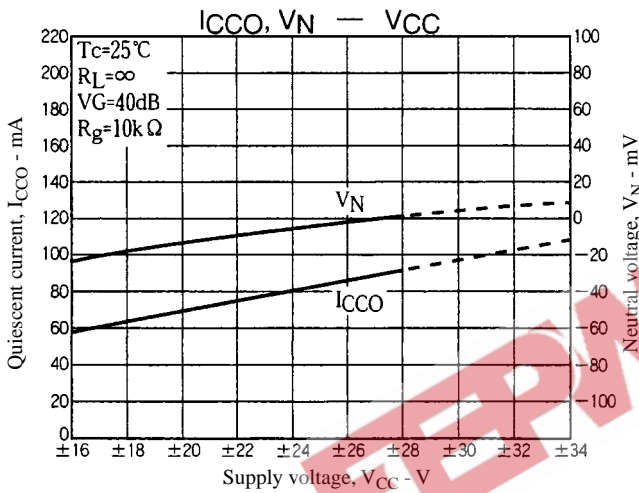
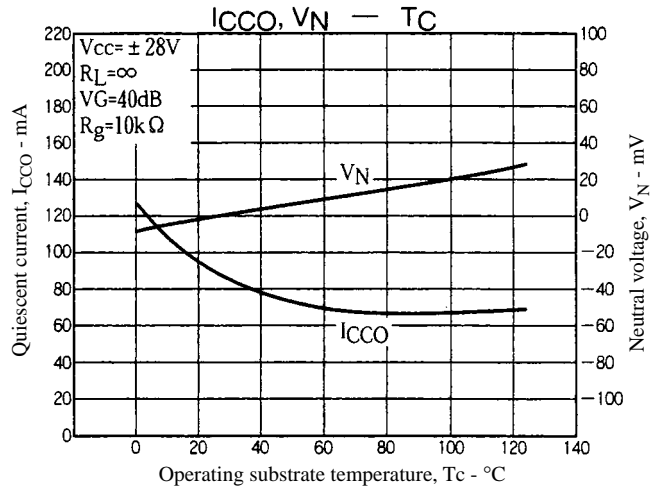
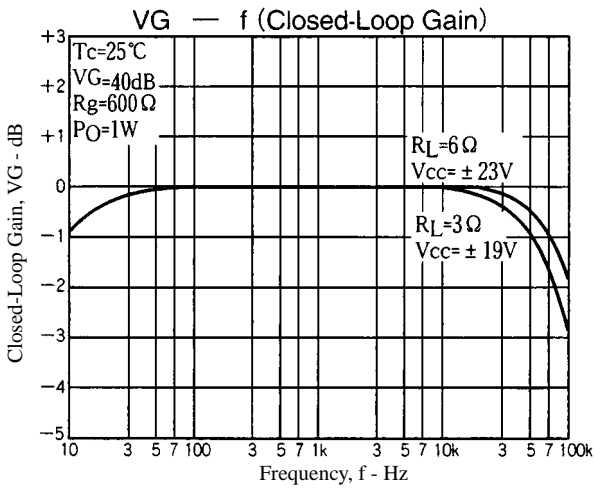
$$\text{From expression (2)'}: \theta_{c-a} < (150 - 50)/36 - 2.1/6 < 2.42$$

Therefore, to satisfy both expressions, the required heatsink must have a thermal resistance less than 2.08°C/W.

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







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