


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

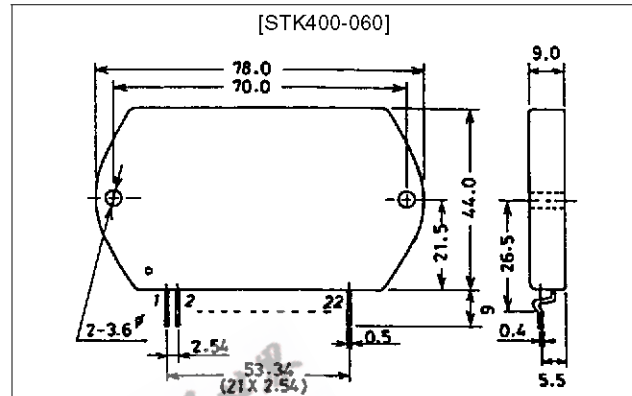
Features

- 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.

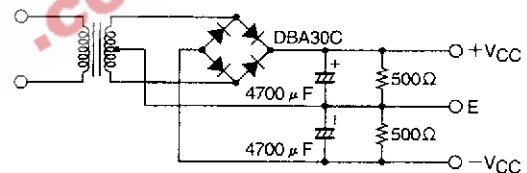
Package Dimensions

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 | θ_{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 |

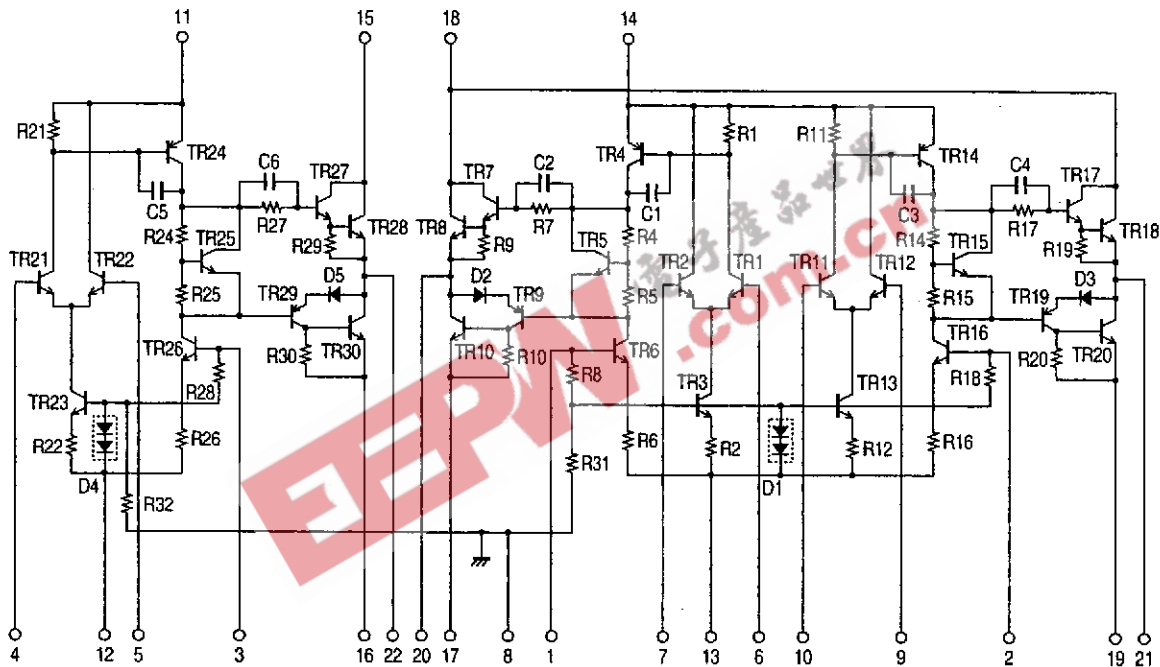
Notes.

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

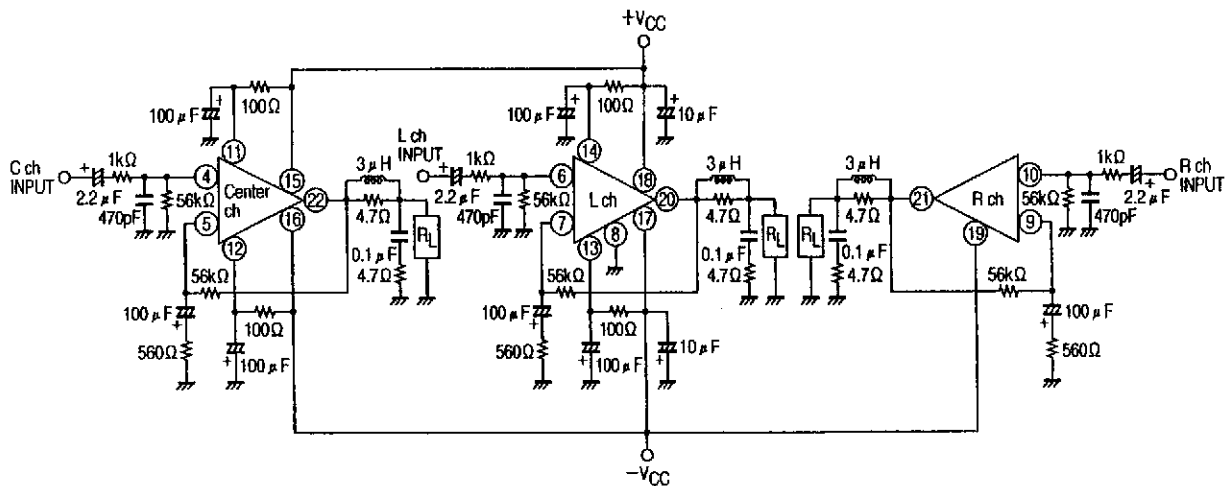
Available time for load short-circuit and output noise voltage are measured using the transformer power supply specified on page 1.

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 _{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) | | | | | 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 | 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_{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, θ_{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 θ_{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 θ_{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, θ_{j-c} , is 1.8°C/W. If the guaranteed maximum ambient temperature, T_a , is 50°C, then the required heatsink thermal resistance, θ_{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 $R_L = 3\Omega$:

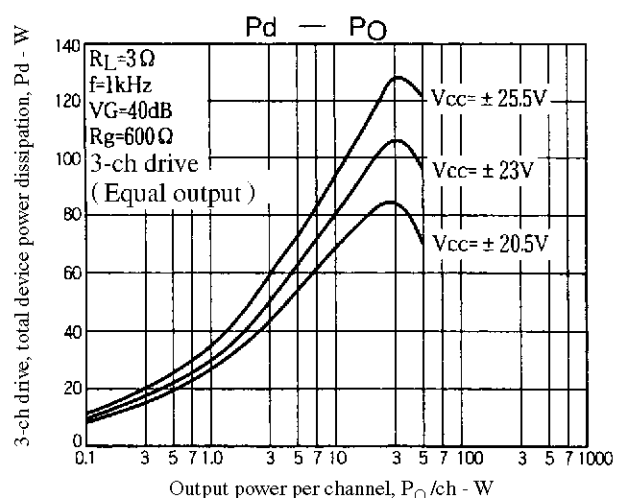
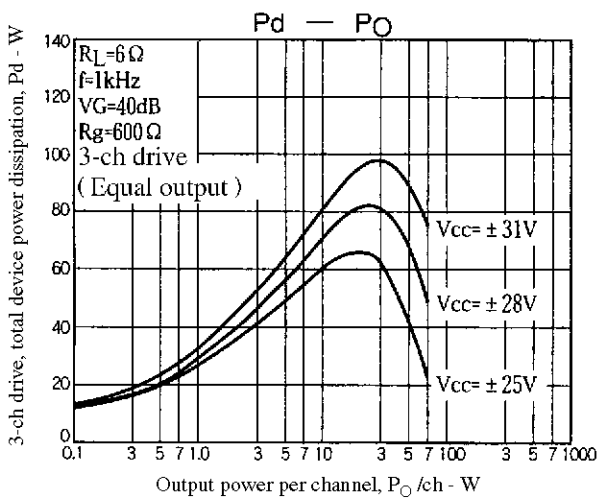
$$P_d = 58\text{W (for } 1/10 P_O \text{ max} = 3.5\text{W)}$$

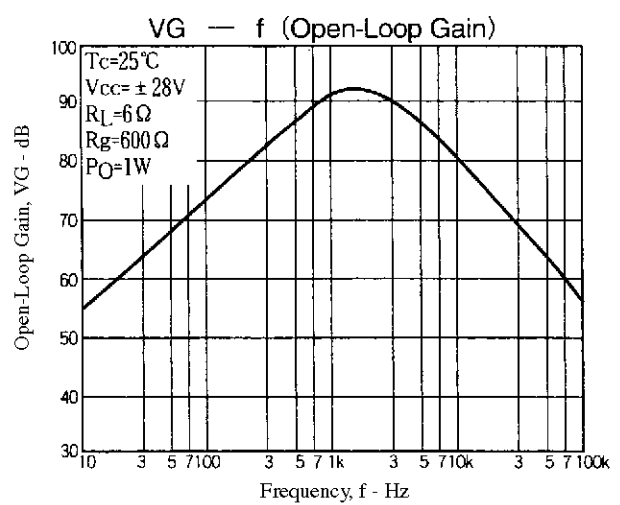
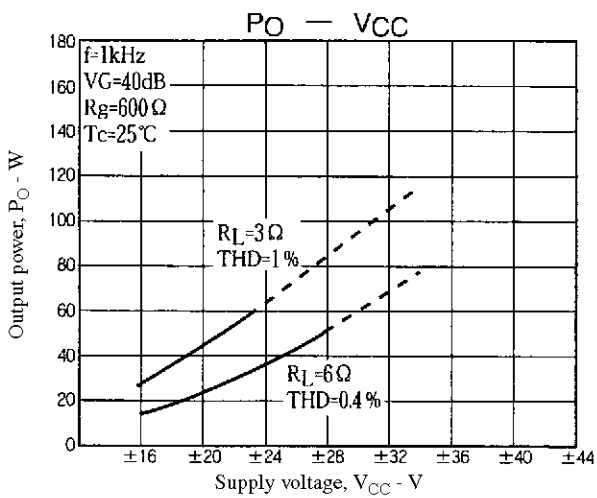
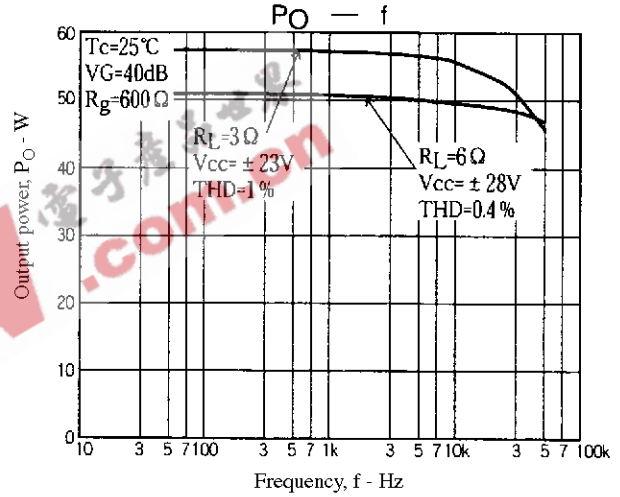
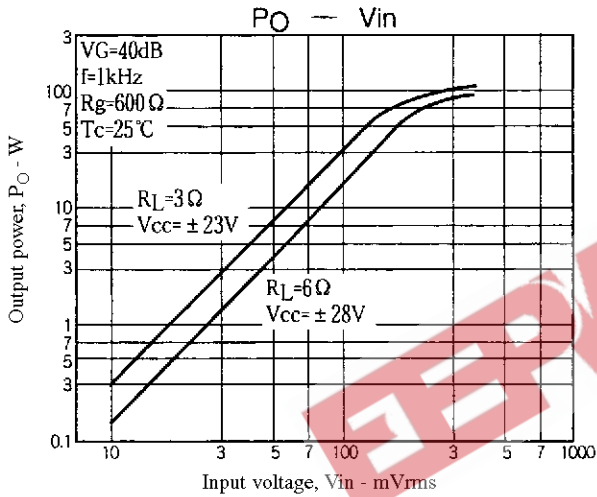
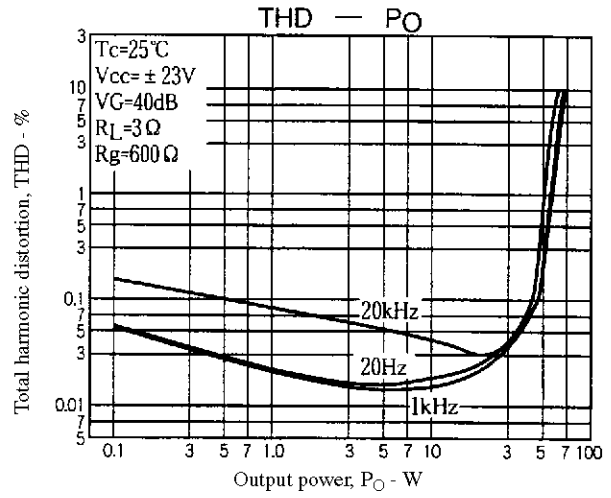
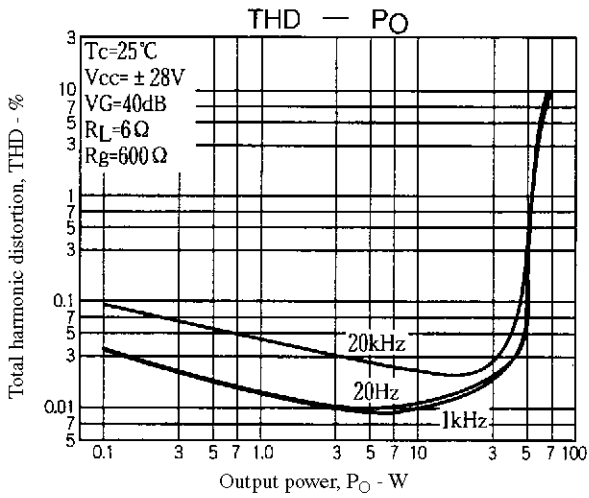
$$\text{From expression (1)'}: \theta_{c-a} < (125 - 50)/58 < 1.29$$

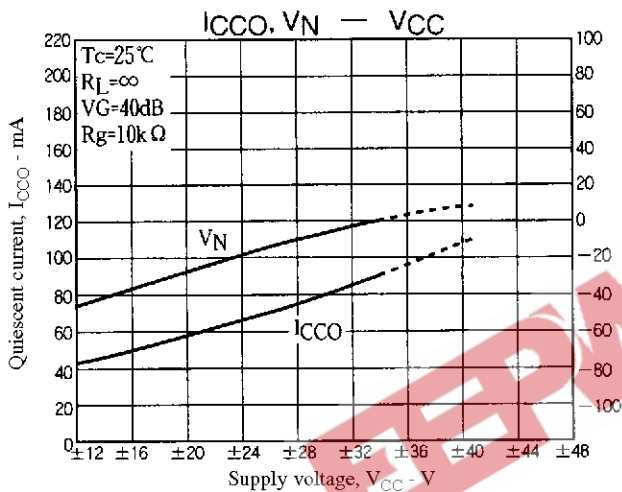
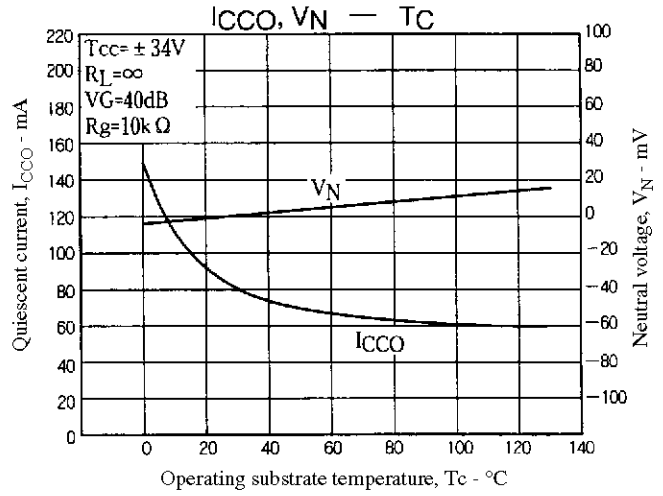
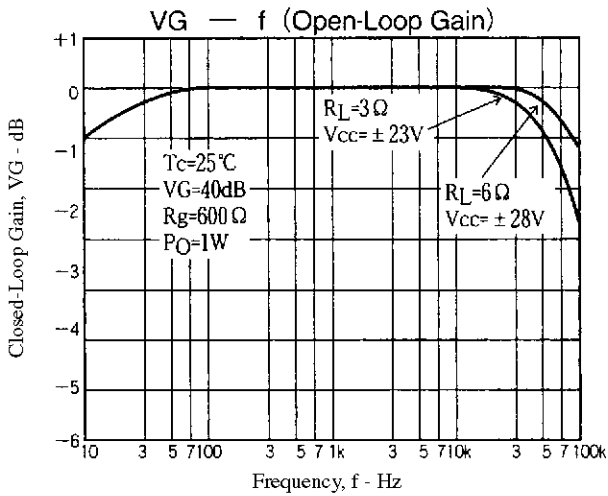
$$\text{From expression (2)'}: \theta_{c-a} < (150 - 50)/58 - 1.8/6 < 1.42$$

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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