

**SANYO**

No. 5178

**STK405-050**

**2ch AF Power Amplifier (Split Power Supply)**  
**30W + 30W min, THD = 10%**

## Overview

The STK405-050, a member of the STK405-000 series, is a low-cost, 2-channel audio power amplifier hybrid IC that is ideal for a wide range of stereo sets. It has dedicated  $6\Omega$  output drive, in contrast with the STK401-000 series which supports  $6\Omega/3\Omega$  output drive.

## Features

- Class B amplifiers
- Output load impedance  $R_L = 6\Omega$  support
- EIAJ-output compatible ( $f = 1\text{kHz}$ , THD = 10%)
- Low supply switching shock noise
- Pin assignment grouped into individual blocks of inputs, outputs and supply lines to minimize the adverse effects of pattern layout on operating characteristics
- External bootstrap circuit not necessary
- Standby operation possible using external circuit
- Voltage gain  $V_G = 26\text{dB}$  for easy gain distribution within the set
- Member of 10W/ch to 80W/ch pin-compatible series

## Series Organization

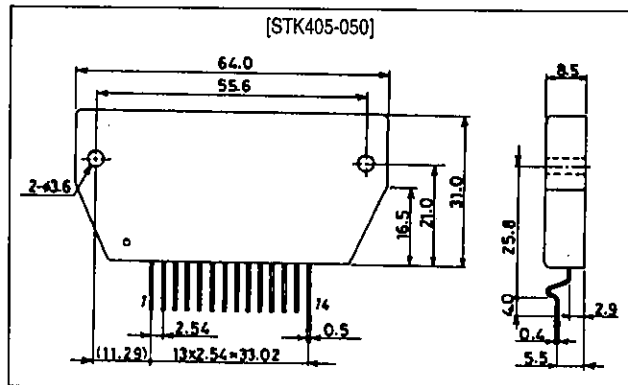
The following devices form a series with differing output capacity. Some of the following devices are under development. Contact your Sanyo sales representative if you require more detailed information.

| Type No.   | Output power | Supply voltage [V] |            |
|------------|--------------|--------------------|------------|
|            |              | $V_{CC}$ max       | $V_{CC}$   |
| STK405-010 | 10W + 10W    | $\pm 26.0$         | $\pm 14.0$ |
| STK405-030 | 20W + 20W    | $\pm 30.5$         | $\pm 18.5$ |
| STK405-050 | 30W + 30W    | $\pm 34.5$         | $\pm 22.0$ |
| STK405-070 | 40W + 40W    | $\pm 39.0$         | $\pm 25.0$ |
| STK405-090 | 50W + 50W    | $\pm 42.0$         | $\pm 26.5$ |
| STK405-100 | 60W + 60W    | $\pm 45.0$         | $\pm 29.0$ |
| STK405-110 | 70W + 70W    | $\pm 50.0$         | $\pm 31.0$ |
| STK405-120 | 80W + 80W    | $\pm 52.5$         | $\pm 33.0$ |

## Package Dimensions

unit: mm

4158



## Specifications

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

| Parameter                             | Symbol               | Conditions   | Ratings     | Unit               |
|---------------------------------------|----------------------|--|-------------|--------------------|
| Maximum supply voltage                | $V_{CC \text{ max}}$ |  | $\pm 34.5$  | V                  |
| Thermal resistance                    | $\theta_{j-c}$       | Per power transistor   | 3.4         | $^\circ\text{C/W}$ |
| 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 | $t_s$                | $V_{CC} = \pm 22\text{V}$ , $R_L = 6\Omega$ , $f = 50\text{Hz}$ , $P_O = 30\text{W}$ | 1           | s                  |

### Operating Characteristics at $T_a = 25^\circ\text{C}$ , $R_L = 6\Omega$ (noninductive load), $R_g = 600\Omega$ , $V_G = 26\text{dB}$

| Parameter                 | Symbol     | Conditions  | min  | typ       | max  | Unit             |
|---------------------------|------------|---|------|-----------|------|------------------|
| Quiescent current         | $I_{CCO}$  | $V_{CC} = \pm 28.0\text{V}$ , no load                                     | -    | 13        | 20   | mA               |
| Output power              | $P_O$      | $V_{CC} = \pm 22.0\text{V}$ , $f = 1\text{kHz}$ , $\text{THD} = 10.0\%$   | 30   | -         | -    | W                |
| Total harmonic distortion | THD        | $V_{CC} = \pm 22.0\text{V}$ , $f = 1\text{kHz}$ , $P_O = 5.0\text{W}$     | -    | 0.04      | 0.1  | %                |
| Frequency response        | $f_L, f_H$ | $V_{CC} = \pm 22.0\text{V}$ , $P_O = 1.0\text{W}$ , $_{-3}^{+0}\text{dB}$ | -    | 20 to 50k | -    | Hz               |
| Input impedance           | $r_i$      | $V_{CC} = \pm 22.0\text{V}$ , $f = 1\text{kHz}$ , $P_O = 1.0\text{W}$     | -    | 55        | -    | $\text{k}\Omega$ |
| Output noise voltage      | $V_{NO}$   | $V_{CC} = \pm 28.0\text{V}$ , $R_g = 10\text{k}\Omega$                    | -    | -         | 1.2  | mVrms            |
| Neutral voltage           | $V_N$      | $V_{CC} = \pm 28.0\text{V}$   | -100 | 0         | +100 | mV               |

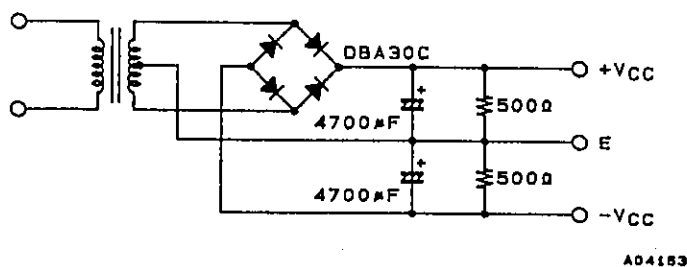
Notes.

All tests are measured using a regulated voltage supply unless otherwise specified.

Available time for load short-circuit and output noise voltage are measured using the transformer supply specified below.

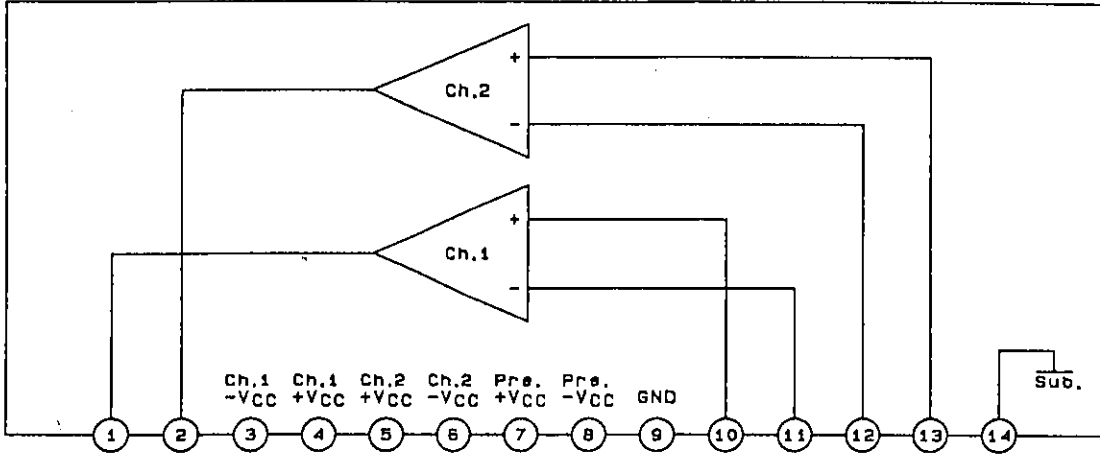
The output noise voltage is the peak value of an average-reading meter with an rms value scale (VTVM). A regulated AC supply (50Hz) should be used to eliminate the effects of AC primary line flicker noise.

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



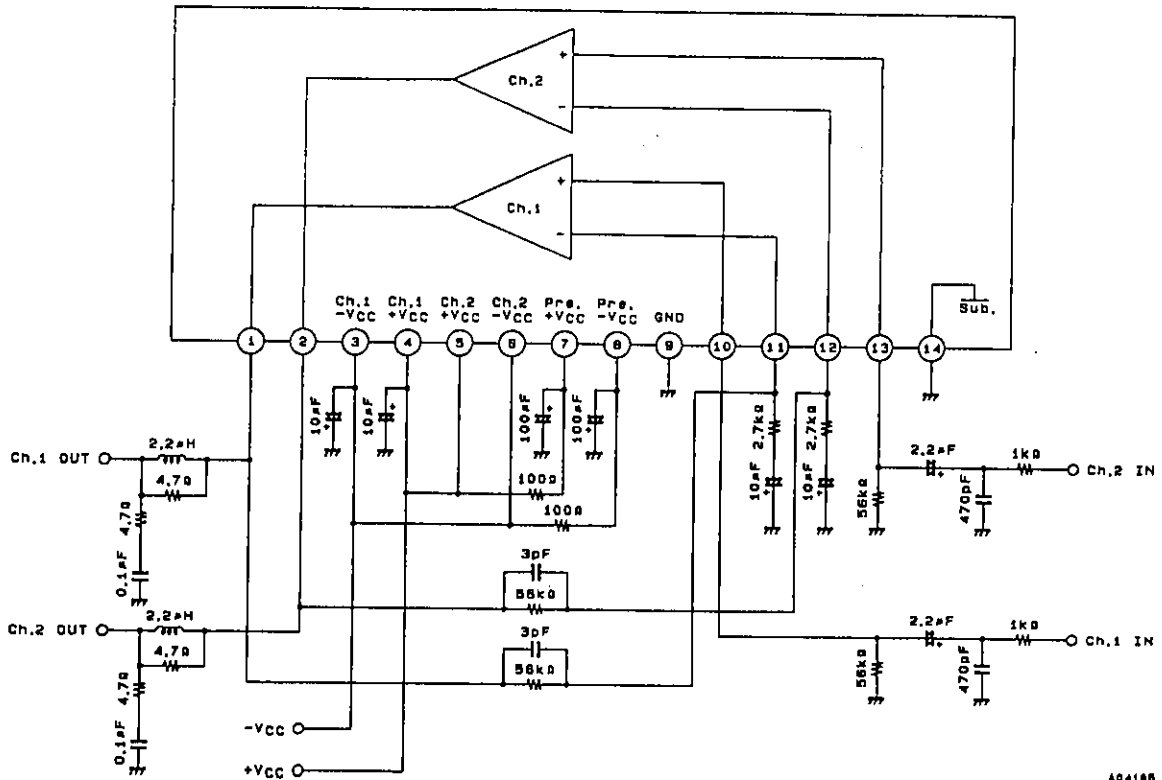
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Block Diagram



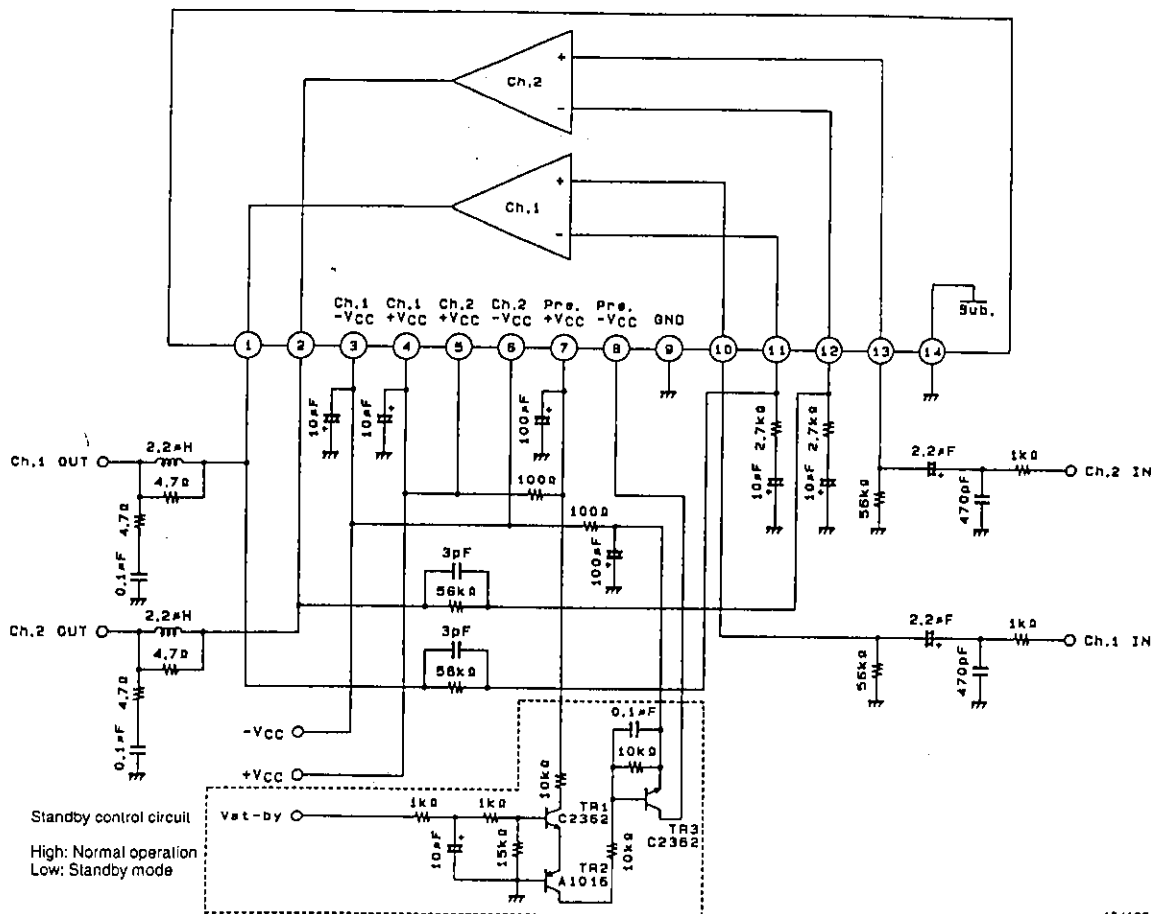
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Test Circuit



A04185

Sample Application Circuit (Standby Mode Supported)



AS4106

Heatsink Design Considerations

The heatsink thermal resistance,  $\theta_{c-a}$ , required to dissipate the STK405-050 device total power dissipation,  $P_d$ , is determined as follows:

Condition 1: IC 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 power transistor thermal resistance per 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 STK405-050  $V_{CC} = \pm 22.0\text{V}$  and  $R_L = 6\Omega$ , for a continuous sine wave signal, is a maximum of 33.5W, as shown in the  $P_d-P_O$  characteristic 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,

$$P_d = 23\text{W (for } 1/10 P_O \text{ max} = 3\text{W)}$$

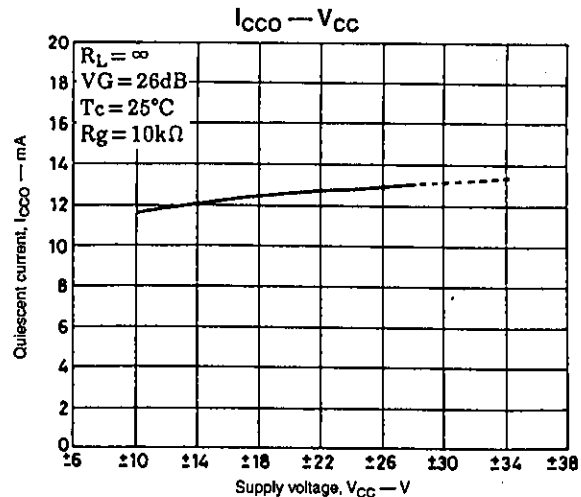
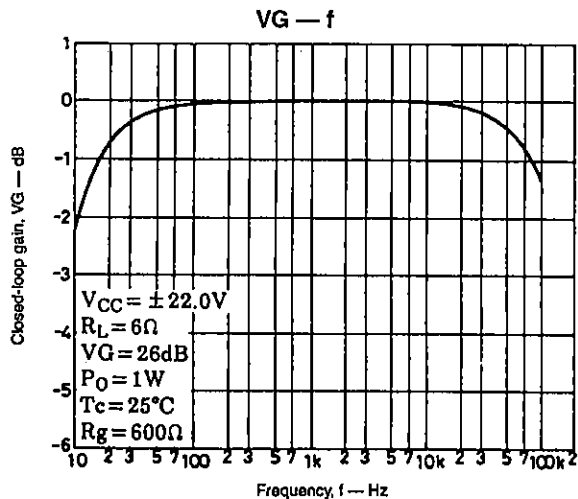
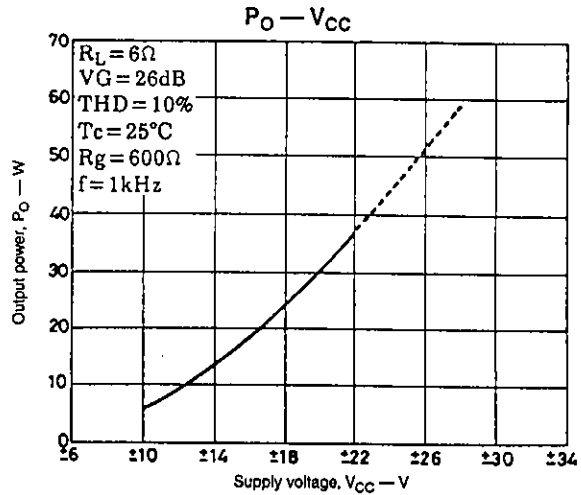
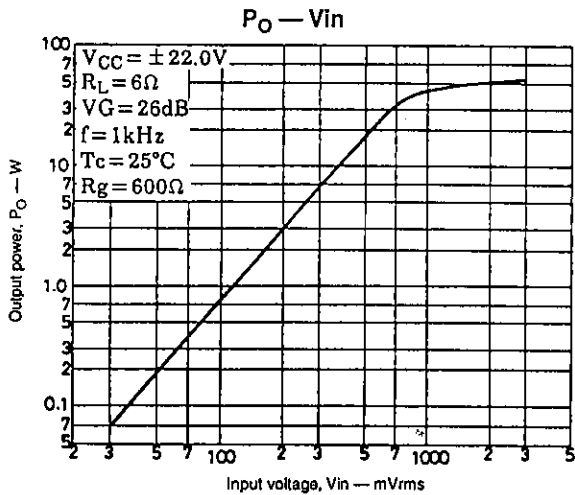
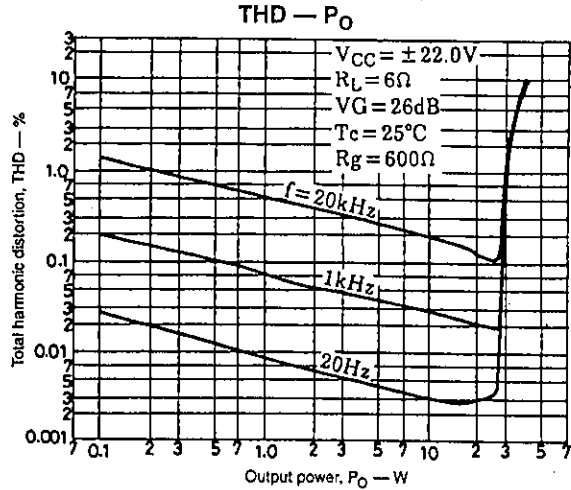
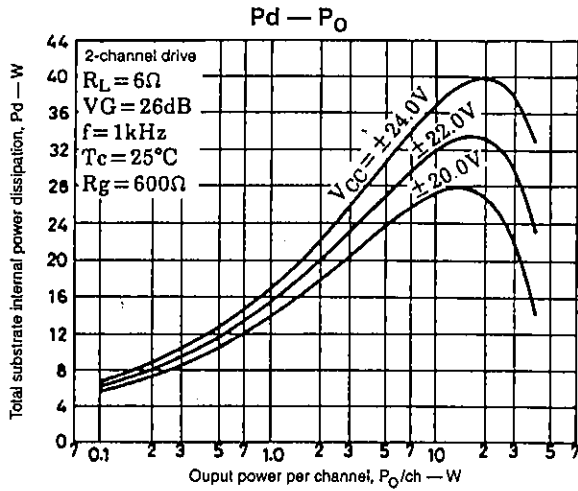
The STK405-050 has 4 power transistors, and the thermal resistance per transistor,  $\theta_{j-c}$ , is 3.4°C/W. If the guaranteed maximum ambient temperature,  $T_a$ , is 50°C, then the required heatsink thermal resistance,  $\theta_{c-a}$ , is:

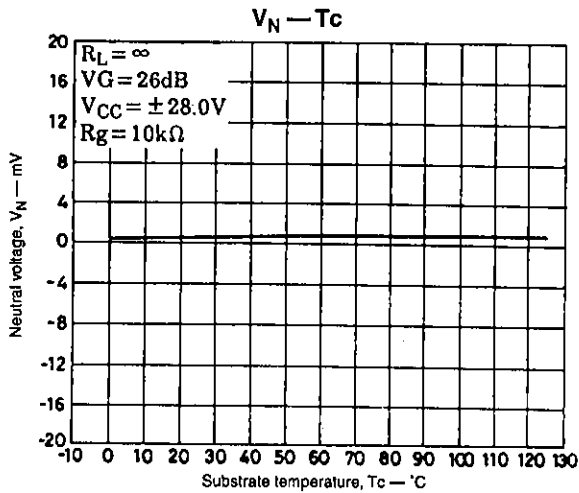
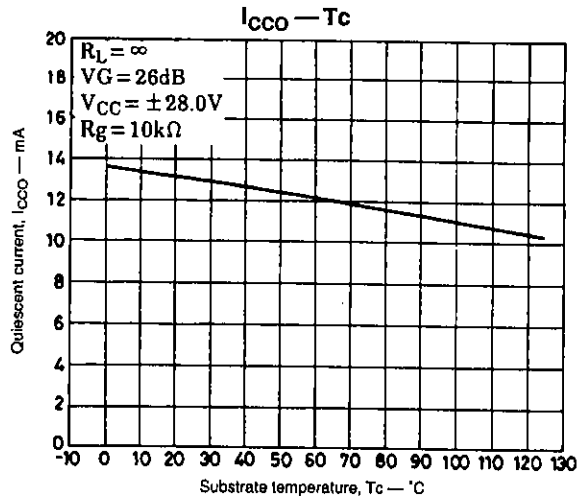
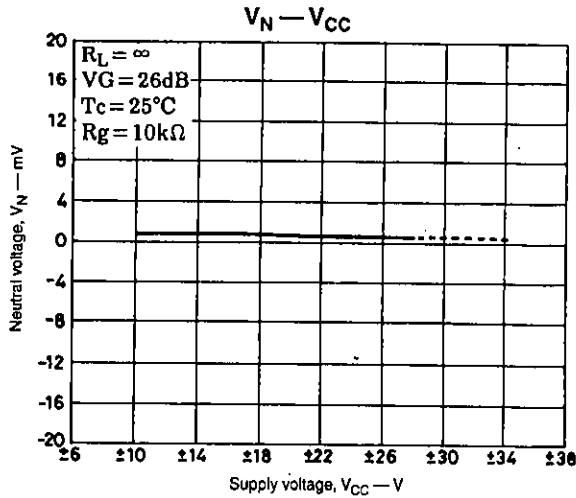
From expression (1):  $\theta_{c-a} < (125 - 50)/23 < 3.26$

From expression (2):  $\theta_{c-a} < (150 - 50)/23 - 3.4/4 < 3.49$

Therefore, to satisfy both expressions, the required heat-sink must have a thermal resistance less than 3.26°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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