

**SANYO**

No. 5180

**STK405-090**

**2ch AF Power Amplifier (Split Power Supply)**  
**50W + 50W min, THD = 10%**

## Overview

The STK405-090, 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

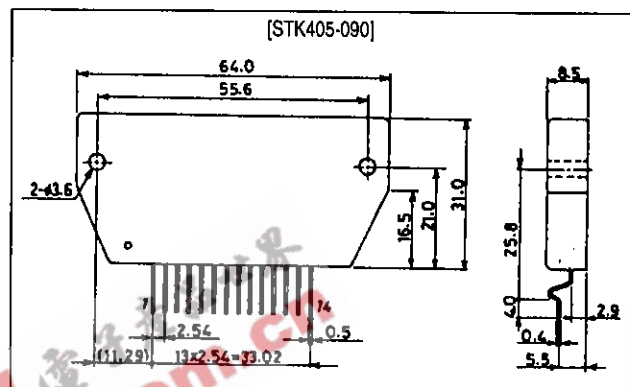
The following devices form a series with differing output capacity. Some of the following devices are under development. Contact your Sanyo sales representative if you require more detailed information.

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	$V_{CC \text{ max}}$		$\pm 42$	V
Thermal resistance	$\theta_{j-c}$	Per power transistor	2.7	$^\circ\text{C/W}$
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	$t_s$	$V_{CC} = \pm 26.5\text{V}$ , $R_L = 6\Omega$ , $f = 50\text{Hz}$ , $P_O = 50\text{W}$	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	$I_{CCO}$	$V_{CC} = \pm 34.0\text{V}$ , no load	-	12	20	mA
Output power	$P_O$	$V_{CC} = \pm 26.5\text{V}$ , $f = 1\text{kHz}$ , $\text{THD} = 10.0\%$	50	-	-	W
Total harmonic distortion	THD	$V_{CC} = \pm 26.5\text{V}$ , $f = 1\text{kHz}$ , $P_O = 5.0\text{W}$	-	0.04	0.1	%
Frequency response	$f_L, f_H$	$V_{CC} = \pm 26.5\text{V}$ , $P_O = 1.0\text{W}$ , $_{-3}^{+0}\text{dB}$	-	20 to 50k	-	Hz
Input impedance	$r_i$	$V_{CC} = \pm 26.5\text{V}$ , $f = 1\text{kHz}$ , $P_O = 1.0\text{W}$	-	55	-	k $\Omega$
Output noise voltage	$V_{NO}$	$V_{CC} = \pm 34.0\text{V}$ , $R_g = 10\text{k}\Omega$	-	-	1.2	mVrms
Neutral voltage	$V_N$	$V_{CC} = \pm 34.0\text{V}$	-100	0	+100	mV

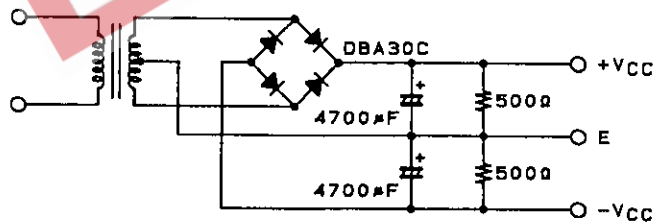
**Notes.**

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.

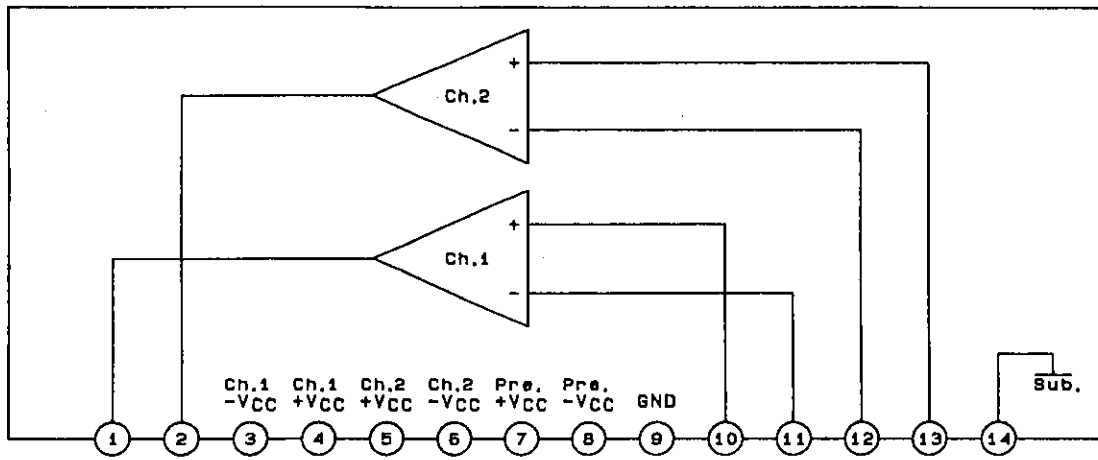
The output noise voltage is the peak value of an average-reading meter with an rms value scale (VTVM). A regulated AC supply (50Hz) should be used to eliminate the effects of AC primary line flicker noise.

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



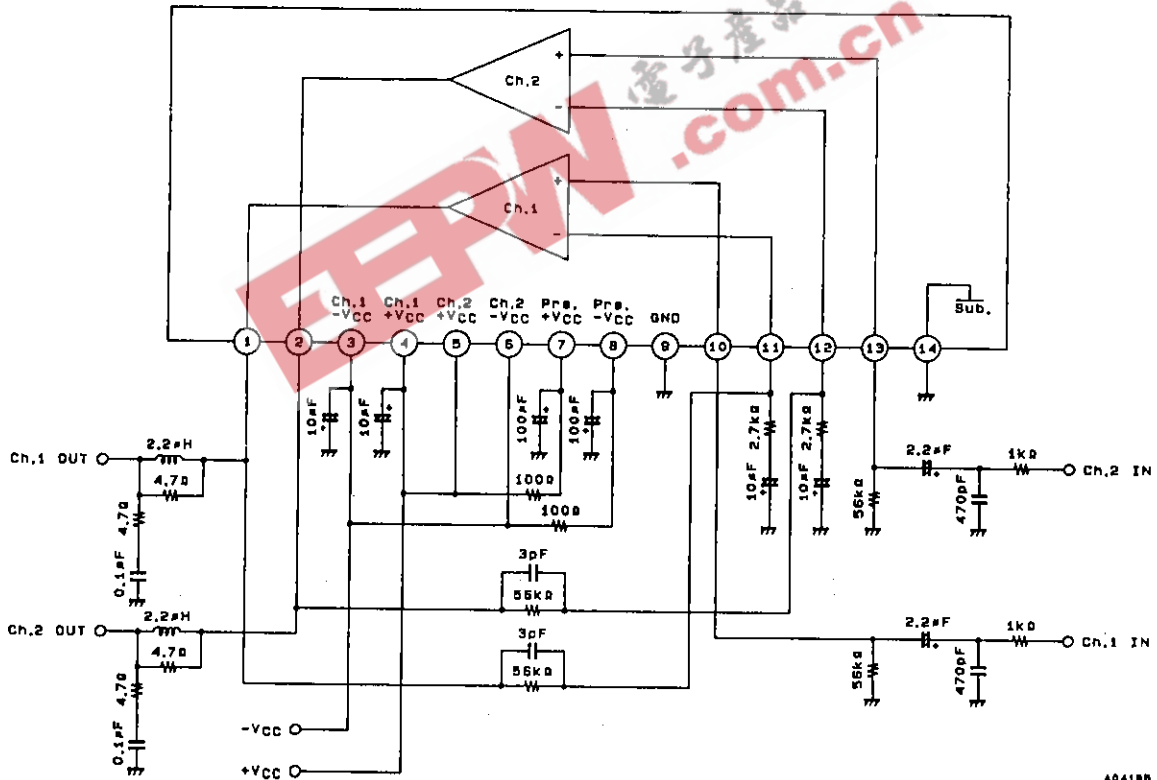
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Block Diagram



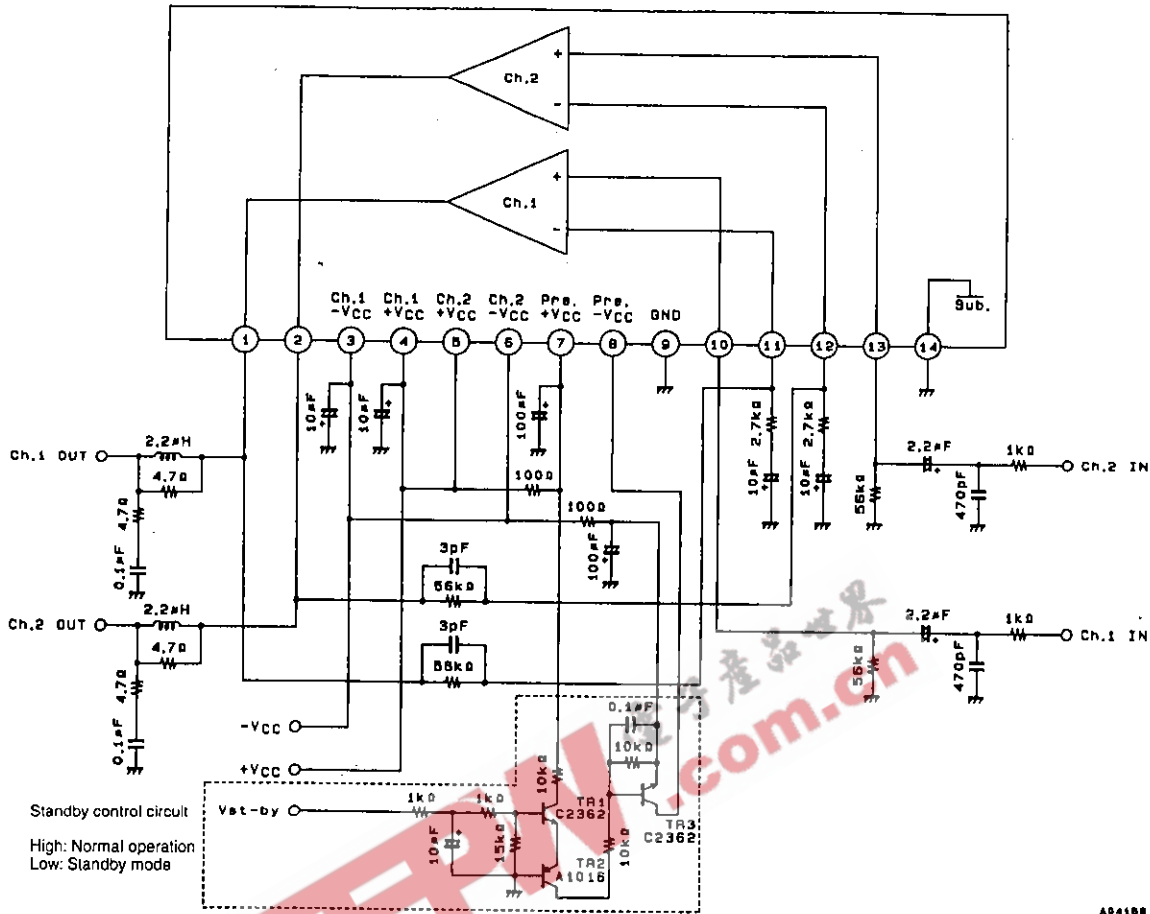
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Test Circuit



A04185

### Sample Application Circuit (Standby Mode Supported)



404108

### Heatsink Design Considerations

The heatsink thermal resistance,  $\theta_{c-a}$ , required to dissipate the STK405-090 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 STK405-090  $V_{CC} = \pm 26.5V$  and  $R_L = 6\Omega$ , for a continuous sine wave signal, is a maximum of 48W, 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,

$$P_d = 34.5W \text{ (for } 1/10 P_O \text{ max} = 5W)$$

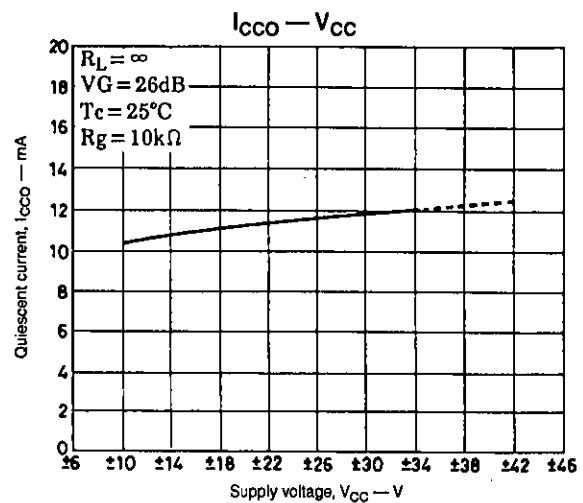
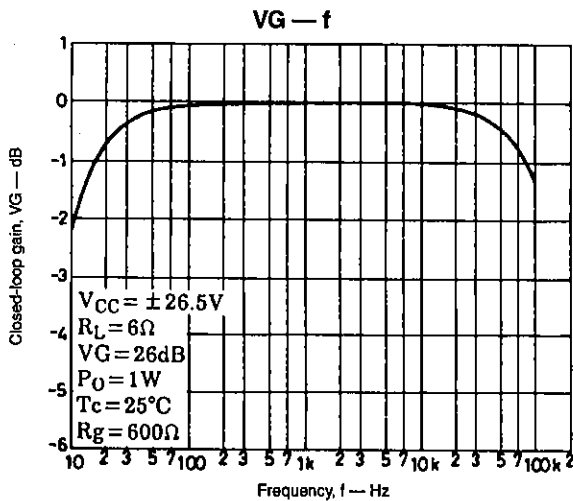
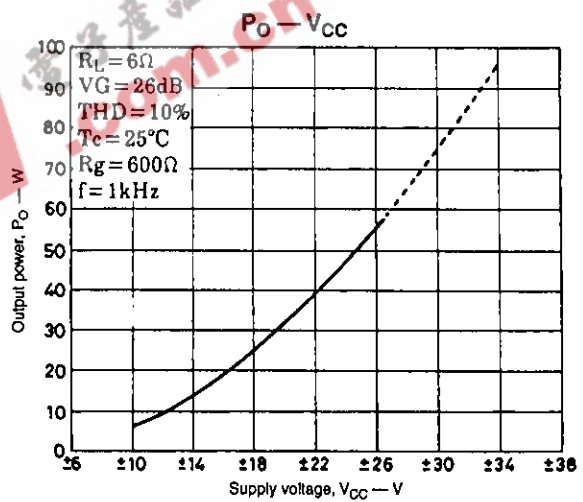
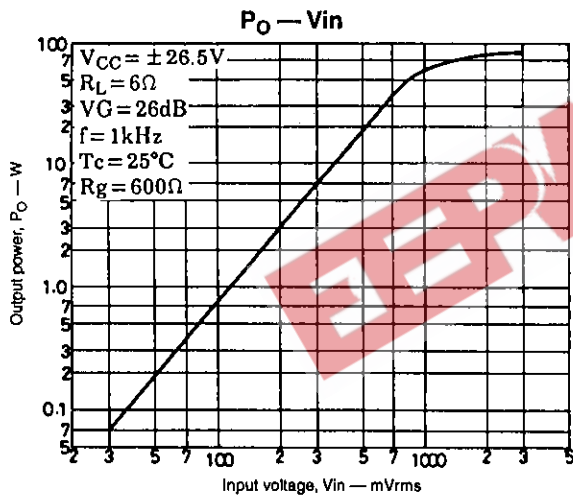
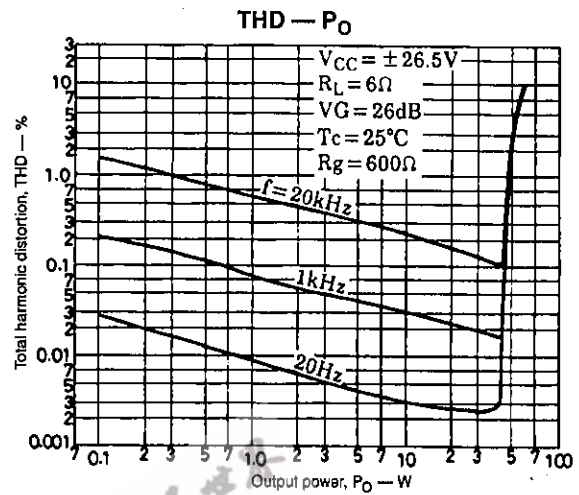
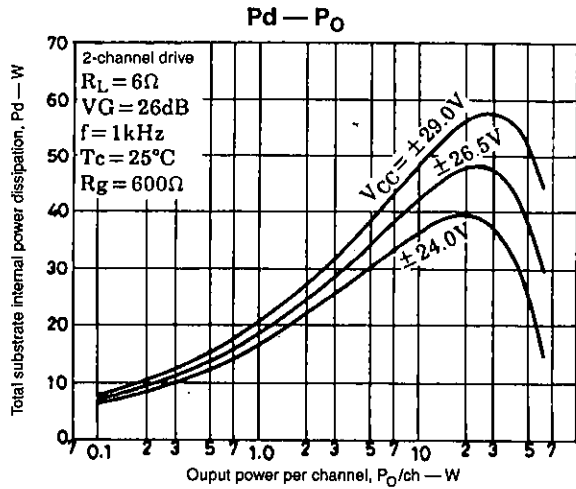
The STK405-090 has 4 power transistors, and the thermal resistance per transistor,  $\theta_{j-c}$ , is 2.7°C/W. If the guaranteed maximum ambient temperature,  $T_a$ , is 50°C, then the required heatsink thermal resistance,  $\theta_{c-a}$ , is:

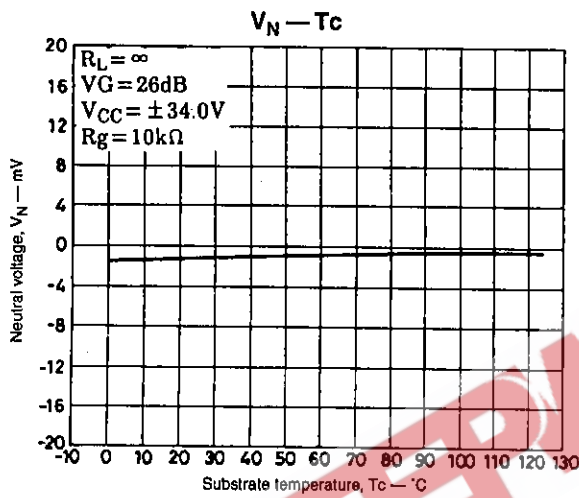
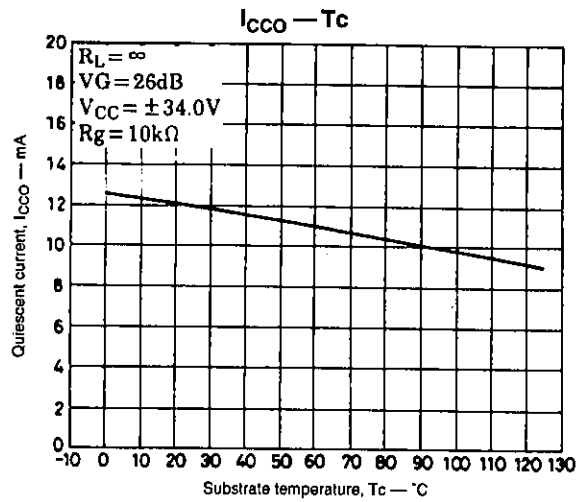
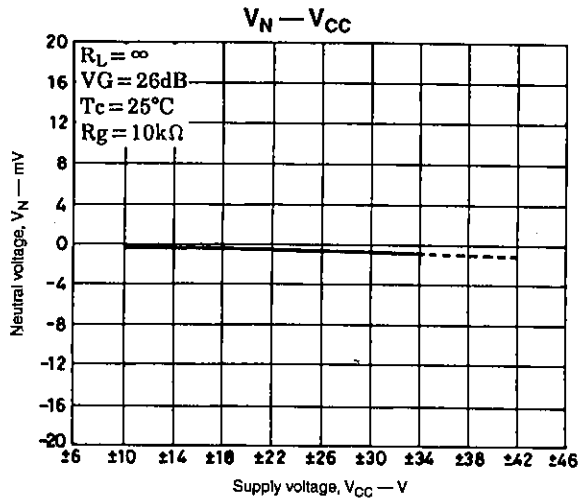
From expression (1):  $\theta_{c-a} < (125 - 50)/34.5$   
 $< 2.17$

From expression (2):  $\theta_{c-a} < (150 - 50)/34.5 - 2.7/4$   
 $< 2.22$

Therefore, to satisfy both expressions, the required heat-sink must have a thermal resistance less than  $2.17^{\circ}\text{C}/\text{W}$ .

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





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