

**SANYO****STK400-010****3ch AF Power Amplifier (Split Power Supply)  
(10W + 10W + 10W min, THD = 0.4%)****Overview**

The STK400-010 is an audio power amplifier IC for multi-channel speaker applications. It comprises three 10W channels (left, right and center) in a single package. It is fully pin compatible with the 3-channel output devices (STK400-×00 series) and 2-channel output devices (STK401-×00 series). In addition, it supports 6/3Ω output load impedance.

**Features**

- Pin compatible with the 3-channel output devices (STK400-×00 series) and 2-channel output devices (STK401-×00 series)
- Output load impedance  $R_L=6/3\Omega$  supported
- Pin configuration grouped into individual blocks of inputs, outputs and supply lines to minimize the adverse effects of pattern layout on operating characteristics.
- Few external components

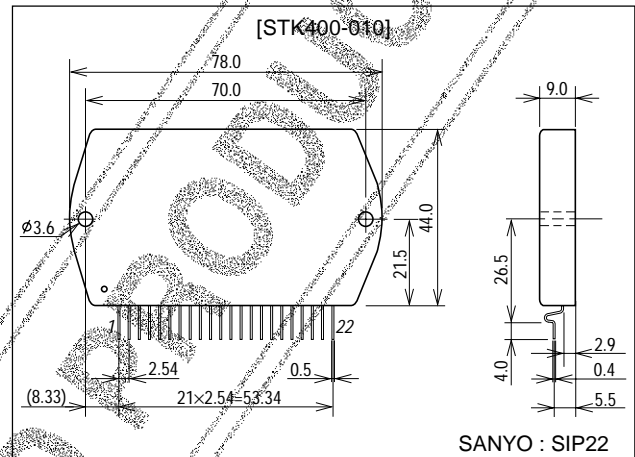
**Specifications****Maximum Ratings** at  $T_a = 25^\circ\text{C}$ 

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	$V_{CC\text{ max}}$		$\pm 26$	V
Thermal resistance	$\theta_{j-c}$	Per power transistor	2.6	$^\circ\text{C/W}$
Junction temperature	$T_j$		150	$^\circ\text{C}$
Operating temperature	$T_o$		125	$^\circ\text{C}$
Storage temperature	$T_{stg}$		-30 to +125	$^\circ\text{C}$
Available time for load short-circuit	$t_s$	$V_{CC}=\pm 17\text{V}$ , $R_L=6\Omega$ , $f=50\text{Hz}$ , $P_O=10\text{W}$	1	s

**Package Dimensions**

unit:mm

4086A



■ Any and all SANYO products described or contained herein do not have specifications that can handle applications that require extremely high levels of reliability, such as life-support systems, aircraft's control systems, or other applications whose failure can be reasonably expected to result in serious physical and/or material damage. Consult with your SANYO representative nearest you before using any SANYO products described or contained herein in such applications.

■ SANYO assumes no responsibility for equipment failures that result from using products at values that exceed, even momentarily, rated values (such as maximum ratings, operating condition ranges, or other parameters) listed in products specifications of any and all SANYO products described or contained herein.

**SANYO Electric Co.,Ltd. Semiconductor Company**

TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110-8534 JAPAN

# STK400-010

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	Ratings			Unit
			min	typ	max	
Output power	$P_{O1}$	$V_{CC} = \pm 17\text{V}$ , $f = 20\text{Hz}$ to $20\text{kHz}$ , $\text{THD} = 0.4\%$	10	15		W
	$P_{O2}$	$V_{CC} = \pm 14\text{V}$ , $f = 1\text{kHz}$ , $\text{THD} = 1.0\%$ , $R_L = 3\Omega$	10	15		W
Total harmonic distortion	THD1	$V_{CC} = \pm 17\text{V}$ , $f = 20\text{Hz}$ to $20\text{kHz}$ , $P_O = 1.0\text{W}$			0.4	%
	THD2	$V_{CC} = \pm 17\text{V}$ , $f = 1\text{kHz}$ , $P_O = 5.0\text{W}$		0.02		%
Frequency response	$f_L, f_H$	$V_{CC} = \pm 17\text{V}$ , $P_O = 1.0\text{W}$ , $_{-3}^{+0}\text{dB}$		20 to 50k		Hz
Input impedance	$r_i$	$V_{CC} = \pm 17\text{V}$ , $f = 1\text{kHz}$ , $P_O = 1.0\text{W}$		55		$k\Omega$
Output noise voltage	$V_{NO}$	$V_{CC} = \pm 22\text{V}$ , $R_g = 10k\Omega$			1.2	mVrms
Quiescent current	$I_{CCO}$	$V_{CC} = \pm 22\text{V}$	30	90	150	mA
Neutral voltage	$V_N$	$V_{CC} = \pm 22\text{V}$	-70	0	+70	mV

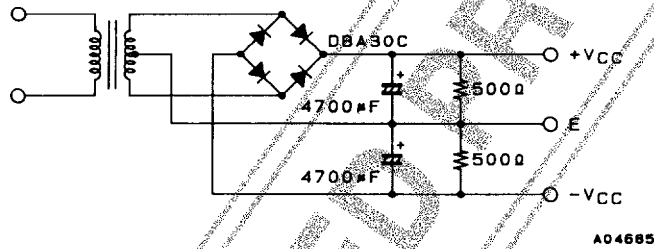
Note.

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

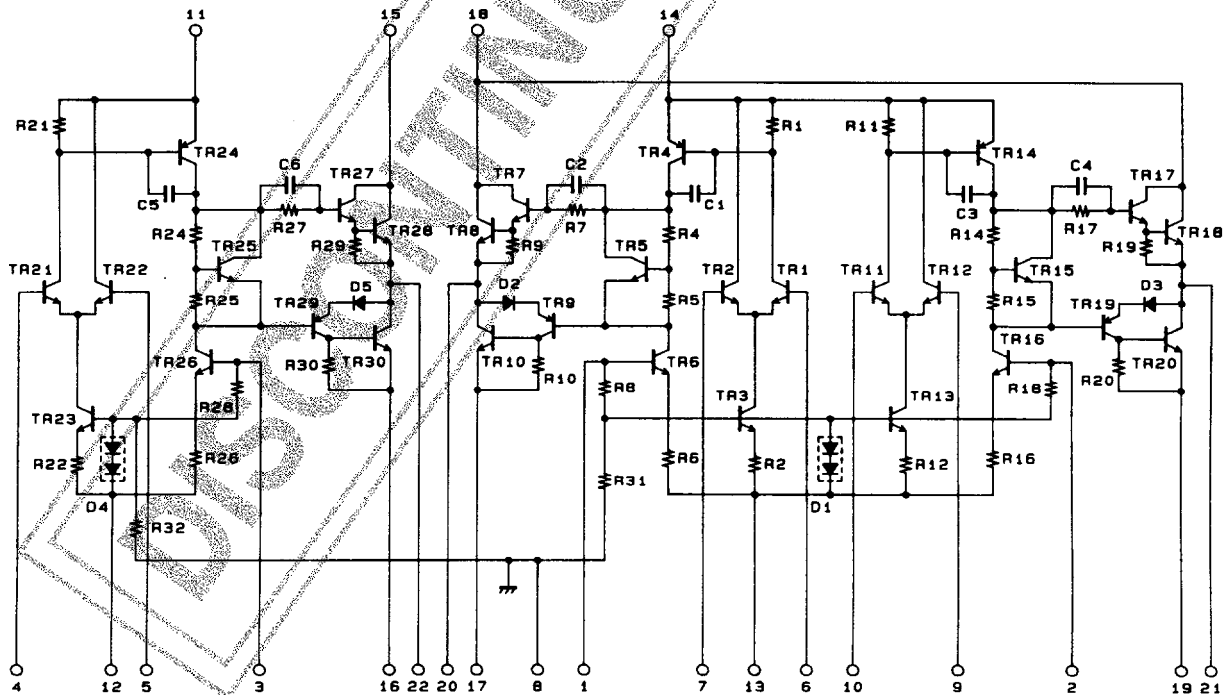
Available time for load short-circuit and output noise voltage are measured using the transformer supply specified below.

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.

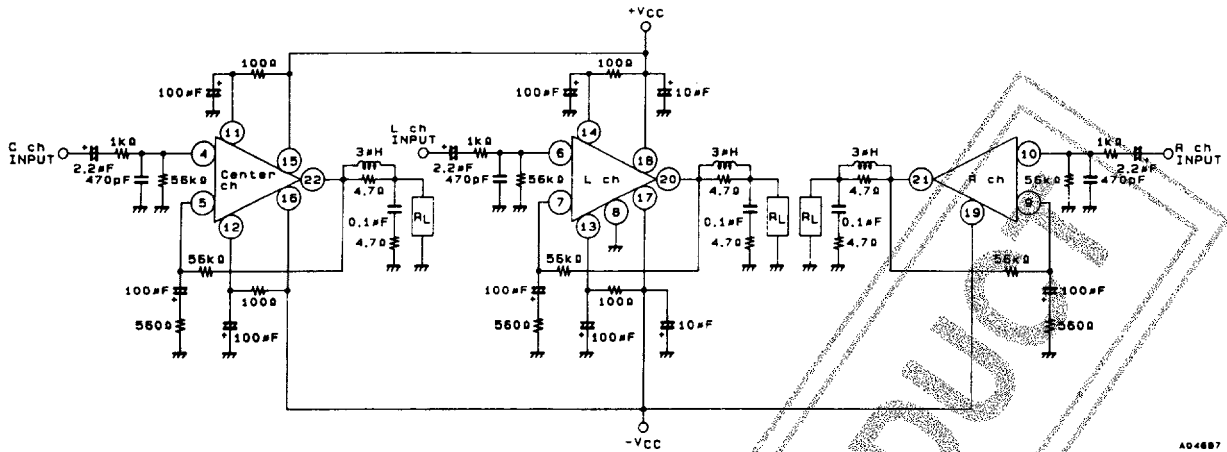
## Specified Transformer Supply (RP-22 or Equivalent)



## Equivalent Circuit



Sample Application Circuit



Series Configuration

These devices form a series of pin-compatible devices with different number of output channels, output ratings and total harmonic distortion. Some of these devices are under development. Contact your Sanyo sales representative if you require more detailed information.

STK400-000, STK400-200 series (3-channel, same output rating)				STK401-000, STK401-200 series (2-channel)				Supply voltage [V]1					
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> max1	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 ratings)				Supply voltage [V]1					
Type No.	THD [%]	Type No.	THD [%]	Rated output	V <sub>CC</sub> max1	V <sub>CC</sub> max1	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
				Lch, Rch	15W	-	±29.0	±20.0	±16.0
STK400-460	0.4	STK400-660	0.08	Cch	35W	-	±41.0	±28.0	±23.0
				Lch, Rch	15W	-	±29.0	±20.0	±16.0
STK400-470	0.4	STK400-670	0.08	Cch	40W	-	±44.0	±30.0	±24.0
				Lch, Rch	20W	-	±34.0	±23.0	±19.0
STK400-480	0.4	STK400-680	0.08	Cch	45W	-	±45.0	±31.0	±25.0
				Lch, Rch	20W	-	±34.0	±23.0	±19.0
STK400-490	0.4	STK400-690	0.08	Cch	50W	-	±47.0	±32.0	±26.0
				Lch, Rch	25W	-	±36.0	±25.0	±21.0
STK400-500	0.4	STK400-700	0.08	Cch	60W	-	±51.0	±35.0	±27.0
				Lch, Rch	30W	-	±39.0	±26.0	±22.0
STK400-510	0.4	STK400-710	0.08	Cch	70W	±56.0	-	±38.0	-
				Lch, Rch	35W	-	±41.0	±28.0	±23.0
STK400-520	0.4	STK400-720	0.08	Cch	80W	±61.0	-	±42.0	-
				Lch, Rch	40W	-	±44.0	±30.0	±24.0
STK400-530	0.4	STK400-730	0.08	Cch	100W	±65.0	-	±45.0	-
				Lch, Rch	50W	-	±47.0	±32.0	±26.0

1. 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 dissipate the STK400-010 device total power dissipation,  $P_d$ , is determined as follows :

Condition 1: IC substrate temperature not to exceed 125°C  
 $P_d \times \theta_{c-a} + T_a < 125^\circ\text{C}$  ..... (1)

Where  $T_a$  is the guaranteed maximum ambient temperature.

Condition 2: Power transistor junction temperature,  $T_j$ , not to exceed 150°C  
 $P_d \times \theta_{c-a} + P_d/N \times \theta_{j-c} + T_a < 150^\circ\text{C}$  ..... (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.

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

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

The heatsink required must have a thermal resistance that simultaneously satisfied 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 STK400-010  $V_{CC} = \pm 17\text{V}$  and  $R_L = 6\Omega$ , for a continuous sine wave signal, is a maximum of 29.8W, as shown in the "Pd-P<sub>O</sub>" characteristics graph.

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

$$P_d = 16.8\text{W} \text{ [for } (1/10) \times P_{O \text{ max}} = 1\text{W}]$$

The STK400-010 has 6 power transistors, and the thermal resistance per transistor,  $\theta_{j-c}$ , is 2.6°C/W. If the guaranteed maximum ambient temperature,  $T_a$ , is 50°C, then the required heatsink thermal resistance,  $\theta_{c-a}$ , is :

$$\text{From expression (1)'} : \theta_{c-a} < (125 - 50) / 16.8 < 4.46$$

$$\text{From expression (2)'} : \theta_{c-a} < (150 - 50) / 16.8 - 2.6/6 < 5.52$$

Therefore, to satisfy both expressions, the required heatsink must have a thermal resistance less than 4.46°C/W.

Similarly, when STK400-010  $V_{CC} = \pm 14\text{V}$  and  $R_L = 3\Omega$ ,

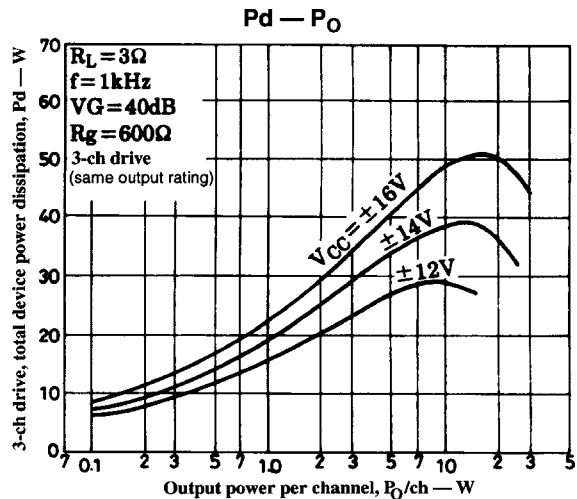
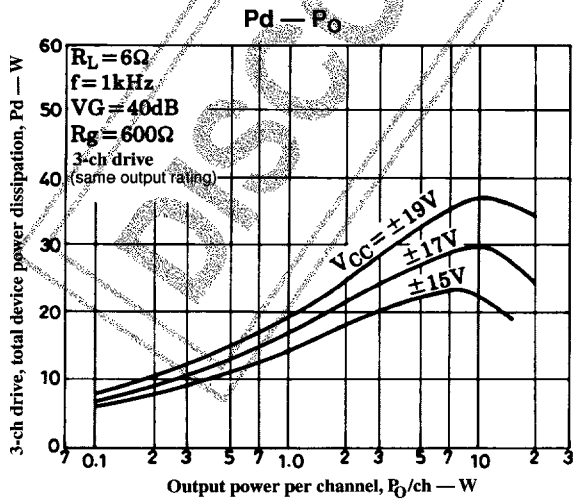
$$P_d = 18.9\text{W} \text{ [for } (1/10) \times P_{O \text{ max}} = 1\text{W}]$$

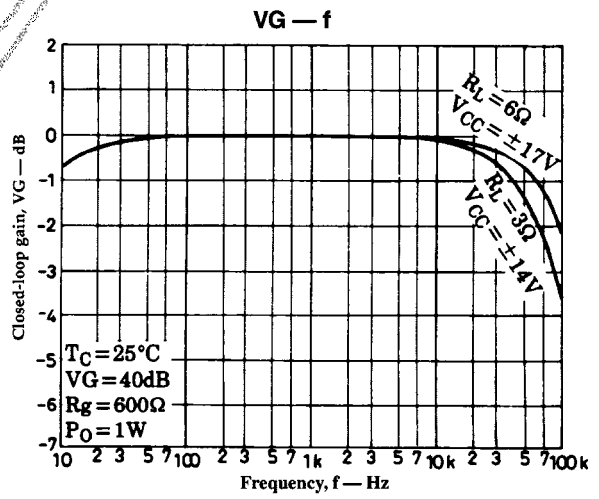
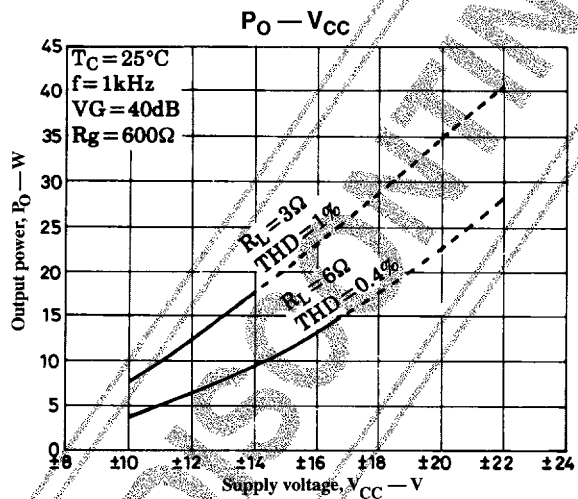
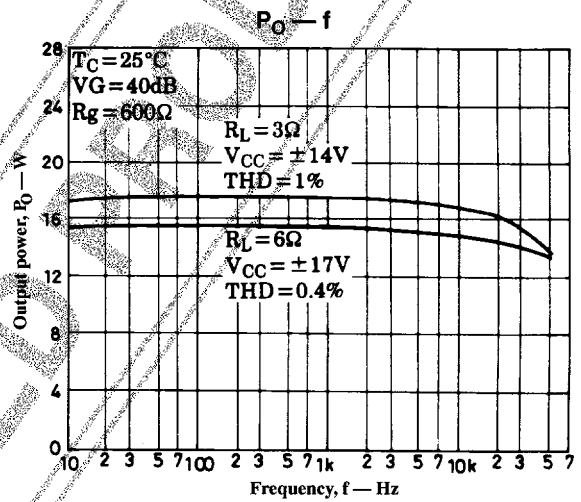
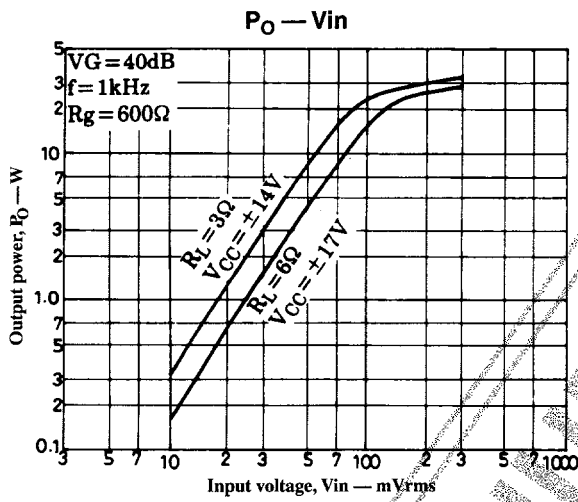
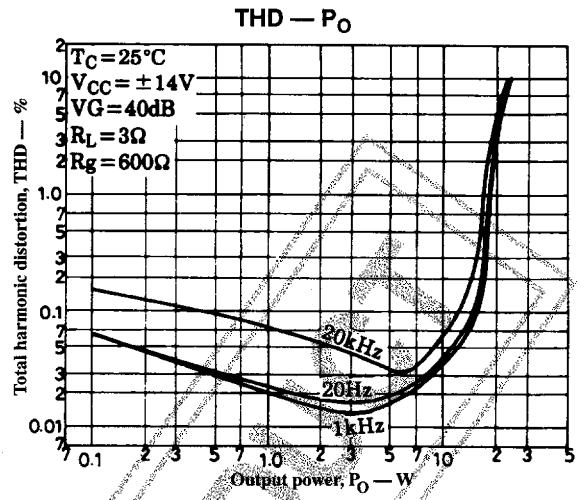
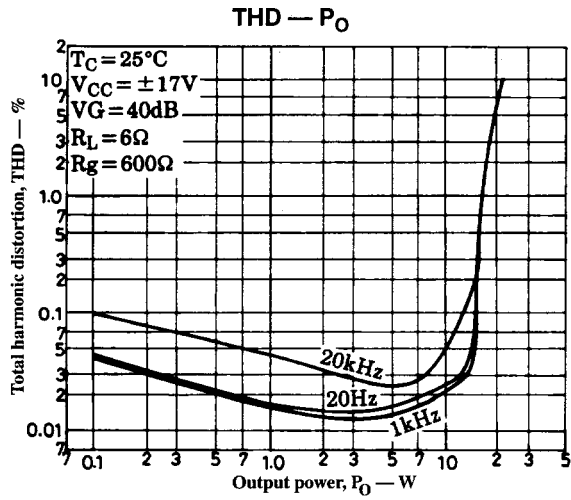
$$\text{From expression (1)'} : \theta_{c-a} < (125 - 50) / 18.9 < 3.97$$

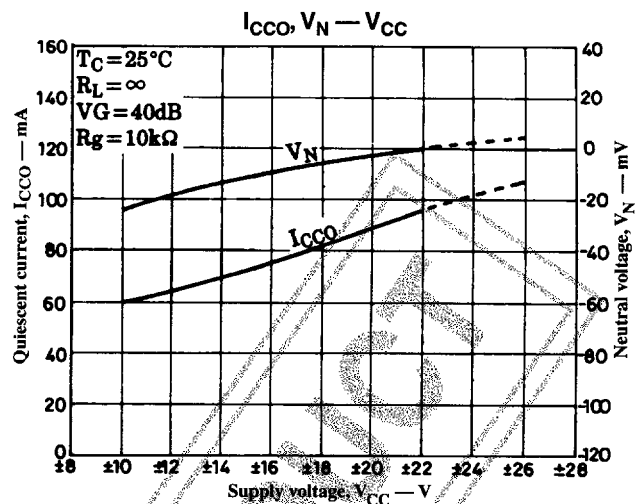
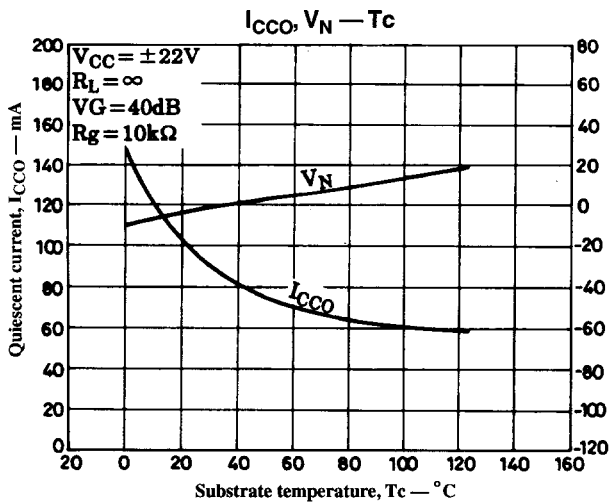
$$\text{From expression (2)'} : \theta_{c-a} < (150 - 50) / 18.9 - 2.6/6 < 4.86$$

Therefore, to satisfy both expressions, the required heatsink must have a thermal resistance less than 3.97°C/W.

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







- Specifications of any and all SANYO products described or contained herein stipulate the performance, characteristics, and functions of the described products in the independent state, and are not guarantees of the performance, characteristics, and functions of the described products as mounted in the customer's products or equipment. To verify symptoms and states that cannot be evaluated in an independent device, the customer should always evaluate and test devices mounted in the customer's products or equipment.
- SANYO Electric Co., Ltd. strives to supply high-quality high-reliability products. However, any and all semiconductor products fail with some probability. It is possible that these probabilistic failures could give rise to accidents or events that could endanger human lives, that could give rise to smoke or fire, or that could cause damage to other property. When designing equipment, adopt safety measures so that these kinds of accidents or events cannot occur. Such measures include but are not limited to protective circuits and error prevention circuits for safe design, redundant design, and structural design.
- In the event that any or all SANYO products (including technical data, services) described or contained herein are controlled under any of applicable local export control laws and regulations, such products must not be exported without obtaining the export license from the authorities concerned in accordance with the above law.
- No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, or any information storage or retrieval system, or otherwise, without the prior written permission of SANYO Electric Co., Ltd.
- Any and all information described or contained herein are subject to change without notice due to product/technology improvement, etc. When designing equipment, refer to the "Delivery Specification" for the SANYO product that you intend to use.
- Information (including circuit diagrams and circuit parameters) herein is for example only; it is not guaranteed for volume production. SANYO believes information herein is accurate and reliable, but no guarantees are made or implied regarding its use or any infringements of intellectual property rights or other rights of third parties.

This catalog provides information as of September, 1999. Specifications and information herein are subject to change without notice.