

**SANYO****STK401-140****2ch AF Power Amplifier (Split Power Supply)  
(120W + 120W min, THD = 0.4%)****Overview**

A major feature of Sanyo thick-film power amplifier ICs is that all ICs within a given product series are pin compatible. This allows users to construct a product line of amplifiers with differing power output capacities using the same PCB design by simply changing the hybrid IC used. Sanyo has now developed a new series that expands this intra-series pin compatibility to also provide compatibility between certain series. Adoption of the ICs in this new series also allows the development of both two- and three-channel amplifiers on the same PCB. Furthermore, this new series supports 3 and 6  $\Omega$  drive to handle the recent trend toward lower impedance speakers.

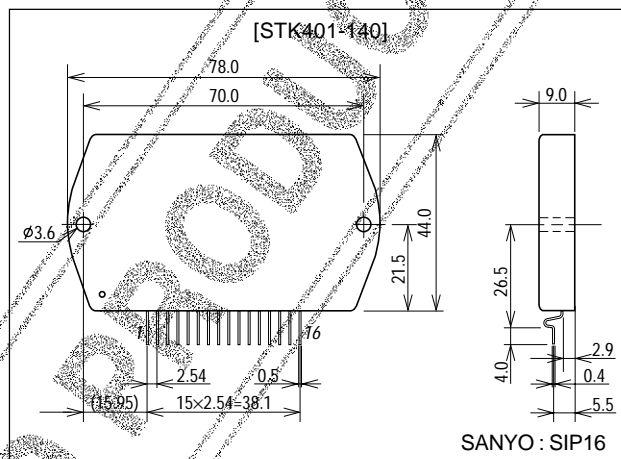
**Features**

- Pin compatibility  
STK400-000 series (three channels/single package)  
↓  
STK401-000 series (two channels/single package)
- Support for output load impedances of 3 or 6  $\Omega$
- New pin assignment  
The new pin assignment groups the input, output, and power supply systems into separate blocks. This minimizes characteristic degradation due to problems with the PCB pattern layout.
- Minimal number of required external components  
The bootstrap resistor and capacitor required in earlier series are no longer necessary.

**Package Dimensions**

unit:mm

4029

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

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	$V_{CC\text{ max}}$		$\pm 74$	V
Thermal resistance	$\theta_{j-c}$	Per power transistor	1.0	$^\circ\text{C/W}$
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	$t_s$	$V_{CC}=\pm 51\text{V}$ , $R_L=6\Omega$ , $f=50\text{Hz}$ , $P_O=120\text{W}$	0.5	s

■ 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

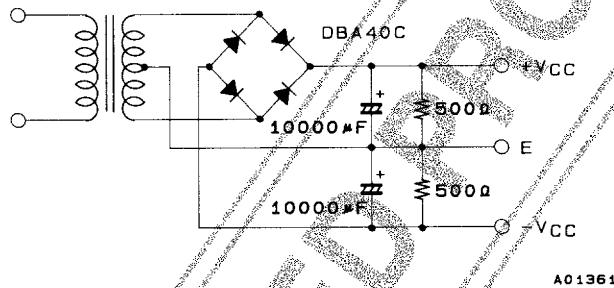
# STK401-140

**Operating Characteristics** at  $T_a = 25^\circ\text{C}$ ,  $R_L=6\Omega$ ,  $R_g=600\Omega$ ,  $V_G=40\text{dB}$ , and with a noninductive load ( $R_L$ )

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Quiescent current	$I_{CCO}$	$V_{CC}=\pm 61\text{V}$	20	60	100	mA
Output power	$P_O$	$V_{CC}=\pm 51\text{V}$ , $f=20\text{Hz}$ to $20\text{kHz}$ , $\text{THD}=0.4\%$	120	140		W
Total harmonic distortion	THD1	$V_{CC}=\pm 51\text{V}$ , $f=20\text{Hz}$ to $20\text{kHz}$ , $P_O=1.0\text{W}$			0.4	%
	THD2	$V_{CC}=\pm 51\text{V}$ , $f=1\text{kHz}$ , $P_O=30\text{W}$		0.02		%
Frequency characteristics	$f_L, f_H$	$V_{CC}=\pm 51\text{V}$ , $P_O=1.0\text{W}$ , $+3$ dB		20 to 50k		Hz
Input impedance	$r_i$	$V_{CC}=\pm 51\text{V}$ , $f=1\text{kHz}$ , $P_O=1.0\text{W}$		56		k $\Omega$
Output noise voltage	$V_{NO}$	$V_{CC}=\pm 61\text{V}$ , $R_g=10\text{k}\Omega$			1.2	mVrms
Neutral voltage	$V_N$	$V_{CC}=\pm 61\text{V}$	-70	0	+70	mV

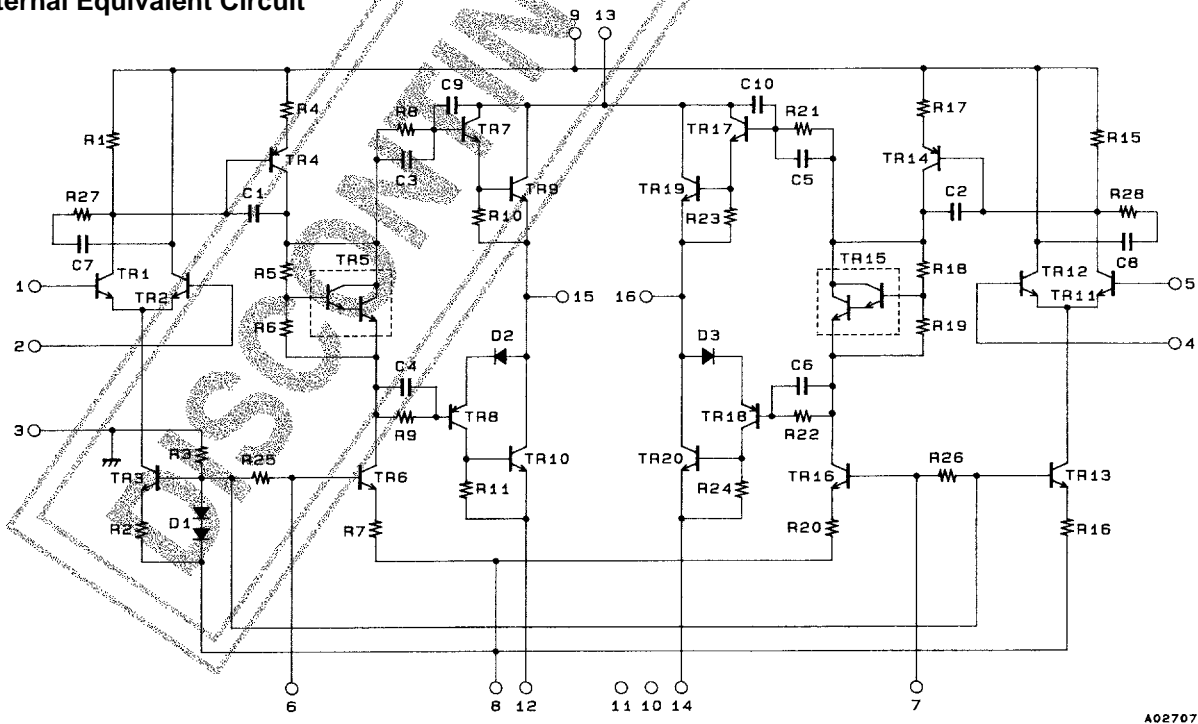
**Note.**

1. Use a rated power supply for the test unless otherwise noted.
2. Use the specified transformer power supply shown in the figure when measuring the available time for load shorted and the output noise voltage.
3. The output noise voltage is the peak value measured with an averaging rms scale volt meter (VTVM). A 50 Hz AC stabilized power supply should be used to eliminate the effects fo AC primary line flicker noise when an AC power supply is used.



**Specified Transformer Power Supply (MG-250 equivalent)**

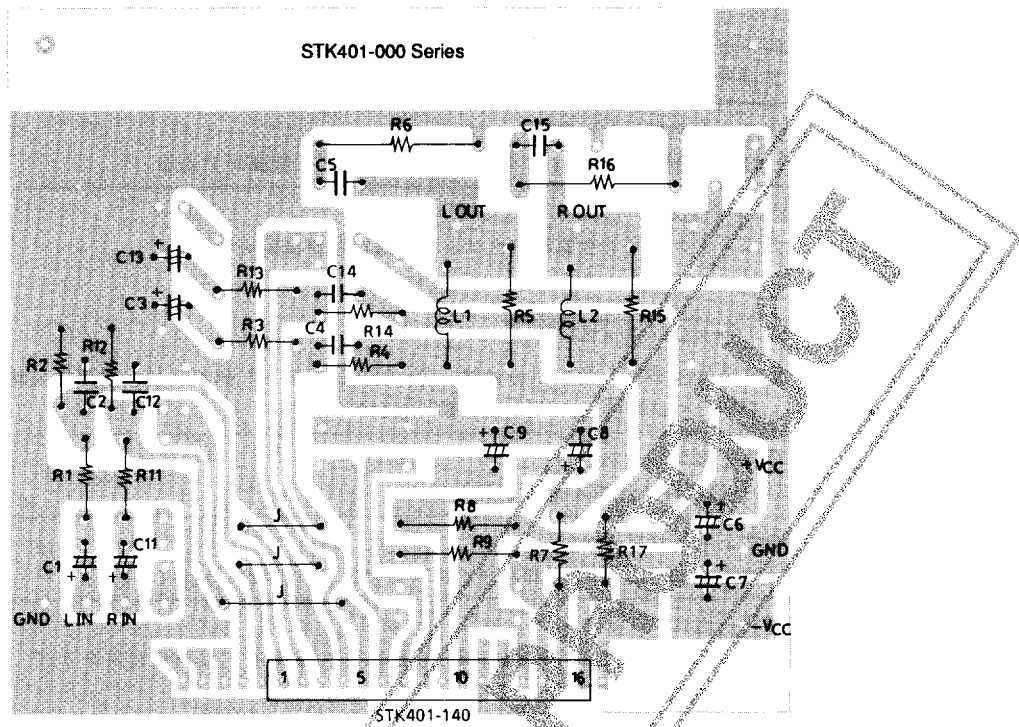
**Internal Equivalent Circuit**



A02707

# STK401-140

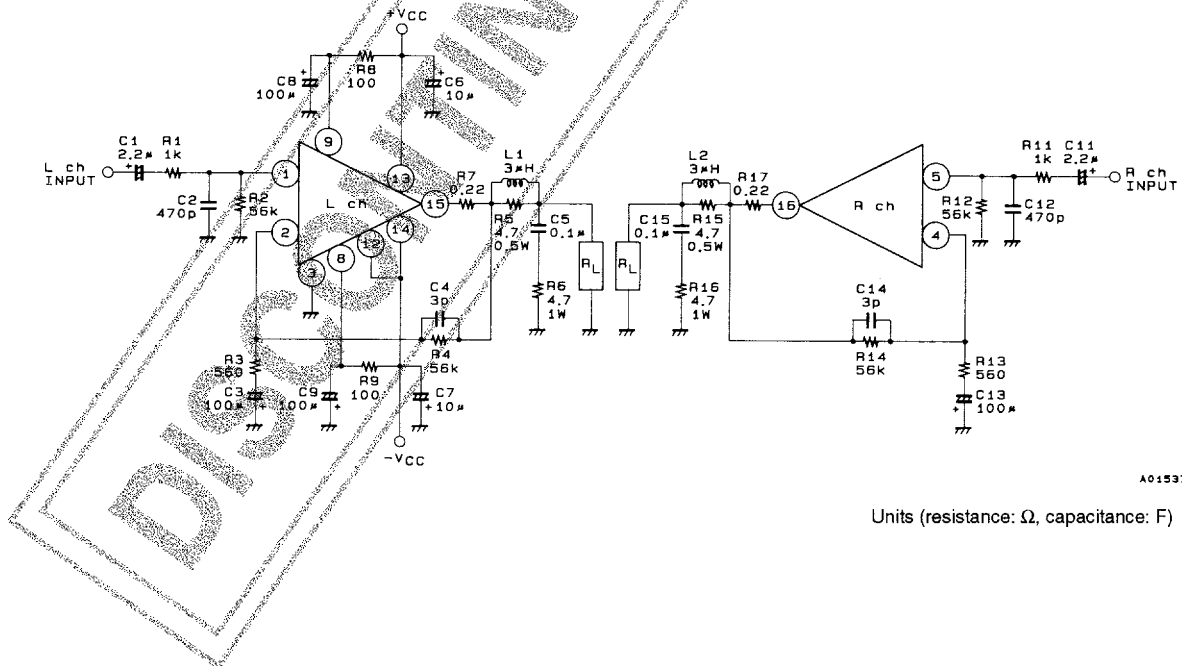
## Sample PCB Pattern used with either Two- or Three-Channel Amplifiers



Copper (Cu) foil surface

Pin 1 in the STK401-000 series corresponds to pin 6 in the STK400-000 series.

## Sample Application Circuit

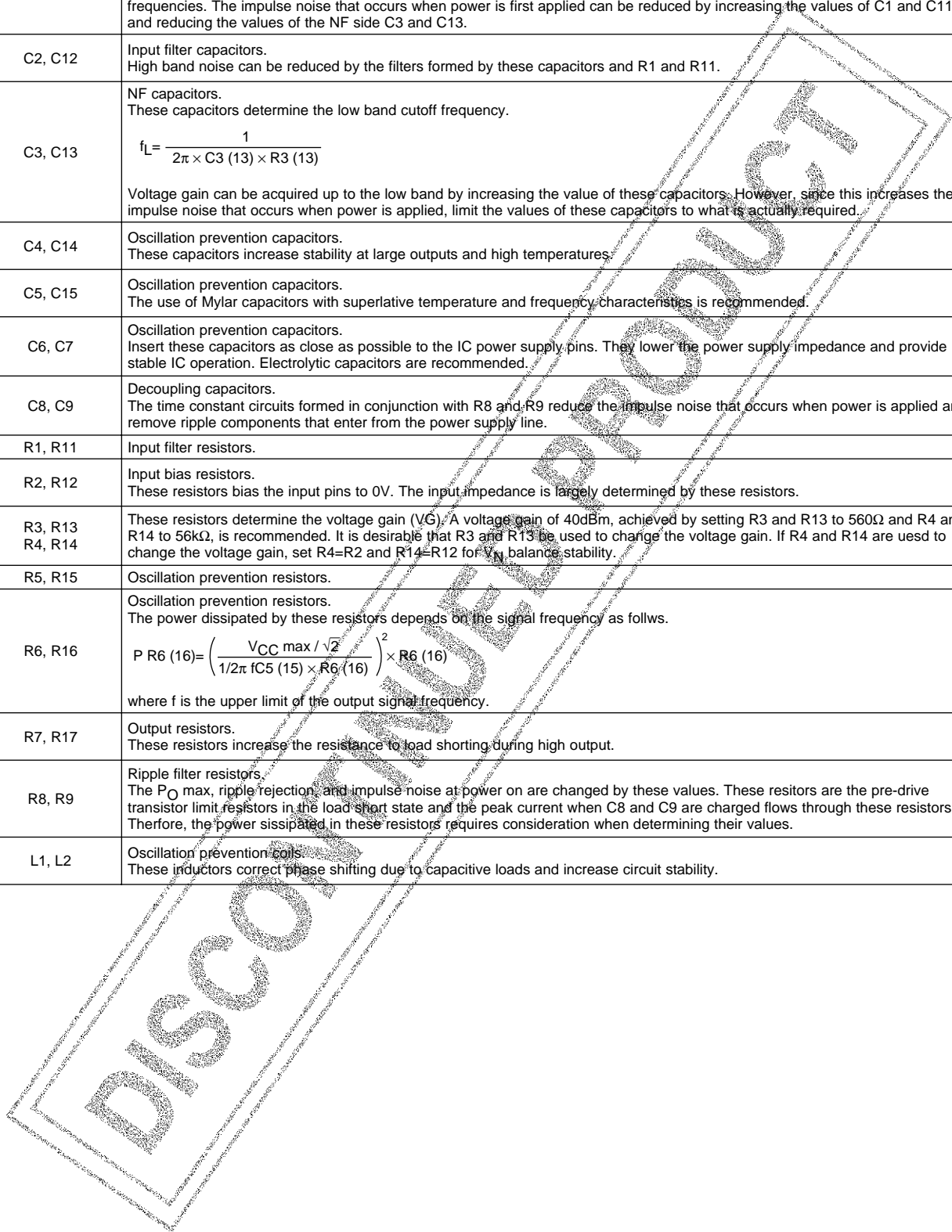


Units (resistance:  $\Omega$ , capacitance: F)

A01537

External Component Descriptions

Item	Function
C1, C11	Input coupling capacitors. Used to block the DC component. Reducing the reactance value of these capacitors can reduce output noise, since output noise is exacerbated due to the 1/f noise signal source resistance dependencies if these capacitors have a large reactances at low frequencies. The impulse noise that occurs when power is first applied can be reduced by increasing the values of C1 and C11, and reducing the values of the NF side C3 and C13.
C2, C12	Input filter capacitors. High band noise can be reduced by the filters formed by these capacitors and R1 and R11.
C3, C13	NF capacitors. These capacitors determine the low band cutoff frequency. $f_L = \frac{1}{2\pi \times C3(13) \times R3(13)}$ Voltage gain can be acquired up to the low band by increasing the value of these capacitors. However, since this increases the impulse noise that occurs when power is applied, limit the values of these capacitors to what is actually required.
C4, C14	Oscillation prevention capacitors. These capacitors increase stability at large outputs and high temperatures.
C5, C15	Oscillation prevention capacitors. The use of Mylar capacitors with superlative temperature and frequency characteristics is recommended.
C6, C7	Oscillation prevention capacitors. Insert these capacitors as close as possible to the IC power supply pins. They lower the power supply impedance and provide stable IC operation. Electrolytic capacitors are recommended.
C8, C9	Decoupling capacitors. The time constant circuits formed in conjunction with R8 and R9 reduce the impulse noise that occurs when power is applied and remove ripple components that enter from the power supply line.
R1, R11	Input filter resistors.
R2, R12	Input bias resistors. These resistors bias the input pins to 0V. The input impedance is largely determined by these resistors.
R3, R13 R4, R14	These resistors determine the voltage gain (VG). A voltage gain of 40dBm, achieved by setting R3 and R13 to 560Ω and R4 and R14 to 56kΩ, is recommended. It is desirable that R3 and R13 be used to change the voltage gain. If R4 and R14 are used to change the voltage gain, set R4=R2 and R14=R12 for V <sub>IN</sub> balance stability.
R5, R15	Oscillation prevention resistors.
R6, R16	Oscillation prevention resistors. The power dissipated by these resistors depends on the signal frequency as follows. $P_{R6(16)} = \left( \frac{V_{CC \max} / \sqrt{2}}{1/2\pi f C5(15) \times R6(16)} \right)^2 \times R6(16)$ where f is the upper limit of the output signal frequency.
R7, R17	Output resistors. These resistors increase the resistance to load shorting during high output.
R8, R9	Ripple filter resistors. The P <sub>O</sub> max, ripple rejection, and impulse noise at power on are changed by these values. These resistors are the pre-drive transistor limit resistors in the load short state and the peak current when C8 and C9 are charged flows through these resistors. Therefore, the power dissipated in these resistors requires consideration when determining their values.
L1, L2	Oscillation prevention coils. These inductors correct phase shifting due to capacitive loads and increase circuit stability.



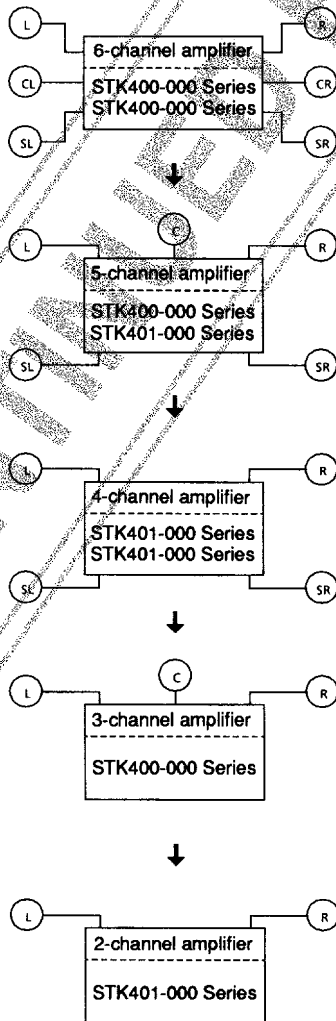
# STK401-140

## Series Configuration

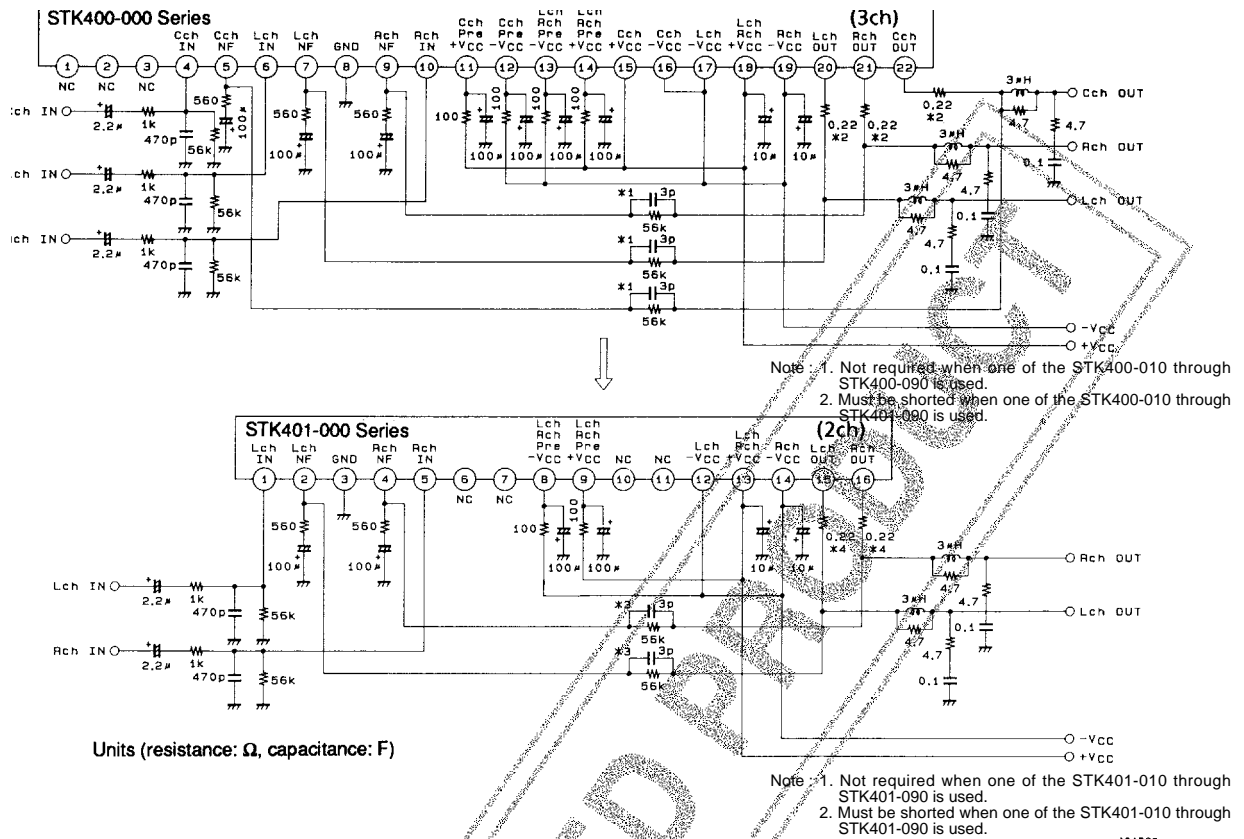
3-channel amplifiers type No.	Rated output	2-channel amplifiers type No.	Rated output	THD [%] f=20Hz to 20kHz	Power supply voltage [V]			
					V <sub>CC</sub> max1	V <sub>CC</sub> max2	V <sub>CC</sub> 1	V <sub>CC</sub> 2
STK400-010	10W × 3	STK401-010	10W × 2	0.4	–	±26	±17.5	±14
STK400-020	15W × 3	STK401-020	15W × 2		–	±29	±20	±16
STK400-030	20W × 3	STK401-030	20W × 2		–	±34	±23	±19
STK400-040	25W × 3	STK401-040	25W × 2		–	±36	±25	±21
STK400-050	30W × 3	STK401-050	30W × 2		–	±39	±26	±22
STK400-060	35W × 3	STK401-060	35W × 2		–	±41	±28	±23
STK400-070	40W × 3	STK401-070	40W × 2		–	±44	±30	±24
STK400-080	45W × 3	STK401-080	45W × 2		–	±45	±31	±25
STK400-090	50W × 3	STK401-090	50W × 2		–	±47	±32	±26
STK400-100	60W × 3	STK401-100	60W × 2		–	±51	±35	±27
STK400-110	70W × 3	STK401-110	70W × 2		±56.0	–	±38	–
–	–	STK401-120	80W × 2		±61.0	–	±42	–
–	–	STK401-130	100W × 2		±65.0	–	±45	–
–	–	STK401-140	120W × 2		±74.0	–	±51	–

Note : V<sub>CC</sub> max1 When R<sub>L</sub>=6Ω  
 V<sub>CC</sub> max2 When R<sub>L</sub>=between 3 and 6Ω  
 V<sub>CC</sub>1 When R<sub>L</sub>=6Ω  
 V<sub>CC</sub>2 When R<sub>L</sub>=3Ω

## End Product Series Design Example Using the Same PCB



External Circuit Diagram



Thermal Design Example

The thermal resistance  $\theta_{c-a}$  of the required heat sink for a total case-internal power dissipation  $P_d$  for the STK401-140 can be derived as follows :

Condition 1 : The IC case temperature  $T_c$  must not exceed  $125^\circ\text{C}$   
 $P_d \times \theta_{c-a} + T_a < 125^\circ\text{C}$  ..... (1)  
 $T_a$  : Set guaranteed ambient temperature

Condition 2 : The individual power transistor junction temperatures must not exceed  $150^\circ\text{C}$ .  
 $P_d \times \theta_{c-a} + P_d / N \times \theta_{j-c} + T_a < 150^\circ\text{C}$  ..... (2)  
 $N$  : Number of power transistors  
 $\theta_{j-c}$  : Thermal resistance per power transistor

However, the power dissipated by the power transistors ( $P_d$ ) is divided evenly among the  $N$  transistors.

Solving equations (1) and (2) for  $\theta_{c-a}$  gives :  
 $\theta_{c-a} < (125 - T_a) / P_d$  ..... (1)'  
 $\theta_{c-a} < (150 - T_a) / P_d - \theta_{j-c} / N$  ..... (2)'

A value that satisfies these two equations will be the required heat sink thermal resistance. The required heat sink thermal resistance can be derived from formulas (1)' and (2)' once the following specifications have been determined:

- Power supply voltage :  $V_{CC}$
- Load resistance :  $R_L$
- Guaranteed ambient temperature :  $T_a$

When the STK401-140  $V_{CC}$  is  $\pm 51\text{V}$  and  $R_L$  is  $6\Omega$ , the case-internal total power dissipation for a continuous sine wave signal will have a maximum value of  $177\text{W}$ , as shown in Figure 1. One tenth of the  $P_O$  max for this kind of continuous signal is generally used as an estimate of power dissipation for actual music signals, although this may vary somewhat depending on safety standards.  
 $P_d = 107\text{W}$  (When  $1/10 P_O$  max is  $12\text{W}$ )

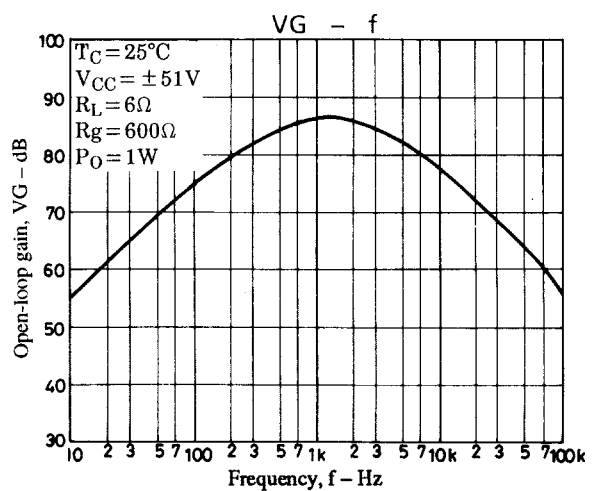
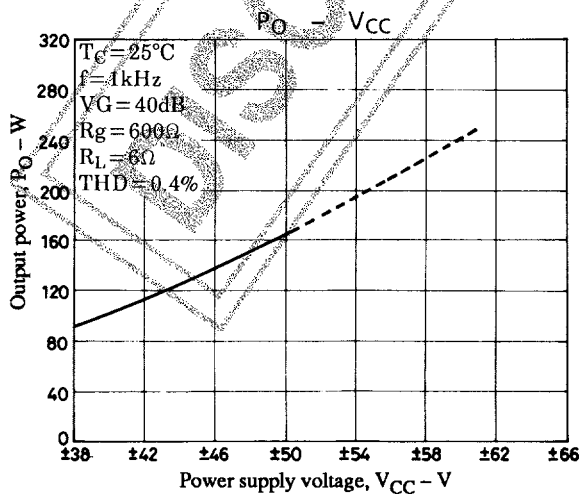
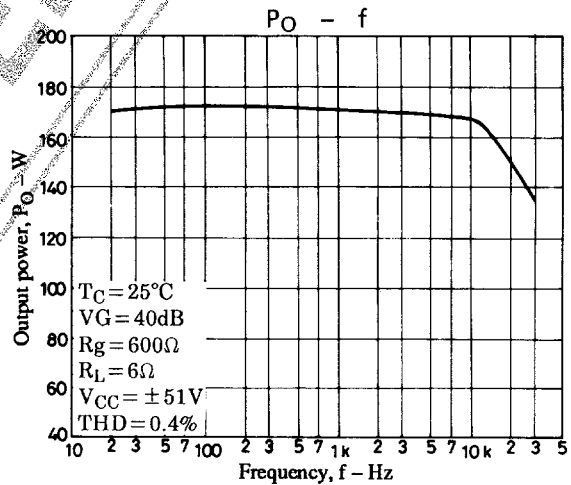
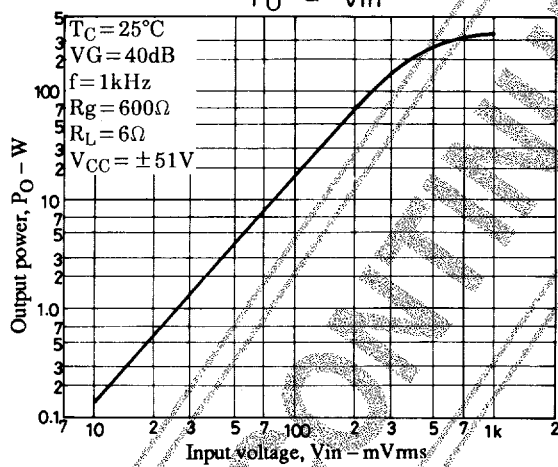
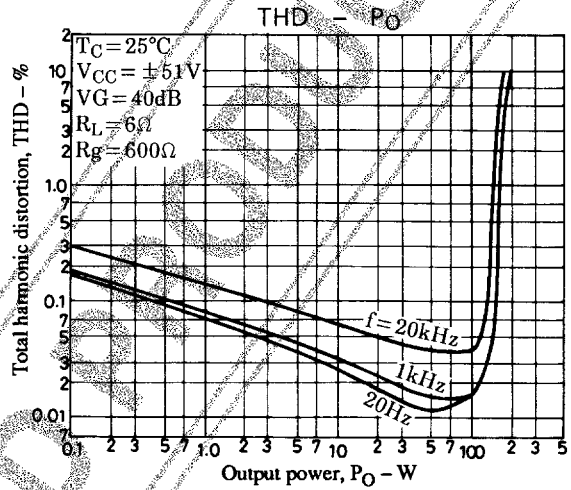
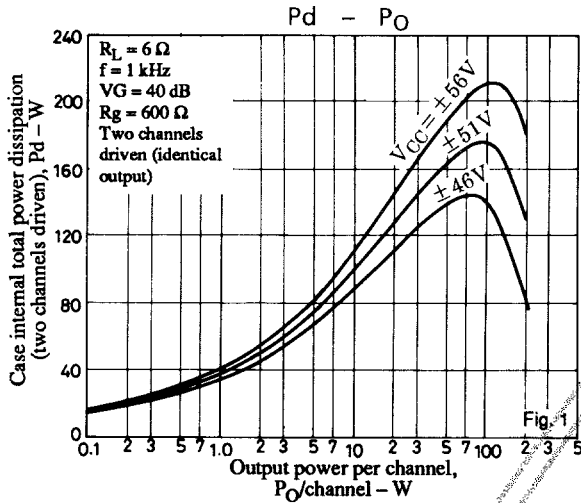
# STK401-140

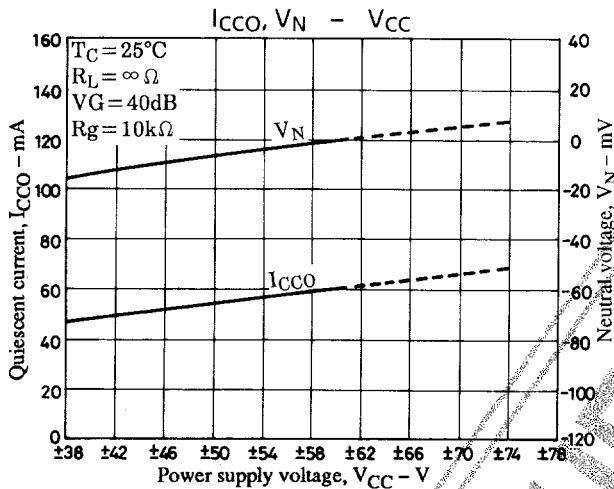
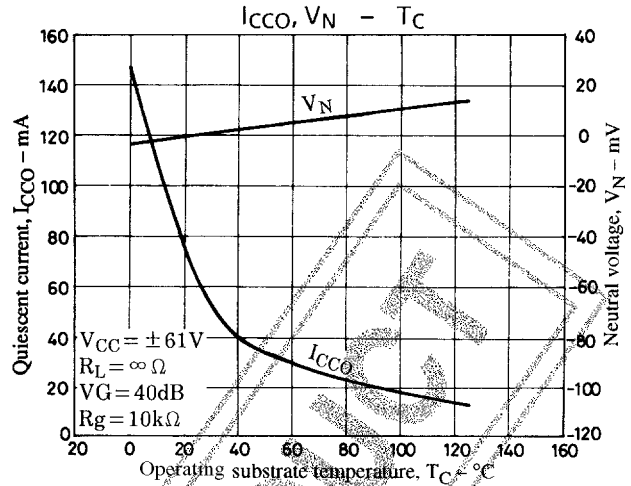
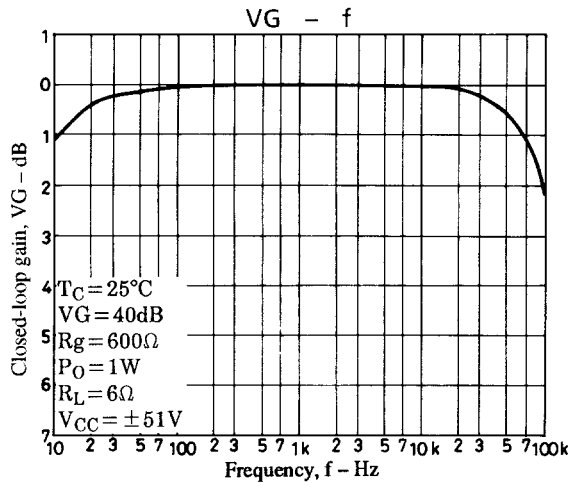
The STK401-140 has four power transistors and the thermal resistance per transistor is  $1.0^{\circ}\text{C}/\text{W}$ . If the guaranteed ambient temperature  $T_a$  is  $50^{\circ}\text{C}$  then the required heat sink thermal resistance can be calculated as follows.

$$\text{From formula (1)'} : \theta_{c-a} < (125-50)/107 < 0.70$$

$$\text{From formula (2)'} : \theta_{c-a} < (150-50)/107-1.0/4 < 0.68$$

Therefore the value  $0.68^{\circ}\text{C}/\text{W}$ , which satisfies both of these formulas, is the required heat sink thermal resistance. Note that this thermal design example assumes a rated power supply and the actual thermal design must be confirmed in the end product itself.





- 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.