



# STK404-120

## One-Channel Class AB Audio Power Amplifier IC 80 W

### Overview

The STK404-000 series products are audio power amplifier hybrid ICs that consist of optimally-designed discrete component power amplifier circuits that have been miniaturized using SANYO's unique insulated metal substrate technology (IMST). The adoption of a newly-developed low thermal resistance substrate allows this series of devices to be provided in miniature packages significantly more compact than earlier Sanyo products with similar specifications.

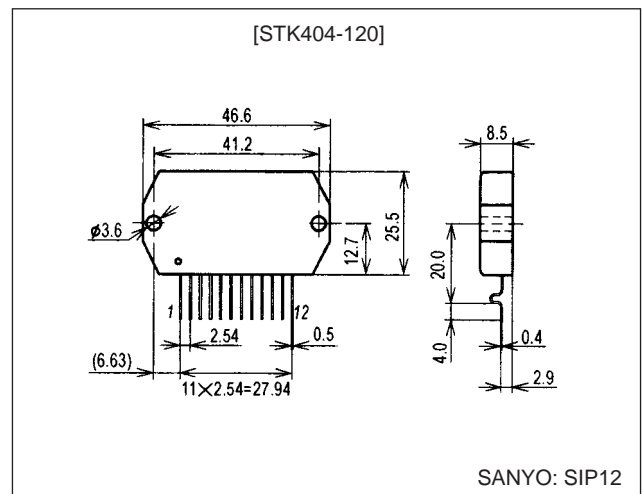
### Features

- Series of pin compatible power amplifiers ranging from 45 W to 180 W (10%/1 kHz) devices. The same printed circuit board can be used depending on the output power grade.
- Miniature packages
  - 30 W to 40 W (THD = 0.4%,  $f = 20$  Hz to 20 kHz); 44.0 mm × 25.5 mm × 8.5 mm \*
  - 50 W to 80 W (THD = 0.4%,  $f = 20$  Hz to 20 kHz); 46.6 mm × 25.5 mm × 8.5 mm \*
  - 100 W to 120 W (THD = 0.4%,  $f = 20$  Hz to 20 kHz); 59.2 mm × 25.5 mm × 8.5 mm \*
- \*: Not including the pins.
- Output load impedance:  $R_L = 6 \Omega$
- Allowable load shorted time: 0.3 seconds
- Built-in thermal protection circuit
- Supports the use of standby, muting, and load shorting protection circuits.

### Package Dimensions

unit: mm

#### 4199-SIP12



SANYO: SIP12

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

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

## STK404-120

### Series Organization

These products are organized as a series based on their output capacity.

Item	Type No.						
	STK404-050	STK404-070	STK404-090	STK404-100	STK404-120	STK404-130	STK404-140
Output 1 (0.4%/20 Hz to 20 kHz)	30 W	40 W	50 W	60 W	80 W	100 W	120 W
Output 2 (10%/1 kHz)	45 W	60 W	80 W	90 W	120 W	150 W	180 W
Maximum supply voltage (6 Ω)	±37 V	±43 V	±46 V	±51 V	±59 V	±64 V	±73 V
Recommended supply voltage (6 Ω)	±26 V	±30 V	±32 V	±35 V	±41 V	±45 V	±51 V
Remarks	—		Built-in thermal protection circuit				
Package	44.0 mm × 25.5 mm × 8.5 mm		46.6 mm × 25.5 mm × 8.5 mm		59.2 mm × 25.5 mm × 8.5 mm		

### Specifications

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

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage (No signal)	$V_{CC \text{ max}(0)}$		±65	V
Maximum supply voltage	$V_{CC \text{ max}(1)}$	$R_L = 6 \Omega$	±59	V
Thermal sensor maximum voltage	$V_p$	Between pins 1 and 4	16	V
Thermal sensor maximum current	$I_p$	Between pins 1 and 4	30	mA
Thermal resistance	$\theta_{j-c}$	Per power transistor	1.9	$^\circ\text{C}/\text{W}$
Junction temperature	$T_j \text{ max}$	Both the $T_j \text{ max}$ and the $T_c \text{ max}$ conditions must be met.	150	$^\circ\text{C}$
IC substrate operating temperature	$T_c \text{ max}$		125	$^\circ\text{C}$
Thermal sensor operating temperature *2	$T_p \text{ max}$		145	$^\circ\text{C}$
Storage temperature	$T_{\text{stg}}$		-30 to +125	$^\circ\text{C}$
Allowable load shorted time *4	$t_s$	$V_{CC} = \pm 41.0 \text{ V}$ , $R_L = 6 \Omega$ , $f = 50 \text{ Hz}$ , $P_O = 80 \text{ W}$	0.3	s

#### Operating Characteristics at $T_c = 25^\circ\text{C}$ , $R_L = 6 \Omega$ (noninductive load), $R_g = 600 \Omega$ , $V_G = 30 \text{ dB}$

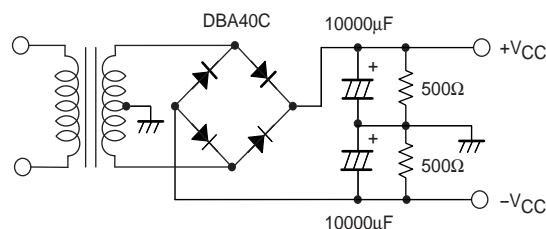
Parameter	Symbol	Conditions*1				Ratings			Unit	
		$V_{CC}$ (V)	f (Hz)	$P_O$ (W)	THD (%)	min	typ	max		
Output power	$P_O$ (1)	±41.0	20 to 20 k		0.4	80			W	
	$P_O$ (2)	±41.0	1 k		10		120			
Frequency characteristics	$f_L, f_H$	±41.0		1.0		+0 -3 dB		20 to 20 k	Hz	
Input impedance	$r_i$	±41.0	1 k	1.0			55		kΩ	
Output noise voltage *3	$V_{NO}$	±49.0				$R_g = 10 \text{ k}\Omega$	1.2		mVrms	
Quiescent current	$I_{CCO}$	±49.0				No loading		50	mA	
Neutral voltage	$V_N$	±49.0					-100	0	+100	mV
Thermal sensor resistance	$R_p$	$T_p = 25^\circ\text{C}$ , between pins 1 and 4					470		Ω	
Thermal sensor temperature	$T_p$	$R_p = 4.7 \text{ k}\Omega$ , between pins 1 and 4					145		$^\circ\text{C}$	

Notes: 1. Unless otherwise noted, use a constant-voltage supply for the power supply used during inspection.

2. The thermal sensor temperature (+125 to +145 $^\circ\text{C}$ ) is designed to prevent incorrect operation, but does not guarantee continued operation of the hybrid IC. The total integrated time this device spends operating in the temperature range +125 to +145 $^\circ\text{C}$  must not exceed 12 hours.

3. The output noise voltage values shown are peak values read with a VTVM. However, an AC stabilized (50 Hz) power supply should be used to minimize the influence of AC primary side flicker noise on the reading.

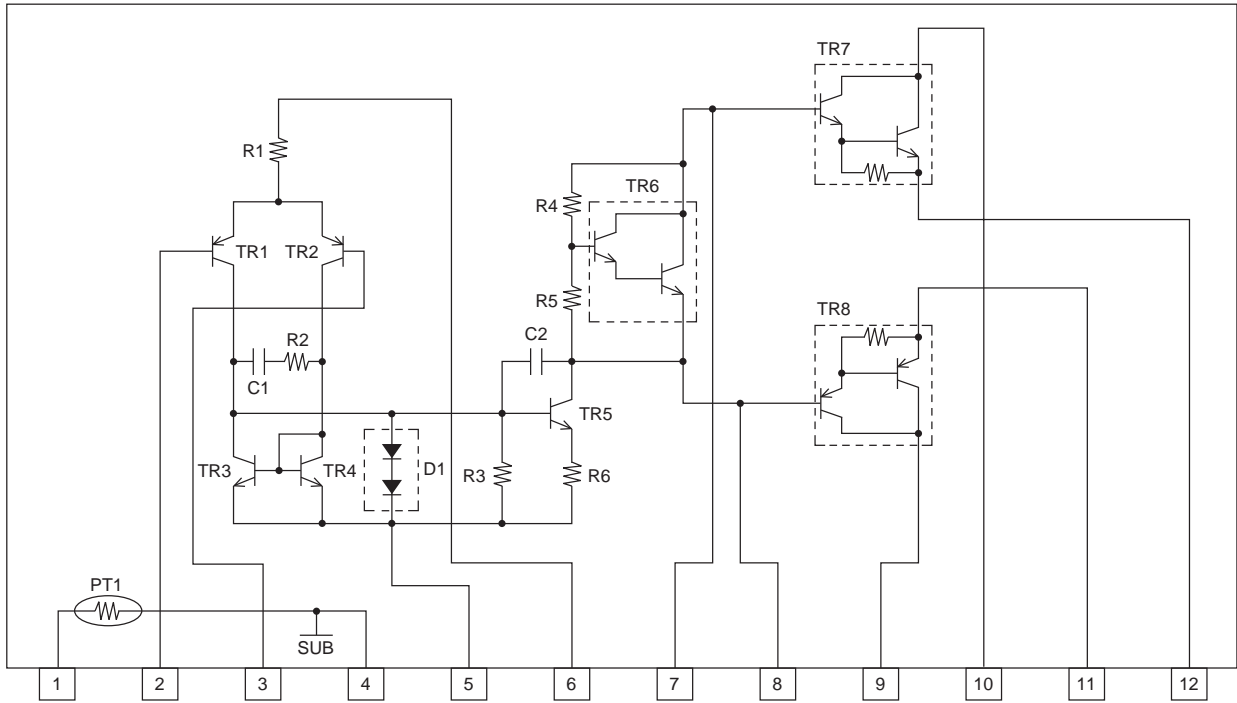
4. Use the transformer power supply circuit shown in the figure below for allowable load shorted time measurement and output noise voltage measurement. This IC is designed assuming that applications will provide a load-shorting protection function that operates within 0.3 seconds of the load being shorted and that either cuts off power to the IC or eliminates the load-shortened state in some other manner.



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

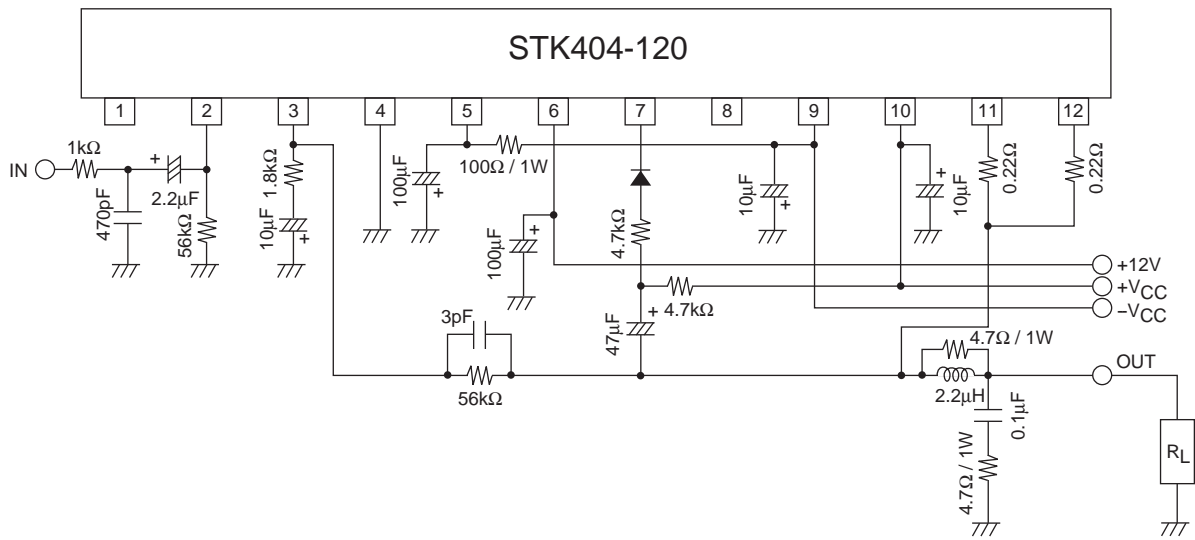
# STK404-120

## Internal Equivalent Circuit



ITF02223

## Sample Application Circuit



ITF02224

## Thermal Design Example

The heat sink thermal resistance,  $\theta_{c-a}$ , required to handle the total power dissipated within this hybrid IC is determined as follows:

Condition 1: The IC substrate temperature  $T_c$  must not exceed 125°C.

$$P_d \times \theta_{c-a} + T_a < 125^\circ\text{C} \dots (1)$$

$T_a$ : Guaranteed ambient temperature for the end product.

Condition 2: The junction temperature of each transistor must not exceed 150°C.

$$P_d \times \theta_{c-a} + P_d/N \times \theta_{j-c} + T_a < 150^\circ\text{C} \dots (2)$$

$N$ : Number of power transistors

$\theta_{j-c}$ : Thermal resistance per power transistor

We take the power dissipation in the power transistors to be  $P_d$  evenly distributed across those  $N$  power transistors.

If we solve for  $\theta_{c-a}$  in equations (1) and (2), we get the following inequalities:

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

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

Values that satisfy both these inequalities at the same time are the required heat sink thermal resistance values.

Determining the following specifications allows us to obtain the required heat sink thermal resistance from inequalities (1)' and (2)':

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

Example:

Assume that the IC supply voltage,  $V_{CC}$ , is  $\pm 41$  V,  $R_L$  is 6  $\Omega$ , and that the signal is a continuous sine wave. In this case, from the  $P_d - P_O$  characteristics, the maximum power will be 56 W for a signal with a frequency of 1 kHz.

For actual music signals, it is usual to use a  $P_d$  of 1/8 of  $P_{Omax}$ , which is the power estimated for continuous signals in this manner. (Note that depending on the particular safety standard used, a value somewhat different from the value of 1/8 used here may be used.)

That is:

$$P_d = 38 \text{ W (when } 1/8 P_{Omax} \text{ is } 10 \text{ W)}$$

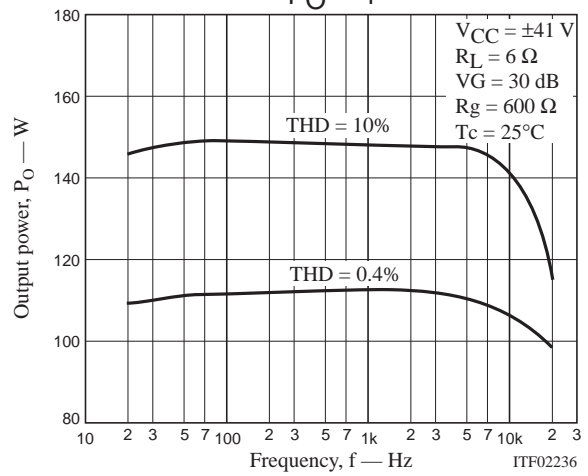
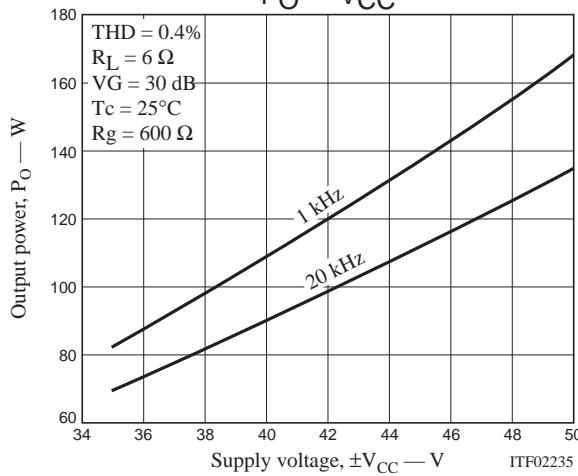
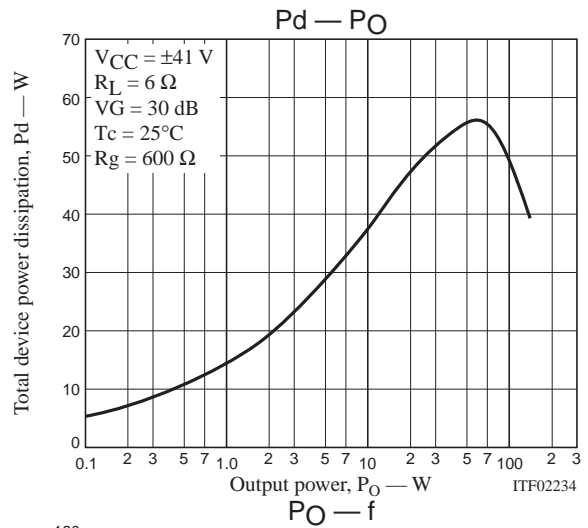
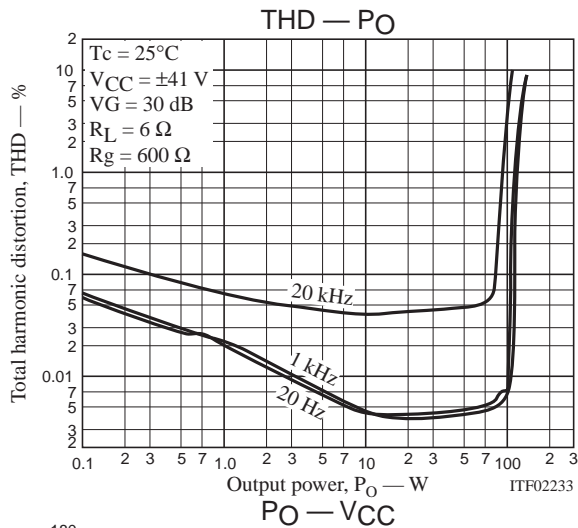
The number,  $N$ , of power transistors in the hybrid IC's audio amplifier block is 2. Since the thermal resistance,  $\theta_{j-c}$ , per transistor is 1.9°C/W, the required heat sink thermal resistance,  $\theta_{c-a}$ , for a guaranteed ambient temperature of 50°C will be as follows:

$$\begin{aligned} \text{From inequality (1)': } \theta_{c-a} &< (125 - 50)/38 \\ &< 1.97 \end{aligned}$$

$$\begin{aligned} \text{From inequality (2)': } \theta_{c-a} &< (150 - 50)/38 - 1.9/2 \\ &< 1.68 \end{aligned}$$

Therefore, the thermal resistance that satisfies both these expressions at the same time is 1.68°C/W.

Note that this thermal design example assumes the use of a constant-voltage power supply, and is only provided as an example for reference purposes. Thermal designs must be tested in an actual end product.



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