SANYO

STK402-070

Two-Channel Class AB Audio Power Amplifier IC
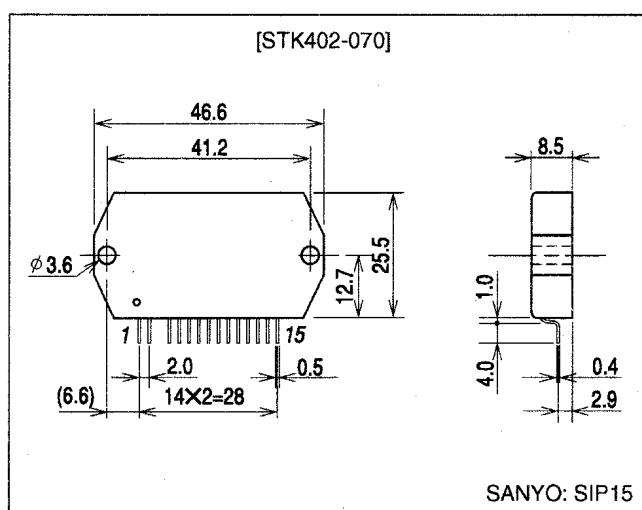## 40W + 40W

Overview

The STK402-000 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). SANYO has adopted a new low thermal resistance substrate in these products to reduce the package size by about 60% as compared to the earlier SANYO STK407-000 series.

Features

• Series of pin compatible power amplifiers ranging from 20 W × 2 channels to 120 W × 2 channel (10%/1 kHz) devices. The same printed circuit board can be used depending on the output power grade.

• The pin arrangement is compatible with that of the 3-channel STK402-200 series. This means that 3-channel printed circuit boards can also be used for 2-channel products.

• Miniature packages
 — 15 W/ch to 40 W/ch (THD = 0.4%, f = 20 Hz to 20 kHz); 46.6 mm × 25.5 mm × 8.5 mm *
 — 50 W/ch to 80 W/ch (THD = 0.4%, f = 20 Hz to 20 kHz); 59.2 mm × 31.0 mm × 8.5 mm *
 *: Not including the pins.

• Output load impedance: $R_L = 6 \ \Omega$

• Allowable load shorted time: 0.3 seconds

• Supports the use of standby, muting, and load shorting protection circuits.

Package Dimensions

unit: mm
4189-SIP15

[STK402-070]

SANYO: SIP15

Series Organization

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

Item	Type No.							
	STK402-020	STK402-030	STK402-040	STK402-050	STK402-070	STK402-090	STK402-100	STK402-120
Output 1 (10%/1 kHz)	20 W + 20 W	30 W + 30 W	40 W + 40 W	45 W +45 W	60 W + 60 W	80 W + 80 W	100 W + 100 W	120 W + 120 W
Output 2 (0.4%/20 Hz to 20 kHz)	15 W + 15 W	20 W + 20 W	25 W + 25 W	30 W + 30 W	40 W + 40 W	50 W + 50 W	60 W + 60 W	80 W + 80 W
Maximum supply voltage (No signal)	±30 V	±34 V	±38 V	±40 V	±50 V	±54 V	±57 V	±65 V
Maximum supply voltage (6 Ω)	±28 V	±32 V	±36 V	±38 V	±44 V	±47 V	±50 V	±57 V
Recommended supply voltage (6 Ω)	±19 V	±22 V	±25 V	±26.5 V	±30 V	±32 V	±35 V	±39 V
Package	46.6 mm × 25.5 mm × 8.5 mm				59.2 mm × 31.0 mm × 8.5 mm			

Specifications
Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage (No signal)	V_{CC} max(0)		±50	V
Maximum supply voltage	V_{CC} max(1)	R_L = 6 Ω	±44	V
Thermal resistance	θj-c	Per power transistor	3.2	°C/W
Junction temperature	Tj max	Both the Tj max and the Tc max conditions must be met.	150	°C
Operating IC substrate temperature	Tc max		125	°C
Storage temperature	Tstg		−30 to +125	°C
Allowable load shorted time	ts	V_{CC} = ±30.0 V, R_L = 6 Ω, f = 50 Hz, P_O = 40 W	0.3	s

Operating Characteristics at Ta = 25°C, R_L = 6 Ω (noninductive load), Rg = 600 Ω, VG = 30 dB

Parameter	Symbol	Conditions*1					Ratings			Unit
		V_{CC} (V)	f (Hz)	P_O (W)	THD (%)		min	typ	max	
Output power	P_O (1)	±30.0	20 to 20 k		0.4		38	40		W
(continuous output)	P_O (2)	±30.0	1 k		10			60		
Total harmonic distortion	THD (1)	±30.0	20 to 20 k	1.0		VG = 30 dB			0.4	%
	THD (2)	±30.0	1 k	5.0		VG = 30 dB		0.01		
Frequency characteristics	f_L, f_H	±30.0		1.0		+0 −3 dB		20 to 50 k		Hz
Input impedance	ri	±30.0	1 k	1.0				55		kΩ
Output noise voltage *2	V_{NO}	±36.0				Rg = 2.2 kΩ			1.2	mVrms
Quiescent current	I_{CCO}	±36.0					10	40	80	mA
Neutral voltage	V_N	±36.0					−70	0	+70	mV

Notes: 1. Unless otherwise noted, use a constant-voltage supply for the power supply used during inspection.
2. 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.
Use the transformer power supply circuit stipulated in the figure below for output noise voltage measurement.
3. Use the transformer power supply circuit stipulated in the figure below for allowable load shorted time measurement.
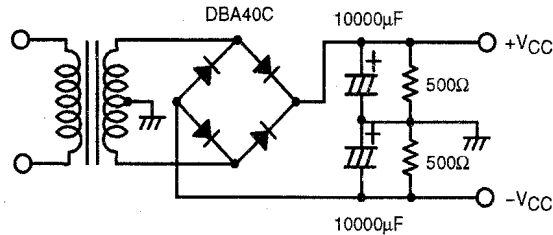
Stipulated Transformer Power Supply (MG-200 equivalent)

Internal Equivalent Circuit

Sample Application Circuit
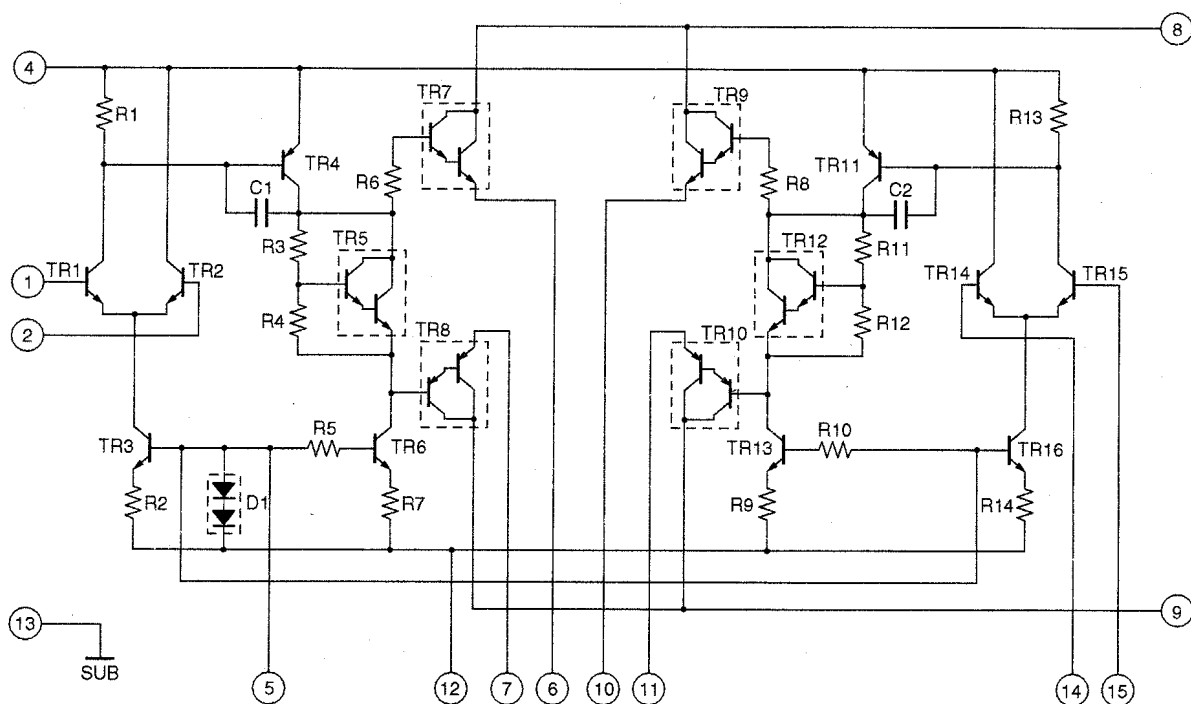
Thermal Design Example

The thermal resistance, θc-a of the required heat sink for the power dissipation, Pd, within the hybrid IC is determined as follows.

Condition 1: The IC substrate temperature, Tc, must not exceed 125°C.

$$Pd \times \theta c - a + Ta < 125°C \quad \cdots \cdots \cdots (1)$$

Ta: Guaranteed ambient temperature for the end product.

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

$$Pd \times \theta c - a + Pd/N \times \theta j - c + Ta < 150°C \quad \cdots \cdots \cdots (2)$$

N: Number of power transistors
θc-a: Thermal resistance per power transistor

However, the power dissipation, Pd, for the power transistors shall be allocated equally among the N transistors.
The following inequalities results from solving equations (1) and (2) for θc-a.

$$\theta c - a < (125 - Ta) / Pd \quad \cdots \cdots \cdots \cdots \cdots \cdots (1)'$$
$$\theta c - a < (150 - Ta) / Pd - \theta j - c/N \quad \cdots \cdots \cdots (2)'$$

Values that satisfy these two inequalities at the same time represent the required heat sink thermal resistance.
When the following specifications have been stipulated, the required heat sink thermal resistance can be determined from formulas (1)' and (2)'.

- Supply voltage — V_{CC}

- Load resistance value — RL

- Guaranteed ambient temperature — Ta

[Example]
When the IC supply voltage, V_{CC}, is ±30 V and R_L is 6 Ω, the IC internal power dissipation, Pd, will be a maximum of 63 W for a continuous sine wave signal at 1 kHz, according to the Pd – P_O characteristics.

For the music signals normally handled by audio amplifiers, a value of 1/8 P_O max is generally used for Pd as an estimate of the power dissipation based on this type of continuous signal. (Note that the factor used may differ depending on the safety standards used.)
That is:

$$Pd = 42 \text{ W (When 1/8 } P_O \text{ max = 5 W)}$$

The number of power transistors in the audio amplifier block of these hybrid ICs, N, is 4, and the thermal resistance per transistor is 3.2°C/W. Therefore, the required heat sink thermal resistance for a guaranteed ambient temperature of 50°C will be as follows.

From formula (1)'   θc – a < (125 – 50) /42
                                    < 1.78
From formula (2)'   θc – a < (150 – 50) /42 – 3.2/4
                                    < 1.58

Therefore, 1.58°C/W is the required heat sink thermal resistance.

Note that this thermal design example assumes the use of a constant-voltage power supply, and is therefore not a verified design for any particular user's end product.

P_d — P_O

$V_{CC}=\pm30V$
$R_L=6\Omega$
$f=1kHz$
$VG=30dB$
$Rg=600\Omega$
2ch drive
(same output rating)

Total device power dissipation, P_d — W

Output power per channel, P_O / ch — W   ITF02132

THD — P_O

$Tc=25°C$
$V_{CC}=\pm30V$
$VG=30dB$
$R_L=6\Omega$
$Rg=600\Omega$

Total harmonic distortion, THD — %

20kH
1kHz
20Hz

Output power, P_O — W   ITF02133

I_{CCO} — P_O

$R_L=6\Omega$
$f=1kHz$
$Rg=600\Omega$
1ch drive

Total current consumption, I_{CCO} / ch — A

Output power per channel, P_O / ch — W   ITF02134

P_O — f

$Tc=25°C$
$VG=30dB$
$Rg=600\Omega$

$R_L=6\Omega$, $V_{CC}=\pm30V$, THD=10%

$R_L=6\Omega$, $V_{CC}=\pm30V$, THD=0.4%

Output power, P_O — W

Frequency, f — Hz   ITF02135

P_O — V_{CC}

$Tc=25°C$
$f=1kHz$
$VG=30dB$
$R_L=6\Omega$
$Rg=600\Omega$
2ch drive

THD=10%
THD=0.4%

Output power, P_O — W

Supply voltage, V_{CC} — V   ITF02136