TENTATIVE

SANYO Semiconductors

DATA SHEET

Thick-Film Hybrid IC

STK404-000N-E series

1ch class-AB Audio Power IC from 60W to 180W

Overview

The STK404-000N-E series is hybrid IC for the audio power amplifier that mounts discrete components as the audio power amplifier circuit in small space using the original Insulated Metal Substrate Technology IMST. The compact package has been achieved by adopting the low thermal resistance substrate (our conventional model kind ratio).

Application

- Audio Power use

Features

- Pin-to-pin compatible outputs ranging from 60W to 180W
- Miniature package (44.0x25.6x8.5mm, 46.6x25.5x8.5mm, 59.2×25.5×8.5mm)
- Output load impedance RL=6ohm recommended.
- Allowable load shorted time: 0.3 second
- Allows the use of predesigned applications for standby, mute, and the load short protection circuit.

Selection Guide

	STK404-070N-E	STK404-120N-E	STK404-140N-E
Output1 (10%/1kHz)	60W × 1ch	120W × 1ch	180W × 1ch
Output2 (1%/20Hz to 20kHz)	40W × 1ch	80W × 1ch	120W × 1ch
Maximum rating V_{CC} max (no sig.)	±46V	±65V	±78V
Maximum rating V_{CC} (6Ω)	±39V	±59V	±73V
Recommended operating V_{CC} (6Ω)	±30V	±41V	±51V
Package size	44.0mm×25.6mm×8.5mm	46.6mm×25.5mm×8.5mm	59.2mm×25.5mm×8.5mm

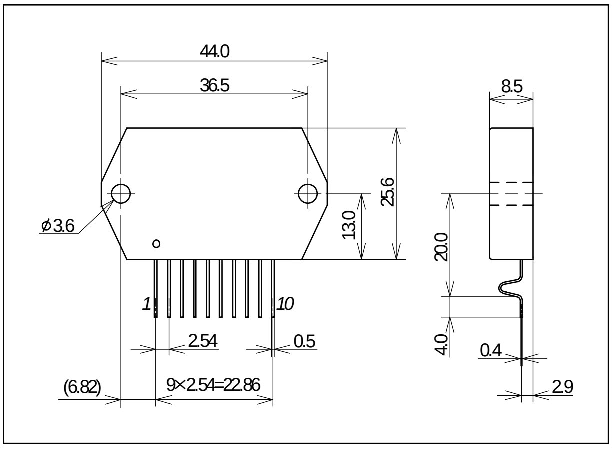
SANYO Semiconductor Co., Ltd.
TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110-8534 JAPAN

Package Dimensions

RoHS DIRECTIVE PASS

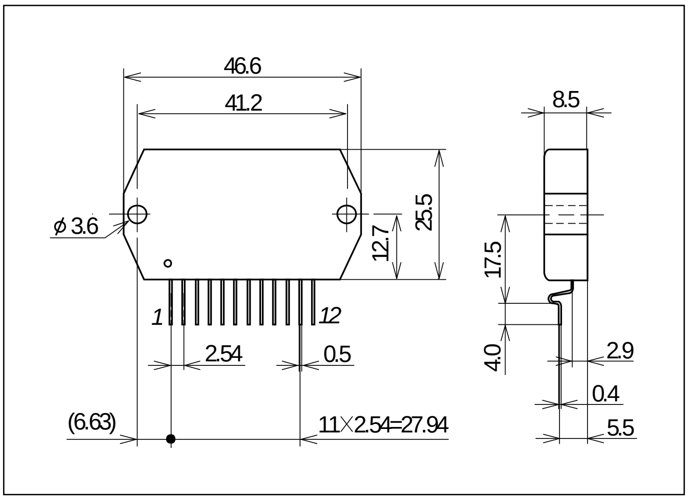
STK404-070N-E

unit : mm (typ)



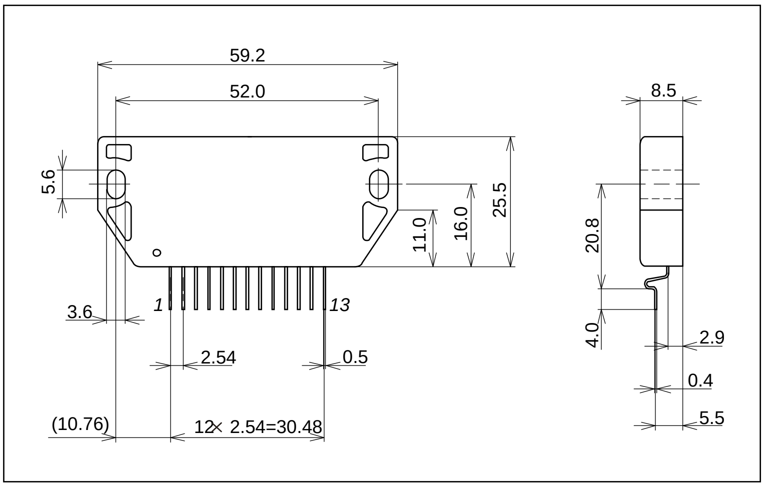
STK404-120N-E

unit : mm (typ)



STK404-140N-E

unit : mm (typ)



Pin Layout

[STK404-000Nsr Pin Layout]

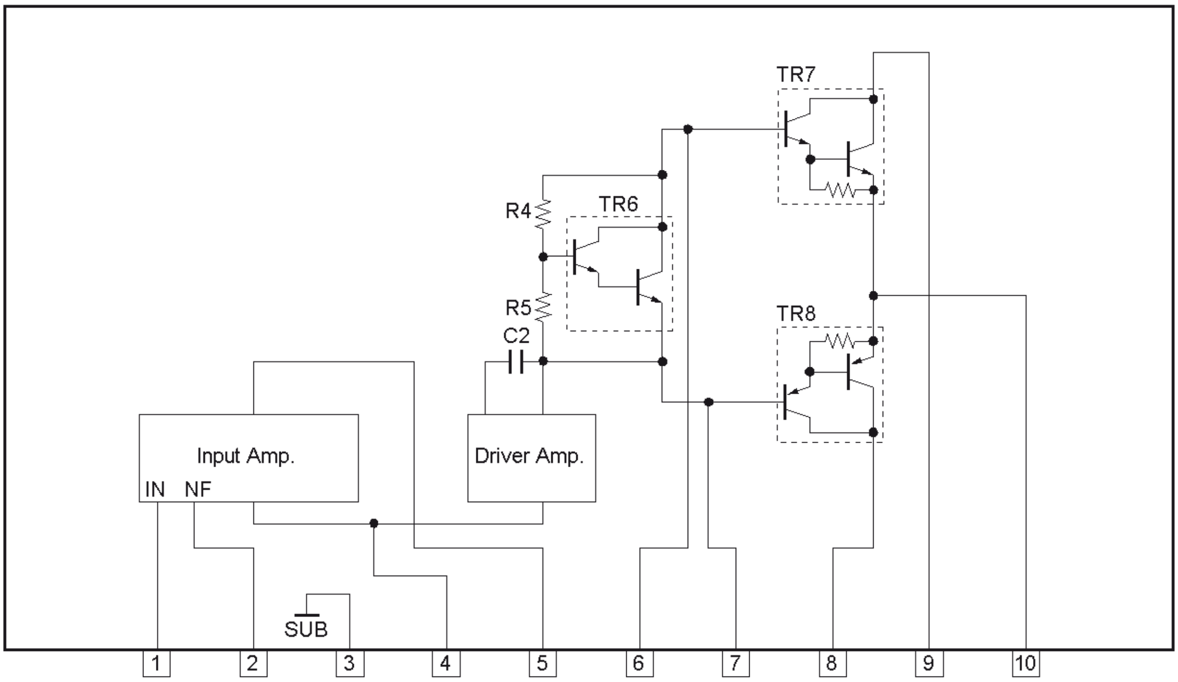
	1	2	3	4	5	6	7	8	9	10
(Size) 44.0mm×25.6mm×8.5mm	1ch classAB/2.54mm									
STK404-070N 60W/JEITA	IN/CH1	NF/CH1	SUB	-PRE	+PRE	+powerTR	-powerTR	-VCC	+VCC	OUT/CH1

	1	2	3	4	5	6	7	8	9	10	11	12
(Size) 46.6mm×25.5mm×8.5mm	1ch classAB/2.54mm											
STK404-120N 120W/JEITA	TH	IN/CH1	NF/CH1	SUB	-PRE	+PRE	+powerTR	-powerTR	-VCC	+VCC	OUT/CH1-	OUT/CH1+

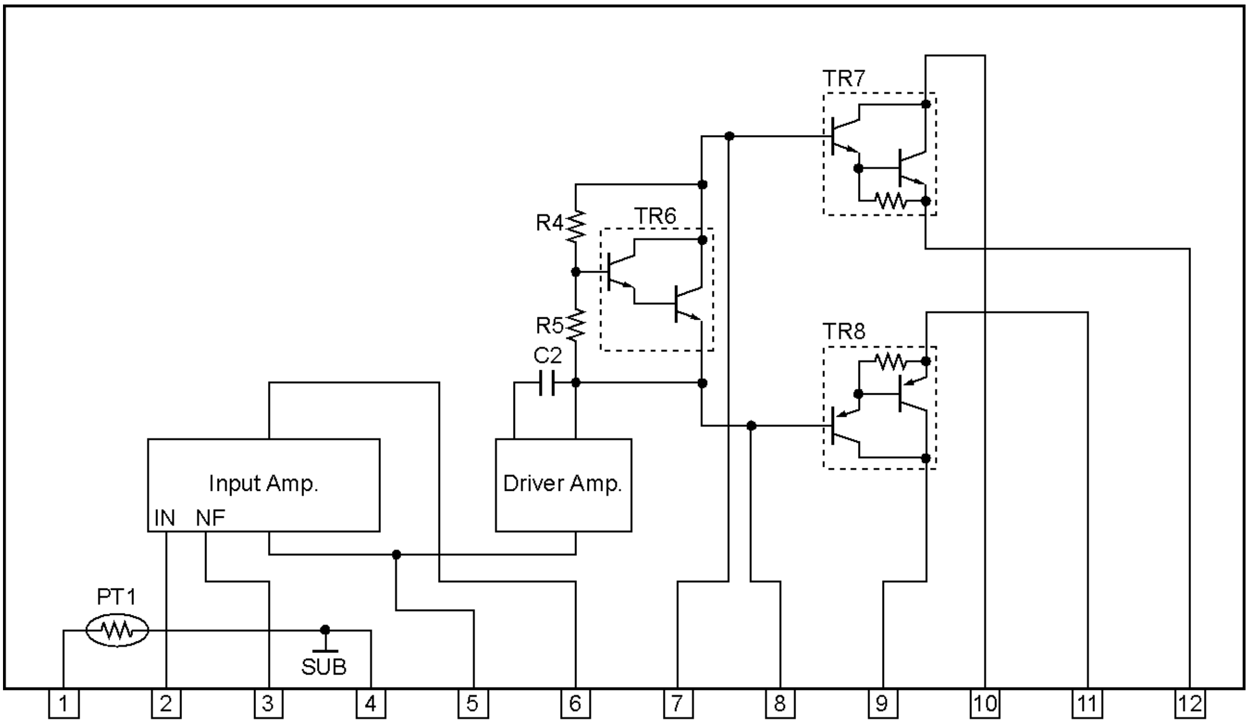
	1	2	3	4	5	6	7	8	9	10	11	12	13
(Size) 59.2mm×25.5mm×8.5mm	1ch classAB/2.54mm												
STK404-140N 180W/JEITA	TH1	TH2	IN/CH1	NF/CH1	SUB	-PRE	+PRE	+powerTR	-powerTR	-VCC	+VCC	OUT/CH1-	OUT/CH1+

Equivalent Circuit

STK404-070N-E

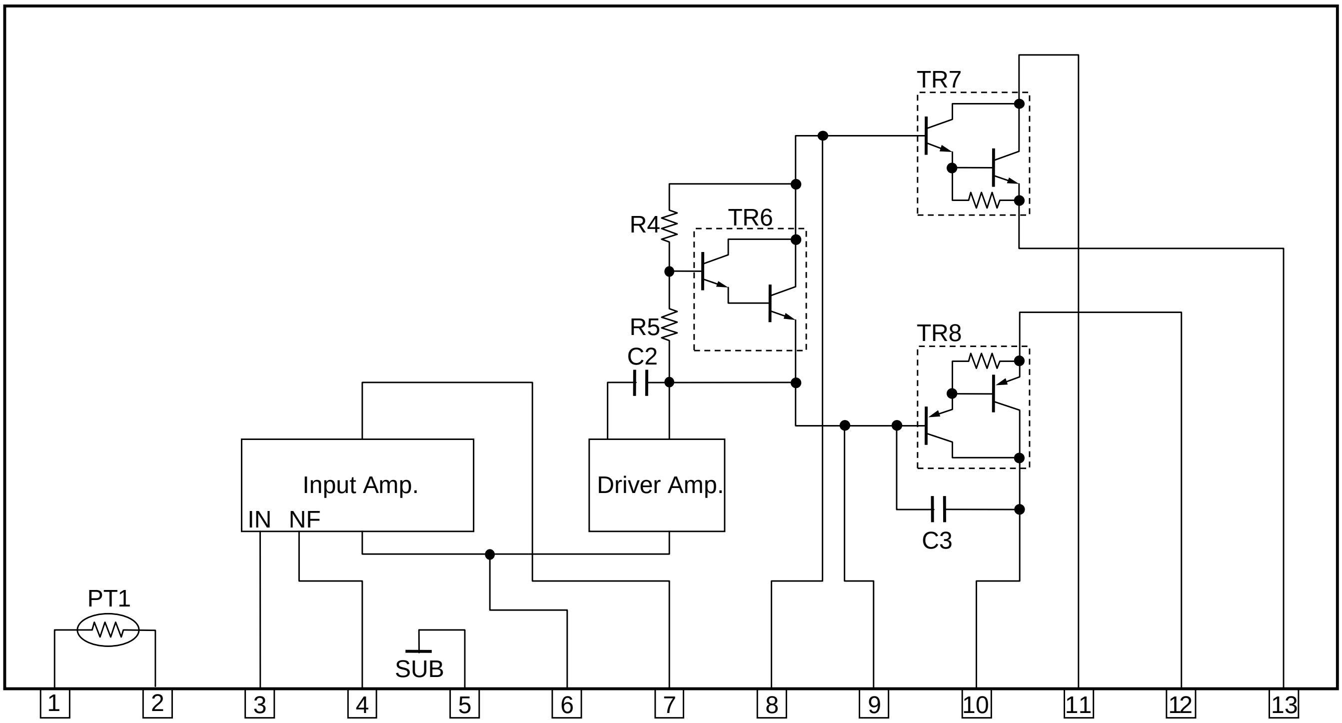


STK404-120N-E



Equivalent Circuit

STK404-140N-E



STK404-070N-E

Specifications

Absolute Maximum Ratings at Ta = 25°C, Tc = 25°C unless otherwise specified

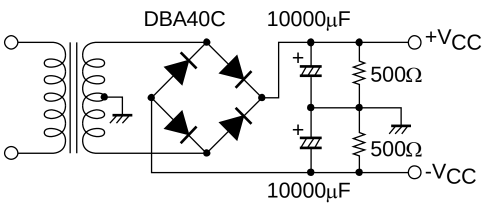
Parameter	Symbol	Conditions	Ratings	Unit
Power supply voltage 1	V_{CC} max1	Non-signal	±46	V
Power supply voltage 2	V_{CC} max2	Signal, R_L = 6Ω	±39	V
Thermal resistance	θj-c	Per one power transistor	3.0	°C/W
Junction temperature	Tj max		150	°C
Operating substrate temperature	Tc max		125	°C
Storage temperature	Tstg		-30 to +125	°C
Allowable time for load short-circuit *3	ts	V_{CC} = ±28V, R_L = 6Ω, f = 50Hz P_O = 40W	0.3	s

Operating Characteristics at Tc = 25°C, R_L = 6Ω (Non-inductive load), Rg = 600Ω, VG = 30dB

Parameter	Symbol	Conditions					Ratings			Unit
		V_{CC} [V]	f [Hz]	P_O [W]	THD [%]		min	typ	max	
Output power	P_O 1	±30	20 to 20k		0.4		40			W
	P_O 2	±30	1k		10			60		
Frequency characteristics	f_L, f_H	±30		1.0		+0 -3dB		20 to 20k		Hz
Input impedance	ri	±30	1k	1.0				55		kΩ
Output noise voltage *2	V_{NO}	±36				Rg=10kΩ		1.2		mVrms
Output neutral voltage	V_N	±36					-100	0	+100	mV
Quiescent current	I_{CCO}	±36				No load	4		14	mA

[Note]
*1. All tests are measured using a constant-voltage supply unless otherwise specified.
*2. The output noise voltage is peak value of an average-reading meter with a rms value scale (VTVM).
A regulated AC supply (50Hz) should be used to eliminate the effects of AC primary line flicker noise.
*3. Allowable time for load short-circuit and output noise voltage are measured using the specified transformer power supply. About the load short circuit, it is designed assuming protecting by cut-off within 0.3 second.
*4. Weight of 1 HIC : (Typ) 10.4g Outer carton dimensions (W×L×H) : 420mm×233mm×277mm

Specified transformer power supply
(Equivalent to MG-200)



STK404-120N-E

Specifications

Absolute Maximum Ratings at Ta = 25°C, Tc = 25°C unless otherwise specified

Parameter	Symbol	Conditions	Ratings	Unit
Power supply voltage 1	V_{CC} max1	Non- signal	±65	V
Power supply voltage 2	V_{CC} max2	Signal, R_L = 6Ω	±59	V
Thermal detector maximum voltage	Vp	1-4pin	16	V
Thermal detector maximum current	Ip	1-4pin	30	mA
Thermal resistance	θj-c	Per one power transistor	1.7	°C/W
Junction temperature	Tj max		150	°C
Operating substrate temperature	Tc max		125	°C
Storage temperature	Tstg		-30 to +125	°C
Allowable time for load short-circuit *4	ts	V_{CC} = ±41V, R_L = 6Ω, f = 50Hz P_O = 80W	0.3	s

Operating Characteristics at Tc = 25°C, R_L = 6Ω (Non-inductive load), Rg = 600Ω, VG = 30dB

Parameter	Symbol	Conditions					Ratings			Unit
		V_{CC} [V]	f [Hz]	P_O [W]	THD [%]		min	typ	max	
Output power	P_O 1	±41	20 to 20k		1.0		80			W
	P_O 2	±41	1k		10			120		W
Frequency characteristics	f_L, f_H	±41		1.0		+0 -3dB		20 to 20k		Hz
Input impedance	ri	±41	1k	1.0				55		kΩ
Output noise voltage *3	V_{NO}	±49				Rg=10kΩ		1.2		mVrms
Output neutral voltage	V_N	±49					-100	0	+100	mV
Quiescent current	I_{CCO}	±49				No load			60	mA
Thermal detector resistance *2	Rp	Tp=25°C, 1-4pin						470		Ω
Thermal detector operate temperrature *2	Tp	Rp=4.7kΩ, 1-4pin						135		°C

[Note]

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

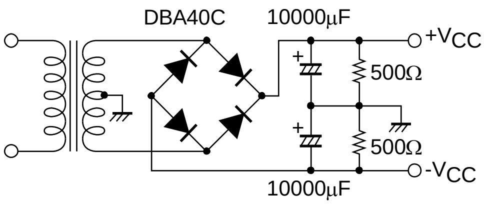
*2. Thermal Detector temperature (+135°C±5°C) indicates the value at unusual operation, therefore, does not indicate the guaranteed value at usual operation.
Thermal Detector is PRF18series (AS characteristic) manufactured by MURATA.

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

*4. Allowable time for load short-circuit and output noise voltage are measured using the specified transformer power supply. About the load short circuit, it is designed assuming protecting by cut-off within 0.3 second.

*5. Weight of 1 HIC : 12.6g Outer carton dimensions (W×L×H) : 420mm×233mm×277mm

(Equivalent to MG-250)



STK404-140N-E

Specifications

Absolute Maximum Ratings at Ta = 25°C, Tc = 25°C unless otherwise specified

Parameter	Symbol	Conditions	Ratings	Unit
Power supply voltage 1	V_{CC} max1	Non- signal	±78	V
Power supply voltage 2	V_{CC} max2	Signal, R_L = 6Ω	±73	V
Thermal detector maximum voltage	Vp	1-2pin	16	V
Thermal detector maximum current	Ip	1-2pin	30	mA
Thermal resistance	θj-c	Per one power transistor	1.1	°C/W
Junction temperature	Tj max		150	°C
Operating substrate temperature	Tc max		125	°C
Storage temperature	Tstg		-30 to +125	°C
Allowable time for load short-circuit *4	ts	V_{CC} = ±51V, R_L = 6Ω, f = 50Hz P_O = 120W	0.3	s

Operating Characteristics at Tc = 25°C, R_L = 6Ω (Non-inductive load), Rg = 600Ω, VG = 30dB

Parameter	Symbol	Conditions					Ratings			Unit
		V_{CC} [V]	f [Hz]	P_O [W]	THD [%]		min	typ	max	
Output power	P_O 1	±51	20 to 20k		1.0		120			W
	P_O 2	±51	1k		10			180		W
Frequency characteristics	f_L, f_H	±51		1.0		+0 -3dB	20 to 20k			Hz
Input impedance	ri	±51	1k	1.0				55		kΩ
Output noise voltage *3	V_{NO}	±62				Rg=10kΩ		1.2		mVrms
Output neutral voltage	V_N	±62					-100	0	+100	mV
Quiescent current	I_{CCO}	±62				No load			60	mA
Thermal detector resistance *2	Rp	Tp=25°C, 1-2pin						470		Ω
Thermal detector operate temperrature *2	Tp	Rp=4.7kΩ, 1-2pin						145		°C

[Note]

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

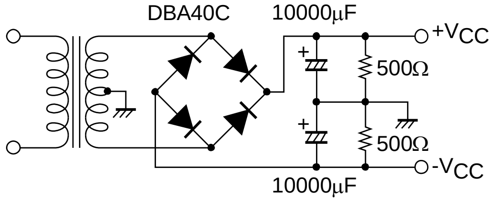
*2. Thermal Detector temperature (+145°C±5°C) indicates the value at unusual operation, therefore, does not indicate the guaranteed value at usual operation.
Thermal Detector is PRF18series (AS characteristic) manufactured by MURATA.

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

*4. Allowable time for load short-circuit and output noise voltage are measured using the specified transformer power supply. About the load short circuit, it is designed assuming protecting by cut-off within 0.3 second.

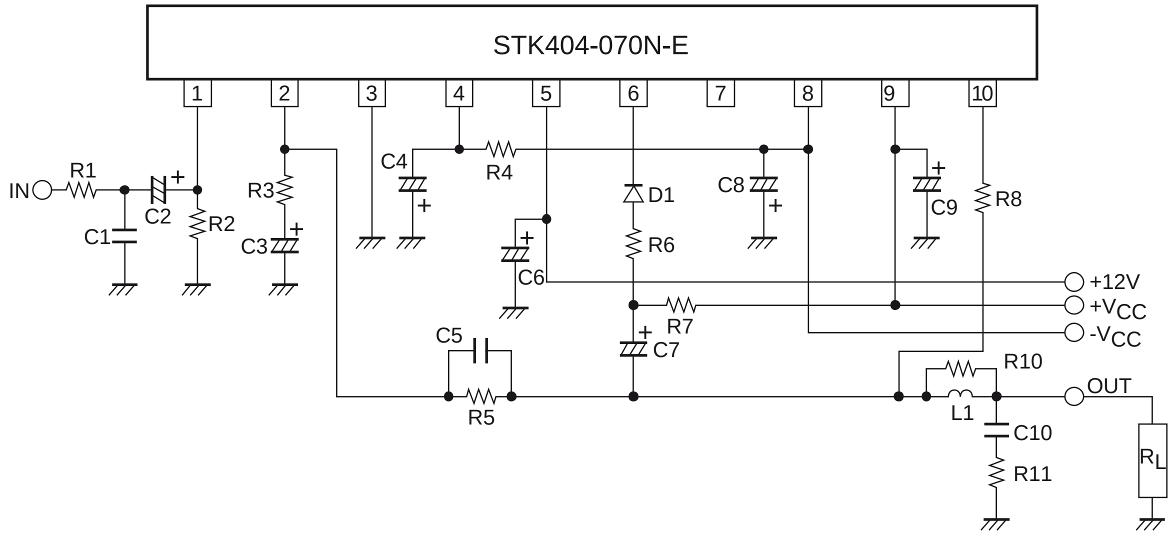
*5. Weight of 1 HIC : 17.2g Outer carton dimensions (W×L×H) : 502mm×247mm×282mm

(Equivalent to MG-250)



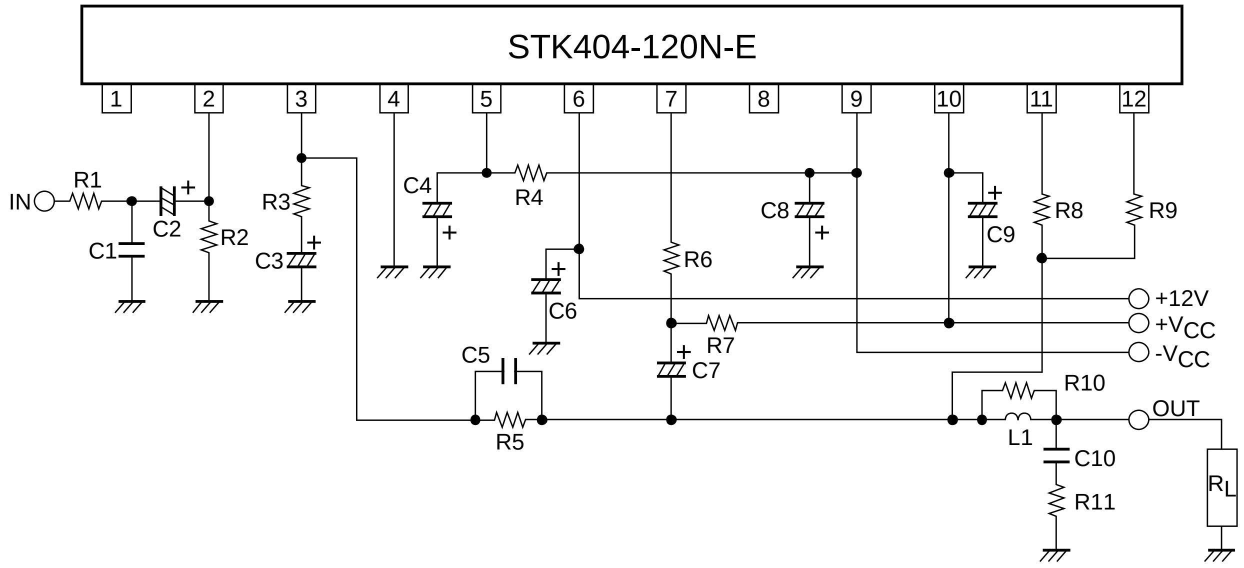
Test Circuit

STK404-070N-E



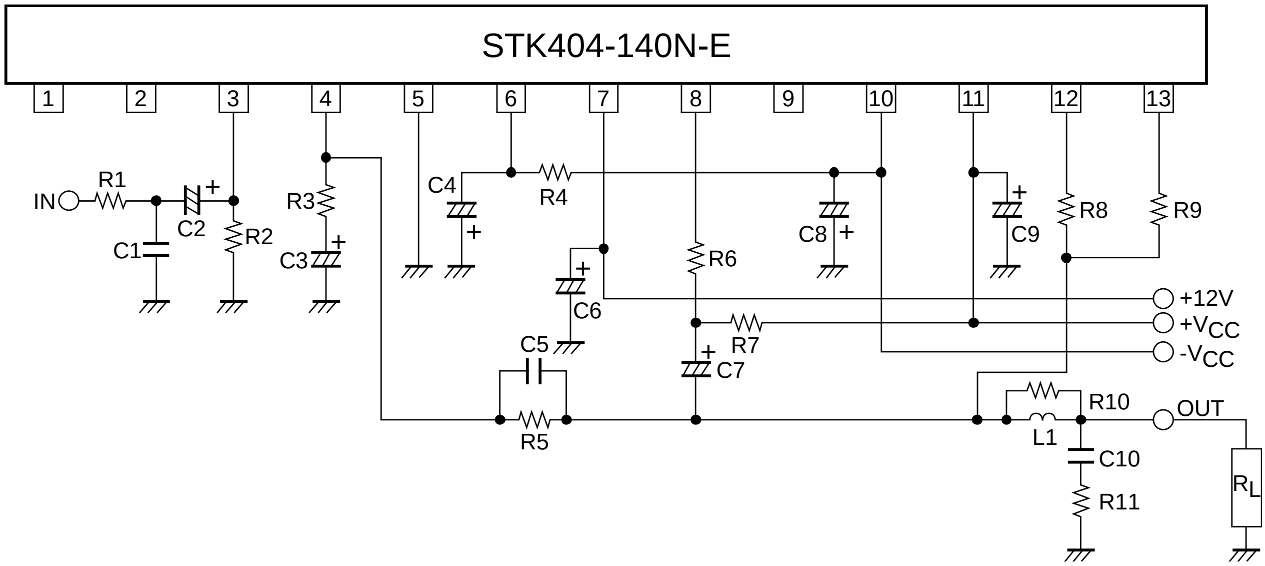
Test Circuit

STK404-120N-E



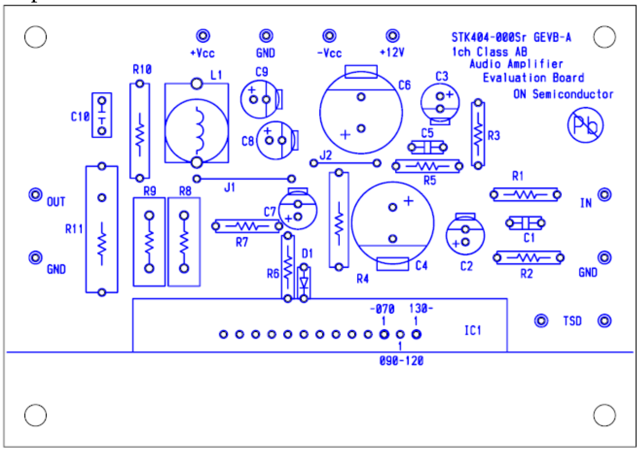
Test Circuit

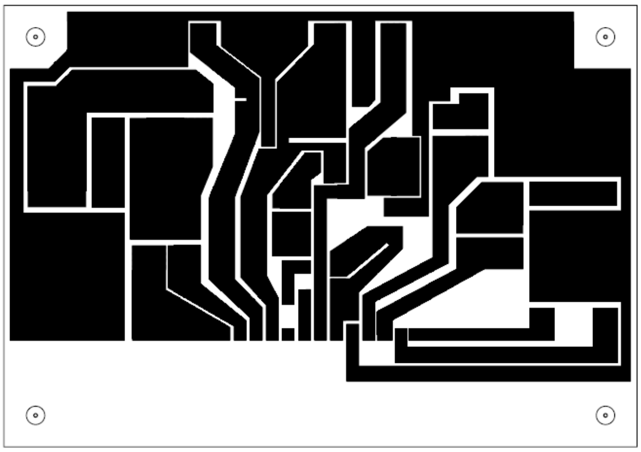
STK404-140N-E



PCB Layout Example

Top view



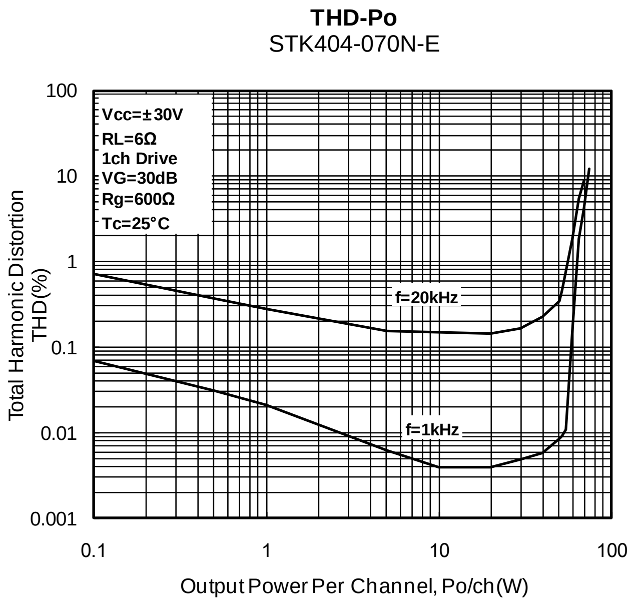


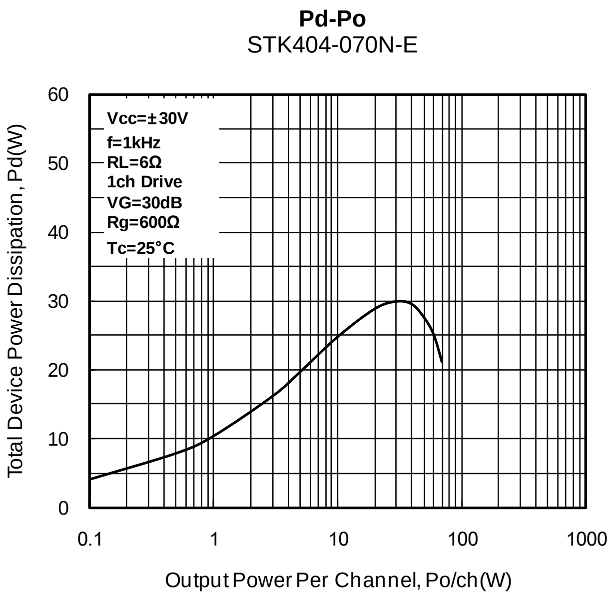
PCB parts list

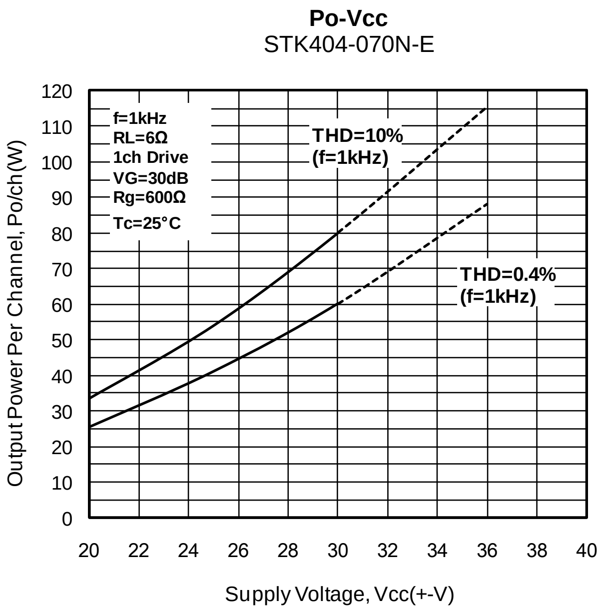
Type (IC1)	STK404-070N-E	STK404-120N-E	STK404-140N-E
Position of (1)pin	Third from the right end	Second from the right end	The right end
Location			
R1	1kΩ	←	←
R2	56kΩ	←	←
R3	1.8kΩ	←	←
R4	100Ω/1W	←	←
R5	56kΩ	←	←
R6	10kΩ/1W	4.7kΩ/1W	5.1kΩ/1W
R7	10kΩ/1W	4.7kΩ/1W	5.1kΩ/1W
R8	0.22Ω/5W	←	←
R9	-	0.22Ω/5W	←
R10	4.7Ω/1W	←	←
R11	4.7Ω/1W	←	←
C1	470pF	←	←
C2	2.2μF/50V	←	←
C3	10μF/50V	←	←
C4	100μF/100V	←	←
C5	5pF	←	←
C6	100μF/50V	←	←
C7	47μF/100V	←	←
C8	10μF/100V	←	←
C9	10μF/100V	←	←
C10	0.1μF	←	←
D1	200V/0.5A	Short	Short
L1	2.2μH	←	←
J1	15mm	←	←
J2	10mm	←	←

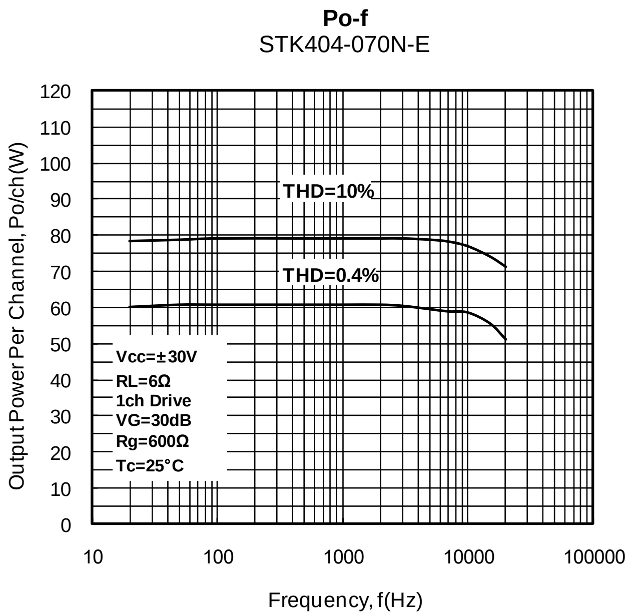
Characteristic of Evaluation Board

STK404-070N-E



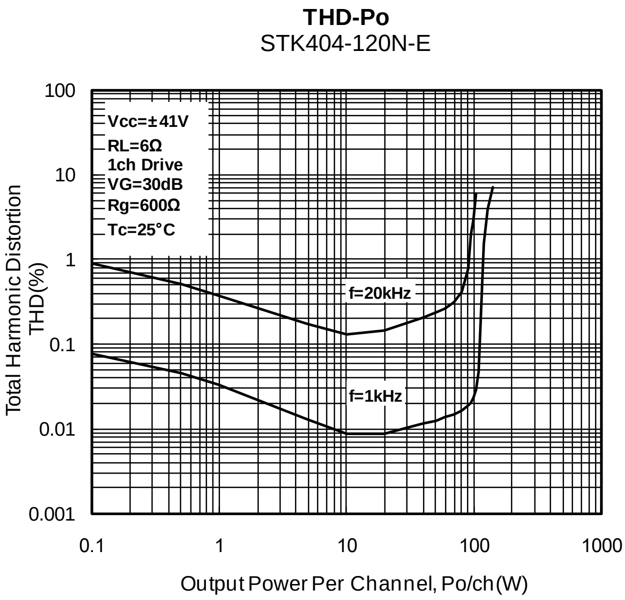


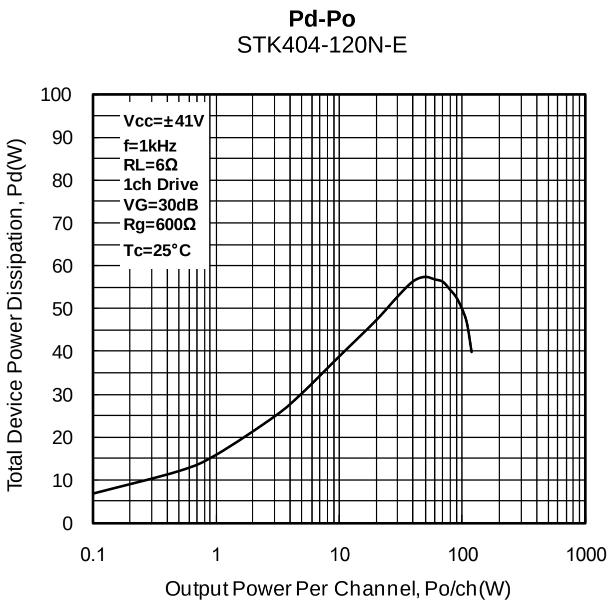


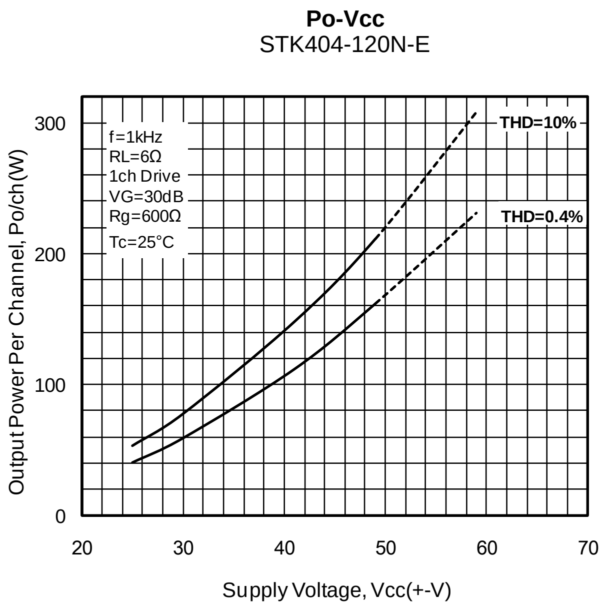


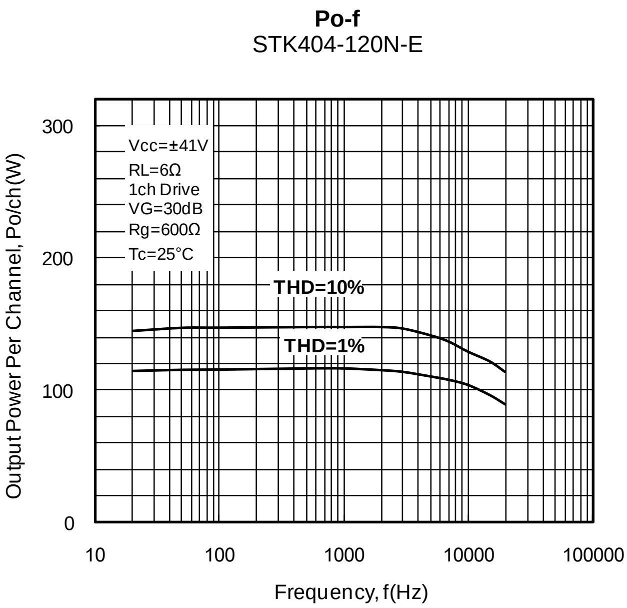
Characteristic of Evaluation Board

STK404-120N-E





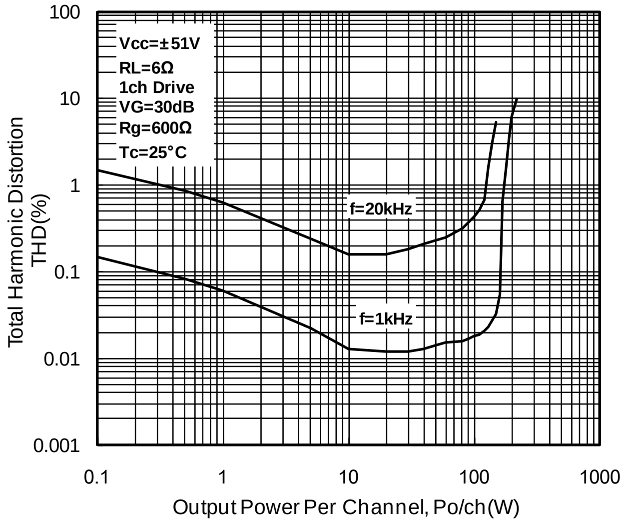




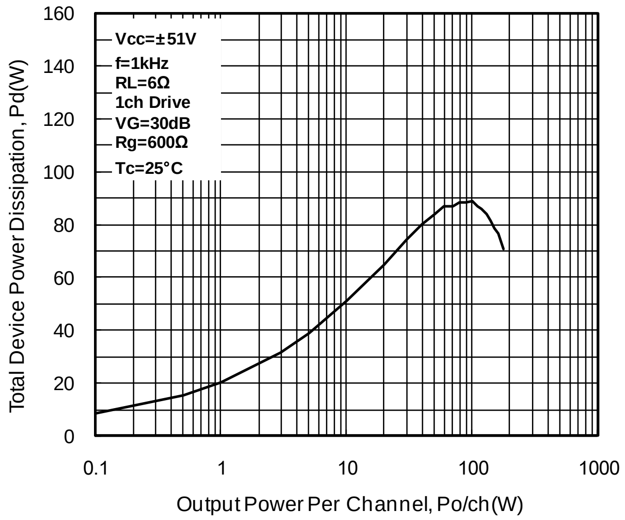
Characteristic of Evaluation Board

STK404-140N-E

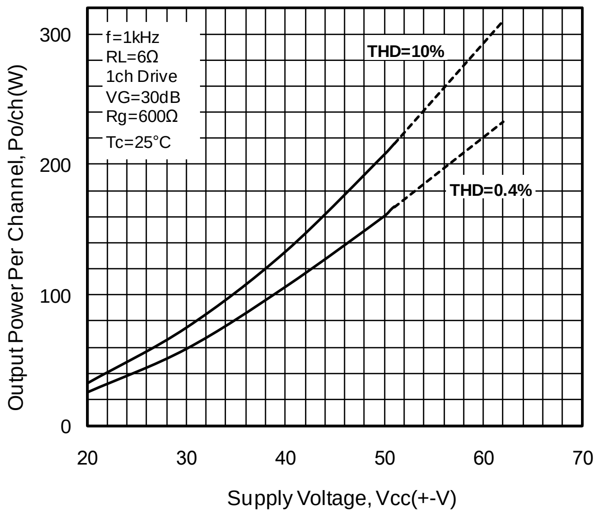
THD-Po
STK404-140N-E



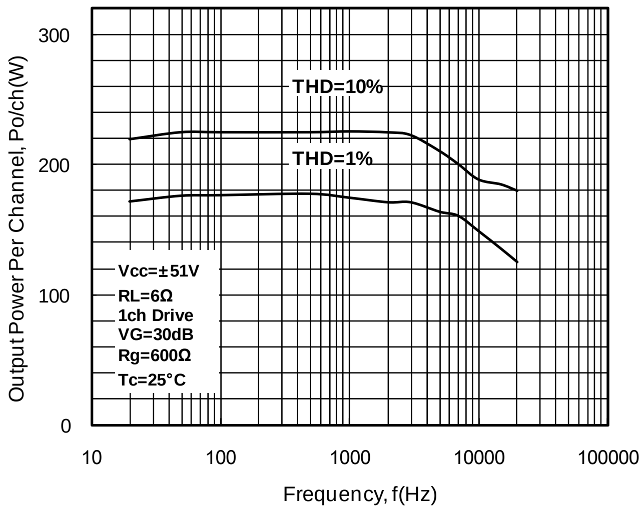
Pd-Po
STK404-140N-E



Po-Vcc
STK404-140N-E



Po-f
STK404-140N-E



A Thermal Design Tip For STK404-070N-E Amplifier

[Thermal Design Conditions]

The thermal resistance (θc-a) of the heat-sink which manages the heat dissipation inside the Hybrid IC will be determined as follow:

(Condition 1) The case temperature (Tc) of the Hybrid IC should not exceed 125°C

$Pd \times \theta c\text{-}a + Ta < 125°C$ ··························(1)

Where Ta : the ambient temperature for the system

(Condition 2) The junction temperature of each power transistor should not exceed 150°C

$Pd \times \theta c\text{-}a + Pd/N \times \theta j\text{-}c + Ta < 150°C$ ··························(2)

Where N : the number of transistors (two for 1 channel , ten for channel)

θj-c : the thermal resistance of each transistor (see specification)

Note that the power consumption of each power transistor is assumed to be equal to the total power dissipation (Pd) divided by the number of transistors (N).

From the formula (1) and (2), we will obtain:

$\theta c\text{-}a < (125 - Ta)/Pd$ ··························(1)’

$\theta c\text{-}a < (150 - Ta)/Pd - \theta j\text{-}c/N$ ··························(2)’

The value which satisfies above formula (1)’ and (2)’ will be the thermal resistance for a desired heat-sink.

Note that all of the component except power transistors employed in the Hybrid IC comply with above conditions.

[Example of Thermal Design]

Generally, the power consumption of actual music signals are being estimated by the continuous signal of 1/8 P_O max. (Note that the value of 1/8 P_O max may be varied from the country to country.)

(Sample of STK404-070N-E ; 40W×1ch)

If V_{CC} is ±30V, and R_L is 6Ω, then the total power dissipation (Pd) of inside Hybrid IC is as follow;

Pd = 19.6W (at 5W output power,1/8 of P_O max)

There are two (2) transistors in Audio Section of this Hybrid IC, and thermal resistance (θj-c) of each transistor is 3.0°C/W. If the ambient temperature (Ta) is guaranteed for 50°C, then the thermal resistance (θc-a) of a desired heat-sink should be;

From (1)’ $\theta c\text{-}a < (125 - 50)/19.6$

< 3.83

From (2)’ $\theta c\text{-}a < (150 - 50)/19.6 - 3.0/2$

< 3.60

Therefore, in order to satisfy both (1)’ and (2)’, the thermal resistance of a desired Heat-sink will be 3.60°C/W.

[Note]

Above are reference only. The samples are operated with a constant power supply. Please verify the conditions when your system is actually implemented.

A Thermal Design Tip For STK404-120N-E Amplifier

[Thermal Design Conditions]

The thermal resistance (θc-a) of the heat-sink which manages the heat dissipation inside the Hybrid IC will be determined as follow:

(Condition 1) The case temperature (Tc) of the Hybrid IC should not exceed 125°C

$Pd \times \theta c\text{-}a + Ta < 125°C$ ··························(1)

Where Ta : the ambient temperature for the system

(Condition 2) The junction temperature of each power transistor should not exceed 150°C

$Pd \times \theta c\text{-}a + Pd/N \times \theta j\text{-}c + Ta < 150°C$ ··························(2)

Where N : the number of transistors (two for 1 channel , ten for channel)

θj-c : the thermal resistance of each transistor (see specification)

Note that the power consumption of each power transistor is assumed to be equal to the total power dissipation (Pd) divided by the number of transistors (N).

From the formula (1) and (2), we will obtain:

$\theta c\text{-}a < (125 - Ta)/Pd$ ··························(1)’

$\theta c\text{-}a < (150 - Ta)/Pd - \theta j\text{-}c/N$ ··························(2)’

The value which satisfies above formula (1)’ and (2)’ will be the thermal resistance for a desired heat-sink.

Note that all of the component except power transistors employed in the Hybrid IC comply with above conditions.

[Example of Thermal Design]

Generally, the power consumption of actual music signals are being estimated by the continuous signal of 1/8 P_O max. (Note that the value of 1/8 P_O max may be varied from the country to country.)

(Sample of STK404-120N-E ; 80W×1ch)

If V_{CC} is ±41V, and R_L is 6Ω, then the total power dissipation (Pd) of inside Hybrid IC is as follow;

Pd = 37.5W (at 10W output power,1/8 of P_O max)

There are four (2) transistors in Audio Section of this Hybrid IC, and thermal resistance (θj-c) of each transistor is 1.7°C/W. If the ambient temperature (Ta) is guaranteed for 50°C, then the thermal resistance (θc-a) of a desired heat-sink should be;

From (1)’ $\theta c\text{-}a < (125 - 50)/37.5$

< 2.00

From (2)’ $\theta c\text{-}a < (150 - 50)/37.5 - 1.7/2$

< 1.82

Therefore, in order to satisfy both (1)’ and (2)’, the thermal resistance of a desired Heat-sink will be 1.82°C/W.

[Note]

Above are reference only. The samples are operated with a constant power supply. Please verify the conditions when your system is actually implemented.

A Thermal Design Tip For STK404-140N-E Amplifier

[Thermal Design Conditions]

The thermal resistance (θc-a) of the heat-sink which manages the heat dissipation inside the Hybrid IC will be determined as follow:

(Condition 1) The case temperature (Tc) of the Hybrid IC should not exceed 125°C

$Pd \times \theta c\text{-}a + Ta < 125°C$ ··························· (1)

Where Ta : the ambient temperature for the system

(Condition 2) The junction temperature of each power transistor should not exceed 150°C

$Pd \times \theta c\text{-}a + Pd/N \times \theta j\text{-}c + Ta < 150°C$ ··························· (2)

Where N : the number of transistors (two for 1 channel , ten for channel)

θj-c : the thermal resistance of each transistor (see specification)

Note that the power consumption of each power transistor is assumed to be equal to the total power dissipation (Pd) divided by the number of transistors (N).

From the formula (1) and (2), we will obtain:

$\theta c\text{-}a < (125 - Ta)/Pd$ ··························· (1)’

$\theta c\text{-}a < (150 - Ta)/Pd - \theta j\text{-}c/N$ ··························· (2)’

The value which satisfies above formula (1)’ and (2)’ will be the thermal resistance for a desired heat-sink.

Note that all of the component except power transistors employed in the Hybrid IC comply with above conditions.

[Example of Thermal Design]

Generally, the power consumption of actual music signals are being estimated by the continuous signal of 1/8 P_O max. (Note that the value of 1/8 P_O max may be varied from the country to country.)

(Sample of STK404-140N-E ; 120W×1ch)

If V_{CC} is ±51V, and R_L is 6Ω, then the total power dissipation (Pd) of inside Hybrid IC is as follow;

Pd = 57.2W (at 15W output power,1/8 of P_O max)

There are four (2) transistors in Audio Section of this Hybrid IC, and thermal resistance (θj-c) of each transistor is 1.1°C/W. If the ambient temperature (Ta) is guaranteed for 50°C, then the thermal resistance (θc-a) of a desired heat-sink should be;

From (1)’ $\theta c\text{-}a < (125 - 50)/57.2$

< 1.31

From (2)’ $\theta c\text{-}a < (150 - 50)/57.2 - 1.1/2$

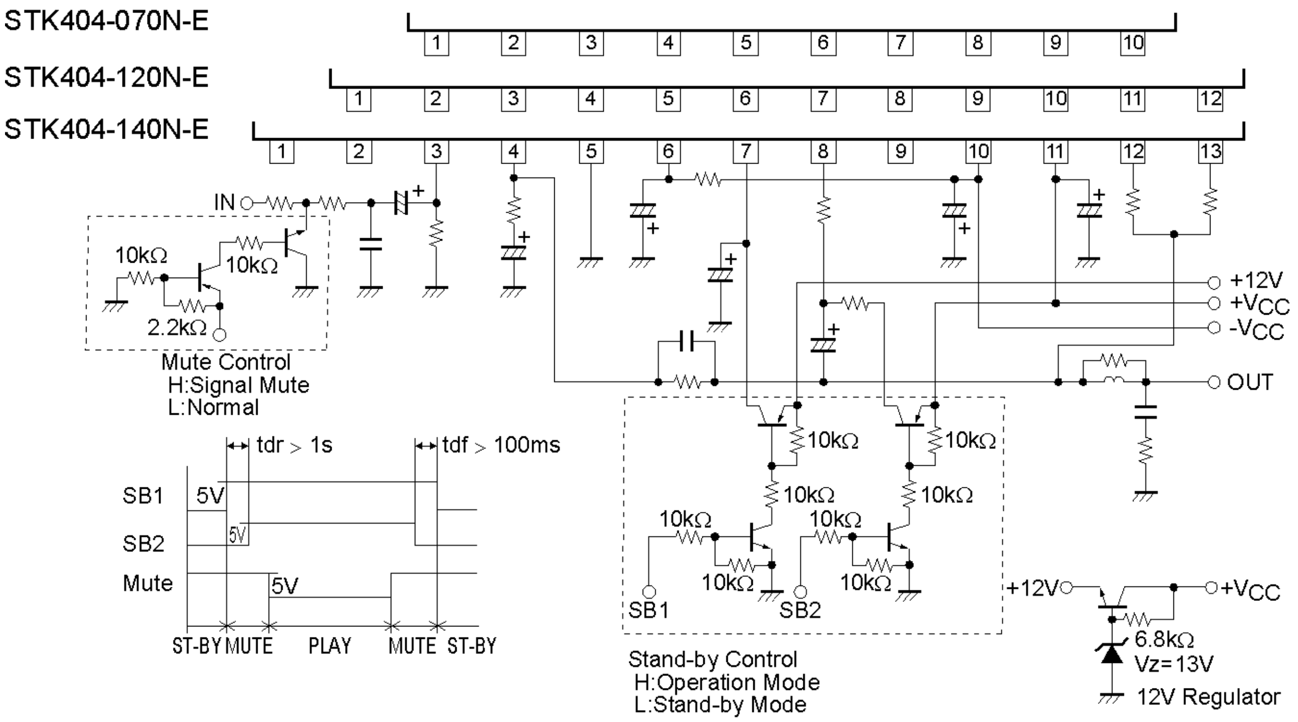
< 1.19

Therefore, in order to satisfy both (1)’ and (2)’, the thermal resistance of a desired Heat-sink will be 1.19°C/W.

[Note]

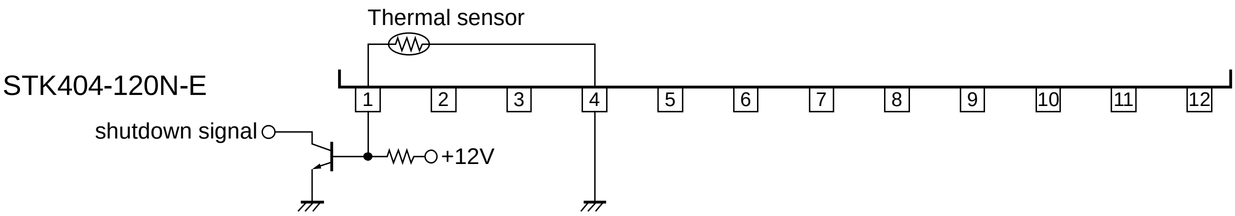
Above are reference only. The samples are operated with a constant power supply. Please verify the conditions when your system is actually implemented.

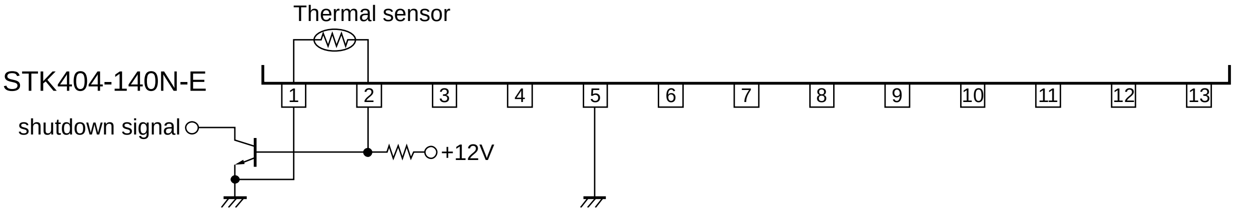
STK404-000N-Ese Stand-by control & Mute control Application



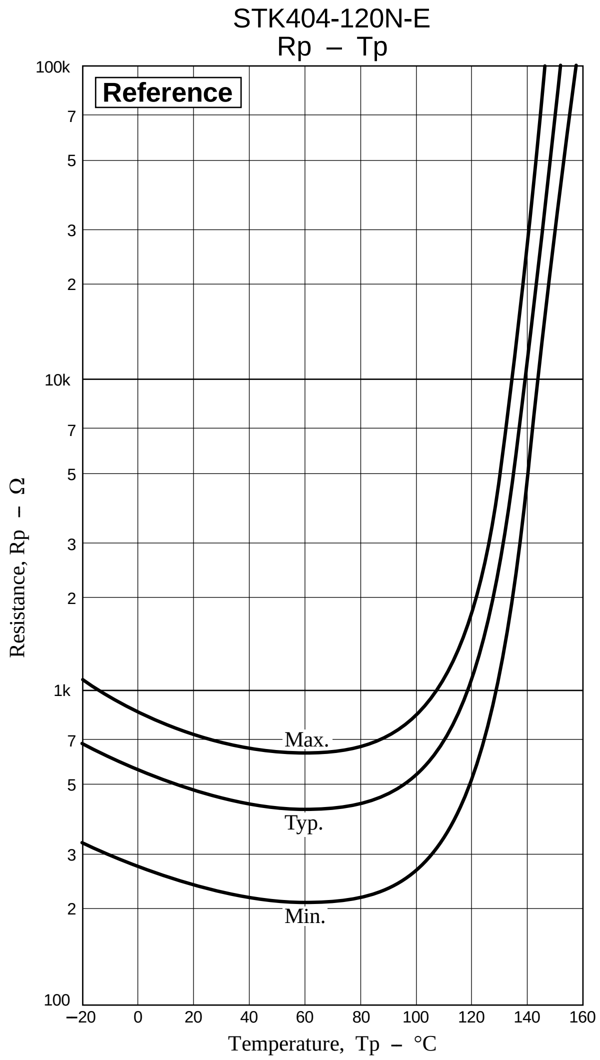
STK404-000N-Esr Thermal shut down Application

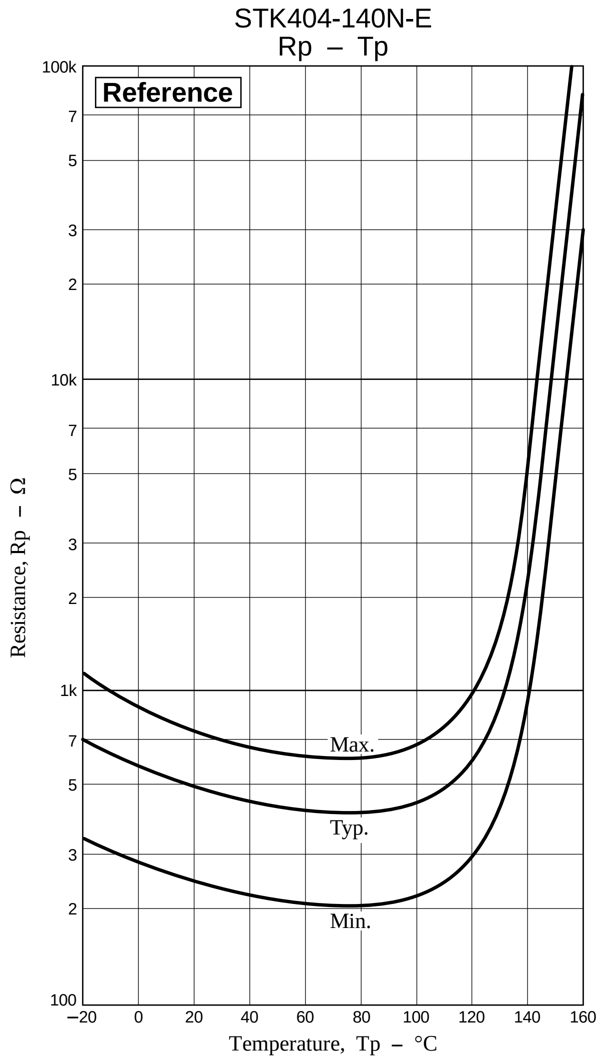
STK404-070N-E No thermal sensor



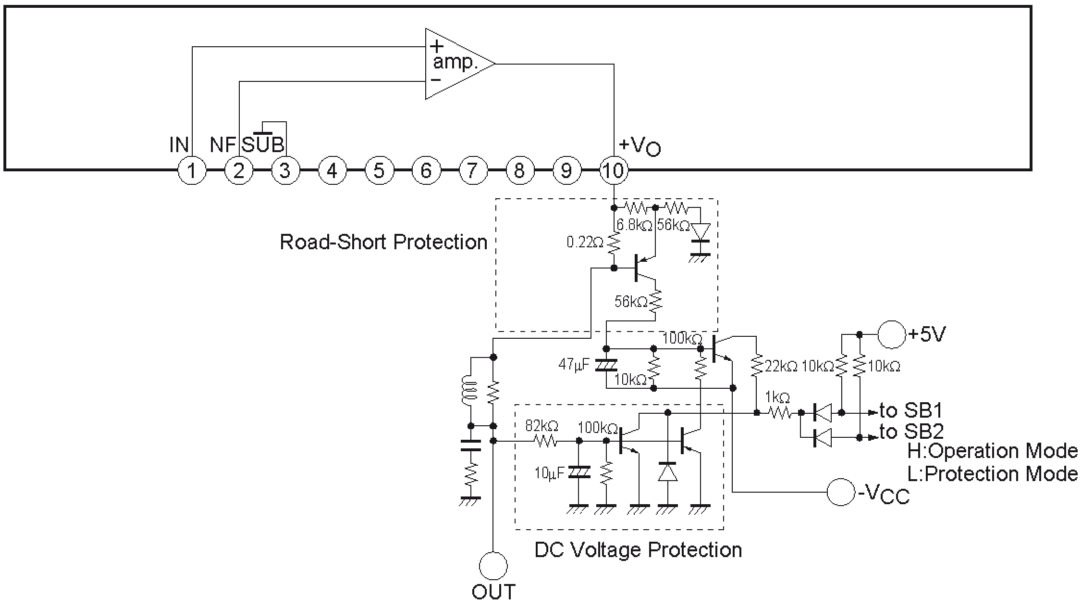


Thermal Sensor Characteristic

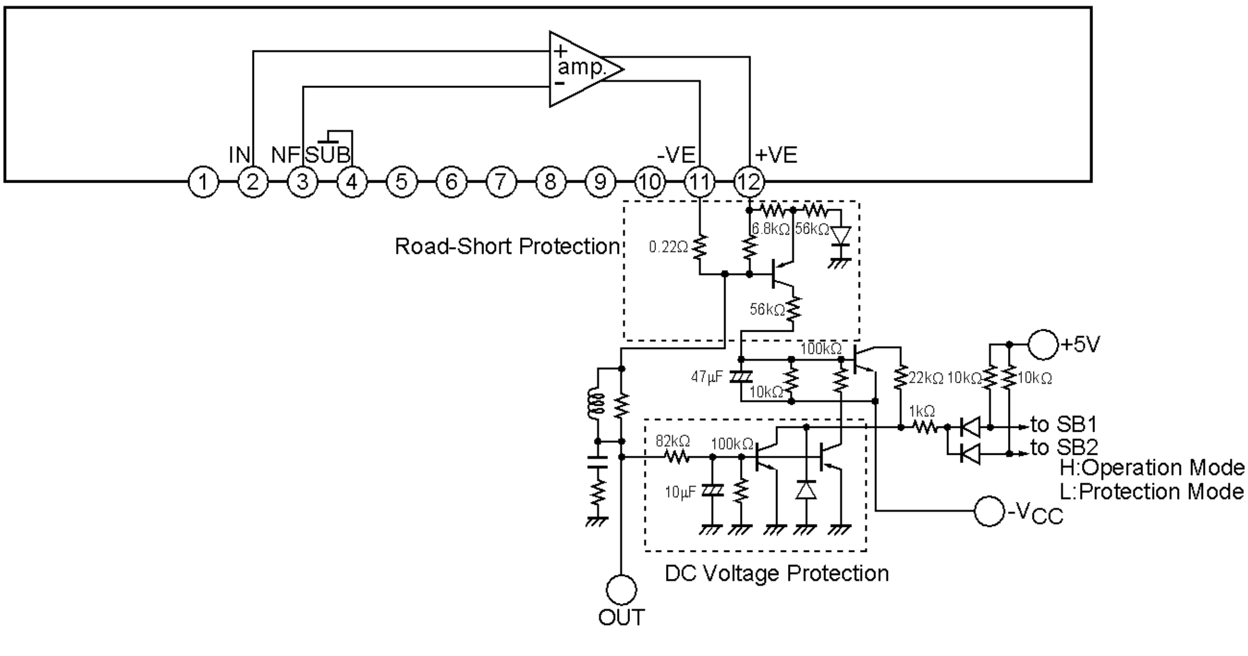




STK404-070N-E Road-Short & DC Voltage Protection Application



STK404-120N-E Road-Short & DC Voltage Protection Application



STK404-140N-E Road-Short & DC Voltage Protection Application