Ordering number : EN*A1470A

Preliminary

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SANYO Semiconductors
DATA SHEET

STK433-040-E — Thick-Film Hybrid IC 2-channel class AB audio power IC, 40W+40W

Overview

The STK433-040-E is a hybrid IC designed to be used in 40W × 2ch class AB audio power amplifiers.

Applications

- Audio power amplifiers.

Features

- Pin-to-pin compatible outputs ranging from 30W to 60W.
- Can be used to replace the STK433-100 series (80W to 150W/2ch) and STK433-200/-300 series (3-channel) due to its pin compatibility.
- Miniature package (47.0mm × 25.6mm × 9.0mm)
- Output load impedance: R_L = 6Ω to 4Ω supported
- Allowable load shorted time: 0.3 second
- Allows the use of predesigned applications for standby and mute circuits.

Series Models

	STK433-030-E	STK433-040-E	STK433-060-E	STK433-070-E
Output 1 (10%/1kHz)	30W×2 channels	40W×2 channels	50W×2 channels	60W×2 channels
Output 2 (0.4%/20Hz to 20kHz)	20W×2 channels	25W×2 channels	35W×2 channels	40W×2 channels
Max. rated V_{CC} (quiescent)	±34V	±38V	±46V	±50V
Max. rated V_{CC} (6Ω)	±32V	±36V	±40V	±44V
Max. rated V_{CC} (4Ω)	±26V	±30V	±33V	±37V
Recommended operating V_{CC} (6Ω)	±21V	±24V	±27V	±29V
Dimensions (excluding pin height)	47.0mm×25.6mm×9.0mm			

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Specifications

Absolute Maximum Ratings at Ta = 25°C (excluding rated temperature items), Tc=25°C unless otherwise specified

Parameter	Symbol	Conditions	Ratings	Unit
Maximum quiescent supply voltage 0	V_{CC} max (0)	When no signal	±38	V
Maximum supply voltage 1	V_{CC} max (1)	R_L≥6Ω	±36	V
Maximum supply voltage 2	V_{CC} max (2)	R_L=4Ω	±30	V
Minimum operating supply voltage	V_{CC} min		±10	V
Pin 13 input voltage	VST max		-0.3 to +5.5	V
Thermal resistance	θj-c	Per power transistor	4.2	°C/W
Junction temperature	Tj max	Both the Tj max and Tc max conditions must be met.	150	°C
IC substrate operating temperature	Tc max		125	°C
Storage temperature	Tstg		-30 to +125	°C
Allowable load shorted time *4	ts	V_H=±24V, R_L=6Ω, f=50Hz, P_O=25W, 1-channel active	0.3	s

Operating Characteristics at Tc=25°C, R_L=6Ω, Rg=600Ω, VG=30dB, non-inductive load R_L, unless otherwise specified

Parameter	Symbol	Conditions *2					Ratings			unit
		V_{CC} (V)	f (Hz)	P_O (W)	THD (%)		min	typ	max	
Output power *1	P_O (1)	±24	20 to 20k		0.4		23	25		W
	P_O (2)	±24	1k		10			40		W
	P_O (3)	±20	1k		1	R_L=4Ω		25		W
Total harmonic distortion *1	THD (1)	±24	20 to 20k	5.0					0.4	%
	THD (2)	±24	1k	5.0				0.02		%
Frequency characteristics *1	f_L, f_H	±24		1.0		+0 -3dB	20 to 50k			Hz
Input impedance	ri	±24	1k	1.0				55		kΩ
Output noise voltage *3	V_{NO}	±29				Rg=2.2kΩ			1.0	mVrms
Quiescent current	I_{CCO}	±29				No loading	20	45	70	mA
Standby current	I_{CST}	±29							1	mA
Output neutral voltage	V_N	±29					-70	0	+70	mV
Pin 13 voltage when standby ON	VST ON	±24				Standby			0.6	V
Pin 13 voltage when standby OFF	VST OFF	±24				Operating	2.5			V

[Remarks]

*1: For 1-channel operation

*2: Unless otherwise specified, use a constant-voltage power supply to supply power when inspections are carried out.

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

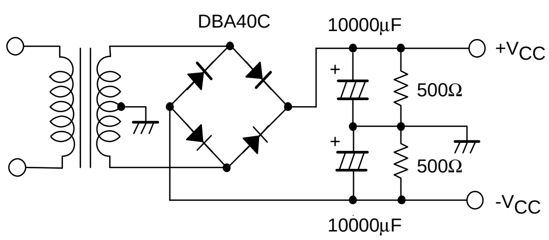
*4: Use the transformer power supply circuit shown in the figure below for allowable load shorted time measurement.

*5: Please connect –Pre V_{CC} pin (#1 pin) with the stable minimum voltage and connect so that current does not flow in by reverse bias.

* Thermal design must be implemented based on the conditions under which the customer's end products are expected to operate on the market.

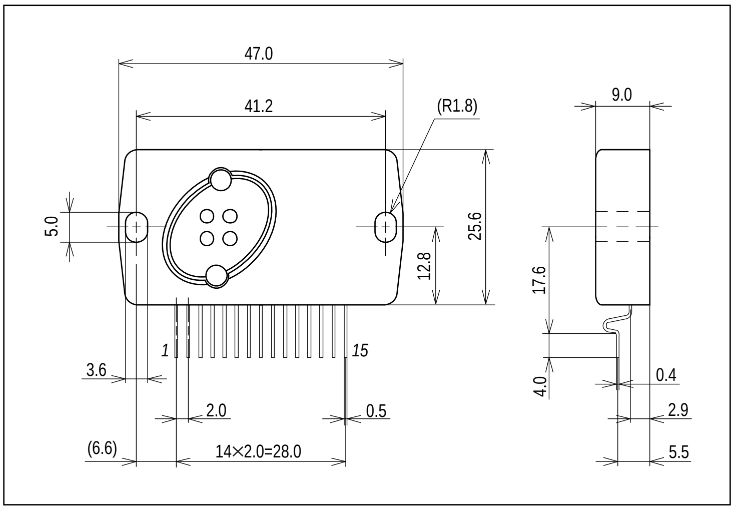
* A thermoplastic adhesive is used to adhere the case.

Designated transformer power supply (MG-200 equivalent)

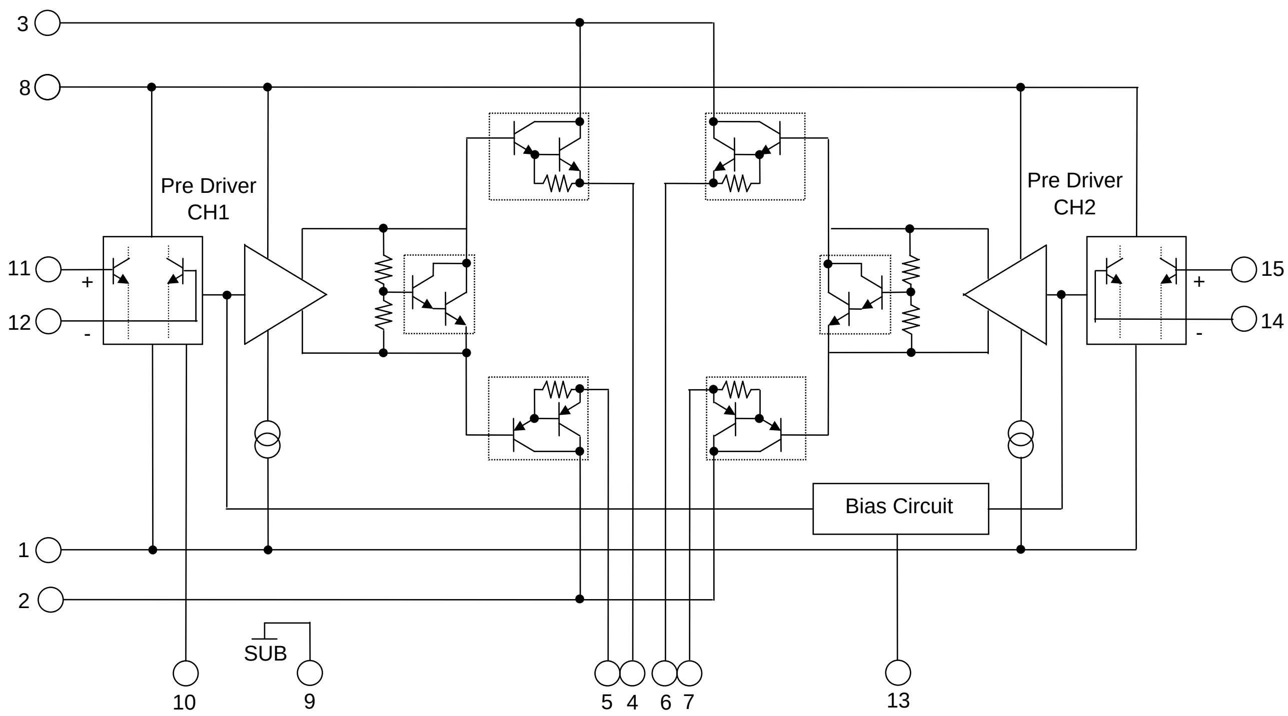


Package Dimensions

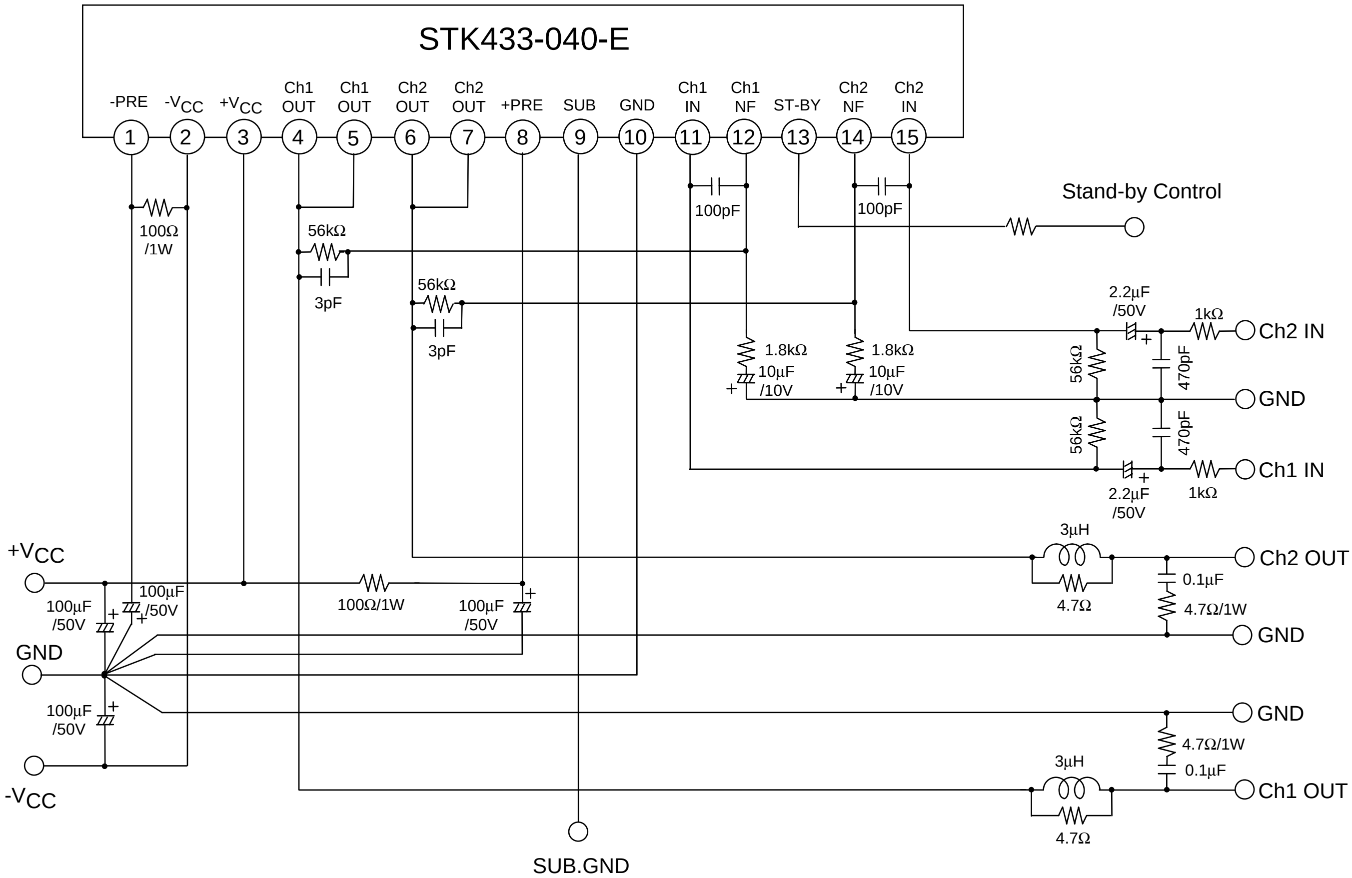
unit:mm (typ)



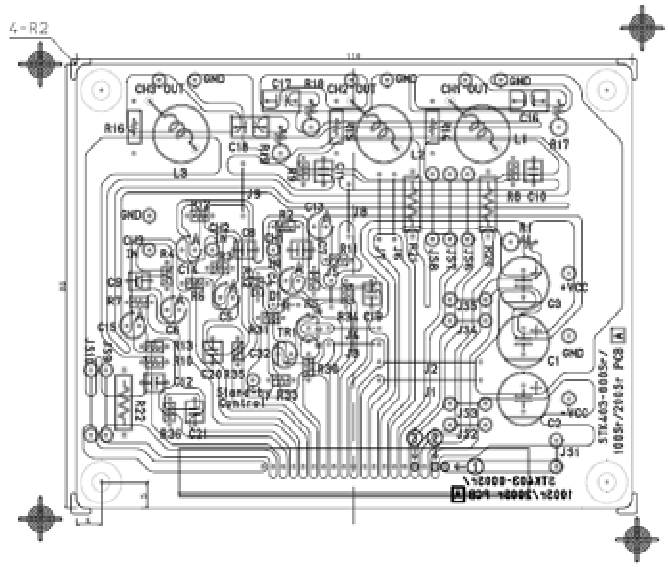
Internal Equivalent Circuit



Application Circuit Example



Sample PCB Trace Pattern



STK433-000/-200/STK403-100Sr PCB PARTS LIST

PCB Name: STK403-000Sr/100Sr/200Sr PCBA

Location No. (*3)		PARTS	RATING	Component	
				STK433-030/-040	STK433-060/-070
				STK433-230/-240	STK433-260/-270
					STK403-090 to130
Hybrid IC#1 Pin Position		-	-	①	
R01		ERG1SJ101	100Ω, 1W	enable	
R02, R03 (R4)		RN16S102FK	1kΩ, 1/6W	enable	
R05, R06, R08, R09 (R7, R10)		RN16S563FK	56kΩ, 1/6W	enable	
R11, R12 (R13)		RN16S182FK	1.8kΩ, 1/6W	enable	
R14, R15 (R16)		RN14S4R7FK	4.7Ω, 1/4W	enable	
R17, R18 (R19)		ERX1SJ4R7	4.7Ω, 1W	enable	
R20, R21 (R22)		ERX2SJR22	0.22Ω, 2W	short	enable
C01, C02, C03		100MV100HC	100μF, 100V	enable	
C04, C05 (C06)		50MV2R2HC	2.2μF, 50V	enable (*1)	
C07, C08 (C09)		DD104-63B471K50	470pF, 50V	enable	
C10, C11 (C12)		DD104-63CJ030C50	3pF, 50V	enable (*2)	
C13, C14 (C15)		10MV10HC	10μF, 10V	enable (*1)	
C16, C17 (C18)		ECQ-V1H104JZ	0.1μF, 50V	enable	
C19, C20 (C21)		DD104-63B***K50	***pF, 50V	100pF	
R34, R35 (R36)		RN16S302FK	3kΩ, 1/6W	Short	
L01, L02 (L3)		-	3μH	enable	
Stand-By Control Circuit	Tr1	2SC2274 (Reference)	VCE≥50V, IC≥10mA	enable	
	D1	GMB01 (Reference)	Di	enable	
	R30	RN16S512FK	5.1kΩ, 1/6W	STK433-*00series	
		RN16S103FK	13kΩ, 1/6W	STK403-100series	
	R31	RN16S333FK	33kΩ, 1/6W	enable	
	R32	RN16S102FK	1kΩ, 1/6W	enable	
	R33	RN16S202FK	2kΩ, 1/6W	enable	
	C32	10MV33HC	33μF, 10V	enable	
J1, J2, J3, J4, J5, J6, J8, J9		-	-	enable	
J7, JS2, JS3, JS4, JS5, JS7 JS8, JS9		-	-	-	
JS6, JS10		-	-	enable	
JS1		-	-	enable	

(*1) Capacitor mark "A" side is "-" (negative).
(*2) STK433-200Sr (3ch) is 8pF use.
(*3) Location No.( ) parts is STK433-200Sr (3ch) only use.

Pin Assignments

[STK433-000/-100/-200Sr & STK415/416-100Sr Pin Layout]

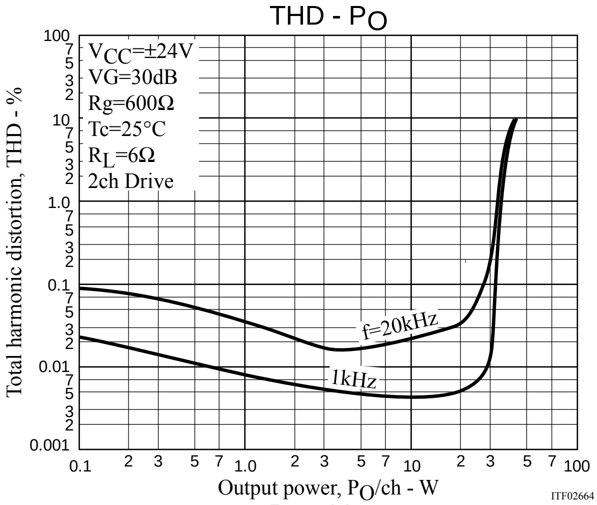
2-channel class-AB	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	2-channel class AB/2.00mm														
STK433-030-E 30W/JEITA **STK433-040-E 40W/JEITA** STK433-060-E 50W/JEITA STK433-070-E 60W/JEITA STK433-090-E 80W/JEITA STK433-100-E 100W/JEITA STK433-120-E 120W/JEITA STK433-130-E 150W/JEITA	-PRE	-VCC	+VCC	OUT/CH1+	OUT/CH1-	OUT/CH2+	OUT/CH2-	+PRE	SUB•GND	GND	IN/CH1	NF/CH1	STAND-BY	NF/CH2	IN/CH2

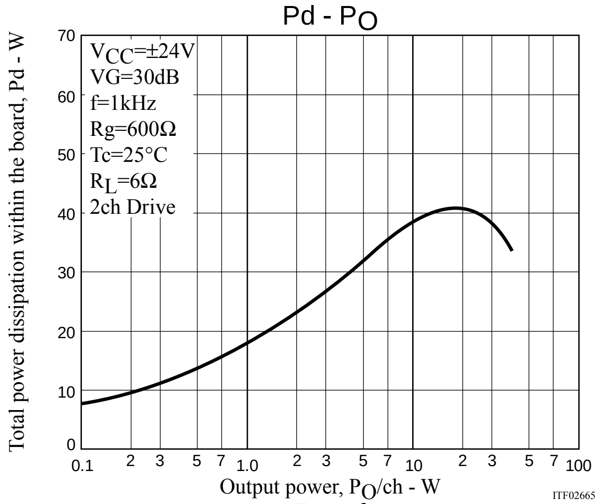
3-channel class-AB	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
	3-channel class AB/2.00mm																		
STK433-230A-E 30W/JEITA STK433-240A-E 40W/JEITA STK433-260A-E 50W/JEITA STK433-270-E 60W/JEITA STK433-290-E 80W/JEITA STK433-300-E 100W/JEITA STK433-320-E 120W/JEITA STK433-330-E 150W/JEITA	-PRE	-VCC	+VCC	OUT/CH1+	OUT/CH1-	OUT/CH2+	OUT/CH2-	+PRE	SUB•GND	GND	IN/CH1	NF/CH1	STAND-BY	NF/CH2	IN/CH2	IN/CH3	NF/CH3	OUT/CH3+	OUT/CH3-

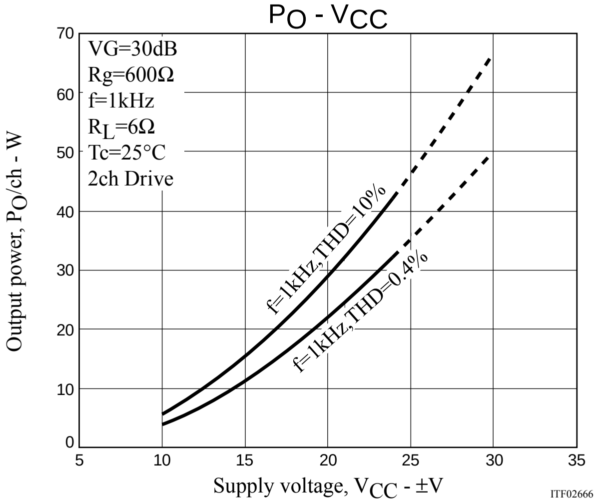
2-channel class-H	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
	2-channel class H/2.00mm																		
STK415-090-E 80W/JEITA STK415-100-E 90W/JEITA STK415-120-E 120W/JEITA STK415-130-E 150W/JEITA STK415-140-E 180W/JEITA	+VL	-VL	+OFFSET	-OFFSET	-PRE	-VH	+VH	OUT/CH1+	OUT/CH1-	OUT/CH2+	OUT/CH2-	+PRE	SUB•GND	GND	IN/CH1	NF/CH1	STAND-BY	NF/CH2	IN/CH2

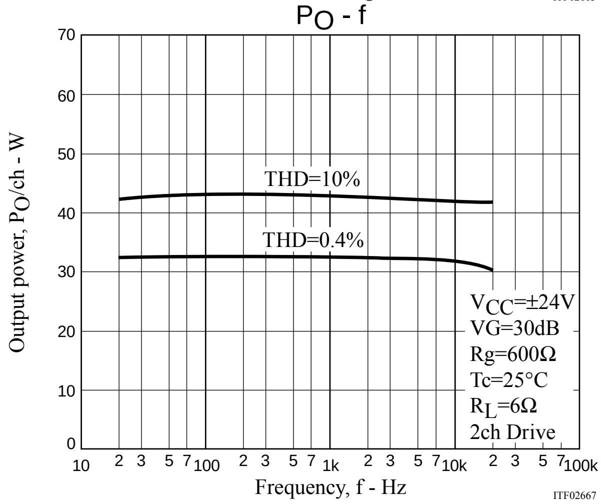
3-channel class-H	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
	3-channel class H/2.00mm																						
STK416-090-E 80W/JEITA STK416-100-E 90W/JEITA STK416-120-E 120W/JEITA STK416-130-E 150W/JEITA	+VL	-VL	+OFFSET	-OFFSET	-PRE	-VH	+VH	OUT/CH1+	OUT/CH1-	OUT/CH2+	OUT/CH2-	+PRE	SUB•GND	GND	IN/CH1	NF/CH1	STAND-BY	NF/CH2	IN/CH2	IN/CH3	NF/CH3	OUT/CH3+	OUT/CH3-

Evaluation Board Characteristics









[Thermal Design Example for STK433-040-E (R_L = 6Ω)]

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

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

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

Ta: Guaranteed ambient temperature for the end product

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

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

N: Number of power transistors

θj-c: Thermal resistance per power transistor

However, the power dissipation, Pd, for the power transistors shall be allocated equally among the number of power transistors.

The following inequalities result from solving equations (1) and (2) for θc-a.

$$\theta c\text{-}a < (125 - Ta)/Pd \quad \text{......} \quad (1)'$$

$$\theta c\text{-}a < (150 - Ta)/Pd - \theta j\text{-}c/N \quad \text{......} \quad (2)'$$

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 R_L
- Guaranteed ambient temperature Ta

[Example]

When the IC supply voltage, V_{CC}, is ±24V and R_L is 6Ω, the total power dissipation, Pd, within the hybrid IC, will be a maximum of 41W at 1kHz for a continuous sine wave signal according to the Pd-P_O characteristics.

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

This is:

Pd ≈ 31.8W (when 1/8P_O max. = 5.0W, P_O max. = 40W).

The number of power transistors in audio amplifier block of these hybrid ICs, N, is 4, and the thermal resistance per transistor, θj-c, is 4.2°C/W. Therefore, the required heat sink thermal resistance for a guranteed ambient temperature, Ta, of 50°C will be as follows.

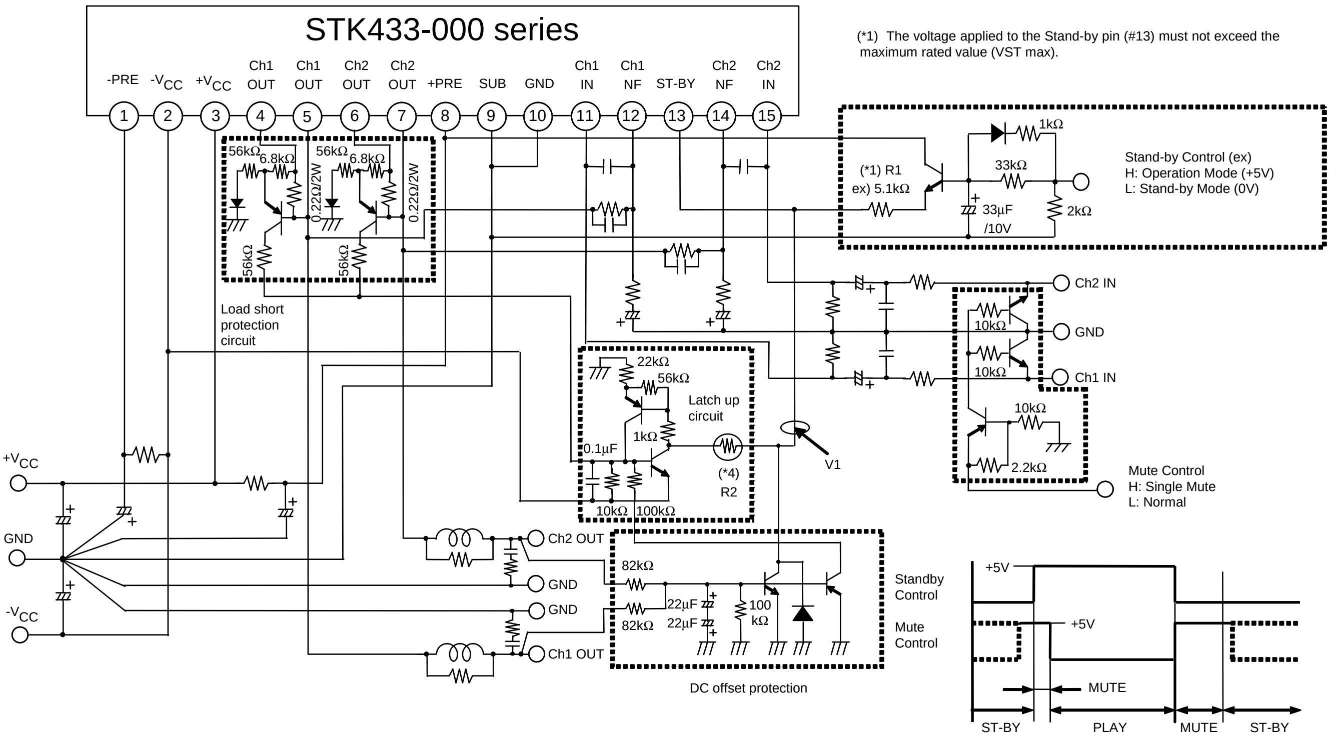
From formula (1)' θc-a < (125 – 50)/31.8
< 2.36

From formula (2)' θc-a < (150 – 50)/31.8 – 4.2/4
< 2.09

Therefore, the value of 2.09°C/W, which satisfies both of these formulae, is the required thermal resistance of the heat sink.

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.

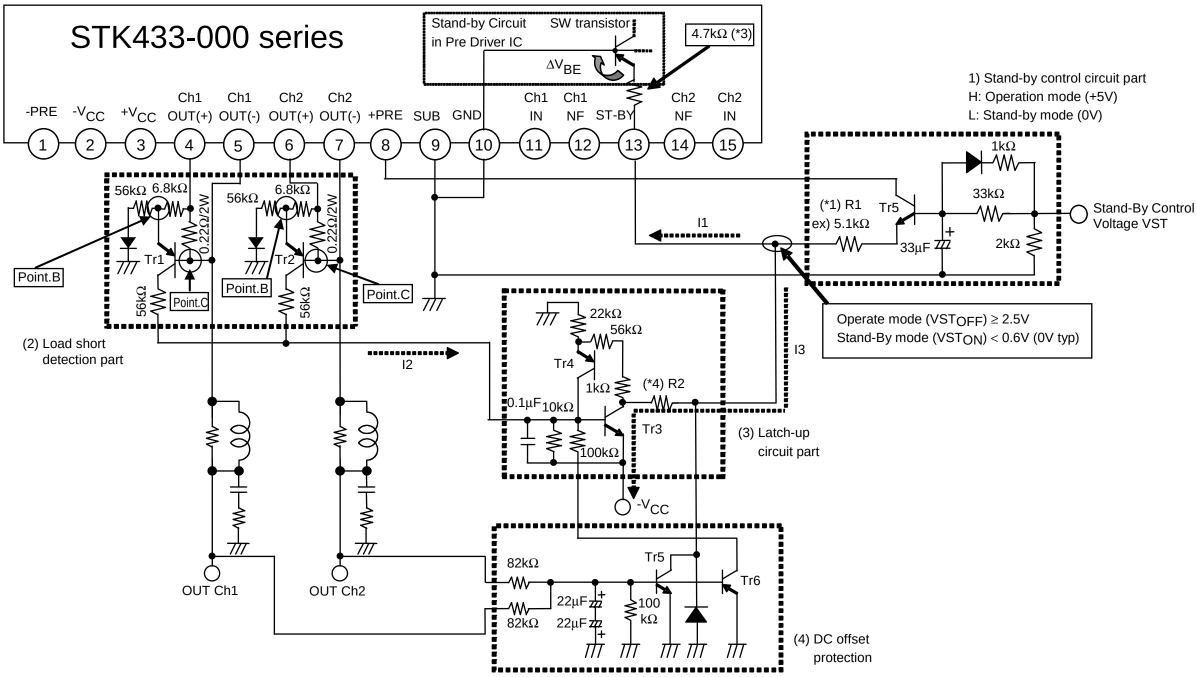
STK433-000 Series Standby Control, Mute Control, Load-short Protection & DC offset Protection application



(*1) R1 is changed depending on the power-supply voltage (-V_{CC}).

Please set resistance (R1) to become “V1 ≈ 0V” by the following calculation types.

STK433-000 Series Application Explanation



The protection circuit application for the STK433-000sr consists of the following blocks (blocks (1) to (4)).
(1) Standby control circuit block
(2) Load short-circuit detection block
(3) Latch-up circuit block
(4) DC voltage protection block

1) Standby control circuit block
Concerning pin 13 reference voltage VST

<1> Operation mode
The switching transistor of the predriver IC turns on when the pin 13 reference voltage, VST, becomes greater than or equal to 2.5V, placing the amplifier into the operation mode.
Example: When VST (min.) = 2.5V
I1 is approximately equal to 0.40mA since $VST = (*2) \times IST + 0.6V \rightarrow 2.5V = 4.7k\Omega \times IST + 0.6V$.

<2> Standby mode
The switching transistor of the predriver IC turns off when the pin 13 reference voltage, VST, becomes lower than or equal to 0.6V (typ. 0V), placing the amplifier into the standby mode.
Example: When VST = 0.6V
I1 is approximately equal to 0mA since $VST = (*2) \times IST + 0.6V \rightarrow 0.6V = 4.7k\Omega \times IST + 0.6V$.

(*1) Limiting resistor
Determine the value of R1 so that the voltage VST applied to the standby pin (pin 13) falls within the rating (+2.5V to 5.5V (typ. 3.0V)).

(*2) The standby control voltage must be supplied from the host including microcontrollers.

(*3) A 4.7kΩ limiting resistor is also incorporated inside the hybrid IC (at pin 13).

2) Load short-circuit detection block

Since the voltage between point B and point C is less than 0.6V in normal operation mode (V_{BE} < 0.6V) and TR1 (or TR2) is not activated, the load short-circuit detection block does not operate.

When a load short-circuit occurs, however, the voltage between point B and point C becomes larger than 0.6V, causing TR1 (or TR2) to turn on (V_{BE} > 0.6V), and current I2 to flows.

3) Latch-up circuit block

TR3 is activated when I2 is supplied to the latch-up circuit.

When TR3 turns on and current I3 starts flowing, VST goes down to 0V (standby mode), protecting the power amplifier.

Since TR3 and TR4 configure a thyristor, once TR3 is activated, the IC is held in the standby mode.

To release the standby mode and reactivate the power amplifier, it is necessary to set the standby control voltage (*2) temporarily low (0V). Subsequently, when the standby control is returned to high, the power amplifier will become active again.

(*4) The I3 value varies depending on the supply voltage. Determine the value of R2 using the formula below, so that I1 is equal to or less than I3.

$I1 \leq I3 = V_{CC}/R2$

4) DC offset protection block

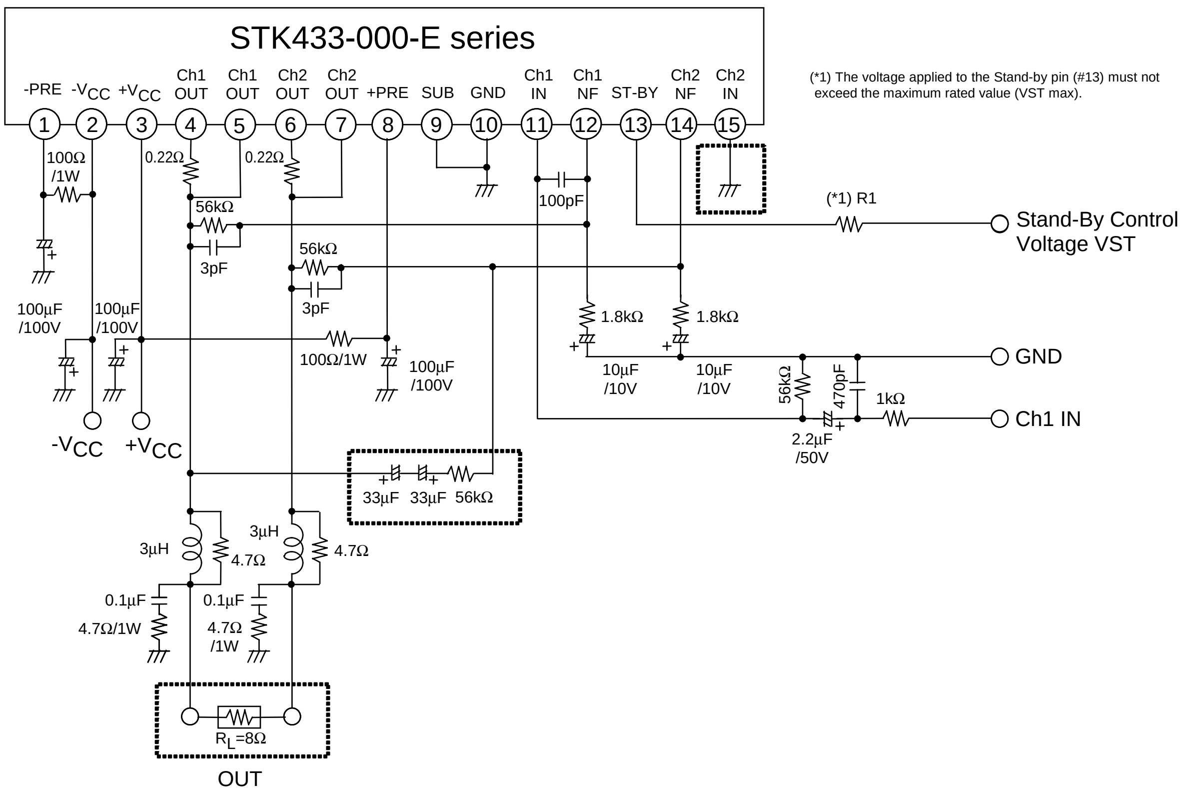
The DC offset protection circuit is activated when ±0.5V (typ) voltage is applied to either "OUT CH1" or "OUT CH2," and the hybrid IC is shut down (standby mode).

To release the IC from the standby mode and reactivate the power amplifier, it is necessary to set the standby control voltage temporarily low (0V).

Subsequently, when the standby control is returned to high (+5V, for example), the power amplifier will become active again.

The protection level must be set using the 82kΩ resistor. Furthermore, the time constant must be determined using 22µ//22µ capacitors to prevent the amplifier from malfunctioning due to the audio signal.

STK433-000 Series BTL Application



This catalog provides information as of July, 2009. Specifications and information herein are subject to change without notice.