



# STK433-040N-E

Thick-Film Hybrid IC

## 2ch class-AB Audio Power IC 40W+40W

ON Semiconductor®

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### Overview

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

### Application

- Audio Power amplifiers

### Features

- Pin-to-pin compatible outputs ranging from 40W to 150W.
- Output load impedance:  $R_L = 6\Omega$  recommended.
- Allows the use of predesigned applications for standby and mute circuit.
- Miniature package.
- Allowable load shorted time: 0.3 second

### Series model

	STK433-040N-E	STK433-060N-E	STK433-130N-E
Output1 (10%/1kHz)	40W × 2ch	50W × 2ch	150W × 2ch
Output2 (0.4%/20Hz to 20kHz)	25W × 2ch	35W × 2ch	100W × 2ch
Max. rating $V_{CC}$ (quiescent)	±38V	±46V	±71.5V
Max. rating $V_{CC}$ (6Ω)	±36V	±40V	±63V
Recommended operating $V_{CC}$ (6Ω)	±24V	±27V	±44V
Dimensions (excluding pin height)	47.0mm×25.6mm×9.0mm		67.0mm×25.6mm×9.0mm

	STK433-330N-E	STK433-840N-E	STK433-890N-E
Output1 (10%/1kHz)	150W × 3ch	40W × 4ch	80W × 4ch
Output2 (0.4%/20Hz to 20kHz)	100W × 3ch	25W × 4ch	50W × 4ch
Max. rating $V_{CC}$ (quiescent)	±71.5V	±38V	±54V
Max. rating $V_{CC}$ (6Ω)	±63V	±36V	±47V
Recommended operating $V_{CC}$ (6Ω)	±44V	±25V	±34V
Dimensions (excluding pin height)	64.0mm×36.6mm×9.0mm	64.0mm×31.1mm×9.0mm	78.0mm×44.1mm×9.0mm

### Specifications

**Absolute Maximum Ratings** at  $T_a = 25^\circ\text{C}$ ,  $T_c = 25^\circ\text{C}$  unless otherwise specified

Parameter	Symbol	Conditions	Ratings	Unit
Maximum power supply voltage	$V_{CC}$ max (0)	Non- signal	±38	V
	$V_{CC}$ max (1)	Signal, $R_L \geq 6\Omega$	±36	V
	$V_{CC}$ max (2)	Signal, $R_L \geq 4\Omega$	±30	V
Minimum operation supply voltage	$V_{CC}$ min		±10	V
#13 Operating voltage *5	VST OFF max	#13 voltage	-0.3 to +5.5	V
Thermal resistance	$\theta_{j-c}$	Per one power transistor	4.2	$^\circ\text{C}/\text{W}$
Junction temperature	$T_j$ max	Should satisfy $T_j$ max and $T_c$ max	150	$^\circ\text{C}$
Operating substrate temperature	$T_c$ max		125	$^\circ\text{C}$
Storage temperature	$T_{stg}$		-30 to +125	$^\circ\text{C}$
Allowable time for load short-circuit *4	$t_s$	$V_{CC} = \pm 24\text{V}$ , $R_L = 6\Omega$ , $f = 50\text{Hz}$ $P_O = 25\text{W}$ , 1ch drive	0.3	s

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

### ORDERING INFORMATION

See detailed ordering and shipping information on page 11 of this data sheet.

# STK433-040N-E

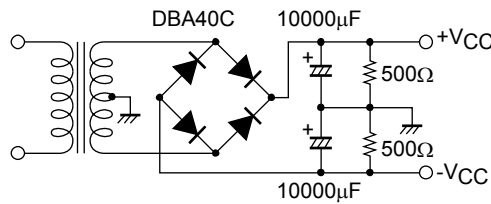
**Operating Characteristics** at  $T_c = 25^\circ\text{C}$ ,  $R_L = 6\Omega$  (Non-inductive Load),  $R_g = 600\Omega$ ,  $V_G = 30\text{dB}$

Parameter	Symbol	Conditions *2				Ratings			Unit	
		$V_{CC}$ [V]	f [Hz]	$P_O$ [W]	THD [%]	min	typ	max		
Output power *1	$P_{O1}$	$\pm 24$	20 to 20k		0.4	23	25		W	
	$P_{O2}$	$\pm 24$	1k		10		40			
	$P_{O3}$	$\pm 20$	1k		1	$R_L = 4\Omega$	25			
Total harmonic distortion *1	THD 1	$\pm 24$	20 to 20k	5.0				0.4	%	
	THD 2	$\pm 24$	1k							$V_G = 30\text{dB}$
Frequency characteristics *1	$f_L, f_H$	$\pm 24$		1.0		+0 -3dB	20 to 50k		Hz	
Input impedance	$r_i$	$\pm 24$	1k	1.0			55		$k\Omega$	
Output noise voltage *3	$V_{NO}$	$\pm 29$				$R_g = 2.2k\Omega$		1.0	mVrms	
Quiescent current	$I_{CCO}$	$\pm 29$				No load	15	30	70	mA
Quiescent current at stand-by	$I_{CST}$	$\pm 29$							1.0	mA
Output neutral voltage	$V_N$	$\pm 29$					-70	0	+70	mV
#13 Stand-by ON threshold *5	VST ON	$\pm 24$				Stand-by		0	0.6	V
#13 Stand-by OFF threshold *5	VST OFF	$\pm 24$				Operation	2.5	3.0	5.5	V

**Note**

- \*1. 1channel operation.
- \*2. All tests are measured using a constant-voltage supply unless otherwise specified
- \*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.
- \*5. Please connect - PreVcc pin (#1 pin) with the stable minimum voltage.  
and connect so that current does not flow in by reverse bias.
- \*6. In case of heat sink design, we request customer to design in the condition to have assumed market.
- \* The case of this Hybrid-IC is using thermosetting silicon adhesive (TSE322SX).
- \* Weight of HIC : (typ) 12.0g  
Outer carton dimensions (W×L×H) : 452mm×325mm×192mm

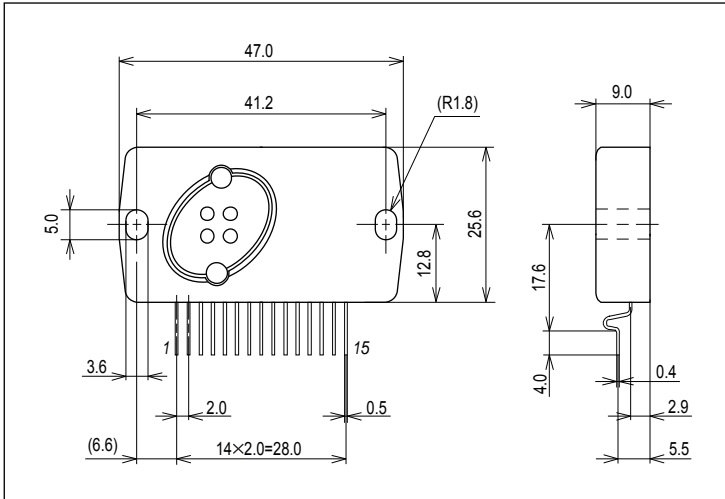
**Specified transformer power supply  
(Equivalent to MG-200)**



# STK433-040N-E

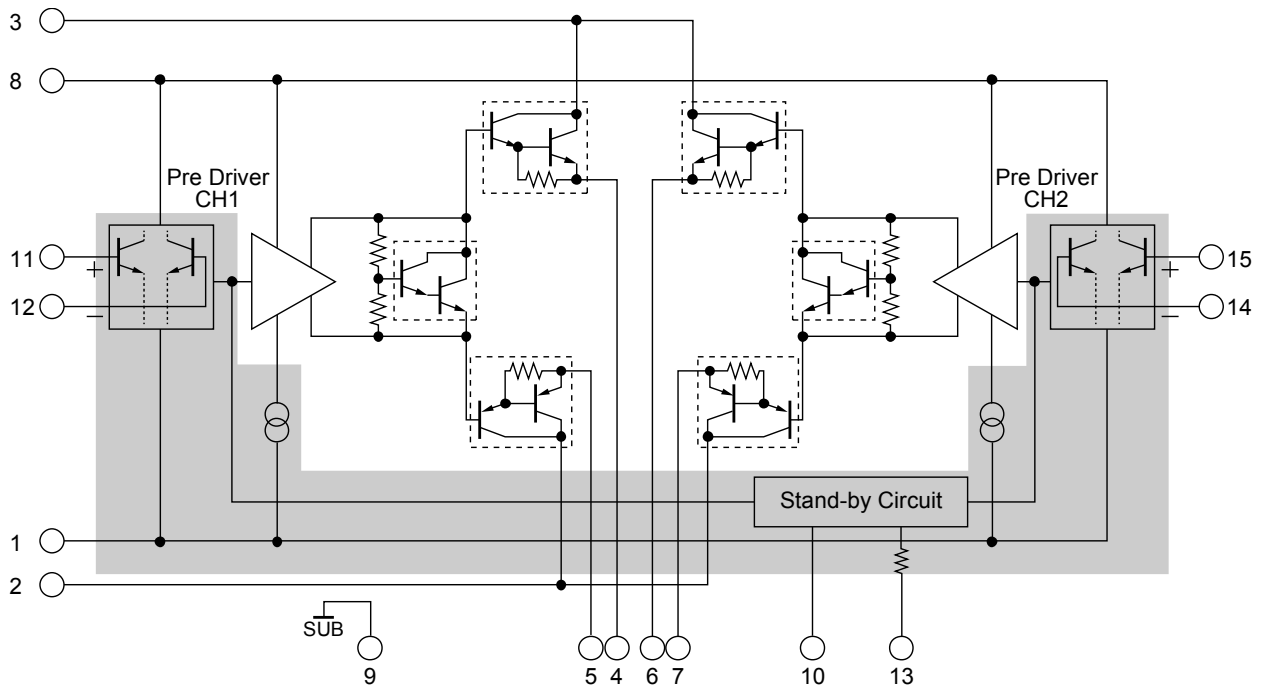
## Package Dimensions

unit : mm (typ)



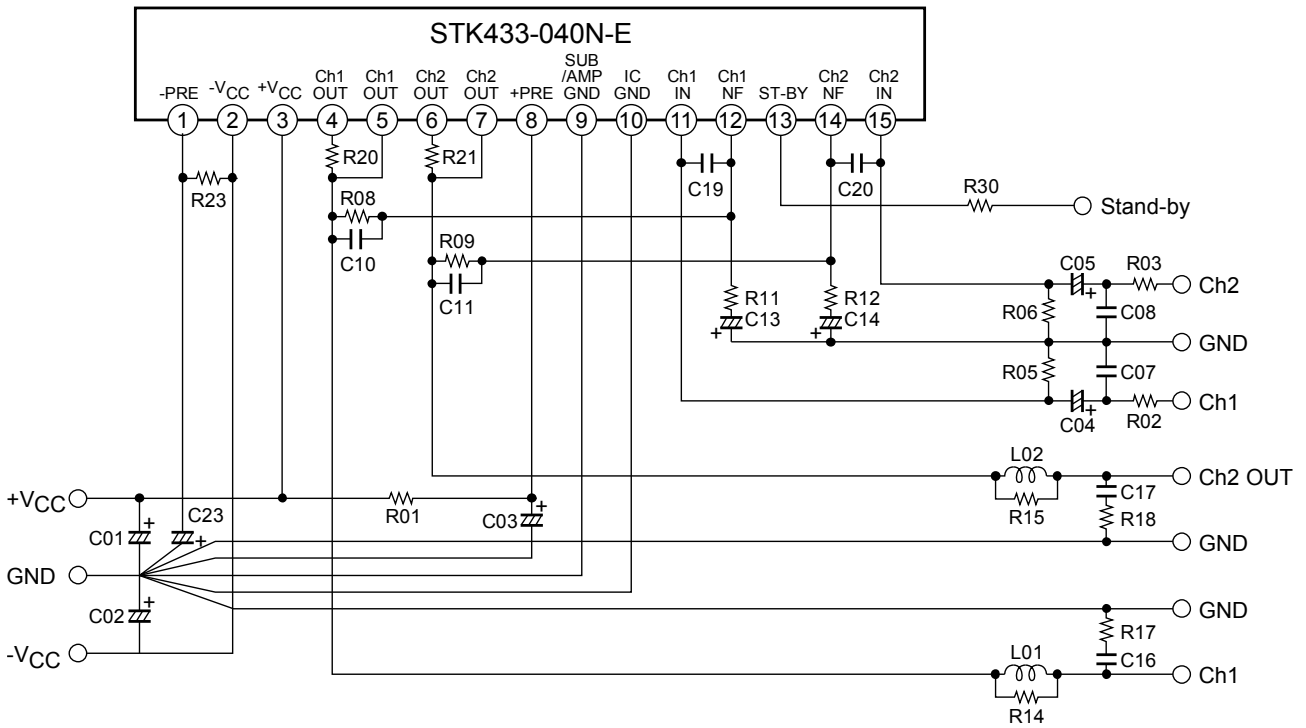
RoHS directive pass

## Equivalent Circuit



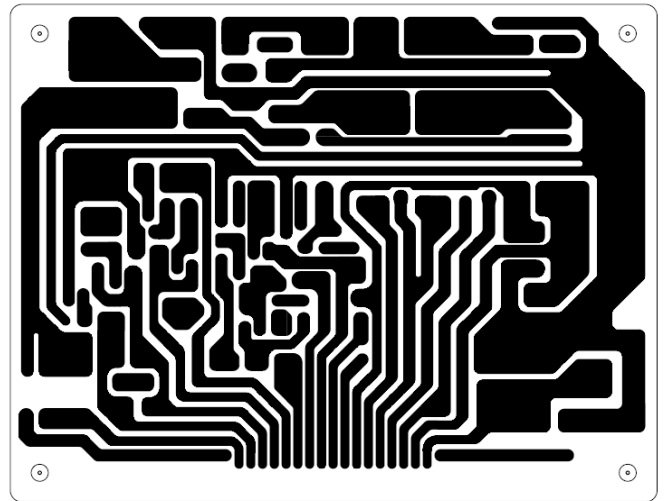
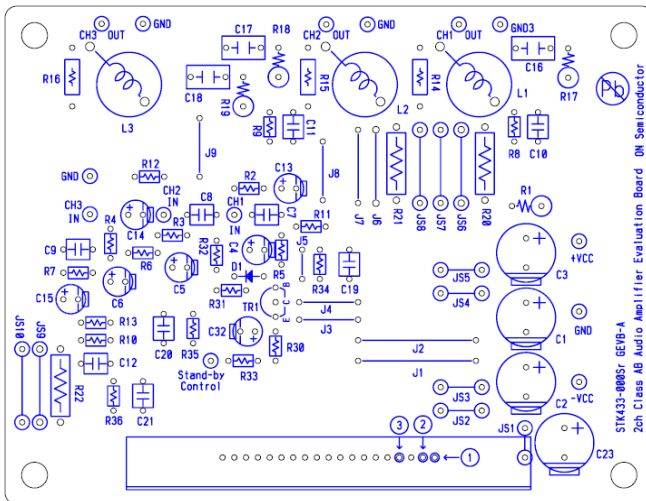
# STK433-040N-E

## Application Circuit



## PCB Layout Example

Top view



## STK433-040N-E

### STK433-040N-E/060N-E/130N-E/330N-E PCB PARTS LIST

PCB Name : STK433 - 000Sr GEVB - A

Location No.  (*2) 2ch Amp doesn't mount parts of (    ).	RATING	Component		
Hybrid IC#1 Pin Position	-	STK433-		
		040N-E	060N-E	130N-E/ 330N-E
R01	100Ω, 1W	○		
R02, R03, (R04)	1kΩ, 1/6W	○		
R05, R06, (R07), R08, R09, (R10)	56KΩ, 1/6W	○		
R11, R12, (R13)	1.8KΩ, 1/6W	○		
R14, R15, (R16)	4.7Ω, 1/4W	○		
R17, R18, (R19)	4.7Ω, 1W	○		
R20, R21, (R22)	0.22Ω, 2W	○	○	-
	0.22Ω, 5W	-	-	○
C01, C02, C03, C23	100μF, 100V	○		
C04, C05, (C06)	2.2μF, 50V	○		
C07, C08, (C09)	470pF, 50V	○		
C10, C11, (C12)	3pF, 50V	○		
C13, C14, (C15)	10μF, 16V	○		
C16, C17, (C18)	0.1μF, 50V	○		
C19, C20, (C21)	***pF, 50V	100pF	56pF	N.C.
R34, R35, (R36)	Jumper	Short		
L01, L02, (L03)	3μH	○		
Stand-By Control Circuit	Tr1	VCE ≥ 75V, IC ≥ 1mA		
	D1	Di		
	R30 (*2)	2.7kΩ, 1/6W		
	R31	33kΩ, 1/6W		
	R32	1kΩ, 1/6W		
	R33	2kΩ, 1/6W		
	C32	33μF, 10V		
J1, J2, J3, J4, J5, J6, J8, J9	Jumper	○		
J7, JS2, JS3, JS4, JS5, JS7 JS8, JS9	-	-		
JS6, JS10	Jumper	○		
JS1 (R23)	100Ω, 1W	○		

(\*1) STK433-040N-E/060N-E/130N-E (2ch Amp) doesn't mount parts of (    )

(\*2) Recommended standby circuit is used.

# STK433-040N-E

## Recommended external components

STK433-040N-E/060N-E/130N-E/330N-E

Parts Location	Recommended value	Circuit purpose	Above Recommended value	Below Recommended value
R01, R23	100Ω/1W	Resistance for Ripple filter. (Fuse resistance is recommended. Ripple filter is constituted with C03, C23.)	Short-through current may decrease at high frequency.	Short-through current may increase at high frequency.
R02, R03, R04	1kΩ	Resistance for input filters.	-	-
R05, R06, R07	56kΩ	Input impedance is determined.	Output neutral voltage(VN) shift. (It is referred that R05=R08, R06=R09)	
R08, R09, R10	56kΩ	Voltage Gain (VG) is determined with R11, R12, R13	-	-
R11, R12, R13	1.8kΩ	Voltage Gain (VG) is determined with R8, R9, R10 (As for VG, it is desirable to set up by R11, R12, R13)	It may oscillate. (Vg < 30dB)	With especially no problem
R14, R15, R16	4.7Ω	Resistance for oscillation prevention.	-	-
R17, R18, R19	4.7Ω/1W	Resistance for oscillation prevention.	-	-
R20, R21, R22	0.22Ω/2W (040N-E,060N-E) 0.22Ω/5W (130N-E,330N-E)	This resistance is used as detection resistance of the protection circuit application.	Decrease of Maximum output Power	It may cause thermal runaway
R30	Note *5	Select Restriction resistance, for the impression voltage of '#17 (Stand-By) pin' must not exceed the maximum rating.		
C01, C02	100μF/50V	Capacitor for oscillation prevention. • Locate near the HIC as much as possible. • Power supply impedance is lowered and stable operation of the IC is carried out. (Electrolytic capacitor is recommended.)	-	-
C03, C23	100μF/50V	Decoupling capacitor • The Ripple ingredient mixed in an input side is removed from a power supply line. (Ripple filter is constituted with R01, R23.)	The change in the Ripple ingredient mixed in an input side from a power supply line	
C04, C05, C06	2.2μF/50V	Input coupling capacitor.(for DC current prevention.)	-	
C07, C08, C09	470pF	Input filter capacitor • A high frequency noise is reduced with the filter constituted by R02, R03, R04	-	
C10, C11, C12	3pF	Capacitor for oscillation prevention.	It may oscillate.	
C13, C14, C15	10μF/10V	Negative feedback capacitor. The cutoff frequency of a low cycle changes. ( $f_L = 1/(2\pi \cdot C13 \cdot R11)$ )	The voltage gain (VG) of low frequency is extended. However, the pop noise at the time of a power supply injection also becomes large.	The voltage gain (VG) of low frequency decreases.
C16, C17, C18	0.1μF	Capacitor for oscillation prevention.	It may oscillate.	
C19, C20, C21	100pF (040N-E) 56pF (060N-E) N.C. (130N-E, 330N-E)	Capacitor for oscillation prevention.	It may oscillate.	
L01, L02, L03	3μH	Coil for oscillation prevention.	With especially no problem	It may oscillate.

## STK433-040N-E

### Pin Layout

[STK433-000N/-100N/-300Nsr Pin Layout]

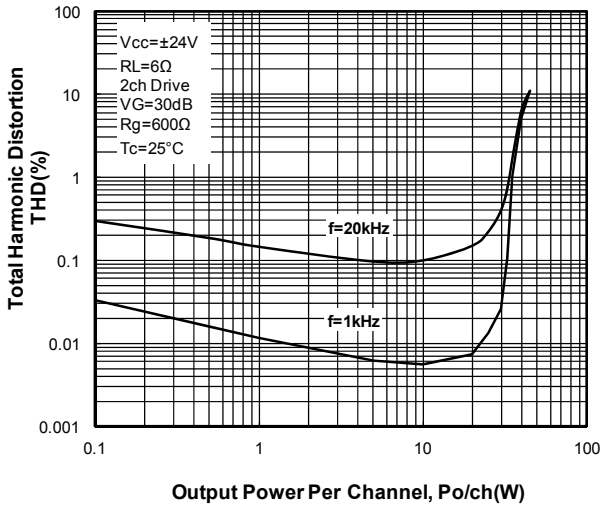
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15				
(Size) 47.0mm×25.6mm×9.0mm	2ch classAB/2.00mm																		
STK433-040N 40W/JEITA	-	-	+	O	O	O	O	+			I	N	S	N	I				
STK433-060N 50W/JEITA	P	V	V	U	U	U	U	P	S	G	N	F	T	F	N				
	R	C	C	T	T	T	T	R	U	N	/	/	A	/	/				
	E	C	C	/	/	/	/	E	B	D	C	C	N	C	C				
				C	C	C	C				H	H	D	H	H				
(Size) 67.0mm×25.6mm×9.0mm				H	H	H	H				1	1		2	2				
STK433-130N 150W/JEITA				1	1	2	2						B						
				+	-	+	-						Y						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
(Size) 64.0mm×36.6mm×9.0mm	3ch classAB/2.00mm																		
STK433-330N 150W/JEITA	-	-	+	O	O	O	O	+			I	N	S	N	I	I	N	O	O
	P	V	V	U	U	U	U	P	S	G	N	F	T	F	N	N	F	U	U
	R	C	C	T	T	T	T	R	U	N	/	/	A	/	/	/	/	T	T
	E	C	C	/	/	/	/	E	B	D	C	C	N	C	C	C	C	/	/
				C	C	C	C				H	H	D	H	H	H	H	C	C
				H	H	H	H				1	1		2	2	3	3	H	H
				1	1	2	2						B					3	3
				+	-	+	-						Y					+	-

[STK433-000N/-100N/-800Nsr Pin Layout]

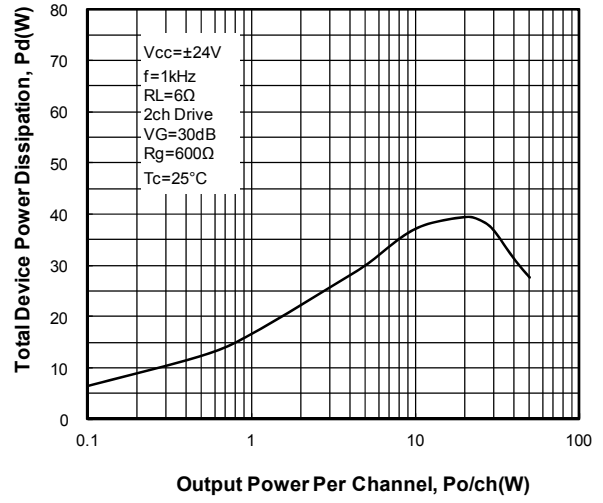
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15										
(Size) 47.0mm×25.6mm×9.0mm	2ch classAB/2.00mm																								
STK433-040N 40W/JEITA	-	-	+	O	O	O	O	+			I	N	S	N	I										
STK433-060N 50W/JEITA	P	V	V	U	U	U	U	P	S	G	N	F	T	F	N										
	R	C	C	T	T	T	T	R	U	N	/	/	A	/	/										
	E	C	C	/	/	/	/	E	B	D	C	C	N	C	C										
				C	C	C	C				H	H	D	H	H										
(Size) 67.0mm×25.6mm×9.0mm				H	H	H	H				1	1		2	2										
STK433-130N 150W/JEITA				1	1	2	2						B												
				+	-	+	-						Y												
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
(Size) 64.0mm×31.1mm×9.0mm	4ch classAB/2.00mm																								
STK433-840N 40W/JEITA	-	-	+	O	O	O	O	+			I	N	S	N	I	I	N	I	I	N	O	O	O	O	
	P	V	V	U	U	U	U	P	S	G	N	F	T	F	N	N	F	N	N	N	F	U	U	U	U
	R	C	C	T	T	T	T	R	U	N	/	/	A	/	/	/	/	/	/	/	/	T	T	T	T
	E	C	C	/	/	/	/	E	B	D	C	C	N	C	C	C	C	C	C	C	C	/	/	/	/
				C	C	C	C				H	H	D	H	H	H	H	H	H	H	H	C	C	C	C
(Size) 78.0mm×44.1mm×9.0mm				H	H	H	H				1	1		2	2	3	3	4	4	4	4	H	H	H	H
STK433-890N 80W/JEITA				1	1	2	2						B								3	3	4	4	
				+	-	+	-						Y								-	+	-	+	

Characteristic of Evaluation Board

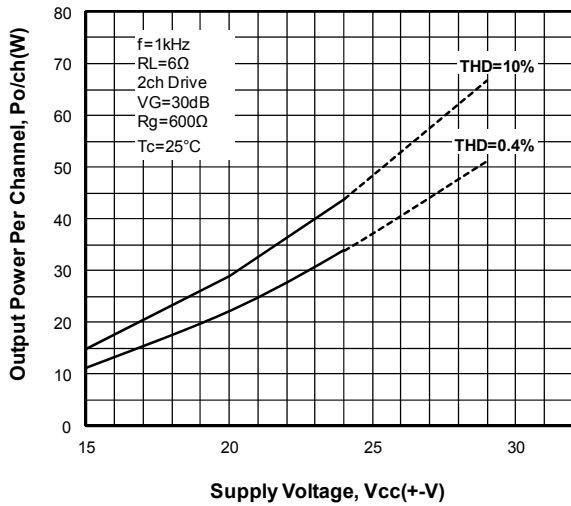
**THD-Po**  
STK433-040N-E



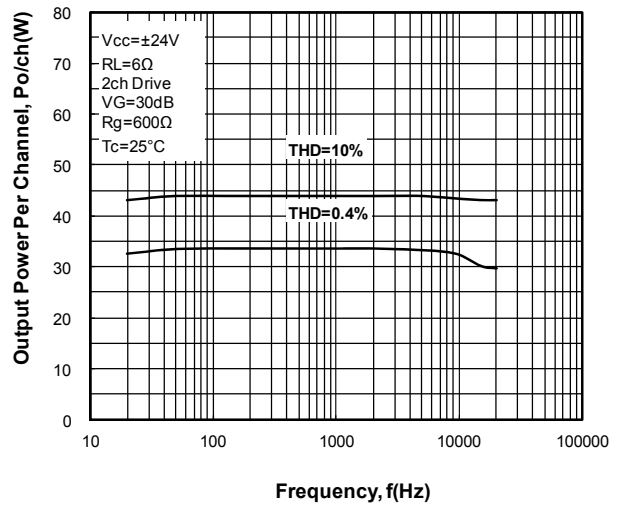
**Pd-Po**  
STK433-040N-E



**Po-Vcc**  
STK433-040N-E



**Po-f**  
STK433-040N-E





**A Thermal Design Tip For STK433-040N-E Amplifier**

[Thermal Design Conditions]

The thermal resistance ( $\theta_{c-a}$ ) of the heat-sink which manages the heat dissipation inside the Hybrid IC will be determined as follow:

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

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

Where  $T_a$  : the ambient temperature for the system

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

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

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

$\theta_{j-c}$  : 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 ( $P_d$ ) divided by the number of transistors ( $N$ ).

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

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

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

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  $P_{O \text{ max}}$ . (Note that the value of 1/8  $P_{O \text{ max}}$  may be varied from the country to country.)

(Sample of STK433-040N-E ; 25W×2ch)

If  $V_{CC}$  is ±24V, and  $R_L$  is 6Ω, then the total power dissipation ( $P_d$ ) of inside Hybrid IC is as follow;

$$P_d = 26W \text{ (at 3.13W output power, 1/8 of } P_{O \text{ max}})$$

There are four (4) transistors in Audio Section of this Hybrid IC, and thermal resistance ( $\theta_{j-c}$ ) of each transistor is 4.2°C/W. If the ambient temperature ( $T_a$ ) is guaranteed for 50°C, then the thermal resistance ( $\theta_{c-a}$ ) of a desired heat-sink should be;

$$\begin{aligned} \text{From (1)'} \quad \theta_{c-a} &< (125 - 50)/26 \\ &< 2.88 \end{aligned}$$

$$\begin{aligned} \text{From (2)'} \quad \theta_{c-a} &< (150 - 50)/26 - 4.2/4 \\ &< 2.79 \end{aligned}$$

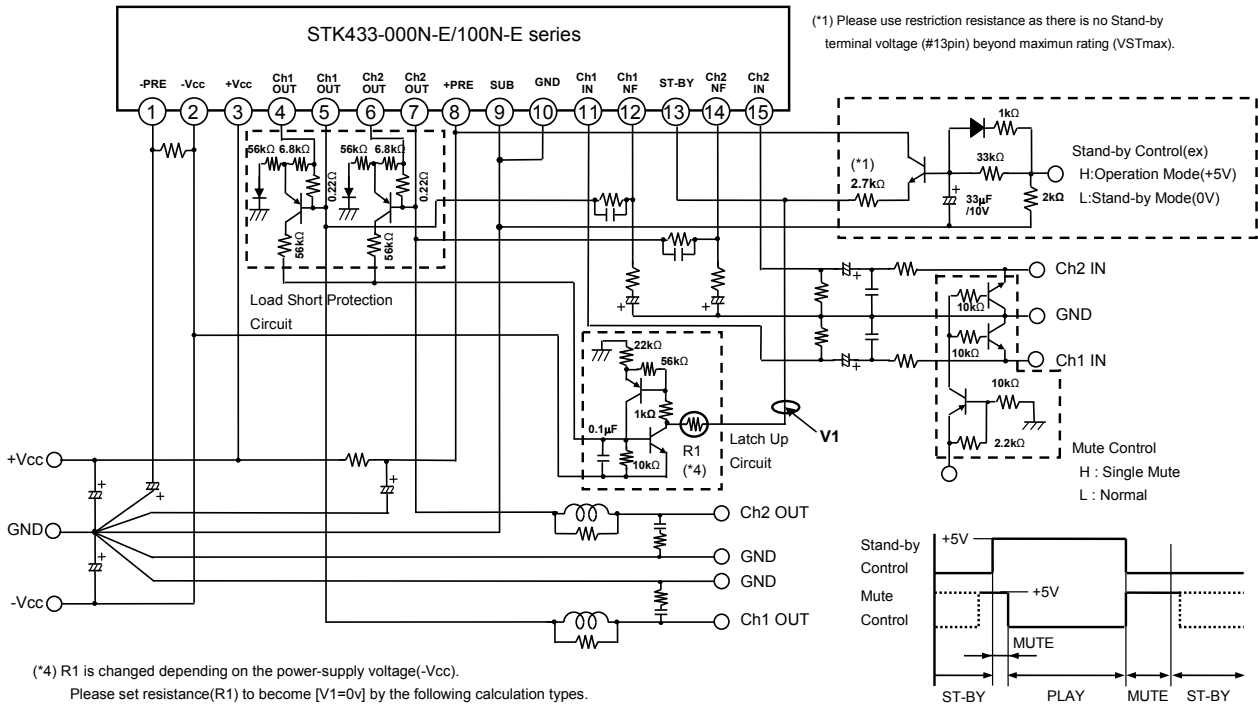
Therefore, in order to satisfy both (1)' and (2)', the thermal resistance of a desired Heat-sink will be 2.79°C/W.

[Note]

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

# STK433-040N-E

## STK433-000N-E/100N-E series Stand-by Control & Mute Control & Load-Short Protection Application

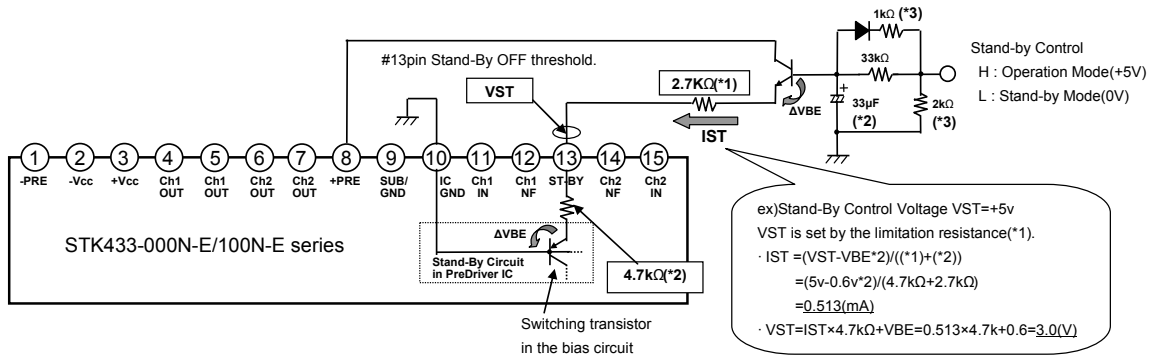


### [STK433-000N-E/100N-E series Stand-By Control Example]

#### [Feature]

- The pop noise which occurs to the time of power supply on/off can be improved substantially by recommendation Stand-By Control Application.
- Stand-By Control can be done by additionally adjusting the limitation resistance to the voltage such as micom, the set design is easy.

(Reference circuit) STK433-000N-E/100N-E series test circuit To Stand-By Control added +5V.



#### [Operation explanation] #13pin Stand-By Control Voltage VST

##### (1) Operation Mode

The switching transistor in the bias circuit turns on and places the amplifier into the operating mode, when 13pin (VST) voltage added above 2.5V (typ 3.0V).

##### (2) Stand-By Mode

When 13pin (VST) voltage is stopped (= 0V), the switching transistor in the bias circuit turn off, placing the amplifier into the standby mode.

- (\*1) The current limiting resistor must be used to ensure that stand-by pin (13pin) voltage does not exceed its maximum rated value VST max.
- (\*2) The pop noise level when the power is turned on can be reduced by setting the time constant with a capacitor in operating mode.
- (\*3) Determines the time constant at which the capacitor (\*2) is discharged in stand-by mode.

## STK433-040N-E

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### ORDERING INFORMATION

Device	Package	Shipping (Qty / Packing)
STK433-040N-E	SIP15 (Pb-Free)	25 / Bulk Box

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