

STRUCTURE: Silicon monolithic integrated circuits  
 PRODUCT: Stereo Class-D Power Amplifier For Speaker  
 TYPE: **BD5431EFS**  
 PACKAGE: HTSSOP-A44  
 FEATURES:

- 1) Differential Analog / PWM inputs
- 2) High efficiency and low heat generation eliminates external heat-sinks
- 3) Eliminates pop noise generated when the power supply goes on/off, or when the power supply is suddenly shut off
- 4) High quality muting performance is realized by using the soft-switching technology
- 5) Incorporates a master/slave function that enables synchronous operation when several units are used simultaneously
- 6) Allows the internal PWM sampling clock frequency to be adjusted

○Absolute maximum ratings (Ta=25°C)

Item	Symbol	Limit	Unit	Conditions
Supply voltage	V <sub>CC</sub>	+20	V	Pin7、8、15、16、29、30、37、38、40 ※1 ※2
Power dissipation	P <sub>d</sub>	2.0	W	※3
		4.5	W	※4
Input voltage for signal pin	V <sub>IN</sub>	-0.2 ~ +7.2	V	Pin1、2、3、4 ※1
Input voltage for control pin	V <sub>CONT</sub>	-0.2 ~ V <sub>CC</sub> +0.2	V	Pin20、24 ※1
Input voltage for clock pin	V <sub>OSC</sub>	-0.2 ~ +7.2	V	Pin23 ※1
Operating temperature range	T <sub>opr</sub>	-40 ~ +85	°C	
Storage temperature range	T <sub>stg</sub>	-55 ~ +150	°C	
Maximum junction temperature	T <sub>jmax</sub>	+150	°C	

※1 The voltage that can be applied, based on GND(Pin11, 12, 33, 34, 43)

※2 Do not, however exceed P<sub>d</sub> and T<sub>jmax</sub>=150°C.

※3 70mm × 70mm × 1.6mm, FR4, 1-layer glass epoxy board (Copper on bottom layer 0%)

Derating in done at 16mW/°C for operating above Ta=25°C. There are thermal vias on the board.

※4 70mm × 70mm × 1.6mm, FR4, 2-layer glass epoxy board (Copper on bottom layer 100%)

Derating in done at 36mW/°C for operating above Ta=25°C. There are thermal vias on the board.

○Operating conditions (Ta=25°C)

Item	Symbol	Limit	Unit	Conditions
Supply voltage	V <sub>CC</sub>	+10 ~ +16.5	V	Pin7、8、15、16、29、30、37、38、40 ※1
Load impedance	R <sub>L</sub>	4 ~ 16	Ω	※5

※5 Do not, however exceed P<sub>d</sub>.

※ No radiation-proof design

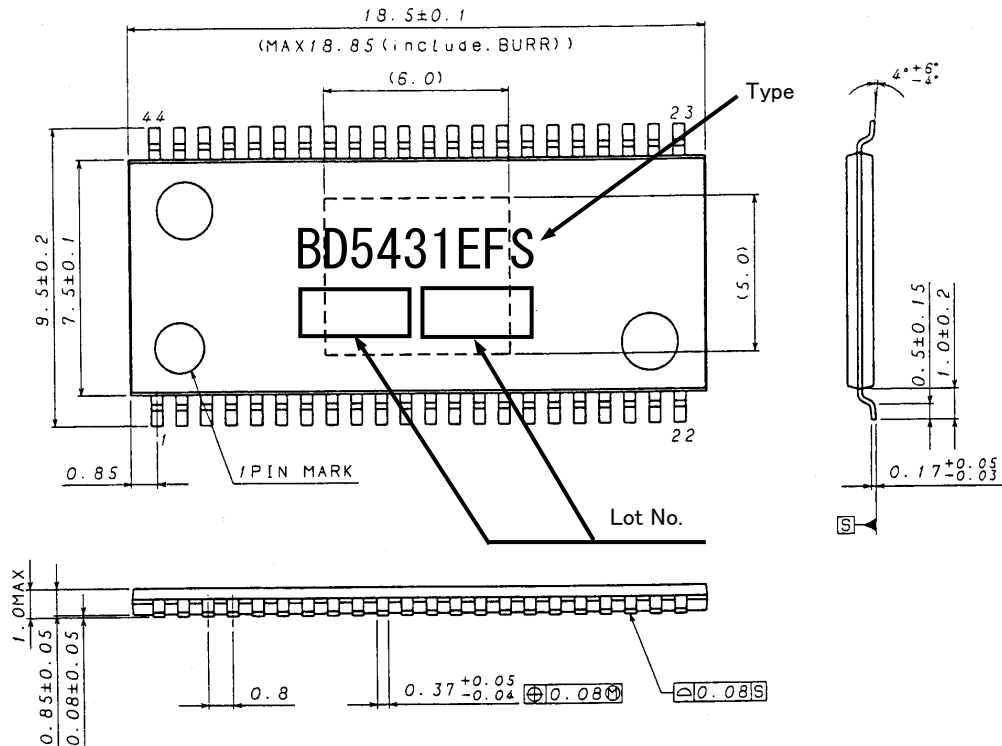
○Electrical characteristics

(Unless otherwise specified Ta=25°C, Vcc=12V, f=1kHz differential analog input, Rg=0Ω, RL=8Ω, MUTEX=H, MS=L)

Item	Symbol	Limit			Unit	Conditions
		Min	Typ	Max		
Whole circuit						
Circuit current 1 (Sampling mode)	I <sub>CC1</sub>	-	25	50	mA	
Circuit current 2 (Mute mode)	I <sub>CC2</sub>	-	10	20	mA	MUTEX=L
Control circuit						
H level input voltage	V <sub>IH</sub>	2.3	-	12	V	MUTEX, MS
L level input voltage	V <sub>IL</sub>	0	-	0.8	V	MUTEX, MS
Audio circuit						
Voltage gain	G <sub>v</sub>	22	23.5	25	dB	P <sub>o</sub> =1W, 20log(V <sub>out</sub> /V <sub>in</sub> )
Maximum output power 1	P <sub>O1</sub>	-	10	-	W	R <sub>L</sub> =8Ω, THD+n=10% ※1
Maximum output power 2	P <sub>O2</sub>	-	17	-	W	R <sub>L</sub> =4Ω, THD+n=10% ※1
Total harmonic distortion	THD	-	0.1	-	%	P <sub>o</sub> =1W, BW=20Hz~20kHz ※1
Crosstalk	CT	60	75	-	dB	P <sub>o</sub> =1W, R <sub>g</sub> =0Ω, BW=IHF-A
Output noise voltage (Sampling mode)	V <sub>NO</sub>	-	60	160	μVrms	R <sub>g</sub> =0Ω, BW=IHF-A
Residual noise voltage (Mute mode)	V <sub>NOM</sub>	-	1	10	μVrms	MUTEX=L, R <sub>g</sub> =0Ω, BW=IHF-A
Internal sampling clock frequency	F <sub>OSC</sub>	180	250	320	kHz	

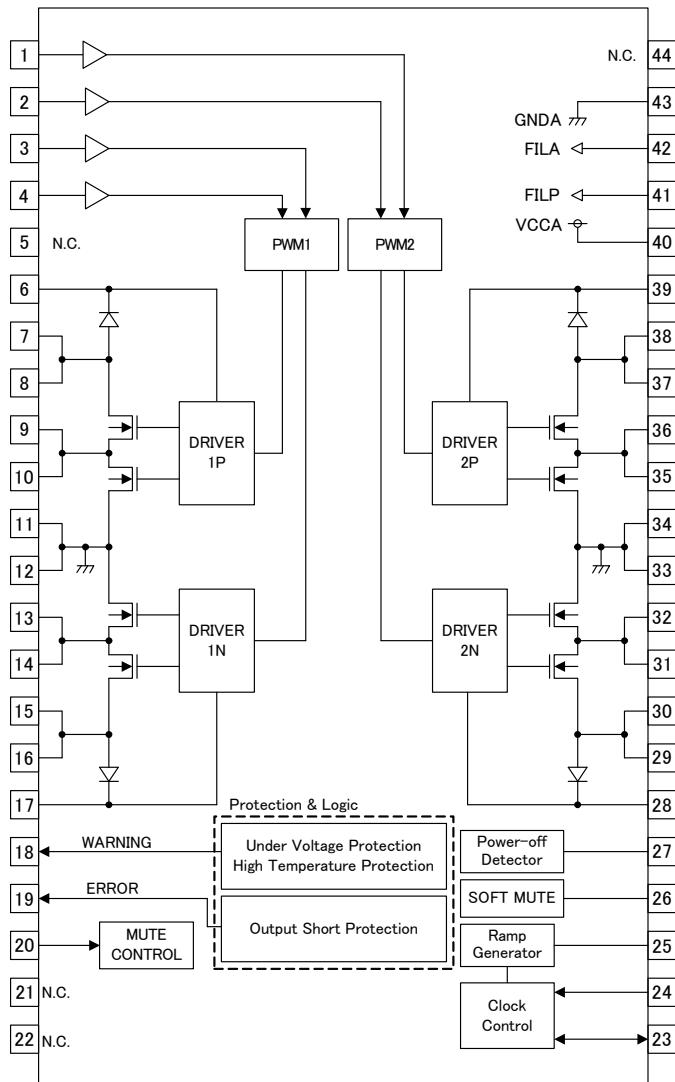
※1 These items show the typical performance of device and depend on board layout, parts, power supply.  
The standard value is in mounting device and parts on surface of ROHM's board directly.

○Package outline



(UNIT: mm)  
PKG: HTSSOP-A44  
Drawing No.: EX195-5002

○Block diagram



○Pin No. / Pin name

Pin No.	Pin name	Pin No.	Pin name
1	IN2N	44	N.C.
2	IN2P	43	GNDA
3	IN1N	42	FILA
4	IN1P	41	FILP
5	N.C.	40	VCCA
6	BSP1P	39	BSP2P
7	VCCP1P	38	VCCP2P
8		37	
9	OUT1P	36	OUT2P
10		35	
11	GNDP1	34	GNDP2
12		33	
13	OUT1N	32	OUT2N
14		31	
15	VCCP1N	30	VCCP2N
16		29	
17	BSP1N	28	BSP2N
18	WARNING	27	VHOLD
19	ERROR	26	TM
20	MUTEX	25	ROSC
21	N.C.	24	MS
22	N.C.	23	OSC

N.C. : Non Connection.

○Operation Notes

- (1) Absolute maximum ratings  
Use of the IC in excess of absolute maximum ratings such as the applied voltage or operating temperature range may result in IC damage. Assumptions should not be made regarding the state of the IC (short mode or open mode) when such damage is suffered. A physical safety measure such as a fuse should be implemented when use of the IC in a special mode where the absolute maximum ratings may be exceeded is anticipated.
- (2) Power supply lines  
As return of current regenerated by back EMF of output coil happens, take steps such as putting capacitor between power supply and GND as a electric pathway for the regenerated current. Be sure that there is no problem with each property such as emptied capacity at lower temperature regarding electrolytic capacitor to decide capacity value. If the connected power supply does not have sufficient current absorption capacity, regenerative current will cause the voltage on the power supply line to rise, which combined with the product and its peripheral circuitry may exceed the absolute maximum ratings. It is recommended to implement a physical safety measure such as the insertion of a voltage clamp diode between the power supply and GND pins.
- (3) GND potential  
Ensure a minimum GND pin potential in all operating conditions.
- (4) Setting of heat  
Use a thermal design that allows for a sufficient margin in light of the power dissipation (Pd) in actual operating conditions. This IC exposes its frame of the backside of package. Note that this part is assumed to use after providing heat dissipation treatment to improve heat dissipation efficiency. Try to occupy as wide as possible with heat dissipation pattern not only on the board surface but also the backside.  
Class-D power amplifier is High efficiency and low heat generation by comparison with conventional Analog power amplifier. However, In case it is operated continuously by maximum output power, Power dissipation(Pdiss) may exceed package dissipation. Please consider about heat design that Power dissipation(Pdiss) does not exceed Package dissipation(Pd) in average power(Poav). (Tjmax :Maximum junction temperature=150°C、Ta :Peripheral temperature[°C]、θja :Thermal resistance of package[°C/W]、Poav:Average power[W]、η :Efficiency)  

$$\text{Package dissipation: } P_d \text{ (W)} = (T_{j\max} - T_a) / \theta_{ja}$$

$$\text{Power dissipation: } P_{\text{diss}} \text{ (W)} = P_{\text{oav}} * (1 / \eta - 1)$$
- (5) Actions in strong magnetic field  
Use caution when using the IC in the presence of a strong magnetic field as doing so may cause the IC to malfunction.
- (6) Thermal shutdown circuit  
This product is provided with a built-in thermal shutdown circuit. When the thermal shutdown circuit operates, the output transistors are placed under open status. The thermal shutdown circuit is primarily intended to shut down the IC avoiding thermal runaway under abnormal conditions with a chip temperature exceeding Tjmax = 150°C, and is not intended to protect and secure an electrical appliance.
- (7) Shorts between pins and misinstallation  
When mounting the LSI on a board, pay adequate attention to orientation and placement discrepancies of the LSI. If it is misinstalled and the power is turned on, the LSI may be damaged. It also may be damaged if it is shorted by a foreign substance coming between pins of the LSI or between a pin and a power supply or a pin and a GND.
- (8) Power supply on/off  
In case power supply is started up, MUTEX(Pin20) always should be set LOW, And in case power supply is shut down, it should be set LOW likewise. Then it is possible to eliminate pop noise when power supply is turned on/off. And also, all power supply terminals should start up and shut down together.
- (9) WARNING terminal(Pin18), ERROR terminal(Pin19)  
A WARNING flag is outputted when Under Voltage Protection and High Temperature Protection are operated. A Error flag is outputted when Output Short Protection and Output DC Voltage Protection are operated. These flags are the function which the condition of this product is shown in. The use which aimed at the protection except for this product is prohibition.
- (10) N.C. terminal(Pin5, 21, 22, 44)  
N.C. terminal(Non Connection Pin) does not connect to the inside circuit. Therefore, please open or connect to GND.

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Телефон: 8 (812) 309-75-97 (многоканальный)

Факс: 8 (812) 320-03-32

Электронная почта: [ocean@oceanchips.ru](mailto:ocean@oceanchips.ru)

Web: <http://oceanchips.ru/>

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А