

STRUCTURE: Silicon monolithic integrated circuits  
PRODUCT: Stereo Class-D Power Amplifier For Speaker

TYPE: **BD5421EFS**

PACKAGE: HTSSOP-A44

FEATURES:

- 1) High efficiency and low heat generation eliminates external heat-sinks
- 2) Eliminates pop noise generated when the power supply goes on/off, or when the power supply is suddenly shut off
- 3) High quality muting performance is realized by using the soft-switching technology
- 4) Incorporates a master/slave function that enables synchronous operation when several units are used simultaneously
- 5) Allows the gain to be adjusted via external resistance
- 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, 42 ※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 ~ +9.2	V	Pin1, 2, 43, 44 ※1
Input voltage for control pin	V <sub>CONT</sub>	-0.2 ~ V <sub>CC</sub> +0.2	V	Pin21, 22, 24 ※1
Input voltage for clock pin	V <sub>OSC</sub>	-0.2 ~ +9.2	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, 27, 33, 34, 40)

※2 Do not, however exceed P<sub>d</sub>, ASO 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, 42 ※1
Load impedance	R <sub>L</sub>	4 ~ 16	Ω	※5

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

No radiation-proof design

Status this document

This Japanese version of this document is the formal specification.

A customer may use this translation version only for reference to help reading the formal version.

If there are any differences in translation version of this document, formal version takes priority.

Application example

- ROHM cannot provide adequate confirmation of patents.
- The product described in this specification is designed to be used with ordinary electronic equipment or devices (such as audio-visual equipment, office-automation equipment, communications devices, electrical appliances, and electronic toys). Should you intend to use this product with equipment or devices which require an extremely high level of reliability and the malfunction of which would directly endanger human life (such as medical instruments, transportation equipment, aerospace machinery, nuclear-reactor controllers, fuel controllers and other safety devices), please be sure to consult with our sales representative in advance.
- ROHM assumes no responsibility for use of any circuits described herein, conveys no license under any patent or other right, and makes no representations that the circuits are free from patent infringement.

DESIGN <i>Saeshi Aishi</i>	CHECK <i>Koji Takahata</i>	APPROVAL <i>Koichi Yamamoto</i>	DATE: 6/Feb./2007	SPECIFICATION No. : TSZ02201-BD5421EFS-1-2
			REV. B	<b>ROHM CO., LTD.</b>

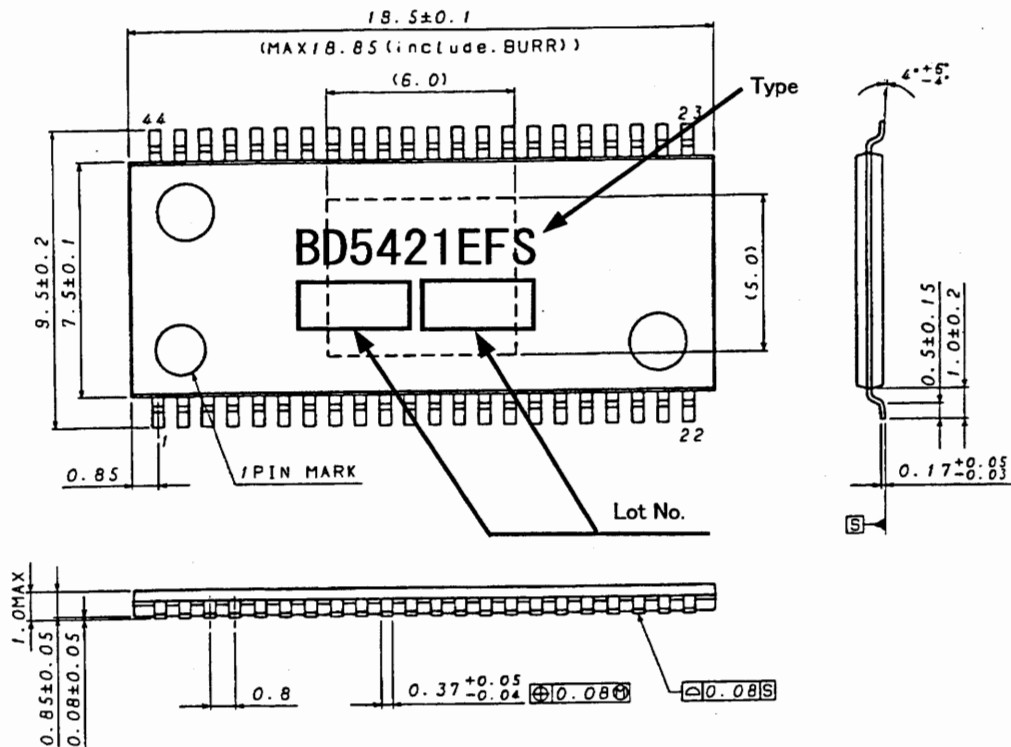
○Electrical characteristics

(Unless otherwise specified  $T_a=25^\circ\text{C}$ ,  $V_{cc}=12\text{V}$ ,  $f=1\text{kHz}$ ,  $R_g=0\Omega$ ,  $\text{Gain}=29.6\text{dB}$ ,  $R_L=8\Omega$ )

Item	Symbol	Limit			Unit	Conditions
		Min	Typ	Max		
<b>Whole circuit</b>						
Circuit current 1 (Sampling mode)	$I_{CC1}$	-	25	50	mA	
Circuit current 2 (Mute mode)	$I_{CC2}$	-	10	20	mA	MUTEX=L
Circuit current 3 (Shutdown mode)	$I_{CC3}$	-	4	10	mA	SDX=L, MUTEX=L
<b>Control circuit</b>						
H level input voltage	$V_{IH}$	2.3	-	12	V	SDX, MUTEX, MS
L level input voltage	$V_{IL}$	0	-	0.8	V	SDX, MUTEX, MS
<b>Audio circuit</b>						
Voltage gain	$G_v$	27.6	29.6	31.6	dB	
Maximum output power 1	$P_{O1}$	-	10	-	W	$R_L=8\Omega$ , THD+n=10% ※1
Maximum output power 2	$P_{O2}$	-	17	-	W	$R_L=4\Omega$ , THD+n=10% ※1
Total harmonic distortion	THD	-	0.1	-	%	$P_o=1\text{W}$ , BW=20Hz~20kHz ※1
Crosstalk	CT	55	75	-	dB	$P_o=1\text{W}$ , $R_g=0\Omega$ , BW=IHF-A
Output noise voltage (Sampling mode)	$V_{NO}$	-	170	300	$\mu\text{Vrms}$	$R_g=0\Omega$ , BW=IHF-A
Residual noise voltage (Mute mode)	$V_{NOM}$	-	1	10	$\mu\text{Vrms}$	MUTEX=L, $R_g=0\Omega$ , BW=IHF-A
Internal sampling clock frequency	$F_{OSC}$	180	250	320	kHz	MS=L

※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.

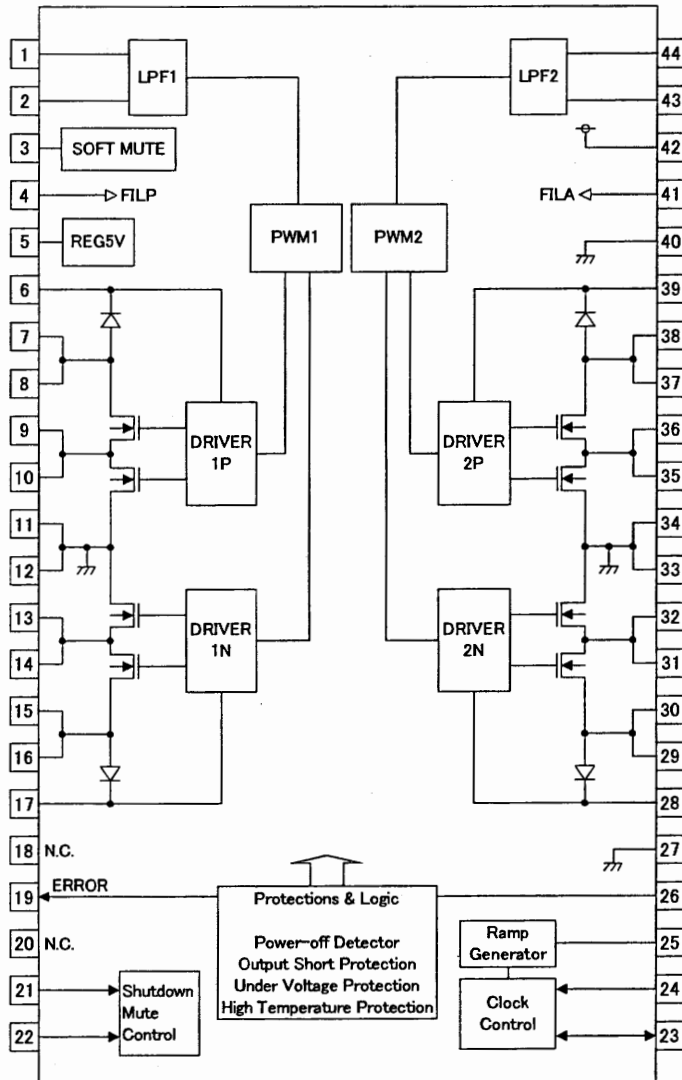
○Package outline



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

Block diagram

Pin No. / Pin name



Pin No.	Pin name	Pin No.	Pin name
1	IN1	44	IN2
2	LPF1	43	LPF2
3	TM	42	VCCA
4	FILP	41	FILA
5	REG5V	40	GND4
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	N.C.	27	GND5
19	ERR	26	VHOLD
20	N.C.	25	ROSC
21	SDX	24	MS
22	MUTEX	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)

$$\text{Package dissipation: } Pd \text{ (W)} = (T_{jmax} - T_a) / \theta_{ja}$$

$$\text{Power dissipation: } Pdiss \text{ (W)} = Poav * (1 / \eta - 1)$$

(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) ASO

When using the IC, set the output transistor so that it does not exceed absolute maximum ratings or ASO.

(7) Thermal shutdown circuit

This IC incorporates a TSD (Thermal shutdown) circuit. If the chip temperature exceeds Tjmax =150°C, output transistors will be open. The TSD circuit is designed only to shut the IC off to prevent runaway thermal operation. It is not designed to protect or guarantee peripheral equipment. Do not use the TSD function to protect peripheral equipment.

(8) 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. Especially, Use caution that the destroy and heating up by shorting Pin6, 17, 28, 39 to a GND and 5pin to a power supply is confirmed.

(9) Power supply on/off

In case power supply is started up, MUTEX(Pin22) 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.

(10) ERR terminal(Pin19)

A Error flag is outputted when Power-off Detector, Output Short Protection, Under Voltage Protection, and High Temperature Protection are operated. However, it is not designed to protect or guarantee peripheral equipment. Do not use the ERR terminal to protect peripheral equipment.

(11) N.C. terminal(Pin18, 20)

N.C. terminal(Non Connection Pin) does not connect to the inside circuit. Therefore, please open or connect to GND.