

STRUCTURE: Silicon monolithic integrated circuits  
 PRODUCT: Stereo Class-D Power Amplifier For Speaker  
 TYPE: **BD5413EFV**

PACKAGE: HTSSOP-B24  
 FEATURES:

- 1) Small power package with cut the external parts
- 2) Low shut-down current consumption
- 3) Eliminates pop noise generated when the power supply goes on/off, or when the power supply is suddenly shut off
- 4) High efficiency and low heat generation eliminates external heat-sinks
- 5) Sampling clock frequency selectable(3 steps)

○Absolute maximum ratings (Ta=25°C)

Item	Symbol	Limit	Unit	Conditions
Supply voltage	V <sub>CC</sub>	+15	V	Pin3、5、10、12、16、21 ※1 ※2
Power dissipation	P <sub>d</sub>	1.1	W	※3
		2.8	W	※4
Input voltage for signal pin	V <sub>IN</sub>	-0.2 ~ V <sub>CC</sub> +0.2	V	Pin23、24 ※1
Input voltage for control pin	V <sub>CONT</sub>	-0.2 ~ V <sub>CC</sub> +0.2	V	Pin4、14、15 ※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(Pin1, 7, 8, 13, 18, 19)

※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 8.8mW/°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 22.4mW/°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>	+6 ~ +10.5	V	Pin3、5、10、12、16、21
Load impedance	R <sub>L</sub>	6 ~ 16	Ω	※5

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

※ 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.

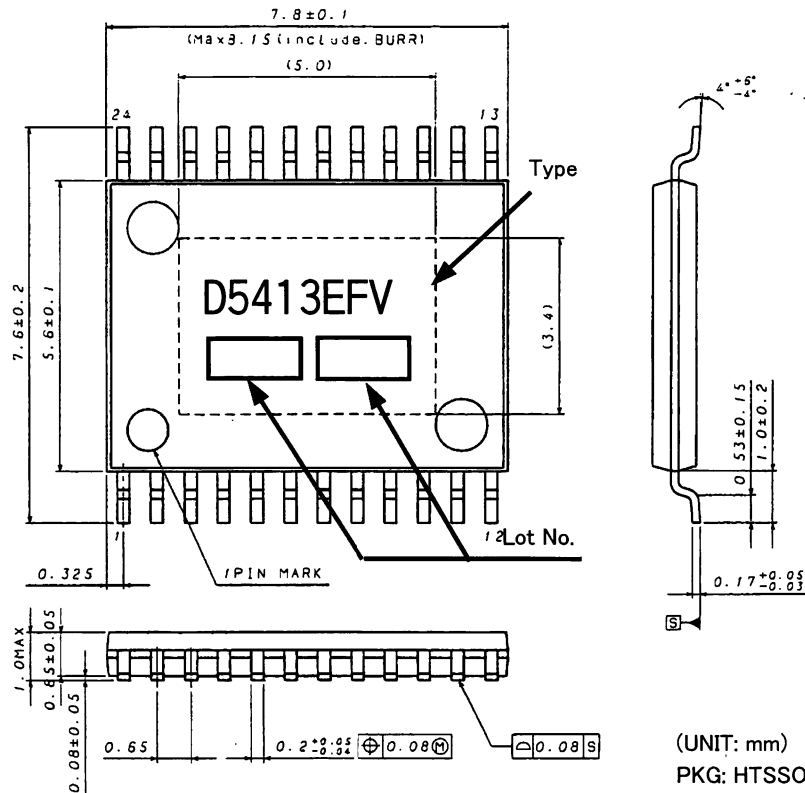
○Electrical characteristics

(Unless otherwise specified Ta=25°C, Vcc=9V, f=1kHz, Rg=0Ω, RL=8Ω, SDX=H, FC=M(Open))

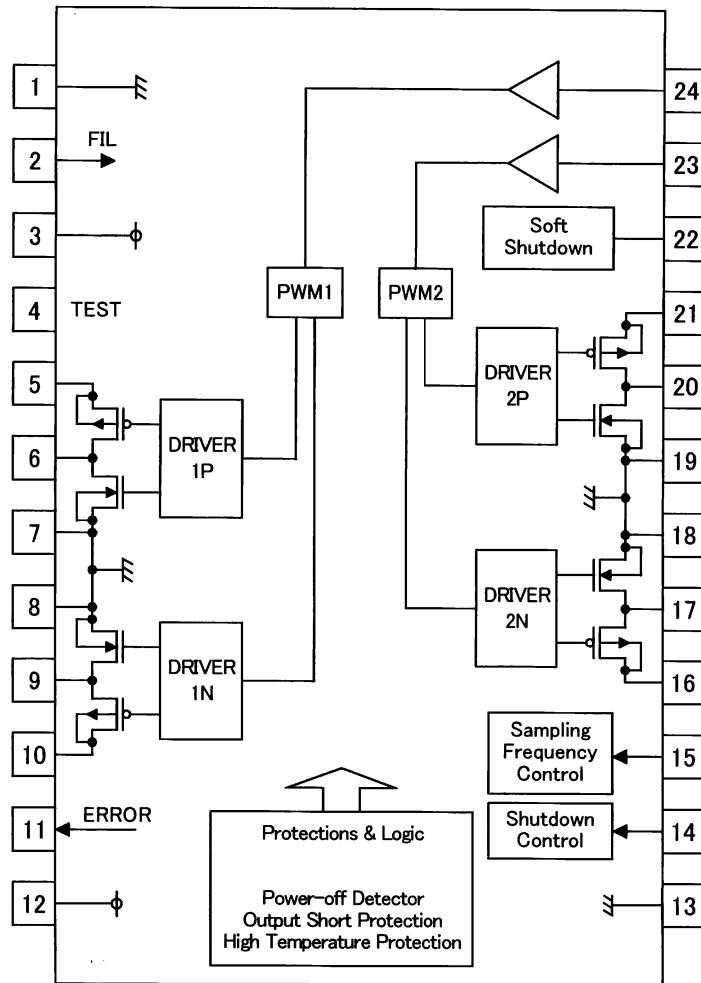
Item	Symbol	Limit			Unit	Conditions
		Min	Typ	Max		
<b>Whole circuit</b>						
Circuit current 1 (Sampling mode)	I <sub>CC1</sub>	-	12	30	mA	No load
Circuit current 2 (Shut down mode)	I <sub>CC2</sub>	-	1	10	μA	SDX=L
<b>Control circuit</b>						
SDX H level input voltage	V <sub>IHSDX</sub>	2.5	-	9	V	Sampling mode
SDX L level input voltage	V <sub>ILSDX</sub>	0	-	0.5	V	Shut down mode
FC H level input voltage	V <sub>IHFC</sub>	8.2	-	9	V	Fs=300kHz setting
FC M level input voltage	V <sub>IMFC</sub>	3.8	-	5.2	V	Fs=250kHz setting
FC L level input voltage	V <sub>ILFC</sub>	0	-	0.8	V	Fs=200kHz setting
<b>Audio circuit</b>						
Voltage gain	Gv	28	30	32	dB	Po=1W
Maximum output power 1	P <sub>O1</sub>	-	4	-	W	RL=8Ω, THD+n=10% ※1
Maximum output power 2	P <sub>O2</sub>	-	5	-	W	RL=6Ω, THD+n=10% ※1
Total harmonic distortion	THD	-	0.2	-	%	Po=1W, BW=20Hz~20kHz ※1
Crosstalk	CT	45	65	-	dB	Po=1W, Rg=0Ω, BW=IHF-A
Output noise voltage	V <sub>NO</sub>	-	90	200	μVrms	Rg=0Ω, BW=IHF-A
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



○Block diagram



○Pin No. / Pin name

Pin No.	Pin name	Pin No.	Pin name
1	GNDA	24	IN1
2	FIL	23	IN2
3	VCCA	22	TS
4	TEST	21	VCCP2P
5	VCCP1P	20	OUT2P
6	OUT1P	19	GNDP2
7	GNDP1	18	
8		17	OUT2N
9	OUT1N	16	VCCP2N
10	VCCP1N	15	FC
11	ERR	14	SDX
12	VCCD	13	GNDD

○ 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)

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

$$\text{Power dissipation: } P_{diss} \text{ (W)} = P_{oav} * (1 / \eta - 1)$$

(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, SDX(Pin14) 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) ERROR terminal(Pin11)

A Error flag is outputted when Output Short Protection or High Temperature Protection are operated. However, it is not designed to protect or guarantee peripheral equipment. Do not use the ERROR terminal to protect peripheral equipment.

(10) TEST terminal(Pin4)

TEST terminal does not use. Therefore, please open or connect to VCC.

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