STRUCTURE: Silicon Semiconductor integrated circuits
PRODUCT: Stereo Class D Speaker Amplifier

TYPE: **BD5451EFV**

PACKAGE: HTSSOP-B28

FEATURES:

1) This IC has one system of digital audio interface.
   (I^2S format、SDATA: 16 / 20 / 24bit、LRCLK: 32kHz / 44.1kHz / 48kHz、BCLK: 64fs(fixed)、MCLK: 256fs(fixed))
2) Low supply current at RESET mode.
3) The decrease in sound quality because of the change of the power supply voltage is prevented with the feedback circuitry of the output. In addition, a low noise and low distortion are achieved.
   Eliminate large electrolytic-capacitors for high performance of Power Supply Rejection.
4) S/N of the system can be optimized by adjusting the gain setting among 2 steps. (20dB / 26dB)
5) Available for Monaural mode.
6) Within the wide range of the power supply voltage, it is possible to operate in a single power supply. (10～18V)
7) It contributes to miniaturizing, making to the thin type, and the power saving of the system by high efficiency and low heat.
8) Eliminates pop noise generated when the power supply goes on/off, or when the power supply is suddenly shut off. High quality muting performance is realized by using the soft-muting technology.
9) This IC is a highly reliable design to which it has various protection functions.
   (High temperature protection, Under voltage protection, Output short protection, Output DC voltage protection and Clock stop protection, (MCLK, BCLK, LRCLK)
10) Small package (HTSSOP-B28 package) contributes to reduction of PCB area.

●Absolute maximum ratings (Ta=25℃)

Item	Symbol	Limit	Unit	Conditions
Supply voltage	VCC	22	V	Pin 14, 15, 16, 27, 28 ※1 ※2
Power dissipation	Pd	3.3	W	※3
		4.7		※4
Input voltage	V_{IN}	-0.3 ～ 4.5	V	Pin 1～6, 13 ※1
Terminal voltage 1	V_{PIN1}	-0.3 ～ 7.0	V	Pin 8, 11, 12 ※1
Terminal voltage 2	V_{PIN2}	-0.3 ～ 4.5	V	Pin 9 ※1
Terminal voltage 3	V_{PIN3}	22	V	Pin 17, 18, 20～23, 25, 26 ※1
Open-drain terminal voltage	V_{ERR}	-0.3 ～ 22	V	Pin 10 ※1
Operating temperature range	Topr	-25 ～ +85	℃	
Storage temperature range	Tstg	-55 ～ +150	℃	
Maximum junction temperature	Tjmax	+150	℃	

※1 The voltage that can be applied reference to GND (Pin 7, 19, 24).
※2 Do not, however exceed Pd and Tjmax=150℃.
※3 70mm×70mm×1.6mm, FR4, 2-layer glass epoxy board (Copper on bottom layer : 70mm×70mm)
Derating in done at 26.4mW/℃ for operating above Ta＝25℃. There are thermal via on the board.
※4 70mm×70mm×1.6mm, FR4, 4-layer glass epoxy board (Copper on bottom layer : 70mm×70mm)
Derating in done at 37.6mW/℃ for operating above Ta＝25℃. There are thermal via on the board.

●Operating conditions (Ta=25℃)

Item	Symbol	Limit	Unit	Conditions
Supply voltage	V_{CC}	10 ～ 18	V	Pin 14, 15, 16, 27, 28 ※1 ※2
Minimum load impedance	R_L	3.6	Ω	V_{CC}≦18V ※5
		3.2	Ω	V_{CC}≦16V ※5

※5 Do not, however exceed Pd.
No radiation-proof design.

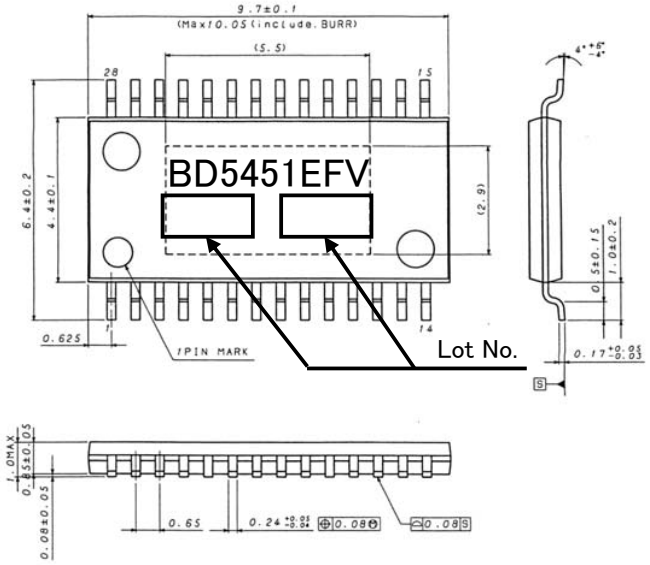
●Electrical characteristics

（Unless otherwise specified Ta=25℃, V_{CC}=12V, f=1kHz, R_L=8Ω, RSTX=3.3V, MUTEX=3.3V, Gain=20dB, fs=48kHz, Output LC filter ： L=10μH, C=0.1μF）

Item	Symbol	Limit			Unit	Conditions
		Min	Typ	Max		
Total circuit						
Circuit current (Reset mode)	I_{CC1}	-	0.1	0.2	mA	Pin 14, 15, 16, 27, 28、No load, RSTX=0V, MUTEX=0V
Circuit current (Mute mode)	I_{CC2}	-	15	25	mA	Pin 14, 15, 16, 27, 28、No load, RSTX=3.3V, MUTEX=0V
Circuit current (Sampling mode)	I_{CC3}	-	50	80	mA	Pin 14, 15, 16, 27, 28、No load, RSTX=3.3V, MUTEX=3.3V
Open-drain terminal Low level voltage	V_{ERR}	-	-	0.8	V	Pin 10, I_O=0.5mA
Regulator output voltage 1	V_{REG_G}	4.7	5.0	5.3	V	Pin 11
Regulator output voltage 2	V_{REG_3}	3.0	3.3	3.6	V	Pin 9
High level input voltage	V_{IH}	2.0	-	3.3	V	Pin 1～6, 13
Low level input voltage	V_{IL}	0	-	0.9	V	Pin 1～6, 13
Input current (Input pull-down terminal)	I_{IH}	50	66	95	μA	Pin 1～6, 13, VIN = 3.3V
Speaker Output						
Maximum output power 1	P_{O1}	-	10	-	W	THD+n=10%, Gain=20dB ※6
Maximum output power 2	P_{O_2}	-	15	-	W	Vcc=15V, THD+n=10%, Gain=26dB ※6
Voltage gain	G_{V20}	19	20	21	dB	Po=1W, Gain=20dB ※6
	G_{V26}	25	26	27	dB	Po=1W, Gain=26dB ※6
Total harmonic distortion	THD	-	0.07	-	%	P_O=1W, BW=20～20kHz ※6
Crosstalk	CT	66	80	-	dB	P_O=1W, BW=IHF-A ※6
PSRR	PSRR	-	70	-	dB	Vripple=1Vrms, f=1kHz ※6
Output noise voltage (Sampling mode)	V_{NO}	-	100	200	μVrms	－∞dBFS, BW=IHF-A ※6
PWM sampling frequency	f_{PWM1}	-	256	-	kHz	fs=32kHz ※6
	f_{PWM2}	-	352.8	-	kHz	fs=44.1kHz ※6
	f_{PWM3}	-	384	-	kHz	fs=48kHz ※6

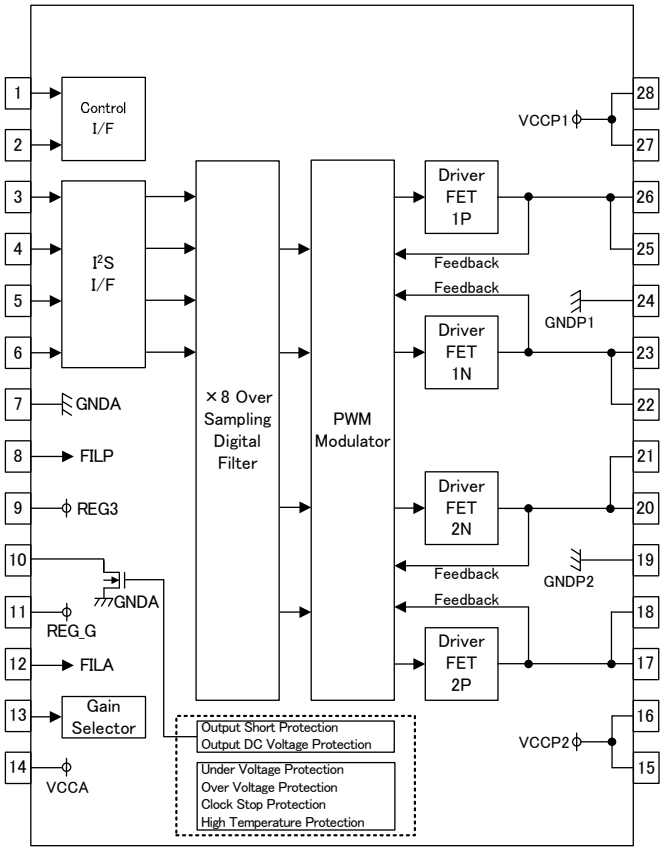
※6 These items show the typical performance of device and depend on board layout, parts, and power supply.
The standard value is in mounting device and parts on surface of ROHM's board directly.

●Package outline



(UNIT: mm)
PKG: HTSSOP-B28
Drawing No: EX199-5002-1

●Block diagram



●Pin No., Pin name

Pin No.	Pin name
1	RSTX
2	MUTEX
3	SDATA
4	LRCLK
5	BCLK
6	MCLK
7	GNDA
8	FILP
9	REG3
10	ERROR
11	REG_G
12	FILA
13	GAIN
14	VCCA
15	VCCP2
16	
17	OUT2P
18	
19	GNDP2
20	OUT2N
21	
22	OUT1N
23	
24	GNDP1
25	OUT1P
26	
27	VCCP1
28	

●Notes for use

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(Pin 7, 19, 24).

Any state must become the lowest voltage about GND terminal and VSS terminal.

4) Input terminal

The parasitic elements are formed in the IC because of the voltage relation. The parasitic element operating causes the wrong operation and destruction. Therefore, please be careful so as not to operate the parasitic elements by impressing to input terminals lower voltage than GND and VSS. Please do not apply the voltage to the input terminal when the power-supply voltage is not impressed.

5) 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 speaker 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℃, Ta :Peripheral temperature[℃], θja :Thermal resistance of package[℃/W], Poav:Average power[W], η:Efficiency)

Package dissipation : Pd(W)=(Tjmax - Ta)／θja

Power dissipation : Pdiss(W)= Poav ×(1／η- 1)

6) 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.

7) 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℃.

8) Shorts between pins and misinstallation

When mounting the IC on a board, pay adequate attention to orientation and placement discrepancies of the IC. If it is misinstalled and the power is turned on, the IC may be damaged. It also may be damaged if it is shorted by a foreign substance coming between pins of the IC or between a pin and a power supply or a pin and a GND.

9) Power supply on/off (Pin 14, 15, 16, 27, 28)

In case power supply is started up, RSTX(Pin 1)and MUTEX(Pin 2) 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) ERROR terminal(Pin 10)

A error flag is outputted when Output short protection and DC voltage protection in the speaker are operated. These flags are the function which the condition of this product is shown in.

11) Precautions for Spealer-setting

If the impedance characteristics of the speakers at high-frequency range while increase rapidly, the IC might not have stable-operation in the resonance frequency range of the LC-filter. Therefore, consider adding damping-circuit, etc., depending on the impedance of the speaker.

Notes

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