Structure: Silicon Monolithic IC

Product Name Stereo Class-D Speaker Amplifier for Notebook PC

Part Number **BD5471MUV**

Measurement circuit Fig.1

Package Outlines Fig.2 VQFN024V4040 (Plastic Mold)

Block Diagram Fig.3

Pin Assignment Fig.4

Function／Features

・High output power
2.5W /4Ω/ BTL (VDD=5V, THD+N=10%)
1.5W /8Ω/ BTL (VDD=5V, THD+N=10%)
・Gain selectable by the external control(6,12,18,24dB)
・Pop noise suppression circuitry
・Standby function (Mute function)
・Protection circuitry (Short protection, Thermal shutdown, Under voltage lockout)
・Built-in 3.3V regulator
・Built-in BEEP detect circuitry
・High power small package VQFN024V4040

Absolute Maximum Ratings (Ta=+25℃)

Item	Symbol	Rating	Unit
Power Supply Voltage	VDD	7.0	V
Power Dissipation	Pd	0.7 *1	W
		2.2 *2	W
Storage Temperature Range	Tstg	−55 ～ +150	℃
Input Terminal Input Voltage Range *3	Vin	−0.3～VDD+0.3	V
Control Terminal Input Voltage Range *4	Vctl	−0.3～VDD+0.3	V

*1 74.2mm×74.2mm×1.6mm, FR4 1-layer glass epoxy board(Copper on top layer 0%)
Derating in done at 5.6mW/℃ for operating above Ta=25℃. There are thermal via on the board
*2 74.2mm×74.2mm×1.6mm, FR4 4-layer glass epoxy board(Copper on bottom 2 and 3 layer 100%)
Derating in done at 17.6mW/℃ for operating above Ta=25℃. There are thermal via on the board
*3 Input Terminal (INL+, INL−, INR+, INR−)
*4 Control Terminal (MUTE, G0, G1, EAPD, BEEP, REG_SD)

Operating Conditions

Item	Symbol	Range	Unit
Power Supply Voltage	VDD	+4.5 ～ +5.5	V
Temperature	Topr	−40 ～ +85	℃

※This product is not designed for protection against radioactive rays.

■ Electric Characteristics

(Unless otherwise specified, Ta=+25°C, VDD=+5.0V, AC item=LC Filter ; L=22μH, C=1μF)

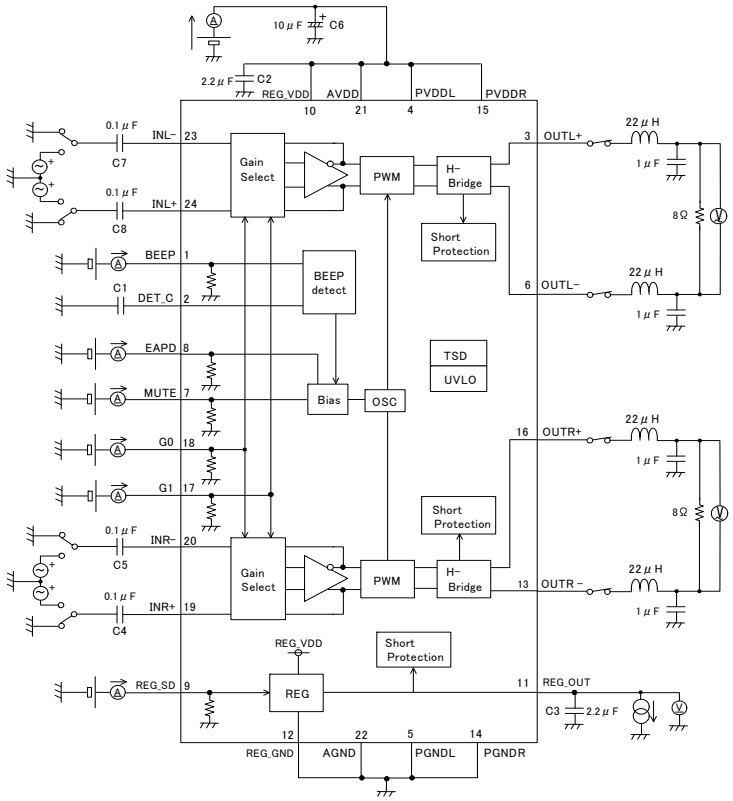
Item	Symbol	Limit			Unit	Conditions
		MIN.	TYP.	MAX.		
Circuit current (Active)	I_{CC}	—	5.5	12.0	mA	Active mode, MUTE=H, EAPD=H, No load
Circuit current (Standby)	I_{CCS}	—	0.1	1.0	mA	Standby mode, MUTE=H,EAPD=L
Circuit current (Regulator)	I_{CCR}	—	0.15	1.0	mA	Regulator Mode, MUTE=EAPD=L REG_SD=H
Circuit current (Shutdown)	I_{CCSD}	—	0.1	2.0	uA	Shutdown mode, MUTE=L, REG_SD=L
<Speaker Amplifier>						
Output power 1	P_{O1}	0.8	1.2	—	W	BTL, f=1kHz, THD+N=1% *1, *2
Output power 2	P_{O2}	1.0	1.5	—	W	BTL, f=1kHz, THD+N=10% *1, *2
Voltage gain	G_V	5.5	6.0	6.5	dB	BTL, G0=G1=GND
		11.5	12	12.5	dB	BTL, G0=GND, G1=VDD
		17.5	18	18.5	dB	BTL, G0=VDD, G1=GND
		23.5	24	24.5	dB	BTL, G0=G1=VDD
Total harmonic distortion	THD+N	—	0.2	1.0	%	BTL, Po=0.7*P_{O1} *1, *2
Crosstalk	C_T	60	70	—	dB	BTL, f=1kHz *1, *3
S/N	SNR	70	90	—	dB	BTL, Po=P_{O1} *1, *3
Switching Frequency	Fosc	175	250	325	kHz	
Start-up time	Ton	0.78	1.02	1.46	msec	
Input resistance	R_{IN}	63	90	117	kΩ	G0=G1=GND
		42	60	78	kΩ	G0=GND, G1=VDD
		25	36	47	kΩ	G0=VDD, G1=GND
		14	20	26	kΩ	G0=G1=VDD
<Regulator>						
Output voltage	Vo	3.15	3.30	3.45	V	Io=150mA
Maximum output current	Iom	150	200	—	mA	Vo=3.15V
Load regulation	L_{REG}	—	0.4	1	mV/mA	Io=0→150mA
<Control terminal (MUTE, G0, G1, EAPD, BEEP, REG_SD) >						
Control terminal input voltage — High-level	V_{CTLH}	1.4	—	VDD	V	
Control terminal input voltage — Low-level	V_{CTLL}	0	—	0.4	V	
Control terminal input current	I_{CTL}	22	33	44	uA	Control terminal Input voltage V_{CTL}=5V

BTL : The voltage between 3pin and 6pin, 13pin and 16pin, *1 : R_L=8Ω, *2 : B.W.=400～30kHz, *3 : DIN AUDIO

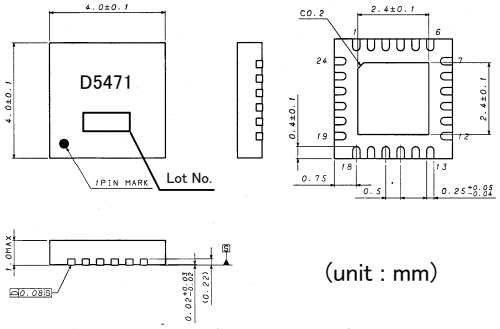
■ Control terminal

Pin name	Pin level	Conditions
MUTE	H/L	SPAMP active/shutdown
EAPD	H/L	SPAMP active/standby
BEEP	H/L	SPAMP active/standby
REG_SD	H/L	REG active/shutdown

■Measurement circuit (Fig. 1)



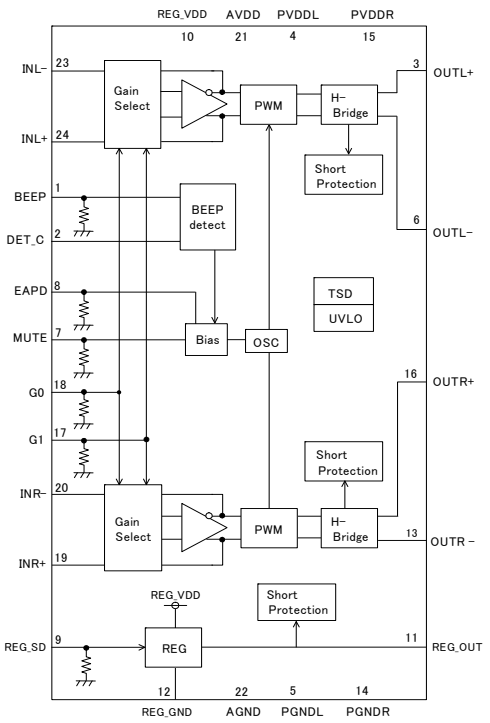
■Package Outlines (Fig. 2)



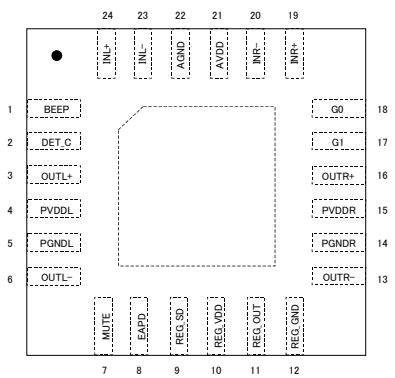
(unit : mm)

VQFN024V4040(Plastic Mold)

■Block Diagram (Fig. 3)



■Pin Assignment <top view> (Fig. 4)



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■ Cautions on use

(1) Absolute maximum ratings

This IC may be damaged if the absolute maximum ratings for the applied voltage, temperature range, or other parameters are exceeded. Therefore, avoid using a voltage or temperature that exceeds the absolute maximum ratings.
If it is possible that absolute maximum ratings will be exceeded, use fuses or other physical safety measures and determine ways to avoid exceeding the IC's absolute maximum ratings.

(2) GND terminal's potential

Try to set the minimum voltage for GND terminal's potential, regardless of the operation mode.

(3) Shorting between pins and mounting errors

When mounting the IC chip on a board, be very careful to set the chip's orientation and position precisely.
When the power is turned on, the IC may be damaged if it is not mounted correctly.
The IC may also be damaged if a short occurs (due to a foreign object, etc.) between two pins, between a pin and the power supply, or between a pin and the GND.

(4) Operation in strong magnetic fields

Note with caution that operation faults may occur when this IC operates in a strong magnetic field.

(5) Thermal design

Ensure sufficient margins to the thermal design by taking in to account the allowable power dissipation during actual use modes, because this IC is power amp. When excessive signal inputs which the heat dissipation is insufficient condition, it is possible that thermal shutdown circuit is active.

(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 shutdown the IC avoiding thermal runaway under abnormal conditions with a chip temperature exceeding Tjmax = +150℃, and is not intended to protect and secure an electrical appliance.

(7) Load of the output terminal

This IC corresponds to dynamic speaker load, and doesn't correspond to the load except for dynamic speakers.

(8) The short protection of the output terminal

This IC is built in the short protection for a protection of output transistors.
When the short protection is operated, output terminal becomes Hi-Z condition and is stopped with latch.
Once output is stopped with latch, output does not recover automatically by canceling the short-circuiting condition.
The condition of stopping with latch is cancelled, when power supply or standby signal is turned off and turned on again.

(9) Operating ranges

The rated operating power supply voltage range (VDD=+4.5V～+5.5V) and the rated operating temperature range (Ta=-40℃～+85℃) are the range by which basic circuit functions is operated. Characteristics and rated output power are not guaranteed in all power supply voltage ranges or temperature ranges.

(10) Electrical characteristics

Electrical characteristics 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.

(11) Power decoupling capacitor

Because the big peak current flows through the power line, the class-D amplifier has an influence on the audio characteristic by the capacitance value or the arrangement part of the power decoupling capacitor.
Select enough small value(more than 10uF) of ESR(Equivalent Series Resistance),
and arrange a power decoupling capacitor as close as possible to the terminal of IC.
When a load is less than 8Ω, arrange a capacitor against to each power supply terminal as close as possible.

(12) Power supply

Use single power supply, because power supplies (4,10,15,21pin) of audio amplifier and regulator are shorted inside.

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