Analog Sound Processor Series

6ch Sound Processor for High-Quality Audio with Built-in Advanced Switch

BD34602FS-M

Description

BD34602FS-M is a 6ch independent volume system. It is designed to have high-quality sound by improving the op-amp and optimizing the design layout. In addition, it is compatible, same package and it has common control with BD3461FS, therefore replacement from BD3461FS is easy.

Features

- AEC-Q100 Qualified(Note 1)
- Advanced switch circuit can reduce the switching pop noise during volume attenuation
- Built-in 6ch independent volume circuit available with changing by 1dB/Step
- Built-in DIFF amplifier inputs, ideal for external input
- Built-in volume circuit for mixing external signal available with changing by 1dB/Step
- Package is SSOP-A24. Putting input-terminals together and output-terminals together can make PCB layout easier and can makes area of PCB smaller.
- It is possible to control by 3.3V for I^{2}C-BUS Controller

(Note1 : Grade 3)

Applications

- Suitable for the Car Audio systems, Car Navigation systems.

Key Specifications

- Total harmonic distortion : 0.0004%
- Maximum input voltage : 2.35Vrms(Typ)
- Maximum output voltage : 2.35Vrms(Typ)
- Output noise voltage : 1.3μVrms(Typ)
- Residual output noise voltage : 1.3μVrms(Typ)
- Ripple rejection : 80dB (Typ)
- Operating temperature range : -40°C to +85°C

Package

	W(Typ) x D(Typ) x H(Max)
SSOP-A24	10.00mm x 7.80mm x 2.10mm

SSOP-A24

Typical Application Circuit

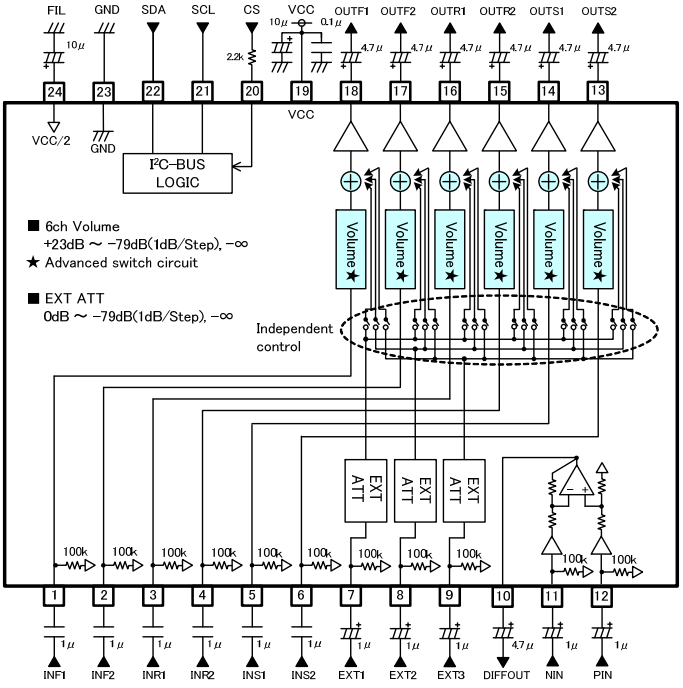


Figure 1. Application Circuit

Pin Configuration

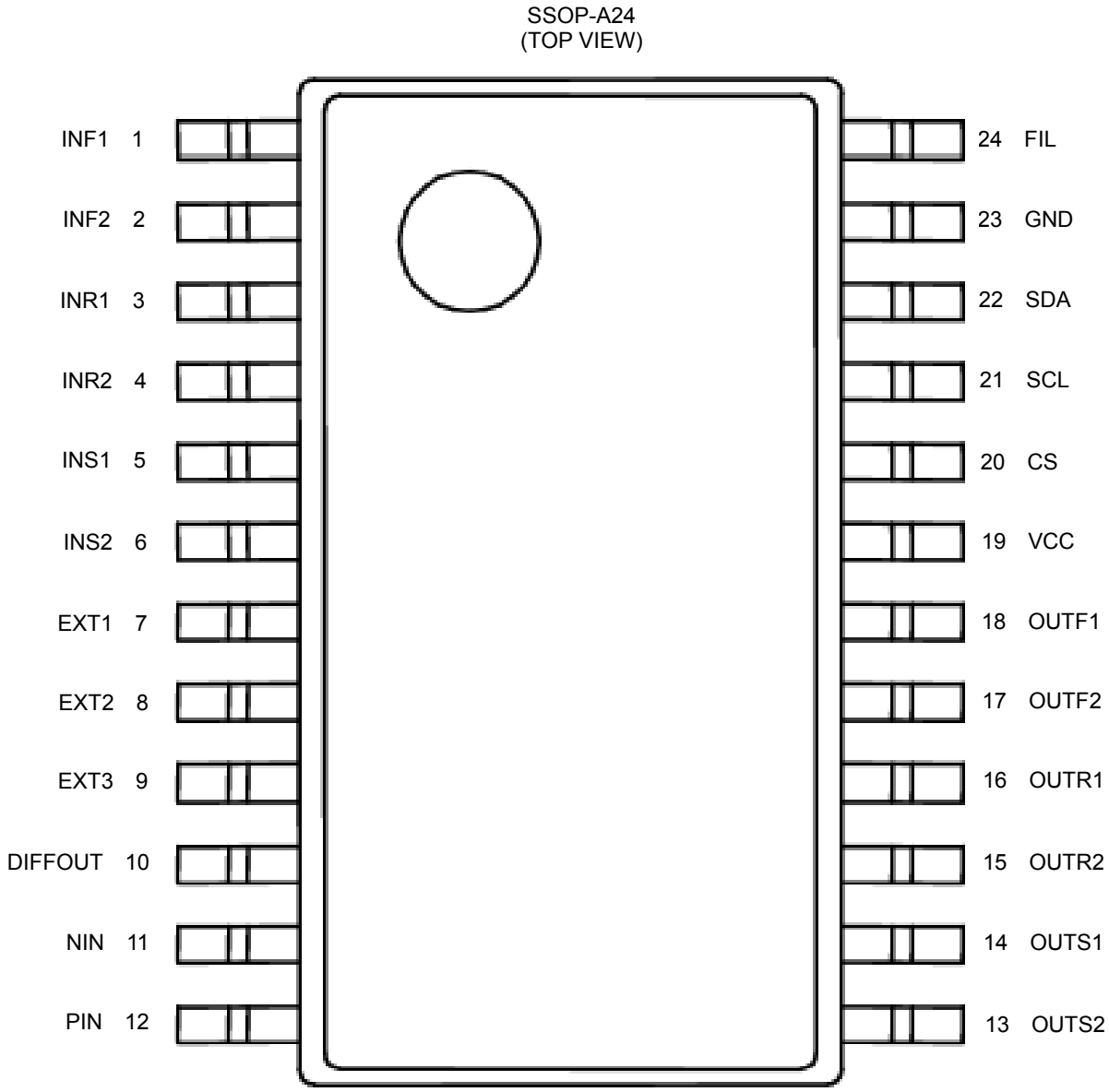


Figure 2. Pin Configuration

Descriptions of terminal

Terminal No.	Terminal Name	Description	Terminal No.	Terminal Name	Description
1	INF1	Front input terminal of 1ch	13	OUTS2	Subwoofer output terminal of 2ch
2	INF2	Front input terminal of 2ch	14	OUTS1	Subwoofer output terminal of 1ch
3	INR1	Rear input terminal of 1ch	15	OUTR2	Rear output terminal of 2ch
4	INR2	Rear input terminal of 2ch	16	OUTR1	Rear output terminal of 1ch
5	INS1	Subwoofer input terminal of 1ch	17	OUTF2	Front output terminal of 2ch
6	INS2	Subwoofer input terminal of 2ch	18	OUTF1	Front output terminal of 1ch
7	EXT1	External input terminal of 1ch	19	VCC	Power supply terminal
8	EXT2	External input terminal of 2ch	20	CS	Chip select terminal
9	EXT3	External input terminal of 3ch	21	SCL	I^2C-BUS clock terminal
10	DIFFOUT	DIFF amp output terminal	22	SDA	I^2C-BUS data terminal
11	NIN	DIFF amp negative input terminal	23	GND	GND terminal
12	PIN	DIFF amp positive input terminal	24	FIL	VCC/2 terminal

Block diagram

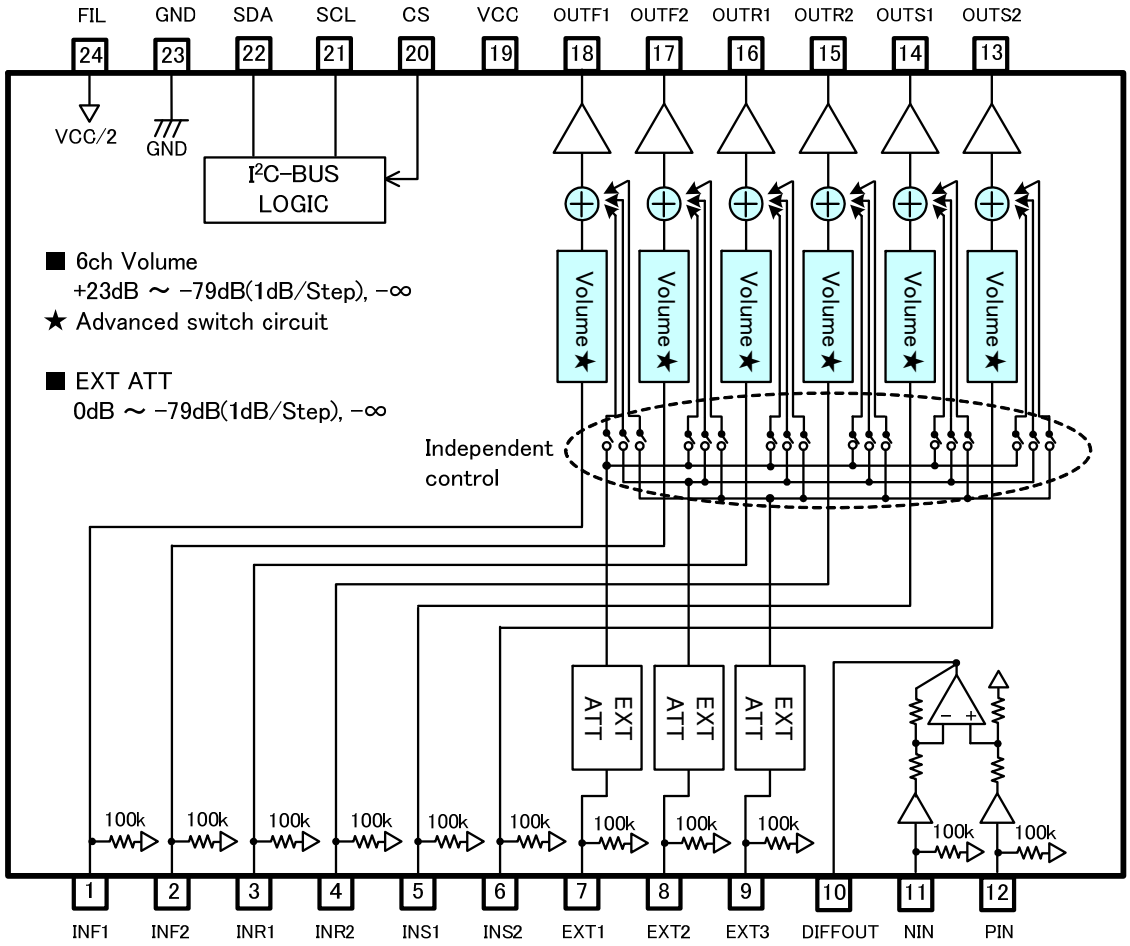


Figure 3. Block diagram

●The audible signal inputted from 1pin to 6pin are adjusted independently in volume block, and outputted from 13pin to 18pin.
●The audible signal inputted from 7pin to 9pin are adjusted independently in EXT ATT block, and added independently to the audible signal inputted from 1pin to 6pin in EXT ON/OFF block, and outputted from 13pin to 18pin.

Absolute maximum ratings (Ta=25°C)

Item	Symbol	Ratings	Unit
Power supply Voltage	VCC MAX	10	V
Input voltage	Pd	1.0 (Note1)	W
Input voltage	Vin	GND-0.3 to VCC+0.3	V
Operating Temperature	Topr	-40 to +85	°C
Storage Temperature	Tstg	-55 to +150	°C

(Note 1) SSOP-A24:Derating at 8.0mW/°C for operating above Ta≥25°C (mounted on 70×70×1.6mm ROHM standard board)
(Note 2) If it is within the operating voltage range, circuit functions and operation are guaranteed within this operating temperature.

Caution: Operating the IC over the absolute maximum ratings may damage the IC. The damage can either be a short circuit between pins or an open circuit between pins and the internal circuitry. Therefore, it is important to consider circuit protection measures, such as adding a fuse, in case the IC is operated over the absolute maximum ratings.

Operating Range

Item	Symbol	MIN	TYP	MAX	Unit
Power Supply	VCC	7.0	8.5	9.5	V

Electrical characteristic

(Unless otherwise specified, Ta=25°C, VCC=8.5V, f=1kHz, Vin=1Vrms, RL=10kΩ, INF1, INF2 Input, Volume=0dB)

BLOCK	Item	Symbol	Limit			Unit	Conditions
			Min	Typ	Max		
GENERAL	Circuit Current upon no signal	IQ	—	35	50	mA	No signal
	Voltage gain	G_V	-0.5	0	0.5	dB	G_V=20log(VOUT/VIN)
	Channel balance	CB	-0.5	0	0.5	dB	CB=G_{V1CH}-G_{V2CH}
	Total harmonic distortion + Noise	THD+N 1k	—	0.0004	0.05	%	VOUT=1Vrms, f=1kHz BW=400-30kHz
		THD+N 10k	—	0.002	0.05	%	VOUT=1Vrms, f=10kHz BW=400-80kHz
	Output noise voltage	V_{NO}	—	1.3	9	μVrms	Rg=0Ω, BW=IHF-A＊
	Residual output noise voltage	V_{NOR}	—	1.3	9	μVrms	Volume=-∞ Rg=0, BW=IHF-A＊
	Cross-talk between channels	CTC1k	—	-109	-90	dB	Rg=0Ω, BW=IHF-A＊ CTC1k=20log(VOUT/VIN) f=1kHz
		CTC10k	—	-103	-90	dB	Rg=0Ω, BW=400-80kHz CTC10k=20log(VOUT/VIN) f=10kHz
	Ripple rejection	RR	55	80	—	dB	f=100Hz, VCCIN=100mVrms RR=20log(VCCIN/VOUT)
VOLUME	Input impedance	$R_{IN\ V}$	70	100	130	kΩ	
	Maximum input voltage	V_{IM1k}	2	2.35	—	Vrms	VIM at THD+N(VOUT)=1% BW=400-30kHz, f=1kHz
		V_{IM10k}	2	2.35	—	Vrms	VIM at THD+N(VOUT)=1% BW=400-80kHz, f=10kHz
	Maximum gain	$G_{V\ BST}$	22	23	24	dB	Gain=23dB, VIN=100mVrms $G_{V\ BST}$=20log(VOUT/VIN)
	Maximum attenuation	$G_{V\ MIN1k}$	—	-109	-90	dB	Volume=-∞ $G_{V\ MIN1k}$=20log(VOUT/VIN) BW=IHF-A＊, f=1kHz
		$G_{V\ MIN10k}$	—	-103	-90	dB	Volume=-∞ $G_{V\ MIN10k}$=20log(VOUT/VIN) BW=400-80kHz, f=10kHz
	Gain set error	$G_{V\ ERR}$	-1.0	0	1.0	dB	Gain=+1～+23dB
	Attenuation set error 1	$G_{V\ ERR1}$	-0.5	0	0.5	dB	ATT=-1～-15dB
	Attenuation set error 2	$G_{V\ ERR2}$	-1.0	0	1.0	dB	ATT=-16～-47dB
	Attenuation set error 3	$G_{V\ ERR3}$	-2.0	0	2.0	dB	ATT=-48～-79dB
	Output impedance	R_{OUT}	70	100	130	Ω	Vin=100mVrms
	Maximum output voltage	V_{OM1k}	2	2.35	—	Vrms	THD+N=1% BW=400-30kHz, f=1kHz
		V_{OM10k}	2	2.35	—	Vrms	THD+N=1% BW=400-80kHz, f=10kHz
EXT ATT	Input impedance	$R_{IN\ M}$	70	100	130	kΩ	
	Maximum attenuation	$G_{M\ MIN}$	—	-90	-80	dB	$G_{M\ MIN}$=20log(VOUT/VIN) BW=IHF-A＊, ATT=-∞
DIFF	Input impedance	$R_{IN\ D}$	70	100	130	kΩ	
	Common mode rejection ratio	CMRR	50	65	—	dB	PIN and NIN input CMRR=20log10(VIN/VOUT) BW=IHF-A＊

Phase between input / output is same

＊ VP-9690(Average value detection, effective value display) filter by Panasonic is used for * measurement.

Typical Performance Curve(s)

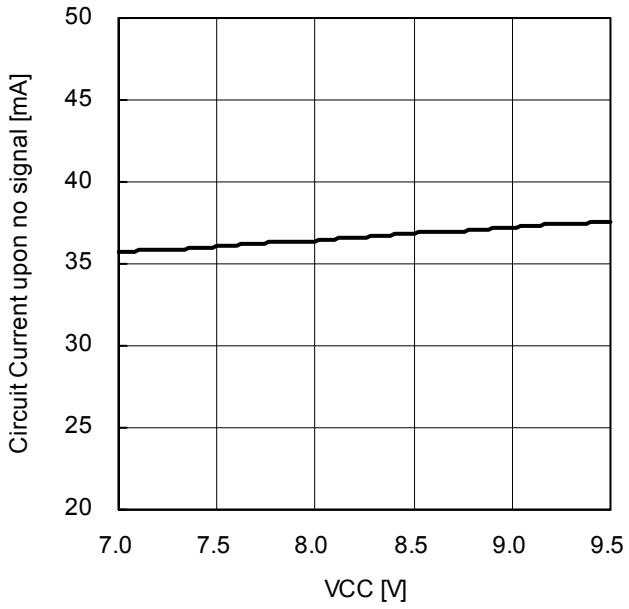


Figure 4. VCC vs Circuit Current upon no signal

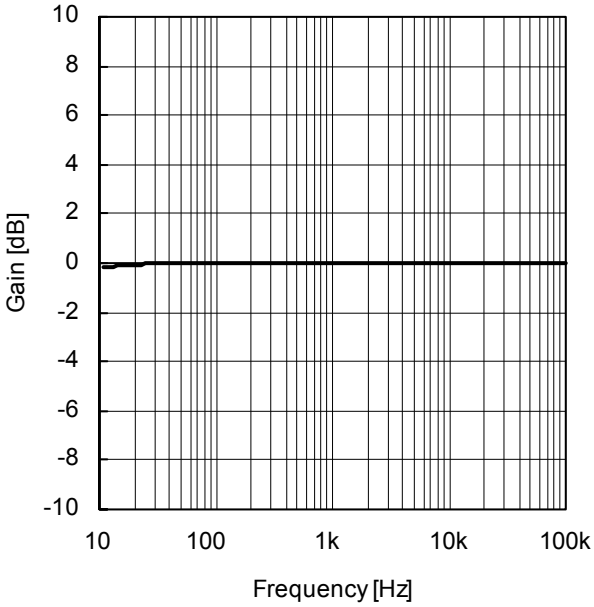


Figure 5. Gain vs Frequency

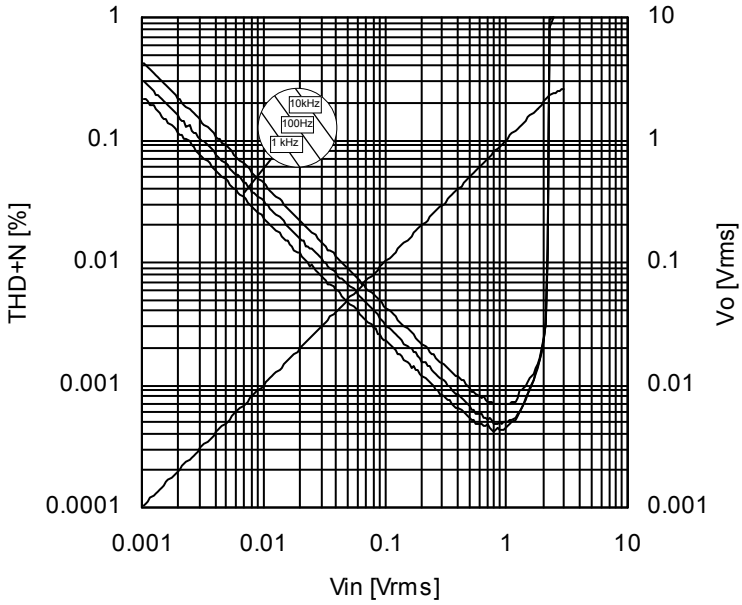


Figure 6. THD+N vs VIN / VO

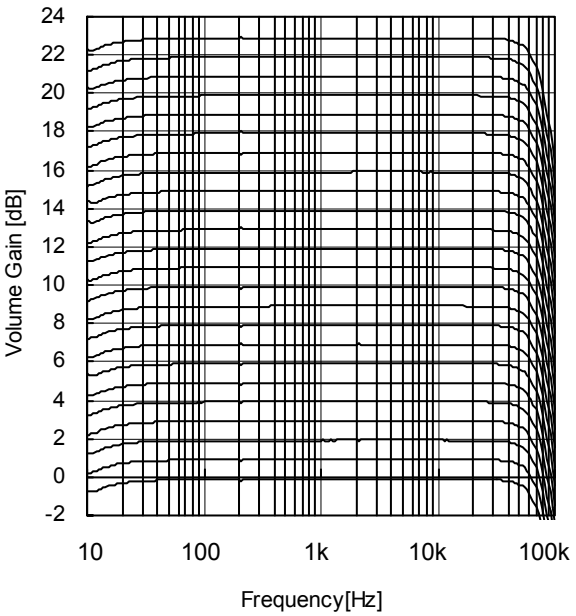


Figure 7. Volume Gain vs Frequency
(Volume Gain = +23dB ～ 0dB)

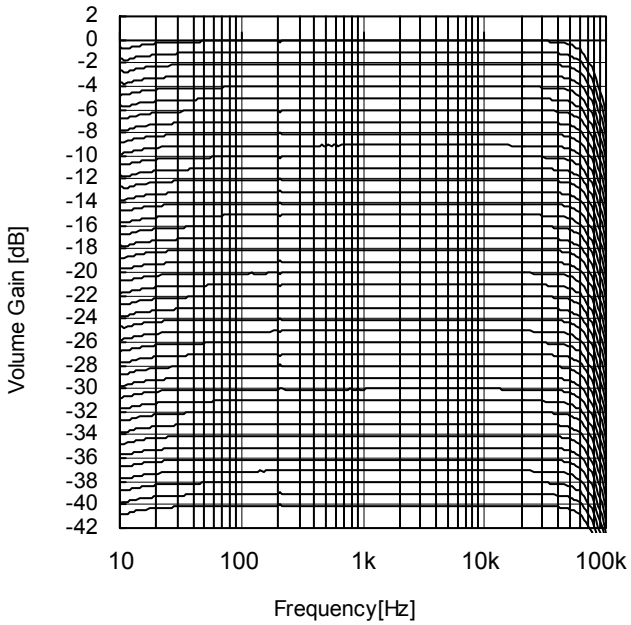


Figure 8. Volume Gain vs Frequency
(Volume Gain = 0dB ～ -40dB)

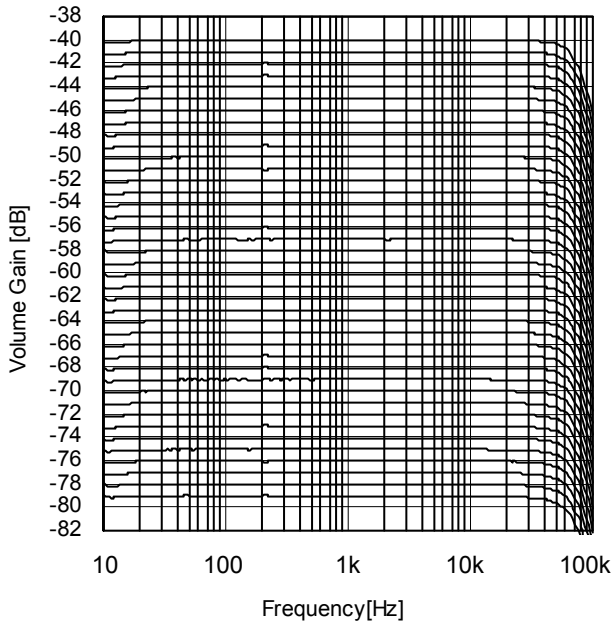


Figure 9. Volume Gain vs Frequency
(Volume Gain = -40dB ～ -79dB)

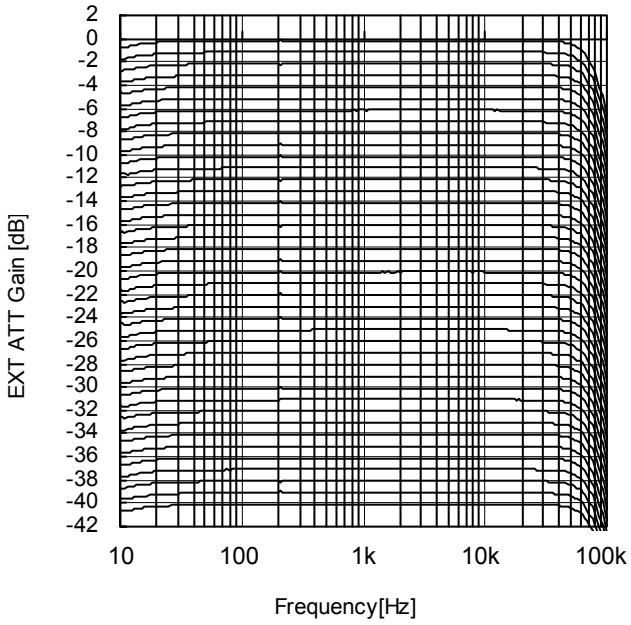


Figure 10. EXT ATT Gain vs Frequency
(EXT ATT Gain = 0dB ～ -40dB)

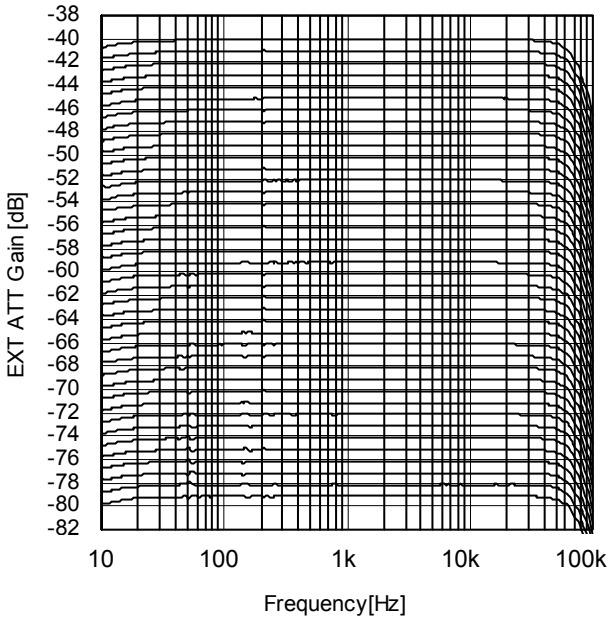


Figure 11. EXT ATT Gain vs Frequency
(EXT ATT Gain = -40dB ～ -79dB)

(Note) The measurement results of Figure 7 to Figure 11 used by 80kHz LPF.

CONTROL SIGNAL SPECIFICATION

(1) Electrical specifications and timing for bus lines and I/O stages

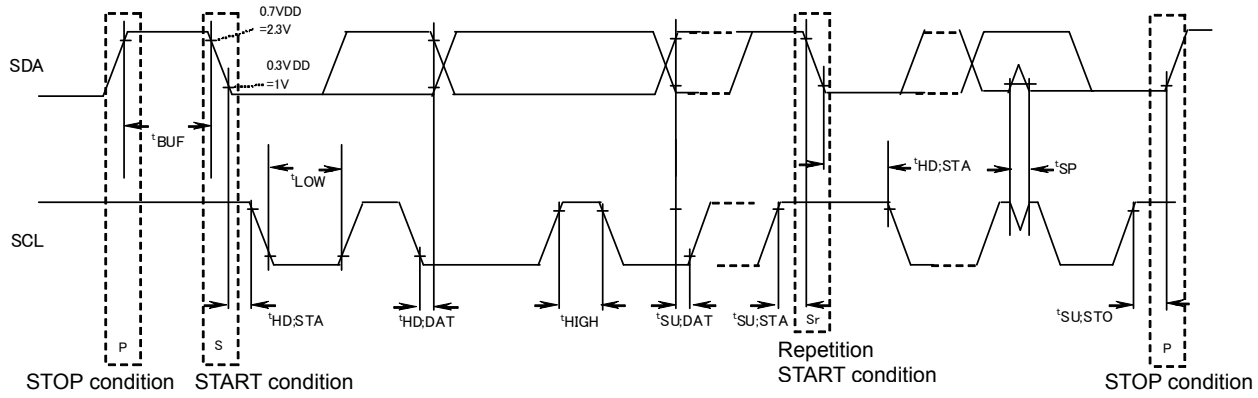


Figure 12. Definition of timing on the I²C-BUS

Table 1 Characteristics of the SDA and SCL bus lines for I²C-BUS devices

	Item	Symbol	Fast-mode I²C-BUS)		Unit
			Min	Max	
1	SCL clock frequency	fSCL	0	400	kHz
2	Bus free time between a STOP and START condition	tBUF	1.3	—	µs
3	Hold time (repeated) START condition. After this period, the first clock pulse is generated	tHD;STA	0.6	—	µs
4	LOW period of the SCL clock	tLOW	1.3	—	µs
5	HIGH period of the SCL clock	tHIGH	0.6	—	µs
6	Set-up time for a repeated START condition	tSU;STA	0.6	—	µs
7	Data hold time	tHD;DAT	0	—	µs
8	Data set-up time	tSU;DAT	100	—	ns
9	Set-up time for STOP condition	tSU;STO	0.6	—	µs

All values referred to $V_{IH\ min.}$ and $V_{IL\ max.}$ Levels (see Table 2).

Table 2 Input/Output Characteristics of the SDA and SCL terminal for I²C-BUS devices

	Item	Symbol	Fast-mode I²C-BUS)		Unit
			Min	Max	
10	LOW level input voltage	V_{IL}	-0.5	1	V
11	HIGH level input voltage	V_{IH}	2.3	-	V
12	Pulse width of spikes which must be suppressed by the input filter.	tSP	0	50	ns
13	LOW level output voltage : At 3mA sink current	V_{OL1}	0	0.4	V
14	Input current each I/O pin with an input voltage between 0.4V and 4.5 VDDmax.	Ii	-10	10	µA

Table 3 Input Characteristics of the CS terminal (Slave Address can be changed by the setting of CS terminal)

	Item	Symbol	Min	Max	Unit
1	CS = Low ： Slave Address 80 hex	V_{CSL}	-0.5	1	V
2	CS = High ： Slave Address 84 hex	V_{CSH}	2.3	VCC	V

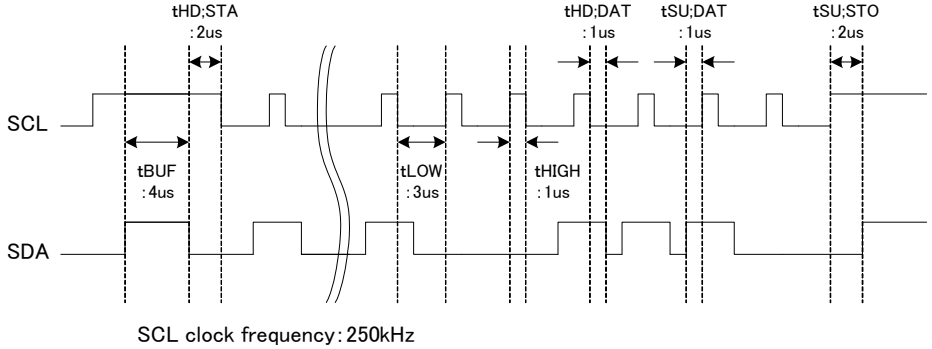


Figure 13.
A command timing example in the I²C-BUS data transmission

(2) I²C-BUS FORMAT

	MSB LSB		MSB LSB		MSB LSB		
S	Slave Address	A	Select Address	A	Data	A	P
1bit	8bit	1bit	8bit	1bit	8bit	1bit	1bit

S = Start conditions (Recognition of start bit)
Slave Address = Recognition of Slave Address. 7 bits in upper order are voluntary. The least significant bit is "L" due to writing.
A = ACKNOWLEDGE bit (Recognition of acknowledgement)
Select Address = Select every of volume, bass and treble.
Data = Data on every volume and tone.
P = Stop condition (Recognition of stop bit)

(3) I²C-BUS Interface Protocol

1) Basic form

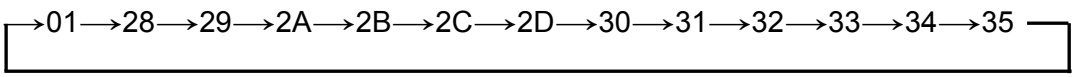
S	Slave Address	A	Select Address	A	Data	A	P
	MSB LSB		MSB LSB		MSB LSB		

2) Automatic increment (For an assigned Select Address increases (+1) according to the number of data.)

S	Slave Address	A	Select Address	A	Data1	A	Data2	A	····	DataN	A	P
	MSB LSB		MSB LSB		MSB LSB		MSB LSB			MSB LSB		

No.1. Data1 is set as data of address specified by Select Address.
No.2. Data2 is set as data of next address from the address specified by No.1.
No.3. DataN is set as data of address incremented N-1 times from the address specified by No.1.

The Select Address is circulated by the automatic increment function, as shown below (hex).



3) Configuration unavailable for transmission (In this case, only Select Address1 is set.

S	Slave Address	A	Select Address1	A	Data	A	Select Address 2	A	Data	A	P
	MSB LSB		MSB LSB		MSB LSB		MSB LSB		MSB LSB		

(Note) If any data is transmitted as Select Address 2 next to data, it is recognized as data, not as Select Address 2.

(4) Slave Address

Because the Slave Address can be changed by the setting of CS, it is possible to use two chips at the same time on identical BUS.

CS Terminal Voltage Condition	A6	A5	A4	A3	A2	A1	A0	R/W	Hex
CS = Low : -0.5V to 1.0V	1	0	0	0	0	0	0	0	80
CS = High : 2.3V to VCC	1	0	0	0	0	1	0	0	84

Establish the voltage of CS terminal in the condition to have been defined.

(5) Select Address & Data

Items to be set	Select Address (hex)	MSB Data LSB							
		D7	D6	D5	D4	D3	D2	D1	D0
EXT ATT 1dB/Step Enable	01	0	0	0	0	EXT ATT 1dB/Step Enable	1	0	0
Advanced Switch Time of EXT ON/OFF	02	0	Advanced Switch Time of EXT ON/OFF 2			Advanced Switch Time of EXT ON/OFF 1		0	0
Volume Gain Front 1ch (F1)	28	Volume Gain (F1)							
Volume Gain Front 2ch (F2)	29	Volume Gain (F2)							
Volume Gain Rear 1ch (R1)	2A	Volume Gain (R1)							
Volume Gain Rear 2ch (R2)	2B	Volume Gain (R2)							
Volume Gain Subwoofer 1ch (S1)	2C	Volume Gain (S1)							
Volume Gain Subwoofer 2ch (S2)	2D	Volume Gain (S2)							
EXT1 ON/OFF	30	EXT1 S2	EXT1 S1	EXT1 R2	EXT1 R1	EXT1 F2	EXT1 F1	0	0
EXT2 ON/OFF	31	EXT2 S2	EXT2 S1	EXT2 R2	EXT2 R1	EXT2 F2	EXT2 F1	0	0
EXT3 ON/OFF	32	EXT3 S2	EXT3 S1	EXT3 R2	EXT3 R1	EXT3 F2	EXT3 F1	0	0
EXT 1 ATT Gain	33	EXT1 ATT Gain							
EXT 2 ATT Gain	34	EXT2 ATT Gain							
EXT 3 ATT Gain	35	EXT3 ATT Gain							
Test Mode	F0	0	0	0	0	0	0	0	0
System Reset	FE	1	0	0	0	0	0	0	1

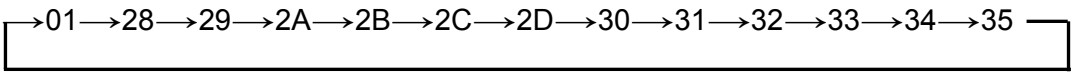
Advanced switch

Note(Please be sure to follow the instructions)
It is written with “0”, “1” by the above table, please set “0”, “1” in the same way as above table.
In case of different settings, there is possibility of cause unintended behavior.

Instructions of the data format

1. In function changing of the hatching part, it works Advanced switch(In detail, please refer p13).

2. Upon continuous data transfer, the Select Address is circulated by the automatic increment function, as shown below(hex).



※Select Address 02(hex) is not included in the automatic increment to keep BD3461FS software compatible.

3. When changing “EXT = ON/OFF”, it is not corresponded for advance switch. Therefore, please do the measure that applies mute on the side of a set at the time of these setting changes

Explanation of each Select Address

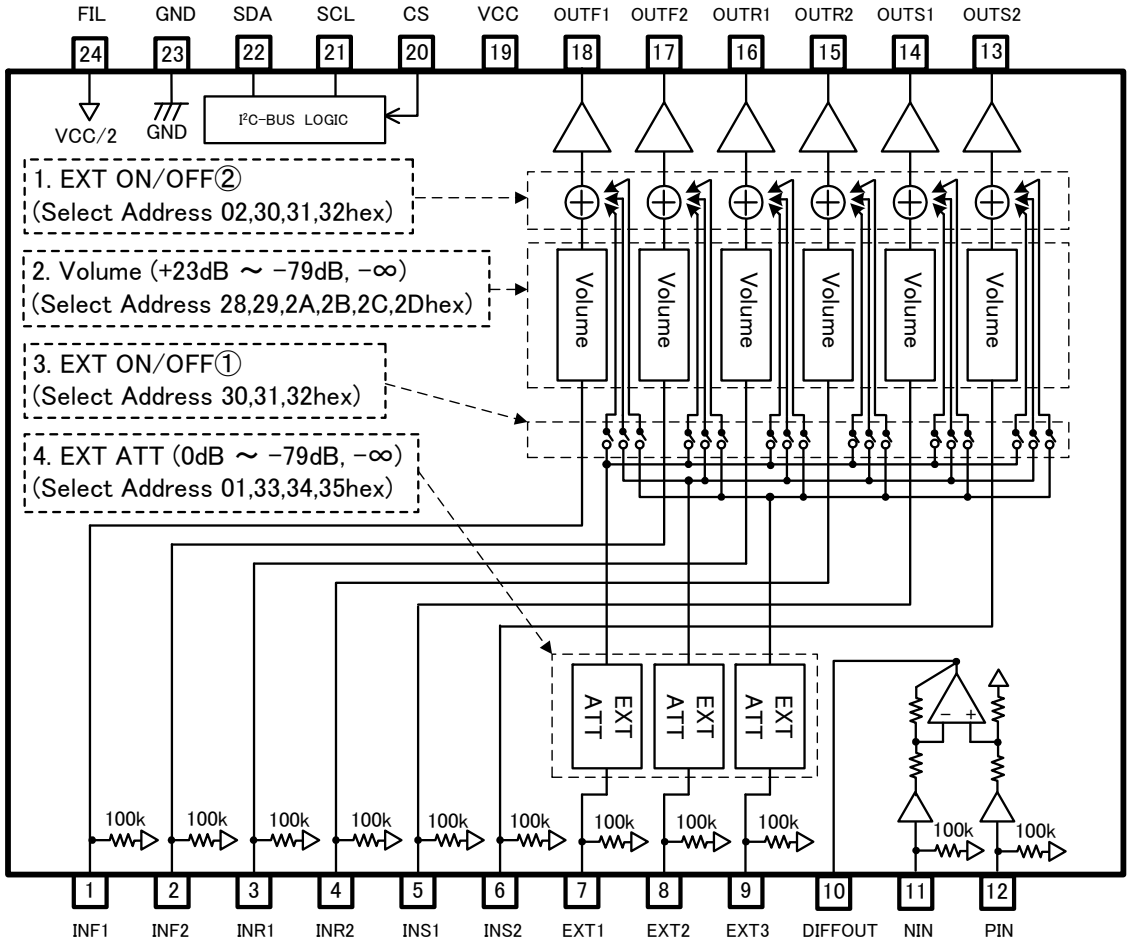


Figure.14 Block diagram

It is able to control to 1 to 4 in block diagram by each Select Address. About detail explanation is Follow as.

●The audible signal inputted from 1pin to 6pin are adjusted independently in volume block(2 in block diagram).

< Select Address 28, 29, 2A, 2B, 2C 2D(hex) : Volume >
It is able to select adjustment of audible signal in volume block(+23dB to -79dB, -∞).

●The audible signal inputted from 7pin to 9pin are adjusted independently in EXT ATT block(4 in block diagram), and added independently to the audible signal inputted from 1pin to 6pin in EXT ON/OFF block.
(EXT ON/OFF① block (3 in block diagram) : path select, EXT ON/OFF② block (1 in block diagram) : add)

< Select Address 01(hex) : EXT ATT 1dB/Step Enable >
About adjustment of audible signal in EXT ATT block (4 in block diagram), it is able to select 1dB/Step mode ON/OFF.

< Select Address 02(hex) : Advanced Switch Time of EXT ON/OFF >
Advanced Switch function is applied to EXT ON/OFF for prevention switching pop-noise. (About Advanced Switch, refer to 15page) It is able to select switching time of Advanced Switch by Select Address 02(hex).

< Select Address 30, 31, 32(hex) : EXT ON/OFF >
The audible signal inputted from 7pin to 9pin is added to the audible signal inputted from 1pin to 6pin.
It is able to select path of above combination (1 and 3 in block diagram).

< Select Address 33, 34, 35(hex) : EXT ATT >
It is able to select adjustment (0dB to -79dB, -∞) of audible signal in EXT ATT block (3 in block diagram).

Select Address 01(hex) EXT ATT 1dB/Step Enable

MODE	MSB			EXT ATT 1dB/Step Enable				LSB
	D7	D6	D5	D4	D3	D2	D1	D0
OFF	0	0	0	0	0	0	0	0
ON					1			

Select Address 02(hex) Advanced Switch Time of EXT ON/OFF

MODE	MSB			Advanced Switch Time of EXT ON/OFF 1				LSB
	D7	D6	D5	D4	D3	D2	D1	D0
11.2msec	0	Advanced Switch Time of EXT ON/OFF 2			0	0	0	0
4.7msec					0	1		
7.2msec					1	0		
14.4msec					1	1		

Select Address 02(hex) Advanced Switch Time of EXT ON/OFF

MODE	MSB			Advanced Switch Time of EXT ON/OFF 2				LSB
	D7	D6	D5	D4	D3	D2	D1	D0
x1	0	0	0	0	Advanced Switch Time of EXT ON/OFF 1		0	0
x2		0	0	1				
x3		0	1	0				
x4		0	1	1				
x5		1	0	0				
x6		1	0	1				
x7		1	1	0				
x8		1	1	1				

Select Address 28, 29, 2A, 2B, 2C 2D(hex) Volume

Gain & ATT	MSB			Volume Gain/Attenuation				LSB
	D7	D6	D5	D4	D3	D2	D1	D0
Prohibition ※	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	1
	:	:	:	:	:	:	:	:
	0	1	1	0	1	0	0	0
23dB	0	1	1	0	1	0	0	1
22dB	0	1	1	0	1	0	1	0
21dB	0	1	1	0	1	0	1	1
:	:	:	:	:	:	:	:	:
-77dB	1	1	0	0	1	1	0	1
-78dB	1	1	0	0	1	1	1	0
-79dB	1	1	0	0	1	1	1	1
Prohibition ※	1	1	0	1	0	0	0	0
	:	:	:	:	:	:	:	:
	1	1	1	1	1	1	1	0
-∞dB	1	1	1	1	1	1	1	1

: Initial condition

Select Address 30, 31, 32(hex) EXT ON/OFF

MODE	MSB			EXT F1				LSB
	D7	D6	D5	D4	D3	D2	D1	D0
OFF	EXT S2	EXT S1	EXT R2	EXT R1	EXT F2	0	0	0
ON						1		

MODE	MSB			EXT F2				LSB
	D7	D6	D5	D4	D3	D2	D1	D0
OFF	EXT S2	EXT S1	EXT R2	EXT R1	0	EXT F1	0	0
ON					1			

MODE	MSB			EXT R1				LSB
	D7	D6	D5	D4	D3	D2	D1	D0
OFF	EXT S2	EXT S1	EXT R2	0	EXT F2	EXT F1	0	0
ON				1				

MODE	MSB			EXT R2				LSB
	D7	D6	D5	D4	D3	D2	D1	D0
OFF	EXT S2	EXT S1	0	EXT R1	EXT F2	EXT F1	0	0
ON			1					

MODE	MSB			EXT S1				LSB
	D7	D6	D5	D4	D3	D2	D1	D0
OFF	EXT S2	0	EXT R2	EXT R1	EXT F2	EXT F1	0	0
ON		1						

MODE	MSB			EXT S2				LSB
	D7	D6	D5	D4	D3	D2	D1	D0
OFF	0	EXT S1	EXT R2	EXT R1	EXT F2	EXT F1	0	0
ON	1							

Select Address 33, 34, 35(hex) EXT ATT ※Select Address 01(hex), D3 = 0, (EXT 1dB Enable = OFF)

Gain	MSB			EXT Attenuation				LSB
	D7	D6	D5	D4	D3	D2	D1	D0
0dB	0	0	0	0	0	0	0	0
-8dB						0	0	1
-16dB						0	1	0
-24dB						0	1	1
-32dB						1	0	0
-48dB						1	0	1
-64dB						1	1	0
-∞dB						1	1	1

Select Address 33, 34, 35(hex) EXT ATT ※Select Address 01(hex), D3 = 1, (EXT 1dB Enable = ON)

Gain & ATT	MSB			EXT Attenuation				LSB
	D7	D6	D5	D4	D3	D2	D1	D0
0dB	1	0	0	0	0	0	0	0
-1dB	1	0	0	0	0	0	0	1
-2dB	1	0	0	0	0	0	1	0
:	:	:	:	:	:	:	:	:
-77dB	1	1	0	0	1	1	1	0
-78dB	1	1	0	0	1	1	1	0
-79dB	1	1	0	0	1	1	1	1
Prohibition ※	1	1	0	1	0	0	0	0
	:	:	:	:	:	:	:	:
	1	1	1	1	1	1	1	0
-∞	1	1	1	1	1	1	1	1

: Initial condition

(6) About power on reset

At on of supply voltage circuit made initialization inside IC is built-in. Please send data to all address as initial data at supply voltage on. And please supply mute at set side until this initial data is sent.

Item	Symbol	Limit			Unit	Condition
		Min	Typ	Max		
Rise time of VCC	Trise	33	—	—	μsec	VCC rise time from 0V to 5V
VCC voltage of release power on reset	Vpor	—	4.1	—	V	

(7) About start-up and power off sequence on IC

In power supply off, please set a register state of the IC as follows.

・Volume Gain /Attenuation = MINF (SelectAddress28,29,2A,2B,2C,2D(hex), Data = FF(hex))

・EXT1,2,3 ON/OFF = OFF (SelectAddress30,31,32(hex), Data = 00(hex))

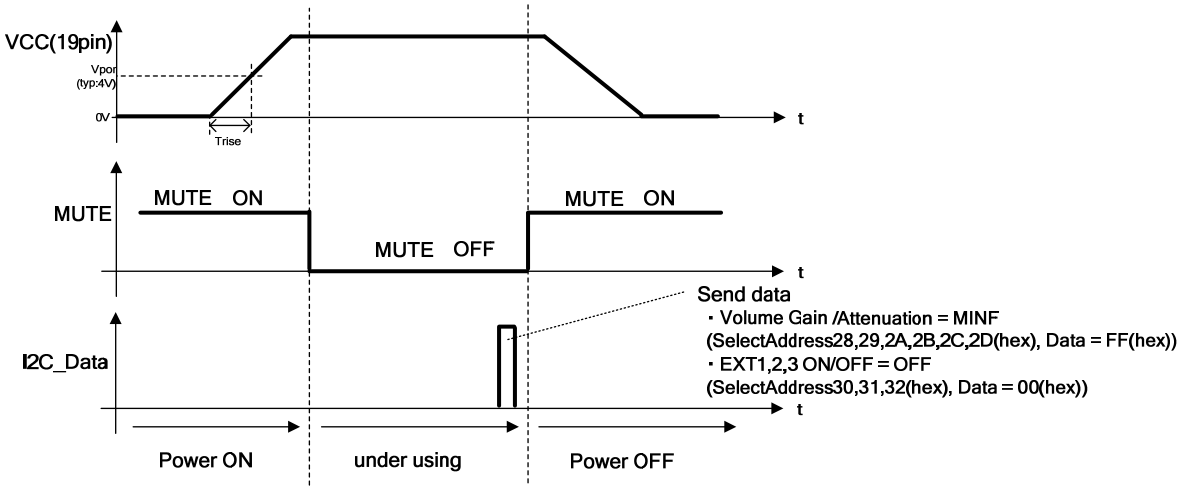


Figure 15. The sequence of power supply ON/OFF

・Select Address 28, 29, 2A, 2B, 2C 2D(hex)　Volume　(Gain = +23dB ～ -79dB, -∞)
・Select Address 33, 34, 35(hex)　EXT ATT　(Gain = 0dB ～ -79dB, -∞)
※Select Address 01(hex), D3 = 1, (EXT 1dB Enable = ON)

Volume gain attenuation

(dB)	D7	D6	D5	D4	D3	D2	D1	D0	(dB)	D7	D6	D5	D4	D3	D2	D1	D0
+23	0	1	1	0	1	0	0	1	-29	1	0	0	1	1	1	0	1
+22	0	1	1	0	1	0	1	0	-30	1	0	0	1	1	1	1	0
+21	0	1	1	0	1	0	1	1	-31	1	0	0	1	1	1	1	1
+20	0	1	1	0	1	1	0	0	-32	1	0	1	0	0	0	0	0
+19	0	1	1	0	1	1	0	1	-33	1	0	1	0	0	0	0	1
+18	0	1	1	0	1	1	1	0	-34	1	0	1	0	0	0	1	0
+17	0	1	1	0	1	1	1	1	-35	1	0	1	0	0	0	1	1
+16	0	1	1	1	0	0	0	0	-36	1	0	1	0	0	1	0	0
+15	0	1	1	1	0	0	0	1	-37	1	0	1	0	0	1	0	1
+14	0	1	1	1	0	0	1	0	-38	1	0	1	0	0	1	1	0
+13	0	1	1	1	0	0	1	1	-39	1	0	1	0	0	1	1	1
+12	0	1	1	1	0	1	0	0	-40	1	0	1	0	1	0	0	0
+11	0	1	1	1	0	1	0	1	-41	1	0	1	0	1	0	0	1
+10	0	1	1	1	0	1	1	0	-42	1	0	1	0	1	0	1	0
+9	0	1	1	1	0	1	1	1	-43	1	0	1	0	1	0	1	1
+8	0	1	1	1	1	0	0	0	-44	1	0	1	0	1	1	0	0
+7	0	1	1	1	1	0	0	1	-45	1	0	1	0	1	1	0	1
+6	0	1	1	1	1	0	1	0	-46	1	0	1	0	1	1	1	0
+5	0	1	1	1	1	0	1	1	-47	1	0	1	0	1	1	1	1
+4	0	1	1	1	1	1	0	0	-48	1	0	1	1	0	0	0	0
+3	0	1	1	1	1	1	0	1	-49	1	0	1	1	0	0	0	1
+2	0	1	1	1	1	1	1	0	-50	1	0	1	1	0	0	1	0
+1	0	1	1	1	1	1	1	1	-51	1	0	1	1	0	0	1	1
0	1	0	0	0	0	0	0	0	-52	1	0	1	1	0	1	0	0
-1	1	0	0	0	0	0	0	1	-53	1	0	1	1	0	1	0	1
-2	1	0	0	0	0	0	1	0	-54	1	0	1	1	0	1	1	0
-3	1	0	0	0	0	0	1	1	-55	1	0	1	1	0	1	1	1
-4	1	0	0	0	0	1	0	0	-56	1	0	1	1	1	0	0	0
-5	1	0	0	0	0	1	0	1	-57	1	0	1	1	1	0	0	1
-6	1	0	0	0	0	1	1	0	-58	1	0	1	1	1	0	1	0
-7	1	0	0	0	0	1	1	1	-59	1	0	1	1	1	0	1	1
-8	1	0	0	0	1	0	0	0	-60	1	0	1	1	1	1	0	0
-9	1	0	0	0	1	0	0	1	-61	1	0	1	1	1	1	0	1
-10	1	0	0	0	1	0	1	0	-62	1	0	1	1	1	1	1	0
-11	1	0	0	0	1	0	1	1	-63	1	0	1	1	1	1	1	1
-12	1	0	0	0	1	1	0	0	-64	1	1	0	0	0	0	0	0
-13	1	0	0	0	1	1	0	1	-65	1	1	0	0	0	0	0	1
-14	1	0	0	0	1	1	1	0	-66	1	1	0	0	0	0	1	0
-15	1	0	0	0	1	1	1	1	-67	1	1	0	0	0	0	1	1
-16	1	0	0	1	0	0	0	0	-68	1	1	0	0	0	1	0	0
-17	1	0	0	1	0	0	0	1	-69	1	1	0	0	0	1	0	1
-18	1	0	0	1	0	0	1	0	-70	1	1	0	0	0	1	1	0
-19	1	0	0	1	0	0	1	1	-71	1	1	0	0	0	1	1	1
-20	1	0	0	1	0	1	0	0	-72	1	1	0	0	1	0	0	0
-21	1	0	0	1	0	1	0	1	-73	1	1	0	0	1	0	0	1
-22	1	0	0	1	0	1	1	0	-74	1	1	0	0	1	0	1	0
-23	1	0	0	1	0	1	1	1	-75	1	1	0	0	1	0	1	1
-24	1	0	0	1	1	0	0	0	-76	1	1	0	0	1	1	0	0
-25	1	0	0	1	1	0	0	1	-77	1	1	0	0	1	1	0	1
-26	1	0	0	1	1	0	1	0	-78	1	1	0	0	1	1	1	0
-27	1	0	0	1	1	0	1	1	-79	1	1	0	0	1	1	1	1
-28	1	0	0	1	1	1	0	0	-∞	1	1	1	1	1	1	1	1

:Initial condition

About advanced switch circuit

【1】Advanced switch technology

1-1. Advanced switch effects

Advanced switch technology is Rohm original switching pop noise prevention technology. The audible signal is discontinuous during the gain switching instantly which cause the noise to occur. This Advanced switch circuit will prevent this discontinuous signal by completing the signal waveform and will significantly reduce the noise.

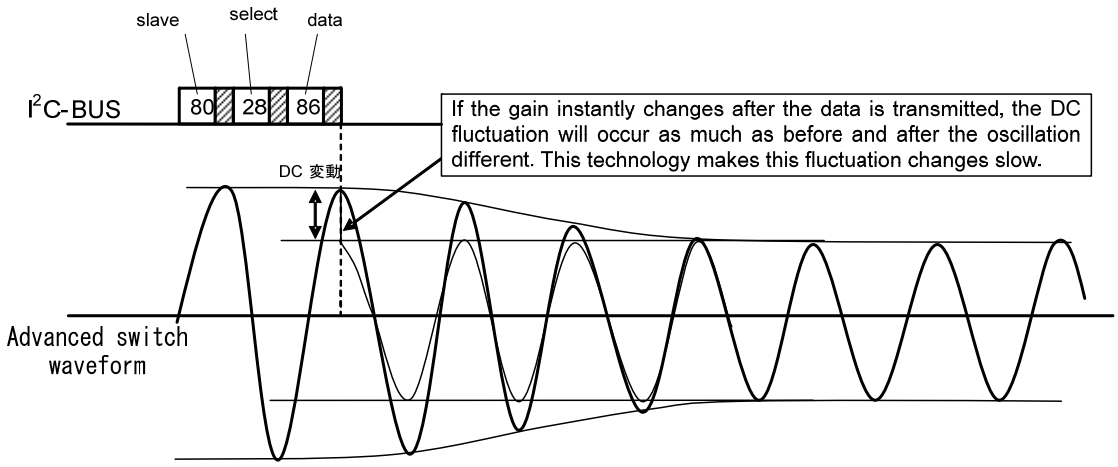


Figure 16. Advanced switch wave

This Advanced switch technology will start the switching when received the signal sent from the micon. At any constant time, the switching waveform is shown as above figure. This IC will optimally operate by internally processing the data sent from the micon to prevent the switching shock.

However, sometimes the switching waveform is not like the intended form depends on the transmission timing. Therefore, below is the example of the relationship between the transmission timing and actual switching time. Please consider this relationship for the setting.

1-2. The kind of the Transferring Data

・Data setting other than Advanced switch supported items
(P.9 Select Address and data　Data format without hatching)
There is no particular rule about transferring data.

・Advanced switch supported items data setting
(P.9 Select Address and data　Data format with hatching)
There is no particular rule about transferring data, but Advanced switch must follow the switching sequence as mentioned in【2】.

※　Advanced switch supported blocks are “Volume” and ”EXT ON/OFF”(In detail, please refer p9).

【2】Data transmission of Advanced switch supported items

2-1. Switching time of Advanced switch

Switching time includes [Twait(Wait time)], [Tsft(A→B switching time)] and [Tsft(B→A switching time)]. 25msec is needed per 1 switching. (Tsoft = Twait + 2 * Tsft, Twait=2.3msec, Tsft=11.2msec)

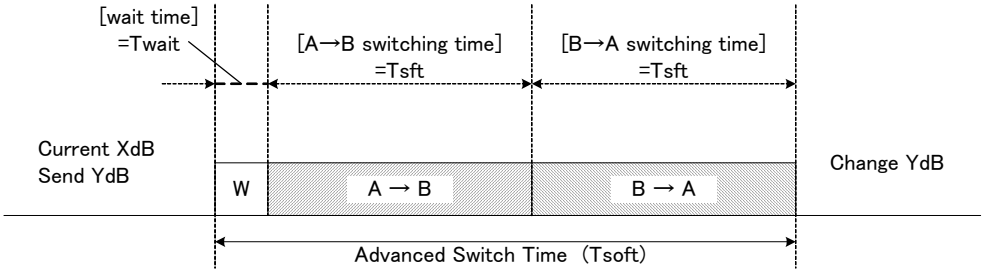


Figure 17. About Advanced switching time

In Figure 8, Start/Stop state is expressed as “A” and temporary state is expressed as “B”.
The switching sequence of Advance switch will be, A(start)→B→A(stop), thus switching will not stop at B state.
In other words, switching is performed from A(Initial gain)→B(set gain→A(set gain) when switching from initial gain to set gain.

It is possible to change the switching time of Advanced switch time by setting the EXT Advanced switch multi sel and Advanced Switch Time of EXT at select Address2.
If only EXT ON/OFF is performed in all Advanced switch operation, the switching time of Advanced switch is determined by EXT Advanced switch multi sel and Advanced Switch Time of EXT.

For example
EXT Advanced switch multi sel is set to x8 and Advanced Switch Time of EXT is set to 14.4msec
In this case, the switching time of Advanced switch is determined as below.

EXT Advanced switch multi sel x Advanced Switch Time of EXT = 115.2msec

This is equal to switching time of A→B or B→A(Tsft).

As mentioned in Figure 11 (Start sequence of Advanced switch), each ch(6channels) volume and EXT ON/OFF switch at the same timing. When each ch(6channels) volume switches at the same time EXT ON/OFF operation is performed, switching time of each ch(6channels) volume will be the same as EXT ON/OFF switching set by calculation above. In other words, switching time of EXT ON/OFF has higher priority than that of the 6channels volume

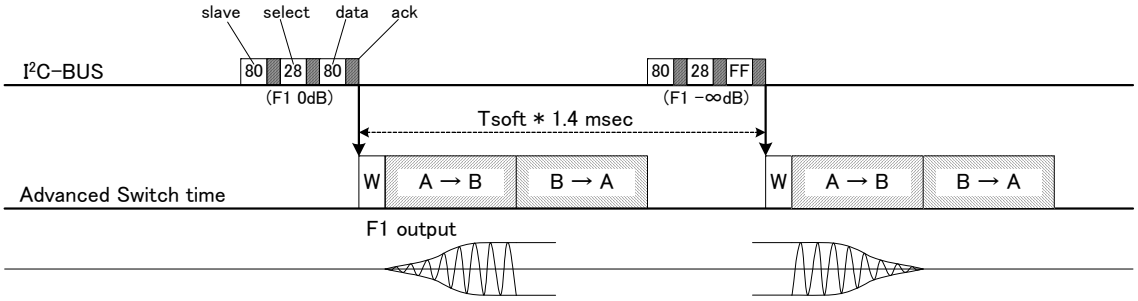
Even if switching time of EXT ON/OFF is set by calculation above, when EXT ON/OFF switching is not being performed, switching time of each ch(6channels) volume is determined as Tsft＝11.2msec. Please exercise caution when setting the switching time of Advanced switch.

2-2. Explanation on data transmission's timing and switching operation.

The following examples show the time chart from the time a data is transmitted until the switching starts.

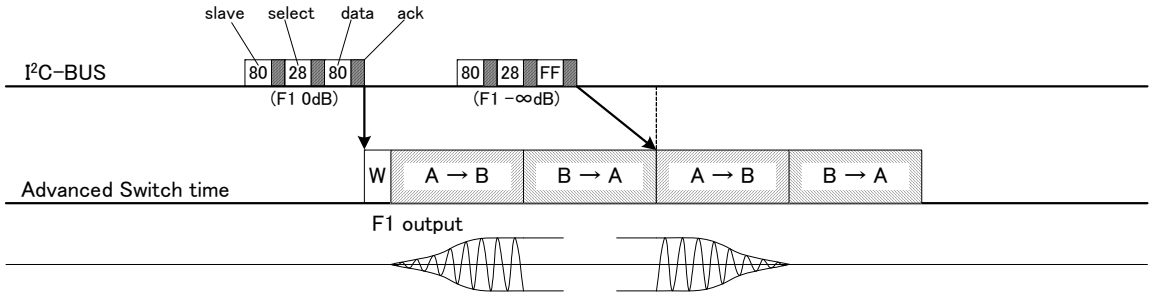
■ Transmission example 1

This is an example when transmitting data in same block with enough transmission interval.
This enough interval refers to the tolerance margin time of Tsoft multiplied by 1.4.



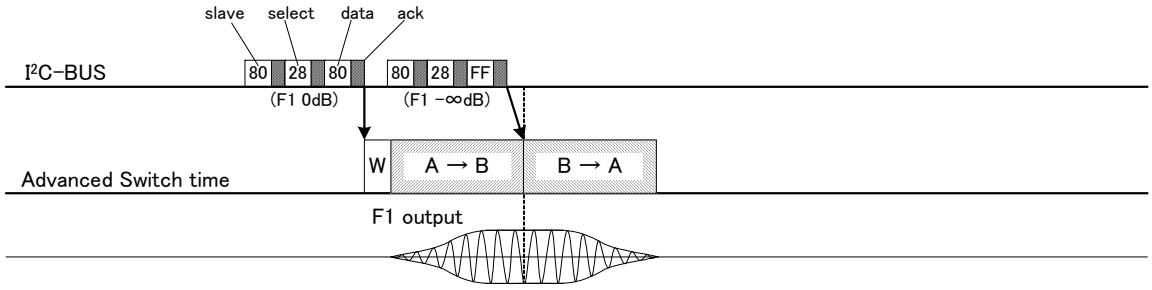
■ Transmission example 2

This is an example when the transmission interval is not enough (smaller than transmission example 1).
When the data is transmitted during the first switching operation, the second data transmission will continue after complete the first switching. In this case, there is no wait time (Twait) before the second switching.

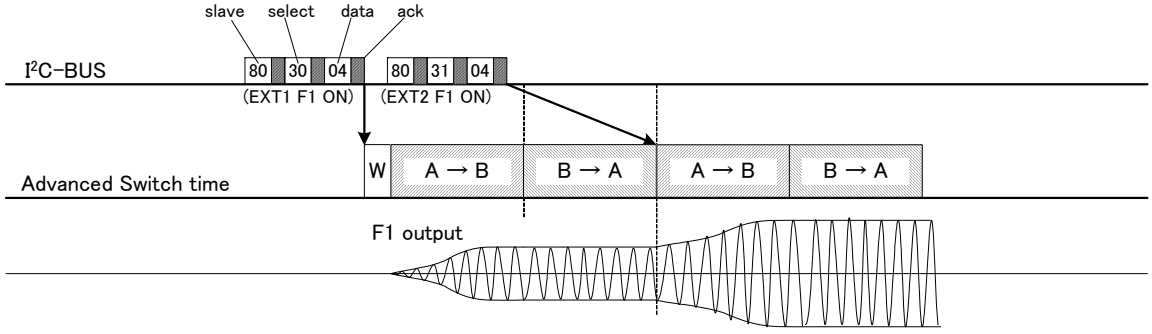


■ Transmission example 3

This is an example when transmission interval is even smaller (smaller than transmission example 2).
When the data is transmitted during the first switching, and it is during A→B switching operation, if the transmitted data is volume, switching of new data is performed at B→A timing



If the transmitted data is EXT ON/OFF switching, when other switching data is sent during A→B switching, switching's will be the same as Transmission example 2



About data transmission to multi-channels, there is a caution. It is possible that Lch and Rch in same block(Front/Rear/Sub) can be switched at the same timing. For example, when the data transmission is set as the figure below, it is possible that OUTF1 and OUTF2 can be switched at the same timing(Data ② is sent for FL (Lch) and data ② is sent for FR (Rch)). Please take note that Twait is wait time for starting switching and designed to 2.3msec. (Considering fluctuation of element, Twait may change from 1.2msec (Min.) to 4.6msec (Max.).

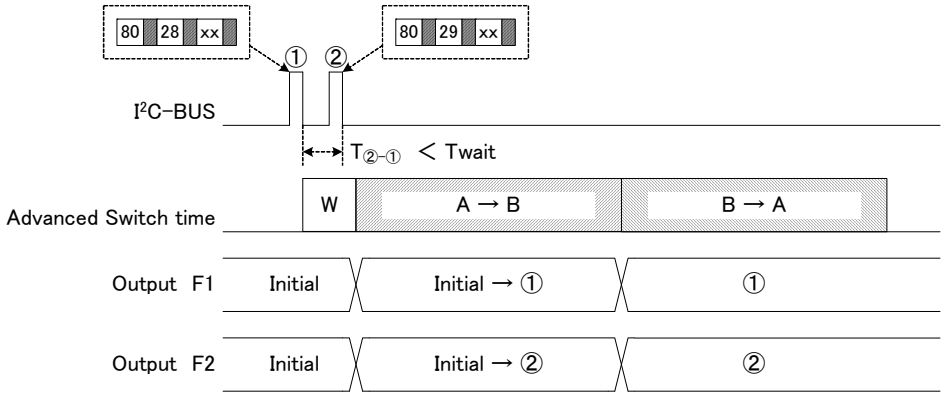


Figure 18. The operation during multi-channels (1ch, 2ch) data transmission (smaller than Twait interval).

Next, when data ② is not transmitted during the Twait, the switching operation is as following figure.

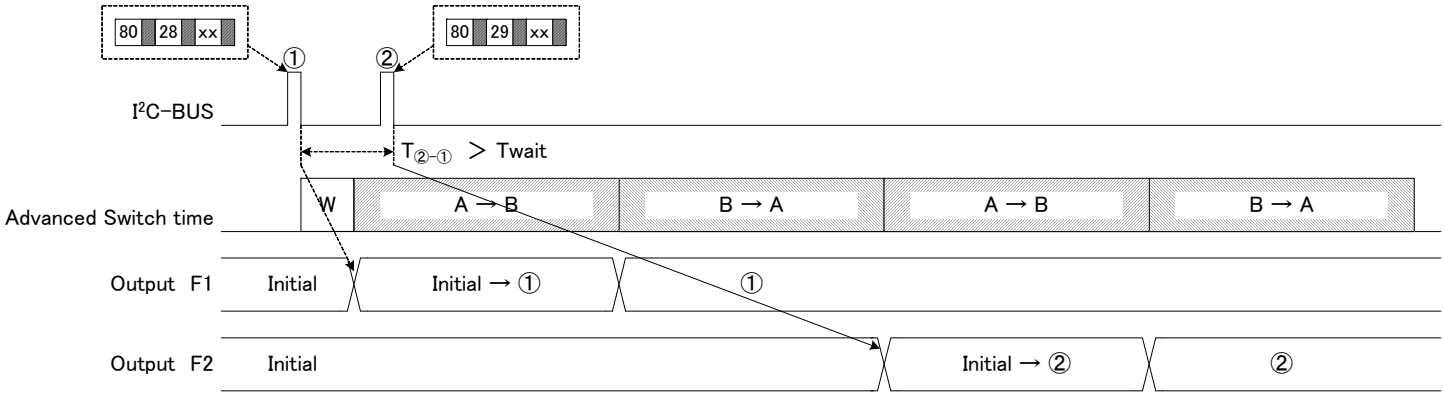
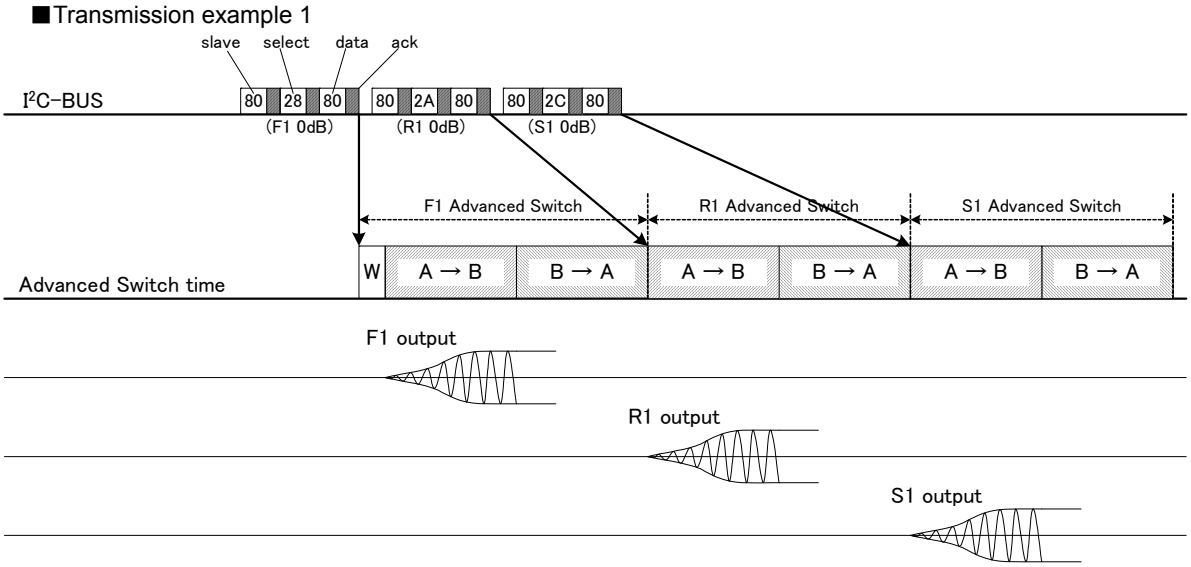


Figure 19. The operation during multi-channels (1ch, 2ch) data transmission (larger than Twait interval).

2-3. Multi-blocks data transmission timing and switching operation.

In case the data is transmitted to the multi-blocks, the processing is performed internally by BS unit.
Micro step volume starting order is determined by BS unit.



※It is the same even if it transfers data in auto increment mode.

There are no timing regulations of I²C-BUS transferring data. But the timing of a change start after the end of the present change. In addition, the timing of Advanced switch is not depended of a transferring data turn, but conforms in turn of the following figure.

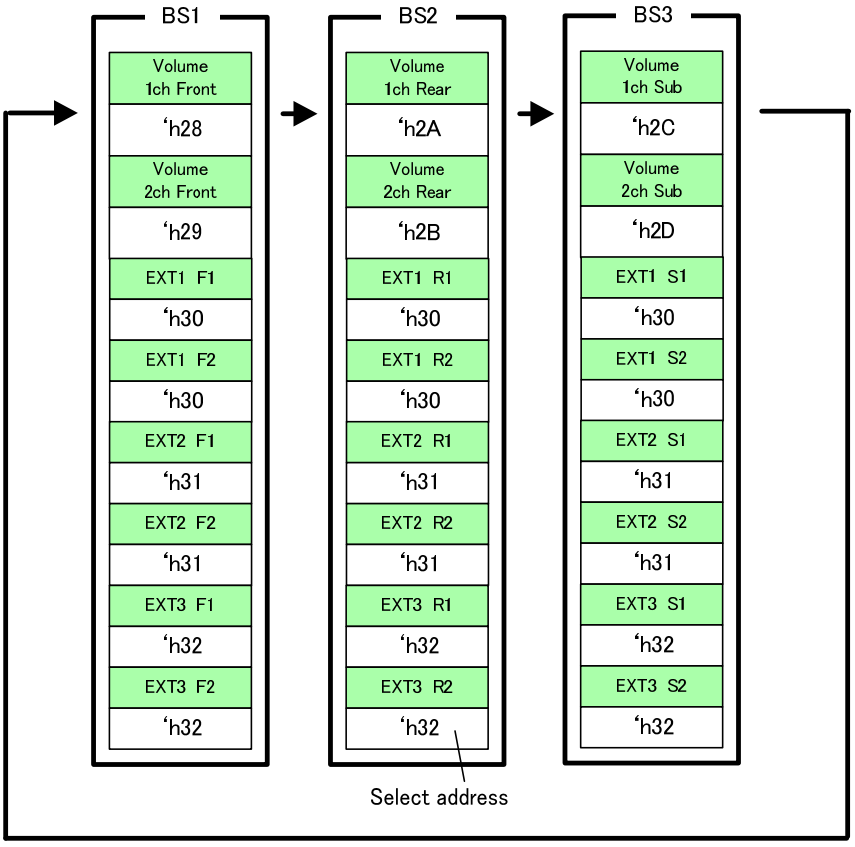
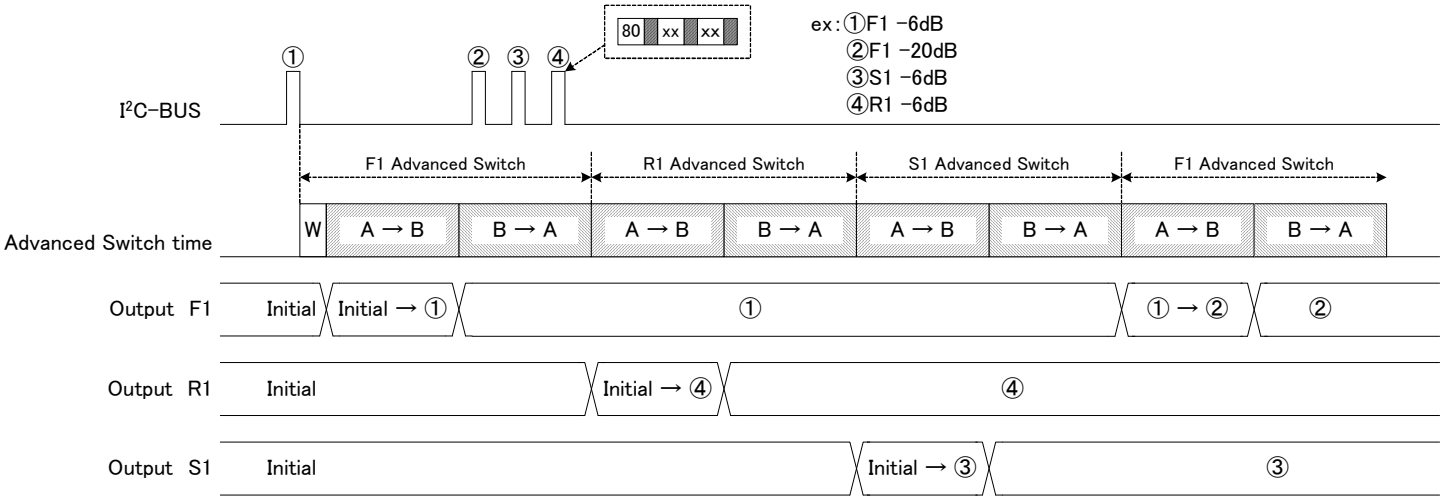


Figure 20. The turn of Advanced switch start

※The block in the same group can start the Advanced switch in the same time.

■Transmission example 2

In case of the transmission order is different with actual switching order.

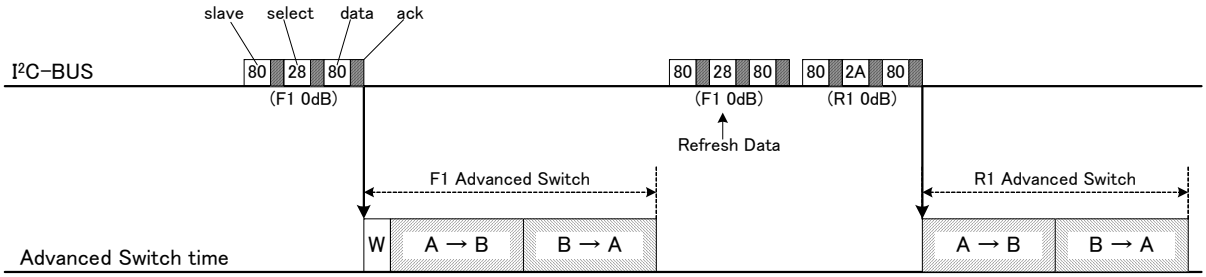


During Front switching, in case of Front/Rear/SW continuously received, Rear and SW switching are the priority.
If you want the switching starts as the data transmission order, please transmit the next data after current switching is ended.

■Transmission example 3

For Refresh data, the IC will internally judge that there is no difference with the current data setting and therefore gain switching operation will not start.

Continuing the Refresh data and transmit the other block data.



Application Circuit Diagram

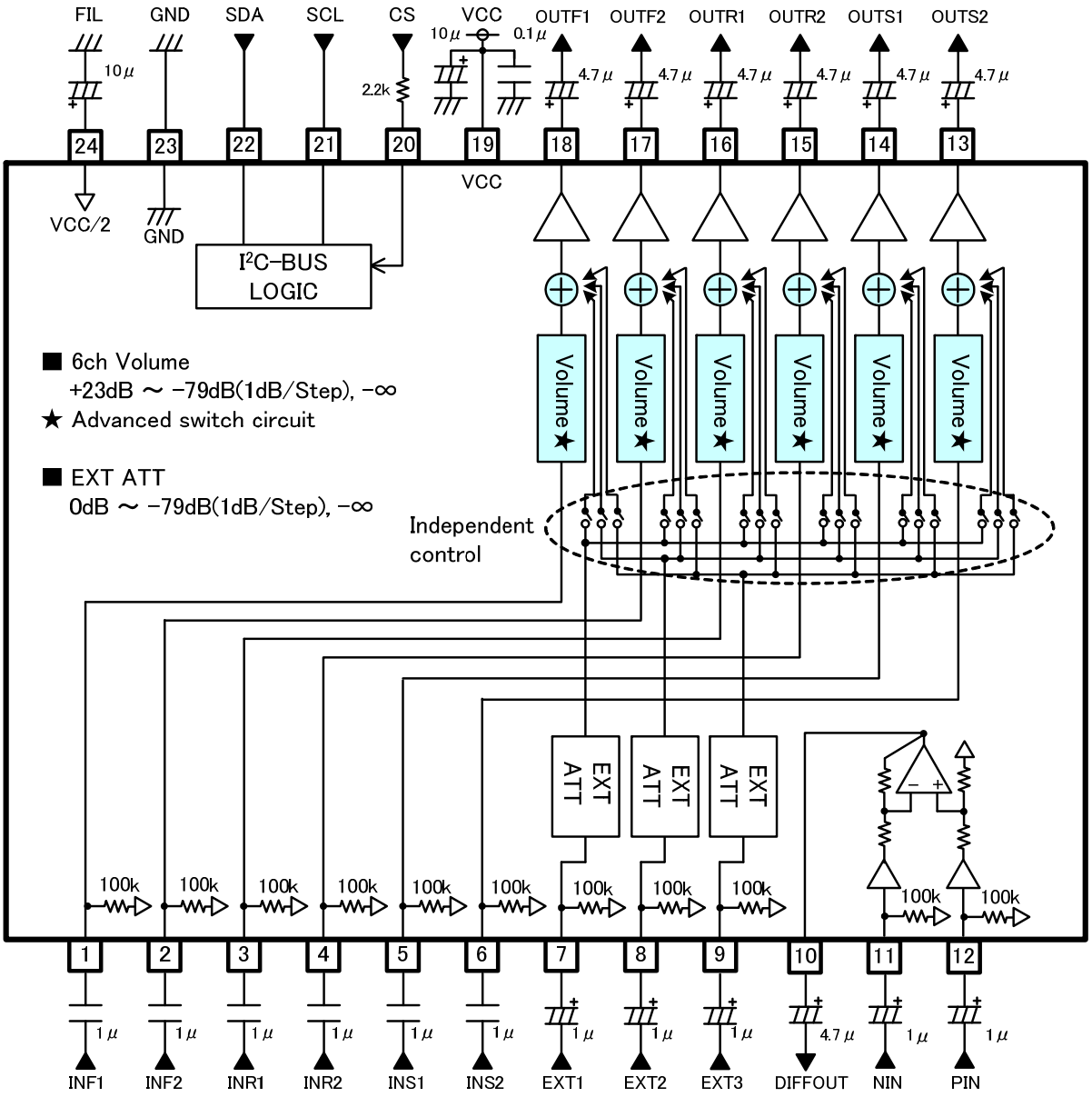


Figure 21. Application Circuit Diagram

UNIT
RESISTANCE: Ω
CAPACITANCE: F

Notes on wiring

①Please connect the decoupling capacitor of the power supply in the shortest distance as much as possible to VCC and GND, VEE.
②Lines of GND shall be one-point connected.
③Wiring pattern of Dagital shall be away from the analog unit and cross-talk is not acceptable.
④Lines of SCL and SDA of I^2C BUS shall not be parallel if possible. The lines shall be shielded, if they are adjacent to each other.
⑤Lines of analog input shall not be parallel if possible. The lines shall be shielded, if they are adjacent to each other.

Power Dissipation

Thermal design for the IC

Temperature has great influence to the IC characteristics, and exceeding the absolute maximum ratings may degrade and damage the IC. A proper consideration must be given from two points, immediate damage and long-term reliability of operation.

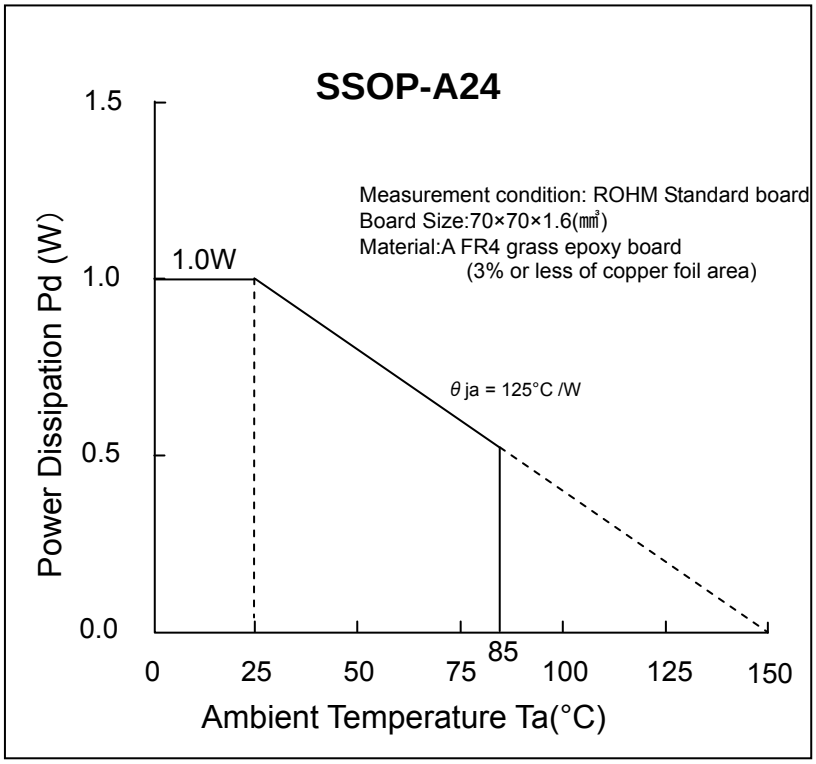
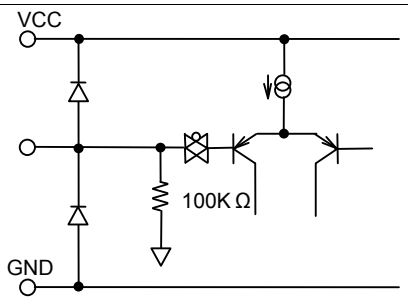
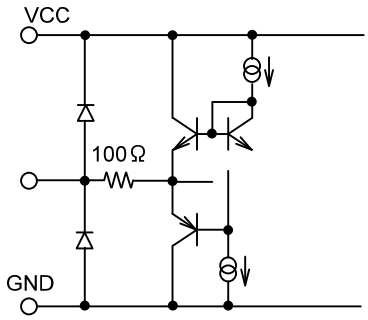
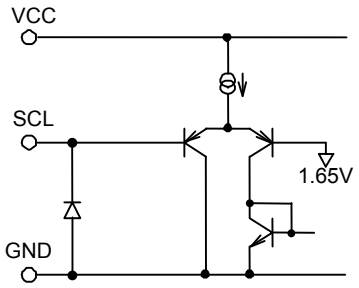
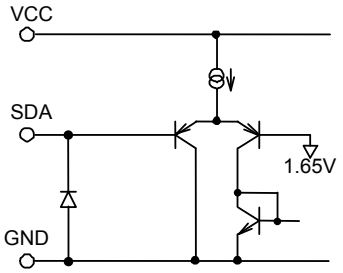
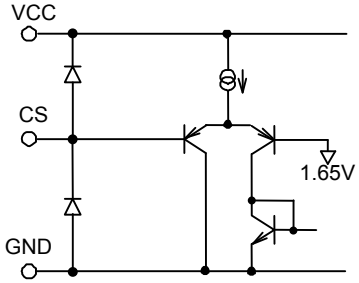


Figure 22. Temperature Derating Curve

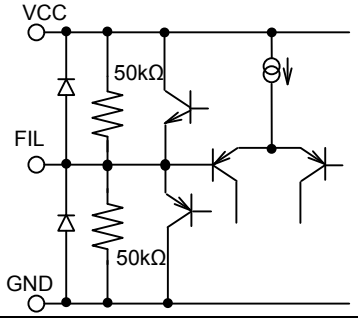
Note) Values mentioned above are based on actual measurement, and not guaranteed.

Note) Power dissipation value varies depending to the board on which the IC is mounted.

Terminal Equivalent Circuit and Description

Terminal No.	Terminal Name	Terminal Voltage	Equivalent Circuit	Terminal Description
1 2 3 4 5 6 7 8 9 11 12	INF1 INF2 INR1 INR2 INS1 INS2 EXT1 EXT2 EXT3 NIN PIN	4.25V		A terminal for signal input. The input impedance is 100kΩ(typ).
10 13 14 15 16 17 18	DIFFOUT OUTS2 OUTS1 OUTR2 OUTR1 OUTF2 OUTF1	4.25V		A terminal for fader output.
22	SCL	—		A terminal for clock input of I^2C-BUS.
23	SDA	—		A terminal for data input of I^2C-BUS.
20	CS	—		CS Input Terminal. A terminal for Slave Address selection. “CS” is “High”→Slave Address “84 H” “CS” is “Low”→ Slave Address “80 H”

The figure in the pin explanation and input/output equivalent circuit is reference value, it’s doesn’t guarantee the value.

Terminal No.	Terminal Name	Terminal Voltage	Equivalent Circuit	Terminal Description
19	VCC	8.5V		Power supply terminal.
23	GND	0V		Ground terminal.
24	FIL	4.25V		1/2 VCC terminal. Voltage for reference bias of analog signal system. The simple precharge circuit and simple discharge circuit for an external capacitor are built in.

The figure in the pin explanation and input/output equivalent circuit is reference value, it's doesn't guarantee the value.

Operational Notes

1. **Reverse Connection of Power Supply**
   Connecting the power supply in reverse polarity can damage the IC. Take precautions against reverse polarity when connecting the power supply, such as mounting an external diode between the power supply and the IC's power supply pins.

2. **Power Supply Lines**
   Design the PCB layout pattern to provide low impedance supply lines. Furthermore, connect a capacitor to ground at all power supply pins. Consider the effect of temperature and aging on the capacitance value when using electrolytic capacitors.

3. **Ground Voltage**
   Ensure that no pins are at a voltage below that of the ground pin at any time, even during transient condition.

4. **Ground Wiring Pattern**
   When using both small-signal and large-current ground traces, the two ground traces should be routed separately but connected to a single ground at the reference point of the application board to avoid fluctuations in the small-signal ground caused by large currents. Also ensure that the ground traces of external components do not cause variations on the ground voltage. The ground lines must be as short and thick as possible to reduce line impedance.

5. **Thermal Consideration**
   Should by any chance the power dissipation rating be exceeded the rise in temperature of the chip may result in deterioration of the properties of the chip. In case of exceeding this absolute maximum rating, increase the board size and copper area to prevent exceeding the Pd rating.

6. **Recommended Operating Conditions**
   These conditions represent a range within which the expected characteristics of the IC can be approximately obtained. The electrical characteristics are guaranteed under the conditions of each parameter.

7. **Inrush Current**
   When power is first supplied to the IC, it is possible that the internal logic may be unstable and inrush current may flow instantaneously due to the internal powering sequence and delays, especially if the IC has more than one power supply. Therefore, give special consideration to power coupling capacitance, power wiring, width of ground wiring, and routing of connections.

8. **Operation Under Strong Electromagnetic Field**
   Operating the IC in the presence of a strong electromagnetic field may cause the IC to malfunction.

9. **Testing on Application Boards**
   When testing the IC on an application board, connecting a capacitor directly to a low-impedance output pin may subject the IC to stress. Always discharge capacitors completely after each process or step. The IC's power supply should always be turned off completely before connecting or removing it from the test setup during the inspection process. To prevent damage from static discharge, ground the IC during assembly and use similar precautions during transport and storage.

10. **Inter-pin Short and Mounting Errors**
    Ensure that the direction and position are correct when mounting the IC on the PCB. Incorrect mounting may result in damaging the IC. Avoid nearby pins being shorted to each other especially to ground, power supply and output pin. Inter-pin shorts could be due to many reasons such as metal particles, water droplets (in very humid environment) and unintentional solder bridge deposited in between pins during assembly to name a few.

11. **Unused Input Terminals**
    Because the input impedance of the terminal becomes 100kΩ when the signal input terminal makes a terminal open, the plunge noise from outside sometimes becomes a problem.
    About unused input pin, please connect to GND through capacitor, or please set that channel MUTE.
    About unused output pin, it is no problem to set to open.

Operational Notes – continued 1

12. **Regarding the Input Pin of the IC**
This monolithic IC contains P+ isolation and P substrate layers between adjacent elements in order to keep them isolated. P-N junctions are formed at the intersection of the P layers with the N layers of other elements, creating a parasitic diode or transistor. For example (refer to figure below):

When GND > Pin A and GND > Pin B, the P-N junction operates as a parasitic diode.
When GND > Pin B, the P-N junction operates as a parasitic transistor.

Parasitic diodes inevitably occur in the structure of the IC. The operation of parasitic diodes can result in mutual interference among circuits, operational faults, or physical damage. Therefore, conditions that cause these diodes to operate, such as applying a voltage lower than the GND voltage to an input pin (and thus to the P substrate) should be avoided.

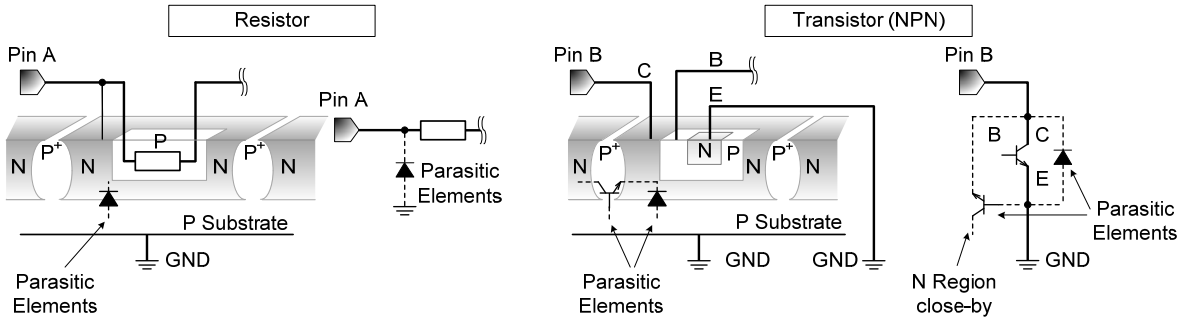


Figure 23. Example of monolithic IC structure

13. **Ceramic Capacitor**
When using a ceramic capacitor, determine the dielectric constant considering the change of capacitance with temperature and the decrease in nominal capacitance due to DC bias and others.

14. **About power ON/OFF**
At power ON/OFF, a pop sound will be generated and, therefore, use MUTE on the set.

15. **About EXT ATT(**Select Address 33, 34, 35(hex)) switching
When switching EXT ATT, please set EXT OFF.

16. **About Volume gain switching, EXT ON/OFF switching**
In case of the boost of the volume when changing to the high gain which exceeds +12dB especially, the switching pop noise sometimes becomes big. (For example, in case gain of the power amplifier is set to +26dB, and switching time is set to 11.2msec)
In this case, countermeasures as below are recommended to decrease this pop noise.
・Switching gain by only 1dB/Step
・Increase switching time (In detail, please refer p9.)

Operational Notes – continued 2

16. About output load characteristics
The usage of load for output are below (reference). Please use the load more than 10[kΩ](TYP).

Output terminal

Terminal No.	Terminal Name	Terminal No.	Terminal Name	Terminal No.	Terminal Name	Terminal No.	Terminal Name
18	OUTF1	16	OUTR1	14	OUTS1	10	DIFFOUT
17	OUTF2	15	OUTR2	13	OUTS2		

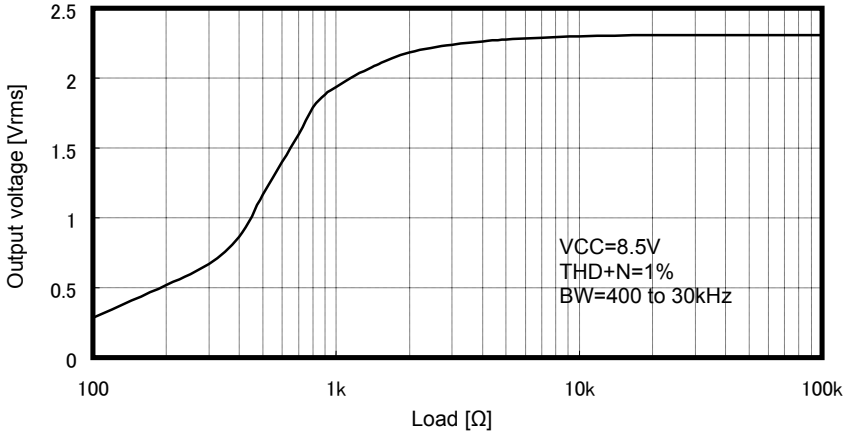


Figure 24. Output load characteristic VCC=8.5V (Reference)

17. About constant set up of input coupling capacitor

In the signal input terminal, the constant setting of input coupling capacitor C(F) be sufficient input impedance R_{IN}(from 70 to 130kΩ) inside IC and please decide. The first HPF characteristic of RC is composed.

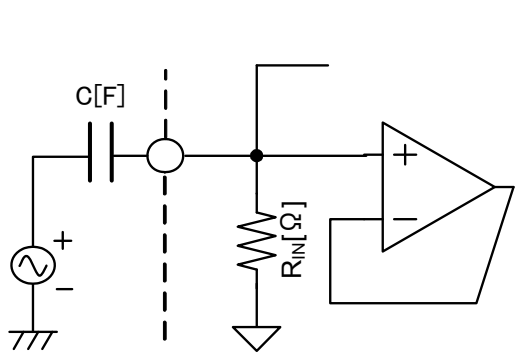
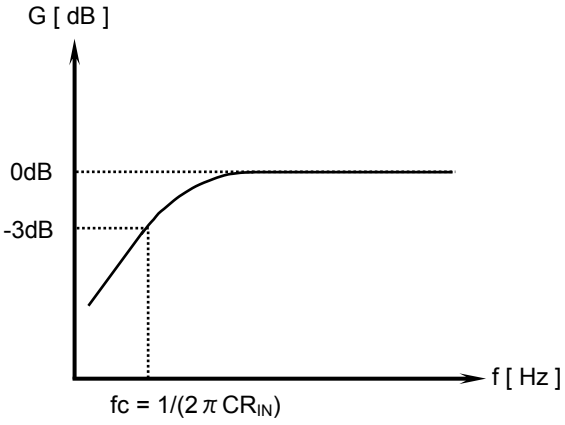


Figure 25. Input equivalent circuit



Ordering Information

B D 3 4 6 0 2 F S	-	ME 2

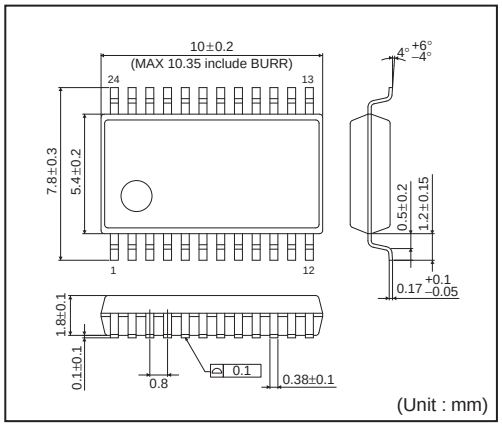
Part Number

Package
FS: SSOP-A24

Product Rank
M : for Automotive
Packaging and forming specification
E2 : Embossed tape and reel
(SSOP-A24)

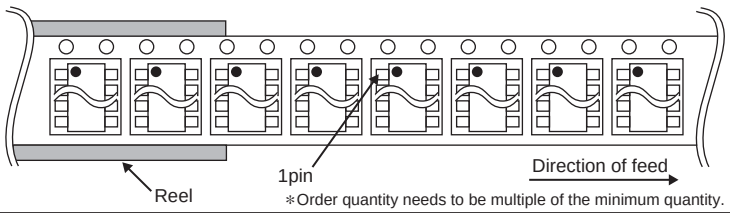
Physical Dimension, Tape and Reel Information

SSOP-A24



<Tape and Reel information>

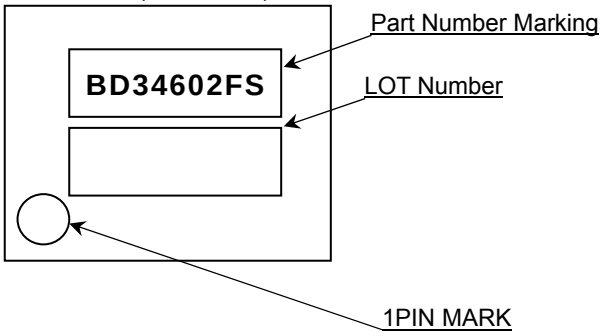
Tape	Embossed carrier tape
Quantity	2000pcs
Direction of feed	E2 (The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand)



∗Order quantity needs to be multiple of the minimum quantity.

Marking Diagrams

SSOP-A24(TOP VIEW)



Revision History

Date	Revision	Changes
22.Oct.2015	001	New Release

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(Note1) Medical Equipment Classification of the Specific Applications

JAPAN	USA	EU	CHINA
CLASSⅢ	CLASSⅢ	CLASSⅡb	CLASSⅢ
CLASSⅣ		CLASSⅢ	

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   [b] Installation of redundant circuits to reduce the impact of single or multiple circuit failure

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   [b] Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
   [c] Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl_2, H_2S, NH_3, SO_2, and NO_2
   [d] Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
   [e] Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
   [f] Sealing or coating our Products with resin or other coating materials
   [g] Use of our Products without cleaning residue of flux (even if you use no-clean type fluxes, cleaning residue of flux is recommended); or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering
   [h] Use of the Products in places subject to dew condensation

4. The Products are not subject to radiation-proof design.

5. Please verify and confirm characteristics of the final or mounted products in using the Products.

6. In particular, if a transient load (a large amount of load applied in a short period of time, such as pulse. is applied, confirmation of performance characteristics after on-board mounting is strongly recommended. Avoid applying power exceeding normal rated power; exceeding the power rating under steady-state loading condition may negatively affect product performance and reliability.

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8. Confirm that operation temperature is within the specified range described in the product specification.

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2. In principle, the reflow soldering method must be used on a surface-mount products, the flow soldering method must be used on a through hole mount products. If the flow soldering method is preferred on a surface-mount products, please consult with the ROHM representative in advance.

For details, please refer to ROHM Mounting specification

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This Product is electrostatic sensitive product, which may be damaged due to electrostatic discharge. Please take proper caution in your manufacturing process and storage so that voltage exceeding the Products maximum rating will not be applied to Products. Please take special care under dry condition (e.g. Grounding of human body / equipment / solder iron, isolation from charged objects, setting of Ionizer, friction prevention and temperature / humidity control).

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   - [b] the temperature or humidity exceeds those recommended by ROHM
   - [c] the Products are exposed to direct sunshine or condensation
   - [d] the Products are exposed to high Electrostatic

2. Even under ROHM recommended storage condition, solderability of products out of recommended storage time period may be degraded. It is strongly recommended to confirm solderability before using Products of which storage time is exceeding the recommended storage time period.

3. Store / transport cartons in the correct direction, which is indicated on a carton with a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.

4. Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

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