

M62464BFP

Dolby Pro Logic Surround Decoder with Discrete 5.1ch Analog Input

REJ03F0218-0201

Rev.2.01

Mar 31, 2008

Description

The M62464BFP is a Single Chip Dolby Pro Logic Surround Decoder with Discrete 5.1ch Analog Input. This LSI has all of required functions for Dolby Pro Logic Surround and also 5.1ch analog input. for Dolby Digital.

Note: Dolby and the double-D symbol are trademarks of Dolby Laboratories Licensing Corporation. San Francisco, CA94103-4813, USA.

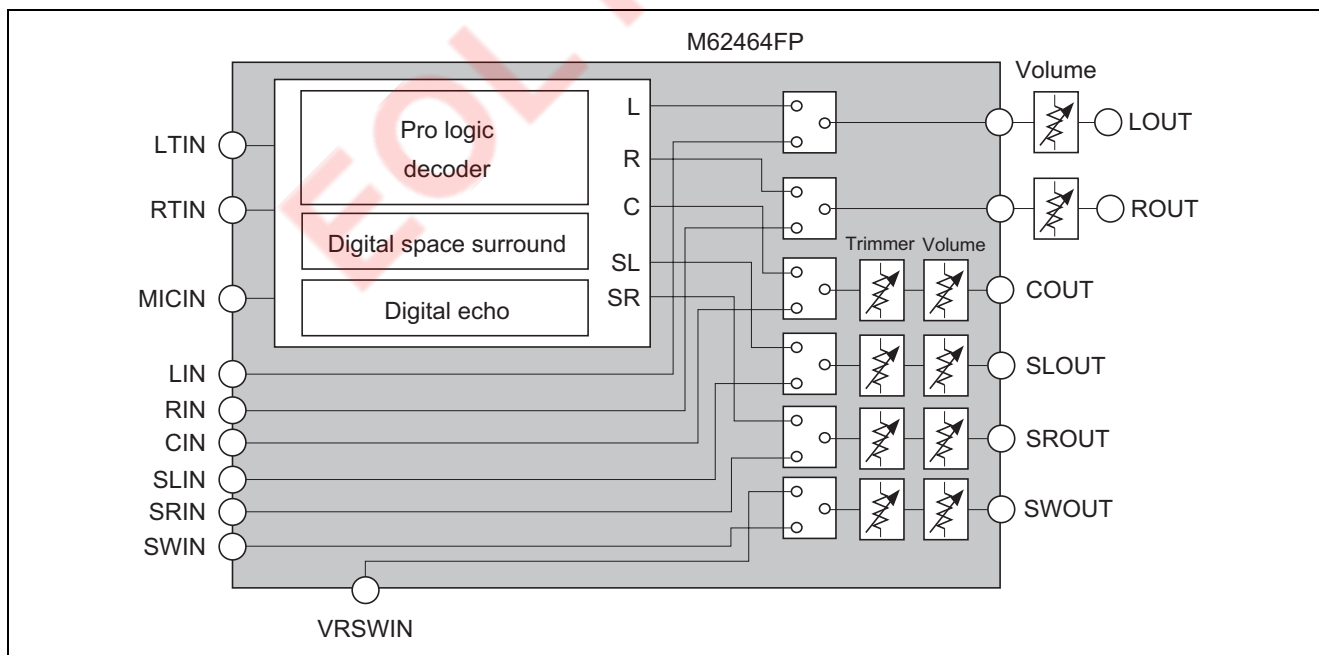
This device available only to licensees of Dolby Lab.

Licensing and application information may be obtained from Dolby Lab.

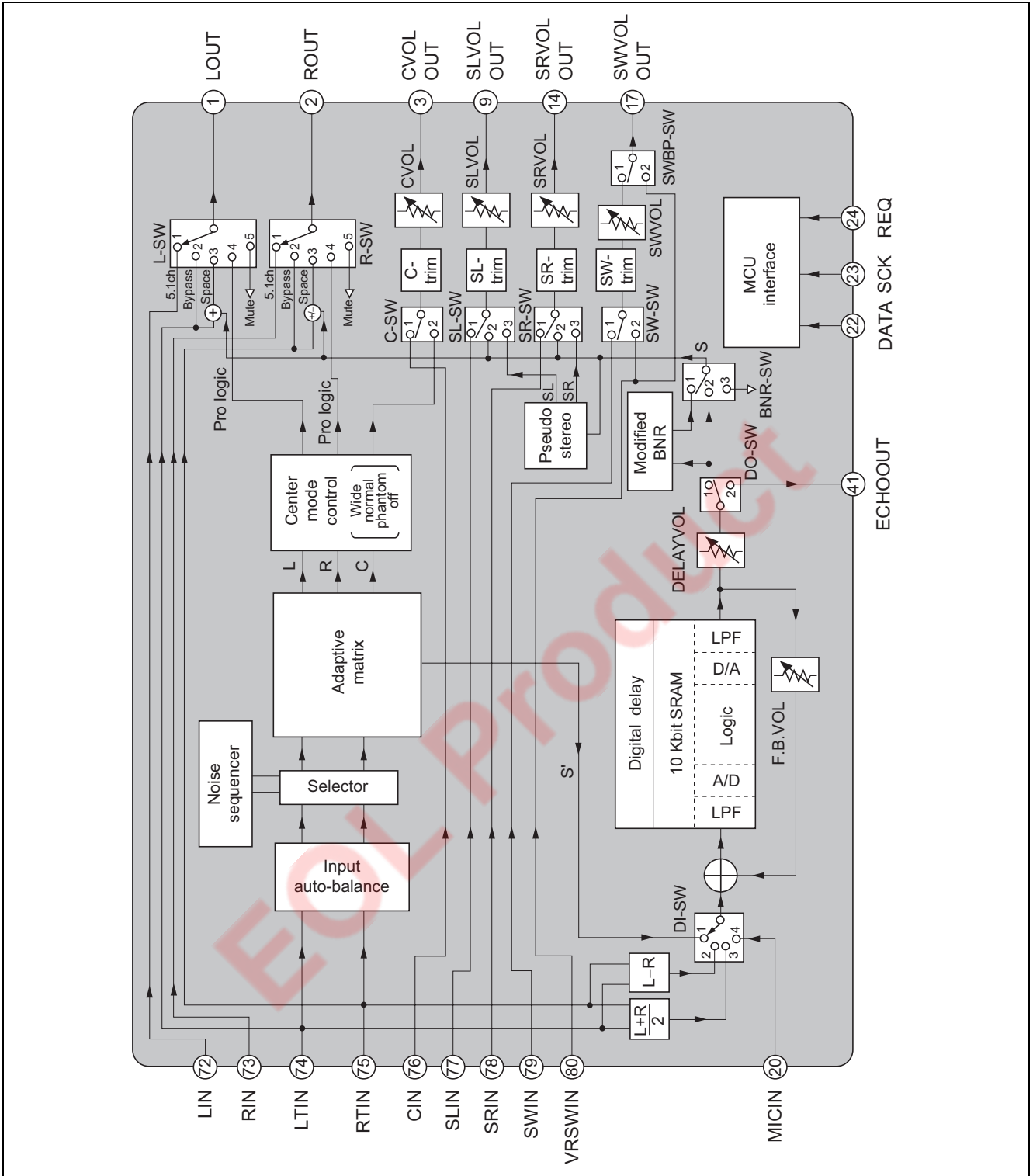
Features

- Includes all functions necessary for Dolby Pro Logic Surround
- Includes 5.1ch (L, R, C, SL, SR, SW) analog input for Dolby Digital
- 4ch (C, SL, SR, SW) Master Volume
- Digital Space Surround such as Disco, Hall and Live
- Pseudo Stereo Surround for Digital Space Surround
- Digital Echo for Karaoke Function Delay time 123,184 ms
- 3-lines MCU control
- Current control oscillation circuit for system clock

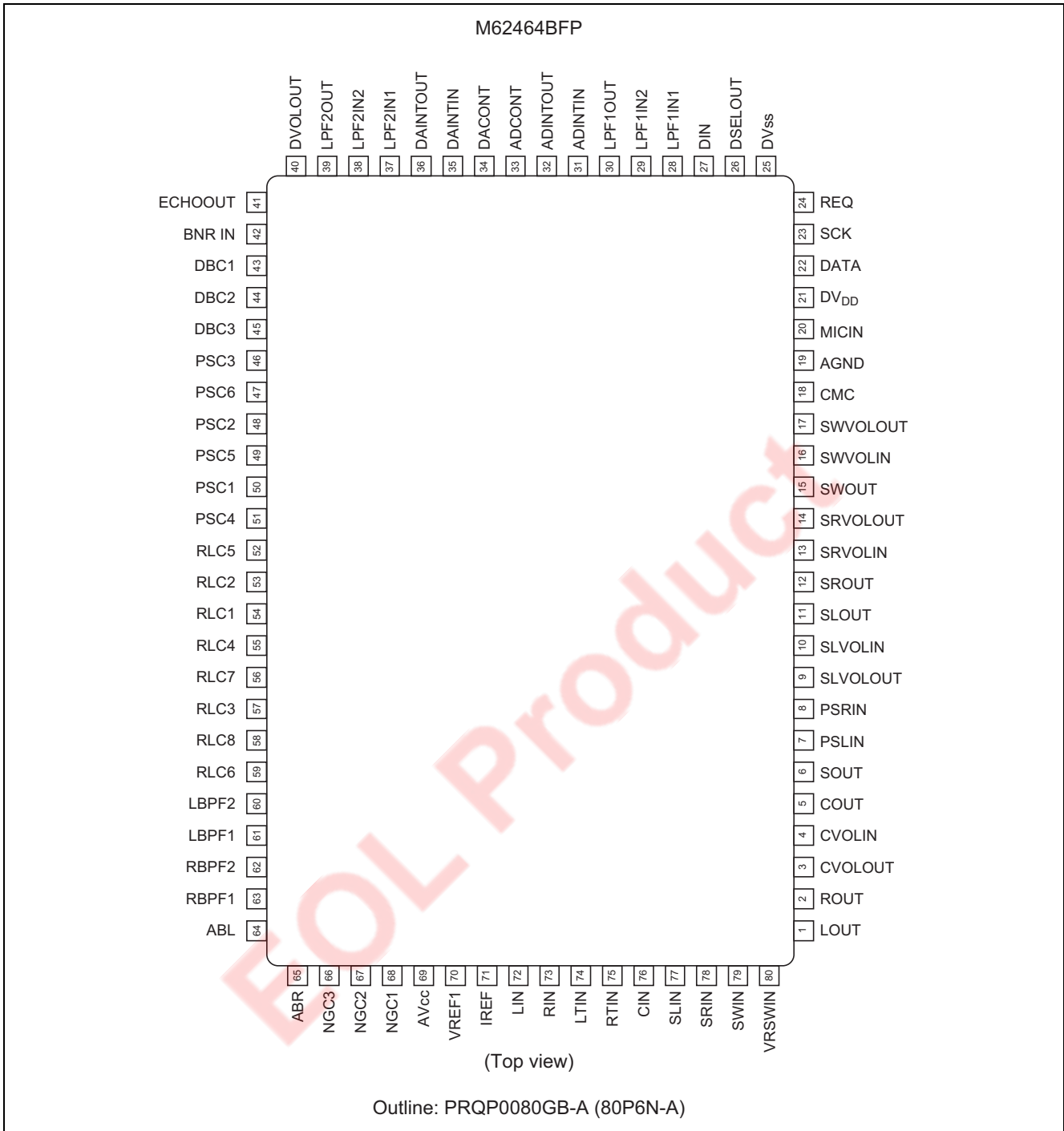
System Block Diagram



Block Diagram



Pin Arrangement



Functional Description

Function		Description
1	Fundamental function for Dolby Pro Logic surround decoder	<ul style="list-style-type: none"> Adaptive Matrix Input Auto-Balance Noise Sequencer Center Mode Control ON/OFF WIDE/NORMAL/PHANTOM Modified Dolby B type Noise Reduction 4ch (L, R, C, S), 3ch (L, R, C) Mode Switch
2	5.1ch Analog Input for Dolby Digital	L, R, C, SL, SR, SW ch Analog Input Support
3	C, SL, SR, SW ch master volume	0 to -79 dB/1 dB step, and -∞
4	C, SL, SR, SW ch Trimmer	0 to -31 dB/1 dB step
5	RAM for digital delay	10 K-bit RAM
6	Circuit for space surround and echo	Digital delay circuit can be used for Space Surround such as a Disco, Hall or Live, and Karaoke echo.
7	Pseudo stereo surround	Pseudo Stereo Surround is available in Space Surround.
8	Digital delay time	Short Delay 15.4, 20.5, 25.6, 29.2, 51.2 ms Long Delay 123, 184 ms
9	Feedback volume	Delay Signal Feedback Volume -3 to -21 dB/3 dB step, and -∞
10	Delay effect volume	Delay Signal Effect Volume 0 to -18 dB/3 dB step, and -∞
11	Bypass switch	Bypass the decode circuit
12	Output mute	Mute the Lch and Rch output
13	MCU interface	Controlled by 3-lines serial data from MCU Including the Chip Address (2 bit)
14	Current control oscillation circuit	Including the oscillation circuit without external parts.

Absolute Maximum Ratings

(Ta = 25°C, unless otherwise noted)

Item	Symbol	Ratings	Unit	Condition
Supply voltage	V _{CC}	10.5	V	
	V _{DD}	6.5	V	
Power dissipation	P _d	1.4	W	
Operating temperature	T _{opr}	-20 to +75	°C	
Storage temperature	T _{stg}	-40 to +125	°C	

Recommended Operating Condition

Item	Symbol	Limits			Unit	Condition
		Min	Typ	Max		
Supply voltage	V _{CC}	8	9	10	V	
	V _{DD}	4.5	5	5.5	V	
Input voltage (L)	V _{IL}	0	—	0.8	V	22, 23, 24 pin
Input voltage (H)	V _{IH}	2.2	—	V _{DD}	V	22, 23, 24 pin

Electrical Characteristics

($T_a = 25^\circ\text{C}$, $V_{CC} = 9\text{V}$, $V_{DD} = 5\text{V}$, $0\text{dBd} = 300\text{mVrms}$, at COU, $f = 1\text{kHz}$ Unless otherwise noted)

Item	Symbol	Limits			Unit	Conditions
		Min	Typ	Max		
Total						
Circuit current	I_{CC}	—	30	45	mA	No signal
Circuit current	I_{DD}	—	15	25	mA	No signal
Auto-balance						
Capture range	CPR	—	5	—	dB	
Error collection	CER	—	4	—	dB	
Adaptive Matrix						
Output level accuracy relative to Cch	ΔVoL	-0.5	0	0.5	dB	L, R, S'ch output
Matrix rejection	MR	25	40	—	dB	L, R, C, S'ch output
Head room	HRAM	15	17	—	dB	THD = 1%, L, R, C ch output
Total harmonic distortion	THDAM	—	0.05	0.2	%	L, R, C ch output 30kHz LPF
S/N ratio	SNAM	70	80	—	dB	$R_g = 0\Omega$, weighted CCIR/ARM
Noise Sequencer						
Output noise level	V_{no}	-15	-12.5	-10	dB	L, R, C, S'ch output
Noise level accuracy relative to Cch	ΔV_{no}	-0.5	0	0.5	dB	L, R, S'ch output
Modified B-type Noise Reduction (0dB reference is 300mVrms/100Hz at SOUT)						
Gain between input and output	VGNR	3.8	6.8	9.8	dB	$V_{in} = 0\text{dBd}$, $f = 100\text{Hz}$
Decode character1	DEC1	-1.6	-0.1	1.4	dB	$V_{in} = 0\text{dBd}$, $f = 1.0\text{kHz}$
Decode character2	DEC2	-3.0	-1.5	0		$V_{in} = -15\text{dBd}$, $f = 1.4\text{kHz}$
Decode character3	DEC3	-6.8	-5.3	-3.8		$V_{in} = -40\text{dBd}$, $f = 5.0\text{kHz}$
Total harmonic distortion	THDNR	—	0.07	0.3	%	$V_{in} = 0\text{dBd}$, $f = 1\text{kHz}$, 30kHz LPP
Head room	HRNR	15	17	—	dB	THD = 1%
S/N ratio	SNNR	68	78	—	dB	$R_g = 0\Omega$, weighted CCIR/ARM
Cch/SLch/SRch/SWch Master Volume						
Maximum attenuation	ATTmax	—	-95	-87	dB	$ATT = -\infty$, $V_i = 2\text{Vrms}$
Minimum attenuation	ATTmin	-3.0	0	3.0	dB	$ATT = 0\text{dB}$, $TRIM = 0\text{dB}$
Volume step1	VOLS1	0.5	1.0	1.5	dB	$ATT = 0$ to -40dB , $TRIM = 0\text{dB}$
Volume step2	VOLS2	0.2	1.0	1.8	dB	$ATT = -40$ to -76dB , $TRIM = 0\text{dB}$
S/N ratio	SNVOL	85	95	—	dB	$ATT = -\infty$, CCIR/ARM
Cch/SLch/SRch/SWch Trimmer						
Maximum attenuation	TRIMmax	-34	-31	-28	dB	$TRIM = -31\text{dB}$, $VOLATT = 0\text{dB}$
Minimum attenuation	TRIMmin	-3.0	0	3.0	dB	$TRIM = 0\text{dB}$, $VOLATT = 0\text{dB}$
Trimmer step	TRIMS	0.6	1.0	1.4	dB	$VOLATT = 0\text{dB}$
Line (Bypass)						
Total harmonic distortion	THDLN	—	0.002	0.05	%	30kHz LPF
S/N ratio	SNLN	95	100	—	dB	DIN-AUDIO
Line cross-talk	CTLN	70	80	—	dB	
Input impedance	Z_i	11	22	44	k Ω	

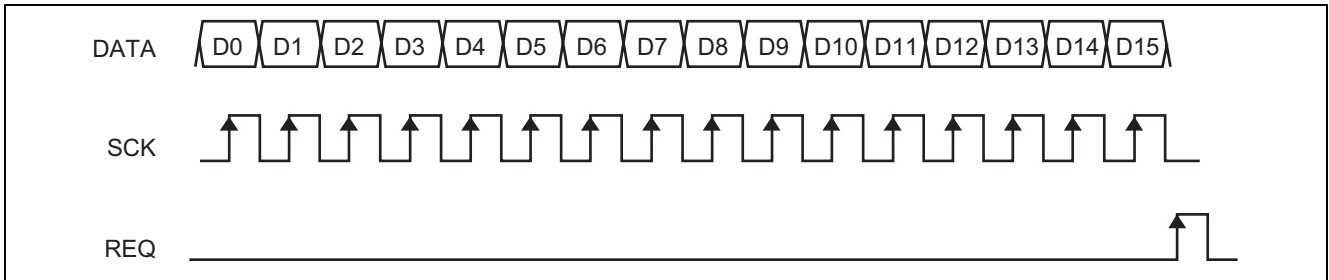
(Ta = 25°C, V_{CC} = 9 V, V_{DD} = 5 V, 0dBd = 300 mVrms, at COUT, f = 1 kHz Unless otherwise noted)

Item	Symbol	Limits			Unit	Conditions	
		Min	Typ	Max			
Digital delay							
Input/output voltage gain	GvD	-3.0	0	+3.0	dB	DIN-DVOLUME, DVOL = 0dB	
Delay time	Td	17.4	20.5	23.6	ms	Td = 20.5ms	
Total harmonic distortion	THDD	—	0.5	0.9	%	30kHzLPF	Td = 20.5ms
		—	1.2	2.2			Td = 51.2ms
		—	3.0	5.6			Td = 184ms
Output noise voltage	NoD	—	-92	-80	dBV	Vin = 0Vrms JIS-A	Td = 20.5ms
		—	-84	-70			Td = 51.2ms
		—	-80	-65			Td = 184ms
Maximum output voltage	Vomax	0.7	1.0	—	Vrms	THD = 10%	
LPF cut-off frequency	LPFfc	6.0	7.0	8.0	kHz	Td = 15.4 to 51.2ms Gv = -3dB	
		—	3.0	—	kHz	Td = 123 to 184ms Gv = -3dB	
Feedback volume							
Maximum attenuation	FBATTmax	—	-70	-60	dB	ATT = -∞	
Minimum attenuation	FBATTmin	-6.0	-3.0	0	dB	ATT = -3dB	
Volume step	FBVOLS	1.5	3.0	4.5	dB		
Delay volume							
Maximum attenuation	DLATTmax	—	-70	-60	dB	ATT = -∞	
Minimum attenuation	DLATTmin	-3.0	0	3.0	dB	ATT = 0dB	
Volume step	DLVOLS	1.5	3.0	4.5	dB		

Serial Data Control Format

(1) Data Input Format

DATA is read at the rising edge of SCK, and loaded last 16 bits at the rising edge of REQ.



D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	
L	L	L	—	Mode Set		Pro Logic Mode	Center Mode	Auto-Balance	Noise Sequencer			L	H			
		H	—	"L"	Delay Time		Space Surround Mode									
L	H	L	L	Delay Volume		Cch Volume			Chip Address	Chip Address						
		L	H	Feedback Volume		SLch Volume										
		H	L	—		SRch Volume										
		H	H	—		SW-VOL Set	SWch Volume									
H	L	L	—	Cch Trimmer			SWch Trimmer									
		H	—	SLch Trimmer			SRch Trimmer									
H	H	Test Mode (user inhibit)														

(2) Control condition

Control Mode	Contents	
1	Mode set	5.1ch Input / Normal Stereo / Dolby Pro Logic / Space Surround / Echo / Mute
2	Pro logic mode	4ch Pro Logic / 3ch stereo
3	Center mode	Wide / Normal / Phantom / OFF
4	Delay time	15.4, 20.5, 25.6, 29.2, 51.2 ms (Short delay) 123, 184 ms (Long delay)
5	Noise sequencer	ON / OFF Lch / Rch / Cch / Sch
6	Auto-balance	Input Auto-Balance ON / OFF
7	Space surround mode	L/R Output: Dolby Pro Logic / Space Surround Delay input: S'/L-R/ (L+R) /2/MICIN Delay output mixing, BNR: ON/OFF Surround signal: Monaural/Pseudo Stereo
8	Delay volume	0 to -18 dB/3 dB step & -∞
9	Feedback volume	-3 to -21 dB/3 dB step & -∞
10	Master volume	C, SL, SR, SWch Master Volume 0 to -79 dB/1 dB step & -∞
11	Trimmer	C, SL, SR, SWch Trimmer 0 to -31 dB/1 dB step
12	SW volume set	SW Volume: Volume/Bypass
13	Chip address	Input date effect or not

(3) Set Condition

a. Mode Set

(D0 = "L", D1 = "L", D2 = "L")

D4	D5	D6	Condition
L	L	L	5.1ch Signal input
L	L	H	Normal stereo (bypass)
L	H	L	Dolby Pro Logic Surround
L	H	H	Space surround
H	L	L	Echo
H	L	H	Output mute

b. Pro Logic Mode

(D0 = "L", D1 = "L", D2 = "L")

D7	Condition
L	4ch Pro Logic
H	3ch Stereo

c. Center Mode

(D0 = "L", D1 = "L", D2 = "L")

D8	D9	Condition
L	L	Wide
L	H	Normal
H	L	Phantom
H	H	OFF

d. Delay Time

(D0 = "L", D1 = "L", D2 = "H")

D5	D6	D7	Delay Time	Sampling Frequency	LPF Cut-off Frequency
L	L	L	15.4 ms	500 kHz	7 kHz
L	L	H	20.5 ms	500 kHz	
L	H	L	25.6 ms	400 kHz	
L	H	H	29.2 ms	333 kHz	
H	L	L	51.2 ms	200 kHz	
H	L	H	123 ms	83.3 kHz	3 kHz
H	H	L	184 ms	55.6 kHz	

e. Noise Sequencer

(D0 = "L", D1 = "L", D2 = "L")

D11	D12	D13	Condition	
L	—	—	Noise Sequencer OFF	—
H	L	L	Noise Sequencer ON	Lch
	L	H		Rch
	H	L		Cch
	H	H		Sch

f. Auto-Balance

(D0 = "L", D1 = "L", D2 = "L")

D10	Condition
L	Auto-Balance OFF
H	Auto-Balance ON

g. Space Surround Mode

(D0 = "L", D1 = "L", D2 = "H")

L/R Output

D8	Condition
L	Dolby Pro Logic
H	Space Surround

Delay Mixing Polarity

D9	Mixing Polarity
L	L+Delay signal / R+Delay signal
H	L+Delay signal / R-Delay signal

Delay Input

D10	D11	Delay Input
L	X	S'
H	L	L-R
H	H	(L+R) /2

Note: L or H

BNR

D12	BNR
L	OFF
H	ON

Surround Signal

D13	Surround Signal
L	Monaural
H	Pseudo Stereo

h. Delay Volume

(D0 = "L", D1 = "H", D2 = "L", D3 = "L")

D4	D5	D6	Volume
L	L	L	0 dB
L	L	H	-3 dB
L	H	L	-6 dB
L	H	H	-9 dB
H	L	L	-12 dB
H	L	H	-15 dB
H	H	L	-18 dB
H	H	H	-∞

i. Feedback Volume

(D0 = "L", D1 = "H", D2 = "L", D3 = "H")

D4	D5	D6	Volume
L	L	L	-3 dB
L	L	H	-6 dB
L	H	L	-9 dB
L	H	H	-12 dB
H	L	L	-15 dB
H	L	H	-18 dB
H	H	L	-21 dB
H	H	H	-∞

j. C, SL, SR, SW ch Volume

(D0 = "L", D1 = "H")

Volume Level	D11	D10	D9	D8	D7
0 dB	L	L	L	L	L
-2 dB	L	L	L	L	H
-4 dB	L	L	L	H	L
-6 dB	L	L	L	H	H
-8 dB	L	L	H	L	L
-10 dB	L	L	H	L	H
-12 dB	L	L	H	H	L
-14 dB	L	L	H	H	H
-16 dB	L	H	L	L	L
-18 dB	L	H	L	L	H
-20 dB	L	H	L	H	L
-22 dB	L	H	L	H	H
-24 dB	L	H	H	L	L
-26 dB	L	H	H	L	H
-28 dB	L	H	H	H	L
-30 dB	L	H	H	H	H
-32 dB	H	L	L	L	L
-34 dB	H	L	L	L	H
-36 dB	H	L	L	H	L
-38 dB	H	L	L	H	H
-40 dB	H	L	H	L	L
-42 dB	H	L	H	L	H
-44 dB	H	L	H	H	L
-48 dB	H	L	H	H	H
-52 dB	H	H	L	L	L
-56 dB	H	H	L	L	H
-60 dB	H	H	L	H	L
-64 dB	H	H	L	H	H
-68 dB	H	H	H	L	L
-72 dB	H	H	H	L	H
-76 dB	H	H	H	H	L
-∞	H	H	H	H	H

Volume Level	D13	D12
0 dB	L	L
-1 dB	L	H
-2 dB	H	L
-3 dB	H	H

SW Volume Setting

D6 (D0 = "L", D1 = "H", D2 = "H", D3 = "H")	Condition	SWBP-SW
L	SW Volume Bypass	2
H	SW Volume Controlled	1

k. C, SL, SR, SW ch Trimmer

(D0 = "H", D1 = "L")

Trimmer Level	D8	D7	D6	D5	D4
	D13	D12	D11	D10	D9
0 dB	L	L	L	L	L
-1 dB	L	L	L	L	H
-2 dB	L	L	L	H	L
-3 dB	L	L	L	H	H
-4 dB	L	L	H	L	L
-5 dB	L	L	H	L	H
-6 dB	L	L	H	H	L
-7 dB	L	L	H	H	H
-8 dB	L	H	L	L	L
-9 dB	L	H	L	L	H
-10 dB	L	H	L	H	L
-11 dB	L	H	L	H	H
-12 dB	L	H	H	L	L
-13 dB	L	H	H	L	H
-14 dB	L	H	H	H	L
-15 dB	L	H	H	H	H
-16 dB	H	L	L	L	L
-17 dB	H	L	L	L	H
-18 dB	H	L	L	H	L
-19 dB	H	L	L	H	H
-20 dB	H	L	H	L	L
-21 dB	H	L	H	L	H
-22 dB	H	L	H	H	L
-23 dB	H	L	H	H	H
-24 dB	H	H	L	L	L
-25 dB	H	H	L	L	H
-26 dB	H	H	L	H	L
-27 dB	H	H	L	H	H
-28 dB	H	H	H	L	L
-29 dB	H	H	H	L	H
-30 dB	H	H	H	H	L
-31 dB	H	H	H	H	H

Note: When (Trimmer level) + (Master Volume) is less than -87 dB, total attenuation level is set to -87 dB.

I. Chip Address

D14	D15	Date Read
L	H	Enable
Others		Unable

Relation between Mode Setting and Switch Condition

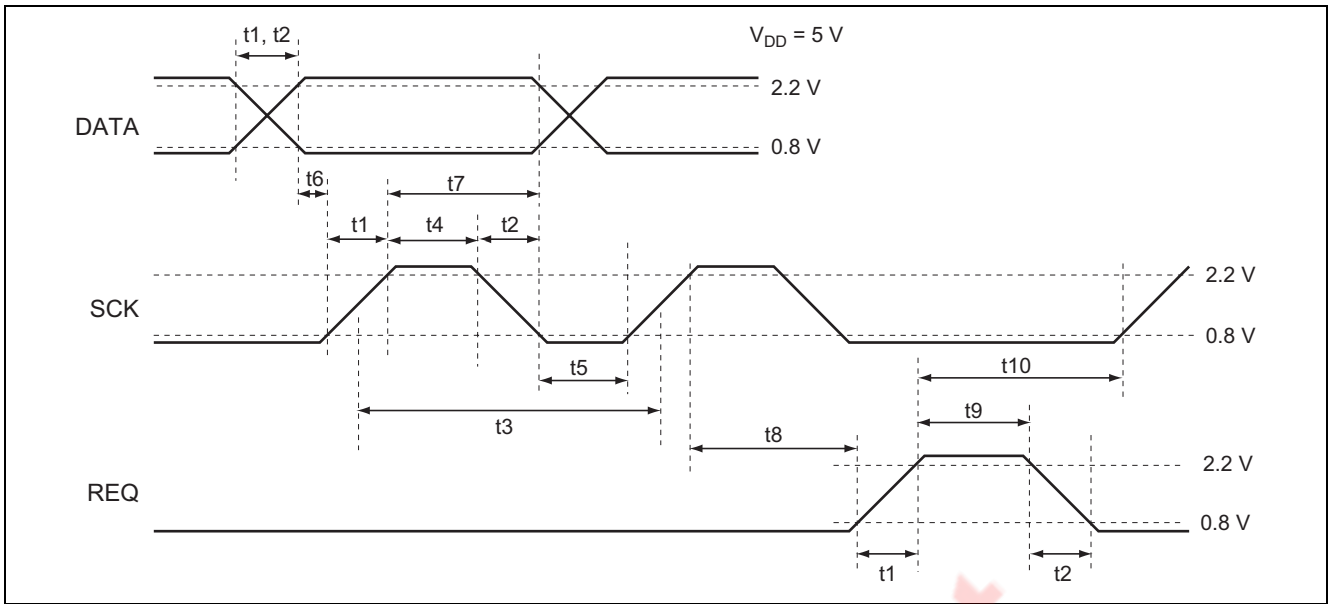
Mode Setting	Pro Logic Mode (D0 = L, D1 = L, D2 = L) D7	Space Surround Mode (D0 = L, D1 = L, D2 = H)					Switch Condition								
		D8	D10	D11	D12	D13	L-SW	R-SW	C-SW	SL-SW	SR-SW	SW-SW	DI-SW	DO-SW	BNR-SW
5.1ch Signal Input	X	X	X	X	X	X	1	1	1	1	1	1	4	2	3
Normal stereo	L ^(Note 3)	X	L (Note 2)	X (Note 2)	L (Note 3)	L (Note 1)	2	2	2	2	2	2	1	1	2
	H		H	L	H	H									
	H	H	H	X									3		
Dolby Pro Logic Surround	L	X	X	X	X	X	4	4	2	2	2	2	1	1	1
	H														
Space Surround	X	L (Note 4)	L (Note 2)	X (Note 2)	L (Note 3)	L (Note 1)	4 (Note 4)	4 (Note 4)	2	2 (Note 1)	2 (Note 1)	2	1 (Note 2)	1	2 (Note 3)
		H	H	L	H	H	3	3		3	3		2		1
		H	H	H										3	
Echo	X	X	X	X	X	X	2	2	1	1	1	2	4	2	3
Mute	X	X	X	X	X	X	5	5	1	1	1	2	4	2	3

Notes: X: L or H

At Bypass or Space Surround Mode, the condition of SL-SW, SR-SW, DI-SW and BNR-SW depend on D7, D10, D11, D12 and D13 settings.

1. SL-SW, SR-SW: depend on D13
2. DI-SW: depend on D10 and D11
3. BNR-SW: depend on D7 and D12
4. At Space Surround Mode, the condition of L-SW and R-SW depend on D8

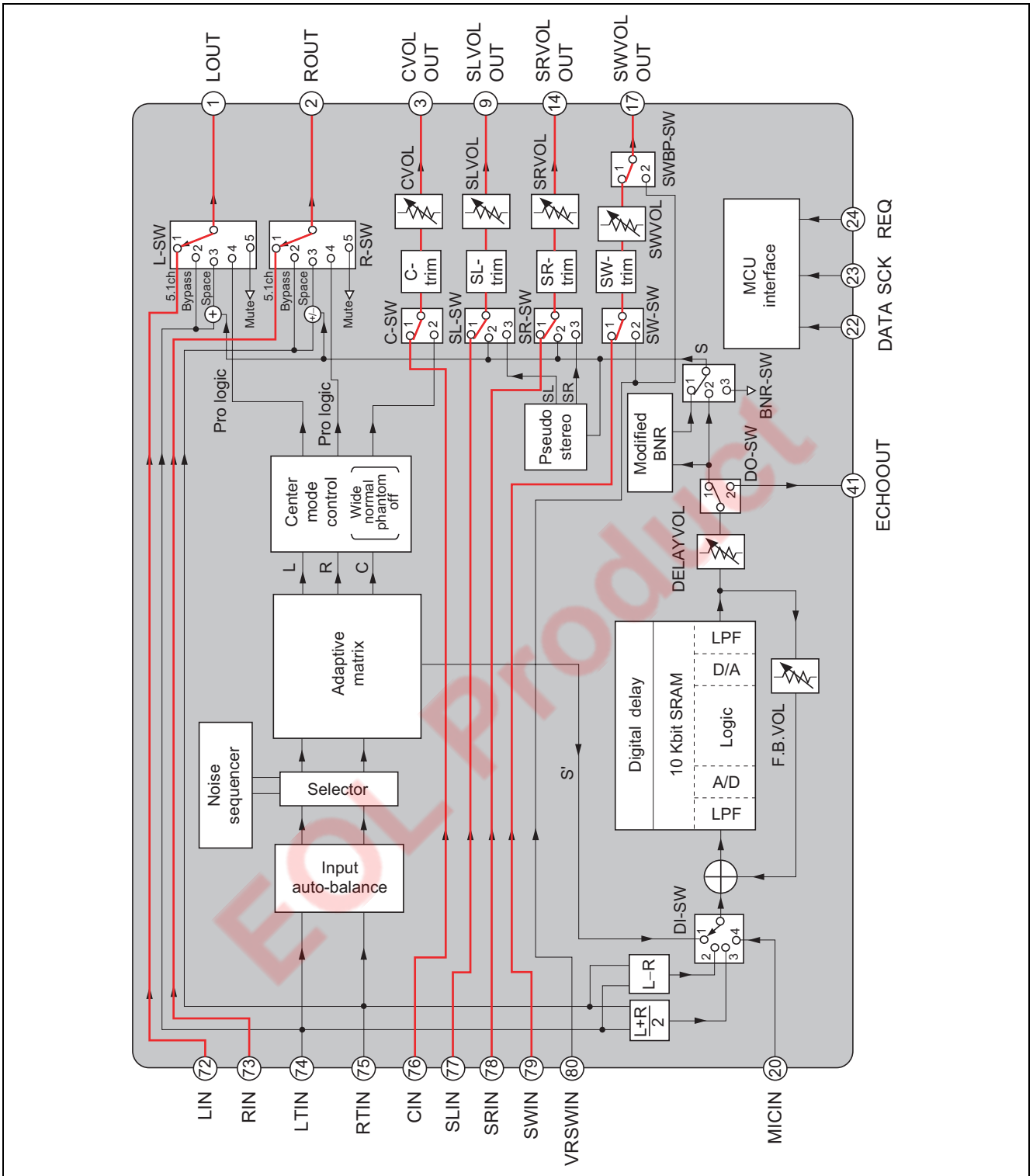
(4) Data Timing



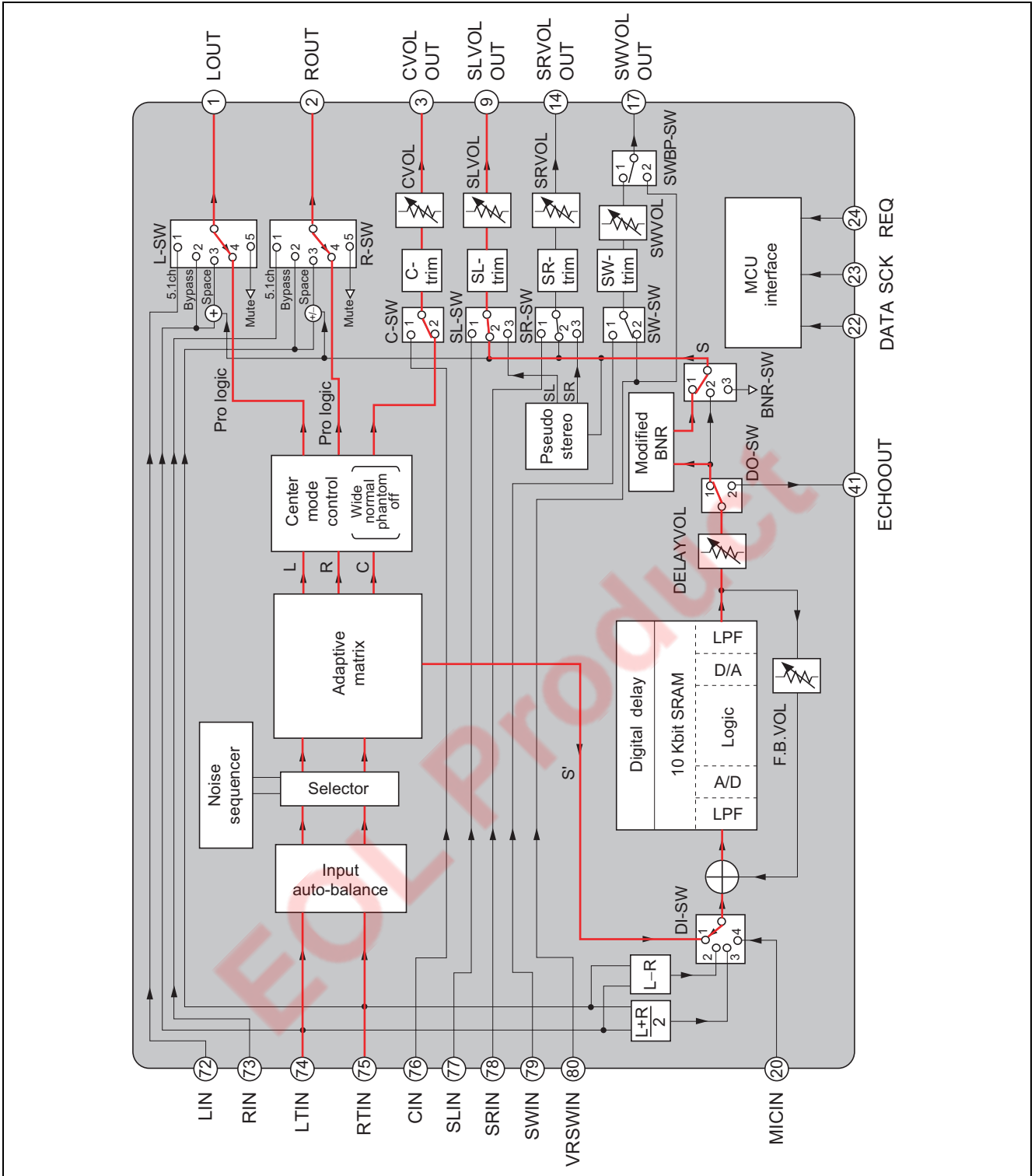
Name	Symbol	Min	Typ	Max	Units
Signal rise time	t1	—	—	0.5	μs
Signal fall time	t2	—	—	0.5	μs
SCK clock width	t3	2	—	—	μs
SCK "H" pulse width	t4	0.8	—	—	μs
SCK "L" pulse width	t5	0.8	—	—	μs
DATA setup time	t6	0.8	—	—	μs
DATA hold time	t7	0.8	—	—	μs
REQ rise hold time	t8	1.6	—	—	μs
REQ "H" pulse width	t9	0.8	—	—	μs
SCK setup time	t10	1.6	—	—	μs

Mode Example

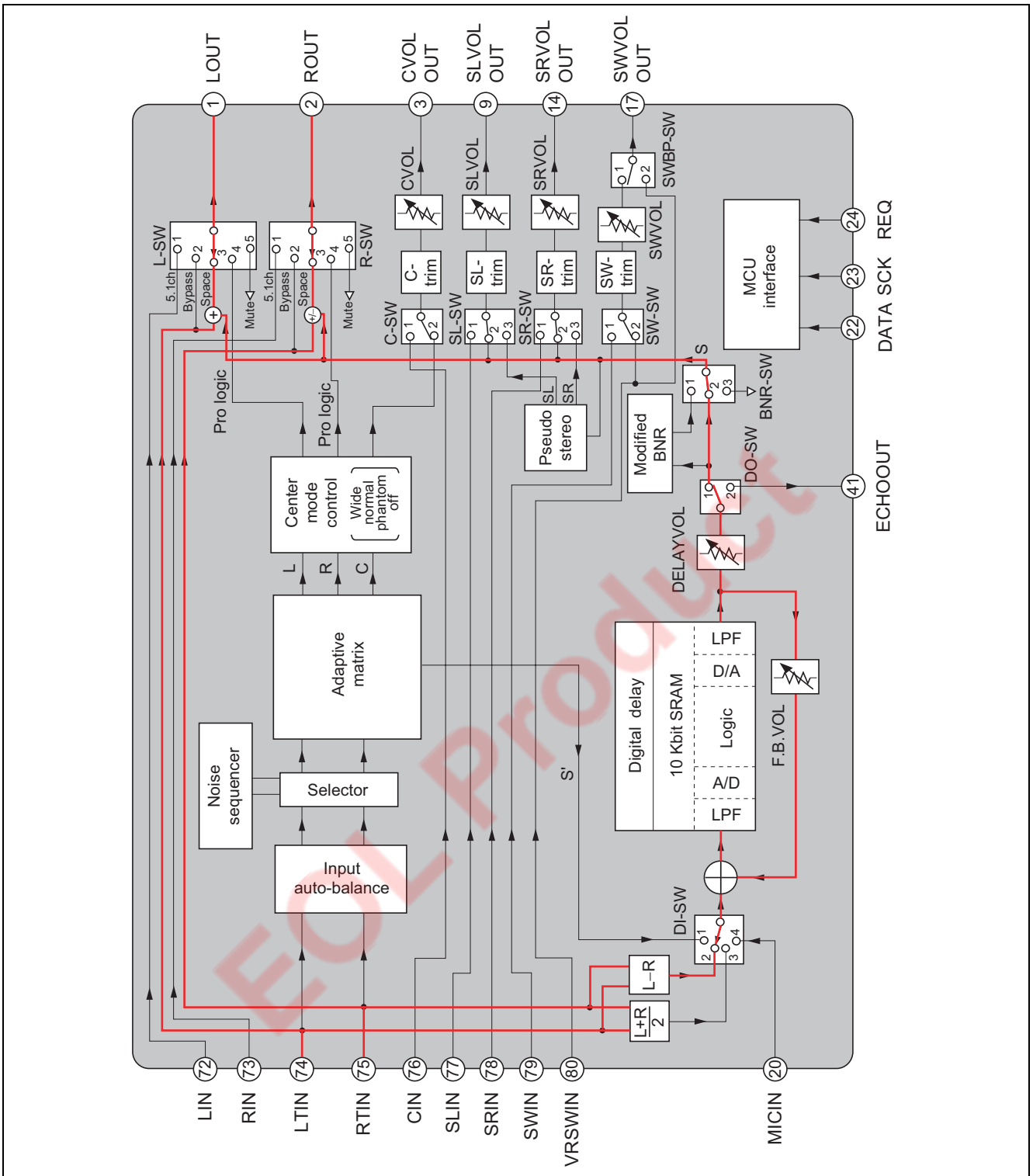
(1) 5.1ch Input



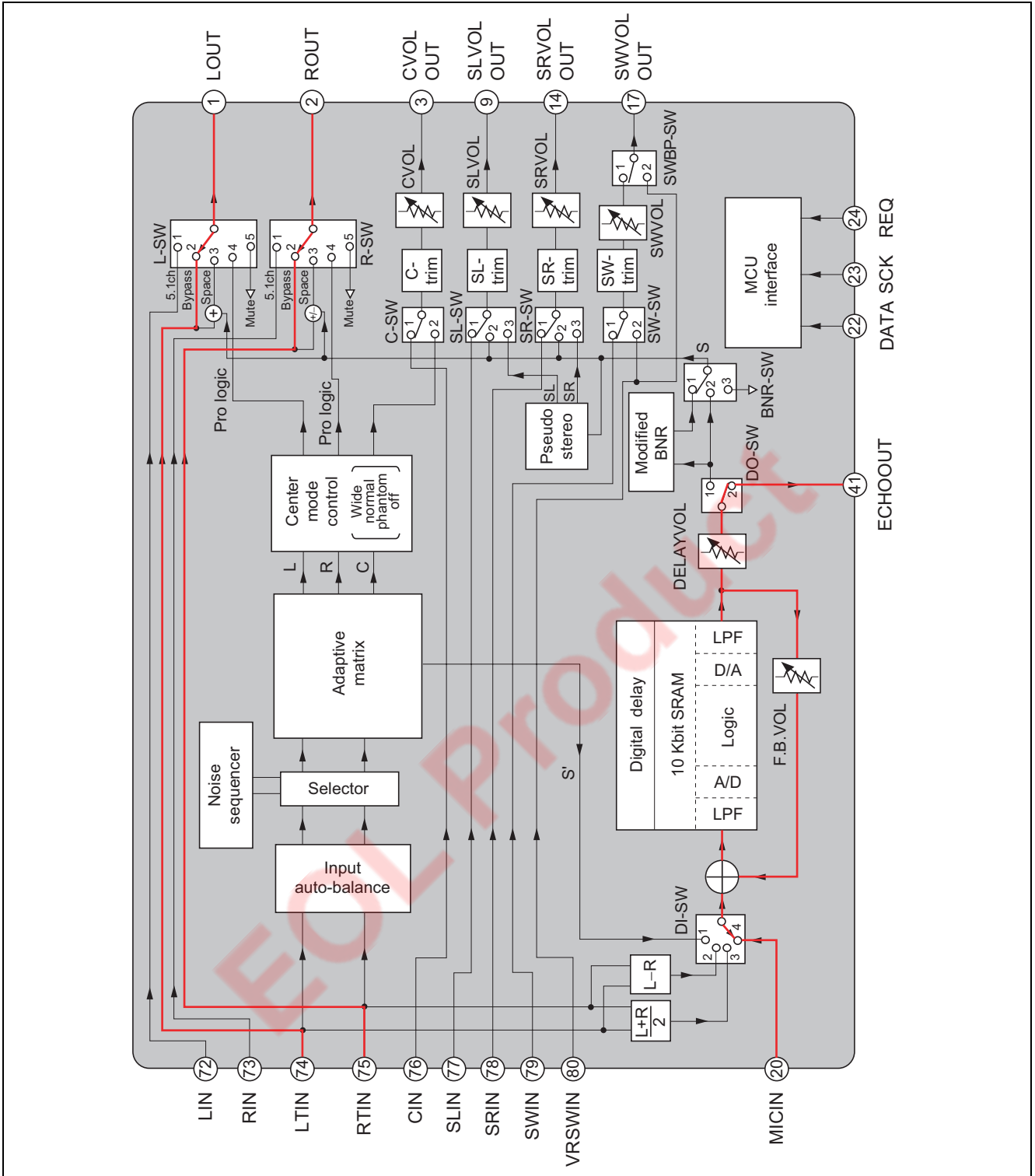
(2) Pro Logic Surround



(3) Space Surround

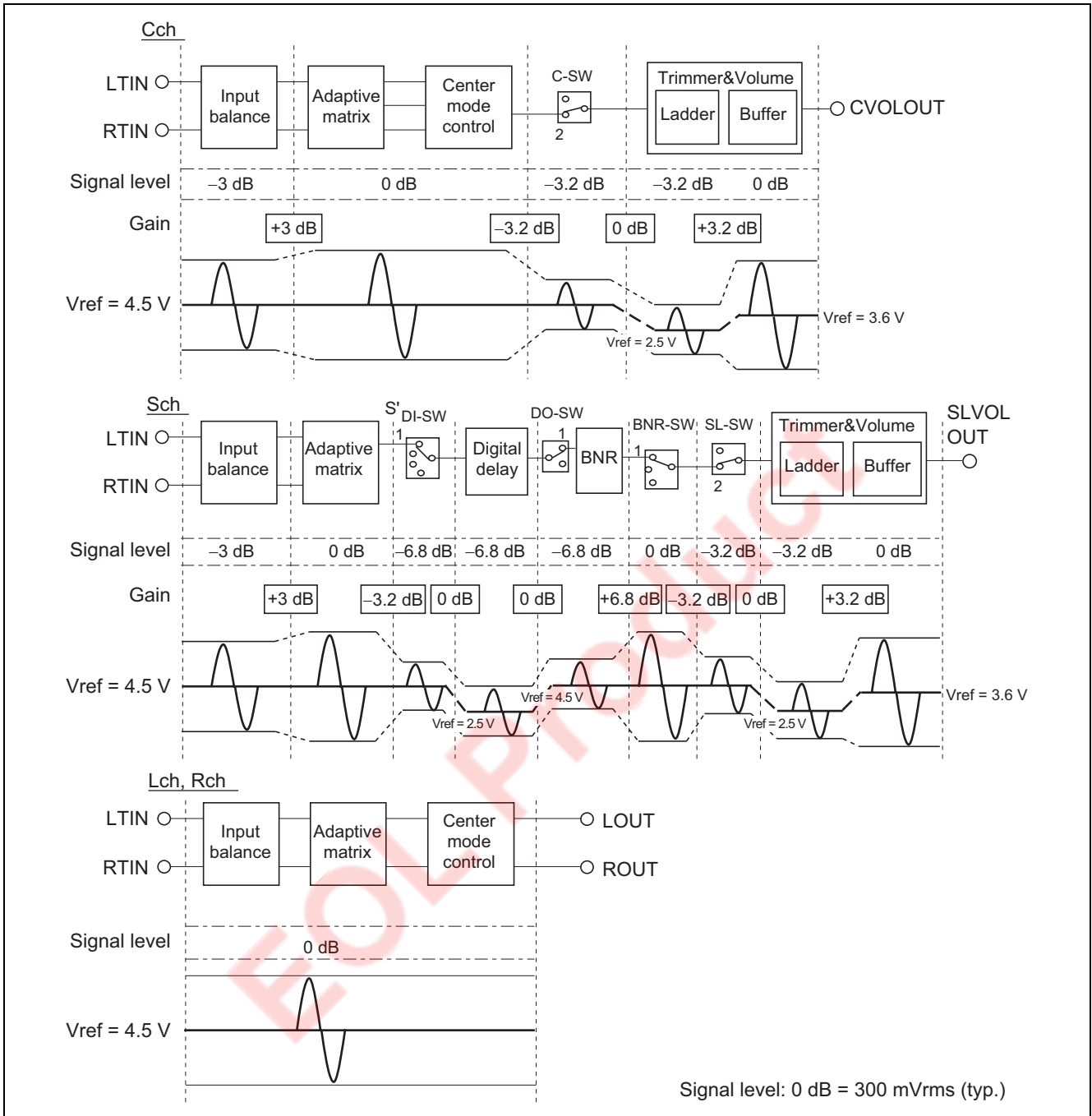


(4) Echo

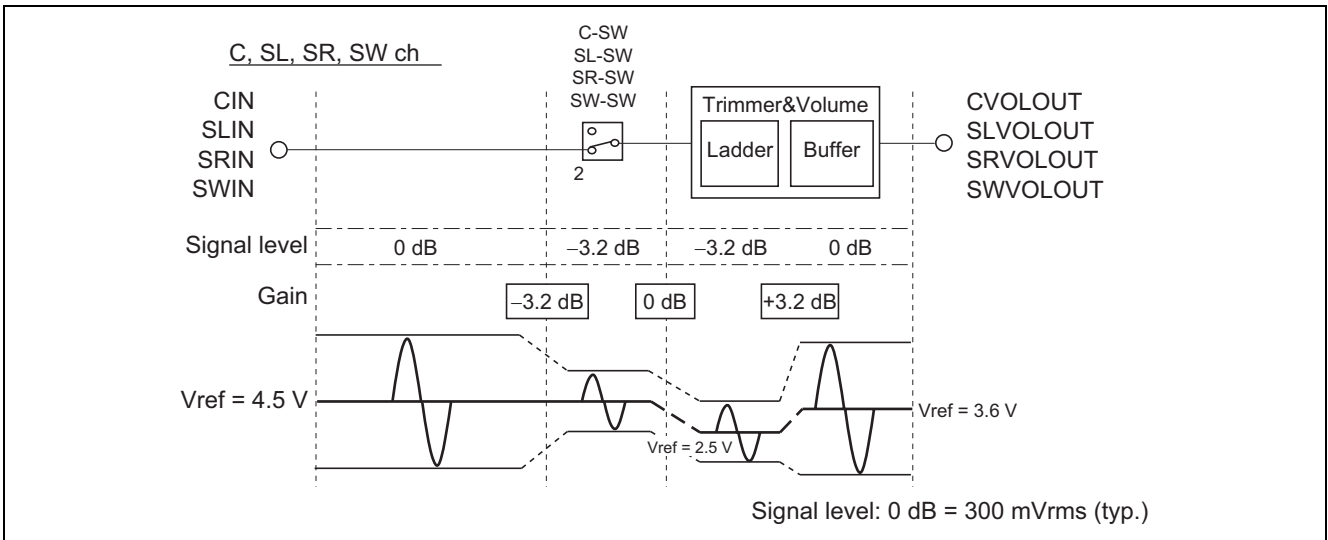


Level Diagram

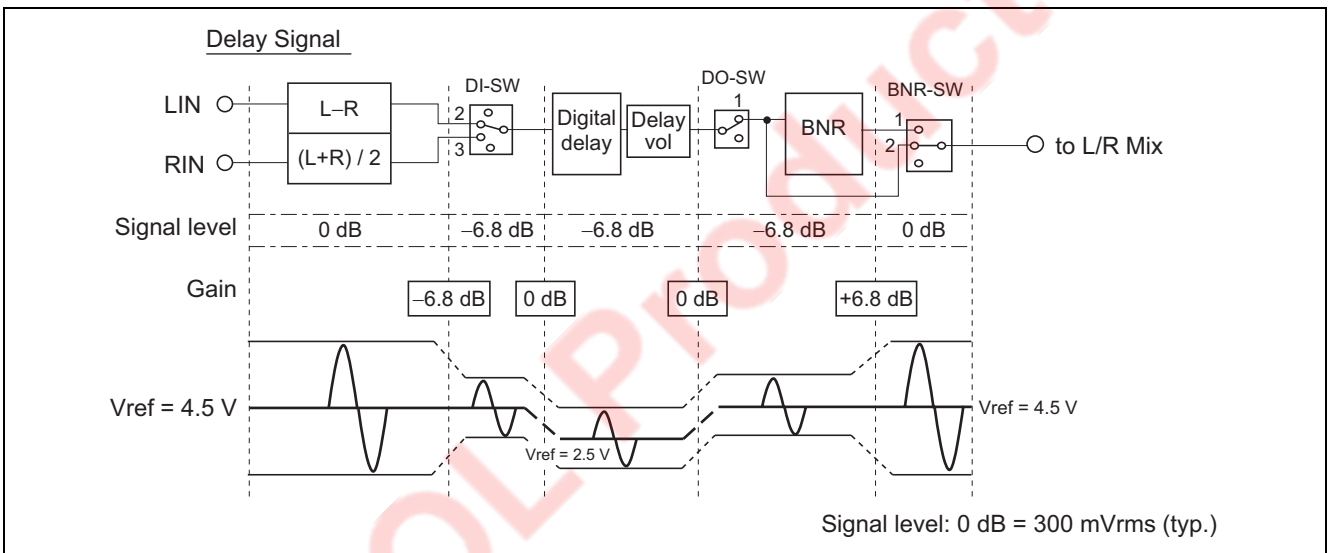
(1) Dolby Pro Logic Surround Mode



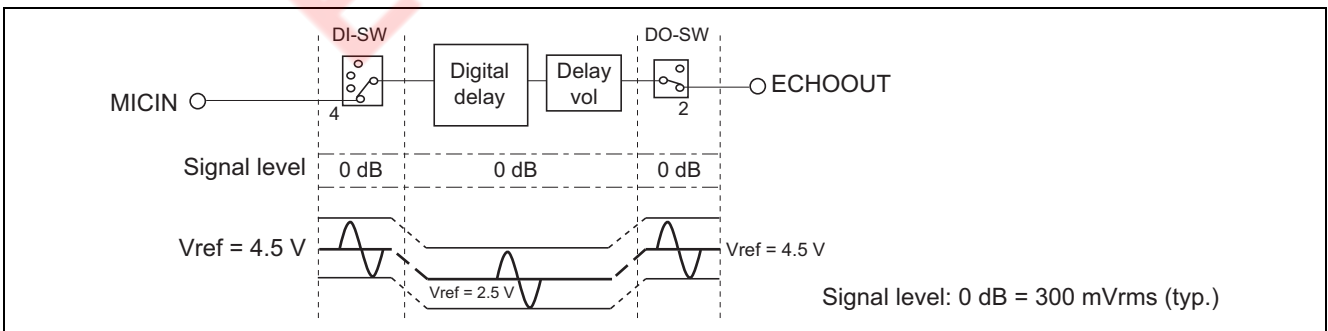
(2) 5.1ch Signal Input Mode



(3) Space Surround Mode

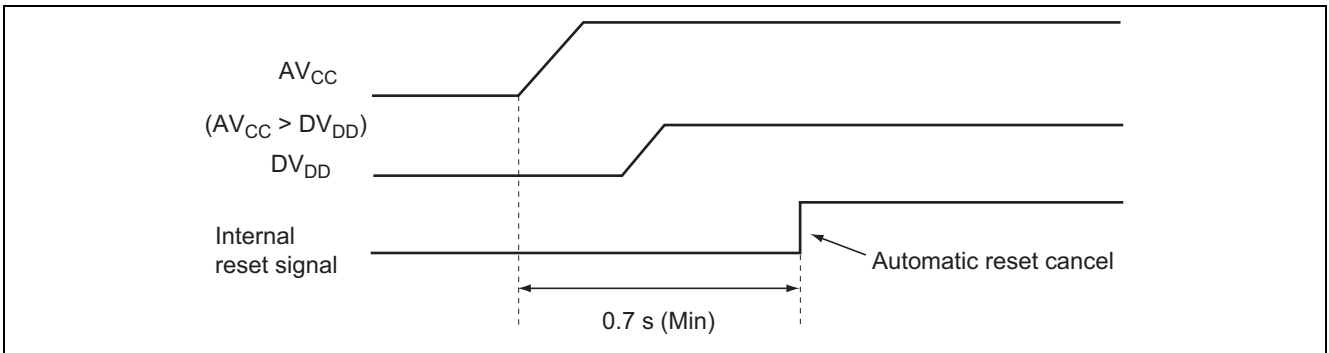


(4) Echo Mode



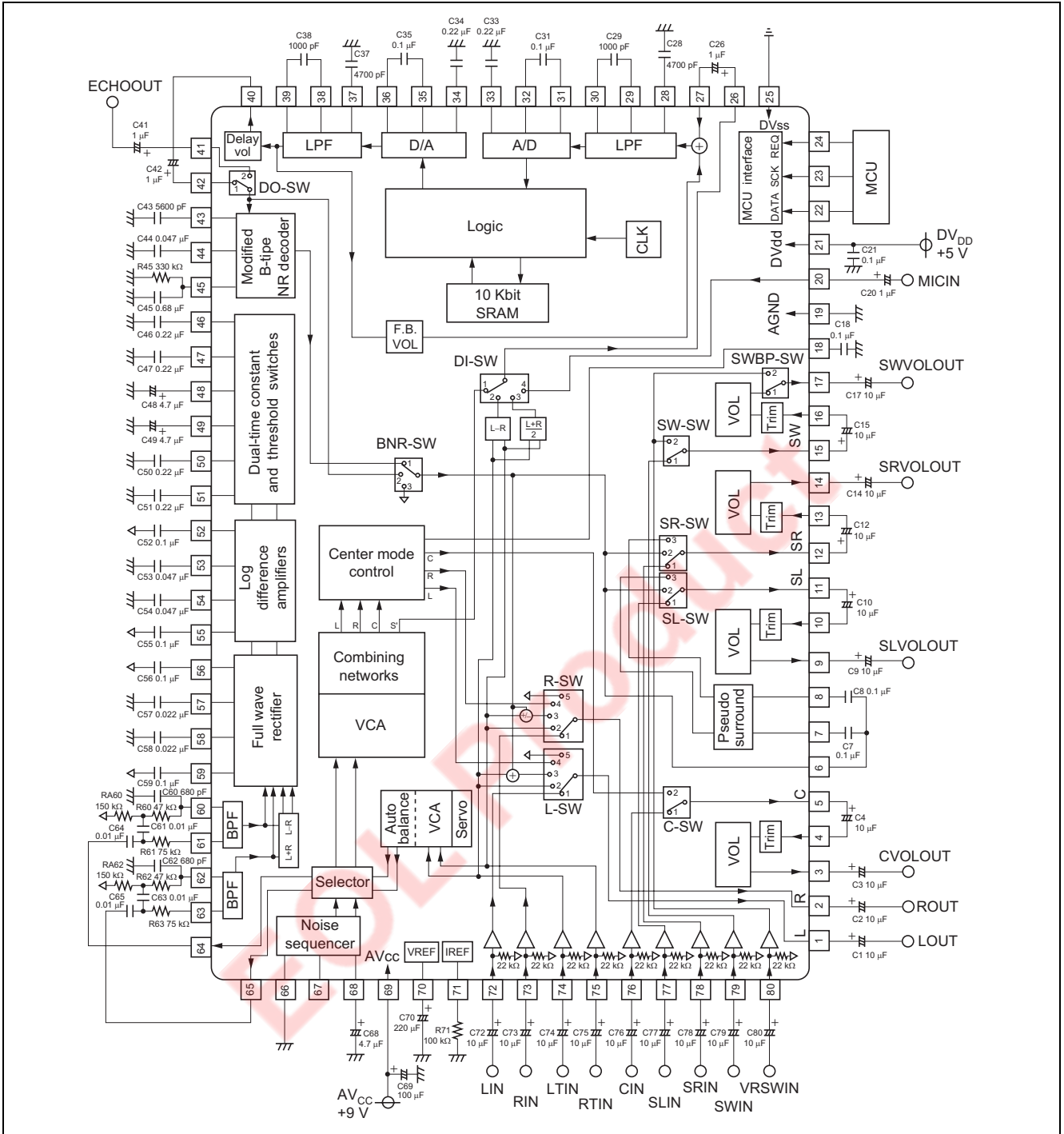
Notice

Relation AV_{CC} and DV_{DD} at power supply Digital V_{DD} must be supplied less than 0.7 seconds from analog V_{CC} supply.



EOL Product

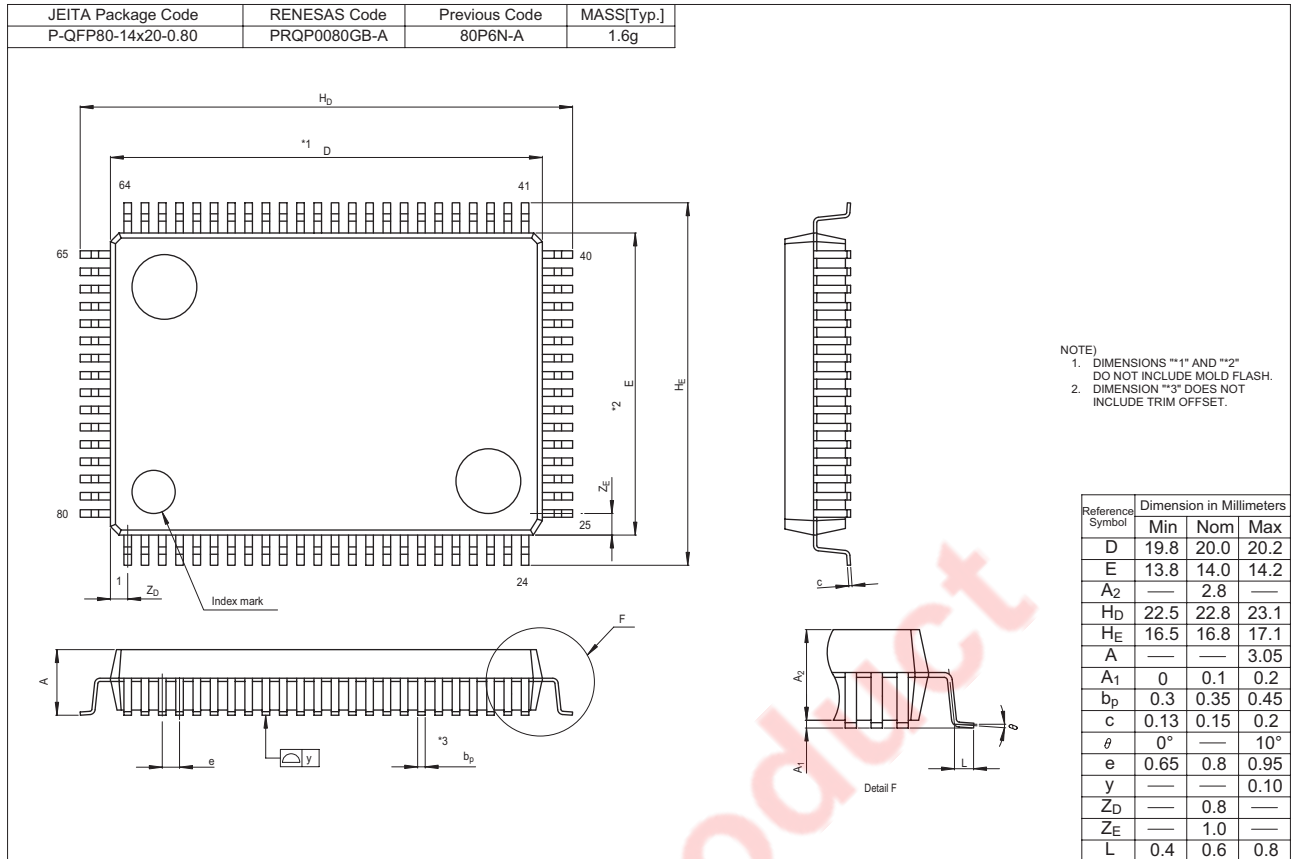
Application Example



External Parts List

Parts No.	Values	Unit	Tol.	Parts No.	Values	Unit	Tol.
C1	10	μF		C57	0.022	μF	5%
C2	10	μF		C58	0.022	μF	5%
C3	10	μF		C59	0.1	μF	20%
C4	10	μF		C60	680	pF	5%
C7	0.1	μF		C61	0.01	μF	5%
C8	0.1	μF		C62	680	pF	5%
C9	10	μF		C63	0.01	μF	5%
C10	10	μF		C64	0.01	μF	5%
C12	10	μF		C65	0.01	μF	5%
C14	10	μF		C68	4.7	μF	
C15	10	μF		C69	100	μF	
C17	10	μF		C70	220	μF	
C18	0.1	μF	10%	C72	10	μF	
C20	1.0	μF		C73	10	μF	
C21	0.1	μF		C74	10	μF	
C26	1.0	μF		C75	10	μF	
C28	4700	pF	5%	C76	10	μF	
C29	1000	pF	5%	C77	10	μF	
C31	0.1	μF	5%	C78	10	μF	
C33	0.22	μF	5%	C79	10	μF	
C34	0.22	μF	5%	C80	10	μF	
C35	0.1	μF	5%				
C37	4700	pF	5%				
C38	1000	pF	5%				
C41	1.0	μF					
C42	1.0	μF					
C43	5600	pF	5%				
C44	0.047	μF	5%	R45	330	kΩ	10%
C45	0.68	μF	10%	R60	47	kΩ	5%
C46	0.22	μF	10%	RA60	150	kΩ	5%
C47	0.22	μF	10%	R61	75	kΩ	5%
C48	4.7	μF	20%	R62	47	kΩ	5%
C49	4.7	μF	20%	RA62	150	kΩ	5%
C50	0.22	μF	10%	R63	75	kΩ	5%
C51	0.22	μF	10%	R71	100	kΩ	5%
C52	0.1	μF	20%				
C53	0.047	μF	5%				
C54	0.047	μF	5%				
C55	0.1	μF	20%				
C56	0.1	μF	20%				

Package Dimensions



EOL Product

Notes:

1. This document is provided for reference purposes only so that Renesas customers may select the appropriate Renesas products for their use. Renesas neither makes warranties or representations with respect to the accuracy or completeness of the information contained in this document nor grants any license to any intellectual property rights or any other rights of Renesas or any third party with respect to the information in this document.
2. Renesas shall have no liability for damages or infringement of any intellectual property or other rights arising out of the use of any information in this document, including, but not limited to, product data, diagrams, charts, programs, algorithms, and application circuit examples.
3. You should not use the products or the technology described in this document for the purpose of military applications such as the development of weapons of mass destruction or for the purpose of any other military use. When exporting the products or technology described herein, you should follow the applicable export control laws and regulations, and procedures required by such laws and regulations.
4. All information included in this document such as product data, diagrams, charts, programs, algorithms, and application circuit examples, is current as of the date this document is issued. Such information, however, is subject to change without any prior notice. Before purchasing or using any Renesas products listed in this document, please confirm the latest product information with a Renesas sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas such as that disclosed through our website. (<http://www.renesas.com>)
5. Renesas has used reasonable care in compiling the information included in this document, but Renesas assumes no liability whatsoever for any damages incurred as a result of errors or omissions in the information included in this document.
6. When using or otherwise relying on the information in this document, you should evaluate the information in light of the total system before deciding about the applicability of such information to the intended application. Renesas makes no representations, warranties or guarantees regarding the suitability of its products for any particular application and specifically disclaims any liability arising out of the application and use of the information in this document or Renesas products.
7. With the exception of products specified by Renesas as suitable for automobile applications, Renesas products are not designed, manufactured or tested for applications or otherwise in systems the failure or malfunction of which may cause a direct threat to human life or create a risk of human injury or which require especially high quality and reliability such as safety systems, or equipment or systems for transportation and traffic, healthcare, combustion control, aerospace and aeronautics, nuclear power, or undersea communication transmission. If you are considering the use of our products for such purposes, please contact a Renesas sales office beforehand. Renesas shall have no liability for damages arising out of the uses set forth above.
8. Notwithstanding the preceding paragraph, you should not use Renesas products for the purposes listed below:
 - (1) artificial life support devices or systems
 - (2) surgical implantations
 - (3) healthcare intervention (e.g., excision, administration of medication, etc.)
 - (4) any other purposes that pose a direct threat to human lifeRenesas shall have no liability for damages arising out of the uses set forth in the above and purchasers who elect to use Renesas products in any of the foregoing applications shall indemnify and hold harmless Renesas Technology Corp., its affiliated companies and their officers, directors, and employees against any and all damages arising out of such applications.
9. You should use the products described herein within the range specified by Renesas, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas shall have no liability for malfunctions or damages arising out of the use of Renesas products beyond such specified ranges.
10. Although Renesas endeavors to improve the quality and reliability of its products, IC products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Please be sure to implement safety measures to guard against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other applicable measures. Among others, since the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or system manufactured by you.
11. In case Renesas products listed in this document are detached from the products to which the Renesas products are attached or affixed, the risk of accident such as swallowing by infants and small children is very high. You should implement safety measures so that Renesas products may not be easily detached from your products. Renesas shall have no liability for damages arising out of such detachment.
12. This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written approval from Renesas.
13. Please contact a Renesas sales office if you have any questions regarding the information contained in this document, Renesas semiconductor products, or if you have any other inquiries.



RENESAS SALES OFFICES

<http://www.renesas.com>

Refer to "<http://www.renesas.com/en/network>" for the latest and detailed information.

Renesas Technology America, Inc.
450 Holger Way, San Jose, CA 95134-1368, U.S.A
Tel: <1> (408) 382-7500, Fax: <1> (408) 382-7501

Renesas Technology Europe Limited
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K.
Tel: <44> (1628) 585-100, Fax: <44> (1628) 585-900

Renesas Technology (Shanghai) Co., Ltd.
Unit 204, 205, AZIACenter, No.1233 Lujiazui Ring Rd, Pudong District, Shanghai, China 200120
Tel: <86> (21) 5877-1818, Fax: <86> (21) 6887-7858/7898

Renesas Technology Hong Kong Ltd.
7th Floor, North Tower, World Finance Centre, Harbour City, Canton Road, Tsimshatsui, Kowloon, Hong Kong
Tel: <852> 2265-6688, Fax: <852> 2377-3473

Renesas Technology Taiwan Co., Ltd.
10th Floor, No.99, Fushing North Road, Taipei, Taiwan
Tel: <886> (2) 2715-2888, Fax: <886> (2) 3518-3399

Renesas Technology Singapore Pte. Ltd.
1 Harbour Front Avenue, #06-10, Keppel Bay Tower, Singapore 098632
Tel: <65> 6213-0200, Fax: <65> 6278-8001

Renesas Technology Korea Co., Ltd.
Kukje Center Bldg. 18th Fl., 191, 2-ka, Hangang-ro, Yongsan-ku, Seoul 140-702, Korea
Tel: <82> (2) 796-3115, Fax: <82> (2) 796-2145

Renesas Technology Malaysia Sdn. Bhd
Unit 906, Block B, Menara Amcorp, Amcorp Trade Centre, No.18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: <603> 7955-9390, Fax: <603> 7955-9510