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.

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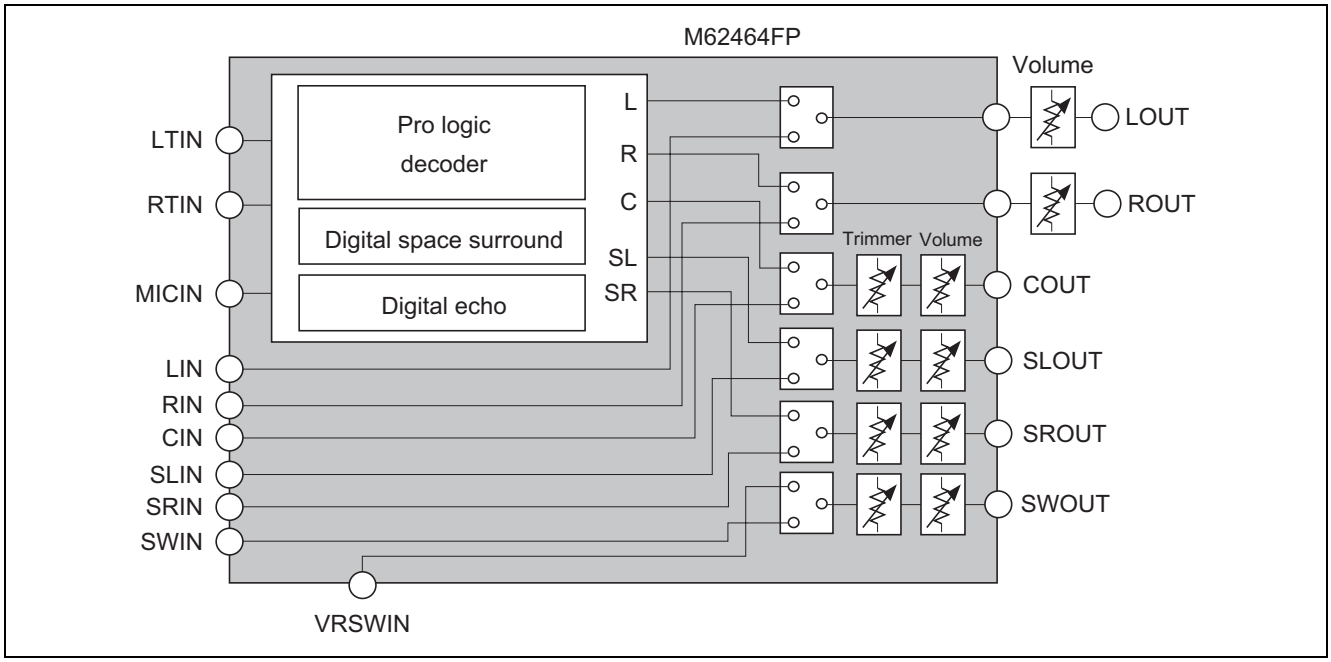
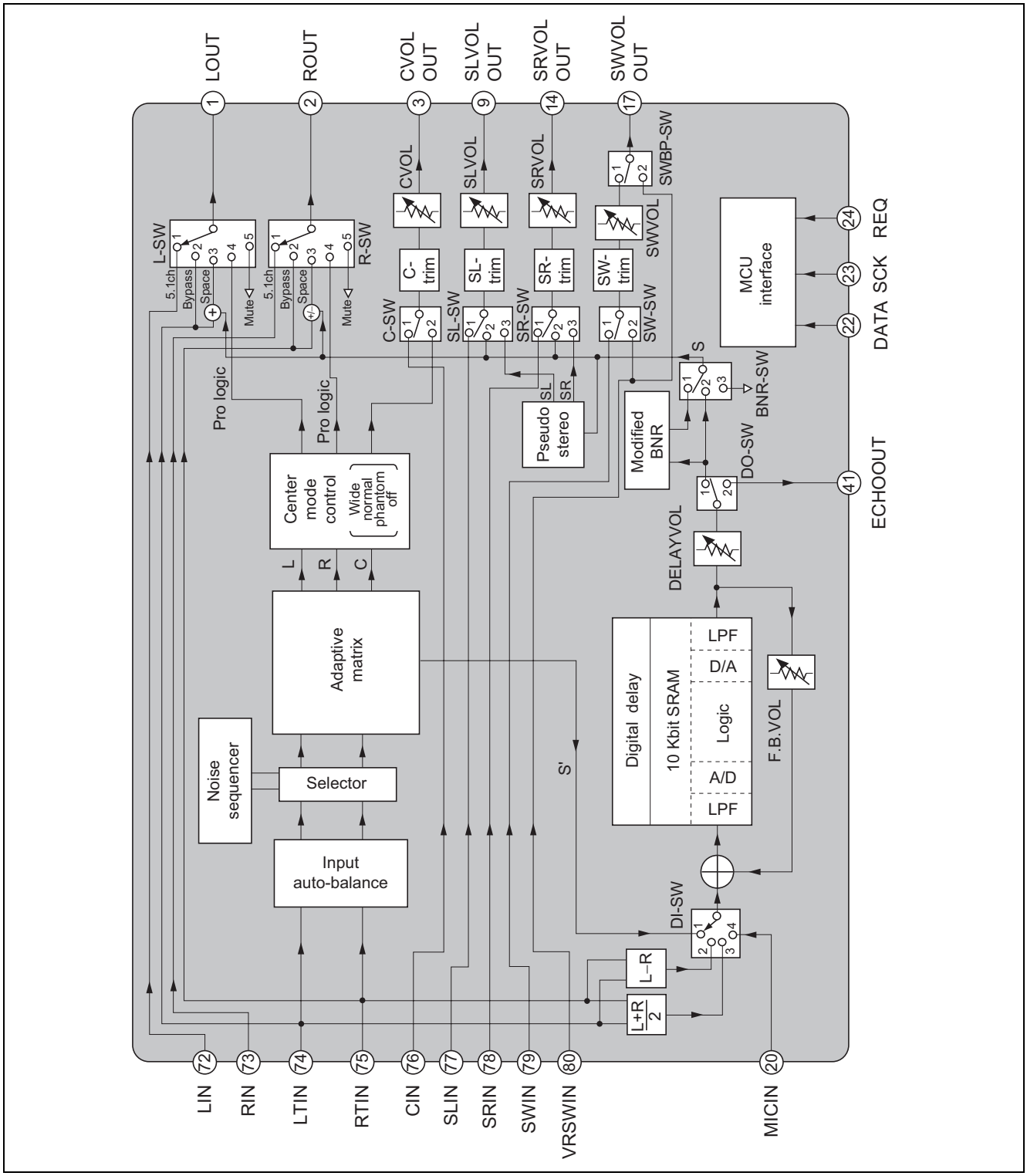
Features

- 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

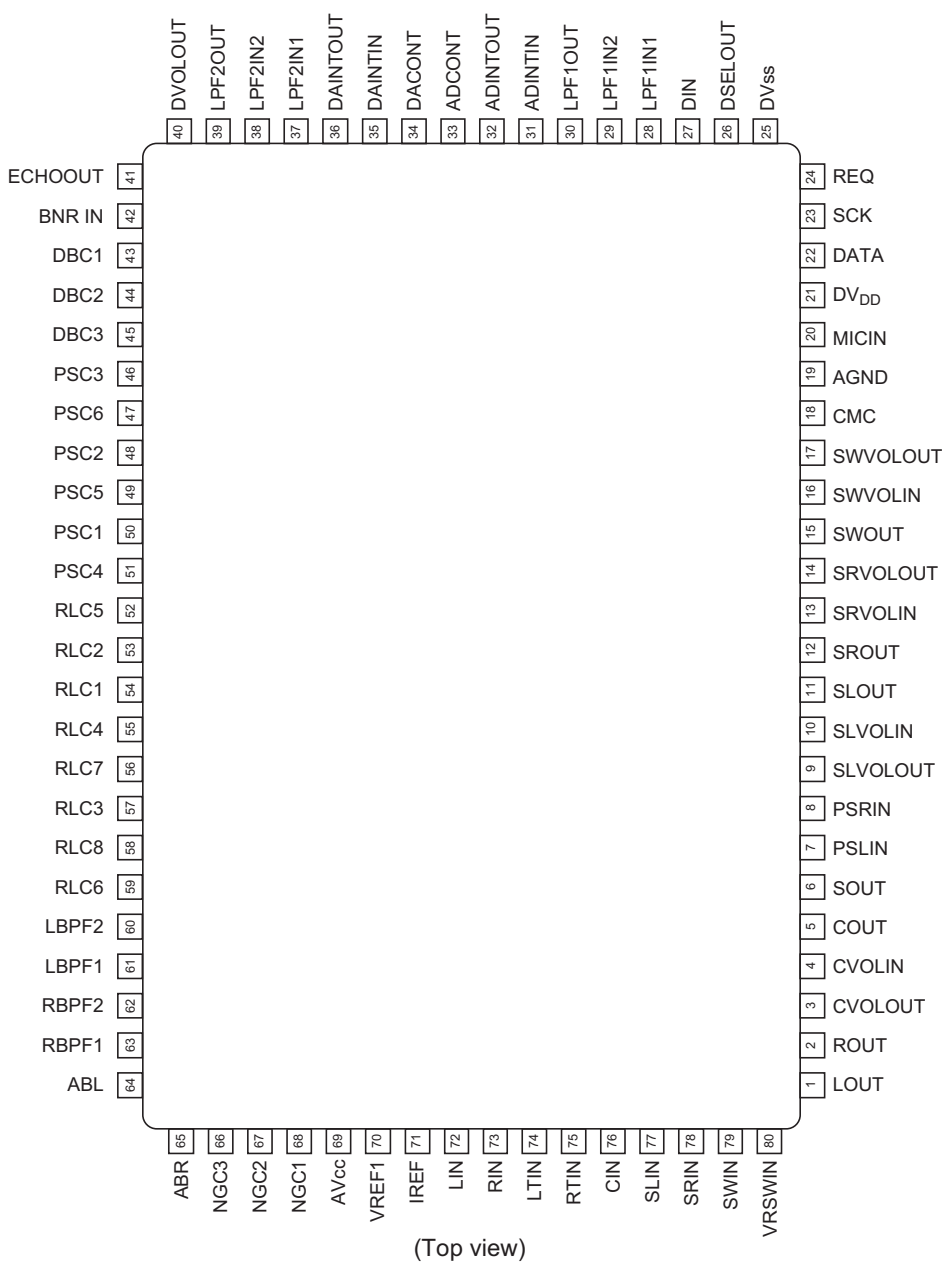
System Block Diagram



Block Diagram



Pin Arrangement



Outline: PRQP0080GB-A (80P6N-A)

Functional Description

Function		Description
1	Fundamental function for Dolby Pro Logic surround decoder	• 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	Pd	1.4	W	
Operating temperature	Topr	–20 to +75	°C	
Storage temperature	Tstg	–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

(Ta = 25°C, V_{CC} = 9V, V_{DD} = 5 V, 0dBd = 300 mVrms, at COUT, f = 1 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	Rg = 0Ω, weighted CCIR/ARM
Noise Sequencer						
Output noise level	Vno	–15	–12.5	–10	dB	L, R, C, S'ch output
Noise level accuracy relative to Cch	ΔVno	–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	Vin = 0dBd, f = 100Hz
Decode character1	DEC1	–1.6	–0.1	1.4	dB	Vin = 0dBd, f = 1.0kHz
Decode character2	DEC2	–3.0	–1.5	0		Vin = –15dBd, f = 1.4kHz
Decode character3	DEC3	–6.8	–5.3	–3.8		Vin = –40dBd, f = 5.0kHz
Total harmonic distortion	THDNR	—	0.07	0.3	%	Vin = 0dBd, f = 1kHz, 30kHz LPP
Head room	HRNR	15	17	—	dB	THD = 1%
S/N ratio	SNNR	68	78	—	dB	Rg = 0Ω, weighted CCIR/ARM
Cch/SLch/SRch/SWch Master Volume						
Maximum attenuation	ATTmax	—	–95	–87	dB	ATT = –∞, Vi = 2Vrms
Minimum attenuation	ATTmin	–3.0	0	3.0	dB	ATT = 0dB, TRIM = 0dB
Volume step1	VOLS1	0.5	1.0	1.5	dB	ATT = 0 to –40dB, TRIM = 0dB
Volume step2	VOLS2	0.2	1.0	1.8	dB	ATT = –40 to –76dB, TRIM = 0dB
S/N ratio	SNVOL	85	95	—	dB	ATT = –∞, CCIR/ARM
Cch/SLch/SRch/SWch Trimmer						
Maximum attenuation	TRIMmax	–34	–31	–28	dB	TRIM = –31dB, VOLATT = 0dB
Minimum attenuation	TRIMmin	–3.0	0	3.0	dB	TRIM = 0dB, VOLATT = 0dB
Trimmer step	TRIMS	0.6	1.0	1.4	dB	VOLATT = 0dB
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	Zi	11	22	44	kΩ	

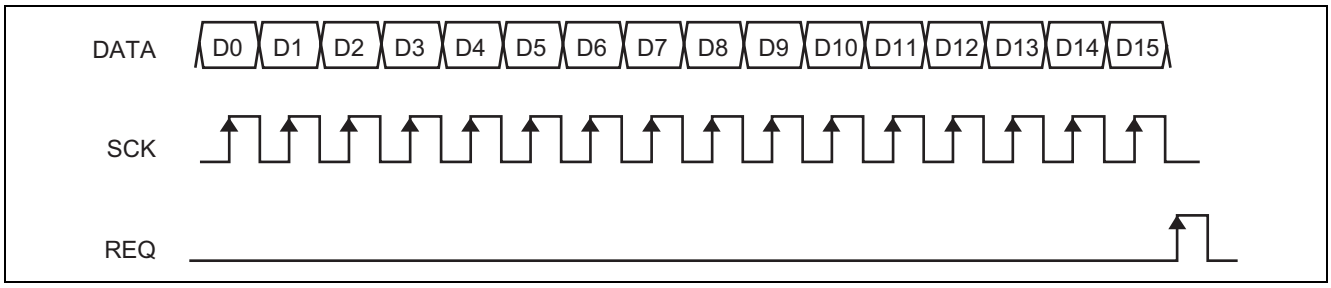
(Ta = 25°C, V_{CC} = 9 V, V_{DD} = 5 V, 0dBd = 300 mVrms, at COUT, f = 1 kHz Unless otherwise noted)

Item	Symbol	Limits			Unit	Conditions	
		Min	Typ	Max			
Digital delay							
Input/output voltage gain	GvD	–3.0	0	+3.0	dB	DIN-DVOLOUT, 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 D13	D7 D12	D6 D11	D5 D10	D4 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.

l. Chip Address

D14	D15	Date Read
L	H	Enable
Others		Unable

Relation between Mode Setting and Switch Condition

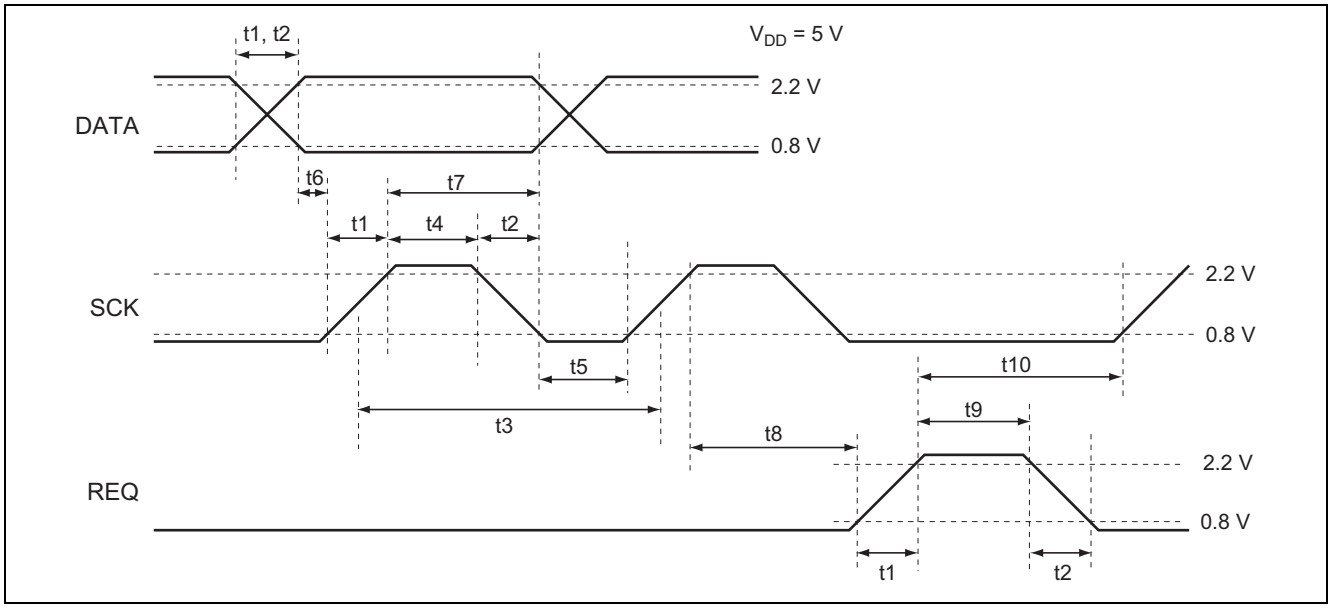
Mode Setting	Pro Logic Mode (D0 = L, D1 = L, D2 = L) D7	Space Surround Mode (D0 = L, D1 = L, D2 = H) D8	D10	D11	D12	D13	Switch Condition L–SW	R-SW	C-SW	SL-SW	SR-SW	SW-SW	DI-SW	DO-SW	BNR-SW
5.1ch Signal Input	X	X	X	X	X	X	X	1	1	1	1	1	1	4	2	3
Normal stereo	L (Note 3)	X	L (Note 2)	X (Note 2)	L (Note 3)	L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

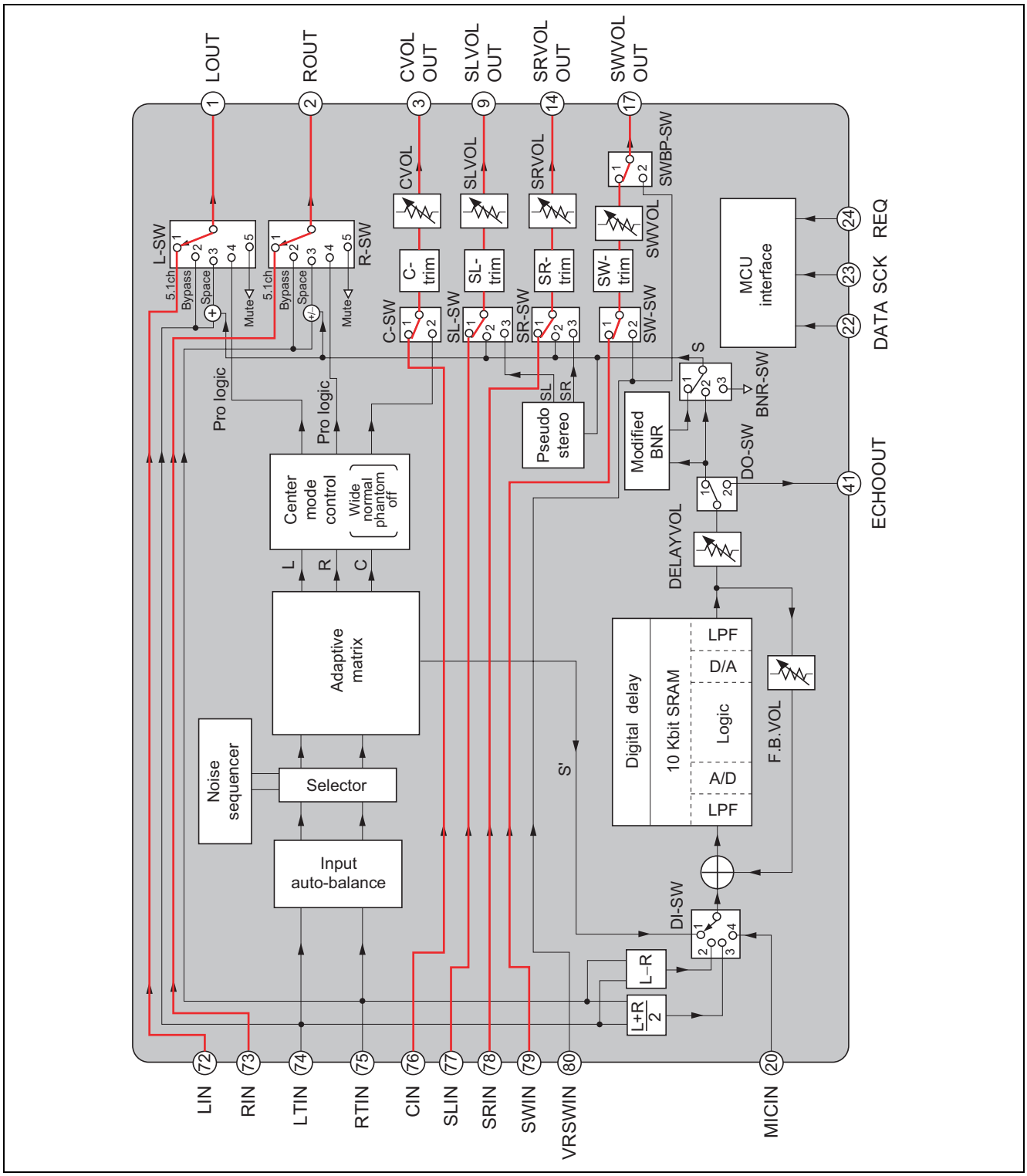
(4) Data Timing



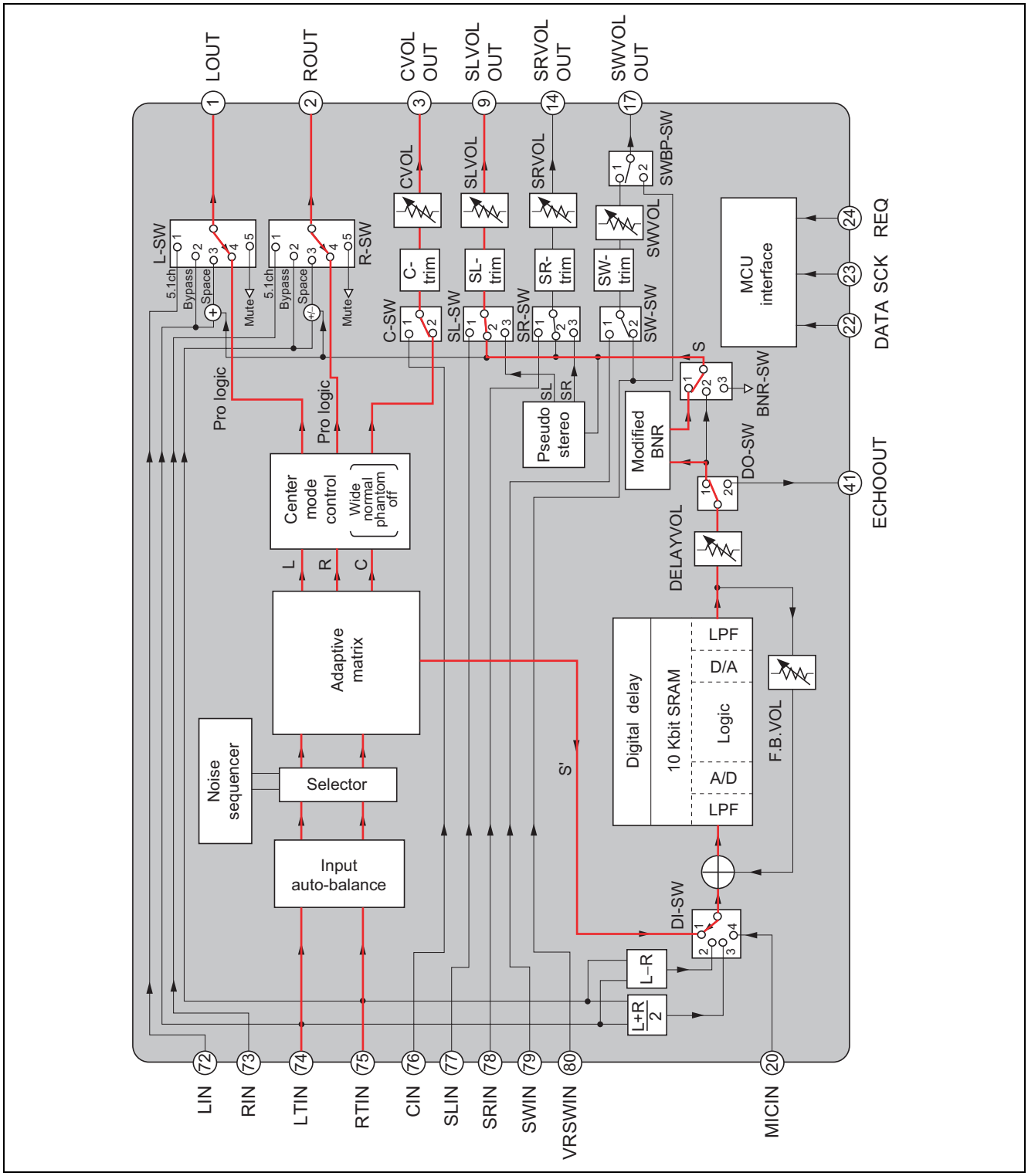
Name	Symbol	Min	Typ	Max	Units
Signal rise time	t1	—	—	0.5	µs
Signal fall time	t2	—	—	0.5	µs
SCK clock width	t3	2	—	—	µs
SCK “H” pulse width	t4	0.8	—	—	µs
SCK “L” pulse width	t5	0.8	—	—	µs
DATA setup time	t6	0.8	—	—	µs
DATA hold time	t7	0.8	—	—	µs
REQ rise hold time	t8	1.6	—	—	µs
REQ “H” pulse width	t9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

Mode Example

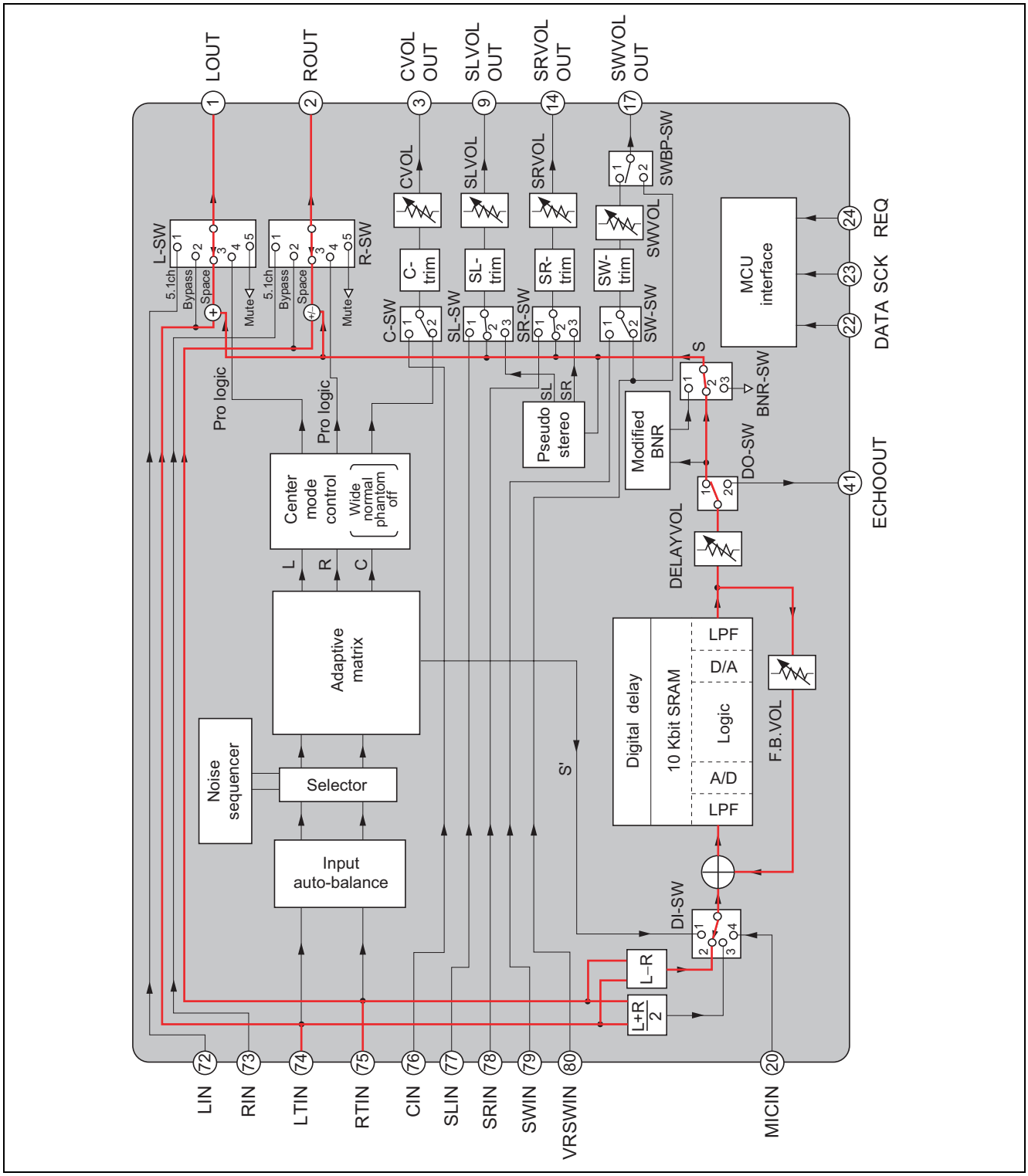
(1) 5.1ch Input



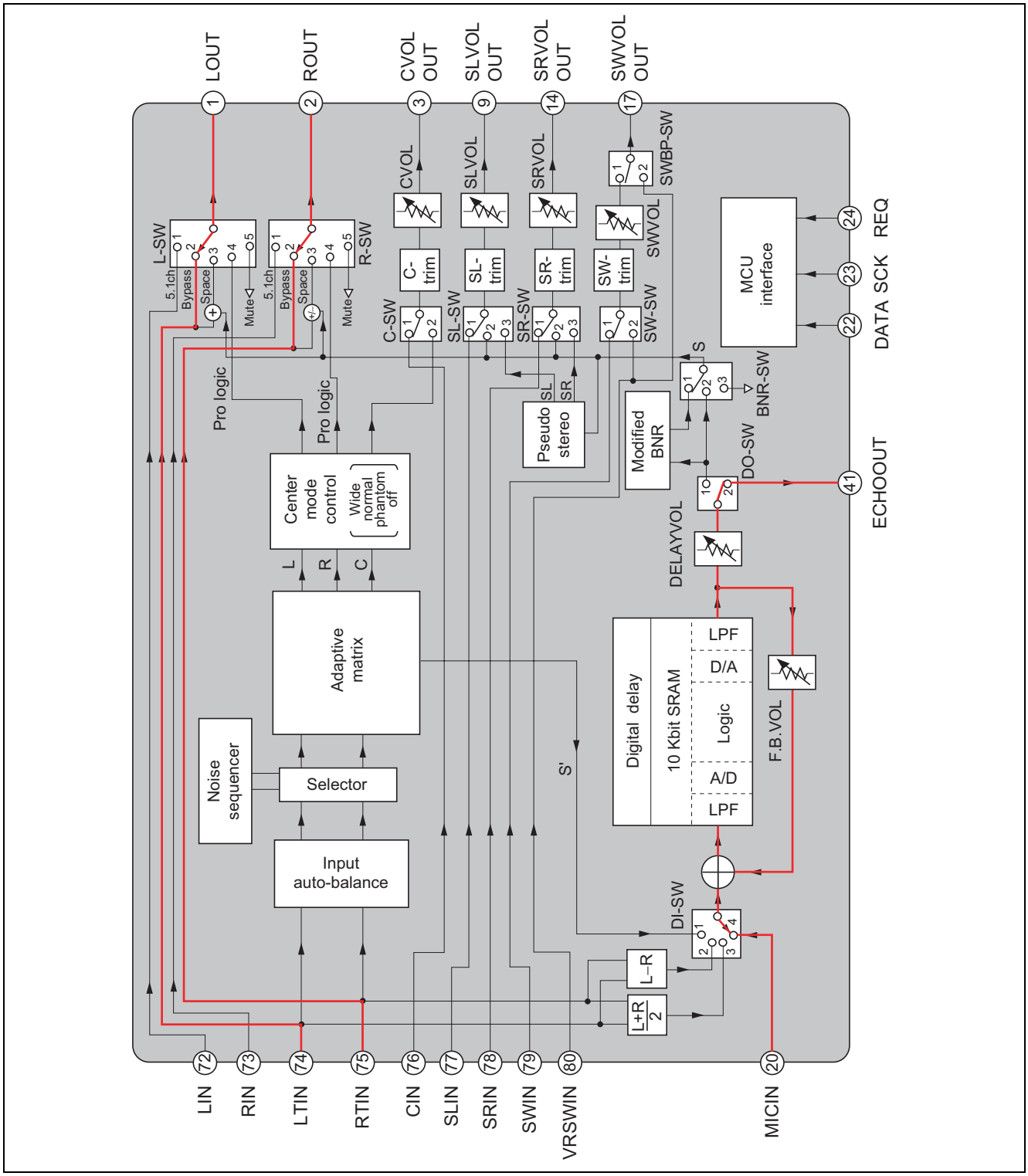
(2) Pro Logic Surround



(3) Space Surround

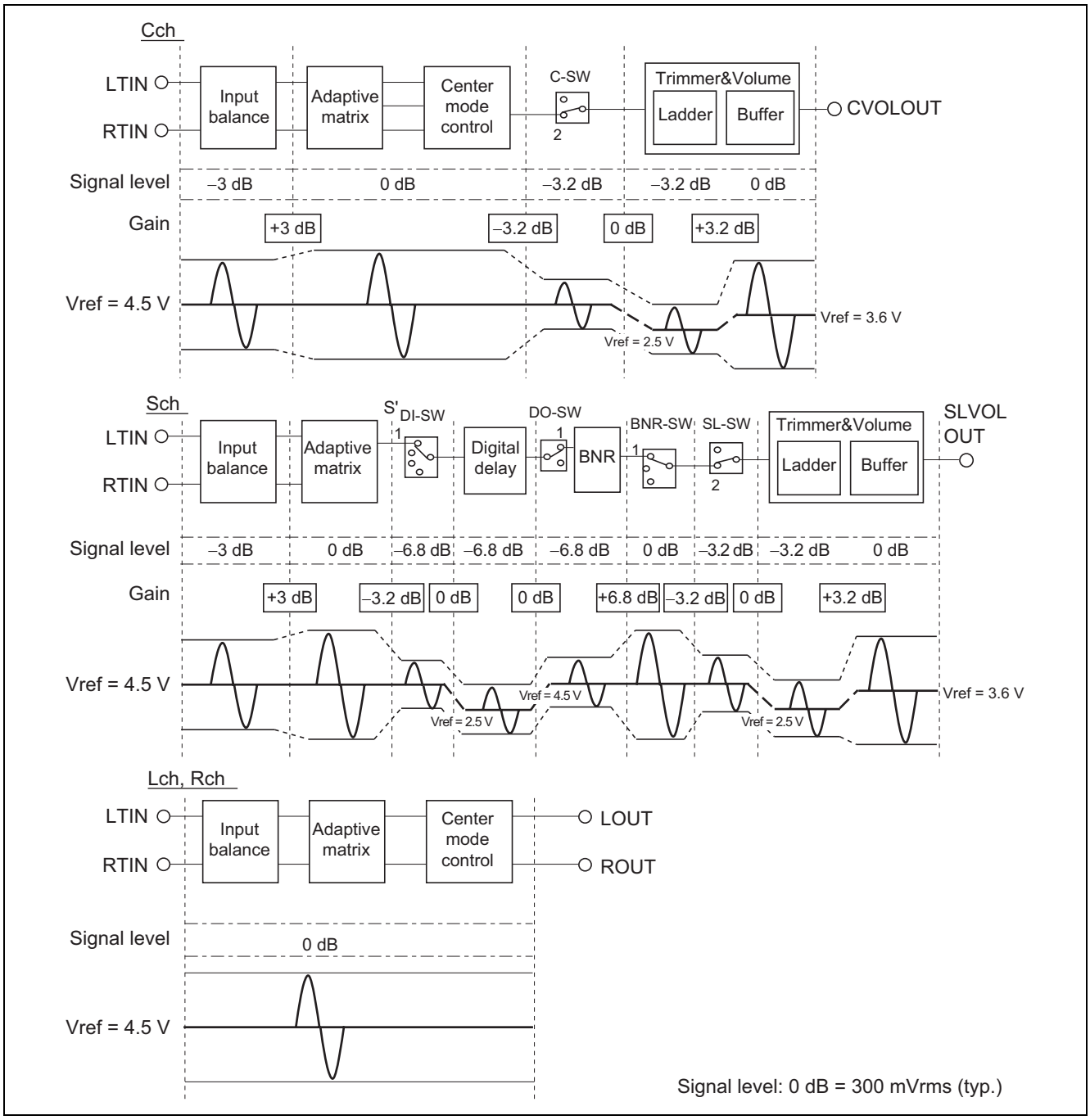


(4) Echo

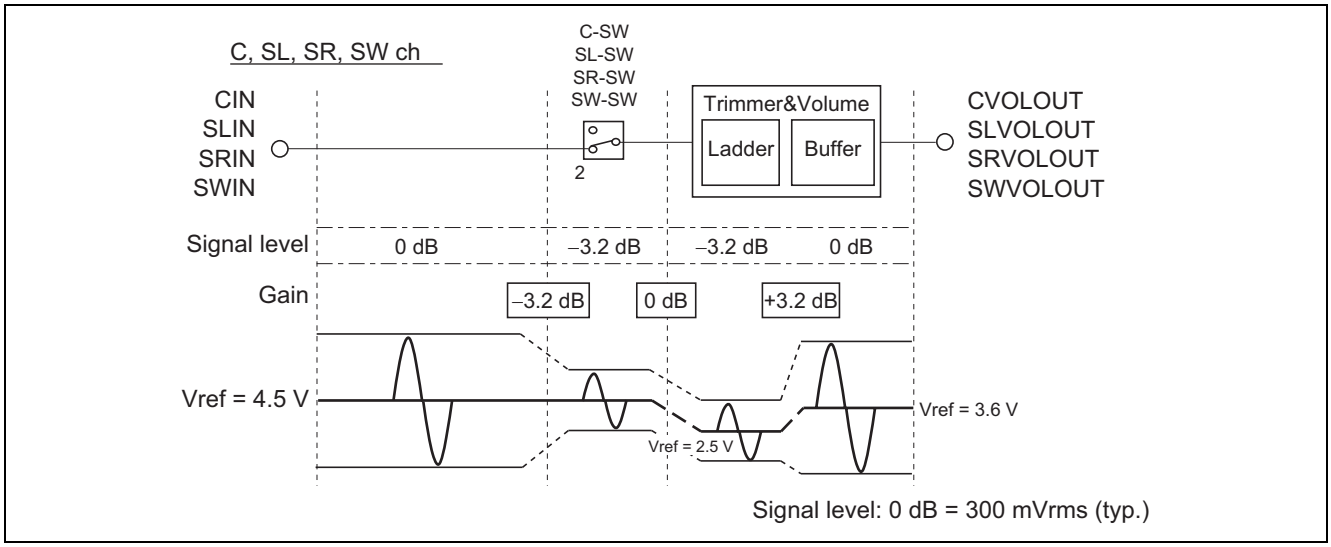

LOUT
ROUT
CVOL OUT
SLVOL OUT
SRVOL OUT
SWVOL OUT
1
2
3
9
14
17
L-SW
R-SW
5.1ch
Bypass
Space
Mute
CVOL
SLVOL
SRVOL
SWVOL
SWBP-SW
C-trim
SL-trim
SR-trim
SW-trim
C-SW
SL-SW
SR-SW
SW-SW
MCU interface
24
23
22
REQ
DATA
SCK
S
BNR-SW
Pro logic
Pseudo stereo
SL
SR
Modified BNR
DO-SW
41
ECHOOUT
Center mode control
Wide
normal
phantom
off
L
R
C
DELAYVOL
Adaptive matrix
Digital delay
10 Kbit SRAM
LPF
D/A
Logic
A/D
LPF
F.B.VOL
Noise sequencer
Selector
Input auto-balance
S'
DI-SW
L–R
L+R/2
72
73
74
75
76
77
78
79
80
20
LIN
RIN
LTIN
RTIN
CIN
SLIN
SRIN
SWIN
VRSWIN
MICIN

Level Diagram

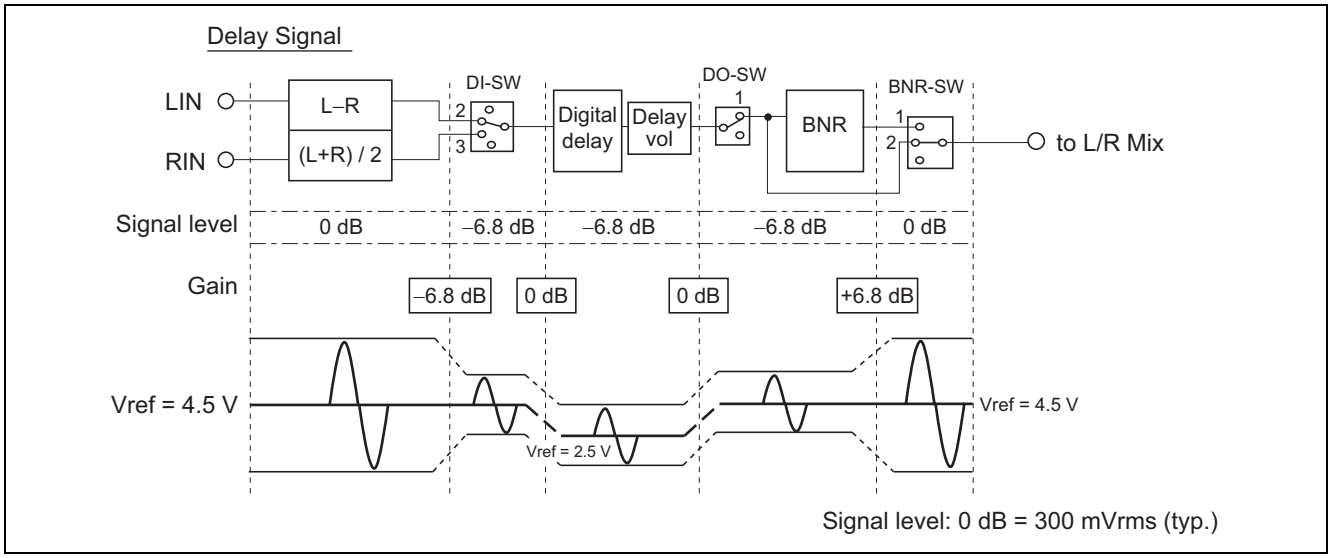
(1) Dolby Pro Logic Surround Mode



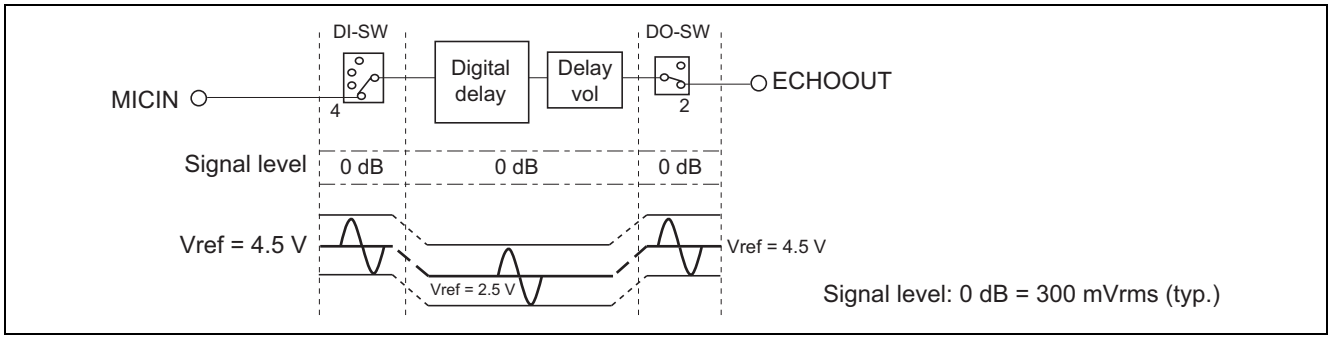
(2) 5.1ch Signal Input Mode



(3) Space Surround Mode

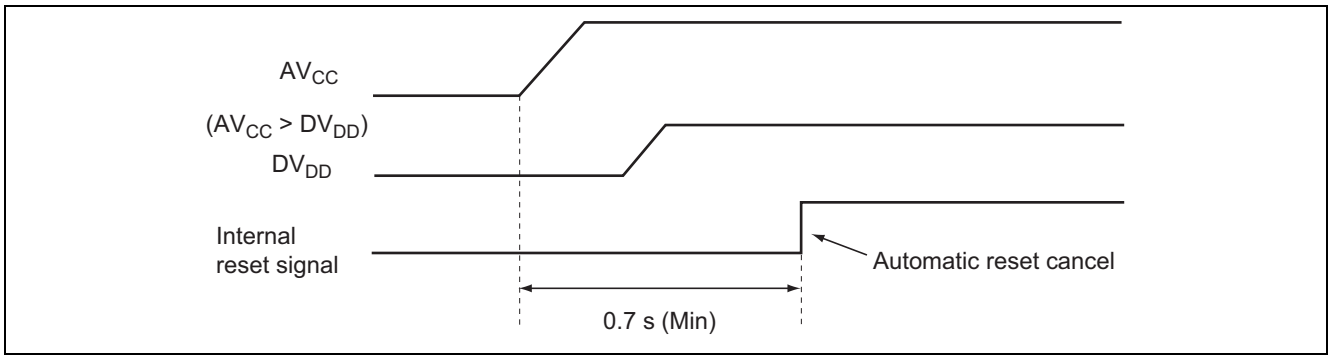


(4) Echo Mode

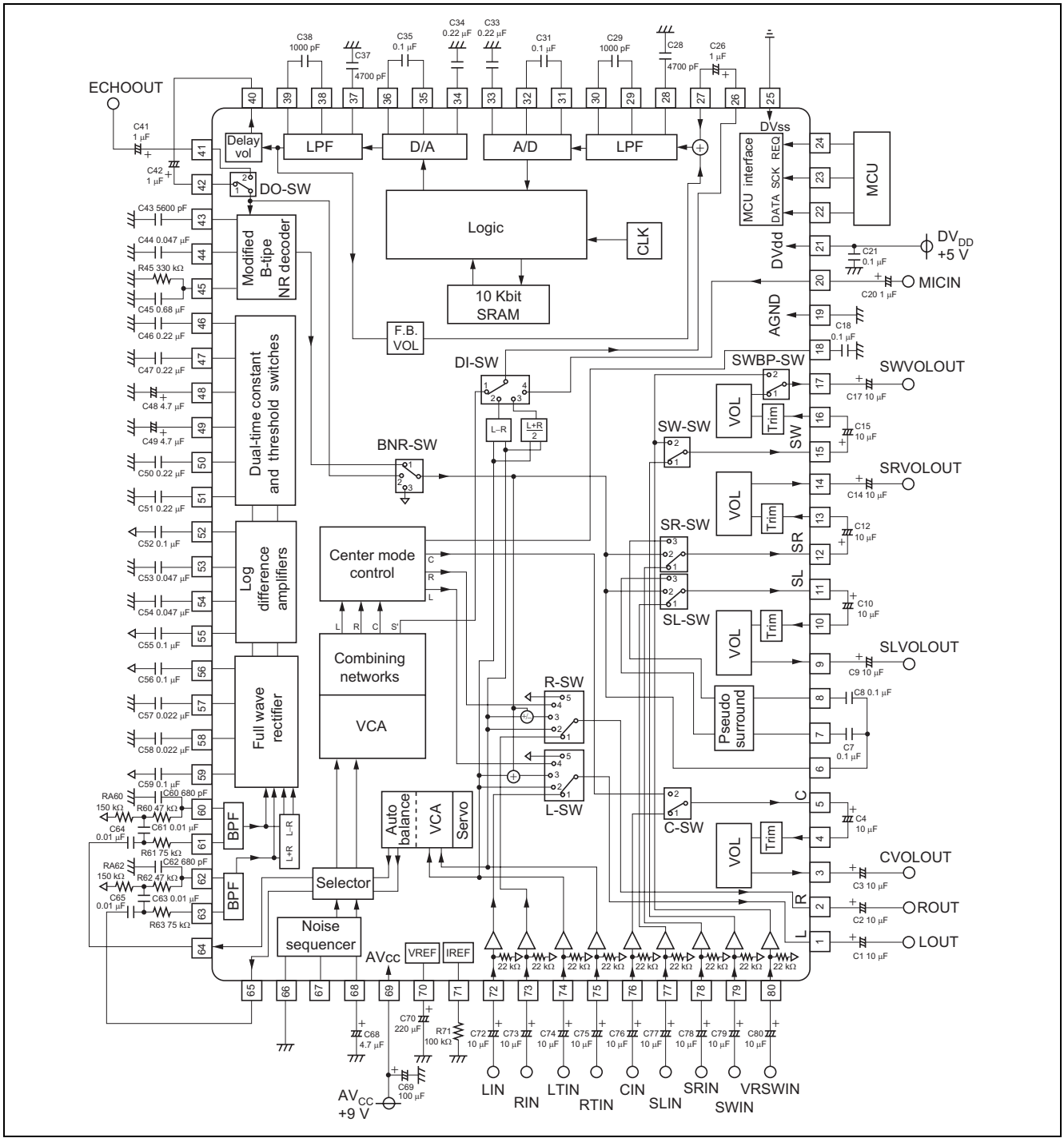


Notice

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.



Application Example

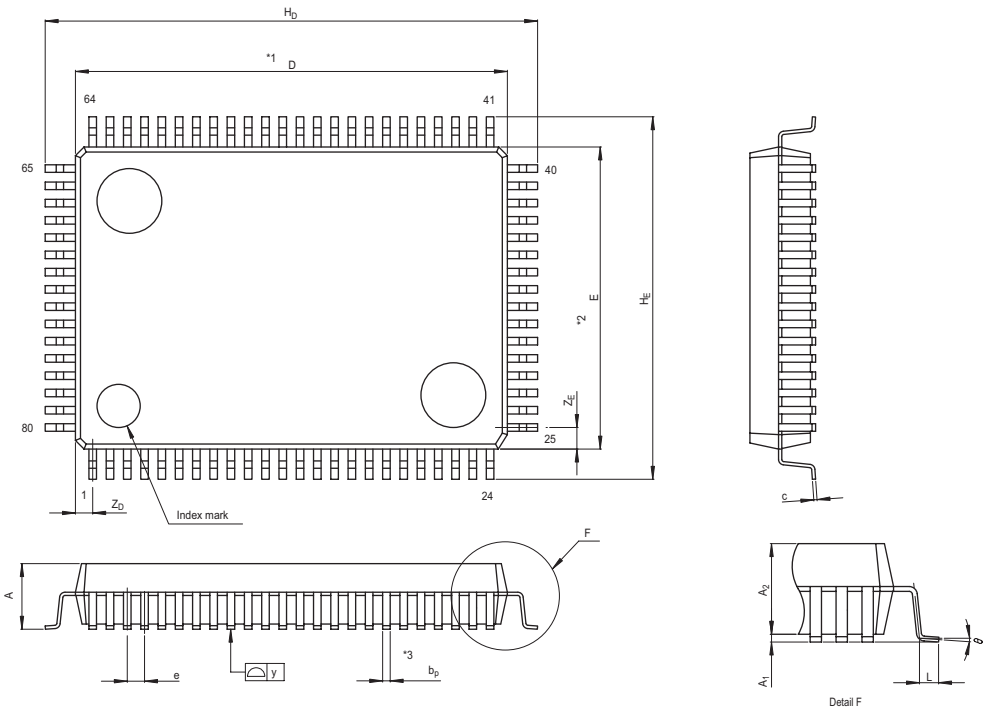


External Parts List

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

JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-QFP80-14x20-0.80	PRQP0080GB-A	80P6N-A	1.6g



NOTE)
1. DIMENSIONS "*1" AND "*2" DO NOT INCLUDE MOLD FLASH.
2. DIMENSION "*3" DOES NOT INCLUDE TRIM OFFSET.

Reference Symbol	Dimension in Millimeters		
	Min	Nom	Max
D	19.8	20.0	20.2
E	13.8	14.0	14.2
A_2	—	2.8	—
H_D	22.5	22.8	23.1
H_E	16.5	16.8	17.1
A	—	—	3.05
A_1	0	0.1	0.2
b_p	0.3	0.35	0.45
c	0.13	0.15	0.2
θ	0°	—	10°
e	0.65	0.8	0.95
y	—	—	0.10
Z_D	—	0.8	—
Z_E	—	1.0	—
L	0.4	0.6	0.8

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