

To all our customers

Regarding the change of names mentioned in the document, such as Mitsubishi Electric and Mitsubishi XX, to Renesas Technology Corp.

The semiconductor operations of Hitachi and Mitsubishi Electric were transferred to Renesas Technology Corporation on April 1st 2003. These operations include microcomputer, logic, analog and discrete devices, and memory chips other than DRAMs (flash memory, SRAMs etc.)

Accordingly, although Mitsubishi Electric, Mitsubishi Electric Corporation, Mitsubishi Semiconductors, and other Mitsubishi brand names are mentioned in the document, these names have in fact all been changed to Renesas Technology Corp. Thank you for your understanding. Except for our corporate trademark, logo and corporate statement, no changes whatsoever have been made to the contents of the document, and these changes do not constitute any alteration to the contents of the document itself.

Note : Mitsubishi Electric will continue the business operations of high frequency & optical devices and power devices.

Renesas Technology Corp.
Customer Support Dept.
April 1, 2003

PRELIMINARY
Notice : This is not a final specification.
some parametric limits are subject to change.

MITSUBISHI SOUND PROCESSOR

M62435FP

ELECTRIC VOLUME CONTROL WITH TONE CONTROLLER FOR 4-SPEAKER APPLICATIONS

Description

- Developed for car audio
- Uses it for analog small signal handling of stage before power amplifier
- Use to Home audio system, television are thought about other than car audio system

Features

- Built-in zero cross detector prevents click noise
- Differential Amplifier
- Loudness
- Tone Control Bass/Mid/Treble
- Master Volume/Fader Volume
- Serial Data Control



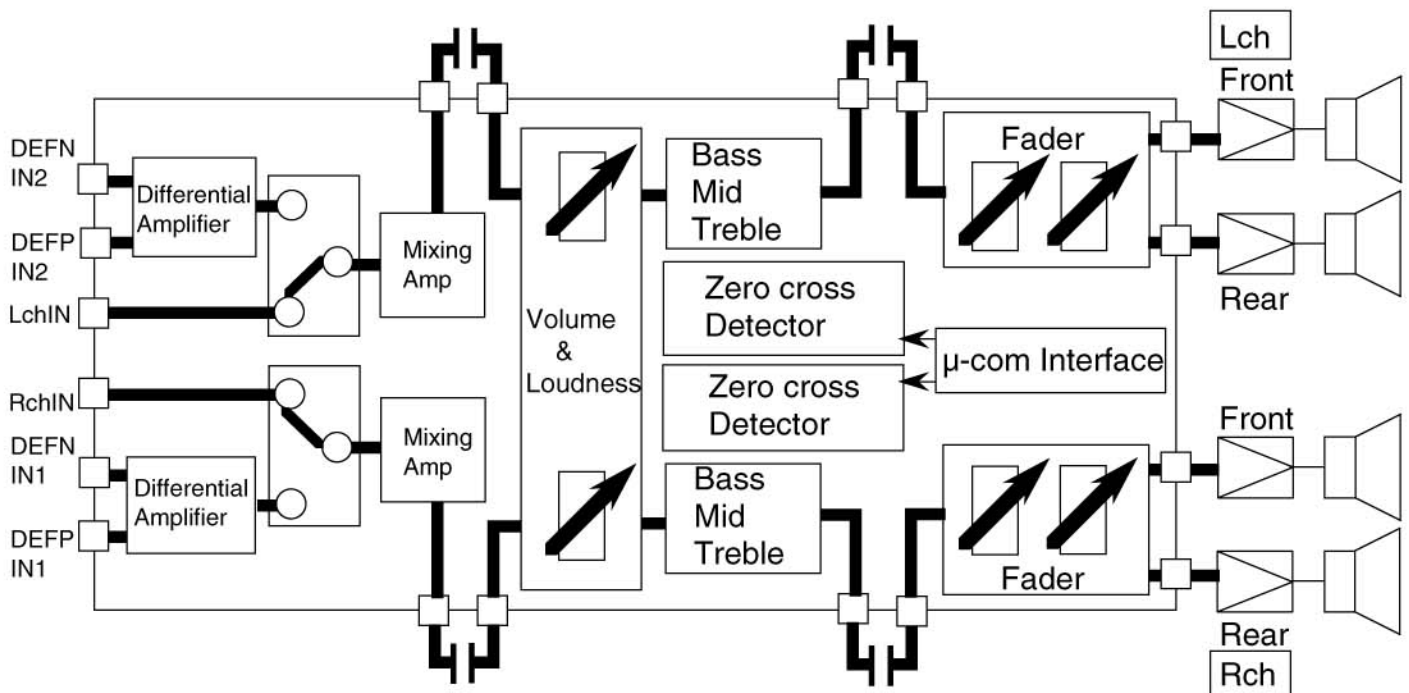
Outline 36P2R

Recommended Operating Conditions

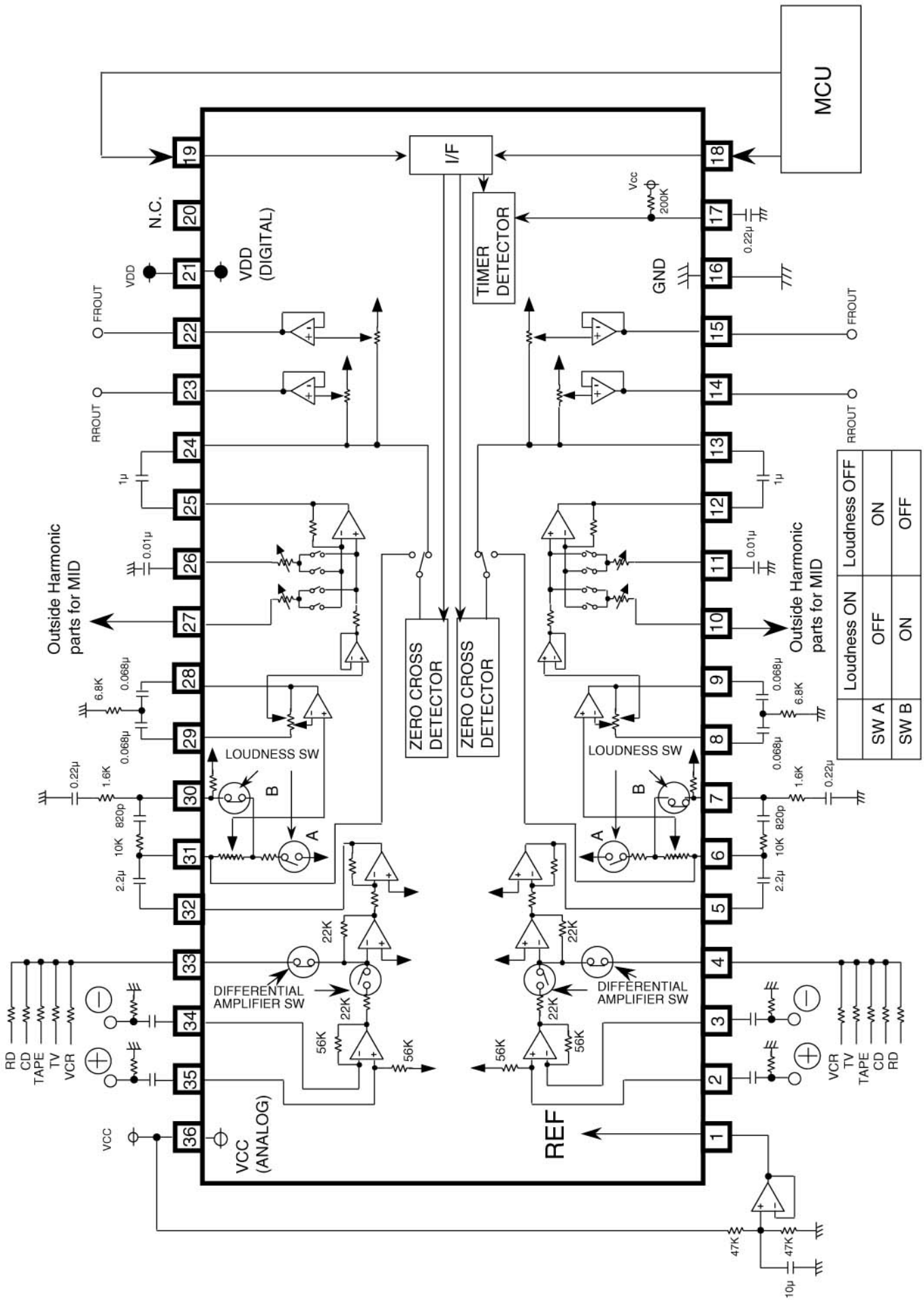
Supply voltage range.....Vcc=6 to 9V
VDD=4 to 6V

Rated supply voltage.....Vcc=8V
VDD=5V

Block Diagram



Pin Configuration & Application Example



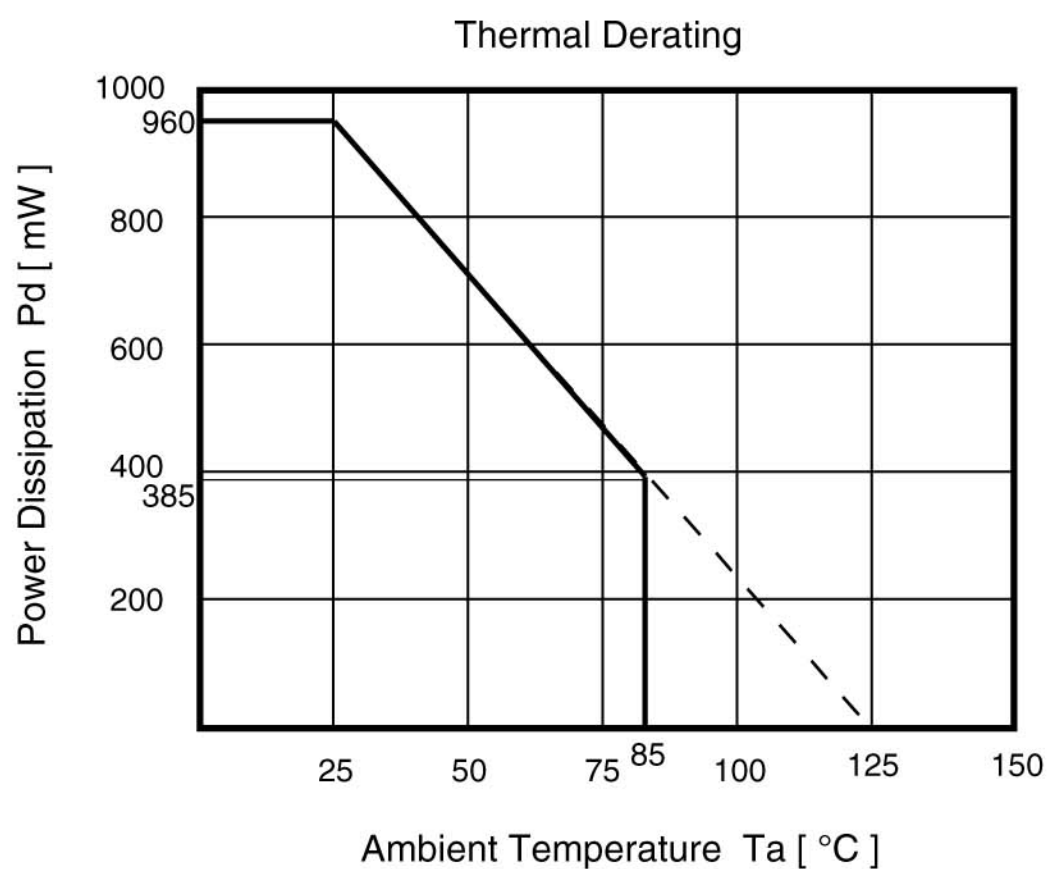
Pin Description

Pin No.	Symbol	Function
1	REF	IC signal ground. Apply 1/2 Vcc
2	DEFP IN1	Differential amplifier input +
3	DEFN IN1	Differential amplifier input -
4	MIX IN1	Mixing amplifier input -
5	MIX OUT1	Mixing amplifier input +
6	VOL IN1	Input pin of the volume block
7	LOUD IN1	Pin for setting the frequency characteristics of the loudness block
8	BASSA1	Pin for setting the frequency characteristics of the tone(Bass) block
9	BASSB1	
10	MID1	R-ladder terminal of tone(Mid)
11	TRE1	R-ladder terminal of tone(Treble)
12	TONE OUT1	Output pin of the tone block
13	FADER IN1	Input pin of the fader volume
14	REAR OUT1	Output pin of the fader volume(Rear)
15	FRONT OUT1	Output pin of the fader volume(Front)
16	GND	Ground
17	TIM1	Timer setting terminal The relationship between outside parts C and setting time is $T=13.8 \times 10^{-4} \cdot C(\text{sec})$.
18	DATA	Input pin of the control data This pin inputs data in synchronization with CLOCK

Pin No.	Symbol	Function
19	CLOCK	Clock input pin for serial data transfer
20	N.C.	Non Connection
21	V _{DD}	Digital power supply pin, normally +5V
22	FRONT OUT2	Output pin of the fader volume(Front)
23	REAR OUT2	Output pin of the fader volume(Rear)
24	FADER IN2	Input pin of the fader volume
25	TONE OUT2	Output pin of the tone block
26	TRE2	R-ladder terminal of tone(Treble)
27	MID2	R-ladder terminal of tone(Mid)
28	BASSB2	Pin for setting the frequency characteristics of the tone(Bass) block
29	BASSA2	
30	LOUD IN2	Pin for setting the frequency characteristics of the loudness block
31	VOL IN2	Input pin of the volume block
32	MIX OUT2	Mixing amplifier output
33	MIX IN2	Mixing amplifier input
34	DEFN IN2	Differential amplifier input -
35	DEFP IN2	Differential amplifier input +
36	V _{CC}	Analog power supply pin

Absolute Maximum Ratings

Symbol	Parameter	Conditions	Ratings	Unit
V_{CC}, V_{DD}	Supply Voltage		10 , 7	V
P_d	Power Dissipation	$T_a \leq 25^\circ\text{C}$	990	mW
K_θ	Thermal Derating Ratio	$T_a \geq 25^\circ\text{C}$	9.9	mW/ $^\circ\text{C}$
T_{opr}	Operating Temperature		-30 ~ 85	$^\circ\text{C}$
T_{stg}	Storage Temperature		-55 ~ 125	$^\circ\text{C}$

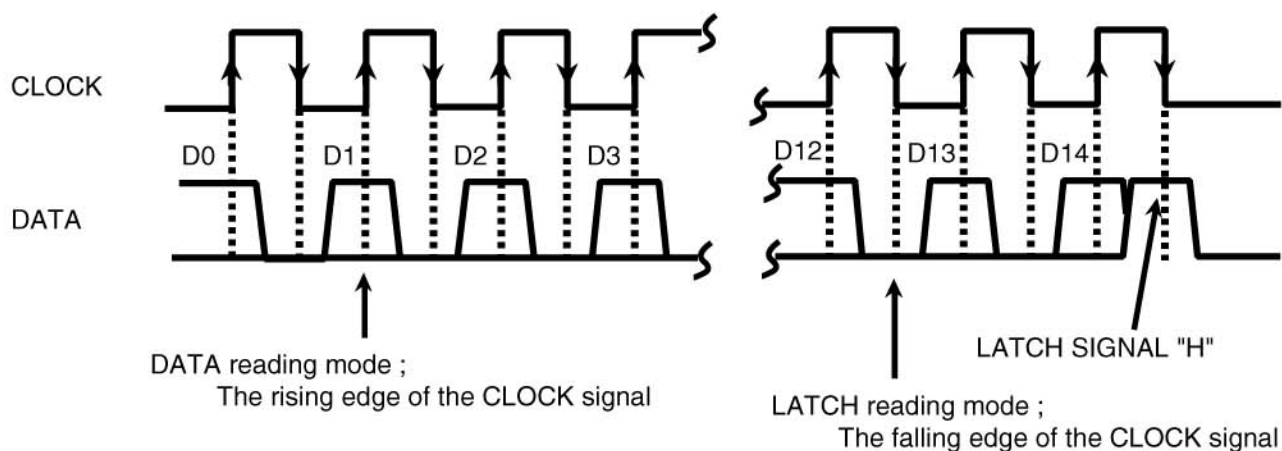


Electrical Characteristics

Ta=25°C, Vcc=8V, VDD=5V, VOL/FADER=0dB, TONE/FLAT, Loudness OFF unless otherwise noted

Symbol	Parameter	Test Conditions	Limits			Unit
			Min	typ	Max	
Icc	Circuit current	No input signal	—	20	35	mA
Gv	Pass Gain	Outside resistor 22KΩ of pin4,33 Outside resistor 56KΩ of pin2,3,34,35	-3.5	0	3.5	dB
ATT(VOL)	Maximum Attenuation	Vi=1Vrms, f=1KHz ATT(VOL)=-30dB	-32.5	-30	-27.5	dB
ΔATT(VOL)	Attenuation Error	ATT(VOL)= 0dB	-2.5	0	2.5	dB
VIM	Maximum Input Voltage	f=1KHz, BW:400 to 30KHz THD=1%	1.8	2.2	—	Vrms
G(Bass)B	Bass Boost	f=100Hz	13	16	19	dB
G(Bass)C	Bass Cut	f=100Hz	-15	-12	-9	dB
G(MID)B	MID Boost	f=1KHz (Outside Harmonic amplifier)	9	12	15	dB
G(MID)C	MID Cut	f=1KHz (Outside Harmonic amplifier)	-15	-12	-9	dB
G(Tre)B	Treble Boost	f=10KHz	9	12	15	dB
G(Tre)C	Treble Cut	f=10KHz	-15	-12	-9	dB
ATT(FED)	Maximum Attenuation	Vi=1Vrms, f=1KHz ATT(FED)= -∞dB	—	-90	-80	dB
VOM	Maximum Output Voltage	f=1KHz, BW:400 to 30KHz THD=1%	1.8	2.2	—	Vrms
Vno 1	Output Noise Voltage	Rg=0, DIN-AUDIO	—	10	18	μVrms
Vno 2		ATT(VOL)= -30dB ATT(FED)= -∞dB Rg=0, DIN-AUDIO	—	3	8	
THD	Total Harmonic Distortion	f=1KHz, Vo=0.5Vrms BW:400Hz to 30KHz	—	0.03	0.05	%
CS	Channel Separation	f=1KHz	—	-90	-80	dB
CT	Cross Talk of Differential amplifier SW	f=1KHz	—	-75	-65	dB
G(LOUD)L	Voltage Gain of Loudness	Loudness ON f=100Hz, ATT(VOL)=-30dB	7.0	11.0	15.0	dB
G(LOUD)H		Loudness ON f=10KHz, ATT(VOL)=-30dB	3.5	6.5	9.5	

RELATIONSHIP BETWEEN DATA AND CLOCK



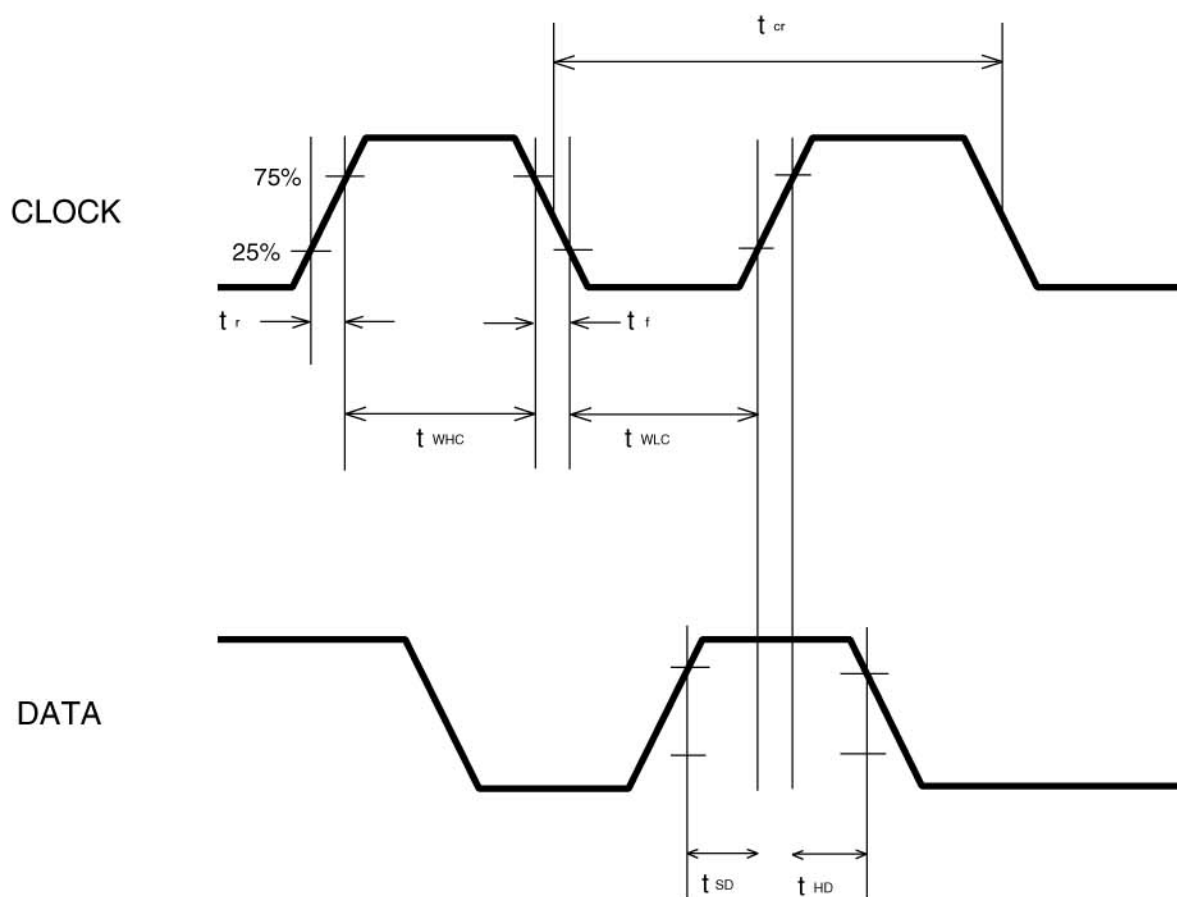
DIGITAL CIRCUIT DC CHARACTERISTICS

Symbol	Parameter	Test conditions	Limits			Unit
			Min	typ	Max	
V_{IL}	"L" level input voltage	DATA, CLOCK pins	0	~	$0.2V_{DD}$	V
V_{IH}	"H" level input voltage		$0.8V_{DD}$	~	V_{DD}	
I_{IL}	"L" level input current	$V_i = 0$	-10	—	10	μA
I_{IH}	"H" level input current	$V_i = V_{DD}$	—	—	10	

DIGITAL CIRCUIT AC CHARACTERISTICS

Symbol	Parameter	Limits			Unit
		Min	typ	Max	
t_{cr}	CLOCK Cycle time	4	—	—	μS
t_{WHC}	CLOCK pulse width ("H" level)	1.6	—	—	
t_{WLC}	CLOCK pulse width ("L" level)	1.6	—	—	
t_r	CLOCK rise time	—	—	0.4	
t_f	CLOCK fall time	—	—	0.4	
t_{SD}	DATA setup time	0.8	—	—	
t_{HD}	DATA hold time	0.8	—	—	

CLOCK DATA TIMING



Data Input Format

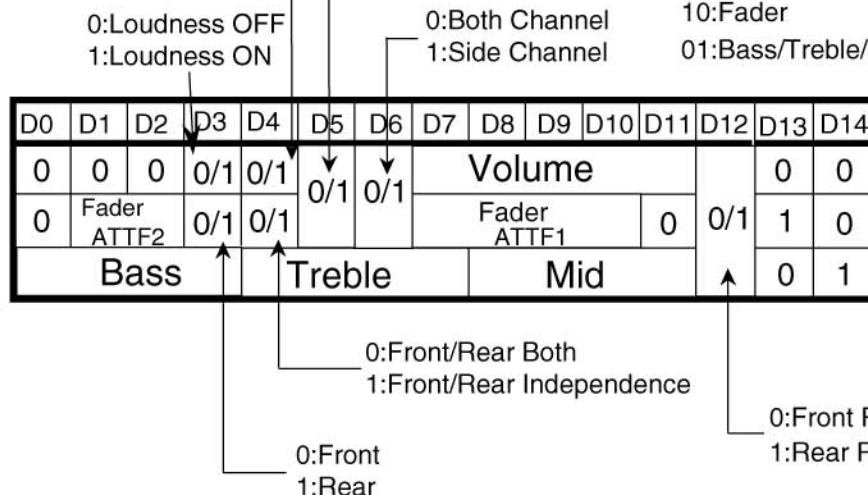
0: Differential Amplifier SW OFF
1: Differential Amplifier SW ON

0:1CH
1:2CH

Data Select(D13,D14)

00:Loudness/Differential Amplifier/Volume
10:Fader

01:Bass/Treble/Mid



Volume Code

ATT V1	D7	D8	D9
0dB	1	0	1
-4dB	0	0	1
-8dB	1	1	0
-12dB	0	1	0
-16dB	1	0	0
-20dB	0	0	0
-24dB	0	1	1
-28dB	1	1	1

ATT V2	D10	D11
0dB	1	1
-1dB	0	1
-2dB	1	0
-3dB	0	0

Fader Code

ATT F1	D7	D8	D9	D10
0dB	1	0	0	1
-8dB	1	1	1	0
-16dB	0	1	1	0
-24dB	1	0	1	0
-32dB	0	0	1	0
-40dB	1	1	0	0
-48dB	0	1	0	0
-56dB	1	0	0	0
-∞dB	0	0	0	0

ATT F2	D1	D2
0dB	1	1
-2dB	0	1
-4dB	1	0
-6dB	0	0

Tone Code

Bass	D0	D1	D2	D3
16dB	0	0	0	1
14dB	1	1	1	0
12dB	0	1	1	0
10dB	1	0	1	0
8dB	0	0	1	0
6dB	1	1	0	0
4dB	0	1	0	0
2dB	1	0	0	0
0dB	0	0	0	0
-2dB	1	0	0	1
-4dB	0	1	0	1
-6dB	1	1	0	1
-8dB	0	0	1	1
-10dB	1	0	1	1
-12dB	0	1	1	1

Treble	D4	D5	D6	D7
12dB	0	1	1	0
10dB	1	0	1	0
8dB	0	0	1	0
6dB	1	1	0	0
4dB	0	1	0	0
2dB	1	0	0	0
0dB	0	0	0	0
-2dB	1	0	0	1
-4dB	0	1	0	1
-6dB	1	1	0	1
-8dB	0	0	1	1
-10dB	1	0	1	1
-12dB	0	1	1	1

Mid	D8	D9	D10	D11
12dB	0	1	1	0
10dB	1	0	1	0
8dB	0	0	1	0
6dB	1	1	0	0
4dB	0	1	0	0
2dB	1	0	0	0
0dB	0	0	0	0
-2dB	1	0	0	1
-4dB	0	1	0	1
-6dB	1	1	0	1
-8dB	0	0	1	1
-10dB	1	0	1	1
-12dB	0	1	1	1