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

M62446AFP

6CH ELECTRONIC VOLUME WITH TONE CONTROL

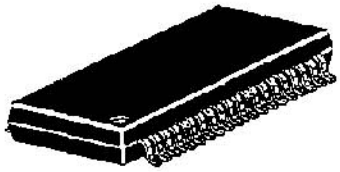
DESCRIPTION

The M62446AFP is 6ch electronic volume with tone control. This IC is revised from M62446FP. The extended function of M62446AFP is volume level and tone control level. M62446AFP is easy to use more than M62446FP.

FEATURES

(note) * is an extended function.

- 6ch Electric volume
  Volume level : 0 to -95dB(1dB/step)*
  <M62446FP:0 to -79dB(1dB/step)>
- Tone control
  Bass/Treble : -14dB to +14dB(2dB/step)*
  <M62446FP:-10dB to +10dB(2dB/step)>
- Noise voltage : 1.5μVrms <M62446FP:2.2μVrms>
- 4 Output ports
- Bypass mode is high quality sound.



Outline 42P2R-A
0.8mm pitch 450mil ssop
(8.4mm×17.5mm×2.0mm)

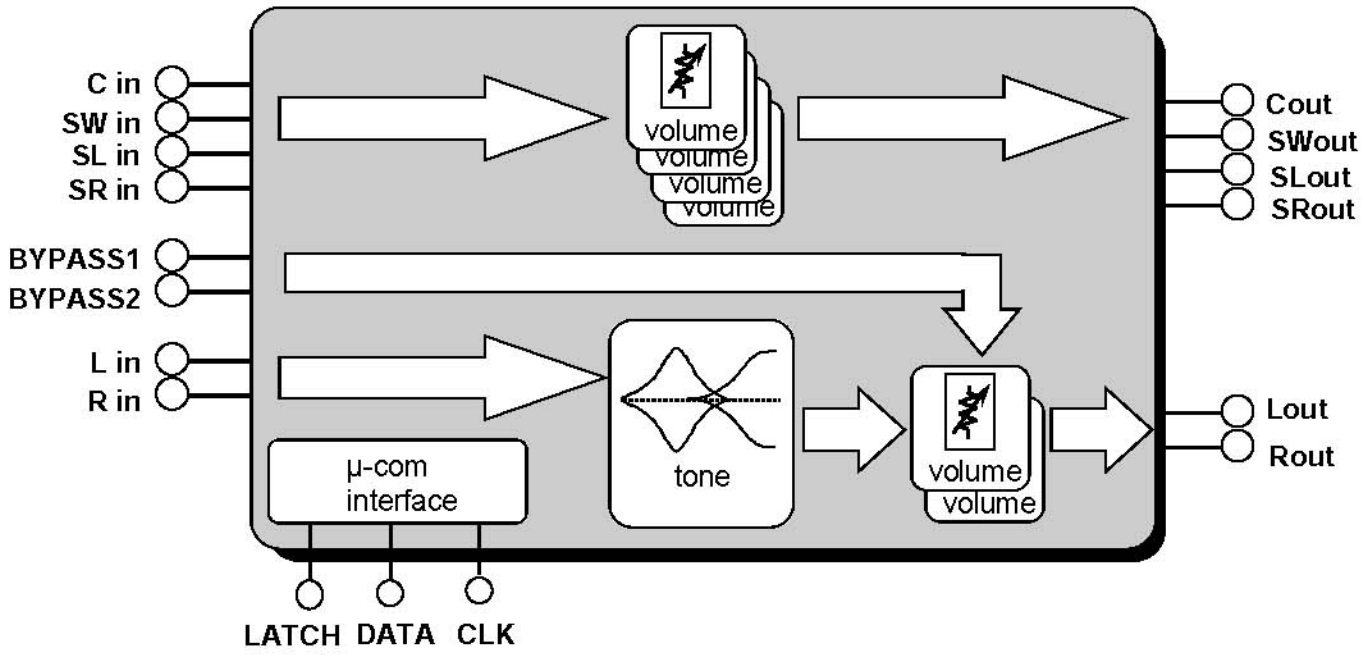
APPLICATION

DVD,Home Audio equipment,TV

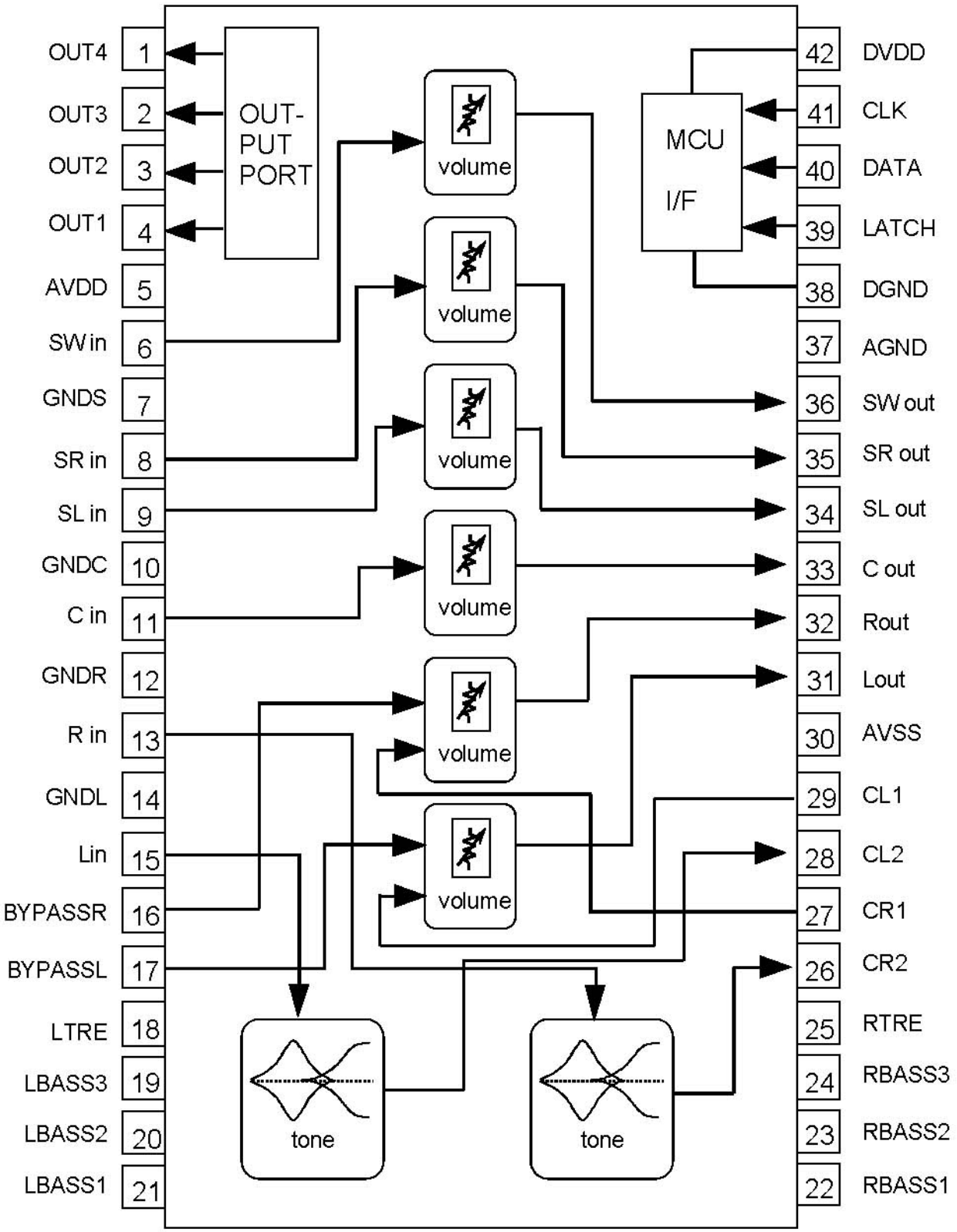
RECOMMENDED OPERATING CONDITIONS

Supply voltage range----------±4.5 to ±7.5V(analog), 4.5 to 5.5V(digital)
Recommended supply voltage----------±7.0V(analog), 5.0V(digital)

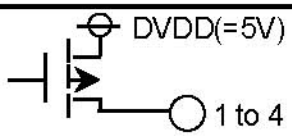
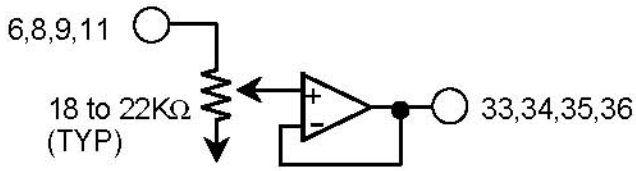
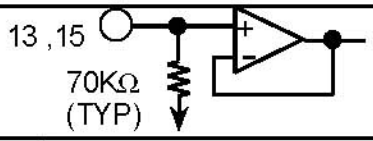
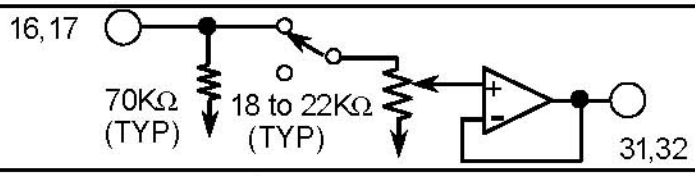
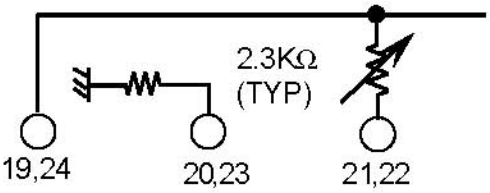
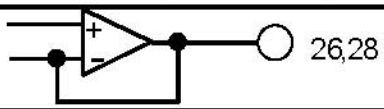
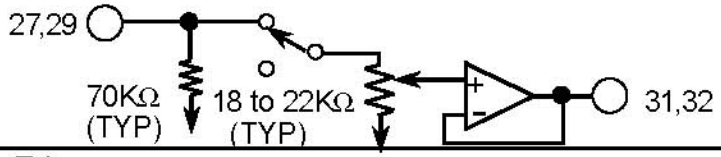
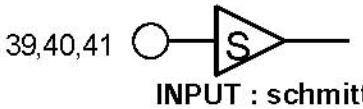
SYSTEM BLOCK DIAGRAM



PIN CONFIGURATION AND BLOCK DIAGRAM



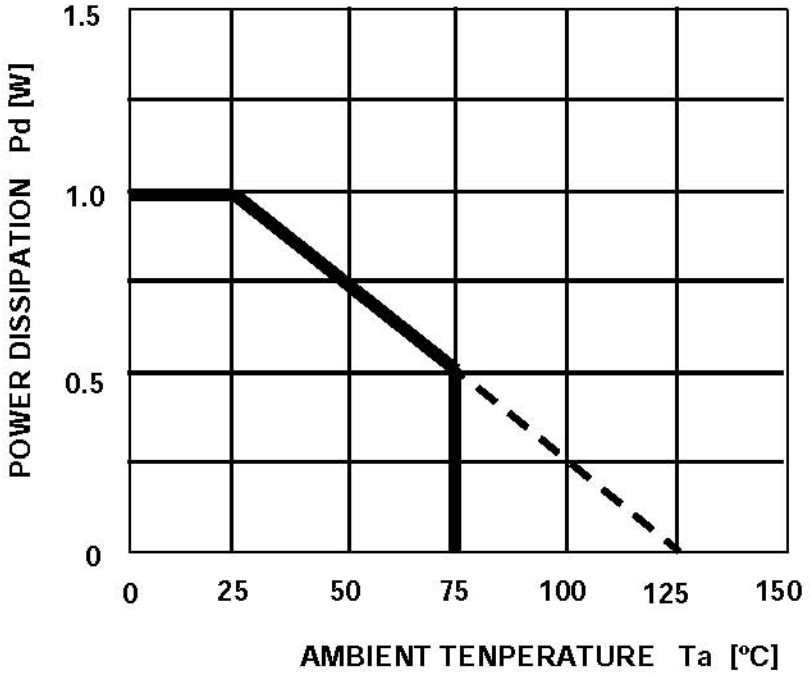
PIN DESCLIPTION

Pin No.	Symbol	Function	Circuit
1 2 3 4	OUT4 OUT3 OUT2 OUT1	Port OUTPUT	OUTPUT:PMOS Transistor open drain 
5	AVDD	Analog positive Power supply	+7V
7 10 12 14	GNDS GNDC GNDR GNDL	GND	Connect to analog GND
6 8 9 11	SW in SR in SL in C in	Volume INPUT	
36 35 34 33	SW out SR out SL out C out	Volume OUTPUT	
13 15	R in L in	Tone INPUT	
16 17 31 32	BYPASSR BYPASSL Lout Rout	L,R Volume INPUT in BYPASS mode L OUTPUT R OUTPUT	
18 25	LTRE RTRE	tone Treble cycle control	
19 24 20 23 21 26	LBASS3 RBASS3 LBASS2 RBASS2 LBASS1 RBASS1	tone Bass cycle control	
22 28	CR2 CL2	Tone OUTPUT	
27 29 31 32	CR1 CL1 Lout Rout	L,R Volume INPUT L OUTPUT R OUTPUT	
30	AVSS	Analog negative Power Supply	-7V
37	AGND	Analog GND	
38	DGND	Digital GND	
39 40 41	LATCH DATA CLK	Latch INPUT Data INPUT Clock INPUT Forward data	 **INPUT : schmitt trigger type**
42	DVDD	Digital Power supply	+5V

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Condition	Ratings	Unit
Vsupply	Supply Voltage	AVDD-AVSS	16	V
		DVDD-DGND	7	
Pd	Power dissipation	Ta≤25 ºC	1000	mW
Kθ	Thermal derating	Ta>25 ºC	10	mW/ºC
Topr	Operating temperature		-20 to +75	ºC
Tstg	Storage temperature		-40 to +125	ºC

THERMAL DERATING(MAXMUM RATING)
(with the standard board)



*Standard board
- board size 70mm X 70mm
- board thickness 1.6mm
- board material glass epoxy
- copper pattern
  copper thickness 18µm
  copper size 0.25mm(wide) 30mm(length/lead)

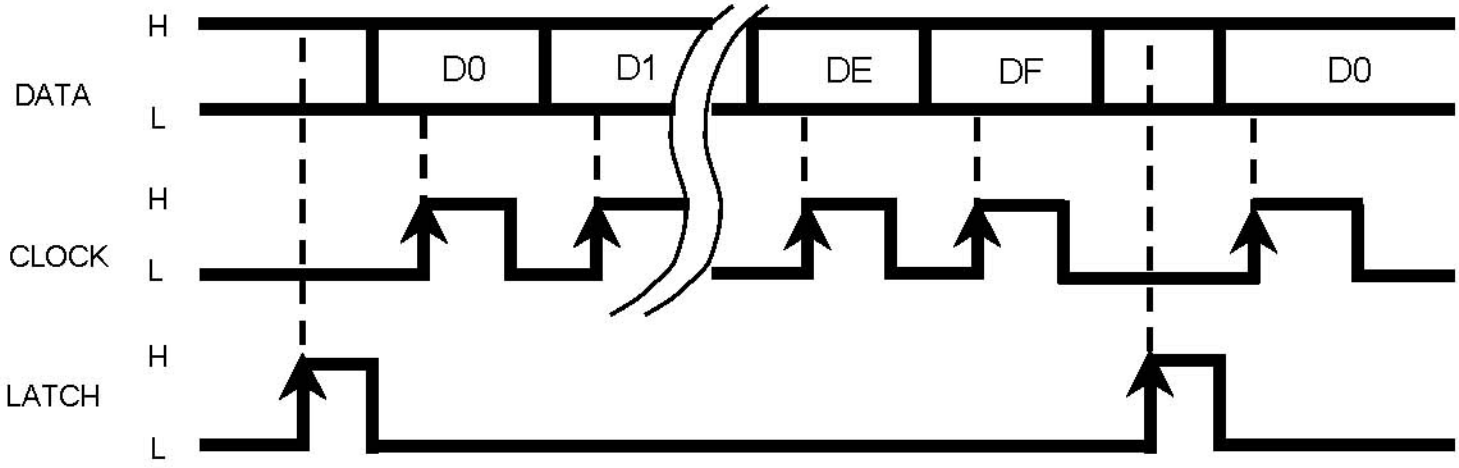
RECOMMENDED OPRETING CONFITION

(Ta=25ºC, unless otherwise noted.)

Parameter	Symbol	Condition	MIN	TYP	MAX	Unit
Analog positive Supply Voltage	AVDD		4.5	7.0	7.5	V
Analog negative Supply Voltage	AVSS		-7.5	-7.0	-4.5	V
Digital Supply Voltage	DVDD		4.5	5.0	5.5	V
High-level Input Voltage	VIH		DVDD×0.7	—	DVDD	V
Low-level Input Voltage	VIL		DGND	—	DVDD×0.3	V

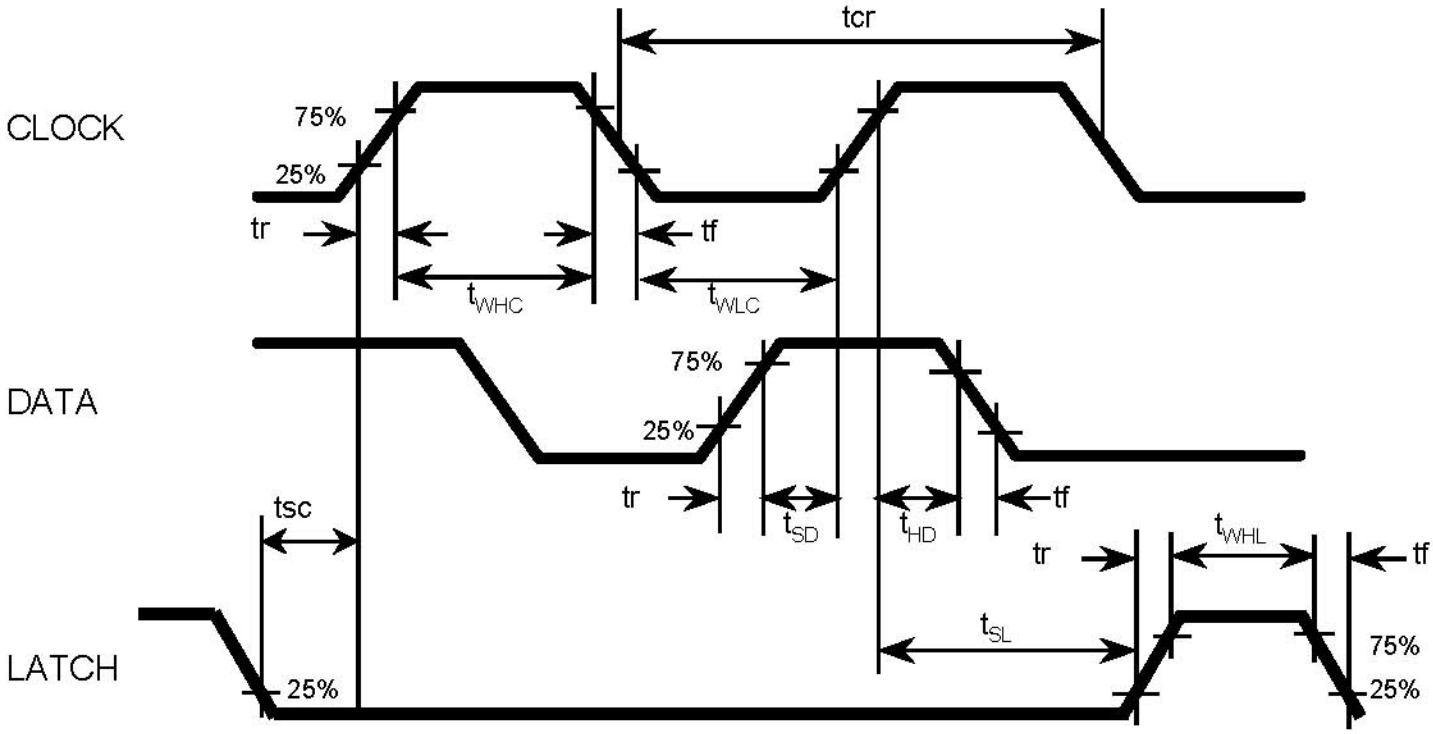
(Note) AVSS≤DGND<DVDD≤AVDD

RERATIONSHIP BETWEEN DATA AND CLOCK AND LATCH



note : CLOCK and LATCH function at raising edges of pulse .

DATA TIMING(Recommended conditions)



DIGITAL BLOCK TIMING REGULATION

Symbol	Parameter	Limits			Unit
		Min	typ	Max	
tcr	CLOCK cycle time	8	–	–	μsec
t_{WHC}	CLOCK pulse width ("H"level)	3.2	–	–	
t_{WLC}	CLOCK pulse width ("L"level)	3.2	–	–	
tr	CLOCK,DATA,LATCH rise time	–	–	0.8	
tf	CLOCK,DATA,LATCH fall time	–	–	0.8	
t_{SD}	DATA setup time	1.6	–	–	
t_{HD}	DATA hold time	1.6	–	–	
t_{SL}	LATCH setup time	2	–	–	
t_{WHL}	LATCH pulse width	3.2	–	–	
t_{SC}	CLOCK start time after LACTH	3.2	–	–	

DIGITAL CONTROL SPECIFICATION

Fore kinds of input format options are available by changing slot settings of DE and DF.
(When the IC is powered up , the internal settings are not fixed.)

(1)

D01	D11	D21	D31	D41	D51	D61	D71	D81	D91	DA1	DB1	DC1	DD1	DE	DF
TONE CONT TLEBLE				1	2	3	4	TONE CONT BASS				0	TONE :0 BYPASS :1	0	0
				OUTPUT PORT n CONT High:1,Low:0											

(2)

D02	D12	D22	D32	D42	D52	D62	D72	D82	D92	DA2	DB2	DC2	DD2	DE	DF
VOLUME Lch							VOLUME Rch							0	1

(3)

D03	D13	D23	D33	D43	D53	D63	D73	D83	D93	DA3	DB3	DC3	DD3	DE	DF
VOLUME Cch							VOLUME SWch							1	0

(4)

D04	D14	D24	D34	D44	D54	D64	D74	D84	D94	DA4	DB4	DC4	DD4	DE	DF
VOLUME SLch							VOLUME SRch							1	1

SETTING CODE

(1) Tone control (bass / treble)

(Note) * is an extended function.

ATT	Treble / bass	D01 / D81	D11 / D91	D21 / DA1	D31 / DB1
*	- 14dB	1	1	1	1
*	- 12dB	1	1	0	1
	- 10dB	1	1	1	0
	- 8dB	1	1	0	0
	- 6dB	1	0	1	1
	- 4dB	1	0	1	0
	- 2dB	1	0	0	1
	+ 0dB	0	0	0	0
	+ 2dB	0	0	0	1
	+ 4dB	0	0	1	0
	+ 6dB	0	0	1	1
	+ 8dB	0	1	0	0
	+ 10dB	0	1	1	0
*	+ 12dB	0	1	0	1
*	+ 14dB	0	1	1	1

(2) Port output

D41 D51 D61 D71	
Out:H	1
Out:L	0

(3) BYPASS control

DD1	
BYPASS	1
TONE	0

Note : Do not input other data than the above.

(4)-1 VOLUME (0 to -39dB) Note : Do not input other data than the above.

ATT	VOLUME	D0X	D1X	D2X	D3X	D4X	D5X	D6X
		D7X	D8X	D9X	DAX	DBX	DCX	DDX
0dB		0	0	0	0	0	0	0
–1dB		0	0	0	0	0	0	1
–2dB		0	0	0	0	0	1	0
–3dB		0	0	0	0	0	1	1
–4dB		0	0	0	0	1	0	0
–5dB		0	0	0	0	1	0	1
–6dB		0	0	0	0	1	1	0
–7dB		0	0	0	0	1	1	1
–8dB		0	0	0	1	0	0	0
–9dB		0	0	0	1	0	0	1
–10dB		0	0	0	1	0	1	0
–11dB		0	0	0	1	0	1	1
–12dB		0	0	0	1	1	0	0
–13dB		0	0	0	1	1	0	1
–14dB		0	0	0	1	1	1	0
–15dB		0	0	0	1	1	1	1
–16dB		0	0	1	0	0	0	0
–17dB		0	0	1	0	0	0	1
–18dB		0	0	1	0	0	1	0
–19dB		0	0	1	0	0	1	1
–20dB		0	0	1	0	1	0	0
–21dB		0	0	1	0	1	0	1
–22dB		0	0	1	0	1	1	0
–23dB		0	0	1	0	1	1	1
–24dB		0	0	1	1	0	0	0
–25dB		0	0	1	1	0	0	1
–26dB		0	0	1	1	0	1	0
–27dB		0	0	1	1	0	1	1
–28dB		0	0	1	1	1	0	0
–29dB		0	0	1	1	1	0	1
–30dB		0	0	1	1	1	1	0
–31dB		0	0	1	1	1	1	1
–32dB		0	1	0	0	0	0	0
–33dB		0	1	0	0	0	0	1
–34dB		0	1	0	0	0	1	0
–35dB		0	1	0	0	0	1	1
–36dB		0	1	0	0	1	0	0
–37dB		0	1	0	0	1	0	1
–38dB		0	1	0	0	1	1	0
–39dB		0	1	0	0	1	1	1

(4)-2 VOLUME(-40 to -∞dB)

Note : Do not input other data than the above.

ATT	VOLUME	D0X	D1X	D2X	D3X	D4X	D5X	D6X
		D7X	D8X	D9X	DAX	DBX	DCX	DDX
–40dB		0	1	0	1	0	0	0
–41dB		0	1	0	1	0	0	1
–42dB		0	1	0	1	0	1	0
–43dB		0	1	0	1	0	1	1
–44dB		0	1	0	1	1	0	0
–45dB		0	1	0	1	1	0	1
–46dB		0	1	0	1	1	1	0
–47dB		0	1	0	1	1	1	1
–48dB		0	1	1	0	0	0	0
–49dB		0	1	1	0	0	0	1
–50dB		0	1	1	0	0	1	0
–51dB		0	1	1	0	0	1	1
–52dB		0	1	1	0	1	0	0
–53dB		0	1	1	0	1	0	1
–54dB		0	1	1	0	1	1	0
–55dB		0	1	1	0	1	1	1
–56dB		0	1	1	1	0	0	0
–57dB		0	1	1	1	0	0	1
–58dB		0	1	1	1	0	1	0
–59dB		0	1	1	1	0	1	1
–60dB		0	1	1	1	1	0	0
–61dB		0	1	1	1	1	0	1
–62dB		0	1	1	1	1	1	0
–63dB		0	1	1	1	1	1	1
–64dB		1	0	0	0	0	0	0
–65dB		1	0	0	0	0	0	1
–66dB		1	0	0	0	0	1	0
–67dB		1	0	0	0	0	1	1
–68dB		1	0	0	0	1	0	0
–69dB		1	0	0	0	1	0	1
–70dB		1	0	0	0	1	1	0
–71dB		1	0	0	0	1	1	1
–72dB		1	0	0	1	0	0	0
–73dB		1	0	0	1	0	0	1
–74dB		1	0	0	1	0	1	0
–75dB		1	0	0	1	0	1	1
–76dB		1	0	0	1	1	0	0
–77dB		1	0	0	1	1	0	1
–78dB		1	0	0	1	1	1	0
–79dB		1	0	0	1	1	1	1
–∞dB		1	0	1	0	0	0	0

(4)-3 VOLUME (-80 to -∞dB)

This is an extended function from M62446FP.

ATT VOLUME	D0X	D1X	D2X	D3X	D4X	D5X	D6X
	D7X	D8X	D9X	DAX	DBX	DCX	DDX
–∞dB	1	0	1	0	0	0	1
–∞dB	1	0	1	0	0	1	0
–∞dB	1	0	1	0	0	1	1
↓							
–∞dB	1	0	1	1	1	1	0
–∞dB	1	0	1	1	1	1	1
–80dB	1	1	0	0	0	0	0
–81dB	1	1	0	0	0	0	1
–82dB	1	1	0	0	0	1	0
–83dB	1	1	0	0	0	1	1
–84dB	1	1	0	0	1	0	0
–85dB	1	1	0	0	1	0	1
–86dB	1	1	0	0	1	1	0
–87dB	1	1	0	0	1	1	1
–88dB	1	1	0	1	0	0	0
–89dB	1	1	0	1	0	0	1
–90dB	1	1	0	1	0	1	0
–91dB	1	1	0	1	0	1	1
–92dB	1	1	0	1	1	0	0
–93dB	1	1	0	1	1	0	1
–94dB	1	1	0	1	1	1	0
–95dB	1	1	0	1	1	1	1
–∞dB	1	1	1	0	0	0	0
–∞dB	1	1	1	0	0	0	1
↓							
↓							
–∞dB	1	1	1	1	1	1	0
–∞dB	1	1	1	1	1	1	1

ELECTRICAL CHARACTERISTICS

(Ta=25°C, AVDD/AVSS/DVDD=7/-7V/5V , f=1kHz,unless otherwise noted.
Rg=1KΩ, RL=10KΩ, TONE CONTROL • VOL are set to 0dB/FLAT.)

(1) Power supply characteristics

Parameter	Symbol	Test condition	Limits			Unit
			Min	typ	Max	
Analog positive circuit current	AIdd	Current at pin 5 No signal	—	22	35	mA
Analog negative circuit current	AIss	Current at pin 30 No signal	—	22	35	mA
Digital circuit current	DIdd	Current at pin 42 No signal	—	1.0	2.0	mA

(2) Input / Output characteristics

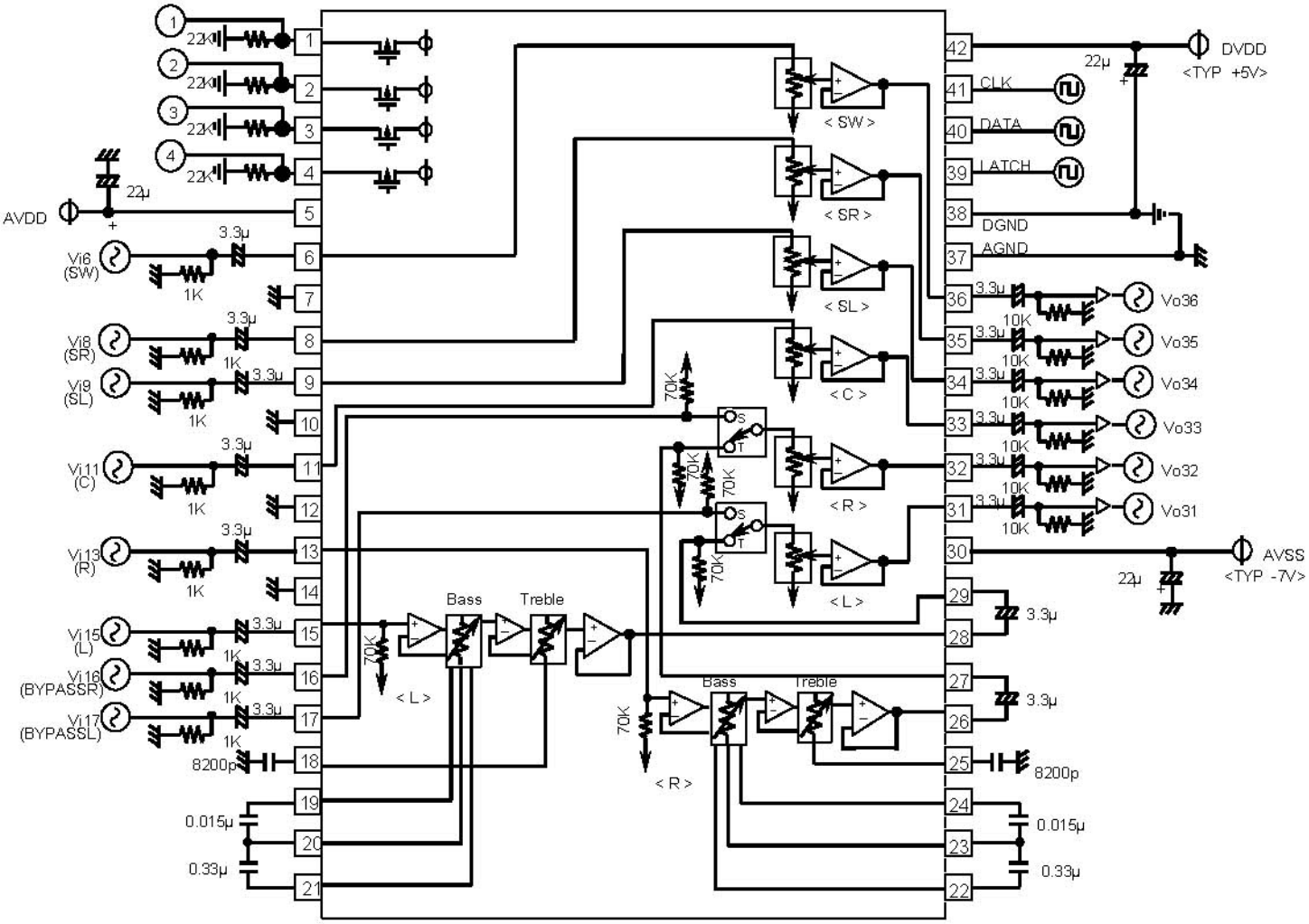
Parameter	Symbol	Test condition	Limits			Unit
			Min	typ	Max	
Input resistance	Ri	13,15,16,17,27,29pin	35	70	150	KΩ
Maximum output voltage	VOM	6,8,9,11,13,15,16,17pin INPUT 31 to 36pin OUTPUT THD=1%	3.0	4.2	—	Vrms
Pass gain	Gv	Vi=0.2Vrms,FLAT ,8,9,11,13,15,16,17pin INPUT 31 to 36pin OUTPUT	-2.0	0	2.0	dB
Distortion	THD	BW=400 to 30KHz Vi=0.2Vrms , RL=10KΩ	—	0.002	0.09	%
Output noise voltage	Vn(VOL)	31 to 36pin,Rg=0KΩ, JIS-A,VOL=0dB	—	1.5	6	μVrms
	Vn(tone)	31,32pin JIS-A,VOL=0dB	—	5	20	μVrms
Maximum attenuation	ATTmax	31 to 36pin JIS-A,VOL=−∞dB	—	-100	-95	dB
Volume gain between channels	Dvol		-1.5	0	1.5	dB
Crosstalk between channels	CT	Vo=0.5Vrms , RL=10KΩ,JIS-A Rg=1KΩ	—	-80	-65	dB
Port output current	IL		0.2	—	—	mA

(3) Tone control characteristics

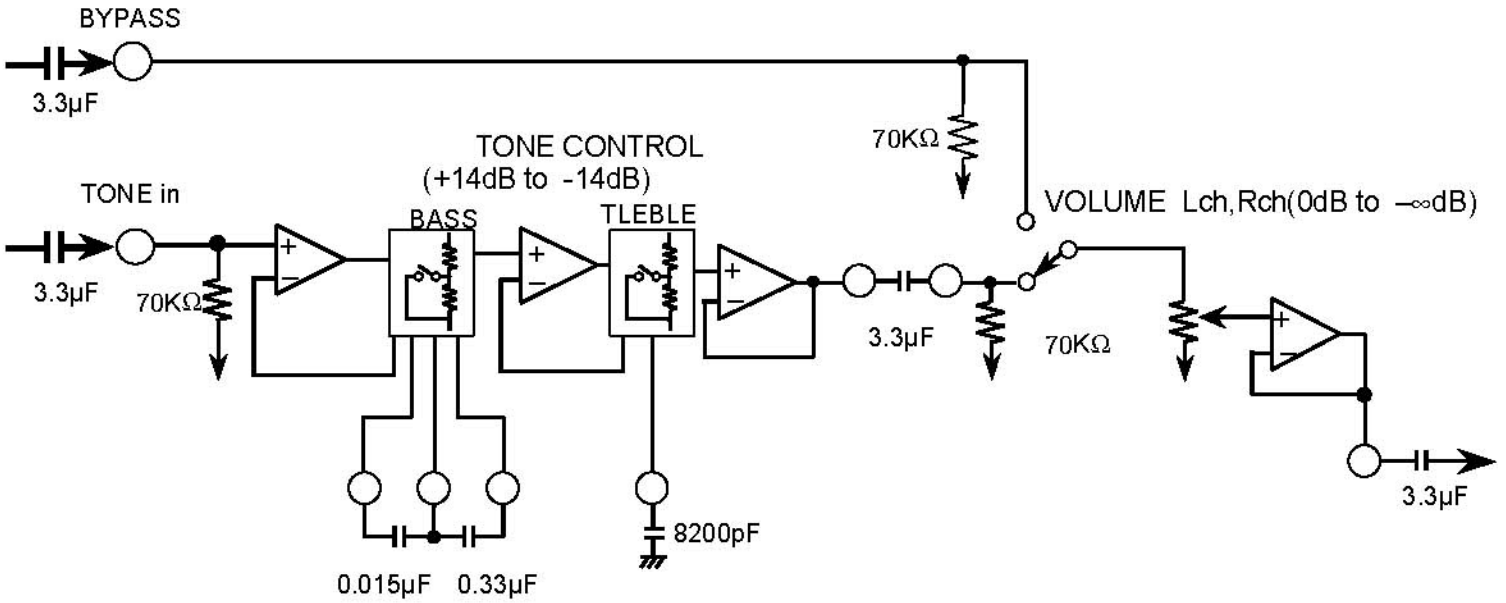
(Note) * is an expanded function.

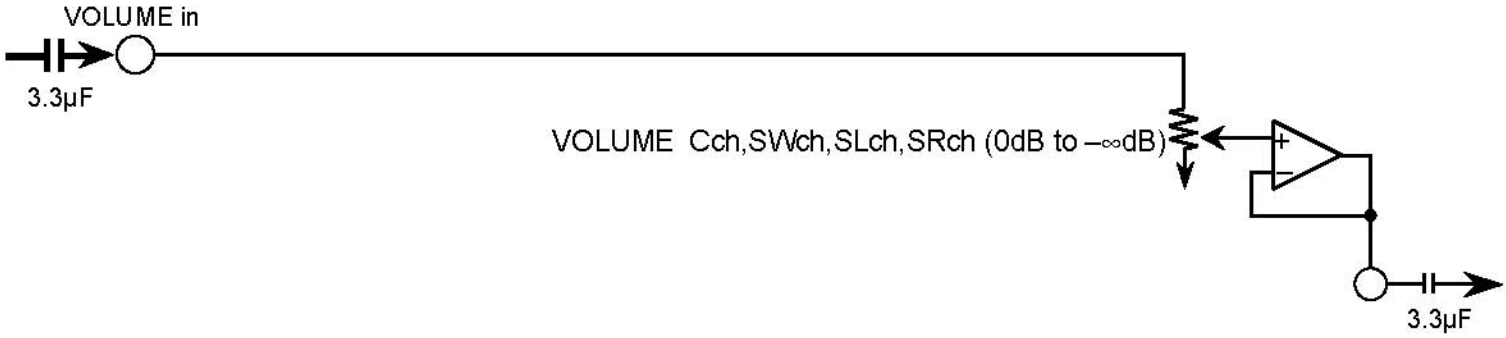
Parameter	Symbol	Test condition	Limits			Unit
			Min	typ	Max	
Tone control voltage gain	*T +14dB	Vo=0.2Vrms TLEBLE(f=10kHz), BASS(f=100Hz) Voltage gain (Input to pin13,15 Output from pin31,32) INPUT 13,15pin OUTPUT 31,32pin	12	14	16	dB
	*T +12dB		10	12	14	dB
	T +10dB		8	10	12	dB
	T +8dB		6	8	10	dB
	T +6dB		4.5	6	7.5	dB
	T +4dB		2.5	4	5.5	dB
	T +2dB		1	2	3	dB
	T -2dB		-3	-2	-1	dB
	T -4dB		-5.5	-4	-2.5	dB
	T -6dB		-7.5	-6	-4.5	dB
	T -8dB		-10	-8	-6	dB
	T -10dB		-12	-10	-8	dB
	*T -12dB		-14	-12	-10	dB
	*T -14dB		-16	-14	-12	dB
Balance between channel	BALT	Input 13 ,15pin Vo=0.2Vrms Output31,32pin	-1.5	0	+1.5	dB

TEST CIRCUIT

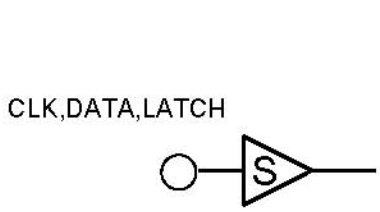


SIGNAL PROCESSING DIAGRAM

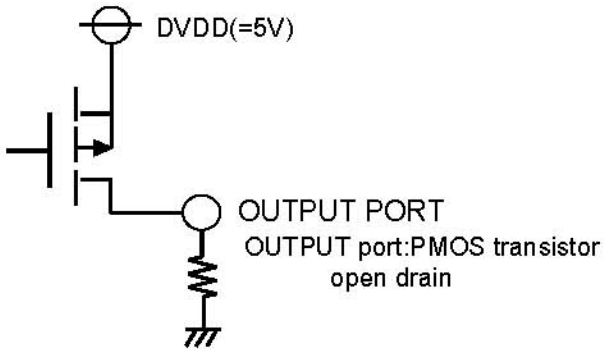




Note.(1)The resistance value of Volume change about 18 to 22KΩ by attenuated condition.
(2)No built in a zero cross circuit.
(3)When the mode changed(BYPASS/TONE),it is necessary the muting function.

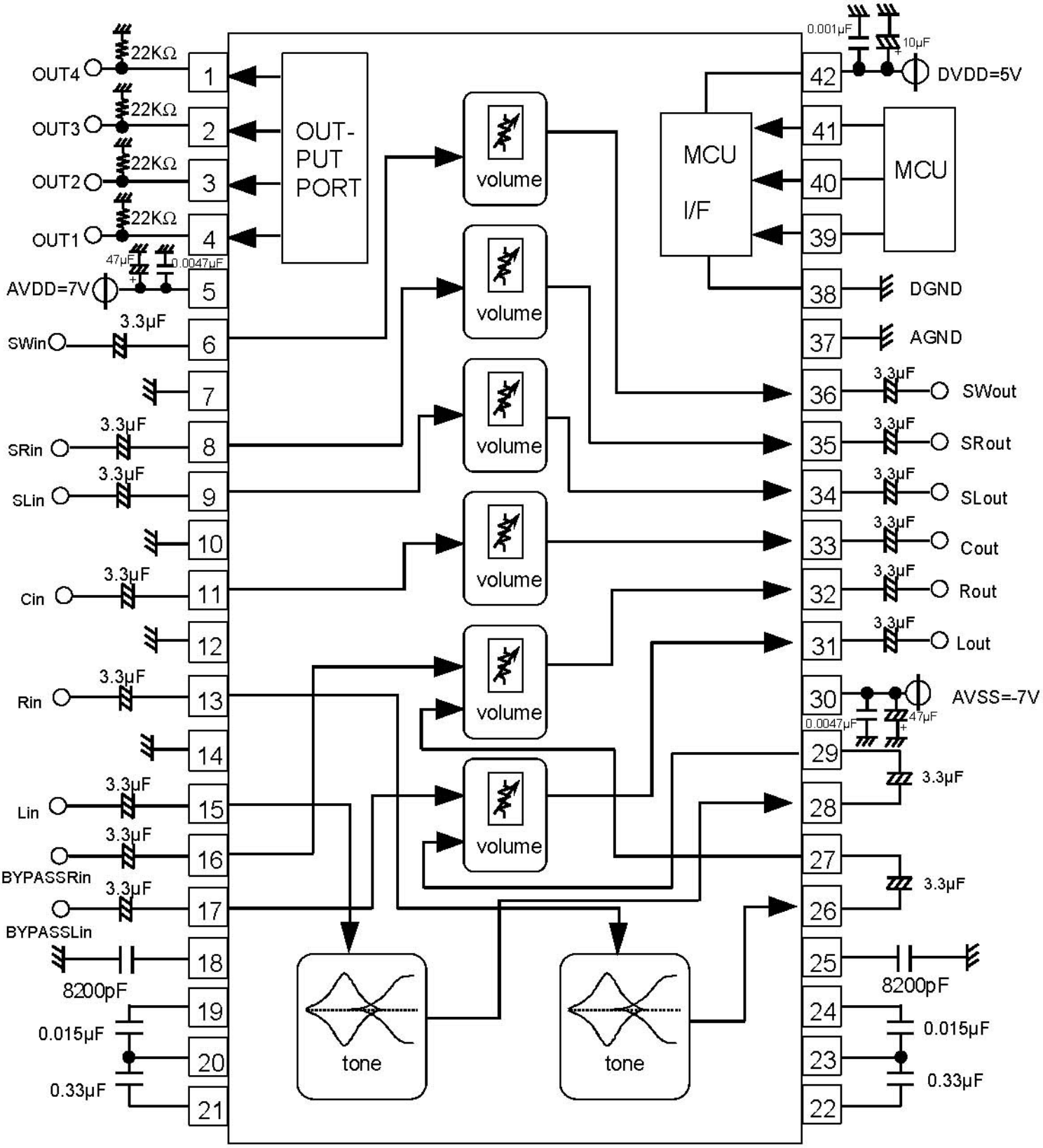


INPUT : Schmitt trigger type



APPLICATION EXAMPLE

(When using Tone control and Bypass)

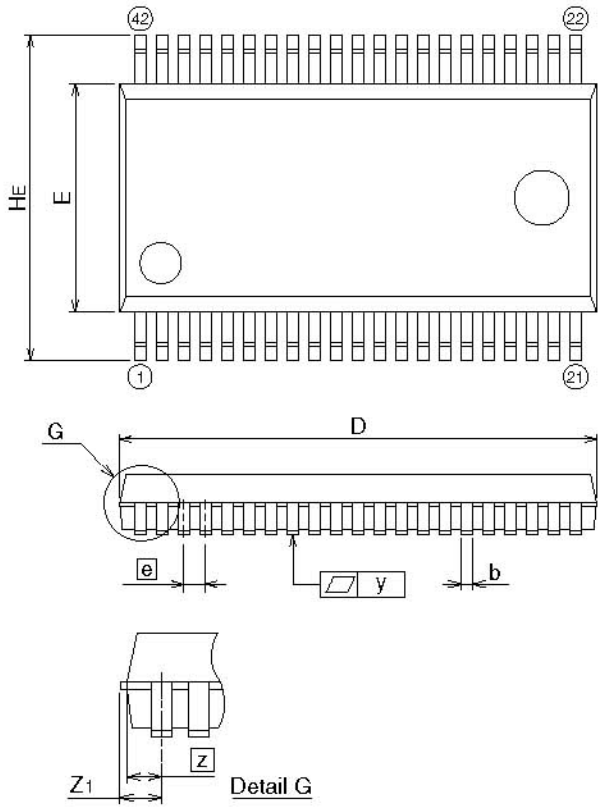


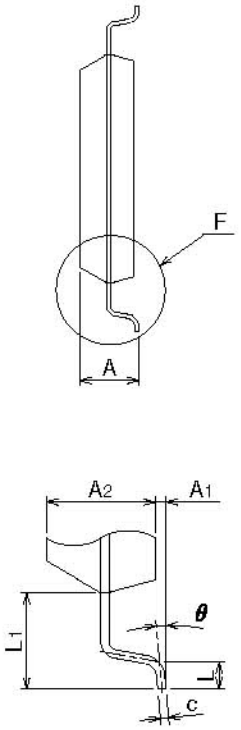
DETAILED DIAGRAM OF PACKAGE OUTLINE

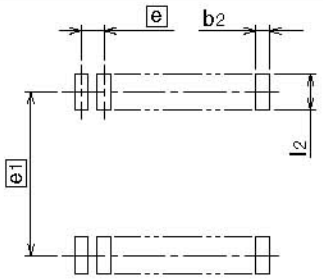
42P2R-A (MMP)

Plastic 42pin 450mil SSOP

EIAJ Package Code	JEDEC Code	Weight(g)	Lead Material
SSOP42-P-450-0.80	–	0.63	Alloy 42/Cu Alloy







Recommended Mount Pad

Symbol	Dimension in Millimeters		
	Min	Nom	Max
A	–	–	2.4
A_1	0.05	–	–
A_2	–	2.0	–
b	0.35	0.4	0.5
c	0.13	0.15	0.2
D	17.3	17.5	17.7
E	8.2	8.4	8.6
e	–	0.8	–
H_E	11.63	11.93	12.23
L	0.3	0.5	0.7
L_1	–	1.765	–
z	–	0.75	–
Z_1	–	–	0.9
y	–	–	0.15
θ	0	–	10
b_2	–	0.5	–
e1	–	11.43	–
l_2	1.27	–	–

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