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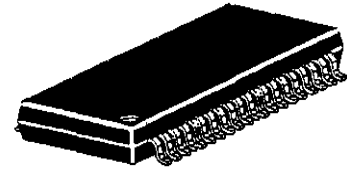
Outline 42P2R-A
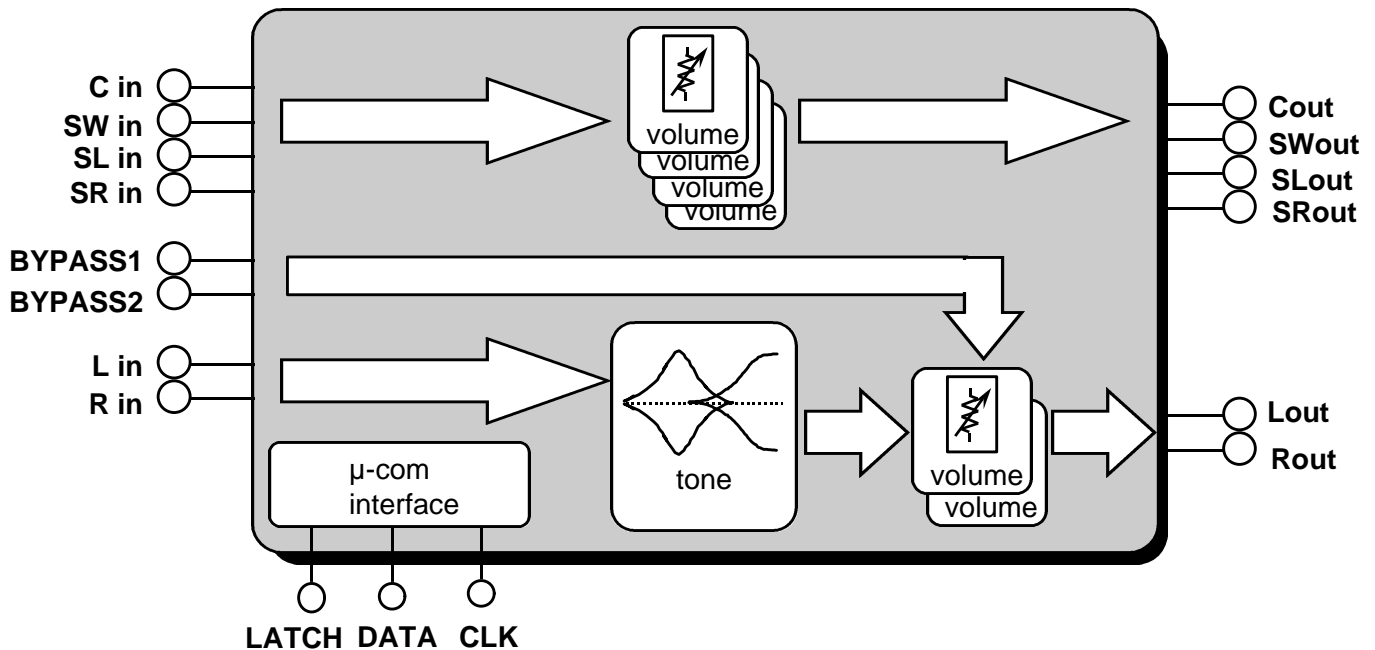0.8mm pitch 450mil ssop
(8.4mm×17.5mm×2.0mm)
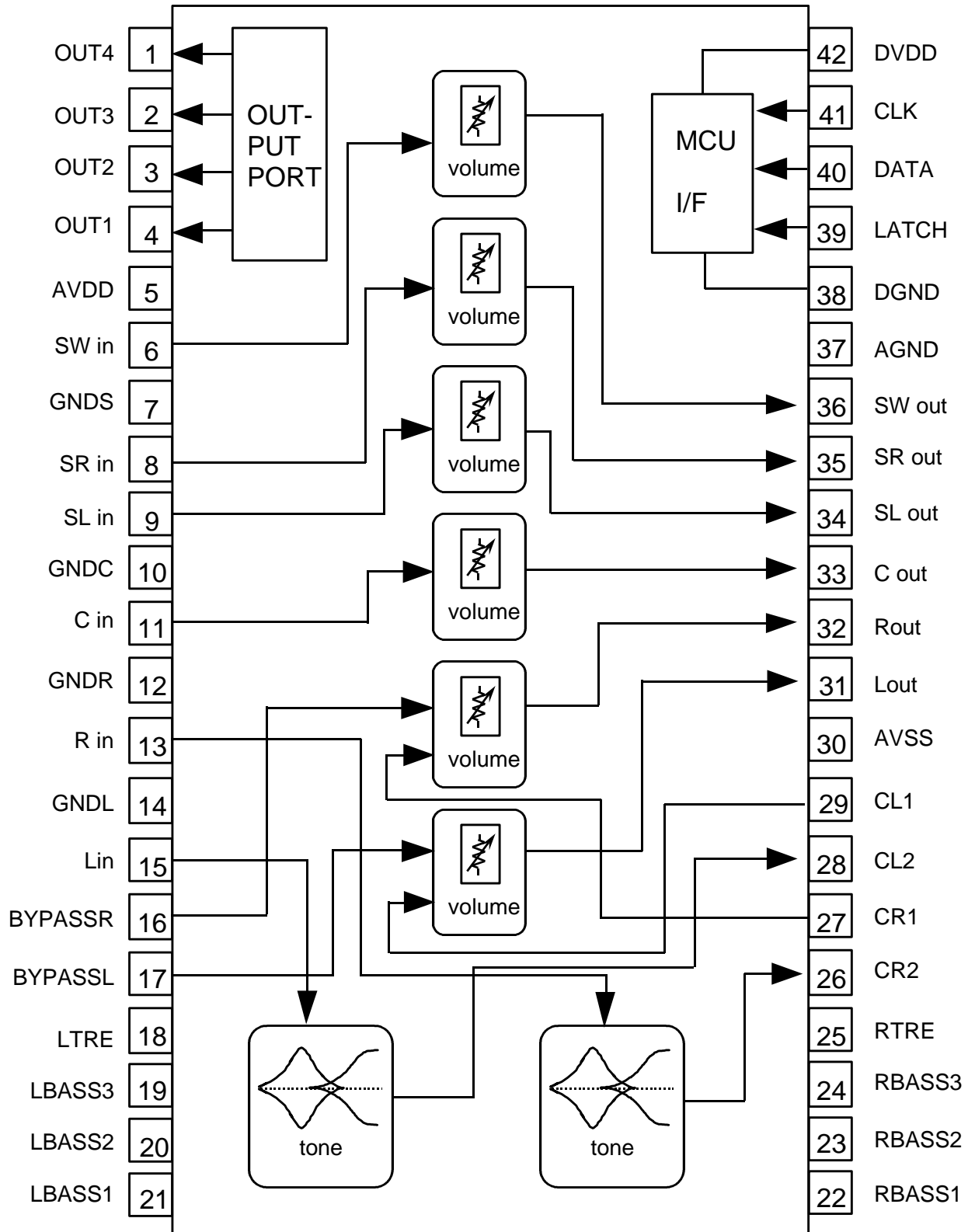
APPLICATION

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)
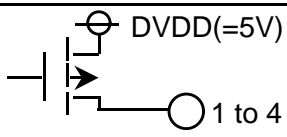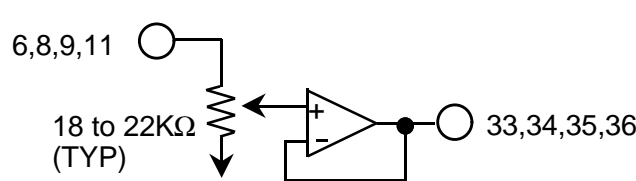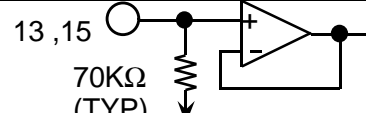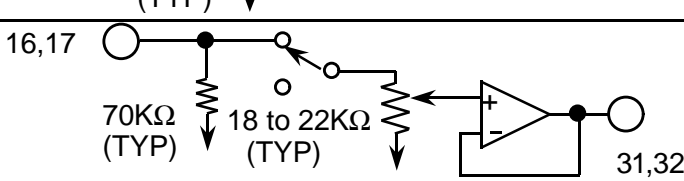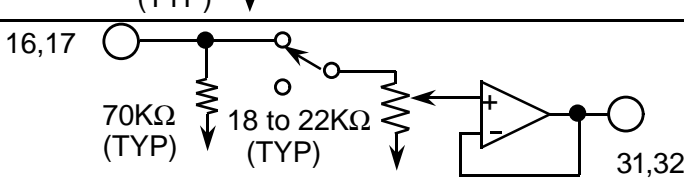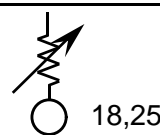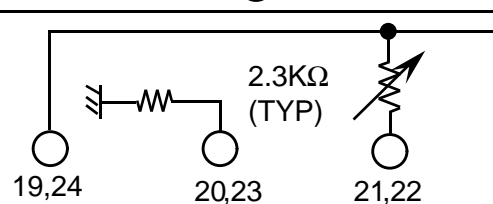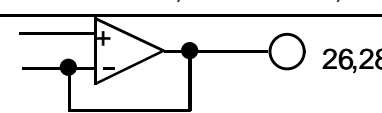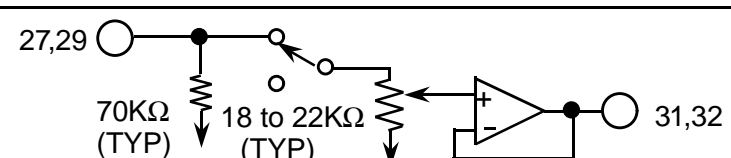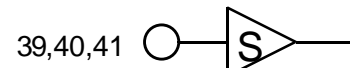
SYSTEM BLOCK DIAGRAM

MITSUBISHI ELECTRIC

PIN CONFIGURATION AND BLOCK DIAGRAM

Pin	Signal		Signal	Pin
1	OUT4		DVDD	42
2	OUT3		CLK	41
3	OUT2		DATA	40
4	OUT1		LATCH	39
5	AVDD		DGND	38
6	SW in		AGND	37
7	GNDS		SW out	36
8	SR in		SR out	35
9	SL in		SL out	34
10	GNDC		C out	33
11	C in		Rout	32
12	GNDR		Lout	31
13	R in		AVSS	30
14	GNDL		CL1	29
15	Lin		CL2	28
16	BYPASSR		CR1	27
17	BYPASSL		CR2	26
18	LTRE		RTRE	25
19	LBASS3		RBASS3	24
20	LBASS2		RBASS2	23
21	LBASS1		RBASS1	22

Blocks: OUT-PUT PORT, volume (×6), MCU I/F, tone (×2)

6CH ELECTRONIC VOLUME WITH TONE CONTROL

PIN DESCLIPTION

Pin No.	Symbol	Function	Circuit
1	OUT4	Port OUTPUT	OUTPUT:PMOS Transistor open drain — DVDD(=5V), 1 to 4
2	OUT3		
3	OUT2		
4	OUT1		
5	AVDD	Analog positive Power supply	+7V
7	GNDS	GND	Connect to analog GND
10	GNDC		
12	GNDR		
14	GNDL		
6	SW in	Volume INPUT	6,8,9,11 ; 18 to 22KΩ (TYP) ; 33,34,35,36
8	SR in		
9	SL in		
11	C in		
36	SW out	Volume OUTPUT	
35	SR out		
34	SL out		
33	C out		
13	R in	Tone INPUT	13 ,15 ; 70KΩ (TYP)
15	L in		
16	BYPASSR	L,R Volume INPUT in BYPASS mode	16,17 ; 70KΩ (TYP) ; 18 to 22KΩ (TYP) ; 31,32
17	BYPASSL		
31	Lout	L OUTPUT	
32	Rout	R OUTPUT	
18	LTRE	tone Treble cycle control	18,25
25	RTRE		
19	LBASS3	tone Bass cycle control	2.3KΩ (TYP) ; 19,24 ; 20,23 ; 21,22
24	RBASS3		
20	LBASS2		
23	RBASS2		
21	LBASS1		
26	RBASS1		
22	CR2	Tone OUTPUT	26,28
28	CL2		
27	CR1	L,R Volume INPUT	27,29 ; 70KΩ (TYP) ; 18 to 22KΩ (TYP) ; 31,32
29	CL1		
31	Lout	L OUTPUT	
32	Rout	R OUTPUT	
30	AVSS	Analog negative Power Supply	- 7V
37	AGND	Analog GND	
38	DGND	Digital GND	
39	LATCH	Latch INPUT	39,40,41 — S ; **INPUT : schmitt trigger type**
40	DATA	Data INPUT	
41	CLK	Clock INPUT Forward data	
42	DVDD	Digital Power supply	+5V

6CH ELECTRONIC VOLUME WITH TONE CONTROL

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)

POWER DISSIPATION Pd [W] (vertical axis)

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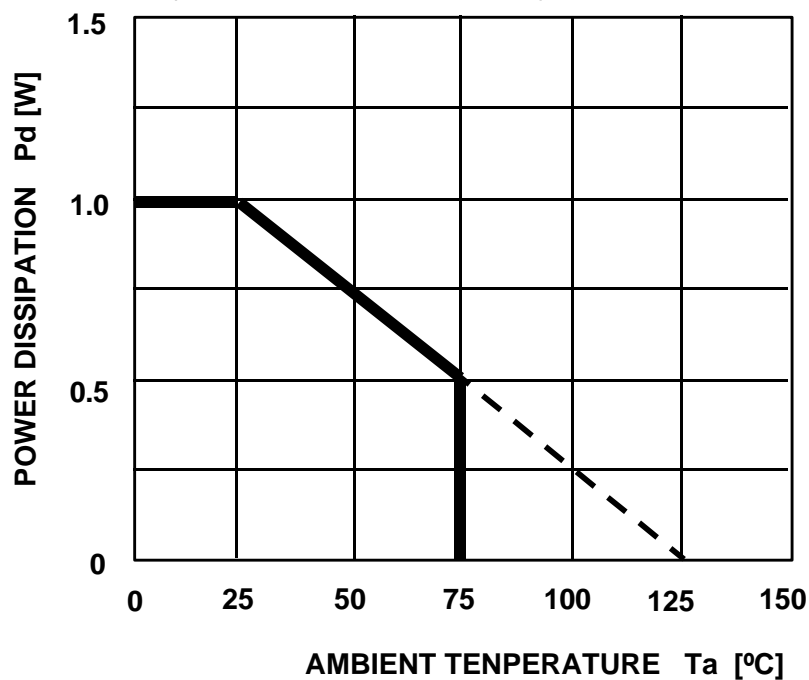
*Standard board
- board size   70mm X 70mm
- board thickness   1.6mm
- board material   glass epoxy
- copper pattern
  copper thickness   18μm
  copper size   0.25mm(wide) 30mm(length/lead)

**MITSUBISHI
ELECTRIC**

4

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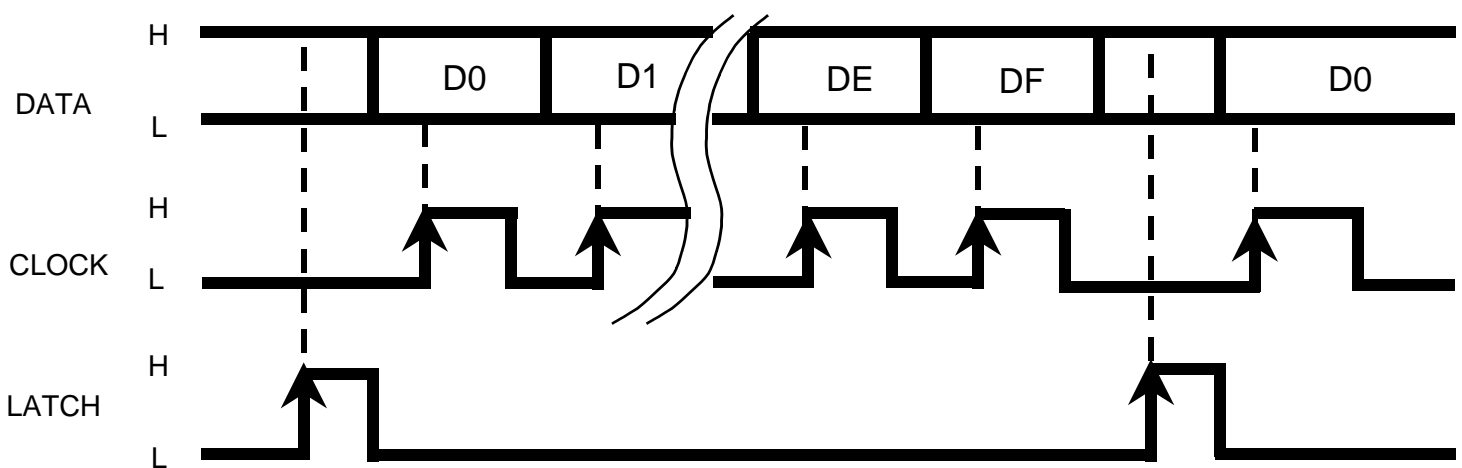
note : CLOCK and LATCH function at raising edges of pulse .

MITSUBISHI ELECTRIC

DATA TIMING(Recommended conditions)
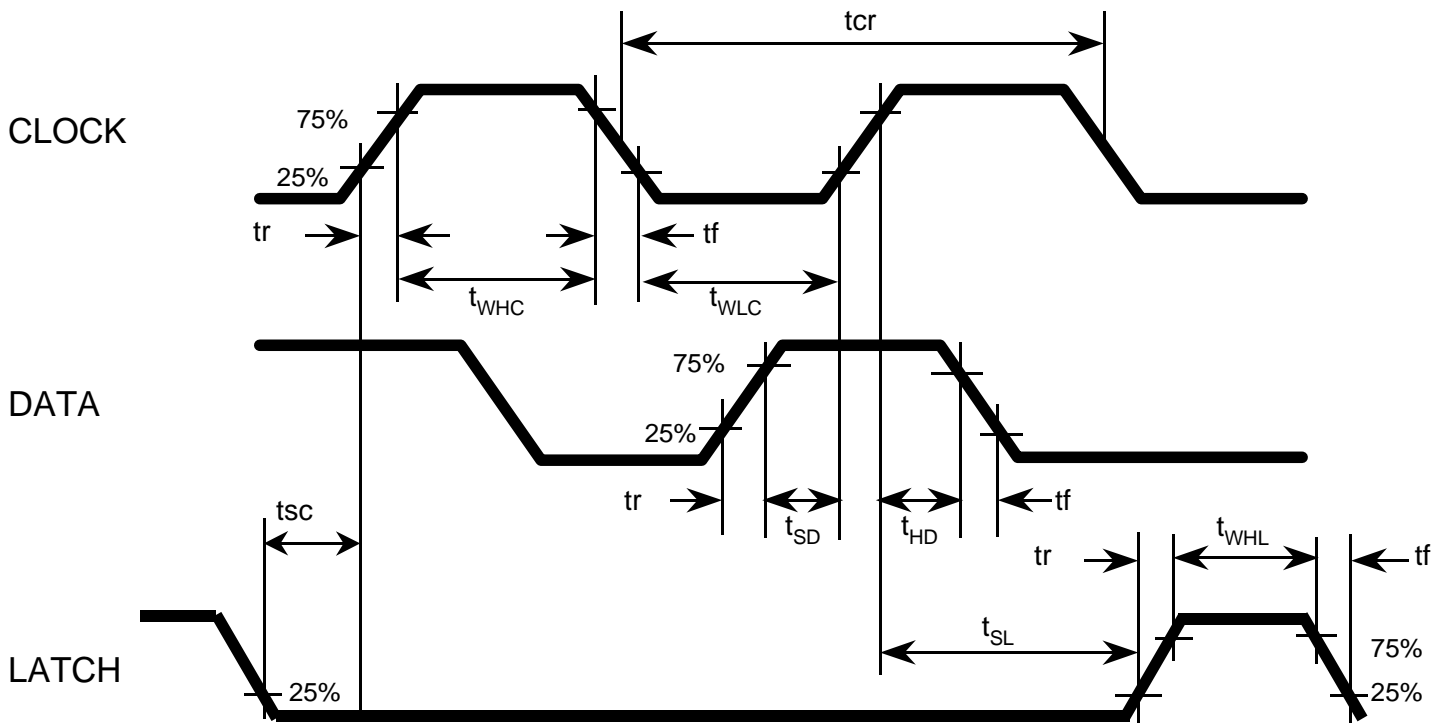
DIGITAL BLOCK TIMING REGULATION

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.

MITSUBISHI ELECTRIC

(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 D7X	D1X D8X	D2X D9X	D3X DAX	D4X DBX	D5X DCX	D6X 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

6CH ELECTRONIC VOLUME WITH TONE CONTROL

ELECTRICAL CHARACTERISTICS

(Ta=25ºC, 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	6,8,9,11,13,15,16,17pinINPUT 31 to 36pinOUTPUT THD=1%	3.0	4.2	—	Vrms
Pass gain	Gv	Vi=0.2Vrms,FLAT ,8,9,11,13,15,16,17pinINPUT 31 to 36pinOUTPUT	-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

6CH ELECTRONIC VOLUME WITH TONE CONTROL

(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)	12	14	16	dB
	* T +12dB		10	12	14	dB
	T +10dB		8	10	12	dB
	T +8dB	Voltage gain (Input to pin13,15 Output from pin31,32)	6	8	10	dB
	T +6dB		4.5	6	7.5	dB
	T +4dB	INPUT 13,15pin OUTPUT 31,32pin	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

MITSUBISHI ELECTRIC
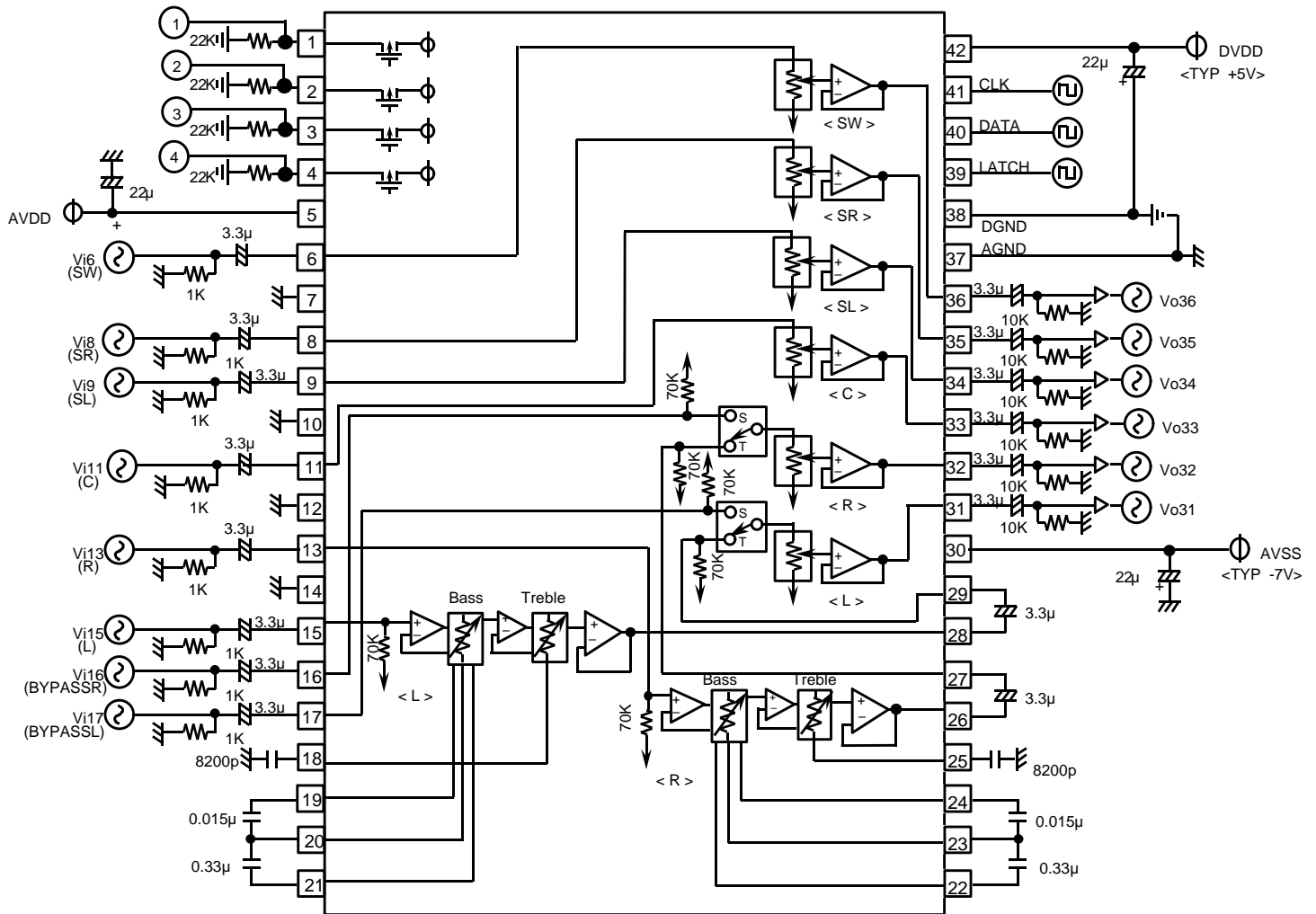
SIGNAL PROCESSING DIAGRAM

BYPASS

3.3μF

TONE in

3.3μF   70K

TONE CONTROL
(+14dB to -14dB)

BASS   TLEBLE

0.015μF   0.33μF

8200pF

70KΩ

VOLUME Lch,Rch(0dB to −∞dB)

3.3μF   70KΩ

3.3μF

VOLUME in

3.3μF

VOLUME Cch,SWch,SLch,SRch (0dB to −∞dB)

3.3μF
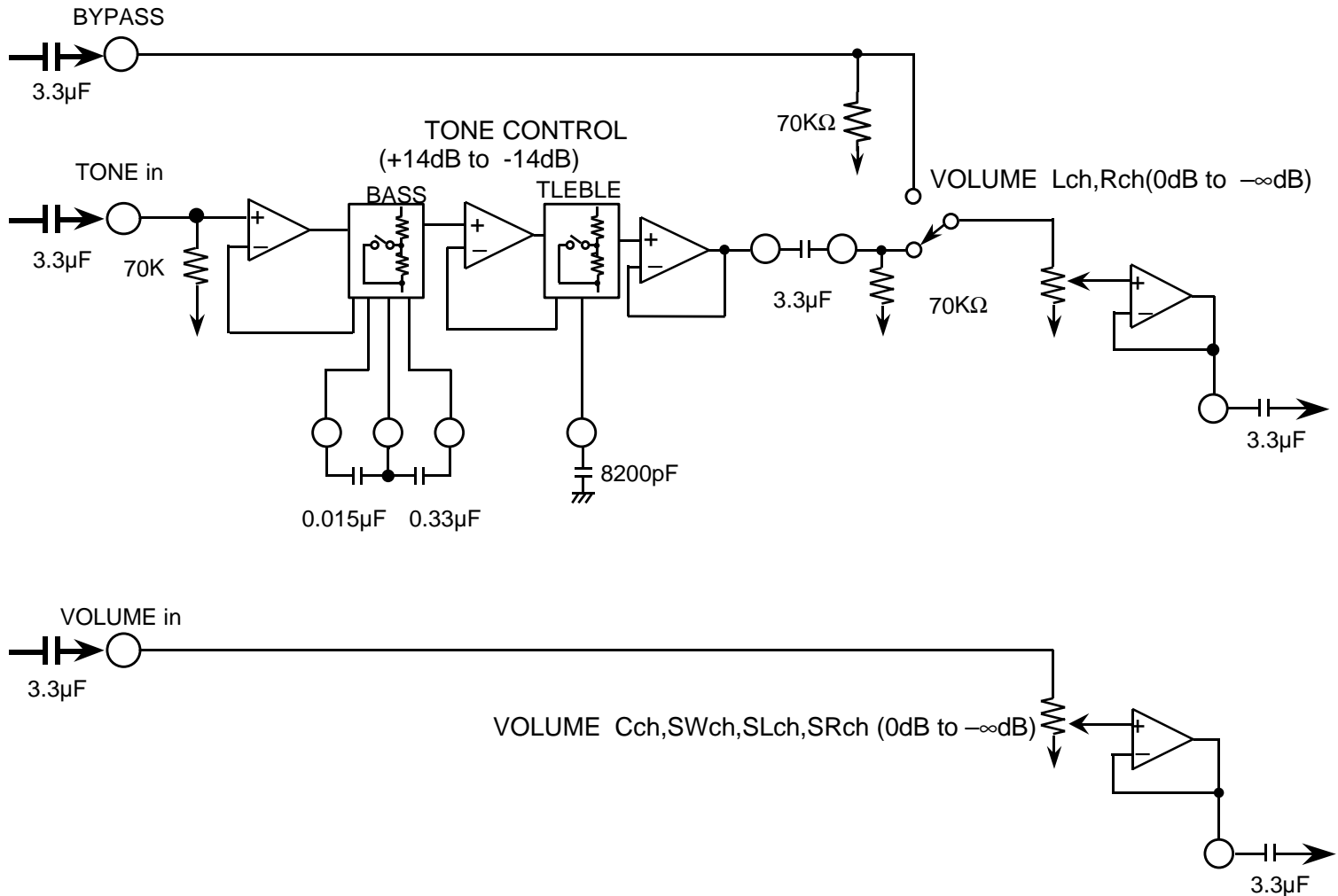
Note.(1)The resistance value of Volume change about 18 to 22K by attenuated condition.
(2)No built in a zero cross circuit.
(3)When the mode changed(BYPASS/TONE),it is necessary the muting function.

CLK,DATA,LATCH

S

INPUT : Schmitt trigger type

DVDD(=5V)

OUTPUT PORT
OUTPUT port:PMOS transistor
open drain
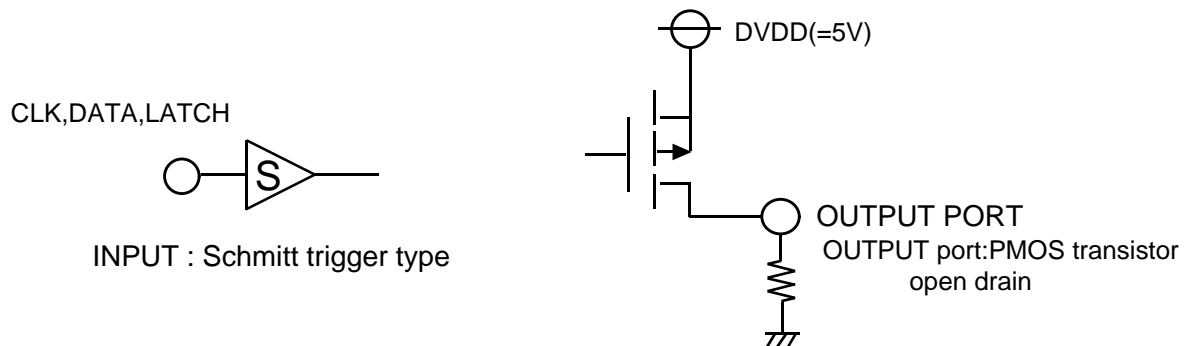
APPLICATION EXAMPLE

(When using Tone control and Bypass)
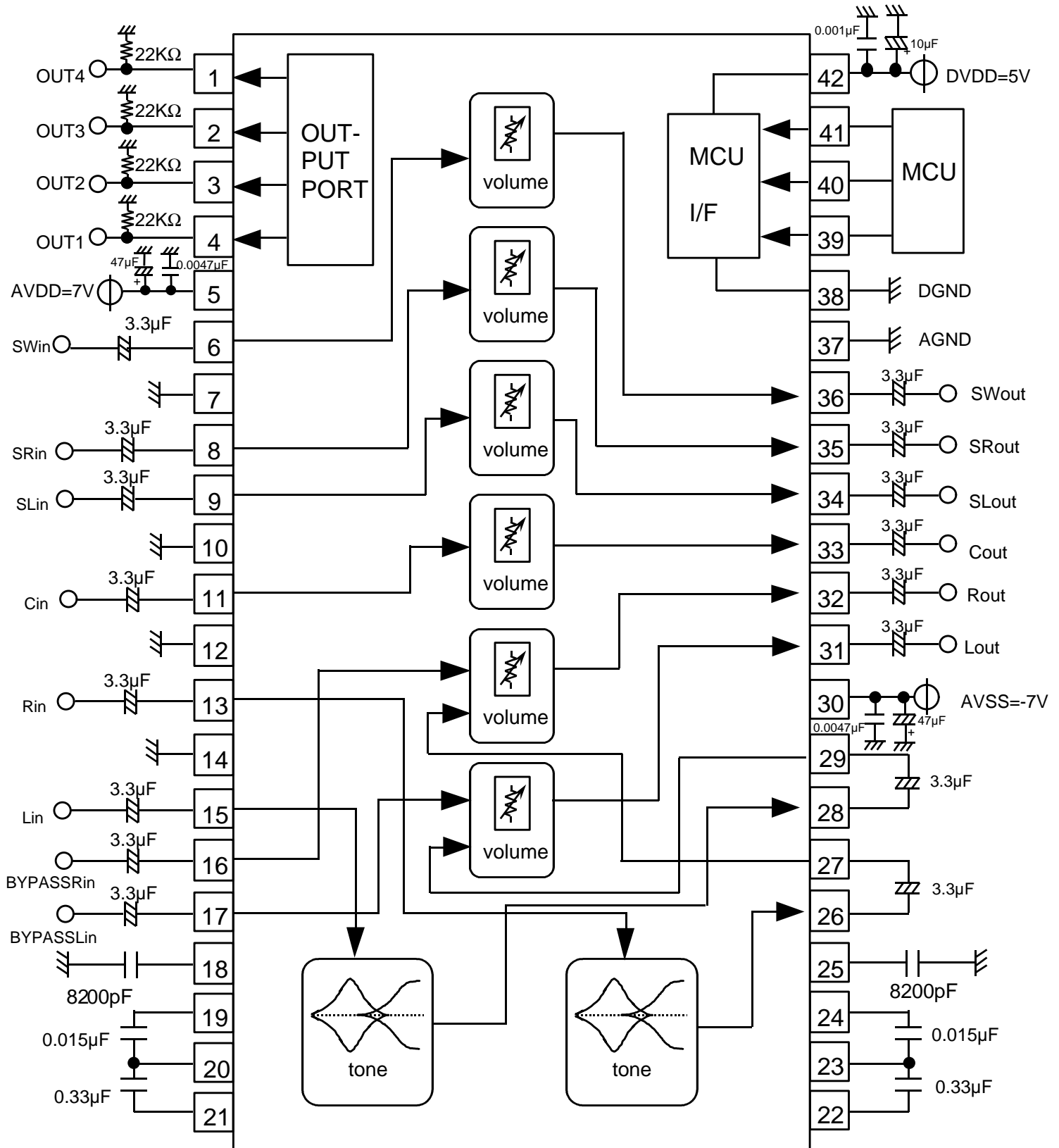
DETAILED DIAGRAM OF PACKAGE OUTLINE

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
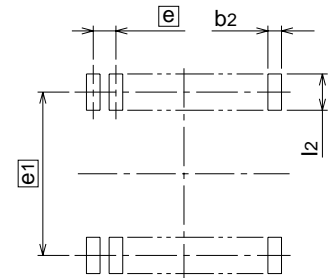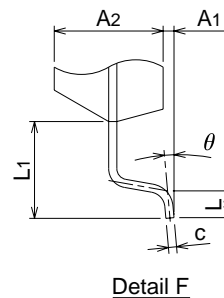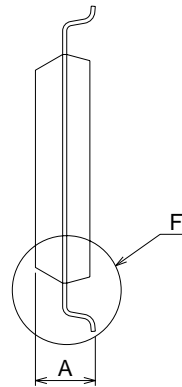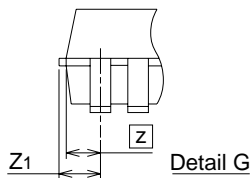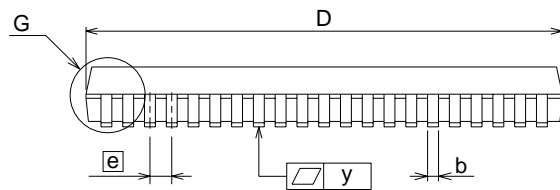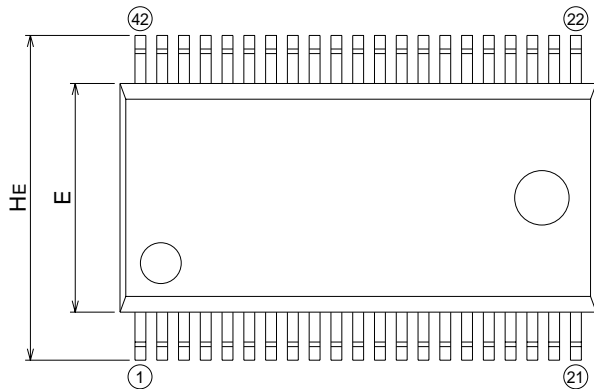
Recommended Mount Pad

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
$\boxed{e}$	–	0.8	–
H_E	11.63	11.93	12.23
L	0.3	0.5	0.7
L_1	–	1.765	–
$\boxed{z}$	–	0.75	–
Z_1	–	–	0.9
y	–	–	0.15
θ	0°	–	10°
b_2	–	0.5	–
$\boxed{e1}$	–	11.43	–
l_2	1.27	–	–

Detail G

Detail F

MITSUBISHI ELECTRIC