

PRELIMINARY
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 some parametric limits are subject to change.

MITSUBISHI SOUND PROCESSORS

M62444FP

4CH ELECTRIC VOLUME WITH TRIMMER

DESCRIPTION

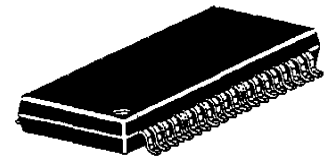
The M62444FP is 4 channels electric volume with trimmer controlled 3-wire serial data.

The IC is suitable for use in home-use audio systems and TV sets.

FEATURES

- Electric volume(Master volume)
 - Volume level 0dB to -80dB, -∞dB (32steps)
- Electric volume(trimmer volume)
 - Volume level 0dB to -24dB (1dB/step)
- 2 channels bass boost(loudness type)
- 6 Output ports
- Built-in microcomputer interface circuit controlled by 8-bit serial data.

PACKAGE



Outline

42P2R

APPLICATION

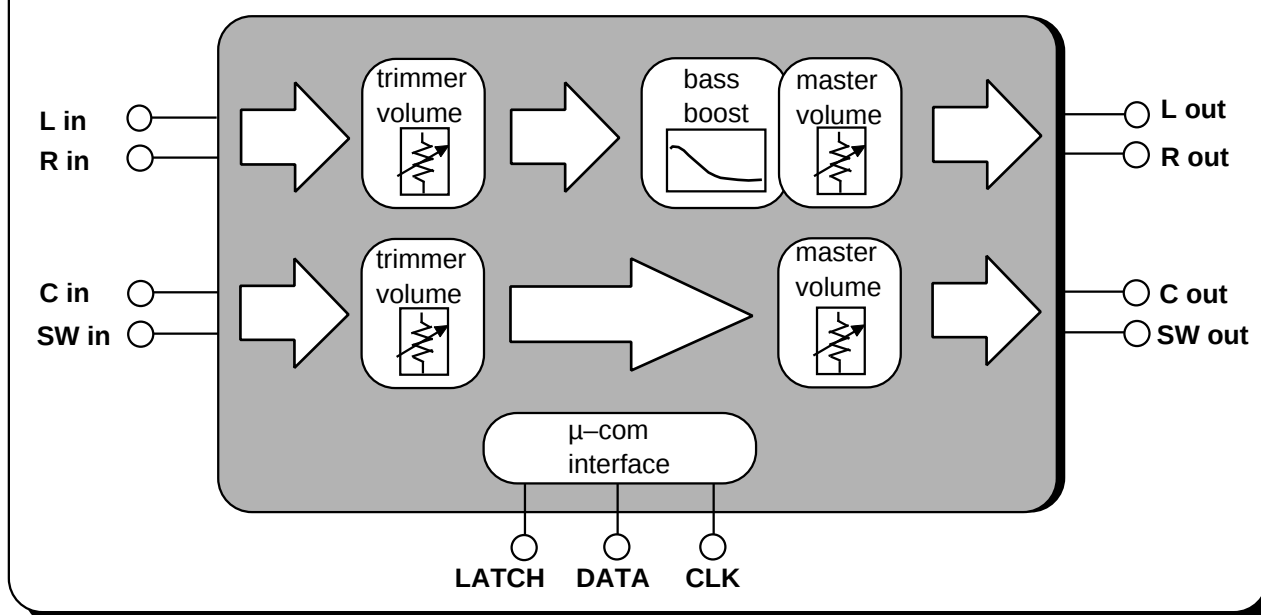
DVD, Home Audio equipment, TV

RECOMMENDED OPERATING CONDITIONS

Supply voltage range ±4.5 to ±7.3V (analog)
 4.5 to 5.5V (digital)

Rated supply voltage ±7.0V (analog)
 5.0V (digital)

SYSTEM BLOCK DIAGRAM



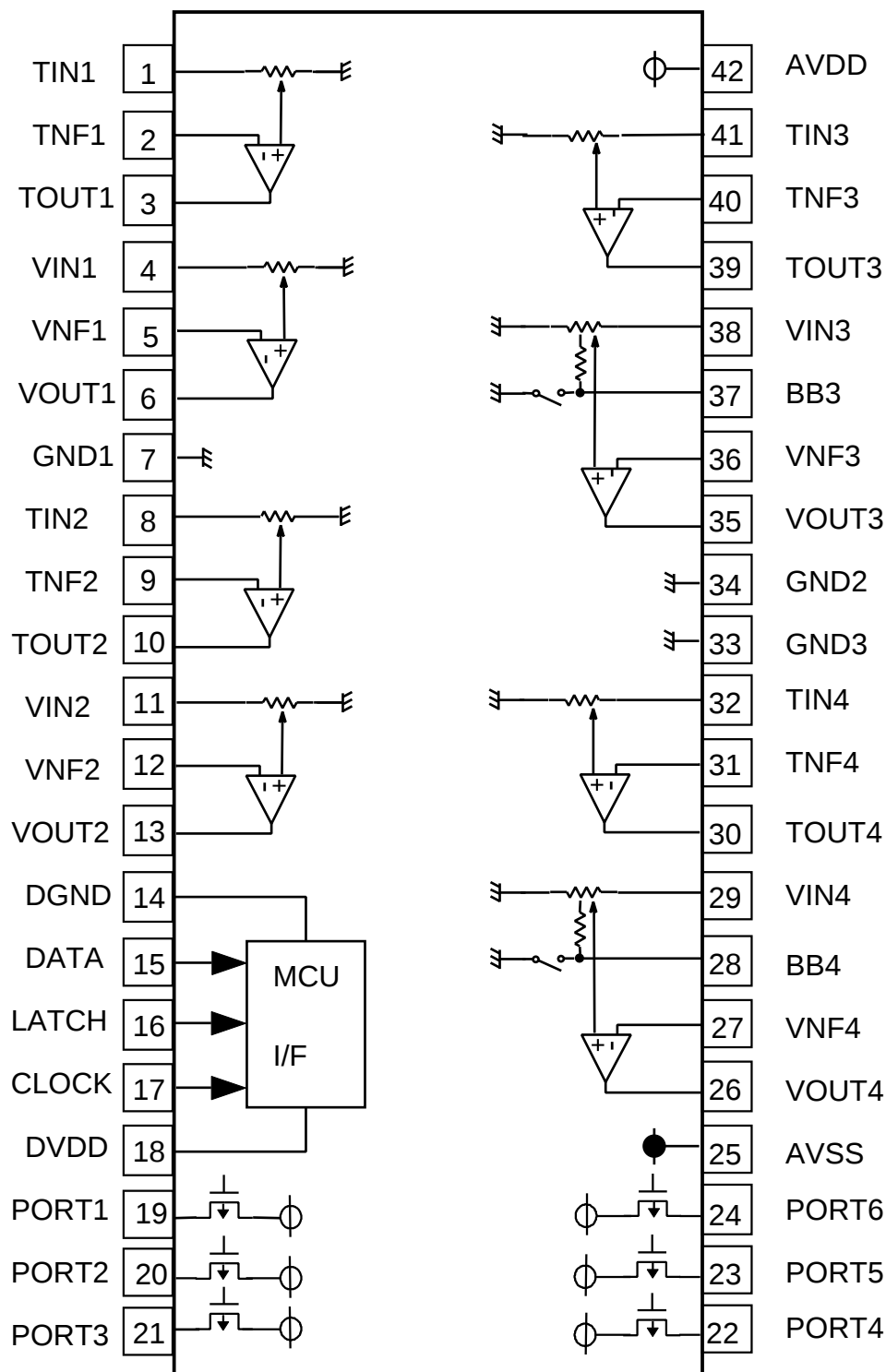
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PIN CONFIGURATION AND IC INTERNAL BLOCK DIAGRAM



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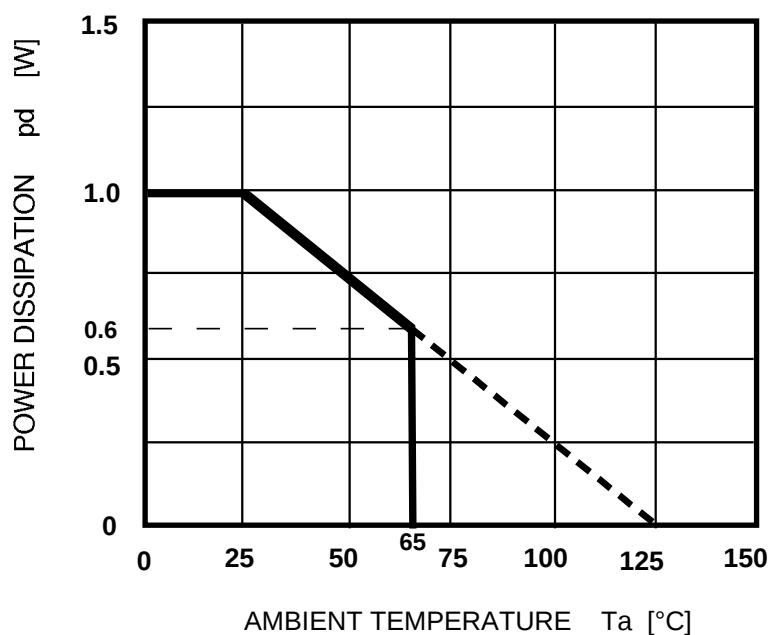
M62444FP

4CH ELECTRIC VOLUME WITH TRIMMER

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Conditions	Ratings	Unit
Vsupply	Supply Voltage	AVDD-AVSS	16	V
Pd	Power dissipation	Ta ≤ 25°C	1000	mW
kθ	Thermal derating	Ta > 25°C	10	mW/ °C
Topr	Operating temperature		-20 to +65	°C
Tstg	Storage temperature		-40 to ±125	°C

THERMAL DERATING
(MAXIMUM RATING)



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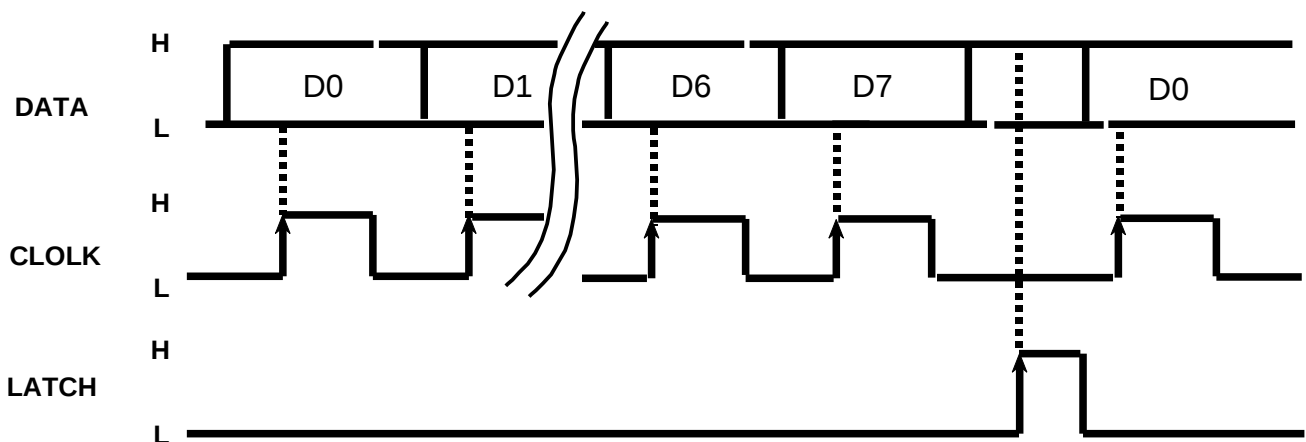
RECOMMENDED OPERATING CONDITION

(Ta=25°C, unless otherwise noted)

Parameter	Symbol	Condition	MIN	TYP	MAX	Unit
Positive supply voltage	AVDD		4.5	7.0	7.3	V
	DVDD		4.5	5.0	5.5	
Negative supply voltage	AVSS		-7.3	-7.0	-4.5	V
High-level Input Voltage	VIH		(DVDD/2)+1	—	DVDD	V
Low-level Input Voltage	VIL		DGND	—	(DVDD/2)-1	V
Output port maximum current	IOH	"H" level	—	—	3	mA

(note) $AVSS \leq DGND < DVDD \leq AVDD$

DATA TIMING (Recommended conditions)



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

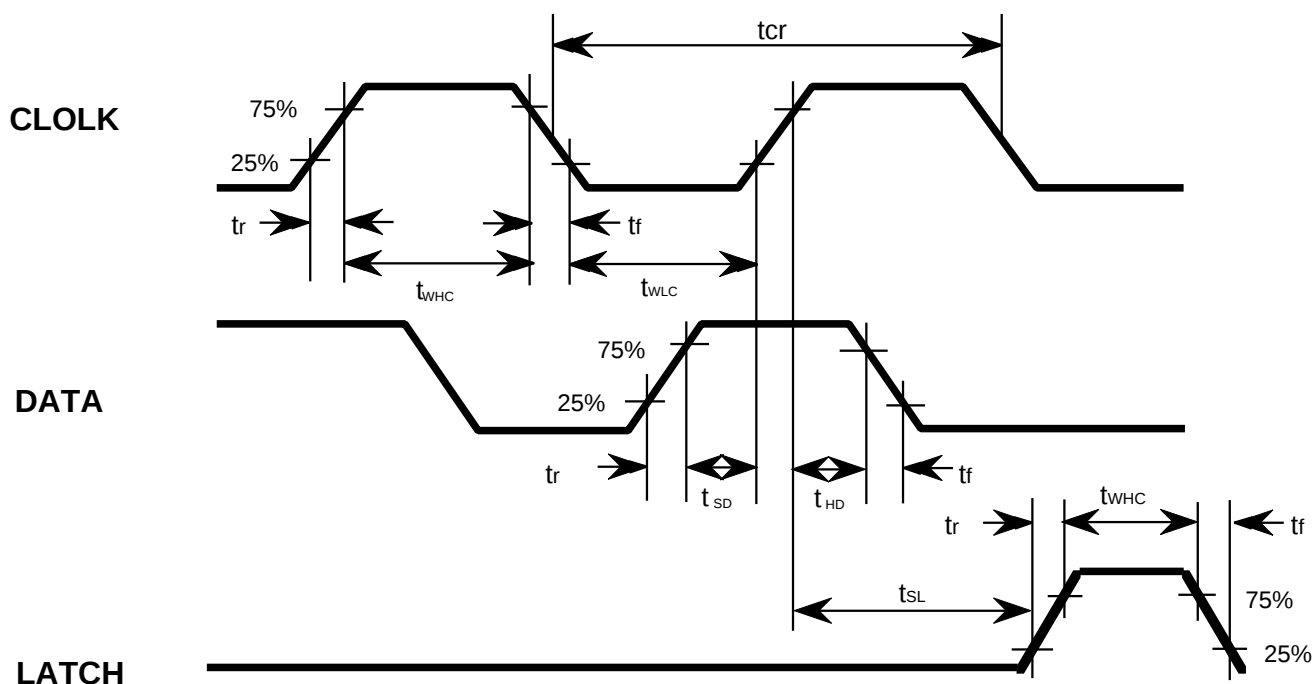
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4CH ELECTRIC VOLUME WITH TRIMMER

CLOCK, DATA, LATCH TIMING



DIGITAL BLOCK TIMING REGULATION

Symbol	Parameter	Limits			Unit
		Min	typ	Max	
t_{cr}	CLOCK cycle time	8	—	—	μs
t_{WHC}	CLOCK pulse width ("H"level)	3.2	—	—	
t_{WLC}	CLOCK pulse width ("L"level)	3.2	—	—	
t_r	CLOCK, DATA, LATCH rise time	—	—	0.8	
t_f	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	—	—	

DIGITAL CONTROL SPECIFICATION

Fore kinds of input format options are available by changing slot settings of D6 and D7.
 (When the IC is powered up , the internal settings are not fixed.)

(1)	D01	D11	D21	D31	D41	D51	D61	D71
	TRIMMER VOLUME 1					0	0	0
(2)	D02	D12	D22	D32	D42	D52	D62	D72
	TRIMMER VOLUME 2					1	0	0
(3)	D03	D13	D23	D33	D43	D53	D63	D73
	TRIMMER VOLUME 3					0	0	1
(4)	D04	D14	D24	D34	D44	D54	D64	D74
	TRIMMER VOLUME 4					1	0	1
(5)	D05	D15	D25	D35	D45	D55	D65	D75
	MASTER VOLUME					BASS BOOST (LOUDNESS) 1 : ON 0 : OFF	1	0
(6)	D06	D16	D26	D36	D46	D56	D66	D76
	OUTPUT PORT 1 1 : H 0 : L	OUTPUT PORT 2 1 : H 0 : L	OUTPUT PORT 3 1 : H 0 : L	OUTPUT PORT 4 1 : H 0 : L	OUTPUT PORT 5 1 : H 0 : L	OUTPUT PORT 6 1 : H 0 : L	1	1

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4CH ELECTRIC VOLUME WITH TRIMMER

SETTING CODE

TRIMMER VOLUME 1 to 4

Note : Do not input other data
than the above.

ATT	D0X	D1X	D2X	D3X	D4X
- 0dB	0	0	0	0	0
- 1dB	1	0	0	0	0
- 2dB	0	1	0	0	0
- 3dB	1	1	0	0	0
- 4dB	0	0	1	0	0
- 5dB	1	0	1	0	0
- 6dB	0	1	1	0	0
- 7dB	1	1	1	0	0
- 8dB	0	0	0	1	0
- 9dB	1	0	0	1	0
- 10dB	0	1	0	1	0
- 11dB	1	1	0	1	0
- 12dB	0	0	1	1	0
- 13dB	1	0	1	1	0
- 14dB	0	1	1	1	0
- 15dB	1	1	1	1	0
- 16dB	0	0	0	0	1
- 17dB	1	0	0	0	1
- 18dB	0	1	0	0	1
- 19dB	1	1	0	0	1
- 20dB	0	0	1	0	1
- 21dB	1	0	1	0	1
- 22dB	0	1	1	0	1
- 23dB	1	1	1	0	1
- 24dB	0	0	0	1	1

MASTER VOLUME

Note : Do not input other data
than the above.

ATT	D05	D15	D25	D35	D45
- 0dB	0	0	0	0	0
- 2dB	1	0	0	0	0
- 4dB	0	1	0	0	0
- 6dB	1	1	0	0	0
- 8dB	0	0	1	0	0
- 10dB	1	0	1	0	0
- 12dB	0	1	1	0	0
- 14dB	1	1	1	0	0
- 16dB	0	0	0	1	0
- 18dB	1	0	0	1	0
- 20dB	0	1	0	1	0
- 22dB	1	1	0	1	0
- 24dB	0	0	1	1	0
- 26dB	1	0	1	1	0
- 28dB	0	1	1	1	0
- 30dB	1	1	1	1	0
- 32dB	0	0	0	0	1
- 34dB	1	0	0	0	1
- 36dB	0	1	0	0	1
- 38dB	1	1	0	0	1
- 40dB	0	0	1	0	1
- 44dB	1	0	1	0	1
- 48dB	0	1	1	0	1
- 52dB	1	1	1	0	1
- 56dB	0	0	0	1	1
- 60dB	1	0	0	1	1
- 64dB	0	1	0	1	1
- 68dB	1	1	0	1	1
- 72dB	0	0	1	1	1
- 76dB	1	0	1	1	1
- 80dB	0	1	1	1	1
- ∞	1	1	1	1	1

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ELECTRICAL CHARACTERISTICS

(Ta=25°C, AVDD=7.0V, AVSS=-7.0V, DVDD=5.0V, f=1kHz, TRIMMER/MASTER VOLUME=0dB, Post Amp.gain=0dB, unless otherwise noted.)

(1) Power supply characteristics

Parameter	Symbol	Test condition	Limits			Unit
			MIN	TYP	MAX	
Analog positive circuit current	A _{Idd}	AVDD=7.0V, AVSS= -7.0V Current at pin 42 No signal	—	30	40	mA
Analog negative circuit current	A _{Iss}	AVDD=7.0V, AVSS= -7.0V Current at pin 25 No signal	-40	-30	—	mA
Digital circuit current	D _{Idd}	DVDD= 5V Current at pin 18 No signal	—	0.1	1.0	mA

(2) Input / Output characteristics

Parameter	Symbol	Test condition	Limits			Unit
			MIN	TYP	MAX	
Maximum output voltage	V _{omax}	6,13,35,26pin OUTPUT RL=10KΩ, THD=1%	3.0	4.0	—	V _{rms}
Pass gain	G _v	V _{in} =1V _{rms} , FLAT, 1,8,41,32pin INPUT 6,13,35,26pin OUTPUT	-2.0	0	2.0	dB
Distortion	THD	6,13,35,26pin OUTPUT V _i =0.2V _{rms} , RL=10KΩ, BW=400 to 30kHz	—	0.003	0.05	%
Output noise voltage	V _{no0}	6,13,35,26pin OUTPUT No signal, JIS-A R _g =0Ω, VOL=0dB	—	3.0	15	μV _{rms}
	V _{no∞}	6,13,35,26pin OUTPUT No signal, JIS-A R _g =0Ω, VOL=-∞	—	2.5	7.5	μV _{rms}
Maximum attenuation	ATT _{max}	6,13,35,26pin OUTPUT JIS-A R _g =1kΩ, TRIMMER VOL=0dB	-86	-95	—	dB
Volume gain between channels	D _{VOL}	6,13,35,26pin OUTPUT	-1.5	0	1.5	dB
Crosstalk between channels	CT	V _o =0.5V _{rms} , RL=10KΩ, JIS-A R _g =1kΩ	—	-97	-60	dB
Bass boost gain	G _{vbb}	V _o =0.5V _{rms} , f=100Hz TRIMMER VOL=0dB, MASTER VOL=-26dB Bass boost=OFF  41,32pin INPUT 35,26pin OUTPUT	7	11	15	dB
OUTPUT PORT "H" current	I _{OH}	VOH=6.5V, AVDD=7V	1.0	—	—	mA
OUTPUT PORT "H" voltage	VOH	I _{OH} =3mA, AVDD=7V	5.5	—	—	V

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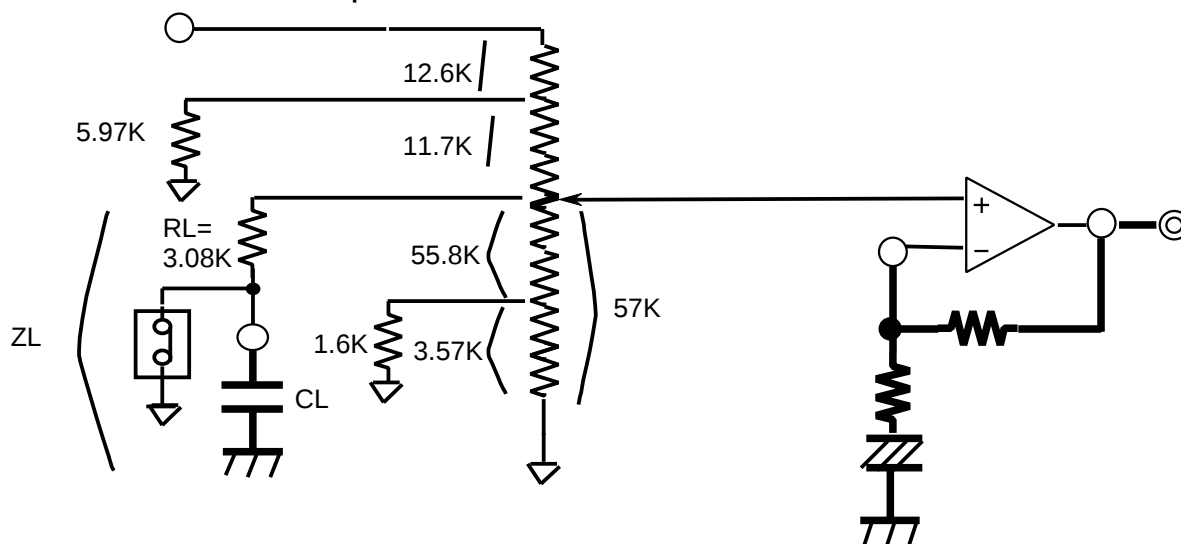
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FUNCTION DESCRIPTION

Bass Boost Equivalent Circuit



Bass Boost loudness Equivalent Circuit (Center Tup Type)

Regard " $RL + \frac{1}{wCL}$ " as "ZL"

Next formula show the frequency characteristic.

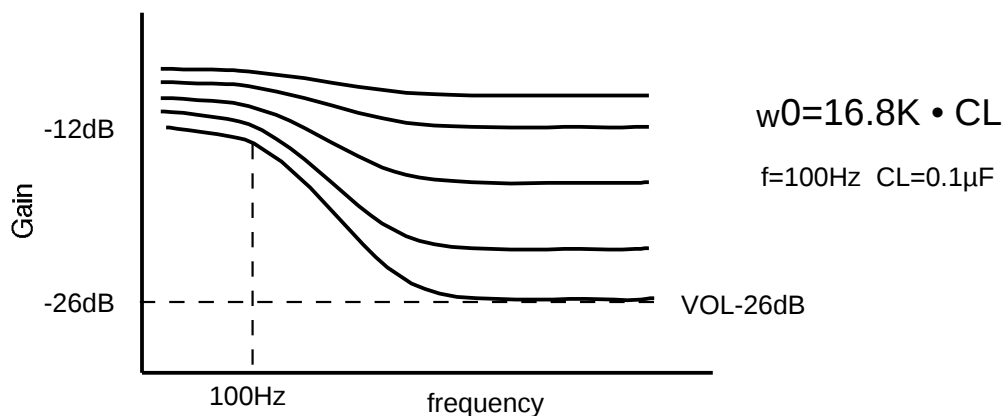
$$Gv = 20 \text{ Log} \left(\frac{ZL // 57K}{11.7K + ZL // 57K} \cdot \frac{5.97K // (11.7K + ZL // 57K)}{12.6K + 5.97K // (11.7K + ZL // 57K)} \right)$$

When a frequency is enough low ,

$$Gv = 20 \text{ Log} \left(\frac{57K}{11.7K + 57K} \cdot \frac{5.97K // (11.7K + 57K)}{12.6K + 5.97K // (11.7K + 57K)} \right) = -11.9\text{dB}$$

When a frequency is enough high ,

$$Gv = 20 \text{ Log} \left(\frac{3.08K // 57K}{11.7K + 3.08K // 57K} \cdot \frac{5.97K // (11.7K + 3.08K // 57K)}{12.6K + 5.97K // (11.7K + 3.08K // 57K)} \right) = -26\text{dB}$$



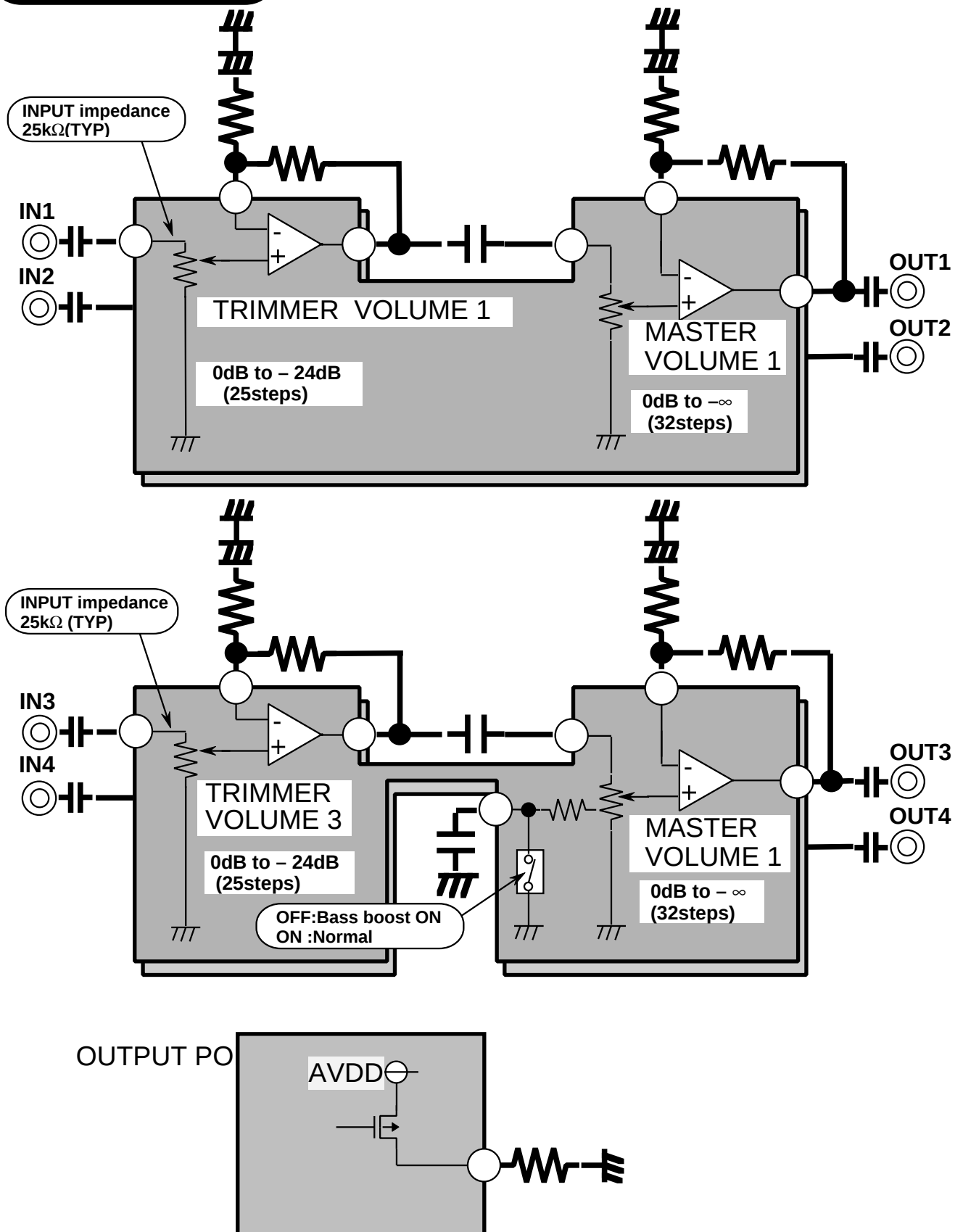
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SYSTEM DIAGRAM



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APPLICATION EXAMPLE

