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

MITSUBISHI SOUND PROCESSOR

M62445FP

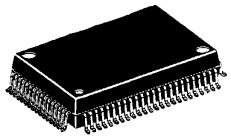
DIGITAL SOUND CONTROLLER WITH DYNAMIC BASS BOOST

DIGITAL SOUND CONTROLLER WITH DYNAMIC BASS BOOST

APPLICATION

Mini-Compo,Radio cassette etc.

OUTLINE



64P6N
64pinQFP
(Lead pitch0.8mm)

FEATURES

<Dynamic Bass Boost>
- Maximum boost level setting was adapted input level.
- Maximum boost level setting:20dB,15dB,10dB,5dB,0dB(OFF)

<Input Selector>
- Tch stereo input mode (A,B,C,D,E)

<Tone controlle>
- Bass/Treble(±10dB,8dB,6dB,4dB,2dB,flat)

<Gain controlle>
- Through gain controlle(22dB ~ 36dB;2dB/step)

<Function mode select>
- Monoral(L,R,L+R),Vocal cut

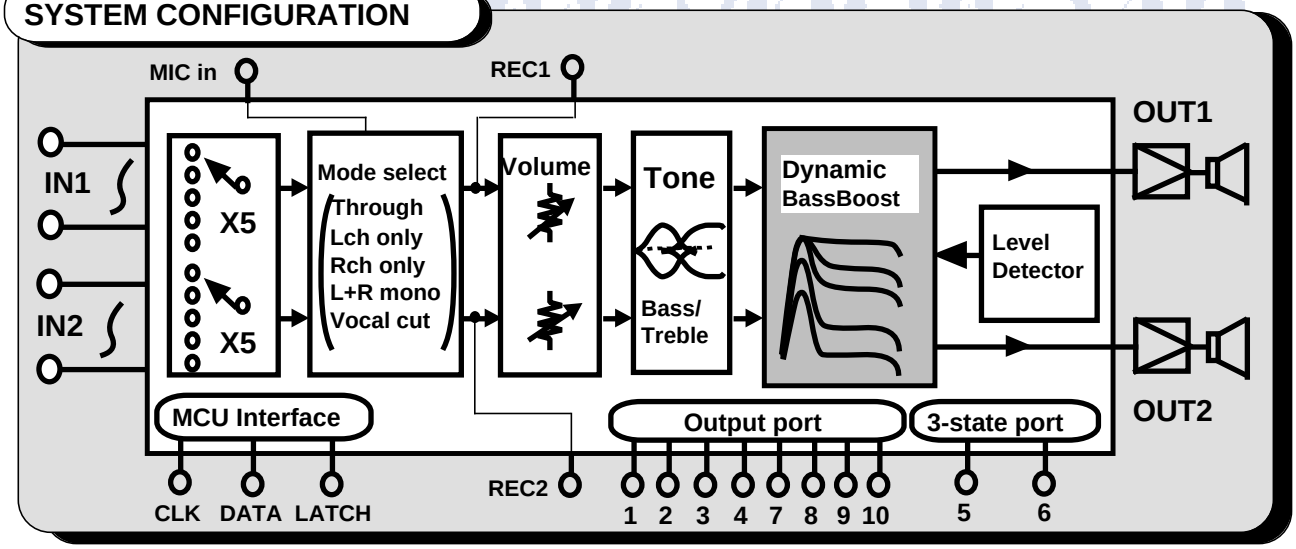
<Electric volume>
- 0dB ~ -87dB(1dB/Step), -∞

<Expansion output port>
- NPN open colector output (8pcs),3-state output (2pcs)

RECOMMENDED OPERATING CONDITIONS

Rated supply voltage••••••Analog VCC=4.75V/VEE=-4.75V(typ)
Digital VDD=4.75V(typ)

SYSTEM CONFIGURATION



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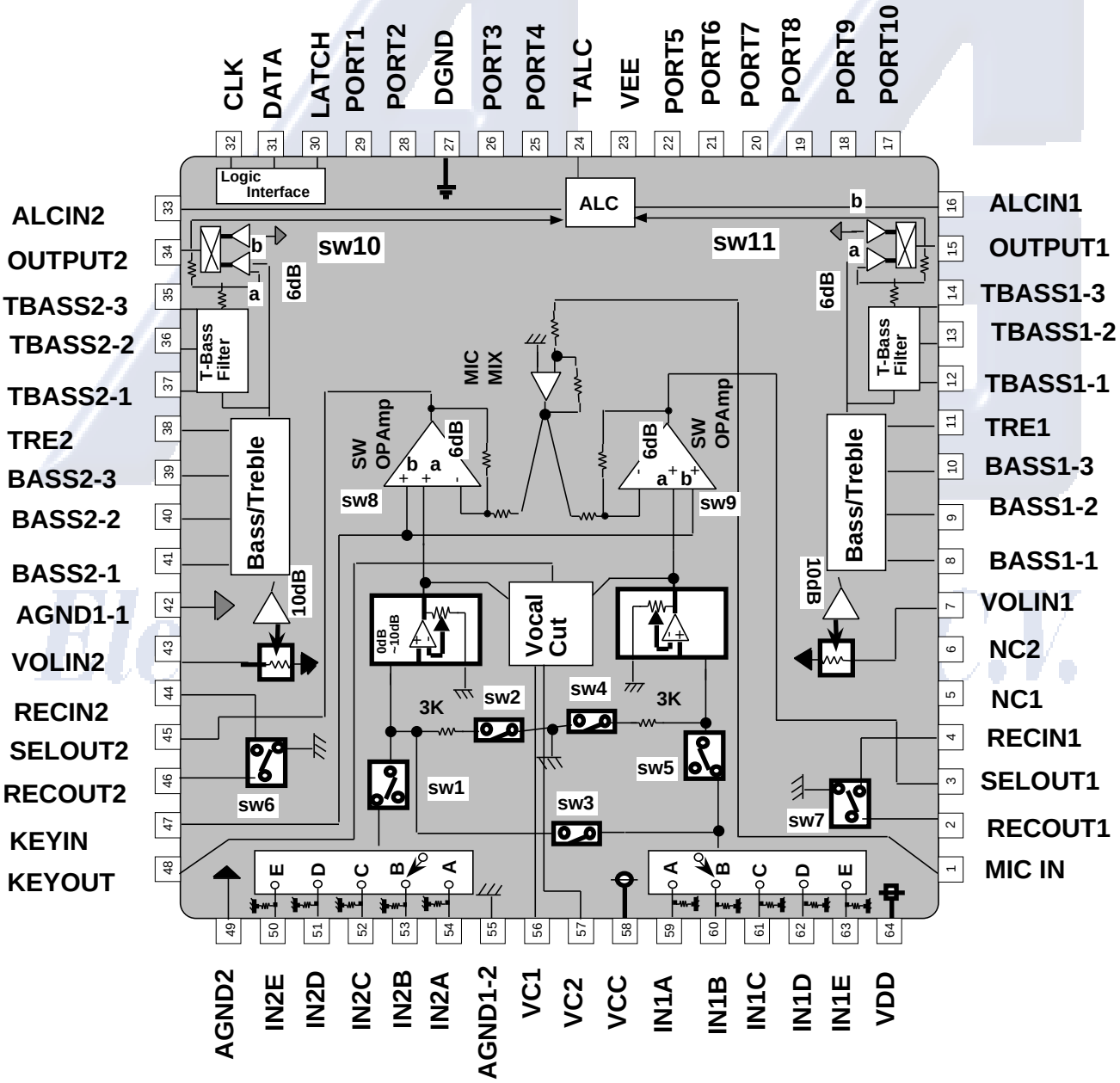
Block diagram/Pin configuration



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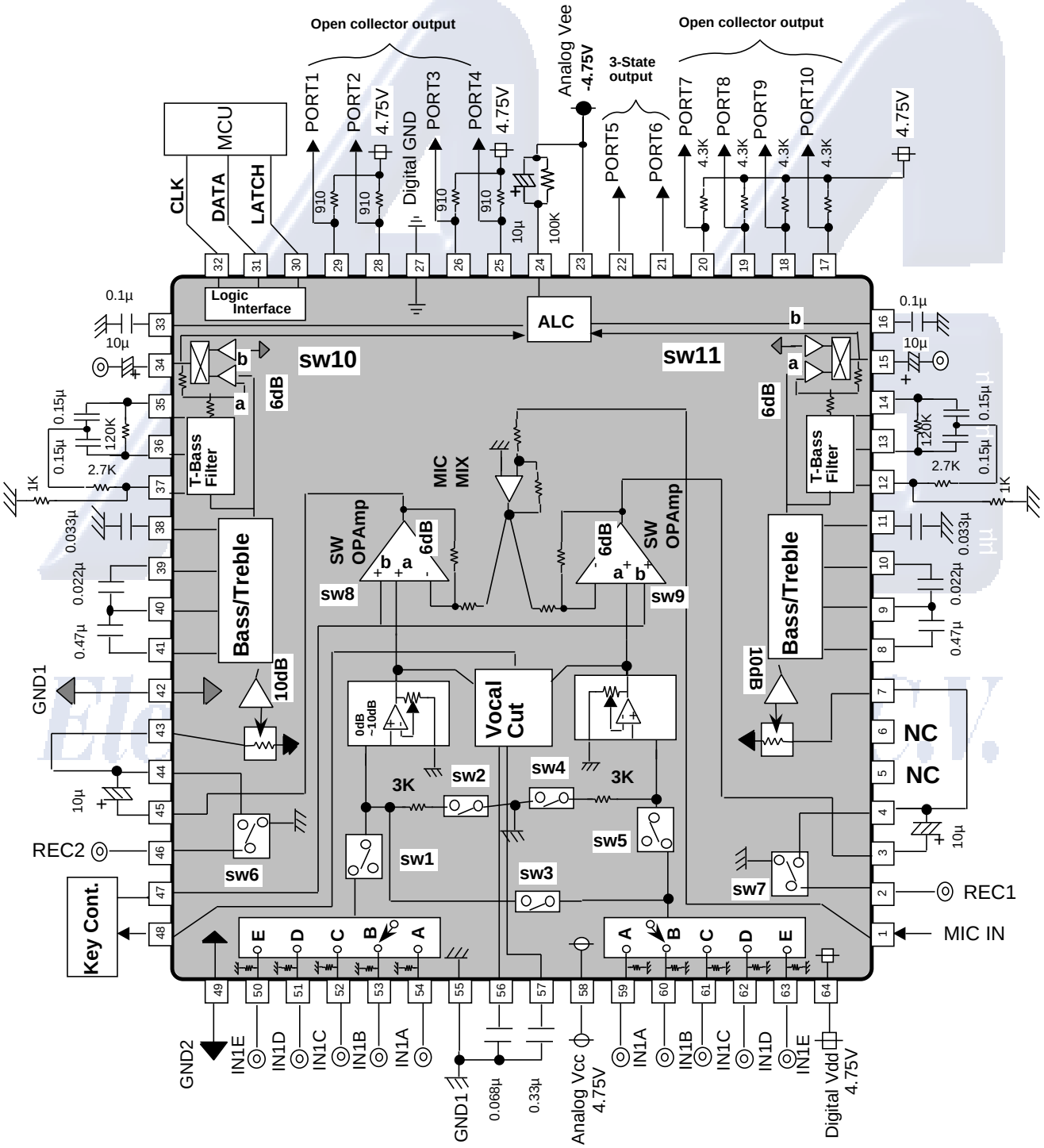
Application circuit



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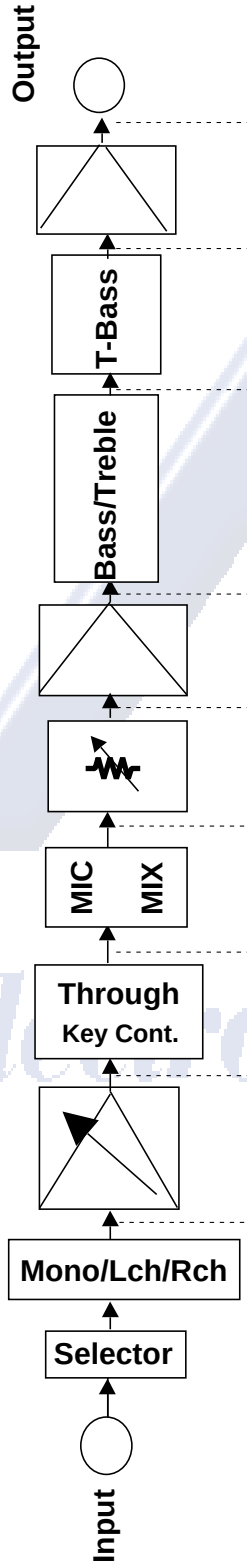
M62445FP Signal Level Diagram



Gain	0dB	-2dB~12dB (2dB/step)	0dB	6dB	-2dB~ -80dB (1dB/step)	12dB	-10dB~ +10dB (2dB/step)	0dB~ +20dB (5dB/step)	6dB						
Output Level	Maxmum Input/Output Level(8dBV;2.5Vrms typ)									2dBV (1.25Vrms)	-4dBV (630mVrms)	-14dBV (200mVrms)	-20dBV (100mVrms)	-28dBV (40mVrms)	
		G:8dB		G:6dB	ATT:-2dB	G:12dB	G:0dB		G:6dB						
Noise Level	1.5µVrms	4.3µVrms	5.0µVrms	10.0µVrms	2.5µVrms	10µVrms	6µVrms	6µVrms	7µVrms	15µVrms					
					ATT:-∞	1.5µVrms	6µVrms								

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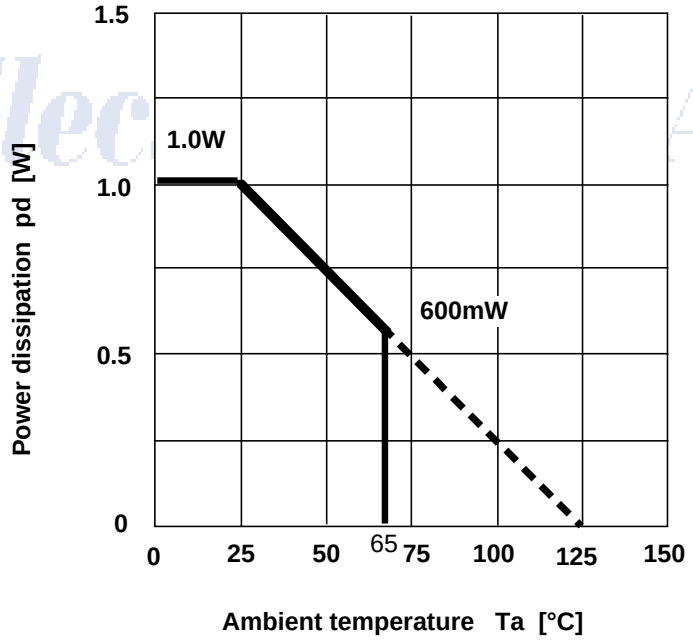
Absolute supply voltage

Symbol	Parameter	Conditions	Ratings	Unit
VCC,VDD	Analog(+) Digital supply voltage		+5.0	V
VEE	Analog(-) supply voltage		-5.0	V
Pd	Power dissipation	Ta≤25°C	1000	mW
Kθ	Thermal derating	Ta>25°C	10	mW/°C
Topr	Operating temperature		-20~+65	°C
Tstg	Storage temperature		-40~+125	°C

Thermal derating



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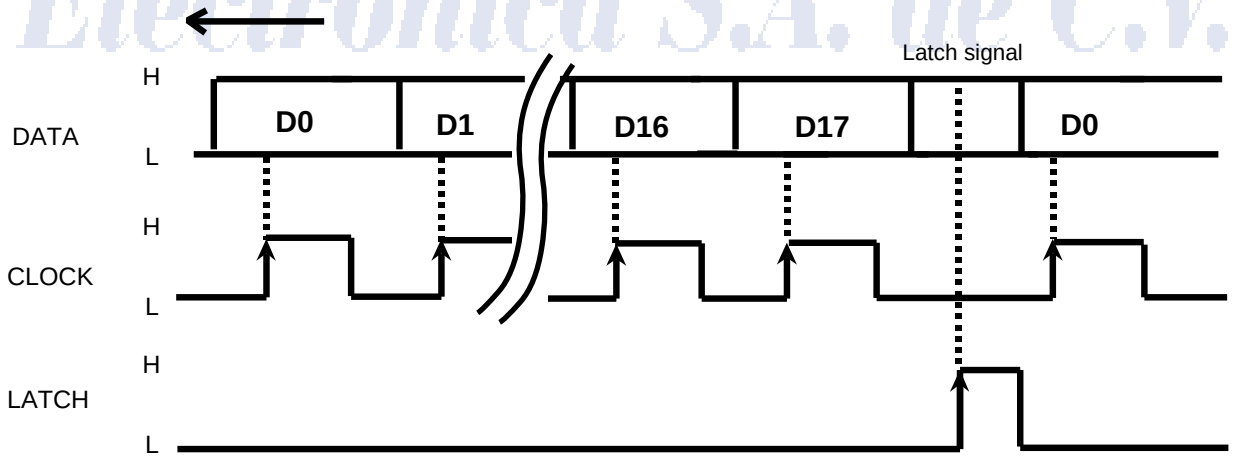
Recommended operating conditions

(Ta=25°C, Unless otherwise noted.)

Parameter	Symbol	Conditions	Limits			Unit
			MIN	TYP	MAX	
Analog(+)supply voltage	VCC	Noted1	4.5	4.75	5.0	V
Analog(-)supply voltage	VEE	Noted1	-5.0	-4.75	-4.5	V
Digital supply voltage	VDD	VDD≤VCC	4.5	4.75	5.0	V
Logic "H"level input voltage	VIH		0.7xVDD	—	VDD	V
Logic "L"level input voltage	VIL		0	—	0.3xVDD	V

Note1)When the IC use power supplies,the first,provide to VEE,and then provide to Vcc and VDD.

Relationships between data and clock



Data signal read at the rising edge of clock signal.
Signal is latched at the rising edge of the latch signal.
(When data and clock signal are "H",can not recieve the latch signal.)

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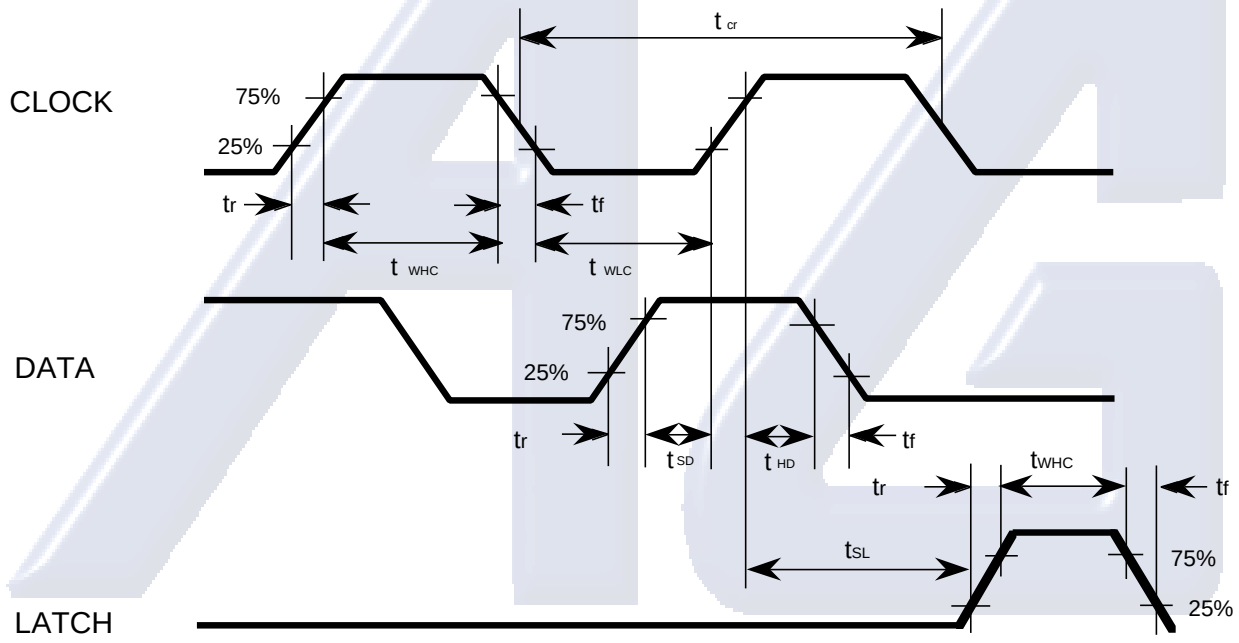
Clock and data timings



Timing definition of digital block

Symbol	Parameter	Limits			Unit
		Min	typ	Max	
t_{cr}	Clock cycle time	4	–	–	µsec
t_{WHC}	Clock pulse width("H"level)	1.6	–	–	
t_{WLC}	Clock pulse width("L"level)	1.6	–	–	
t_r	Rising time of clock,data and latch	–	–	0.4	
t_f	Falling time of clock,data and latch	–	–	0.4	
t_{SD}	Data setup time	0.8	–	–	
t_{HD}	Data hold time	0.8	–	–	
t_{SL}	Latch setup time	1	–	–	
t_{WHL}	Latch pulse width	1.6	–	–	

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Data inpup format

Four kinds of input format options are available by changing slot settngs of D15,D16 and D17.

(Initialize all data of the four formats when power is turned on.)

Input direction

Input format selection slot

MSB LSB

	DO	D1	D2	D3	D4	D5	D6	D7	D8	D9	D1O	D11	D12	D13	D14	D15	D16	D17
(A)	Input selector control			Gain control			Rec mute	0	KARAOKE control				0	0	0	0	0	0
	I0	I1	I2	G0	G1	G2	M0		K0	K1	K2	K3						
(B)	Port output1-4 (Open collector output)				Port output5,6 (3state output)				Port output7-10 (Open collector output)				0	0	0	1	0	0
	O0	O1	O2	O3	Ss0	Ss1	St0	St1	O6	O7	O8	O9						
(C)	Lch volume control							1	Rch volume control							0	1	1
	L0	L1	L2	L3	L4	L5	L6		R0	R1	R2	R3	R4	R5	R6			
(D)	Bass boost/cut				Treble boost/cut				T-bass gain				0	0	0	0	1	1	1
	B0	B1	B2	B3	T0	T1	T2	T3	TB0	TB1	TB2							

(A) -1 **Input selector setting code**

Selector	I0	I1	I2	Sel.SW	sw1,5	sw2,4
Input mute	0	0	0	Alloff	off	on
A	0	0	1	A	on	off
B	0	1	0	B		
C	0	1	1	C		
D	1	0	0	D		
E	1	0	1	E		
Prohibition	1	1	0	Unsettled	Unsettled	Unsettled
Prohibition	1	1	1	Unsettled	Unsettled	Unsettled

(A) -2 **Gain control setting code**

Gain	G0	G1	G2
0 dB	0	0	0
2 dB	0	0	1
4 dB	0	1	0
6 dB	0	1	1
8 dB	1	0	0
10 dB	1	0	1
12 dB	1	1	0
14 dB	1	1	1

(A) -3 **KARAOKE control settinng code**

	K0	K1	K2	K3	sw1	sw2	sw3	sw4	sw5	sw8§9
STEREO	1	1	0	0	on	off	off	off	on	a
MONO(L+R)	1	1	1	1	on	off	on	on	off	b
L MPX	1	0	1	1	on	off	off	on	off	b
R MPX	0	1	1	1	off	off	on	on	off	b
Vocal cut (L-R)	1	1	0	1	on	off	off	off	on	b

(A) -4
Rec mute setting code

Rec output	M0
Rec mute OFF	0
Rec mute ON	1

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(B) -1 (Port output mode)

Open collector output

Data	O0	O1	O2	O3	O6	O7	O8	O9
Pin	Port 1	Port 2	Port 3	Port 4	Port 7	Port 8	Port 9	Port 10
0	Current sink(Tr.) OFF							
1	Current sink(Tr.) ON							

(B) -2 (3-State port output mode)

CMos Tr.output

Ss0	Ss1	Port 5
0	0	Low
1	0	open
0	1	open
1	1	Hi

St0	St1	Port 6
0	0	Low
1	0	open
0	1	open
1	1	Hi

(C) -1 **Master volume setting codes**

ATT	Lch	L0	L1	L2	L3	L4
	Rch	R0	R1	R2	R3	R4
-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
-40dB		1	1	0	0	1
-44dB		0	0	1	0	1
-48dB		1	0	1	0	1
-52dB		0	1	1	0	1
-56dB		1	1	1	0	1
-60dB		0	0	0	1	1
-64dB		1	0	0	1	1
-68dB		0	1	0	1	1
-72dB		1	1	0	1	1
-76dB		0	0	1	1	1
-80dB		1	0	1	1	1
-84dB		0	1	1	1	1
-∞		1	1	1	1	1

ATT	L5	L6
	R5	R6
-0dB	0	0
-1dB	1	0
-2dB	0	1
-3dB	1	1

L5,L6(R5,R6) of data are enabled at less than -36dB setting.
When more than -34dB setting,only L5 and R5 of data are enabled.

Note) Volume ATT setting is design target.

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(D) -1 Tone control setting code.

Bass				Gain	Treble			
B0	B1	B2	B3		T0	T1	T2	T3
1	0	1	1	+10dB	1	0	1	1
0	0	1	1	+8dB	0	0	1	1
1	1	0	1	+6dB	1	1	0	1
0	1	0	1	+4dB	0	1	0	1
1	0	0	1	+2dB	1	0	0	1
0	0	0	1	0dB	0	0	0	1
0	0	0	0	0dB	0	0	0	0
1	0	0	0	-2dB	1	0	0	0
0	1	0	0	-4dB	0	1	0	0
1	1	0	0	-6dB	1	1	0	0
0	0	1	0	-8dB	0	0	1	0
1	0	1	0	-10dB	1	0	1	0

(D) -2 Dynamic bass boost setting code.

Gain	TB0	TB1	TB2	sw9,10
Output mute	0	0	0	b
T-Bass OFF	1	0	0	a
5dB	0	1	0	↓
10dB	1	1	0	↓
15dB	0	0	1	↓
20dB	1	0	1	↓
Prohibition	0	1	1	↓
Prohibition	1	1	1	↓

Note) Gain setting code is only name.
If external compornent parts are change, Gain setting is different.

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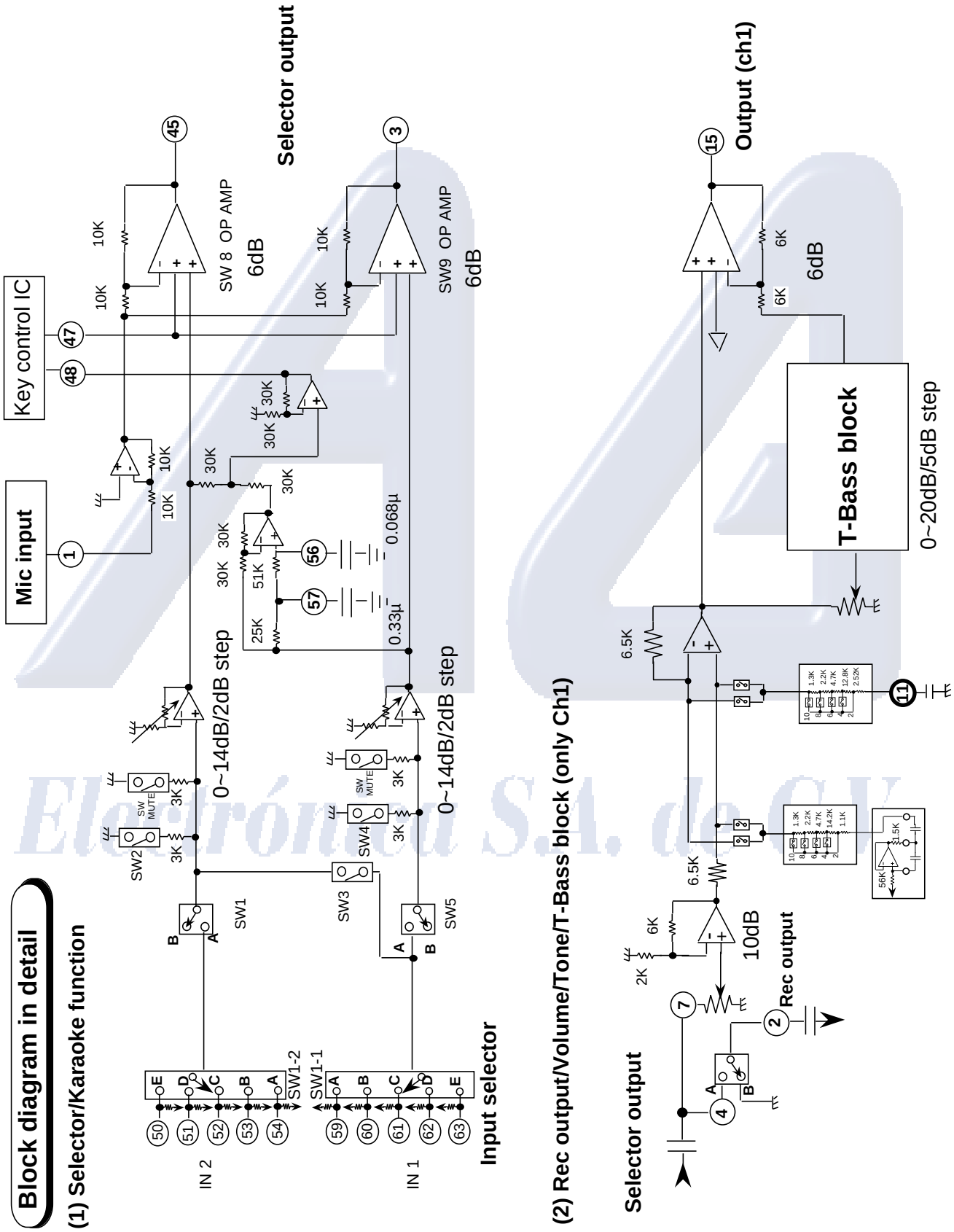
Block diagram in detail



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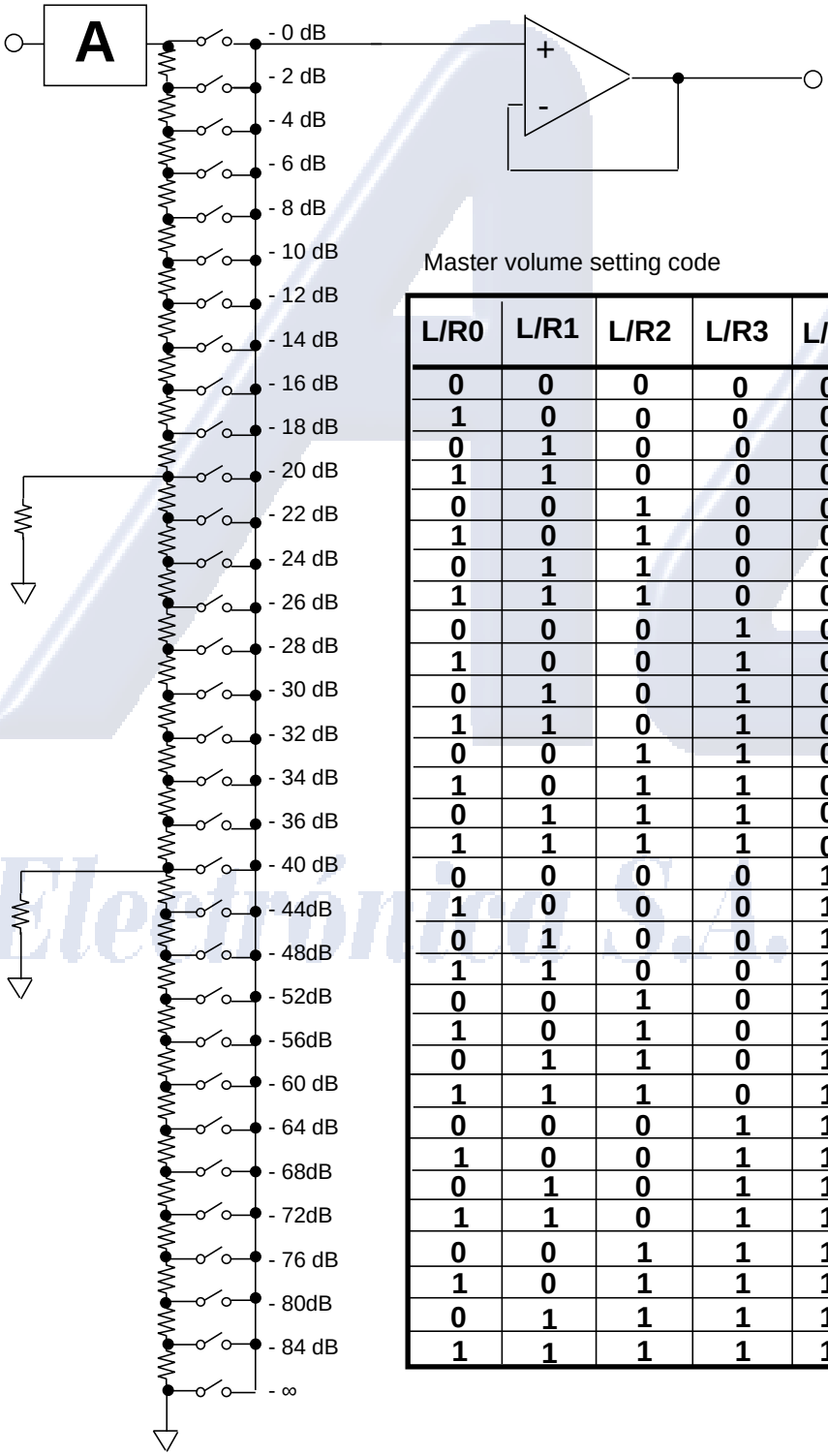
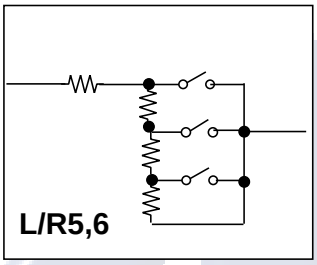
Master volume circuit

A:3dBATT





Master volume setting code

L/R0	L/R1	L/R2	L/R3	L/R4	ATT
0	0	0	0	0	-0.0dB
1	0	0	0	0	-2.0dB
0	1	0	0	0	-4.0dB
1	1	0	0	0	-6.0dB
0	0	1	0	0	-8.0dB
1	0	1	0	0	-10.0dB
0	1	1	0	0	-12.0dB
1	1	1	0	0	-14.0dB
0	0	0	1	0	-16.0dB
1	0	0	1	0	-18.0dB
0	1	0	1	0	-20.0dB
1	1	0	1	0	-22.0dB
0	0	1	1	0	-24.0dB
1	0	1	1	0	-26.0dB
0	1	1	1	0	-28.0dB
1	1	1	1	0	-30.0dB
0	0	0	0	1	-32.0dB
1	0	0	0	1	-34.0dB
0	1	0	0	1	-36.0dB
1	1	0	0	1	-40.0dB
0	0	1	0	1	-44.0dB
1	0	1	0	1	-48.0dB
0	1	1	0	1	-52.0.0dB
1	1	1	0	1	-56.0.0dB
0	0	0	1	1	-60.0dB
1	0	0	1	1	-64.0dB
0	1	0	1	1	-68.0dB
1	1	0	1	1	-72.0dB
0	0	1	1	1	-76.0dB
1	0	1	1	1	-80.0dB
0	1	1	1	1	-84.0dB
1	1	1	1	1	- ∞

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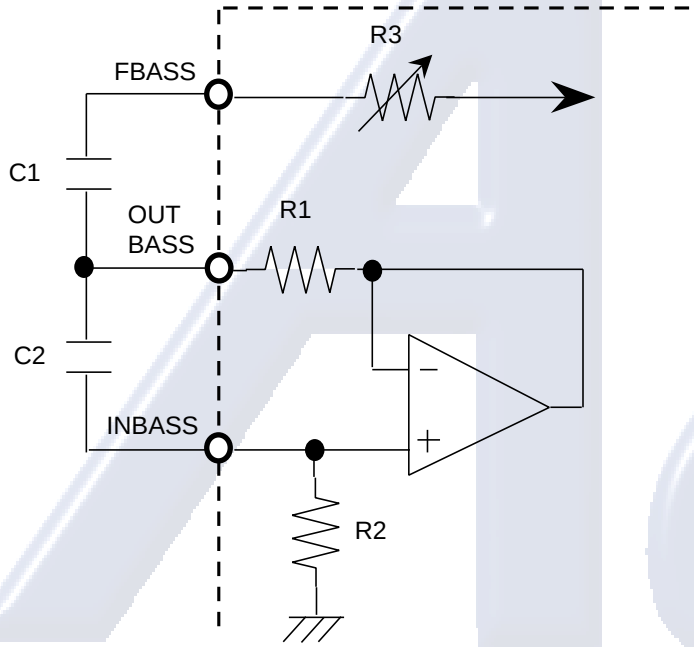
Tone control circuit

(1)Equivalent circuit of tone control (bass) resonance circuit block



Center frequency

$f0 = 1 / 2 \sqrt{C1 \cdot C2 \cdot R1 \cdot R2}$ [Hz]

$Q = \sqrt{C2 \ (R1 \cdot R2) / C1 \ (R1+R3)^2}$

(Ex.)Bass band (f=150Hz)
R1=1.5KΩ , R2=56KΩ
C1=1.5μ , C2=0.01μ

Fig.1 Internal resonance equivalent circuit

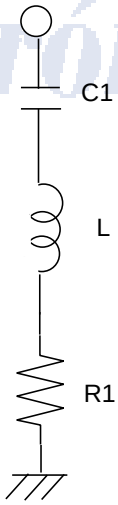


Fig.1 means Fig.2 in equivalence.
The part constant is converted
by the following formula.

L=C2 • R1 • R2

Fig.2 Equivalent circuit using L

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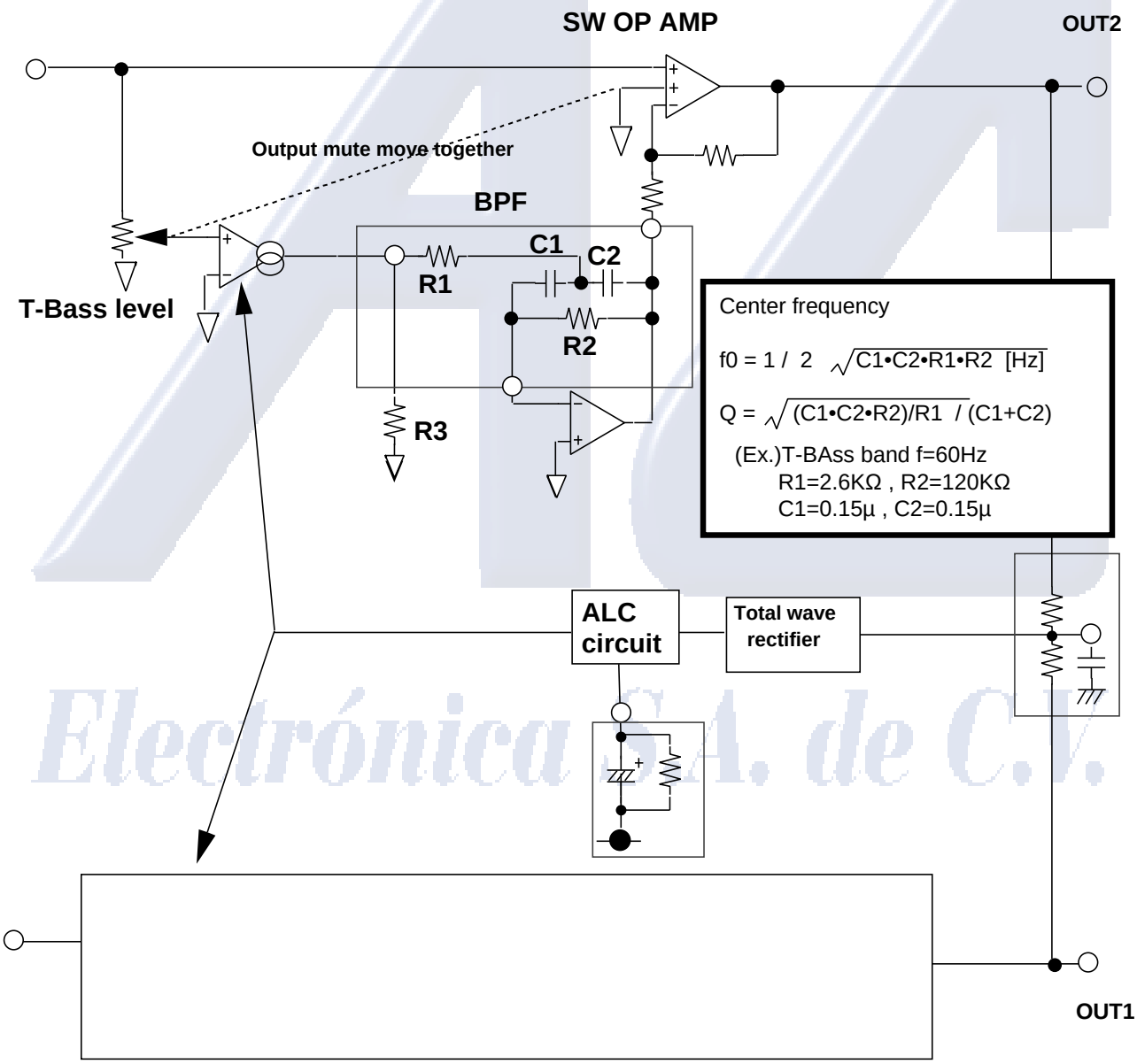
Dynamic bass boost (T-Bass) circuit



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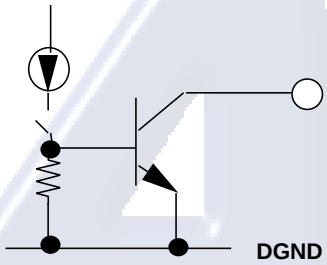
Output port circuit

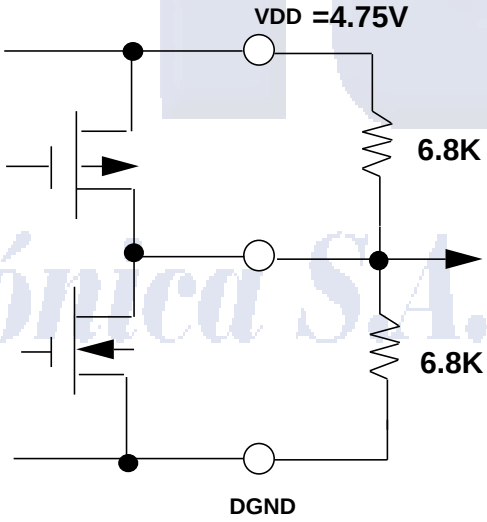
(1) Output port : Open collector output

Pin29,28,26,25: Io=5mA,Vc=0.35V(typ)
Pin20,19,18,17: Io=1mA,Vc=0.25V(typ)



Voltage rage of output port = DGND~12V

(2) Output port : 3-state output



	Ex.Output value
Hi :	4.35V
Mid :	2.4V
Low :	0.35V

Voltage rage of output port = DGND~DVDD

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Electrical characteristics

(Ta=25°C, VCC,VDD=4.75V , VEE=-4.75V,f=1kHz,unless otherwise noted.
Gain control=8dB,tone control,volume=0dB/flat)

(1) Power supply characteristics

Parameter	Symbol	Test condition	Limits			Unit
			Min	typ	Max	
Circuit current of analog positive power supply	ICC	No input signal	—	26	37	mA
Circuit current of analog negative power supply	IEE	No input signal	-50	-37	—	mA
Circuit current of digital power supply	IDD	No input signal	—	0.8	10	mA

(2) Input/output characteristics

	Parameter	Symbol	Test condition	Limits			Unit
				Min	typ	Max	
Normal	Input resistance	Rin			51		KΩ
	Crosstalk between selectors	ST	Vi=0.04Vrms , RL=10KΩ,JIS-A Rg=10KΩ,1pin=GND	—	-75	-60	dB
	Maximum output voltage	VOM	RL =10KΩ,THD=1%	2.20	2.45	—	Vrms
	Pass gain	Gv	Vi=0.04Vrms,FLAT	27	30	33	dB
	Total harmonic distortion	THD	BW=400~30kHz Vo=1.0Vrms , RL=10KΩ	—	0.02	0.05	%
		THD(REC)	BW=400~30kHz Vo=0.16Vrms , RL=10KΩ	—	0.02	0.05	
	Output noise voltage	Vno1	Rg=0Ω,JIS-A, VOL=0dB,Gain:0dB	—	60	100	µVrms
		Vno2	Rg=0Ω,JIS-A, VOL=-∞dB,Gain:0dB	—	15	30	
		VNO(REC)	Rg=0Ω,JIS-A, Gain:0dB	—	10	20	
	Crosstalk between channels	CT	Vo=0.04Vrms , RL=10KΩ,JIS-A Rg=10KΩ,1pin=GND	—	-75	-60	dB
Volume	Maximum attenuation	ATTmax	7,43pin=2Vrms ATTmax=20log(Vo/12.6)	—	-116	-106	dB
	Volume step	VOLSTEP	29,36pin,Rg=10KΩ,JIS-A, VOL=-∞dB	—	1	—	
	Gain declination between volume	Dvol		-1.5	0	1.5	

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Parameter		Symbol	Test condition	Limits Min	Limits typ	Limits Max	Unit
Gain control	Gain control maximum gain	GCMAX	Vo=0.04Vrms , RL=10KΩ,JIS-A Rg=10KΩ,Gain:14dB~0dB	12	14	16	dB
	Gain control step	GCSTEP		—	2	—	
	Balance between channels	BALT		-1.5	0	+1.5	
Tone control	Tone control voltage gain	T -10dB	Vo=0.04Vrms Treble (f=10KHz) Bass (f=150Hz)	-13	-10	-7	dB
		T +10dB		7	10	13	
	Tone control step	TCSTEP		—	2	—	
	Balance between channels	BALT		-1.5	0	+1.5	
T-Bass control	T-Bass voltage gain maximum range	TBB20dB	f=60Hz,Vi=0.01Vrms	15	20	25	dB
	T-Bass step	TBSTEP		—	5	—	
	Balance between channels	BALT		-2.0	0	+2.0	

(3) Output port

Parameter	Symbol	Test condition	Limits Min	Limits typ	Limits Max	Unit
Remain voltage of output port pin29,28,26,25(Open collector output)	VpOC	RL=910Ω(5mA) VDD=4.75V	—	0.3	0.6	V
Remain voltage of output port pin20,19,18,17(Open collector output)	VpOC	RL=4.3KΩ(1mA) VDD=4.75V	—	0.3	0.6	
3-state output "H" voltage	VpTH	R(GND):6.8KΩ R(Vdd):6.8KΩ	4.25	4.50	—	
3-state output "L" voltage	VpTL	R(GND):6.8KΩ R(Vdd):6.8KΩ	—	0.35	0.5	

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