

**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.

### 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

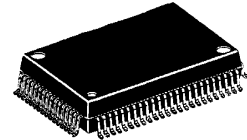
#### <Electric volume>

- 0dB ~ -87dB(1dB/Step), -

#### <Expansion output port>

- NPN open collector output (8pcs), 3-state output (2pcs)

### OUTLINE



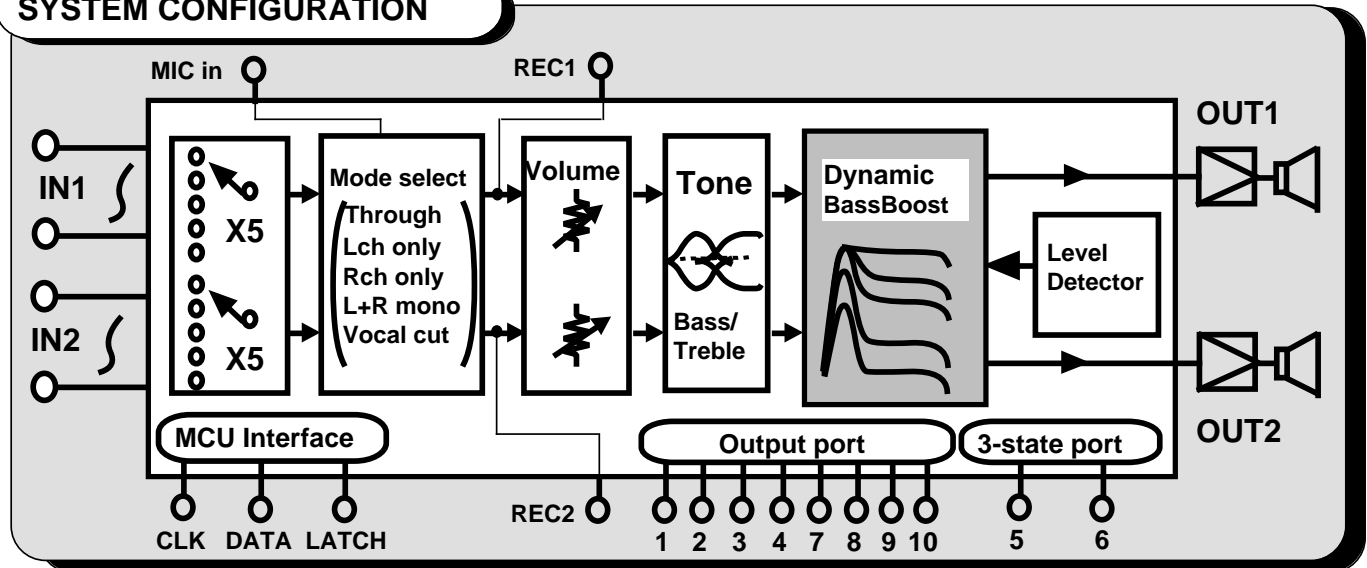
**64P6N**

64pinQFP  
 (Lead pitch 0.8mm)

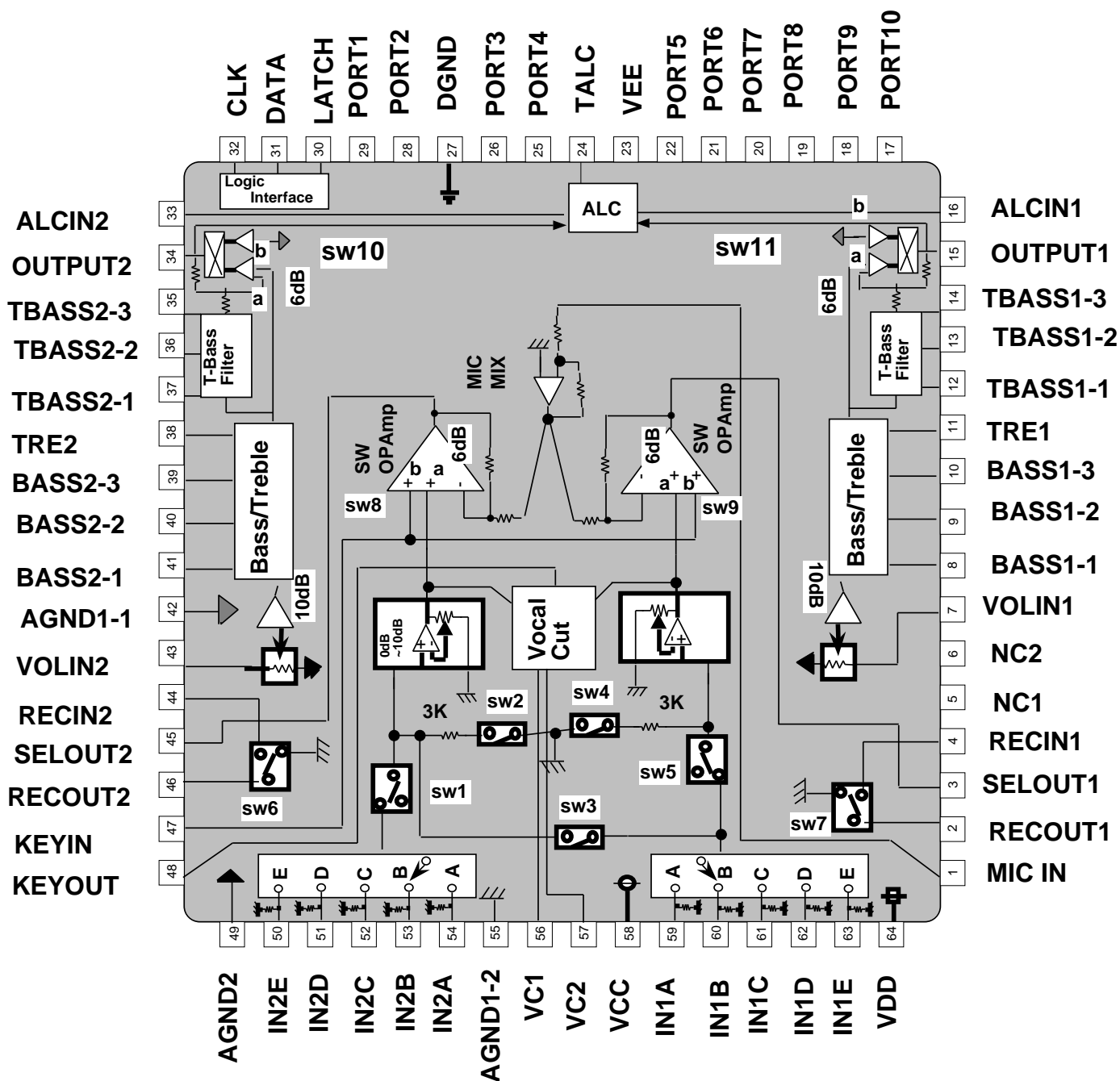
### RECOMMENDED OPERATING CONDITIONS

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

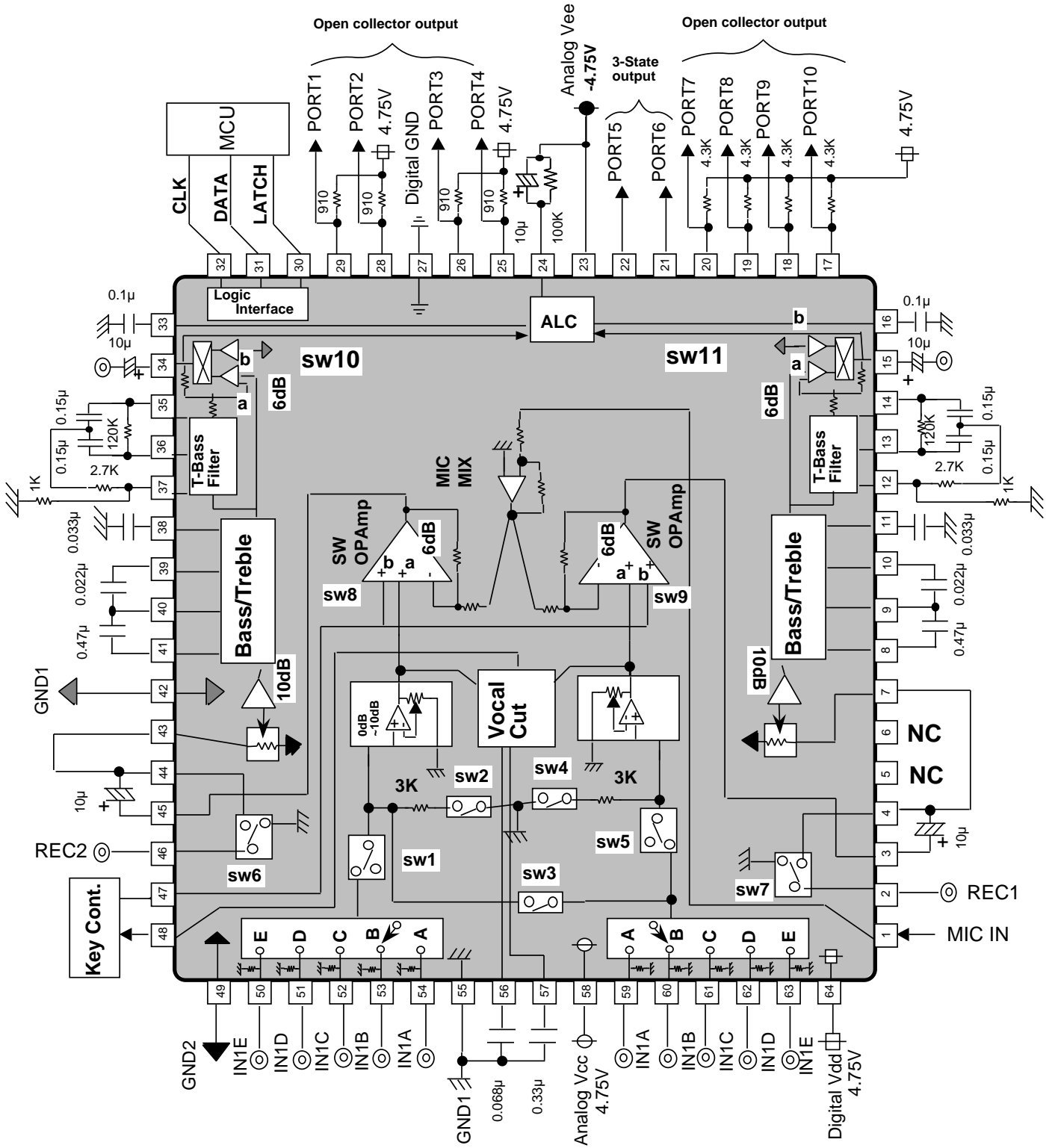
### SYSTEM CONFIGURATION



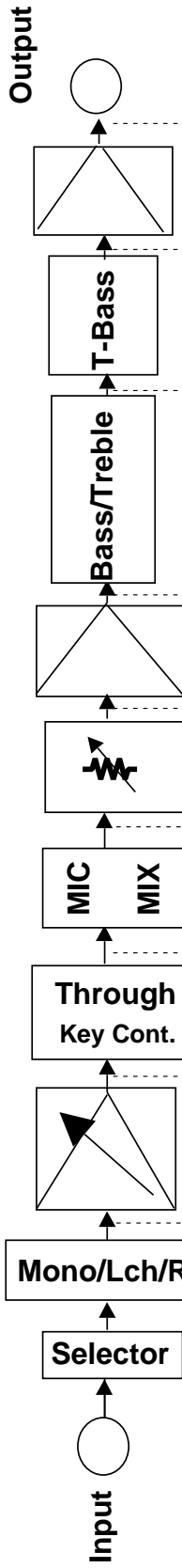
## Block diagram/Pin configuration



# Application circuit



# M62445FP Signal Level Diagram



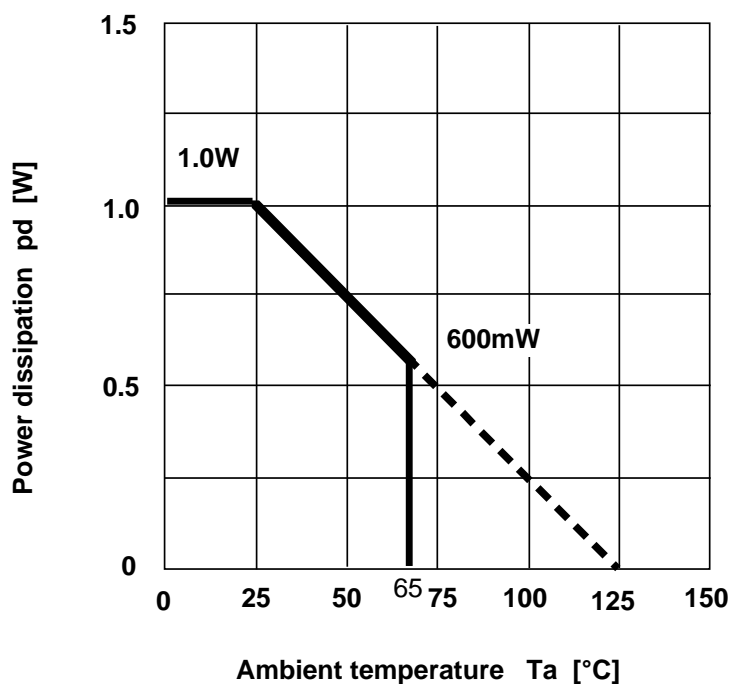
<b>Gain</b>	0dB	-2dB~12dB (2dB/step)	0dB	6dB	-2dB~-80dB (1dB/step)	12dB	-10dB~+10dB (2dB/step)	0dB~+20dB (5dB/step)	6dB
<b>Output Level</b>	-28dBV (40mVrms)	G:8dB	-20dBV (100mVrms)	G:6dB	-14dBV (200mVrms)	G:12dB	G:0dB	G:6dB	2dBV (1.25Vrms)
<b>Noise Level</b>	1.5μVrms	4.3μVrms	5.0μVrms	10.0μVrms	2.5μVrms	10μVrms	6μVrms	7μVrms	15μVrms

Maximum Input/Output Level(8dBV;2.5Vrms typ)

## Absolute supply voltage

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

**Thermal derating**



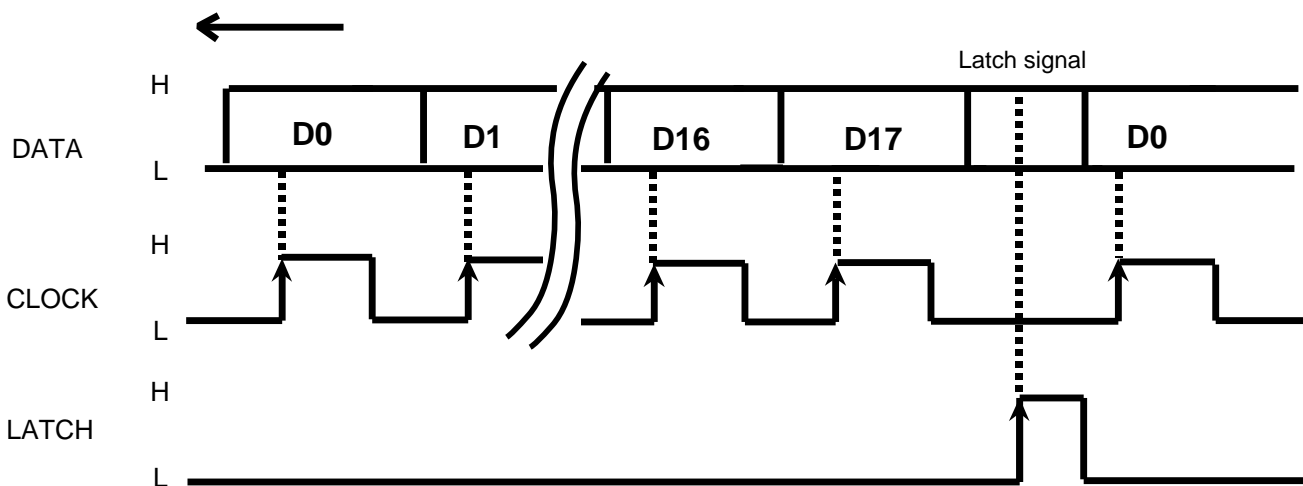
## Recommended operating conditions

( 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

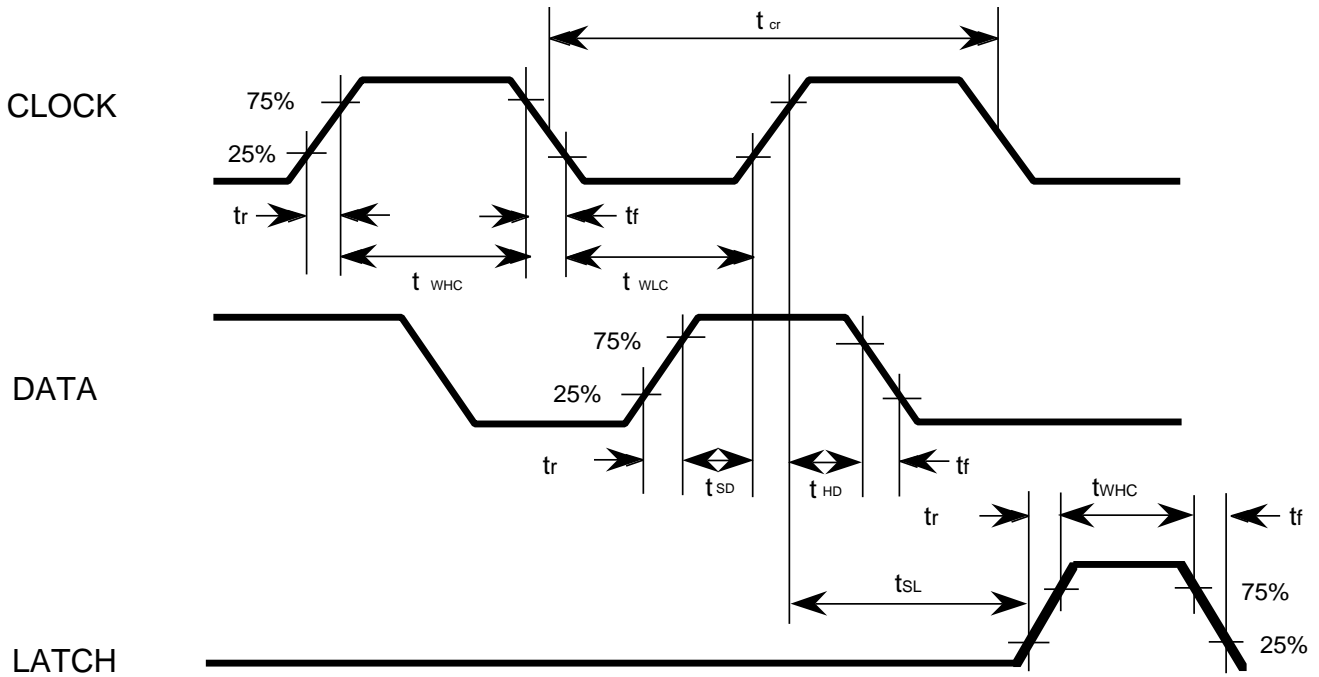
Note1) When the IC use power supplies, the first, provide to VEE, and then provide to Vcc and VDD.

## 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 receive the latch signal. )

## 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	-	-	

## Data input format

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

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

Input format  
selection slot

← Input direction

	MSB														LSB			
	DO	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17
(A)	Input selector control <b>I0 I1 I2</b>			Gain control <b>G0 G1 G2</b>			Rec mute <b>M0</b>	0	KARAOKE control <b>K0 K1 K2 K3</b>				0	0	0	0	0	0
(B)	Port output1-4 (Open collector output) <b>O0 O1 O2 O3</b>				Port output5,6 (3state output) <b>Ss0 Ss1 St0 St1</b>				Port output7-10 (Open collector output) <b>O6 O7 O8 O9</b>				0	0	0	1	0	0
(C)	Lch volume control <b>L0 L1 L2 L3 L4 L5 L6</b>						1	Rch volume control <b>R0 R1 R2 R3 R4 R5 R6</b>						0	1	1		
(D)	Bass boost/cut <b>B0 B1 B2 B3</b>				Treble boost/cut <b>T0 T1 T2 T3</b>				T-bass gain <b>TB0 TB1 TB2</b>			0	0	0	0	1	1	1

(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 setting 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



(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	St0	St1	Port 6
0	0	Low	0	0	Low
1	0	open	1	0	open
0	1	open	0	1	open
1	1	Hi	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	0
-2dB	1	0	0	0	0	0
-4dB	0	1	0	0	0	0
-6dB	1	1	0	0	0	0
-8dB	0	0	1	0	0	0
-10dB	1	0	1	0	0	0
-12dB	0	1	1	0	0	0
-14dB	1	1	1	0	0	0
-16dB	0	0	0	1	0	0
-18dB	1	0	0	1	0	0
-20dB	0	1	0	1	0	0
-22dB	1	1	0	1	0	0
-24dB	0	0	1	1	0	0
-26dB	1	0	1	1	0	0
-28dB	0	1	1	1	0	0
-30dB	1	1	1	1	0	0
-32dB	0	0	0	0	1	0
-34dB	1	0	0	0	1	0
-36dB	0	1	0	0	1	0
-40dB	1	1	0	0	1	0
-44dB	0	0	1	0	1	0
-48dB	1	0	1	0	1	0
-52dB	0	1	1	0	1	0
-56dB	1	1	1	0	1	0
-60dB	0	0	0	1	1	0
-64dB	1	0	0	1	1	0
-68dB	0	1	0	1	1	0
-72dB	1	1	0	1	1	0
-76dB	0	0	1	1	1	0
-80dB	1	0	1	1	1	0
-84dB	0	1	1	1	1	0
-	1	1	1	1	1	0

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.

(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.

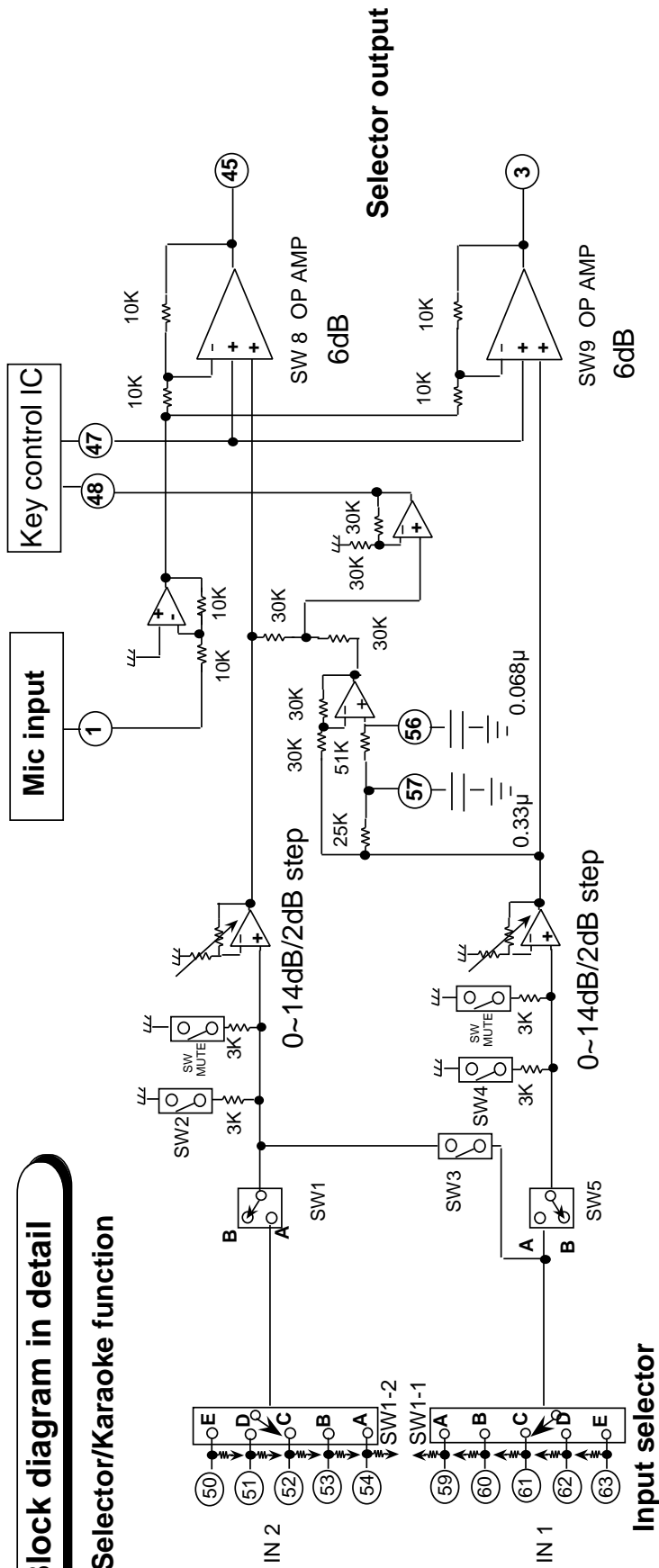
Gain	TB0	TB1	TB2	sw9,10
Output mute	0	0	0	b
T-Bass OFF	1	0	0	a
5dB	0	1	0	
10dB	1	1	0	
15dB	0	0	1	
20dB	1	0	1	
Prohibition	0	1	1	
Prohibition	1	1	1	↓

Note) Gain setting code is only name.

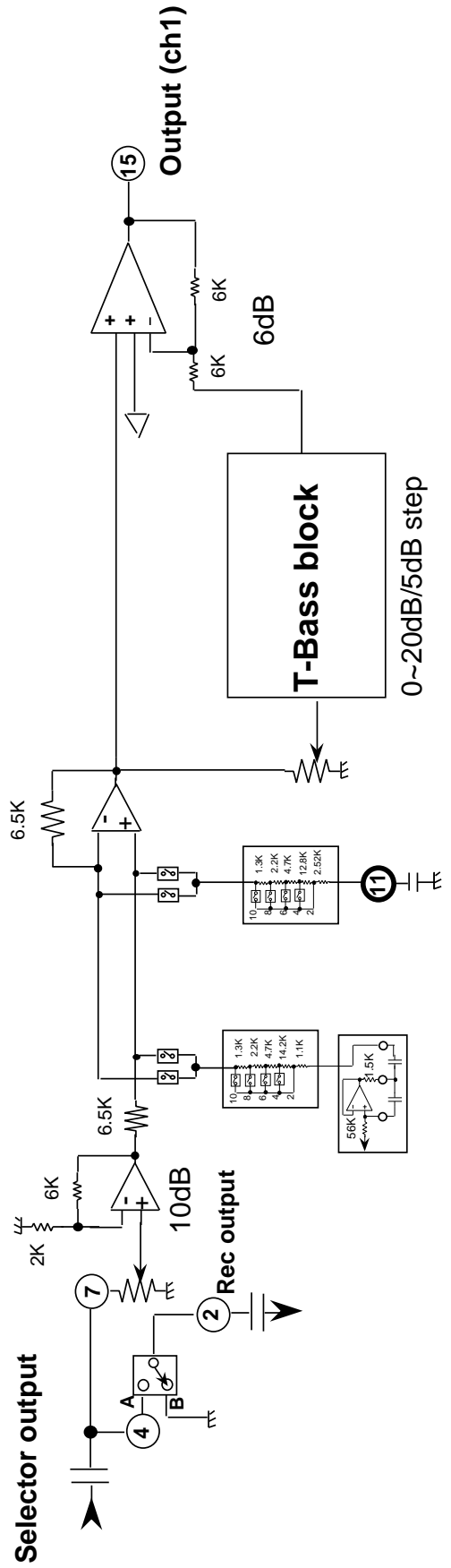
If external component parts are change, Gain setting is different.

# Block diagram in detail

(1) Selector/Karaoke function

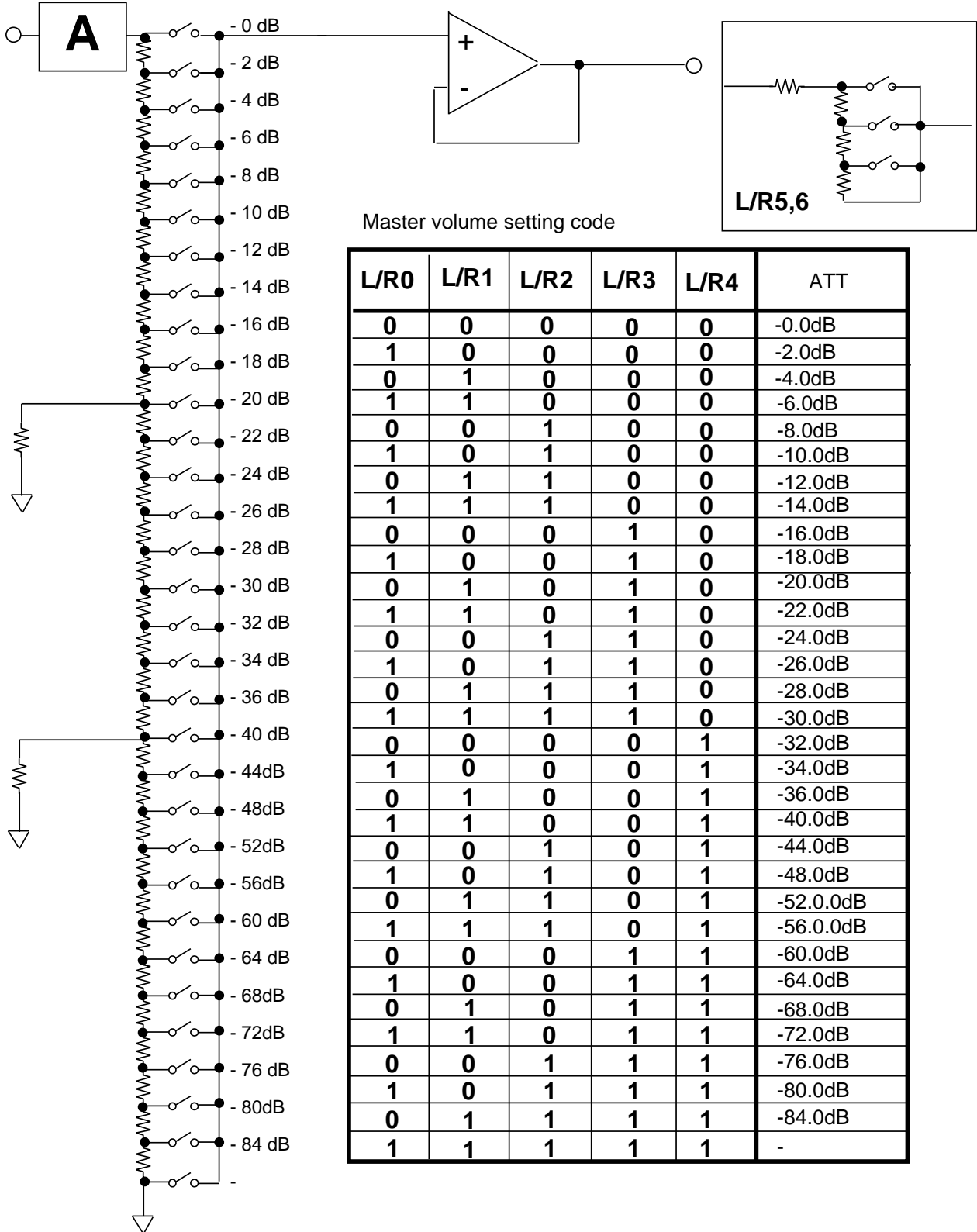


(2) Rec output/Volume/Tone/T-Bass block (only Ch1)



# Master volume circuit

**A:3dBATT**

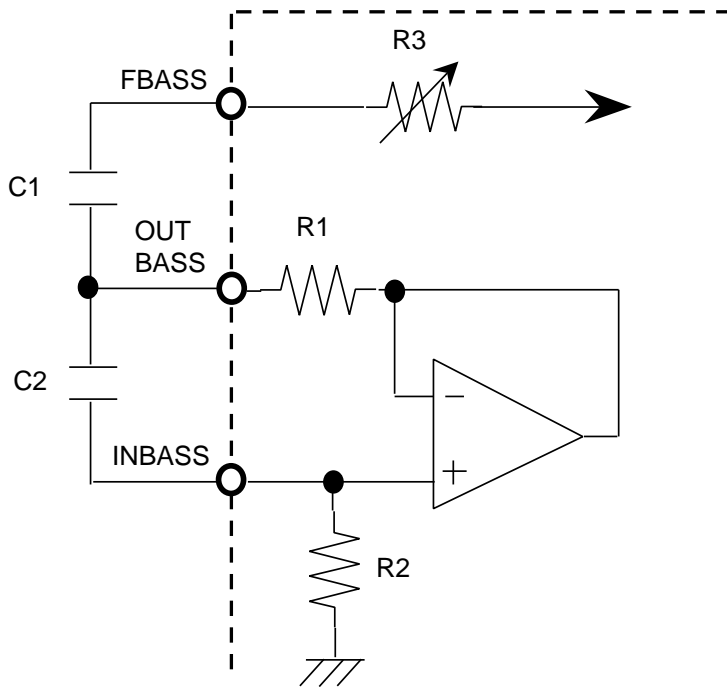


Master volume setting code

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	-52.0dB
1	1	1	0	1	-56.0dB
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	-

## Tone control circuit

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



Center frequency

$$f_0 = 1 / 2 \sqrt{C_1 \cdot C_2 \cdot R_1 \cdot R_2} \text{ [Hz]}$$

$$Q = \sqrt{C_2 (R_1 \cdot R_2) / C_1 (R_1 + R_3)^2}$$

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

Fig.1 Internal resonance equivalent circuit

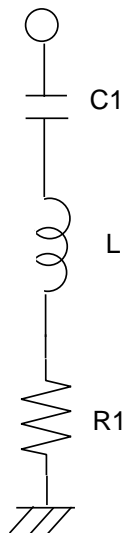
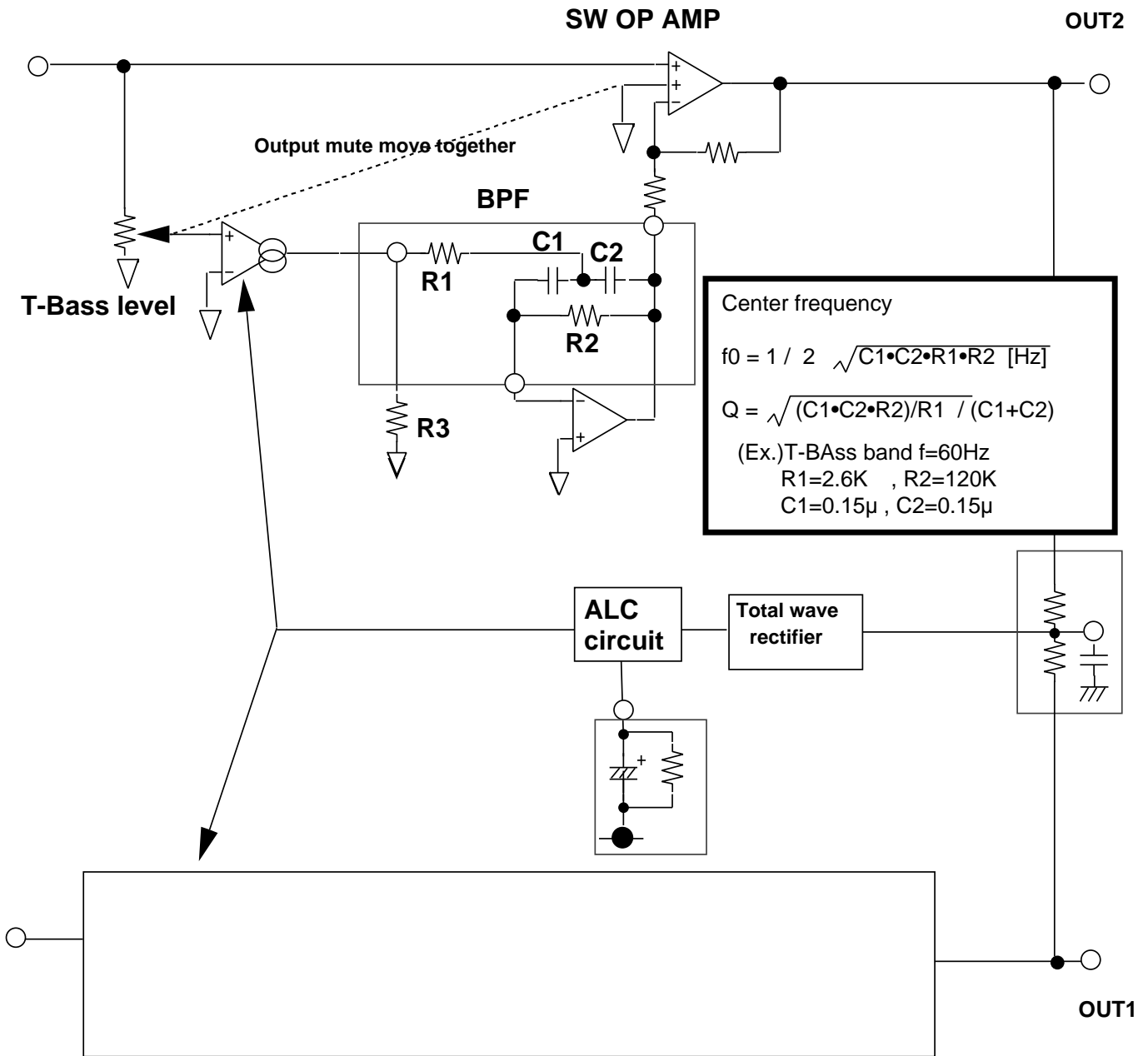


Fig.1 means Fig.2 in equivalence.  
 The part constant is converted  
 by the following formula.

$$L = C_2 \cdot R_1 \cdot R_2$$

Fig.2 Equivalent circuit using L

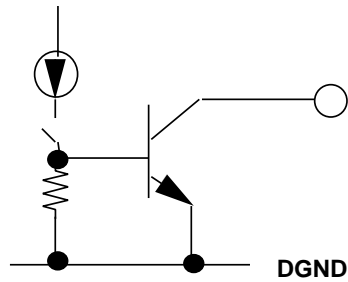
# Dynamic bass boost (T-Bass) circuit



## Output port circuit

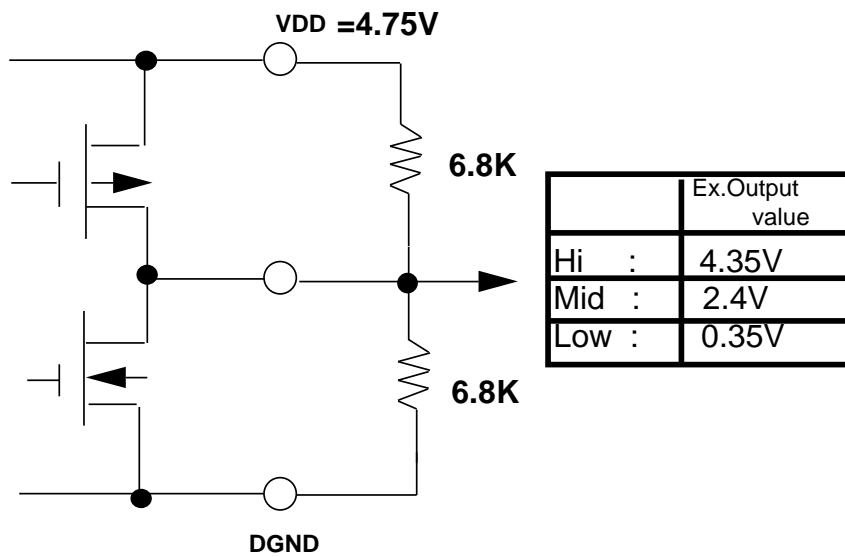
(1) Output port : Open collector output

Pin29,28,26,25:  $I_o=5\text{mA}$ ,  $V_c=0.35\text{V}(\text{typ})$   
 Pin20,19,18,17:  $I_o=1\text{mA}$ ,  $V_c=0.25\text{V}(\text{typ})$



Voltage range of output port = DGND~12V

(2) Output port : 3-state output



Voltage range of output port = DGND~DVDD

## Electrical characteristics

( $T_a=25^{\circ}\text{C}$ ,  $V_{CC}, V_{DD}=4.75\text{V}$ ,  $V_{EE}=-4.75\text{V}$ ,  $f=1\text{kHz}$ , 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		K
	Crosstalk between selectors	ST	$V_i=0.04\text{V}_{\text{rms}}$ , $R_L=10\text{K}$ , JIS-A $R_g=10\text{K}$ , 1pin=GND	—	-75	-60	dB
	Maximum output voltage	VOM	$R_L=10\text{K}$ , THD=1%	2.20	2.45	—	V <sub>rms</sub>
	Pass gain	Gv	$V_i=0.04\text{V}_{\text{rms}}$ , FLAT	27	30	33	dB
	Total harmonic distortion	THD	BW=400~30kHz $V_o=1.0\text{V}_{\text{rms}}$ , $R_L=10\text{K}$	—	0.02	0.05	%
		THD(REC)	BW=400~30kHz $V_o=0.16\text{V}_{\text{rms}}$ , $R_L=10\text{K}$	—	0.02	0.05	
	Output noise voltage	Vno1	$R_g=0$ , JIS-A, VOL=0dB, Gain:0dB	—	60	100	$\mu\text{V}_{\text{rms}}$
		Vno2	$R_g=0$ , JIS-A, VOL=- dB, Gain:0dB	—	15	30	
VNO(REC)		$R_g=0$ , JIS-A, Gain:0dB	—	10	20		
Crosstalk between channels	CT	$V_o=0.04\text{V}_{\text{rms}}$ , $R_L=10\text{K}$ , JIS-A $R_g=10\text{K}$ , 1pin=GND	—	-75	-60	dB	
Volume	Maximum attenuation	ATTmax	7,43pin=2V <sub>rms</sub> ATTmax=20log( $V_o/12.6$ )	—	-116	-106	dB
	Volume step	VOLSTEP	29,36pin, $R_g=10\text{K}$ , JIS-A, VOL=- dB	—	1	—	
	Gain declination between volume	Dvol		-1.5	0	1.5	



Parameter		Symbol	Test condition	Limits			Unit
				Min	typ	Max	
Gain control	Gain control maximum gain	GCMAX	Vo=0.04Vrms , RL=10K ,JIS-A Rg=10K ,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			Unit
			Min	typ	Max	
Remain voltage of output port pin29,28,26,25(Open collector output)	VpOC	RL=910 (5mA) VDD=4.75V	—	0.3	0.6	V
Remain voltage of output port pin20,19,18,17(Open collector output)	VpOC	RL=4.3K (1mA) VDD=4.75V	—	0.3	0.6	
3-state output "H" voltage	VpTH	R(GND):6.8K R(Vdd):6.8K	4.25	4.50	—	
3-state output "L" voltage	VpTL	R(GND):6.8K R(Vdd):6.8K	—	0.35	0.5	