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

MITSUBISHI SOUND PROCESSORS

# M615XXFP

Digital controlled Sound Controller

## Tone and Volume controller with 6ch selector

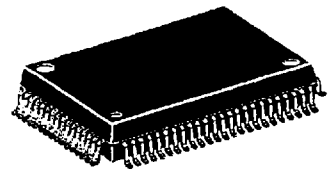
### APPLICATION

Mini Stereo / AV Amplifier / TV

### FEATURE

- Input Selector (6ch+MUTE)
- Input ATT (-5dB) [ON/OFF]
- Tone ATT (-8dB,-13dB)
- 5 Band Tone Control
  3 Band resonate type
  L , H Band shelving type(LPF,HPF type)
- Master Volume 1dB step, 2ch independent control
  (2ch 0 to -79dB,mute) L , R ch
- Trim Volume 1dB step, 2ch independent control
  (2ch 0 to -15dB) L , R ch
- SURROUND Volume 6 step(0 to -10dB)
- Multiple sound select(REC OUT) [L/Ronly]
- DPL Input Select
- REC Output 2ch(Between 1ch with MUTE)
- Output for Spectrum Analyzer (L+R/2)
- Correspond to Key control
- Bass Boost circuit [ON/OFF]
- Super Woofer Output
- Sound Effect circuit (Sound clearly)
- Power Supply :± power and Single power available (When use single power , need the power for reference)

### Package Outline



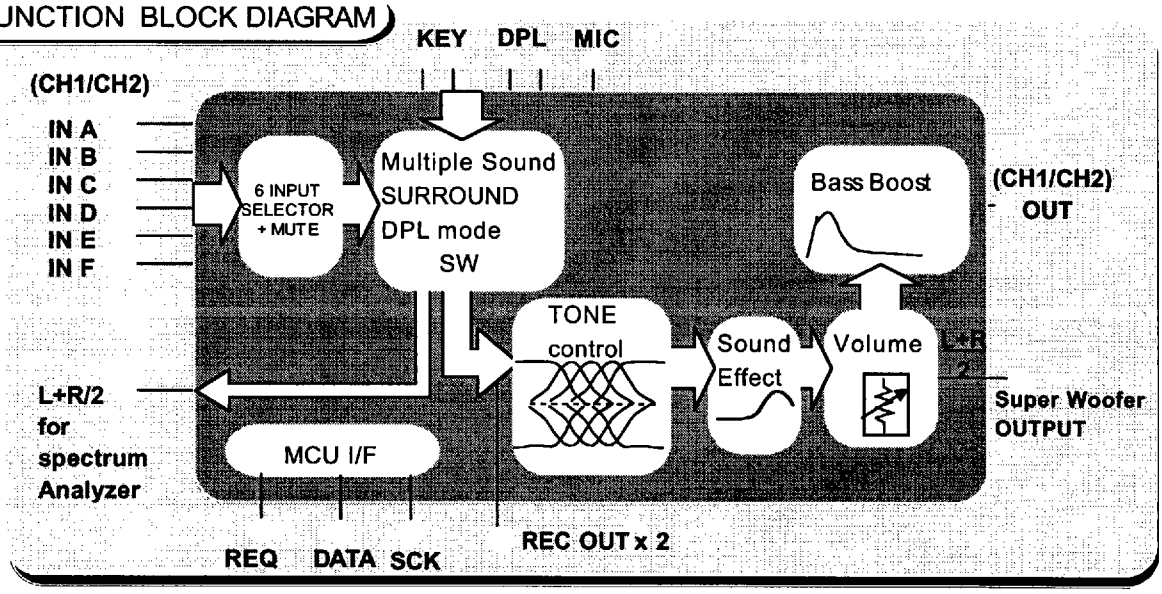
80P6N

lead pitch : 0.8 mm
size : 20.0mm x 14.0mm x 2.8mm

### RECOMMENDED OPERATION VOLTAGE

SUPPLY VOLTAGE RANGE : ± 4.0 to ± 5.0V [Single power 8.0 to 10.0V]

### FUNCTION BLOCK DIAGRAM



PRELIMINARY
Notice : This is not a final specification.
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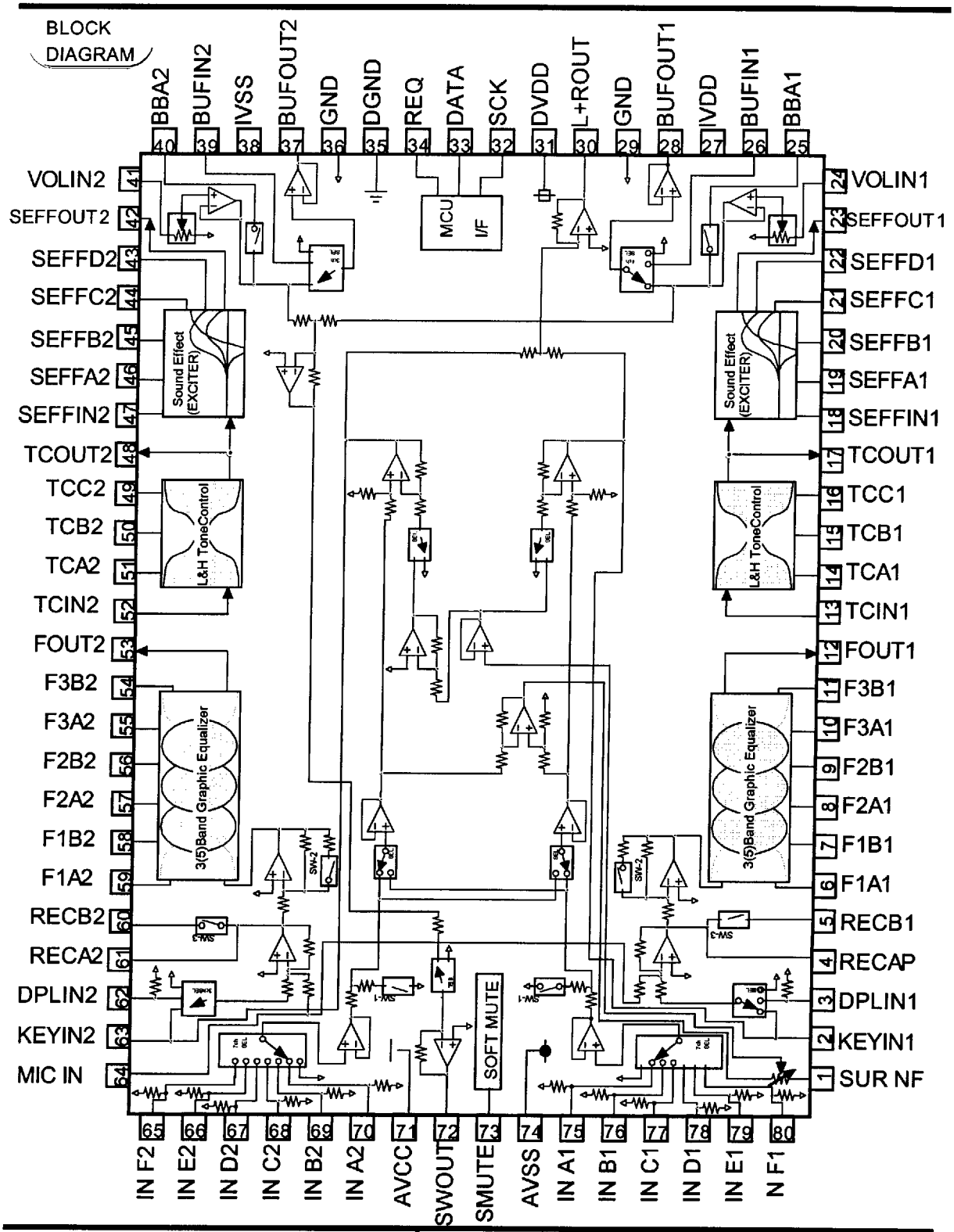
# M615XXFP

**Digital controlled Sound Controller**

BLOCK DIAGRAM

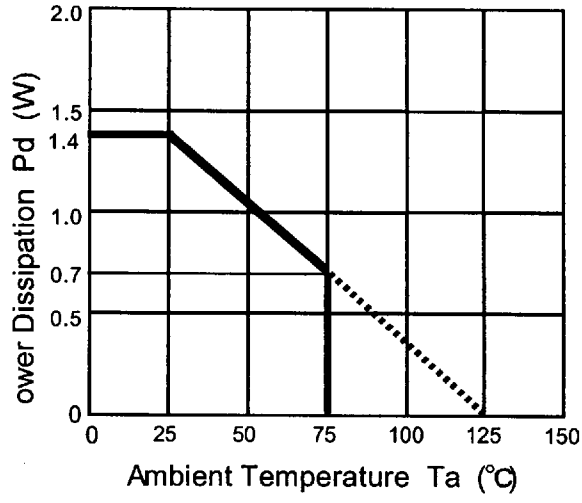


## Electric Characteristics

### (1).Absolute Maximum ratings

(Ta=25 ℃,AVDD=4.5V,AVSS=-4.5V,DVDD=5.0V ,f=1kHz unless otherwise noted )
( Normal mode , Tone control and Bass boost controlled 0dB )

| Symbol | Parameter | Conditions | Ratings | Units |
|---|---|---|---|---|
| Vcc | Supply Voltage | | ± 5.25 (10.5) | V |
| VDD | | | 6.5 | V |
| Pd | Power Dissipation | | 1.4 | W |
| Topr | Operating Temperature | | -20 to +75 | C |
| Tstg | Storage Temperature | | -40 to +125 | C |




### (2)RECommended Operating Condition

| Parameter | symbol | Test conditions | Limits | | | Units |
|---|---|---|---|---|---|---|
| | | | Min | typ | Max | |
| Analog positive supply current | AICC | AVCC=4.5V, AVSS= -4.5V 71pin current No signal | — | 30 | 50 | mA |
| Analog negative supply current | AIss | AVcc=4.5V, AVSS= -4.5V 74pin current No signal | -50 | -30 | — | mA |
| Digital supply current | DIdd | DVDD= 5V 31pin current No signal | — | 0.5 | 1.0 | mA |

## (3)Characteristics of output /input

(Ta=25 ℃,AVDD=4.5V,AVSS=-4.5V,DVDD=5.0V ,f=1kHz unless otherwise noted )
( Normal mode , Tone control and Bass boost controlled 0dB )

| Parameter | symbol | Test conditions | | Limits Min | Limits typ | Limits Max | Units |
|---|---|---|---|---|---|---|---|
| Input Resistance | Rin | 75pin,70Pin | | 40 | 60 | 80 | KΩ |
| Maximum Output Voltage | VIM | (75,70)pin Input,(28,37)pin Output RL =10KΩ , THD=1% | | 1.5 | 1.8 | — | Vrms |
| Output terminal Voltage | Vodc | 28pin,37pin, No signal | | -0.4 | 0.0 | 0.4 | V |
| | VRECdc | 4pin,61pin, No signal | | -0.4 | 0.0 | 0.4 | V |
| Through Gain | Gv | Vin=1Vrms,FLAT,(75,70pin) - (28,37pin)gain | | -10.0 | -8.0 | -6.0 | dB |
| Maximum Attenuation | ATT | Vo=1Vrms,28,37pin JIS-A filter | | — | -85 | -77 | dB |
| Output Noise Voltage | Vono | JIS-A filter No signal,Rg=10K FLAT(pass) | 28,37pin | — | 4.0 | 10.0 | μVrms |
| | VRECno | | 4,61pin | — | 4.0 | 8.0 | μVrms |
| Distortion | THD | 28pin,37pin, BW=400 to 30kHz Vo=300mVrms , RL=10KΩ | | — | 0.01 | 0.05 | % |
| | THDRECA | 4pin,61pin, BW=400 to 30kHz Vo=300mVrms , RL=30KΩ | | — | 0.01 | 0.05 | % |
| | THDRECB | 5pin,60pin, BW=400 to 30kHz Vo=300mVrms , RL=51KΩ | | — | 0.01 | 0.05 | % |
| Channel cross-talk | CT | Vo=0.5Vrms , RL=10KΩ ,JIS-A 28pin-37pin Rg=10KΩ | | — | -70 | -55 | dB |
| | CTREC | Vo=0.5Vrms , RL=30KΩ ,JIS-A 4pin-61pin Rg=10KΩ | | — | -70 | -55 | dB |

## (4)TONE CONTROL CHARACTERISTICS

| Parameter | symbol | | Test conditions | | Limits Min | Limits typ | Limits Max | Units |
|---|---|---|---|---|---|---|---|---|
| LO Tone Output Gain | GboostL | LO | +13dB | f=100Hz : LO TONE<br>f=10kHz : HI TONE<br>f=1KHz : F1 to F3<br>Vo=1Vrms<br>Gain<br>from input4pin,61pin<br>to output17pin,48pin | 10 | 13 | 16 | dB |
| | GcutL | LO | -13dB | | -10 | -13 | -16 | dB |
| Tone Output Gain | Gboost* | F1 to F3 | +8 dB | | 6 | 8 | 10 | dB |
| | Gcut* | F1 to F3 | -8 dB | | -6 | -8 | -10 | dB |
| HI Tone Output Gain | GboostH | HI | +8 dB | | 6 | 8 | 10 | dB |
| | GcutH | HI | -8 dB | | -6 | -8 | -10 | dB |
| Channel Balance | BALton | | f=1KHz,Vo=1Vrms,6,59pin Input<br>21,44pin Output<br>each Boost +8,-6dB | | -1.5 | 0 | +1.5 | dB |

## (5)CH1 / CH2 Mix Signal

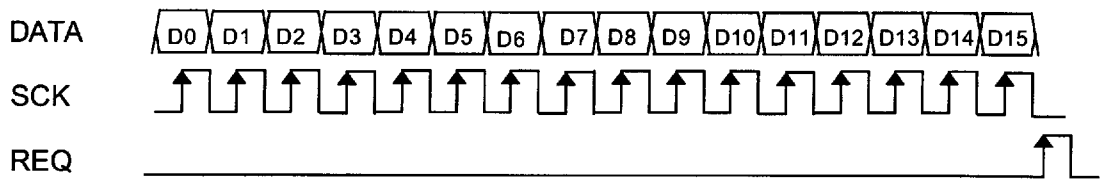
(This character is regulated only one channel input. )

| Parameter | | symbol | Test conditions | Limits Min | Limits typ | Limits Max | Units |
|---|---|---|---|---|---|---|---|
| Super Woofer Output | Gain | GvSW | The same condition Gv<br>RL=30KΩ | -8.0 | -6.0 | -4.0 | dB |
| | Distortion | THDSW | BW=400 to 30kHz<br>Vo=0.5Vrms , RL=30KΩ | — | 0.03 | 0.15 | % |
| | Output Noise Voltage | VnoSW | No signal: JIS-A filter<br>The same condition Vono | — | 50 | 100 | μVrms |
| (L+R)/2(spectrum)output gain | | GvLR | The same condition Gv<br>RL=51KΩ | -8.0 | -6.0 | -4.0 | dB |

*In case of CH1,CH2 same phase,same amplitude,output gain is 0dB.

## INPUT DATA FORMAT

DATA is read at the rising edge of SCK, and loaded last 16 bits at the rising edge of REQ.




( Please all data of 4 format ininalize at Power supply.)

| | D0 | D1 | D2 | D3 | D4 | D5 | D6 | D7 | D8 | D9 | D10 | D11 | D12 | D13 | D14 | D15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 0 | 0 | '(1) INPUT Selector | | | '(2) InputATT | '(3) TONE ATT | '(4) Multiple Sound | | '(5) Sur/Nor | '(6) REC8MUTE | '(7) SURROUND ATT | | | | |
| B | 0 | 1 | '(8) TONE Selector | | | '(9) TONE control | | | | '(10) BassBoost | '(11) DPL Sel | '(12) Sound Effect | | | Chip Address | |
| C | 1 | 0 | '(16) ALLMUTE | (13)-L Lch Trim Volume | | | | (14)-L Lch ShiftVolume | | (15)-L Lch Master Volume | | | | | 1 | 1 |
| D | 1 | 1 | '(17) SWMUTE | (13)-R Rch Trim Volume | | | | (14)-R Rch ShiftVolume | | (15)-R Rch Master Volume | | | | | | |

(1)INPUT SELECTOR

| NPUT SEL. | D2A | D3A | D4A |
|---|---|---|---|
| A | 0 | 0 | 0 |
| B | 0 | 0 | 1 |
| C | 0 | 1 | 0 |
| D | 0 | 1 | 1 |
| E | 1 | 0 | 0 |
| F | 1 | 0 | 1 |
| MUTE | 1 | 1 | 1 |

(2)INPUT ATT

| INPUT ATT | D5A | SW-1 |
|---|---|---|
| 0dB | 0 | OFF |
| -5dB | 1 | ON |

(3)Tone ATT

| TONE ATT | D6A | SW-2 |
|---|---|---|
| -8dB | 0 | OFF |
| -13dB | 1 | ON |

(4)Multiple Sound

| CH SEL. | D7A | D8A |
|---|---|---|
| NORMAL | 0 | 0 |
| CH1 ONLY | 0 | 1 |
| CH2 ONLY | 1 | 0 |
| (CH1<>CH2) | 1 | 1 |

(5)SURROUND / Normal

| SEL | D9A |
|---|---|
| NORMAL | 0 |
| SURROUND | 1 |

(6)REC B MUTE

| REC B | D10A | SW-3 |
|---|---|---|
| THRU | 0 | ON |
| MUTE | 1 | OFF |

(7)SURROUND ATT

| NPUT SEL. | D11A | D12A | D13A |
|---|---|---|---|
| 0dB | 0 | 0 | 0 |
| -1dB | 0 | 0 | 1 |
| -2dB | 0 | 1 | 0 |
| -4dB | 0 | 1 | 1 |
| -6dB | 1 | 0 | 0 |
| -10dB | 1 | 0 | 1 |

(11)DPL Selector

| DPL SEL. | D10B |
|---|---|
| THRU | 0 |
| DPL | 1 |

* Don't Input the Illegal DATA.

(8) TONE Selector

| TONE SEL. | D2B | D3B | D4B |
|---|---|---|---|
| LO TONE | 0 | 0 | 0 |
| TONE1(F1) | 0 | 0 | 1 |
| TONE2(F2) | 0 | 1 | 0 |
| TONE3(F3) | 0 | 1 | 1 |
| HI TONE | 1 | 0 | 0 |
| ALL BAND | 1 | 1 | 1 |

(9) Tone control

| LO | F1-F3,HI | D8B | D7B | D6B | D5B |
|---|---|---|---|---|---|
| +13dB | +8dB | 1 | 1 | 0 | 0 |
| +9dB | +6dB | 1 | 0 | 1 | 1 |
| +6dB | +4dB | 1 | 0 | 1 | 0 |
| +3dB | +2dB | 1 | 0 | 0 | 1 |
| +0dB | +0dB | 1 | 0 | 0 | 0 |
| -0dB | -0dB | 0 | 0 | 0 | 0 |
| -3dB | -2dB | 0 | 0 | 0 | 1 |
| -6dB | -4dB | 0 | 0 | 1 | 0 |
| -9dB | -6dB | 0 | 0 | 1 | 1 |
| -13dB | -8dB | 0 | 1 | 0 | 0 |

(10) Bass Boost

| Bus Boost | D9B |
|---|---|
| No Boost | 0 |
| Boost ON | 1 |

(12) Sound Effect

| | TONE SEL. | D13B | D12B | D11B |
|---|---|---|---|---|
| phase | 0dB | 0 | 0 | 0 |
| | +3dB | 0 | 0 | 1 |
| | +6dB | 0 | 1 | 0 |
| | +9dB | 0 | 1 | 1 |
| -phase | 0dB | 1 | 0 | 0 |
| | -3dB | 1 | 0 | 1 |
| | -6dB | 1 | 1 | 0 |
| | -9dB | 1 | 1 | 1 |

* 0dB=Effect through (Both Mode)

(13) Trim Volume(Lch,Rch)

| TONE SEL. | D6C,D | D5C,D | D4C,D | D3C,D |
|---|---|---|---|---|
| 0dB | 0 | 0 | 0 | 0 |
| -1dB | 0 | 0 | 0 | 1 |
| -2dB | 0 | 0 | 1 | 0 |
| -3dB | 0 | 0 | 1 | 1 |
| -4dB | 0 | 1 | 0 | 0 |
| -5dB | 0 | 1 | 0 | 1 |
| -6dB | 0 | 1 | 1 | 0 |
| -7dB | 0 | 1 | 1 | 1 |
| -8dB | 1 | 0 | 0 | 0 |
| -9dB | 1 | 0 | 0 | 1 |
| -10dB | 1 | 0 | 1 | 0 |
| -11dB | 1 | 0 | 1 | 1 |
| -12dB | 1 | 1 | 0 | 0 |
| -13dB | 1 | 1 | 0 | 1 |
| -14dB | 1 | 1 | 1 | 0 |
| -15dB | 1 | 1 | 1 | 1 |

(14) Shift Volume(Lch,Rch)

| NPUT SEL. | D8C,D | D7C,D |
|---|---|---|
| 0dB | 0 | 0 |
| -1dB | 0 | 1 |
| -2dB | 1 | 0 |
| -3dB | 1 | 1 |

(15) Master Volume (Lch,Rch)

| ATT | D13C,D | D12C,D | D11C,D | D10C,D | D9C,D |
|---|---|---|---|---|---|
| 0dB | 0 | 0 | 0 | 0 | 0 |
| -2.0dB | 1 | 0 | 0 | 0 | 0 |
| -4.0dB | 0 | 1 | 0 | 0 | 0 |
| -6.0dB | 1 | 1 | 0 | 0 | 0 |
| -8.0dB | 0 | 0 | 1 | 0 | 0 |
| -10.0dB | 1 | 0 | 1 | 0 | 0 |
| -12.0dB | 0 | 1 | 1 | 0 | 0 |
| -14.0dB | 1 | 1 | 1 | 0 | 0 |
| -16.0dB | 0 | 0 | 0 | 1 | 0 |
| -18.0dB | 1 | 0 | 0 | 1 | 0 |
| -20.0dB | 0 | 1 | 0 | 1 | 0 |
| -22.0dB | 1 | 1 | 0 | 1 | 0 |
| -24.0dB | 0 | 0 | 1 | 1 | 0 |
| -26.0dB | 1 | 0 | 1 | 1 | 0 |
| -28.0dB | 0 | 1 | 1 | 1 | 0 |
| -30.0dB | 1 | 1 | 1 | 1 | 0 |
| -32.0dB | 0 | 0 | 0 | 0 | 1 |
| -34.0dB | 1 | 0 | 0 | 0 | 1 |
| -36.0dB | 0 | 1 | 0 | 0 | 1 |
| -38.0dB | 1 | 1 | 0 | 0 | 1 |
| -40.0dB | 0 | 0 | 1 | 0 | 1 |
| -42.0dB | 1 | 0 | 1 | 0 | 1 |
| -44.0dB | 0 | 1 | 1 | 0 | 1 |
| -48.0dB | 1 | 1 | 1 | 0 | 1 |
| -52.0dB | 0 | 0 | 0 | 1 | 1 |
| -56.0dB | 1 | 0 | 0 | 1 | 1 |
| -60.0dB | 0 | 1 | 0 | 1 | 1 |
| -64.0dB | 1 | 1 | 0 | 1 | 1 |
| -68.0dB | 0 | 0 | 1 | 1 | 1 |
| -72.0dB | 1 | 0 | 1 | 1 | 1 |
| -76.0dB | 0 | 1 | 1 | 1 | 1 |
| MUTE | 1 | 1 | 1 | 1 | 1 |

(16) All MUTE

| DPL | D2C |
|---|---|
| NO MUTE | 0 |
| ALL MUTE | 1 |

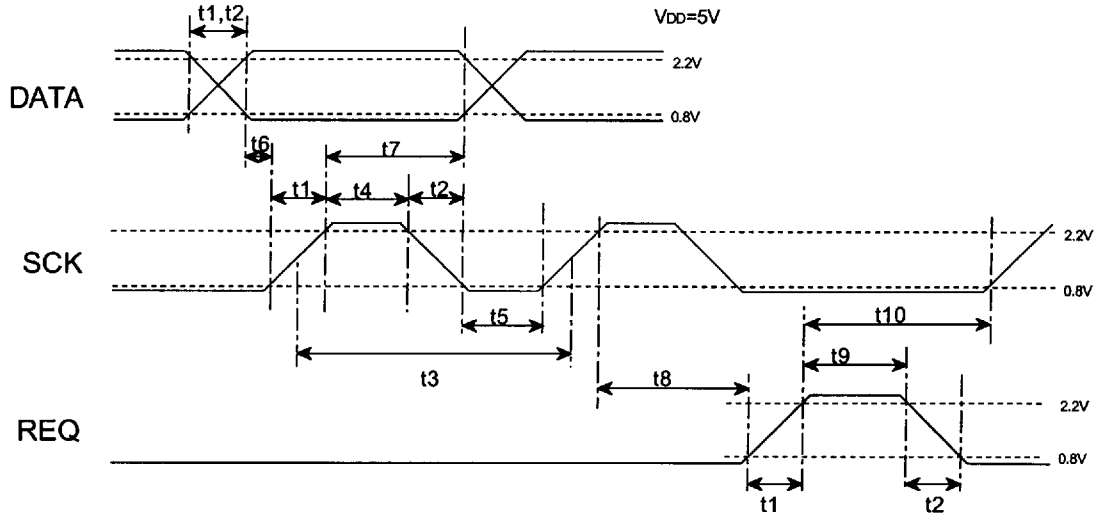
All MUTE condition:
Master Volume (L,R)=MUTE,
INPUT SELECTOR=MUTE

(17) SW MUTE

| SW | D2D |
|---|---|
| SWOUT | 0 |
| SWMUTE | 1 |

* Don't Input the Illegal DATA.

## DATA TIMING



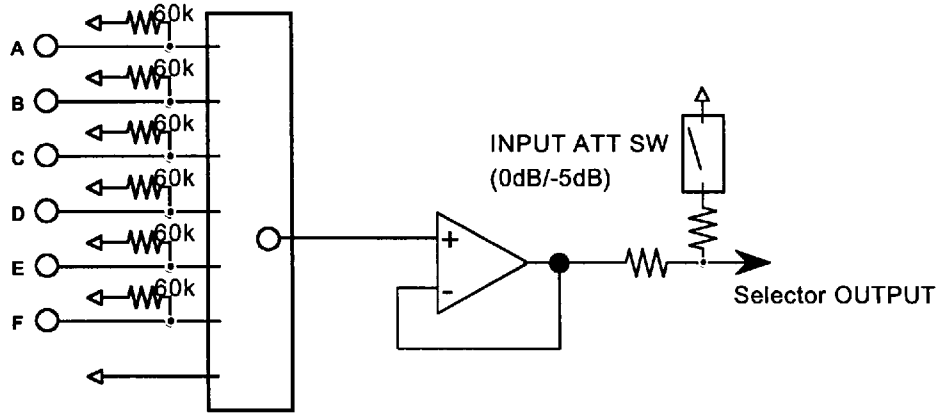

| Symbol | Name | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| t1 | Signal rise time | — | — | 0.5 | µS |
| t2 | Signal fall time | — | — | 0.5 | µS |
| t3 | SCK clock width | 2 | — | — | µS |
| t4 | SCK "H" pulse width | 0.8 | — | — | µS |
| t5 | SCK "L" pulse width | 0.8 | — | — | µS |
| t6 | DATA setup time | 0.8 | — | — | µS |
| t7 | DATA hold time | 0.8 | — | — | µS |
| t8 | REQ rise hold time | 1.6 | — | — | µS |
| t9 | REQ "H" pulse width | 0.8 | — | — | µS |
| t10 | SCK setup time | 1.6 | — | — | µS |

## DESCRIPTION OF FUNCTION

(1)Input Selector , Input Attenuator

2ch 6 Input+MUTE Selector built-in.

Input Selector is controlled ATT SW.(0dB/-5dB)

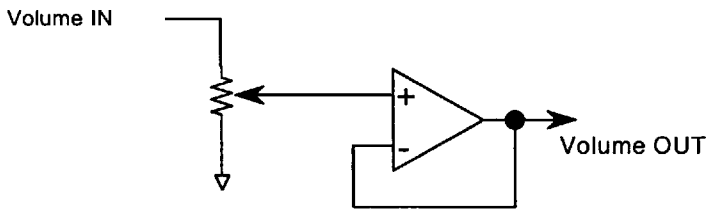



(2)Master Volume(CH1,CH2) , Trim Volume

This IC have 2 channel electric volume, 2 channel independent control.
It has low distortion and low noise.
It is able to control each Master and Trim Volume.

Master Volume :0dB to -79dB / 1dB step , MUTE
Trim Volume :0dB to -15dB / 1dB step

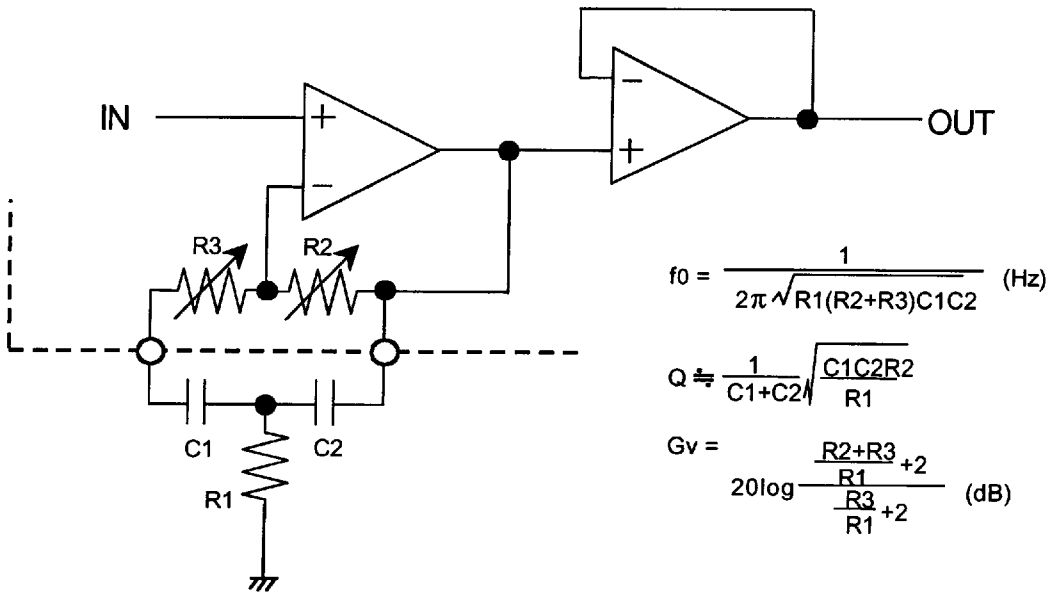
Volume output consist of adding Master volume and Trim volume.
In case (Trim) + (Master) under -88dB , TOTAL ATT = -87dB.
Only Master Volume = MUTE , TOTAL ATT = MUTE



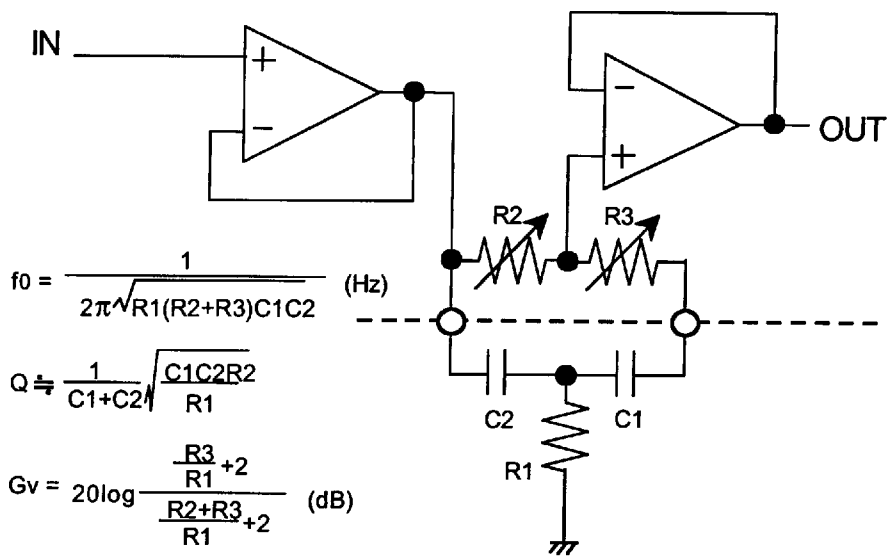

Master Volume: 0dB to -79dB/1dB step , MUTE
Trim Volume : 0dB to -15dB/1dB step

(3)Tone control circuit

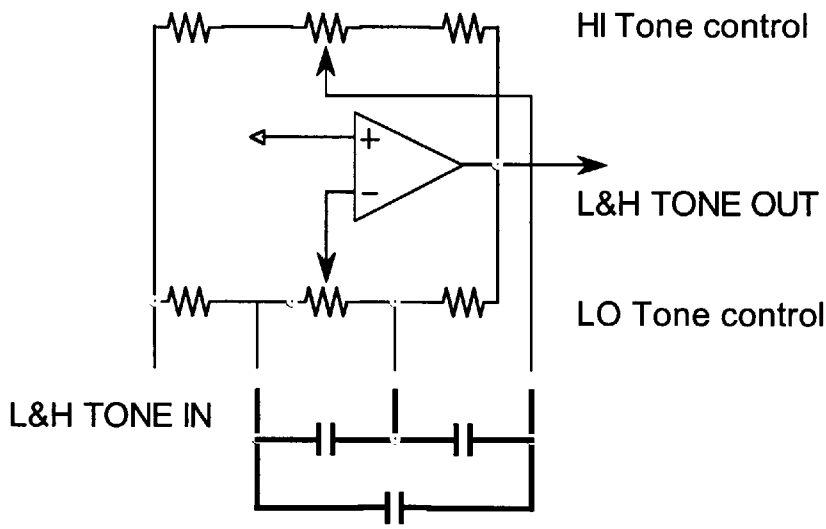
3-1 3Band resonate type (Boost Mode)



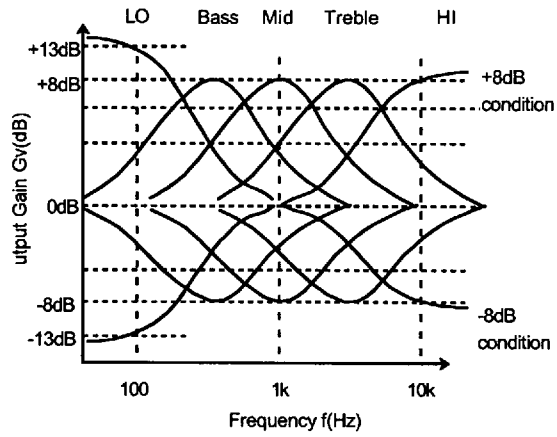

3-2 3Band resonate type(Cut Mode)



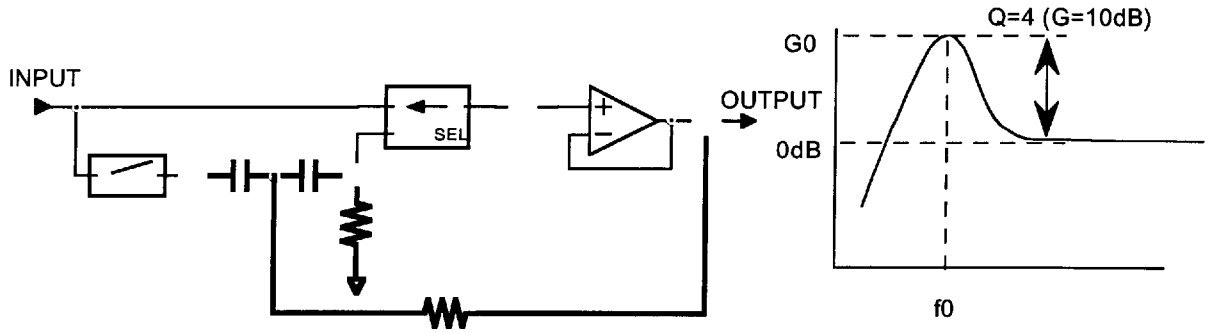
## 3-3 LO and HI Tone control circuit



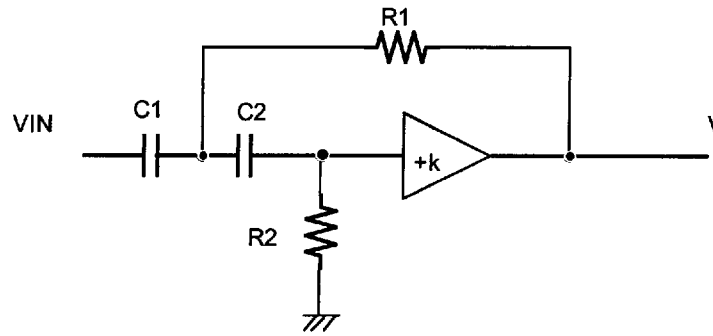

<Frequency Characteristic>



## (4)Bass Boost circuit




Positive feedback 2 order HPF circuit




2 order HPF Gain Characteristic (ex.)

| Q | g0 |
|---|---|
| 1 | 0 to 1 dB |
| 2 | 6 dB |
| 4 | 10 dB |
| 5 | 13 dB |
| 10 | 20 dB |

$$\frac{VOUT}{VIN} = \frac{Ks^2}{s^2+s\left[\frac{1}{R2C1}+\frac{1}{R2C2}+(1-K)\frac{1}{R1C1}\right]+\frac{1}{R1R2C1C2}}$$

$$\omega 0^2 = \frac{1}{R1R2C1C2}$$

$$Q = \frac{1}{\sqrt{\frac{R1C1}{R2C2}}+\sqrt{\frac{R1C2}{R2C1}}+(1-K)\sqrt{\frac{R2C2}{R1C1}}}$$

Bass boost consist of positive feedback 2 order HPF circuit
Method of calculation indicate below.

In this condition

C1 = C2 = Cf , K = +1
calculated

Rf = 1/((ω0Cf) (1)

R1 = Rf/2Q (2)

R2 = 2QRf (3)

Fc=70Hz,Q=4

0=2π x70Hz, Q=4

In this condition

C1=C2=Cf=0.1μF,
from (1), (2), (3)

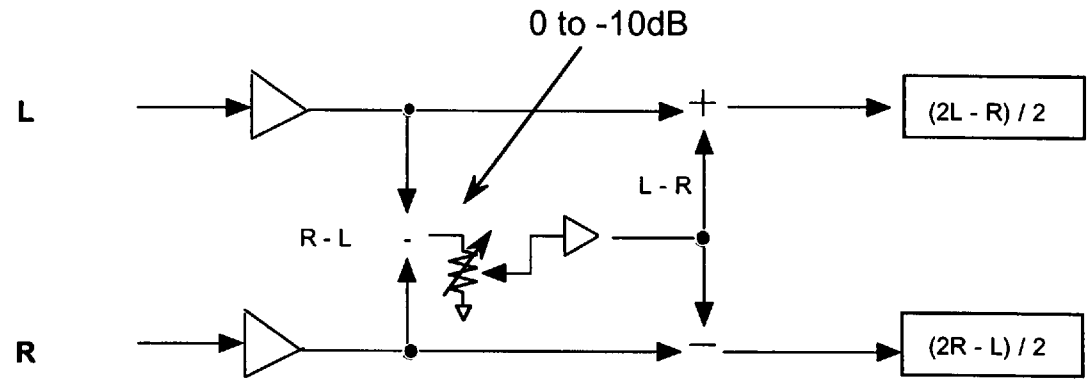
Rf=22.7 KΩ

R1 = 2.84KΩ

R2 = 182 KΩ

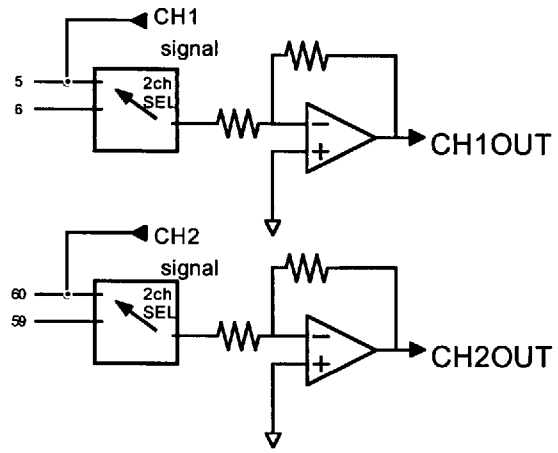
R1, R2= about 3.0KΩ , 200KΩ

(5)SURROUND Mode

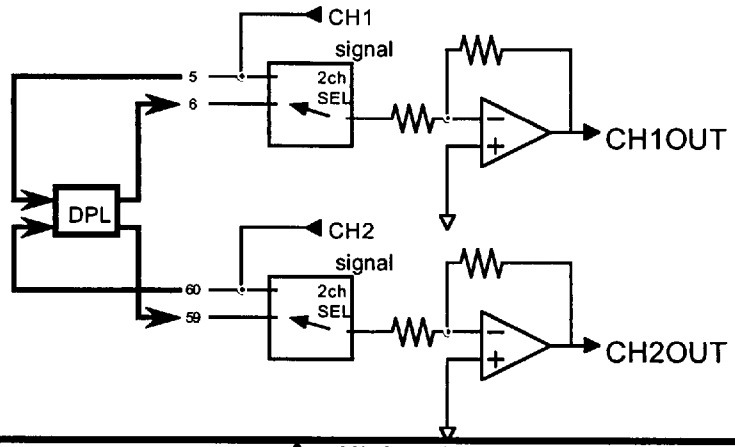



(6)DPL Mode select

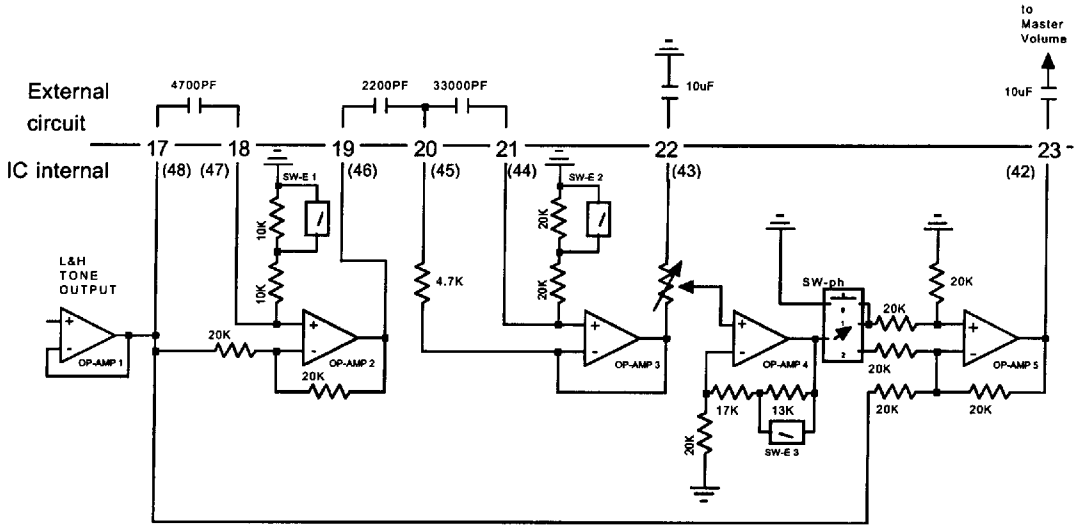
8-1 Thru Mode




8-2 DPL Mode



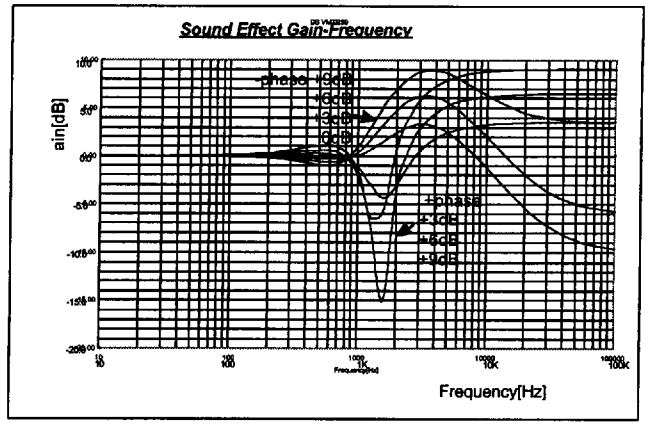
## (7)Sound Effect




SW-E1,SW-E2,SW-E3,SW-ph

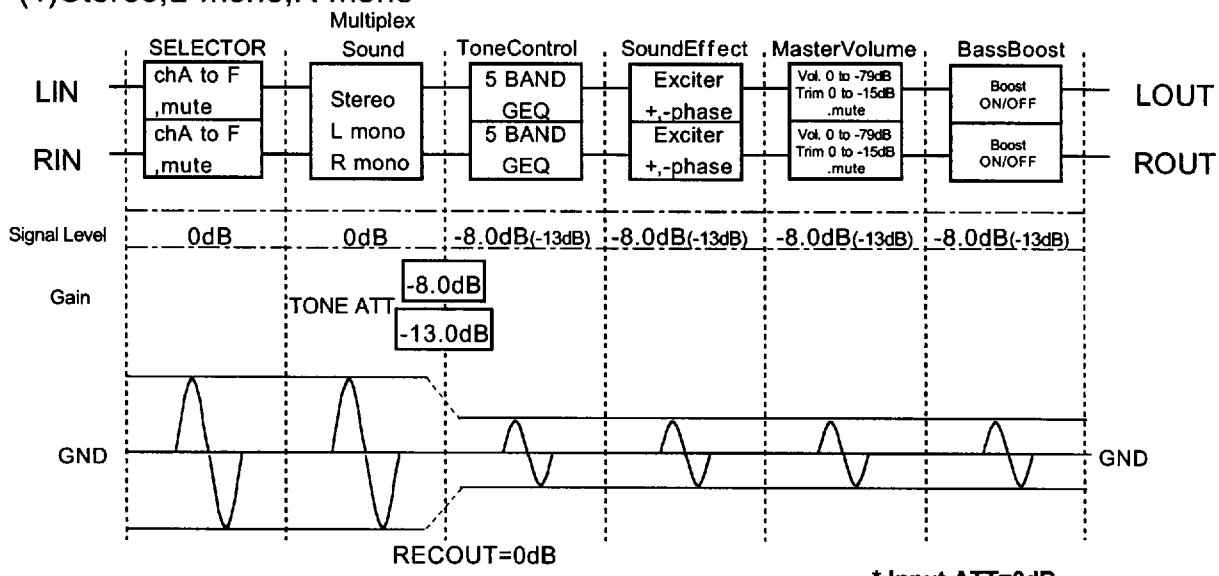
| Condition | SW-E1,E2 | SW-E3 | SW-ph |
|---|---|---|---|
| -phase | ON | OFF | 1 |
| +phase | OFF | ON | 2 |
| 0dB(through) | - | - | 0 (1,2:off) |

Sound Effect Frequency Characteristic



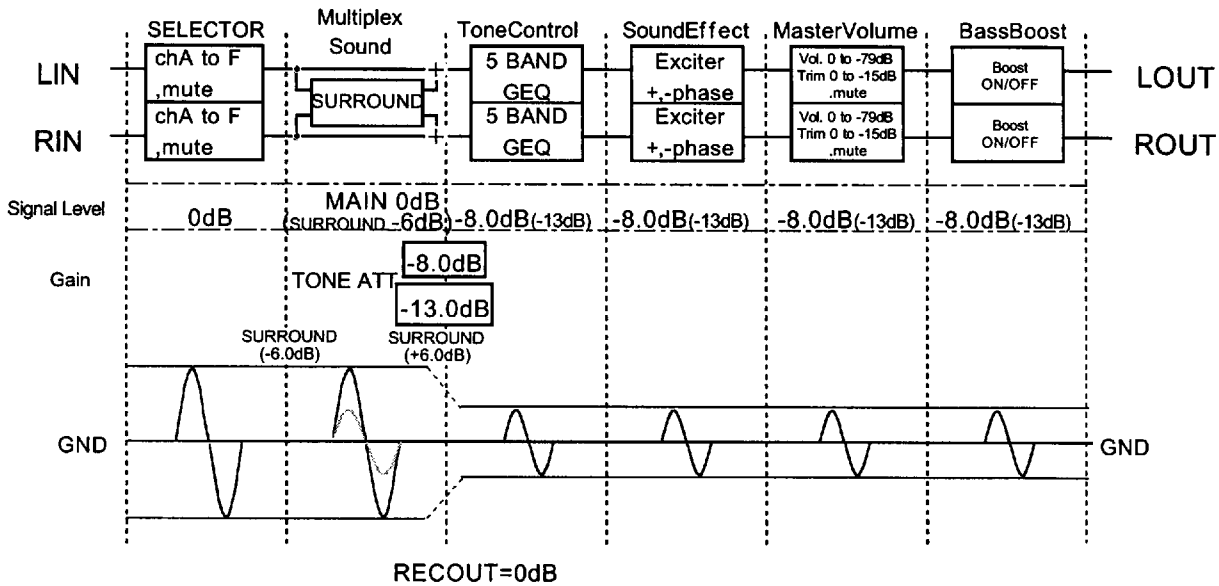
## LEVEL DIAGRAM

### (1)Stereo,L mono,R mono




*** Input ATT=0dB**

### (2)SURROUND




*** Input ATT=0dB**

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

# M615XXFP

**Digital controlled Sound Controller**