

# PRELIMINARY

# M61515FP

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

## TONE CONTROL/VOLUME CONTROL

### DESCRIPTION

The M61515FP is the sound controller powered by "QSurround" system. The "QSurround" system decodes and virtualizes multi-speaker surround sound from various matrix surround encoded sources such as: Dolby Surround, stereo downmixed AC-3, stereo downmixed DTS. Produces normal and wide 3D sound expansion from any stereo input signal.

(Note) This device is produced under license from QSound Lab, Inc. (Canada).

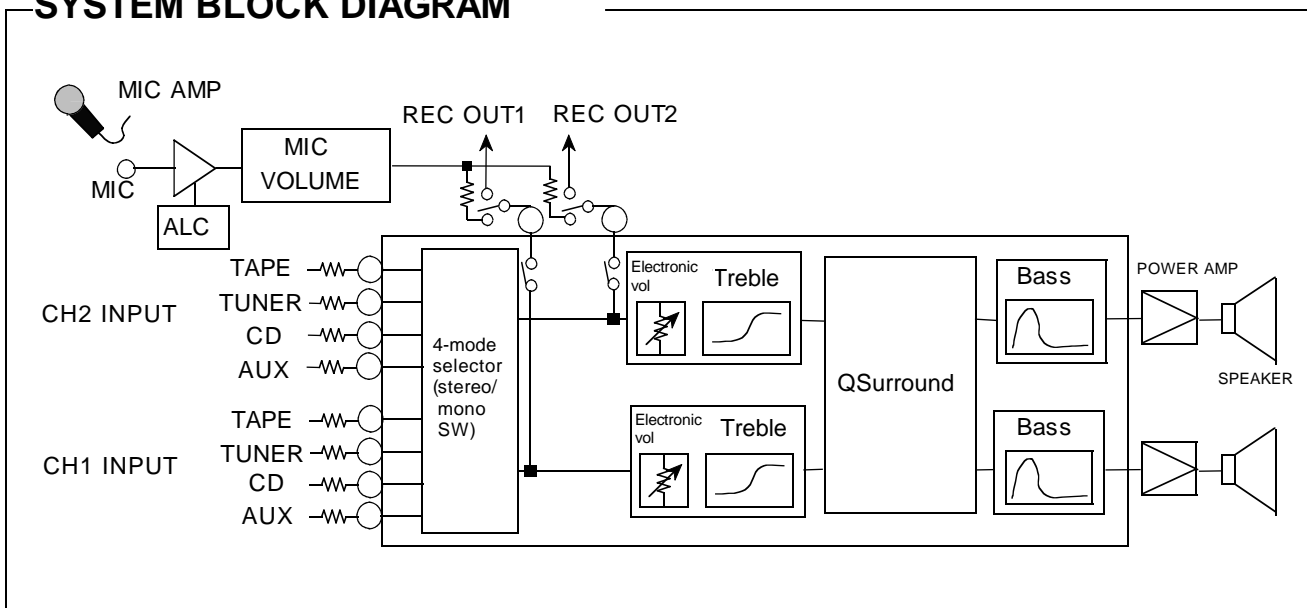
### FEATURES

- Built-in "QSurround" sound technology
- Electronic volume.  
0 ~ -84dB, infinitesimal
- 2-band tone control  
Bass(0 ~ +21dB/3dB STEP)  
Treble(0 ~ +9dB/3dB STEP)
- 5 input selector(The fifth input can be used as REC OUT or MIC MIX.)

### RECOMMENDED OPERATING CONDITIONS

Supply voltage range ----- ±2.25 ~ ±2.75V

### SYSTEM BLOCK DIAGRAM



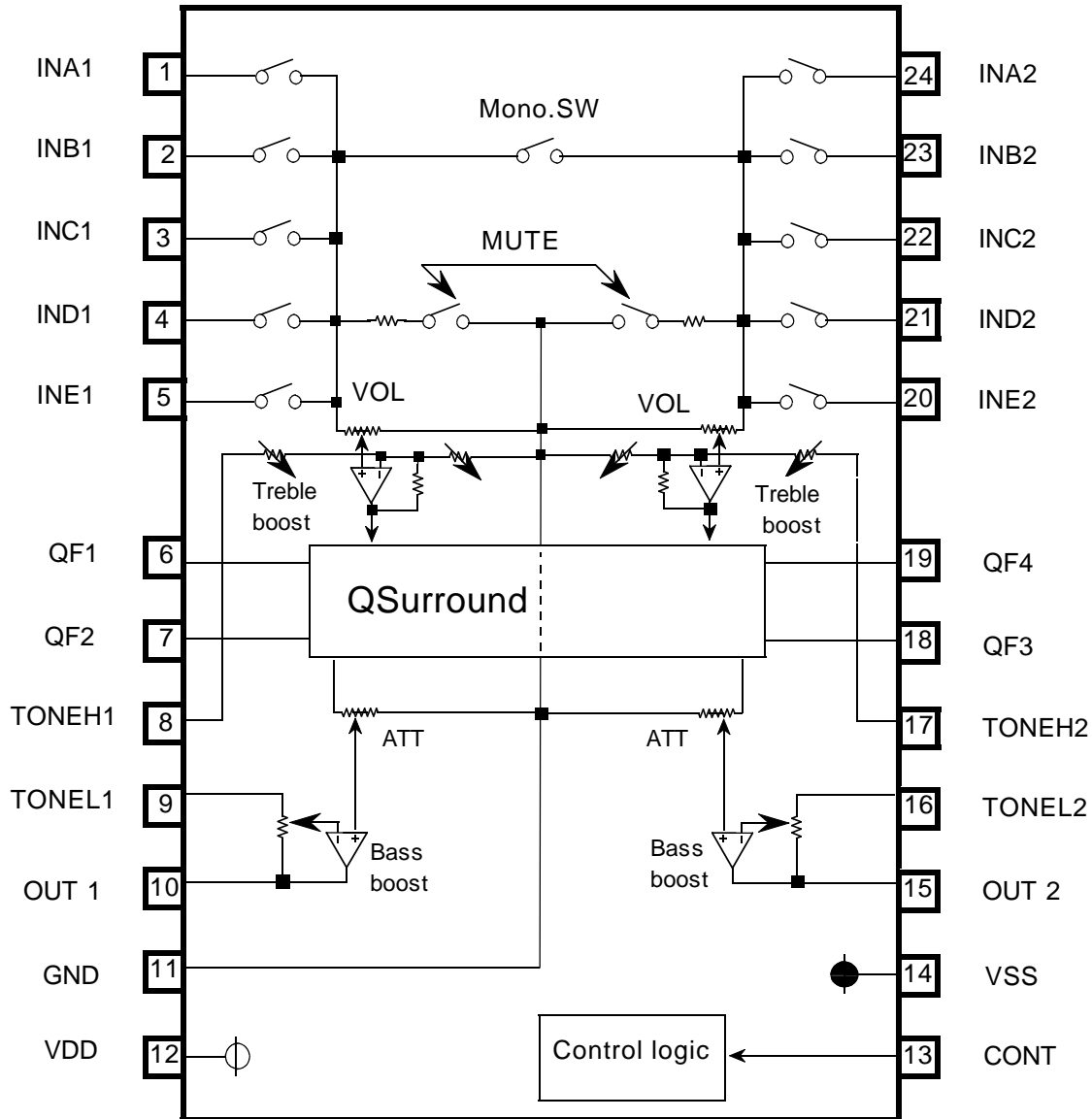
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### BLOCK DIAGRAM



Units Resistance :  
 Capacitance: F

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TONE CONTROL/VOLUME CONTROL

**PIN DESCRIPTION**

| Pin No. | Name   | Function  |
|---------|--------|---|
| 1       | IN A1  | INPUTs of the channel 1<br><div style="border: 1px solid black; padding: 5px; margin-top: 10px;">                         The switch of INE can be controlled independently.<br/>                         Please set "ALL OFF" mode when the switch of E is only ON.                     </div> |
| 2       | IN B1  |   |
| 3       | IN C1  |   |
| 4       | IN D1  |   |
| 5       | IN E1  |   |
| 6       | QF1    | QSurround filter 1  |
| 7       | QF2    | QSurround filter 2  |
| 8       | TONEH1 | Treble control adjustment of the channel 1  |
| 9       | TONEL1 | Bass control adjustment of the channel 1  |
| 10      | OUT1   | OUTPUT of the channel 1   |
| 11      | GND    | Ground  |
| 12      | VDD    | Supply voltage(+)   |
| 13      | CONT   | Control data input from a microcontroller   |
| 14      | VSS    | Supply voltage(-)   |
| 15      | OUT2   | OUTPUT of the channel 2   |
| 16      | TONEL2 | Bass control adjustment of the channel 2  |
| 17      | TONEH2 | Treble control adjustment of the channel 2  |
| 18      | QF3    | QSurround filter 3  |
| 19      | QF4    | QSurround filter 4  |
| 20      | IN E2  | INPUTs of the channel 2<br><div style="border: 1px solid black; padding: 5px; margin-top: 10px;">                         The switch of INE can be controlled independently.<br/>                         Please set "ALL OFF" mode when the switch of E is only ON.                     </div> |
| 21      | IN D2  |   |
| 22      | IN C2  |   |
| 23      | IN B2  |   |
| 24      | IN A2  |   |

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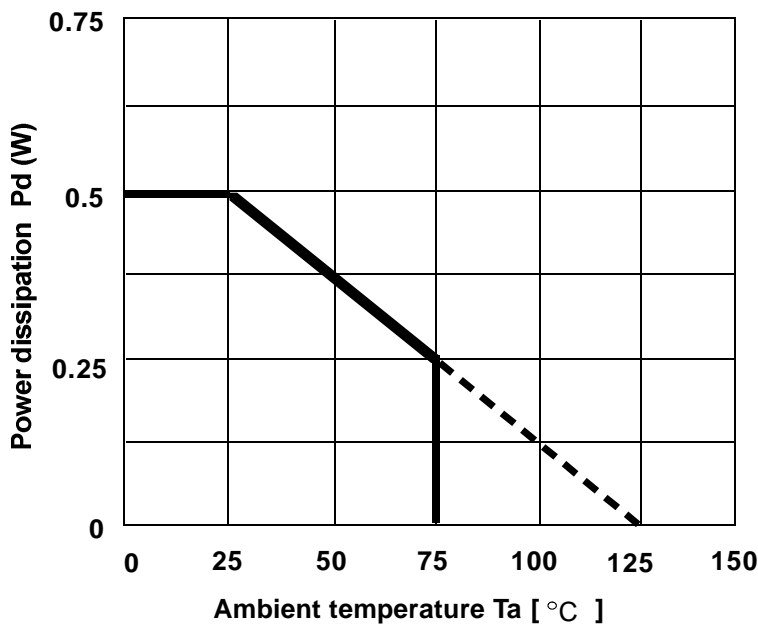
## TONE CONTROL/VOLUME CONTROL

### ABSOLUTE MAXIMUM RATINGS

(Ta=25 °C, unless otherwise noted)

| Symbol       | Parameter             | Test conditions | Rating    | Unit  |
|--------------|-----------------------|-----------------|-----------|-------|
| VDD-VSS      | Supply voltage        |                 | 6.0       | V     |
| $K_{\theta}$ | Thermal derating      | Note:1          | 5         | mW/°C |
| Pd           | Power dissipation     |                 | 500       | mW    |
| Topr         | Operating temperature |                 | -20 ~ 75  | °C    |
| Tstg         | Storage temperature   |                 | -40 ~ 125 | °C    |

### Thermal derating(maximum rating)



Note.1 reference PC Board

Size :70mmX70mm  
 Thickness:1.6mm  
 Material :glass epoxy

Copper pattern dimension  
 Width :0.25mm  
 Length :25 ~ 30mm/lead  
 Thickness:18um

### Recommended operating conditions

| Symbol | Parameter                  | Pin No. | Condition | Limits |      |       | Unit |
|--------|----------------------------|---------|-----------|--------|------|-------|------|
|        |                            |         |           | min.   | typ. | max.  |      |
| VDD    | Supply voltage(+)          | 12      |           | 2.25   | 2.5  | 2.75  | V    |
| VSS    | Supply voltage(-)          | 14      |           | -2.75  | -2.5 | -2.25 |      |
| CONT   | Control data input voltage | 13      |           | GND    | —    | VDD   |      |

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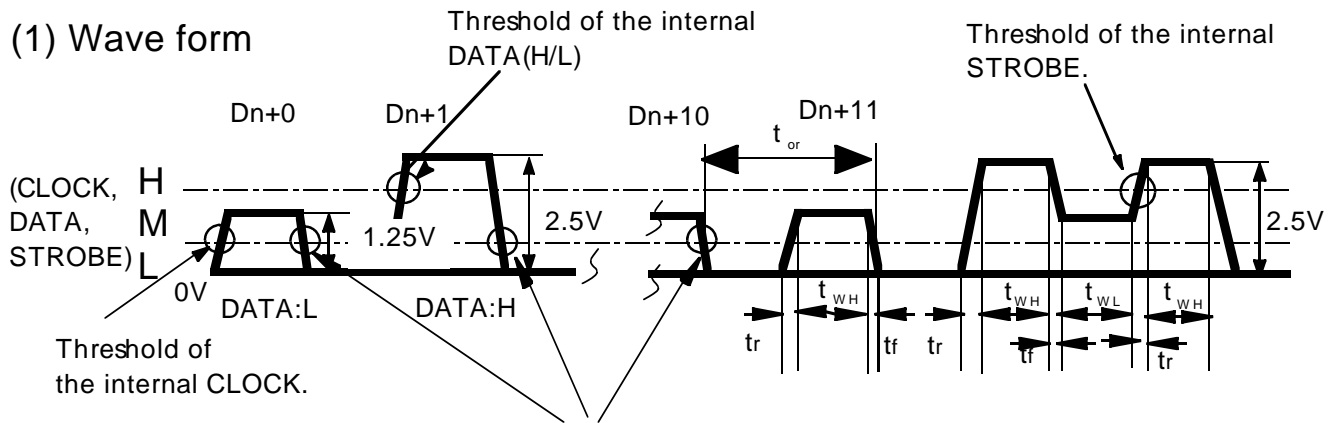
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## TONE CONTROL/VOLUME CONTROL

### CONTROL SIGNALS SPECIFICATION

#### (1) Wave form



The internal DATA latch at the falling edges of this clock signal.

#### (2) Voltage control signal

| Digital input signal |   | Condition          | Limits |                 |      | Unit |
|----------------------|---|--------------------|--------|-----------------|------|------|
|                      |   |                    | min.   | typ.            | max. |      |
| L signal             | L | VDD=2.5V,VSS=-2.5V | GND    | —               | 0.4  | V    |
| M signal             | M | VDD=2.5V,VSS=-2.5V | 1.0    | 1.25<br>(VDD/2) | 1.5  |      |
| H signal             | H | VDD=2.5V,VSS=-2.5V | 2.1    | —               | VDD  |      |

#### (3) Timing control signal

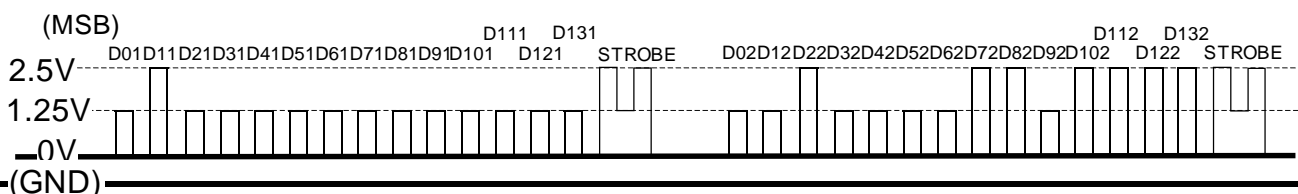
| Symbol    | Parameter                               | Limits |     |     | Unit |
|-----------|---|--------|-----|-----|------|
|           |   | min    | typ | max |      |
| $t_{cr}$  | Cycle time of digital signal            | 8      | —   | —   | μsec |
| $t_{wH}$  | Pulse width of digital signal("H"level) | 3.6    | —   | —   |      |
| $t_{wLC}$ | Pulse width of digital signal("L"level) | 3.6    | —   | —   |      |
| $t_r$     | Rise time of digital signal             | —      | —   | 0.4 |      |
| $t_f$     | Fall time of digital signal             | —      | —   | 0.4 |      |

#### (4) Control signal example(Refer to page 6 on the control data)

An example of the mode control

BYPASS/SURROUND SW: SURROUND  
 VOL/TREBLE SHARE AMP GAIN: 20dB  
 INPUT : INA,  
 VOLUME : 0dB  
 MUTE : OFF

SURROUND MODE: QSurround  
 SURROUND EFFECT: 0dB  
 MODE: STEREO  
 BASS: 18dB  
 TREBLE: 6dB  
 RECOUT: ON(INE)



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STONE CONTROL/VOLUME CONTROL

CONTROL DATA FORMAT

\*It's necessary to set up the all control data after power on.

(1) INPUT DATA

(MSB) ← Input order

|       |     |                           |   |   |   |     |     |     |     |   |   |      |      |
|-------|-----|---------------------------|---|---|---|-----|-----|-----|-----|---|---|------|------|
| D01   | D11 | D21                       | D31   | D41   | D51                                     | D61 | D71 | D81 | D91 | D101  | D111  | D121 | D131 |
| Slot1 | 0   | Bypass/<br>Surround<br>SW | Vol/Treble share amp<br>gain SW<br>0:20dB<br>1:18dB<br>2:16dB<br>3:14dB | INPUT<br>0:IN A<br>1:IN B<br>2:IN C<br>3:IN D | D2 to D6:(a)Master v olume<br>condition |     |     |     |     | MUTE<br>ON/OFF<br>0:OFF<br>1:ON<br><br>(INPUT ALL<br>OFF) | CHIP/SLOT SELECT<br>0:select<br>1:no select<br>2:no select<br>3:no select |      |      |

|       |               |                 |  |  |   |                                 |   |     |     |      |      |      |      |
|-------|---------------|-----------------|--|--|---|---------------------------------|---|-----|-----|------|------|------|------|
| D02   | D12           | D22             | D32  | D42  | D52   | D62                             | D72   | D82 | D92 | D102 | D112 | D122 | D132 |
| Slot2 | Surround mode | Surround effect | Mode select<br>0:stereo<br>1:mono1 only<br>2:mono2 only<br>3:mono1+2 | Bass(boost)<br>0:0dB, 1:3dB,<br>2:6dB, 3:9dB,<br>4:12dB, 5:15dB,<br>6:18dB, 7:21dB | Treble(boost)<br>0:0dB,1:3dB<br>2:6dB,3:9dB | IN E<br>ON/OFF<br>0:OFF<br>1:ON | CHIP/SLOT SELECT<br>0:no select<br>1:no select<br>2:no select<br>3:select |     |     |      |      |      |      |

(a) Master volume

| ATT               | D61 | D71 | D81 | D91 | D101 |
|-------------------|-----|-----|-----|-----|------|
| -0.0dB            | 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    |
| -40.0dB           | 1   | 1   | 0   | 0   | 1    |
| -44.0dB           | 0   | 0   | 1   | 0   | 1    |
| -48.0dB           | 1   | 0   | 1   | 0   | 1    |
| -52.0dB           | 0   | 1   | 1   | 0   | 1    |
| -56.0dB           | 1   | 1   | 1   | 0   | 1    |
| -60.0dB           | 0   | 0   | 0   | 1   | 1    |
| -64.0dB           | 1   | 0   | 0   | 1   | 1    |
| -68.0dB           | 0   | 1   | 0   | 1   | 1    |
| -72.0dB           | 1   | 1   | 0   | 1   | 1    |
| -76.0dB           | 0   | 0   | 1   | 1   | 1    |
| -80.0dB           | 1   | 0   | 1   | 1   | 1    |
| -84.0dB           | 0   | 1   | 1   | 1   | 1    |
| the infinitesimal | 1   | 1   | 1   | 1   | 1    |

(b) Input select

| Input select      |             | D41  | D51 | D111 | D112 |
|-------------------|-------------|------|-----|------|------|
| IN A              | IN E<br>off | 0    | 0   | 0    | 0    |
| IN B              |             | 1    | 0   |      |      |
| IN C              |             | 0    | 1   |      |      |
| IN D              |             | 1    | 1   |      |      |
| IN A to D all OFF |             | *    | *   | 1    | 1 *1 |
| IN A-D<br>select  | IN E<br>on  | A: 0 | 0   | 0    | 1 *2 |
|                   |             | B: 1 | 0   |      |      |
|                   |             | C: 0 | 1   |      |      |
|                   |             | D: 1 | 1   |      |      |

\*1) The input impedance is about 5k as input INE.  
\*2) INE can be controlled independently .  
It can be used as Rec output.

(c) Mode control

| Mode       | D42 | D52 |
|------------|-----|-----|
| stereo     | 0   | 0   |
| mono1 only | 1   | 0   |
| mono2 only | 0   | 1   |
| mono1+2    | 1   | 1   |

(d) Treble control

| Treble | D92 | D102 |
|--------|-----|------|
| 0dB    | 0   | 0    |
| 3dB    | 1   | 0    |
| 6dB    | 0   | 1    |
| 9dB    | 1   | 1    |

(e) Bass control

| Bass | D62 | D72 | D82 |
|------|-----|-----|-----|
| 0dB  | 0   | 0   | 0   |
| 3dB  | 1   | 0   | 0   |
| 6dB  | 0   | 1   | 0   |
| 9dB  | 1   | 1   | 0   |
| 12dB | 0   | 0   | 1   |
| 15dB | 1   | 0   | 1   |
| 18dB | 0   | 1   | 1   |
| 21dB | 1   | 1   | 1   |

(f) Chip/Slot control

| Chip/Slot     | D12* | D13* |
|---------------|------|------|
| select(slot1) | 0    | 0    |
| no select     | 1    | 0    |
| no select     | 0    | 1    |
| select(slot1) | 1    | 1    |

(g) Treble amp gain SW

| Gain SW | D21 | D31 |
|---------|-----|-----|
| 20dB    | 0   | 0   |
| 18dB    | 1   | 0   |
| 16dB    | 0   | 1   |
| 14dB    | 1   | 1   |

(h) Bypass/ Surround SW

| Bypass/<br>Surround SW | D11 |
|------------------------|-----|
| By pass                | 0   |
| Surround               | 1   |

(i) Surround mode

| Mode                 | D02 | D12 |
|----------------------|-----|-----|
| QSurround            | 0   | 0   |
| REAR Surround        | 1   | 0   |
| REAR Normal surround | 0   | 1   |
| Normal surround      | 1   | 1   |

(j) Surround effect

(Valid in the surround mode.  
Set 0dB at QSurround.)

| Effect | D22 | D32 |
|--------|-----|-----|
| +3dB   | 0   | 0   |
| 0dB    | 1   | 0   |
| -3dB   | 0   | 1   |
| -6dB   | 1   | 1   |

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## TONE CONTROL/VOLUME CONTROL

### (2) NOTICE OF CONTROL DATA

1. Input only the control data at (1) INPUT DATA.
2. The interval of data transmission from the microcontroller is over 0.1 sec. This is waiting time for soft-switching to reduce the shocknoise.
3. It's necessary to set up the all control data after power-on, although the internal circuit is forced as below, when  $(VDD - VSS) \leq 3.3V(TYP)$ .

| Parameter       | Condition        |
|-----------------|------------------|
| Gain SW         | 18dB             |
| Input select    | ALL OFF          |
| Master volume   | infinitesimal    |
| MUTE            | ON(Input ALLOFF) |
| Surround effect | - 6dB            |
| Surround        | OFF              |
| Surround mode   | QSurround        |
| Mode select     | stereo           |
| Bass            | 0dB              |
| Treble          | 0dB              |
| IN E            | ON               |

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TONE CONTROL/VOLUME CONTROL

ELECTRICAL CHARACTERISTICS

(VDD=2.5V, VSS=-2.5V, f=1kHz, Vi=100mV(rms), VOL=0dB, BASS=0dB, TREBLE=0dB, VOL/TREBLE SHARE AMP=18dB, SURROUND=BYPASS, RL=10K, Ta=25°C, unless otherwise noted)

| Symbol | Parameter                                | Condition  | Limits                |      |      | Unit  |    |
|--------|--|--|-----------------------|------|------|-------|----|
|        |  |  | min.                  | typ. | max. |       |    |
| IDD    | Circuit current of positive power supply | Quiescent  | —                     | 30   | 45   | mA    |    |
| ISS    | Circuit current of negative power supply | Quiescent  | —                     | -30  | -45  | mA    |    |
| Gv1    | Voltage gain (selector)                  | Vol/Treble share amp gain=18dB<br>Bypass                           | 16                    | 18   | 20   | dB    |    |
| Gv2    | Voltage gain (tone control)              | Vol/Treble share amp gain=18dB<br>QSurround mode Vi=20mVrms        | 25.5                  | 27.5 | 29.5 | dB    |    |
| Vomax  | Maximum output voltage                   | RL=10k, THD=1%   | 1.2                   | 1.6  | —    | Vrms  |    |
| THD    | Total harmonic distortion                | BW=400 ~ 30kHz   | —                     | 0.02 | 0.08 | %     |    |
| No1    | Output noise voltage                     | JIS-A, Rg=5.1k, VOL=the infinitesimal<br>BYPASS                    | —                     | 6    | 15   | μVrms |    |
| No2    |  | JIS-A, Rg=5.1k, VOL=the infinitesimal<br>QSurround mode            | —                     | 11   | 30   | μVrms |    |
| ATTmax | Maximum attenuation                      | Output reference level (Vo=1Vrms),<br>ATT=the infinitesimal, JIS-A | —                     | -95  | -90  | dB    |    |
| GB1    | Bass boost                               | 3dB  | f=1kHz,<br>Vo=80mVrms | 1.5  | 3    | 4.5   | dB |
| GB2    |  | 6dB  |                       | 4.5  | 6    | 7.5   |    |
| GB3    |  | 9dB  |                       | 7.5  | 9    | 10.5  |    |
| GB4    |  | 12dB   |                       | 10.5 | 12   | 13.5  |    |
| GB5    |  | 15dB   |                       | 13.5 | 15   | 16.5  |    |
| GB6    |  | 18dB   |                       | 16.5 | 18   | 19.5  |    |
| GB7    |  | 21dB   |                       | 19.5 | 21   | 22.5  |    |
| GT1    | Treble boost                             | 3dB  | f=1kHz,<br>Vo=80mVrms | 1.5  | 3    | 4.5   | dB |
| GT2    |  | 6dB  |                       | 4.5  | 6    | 7.5   |    |
| GT3    |  | 9dB  |                       | 7.5  | 9    | 10.5  |    |



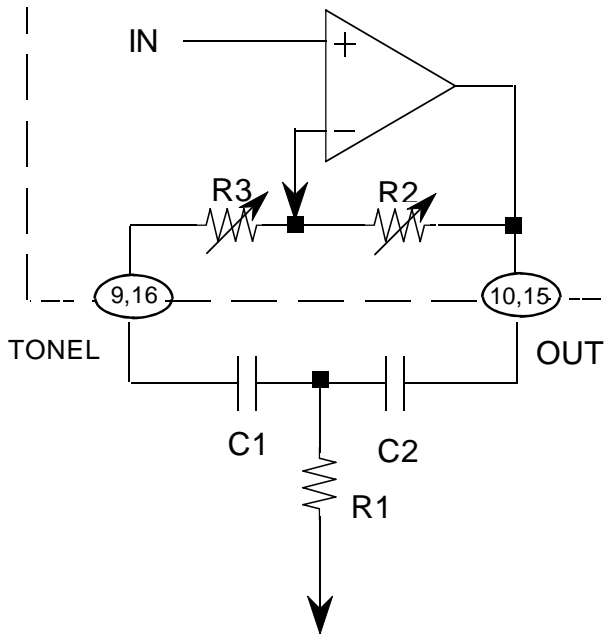
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FUNCTION DESCRIPTION

(1) Equivalent circuit of the bass boost



$$F_0 = \frac{1}{2\pi \sqrt{R_1(R_2+R_3)C_1C_2}} \text{ (Hz)}$$

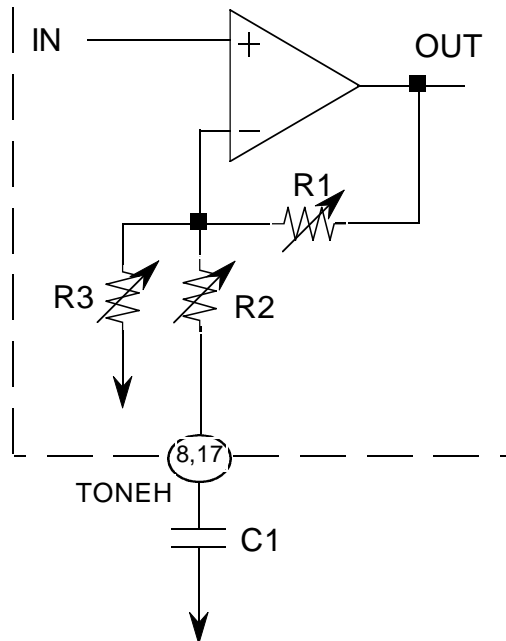
$$Q = \frac{1}{C_1+C_2} \sqrt{\frac{C_1C_2R_2}{R_1}}$$

$$G_v = 20 \log \frac{\frac{R_2+R_3}{R_1} + 2}{\frac{R_3}{R_1} + 2} \text{ (dB)} \quad (C_1=C_2)$$

R2,R3 (typical)

| Bass boost      | 3dB  | 6dB  | 9dB  | 12dB | 15dB | 18dB | 21dB |
|-----------------|------|------|------|------|------|------|------|
| Resistor R2     | 15.4 | 25.7 | 32.9 | 38.7 | 41.6 | 44.2 | 46   |
| (k) Resistor R3 | 30.6 | 20.3 | 13.1 | 7.3  | 4.4  | 1.8  | 0    |

(2) Equivalent circuit of the treble boost



$$F_c = \frac{1}{2\pi \cdot R_2 \cdot C_1} \text{ (Hz)}$$

$$G_v = 20 \log \frac{R_1 + \{(R_2+Z_c)\} // R_3}{(R_2+Z_c) // R_3} \text{ (dB)}$$

$$Z_c = \frac{1}{j\omega C_1} \text{ (ohm)}$$

R2 (typical)

| Treble boost | 3dB | 6dB | 9dB |
|--------------|-----|-----|-----|
| R2 (k)       | 5.3 | 2.2 | 1.2 |

R1,R3 (typical)

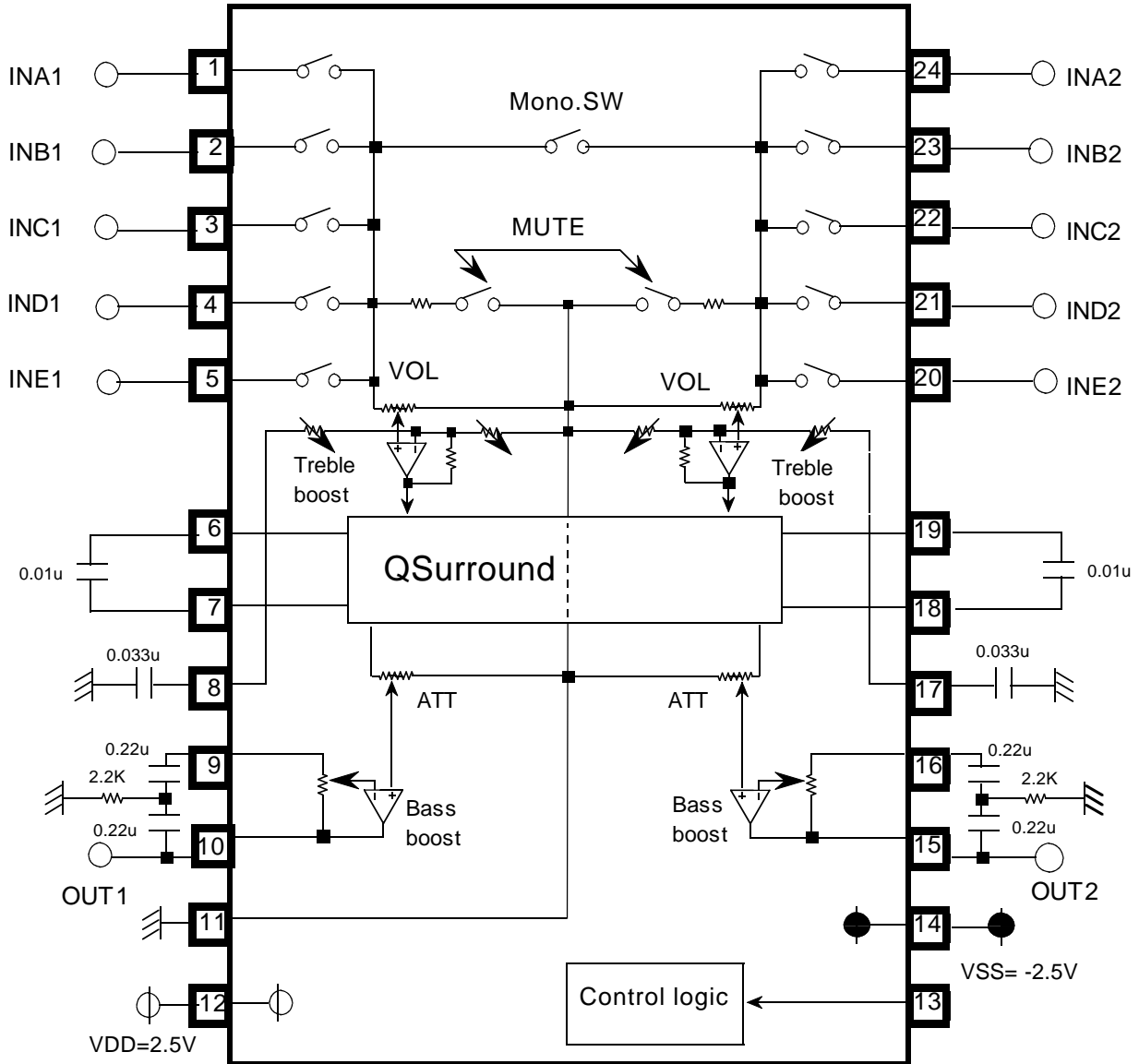
| Gain   | 14dB  | 16dB  | 18dB  | 20dB  |
|--------|-------|-------|-------|-------|
| R1 (k) | 10.88 | 13.65 | 17.21 | 21.60 |
| R3 (k) | 2.72  | 2.57  | 2.48  | 2.40  |

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TONE CONTROL/VOLUME CONTROL

APPLICATION EXAMPLE



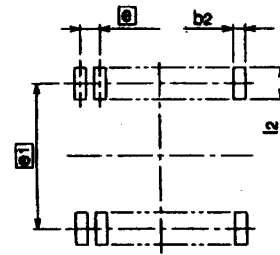
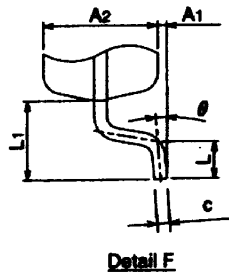
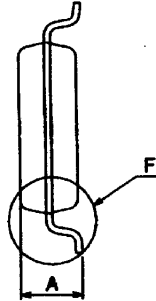
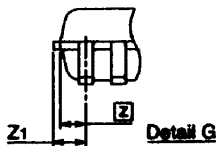
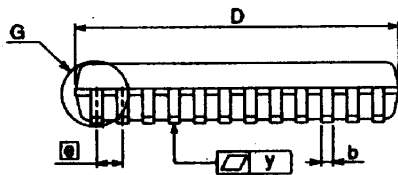
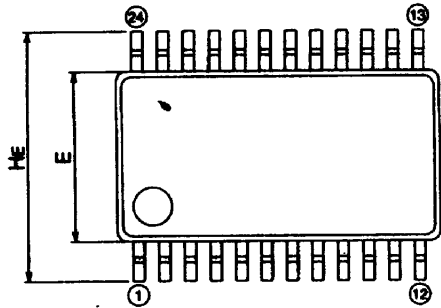
Units Resistor :  
 Capacitor: F

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TONE CONTROL/VOLUME CONTROL

OUTLINE



Recommended Mount Pad

| Symbol | Dimension in Millimeters |      |      |
|--------|--------------------------|------|------|
|        | Min                      | Nom  | Max  |
| A      | -                        | -    | 2.1  |
| A1     | 0                        | 0.1  | 0.2  |
| A2     | -                        | 1.8  | -    |
| b      | 0.3                      | 0.35 | 0.45 |
| c      | 0.18                     | 0.2  | 0.25 |
| D      | 10.0                     | 10.1 | 10.2 |
| E      | 5.2                      | 5.3  | 5.4  |
| g1     | -                        | 0.8  | -    |
| HE     | 7.5                      | 7.8  | 8.1  |
| L      | 0.4                      | 0.6  | 0.8  |
| L1     | -                        | 1.25 | -    |
| Z      | -                        | 0.65 | -    |
| Z1     | -                        | -    | 0.8  |
| y      | -                        | -    | 0.1  |
| θ      | 0°                       | -    | 8°   |
| b2     | -                        | 0.5  | -    |
| g1     | -                        | 7.62 | -    |
| lz     | 1.27                     | -    | -    |