



## Sound Fader Controller IC

**PT2318**

### DESCRIPTION

PT2318 is a sound fader controller IC utilizing CMOS Technology specially designed for car radio hi-fi audio applications. Four selectable stereo inputs, 1 mono input, bass, treble, volume, balance and fader controls, mute function and a special loudness feature which is automatically controlled in combination with the volume level setting are all built into a single I<sup>2</sup>C bus controlled stereo preamplifier chip having the highest performance and reliability. Pin assignments and application circuits are optimized for easy PCB layout and cost saving advantages.

### FEATURES

- CMOS technology
- I<sup>2</sup>C bus control interface
- 4 selectable stereo inputs
- 1 mono input
- Volume, Balance and Fader controls
- Bass & Treble controls
- Noise reduction circuit interface provided
- External equalizer interface provided
- Mute control at audio signal zero crossing
- Internal power-on reset function
- Mute function controlled via the I<sup>2</sup>C bus or pin
- Special automatic loudness feature in combination with the volume setting

### APPLICATIONS

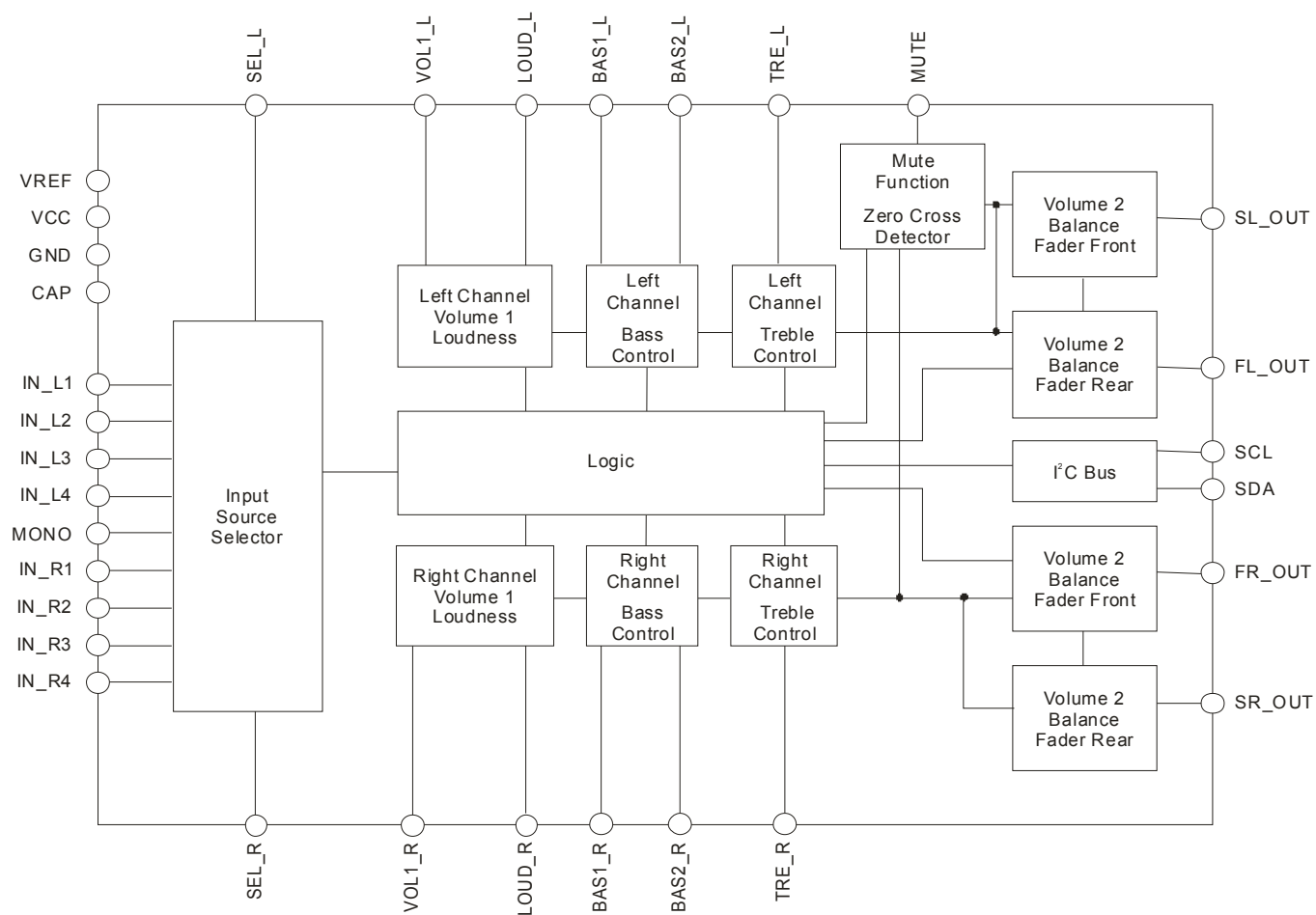
- Car audio
- Hi-Fi audio applications



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# BLOCK DIAGRAM

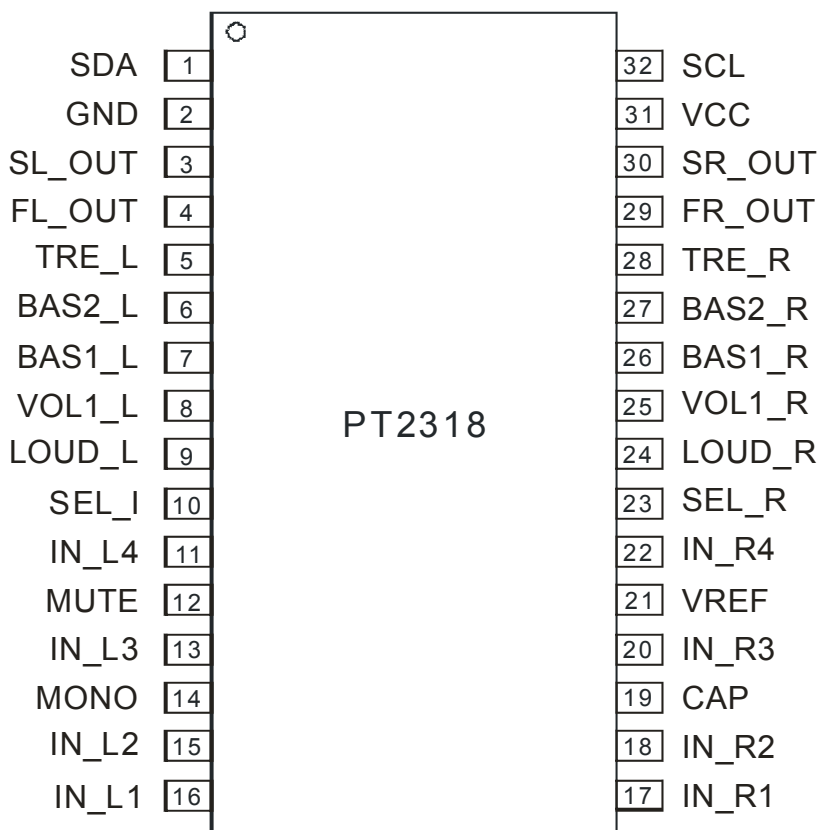




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## PIN CONFIGURATION





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## PIN DESCRIPTION

| Pin Name | I/O | Description                                                                        | Pin No. |
|----------|-----|------------------------------------------------------------------------------------|---------|
| SDA      | I   | Serial Data Input Pin                                                              | 1       |
| GND      | -   | Ground                                                                             | 2       |
| SL_OUT   | O   | Left Rear Channel Output Pin                                                       | 3       |
| FL_OUT   | O   | Left Front Channel Output Pin                                                      | 4       |
| TRE_L    | I/O | Left Channel Treble Control Pin<br>or may be used as External Equalizer Input Pin  | 5       |
| BAS2_L   | I/O | Left Channel Bass Control Pin<br>or may be used as External Equalizer Output Pin   | 6       |
| BAS1_L   | I   | Left Channel Bass Control Pin                                                      | 7       |
| VOL1_L   | I   | Left Control Section Volume Input Pin                                              | 8       |
| LOUD_L   | I   | Left Control Section Loudness Input Pin                                            | 9       |
| SEL_L    | O   | Left Channel Output Source Selector                                                | 10      |
| IN_L4    | I   | Left Channel Source 4 Input Pin                                                    | 11      |
| MUTE     | I   | Mute Function Control Pin                                                          | 12      |
| IN_L3    | I   | Left Channel Source 3 Input Pin                                                    | 13      |
| MONO     | I   | Input "MONO" Source                                                                | 14      |
| IN_L2    | I   | Left Channel Source 2 Input Pin                                                    | 15      |
| IN_L1    | I   | Left Channel Source 1 Input Pin                                                    | 16      |
| IN_R1    | I   | Right Channel Source 1 Input Pin                                                   | 17      |
| IN_R2    | I   | Right Channel Source 2 Input Pin                                                   | 18      |
| CAP      | -   | Supply Electronic Filtering                                                        | 19      |
| IN_R3    | I   | Right Channel Source 3 Input Pin                                                   | 20      |
| VREF     | -   | Reference Voltage (0.5Vcc)                                                         | 21      |
| IN_R4    | I   | Right Channel Source 4 Input Pin                                                   | 22      |
| SEL_R    | O   | Right Channel Output Source Selector                                               | 23      |
| LOUD_R   | I   | Right Control Section Loudness Input Pin                                           | 24      |
| VOL1_R   | I   | Right Control Section Volume 1 Input Pin                                           | 25      |
| BAS1_R   | I   | Right Channel Bass Control Pin                                                     | 26      |
| BAS2_R   | I/O | Right Channel Bass Control Pin<br>Or may be used as External Equalizer Output Pin  | 27      |
| TRE_R    | I/O | Right Channel Treble Control Pin<br>Or may be used as External Equalizer Input Pin | 28      |
| FR_OUT   | O   | Right Front Output Pin                                                             | 29      |
| SR_OUT   | O   | Right Rear Output Pin                                                              | 30      |
| VCC      | -   | Supply Voltage                                                                     | 31      |
| SCL      | I   | Serial Clock Input Pin                                                             | 32      |



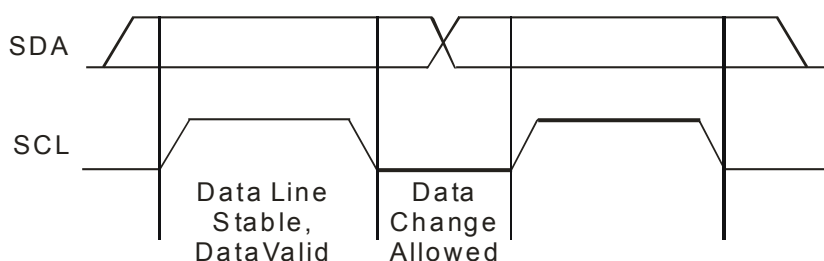
## FUNCTION DESCRIPTION

### BUS INTERFACE

Data are transmitted to and from the microprocessor to the PT2318 via the SDA and SCL. The SDA and SCL make up the BUS Interface. It should be noted that the pull-up resistors must be connected to the positive supply voltage.

### DATA VALIDITY

A data on the SDA Line is considered valid and stable only when the SCL Signal is in HIGH State. The HIGH and LOW States of the SDA Line can only change when the SCL signal is LOW. Please refer to the figure below.



### START AND STOP CONDITIONS

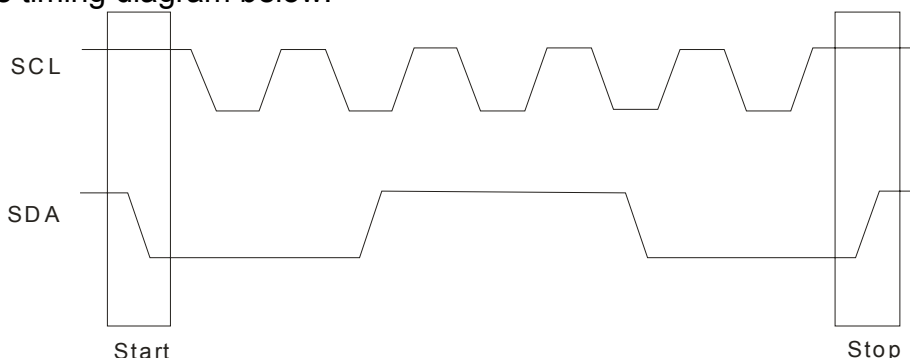
A Start Condition is activated when

1. the SCL is set to HIGH and
2. SDA shifts from HIGH to LOW State.

The Stop Condition is activated when

1. SCL is set to HIGH and
2. SDA shifts from LOW to HIGH State.

Please refer to the timing diagram below.





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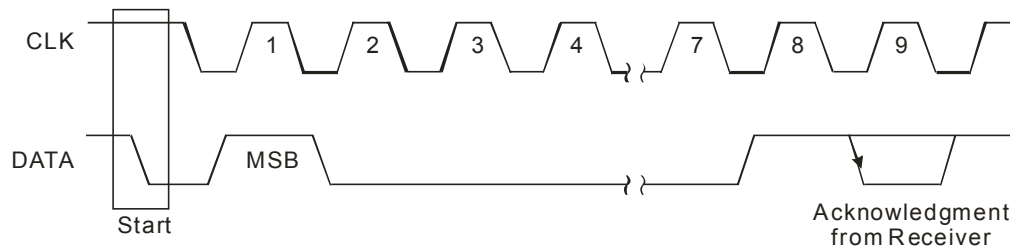
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### **BYTE FORMAT**

Every byte transmitted to the SDA Line consists of 8 bits. Each byte must be followed by an Acknowledge Bit. The MSB is transmitted first.

### **ACKNOWLEDGE**

During the Acknowledge Clock Pulse, the master ( $\mu P$ ) puts a resistive HIGH level on the SDA Line. The peripheral (audio processor) that acknowledges has to pull-down (LOW) the SDA line during the Acknowledge Clock Pulse so that the SDA Line is in a Stable Low State during this Clock Pulse. Please refer to the diagram below.



The audio processor that has been addressed has to generate an Acknowledge after receiving each byte, otherwise, the SDA Line will remain at the High Level during the ninth (9th) Clock Pulse. In this case, the master transmitter can generate the STOP Information in order to abort the transfer.

### **TRANSMISSION WITHOUT ACKNOWLEDGE**

If you want to avoid the acknowledge detection of the audio processor, a simpler  $\mu P$  transmission may be used. Wait one clock and do not check the slave acknowledge of this same clock then send the new data. If you use this approach, there are greater chances of faulty operation as well as decrease in noise immunity.



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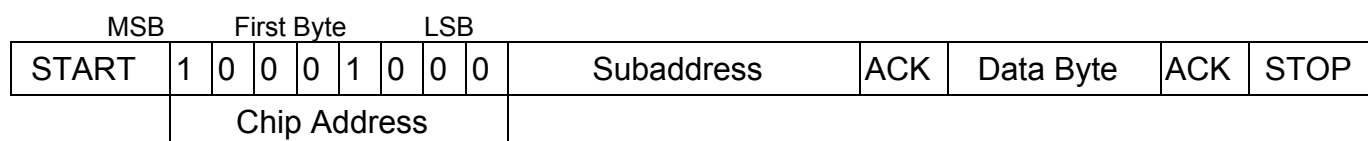
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### INTERFACE PROTOCOL

The interface protocol consists of the following:

1. START Condition
2. Chip Address Byte=80H
3. ACK=Acknowledge Bit
4. Data Byte
5. STOP Condition

Please refer to the diagram below:



Notes:

1. ACK=ACKNOWLEDGE
2. Max. Clock Speed=100K Bits/S

The SUBADDRESS is the Second Byte transmitted following the CHIP ADDRESS Byte. Please refer to the table below.

| MSB |   |   |   | LSB |    |    |    | Function            |
|-----|---|---|---|-----|----|----|----|---------------------|
| 7   | 6 | 5 | 4 | 3   | 2* | 1* | 0* |                     |
| 0   | 0 | 0 | 0 | 0   | 0  | 0  | 0  | Volume/Loudness     |
| 0   | 0 | 0 | 0 | 0   | 0  | 0  | 1  | Fader: Front, Right |
| 0   | 0 | 0 | 0 | 0   | 0  | 1  | 0  | Fader: Front, Left  |
| 0   | 0 | 0 | 0 | 0   | 0  | 1  | 1  | Fader: Rear, Right  |
| 0   | 0 | 0 | 0 | 0   | 1  | 0  | 0  | Fader: Rear, Left   |
| 0   | 0 | 0 | 0 | 0   | 1  | 0  | 1  | Bass                |
| 0   | 0 | 0 | 0 | 0   | 1  | 1  | 0  | Treble              |
| 0   | 0 | 0 | 0 | 0   | 1  | 1  | 1  | Selector Switch     |

Note: These are Significant SUBADDRESS bits.

The last bits of SUBADDRESS are named “specific bit”. When more than one data bit send to PT2318, the SUBADDRESS will increase automatically depend on specific bit. It is unnecessary to send to SUBADDRESS, data bit will fill in SUBADDRESS bit. Please refer to following table.

| START | Chip Address | ACK | Sub Address | ACK | Data Byte                     | ACK | Data Byte                     | ACK | Data Byte                     | ACK | Data Byte                     | ACK | STOP |
|-------|--------------|-----|-------------|-----|-------------------------------|-----|-------------------------------|-----|-------------------------------|-----|-------------------------------|-----|------|
| Start | 80H          |     | 00H         |     | Corresponding Sub Address 00H |     | Corresponding Sub Address 01H |     | Corresponding Sub Address 02H |     | Corresponding Sub Address 03H |     | End  |



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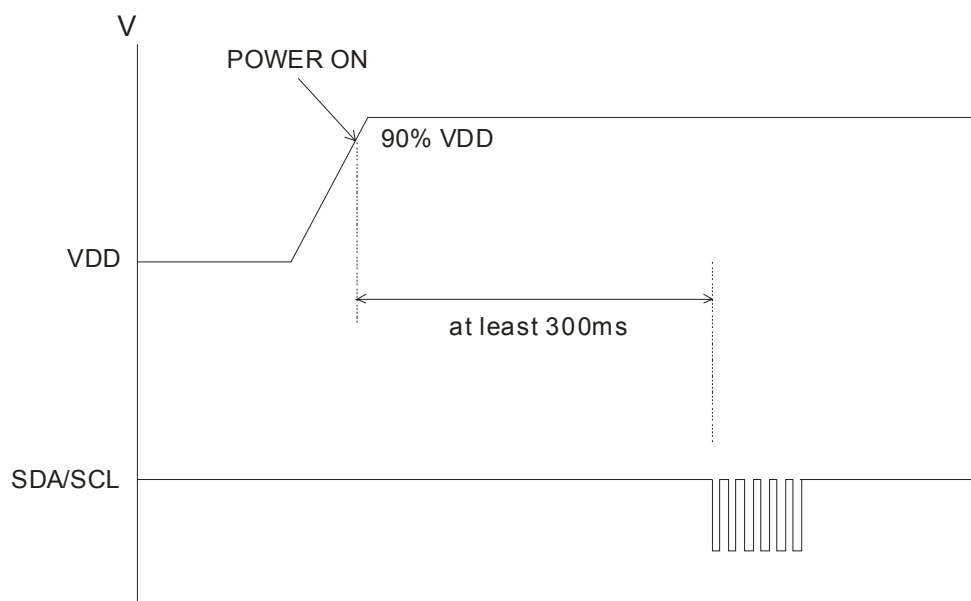
The Third Byte following the CIP ADDRESS & SUBADDRESS is defined in the table below.

| MSB |      |      |      | LSB  |      |      |      | Function            |
|-----|------|------|------|------|------|------|------|---------------------|
| 7   | 6    | 5    | 4    | 3    | 2    | 1    | 0    |                     |
| ZCM | LOFF | V5   | V4   | V3   | V2   | V1   | V0   | Volume/Loudness     |
| X   | X    | FFR5 | FFR4 | FFR3 | FFR2 | FFR1 | FFR0 | Fader: Front, Right |
| X   | X    | FFL5 | FFL4 | FFL3 | FFL2 | FFL1 | FFL0 | Fader: Front, Left  |
| X   | X    | FSR5 | FSR4 | FSR3 | FSR2 | FSR1 | FSR0 | Fader: Rear, Right  |
| X   | X    | FSL5 | FSL4 | FSL3 | FSL2 | FSL1 | FSL0 | Fader: Rear, Left   |
| X   | X    | X    | BAS4 | BAS3 | BAS2 | BAS1 | BAS0 | Bass                |
| X   | X    | X    | TRE4 | TRE3 | TRE2 | TRE1 | TRE0 | Treble              |
| GMU | X    | X    | X    | X    | SC2  | SC1  | SC0  | Selector Switch     |

X=Irrelevant (It should be noted that during testing, this bit is given the value of “1”)

## I<sup>2</sup>C BUS START-UP TIMING

After Power is turned ON, PT2318 needs to wait for a short time in order to insure stability. This waiting period is relative to the value of Cref. When Cref=10  $\mu$ F, the waiting time period for PT2318 to send I<sup>2</sup>C Bus Signal is at least 300ms. If the waiting time period is less than 300ms, I<sup>2</sup>C Control may fail. Please refer to the figure below.







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### ***SOURCE SELECTOR***

PT2318 provides 4 selectable stereo inputs and one mono input. The source selector is used to select any one of the mentioned source input options. Please refer to the table below.

| Input Source                 | Source Selector Bits |     |     |
|------------------------------|----------------------|-----|-----|
|                              | SC2                  | SC1 | SC0 |
| Stereo Inputs: IN_L1 & IN_R1 | 1                    | 1   | 1   |
| Stereo Inputs: IN_L2 & IN_R2 | 1                    | 1   | 0   |
| Stereo Inputs: IN_L3 & IN_R3 | 1                    | 0   | 1   |
| Stereo Inputs: IN_L4 & IN_R4 | 1                    | 0   | 0   |
| Mono Input: MONO             | 0                    | X   | X   |

Notes:

1. SC0 to SC2=Source Selector Control Bits
2. X=Irrelevant



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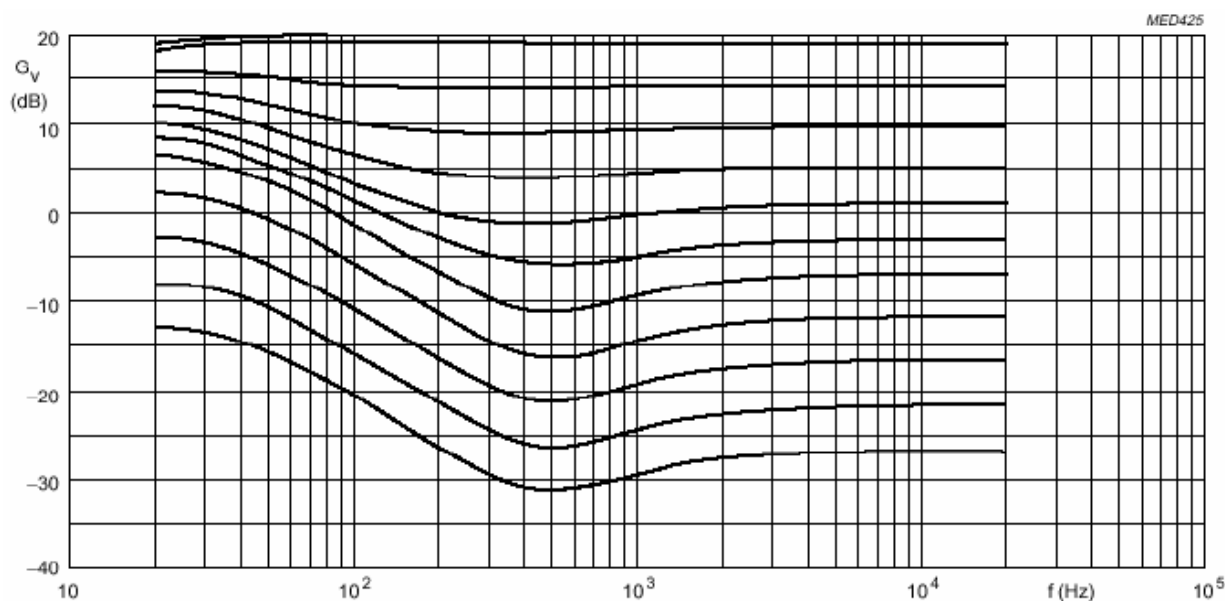
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### VOLUME CONTROL

The Volume Control Function consists of two blocks; namely, Volume 1 Control Block and Volume 2 Control Block.

#### VOLUME 1 CONTROL BLOCK

The Volume 1 Control Block has an attenuation range of +20dB to -31dB at 1dB/step. The left and right channels have the same gain/attenuation setting. This block operates in conjunction with the Loudness Control. When the Volume 1 Control maximum gain (=20dB) is selected, the filter characteristic is linear. The filter characteristic increases automatically over a range of 32dB down to a setting of -12dB. This means that the Volume 1 Control Block maximum filter characteristics is obtained at a -12dB setting. If the volume is further reduced, the filter characteristics are not in any way affected. The maximum selected filter characteristics is determined by the external components. Please refer to the diagram below.



Volume control and Loudness (Low Roll-Off Frequency included)

#### VOLUME 2 CONTROL BLOCK

The Volume 2 Control Block operates in combination with the Balance and Fader Functions. Each output has one independent attenuator which has a control range of 0dB to -55dB at 1dB/step with an additional mute step.

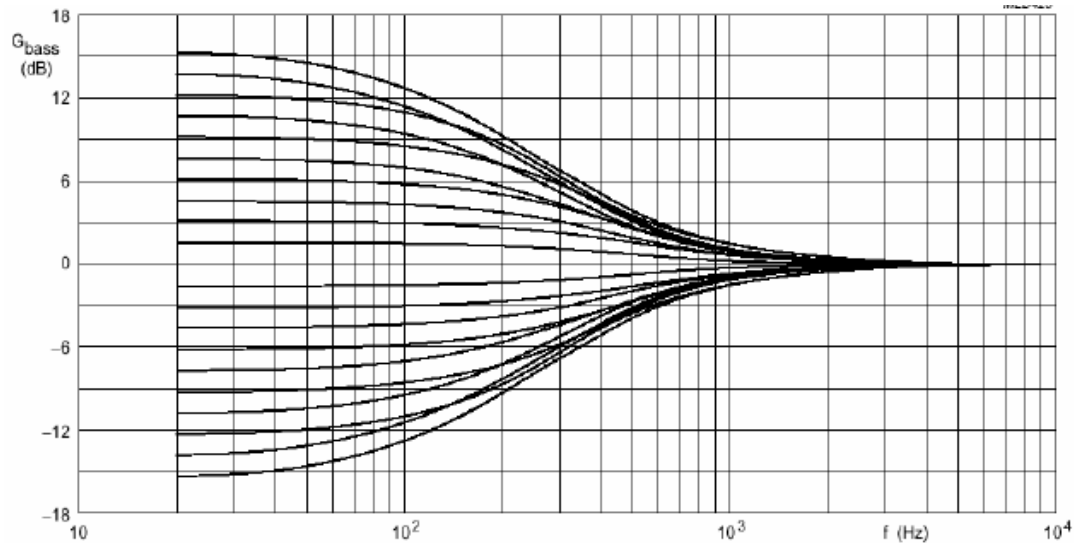


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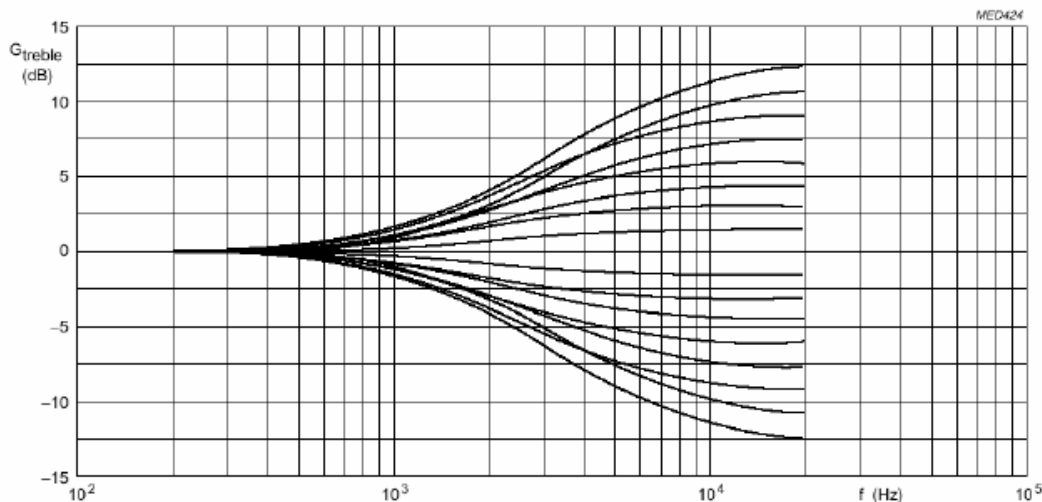
### BASS FUNCTION

The bass function has a control range of -15dB to +15dB at 40Hz. The basic step width of the bass control is 3dB. The intermediate steps are obtained by switching 1.5dB boost and 1.5 dB attenuation steps. The bass control function can be disabled via the I<sup>2</sup>C Bus. If the bass control function is disabled, the internal signal flow is discontinued, and the pins -- BAS2\_L and BAS2-R are used as inputs for connecting an external equalizer. The Bass Function Frequency Response curve is shown below:



### TREBLE FUNCTION

The Treble Function has a control range of -12dB to +12dB at 1.5dB / step at 15KHz. The basic step width of the treble control is 3dB and the intermediate steps are obtained by switching 1.5dB boost and 1.5 dB attenuation steps. The treble control function can be disabled via the I<sup>2</sup>C Bus. If the treble control function is disabled, the internal signal flow is discontinued, and the treble pins -- TRE\_L and TRE\_R -- are used as inputs for connecting an external equalizer. The Treble Function Frequency Response Curve is given below.





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### VOLUME SETTING

The volume setting table is given below. The loudness characteristic increases in a linear manner for every step in the volume whose range is from +20dB to -11dB.

| GV (dB) | V5 | V4 | V3 | V2 | V1 | V0 |
|---------|----|----|----|----|----|----|
| 20      | 1  | 1  | 1  | 1  | 1  | 1  |
| 19      | 1  | 1  | 1  | 1  | 1  | 0  |
| 18      | 1  | 1  | 1  | 1  | 0  | 1  |
| 17      | 1  | 1  | 1  | 1  | 0  | 0  |
| 16      | 1  | 1  | 1  | 0  | 1  | 1  |
| 15      | 1  | 1  | 1  | 0  | 1  | 0  |
| 14      | 1  | 1  | 1  | 0  | 0  | 1  |
| 13      | 1  | 1  | 1  | 0  | 0  | 0  |
| 12      | 1  | 1  | 0  | 1  | 1  | 1  |
| 11      | 1  | 1  | 0  | 1  | 1  | 0  |
| 10      | 1  | 1  | 0  | 1  | 0  | 1  |
| 9       | 1  | 1  | 0  | 1  | 0  | 0  |
| 8       | 1  | 1  | 0  | 0  | 1  | 1  |
| 7       | 1  | 1  | 0  | 0  | 1  | 0  |
| 6       | 1  | 1  | 0  | 0  | 0  | 1  |
| 5       | 1  | 1  | 0  | 0  | 0  | 0  |
| 4       | 1  | 0  | 1  | 1  | 1  | 1  |
| 3       | 1  | 0  | 1  | 1  | 1  | 0  |
| 2       | 1  | 0  | 1  | 1  | 0  | 1  |
| 1       | 1  | 0  | 1  | 1  | 0  | 0  |
| 0       | 1  | 0  | 1  | 0  | 1  | 1  |
| -1      | 1  | 0  | 1  | 0  | 1  | 0  |
| -2      | 1  | 0  | 1  | 0  | 0  | 1  |
| -3      | 1  | 0  | 1  | 0  | 0  | 0  |
| -4      | 1  | 0  | 0  | 1  | 1  | 1  |
| -5      | 1  | 0  | 0  | 1  | 1  | 0  |
| -6      | 1  | 0  | 0  | 1  | 0  | 1  |
| -7      | 1  | 0  | 0  | 1  | 0  | 0  |
| -8      | 1  | 0  | 0  | 0  | 1  | 1  |
| -9      | 1  | 0  | 0  | 0  | 1  | 0  |
| -10     | 1  | 0  | 0  | 0  | 0  | 1  |
| -11     | 1  | 0  | 0  | 0  | 0  | 0  |



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The loudness characteristic is constant during the volume range from -12dB to -31 dB.

| GV (dB) | V5 | V4 | V3 | V2 | V1 | V0 |
|---------|----|----|----|----|----|----|
| -12     | 0  | 1  | 1  | 1  | 1  | 1  |
| -13     | 0  | 1  | 1  | 1  | 1  | 0  |
| -14     | 0  | 1  | 1  | 1  | 0  | 1  |
| -15     | 0  | 1  | 1  | 1  | 0  | 0  |
| -16     | 0  | 1  | 1  | 0  | 1  | 1  |
| -17     | 0  | 1  | 1  | 0  | 1  | 0  |
| -18     | 0  | 1  | 1  | 0  | 0  | 1  |
| -19     | 0  | 1  | 1  | 0  | 0  | 0  |
| -20     | 0  | 1  | 0  | 1  | 1  | 1  |
| -21     | 0  | 1  | 0  | 1  | 1  | 0  |
| -22     | 0  | 1  | 0  | 1  | 0  | 1  |
| -23     | 0  | 1  | 0  | 1  | 0  | 0  |
| -24     | 0  | 1  | 0  | 0  | 1  | 1  |
| -25     | 0  | 1  | 0  | 0  | 1  | 0  |
| -26     | 0  | 1  | 0  | 0  | 0  | 1  |
| -27     | 0  | 1  | 0  | 0  | 0  | 0  |
| -28     | 0  | 0  | 1  | 1  | 1  | 1  |
| -29     | 0  | 0  | 1  | 1  | 1  | 0  |
| -30     | 0  | 0  | 1  | 1  | 0  | 1  |
| -31     | 0  | 0  | 1  | 1  | 0  | 0  |

The steps are repeated for range -28dB to -31dB.

| GV(dB) | V5 | V4 | V3 | V2 | V1 | V0 |
|--------|----|----|----|----|----|----|
| -28    | 0  | 0  | 1  | 0  | 1  | 1  |
| -29    | 0  | 0  | 1  | 0  | 1  | 0  |
| -30    | 0  | 0  | 1  | 0  | 0  | 1  |
| -31    | 0  | 0  | 1  | 0  | 0  | 0  |
| -28    | 0  | 0  | 0  | 1  | 1  | 1  |
| -29    | 0  | 0  | 0  | 1  | 1  | 0  |
| -30    | 0  | 0  | 0  | 1  | 0  | 1  |
| -31    | 0  | 0  | 0  | 1  | 0  | 0  |
| -28    | 0  | 0  | 0  | 0  | 1  | 1  |
| -29    | 0  | 0  | 0  | 0  | 1  | 0  |
| -30    | 0  | 0  | 0  | 0  | 0  | 1  |
| -31    | 0  | 0  | 0  | 0  | 0  | 0  |



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The Volume 2 (Balance & Fader) Setting is shown below.

| GV (dB) | FSR5 | FSR4 | FSR3 | FSR2 | FSR1 | FSR0 |
|---------|------|------|------|------|------|------|
|         | FSR5 | FSR4 | FSR3 | FSR2 | FSR1 | FSR0 |
|         | FFL5 | FFL4 | FFL3 | FFL2 | FFL1 | FFL0 |
|         | FFR5 | FFR4 | FFR3 | FFR2 | FFR1 | FFR0 |
| 0       | 1    | 1    | 1    | 1    | 1    | 1    |
| -1      | 1    | 1    | 1    | 1    | 1    | 0    |
| -2      | 1    | 1    | 1    | 1    | 0    | 1    |
| -3      | 1    | 1    | 1    | 1    | 0    | 0    |
| -4      | 1    | 1    | 1    | 0    | 1    | 1    |
| -5      | 1    | 1    | 1    | 0    | 1    | 0    |
| -6      | 1    | 1    | 1    | 0    | 0    | 1    |
| -7      | 1    | 1    | 1    | 0    | 0    | 0    |
| -8      | 1    | 1    | 0    | 1    | 1    | 1    |
| -9      | 1    | 1    | 0    | 1    | 1    | 0    |
| -10     | 1    | 1    | 0    | 1    | 0    | 1    |
| -11     | 1    | 1    | 0    | 1    | 0    | 0    |
| -12     | 1    | 1    | 0    | 0    | 1    | 1    |
| -13     | 1    | 1    | 0    | 0    | 1    | 0    |
| -14     | 1    | 1    | 0    | 0    | 0    | 1    |
| -15     | 1    | 1    | 0    | 0    | 0    | 0    |
| -16     | 1    | 0    | 1    | 1    | 1    | 1    |
| -17     | 1    | 0    | 1    | 1    | 1    | 0    |
| -18     | 1    | 0    | 1    | 1    | 0    | 1    |
| -19     | 1    | 0    | 1    | 1    | 0    | 0    |
| -20     | 1    | 0    | 1    | 0    | 1    | 1    |
| -21     | 1    | 0    | 1    | 0    | 1    | 0    |
| -22     | 1    | 0    | 1    | 0    | 0    | 1    |
| -23     | 1    | 0    | 1    | 0    | 0    | 0    |
| -24     | 1    | 0    | 0    | 1    | 1    | 1    |
| -25     | 1    | 0    | 0    | 1    | 1    | 0    |
| -26     | 1    | 0    | 0    | 1    | 0    | 1    |
| -27     | 1    | 0    | 0    | 1    | 0    | 0    |
| -28     | 1    | 0    | 0    | 0    | 1    | 1    |
| -29     | 1    | 0    | 0    | 0    | 1    | 0    |
| -30     | 1    | 0    | 0    | 0    | 0    | 1    |
| -31     | 1    | 0    | 0    | 0    | 0    | 0    |
| -32     | 0    | 1    | 1    | 1    | 1    | 1    |
| -33     | 0    | 1    | 1    | 1    | 1    | 0    |
| -34     | 0    | 1    | 1    | 1    | 0    | 1    |
| -35     | 0    | 1    | 1    | 1    | 0    | 0    |



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| GV (dB) | FSR5 | FSR4 | FSR3 | FSR2 | FSR1 | FSR0 |
|---------|------|------|------|------|------|------|
|         | FSR5 | FSR4 | FSR3 | FSR2 | FSR1 | FSR0 |
|         | FFL5 | FFL4 | FFL3 | FFL2 | FFL1 | FFL0 |
|         | FFR5 | FFR4 | FFR3 | FFR2 | FFR1 | FFR0 |
| -36     | 0    | 1    | 1    | 0    | 1    | 1    |
| -37     | 0    | 1    | 1    | 0    | 1    | 0    |
| -38     | 0    | 1    | 1    | 0    | 0    | 1    |
| -39     | 0    | 1    | 1    | 0    | 0    | 0    |
| -40     | 0    | 1    | 0    | 1    | 1    | 1    |
| -41     | 0    | 1    | 0    | 1    | 1    | 0    |
| -42     | 0    | 1    | 0    | 1    | 0    | 1    |
| -43     | 0    | 1    | 0    | 1    | 0    | 0    |
| -44     | 0    | 1    | 0    | 0    | 1    | 1    |
| -45     | 0    | 1    | 0    | 0    | 1    | 0    |
| -46     | 0    | 1    | 0    | 0    | 0    | 1    |
| -47     | 0    | 1    | 0    | 0    | 0    | 0    |
| -48     | 0    | 0    | 1    | 1    | 1    | 1    |
| -49     | 0    | 0    | 1    | 1    | 1    | 0    |
| -50     | 0    | 0    | 1    | 1    | 0    | 1    |
| -51     | 0    | 0    | 1    | 1    | 0    | 0    |
| -52     | 0    | 0    | 1    | 0    | 1    | 1    |
| -53     | 0    | 0    | 1    | 0    | 1    | 0    |
| -54     | 0    | 0    | 1    | 0    | 0    | 1    |
| -55     | 0    | 0    | 1    | 0    | 0    | 0    |
| MUTE    | 0    | 0    | 0    | 1    | 1    | 1    |
| MUTE    | 0    | 0    | 0    | 1    | 1    | 0    |
| MUTE    | 0    | 0    | 0    | 1    | 0    | 1    |
| MUTE    | 0    | 0    | 0    | 1    | 0    | 0    |
| MUTE    | 0    | 0    | 0    | 0    | 1    | 1    |
| MUTE    | 0    | 0    | 0    | 0    | 1    | 0    |
| MUTE    | 0    | 0    | 0    | 0    | 0    | 1    |
| MUTE    | 0    | 0    | 0    | 0    | 0    | 0    |

Note: Only the subaddress changes, the data remains the same for a particular range.



## Sound Fader Controller IC

**PT2318**

Bass setting is shown below.

| <b>G<sub>BASS</sub> (dB)</b> | <b>BAS4</b> | <b>BAS3</b> | <b>BAS2</b> | <b>BAS1</b> | <b>BAS0</b> |
|------------------------------|-------------|-------------|-------------|-------------|-------------|
| +15.0                        | 1           | 1           | 1           | 1           | 1           |
| +13.5                        | 1           | 1           | 1           | 1           | 0           |
| +15.0                        | 1           | 1           | 1           | 0           | 1           |
| +13.5                        | 1           | 1           | 1           | 0           | 0           |
| +15.0                        | 1           | 1           | 0           | 1           | 1           |
| +13.5                        | 1           | 1           | 0           | 1           | 0           |
| +12.0                        | 1           | 1           | 0           | 0           | 1           |
| +10.5                        | 1           | 1           | 0           | 0           | 0           |
| +9.0                         | 1           | 0           | 1           | 1           | 1           |
| +7.5                         | 1           | 0           | 1           | 1           | 0           |
| +6.0                         | 1           | 0           | 1           | 0           | 1           |
| +4.5                         | 1           | 0           | 1           | 0           | 0           |
| +3.0                         | 1           | 0           | 0           | 1           | 1           |
| +1.5                         | 1           | 0           | 0           | 1           | 0           |
| 0 (see note 1)               | 1           | 0           | 0           | 0           | 1           |
| 0 (see note 2)               | 1           | 0           | 0           | 0           | 0           |
| -1.5                         | 0           | 1           | 1           | 1           | 1           |
| -3.0                         | 0           | 1           | 1           | 1           | 0           |
| -4.5                         | 0           | 1           | 1           | 0           | 1           |
| -6.0                         | 0           | 1           | 1           | 0           | 0           |
| -7.5                         | 0           | 1           | 0           | 1           | 1           |
| -9.0                         | 0           | 1           | 0           | 1           | 0           |
| -10.5                        | 0           | 1           | 0           | 0           | 1           |
| -12.0                        | 0           | 1           | 0           | 0           | 0           |
| -13.5                        | 0           | 0           | 1           | 1           | 1           |
| -15.0                        | 0           | 0           | 1           | 1           | 0           |
| -13.5                        | 0           | 0           | 1           | 0           | 1           |
| -15.0                        | 0           | 0           | 1           | 0           | 0           |
| (see note 3)                 | 0           | 0           | 0           | 1           | 1           |
| (see note 3)                 | 0           | 0           | 0           | 1           | 0           |
| (see note 3)                 | 0           | 0           | 0           | 0           | 1           |
| (see note 3 & 4)             | 0           | 0           | 0           | 0           | 0           |

### Notes:

1. Recommended Data Word for step 0dB.
2. Result of 1.5dB boost and 1.5dB attenuation.
3. The last four bass control data words mute the bass response.
4. The last bass and treble control data words (00000) enable the external equalizer connection.





## Sound Fader Controller IC

**PT2318**

Treble setting is shown below.

| <b>G<sub>TREBLE</sub> (dB)</b> | <b>TRE4</b> | <b>TRE3</b> | <b>TRE2</b> | <b>TRE1</b> | <b>TRE0</b> |
|--------------------------------|-------------|-------------|-------------|-------------|-------------|
| +12.0                          | 1           | 1           | 1           | 1           | 1           |
| +10.5                          | 1           | 1           | 1           | 1           | 0           |
| +12.0                          | 1           | 1           | 1           | 0           | 1           |
| +10.5                          | 1           | 1           | 1           | 0           | 0           |
| +12.0                          | 1           | 1           | 0           | 1           | 1           |
| +10.5                          | 1           | 1           | 0           | 1           | 0           |
| +12.0                          | 1           | 1           | 0           | 0           | 1           |
| +10.5                          | 1           | 1           | 0           | 0           | 0           |
| +9.0                           | 1           | 0           | 1           | 1           | 1           |
| +7.5                           | 1           | 0           | 1           | 1           | 0           |
| +6.0                           | 1           | 0           | 1           | 0           | 1           |
| +4.5                           | 1           | 0           | 1           | 0           | 0           |
| +3.0                           | 1           | 0           | 0           | 1           | 1           |
| +1.5                           | 1           | 0           | 0           | 1           | 0           |
| 0 (see note 1)                 | 1           | 0           | 0           | 0           | 1           |
| 0 (see note 2)                 | 1           | 0           | 0           | 0           | 0           |
| -1.5                           | 0           | 1           | 1           | 1           | 1           |
| -3.0                           | 0           | 1           | 1           | 1           | 0           |
| -4.5                           | 0           | 1           | 1           | 0           | 1           |
| -6.0                           | 0           | 1           | 1           | 0           | 0           |
| -7.5                           | 0           | 1           | 0           | 1           | 1           |
| -9.0                           | 0           | 1           | 0           | 1           | 0           |
| -10.5                          | 0           | 1           | 0           | 0           | 1           |
| -12.0                          | 0           | 1           | 0           | 0           | 0           |
| (see note 3)                   | 0           | 0           | 1           | 1           | 1           |
| (see note 3)                   | 0           | 0           | 1           | 1           | 0           |
| (see note 3)                   | 0           | 0           | 1           | 0           | 1           |
| (see note 3)                   | 0           | 0           | 1           | 0           | 0           |
| (see note 3)                   | 0           | 0           | 0           | 1           | 1           |
| (see note 3)                   | 0           | 0           | 0           | 1           | 0           |
| (see note 3)                   | 0           | 0           | 0           | 0           | 1           |
| (see note 3 & 4)               | 0           | 0           | 0           | 0           | 0           |

### Notes:

1. Recommended Data Word for step 0dB.
2. Result of 1.5dB boost and 1.5dB attenuation.
3. The last eight treble control data words select the treble output.
4. The last bass and treble control data words (00000) enable the external equalizer connection.



## Sound Fader Controller IC

**PT2318**

### MUTE

PT2318 provides three mute modes namely:

1. Zero Crossing Mode via the I<sup>2</sup>C bus using 2 independent zero crossing detectors.
2. Fast Mute via Mute Pin
3. Fast Mute via I<sup>2</sup>C Bus either by General Mute (GMU) or by Volume 2 Block Setting.

The following table shows the setting for the Zero Crossing Mode and the General Mute Mode

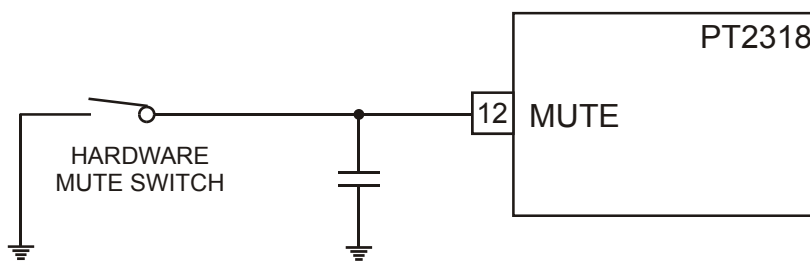
| GMU | ZCM | Function                                      |
|-----|-----|-----------------------------------------------|
| 0   | 0   | Direct MUTE off                               |
| 0   | 1   | MUTE off delayed until the next Zero Crossing |
| 1   | 0   | Direct MUTE                                   |
| 1   | 1   | MUTE delayed until the next Zero Crossing     |

Notes:

1. GMU=General Mute Bit (Mute control for all outputs)
2. ZCM=Zero Crossing Mode Bit

The mute function is immediately performed if the ZCM="0". If ZCM="1", the mute is activated after changing the GMU bit. The actual mute switching is delayed until the next zero crossing of the audio frequency signal. The left and right audio channels are independent of each other, therefore, there are two built-in comparators controlling the independent mute switches. In order to avoid too much delay in mute switching when very low frequencies are processed, the maximum delay time is limited to a typical value of 100ms by an integrated timing circuit and an external capacitor. This timing circuit is triggered by the reception of a new data word for the switch function (including a GMU bit). After an external capacitor is discharged and charged, the muting switch follows the GMU bit if there was no zero crossing detected during that particular time.

Externally controlling the mute function is possible. If the mute pin is set to Ground, all outputs are muted immediately (this is the hardware mute.). Please refer to the diagram below.



The mute request overwrites all mute controls via the I<sup>2</sup>C bus for the time the pin is held at "LOW" level.

The hardware mute function is ideal for Radio Data System applications. The zero crossing mute avoids modulation plops. This feature is advantageous when the changing presets and/or sources.

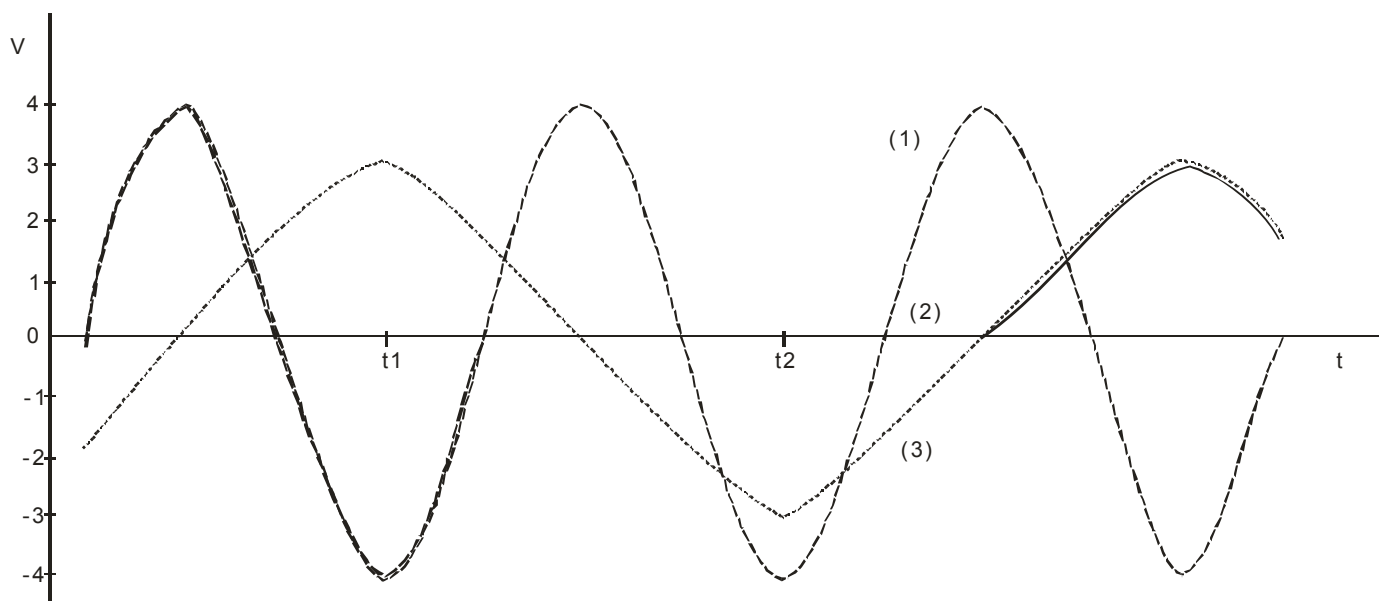


## Sound Fader Controller IC

PT2318

### INPUT SIGNAL SELECTION VIA ZERO CROSS MUTE MODE

A selection from the Input A (IN\_L1) to Input B (IN\_L2) Left Channels produces a modulation click at the time of the switching. This will depend on the difference between the signal values. Please refer to the diagram below for the zero cross function (L Channel Only)



Notes:

1. (1)=Output
2. (2)=Input 2 (IN\_L2)
3. (3)=Input 1 (IN\_L1)

At t1, the maximum different between signals is 7Vp-p. At this point, a loud click can be heard. Using the zero cross detector, no modulation click is audible.

### LOUDNESS FUNCTION

The Loudness Function is used in combination with Volume 1 Control Block and may be enabled or disabled via the I<sup>2</sup>C Bus Control. Please refer to the table below for Loudness Function setting.

| Loudness Function | LOFF |
|-------------------|------|
| Loudness On       | 0    |
| Loudness Off      | 1    |

Note: LOFF=Loudness Function Control Bit



## Sound Fader Controller IC

**PT2318**

## ABSOLUTE MAXIMUM RATING

| Parameter                                  | Symbol | Conditions | Min. | Max. | Unit |
|--------------------------------------------|--------|------------|------|------|------|
| Supply voltage                             | Vcc    |            | 0    | 10   | V    |
| Operating temperature                      | Topr   |            | -40  | +85  | °C   |
| Storage temperature                        | Tstg   |            | -65  | +150 | °C   |
| Voltage at each pin<br>(when Pin 2 as GND) | Vpin   |            | 0    | Vcc  | V    |

## ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, Vcc=8.5V, Rs=600Ω, RL=10kΩ, CL=2.5nF, AC Coupled, f=1KHz, Ta=25°C, Gain Control: Gv=0dB, Bass=Linear, Treble=Linear, Fader=Off, Balance in Mid Position Loudness Off)

| Parameter                               | Symbol          | Conditions                                                  | Min.  | Typ. | Max. | Unit |
|-----------------------------------------|-----------------|-------------------------------------------------------------|-------|------|------|------|
| Supply voltage                          | Vcc             | -                                                           | 7.5   | 8.5  | 9.5  | V    |
| Supply current                          | Ic              | -                                                           | -     | 26   | 32   | mA   |
| Internal DC voltage<br>(Input & Output) | VDC             | -                                                           | 3.75  | 4.0  | 4.25 | V    |
| Max. voltage gain                       | GVmax           | Rs=0Ω, RL=∞                                                 | 19    | 20   | 21   | dB   |
| Input sensitivity                       | Vi (rms)        | VO=2000mV, Gv=20dB                                          | -     | 200  | -    | mV   |
| Roll-off frequency                      | f <sub>ro</sub> | CKIN=220nF, CKVL=220nF, Zi=Zi(min)<br>Low frequency (-1dB)  | 60    | -    | -    | Hz   |
|                                         |                 | CKIN=220nF, CKVL=220nF, Zi=Zi(min)<br>Low frequency (-3dB)  | 30    | -    | -    | Hz   |
|                                         |                 | CKIN=220nF, CKVL=220nF, Zi=Zi(min)<br>High frequency (-1dB) | 20000 | -    | -    | Hz   |
|                                         |                 | CKIN=470nF, CKVL=220nF, Zi=Zi(typ)<br>Low frequency (-3dB)  | 17    | -    | -    | Hz   |
| Channel separation                      | α <sub>cs</sub> | Vi=2V, 250Hz to 10KHz                                       | 90    | 96   | -    | dB   |
| Total harmonic distortion               | THD             | 20Hz to 12.5KHz, Vi=100mV, Gv=20dB                          | -     | 0.07 | -    | %    |
|                                         |                 | 20Hz to 12.5KHz, Vi=1V, Gv=0dB                              | -     | 0.05 | -    | %    |
|                                         |                 | 20Hz to 12.5KHz, Vi=2V, Gv=0dB                              | -     | 0.2  | -    | %    |
|                                         |                 | 20Hz to 12.5KHz, Vi=2V, Gv=-10dB                            | -     | 0.03 | -    | %    |
| Ripple rejection                        | RR              | Vr(rms)<200mV, f=100Hz                                      | -     | 62   | -    | dB   |
| Signal to noise ratio                   | S/N             | Vo=2.0V, Gv=0dB                                             | -     | 99   | -    | dB   |
|                                         |                 | Vo=2.0V, Gv=12dB                                            | -     | 91   | -    | dB   |
|                                         |                 | Vo=2.0V, Gv=12dB                                            | -     | 83   | -    | dB   |
| Crosstalk                               | α <sub>ct</sub> | Between bus input & signal outputs                          | -     | 110  | -    | dB   |
| Input impedance                         | Zi              | -                                                           | 22    | 30   | 40   | KΩ   |



## Sound Fader Controller IC

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| Parameter                                                                                        | Symbol       | Conditions                            | Min. | Typ. | Max. | Unit       |
|--------------------------------------------------------------------------------------------------|--------------|---------------------------------------|------|------|------|------------|
| Input isolation<br>(One selected source to any other input)                                      | $\alpha_s$   | f=1KHz                                | -    | 104  | -    | dB         |
|                                                                                                  |              | f=12.5KHz                             | -    | 95   | -    | dB         |
| Max. input voltage<br>(RMS value)                                                                | $V_i$ (rms)  | THD<0.5%, Vcc=8.5V                    | -    | 2.7  | -    | V          |
|                                                                                                  |              | THD<0.5%, Vcc=7.5V                    | -    | 2.3  | -    | V          |
| Output impedance                                                                                 | $Z_o$        |                                       | -    | 130  | 220  | $\Omega$   |
| Output load resistance                                                                           | $R_L$        |                                       | 10   | -    | -    | K $\Omega$ |
| Voltage gain<br>(Source selector)                                                                | $G_v$        |                                       | -    | 0    | -    | dB         |
| <b>Control Section (Source Selector not connected, Source Resistance=600<math>\Omega</math>)</b> |              |                                       |      |      |      |            |
| Input impedance                                                                                  | $Z_i$        | Volume input                          | 70   | 150  | 200  | K $\Omega$ |
|                                                                                                  |              | Loudness input                        | 20   | 30   | 40   | K $\Omega$ |
| Output impedance                                                                                 | $Z_o$        |                                       | -    | 130  | 220  | $\Omega$   |
| Output load resistance                                                                           | $R_L$        |                                       | 2    | -    | -    | K $\Omega$ |
| Max. input voltage                                                                               | $V_i$ (rms)  | THD<0.5%                              | -    | 2.4  | -    | V          |
| Noise output voltage                                                                             | $V_{no}$     | $G_v=20$ dB                           | -    | 120  | 220  | $\mu$ V    |
|                                                                                                  |              | $G_v=0$ dB                            | -    | 25   | 50   | $\mu$ V    |
|                                                                                                  |              | $G_v=-66$ dB                          | -    | 13   | 22   | $\mu$ V    |
|                                                                                                  |              | MUTE position                         | -    | 13   | -    | $\mu$ V    |
| Total continuous control range                                                                   | $CR_{tot}$   |                                       | -    | 106  | -    | dB         |
| Recommended control range                                                                        |              |                                       | -    | 86   | -    | dB         |
| Step resolution                                                                                  | $G_{step}$   | Step range                            | -    | 1    | -    | dB         |
|                                                                                                  |              | Step error between any adjoining step | -    | -    | 1.0  | dB         |
| Attenuation set error                                                                            | $\Delta G_a$ | $G_v=+20$ to $-50$ dB                 | -    | -    | 2    | dB         |
|                                                                                                  |              | $G_v=-51$ to $-66$ dB                 | -    | -    | 3    | dB         |
| Gain tracking error                                                                              | $\Delta G_t$ | $G_v=+20$ to $-50$ dB                 | -    | -    | 2    | dB         |
| Mute attenuation                                                                                 | MUTEatt      |                                       | 95   | 100  | -    | dB         |
| <b>Volume 1 Control + Loudness</b>                                                               |              |                                       |      |      |      |            |
| Continuous volume control range                                                                  | $CR_{vol}$   |                                       | -    | 51   | -    | dB         |
| Voltage gain                                                                                     | $G_v$        |                                       | -31  | -    | +20  | dB         |
| Step resolution                                                                                  | $G_{step}$   |                                       | -    | 1    | -    | dB         |
| Max. loudness                                                                                    | $LB_{max}$   | f=40Hz                                | -    | 15   | -    | dB         |
|                                                                                                  |              | f=10KHz                               | -    | 4    | -    | dB         |



## Sound Fader Controller IC

**PT2318**

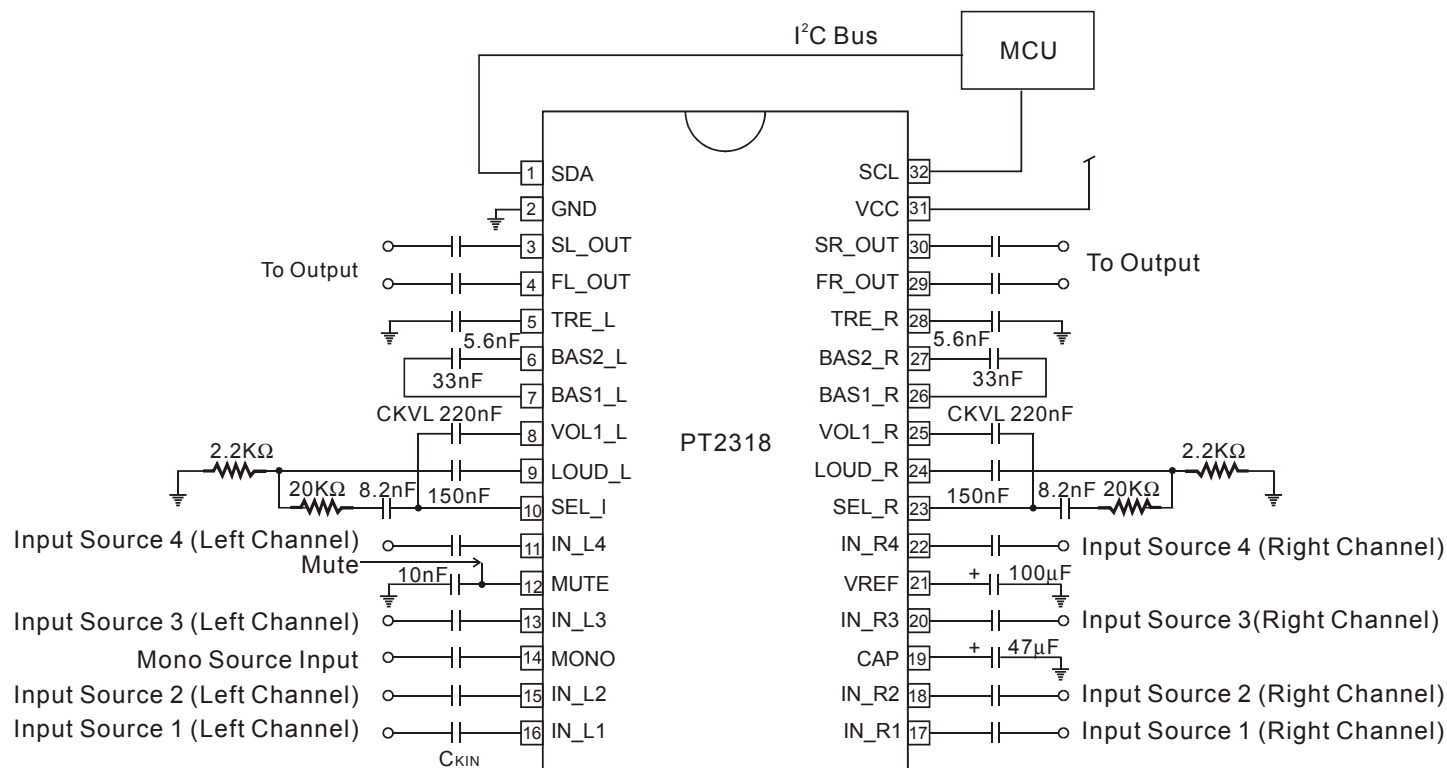
| Parameter                                          | Symbol  | Conditions | Min. | Typ. | Max. | Unit |
|----------------------------------------------------|---------|------------|------|------|------|------|
| <b>Bass Control</b>                                |         |            |      |      |      |      |
| Max. boost<br>(Bass control)                       | Gbass   | f=40Hz     | +14  | +15  | +16  | dB   |
| Max. attenuation                                   |         | f=40Hz     | -14  | -15  | -16  | dB   |
| Step resolution<br>(Toggle switching)              | Gstep   | f=40Hz     | -    | 1.5  | -    | dB   |
| Step error between any<br>adjoining step           | Gstep   | f=40Hz     | -    | -    | 1    | dB   |
| <b>Treble Control</b>                              |         |            |      |      |      |      |
| Max. boost                                         | Gtreble | f=15KHz    | +11  | +12  | +13  | dB   |
| Max. attenuation                                   | Gtreble | f=15KHz    | -11  | -12  | -13  | dB   |
| Max. boost 2                                       | Gtreble | f>15KHz    | -    | -    | 15   | dB   |
| Step resolution<br>(Toggle switching)              | Gstep   | f=15KHz    | -    | 1.5  | -    | dB   |
| Step error between any<br>adjoining step           | Gstep   | f=15KHz    | -    | -    | 1    | dB   |
| <b>Volume 2 + Balance + Fader Controls</b>         |         |            |      |      |      |      |
| Continuous attenuation<br>(Fader & volume control) | CR      |            | -    | 55   | -    | dB   |
| Step resolution                                    | Gstep   |            | -    | 1    | 2    | dB   |
| Attenuation set error                              | Gstep   |            | -    | -    | 2    | dB   |
| <b>Hardware Mute</b>                               |         |            |      |      |      |      |
| <b>Mute: Active</b>                                |         |            |      |      |      |      |
| Input level                                        | VSWLOW  |            | -    | 0.8  | -    | V    |
| <b>Zero Crossing Mute</b>                          |         |            |      |      |      |      |
| Discharger current                                 | Id      |            | -    | 0.6  | -    | μA   |
| Charge current                                     | Ich     |            | -300 | -150 | -    | μA   |
| Delay switch level                                 | VSWDEL  |            | -    | 1.5  | -    | V    |
| Delay time                                         | td      | Cm=10nF    | -    | 100  | -    | ms   |
| Window for audio signal<br>zero crossing detection | Vwind   |            | -    | 50   | -    | mV   |
| <b>Muting at Power Supply Drop</b>                 |         |            |      |      |      |      |
| Supply drop for MUTE<br>active                     | Vccdrop |            | 6.9  | 7    | -    | V    |
| <b>I<sup>2</sup>C Bus Control</b>                  |         |            |      |      |      |      |
| High level input voltage                           | VIH     |            | 3.4  | -    | 9.5  | V    |
| Low level input voltage                            | VIL     |            | -0.3 | -    | +1.5 | V    |



## Sound Fader Controller IC

PT2318

# APPLICATION CIRCUIT





## ORDER INFORMATION

| Valid Part Number | Package Type         | Top Code |
|-------------------|----------------------|----------|
| PT2318-S          | 32 Pins, SOP, 300mil | PT2318-S |
| PT2318            | 32 Pins, DIP, 600mil | PT2318   |



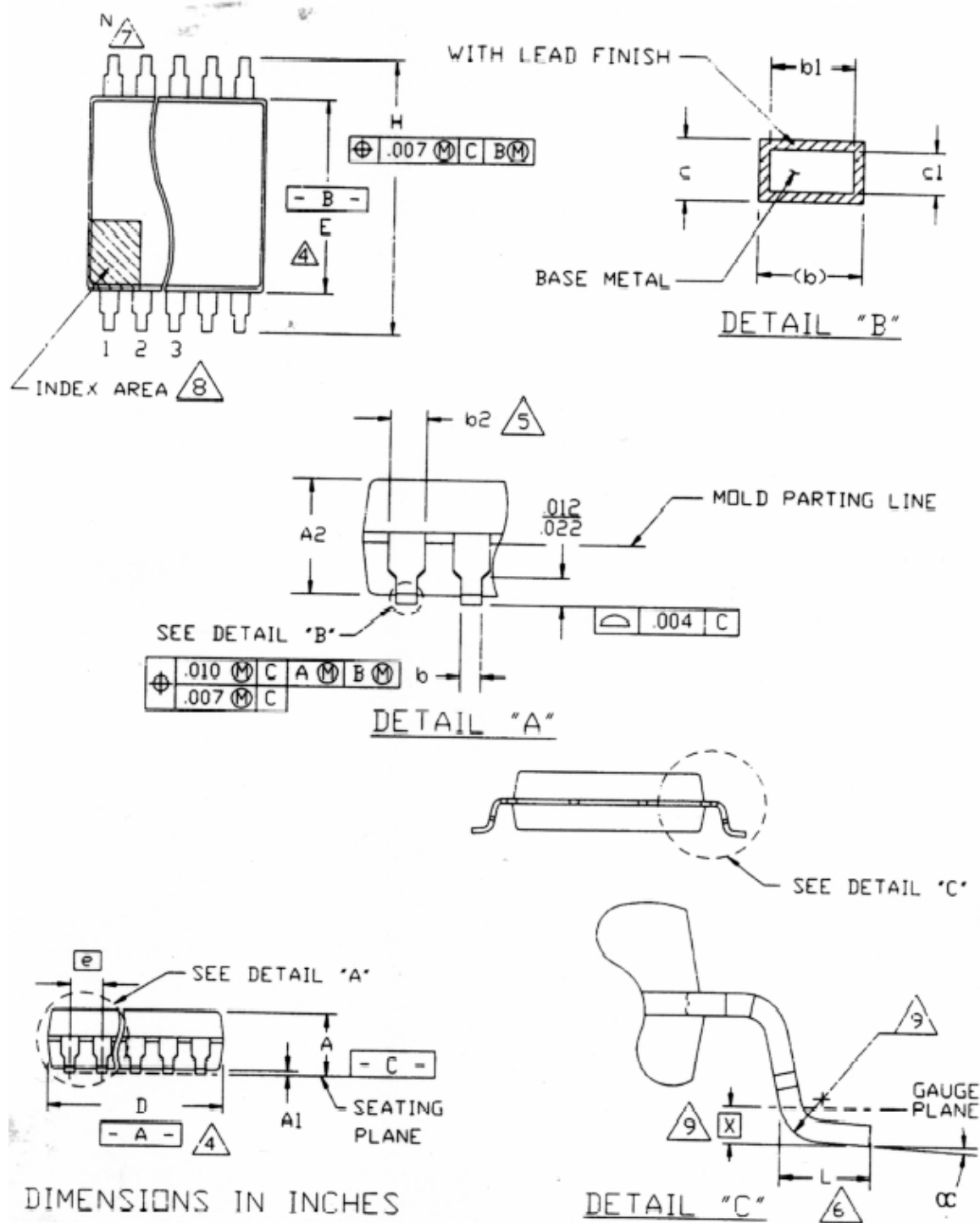


Sound Fader Controller IC

PT2318

# PACKAGE INFORMATION

32 PINS, SOP, 300MIL





Sound Fader Controller IC

PT2318

| Symbols  | Min.       | Nom.  | Max.   |
|----------|------------|-------|--------|
| A        | -          | -     | 0.104  |
| A1       | 0.004      |       | 0.30   |
| A2       | 0.082      | 0.088 | 0.094  |
| b        | 0.014      | 0.016 | 0.020  |
| b1       | 0.014      | 0.016 | 0.018  |
| b2       | 0.026      | 0.028 | 0.032  |
| c        | 0.007      | 0.008 | 0.0125 |
| c1       | 0.007      | 0.008 | 0.010  |
| D        | 0.812      | 0.818 | 0.824  |
| E        | 0.292      | 0.296 | 0.299  |
| e        | 0.050 BSC. |       |        |
| H        | 0.405      | 0.412 | 0.419  |
| L        | 0.021      | 0.031 | 0.041  |
| $\alpha$ | 0°         | 4°    | 8°     |

Notes:

1. Dimensioning and tolerancing per ANSI Y14.5-1982.
2. Dimension D does not include mold flash, protrusions or gate burrs. Mold Flash, protrusion or gate burrs shall not exceed 0.15mm (0.006 in) per side.
3. Dimension E does not include interlead flash or protrusions. Interlead flash or protrusions shall not exceed 0.25 mm (0.010 in) per side.
4. The chamfer on the body is optional. If not present, a visual index feature must be located within the crosshatched area.
5. L is the length of the terminal for soldering to a substrate.
6. The lead width B as measured 0.36 mm (0.014 in) or greater above the seating plane, shall not exceed a maximum value of 0.61 mm (0.24 in)
7. Controlling dimension: MILLIMETER.
8. N=Number of terminal position (N=32)
9. Refer to JEDEC MO-119 variation AC.

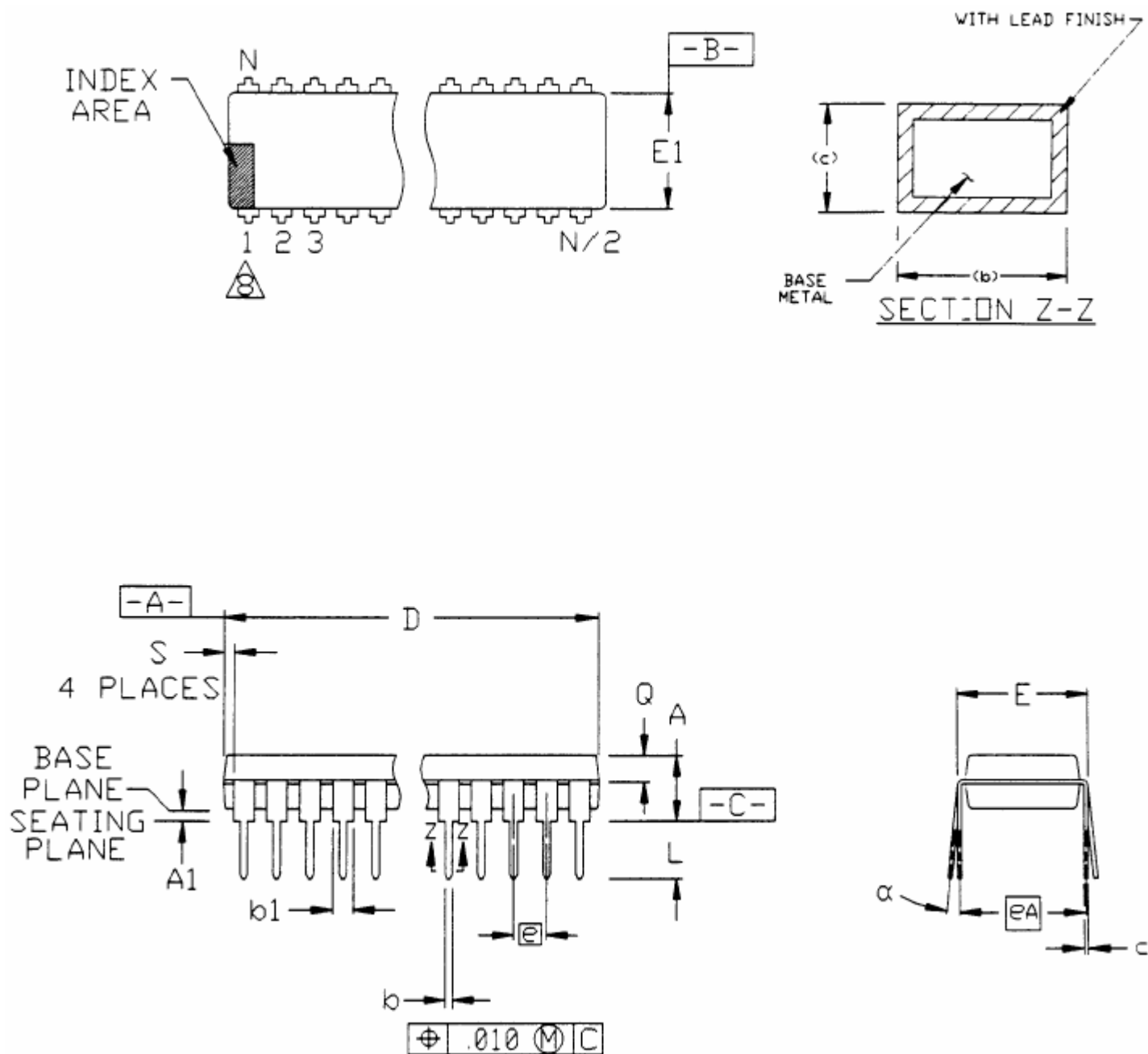
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Sound Fader Controller IC

PT2318

32 PINS, DIP, 600MIL





Sound Fader Controller IC

PT2318

| Symbol   | Min.       | Nom. | Max.  |
|----------|------------|------|-------|
| A        | 0.170      | -    | 0.200 |
| A1       | 0.015      | -    | 0.050 |
| B        | 0.016      | -    | 0.022 |
| B1       | 0.045      | -    | 0.067 |
| C        | 0.009      | -    | 0.015 |
| D        | 1.600      | -    | 1.670 |
| E        | 0.600      | -    | 0.625 |
| E1       | 0.530      | -    | 0.560 |
| e1       | 0.100 BSC. |      |       |
| eA       | 0.600 BSC. |      |       |
| L        | 0.120      | -    | 0.150 |
| $\alpha$ | 0°         | -    | 15°   |
| Q        | 0.065      | -    | 0.080 |
| S        | 0.065      | -    | 0.087 |

Notes:

1. Refer to applicable symbol list.
  2. Dimension and tolerancing per ANSI Y14.5-1982
  3.  $\alpha$  applies to spread leads prior to installation.
  4. N=Number of terminal position (N=32)
  5. D & E1 does not include mold flash. Allowable flash is 0.010 per side.
  6. Outlines on which the seating plane is coincident with the base plane (A1=0) terminal lead standoffs are not required, and B1 may equal B along any part of the lead above the seating/base plane.
  7. Pin 1 identifier must be located in this area.
  8. Controlling dimension: INCH.
  9. Refer to JEDEC MO-015 variation AP.
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