



DESCRIPTION

PT2256 is an electronic volume controller IC utilizing CMOS Technology specially designed for use on audio equipment. It has 2 built-in channels making it ideally suitable for mono and stereo sound applications. PT2256 provides the Loudness Function, a wide frequency response range and a very low total harmonic distortion, thereby guaranteeing a highly effective and reliable performance. It is housed in 16-pin DIP or SOP package and is functionally compatible with TC9235P. Pin assignments and application circuit are optimized for low cost advantages and easy PCB Layout.

FEATURES

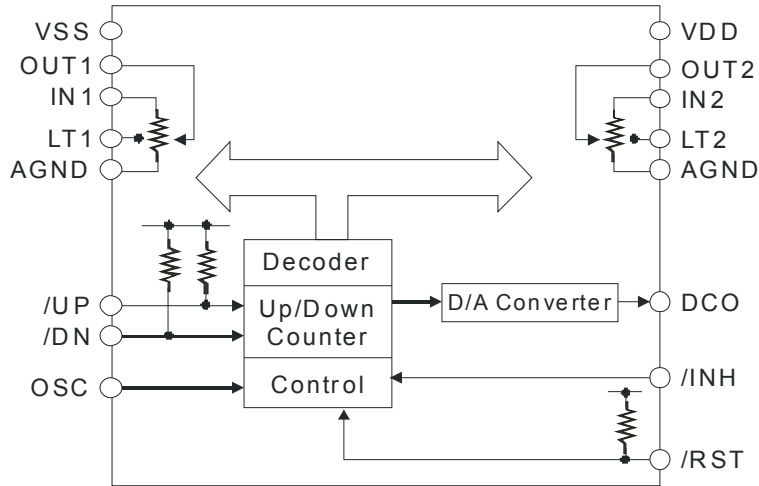
- CMOS technology
- Low power consumption
- Least external components
- 2 channels in the same chip
- 0dB to -78dB attenuation can be controlled by up and down pin
- 20dB tap for loudness circuit
- Built-in DC output circuit (8 levels) for volume level metering
- Wide frequency response range
- Low total harmonic distortion
- Available in 16 pins DIP or SOP

APPLICATION

- Audio equipment volume control

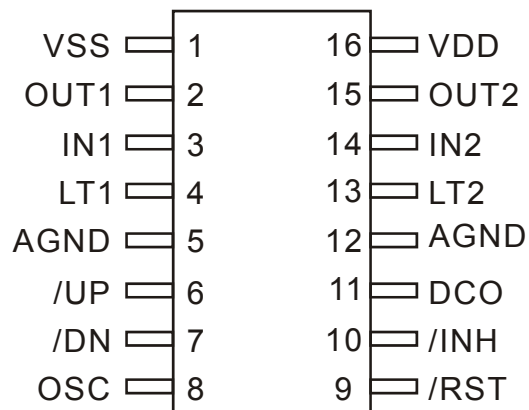


BLOCK DIAGRAM





PIN CONFIGURATION



PT2256



Electronic Volume Controller IC **PT2256**

PIN DESCRIPTION

| Pin Number | I/O | Description | Pin No. |
|------------|-----|--|---------|
| VSS | - | Negative power supply | 1 |
| OUT1 | O | Volume output pin 1 | 2 |
| IN1 | I | Volume input pin 1 | 3 |
| LT1 | O | Tap output pin 1 for loudness function | 4 |
| AGND | - | Analog ground pins 1 | 5, 12 |
| UP | I | Volume up control input pin. The 1 step/1 push volume is controlled by pressing the up Key. If the key has been pushed continuously increase. Built-in pull-up resistor. | 6 |
| DN | I | Volume down control input pin. The 1 step/1 push volume is controlled by pressing the down Key. If the key is continuously pressed, the volume control will continuously decrease. Built-in pull-up resistor. | 7 |
| OSC | I/O | Oscillation pin. The oscillation circuit of a resistor and capacitor connection. Oscillator is activated when the key is pressed. | 8 |
| RST | I | Reset pin. This pin sets the initial volume level. The volume level is set to -46dB by "L" Input. Built-in pull-up resistor low active | 9 |
| /INH | I | Backup mode input pin | 10 |
| DCO | O | DC output pin for volume level meter | 11 |
| LT2 | O | Tap output pin 2 for loudness function | 13 |
| IN2 | I | Volume input pin 2 | 14 |
| OUT2 | O | Volume output pin 2 | 15 |
| VDD | - | Positive power supply | 16 |



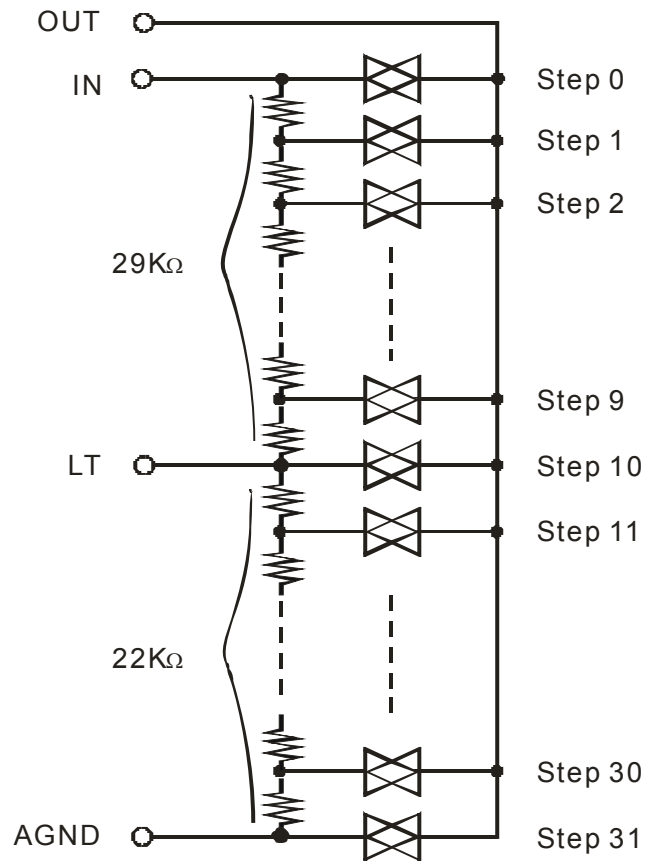
FUNCTION DESCRIPTION

ATTENUATION

The PT2256 volume control circuit consists of ladder resistors and analog switches. The Tap for loudness function is connected to the Step 10 (-20dB). When the (3.9K Ω) resistor is connected between LT and AGND pins, the attenuation is given in table below.

| Step | Attenuation (dB) | Step | Attenuation (dB) |
|------|------------------|------|------------------|
| 0 | 0 | 16 | -32 |
| 1 | -2 | 17 | -34 |
| 2 | -4 | 18 | -36 |
| 3 | -6 | 19 | -38 |
| 4 | -8 | 20 | -40 |
| 5 | -10 | 21 | -42 |
| 6 | -12 | 22 | -46 |
| 7 | -14 | 23 | -50 |
| 8 | -16 | 24 | -54 |
| 9 | -18 | 25 | -58 |
| 10 | -20 | 26 | -62 |
| 11 | -22 | 27 | -66 |
| 12 | -24 | 28 | -70 |
| 13 | -26 | 29 | -74 |
| 14 | -28 | 30 | -78 |
| 15 | -30 | 31 | ∞ |

The equivalent circuit is shown below:



Note: Step 22 has an initial value of -46dB.



Electronic Volume Controller IC

PT2256

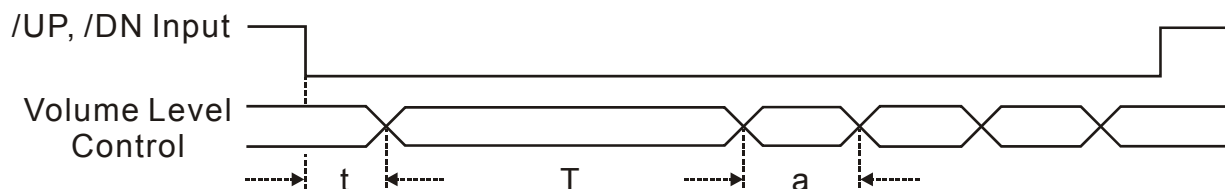
DC OUTPUT FOR VOLUME LEVEL

The DC Output for the Volume Level Meter is internally connected to the D/A Converter. PT2256 has 8 stages of output voltage with each stage corresponding to a particular volume level. Please refer to the table below:

| Step | Attenuation (dB) | Output Voltage (V) |
|-------|------------------|--------------------|
| 0-3 | 0-6 | 7/8 VDD |
| 4-7 | 8-14 | 6/8 VDD |
| 8-11 | 16-22 | 5/8 VDD |
| 12-15 | 24-30 | 4/8 VDD |
| 16-19 | 32-38 | 3/8 VDD |
| 20-23 | 40-50 | 2/8 VDD |
| 24-27 | 54-66 | 1/8 VDD |
| 28-31 | 70-∞ | 0 |

UP/DOWN VOLUME CONTROL

PT2256 features two Volume Control Pins, namely: UP and DN. UP is the control pin used to increase volume level while the DN is the control pin used to decrease the volume level. Thus, volume level may regulated using the Up or Down Keys. These keys are operated on a 1 step/1 push volume level control when UP or DN keys are set to “L” Level. If the keys are continuously pressed (input “Low”), then the volume level continuously steps up or down as the case maybe. Please refer to the diagram below for the timing of the key input.



Notes:

1. t= Preventive Time for Chattering (2.2 x 1/fosc)
2. T= Switching Time to Automatic Mode (10 x 1/fosc)
3. a=Up, Down Speed (2x1/fosc)

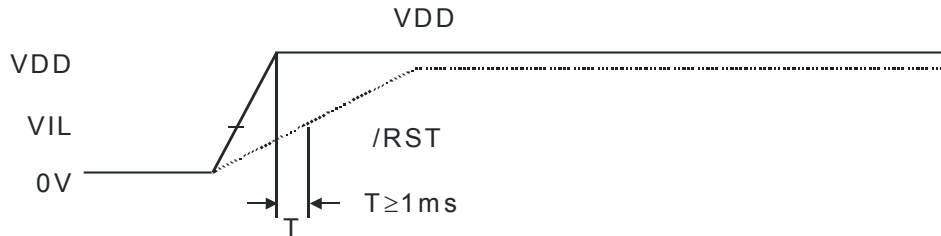


Electronic Volume Controller IC

PT2256

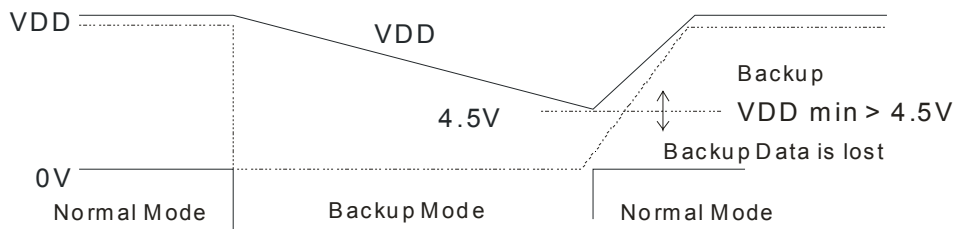
INITIALIZATION WHEN POWER ON

PT2256 has an auto-initialization function during the Power On period. When Power is turned ON, the volume level is set to the initial value of -46 dB by setting the RST pin to "L" level. Please refer to the diagram below.

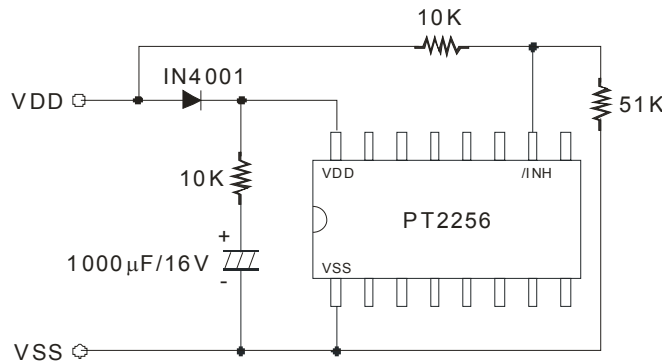


BACK UP WHEN POWER OFF

When the /INH Pin is set at "L" Level, all input and output pins are disabled and the current consumption is reduced to the minimum. Under this condition, the backup becomes possible. Please refer to the diagram below:



The backup circuit is given below:



Note:

If the VDD drops from 12V to 4.5V, then the backup is possible for a period of 6 days. However, if VDD-Vss drops below 4.5V, the backup becomes impossible.



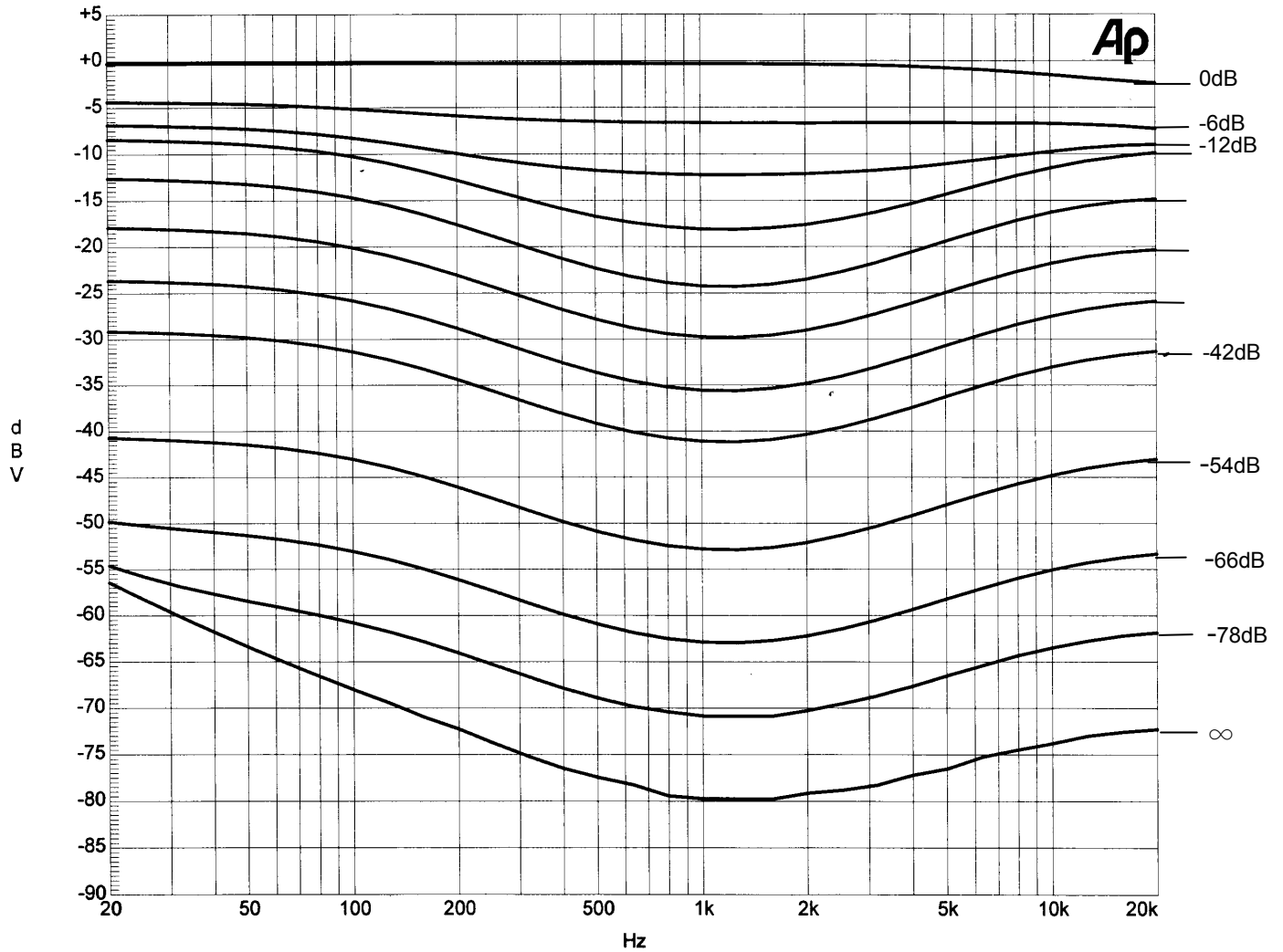
Electronic Volume Controller IC

PT2256

LOUDNESS FREQUENCY RESPONSE

The figure below shows the Loudness Frequency Response Diagram.

Audio Precision





ABSOLUTE MAXIMUM RATINGS

(Unless otherwise stated, Ta=25°C)

| Parameter | Symbol | Rating | Unit |
|-----------------------|--------|-----------------|------|
| Supply voltage | VDD | -0.3 to 13 | V |
| Input voltage | VIN | -0.3 to VDD+0.3 | V |
| Power dissipation | PD | 300 | mW |
| Operating temperature | Topr | -40 to +85 | °C |
| Storage temperature | Tstg | -65 ~ +150 | °C |



Electronic Volume Controller IC

PT2256

ELECTRICAL CHARACTERISTICS

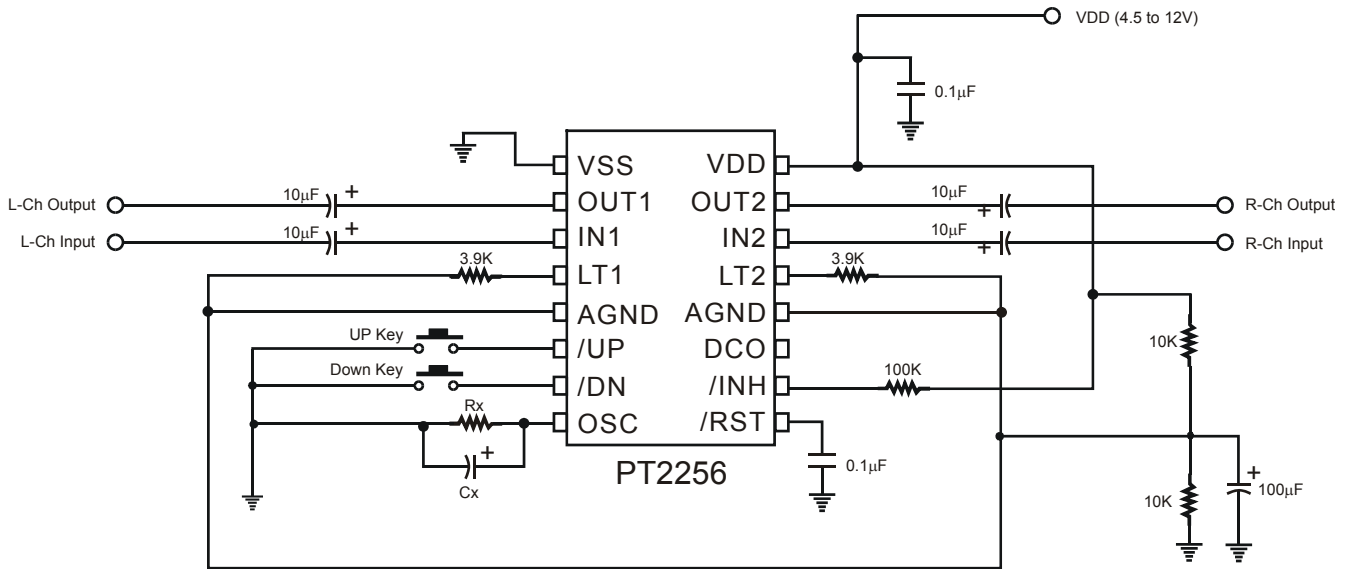
(Unless otherwise stated, Ta=25°C, VDD=9V)

| Parameter | Symbol | Test Condition | Min. | Typ. | Max. | Unit | |
|--------------------------------|-----------------|--|---------|------|--------|------|------|
| Operating supply voltage | VDD | | 4.5 | 9.0 | 12 | V | |
| Operating supply current | IDD | No load, FOSC=20Hz | - | 0.3 | 1.0 | mA | |
| Stand-by current | ISB | OSC=0V, /INH=0V | - | 0.1 | 10 | μA | |
| Backup voltage | VOD | /INH Pin=0V | 2.0 | - | 12 | V | |
| Backup current | IOD | | - | 0.1 | 1.0 | μA | |
| High level input voltage | VIH | /UP, /DN, /RST | 0.7VDD | - | VDD | V | |
| | | /INH | 0.8VDD | - | VDD | | |
| Low level input voltage | VIL | /UP, /DN, /RST | 0 | - | 0.3VDD | V | |
| | | /INH | 0 | - | 0.7VDD | | |
| Voltage resistor | RVR | Between IN~AGND resistor | 45 | 51 | 75 | KΩ | |
| | | Between IN~LT resistor | 26 | 29 | 45 | | |
| | | Between LT~AGND resistor | 19 | 22 | 32 | | |
| High level input current | I _{IH} | /INH input pin. VIL=VDD | -1 | - | 1 | μA | |
| Low level input current | I _{IL} | /INH input pin, VIN=0V | -1 | - | 1 | μA | |
| Pull-up resistor | R _{up} | /UP, /DN, /RST input pin | 90 | 110 | 130 | KΩ | |
| Analog switch on resistor | R _{ON} | When 0dB, Between IN1~OUT1 and IN2~OUT2 Resistor | - | 250 | 400 | Ω | |
| Attenuation error | ΔATT | Test attenuation value | - | 0 | ±2.0 | dB | |
| Balance between left and right | ΔRVR | Volume resistor error between left and right | - | 0 | ±3.0 | % | |
| Total harmonic distortion | THD | FIN=1KHz, VIN=1Vrms, RL=100KΩ, Rg=600Ω | 0dB | - | 0.01 | - | % |
| Maximum attenuation | ATTMAX | | ∞dB | - | 80 | - | dB |
| Cross noise | CT | | 0dB | - | 80 | - | dB |
| Output noise | VN | | 0dB | - | -90 | - | dB |
| OSC frequency | FOSC | CX=2.2μf, Rx=33KΩ | - | 18 | - | Hz | |
| Output resistance | ROUT | FIN=1KHz, VIN=1Vrms, Volume control=0dB | 550 | 650 | 750 | Ω | |
| Maximum input amplitude | VIN | FIN=1KHz, volume control=0dB, THD<0.08% | VDD=9V | - | - | 3.5 | Vrms |
| | | | VDD=12V | - | - | 4.0 | |



APPLICATION CIRCUIT

SINGLE POWER SUPPLY (NO LOUDNESS AND NO BACKUP CIRCUIT)



Note:

Modifying the values of Rx and Cx affects the Oscillator Frequency of the IC. If the Fosc value is big, then the volume control change is fast. Likewise, if the Fosc value is small, the volume control change is slow. It is suggested that Rx=33K, Cx=2.2µF.

The table for the Rx, Cx and Fosc values are given below:

| Rx | Cx | Fosc |
|-----|-------|--------|
| 33K | 1.0µF | 34.1Hz |
| 33K | 2.2µF | 17.8Hz |
| 33K | 10µF | 3.4Hz |

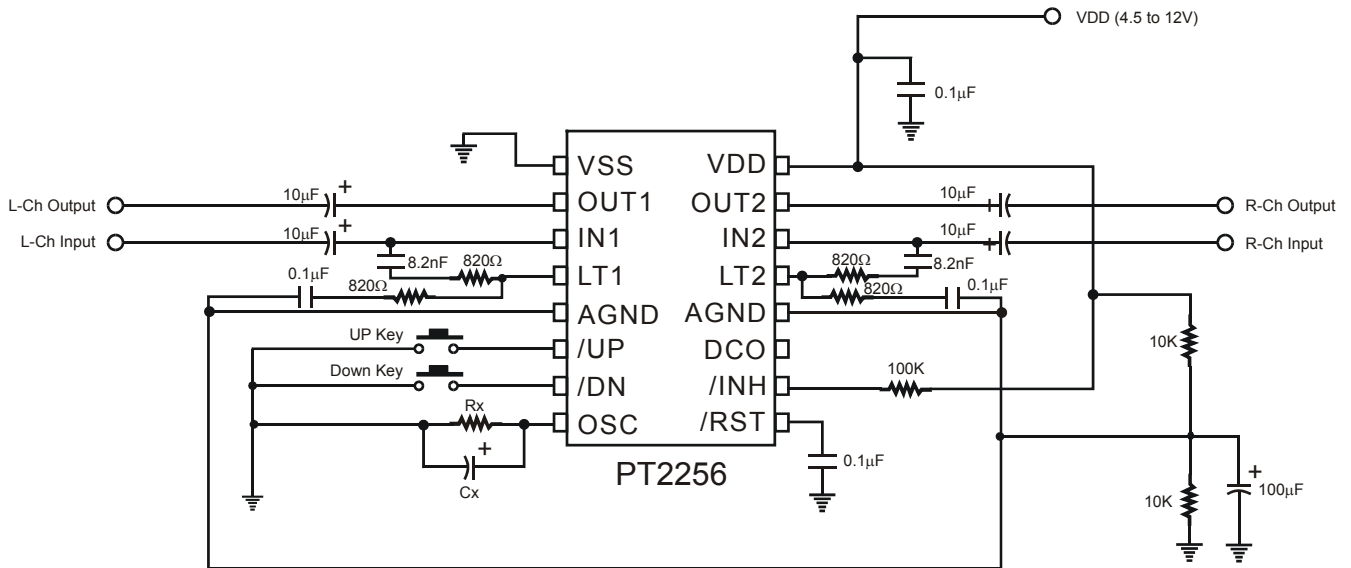
| Rx | Cx | Fosc |
|------|-------|--------|
| 33K | 1.0µF | 34.1Hz |
| 51K | 1.0µF | 22.7Hz |
| 100K | 1.0µF | 11.8Hz |



Electronic Volume Controller IC

PT2256

INCLUDING LOUDNESS BUT NO BACKUP CIRCUIT



Note:

Modifying the values of Rx and Cx affects the Oscillator Frequency of the IC. If the Fosc value is big, then the volume control change is fast. Likewise, if the Fosc value is small, the volume control change is slow. It is suggested that Rx=33K, Cx=2.2μF.

The table for the Rx, Cx and Fosc values are given below.

| Rx | Cx | Fosc |
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| 33K | 1.0μF | 34.1Hz |
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| Rx | Cx | Fosc |
|------|-------|--------|
| 33K | 1.0μF | 34.1Hz |
| 51K | 1.0μF | 22.7Hz |
| 100K | 1.0μF | 11.8Hz |



ORDER INFORMATION

| Part Number | Package | Top Code |
|---------------|----------------------|-----------|
| PT2256 | 16 Pins, DIP, 300mil | PT2256 |
| PT2256-S | 16 Pins, SOP, 300mil | PT2256-S |
| PT2256-SN | 16 Pins, SOP, 150mil | PT2256-SN |
| PT2256 (L) | 16 Pins, DIP, 300mil | PT2256 |
| PT2256-S (L) | 16 Pins, SOP, 300mil | PT2256-S |
| PT2256-SN (L) | 16 Pins, SOP, 150mil | PT2256-SN |

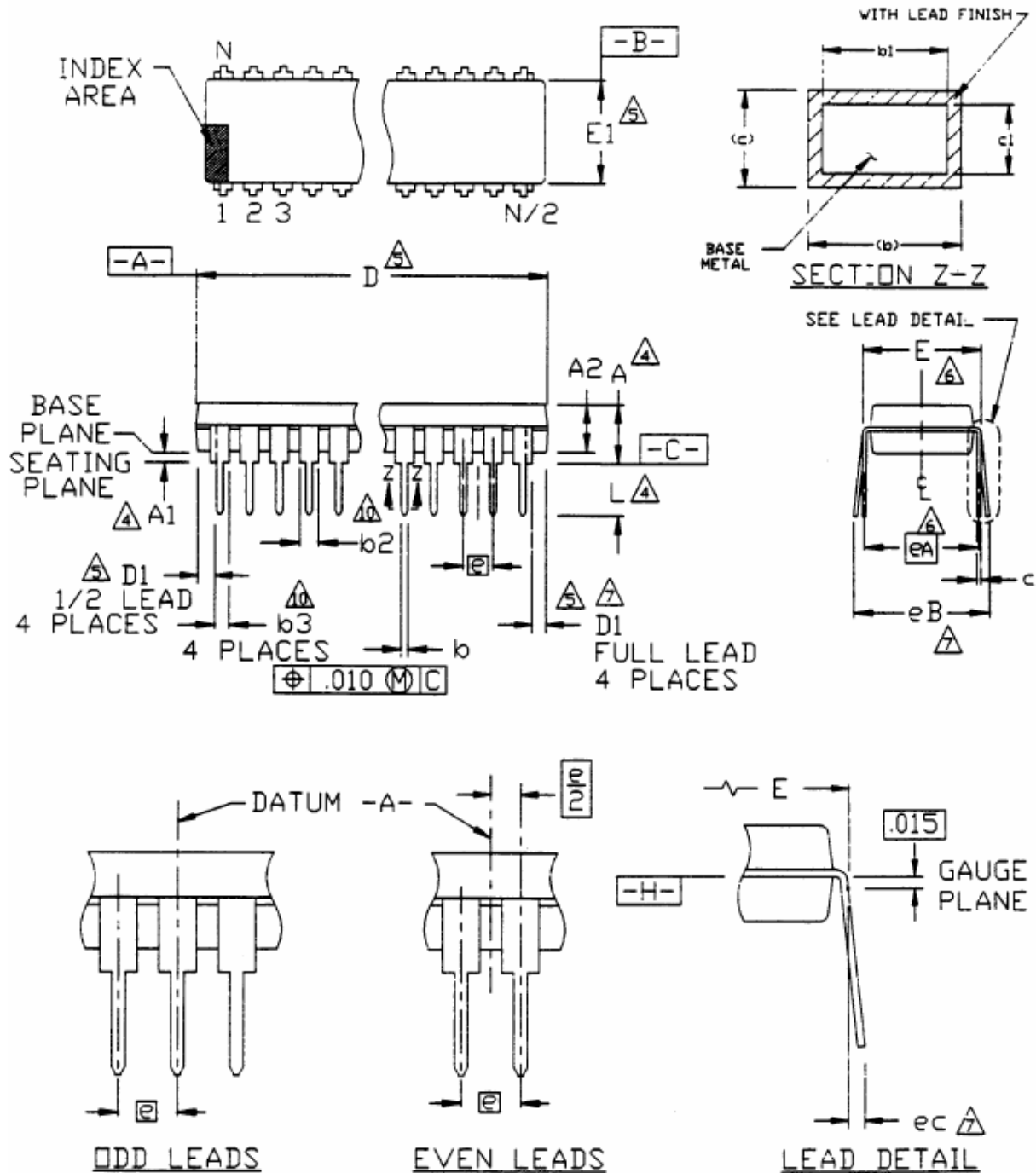
Notes:

1. (L), (C) or (S) = Lead Free.
2. The Lead Free mark is put in front of the date code.



PACKAGE INFORMATION

16PINS, DIP, 300MIL





Electronic Volume Controller IC

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| Symbol | Min. | Nom. | Max. |
|--------|-------|-----------|-------|
| A | - | - | 0.210 |
| A1 | 0.015 | - | - |
| A2 | 0.115 | 0.130 | 0.195 |
| b | 0.014 | 0.018 | 0.022 |
| b1 | 0.014 | 0.018 | 0.020 |
| b2 | 0.045 | 0.060 | 0.070 |
| b3 | 0.030 | 0.039 | 0.045 |
| c | 0.008 | 0.010 | 0.014 |
| c1 | 0.008 | 0.010 | 0.011 |
| D | 0.780 | 0.790 | 0.800 |
| D1 | 0.005 | - | - |
| E | 0.300 | 0.310 | 0.325 |
| E1 | 0.240 | 0.250 | 0.280 |
| e | | 0.100 bsc | |
| eA | | 0.300 bsc | |
| eB | - | - | 0.430 |
| eC | 0.000 | - | 0.060 |
| L | 0.115 | 0.130 | 0.150 |

Notes:

- All dimensions are in INCHES.
- Dimensioning and tolerancing per ANSI Y14.5M-1982.
- Dimensions "A", "A1" and "L" are measured with the package seated in JEDEC Seating Plane Gauge GS-3.
- "D", "D1" and "E1" dimensions do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.010 inch.
- "E" and "eA" measured with the leads constrained to be perpendicular to datum -c-. "eB" and "eC" are measured at the lead tips with the loads unconstrained.
- "N" is the number of terminal positions. (N=16)
- Pointed or rounded lead tips are preferred to ease insertion.
- "b2" and "b3" maximum dimensions are not include dambar protrusions. Dambar protrusions shall not exceed 0.010 inch (0.25 mm).
- Distance between leads including Dambar protrusions to be 0.005 inch minimum.
- Datum plane -H- coincident with the bottom of lead, where lead exits body.
- Refer to JEDEC MS-001 Variation AB.

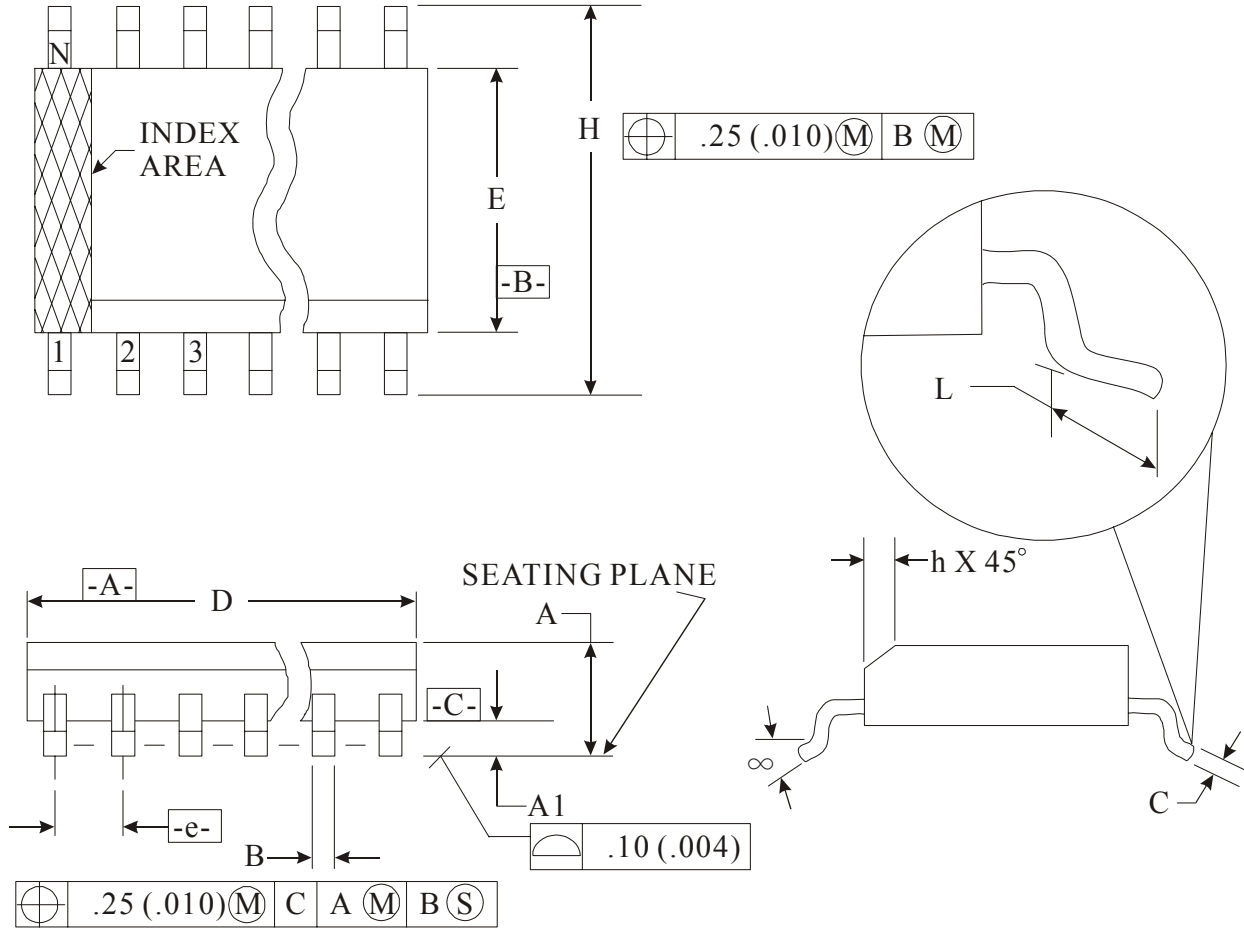
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Electronic Volume Controller IC

PT2256

16PINS, SOPM, 300MIL



| Symbol | Min. | Max |
|----------|----------|-------|
| A | 2.35 | 2.65 |
| A1 | 0.10 | 0.30 |
| B | 0.33 | 0.51 |
| C | 0.23 | 0.32 |
| D | 10.10 | 10.50 |
| E | 7.40 | 7.60 |
| e | 1.27 BSC | |
| H | 10.00 | 10.65 |
| h | 0.25 | 0.75 |
| L | 0.40 | 1.27 |
| α | 0° | 8° |



Electronic Volume Controller IC

PT2256

Notes:

1. Dimensioning and tolerancing per ANSI Y14.5M-1982.
2. Dimension "D" does not include mold flash, protrusions or gate burrs. Mold Flash, protrusion or gate burrs shall not exceed 0.15 mm (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 it is 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. N is the number of the terminal positions (N=16)
7. 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).
8. Controlling dimension : MILLIMETER.
9. Refer to JEDEC MS-013, Variation AA.

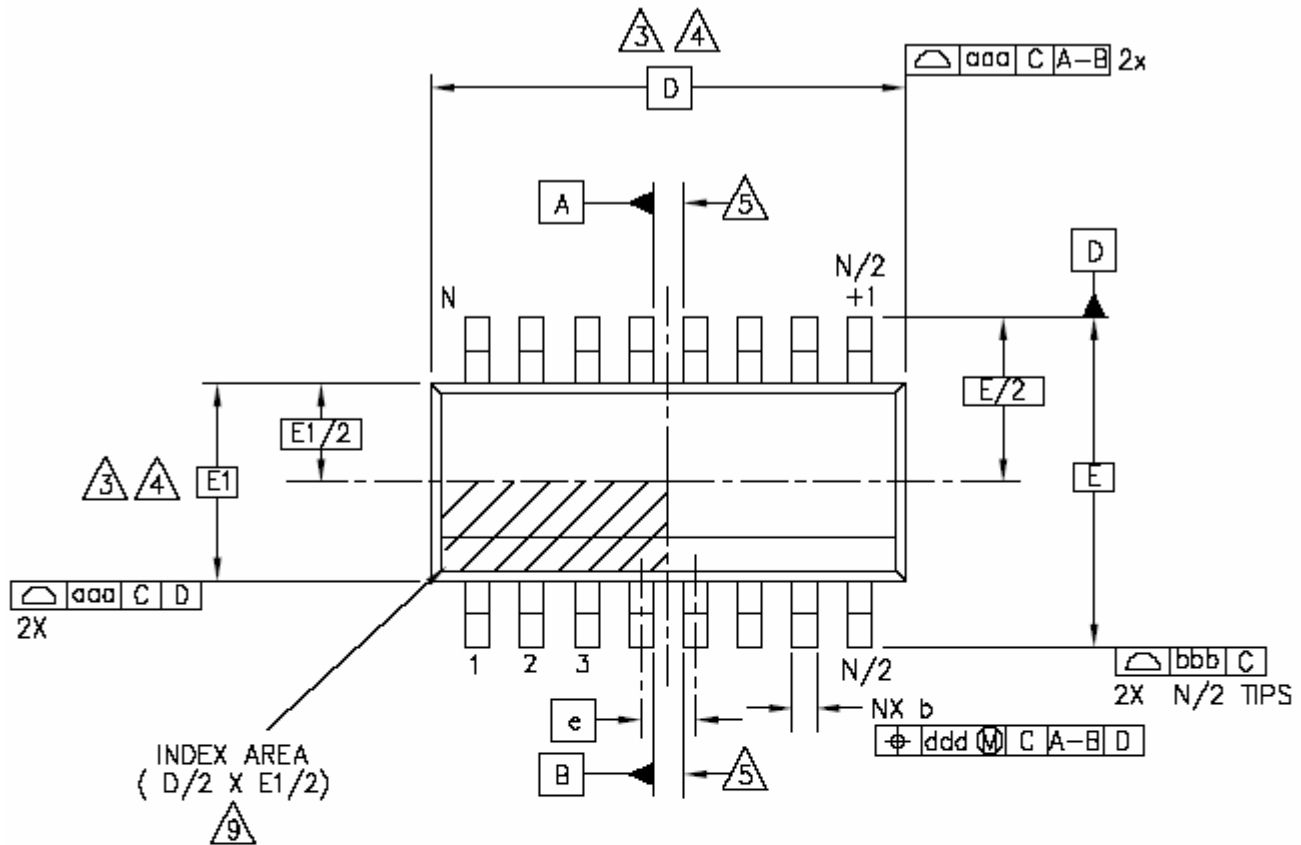
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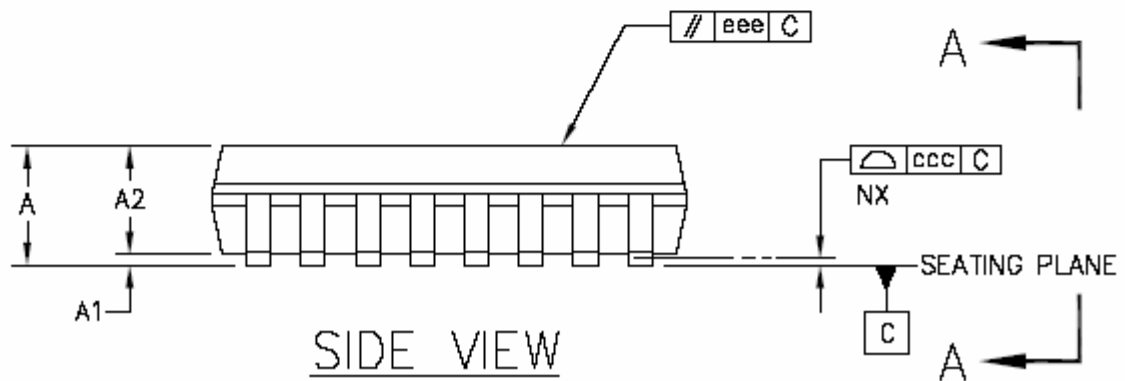
Electronic Volume Controller IC

PT2256

16 PINS, SOP, 150MIL



TOP VIEW



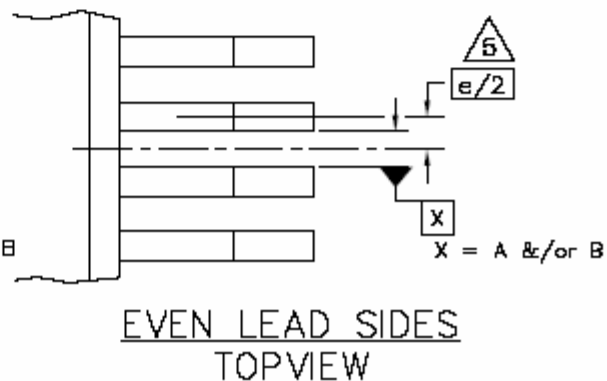
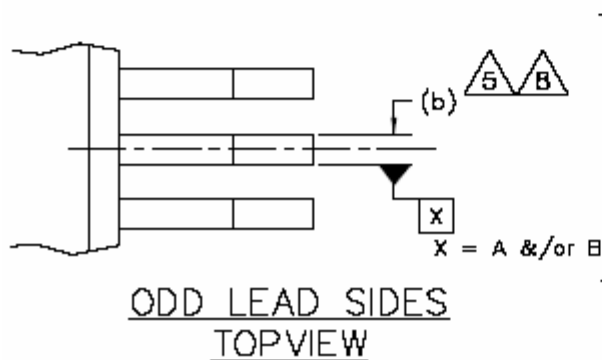
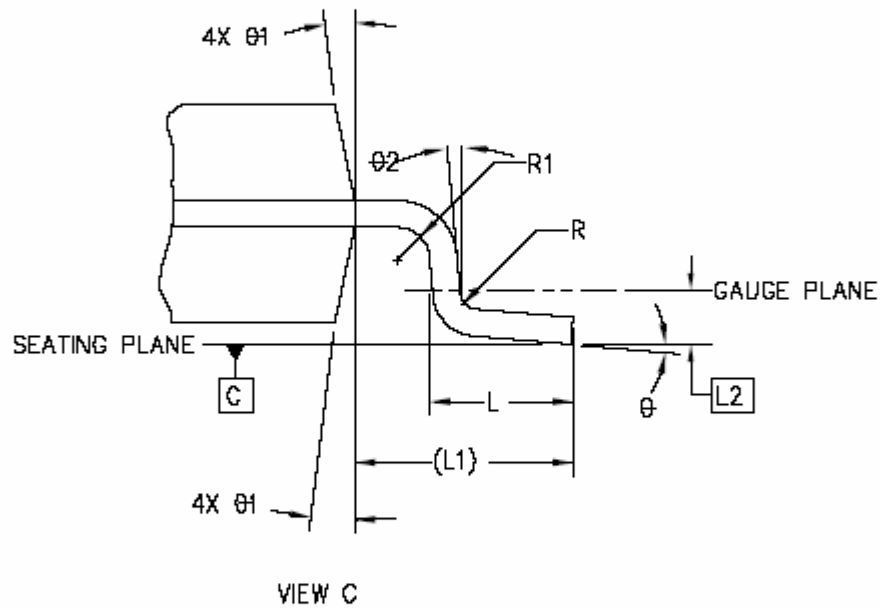
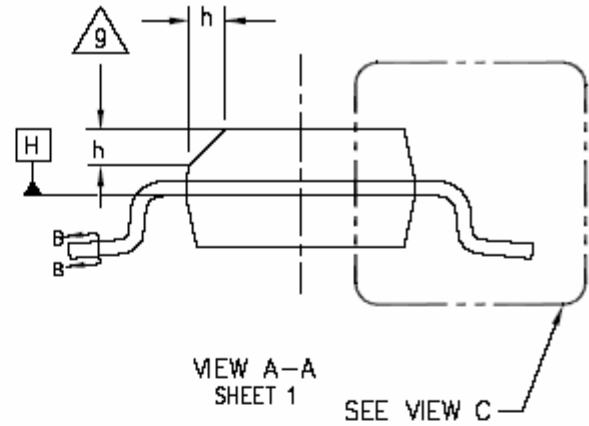
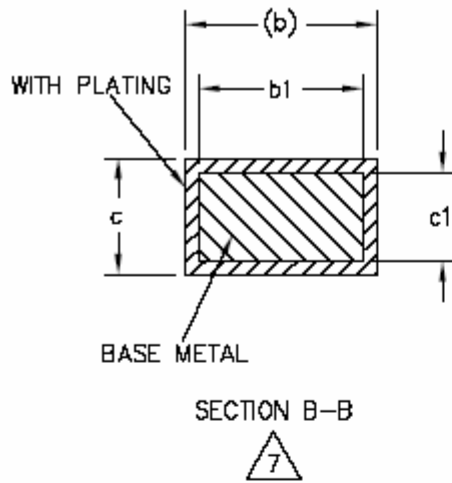
SIDE VIEW

SEE SHEET 2



Electronic Volume Controller IC

PT2256





Electronic Volume Controller IC **PT2256**

| Symbol | Min. | Typ. | Max. |
|--------|-----------|------|------|
| A | 1.35 | - | 1.75 |
| A1 | 0.10 | - | 0.25 |
| A2 | 1.25 | - | 1.65 |
| b | 0.31 | - | 0.51 |
| b1 | 0.28 | - | 0.48 |
| c | 0.17 | - | 0.25 |
| c1 | 0.17 | - | 0.23 |
| D | 9.90 BSC. | | |
| E | 6.00 BSC. | | |
| E1 | 3.90 BSC. | | |
| e | 1.27 BSC. | | |
| L | 0.40 | - | 1.27 |
| L1 | 1.04 REF. | | |
| L2 | 0.25 BSC. | | |
| R | 0.07 | - | - |
| R1 | 0.07 | - | - |
| h | 0.25 | - | 0.50 |
| θ | 0° | - | 8° |
| θ1 | 5° | - | 15° |
| θ2 | 0° | - | - |

Notes:

1. Dimensioning and tolerancing per ANSI Y 14.5M-1994
2. Controlling Dimension: MILLIMETERS.
3. Dimension D does not include mold flash protrusions or gate burrs. Mold flash, protrusions or gate burrs shall not exceed 0.15 mm (0.006 in) per end. Dimension E1 does not include interlead flash or protrusion. Interlead flash or protrusion shall not exceed 0.25mm per side. D and E1 dimensions are determined at datum H.
4. The package top may be smaller than the package bottom. Dimensions D and E1 are determined at the outermost extremes of the plastic body exclusive of mold flash, tie bar burrs, gate burrs and interlead flash, but including any mismatch between the top and bottom of the plastic body.
5. Datums A & B to be determined at datum H.
6. N is the number of terminal positions. (N=16)
7. The dimensions apply to the flat section of the lead between 0.10 to 0.25mm from the lead tip.
8. Dimension “b” does not include dambar protrusion. Allowable dambar protrusion shall be 0.10mm total in excess of the “b” dimension at maximum material condition. The dambar cannot be located on the lower radius of the foot.
9. This chamfer feature is optional. If it is not present, then a pin 1 identifier must be located within the index area indicated.
10. Refer to JEDEC MS-012, Variation AC.
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REVISION HISTORY

| Date | Revision # | Reference # | Remarks |
|------------------|------------|-------------|---|
| September, 2000 | 01 | PT2256 v1.3 | Modification #: 000803 Approval #: 000902 Request #: |
| July, 19, 2004 | 02 | PT2256V1.4 | Request No.: 040708 Approval #: 040705 Modification #: 040705 |
| August, 13, 2004 | 03 | PT2256 V1.5 | Request No.: 040811 Approval #: 040806 Modification #: 040805 |
| March, 24, 2006 | 04 | PT2256 V1.6 | Approval #: 060316 Modification #: 060315 |
| August, 15, 2006 | 05 | PT2256 V1.7 | Approval #: 060811 Modification #: 060806 |