Princeton Technology Corp.
Tel: 886-2-66296288
Fax: 886-2-29174598
URL: http://www.princeton.com.tw



# DESCRIPTION

PT2351 is an 8-pin subwoofer cross-over low pass filter chip utilizing CMOS Technology having a slope rate of -12dB/oct or -18 dB/oct. Using an external capacitor, the roll-off point can be adjusted to meet your needs or taste. PT2351 has low distortion, high input impedance and low output impedance design. The application circuit and pin assignments are optimized for easy PCB Layout and cost saving benefits.

# FEATURES

- CMOS Technology
- Single Power Supply: 3V to 9V
- Second Order Low Pass Filter Design with Slope Rate = -12dB/oct
- Third Order Low Pass Filter Design with Slope Rate = -18 dB/oct
- Low Output Impedance (Typ. 40Ω)
- Least External Components
- The Roll-Off Point can be adjusted using an External Capacitor
- 2-Channel Inputs are mixed to a Single Subwoofer Output
- Available in 8-pin, SOP or DIP

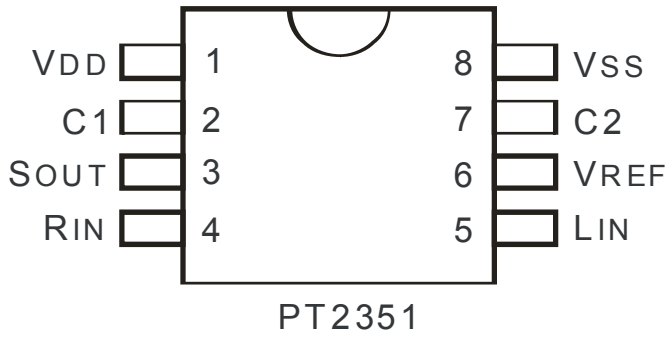
# APPLICATIONS

- Multi-Media Audio Subwoofer System
- Audio Equipment
- Sound Card
- Home Theater System
- Other Audio Equipment

Tel: 886-2-66296288
Fax: 886-2-29174598
URL: http://www.princeton.com.tw



# PIN CONFIGURATION

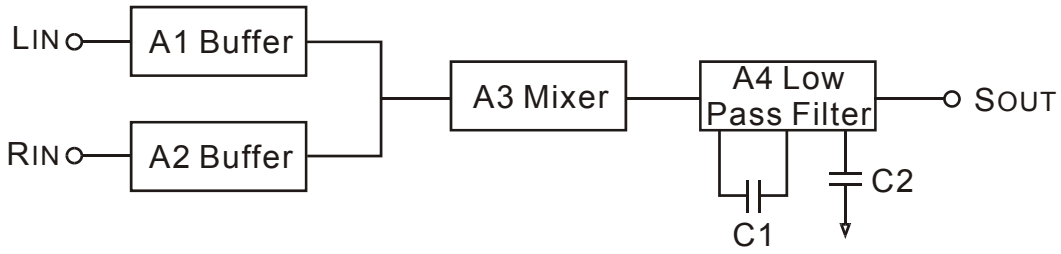



# PIN DESCRIPTION

| Pin Name | I/O | Description | Pin No. |
|---|---|---|---|
| $V_{DD}$ | - | Positive Power Supply | 1 |
| C1 | I | Connect a capacitor to SOUT | 2 |
| $S_{OUT}$ | O | Subwoofer Output Pin | 3 |
| $R_{IN}$ | I | Right Channel Input | 4 |
| $L_{IN}$ | I | Left Channel Input | 5 |
| $V_{REF}$ | - | Voltage Reference Pin<br>Connect 100μF to GND | 6 |
| C2 | I | Connect a capacitor to VREF | 7 |
| $V_{SS}$ | - | Ground | 8 |

# FUNCTION DESCRIPTION

The signals from the Left and Right Channels are applied to the A1 and A2 Buffers respectively. The signals are then mixed via the A3 Mixer and passes through the A4 Sallen Key Low Pass Filter. The roll-off point can be adjusted by changing the values of the external capacitors C1 and C2. Please refer to the diagram below.



Tel: 886-2-66296288
Fax: 886-2-29174598
URL: http://www.princeton.com.tw



# ABSLOUTE MAXIMUM RATING

| Parameter | Symbol | Rating | Unit |
|---|---|---|---|
| Operating Voltage | $V_{DD}$ | 10 | V |
| Input Voltage | $V_I$ | -0.3 to $V_{CC}$+0.3 | ℃ |
| Operating Temperature | Topr | -40 ~ +85 | ℃ |
| Storage Temperature | Tstg | -65 ~ +150 | V |

# DC ELECTRICAL CHARACTERISTICS

(Unless otherwise stated, $V_{CC}$=8V, $V_{IN}$=0.5Vrms, f=1KHz)

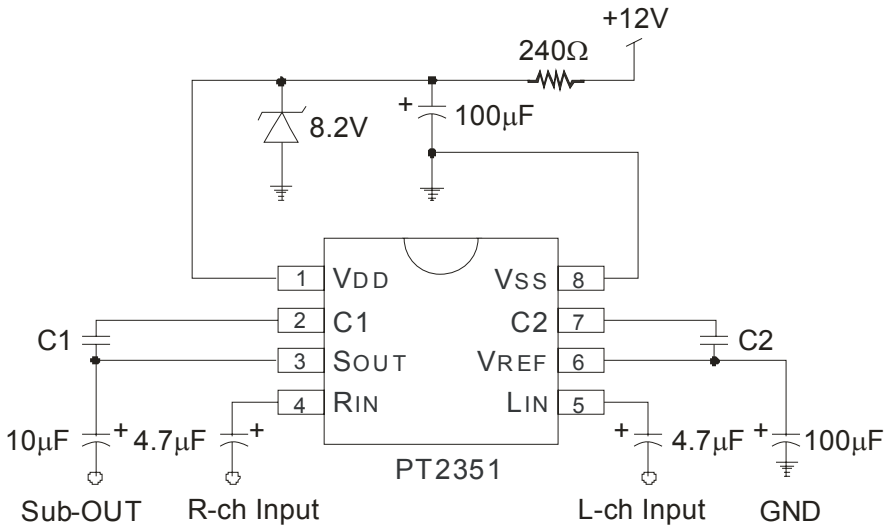
| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Operating Voltage | $V_{DD}$ | | 3 | 8 | 9 | V |
| Operating Current | $I_S$ | $V_{IN}$=0V | - | 8 | 12 | mA |
| Subwoofer Total Harmonic Distortion | SW THD | f=100Hz | - | 0.1 | 0.5 | % |
| Output Noise | $N_O$ | $V_{IN}$=0V, No Weighting | - | -82 | -75 | dB |
| Subwoofer Gain | $SG_N$ | f=100Hz | - | 10 | - | dB |
| Input Impedance | $R_{IN}$ | No Input | - | 100 | - | KΩ |
| Subwoofer Output Impedance | $S_{OUT}$ | f=100Hz | - | 40 | - | Ω |
| Max. Output Voltage | $V_{CL}$ | f=100Hz THD=1% | - | 2.8 | - | Vrms |

Tel: 886-2-66296288
Fax: 886-2-29174598
URL: http://www.princeton.com.tw



# SECOND ORDER LOW PASS FILTER APPLICATION CIRCUIT

The Second Order Low Pass Filter application circuit only needs very few components. The Cross-Over Filter Point can be adjusted by modifying the values of capacitors -- C1, and C2. For better circuit characteristic, it is recommended that C2 be twice the value of C1. Please refer to the diagram below.



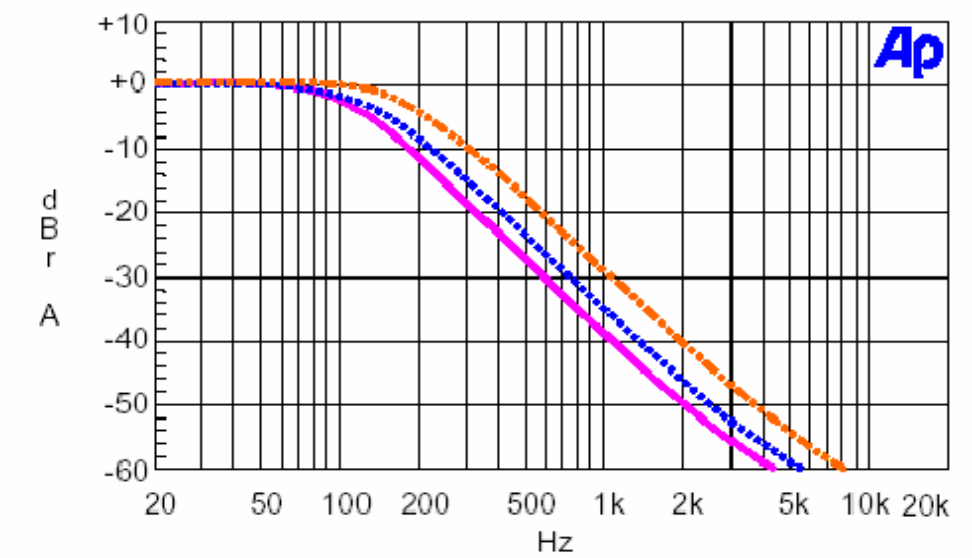
Tel: 886-2-66296288
Fax: 886-2-29174598
URL: http://www.princeton.com.tw



## *SECOND ORDER LOW PASS FILTER FREQUENCY CURVE*

The Second Order Low Pass Filter Frequency Curve is given in the diagram below. Curves from Left to Right show the Cross-Over Frequency Curve Point at 100Hz, 130 Hz and 200Hz respectively.

Test Conditions: Vcc= +8V, Input Level = 0.3Vrms, 20Hz to 20KHz

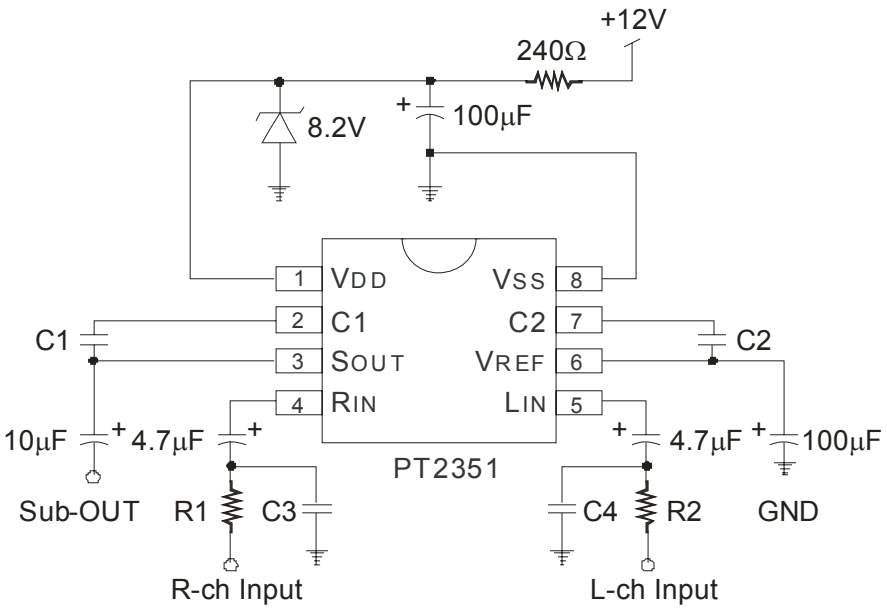



The table below shows the various Cross-Over Frequencies at different C1 and C2 values.
If you need a very precise Cross-Over Frequency, we recommend that you use a tolerance value of 5%.

| Cross-Over Frequency | C1 | C2 |
|---|---|---|
| 80Hz | 0.100μF | 0.24μF |
| 100Hz | 0.082μF | 0.18μF |
| 130Hz | 0.068μF | 0.15μF |
| 200Hz | 0.056μF | 0.10μF |
| 260Hz | 0.047μF | 0.10μF |

# THIRD ORDER FREQUENCY RESPONSE CURVE

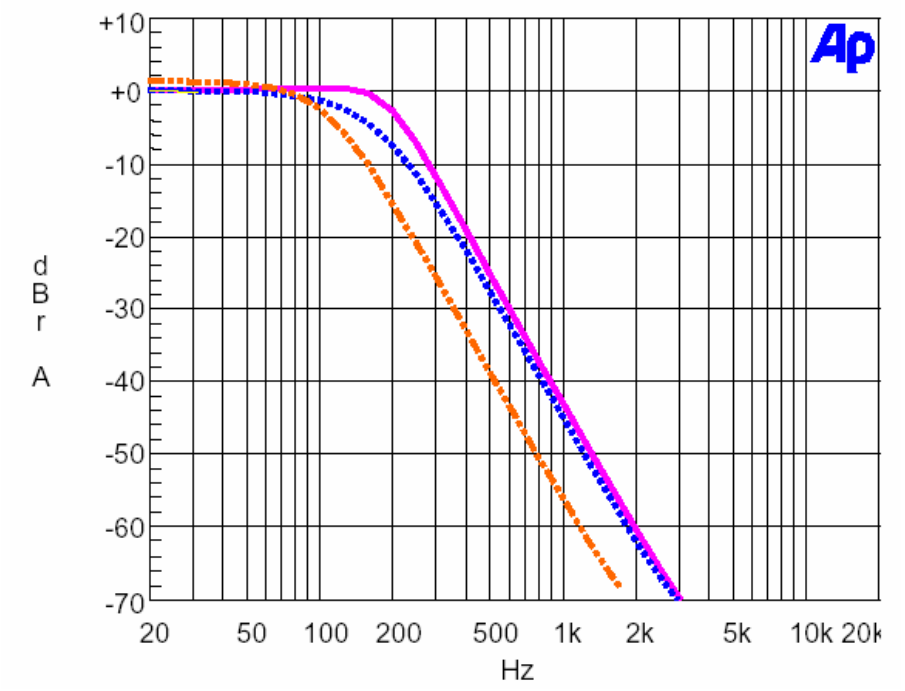
If you need more High Frequency Attenuation, then you just need to add the R-C group between the capacitor 4.7μF and the Input terminals (RIN and LIN) to achieve a Third Order Frequency Response. Please refer to the diagram below.



## *THIRD ORDER LOW PASS FILTER FREQUENCY CURVE*

The Third Order Frequency Response Curve is given in the figure below. Curves shown from Left to Right are the Cross-Over Points at 100Hz, 160Hz, and 200 Hz respectively.

Test conditions: Vcc=+8V, Input Level=0.3Vrms, 20Hz to 20KHz



Tel: 886-2-66296288
Fax: 886-2-29174598
URL: http://www.princeton.com.tw



The Table below shows the various Third Order Cross-Over Frequencies at different R1, R2, C1, C2, C3 and C4 values. You will see from the Table below that some values of C1, C2, C3 and C4 will display two capacitor values enclosed in parenthesis. This means that the top capacitor value is theoretical and therefore cannot be found in the actual market. Under these conditions, you can connect the capacitors found in the parenthesis in parallel. For example: At the Cross-Over Frequency Point = 60Hz, you will notice that C1 value is displayed as 0.133μF (0.1μF//0.033μF)

This simply means that 0.1 μF must be connected in parallel to 0.033μF to achieve 0.133μF capacitor.

If you do not need a very precise Cross-Over Frequency, you can just use the closest capacitor value you can find; however, the Cross-Over Frequency will slightly differ.

| Cross-Over Frequency | R1, R2 | C1 | C2 | C3, C4 |
|---|---|---|---|---|
| 40Hz | 2.2K | 0.2μF | 0.42μF (0.39μF//0.033μF) | 1.56μF (1μF//0.56μF) |
| 60Hz | 2.2K | 0.133μF (0.1μF//0.033μF) | 0.27μF | 1μF |
| 80Hz | 2.2K | 0.115μF (0.1μF//0.015μF) | 0.22μF | 1μF |
| 100Hz | 2.2K | 0.09μF (0.068μF//0.022μF) | 0.168μF (0.1μF//0.068μF) | 0.82μF |
| 130Hz | 2.2K | 0.068μF | 0.127μF (0.1μF//0.027μF) | 0.68μF |
| 160Hz | 2.2K | 0.056μF | 0.11μF (0.1μF//0.01μF) | 0.47μF |
| 200Hz | 2.2K | 0.047μF | 0.086μF (0.068μF//0.018μF) | 0.47μF |
| 250Hz | 2.2K | 0.036μF (0.033μF//3300μF) | 0.068μF | 0.33μF |
| 300Hz | 2.2K | 0.03μF (0.027μF//3300μF) | 0.56μF | 0.29μF (0.27μF//0.022μF) |

Tel: 886-2-66296288
Fax: 886-2-29174598
URL: http://www.princeton.com.tw



# ORDER INFORMATION

| Valid Part Number | Package Type | Top Code |
|---|---|---|
| PT2351 | 8 Pins, DIP (300 mil) | PT2351 |
| PT2351-S | 8 Pins, SOP (150 mil) | PT2351-S |
| PT2351 (L) | 8 Pins, DIP (300 mil) | PT2351 |
| PT2351-S (L) | 8 Pins, SOP (150 mil) | PT2351-S |

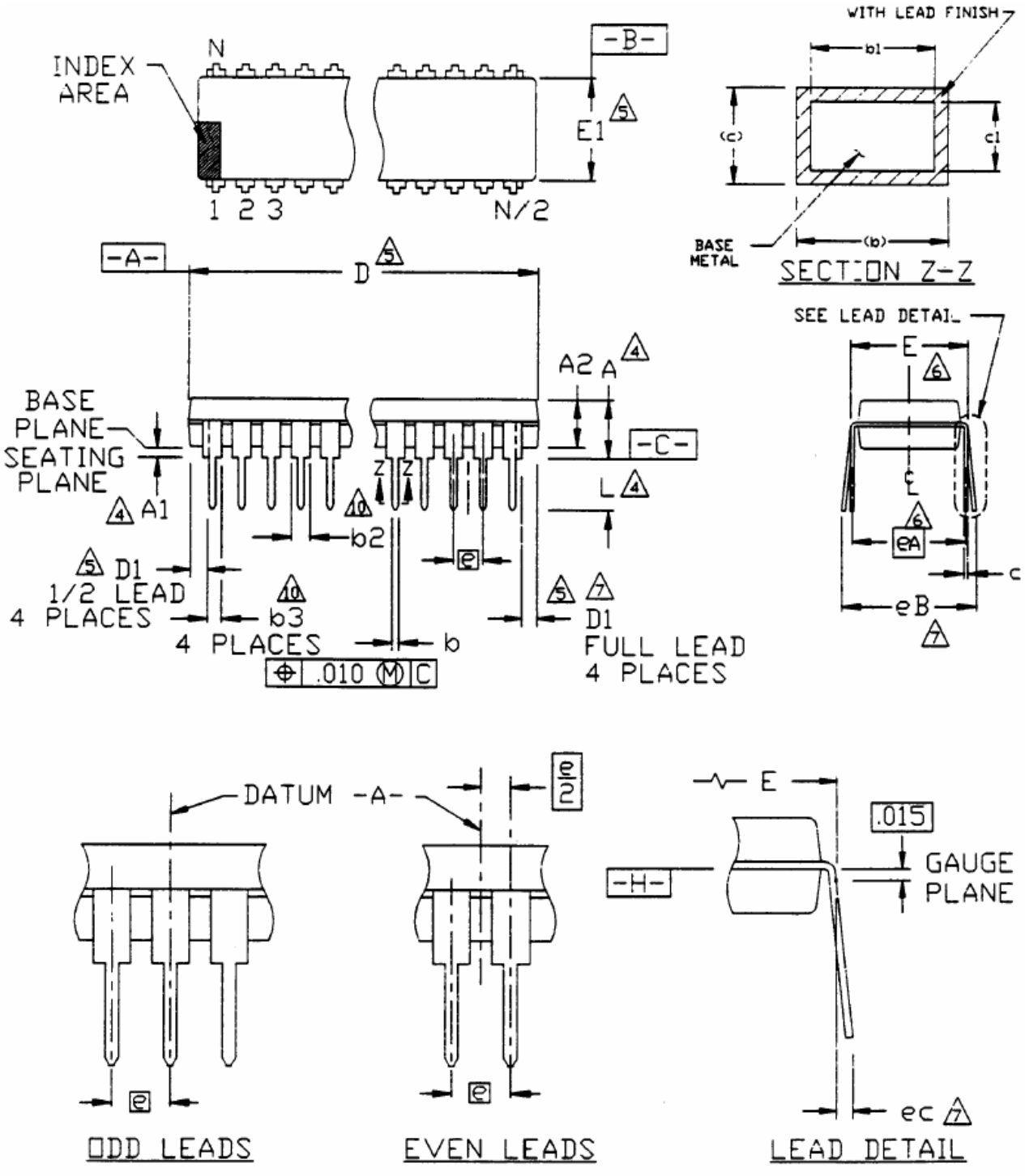
Notes:
1. (L) = Lead Free
2. The Lead Free mark is put in front of the date code

Tel: 886-2-66296288
Fax: 886-2-29174598
URL: http://www.princeton.com.tw



# PACKAGE INFORMATION

## *8 PINS, DIP, 300 MIL*



Tel: 886-2-66296288
Fax: 886-2-29174598
URL: http://www.princeton.com.tw



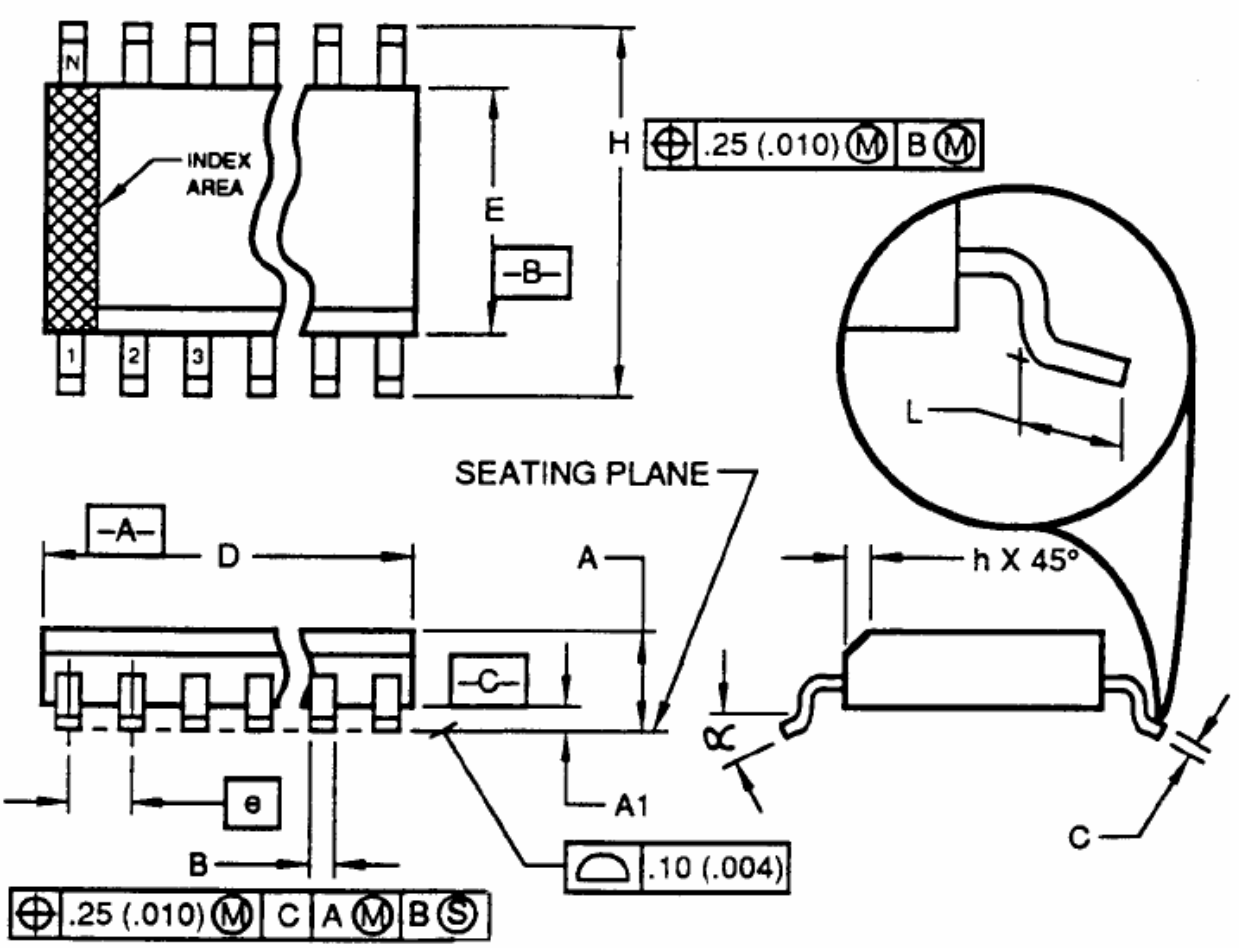
| Symbol | Min. | Nom. | Max. |
|---|---|---|---|
| A | - | - | 0.210 |
| A1 | 0.015 | - | - |
| A2 | 0.115 | 0.130 | 0.195 |
| b | 0.014 | 0.018 | 0.022 |
| b1 | 0.014 | 0.018 | 0.020 |
| b2 | 0.045 | 0.060 | 0.070 |
| b3 | 0.030 | 0.039 | 0.045 |
| c | 0.008 | 0.010 | 0.014 |
| c1 | 0.008 | 0.010 | 0.011 |
| D | 0.355 | 0.365 | 0.400 |
| 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 |

Note:
1. Controlling Dimensions: INCHES.
2. Dimensioning and tolerancing per ANSI Y14.5M-1982.
3. Symbols are defined in the “MO Series Symbol LIST” in Section 2.2 of Publication No.95.
4. Dimension A, A1 and L are measured with the package seated in JEDEC Seating Plane Gauge GS-3.
5. D, D1 and E1 dimensions do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.010 inch.
6. E and eA measured with the leads constrained to be perpendicular to data -c- .
7. eB and eC are measured at the lead tips with the leads unconstrained.
8. N is the number of leads (N=8)
9. Pointed or rounded lead tips are preferred to ease insertion.
10. b2 and b3 maximum dimensions do not include dambar protrusions. Dambar protrusions shall not exceed 0.010 inch (0.25mm)
11. Variation BA has a b3 dimension and is 1/2 lead package.
12. Distance between the leads including dambar protrusions to be 0.005 inch minimum.
13. Datum plane -H- coincident with the bottom of lead, where lead exits the body.
14. Refer to JEDEC MS-001, Variation BA.
    JEDEC is the registered trademark of JEDEC SOLID STATE TECHNOLOGY ASSOCIATION.

Tel: 886-2-66296288
Fax: 886-2-29174598
URL: http://www.princeton.com.tw



## *8 PINS, SOP, 150 MIL*




| Symbol | Min. | Max. |
|---|---|---|
| A | 1.35 | 1.75 |
| A1 | 0.10 | 0.25 |
| B | 0.33 | 0.51 |
| C | 0.19 | 0.25 |
| D | 4.80 | 5.00 |
| E | 3.80 | 4.00 |
| e | 1.27 bsc. | |
| H | 5.80 | 6.20 |
| h | 0.25 | 0.50 |
| L | 0.40 | 1.27 |
| ∞ | 0° | 8° |

Tel: 886-2-66296288
Fax: 886-2-29174598
URL: http://www.princeton.com.tw



Note:
1. Controlling Dimension: MILLIMETERS.
2. Dimensioning and tolerancing per ANSI Y 14.5M-1982
3. Dimension D does not include mold flash protrusions or gate burrs. Mold flash, protrusions and gate burrs shall not exceed 0.15 mm (0.006 in) per side.
4. Dimension E does not include interlead flash or protrusions. Inter-lead flash and protrusions shall not exceed 0.25 mm (0.010 in) per side.
5. The chamfer on the body is optional. If it is not present, a visual index feature must be located within the crosshatched area.
6. L is the length of terminal for soldering to a substrate.
7. N is the number of terminal positions. (N=8)
8. 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 (0.024 in).
9. Refer to JEDEC MS-012, Variation AA.
   JEDEC is the registered trademark of JEDEC SOLID STATE TECHNOLOGY ASSOCIATION.