## Single Volatile 32-Tap XDCP

The Intersil ISL90461 is a digitally controlled potentiometer (XDCP). Configured as a variable resistor, the device consists of a resistor array, wiper switches, a control section, and volatile memory. The wiper position is controlled by a 2-pin Up /Down interface.

The potentiometer is implemented by a resistor array composed of 31 resistive elements and a wiper switching network. Between each element and at either end are tap points accessible to the wiper terminal. The position of the wiper element is controlled by the $\overline{CS}$ and U/$\overline{D}$ inputs.

The device can be used in a wide variety of applications including:

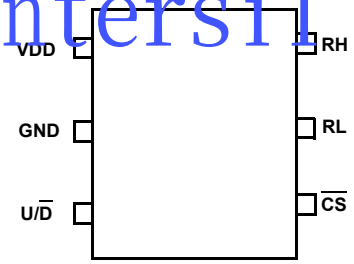
- LCD contrast control
- Parameter and bias adjustments
- Industrial and Automotive Control
- Transducer adjustment of pressure, temperature, position, chemical, and optical sensors
- Laser Diode driver biasing
- Gain control and offset adjustment

## Features

- Volatile solid-state potentiometer
- 2-pin UP/DN interface
- DCP terminal voltage, 2.7V to 5.5V
- Tempco 35 ppm/°C typical
- 32 wiper tap points
- Low power CMOS
  - Active current, 25µA max.
  - Supply current 0.3µA
- Available $R_{TOTAL}$ values = 10kΩ, 50kΩ, 100kΩ
- Temperature Range -40°C to +85°C
- Packages
  - 6 Ld SC-70, SOT-23
- Pb-Free Plus Anneal Available (RoHS Compliant)

## Pinout

**ISL90461**
**(SOT-23, SC-70)**
TOP VIEW



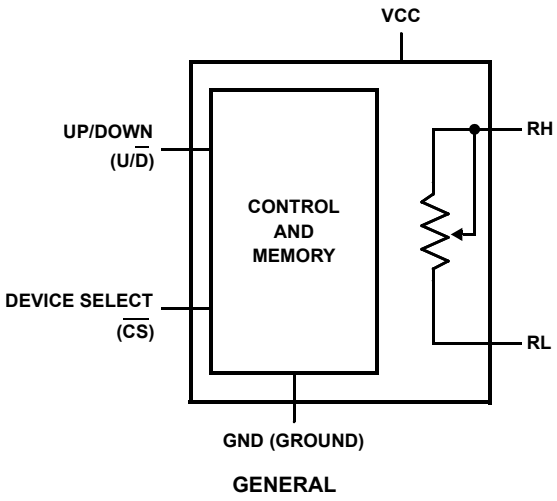



## Ordering Information

| PART NUMBER | PART MARKING | $R_{TOTAL}$ (K) | TEMP RANGE (°C) | PACKAGE | PKG. DWG. # |
|---|---|---|---|---|---|
| ISL90461WIE627-TK | AJP | 10 | -40 to +85 | 6 Ld SC-70 | P6.049 |
| ISL90461WIE627Z-TK (See Note) | DEE | | -40 to +85 | 6 Ld SC-70 (Pb-free) | P6.049 |
| ISL90461WIH627-TK | AJY | | -40 to +85 | 6 Ld SOT-23 | P6.064 |
| ISL90461WIH627Z-TK (See Note) | DEF | | -40 to +85 | 6 Ld SOT-23 (Pb-free) | P6.064 |
| ISL90461UIE627-TK | AJR | 50 | -40 to +85 | 6 Ld SC-70 | P6.049 |
| ISL90461UIE627Z-TK (See Note) | DEC | | -40 to +85 | 6 Ld SC-70 (Pb-free) | P6.049 |
| ISL90461UIH627-TK | AKA | | -40 to +85 | 6 Ld SOT-23 | P6.064 |
| ISL90461UIH627Z-TK (See Note) | DED | | -40 to +85 | 6 Ld SOT-23 (Pb-free) | P6.064 |
| ISL90461TIE627-TK | AJQ | 100 | -40 to +85 | 6 Ld SC-70 | P6.049 |
| ISL90461TIE627Z-TK (See Note) | DEA | | -40 to +85 | 6 Ld SC-70 (Pb-free) | P6.049 |
| ISL90461TIH627-TK | AJZ | | -40 to +85 | 6 Ld SOT-23 | P6.064 |
| ISL90461TIH627Z-TK (See Note) | DEB | | -40 to +85 | 6 Ld SOT-23 (Pb-free) | P6.064 |

NOTE: Intersil Pb-free plus anneal products employ special Pb-free material sets; molding compounds/die attach materials and 100% matte tin plate termination finish, which are RoHS compliant and compatible with both SnPb and Pb-free soldering operations. Intersil Pb-free products are MSL classified at Pb-free peak reflow temperatures that meet or exceed the Pb-free requirements of IPC/JEDEC J STD-020

## Block Diagram




GENERAL

## Pin Descriptions

| 6-PIN | SYMBOL | DESCRIPTION |
|---|---|---|
| 1 | VDD | Supply voltage |
| 2 | GND | Ground |
| 3 | U/D | Up - Down |
| 4 | CS | Chip select |
| 5 | RL | Low terminal |
| 6 | RH | High terminal/ Wiper terminal |

## Absolute Maximum Ratings

Storage temperature . . . . . -65°C to +150°C
Voltage on $\overline{CS}$, U/$\overline{D}$ and VCC
with respect to GND . . . . . -1V to +7V
Lead temperature (soldering 10s) . . . . . 300°C
$I_W$ (10s) . . . . . ±6mA
Power rating. . . . . 1mW

## Recommended Operating Conditions

Temperature Range (Industrial). . . . . -40°C to +85°C
Supply Voltage ($V_{CC}$) . . . . . 2.7V to 5.5V

*CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.*

## Potentiometer Specifications

Over recommended operating conditions unless otherwise stated.

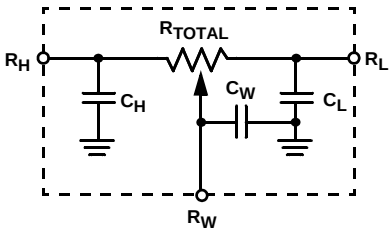
| SYMBOL | PARAMETER | TEST CONDITIONS/NOTES | MIN | TYP (Note 4) | MAX | UNIT |
|---|---|---|---|---|---|---|
| $R_{TOT}$ | End to end resistance | W version | 8 | 10 | 12 | kΩ |
| | | U version | 40 | 50 | 60 | kΩ |
| | | T version | 80 | 100 | 120 | kΩ |
| $V_R$ | RH, RL terminal voltages | | 0 | | $V_{CC}$ | V |
| | Noise | Ref: 1kHz | | -120 | | dBV |
| $R_W$ | Wiper Resistance | | | 600 | | Ω |
| $I_W$ | Wiper Current | | | | 0.6 | mA |
| | Resolution | | 1 | | 32 | Taps |
| | Absolute linearity (Note 1) | $R_{H(n)(actual)} - R_{H(n)(expected)}$ | | | ±1 | MI (Note 3) |
| | Relative linearity (Note 2) | $R_{H(n+1)} - [R_{H(n)+MI}]$ | | | ±0.5 | MI (Note 3) |
| | $R_{TOTAL}$ temperature coefficient | | | ±35 | | ppm/°C |
| $C_H/C_L/C_W$ | Potentiometer capacitances | See equivalent circuit | | 10/10/25 | | pF |



NOTES:

1. Absolute linearity is utilized to determine actual wiper voltage versus expected voltage = ($R_{H(n)}$(actual) - $R_{H(n)}$(expected)) = ±1 MI Maximum. n = 1 .. 29 only
2. Relative linearity is a measure of the error in step size between taps = $R_{H(n+1)} - [R_{H(n)} + MI] = ±0.5$ MI, n = 1 .. 29 only.
3. 1 MI = Minimum Increment = $R_{TOT}/31$.
4. Typical values are for $T_A$ = 25°C and nominal supply voltage.

## Equivalent Circuit



## DC Electrical Specifications

Over recommended operating conditions unless otherwise specified.

| SYMBOL | PARAMETER | TEST CONDITIONS | MIN | TYP (Note 4) | MAX | UNIT |
|---|---|---|---|---|---|---|
| $I_{CC}$ | $V_{CC}$ active current (Increment) | $\overline{CS}$ = 0V, U/$\overline{D}$ = $f_{clock}$ = 1MHz and $V_{CC}$ = 3V | | | 25 | µA |
| $I_{SB}$ | Standby supply current | $\overline{CS}$ = $V_{CC}$, U/$\overline{D}$ = GND or $V_{CC}$ = 3V | | 0.3 | 1 | µA |
| $I_{LI}$ | CS input leakage current | $V_{IN}$ = GND to $V_{CC}$ | | | ±1 | µA |
| $V_{IH}$ | $\overline{CS}$, U/$\overline{D}$ input HIGH voltage | | $V_{CC}$ x 0.7 | | | V |
| $V_{IL}$ | $\overline{CS}$, U/$\overline{D}$ input LOW voltage | | | | $V_{CC}$ x 0.3 | V |
| $C_{IN}$ | $\overline{CS}$, U/$\overline{D}$ input capacitance | $V_{CC}$ = 3V, $V_{IN}$ = $V_{SS}$, $T_A$ = 25°C, f = 1MHz | | 10 | | pF |

## Timing Specifications

(Over recommended operating conditions unless otherwise specified)

| SYMBOL | PARAMETER | MIN | TYP (Note 4) | MAX | UNIT |
|---|---|---|---|---|---|
| $t_{CU}$ | U/$\overline{D}$ to $\overline{CS}$ setup | 25 | | | ns |
| $t_{CI}$ | $\overline{CS}$ to U/$\overline{D}$ setup | 50 | | | ns |
| $t_{IC}$ | $\overline{CS}$ to U/$\overline{D}$ hold | 25 | | | ns |
| $t_{IL}$ | U/$\overline{D}$ LOW period | 300 | | | ns |
| $t_{IH}$ | U/$\overline{D}$ HIGH period | 300 | | | ns |
| $f_{TOGGLE}$ | Up/Down toggle Rate | | 1 | | MHz |
| $t_{SETTLE}$ | Output settling time | | 1 | | µs |



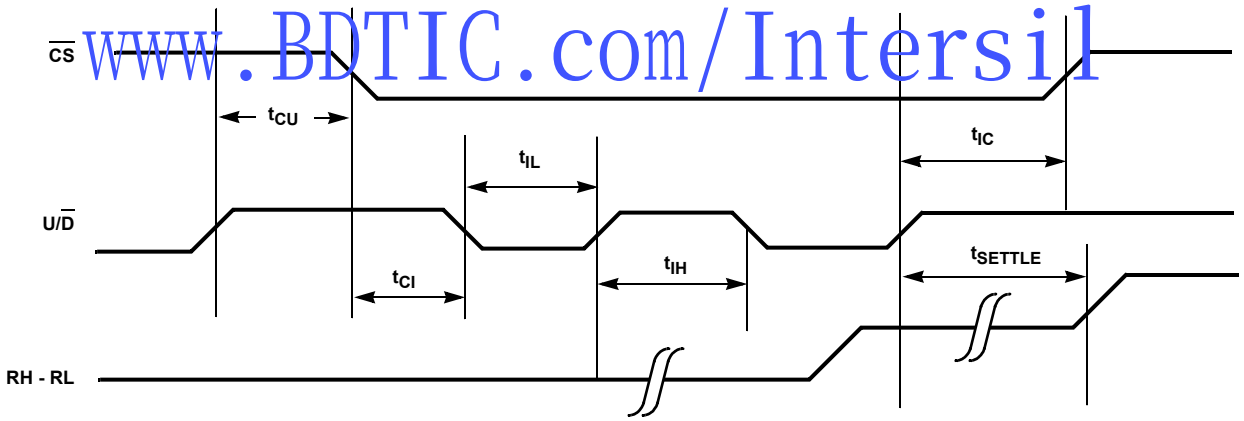



FIGURE 1. SERIAL INTERFACE TIMING DIAGRAM, INCREMENT

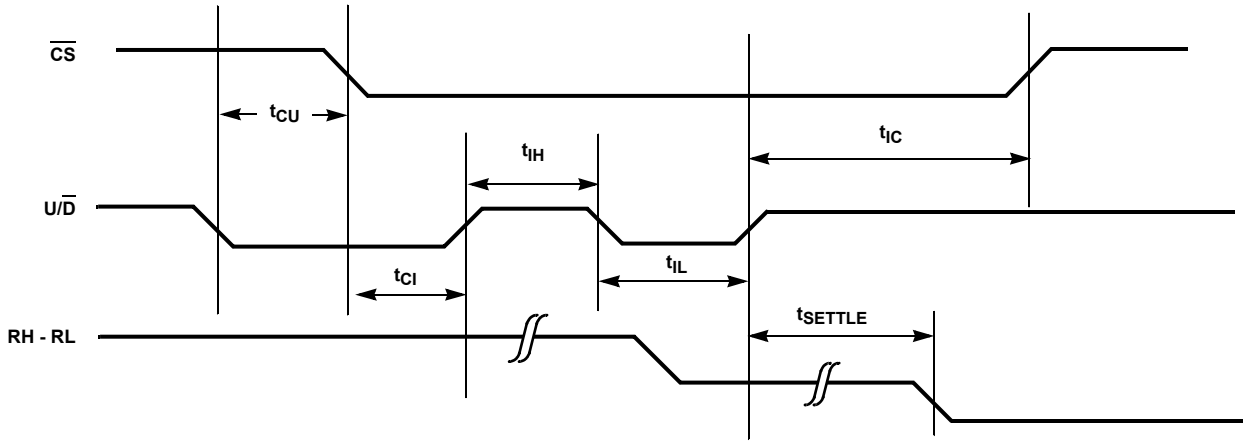



FIGURE 2. SERIAL INTERFACE TIMING DIAGRAM, DECREMENT

## Pin Descriptions

### RH and RL

The ISL90461 contains a digital potentiometer configured as a variable resistor. The wiper of the potentiometer is tied to one end of the potentiometer at terminal RH, and the RL pin is the other terminal of the potentiometer. The resistance from the RH pin to the RL pin will vary with the potentiometer setting. At the highest setting the resistance will be maximum (Rtot) and at the lowest setting it will be minimum. As the wiper position is incremented, the wiper will move from the Low terminal to the High terminal.

### Up/Down (U/$\overline{D}$)

The U/$\overline{D}$ input controls the direction of the wiper movement and whether the counter is incremented or decremented.

### Chip Select ($\overline{CS}$)

The device is selected when the $\overline{CS}$ input is LOW. The current counter value is stored in volatile memory when $\overline{CS}$ is returned HIGH. When $\overline{CS}$ is high, the device is placed in low power standby mode.

## Principles of Operation

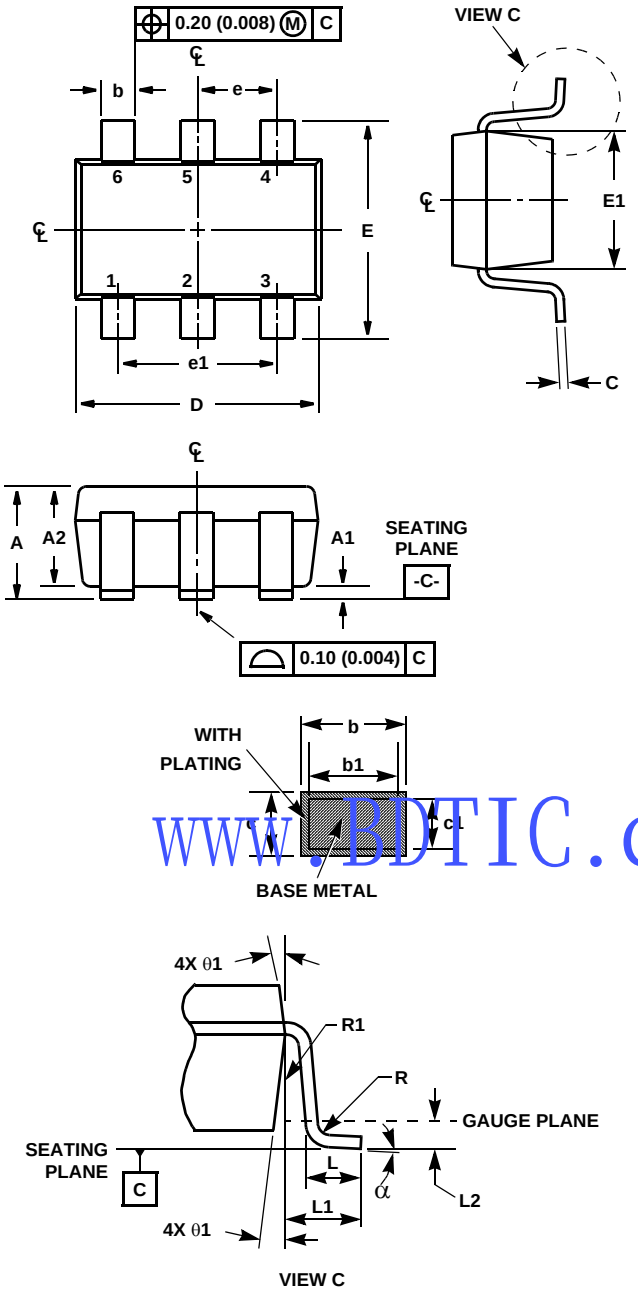
There are two sections of the ISL90461: the input control, counter and decode section; and the resistor array. The input control section operates just like an up/down counter. The output of this counter is decoded to turn on a single electronic switch connecting a point on the resistor array to the wiper output. The resistor array is comprised of 31 individual resistors connected in series. At either end of the array and between each resistor is an electronic switch that transfers the connection at that point to the wiper. The wiper is connected to the RH terminal, forming a variable resistor from RH to RL.

The direction of the wiper movement is defined when the device is selected. If during $\overline{CS}$ transition from High to Low the U/$\overline{D}$ input is LOW, the wiper will move down on each rising edge of U/$\overline{D}$ toggling. Similarly, the wiper will move up on each rising edge of U/$\overline{D}$ toggling if, during $\overline{CS}$ transition from High to Low, the U/$\overline{D}$ input is High.

The wiper, when at either fixed terminal, acts like its mechanical equivalent and does not move beyond the last position. That is, the counter does not wrap around when clocked to either extreme.

If the wiper is moved several positions, multiple taps are connected to the wiper for $t_{SETTLE}$ (U/$\overline{D}$ to RH change). The 2-terminal resistance value for the device can temporarily change by a significant amount if the wiper is moved several positions.

## Small Outline Transistor Plastic Packages (SC70-6)




### P6.049

**6 LEAD SMALL OUTLINE TRANSISTOR PLASTIC PACKAGE**

| SYMBOL | INCHES | | MILLIMETERS | | NOTES |
|---|---|---|---|---|---|
| | MIN | MAX | MIN | MAX | |
| A | 0.031 | 0.043 | 0.80 | 1.10 | - |
| A1 | 0.000 | 0.004 | 0.00 | 0.10 | - |
| A2 | 0.031 | 0.039 | 0.00 | 1.00 | - |
| b | 0.006 | 0.012 | 0.15 | 0.30 | - |
| b1 | 0.006 | 0.010 | 0.15 | 0.25 | |
| c | 0.003 | 0.009 | 0.08 | 0.22 | 6 |
| c1 | 0.003 | 0.009 | 0.08 | 0.20 | 6 |
| D | 0.073 | 0.085 | 1.85 | 2.15 | 3 |
| E | 0.071 | 0.094 | 1.80 | 2.40 | - |
| E1 | 0.045 | 0.053 | 1.15 | 1.35 | 3 |
| e | 0.0256 Ref | | 0.65 Ref | | - |
| e1 | 0.0512 Ref | | 1.30 Ref | | - |
| L | 0.010 | 0.018 | 0.26 | 0.46 | 4 |
| L1 | 0.017 Ref. | | 0.420 Ref. | | |
| L2 | 0.006 BSC | | 0.15 BSC | | |
| N | 6 | | 6 | | 5 |
| R | 0.004 | - | 0.10 | - | |
| R1 | 0.004 | 0.010 | 0.15 | 0.25 | |
| α | $0^o$ | $8^o$ | $0^o$ | $8^o$ | - |

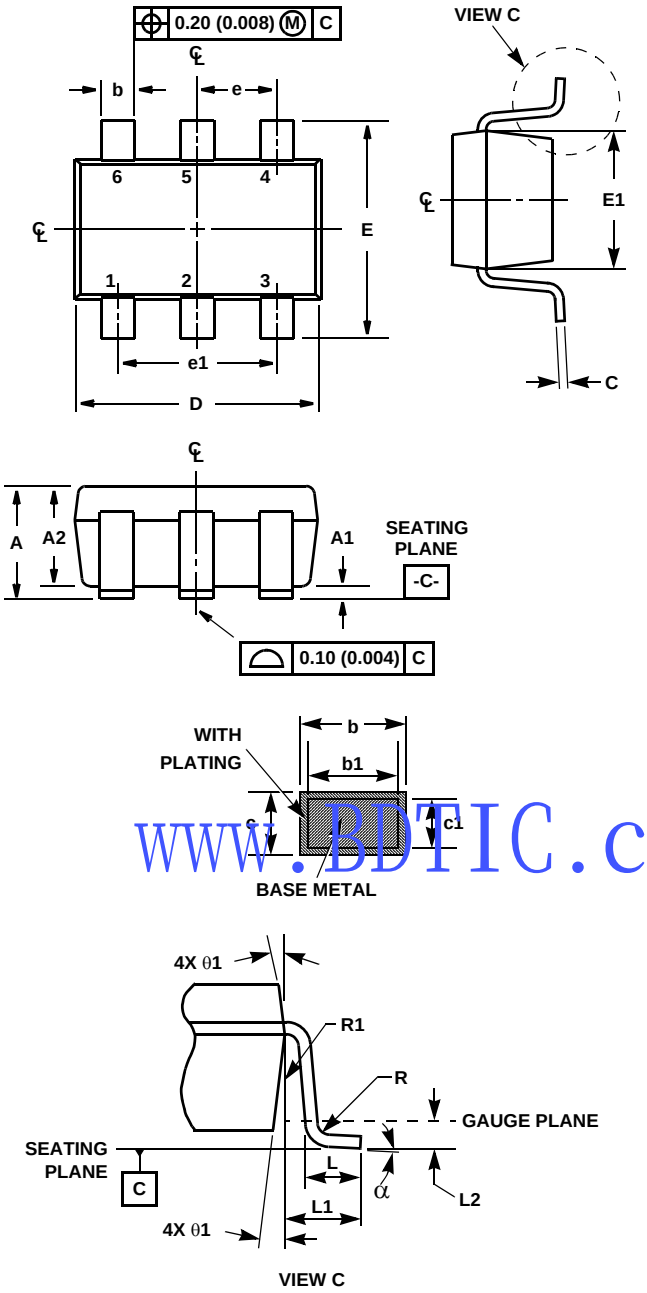
Rev. 2 9/03



NOTES:

1. Dimensioning and tolerance per ASME Y14.5M-1994.
2. Package conforms to EIAJ SC70 and JEDEC MO203AB.
3. Dimensions D and E1 are exclusive of mold flash, protrusions, or gate burrs.
4. Footlength L measured at reference to gauge plane.
5. “N” is the number of terminal positions.
6. These Dimensions apply to the flat section of the lead between 0.08mm and 0.15mm from the lead tip.
7. Controlling dimension: MILLIMETER. Converted inch dimensions are for reference only

## Small Outline Transistor Plastic Packages (SOT23-6)




### P6.064

**6 LEAD SMALL OUTLINE TRANSISTOR PLASTIC PACKAGE**

| SYMBOL | INCHES | | MILLIMETERS | | NOTES |
|---|---|---|---|---|---|
| | MIN | MAX | MIN | MAX | |
| A | 0.036 | 0.057 | 0.90 | 1.45 | - |
| A1 | 0.000 | 0.0059 | 0.00 | 0.15 | - |
| A2 | 0.036 | 0.051 | 0.90 | 1.30 | - |
| b | 0.012 | 0.020 | 0.30 | 0.50 | - |
| b1 | 0.012 | 0.018 | 0.30 | 0.45 | |
| c | 0.003 | 0.009 | 0.08 | 0.22 | 6 |
| c1 | 0.003 | 0.008 | 0.08 | 0.20 | 6 |
| D | 0.111 | 0.118 | 2.80 | 3.00 | 3 |
| E | 0.103 | 0.118 | 2.60 | 3.00 | - |
| E1 | 0.060 | 0.068 | 1.50 | 1.75 | 3 |
| e | 0.0374 Ref | | 0.95 Ref | | - |
| e1 | 0.0748 Ref | | 1.90 Ref | | - |
| L | 0.014 | 0.022 | 0.35 | 0.55 | 4 |
| L1 | 0.024 Ref. | | 0.60 Ref. | | |
| L2 | 0.010 Ref. | | 0.25 Ref. | | |
| N | 6 | | 6 | | 5 |
| R | 0.004 | - | 0.10 | - | |
| R1 | 0.004 | 0.010 | 0.10 | 0.25 | |
| α | $0^o$ | $8^o$ | $0^o$ | $8^o$ | - |

Rev. 3 9/03



NOTES:

1. Dimensioning and tolerance per ASME Y14.5M-1994.
2. Package conforms to EIAJ SC-74 and JEDEC MO178AB.
3. Dimensions D and E1 are exclusive of mold flash, protrusions, or gate burrs.
4. Footlength L measured at reference to gauge plane.
5. “N” is the number of terminal positions.
6. These Dimensions apply to the flat section of the lead between 0.08mm and 0.15mm from the lead tip.
7. Controlling dimension: MILLIMETER. Converted inch dimensions are for reference only