

## ISL6700

80V/1.25A Peak, Medium Frequency, Low Cost, Half-Bridge Driver

FN9077

Rev.6.00

December 29, 2004

The ISL6700 is an 80V/1.25A peak, medium frequency, low cost, half-bridge driver IC available in 8-lead SOIC and 12-lead QFN plastic packages. The low-side and high-side gate drivers are independently controlled and matched to 25ns. This gives the user maximum flexibility in dead-time selection and driver protocol. Undervoltage protection on both the low-side and high-side supplies force the outputs low. Non-latching, level-shift translation is used to control the upper drive circuit. Unlike some competitors, the high-side output returns to its correct state after a momentary undervoltage of the high-side supply.

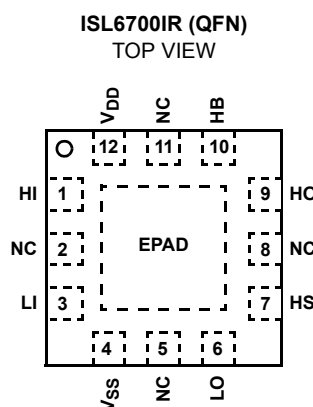
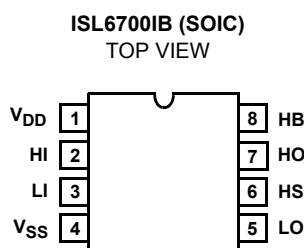
### Ordering Information

| PART NUMBER              | TEMP. RANGE (°C) | PACKAGE                    | PKG. DWG. # |
|--------------------------|------------------|----------------------------|-------------|
| ISL6700IB                | -40 to 125       | 8 Ld SOIC                  | M8.15       |
| ISL6700IBZ<br>(See Note) | -40 to 125       | 8 Ld SOIC<br>(Pb-free)     | M8.15       |
| ISL6700IR                | -40 to 125       | 12 Ld 4x4 QFN              | L12.4x4     |
| ISL6700IRZ<br>(See Note) | -40 to 125       | 12 Ld 4x4 QFN<br>(Pb-free) | L12.4x4     |

Add "-T" suffix to part number for tape and reel packaging.

NOTE: Intersil Pb-free 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.

### Pinouts



NOTE: EPAD = Exposed PAD.

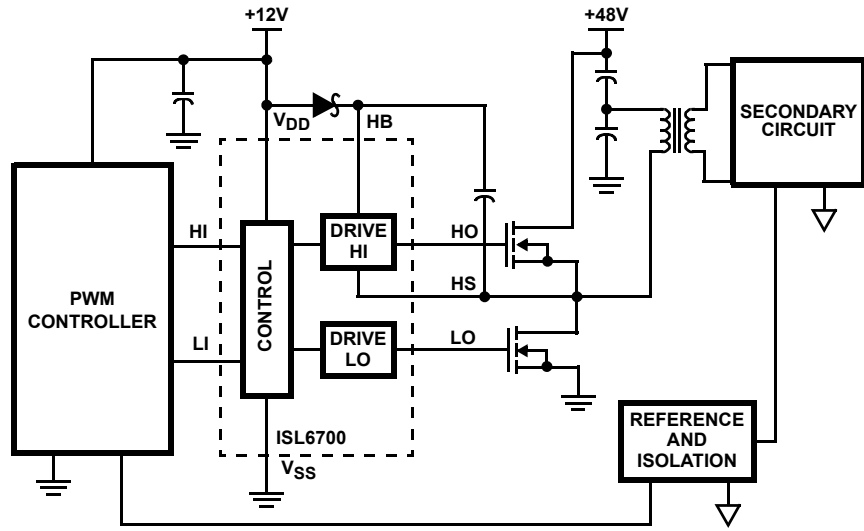
### Features

- Drives 2 N-Channel MOSFETs in Half-Bridge Configuration
- Space Saving SO8 and Low  $R_{C-S}$  QFN Packages
- Phase Supply Max Voltage to 80VDC
- Bootstrap Supply Max Voltage to 96VDC
- Drives 1000pF Load with Rise and Fall Times Typ. 15ns
- TTL/CMOS Compatible Input Thresholds
- Independent Inputs for Non-Half-Bridge Topologies
- No Start-Up Problems
- Low Power Consumption
- Wide Supply Range
- Supply Undervoltage Protection
- QFN Package
  - Compliant to JEDEC PUB95 MO-220 QFN
  - Quad Flat No Leads - Package Outline
- Pb-Free Available (RoHS Compliant)

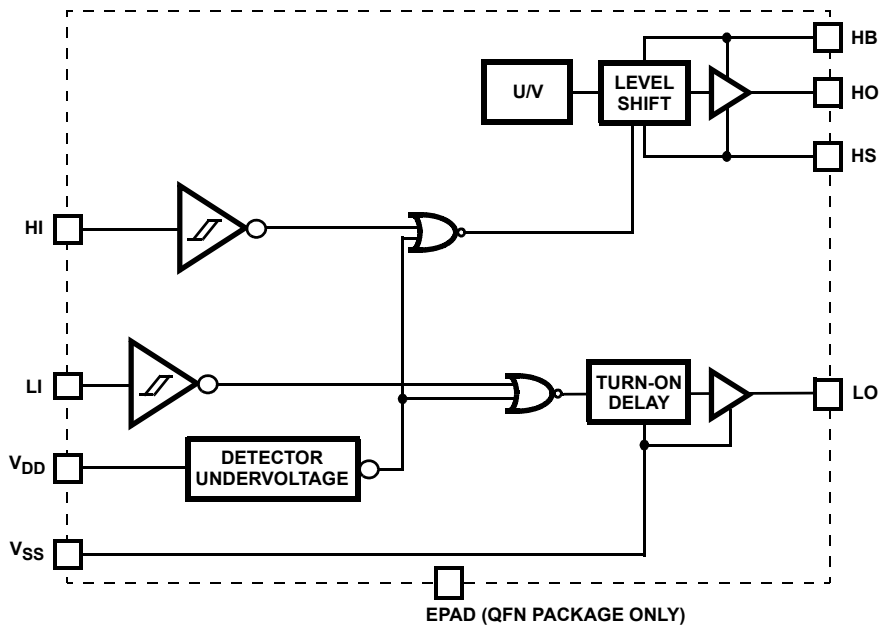
### Applications

- Telecom/Datacom Power Supplies
- Half-Bridge Converters
- Two-Switch Forward Converters
- Active Clamp Forward Converters

**Application Block Diagram**



**Functional Block Diagram**



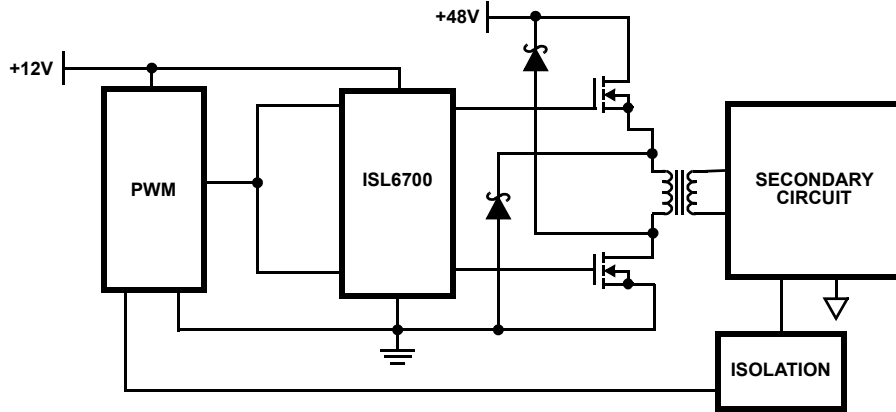


FIGURE 1. TWO-SWITCH FORWARD CONVERTER

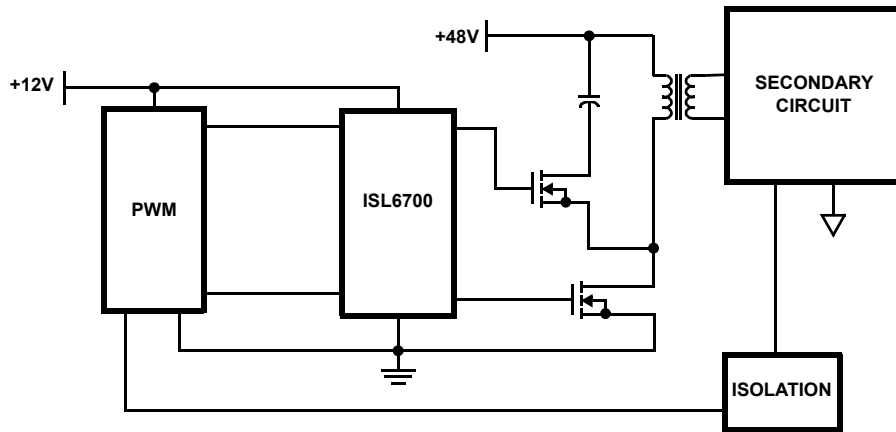


FIGURE 2. FORWARD CONVERTER WITH AN ACTIVE CLAMP

**Absolute Maximum Ratings**

|                                   |                                      |
|-----------------------------------|--------------------------------------|
| Supply Voltage, $V_{DD}$ (Note 1) | -0.3V to 16V                         |
| LI and HI Voltages (Note 1)       | -0.3V to $V_{DD} + 0.3V$             |
| Voltage on HS (Note 1)            | 0V to 80V                            |
| Voltage on HB (Note 1)            | $V_{HS} - 0.3V$ to $V_{HS} + V_{DD}$ |
| Voltage on LO (Note 1)            | $V_{SS} - 0.3V$ to $V_{DD} + 0.3V$   |
| Voltage on HO (Note 1)            | $V_{HS} - 0.3V$ to $V_{HB} + 0.3V$   |
| Phase Slew Rate                   | 20V/ns                               |

**Maximum Recommended Operating Conditions**

|                          |                                      |
|--------------------------|--------------------------------------|
| Supply Voltage, $V_{DD}$ | 9V to 15V                            |
| Voltage on HS            | 0V to 75V                            |
| Voltage on HS (Note 2)   | (Repetitive Transient) -1V to 80V    |
| Voltage on HB            | $V_{HS} + 7.5V$ to $V_{HS} + V_{DD}$ |

**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 recommended operating conditions of this specification is not implied.

**NOTES:**

- All voltages referenced to  $V_{SS}$  unless otherwise specified.
- Based on  $V_{DD} = 15V$ . The magnitude of the allowable negative transient on the HS pin is a function of the  $V_{DD}$  supply voltage.  $V_{HS} < 15.6V - V_{DD} + V_F$ , where  $V_{HS}$  is the magnitude of the allowable negative transient and  $V_F$  is the forward voltage drop of the bootstrap diode.
- $\theta_{JA}$  is measured with the component mounted on a high effective thermal conductivity test board in free air. See Tech Brief TB379 for details.
- $\theta_{JA}$  is measured in free air with the component mounted on a high effective thermal conductivity test board with "direct attach" features.  $\theta_{JC}$ , the "case temp" is measured at the center of the exposed metal pad on the package underside. See Tech Brief TB379.

**Thermal Information**

|  |                                |                      |
|--|--------------------------------|----------------------|
| Thermal Resistance (Typical)                               | $\theta_{JA}$ (°C/W)           | $\theta_{JC}$ (°C/W) |
| SOIC (Note 3)  | 95                             | N/A                  |
| QFN (Note 4)   | 49                             | 7                    |
| Max Power Dissipation at 25°C in Free Air (SOIC, Note 3)   | 1.316W                         |                      |
| Max Power Dissipation at 25°C in Free Air (QFN, Note 4)    | 2.976W                         |                      |
| Maximum Storage Temperature Range                          | -65°C to +150°C                |                      |
| Maximum Junction Temperature Range                         | -40°C to +150°C                |                      |
| Maximum Lead Temperature (Soldering 10s)                   | +300°C (SOIC - Lead Tips Only) |                      |
| For Recommended soldering conditions see Tech Brief TB389. |                                |                      |

**Electrical Specifications**  $V_{DD} = V_{HB} = 12V$ ,  $V_{SS} = V_{HS} = 0V$ , No Load on LO or HO, Unless Otherwise Specified

| PARAMETERS   | SYMBOL      | TEST CONDITIONS                           | $T_J = 25^\circ\text{C}$ |      |      | $T_J = -40^\circ\text{C TO } 125^\circ\text{C}$ |      | UNITS         |
|--|-------------|---|--------------------------|------|------|---|------|---------------|
|  |             |   | MIN                      | TYP  | MAX  | MIN   | MAX  |               |
| <b>SUPPLY CURRENTS &amp; UNDERVOLTAGE PROTECTION</b> |             |   |                          |      |      |   |      |               |
| $V_{DD}$ Quiescent Current                           | $I_{DD}$    | LI = 0 or $V_{DD}$                        | -                        | 1.9  | 2.2  | -   | 2.4  | mA            |
| $V_{DD}$ Operating Current                           | $I_{DDO}$   | f = 50kHz                                 | -                        | 2.0  | 2.2  | -   | 2.5  | mA            |
| $V_{DD}$ Operating Current                           | $I_{DDO}$   | f = 500kHz                                | -                        | 2.5  | 3.0  | -   | 4.0  | mA            |
| HB Off Quiescent Current                             | $I_{HBL}$   | HI = 0                                    | -                        | 1.25 | 1.5  | -   | 1.8  | mA            |
| HB On Quiescent Current                              | $I_{HBH}$   | HI = $V_{DD}$                             | -                        | 170  | 240  | -   | 250  | $\mu\text{A}$ |
| HB Operating Current                                 | $I_{HBO}$   | f = 50kHz, $C_L = 1000\text{pF}$          | -                        | 1.45 | 1.8  | -   | 2.0  | mA            |
| HB Operating Current                                 | $I_{HBO}$   | f = 500kHz, $C_L = 1000\text{pF}$         | -                        | 2.4  | 2.8  | -   | 3.0  | mA            |
| HS Leakage Current                                   | $I_{HLK}$   | $V_{HS} = 80V$<br>$V_{HB} = 96V$          | -                        | -    | 1    | -   | 1    | $\mu\text{A}$ |
| $V_{DD}$ Rising Undervoltage Threshold               | $V_{DDUV+}$ |   | 6.8                      | 7.6  | 8.25 | 6.5   | 8.5  | V             |
| $V_{DD}$ Falling Undervoltage Threshold              | $V_{DDUV-}$ |   | 6.5                      | 7.1  | 7.8  | 6.25  | 8.1  | V             |
| Undervoltage Hysteresis                              | UVHYS       |   | 0.17                     | 0.45 | 0.75 | 0.15  | 0.90 | V             |
| HB Undervoltage Threshold                            | VHBUV       | Referenced to HS                          | 4.8                      | 5.3  | 6.5  | 4.0   | 7.5  | V             |
| <b>INPUT PINS: LI and HI</b>                         |             |   |                          |      |      |   |      |               |
| Low Level Input Voltage                              | $V_{IL}$    | Full Operating Conditions                 | 0.8                      | 1.6  | -    | 0.8   | -    | V             |
| High Level Input Voltage                             | $V_{IH}$    | Full Operating Conditions                 | -                        | 1.7  | 2.2  | -   | 2.2  | V             |
| Input Voltage Hysteresis                             |             |   | -                        | 100  | -    | -   | -    | mV            |
| Low Level Input Current                              | $I_{IL}$    | $V_{IN} = 0V$ , Full Operating Conditions | -70                      | -60  | -30  | -80   | -30  | $\mu\text{A}$ |
| High Level Input Current                             | $I_{IH}$    | $V_{IN} = 5V$ , Full Operating Conditions | 30                       | 115  | 130  | 30  | 145  | $\mu\text{A}$ |

**Electrical Specifications**  $V_{DD} = V_{HB} = 12V$ ,  $V_{SS} = V_{HS} = 0V$ , No Load on LO or HO, Unless Otherwise Specified (Continued)

| PARAMETERS                                  | SYMBOL          | TEST CONDITIONS | $T_J = 25^\circ\text{C}$ |     |     | $T_J = -40^\circ\text{C TO } 125^\circ\text{C}$ |     | UNITS |
|---|-----------------|-----------------|--------------------------|-----|-----|---|-----|-------|
|   |                 |                 | MIN                      | TYP | MAX | MIN   | MAX |       |
| <b>GATE DRIVER OUTPUT PINS: LO &amp; HO</b> |                 |                 |                          |     |     |   |     |       |
| Low Level Output Voltage                    | $V_{OL}$        | $I_{OUT} = 0A$  | -                        | -   | 0.1 | -   | 0.1 | V     |
| High Level Output Voltage                   | $V_{DD}-V_{OH}$ | $I_{OUT} = 0A$  | -                        | -   | 0.1 | -   | 0.1 | V     |
| Peak Pullup Current                         | $I_{O+}$        | $V_{OUT} = 0V$  | -                        | 1.4 | -   | -   | -   | A     |
| Peak Pulldown Current                       | $I_{O-}$        | $V_{OUT} = 12V$ | -                        | 1.3 | -   | -   | -   | A     |

**Switching Specifications**  $V_{DD} = V_{HB} = 12V$ ,  $V_{SS} = V_{HS} = 0V$ , No Load on LO or HO, Unless Otherwise Specified

| PARAMETERS  | SYMBOL     | TEST CONDITIONS                | $T_J = 25^\circ\text{C}$ |     |     | $T_J = -40^\circ\text{C TO } 125^\circ\text{C}$ |     | UNITS |
|---|------------|--------------------------------|--------------------------|-----|-----|---|-----|-------|
|   |            |                                | MIN                      | TYP | MAX | MIN   | MAX |       |
| Lower Turn-off Propagation Delay (LI Falling to LO Falling) | $t_{LPHL}$ |                                | -                        | 45  | 50  | -   | 65  | ns    |
| Upper Turn-off Propagation Delay (HI Falling to HO Falling) | $t_{HPLH}$ |                                | -                        | 60  | 75  | -   | 90  | ns    |
| Lower Turn-on Propagation Delay (LI Rising to LO Rising)    | $t_{LPLH}$ |                                | -                        | 75  | 82  | -   | 95  | ns    |
| Upper Turn-on Propagation Delay (HI Rising to HO Rising)    | $t_{HPLH}$ |                                | -                        | 70  | 75  | -   | 95  | ns    |
| Deadtime, ( $t_{HPLH} - t_{LPHL}$ )                         | $DHt_{ON}$ | LI, HI switched simultaneously | 0                        | 24  | -   | 0   | -   | ns    |
| Deadtime, ( $t_{LPLH} - t_{HPLH}$ )                         | $DLt_{ON}$ |                                | 0                        | 17  | -   | 0   | -   | ns    |
| Rise Time   | $t_R$      |                                | -                        | 5   | 20  | -   | 25  | ns    |
| Fall Time   | $t_F$      |                                | -                        | 5   | 20  | -   | 25  | ns    |
| Delay Matching: Lower Turn-On and Upper Turn-Off            | $t_{MON}$  |                                | -                        | 8   | 20  | -   | 25  | ns    |
| Delay Matching: Lower Turn-Off and Upper Turn-On            | $t_{MOFF}$ |                                | -                        | -15 | 25  | -   | 30  | ns    |

**Pin Descriptions**

| SYMBOL   | DESCRIPTION   |
|----------|---|
| $V_{DD}$ | Positive supply to control logic and lower gate drivers. De-couple this pin to $V_{SS}$ . Connect anode of bootstrap diode to this pin.                                   |
| HI       | Logic level input that controls the HO output.  |
| LI       | Logic level input that controls the LO output.  |
| $V_{SS}$ | Chip negative supply, generally will be ground.   |
| LO       | Low-side output. Connect to gate of low-side power MOSFET.  |
| HS       | High-side source connection. Connect to source of high-side power MOSFET. Connect negative side of bootstrap capacitor to this pin.                                       |
| HO       | High-side output. Connect to gate of high-side power MOSFET.  |
| HB       | High-side bootstrap supply. External bootstrap diode and capacitor are required. Connect cathode of bootstrap diode and positive side of bootstrap capacitor to this pin. |
| EPAD     | Exposed pad. Connect to ground or float. The EPAD is electrically isolated from all other pins.   |

Timing Diagrams

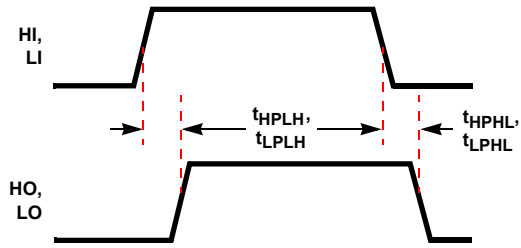


FIGURE 3.

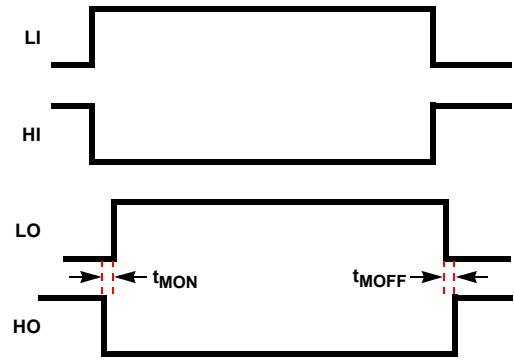
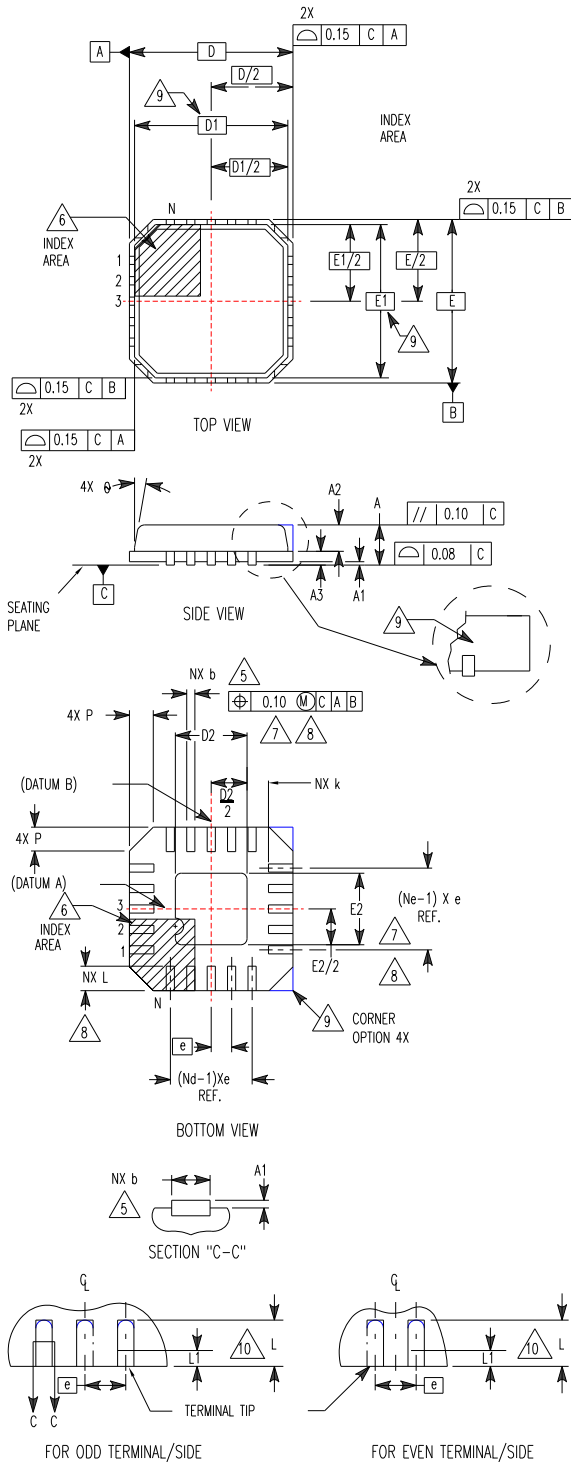


FIGURE 4.

**Quad Flat No-Lead Plastic Package (QFN)  
Micro Lead Frame Plastic Package (MLFP)**

**L12.4x4**

**12 LEAD QUAD FLAT NO-LEAD PLASTIC PACKAGE  
(COMPLIANT TO JEDEC MO-220-VGGC ISSUE C)**



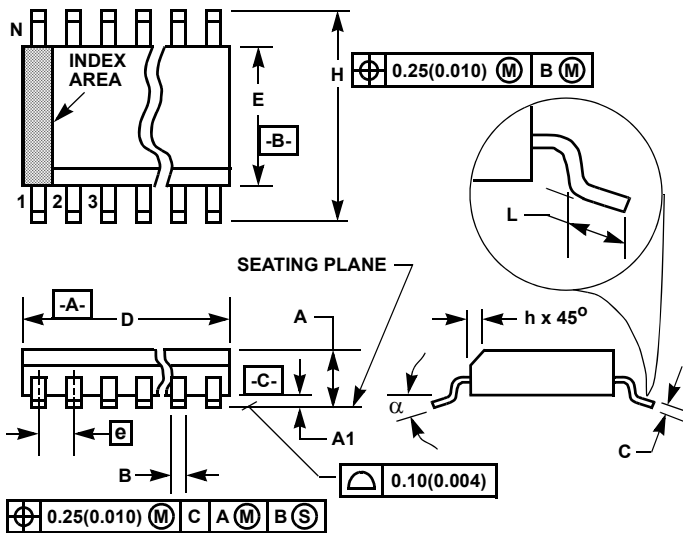
| SYMBOL | MILLIMETERS |         |      | NOTES |
|--------|-------------|---------|------|-------|
|        | MIN         | NOMINAL | MAX  |       |
| A      | 0.80        | 0.90    | 1.00 | -     |
| A1     | -           | -       | 0.05 | -     |
| A2     | -           | -       | 1.00 | 9     |
| A3     | 0.20 REF    |         |      | 9     |
| b      | 0.23        | 0.28    | 0.38 | 5, 8  |
| D      | 4.00 BSC    |         |      | -     |
| D1     | 3.75 BSC    |         |      | 9     |
| D2     | 1.95        | 2.10    | 2.25 | 7, 8  |
| E      | 4.00 BSC    |         |      | -     |
| E1     | 3.75 BSC    |         |      | 9     |
| E2     | 1.95        | 2.10    | 2.25 | 7, 8  |
| e      | 0.80 BSC    |         |      | -     |
| k      | 0.25        | -       | -    | -     |
| L      | 0.35        | 0.60    | 0.75 | 8     |
| L1     | -           | -       | 0.15 | 10    |
| N      | 12          |         |      | 2     |
| Nd     | 3           |         |      | 3     |
| Ne     | 3           |         |      | 3     |
| P      | -           | -       | 0.60 | 9     |
| θ      | -           | -       | 12   | 9     |

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**NOTES:**

1. Dimensioning and tolerancing conform to ASME Y14.5-1994.
2. N is the number of terminals.
3. Nd and Ne refer to the number of terminals on each D and E.
4. All dimensions are in millimeters. Angles are in degrees.
5. Dimension b applies to the metallized terminal and is measured between 0.15mm and 0.30mm from the terminal tip.
6. The configuration of the pin #1 identifier is optional, but must be located within the zone indicated. The pin #1 identifier may be either a mold or mark feature.
7. Dimensions D2 and E2 are for the exposed pads which provide improved electrical and thermal performance.
8. Nominal dimensions are provided to assist with PCB Land Pattern Design efforts, see Intersil Technical Brief TB389.
9. Features and dimensions A2, A3, D1, E1, P & θ are present when Anvil singulation method is used and not present for saw singulation.
10. Depending on the method of lead termination at the edge of the package, a maximum 0.15mm pull back (L1) maybe present. L minus L1 to be equal to or greater than 0.3mm.

**Small Outline Plastic Packages (SOIC)**



**M8.15 (JEDEC MS-012-AA ISSUE C)**  
**8 LEAD NARROW BODY SMALL OUTLINE PLASTIC PACKAGE**

| SYMBOL | INCHES    |        | MILLIMETERS |      | NOTES |
|--------|-----------|--------|-------------|------|-------|
|        | MIN       | MAX    | MIN         | MAX  |       |
| A      | 0.0532    | 0.0688 | 1.35        | 1.75 | -     |
| A1     | 0.0040    | 0.0098 | 0.10        | 0.25 | -     |
| B      | 0.013     | 0.020  | 0.33        | 0.51 | 9     |
| C      | 0.0075    | 0.0098 | 0.19        | 0.25 | -     |
| D      | 0.1890    | 0.1968 | 4.80        | 5.00 | 3     |
| E      | 0.1497    | 0.1574 | 3.80        | 4.00 | 4     |
| e      | 0.050 BSC |        | 1.27 BSC    |      | -     |
| H      | 0.2284    | 0.2440 | 5.80        | 6.20 | -     |
| h      | 0.0099    | 0.0196 | 0.25        | 0.50 | 5     |
| L      | 0.016     | 0.050  | 0.40        | 1.27 | 6     |
| N      | 8         |        | 8           |      | 7     |
| α      | 0°        | 8°     | 0°          | 8°   | -     |

**NOTES:**

1. Symbols are defined in the "MO Series Symbol List" in Section 2.2 of Publication Number 95.
2. Dimensioning and tolerancing per ANSI Y14.5M-1982.
3. Dimension "D" does not include mold flash, protrusions or gate burrs. Mold flash, protrusion and gate burrs shall not exceed 0.15mm (0.006 inch) per side.
4. Dimension "E" does not include interlead flash or protrusions. Interlead flash and protrusions shall not exceed 0.25mm (0.010 inch) 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.
8. Terminal numbers are shown for reference only.
9. The lead width "B", as measured 0.36mm (0.014 inch) or greater above the seating plane, shall not exceed a maximum value of 0.61mm (0.024 inch).
10. Controlling dimension: MILLIMETER. Converted inch dimensions are not necessarily exact.

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