

# Low-Voltage Supervisory Circuit

## Description

This device was designed to provide all the operational features of the SG1543/2543/3543 devices with the added advantage of uncommitted inputs to the voltage sensing comparators. This allows monitoring of voltage levels less than 2.5 volts by dividing down the internal reference supply.

In all other respects, the SG1544 series is identical to the SG1543 series. These monolithic devices contain all the functions necessary to monitor and control the output of a sophisticated power supply system. Over-voltage sensing with provision to trigger an external SCR "crowbar" shutdown; an under-voltage circuit which can be used to monitor either the output or sample the input line voltage; and a third op-amp/comparator usable for current sensing are all included in this IC, together with an independent, accurate reference generator.

The voltage-sensing input comparators are identical and can be used with threshold levels from zero volts to  $V_{IN}$  (3V). Each has approximately 25mV of hysteresis which is offset so the switching differential threshold is zero on the non-inverting input for rising levels and zero on the inverting input for falling signals. All other operating characteristics are as described in the SG1543 data sheet and application note.

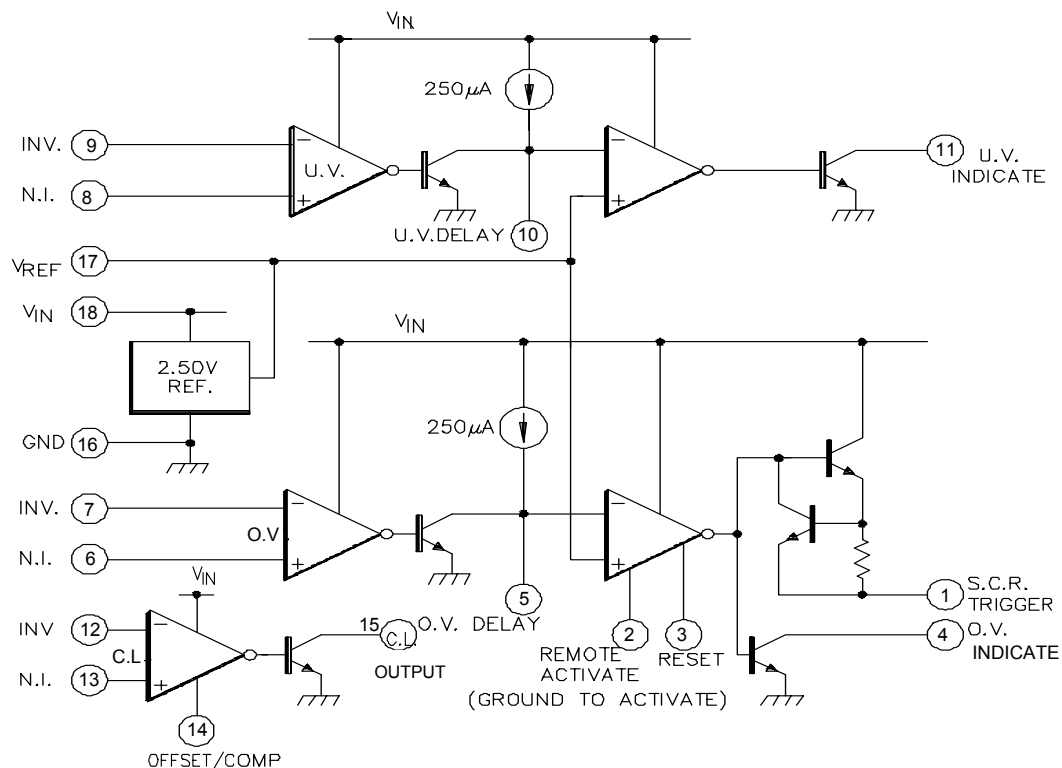
## Features

- Uncommitted Comparator Inputs for Wide Input Flexibility
- Common-Mode Range from Zero to Near Supply Voltage
- Reference Voltage Trimmed to 1% Accuracy
- Over-Voltage, Under-Voltage, and Current Sensing Circuits all included
- SCR "Crowbar" Drive of 300mA
- Programmable Time Delays
- Open-Collector Outputs and Remote Activation Capability
- Total Standby Current Less Than 10mA

## High Reliability Features

- Available to MIL-STD-883, ¶ 1.2.1
- MSC-AMS level "S" Processing Available

## Block Diagram



**Figure 1 - Block Diagram**

## Absolute Maximum Ratings (Note 1)

|  |                  |
|--|------------------|
| Input Supply Voltage (+V <sub>IN</sub> ) ..... | 40V              |
| Sense Inputs .....                             | +V <sub>IN</sub> |
| SCR Trigger Current (Note 2) .....             | 300mA            |
| Indicator Output Voltage .....                 | 40V              |

|  |                |
|--|----------------|
| Indicator Output Sink Current .....                                  | 50mA           |
| Operating Junction Temperature                                       |                |
| Hermetic (J Package) .....   | 150°C          |
| Plastic (N, DW Packages) .....                                       | 150°C          |
| Storage Temperature Range .....                                      | -65°C to 150°C |
| RoHS Peak Package Solder Reflow (40 sec. max. exp.)...260°C (+0, -5) |                |

Note 1. Values beyond which damage may occur.

Note 2. At higher input voltages, a dissipation limiting resistor, R<sub>G</sub> is required. See Figure 2.

## Thermal Data

J Package:

|   |        |
|---|--------|
| Thermal Resistance-Junction to Case, θ <sub>JC</sub> .....    | 25°C/W |
| Thermal Resistance-Junction to Ambient, θ <sub>JA</sub> ..... | 70°C/W |

N Package:

|   |        |
|---|--------|
| Thermal Resistance-Junction to Case, θ <sub>JC</sub> .....    | 30°C/W |
| Thermal Resistance-Junction to Ambient, θ <sub>JA</sub> ..... | 60°C/W |

DW Package:

|   |        |
|---|--------|
| Thermal Resistance-Junction to Case, θ <sub>JC</sub> .....    | 35°C/W |
| Thermal Resistance-Junction to Ambient, θ <sub>JA</sub> ..... | 90°C/W |

Note A. Junction Temperature Calculation: T<sub>J</sub> = T<sub>A</sub> + (P<sub>D</sub> × J<sub>A</sub>).

Note B. The above numbers for θ<sub>JC</sub> are maximums for the limiting thermal resistance of the package in a standard mounting configuration. The θ<sub>JA</sub> numbers are meant to be guidelines for the thermal performance of the device/pc-board system. All of the above assume no ambient airflow.

## Recommended Operating Conditions (Note 3)

|  |                            |
|--|----------------------------|
| Input Supply Voltage (+V <sub>IN</sub> ) ..... | 4.7V to 40V                |
| Current Limit Common Mode                      |                            |
| Input Voltage Range .....                      | 0V to +V <sub>IN</sub> -3V |
| Reference Load Current .....                   | 0 to 10mA                  |
| Indicator Output Voltage .....                 | 4.7V to 40V                |
| Indicator Output Current .....                 | 0 to 10mA                  |

|                                       |                |
|---------------------------------------|----------------|
| Delay Timing Capacitor (Note 4) ..... | 0 to 1μF       |
| Operating Ambient Temperature Range   |                |
| SG1544 .....                          | -55°C to 125°C |
| SG2544 .....                          | -25°C to 85°C  |
| SG3544 .....                          | 0°C to 70°C    |

Note 3: Range over which the device is functional.

Note 4. Larger value capacitor may be used with peak current limiting. See Figure 2.

## Electrical Characteristics

(Unless otherwise specified, these specifications apply over the operating ambient temperatures for SG1544 with -55°C ≤ T<sub>A</sub> ≤ 125°C, SG2544 with -25°C ≤ T<sub>A</sub> ≤ 85°C, SG3544 with 0°C ≤ T<sub>A</sub> ≤ 70°C, and +V<sub>IN</sub> = 10V. Indicator outputs have 2kΩ pull-up resistors. All electrical ratings and specifications are tested with the inverting over-voltage input and the non-inverting under-voltage input externally connected to the 2.5V reference. Low duty cycle testing techniques are used which maintains junction and case temperatures equal to the ambient temperature.)

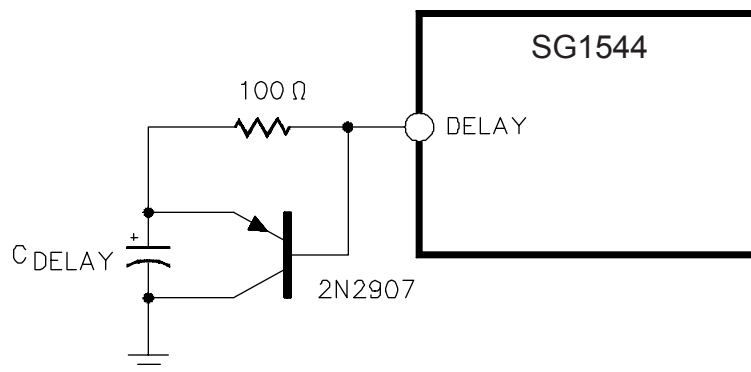
| Parameter                | Test Conditions                           | SG1544/SG2544 |      |      | SG3544 |      |      | Units |
|--------------------------|---|---------------|------|------|--------|------|------|-------|
|                          |   | Min.          | Typ. | Max. | Min.   | Typ. | Max. |       |
| <b>Supply Section</b>    |   |               |      |      |        |      |      |       |
| Input Voltage Range      | T <sub>J</sub> = 25°C to T <sub>MAX</sub> | 4.5           |      | 40   | 4.5    |      | 40   | V     |
|                          |   | 4.7           |      | 40   | 4.7    |      | 40   | V     |
| Supply Current           | +V <sub>IN</sub> = 40V, Outputs open      |               | 7    | 10   |        | 7    | 10   | mA    |
| <b>Reference Section</b> |   |               |      |      |        |      |      |       |
| Output Voltage           | T <sub>J</sub> = 25°C                     | 2.48          | 2.50 | 2.52 | 2.45   | 2.50 | 2.55 | V     |
|                          |   | 2.45          |      | 2.55 | 2.40   |      | 2.60 | V     |
| Line Regulation          | +V <sub>IN</sub> = 5 to 30V               |               | 1    | 5    |        | 1    | 5    | mV    |
| Load Regulation          | I <sub>REF</sub> = 0 to 10mA              |               | 1    | 10   |        | 1    | 10   | mV    |
| Short Circuit Current    | V <sub>REF</sub> = 0V                     | 12            | 25   | 40   | 12     | 25   | 40   | mA    |
| Temperature Stability    |   |               | .005 |      |        | .005 |      | %/°C  |

## Electrical Characteristics (Continued)

| Parameter                        | Test Conditions  | SG1544/SG2544 |      |                     | SG3544 |      |                     | Units             |
|----------------------------------|--|---------------|------|---------------------|--------|------|---------------------|-------------------|
|                                  |  | Min.          | Typ. | Max.                | Min.   | Typ. | Max.                |                   |
| <b>Comparator Section</b>        |  |               |      |                     |        |      |                     |                   |
| Input Threshold (Note 5)         | $T_J = 25^\circ\text{C}$   | 2.45          | 2.50 | 2.55                | 2.40   | 2.50 | 2.60                | V                 |
|                                  |  | 2.40          |      | 2.60                | 2.35   |      | 2.65                | V                 |
| Input Hysteresis                 |  |               | 25   |                     |        | 25   |                     | mV                |
| Input Bias Current               | Sense input = 0V   |               | 0.3  | 1.0                 |        | 0.3  | 1.0                 | $\mu\text{A}$     |
| Delay Saturation                 |  |               | 0.2  | 0.5                 |        | 0.2  | 0.5                 | V                 |
| Delay High Level                 |  |               | 6    | 8                   |        | 6    | 8                   | V                 |
| Delay Charging Current           | $V_D = 0\text{V}$  | 200           | 250  | 300                 | 200    | 250  | 300                 | $\mu\text{A}$     |
| Indicate Saturation              | $I_L = 10\text{mA}$  |               | 0.2  | 0.5                 |        | 0.2  | 0.5                 | V                 |
| Indicate Leakage                 | $V_{IND} = 40\text{V}$   |               | .01  | 1.0                 |        | 0.1  | 1.0                 | $\mu\text{A}$     |
| Propagation Delay                | $V_{O.V. N.I. IN} = 2.7\text{V}$ , $V_{U.V. INV. IN} = 2.3\text{V}$ , $T_J = 25^\circ\text{C}$ |               |      |                     |        |      |                     |                   |
|                                  | $C_D = 0$  |               | 400  |                     |        | 400  |                     | ns                |
|                                  | $C_D = 1\mu\text{F}$   |               | 10   |                     |        | 10   |                     | ms                |
| <b>SCR Trigger Section</b>       |  |               |      |                     |        |      |                     |                   |
| Peak Output Current              | $+V_{IN} = 5\text{V}$ , $R_G = 0$ , $V_O = 0$  | 100           | 200  | 400                 | 100    | 200  | 400                 | mA                |
| Peak Output Voltage              | $+V_{IN} = 15\text{V}$ , $I_O = 100\text{mA}$  | 12            | 13   |                     | 12     | 13   |                     | V                 |
| Output Off Voltage               | $+V_{IN} = 40\text{V}$ , $R_L = 1\text{k}\Omega$   |               | 0    | 0.1                 |        | 0    | 0.1                 | V                 |
| Remote Activate Current          | REM. ACT. pin = Gnd  |               | 0.4  | 0.8                 |        | 0.4  | 0.8                 | mA                |
| Remote Activate Voltage          | REM. ACT pin open  |               | 2    | 6                   |        | 2    | 6                   | V                 |
| Reset Current                    | RESET pin = Gnd, REM. ACT. = Gnd   |               | 0.4  | 0.8                 |        | 0.4  | 0.8                 | mA                |
| Reset Voltage                    | RESET pin open, REM. ACT. = Gnd  |               | 2    | 6                   |        | 2    | 6                   | V                 |
| Output Current Rise Time         | $R_L = 50\Omega$ , $T_J = 25^\circ\text{C}$ , $C_D = 0$  |               | 400  |                     |        | 400  |                     | mA/ $\mu\text{s}$ |
| Prop. Delay from REM. ACT. Pin   | $V_{REM. ACT.} = 0.4\text{V}$  |               | 300  |                     |        | 300  |                     | ns                |
| Prop. Delay fom O.V. N.I. IN Pin | $V_{O.V. N.I. INPUT} = 2.7\text{V}$  |               | 500  |                     |        | 500  |                     | ns                |
| <b>Current Limit Section</b>     |  |               |      |                     |        |      |                     |                   |
| Input Voltage Range              |  | 0             |      | $V_{IN} -3\text{V}$ | 0      |      | $V_{IN} -3\text{V}$ | V                 |
| Input Bias Current               | OFFSET/COMP pin open, $V_{CM} = 0\text{V}$   |               | 0.3  | 1.0                 |        | 0.3  | 1.0                 | $\mu\text{A}$     |
| Input Offset Voltage             | OFFSET/COMP pin open, $V_{CM} = 0\text{V}$   |               | 0    | 10                  |        | 0    | 15                  | mV                |
|                                  | $10\Omega$ from OFFSET/COMP pin to Gnd, $T_J = 25^\circ\text{C}$                               | 80            | 100  | 120                 | 70     | 100  | 130                 | mV                |
| CMRR                             | $0 \leq V_{CM} \leq 12\text{V}$ , $V_{IN} = 15\text{V}$  | 60            | 70   |                     | 60     | 70   |                     | dB                |
| AVOL                             | OFFSET/COMP pin open, $V_{CM} = 0\text{V}$   | 72            | 80   |                     | 72     | 80   |                     | dB                |
| Output Saturation                | $I_L = 10\text{mA}$  |               | 0.2  | 0.5                 |        | 0.2  | 0.5                 | V                 |
| Output Leakage                   | $V_{IND} = 40\text{V}$   |               | .01  | 1.0                 |        | .01  | 1.0                 | $\mu\text{A}$     |
| Small Signal Bandwidth           | $A_V = 0\text{dB}$ , $T_J = 25^\circ\text{C}$  |               | 5    |                     |        | 5    |                     | MHz               |
| Propagation Delay                | $V_{OVERDRIVE} = 100\text{mV}$ , $T_J = 25^\circ\text{C}$                                      |               | 200  |                     |        | 200  |                     | ns                |

Note 5. Input voltage rising on O.V. N.I. INPUT and falling on U.V. INV. INPUT.

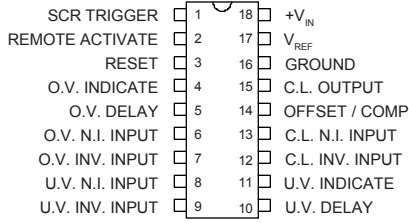
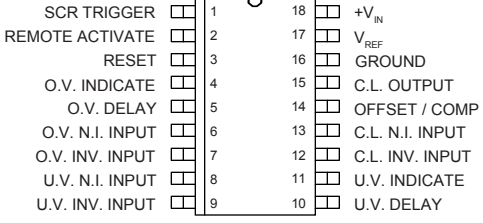
## Application Information



**Figure 2** - Surge Limit Circuit for Large Delay Capacitors

The 100 ohm resistor ( $R_G$ ) limits the peak discharge current into the SG1544 while the external PNP transistor provides a high peak-current discharge path for the delay capacitor.

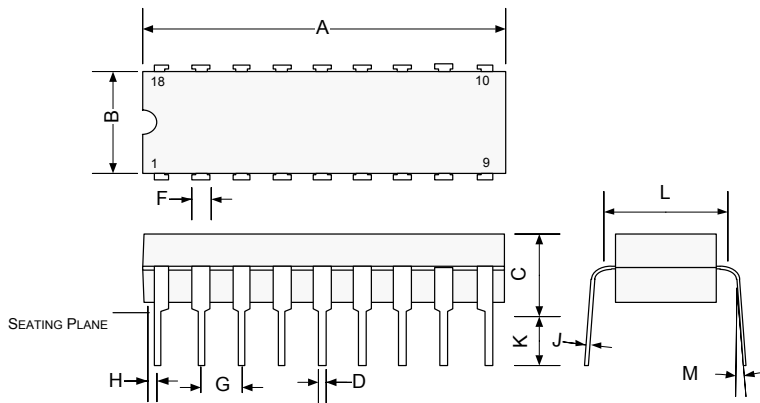
## Connection Diagrams and Ordering Information (See Notes Below)

| Package  | Part No.  | Ambient Temperature Range  | Connection Diagram   |
|--|---|--|--|
| 18-PIN CERAMIC DIP<br>J - PACKAGE                | SG1544J-883B<br>SG1544J-DESC<br>SG1544J<br>SG2544J<br>SG3544J | -55°C to 125°C<br>-55°C to 125°C<br>-55°C to 125°C<br>-25°C to 85°C<br>0°C to 70°C |  <p>N Package: RoHS Compliant / Pb-free Transition DC: 0503<br/>N Package: RoHS / Pb-free 100% Matte Tin lead Finish</p>   |
| 18-PIN PLASTIC DIP<br>N - PACKAGE                | SG2544N<br>SG3544N  | -25°C to 85°C<br>0°C to 70°C   |  |
| 18-PIN WIDE BODY<br>PLASTIC SOIC<br>DW - PACKAGE | SG2544DW<br>SG3544DW  | -25°C to 85°C<br>0°C to 70°C   |  <p>DW Package: RoHS Compliant / Pb-free Transition DC: 0516<br/>DW Package: RoHS / Pb-free 100% Matte Tin lead Finish</p> |

- Note
1. Contact factory for DESC product availability.
  2. All packages are viewed from the top.
  3. J package uses Sn63/Pb37 hot solder lead finish, contact factory for availability of a RoHS version.

# Package Outline Dimensions

Controlling dimensions are in inches, metric equivalents are shown for general information.

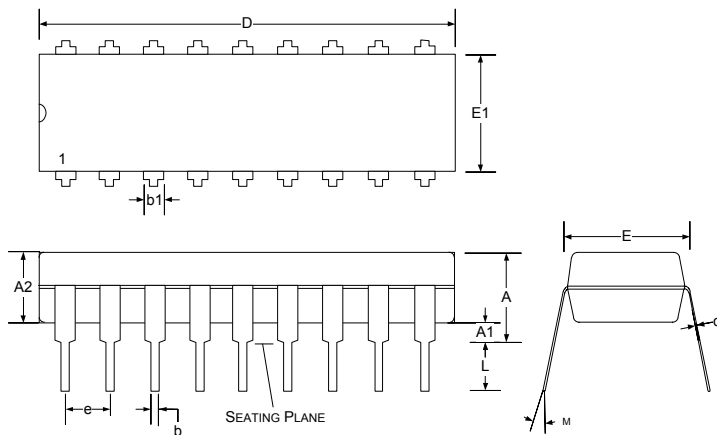


| DIM | MILLIMETERS |       | INCHES    |       |
|-----|-------------|-------|-----------|-------|
|     | MIN         | MAX   | MIN       | MAX   |
| A   | -           | 24.38 | -         | 0.960 |
| B   | 5.59        | 7.11  | 0.220     | 0.280 |
| C   | -           | 5.08  | -         | 0.200 |
| D   | 0.38        | 0.51  | 0.015     | 0.020 |
| F   | 1.02        | 1.77  | 0.040     | 0.070 |
| G   | 2.54 BSC    |       | 0.100 BSC |       |
| H   | -           | 2.03  | -         | 0.080 |
| J   | 0.20        | 0.38  | 0.008     | 0.015 |
| K   | 3.18        | 5.08  | 0.125     | 0.200 |
| L   | 7.37        | 7.87  | 0.290     | 0.310 |
| M   | -           | 15°   | -         | 15°   |

**Note:**

Dimensions do not include protrusions; these shall not exceed 0.155mm (.006") on any side. Lead dimension shall not include solder coverage.

**Figure 3 - J 18-Pin CERDIP Package Dimensions**



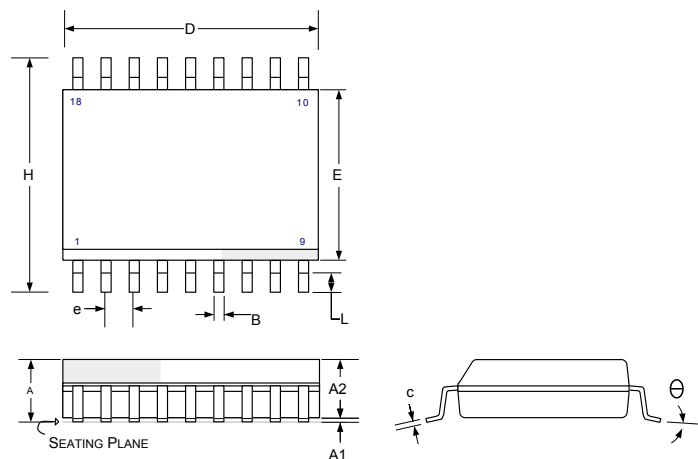
| DIM | MILLIMETERS |       | INCHES    |       |
|-----|-------------|-------|-----------|-------|
|     | MIN         | MAX   | MIN       | MAX   |
| A   | -           | 5.33  | -         | 0.210 |
| A1  | 0.38        | -     | 0.015     | -     |
| A2  | 3.30 Typ    |       | 0.130 Typ |       |
| b   | 0.36        | 0.56  | 0.014     | 0.022 |
| b1  | 1.14        | 1.78  | 0.045     | 0.070 |
| c   | 0.20        | 0.36  | 0.008     | 0.014 |
| D   | 22.35       | 23.34 | 0.880     | 0.920 |
| e   | 2.54 BSC    |       | 0.100 BSC |       |
| E   | 7.62        | 8.26  | 0.300     | 0.325 |
| E1  | 6.10        | 7.11  | 0.240     | 0.280 |
| L   | 2.92        | 3.81  | 0.115     | 0.150 |
| M   | -           | 15°   | -         | 15°   |

**Note:**

Dimensions do not include protrusions; these shall not exceed 0.155mm (.006") on any side. Lead dimension shall not include solder coverage.

**Figure 4 - N 18-Pin Plastic Dual Inline Package Dimensions**

## Package Outline Dimensions (continued)



| DIM      | MILLIMETERS |       | INCHES   |       |
|----------|-------------|-------|----------|-------|
|          | MIN         | MAX   | MIN      | MAX   |
| A        | 2.35        | 2.65  | 0.093    | 0.104 |
| A1       | 0.10        | 0.30  | 0.004    | 0.012 |
| A2       | 2.20        | 2.55  | 0.086    | 0.100 |
| B        | 0.33        | 0.51  | 0.013    | 0.020 |
| c        | 0.23        | 0.32  | 0.009    | 0.013 |
| D        | 11.40       | 11.70 | 0.449    | 0.461 |
| E        | 7.40        | 7.60  | 0.291    | 0.299 |
| e        | 1.27 BSC    |       | 0.05 BSC |       |
| H        | 10.00       | 10.65 | 0.394    | 0.419 |
| L        | 0.40        | 1.27  | 0.016    | 0.050 |
| $\theta$ | 0°          | 8°    | 0°       | 8°    |
| *LC      | –           | 0.10  | –        | 0.004 |

Lead co planarity

**Note:**

Dimensions do not include protrusions; these shall not exceed 0.155mm (.006") on any side. Lead dimension shall not include solder coverage.

**Figure 5 • DW 18-Pin Plastic Wide-body SOIC (SOWB) Package Dimensions**



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