

# NS5B1G384

## Single (NC) Normally Closed SPST Analog Switch

The NS5B1G384 is Single Pole Single Throw (SPST) high-speed TTL-compatible switch. The low resistance and capacitance characteristics of this switch make it ideal for low-distortion audio, video, and data routing applications. The switch has a normally closed logic configuration meaning the switch is on (NC connected to COM) when IN is low. These switches are available in 5-pin SC-70 and 5-pin TSOP-5 (SOT23-5) packages for operation over the industrial (-40°C to +85°C) temperature range.

### Features

- $V_{CC}$  Operating Range: 2.0 V to 5.5 V
- Low On Resistance :  $R_{ON}$ : 4.0  $\Omega$  Typical @  $V_{CC} = 4.5$  V
- Minimal Propagation Delay :  $t_{pd} < 0.5$  ns
- Control Input Compatible with TTL Levels
- ESD Performance: Human Body Model  $> \pm 2$  kV
- 5-Pin SC-70 or 5-Pin TSOP-5 Packages Available
- These are Pb-Free Devices

### Typical Applications

- Audio, Video, and High-Speed Data Switching
- Mobile Phones
- Portable Devices
- Desktop & Notebook Computing



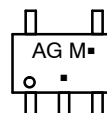
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<http://onsemi.com>

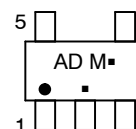
### MARKING DIAGRAMS



**SC-70  
CASE 419A**



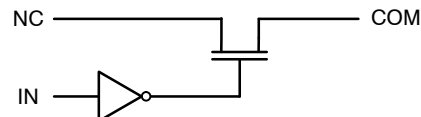
**TSOP-5  
(SOT23-5)  
CASE 483**



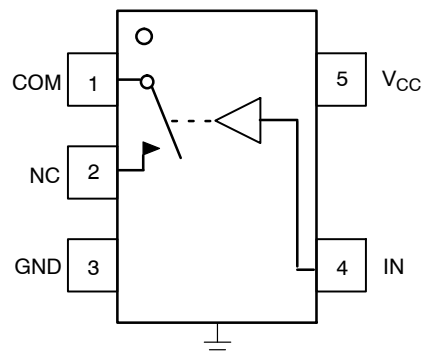
AG = For SC-70  
AD = For TSOP-5  
M = Date Code  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

### LOGIC DIAGRAM



### PIN ASSIGNMENTS



### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 4 of this data sheet.

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## PIN DESCRIPTION

| PIN # | Name            | Direction | Description                 |
|-------|-----------------|-----------|-----------------------------|
| 1     | COM             | I/O       | Common Signal Line          |
| 2     | NC              | I/O       | Normally Closed Signal Line |
| 3     | GND             | Input     | Ground                      |
| 4     | IN              | Input     | Control Signal Line         |
| 5     | V <sub>CC</sub> | Input     | Voltage Supply              |

## TRUTH TABLE

| IN Control Input | Function                 |
|------------------|--------------------------|
| L                | NC Connected to COM      |
| H                | NC Disconnected from COM |

## MAXIMUM RATINGS

| Symbol              | Pins            | Rating                           | Value                         | Condition      | Unit |
|---------------------|-----------------|----------------------------------|-------------------------------|----------------|------|
| V <sub>CC</sub>     | V <sub>CC</sub> | Positive DC Supply Voltage       | −0.5 to +7.0                  |                | V    |
| V <sub>IS</sub>     | NC or COM       | Analog Signal Voltage            | −0.5 to V <sub>CC</sub> + 0.5 |                | V    |
| V <sub>IN</sub>     | IN              | Control Input Voltage            | −0.5 to +7.0                  |                | V    |
| I <sub>IS_CON</sub> | NC or COM       | Analog Signal Continuous Current | ± 300                         | Closed Switch  | mA   |
| I <sub>IS_PK</sub>  | NC or COM       | Analog Signal Peak Current       | ± 500                         | 10% Duty Cycle | mA   |
| I <sub>IN</sub>     | IN              | Control Input Current            | ± 20                          |                | mA   |
| T <sub>STG</sub>    |                 | Storage Temperature Range        | −65 to 150                    |                | °C   |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

## RECOMMENDED OPERATING CONDITIONS

| Symbol                          | Pins            | Parameter                   | Value                  | Condition               | Unit |
|---------------------------------|-----------------|-----------------------------|------------------------|-------------------------|------|
| V <sub>CC</sub>                 | V <sub>CC</sub> | Positive DC Supply Voltage  | 2.0 to 5.5             |                         | V    |
| V <sub>IS</sub>                 | NC or COM       | Analog Signal Voltage       | GND to V <sub>CC</sub> |                         | V    |
| V <sub>IN</sub>                 | IN              | Control Input Voltage       | GND to 5.5             |                         | V    |
| T <sub>A</sub>                  |                 | Operating Temperature Range | −40 to +85             |                         | °C   |
| t <sub>r</sub> , t <sub>f</sub> |                 | Input Rise or Fall Time     | 20                     | V <sub>CC</sub> = 3.3 V | ns/V |
|                                 |                 |                             | 10                     | V <sub>CC</sub> = 5.0 V |      |

Minimum and maximum values are guaranteed through test or design across the **Recommended Operating Conditions**, where applicable. Typical values are listed for guidance only and are based on the particular conditions listed for each section, where applicable. These conditions are valid for all values found in the characteristics tables unless otherwise specified in the test conditions.

## ESD PROTECTION

| Pins     | Description      | Minimum Voltage |
|----------|------------------|-----------------|
| All Pins | Human Body Model | 2 kV            |

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## DC ELECTRICAL CHARACTERISTICS

### CONTROL INPUT (Typical: T = 25°C)

| Symbol          | Pins | Parameter             | Test Conditions                       | V <sub>CC</sub><br>(V) | -40°C to +85°C |      |      | Unit |
|-----------------|------|-----------------------|---------------------------------------|------------------------|----------------|------|------|------|
|                 |      |                       |                                       |                        | Min            | Typ  | Max  |      |
| V <sub>IH</sub> | IN   | Control Input High    |                                       | 4.5 – 5.5              | 2.0            |      |      | V    |
| V <sub>IL</sub> | IN   | Control Input Low     |                                       | 4.5 – 5.5              |                |      | 0.8  | V    |
| I <sub>IN</sub> | IN   | Control Input Leakage | 0 ≤ V <sub>IN</sub> ≤ V <sub>CC</sub> | 5.0                    |                | ±0.1 | ±0.5 | μA   |

### SUPPLY CURRENT AND LEAKAGE (Typical: T = 25°C)

| Symbol                    | Pins            | Parameter         | Test Conditions                                                                                             | V <sub>CC</sub><br>(V) | -40°C to +85°C |      |      | Unit |
|---------------------------|-----------------|-------------------|-------------------------------------------------------------------------------------------------------------|------------------------|----------------|------|------|------|
|                           |                 |                   |                                                                                                             |                        | Min            | Typ  | Max  |      |
| I <sub>NC</sub><br>(OFF)  | NC              | OFF State Leakage | V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub><br>V <sub>NC</sub> = 1.0 V<br>V <sub>COM</sub> = 4.5 V | 5.5                    |                | ±10  | ±100 | nA   |
| I <sub>COM</sub><br>(OFF) | COM             | OFF State Leakage | V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub><br>V <sub>NC</sub> = 4.5 V<br>V <sub>COM</sub> = 1.0 V | 5.5                    |                | ±10  | ±100 | nA   |
| I <sub>CC</sub>           | V <sub>CC</sub> | Quiescent Supply  | V <sub>IN</sub> and V <sub>IS</sub> = V <sub>CC</sub> or GND<br>I <sub>D</sub> = 0 A                        | 2.0 – 5.5              |                | ±0.1 | ±1.0 | μA   |
| I <sub>OFF</sub>          | IN              | Power Off Leakage | V <sub>IN</sub> = 5.5 V or GND                                                                              | 0                      |                | ±0.5 | ±1.0 | μA   |

### ON RESISTANCE (Typical: T = 25°C)

| Symbol          | Pins    | Parameter     | Test Conditions                                                                                                                                      | V <sub>CC</sub><br>(V) | -40°C to +85°C |                    |                  | Unit |
|-----------------|---------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|----------------|--------------------|------------------|------|
|                 |         |               |                                                                                                                                                      |                        | Min            | Typ                | Max              |      |
| R <sub>ON</sub> | NC, COM | ON Resistance | V <sub>IS</sub> = 0 V, I <sub>ON</sub> = 30 mA<br>V <sub>IS</sub> = 0 V, I <sub>ON</sub> = 64 mA<br>V <sub>IS</sub> = 2.4 V, I <sub>ON</sub> = 15 mA | 4.5<br>4.5<br>4.5      |                | 4.0<br>4.0<br>11.5 | 7.0<br>7.0<br>15 | Ω    |

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## AC ELECTRICAL CHARACTERISTICS

**TIMING/FREQUENCY** (Typical: T = 25°C, R<sub>L</sub> = 50 Ω, C<sub>L</sub> = 35 pF, f = 1 MHz)

| Symbol           | Pins      | Parameter         | Test Conditions                        | V <sub>CC</sub><br>(V) | -40°C to +85°C |     |     | Unit |
|------------------|-----------|-------------------|----------------------------------------|------------------------|----------------|-----|-----|------|
|                  |           |                   |                                        |                        | Min            | Typ | Max |      |
| t <sub>ON</sub>  | IN to NC  | Turn On Time      | As Above, Figures 1 and 2              | 4.5                    |                |     | 6.0 | ns   |
| t <sub>OFF</sub> | IN to NC  | Turn Off Time     | As Above, Figures 1 and 2              | 4.5                    |                |     | 2.0 | ns   |
| t <sub>pD</sub>  | NC to COM | Propagation Delay |                                        | 4.5                    |                |     | 0.5 | ns   |
| BW               |           | -3dB Bandwidth    | C <sub>L</sub> = 5 pF, Figures 3 and 4 | 4.5                    |                | 330 |     | MHz  |

**CAPACITANCE** (Typical: T = 25°C, R<sub>L</sub> = 50 Ω, C<sub>L</sub> = 5 pF, f = 1 MHz)

| Symbol           | Pins      | Parameter       | Test Conditions                                  | V <sub>CC</sub><br>(V) | -40°C to +85°C |     |     | Unit |
|------------------|-----------|-----------------|--------------------------------------------------|------------------------|----------------|-----|-----|------|
|                  |           |                 |                                                  |                        | Min            | Typ | Max |      |
| C <sub>IN</sub>  | IN        | Control Input   |                                                  | 0 V                    |                | 2.2 |     | pF   |
| C <sub>ON</sub>  | NC to COM | Through Switch  | V <sub>IN</sub> = 0V                             | 4.5 V                  |                | 12  |     | pF   |
| C <sub>OFF</sub> | NC        | Unselected Port | V <sub>IS</sub> = 4.5 V, V <sub>IN</sub> = 4.5 V | 4.5 V                  |                | 4.1 |     | pF   |

## DEVICE ORDERING INFORMATION

| Device Order Number | Package Type        | Tape & Reel Size <sup>†</sup> |
|---------------------|---------------------|-------------------------------|
| NS5B1G384DFT2G      | SC-70<br>(Pb-Free)  | 3000 / Tape & Reel            |
| NS5B1G384DTT1G      | TSOP-5<br>(Pb-Free) | 3000 / Tape & Reel            |

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

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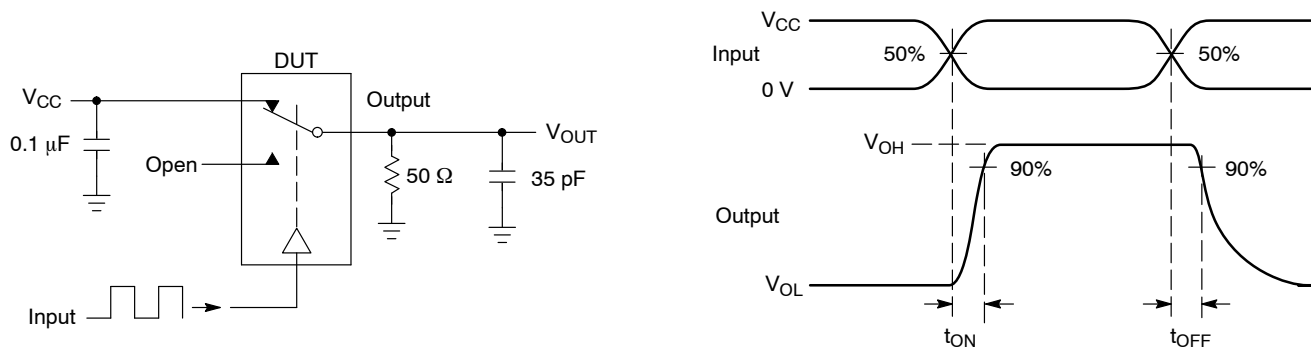


Figure 1.  $t_{ON}/t_{OFF}$

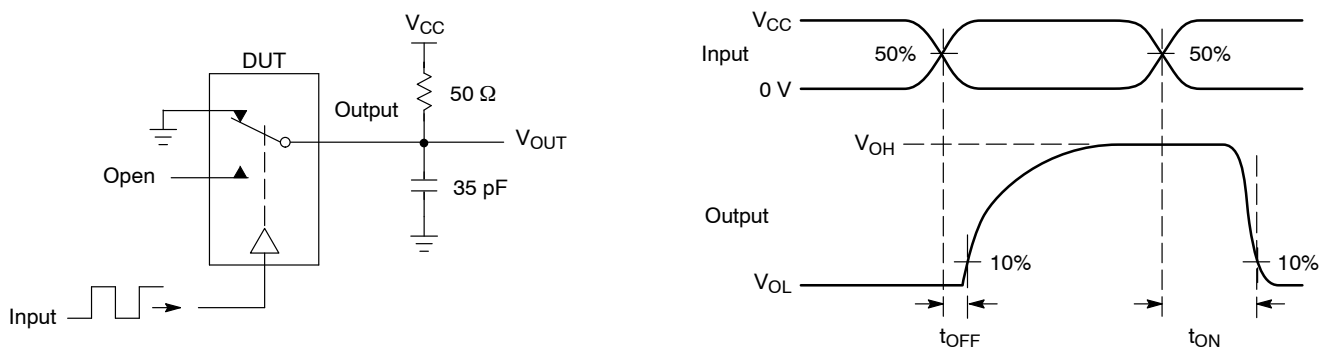
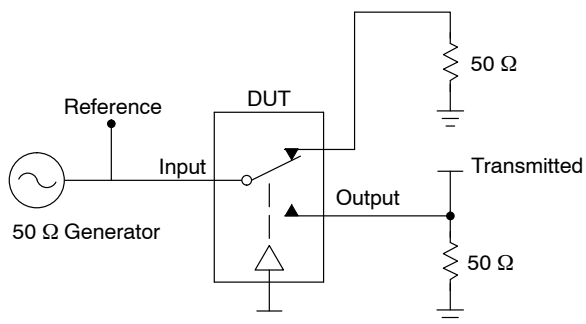


Figure 2.  $t_{ON}/t_{OFF}$



Channel switch control/s test socket is normalized. Off isolation is measured across an off channel. On loss is the bandwidth of an On switch.  $V_{ISO}$ , Bandwidth and  $V_{ONL}$  are independent of the input signal direction.

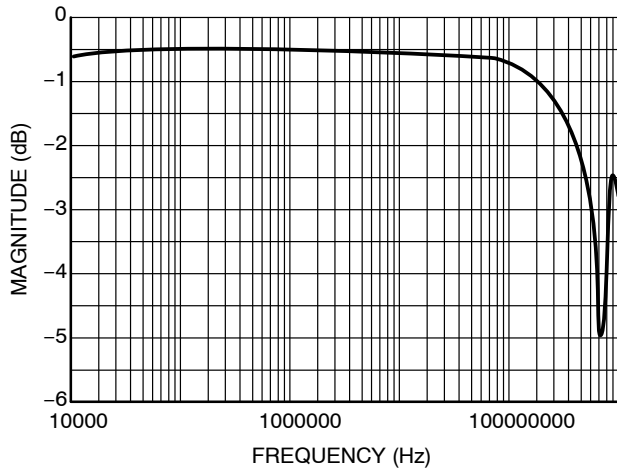
$$V_{ISO} = \text{Off Channel Isolation} = 20 \log \left( \frac{V_{OUT}}{V_{IN}} \right) \text{ for } V_{IN} \text{ at } 100 \text{ kHz}$$

$$V_{ONL} = \text{On Channel Loss} = 20 \log \left( \frac{V_{OUT}}{V_{IN}} \right) \text{ for } V_{IN} \text{ at } 100 \text{ kHz to } 50 \text{ MHz}$$

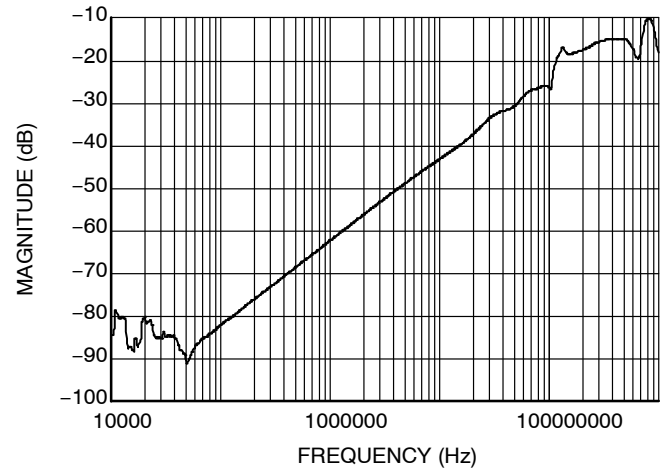
Bandwidth (BW) = the frequency 3 dB below  $V_{ONL}$

$V_{CT}$  = Use  $V_{ISO}$  setup and test to all other switch analog input/outputs terminated with 50 Ω

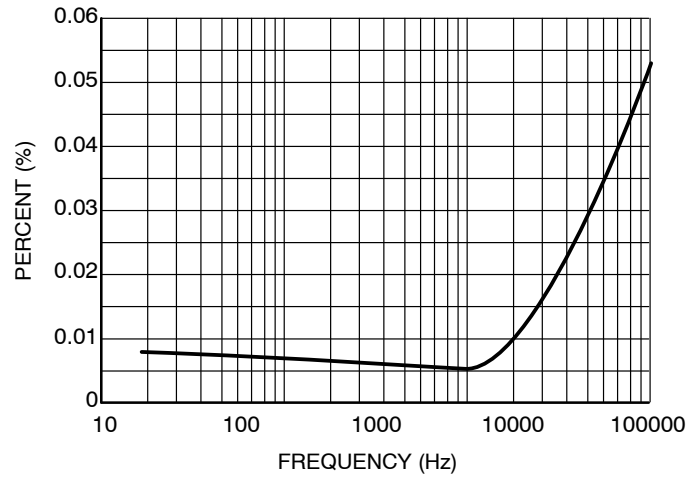
Figure 3. Off Channel Isolation/On Channel Loss (BW)/Crosstalk (On Channel to Off Channel)/ $V_{ONL}$



**Figure 4. Typical Bandwidth @  $V_{CC} = 5.5$  V,  
25°C**



**Figure 5. Off-Channel Isolation @  $V_{CC} = 5.5$  V,  
25°C**

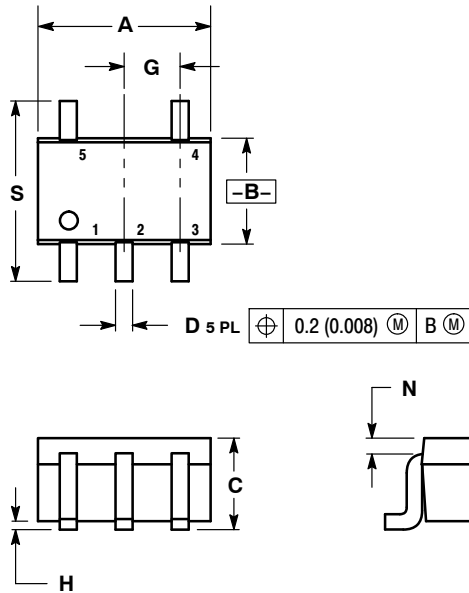


**Figure 6. Typical Total Harmonic Distortion @  
 $V_{CC} = 4.5$  V**

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## PACKAGE DIMENSIONS

SC-88A (SC-70-5/SOT-353)  
CASE 419A-02  
ISSUE K



### NOTES:

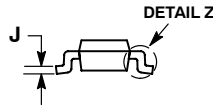
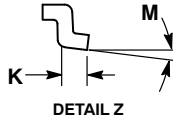
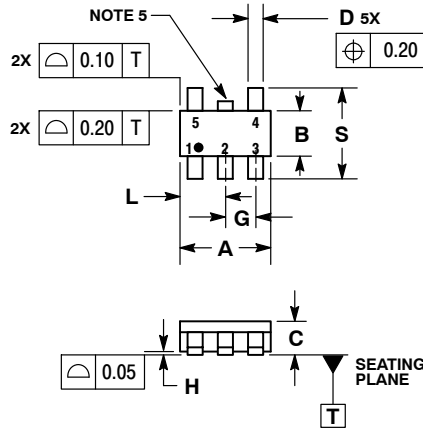
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. 419A-01 OBSOLETE. NEW STANDARD 419A-02.
4. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

| DIM | INCHES    |       | MILLIMETERS |      |
|-----|-----------|-------|-------------|------|
|     | MIN       | MAX   | MIN         | MAX  |
| A   | 0.071     | 0.087 | 1.80        | 2.20 |
| B   | 0.045     | 0.053 | 1.15        | 1.35 |
| C   | 0.031     | 0.043 | 0.80        | 1.10 |
| D   | 0.004     | 0.012 | 0.10        | 0.30 |
| G   | 0.026 BSC |       | 0.65 BSC    |      |
| H   | ---       | 0.004 | ---         | 0.10 |
| J   | 0.004     | 0.010 | 0.10        | 0.25 |
| K   | 0.004     | 0.012 | 0.10        | 0.30 |
| N   | 0.008 REF |       | 0.20 REF    |      |
| S   | 0.079     | 0.087 | 2.00        | 2.20 |

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## PACKAGE DIMENSIONS

### TSOP-5, SOT23-5 CASE 483-02 ISSUE H

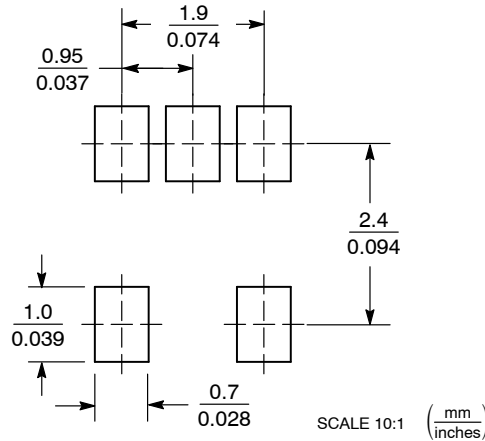


#### NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.
5. OPTIONAL CONSTRUCTION: AN ADDITIONAL TRIMMED LEAD IS ALLOWED IN THIS LOCATION. TRIMMED LEAD NOT TO EXTEND MORE THAN 0.2 FROM BODY.

| DIM | MILLIMETERS |      |
|-----|-------------|------|
|     | MIN         | MAX  |
| A   | 3.00        | BSC  |
| B   | 1.50        | BSC  |
| C   | 0.90        | 1.10 |
| D   | 0.25        | 0.50 |
| G   | 0.95        | BSC  |
| H   | 0.01        | 0.10 |
| J   | 0.10        | 0.26 |
| K   | 0.20        | 0.60 |
| L   | 1.25        | 1.55 |
| M   | 0°          | 10°  |
| S   | 2.50        | 3.00 |

#### SOLDERING FOOTPRINT\*



\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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