Single Inverter with Open Drain Output

NL17SZ06

The NL17SZ06 is a single inverter with open drain output in tiny footprint packages.

Features

- Designed for 1.65 V to 5.5 V V_{CC} Operation
- 2.1 ns t_{PD} at $V_{CC} = 5 \text{ V (typ)}$
- Input/Output Overvoltage Tolerant up to 5.5 V
- I_{OFF} Supports Partial Power Down Protection
- Source/Sink 24 mA at 3.0 V
- Available in SC-88A, SC-74A, SOT-553, SOT-953 and UDFN6 Packages
- Chip Complexity < 100 FETs
- NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable
- These Devices are Pb–Free, Halogen Free/BFR Free and are RoHS Compliant

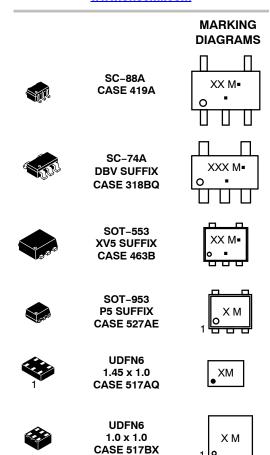


Figure 1. Logic Symbol



ON Semiconductor®

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XX = Specific Device Code M = Date Code*

= Pb-Free Package

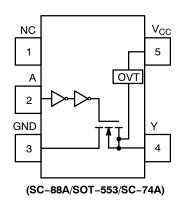
(Note: Microdot may be in either location)

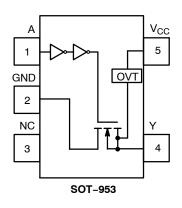
*Date Code orientation and/or position may vary depending upon manufacturing location.

ORDERING INFORMATION

See detailed ordering, marking and shipping information in the package dimensions section on page 7 of this data sheet.

1





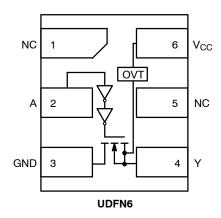


Figure 2. Pinout (Top View)

PIN ASSIGNMENT (SC-88A/SOT-553/SC-74A)

| Pin | Function |
|-----|-----------------|
| 1 | NC |
| 2 | А |
| 3 | GND |
| 4 | Υ |
| 5 | V _{CC} |

PIN ASSIGNMENT (SOT-953)

| Pin | Function |
|-----|-----------------|
| 1 | Α |
| 2 | GND |
| 3 | NC |
| 4 | Y |
| 5 | V _{CC} |

PIN ASSIGNMENT (UDFN)

| Pin | Function |
|-----|-----------------|
| 1 | NC |
| 2 | Α |
| 3 | GND |
| 4 | Y |
| 5 | NC |
| 6 | V _{CC} |

FUNCTION TABLE

| A Input | Y Output |
|---------|----------|
| L | Z |
| Н | L |

MAXIMUM RATINGS

| Symbol | | Characteristics | Value | Unit |
|-------------------------------------|---|--|---|------|
| V _{CC} | DC Supply Voltage | SC-88A (NLV) SC-74A, SC-88A, SOT-553, SOT-953, UDFN6 | -0.5 to +7.0 -0.5 to +6.5 | V |
| V _{IN} | DC Input Voltage | SC-88A (NLV) SC-74A, SC-88A, SOT-553, SOT-953, UDFN6 | -0.5 to +7.0 -0.5 to +6.5 | V |
| V _{OUT} | DC Output Voltage SC-88A (NLV) | Active–Mode (High or Low State) Tri–State Mode (Note 1) Power–Down Mode ($V_{CC} = 0 \text{ V}$) | -0.5 to V _{CC} + 0.5 -0.5 to +7.0 -0.5 to +7.0 | V |
| | DC Output Voltage SC-74A, SC-88A, SOT-553, SOT-953, UDFN6 | Active–Mode (High or Low State) Tri–State Mode (Note 1) Power–Down Mode ($V_{CC} = 0 \text{ V}$) | -0.5 to V _{CC} + 0.5 -0.5 to +6.5 -0.5 to +6.5 | V |
| I _{IK} | DC Input Diode Current | V _{IN} < GND | -50 | mA |
| I _{OK} | DC Output Diode Current | V _{OUT} < GND | -50 | mA |
| I _{OUT} | DC Output Source/Sink Current | | ±50 | mA |
| I _{CC} or I _{GND} | DC Supply Current per Supply F | ±100 | mA | |
| T _{STG} | Storage Temperature Range | -65 to +150 | °C | |
| TL | Lead Temperature, 1 mm from C | Case for 10 secs | 260 | °C |
| TJ | Junction Temperature Under Bia | as | +150 | °C |
| $\theta_{\sf JA}$ | Thermal Resistance (Note 2) | SC-88A SC-74A SOT-553 SOT-953 UDFN6 | 377 320 324 254 154 | °C/W |
| P _D | Power Dissipation in Still Air | SC-88A SC-74A SOT-553 SOT-953 UDFN6 | 332 390 386 491 812 | mW |
| MSL | Moisture Sensitivity | | Level 1 | - |
| F _R | Flammability Rating | Oxygen Index: 28 to 34 | UL 94 V-0 @ 0.125 in | _ |
| V _{ESD} | ESD Withstand Voltage (Note 3) | Human Body Model Charged Device Model | 2000 1000 | V |
| I _{Latchup} | Latchup Performance (Note 4) | | ±100 | mA |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Applicable to devices with outputs that may be tri-stated.

2. Measured with minimum pad spacing on an FR4 board, using 10mm-by-1inch, 2 ounce copper trace no air flow per JESD51-7.

3. HBM tested to ANSI/ESDA/JEDEC JS-001-2017. CDM tested to EIA/JESD22-C101-F. JEDEC recommends that ESD qualification to EIA/JESD22-A115-A (Machine Model) be discontinued per JEDEC/JEP172A.

4. Tested to EIA/JESD78 Class II.

RECOMMENDED OPERATING CONDITIONS

| Symbol | Chara | Characteristics | | | Unit |
|---------------------------------|--|---|-------------|-------------------------------|------|
| V _{CC} | Positive DC Supply Voltage | | 1.65 | 5.5 | V |
| V _{IN} | DC Input Voltage | | 0 | 5.5 | V |
| V _{OUT} | DC Output Voltage | Active–Mode (High or Low State) Tri–State Mode (Note 1) Power–Down Mode ($V_{\rm CC}$ = 0 V) | 0 0 0 | V _{CC} 5.5 5.5 | |
| T _A | Operating Temperature Range | | -55 | +125 | °C |
| t _r , t _f | Input Rise and Fall Time SC-88A (NLV) | $V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$ $V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$ | 0 0 | 100 20 | ns/V |
| | Input Rise and Fall Time SC-74A, SC-88A, SOT-553, SOT-953, UDFN6 | $\begin{array}{c} V_{CC} = 1.65 \ V \ to \ 1.95 \ V \\ V_{CC} = 2.3 \ V \ to \ 2.7 \ V \\ V_{CC} = 3.0 \ V \ to \ 3.6 \ V \\ V_{CC} = 4.5 \ V \ to \ 5.5 \ V \end{array}$ | 0 0 0 | 20 20 10 5 | |

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

DC ELECTRICAL CHARACTERISTICS

| | | | V _{CC} | $T_A = 25^{\circ}C$ | | -55°C ≤ T | _A ≤ 125°C | | |
|------------------|-----------------------------------|---|--|----------------------|---|--|----------------------|--|-------|
| Symbol | Parameter | Condition | (V) | Min | Тур | Max | Min | Max | Units |
| V _{IH} | High-Level Input | | 1.65 to 1.95 | 0.65 V _{CC} | - | - | 0.65 V _{CC} | - | V |
| | Voltage | | 2.3 to 5.5 | 0.70 V _{CC} | - | - | 0.70 V _{CC} | - | |
| V _{IL} | Low-Level Input | | 1.65 to 1.95 | - | - | 0.35 V _{CC} | - | 0.35 V _{CC} | V |
| | Voltage | | 2.3 to 5.5 | - | 1 | 0.30 V _{CC} | - | 0.30 V _{CC} | |
| V _{OL} | Low-Level Output Voltage | $\begin{array}{l} V_{IN} = V_{IH} \text{ or } V_{IL} \\ I_{OL} = 100 \ \mu\text{A} \\ I_{OL} = 4 \ \text{mA} \\ I_{OL} = 8 \ \text{mA} \\ I_{OL} = 12 \ \text{mA} \\ I_{OL} = 16 \ \text{mA} \\ I_{OL} = 24 \ \text{mA} \\ I_{OL} = 32 \ \text{mA} \end{array}$ | 1.65 to 5.5 1.65 2.3 2.7 3.0 3.0 4.5 | 111111 | 0.08 0.2 0.22 0.28 0.38 0.42 | 0.1 0.24 0.3 0.4 0.4 0.55 0.55 | 111111 | 0.1 0.24 0.3 0.4 0.4 0.55 0.55 | V |
| I _{IN} | Input Leakage Current | V _{IN} = 5.5 V or GND | 1.65 to 5.5 | - | - | ±0.1 | - | ±1.0 | μΑ |
| l _{OZ} | 3-State Output Leakage Current | V _{OUT} = 0 V to 5.5 V | 1.65 to 5.5 | ı | ı | ±0.5 | ı | ±5.0 | μА |
| l _{OFF} | Power Off Leakage Current | V _{IN} = 5.5 V or V _{OUT} = 5.5 V | 0 | _ | _ | 1.0 | - | 10 | μΑ |
| Icc | Quiescent Supply Current | V _{IN} = V _{CC} or GND | 5.5 | - | - | 1.0 | - | 10 | μА |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

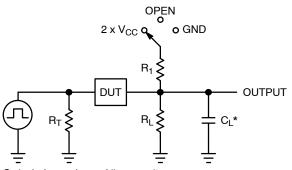
AC ELECTRICAL CHARACTERISTICS

| | | | V _{CC} | T, | _A = 25° | С | -55°C ≤ T | _A ≤ 125°C | |
|------------------|-----------------------------|------------|-----------------|-----|--------------------|-----|-----------|----------------------|-------|
| Symbol | Parameter | Condition | (V) | Min | Тур | Max | Min | Max | Units |
| t _{PZL} | Propagation Delay, | | 1.65 to 1.95 | - | 6.0 | 9.0 | _ | 9.5 | ns |
| | A to Y (Figures 3 and 4) | 2.3 to 2.7 | - | 3.6 | 6.1 | - | 6.5 | | |
| | | | 3.0 to 3.6 | - | 2.7 | 5.6 | = | 6.0 | |
| | | | 4.5 to 5.5 | - | 2.1 | 4.4 | = | 4.8 | |
| t _{PLZ} | Propagation Delay, | | 1.65 to 1.95 | - | 4.0 | 9.0 | = | 9.5 | ns |
| | A to Y (Figures 3 and 4) | 2.3 to 2.7 | - | 2.8 | 6.1 | - | 6.5 | | |
| | | | 3.0 to 3.6 | _ | 2.5 | 5.6 | _ | 6.0 | |
| | | | 4.5 to 5.5 | _ | 2.2 | 4.4 | _ | 4.8 | |

CAPACITIVE CHARACTERISTICS

| Symbol | Parameter | Condition | Typical | Units |
|------------------|--|---|---------|-------|
| C _{IN} | Input Capacitance | V_{CC} = 5.5 V, V_{IN} = 0 V or V_{CC} | 2.5 | pF |
| C _{OUT} | Output Capacitance | V_{CC} = 5.5 V, V_{IN} = 0 V or V_{CC} | 2.5 | pF |
| C _{PD} | Power Dissipation Capacitance (Note 5) | 10 MHz, V_{CC} = 3.3 V, V_{IN} = 0 V or V_{CC} 10 MHz, V_{CC} = 5.5 V, V_{IN} = 0 V or V_{CC} | 9 11 | pF |

^{5.} C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation: I_{CC(OPR)} = C_{PD} • V_{CC} • f_{in} + I_{CC}. C_{PD} is used to determine the no–load dynamic power consumption; P_D = C_{PD} • V_{CC}² • f_{in} + I_{CC} • V_{CC}.



| Test | Switch Position | C _L , pF | R_L, Ω | R ₁ , Ω | |
|-------------------------------------|---------------------|------------------------------|---------------|--------------------|--|
| t _{PLH} / t _{PHL} | Open | See AC Characteristics Table | | | |
| t _{PLZ} / t _{PZL} | 2 x V _{CC} | 50 | 500 | 500 | |
| t _{PHZ} / t _{PZH} | GND | 50 | 500 | 500 | |

X = Don't Care

C_L includes probe and jig capacitance R_T is Z_{OUT} of pulse generator (typically 50 Ω) f=1 MHz

Figure 3. Test Circuit

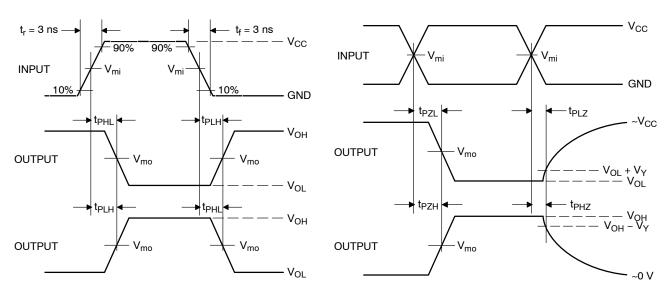


Figure 4. Switching Waveforms

| | | V _m | | |
|---------------------|---------------------|-------------------------------------|---|--------------------|
| V _{CC} , V | V _{mi} , V | t _{PLH} , t _{PHL} | t _{PZL} , t _{PLZ} , t _{PZH} , t _{PHZ} | V _Y , V |
| 1.65 to 1.95 | V _{CC} /2 | V _{CC} /2 | V _{CC} /2 | 0.15 |
| 2.3 to 2.7 | V _{CC} /2 | V _{CC} /2 | V _{CC} /2 | 0.15 |
| 3.0 to 3.6 | V _{CC} /2 | V _{CC} /2 | V _{CC} /2 | 0.3 |
| 4.5 to 5.5 | V _{CC} /2 | V _{CC} /2 | V _{CC} /2 | 0.3 |

DEVICE ORDERING INFORMATION

| Device | Packages | Specific Device Code | Pin 1 Orientation (See below) | Shipping [†] |
|------------------------------------|--------------------------|----------------------|----------------------------------|-----------------------|
| NL17SZ06DFT2G | SC-88A | LF | Q4 | 3000 / Tape & Reel |
| NLV17SZ06DFT2G* | SC-88A | LF | Q4 | 3000 / Tape & Reel |
| NL17SZ06DBVT1G | SC-74A | AF | Q4 | 3000 / Tape & Reel |
| NL17SZ06XV5T2G | SOT-553 | LF | Q4 | 4000 / Tape & Reel |
| NL17SZ06P5T5G (In Development) | SOT-953 | TBD | Q2 | 8000 / Tape & Reel |
| NL17SZ06MU1TCG (In Development) | UDFN6, 1.45 x 1.0 x 0.5P | TBD | Q4 | 3000 / Tape & Reel |
| NL17SZ06MU3TCG (In Development) | UDFN6, 1.0 x 1.0 x 0.35P | TBD | Q4 | 3000 / Tape & Reel |

[†]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.

Pin 1 Orientation in Tape and Reel

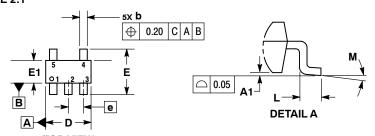
Direction of Feed

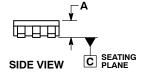


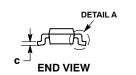
^{*}NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable.



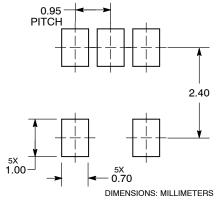
DATE 18 JAN 2018







RECOMMENDED 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.

NOTES:

- IES:
 DIMENSIONING AND TOLERANCING PER ASME
 Y14.5M, 1994.
 CONTROLLING DIMENSION: MILLIMETERS.
 MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH
 THICKNESS. MINIMUM LEAD THICKNESS IS THE
 MINIMUM THICKNESS OF BASE MATERIAL.
- DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.15 PER SIDE.

| | MILLIMETERS | | | |
|-----|-------------|------|--|--|
| DIM | MIN | MAX | | |
| Α | 0.90 | 1.10 | | |
| A1 | 0.01 | 0.10 | | |
| b | 0.25 | 0.50 | | |
| С | 0.10 | 0.26 | | |
| D | 2.85 | 3.15 | | |
| Е | 2.50 | 3.00 | | |
| E1 | 1.35 | 1.65 | | |
| е | 0.95 BSC | | | |
| L | 0.20 | 0.60 | | |
| М | 0° 10° | | | |

GENERIC MARKING DIAGRAM*



XXX = Specific Device Code

Μ = Date Code = Pb-Free Package

(Note: Microdot may be in either location)

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot " ", may or may not be present. Some products may not follow the Generic Marking.

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| DESCRIPTION: | SC-74A | | PAGE 1 OF 1 |

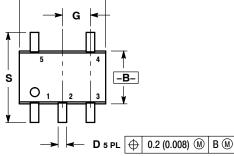
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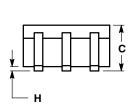


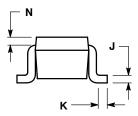
SC-88A (SC-70-5/SOT-353) CASE 419A-02 **ISSUE L**

DATE 17 JAN 2013

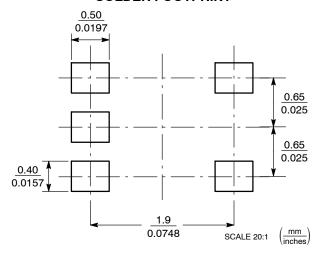








SOLDER FOOTPRINT



NOTES:

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

| | INCHES | | MILLIN | IETERS |
|-----|-----------|-------|--------|--------|
| DIM | MIN | MAX | MIN | MAX |
| Α | 0.071 | 0.087 | 1.80 | 2.20 |
| В | 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 |
| Н | | 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 |

GENERIC MARKING DIAGRAM*



XXX = Specific Device Code

= Date Code

= Pb-Free Package

(Note: Microdot may be in either location)

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "•", may or may not be present. Some products may not follow the Generic Marking.

| STYLE 1: | STYLE 2: | STYLE 3: | STYLE 4: | STYLE 5: |
|-----------------------------|-----------------------------|-----------------------------|----------------------------|--------------------------------|
| PIN 1. BASE | PIN 1. ANODE | PIN 1. ANODE 1 | PIN 1. SOURCE 1 | PIN 1. CATHODE |
| 2. EMITTER | 2. EMITTER | 2. N/C | 2. DRAIN 1/2 | COMMON ANODE |
| 3. BASE | 3. BASE | 3. ANODE 2 | SOURCE 1 | CATHODE 2 |
| 4. COLLECTOR | COLLECTOR | CATHODE 2 | 4. GATE 1 | CATHODE 3 |
| COLLECTOR | CATHODE | CATHODE 1 | 5. GATE 2 | CATHODE 4 |
| | | | | |

| 5. COLLECTOR | 5. CATHODE | 5. CATHODE 1 | 5. GATE 2 | 5. CATHODE 4 |
|---|--|--|--|---|
| STYLE 6: PIN 1. EMITTER 2 2. BASE 2 3. EMITTER 1 4. COLLECTOR 5. COLLECTOR 2/BASE 1 | STYLE 7: PIN 1. BASE 2. EMITTER 3. BASE 4. COLLECTOR 5. COLLECTOR | STYLE 8: PIN 1. CATHODE 2. COLLECTOR 3. N/C 4. BASE 5. EMITTER | STYLE 9: PIN 1. ANODE 2. CATHODE 3. ANODE 4. ANODE 5. ANODE | Note: Please refer to datasheet for style callout. If style type is not called out in the datasheet refer to the device datasheet pinout or pin assignment. |

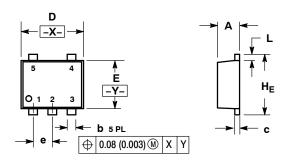
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|------------------|------------------------|---|-------------|
| DESCRIPTION: | SC-88A (SC-70-5/SOT-35 | 63) | PAGE 1 OF 1 |

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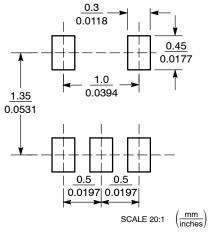


SOT-553, 5 LEAD CASE 463B **ISSUE C**

DATE 20 MAR 2013



RECOMMENDED 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.

- NOTES:
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: MILLIMETERS
 3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH
 THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM
 THICKNESS OF BASE MATERIAL.

| | MILLIMETERS | | | | INCHES | |
|-----|-------------|------|------|-------|-----------|-------|
| DIM | MIN | NOM | MAX | MIN | NOM | MAX |
| Α | 0.50 | 0.55 | 0.60 | 0.020 | 0.022 | 0.024 |
| b | 0.17 | 0.22 | 0.27 | 0.007 | 0.009 | 0.011 |
| С | 0.08 | 0.13 | 0.18 | 0.003 | 0.005 | 0.007 |
| D | 1.55 | 1.60 | 1.65 | 0.061 | 0.063 | 0.065 |
| Е | 1.15 | 1.20 | 1.25 | 0.045 | 0.047 | 0.049 |
| е | 0.50 BSC | | | | 0.020 BSC | |
| L | 0.10 | 0.20 | 0.30 | 0.004 | 0.008 | 0.012 |
| HE | 1.55 | 1.60 | 1.65 | 0.061 | 0.063 | 0.065 |

GENERIC MARKING DIAGRAM*



XX = Specific Device Code

M = Date Code

= Pb-Free Package

(Note: Microdot may be in either location)

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot " ■", may or may not be present.

| STYLE 1: | STYLE 2: PIN 1. CATHODE 2. COMMON ANODE 3. CATHODE 2 4. CATHODE 3 5. CATHODE 4 | STYLE 3: | STYLE 4: | STYLE 5: |
|--|--|---|---|--------------|
| PIN 1. BASE | | PIN 1. ANODE 1 | PIN 1. SOURCE 1 | PIN 1. ANODE |
| 2. EMITTER | | 2. N/C | 2. DRAIN 1/2 | 2. EMITTER |
| 3. BASE | | 3. ANODE 2 | 3. SOURCE 1 | 3. BASE |
| 4. COLLECTOR | | 4. CATHODE 2 | 4. GATE 1 | 4. COLLECTOR |
| 5. COLLECTOR | | 5. CATHODE 1 | 5. GATE 2 | 5. CATHODE |
| STYLE 6: PIN 1. EMITTER 2 2. BASE 2 3. EMITTER 1 4. COLLECTOR 1 5. COLLECTOR 2/BASE 1 | STYLE 7: PIN 1. BASE 2. EMITTER 3. BASE 4. COLLECTOR 5. COLLECTOR | STYLE 8: PIN 1. CATHODE 2. COLLECTOR 3. N/C 4. BASE 5. EMITTER | STYLE 9: PIN 1. ANODE 2. CATHODE 3. ANODE 4. ANODE 5. ANODE | |

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