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TinyLogic ULP-A Dual Inverter

NC7WV04

The NC7WV04 is a dual inverter in tiny footprint packages. The device is designed to operate for $V_{CC} = 0.9\text{ V}$ to 3.6 V .

Features

- Designed for 0.9 V to 3.6 V V_{CC} Operation
- 1.6 ns t_{PD} at 3.3 V (Typ)
- Inputs/Outputs Over-Voltage Tolerant up to 3.6 V
- I_{OFF} Supports Partial Power Down Protection
- Source/Sink 24 mA at 3.3 V
- Available in SC-88A and MicroPak™ Packages
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

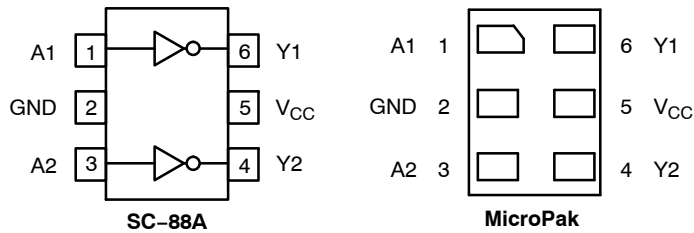


Figure 1. Pinout Diagrams (Top Views)

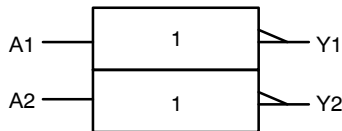


Figure 2. Logic Symbol

PIN ASSIGNMENT

| Pin | Function |
|-----|----------|
| 1 | A1 |
| 2 | GND |
| 3 | A2 |
| 4 | Y2 |
| 5 | V_{CC} |
| 6 | Y1 |



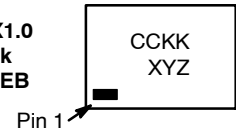
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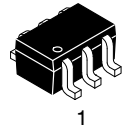
MARKING DIAGRAMS



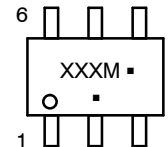
SIP6 1.45X1.0
MicroPak
CASE 127EB



- CC = Specific Device Code
- KK = 2-Digit Lot Run Traceability Code
- XY = 2-Digit Date Code
- Z = Assembly Plant Code



SC-88
DF SUFFIX
CASE 419B-02



- XXX = 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 on page 6 of this data sheet.

FUNCTION TABLE

| A Input | Y Output |
|---------|----------|
| L | H |
| H | L |

NC7WV04

MAXIMUM RATINGS

| Symbol | Characteristics | Value | Unit |
|-----------------------|--|--|---------------|
| V_{CC} | DC Supply Voltage | -0.5 to +4.3 | V |
| V_{IN} | DC Input Voltage | -0.5 to +4.3 | V |
| V_{OUT} | DC Output Voltage Active-Mode (High or Low State) Tri-State Mode (Note 1) Power-Down Mode ($V_{CC} = 0$ V) | -0.5 to $V_{CC} + 0.5$ -0.5 to +4.3 -0.5 to +4.3 | 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 Pin or Ground Pin | ± 50 | mA |
| T_{STG} | Storage Temperature Range | -65 to +150 | $^{\circ}C$ |
| T_L | Lead Temperature, 1 mm from Case for 10 Seconds | 260 | $^{\circ}C$ |
| T_J | Junction Temperature Under Bias | +150 | $^{\circ}C$ |
| θ_{JA} | Thermal Resistance (Note 2) | SC-88A MicroPak 377 154 | $^{\circ}C/W$ |
| P_D | Power Dissipation in Still Air | SC-88A MicroPak 332 812 | 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 10 mm-by-1 inch, 2 ounce copper trace no air flow per JESD51-7.
3. HBM tested to EIA / JESD22-A114-A. CDM tested to JESD22-C101-A. JEDEC recommends that ESD qualification to EIA/JESD22-A115A (Machine Model) be discontinued.
4. Tested to EIA/JESD78 Class II.

NC7WV04

RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Min | Max | Unit |
|---------------------------------|-------------------------------------|---|-------------------------------|------|
| V _{CC} | Positive DC Supply Voltage | 0.9 | 3.6 | V |
| V _{IN} | DC Input Voltage | 0 | 3.6 | V |
| V _{OUT} | DC Output Voltage | Active-Mode (High or Low State) Tri-State Mode (Note 1) Power-Down Mode (V _{CC} = 0 V) | V _{CC} 3.6 3.6 | |
| T _A | Operating Temperature Range | -40 | +85 | °C |
| t _r , t _f | Input Transition Rise and Fall Time | V _{CC} = 3.3 V ± 0.3 V | | ns/V |

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

| Symbol | Parameter | Condition | V _{CC} (V) | T _A = 25°C | | | T _A = -40°C to +85°C | | Unit |
|--------------------------|---------------------------|--|---------------------|------------------------|-----------------------|------------------------|---------------------------------|------------------------|------|
| | | | | Min | Typ | Max | Min | Max | |
| V _{IH} | High-Level Input Voltage | | 0.9 | - | 0.5 | - | - | - | V |
| | | | 1.1 to 1.3 | 0.65 x V _{CC} | - | - | 0.65 x V _{CC} | - | |
| | | | 1.4 to 1.6 | 0.65 x V _{CC} | - | - | 0.65 x V _{CC} | - | |
| | | | 1.65 to 1.95 | 0.65 x V _{CC} | - | - | 0.65 x V _{CC} | - | |
| | | | 2.3 to <2.7 | 1.6 | - | - | 1.6 | - | |
| | | | 2.7 to 3.6 | 2.0 | - | - | 2.0 | - | |
| V _{IL} | Low-Level Input Voltage | | 0.9 | - | 0.5 | - | - | - | V |
| | | | 1.1 to 1.3 | - | - | 0.35 x V _{CC} | - | 0.35 x V _{CC} | |
| | | | 1.4 to 1.6 | - | - | 0.35 x V _{CC} | - | 0.35 x V _{CC} | |
| | | | 1.65 to 1.95 | - | - | 0.35 x V _{CC} | - | 0.35 x V _{CC} | |
| | | | 2.3 to <2.7 | - | - | 0.7 | - | 0.7 | |
| | | | 2.7 to 3.6 | - | - | 0.8 | - | 0.8 | |
| V _{OH} | High-Level Output Voltage | V _{IN} = V _{IH} or V _{IL} | | | | | | | V |
| | | I _{OH} = -100 μA | 0.9 | - | V _{CC} - 0.1 | - | - | - | |
| | | | 1.1 to 1.3 | V _{CC} - 0.1 | - | - | V _{CC} - 0.1 | - | |
| | | | 1.4 to 1.6 | V _{CC} - 0.1 | - | - | V _{CC} - 0.1 | - | |
| | | | 1.65 to 1.95 | V _{CC} - 0.2 | - | - | V _{CC} - 0.2 | - | |
| | | | 2.3 to <2.7 | V _{CC} - 0.2 | - | - | V _{CC} - 0.2 | - | |
| | | | 2.7 to 3.6 | V _{CC} - 0.2 | - | - | V _{CC} - 0.2 | - | |
| | | I _{OH} = -2 mA | 1.1 to 1.3 | 0.75 x V _{CC} | - | - | 0.75 x V _{CC} | - | |
| | | I _{OH} = -4 mA | 1.4 to 1.6 | 0.75 x V _{CC} | - | - | 0.75 x V _{CC} | - | |
| | | I _{OH} = -6 mA | 1.65 to 1.95 | 1.25 | - | - | 1.25 | - | |
| | | | 2.3 to <2.7 | 2.0 | - | - | 2.0 | - | |
| | | I _{OH} = -12 mA | 2.3 to <2.7 | 1.8 | - | - | 1.8 | - | |
| | | | 2.7 to 3.6 | 2.2 | - | - | 2.2 | - | |
| | | I _{OH} = -18 mA | 2.3 to <2.7 | 1.7 | - | - | 1.7 | - | |
| | | | 2.7 to 3.6 | 2.4 | - | - | 2.4 | - | |
| I _{OH} = -24 mA | 2.7 to 3.6 | 2.2 | - | - | 2.2 | - | | | |

NC7WV04

DC ELECTRICAL CHARACTERISTICS (continued)

| Symbol | Parameter | Condition | V _{CC} (V) | T _A = 25°C | | | T _A = -40°C to +85°C | | Unit | |
|-------------------------|---------------------------|---|---------------------|-----------------------|-----|------------------------|---------------------------------|------------------------|------|---|
| | | | | Min | Typ | Max | Min | Max | | |
| V _{OL} | Low-Level Output Voltage | V _{IN} = V _{IH} or V _{IL} | | | | | | | V | |
| | | I _{OL} = 100 μA | 0.9 | - | 0.1 | - | - | - | | - |
| | | | 1.1 to 1.3 | - | - | 0.1 | - | 0.1 | | - |
| | | | 1.4 to 1.6 | - | - | 0.1 | - | 0.1 | | - |
| | | | 1.65 to 1.95 | - | - | 0.2 | - | 0.2 | | - |
| | | | 2.3 to < 2.7 | - | - | 0.2 | - | 0.2 | | - |
| | | | 2.7 to 3.6 | - | - | 0.2 | - | 0.2 | | - |
| | | I _{OL} = 2 mA | 1.1 to 1.3 | - | - | 0.25 x V _{CC} | - | 0.25 x V _{CC} | | - |
| | | I _{OL} = 4 mA | 1.4 to 1.6 | - | - | 0.25 x V _{CC} | - | 0.25 x V _{CC} | | - |
| | | I _{OL} = 6 mA | 1.65 to 1.95 | - | - | 0.3 | - | 0.3 | | - |
| | | | 2.3 to < 2.7 | - | - | 0.4 | - | 0.4 | | - |
| | | I _{OL} = 12 mA | 2.3 to < 2.7 | - | - | 0.4 | - | 0.4 | | - |
| | | | 2.7 to 3.6 | - | - | 0.4 | - | 0.4 | | - |
| I _{OL} = 18 mA | 2.3 to < 2.7 | - | - | 0.6 | - | 0.6 | - | | | |
| | 2.7 to 3.6 | - | - | 0.4 | - | 0.4 | - | | | |
| I _{OL} = 24 mA | 2.7 to 3.6 | - | - | 0.55 | - | 0.55 | - | | | |
| I _{IN} | Input Leakage Current | V _{IN} = 0 V to 3.6 V | 0.9 to 3.6 | - | - | ±0.1 | - | ±0.5 | μA | |
| I _{OFF} | Power Off Leakage Current | V _{IN} = 0 V to 3.6 V or V _{OUT} = 0 V to 3.6 V | 0 | - | - | 0.5 | - | 0.5 | μA | |
| I _{CC} | Quiescent Supply Current | V _{IN} = V _{CC} or GND | 0.9 to 3.6 | - | - | 0.9 | - | 0.9 | μA | |

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

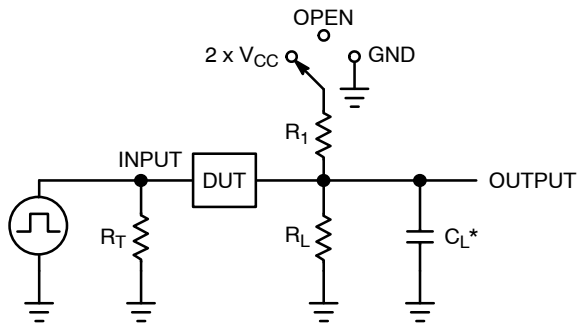
| Symbol | Parameter | Condition | V _{CC} (V) | T _A = 25°C | | | T _A = -40°C to +85°C | | Unit |
|--|---|--|---------------------|-----------------------|------|------|---------------------------------|------|------|
| | | | | Min | Typ | Max | Min | Max | |
| t _{PLH} , t _{PHL} | Propagation Delay, A to Y (Figures 3 and 4) | R _L = 1 MΩ, C _L = 15 pF | 0.9 | - | 17.4 | - | - | - | ns |
| | | R _L = 2 kΩ, C _L = 15 pF | 1.1 to 1.3 | - | 4.5 | 12.1 | - | 14.9 | |
| | | | 1.4 to 1.6 | - | 2.9 | 5.4 | - | 6.0 | |
| | | | 1.65 to 1.95 | - | 2.5 | 4.6 | - | 5.2 | |
| | | R _L = 500 Ω, C _L = 30 pF | 2.3 to 2.7 | - | 1.9 | 3.6 | - | 3.8 | |
| | | | 2.7 to 3.6 | - | 1.6 | 3.0 | - | 3.3 | |

CAPACITIVE CHARACTERISTICS

| Symbol | Parameter | Test Condition | Typical (T _A = 25°C) | Unit |
|------------------|--|--|---------------------------------|------|
| C _{IN} | Input Capacitance | V _{CC} = 0 V | 2.0 | pF |
| C _{OUT} | Output Capacitance | V _{CC} = 0 V | 4.5 | pF |
| C _{PD} | Power Dissipation Capacitance (Note 5) | f = 10 MHz, V _{CC} = 0.9 to 3.6 V, V _{IN} = 0 V or V _{CC} | 10.0 | 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}.

NC7WV04



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

| Test | Switch Position |
|---------------------|-------------------|
| t_{PLH} / t_{PHL} | Open |
| t_{PLZ} / t_{PZL} | $2 \times V_{CC}$ |
| t_{PHZ} / t_{PZH} | GND |

Figure 3. Test Circuit



| V_{CC}, V | V_{mi}, V | V_{mo}, V | V_Y, V |
|--------------|--------------|--------------|----------|
| 0.9 | $V_{CC} / 2$ | $V_{CC} / 2$ | 0.1 |
| 1.1 to 1.3 | $V_{CC} / 2$ | $V_{CC} / 2$ | 0.1 |
| 1.4 to 1.6 | $V_{CC} / 2$ | $V_{CC} / 2$ | 0.1 |
| 1.65 to 1.95 | $V_{CC} / 2$ | $V_{CC} / 2$ | 0.15 |
| 2.3 to 2.7 | $V_{CC} / 2$ | $V_{CC} / 2$ | 0.15 |
| 3.0 to 3.6 | 1.5 | 1.5 | 0.3 |

Figure 4. Switching Waveforms

NC7WV04

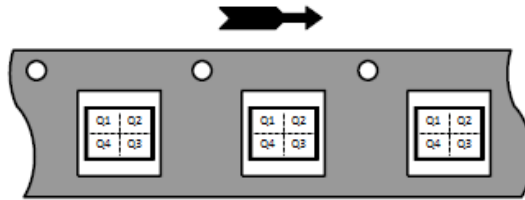
ORDERING INFORMATION

| Device | Package | Marking | Pin 1 Orientation (See below) | Shipping† |
|------------|----------|---------|----------------------------------|--------------------|
| NC7WV04P6X | SC-88 | V04 | Q4 | 3000 / Tape & Reel |
| NC7WV04L6X | MicroPak | BA | Q4 | 5000 / 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

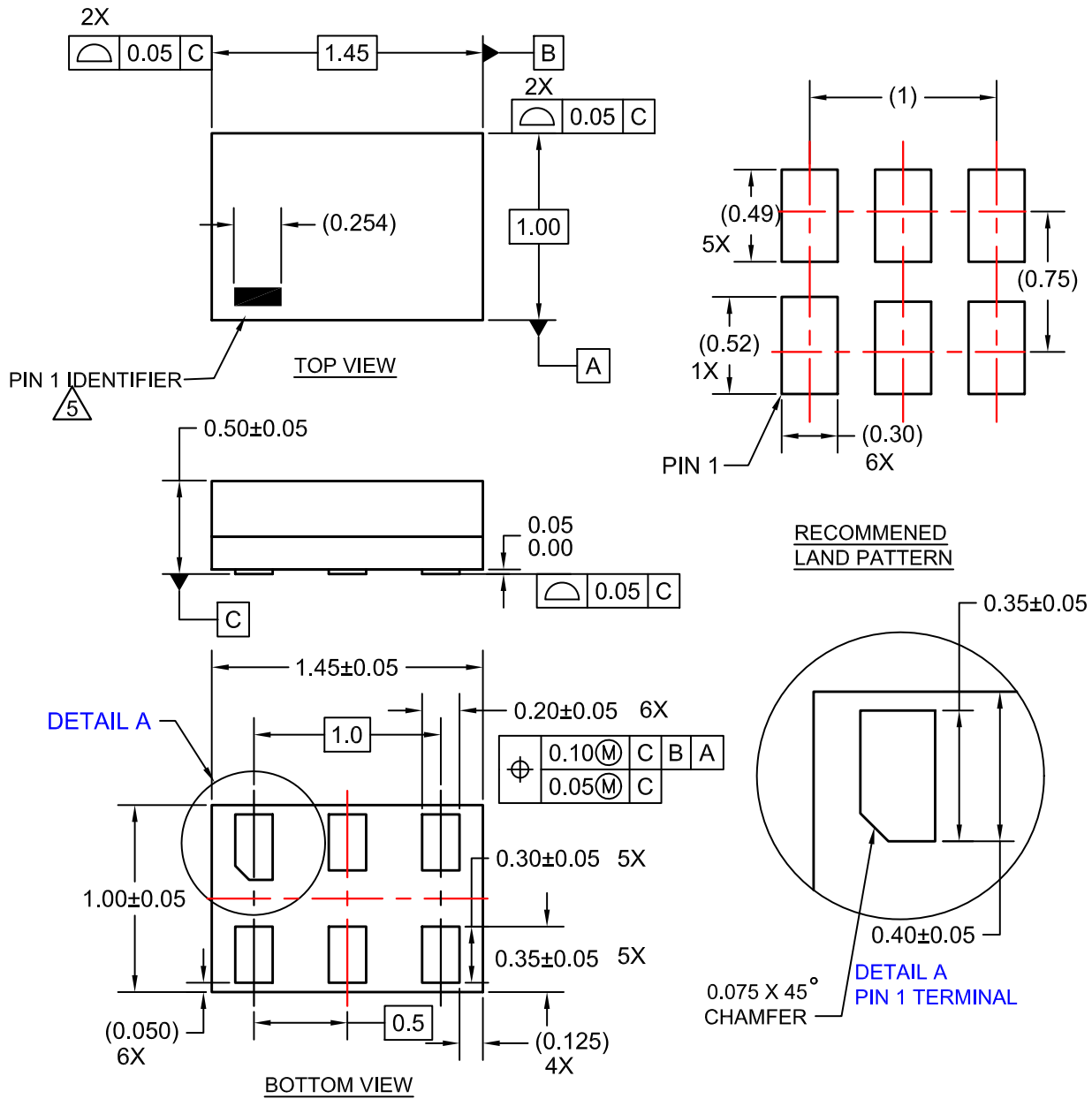


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NC7WV04

PACKAGE DIMENSIONS

SIP6 1.45X1.0
CASE 127EB
ISSUE O



NOTES:

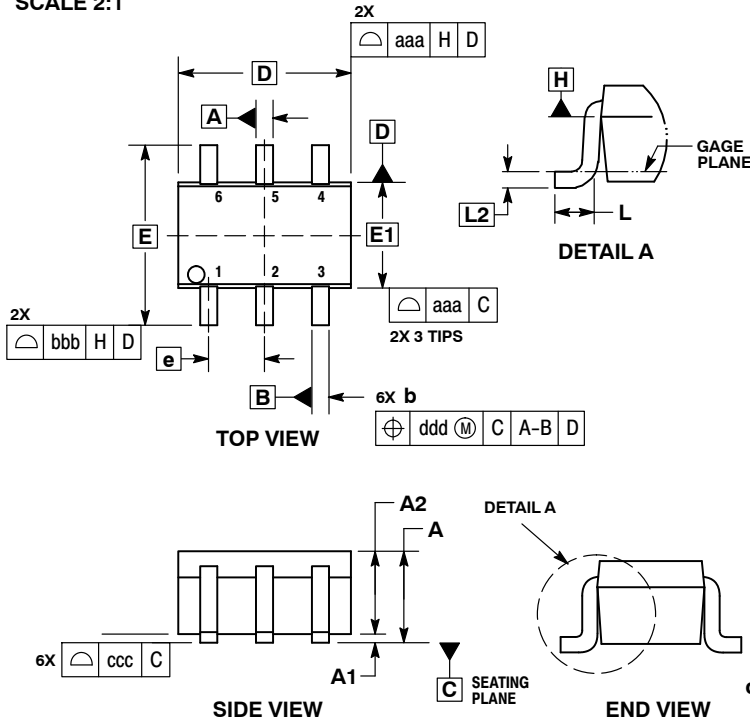
1. CONFORMS TO JEDEC STANDARD MO-252 VARIATION UAAD
2. DIMENSIONS ARE IN MILLIMETERS
3. DRAWING CONFORMS TO ASME Y14.5M-2009
4. PIN ONE IDENTIFIER IS 2X LENGTH OF ANY OTHER LINE IN THE MARK CODE LAYOUT.



1
SCALE 2:1

SC-88/SC70-6/SOT-363
CASE 419B-02
ISSUE Y

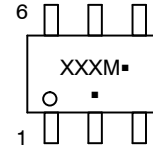
DATE 11 DEC 2012



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
 2. CONTROLLING DIMENSION: MILLIMETERS.
 3. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.20 PER END.
 4. DIMENSIONS D AND E1 AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY AND DATUM H.
 5. DATUMS A AND B ARE DETERMINED AT DATUM H.
 6. DIMENSIONS b AND c APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.08 AND 0.15 FROM THE TIP.
 7. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 TOTAL IN EXCESS OF DIMENSION b AT MAXIMUM MATERIAL CONDITION. THE DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OF THE FOOT.

| DIM | MILLIMETERS | | | INCHES | | |
|-----|-------------|------|------|-----------|-------|-------|
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | --- | --- | 1.10 | --- | --- | 0.043 |
| A1 | 0.00 | --- | 0.10 | 0.000 | --- | 0.004 |
| A2 | 0.70 | 0.90 | 1.00 | 0.027 | 0.035 | 0.039 |
| b | 0.15 | 0.20 | 0.25 | 0.006 | 0.008 | 0.010 |
| C | 0.08 | 0.15 | 0.22 | 0.003 | 0.006 | 0.009 |
| D | 1.80 | 2.00 | 2.20 | 0.070 | 0.078 | 0.086 |
| E | 2.00 | 2.10 | 2.20 | 0.078 | 0.082 | 0.086 |
| E1 | 1.15 | 1.25 | 1.35 | 0.045 | 0.049 | 0.053 |
| e | 0.65 BSC | | | 0.026 BSC | | |
| L | 0.26 | 0.36 | 0.46 | 0.010 | 0.014 | 0.018 |
| L2 | 0.15 BSC | | | 0.006 BSC | | |
| aaa | 0.15 | | | 0.006 | | |
| bbb | 0.30 | | | 0.012 | | |
| ccc | 0.10 | | | 0.004 | | |
| ddd | 0.10 | | | 0.004 | | |

GENERIC MARKING DIAGRAM*



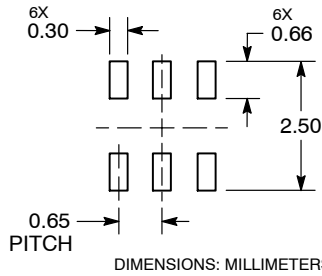
- XXX = Specific Device Code
- M = Date Code*
- = Pb-Free Package

(Note: Microdot may be in either location)

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

*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.

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.

STYLES ON PAGE 2

| | | |
|-------------------------|-----------------------------|--|
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| DESCRIPTION: | SC-88/SC70-6/SOT-363 | PAGE 1 OF 9 |

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NC7WV04

SC-88/SC70-6/SOT-363
CASE 419B-02
ISSUE Y

DATE 11 DEC 2012

| | | | | | |
|--|--|---|---|---|---|
| STYLE 1: PIN 1. EMITTER 2 2. BASE 2 3. COLLECTOR 1 4. EMITTER 1 5. BASE 1 6. COLLECTOR 2 | STYLE 2: CANCELLED | STYLE 3: CANCELLED | STYLE 4: PIN 1. CATHODE 2. CATHODE 3. COLLECTOR 4. EMITTER 5. BASE 6. ANODE | STYLE 5: PIN 1. ANODE 2. ANODE 3. COLLECTOR 4. EMITTER 5. BASE 6. CATHODE | STYLE 6: PIN 1. ANODE 2 2. N/C 3. CATHODE 1 4. ANODE 1 5. N/C 6. CATHODE 2 |
| STYLE 7: PIN 1. SOURCE 2 2. DRAIN 2 3. GATE 1 4. SOURCE 1 5. DRAIN 1 6. GATE 2 | STYLE 8: CANCELLED | STYLE 9: PIN 1. EMITTER 2 2. EMITTER 1 3. COLLECTOR 1 4. BASE 1 5. BASE 2 6. COLLECTOR 2 | STYLE 10: PIN 1. SOURCE 2 2. SOURCE 1 3. GATE 1 4. DRAIN 1 5. DRAIN 2 6. GATE 2 | STYLE 11: PIN 1. CATHODE 2 2. CATHODE 2 3. ANODE 1 4. CATHODE 1 5. CATHODE 1 6. ANODE 2 | STYLE 12: PIN 1. ANODE 2 2. ANODE 2 3. CATHODE 1 4. ANODE 1 5. ANODE 1 6. CATHODE 2 |
| STYLE 13: PIN 1. ANODE 2. N/C 3. COLLECTOR 4. EMITTER 5. BASE 6. CATHODE | STYLE 14: PIN 1. VREF 2. GND 3. GND 4. IOUT 5. VEN 6. VCC | STYLE 15: PIN 1. ANODE 1 2. ANODE 2 3. ANODE 3 4. CATHODE 3 5. CATHODE 2 6. CATHODE 1 | STYLE 16: PIN 1. BASE 1 2. EMITTER 2 3. COLLECTOR 2 4. BASE 2 5. EMITTER 1 6. COLLECTOR 1 | STYLE 17: PIN 1. BASE 1 2. EMITTER 1 3. COLLECTOR 2 4. BASE 2 5. EMITTER 2 6. COLLECTOR 1 | STYLE 18: PIN 1. VIN1 2. VCC 3. VOUT2 4. VIN2 5. GND 6. VOUT1 |
| STYLE 19: PIN 1. I OUT 2. GND 3. GND 4. V CC 5. V EN 6. V REF | STYLE 20: PIN 1. COLLECTOR 2. COLLECTOR 3. BASE 4. EMITTER 5. COLLECTOR 6. COLLECTOR | STYLE 21: PIN 1. ANODE 1 2. N/C 3. ANODE 2 4. CATHODE 2 5. N/C 6. CATHODE 1 | STYLE 22: PIN 1. D1 (i) 2. GND 3. D2 (i) 4. D2 (c) 5. VBUS 6. D1 (c) | STYLE 23: PIN 1. Vn 2. CH1 3. Vp 4. N/C 5. CH2 6. N/C | STYLE 24: PIN 1. CATHODE 2. ANODE 3. CATHODE 4. CATHODE 5. CATHODE 6. CATHODE |
| STYLE 25: PIN 1. BASE 1 2. CATHODE 3. COLLECTOR 2 4. BASE 2 5. EMITTER 6. COLLECTOR 1 | STYLE 26: PIN 1. SOURCE 1 2. GATE 1 3. DRAIN 2 4. SOURCE 2 5. GATE 2 6. DRAIN 1 | STYLE 27: PIN 1. BASE 2 2. BASE 1 3. COLLECTOR 1 4. EMITTER 1 5. EMITTER 2 6. COLLECTOR 2 | STYLE 28: PIN 1. DRAIN 2. DRAIN 3. GATE 4. SOURCE 5. DRAIN 6. DRAIN | STYLE 29: PIN 1. ANODE 2. ANODE 3. COLLECTOR 4. EMITTER 5. BASE/ANODE 6. CATHODE | STYLE 30: PIN 1. SOURCE 1 2. DRAIN 2 3. DRAIN 2 4. SOURCE 2 5. GATE 1 6. DRAIN 1 |

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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