# NC7S00

# TinyLogic HS 2-Input NAND Gate

## Description

The NC7S00 is a single 2−Input high performance CMOS NAND Gate. Advanced Silicon Gate CMOS fabrication assures high speed and low power circuit operation over a broad $V_{CC}$ range. ESD protection diodes inherently guard both inputs and output with respect to the $V_{CC}$ and GND rails. Three stages of gain between inputs and output assures high noise immunity and reduced sensitivity to input edge rate.

## Features

- Space Saving SC−74A and SC−88A 5−Lead Package
- Ultra Small MicroPak™ Leadless Package
- High Speed: $t_{PD}$ = 3.5 ns Typ
- Low Quiescent Power: $I_{CC}$< 1 μA
- Balanced Output Drive: 2 mA $I_{OL}$, −2 mA $I_{OH}$
- Broad $V_{CC}$ Operating Range: 2 V – 6 V
- Balanced Propagation Delays
- Specified for 3 V Operation
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant
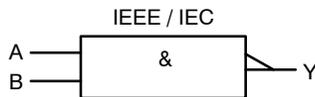
**Figure 1. Logic Symbol**

## ON Semiconductor®

### MARKING DIAGRAMS

SIP6
CASE 127EB

A3KK
XYZ

Pin 1

SC−74A
CASE 318BQ

7S00T

SC−88A
CASE 419A−02

S00T
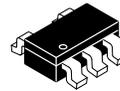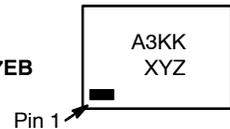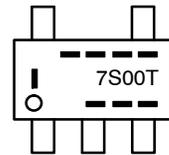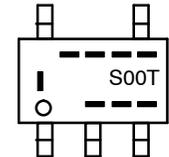
A3, 7S00, S00 = Specific Device Code
KK          = 2−Digit Lot Run Traceability Code
XY          = 2−Digit Date Code Format
Z           = Assembly Plant Code
T           = Die Run Code
▬ ▬ ▬ ▬     = Year Coding Scheme
▐▪▬         = Plant Code Identifier
▬ ▬ ▬       = Eight−Week Datacoding Scheme

### ORDERING INFORMATION

See detailed ordering, marking and shipping information in the package dimensions section on page 5 of this data sheet.

**Pin Configurations**
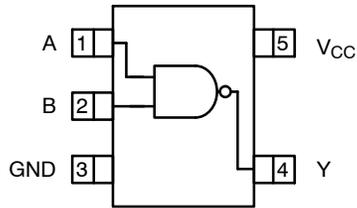


**Figure 2. SC−88A and SC−74A (Top View)**
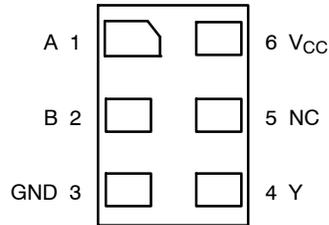


**Figure 3. MicroPak (Top Through View)**

**PIN DESCRIPTIONS**

| Pin Names | Description |
| --- | --- |
| A, B | Inputs |
| Y | Output |
| NC | No Connect |

**FUNCTION TABLE** $(Y = \overline{AB})$

| Inputs | | Output |
| --- | --- | --- |
| **A** | **B** | **Y** |
| L | L | H |
| L | H | H |
| H | L | H |
| H | H | L |

H = HIGH Logic Level
L = LOW Logic Level

**ABSOLUTE MAXIMUM RATINGS**

| Symbol | Parameter | | Min | Max | Unit |
| --- | --- | --- | --- | --- | --- |
| $V_{CC}$ | Supply Voltage | | −0.5 | 6.5 | V |
| $I_{IK}$ | DC Input Diode Current | $V_{IN} \leq -0.5$ V | – | −20 | mA |
| | | $V_{IN} \geq V_{CC} + 0.5$ V | – | +20 | |
| $V_{IN}$ | DC Input Voltage | | −0.5 | $V_{CC} + 0.5$ | V |
| $I_{OK}$ | DC Output Diode Current | $V_{OUT} < -0.5$ V | – | −20 | mA |
| | | $V_{OUT} > V_{CC} + 0.5$ V | – | +20 | |
| $V_{OUT}$ | DC Output Voltage | | −0.5 | $V_{CC} + 0.5$ | V |
| $I_{OUT}$ | DC Output Source or Sink Current | | – | ±12.5 | mA |
| $I_{CC}$ or $I_{GND}$ | DC $V_{CC}$ or Ground Current per Output Pin | | – | ±25 | mA |
| $T_{STG}$ | Storage Temperature | | −65 | +150 | °C |
| $T_J$ | Junction Temperature | | – | +150 | °C |
| $T_L$ | Lead Temperature (Soldering, 10 Seconds) | | – | +260 | °C |
| $P_D$ | Power Dissipation in Still Air | SC−74A | – | 225 | mW |
| | | SC−88A | – | 190 | |
| | | MicroPak | – | 327 | |

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.

## RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Conditions | Min | Max | Unit |
|---|---|---|---|---|---|
| $V_{CC}$ | Supply Voltage | | 2.0 | 6.0 | V |
| $V_{IN}$ | Input Voltage | | 0 | $V_{CC}$ | V |
| $V_{OUT}$ | Output Voltage | | 0 | $V_{CC}$ | V |
| $T_A$ | Operating Temperature | | −40 | +85 | °C |
| $t_r$, $t_f$ | Input Rise and Fall Times | $V_{CC}$ at 2.0 V | 0 | 20 | ns |
| | | $V_{CC}$ at 3.0 V | 0 | 20 | |
| | | $V_{CC}$ at 4.5 V | 0 | 10 | |
| | | $V_{CC}$ at 6.0 V | 0 | 5 | |
| $\theta_{JA}$ | Thermal Resistance | SC−74A | – | 555 | °C/W |
| | | SC−88A | – | 659 | |
| | | MicroPak | – | 382 | |

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.
1. Unused inputs must be held HIGH or LOW. They may not float.

## DC ELECTICAL CHARACTERISTICS

| Symbol | Parameter | $V_{CC}$ (V) | Conditions | | $T_A$ = +25°C | | | $T_A$ = −40 to +85°C | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Min | Typ | Max | Min | Max | |
| $V_{IH}$ | HIGH Level Input Voltage | 2.0 | | | 1.50 | – | – | 1.50 | – | V |
| | | 3.0 – 6.0 | | | 0.7 x $V_{CC}$ | – | – | 0.7 x $V_{CC}$ | – | |
| $V_{IL}$ | LOW Level Input Voltage | 2.0 | | | – | – | 0.50 | – | 0.50 | V |
| | | 3.0 – 6.0 | | | – | – | 0.3 x $V_{CC}$ | – | 0.3 x $V_{CC}$ | |
| $V_{OH}$ | HIGH Level Output Voltage | 2.0 | $I_{OH}$ = −20 μA, $V_{IN}$ = $V_{IL}$ | | 1.90 | 2.0 | – | 1.90 | – | V |
| | | 3.0 | | | 2.90 | 3.0 | – | 2.90 | – | |
| | | 4.5 | | | 4.40 | 4.5 | – | 4.40 | – | |
| | | 6.0 | | | 5.90 | 6.0 | – | 5.90 | – | |
| | | 3.0 | $V_{IN}$ = $V_{IL}$ | $I_{OH}$ = −1.3 mA | 2.68 | 2.85 | – | 2.63 | – | |
| | | 4.5 | | $I_{OH}$ = −2 mA | 4.18 | 4.35 | – | 4.13 | – | |
| | | 6.0 | | $I_{OH}$ = −2.6 mA | 5.68 | 5.85 | – | 5.63 | – | |
| $V_{OL}$ | LOW Level Output Voltage | 2.0 | $I_{OL}$ = 20 μA, $V_{IN}$ = $V_{IH}$ | | – | 0.0 | 0.10 | – | 0.10 | V |
| | | 3.0 | | | – | 0.0 | 0.10 | – | 0.10 | |
| | | 4.5 | | | – | 0.0 | 0.10 | – | 0.10 | |
| | | 6.0 | | | – | 0.0 | 0.10 | – | 0.10 | |
| | | 3.0 | $V_{IN}$ = $V_{IH}$ | $I_{OH}$ = 1.3 mA | – | 0.1 | 0.26 | – | 0.33 | |
| | | 4.5 | | $I_{OL}$ = 2 mA | – | 0.1 | 0.26 | – | 0.33 | |
| | | 6.0 | | $I_{OL}$ = 2.6 mA | – | 0.1 | 0.26 | – | 0.33 | |
| $I_{IN}$ | Input Leakage Current | 6.0 | $V_{IN}$ = $V_{CC}$, GND | | – | – | ±0.1 | – | ±1.0 | μA |
| $I_{CC}$ | Quiescent Supply Current | 6.0 | $V_{IN}$ = $V_{CC}$, GND | | – | – | 1.0 | – | 10.0 | μA |

## AC ELECTRICAL CHARACTERISTICS

| Symbol | Parameter | $V_{CC}$ (V) | Conditions | $T_A = +25°C$ | | | $T_A = -40$ to $+85°C$ | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | Min | Max | |
| $t_{PLH}$, $t_{PHL}$ | Propagation Delay (Figure 4, 6) | 5.0 | $C_L = 15$ pF | – | 3.5 | 15 | – | – | ns |
| | | 2.0 | $C_L = 50$ pF | – | 19 | 100 | – | 125 | |
| | | 3.0 | | – | 10.5 | 27 | – | 35 | |
| | | 4.5 | | – | 7.5 | 20 | – | 25 | |
| | | 6.0 | | – | 6.5 | 17 | – | 21 | |
| $t_{TLH}$, $t_{THL}$ | Output Transition Time (Figure 4, 6) | 5.0 | $C_L = 15$ pF | – | 3.0 | 10 | – | – | ns |
| | | 2.0 | $C_L = 50$ pF | – | 25 | 125 | – | 155 | |
| | | 3.0 | | – | 16 | 35 | – | 45 | |
| | | 4.5 | | – | 11 | 25 | – | 31 | |
| | | 6.0 | | – | 9 | 21 | – | 26 | |
| $C_{IN}$ | Input Capacitance | Open | | – | 2 | 10 | – | 10 | pF |
| $C_{PD}$ | Power Dissipation Capacitance (Figure 5) | 5.0 | (Note 2) | – | 6 | – | – | – | pF |

2. $C_{PD}$ is defined as the value of the internal equivalent capacitance which is derived from dynamic operating current consumption ($I_{CCD}$) at no output loading and operating at 50% duty cycle. $C_{PD}$ is related to $I_{CCD}$ dynamic operating current by the expression:
$I_{CCD} = (C_{PD})(V_{CC})(f_{IN}) + (I_{CC}static)$.

### AC Loading and Waveforms
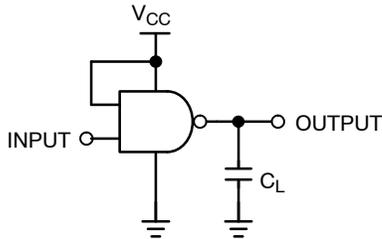


$C_L$ includes load and stray capacitance
Input PRR = 1.0 MHz, $t_W$ = 500 ns

**Figure 4. AC Test Circuit**
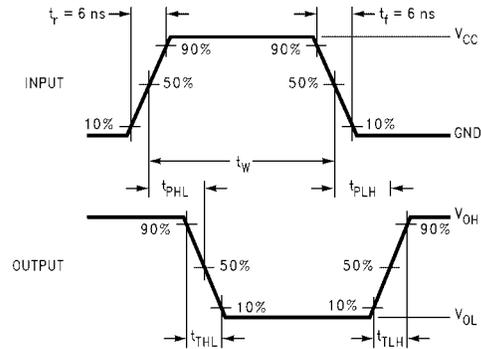


**Figure 6. AC Waveforms**
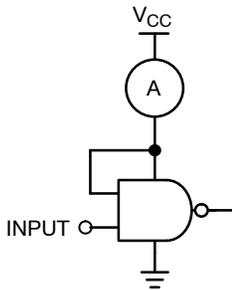


Input = AC Waveform;
PRR = Variable; Duty Cycle = 50%.

**Figure 5. $I_{CCD}$ Test Circuit**

**DEVICE ORDERING INFORMATION**

| Device | Top Mark | Packages | Shipping† |
|---|---|---|---|
| NC7S00M5X | 7S00 | SC−74A | 3000 / Tape & Reel |
| NC7S00P5X | S00 | SC−88A | 3000 / Tape & Reel |
| NC7S00L6X | A3 | SIP6, MicroPak | 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.

# NC7S00

## PACKAGE DIMENSIONS

**SIP6 1.45X1.0**
CASE 127EB
ISSUE O

TOP VIEW

PIN 1 IDENTIFIER

2X

0.05 C

1.45

B

2X

0.05 C

1.00

A

(0.254)

RECOMMENED
LAND PATTERN

(1)

(0.49)
5X

(0.52)
1X

(0.75)

(0.30)
6X

PIN 1

0.50±0.05

0.05
0.00

0.05 C

C

1.45±0.05

DETAIL A

1.0

0.20±0.05   6X

0.10 (M) C B A
0.05 (M) C

0.30±0.05   5X

1.00±0.05

0.35±0.05   5X

(0.050)
6X

0.5

(0.125)
4X

BOTTOM VIEW

0.35±0.05

0.40±0.05

0.075 X 45°
CHAMFER

DETAIL A
PIN 1 TERMINAL
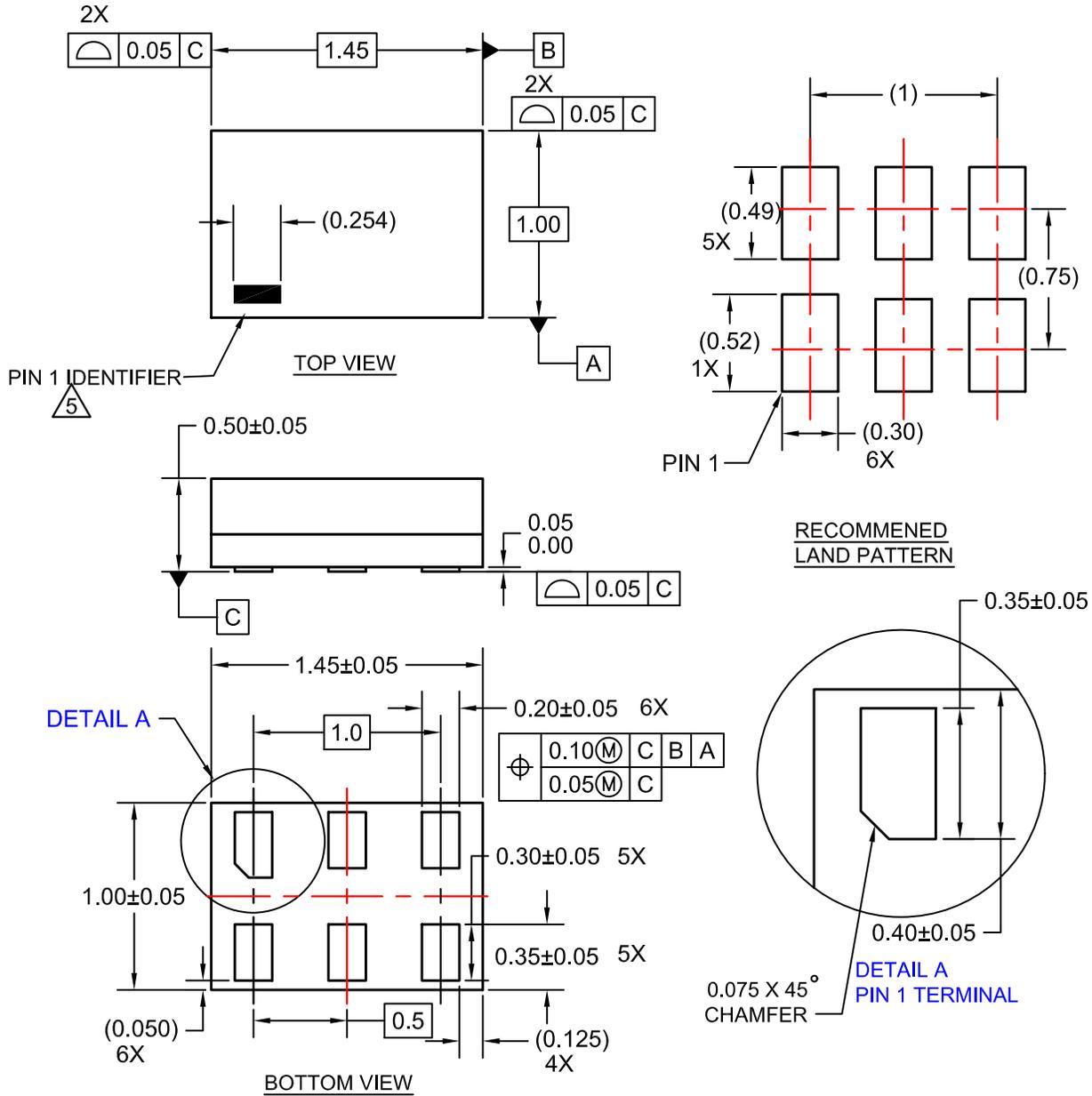
NOTES:

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.

## PACKAGE DIMENSIONS

**SC−74A**
CASE 318BQ
ISSUE B



TOP VIEW

DETAIL A

SIDE VIEW

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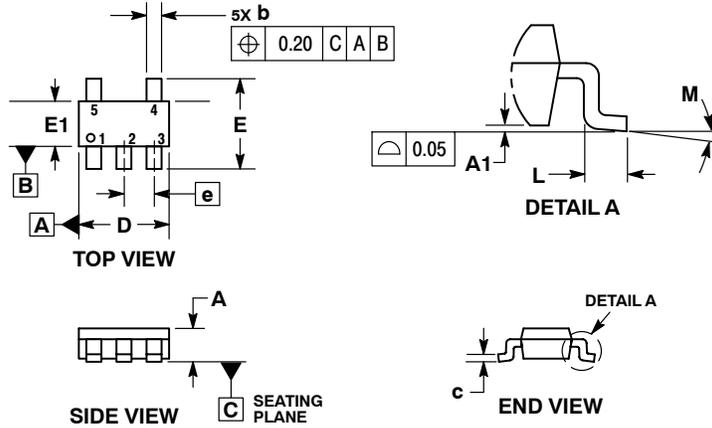
NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.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

| DIM | MILLIMETERS | |
| --- | --- | --- |
| | MIN | MAX |
| A | 0.90 | 1.10 |
| A1 | 0.01 | 0.10 |
| b | 0.25 | 0.50 |
| c | 0.10 | 0.26 |
| D | 2.85 | 3.15 |
| E | 2.50 | 3.00 |
| E1 | 1.35 | 1.65 |
| e | 0.95 BSC | |
| L | 0.20 | 0.60 |
| M | 0 ° | 10 ° |

**RECOMMENDED SOLDERING FOOTPRINT\***



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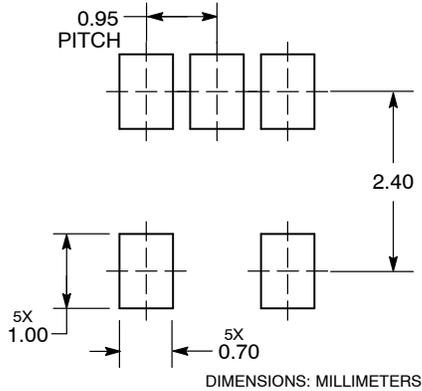
\*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

## PACKAGE DIMENSIONS

### SC−88A (SC−70−5/SOT−353)
CASE 419A−02
ISSUE L
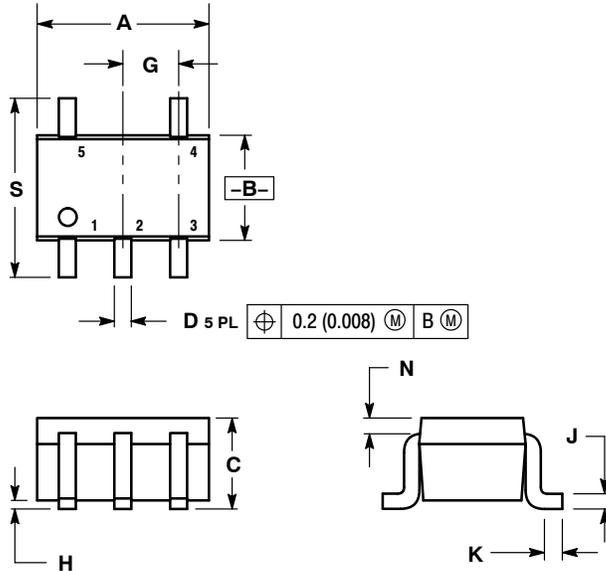
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. 419A−01 OBSOLETE. NEW STANDARD 419A−02.
4. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

| 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 |

D 5 PL  ⊕ 0.2 (0.008) Ⓜ B Ⓜ

### SOLDER FOOTPRINT

$\frac{0.50}{0.0197}$

$\frac{0.65}{0.025}$

$\frac{0.65}{0.025}$

$\frac{0.40}{0.0157}$

$\frac{1.9}{0.0748}$

SCALE 20:1  $\left(\frac{mm}{inches}\right)$
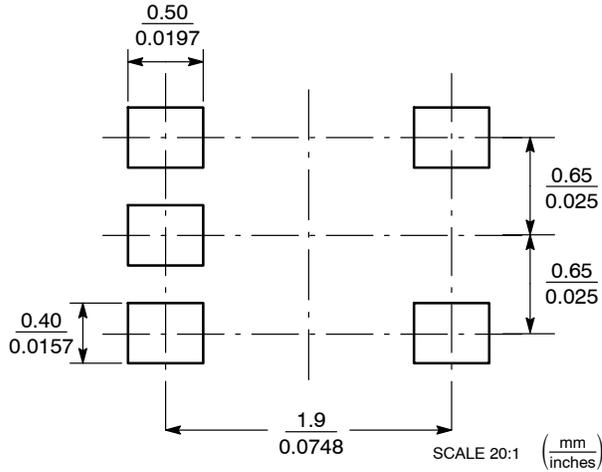
STYLE 1:
PIN 1. BASE
2. EMITTER
3. BASE
4. COLLECTOR
5. COLLECTOR

STYLE 2:
PIN 1. ANODE
2. EMITTER
3. BASE
4. COLLECTOR
5. CATHODE

STYLE 3:
PIN 1. ANODE 1
2. N/C
3. ANODE 2
4. CATHODE 2
5. CATHODE 1

STYLE 4:
PIN 1. SOURCE 1
2. DRAIN 1/2
3. SOURCE 1
4. GATE 1
5. GATE 2

STYLE 5:
PIN 1. CATHODE
2. COMMON ANODE
3. CATHODE 2
4. CATHODE 3
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

**NC7S00**