# **ON Semiconductor**

# Is Now



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# **TinyLogic ULP-A Buffer with Three-State Output**

# **NC7SP126**

The NC7SP126 is a single non-inverting 3-state buffer in tiny footprint packages. The device is designed to operate for  $V_{\rm CC}$  = 0.9 V to 3.6 V.

#### **Features**

- Designed for 0.9 V to 3.6 V V<sub>CC</sub> Operation
- 2.6 ns t<sub>PD</sub> at 3.3 V (Typ)
- Inputs/Outputs Over-Voltage Tolerant up to 3.6 V
- I<sub>OFF</sub> Supports Partial Power Down Protection
- Source/Sink 2.6 mA at 3.3 V
- Available in SC−88A and MicroPak<sup>™</sup> Packages
- These Devices are Pb–Free, Halogen Free/BFR Free and are RoHS Compliant

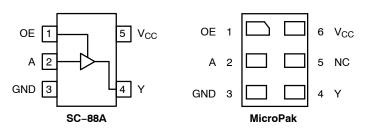


Figure 1. Pinout Diagrams (Top Views)

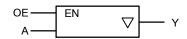
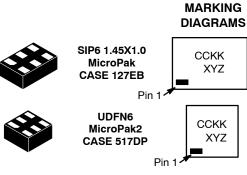


Figure 2. Logic Symbol

# ON

# ON Semiconductor®

www.onsemi.com



CC = Specific Device Code

KK = 2-Digit Lot Run Traceability Code

XY = 2-Digit Date Code Z = Assembly Plant Code



XXX = Specific Device Code

M = Date Code

■ = Pb-Free Package

# **ORDERING INFORMATION**

See detailed ordering, marking and shipping information on page 7 of this data sheet.

# **PIN ASSIGNMENT**

Pin	SC88A	MicroPak
1	OE	OE
2	Α	Α
3	GND	GND
4	Υ	Y
5	V <sub>CC</sub>	N.C.
6	-	V <sub>CC</sub>

N.C. = No Connect

# **FUNCTION TABLE**

Inp	Output	
OE	А	Υ
L	Х	Z
Н	L	L
Н	Н	Н

X = Don't Care

Z = High Impedance State

# **MAXIMUM RATINGS**

Symbol	Cha	aracteristics	Value	Unit
V <sub>CC</sub>	DC Supply Voltage		-0.5 to +4.3	٧
V <sub>IN</sub>	DC Input Voltage		-0.5 to +4.3	V
V <sub>OUT</sub>	DC Output Voltage	-0.5 to V <sub>CC</sub> + 0.5 -0.5 to +4.3 -0.5 to +4.3	V	
I <sub>IK</sub>	DC Input Diode Current	V <sub>IN</sub> < GND	-50	mA
I <sub>OK</sub>	DC Output Diode Current	V <sub>OUT</sub> < GND	-50	mA
I <sub>OUT</sub>	DC Output Source/Sink Current		±50	mA
I <sub>CC</sub> or I <sub>GND</sub>	DC Supply Current per Supply Pin	or Ground Pin	±50	mA
T <sub>STG</sub>	Storage Temperature Range		-65 to +150	°C
TL	Lead Temperature, 1 mm from Case	e for 10 Seconds	260	°C
TJ	Junction Temperature Under Bias		+150	°C
$\theta_{\sf JA}$	Thermal Resistance (Note 2)	SC-88A MicroPak	377 154	°C/W
$P_{D}$	Power Dissipation in Still Air	SC-88A MicroPak	332 812	mW
MSL	Moisture Sensitivity		Level 1	-
F <sub>R</sub>	Flammability Rating	Oxygen Index: 28 to 34	UL 94 V-0 @ 0.125 in	-
V <sub>ESD</sub>	ESD Withstand Voltage (Note 3)	Human Body Model Charged Device Model	4000 2000	V
I <sub>Latchup</sub>	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.

- Applicable to devices with outputs that may be tri-stated.
   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.
   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.
   Tested to EIA/JESD78 Class II.

# **RECOMMENDED OPERATING CONDITIONS**

Symbol	Parameter			Max	Unit
V <sub>CC</sub>	Positive DC Supply Voltage		0.9	3.6	V
V <sub>IN</sub>	DC Input Voltage		0	3.6	V
V <sub>OUT</sub>	DC Output Voltage	Active–Mode (High or Low State) Tri–State Mode (Note 1) $Power$ –Down Mode ( $V_{CC}$ = 0 V)	0 0 0	V <sub>CC</sub> 3.6 3.6	
T <sub>A</sub>	Operating Temperature Range		-40	+85	°C
t <sub>r</sub> , t <sub>f</sub>	Input Transition Rise and Fall Time	$V_{CC}$ = 3.3 V $\pm$ 0.3 V	0	10	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

				T <sub>A</sub> = 25°C			$T_A = -40^{\circ}$	C to +85°C	
Symbol	Parameter	Condition	V <sub>CC</sub> (V)	Min	Тур	Max	Min	Max	Unit
V <sub>IH</sub>	High-Level Input		0.9	-	0.5	-	-	-	V
	Voltage		1.1 to 1.3	0.65 x V <sub>CC</sub>	_	-	0.65 x V <sub>CC</sub>	-	
			1.4 to 1.6	0.65 x V <sub>CC</sub>	_	-	0.65 x V <sub>CC</sub>	-	
			1.65 to 1.95	0.65 x V <sub>CC</sub>	_	-	0.65 x V <sub>CC</sub>	-	
			2.3 to 2.7	1.6	_	-	1.6	-	
			3.0 to 3.6	2.1	-	-	2.1	-	
V <sub>IL</sub>	Low-Level Input		0.9	-	0.5	-	_	-	V
	Voltage		1.1 to 1.3	-	_	0.35 x V <sub>CC</sub>	-	0.35 x V <sub>CC</sub>	
			1.4 to 1.6	-	-	0.35 x V <sub>CC</sub>	_	0.35 x V <sub>CC</sub>	
			1.65 to 1.95	_	_	0.35 x V <sub>CC</sub>	-	0.35 x V <sub>CC</sub>	
			2.3 to 2.7	-	_	0.7	-	0.7	
			3.0 to 3.6	-	-	0.9	-	0.9	
V <sub>OH</sub>	High-Level Output	$V_{IN} = V_{IH}$ or $V_{IL}$							V
	Voltage	I <sub>OH</sub> = -20 μA	0.9	_	V <sub>CC</sub> - 0.1	-	-	-	
			1.1 to 1.3	V <sub>CC</sub> - 0.1	-	-	V <sub>CC</sub> - 0.1	-	
			1.4 to 1.6	V <sub>CC</sub> - 0.1	_	-	V <sub>CC</sub> - 0.1	-	
			1.65 to 1.95	V <sub>CC</sub> - 0.1	_	_	V <sub>CC</sub> - 0.1	-	
			2.3 to 2.7	V <sub>CC</sub> - 0.1	_	-	V <sub>CC</sub> - 0.1	-	
			3.0 to 3.6	V <sub>CC</sub> - 0.1	_	_	V <sub>CC</sub> - 0.1	-	
		$I_{OH} = -0.5 \text{ mA}$	1.1 to 1.3	0.75 x V <sub>CC</sub>	_	-	0.70 x V <sub>CC</sub>	-	
		I <sub>OH</sub> = −1 mA	1.4 to 1.6	1.07	_	_	0.99	-	
		I <sub>OH</sub> = -1.5 mA	1.65 to 1.95	1.24	_	-	1.22	-	
		$I_{OH} = -2.1 \text{ mA}$	2.3 to 2.7	1.95	_	_	1.87	-	
		$I_{OH} = -2.6 \text{ mA}$	3.0 to 3.6	2.61	_	-	2.55	-	

# DC ELECTRICAL CHARACTERISTICS (continued)

				٦	Γ <sub>A</sub> = 25°	С	T <sub>A</sub> = -40°	C to +85°C	
Symbol	Parameter	Condition	V <sub>CC</sub> (V)	Min	Тур	Max	Min	Max	Unit
V <sub>OL</sub>	Low-Level Output	$V_{IN} = V_{IH}$ or $V_{IL}$							V
	Voltage	I <sub>OL</sub> = 20 μA	0.9	ı	0.1	-	-	-	
			1.1 to 1.3	-	-	0.1	-	0.1	
			1.4 to 1.6	ı	-	0.1	ı	0.1	
			1.65 to 1.95	ı	-	0.1	ı	0.1	
			2.3 to 2.7	ı	-	0.1	-	0.1	
			3.0 to 3.6	ı	-	0.1	ı	0.1	
		I <sub>OL</sub> = 0.5 mA	1.1 to 1.3	-	-	0.3 x V <sub>CC</sub>	-	0.3 x V <sub>CC</sub>	
		I <sub>OL</sub> = 1 mA	1.4 to 1.6	ı	-	0.31	ı	0.37	
		I <sub>OL</sub> = 1.5 mA	1.65 to 1.95	-	-	0.31	-	0.35	
		I <sub>OL</sub> = 2.1 mA	2.3 to 2.7	-	-	0.31	-	0.33	
		I <sub>OL</sub> = 2.6 mA	3.0 to 3.6	-	-	0.31	-	0.33	
I <sub>IN</sub>	Input Leakage Current	V <sub>IN</sub> = 0 V to 3.6 V	0.9 to 3.6	ı	-	±0.1	ı	±0.5	μΑ
l <sub>OZ</sub>	3-State Output Leakage Current	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = 0$ V to 3.6 V	0.9 to 3.6	-	-	±0.5	-	±0.5	μΑ
l <sub>OFF</sub>	Power Off Leakage Current	V <sub>IN</sub> = 0 V to 3.6 V or V <sub>OUT</sub> = 0 V to 3.6 V	0	ı	-	0.5	1	0.5	μΑ
Icc	Quiescent Supply Current	V <sub>IN</sub> = V <sub>CC</sub> or GND	0.9 to 3.6	_	_	0.9	_	0.9	μΑ

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**

				٦	Γ <sub>A</sub> = 25°(	2	T <sub>A</sub> = -40°C	C to +85°C		
Symbol	Parameter	Condition	V <sub>CC</sub> (V)	Min	Тур	Max	Min	Max	Unit	
t <sub>PLH</sub> , t <sub>PHL</sub>	Propagation Delay,		0.9	-	50.7	-	-	-	ns	
	A to Y (Figures 3 and 4)		1.10 to 1.30	-	13.4	27.6	-	39.6		
			1.40 to 1.60	_	6.8	11.2	-	14.5		
			1.65 to 1.95	-	4.8	8.6	-	11.6		
			2.3 to 2.7	-	3.1	6.3	-	8.2		
			3.0 to 3.6	-	2.6	5.3	-	7.2		
$t_{PZH}, t_{PZL}$	Output Enable Time,	$R_1 = R_L = 5 \text{ k}\Omega$	0.9	-	50.6	-	-	-	ns	
	OE to Y (Figures 3 and 4)	C <sub>L</sub> = 10 pF	1.10 to 1.30	-	13.2	26.7	-	40.4		
			1.40 to 1.60	-	6.7	11.9	-	14.8		
			1.65 to 1.95	-	4.7	9.7	-	12.3		
				2.3 to 2.7	-	3.0	7.7	-	10.5	
			3.0 to 3.6	-	2.5	6.9	-	8.6		
$t_{PHZ}, t_{PLZ}$	Output Disable Time,	$R_1 = R_L = 5 \text{ k}\Omega$	0.9	-	14.6	-	-	-	ns	
	OE to Y (Figures 3 and 4)	C <sub>L</sub> = 10 pF	1.10 to 1.30	-	8.2	20.5	-	42.0		
	( · garaca a ana · y		1.40 to 1.60	-	6.3	15.3	-	18.0		
		1.65 to 1.95	-	6.1	14.7	-	17.8			
			2.3 to 2.7	-	5.8	13.7	-	15.0		
			3.0 to 3.6	-	5.7	13.5	-	14.8		

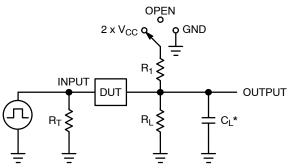
# AC ELECTRICAL CHARACTERISTICS (continued)

				1	T <sub>A</sub> = 25°C		T <sub>A</sub> = -40°	C to +85°C	
Symbol	Parameter	Condition	V <sub>CC</sub> (V)	Min	Тур	Max	Min	Max	Unit
t <sub>PLH</sub> , t <sub>PHL</sub>	Propagation Delay,	$R_L = 1 M\Omega$ , $C_L = 15 pF$	0.9	-	52.3	-	_	-	ns
	A to Y (Figures 3 and 4)		1.10 to 1.30	-	14.0	28.6	_	42.5	1
			1.40 to 1.60	-	7.2	11.8	_	15.4	
			1.65 to 1.95	-	5.2	9.1	_	12.2	
			2.3 to 2.7	-	3.4	6.6	-	8.6	1
			3.0 to 3.6	-	2.8	5.6	-	7.5	1
t <sub>PZH</sub> , t <sub>PZL</sub>	Output Enable Time,	$R_1 = R_L = 5 \text{ k}\Omega$	0.9	-	52.2	-	_	-	ns
	OE to Y (Figures 3 and 4)	$C_L = 15 \text{ pF}$	1.10 to 1.30	-	13.7	27.9	_	43.3	
	,		1.40 to 1.60	-	7.1	12.5	_	15.5	
			1.65 to 1.95	-	5.1	10.2	-	12.9	1
			2.3 to 2.7	-	3.2	8.0	-	9.9	1
			3.0 to 3.6	-	2.7	7.2	-	8.9	
t <sub>PHZ</sub> , t <sub>PLZ</sub>	Output Disable Time,	$R_1 = R_L = 5 \text{ k}\Omega$	0.9	-	16.1	-	-	-	ns
	OE to Y (Figures 3 and 4)	C <sub>L</sub> = 15 pF	1.10 to 1.30	-	9.3	21.6	-	44.9	1
	( '9	rigares c and 1)	1.40 to 1.60	-	7.1	15.9	-	18.8	
			1.65 to 1.95	-	7.1	15.2	-	18.2	
			2.3 to 2.7	-	6.8	14.1	-	15.4	
			3.0 to 3.6	-	6.5	13.9	-	15.1	
t <sub>PLH</sub> , t <sub>PHL</sub>	Propagation Delay,	$R_L = 1 M\Omega$ , $C_L = 30 pF$	0.9	-	56.9	-	-	-	ns
	A to Y (Figures 3 and 4)		1.10 to 1.30	-	15.6	32.0	-	51.1	
			1.40 to 1.60	-	8.6	13.8	-	17.7	1
			1.65 to 1.95	-	6.3	10.6	-	14.0	
			2.3 to 2.7	-	4.1	7.6	-	9.9	1
			3.0 to 3.6	-	3.4	6.4	_	8.9	
$t_{PZH}$ , $t_{PZL}$	Output Enable Time,	$R_1 = R_L = 5 \text{ k}\Omega$	0.9	-	56.8	-	_	-	ns
	OE to Y (Figures 3 and 4)	C <sub>L</sub> = 30 pF	1.10 to 1.30	-	15.4	31.6	_	51.9	
	,		1.40 to 1.60	-	8.5	14.5	_	17.9	
			1.65 to 1.95	-	6.2	11.7	_	14.7	
			2.3 to 2.7	-	3.9	9.1	_	11.1	
			3.0 to 3.6	-	3.3	8.1	_	10.1	
t <sub>PHZ</sub> , t <sub>PLZ</sub>	Output Disable Time,	$R_1 = R_L = 5 \text{ k}\Omega$	0.9	-	20.3	-	_	-	ns
	OE to Y (Figures 3 and 4)	C <sub>L</sub> = 30 pF	1.10 to 1.30	-	12.3	24.8	-	53.5	1
	,		1.40 to 1.60	-	10.2	20.5	_	21.1	]
			1.65 to 1.95	-	10.2	19.5	_	20.5	]
			2.3 to 2.7	-	9.5	18.5	_	19.5	
			3.0 to 3.6	-	8.6	14.8	_	16.3	

# **CAPACITIVE CHARACTERISTICS**

Symbol	Parameter	Parameter Test Condition		Unit
C <sub>IN</sub>	Input Capacitance	V <sub>CC</sub> = 0 V	2.0	pF
C <sub>OUT</sub>	Output Capacitance	V <sub>CC</sub> = 0 V	4.0	pF
C <sub>PD</sub>	Power Dissipation Capacitance (Note 5)	$f = 10 \text{ MHz}, V_{CC} = 0.9 \text{ to } 3.6 \text{ V}, V_{IN} = 0 \text{ V or } V_{CC}$	8.0	pF

<sup>5.</sup> C<sub>PD</sub> 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<sub>CC(OPR)</sub> = C<sub>PD</sub> • V<sub>CC</sub> • f<sub>in</sub> + I<sub>CC</sub>. C<sub>PD</sub> is used to determine the no–load dynamic power consumption: P<sub>D</sub> = C<sub>PD</sub> • V<sub>CC</sub><sup>2</sup> • f<sub>in</sub> + I<sub>CC</sub> • V<sub>CC</sub>.

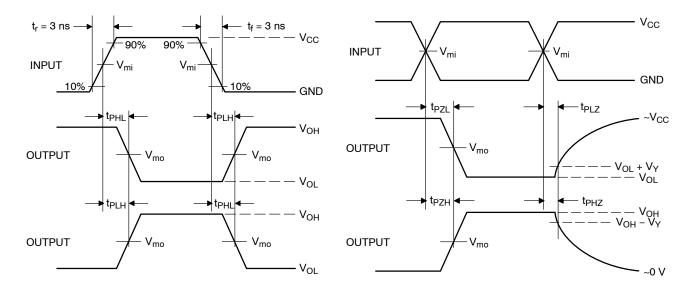


Test	Switch Position
t <sub>PLH</sub> / t <sub>PHL</sub>	Open
t <sub>PLZ</sub> / t <sub>PZL</sub>	2 x V <sub>CC</sub>
t <sub>PHZ</sub> / t <sub>PZH</sub>	GND

C<sub>L</sub> includes probe and jig capacitance

 $R_T$  is  $Z_{OUT}$  of pulse generator (typically 50  $\Omega$ ) f=1 MHz

Figure 3. Test Circuit



V <sub>CC</sub> , V	V <sub>mi</sub> , V	V <sub>mo</sub> , V	V <sub>Y</sub> , V
0.9	V <sub>CC</sub> / 2	V <sub>CC</sub> / 2	0.1
1.1 to 1.3	V <sub>CC</sub> / 2	V <sub>CC</sub> / 2	0.1
1.4 to 1.6	V <sub>CC</sub> / 2	V <sub>CC</sub> / 2	0.1
1.65 to 1.95	V <sub>CC</sub> / 2	V <sub>CC</sub> / 2	0.15
2.3 to 2.7	V <sub>CC</sub> / 2	V <sub>CC</sub> / 2	0.15
3.0 to 3.6	1.5	1.5	0.3

Figure 4. Switching Waveforms

# **ORDERING INFORMATION**

Device	Package	Marking	Pin 1 Orientation (See below)	Shipping <sup>†</sup>
NC7SP126P5X	SC-88A	P26	Q4	3000 / Tape & Reel
NC7SP126L6X	MicroPak	L6	Q4	5000 / Tape & Reel
NC7SP126FHX	MicroPak2	L6	Q4	5000 / 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.

# Pin 1 Orientation in Tape and Reel

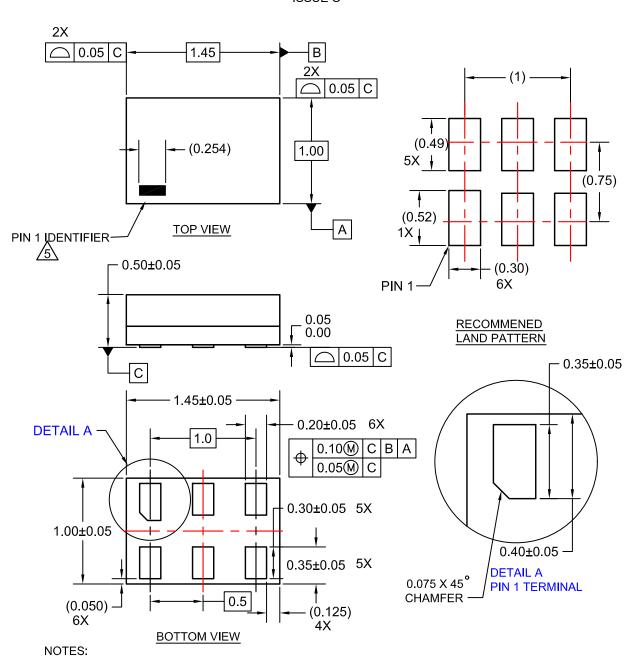
# **Direction of Feed**



MicroPak is trademark of Semiconductor Components Industries, LLC (SCILLC) or its subsidiaries in the United States and/or other countries.

# **PACKAGE DIMENSIONS**

SIP6 1.45X1.0 CASE 127EB ISSUE O

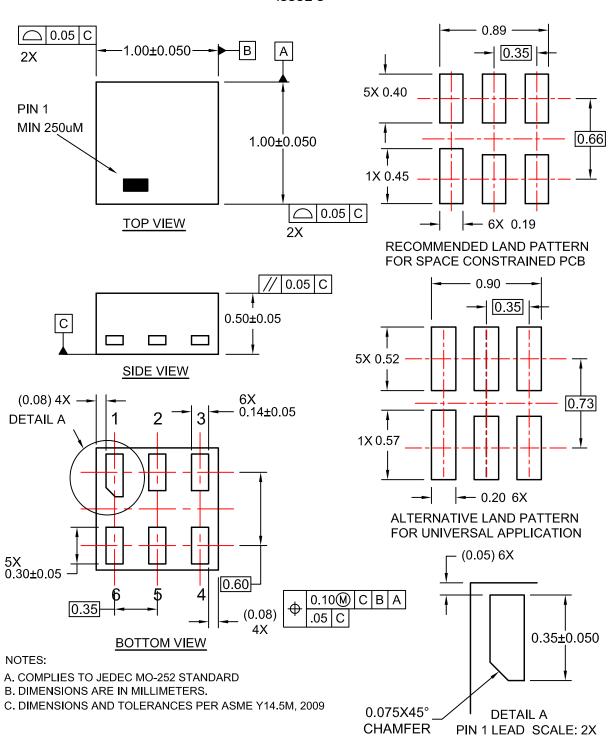


- 1, CONFORMS TO JEDEC STANDARD MO-252 VARIATION UAAD
- 2. DIMENSIONS ARE IN MILLIMETERS
- 3. DRAWING CONFORMS TO ASME Y14.5M-2009
  4. PIN ONE IDENTIFIER IS 2X LENGTH OF ANY

OTHER LINE IN THE MARK CODE LAYOUT.

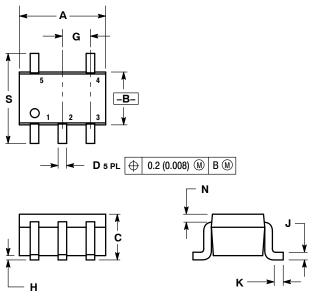
# **PACKAGE DIMENSIONS**

# **UDFN6 1.0X1.0, 0.35P**CASE 517DP ISSUE O



#### PACKAGE DIMENSIONS

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



#### NOTES:

- NOTES:

  1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.

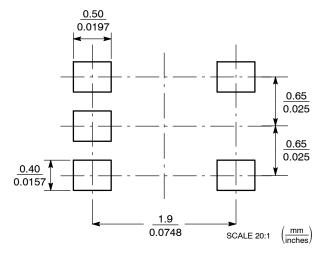
  2. CONTROLLING DIMENSION: INCH.

  3. 419A-01 OBSOLETE. NEW STANDARD
- 419A-02.

  4. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
Α	0.071	0.087	1.80	2.20
В	0.045	0.053	1.15	1.35
С	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

# **SOLDER FOOTPRINT**



STYLE 1:
PIN 1. BASE
<ol><li>EMITTER</li></ol>
3. BASE
<ol><li>COLLECTOR</li></ol>
<ol><li>COLLECTOR</li></ol>

PIN 1. EMITTER 2 2. BASE 2 3. EMITTER 1 4. COLLECTOR

5. COLLECTOR 2/BASE 1

STYLE 6:

STYLE 7:

PIN 1. ANODE 2. EMITTER

STYLE 2:

PIN 1. BASE 2. EMITTER 3. BASE 4. COLLECTOR 5. COLLECTOR

3. BASE 4. COLLECTOR 5. CATHODE

STYLE 8: PIN 1. CATHODE 2. COLLECTOR 3. N/C 4. BASE

PIN 1. ANODE 1 2. N/C N/C
 ANODE 2
 CATHODE 2
 CATHODE 1

STYLE 3:

5. EMITTER

STYLE 4:

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

STYLE 9: PIN 1. ANODE 2. CATHODE 3. ANODE 4. ANODE 5. ANODE

STYLE 5:

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

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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