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TinyLogic ULP-A Universal Configurable Logic Gates

NC7SP57, NC7SP58

The NC7SP57 and NC7SP58 are universal configurable logic gates in tiny footprint packages. The devices are 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
- 3.4 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 2.6 mA at 3.3 V
- Available in SC-88 and MicroPak™ Packages
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

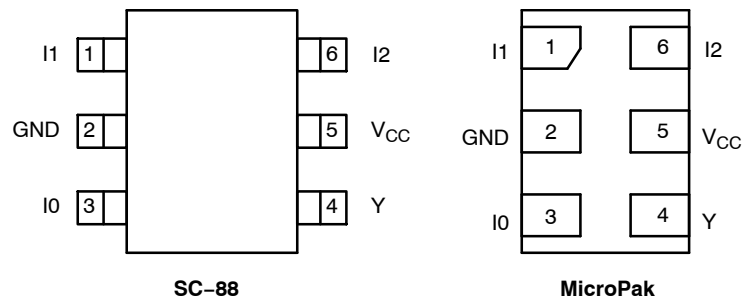


Figure 1. Pinout Diagrams (Top Views)

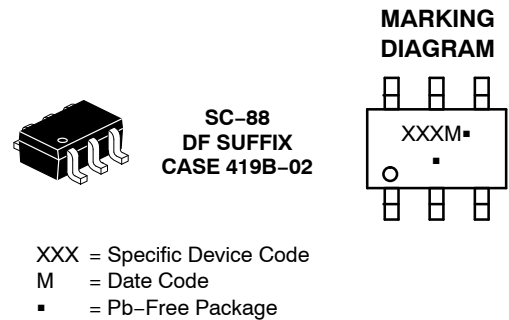
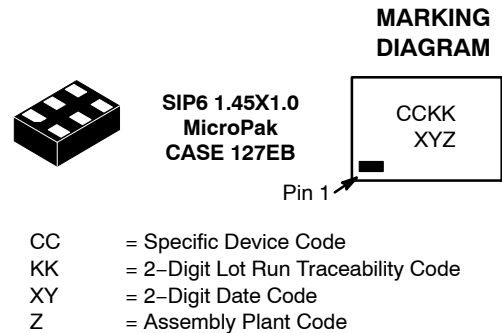
PIN ASSIGNMENT

Pin	SC-88	MicroPak
1	I1	I1
2	GND	GND
3	I0	I0
4	Y	Y
5	V_{CC}	V_{CC}
6	I2	I2



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ORDERING INFORMATION

See detailed ordering, marking and shipping information on page 9 of this data sheet.

NC7SP57, NC7SP58

FUNCTION TABLE

Inputs			NC7SP57	NC7SP58
I2	I1	I0	$Y = (\overline{I0}) \cdot (\overline{I2}) + (I1) \cdot (I2)$	$Y = (I0) \cdot (\overline{I2}) + (\overline{I1}) \cdot (I2)$
L	L	L	H	L
L	L	H	L	H
L	H	L	H	L
L	H	H	L	H
H	L	L	L	H
H	L	H	L	H
H	H	L	H	L
H	H	H	H	L

FUNCTION SELECTION TABLE

2-Input Logic Function	Device Selection	Connection Configuration
2-Input AND	NC7SP57	Figure 2
2-Input AND with inverted input	NC7SP58	Figure 8, 9
2-Input AND with both inputs inverted	NC7SP57	Figure 5
2-Input NAND	NC7SP58	Figure 7
2-Input NAND with inverted input	NC7SP57	Figure 3, 4
2-Input NAND with both inputs inverted	NC7SP58	Figure 10
2-Input OR	NC7SP58	Figure 10
2-Input OR with inverted input	NC7SP57	Figure 3, 4
2-Input OR with both inputs inverted	NC7SP58	Figure 7
2-Input NOR	NC7SP57	Figure 5
2-Input NOR with inverted input	NC7SP58	Figure 8, 9
2-Input NOR with both inputs inverted	NC7SP57	Figure 2
2-Input XOR	NC7SP58	Figure 11
2-Input XNOR	NC7SP57	Figure 6

NC7SP57, NC7SP58

Logic Configurations NC7SP57

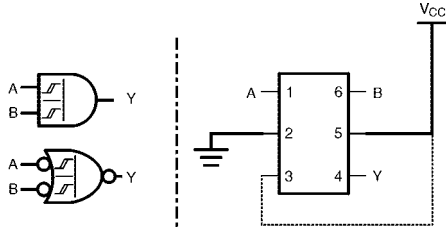


Figure 2. 2-Input AND Gate

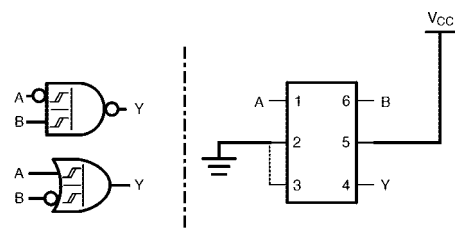


Figure 3. 2-Input NAND with Inverted A Input

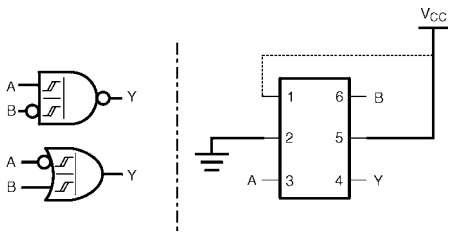


Figure 4. 2-Input NAND with Inverted B Input

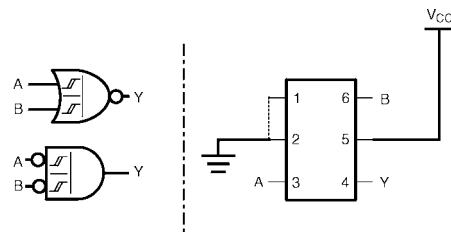


Figure 5. 2-Input NOR Gate

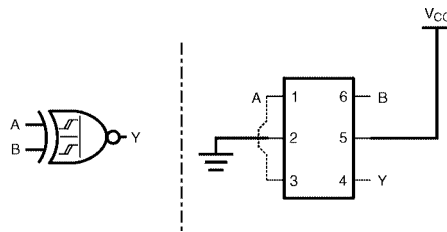


Figure 6. 2-Input XNOR Gate

NOTE: Figure 2 through Figure 6 show the logical functions that can be implemented using the NC7SP57. The diagrams show the DeMorgan's equivalent logic duals for a given 2-input function. Next to the logical implementation is the board level physical implementation of how the pins of the function should be connected.

NC7SP57, NC7SP58

Logic Configurations NC7SP58

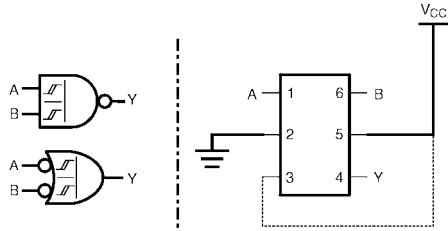


Figure 7. 2-Input NAND Gate

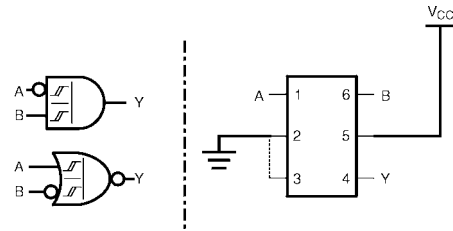


Figure 8. 2-Input AND with Inverted A Input

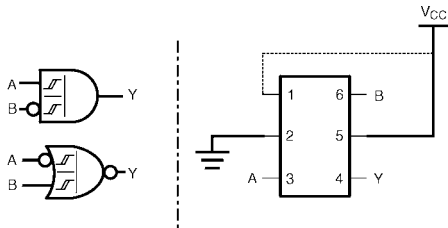


Figure 9. 2-Input AND with Inverted B Input

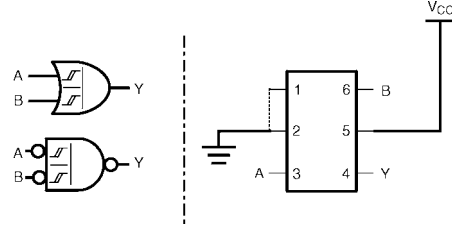


Figure 10. 2-Input OR Gate

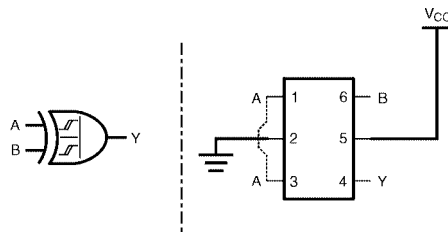


Figure 11. 2-Input XOR Gate

NOTE: Figure 7 through Figure 11 show the logical functions that can be implemented using the NC7SP58. The diagrams show the DeMorgan's equivalent logic duals for a given 2-input function. Next to the logical implementation is the board level physical implementation of how the pins of the function should be connected.

NC7SP57, NC7SP58

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 11) 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	°C
T _L	Lead Temperature, 1 mm from Case for 10 Seconds	260	°C
T _J	Junction Temperature Under Bias	+150	°C
θ _{JA}	Thermal Resistance (Note 12) SC-88 MicroPak	377 154	°C/W
P _D	Power Dissipation in Still Air SC-88 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.

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 11) Power-Down Mode (V _{CC} = 0 V)	0 0 0	V _{CC} 3.6 3.6	V
T _A	Operating Temperature Range	-40	+85	°C
t _r , t _f	Input Transition Rise and Fall Time	0	No Limit	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.

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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 _P	Positive Threshold Voltage		0.9	-	0.62	-	-	-	V
			1.1	-	-	1.0	-	1.0	
			1.4	-	-	1.2	-	1.2	
			1.65	-	-	1.5	-	1.5	
			3.0	-	-	1.9	-	1.9	
			3.0 to 3.6	-	-	2.6	-	2.6	
V _N	Negative Threshold Voltage		0.9	-	0.34	-	-	-	V
			1.1	0.15	-	-	0.15	-	
			1.4	0.2	-	-	0.2	-	
			1.65	0.25	-	-	0.25	-	
			2.3	0.4	-	-	0.4	-	
			3.0	0.6	-	-	0.6	-	
V _H	Hysteresis Voltage		0.9	-	0.29	-	-	-	V
			1.1	0.08	-	0.6	0.08	0.6	
			1.4	0.09	-	0.8	0.09	0.8	
			1.65	0.1	-	1.0	0.1	1.0	
			2.3	0.25	-	1.1	0.25	1.1	
			3.0	0.6	-	1.8	0.6	1.8	
V _{OH}	High-Level Output Voltage	V _{IN} = V _{IH} or V _{IL}							V
		I _{OH} = -20 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} - 0.1	-	-	V _{CC} - 0.1	-	
			2.3 to 2.7	V _{CC} - 0.1	-	-	V _{CC} - 0.1	-	
			3.0 to 3.6	V _{CC} - 0.1	-	-	V _{CC} - 0.1	-	
		I _{OH} = -0.5 mA	1.1 to 1.3	0.75 x V _{CC}	-	-	0.70 x V _{CC}	-	
		I _{OH} = -1 mA	1.4 to 1.6	1.07	-	-	0.99	-	
		I _{OH} = -1.5 mA	1.65 to 1.95	1.24	-	-	1.22	-	
		I _{OH} = -2.1 mA	2.3 to 2.7	1.95	-	-	1.87	-	
I _{OH} = -2.6 mA	3.0 to 3.6	2.61	-	-	2.55	-			
V _{OL}	Low-Level Output Voltage	V _{IN} = V _{IH} or V _{IL}							V
		I _{OL} = 20 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	-	-	0.1	-	0.1	
			2.3 to 2.7	-	-	0.1	-	0.1	
			3.0 to 3.6	-	-	0.1	-	0.1	
		I _{OL} = 0.5 mA	1.1 to 1.3	-	-	0.3 x V _{CC}	-	0.3 x V _{CC}	
		I _{OL} = 1 mA	1.4 to 1.6	-	-	0.31	-	0.37	
		I _{OL} = 1.5 mA	1.65 to 1.95	-	-	0.31	-	0.35	
		I _{OL} = 2.1 mA	2.3 to 2.7	-	-	0.31	-	0.33	
I _{OL} = 2.6 mA	3.0 to 3.6	-	-	0.31	-	0.33			

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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	
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

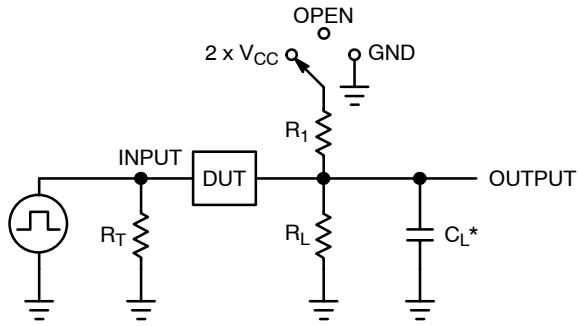
Symbol	Parameter	Condition	V _{CC} (V)	T _A = 25°C			T _A = -40°C to +85°C		Unit
				Min	Typ	Max	Min	Max	
t _{PLH} , t _{PHL}	Propagation Delay, (I0 or I1 or I2) to Y (Figures 12 and 13)	R _L = 1 MΩ, C _L = 10 pF	0.9	-	54.3	-	-	-	ns
			1.10 to 1.30	-	15.1	30.8	-	51.0	
			1.40 to 1.60	-	8.2	17.0	-	21.0	
			1.65 to 1.95	-	5.9	14.0	-	17.0	
			2.3 to 2.7	-	4.0	10.0	-	13.0	
			3.0 to 3.6	-	3.4	8.0	-	12.0	
t _{PLH} , t _{PHL}	Propagation Delay, (I0 or I1 or I2) to Y (Figures 12 and 13)	R _L = 1 MΩ, C _L = 15 pF	0.9	-	55.8	-	-	-	ns
			1.10 to 1.30	-	15.6	32.1	-	52.0	
			1.40 to 1.60	-	8.6	18.0	-	22.0	
			1.65 to 1.95	-	6.3	15.0	-	18.0	
			2.3 to 2.7	-	4.2	11.0	-	14.0	
			3.0 to 3.6	-	3.6	9.0	-	12.0	
t _{PLH} , t _{PHL}	Propagation Delay, (I0 or I1 or I2) to Y (Figures 12 and 13)	R _L = 1 MΩ, C _L = 30 pF	0.9	-	60.2	-	-	-	ns
			1.10 to 1.30	-	17.2	33.6	-	55.0	
			1.40 to 1.60	-	9.9	20.0	-	24.0	
			1.65 to 1.95	-	7.4	17.0	-	20.0	
			2.3 to 2.7	-	5.0	12.0	-	15.0	
			3.0 to 3.6	-	4.1	11.0	-	14.0	

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	4.0	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}	8.0	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}.

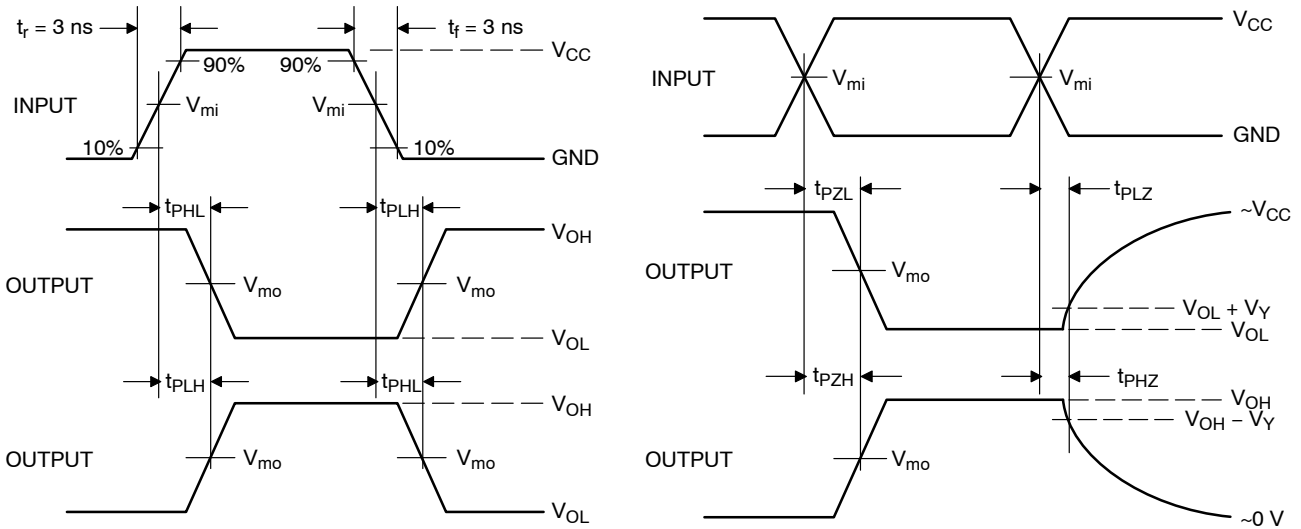
NC7SP57, NC7SP58



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 12. 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 13. Switching Waveforms

NC7SP57, NC7SP58

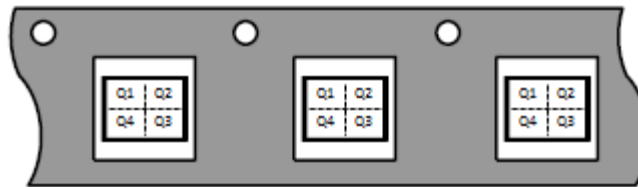
ORDERING INFORMATION

Device	Package	Marking	Pin 1 Orientation (See below)	Shipping†
NC7SP57P6X	SC-88	P57	Q4	3000 / Tape & Reel
NC7SP57L6X	MicroPak	K9	Q4	5000 / Tape & Reel
NC7SP58P6X	SC-88	P58	Q4	3000 / Tape & Reel
NC7SP58L6X	MicroPak	L3	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

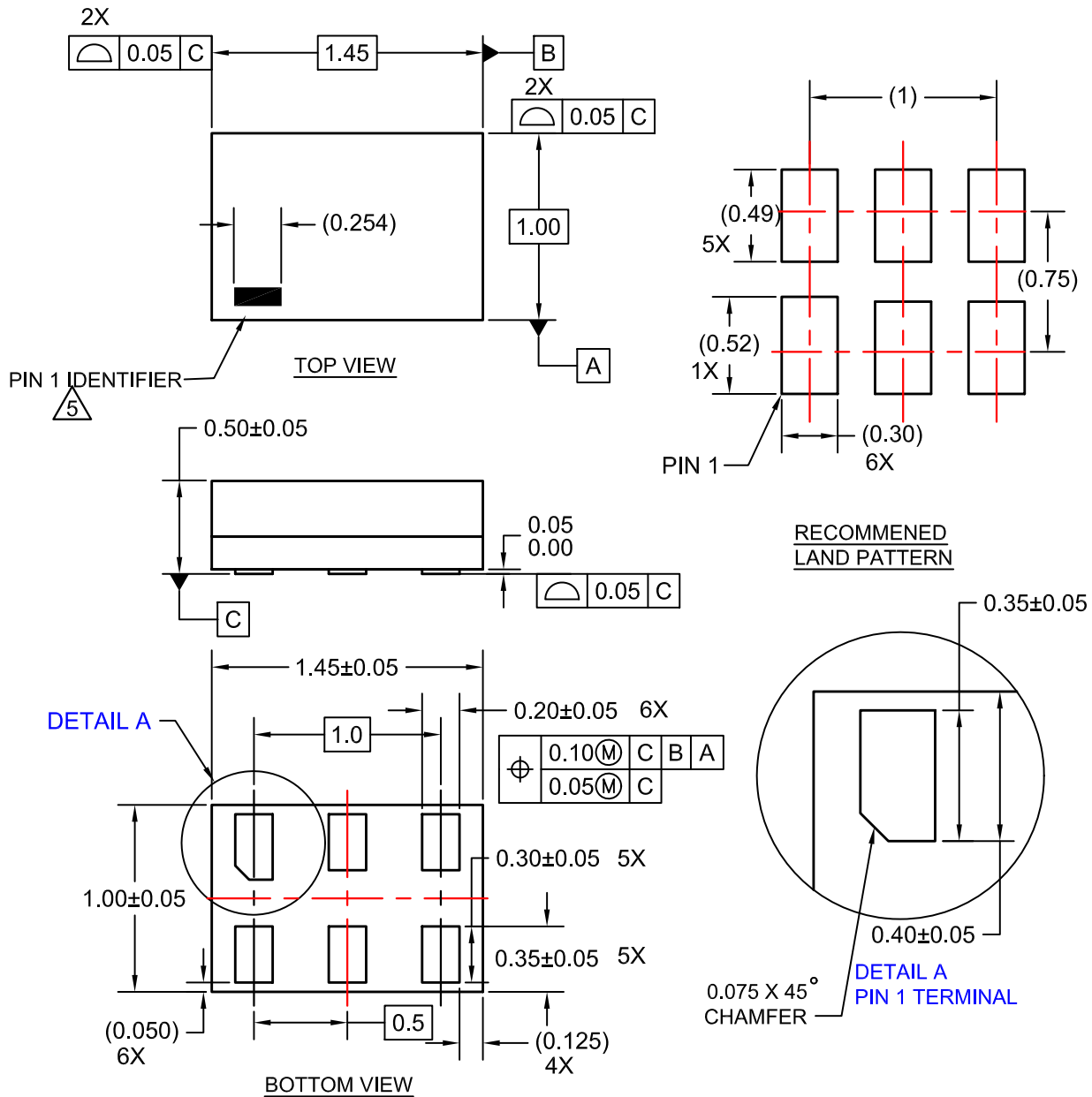
Direction of Feed



NC7SP57, NC7SP58

PACKAGE DIMENSIONS

SIP6 1.45X1.0
CASE 127EB
ISSUE O



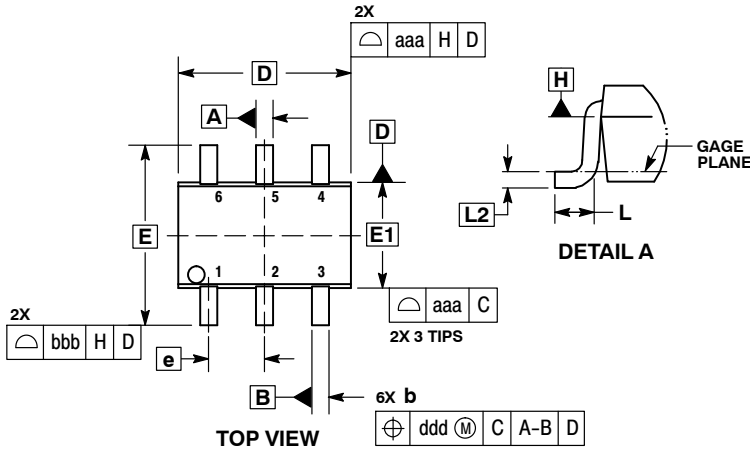
NOTES:

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.

NC7SP57, NC7SP58

PACKAGE DIMENSIONS

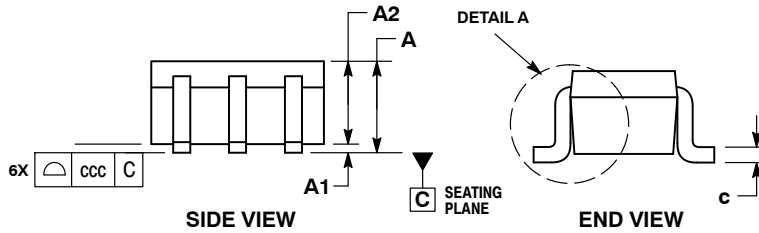
SC-88/SC70-6/SOT-363
CASE 419B-02
ISSUE Y



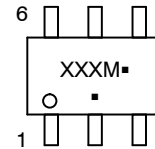
NOTES:

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*



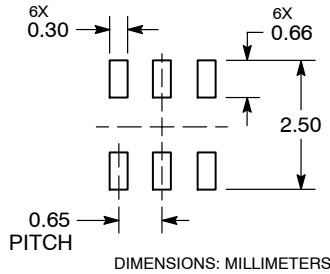
XXX = Specific Device Code
M = Date Code*
▪ = Pb-Free Package

(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

NC7SP57, NC7SP58


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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