

TinyLogic UHS D-Type Flip-Flop with 3-STATE Output

NC7SZ374

Description

The NC7SZ374 is a single positive edge-triggered D-type CMOS Flip-Flop with 3-STATE output from ON Semiconductor's Ultra High Speed Series of TinyLogic in the space saving SC-88 6-lead package. The device is fabricated with advanced CMOS technology to achieve ultra high speed with high output drive while maintaining low static power dissipation over a very broad V_{CC} operating range. The device is specified to operate over the 1.65 V to 5.5 V V_{CC} range. The inputs and output are high impedance when V_{CC} is 0 V. Inputs tolerate voltages up to 5.5 V independent of V_{CC} operating voltage. This single flip-flop will store the state of the D input that meets the setup and hold time requirements on the LOW-to-HIGH Clock (CP) transition. The output tolerates voltages above V_{CC} in the 3-STATE condition.

Features

- Space Saving SC-88 6-Lead Package
- Ultra Small MicroPak™ Leadless Package
- Ultra High Speed: $t_{PD} = 2.6$ ns Typ into 50 pF at 5 V V_{CC}
- High Output Drive: ± 24 mA at 3 V V_{CC}
- Broad V_{CC} Operating Range: 1.65 V to 5.5 V
- Matches the Performance of LCX when Operated at 3.3 V V_{CC}
- Power Down High Impedance Inputs / Output
- Overvoltage Tolerant Inputs Facilitate 5 V – 3 V Translation
- Patented Noise / EMI Reduction Circuitry Implemented
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

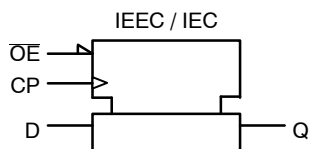


Figure 1. Logic Symbol



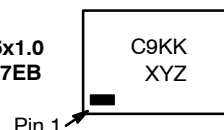
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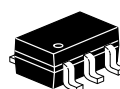
MARKING DIAGRAMS



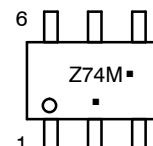
SIP6 1.45x1.0
CASE 127EB



Pin 1



SC-88
CASE 419B-02



C9, Z74	= Specific Device Code
KK	= 2-Digit Lot Run Traceability Code
XY	= 2-Digit Date Code Format
Z	= Assembly Plant 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 6 of this data sheet.

Connection Diagrams

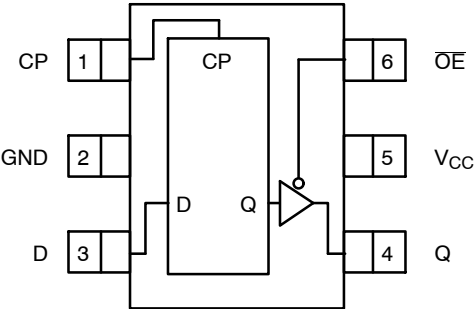


Figure 2. SC-88 (Top View)

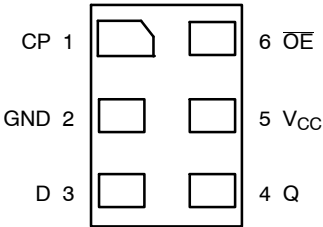
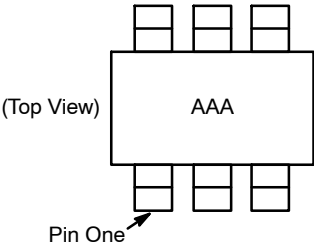


Figure 4. MicroPak (Top Through View)



AAA represents Product Code Top Mark – see ordering code.
NOTE: Orientation of Top Mark determines Pin One location.
Read the top product code mark left to right, Pin One is the lower left pin (see diagram).

Figure 3. Pin 1 Orientation

PIN DESCRIPTIONS

Pin Name	Description
D	Data Input
CP	Clock Pulse Input
OE	Output Enable Input
Q	Flip-Flop Output

FUNCTION TABLE

Inputs			Output
CP	D	OE	Q
	L	L	L
	H	L	H
	X	L	Q _n
X	X	H	Z

H = HIGH Logic Level
L = LOW Logic Level
X = Immaterial
Z = High Impedance
Q_n = No Change in Data

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter		Min	Max	Unit
V _{CC}	Supply Voltage		-0.5	+6.5	V
V _{IN}	DC Input Voltage		-0.5	+6.5	V
V _{OUT}	DC Output Voltage		-0.5	+6.5	V
I _{IK}	DC Input Diode Current	V _{IN} < 0 V	-	-50	mA
I _{OK}	DC Output Diode Current	V _{OUT} < 0 V	-	-50	mA
I _{OUT}	DC Output Source / Sink Current		-	±50	mA
I _{CC} / I _{GND}	DC V _{CC} / GND Current		-	±50	mA
T _{STG}	Storage Temperature Range		-65	+150	°C
T _J	Junction Temperature under Bias		-	150	°C
T _L	Junction Lead Temperature (Soldering, 10 Seconds)		-	260	°C
P _D	Power Dissipation in Still Air	SC-88	-	332	mW
		MicroPak	-	812	

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 Operating		1.65	5.5	V
	Supply Voltage Data Retention		1.5	5.5	
V _{IN}	Input Voltage		0	5.5	V
V _{OUT}	Output Voltage	Active State	0	V _{CC}	V
		3-STATE	0	5.5	V
t _r , t _f	Input Rise and Fall Time	V _{CC} = 1.8 V, 2.5 V ±0.2 V	0	20	ns/V
		V _{CC} = 3.3 V ±0.3 V	0	10	
		V _{CC} = 5.5 V ±0.5 V	0	5	
T _A	Operating Temperature		-40	+85	°C
θ _{JA}	Thermal Resistance	SC-88	-	377	°C/W
		MicroPak	-	154	

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 ELECTRICAL 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 Control Input Voltage	1.65 to 1.95		0.65 V _{CC}	–	–	0.65 V _{CC}	–	V
		2.3 to 5.5		0.7 V _{CC}	–	–	0.7 V _{CC}	–	
V _{IL}	LOW Level Control Input Voltage	1.65 to 1.95		–	–	0.35 V _{CC}	–	0.35 V _{CC}	V
		2.3 to 5.5		–	–	0.3 V _{CC}	–	0.3 V _{CC}	
V _{OH}	HIGH Level Control Output Voltage	1.65	V _{IN} = V _{IH} or V _{IL}	I _{OH} = -100 µA	1.55	1.65	–	1.55	V
		1.8			1.7	1.8	–	1.7	
		2.3			2.2	2.3	–	2.2	
		3.0			2.9	3.0	–	2.9	
		4.5			4.4	4.5	–	4.4	
		1.65			1.24	1.52	–	1.29	
		2.3		I _{OH} = -8 mA	1.9	2.15	–	1.9	
		3.0		I _{OH} = -16 mA	2.4	2.8	–	2.4	
		3.0		I _{OH} = -24 mA	2.3	2.68	–	2.3	
		4.5		I _{OH} = -32 mA	3.8	4.2	–	3.8	
V _{OL}	LOW Level Control Output Voltage	1.65	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 100 µA	–	0.0	0.1	–	V
		1.8			–	0.0	0.1	–	
		2.3			–	0.0	0.1	–	
		3.0			–	0.0	0.1	–	
		4.5			–	0.0	0.1	–	
		1.65		I _{OL} = 4 mA	–	0.08	0.24	–	
		2.3		I _{OL} = 8 mA	–	0.10	0.3	–	
		3.0		I _{OL} = 16 mA	–	0.15	0.4	–	
		3.0		I _{OL} = 24 mA	–	0.22	0.55	–	
		4.5		I _{OL} = 32 mA	–	0.22	0.55	–	
I _{IN}	Input Leakage Current	1.65 to 5.5	0 ≤ V _{IN} ≤ 5.5 V	–	–	±0.1	–	±1.0	µA
I _{OZ}	3-STATE Output Leakage	1.65 to 5.5	V _{IN} = V _{IL} or V _{IH} 0 ≤ V _{OUT} ≤ 5.5 V	–	–	±0.5	–	±5.0	µA
I _{OFF}	Power Off Leakage Current	0.0	V _{IN} or V _{OUT} = 5.5 V	–	–	1.0	–	10	µA
I _{CC}	Quiescent Supply Current	1.65 to 5.5	V _{IN} = 5.5 V, 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	
f _{MAX}	Maximum Clock Frequency (Figures 5, 7)	1.65	C _L = 50 pF, R _D = 500 Ω, S ₁ = Open	–	–	–	100	–	MHz
		1.8		–	–	–	100	–	
		2.5 ±0.2		–	–	–	125	–	
		3.3 ±0.3		–	–	–	150	–	
		5.0 ±0.5		–	–	–	175	–	
t _{PLH} , t _{PHL}	Propagation Delay, CP to Q (Figures 5, 7)	1.65	C _L = 15 pF, R _D = 1 MΩ, S ₁ = Open	–	9.7	1.50	–	16.5	ns
		1.8		–	6.5	10.0	–	11.0	
		2.5 ±0.2		–	3.8	6.5	–	7.0	
		3.3 ±0.3		–	2.8	4.5	–	5.0	
		5.0 ±0.5		–	2.2	3.5	–	3.8	
		3.3 ±0.3	C _L = 50 pF, R _D = 500 Ω, S ₁ = Open	–	3.4	5.5	–	6.2	
		5.0 ±0.5		–	2.6	4.0	–	4.7	
t _{PZL} , t _{PZH}	Output Enable Time (Figures 5, 8)	1.65	C _L = 50 pF, V _I = 2 × V _{CC} , R _U , R _D = 500 Ω, S ₁ = GND for t _{PZH} S ₁ = V _I for t _{PZL}	–	9.0	13.5	–	14.3	ns
		1.8		–	6.0	9.0	–	9.5	
		2.5 ±0.2		–	3.7	6.0	–	6.6	
		3.3 ±0.3		–	2.8	5.0	–	5.3	
		5.0 ±0.5		–	2.2	3.7	–	3.9	
t _{PLZ} , t _{PHZ}	Output Disable Time (Figures 5, 8)	1.65	C _L = 50 pF, V _I = 2 × V _{CC} , R _U , R _D = 500 Ω, S ₁ = GND for t _{PHZ} S ₁ = V _I for t _{PLZ}	–	7.7	12.0	–	13.0	ns
		1.8		–	5.1	8.0	–	8.5	
		2.5 ±0.2		–	3.5	6.0	–	6.3	
		3.3 ±0.3		–	2.8	4.5	–	4.7	
		5.0 ±0.5		–	2.23	3.7	–	3.9	
t _S	Setup Time, CP to D (Figures 5, 9)	2.5 ±0.2	C _L = 50 pF, R _D = 500 Ω, S ₁ = Open	–	–	–	2.5	–	ns
		3.3 ±0.3		–	–	–	2.0	–	
		5.0 ±0.5		–	–	–	1.5	–	
t _H	Hold Time, CP to D (Figures 5, 9)	2.5 ±0.2	C _L = 50 pF, R _D = 500 Ω, S ₁ = Open	–	–	–	1.5	–	ns
		3.3 ±0.3		–	–	–	1.5	–	
		5.0 ±0.5		–	–	–	1.5	–	
t _W	Pulse Width, CP (Figures 5, 9)	2.5 ±0.2	C _L = 50 pF, R _D = 500 Ω, S ₁ = Open	–	–	–	3.0	–	ns
		3.3 ±0.3		–	–	–	2.8	–	
		5.0 ±0.5		–	–	–	2.5	–	

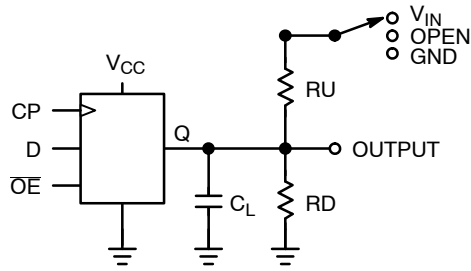
CAPACITANCE (T_A = +25°C, f = 1 MHz)

Symbol	Parameter	Condition	Typ	Max	Units
C _{IN}	Input Capacitance	V _{CC} = Open, V _{IN} = 0 V or V _{CC}	3	–	pF
C _{OUT}	Output Capacitance	V _{CC} = 3.3 V, V _{IN} = 0 V or V _{CC}	4	–	pF
C _{PD}	Power Dissipation Capacitance (Note 2)	V _{CC} = 3.3 V V _{CC} = 5.0 V	10 12	–	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. (See Figure 6)

C_{PD} is related to I_{CCD} dynamic operating current by the expression: I_{CCD} = (C_{PD}) (V_{CC}) (f_{IN}) + (I_{CCstatic}).

AC Loading and Waveforms



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

Figure 5. AC Test Circuit

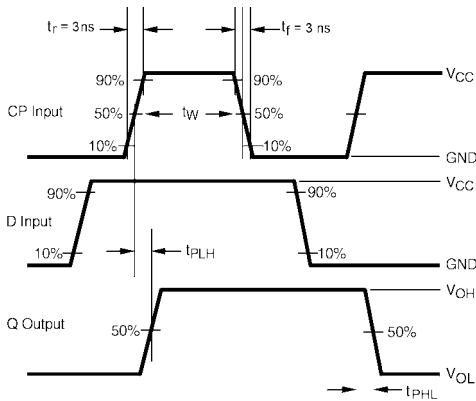
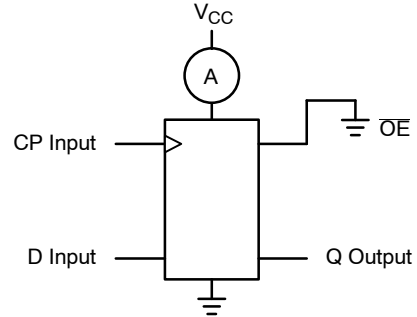


Figure 7. AC Waveforms



CP Input = AC Waveform; $t_r = t_f = 1.8$ ns;
CP Input PRR = 10 MHz; Duty Cycle = 50%
D Input PRR = 5 MHz; Duty Cycle = 50%.

Figure 6. I_{CCD} Test Circuit

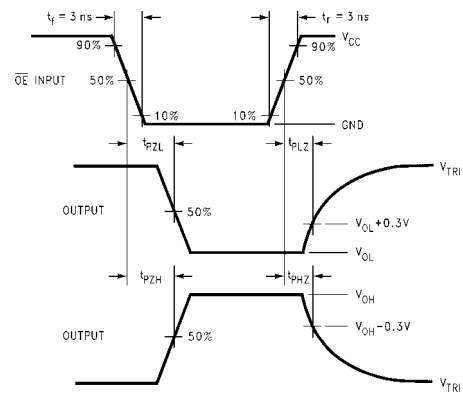


Figure 8. AC Waveforms

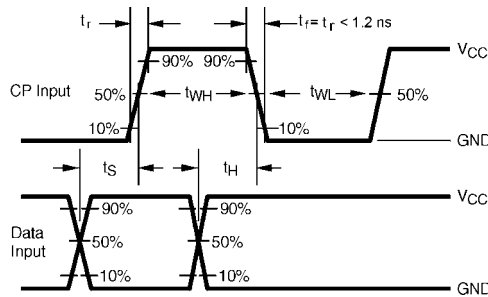


Figure 9. AC Waveforms

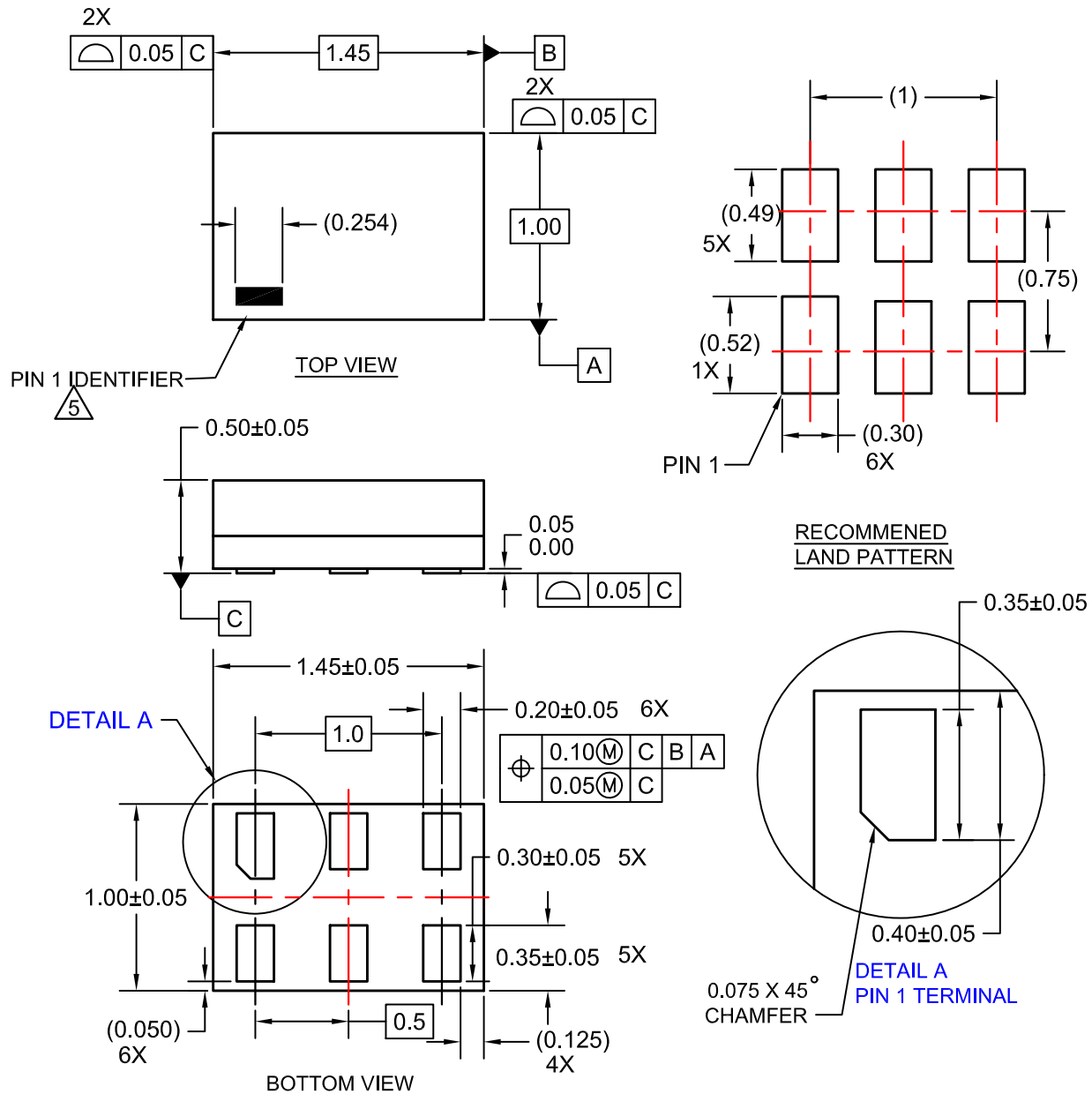
ORDERING INFORMATION

Device	Top Mark	Packages	Shipping [†]
NC7SZ374P6X	Z74	6-Lead SC70, EIAJ SC88, 1.25 mm Wide	3000 / Tape & Reel
NC7SZ374L6X	C9	6-Lead MicroPak, 1.00 mm Wide	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.

ON

DATE 31 AUG 2016



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.

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MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

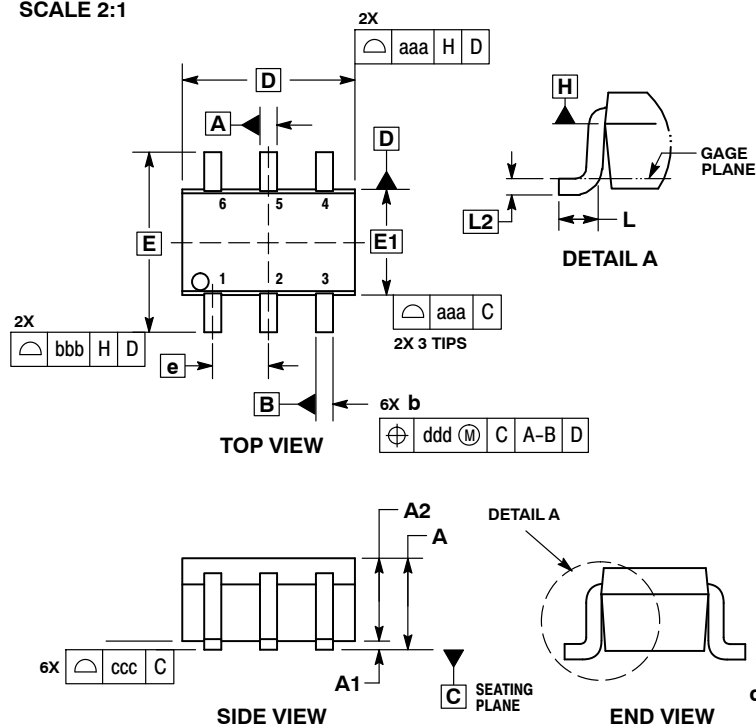
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SCALE 2:1

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

DATE 11 DEC 2012

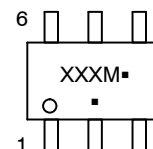


NOTES:

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*



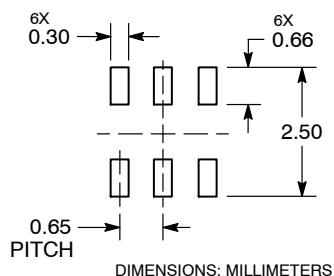
XXX = Specific Device Code
M = Date Code*
▪ = Pb-Free Package

(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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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. IOUT 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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