MC74VHC1G135

2-Input NAND Schmitt-Trigger with Open Drain Output

The MC74VHC1G135 is a single gate CMOS Schmitt NAND trigger with an open drain output fabricated with silicon gate CMOS technology. It achieves high speed operation similar to equivalent Bipolar Schottky TTL while maintaining CMOS low power dissipation.

The internal circuit is composed of three stages, including an open drain output which provides the capability to set the output switching level. This allows the MC74VHC1G135 to be used to interface 5.0 V circuits to circuits of any voltage between V_{CC} and 7.0 V using an external resistor and power supply.

The MC74VHC1G135 input structure provides protection when voltages up to 7 V are applied, regardless of the supply voltage.

The MC74VHC1G135 can be used to enhance noise immunity or to square up slowly changing waveforms.

- High Speed: t_{PD} = 4.9 ns (Typ) at V_{CC} = 5.0 V
- Low Internal Power Dissipation: I_{CC} = 1 μA (Max) at T_A = 25°C
- Power Down Protection Provided on Inputs
- Pin and Function Compatible with Other Standard Logic Families
- Chip Complexity: FETs = 70; Equivalent Gates = 18

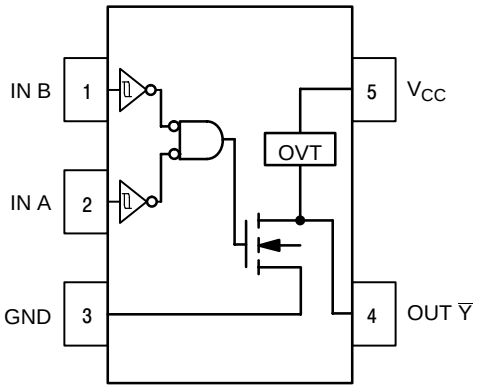

Figure 1. Pinout (Top View)

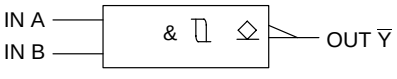

Figure 2. Logic Symbol

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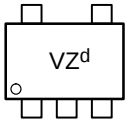
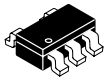
MARKING DIAGRAMS

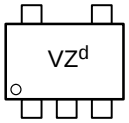
SC−88A / SOT−353/SC−70
DF SUFFIX
CASE 419A



Pin 1
d = Date Code



TSOP−5/SOT−23/SC−59
DT SUFFIX
CASE 483



Pin 1
d = Date Code

PIN ASSIGNMENT	
1	IN B
2	IN A
3	GND
4	OUT $\overline{Y}$
5	V_{CC}

FUNCTION TABLE

Inputs		Output
A	**B**	**$\overline{Y}$**
L	L	Z
L	H	Z
H	L	Z
H	H	L

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 4 of this data sheet.

MAXIMUM RATINGS (Note 1)

Symbol	Characteristics		Value	Unit
V_{CC}	DC Supply Voltage		−0.5 to +7.0	V
V_{IN}	DC Input Voltage		−0.5 to +7.0	V
V_{OUT}	DC Output Voltage		−0.5 to 7.0	V
I_{IK}	Input Diode Current		−20	mA
I_{OK}	Output Diode Current	V_{OUT} < GND; V_{OUT} > V_{CC}	+20	mA
I_{OUT}	DC Output Current, per Pin		+25	mA
I_{CC}	DC Supply Current, V_{CC} and GND		+50	mA
P_D	Power dissipation in still air	SC−88A, TSOP−5	200	mW
θ_{JA}	Thermal resistance	SC−88A, TSOP−5	333	°C/W
T_L	Lead temperature, 1 mm from case for 10 s		260	°C
T_J	Junction temperature under bias		+150	°C
T_{stg}	Storage temperature		−65 to +150	°C
V_{ESD}	ESD Withstand Voltage	Human Body Model (Note 2) Machine Model (Note 3) Charged Device Model (Note 4)	> 2000 > 200 N/A	V
$I_{Latch-Up}$	Latch−Up Performance	Above V_{CC} and Below GND at 125°C (Note 5)	±500	mA

1. Maximum Ratings are those values beyond which damage to the device may occur. Exposure to these conditions or conditions beyond those indicated may adversely affect device reliability. Functional operation under absolute−maximum−rated conditions is not implied. Functional operation should be restricted to the Recommended Operating Conditions.
2. Tested to EIA/JESD22−A114−A
3. Tested to EIA/JESD22−A115−A
4. Tested to JESD22−C101−A
5. Tested to EIA/JESD78

RECOMMENDED OPERATING CONDITIONS

Symbol	Characteristics	Min	Max	Unit
V_{CC}	DC Supply Voltage	2.0	5.5	V
V_{IN}	DC Input Voltage	0.0	5.5	V
V_{OUT}	DC Output Voltage	0.0	7.0	V
T_A	Operating Temperature Range	−55	+125	°C

DEVICE JUNCTION TEMPERATURE VERSUS TIME TO 0.1% BOND FAILURES

Junction Temperature °C	Time, Hours	Time, Years
80	1,032,200	117.8
90	419,300	47.9
100	178,700	20.4
110	79,600	9.4
120	37,000	4.2
130	17,800	2.0
140	8,900	1.0

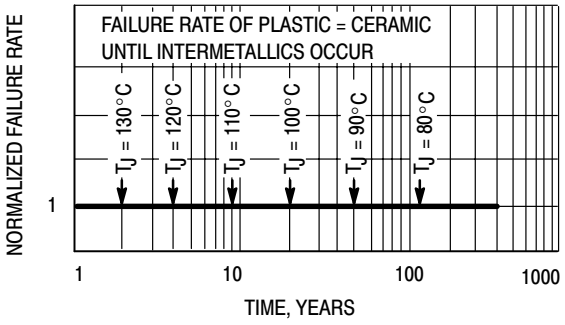


Figure 3. Failure Rate vs. Time Junction Temperature

DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Conditions	V_{CC} (V)	T_A = 25°C			$T_A \le$ 85°C		−55 ≤ $T_A \le$ 125°C		Unit
				Min	Typ	Max	Min	Max	Min	Max	
V_{T+}	Positive Threshold Voltage		3.0 4.5 5.5	1.50 2.35 2.80	1.88 2.66 3.21	2.25 3.10 3.70	1.50 2.35 2.80	2.25 3.10 3.70	1.50 2.35 2.80	2.25 3.10 3.70	V
V_{T-}	Negative Threshold Voltage		3.0 4.5 5.5	0.65 1.10 1.45	1.03 1.62 2.02	1.40 2.10 2.60	0.65 1.10 1.45	1.40 2.10 2.60	0.65 1.10 1.45	1.40 2.10 2.60	V
V_H	Hysteresis Voltage		3.0 4.5 5.5	0.30 0.40 0.50	0.85 1.05 1.20	1.60 2.00 2.25	0.30 0.40 0.50	1.60 2.00 2.25	0.30 0.40 0.50	1.60 2.00 2.25	V
V_{OH}	Minimum High−Level Output Voltage I_{OH} = −50 μA	$V_{IN} = V_{IH}$ or V_{IL} I_{OH} = −50 μA	2.0 3.0 4.5	1.9 2.9 4.4	2.0 3.0 4.5		1.9 2.9 4.4		1.9 2.9 4.4		V
		I_{OH} = −4 mA I_{OH} = −8 mA	3.0 4.5	2.58 3.94			2.48 3.80		2.34 3.66		V
V_{OL}	Maximum Low−Level Output Voltage	$V_{IN} = V_{IH}$ or V_{IL} I_{OL} = 50 μA	2.0 3.0 4.5		0.0 0.0 0.0	0.1 0.1 0.1		0.1 0.1 0.1		0.1 0.1 0.1	V
		I_{OL} = 4 mA I_{OL} = 8 mA	3.0 4.5			0.36 0.36		0.44 0.44		0.52 0.52	V
I_{IN}	Maximum Input Leakage Current	V_{IN} = 5.5 V or GND	0 to 5.5			±0.1		±1.0		±1.0	μA
I_{CC}	Maximum Quiescent Supply Current	$V_{IN} = V_{CC}$ or GND	5.5			1.0		20		40	μA
I_{OPD}	Maximum Off−state Leakage Current	V_{OUT} = 5.5 V	0			0.25		2.5		5.0	μA

AC ELECTRICAL CHARACTERISTICS C_{load} = 50 pF, Input t_r/t_f = 3.0 ns

Symbol	Parameter	Test Conditions	T_A = 25°C			$T_A \le$ 85°C		−55 ≤ $T_A \le$ 125°C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
t_{PZL}	Maximum Output Enable Time, A or B to $\overline{Y}$	V_{CC} = 3.3 ± 0.3 V C_L = 15 pF $R_L = R_I$ = 500 Ω C_L = 50 pF		7.6 10.1	11.9 15.4	1.0 1.0	14.0 17.5	1.0 1.0	16.1 19.6	ns
		V_{CC} = 5.0 ± 0.5 V C_L = 15 pF $R_L = R_I$ = 500 Ω C_L = 50 pF		4.9 6.4	7.7 9.7	1.0 1.0	9.0 11.0	1.0 1.0	10.3 12.3	
t_{PLZ}	Maximum Output Disable Time	V_{CC} = 3.3 ± 0.3 V C_L = 50 pF $R_L = R_I$ = 500 Ω		10.1	15.4		17.5		19.6	ns
		V_{CC} = 5.0 ± 0.5 V C_L = 50 pF $R_L = R_I$ = 500 Ω		6.4	9.7		11.0		12.3	
C_{IN}	Maximum Input Capacitance			5.0	10		10		10	pF

		Typical @ 25°C, V_{CC} = 5.0 V	
C_{PD}	Power Dissipation Capacitance (Note 6)	16	pF

6. 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: $I_{CC(OPR)} = C_{PD} \bullet V_{CC} \bullet f_{in} + I_{CC}$. C_{PD} is used to determine the no−load dynamic power consumption; $P_D = C_{PD} \bullet V_{CC}^2 \bullet f_{in} + I_{CC} \bullet V_{CC}$.

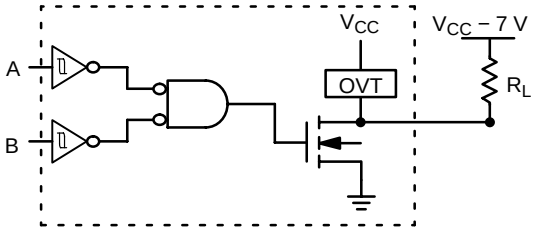


Figure 4. Output Voltage Mismatch Application

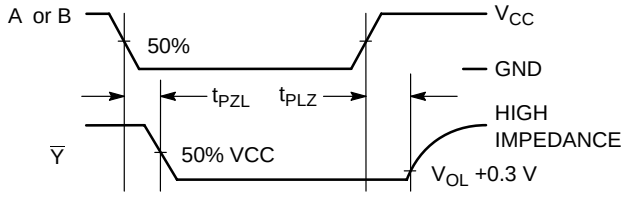
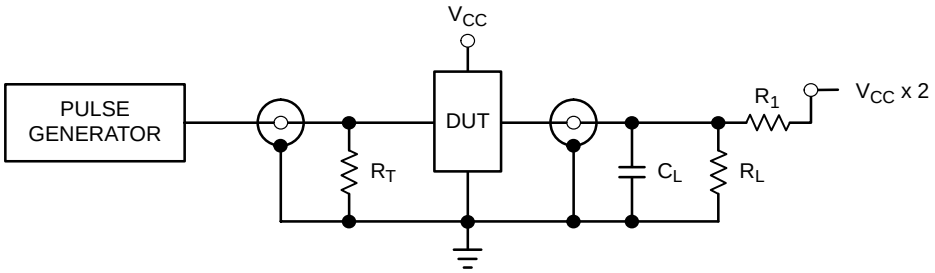


Figure 5. Switching Waveforms



C_L = 50 pF equivalent (Includes jig and probe capacitance)
$R_L = R_1$ = 500 Ω or equivalent
$R_T = Z_{OUT}$ of pulse generator (typically 50 Ω)

Figure 6. Test Circuit

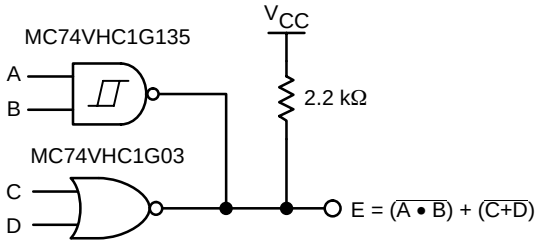


Figure 7. Complex Boolean Functions

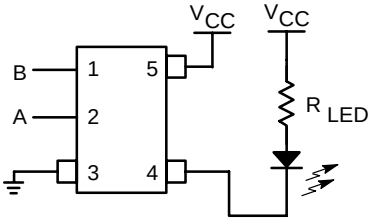


Figure 8. LED Driver

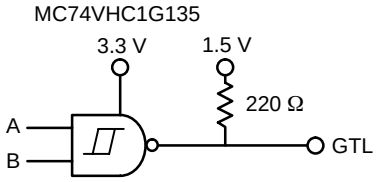


Figure 9. GTL Driver

DEVICE ORDERING INFORMATION

Device Order Number	Device Nomenclature						Package Type (Name/SOT#/ Common Name)	Tape and Reel Size†
	Circuit Indicator	Temp Range Identifier	Technology	Device Function	Package Suffix	Tape & Reel Suffix		
MC74VHC1G135DFT1	MC	74	VHC1G	135	DF	T1	SC−88A / SOT−353 / SC−70	178 mm (7”) 3000 Unit
MC74VHC1G135DFT2	MC	74	VHC1G	135	DF	T2	SC−88A / SOT−353 / SC−70	178 mm (7”) 3000 Unit
MC74VHC1G135DTT1	MC	74	VHC1G	135	DT	T1	TSOP−5 / SOT−23 / SC−59	178 mm (7”) 3000 Unit

†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.

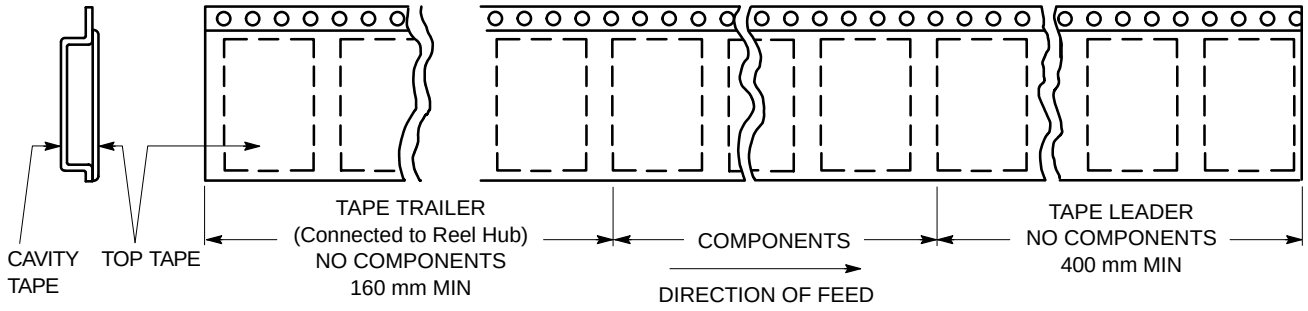


Figure 10. Tape Ends for Finished Goods

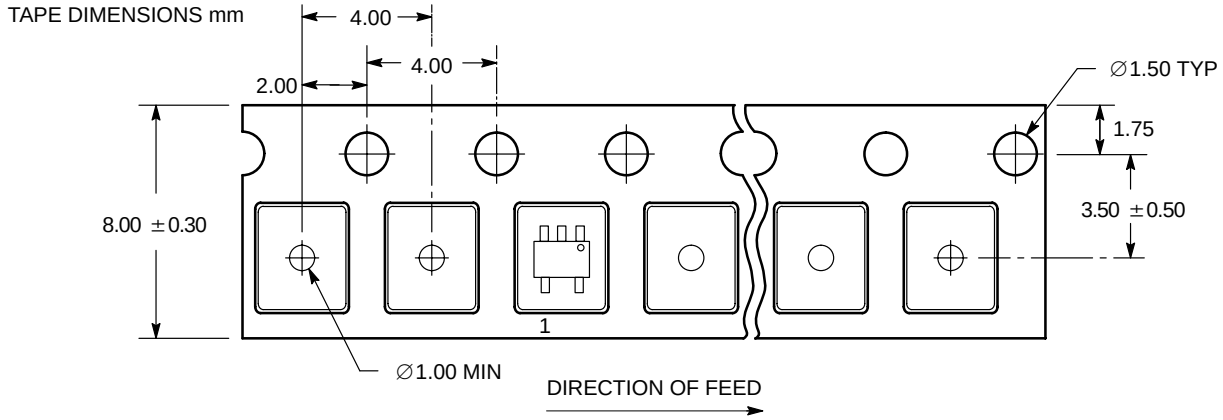


Figure 11. SC−70−5/SC−88A/SOT−353 DFT1 Reel Configuration/Orientation

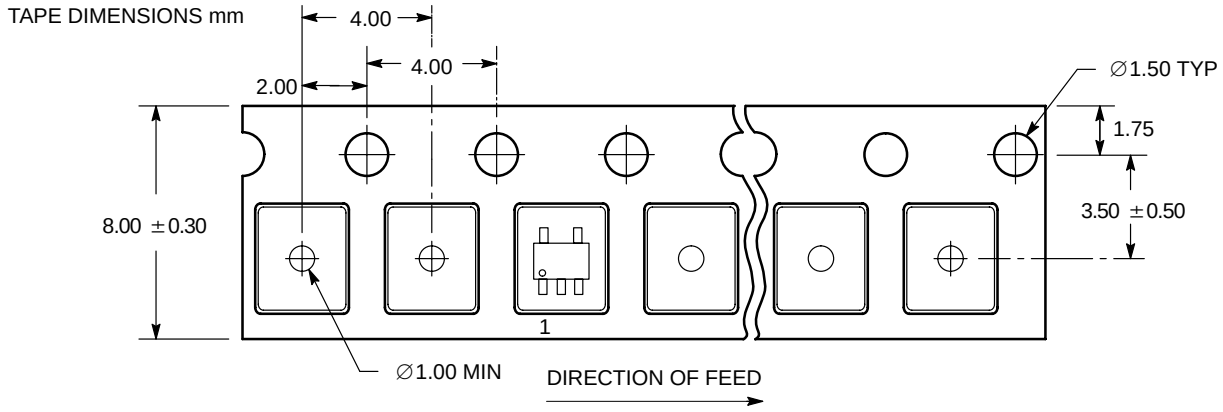


Figure 12. SC−70/SC−88A/SOT−353 DFT2 and SOT23−5/TSOP−5/SC59−5 DTT1 Reel Configuration/Orientation

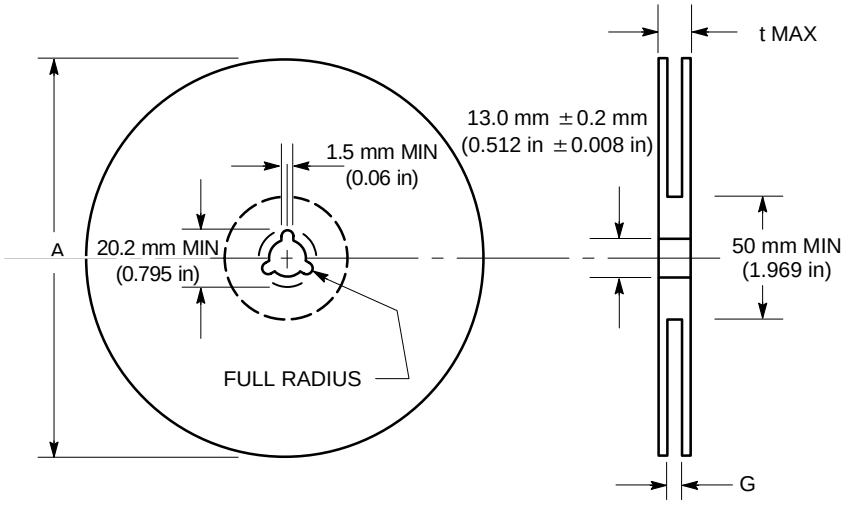


Figure 13. Reel Dimensions

REEL DIMENSIONS

Tape Size	T and R Suffix	A Max	G	t Max
8 mm	T1, T2	178 mm (7 in)	8.4 mm, + 1.5 mm, −0.0 (0.33 in + 0.059 in, −0.00)	14.4 mm (0.56 in)

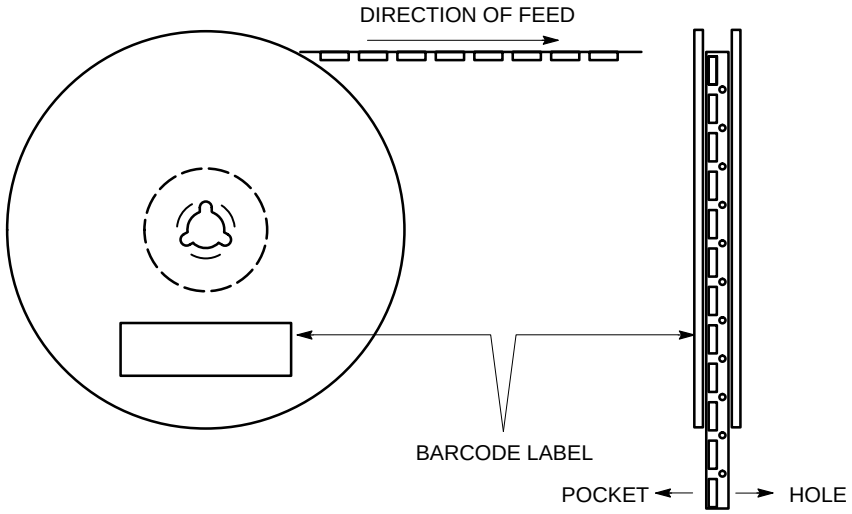
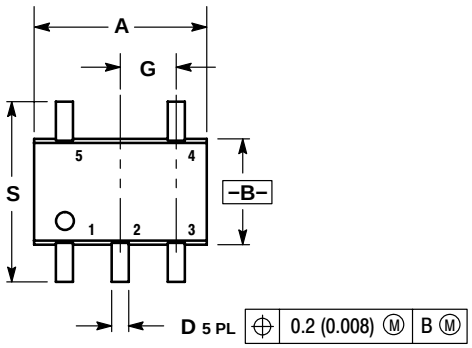
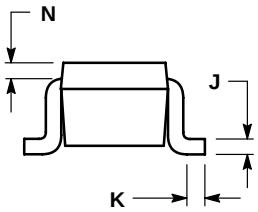


Figure 14. Reel Winding Direction

PACKAGE DIMENSIONS

SC70−5/SC−88A/SOT−353
DF SUFFIX
5−LEAD PACKAGE
CASE 419A−02
ISSUE G





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
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

SOLDERING FOOTPRINT*

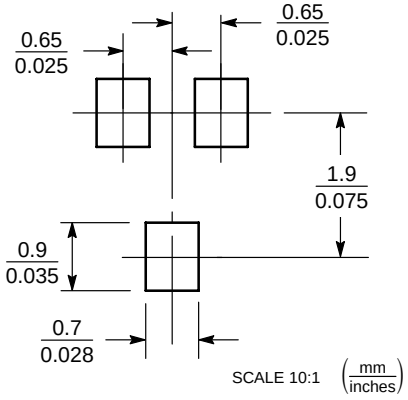
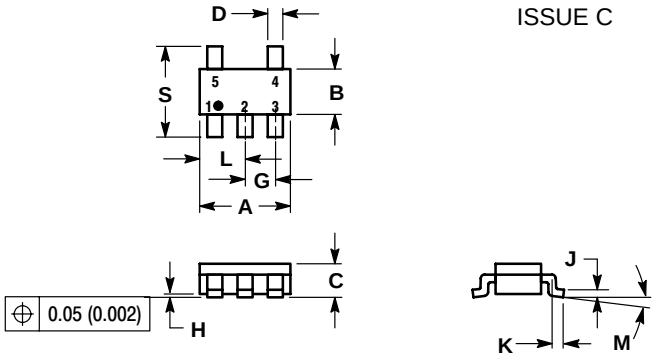


Figure 15. SC−70/SOT−323

*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

SOT23−5/TSOP−5/SC59−5
DT SUFFIX
5−LEAD PACKAGE
CASE 483−01
ISSUE C



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. A AND B DIMENSIONS DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	2.90	3.10	0.1142	0.1220
B	1.30	1.70	0.0512	0.0669
C	0.90	1.10	0.0354	0.0433
D	0.25	0.50	0.0098	0.0197
G	0.85	1.05	0.0335	0.0413
H	0.013	0.100	0.0005	0.0040
J	0.10	0.26	0.0040	0.0102
K	0.20	0.60	0.0079	0.0236
L	1.25	1.55	0.0493	0.0610
M	0	10	0	10
S	2.50	3.00	0.0985	0.1181

SOLDERING FOOTPRINT*

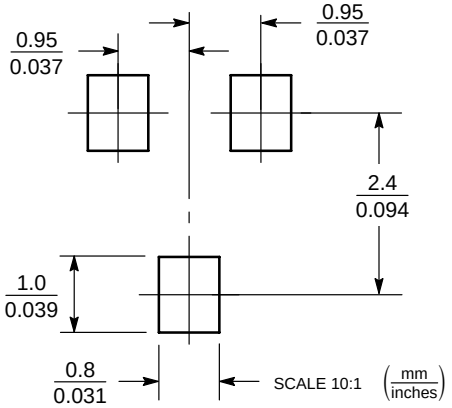


Figure 16. SC−59

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

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 USA
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Fax: 303−675−2176 or 800−344−3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800−282−9855 Toll Free USA/Canada

Japan: ON Semiconductor, Japan Customer Focus Center
2−9−1 Kamimeguro, Meguro−ku, Tokyo, Japan 153−0051
Phone: 81−3−5773−3850

ON Semiconductor Website: http://onsemi.com

Order Literature: http://www.onsemi.com/litorder

For additional information, please contact your local Sales Representative.