

# MC74VHC1GU04

## Single Unbuffered Inverter

The MC74VHC1GU04 is an advanced high speed CMOS Unbuffered inverter fabricated with silicon gate CMOS technology.

This device consists of a single unbuffered inverter. In combination with others, or in the MC74VHCU04 Hex Unbuffered Inverter, these devices are well suited for use as oscillators, pulse shapers, and in many other applications requiring a high-input impedance amplifier. For digital applications, the MC74VHC1G04 or the MC74VHC04 are recommended.

The internal circuit is composed of three stages, including a buffer output which provides high noise immunity and stable output.

The MC74VHC1GU04 input structure provides protection when voltages up to 7.0 V are applied, regardless of the supply voltage. This allows the MC74VHC1GU04 to be used to interface 5.0 V circuits to 3.0 V circuits.

- High Speed:  $t_{PD} = 2.5$  ns (Typ) at  $V_{CC} = 5$  V
- Low Power Dissipation:  $I_{CC} = 1$   $\mu$ A (Max) at  $T_A = 25^\circ\text{C}$
- Power Down Protection Provided on Inputs
- Balanced Propagation Delays
- Pin and Function Compatible with Other Standard Logic Families
- Chip Complexity: FETs = 105

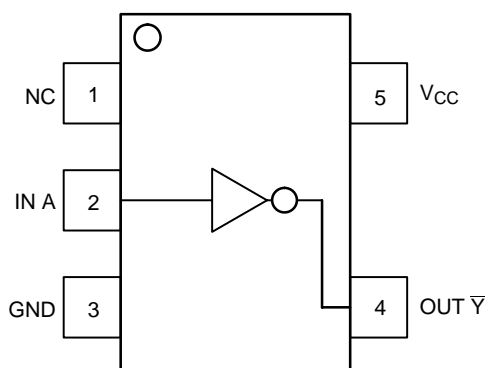


Figure 1. Pinout

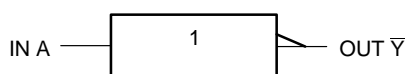


Figure 2. Logic Symbol

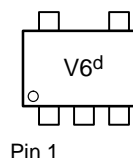


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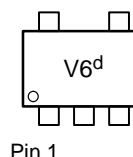
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### MARKING DIAGRAMS

5  
1  
SC70-5/SC-88A/SOT-353  
DF SUFFIX  
CASE 419A



5  
1  
SOT23-5/TSOP-5/SC59-5  
DT SUFFIX  
CASE 483



d = Date Code

### PIN ASSIGNMENT

Pin	Assignment
1	NC
2	IN A
3	GND
4	OUT $\bar{Y}$
5	$V_{CC}$

### FUNCTION TABLE

A Input	$\bar{Y}$ Output
L	H
H	L

### ORDERING INFORMATION

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

# MC74VHC1GU04

## MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	DC Supply Voltage	− 0.5 to + 7.0	V
V <sub>IN</sub>	DC Input Voltage	−0.5 to +7.0	V
V <sub>OUT</sub>	DC Output Voltage	− 0.5 to V <sub>CC</sub> + 0.5	V
I <sub>IK</sub>	DC Input Diode Current	−20	mA
I <sub>OK</sub>	DC Output Diode Current	± 20	mA
I <sub>OUT</sub>	DC Output Sink Current	± 12.5	mA
I <sub>CC</sub>	DC Supply Current per Supply Pin	± 25	mA
T <sub>STG</sub>	Storage Temperature Range	− 65 to + 150	°C
T <sub>L</sub>	Lead Temperature, 1 mm from Case for 10 Seconds	260	°C
T <sub>J</sub>	Junction Temperature Under Bias	+ 150	°C
θ <sub>JA</sub>	Thermal Resistance	SC70-5/SC-88A (Note 1) TSOP-5 350 230	°C/W
P <sub>D</sub>	Power Dissipation in Still Air at 85°C	SC70-5/SC-88A TSOP-5 150 200	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	Human Body Model (Note 2) Machine Model (Note 3) Charged Device Model (Note 4) > 1500 > 200 N/A	V
I <sub>LATCH-UP</sub>	Latch-Up Performance	Above V <sub>CC</sub> and Below GND at 125°C (Note 5) ± 500	mA

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.

1. Measured with minimum pad spacing on an FR4 board, using 10 mm-by-1 inch, 2-ounce copper trace with no air flow.
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	Parameter	Min	Max	Unit
V <sub>CC</sub>	DC Supply Voltage	2.0	5.5	V
V <sub>IN</sub>	DC Input Voltage	0.0	5.5	V
V <sub>OUT</sub>	DC Output Voltage	0.0	V <sub>CC</sub>	V
T <sub>A</sub>	Operating Temperature Range	− 55	+ 125	°C
t <sub>r</sub> , t <sub>f</sub>	Input Rise and Fall Time	V <sub>CC</sub> = 3.3 V ± 0.3 V V <sub>CC</sub> = 5.0 V ± 0.5 V 0 0	100 20	ns/V

## 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

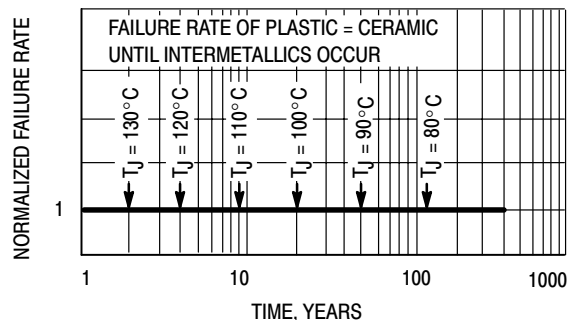


Figure 3. Failure Rate vs. Time Junction Temperature

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## DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> = 25°C			T <sub>A</sub> ≤ 85°C		-55 ≤ T <sub>A</sub> ≤ 125°C		Unit
				Min	Typ	Max	Min	Max	Min	Max	
V <sub>IH</sub>	Minimum High-Level Input Voltage		2.0 3.0 4.5 5.5	1.7 2.4 3.6 4.4			1.7 2.4 3.6 4.4		1.7 2.4 3.6 4.4		V
V <sub>IL</sub>	Maximum Low-Level Input Voltage		2.0 3.0 4.5 5.5			0.3 0.6 0.9 1.1		0.3 0.6 0.9 1.1		0.3 0.6 0.9 1.1	V
V <sub>OH</sub>	Minimum High-Level Output Voltage V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>OH</sub> = -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
		V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>OH</sub> = -4 mA I <sub>OH</sub> = -8 mA	3.0 4.5	2.58 3.94			2.48 3.80		2.34 3.66		V
V <sub>OL</sub>	Maximum Low-Level Output Voltage V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>OL</sub> = 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
		V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>OL</sub> = 4 mA I <sub>OL</sub> = 8 mA	3.0 4.5			0.36 0.36		0.44 0.44		0.52 0.52	V
I <sub>IN</sub>	Maximum Input Leakage Current	V <sub>IN</sub> = 5.5 V or GND	0 to 5.5			±0.1		±1.0		±1.0	μA
I <sub>CC</sub>	Maximum Quiescent Supply Current	V <sub>IN</sub> = V <sub>CC</sub> or GND	5.5			1.0		20		40	μA

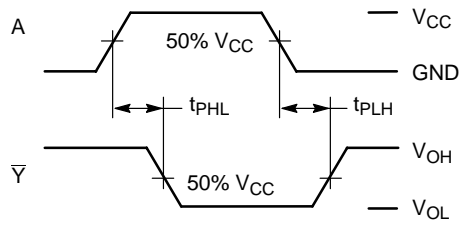
## AC ELECTRICAL CHARACTERISTICS Input t<sub>r</sub> = t<sub>f</sub> = 3.0 ns

Symbol	Parameter	Test Conditions	T <sub>A</sub> = 25°C			T <sub>A</sub> ≤ 85°C		-55 ≤ T <sub>A</sub> ≤ 125°C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
t <sub>PLH</sub> , t <sub>PHL</sub>	Maximum Propagation Delay, Input A to Y	V <sub>CC</sub> = 3.3 ± 0.3 V C <sub>L</sub> = 15 pF C <sub>L</sub> = 50 pF		3.5 4.8	8.9 11.4		10.5 13.0		12.0 15.5	ns
		V <sub>CC</sub> = 5.0 ± 0.5 V C <sub>L</sub> = 15 pF C <sub>L</sub> = 50 pF		2.5 3.8	5.5 7.0		6.5 8.0		8.0 9.5	
C <sub>IN</sub>	Maximum Input Capacitance			4	10		10		10	pF

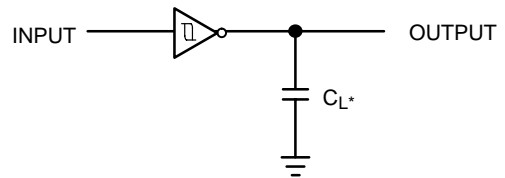
C <sub>PD</sub>	Power Dissipation Capacitance (Note 6)	Typical @ 25°C, V <sub>CC</sub> = 5.0V	pF
		22	

6. 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>.

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**Figure 4. Switching Waveforms**



\*Includes all probe and jig capacitance.  
A 1-MHz square input wave is recommended for propagation delay tests.

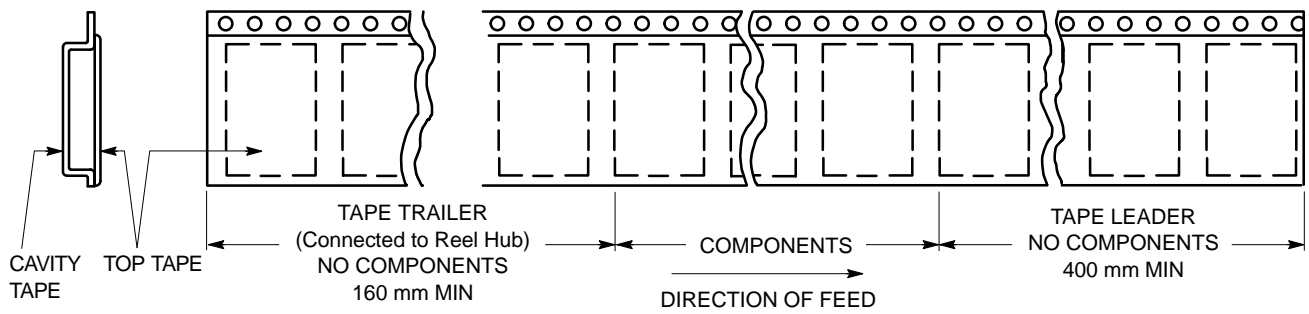
**Figure 5. Test Circuit**

## DEVICE ORDERING INFORMATION

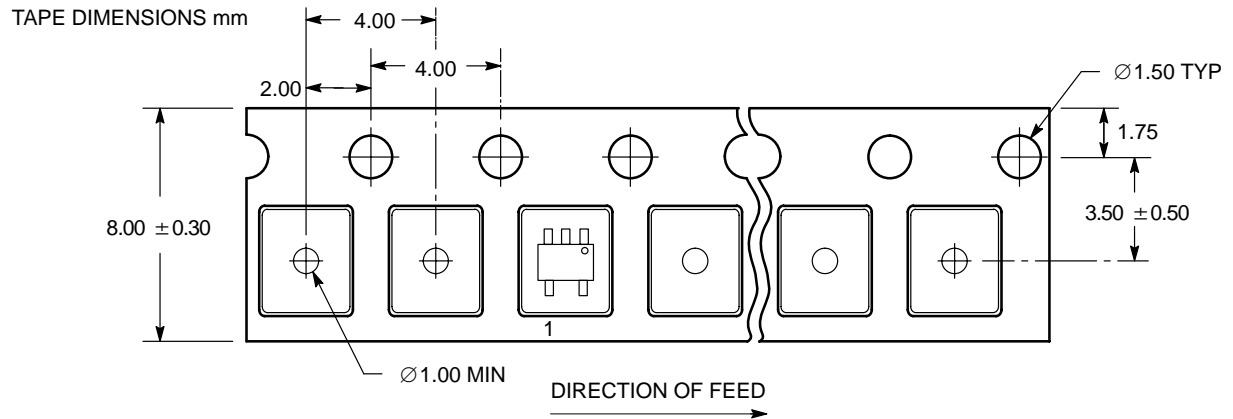
Device Order Number	Device Nomenclature						Package Type (Name/SOT#/Common Name)	Tape and Reel Size†
	Circuit Indicator	Temp Range Identifier	Technology	Device Function	Package Suffix	Tape & Reel Suffix		
MC74VHC1GU04DFT1	MC	74	VHC1G	U04	DF	T1	SC70-5/SC-88A/SOT-353	178 mm (7 in) 3000 Unit
MC74VHC1GU04DFT2	MC	74	VHC1G	U04	DF	T2	SC70-5/SC-88A/SOT-353	178 mm (7 in) 3000 Unit
MC74VHC1GU04DTT1	MC	74	VHC1G	U04	DT	T1	SOT23-5/TSOP-5 / SC59-5	178 mm (7 in) 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.

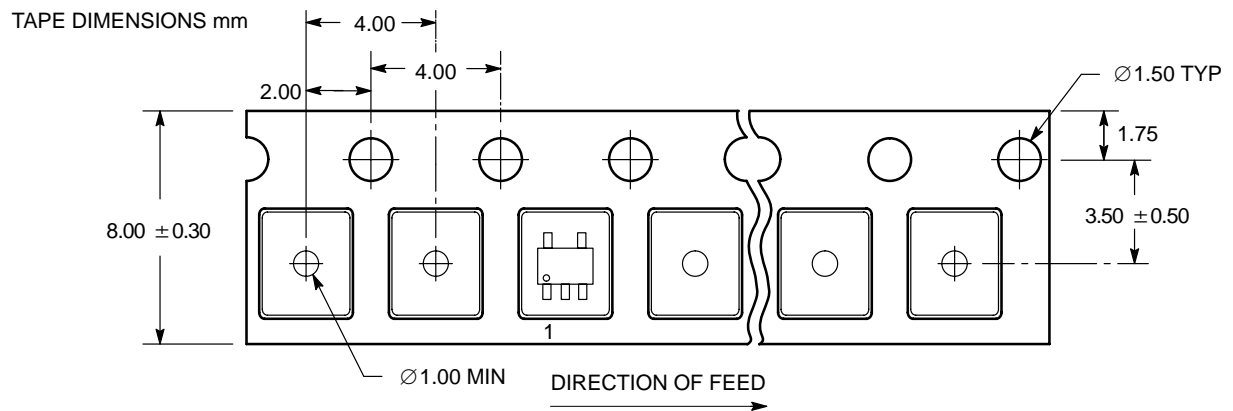
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**Figure 6. Tape Ends for Finished Goods**



**Figure 7. SC-70-5/SC-88A/SOT-353 DFT1 Reel Configuration/Orientation**



**Figure 8. SC-70/SC-88A/SOT-353 DFT2 and SOT23-5/TSOP-5/SC59-5 DTT1 Reel Configuration/Orientation**

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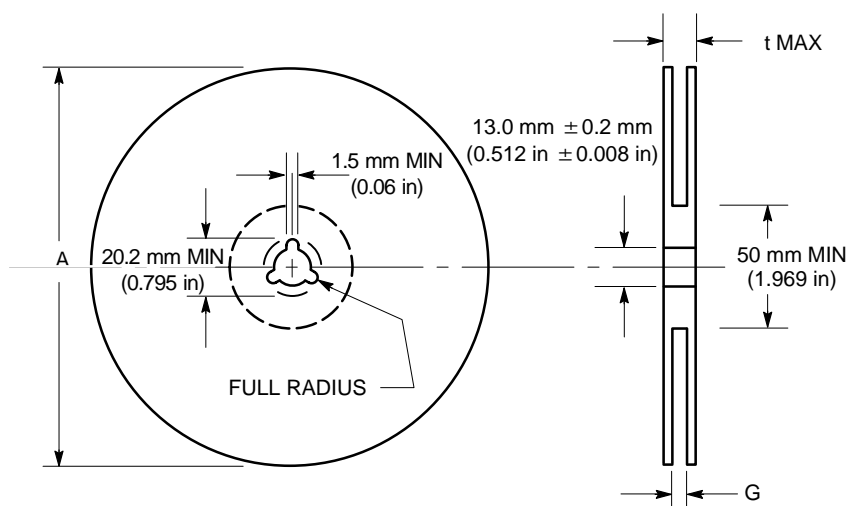


Figure 9. Reel Dimensions

### 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)

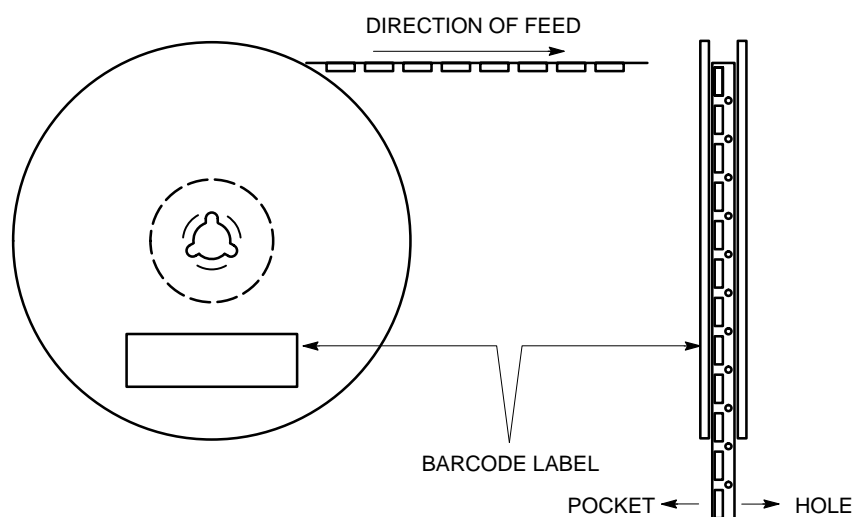
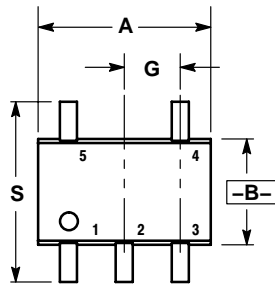


Figure 10. Reel Winding Direction

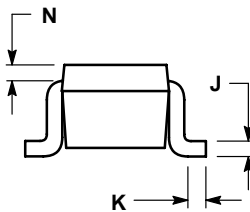
# MC74VHC1GU04

## PACKAGE DIMENSIONS

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



D 5 PL  $\oplus$  0.2 (0.008) (M) B (M)

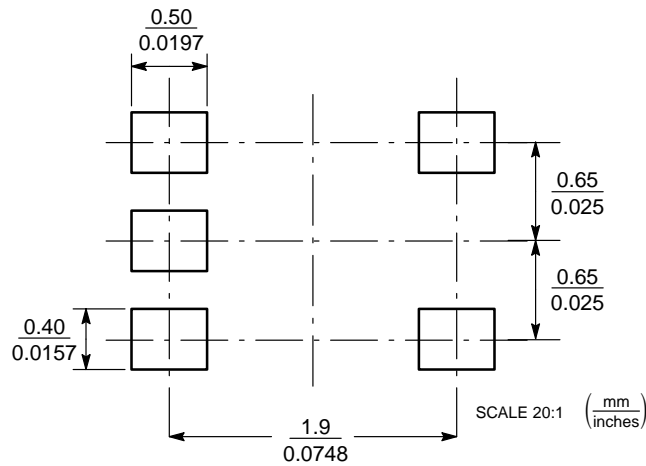


### NOTES:

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

### SOLDERING FOOTPRINT\*



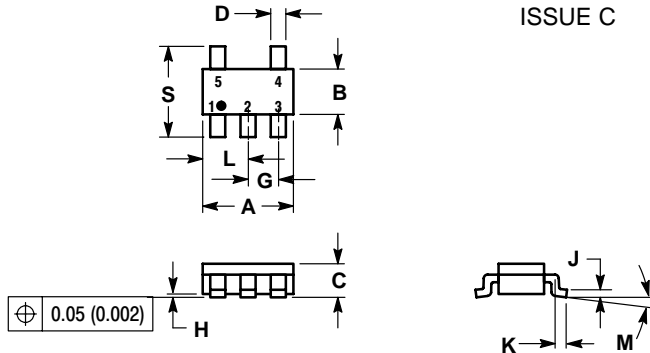
**Figure 11. SC-88A/SC70-5/SOT-353**

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

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## 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.

DIM	MILLIMETERS		INCHES	
	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\*

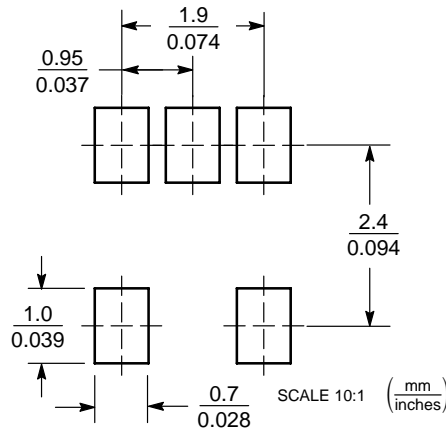



Figure 12. THIN SOT23-5/TSOP-5/SC59-5

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

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