

MC74VHC1GT04

Inverting Buffer / CMOS Logic Level Shifter with LSTTL-Compatible Inputs

The MC74VHC1GT04 is a single gate inverting buffer 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 a buffer output which provides high noise immunity and stable output.

The device input is compatible with TTL-type input thresholds and the output has a full 5V CMOS level output swing. The input protection circuitry on this device allows overvoltage tolerance on the input, allowing the device to be used as a logic-level translator from 3.0V CMOS logic to 5.0V CMOS Logic or from 1.8V CMOS logic to 3.0V CMOS Logic while operating at the high-voltage power supply.

The MC74VHC1GT04 input structure provides protection when voltages up to 7V are applied, regardless of the supply voltage. This allows the MC74VHC1GT04 to be used to interface 5V circuits to 3V circuits. The output structures also provide protection when $V_{CC} = 0V$. These input and output structures help prevent device destruction caused by supply voltage – input/output voltage mismatch, battery backup, hot insertion, etc.

- High Speed: $t_{PD} = 3.8ns$ (Typ) at $V_{CC} = 5V$
- Low Power Dissipation: $I_{CC} = 2\mu A$ (Max) at $T_A = 25^\circ C$
- TTL-Compatible Inputs: $V_{IL} = 0.8V$; $V_{IH} = 2.0V$
- CMOS-Compatible Outputs: $V_{OH} > 0.8V_{CC}$; $V_{OL} < 0.1V_{CC}$ @Load
- Power Down Protection Provided on Inputs and Outputs
- Balanced Propagation Delays
- Pin and Function Compatible with Other Standard Logic Families
- Latchup Performance Exceeds 300mA
- ESD Performance: HBM > 1500V; MM > 200V

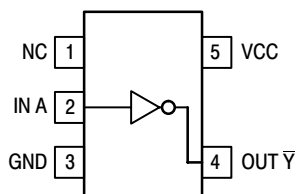


Figure 1. 5-Lead SOT-353 Pinout (Top View)

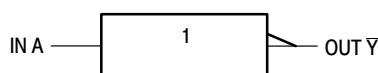


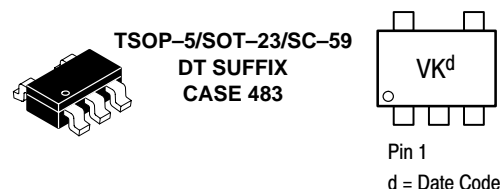
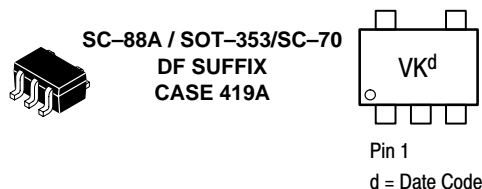
Figure 2. Logic Symbol



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MARKING DIAGRAMS



PIN ASSIGNMENT

	PIN ASSIGNMENT
1	NC
2	IN A
3	GND
4	OUT \bar{Y}
5	VCC

ORDERING INFORMATION

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

FUNCTION TABLE

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

MC74VHC1GT04

MAXIMUM RATINGS*

Characteristics	Symbol	Value	Unit
DC Supply Voltage	V_{CC}	-0.5 to +7.0	V
DC Input Voltage	V_{IN}	-0.5 to +7.0	V
DC Output Voltage $V_{CC} = 0$ High or Low State	V_{OUT}	-0.5 to 7.0 -0.5 to $V_{CC} + 0.5$	V
Input Diode Current	I_{IK}	-20	mA
Output Diode Current ($V_{OUT} < GND$; $V_{OUT} > V_{CC}$)	I_{OK}	+20	mA
DC Output Current, per Pin	I_{OUT}	+25	mA
DC Supply Current, V_{CC} and GND	I_{CC}	+50	mA
Power dissipation in still air, SC-88A †	P_D	200	mW
Lead temperature, 1 mm from case for 10 s	T_L	260	°C
Storage temperature	T_{stg}	-65 to +150	°C

* 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.

† Derating — SC-88A Package: -3 mW/°C from 65° to 125°C

RECOMMENDED OPERATING CONDITIONS

Characteristics	Symbol	Min	Max	Unit
DC Supply Voltage	V_{CC}	3.0	5.5	V
DC Input Voltage	V_{IN}	0.0	5.5	V
DC Output Voltage $V_{CC} = 0$ High or Low State	V_{OUT}	0.0 0.0	5.5 V_{CC}	V
Operating Temperature Range	T_A	-55	+125	°C
Input Rise and Fall Time $V_{CC} = 3.3V \pm 0.3V$ $V_{CC} = 5.0V \pm 0.5V$	t_r, t_f	0 0	100 20	ns/V

The θ_{JA} of the package is equal to 1/Derating. Higher junction temperatures may affect the expected lifetime of the device per the table and figure below.

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

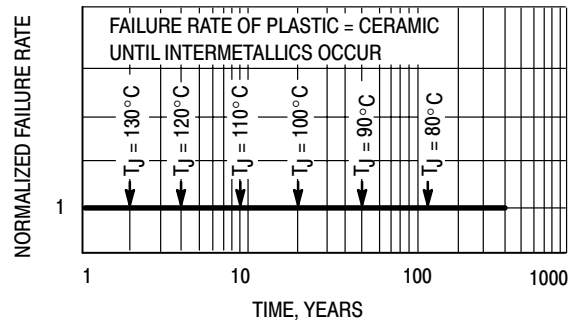


Figure 3. Failure Rate vs. Time Junction Temperature

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DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Conditions	V _{CC} (V)	T _A = 25°C			T _A ≤ 85°C		T _A ≤ 125°C		Unit
				Min	Typ	Max	Min	Max	Min	Max	
V _{IH}	Minimum High-Level Input Voltage		3.0 4.5 5.5	1.4 2.0 2.0			1.4 2.0 2.0		1.4 2.0 2.0		V
V _{IL}	Maximum Low-Level Input Voltage		3.0 4.5 5.5			0.53 0.8 0.8		0.53 0.8 0.8		0.53 0.8 0.8	V
V _{OH}	Minimum High-Level Output Voltage V _{IN} = V _{IH} or V _{IL}	V _{IN} = V _{IH} or V _{IL} I _{OH} = -50μA	3.0 4.5	2.9 4.4	3.0 4.5		2.9 4.4		2.9 4.4		V
		V _{IN} = V _{IH} or V _{IL} I _{OH} = -4mA	3.0 4.5	2.58 3.94			2.48 3.80		2.34 3.66		V
		V _{IN} = V _{IH} or V _{IL} I _{OH} = -8mA	3.0 4.5								V
V _{OL}	Maximum Low-Level Output Voltage V _{IN} = V _{IH} or V _{IL}	V _{IN} = V _{IH} or V _{IL} I _{OL} = 50μA	3.0 4.5		0.0 0.0	0.1 0.1		0.1 0.1		0.1 0.1	V
		V _{IN} = V _{IH} or V _{IL} I _{OL} = 4mA	3.0 4.5			0.36 0.36		0.44 0.44		0.52 0.52	V
		V _{IN} = V _{IH} or V _{IL} I _{OL} = 8mA	3.0 4.5								V
I _{IN}	Maximum Input Leakage Current	V _{IN} = 5.5V 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			2.0		20		40	μA
I _{CCT}	Quiescent Supply Current	Input: V _{IN} = 3.4V	5.5			1.35		1.50		1.65	mA
I _{OPD}	Output Leakage Current	V _{OUT} = 5.5V	0.0			0.5		5.0		10	μA

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

Symbol	Parameter	Test Conditions	T _A = 25°C			T _A ≤ 85°C		T _A ≤ 125°C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
t _{PLH} , t _{PHL}	Maximum Propagation Delay, Input A to Y	V _{CC} = 3.0 ± 0.3V C _L = 15 pF C _L = 50 pF		5.0 6.2	10.0 13.5		11.0 15.0		13.0 17.5	ns
		V _{CC} = 5.0 ± 0.5V C _L = 15 pF C _L = 50 pF		3.8 4.2	6.7 7.7		7.5 8.5		8.5 9.5	
C _{IN}	Maximum Input Capacitance			5	10		10		10	pF

C _{PD}	Power Dissipation Capacitance (Note 1.)	Typical @ 25°C, V _{CC} = 5.0V	pF
		10	

1. 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}.

MC74VHC1GT04

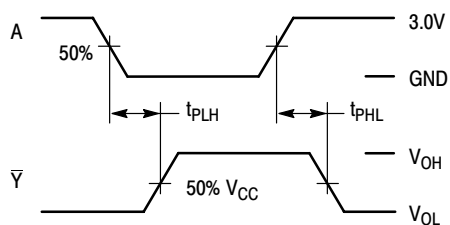
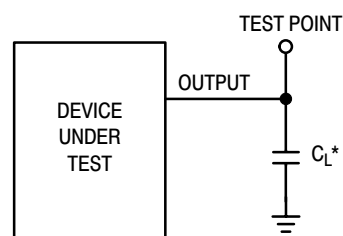


Figure 4. Switching Waveforms



*Includes all probe and jig capacitance

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		
MC74VHC1GT04DFT2	MC	74	VHC1G	T04	DF	T2	SC-88A / SOT-353 / SC-70	178 mm (7") 3000 Unit
MC74VHC1GT04DFT4	MC	74	VHC1G	T04	DF	T4	SC-88A / SOT-353 / SC-70	330 mm (13") 10000 Unit
MC74VHC1GT04DTT1	MC	74	VHC1G	T04	DT	T1	TSOPS / SOT-23 / SC-59	178 mm (7") 3000 Unit
MC74VHC1GT04DTT3	MC	74	VHC1G	T04	DT	T3	TSOPS / SOT-23 / SC-59	330 mm (13") 10000 Unit

MC74VHC1GT04

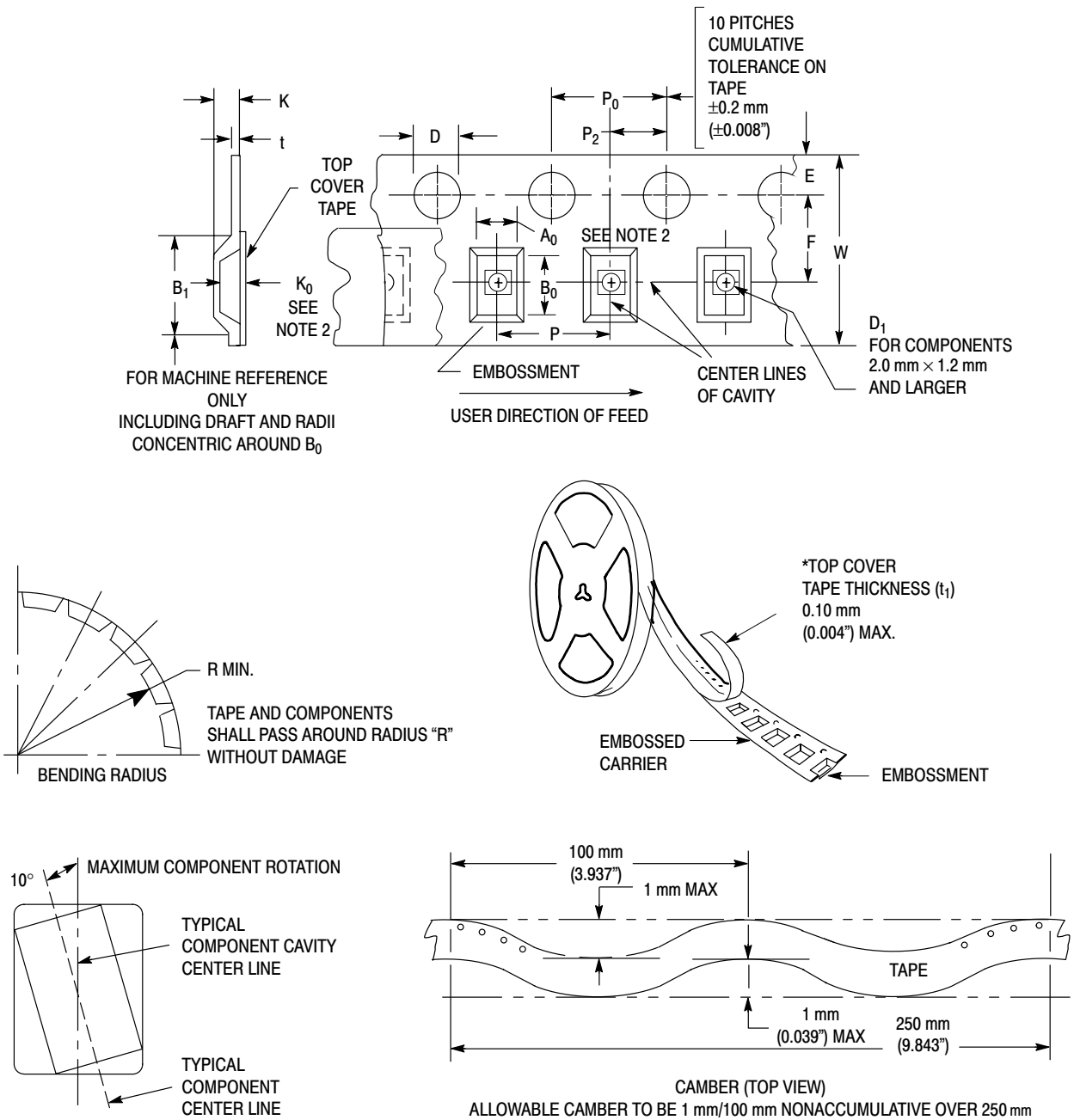


Figure 6. Carrier Tape Specifications

EMBOSSED CARRIER DIMENSIONS (See Notes 1 and 2)

Tape Size	B_1 Max	D	D_1	E	F	K	P	P_0	P_2	R	T	W
8 mm	4.35 mm (0.171")	1.5 +0.1/-0.0 mm (0.059 +0.004/-0.0")	1.0 mm Min (0.039")	1.75 ± 0.1 mm (0.069 ± 0.004 ")	3.5 ± 0.5 mm (1.38 ± 0.002 ")	2.4 mm (0.094")	4.0 ± 0.10 mm (0.157 ± 0.004 ")	4.0 ± 0.1 mm (0.156 ± 0.004 ")	2.0 ± 0.1 mm (0.079 ± 0.002 ")	25 mm (0.98")	0.3 ± 0.05 mm (0.01 +0.0038/-0.0002")	8.0 ± 0.3 mm (0.315 ± 0.012 ")

1. Metric Dimensions Govern—English are in parentheses for reference only.

2. A_0 , B_0 , and K_0 are determined by component size. The clearance between the components and the cavity must be within 0.05 mm min to 0.50 mm max. The component cannot rotate more than 10° within the determined cavity

MC74VHC1GT04

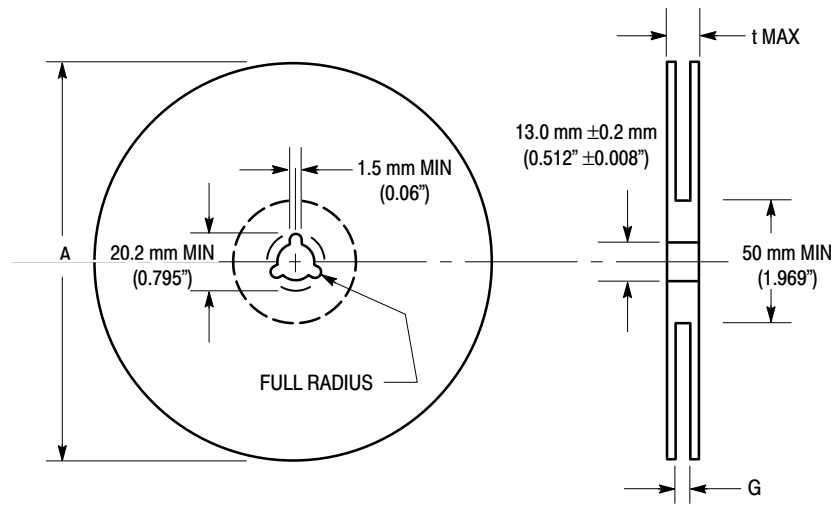


Figure 7. Reel Dimensions

REEL DIMENSIONS

Tape Size	T&R Suffix	A Max	G	t Max
8 mm	T1, T2	178 mm (7")	8.4 mm, +1.5 mm, -0.0 (0.33" + 0.059", -0.00)	14.4 mm (0.56")
8 mm	T3, T4	330 mm (13")	8.4 mm, +1.5 mm, -0.0 (0.33" + 0.059", -0.00)	14.4 mm (0.56")

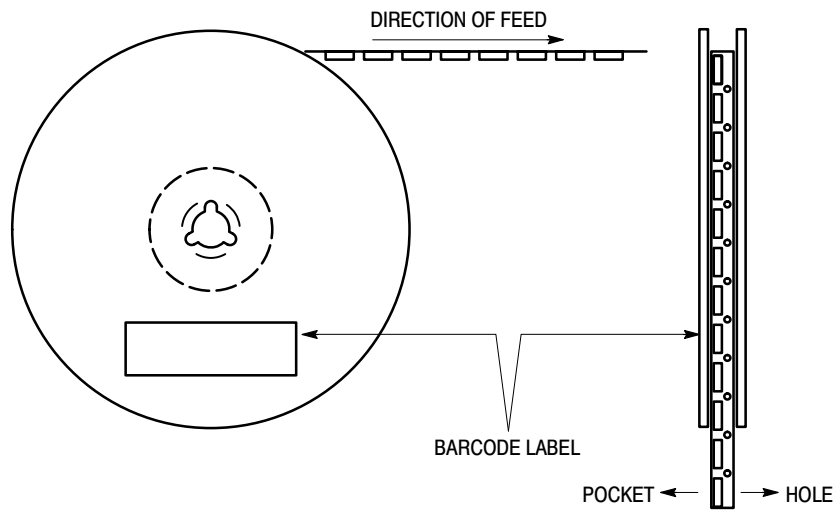


Figure 8. Reel Winding Direction

MC74VHC1GT04

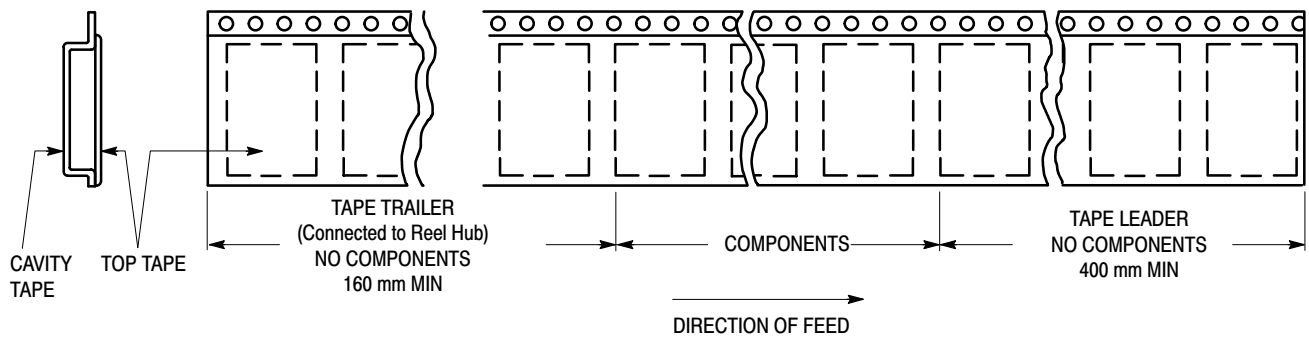


Figure 9. Tape Ends for Finished Goods

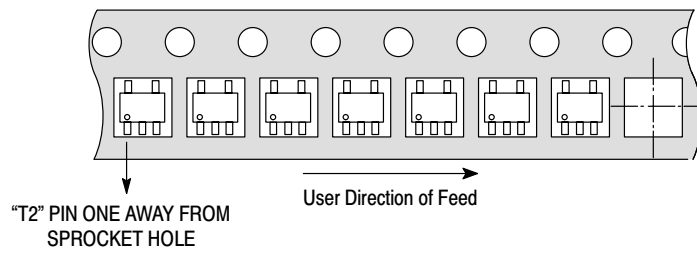


Figure 10. DFT2 and DFT4 (SC88A) Reel Configuration/Orientation

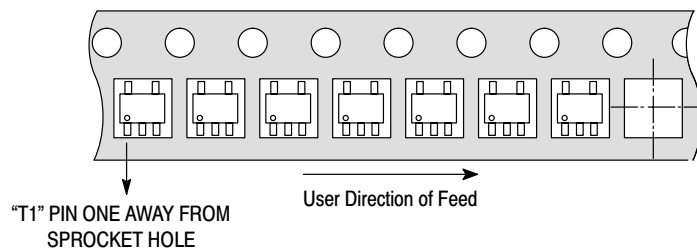
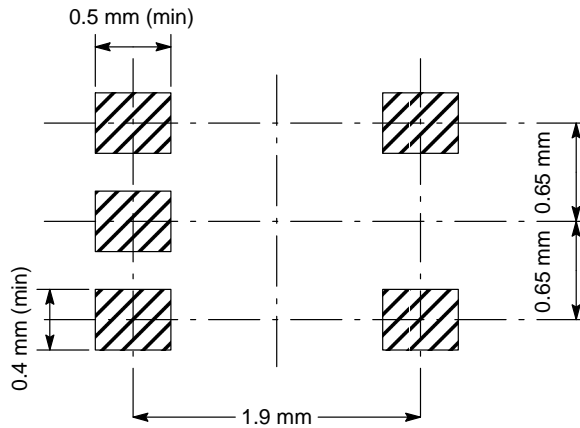
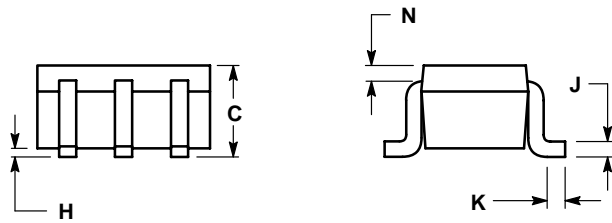
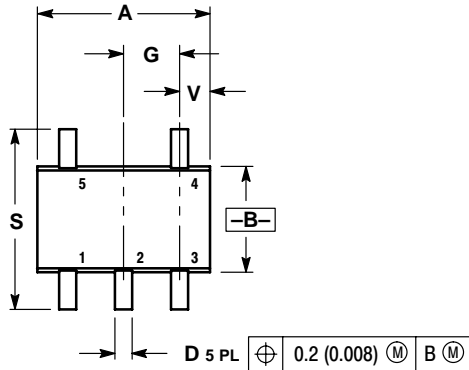


Figure 11. DTT1 and DTT3 (TSOP5) Reel Configuration/Orientation

MC74VHC1GT04

SC-88A / SOT-353 / SC-70
 DF SUFFIX
 5-LEAD PACKAGE
 CASE 419A-01
 ISSUE B



- NOTES:
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: MM.

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
V	0.012	0.016	0.30	0.40

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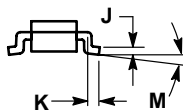
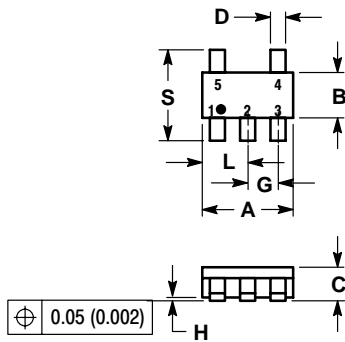
TSOP-5 / SOT-23 / SC-59

DT SUFFIX

5-LEAD PACKAGE

CASE 483-01

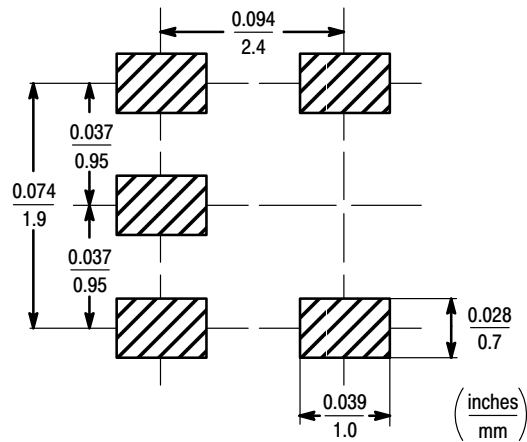
ISSUE A



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.

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	1.00	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



Notes

Notes

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