

# MC74VHC1GT86

## 2-Input Exclusive OR Gate / CMOS Logic Level Shifter with LSTTL-Compatible Inputs

The MC74VHC1GT86 is an advanced high speed CMOS 2-input Exclusive OR gate 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 MC74VHC1GT86 input structure provides protection when voltages up to 7V are applied, regardless of the supply voltage. This allows the MC74VHC1GT86 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:  $t_{PD} = 4.8ns$  (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 > 2000V; MM > 200V, CDM > 1500V

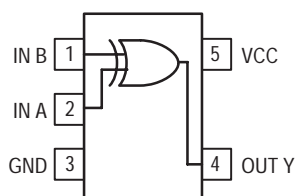
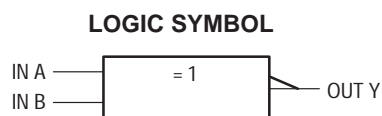


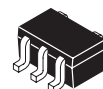
Figure 1. 5-Lead SOT-353 Pinout (Top View)



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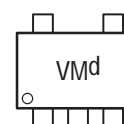
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SC-88A / SOT-353  
DF SUFFIX  
CASE 419A

### MARKING DIAGRAM



Pin 1  
d = Date Code

### PIN ASSIGNMENT

|   | PIN ASSIGNMENT |
|---|----------------|
| 1 | IN B           |
| 2 | IN A           |
| 3 | GND            |
| 4 | OUT 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

| Inputs |   | Output |
|--------|---|--------|
| A      | B | Y      |
| L      | L | L      |
| L      | H | H      |
| H      | L | H      |
| H      | H | L      |

# MC74VHC1GT86

## 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 $V_{CC} = 0$<br>High or Low State           | $V_{OUT}$ | -0.5 to 7.0<br>-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   | $V_{CC}$   | 4.5        | 5.5             | V    |
| DC Input Voltage  | $V_{IN}$   | 0.0        | 5.5             | V    |
| DC Output Voltage $V_{CC} = 0$<br>High or Low State                           | $V_{OUT}$  | 0.0<br>0.0 | 5.5<br>$V_{CC}$ | V    |
| Operating Temperature Range   | $T_A$      | -55        | +85             | °C   |
| Input Rise and Fall Time $V_{CC} = 3.3V \pm 0.3V$<br>$V_{CC} = 5.0V \pm 0.5V$ | $t_r, t_f$ | 0<br>0     | 100<br>20       | ns/V |

# MC74VHC1GT86

## DC ELECTRICAL CHARACTERISTICS

| Symbol           | Parameter   | Test Conditions   | V <sub>CC</sub><br>(V) | T <sub>A</sub> = 25°C |            |                    | T <sub>A</sub> ≤ 85°C |                    | T <sub>A</sub> ≤ 125°C |                    | Unit |
|------------------|---|---|------------------------|-----------------------|------------|--------------------|-----------------------|--------------------|------------------------|--------------------|------|
|                  |   |   |                        | Min                   | Typ        | Max                | Min                   | Max                | Min                    | Max                |      |
| V <sub>IH</sub>  | Minimum High-Level Input Voltage  |   | 3.0<br>4.5<br>5.5      | 1.2<br>2.0<br>2.0     |            |                    | 1.2<br>2.0<br>2.0     |                    | 1.2<br>2.0<br>2.0      |                    | V    |
| V <sub>IL</sub>  | Maximum Low-Level Input Voltage   |   | 3.0<br>4.5<br>5.5      |                       |            | 0.53<br>0.8<br>0.8 |                       | 0.53<br>0.8<br>0.8 |                        | 0.53<br>0.8<br>0.8 | V    |
| V <sub>OH</sub>  | Minimum High-Level Output Voltage<br>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><br>I <sub>OH</sub> = -50μA | 3.0<br>4.5             | 2.9<br>4.4            | 3.0<br>4.5 |                    | 2.9<br>4.4            |                    | 2.9<br>4.4             |                    | V    |
|                  |   | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>I <sub>OH</sub> = -4mA  | 3.0<br>4.5             | 2.58<br>3.94          |            |                    | 2.48<br>3.80          |                    | 2.34<br>3.66           |                    | V    |
|                  |   | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>I <sub>OH</sub> = -8mA  | 3.0<br>4.5             |                       |            |                    |                       |                    |                        |                    | V    |
| V <sub>OL</sub>  | Maximum Low-Level Output Voltage<br>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><br>I <sub>OL</sub> = 50μA  | 3.0<br>4.5             |                       | 0.0<br>0.0 | 0.1<br>0.1         |                       | 0.1<br>0.1         |                        | 0.1<br>0.1         | V    |
|                  |   | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>I <sub>OL</sub> = 4mA   | 3.0<br>4.5             |                       |            | 0.36<br>0.36       |                       | 0.44<br>0.44       |                        | 0.52<br>0.52       | V    |
|                  |   | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>I <sub>OL</sub> = 8mA   | 3.0<br>4.5             |                       |            |                    |                       |                    |                        |                    | V    |
| I <sub>IN</sub>  | Maximum Input Leakage Current   | V <sub>IN</sub> = 5.5V 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                    |                       |            | 2.0                |                       | 20                 |                        | 40                 | μA   |
| I <sub>CCT</sub> | Quiescent Supply Current  | Input: V <sub>IN</sub> = 3.4V   | 5.5                    |                       |            | 1.35               |                       | 1.50               |                        | 1.65               | mA   |
| I <sub>OPD</sub> | Output Leakage Current  | V <sub>OUT</sub> = 5.5V   | 0.0                    |                       |            | 0.5                |                       | 5.0                |                        | 10                 | μA   |

## AC ELECTRICAL CHARACTERISTICS (C<sub>load</sub> = 50 pF, Input t<sub>r</sub> = t<sub>f</sub> = 3.0ns)

| Symbol                                 | Parameter                                       | Test Conditions                                     | T <sub>A</sub> = 25°C |     |      | T <sub>A</sub> ≤ 85°C |      | T <sub>A</sub> ≤ 125°C |      | Unit |
|--|---|---|-----------------------|-----|------|-----------------------|------|------------------------|------|------|
|  |   |   | Min                   | Typ | Max  | Min                   | Max  | Min                    | Max  |      |
| t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | Maximum Propagation Delay,<br>Input A or B to Y | V <sub>CC</sub> = 3.0 ± 0.3V C <sub>L</sub> = 15 pF |                       | 5.0 | 11.0 |                       | 13.0 |                        | 15.5 | ns   |
|  |   | C <sub>L</sub> = 50 pF                              |                       | 6.2 | 14.5 |                       | 16.5 |                        | 19.5 |      |
|  |   | V <sub>CC</sub> = 5.0 ± 0.5V C <sub>L</sub> = 15 pF |                       | 3.1 | 6.8  |                       | 8.0  |                        | 10.0 |      |
| C <sub>IN</sub>                        | Maximum Input Capacitance                       | C <sub>L</sub> = 50 pF                              |                       | 4.2 | 8.8  |                       | 10.0 |                        | 12.0 | pF   |
|  |   |   |                       | 5.5 | 10   |                       | 10   |                        | 10   |      |

|                 |   |  |    |
|-----------------|---|--|----|
| C <sub>PD</sub> | Power Dissipation Capacitance (Note 1.) | Typical @ 25°C, V <sub>CC</sub> = 5.0V | pF |
|                 |   | 11                                     |    |

1. 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>.

# MC74VHC1GT86

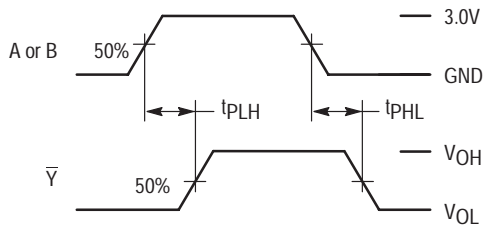
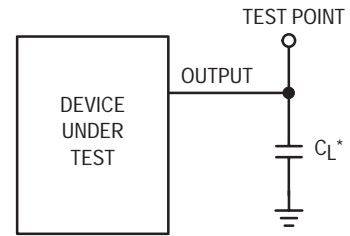


Figure 2. Switching Waveforms



\*Includes all probe and jig capacitance

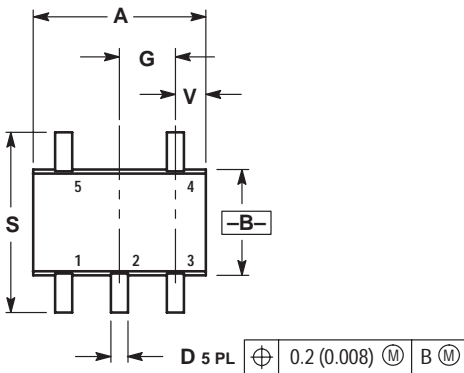
Figure 3. Test Circuit

## DEVICE ORDERING INFORMATION

| Device Order Number | Device Nomenclature |                       |             |            |                 |                |                    | Package Type       | Tape and Reel Size |
|---------------------|---------------------|-----------------------|-------------|------------|-----------------|----------------|--------------------|--------------------|--------------------|
|                     | Circuit Indicator   | Temp Range Identifier | Tech-nology | Input Type | Device Function | Package Suffix | Tape & Reel Suffix |                    |                    |
| MC74VHC1GT86DFT1    | MC                  | 74                    | VHC1G       | T          | 86              | DF             | T1                 | SC-88A/<br>SOT-353 | 7-Inch/3000 Unit   |

## PACKAGE DIMENSIONS

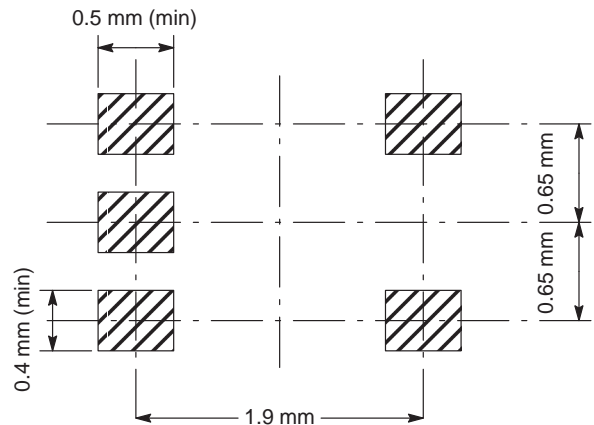
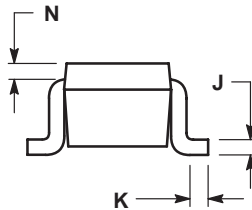
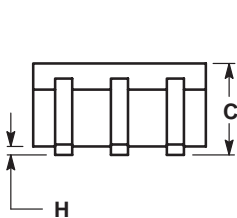
SC-88A / SOT-353  
DF SUFFIX  
5-LEAD PACKAGE  
CASE 419A-01  
ISSUE B



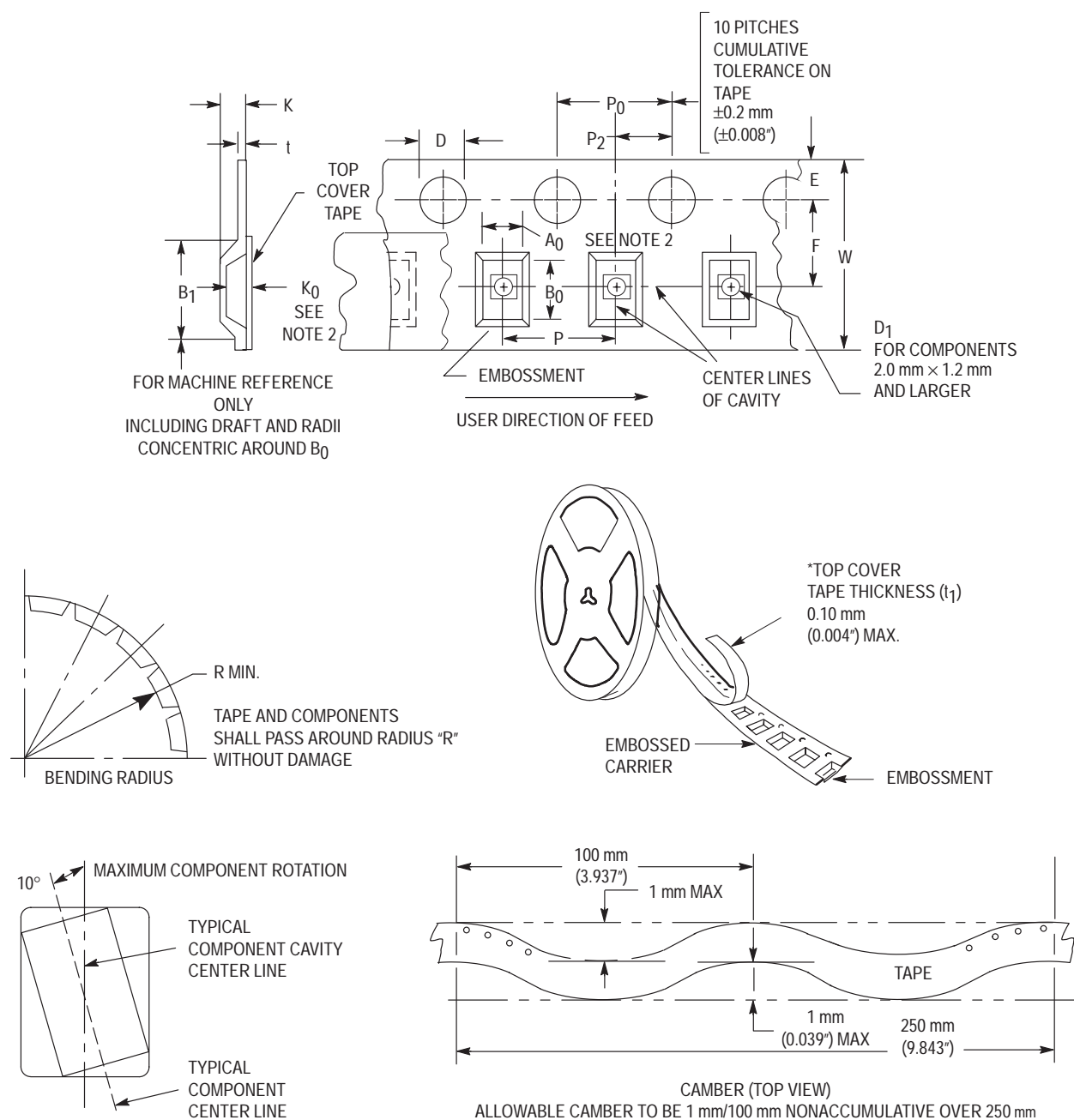
### NOTES:

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 |



# MC74VHC1GT86



**Figure 4. 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 $\pm 0.1$ mm (0.069 $\pm 0.004$ ") | 3.5 $\pm 0.5$ mm (1.38 $\pm 0.002$ ") | 2.4 mm (0.094") | 4.0 $\pm 0.10$ mm (0.157 $\pm 0.004$ ") | 4.0 $\pm 0.1$ mm (0.156 $\pm 0.004$ ") | 2.0 $\pm 0.1$ mm (0.079 $\pm 0.002$ ") | 25 mm (0.98") | 0.3 $\pm 0.05$ mm (0.01 +0.0038/-0.0002") | 8.0 $\pm 0.3$ mm (0.315 $\pm 0.012$ ") |

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

# MC74VHC1GT86

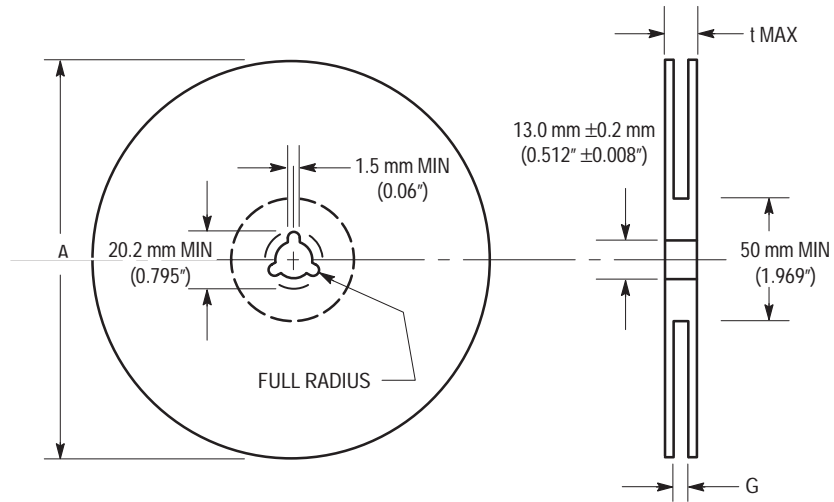


Figure 5. Reel Dimensions

## REEL DIMENSIONS

| Tape Size | A Max           | G  | t Max              |
|-----------|-----------------|--|--------------------|
| 8 mm      | 330 mm<br>(13") | 8.400 mm, +1.5 mm, -0.0<br>(0.33", +0.059", -0.00) | 14.4 mm<br>(0.56") |

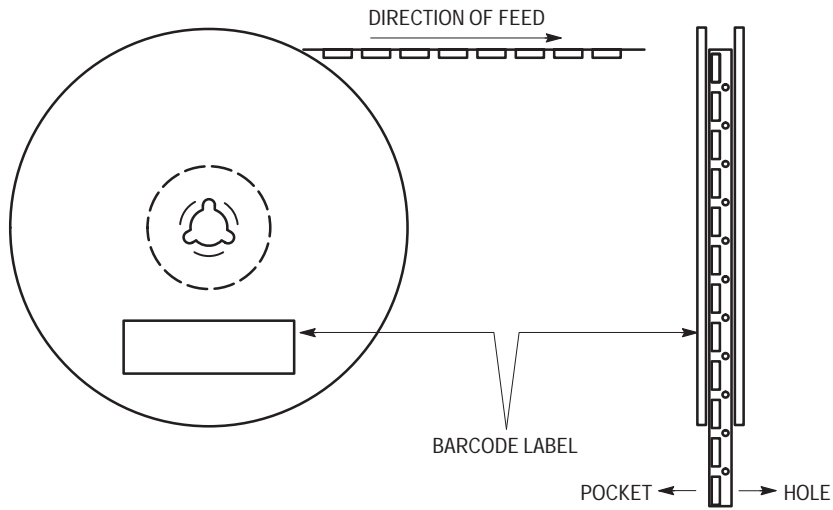
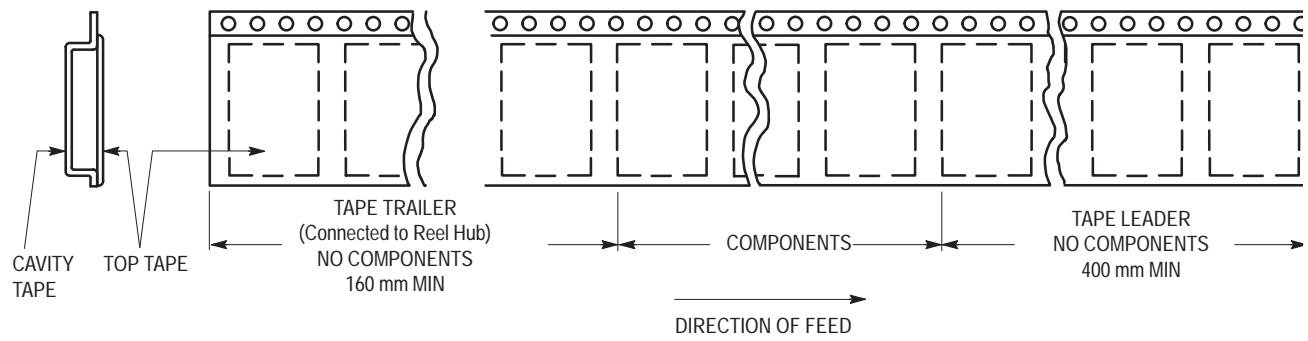
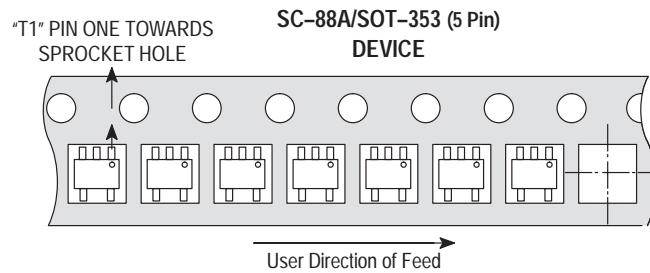


Figure 6. Reel Winding Direction


## MC74VHC1GT86



**Figure 7. Tape Ends for Finished Goods**



**Figure 8. Reel Configuration**

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