

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: $I_{CC} = 1$ μ A (Max) at $T_A = 25^\circ$ C
- Power Down Protection Provided on Inputs
- Pin and Function Compatible with Other Standard Logic Families
- Chip Complexity: FETs = 70; Equivalent Gates = 18

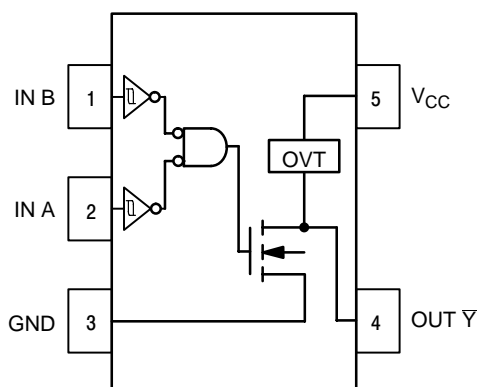


Figure 1. Pinout (Top View)

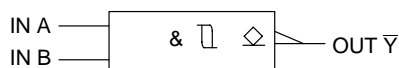


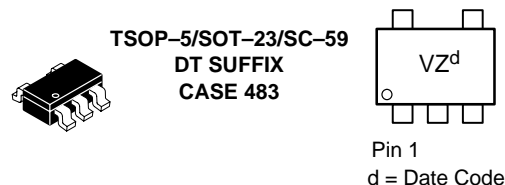
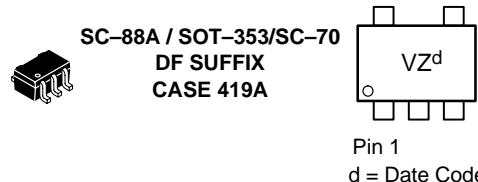
Figure 2. Logic Symbol



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MARKING DIAGRAMS



PIN ASSIGNMENT

| | |
|---|---------------|
| 1 | IN B |
| 2 | IN A |
| 3 | GND |
| 4 | OUT \bar{Y} |
| 5 | V_{CC} |

FUNCTION TABLE

| Inputs | | Output |
|--------|---|-----------|
| A | B | \bar{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.

MC74VHC1G135

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 |

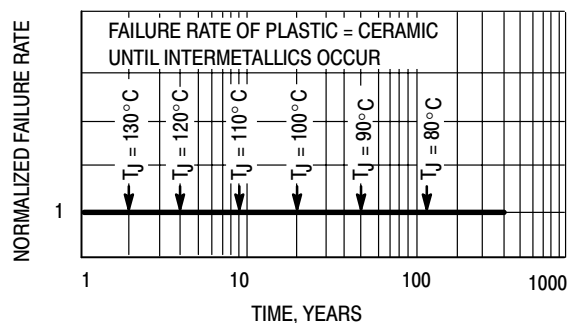


Figure 3. Failure Rate vs. Time Junction Temperature

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DC ELECTRICAL CHARACTERISTICS

| Symbol | Parameter | Test Conditions | V _{CC} (V) | T _A = 25°C | | | T _A ≤ 85°C | | -55 ≤ T _A ≤ 125°C | | Unit |
|------------------|---|--|---------------------|-----------------------|------|------|-----------------------|------|------------------------------|------|------|
| | | | | Min | Typ | Max | Min | Max | Min | Max | |
| V _{T+} | Positive Threshold Voltage | | 3.0 | 1.50 | 1.88 | 2.25 | 1.50 | 2.25 | 1.50 | 2.25 | V |
| | | | 4.5 | 2.35 | 2.66 | 3.10 | 2.35 | 3.10 | 2.35 | 3.10 | |
| | | | 5.5 | 2.80 | 3.21 | 3.70 | 2.80 | 3.70 | 2.80 | 3.70 | |
| V _{T-} | Negative Threshold Voltage | | 3.0 | 0.65 | 1.03 | 1.40 | 0.65 | 1.40 | 0.65 | 1.40 | V |
| | | | 4.5 | 1.10 | 1.62 | 2.10 | 1.10 | 2.10 | 1.10 | 2.10 | |
| | | | 5.5 | 1.45 | 2.02 | 2.60 | 1.45 | 2.60 | 1.45 | 2.60 | |
| V _H | Hysteresis Voltage | | 3.0 | 0.30 | 0.85 | 1.60 | 0.30 | 1.60 | 0.30 | 1.60 | V |
| | | | 4.5 | 0.40 | 1.05 | 2.00 | 0.40 | 2.00 | 0.40 | 2.00 | |
| | | | 5.5 | 0.50 | 1.20 | 2.25 | 0.50 | 2.25 | 0.50 | 2.25 | |
| V _{OH} | Minimum High-Level Output Voltage I _{OH} = -50 μA | V _{IN} = V _{IH} or V _{IL} I _{OH} = -50 μA | 2.0 | 1.9 | 2.0 | | 1.9 | | 1.9 | | V |
| | | | 3.0 | 2.9 | 3.0 | | 2.9 | | 2.9 | | |
| | | 4.5 | 4.4 | 4.5 | | 4.4 | | 4.4 | | | |
| | | I _{OH} = -4 mA I _{OH} = -8 mA | 3.0 | 2.58 | | | 2.48 | | 2.34 | | V |
| 4.5 | 3.94 | | | 3.80 | | 3.66 | | | | | |
| V _{OL} | Maximum Low-Level Output Voltage | V _{IN} = V _{IH} or V _{IL} I _{OL} = 50 μA | 2.0 | | 0.0 | 0.1 | | 0.1 | | 0.1 | V |
| | | | 3.0 | | 0.0 | 0.1 | | 0.1 | | 0.1 | |
| | | 4.5 | | 0.0 | 0.1 | | 0.1 | | 0.1 | | |
| | | I _{OL} = 4 mA I _{OL} = 8 mA | 3.0 | | | 0.36 | | 0.44 | | 0.52 | V |
| 4.5 | | | 0.36 | | 0.44 | | 0.52 | | | | |
| I _{IN} | Maximum Input Leakage Current | V _{IN} = 5.5 V or GND | 0 to 5.5 | | | ±0.1 | | ±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 ≤ 85°C | | -55 ≤ T _A ≤ 125°C | | Unit |
|------------------|--|--|-----------------------|------|------|-----------------------|------|------------------------------|------|------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| t _{PZL} | Maximum Output Enable Time, A or B to \bar{Y} | V _{CC} = 3.3 ± 0.3 V R _L = R _I = 500 Ω C _L = 15 pF C _L = 50 pF | | 7.6 | 11.9 | 1.0 | 14.0 | 1.0 | 16.1 | ns |
| | | | | 10.1 | 15.4 | 1.0 | 17.5 | 1.0 | 19.6 | |
| | | V _{CC} = 5.0 ± 0.5 V R _L = R _I = 500 Ω C _L = 15 pF C _L = 50 pF | | 4.9 | 7.7 | 1.0 | 9.0 | 1.0 | 10.3 | |
| t _{PLZ} | Maximum Output Disable Time | V _{CC} = 3.3 ± 0.3 V R _L = R _I = 500 Ω C _L = 50 pF | | 10.1 | 15.4 | | 17.5 | | 19.6 | ns |
| | | | | | | | | | | |
| | | V _{CC} = 5.0 ± 0.5 V R _L = R _I = 500 Ω C _L = 50 pF | | 6.4 | 9.7 | | 11.0 | | 12.3 | |
| C _{IN} | Maximum Input Capacitance | | | 5.0 | 10 | | 10 | | 10 | pF |

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

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} • 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}.

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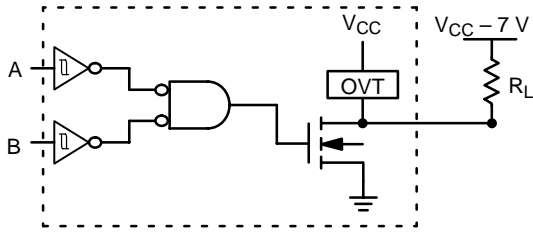


Figure 4. Output Voltage Mismatch Application

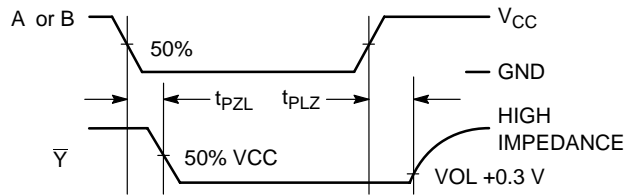
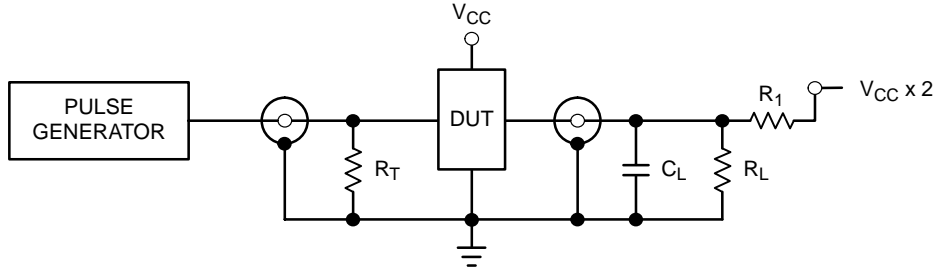


Figure 5. Switching Waveforms



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

Figure 6. Test Circuit

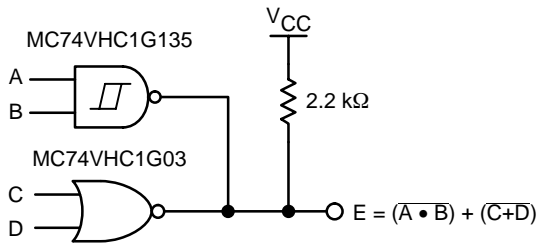


Figure 7. Complex Boolean Functions

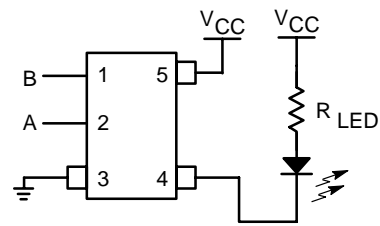


Figure 8. LED Driver

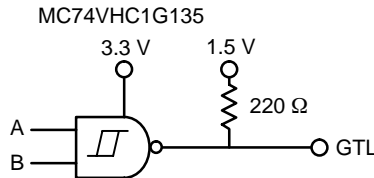


Figure 9. GTL Driver

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 | TSOPS / SOT-23 / SC-59 | 178 mm (7") 3000 Unit |

MC74VHC1G135



Figure 10. Tape Ends for Finished Goods

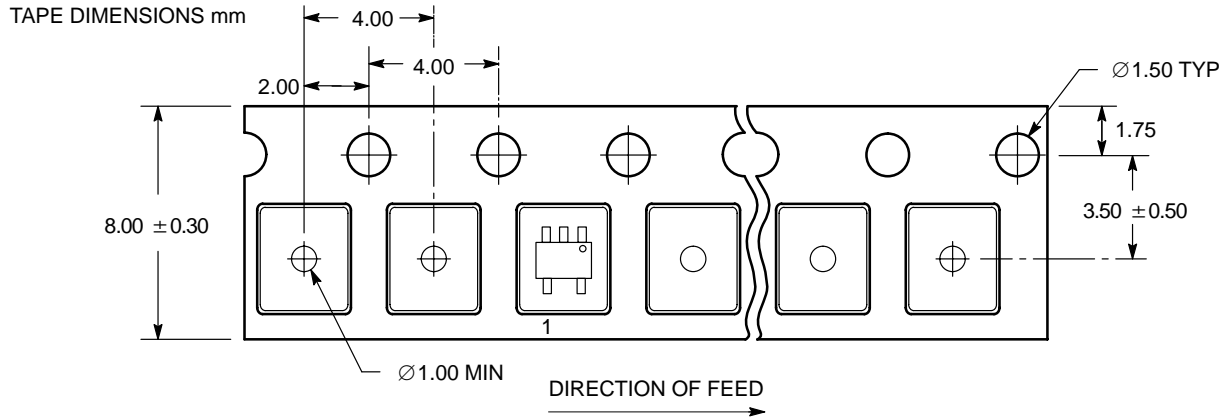


Figure 11. SC-70-5/SC-88A/SOT-353 DFT1 Reel Configuration/Orientation

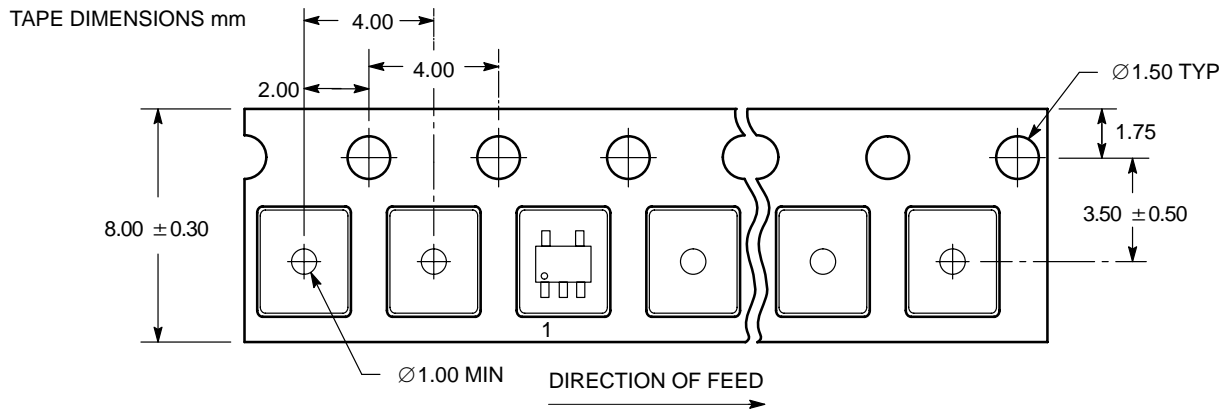


Figure 12. SC-70/SC-88A/SOT-353 DFT2 and SOT23-5/TSOP-5/SC59-5 DTT1 Reel Configuration/Orientation

MC74VHC1G135

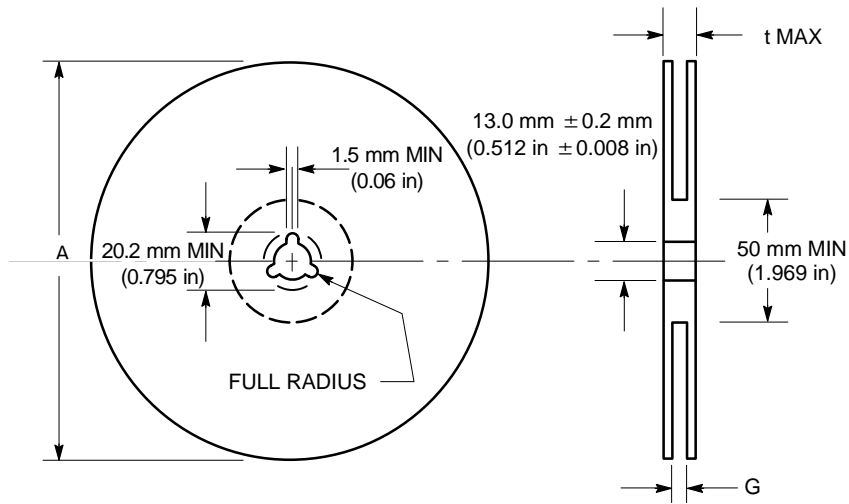


Figure 13. Reel Dimensions

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) |

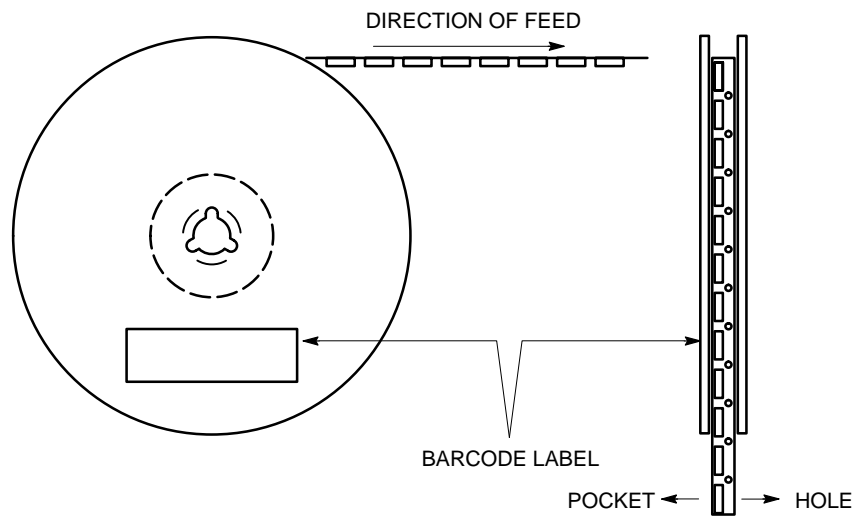
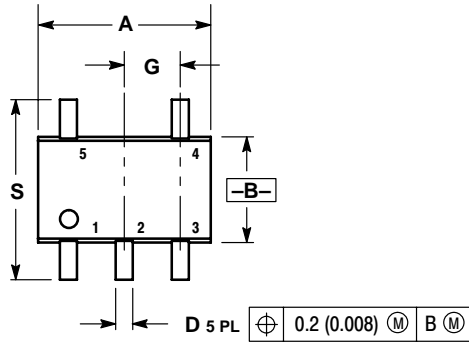


Figure 14. Reel Winding Direction

MC74VHC1G135

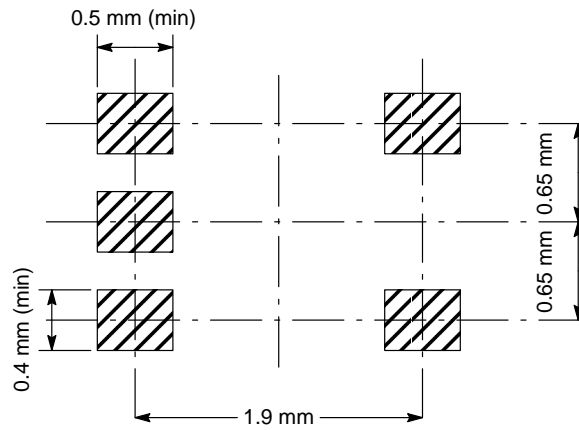
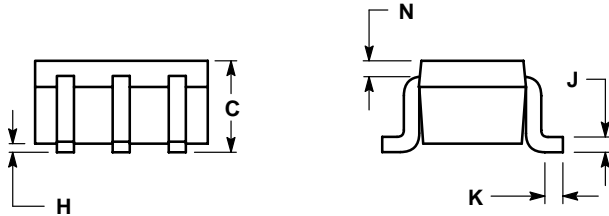
PACKAGE DIMENSIONS

SC-88A / SOT-353 / SC-70
 DF SUFFIX
 5-LEAD PACKAGE
 CASE 419A-02
 ISSUE F



- NOTES:
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH.
 3. 419A-01 OBSOLETE. NEW STANDARD 419A-02.

| 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 |



MC74VHC1G135

PACKAGE DIMENSIONS

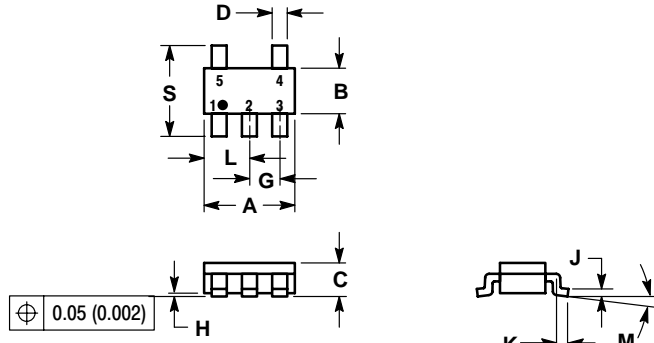
TSOP-5 / SOT-23 / SC-59

DT SUFFIX

5-LEAD PACKAGE

CASE 483-01

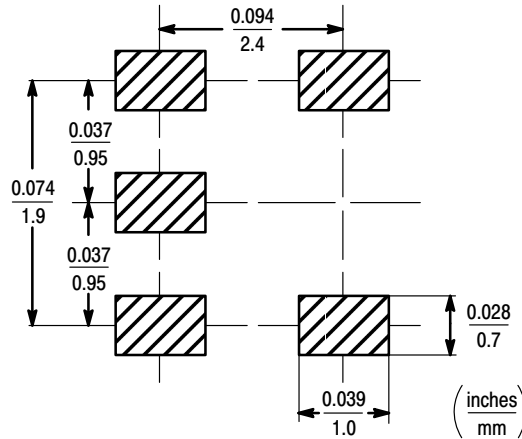
ISSUE B




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 | 1.05 | 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 |



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