# TCM1030, TCM1050
# DUAL TRANSIENT-VOLTAGE SUPPRESSORS

- **Meet or Exceed Bell Standard LSSGR Requirements**
- **Externally-Controlled Negative Firing Voltage . . . −90 V Max**
- **Accurately Controlled, Wide Negative Firing Voltage Range . . . −5 V to −85 V**
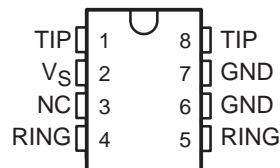- **Positive Surge Current (see Note 1):**

  |          | **TCM1030** | **TCM1050** |
  |----------|-------------|-------------|
  | **10/1000** | **16 A** | **30 A** |
  | **10/160**  | **25 A** | **45 A** |
  | **2/10**    | **35 A** | **50 A** |

- **Negative Surge Current (see Note 1):**

  |          | **TCM1030** | **TCM1050** |
  |----------|-------------|-------------|
  | **10/1000** | **−16 A** | **−25 A** |
  | **10/160**  | **−25 A** | **−29 A** |
  | **2/10**    | **−35 A** | **−36 A** |

- **High Holding Current**
  - **TCM1030 . . . 100 mA Min**
  - **TCM1050 . . . 150 mA Min**

**D OR P PACKAGE**
**(TOP VIEW)**

| | | | |
|---|---|---|---|
| TIP | 1 | 8 | TIP |
| $V_S$ | 2 | 7 | GND |
| NC | 3 | 6 | GND |
| RING | 4 | 5 | RING |

NC – No internal connection
The D package is available taped and reeled. Add R suffix (i.e., TCM1030DR).

## description

The TCM1030 and TCM1050 dual transient-voltage suppressors are designed specifically for telephone line card protection against lightning and transients (voltage transients) induced by ac lines. One of the TIP terminals (pin 1 or 8) and one of the RING terminals (pin 4 or 5) are connected to the tip and ring circuits of a SLIC (subscriber-line interface circuit). The battery feed connections between the SLIC and the subscriber line are from the remaining TIP (pin 1 or 8) and RING (pin 4 or 5) through the TCM1030 or the TCM1050 to the tip and ring lines. Transients are suppressed between tip and ground, and ring and ground.

Positive transients are clamped by diodes D1 and D2. Negative transients that are more negative than $V_S$ cause the SCRs, Q1 and Q2, to crowbar. The high holding current of the SCRs prevent dc latchup as the transient subsides.

The TCM1030 and TCM1050 are characterized for operation from −40°C to 85°C.

NOTE 1:  The notation 10/1000 refers to a waveshape having $t_r$ = 10 μs and $t_w$ = 1000 μs ending at 50% of the peak value. The notation 10/160 is $t_r$ = 10 μs and $t_w$ = 160 μs. The notation 2/10 is $t_r$ = 2 μs and $t_w$ = 10 μs.

Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

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## functional block diagram
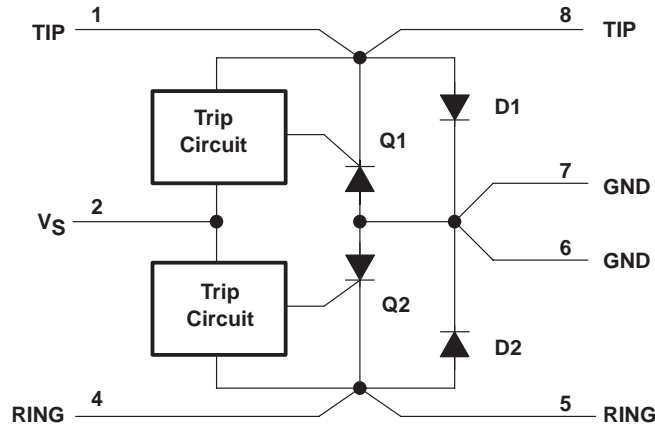


## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

| | | |
|---|---|---|
| TCM1030 nonrepetitive peak surge current (see Note 1): | 10/1000 | $\pm16$ A |
| | 10/160 | $\pm25$ A |
| | 2/10 | $\pm35$ A |
| TCM1050 nonrepetitive peak positive surge current: (see Note 1) | 10/1000 | 30 A |
| | 10/160 | 45 A |
| | 2/10 | 50 A |
| TCM1050 nonrepetitive peak negative surge current: (see Note 1) | 10/1000 | $-25$ A |
| | 10/160 | $-29$ A |
| | 2/10 | $-36$ A |

Nonrepetitive peak surge current, $t_W = 10$ ms, half sinewave (see Note 2) . . . . . . . . . . . . . . . . . . . . . . . . . 5 A
Continuous 60-Hz sinewave at 1 A . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 2 s
Continuous total power dissipation . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . See Dissipation Rating Table
Operating free-air temperature range, $T_A$ . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . −40°C to 85°C
Storage temperature range, $T_{stg}$ . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . −40°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: D or P package . . . . . . . . . . . . . . . . . 260°C

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES: 1 The notation 10/1000 refers to a waveshape having $t_r = 10$ μs and $t_W = 1000$ μs ending at 50% of the peak value. The notation 10/160 is $t_r = 10$ μs and $t_W = 160$ μs. The notation 2/10 is $t_r = 2$ μs and $t_W = 10$ μs.
2. This value applies when the case temperature is at or below 85°C. The surge current may be repeated after the device has returned to thermal equilibrium.

### DISSIPATION RATING TABLE

| PACKAGE | $T_A \leq 25°C$ POWER RATING | OPERATING FACTOR ABOVE $T_A = 25°C$ | $T_A = 85°C$ POWER RATING |
|---|---|---|---|
| D | 725 mW | 5.8 mW/°C | 377 mW |
| P | 1000 mW | 8.0 mW/°C | 520 mW |

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## electrical characteristics over operating free-air temperature range (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | TCM1030 | | | TCM1050 | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | TYP† | MAX | MIN | TYP† | MAX | |
| $V_{CF}$ | Forward clamping voltage (diode forward voltage) (see Note 3) | $I_{FM}$ = 1-A transient | | 1.2 | 2 | | 1.2 | 2 | V |
| | | $I_{FM}$ = 10-A transient | | 2.5 | 4 | | 2 | 4 | |
| | | $I_{FM}$ = 16-A transient | | 4 | 5 | | 2.5 | 5 | |
| | | $I_{FM}$ = 30-A transient | — | — | — | | 3.1 | 5 | |
| $V_{C(R)}$ | Reverse clamping voltage (SCR on-state voltage) (see Note 3) | $I_{TM}$ = 1-A transient | | −1.2 | −2 | | −1.2 | −2 | V |
| | | $I_{TM}$ = 10-A transient | | −2.5 | −4 | | −2.5 | −4 | |
| | | $I_{TM}$ = 16-A transient | | −4 | −5 | | −3 | −5 | |
| | | $I_{TM}$ = 30-A transient | — | — | — | | −4.8 | −7 | |
| $I_{I(trip)}$ | Trip current (see Note 4) | $V_S$ = −50 V | −100 | | −325 | −100 | | −325 | mA |
| $I_H$ | Holding current | $V_S$ = −50 V | −100 | | | −150 | | | mA |
| $V_{I(trip)}$ | Trip voltage | $V_S$ = −50 V,     I = trip current | −50 | | −55 | −50 | | −55 | V |
| | | $V_S$ = −65 V,     I = trip current | −65 | | −70 | −65 | | −70 | |
| | | $V_S$ = −85 V,     I = trip current | — | — | — | −85 | | −90 | |
| $I_{I(stby)}$ | Standby current | TIP and RING at −85 V or GND, $V_S$ = −85 V | | | ±5 | | | ±5 | µA |
| | Transient overshoot voltage | $V_S$ = −50 V,     $t_r$ = 10 ns | | 2.5 | | | 2.5 | | V |
| $C_{off}$ | Off-state (high impedance) capacitance | TIP and RING at −50 V | | 25 | | | 25 | | pF |
| | | TIP and RING at GND | | 50 | | | 50 | | |
| dv/dt | Critical rate of rise of off-state voltage (see Note 5) | $V_S$ open,     $V_S$ = −50 V | | −1 | | | −1 | | kV/µs |

† All typical values are at $T_A$ = 25°C.

NOTES: 3. The current flows through one TIP (or RING) terminal and one of the GND terminals. The voltage is measured between the other TIP (or RING) terminal and the other GND terminal. Measurement time ≤ 1 ms.

4. The negative value of trip current refers to the current flowing out of TIP or RING on the line side that is sufficient in magnitude to trigger the SCRs. Measurement time ≤ 1 ns.

5. The critical dv/dt is measured using a linear rate of rise with the maximum voltage limited to −50 V with $V_S$ connected to TIP or RING being measured.

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## TYPICAL CHARACTERISTICS

**TIP OR RING CURRENT**
**vs**
**TIP OR RING TO GND VOLTAGE**



**Figure 1**
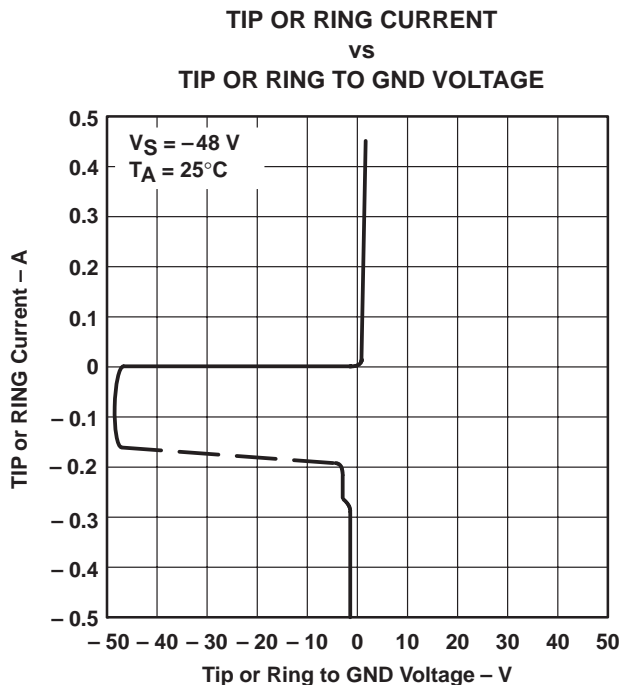
## APPLICATION INFORMATION

The trip voltage represents the most negative level of stress applied to the system. Positive transients are clamped by diodes D1 and D2. When a negative transient is applied, current flows from $V_S$ to TIP or RING where the transient voltage is applied. When the current through TIP or RING reaches the pulse-trip current, the SCR turns on and shorts TIP or RING to GND. The majority of the transient energy is dissipated in the external resistor (nominally 100 Ω for the TCM1030 and 70 Ω for the TCM1050). Current into $V_S$ ceases when the SCR turns on. When the energy of the transient has been dissipated so that the current into TIP or RING due to the transient plus the battery feed supply is less than the holding current, the SCR turns off.

To help ensure reliability and consistency in the firing voltage, it is recommended that two capacitors be connected between $V_S$ and GND, as close to the device terminals as possible. One capacitor should be a 0.1-μF, 100-V ceramic unit and the other, a 0.47-μF, 100-V stacked-film (not wound) metalized plastic capacitor. If inductance is present in the line to $V_S$, these capacitors help prevent overshoot in the firing voltage during fast rise-time transients.

To avoid dc latchup after the SCR has fired, the current must be less than the holding current, $I_H$. To prevent dc latchup, the line feed current must be limited to the following conditions:

$$\frac{V_{TP} - V_{RP}}{R_{line} + 2R_p} < I_H$$

where $V_{TP}$ and $V_{RP}$ are the voltages on TIP and RING, respectively, of the TCM1030 or TCM1050. Induced ac currents into TIP or RING (e.g., power-line inductive coupling) must be less than the trip current to prevent the SCR from firing.

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## APPLICATION INFORMATION

Line short-circuits to external power sources can damage the suppressor due to excessive power dissipation. Conventional protection techniques, such as fuses or PTC (positive temperature coefficient) thermistors, should be used to eliminate or reduce the fault current.

Figure 2 shows a typical line card application circuit.
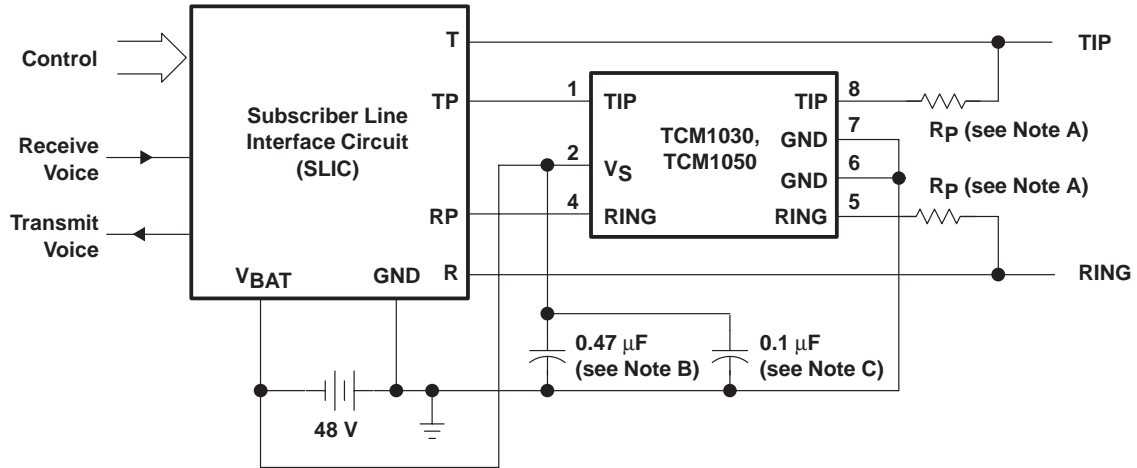


NOTES: A. $R_P$ is 100 Ω minimum for TCM1030 and 70 Ω minimum for TCM1050.
　　　　 B. 0.47 μF, 100 V stacked film metalized plastic capacitor
　　　　 C. 0.1 μF, 100 V ceramic capacitor

**Figure 2. Typical Line Card Application Circuit**

## MECHANICAL DATA

**D (R-PDSO-G\*\*)**             **PLASTIC SMALL-OUTLINE PACKAGE**

**14 PIN SHOWN**
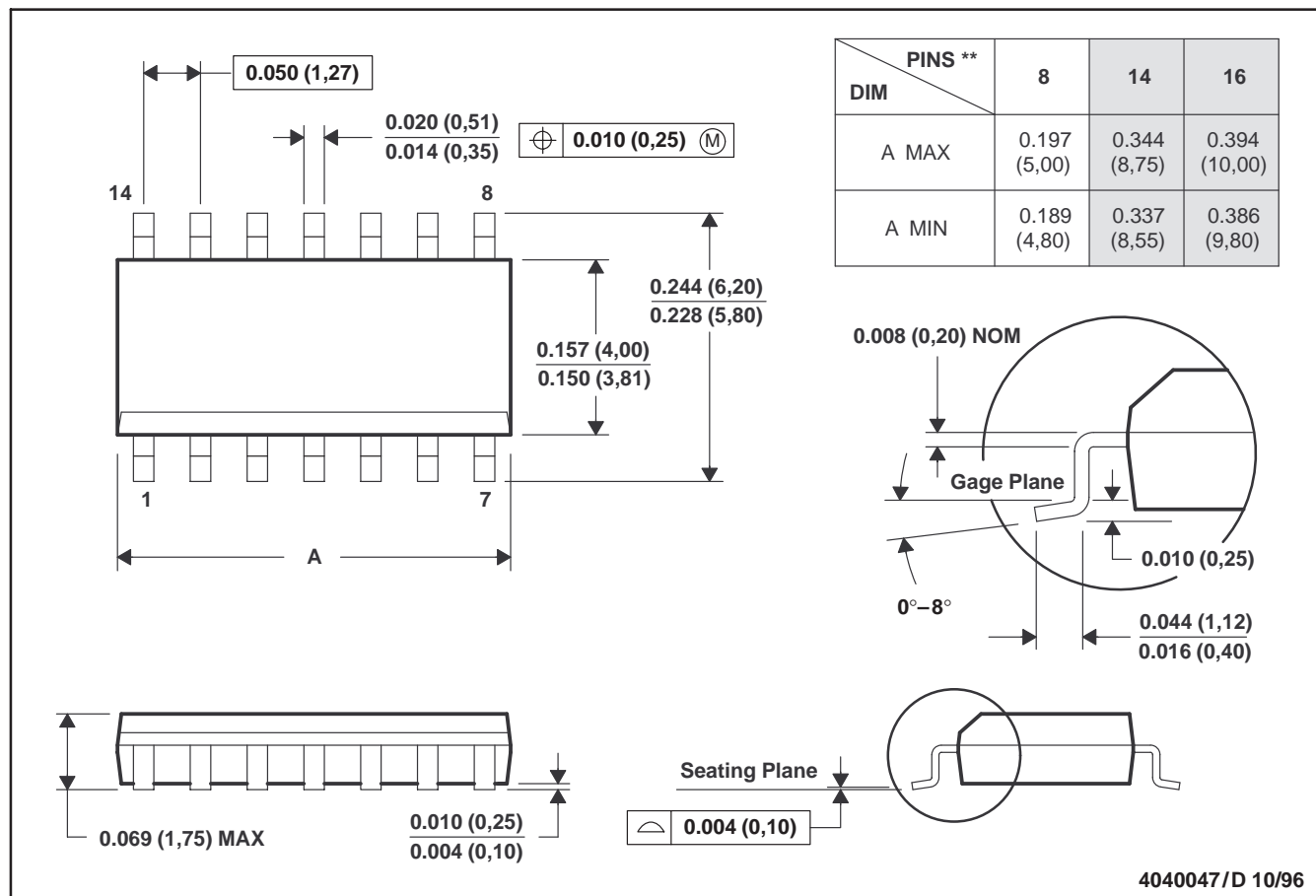


| PINS \*\* / DIM | 8 | 14 | 16 |
|---|---|---|---|
| A MAX | 0.197 (5,00) | 0.344 (8,75) | 0.394 (10,00) |
| A MIN | 0.189 (4,80) | 0.337 (8,55) | 0.386 (9,80) |

4040047 / D 10/96

NOTES:  A.  All linear dimensions are in inches (millimeters).
            B.  This drawing is subject to change without notice.
            C.  Body dimensions do not include mold flash or protrusion, not to exceed 0.006 (0,15).
            D.  Falls within JEDEC MS-012

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## MECHANICAL DATA

**P (R-PDIP-T8)**                                                **PLASTIC DUAL-IN-LINE PACKAGE**



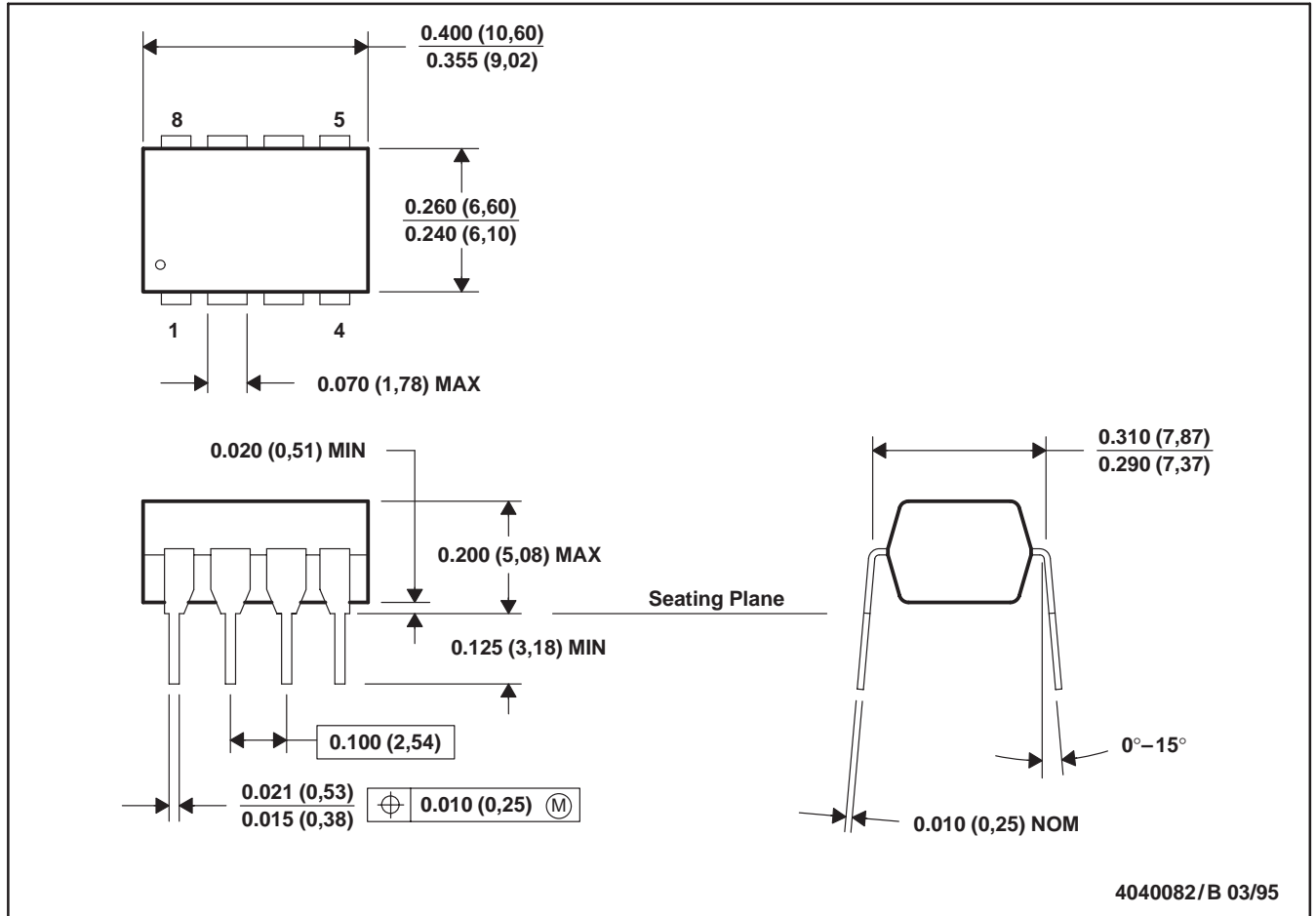$\dfrac{0.400\ (10,60)}{0.355\ (9,02)}$

$\dfrac{0.260\ (6,60)}{0.240\ (6,10)}$

0.070 (1,78) MAX

0.020 (0,51) MIN

0.200 (5,08) MAX

Seating Plane

0.125 (3,18) MIN

0.100 (2,54)

$\dfrac{0.021\ (0,53)}{0.015\ (0,38)}$    ⊕ | 0.010 (0,25) Ⓜ

$\dfrac{0.310\ (7,87)}{0.290\ (7,37)}$

0°−15°

0.010 (0,25) NOM

4040082 / B 03/95

**PRODUCT PREVIEW**

NOTES: A. All linear dimensions are in inches (millimeters).
         B. This drawing is subject to change without notice.
         C. Falls within JEDEC MS-001

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# PACKAGE MATERIALS INFORMATION

## TAPE AND REEL INFORMATION

**REEL DIMENSIONS**

**TAPE DIMENSIONS**

| | |
|---|---|
| A0 | Dimension designed to accommodate the component width |
| B0 | Dimension designed to accommodate the component length |
| K0 | Dimension designed to accommodate the component thickness |
| W | Overall width of the carrier tape |
| P1 | Pitch between successive cavity centers |

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**

*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TCM1050DR | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.4 | 5.2 | 2.1 | 8.0 | 12.0 | Q1 |

# PACKAGE MATERIALS INFORMATION

**TAPE AND REEL BOX DIMENSIONS**



*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---|---|---|---|---|---|---|---|
| TCM1050DR | SOIC | D | 8 | 2500 | 367.0 | 367.0 | 38.0 |

# PACKAGE MATERIALS INFORMATION

## TUBE



*All dimensions are nominal

| Device | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (µm) | B (mm) |
|---|---|---|---|---|---|---|---|---|
| TCM1050D | D | SOIC | 8 | 75 | 505.46 | 6.76 | 3810 | 4 |

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