

**RADIATION HARDENED
NPN POWER SILICON TRANSISTOR**
Qualified per MIL-PRF-19500/544

Qualified Levels:
JANS_M, JANS_D,
JANS_P, JANS_L,
JANS_R, JANS_F

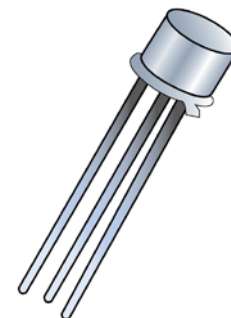
DESCRIPTION

These RHA level 2N5152 and 2N5154 silicon transistor devices are military Radiation Hardness Assurance qualified up to a JANSF level for high-reliability applications. Microsemi also offers numerous other products to meet higher and lower power voltage regulation applications.

Important: For the latest information, visit our website <http://www.microsemi.com>.

FEATURES

- JEDEC registered 2N5152 and 2N5154.
- JANS RHA qualifications are available per MIL-PRF-19500/544.





**TO-39 (TO-205AD)
Package**

APPLICATIONS / BENEFITS

- High frequency operation.
- Lightweight.
- High-speed power-switching applications.
- High-reliability applications.

Also available in:

 **TO-5 Package**
(long-leaded)
JANS_2N5152L &
JANS_2N5154L

 **U3 Package**
(surface mount)
JANS_2N5152U3 &
JANS_2N5154U3

MAXIMUM RATINGS

| Parameters/Test Conditions | Symbol | Value | Unit |
|--|---------------------|-------------|------|
| Junction and Storage Temperature | T_J and T_{STG} | -65 to +200 | °C |
| Thermal Resistance Junction-to-Ambient | $R_{\theta JA}$ | 175 | °C/W |
| Thermal Resistance Junction-to-Case | $R_{\theta JC}$ | 10 | °C/W |
| Reverse Pulse Energy ⁽¹⁾ | | 15 | mJ |
| Collector Current (dc) | I_C | 2 | A |
| Collector to base voltage (static), emitter open | V_{CBO} | 100 | V |
| Collector to emitter voltage (static) base open | V_{CEO} | 80 | V |
| Emitter to base voltage (static) collector open | V_{EBO} | 5.5 | V |
| Steady-State Power Dissipation @ $T_A = +25$ °C | P_D | 1 | W |
| Steady-State Power Dissipation @ $T_C = +25$ °C | P_D | 10 | W |

Notes: 1. This rating is based on the capability of the transistors to operate safely in the unclamped inductive load energy test circuit.

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MECHANICAL and PACKAGING

- CASE: Hermetically sealed, kovar base, nickel cap.
- TERMINALS: Gold plate over nickel.
- MARKING: Part number, date code, manufacturer's ID.
- POLARITY: NPN
- WEIGHT: Approximately 1.064 grams.
- See [Package Dimensions](#) on last page.

PART NOMENCLATURE**JANSM 2N5152****Reliability Level**

JANSM – 3K Rads (Si)
JANSJ – 10K Rads (Si)
JANSP – 30K Rads (Si)
JANSL – 50K Rads (Si)
JANSR – 100K Rads (Si)
JANSF – 300K Rads (Si)

JEDEC type number

(See [Electrical Characteristics](#) table)

SYMBOLS & DEFINITIONS

| Symbol | Definition |
|-----------|---|
| C_{obo} | Common-base open-circuit output capacitance. |
| I_{CEO} | Collector cutoff current, base open. |
| I_{CEX} | Collector cutoff current, circuit between base and emitter. |
| I_{EBO} | Emitter cutoff current, collector open. |
| h_{FE} | Common-emitter static forward current transfer ratio. |
| V_{CEO} | Collector-emitter voltage, base open. |
| V_{CBO} | Collector-emitter voltage, emitter open. |
| V_{EBO} | Emitter-base voltage, collector open. |

ELECTRICAL CHARACTERISTICS @ $T_A = +25^\circ\text{C}$ unless otherwise noted.
OFF CHARACTERISTICS

| Parameters / Test Conditions | Symbol | Min. | Max. | Unit |
|---|---------------|------|------------|---------------------|
| Collector-Emitter Breakdown Voltage $I_C = 100\text{ mA}, I_B = 0$ | $V_{(BR)CEO}$ | 80 | | V |
| Emitter-Base Cutoff Current $V_{EB} = 4.0\text{ V}, I_C = 0$ $V_{EB} = 5.5\text{ V}, I_C = 0$ | I_{EBO} | | 1.0 1.0 | μA mA |
| Collector-Emitter Cutoff Current $V_{CE} = 60\text{ V}, V_{BE} = 0$ $V_{CE} = 100\text{ V}, V_{BE} = 0$ | I_{CES} | | 1.0 1.0 | μA mA |
| Collector-Emitter Cutoff Current $V_{CE} = 40\text{ V}, I_B = 0$ | I_{CEO} | | 50 | μA |

ON CHARACTERISTICS

| Parameters / Test Conditions | Symbol | Min. | Max. | Unit |
|---|---------------|----------------------------------|-----------------------------------|------|
| Forward-Current Transfer Ratio $I_C = 50\text{ mA}, V_{CE} = 5\text{ V}$ $I_C = 2.5\text{ A}, V_{CE} = 5\text{ V}$ $I_C = 5\text{ A}, V_{CE} = 5\text{ V}$ | h_{FE} | 20 50 30 70 20 40 | -- -- 90 200 -- -- | |
| Collector-Emitter Saturation Voltage $I_C = 2.5\text{ A}, I_B = 250\text{ mA}$ $I_C = 5.0\text{ A}, I_B = 500\text{ mA}$ | $V_{CE(sat)}$ | | 0.75 1.5 | V |
| Base-Emitter Voltage Non-Saturation $I_C = 2.5\text{ A}, V_{CE} = 5\text{ V}$ | V_{BE} | | 1.45 | V |
| Base-Emitter Saturation Voltage $I_C = 2.5\text{ A}, I_B = 250\text{ mA}$ $I_C = 5.0\text{ A}, I_B = 500\text{ mA}$ | $V_{BE(sat)}$ | | 1.45 2.2 | V |

DYNAMIC CHARACTERISTICS

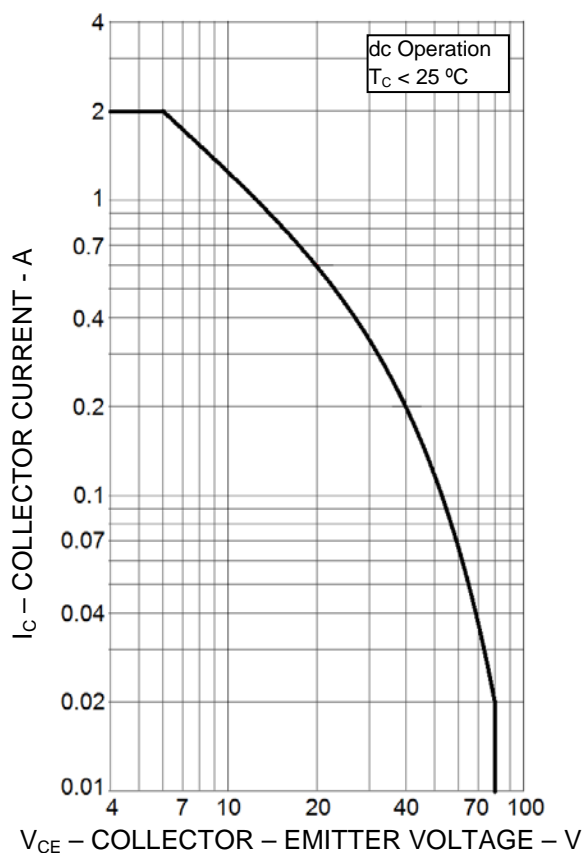
| Parameters / Test Conditions | Symbol | Min. | Max. | Unit |
|--|------------|----------|------|------|
| Magnitude of Common Emitter Small-Signal Short-Circuit Forward Current Transfer Ratio $I_C = 500\text{ mA}, V_{CE} = 5\text{ V}, f = 10\text{ MHz}$ | $ h_{fe} $ | 6 7 | | |
| Small-signal short Circuit Forward-Current Transfer Ratio $I_C = 100\text{ mA}, V_{CE} = 5\text{ V}, f = 1\text{ KHz}$ | h_{fe} | 20 50 | | |
| Output Capacitance $V_{CB} = 10\text{ V}, I_E = 0, f = 1.0\text{ MHz}$ | C_{obo} | | 250 | pF |

ELECTRICAL CHARACTERISTICS @ $T_A = +25\text{ }^{\circ}\text{C}$ unless otherwise noted. (continued)
SWITCHING CHARACTERISTICS

| Parameters / Test Conditions | Symbol | Min. | Max. | Unit |
|---|-----------|------|------|---------------|
| Turn-On Time $I_C = 5\text{ A}$, $I_{B1} = 500\text{ mA}$ | t_{on} | | 0.5 | μs |
| Turn-Off Time $R_L = 6\Omega$ | t_{off} | | 1.5 | μs |
| Storage Time $I_{B2} = -500\text{ mA}$ | t_S | | 1.4 | μs |
| Fall Time $V_{BE(OFF)} = 3.7\text{ V}$ | t_f | | 0.5 | μs |

SAFE OPERATING AREA (See SOA graph below and [MIL-STD-750, method 3053](#))

DC Tests
 $T_C = +25\text{ }^{\circ}\text{C}$, $t_P = 1.0\text{ s}$, 1 Cycle

Test 1
 $V_{CE} = 5.0\text{ V}$, $I_C = 2.0\text{ A}$
Test 2
 $V_{CE} = 32\text{ V}$, $I_C = 310\text{ mA}$
Test 3
 $V_{CE} = 80\text{ V}$, $I_C = 12.5\text{ mA}$

Maximum Safe Operating Area

ELECTRICAL CHARACTERISTICS @ $T_A = +25\text{ }^{\circ}\text{C}$, unless otherwise noted (continued)
POST RADIATION ELECTRICAL CHARACTERISTICS

| Parameters / Test Conditions | Symbol | Min. | Max. | Unit |
|---|---------------|--|--------------|---------------|
| Collector to Emitter Cutoff Current $V_{CE} = 40\text{ V}$ | I_{CEO} | | 100 | μA |
| Emitter to Base Cutoff Current $V_{EB} = 4\text{ V}$ | I_{EBO} | | 2.0 | μA |
| Breakdown Voltage, Collector to Emitter $I_C = 100\text{ mA}$ | $V_{(BR)CEO}$ | 80 | | V |
| Collector to Emitter Cutoff Current $V_{CE} = 60\text{ V}$ | I_{CES} | | 2.0 | μA |
| Emitter to Base Cutoff Current $V_{EB} = 5.5\text{ V}$ | I_{EBO} | | 2.0 | mA |
| Forward-Current Transfer Ratio ⁽¹⁾ $I_C = 50\text{ mA}$, $V_{CE} = 5\text{ V}$ 2N5152 2N5154 $I_C = 2.5\text{ A}$, $V_{CE} = 5\text{ V}$ 2N5152 2N5154 $I_C = 5\text{ A}$ pulsed, $V_{CE} = 5\text{ V}$ 2N5152 2N5154 | $[h_{FE}]$ | [10] [25] [15] [35] [10] [20] | 90 200 | |
| Base to Emitter voltage (non-saturated) $V_{CE} = 5\text{ V}$, $I_C = 2.5\text{ A}$, pulsed | V_{BE} | | 1.45 | V |
| Collector-Emitter Saturation Voltage $I_C = 2.5\text{ mA}$, $I_B = 250\text{ mA}$, pulsed $I_C = 500\text{ mA}$, $I_B = 500\text{ mA}$, pulsed | $V_{CE(sat)}$ | | 0.86 1.73 | V |
| Base-Emitter Saturation Voltage $I_C = 2.5\text{ A}$, $I_B = 250\text{ mA}$, pulsed $I_C = 5\text{ A}$, $I_B = 500\text{ mA}$, pulsed | $V_{BE(sat)}$ | | 1.67 2.53 | V |

- (1) See method 1019 of MIL-STD-750 for how to determine $[h_{FE}]$ by first calculating the delta ($1/h_{FE}$) from the pre- and post-radiation h_{FE} . Notice the $[h_{FE}]$ is not the same as h_{FE} and cannot be measured directly. The $[h_{FE}]$ value can never exceed the pre-radiation minimum h_{FE} that it is based upon.

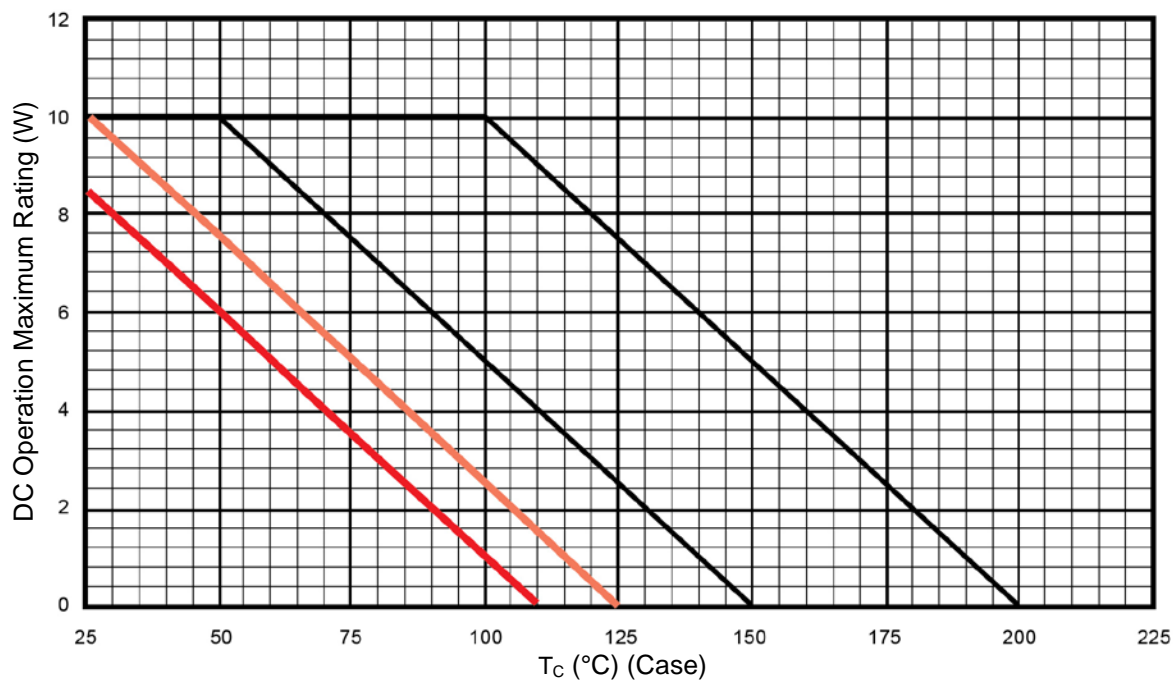
GRAPHS


FIGURE 1
Temperature-Power Derating Curve

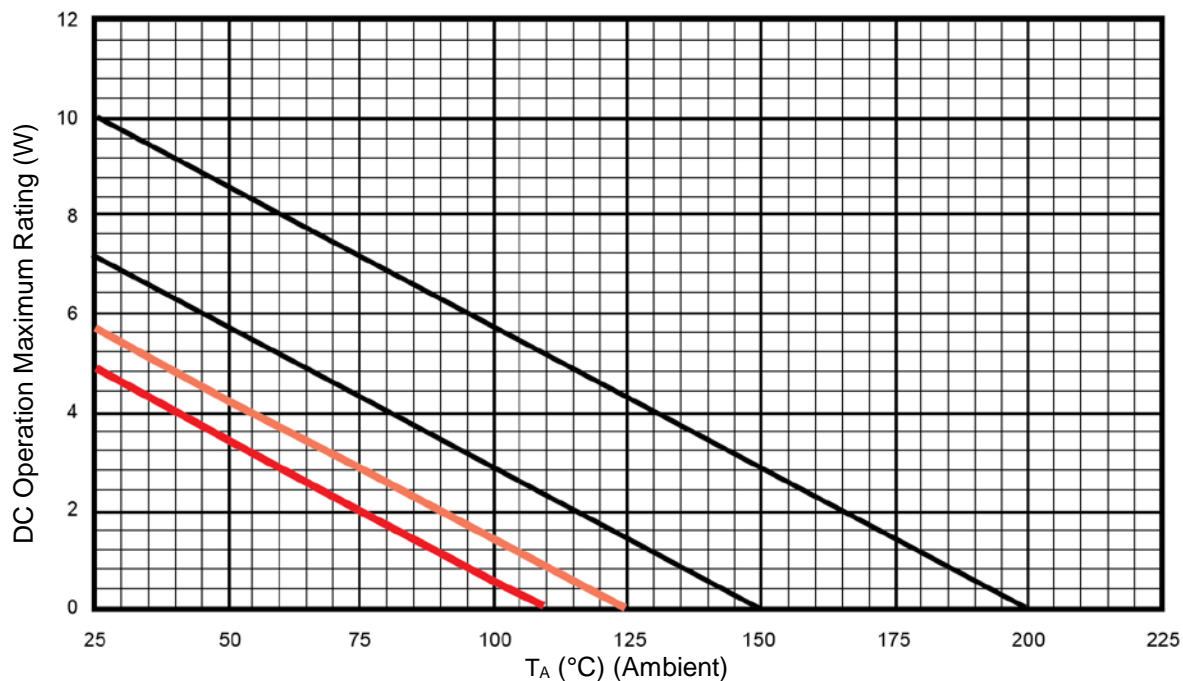


FIGURE 2
Temperature-Power Derating Curve

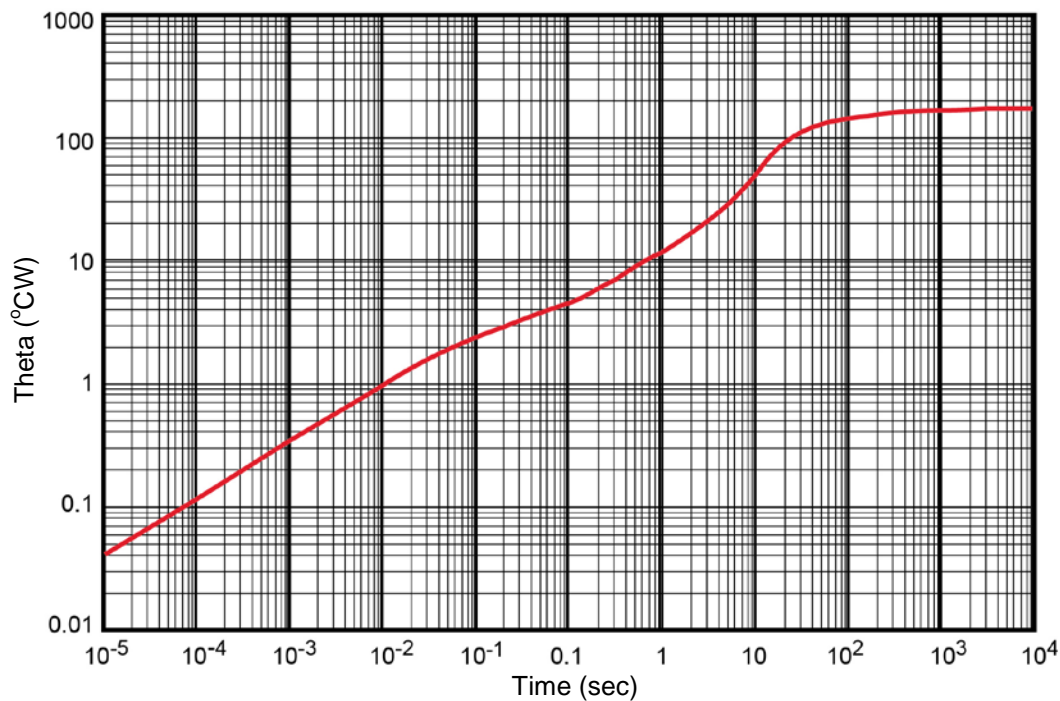
GRAPHS (continued)


FIGURE 3
Thermal Impedance ($R_{\Theta JA}$)

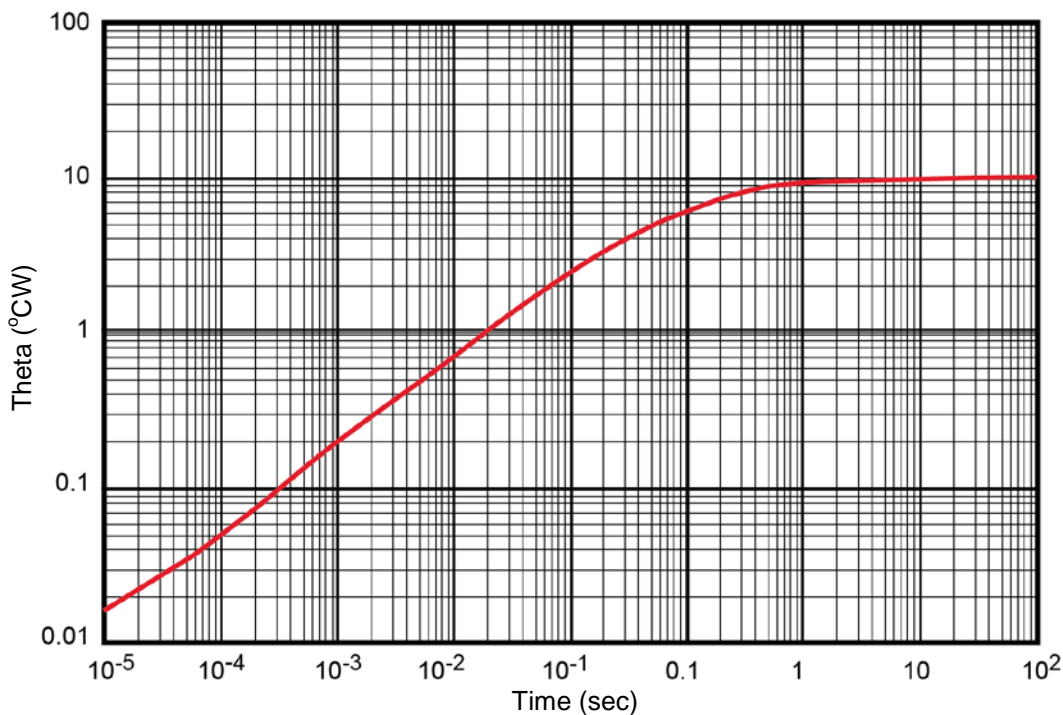
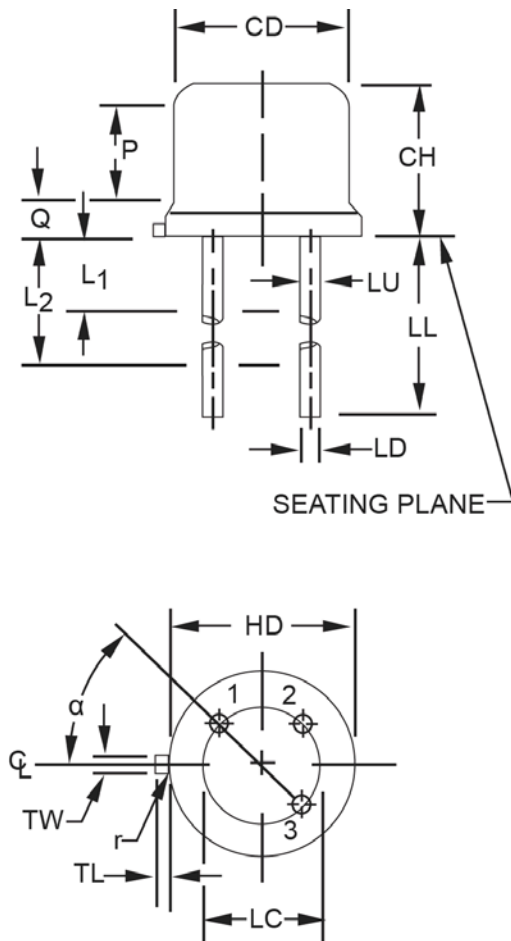


FIGURE 4
Thermal Impedance ($R_{\Theta JC}$)

PACKAGE DIMENSIONS


| Symbol | Dimensions | | | | Note |
|--------|-------------|------|-------------|------|------|
| | Inch | | Millimeters | | |
| | Min | Max | Min | Max | |
| CD | .305 | .335 | 7.75 | 8.51 | 6 |
| CH | .240 | .260 | 6.10 | 6.60 | |
| HD | .335 | .370 | 8.51 | 9.40 | |
| LC | .200 TP | | 5.08 TP | | 7 |
| LD | .016 | .019 | 0.41 | 0.48 | 8,9 |
| LL | See note 14 | | | | |
| LU | .016 | .019 | 0.41 | 0.48 | 8,9 |
| L1 | | .050 | | 1.27 | 8,9 |
| L2 | .250 | | 6.35 | | 8,9 |
| P | .100 | | 2.54 | | 7 |
| Q | | .030 | | 0.76 | 5 |
| TL | .029 | .045 | 0.74 | 1.14 | 3,4 |
| TW | .028 | .034 | 0.71 | 0.86 | 3 |
| r | | .010 | | 0.25 | 10 |
| α | 45° TP | | 45° TP | | 7 |

NOTES:

- Dimensions are in inches.
- Millimeters are given for general information only.
- Beyond r (radius) maximum, TW shall be held for a minimum length of .011 (0.28 mm).
- Dimension TL measured from maximum HD.
- Body contour optional within zone defined by HD, CD, and Q.
- CD shall not vary more than .010 inch (0.25 mm) in zone P. This zone is controlled for automatic handling.
- Leads at gauge plane .054 +.001 -.000 inch (1.37 +0.03 -0.00 mm) below seating plane shall be within .007 inch (0.18 mm) radius of true position (TP) at maximum material condition (MMC) relative to tab at MMC. The device may be measured by direct methods or by gauging procedure.
- Dimension LU applies between L1 and L2. Dimension LD applies between L2 and LL minimum. Diameter is uncontrolled in and beyond LL minimum.
- All three leads.
- The collector shall be internally connected to the case.
- Dimension r (radius) applies to both inside corners of tab.
- In accordance with ASME Y14.5M, diameters are equivalent to Φx symbology.
- Lead 1 = emitter, lead 2 = base, lead 3 = collector.
- TO-39 dimension LL = .5 inch (12.70 mm) min. and .750 inch (19.05 mm) max.

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