



## PNP SWITCHING SILICON TRANSISTOR

**Qualified per MIL-PRF-19500/290**

*Qualified Levels:  
JAN, JANTX, JANTXV  
and JANS*

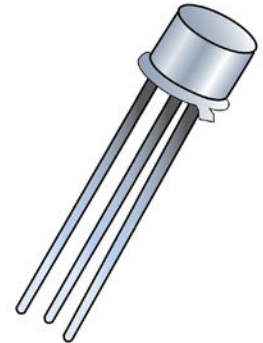
### DESCRIPTION

This family of 2N2904 and 2N2905A switching transistors are military qualified up to the JANS level for high-reliability applications. These devices are also available in a TO-5 package. Microsemi also offers numerous other transistor products to meet higher and lower power ratings with various switching speed requirements in both through-hole and surface-mount packages.

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


### FEATURES

- JEDEC registered 2N2904 through 2N2905A series.
- JAN, JANTX, JANTXV, and JANS qualifications are available per MIL-PRF-19500/290. (See [part nomenclature](#) for all available options.)
- RoHS compliant versions available (commercial grade only).



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

Also available in:

**TO-5 package**  
(long-leaded)  
 [2N2904AL & 2N2905AL](#)

### APPLICATIONS / BENEFITS

- General purpose transistors for high speed switching applications.
- Military and other high-reliability applications.

### MAXIMUM RATINGS

| Parameters / Test Conditions                   | Symbol               | Value                                 |                    | Unit          |
|--|----------------------|---------------------------------------|--------------------|---------------|
|  |                      | 2N2904<br>2N2905                      | 2N2904A<br>2N2905A |               |
| Collector-Emitter Voltage                      | $V_{CEO}$            | 40                                    | 60                 | V             |
| Collector-Base Voltage                         | $V_{CBO}$            | 60                                    |                    | V             |
| Emitter-Base Voltage                           | $V_{EBO}$            | 5.0                                   |                    | V             |
| Thermal Resistance Junction-to-Ambient         | $R_{\theta JA}$      | 195                                   |                    | $^{\circ}C/W$ |
| Thermal Resistance Junction-to-Case            | $R_{\theta JC}$      | 50                                    |                    | $^{\circ}C/W$ |
| Collector Current                              | $I_C$                | 600                                   |                    | mA            |
| Total Power Dissipation                        | $P_T$                | @ $T_A = +25^{\circ}C$ <sup>(1)</sup> | 0.8                | W             |
|  |                      | @ $T_C = +25^{\circ}C$ <sup>(2)</sup> | 3.0                |               |
| Operating & Storage Junction Temperature Range | $T_J$ &<br>$T_{stg}$ | -65 to +200                           |                    | $^{\circ}C$   |

- Notes:**
1. For derating, see [figures 1 and 2](#).
  2. For thermal impedance, see [figures 3 and 4](#).

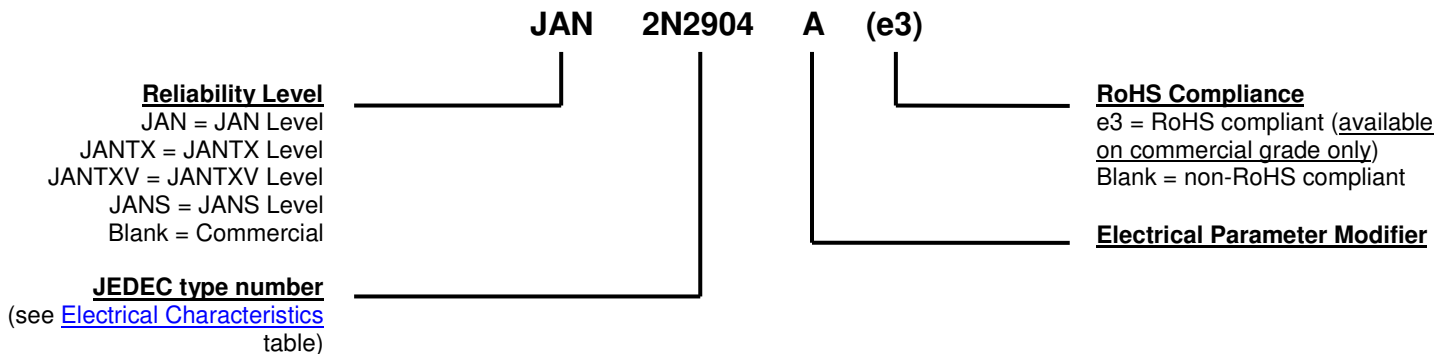
**MSC – Lawrence**  
6 Lake Street,  
Lawrence, MA 01841  
Tel: 1-800-446-1158 or  
(978) 620-2600  
Fax: (978) 689-0803

**MSC – Ireland**  
Gort Road Business Park,  
Ennis, Co. Clare, Ireland  
Tel: +353 (0) 65 6840044  
Fax: +353 (0) 65 6822298

**Website:**  
[www.microsemi.com](http://www.microsemi.com)

**MECHANICAL and PACKAGING**

- CASE: Hermetically sealed, kovar base, nickel cap.
- TERMINALS: Leads are kovar, nickel plated, and finish is solder dip (Sn63/Pb37). Can be RoHS compliant with pure matte-tin (commercial grade only).
- MARKING: Part number, date code, manufacturer's ID.
- POLARITY: PNP (see package outline).
- WEIGHT: Approximately 1.064 grams.
- See [Package Dimensions](#) on last page.

**PART NOMENCLATURE**

**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 @  $T_A = +25\text{ }^\circ\text{C}$ , unless otherwise noted**

| Parameters / Test Conditions   | Symbol        | Min.                  | Max.                     | Unit                           |
|--|---------------|-----------------------|--------------------------|--------------------------------|
| <b>OFF CHARACTERISTICS</b>   |               |                       |                          |                                |
| Collector-Emitter Breakdown Current<br>$I_C = 10\text{ mA}$<br>2N2904, 2N2905<br>2N2904A, 2N2905A                          | $V_{(BR)CEO}$ | 40<br>60              |                          | V                              |
| Collector-Emitter Cutoff Voltage<br>$V_{CE} = 40\text{ V}$<br>$V_{CE} = 60\text{ V}$<br>2N2904, 2N2905<br>2N2904A, 2N2905A | $I_{CES}$     |                       | 1.0                      | $\mu\text{A}$                  |
| Collector-Base Cutoff Current<br>$V_{CB} = 60\text{ V}$<br>All Types   | $I_{CBO1}$    |                       | 10                       | $\mu\text{A}$                  |
| $V_{CB} = 50\text{ V}$<br>2N2904, 2N2905<br>2N2904A, 2N2905A   | $I_{CBO2}$    |                       | 20<br>10                 | nA<br>nA                       |
| $V_{CB} = 50\text{ V @ } T_A = +150\text{ }^\circ\text{C}$<br>2N2904, 2N2905<br>2N2904A, 2N2905A                           | $I_{CBO3}$    |                       | 20<br>10                 | $\mu\text{A}$<br>$\mu\text{A}$ |
| Emitter-Base Cutoff Current<br>$V_{EB} = 3.5\text{ V}$<br>$V_{EB} = 5.0\text{ V}$  | $I_{EBO}$     |                       | 50<br>10                 | nA<br>$\mu\text{A}$            |
| <b>ON CHARACTERISTICS <sup>(1)</sup></b>   |               |                       |                          |                                |
| Forward-Current Transfer Ratio<br>$I_C = 0.1\text{ mA, } V_{CE} = 10\text{ V}$<br>2N2904<br>2N2905<br>2N2904A<br>2N2905A   | $h_{FE}$      |                       | 20<br>35<br>40<br>75     |                                |
| $I_C = 1.0\text{ mA, } V_{CE} = 10\text{ V}$<br>2N2904<br>2N2905<br>2N2904A<br>2N2905A                                     |               | 25<br>50<br>40<br>100 | 175<br>450<br>175<br>450 |                                |
| $I_C = 10\text{ mA, } V_{CE} = 10\text{ V}$<br>2N2904<br>2N2905<br>2N2904A<br>2N2905A                                      |               | 35<br>75<br>40<br>100 |                          |                                |
| $I_C = 150\text{ mA, } V_{CE} = 10\text{ V}$<br>2N2904, 2N2904A<br>2N2905, 2N2905A   |               | 40<br>100             | 120<br>300               |                                |
| $I_C = 500\text{ mA, } V_{CE} = 10\text{ V}$<br>2N2904<br>2N2905<br>2N2904A<br>2N2905A                                     |               | 20<br>30<br>40<br>50  |                          |                                |

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

| Parameters / Test Conditions   | Symbol        | Min. | Max.       | Unit |
|--|---------------|------|------------|------|
| <b>ON CHARACTERISTICS <sup>(1)</sup> (continued)</b>   |               |      |            |      |
| Collector-Emitter Saturation Voltage<br>$I_C = 150\text{ mA}$ , $I_B = 15\text{ mA}$<br>$I_C = 500\text{ mA}$ , $I_B = 50\text{ mA}$ | $V_{CE(sat)}$ |      | 0.4<br>1.6 | V    |
| Base-Emitter Saturation Voltage<br>$I_C = 150\text{ mA}$ , $I_B = 15\text{ mA}$<br>$I_C = 500\text{ mA}$ , $I_B = 50\text{ mA}$      | $V_{BE(sat)}$ |      | 1.3<br>2.6 | V    |

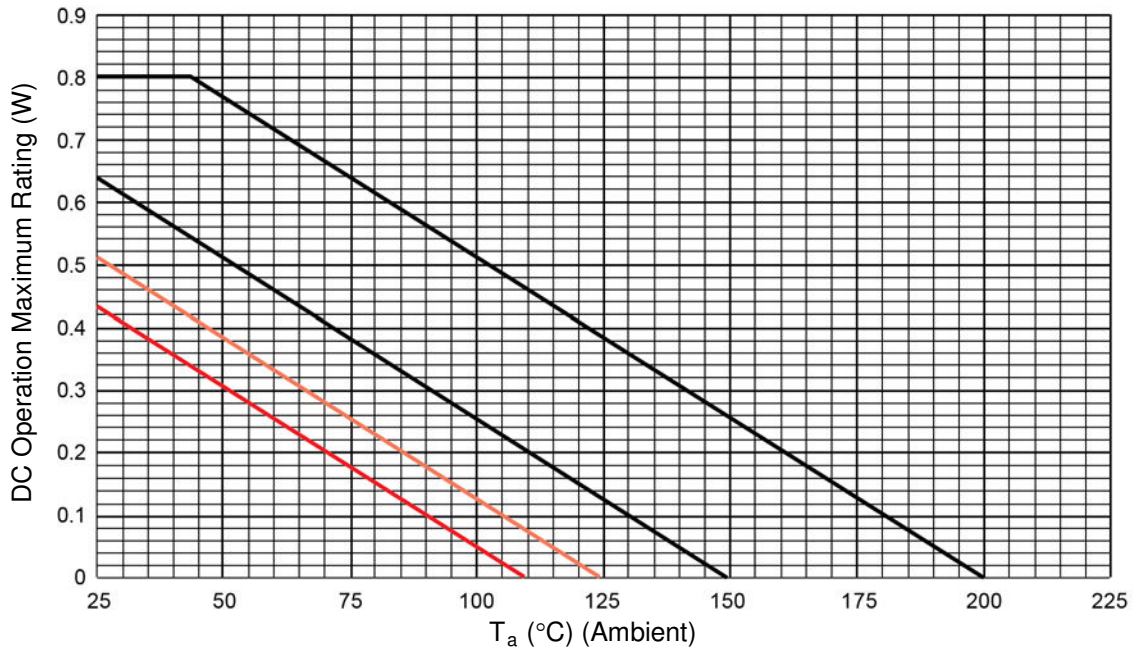
(1) Pulse Test: Pulse Width = 300  $\mu\text{s}$ , duty cycle  $\leq 2.0\%$ .

**DYNAMIC CHARACTERISTICS**

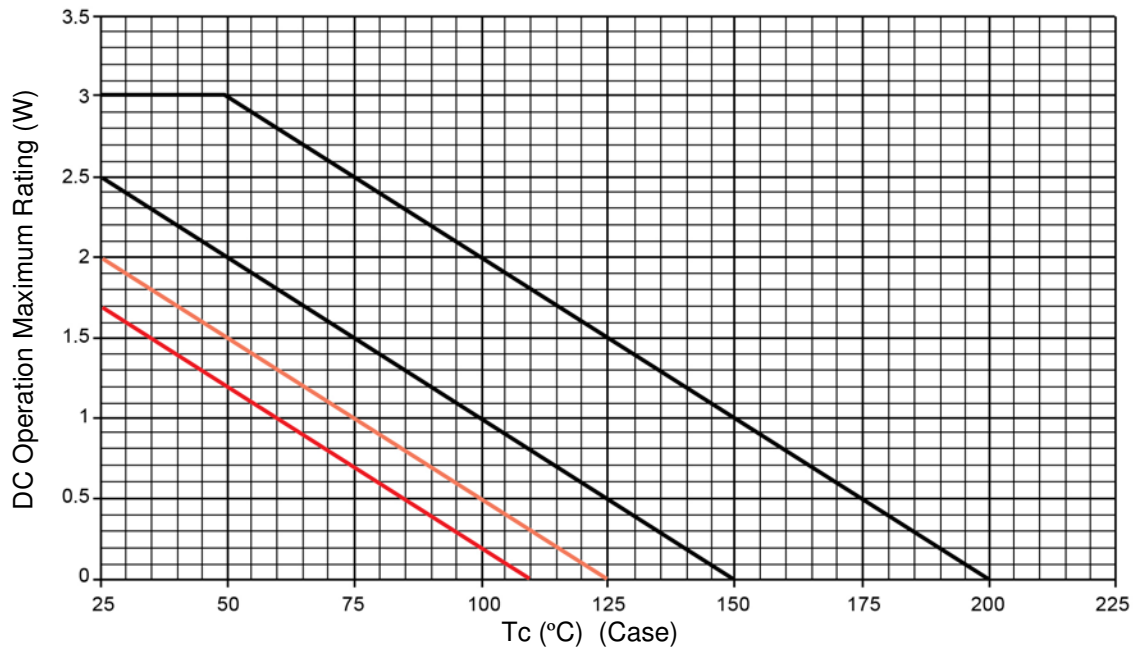
| Parameters / Test Conditions   | Symbol     | Min. | Max.           | Unit |
|--|------------|------|----------------|------|
| Small-Signal Short-Circuit Forward-Current Transfer Ratio<br>$I_C = 1.0\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 1.0\text{ kHz}$<br>2N2904<br>2N2905<br>2N2904A, 2N2905A | $h_{fe}$   |      | 25<br>50<br>40 |      |
| Small-Signal Short-Circuit Forward-Current Transfer Ratio<br>$I_C = 50\text{ mA}$ , $V_{CE} = 20\text{ V}$ ,<br>$f = 100\text{ MHz}$                                       | $ h_{fe} $ |      | 2.0            |      |
| Output Capacitance<br>$V_{CB} = 10\text{ V}$ , $I_E = 0$ ,<br>$100\text{ kHz} \leq f \leq 1.0\text{ MHz}$  | $C_{obo}$  |      | 8.0            | pF   |
| Input Capacitance<br>$V_{EB} = 2.0\text{ V}$ , $I_C = 0$ ,<br>$100\text{ kHz} \leq f \leq 1.0\text{ MHz}$  | $C_{ibo}$  |      | 30             | pF   |

**SWITCHING CHARACTERISTICS**

| Parameters / Test Conditions | Symbol    | Min. | Max. | Unit |
|------------------------------|-----------|------|------|------|
| Turn-On Time                 | $t_{on}$  |      | 45   | ns   |
| Turn-Off Time                | $t_{off}$ |      | 300  | ns   |

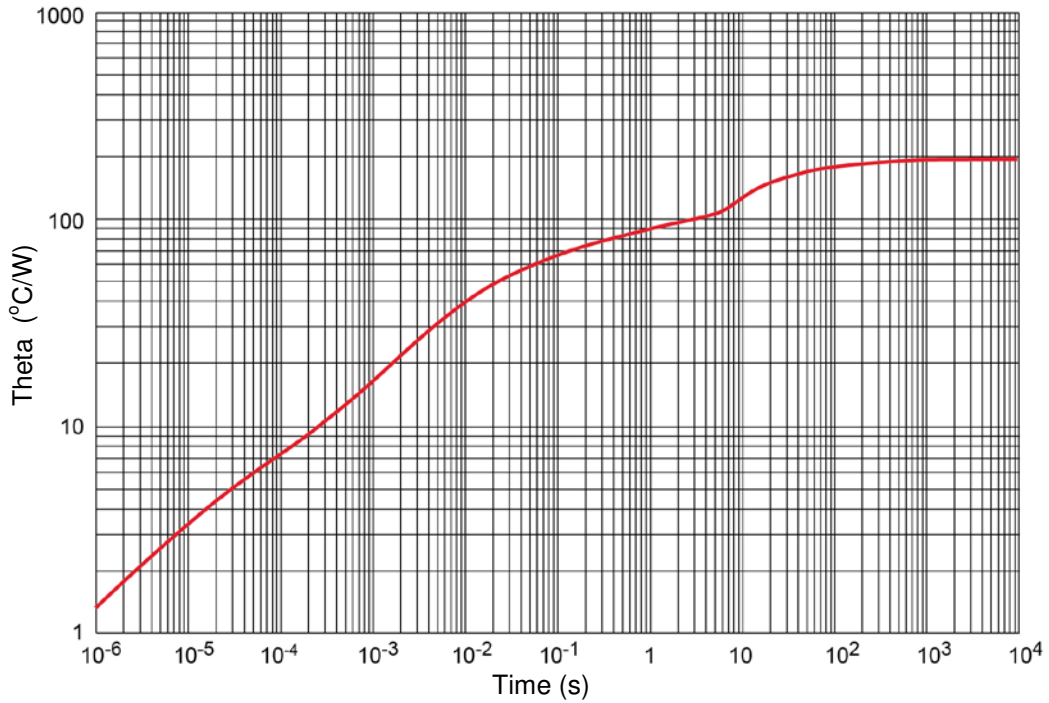
**GRAPHS**


**FIGURE 1**  
Derating (R<sub>θJA</sub>) PCB



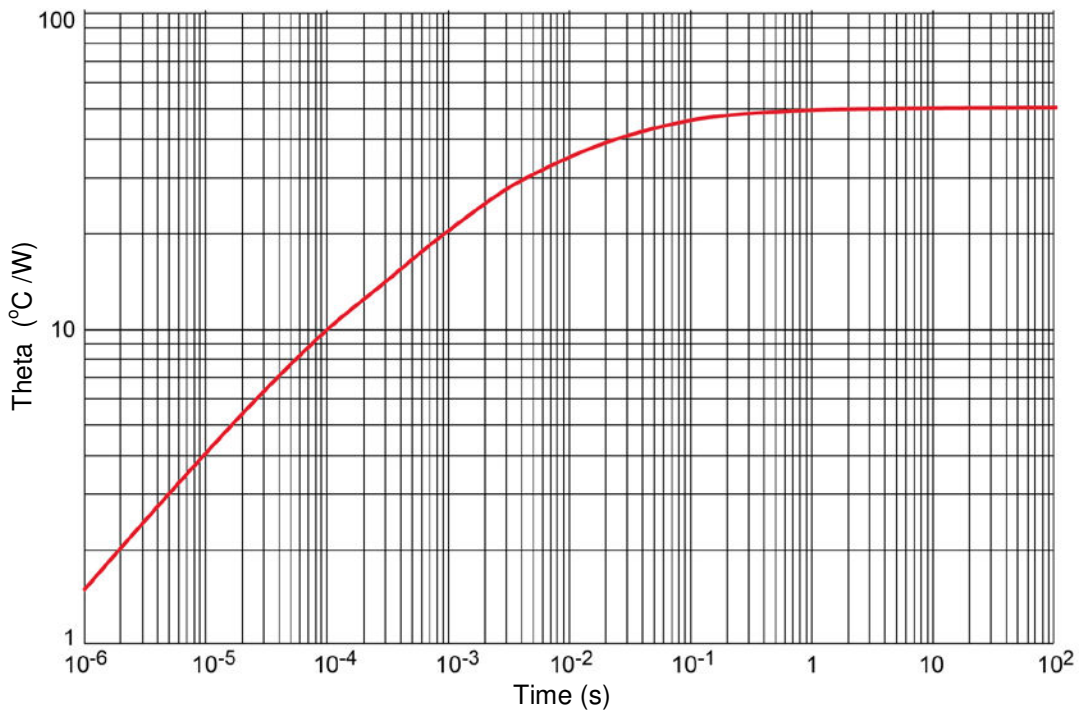
**FIGURE 2**  
Derating (R<sub>θJA</sub>) PCB

GRAPHS (continued)



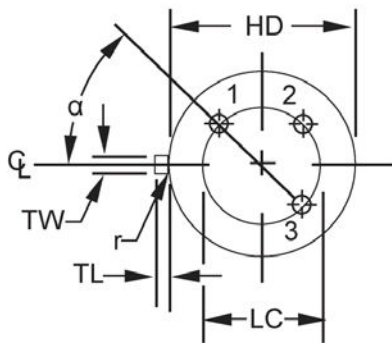
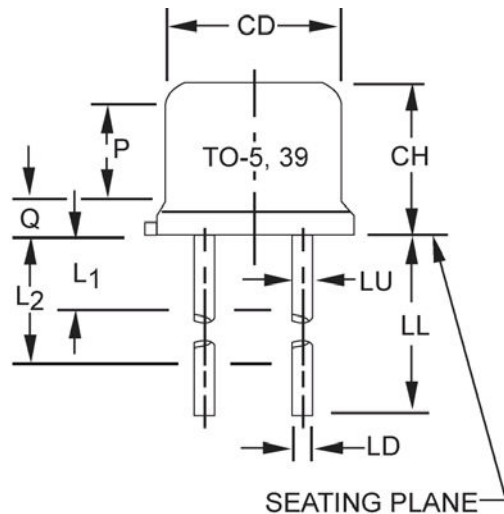
**FIGURE 3**

Thermal impedance graph ( $R_{\theta JA}$ )



**FIGURE 4**

Thermal impedance graph ( $R_{\theta JA}$ )

**PACKAGE DIMENSIONS**


| Symbol    | Dimensions |       |             |       | Note     |
|-----------|------------|-------|-------------|-------|----------|
|           | Inch       |       | Millimeters |       |          |
|           | Min        | Max   | Min         | Max   |          |
| <b>CD</b> | 0.305      | 0.335 | 7.75        | 8.51  |          |
| <b>CH</b> | 0.240      | 0.260 | 6.10        | 6.60  |          |
| <b>HD</b> | 0.335      | 0.370 | 8.51        | 9.40  |          |
| <b>LC</b> | 0.200 TP   |       | 5.08 TP     |       | 6        |
| <b>LD</b> | 0.016      | 0.021 | 0.41        | 0.53  | 7, 8     |
| <b>LL</b> | 0.500      | 0.750 | 12.70       | 19.05 | 7, 8, 12 |
| <b>LU</b> | 0.016      | 0.019 | 0.41        | 0.48  | 7, 8     |
| <b>L1</b> |            | 0.050 |             | 1.27  | 7, 8     |
| <b>L2</b> | 0.250      |       | 6.35        |       | 7, 8     |
| <b>P</b>  | 0.100      |       | 2.54        |       |          |
| <b>Q</b>  |            | 0.050 |             | 1.27  | 5        |
| <b>TL</b> | 0.029      | 0.045 | 0.74        | 1.14  | 4        |
| <b>TW</b> | 0.028      | 0.034 | 0.71        | 0.86  | 3        |
| <b>r</b>  |            | 0.010 |             | 0.25  | 10       |
| <b>α</b>  | 45° TP     |       | 45° TP      |       | 6        |

**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.
- 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.
- Dimension LU applies between L1 and L2. Dimension LD applies between L2 and LL minimum. Diameter is uncontrolled in L1 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  $\Phi$ x symbology.
- For "L" suffix devices, dimension LL is 1.50 (38.10 mm) minimum, 1.75 (44.45 mm) maximum.
- Lead 1 = emitter, lead 2 = base, lead 3 = collector.