



## NPN SILICON TRANSISTOR

Qualified per MIL-PRF-19500/366

Qualified Levels:  
JAN, JANTX, JANTXV  
and JANS

### DESCRIPTION

This family of 2N3498 thru 2N3501 epitaxial planar transistors are military qualified up to a JANS level for high-reliability applications. These devices are also available in TO-5 and low profile U4 packaging. 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 2N3498 through 2N3501 series.
- JAN, JANTX, JANTXV, and JANS qualifications are available per MIL-PRF-19500/366. (See [part nomenclature](#) for all available options.)
- RoHS compliant versions available (commercial grade only).

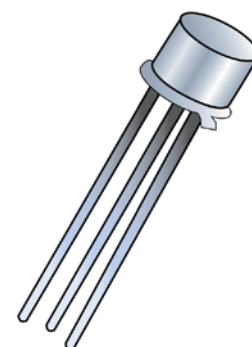
### APPLICATIONS / BENEFITS

- General purpose transistors for medium power applications requiring high frequency switching and low package profile.
- Military and other high-reliability applications.

### MAXIMUM RATINGS

| Parameters / Test Conditions                                                                                            | Symbol          | 2N3498<br>2N3499 | 2N3500<br>2N3501 | Unit                 |
|-------------------------------------------------------------------------------------------------------------------------|-----------------|------------------|------------------|----------------------|
| Collector-Emitter Voltage                                                                                               | $V_{CEO}$       | 100              | 150              | V                    |
| Collector-Base Voltage                                                                                                  | $V_{CBO}$       | 100              | 150              | V                    |
| Emitter-Base Voltage                                                                                                    | $V_{EBO}$       | 6.0              | 6.0              | V                    |
| Collector Current                                                                                                       | $I_C$           | 500              | 300              | mA                   |
| Thermal Resistance Junction-to-Ambient                                                                                  | $R_{\theta JA}$ | 175              |                  | $^{\circ}\text{C/W}$ |
| Thermal Resistance Junction-to-Case                                                                                     | $R_{\theta JC}$ | 30               |                  | $^{\circ}\text{C/W}$ |
| Total Power Dissipation<br>@ $T_A = +25^{\circ}\text{C}$ <sup>(1)</sup><br>@ $T_C = +25^{\circ}\text{C}$ <sup>(2)</sup> | $P_T$           | 1.0<br>5.0       |                  | W                    |
| Operating & Storage Junction Temperature Range                                                                          | $T_J, T_{stg}$  | -65 to +200      |                  | $^{\circ}\text{C}$   |

**Notes:** 1. See [figure 1](#).  
2. See [figure 2](#).



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

Also available in:

**TO-5 package**  
(long-leaded)  
 2N3498L – 2N3501L

**U4 package**  
(surface mount)  
 2N3498U4 – 2N3501U4

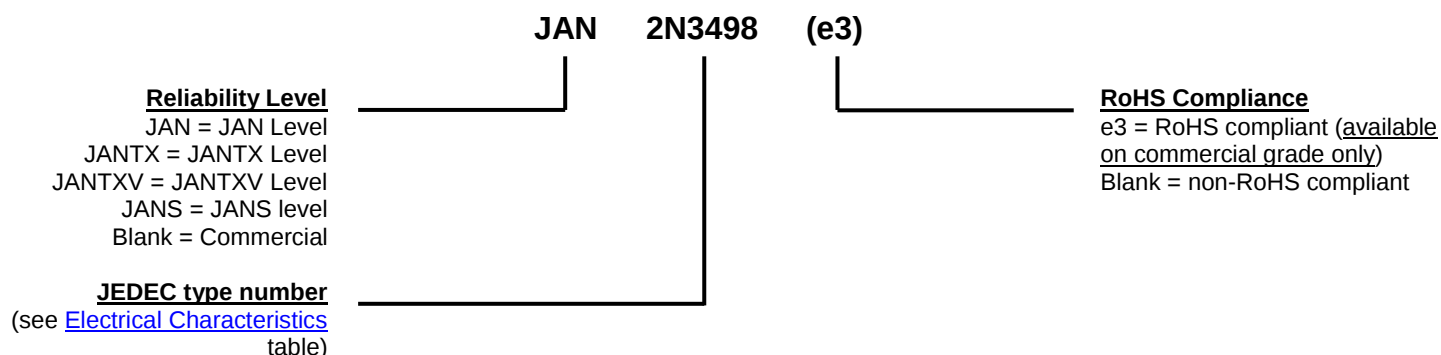
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**MECHANICAL and PACKAGING**

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

| Characteristic                                                                                                                                                                                                  | Symbol        | Min.       | Max.                 | Unit                                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|------------|----------------------|--------------------------------------------|
| <b>OFF CHARACTERISTICS</b>                                                                                                                                                                                      |               |            |                      |                                            |
| Collector-Emitter Breakdown Voltage<br>$I_C = 10\text{ mA}$ , pulsed<br>2N3498, 2N3499<br>2N3500, 2N3501                                                                                                        | $V_{(BR)CEO}$ | 100<br>150 |                      | V                                          |
| Collector-Base Cutoff Current<br>$V_{CB} = 50\text{ V}$<br>$V_{CB} = 75\text{ V}$<br>$V_{CB} = 100\text{ V}$<br>$V_{CB} = 150\text{ V}$<br>2N3498, 2N3499<br>2N3500, 2N3501<br>2N3498, 2N3499<br>2N3500, 2N3501 | $I_{CBO}$     |            | 50<br>50<br>10<br>10 | nA<br>nA<br>$\mu\text{A}$<br>$\mu\text{A}$ |
| Emitter-Base Cutoff Current<br>$V_{EB} = 4.0\text{ V}$<br>$V_{EB} = 6.0\text{ V}$                                                                                                                               | $I_{EBO}$     |            | 25<br>10             | nA<br>$\mu\text{A}$                        |

**ON CHARACTERISTICS <sup>(1)</sup>**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |               |                                                                       |                   |   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------------------------------------------------------------------|-------------------|---|
| Forward-Current Transfer Ratio<br>$I_C = 0.1\text{ mA}$ , $V_{CE} = 10\text{ V}$<br>2N3498, 2N3500<br>2N3499, 2N3501<br>$I_C = 1.0\text{ mA}$ , $V_{CE} = 10\text{ V}$<br>2N3498, 2N3500<br>2N3499, 2N3501<br>$I_C = 10\text{ mA}$ , $V_{CE} = 10\text{ V}$<br>2N3498, 2N3500<br>2N3499, 2N3501<br>$I_C = 150\text{ mA}$ , $V_{CE} = 10\text{ V}$<br>2N3498, 2N3500<br>2N3499, 2N3501<br>$I_C = 300\text{ mA}$ , $V_{CE} = 10\text{ V}$<br>2N3500<br>2N3501<br>$I_C = 500\text{ mA}$ , $V_{CE} = 10\text{ V}$<br>2N3498<br>2N3499 | $h_{FE}$      | 20<br>35<br>25<br>50<br>35<br>75<br>40<br>100<br>15<br>20<br>15<br>20 | 120<br>300        |   |
| Collector-Emitter Saturation Voltage<br>$I_C = 10\text{ mA}$ , $I_B = 1.0\text{ mA}$<br>$I_C = 300\text{ mA}$ , $I_B = 30\text{ mA}$<br>$I_C = 150\text{ mA}$ , $I_B = 15\text{ mA}$<br>All Types<br>2N3498, 2N3499<br>2N3500, 2N3501                                                                                                                                                                                                                                                                                             | $V_{CE(sat)}$ |                                                                       | 0.2<br>0.6<br>0.4 | V |
| Base-Emitter Saturation Voltage<br>$I_C = 10\text{ mA}$ , $I_B = 1.0\text{ mA}$<br>$I_C = 300\text{ mA}$ , $I_B = 30\text{ mA}$<br>$I_C = 150\text{ mA}$ , $I_B = 15\text{ mA}$<br>All Types<br>2N3498, 2N3499<br>2N3500, 2N3501                                                                                                                                                                                                                                                                                                  | $V_{BE(sat)}$ |                                                                       | 0.8<br>1.4<br>1.2 | V |

**DYNAMIC CHARACTERISTICS**

|                                                                                                                                               |            |     |           |    |
|-----------------------------------------------------------------------------------------------------------------------------------------------|------------|-----|-----------|----|
| Forward Current Transfer Ratio, Magnitude<br>$I_C = 20\text{ mA}$ , $V_{CE} = 20\text{ V}$ , $f = 100\text{ MHz}$                             | $ h_{fe} $ | 1.5 | 8.0       |    |
| Output Capacitance<br>$V_{CB} = 10\text{ V}$ , $I_E = 0$ ,<br>$100\text{ kHz} \leq f \leq 1.0\text{ MHz}$<br>2N3498, 2N3499<br>2N3500, 2N3501 | $C_{obo}$  |     | 10<br>8.0 | pF |
| Input Capacitance<br>$V_{EB} = 0.5\text{ V}$ , $I_C = 0$ , $100\text{ kHz} \leq f \leq 1.0\text{ MHz}$                                        | $C_{ibo}$  |     | 80        | pF |

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

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

| Characteristic                                                                    | Symbol    | Min. | Max. | Unit |
|-----------------------------------------------------------------------------------|-----------|------|------|------|
| Turn-On Time<br>$V_{EB} = 5\text{ V}; I_C = 150\text{ mA}; I_{B1} = 15\text{ mA}$ | $t_{on}$  |      | 115  | ns   |
| Turn-Off Time<br>$I_C = 150\text{ mA}; I_{B1} = I_{B2} = -15\text{ mA}$           | $t_{off}$ |      | 1150 | ns   |

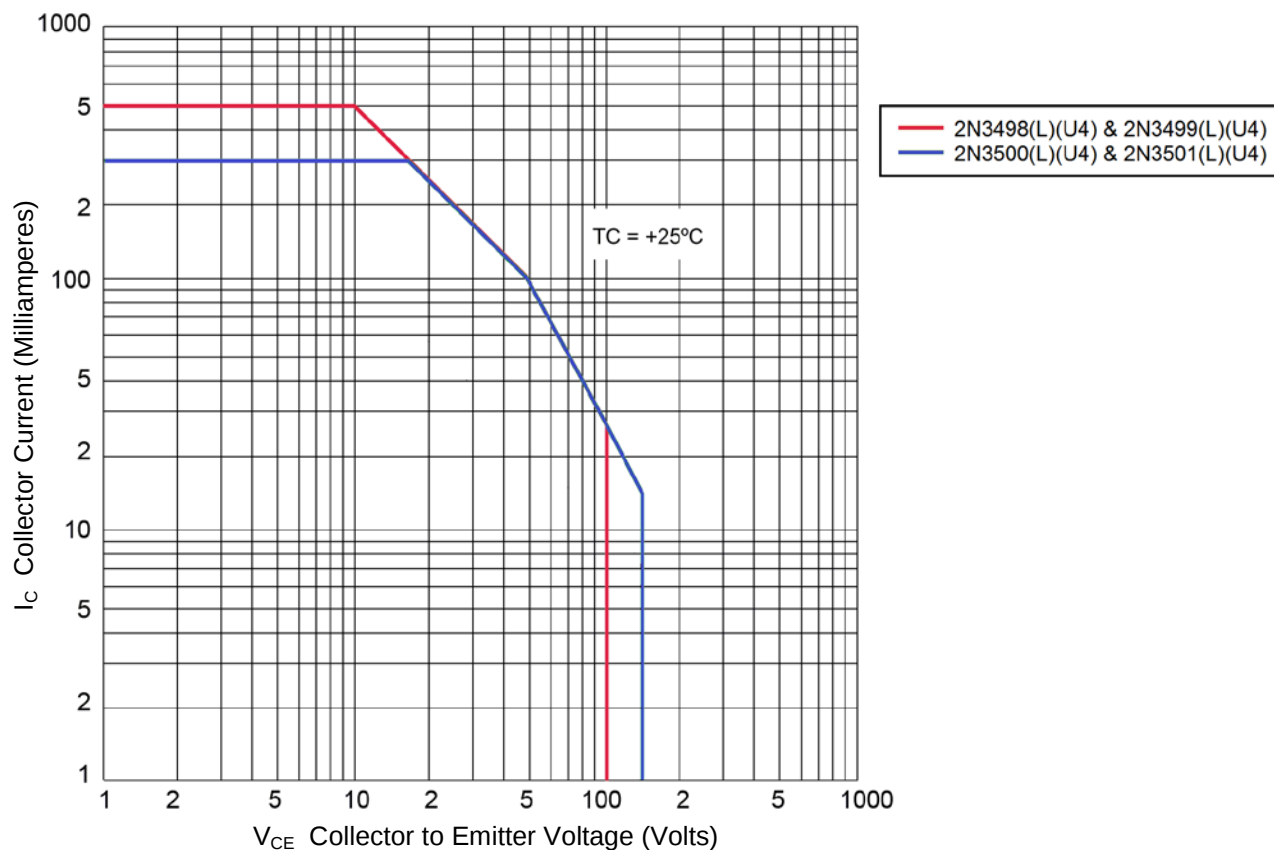
**SAFE OPERATING AREA (See SOA figure and reference [MIL-STD-750 method 3053](#))**
**DC Tests**
 $T_C = +25^\circ\text{C}$ ,  $t_r \geq 10\text{ ns}$ ; 1 Cycle,  $t = 1.0\text{ s}$ 
**Test 1**
 $V_{CE} = 10\text{ V}$ ,  $I_C = 500\text{ mA}$  2N3498, 2N3499

 $V_{CE} = 16.67\text{ V}$ ,  $I_C = 300\text{ mA}$  2N3500, 2N3501

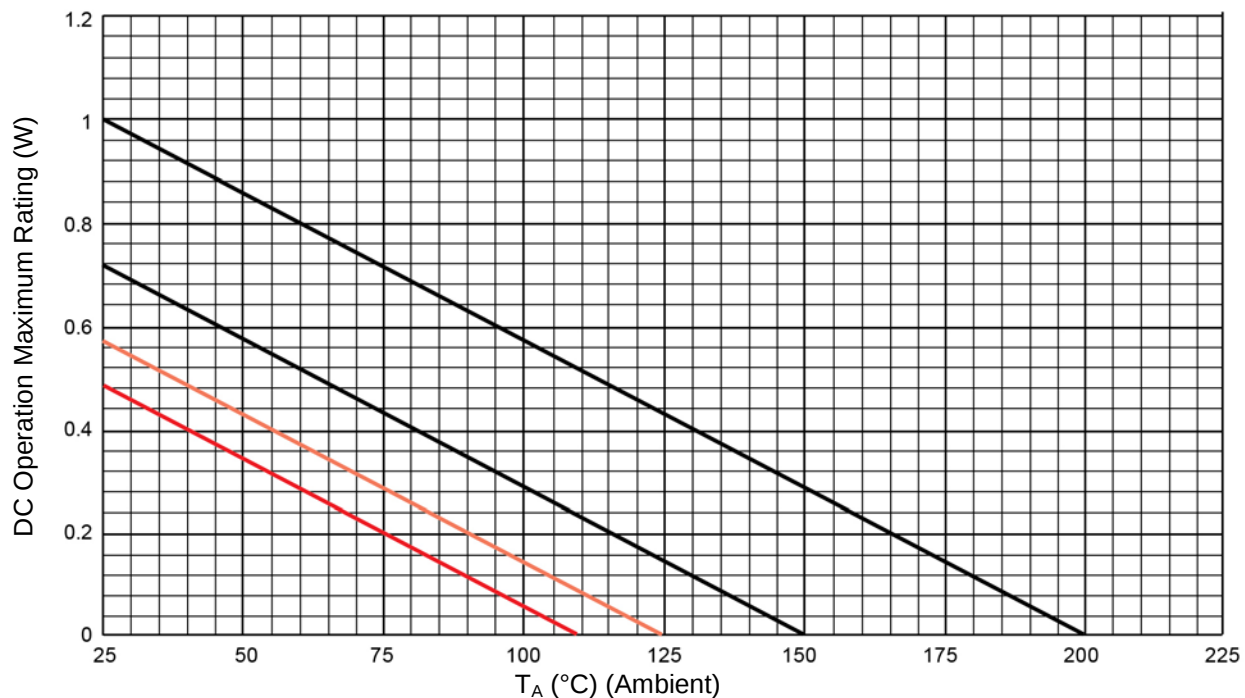
**Test 2**
 $V_{CE} = 50\text{ V}$ ,  $I_C = 100\text{ mA}$  All Types

**Test 3**
 $V_{CE} = 80\text{ V}$ ,  $I_C = 40\text{ mA}$  All Types

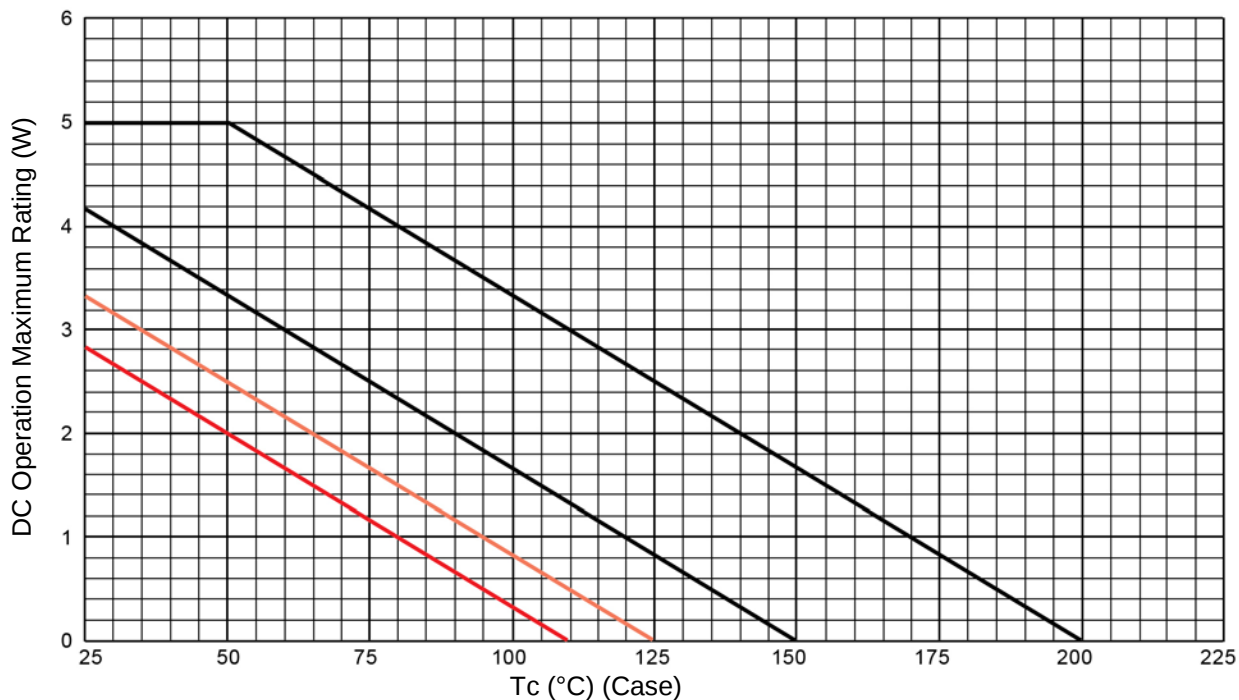
**Clamped Switching**
 $T_A = +25^\circ\text{C}$ 
**Test 1**
 $I_B = 85\text{ mA}$ ,  $I_C = 500\text{ mA}$  2N3498, 2N3499

 $I_B = 50\text{ mA}$ ,  $I_C = 300\text{ mA}$  2N3500, 2N3501

Maximum Safe Operating Area

# GRAPHS

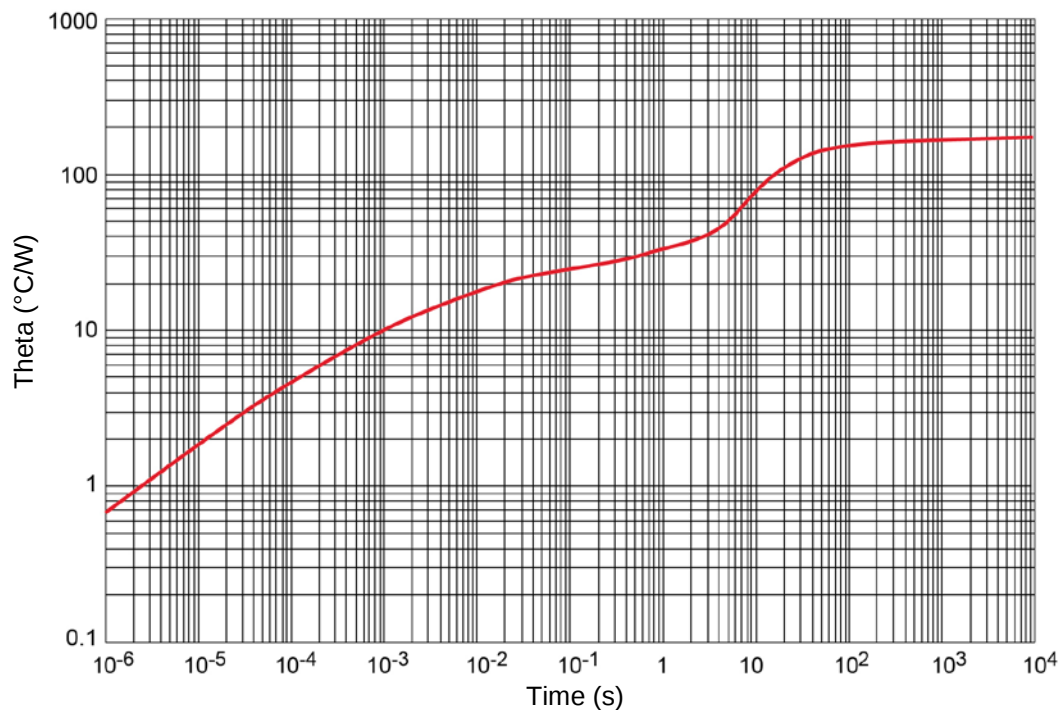


**FIGURE 1**  
Derating for all devices ( $R_{\theta JA}$ )



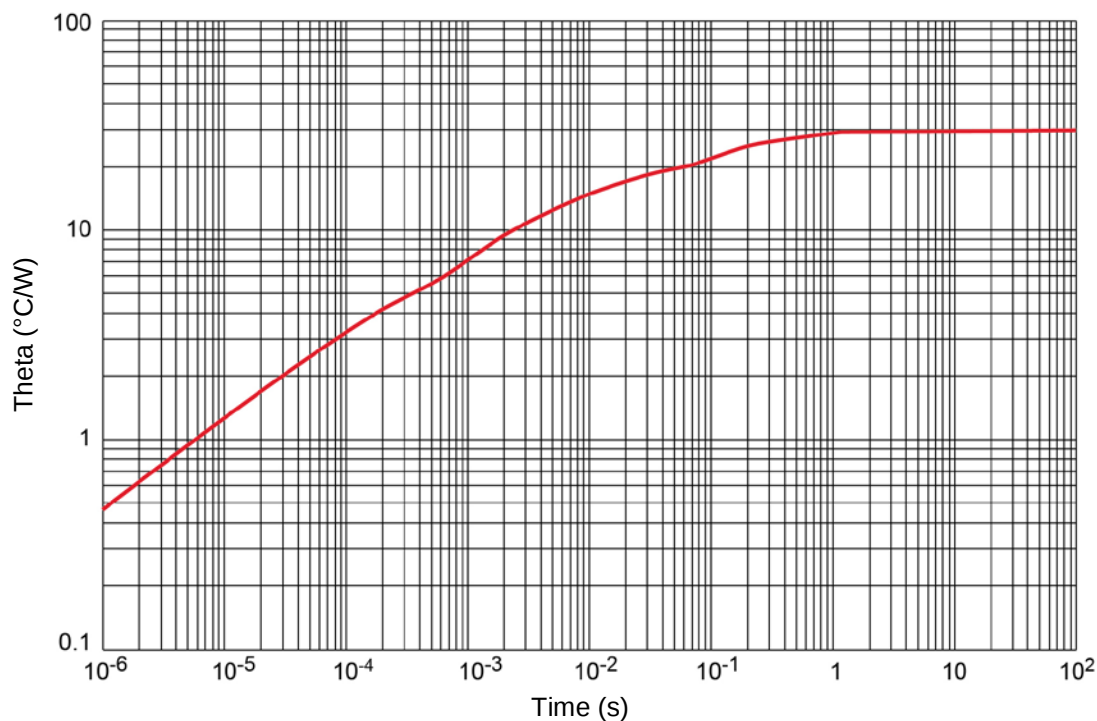
**FIGURE 2**  
Derating for all devices ( $R_{\theta JC}$ )

# GRAPHS



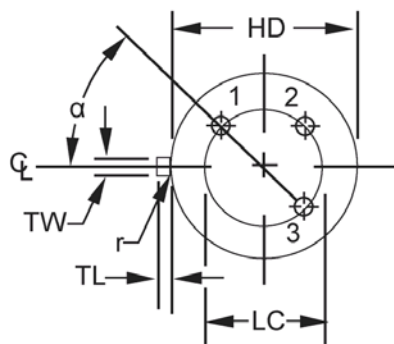
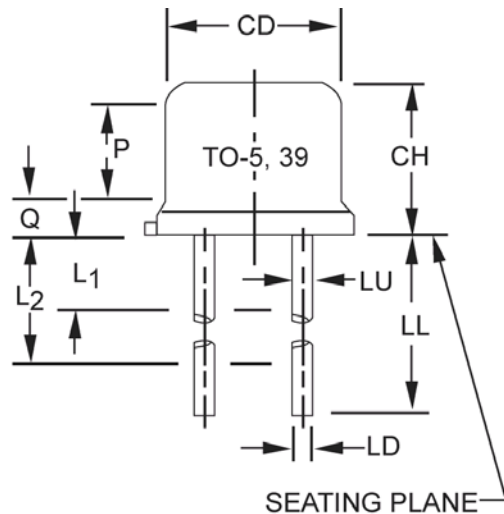
**FIGURE 3**

Thermal Impedance Graph ( $R_{\theta JA}$ )



**FIGURE 4**

Thermal Impedance Graph ( $R_{\theta JC}$ )

**PACKAGE DIMENSIONS**


| Symbol | Dimensions             |       |             |      | Note   |
|--------|------------------------|-------|-------------|------|--------|
|        | Inch                   |       | Millimeters |      |        |
|        | Min                    | Max   | Min         | Max  |        |
| CD     | 0.305                  | 0.335 | 7.75        | 8.51 |        |
| CH     | 0.240                  | 0.260 | 6.10        | 6.60 |        |
| HD     | 0.335                  | 0.370 | 8.51        | 9.40 |        |
| LC     | 0.200 TP               |       | 5.08 TP     |      | 6      |
| LD     | 0.016                  | 0.021 | 0.41        | 0.53 | 7      |
| LL     | See notes 7, 12 and 13 |       |             |      |        |
| LU     | 0.016                  | 0.019 | 0.41        | 0.48 | 7, 13  |
| L1     |                        | 0.050 |             | 1.27 | 13     |
| L2     | 0.250                  |       | 6.35        |      | 13     |
| P      | 0.100                  |       | 2.54        |      | 5      |
| Q      |                        | 0.050 |             | 1.27 | 4      |
| TL     | 0.029                  | 0.045 | 0.74        | 1.14 | 3      |
| TW     | 0.028                  | 0.034 | 0.71        | 0.86 | 10, 11 |
| r      |                        | 0.010 |             | 0.25 | 11     |
| α      | 45° TP                 |       | 45° TP      |      | 6      |

**NOTES:**

1. Dimension are in inches.
2. Millimeters are given for general information only.
3. Symbol TL is measured from HD maximum.
4. Details of outline in this zone are optional.
5. Symbol CD shall not vary more than .010 (0.25 mm) in zone P. This zone is controlled for automatic handling.
6. Leads at gauge plane .054 inch (1.37 mm) +.001 inch (0.03 mm) -.000 inch (0.00 mm) below seating plane shall be within .007 inch (0.18 mm) radius of true position (TP) relative to tab. Device may be measured by direct methods or by gauge.
7. Symbol LD applies between L1 and L2. Dimension LD applies between L2 and LL minimum. Lead diameter shall not exceed .042 inch (1.07 mm) within L1 and beyond LL minimum.
8. Lead designation, shall be as follows: 1 - emitter, 2 - base, 3 - collector.
9. Lead number three is electrically connected to case.
10. Beyond r maximum, TW shall be held for a minimum length of .011 inch (0.28 mm).
11. Symbol r applied to both inside corners of tab.
12. For transistor types 2N3498, 2N3499, 2N3500, and 2N3501, LL = .50 inch (12.7 mm) minimum and .750 inch (19.1 mm) maximum. For transistor types 2N3498L, 2N3499L, 2N3500L, and 2N3501L, LL = 1.50 inches (38.1 mm) minimum and 1.750 inches (44.5 mm) maximum.
13. All three leads.
14. In accordance with ASME Y14.5M, diameters are equivalent to  $\Phi$ x symbology.

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