



## RADIATION HARDENED NPN SILICON SWITCHING TRANSISTOR

*Qualified per MIL-PRF-19500/366*

Qualified Levels:  
JAN, JANTX, JANTXV  
AND JANS

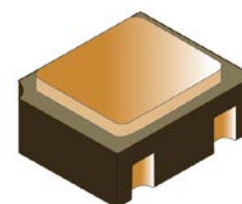
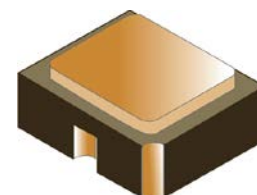
### DESCRIPTION

This 2N3501 epitaxial planar transistor is military qualified up to a JANS level for high-reliability applications. This device is also available in thru hole TO-5 and TO-39 packaging as well as a low profile U4 surface mount. 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

- Surface mount equivalent of JEDEC registered 2N3501 number.
- JAN, JANTX, JANTXV and JANS qualifications are available per MIL-PRF-19500/366. (See [part nomenclature](#) for all available options.)
- RoHS compliant by design.



### UB Package

Also available in:

**TO-5 package**  
(long-leaded)

 [2N3498L – 2N3501L](#)

**TO-39 (TO-205AD)**  
**package**  
(leaded)

 [2N3498 – 2N3501](#)

**U4 package**  
(surface mount)

 [2N3498U4 – 2N3501U4](#)

### APPLICATIONS / BENEFITS

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

### MAXIMUM RATINGS @ T<sub>C</sub> = +25 °C unless otherwise noted

| Parameters / Test Conditions              | Symbol                            | Value       | Unit |
|-------------------------------------------|-----------------------------------|-------------|------|
| Junction & Storage Temperature Range      | T <sub>J</sub> , T <sub>stg</sub> | -65 to +200 | °C   |
| Thermal Resistance Junction-to-Ambient    | R <sub>θJA</sub>                  | 325         | °C/W |
| Thermal Resistance Junction-to-Solder Pad | R <sub>θJSP</sub>                 | 90          | °C/W |
| Collector-Emitter Voltage                 | V <sub>CEO</sub>                  | 150         | V    |
| Collector-Base Voltage                    | V <sub>CBO</sub>                  | 150         | V    |
| Emitter-Base Voltage                      | V <sub>EBO</sub>                  | 6.0         | V    |
| Collector Current                         | I <sub>C</sub>                    | 300         | mA   |
| Total Power Dissipation                   | P <sub>T</sub>                    | 0.5         | W    |
|                                           |                                   |             |      |

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

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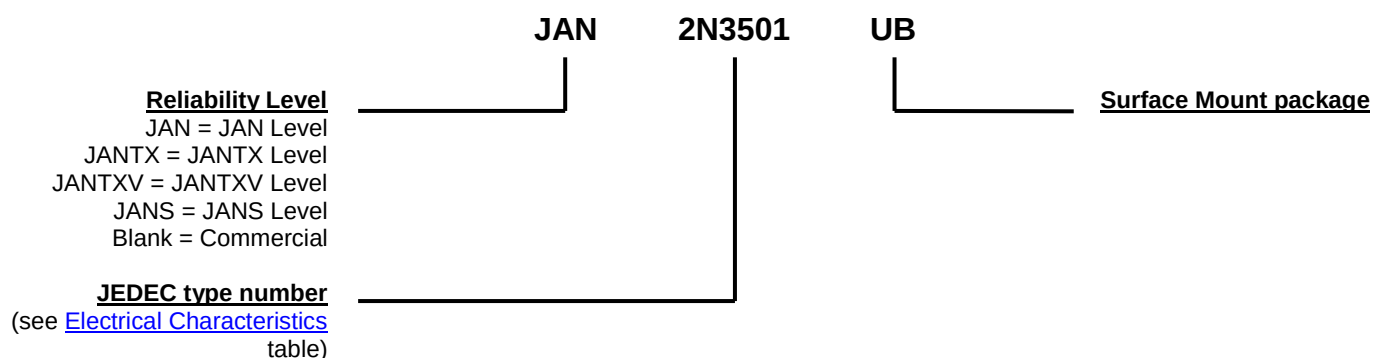
**Website:**

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

### MECHANICAL and PACKAGING

- CASE: Ceramic.
- TERMINALS: Gold plating over nickel under plate.
- MARKING: Part number, date code, manufacturer's ID.
- TAPE & REEL option: Standard per EIA-418D. Consult factory for quantities.
- WEIGHT: < 0.04 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**

| Parameters / Test Conditions | Symbol | Min. | Max. | Unit |
|------------------------------|--------|------|------|------|
|------------------------------|--------|------|------|------|

**OFF CHARACTERISTICS**

|                                                                                    |               |     |          |                     |
|------------------------------------------------------------------------------------|---------------|-----|----------|---------------------|
| Collector-Emitter Breakdown Voltage<br>$I_C = 10\text{ mA}$ , pulsed               | $V_{(BR)CEO}$ | 150 |          | V                   |
| Collector-Base Cutoff Current<br>$V_{CB} = 75\text{ V}$<br>$V_{CB} = 150\text{ V}$ | $I_{CBO}$     |     | 50<br>10 | nA<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>$I_C = 1.0\text{ mA}$ , $V_{CE} = 10\text{ V}$<br>$I_C = 10\text{ mA}$ , $V_{CE} = 10\text{ V}$<br>$I_C = 150\text{ mA}$ , $V_{CE} = 10\text{ V}$<br>$I_C = 300\text{ mA}$ , $V_{CE} = 10\text{ V}$ | $h_{FE}$      | 35<br>50<br>75<br>100<br>20 | 300        |   |
| Collector-Emitter Saturation Voltage<br>$I_C = 10\text{ mA}$ , $I_B = 1.0\text{ mA}$<br>$I_C = 150\text{ mA}$ , $I_B = 15\text{ mA}$                                                                                                                                                    | $V_{CE(sat)}$ |                             | 0.2<br>0.4 | V |
| Base-Emitter Saturation Voltage<br>$I_C = 10\text{ mA}$ , $I_B = 1.0\text{ mA}$<br>$I_C = 150\text{ mA}$ , $I_B = 15\text{ mA}$                                                                                                                                                         | $V_{BE(sat)}$ |                             | 0.8<br>1.2 | V |

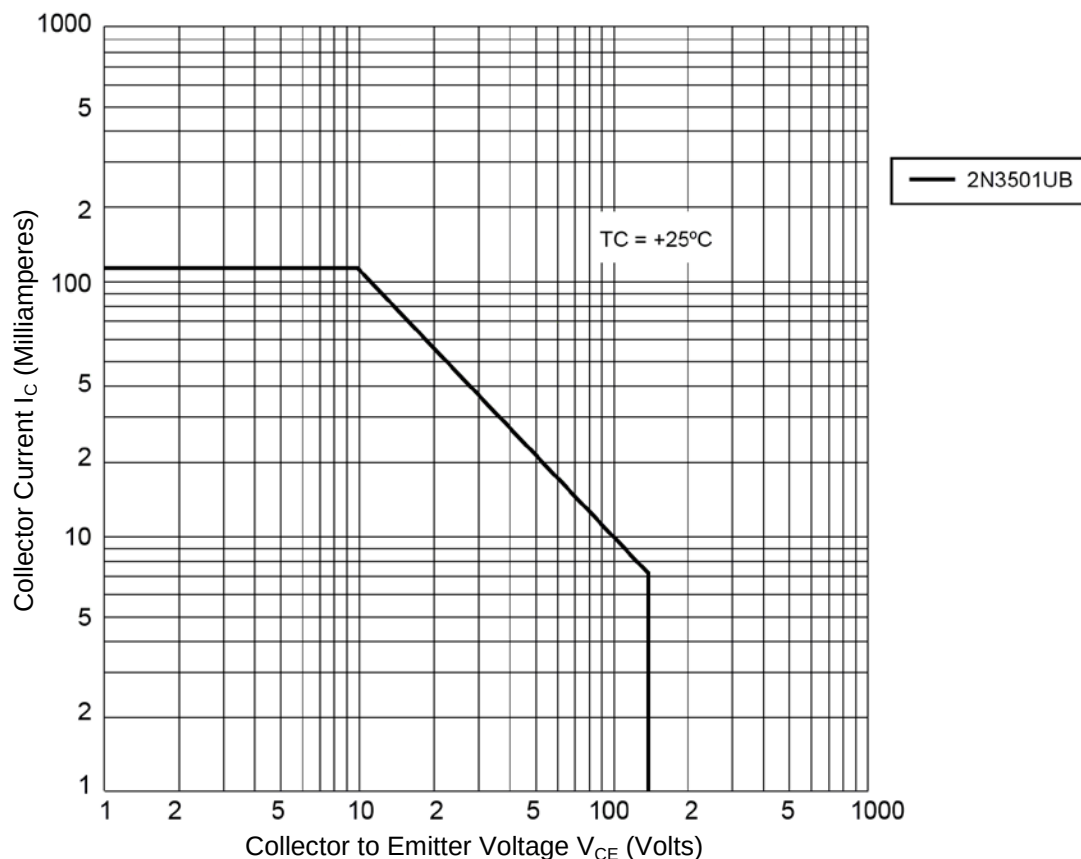
**DYNAMIC CHARACTERISTICS**

|                                                                                                                   |            |     |     |    |
|-------------------------------------------------------------------------------------------------------------------|------------|-----|-----|----|
| 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>$100\text{ kHz} \leq f \leq 1.0\text{ MHz}$         | $C_{obo}$  |     | 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 |

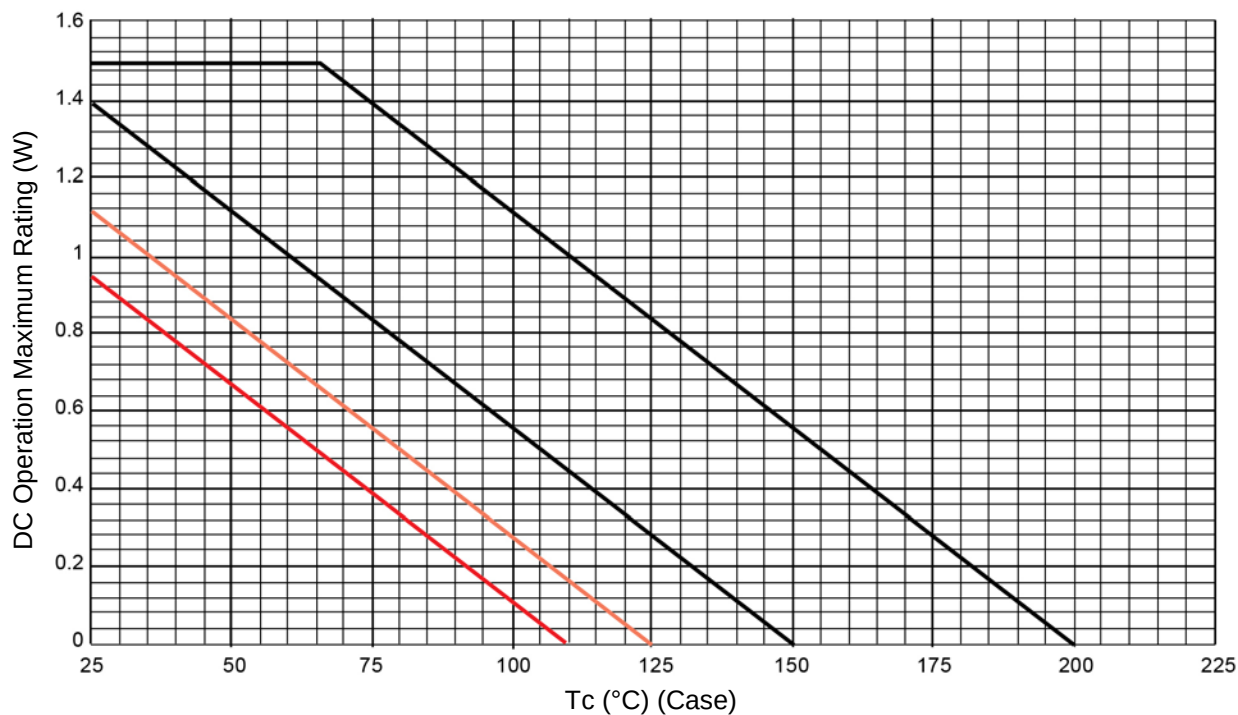
(1) Pulse Test: pulse width =  $300\text{ }\mu\text{s}$ , duty cycle  $\leq 2.0\%$ .

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

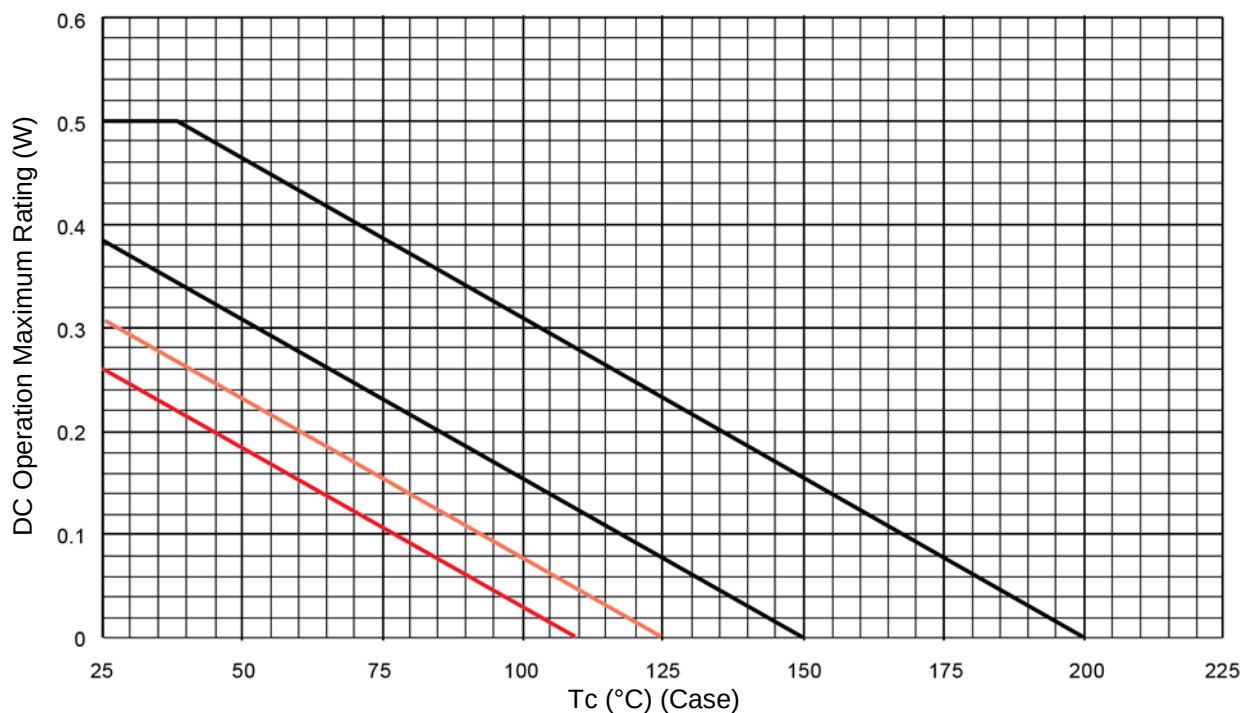
| Parameters / Test Conditions                                                            | Symbol    | Min. | Max. | Unit |
|-----------------------------------------------------------------------------------------|-----------|------|------|------|
| Turn-On Time<br>$V_{EB} = 5\text{ V}$ ; $I_C = 150\text{ mA}$ ; $I_{B1} = 15\text{ mA}$ | $t_{on}$  |      | 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**
 $T_C = +25\text{ }^{\circ}\text{C}$ ,  $t_r \geq 10\text{ ns}$ ; 1 Cycle,  $t = 1.0\text{ s}$ 
**Test 1**
 $V_{CE} = 10\text{ V}$ ,  $I_C = 113\text{ mA}$ 
**Test 2**
 $V_{CE} = 50\text{ V}$ ,  $I_C = 23\text{ mA}$ 
**Test 3**
 $V_{CE} = 80\text{ V}$ ,  $I_C = 14\text{ mA}$ 
**Clamped Switching**
 $T_A = +25\text{ }^{\circ}\text{C}$ 
**Test 1**
 $I_B = 50\text{ mA}$ ,  $I_C = 300\text{ mA}$ 


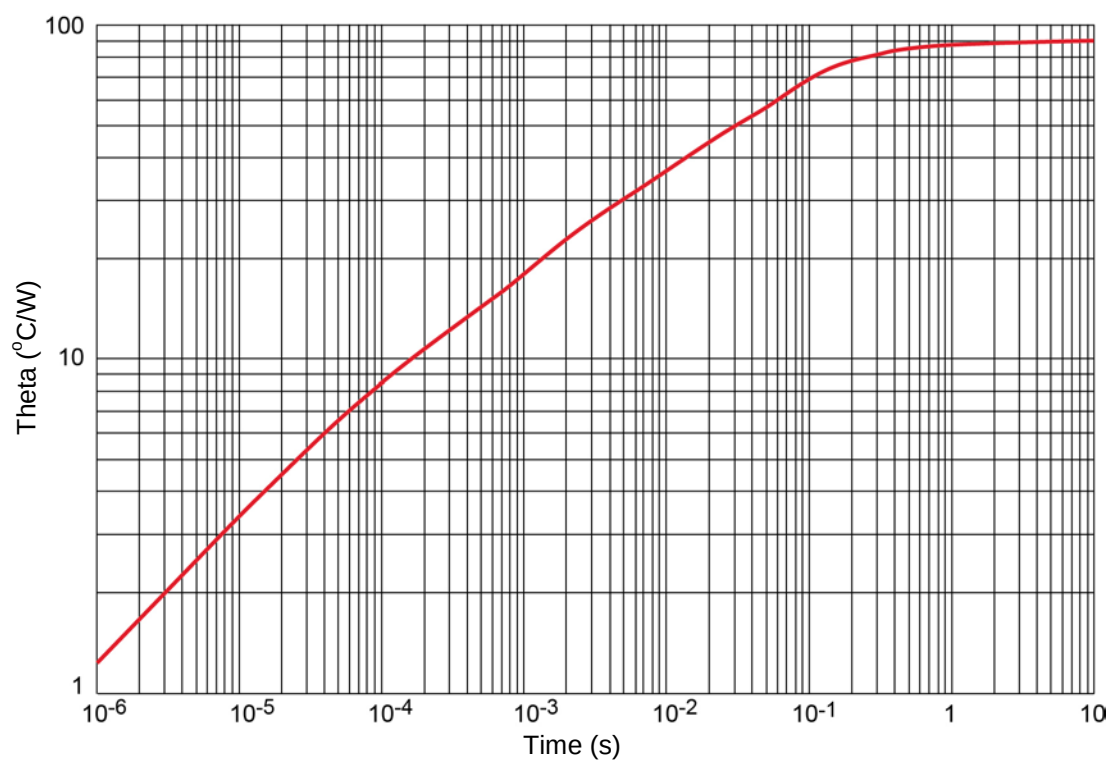
Maximum Safe Operating Area

**GRAPHS**

**FIGURE 1**

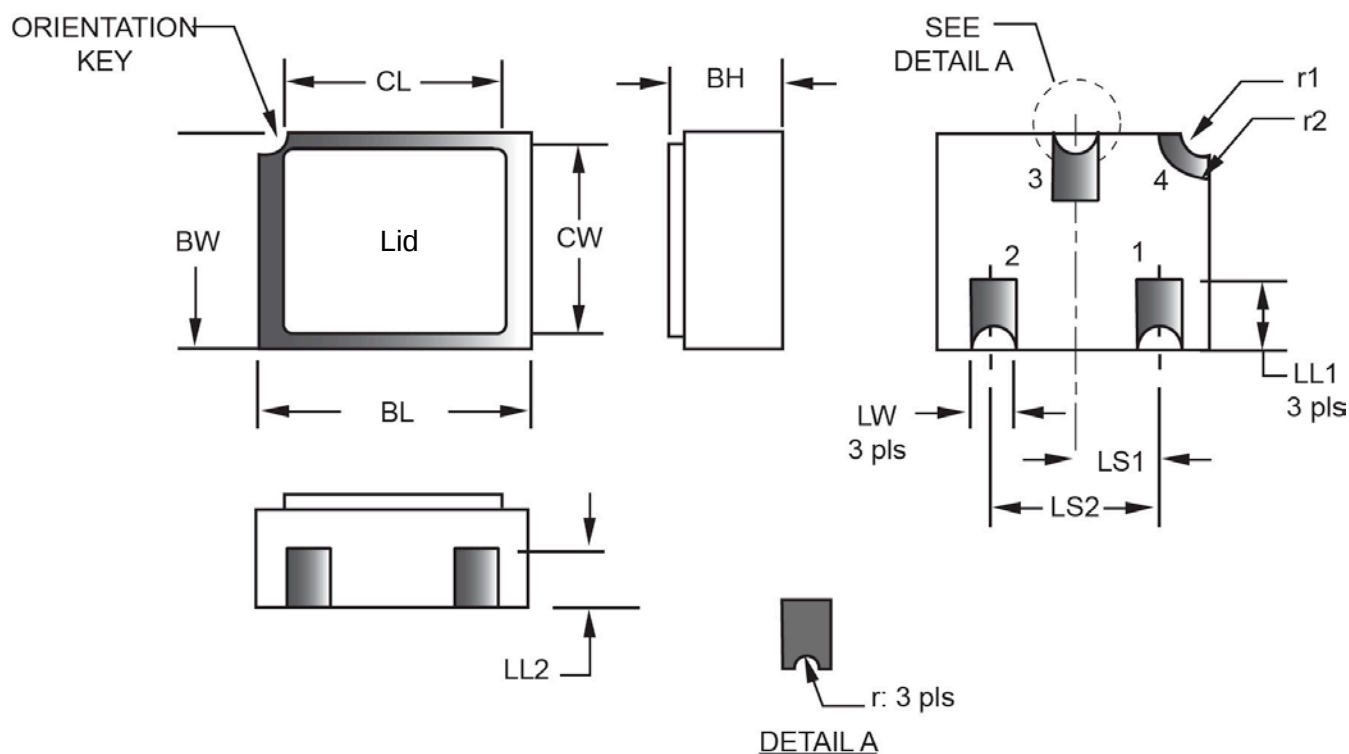
Derating for all devices ( $R_{\theta JSP}$ )


**FIGURE 2**

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

**GRAPHS**

**FIGURE 3**

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

**PACKAGE DIMENSIONS**


| Symbol          | Dimensions |      |             |      | Note | Symbol          | Dimensions |      |             |       | Note |
|-----------------|------------|------|-------------|------|------|-----------------|------------|------|-------------|-------|------|
|                 | Inch       |      | Millimeters |      |      |                 | Inch       |      | Millimeters |       |      |
|                 | Min        | Max  | Min         | Max  |      |                 | Min        | Max  | Min         | Max   |      |
| BH              | .046       | .056 | 1.17        | 1.42 |      | LS <sub>1</sub> | .036       | .040 | 0.91        | 1.02  |      |
| BL              | .115       | .128 | 2.92        | 3.25 |      | LS <sub>2</sub> | .071       | .079 | 1.80        | 2.01  |      |
| BW              | .085       | .108 | 2.16        | 2.74 |      | LW              | .016       | .024 | 0.41        | 0.61  |      |
| CL              | -          | .128 | -           | 3.25 |      | r               | -          | .008 | -           | 0.203 |      |
| CW              | -          | .108 | -           | 2.74 |      | r <sub>1</sub>  | -          | .012 | -           | 0.305 |      |
| LL <sub>1</sub> | .022       | .038 | 0.56        | 0.97 |      | r <sub>2</sub>  | -          | .022 | -           | 0.559 |      |
| LL <sub>2</sub> | .017       | .035 | 0.43        | 0.89 |      |                 |            |      |             |       |      |

**NOTES:**

1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. Hatched areas on package denote metallized areas.
4. Lid material: Kovar.
5. Pad 1 = Base, Pad 2 = Emitter, Pad 3 = Collector, Pad 4 = Shielding connected to the lid.
6. In accordance with ASME Y14.5M, diameters are equivalent to  $\Phi$ x symbology.