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## Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China





## 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.

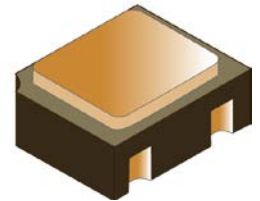
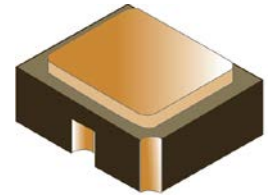
### APPLICATIONS / BENEFITS

- 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>CB0</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 1.5	W
		@ T <sub>A</sub> = +25 °C <sup>(1)</sup>	
		@ T <sub>SP</sub> = +25 °C <sup>(2)</sup>	


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




### 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](#)

#### **MSC – Lawrence**

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

#### **MSC – Ireland**

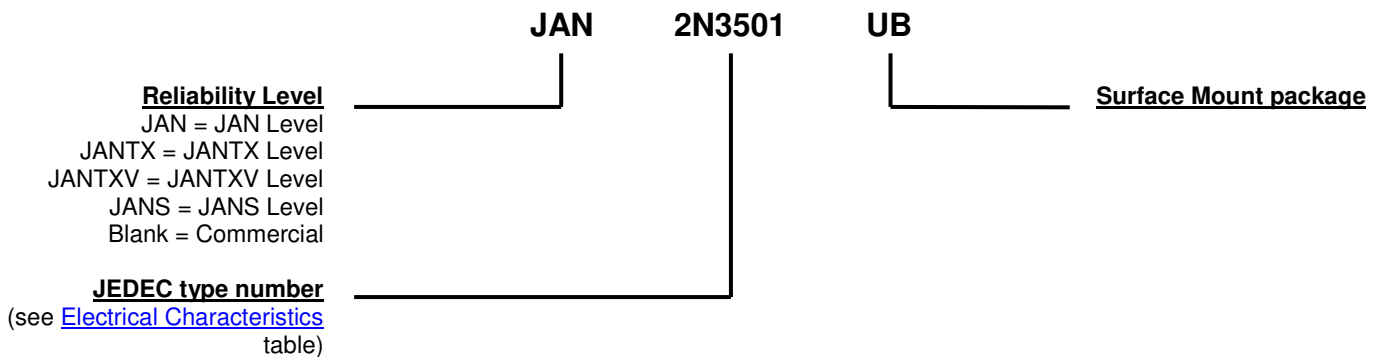
Gort Road Business Park,  
Ennis, Co. Clare, Ireland  
Tel: +353 (0) 65 6840044  
Fax: +353 (0) 65 6822298

**Website:**

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

**MECHANICAL and PACKAGING**

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

Parameters / Test Conditions	Symbol	Min.	Max.	Unit
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**OFF CHARACTERISTICS**

Collector-Emitter Breakdown Voltage $I_C = 10\text{ mA}$ , pulsed	$V_{(BR)CEO}$	150		V
Collector-Base Cutoff Current $V_{CB} = 75\text{ V}$ $V_{CB} = 150\text{ V}$	$I_{CBO}$		50 10	nA $\mu\text{A}$
Emitter-Base Cutoff Current $V_{EB} = 4.0\text{ V}$ $V_{EB} = 6.0\text{ V}$	$I_{EBO}$		25 10	nA $\mu\text{A}$

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

Forward-Current Transfer Ratio $I_C = 0.1\text{ mA}$ , $V_{CE} = 10\text{ V}$ $I_C = 1.0\text{ mA}$ , $V_{CE} = 10\text{ V}$ $I_C = 10\text{ mA}$ , $V_{CE} = 10\text{ V}$ $I_C = 150\text{ mA}$ , $V_{CE} = 10\text{ V}$ $I_C = 300\text{ mA}$ , $V_{CE} = 10\text{ V}$	$h_{FE}$	35 50 75 100 20	300	
Collector-Emitter Saturation Voltage $I_C = 10\text{ mA}$ , $I_B = 1.0\text{ mA}$ $I_C = 150\text{ mA}$ , $I_B = 15\text{ mA}$	$V_{CE(sat)}$		0.2 0.4	V
Base-Emitter Saturation Voltage $I_C = 10\text{ mA}$ , $I_B = 1.0\text{ mA}$ $I_C = 150\text{ mA}$ , $I_B = 15\text{ mA}$	$V_{BE(sat)}$		0.8 1.2	V

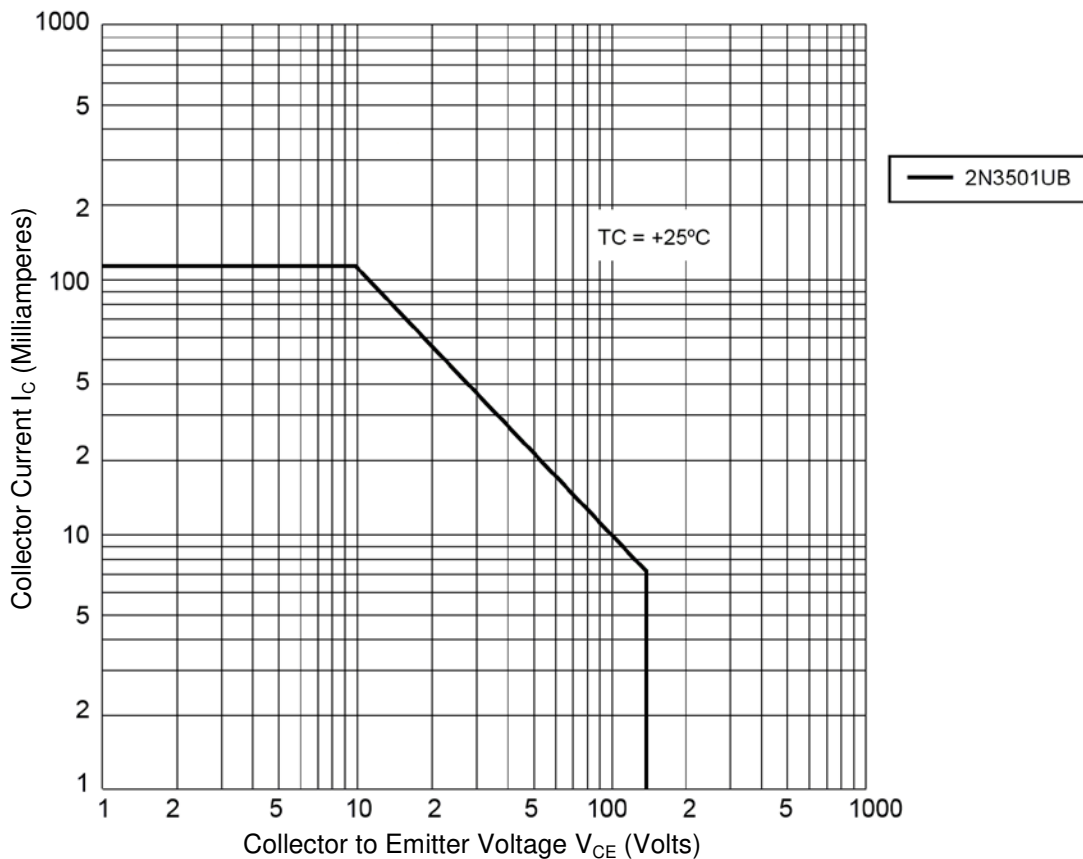
**DYNAMIC CHARACTERISTICS**

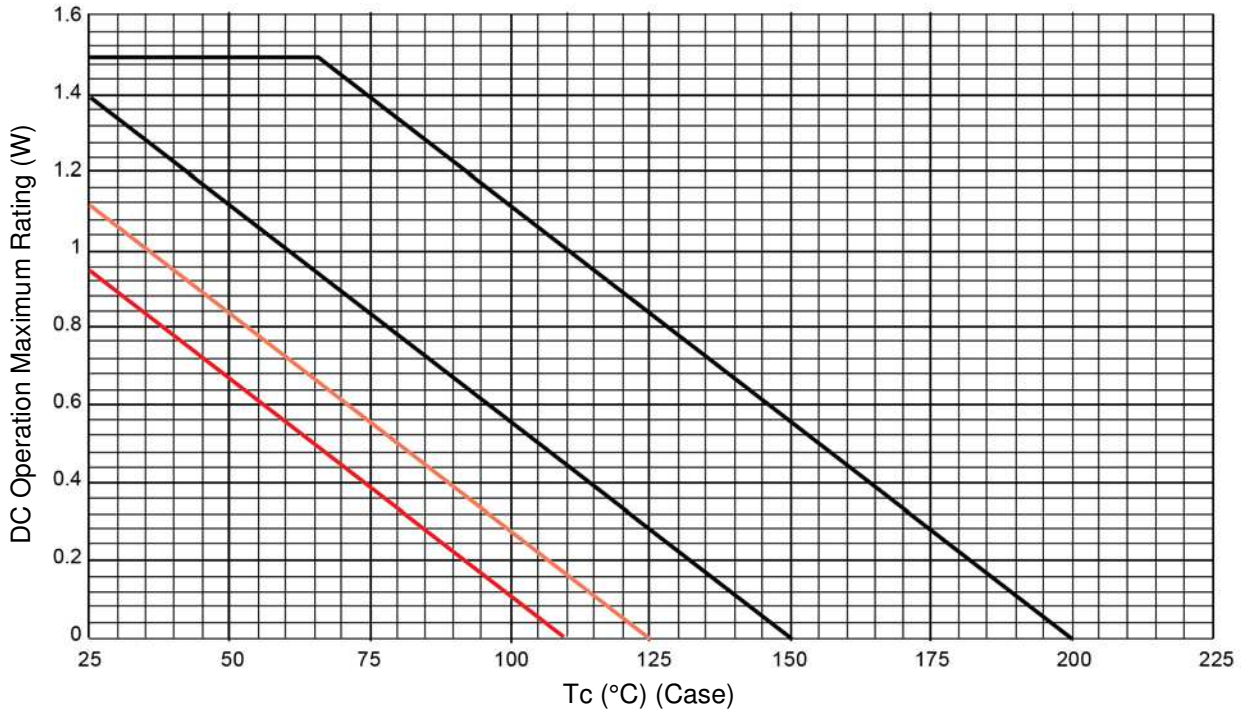
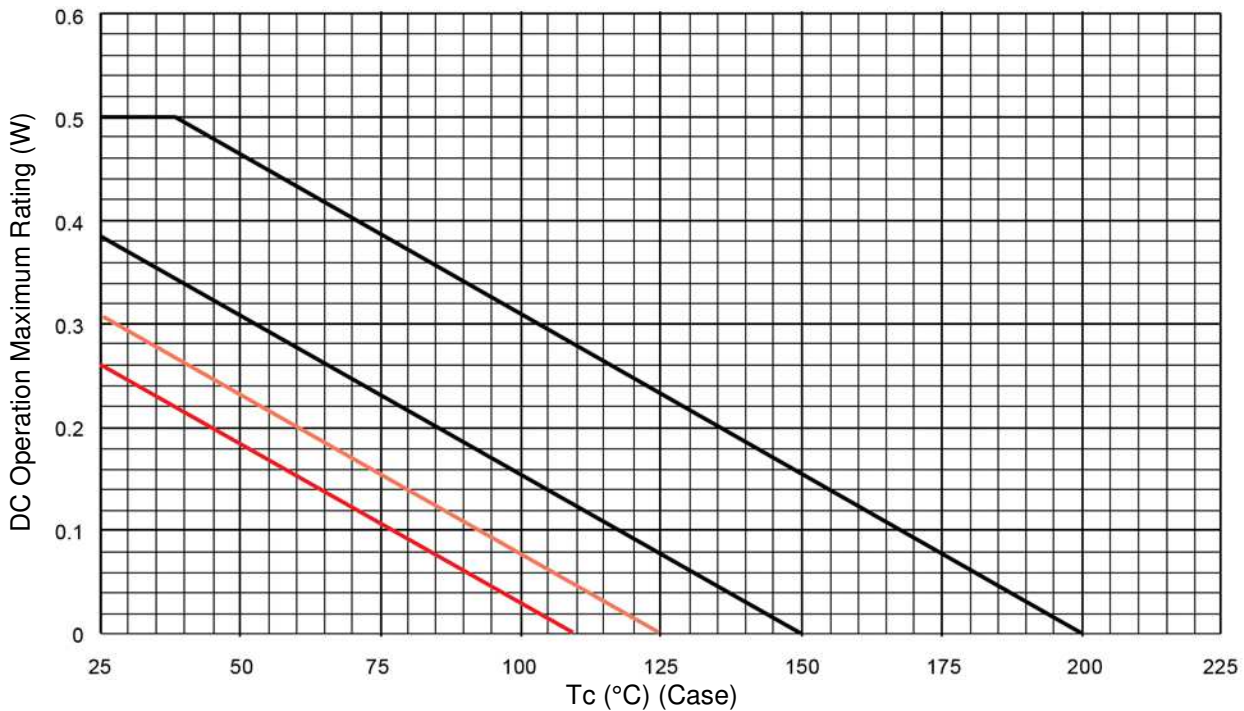
Forward Current Transfer Ratio, Magnitude $I_C = 20\text{ mA}$ , $V_{CE} = 20\text{ V}$ , $f = 100\text{ MHz}$	$ h_{fe} $	1.5	8.0	
Output Capacitance $V_{CB} = 10\text{ V}$ , $I_E = 0$ , $100\text{ kHz} \leq f \leq 1.0\text{ MHz}$	$C_{obo}$		8.0	pF
Input Capacitance $V_{EB} = 0.5\text{ V}$ , $I_C = 0$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

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

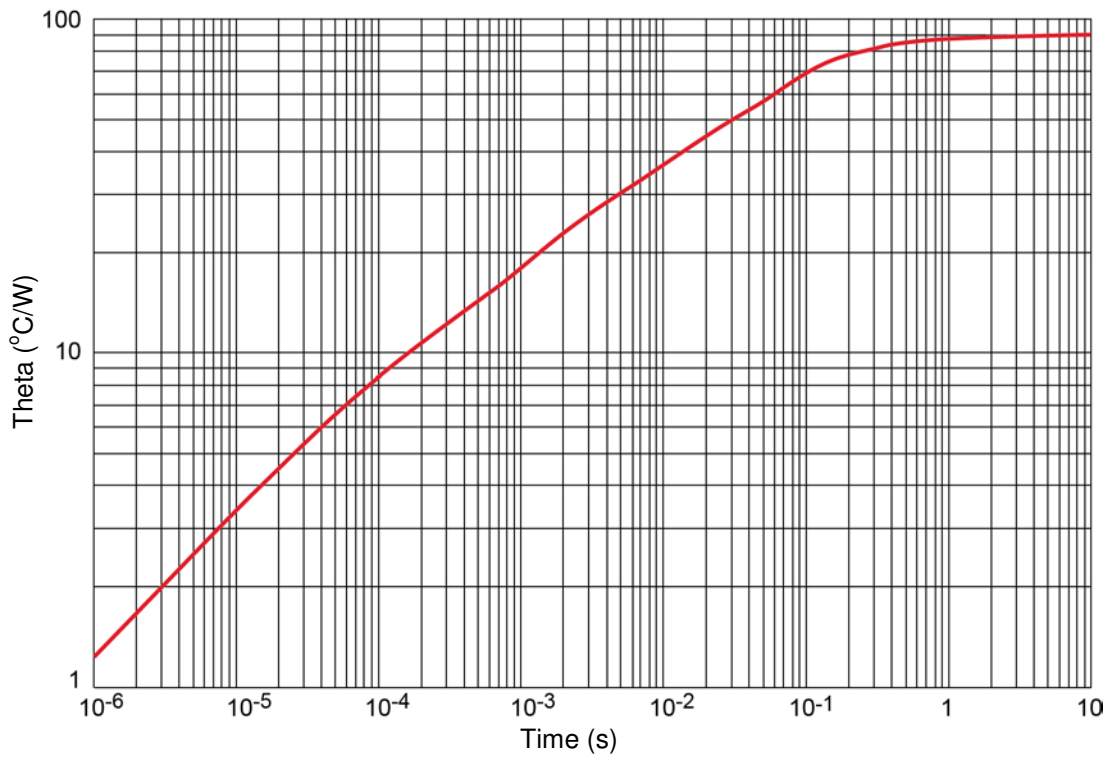
**ELECTRICAL CHARACTERISTICS @  $T_A = +25^\circ\text{C}$ , unless otherwise noted (continued)**
**SWITCHING CHARACTERISTICS**

Parameters / Test Conditions	Symbol	Min.	Max.	Unit
Turn-On Time $V_{EB} = 5\text{ V}; I_C = 150\text{ mA}; I_{B1} = 15\text{ mA}$	$t_{on}$		115	ns
Turn-Off Time $I_C = 150\text{ mA}; I_{B1} = I_{B2} = 15\text{ mA}$	$t_{off}$		1150	ns

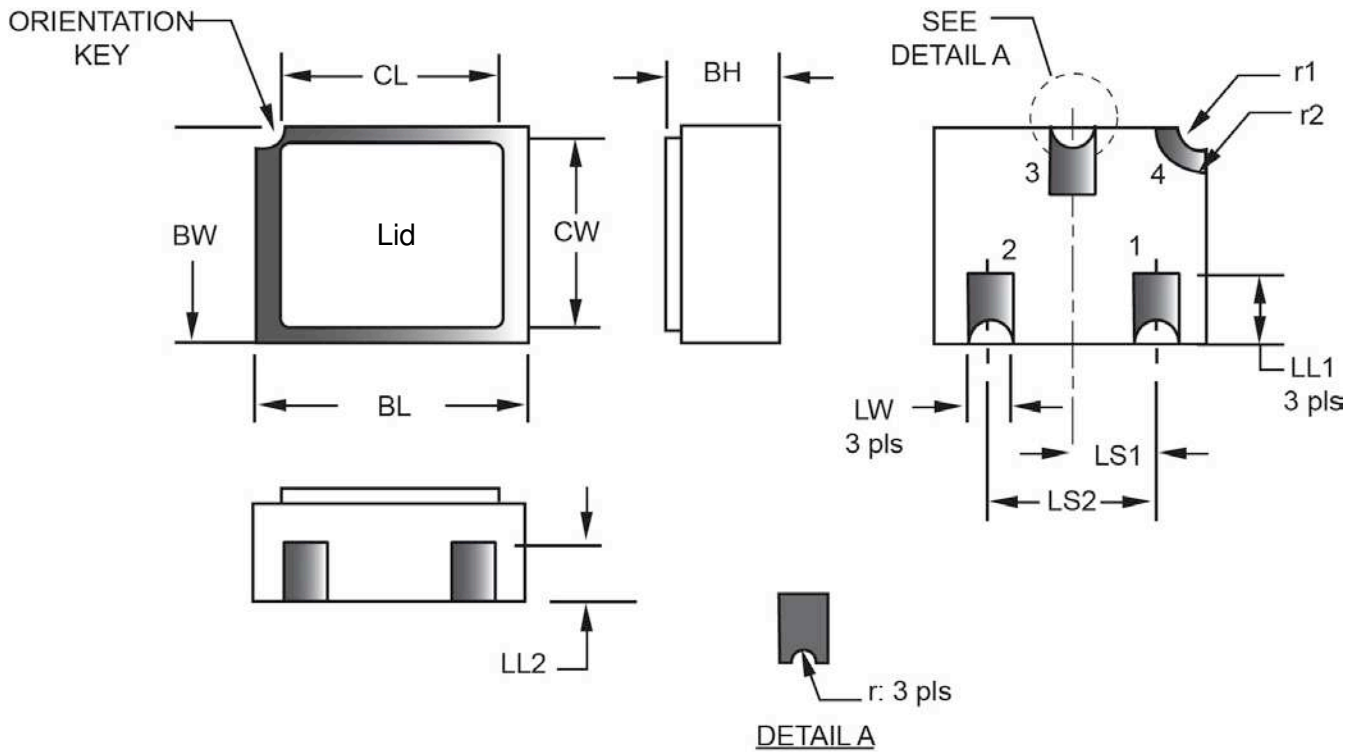
**SAFE OPERATING AREA (See SOA figure and reference [MIL-STD-750 method 3053](#))**
**DC Tests**
 $T_C = +25^\circ\text{C}$ ,  $t_r \geq 10\text{ ns}$ ; 1 Cycle,  $t = 1.0\text{ s}$ 
**Test 1**
 $V_{CE} = 10\text{ V}, I_C = 113\text{ mA}$ 
**Test 2**
 $V_{CE} = 50\text{ V}, I_C = 23\text{ mA}$ 
**Test 3**
 $V_{CE} = 80\text{ V}, I_C = 14\text{ mA}$ 
**Clamped Switching**
 $T_A = +25^\circ\text{C}$ 
**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 ( $R_{\theta\text{JSP}}$ )

**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.