RoHS compliant

RADIATION HARDENED NPN SILICON SWITCHING TRANSISTOR

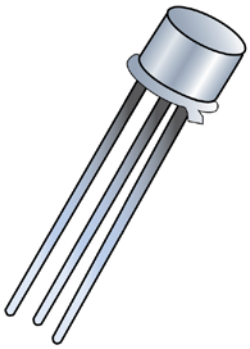
Qualified per MIL-PRF-19500/366

Qualified Levels: JANSM, JANSD, JANSP, JANSL and JANSR

DESCRIPTION

This family of JANS 2N3498 through JANS 2N3501 epitaxial, planar transistors are military qualified in five RHA (Radiation Hardness Assurance) levels for high-reliability applications. These devices are also available in TO-5 and low profile surface mount UB packaging. Microsemi also offers numerous other radiation hardened 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.



TO-39 (TO-205AD) Package

FEATURES

- JEDEC registered 2N3498 through 2N3501 series numbers.
- RHA level JAN qualifications per MIL-PRF-19500/366 (see part nomenclature for all options).
- RoHS compliant by design.

Also available in:

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

UB package
(surface mount)
JANS 2N3501UB

APPLICATIONS / BENEFITS

- General purpose transistors for medium power applications requiring high frequency switching and radiation hardness.
- Leaded TO-39 package.
- Lightweight.
- Military and other high-reliability, rad-hard applications.

MAXIMUM RATINGS @ T_C = +25 ºC unless otherwise noted

Parameters / Test Conditions	Symbol	2N3498 2N3499	2N3500 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		°C/W
Thermal Resistance Junction-to-Case	$R_{\Theta JC}$	30		°C/W
Total Power Dissipation @ T_A = +25 °C (1) @ T_C = +25 °C (2)	P_T	1.0 5.0		W
Operating & Storage Junction Temperature Range	T_J, T_{stg}	-65 to +200		°C

Notes: 1. See figure 1.
2. See figure 2.

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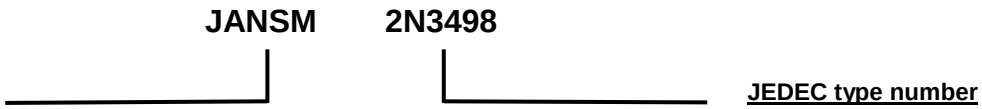
MECHANICAL and PACKAGING

- CASE: Hermetically sealed, kovar base, nickel cap.
- TERMINALS: Leads are gold plated.
- MARKING: Part number, date code, manufacturer's ID.
- WEIGHT: Approximately 1.064 grams.
- See Package Dimensions on last page.

PART NOMENCLATURE



Reliability Level
JANSM = 3K Rads (Si)
JANSD = 10K Rads (Si)
JANSP = 30K Rads (Si)
JANSL = 50K Rads (Si)
JANSR = 100K Rads (Si)

JEDEC type number

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 °C, unless otherwise noted

Parameters / Test Conditions		Symbol	Min.	Max.	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage					
I_C = 10 mA, pulsed	2N3498, 2N3499	$V_{(BR)CEO}$	100		V
	2N3500, 2N3501		150		
Collector-Base Cutoff Current					
V_{CB} = 50 V	2N3498, 2N3499	I_{CBO}		50	nA
V_{CB} = 75 V	2N3500, 2N3501			50	nA
V_{CB} = 100 V	2N3498, 2N3499			10	µA
V_{CB} = 150 V	2N3500, 2N3501			10	µA
Emitter-Base Cutoff Current					
V_{EB} = 4.0 V		I_{EBO}		25	nA
V_{EB} = 6.0 V				10	µA
ON CHARACTERISTICS (1)					
Forward-Current Transfer Ratio					
I_C = 0.1 mA, V_{CE} = 10 V	2N3498, 2N3500	h_{FE}	20		
	2N3499, 2N3501		35		
I_C = 1.0 mA, V_{CE} = 10 V	2N3498, 2N3500		25		
	2N3499, 2N3501		50		
I_C = 10 mA, V_{CE} = 10 V	2N3498, 2N3500		35		
	2N3499, 2N3501		75		
I_C = 150 mA, V_{CE} = 10 V	2N3498, 2N3500		40	120	
	2N3499, 2N3501		100	300	
I_C = 300 mA, V_{CE} = 10 V	2N3500		15		
	2N3501		20		
I_C = 500 mA, V_{CE} = 10 V	2N3498		15		
	2N3499		20		
Collector-Emitter Saturation Voltage					
I_C = 10 mA, I_B = 1.0 mA	All Types	$V_{CE(sat)}$		0.2	V
I_C = 300 mA, I_B = 30 mA	2N3498, 2N3499			0.6	
I_C = 150 mA, I_B = 15 mA	2N3500, 2N3501			0.4	
Base-Emitter Saturation Voltage					
I_C = 10 mA, I_B = 1.0 mA	All Types	$V_{BE(sat)}$		0.8	V
I_C = 300 mA, I_B = 30 mA	2N3498, 2N3499			1.4	
I_C = 150 mA, I_B = 15 mA	2N3500, 2N3501			1.2	
DYNAMIC CHARACTERISTICS					
Forward Current Transfer Ratio, Magnitude					
I_C = 20 mA, V_{CE} = 20 V, f = 100 MHz		$\lvert h_{fe} \rvert$	1.5	8.0	
Output Capacitance					
V_{CB} = 10 V, I_E = 0,	2N3498, 2N3499	C_{obo}		10	pF
100 kHz ≤ f ≤ 1.0 MHz	2N3500, 2N3501			8.0	
Input Capacitance					
V_{EB} = 0.5 V, I_C = 0, 100 kHz ≤ f ≤ 1.0 MHz		C_{ibo}		80	pF

(1) Pulse Test: pulse width = 300 µs, duty cycle ≤ 2.0%.

ELECTRICAL CHARACTERISTICS @ T_A = +25 °C, unless otherwise noted (continued)

SWITCHING CHARACTERISTICS

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

SAFE OPERATING AREA (See SOA figure and reference MIL-STD-750 method 3053)

DC Tests

T_C = +25 ºC, $t_r \geq$ 10 ns; 1 Cycle, t = 1.0 s

Test 1

V_{CE} = 10 V, I_C = 500 mA	2N3498, 2N3499
V_{CE} = 16.67 V, I_C = 300 mA	2N3500, 2N3501

Test 2

V_{CE} = 50 V, I_C = 100 mA	All Types

Test 3

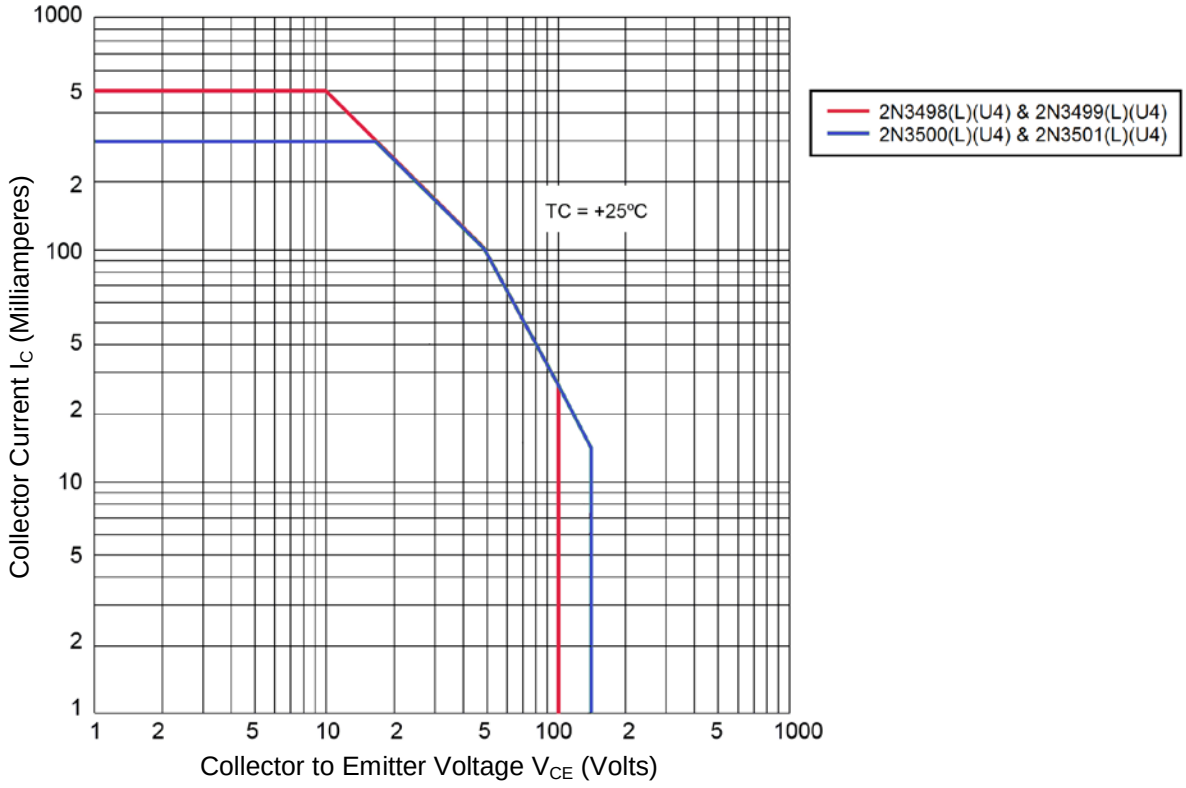
V_{CE} = 80 V, I_C = 40 mA	All Types

Clamped Switching

T_A = +25 ºC

Test 1

I_B = 85 mA, I_C = 500 mA	2N3498, 2N3499
I_B = 50 mA, I_C = 300 mA	2N3500, 2N3501



Maximum Safe Operating Area

ELECTRICAL CHARACTERISTICS @ T_A = +25 °C, unless otherwise noted (continued)

POST RADIATION ELECTRICAL CHARACTERISTICS

Parameters / Test Conditions		Symbol	Min.	Max.	Unit
Collector-Emitter Breakdown Voltage					
I_C = 10 mA	2N3498, 2N3499	$V_{(BR)CEO}$	100		V
	2N3500, 2N3501		150		
Collector-Base Cutoff Current					
V_{CB} = 100 V	2N3498, 2N3499	I_{CBO}		20	µA
V_{CB} = 150 V	2N3500, 2N3501			20	µA
V_{CB} = 50 V	2N3498, 2N3499			100	nA
V_{CB} = 75 V	2N3500, 2N3501			100	nA
Collector to Emitter Cutoff					
V_{CE} = 80 V	2N3498, 2N3499	I_{CEO}		2	µA
V_{CE} = 120 V	2N3500, 2N3501				
Emitter-Base Cutoff Current					
V_{EB} = 4.0 V		I_{EBO}		50	nA
V_{EB} = 6.0 V				20	µA
Forward-Current Transfer Ratio					
I_C = 0.1 mA, V_{CE} = 10 V	2N3498, 2N3500	[h_{FE}]	[10]		
	2N3499, 2N3501		[17.5]		
I_C = 1.0 mA, V_{CE} = 10 V	2N3498, 2N3500		[12.5]		
	2N3499, 2N3501		[25]		
I_C = 10 mA, V_{CE} = 10 V	2N3498, 2N3500		[17.5]		
	2N3499, 2N3501		[37.5]		
I_C = 150 mA, V_{CE} = 10 V	2N3498, 2N3500		[20]	120	
	2N3499, 2N3501		[50]	300	
I_C = 300 mA, V_{CE} = 10 V	2N3500		[7.5]		
	2N3501		[10]		
I_C = 500 mA, V_{CE} = 10 V	2N3498		[7.5]		
	2N3499		[10]		
Collector-Emitter Saturation Voltage					
I_C = 10 mA, I_B = 1.0 mA	All Types			0.23	
I_C = 300 mA, I_B = 30 mA	2N3498, 3N3499	$V_{CE(sat)}$		0.69	V
I_C = 150 mA, I_B = 15 mA	2N3500, 2N3501			0.46	
Base-Emitter Saturation Voltage					
I_B = 10 mA, I_B = 1.0 mA	All Types			0.92	
I_B = 300 mA, I_B = 30 mA	2N3498, 3N3499	$V_{BE(sat)}$		1.61	V
I_B = 150 mA, I_B = 15 mA	2N3500, 2N3501			1.38	

GRAPHS

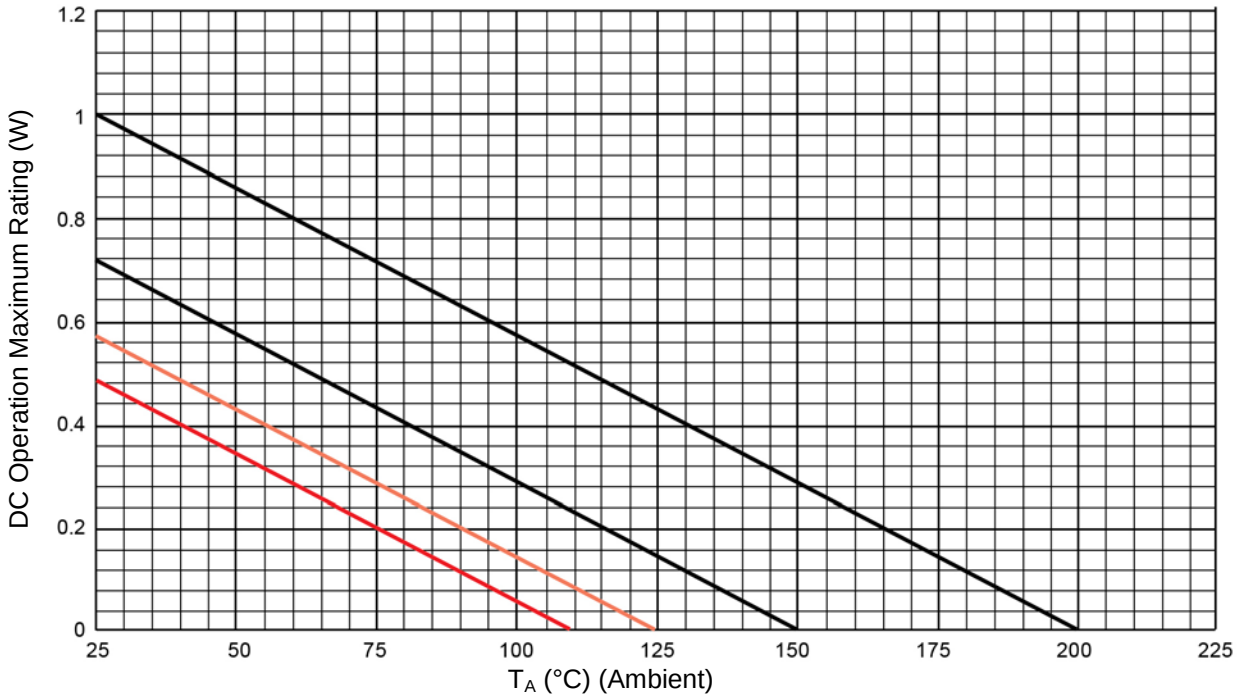


FIGURE 1
Derating for all devices ($R_{\Theta JA}$)

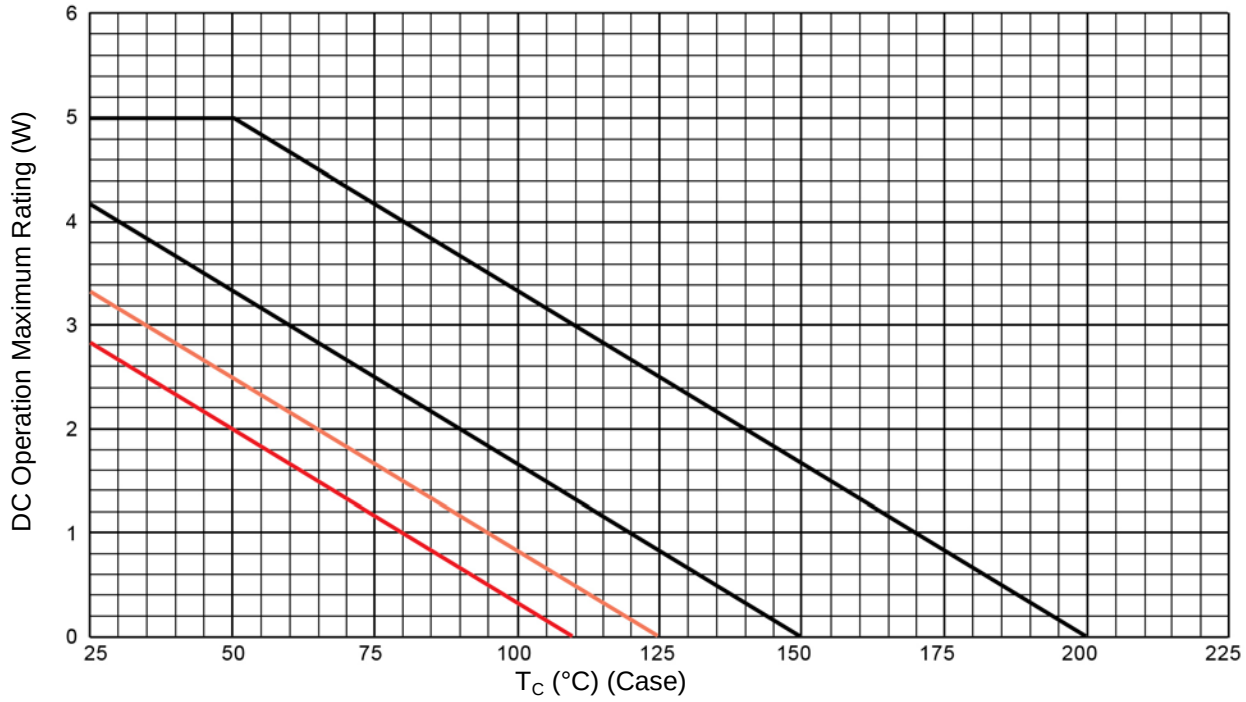


FIGURE 2
Derating for all devices ($R_{\Theta JC}$)

GRAPHS (continued)

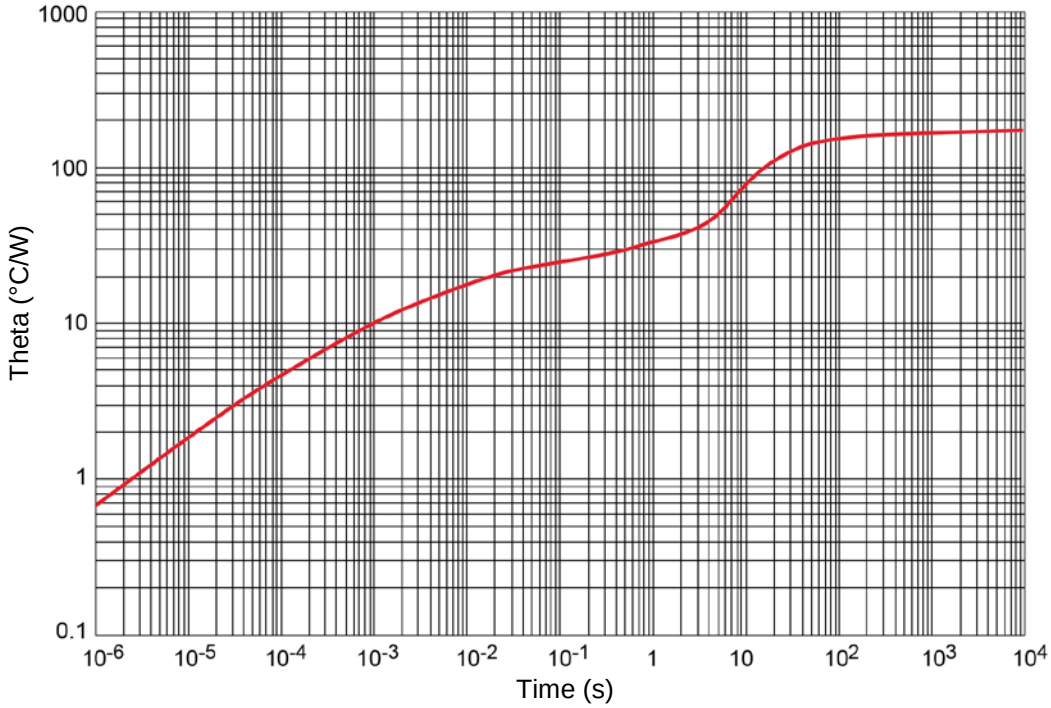


FIGURE 6
Thermal impedance graph ($R_{\Theta JA}$)

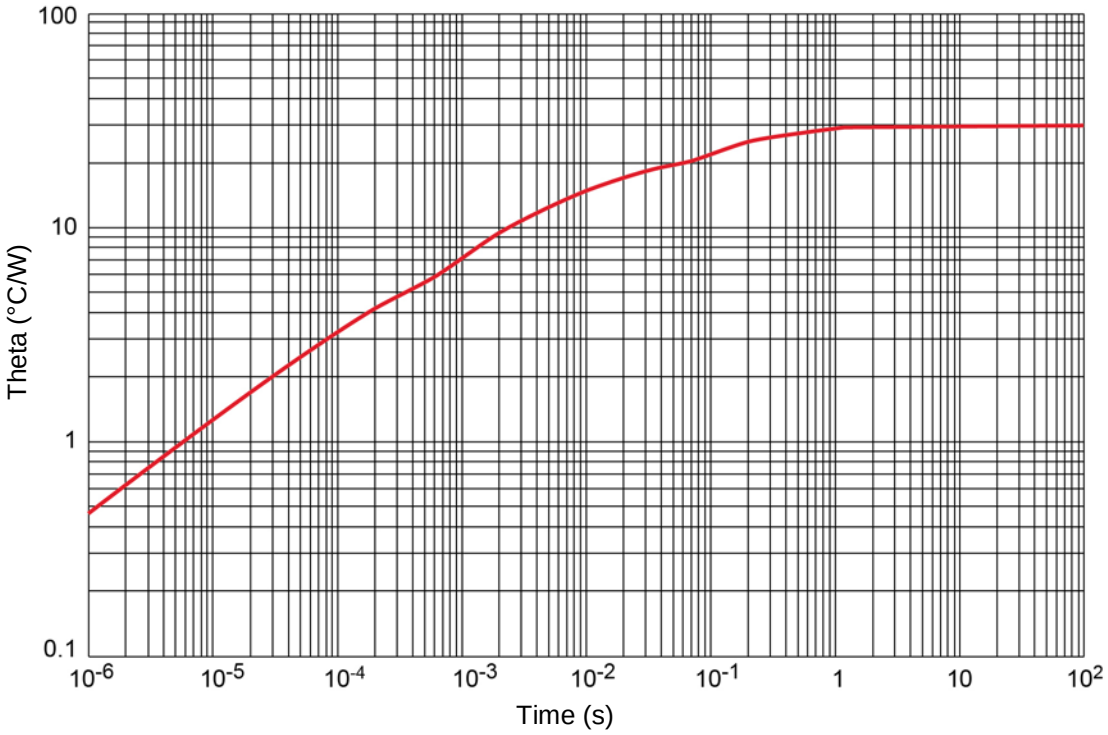
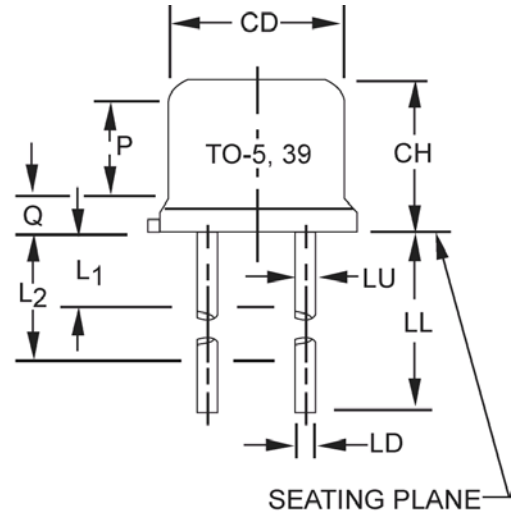
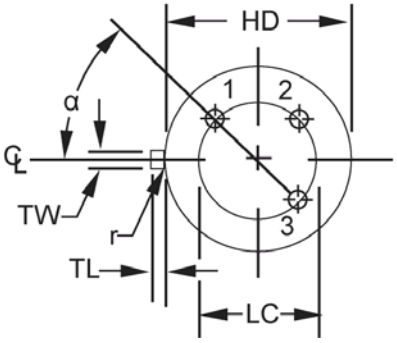


FIGURE 7
Thermal impedance graph ($R_{\Theta JC}$)

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	0.500	0.750	12.70	19.10	7, 12
LU	0.016	0.019	0.41	0.48	7, 12
L1		0.050		1.27	12
L2	0.250		6.35		12
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. All three leads.
13. In accordance with ASME Y14.5M, diameters are equivalent to Φx symbology.