

# RADIATION HARDENED LOW POWER NPN SILICON TRANSISTOR

Qualified per MIL-PRF-19500/391

#### **DESCRIPTION**

This RHA level 2N3019 and 2N3019S NPN leaded metal device is RAD hard qualified for high-reliability applications. Microsemi also offers numerous other transistor products to meet higher and lower power ratings with various switching speed requirements in both throughhole and surface-mount packages.

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

#### **FEATURES**

- JEDEC registered 2N3019.
- RHA level JAN qualifications per MIL-PRF-19500/391 (see part nomenclature for all options).

#### **APPLICATIONS / BENEFITS**

- Leaded TO-39 and TO-5 package.
- Lightweight.
- Low power.
- Military and other high-reliability applications.

TO-18 (TO-206AA)

TO-39 (TO-205AD)

and TO-5 Package

Also available in: TO-46 (TO-206AB)

Qualified Levels:

JANSM, JANSD,

JANSP, JANSL, and **JANSR** 

> (leaded) **JANS 2N3700**

**UB** package

(leaded) JANS\_2N3057A

(leaded) **JANS 2N3700UB** 

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

Parameters/Test Conditions	Symbol	Value	Unit
Junction and Storage Temperature	$T_J$ and $T_{STG}$	-65 to +200	°C
Thermal Resistance Junction-to-Ambient	R <sub>ÐJA</sub>	195	°C/W
Thermal Resistance Junction-to-Case	Rejc	30	°C/W
Collector-Emitter Voltage	$V_{CEO}$	80	V
Collector-Base Voltage	$V_{CBO}$	140	V
Emitter-Base Voltage	$V_{EBO}$	7.0	V
Collector Current	lc	1.0	Α
Total Power Dissipation: @ $T_A = +2$	25 °C <sup>(1)</sup> P <sub>D</sub>	0.8	W
@ T <sub>C</sub> = +2	25 °C <sup>(2)</sup>	5.0	

- 1. Derate linearly 4.6 mW/°C for  $T_A \ge +25$  °C.
- 2. Derate linearly 28.6 mW/°C for T<sub>C</sub> ≥ +25 °C.

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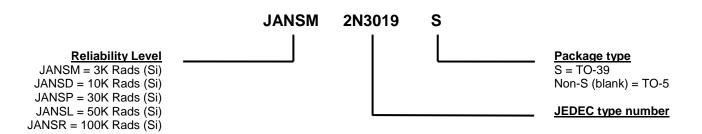
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#### **MECHANICAL and PACKAGING**

- CASE: Hermetically sealed, kovar base, nickel cap.
- TERMINALS: Gold plate, solder dip (Sn63/Pb37) available upon request.
- MARKING: Part number, date code, manufacturer's ID and serial number.
- POLARITY: NPN.
- WEIGHT: Approximately 1.064 grams.
- See <u>Package Dimensions</u> on last page.

#### **PART NOMENCLATURE**



SYMBOLS & DEFINITIONS					
Symbol	Symbol Definition				
f	frequency				
I <sub>B</sub>	Base current (dc)				
Ι <sub>Ε</sub>	Emitter current (dc)				
T <sub>A</sub>	Ambient temperature				
T <sub>C</sub>	Case temperature				
$V_{CB}$	Collector to base voltage (dc)				
$V_{CE}$	Collector to emitter voltage (dc)				
$V_{EB}$	Emitter to base voltage (dc)				



### **ELECTRICAL CHARACTERISTICS** @ T<sub>A</sub> = +25 °C, unless otherwise noted

Parameters / Test Conditions	Symbol	Min.	Max.	Unit	
OFF CHARACTERTICS					
Collector-Emitter Breakdown Current I <sub>C</sub> = 30 mA	V <sub>(BR)CEO</sub>	80		V	
Collector-Base Cutoff Current V <sub>CB</sub> = 140 V	I <sub>CBO</sub>		10	μΑ	
Emitter-Base Cutoff Current $V_{EB} = 7 \text{ V}$	I <sub>EBO1</sub>		10	μΑ	
Collector-Emitter Cutoff Current V <sub>CE</sub> = 90 V	I <sub>CES</sub>		10	ηΑ	
Emitter-Base Cutoff Current V <sub>EB</sub> = 5.0 V	I <sub>EBO2</sub>		10	ηΑ	
ON CHARACTERTICS					
Forward-Current Transfer Ratio					
$I_C = 150 \text{ mA}, V_{CE} = 10 \text{ V}$		100	300		
$I_C = 0.1 \text{ mA}, V_{CE} = 10 \text{ V}$		50	300		
$I_C = 10 \text{ mA}, V_{CE} = 10 \text{ V}$	$h_{FE}$	90			
$I_C = 500 \text{ mA}, V_{CE} = 10 \text{ V}$		50	300		
$I_C = 1.0 \text{ A}, V_{CE} = 10 \text{ V}$		15			
Collector-Emitter Saturation Voltage					
$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$ $I_C = 500 \text{ mA}, I_B = 50 \text{ mA}$	V <sub>CE(sat)</sub>		0.2 0.5	V	
Base-Emitter Saturation Voltage					
$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$	V <sub>BE(sat)</sub>		1.1	V	

#### **DYNAMIC CHARACTERISTICS**

Parameters / Test Conditions	Symbol	Min.	Max.	Unit
Small-Signal Short-Circuit Forward Current Transfer Ratio $I_C = 1.0$ mA, $V_{CE} = 5.0$ V, $f = 1.0$ kHz	h <sub>fe</sub>	80	400	
Magnitude of Small-Signal Short-Circuit Forward Current Transfer Ratio $I_C = 50 \text{ mA}, \ V_{CE} = 10 \text{ V}, \ f = 20 \text{ MHz}$	h <sub>fe</sub>	5.0	20	
Output Capacitance $V_{CB} = 10 \text{ V}, I_E = 0, 100 \text{ kHz} \le f \le 1.0 \text{ MHz}$	C <sub>obo</sub>		12	pF
Input Capacitance $V_{EB} = 0.5 \text{ V}, I_{C} = 0, 100 \text{ kHz} \le f \le 1.0 \text{ MHz}$	C <sub>ibo</sub>		60	pF

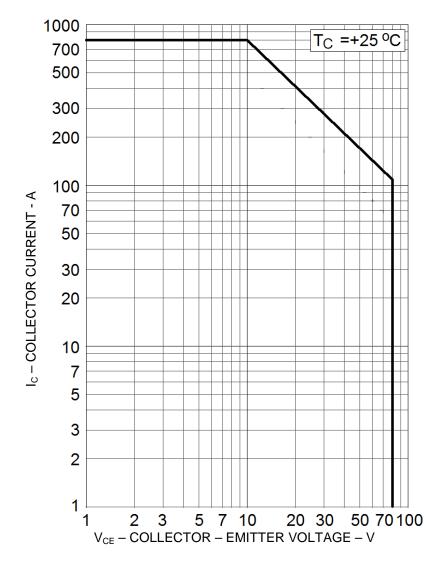


#### **ELECTRICAL CHARACTERISTICS** @ T<sub>A</sub> = +25 °C, unless otherwise noted (continued)

#### SAFE OPERATION AREA (See SOA graph below and MIL-STD-750, method 3053)

DC Tests $T_C = 25$ °C, 1 cycle, $t = 10$ ms		
<b>Test 1</b> 2N3019, 2N3019S	$V_{CE} = 10 \text{ V}$ $I_C = 500 \text{ mA}$	
Test 2 2N3019, 2N3019S	$V_{CE} = 40 \text{ V}$ $I_C = 125 \text{ mA}$	
<b>Test 3</b> 2N3019, 2N3019S	$V_{CE} = 80 \text{ V}$ $I_C = 60 \text{ mA}$	

(1) Pulse Test: Pulse Width = 300 µs, duty cycle ≤ 2.0%



Maximum Safe Operating Area



#### **ELECTRICAL CHARACTERISTICS** @ T<sub>A</sub> = +25 °C, unless otherwise noted (continued)

#### POST RADIATION ELECTRICAL CHARACTERISTICS

Parameters / Test Conditions	Symbol	Min.	Max.	Unit
Collector to Base Cutoff Current $V_{CB} = 140 \text{ V}$	I <sub>CBO</sub>		20	μA
Emitter to Base Cutoff Current $V_{EB} = 7 \text{ V}$	I <sub>EBO</sub>		20	μΑ
Collector to Emitter Breakdown Voltage I <sub>C</sub> = 30 mA	V <sub>(BR)CEO</sub>	80		V
Collector-Emitter Cutoff Current V <sub>CE</sub> = 90 V	I <sub>CES</sub>		20	ηΑ
Emitter-Base Cutoff Current V <sub>EB</sub> = 5.0 V	I <sub>EBO</sub>		20	ηΑ
Forward-Current Transfer Ratio $^{(2)}$ $I_C = 150$ mA, $V_{CE} = 10$ V		[50]	300	
$I_C = 0.1 \text{ mA}, V_{CE} = 10 \text{ V}$		[25]	300	
$I_C = 10 \text{ mA}, V_{CE} = 10 \text{ V}$	[h <sub>FE</sub> ]	[45]		
$I_C = 500 \text{ mA}, V_{CE} = 10 \text{ V}$		[25]	300	
$I_C = 1 \text{ A}, V_{CE} = 10 \text{ V}$		[7.5]		
Collector-Emitter Saturation Voltage $I_C = 150$ mA, $I_B = 15$ mA $I_C = 500$ mA, $I_B = 50$ mA	V <sub>CE(sat)</sub>		0.23 0.58	V
Base-Emitter Saturation Voltage $I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$	$V_{BE(sat)}$		1.27	V

<sup>(2)</sup> See method 1019 of MIL-STD-750 for how to determine [hFE] by first calculating the delta (1/hFE) from the preand post-radiation hFE. Notice the [hFE] is not the same as hFE and cannot be measured directly. The [hFE] value can never exceed the pre-radiation minimum hFE that it is based upon.



#### **GRAPHS**

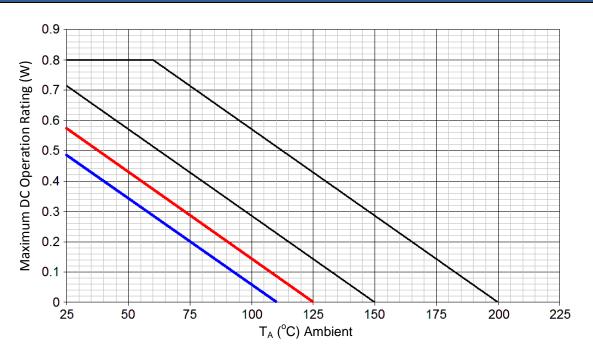


FIGURE 1
Temperature – Power Derating (R<sub>eJA</sub>)

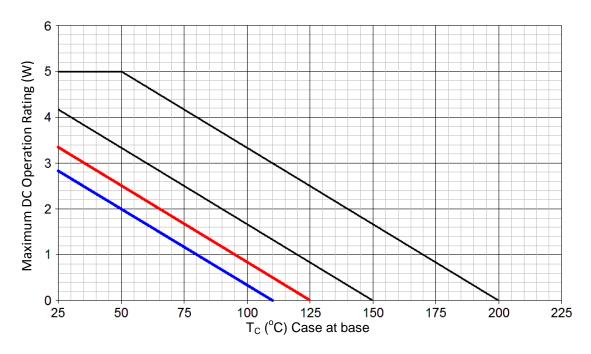
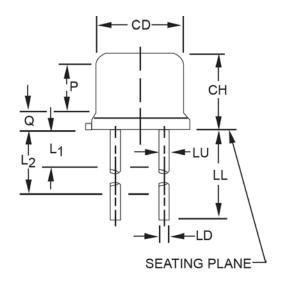


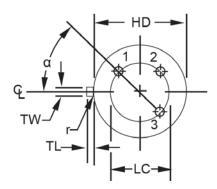
FIGURE 2
Temperature – Power Derating (R<sub>eJC</sub>)



#### **PACKAGE DIMENSIONS**



	Dimensions				
Symbol	Inc	hes	Millimeters		Notes
	Min	Max	Min	Max	
CD	.305	.335	7.75	8.51	
СН	.240	.260	6.10	6.60	
HD	.335	.370	8.51	9.40	
LC	.200 TP		5.08 TP		6
LD	.016	.021	0.41	0.53	7, 8
LL	.500	.750	12.70	19.05	7, 8, 12
LU	.016	.019	0.41	0.48	7, 8
L <sub>1</sub>		.050		1.27	7, 8
L <sub>2</sub>	.250		6.35		7, 8
Q		.050		1.27	5
TL	.029	.045	0.74	1.14	4
TW	.028	.034	0.71	0.86	3
r		.010		0.25	10
α	45°	TP	45° TP		6
Р	.100		2.54		



#### **NOTES:**

- 1. Dimension are in inches.
- 2. Millimeters are given for general information only.
- 3. Beyond r (radius) maximum, TW shall be held for a minimum length of .011 (0.28 mm).
- 4. Dimension TL measured from maximum HD.
- 5. Body contour optional within zone defined by HD, CD, and Q.
- 6. 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. The device may be measured by direct methods.
- 7. Dimension LU applies between L<sub>1</sub> and L<sub>2</sub>. Dimension LD applies between L<sub>2</sub> and minimum. Diameter is uncontrolled in L<sub>1</sub> and beyond LL minimum.
- 8. All three leads.
- 9. The collector shall be internally connected to the case.
- 10. Dimension r (radius) applies to both inside corners of tab.
- 11. In accordance with ASME Y14.5M, diameters are equivalent to  $\Phi x$  symbology.
- 12. For "S" suffix devices, dimension LL is 0.500 (12.70 mm) minimum, 0.750 (19.05 mm) maximum.
- 13. Lead 1 = emitter, lead 2 = base, lead 3 = collector.
- 14. TO-39, Dim LL is 0.50" 0.75"; TO-5, Dim LL is 1.500" 1.750"

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