



## PNP Silicon Low-Power Transistor

*Qualified per MIL-PRF-19500/485*

*Qualified Levels:  
JAN, JANTX, JANTXV  
and JANS*

### DESCRIPTION

This family of 2N5415 and 2N5416 epitaxial planar transistors are military qualified up to a JANS level for high-reliability applications. These devices are also available in TO-39 and low profile U4 and UA packaging.

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

### FEATURES

- JEDEC registered 2N5415 through 2N5416 series
- JAN, JANTX, JANTXV, and JANS qualifications are available per MIL-PRF-19500/485. (See [part nomenclature](#) for all available options.)
- RoHS compliant

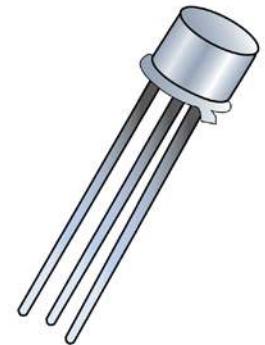
### APPLICATIONS / BENEFITS

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

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

Parameters / Test Conditions	Symbol	2N5415	2N5416	Unit
Collector-Emitter Voltage	V <sub>CEO</sub>	200	300	V
Collector-Base Voltage	V <sub>CB0</sub>	200	350	V
Emitter-Base Voltage	V <sub>EBO</sub>	6.0	6.0	V
Collector Current	I <sub>C</sub>	1.0	1.0	A
Operating & Storage Junction Temperature Range	T <sub>J</sub> , T <sub>stg</sub>	-65 to +200		°C
Thermal Resistance Junction-to-Ambient	R <sub>θJA</sub>	234		°C/W
Thermal Resistance Junction-to-Case	R <sub>θJC</sub>	17.5		°C/W
Total Power Dissipation	P <sub>T</sub>	0.75	10	W
		@ T <sub>A</sub> = +25 °C <sup>(1)</sup>		
		@ T <sub>C</sub> = +25 °C <sup>(2)</sup>		

- Notes:**
1. Derate linearly 4.29 mW/°C for T<sub>A</sub> > +25 °C
  2. Derate linearly 57.2 mW/°C for T<sub>C</sub> > +25 °C




### TO-5 Package

Also available in:


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

 [2N5415S – 2N5416S](#)

**U4 package**  
(surface mount)

 [2N5415U4 – 2N5416U4](#)

**UA package**  
(surface mount)

 [2N5415UA – 2N5416UA](#)

#### **MSC – Lawrence**

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#### **MSC – Ireland**

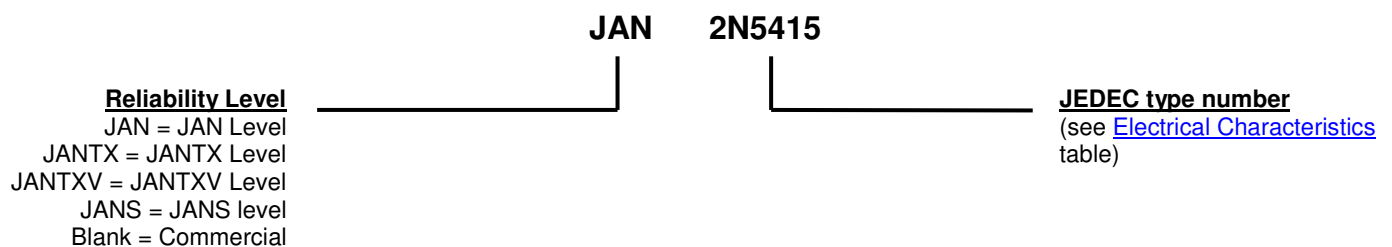
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**Website:**

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

**MECHANICAL and PACKAGING**

- CASE: Hermetically sealed, kovar base, nickel cap
- TERMINALS: Leads are gold plated kovar (Solder dip (Sn63/Pb37) is available upon special request. NOTE: Solder dipping will eliminate RoHS compliance.)
- MARKING: Part number, date code, manufacturer's ID
- POLARITY: NPN
- WEIGHT: Approximately 1.14 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**
**OFF CHARACTERISTICS**

Parameters / Test Conditions	Symbol	Min.	Max.	Unit
Collector-Emitter Breakdown Voltage $I_C = 50\text{ mA}$ , $I_B = 5\text{ mA}$ , $L = 25\text{ mH}$ ; $f = 30 - 60\text{ Hz}$	2N5415 2N5416 $V_{(BR)CEO}$	200 300		V
Emitter-Base Cutoff Current $V_{EB} = 6.0\text{ V}$	$I_{EBO}$		20	$\mu\text{A}$
Collector-Emitter Cutoff Current $V_{CE} = 200\text{ V}$ , $V_{BE} = 1.5\text{ V}$ $V_{CE} = 300\text{ V}$ , $V_{BE} = 1.5\text{ V}$	2N5415 2N5416 $I_{CEX}$		50	$\mu\text{A}$
Collector-Emitter Cutoff Current $V_{CE} = 150\text{ V}$ $V_{CE} = 250\text{ V}$	2N5415 2N5416 $I_{CEO1}$		50	$\mu\text{A}$
Collector-Emitter Cutoff Current $V_{CE} = 200\text{ V}$ $V_{CE} = 300\text{ V}$	2N5415 2N5416 $I_{CEO2}$		1	mA
Collector-Base Cutoff Current $V_{CB} = 175\text{ V}$ $V_{CB} = 280\text{ V}$	2N5415 2N5416 $I_{CBO1}$		50	$\mu\text{A}$
$V_{CB} = 200\text{ V}$ $V_{CB} = 350\text{ V}$	2N5415 2N5416 $I_{CBO2}$		500	$\mu\text{A}$
$V_{CB} = 175\text{ V}$ , $T_A = +150\text{ }^\circ\text{C}$ $V_{CB} = 280\text{ V}$ , $T_A = +150\text{ }^\circ\text{C}$	2N5415 2N5416 $I_{CBO3}$		1	mA

**ON CHARACTERISTICS**

Parameters / Test Conditions	Symbol	Min.	Max.	Unit
Forward-Current Transfer Ratio $I_C = 50\text{ mA}$ , $V_{CE} = 10\text{ V}$ $I_C = 1\text{ mA}$ , $V_{CE} = 10\text{ V}$ $I_C = 50\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $T_A = +150\text{ }^\circ\text{C}$	$h_{FE}$	30 15 15	120	
Collector-Emitter Saturation Voltage $I_C = 50\text{ mA}$ , $I_B = 5\text{ mA}$	$V_{CE(sat)}$		2.0	V
Base-Emitter Voltage Non-Saturation $I_C = 50\text{ mA}$ , $V_{CE} = 10\text{ V}$	$V_{BE}$		1.5	V

**DYNAMIC CHARACTERISTICS**

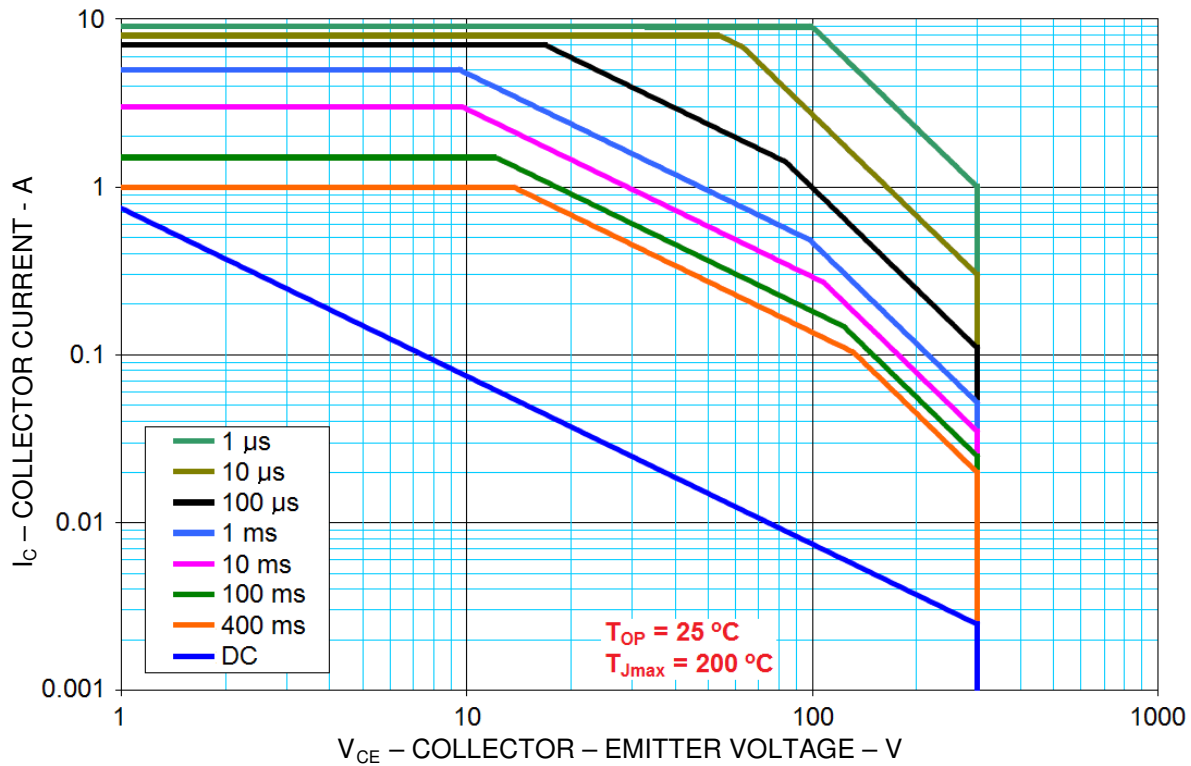
Parameters / Test Conditions	Symbol	Min.	Max.	Unit
Magnitude of Common Emitter Small-Signal Short-Circuit Forward Current Transfer Ratio $I_C = 10\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 5\text{ MHz}$	$ h_{fe} $	3	15	
Small-signal short Circuit Forward-Current Transfer Ratio $I_C = 5\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f \leq 1\text{ kHz}$	$h_{fe}$	25		
Output Capacitance $V_{CB} = 10\text{ V}$ , $I_E = 0$ , $100\text{ kHz} \leq f \leq 1\text{ MHz}$	$C_{obo}$		15	pF

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

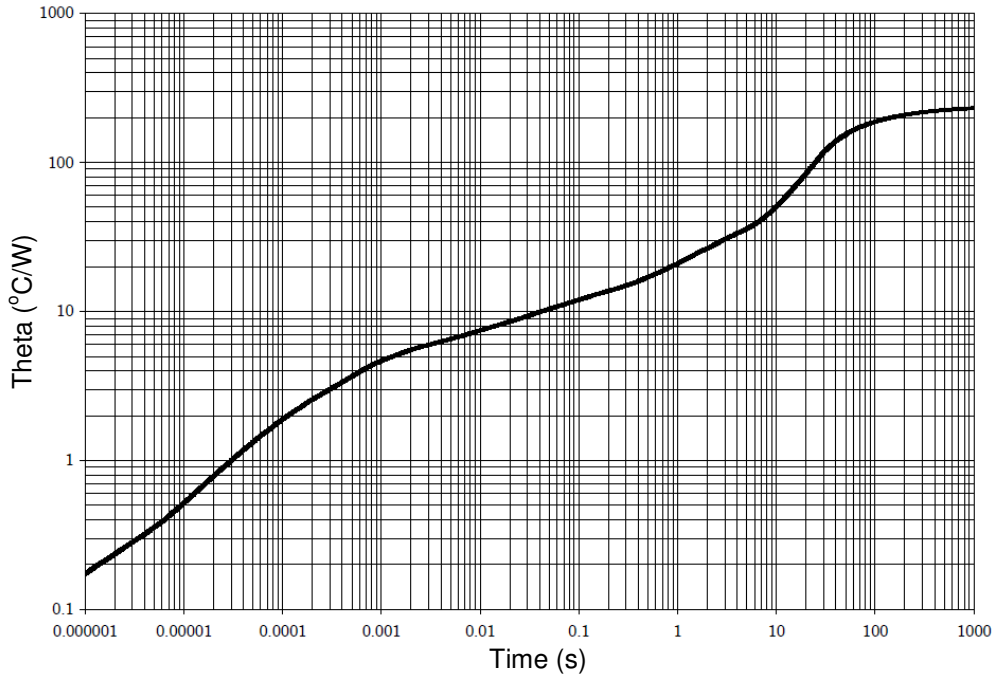
Parameters / Test Conditions	Symbol	Min.	Max.	Unit
Turn-On Time $V_{CC} = 200\text{ V}$ , $I_C = 50\text{ mA}$ , $I_{B1} = 5\text{ mA}$	$t_{on}$		1	$\mu\text{s}$
Turn-Off Time $V_{CC} = 200\text{ V}$ , $I_C = 50\text{ mA}$ , $I_{B1} = I_{B2} = 5\text{ mA}$	$t_{off}$		10	$\mu\text{s}$

**SAFE OPERATING AREA (See SOA graph below and [MIL-STD-750, method 3053](#))**
**DC Tests**
 $T_C = +25\text{ }^\circ\text{C}$ ,  $t_P = 0.4\text{ s}$ , 1 Cycle

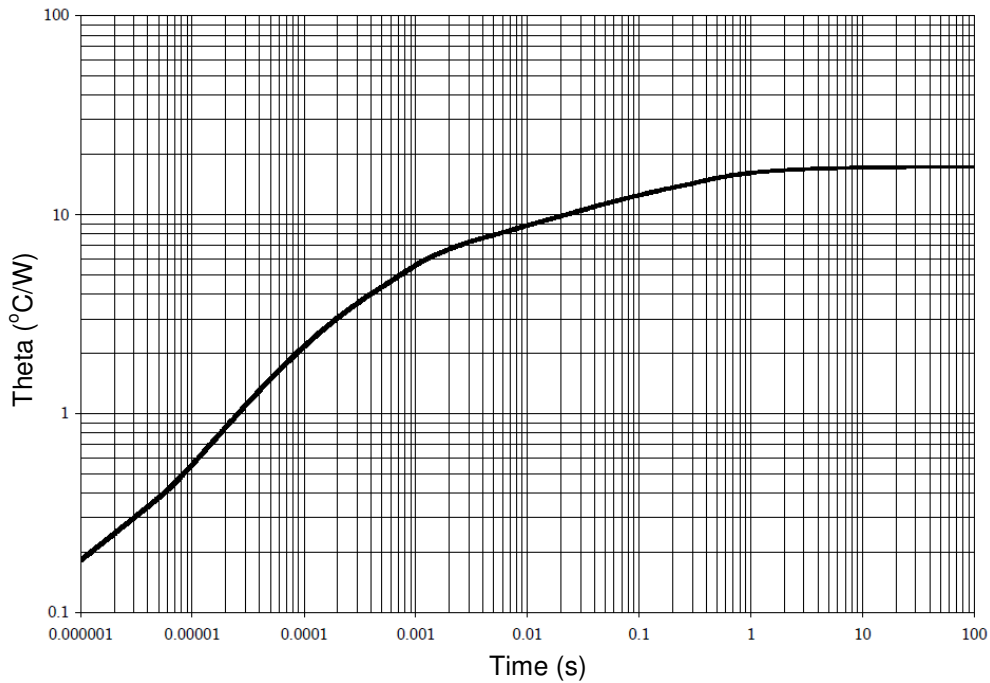
**Test 1**
 $V_{CE} = 10\text{ V}$ ,  $I_C = 1\text{ A}$ 
**Test 2**
 $V_{CE} = 100\text{ V}$ ,  $I_C = 100\text{ mA}$ 
**Test 3**
 $V_{CE} = 200\text{ V}$ ,  $I_C = 24\text{ mA}$  (2N5415 only)

**Test 4**
 $V_{CE} = 300\text{ V}$ ,  $I_C = 10\text{ mA}$  (2N5416 only)

**Maximum Safe Operating Area ( $T_J = 200\text{ }^\circ\text{C}$ )**

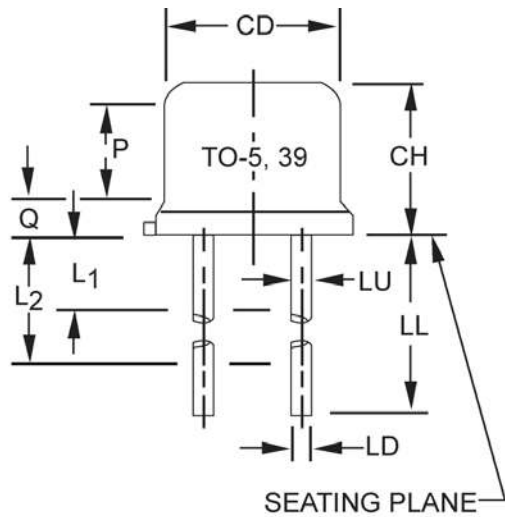
GRAPHS



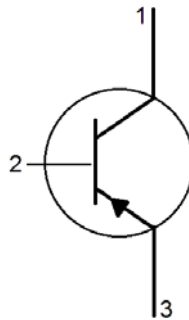
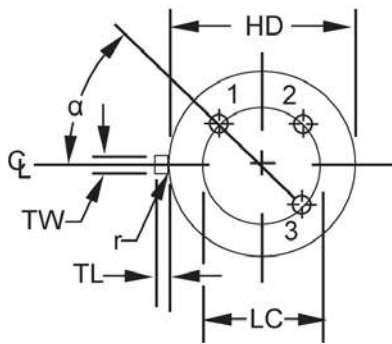
**FIGURE 1**  
Thermal impedance graph ( $R_{\theta JA}$ )



**FIGURE 2**  
Thermal impedance graph ( $R_{\theta JA}$ )

**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
$\alpha$	45° TP		45° TP		6


**NOTES:**

1. Dimensions are in inches.
2. Millimeters are given for 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 0.010 (0.25 mm) in zone P. This zone is controlled for automatic handling.
6. Leads at gauge plane 0.054 inch (1.37 mm) +0.001 inch (0.03 mm) -0.000 inch (0.00 mm) below seating plane shall be within 0.007 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 0.042 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 0.011 inch (0.28 mm).
11. Symbol r applied to both inside corners of tab.
12. For transistor types 2N5415 and 2N5416, dimension LL shall be 1.5 inches (38.1 mm) minimum and 1.75 inch (44.4 mm) maximum.
13. All three leads.
14. In accordance with ASME Y14.5M, diameters are equivalent to  $\Phi$ x symbology.