



PNP Silicon Low-Power Transistor

Qualified per MIL-PRF-19500/485

Qualified Levels:
JAN, JANTX, JANTXV
and JANS

DESCRIPTION

This family of 2N5415S and 2N5416S epitaxial planar transistors are military qualified up to a JANS level for high-reliability applications. These devices are also available in the longer leaded TO-5 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 commercial version

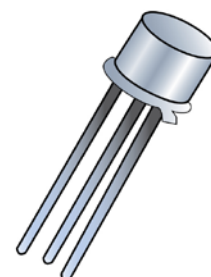
APPLICATIONS / BENEFITS

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

MAXIMUM RATINGS @ $T_A = +25^\circ\text{C}$ unless otherwise noted

| Parameters / Test Conditions | Symbol | 2N5415S | 2N5416S | Unit |
|---|-----------------|-------------|---------|--------------------|
| Collector-Emitter Voltage | V_{CEO} | 200 | 300 | V |
| Collector-Base Voltage | V_{CBO} | 200 | 350 | V |
| Emitter-Base Voltage | V_{EBO} | 6.0 | 6.0 | V |
| Collector Current | I_C | 1.0 | 1.0 | A |
| Operating & Storage Junction Temperature Range | T_J, T_{stg} | -65 to +200 | | $^\circ\text{C}$ |
| Thermal Resistance Junction-to-Ambient | $R_{\theta JA}$ | 234 | | $^\circ\text{C/W}$ |
| Thermal Resistance Junction-to-Case | $R_{\theta JC}$ | 17.5 | | $^\circ\text{C/W}$ |
| Total Power Dissipation @ $T_A = +25^\circ\text{C}$ ⁽¹⁾ @ $T_C = +25^\circ\text{C}$ ⁽²⁾ | P_T | 0.75 10 | | W |


Notes: 1. Derate linearly 4.29 mW/ $^\circ\text{C}$ for $T_A > +25^\circ\text{C}$.
2. Derate linearly 57.2 mW/ $^\circ\text{C}$ for $T_C > +25^\circ\text{C}$.




TO-205AD (TO-39) Package

Also available in:

TO-5 package
(long-leaded)

 [2N5415 – 2N5416](#)

U4 package
(surface mount)

 [2N5415U4 – 2N5416U4](#)

UA package
(surface mount)

 [2N5415UA – 2N5416UA](#)

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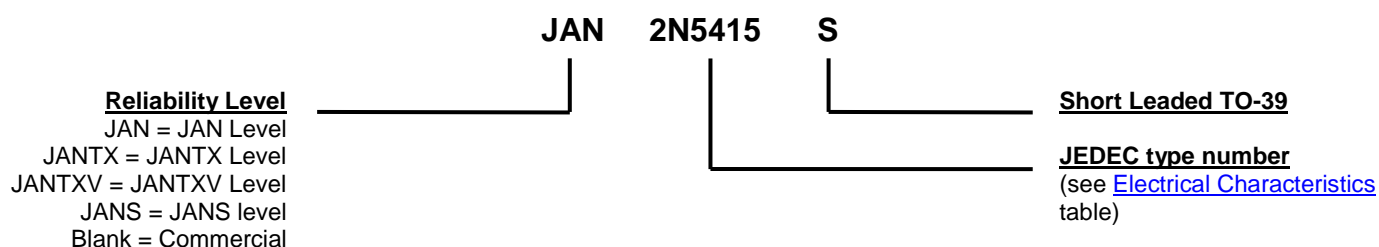
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MECHANICAL and PACKAGING

- CASE: Hermetically sealed, kovar base, nickel cap
- TERMINALS: Gold plated kovar and solder dip (Sn63/Pb37) on JAN, JANTX, and JANTXV versions. NOTE: Solder dipped versions are not RoHS compliant.
- MARKING: Part number, date code, manufacturer's ID and serial number
- POLARITY: PNP
- WEIGHT: Approximately 1.064 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
OFF CHARACTERISTICS

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

ON CHARACTERISTICS

| Parameters / Test Conditions | Symbol | Min. | Max. | Unit |
|---|---------------|----------------|------|------|
| Forward-Current Transfer Ratio $I_C = 50\text{ mA}$, $V_{CE} = 10\text{ V}$ $I_C = 1\text{ mA}$, $V_{CE} = 10\text{ V}$ $I_C = 50\text{ mA}$, $V_{CE} = 10\text{ V}$, $T_A = +150^\circ\text{C}$ | 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 |

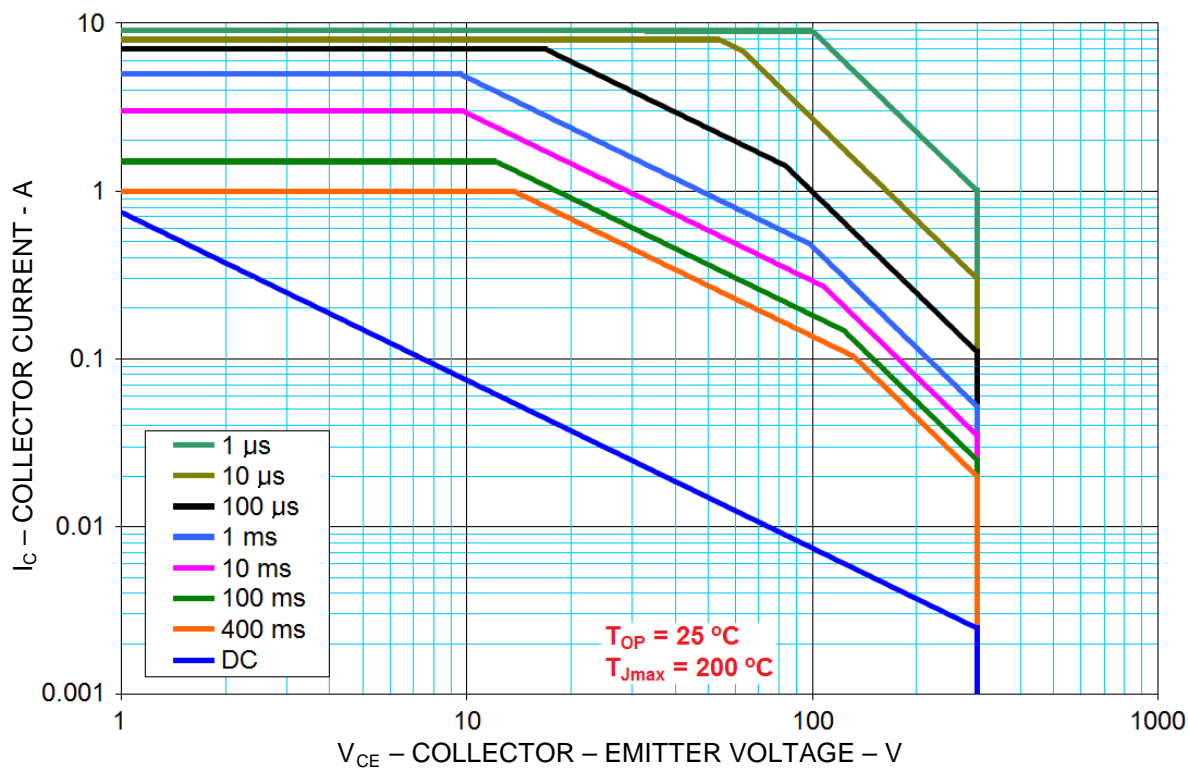
ELECTRICAL CHARACTERISTICS @ $T_A = +25\text{ }^{\circ}\text{C}$ unless otherwise noted. (continued)
SWITCHING CHARACTERISTICS

| 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 | μs |
| Turn-Off Time $V_{CC} = 200\text{ V}$, $I_C = 50\text{ mA}$, $I_{B1} = I_{B2} = 5\text{ mA}$ | t_{off} | | 10 | μs |

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
 $V_{CE} = 200\text{ V}$, $I_C = 24\text{ mA}$ (2N5415S only)

Test 4
 $V_{CE} = 300\text{ V}$, $I_C = 10\text{ mA}$ (2N5416S only)

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

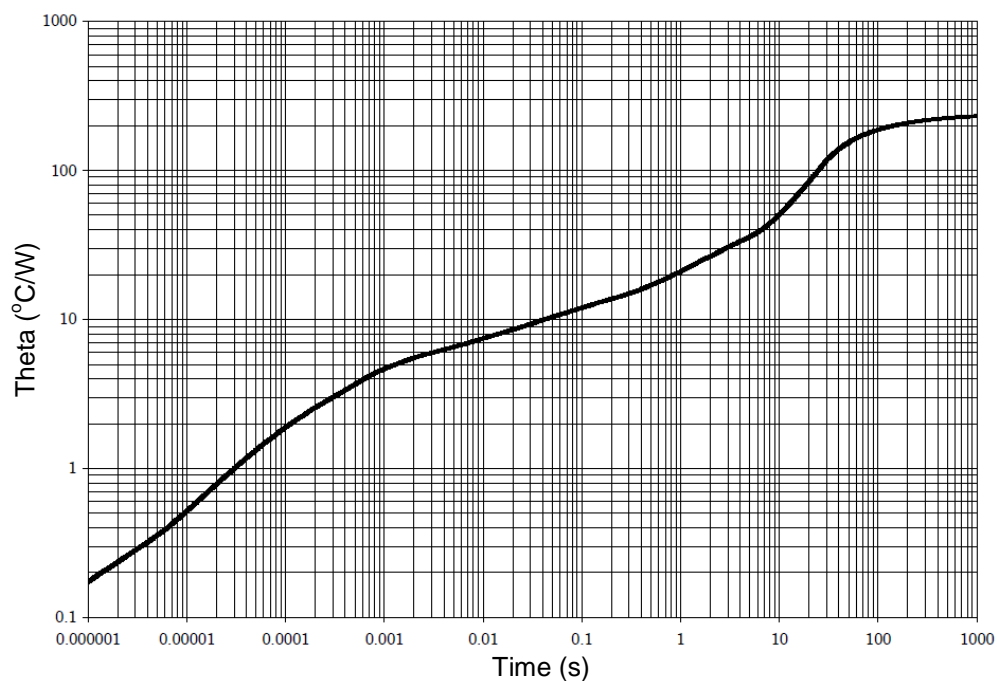
GRAPHS


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

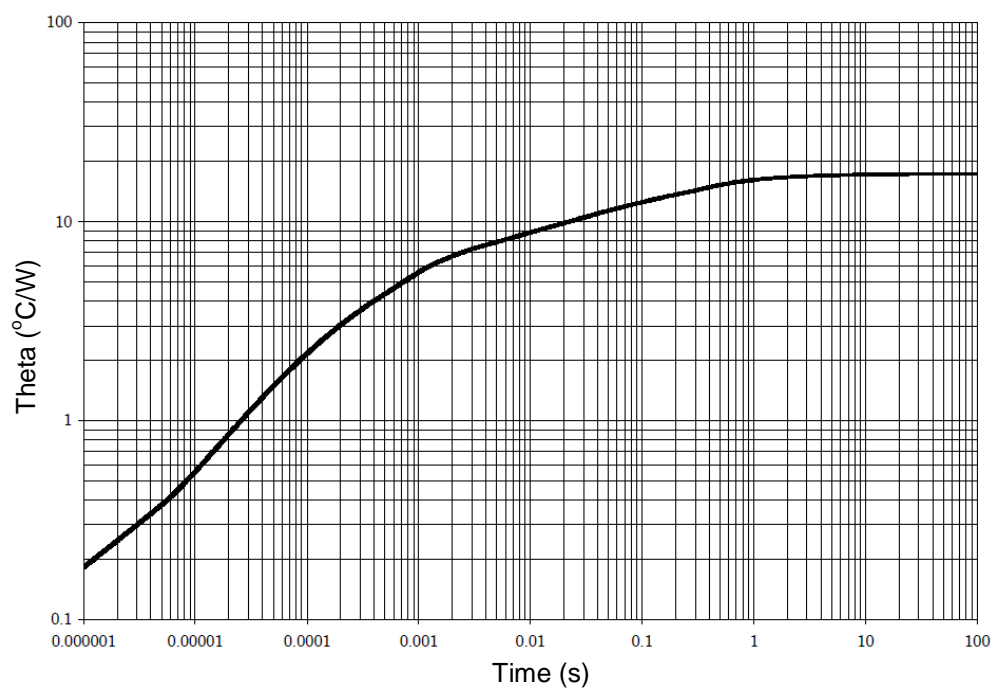
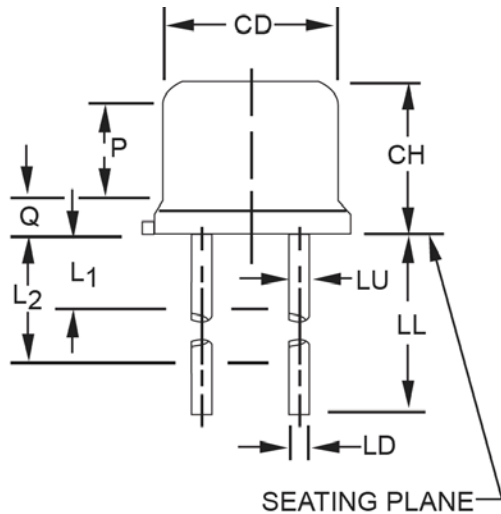
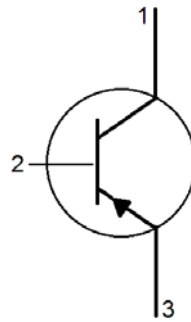
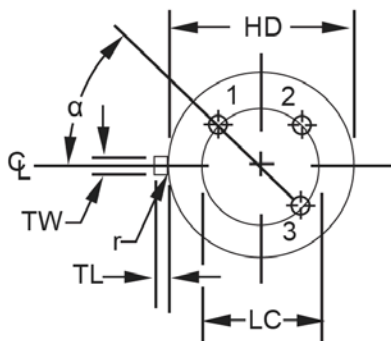


FIGURE 2
Thermal impedance graph ($R_{\theta JA}$)

PACKAGE DIMENSIONS


| Symbol | Dimensions | | | | Notes |
|----------------|------------|-------|-------------|-------|-------|
| | 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, 8 |
| LL | 0.500 | 0.750 | 12.70 | 19.05 | 7, 8 |
| LU | 0.016 | 0.019 | 0.41 | 0.48 | 7, 8 |
| L ₁ | - | 0.050 | - | 1.27 | 7, 8 |
| L ₂ | 0.250 | - | 6.35 | - | 7, 8 |
| Q | - | 0.050 | - | 1.27 | 5 |
| TL | 0.029 | 0.045 | 0.74 | 1.14 | 4 |
| TW | 0.028 | 0.034 | 0.71 | 0.86 | 3 |
| r | - | 0.010 | - | 0.25 | 10 |
| α | 45° TP | | 45° TP | | 6 |
| P | 0.100 | - | 2.54 | - | |


NOTES:

1. Dimensions are in inches.
2. Millimeters are given for information only.
3. Beyond r (radius) maximum, TW shall be held for a minimum length of 0.011 (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 0.054 +0.001 -0.000 inch (1.37 +0.03 -0.00 mm) below seating plane shall be within 0.007 inch (0.18 mm) radius of true position (TP) at maximum material condition (MMC) relative to tab at MMC. This device may be measured by direct methods.
7. Dimension LU applies between L₁ and L₂. Dimension LD applies between L₂ and minimum. Diameter is uncontrolled in L₁ 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 Φx symbology.
12. Lead 1 = emitter, lead 2 = base, lead 3 = collector.