RoHS

*Available on commercial versions*

# NPN MEDIUM POWER SILICON TRANSISTOR

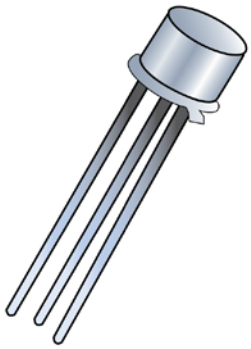
***Qualified per MIL-PRF-19500/393***

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

## DESCRIPTION

This family of high-frequency, epitaxial planar transistors feature low saturation voltage. These devices are also available in TO-5 and low profile U4 packages. 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.



**TO-39 (TO-205AD) Package**

## FEATURES

- JEDEC registered 2N3418 through 2N3421 series.
- JAN, JANTX, and JANTXV qualifications are available per MIL-PRF-19500/393.
- RoHS compliant versions available (commercial grade only).
- $V_{CE(sat)}$ = 0.25 V @ Ic = 1 A.
- Rise time $t_r$ = 0.22 µs max @ $I_C$ = 1.0 A, $I_{B1}$ = 100 mA.
- Fall time $t_f$ = 0.20 µs max @ $I_C$ = 1.0 A, $I_{B2}$ = -10 0 mA.

## APPLICATIONS / BENEFITS

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

Also available in:

**TO-5 package**
**(leaded)**
2N3418 – 2N3421

**U4 package**
**(surface mount)**
2N3418U4 – 2N3421U4

## MAXIMUM RATINGS

| Parameters / Test Conditions | Symbol | 2N3418S 2N3420S | 2N3419S 2N3421S | Unit |
|---|---|---|---|---|
| Collector-Emitter Voltage | $V_{CEO}$ | 60 | 80 | V |
| Collector-Base Voltage | $V_{CBO}$ | 85 | 125 | V |
| Emitter-Base Voltage | $V_{EBO}$ | 8 | | V |
| Collector Current<br>tp <= 1 ms, duty cycle <= 50% | $I_C$ | 3<br>5 | | A |
| Total Power Dissipation @ $T_A$ = +25 °C (1)<br>@ $T_C$ = +100 °C (2) | $P_D$ | 1<br>5 | | W |
| Operating & Storage Junction Temperature Range | $T_J$, $T_{stg}$ | -65 to +200 | | °C |

**Notes:** 1. Derate linearly 5.72 mW/°C for $T_A$ > +25 °C.
2. Derate linearly 150 mW/°C for $T_C$ > +100 °C.

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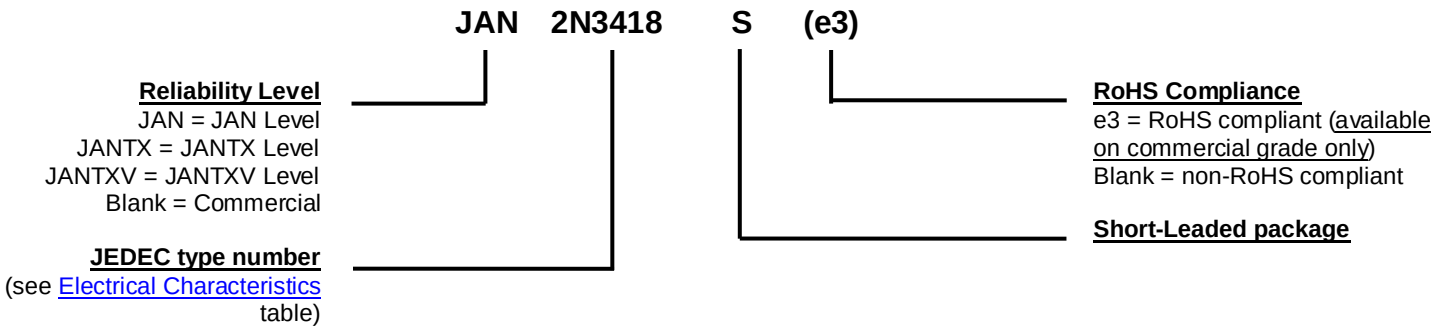
## MECHANICAL and PACKAGING

- CASE: Hermetically sealed, kovar base, nickel cap.
- MARKING: Part number, date code, manufacturer's ID.
- POLARITY: 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. |
| $T_A$ | Ambient temperature, free-air temperature. |
| $V_{CEO}$ | Collector-emitter voltage, base open. |
| $V_{CBO}$ | Collector-emitter voltage, emitter open. |
| $V_{EBO}$ | Emitter-base voltage, collector open. |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## ELECTRICAL CHARACTERISTICS ($T_A$ = +25°C, unless otherwise noted)

### OFF CHARACTERISTICS

| Parameters / Test Conditions | | Symbol | Min. | Max. | Unit |
|---|---|---|---|---|---|
| Collector-Emitter Breakdown Current<br>$I_C$ = 50 mA, $I_B$ = 0 | 2N3418S, 2N3420S<br>2N3419S, 2N3421S | $V_{(BR)CEO}$ | 60<br>80 | | V |
| Collector-Emitter Cutoff Current<br>$V_{BE}$ = -0.5 V, $V_{CE}$ = 80 V<br>$V_{BE}$ = -0.5 V, $V_{CE}$ = 120 V | 2N3418S, 2N3420S<br>2N3419S, 2N3421S | $I_{CEX}$ | | 0.3<br>0.3 | µA |
| Collector-Base Cutoff Current<br>$V_{CE}$ = 45 V, $I_B$ = 0<br>$V_{CE}$ = 60 V, $I_B$ = 0 | 2N3418S, 2N3420S<br>2N3419S, 2N3421S | $I_{CEO}$ | | 5.0<br>5.0 | µA |
| Emitter-Base Cutoff Current<br>$V_{EB}$ = 6.0 V, $I_C$ = 0<br>$V_{EB}$ = 8.0 V, $I_C$ = 0 | | $I_{EBO}$ | | 0.5<br>10 | µA |

### ON CHARACTERISTICS (1)

| Parameters / Test Conditions | | Symbol | Min. | Max. | Unit |
|---|---|---|---|---|---|
| Forward-Current Transfer Ratio | | | | | |
| $I_C$ = 100 mA, $V_{CE}$ = 2.0 V | 2N3418S, 2N3419S<br>2N3420S, 2N3421S | | 20<br>40 | | |
| $I_C$ = 1.0 A, $V_{CE}$ = 2.0 V | 2N3418S, 2N3419S<br>2N3420S, 2N3421S | | 20<br>40 | 60<br>120 | |
| $I_C$ = 2.0 A, $V_{CE}$ = 2.0 V | 2N3418S, 2N3419S<br>2N3420S, 2N3421S | $h_{FE}$ | 15<br>30 | | |
| $I_C$ = 5.0 A, $V_{CE}$ = 5.0 V | 2N3418S, 2N3419S<br>2N3420S, 2N3421S | | 10<br>15 | | |
| Collector-Emitter Saturation Voltage<br>$I_C$ = 1.0 A, $I_B$ = 0.1 A<br>$I_C$ = 2.0 A, $I_B$ = 0.2 A | | $V_{CE(sat)}$ | | 0.25<br>0.5 | V |
| Base-Emitter Saturation Voltage<br>$I_C$ = 1.0 A, $I_B$ = 0.1 A<br>$I_C$ = 2.0 A, $I_B$ = 0.2 A | | $V_{BE(sat)}$ | 0.6<br>0.7 | 1.2<br>1.4 | V |

### DYNAMIC CHARACTERISTICS

| Parameters / Test Conditions | Symbol | Min. | Max. | Unit |
|---|---|---|---|---|
| Magnitude of Common Emitter Small-Signal Short Circuit Forward Current Transfer Ratio<br>$I_C$ = 0.1 A, $V_{CE}$ = 10 V, f = 20 MHz | $\|h_{fe}\|$ | 1.3 | 0.8 | |
| Output Capacitance<br>$V_{CB}$ = 10 V, $I_E$ = 0, 100 kHz ≤ f ≤ 1.0 MHz | $C_{obo}$ | | 150 | pF |

**NOTES:** (1) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤ 2.0%.


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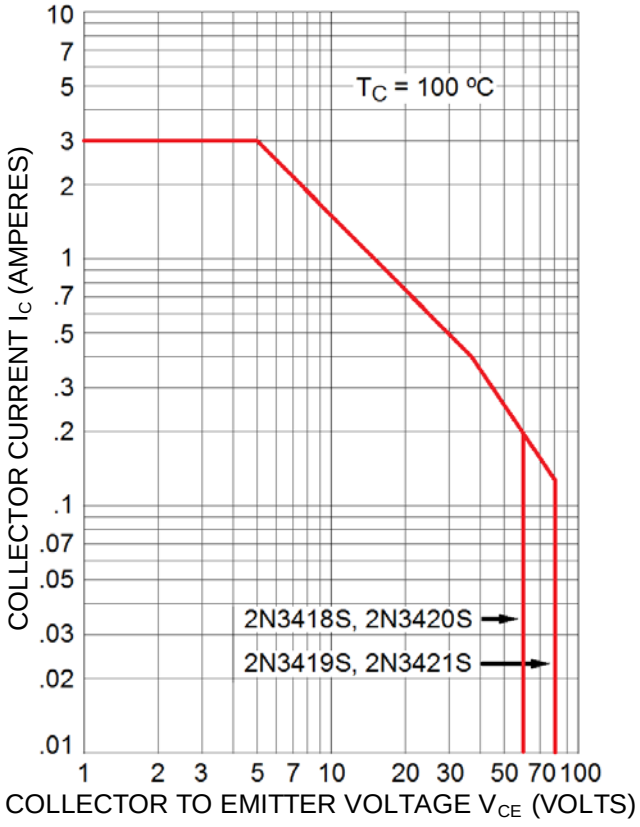
## ELECTRICAL CHARACTERISTICS ($T_A$ = +25°C, unless otherwise noted) continued

### SWITCHING CHARACTERISTICS

| Parameters / Test Conditions (for all symbols) | | Symbol | Min. | Max. | Unit |
|---|---|---|---|---|---|
| Delay Time<br>Rise Time | $V_{BE(off)}$ = -3.7 V,<br>$I_C$ = 1.0 A, $I_{B1}$ = 100 mA | $t_d$<br>$t_r$ | | 0.08<br>0.22 | µs |
| Storage Time<br>Fall Time | $V_{BE(off)}$ = -3.7 V,<br>$I_C$ = 1.0 A, $I_{B2}$ = -100 mA | $t_s$<br>$t_f$ | | 1.10<br>0.20 | µs |
| Turn-Off Time | $V_{BE(off)}$ = -3.7 V, $I_C$ = 1.0 A,<br>$I_{B2}$ = -100 mA, $R_L$ = 20 Ω | $t_{off}$ | | 1.20 | µs |

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

**DC Test**
$T_C$ = +100 °C, 1 cycle, t ≥ 1.0 s
**Test 1**
$V_{CE}$ = 5.0 V, $I_C$ = 3.0 A
**Test 2**
$V_{CE}$ = 37 V, $I_C$ = 0.4 A
**Test 3**
$V_{CE}$ = 60 V, $I_C$ = 0.185 A — 2N3418S, 2N3420S
$V_{CE}$ = 80 V, $I_C$ = 0.12 A — 2N3419S, 2N3421S
**Clamped Switching** — $T_A$ = +25 °C, $I_B$ = 0.5 A, $I_C$ = 3.0 A




Maximum Safe Operating Area (continuous dc)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## GRAPHS

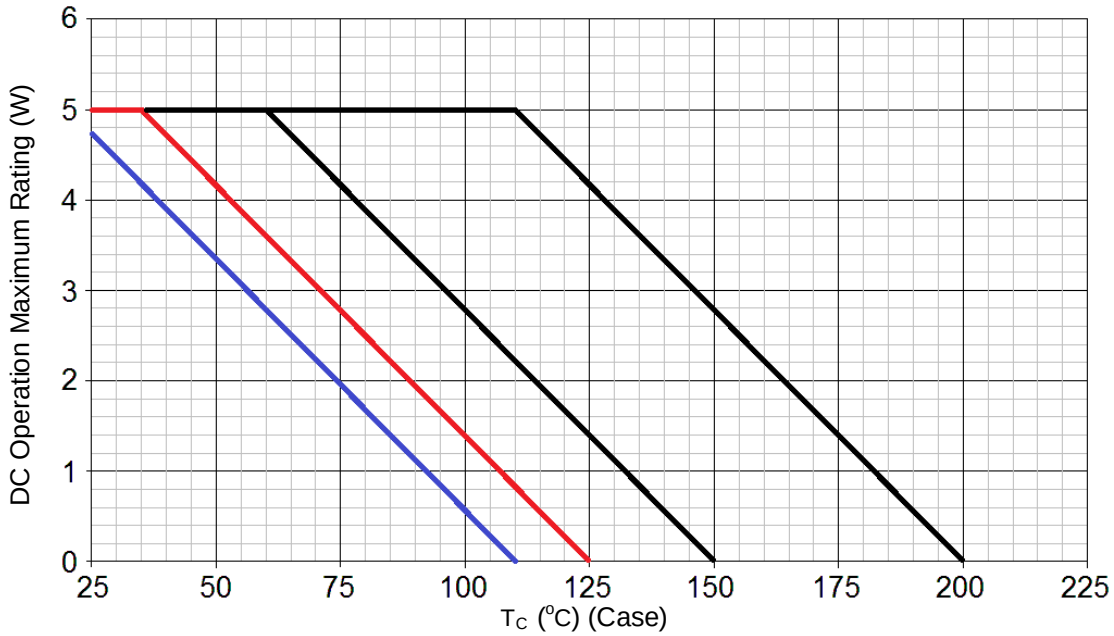


**FIGURE 1**

Temperature-Power Derating Curve

**NOTES:** Thermal Resistance Junction to Case = 4.5 °C/W
Max Finish-Alloy Temp = 175.0 °C

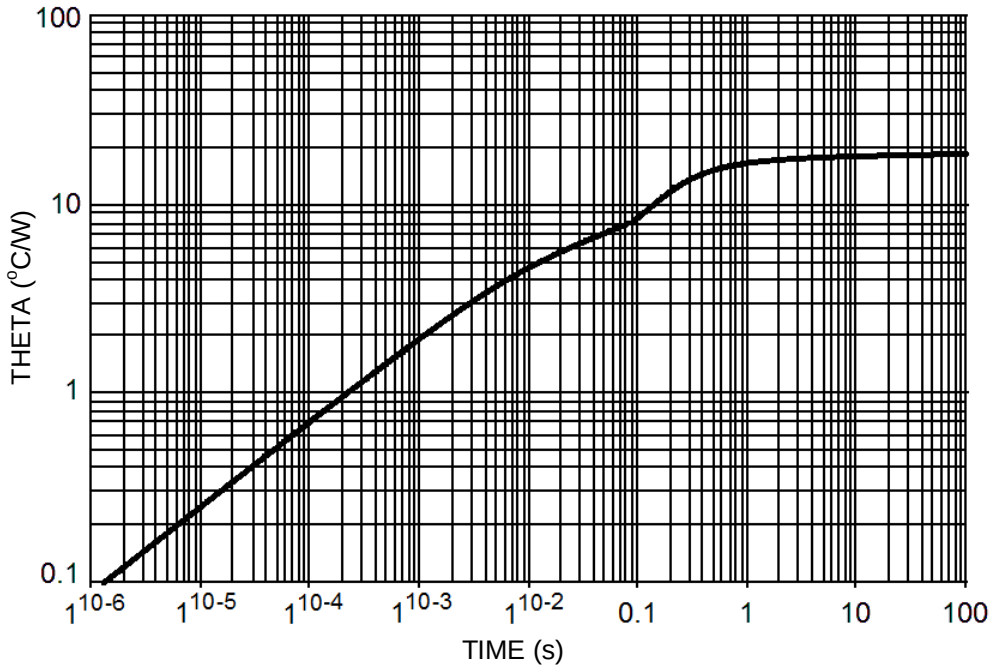


**FIGURE 2**

Maximum Thermal Impedance

**NOTE:** $T_C$ = +25 °C, Thermal Resistance $R_{\theta JC}$ = 4.5 °C/W


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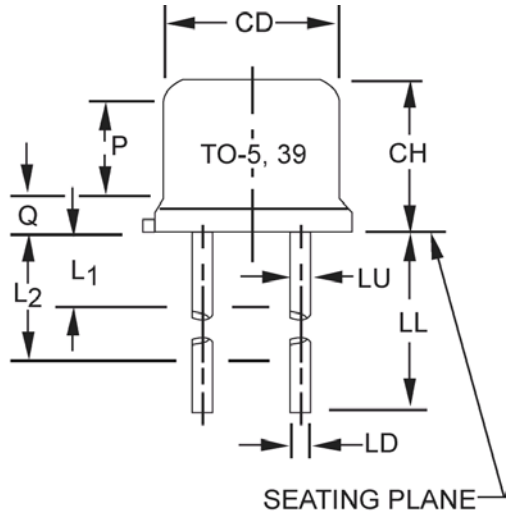
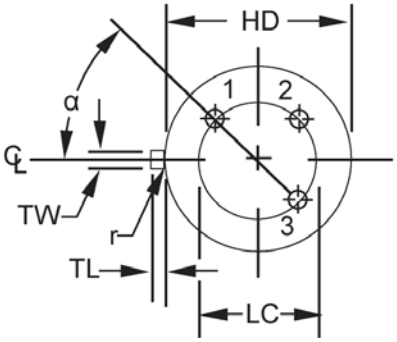
## PACKAGE DIMENSIONS




| Symbol | Dimensions | | | | Note |
|---|---|---|---|---|---|
| | Inches | | Millimeters | | |
| | Min | Max | Min | Max | |
| CD | .305 | .335 | 7.75 | 8.51 | |
| CH | .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 | |
| LL | .500 | .750 | 12.7 | 19.05 | 7 |
| LU | See notes 7, 13, 14 | | | | |
| $L_1$ | | .050 | | 1.27 | 7 |
| $L_2$ | .250 | | 6.35 | | 7 |
| P | .100 | | 2.54 | | 5 |
| Q | | .040 | | 1.02 | 4 |
| TL | .029 | .045 | 0.74 | 1.14 | 3, 10 |
| TW | .028 | .034 | 0.71 | .86 | 9, 10 |
| r | | .010 | | 0.25 | 11 |
| α | 45° TP | | 45° TP | | 6 |




1. Dimensions 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 inch (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 TP relative to tab. Device may be measured by direct methods or by gauge.
7. Symbol LU applies between L1 and L2. Dimension LD applies between L2 and LL minimum. Diameter is uncontrolled in L1 and beyond LL minimum.
8. Lead number 3 is electrically connected to case.
9. Beyond r maximum, TW shall be held for a minimum length of .021 inch (0.53 mm).
10. Lead number 4 omitted on this variation.
11. Symbol r applied to both inside corners of tab.
12. For transistor types 2N3418S, 2N3419S, 2N3420S, 2N3421S, LL is .500 (12.70 mm) minimum and .750 (19.05 mm) maximum.
13. In accordance with ASME Y14.5M, diameters are equivalent to Φx symbology.
14. Lead 1 is emitter, lead 2 is base, and lead 3 is collector.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