

## NPN HIGH POWER SILICON TRANSISTOR

Qualified per MIL-PRF-19500/371

### Devices

2N3902

2N5157

### Qualified Level

JAN  
JANTX

### MAXIMUM RATINGS

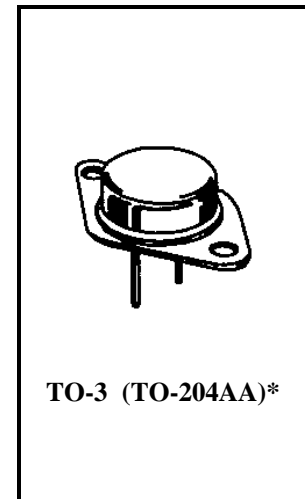
| Ratings                               | Symbol         | 2N3902                                | 2N5157 | Unit        |
|---------------------------------------|----------------|---------------------------------------|--------|-------------|
| Collector-Emitter Voltage             | $V_{CEO}$      | 400                                   | 500    | Vdc         |
| Emitter-Base Voltage                  | $V_{EBO}$      | 5.0                                   | 6.0    | Vdc         |
| Collector-Base Voltage                | $V_{CBO}$      | 700                                   |        | Vdc         |
| Base Current                          | $I_B$          | 2.0                                   |        | Adc         |
| Collector Current                     | $I_C$          | 3.5                                   |        | Adc         |
| Total Power Dissipation               | $P_T$          | @ $T_A = +25^{\circ}C$ <sup>(1)</sup> | 5.0    | W           |
|                                       |                | @ $T_C = +75^{\circ}C$ <sup>(2)</sup> | 100    | W           |
| Operating & Storage Temperature Range | $T_j, T_{stg}$ | -65 to +200                           |        | $^{\circ}C$ |

### THERMAL CHARACTERISTICS

| Characteristics                      | Symbol          | Max. | Unit          |
|--------------------------------------|-----------------|------|---------------|
| Thermal Resistance, Junction-to-Case | $R_{\theta JC}$ | 1.25 | $^{\circ}C/W$ |

1) Derate linearly 29 mW/ $^{\circ}C$  for  $T_A > +25^{\circ}C$

2) Derate linearly 0.8 W/ $^{\circ}C$  for  $T_C > +75^{\circ}C$



\*See Appendix A for Package Outline

### ELECTRICAL CHARACTERISTICS

| Characteristics | Symbol | Min. | Max. | Unit |
|-----------------|--------|------|------|------|
|-----------------|--------|------|------|------|

### OFF CHARACTERISTICS

|  |                  |           |            |           |
|--|------------------|-----------|------------|-----------|
| Collector-Emitter Cutoff Current<br>$V_{CE} = 325$ Vdc<br>$V_{CE} = 400$ Vdc | 2N3902<br>2N5157 | $I_{CEO}$ | 250<br>250 | $\mu$ Adc |
| Collector-Emitter Cutoff Current<br>$V_{BE} = 1.5$ Vdc; $V_{CE} = 700$ Vdc   |                  | $I_{CEX}$ | 500        | $\mu$ Adc |
| Emitter-Base Cutoff Current<br>$V_{EB} = 5.0$ Vdc<br>$V_{EB} = 6.0$ Vdc      | 2N3902<br>2N5157 | $I_{EBO}$ | 200<br>200 | $\mu$ Adc |

### ON CHARACTERISTICS<sup>(3)</sup>

|  |  |               |            |     |
|--|--|---------------|------------|-----|
| Base-Emitter Saturation Voltage<br>$I_C = 1.0$ Adc; $I_B = 0.1$ Adc<br>$I_C = 3.5$ Adc; $I_B = 0.7$ Adc      |  | $V_{BE(sat)}$ | 1.5<br>2.0 | Vdc |
| Collector-Emitter Saturation Voltage<br>$I_C = 1.0$ Adc; $I_B = 0.1$ Adc<br>$I_C = 3.5$ Adc; $I_B = 0.7$ Adc |  | $V_{CE(sat)}$ | 0.8<br>2.5 | Vdc |

**2N3902, 2N5157 JAN SERIES**

**ELECTRICAL CHARACTERISTICS (con't)**

| Characteristics  | Symbol                | Min.                | Max. | Unit |
|--|-----------------------|---------------------|------|------|
| <b>ON CHARACTERISTICS<sup>(3)</sup> (con't)</b>  |                       |                     |      |      |
| Forward-Current Transfer Ratio<br>I <sub>C</sub> = 0.5 Adc; V <sub>CE</sub> = 5.0 Vdc<br>I <sub>C</sub> = 1.0 Adc; V <sub>CE</sub> = 5.0 Vdc<br>I <sub>C</sub> = 2.5 Adc; V <sub>CE</sub> = 5.0 Vdc<br>I <sub>C</sub> = 3.5 Adc; V <sub>CE</sub> = 5.0 Vdc | h <sub>FE</sub>       | 25<br>30<br>10<br>5 | 90   |      |
| Collector-Emitter Sustaining Voltage<br>I <sub>C</sub> = 100 mAdc  | V <sub>CEO(sus)</sub> | 325<br>400          |      | Vdc  |

**DYNAMIC CHARACTERISTICS**

|  |                  |     |     |    |
|--|------------------|-----|-----|----|
| Small-Signal Short-Circuit Forward Current Transfer Ratio<br>I <sub>C</sub> = 0.2 Adc; V <sub>CE</sub> = 10 Vdc, f = 1 MHz | h <sub>fe</sub>  | 2.5 | 25  |    |
| Output Capacitance<br>V <sub>CB</sub> = 10 Vdc; I <sub>E</sub> = 0, 100 kHz ≤ f ≤ 1.0 MHz                                  | C <sub>obo</sub> |     | 250 | pF |

**SWITCHING CHARACTERISTICS**

|  |                  |  |     |    |
|--|------------------|--|-----|----|
| Turn-On Time<br>V <sub>CC</sub> = 125 Vdc; I <sub>C</sub> = 1.0 Adc; I <sub>B1</sub> = 0.1 Adc                               | t <sub>on</sub>  |  | 0.8 | μs |
| Turn-Off Time<br>V <sub>CC</sub> = 125 Vdc; I <sub>C</sub> = 1.0 Adc; I <sub>B1</sub> = 0.1 Adc; -I <sub>B2</sub> = 0.50 Adc | t <sub>off</sub> |  | 1.7 | μs |

**SAFE OPERATING AREA**

|   |        |  |  |  |
|---|--------|--|--|--|
| <b>DC Tests (continuous)</b>  |        |  |  |  |
| T <sub>C</sub> = +25°C; t ≥ 1.0 s (See Figure 3 of MIL-PRF-19500/371)   |        |  |  |  |
| <b>Test 1</b>   |        |  |  |  |
| V <sub>CE</sub> = 28.6 Vdc, I <sub>C</sub> = 3.5 Adc  |        |  |  |  |
| <b>Test 2</b>   |        |  |  |  |
| V <sub>CE</sub> = 70 Vdc, I <sub>C</sub> = 1.43 Adc   |        |  |  |  |
| <b>Test 3</b>   |        |  |  |  |
| V <sub>CE</sub> = 325 Vdc, I <sub>C</sub> = 55 mAdc   | 2N3902 |  |  |  |
| V <sub>CE</sub> = 400 Vdc, I <sub>C</sub> = 35 mAdc   | 2N5157 |  |  |  |
| <b>Switching Tests</b>  |        |  |  |  |
| <b>Load condition C (unclamped inductive load)</b>  |        |  |  |  |
| T <sub>C</sub> = 25°C; duty cycle ≤ 10%; R <sub>S</sub> = 0.1 Ω (See Figure 4 of MIL-PRF-19500/371)   |        |  |  |  |
| <b>Test 1</b>   |        |  |  |  |
| t <sub>p</sub> = approximately 3 ms (vary to obtain I <sub>C</sub> ); R <sub>BB1</sub> = 20 Ω; V <sub>BB1</sub> = 10 Vdc; R <sub>BB2</sub> = 3 kΩ;<br>V <sub>BB2</sub> = 1.5 Vdc; V <sub>CC</sub> = 50 Vdc; I <sub>C</sub> = 3.5 Adc; L = 60 mH; R = 3 Ω; R <sub>L</sub> ≤ 14Ω.   |        |  |  |  |
| <b>Test 2</b>   |        |  |  |  |
| t <sub>p</sub> = approximately 3 ms (vary to obtain I <sub>C</sub> ); R <sub>BB1</sub> = 100 Ω; V <sub>BB1</sub> = 10 Vdc; R <sub>BB2</sub> = 3 kΩ;<br>V <sub>BB2</sub> = 1.5 Vdc; I <sub>C</sub> = 0.6 Adc V <sub>CC</sub> = 50 Vdc; L = 200 mH; R = 8 Ω; R <sub>L</sub> ≤ 83Ω.  |        |  |  |  |
| <b>Switching Tests</b>  |        |  |  |  |
| <b>Load condition (clamped inductive load)</b>  |        |  |  |  |
| T <sub>C</sub> = +25°C; duty cycle ≤ 10%. (See Figure 5 of MIL-PRF-19500/371)   |        |  |  |  |
| <b>Test 1</b>   |        |  |  |  |
| t <sub>p</sub> = approximately 30 ms (vary to obtain I <sub>C</sub> ); R <sub>S</sub> = 0.1 Ω; R <sub>BB1</sub> = 20 Ω; V <sub>BB1</sub> = 10 Vdc; R <sub>BB2</sub> = 100 Ω;<br>V <sub>BB2</sub> = 1.5 Vdc; V <sub>CC</sub> = 50 Vdc; I <sub>C</sub> = 3.5 Adc; L = 60 mH; R = 3 Ω; R <sub>L</sub> ≥ 0Ω.<br>(A suitable clamping circuit or diode can be used.) |        |  |  |  |
| Clamp Voltage = 400 +0, -5 Vdc  | 2N3902 |  |  |  |
| Clamp Voltage = 500 +0, -5 Vdc  | 2N5157 |  |  |  |
| (Clamped voltage must be reached)   |        |  |  |  |

3.) Pulse Test: Pulse Width = 300μs, Duty Cycle ≤ 2.0%.



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