

2N3902 & 2N5157

NPN High Power Silicon Transistors

Rev. V2

Features

- Available in JAN, JANTX, JANTXV per MIL-PRF-19500/371
- TO-3 (TO-204AA) Package



Electrical Characteristics

| Parameter | Test Conditions | Symbol | Units | Min. | Max. |
|---|--|---------------|-----------------|---------------------|------------|
| Off Characteristics | | | | | |
| Collector - Emitter Cutoff Current | $V_{CE} = 400 \text{ Vdc}$, 2N3902 $V_{CE} = 500 \text{ Vdc}$, 2N5157 | I_{CEO} | μAdc | — | 100 100 |
| Collector - Emitter Cutoff Current | $V_{BE} = 1.5 \text{ Vdc}$, $V_{CE} = 700 \text{ Vdc}$ | I_{CEX} | μAdc | — | 20 |
| Collector - Emitter Cutoff Current | $V_{BE} = 5 \text{ Vdc}$, 2N3902 $V_{BE} = 6 \text{ Vdc}$, 2N5157 | I_{EBO} | μAdc | — | 200 200 |
| On Characteristics¹ | | | | | |
| Forward Current Transfer Ratio | $I_C = 0.5 \text{ Adc}$, $V_{CE} = 5 \text{ Vdc}$ $I_C = 1.0 \text{ Adc}$, $V_{CE} = 5 \text{ Vdc}$ $I_C = 2.5 \text{ Adc}$, $V_{CE} = 5 \text{ Vdc}$ $I_C = 3.5 \text{ Adc}$, $V_{CE} = 5 \text{ Vdc}$ | H_{FE} | - | 25 30 10 5 | 90 |
| Collector - Emitter Saturation Voltage | $I_C = 1.0 \text{ Adc}$, $I_B = 0.1 \text{ Adc}$ $I_C = 3.5 \text{ Adc}$, $I_B = 0.7 \text{ Adc}$ | $V_{CE(SAT)}$ | Vdc | — | 0.8 2.5 |
| Base - Emitter Saturation Voltage | $I_C = 1.0 \text{ Adc}$, $I_B = 0.1 \text{ Adc}$ $I_C = 3.5 \text{ Adc}$, $I_B = 0.7 \text{ Adc}$ | $V_{CE(SAT)}$ | Vdc | — | 1.5 2.0 |
| Dynamic Characteristics | | | | | |
| Small-Signal Short-Circuit Forward Current Transfer Ratio | $I_C = 0.2 \text{ Adc}$, $V_{CE} = 10 \text{ Vdc}$, $f = 1 \text{ MHz}$ | $ H_{FE} $ | - | 2.5 | 25 |
| Output Capacitance | $V_{CB} = 10 \text{ Vdc}$, $I_E = 0$, $100 \text{ kHz} \leq f \leq 1 \text{ MHz}$ | C_{OBO} | pF | — | 250 |

1. Pulse Test: Pulse Width = 300 μs , Duty Cycle $\leq 2.0\%$.

(Continued next page)

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Electrical Characteristics

| Parameter | Test Conditions | Symbol | Units | Min. | Max. |
|--|---|-----------|---------------|------|------|
| Switching Characteristics | | | | | |
| Turn-On Time | $V_{CC} = 125 \text{ Vdc}; I_C = 1.0 \text{ Adc}; I_{B1} = 0.1 \text{ Adc}$ | T_{ON} | μs | — | 0.8 |
| Turn-Off Time | $V_{CC} = 125 \text{ Vdc}; I_C = 1.0 \text{ Adc}; I_{B1} = 0.1 \text{ Adc}, -I_{B2} = 0.50 \text{ Adc}$ | T_{OFF} | μs | — | 1.7 |
| Safe Operating Area | | | | | |
| <p>DC Tests: $T_C = +25^\circ\text{C}$, 1 Cycle, $t = 1.0 \text{ s}$ (see Fig. 3 of MIL-PRF-19500/371)</p> <p>Test 1: $V_{CE} = 28.6 \text{ Vdc}, I_C = 3.5 \text{ Adc}$</p> <p>Test 2: $V_{CE} = 70 \text{ Vdc}, I_C = 1.43 \text{ Adc}$</p> <p>Test 3: $V_{CE} = 325 \text{ Vdc}, I_C = 55 \text{ mAdc}$, 2N3902 $V_{CE} = 400 \text{ Vdc}, I_C = 35 \text{ mAdc}$, 2N5157</p> <p>Switching Tests:</p> <p>Load Condition C (unclamped inductive load): $T_C = +25^\circ\text{C}$, duty cycle $<10\%$; $R_S = 0.1 \Omega$ (See Fig. 4 of MIL-PRF-19500/371)</p> <p>Test 1: $t_P =$ approximately 3 ms (vary to obtain I_C), $R_{BB1} = 20 \Omega$, $V_{BB1} = 10 \text{ Vdc}$; $R_{BB2} = 3 \text{ k}\Omega$, $V_{BB2} = 1.5 \text{ Vdc}$, $V_{CC} = 50 \text{ Vdc}$, $I_C = 3.5 \text{ Adc}$, $L = 60 \text{ mH}$, $R = 3 \Omega$; $R_L < 14 \Omega$</p> <p>Test 2: $t_P =$ approximately 3 ms (vary to obtain I_C), $R_{BB1} = 100 \Omega$, $V_{BB1} = 10 \text{ Vdc}$; $R_{BB2} = 3 \text{ k}\Omega$, $V_{BB2} = 1.5 \text{ Vdc}$, $I_C = 0.6 \text{ Adc}$, $V_{CC} = 50 \text{ Vdc}$, $L = 200 \text{ mH}$, $R = 8 \Omega$; $R_L < 83 \Omega$</p> <p>Load Condition (clamped inductive load): $T_C = +25^\circ\text{C}$, duty cycle $<10\%$ (See Fig. 5 of MIL-PRF-19500/371)</p> <p>Test 1: $t_P =$ approximately 30 ms (vary to obtain I_C), $R_S = 0.1 \Omega$, $R_{BB1} = 20 \Omega$, $V_{BB1} = 10 \text{ Vdc}$; $R_{BB2} = 100 \Omega$, $V_{BB2} = 1.5 \text{ Vdc}$, $V_{CC} = 50 \text{ Vdc}$, $I_C = 3.5 \text{ Adc}$, $L = 60 \text{ mH}$, $R = 3 \Omega$; $R_L < 0 \Omega$ (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)</p> | | | | | |

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Absolute Maximum Ratings

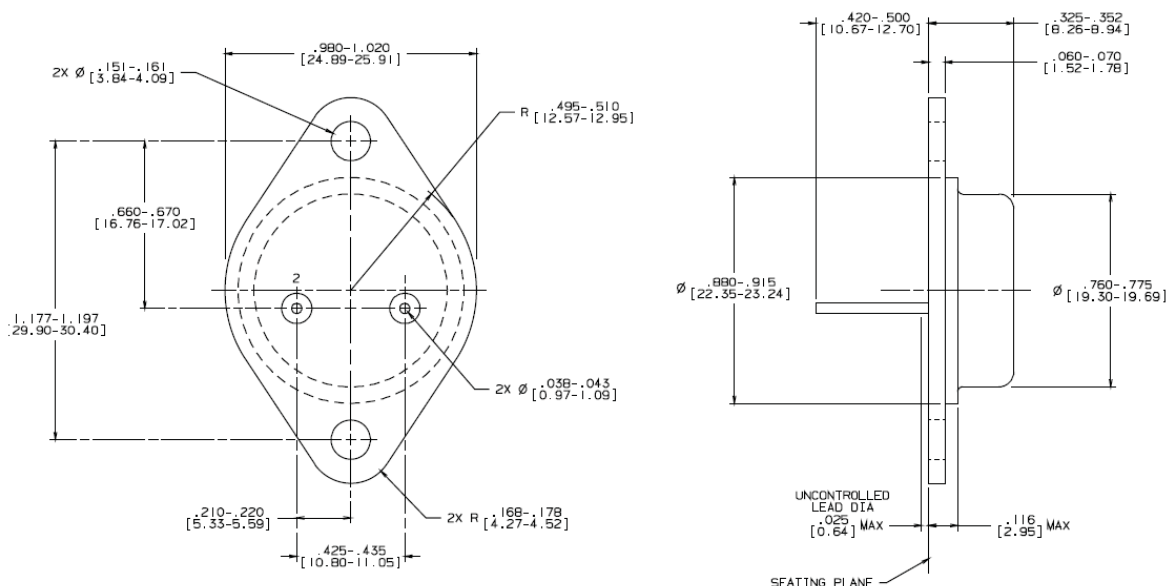
| Ratings | Symbol | Value |
|---|-------------------|---|
| Collector - Emitter Voltage 2N3902 2N5157 | V_{CEO} | 400 Vdc 500 Vdc |
| Emitter - Base Voltage 2N3902 2N5157 | V_{EBO} | 5 Vdc 6 Vdc |
| Collector - Base Voltage | V_{CBO} | 700 Vdc |
| Base Current | I_B | 2.0 Adc |
| Collector Current | I_C | 3.5 Adc |
| Total Power Dissipation @ $T_A = +25^{\circ}\text{C}^2$ @ $T_A = +25^{\circ}\text{C}^3$ | P_T | 5 W 100 W |
| Operating & Storage Temperature Range | T_{OP}, T_{STG} | -65°C to $+200^{\circ}\text{C}$ |

- Derate linearly @ 28.57 mW / °C for $T_A > +25^{\circ}\text{C}$.
- Derate linearly @ 0.8 mW / °C for $T_C > +75^{\circ}\text{C}$.

Thermal Characteristics

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

Outline Drawing



- Notes:
- Dimensions in inches [mm]
 - Standard header type solid base.
 - Standard lead finish: per MIL-M-38510 type x or equivalent.
 - Lead not bent $>15^{\circ}$
 - Dimensions based on JEDEC standard TO-3 publication 95, PA

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