

NPN HIGH POWER SILICON TRANSISTOR

Qualified per MIL-PRF-19500/371

Devices

2N3902

2N5157

Qualified Level

JAN
JANTX

MAXIMUM RATINGS

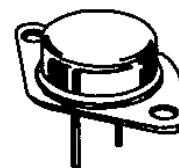
Ratings	Symbol	2N3902	2N5157	Unit
Collector-Emitter Voltage	V_{CEO}	400	500	Vdc
Emitter-Base Voltage	V_{EBO}	5.0	6.0	Vdc
Collector-Base Voltage	V_{CBO}	700		Vdc
Base Current	I_B	2.0		Adc
Collector Current	I_C	3.5		Adc
Total Power Dissipation @ $T_A = +25^{\circ}\text{C}$ ⁽¹⁾ @ $T_C = +75^{\circ}\text{C}$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

THERMAL CHARACTERISTICS

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

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

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



TO-3 (TO-204AA)*

*See Appendix A for Package Outline

ELECTRICAL CHARACTERISTICS

Characteristics	Symbol	Min.	Max.	Unit
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OFF CHARACTERISTICS

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

ON CHARACTERISTICS⁽³⁾

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

ELECTRICAL CHARACTERISTICS (con't)

Characteristics	Symbol	Min.	Max.	Unit
ON CHARACTERISTICS⁽³⁾ (con't)				
Forward-Current Transfer Ratio $I_C = 0.5 \text{ Adc}; V_{CE} = 5.0 \text{ Vdc}$ $I_C = 1.0 \text{ Adc}; V_{CE} = 5.0 \text{ Vdc}$ $I_C = 2.5 \text{ Adc}; V_{CE} = 5.0 \text{ Vdc}$ $I_C = 3.5 \text{ Adc}; V_{CE} = 5.0 \text{ Vdc}$	h_{FE}	25 30 10 5	90	
Collector-Emitter Sustaining Voltage $I_C = 100 \text{ mAdc}$ 2N3902 2N5157	$V_{CEO(sus)}$	325 400		Vdc

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 $V_{CB} = 10 \text{ Vdc}; I_E = 0, 100 \text{ kHz} \leq f \leq 1.0 \text{ MHz}$	C_{obo}		250	pF

SWITCHING CHARACTERISTICS

Turn-On Time $V_{CC} = 125 \text{ Vdc}; I_C = 1.0 \text{ Adc}; I_{B1} = 0.1 \text{ Adc}$	t_{on}		0.8	μs
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}		1.7	μs

SAFE OPERATING AREA**DC Tests (continuous)**

$T_C = +25^\circ\text{C}; t \geq 1.0 \text{ s}$ (See Figure 3 of MIL-PRF-19500/371)

Test 1

$V_{CE} = 28.6 \text{ Vdc}, I_C = 3.5 \text{ Adc}$

Test 2

$V_{CE} = 70 \text{ Vdc}, I_C = 1.43 \text{ Adc}$

Test 3

$V_{CE} = 325 \text{ Vdc}, I_C = 55 \text{ mAdc}$ 2N3902

$V_{CE} = 400 \text{ Vdc}, I_C = 35 \text{ mAdc}$ 2N5157

Switching Tests**Load condition C (unclamped inductive load)**

$T_C = 25^\circ\text{C};$ duty cycle $\leq 10\%; R_S = 0.1 \Omega$ (See Figure 4 of MIL-PRF-19500/371)

Test 1

$t_P =$ approximately 3 ms (vary to obtain I_C); $R_{BB1} = 20 \Omega; V_{BB1} = 10 \text{ Vdc}; R_{BB2} = 3 \text{ k}\Omega;$

$V_{BB2} = 1.5 \text{ Vdc}; V_{CC} = 50 \text{ Vdc}; I_C = 3.5 \text{ Adc}; L = 60 \text{ mH}; R = 3 \Omega; R_L \leq 14\Omega.$

Test 2

$t_P =$ approximately 3 ms (vary to obtain I_C); $R_{BB1} = 100 \Omega; V_{BB1} = 10 \text{ Vdc}; R_{BB2} = 3 \text{ k}\Omega;$

$V_{BB2} = 1.5 \text{ Vdc}; I_C = 0.6 \text{ Adc}; V_{CC} = 50 \text{ Vdc}; L = 200 \text{ mH}; R = 8 \Omega; R_L \leq 83\Omega.$

Switching Tests**Load condition (clamped inductive load)**

$T_C = +25^\circ\text{C};$ duty cycle $\leq 10\%.$ (See Figure 5 of MIL-PRF-19500/371)

Test 1

$t_P =$ approximately 30 ms (vary to obtain I_C); $R_S = 0.1 \Omega; R_{BB1} = 20 \Omega; V_{BB1} = 10 \text{ Vdc}; R_{BB2} = 100 \Omega;$

$V_{BB2} = 1.5 \text{ Vdc}; V_{CC} = 50 \text{ Vdc}; I_C = 3.5 \text{ Adc}; L = 60 \text{ mH}; R = 3 \Omega; R_L \geq 0\Omega.$

(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)

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