

# NPN HIGH POWER SILICON TRANSISTOR

Qualified per MIL-PRF-19500/371

**Devices** Qualified Level

2N3902 2N5157

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	$I_{\mathrm{B}}$	2.0		Adc
Collector Current	$I_{C}$	3.5		Adc
Total Power Dissipation @ $T_A = +25^0 C^{(1)}$ @ $T_C = +75^0 C^{(2)}$	D	5.0		W
$@ T_C = +75^0 C^{(2)}$	$P_{T}$	10	00	W
Operating & Storage Temperature Range	T <sub>j</sub> , T <sub>stg</sub>	-65 to +200		°C

## THERMAL CHARACTERISTICS

Characteristics	Symbol	Max.	Unit
Thermal Resistance, Junction-to-Case	$R_{ heta JC}$	1.25	<sup>0</sup> C/W

<sup>1)</sup> Derate linearly 29 mW/ $^{\circ}$ C for T<sub>A</sub> > +25 $^{\circ}$ C



Outline

## **ELECTRICAL CHARACTERISTICS**

Characteristics		Symbol	Min.	Max.	Unit
OFF CHARACTERISTICS					
Collector-Emitter Cutoff Current					
$V_{CE} = 325 \text{ Vdc}$	2N3902	$I_{CEO}$		250	μAdc
$V_{CE} = 400 \text{ Vdc}$	2N5157			250	
Collector-Emitter Cutoff Current		т		500	۸ .1
$V_{BE} = 1.5 \text{ Vdc}; V_{CE} = 700 \text{ Vdc}$		$I_{CEX}$		500	μAdc
Emitter-Base Cutoff Current					
$V_{EB} = 5.0 \text{ Vdc}$	2N3902	$I_{\mathrm{EBO}}$		200	μAdc
$V_{EB} = 6.0 \text{ Vdc}$	2N5157			200	
ON CHARACTERISTICS <sup>(3)</sup>					
Base-Emitter Saturation Voltage					
$I_C = 1.0 \text{ Adc}; I_B = 0.1 \text{ Adc}$		$V_{\mathrm{BE}(\mathrm{sat})}$		1.5	Vdc
$I_C = 3.5 \text{ Adc}; I_B = 0.7 \text{ Adc}$				2.0	
Collector-Emitter Saturation Voltage					
$I_C = 1.0 \text{ Adc}; I_B = 0.1 \text{ Adc}$		$V_{CE(sat)}$		0.8	Vdc
$I_C = 3.5 \text{ Adc}; I_B = 0.7 \text{ Adc}$				2.5	
Lake Street, Lawrence, MA 01841					12010

1-800-446-1158 / (978) 794-1666 / Fax: (978) 689-0803

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<sup>2)</sup> Derate linearly 0.8 W/ $^{0}$ C for  $T_{C} > +75^{0}$ C

### 2N3902, 2N5157 JAN SERIES

#### ELECTRICAL CHARACTERISTICS (con't)

Characteris	tics	Symbol	Min.	Max.	Unit
ON CHARACTERISTICS(3) (con't					
Forward-Current Transfer Ratio					
$I_C = 0.5 \text{ Adc}; V_{CE} = 5.0 \text{ Vdc}$			25		
$I_{C} = 1.0 \text{ Adc}; V_{CE} = 5.0 \text{ Vdc}$ $I_{C} = 2.5 \text{ Adc}; V_{CE} = 5.0 \text{ Vdc}$		$h_{ m FE}$	30	90	
			10		
$I_C = 3.5 \text{ Adc}; V_{CE} = 5.0 \text{ Vdc}$			5		
Collector-Emitter Sustaining Voltage					
$I_C = 100 \text{ mAdc}$	2N3902	V <sub>CEO(sus)</sub>	325		Vdc
	2N5157		400		
DYNAMIC CHARACTERISTICS					
Small-Signal Short-Circuit Forward Cu	rrent Transfer Ratio	$ h_{\mathrm{fe}} $	2.5	25	
$I_C = 0.2 \text{ Adc}; V_{CE} = 10 \text{ Vdc}, f = 1 \text{ MI}$	·Iz	II <sub>fe</sub>			
Output Capacitance		$C_{obo}$		250	pF
$V_{CB} = 10 \text{ Vdc}; I_E = 0, 100 \text{ kHz} \le f \le$	1.0 MHz	Cobo			
SWITCHING CHARACTERISTI	CS				
Turn-On Time		ton		0.8	Пе
$V_{CC} = 125 \text{ Vdc}$ ; $I_C = 1.0 \text{ Adc}$ ; $I_{B1} = 0$ .	l Adc	OII		0.6	μs
Turn-Off Time		<sup>t</sup> off	1.7	1.7	μs
$V_{CC} = 125 \text{ Vdc}; I_C = 1.0 \text{ Adc}; I_{B1} = 0$	$.1 \text{ Adc}; -I_{B2} = 0.50 \text{ Adc}$	OH		1./	

#### SAFE OPERATING AREA

## DC Tests (continuous)

 $T_C = +25^{\circ}C$ ;  $t \ge 1.0$  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)**

 $T_C = 25^{\circ}C$ ; 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 Vdc;  $V_{CC}$  = 50 Vdc;  $I_{C}$  = 3.5 Adc; L = 60 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 mH;  $R = 8 \Omega$ ;  $R_L \le 83 \Omega$ .

## **Switching Tests**

#### **Load condition (clamped inductive load)**

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

## Test 1

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

 $V_{BB2}=1.5~Vdc;~V_{CC}=50~Vdc;~I_{C}=3.5~Adc;~L=60~mH;~R=3~\Omega;~R_{L}\geq0\Omega.$ 

(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 =  $300\mu$ s, Duty Cycle  $\leq 2.0\%$ .

### 6 Lake Street, Lawrence, MA 01841

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