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## NPN HIGH POWER SILICON TRANSISTOR

Devices

2N3902

2N5157

Ratings	Symbol	2N3902	2N5157	Unit	1
Collector-Emitter Voltage	V <sub>CEO</sub>	400	500	Vdc	
Emitter-Base Voltage	VEBO	5.0	6.0	Vdc	
Collector-Base Voltage	V <sub>CBO</sub>	70	00	Vdc	
Base Current	IB	2	.0	Adc	
Collector Current	I <sub>C</sub>	3	.5	Adc	
Total Power Dissipation $(a) T_A = +25^{\circ}C^{(1)}$ $(b) T_C = +75^{\circ}C^{(2)}$	P <sub>T</sub>	-	.0 00	W W	
Operating & Storage Temperature Range	T <sub>j,</sub> T <sub>stg</sub>	-65 to	+200	°C	•
THERMAL CHARACTERISTICS					
Characteristics	Symbol	M	ax.	Unit	TO-3 (TO-204AA)*
Thermal Resistance, Junction-to-Case	R <sub>0JC</sub>	1.	25	<sup>0</sup> C/W	
) Derate linearly 29 mW/ $^{0}$ C for T <sub>A</sub> > +25 $^{0}$ C ) Derate linearly 0.8 W/ $^{0}$ C for T <sub>C</sub> > +75 $^{0}$ C	<u></u>				*See Appendix A for Package

## Outline

## ELECTRICAL CHARACTERISTICS

Characteristics		Symbol	Min	Max.	Unit
OFF CHARACTERISTICS					
Collector-Emitter Cutoff Current					
$V_{CE} = 325 \text{ Vdc}$	2N3902	I <sub>CEO</sub>		250	μAdc
$V_{CE} = 400 \text{ Vdc}$	2N5157			250	
Collector-Emitter Cutoff Current		I <sub>CEN</sub>		500	μAde
$V_{BE} = 1.5$ Vdc; $V_{CE} = 700$ Vdc					
Emitter-Base Cutoff Current					
$V_{EB} = 5.0 \text{ Vdc}$	2N3902	I <sub>EBO</sub>		200	μAdc
$V_{EB} = 6.0 \text{ Vdc}$	2N5157			200	
ON CHARACTERISTICS <sup>(3)</sup>					
Base-Emitter Saturation Voltage					
$I_{\rm C} = 1.0$ Adc; $I_{\rm B} = 0.1$ Adc		V <sub>BE(sat)</sub>		1.5	Vdc
$I_{\rm C} = 3.5  {\rm Adc};  I_{\rm B} = 0.7  {\rm Adc}$				2.0	
Collector-Emitter Saturation Voltage					
$I_{\rm C}$ = 1.0 Adc; $I_{\rm B}$ = 0.1 Adc		V <sub>CE(sat)</sub>		0.8	Vdc
$I_{\rm C} = 3.5 {\rm Adc};  I_{\rm B} = 0.7 {\rm Adc}$				2.5	L

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NJ Semi-Conductors reserves the right to change test conditions, parameter limits and package dimensions without notice. Information turnished by NJ Semi-Conductors is believed to be both accurate and reliable at the time of going to press. However NJ Semi-Conductors assumes no responsibility for any errors or omissions discovered in its use. NJ Semi-Conductors encourages customers to verify that datasheets are current before placing orders.

## ELECTRICAL CHARACTERISTICS (con't)

ELECTRICAL CHARACTERISTICS (con t) Characteristics	Symbol	Min.	Max.	Unit
ON CHARACTERISTICS <sup>(3)</sup> (con't)	<u></u>			
Forward-Current Transfer Ratio				
$I_C = 0.5$ Adc; $V_{CE} = 5.0$ Vdc		25		
$I_{\rm C} = 1.0 \text{Adc}, V_{\rm CE} = 5.0 \text{Vdc}$	h <sub>FE</sub>	30	90	
$I_{\rm C} = 2.5 {\rm Adc}, V_{\rm CE} = 5.0 {\rm Vdc}$	<i>FE</i> ,	10		
		5		
$I_C = 3.5 \text{ Adc}; V_{CE} = 5.0 \text{ Vdc}$				
Collector-Emitter Sustaining Voltage Lo = 100 mAdc 2N39	02 V <sub>CEO(sus)</sub>	325		Vde
$I_{\rm C} = 100 \text{ mAdc} \qquad 2N39$ $2N51$		400		
DYNAMIC CHARACTERISTICS Small-Signal Short-Circuit Forward Current Transfer I	Ratio			
-	h <sub>fe</sub>	2.5	25	
$I_{C} = 0.2 \text{ Adc}; V_{CE} = 10 \text{ Vdc}, f = 1 \text{ MHz}$			1	·
Output Capacitance $100 \text{ kHz} \leq 6 \leq 10 \text{ MHz}$	C <sub>obo</sub>		250	pF
$V_{CB} = 10 \text{ Vdc}; I_E = 0, 100 \text{ kHz} \le f \le 1.0 \text{ MHz}$			<u> </u>	
SWITCHING CHARACTERISTICS			1	
Tum-On Time	ton		0.8	μs
$V_{CC} = 125$ Vdc; $I_C = 1.0$ Adc; $I_{B1} = 0.1$ Adc		<u> </u>	+	
Tum-Off Time	o so a de		1.7	μs
$V_{CC}$ = 125 Vdc; $I_C$ = 1.0 Adc; $I_{B1}$ = 0.1 Adc; $-I_{B2}$ =	0.50 Adc		<u> </u>	
SAFE OPERATING AREA	· · · · · · · · · · · · · · · · · · ·			
DC Tests (continuous)				
$T_C = +25^{\circ}C$ ; t $\geq 1.0$ s (See Figure 3 of MIL-PRF-195	500/371)			
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				
$V_{CE} = 325 \text{ Vdc}, I_C = 55 \text{ mAdc}$ 2N39	902			
$V_{CE} = 400 \text{ Vdc}, I_C = 35 \text{ mAdc}$ 2N51	157			
Switching Tests				
Load condition C (unclamped inductive load)				
$T_{\rm C}$ = 25°C; duty cycle $\leq$ 10%; $R_{\rm S}$ = 0.1 $\Omega$ (See Figu	re 4 of MIL-PRF-19500/371)			
Test 1		_		
$t_P$ = approximately 3 ms (vary to obtain I <sub>C</sub> ); $R_{BB1}$ = 2	$0 \Omega; V_{BB1} = 10 Vdc; R_{BB2} = 3 k\Omega$	2;		
$V_{BB2} = 1.5$ Vdc; $V_{CC} = 50$ Vdo; $I_C = 3.5$ Adc; $L = 60$ Test 2	) mH; R = 3 $\Omega$ ; R <sub>L</sub> $\leq 14\Omega$ .			
		0.		
$t_P$ = approximately 3 ms (vary to obtain I <sub>C</sub> ); $R_{BB1}$ = 10	$00 \ \Omega; \ V_{BB1} = 10 \ Vdc; \ R_{BB2} = 3 \ k$	12,		
		22,		
$V_{BB2} = 1.5$ Vdc; $I_C = 0.6$ Adc $V_{CC} = 50$ Vdc; $L = 200$		<u>.</u>		
		22,		
$V_{BB2} = 1.5$ Vdc; $I_C = 0.6$ Adc $V_{CC} = 50$ Vdc; $L = 200$ Switching Tests Load condition (clamped inductive load)		22,		
$V_{BB2} = 1.5$ Vdc; $I_C = 0.6$ Adc $V_{CC} = 50$ Vdc; $L = 200$ Switching Tests Load condition (clamped inductive load) $T_C = +25^{\circ}C$ ; duty cycle $\le 10^{\circ}$ . (See Figure 5 of M Test 1	) mH; R = 8 $\Omega$ ; R <sub>L</sub> $\leq$ 83 $\Omega$ . IIL-PRF-19500/371)			
$V_{BB2} = 1.5 \text{ Vdc}; I_C = 0.6 \text{ Adc } V_{CC} = 50 \text{ Vdc}; L = 200$ Switching Tests Load condition (clamped inductive load) $T_C = +25^{\circ}C;$ duty cycle $\leq 10\%$ . (See Figure 5 of M	) mH; R = 8 $\Omega$ ; R <sub>L</sub> $\leq$ 83 $\Omega$ . IIL-PRF-19500/371)		Ω;	
$\begin{split} V_{BB2} &= 1.5 \text{ Vdc};  I_C = 0.6 \text{ Adc } V_{CC} = 50 \text{ Vdc};  L = 200 \\ \textbf{Switching Tests} \\ \textbf{Load condition (clamped inductive load)} \\ T_C &= +25^0\text{C}; \text{ duty cycle} \leq 10\%.  (\text{See Figure 5 of M}) \\ \textbf{Test 1} \\ t_p &= \text{approximately 30 ms (vary to obtain } I_C);  R_S = 0. \end{split}$	) mH; R = 8 Ω; R <sub>L</sub> ≤ 83Ω. IIL-PRF-19500/371) 1 Ω; R <sub>BB1</sub> = 20 Ω; V <sub>BB1</sub> = 10 Vda		Ω;	
$\begin{split} &V_{BB2} = 1.5 \text{ Vdc};  I_C = 0.6 \text{ Adc } V_{CC} = 50 \text{ Vdc};  L = 200 \\ &\textbf{Switching Tests} \\ &\textbf{Load condition (clamped inductive load)} \\ &T_C = +25^{\circ}\text{C}; \text{ duty cycle} \leq 10\%.  (\text{See Figure 5 of M}) \\ &\textbf{Test 1} \\ &t_P = \text{approximately 30 ms (vary to obtain } I_C);  R_S = 0. \\ &V_{BB2} = 1.5 \text{ Vdc}; V_{CC} = 50 \text{ Vdc};  I_C = 3.5 \text{ Adc};  L = 600 \\ &\textbf{V}_{BB2} = 1.5 \text{ Vdc};  V_{CC} = 50 \text{ Vdc};  I_C = 3.5 \text{ Adc};  L = 600 \\ &\textbf{V}_{BB2} = 1.5 \text{ Vdc};  V_{CC} = 50 \text{ Vdc};  I_C = 3.5 \text{ Adc};  L = 600 \\ &\textbf{V}_{BB2} = 1.5 \text{ Vdc};  V_{CC} = 50 \text{ Vdc};  I_C = 3.5     I_C = 3.5    I_C = 3.5    I_C = 3.5    I_C = 3.5   I_C = 3.5   I_C = 3.5   I_C = 3.5   I_C = 3.5   I_C = 3.5   I_C = 3.5   I_C = 3.5   I_C = 3.5   I_C = 3.5   I_C = 3.5  $	) mH; R = 8 Ω; R <sub>L</sub> ≤ 83Ω. IIL-PRF-19500/371) 1 Ω; R <sub>BB1</sub> = 20 Ω; V <sub>BB1</sub> = 10 Vda		Ω;	
$V_{BB2} = 1.5 \text{ Vdc}; I_C = 0.6 \text{ Adc } V_{CC} = 50 \text{ Vdc}; L = 200$ Switching Tests Load condition (clamped inductive load) $T_C = +25^{\circ}C$ ; duty cycle $\leq 10\%$ . (See Figure 5 of M Test 1 $t_P = approximately 30 \text{ ms}$ (vary to obtain $I_C$ ); $R_s = 0$ . $V_{BB2} = 1.5 \text{ Vdc}; V_{CC} = 50 \text{ Vdc}; I_C = 3.5 \text{ Adc}; L = 600$ (A suitable clamping circuit or diode can be used.)	$0 \text{ mH}; \text{R} = 8 \Omega; \text{R}_{L} \le 83\Omega.$ 11L-PRF-19500/371) $1 \Omega; \text{R}_{BB1} = 20 \Omega; \text{V}_{BB1} = 10 \text{ Vd}_{0}$ $0 \text{ mH}; \text{R} = 3 \Omega; \text{R}_{L} \ge 0\Omega.$		Ω;	
$\begin{split} & V_{BB2} = 1.5 \text{ Vdc; } I_C = 0.6 \text{ Adc } V_{CC} = 50 \text{ Vdc; } L = 200 \\ & \text{Switching Tests} \\ & \text{Load condition (clamped inductive load)} \\ & T_C = +25^{\circ}\text{C; duty cycle} \leq 10\%.  (\text{See Figure 5 of M}) \\ & \text{Test 1} \\ & t_P = \text{approximately 30 ms (vary to obtain } I_C); R_S = 0. \\ & V_{BB2} = 1.5 \text{ Vdc; } V_{CC} = 50 \text{ Vdc; } I_C = 3.5 \text{ Adc; } L = 600 \\ & (\text{A suitable clamping circuit or diode can be used.}) \end{split}$	$0 \text{ mH}; \text{R} = 8 \Omega; \text{R}_{L} ≤ 83\Omega.$ IIL-PRF-19500/371) 1 Ω; R <sub>BB1</sub> = 20 Ω; V <sub>BB1</sub> = 10 Vda 0 mH; R = 3 Ω; R <sub>L</sub> ≥ 0Ω. 202		Ω;	

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