

## RADIATION HARDENED NPN SILICON SWITCHING TRANSISTOR

*Qualified per MIL-PRF-19500/366*

### DEVICES

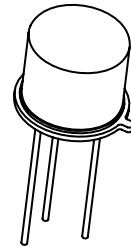
<b>2N3498</b>	<b>2N3499</b>	<b>2N3500</b>	<b>2N3501</b>
<b>2N3498L</b>	<b>2N3499L</b>	<b>2N3500L</b>	<b>2N3501L</b> <b>2N3501UB</b>

### LEVELS

<b>JANSM – 3K Rads (Si)</b>
<b>JANSD – 10K Rads (Si)</b>
<b>JANSP – 30K Rads (Si)</b>
<b>JANSL – 50K Rads (Si)</b>
<b>JANSR – 100K Rads (Si)</b>

### ABSOLUTE MAXIMUM RATINGS ( $T_C = +25^\circ\text{C}$ unless otherwise noted)

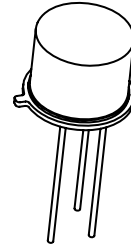
Parameters / Test Conditions	Symbol	2N3498*	2N3501*	Unit
		2N3499*	2N3501*	
Collector-Emitter Voltage	$V_{CEO}$	100	150	Vdc
Collector-Base Voltage	$V_{CBO}$	100	150	Vdc
Emitter-Base Voltage	$V_{EBO}$	6.0	6.0	Vdc
Collector Current	$I_C$	500	300	mAdc
Total Power Dissipation @ $T_A = +25^\circ\text{C}$ @ $T_C = +25^\circ\text{C}$	$P_T$	1.0		W
		5.0		W
Operating & Storage Junction Temperature Range	$T_J, T_{stg}$	-65 to +200		$^\circ\text{C}$



**TO-5\***  
 2N3498L, 2N3499L  
 2N2500L, 2N3501L

### THERMAL CHARACTERISTICS

Parameters / Test Conditions	Symbol	Max.	Unit
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	30	$^\circ\text{C}/\text{W}$
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	175	$^\circ\text{C}/\text{W}$



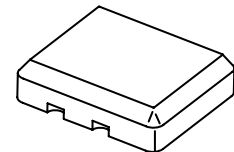
**TO-39\* (TO-205AD)**  
 2N3498, 2N3499  
 2N3500, 2N3501

\* Electrical characteristics for “L” suffix devices are identical to the “non L” corresponding devices.

- Derate linearly 5.71 W/ $^\circ\text{C}$  for  $T_A > 25^\circ\text{C}$
- Derate linearly 28.6 W/ $^\circ\text{C}$  for  $T_C > 25^\circ\text{C}$

### ELECTRICAL CHARACTERISTICS ( $T_A = +25^\circ\text{C}$ , unless otherwise noted)

Parameters / Test Conditions	Symbol	Min.	Max.	Unit
<b>OFF CHARACTERISTICS</b>				
Collector-Emitter Breakdown Voltage $I_C = 10\text{mAdc}$	$V_{(BR)CEO}$	100		Vdc
2N3498, 2N3499 2N3500, 2N3501		150		
Collector-Base Cutoff Current $V_{CB} = 50\text{Vdc}$	$I_{CBO}$		50	$\eta\text{Adc}$
$V_{CB} = 75\text{Vdc}$			50	$\eta\text{Adc}$
$V_{CB} = 100\text{Vdc}$			10	$\mu\text{Adc}$
$V_{CB} = 150\text{Vdc}$			10	$\mu\text{Adc}$



**3 PIN**  
 2N3501UB

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**ELECTRICAL CHARACTERISTICS ( $T_A = +25^\circ\text{C}$ , unless otherwise noted)**

Parameters / Test Conditions	Symbol	Min.	Max.	Unit
<b>OFF CHARACTERISTICS</b>				
Emitter-Base Cutoff Current $V_{EB} = 4.0\text{Vdc}$ $V_{EB} = 6.0\text{Vdc}$	$I_{EBO}$		25 10	$\eta\text{Adc}$ $\mu\text{Adc}$
<b>ON CHARACTERISTICS <sup>(3)</sup></b>				
Forward-Current Transfer Ratio $I_C = 0.1\text{mAdc}$ , $V_{CE} = 10\text{Vdc}$		2N3498, 2N3500 2N3499, 2N3501	20 35	
$I_C = 1.0\text{mAdc}$ , $V_{CE} = 10\text{Vdc}$		2N3498, 2N3500 2N3499, 2N3501	25 50	
$I_C = 10\text{mAdc}$ , $V_{CE} = 10\text{Vdc}$		2N3498, 2N3500 2N3499, 2N3501	35 75	
$I_C = 150\text{mAdc}$ , $V_{CE} = 10\text{Vdc}$		2N3498, 2N3500 2N3499, 2N3501	40 100	120 300
$I_C = 300\text{mAdc}$ , $V_{CE} = 10\text{Vdc}$		2N3500 2N3501	15 20	
$I_C = 500\text{mAdc}$ , $V_{CE} = 10\text{Vdc}$		2N3498 2N3499	15 20	
Collector-Emitter Saturation Voltage $I_C = 10\text{mAdc}$ , $I_B = 1.0\text{mAdc}$ $I_C = 300\text{mAdc}$ , $I_B = 30\text{mAdc}$ $I_C = 150\text{mAdc}$ , $I_B = 15\text{mAdc}$		All Types 2N3498, 2N3499 2N3500, 2N3501	$V_{CE(sat)}$	0.2 0.6 0.4 Vdc
Base-Emitter Saturation Voltage $I_C = 10\text{mAdc}$ , $I_B = 1.0\text{mAdc}$ $I_C = 300\text{mAdc}$ , $I_B = 30\text{mAdc}$ $I_C = 150\text{mAdc}$ , $I_B = 15\text{mAdc}$		All Types 2N3498, 2N3499 2N3500, 2N3501	$V_{BE(sat)}$	0.8 1.4 1.2 Vdc

**DYNAMIC CHARACTERISTICS**

Parameters / Test Conditions	Symbol	Min.	Max.	Unit
Magnitude, Forward Current Transfer Ratio $I_C = 20\text{mAdc}$ , $V_{CE} = 20\text{Vdc}$ , $f = 100\text{MHz}$	$ h_{fe} $	1.5	8.0	
Output Capacitance $V_{CB} = 10\text{Vdc}$ , $I_E = 0$ , $100\text{kHz} \leq f \leq 1.0\text{MHz}$	$C_{obo}$	2N3498, 2N3499 2N3500, 2N3501	10 8.0	pF
Input Capacitance $V_{EB} = 0.5\text{Vdc}$ , $I_C = 0$ , $100\text{kHz} \leq f \leq 1.0\text{MHz}$	$C_{ibo}$		80	pF

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**SWITCHING CHARACTERISTICS**

Parameters / Test Conditions	Symbol	Min.	Max.	Unit
Turn-On Time $V_{EB} = 5V_{dc}; I_C = 150mA_{dc}; I_{B1} = 15mA_{dc}$	$t_{on}$		115	$\eta s$
Turn-Off Time $I_C = 150mA_{dc}; I_{B1} = I_{B2} = 15mA_{dc}$	$t_{off}$		1150	$\eta s$

**SAFE OPERATING AREA**

DC Tests		
$T_C = +25^\circ C, t_r \geq 10\eta s; 1 \text{ Cycle}, t = 1.0s$		
<b>Test 1</b>		
$V_{CE} = 10V_{dc}, I_C = 500mA_{dc}$		2N3498, 2N3499
$V_{CE} = 16.67V_{dc}, I_C = 300mA_{dc}$		2N3500, 2N3501
$V_{CE} = 10V_{dc}, I_C = 113mA_{dc}$		2N3501UB
<b>Test 2</b>		
$V_{CE} = 50V_{dc}, I_C = 100mA_{dc}$		All Types
$V_{CE} = 50V_{dc}, I_C = 23mA_{dc}$		2N3501UB
<b>Test 3</b>		
$V_{CE} = 80V_{dc}, I_C = 40mA_{dc}$		All Types
$V_{CE} = 80V_{dc}, I_C = 14mA_{dc}$		2N3501UB
<b>Clamped Switching</b>		
$T_A = +25^\circ C$		
<b>Test 1</b>		
$I_B = 85mA_{dc}, I_C = 500mA_{dc}$		2N3498, 2N3499
$I_B = 50mA_{dc}, I_C = 300mA_{dc}$		2N3500, 2N3501

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