

## NTE2333 Silicon NPN Power Transistor for Switching Power Applications

**Description:**

The NTE2333 is a silicon NPN Power Transistor in a TO220 package designed for use in 220V line-operated Switchmode Power supplies and electronic light ballasts.

**Features:**

- Improved Efficiency Due to Low Base Drive Requirements:
  - High and Flat DC Current Gain  $h_{FE}$
  - Fast Switching
  - No Coil Required in Base Circuit for Turn-Off (No Current Tail)

**Absolute Maximum Ratings:**

Collector-Emitter Sustaining Voltage, $V_{CEO}$ .....	450V
Collector-Emitter Breakdown Voltage, $V_{CES}$ .....	1000V
Emitter-Base Voltage, $V_{EBO}$ .....	9V
Collector Current, $I_C$	
Continuous .....	6A
Peak (Note 1) .....	15A
Base Current, $I_B$	
Continuous .....	4A
Peak (Note 1) .....	8A
Total Power Dissipation ( $T_C = +25^\circ C$ ), $P_D$ .....	100W
Derate above $25^\circ C$ .....	0.8W/ $^\circ C$
Junction Temperature, $T_J$ .....	+150 $^\circ C$
Storage Temperature Range, $T_{stg}$ .....	-65 $^\circ$ to +150 $^\circ C$
Maximum Thermal Resistance, Junction-to-Case, $R_{thJC}$ .....	1.25 $^\circ C/W$
Maximum Thermal Resistance, Junction-to-Ambient, $R_{thJA}$ .....	62.5 $^\circ C/W$
Maximum Lead Temperature (During Soldering, 1/8" from Case for 5sec), $T_L$ .....	+260 $^\circ C$

Note 1. Pulse Test: Pulse Width = 5ms, Duty Cycle  $\leq$  10%.  
 Note 2. Proper strike and creepage distance must be provided.

**Electrical Characteristics:** ( $T_C = +25^\circ\text{C}$ , unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit		
<b>OFF Characteristics</b>								
Collector–Emitter Sustaining Voltage	$V_{CEO(sus)}$	$I_C = 100\text{mA}$ , $L = 25\text{mH}$	450	–	–	V		
Collector Cutoff Current	$I_{CEO}$	$V_{CE} = 450\text{V}$ , $I_B = 0$	–	–	100	$\mu\text{A}$		
		$V_{CE} = 1000\text{V}$ , $V_{EB} = 0$	–	–	100	$\mu\text{A}$		
	$I_{CES}$	$V_{CE} = 1000\text{V}$ , $V_{EB} = 0$ , $T_C = +125^\circ\text{C}$	–	–	500	$\mu\text{A}$		
		$V_{CE} = 800\text{V}$ , $V_{EB} = 0$ , $T_C = +125^\circ\text{C}$	–	–	100	$\mu\text{A}$		
Emitter Cutoff Current	$I_{EBO}$	$V_{EB} = 9\text{V}$ , $I_C = 0$	–	–	100	$\mu\text{A}$		
<b>ON Characteristics</b>								
Base–Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C = 1.3\text{A}$ , $I_B = 0.13\text{A}$	–	0.83	1.2	V		
		$I_C = 3\text{A}$ , $I_B = 0.6\text{A}$	–	0.94	1.3	V		
Collector–Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C = 1.3\text{A}$ , $I_B = 0.13\text{A}$		–	0.25	0.6	V	
			$T_C = +125^\circ\text{C}$	–	0.27	0.65	V	
		$I_C = 3\text{A}$ , $I_B = 0.6\text{A}$		–	0.35	0.7	V	
			$T_C = +125^\circ\text{C}$	–	0.4	0.8	V	
DC Current Gain	$h_{FE}$	$I_C = 0.5\text{A}$ , $V_{CE} = 5\text{V}$		14	–	34		
			$T_C = +125^\circ\text{C}$	–	32	–		
		$I_C = 3\text{A}$ , $V_{CE} = 1\text{V}$		6	10	–	V	
			$T_C = +125^\circ\text{C}$	5	8	–		
			$T_C = +25^\circ\text{C}$ to $+125^\circ\text{C}$	11	17	–		
$I_C = 10\text{mA}$ , $V_{CE} = 5\text{V}$	$T_C = +25^\circ\text{C}$ to $+125^\circ\text{C}$	10	22	–				
<b>Dynamic Characteristics</b>								
Current Gain Bandwidth Product	$f_T$	$I_C = 0.5\text{A}$ , $V_{CE} = 10\text{V}$ , $f = 1\text{MHz}$	–	14	–	MHz		
Output Capacitance	$C_{ob}$	$V_{CB} = 10\text{V}$ , $I_B = 0$ , $f = 1\text{MHz}$	–	75	120	pF		
Input Capacitance	$C_{ib}$	$V_{EB} = 8\text{V}$	–	1000	1500	pF		
Dynamic Saturation Voltage: Determined $1\mu\text{s}$ and $3\mu\text{s}$ respectively after rising $I_{B1}$ reaches 90% of final $I_{B1}$	$V_{CE(dsat)}$	$I_C = 1.3\text{A}$ , $I_{B1} = 130\text{mA}$ , $V_{CC} = 300\text{V}$	$1\mu\text{s}$		–	5.5	–	V
				$T_C = +125^\circ\text{C}$	–	12.0	–	V
			$3\mu\text{s}$		–	3.0	–	V
				$T_C = +125^\circ\text{C}$	–	7.0	–	V
		$I_C = 3.0\text{A}$ , $I_{B1} = 600\text{mA}$ , $V_{CC} = 300\text{V}$	$1\mu\text{s}$		–	9.5	–	V
				$T_C = +125^\circ\text{C}$	–	14.5	–	V
$3\mu\text{s}$		–	2.0	–	V			
	$T_C = +125^\circ\text{C}$	–	7.5	–	V			
<b>Switching Characteristics: Resistive Load</b> ( $DC \leq 10\%$ , Pulse Width = $20\mu\text{s}$ )								
Turn–On Time	$t_{on}$	$I_C = 3\text{A}$ , $I_{B1} = 600\text{mA}$ , $I_{B2} = 1.5\text{A}$ , $V_{CC} = 300\text{V}$		–	90	180	ns	
			$T_C = +125^\circ\text{C}$	–	100	–	ns	
Turn–Off Time	$t_{off}$			–	1.7	2.5	$\mu\text{s}$	
			$T_C = +125^\circ\text{C}$	–	2.1	–	$\mu\text{s}$	
Turn–On Time	$t_{on}$	$I_C = 1.3\text{A}$ , $I_{B1} = 130\text{mA}$ , $I_{B2} = 650\text{mA}$ , $V_{CC} = 300\text{V}$		–	200	300	ns	
			$T_C = +125^\circ\text{C}$	–	130	–	ns	
Turn–Off Time	$t_{off}$			–	1.2	2.5	$\mu\text{s}$	
			$T_C = +125^\circ\text{C}$	–	1.5	–	$\mu\text{s}$	

**Electrical Characteristics (Cont'd):** ( $T_C = +25^\circ\text{C}$ , unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit	
<b>Switching Characteristics: Inductive Load</b> ( $V_{\text{clamp}} = 300\text{V}$ , $V_{\text{CC}} = 15\text{V}$ , $I = 200\mu\text{H}$ )							
Fall Time	$t_{\text{fi}}$	$I_C = 1.5\text{A}$ , $I_{\text{B1}} = 130\text{mA}$ , $I_{\text{B2}} = 650\text{mA}$		100	180	ns	
			$T_C = +125^\circ\text{C}$	-	120	-	ns
Storage Time	$t_{\text{si}}$			-	1.5	2.5	$\mu\text{s}$
			$T_C = +125^\circ\text{C}$	-	1.9	-	$\mu\text{s}$
Crossover Time	$t_c$		-	220	350	ns	
		$T_C = +125^\circ\text{C}$	-	230	-	ns	
Fall Time	$t_{\text{fi}}$	$I_C = 3\text{A}$ , $I_{\text{B1}} = 600\text{mA}$ , $I_{\text{B2}} = 1.5\text{A}$		85	150	ns	
			$T_C = +125^\circ\text{C}$	-	120	-	ns
Storage Time	$t_{\text{si}}$			-	2.15	3.2	$\mu\text{s}$
			$T_C = +125^\circ\text{C}$	-	2.75	-	$\mu\text{s}$
Crossover Time	$t_c$		-	200	300	ns	
		$T_C = +125^\circ\text{C}$	-	310	-	ns	

