

## NTE98 Silicon NPN Transistor HV Darlington Power Amp, Switch

### **Description:**

The NTE98 is a silicon NPN Darlington transistor in a TO3 type package designed for high voltage, high-speed, power switching in inductive circuits where fall-time is critical. They are particularly suited for line operated switch-mode applications.

### **Applications:**

- Switching Regulators
- Inverters
- Solenoid and Relay Drivers

### **Absolute Maximum Ratings:**

Collector–Emitter Voltage, $V_{CEO(sus)}$ .....	500V
Collector–Emitter Voltage, $V_{CEX(sus)}$ .....	500V
Collector–Emitter Voltage, $V_{CEV}$ .....	700V
Emitter–Base Voltage, $V_{EB}$ .....	8V
Collector Current, $I_C$	
Continuous .....	20A
Peak (Note 1) .....	30A
Base Current, $I_B$	
Continuous .....	2.5A
Peak (Note 1) .....	5.0A
Total Power Dissipation ( $T_C = +25^\circ\text{C}$ ), $P_D$ .....	175W
Derate Above $+25^\circ\text{C}$ .....	1.0W/ $^\circ\text{C}$
Total Power Dissipation ( $T_C = +100^\circ\text{C}$ ), $P_D$ .....	100W
Operating Junction Temperature Range, $T_J$ .....	$-65^\circ$ to $+200^\circ\text{C}$
Storage Temperature Range, $T_{stg}$ .....	$-65^\circ$ to $+200^\circ\text{C}$
Thermal Resistance, Junction–to–Case, $R_{thJC}$ .....	1.0 $^\circ\text{C}/\text{W}$
Lead Temperature (During Soldering, 1/8" from case, 5sec), $T_L$ .....	$+275^\circ\text{C}$

Note 1. Pulse test: Pulse Width = 5ms, Duty Cycle  $\leq$  10%.

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
<b>OFF Characteristics (Note 2)</b>						
Collector–Emitter Sustaining Voltage	$V_{\text{CEO(sus)}}$	$I_C = 100\text{mA}, I_B = 0, V_{\text{clamp}} = 500\text{V}$	500	–	–	V
	$V_{\text{CEX(sus)}}$	$I_C = 2\text{A}, V_{\text{clamp}} = 500\text{V}, T_C = +100^\circ\text{C}$	500	–	–	V
		$I_C = 5\text{A}, V_{\text{clamp}} = 500\text{V}, T_C = +100^\circ\text{C}$	375	–	–	V
Collector Cutoff Current	$I_{\text{CEV}}$	$V_{\text{CEV}} = 700\text{V}, V_{\text{BE(off)}} = 1.5\text{V}$	–	–	0.25	mA
		$V_{\text{CEV}} = 700\text{V}, V_{\text{BE(off)}} = 1.5\text{V}, T_C = +150^\circ\text{C}$	–	–	5.0	mA
	$I_{\text{CER}}$	$V_{\text{CE}} = 700\text{V}, R_{\text{BE}} = 50\Omega, T_C = +100^\circ\text{C}$	–	–	5.0	mA
Emitter Cutoff Current	$I_{\text{EBO}}$	$V_{\text{EB}} = 2\text{V}, I_C = 0$	–	–	175	mA
<b>ON Characteristics (Note 3)</b>						
DC Current Gain	$h_{\text{FE}}$	$V_{\text{CE}} = 5\text{V}, I_C = 5\text{A}$	40	–	400	
		$V_{\text{CE}} = 5\text{V}, I_C = 10\text{A}$	30	–	300	
Collector–Emitter Saturation Voltage	$V_{\text{CE(sat)}}$	$I_C = 10\text{A}, I_B = 500\text{mA}$	–	–	2.0	V
		$I_C = 10\text{A}, I_B = 500\text{mA}, T_C = +100^\circ\text{C}$	–	–	2.5	V
		$I_C = 20\text{A}, I_B = 2\text{A}$	–	–	3.5	V
Base–Emitter Saturation Voltage	$V_{\text{BE(sat)}}$	$I_C = 10\text{A}, I_B = 500\text{mA}$	–	–	2.5	V
		$I_C = 10\text{A}, I_B = 500\text{mA}, T_C = +100^\circ\text{C}$	–	–	2.5	V
Diode Forward Voltage	$V_{\text{F}}$	$I_{\text{F}} = 5\text{A}, \text{Note 3}$	–	3	5	V
<b>Dynamic Characteristics</b>						
Small–Signal Current Gain	$h_{\text{fe}}$	$V_{\text{CE}} = 10\text{V}, I_C = 1\text{A}, f_{\text{test}} = 1\text{MHz}$	8	–	–	
Output Capacitance	$C_{\text{ob}}$	$V_{\text{CB}} = 50\text{V}, I_{\text{E}} = 0, f_{\text{test}} = 100\text{kHz}$	100	–	325	pF
<b>Switching Characteristics (Resistive Load)</b>						
Delay Time	$t_{\text{d}}$	$V_{\text{CC}} = 250\text{V}, I_C = 10\text{A}, I_{\text{B1}} = 500\text{mA}, V_{\text{BE(off)}} = 5\text{V}, t_{\text{p}} = 50\mu\text{s}, \text{Duty Cycle} \leq 2\%$	–	0.12	0.25	$\mu\text{s}$
Rise Time	$t_{\text{r}}$		–	0.5	1.5	$\mu\text{s}$
Storage Time	$t_{\text{s}}$		–	0.8	2.0	$\mu\text{s}$
Fall Time	$t_{\text{f}}$		–	0.2	0.6	$\mu\text{s}$
<b>Switching Characteristics (Inductive Load, Clamped)</b>						
Storage Time	$t_{\text{sv}}$	$I_C = 10\text{A Peak}, V_{\text{clamp}} = 250\text{V}, I_{\text{B1}} = 500\text{mA}, V_{\text{BE(off)}} = 5\text{V}, T_C = +100^\circ\text{C}$	–	1.5	3.5	$\mu\text{s}$
Crossover Time	$t_{\text{c}}$		–	0.36	1.6	$\mu\text{s}$
Storage Time	$t_{\text{sv}}$	$I_C = 10\text{A Peak}, V_{\text{clamp}} = 250\text{V}, I_{\text{B1}} = 500\text{mA}, V_{\text{BE(off)}} = 5\text{V}, T_C = +25^\circ\text{C}$	–	0.8	–	$\mu\text{s}$
Crossover Time	$t_{\text{c}}$		–	0.18	–	$\mu\text{s}$

Note 2. Pulse test: Pulse Width =  $300\mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

Note 3. The internal Collector–Emitter diode can eliminate the need for an external diode to clamp inductive loads. Tests have shown that the Forward Recovery Voltage ( $V_{\text{F}}$ ) of this diode is comparable to that of typical fast recovery rectifiers.

