

2N2291, 2N2292 (GERMANIUM) 2N2293

PNP GERMANIUM POWER SWITCHING TRANSISTORS

... designed for fast switching applications requiring low saturation voltage and excellent collector-emitter sustaining voltage capability.

- Alloy-Diffused Epitaxial Construction
- Low Saturation Voltages –
 $V_{CE(sat)} = 0.5 \text{ Vdc @ } I_C = 5.0 \text{ Adc}$
 $V_{BE(sat)} = 1.0 \text{ Vdc @ } I_C = 5.0 \text{ Adc}$

MAXIMUM RATINGS

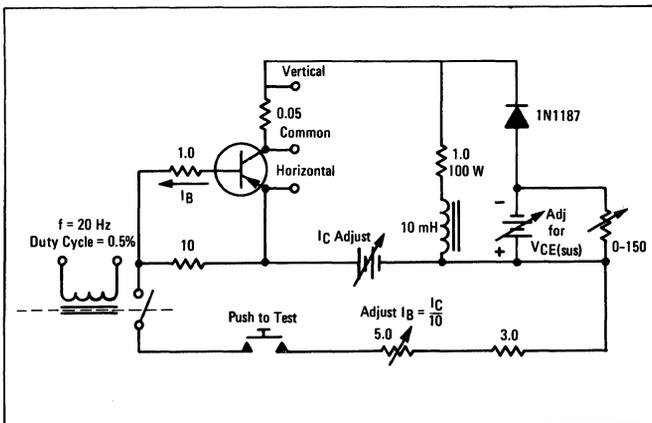
Rating	Symbol	2N2291	2N2292	2N2293	Unit
*Collector-Emitter Voltage	V_{CEO}	30	50	70	Vdc
*Collector-Base Voltage	V_{CB}	40	80	120	Vdc
*Emitter-Base Voltage	V_{EB}	← 1.5 →			Vdc
*Collector Current - Continuous	I_C	← 10 →			A dc
*Base Current - Continuous	I_B	← 3.0 →			A dc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C	P_D	← 70 →			Watts
		← 0.83 →			$\text{W}/^\circ\text{C}$
*Operating and Storage Junction Temperature Range	T_J, T_{stg}	← -65 to +110 →			$^\circ\text{C}$

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	θ_{JC}	1.2	$^\circ\text{C}/\text{W}$

*Indicates JEDEC Registered Data.

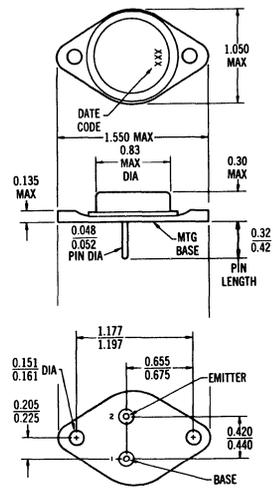
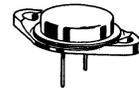
FIGURE 1 – SUSTAINING VOLTAGE TEST CIRCUIT



10 AMPERE

PNP ADE GERMANIUM POWER TRANSISTORS

40-120 VOLTS
70 WATTS



Collector Connected to Case

CASE 11A
(TO-3)

Except Pin Diameter

2N2291 thru 2N2293 (continued)

ELECTRICAL CHARACTERISTICS ($T_C = 25^\circ\text{C}$ unless otherwise noted)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage ($I_C = 100\text{ mA}$, $I_B = 0$)	2N2291 2N2292 2N2293	BV_{CEO}	30 50 70	- - -	Vdc
*Collector-Emitter Sustaining Voltage (See Figure 1) *($I_C = 500\text{ mA}$)	2N2291 2N2292 2N2293	$V_{CE(sus)}$	30 50 70	- - -	Vdc
**($I_C = 5.0\text{ A}$)	2N2291 2N2292 2N2293		25 50 70	- - -	
*Collector-Emitter Breakdown Voltage ($I_C = 50\text{ mA}$, $R_{BE} = 100\text{ ohms}$)	2N2291 2N2292 2N2293	BV_{CER}	40 80 120	- - -	Vdc
*Collector Cutoff Current ($V_{CE} = 15\text{ Vdc}$, $I_B = 0$) ($V_{CE} = 25\text{ Vdc}$, $I_B = 0$) ($V_{CE} = 35\text{ Vdc}$, $I_B = 0$)	2N2291 2N2292 2N2293	I_{CEO}	- - -	50 50 50	mAdc
*Collector Cutoff Current ($V_{CE} = 40\text{ Vdc}$, $V_{BE(off)} = 0.1\text{ Vdc}$, $T_C = 100^\circ\text{C}$) ($V_{CE} = 80\text{ Vdc}$, $V_{BE(off)} = 0.1\text{ Vdc}$, $T_C = 100^\circ\text{C}$) ($V_{CE} = 120\text{ Vdc}$, $V_{BE(off)} = 0.1\text{ Vdc}$, $T_C = 100^\circ\text{C}$)	2N2291 2N2292 2N2293	I_{CEX}	- - -	35 35 35	mAdc
Collector Cutoff Current *($V_{CB} = -2.0\text{ Vdc}$, $I_E = 0$) *($V_{CB} = 40\text{ Vdc}$, $I_E = 0$) *($V_{CB} = 80\text{ Vdc}$, $I_E = 0$) *($V_{CB} = 120\text{ Vdc}$, $I_E = 0$)	All Types 2N2291 2N2292 2N2293	I_{CBO}	- - - -	200 5.0 5.0 5.0	μAdc mAdc
Emitter Cutoff Current ($V_{EB} = 1.5\text{ Vdc}$, $I_C = 0$)		I_{EBO}	-	50	mAdc

ON CHARACTERISTICS

*DC Current Gain ($I_C = 2.0\text{ A}$, $V_{CE} = 5.0\text{ Vdc}$) ($I_C = 5.0\text{ A}$, $V_{CE} = 2.0\text{ Vdc}$)	h_{FE}	40 50	- 120	-
Collector-Emitter Saturation Voltage ($I_C = 5.0\text{ A}$, $I_B = 0.5\text{ A}$)	$V_{CE(sat)}$	-	0.5	Vdc
*Base-Emitter Saturation Voltage ($I_C = 5.0\text{ A}$, $I_B = 0.5\text{ A}$)	$V_{BE(sat)}$	-	1.0	Vdc

SMALL-SIGNAL CHARACTERISTICS

*Small-Signal Current Gain ($I_C = 0.5\text{ A}$, $V_{CE} = 14\text{ Vdc}$, $f = 1.0\text{ kHz}$) ($I_C = 0.5\text{ A}$, $V_{CE} = 6.0\text{ Vdc}$, $f = 30\text{ kHz}$)	h_{fe}	50 15	200 -	-
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SWITCHING CHARACTERISTICS

Rise Time	$(I_C = 5.0\text{ A}$, $I_{B1} = I_{B2} = 0.5\text{ A}$) (See Figure 2)	t_r	-	7.0	μs
Storage Time		t_s	-	10	μs
Fall Time		t_f	-	8.0	μs

*Indicates JEDEC Registered Data.

**Motorola guarantees this data in addition to the JEDEC Registered Data Shown.

FIGURE 2 – SWITCHING TIME TEST CIRCUIT

