



# NPN POWER TRANSISTORS

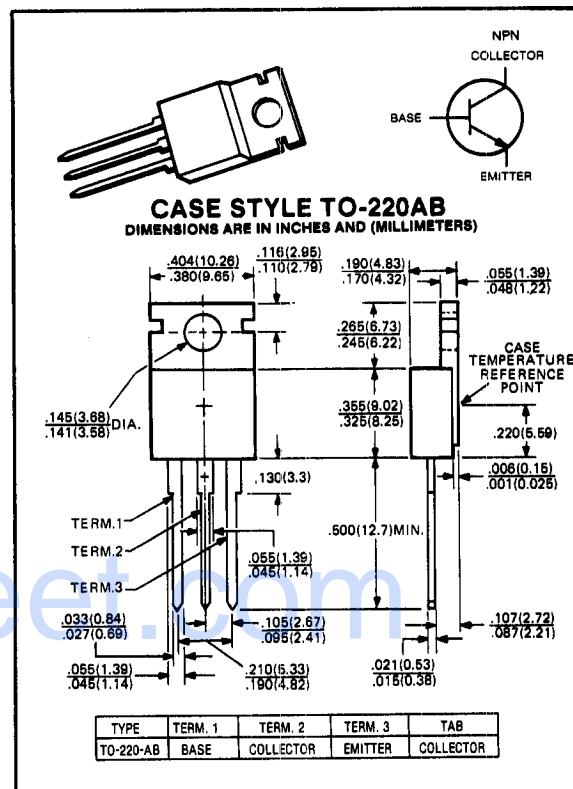
**MJE13005**

**400 VOLTS  
4 AMP, 75 WATTS**

Designed for switching regulator, DC-DC converter, AC-DC inverter, high voltage, high speed switching applications.

**Features:**

- $V_{CEO(sus)} = 400V$  (Min).
- $V_{CEV} = 700V$  blocking capability
- Excellent switching time:  $t_r = 0.7 \mu s$  (Max.),  
 $t_f = 0.9 \mu s$  (Max.)



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maximum ratings ( $T_A = 25^\circ C$ ) (unless otherwise specified)

RATING	SYMBOL	MJE13005	UNITS
Collector-Emitter Voltage	$V_{CEO}$	400	Volts
Collector-Emitter Voltage	$V_{CEV}$	700	Volts
Emitter Base Voltage	$V_{EBO}$	9	Volts
Collector Current — Continuous	$I_C$	4	A
Collector Current — Pulse	$I_{CP}$	8	A
Base Current — Continuous	$I_B$	2	A
Base Current — Pulse	$I_{BP}$	4	A
Emitter Current — Continuous	$I_E$	6	A
Emitter Current — Pulse	$I_{EP}$	12	A
Collector Power Dissipation Derate above $25^\circ C$	$P_C$	2 16	Watts $mW/^\circ C$
Collector Power Dissipation Derate above $25^\circ C$	$P_C$	75 600	Watts $mW/^\circ C$
Operating and Storage Junction Temperature Range	$T_J, T_{STG}$	-65 to +150	$^\circ C$

## thermal characteristics

Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.67	$^{\circ}\text{C}/\text{W}$
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	62.5	$^{\circ}\text{C}/\text{W}$
Maximum Lead Temperature for Soldering Purpose: $\frac{1}{8}$ " from Case for 5 Seconds	$T_L$	275	$^{\circ}\text{C}$

## electrical characteristics ( $T_C = 25^{\circ}\text{C}$ ) (unless otherwise specified)

CHARACTERISTIC	SYMBOL	MIN	TYP	MAX	UNIT
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### off characteristics<sup>(1)</sup>

Collector-Emitter Voltage ( $I_C = 10\text{mA}$ , $I_B = 0$ )	$V_{CE(sus)}$	400	—	—	Volts
Collector Cutoff Current ( $V_{CE} = 700\text{V}$ , $V_{BE} = -1.5\text{V}$ ) ( $V_{CE} = 700\text{V}$ , $V_{BE} = -1.5\text{V}$ , $T_C = 100^{\circ}\text{C}$ )	$I_{CEV}$	—	—	1 5	mA
Emitter Cutoff Current ( $V_{EB} = 9\text{V}$ , $I_C = 0$ )	$I_{EBO}$	—	—	1	mA

### second breakdown

Second Breakdown with Base Forward Biased	FBSOA	SEE FIGURE 11
Clamped Inductive SOA with Base Reversed Bias	RBSOA	SEE FIGURE 12

### on characteristics<sup>(1)</sup>

DC Current Gain ( $I_C = 1\text{A}$ , $V_{CE} = 5\text{V}$ ) ( $I_C = 2\text{A}$ , $V_{CE} = 5\text{V}$ )	$h_{FE}$	10 8	— —	60 40	—
Collector-Emitter Saturation Voltage ( $I_C = 1\text{A}$ , $I_B = 0.2\text{A}$ ) ( $I_C = 2\text{A}$ , $I_B = 0.5\text{A}$ ) ( $I_C = 4\text{A}$ , $I_B = 1\text{A}$ ) ( $I_C = 2\text{A}$ , $I_B = 0.5\text{A}$ , $T_C = 100^{\circ}\text{C}$ )	$V_{CE(sat)}$	— — — —	— — — —	0.5 0.6 1 1	V
Base-Emitter Saturation Voltage ( $I_C = 1\text{A}$ , $I_B = .2\text{A}$ ) ( $I_C = 2\text{A}$ , $I_B = .5\text{A}$ ) ( $I_C = 2\text{A}$ , $I_B = .5\text{A}$ , $T_C = 100^{\circ}\text{C}$ )	$V_{BE(sat)}$	— — —	— — —	1.2 1.6 1.5	V

### dynamic characteristics

Output Capacitance ( $V_{CB} = 10\text{V}$ , $I_E = 0$ )	$C_{ob}$	—	55	—	pF
Current Gain — Bandwidth Product ( $I_C = 500\text{mA}$ , $V_{CE} = 10\text{V}$ , $f_{test} = 1.0\text{MHz}$ )	$f_T$	4	—	—	MHz

### switching characteristics

Resistive Load					
Delay Time	$(V_{CC} = 125\text{V}$ , $I_C = 2\text{A}$ $I_{B1} = -I_{B2} = 0.4\text{A}$ , $t_p = 25\ \mu\text{s}$ Duty Cycle < 1%)	$t_d$	—	—	0.1
Rise Time		$t_r$	—	—	0.7
Storage Time		$t_s$	—	—	4
Fall Time		$t_f$	—	—	0.9
Inductive Load, Clamped					
Storage Time	$(I_C = 2\text{A}$ , $V_{clamp} = 300\text{V}$ $I_{B1} = 0.4\text{A}$ , $V_{BE(off)} = -5\text{V}$ , $T_C = 100^{\circ}\text{C}$ )	$t_{sv}$	—	—	4
Crossover Time		$t_c$	—	—	0.9
Fall Time		$t_f$	—	0.16	—

(1) Pulse Test: Pulse Width -  $300\ \mu\text{s}$  Duty Cycle  $\leq 2\%$ .

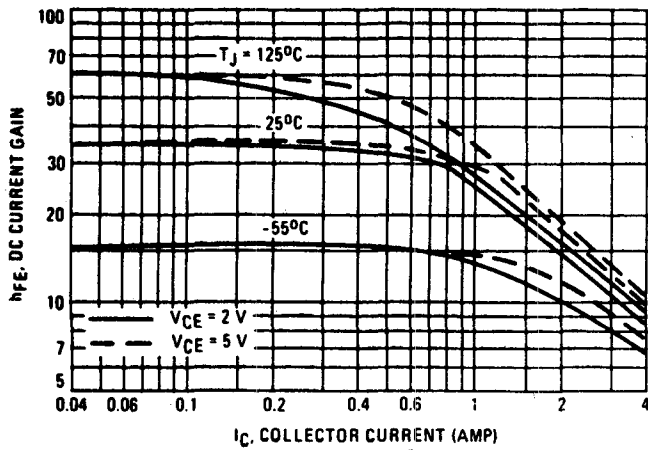


FIGURE 1 - DC CURRENT GAIN

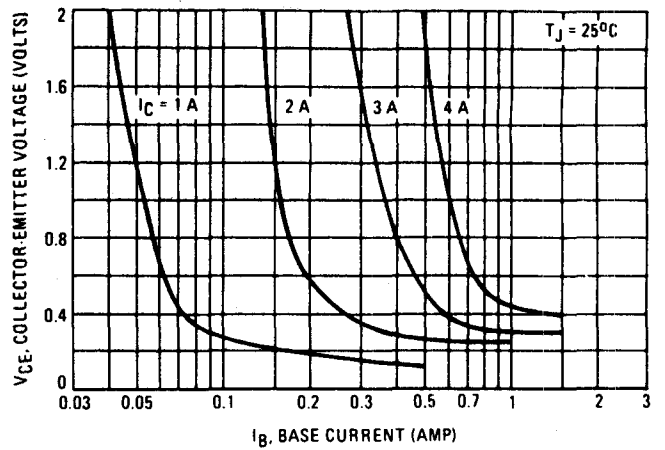


FIGURE 2 - COLLECTOR SATURATION REGION

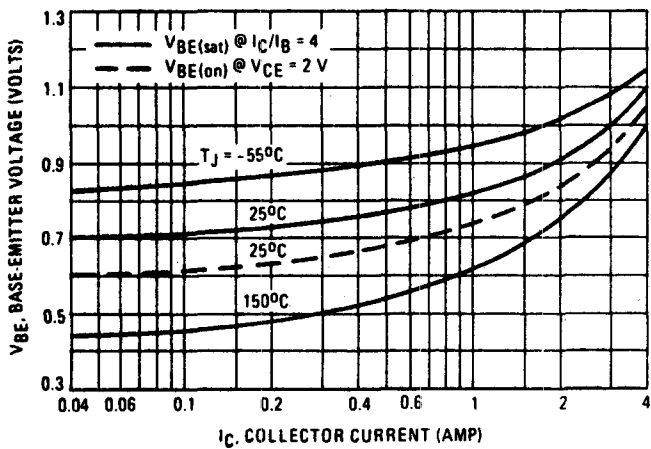


FIGURE 3 - BASE-EMITTER VOLTAGE

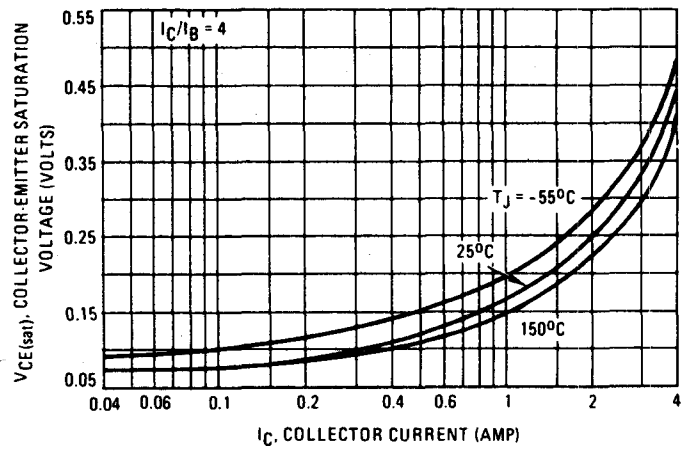


FIGURE 4 - COLLECTOR-EMITTER SATURATION VOLTAGE

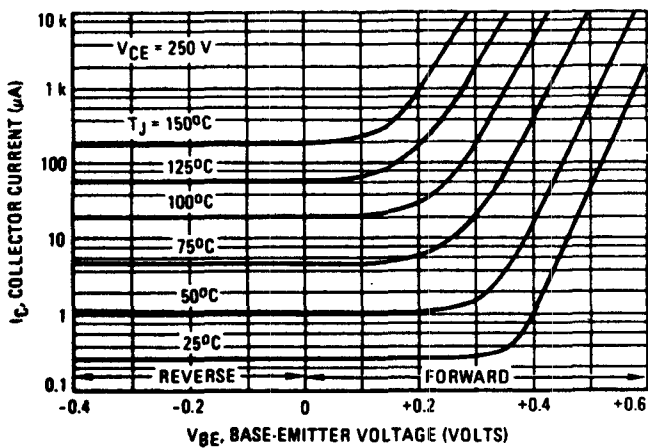


FIGURE 5 - COLLECTOR CUTOFF REGION

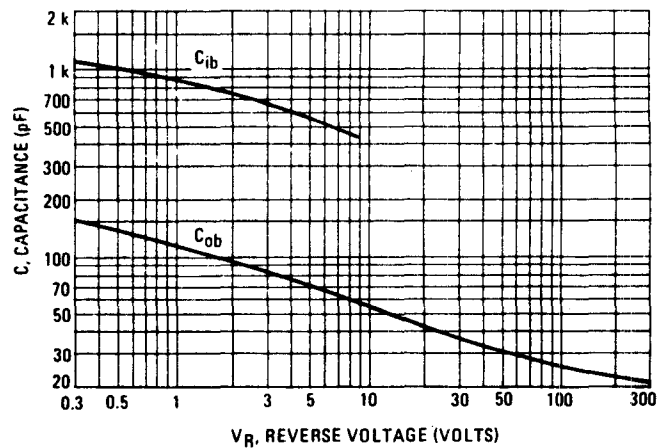


FIGURE 6 - CAPACITANCE

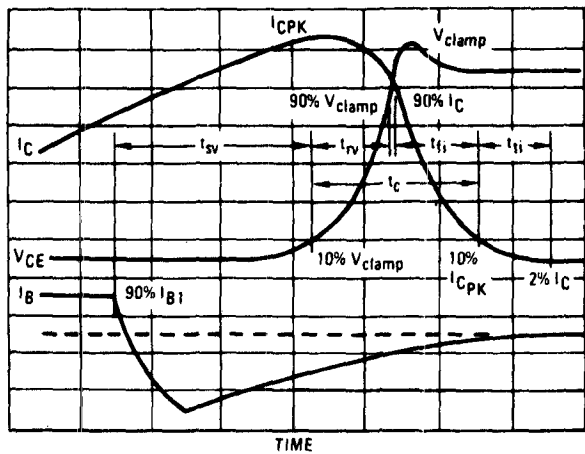


FIGURE 7 - INDUCTIVE SWITCHING MEASUREMENTS

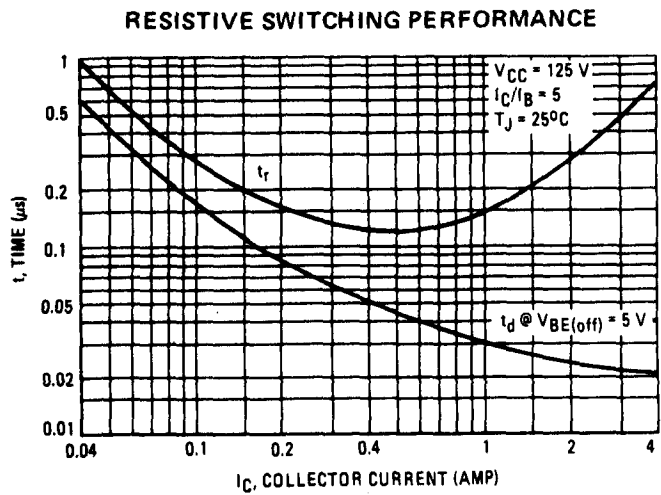


FIGURE 8 - TURN-ON TIME

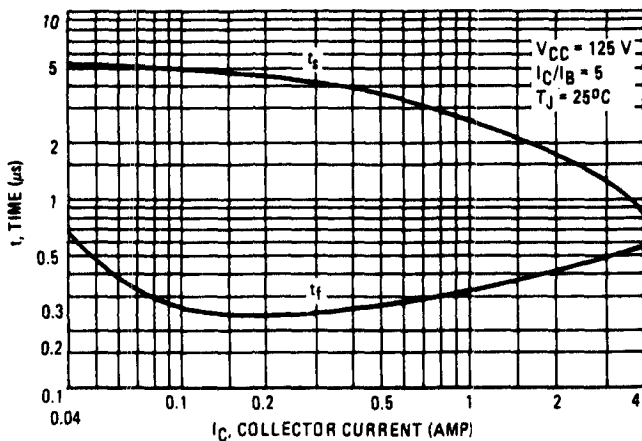


FIGURE 9 - TURN-OFF TIME

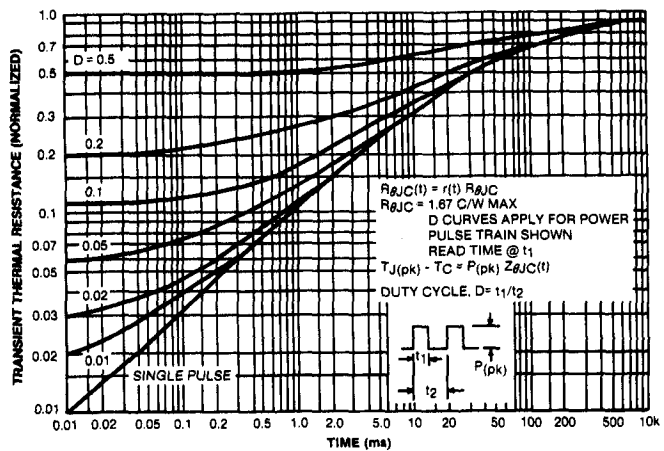


FIGURE 10 TYPICAL THERMAL RESPONSE [ $Z_{\theta JC}(t)$ ]

The Safe Operating Area Figures 11 and 12 are specified ratings for these devices under the test conditions shown.

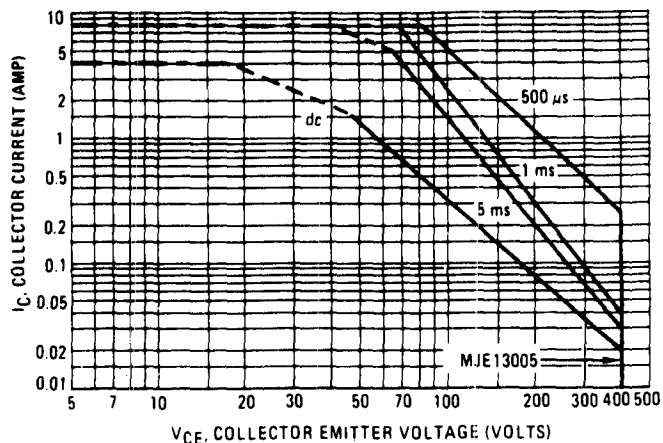


FIGURE 11 - FORWARD BIAS SAFE OPERATING AREA

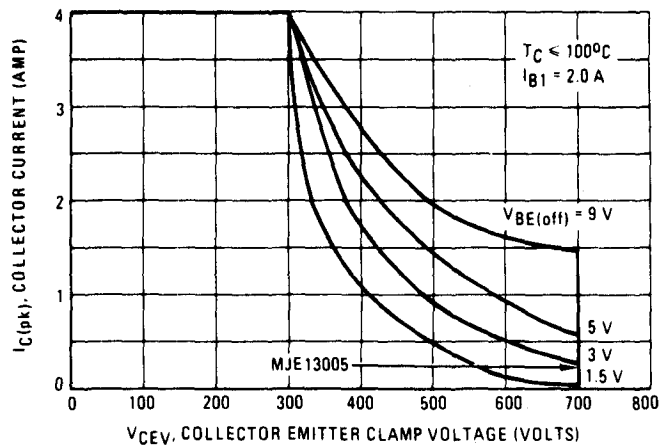


FIGURE 12 - REVERSE BIAS SWITCHING SAFE OPERATING AREA