

## 4-A *SwitchMax* II Power Transistors

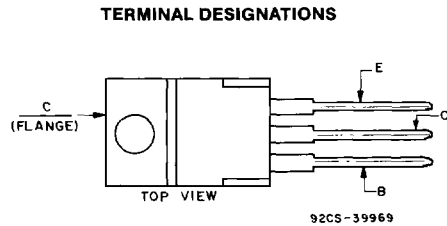
High-Voltage N-P-N Types for Off-Line Power Supplies and Other High-Voltage Switching Applications

**Features:**

- Fast switching speed
- High-voltage ratings:  
 $V_{CEV} = 600\text{ V to }700\text{ V}$
- Low  $V_{CE(sat)}$  at  $I_c = 4\text{ A}$

**Applications:**

- Off-line power supplies
- High-voltage inverters
- Switching regulators



JEDEC TO-220AB

The MJE13004 and MJE13005 *SwitchMax* II series of silicon n-p-n power transistors feature high-voltage capability, fast switching speeds, and low saturation voltages, together with high safe-operating-area (SOA) ratings. They are specially designed for off-line power supplies, converter circuits, and pulse-width-modulated regulators. These high-voltage, high-speed transistors are tested for parameters

that are essential to the design of high-power switching circuits. Switching times, including inductive turn-off time, saturation voltages are specified at 100°C to provide information necessary for worst-case design.

These transistors are supplied in the JEDEC TO-220AB (VERSAWATT) plastic package.

**MAXIMUM RATINGS, Absolute-Maximum Values:**

	MJE13004	MJE13005	
$V_{CEV}$	600	700	V
$V_{BE} = -1.5\text{ V}$	300	400	V
$V_{CEO}$		9	V
$V_{EBO}$		4	A
$I_C(sat)$		4	A
$I_C$		4	A
$I_{CM}$		8	A
$I_B$		2	A
$I_{BM}$		4	A
$P_T$			
@ $T_C = 25^\circ\text{C}$		75	W
@ $T_C = 100^\circ\text{C}$		45	W
$T_C$ above 25°C, derate linearly		0.6	W/°C
$T_{stg}$ $T_J$		-65 to +150	°C
$T_L$			
At distance $\geq 1/8"$ in. (3.17 mm) from seating plane for 10 s max		235	°C
$R_{\theta JC}$		1.67	°C/W

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

Characteristic	Symbol	Min	Typ	Max	Unit
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**\*OFF CHARACTERISTICS**

Collector-Emitter Sustaining Voltage ( $I_C = 10\text{ mA}$ , $I_B = 0$ )	MJE13004 MJE13005	$V_{CE0(sus)}$	300 400	— —	— —	Vdc
Collector Cutoff Current ( $V_{CEV} = \text{Rated Value}$ , $V_{BE(off)} = 1.5\text{ Vdc}$ ) ( $V_{CEV} = \text{Rated Value}$ , $V_{BE(off)} = 1.5\text{ Vdc}$ , $T_C = 100^\circ\text{C}$ )		$I_{CEV}$	— —	— —	1 5	mAdc
Emitter Cutoff Current ( $V_{EB} = 9\text{ Vdc}$ , $I_C = 0$ )		$I_{EBO}$	—	—	1	mAdc

**SECOND BREAKDOWN**

Second Breakdown Collector Current with base forward biased	$I_{S/b}$				See Figure 1
Clamped Inductive SOA with Base Reverse Biased	RBSOA				See Figure 2

**\*ON CHARACTERISTICS**

DC Current Gain ( $I_C = 1\text{ Adc}$ , $V_{CE} = 5\text{ Vdc}$ ) ( $I_C = 2\text{ Adc}$ , $V_{CE} = 5\text{ Vdc}$ )	$h_{FE}$	10 8	— —	60 40	—
Collector-Emitter Saturation Voltage ( $I_C = 1\text{ Adc}$ , $I_B = 0.2\text{ Adc}$ ) ( $I_C = 2\text{ Adc}$ , $I_B = 0.5\text{ Adc}$ ) ( $I_C = 4\text{ Adc}$ , $I_B = 1\text{ Adc}$ ) ( $I_C = 2\text{ Adc}$ , $I_B = 0.5\text{ Adc}$ , $T_C = 100^\circ\text{C}$ )	$V_{CE(sat)}$	— — — —	0.2 0.3 0.7 —	0.5 0.6 1 1	Vdc
Base-Emitter Saturation Voltage ( $I_C = 1\text{ Adc}$ , $I_B = 0.2\text{ Adc}$ ) ( $I_C = 2\text{ Adc}$ , $I_B = 0.5\text{ Adc}$ ) ( $I_C = 2\text{ Adc}$ , $I_B = 0.5\text{ Adc}$ , $T_C = 100^\circ\text{C}$ )	$V_{BE(sat)}$	— — —	0.90 0.95 —	1.2 1.6 1.5	Vdc

**DYNAMIC CHARACTERISTICS**

Current-Gain – Bandwidth Product ( $I_C = 500\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1\text{ MHz}$ )	$f_T$	4	—	—	MHz
Output Capacitance ( $V_{CB} = 10\text{ Vdc}$ , $I_E = 0$ , $f = 0.1\text{ MHz}$ )	$C_{ob}$	—	200	—	pF

**SWITCHING CHARACTERISTICS**

Resistive Load						
Delay Time	$(V_{CC} = 125\text{ Vdc}$ , $I_C = 2\text{ A}$ , $I_{B1} = I_{B2} = 0.4\text{ A}$ , $t_p = 25\text{ }\mu\text{s}$ , Duty Cycle $\leq 1\%$ )	$t_d$	—	0.02	0.1	$\mu\text{s}$
Rise Time		$t_r$	—	0.08	0.7	$\mu\text{s}$
Storage Time		$t_s$	—	1.90	4	$\mu\text{s}$
Fall Time		$t_f$	—	0.16	0.9	$\mu\text{s}$
Inductive Load, Clamped						
Voltage Storage Time	$(I_C = 2\text{ A}$ , $V_{clamp} = 300\text{ Vdc}$ , $I_{B1} = 0.4\text{ A}$ , $V_{BE(off)} = 5\text{ Vdc}$ , $T_C = 100^\circ\text{C}$ )	$t_{sv}$	—	1.60	4	$\mu\text{s}$
Crossover Time		$t_c$	—	0.15	0.9	$\mu\text{s}$
Fall Time		$t_{fi}$	—	0.05	—	$\mu\text{s}$

\*Pulse Test: Pulse Width = 300  $\mu\text{s}$ , Duty Cycle = 2%.

**2**  
**POWER TRANSISTORS**

# MJE13004, MJE13005

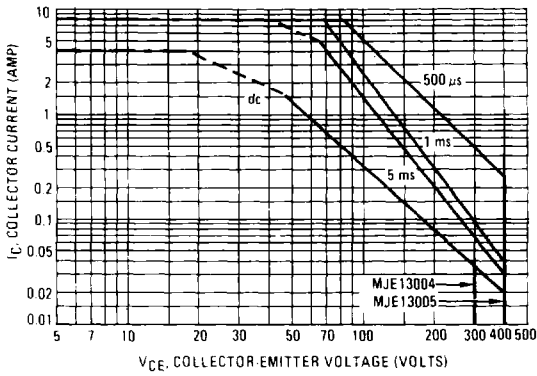


Fig. 1 — Maximum forward-bias safe-operating-areas for both types.

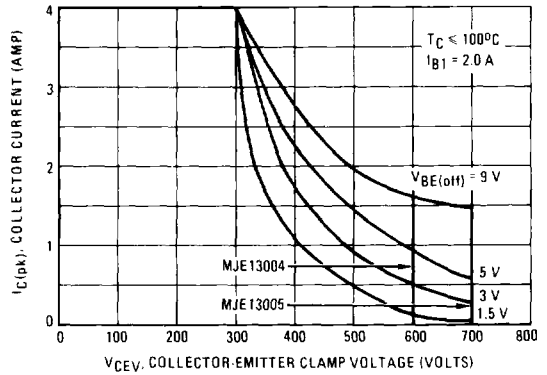


Fig. 2 — Maximum reverse-bias safe-operating-areas for both types.

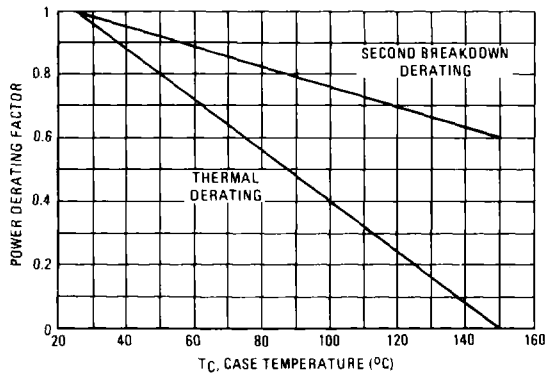


Fig. 3 — Dissipation and  $I_{sb}$  derating curves for both types.