

SWITCHMODE™

NPN Bipolar Power Transistor For Switching Power Supply Applications

The MJE18006 has an applications specific state-of-the-art die designed for use in 220 V line-operated SWITCHMODE Power supplies and electronic light ballasts. This high voltage/high speed transistor offers the following:

- 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)
- Tight Parametric Distributions are Consistent Lot-to-Lot
- Standard TO-220

MAXIMUM RATINGS

Rating	Symbol	MJE18006	Unit
Collector-Emitter Sustaining Voltage	V_{CEO}	450	Vdc
Collector-Emitter Breakdown Voltage	V_{CES}	1000	Vdc
Emitter-Base Voltage	V_{EBO}	9.0	Vdc
Collector Current — Continuous	I_C	6.0	Adc
— Peak(1)	I_{CM}	15	
Base Current — Continuous	I_B	4.0	Adc
— Peak(1)	I_{BM}	8.0	
Total Device Dissipation Derate above 25°C	P_D	100 0.8	Watts W/°C
Operating and Storage Temperature	T_J, T_{stg}	-65 to 150	°C

THERMAL CHARACTERISTICS

Rating	Symbol	MJE18006	Unit
Thermal Resistance — Junction to Case	$R_{\theta JC}$	1.25	°C/W
— Junction to Ambient	$R_{\theta JA}$	62.5	
Maximum Lead Temperature for Soldering Purposes: 1/8" from Case for 5 Seconds	T_L	260	°C

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

Characteristic	Symbol	Min	Typ	Max	Unit
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OFF CHARACTERISTICS

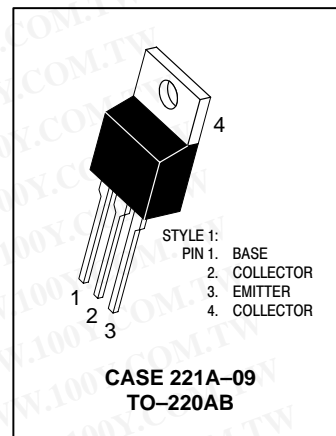
Collector-Emitter Sustaining Voltage ($I_C = 100\text{ mA}, L = 25\text{ mH}$)	$V_{CEO(sus)}$	450	—	—	Vdc
Collector Cutoff Current ($V_{CE} = \text{Rated } V_{CEO}, I_B = 0$)	I_{CEO}	—	—	100	μAdc
Collector Cutoff Current ($V_{CE} = \text{Rated } V_{CES}, V_{EB} = 0$)	I_{CES}	—	—	100	μAdc
($V_{CE} = 800\text{ V}, V_{EB} = 0$)		—	—	500	
($T_C = 125^\circ\text{C}$)		—	—	100	
Emitter Cutoff Current ($V_{EB} = 9.0\text{ Vdc}, I_C = 0$)	I_{EBO}	—	—	100	μAdc

- (1) Pulse Test: Pulse Width = 5.0 ms, Duty Cycle $\leq 10\%$.
 (2) Proper strike and creepage distance must be provided.

MJE18006*

*ON Semiconductor Preferred Device

POWER TRANSISTOR
6.0 AMPERES
1000 VOLTS
100 WATTS



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Preferred devices are ON Semiconductor recommended choices for future use and best overall value.

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

Characteristic	Symbol	Min	Typ	Max	Unit
ON CHARACTERISTICS					
Base-Emitter Saturation Voltage ($I_C = 1.3 \text{ Adc}, I_B = 0.13 \text{ Adc}$) ($I_C = 3.0 \text{ Adc}, I_B = 0.6 \text{ Adc}$)	$V_{BE(sat)}$	— —	0.83 0.94	1.2 1.3	Vdc
Collector-Emitter Saturation Voltage ($I_C = 1.3 \text{ Adc}, I_B = 0.13 \text{ Adc}$) ($T_C = 125^\circ\text{C}$) ($I_C = 3.0 \text{ Adc}, I_B = 0.6 \text{ Adc}$) ($T_C = 125^\circ\text{C}$)	$V_{CE(sat)}$	— — — —	0.25 0.27 0.35 0.4	0.6 0.65 0.7 0.8	Vdc
DC Current Gain ($I_C = 0.5 \text{ Adc}, V_{CE} = 5.0 \text{ Vdc}$) ($I_C = 3.0 \text{ Adc}, V_{CE} = 1.0 \text{ Vdc}$) ($I_C = 1.3 \text{ Adc}, V_{CE} = 1.0 \text{ Vdc}$) ($I_C = 10 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc}$)	h_{FE}	14 — 6.0 5.0 11 10	— 32 10 8.0 17 22	34 — — — — —	—

DYNAMIC CHARACTERISTICS

Current Gain Bandwidth ($I_C = 0.5 \text{ Adc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ MHz}$)	f_T	—	14	—	MHz
Output Capacitance ($V_{CB} = 10 \text{ Vdc}, I_E = 0, f = 1.0 \text{ MHz}$)	C_{ob}	—	75	120	pF
Input Capacitance ($V_{EB} = 8.0 \text{ V}$)	C_{ib}	—	1000	1500	pF
Dynamic Saturation Voltage: Determined 1.0 μs and 3.0 μs respectively after rising I_{B1} reaches 90% of final I_{B1} (see Figure 18)	$V_{CE(dsat)}$	— — — — — —	5.5 12 3.0 7.0 9.5 14.5 2.0 7.5	— — — — — — — —	Volts

SWITCHING CHARACTERISTICS: Resistive Load (D.C. $\leq 10\%$, Pulse Width = 20 μs)

Turn-On Time	($I_C = 3.0 \text{ Adc}, I_{B1} = 0.6 \text{ Adc}, I_{B2} = 1.5 \text{ Adc}, V_{CC} = 300 \text{ V}$) ($T_C = 125^\circ\text{C}$)	t_{on}	— —	90 100	180 —	ns
Turn-Off Time		t_{off}	— —	1.7 2.1	2.5 —	μs
Turn-On Time	($I_C = 1.3 \text{ Adc}, I_{B1} = 0.13 \text{ Adc}, I_{B2} = 0.65 \text{ Adc}, V_{CC} = 300 \text{ V}$) ($T_C = 125^\circ\text{C}$)	t_{on}	— —	200 130	300 —	ns
Turn-Off Time		t_{off}	— —	1.2 1.5	2.5 —	μs

SWITCHING CHARACTERISTICS: Inductive Load ($V_{clamp} = 300 \text{ V}, V_{CC} = 15 \text{ V}, L = 200 \mu\text{H}$)

Fall Time	($I_C = 1.5 \text{ Adc}, I_{B1} = 0.13 \text{ Adc}, I_{B2} = 0.65 \text{ Adc}$) ($T_C = 125^\circ\text{C}$)	t_{fi}	— —	100 120	180 —	ns
Storage Time		t_{si}	— —	1.5 1.9	2.5 —	μs
Crossover Time		t_c	— —	220 230	350 —	ns
Fall Time	($I_C = 3.0 \text{ Adc}, I_{B1} = 0.6 \text{ Adc}, I_{B2} = 1.5 \text{ Adc}$) ($T_C = 125^\circ\text{C}$)	t_{fi}	— —	85 120	150 —	ns
Storage Time		t_{si}	— —	2.15 2.75	3.2 —	μs
Crossover Time		t_c	— —	200 310	300 —	ns

TYPICAL STATIC CHARACTERISTICS

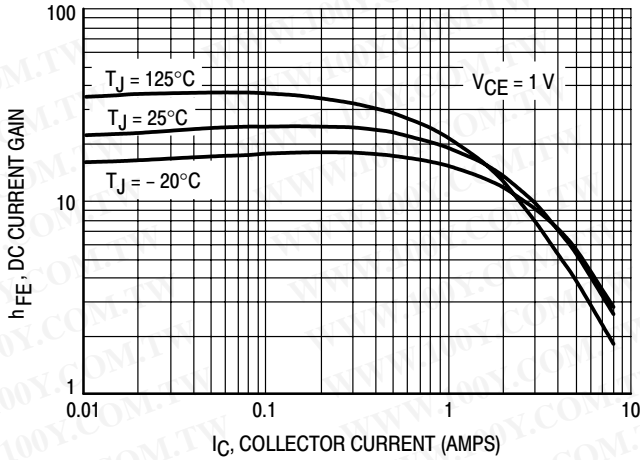


Figure 1. DC Current Gain @ 1 Volt

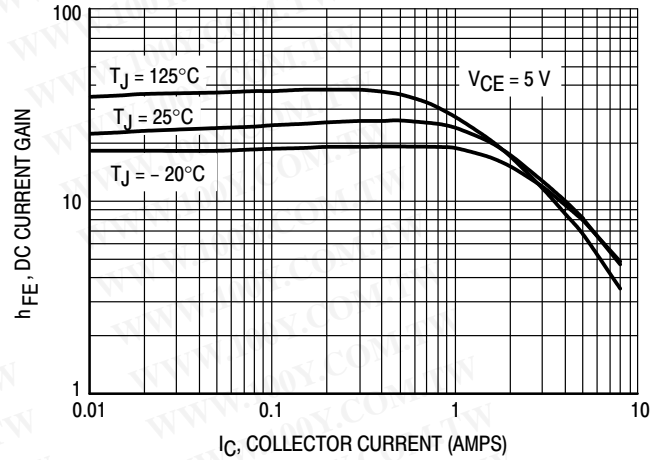


Figure 2. DC Current Gain @ 5 Volts

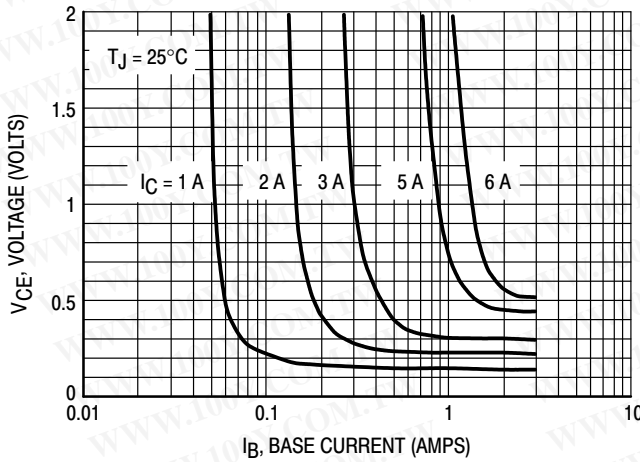


Figure 3. Collector Saturation Region

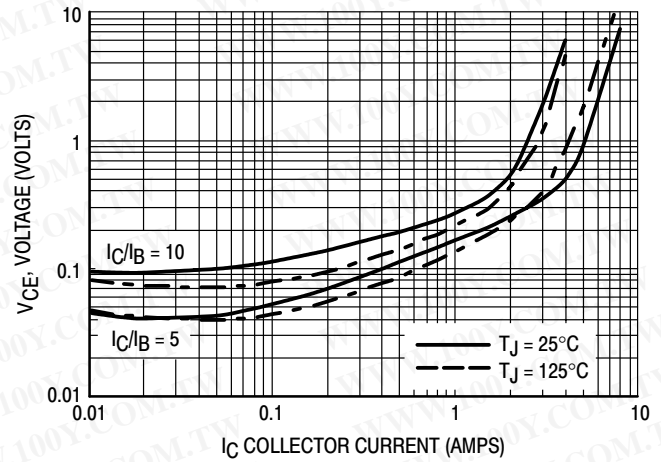


Figure 4. Collector-Emitter Saturation Voltage

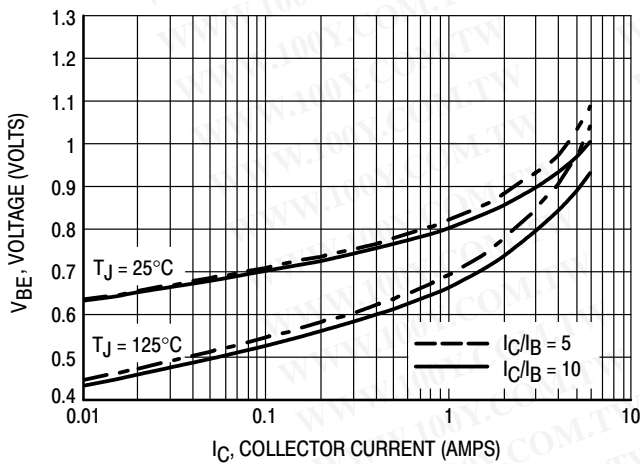


Figure 5. Base-Emitter Saturation Region

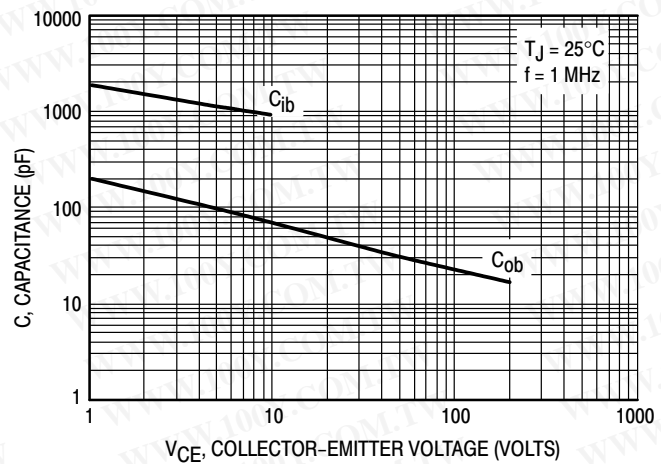


Figure 6. Capacitance

TYPICAL SWITCHING CHARACTERISTICS
($I_{B2} = I_C/2$ for all switching)

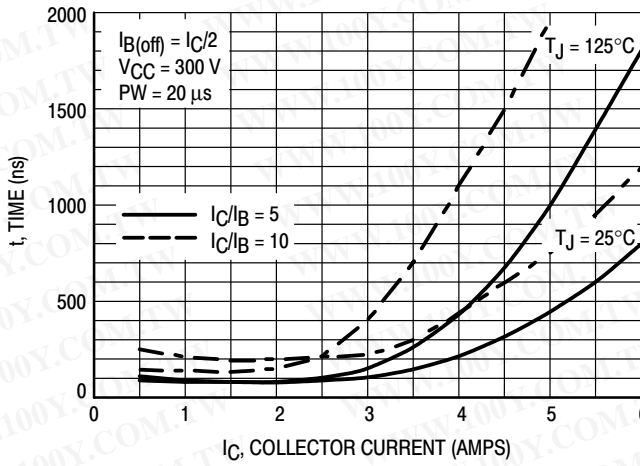


Figure 7. Resistive Switching, t_{on}

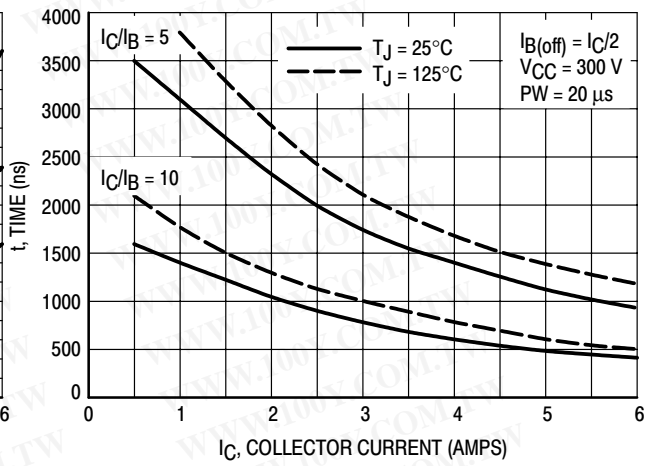


Figure 8. Resistive Switching, t_{off}

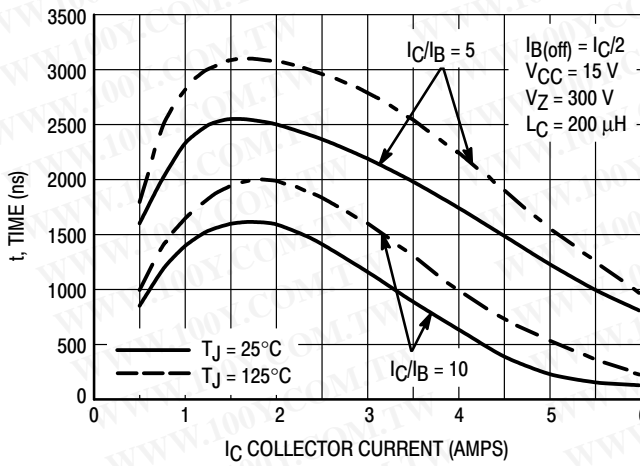


Figure 9. Inductive Storage Time, t_{si}

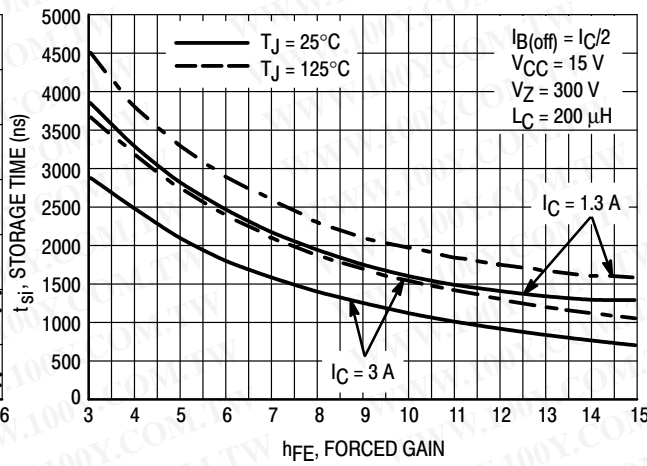


Figure 10. Inductive Storage Time, $t_{si}(h_{FE})$

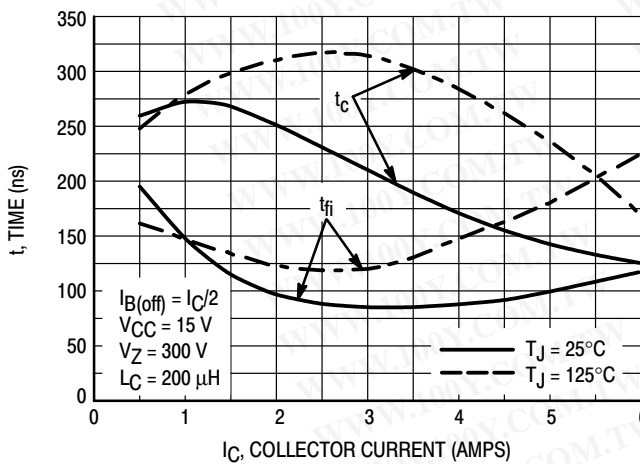


Figure 11. Inductive Switching, t_c and t_{fj}
 $I_C/I_B = 5$

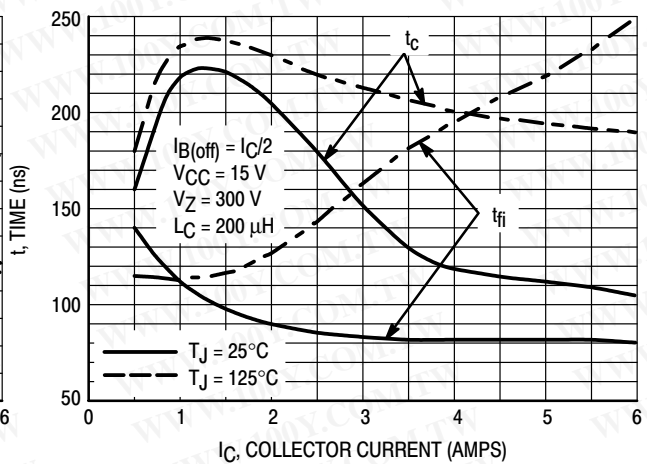


Figure 12. Inductive Switching, t_c and t_{fj}
 $I_C/I_B = 10$

TYPICAL SWITCHING CHARACTERISTICS
($I_{B2} = I_C/2$ for all switching)

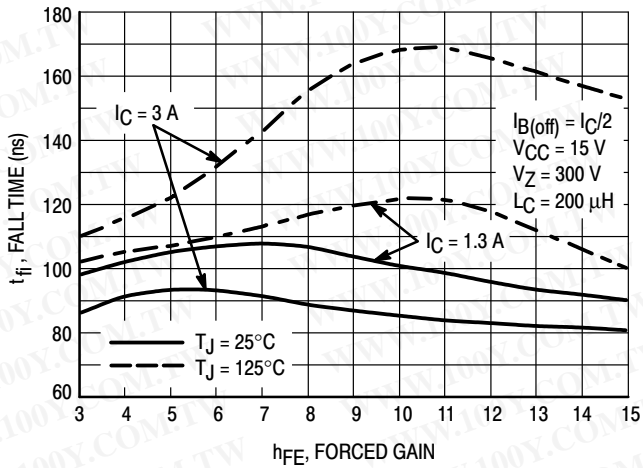


Figure 13. Inductive Fall Time

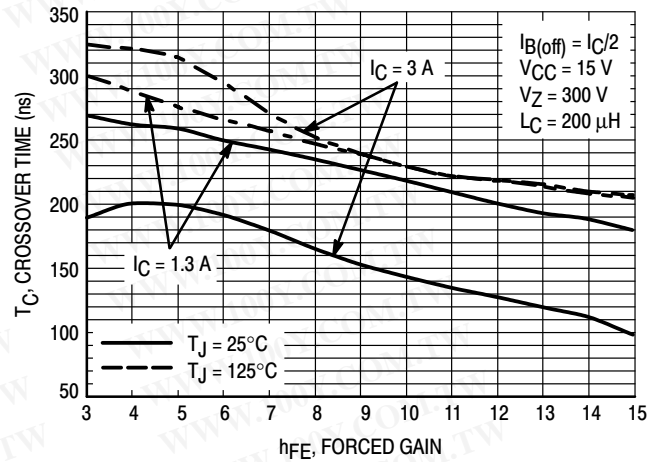


Figure 14. Inductive Crossover Time

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GUARANTEED SAFE OPERATING AREA INFORMATION

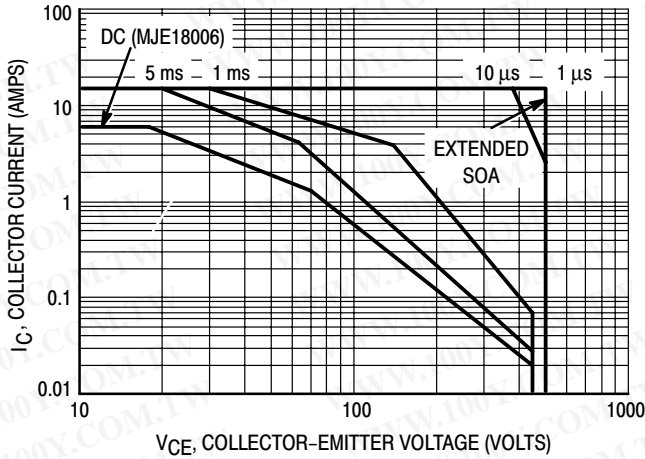


Figure 15. Forward Bias Safe Operating Area

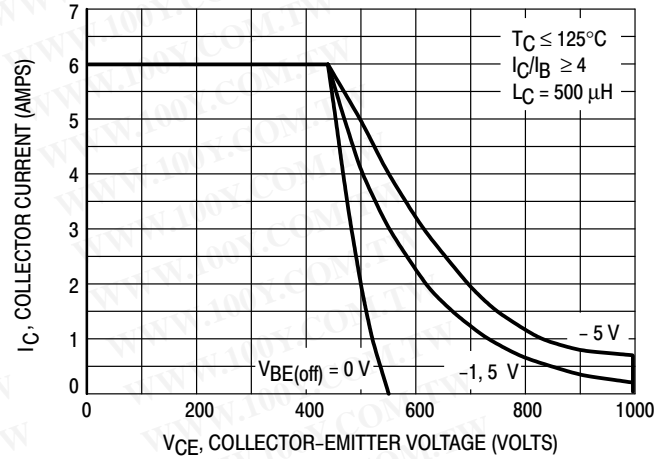


Figure 16. Reverse Bias Switching Safe Operating Area

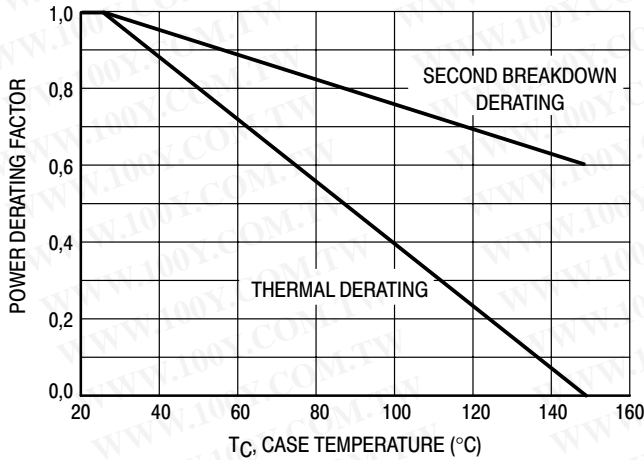


Figure 17. Forward Bias Power Derating

There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe operating area curves indicate $I_C - V_{CE}$ limits of the transistor that must be observed for reliable operation; i.e., the transistor must not be subjected to greater dissipation than the curves indicate. The data of Figure 15 is based on $T_C = 25^\circ\text{C}$; $T_{J(pk)}$ is variable depending on power level. Second breakdown pulse limits are valid for duty cycles to 10% but must be derated when $T_C \geq 25^\circ\text{C}$. Second breakdown limitations do not derate the same as thermal limitations. Allowable current at the voltages shown in Figure 15 may be found at any case temperature by using the appropriate curve on Figure 17. $T_{J(pk)}$ may be calculated from the data in Figure 20. At any case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown. For inductive loads, high voltage and current must be sustained simultaneously during turn-off with the base-to-emitter junction reverse-biased. The safe level is specified as a reverse-biased safe operating area (Figure 16). This rating is verified under clamped conditions so that the device is never subjected to an avalanche mode.

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MJE18006

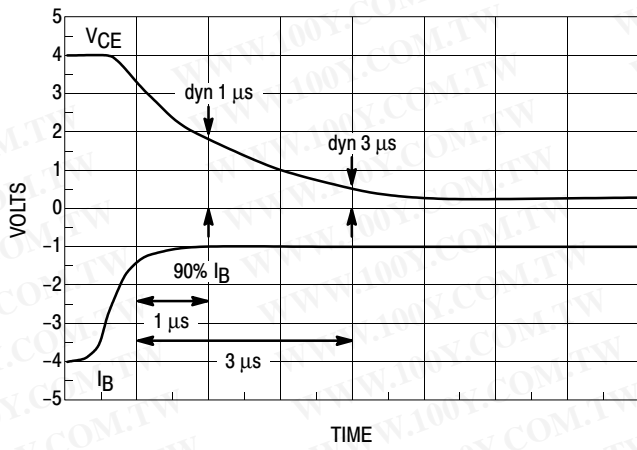


Figure 18. Dynamic Saturation Voltage Measurements

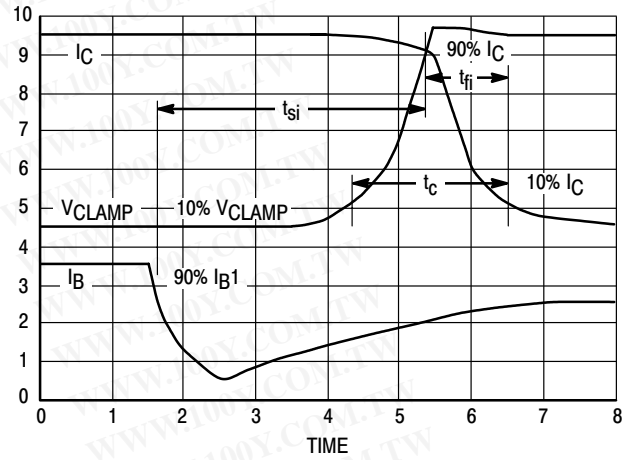
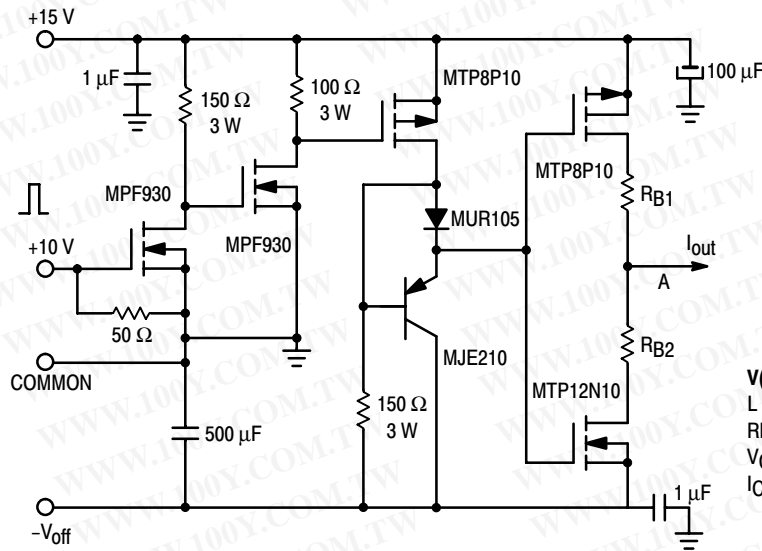


Figure 19. Inductive Switching Measurements



V(BR)CEO(sus)	INDUCTIVE SWITCHING	RBSOA
L = 10 mH	L = 200 μH	L = 500 μH
RB2 = ∞	RB2 = 0	RB2 = 0
VCC = 20 VOLTS	VCC = 15 VOLTS	VCC = 15 VOLTS
IC(pk) = 100 mA	RB1 SELECTED FOR DESIRED IB1	RB1 SELECTED FOR DESIRED IB1

Table 1. Inductive Load Switching Drive Circuit

TYPICAL THERMAL RESPONSE

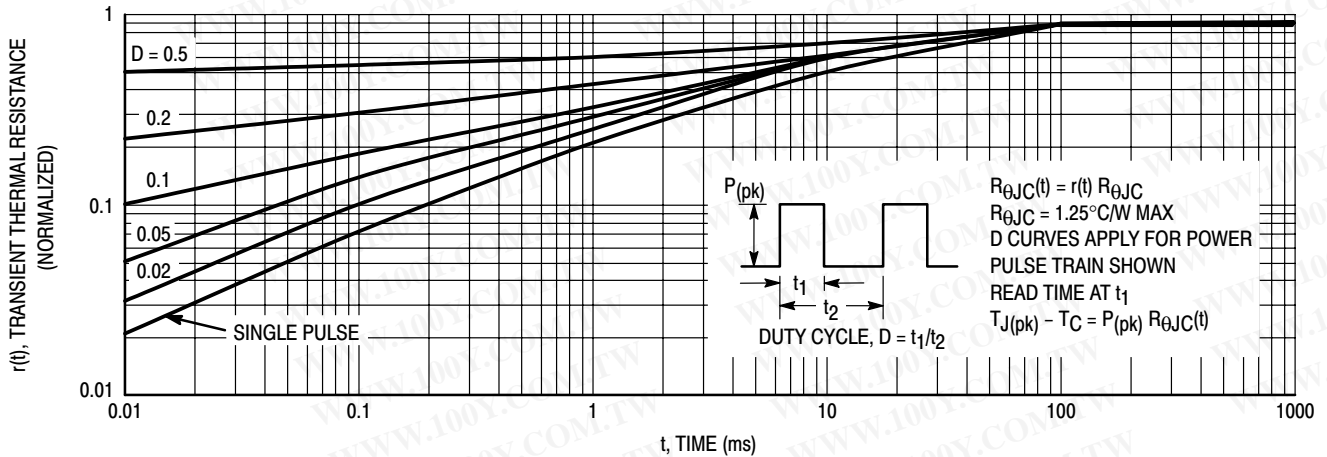


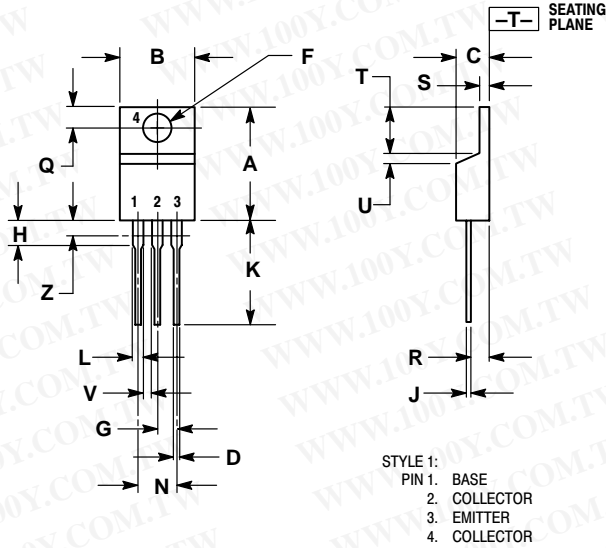
Figure 20. Typical Thermal Response ($Z_{\theta JC}(t)$) for MJE18006

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MJE18006

PACKAGE DIMENSIONS

TO-220AB
CASE 221A-09
ISSUE AA



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.


DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.570	0.620	14.48	15.75
B	0.380	0.405	9.66	10.28
C	0.160	0.190	4.07	4.82
D	0.025	0.035	0.64	0.88
F	0.142	0.147	3.61	3.73
G	0.095	0.105	2.42	2.66
H	0.110	0.155	2.80	3.93
J	0.018	0.025	0.46	0.64
K	0.500	0.562	12.70	14.27
L	0.045	0.060	1.15	1.52
N	0.190	0.210	4.83	5.33
Q	0.100	0.120	2.54	3.04
R	0.080	0.110	2.04	2.79
S	0.045	0.055	1.15	1.39
T	0.235	0.255	5.97	6.47
U	0.000	0.050	0.00	1.27
V	0.045	---	1.15	---
Z	---	0.080	---	2.04

STYLE 1:

1. BASE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

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