

MJE18006G

Switch-mode

NPN Bipolar Power Transistor For Switching Power Supply Applications

The MJE18006G has an applications specific state-of-the-art die designed for use in 220 V line-operated switch-mode power supplies and electronic light ballasts.

Features

- 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
- These Devices are Pb-Free and are RoHS Compliant*

MAXIMUM RATINGS

Rating	Symbol	Value	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 (Note 1)	I_{CM}	15	
Base Current – Continuous	I_B	4.0	Adc
– Peak (Note 1)	I_{BM}	8.0	
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C	P_D	100 0.8	W W/ $^\circ\text{C}$
Operating and Storage Temperature	T_J, T_{stg}	-65 to 150	$^\circ\text{C}$

THERMAL CHARACTERISTICS

Characteristics	Symbol	Max	Unit
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	1.25	$^\circ\text{C/W}$
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	62.5	$^\circ\text{C/W}$
Maximum Lead Temperature for Soldering Purposes 1/8" from Case for 5 Seconds	T_L	260	$^\circ\text{C}$

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

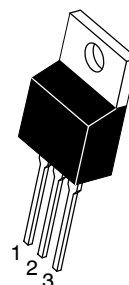
1. Pulse Test: Pulse Width = 5 ms, Duty Cycle $\leq 10\%$.



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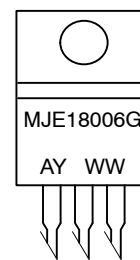
<http://onsemi.com>

**POWER TRANSISTOR
6.0 AMPERES
1000 VOLTS – 100 WATTS**



TO-220AB
CASE 221A-09
STYLE 1

MARKING DIAGRAM



A = Assembly Location
Y = Year
WW = Work Week
G = Pb-Free Package

ORDERING INFORMATION

Device	Package	Shipping
MJE18006G	TO-220 (Pb-Free)	50 Units / Rail

*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

MJE18006G

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise specified)

Characteristic	Symbol	Min	Typ	Max	Unit
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OFF CHARACTERISTICS

Collector–Emitter Sustaining Voltage (I _C = 100 mA, L = 25 mH)	V _{CEO(sus)}	450	–	–	Vdc
Collector Cutoff Current (V _{CE} = Rated V _{CEO} , I _B = 0)	I _{CEO}	–	–	100	μAdc
Collector Cutoff Current (V _{CE} = Rated V _{CE} , V _{EB} = 0)	I _{CES}	–	–	100	μAdc
(T _C = 125°C)		–	–	500	
(V _{CE} = 800 V, V _{EB} = 0)		–	–	100	
Emitter Cutoff Current (V _{EB} = 9.0 Vdc, I _C = 0)	I _{EBO}	–	–	100	μAdc

ON CHARACTERISTICS

Base–Emitter Saturation Voltage (I _C = 1.3 Adc, I _B = 0.13 Adc)	V _{BE(sat)}	–	0.83	1.2	Vdc
(I _C = 3.0 Adc, I _B = 0.6 Adc)		–	0.94	1.3	
Collector–Emitter Saturation Voltage (I _C = 1.3 Adc, I _B = 0.13 Adc)	V _{CE(sat)}	–	0.25	0.6	Vdc
(T _C = 125°C)		–	0.27	0.65	
(I _C = 3.0 Adc, I _B = 0.6 Adc)		–	0.35	0.7	
(T _C = 125°C)		–	0.4	0.8	
DC Current Gain (I _C = 0.5 Adc, V _{CE} = 5.0 Vdc)	h _{FE}	14	–	34	–
(T _C = 125°C)		–	32	–	
(I _C = 3.0 Adc, V _{CE} = 1.0 Vdc)		6.0	10	–	
(T _C = 125°C)		5.0	8.0	–	
(I _C = 1.3 Adc, V _{CE} = 1.0 Vdc)		11	17	–	
(I _C = 10 mAdc, V _{CE} = 5.0 Vdc)		10	22	–	

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:		$(I_C = 1.3 \text{ Adc}$ $I_{B1} = 130 \text{ mAdc}$ $V_{CC} = 300 \text{ V}$)	$1.0 \mu\text{s}$	$(T_C = 125^\circ\text{C})$	$V_{CE(dsat)}$	–	5.5	–	V
Determined $1.0 \mu\text{s}$ and $3.0 \mu\text{s}$ respectively after rising I_{B1} reaches 90% of final I_{B1} (see Figure 18)			$3.0 \mu\text{s}$	$(T_C = 125^\circ\text{C})$		–	12	–	
		$(I_C = 3.0 \text{ Adc}$ $I_{B1} = 0.6 \text{ Adc}$ $V_{CC} = 300 \text{ V}$)	$1.0 \mu\text{s}$	$(T_C = 125^\circ\text{C})$		–	3.0	–	
			$3.0 \mu\text{s}$	$(T_C = 125^\circ\text{C})$		–	7.0	–	
			$1.0 \mu\text{s}$	$(T_C = 125^\circ\text{C})$		–	9.5	–	
			$3.0 \mu\text{s}$	$(T_C = 125^\circ\text{C})$		–	14.5	–	
					–	2.0	–		
					–	7.5	–		

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

Turn–On Time	(I _C = 3.0 Adc, I _{B1} = 0.6 Adc, I _{B2} = 1.5 Adc, V _{CC} = 300 V)	(T _C = 125°C)	t _{on}	–	90	180	ns
Turn–Off Time		(T _C = 125°C)	t _{off}	–	100	–	μs
Turn–On Time	(I _C = 1.3 Adc, I _{B1} = 0.13 Adc, I _{B2} = 0.65 Adc, V _{CC} = 300 V)	(T _C = 125°C)	t _{on}	–	1.7	2.5	μs
Turn–Off Time		(T _C = 125°C)	t _{off}	–	2.1	–	μs
Turn–On Time	(I _C = 1.3 Adc, I _{B1} = 0.13 Adc, I _{B2} = 0.65 Adc, V _{CC} = 300 V)	(T _C = 125°C)	t _{on}	–	200	300	ns
Turn–Off Time		(T _C = 125°C)	t _{off}	–	130	–	μs
Turn–On Time	(I _C = 1.3 Adc, I _{B1} = 0.13 Adc, I _{B2} = 0.65 Adc, V _{CC} = 300 V)	(T _C = 125°C)	t _{on}	–	1.2	2.5	μs
Turn–Off Time		(T _C = 125°C)	t _{off}	–	1.5	–	μs

SWITCHING CHARACTERISTICS: Inductive Load (V_{clamp} = 300 V, V_{CC} = 15 V, L = 200 μH)

Fall Time	(I _C = 1.5 Adc, I _{B1} = 0.13 Adc, I _{B2} = 0.65 Adc)	(T _C = 125°C)	t _{fi}	–	100	180	ns
Storage Time		(T _C = 125°C)	t _{si}	–	120	–	μs
Crossover Time		(T _C = 125°C)	t _c	–	1.5	2.5	μs
Fall Time	(I _C = 3.0 Adc, I _{B1} = 0.6 Adc, I _{B2} = 1.5 Adc)	(T _C = 125°C)	t _{fi}	–	1.9	–	μs
Storage Time		(T _C = 125°C)	t _{si}	–	220	350	ns
Crossover Time		(T _C = 125°C)	t _c	–	230	–	μs
Fall Time	(I _C = 3.0 Adc, I _{B1} = 0.6 Adc, I _{B2} = 1.5 Adc)	(T _C = 125°C)	t _{fi}	–	85	150	ns
Storage Time		(T _C = 125°C)	t _{si}	–	120	–	μs
Crossover Time		(T _C = 125°C)	t _c	–	2.15	3.2	μs
Fall Time	(I _C = 3.0 Adc, I _{B1} = 0.6 Adc, I _{B2} = 1.5 Adc)	(T _C = 125°C)	t _{fi}	–	2.75	–	μs
Storage Time		(T _C = 125°C)	t _{si}	–	200	300	ns
Crossover Time		(T _C = 125°C)	t _c	–	310	–	μs

2. Proper strike and creepage distance must be provided.

TYPICAL STATIC CHARACTERISTICS

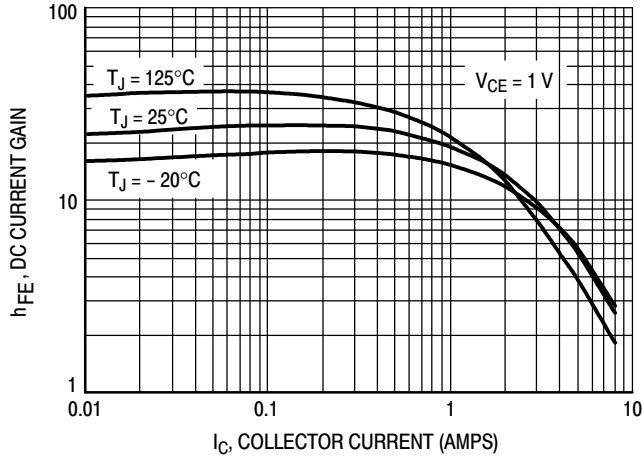


Figure 1. DC Current Gain @ 1 Volt

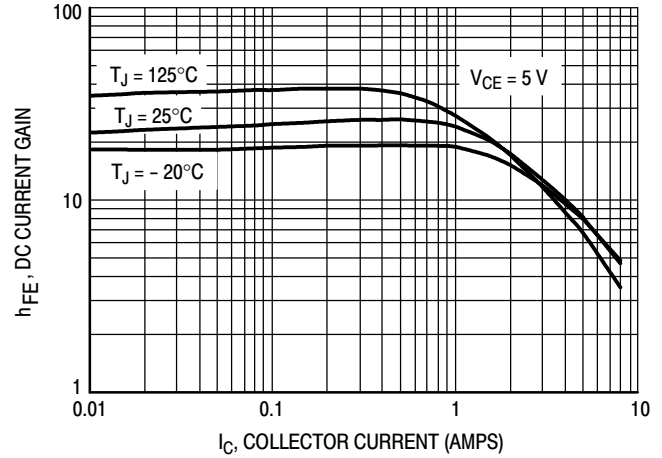


Figure 2. DC Current Gain @ 5 Volts

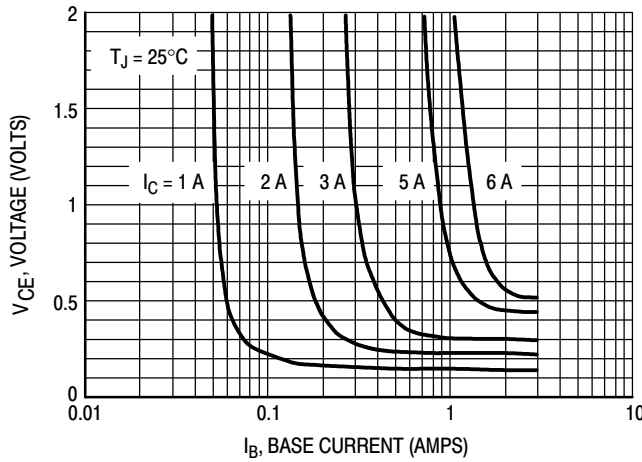


Figure 3. Collector Saturation Region

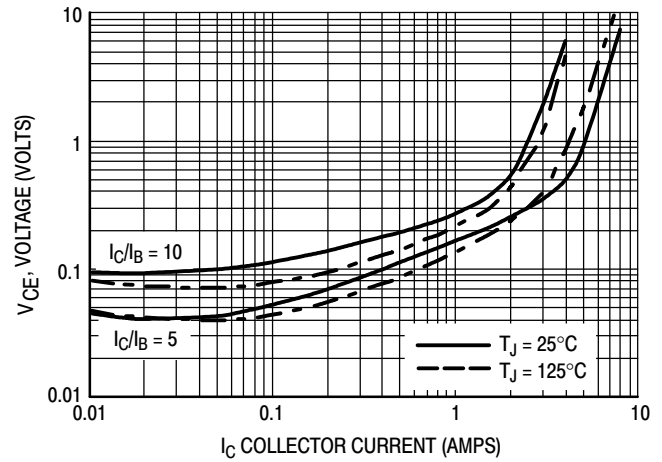


Figure 4. Collector-Emitter Saturation Voltage

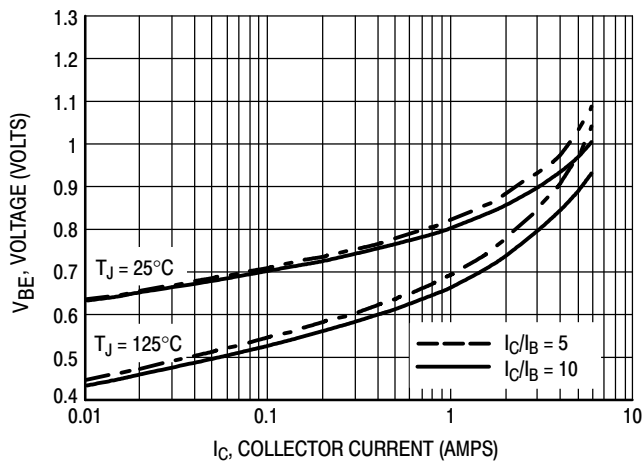


Figure 5. Base-Emitter Saturation Region

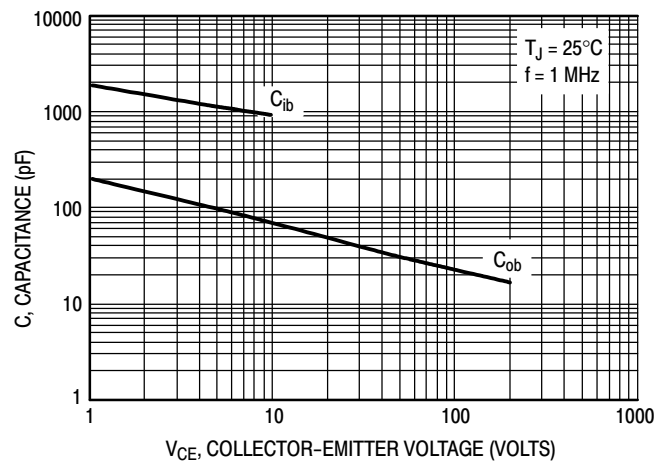


Figure 6. Capacitance

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

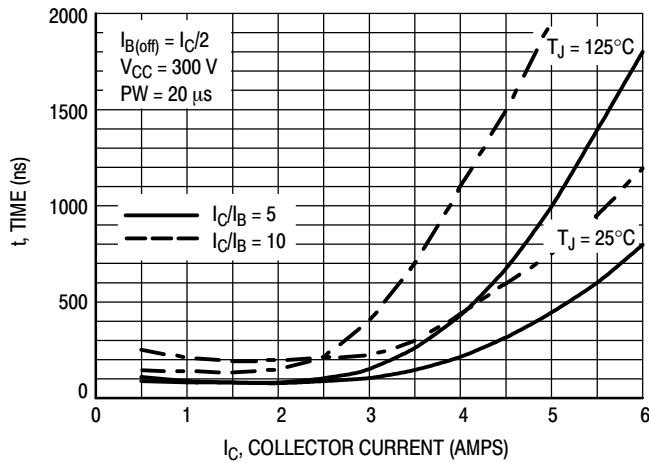


Figure 7. Resistive Switching, t_{on}

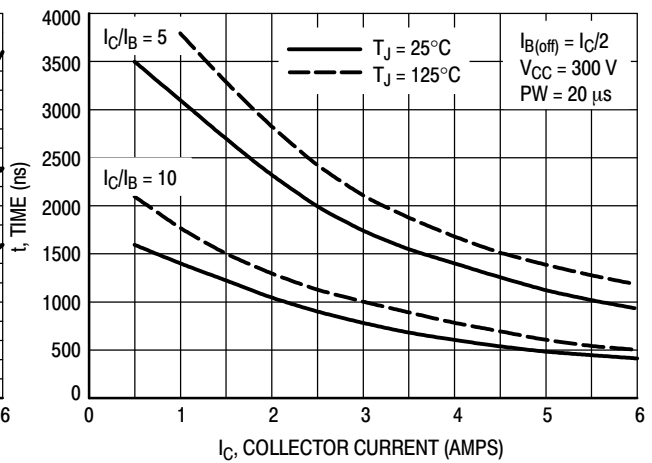


Figure 8. Resistive Switching, t_{off}

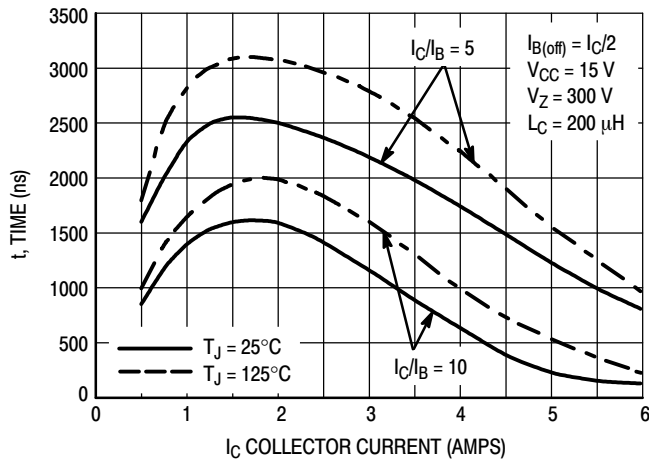


Figure 9. Inductive Storage Time, t_{si}

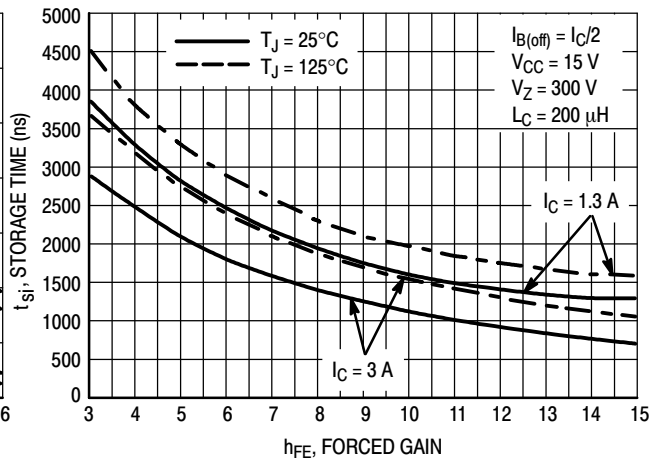


Figure 10. Inductive Storage Time, $t_{si}(h_{FE})$

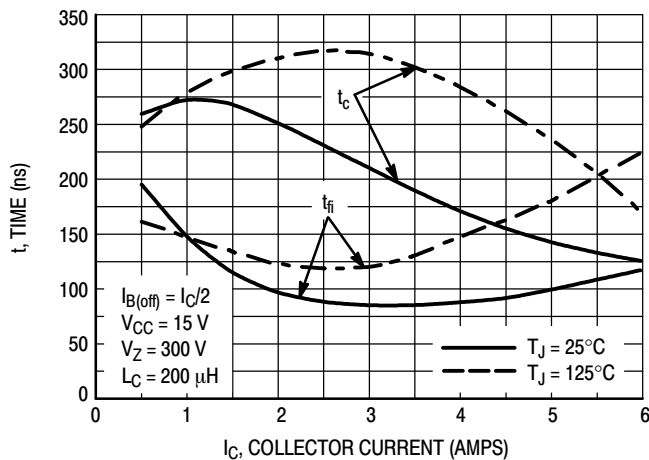


Figure 11. Inductive Switching, t_c and t_{fi}
 $I_C/I_B = 5$

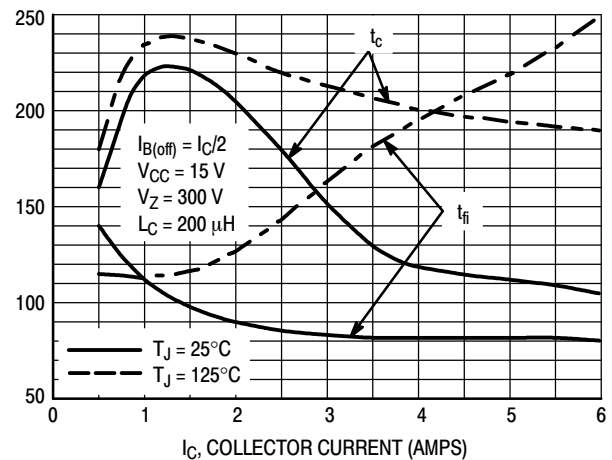


Figure 12. Inductive Switching, t_c and t_{fi}
 $I_C/I_B = 10$

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

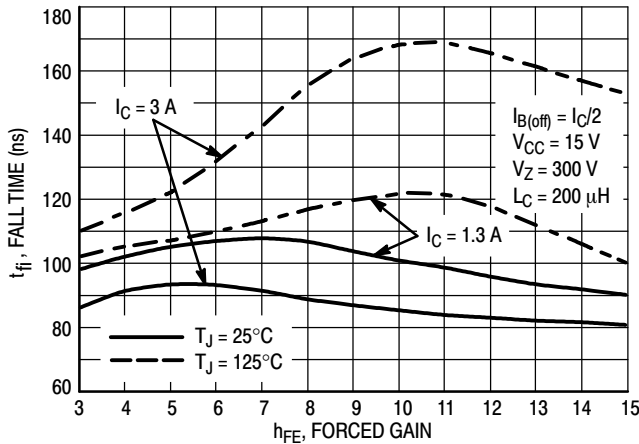


Figure 13. Inductive Fall Time

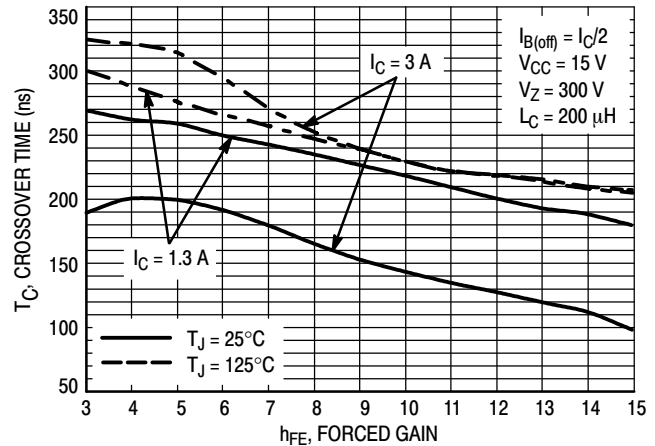


Figure 14. Inductive Crossover Time

GUARANTEED SAFE OPERATING AREA INFORMATION

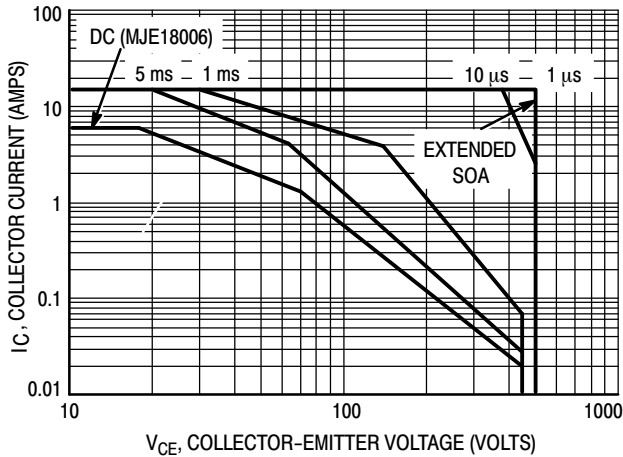


Figure 15. Forward Bias Safe Operating Area

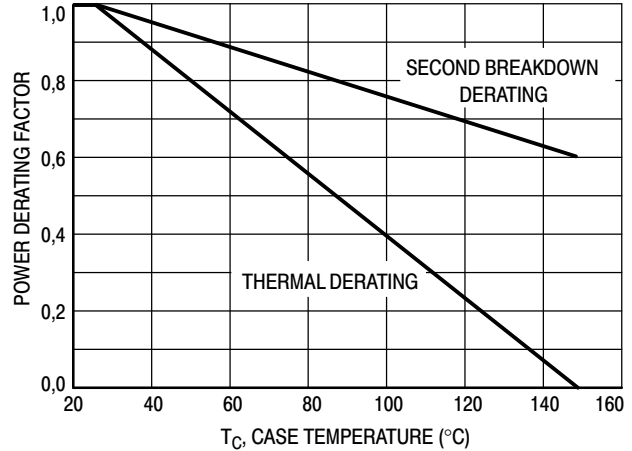


Figure 17. Forward Bias Power Derating

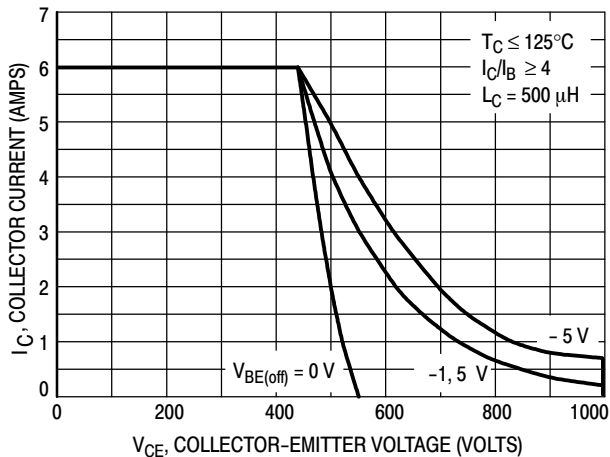


Figure 16. Reverse Bias Switching Safe Operating Area

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.

MJE18006G

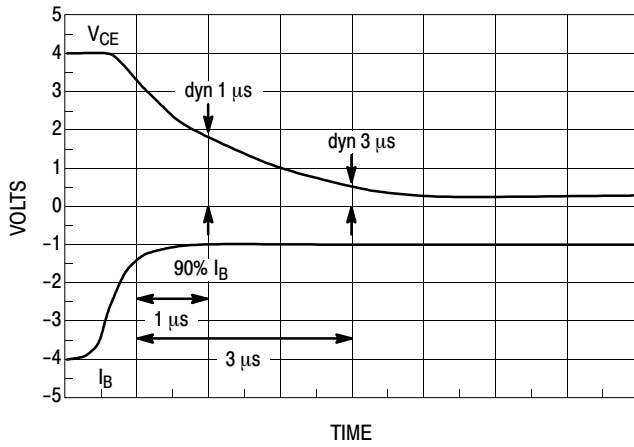


Figure 18. Dynamic Saturation Voltage Measurements

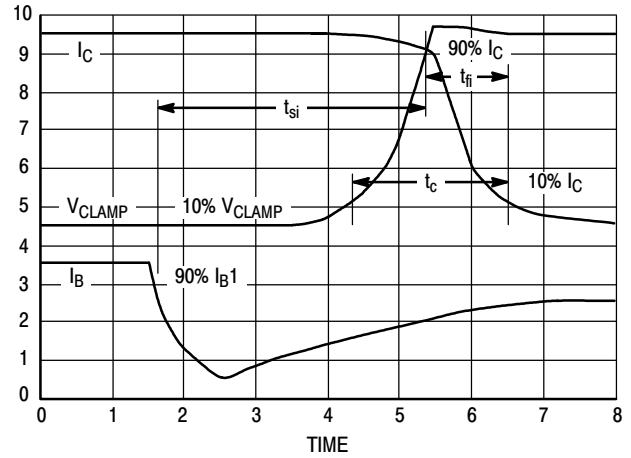
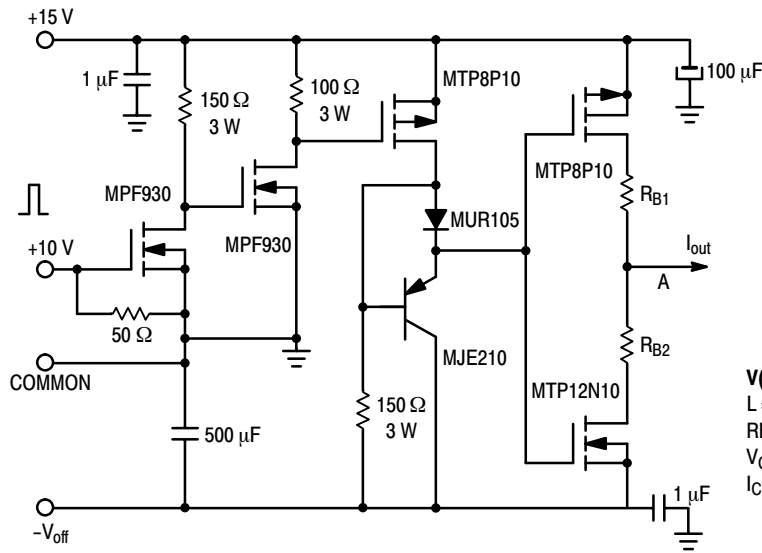


Figure 19. Inductive Switching Measurements



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

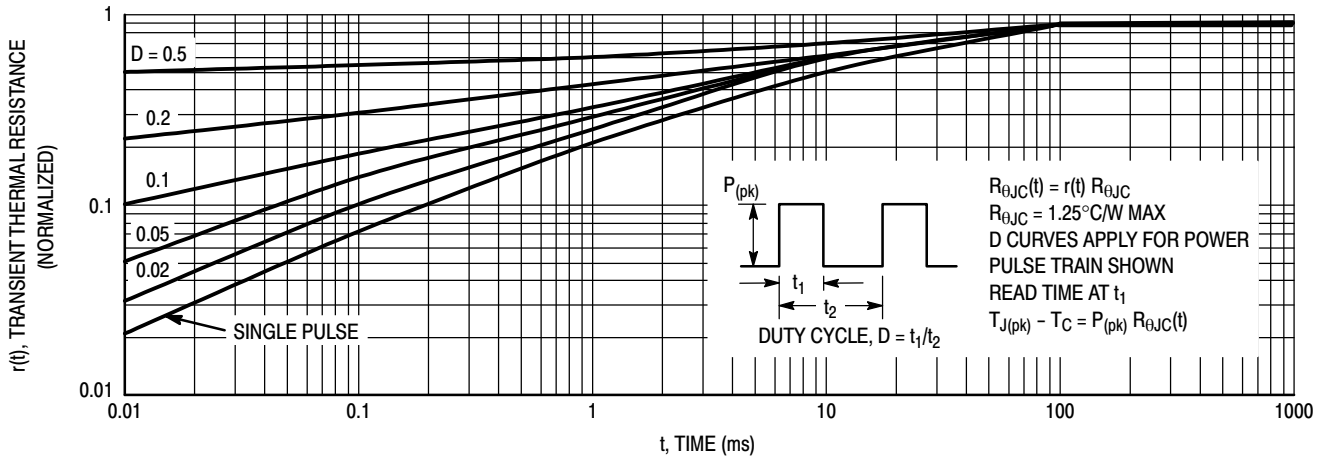
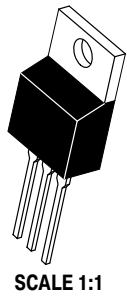


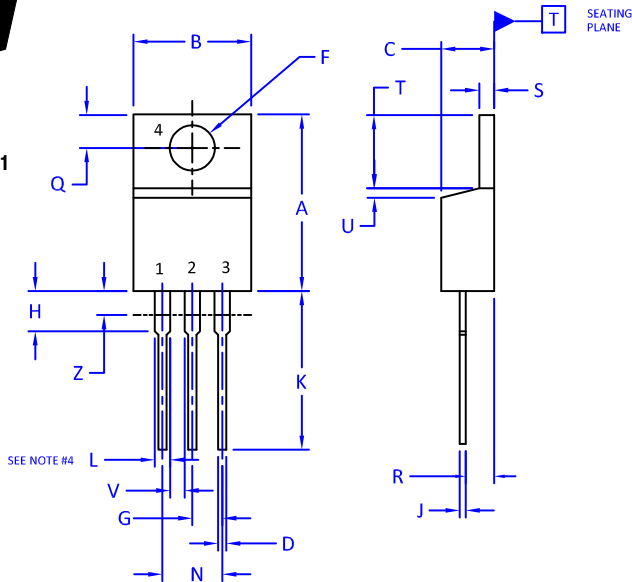
Figure 20. Typical Thermal Response ($Z_{\theta JC}(t)$) for MJE18006

MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



TO-220 CASE 221A ISSUE AK

DATE 13 JAN 2022



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 2009.
2. CONTROLLING DIMENSION: INCHES
3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.
4. MAX WIDTH FOR F102 DEVICE = 1.35MM

DIM	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	0.570	0.620	14.48	15.75
B	0.380	0.415	9.66	10.53
C	0.160	0.190	4.07	4.83
D	0.025	0.038	0.64	0.96
F	0.142	0.161	3.60	4.09
G	0.095	0.105	2.42	2.66
H	0.110	0.161	2.80	4.10
J	0.014	0.024	0.36	0.61
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	1.41
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:
PIN 1. BASE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

STYLE 2:
PIN 1. BASE
2. EMITTER
3. COLLECTOR
4. EMITTER

STYLE 3:
PIN 1. CATHODE
2. ANODE
3. GATE
4. ANODE

STYLE 4:
PIN 1. MAIN TERMINAL 1
2. MAIN TERMINAL 2
3. GATE
4. MAIN TERMINAL 2

STYLE 5:
PIN 1. GATE
2. DRAIN
3. SOURCE
4. DRAIN

STYLE 6:
PIN 1. ANODE
2. CATHODE
3. ANODE
4. CATHODE

STYLE 7:
PIN 1. CATHODE
2. ANODE
3. CATHODE
4. ANODE

STYLE 8:
PIN 1. CATHODE
2. ANODE
3. EXTERNAL TRIP/DELAY
4. ANODE

STYLE 9:
PIN 1. GATE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

STYLE 10:
PIN 1. GATE
2. SOURCE
3. DRAIN
4. SOURCE

STYLE 11:
PIN 1. DRAIN
2. SOURCE
3. GATE
4. SOURCE

STYLE 12:
PIN 1. MAIN TERMINAL 1
2. MAIN TERMINAL 2
3. GATE
4. NOT CONNECTED

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