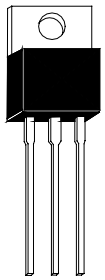
MJE13009

12 AMPERE NPN SILICON POWER TRANSISTOR



TO-220AB

Description

The MJE13009 is designed for high-voltage, high-speed power switching inductive circuits where fall time is critical. They are particularly suited for 115 and 220V switch-controls, Solenoid/Relay drivers and Deflectioncircuits.

Specification Features

- $V_{CEO(sus)}$=400V
- Reverse Bias SOA with Inductive Loads @T_C=100°C
- Inductive Switching Matrix 3 to 12 Amp., 25 and 100°C…tc@8A, 100°C is 120ns(Typ.)
- 700V Blocking Capability
- SOA and Switching Applications Information

Absolute Maximum Ratings

Characteristic	Symbol	Max.	Unit
Collector-Emitter Voltage	$V_{CEO(sus)}$	400	Vdc
Collector-Base Voltage	V_{CBO}	700	Vdc
Emitter-Base Voltage	V_{EBO}	9	Vd
Collector Current-Continuous	I_C	12	Adc
Collector Current-Peak*	I_{CM}	24	Adc
Base Current-Continuous	I_B	6	Adc
Base Current-Peak*	I_{BM}	12	Adc
Emitter Current-Continuous	I_E	18	Adc
Emitter Current-Peak	I_{EM}	36	Adc
Total Power Dissipation@T_A=25°C Derate above 25°C	P_D	2 16	Watts mW/°C
Total Power Dissipation@T_C=25°C Derate above 25°C	P_D	100 800	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-65 to +150	°C

*Pulse Test: Pulse Width ≤380us, Duty Cycle≤2%

Thermal Characteristics

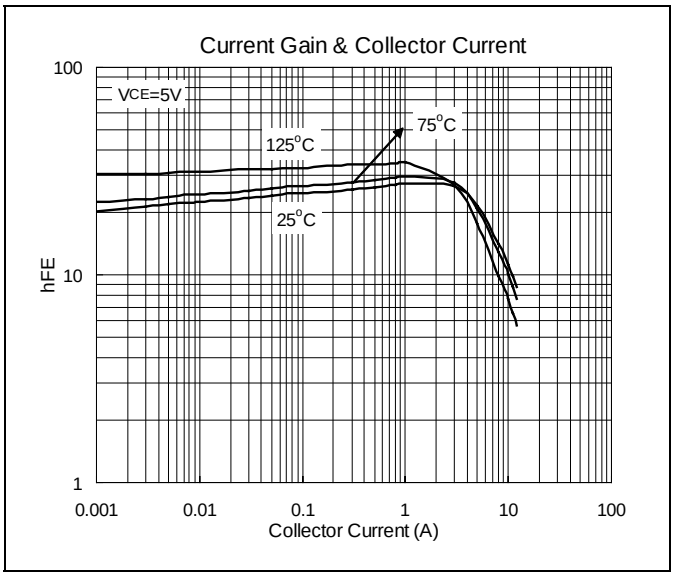
Characteristic	Symbol	Max.	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.25	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	62.5	°C/W
Maximum Lead Temperature for Soldering Purposes: 1/8” from Case for 5 Seconds	T_L	275	°C

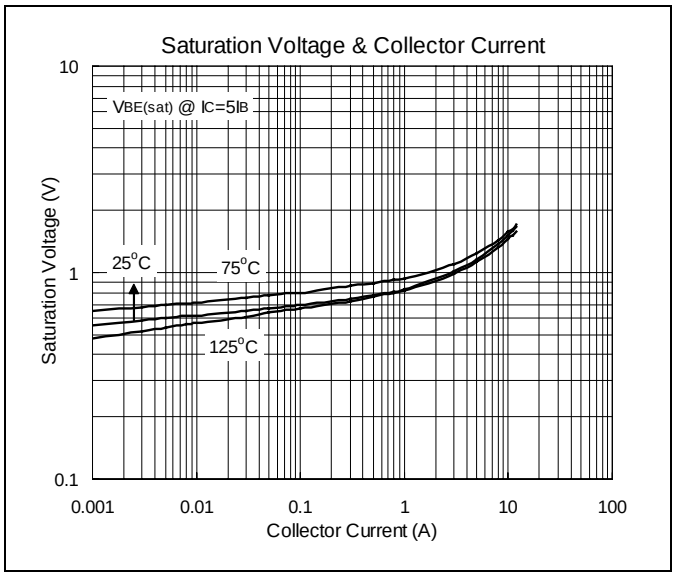
Electrical Characteristics (T_A=25°C unless otherwise noted)

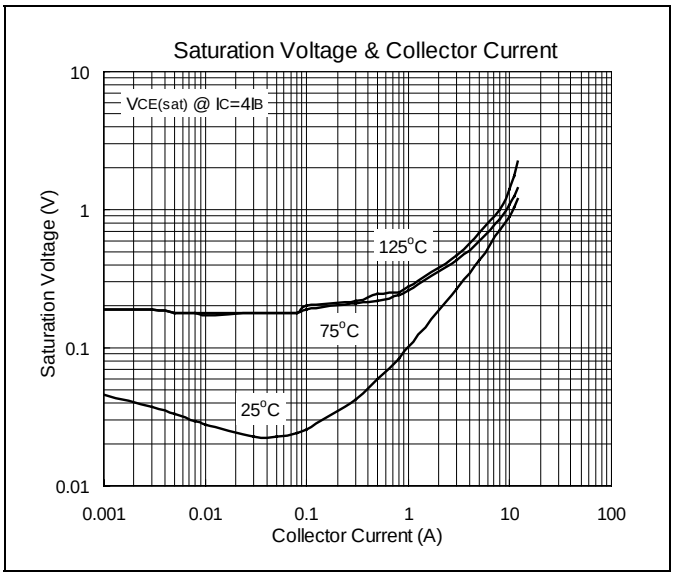
Characteristic	Symbol	Min.	Typ.	Max.	Unit
• Off Characteristics					
Collector-Emitter Sustaining Voltage (I_C=10mA, I_B=0)	$V_{CEO(sus)}$	400	-	-	Vdc
Collector Cutoff Current (V_{CEV}=Rated Value, $V_{BE(off)}$=1.5Vdc (V_{CEV}=Rated Value, $V_{BE(off)}$=1.5Vdc, T_C=100°C)	I_{CEV}	- -	- -	1 5	mAdc
Emitter Cutoff Current (V_{EB}=9Vdc, I_C=0)	I_{EBO}	-	-	1	mAdc
• Second Breakdown					
Second Breakdown Collector Current with base forward biased Clamped Inductive SOA with Base Reverse Biased	Is/b	See Figure 1 See Figure 2			
• On Characteristics					
DC Current Gain (I_C=0.5Adc, V_{CE}=5Vdc) DC Current Gain (I_C=5Adc, V_{CE}=5Vdc) DC Current Gain (I_C=8Adc, V_{CE}=5Vdc) DC Current Gain (I_C=12Adc, V_{CE}=5Vdc)	*h_{FE1} *h_{FE2} *h_{FE3} *h_{FE4}	15 13 8 5	- - - -	- 22 - -	
Collector-Emitter Saturation Voltage (I_C=5Adc, I_B=1Adc) (I_C=8Adc, I_B=1.6Adc) (I_C=12Adc, I_B=3Adc) (I_C=8Adc, I_B=1.6Adc, T_C=100°C)	 *$V_{CE(sat)1}$ *$V_{CE(sat)2}$ *$V_{CE(sat)3}$ *$V_{CE(sat)4}$	 - - - -	 - - - -	 1 1.5 3 2	Vdc
Base-Emitter Saturation Voltage (I_C=5Adc, I_B=1Adc) (I_C=8Adc, I_B=1.6Adc) (I_C=8Adc, I_B=1.6Adc, T_C=100°C)	 *$V_{BE(sat)1}$ *$V_{BE(sat)2}$ *$V_{BE(sat)3}$	 - - -	 - - -	 1.3 1.6 1.5	Vdc
• Dynamic Characteristics					
Current Gain Bandwidth Product (I_C=500mAdc, V_{CE}=10Vdc, f=1MHz)	f_T	4	-	-	MHz
Output Capacitance (V_{CB}=10Vdc, I_E=0, f=0.1MHz)	Cob	-	180	-	pF
• Switching Characteristics					
Delay Time	(V_{CC}=125Vdc, I_C=8A) I_{B1}=I_{B2}=1.6A, tp=25uS Duty Cycle≤1%	td	-	0.06	0.1	uS
Rise Time		tr	-	0.45	1	uS
Storage Time		ts	-	1.3	3	uS
Fall Time		tf	-	0.2	0.7	uS
• Inductive Load, Clamped						
Voltage Storage Time	(I_C=8Adc, V_{clamp}=300Vdc) (I_{B1}=1.6Adc,$V_{BE(off)}$=5Vdc, T_C=100°C)	tsv	-	0.92	2.3	uS
Crossover Time		tc	-	0.12	0.7	uS

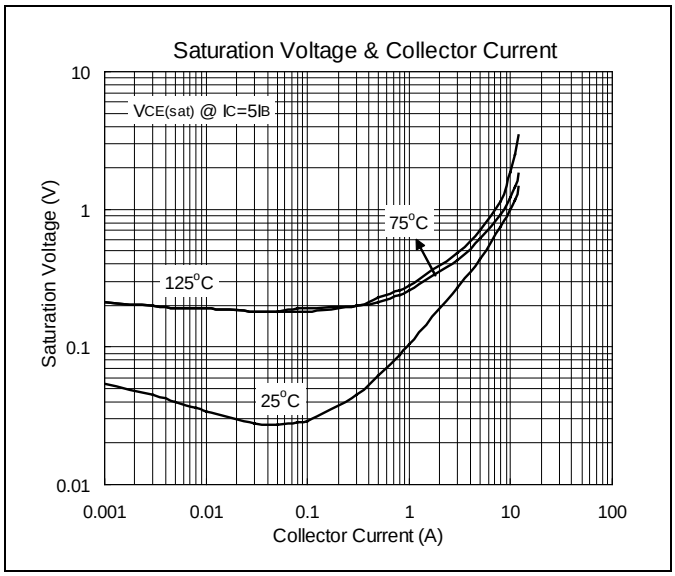
*Pulse Test: Pulse Width ≤380us, Duty Cycle≤2%

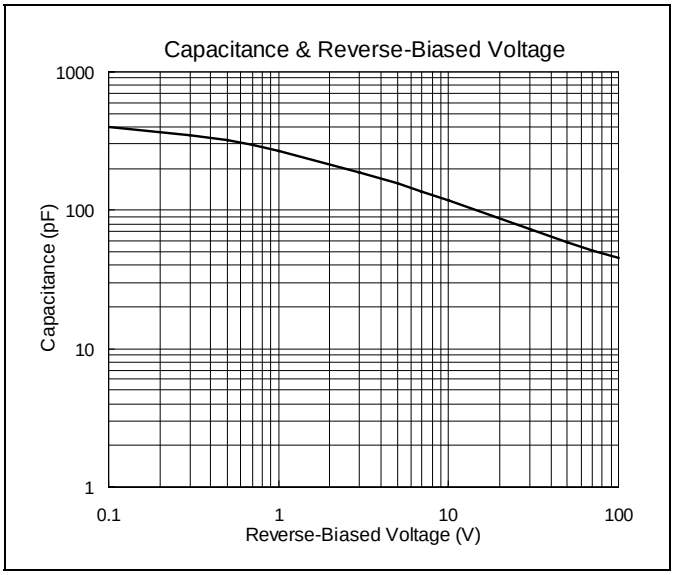
Characteristics Curve

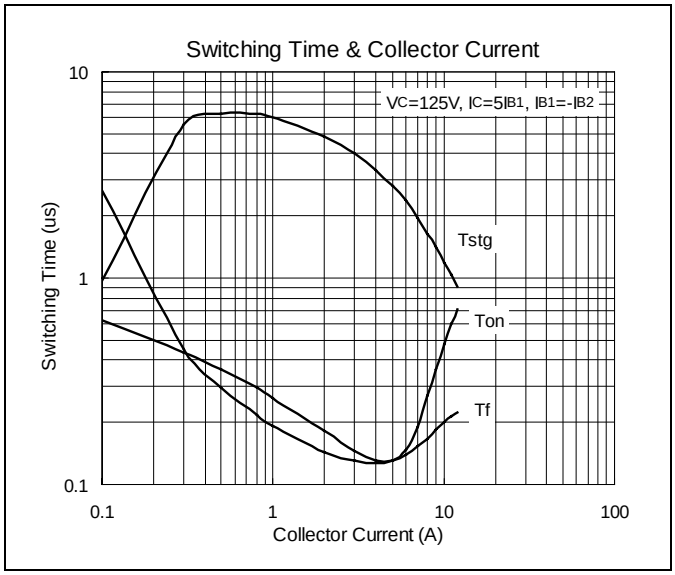


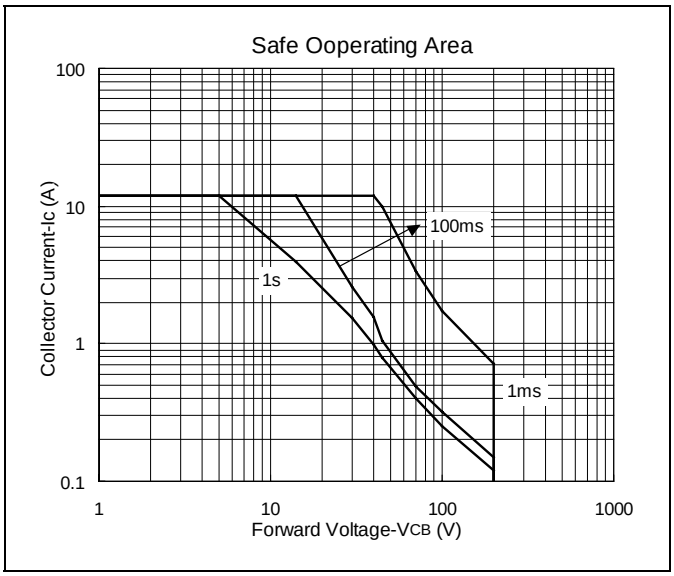




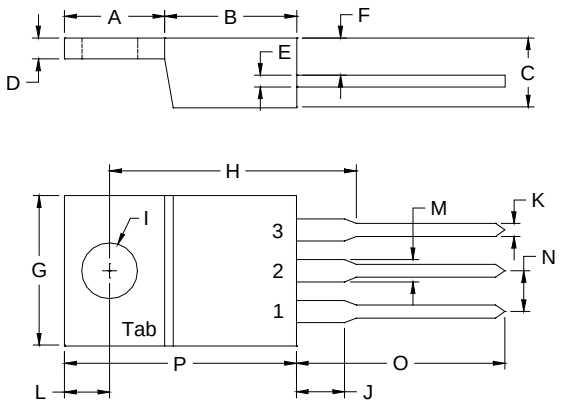







Safe Ooperating Area
100
10
1
0.1
Collector Current-Ic (A)
100ms
1s
1ms
1
10
100
1000
Forward Voltage-VCB (V)

TO-220AB Dimension



DIM	Min.	Max.
A	5.58	7.49
B	8.38	8.90
C	4.40	4.70
D	1.15	1.39
E	0.35	0.60
F	2.03	2.92
G	9.66	10.28
H	-	*16.25
I	-	*3.83
J	3.00	4.00
K	0.75	0.95
L	2.54	3.42
M	1.14	1.40
N	-	*2.54
O	12.70	14.27
P	14.48	15.87

*: Typical, Unit: mm

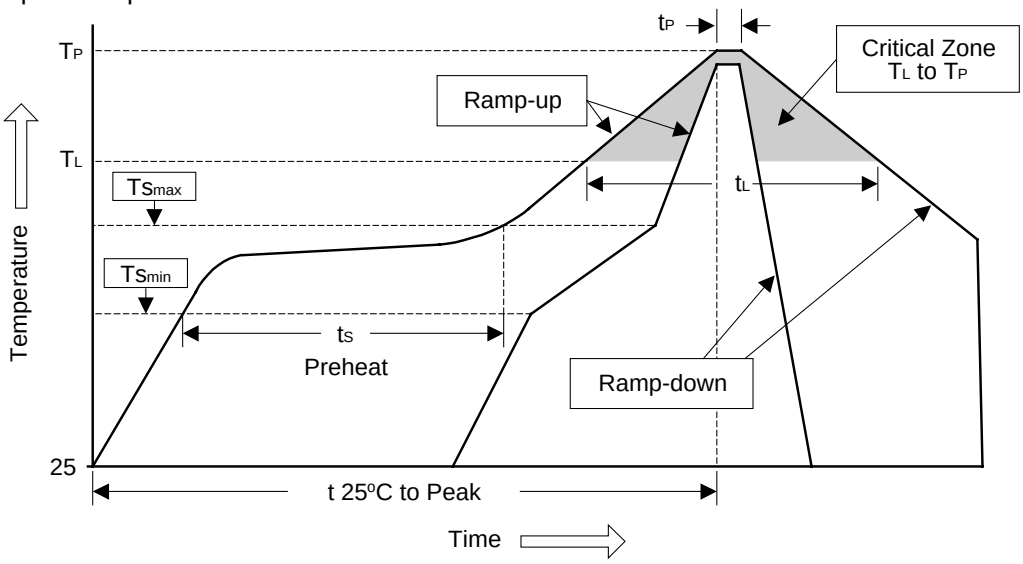
3-Lead TO-220AB
Plastic Package
HSMC Package Code: E

Soldering Methods for HSMC's Products

1. Storage environment: Temperature=10°C~35°C Humidity=65%±15%

2. Reflow soldering of surface-mount devices

Figure 1: Temperature profile



Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Average ramp-up rate (T_L to T_P)	<3°C/sec	<3°C/sec
Preheat - Temperature Min (Ts_{min}) - Temperature Max (Ts_{max}) - Time (min to max) (ts)	 100°C 150°C 60~120 sec	 150°C 200°C 60~180 sec
Tsmax to T_L - Ramp-up Rate	 <3°C/sec	 <3°C/sec
Time maintained above: - Temperature (T_L) - Time (t_L)	 183°C 60~150 sec	 217°C 60~150 sec
Peak Temperature (T_P)	240°C +0/-5°C	260°C +0/-5°C
Time within 5°C of actual Peak Temperature (t_P)	10~30 sec	20~40 sec
Ramp-down Rate	<6°C/sec	<6°C/sec
Time 25°C to Peak Temperature	<6 minutes	<8 minutes

3. Flow (wave) soldering (solder dipping)

Products	Peak temperature	Dipping time
Pb devices.	245°C ±5°C	10sec ±1sec
Pb-Free devices.	260°C ±5°C	10sec ±1sec