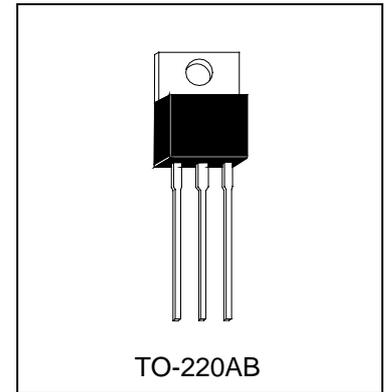


MJE13009

12 AMPERE NPN SILICON POWER TRANSISTOR

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 Deflection circuits.



Specification Features

- $V_{CEO(sus)}=400V$
- Reverse Bias SOA with Inductive Loads @ $T_C=100^{\circ}C$
- Inductive Switching Matrix 3 to 12 Amp., 25 and $100^{\circ}C$...tc@8A, $100^{\circ}C$ 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@ $T_A=25^{\circ}C$ Derate above $25^{\circ}C$	P_D	2 16	Watts mW/ $^{\circ}C$
Total Power Dissipation@ $T_C=25^{\circ}C$ Derate above $25^{\circ}C$	P_D	100 800	Watts mW/ $^{\circ}C$
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-65 to +150	$^{\circ}C$

*Pulse Test: Pulse Width $\leq 380\mu s$, Duty Cycle $\leq 2\%$

Thermal Characteristics

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

Electrical Characteristics ($T_A=25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min.	Typ.	Max.	Unit
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• Off Characteristics

Collector-Emitter Sustaining Voltage ($I_C=10\text{mA}$, $I_B=0$)	$V_{CEO(sus)}$	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 Clamped Inductive SOA with Base Reverse Biased	Is/b	See Figure 1 See Figure 2			
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• On Characteristics

DC Current Gain ($I_C=0.5\text{Adc}$, $V_{CE}=5\text{Vdc}$)	$^*h_{FE1}$	15	-	-	
DC Current Gain ($I_C=5\text{Adc}$, $V_{CE}=5\text{Vdc}$)	$^*h_{FE2}$	13	-	22	
DC Current Gain ($I_C=8\text{Adc}$, $V_{CE}=5\text{Vdc}$)	$^*h_{FE3}$	8	-	-	
DC Current Gain ($I_C=12\text{Adc}$, $V_{CE}=5\text{Vdc}$)	$^*h_{FE4}$	5	-	-	
Collector-Emitter Saturation Voltage ($I_C=5\text{Adc}$, $I_B=1\text{Adc}$) ($I_C=8\text{Adc}$, $I_B=1.6\text{Adc}$) ($I_C=12\text{Adc}$, $I_B=3\text{Adc}$) ($I_C=8\text{Adc}$, $I_B=1.6\text{Adc}$, $T_C=100^\circ\text{C}$)	$^*V_{CE(sat)1}$ $^*V_{CE(sat)2}$ $^*V_{CE(sat)3}$ $^*V_{CE(sat)4}$	- - - -	- - - -	1 1.5 3 2	Vdc
Base-Emitter Saturation Voltage ($I_C=5\text{Adc}$, $I_B=1\text{Adc}$) ($I_C=8\text{Adc}$, $I_B=1.6\text{Adc}$) ($I_C=8\text{Adc}$, $I_B=1.6\text{Adc}$, $T_C=100^\circ\text{C}$)	$^*V_{BE(sat)1}$ $^*V_{BE(sat)2}$ $^*V_{BE(sat)3}$	- - -	- - -	1.3 1.6 1.5	Vdc

• Dynamic Characteristics

Current Gain Bandwidth Product ($I_C=500\text{mAdc}$, $V_{CE}=10\text{Vdc}$, $f=1\text{MHz}$)	f_T	4	-	-	MHz
Output Capacitance ($V_{CB}=10\text{Vdc}$, $I_E=0$, $f=0.1\text{MHz}$)	Cob	-	180	-	pF

• Switching Characteristics

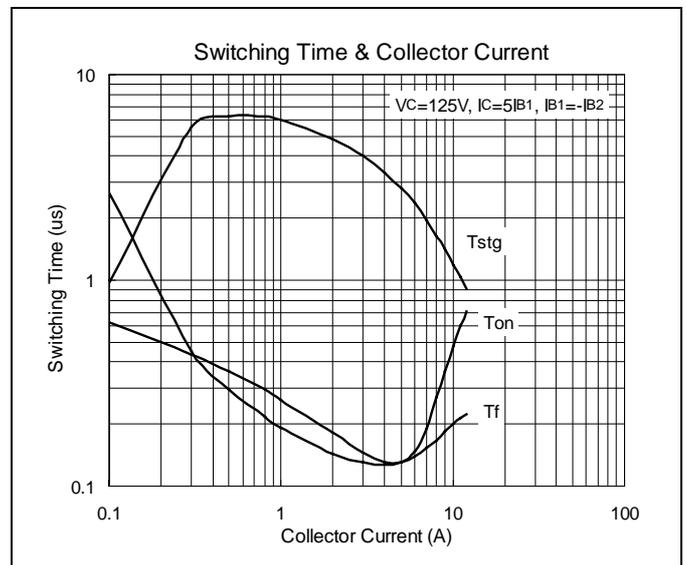
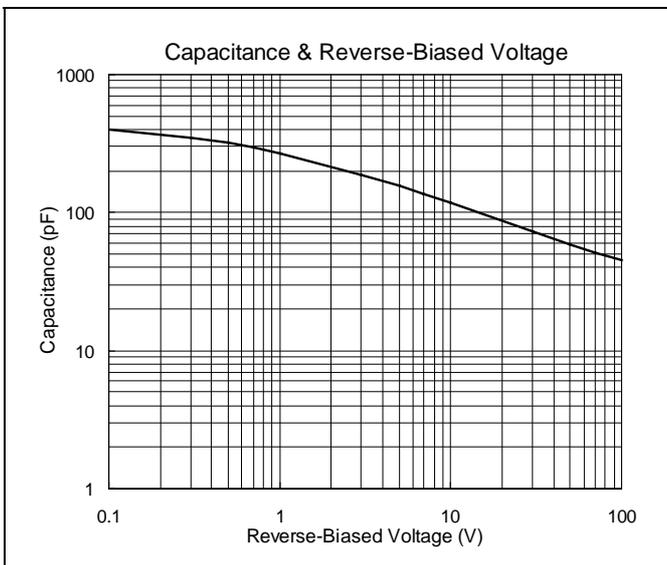
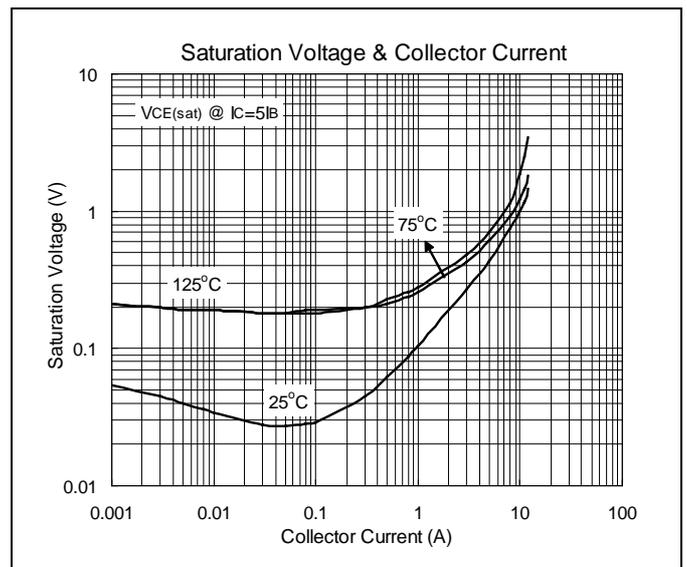
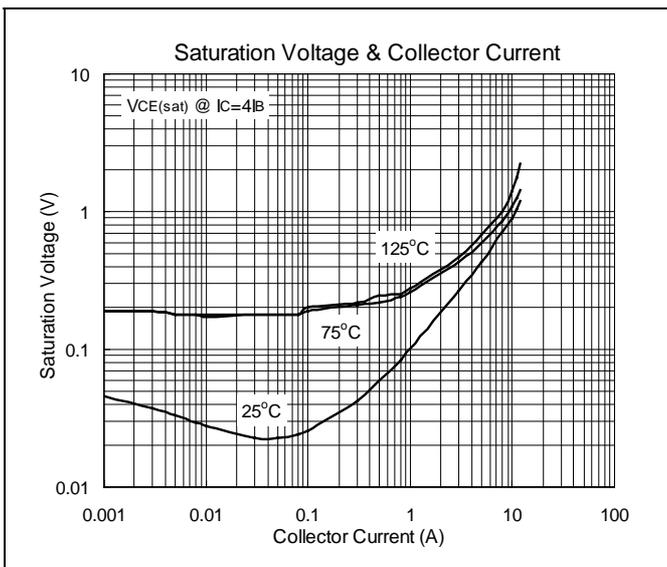
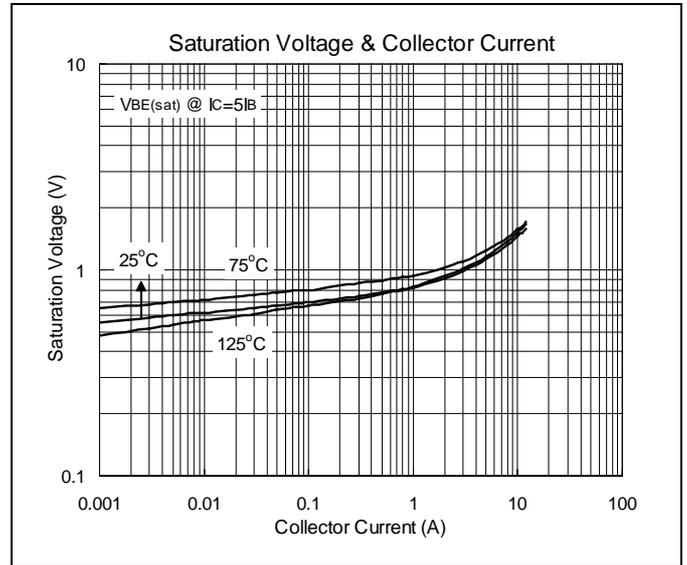
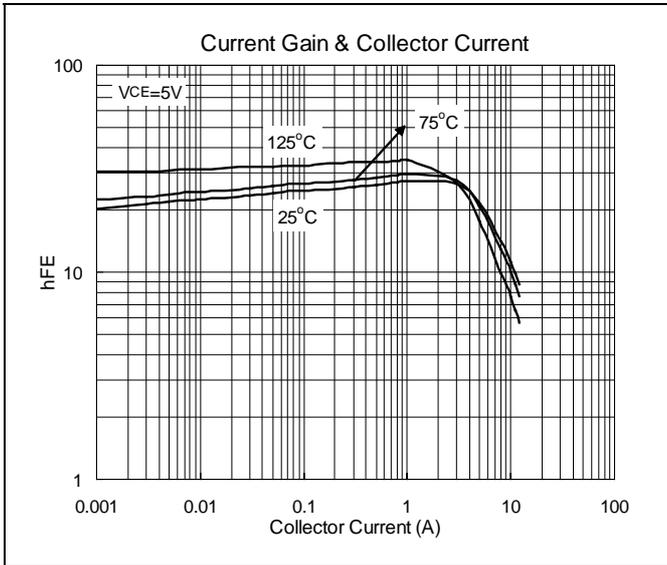
Delay Time	$(V_{CC}=125\text{Vdc}$, $I_C=8\text{A}$ $I_{B1}=I_{B2}=1.6\text{A}$, $t_p=25\mu\text{s}$ Duty Cycle $\leq 1\%$	td	-	0.06	0.1	μs
Rise Time		tr	-	0.45	1	μs
Storage Time		ts	-	1.3	3	μs
Fall Time		tf	-	0.2	0.7	μs

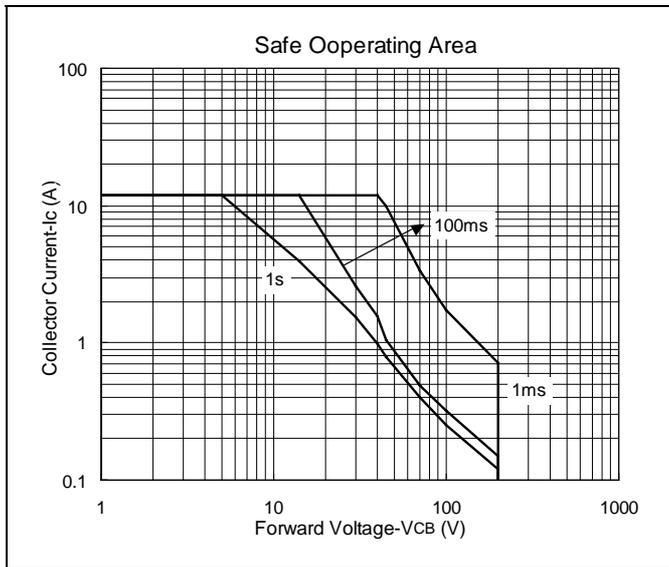
• Inductive Load, Clamped

Voltage Storage Time	$(I_C=8\text{Adc}$, $V_{clamp}=300\text{Vdc}$)	t _{sv}	-	0.92	2.3	μs
Crossover Time	$(I_{B1}=1.6\text{Adc}$, $V_{BE(off)}=5\text{Vdc}$, $T_C=100^\circ\text{C}$)	t _c	-	0.12	0.7	μs

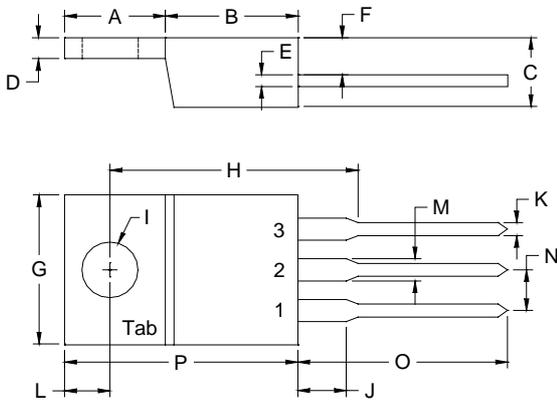
*Pulse Test: Pulse Width $\leq 380\mu\text{s}$, Duty Cycle $\leq 2\%$

Characteristics Curve





TO-220AB Dimension



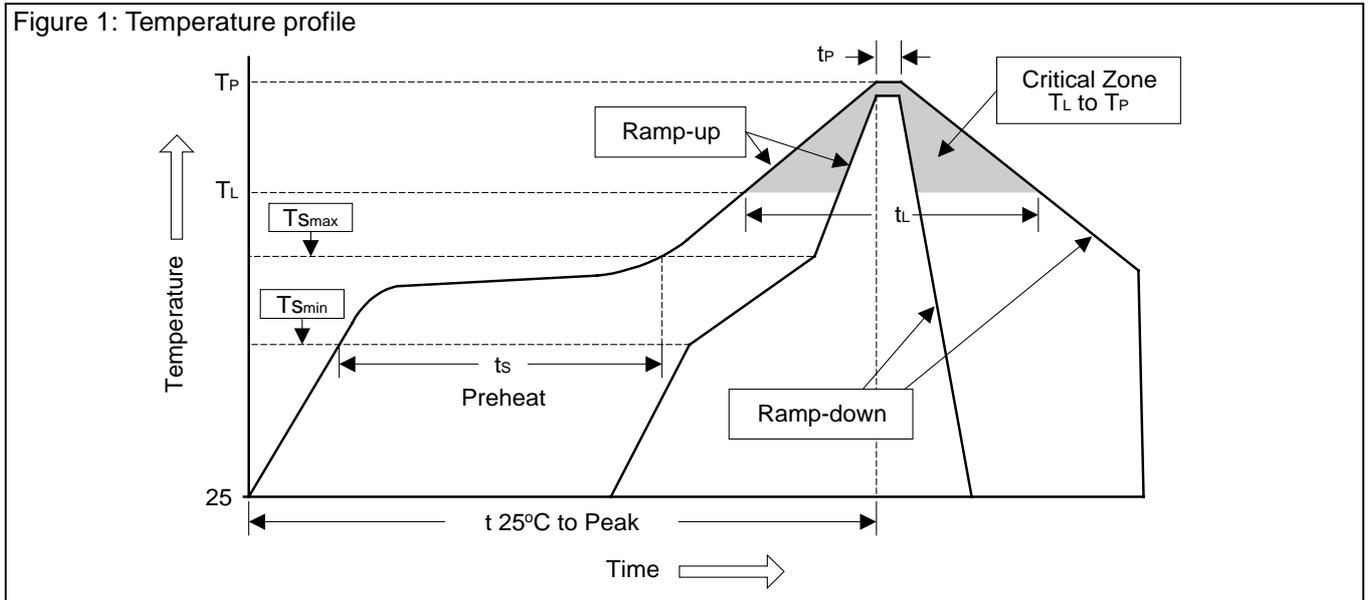
DIM	Min.	Max.
A	5.58	7.49
B	8.38	8.90
C	4.40	4.70
D	1.15	1.39
E	0.35	0.60
F	2.03	2.92
G	9.66	10.28
H	-	*16.25
I	-	*3.83
J	3.00	4.00
K	0.75	0.95
L	2.54	3.42
M	1.14	1.40
N	-	*2.54
O	12.70	14.27
P	14.48	15.87

*: 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



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 (T_{Smin})	100°C	150°C
- Temperature Max (T_{Smax})	150°C	200°C
- Time (min to max) (t_s)	60~120 sec	60~180 sec
T_{Smax} to T_L		
- Ramp-up Rate	<3°C/sec	<3°C/sec
Time maintained above:		
- Temperature (T_L)	183°C	217°C
- Time (t_L)	60~150 sec	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