

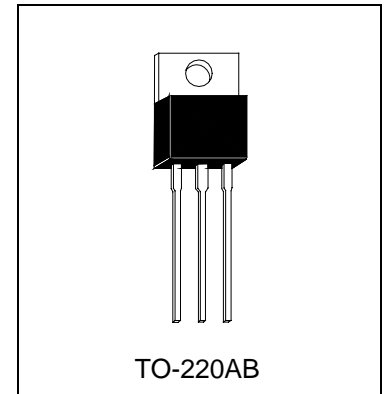


# HMJE13009A

12 AMPERE NPN SILICON POWER TRANSISTOR

## Description

The HMJE13009A 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 ( $I_C=5\text{Adc}$ , $I_B=1\text{Adc}$ )	$^*V_{CE(sat)1}$	-	-	1	Vdc
( $I_C=8\text{Adc}$ , $I_B=1.6\text{Adc}$ )	$^*V_{CE(sat)2}$	-	-	1.5	
( $I_C=12\text{Adc}$ , $I_B=3\text{Adc}$ )	$^*V_{CE(sat)3}$	-	-	3	
( $I_C=8\text{Adc}$ , $I_B=1.6\text{Adc}$ , $T_C=100^\circ\text{C}$ )	$^*V_{CE(sat)4}$	-	-	2	
Base-Emitter Saturation Voltage ( $I_C=5\text{Adc}$ , $I_B=1\text{Adc}$ )	$^*V_{BE(sat)1}$	-	-	1.3	Vdc
( $I_C=8\text{Adc}$ , $I_B=1.6\text{Adc}$ )	$^*V_{BE(sat)2}$	-	-	1.6	
( $I_C=8\text{Adc}$ , $I_B=1.6\text{Adc}$ , $T_C=100^\circ\text{C}$ )	$^*V_{BE(sat)3}$	-	-	1.5	

#### • 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	$\mu\text{s}$
Rise Time		tr	-	0.45	1	$\mu\text{s}$
Storage Time		ts	-	1.3	3	$\mu\text{s}$
Fall Time		tf	-	0.2	0.7	$\mu\text{s}$

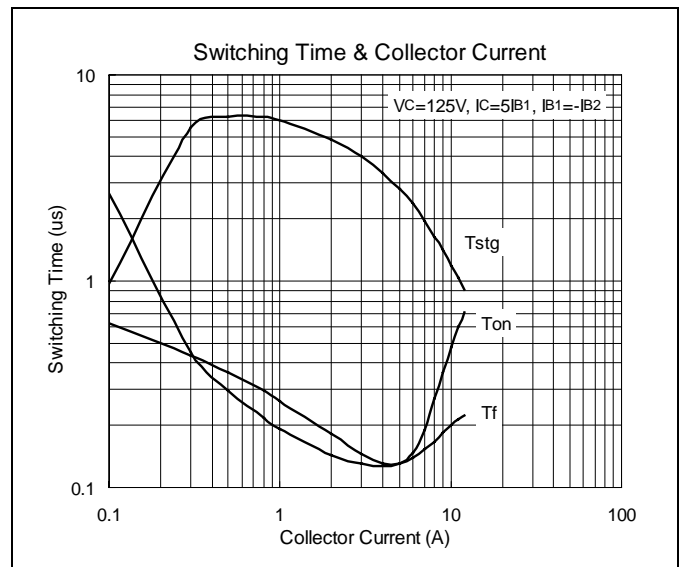
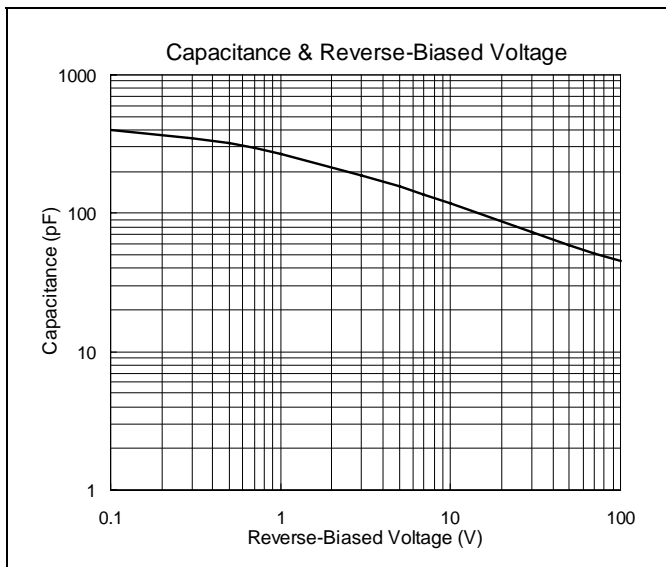
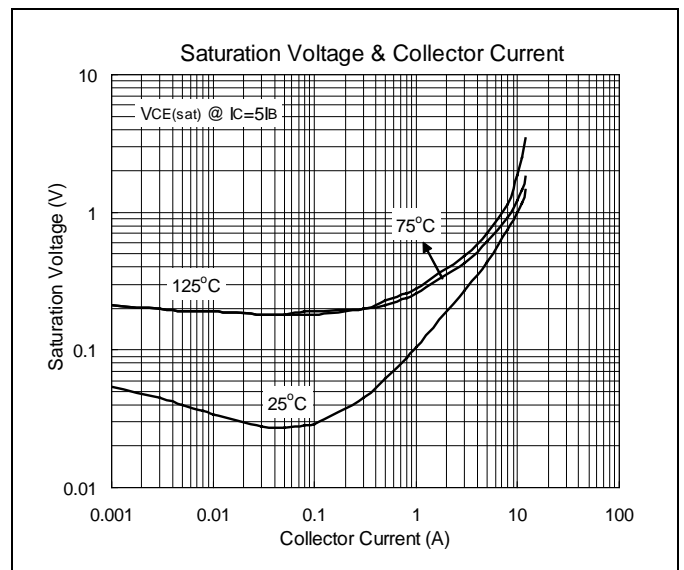
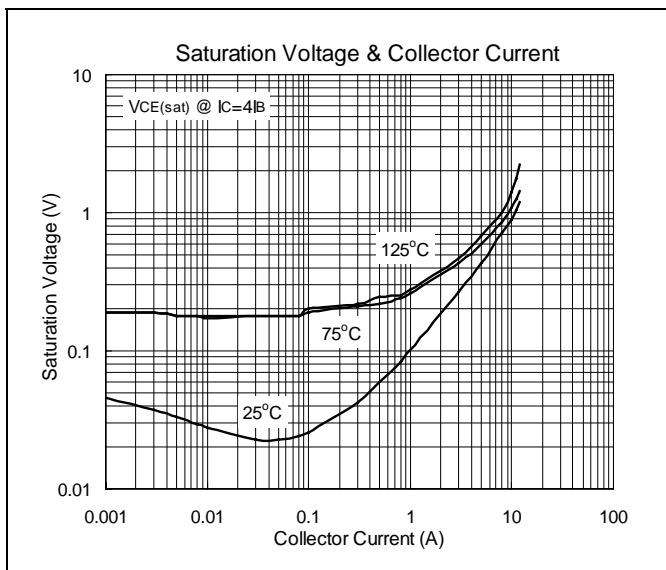
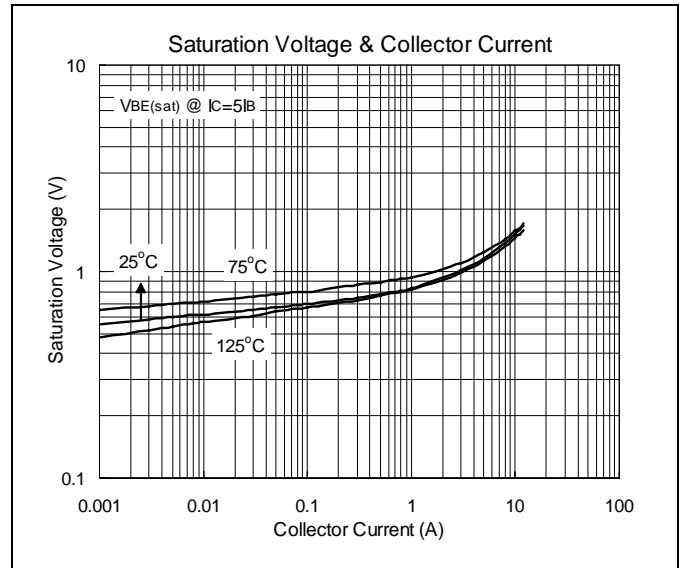
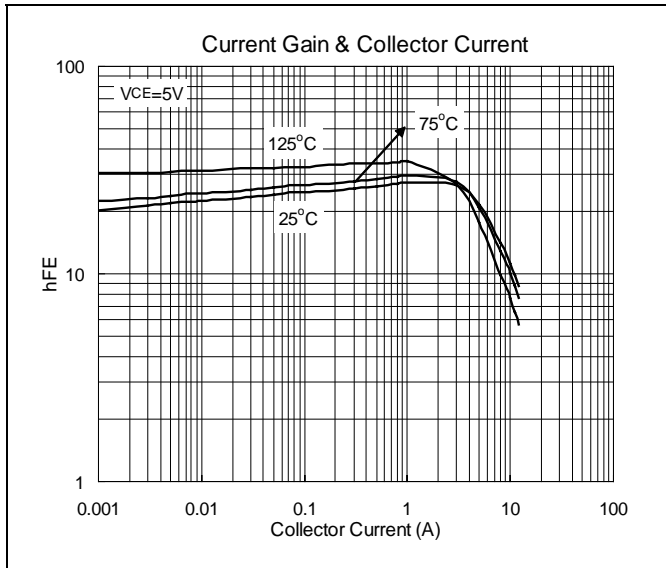
#### • Inductive Load, Clamped

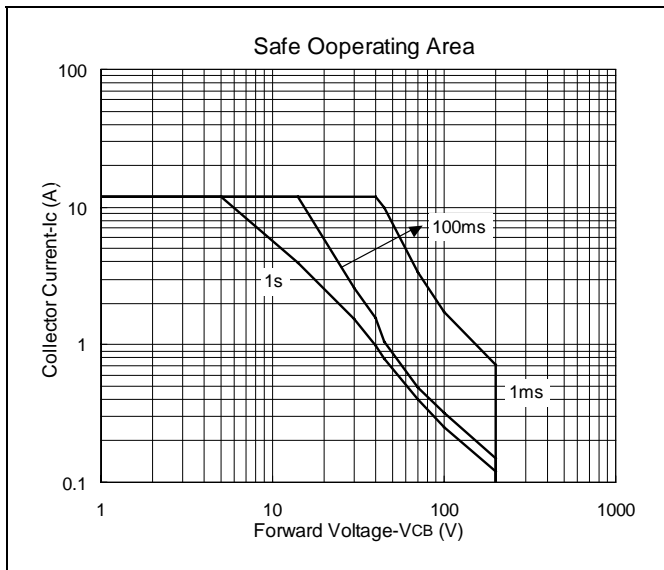
Voltage Storage Time	$(I_C=8\text{Adc}$ , $V_{clamp}=300\text{Vdc}$ )	t <sub>sv</sub>	-	0.92	2.3	$\mu\text{s}$
Crossover Time	$(I_{B1}=1.6\text{Adc}$ , $V_{BE(off)}=5\text{Vdc}$ , $T_C=100^\circ\text{C}$ )	t <sub>c</sub>	-	0.12	0.7	$\mu\text{s}$

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



### Characteristics Curve







### TO-220AB Dimension

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

**Marking:**

Pb Free Mark  
 Pb-Free: "•" (Note)  
 Normal: None

Date Code      Control Code

Note: Green label is used for pb-free packing

Pin Style: 1.Base 2.Collector 3.Emitter

Material:

- Lead solder plating: Sn60/Pb40 (Normal), Sn/3.0Ag/0.5Cu or Pure-Tin (Pb-free)
- Mold Compound: Epoxy resin family, flammability solid burning class: UL94V-0

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

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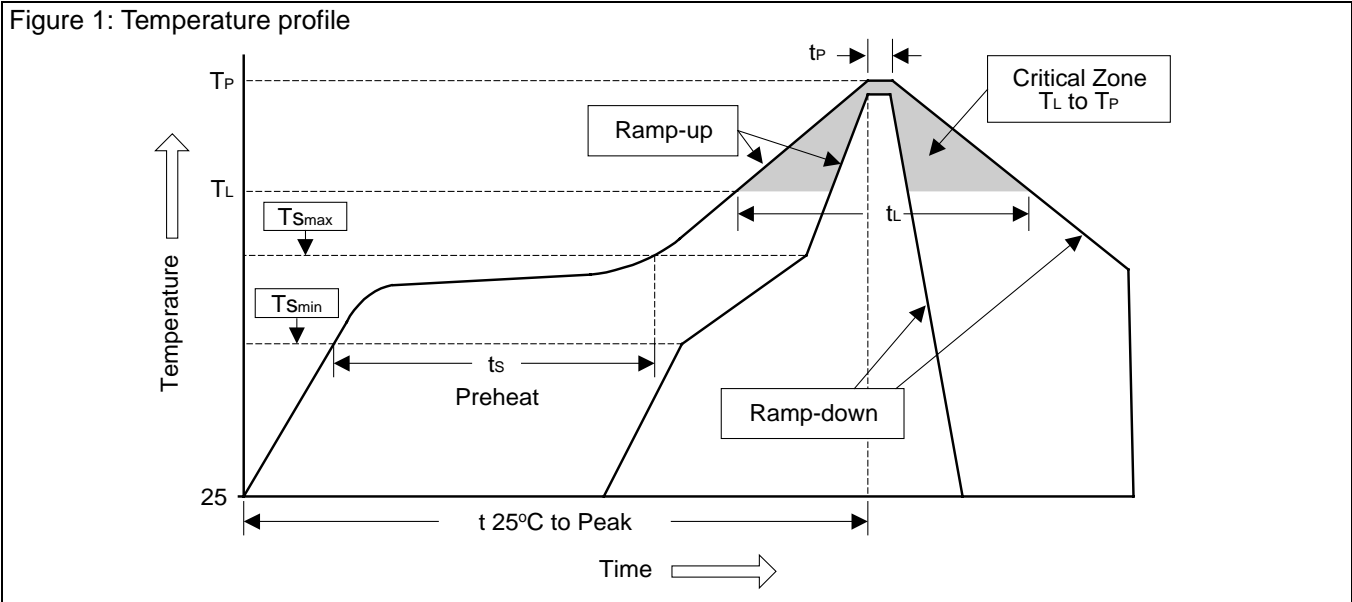
#### Head Office And Factory:

- **Head Office** (Hi-Sincerity Microelectronics Corp.): 10F., No. 61, Sec. 2, Chung-Shan N. Rd. Taipei Taiwan R.O.C.  
 Tel: 886-2-25212056 Fax: 886-2-25632712, 25368454
- **Factory 1:** No. 38, Kuang Fu S. Rd., Fu-Kou Hsin-Chu Industrial Park Hsin-Chu Taiwan. R.O.C  
 Tel: 886-3-5983621~5 Fax: 886-3-5982931



### 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