

# High-Current Complementary Silicon Power Transistors

... designed for use in high-power amplifier and switching circuit applications,

- High Current Capability —  $I_C$  Continuous = 60 Amperes
- DC Current Gain —  $h_{FE} = 15-100$  @  $I_C = 50$  Adc
- Low Collector-Emitter Saturation Voltage —  
 $V_{CE(sat)} = 2.5$  Vdc (Max) @  $I_C = 50$  Adc

## MAXIMUM RATINGS

Rating	Symbol	MJ14001	MJ14002 MJ14003	Unit
Collector-Emitter Voltage	$V_{CEO}$	60	80	Vdc
Collector Base Voltage	$V_{CBO}$	60	80	Vdc
Emitter-Base Voltage	$V_{EBO}$	5		Vdc
Collector Current — Continuous	$I_C$	60		Adc
Base Current — Continuous	$I_B$	15		Adc
Emitter Current — Continuous	$I_E$	75		
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	300	17	Watts W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	$T_J, T_{stg}$	-65 to +200		$^\circ\text{C}$

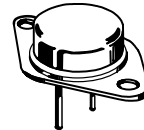
## THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.584	$^\circ\text{C/W}$

**NPN**  
**MJ14002\***  
**PNP**  
**MJ14001**  
**MJ14003\***

\*Motorola Preferred Device

**60 AMPERES**  
**COMPLEMENTARY**  
**SILICON**  
**POWER TRANSISTORS**  
**60-80 VOLTS**  
**300 WATTS**



**CASE 197A-05**  
**TO-204AE (TO-3)**

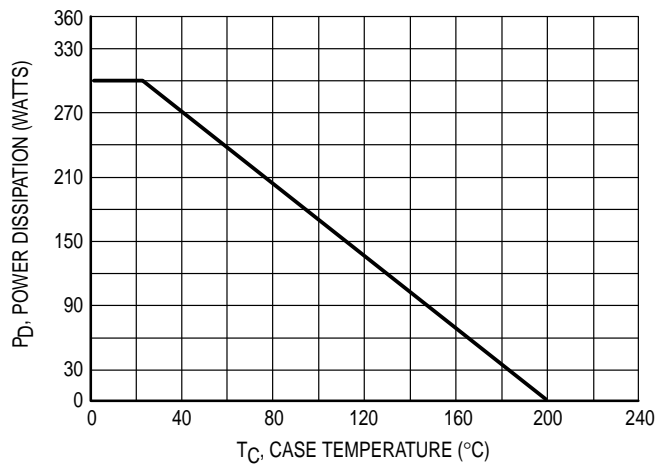


Figure 1. Power Derating

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

# MJ14002 MJ14001 MJ14003

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

Characteristic	Symbol	Min	Max	Unit
<b>OFF CHARACTERISTICS</b>				
Collector–Emitter Sustaining Voltage (1) ( $I_C = 200\text{ mAdc}$ , $I_B = 0$ )	$V_{CEO(sus)}$	60 80	— —	Vdc
Collector Cutoff Current ( $V_{CE} = 30\text{ Vdc}$ , $I_B = 0$ ) ( $V_{CE} = 40\text{ Vdc}$ , $I_B = 0$ )	$I_{CEO}$	— —	1.0 1.0	mA
Collector Cutoff Current ( $V_{CE} = 60\text{ Vdc}$ , $V_{BE(off)} = 1.5\text{ V}$ ) ( $V_{CE} = 80\text{ Vdc}$ , $V_{BE(off)} = 1.5\text{ V}$ )	$I_{CEX}$	— —	1.0 1.0	mA
Collector Cutoff Current ( $V_{CB} = 60\text{ Vdc}$ , $I_E = 0$ ) ( $V_{CB} = 80\text{ Vdc}$ , $I_E = 0$ )	$I_{CBO}$	— —	1.0 1.0	mA
Emitter Cutoff Current ( $V_{BE} = 5\text{ Vdc}$ , $I_C = 0$ )	$I_{EBO}$	—	1.0	mA

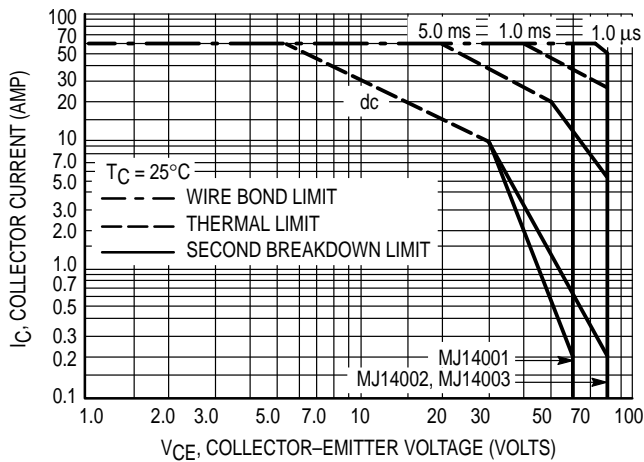
## ON CHARACTERISTICS

DC Current Gain (1) ( $I_C = 25\text{ Adc}$ , $V_{CE} = 3.0\text{ V}$ ) ( $I_C = 50\text{ Adc}$ , $V_{CE} = 3.0\text{ V}$ ) ( $I_C = 60\text{ Adc}$ , $V_{CE} = 3.0\text{ V}$ )	$h_{FE}$	30 15 5	— 100 —	—
Collector–Emitter Saturation Voltage (1) ( $I_C = 25\text{ Adc}$ , $I_B = 2.5\text{ Adc}$ ) ( $I_C = 50\text{ Adc}$ , $I_B = 5.0\text{ Adc}$ ) ( $I_C = 60\text{ Adc}$ , $I_B = 12\text{ Adc}$ )	$V_{CE(sat)}$	— — —	1 2.5 3	Vdc
Base–Emitter Saturation Voltage (1) ( $I_C = 25\text{ Adc}$ , $I_B = 2.5\text{ Adc}$ ) ( $I_C = 50\text{ Adc}$ , $I_B = 5.0\text{ Adc}$ ) ( $I_C = 60\text{ Adc}$ , $I_B = 12\text{ Adc}$ )	$V_{BE(sat)}$	— — —	2 3 4	Vdc

## DYNAMIC CHARACTERISTICS

Output Capacitance ( $V_{CB} = 10\text{ Vdc}$ , $I_E = 0$ , $f = 0.1\text{ MHz}$ )	$C_{ob}$	—	2000	pF
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(1) Pulse Test: Pulse Width = 300  $\mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

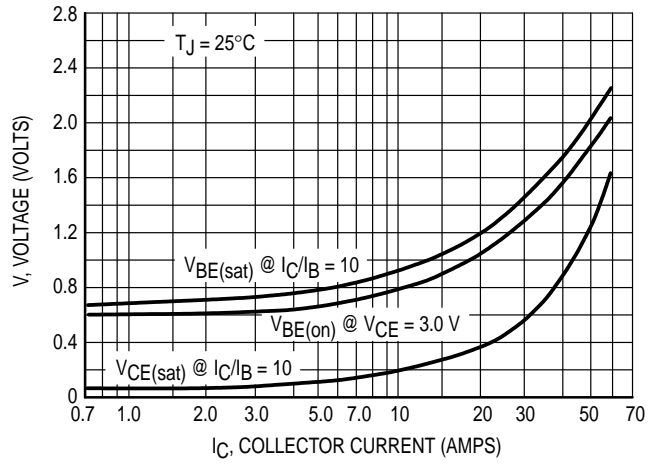
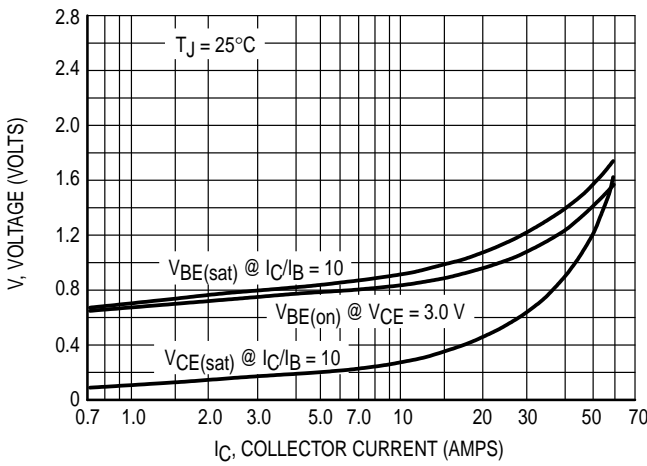
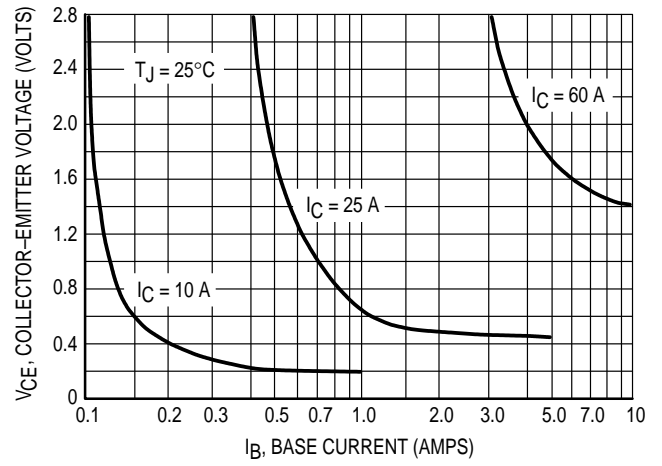
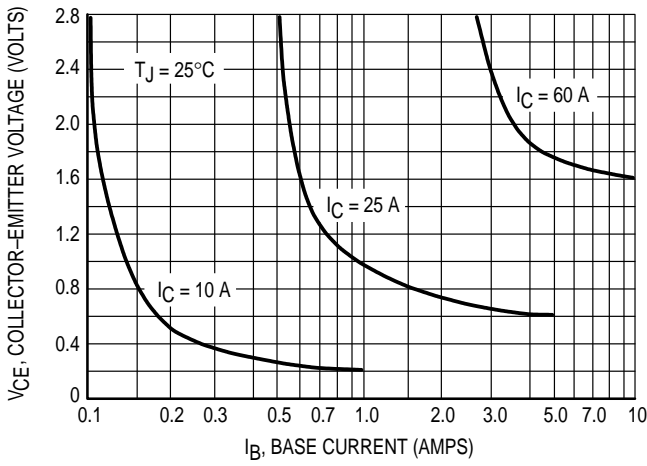
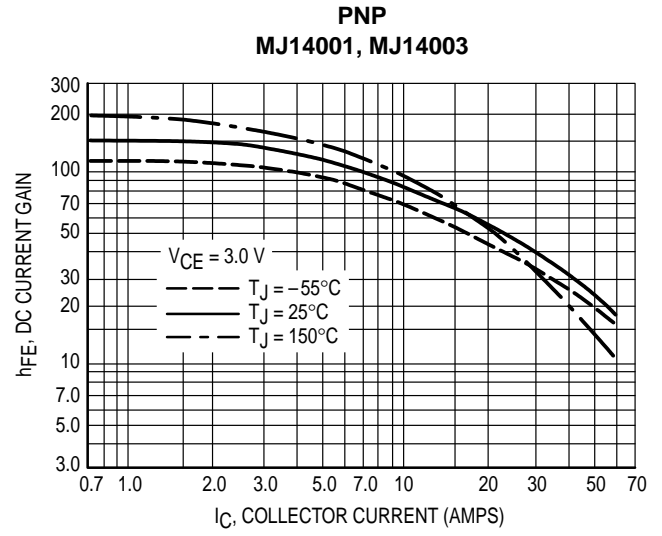
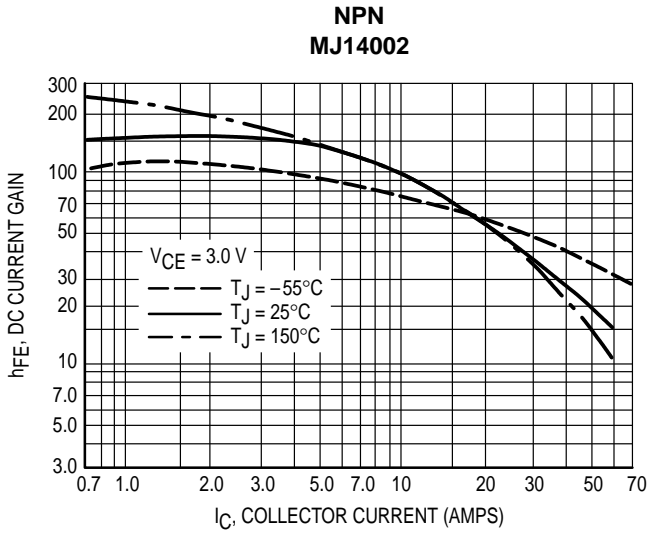


**Figure 2. Maximum Rated Forward Biased Safe Operating Area**

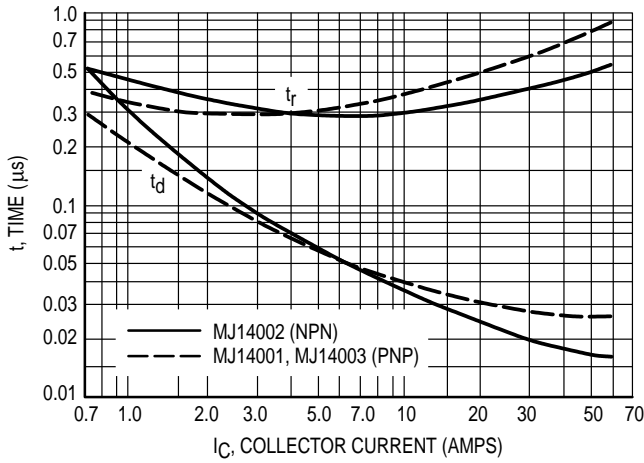
There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe operating area curves indicate  $I_C - V_{CE}$  limits of the transistor that must be observed for reliable operation: i.e., the transistor must not be subjected to greater dissipation than the curves indicate.

The data of Figure 2 is based on  $T_{J(pk)} = 200^\circ\text{C}$ ;  $T_C$  is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided  $T_{J(pk)} \leq 200^\circ\text{C}$ .  $T_{J(pk)}$  may be calculated from the data in Figure 13. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

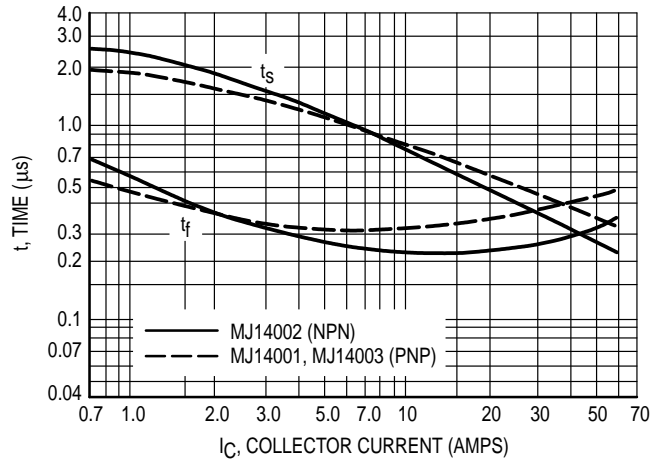
TYPICAL ELECTRICAL CHARACTERISTICS



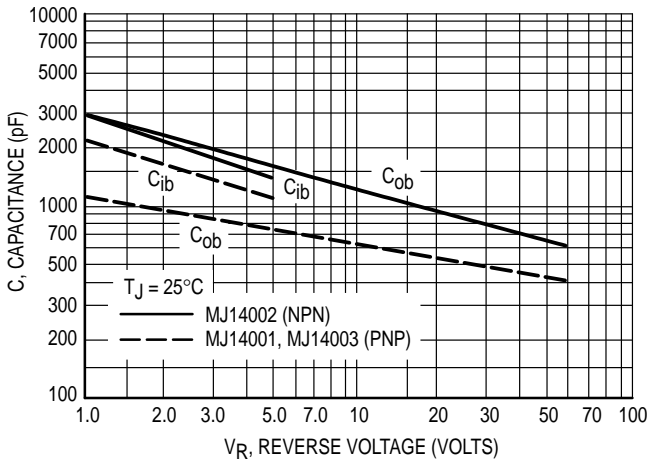
**MJ14002 MJ14001 MJ14003**



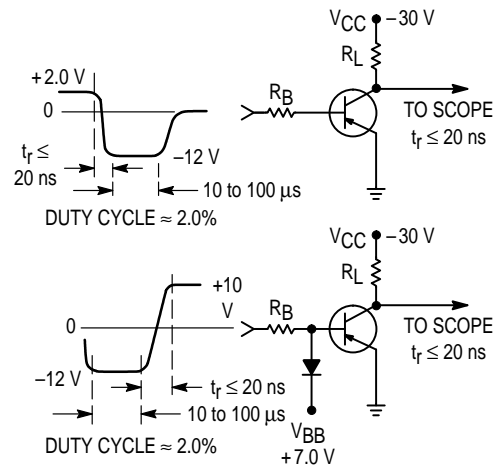
**Figure 9. Turn-On Switching Times**



**Figure 10. Turn-Off Switching Times**

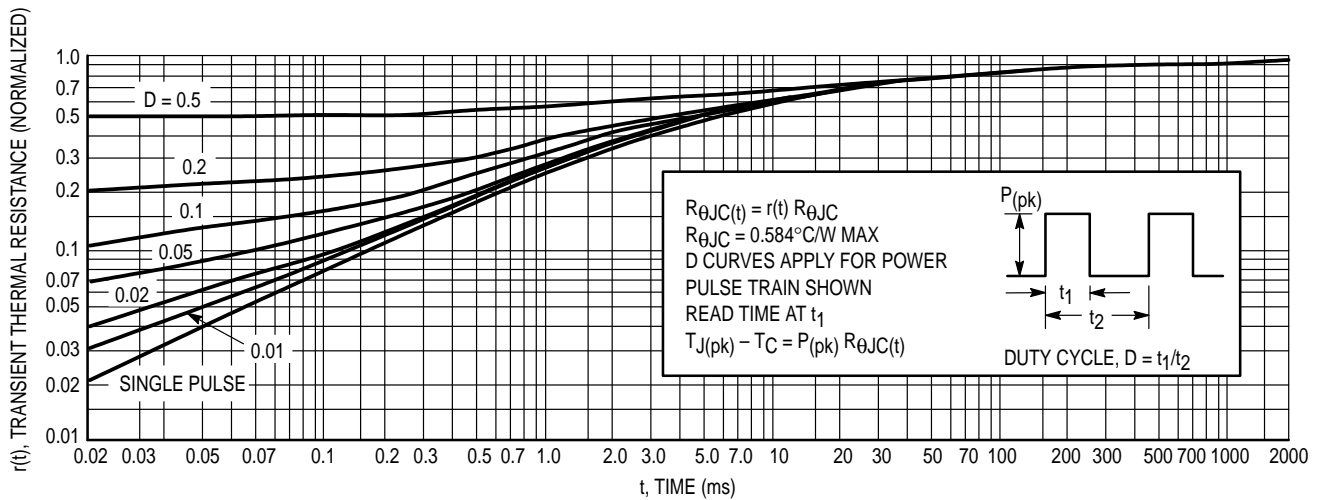


**Figure 11. Capacitance Variation**



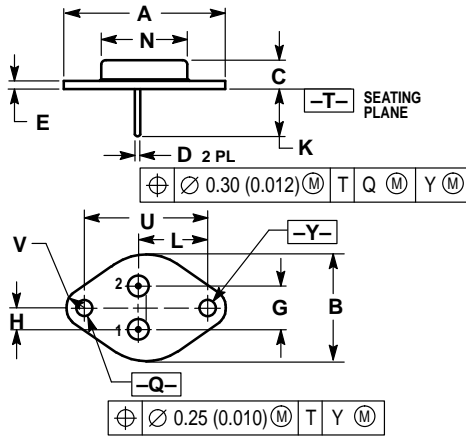
FOR CURVES OF FIGURES 3 & 6,  $R_B$  &  $R_L$  ARE VARIED. INPUT LEVELS ARE APPROXIMATELY AS SHOWN. FOR NPN CIRCUITS, REVERSE ALL POLARITIES.

**Figure 12. Switching Test Circuit**



**Figure 13. Thermal Response**

PACKAGE DIMENSIONS




- NOTES:  
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
 2. CONTROLLING DIMENSION: INCH.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	1.530 REF		38.86 REF	
B	0.990	1.050	25.15	26.67
C	0.250	0.335	6.35	8.51
D	0.057	0.063	1.45	1.60
E	0.060	0.070	1.53	1.77
G	0.430 BSC		10.92 BSC	
H	0.215 BSC		5.46 BSC	
K	0.440	0.480	11.18	12.19
L	0.665 BSC		16.89 BSC	
N	0.760	0.830	19.31	21.08
Q	0.151	0.165	3.84	4.19
U	1.187 BSC		30.15 BSC	
V	0.131	0.188	3.33	4.77

STYLE 1:  
 PIN 1: BASE  
 2: EMITTER  
 CASE: COLLECTOR

CASE 197A-05  
 TO-204AE (TO-3)  
 ISSUE J

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