

## Advance Information

# SWITCHMODE Series

## NPN Silicon Power Transistors

These transistors are designed for high-voltage, high-speed, power switching in inductive circuits where fall time is critical. They are particularly suited for line-operated switchmode applications. The MJ16022 is a selected high-gain version of the MJ16020 for applications where drive current is limited.

Features:

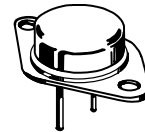
- Fast Switching Times:
  - 30 ns (Typ) Inductive Fall Time
  - 50 ns (Typ) Inductive Crossover Time
  - 800 ns (Typ) Inductive Storage Time
- 100°C Performance Specified for:
  - Reverse-Biased SOA with Inductive Loads
  - Switching Times with Inductive Loads
  - Saturation Voltages

Typical Applications:

- Switching Regulators
- Inverters
- Solenoids and Relay Drivers
- Motor Controls
- Deflection Circuits

**MJ16020**  
**MJ16022**

**NPN SILICON POWER  
TRANSISTOR  
30 AMPERES  
450 VOLTS**



**CASE 197A-05  
TO-204AE**

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

Rating	Symbol	Max	Unit
Collector-Emitter Sustaining Voltage	$V_{CEO}$	450	Vdc
Collector-Emitter Breakdown Voltage	$V_{CEV}$	850	Vdc
Emitter-Base Voltage	$V_{EB}$	6	Vdc
Collector Current — Continuous	$I_C$	30	Adc
— Peak (1)	$I_{CM}$	40	
Base Current — Continuous	$I_B$	20	Adc
— Peak (1)	$I_{BM}$	30	
Total Power Dissipation @ $T_C = 25^\circ\text{C}$	$P_D$	250	Watts
Derate above $25^\circ\text{C}$		1.42	W/°C
Operating and Storage Temperature	$T_J, T_{stg}$	-65 to 200	°C

### THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance — Junction to Case	$R_{\theta JC}$	0.7	°C/W
Maximum Lead Temperature for Soldering Purposes: 1/8" from Case for 5 Seconds	$T_L$	275	°C

(1) Pulse Test: Pulse Width = 5 ms, Duty Cycle < 10%.

This document contains information on a new product. Specifications and information herein are subject to change without notice.

REV 7

**MJ16020 MJ16022****ELECTRICAL CHARACTERISTICS** ( $T_C = 25^\circ\text{C}$  unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS*</b>					
Collector–Emitter Sustaining Voltage ( $I_C = 1\text{ mA}$ , $I = 0$ )	$V_{CEO(sus)}$	450	—	—	Vdc
Collector Cutoff Current ( $V_{CE} = 850\text{ Vdc}$ , $R_{BE} = 50\text{ Ohms}$ , $T_C = 100^\circ\text{C}$ )	$I_{CER}$	—	—	—	mAdc
Collector Cutoff Current ( $V_{CE} = 850\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ ) ( $V_{CE} = 850\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ )	$I_{CES}$	— —	— —	0.5 5	nAdc
Emitter Cutoff Current ( $V_{EB} = 6\text{ Vdc}$ , $I_C = 0$ )	$I_{EBO}$	—	—	2	nAdc
<b>ON CHARACTERISTICS*</b>					
Base–Emitter Saturation Voltage ( $I_C = 20\text{ Adc}$ , $I_B = 2\text{ Adc}$ ) ( $I_C = 20\text{ Adc}$ , $I_B = 2\text{ Adc}$ )	$V_{BE(sat)}$	— —	— —	1.5 1.5	Vdc
Collector–Emitter Saturation Voltage ( $I_C = 20\text{ Adc}$ , $I_B = 1.4\text{ Adc}$ ) ( $I_C = 20\text{ Adc}$ , $I_B = 2.6\text{ Adc}$ ) ( $I_C = 20\text{ Adc}$ , $I_B = 2.6\text{ Adc}$ )	$V_{CE(sat)}$	— — —	— — —	2.5 3 3	Vdc
DC Current Gain ( $I_C = 30\text{ Adc}$ , $V_{CE} = 5\text{ Vdc}$ )	$h_{FE}$	5 7	— —	— —	—
<b>DYNAMIC CHARACTERISTICS</b>					
Output Capacitance ( $V_{CB} = 10\text{ Vdc}$ , $I_E = 0$ , $f_{test} = 1\text{ MHz}$ )	$C_{ob}$	—	—	800	pF

\* Indicates Pulse Test: Pulse Width = 300  $\mu\text{s}$  Max, Duty Cycle = 2%.

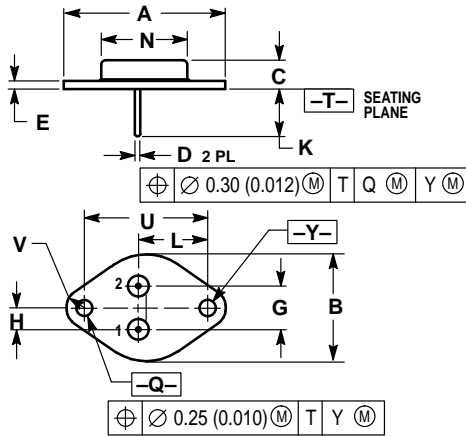
**ELECTRICAL CHARACTERISTICS** ( $T_C = 25^\circ\text{C}$  unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit		
<b>SWITCHING CHARACTERISTICS: MJ16020</b>							
<b>Resistive Load</b>							
Delay Time	$(V_{CC} = 250\text{ Vdc},$ $I_C = 20\text{ Adc},$ $I_{B1} = 2.6\text{ Adc},$ $t_p = 30\ \mu\text{s},$ Duty Cycle < 2%)	$I_{B2} = 5.2\text{ Adc}$ $R_B = 1.6\ \text{Ohm}$	$t_d$	—	20	—	ns
Rise Time			$t_r$	—	200	—	
Storage Time			$t_s$	—	1200	—	
Fall Time		$t_f$	—	200	—		
Storage Time		$(V_{BE(off)} = 5\text{ Vdc})$	$t_s$	—	650	—	
Fall Time			$t_f$	—	80	—	
<b>Inductive Load</b>							
Storage Time	$(I_C = 20\text{ A}, I_{B1} = 2.6\text{ Adc},$ $V_{CE(pk)} = 400\text{ V},$ $V_{BE(off)} = 5\text{ Vdc})$	$(T_C = 100^\circ\text{C})$	$t_{sv}$	—	800	2000	ns
Crossover Time			$t_{fi}$	—	50	200	
Fall Time			$t_c$	—	90	250	
Storage Time	$(I_C = 20\text{ A}, I_{B1} = 2.6\text{ Adc},$ $V_{CE(pk)} = 400\text{ V},$ $V_{BE(off)} = 5\text{ Vdc})$	$(T_C = 150^\circ\text{C})$	$t_{sv}$	—	1050	—	ns
Crossover Time			$t_{fi}$	—	70	—	
Fall Time			$t_c$	—	120	—	

**SWITCHING CHARACTERISTICS: MJ16022**

<b>Resistive Load</b>							
Delay Time	$(V_{CC} = 250\text{ Vdc},$ $I_C = 20\text{ Adc},$ $I_{B1} = 2.6\text{ Adc},$ $t_p = 30\ \mu\text{s},$ Duty Cycle < 2%)	$I_{B2} = 5.2\text{ Adc}$ $R_B = 1.6\ \text{Ohm}$	$t_d$	—	20	—	ns
Rise Time			$t_r$	—	200	—	
Storage Time			$t_s$	—	900	—	
Fall Time		$t_f$	—	150	—		
Storage Time		$(V_{BE(off)} = 5\text{ Vdc})$	$t_s$	—	500	—	
Fall Time			$t_f$	—	40	—	
<b>Inductive Load</b>							
Storage Time	$(I_C = 20\text{ A}, I_{B1} = 2.6\text{ Adc},$ $V_{CE(pk)} = 400\text{ V},$ $V_{BE(off)} = 5\text{ Vdc})$	$(T_C = 100^\circ\text{C})$	$t_{sv}$	—	650	1700	ns
Crossover Time			$t_{fi}$	—	30	150	
Fall Time			$t_c$	—	50	200	
Storage Time	$(I_C = 20\text{ A}, I_{B1} = 2.6\text{ Adc},$ $V_{CE(pk)} = 400\text{ V},$ $V_{BE(off)} = 5\text{ Vdc})$	$(T_C = 150^\circ\text{C})$	$t_{sv}$	—	850	—	ns
Crossover Time			$t_{fi}$	—	30	—	
Fall Time			$t_c$	—	70	—	

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  
 ISSUE J

Motorola reserves the right to make changes without further notice to any products herein. Motorola makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Motorola assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. "Typical" parameters can and do vary in different applications. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. Motorola does not convey any license under its patent rights nor the rights of others. Motorola products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the Motorola product could create a situation where personal injury or death may occur. Should Buyer purchase or use Motorola products for any such unintended or unauthorized application, Buyer shall indemnify and hold Motorola and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that Motorola was negligent regarding the design or manufacture of the part. Motorola and are registered trademarks of Motorola, Inc. Motorola, Inc. is an Equal Opportunity/Affirmative Action Employer.

How to reach us:  
 USA / EUROPE: Motorola Literature Distribution;  
 P.O. Box 20912; Phoenix, Arizona 85036. 1-800-441-2447

JAPAN: Nippon Motorola Ltd.; Tatsumi-SPD-JLDC, Toshikatsu Otsuki,  
 6F Seibu-Butsuryu-Center, 3-14-2 Tatsumi Koto-Ku, Tokyo 135, Japan. 03-3521-8315

MFAX: RMFAX0@email.sps.mot.com - TOUCHTONE (602) 244-6609  
 INTERNET: http://Design-NET.com

HONG KONG: Motorola Semiconductors H.K. Ltd.; 8B Tai Ping Industrial Park,  
 51 Ting Kok Road, Tai Po, N.T., Hong Kong. 852-26629298

