

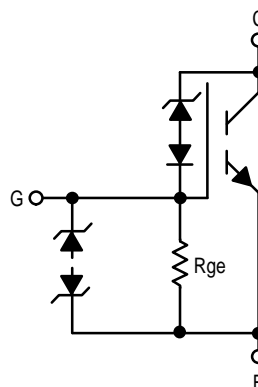
# Advanced Information

## SMARTDISCRETES™

### Internally Clamped, N-Channel IGBT

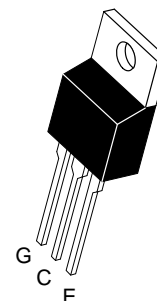
This Logic Level Insulated Gate Bipolar Transistor (IGBT) features Gate–Emitter ESD protection, Gate–Collector overvoltage protection from SMARTDISCRETES™ monolithic circuitry for usage as an **Ignition Coil Driver**.

- Temperature Compensated Gate–Drain Clamp Limits Stress Applied to Load
- Integrated ESD Diode Protection
- Low Threshold Voltage to Interface Power Loads to Logic or Microprocessors
- Low Saturation Voltage
- High Pulsed Current Capability



**MGP20N40CL**

**20 AMPERES  
VOLTAGE CLAMPED  
N-CHANNEL IGBT  
V<sub>ce(on)</sub> = 1.8 VOLTS  
400 VOLTS (CLAMPED)**



**CASE 221A-06, Style 9  
TO-220AB**

#### MAXIMUM RATINGS (T<sub>J</sub> = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Collector–Emitter Voltage	V <sub>CES</sub>	CLAMPED	V <sub>dc</sub>
Collector–Gate Voltage	V <sub>CGR</sub>	CLAMPED	V <sub>dc</sub>
Gate–Emitter Voltage	V <sub>GE</sub>	CLAMPED	V <sub>dc</sub>
Collector Current — Continuous @ T <sub>C</sub> = 25°C	I <sub>C</sub>	20	A <sub>dc</sub>
Reversed Collector Current — pulse width < 100 μs	I <sub>CR</sub>	12	A <sub>pk</sub>
Total Power Dissipation @ T <sub>C</sub> = 25°C (TO-220)	P <sub>D</sub>	150	Watts
Electrostatic Voltage — Gate–Emitter	ESD	3.5	kV
Operating and Storage Temperature Range	T <sub>J</sub> , T <sub>stg</sub>	–55 to 175	°C

#### THERMAL CHARACTERISTICS

Thermal Resistance — Junction to Case — (TO-220) — Junction to Ambient	R <sub>θJC</sub> R <sub>θJA</sub>	1.0 62.5	°C/W
Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 5 seconds	T <sub>L</sub>	275	°C
Mounting Torque, 6–32 or M3 screw	10 lbf•in (1.13 N•m)		

#### UNCLAMPED INDUCTIVE SWITCHING CHARACTERISTICS

Single Pulse Collector–Emitter Avalanche Energy @ Starting T <sub>J</sub> = 25°C @ Starting T <sub>J</sub> = 150°C	E <sub>AS</sub>	550 150	mJ
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This document contains information on a new product. Specifications and information herein are subject to change without notice.

## MGP20N40CL

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

Characteristic	Symbol	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>					
Collector-to-Emitter Breakdown Voltage ( $I_{\text{Clamp}} = 10\text{ mA}$ , $T_J = -40$ to $150^\circ\text{C}$ )	$B_{\text{VCEs}}$	370	405	430	Vdc
Zero Gate Voltage Collector Current ( $V_{\text{CE}} = 350\text{ V}$ , $V_{\text{GE}} = 0\text{ V}$ , $T_J = 150^\circ\text{C}$ ) ( $V_{\text{CE}} = 15\text{ V}$ , $V_{\text{GE}} = 0\text{ V}$ , $T_J = 150^\circ\text{C}$ )	$I_{\text{CES}}$	— —	— —	500 100	$\mu\text{A}$
Resistance Gate-Emitter ( $T_J = -40$ to $150^\circ\text{C}$ )	$R_{\text{GE}}$	10k	16k	30k	$\Omega$
Gate-Emitter Breakdown Voltage ( $I_G = 2\text{ mA}$ )	$B_{\text{VGES}}$	11	13	15	$\pm\text{ V}$
Collector-Emitter Reverse Leakage ( $V_{\text{CE}} = -15\text{ V}$ , $T_J = 150^\circ\text{C}$ )	$I_{\text{CES}}$	—	—	50	mA
Collector-Emitter Reversed Breakdown Voltage ( $I_E = 75\text{ mA}$ )	$B_{\text{VCEr}}$	26	40	120	V

### ON CHARACTERISTICS (1)

Gate Threshold Voltage ( $V_{\text{CE}} = V_{\text{GE}}$ , $I_C = 1\text{ mA}$ ) ( $V_{\text{CE}} = V_{\text{GE}}$ , $I_C = 1\text{ mA}$ , $T_J = 150^\circ\text{C}$ )	$V_{\text{GE(th)}}$	1.0 0.75	1.7 —	2.2 1.8	V
Collector-Emitter On-Voltage ( $V_{\text{GE}} = 5\text{ V}$ , $I_C = 5\text{ A}$ ) ( $V_{\text{GE}} = 5\text{ V}$ , $I_C = 10\text{ A}$ ) ( $V_{\text{GE}} = 5\text{ V}$ , $I_C = 10\text{ A}$ , $T_J = 150^\circ\text{C}$ )	$V_{\text{CE(on)}}$	— — —	1.1 1.4 1.4	1.4 1.9 1.8	V
Forward Transconductance ( $V_{\text{CE}} > 5.0\text{ V}$ , $I_C = 10\text{ A}$ )	$g_{\text{fs}}$	10	18	—	S

### DYNAMIC CHARACTERISTICS

Input Capacitance	$(V_{\text{CE}} = 25\text{ Vdc}$ , $V_{\text{GE}} = 0\text{ Vdc}$ , $f = 1.0\text{ MHz}$ )	$C_{\text{iss}}$	—	2800	—	pF
Output Capacitance		$C_{\text{oss}}$	—	200	—	
Transfer Capacitance		$C_{\text{rss}}$	—	25	—	

### SWITCHING CHARACTERISTICS (1)

Total Gate Charge	$(V_{\text{CC}} = 280\text{ V}$ , $I_C = 20\text{ A}$ , $V_{\text{GE}} = 5\text{ V})$	$Q_g$	—	45	80	nC
Gate-Emitter Charge		$Q_{\text{gs}}$	—	8.0	—	
Gate-Collector Charge		$Q_{\text{gd}}$	—	20	—	
Turn-Off Delay Time	$(V_{\text{CC}} = 320\text{ V}$ , $I_C = 20\text{ A}$ , $L = 200\text{ }\mu\text{H}$ , $R_G = 1\text{ K}\Omega$ )	$t_{\text{d(off)}}$	—	14	—	$\mu\text{s}$
Fall Time		$t_f$	—	4.0	—	
Turn-On Delay Time	$(V_{\text{CC}} = 14\text{ V}$ , $I_C = 20\text{ A}$ , $L = 200\text{ }\mu\text{H}$ , $R_G = 1\text{ K}\Omega$ )	$t_{\text{d(on)}}$	—	2.0	—	$\mu\text{s}$
Rise Time		$t_r$	—	6.0	—	

(1) Pulse Test: Pulse Width  $\leq 300\text{ }\mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

## TYPICAL ELECTRICAL CHARACTERISTICS

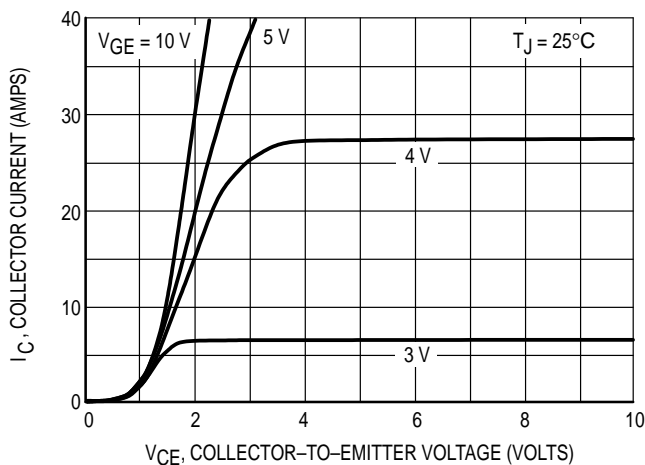
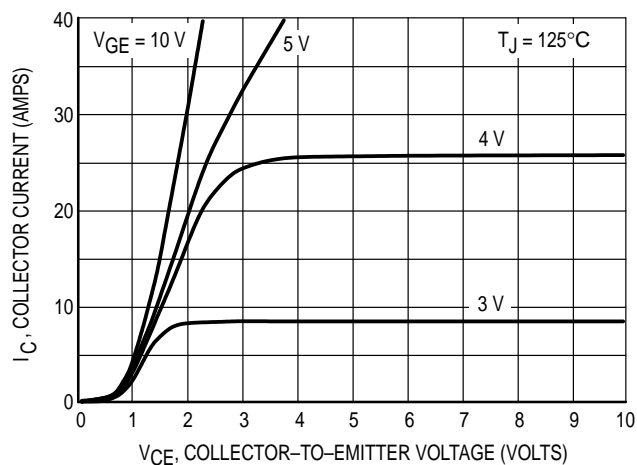
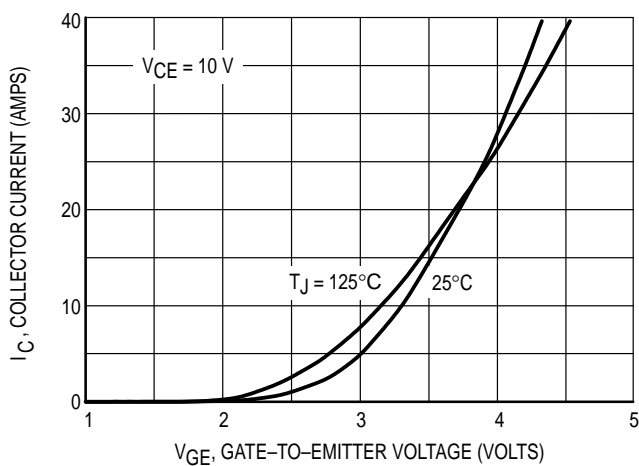
Figure 1. Output Characteristics,  $T_J = 25^\circ\text{C}$ Figure 2. Output Characteristics,  $T_J = 125^\circ\text{C}$ 

Figure 3. Transfer Characteristics

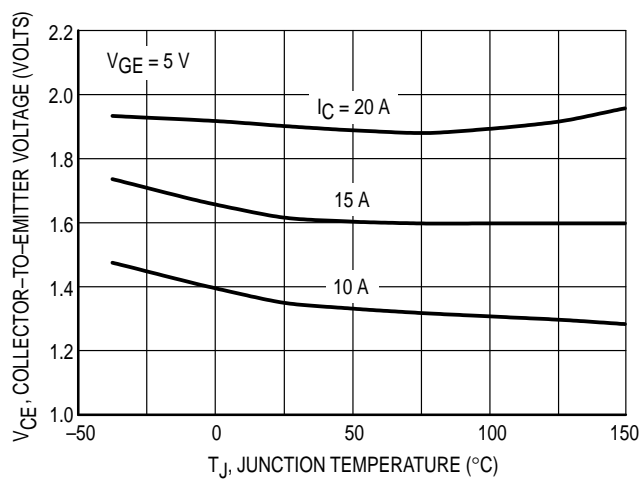


Figure 4. Collector-to-Emitter Saturation Voltage versus Junction Temperature

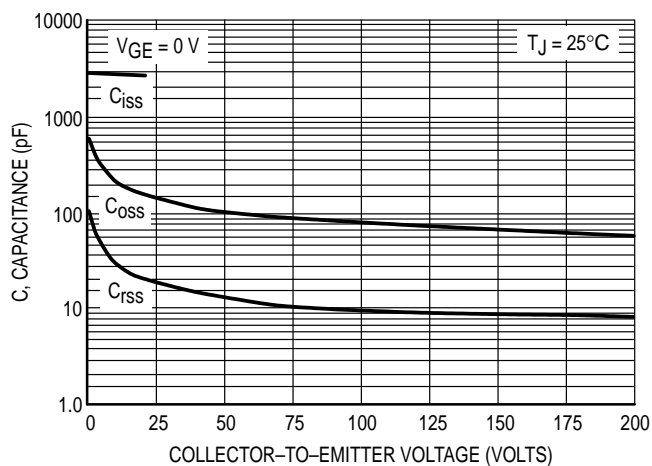
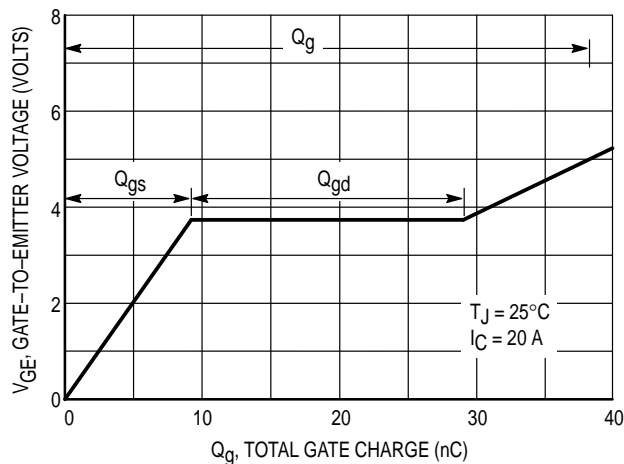
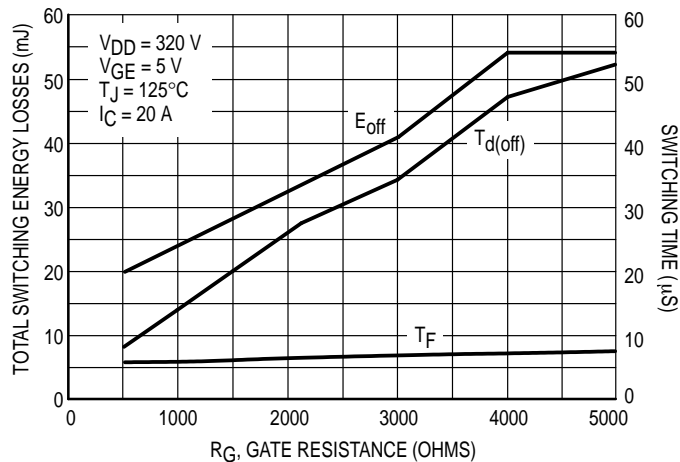


Figure 5. Capacitance Variation

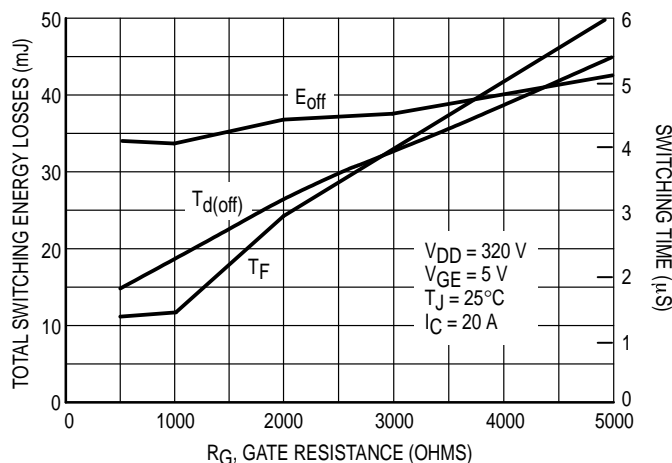
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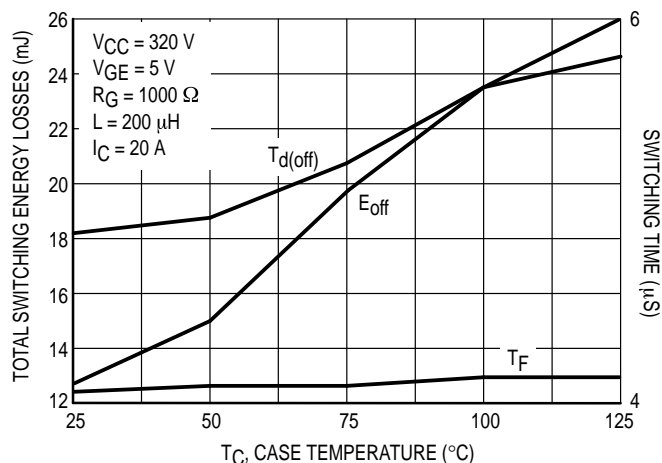
**Figure 6. Gate-to-Emitter and Collector-to-Emitter Voltage vs Total Charge**



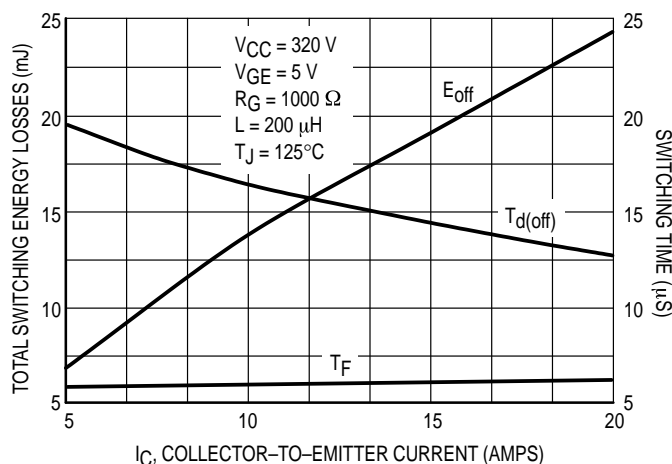
**Figure 7. Total Switching Losses versus Gate Temperature**



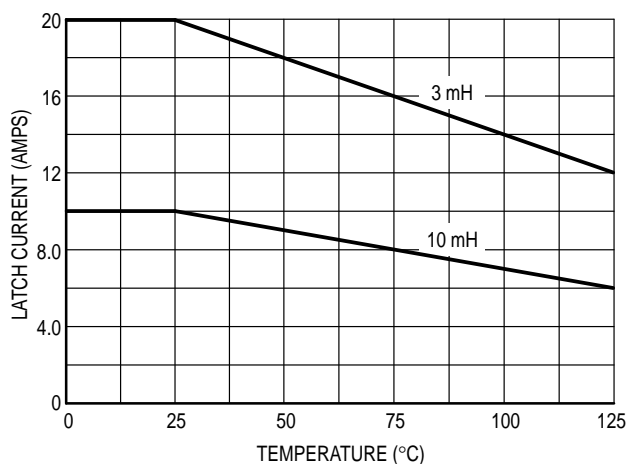
**Figure 8. Total Switching Losses versus Gate Resistance**



**Figure 9. Total Switching Losses versus Case Temperature**



**Figure 10. Total Switching Losses versus Collector Current**



**Figure 11. Latch Current versus Temperature**

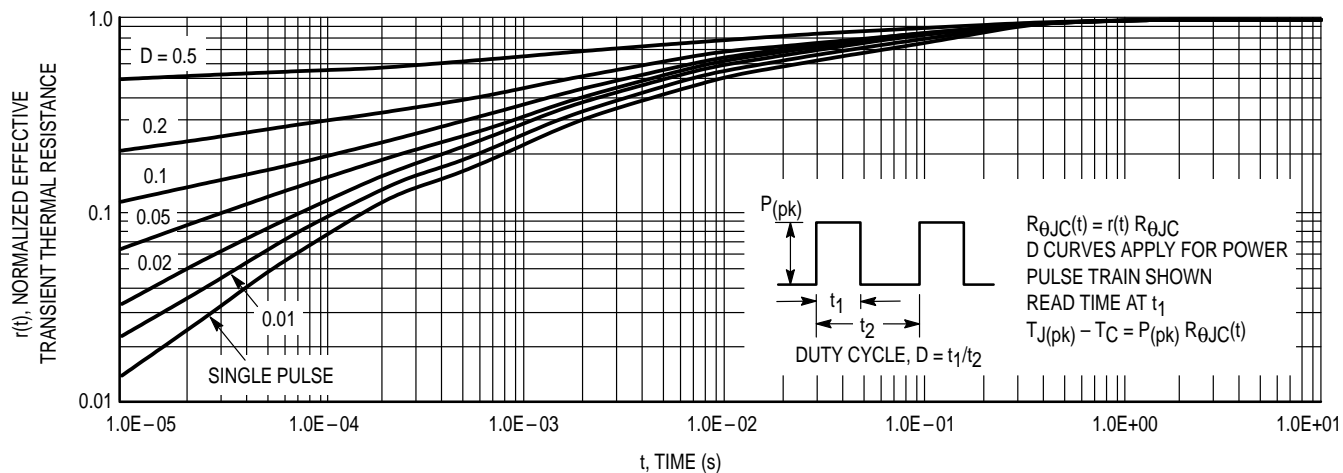
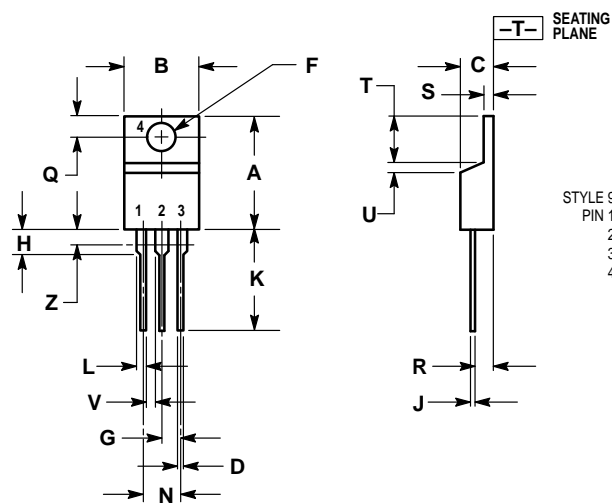


Figure 12. Thermal Response

## PACKAGE DIMENSIONS




STYLE 9:  
PIN 1: GATE  
2: COLLECTOR  
3: EMITTER  
4: COLLECTOR

- NOTES:  
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
2. CONTROLLING DIMENSION: INCH.  
3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.570	0.620	14.48	15.75
B	0.380	0.405	9.66	10.28
C	0.160	0.190	4.07	4.82
D	0.025	0.035	0.64	0.88
F	0.142	0.147	3.61	3.73
G	0.095	0.105	2.42	2.66
H	0.110	0.155	2.80	3.93
J	0.018	0.025	0.46	0.64
K	0.500	0.562	12.70	14.27
L	0.045	0.060	1.15	1.52
N	0.190	0.210	4.83	5.33
Q	0.100	0.120	2.54	3.04
R	0.080	0.110	2.04	2.79
S	0.045	0.055	1.15	1.39
T	0.235	0.255	5.97	6.47
U	0.000	0.050	0.00	1.27
V	0.045	—	1.15	—
Z	—	0.080	—	2.04

CASE 221A-06  
(TO-220AB)  
ISSUE Y

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