

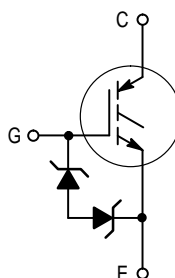
# Designer's™ Data Sheet

## Insulated Gate Bipolar Transistor

### N-Channel Enhancement-Mode Silicon Gate

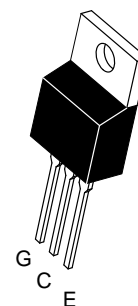
This Insulated Gate Bipolar Transistor (IGBT) uses an advanced termination scheme to provide an enhanced and reliable high voltage-blocking capability. It also provides low on-voltage which results in efficient operation at high current.

- Industry Standard TO-220 Package
- High Speed  $E_{off}$ : 63  $\mu$ J/A typical at 125°C
- Low On-Voltage – 1.7 V typical at 10 A, 125°C
- Robust High Voltage Termination
- ESD Protection Gate-Emitter Zener Diodes



**MGP20N60U**

**IGBT IN TO-220**  
**20 A @ 90°C**  
**31 A @ 25°C**  
**600 VOLTS**  
**VERY LOW**  
**ON-VOLTAGE**



**CASE 221A-09**  
**STYLE 9**  
**TO-220AB**

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

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	$V_{CES}$	600	Vdc
Collector-Gate Voltage ( $R_{GE} = 1.0 \text{ M}\Omega$ )	$V_{CGR}$	600	Vdc
Gate-Emitter Voltage — Continuous	$V_{GE}$	$\pm 20$	Vdc
Collector Current — Continuous @ $T_C = 25^\circ\text{C}$ — Continuous @ $T_C = 90^\circ\text{C}$ — Repetitive Pulsed Current (1)	$I_{C25}$ $I_{C90}$ $I_{CM}$	31 20 62	Adc Apk
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	112 0.89	Watts W/°C
Operating and Storage Junction Temperature Range	$T_J, T_{stg}$	-55 to 150	°C
Thermal Resistance — Junction to Case – IGBT — Junction to Ambient	$R_{\theta JC}$ $R_{\theta JA}$	1.12 65	°C/W
Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 5 seconds	$T_L$	260	°C
Mounting Torque, 6-32 or M3 screw	10 lbf•in (1.13 N•m)		

(1) Pulse width is limited by maximum junction temperature. Repetitive rating.

**Designer's Data for "Worst Case" Conditions** — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. SOA Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

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## MGP20N60U

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

Characteristic	Symbol	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>					
Collector-to-Emitter Breakdown Voltage ( $V_{GE} = 0\text{ Vdc}$ , $I_C = 25\text{ }\mu\text{Adc}$ ) Temperature Coefficient (Positive)	$V_{(BR)CES}$	600 —	— 870	— —	Vdc mV/ $^\circ\text{C}$
Emitter-to-Collector Breakdown Voltage ( $V_{GE} = 0\text{ Vdc}$ , $I_{EC} = 100\text{ mAdc}$ )	$V_{(BR)ECS}$	15	—	—	Vdc
Zero Gate Voltage Collector Current ( $V_{CE} = 600\text{ Vdc}$ , $V_{GE} = 0\text{ Vdc}$ ) ( $V_{CE} = 600\text{ Vdc}$ , $V_{GE} = 0\text{ Vdc}$ , $T_J = 125^\circ\text{C}$ )	$I_{CES}$	— —	— —	10 200	$\mu\text{Adc}$
Gate-Body Leakage Current ( $V_{GE} = \pm 20\text{ Vdc}$ , $V_{CE} = 0\text{ Vdc}$ )	$I_{GES}$	—	—	50	$\mu\text{Adc}$

### ON CHARACTERISTICS (1)

Collector-to-Emitter On-State Voltage ( $V_{GE} = 15\text{ Vdc}$ , $I_C = 5.0\text{ Adc}$ ) ( $V_{GE} = 15\text{ Vdc}$ , $I_C = 5.0\text{ Adc}$ , $T_J = 125^\circ\text{C}$ ) ( $V_{GE} = 15\text{ Vdc}$ , $I_C = 10\text{ Adc}$ )	$V_{CE(on)}$	— — —	1.4 1.3 1.7	1.7 — 2.0	Vdc
Gate Threshold Voltage ( $V_{CE} = V_{GE}$ , $I_C = 1.0\text{ mAdc}$ ) Threshold Temperature Coefficient (Negative)	$V_{GE(th)}$	3.0 —	5.0 10	7.0 —	Vdc mV/ $^\circ\text{C}$
Forward Transconductance ( $V_{CE} = 10\text{ Vdc}$ , $I_C = 10\text{ Adc}$ )	$g_{fe}$	—	7.0	—	Mhos

### DYNAMIC CHARACTERISTICS

Input Capacitance	$(V_{CE} = 25\text{ Vdc}$ , $V_{GE} = 0\text{ Vdc}$ , $f = 1.0\text{ MHz}$ )	$C_{ies}$	—	1060	—	pF
Output Capacitance		$C_{oes}$	—	99	—	
Transfer Capacitance		$C_{res}$	—	15	—	

### SWITCHING CHARACTERISTICS (1)

Turn-On Delay Time	$(V_{CC} = 360\text{ Vdc}$ , $I_C = 10\text{ Adc}$ , $V_{GE} = 15\text{ Vdc}$ , $L = 300\text{ }\mu\text{H}$ , $R_G = 20\text{ }\Omega$ ) Energy losses include "tail"	$t_{d(on)}$	—	43	—	ns
Rise Time		$t_r$	—	45	—	
Turn-Off Delay Time		$t_{d(off)}$	—	144	—	
Fall Time		$t_f$	—	175	—	
Turn-Off Switching Loss		$E_{off}$	—	340	—	$\mu\text{J}$
Turn-On Delay Time	$(V_{CC} = 360\text{ Vdc}$ , $I_C = 10\text{ Adc}$ , $V_{GE} = 15\text{ Vdc}$ , $L = 300\text{ }\mu\text{H}$ , $R_G = 20\text{ }\Omega$ , $T_J = 125^\circ\text{C}$ ) Energy losses include "tail"	$t_{d(on)}$	—	43	—	ns
Rise Time		$t_r$	—	56	—	
Turn-Off Delay Time		$t_{d(off)}$	—	235	—	
Fall Time		$t_f$	—	220	—	
Turn-Off Switching Loss		$E_{off}$	—	625	—	$\mu\text{J}$
Gate Charge	$(V_{CC} = 360\text{ Vdc}$ , $I_C = 10\text{ Adc}$ , $V_{GE} = 15\text{ Vdc}$ )	$Q_T$	—	57	—	nC
		$Q_1$	—	12	—	
		$Q_2$	—	25	—	

### INTERNAL PACKAGE INDUCTANCE

Internal Emitter Inductance (Measured from the emitter lead 0.25" from package to emitter bond pad)	$L_E$	—	7.5	—	nH
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(1) Pulse Test: Pulse Width  $\leq 300\text{ }\mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

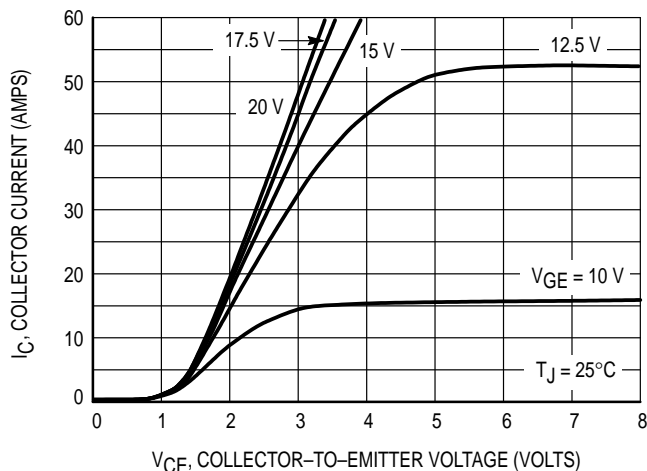


Figure 1. Output Characteristics

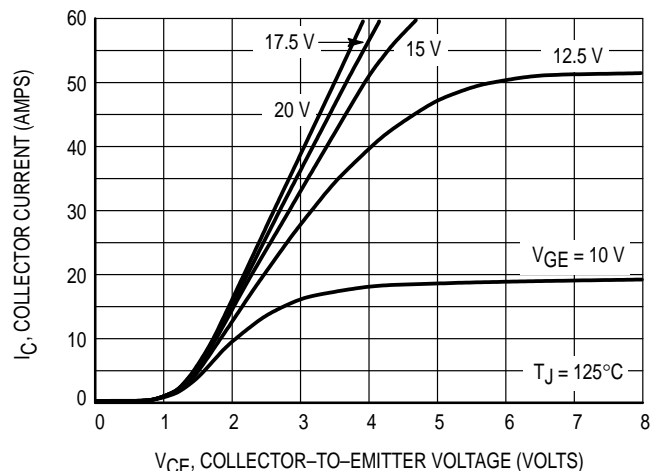


Figure 2. Output Characteristics

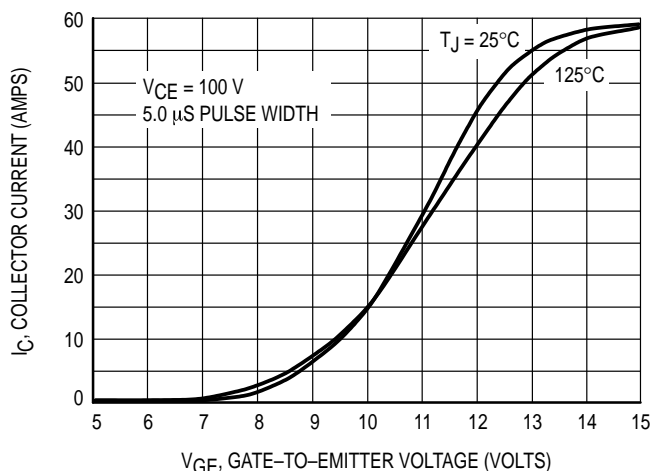


Figure 3. Transfer Characteristics

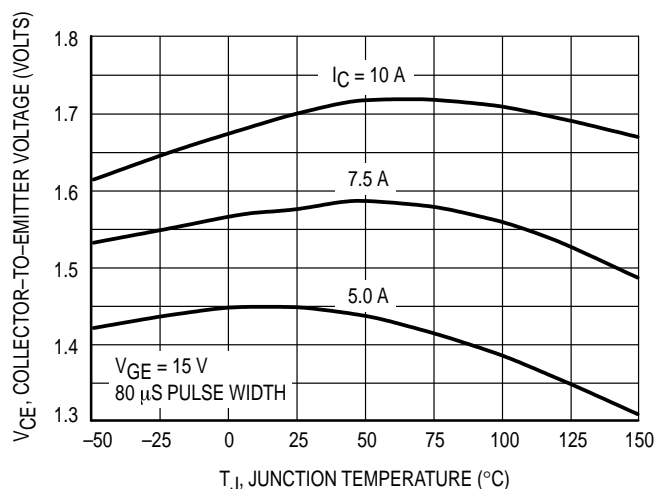


Figure 4. Collector-to-Emitter Saturation Voltage versus Junction Temperature

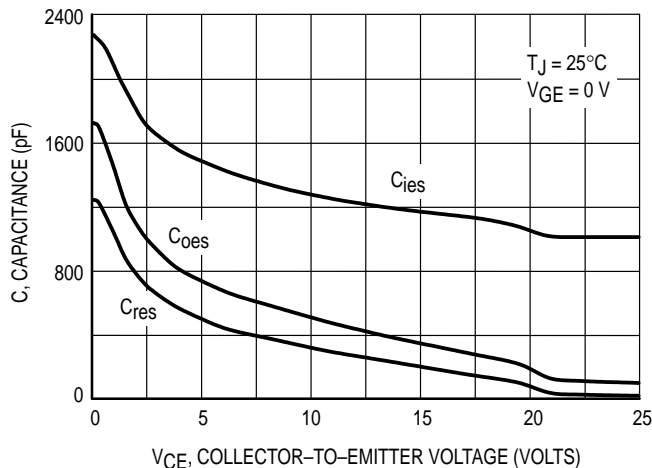


Figure 5. Capacitance Variation

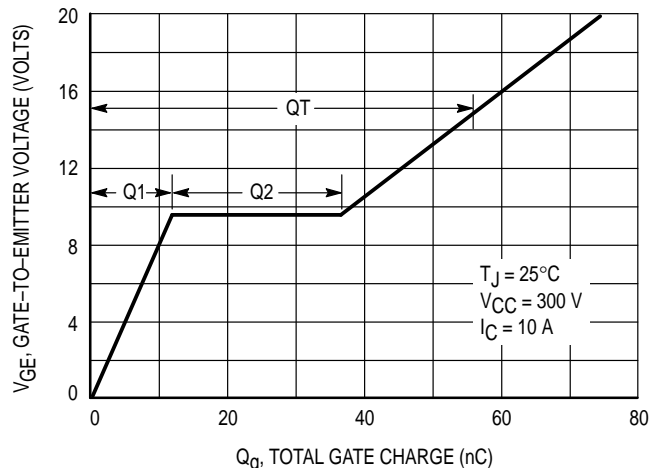
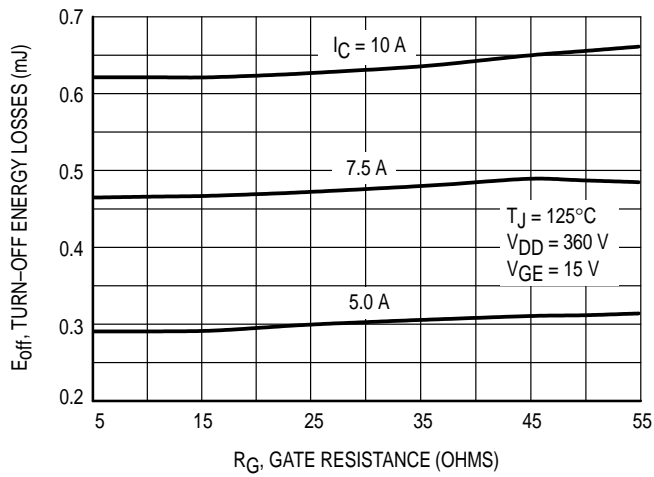
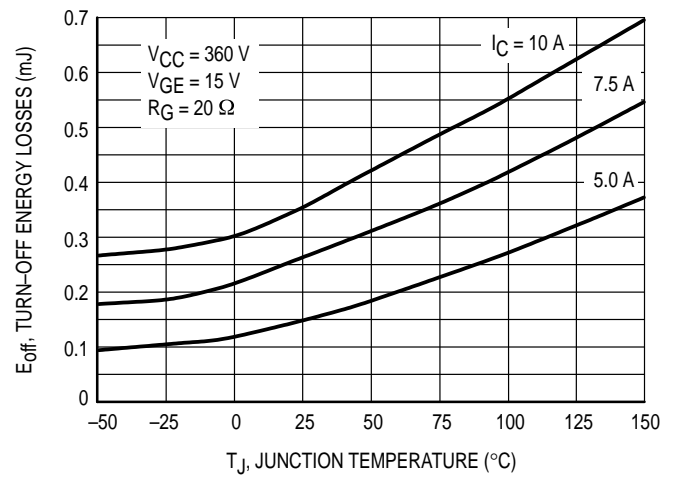


Figure 6. Gate-to-Emitter Voltage versus Total Charge

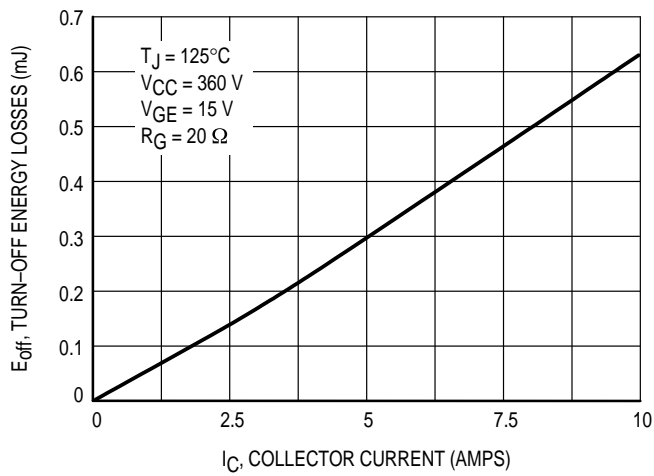
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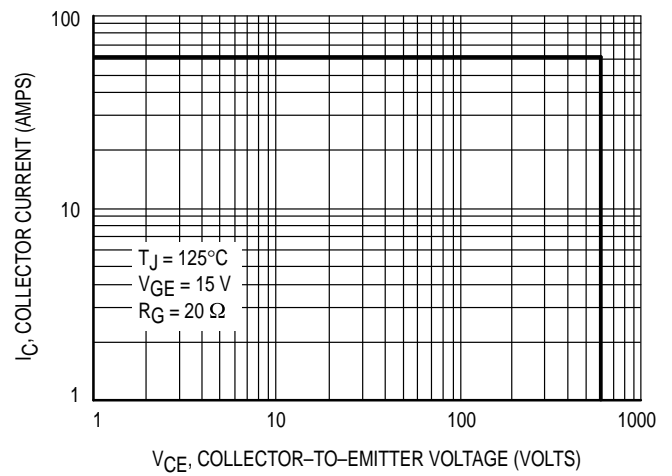
**Figure 7. Turn-Off Energy Losses versus Gate Resistance**



**Figure 8. Turn-Off Energy Losses versus Junction Temperature**

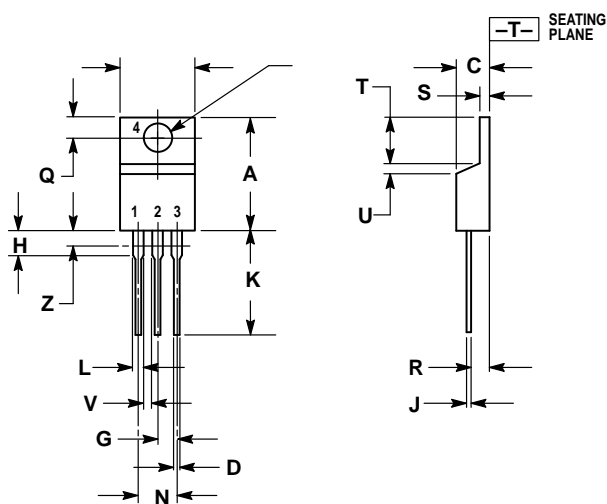


**Figure 9. Turn-Off Energy Losses versus Collector Current**



**Figure 10. Reverse Biased Safe Operating Area**

## 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-09  
ISSUE Z

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