MOTOROLA
SEMICONDUCTOR TECHNICAL DATA

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MGP14N60E

Designer's™ Data Sheet

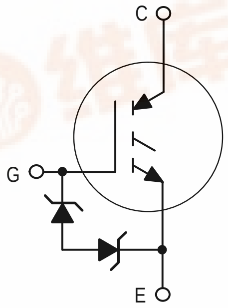
Insulated Gate Bipolar Transistor

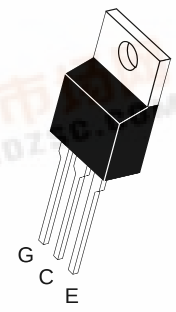
N–Channel Enhancement–Mode Silicon Gate

This Insulated Gate Bipolar Transistor (IGBT) uses an advanced termination scheme to provide an enhanced and reliable high voltage–blocking capability. Its new 600 V IGBT technology is specifically suited for applications requiring both a high temperature short circuit capability and a low $V_{CE(on)}$. It also provides fast switching characteristics and results in efficient operation at high frequencies. This new E–series introduces an Energy–efficient, ESD protected, and short circuit rugged device.

- Industry Standard TO–220 Package
- High Speed: E_{off} = 60 μJ/A typical at 125°C
- High Voltage Short Circuit Capability – 10 μs minimum at 125°C, 400 V
- Low On–Voltage 2.0 V typical at 10 A, 125°C
- Robust High Voltage Termination
- ESD Protection Gate–Emitter Zener Diodes

IGBT IN TO–220
14 A @ 90°C
18 A @ 25°C
600 VOLTS
SHORT CIRCUIT RATED
LOW ON–VOLTAGE





CASE 221A–06
TO–220AB

MAXIMUM RATINGS (T_J = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Collector–Emitter Voltage	V_{CES}	600	Vdc
Collector–Gate Voltage (R_{GE} = 1.0 MΩ)	V_{CGR}	600	Vdc
Gate–Emitter Voltage — Continuous	V_{GE}	±20	Vdc
Collector Current — Continuous @ T_C = 25°C — Continuous @ T_C = 90°C — Repetitive Pulsed Current (1)	I_{C25} I_{C90} I_{CM}	18 14 28	Adc Apk
Total Power Dissipation @ T_C = 25°C Derate above 25°C	P_D	110 0.88	Watts W/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	–55 to 150	°C
Short Circuit Withstand Time (V_{CC} = 400 Vdc, V_{GE} = 15 Vdc, T_J = 125°C, R_G = 20 Ω)	t_{sc}	10	μs
Thermal Resistance — Junction to Case – IGBT — Junction to Ambient	$R_{\theta JC}$ $R_{\theta JA}$	1.1 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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ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted)

Characteristic		Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Collector–to–Emitter Breakdown Voltage		B_{VCES}				Vdc
(V_{GE} = 0 Vdc, I_C = 250 µAdc)			600	—	—	
Temperature Coefficient (Positive)			—	870	—	mV/°C
Emitter–to–Collector Breakdown Voltage (V_{GE} = 0 Vdc, I_{EC} = 100 mAdc)		B_{VECS}	15	—	—	Vdc
Zero Gate Voltage Collector Current		I_{CES}				µAdc
(V_{CE} = 600 Vdc, V_{GE} = 0 Vdc)			—	—	10	
(V_{CE} = 600 Vdc, V_{GE} = 0 Vdc, T_J = 125°C)			—	—	200	
Gate–Body Leakage Current (V_{GE} = ± 20 Vdc, V_{CE} = 0 Vdc)		I_{GES}	—	—	50	µAdc
ON CHARACTERISTICS (1)						
Collector–to–Emitter On–State Voltage		$V_{CE(on)}$				Vdc
(V_{GE} = 15 Vdc, I_C = 5.0 Adc)			—	1.6	1.9	
(V_{GE} = 15 Vdc, I_C = 5.0 Adc, T_J = 125°C)			—	1.5	—	
(V_{GE} = 15 Vdc, I_C = 10 Adc)			—	2.0	2.4	
Gate Threshold Voltage		$V_{GE(th)}$				Vdc
(V_{CE} = V_{GE}, I_C = 1.0 mAdc)			4.0	6.0	8.0	
Threshold Temperature Coefficient (Negative)			—	10	—	mV/°C
Forward Transconductance (V_{CE} = 10 Vdc, I_C = 10 Adc)		g_{fe}	—	5.0	—	Mhos
DYNAMIC CHARACTERISTICS						
Input Capacitance	(V_{CE} = 25 Vdc, V_{GE} = 0 Vdc, f = 1.0 MHz)	C_{ies}	—	1020	—	pF
Output Capacitance		C_{oes}	—	104	—	
Transfer Capacitance		C_{res}	—	17	—	
SWITCHING CHARACTERISTICS (1)						
Turn–On Delay Time	(V_{CC} = 360 Vdc, I_C = 10 Adc, V_{GE} = 15 Vdc, L = 300 µH, R_G = 20 Ω, T_J = 25°C) Energy losses include “tail”	$t_{d(on)}$	—	38	—	ns
Rise Time		t_r	—	40	—	
Turn–Off Delay Time		$t_{d(off)}$	—	120	—	
Fall Time		t_f	—	204	—	
Turn–Off Switching Loss		E_{off}	—	0.35	—	mJ
Turn–On Delay Time	(V_{CC} = 360 Vdc, I_C = 10 Adc, V_{GE} = 15 Vdc, L = 300 µH R_G = 20 Ω, T_J = 125°C) Energy losses include “tail”	$t_{d(on)}$	—	32	—	ns
Rise Time		t_r	—	30	—	
Turn–Off Delay Time		$t_{d(off)}$	—	208	—	
Fall Time		t_f	—	212	—	
Turn–Off Switching Loss		E_{off}	—	0.6	—	mJ
Gate Charge	(V_{CC} = 360 Vdc, I_C = 10 Adc, V_{GE} = 15 Vdc)	Q_T	—	57	—	nC
		Q_1	—	12	—	
		Q_2	—	25	—	
INTERNAL PACKAGE INDUCTANCE						
Internal Emitter Inductance		L_E				nH
(Measured from the emitter lead 0.25″ from package to emitter bond pad)			—	7.5	—	

(1) Pulse Test: Pulse Width ≤ 300 µs, Duty Cycle ≤ 2%.

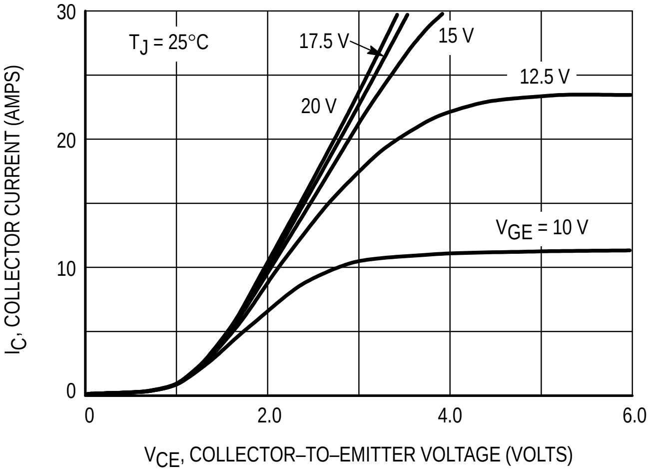


Figure 1. Output Characteristics, T_J = 25°C

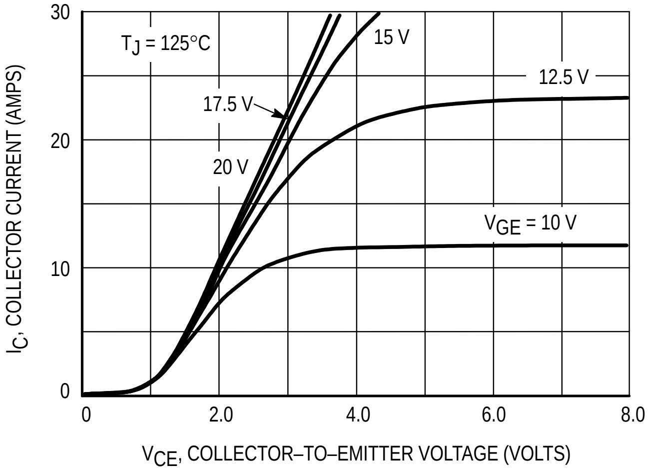


Figure 2. Output Characteristics, T_J = 125°C

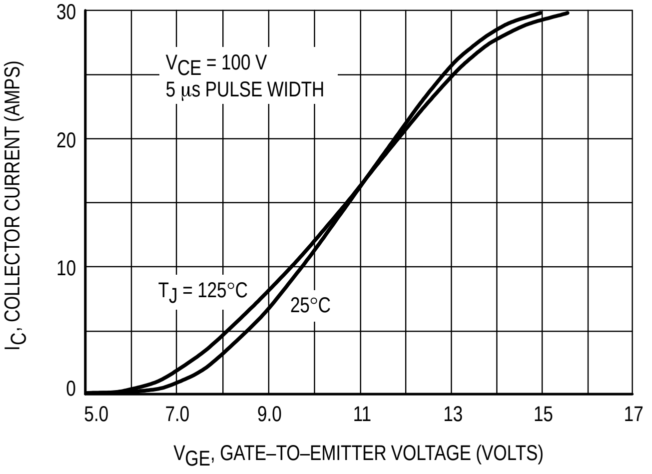


Figure 3. Transfer Characteristics

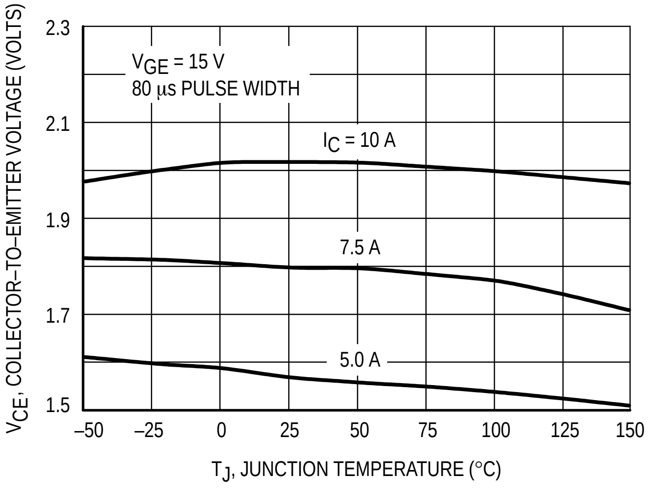


Figure 4. Collector–To–Emitter Saturation Voltage versus Junction Temperature

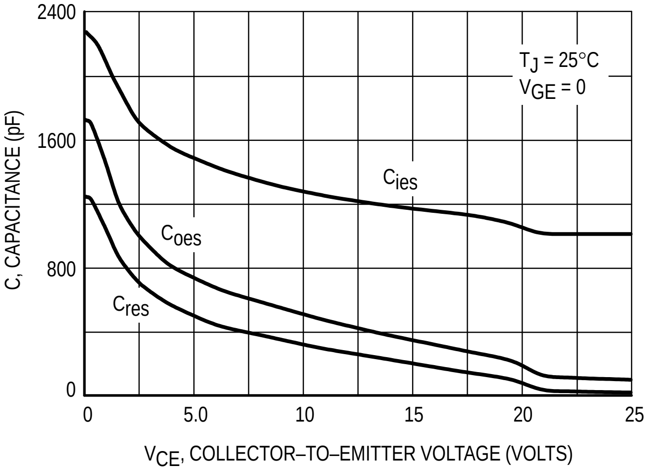


Figure 5. Capacitance Variation

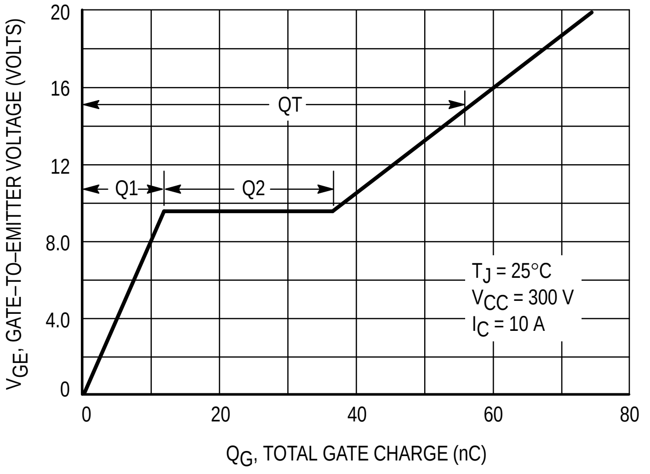


Figure 6. Gate–To–Emitter Voltage versus Total Charge

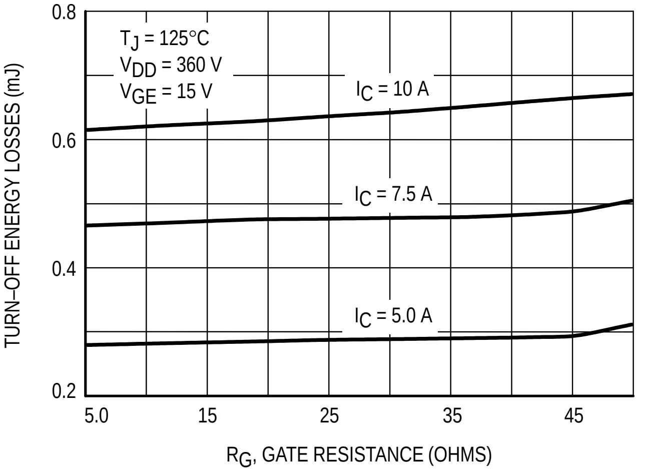


Figure 7. Turn–Off Losses versus Gate Resistance

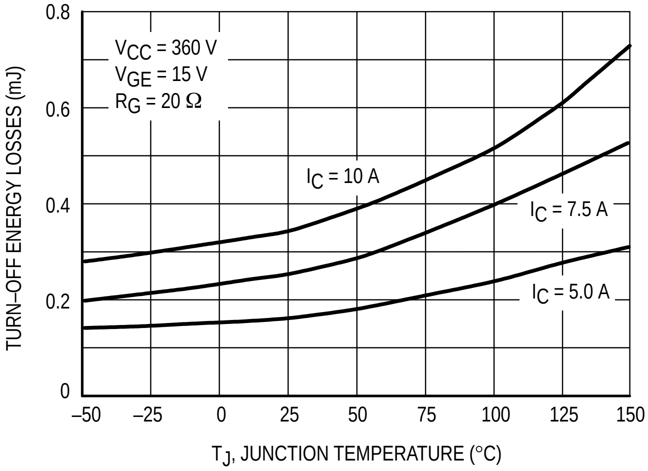


Figure 8. Turn–Off Losses versus Junction Temperature

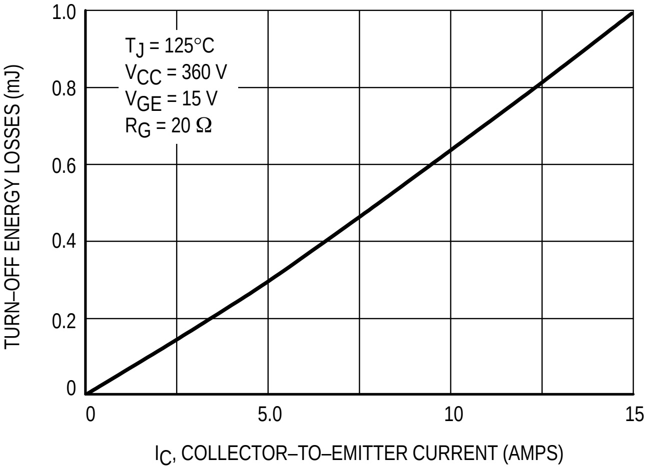


Figure 9. Turn–Off Losses versus Collector–To–Emitter Current

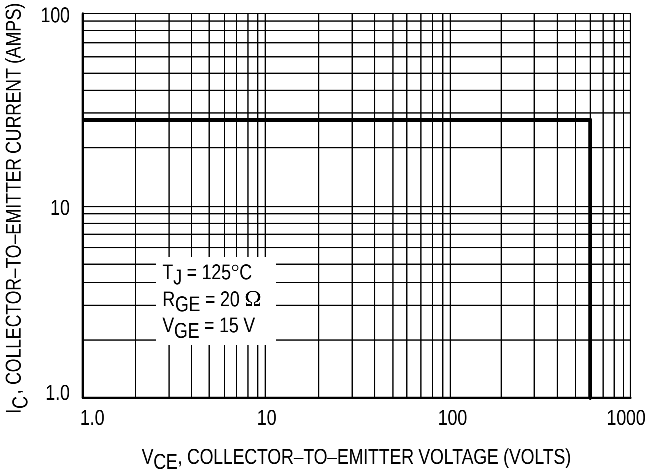
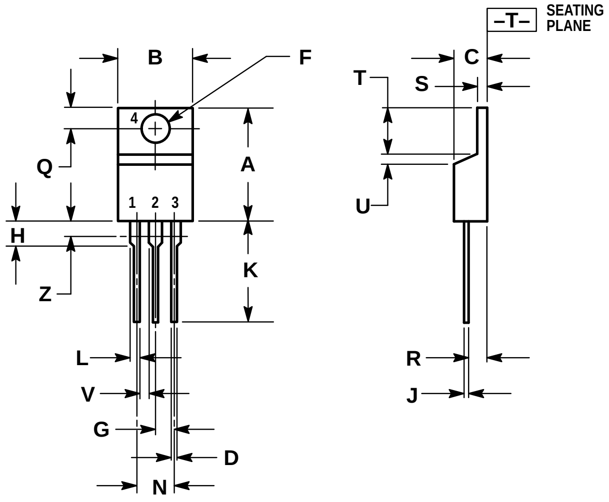


Figure 10. Reverse Biased Safe Operating Area

PACKAGE DIMENSIONS



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.

	INCHES		MILLIMETERS	
DIM	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

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

CASE 221A–06
TO–220AB
ISSUE Y

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