

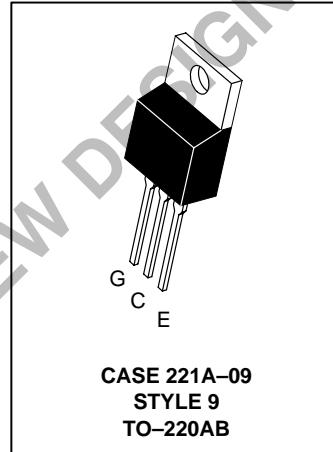
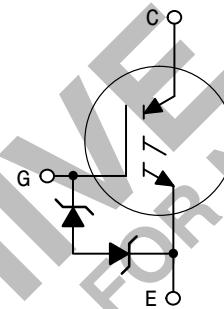
Designer's™ Data Sheet
Insulated Gate Bipolar Transistor
N-Channel Enhancement-Mode Silicon Gate

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: $E_{off} = 60 \mu J/A$ typical at $125^\circ C$
- High Voltage Short Circuit Capability – $10 \mu s$ minimum at $125^\circ C$, 400 V
- Low On-Voltage 2.0 V typical at 8.0 A, $125^\circ C$
- Robust High Voltage Termination
- ESD Protection Gate-Emitter Zener Diodes

MGP11N60E

IGBT IN TO-220
11 A @ $90^\circ C$
15 A @ $25^\circ C$
600 VOLTS
SHORT CIRCUIT RATED
LOW ON-VOLTAGE



MAXIMUM RATINGS ($T_J = 25^\circ C$ 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} | ± 20 | Vdc |
| Collector Current — Continuous @ $T_C = 25^\circ C$ — Continuous @ $T_C = 90^\circ C$ — Repetitive Pulsed Current (1) | I_{C25} I_{C90} I_{CM} | 15 11 22 | Adc Apk |
| Total Power Dissipation @ $T_C = 25^\circ C$ Derate above $25^\circ C$ | P_D | 96 0.77 | Watts W/ $^\circ C$ |
| Operating and Storage Junction Temperature Range | T_J, T_{stg} | -55 to 150 | $^\circ C$ |
| Short Circuit Withstand Time ($V_{CC} = 400 \text{ Vdc}$, $V_{GE} = 15 \text{ Vdc}$, $T_J = 125^\circ C$, $R_G = 20 \Omega$) | t_{sc} | 10 | μs |
| Thermal Resistance — Junction to Case — IGBT — Junction to Ambient | $R_{\theta JC}$ $R_{\theta JA}$ | 1.3 65 | $^\circ C/W$ |
| Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 5 seconds | T_L | 260 | $^\circ C$ |
| 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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MGP11N60E
ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|----------------------|----------|----------|-----------|--------------|
| OFF CHARACTERISTICS | | | | | |
| Collector-to-Emitter Breakdown Voltage (V _{GE} = 0 Vdc, I _C = 25 µAdc) Temperature Coefficient (Positive) | V _{(BR)CES} | 600 — | — 870 | — | Vdc mV/°C |
| Emitter-to-Collector Breakdown Voltage (V _{GE} = 0 Vdc, I _{EC} = 100 mA) | V _{(BR)ECS} | 15 | — | — | Vdc |
| Zero Gate Voltage Collector Current (V _{CE} = 600 Vdc, V _{GE} = 0 Vdc) (V _{CE} = 600 Vdc, V _{GE} = 0 Vdc, T _J = 125°C) | I _{CES} | — — | — — | 10 200 | µAdc |
| 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 _{GE} = 15 Vdc, I _C = 4.0 Adc) (V _{GE} = 15 Vdc, I _C = 4.0 Adc, T _J = 125°C) (V _{GE} = 15 Vdc, I _C = 8.0 Adc) | V _{CE(on)} | — — — | 1.6 1.5 2.0 | 1.9 — 2.4 | Vdc |
| Gate Threshold Voltage (V _{CE} = V _{GE} , I _C = 1.0 mA) Threshold Temperature Coefficient (Negative) | V _{GE(th)} | 4.0 — | 6.0 10 | 8.0 — | Vdc mV/°C |
| Forward Transconductance (V _{CE} = 10 Vdc, I _C = 8.0 Adc) | g _{fe} | — | 3.5 | — | Mhos |

DYNAMIC CHARACTERISTICS

| | | | | | | |
|----------------------|---|------------------|---|-----|---|----|
| Input Capacitance | (V _{CE} = 25 Vdc, V _{GE} = 0 Vdc, f = 1.0 MHz) | C _{ies} | — | 779 | — | pF |
| Output Capacitance | | C _{oes} | — | 81 | — | |
| Transfer Capacitance | | C _{res} | — | 13 | — | |

SWITCHING CHARACTERISTICS (1)

| | | | | | | |
|-------------------------|---|---------------------|---|------|------|----|
| Turn-On Delay Time | (V _{CC} = 360 Vdc, I _C = 8.0 Adc, V _{GE} = 15 Vdc, L = 300 µH, R _G = 20 Ω) Energy losses include "tail" | t _{d(on)} | — | 46 | — | ns |
| Rise Time | | t _r | — | 34 | — | |
| Turn-Off Delay Time | | t _{d(off)} | — | 102 | — | |
| Fall Time | | t _f | — | 226 | — | |
| Turn-Off Switching Loss | | E _{off} | — | 0.32 | 0.40 | mJ |
| Turn-On Delay Time | (V _{CC} = 360 Vdc, I _C = 8.0 Adc, V _{GE} = 15 Vdc, L = 300 µH R _G = 20 Ω, T _J = 125°C) Energy losses include "tail" | t _{d(on)} | — | 42 | — | ns |
| Rise Time | | t _r | — | 26 | — | |
| Turn-Off Delay Time | | t _{d(off)} | — | 214 | — | |
| Fall Time | | t _f | — | 228 | — | |
| Turn-Off Switching Loss | | E _{off} | — | 0.48 | — | mJ |
| Gate Charge | (V _{CC} = 360 Vdc, I _C = 8.0 Adc, V _{GE} = 15 Vdc) | Q _T | — | 39.2 | — | nC |
| | | Q ₁ | — | 8.7 | — | |
| | | Q ₂ | — | 17.4 | — | |

INTERNAL PACKAGE INDUCTANCE

| | | | | | |
|--|----------------|---|-----|---|----|
| Internal Emitter Inductance (Measured from the emitter lead 0.25" from package to emitter bond pad) | L _E | — | 7.5 | — | nH |
|--|----------------|---|-----|---|----|

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

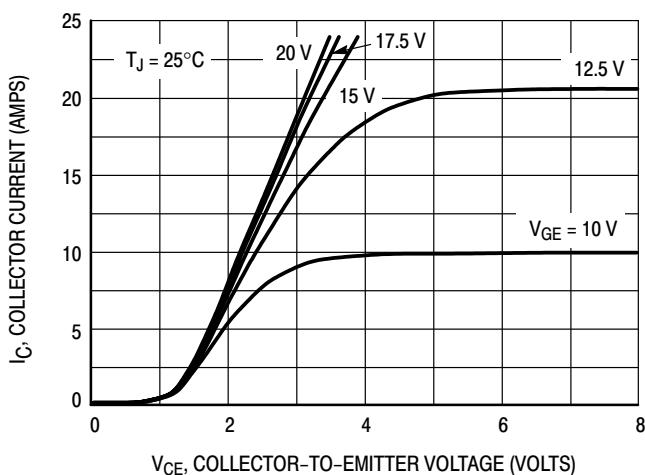


Figure 1. Output Characteristics

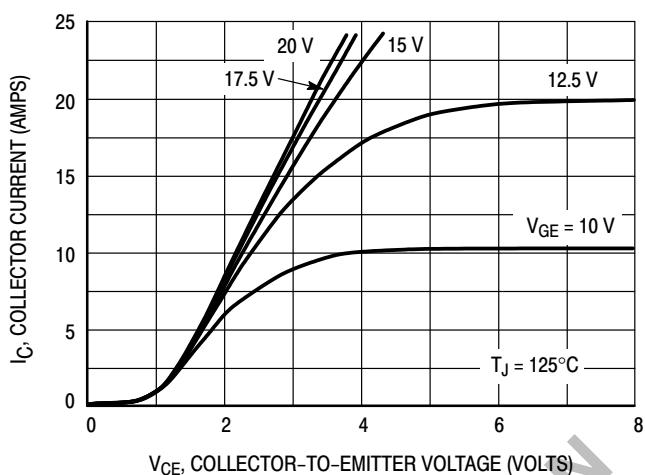


Figure 2. Output Characteristics

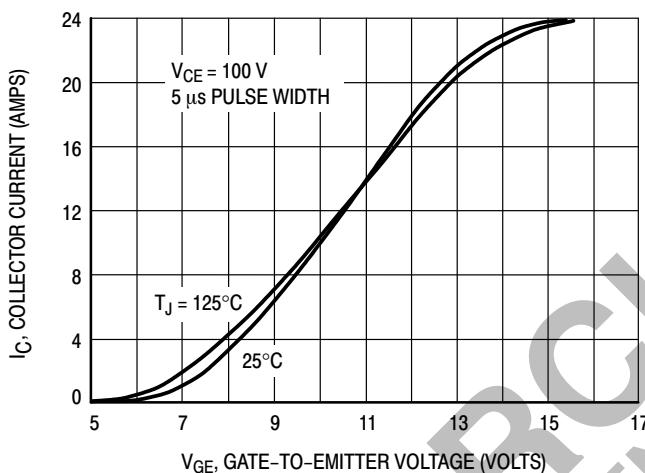


Figure 3. Transfer Characteristics

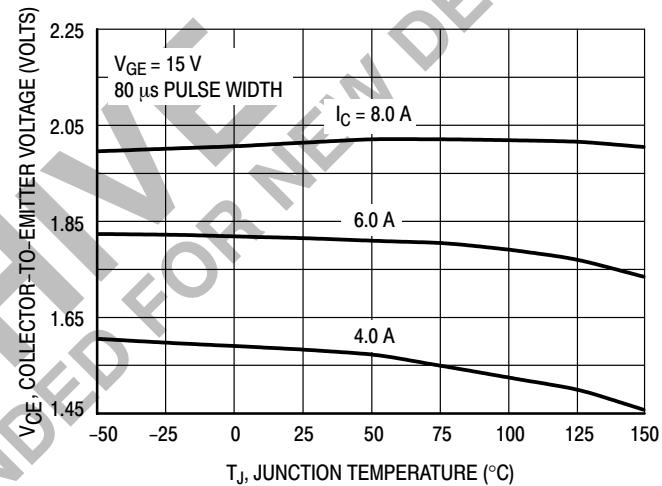


Figure 4. Collector-to-Emitter Saturation Voltage versus Junction Temperature

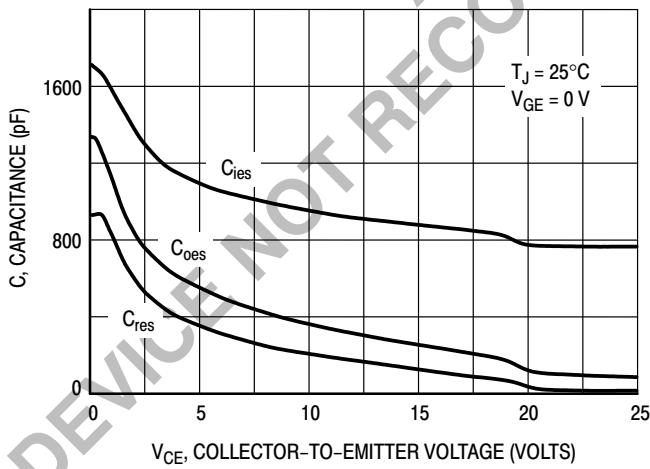


Figure 5. Capacitance Variation

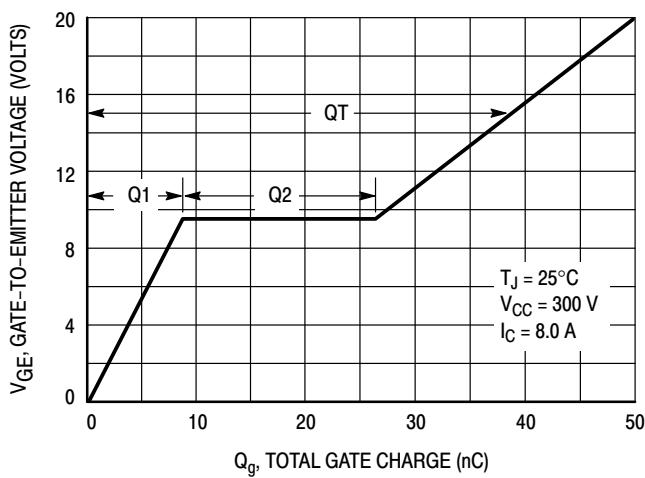


Figure 6. Gate-to-Emitter Voltage versus Total Charge

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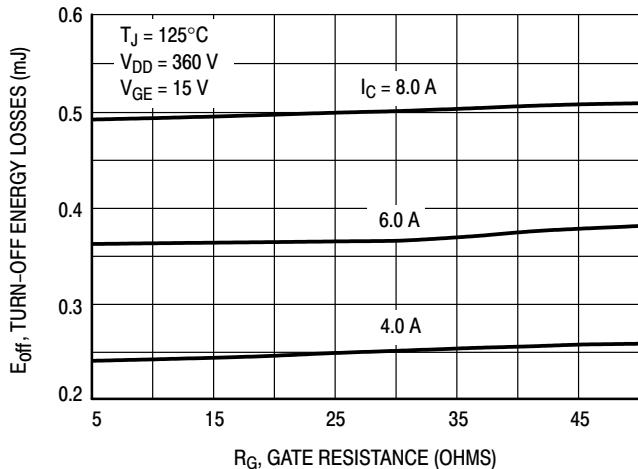


Figure 7. Turn-Off Losses versus Gate Resistance

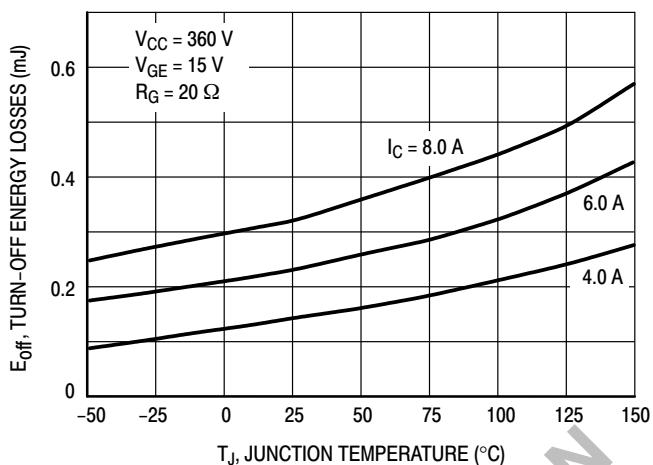


Figure 8. Turn-Off Losses versus Junction Temperature

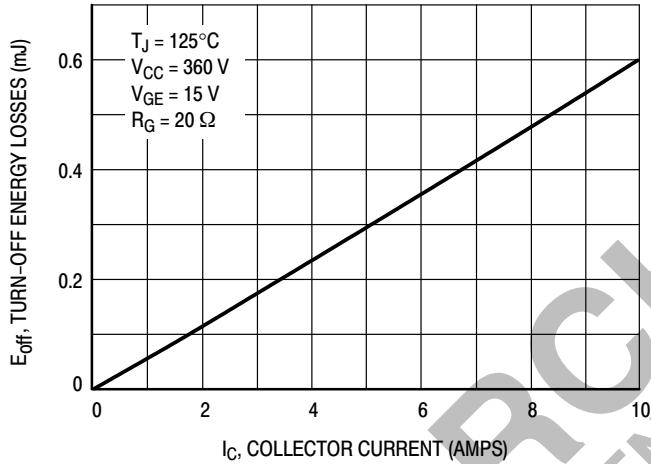


Figure 9. Turn-Off Losses versus Collector Current

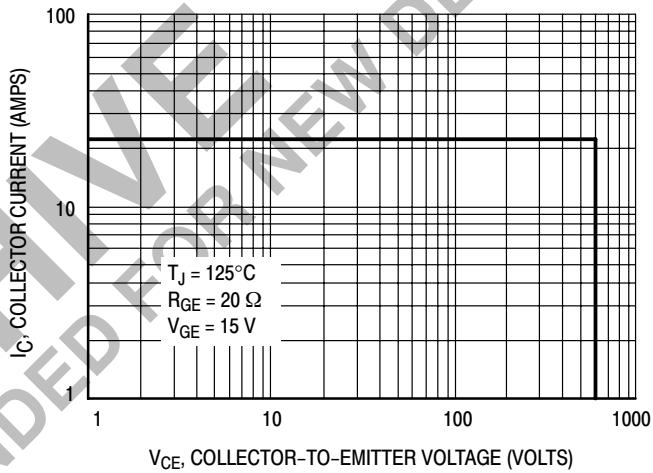
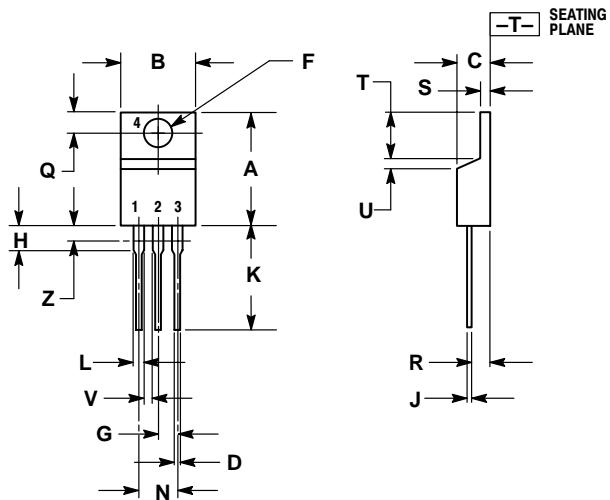


Figure 10. Reverse Biased Safe Operating Area

DEVICE NOT RECOMMENDED FOR NEW DESIGN

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.

| 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 |

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

CASE 221A-09
 TO-220AB
 ISSUE Z

DEVICE NOT RECOMMENDED FOR NEW DESIGN

ARCHIVE
RECOMMENDED FOR NEW DESIGN

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