*Product Preview*

# Insulated Gate Bipolar Transistor

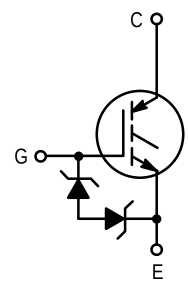
## N–Channel Enhancement–Mode Silicon Gate

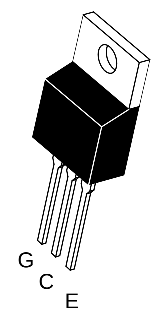
**MGP20N60U**

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

This Insulated Gate Bipolar Transistor (IGBT) uses an advanced termination scheme to provide an enhanced and reliable high voltage–blocking capability. It also provides fast switching characteristics and results in efficient operation at high frequencies.

- Industry Standard TO–220 Package
- High Speed $E_{off}$: 67 μJ/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




**CASE 221A–09, Style 9**
**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<br>— Continuous @ $T_C$ = 90°C<br>— Repetitive Pulsed Current (1) | $I_{C25}$<br>$I_{C90}$<br>$I_{CM}$ | 31<br>20<br>40 | Adc<br><br>Apk |
| Total Power Dissipation @ $T_C$ = 25°C<br>Derate above 25°C | $P_D$ | 142<br>0.89 | Watts<br>W/°C |
| Operating and Storage Junction Temperature Range | $T_J$, $T_{stg}$ | –55 to 150 | °C |
| Thermal Resistance — Junction to Case – IGBT<br>— Junction to Ambient | $R_{\theta JC}$<br>$R_{\theta JA}$ | 1.12<br>65 | °C/W |
| Maximum Lead Temperature for Soldering Purposes, 1/8″ from case for 5 seconds | $T_L$ | 200 | °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.

**ELECTRICAL CHARACTERISTICS** ($T_J$ = 25°C unless otherwise noted)

| Characteristic | Conditions | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | |
| Collector–to–Emitter Breakdown Voltage ($V_{GE}$ = 0 Vdc, $I_C$ = 25 μAdc) | | $V_{(BR)CES}$ | 600 | — | — | Vdc |
| Temperature Coefficient (Positive) | | | — | 870 | — | mV/°C |
| Emitter–to–Collector Breakdown Voltage ($V_{GE}$ = 0 Vdc, $I_{EC}$ = 100 mAdc) | | $V_{(BR)ECS}$ | 15 | — | — | Vdc |
| Zero Gate Voltage Collector Current ($V_{CE}$ = 600 Vdc, $V_{GE}$ = 0 Vdc) | | $I_{CES}$ | — | — | 10 | μAdc |
| ($V_{CE}$ = 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 ($V_{GE}$ = 15 Vdc, $I_C$ = 5.0 Adc) | | $V_{CE(on)}$ | — | 1.4 | 1.7 | Vdc |
| ($V_{GE}$ = 15 Vdc, $I_C$ = 5.0 Adc, $T_J$ = 125°C) | | | — | 1.3 | — | |
| ($V_{GE}$ = 15 Vdc, $I_C$ = 10 Adc, $T_J$ = 125°C) | | | — | 1.7 | 2.0 | |
| Gate Threshold Voltage ($V_{CE}$ = $V_{GE}$, $I_C$ = 1.0 mAdc) | | $V_{GE(th)}$ | 3.0 | 5.0 | 7.0 | Vdc |
| Threshold Temperature Coefficient (Negative) | | | — | 10 | — | mV/°C |
| Forward Transconductance ($V_{CE}$ = 10 Vdc, $I_C$ = 10 Adc) | | $g_{fe}$ | — | 7.0 | — | Mhos |
| **DYNAMIC CHARACTERISTICS** | | | | | | |
| Input Capacitance | ($V_{CE}$ = 25 Vdc, $V_{GE}$ = 0 Vdc, f = 1.0 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 Vdc, $I_C$ = 10 Adc, $V_{GE}$ = 15 Vdc, L = 300 μH, $R_G$ = 20 Ω, $T_J$ = 25°C) Energy losses include “tail” | $t_{d(on)}$ | — | 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 | — | μJ |
| 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” | $t_{d(on)}$ | — | 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 | — | μJ |
| 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 (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%.

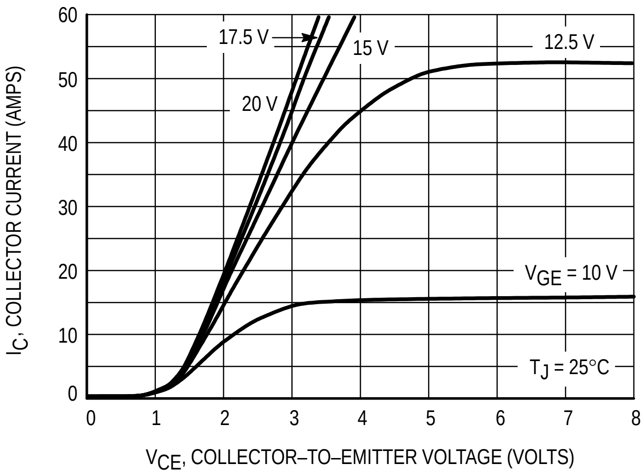



**Figure 1. Output Characteristics**

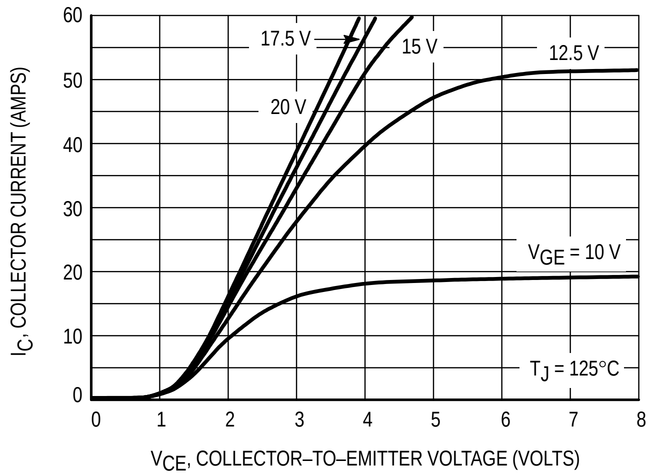



**Figure 2. Output Characteristics**

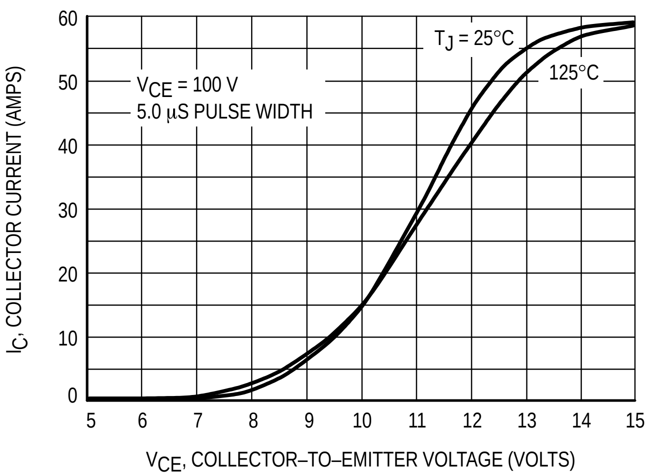



**Figure 3. Transfer Characteristics**

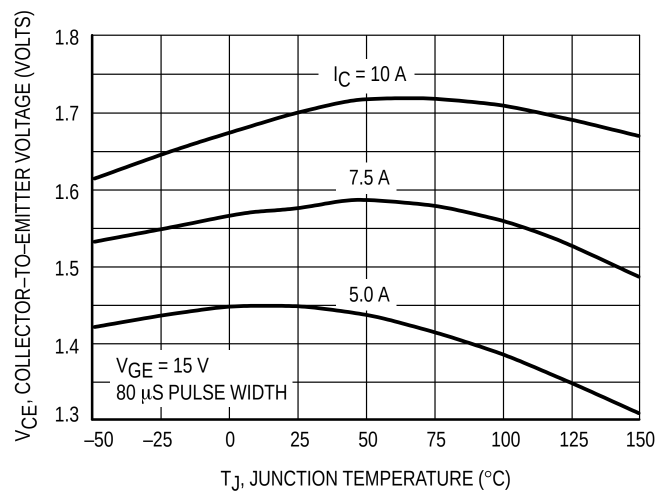



**Figure 4. Collector–To–Emitter Saturation Voltage versus Junction Temperature**

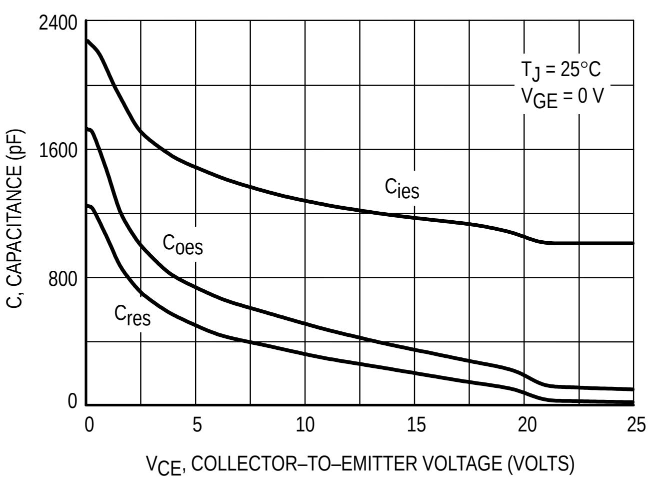



**Figure 5. Capacitance Variation**

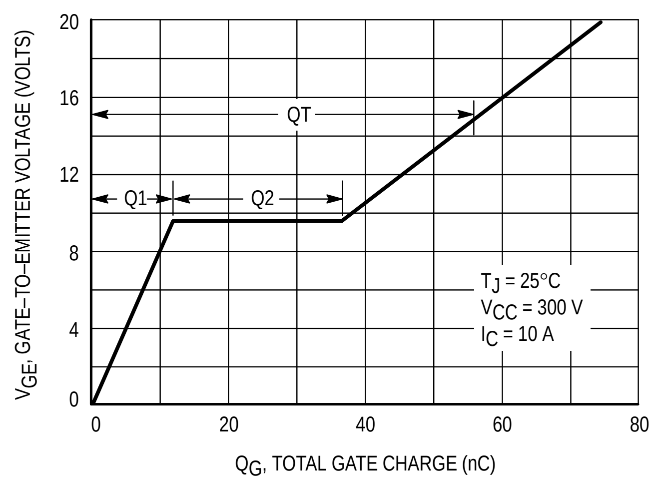



**Figure 6. Gate–To–Emitter Voltage versus Total Charge**

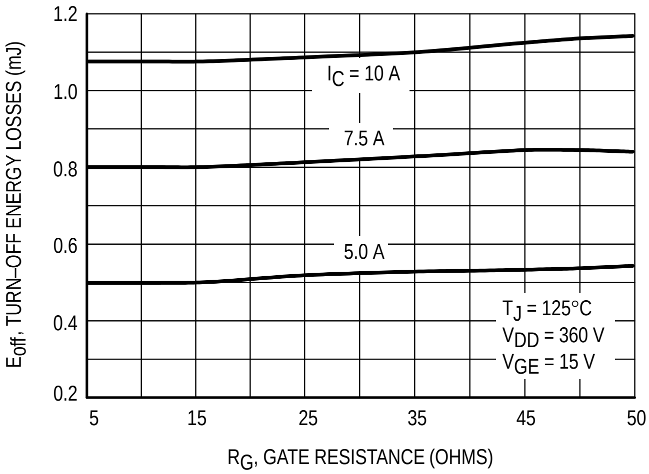



**Figure 7. Turn–Off Losses versus Gate Resistance**

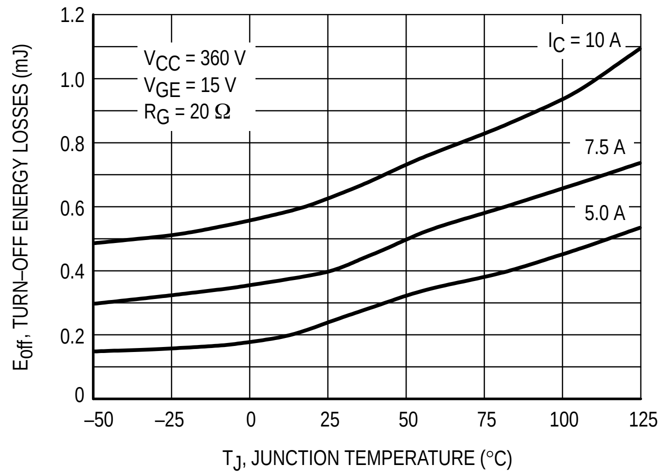



**Figure 8. Turn–Off Losses versus Junction Temperature**

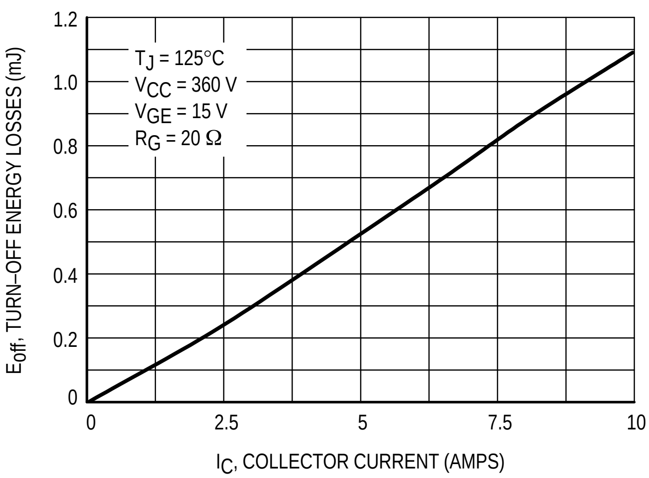



**Figure 9. Turn–Off Losses versus Collector Current**

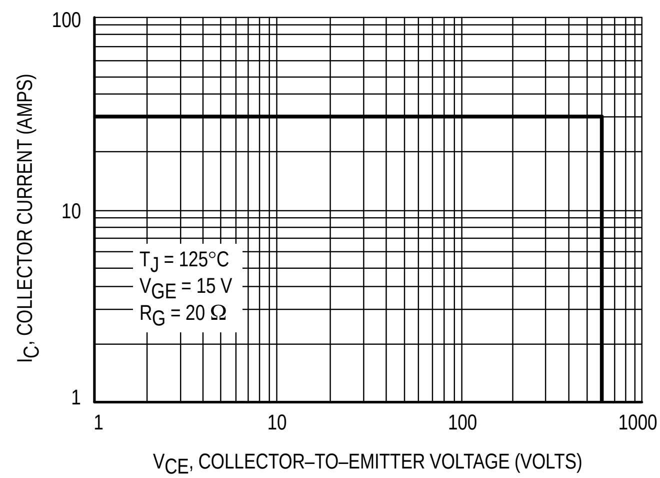
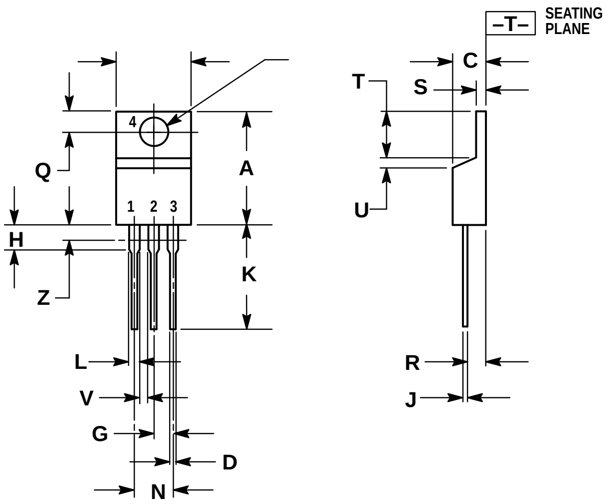



**Figure 10. Reverse Biased Safe Operating Area**

## 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.

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

| | 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 |

**CASE 221A–09**
**ISSUE Z**

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