

# Designer's™ Data Sheet

## Insulated Gate Bipolar Transistor

### N-Channel Enhancement-Mode Silicon Gate

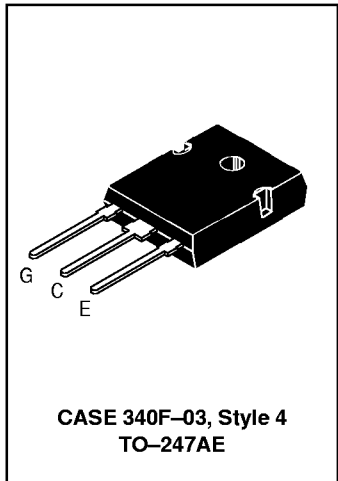
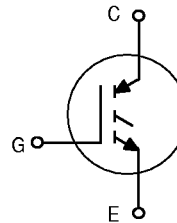
**MGW30N60**

Motorola Preferred Device

This Insulated Gate Bipolar Transistor (IGBT) uses an advanced termination scheme to provide an enhanced and reliable high voltage-blocking capability. Short circuit rated IGBT's are specifically suited for applications requiring a guaranteed short circuit withstand time such as Motor Control Drives. Fast switching characteristics result in efficient operation at high frequencies.

**IGBT IN TO-247**  
**30 A @ 90°C**  
**50 A @ 25°C**  
**600 VOLTS**  
**SHORT CIRCUIT RATED**

- Industry Standard High Power TO-247 Package with Isolated Mounting Hole
- High Speed  $E_{off}$ : 60  $\mu$ s per Amp typical at 125°C
- High Short Circuit Capability – 10  $\mu$ s minimum
- Robust High Voltage Termination
- Robust RBSOA



**MAXIMUM RATINGS** ( $T_C = 25^\circ\text{C}$  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 @ $T_C = 25^\circ\text{C}$<br>— Continuous @ $T_C = 90^\circ\text{C}$<br>— Repetitive Pulsed Current (1)   | $I_{C25}$<br>$I_{C90}$<br>$I_{CM}$ | 50<br>30<br>100      | Adc<br>Apk                   |
| Total Power Dissipation @ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$   | $P_D$                              | 202<br>1.61          | Watts<br>W/ $^\circ\text{C}$ |
| Operating and Storage Junction Temperature Range  | $T_J, T_{stg}$                     | -55 to 150           | $^\circ\text{C}$             |
| Short Circuit Withstand Time<br>( $V_{CC} = 360 \text{ Vdc}$ , $V_{GE} = 15 \text{ Vdc}$ , $T_J = 25^\circ\text{C}$ , $R_G = 20 \Omega$ ) | $t_{sc}$                           | 10                   | $\mu\text{s}$                |
| Thermal Resistance — Junction to Case – IGBT<br>— Junction to Ambient   | $R_{\theta JC}$<br>$R_{\theta JA}$ | 0.62<br>45           | $^\circ\text{C/W}$           |
| Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 5 seconds   | $T_L$                              | 260                  | $^\circ\text{C}$             |
| Mounting Torque, 6-32 or M3 screw   |                                    | 10 lbf•in (1.13 N•m) |                              |

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

**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.

**Preferred** devices are Motorola recommended choices for future use and best overall value.

# MGW30N60

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

| Characteristic  | Symbol            | Min      | Typ      | Max         | Unit         |
|---|-------------------|----------|----------|-------------|--------------|
| Collector-to-Emitter Breakdown Voltage<br>(V <sub>GE</sub> = 0 Vdc, I <sub>C</sub> = 250 μAdc)<br>Temperature Coefficient (Positive)  | BV <sub>CES</sub> | 600<br>— | —<br>870 | —<br>—      | Vdc<br>mV/°C |
| Emitter-to-Collector Breakdown Voltage (V <sub>GE</sub> = 0 Vdc, I <sub>EC</sub> = 100 mAdc)  | BV <sub>ECS</sub> | 25       | —        | —           | Vdc          |
| Zero Gate Voltage Collector Current<br>(V <sub>CE</sub> = 600 Vdc, V <sub>GE</sub> = 0 Vdc)<br>(V <sub>CE</sub> = 600 Vdc, V <sub>GE</sub> = 0 Vdc, T <sub>J</sub> = 125°C) | I <sub>CES</sub>  | —<br>—   | —<br>—   | 100<br>2500 | μAdc         |
| Gate-Body Leakage Current (V <sub>GE</sub> = ± 20 Vdc, V <sub>CE</sub> = 0 Vdc)   | I <sub>GES</sub>  | —        | —        | 250         | nAdc         |

## ON CHARACTERISTICS (1)

|  |                     |             |                      |                   |              |
|--|---------------------|-------------|----------------------|-------------------|--------------|
| Collector-to-Emitter On-State Voltage<br>(V <sub>GE</sub> = 15 Vdc, I <sub>C</sub> = 15 Adc)<br>(V <sub>GE</sub> = 15 Vdc, I <sub>C</sub> = 15 Adc, T <sub>J</sub> = 125°C)<br>(V <sub>GE</sub> = 15 Vdc, I <sub>C</sub> = 30 Adc) | V <sub>CE(on)</sub> | —<br>—<br>— | 2.20<br>2.10<br>2.60 | 2.90<br>—<br>3.45 | Vdc          |
| Gate Threshold Voltage<br>(V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 1 mAdc)<br>Threshold Temperature Coefficient (Negative)  | V <sub>GE(th)</sub> | 4.0<br>—    | 6.0<br>10            | 8.0<br>—          | Vdc<br>mV/°C |
| Forward Transconductance (V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 30 Adc)   | g <sub>fe</sub>     | —           | 15                   | —                 | Mhos         |

## DYNAMIC CHARACTERISTICS

|                      |   |                  |   |      |   |    |
|----------------------|---|------------------|---|------|---|----|
| Input Capacitance    | (V <sub>CE</sub> = 25 Vdc, V <sub>GE</sub> = 0 Vdc,<br>f = 1.0 MHz) | C <sub>ies</sub> | — | 4280 | — | pF |
| Output Capacitance   |   | C <sub>oes</sub> | — | 275  | — |    |
| Transfer Capacitance |   | C <sub>res</sub> | — | 19   | — |    |

## SWITCHING CHARACTERISTICS (1)

|                         |  |                     |   |      |      |    |
|-------------------------|--|---------------------|---|------|------|----|
| Turn-On Delay Time      | (V <sub>CC</sub> = 360 Vdc, I <sub>C</sub> = 30 Adc,<br>V <sub>GE</sub> = 15 Vdc, L = 300 μH<br>R <sub>G</sub> = 20 Ω, T <sub>J</sub> = 25°C)<br>Energy losses include "tail"  | t <sub>d(on)</sub>  | — | 76   | —    | ns |
| Rise Time               |  | t <sub>r</sub>      | — | 80   | —    |    |
| Turn-Off Delay Time     |  | t <sub>d(off)</sub> | — | 348  | —    |    |
| Fall Time               |  | t <sub>f</sub>      | — | 188  | —    |    |
| Turn-Off Switching Loss |  | E <sub>off</sub>    | — | 0.98 | 1.28 |    |
| Turn-On Delay Time      | (V <sub>CC</sub> = 360 Vdc, I <sub>C</sub> = 30 Adc,<br>V <sub>GE</sub> = 15 Vdc, L = 300 μH<br>R <sub>G</sub> = 20 Ω, T <sub>J</sub> = 125°C)<br>Energy losses include "tail" | t <sub>d(on)</sub>  | — | 73   | —    | ns |
| Rise Time               |  | t <sub>r</sub>      | — | 95   | —    |    |
| Turn-Off Delay Time     |  | t <sub>d(off)</sub> | — | 394  | —    |    |
| Fall Time               |  | t <sub>f</sub>      | — | 418  | —    |    |
| Turn-Off Switching Loss |  | E <sub>off</sub>    | — | 1.90 | —    |    |
| Gate Charge             | (V <sub>CC</sub> = 360 Vdc, I <sub>C</sub> = 30 Adc,<br>V <sub>GE</sub> = 15 Vdc)  | Q <sub>T</sub>      | — | 150  | —    | nC |
|                         |  | Q <sub>1</sub>      | — | 30   | —    |    |
|                         |  | Q <sub>2</sub>      | — | 45   | —    |    |

## INTERNAL PACKAGE INDUCTANCE

|  |                |   |    |   |    |
|--|----------------|---|----|---|----|
| Internal Emitter Inductance<br>(Measured from the emitter lead 0.25" from package to emitter bond pad) | L <sub>E</sub> | — | 13 | — | nH |
|--|----------------|---|----|---|----|

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

TYPICAL ELECTRICAL CHARACTERISTICS

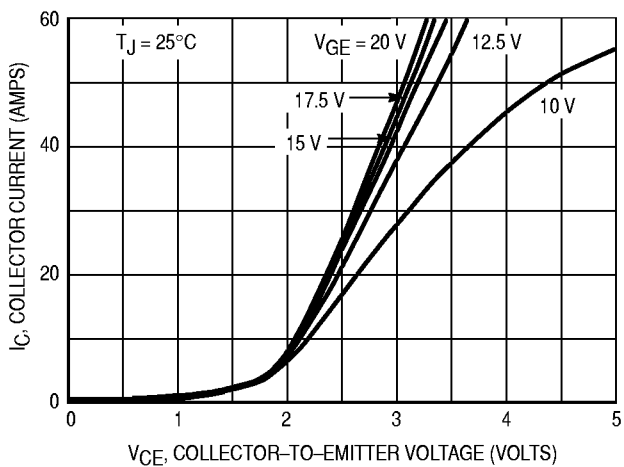


Figure 1. Output Characteristics,  $T_J = 25^\circ\text{C}$

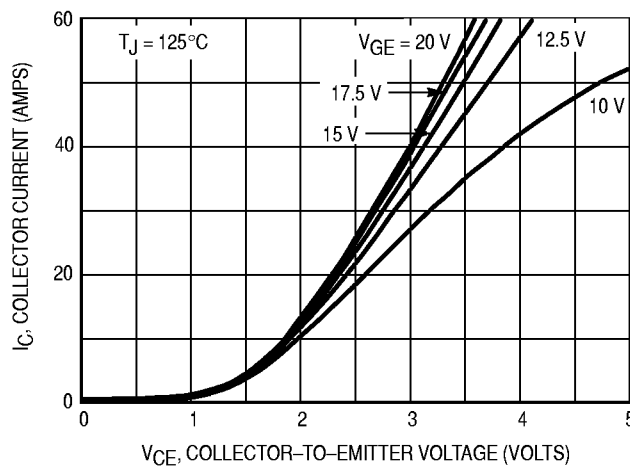


Figure 2. Output Characteristics,  $T_J = 125^\circ\text{C}$

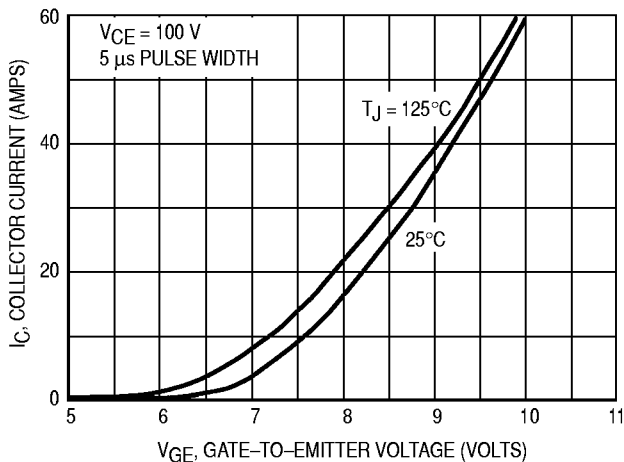


Figure 3. Transfer Characteristics

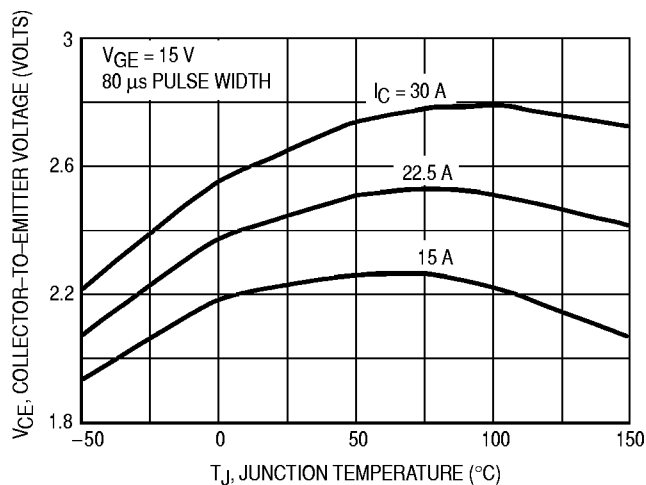


Figure 4. Collector-to-Emitter Saturation Voltage versus Junction Temperature

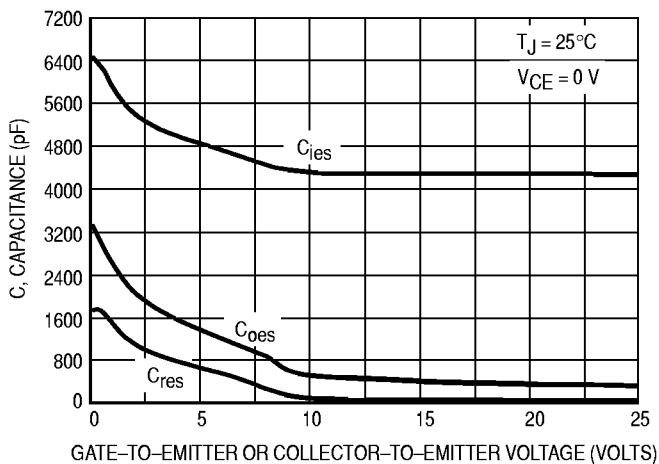


Figure 5. Capacitance Variation

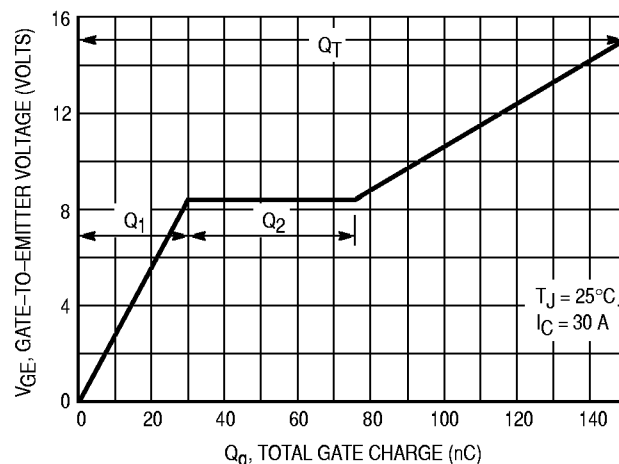
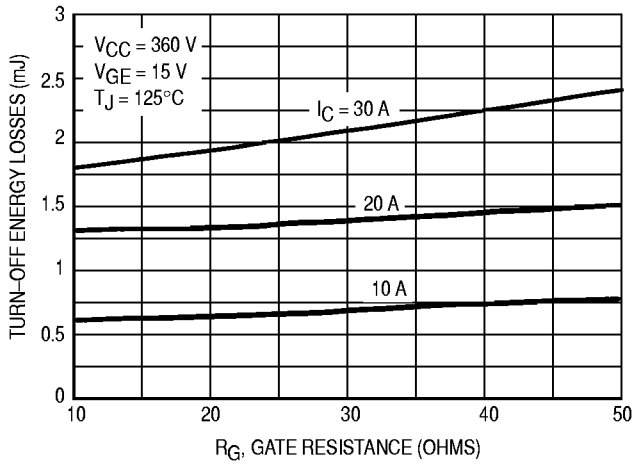
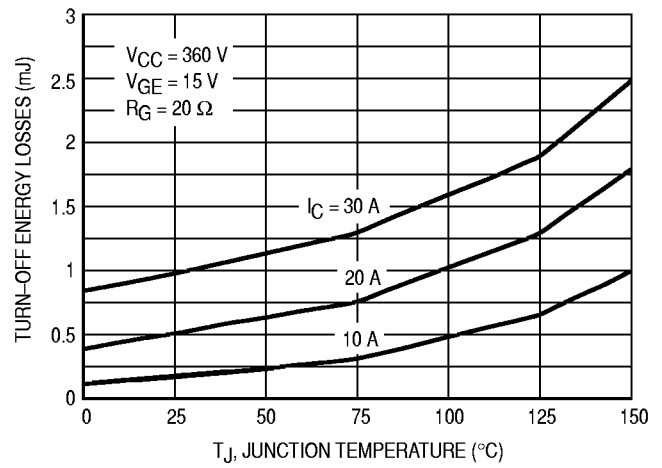


Figure 6. Gate-to-Emitter Voltage versus Total Charge

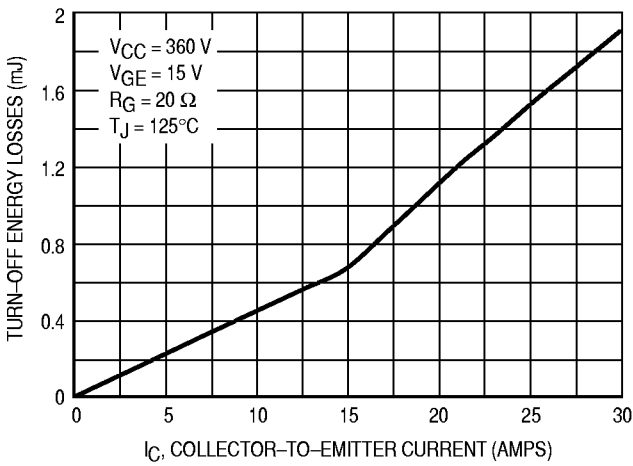
# MGW30N60



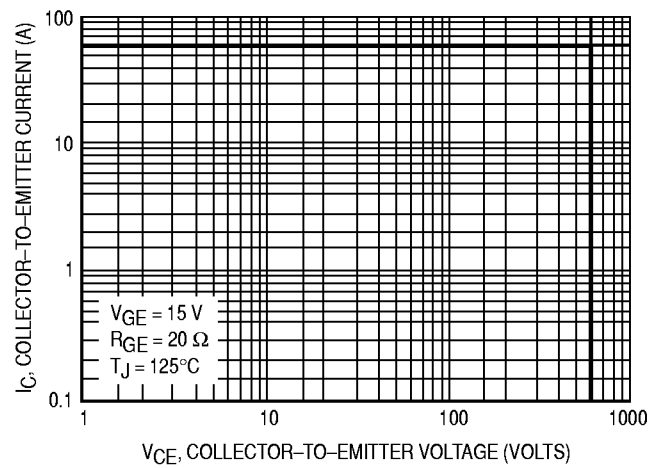
**Figure 7. Turn-Off Losses versus Gate Resistance**



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

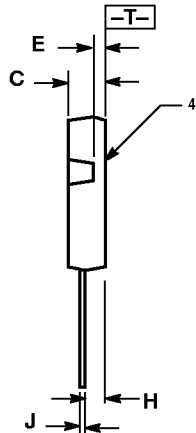
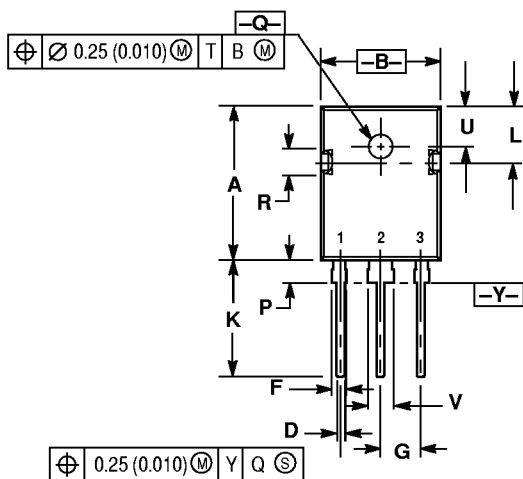


**Figure 9. Turn-Off Losses versus Collector-to-Emitter Current**



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

PACKAGE DIMENSIONS




NOTES:  
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
 2. CONTROLLING DIMENSION: MILLIMETER.

| DIM | MILLIMETERS |       | INCHES    |       |
|-----|-------------|-------|-----------|-------|
|     | MIN         | MAX   | MIN       | MAX   |
| A   | 20.40       | 20.90 | 0.803     | 0.823 |
| B   | 15.44       | 15.95 | 0.608     | 0.628 |
| C   | 4.70        | 5.21  | 0.185     | 0.205 |
| D   | 1.09        | 1.30  | 0.043     | 0.051 |
| E   | 1.50        | 1.63  | 0.059     | 0.064 |
| F   | 1.80        | 2.18  | 0.071     | 0.086 |
| G   | 5.45 BSC    |       | 0.215 BSC |       |
| H   | 2.56        | 2.87  | 0.101     | 0.113 |
| J   | 0.48        | 0.68  | 0.019     | 0.027 |
| K   | 15.57       | 16.08 | 0.613     | 0.633 |
| L   | 7.26        | 7.50  | 0.286     | 0.295 |
| P   | 3.10        | 3.38  | 0.122     | 0.133 |
| Q   | 3.50        | 3.70  | 0.138     | 0.145 |
| R   | 3.30        | 3.80  | 0.130     | 0.150 |
| U   | 5.30 BSC    |       | 0.209 BSC |       |
| V   | 3.05        | 3.40  | 0.120     | 0.134 |

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

CASE 340F-03  
 TO-247AE  
 ISSUE E

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