

# Designer's™ Data Sheet

## Insulated Gate Bipolar Transistor

### N-Channel Enhancement-Mode Silicon Gate

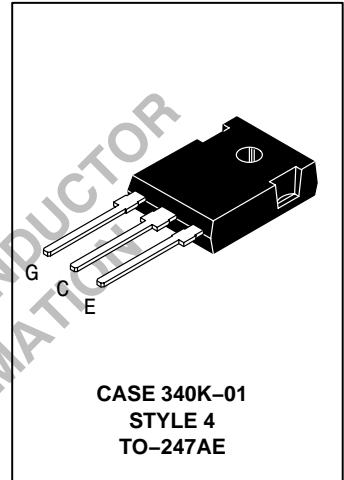
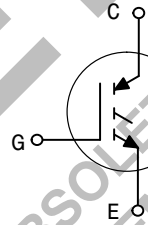
**MGW20N120**

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. Fast switching characteristics result in efficient operation at high frequencies.

**IGBT IN TO-247**  
**20 A @ 90°C**  
**28 A @ 25°C**  
**1200 VOLTS**  
**SHORT CIRCUIT RATED**

- Industry Standard High Power TO-247 Package with Isolated Mounting Hole
- High Speed  $E_{off}$ : 160  $\mu$ J/A typical at 125°C
- High Short Circuit Capability – 10  $\mu$ s minimum
- Robust High Voltage Termination



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

| Rating   | Symbol                             | Value                | Unit                         |
|--|------------------------------------|----------------------|------------------------------|
| Collector-Emitter Voltage  | $V_{CES}$                          | 1200                 | Vdc                          |
| Collector-Gate Voltage ( $R_{GE} = 1.0 \text{ M}\Omega$ )  | $V_{CGR}$                          | 1200                 | 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>$I_{CM}$ | 28<br>20<br>56       | Adc<br>Apk                   |
| Total Power Dissipation @ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$  | $P_D$                              | 174<br>1.39          | 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>( $V_{CC} = 720 \text{ Vdc}$ , $V_{GE} = 15 \text{ Vdc}$ , $T_J = 125^\circ\text{C}$ , $R_G = 20 \Omega$ ) | $t_{sc}$                           | 10                   | $\mu\text{s}$                |
| Thermal Resistance — Junction to Case – IGBT<br>— Junction to Ambient  | $R_{\theta JC}$<br>$R_{\theta JA}$ | 0.7<br>35            | $^\circ\text{C/W}$           |
| 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. 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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**Preferred** devices are Motorola recommended choices for future use and best overall value.

REV 2

# MGW20N120

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

| Characteristic  | Symbol               | Min       | Typ      | Max         | Unit         |
|---|----------------------|-----------|----------|-------------|--------------|
| <b>OFF CHARACTERISTICS</b>  |                      |           |          |             |              |
| Collector-to-Emitter Breakdown Voltage<br>(V <sub>GE</sub> = 0 Vdc, I <sub>C</sub> = 25 μAdc)<br>Temperature Coefficient (Positive)   | V <sub>(BR)CES</sub> | 1200<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)  | V <sub>(BR)ECS</sub> | 25        | —        | —           | Vdc          |
| Zero Gate Voltage Collector Current<br>(V <sub>CE</sub> = 1200 Vdc, V <sub>GE</sub> = 0 Vdc)<br>(V <sub>CE</sub> = 1200 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> = 10 Adc)<br>(V <sub>GE</sub> = 15 Vdc, I <sub>C</sub> = 10 Adc, T <sub>J</sub> = 125°C)<br>(V <sub>GE</sub> = 15 Vdc, I <sub>C</sub> = 20 Adc) | V <sub>CE(on)</sub> | —<br>—<br>— | 2.42<br>2.36<br>2.90 | 3.54<br>—<br>4.99 | Vdc          |
| Gate Threshold Voltage<br>(V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 1.0 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> = 20 Adc)   | g <sub>fe</sub>     | —           | 12                   | —                 | 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> | — | 1860 | — | pF |
| Output Capacitance   |   | C <sub>oes</sub> | — | 122  | — |    |
| Transfer Capacitance |   | C <sub>res</sub> | — | 29   | — |    |

## SWITCHING CHARACTERISTICS (1)

|                         |  |                     |   |      |      |    |
|-------------------------|--|---------------------|---|------|------|----|
| Turn-On Delay Time      | (V <sub>CC</sub> = 720 Vdc, I <sub>C</sub> = 20 Adc,<br>V <sub>GE</sub> = 15 Vdc, L = 300 μH<br>R <sub>G</sub> = 20 Ω)<br>Energy losses include "tail"                         | t <sub>d(on)</sub>  | — | 88   | —    | ns |
| Rise Time               |  | t <sub>r</sub>      | — | 103  | —    |    |
| Turn-Off Delay Time     |  | t <sub>d(off)</sub> | — | 190  | —    |    |
| Fall Time               |  | t <sub>f</sub>      | — | 284  | —    |    |
| Turn-Off Switching Loss |  | E <sub>off</sub>    | — | 1.65 | 2.75 |    |
| Turn-On Delay Time      | (V <sub>CC</sub> = 720 Vdc, I <sub>C</sub> = 20 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>  | — | 83   | —    | ns |
| Rise Time               |  | t <sub>r</sub>      | — | 107  | —    |    |
| Turn-Off Delay Time     |  | t <sub>d(off)</sub> | — | 216  | —    |    |
| Fall Time               |  | t <sub>f</sub>      | — | 494  | —    |    |
| Turn-Off Switching Loss |  | E <sub>off</sub>    | — | 3.19 | —    |    |
| Gate Charge             | (V <sub>CC</sub> = 720 Vdc, I <sub>C</sub> = 20 Adc,<br>V <sub>GE</sub> = 15 Vdc)  | Q <sub>T</sub>      | — | 62   | —    | nC |
|                         |  | Q <sub>1</sub>      | — | 21   | —    |    |
|                         |  | Q <sub>2</sub>      | — | 25   | —    |    |

## 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

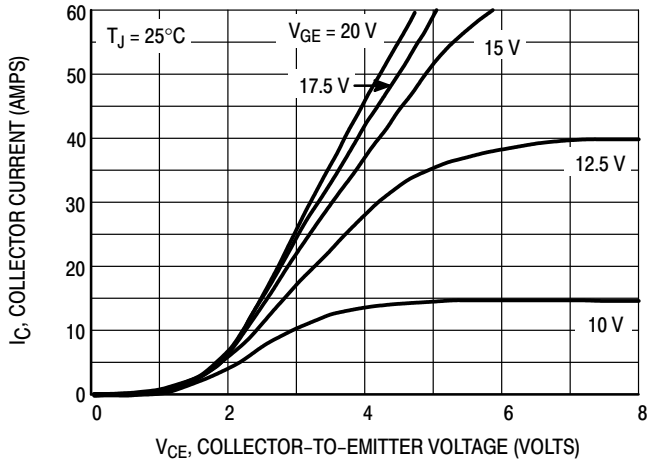


Figure 1. Output Characteristics

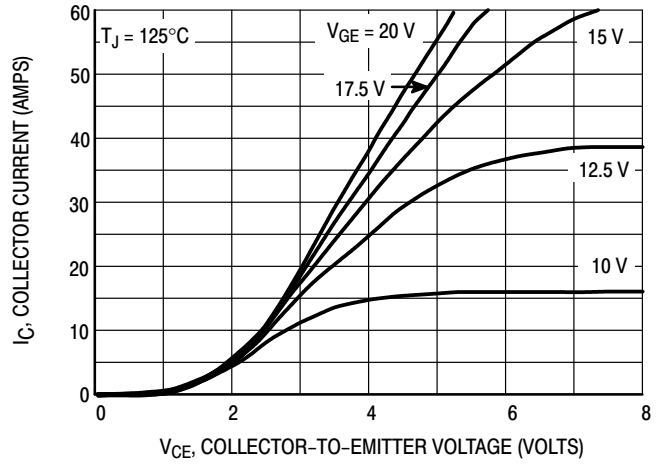


Figure 2. Output Characteristics

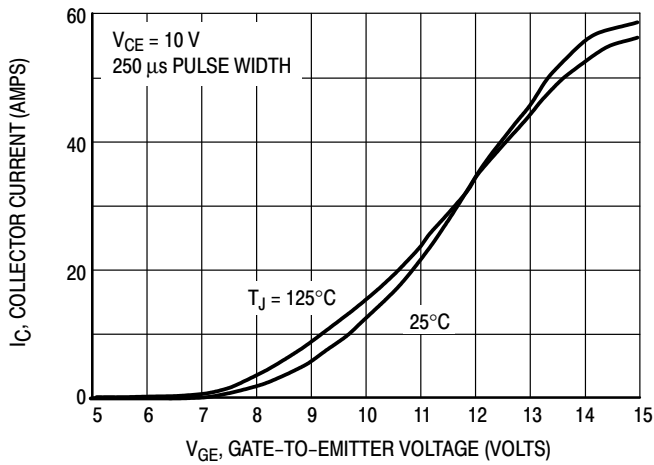


Figure 3. Transfer Characteristics

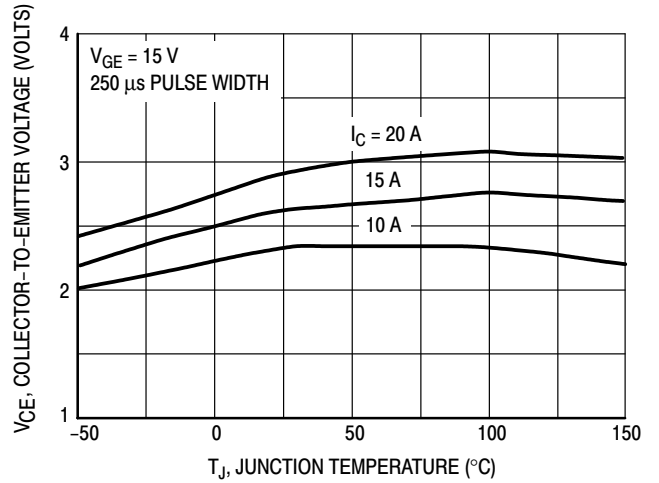


Figure 4. Collector-to-Emitter Saturation Voltage versus Junction Temperature

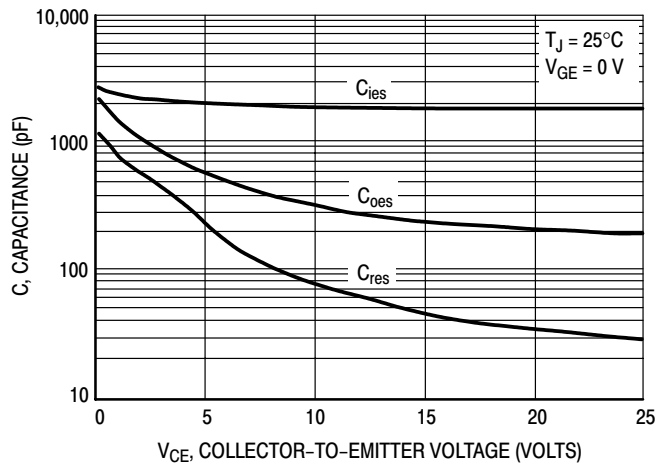


Figure 5. Capacitance Variation

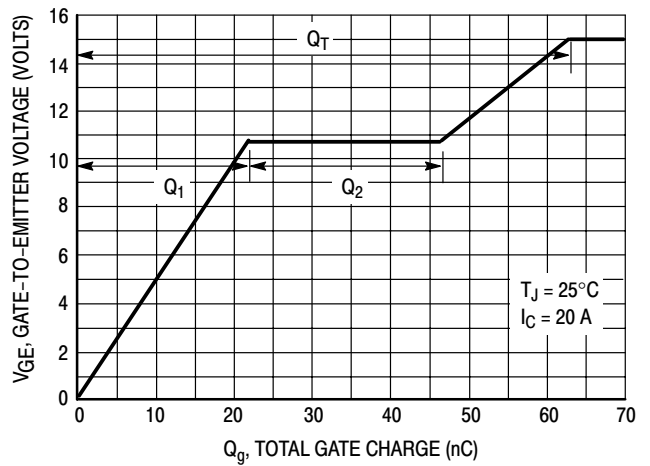


Figure 6. Gate-to-Emitter Voltage versus Total Charge

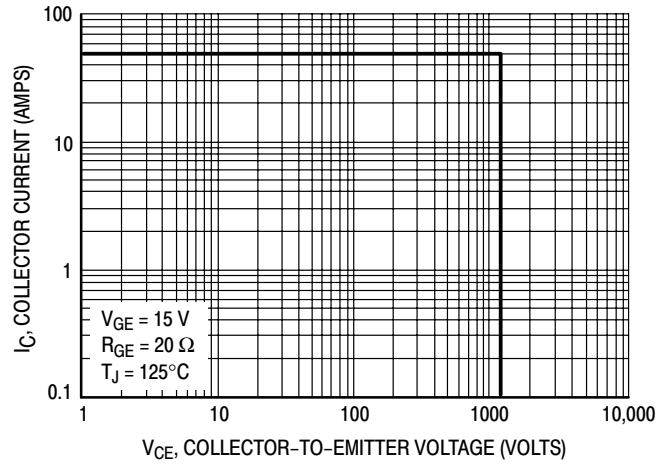


Figure 7. Reverse Biased Safe Operating Area

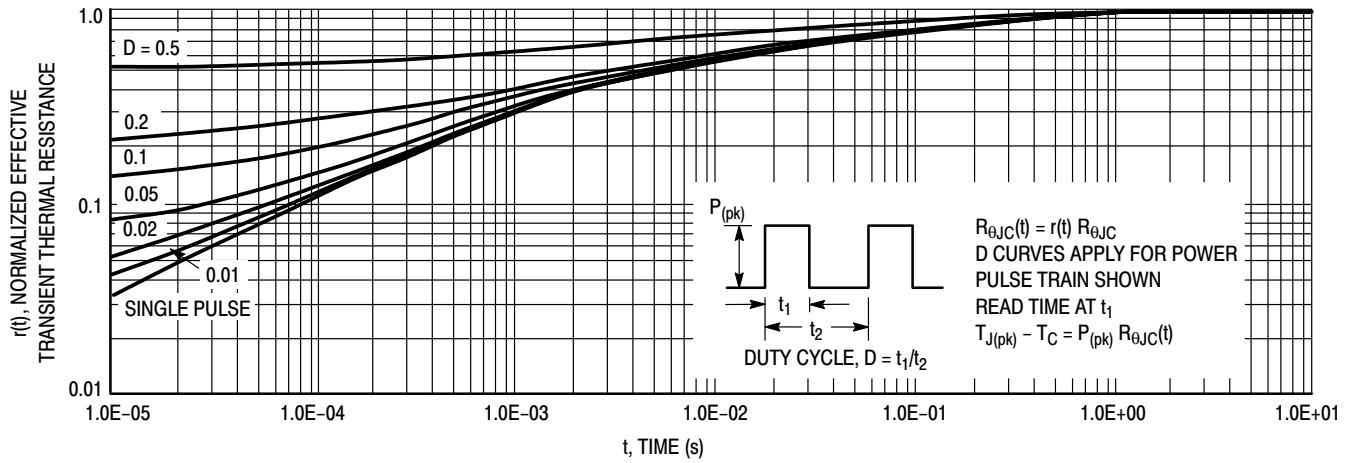
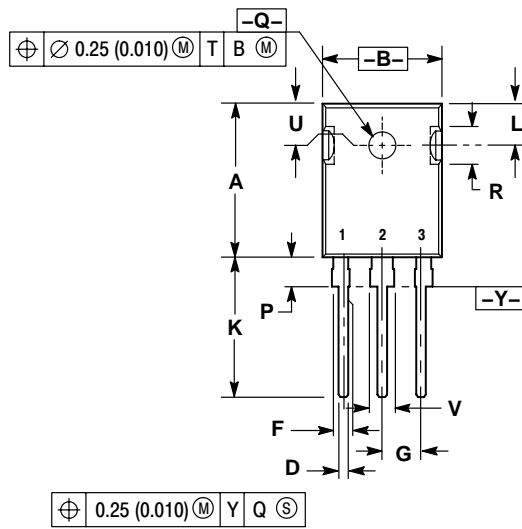


Figure 8. Thermal Response

PACKAGE DIMENSIONS




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

| DIM | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
|     | MIN         | MAX  | MIN       | MAX   |
| A   | 19.7        | 20.3 | 0.776     | 0.799 |
| B   | 15.3        | 15.9 | 0.602     | 0.626 |
| C   | 4.7         | 5.3  | 0.185     | 0.209 |
| D   | 1.0         | 1.4  | 0.039     | 0.055 |
| E   | 1.27 REF    |      | 0.050 REF |       |
| F   | 2.0         | 2.4  | 0.079     | 0.094 |
| G   | 5.5 BSC     |      | 0.216 BSC |       |
| H   | 2.2         | 2.6  | 0.087     | 0.102 |
| J   | 0.4         | 0.8  | 0.016     | 0.031 |
| K   | 14.2        | 14.8 | 0.559     | 0.583 |
| L   | 5.5 NOM     |      | 0.217 NOM |       |
| P   | 3.7         | 4.3  | 0.146     | 0.169 |
| Q   | 3.55        | 3.65 | 0.140     | 0.144 |
| R   | 5.0 NOM     |      | 0.197 NOM |       |
| U   | 5.5 BSC     |      | 0.217 BSC |       |
| V   | 3.0         | 3.4  | 0.118     | 0.134 |

CASE 340K-01  
 TO-247AE  
 ISSUE A

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

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