

# Designer's™ Data Sheet

## Insulated Gate Bipolar Transistor

### N-Channel Enhancement-Mode Silicon Gate

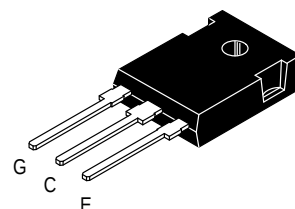
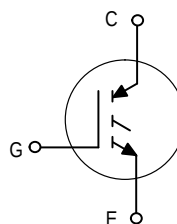
**MGW12N120**

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.

- Industry Standard High Power TO-247 Package with Isolated Mounting Hole
- High Speed  $E_{off}$ : 150  $\mu$ J/A typical at 125°C
- High Short Circuit Capability – 10  $\mu$ s minimum
- Robust High Voltage Termination

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



**CASE 340K-01**  
**STYLE 4**  
**TO-247AE**

#### 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>$I_{CM}$ | 20<br>12<br>40 | Adc<br>Apk                   |
| Total Power Dissipation @ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$                                                      | $P_D$                              | 125<br>0.98    | 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>$R_{\theta JA}$ | 1.0<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. 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

## MGW12N120

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

| Characteristic                                                                                                                                                                          | Symbol        | Min       | Typ      | Max         | Unit                        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------|----------|-------------|-----------------------------|
| <b>OFF CHARACTERISTICS</b>                                                                                                                                                              |               |           |          |             |                             |
| Collector-to-Emitter Breakdown Voltage<br>( $V_{GE} = 0\text{ Vdc}$ , $I_C = 25\text{ }\mu\text{Adc}$ )<br>Temperature Coefficient (Positive)                                           | $V_{(BR)CES}$ | 1200<br>— | —<br>870 | —<br>—      | Vdc<br>mV/ $^\circ\text{C}$ |
| Emitter-to-Collector Breakdown Voltage ( $V_{GE} = 0\text{ Vdc}$ , $I_{EC} = 100\text{ mAdc}$ )                                                                                         | $V_{(BR)ECS}$ | 25        | —        | —           | Vdc                         |
| Zero Gate Voltage Collector Current<br>( $V_{CE} = 1200\text{ Vdc}$ , $V_{GE} = 0\text{ Vdc}$ )<br>( $V_{CE} = 1200\text{ Vdc}$ , $V_{GE} = 0\text{ Vdc}$ , $T_J = 125^\circ\text{C}$ ) | $I_{CES}$     | —<br>—    | —<br>—   | 100<br>2500 | $\mu\text{Adc}$             |
| Gate-Body Leakage Current ( $V_{GE} = \pm 20\text{ Vdc}$ , $V_{CE} = 0\text{ Vdc}$ )                                                                                                    | $I_{GES}$     | —         | —        | 250         | nAdc                        |

### ON CHARACTERISTICS (1)

|                                                                                                                                                                                                                                             |              |             |                     |                   |                             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------|---------------------|-------------------|-----------------------------|
| Collector-to-Emitter On-State Voltage<br>( $V_{GE} = 15\text{ Vdc}$ , $I_C = 5.0\text{ Adc}$ )<br>( $V_{GE} = 15\text{ Vdc}$ , $I_C = 5.0\text{ Adc}$ , $T_J = 125^\circ\text{C}$ )<br>( $V_{GE} = 15\text{ Vdc}$ , $I_C = 10\text{ Adc}$ ) | $V_{CE(on)}$ | —<br>—<br>— | 2.51<br>2.36<br>3.5 | 3.37<br>—<br>4.42 | Vdc                         |
| Gate Threshold Voltage<br>( $V_{CE} = V_{GE}$ , $I_C = 1.0\text{ mAdc}$ )<br>Threshold Temperature Coefficient (Negative)                                                                                                                   | $V_{GE(th)}$ | 4.0<br>—    | 6.0<br>10           | 8.0<br>—          | Vdc<br>mV/ $^\circ\text{C}$ |
| Forward Transconductance ( $V_{CE} = 10\text{ Vdc}$ , $I_C = 10\text{ Adc}$ )                                                                                                                                                               | $g_{fe}$     | —           | 12                  | —                 | Mhos                        |

### DYNAMIC CHARACTERISTICS

|                      |                                                                                 |           |   |     |   |    |
|----------------------|---------------------------------------------------------------------------------|-----------|---|-----|---|----|
| Input Capacitance    | $(V_{CE} = 25\text{ Vdc}$ , $V_{GE} = 0\text{ Vdc}$ ,<br>$f = 1.0\text{ MHz}$ ) | $C_{ies}$ | — | 930 | — | pF |
| Output Capacitance   |                                                                                 | $C_{oes}$ | — | 126 | — |    |
| Transfer Capacitance |                                                                                 | $C_{res}$ | — | 16  | — |    |

### SWITCHING CHARACTERISTICS (1)

|                         |                                                                                                                                                                                                           |              |   |      |      |    |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|---|------|------|----|
| Turn-On Delay Time      | $(V_{CC} = 720\text{ Vdc}$ , $I_C = 10\text{ Adc}$ ,<br>$V_{GE} = 15\text{ Vdc}$ , $L = 300\text{ }\mu\text{H}$<br>$R_G = 20\text{ }\Omega$ )<br>Energy losses include "tail"                             | $t_{d(on)}$  | — | 74   | —    | ns |
| Rise Time               |                                                                                                                                                                                                           | $t_r$        | — | 83   | —    |    |
| Turn-Off Delay Time     |                                                                                                                                                                                                           | $t_{d(off)}$ | — | 76   | —    |    |
| Fall Time               |                                                                                                                                                                                                           | $t_f$        | — | 231  | —    |    |
| Turn-Off Switching Loss |                                                                                                                                                                                                           | $E_{off}$    | — | 0.55 | 1.33 | mJ |
| Turn-On Delay Time      | $(V_{CC} = 720\text{ Vdc}$ , $I_C = 10\text{ Adc}$ ,<br>$V_{GE} = 15\text{ Vdc}$ , $L = 300\text{ }\mu\text{H}$<br>$R_G = 20\text{ }\Omega$ , $T_J = 125^\circ\text{C}$ )<br>Energy losses include "tail" | $t_{d(on)}$  | — | 66   | —    | ns |
| Rise Time               |                                                                                                                                                                                                           | $t_r$        | — | 87   | —    |    |
| Turn-Off Delay Time     |                                                                                                                                                                                                           | $t_{d(off)}$ | — | 120  | —    |    |
| Fall Time               |                                                                                                                                                                                                           | $t_f$        | — | 575  | —    |    |
| Turn-Off Switching Loss |                                                                                                                                                                                                           | $E_{off}$    | — | 1.49 | —    | mJ |
| Gate Charge             | $(V_{CC} = 720\text{ Vdc}$ , $I_C = 10\text{ Adc}$ ,<br>$V_{GE} = 15\text{ Vdc}$ )                                                                                                                        | $Q_T$        | — | 31   | —    | nC |
|                         |                                                                                                                                                                                                           | $Q_1$        | — | 13   | —    |    |
|                         |                                                                                                                                                                                                           | $Q_2$        | — | 14   | —    |    |

### INTERNAL PACKAGE INDUCTANCE

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

(1) Pulse Test: Pulse Width  $\leq 300\text{ }\mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

# TYPICAL ELECTRICAL CHARACTERISTICS

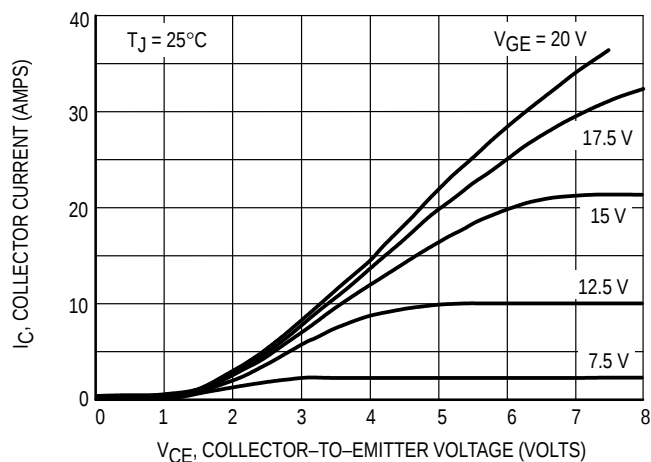


Figure 1. Output Characteristics

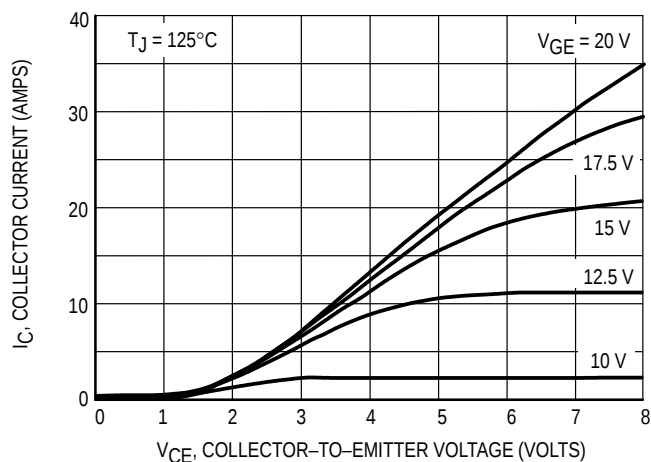


Figure 2. Output Characteristics

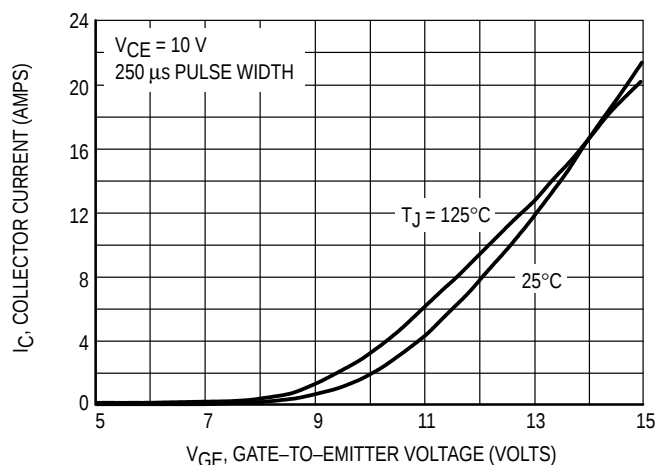


Figure 3. Transfer Characteristics

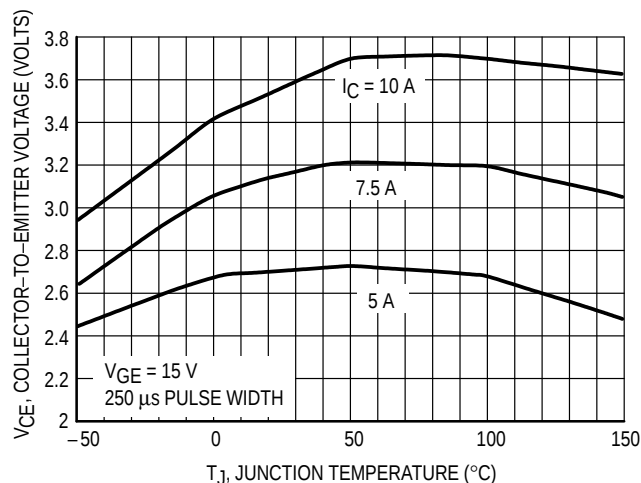


Figure 4. Collector-to-Emitter Saturation Voltage versus Junction Temperature

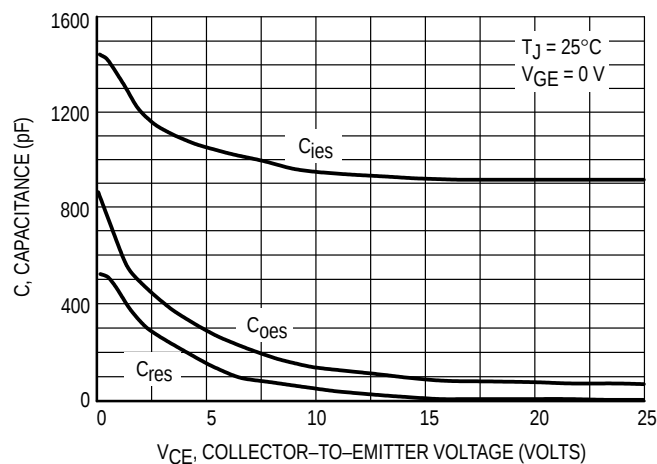


Figure 5. Capacitance Variation

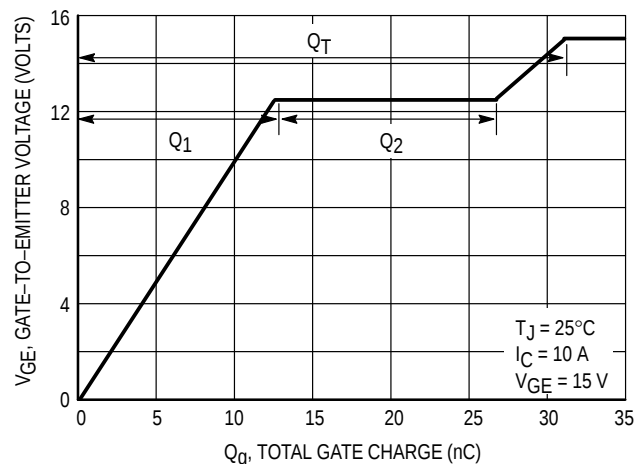


Figure 6. Gate-to-Emitter Voltage versus Total Charge

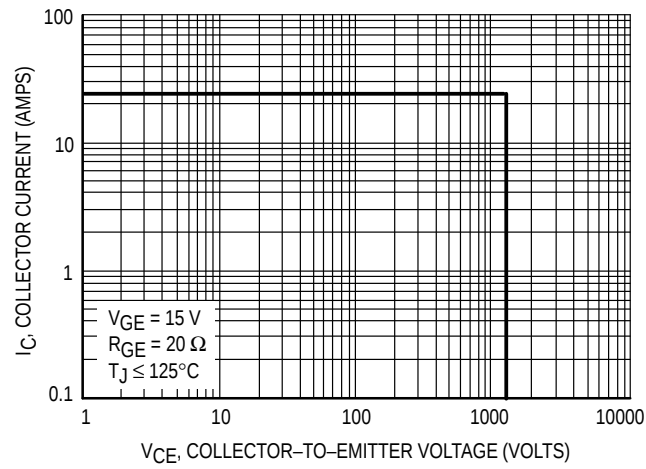


Figure 7. Reverse Biased Safe Operating Area

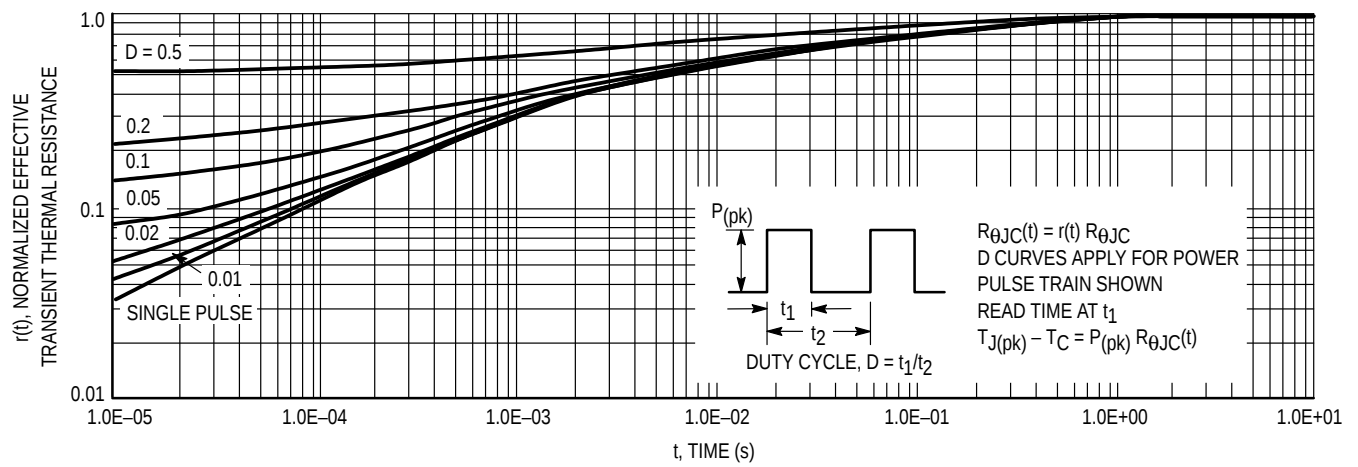
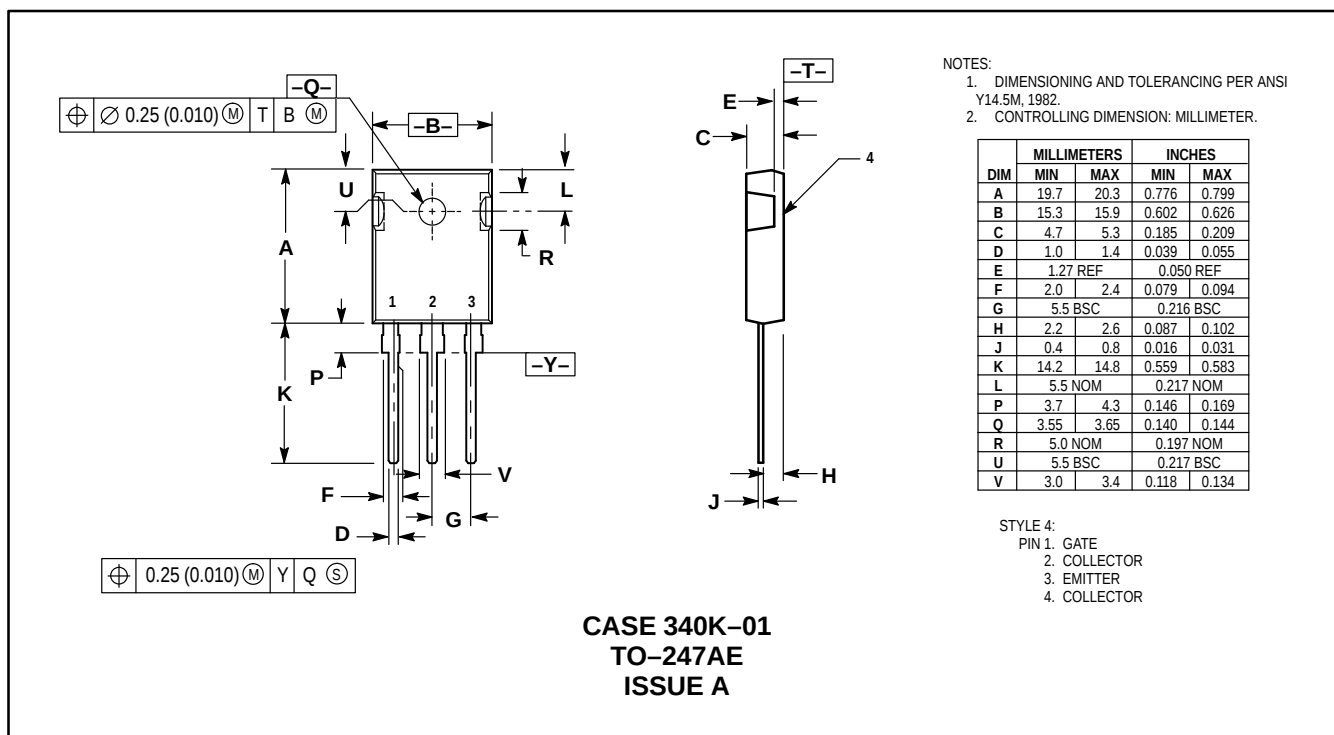


Figure 8. Thermal Response

## PACKAGE DIMENSIONS



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