

# FMG2G150US60E

## Molding Type Module

### General Description

Fairchild's Insulated Gate Bipolar Transistor (IGBT) power modules provide low conduction and switching losses as well as short circuit ruggedness. They are designed for applications such as motor control, uninterrupted power supplies (UPS) and general inverters where short circuit ruggedness is a required feature.

### Features

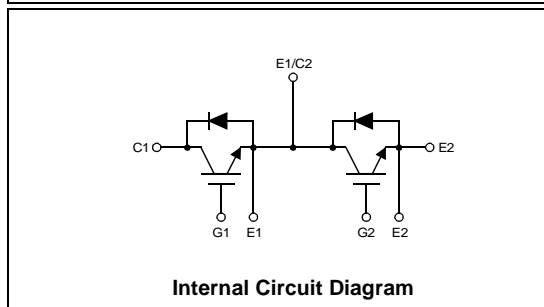
- UL Certified No. E209204
- Short Circuit rated 10us @  $T_C = 100^\circ\text{C}$ ,  $V_{GE} = 15\text{V}$
- High Speed Switching
- Low Saturation Voltage :  $V_{CE(sat)} = 2.2\text{V}$  @  $I_C = 150\text{A}$
- High Input Impedance
- Fast & Soft Anti-Parallel FWD

### Application

- AC & DC Motor Controls
- General Purpose Inverters
- Robotics
- Servo Controls
- UPS



Package Code : 7PM-GA



Internal Circuit Diagram

### Absolute Maximum Ratings $T_C = 25^\circ\text{C}$ unless otherwise noted

| Symbol          | Description  | FMG2G150US60E | Units            |
|-----------------|--|---------------|------------------|
| $V_{CES}$       | Collector-Emitter Voltage                                    | 600           | V                |
| $V_{GES}$       | Gate-Emitter Voltage   | $\pm 20$      | V                |
| $I_C$           | Collector Current @ $T_C = 25^\circ\text{C}$                 | 150           | A                |
| $I_{CM(1)}$     | Pulsed Collector Current                                     | 300           | A                |
| $I_F$           | Diode Continuous Forward Current @ $T_C = 100^\circ\text{C}$ | 150           | A                |
| $I_{FM}$        | Diode Maximum Forward Current                                | 300           | A                |
| $T_{SC}$        | Short Circuit Withstand Time @ $T_C = 100^\circ\text{C}$     | 10            | us               |
| $P_D$           | Maximum Power Dissipation @ $T_C = 25^\circ\text{C}$         | 500           | W                |
| $T_J$           | Operating Junction Temperature                               | -40 to +150   | $^\circ\text{C}$ |
| $T_{stg}$       | Storage Temperature Range                                    | -40 to +125   | $^\circ\text{C}$ |
| $V_{iso}$       | Isolation Voltage @ AC 1minute                               | 2500          | V                |
| Mounting Torque | Power Terminals Screw : M5                                   | 2.0           | N.m              |
|                 | Mounting Screw : M6  | 2.5           | N.m              |

**Notes :**

(1) Repetitive rating : Pulse width limited by max. junction temperature

**Electrical Characteristics of IGBT**  $T_C = 25^\circ\text{C}$  unless otherwise noted

| Symbol                           | Parameter                               | Test Conditions  | Min. | Typ.  | Max.      | Units               |
|----------------------------------|---|--|------|-------|-----------|---------------------|
| <b>Off Characteristics</b>       |   |  |      |       |           |                     |
| $BV_{CES}$                       | Collector-Emitter Breakdown Voltage     | $V_{GE} = 0V, I_C = 250\mu A$  | 600  | --    | --        | V                   |
| $\Delta BV_{CES}/\Delta T_J$     | Temperature Coeff. of Breakdown Voltage | $V_{GE} = 0V, I_C = 1mA$   | --   | 0.6   | --        | V/ $^\circ\text{C}$ |
| $I_{CES}$                        | Collector Cut-Off Current               | $V_{CE} = V_{CES}, V_{GE} = 0V$  | --   | --    | 250       | $\mu A$             |
| $I_{GES}$                        | G-E Leakage Current                     | $V_{GE} = V_{GES}, V_{CE} = 0V$  | --   | --    | $\pm 100$ | nA                  |
| <b>On Characteristics</b>        |   |  |      |       |           |                     |
| $V_{GE(th)}$                     | G-E Threshold Voltage                   | $V_{GE} = 0V, I_C = 150mA$   | 5.0  | 6.0   | 8.5       | V                   |
| $V_{CE(sat)}$                    | Collector to Emitter Saturation Voltage | $I_C = 150A, V_{GE} = 15V$   | --   | 2.2   | 2.8       | V                   |
| <b>Dynamic Characteristics</b>   |   |  |      |       |           |                     |
| $C_{ies}$                        | Input Capacitance                       | $V_{CE} = 30V, V_{GE} = 0V,$<br>$f = 1MHz$   | --   | 12840 | --        | pF                  |
| $C_{oes}$                        | Output Capacitance                      |  | --   | 1400  | --        | pF                  |
| $C_{res}$                        | Reverse Transfer Capacitance            |  | --   | 354   | --        | pF                  |
| <b>Switching Characteristics</b> |   |  |      |       |           |                     |
| $t_{d(on)}$                      | Turn-On Delay Time                      | $V_{CC} = 300V, I_C = 150A,$<br>$R_G = 2.0\Omega, V_{GE} = 15V$<br>Inductive Load, $T_C = 25^\circ\text{C}$  | --   | 40    | --        | ns                  |
| $t_r$                            | Rise Time                               |  | --   | 70    | --        | ns                  |
| $t_{d(off)}$                     | Turn-Off Delay Time                     |  | --   | 90    | --        | ns                  |
| $t_f$                            | Fall Time                               |  | --   | 110   | 200       | ns                  |
| $E_{on}$                         | Turn-On Switching Loss                  |  | --   | 1.6   | --        | mJ                  |
| $E_{off}$                        | Turn-Off Switching Loss                 | --   | 4.8  | --    | mJ        |                     |
| $E_{ts}$                         | Total Switching Loss                    | --   | 6.4  | --    | mJ        |                     |
| $t_{d(on)}$                      | Turn-On Delay Time                      | $V_{CC} = 300V, I_C = 150A,$<br>$R_G = 2.0\Omega, V_{GE} = 15V$<br>Inductive Load, $T_C = 125^\circ\text{C}$ | --   | 40    | --        | ns                  |
| $t_r$                            | Rise Time                               |  | --   | 80    | --        | ns                  |
| $t_{d(off)}$                     | Turn-Off Delay Time                     |  | --   | 100   | --        | ns                  |
| $t_f$                            | Fall Time                               |  | --   | 300   | --        | ns                  |
| $E_{on}$                         | Turn-On Switching Loss                  |  | --   | 2.0   | --        | mJ                  |
| $E_{off}$                        | Turn-Off Switching Loss                 | --   | 8.0  | --    | mJ        |                     |
| $E_{ts}$                         | Total Switching Loss                    | --   | 10.0 | --    | mJ        |                     |
| $T_{sc}$                         | Short Circuit Withstand Time            | $V_{CC} = 300V, V_{GE} = 15V$<br>@ $T_C = 100^\circ\text{C}$   | 10   | --    | --        | $\mu s$             |
| $Q_g$                            | Total Gate Charge                       | $V_{CE} = 300V, I_C = 150A,$<br>$V_{GE} = 15V$   | --   | 620   | 700       | nC                  |
| $Q_{ge}$                         | Gate-Emitter Charge                     |  | --   | 120   | --        | nC                  |
| $Q_{gc}$                         | Gate-Collector Charge                   |  | --   | 270   | --        | nC                  |

**Electrical Characteristics of DIODE**  $T_C = 25^\circ\text{C}$  unless otherwise noted

| Symbol   | Parameter                           | Test Conditions                                     | Min.                      | Typ. | Max. | Units |    |
|----------|-------------------------------------|---|---------------------------|------|------|-------|----|
| $V_{FM}$ | Diode Forward Voltage               | $I_F = 150\text{A}$                                 | $T_C = 25^\circ\text{C}$  | --   | 1.9  | 2.8   | V  |
|          |                                     |   | $T_C = 100^\circ\text{C}$ | --   | 1.8  | --    |    |
| $t_{rr}$ | Diode Reverse Recovery Time         |   | $T_C = 25^\circ\text{C}$  | --   | 90   | 130   | ns |
|          |                                     |   | $T_C = 100^\circ\text{C}$ | --   | 130  | --    |    |
| $I_{rr}$ | Diode Peak Reverse Recovery Current | $I_F = 150\text{A}$<br>$di / dt = 300 \text{ A/us}$ | $T_C = 25^\circ\text{C}$  | --   | 15   | 20    | A  |
|          |                                     |   | $T_C = 100^\circ\text{C}$ | --   | 22   | --    |    |
| $Q_{rr}$ | Diode Reverse Recovery Charge       |   | $T_C = 25^\circ\text{C}$  | --   | 675  | 1270  | nC |
|          |                                     |   | $T_C = 100^\circ\text{C}$ | --   | 1430 | --    |    |

**Thermal Characteristics**

| Symbol          | Parameter                                     | Typ. | Max. | Units              |
|-----------------|---|------|------|--------------------|
| $R_{\theta JC}$ | Junction-to-Case (IGBT Part, per 1/2 Module)  | --   | 0.20 | $^\circ\text{C/W}$ |
| $R_{\theta JC}$ | Junction-to-Case (DIODE Part, per 1/2 Module) | --   | 0.47 | $^\circ\text{C/W}$ |
| $R_{\theta CS}$ | Case-to-Sink (Conductive grease applied)      | 0.03 | --   | $^\circ\text{C/W}$ |
| Weight          | Weight of Module                              | --   | 270  | g                  |

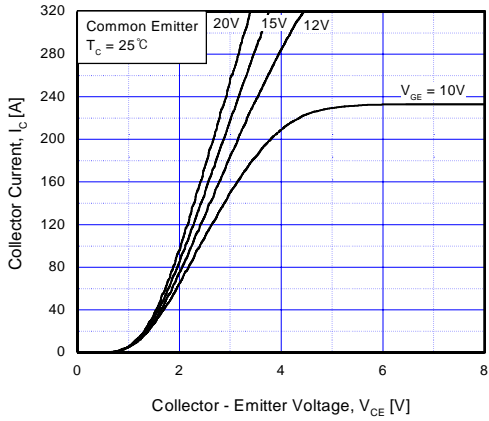


Fig 1. Typical Output Characteristics

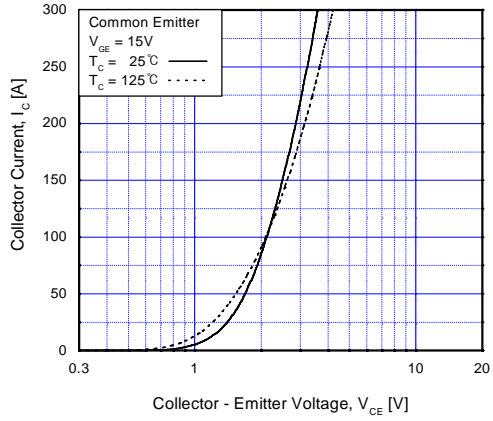


Fig 2. Typical Saturation Voltage Characteristics

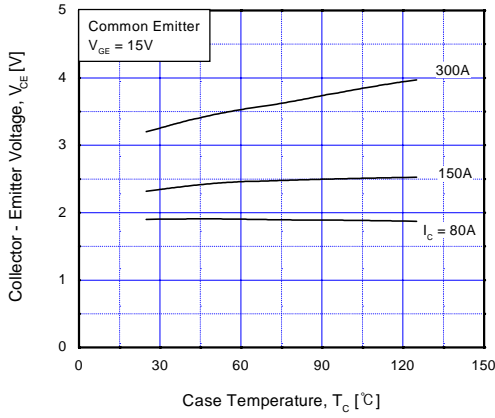


Fig 3. Saturation Voltage vs. Case Temperature at Variant Current Level

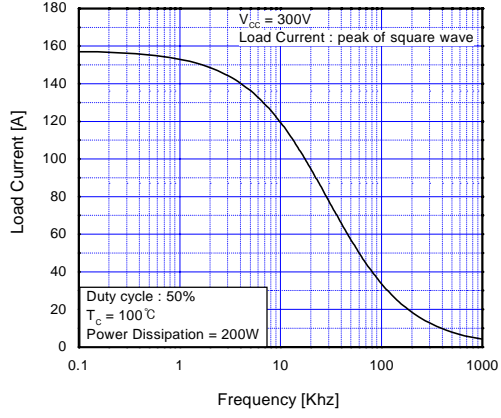


Fig 4. Load Current vs. Frequency

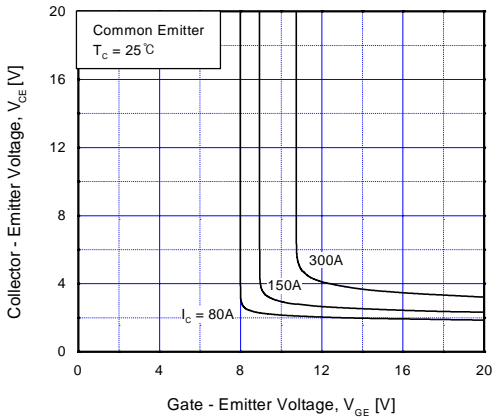


Fig 5. Saturation Voltage vs. V<sub>GE</sub>

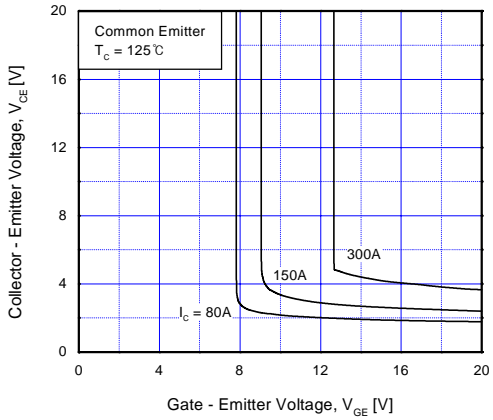


Fig 6. Saturation Voltage vs. V<sub>GE</sub>

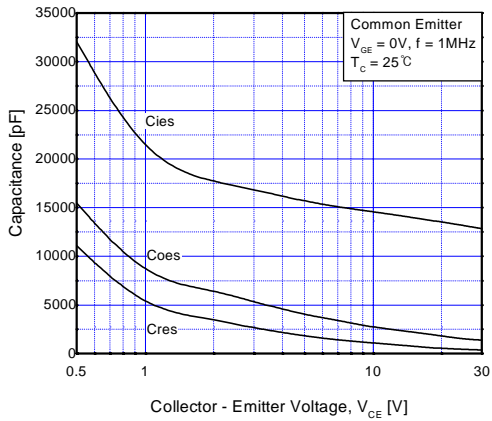


Fig 7. Capacitance Characteristics

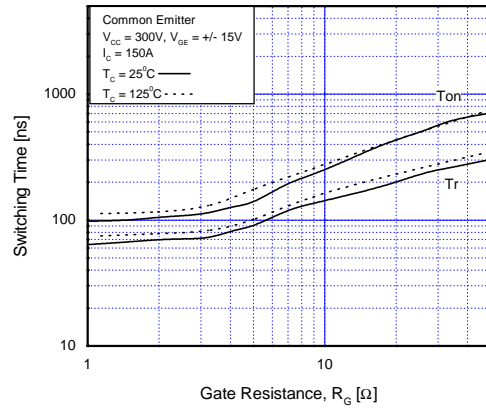


Fig 8. Turn-On Characteristics vs. Gate Resistance

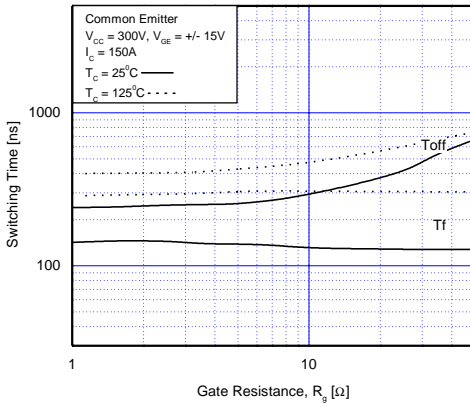


Fig 9. Turn-Off Characteristics vs. Gate Resistance

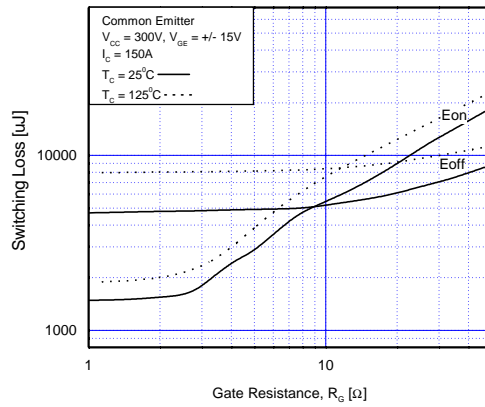


Fig 10. Switching Loss vs. Gate Resistance

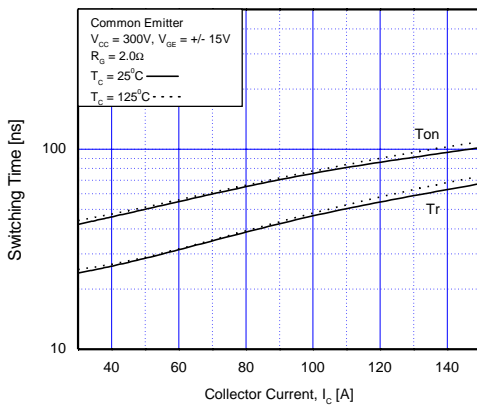


Fig 11. Turn-On Characteristics vs. Collector Current

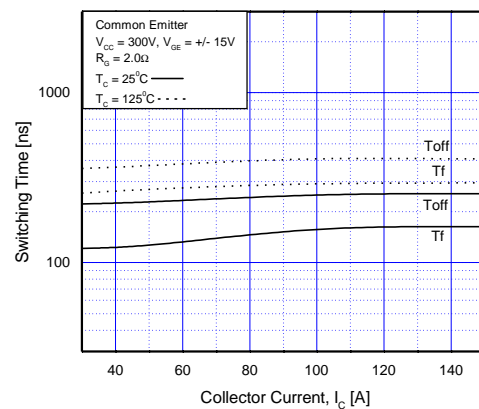


Fig 12. Turn-Off Characteristics vs. Collector Current

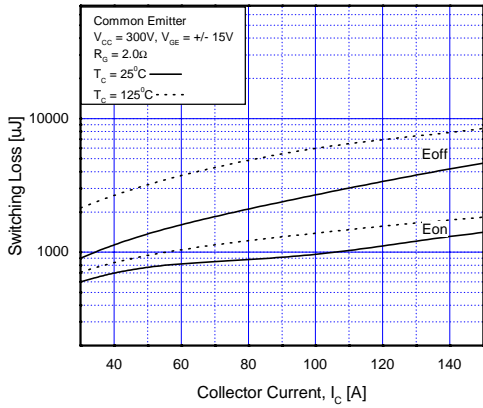


Fig 13. Switching Loss vs. Collector Current

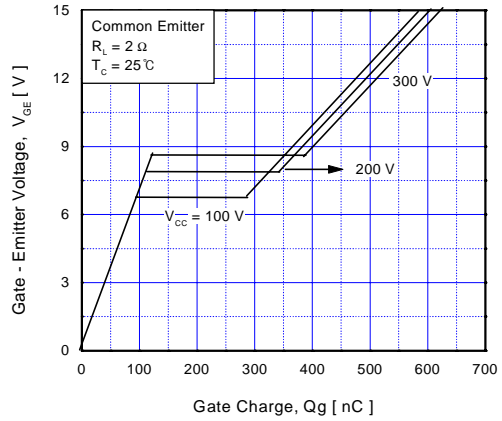


Fig 14. Gate Charge Characteristics

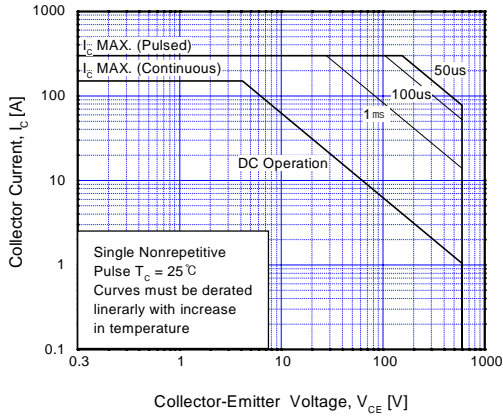


Fig 15. SOA Characteristics

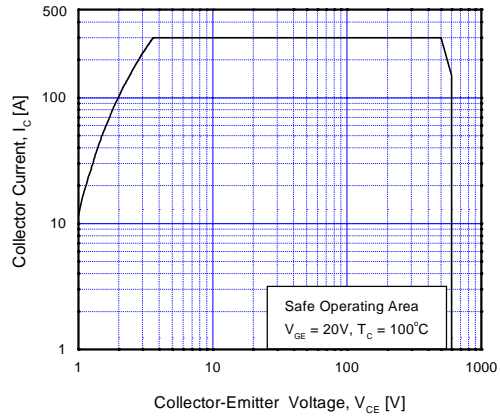


Fig 16. Turn-Off SOA Characteristics

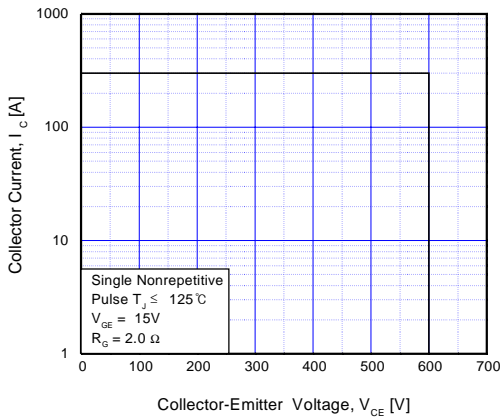


Fig 17. RBSOA Characteristics

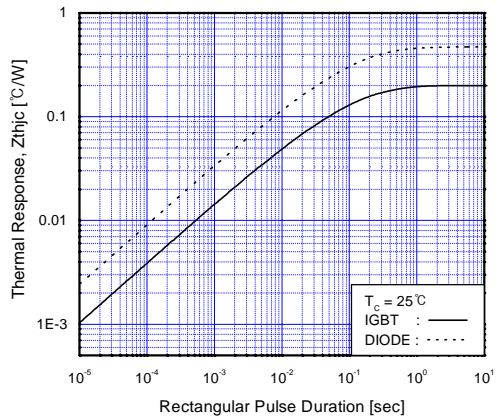


Fig 18. Transient Thermal Impedance

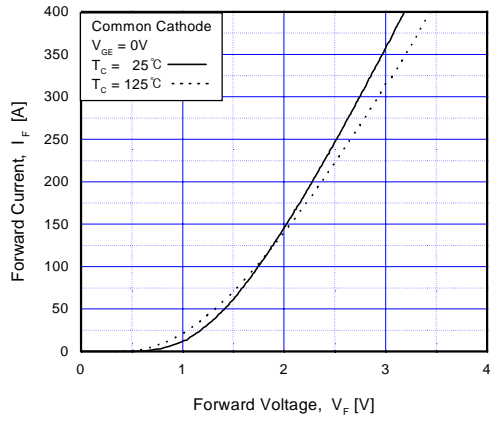


Fig 19. Forward Characteristics

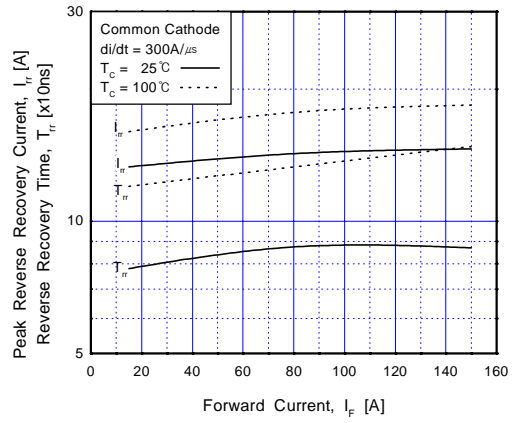
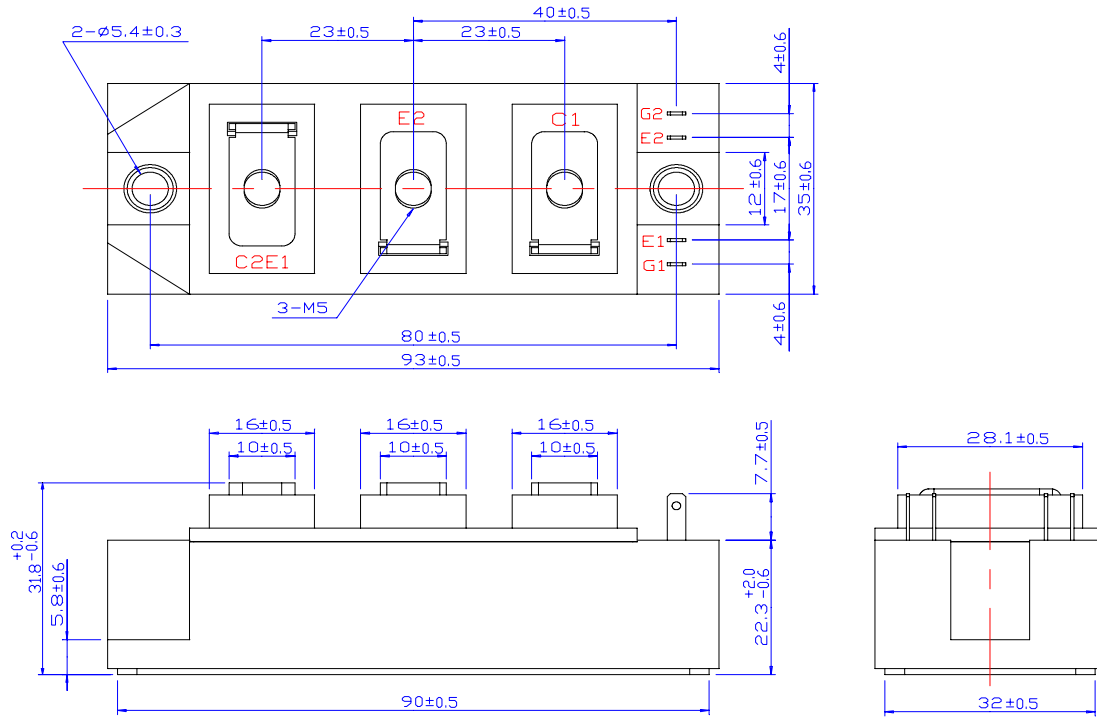


Fig 20. Reverse Recovery Characteristics

# Package Dimension

## 7PM-GA



FMG2G150US60E

Dimensions in Millimeters



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| Bottomless™          | FAST <sup>r</sup> ™ | OPTOLOGIC™               | SMART START™                 | UltraFET <sup>®</sup> |
| CoolFET™             | FRFET™              | OPTOPLANAR™              | SPM™                         | VCX™                  |
| CROSSVOLT™           | GlobalOptoisolator™ | PACMAN™                  | STAR*POWER™                  |                       |
| DenseTrench™         | GTO™                | POP™                     | Stealth™                     |                       |
| DOME™                | HiSeC™              | Power247™                | SuperSOT™-3                  |                       |
| EcoSPARK™            | I <sup>2</sup> C™   | PowerTrench <sup>®</sup> | SuperSOT™-6                  |                       |
| E <sup>2</sup> CMOS™ | ISOPLANAR™          | QFET™                    | SuperSOT™-8                  |                       |
| EnSigna™             | LittleFET™          | QS™                      | SyncFET™                     |                       |
| FACT™                | MicroFET™           | QT Optoelectronics™      | TinyLogic™                   |                       |
| FACT Quiet Series™   | MicroPak™           | Quiet Series™            | TruTranslation™              |                       |

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## PRODUCT STATUS DEFINITIONS

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|--------------------------|------------------------|---|
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