

FAIRCHILD
SEMICONDUCTOR®

September 2001

IGBT

FMG2G50US60

Molding Type Module

General Description

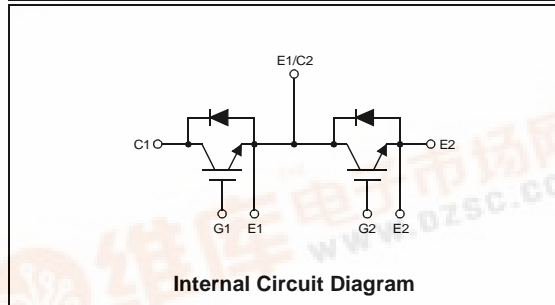
Fairchild's Insulated Gate Bipolar Transistor (IGBT) power modules provide low conduction and switching losses as well as short circuit ruggedness. They are designed for applications such as motor control, uninterrupted power supplies (UPS) and general inverters where short circuit ruggedness is a required 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 : $V_{CE(sat)} = 2.2\text{V}$ @ $I_C = 50\text{A}$
- High Input Impedance
- Fast & Soft Anti-Parallel FWD

Application

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

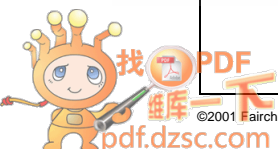


Absolute Maximum Ratings $T_C = 25^\circ\text{C}$ unless otherwise noted

| Symbol | Description | FMG2G50US60 | Units |
|-----------------|--|-------------|------------------|
| V_{CES} | Collector-Emitter Voltage | 600 | V |
| V_{GES} | Gate-Emitter Voltage | ± 20 | V |
| I_C | Collector Current @ $T_C = 25^\circ\text{C}$ | 50 | A |
| $I_{CM(1)}$ | Pulsed Collector Current | 100 | A |
| I_F | Diode Continuous Forward Current @ $T_C = 100^\circ\text{C}$ | 50 | A |
| I_{FM} | Diode Maximum Forward Current | 100 | A |
| T_{SC} | Short Circuit Withstand Time @ $T_C = 100^\circ\text{C}$ | 10 | us |
| P_D | Maximum Power Dissipation @ $T_C = 25^\circ\text{C}$ | 250 | 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 : M5 | 2.0 | N.m |

Notes :

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



Electrical Characteristics of IGBT T_C = 25°C unless otherwise noted

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|--|------|------|-------|-------|
| Off Characteristics | | | | | | |
| BV _{CES} | Collector-Emitter Breakdown Voltage | V _{GE} = 0V, I _C = 250μA | 600 | -- | -- | V |
| ΔB _{VCES} / ΔT _J | Temperature Coeff. of Breakdown Voltage | V _{GE} = 0V, I _C = 1mA | -- | 0.6 | -- | V/°C |
| I _{CES} | Collector Cut-Off Current | V _{CE} = V _{CES} , V _{GE} = 0V | -- | -- | 250 | μA |
| I _{GES} | G-E Leakage Current | V _{GE} = V _{GES} , V _{CE} = 0V | -- | -- | ± 100 | nA |
| On Characteristics | | | | | | |
| V _{GE(th)} | G-E Threshold Voltage | V _{GE} = 0V, I _C = 50mA | 5.0 | 6.0 | 8.5 | V |
| V _{CE(sat)} | Collector to Emitter Saturation Voltage | I _C = 50A, V _{GE} = 15V | -- | 2.2 | 2.8 | V |
| Dynamic Characteristics | | | | | | |
| C _{ies} | Input Capacitance | V _{CE} = 30V, V _{GE} = 0V, f = 1MHz | -- | 3460 | -- | pF |
| C _{oes} | Output Capacitance | | -- | 480 | -- | pF |
| C _{res} | Reverse Transfer Capacitance | | -- | 140 | -- | pF |
| Switching Characteristics | | | | | | |
| t _{d(on)} | Turn-On Delay Time | V _{CC} = 300 V, I _C = 50A, R _G = 5.9Ω, V _{GE} = 15V Inductive Load, T _C = 25°C | -- | 20 | -- | ns |
| t _r | Rise Time | | -- | 30 | -- | ns |
| t _{d(off)} | Turn-Off Delay Time | | -- | 60 | -- | ns |
| t _f | Fall Time | | -- | 110 | 200 | ns |
| E _{on} | Turn-On Switching Loss | | -- | 1.1 | -- | mJ |
| E _{off} | Turn-Off Switching Loss | | -- | 1.2 | -- | mJ |
| E _{ts} | Total Switching Loss | -- | 2.3 | -- | mJ | |
| t _{d(on)} | Turn-On Delay Time | V _{CC} = 300 V, I _C = 50A, R _G = 5.9Ω, V _{GE} = 15V Inductive Load, T _C = 125°C | -- | 20 | -- | ns |
| t _r | Rise Time | | -- | 30 | -- | ns |
| t _{d(off)} | Turn-Off Delay Time | | -- | 70 | -- | ns |
| t _f | Fall Time | | -- | 250 | -- | ns |
| E _{on} | Turn-On Switching Loss | | -- | 1.2 | -- | mJ |
| E _{off} | Turn-Off Switching Loss | | -- | 2.4 | -- | mJ |
| E _{ts} | Total Switching Loss | -- | 3.6 | -- | mJ | |
| T _{sc} | Short Circuit Withstand Time | V _{CC} = 300 V, V _{GE} = 15V @ T _C = 100°C | 10 | -- | -- | us |
| Q _g | Total Gate Charge | V _{CE} = 300 V, I _C = 50A, V _{GE} = 15V | -- | 145 | 210 | nC |
| Q _{ge} | Gate-Emitter Charge | | -- | 28 | 40 | nC |
| Q _{gc} | Gate-Collector Charge | | -- | 65 | 95 | 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 | $I_F = 50\text{A}$ | $T_C = 25^\circ\text{C}$ | -- | 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 | $I_F = 50\text{A}$ $di / dt = 100\text{ A/us}$ | $T_C = 25^\circ\text{C}$ | -- | 5 | 6.5 | A |
| | | | $T_C = 100^\circ\text{C}$ | -- | 7 | -- | |
| Q_{rr} | Diode Reverse Recovery Charge | | $T_C = 25^\circ\text{C}$ | -- | 225 | 422 | nC |
| | | | $T_C = 100^\circ\text{C}$ | -- | 455 | -- | |

Thermal Characteristics

| Symbol | Parameter | Typ. | Max. | Units |
|-----------------|---|------|------|--------------------|
| $R_{\theta JC}$ | Junction-to-Case (IGBT Part, per 1/2 Module) | -- | 0.5 | $^\circ\text{C/W}$ |
| $R_{\theta JC}$ | Junction-to-Case (DIODE Part, per 1/2 Module) | -- | 1.0 | $^\circ\text{C/W}$ |
| $R_{\theta CS}$ | Case-to-Sink (Conductive grease applied) | 0.05 | -- | $^\circ\text{C/W}$ |
| Weight | Weight of Module | -- | 190 | g |

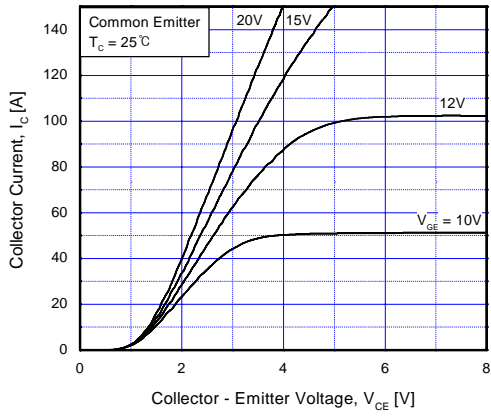


Fig 1. Typical Output Characteristics

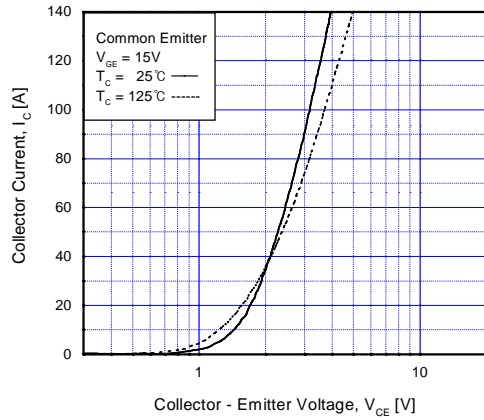


Fig 2. Typical Saturation Voltage Characteristics

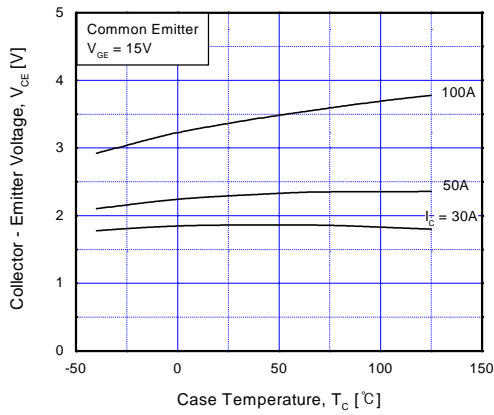


Fig 3. Saturation Voltage vs. Case Temperature at Variant Current Level

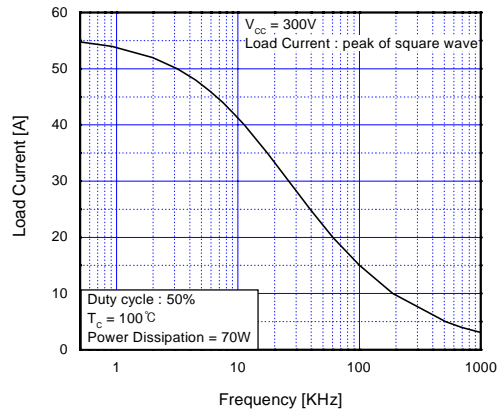


Fig 4. Load Current vs. Frequency

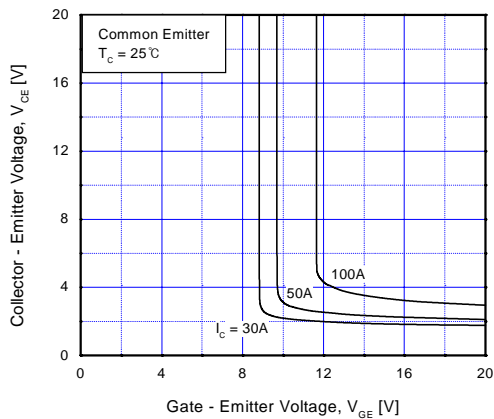


Fig 5. Saturation Voltage vs. V_{GE}

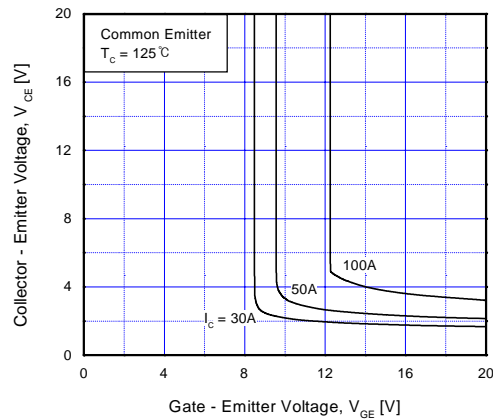


Fig 6. Saturation Voltage vs. V_{GE}

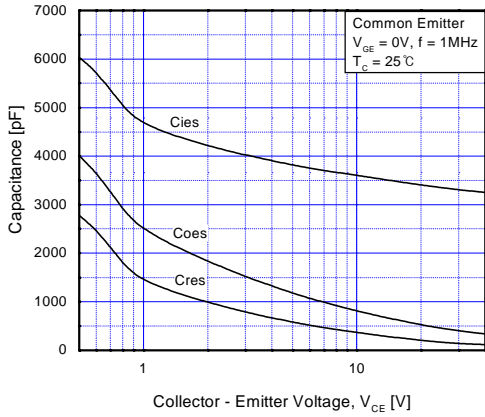


Fig 7. Capacitance Characteristics

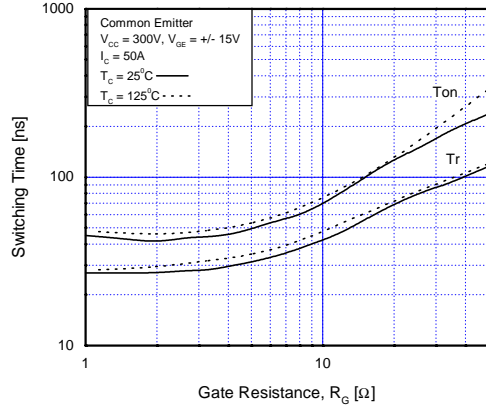


Fig 8. Turn-On Characteristics vs.

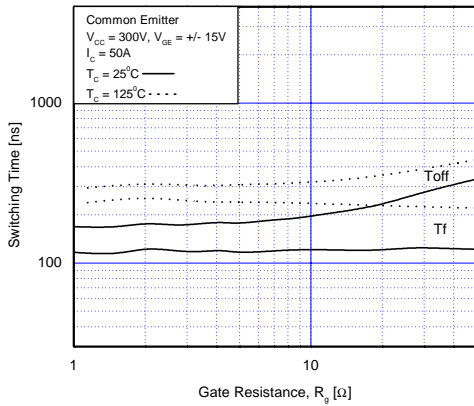


Fig 9. Turn-Off Characteristics vs. Gate Resistance

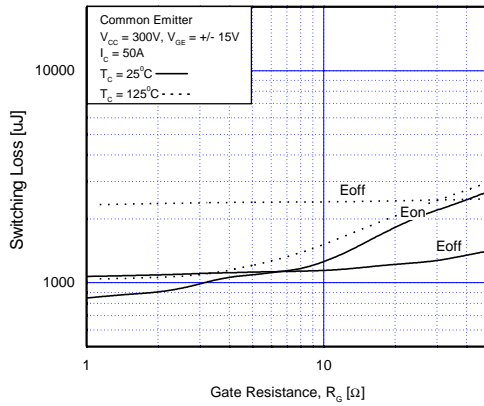


Fig 10. Switching Loss vs. Gate Resistance

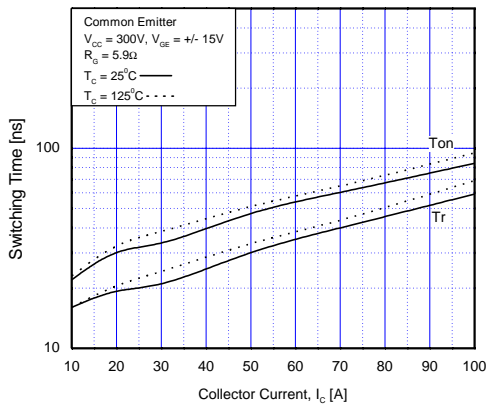


Fig 11. Turn-On Characteristics vs. Collector Current

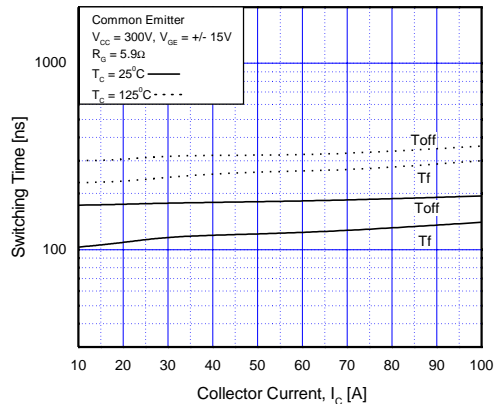


Fig 12. Turn-Off Characteristics vs. Collector Current

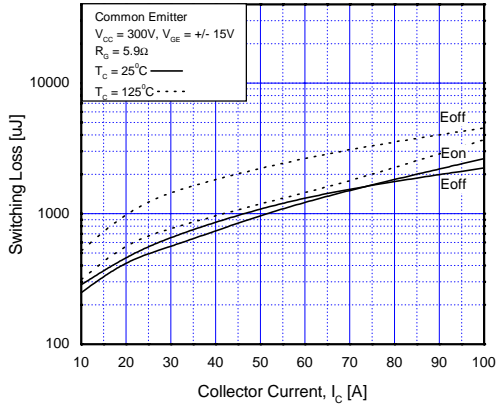


Fig 13. Switching Loss vs. Collector Current

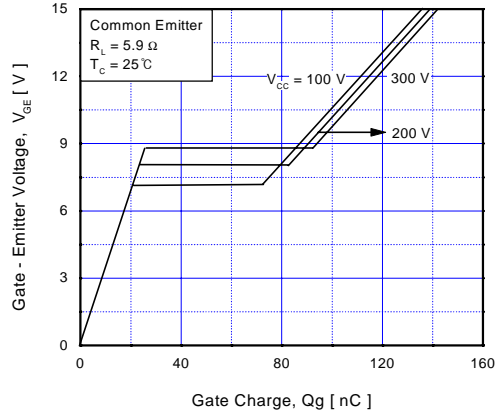


Fig 14. Gate Charge Characteristics

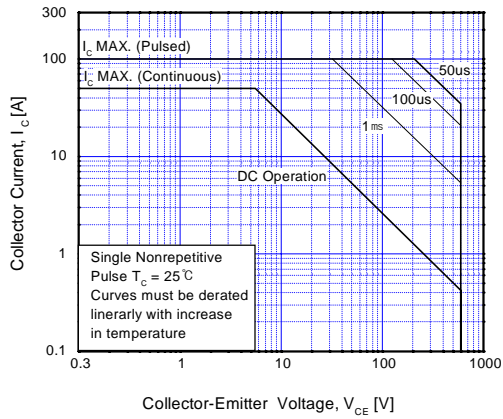


Fig 15. SOA Characteristics

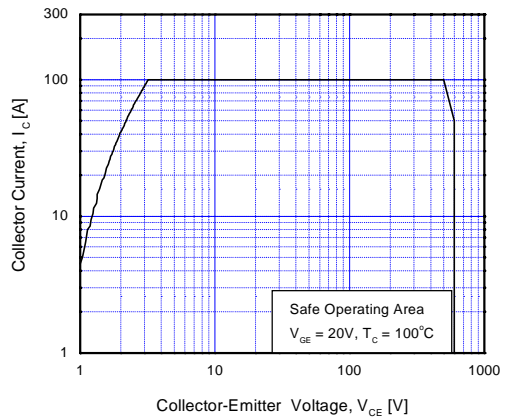


Fig 16. Turn-Off SOA Characteristics

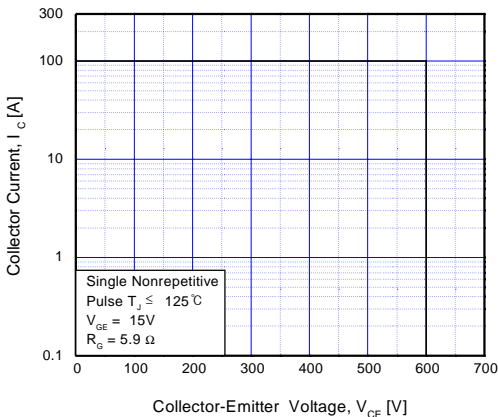


Fig 17. RBSOA Characteristics

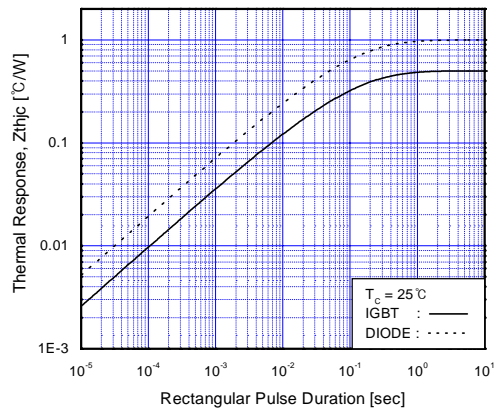


Fig 18. Transient Thermal Impedance

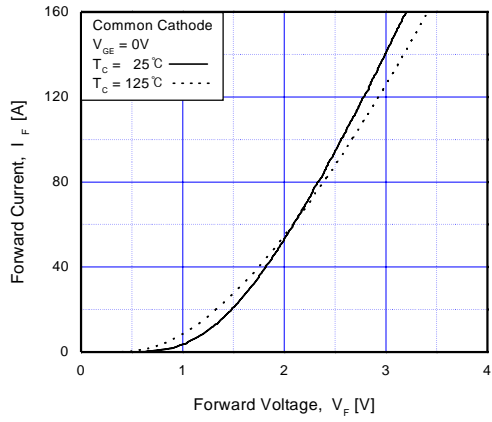


Fig 19. Forward Characteristics

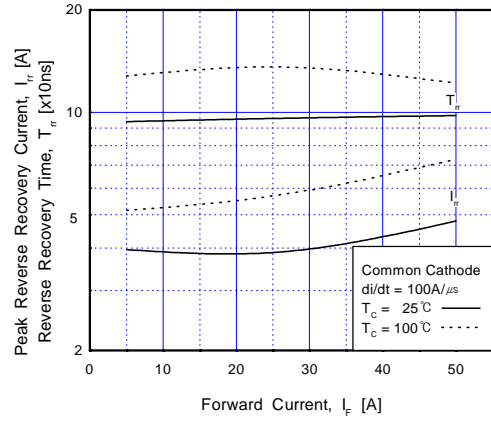


Fig 20. Reverse Recovery Characteristics

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