

## FEATURES

- Ultra Low Loss
- High Ruggedness
- High Short Circuit Capability
- Positive Temperature Coefficient
- With Fast Free-Wheeling Diodes

## APPLICATIONS

- Current Source Inverters
- Matrix Converters
- Bi-directional Switches
- Resonant Converters
- Induction Heating



## ABSOLUTE MAXIMUM RATINGS

$T_C=25^{\circ}\text{C}$  unless otherwise specified

| Symbol                     | Parameter                   | Test Conditions                                       | Values      | Unit               |
|----------------------------|-----------------------------|---|-------------|--------------------|
| <b>IGBT</b>                |                             |   |             |                    |
| $V_{CES}$                  | Collector - Emitter Voltage |   | 1200        | V                  |
| $V_{GES}$                  | Gate - Emitter Voltage      |   | $\pm 20$    | V                  |
| $I_C$                      | DC Collector Current        | $T_C=25^{\circ}\text{C}$                              | 80          | A                  |
|                            |                             | $T_C=80^{\circ}\text{C}$                              | 50          | A                  |
| $I_{Cpuls}$                | Pulsed Collector Current    | $T_C=25^{\circ}\text{C}, t_p=1\text{ms}$              | 170         | A                  |
|                            |                             | $T_C=80^{\circ}\text{C}, t_p=1\text{ms}$              | 110         | A                  |
| $P_{tot}$                  | Power Dissipation Per IGBT  |   | 500         | W                  |
| $T_J$                      | Junction Temperature Range  |   | -40 to +150 | $^{\circ}\text{C}$ |
| $T_{STG}$                  | Storage Temperature Range   |   | -40 to +125 | $^{\circ}\text{C}$ |
| $V_{isol}$                 | Insulation Test Voltage     | AC, $t=1\text{min}$                                   | 3000        | V                  |
| <b>Free-Wheeling Diode</b> |                             |   |             |                    |
| $V_{RRM}$                  | Repetitive Reverse Voltage  |   | 1200        | V                  |
| $I_{F(AV)}$                | Average Forward Current     | $T_C=25^{\circ}\text{C}$                              | 90          | A                  |
|                            |                             | $T_C=80^{\circ}\text{C}$                              | 60          | A                  |
| $I_{F(RMS)}$               | RMS Forward Current         |   | 90          | A                  |
| $I_{FSM}$                  | Non-Repetitive Surge        | $T_J=45^{\circ}\text{C}, t=10\text{ms}, \text{Sine}$  | 430         | A                  |
|                            | Forward Current             | $T_J=45^{\circ}\text{C}, t=8.3\text{ms}, \text{Sine}$ | 450         | A                  |

# MMG50SR120FZB

## ELECTRICAL CHARACTERISTICS

T<sub>C</sub>=25°C unless otherwise specified

| Symbol                     | Parameter                              | Test Conditions  | Min. | Typ. | Max. | Unit |
|----------------------------|--|--|------|------|------|------|
| <b>IGBT</b>                |  |  |      |      |      |      |
| V <sub>GE(th)</sub>        | Gate - Emitter Threshold Voltage       | V <sub>CE</sub> =V <sub>GE</sub> , I <sub>C</sub> =2mA             | 5    | 6.2  | 7    | V    |
| V <sub>CE(sat)</sub>       | Collector - Emitter Saturation Voltage | I <sub>C</sub> =50A, V <sub>GE</sub> =15V, T <sub>J</sub> =25°C    |      | 1.8  |      | V    |
|                            |  | I <sub>C</sub> =50A, V <sub>GE</sub> =15V, T <sub>J</sub> =125°C   |      | 2.0  |      | V    |
| I <sub>CES</sub>           | Collector Leakage Current              | V <sub>CE</sub> =1200V, V <sub>GE</sub> =0V, T <sub>J</sub> =25°C  |      |      | 0.5  | mA   |
|                            |  | V <sub>CE</sub> =1200V, V <sub>GE</sub> =0V, T <sub>J</sub> =125°C |      | 2    |      | mA   |
| I <sub>GES</sub>           | Gate Leakage Current                   | V <sub>CE</sub> =0V, V <sub>GE</sub> =±20V                         | -200 |      | 200  | nA   |
| Q <sub>ge</sub>            | Gate Charge                            | V <sub>CC</sub> =600V, I <sub>C</sub> =50A, V <sub>GE</sub> =±15V  |      | 611  |      | nC   |
| C <sub>ies</sub>           | Input Capacitance                      | V <sub>CE</sub> =25V, V <sub>GE</sub> =0V, f=1MHz                  |      | 4.29 |      | nF   |
| C <sub>oes</sub>           | Output Capacitance                     |  |      | 0.30 |      | nF   |
| C <sub>res</sub>           | Reverse Transfer Capacitance           |  |      | 0.20 |      | nF   |
| t <sub>d(on)</sub>         | Turn - on Delay Time                   | V <sub>CC</sub> =600V, I <sub>C</sub> =50A                         |      | 270  |      | ns   |
| t <sub>r</sub>             | Rise Time                              | R <sub>G</sub> = 18 Ω, V <sub>GE</sub> =±15V                       |      | 60   |      | ns   |
| t <sub>d(off)</sub>        | Turn - off Delay Time                  | T <sub>J</sub> =25°C   |      | 480  |      | ns   |
| t <sub>f</sub>             | Fall Time                              | Inductive Load   |      | 60   |      | ns   |
| t <sub>d(on)</sub>         | Turn - on Delay Time                   | V <sub>CC</sub> =600V, I <sub>C</sub> =50A                         |      | 290  |      | ns   |
| t <sub>r</sub>             | Rise Time                              | R <sub>G</sub> = 18 Ω, V <sub>GE</sub> =±15V                       |      | 60   |      | ns   |
| t <sub>d(off)</sub>        | Turn - off Delay Time                  | T <sub>J</sub> =125°C  |      | 550  |      | ns   |
| t <sub>f</sub>             | Fall Time                              | Inductive Load   |      | 65   |      | ns   |
| E <sub>on</sub>            | Turn - on Switching Energy             | V <sub>CC</sub> =600V, I <sub>C</sub> =50A    T <sub>J</sub> =25°C |      | 6.0  |      | mJ   |
|                            |  | R <sub>G</sub> = 18 Ω    T <sub>J</sub> =125°C                     |      | 8.4  |      | mJ   |
| E <sub>off</sub>           | Turn - off Switching Energy            | V <sub>GE</sub> =±15V    T <sub>J</sub> =25°C                      |      | 3.7  |      | mJ   |
|                            |  | Inductive Load    T <sub>J</sub> =125°C                            |      | 5.8  |      | mJ   |
| <b>Free-Wheeling Diode</b> |  |  |      |      |      |      |
| V <sub>F</sub>             | Forward Voltage                        | I <sub>F</sub> =50A, V <sub>GE</sub> =0V, T <sub>J</sub> =25°C     |      | 1.9  | 2.3  | V    |
|                            |  | I <sub>F</sub> =50A, V <sub>GE</sub> =0V, T <sub>J</sub> =125°C    |      | 1.7  | 2.1  | V    |
| t <sub>rr</sub>            | Reverse Recovery Time                  | I <sub>F</sub> =50A, V <sub>R</sub> =800V                          |      | 180  |      | ns   |
| I <sub>RRM</sub>           | Max. Reverse Recovery Current          | di <sub>F</sub> /dt=-1000A/μs                                      |      | 60   |      | A    |
| Q <sub>rr</sub>            | Reverse Recovery Charge                | T <sub>J</sub> =125°C  |      | 7.1  |      | μC   |

## THERMAL AND MECHANICAL CHARACTERISTICS

| Symbol             | Parameter                           | Test Conditions   | Min. | Typ. | Max. | Unit  |
|--------------------|-------------------------------------|-------------------|------|------|------|-------|
| R <sub>thJC</sub>  | Junction-to-Case Thermal Resistance | Per IGBT          |      |      | 0.3  | K /W  |
| R <sub>thJCD</sub> | Junction-to-Case Thermal Resistance | Per Inverse Diode |      |      | 0.6  | K /W  |
| Torque             | Module-to-Sink                      | Recommended (M6)  | 3    |      | 5    | N · m |
| Torque             | Module Electrodes                   | Recommended (M5)  | 2.5  |      | 5    | N · m |
| Weight             |                                     |                   |      | 150  |      | g     |

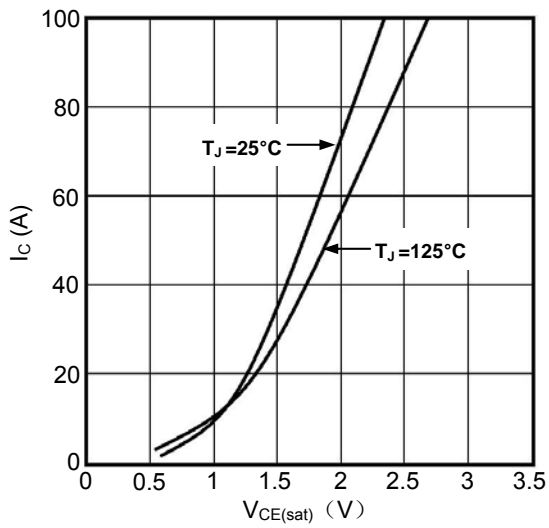


Figure1. Typical Output characteristics

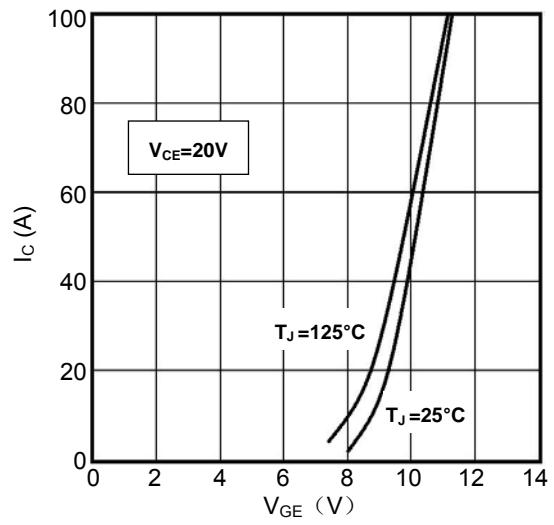


Figure2. Typical Transfer characteristics

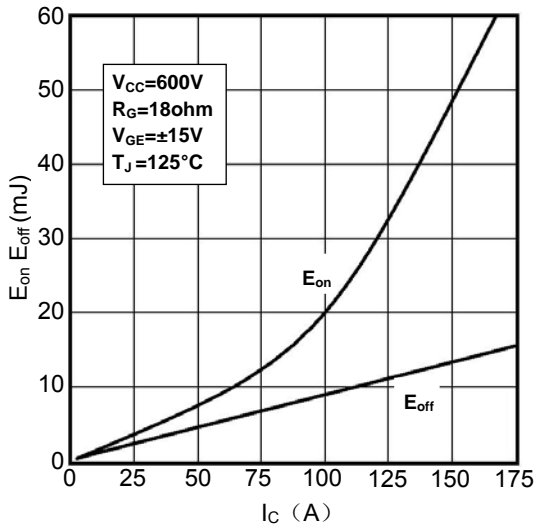


Figure3. Switching Energy vs. Collector Current

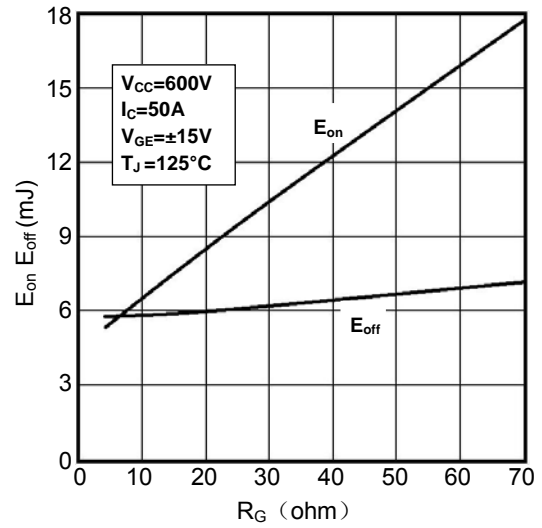


Figure4. Switching Energy vs. Gate Resistor

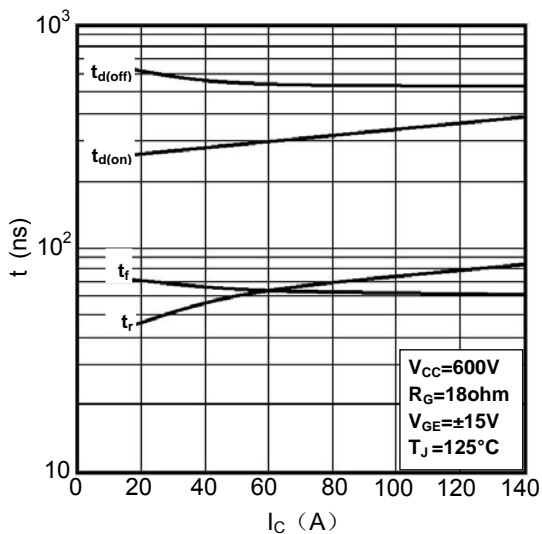


Figure5. Switching Times vs. Collector Current

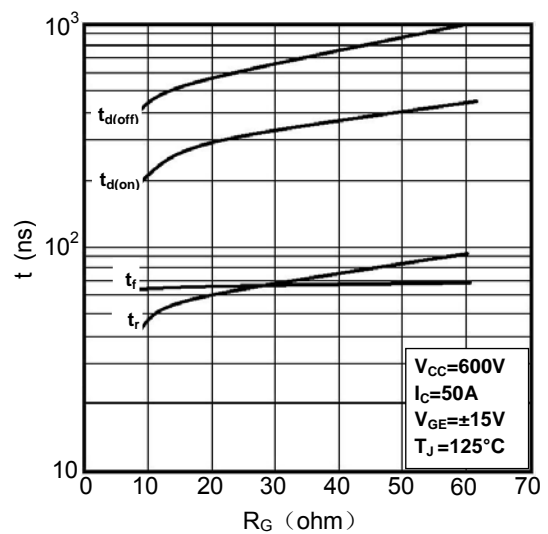


Figure6. Switching Times vs. Gate Resistor

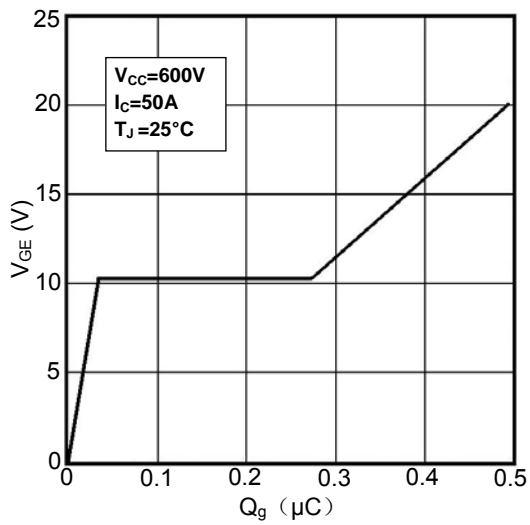


Figure7. Gate Charge characteristics

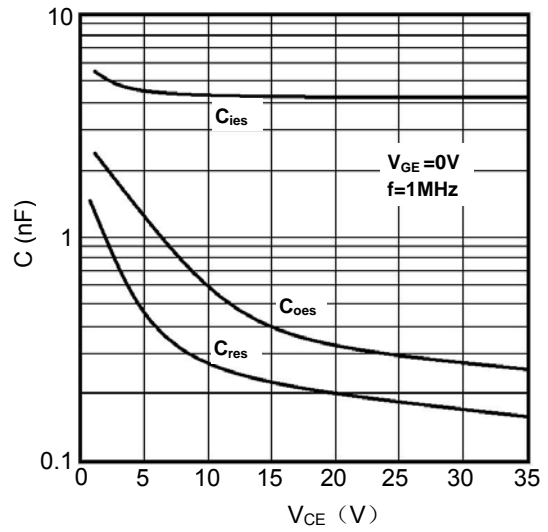


Figure8. Typical Capacitances vs.  $V_{CE}$

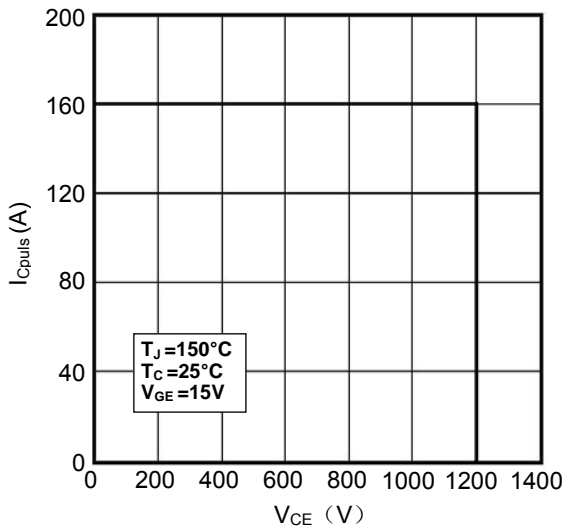


Figure9. Reverse Biased Safe Operating Area

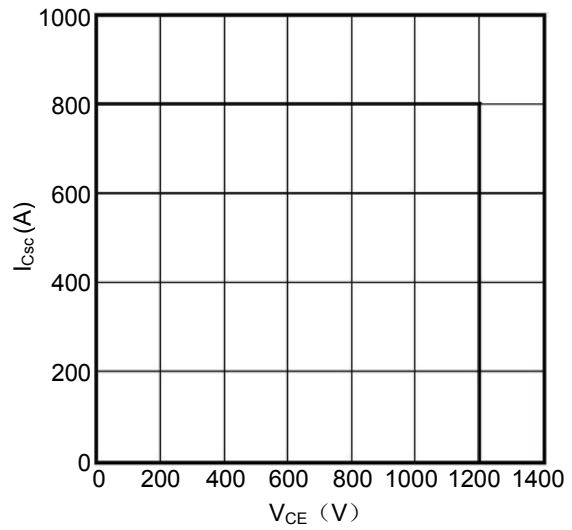


Figure10. Short Circuit Safe Operating Area

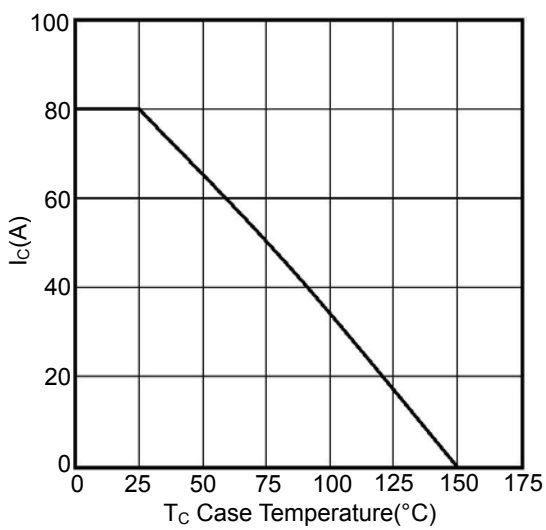


Figure11. Rated Current vs.  $T_C$

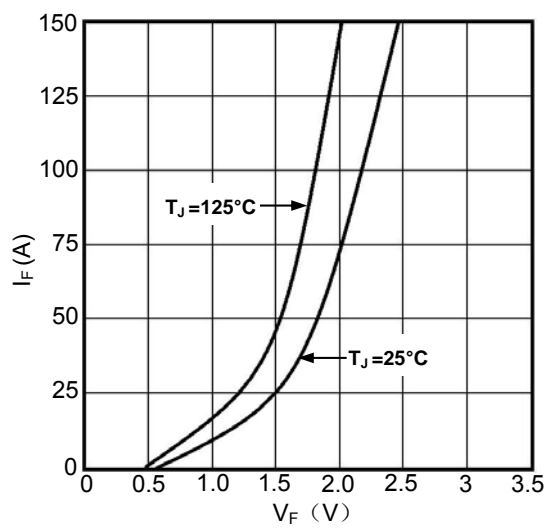
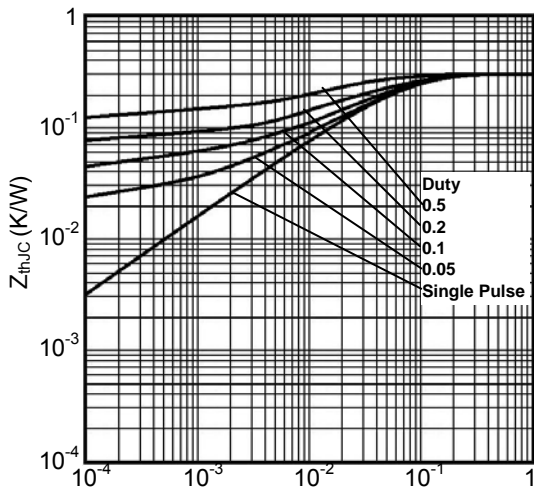
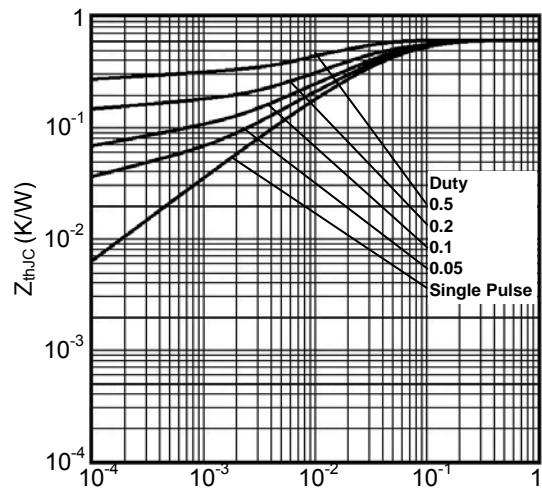


Figure12. Diode Forward Characteristics



Rectangular Pulse Duration (seconds)  
Figure13. Transient Thermal Impedance of IGBT



Rectangular Pulse Duration (seconds)  
Figure14. Transient Thermal Impedance of Diode

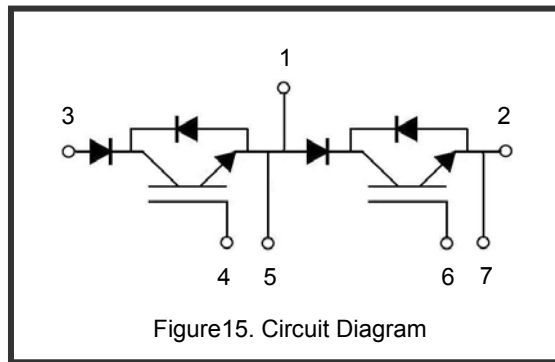


Figure15. Circuit Diagram

