

## FEATURES

- High short circuit capability, self limiting short circuit current
- IGBT CHIP(T4 Fast Trench+Field Stop technology)
- $V_{CE(sat)}$  with positive temperature coefficient
- Fast switching and short tail current
- Free wheeling diodes with fast and soft reverse recovery
- Low switching losses
- $T_{vj\ max} = 175^{\circ}C$

## APPLICATIONS

- High frequency switching application
- Medical applications
- Motion/servo control
- UPS systems



## ABSOLUTE MAXIMUM RATINGS

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

| Symbol       | Parameter                         | Test Conditions                         | Values   | Unit   |
|--------------|-----------------------------------|---|----------|--------|
| <b>IGBT</b>  |                                   |   |          |        |
| $V_{CES}$    | Collector - Emitter Voltage       | $T_{vj}=25^{\circ}C$                    | 1200     | V      |
| $V_{GES}$    | Gate - Emitter Voltage            |   | $\pm 20$ | V      |
| $I_c$        | DC Collector Current              | $T_c=25^{\circ}C$                       | 600      | A      |
|              |                                   | $T_c=80^{\circ}C$                       | 400      | A      |
| $I_{CM}$     | Repetitive Peak Collector Current | $t_p=1ms$                               | 800      | A      |
| $P_{tot}$    | Power Dissipation Per IGBT        |   | 2100     | W      |
| <b>Diode</b> |                                   |   |          |        |
| $V_{RRM}$    | Repetitive Reverse Voltage        | $T_{vj}=25^{\circ}C$                    | 1200     | V      |
| $I_{F(AV)}$  | Average Forward Current           | $T_c=25^{\circ}C$                       | 600      | A      |
|              |                                   | $T_c=80^{\circ}C$                       | 400      | A      |
| $I_{FRM}$    | Repetitive Peak Forward Current   | $t_p=1ms$                               | 800      | A      |
| $I^2t$       |                                   | $T_{vj} = 125^{\circ}C, t=10ms, V_R=0V$ | 25000    | $A^2s$ |

## MMG400D120B6HN

### ELECTRICAL AND THERMAL CHARACTERISTICS $T_c=25^\circ\text{C}$ unless otherwise specified

| Symbol        | Parameter   | Test Conditions   | Min.                         | Typ. | Max. | Unit          |
|---------------|---|---|------------------------------|------|------|---------------|
| <b>IGBT</b>   |   |   |                              |      |      |               |
| $V_{GE(th)}$  | Gate - Emitter Threshold Voltage                  | $V_{CE}=V_{GE}, I_C=16\text{mA}$  | 5.4                          | 6    | 6.5  | V             |
| $V_{CE(sat)}$ | Collector - Emitter Saturation Voltage            | $I_C=400\text{A}, V_{GE}=15\text{V}, T_{Vj}=25^\circ\text{C}$   |                              | 2.1  | 2.5  | V             |
|               |   | $I_C=400\text{A}, V_{GE}=15\text{V}, T_{Vj}=125^\circ\text{C}$  |                              | 2.5  |      | V             |
| $I_{CES}$     | Collector Leakage Current                         | $V_{CE}=1200\text{V}, V_{GE}=0\text{V}, T_{Vj}=25^\circ\text{C}$  |                              |      | 2    | mA            |
|               |   | $V_{CE}=1200\text{V}, V_{GE}=0\text{V}, T_{Vj}=125^\circ\text{C}$   |                              |      | 10   | mA            |
| $I_{GES}$     | Gate Leakage Current                              | $V_{CE}=0\text{V}, V_{GE} \pm 15\text{V}, T_{Vj}=125^\circ\text{C}$   | -400                         |      | 400  | nA            |
| $R_{Gint}$    | Integrated Gate Resistor                          |   |                              | 1.9  |      | $\Omega$      |
| $Q_{ge}$      | Gate Charge                                       | $V_{CE}=600\text{V}, I_C=400\text{A}, V_{GE} = \pm 15\text{V}$  |                              | 1.9  |      | $\mu\text{C}$ |
| $C_{ies}$     | Input Capacitance                                 | $V_{CE}=25\text{V}, V_{GE}=0\text{V}, f=1\text{MHz}$  |                              | 25   |      | nF            |
| $C_{res}$     | Reverse Transfer Capacitance                      |   |                              |      | 1.4  |               |
| $t_{d(on)}$   | Turn - on Delay Time                              | $V_{CC}=600\text{V}, I_C=400\text{A},$<br>$R_G = 1.8 \Omega,$<br>$V_{GE} = \pm 15\text{V},$<br>Inductive Load | $T_{Vj} = 25^\circ\text{C}$  | 170  |      | ns            |
|               |   |   | $T_{Vj} = 125^\circ\text{C}$ | 180  |      | ns            |
|               |   |   | $T_{Vj} = 150^\circ\text{C}$ | 190  |      | ns            |
| $t_r$         | Rise Time   | Inductive Load  | $T_{Vj} = 25^\circ\text{C}$  | 75   |      | ns            |
|               |   |   | $T_{Vj} = 125^\circ\text{C}$ | 85   |      | ns            |
|               |   |   | $T_{Vj} = 150^\circ\text{C}$ | 90   |      | ns            |
| $t_{d(off)}$  | Turn - off Delay Time                             | $V_{CC}=600\text{V}, I_C=400\text{A},$<br>$R_G = 1.8 \Omega,$<br>$V_{GE} = \pm 15\text{V},$<br>Inductive Load | $T_{Vj} = 25^\circ\text{C}$  | 440  |      | ns            |
|               |   |   | $T_{Vj} = 125^\circ\text{C}$ | 490  |      | ns            |
|               |   |   | $T_{Vj} = 150^\circ\text{C}$ | 520  |      | ns            |
| $t_f$         | Fall Time   | Inductive Load  | $T_{Vj} = 25^\circ\text{C}$  | 45   |      | ns            |
|               |   |   | $T_{Vj} = 125^\circ\text{C}$ | 65   |      | ns            |
|               |   |   | $T_{Vj} = 150^\circ\text{C}$ | 75   |      | ns            |
| $E_{on}$      | Turn - on Energy                                  | $V_{CC}=600\text{V}, I_C=400\text{A},$<br>$R_G = 1.8 \Omega,$<br>$V_{GE} = \pm 15\text{V},$<br>Inductive Load | $T_{Vj} = 125^\circ\text{C}$ | 52   |      | mJ            |
|               |   |   | $T_{Vj} = 150^\circ\text{C}$ | 58   |      | mJ            |
| $E_{off}$     | Turn - off Energy                                 | Inductive Load  | $T_{Vj} = 125^\circ\text{C}$ | 22   |      | mJ            |
|               |   |   | $T_{Vj} = 150^\circ\text{C}$ | 24   |      | mJ            |
| $I_{sc}$      | Short Circuit Current                             | $t_{psc} \leq 10\mu\text{s}, V_{GE}=15\text{V}$<br>$T_{Vj}=125^\circ\text{C}, V_{CC}=600\text{V}$             |                              | 1600 |      | A             |
| $R_{thJC}$    | Junction-to-Case Thermal Resistance ( Per IGBT )  |   |                              |      | 0.07 | K /W          |
| <b>Diode</b>  |   |   |                              |      |      |               |
| $V_F$         | Forward Voltage                                   | $I_F=400\text{A}, V_{GE}=0\text{V}, T_{Vj} = 25^\circ\text{C}$  |                              | 1.65 |      | V             |
|               |   | $I_F=400\text{A}, V_{GE}=0\text{V}, T_{Vj} = 125^\circ\text{C}$   |                              | 1.65 |      | V             |
| $t_{rr}$      | Reverse Recovery Time                             | $I_F=400\text{A}, V_R=600\text{V}$  |                              | 500  |      | ns            |
| $I_{RRM}$     | Max. Reverse Recovery Current                     | $di_F/dt=-4000\text{A}/\mu\text{s}$   |                              | 290  |      | A             |
| $E_{rec}$     | Reverse Recovery Energy                           | $T_{Vj} = 125^\circ\text{C}$  |                              | 31   |      | mJ            |
| $R_{thJCD}$   | Junction-to-Case Thermal Resistance ( Per Diode ) |   |                              |      | 0.12 | K /W          |

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## MODULE CHARACTERISTICS

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

| Symbol        | Parameter                  | Test Conditions     | Min. | Typ. | Max. | Unit                    |
|---------------|----------------------------|---------------------|------|------|------|-------------------------|
| $T_{vj\ max}$ | Max. Junction Temperature  |                     |      |      | 175  | $^\circ\text{C}$        |
| $T_{vj\ op}$  | Operating Temperature      |                     | -40  |      | 150  | $^\circ\text{C}$        |
| $T_{stg}$     | Storage Temperature        |                     | -40  |      | 125  | $^\circ\text{C}$        |
| $V_{isol}$    | Insulation Test Voltage    | AC, $t=1\text{min}$ |      | 3000 |      | V                       |
| CTI           | Comparative Tracking Index |                     | 350  |      |      |                         |
| Torque        | Module-to-Sink             | Recommended (M6)    | 3    |      | 5    | $\text{N}\cdot\text{m}$ |
| Torque        | Module Electrodes          | Recommended (M6)    | 2.5  |      | 5    | $\text{N}\cdot\text{m}$ |
| Weight        |                            |                     |      | 300  |      | g                       |

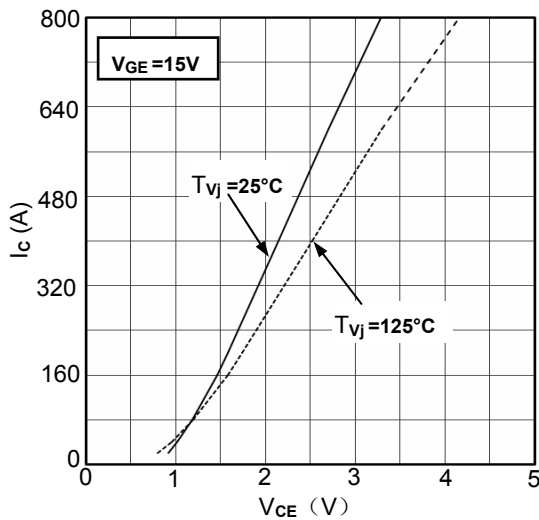


Figure1. Typical Output Characteristics

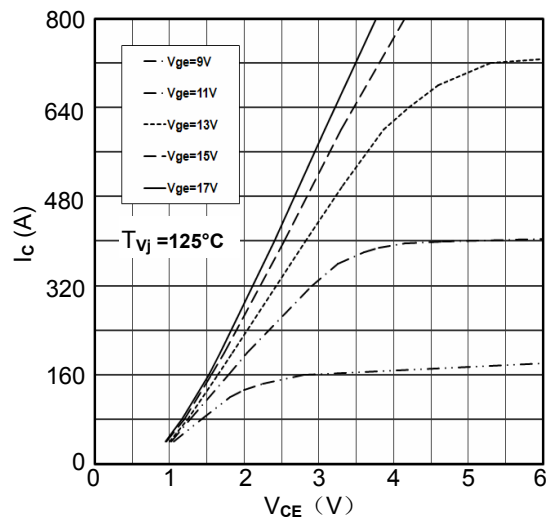


Figure2. Typical Output Characteristics

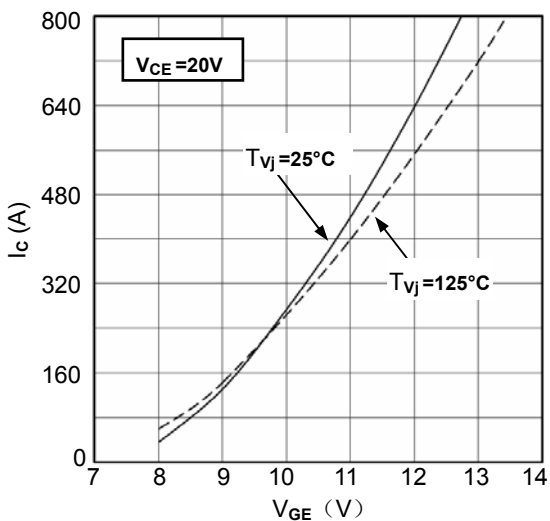


Figure3. Typical Transfer characteristics

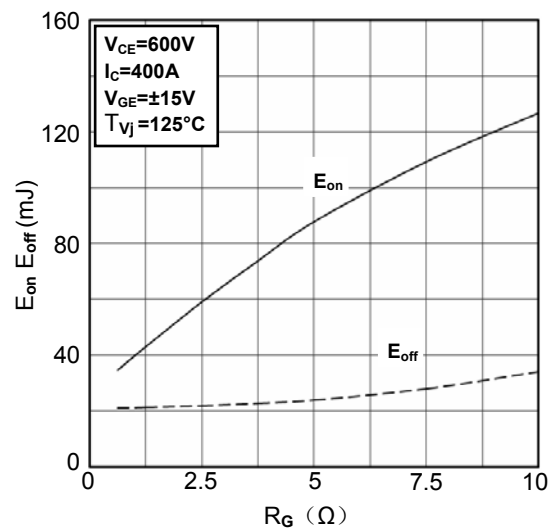


Figure4. Switching Energy vs. Gate Resistor

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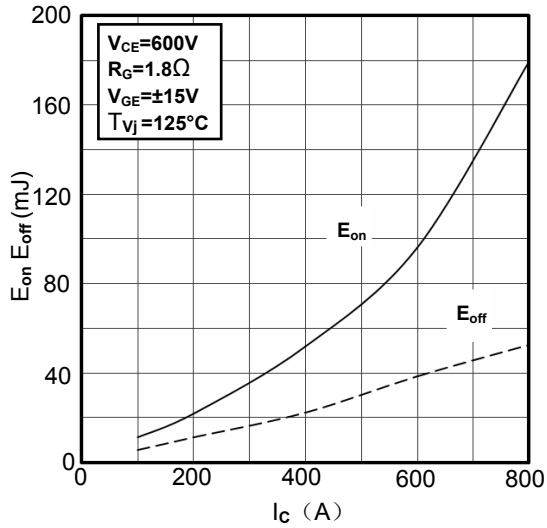


Figure 5. Switching Energy vs. Collector Current

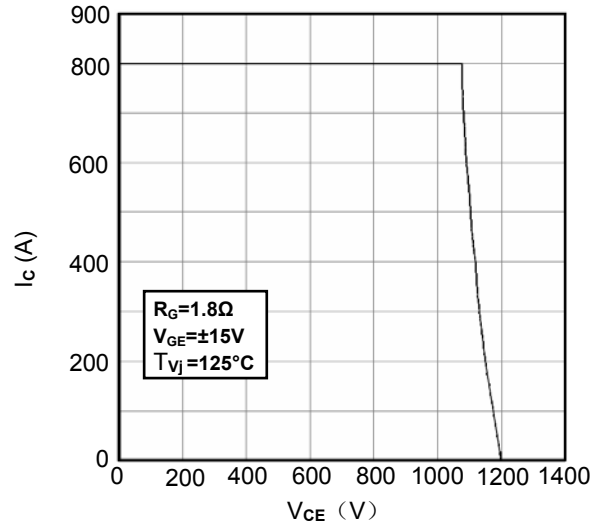


Figure 6. Reverse Biased Safe Operating Area

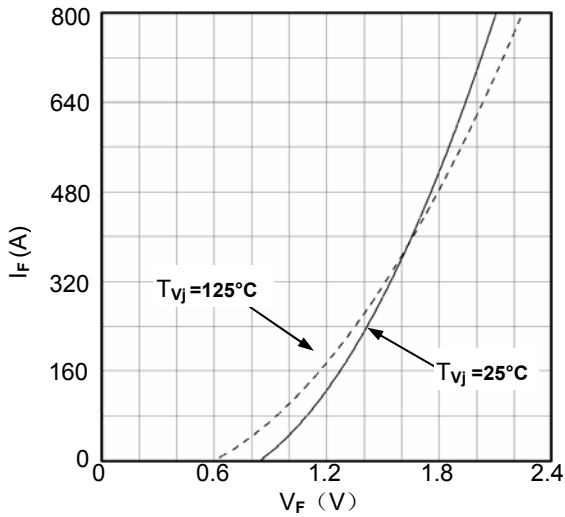


Figure 7. Diode Forward Characteristics

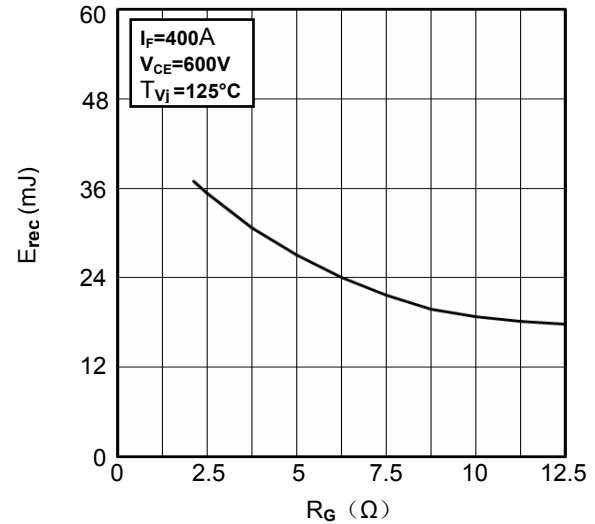


Figure 8. Switching Energy vs. Gate Resistor

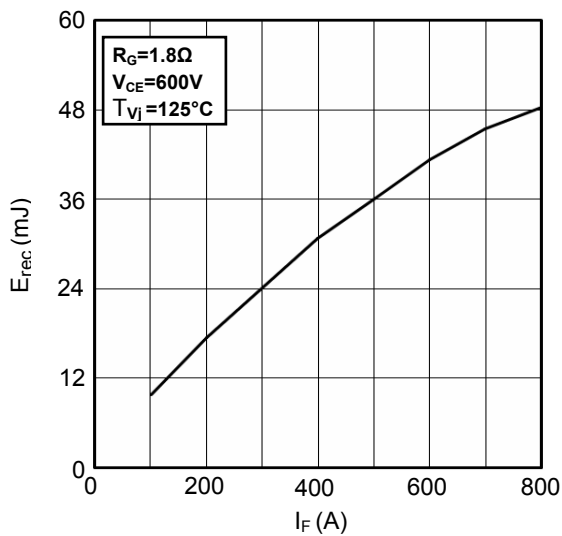


Figure 9. Switching Energy vs. Forward Current

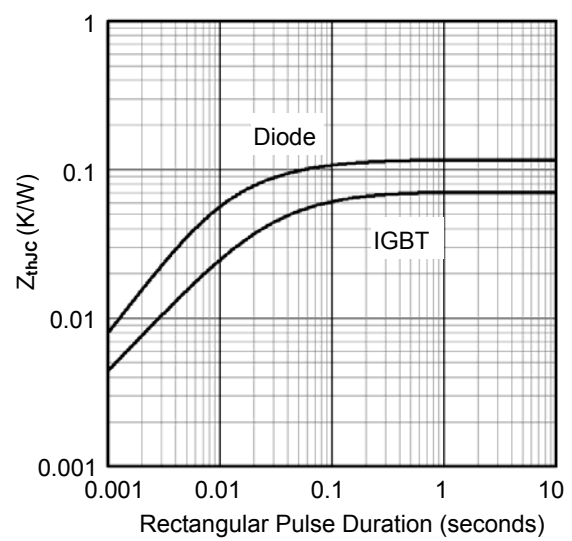


Figure 10. Transient Thermal Impedance

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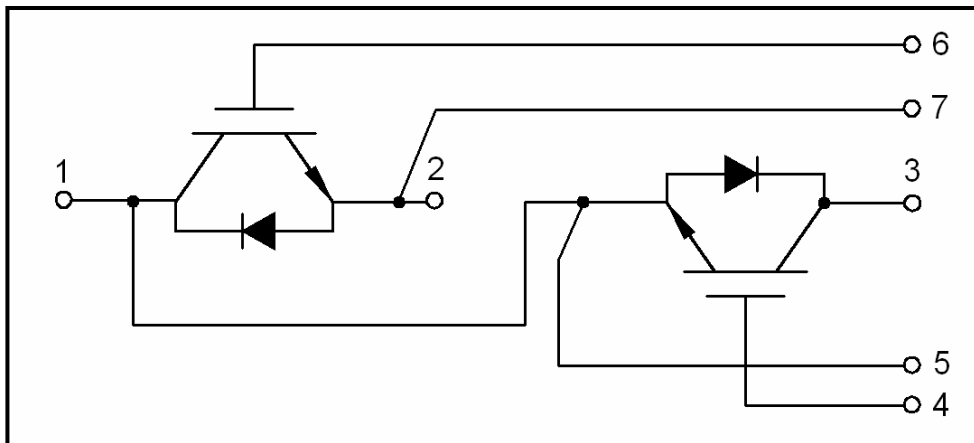
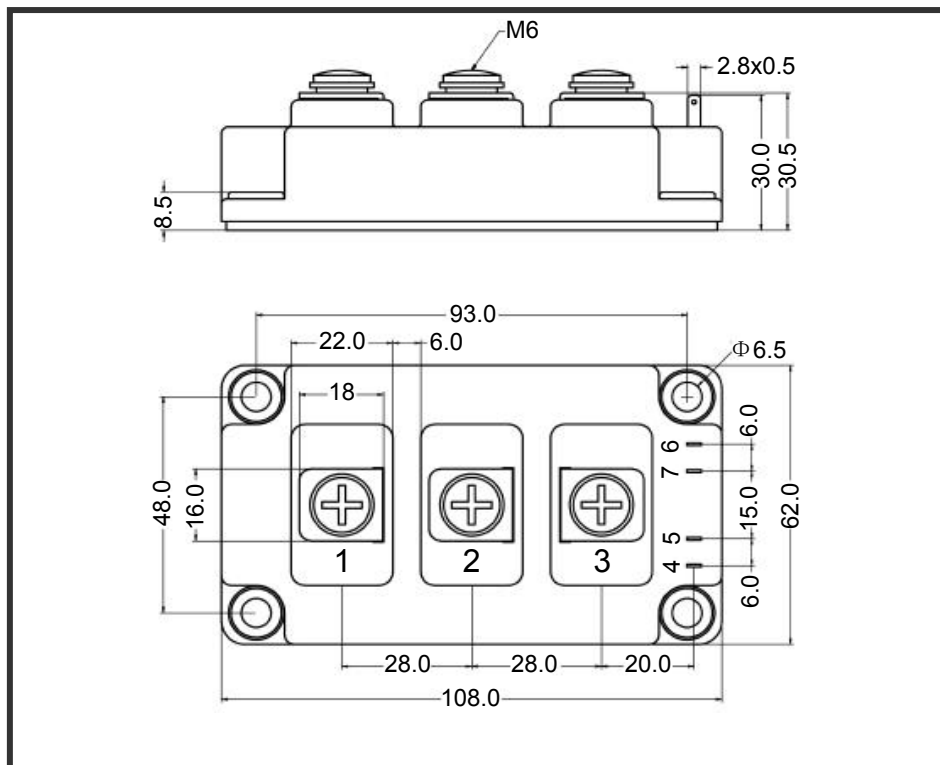


Figure11. Circuit Diagram



Dimensions (mm)  
Figure12. Package Outline