# MMG600K120U6HN

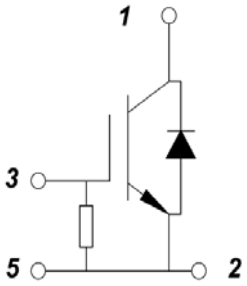
**1200V 600A IGBT Module**

**June 2015** **Version 01** **RoHS Compliant**

## PRODUCT 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
- ☐ 5K Ω Gate Protected Resistance Inside

## APPLICATIONS




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

## IGBT-inverter

### ABSOLUTE MAXIMUM RATINGS

*$T_C$=25°C unless otherwise spe*

| Symbol | Parameter/Test Conditions | | Values | t |
|---|---|---|---|---|
| $V_{CES}$ | Collector Emitter Voltage | $T_J$=25℃ | 1200 | V |
| $V_{GES}$ | Gate Emitter Voltage | | ±20 | |
| $I_C$ | DC Collector Current | $T_C$=25℃ | 800 | A |
| | | $T_C$=80℃ | 600 | |
| $I_{CM}$ | Repetitive Peak Collector Current | tp=1ms | 1200 | |
| $P_{tot}$ | Power Dissipation Per IGBT | | 3300 | W |

## Reverse-Diode

### ABSOLUTE MAXIMUM RATINGS

*$T_C$=25°C unless otherwise spe*

| Symbol | Parameter/Test Conditions | | Values | t |
|---|---|---|---|---|
| $V_{RRM}$ | Repetitive Reverse Voltage | $T_J$=25℃ | 1200 | V |
| $I_{F(AV)}$ | Average Forward Current | $T_C$=25℃ | 600 | A |
| $I_{FRM}$ | Repetitive Peak Forward Current | tp=1ms | 1200 | |
| $I^2t$ | | $T_J$=125℃, t=10ms, $V_R$=0V | 45000 | $A^2S$ |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## IGBT-inverter
## ELECTRICAL CHARACTERISTICS

*$T_C$=25°C unless otherwise spe*

| Symbol | Parameter/Test Conditions | | | Min. | Typ. | Max. | t |
|---|---|---|---|---|---|---|---|
| $V_{GE(th)}$ | Gate Emitter Threshold Voltage | $V_{CE}=V_{GE}$, $I_C$=24mA | | 5.4 | 6.0 | 6.5 | V |
| $V_{CE(sat)}$ | Collector Emitter Saturation Voltage | $I_C$=600A, $V_{GE}$=15V, $T_J$=25℃ | | | 2.1 | 2.5 | |
| | | $I_C$=600A, $V_{GE}$=15V, $T_J$=125℃ | | | 2.5 | | |
| $I_{CES}$ | Collector Leakage Current | $V_{CE}$=1200V, $V_{GE}$=0V, $T_J$=25℃ | | | | 1 | mA |
| | | $V_{CE}$=1200V, $V_{GE}$=0V, $T_J$=125℃ | | | | 10 | mA |
| $I_{GES}$ | Gate Leakage Current | $V_{CE}$=0V,$V_{GE}$=±15V, $T_J$=125℃ | | -400 | | 400 | nA |
| $R_{gint}$ | Integrated Gate Resistor | | | | 1.3 | | Ω |
| $Q_g$ | Gate Charge | $V_{CE}$=600V, $I_C$=600A , $V_{GE}$=15V | | | 2.8 | | μC |
| $C_{ies}$ | Input Capacitance | $V_{CE}$=25V, $V_{GE}$=0V, f =1MHz | | | 35 | | nF |
| $C_{res}$ | Reverse Transfer Capacitance | | | | 2 | | nF |
| $t_{d(on)}$ | Turn on Delay Time | $V_{CC}$=600V,$I_C$=600A $R_G$ =1.3Ω, $V_{GE}$=±15V, Inductive Load | $T_J$=25℃ | | 250 | | ns |
| | | | $T_J$=125℃ | | 320 | | ns |
| | | | $T_J$=150℃ | | 340 | | ns |
| $t_r$ | Rise Time | | $T_J$=25℃ | | 90 | | ns |
| | | | $T_J$=125℃ | | 95 | | ns |
| | | | $T_J$=150℃ | | 100 | | ns |
| $t_{d(off)}$ | Turn off Delay Time | $V_{CC}$=600V,$I_C$=600A $R_G$ =1.3Ω, $V_{GE}$=±15V, Inductive Load | $T_J$=25℃ | | 550 | | ns |
| | | | $T_J$=125℃ | | 650 | | ns |
| | | | $T_J$=150℃ | | 700 | | ns |
| $t_f$ | Fall Time | | $T_J$=25℃ | | 60 | | ns |
| | | | $T_J$=125℃ | | 80 | | ns |
| | | | $T_J$=150℃ | | 90 | | ns |
| $E_{on}$ | Turn on Energy | $V_{CC}$=600V,$I_C$=600A $R_G$ =1.3Ω, $V_{GE}$=±15V, Inductive Load | $T_J$=125℃ | | 48 | | mJ |
| | | | $T_J$=150℃ | | 53 | | mJ |
| $E_{off}$ | Turn off Energy | | $T_J$=125℃ | | 37 | | mJ |
| | | | $T_J$=150℃ | | 40 | | mJ |
| $I_{SC}$ | Short Circuit Current | tpsc≤10μS , $V_{GE}$=15V $T_J$=125℃,$V_{CC}$=600V | | | 2400 | | A |
| $R_{thJC}$ | Junction to Case Thermal Resistance （Per IGBT） | | | | | 0.045 | K/W |

## Reverse-Diode
## ELECTRICAL CHARACTERISTICS

*$T_C$=25°C unless otherwise spe*

| Symbol | Parameter/Test Conditions | | Min. | Typ. | Max. | t |
|---|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | $I_F$=600A , $V_{GE}$=0V, $T_J$=25℃ | | 2.05 | 2.4 | V |
| | | $I_F$=600A , $V_{GE}$=0V, $T_J$=125℃ | | 2.0 | | |
| $t_{rr}$ | Reverse Recovery Time | $I_F$=600A , $V_R$=600V $dI_F/dt$=-6000A/μs $T_J$ =125℃ | | 400 | | ns |
| $I_{RRM}$ | Max. Reverse Recovery Current | | | 500 | | A |
| $Q_{RR}$ | Reverse Recovery Charge | | | 48 | | μC |
| $E_{rec}$ | Reverse Recovery Energy | | | 31 | | mJ |
| $R_{thJCD}$ | Junction to Case Thermal Resistance （Per Diode） | | | | 0.085 | K/W |

## MODULE CHARACTERISTICS

*$T_C$=25°C unless otherwise sp*

| Symbol | Parameter/Test Conditions | | Values | t |
|---|---|---|---|---|
| $T_{Jmax}$ | Max. Junction Temperature | | 175 | ℃ |
| $T_{Jop}$ | Operating Temperature | | -40~150 | |
| $T_{stg}$ | Storage Temperature | | -40~125 | |
| $V_{isol}$ | Isolation Breakdown Voltage | AC, 50Hz(R.M.S), t=1minute | 3000 | V |
| Torque | to heatsink | Recommended（M6） | 3~5 | Nm |
| | to terminal | Recommended（M6） | 2.5~5 | Nm |
| | to terminal | Recommended（M4） | 0.7~1.1 | Nm |
| Weight | | | 330 | g |

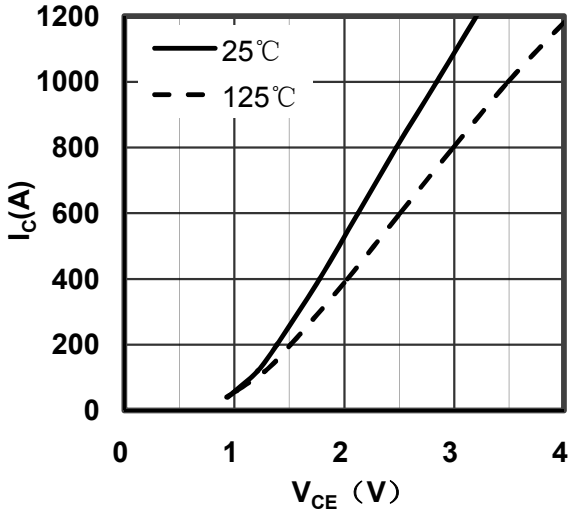



**Figure 1. Typical Output Characteristics IGBT-inverter**

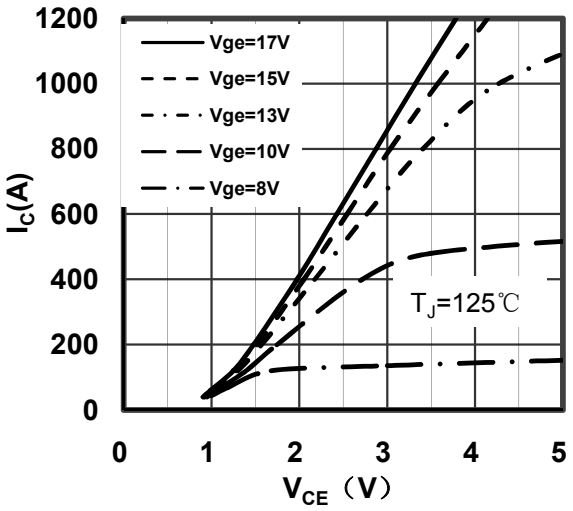



**Figure 2. Typical Output Characteristics IGBT-inverter**

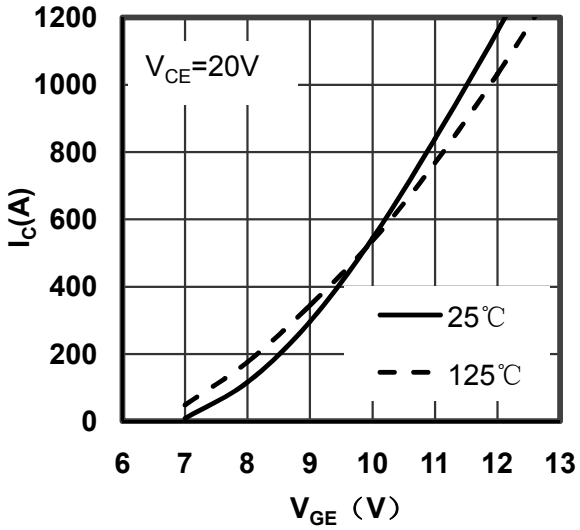



**Figure 3. Typical Transfer Characteristics IGBT-inverter**

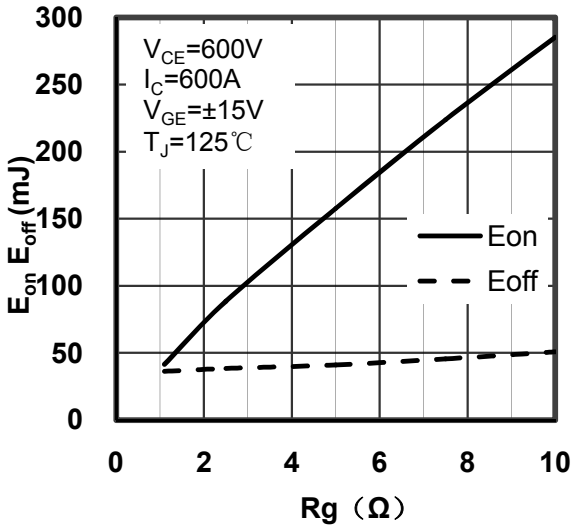



**Figure 4. Switching Energy vs Gate Resistor IGBT-inverter**

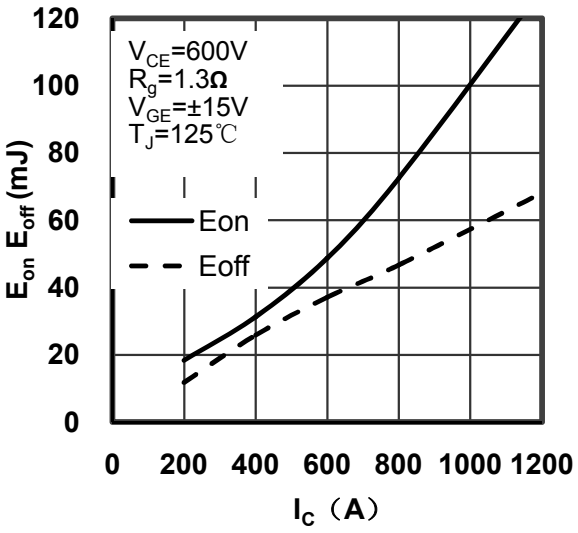



**Figure 5. Switching Energy vs Collector Current IGBT-inverter**

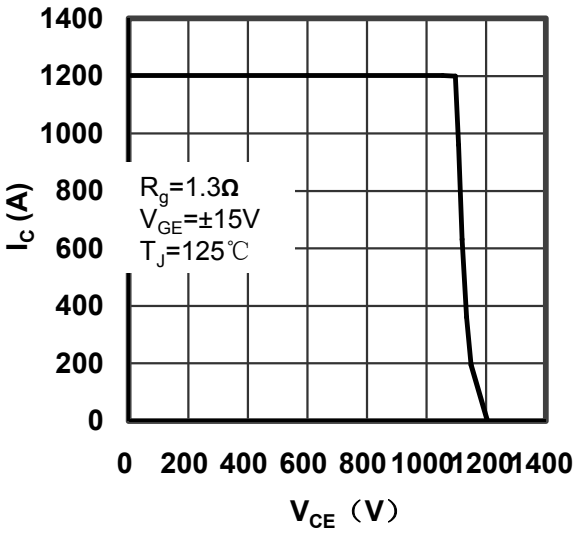



**Figure 6. Reverse Biased Safe Operating Area IGBT-inverter**

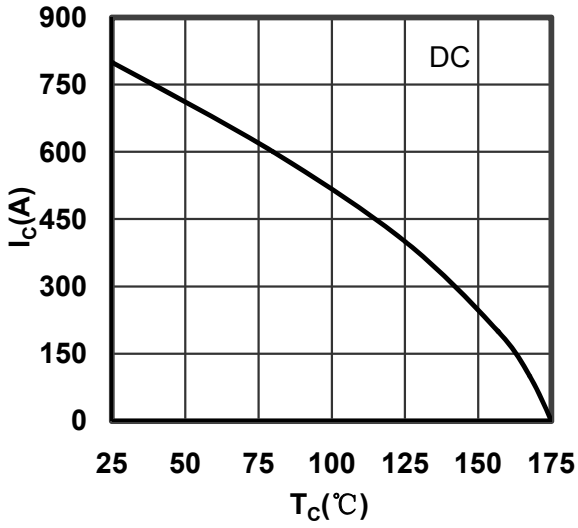



**Figure 7. Collector Current vs Case temperature IGBT -inverter**

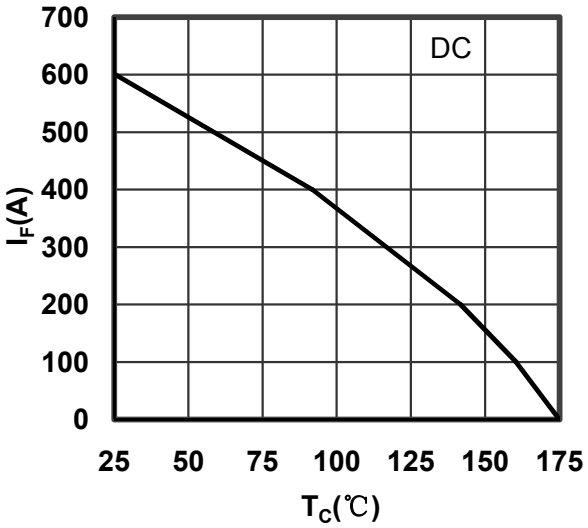



**Figure 8. Forward current vs Case temperature**

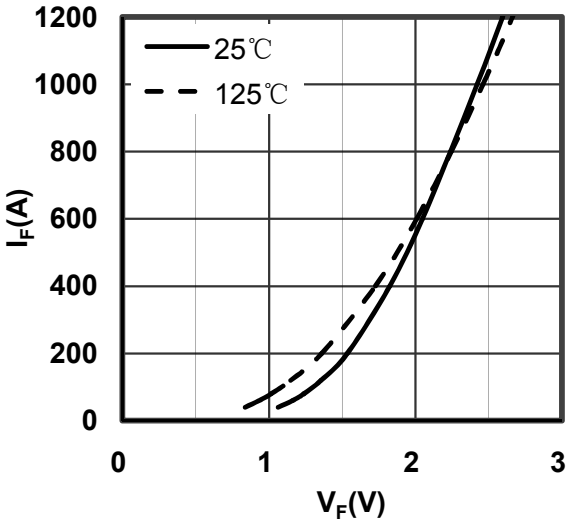



**Figure 9. Diode Forward Characteristics Reverse-Diode**

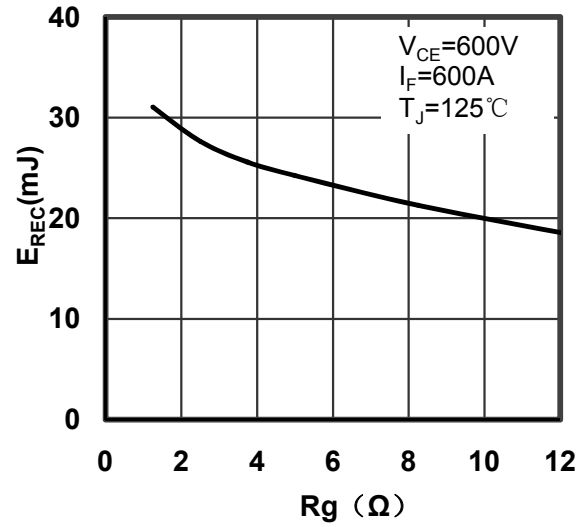



**Figure 10. Switching Energy vs Gate Resistor Reverse-Diode**

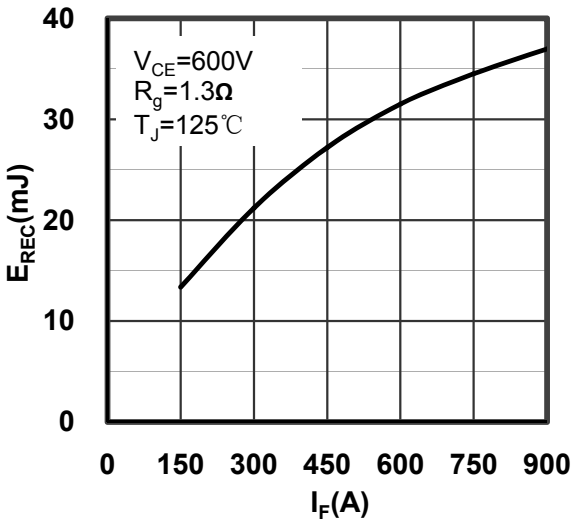



Figure 11. Switching Energy vs Forward Current Reverse-Diode

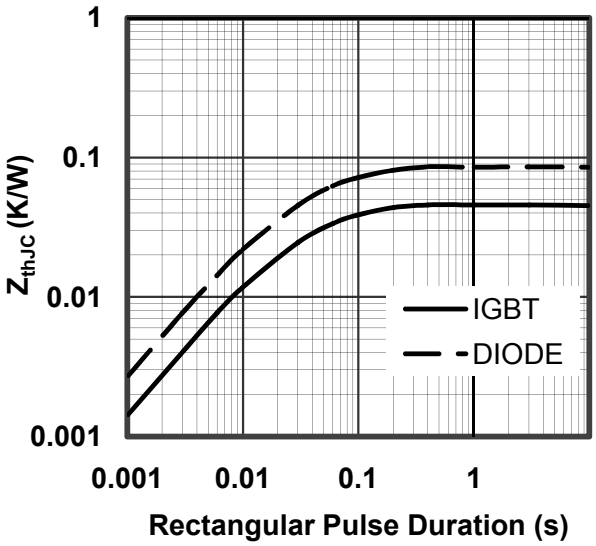
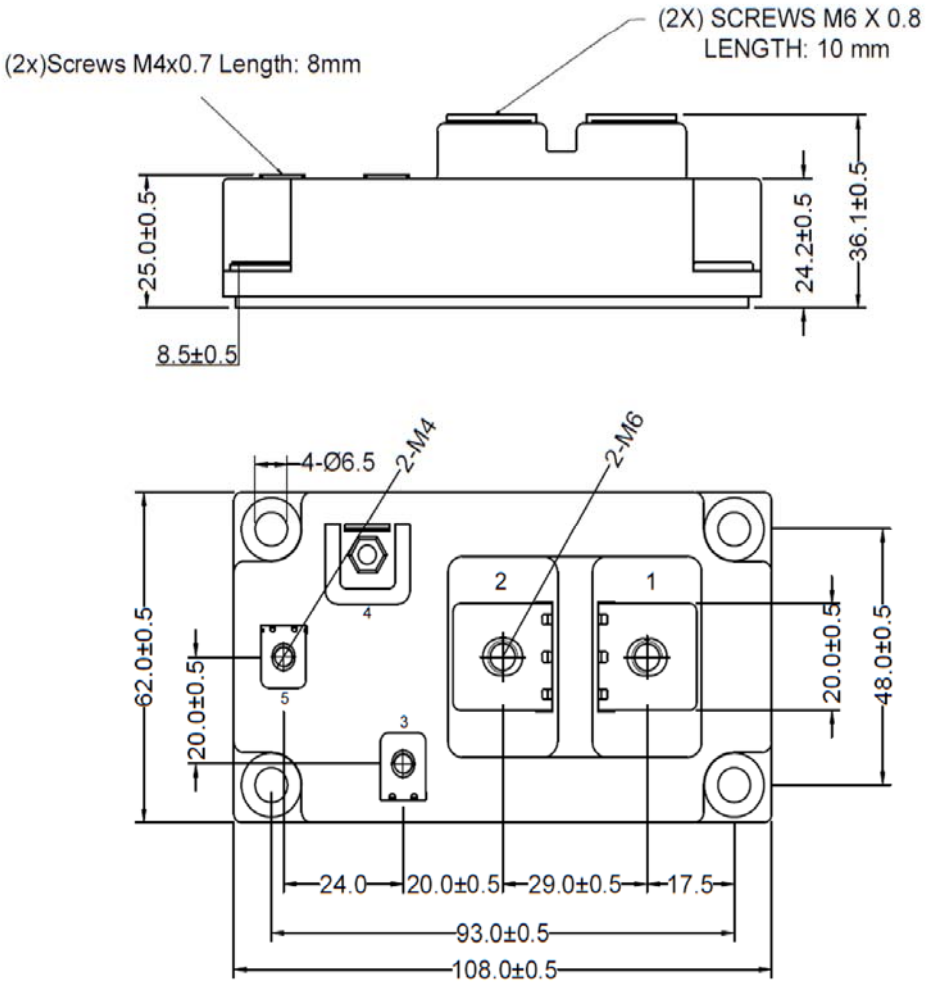



Figure 12. Transient Thermal Impedance of Reverse-Diode and IGBT-inverter




Dimensions in (mm)

Figure 13. Package Outline