# MMGT100WD120XB6C

1200V 100A PIM Module

September 2015 Version 0 RoHS Compliant

## PRODUCT FEATURES

☐ High level of integration

☐ IGBT CHIP(Trench+Field Stop technology)

☐ Low saturation voltage and positive temperature coefficient

☐ Fast switching and short tail current

☐ Free wheeling diodes with fast and soft reverse recovery

☐ Industry standard package with insulated copper base plate and soldering pins for PCB mounting

☐ Temperature sense included

**Rectifier+Brake+Inverter**

## APPLICATIONS

☐ AC motor control

☐ Motion/servo control

☐ Inverter and power supplies

## IGBT-inverter

### ABSOLUTE MAXIMUM RATINGS(*$T_C$=25°C unless otherwise specified*)

| Symbol | Parameter/Test Conditions | | Values | Unit |
|---|---|---|---|---|
| $V_{CES}$ | Collector Emitter Voltage | $T_J$=25℃ | 1200 | V |
| $V_{GES}$ | Gate Emitter Voltage | | ±20 | |
| $I_C$ | DC Collector Current | $T_C$=25℃ | 150 | A |
| | | $T_C$=100℃ | 100 | |
| $I_{CM}$ | Repetitive Peak Collector Current | tp=1ms | 200 | |
| $P_{tot}$ | Power Dissipation Per IGBT | | 576 | W |

## Diode-inverter

### ABSOLUTE MAXIMUM RATINGS (*$T_C$=25°C unless otherwise specified*)

| Symbol | Parameter/Test Conditions | | Values | Unit |
|---|---|---|---|---|
| $V_{RRM}$ | Repetitive Reverse Voltage | $T_J$=25℃ | 1200 | V |
| $I_{F(AV)}$ | Average Forward Current | $T_C$=25℃ | 100 | A |
| $I_{FRM}$ | Repetitive Peak Forward Current | tp=1ms | 200 | |
| $I^2t$ | | $T_J$=125℃, t=10ms, $V_R$=0V | 3200 | $A^2S$ |

## IGBT-inverter
## ELECTRICAL CHARACTERISTICS *($T_C$=25°C unless otherwise specified)*

| Symbol | Parameter/Test Conditions | | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| $V_{GE(th)}$ | Gate Emitter Threshold Voltage | $V_{CE}=V_{GE}$, $I_C$=4mA | | 5.0 | 5.8 | 6.5 | V |
| $V_{CE(sat)}$ | Collector Emitter Saturation Voltage | $I_C$=100A, $V_{GE}$=15V, $T_J$=25℃ | | | 1.75 | 2.25 | |
| | | $I_C$=100A, $V_{GE}$=15V, $T_J$=125℃ | | | 2.05 | | |
| | | $I_C$=100A, $V_{GE}$=15V, $T_J$=150℃ | | | 2.1 | | |
| $I_{CES}$ | Collector Leakage Current | $V_{CE}$=1200V, $V_{GE}$=0V, $T_J$=25℃ | | | | 100 | μA |
| | | $V_{CE}$=1200V, $V_{GE}$=0V, $T_J$=150℃ | | | | 10 | mA |
| $I_{GES}$ | Gate Leakage Current | $V_{CE}$=0V,$V_{GE}$=±15V, $T_J$=25℃ | | -400 | | 400 | nA |
| $R_{gint}$ | Integrated Gate Resistor | | | | 7.5 | | Ω |
| $Q_g$ | Gate Charge | $V_{CE}$=600V, $I_C$=100A , $V_{GE}$=15V | | | 0.5 | | μC |
| $C_{ies}$ | Input Capacitance | $V_{CE}$=25V, $V_{GE}$=0V, f =1MHz | | | 14.5 | | nF |
| $C_{res}$ | Reverse Transfer Capacitance | | | | 140 | | pF |
| $t_{d(on)}$ | Turn on Delay Time | $V_{CC}$=600V,$I_C$=100A<br>$R_G$ =5Ω,<br>$V_{GE}$=±15V,<br>Inductive Load | $T_J$=25℃ | | 300 | | ns |
| | | | $T_J$=125℃ | | 310 | | ns |
| | | | $T_J$=150℃ | | 310 | | ns |
| $t_r$ | Rise Time | | $T_J$=25℃ | | 75 | | ns |
| | | | $T_J$=125℃ | | 80 | | ns |
| | | | $T_J$=150℃ | | 85 | | ns |
| $t_{d(off)}$ | Turn off Delay Time | $V_{CC}$=600V,$I_C$=100A<br>$R_G$ =5Ω,<br>$V_{GE}$=±15V,<br>Inductive Load | $T_J$=25℃ | | 320 | | ns |
| | | | $T_J$=125℃ | | 350 | | ns |
| | | | $T_J$=150℃ | | 360 | | ns |
| $t_f$ | Fall Time | | $T_J$=25℃ | | 80 | | ns |
| | | | $T_J$=125℃ | | 150 | | ns |
| | | | $T_J$=150℃ | | 160 | | ns |
| $E_{on}$ | Turn on Energy | $V_{CC}$=600V,$I_C$=100A<br>$R_G$ =5Ω,<br>$V_{GE}$=±15V,<br>Inductive Load | $T_J$=125℃ | | 12 | | mJ |
| | | | $T_J$=150℃ | | 13 | | mJ |
| $E_{off}$ | Turn off Energy | | $T_J$=125℃ | | 9 | | mJ |
| | | | $T_J$=150℃ | | 9.5 | | mJ |
| $I_{SC}$ | Short Circuit Current | tpsc≤10μS , $V_{GE}$=15V<br>$T_J$=125℃,$V_{CC}$=600V | | | 600 | | A |
| $R_{thJC}$ | Junction to Case Thermal Resistance （ Per IGBT） | | | | | 0.26 | K /W |

## Diode-inverter
## ELECTRICAL CHARACTERISTICS *($T_C$=25°C unless otherwise specified)*

| Symbol | Parameter/Test Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | $I_F$=100A , $V_{GE}$=0V, $T_J$=25℃ | | 1.9 | 2.4 | V |
| | | $I_F$=100A , $V_{GE}$=0V, $T_J$=125℃ | | 1.65 | | |
| | | $I_F$=100A , $V_{GE}$=0V, $T_J$=150℃ | | 1.6 | | |
| $t_{rr}$ | Reverse Recovery Time | $I_F$=100A , $V_R$=600V<br>$dI_F/dt$=-1400A/μs<br>$T_J$ =150℃ | | 300 | | ns |
| $I_{RRM}$ | Max. Reverse Recovery Current | | | 120 | | A |
| $Q_{RR}$ | Reverse Recovery Charge | | | 15.6 | | μC |
| $E_{rec}$ | Reverse Recovery Energy | | | 6.2 | | mJ |
| $R_{thJCD}$ | Junction to Case Thermal Resistance （ Per Diode） | | | | 0.4 | K /W |

## Diode-RECTIFIER

### ABSOLUTE MAXIMUM RATINGS *($T_C$ =25°C unless otherwise specified)*

| Symbol | Parameter/Test Conditions | | Values | Unit |
|---|---|---|---|---|
| $V_{RRM}$ | Repetitive Reverse Voltage | $T_J$=25℃ | 1600 | V |
| $I_{FRMS}$ | R.M.S. Forward Current Per Diode | $T_C$=80℃ | 100 | A |
| $I_{RMS}$ | R.M.S. Current at rectifier output | | 150 | |
| $I_{FSM}$ | Non Repetitive Surge Forward Current | $T_J$=45℃, t=10ms, 50Hz | 1100 | |
| | | $T_J$=45℃, t=8.3ms, 60Hz | 1210 | |
| $I^2t$ | | $T_J$=45℃, t=10ms, 50Hz | 6050 | $A^2S$ |
| | | $T_J$=45℃, t=8.3ms, 60Hz | 6076 | |

## Diode-RECTIFIER

### ELECTRICAL CHARACTERISTICS *($T_C$ =25°C unless otherwise specified)*

| Symbol | Parameter/Test Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | $I_F$=100A , $T_J$ =25℃ | | 1.05 | | V |
| | | $I_F$=100A , $T_J$ =150℃ | | 1.05 | | V |
| $I_R$ | Reverse Leakage Current | $V_R$=1600V, $T_J$=25℃ | | | 50 | µA |
| | | $V_R$=1600V, $T_J$=150℃ | | | 1 | mA |
| $R_{thJCD}$ | Junction to Case Thermal Resistance （ Per Diode） | | | | 0.45 | K /W |

## IGBT-Brake chopper

### ABSOLUTE MAXIMUM RATINGS *($T_C$ =25°C unless otherwise specified)*

| Symbol | Parameter/Test Conditions | | Values | Unit |
|---|---|---|---|---|
| $V_{CES}$ | Collector Emitter Voltage | $T_J$=25℃ | 1200 | V |
| $V_{GES}$ | Gate Emitter Voltage | | ±20 | |
| $I_C$ | DC Collector Current | $T_C$=25℃ | 115 | A |
| | | $T_C$=100℃ | 75 | |
| $I_{CM}$ | Repetitive Peak Collector Current | tp=1ms | 150 | |
| $P_{tot}$ | Power Dissipation Per IGBT | | 440 | W |

## Diode-Brake chopper

### ABSOLUTE MAXIMUM RATINGS *($T_C$ =25°C unless otherwise specified)*

| Symbol | Parameter/Test Conditions | | Values | Unit |
|---|---|---|---|---|
| $V_{RRM}$ | Repetitive Reverse Voltage | $T_J$=25℃ | 1200 | V |
| $I_{F(AV)}$ | Average Forward Current | $T_C$=25℃ | 75 | A |
| $I_{FRM}$ | Repetitive Peak Forward Current | tp=1ms | 150 | |
| $I^2t$ | | $T_J$=125℃, t=10ms, $V_R$=0V | 1800 | $A^2S$ |

## IGBT-Brake chopper

## ELECTRICAL CHARACTERISTICS *($T_C$ =25°C unless otherwise specified)*

| Symbol | Parameter/Test Conditions | | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| $V_{GE(th)}$ | Gate Emitter Threshold Voltage | $V_{CE}$=$V_{GE}$, $I_C$=3mA | | 5.0 | 5.8 | 6.5 | V |
| $V_{CE(sat)}$ | Collector - Emitter Saturation Voltage | $I_C$=75A, $V_{GE}$=15V, $T_J$=25℃ | | | 1.85 | 2.3 | |
| | | $I_C$=75A, $V_{GE}$=15V, $T_J$=125℃ | | | 2.15 | | |
| | | $I_C$=75A, $V_{GE}$=15V, $T_J$=150℃ | | | 2.25 | | |
| $I_{CES}$ | Collector Leakage Current | $V_{CE}$=1200V, $V_{GE}$=0V, $T_J$=25℃ | | | | 100 | μA |
| | | $V_{CE}$=1200V, $V_{GE}$=0V, $T_J$=150℃ | | | | 10 | mA |
| $I_{GES}$ | Gate Leakage Current | $V_{CE}$=0V,$V_{GE}$=±15V, $T_J$=25℃ | | -400 | | 400 | nA |
| $R_{gint}$ | Integrated Gate Resistor | | | | 10 | | Ω |
| $Q_g$ | Gate Charge | $V_{CE}$=600V, $I_C$=75A , $V_{GE}$=15V | | | 0.39 | | μC |
| $C_{ies}$ | Input Capacitance | $V_{CE}$=25V, $V_{GE}$=0V, f =1MHz | | | 11 | | nF |
| $C_{res}$ | Reverse Transfer Capacitance | | | | 100 | | pF |
| $t_{d(on)}$ | Turn on Delay Time | $V_{CC}$=600V,$I_C$=75A<br>$R_G$ =7.5Ω,<br>$V_{GE}$=±15V,<br>Inductive Load | $T_J$=25℃ | | 300 | | ns |
| | | | $T_J$=125℃ | | 310 | | ns |
| | | | $T_J$=150℃ | | 310 | | ns |
| $t_r$ | Rise Time | | $T_J$=25℃ | | 78 | | ns |
| | | | $T_J$=125℃ | | 82 | | ns |
| | | | $T_J$=150℃ | | 84 | | ns |
| $t_{d(off)}$ | Turn off Delay Time | $V_{CC}$=600V,$I_C$=75A<br>$R_G$ =7.5Ω,<br>$V_{GE}$=±15V,<br>Inductive Load | $T_J$=25℃ | | 320 | | ns |
| | | | $T_J$=125℃ | | 350 | | ns |
| | | | $T_J$=150℃ | | 360 | | ns |
| $t_f$ | Fall Time | | $T_J$=25℃ | | 80 | | ns |
| | | | $T_J$=125℃ | | 150 | | ns |
| | | | $T_J$=150℃ | | 160 | | ns |
| $E_{on}$ | Turn on Energy | $V_{CC}$=600V,$I_C$=75A<br>$R_G$ =7.5Ω,<br>$V_{GE}$=±15V,<br>Inductive Load | $T_J$=125℃ | | 9.2 | | mJ |
| | | | $T_J$=150℃ | | 10.1 | | mJ |
| $E_{off}$ | Turn off Energy | | $T_J$=125℃ | | 6.7 | | mJ |
| | | | $T_J$=150℃ | | 7.0 | | mJ |
| $I_{SC}$ | Short Circuit Current | tpsc≤10μS , $V_{GE}$=15V<br>$T_J$=125℃,$V_{CC}$=600V | | | 450 | | A |
| $R_{thJC}$ | Junction to Case Thermal Resistance (Per IGBT) | | | | | 0.34 | K /W |

## IGBT-Brake chopper

## ELECTRICAL CHARACTERISTICS *($T_C$ =25°C unless otherwise specified)*

| Symbol | Parameter/Test Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | $I_F$=75A , $V_{GE}$=0V, $T_J$=25℃ | | 1.9 | 2.4 | V |
| | | $I_F$=75A , $V_{GE}$=0V, $T_J$=125℃ | | 1.65 | | |
| | | $I_F$=75A , $V_{GE}$=0V, $T_J$=150℃ | | 1.6 | | |
| $t_{rr}$ | Reverse Recovery Time | $I_F$=75A , $V_R$=600V<br>$dI_F/dt$=-1000A/μs<br>$T_J$ =150℃ | | 360 | | ns |
| $I_{RRM}$ | Max. Reverse Recovery Current | | | 68 | | A |
| $E_{rec}$ | Reverse Recovery Energy | | | 4.5 | | mJ |
| $R_{thJCD}$ | Junction to Case Thermal Resistance (Per Diode) | | | | 0.6 | K /W |

## NTC CHARACTERISTICS *($T_C$=25°C unless otherwise specified)*

| Symbol | Parameter/Test Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **$R_{25}$** | Resistance | $T_C$ =25℃ | | 5 | | KΩ |
| **$B_{25/50}$** | $R_2 = R_{25}$ exp [$B_{25/50}$(1/$T_2$ - 1/(298.15 K))] | | | 3375 | | K |

## MODULE CHARACTERISTICS *($T_C$=25°C unless otherwise specified)*

| Symbol | Parameter/Test Conditions | | Values | Unit |
|---|---|---|---|---|
| **$T_{Jmax}$** | Max. Junction Temperature | Inverter, Brake-Chopper | 175 | ℃ |
| | | Rectifier | 150 | |
| **$T_{Jop}$** | Operating Temperature | | -40~150 | |
| **$T_{stg}$** | Storage Temperature | | -40~125 | |
| **$V_{isol}$** | Isolation Breakdown Voltage | AC, 50Hz(R.M.S), t=1minute | 3000 | V |
| **CTI** | Comparative Tracking Index | | >200 | |
| **Md** | Mounting Torque | Recommended（M5） | 2.5~5 | Nm |
| **Weight** | | | 300 | g |

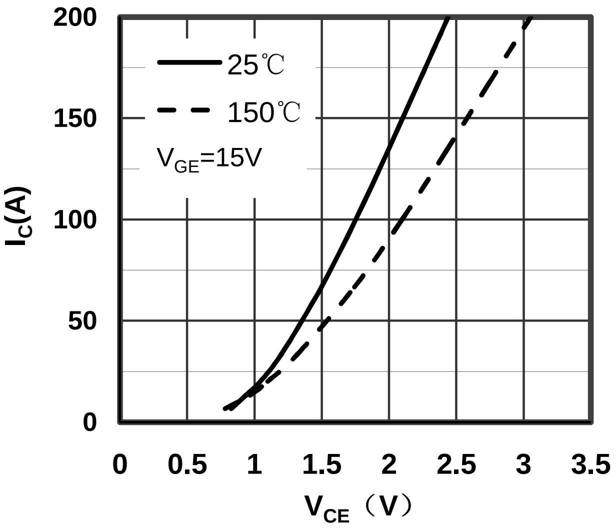


**Figure 1. Typical Output Characteristics IGBT-inverter**

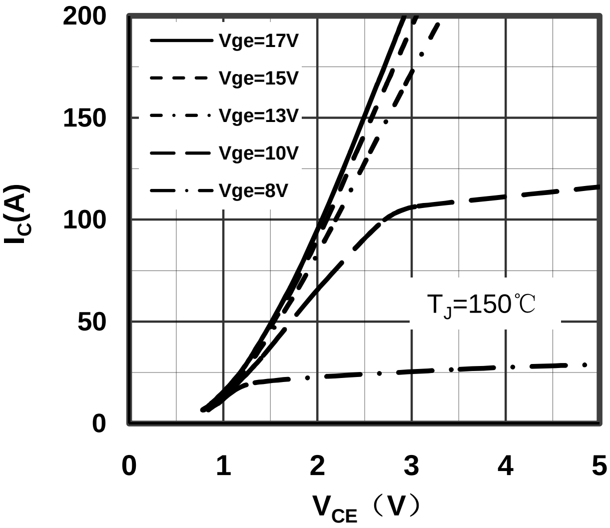


**Figure 2. Typical Output Characteristics IGBT-inverter**

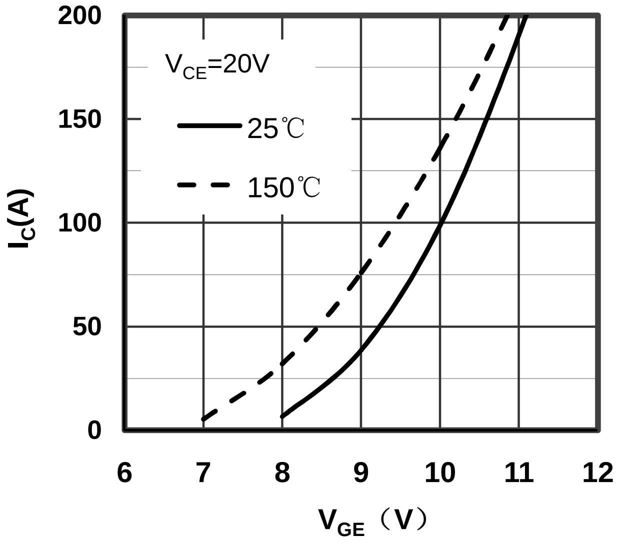


**Figure 3. Typical Transfer Characteristics IGBT-inverter**

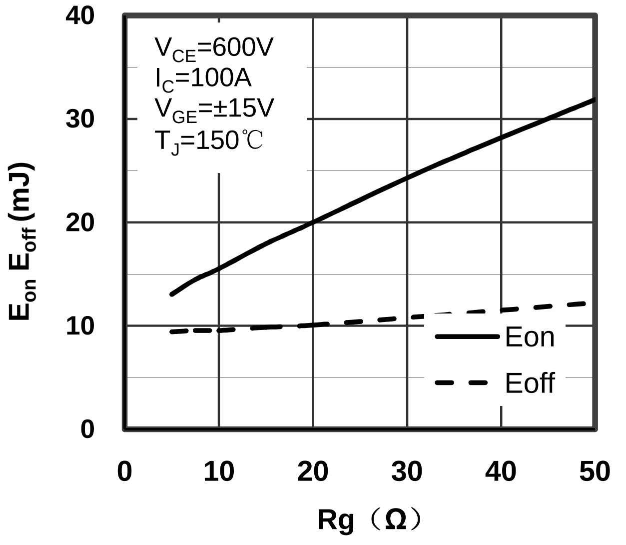


**Figure 4. Switching Energy vs Gate Resistor IGBT-inverter**

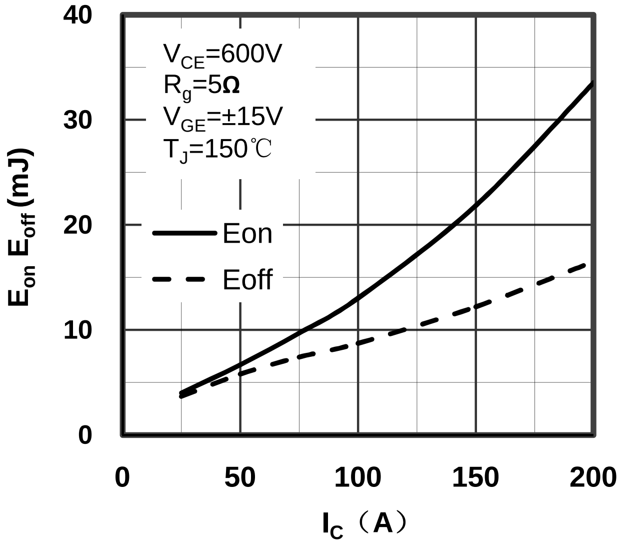


**Figure 5. Switching Energy vs Collector Current IGBT-inverter**

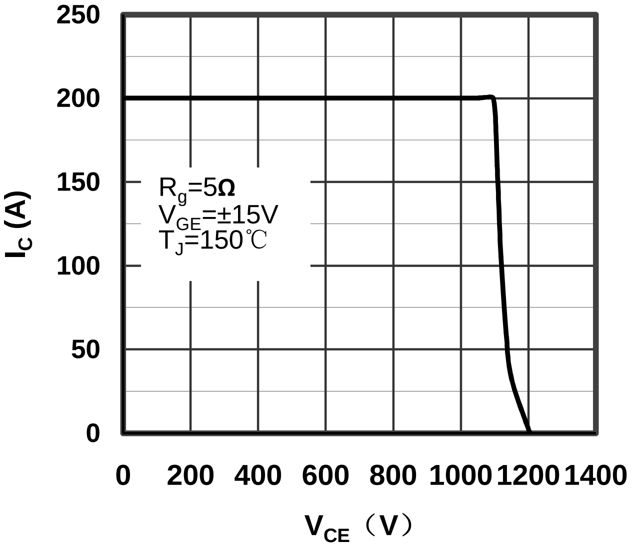


**Figure 6. Reverse Biased Safe Operating Area IGBT-inverter**

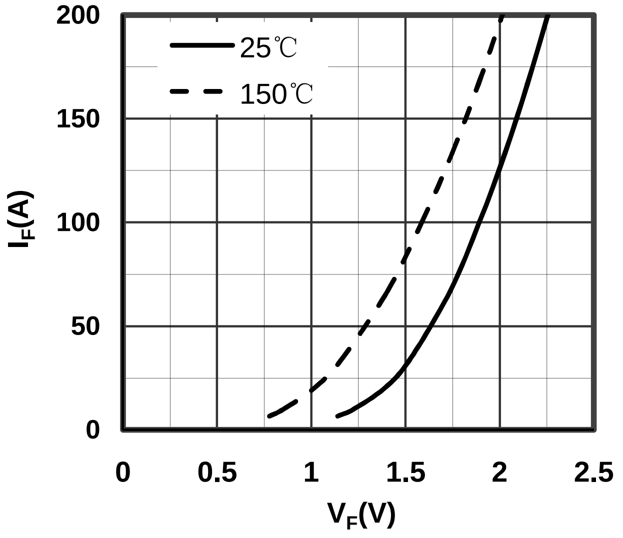


**Figure 7. Diode Forward Characteristics Diode -inverter**

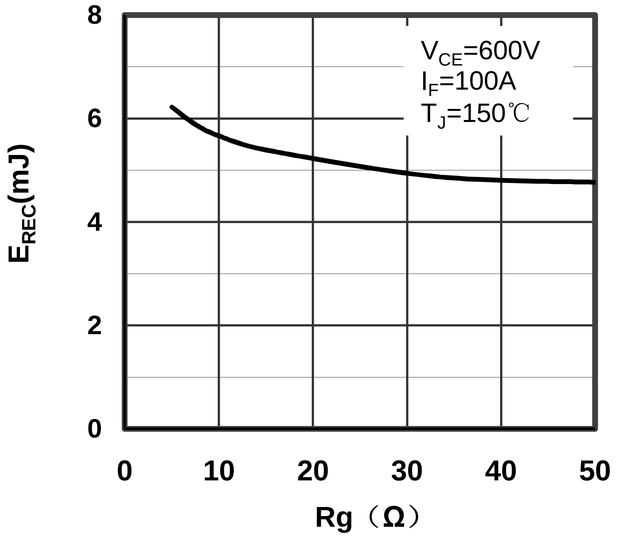


**Figure 8. Switching Energy vs Gate Resistor Diode -inverter**

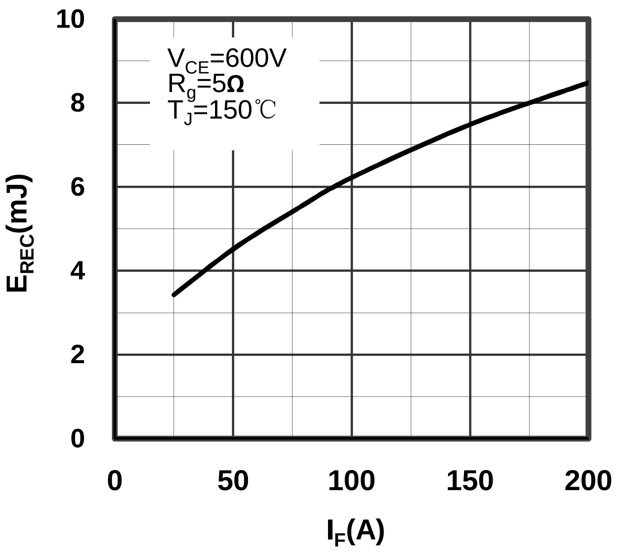


Figure 9. Switching Energy vs Forward Current Diode-inverter

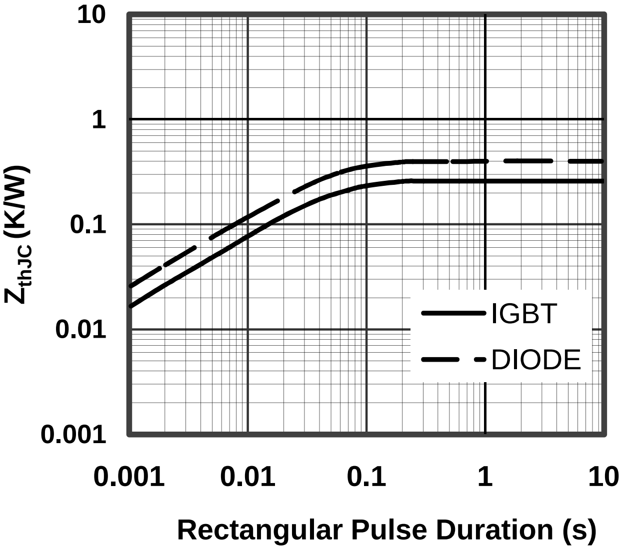


Figure 10. Transient Thermal Impedance of Diode and IGBT-inverter

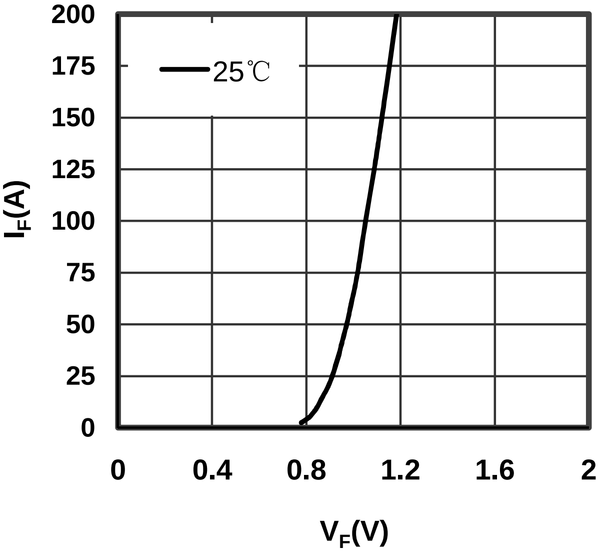


Figure 11. Diode Forward Characteristics Diode- rectifier

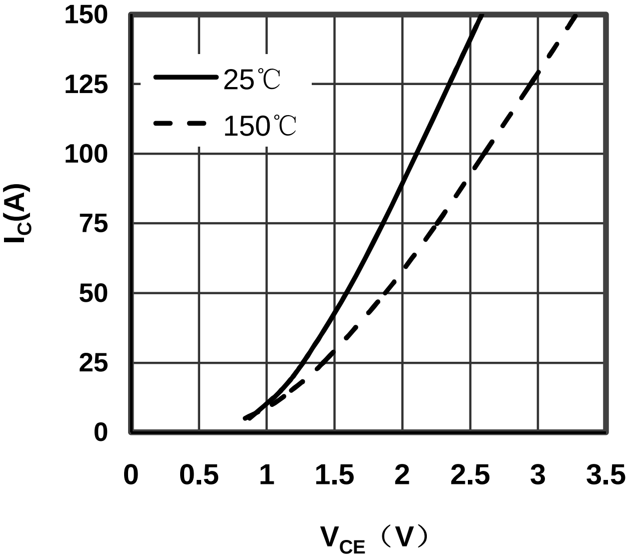


Figure 12. Typical Output Characteristics IGBT- brake chopper

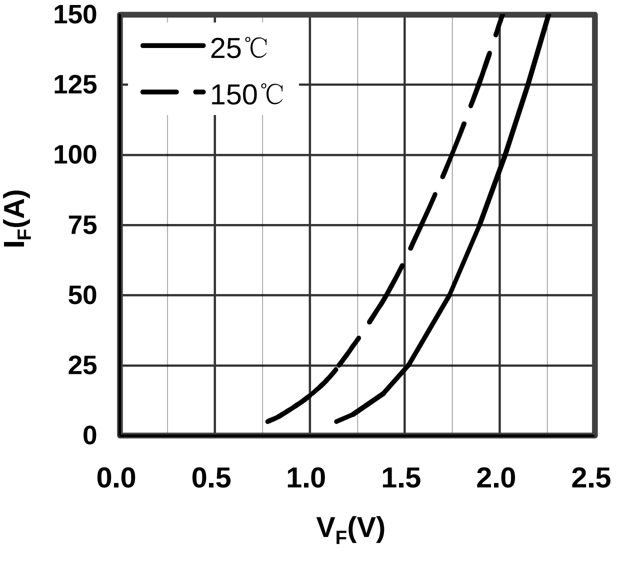


Figure 13. Diode Forward Characteristics Diode - brake chopper

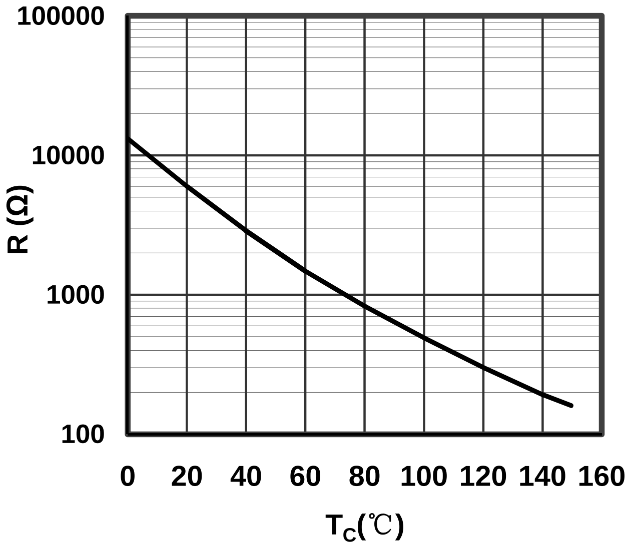


Figure 14. NTC Characteristics

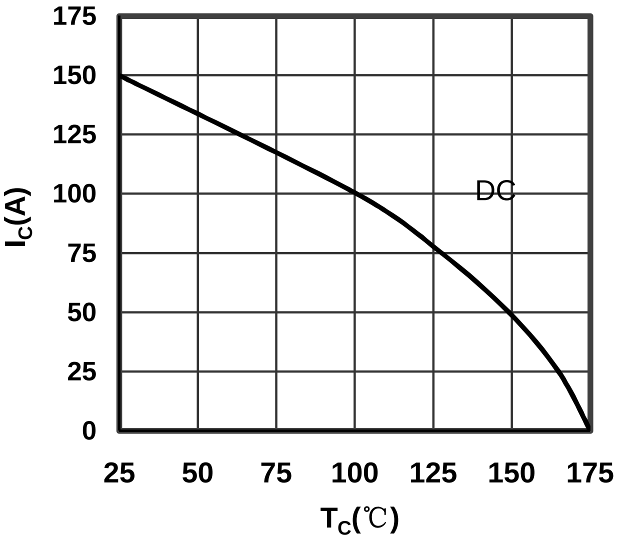


Figure 15. Collector Current vs Case temperature IGBT -inverter

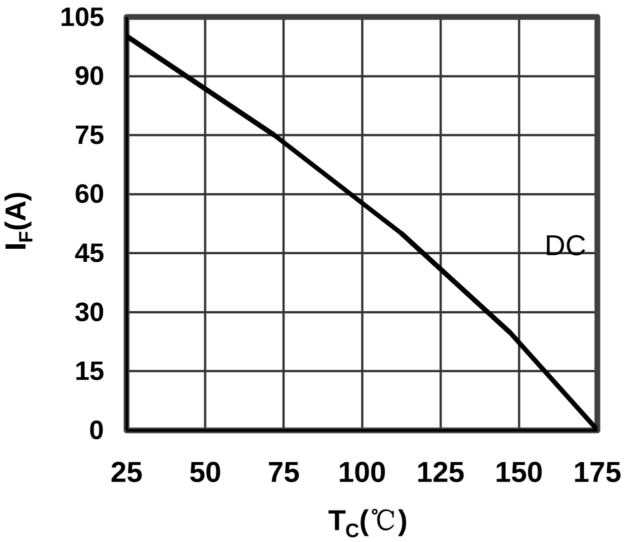


Figure 16. Forward current vs Case temperature Diode -inverter

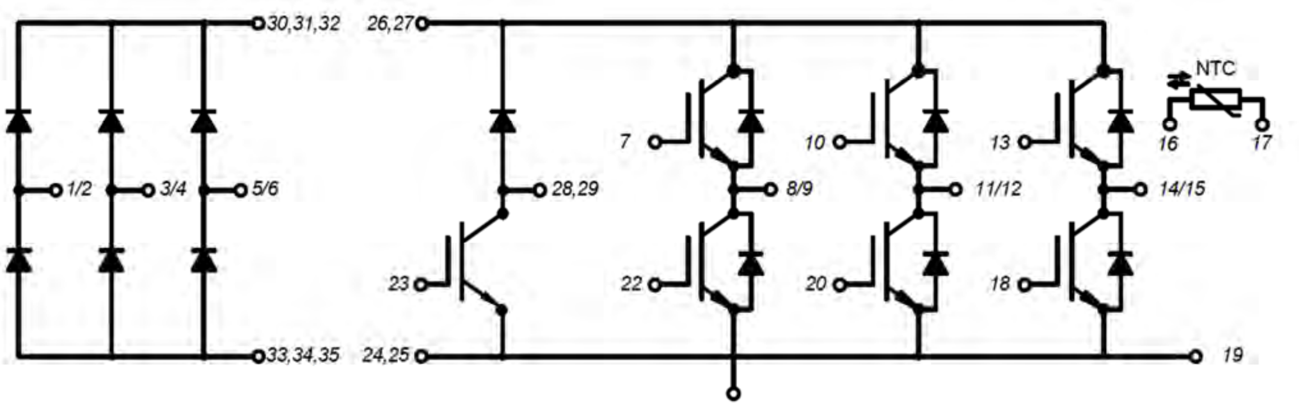
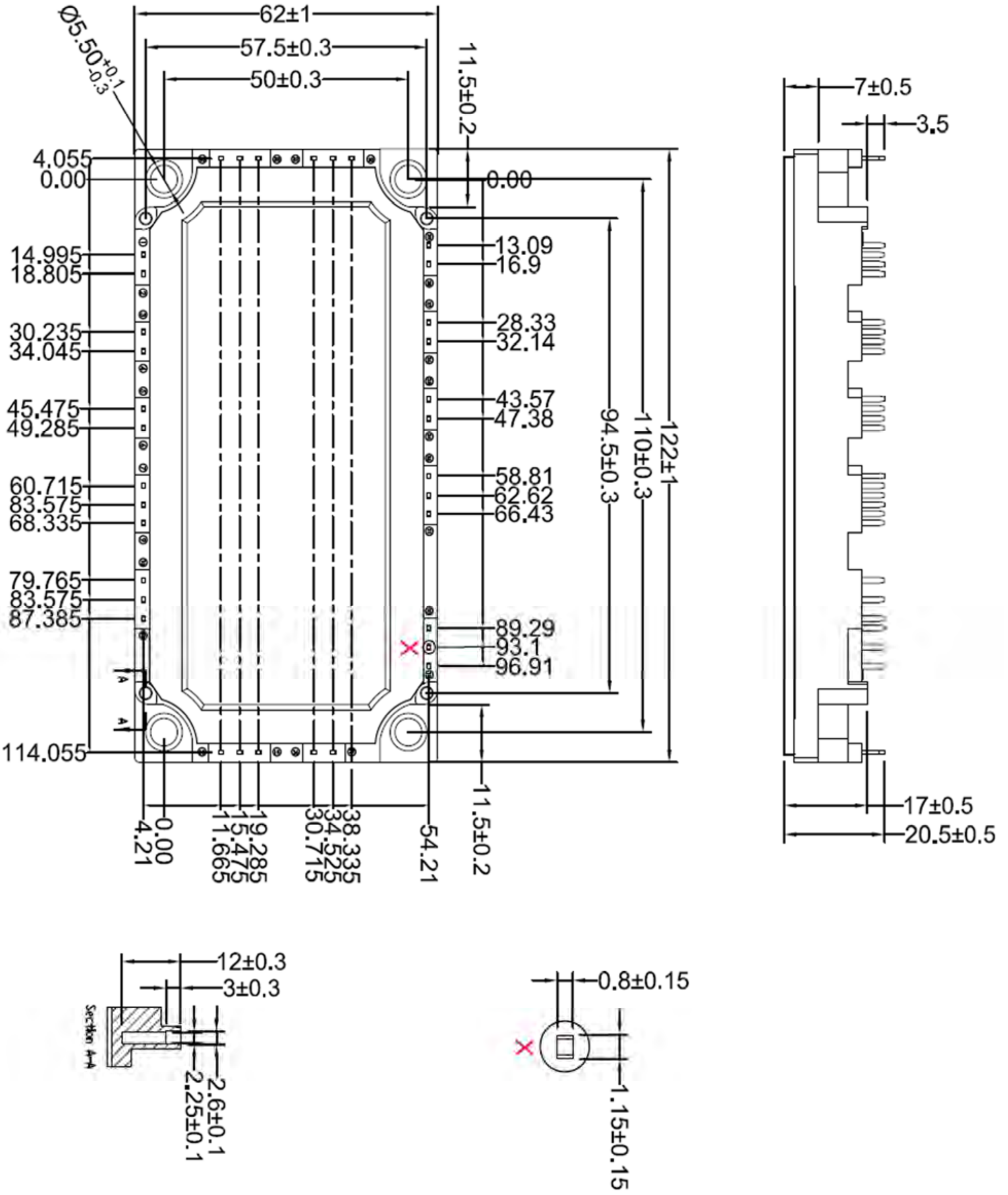


Figure 17. Circuit Diagram



**Dimensions in (mm)**
**Figure 18. Package Outline**