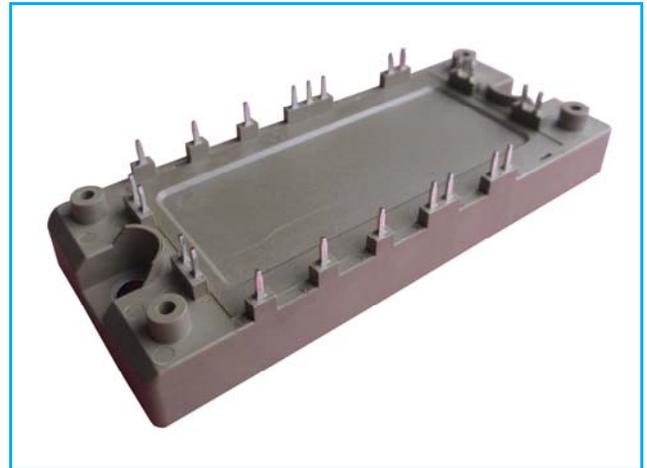


## PRODUCT FEATURES

- 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

## APPLICATIONS

- AC motor control
- Motion/servo control
- Inverter and power supplies



Rectifier+Brake+Inverter

### IGBT-inverter

ABSOLUTE MAXIMUM RATINGS ( $T_C=25^{\circ}\text{C}$  unless otherwise specified)

| Symbol    | Parameter/Test Conditions         |   | Values   | Unit |
|-----------|-----------------------------------|---|----------|------|
| $V_{CES}$ | Collector Emitter Voltage         | $T_J=25^{\circ}\text{C}$                                | 1200     | V    |
| $V_{GES}$ | Gate Emitter Voltage              |   | $\pm 20$ |      |
| $I_C$     | DC Collector Current              | $T_C=25^{\circ}\text{C}, T_{Jmax}=175^{\circ}\text{C}$  | 77       | A    |
|           |                                   | $T_C=100^{\circ}\text{C}, T_{Jmax}=175^{\circ}\text{C}$ | 50       |      |
| $I_{CM}$  | Repetitive Peak Collector Current | $t_p=1\text{ms}$  | 100      |      |
| $P_{tot}$ | Power Dissipation Per IGBT        | $T_C=25^{\circ}\text{C}, T_{Jmax}=175^{\circ}\text{C}$  | 278      | W    |

### Diode-inverter

ABSOLUTE MAXIMUM RATINGS ( $T_C=25^{\circ}\text{C}$  unless otherwise specified)

| Symbol      | Parameter/Test Conditions       |   | Values | Unit                 |
|-------------|---------------------------------|---|--------|----------------------|
| $V_{RRM}$   | Repetitive Reverse Voltage      | $T_J=25^{\circ}\text{C}$                                | 1200   | V                    |
| $I_{F(AV)}$ | Average Forward Current         |   | 50     | A                    |
| $I_{FRM}$   | Repetitive Peak Forward Current | $t_p=1\text{ms}$  | 100    |                      |
| $I^2t$      |                                 | $T_J=125^{\circ}\text{C}, t=10\text{ms}, V_R=0\text{V}$ | 560    | $\text{A}^2\text{S}$ |

MacMic Science & Technology Co., Ltd.

Add: #18, Hua Shan Zhong Lu, New District, Changzhou City, Jiangsu Province, P. R .of China

Tel.: +86-519-85163708 Fax: +86-519-85162291 Post Code: 213022 Website: www.macmicst.com

# MMG50HD120XB6TC

## IGBT-inverter

### ELECTRICAL CHARACTERISTICS ( $T_C=25^\circ\text{C}$ unless otherwise specified)

| Symbol        | Parameter/Test Conditions                      |   | Min.                    | Typ. | Max. | Unit          |
|---------------|--|---|-------------------------|------|------|---------------|
| $V_{GE(th)}$  | Gate Emitter Threshold Voltage                 | $V_{CE}=V_{GE}, I_C=2\text{mA}$   | 5.0                     | 5.8  | 6.5  | V             |
| $V_{CE(sat)}$ | Collector Emitter Saturation Voltage           | $I_C=50\text{A}, V_{GE}=15\text{V}, T_J=25^\circ\text{C}$                                     |                         | 1.85 | 2.25 |               |
|               |  | $I_C=50\text{A}, V_{GE}=15\text{V}, T_J=125^\circ\text{C}$                                    |                         | 2.15 |      |               |
|               |  | $I_C=50\text{A}, V_{GE}=15\text{V}, T_J=150^\circ\text{C}$                                    |                         | 2.25 |      |               |
| $I_{CES}$     | Collector Leakage Current                      | $V_{CE}=1200\text{V}, V_{GE}=0\text{V}, T_J=25^\circ\text{C}$                                 |                         |      | 1    | mA            |
|               |  | $V_{CE}=1200\text{V}, V_{GE}=0\text{V}, T_J=150^\circ\text{C}$                                |                         |      | 10   |               |
| $I_{GES}$     | Gate Leakage Current                           | $V_{CE}=0\text{V}, V_{GE}=\pm 20\text{V}, T_J=25^\circ\text{C}$                               | -400                    |      | 400  | nA            |
| $R_{gint}$    | Integrated Gate Resistor                       |   |                         | 3.6  |      | $\Omega$      |
| $Q_g$         | Gate Charge                                    | $V_{CE}=600\text{V}, I_C=50\text{A}, V_{GE}=15\text{V}$                                       |                         | 0.27 |      | $\mu\text{C}$ |
| $C_{ies}$     | Input Capacitance                              | $V_{CE}=25\text{V}, V_{GE}=0\text{V}, f=1\text{MHz}$  |                         | 3.85 |      | nF            |
| $C_{res}$     | Reverse Transfer Capacitance                   |   |                         |      | 160  |               |
| $t_{d(on)}$   | Turn on Delay Time                             | $V_{CC}=600\text{V}, I_C=50\text{A}$<br>$R_G=10\Omega,$                                       | $T_J=25^\circ\text{C}$  |      | 35   | ns            |
|               |  |   | $T_J=125^\circ\text{C}$ |      | 40   | ns            |
|               |  |   | $T_J=150^\circ\text{C}$ |      | 40   | ns            |
| $t_r$         | Rise Time                                      | $V_{GE}=\pm 15\text{V},$<br>Inductive Load  | $T_J=25^\circ\text{C}$  |      | 35   | ns            |
|               |  |   | $T_J=125^\circ\text{C}$ |      | 40   | ns            |
|               |  |   | $T_J=150^\circ\text{C}$ |      | 40   | ns            |
| $t_{d(off)}$  | Turn off Delay Time                            | $V_{CC}=600\text{V}, I_C=50\text{A}$<br>$R_G=10\Omega,$                                       | $T_J=25^\circ\text{C}$  |      | 250  | ns            |
|               |  |   | $T_J=125^\circ\text{C}$ |      | 290  | ns            |
|               |  |   | $T_J=150^\circ\text{C}$ |      | 310  | ns            |
| $t_f$         | Fall Time                                      | $V_{GE}=\pm 15\text{V},$<br>Inductive Load  | $T_J=25^\circ\text{C}$  |      | 150  | ns            |
|               |  |   | $T_J=125^\circ\text{C}$ |      | 210  | ns            |
|               |  |   | $T_J=150^\circ\text{C}$ |      | 230  | ns            |
| $E_{on}$      | Turn on Energy                                 | $V_{CC}=600\text{V}, I_C=50\text{A}$<br>$R_G=10\Omega,$                                       | $T_J=125^\circ\text{C}$ |      | 8    | mJ            |
|               |  |   | $T_J=150^\circ\text{C}$ |      | 8.5  | mJ            |
| $E_{off}$     | Turn off Energy                                | $V_{GE}=\pm 15\text{V},$<br>Inductive Load  | $T_J=125^\circ\text{C}$ |      | 4    | mJ            |
|               |  |   | $T_J=150^\circ\text{C}$ |      | 4.3  | mJ            |
| $I_{SC}$      | Short Circuit Current                          | $t_{psc}\leq 10\mu\text{s}, V_{GE}=15\text{V}$<br>$T_J=150^\circ\text{C}, V_{CC}=600\text{V}$ |                         | 195  |      | A             |
| $R_{thJC}$    | Junction to Case Thermal Resistance (Per IGBT) |   |                         |      | 0.54 | K/W           |

## Diode-inverter

### ELECTRICAL CHARACTERISTICS ( $T_C=25^\circ\text{C}$ unless otherwise specified)

| Symbol      | Parameter/Test Conditions                       |   | Min. | Typ. | Max. | Unit          |
|-------------|---|---|------|------|------|---------------|
| $V_F$       | Forward Voltage                                 | $I_F=50\text{A}, V_{GE}=0\text{V}, T_J=25^\circ\text{C}$  |      | 1.7  | 2.15 | V             |
|             |   | $I_F=50\text{A}, V_{GE}=0\text{V}, T_J=125^\circ\text{C}$   |      | 1.65 |      |               |
|             |   | $I_F=50\text{A}, V_{GE}=0\text{V}, T_J=150^\circ\text{C}$   |      | 1.65 |      |               |
| $t_{rr}$    | Reverse Recovery Time                           | $I_F=50\text{A}, V_R=600\text{V}$<br>$dI_F/dt=-1500\text{A}/\mu\text{s}$<br>$T_J=150^\circ\text{C}$ |      | 390  |      | ns            |
| $I_{RRM}$   | Max. Reverse Recovery Current                   |   |      | 60   |      | A             |
| $Q_{RR}$    | Reverse Recovery Charge                         |   |      | 9.5  |      | $\mu\text{C}$ |
| $E_{rec}$   | Reverse Recovery Energy                         |   |      | 3.4  |      | mJ            |
| $R_{thJCD}$ | Junction to Case Thermal Resistance (Per Diode) |   |      |      | 0.81 | K/W           |

## MMG50HD120XB6TC

### Diode-RECTIFIER

ABSOLUTE MAXIMUM RATINGS ( $T_C=25^\circ\text{C}$  unless otherwise specified)

| Symbol      | Parameter/Test Conditions            |  | Values | Unit             |
|-------------|--------------------------------------|--|--------|------------------|
| $V_{RRM}$   | Repetitive Reverse Voltage           | $T_J=25^\circ\text{C}$                           | 1600   | V                |
| $I_{F(AV)}$ | Average Forward Current Per Diode    | $T_C=80^\circ\text{C}$                           | 50     | A                |
| $I_{FRMS}$  | R.M.S. Forward Current Per Diode     |  | 75     |                  |
| $I_{RMS}$   | R.M.S. Current at rectifier output   |  | 80     |                  |
| $I_{FSM}$   | Non Repetitive Surge Forward Current | $T_J=45^\circ\text{C}$ , $t=10\text{ms}$ , 50Hz  | 480    |                  |
|             |                                      | $T_J=45^\circ\text{C}$ , $t=8.3\text{ms}$ , 60Hz | 527    |                  |
| $I^2t$      |                                      | $T_J=45^\circ\text{C}$ , $t=10\text{ms}$ , 50Hz  | 1152   | A <sup>2</sup> S |
|             |                                      | $T_J=45^\circ\text{C}$ , $t=8.3\text{ms}$ , 60Hz | 1152   |                  |

### Diode-RECTIFIER

ELECTRICAL CHARACTERISTICS ( $T_C=25^\circ\text{C}$  unless otherwise specified)

| Symbol      | Parameter/Test Conditions                        |  | Min. | Typ. | Max. | Unit          |
|-------------|--|--|------|------|------|---------------|
| $V_F$       | Forward Voltage                                  | $I_F=50\text{A}$ , $T_J=25^\circ\text{C}$    |      | 1.1  | 1.25 | V             |
|             |  | $I_F=50\text{A}$ , $T_J=150^\circ\text{C}$   |      | 1.05 |      | V             |
| $I_R$       | Reverse Leakage Current                          | $V_R=1600\text{V}$ , $T_J=25^\circ\text{C}$  |      |      | 50   | $\mu\text{A}$ |
|             |  | $V_R=1600\text{V}$ , $T_J=150^\circ\text{C}$ |      |      | 1    | mA            |
| $R_{thJCD}$ | Junction to Case Thermal Resistance ( Per Diode) |  |      |      | 0.8  | K /W          |

### IGBT-Brake chopper

ABSOLUTE MAXIMUM RATINGS ( $T_C=25^\circ\text{C}$  unless otherwise specified)

| Symbol    | Parameter/Test Conditions         |  | Values   | Unit |
|-----------|-----------------------------------|--|----------|------|
| $V_{CES}$ | Collector Emitter Voltage         | $T_J=25^\circ\text{C}$                                 | 1200     | V    |
| $V_{GES}$ | Gate Emitter Voltage              |  | $\pm 20$ |      |
| $I_C$     | DC Collector Current              | $T_C=25^\circ\text{C}$ , $T_{Jmax}=175^\circ\text{C}$  | 54       | A    |
|           |                                   | $T_C=100^\circ\text{C}$ , $T_{Jmax}=175^\circ\text{C}$ | 35       |      |
| $I_{CM}$  | Repetitive Peak Collector Current | $t_p=1\text{ms}$                                       | 70       |      |
| $P_{tot}$ | Power Dissipation Per IGBT        | $T_C=25^\circ\text{C}$ , $T_{Jmax}=175^\circ\text{C}$  | 208      | W    |

### Diode-Brake chopper

ABSOLUTE MAXIMUM RATINGS ( $T_C=25^\circ\text{C}$  unless otherwise specified)

| Symbol      | Parameter/Test Conditions       |   | Values | Unit             |
|-------------|---------------------------------|---|--------|------------------|
| $V_{RRM}$   | Repetitive Reverse Voltage      | $T_J=25^\circ\text{C}$                                      | 1200   | V                |
| $I_{F(AV)}$ | Average Forward Current         |   | 25     | A                |
| $I_{FRM}$   | Repetitive Peak Forward Current | $t_p=1\text{ms}$  | 50     |                  |
| $I^2t$      |                                 | $T_J=125^\circ\text{C}$ , $t=10\text{ms}$ , $V_R=0\text{V}$ | 110    | A <sup>2</sup> S |

# MMG50HD120XB6TC

IGBT-Brake chopper

ELECTRICAL CHARACTERISTICS ( $T_C=25^\circ\text{C}$  unless otherwise specified)

| Symbol        | Parameter/Test Conditions                      |   | Min.                    | Typ. | Max. | Unit          |
|---------------|--|---|-------------------------|------|------|---------------|
| $V_{GE(th)}$  | Gate Emitter Threshold Voltage                 | $V_{CE}=V_{GE}, I_C=1.2\text{mA}$   | 5.0                     | 5.8  | 6.5  | V             |
| $V_{CE(sat)}$ | Collector Emitter Saturation Voltage           | $I_C=35\text{A}, V_{GE}=15\text{V}, T_J=25^\circ\text{C}$                                     |                         | 1.85 | 2.25 |               |
|               |  | $I_C=35\text{A}, V_{GE}=15\text{V}, T_J=125^\circ\text{C}$                                    |                         | 2.15 |      |               |
|               |  | $I_C=35\text{A}, V_{GE}=15\text{V}, T_J=150^\circ\text{C}$                                    |                         | 2.25 |      |               |
| $I_{CES}$     | Collector Leakage Current                      | $V_{CE}=1200\text{V}, V_{GE}=0\text{V}, T_J=25^\circ\text{C}$                                 |                         |      | 1    | mA            |
|               |  | $V_{CE}=1200\text{V}, V_{GE}=0\text{V}, T_J=150^\circ\text{C}$                                |                         |      | 10   |               |
| $I_{GES}$     | Gate Leakage Current                           | $V_{CE}=0\text{V}, V_{GE}=\pm 20\text{V}, T_J=25^\circ\text{C}$                               | -400                    |      | 400  | nA            |
| $R_{gint}$    | Integrated Gate Resistor                       |   |                         | 0    |      | $\Omega$      |
| $Q_g$         | Gate Charge                                    | $V_{CE}=600\text{V}, I_C=35\text{A}, V_{GE}=15\text{V}$                                       |                         | 0.21 |      | $\mu\text{C}$ |
| $C_{ies}$     | Input Capacitance                              | $V_{CE}=25\text{V}, V_{GE}=0\text{V}, f=1\text{MHz}$  |                         | 2.8  |      | nF            |
| $C_{res}$     | Reverse Transfer Capacitance                   |   |                         |      | 110  |               |
| $t_{d(on)}$   | Turn on Delay Time                             | $V_{CC}=600\text{V}, I_C=35\text{A}$<br>$R_G=20\Omega,$                                       | $T_J=25^\circ\text{C}$  |      | 35   | ns            |
|               |  |   | $T_J=125^\circ\text{C}$ |      | 40   | ns            |
|               |  |   | $T_J=150^\circ\text{C}$ |      | 40   | ns            |
| $t_r$         | Rise Time                                      | $V_{GE}=\pm 15\text{V},$<br>Inductive Load  | $T_J=25^\circ\text{C}$  |      | 35   | ns            |
|               |  |   | $T_J=125^\circ\text{C}$ |      | 40   | ns            |
|               |  |   | $T_J=150^\circ\text{C}$ |      | 40   | ns            |
| $t_{d(off)}$  | Turn off Delay Time                            | $V_{CC}=600\text{V}, I_C=35\text{A}$<br>$R_G=20\Omega,$                                       | $T_J=25^\circ\text{C}$  |      | 240  | ns            |
|               |  |   | $T_J=125^\circ\text{C}$ |      | 280  | ns            |
|               |  |   | $T_J=150^\circ\text{C}$ |      | 300  | ns            |
| $t_f$         | Fall Time                                      | $V_{GE}=\pm 15\text{V},$<br>Inductive Load  | $T_J=25^\circ\text{C}$  |      | 190  | ns            |
|               |  |   | $T_J=125^\circ\text{C}$ |      | 210  | ns            |
|               |  |   | $T_J=150^\circ\text{C}$ |      | 230  | ns            |
| $E_{on}$      | Turn on Energy                                 | $V_{CC}=600\text{V}, I_C=35\text{A}$<br>$R_G=20\Omega,$                                       | $T_J=125^\circ\text{C}$ |      | 4.4  | mJ            |
|               |  |   | $T_J=150^\circ\text{C}$ |      | 4.7  | mJ            |
| $E_{off}$     | Turn off Energy                                | $V_{GE}=\pm 15\text{V},$<br>Inductive Load  | $T_J=125^\circ\text{C}$ |      | 3.3  | mJ            |
|               |  |   | $T_J=150^\circ\text{C}$ |      | 3.5  | mJ            |
| $I_{SC}$      | Short Circuit Current                          | $t_{psc}\leq 10\mu\text{s}, V_{GE}=15\text{V}$<br>$T_J=150^\circ\text{C}, V_{CC}=600\text{V}$ |                         | 145  |      | A             |
| $R_{thJC}$    | Junction to Case Thermal Resistance (Per IGBT) |   |                         |      | 0.72 | K/W           |

Diode-Brake chopper

ELECTRICAL CHARACTERISTICS ( $T_C=25^\circ\text{C}$  unless otherwise specified)

| Symbol      | Parameter/Test Conditions                       |  | Min. | Typ. | Max. | Unit          |
|-------------|---|--|------|------|------|---------------|
| $V_F$       | Forward Voltage                                 | $I_F=25\text{A}, V_{GE}=0\text{V}, T_J=25^\circ\text{C}$   |      | 1.9  | 2.3  | V             |
|             |   | $I_F=25\text{A}, V_{GE}=0\text{V}, T_J=125^\circ\text{C}$  |      | 1.7  |      |               |
|             |   | $I_F=25\text{A}, V_{GE}=0\text{V}, T_J=150^\circ\text{C}$  |      | 1.65 |      |               |
| $t_{rr}$    | Reverse Recovery Time                           | $I_F=25\text{A}, V_R=600\text{V}$<br>$dI_F/dt=-850\text{A}/\mu\text{s}$<br>$T_J=150^\circ\text{C}$ |      | 300  |      | ns            |
| $I_{RRM}$   | Max. Reverse Recovery Current                   |  |      | 39   |      | A             |
| $Q_{RR}$    | Reverse Recovery Charge                         |  |      | 4.7  |      | $\mu\text{C}$ |
| $E_{rec}$   | Reverse Recovery Energy                         |  |      | 1.6  |      | mJ            |
| $R_{thJCD}$ | Junction to Case Thermal Resistance (Per Diode) |  |      |      | 1.4  | K/W           |

# MMG50HD120XB6TC

## NTC CHARACTERISTICS ( $T_C=25^\circ\text{C}$ unless otherwise specified)

| Symbol      | Parameter/Test Conditions                                     | Min. | Typ. | Max. | Unit             |
|-------------|---|------|------|------|------------------|
| $R_{25}$    | Resistance $T_C = 25^\circ\text{C}$                           |      | 5    |      | $\text{K}\Omega$ |
| $B_{25/50}$ | $R_2 = R_{25} \exp [B_{25/50}(1/T_2 - 1/(298.15 \text{ K}))]$ |      | 3375 |      | K                |

## MODULE CHARACTERISTICS ( $T_C=25^\circ\text{C}$ 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                    | $^\circ\text{C}$ |      |
| $T_{stg}$  | Storage Temperature         | -40~125                    |                  |      |
| $V_{isol}$ | Isolation Breakdown Voltage | AC, 50Hz(R.M.S), t=1minute |                  | 3000 |
| CTI        | Comparative Tracking Index  |                            | >200             |      |
| Md         | Mounting Torque             | Recommended (M5)           | 2.5~5            | Nm   |
| Weight     |                             |                            | 180              | g    |

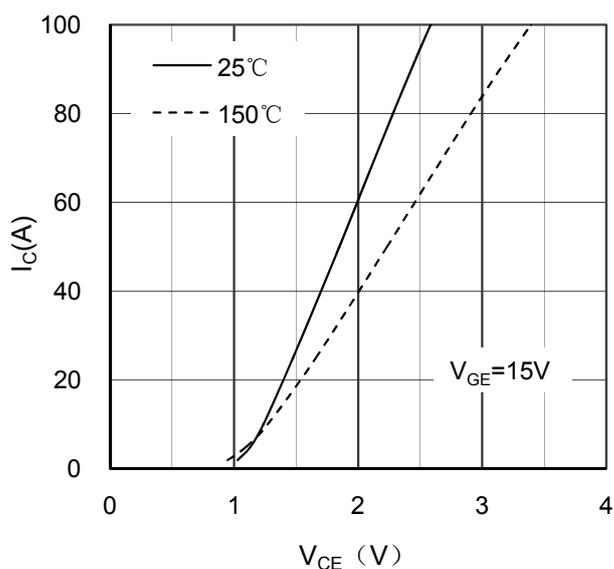


Figure 1. Typical Output Characteristics IGBT-inverter

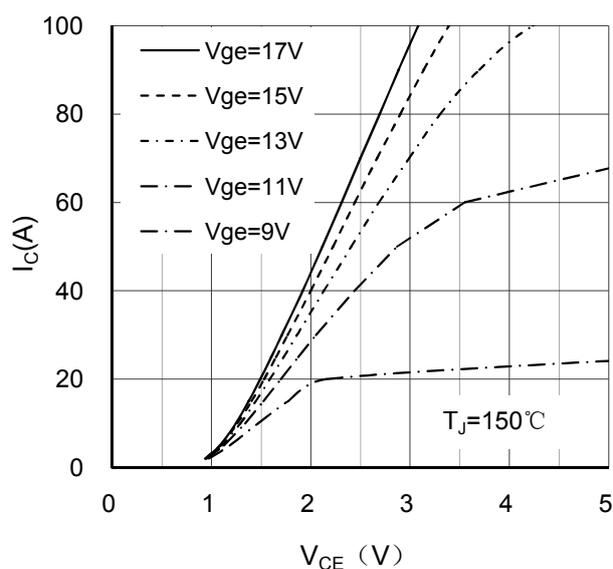


Figure 2. Typical Output Characteristics IGBT-inverter

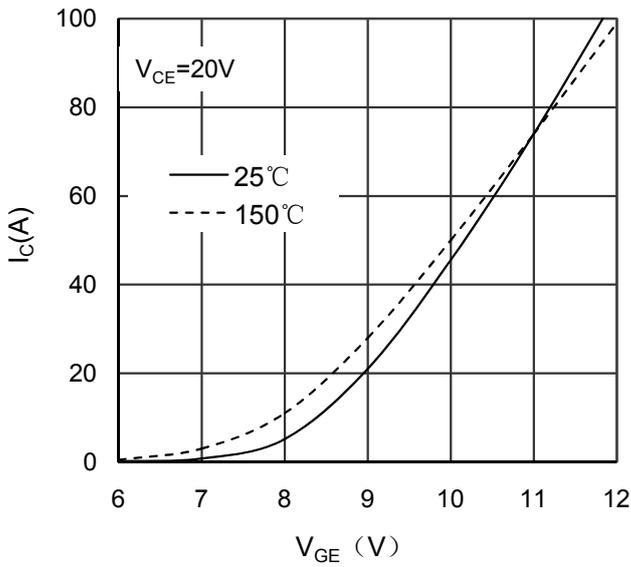


Figure 3. Typical Transfer characteristics IGBT-inverter

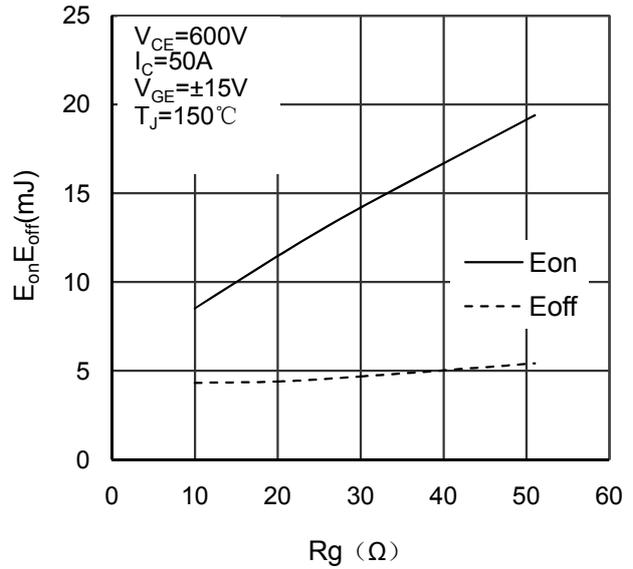


Figure 4. Switching Energy vs Gate Resistor IGBT-inverter

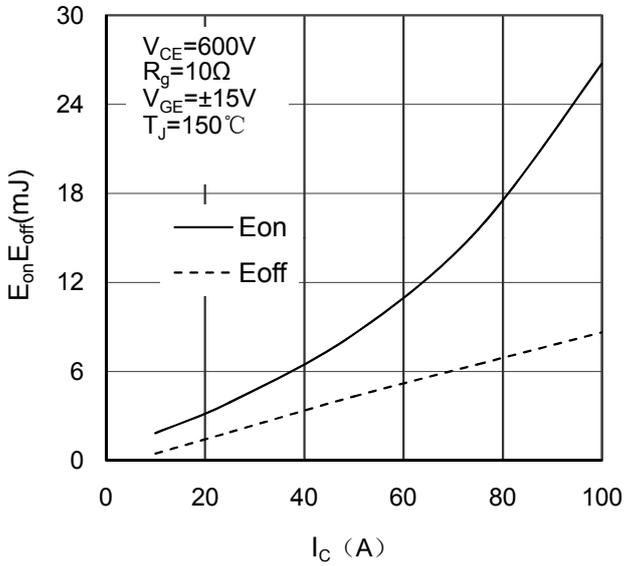


Figure 5. Switching Energy vs Collector Current IGBT-inverter

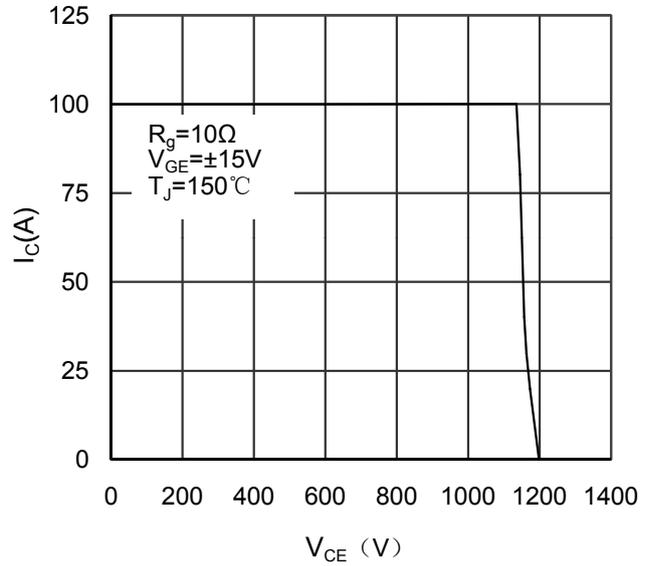


Figure 6. Reverse Biased Safe Operating Area IGBT-inverter

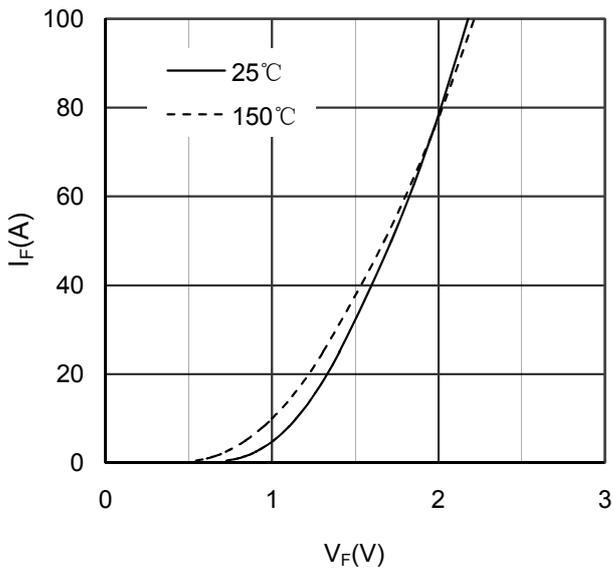


Figure 7. Diode Forward Characteristics Diode -inverter

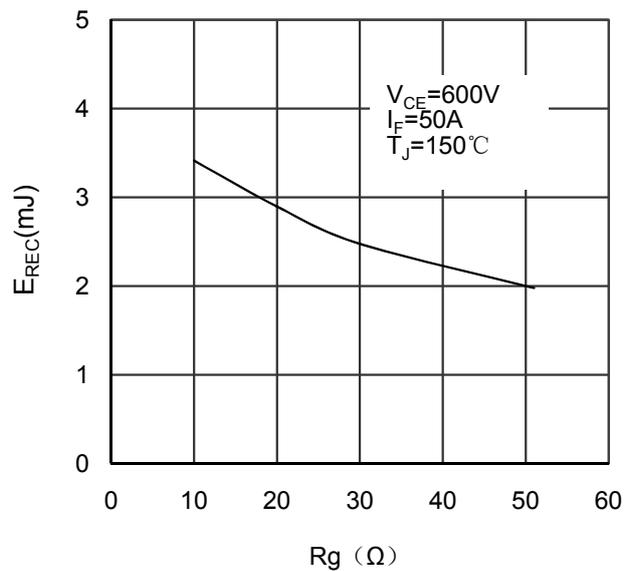


Figure 8. Switching Energy vs Gate Resistor Diode -inverter

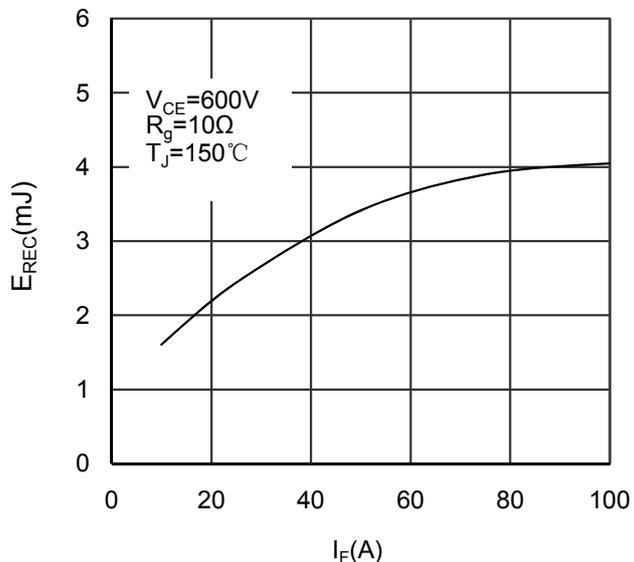


Figure 9. Switching Energy vs Forward Current Diode-inverter

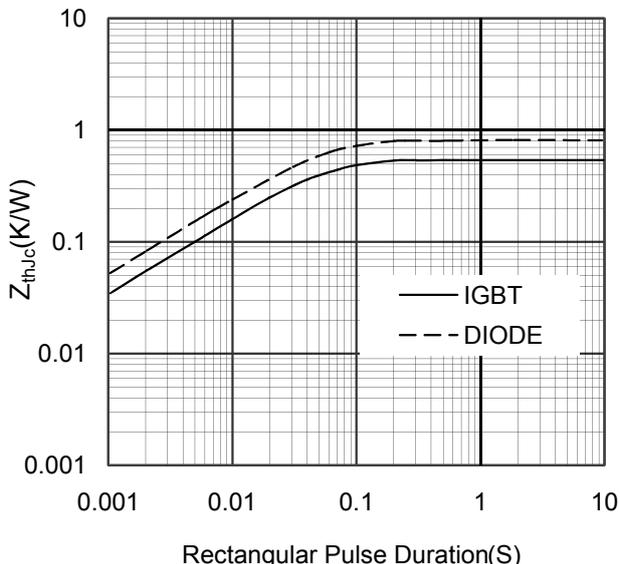


Figure 10. Transient Thermal Impedance of Diode and IGBT-inverter

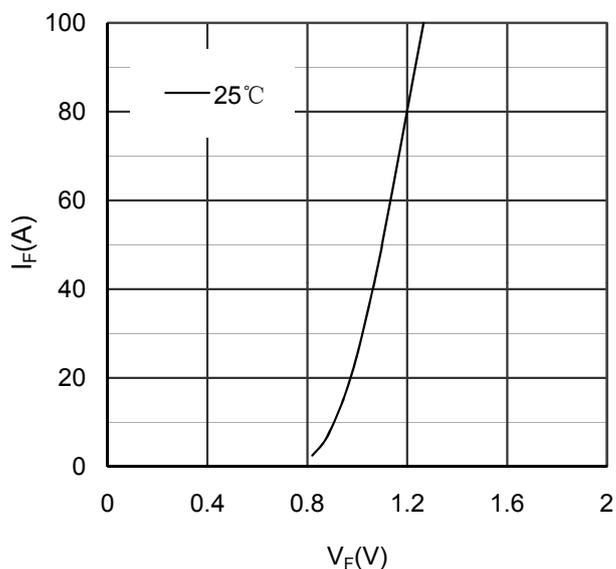


Figure 11. Diode Forward Characteristics Diode- rectifier

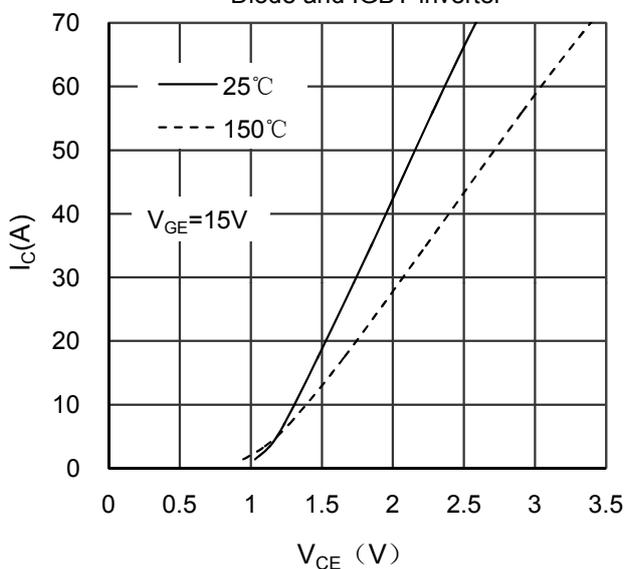


Figure 12. Typical Output Characteristics IGBT- brake chopper

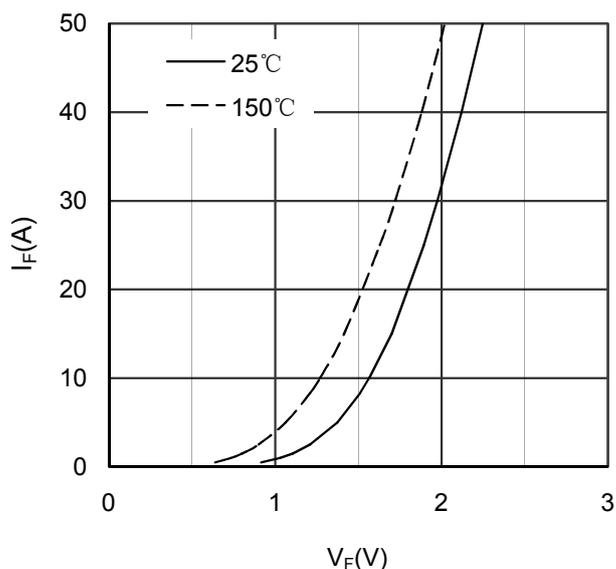


Figure 13. Diode Forward Characteristics Diode - brake chopper

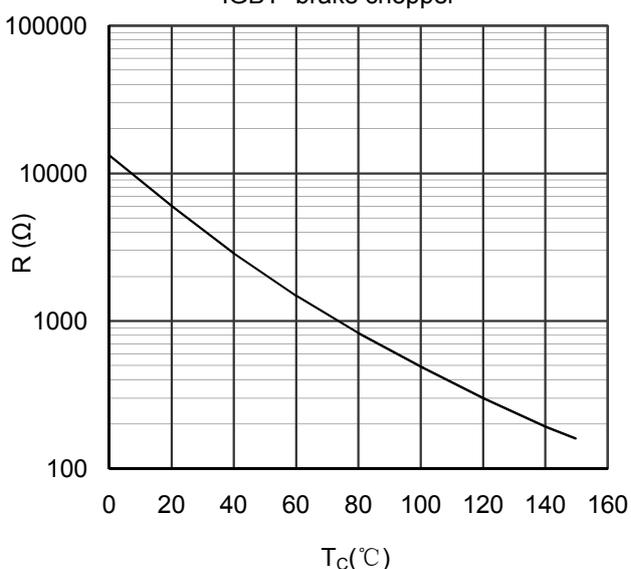


Figure 14. NTC Characteristics

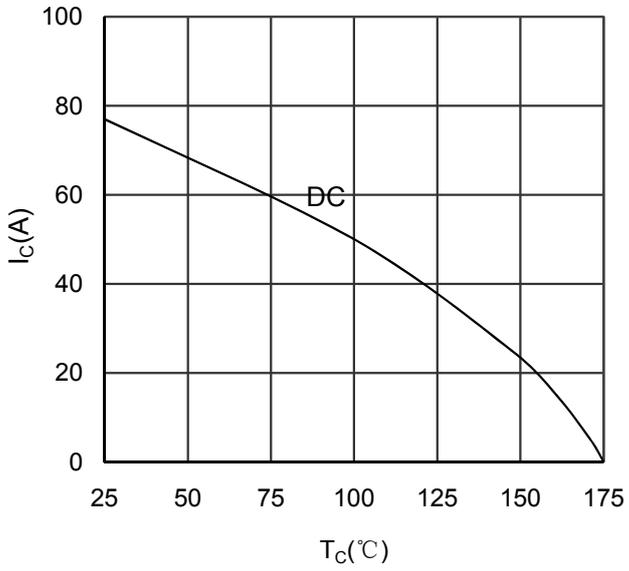


Figure 15. Collector Current vs Case temperature IGBT -inverter

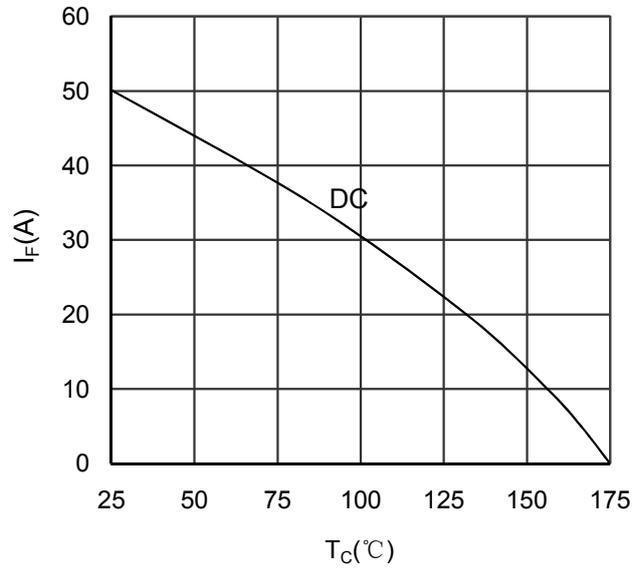


Figure 16. Forward current vs Case temperature Diode -inverter

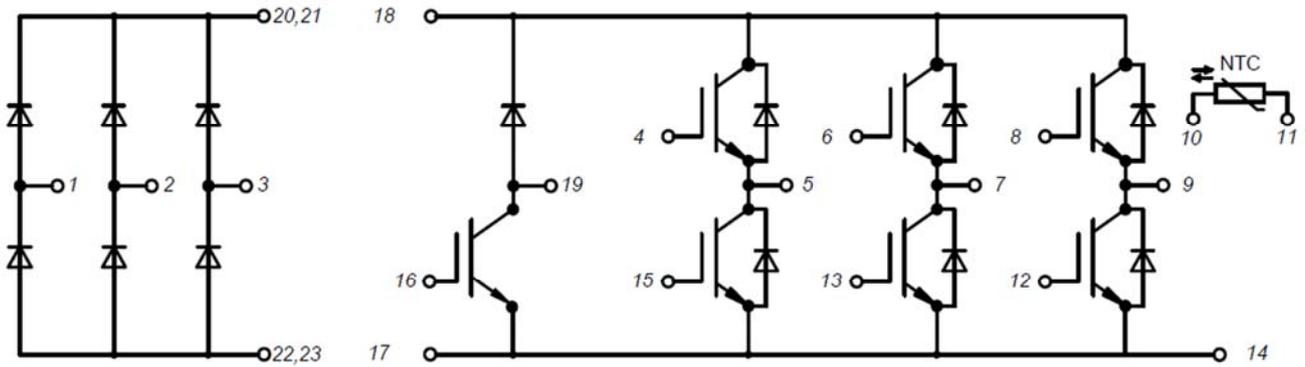
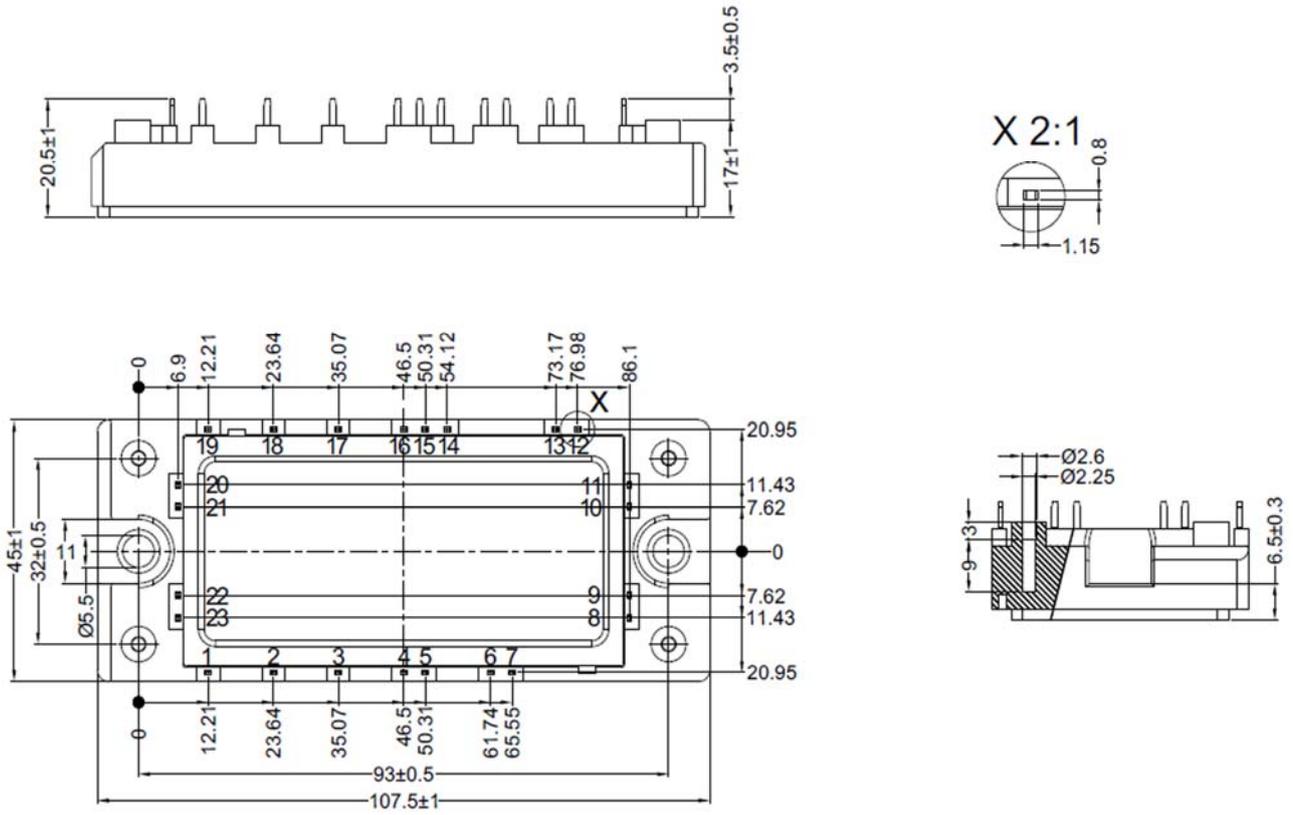


Figure 17. Circuit Diagram



Dimensions in (mm)  
Figure 18. Package Outline