

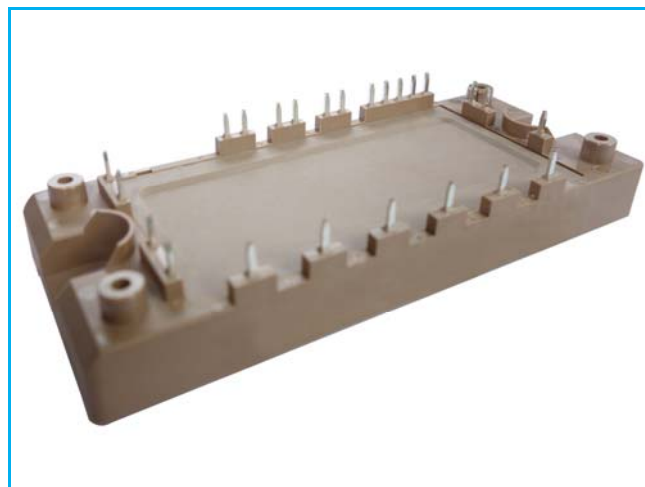
PRODUCT FEATURES

- High level of integration
- IGBT³ 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 | | ± 20 | |
| I_C | DC Collector Current | $T_C=25^\circ\text{C}, T_{Jmax}=150^\circ\text{C}$ | 55 | A |
| | | $T_C=80^\circ\text{C}, T_{Jmax}=150^\circ\text{C}$ | 40 | |
| I_{CM} | Repetitive Peak Collector Current | $t_p=1\text{ms}$ | 80 | |
| P_{tot} | Power Dissipation Per IGBT | $T_C=25^\circ\text{C}, T_{Jmax}=150^\circ\text{C}$ | 195 | 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 | | 40 | A |
| I_{FRM} | Repetitive Peak Forward Current | $t_p=1\text{ms}$ | 80 | |
| I^2t | | $T_J=125^\circ\text{C}, t=10\text{ms}, V_R=0\text{V}$ | 300 | A ² S |

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MMG40H120XB6TN

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 | $V_{CE}=V_{GE}, I_C=1.5\text{mA}$ | 5.0 | 5.8 | 6.5 | V |
| $V_{CE(sat)}$ | Collector Emitter Saturation Voltage | $I_C=40\text{A}, V_{GE}=15\text{V}, T_J=25^\circ\text{C}$ | | 1.8 | 2.3 | |
| | | $I_C=40\text{A}, V_{GE}=15\text{V}, T_J=125^\circ\text{C}$ | | 2.05 | | |
| I_{CES} | Collector Leakage Current | $V_{CE}=1200\text{V}, V_{GE}=0\text{V}, T_J=25^\circ\text{C}$ | | | 100 | μA |
| | | $V_{CE}=1200\text{V}, V_{GE}=0\text{V}, T_J=125^\circ\text{C}$ | | | 10 | mA |
| I_{GES} | Gate Leakage Current | $V_{CE}=0\text{V}, V_{GE}=\pm 15\text{V}, T_J=25^\circ\text{C}$ | -400 | | 400 | nA |
| R_{gint} | Integrated Gate Resistor | | | 6 | | Ω |
| Q_g | Gate Charge | $V_{CE}=600\text{V}, I_C=40\text{A}, V_{GE}=\pm 15\text{V}$ | | 0.33 | | μC |
| C_{ies} | Input Capacitance | $V_{CE}=25\text{V}, V_{GE}=0\text{V}, f=1\text{MHz}$ | | 2.5 | | nF |
| C_{res} | Reverse Transfer Capacitance | | | | 0.11 | |
| $t_{d(on)}$ | Turn on Delay Time | $V_{CC}=600\text{V}, I_C=40\text{A}$ $R_G=27\Omega,$ $V_{GE}=\pm 15\text{V},$ Inductive Load | $T_J=25^\circ\text{C}$ | | 90 | ns |
| | | | $T_J=125^\circ\text{C}$ | | 90 | ns |
| t_r | Rise Time | | $T_J=25^\circ\text{C}$ | | 30 | ns |
| | | | $T_J=125^\circ\text{C}$ | | 50 | ns |
| $t_{d(off)}$ | Turn off Delay Time | | $T_J=25^\circ\text{C}$ | | 420 | ns |
| | | | $T_J=125^\circ\text{C}$ | | 520 | ns |
| t_f | Fall Time | | $T_J=25^\circ\text{C}$ | | 70 | ns |
| | | | $T_J=125^\circ\text{C}$ | | 90 | ns |
| E_{on} | Turn on Energy | | $T_J=25^\circ\text{C}$ | | 4.1 | mJ |
| | | | $T_J=125^\circ\text{C}$ | | 5.8 | mJ |
| E_{off} | Turn off Energy | | $T_J=25^\circ\text{C}$ | | 3.6 | mJ |
| | | | $T_J=125^\circ\text{C}$ | | 4.2 | mJ |
| I_{SC} | Short Circuit Current | $tp_{sc}\leq 10\mu\text{S}, V_{GE}=15\text{V}$ $T_J=125^\circ\text{C}, V_{CC}=900\text{V}$ | | 160 | | A |
| R_{thJC} | Junction to Case Thermal Resistance (Per IGBT) | | | | 0.64 | 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 | $I_F=40\text{A}, V_{GE}=0\text{V}, T_J=25^\circ\text{C}$ | | 1.75 | 2.3 | V |
| | | $I_F=40\text{A}, V_{GE}=0\text{V}, T_J=125^\circ\text{C}$ | | 1.75 | | |
| t_{rr} | Reverse Recovery Time | $I_F=40\text{A}, V_R=600\text{V}$ $di_F/dt=-1000\text{A}/\mu\text{s}$ $T_J=125^\circ\text{C}$ | | 360 | | ns |
| I_{RRM} | Max. Reverse Recovery Current | | | 46 | | A |
| Q_{RR} | Reverse Recovery Charge | | | 8.4 | | μC |
| E_{rec} | Reverse Recovery Energy | | | 3.1 | | mJ |
| R_{thJCD} | Junction to Case Thermal Resistance (Per Diode) | | | | 1.0 | K/W |

MMG40H120XB6TN

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 | A |
| | | $T_J=45^{\circ}\text{C}$, $t=8.3\text{ms}$, 60Hz | 527 | |
| I^2t | | $T_J=45^{\circ}\text{C}$, $t=10\text{ms}$, 50Hz | 1152 | A^2S |
| | | $T_J=45^{\circ}\text{C}$, $t=8.3\text{ms}$, 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 | $I_F=40\text{A}$, $T_J=25^{\circ}\text{C}$ | | 1.06 | 1.2 | V |
| | | $I_F=40\text{A}$, $T_J=150^{\circ}\text{C}$ | | 1.00 | | V |
| I_R | Reverse Leakage Current | $V_R=1600\text{V}$, $T_J=25^{\circ}\text{C}$ | | | 50 | μA |
| | | $V_R=1600\text{V}$, $T_J=150^{\circ}\text{C}$ | | | 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 | | ± 20 | |
| I_C | DC Collector Current | $T_C=25^{\circ}\text{C}$, $T_{Jmax}=150^{\circ}\text{C}$ | 25 | A |
| | | $T_C=80^{\circ}\text{C}$, $T_{Jmax}=150^{\circ}\text{C}$ | 15 | |
| I_{CM} | Repetitive Peak Collector Current | $t_p=1\text{ms}$ | 30 | A |
| P_{tot} | Power Dissipation Per IGBT | $T_C=25^{\circ}\text{C}$, $T_{Jmax}=150^{\circ}\text{C}$ | 105 | 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 | | 15 | A |
| I_{FRM} | Repetitive Peak Forward Current | $t_p=1\text{ms}$ | 30 | |
| I^2t | | $T_J=125^{\circ}\text{C}$, $t=10\text{ms}$, $V_R=0\text{V}$ | 60 | A^2S |

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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 | $V_{CE}=V_{GE}, I_C=0.6\text{mA}$ | 5.2 | 5.8 | 6.4 | V |
| $V_{CE(sat)}$ | Collector - Emitter Saturation Voltage | $I_C=15\text{A}, V_{GE}=15\text{V}, T_J=25^\circ\text{C}$ | | 1.7 | 2.15 | |
| | | $I_C=15\text{A}, V_{GE}=15\text{V}, T_J=125^\circ\text{C}$ | | 1.9 | | |
| I_{CES} | Collector Leakage Current | $V_{CE}=1200\text{V}, V_{GE}=0\text{V}, T_J=25^\circ\text{C}$ | | | 100 | μA |
| | | $V_{CE}=1200\text{V}, V_{GE}=0\text{V}, T_J=125^\circ\text{C}$ | | | 10 | mA |
| I_{GES} | Gate Leakage Current | $V_{CE}=0\text{V}, V_{GE}=\pm 15\text{V}, T_J=25^\circ\text{C}$ | -400 | | 400 | nA |
| R_{gint} | Integrated Gate Resistor | | | 0 | | Ω |
| Q_g | Gate Charge | $V_{CE}=600\text{V}, I_C=15\text{A}, V_{GE}=\pm 15\text{V}$ | | 0.15 | | μC |
| C_{ies} | Input Capacitance | $V_{CE}=25\text{V}, V_{GE}=0\text{V}, f=1\text{MHz}$ | | 1.1 | | nF |
| C_{res} | Reverse Transfer Capacitance | | | 0.04 | | nF |
| $t_{d(on)}$ | Turn on Delay Time | $V_{CC}=600\text{V}, I_C=15\text{A}, R_G=75\Omega, V_{GE}=\pm 15\text{V},$ Inductive Load | $T_J=25^\circ\text{C}$ | 90 | | ns |
| | | | $T_J=125^\circ\text{C}$ | 90 | | ns |
| t_r | Rise Time | $V_{GE}=\pm 15\text{V},$ Inductive Load | $T_J=25^\circ\text{C}$ | 30 | | ns |
| | | | $T_J=125^\circ\text{C}$ | 50 | | ns |
| $t_{d(off)}$ | Turn off Delay Time | $V_{CC}=600\text{V}, I_C=15\text{A}, R_G=75\Omega, V_{GE}=\pm 15\text{V},$ Inductive Load | $T_J=25^\circ\text{C}$ | 420 | | ns |
| | | | $T_J=125^\circ\text{C}$ | 520 | | ns |
| t_f | Fall Time | $V_{GE}=\pm 15\text{V},$ Inductive Load | $T_J=25^\circ\text{C}$ | 70 | | ns |
| | | | $T_J=125^\circ\text{C}$ | 90 | | ns |
| E_{on} | Turn on Energy | $V_{CC}=600\text{V}, I_C=15\text{A}, R_G=75\Omega, V_{GE}=\pm 15\text{V},$ Inductive Load | $T_J=25^\circ\text{C}$ | 1.5 | | mJ |
| | | | $T_J=125^\circ\text{C}$ | 2.1 | | mJ |
| E_{off} | Turn off Energy | $V_{GE}=\pm 15\text{V},$ Inductive Load | $T_J=25^\circ\text{C}$ | 1.1 | | mJ |
| | | | $T_J=125^\circ\text{C}$ | 1.3 | | mJ |
| I_{SC} | Short Circuit Current | $tp_{sc} \leq 10\mu\text{s}, V_{GE}=15\text{V}$ $T_J=125^\circ\text{C}, V_{CC}=900\text{V}$ | | 60 | | A |
| R_{thJC} | Junction to Case Thermal Resistance (Per IGBT) | | | | 1.2 | 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 | $I_F=15\text{A}, V_{GE}=0\text{V}, T_J=25^\circ\text{C}$ | | 1.65 | 2.15 | V |
| | | $I_F=15\text{A}, V_{GE}=0\text{V}, T_J=125^\circ\text{C}$ | | 1.65 | | |
| t_{rr} | Reverse Recovery Time | $I_F=15\text{A}, V_R=600\text{V}$ | | 250 | | ns |
| I_{RRM} | Max. Reverse Recovery Current | $dI_F/dt=-400\text{A}/\mu\text{s}$ | | 16 | | A |
| E_{rec} | Reverse Recovery Energy | $T_J=125^\circ\text{C}$ | | 1.1 | | mJ |
| R_{thJCD} | Junction to Case Thermal Resistance (Per Diode) | | | | 1.5 | K/W |

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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 | 150 | $^\circ\text{C}$ | |
| T_{Jop} | Operating Temperature | -40~125 | | |
| 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 | | | 180 | g |

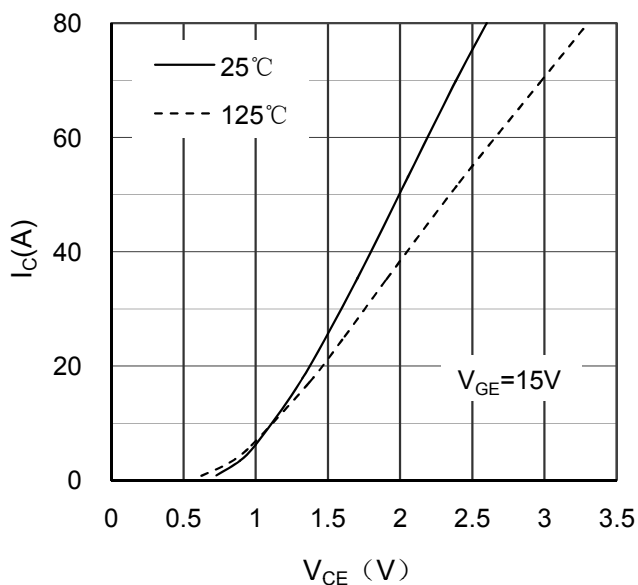


Figure 1. Typical Output Characteristics IGBT-inverter

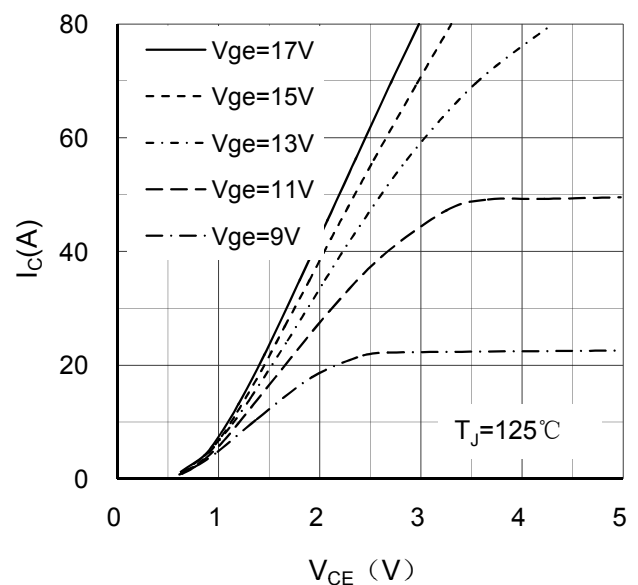


Figure 2. Typical Output Characteristics IGBT-inverter

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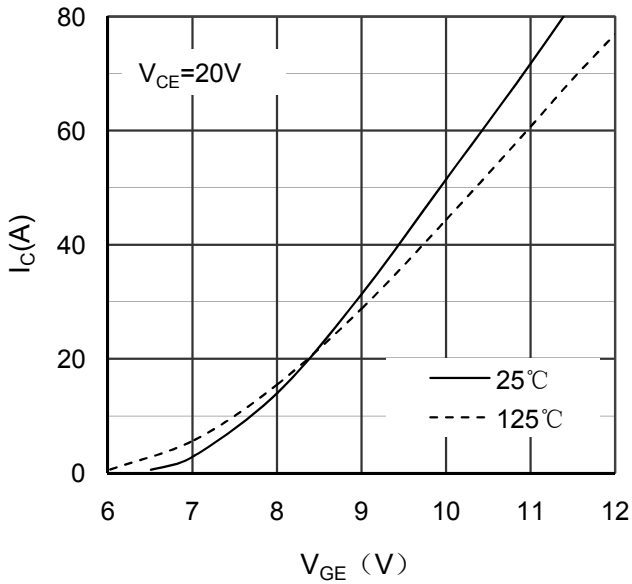


Figure 3. Typical Transfer characteristics IGBT-inverter

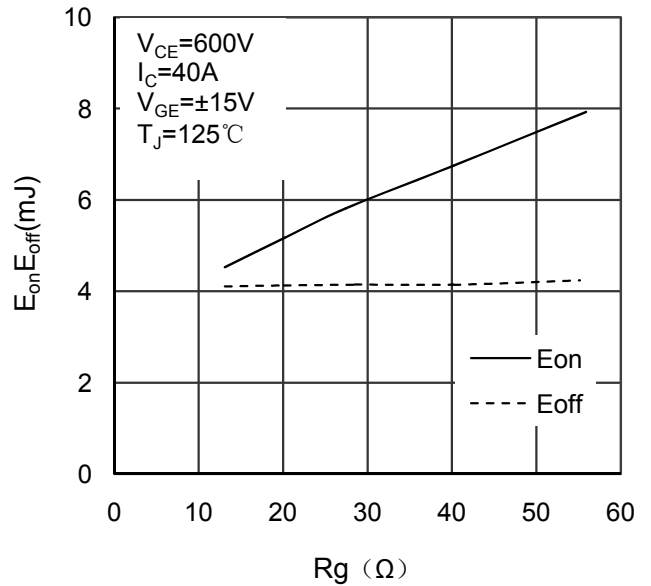


Figure 4. Switching Energy vs Gate Resistor IGBT-inverter

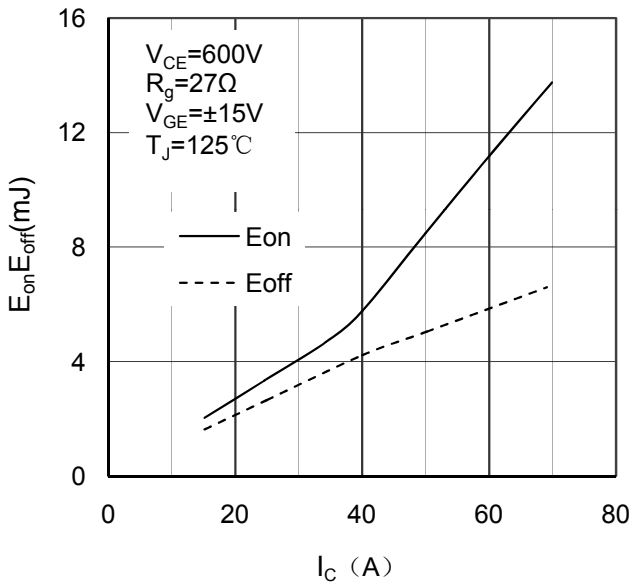


Figure 5. Switching Energy vs Collector Current IGBT-inverter

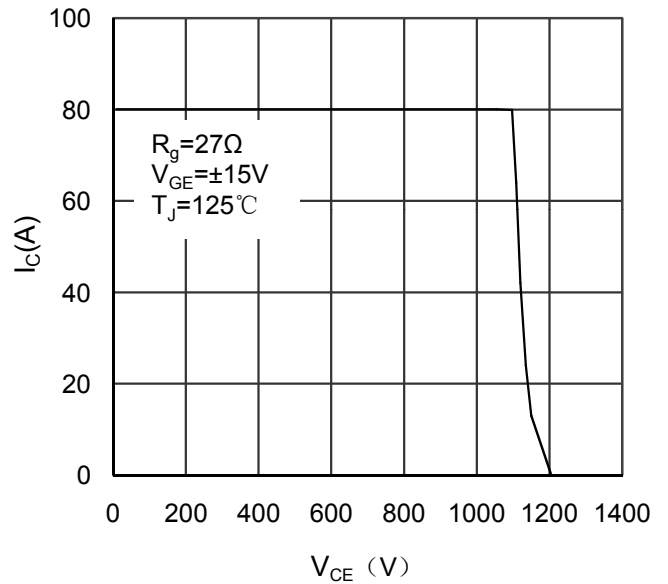


Figure 6. Reverse Biased Safe Operating Area IGBT-inverter

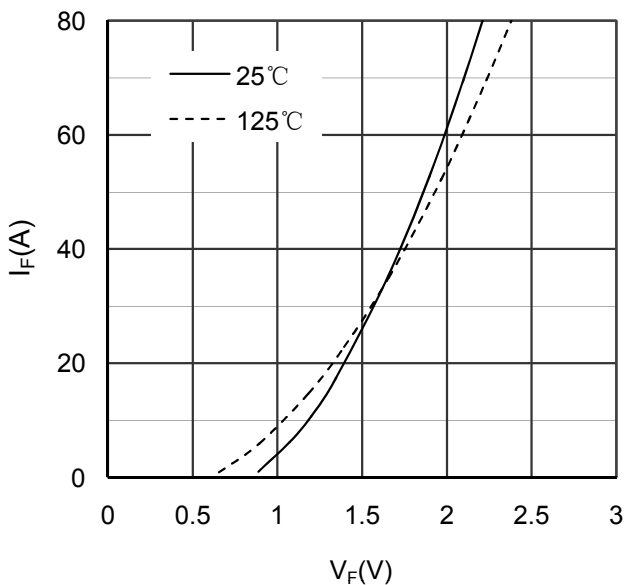


Figure 7. Diode Forward Characteristics Diode -inverter

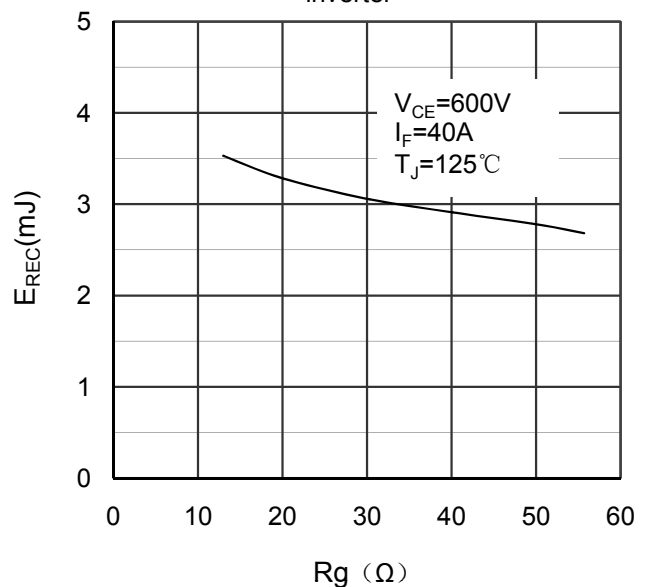


Figure 8. Switching Energy vs Gate Resistor Diode -inverter

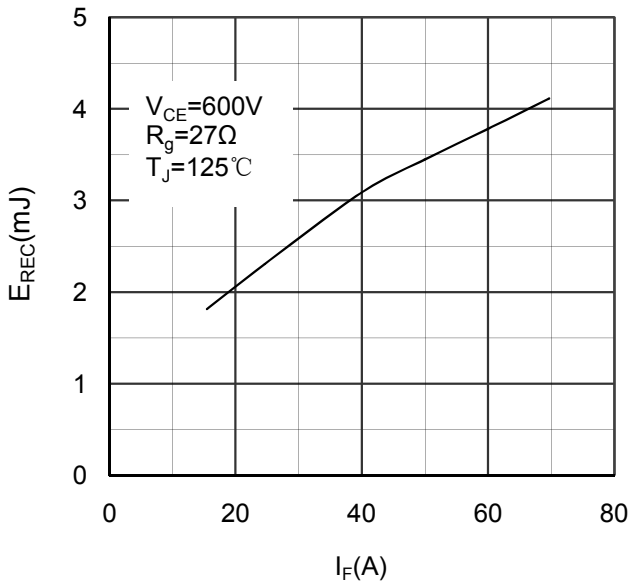


Figure 9. Switching Energy vs Forward Current Diode-inverter

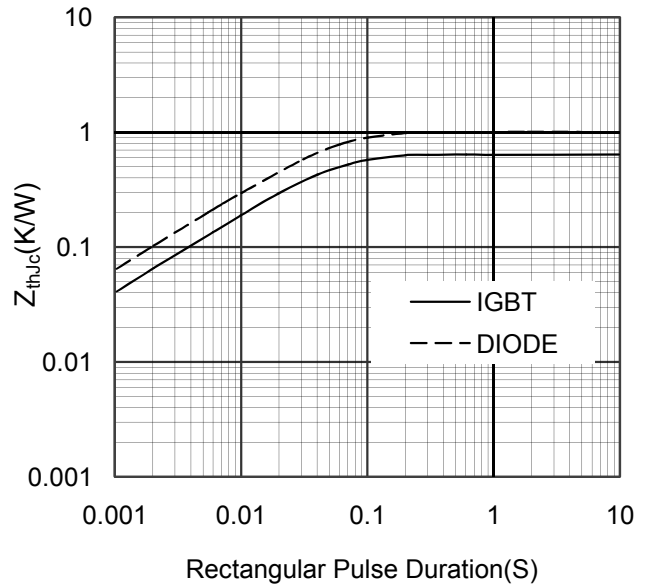


Figure 10. Transient Thermal Impedance of Diode and IGBT-inverter

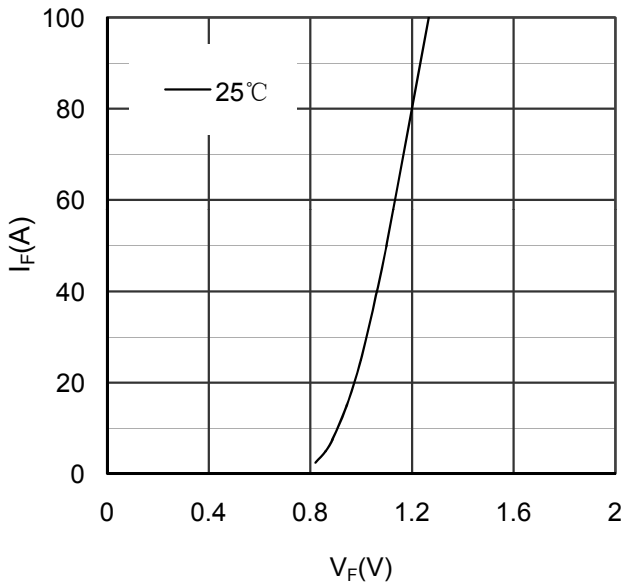


Figure 11. Diode Forward Characteristics Diode- rectifier

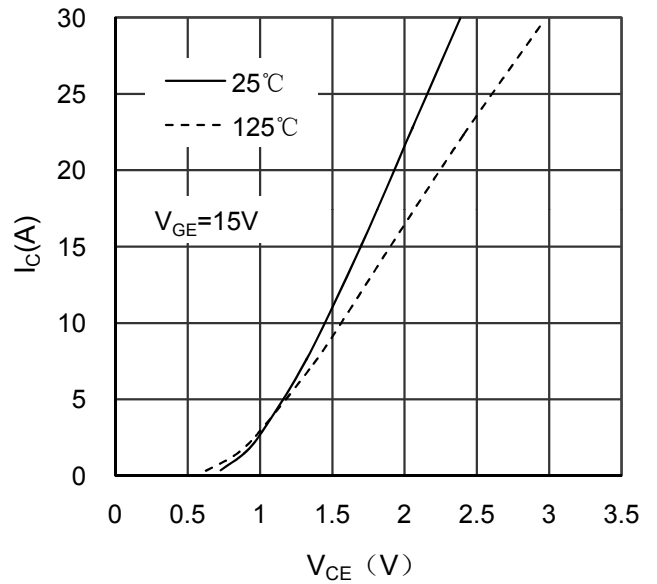


Figure 12. Typical Output Characteristics IGBT- brake chopper

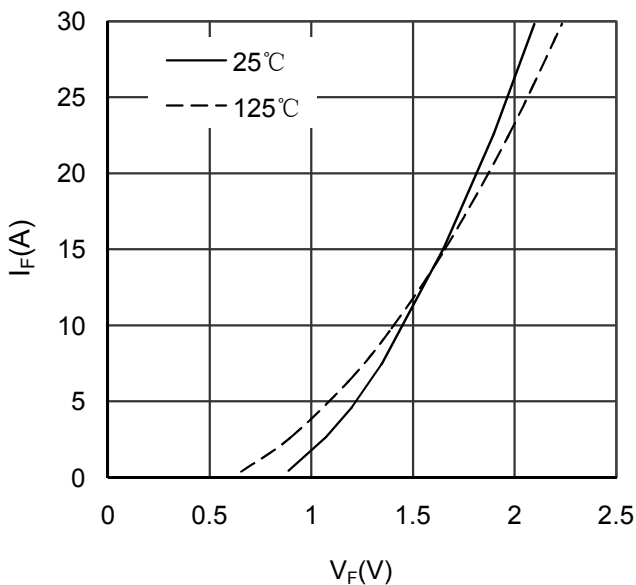


Figure 13. Diode Forward Characteristics Diode - brake chopper

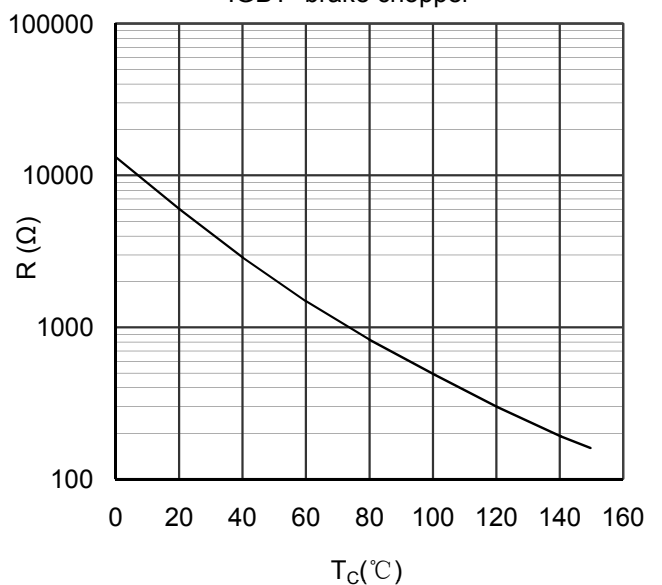


Figure 14. NTC Characteristics

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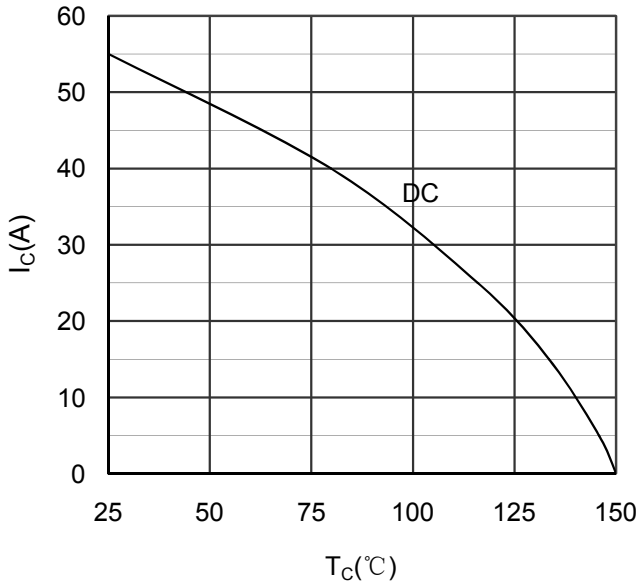


Figure 15. Collector Current vs Case temperature
IGBT -inverter

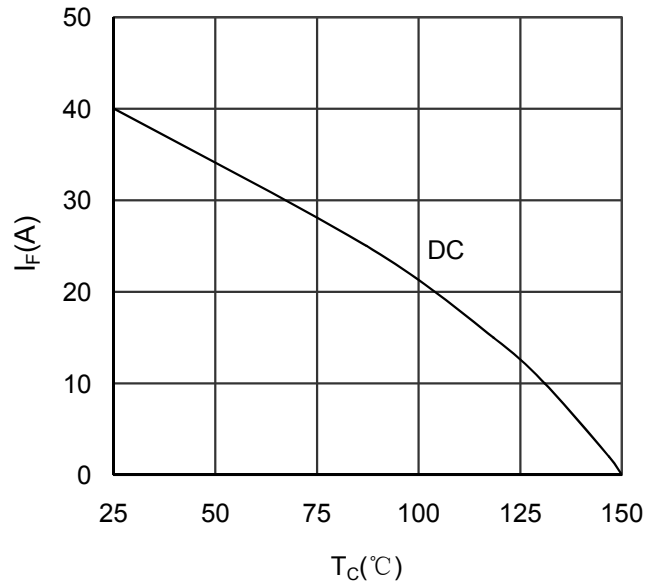


Figure 16. Forward current vs Case temperature
Diode -inverter

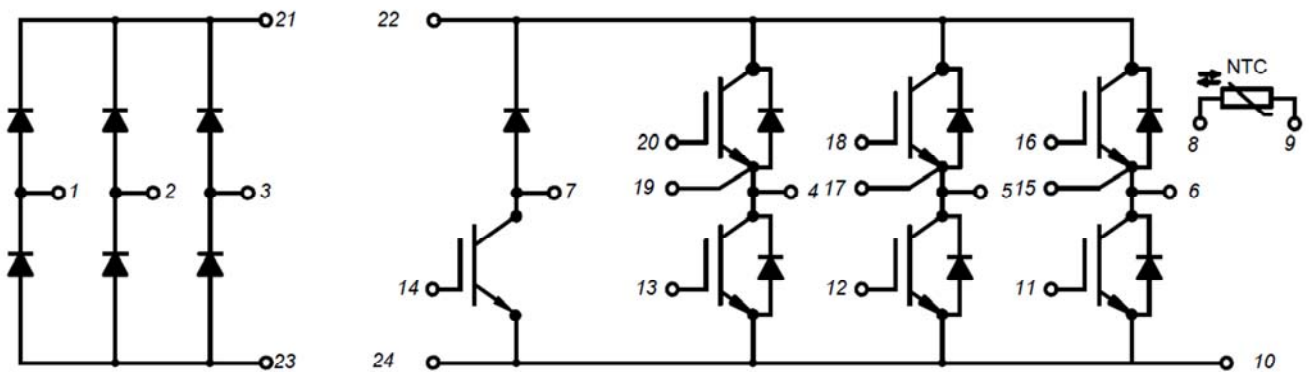
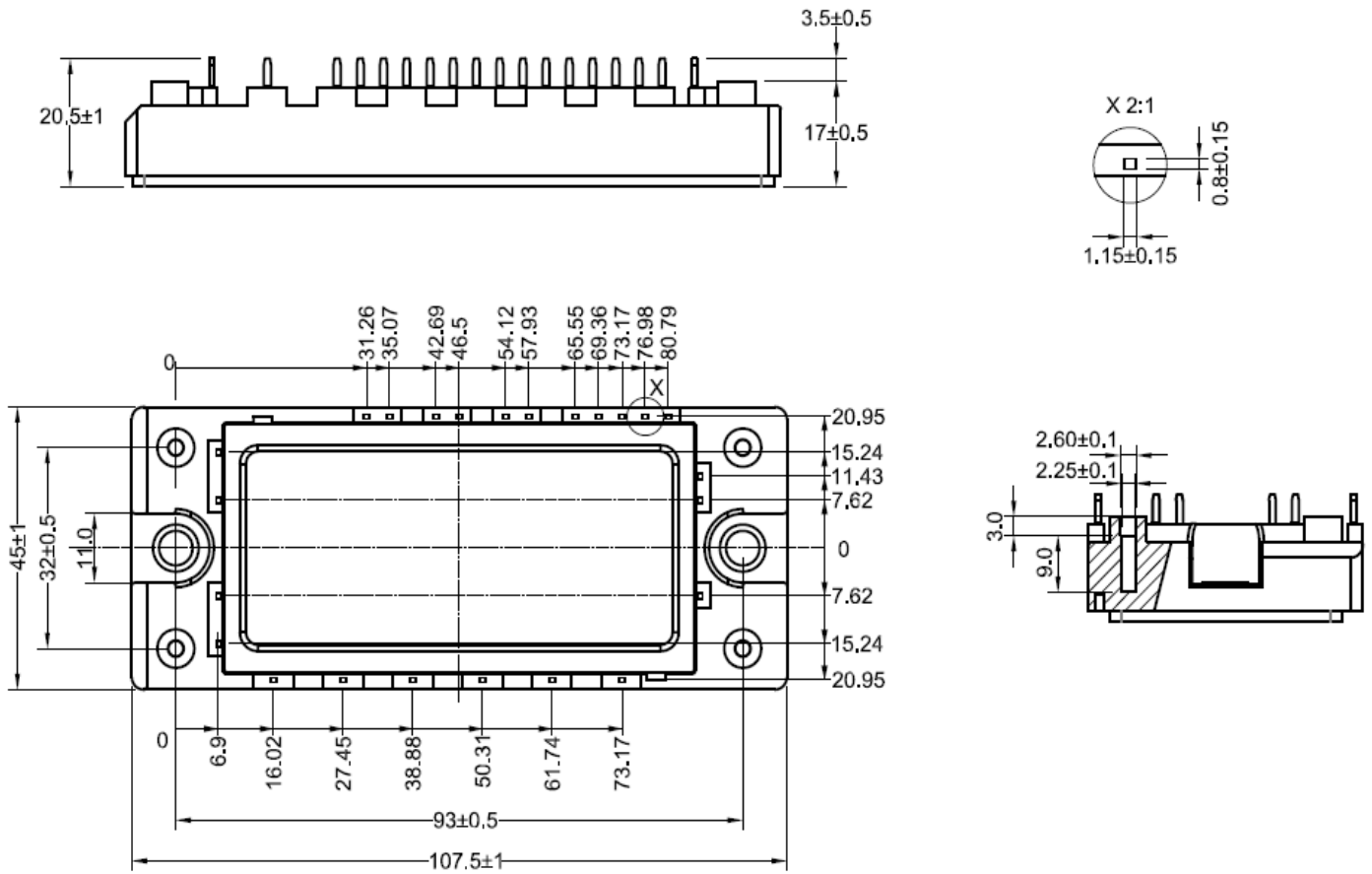


Figure 17. Circuit Diagram

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Dimensions in (mm)
Figure 18. Package Outline