# MMG80C120BF_Y1

1200V 80A IGBT Module

December 2020 Version 01 RoHS Compliant

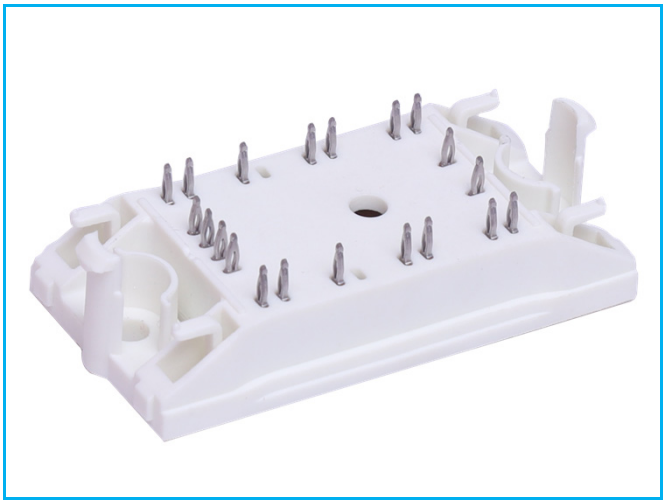
## PRODUCT FEATURES

☐ Mixed voltage component topology

☐ Neutral point clamped inverter

☐ Reactive power capability

☐ Low inductance layout



## APPLICATIONS

☐ Solar inverter

☐ UPS

| Type | $V_{CES}$ | $I_C$ | $T_{Jmax}$ | Marking | Package |
|---|---|---|---|---|---|
| MMG80C120BF_Y1 | 1200V | 30A | 175°C | MMG80C120BF_Y1 | GC |

Half Bridge IGBT(T1 T2)

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 | |
| $I_{CN}$ | Implemented Collector Current | | 80 | A |
| $I_C$ | Continuous DC Collector Current | $T_C$=25℃, $T_{Jmax}$=175℃ | 45 | |
| | | $T_C$=100℃, $T_{Jmax}$=175℃ | 30 | |
| $I_{CM}$ | Repetitive Peak Collector Current | tp=1ms | 160 | |
| $P_{tot}$ | Power Dissipation Per IGBT | $T_C$=25℃, $T_{Jmax}$=175℃ | 277 | W |

Half Bridge Diode(D1 D2)

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 |
| $I_{FN}$ | Implemented Forward Current | | 50 | A |
| $I_F$ | Continuous DC Forward Current | | 30 | |
| $I_{FRM}$ | Repetitive Peak Forward Current | tp=1ms | 100 | |
| $I^2t$ | | $T_J$=125℃, t=10ms, $V_R$=0V | 295 | $A^2s$ |

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Half Bridge IGBT(T1 T2)

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

| Symbol | Parameter/Test Conditions | | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| $V_{GE(th)}$ | Gate Emitter Threshold Voltage | $V_{CE}=V_{GE}$, $I_C$=3.2mA | | 5.0 | 6.0 | 6.5 | V |
| $V_{CE(sat)}$ | Collector Emitter Saturation Voltage | $I_C$=80A, $V_{GE}$=15V, $T_J$=25℃ | | | 1.9 | 2.3 | |
| | | $I_C$=80A, $V_{GE}$=15V, $T_J$=150℃ | | | 2.3 | | |
| | | $I_C$=30A, $V_{GE}$=15V, $T_J$=25℃ | | | 1.36 | 1.65 | |
| | | $I_C$=30A, $V_{GE}$=15V, $T_J$=150℃ | | | 1.46 | | |
| $I_{CES}$ | Collector Leakage Current | $V_{CE}$=1200V, $V_{GE}$=0V, $T_J$=25℃ | | | | 1 | mA |
| | | $V_{CE}$=1200V, $V_{GE}$=0V, $T_J$=150℃ | | | | 10 | mA |
| $I_{GES}$ | Gate Leakage Current | $V_{CE}$=0V,$V_{GE}$=±20V, $T_J$=25℃ | | -400 | | 400 | nA |
| $R_{Gint}$ | Integrated Gate Resistor | | | | 0 | | Ω |
| $Q_g$ | Gate Charge | $V_{CE}$=600V, $I_C$=80A , $V_{GE}$=15V | | | 0.38 | | μC |
| $C_{ies}$ | Input Capacitance | $V_{CE}$=25V, $V_{GE}$=0V, f =1MHz | | | 5 | | nF |
| $C_{res}$ | Reverse Transfer Capacitance | | | | 220 | | pF |
| $t_{d(on)}$ | Turn on Delay Time | $V_{CC}$=400V,$I_C$=30A $R_G$ =7.5Ω, $V_{GE}$=±15V, Inductive Load | $T_J$=25℃ | | 50 | | ns |
| | | | $T_J$=150℃ | | 55 | | ns |
| $t_r$ | Rise Time | | $T_J$=25℃ | | 22 | | ns |
| | | | $T_J$=150℃ | | 25 | | ns |
| $t_{d(off)}$ | Turn off Delay Time | $V_{CC}$=400V,$I_C$=30A $R_G$ =7.5Ω, $V_{GE}$=±15V, Inductive Load | $T_J$=25℃ | | 290 | | ns |
| | | | $T_J$=150℃ | | 380 | | ns |
| $t_f$ | Fall Time | | $T_J$=25℃ | | 115 | | ns |
| | | | $T_J$=150℃ | | 235 | | ns |
| $E_{on}$ | Turn on Energy | $V_{CC}$=400V,$I_C$=30A $R_G$ =7.5Ω, $V_{GE}$=±15V, Inductive Load | $T_J$=25℃ | | 0.75 | | mJ |
| | | | $T_J$=150℃ | | 1.35 | | mJ |
| $E_{off}$ | Turn off Energy | | $T_J$=25℃ | | 1 | | mJ |
| | | | $T_J$=150℃ | | 1.8 | | mJ |
| $I_{SC}$ | Short Circuit Current | tpsc≤10μs , $V_{GE}$=15V $T_J$=125℃,$V_{CC}$=600V | | | 400 | | A |
| $R_{thJC}$ | Junction to Case Thermal Resistance （Per IGBT） | | | | | 0.54 | K /W |

Half Bridge Diode(D1 D2)

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

| Symbol | Parameter/Test Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | $I_F$=50A , $V_{GE}$=0V, $T_J$=25℃ | | 2.35 | 2.65 | V |
| | | $I_F$=50A , $V_{GE}$=0V, $T_J$=150℃ | | 1.77 | | |
| | | $I_F$=30A , $V_{GE}$=0V, $T_J$=25℃ | | 2.06 | | |
| | | $I_F$=30A , $V_{GE}$=0V, $T_J$=150℃ | | 1.48 | | |
| $t_{rr}$ | Reverse Recovery Time | $I_F$=30A , $V_R$=400V $dI_F/dt$=-1600A/μs $T_J$ =150℃ | | 125 | | ns |
| $I_{RRM}$ | Max. Reverse Recovery Current | | | 50 | | A |
| $Q_{RR}$ | Reverse Recovery Charge | | | 2.9 | | μC |
| $E_{rec}$ | Reverse Recovery Energy | | | 0.65 | | mJ |
| $R_{thJCD}$ | Junction to Case Thermal Resistance （Per Diode） | | | | 0.9 | K /W |

Neutral Point IGBT(T3 T4)

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

| Symbol | Parameter/Test Conditions | | Values | Unit |
|---|---|---|---|---|
| $V_{CES}$ | Collector Emitter Voltage | $T_J$=25℃ | 650 | V |
| $V_{GES}$ | Gate Emitter Voltage | | ±20 | |
| $I_{CN}$ | Implemented Collector Current | | 75 | A |
| $I_C$ | Continuous DC Collector Current | $T_C$=25℃, $T_{Jmax}$=175℃ | 60 | |
| | | $T_C$=100℃, $T_{Jmax}$=175℃ | 30 | |
| $I_{CM}$ | Repetitive Peak Collector Current | tp=1ms | 150 | |
| $P_{tot}$ | Power Dissipation Per IGBT | $T_C$=25℃, $T_{Jmax}$=175℃ | 214 | W |

Neutral Point IGBT(T3 T4)

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

| Symbol | Parameter/Test Conditions | | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| $V_{GE(th)}$ | Gate Emitter Threshold Voltage | $V_{CE}$=$V_{GE}$, $I_C$=3.0mA | | 4.8 | 5.6 | 6.5 | V |
| $V_{CE(sat)}$ | Collector Emitter Saturation Voltage | $I_C$=75A, $V_{GE}$=15V, $T_J$=25℃ | | | 1.55 | 1.95 | |
| | | $I_C$=75A, $V_{GE}$=15V, $T_J$=150℃ | | | 1.9 | | |
| | | $I_C$=30A, $V_{GE}$=15V, $T_J$=25℃ | | | 1.17 | | |
| | | $I_C$=30A, $V_{GE}$=15V, $T_J$=150℃ | | | 1.3 | | |
| $I_{CES}$ | Collector Leakage Current | $V_{CE}$=650V, $V_{GE}$=0V, $T_J$=25℃ | | | | 1 | mA |
| | | $V_{CE}$=650V, $V_{GE}$=0V, $T_J$=150℃ | | | | 5 | mA |
| $I_{GES}$ | Gate Leakage Current | $V_{CE}$=0V,$V_{GE}$=±20V, $T_J$=25℃ | | -200 | | 200 | nA |
| $R_{Gint}$ | Integrated Gate Resistor | | | | 0 | | Ω |
| $Q_g$ | Gate Charge | $V_{CE}$=300V, $I_C$=75A , $V_{GE}$=15V | | | 0.36 | | μC |
| $C_{ies}$ | Input Capacitance | $V_{CE}$=25V, $V_{GE}$=0V, f =1MHz | | | 4.4 | | nF |
| $C_{res}$ | Reverse Transfer Capacitance | | | | 200 | | pF |
| $t_{d(on)}$ | Turn on Delay Time | $V_{CC}$=400V,$I_C$=30A $R_G$ =7.5Ω, $V_{GE}$=±15V, Inductive Load | $T_J$=25℃ | | 10 | | ns |
| | | | $T_J$=150℃ | | 15 | | ns |
| $t_r$ | Rise Time | | $T_J$=25℃ | | 23 | | ns |
| | | | $T_J$=150℃ | | 26 | | ns |
| $t_{d(off)}$ | Turn off Delay Time | $V_{CC}$=400V,$I_C$=30A $R_G$ =7.5Ω, $V_{GE}$=±15V, Inductive Load | $T_J$=25℃ | | 210 | | ns |
| | | | $T_J$=150℃ | | 260 | | ns |
| $t_f$ | Fall Time | | $T_J$=25℃ | | 100 | | ns |
| | | | $T_J$=150℃ | | 180 | | ns |
| $E_{on}$ | Turn on Energy | $V_{CC}$=400V,$I_C$=30A $R_G$ =7.5Ω, $V_{GE}$=±15V, Inductive Load | $T_J$=25℃ | | 0.5 | | mJ |
| | | | $T_J$=150℃ | | 1.3 | | mJ |
| $E_{off}$ | Turn off Energy | | $T_J$=25℃ | | 0.95 | | mJ |
| | | | $T_J$=150℃ | | 1.55 | | mJ |
| $I_{SC}$ | Short Circuit Current | tpsc≤6μs , $V_{GE}$=15V $T_J$=125℃,$V_{CC}$=360V | | | 395 | | A |
| $R_{thJC}$ | Junction to Case Thermal Resistance （ Per IGBT） | | | | | 0.7 | K /W |

Neutral Point Diode(D3 D4)

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

| Symbol | Parameter/Test Conditions | | Values | Unit |
|---|---|---|---|---|
| $V_{RRM}$ | Repetitive Reverse Voltage | $T_J$=25℃ | 650 | V |
| $I_{FN}$ | Implemented Forward Current | | 75 | A |
| $I_F$ | Continuous DC Forward Current | | 30 | |
| $I_{FRM}$ | Repetitive Peak Forward Current | tp=1ms | 150 | |
| $I^2t$ | | $T_J$ =125℃, t=10ms, $V_R$=0V | 310 | $A^2s$ |

Neutral Point Diode(D3 D4)

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℃ | | 1.7 | 2.15 | V |
| | | $I_F$=75A , $V_{GE}$=0V, $T_J$=150℃ | | 1.45 | | |
| | | $I_F$=30A , $V_{GE}$=0V, $T_J$=25℃ | | 1.42 | | |
| | | $I_F$=30A , $V_{GE}$=0V, $T_J$=150℃ | | 1.1 | | |
| $t_{rr}$ | Reverse Recovery Time | $I_F$=30A , $V_R$=400V<br>$dI_F/dt$=-2000A/μs<br>$T_J$ =150℃ | | 95 | | ns |
| $I_{RRM}$ | Max. Reverse Recovery Current | | | 90 | | A |
| $Q_{RR}$ | Reverse Recovery Charge | | | 4.4 | | μC |
| $E_{rec}$ | Reverse Recovery Energy | | | 2.3 | | mJ |
| $R_{thJCD}$ | Junction to Case Thermal Resistance （Per Diode） | | | | 1.15 | 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℃ | | 22 | | kΩ |
| $B_{25/50}$ | $R_2 = R_{25} \exp [B_{25/50}(1/T_2 - 1/(298.15\ K))]$ | | | 3950 | | K |

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

| Symbol | Parameter/Test Conditions | | Values | Unit |
|---|---|---|---|---|
| $T_{Jmax}$ | 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（M4） | 0.7~1.1 | Nm |
| Weight | | | 30 | g |

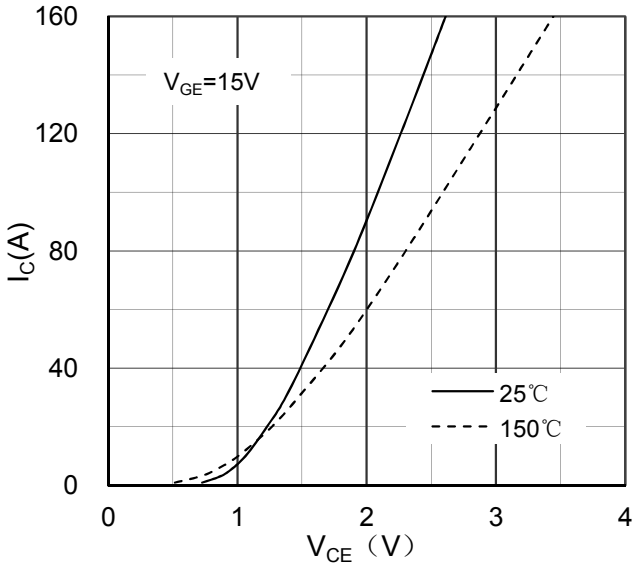



Figure 1. Typical Output Characteristics
Half Bridge IGBT

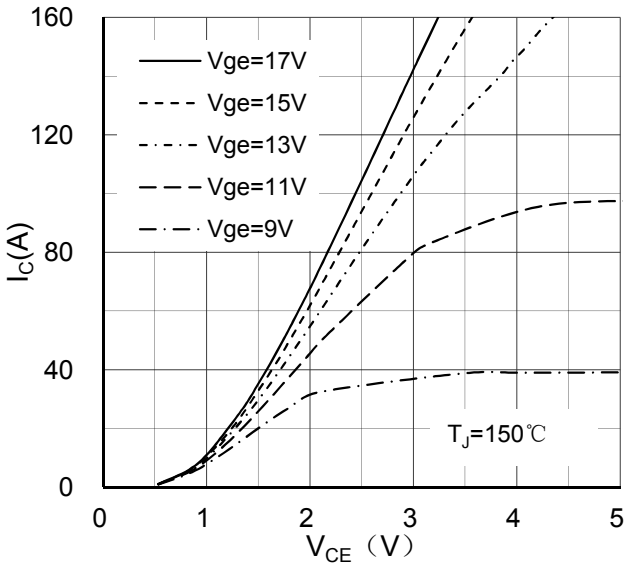



Figure 2. Typical Output Characteristics
Half Bridge IGBT

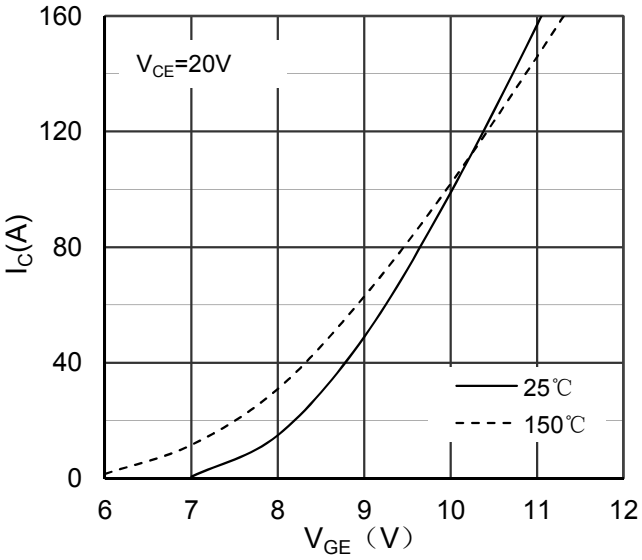



Figure 3. Typical Transfer characteristics Half Bridge IGBT

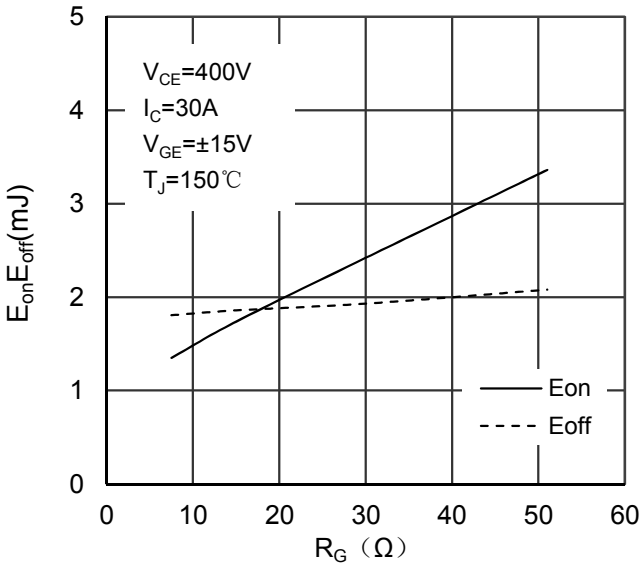



Figure 4. Switching Energy vs Gate Resistor Half Bridge IGBT

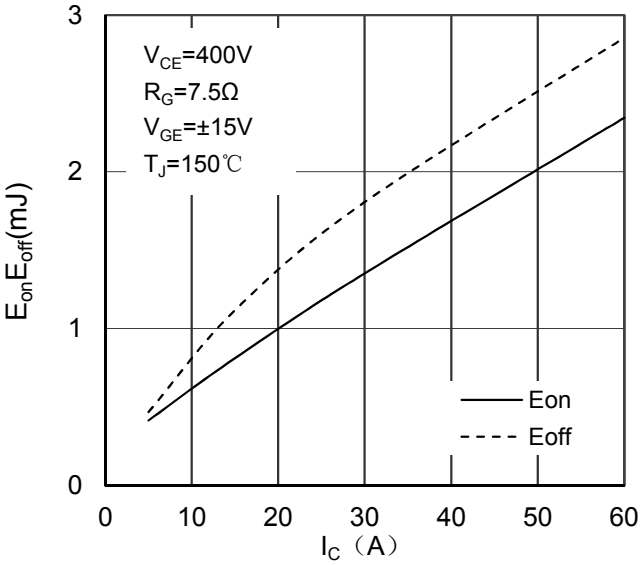



Figure 5. Switching Energy vs Collector Current Half Bridge IGBT

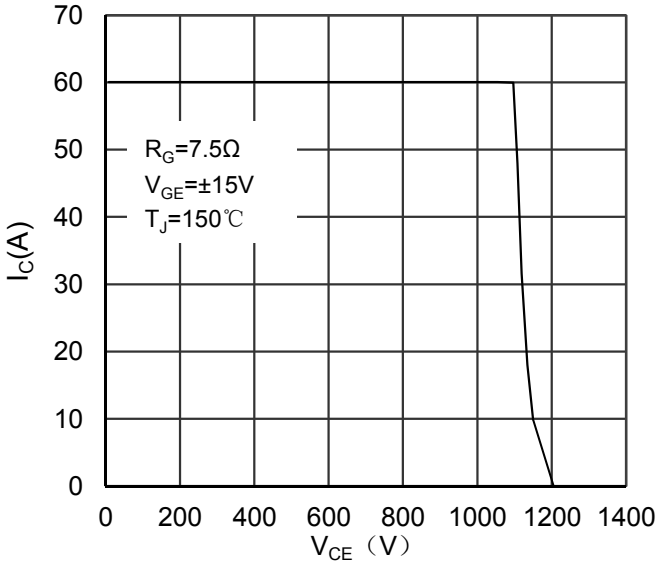



Figure 6. Reverse Biased Safe Operating Area Half Bridge IGBT

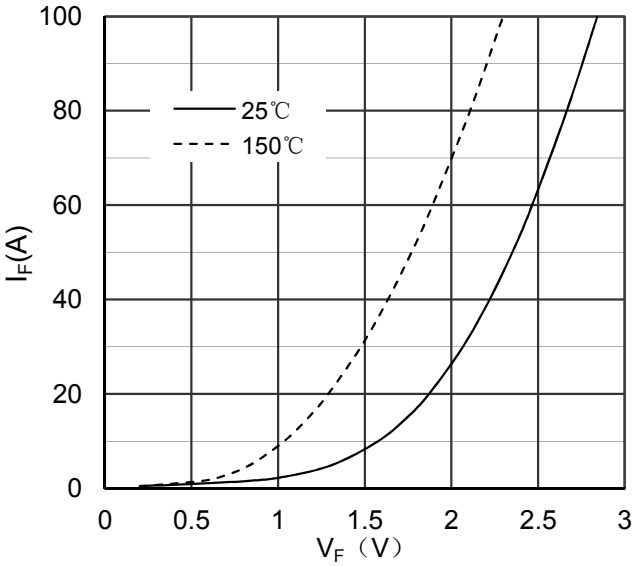



Figure 7. Diode Forward Characteristics Half Bridge Diode

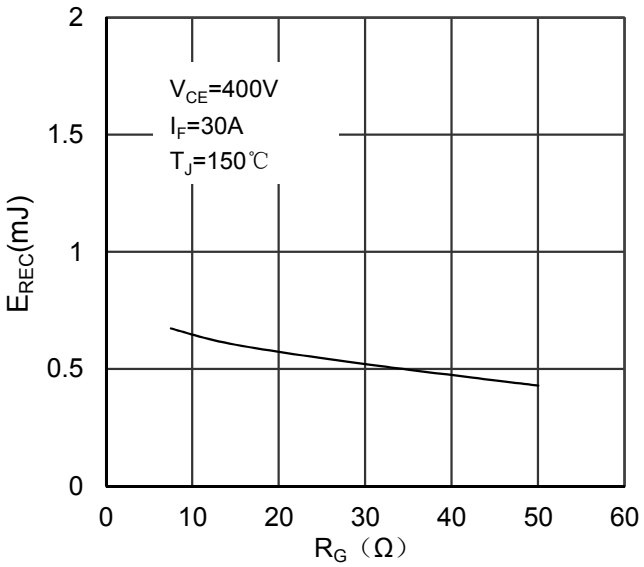



Figure 8. Switching Energy vs Gate Resistor Half Bridge Diode

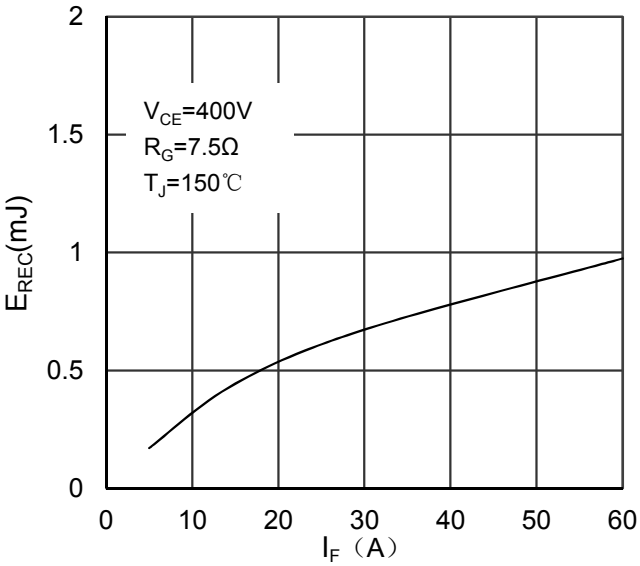



Figure 9. Switching Energy vs Forward Current Half Bridge Diode

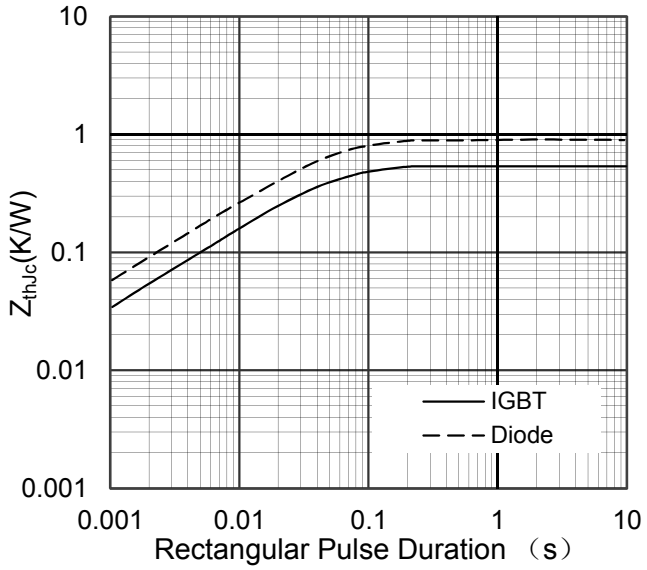



Figure 10. Transient Thermal Impedance of Half Bridge-Diode and IGBT

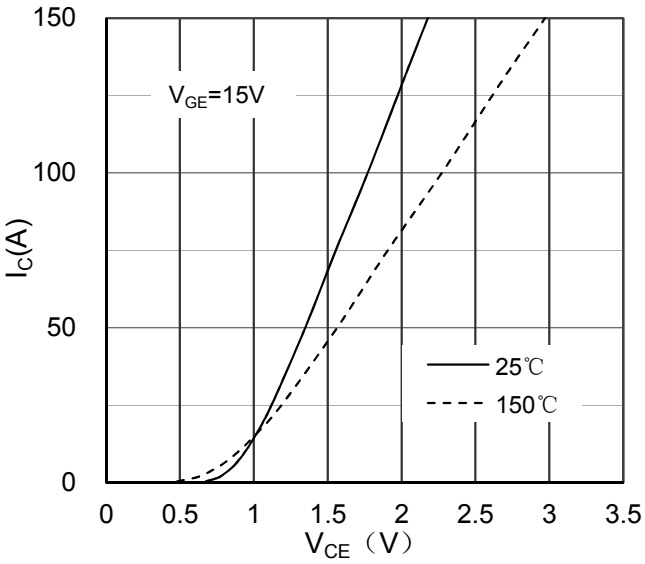



Figure 11. Typical Output Characteristics Neutral Point IGBT

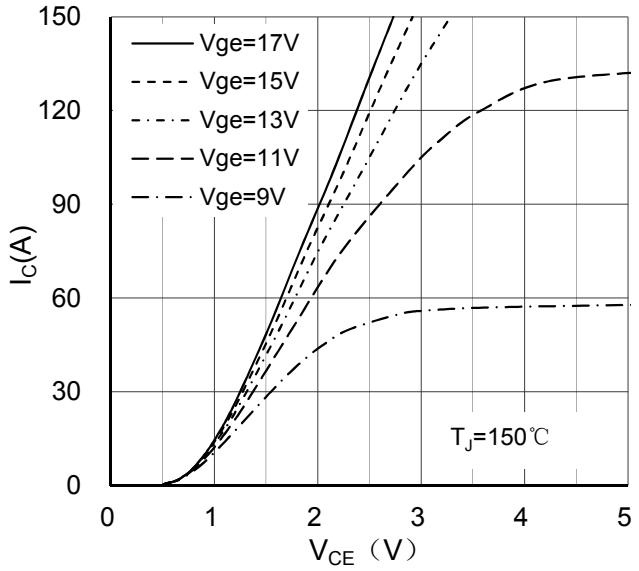



Figure 12. Typical Output Characteristics Neutral Point IGBT

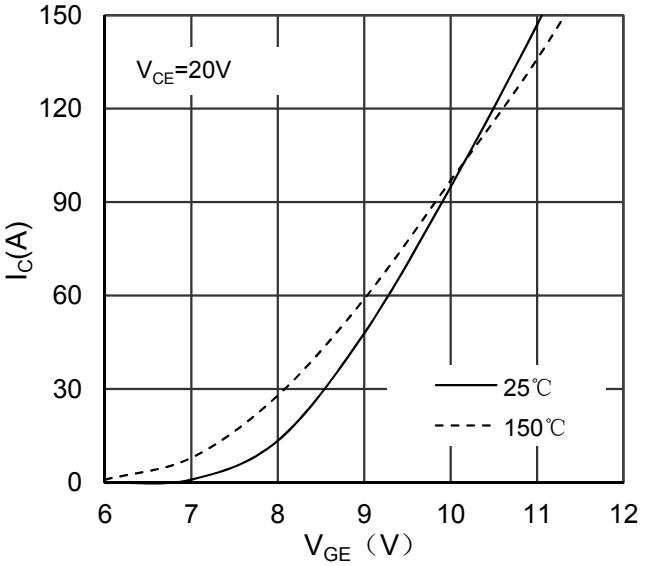



Figure 13. Typical Transfer characteristics Neutral Point IGBT

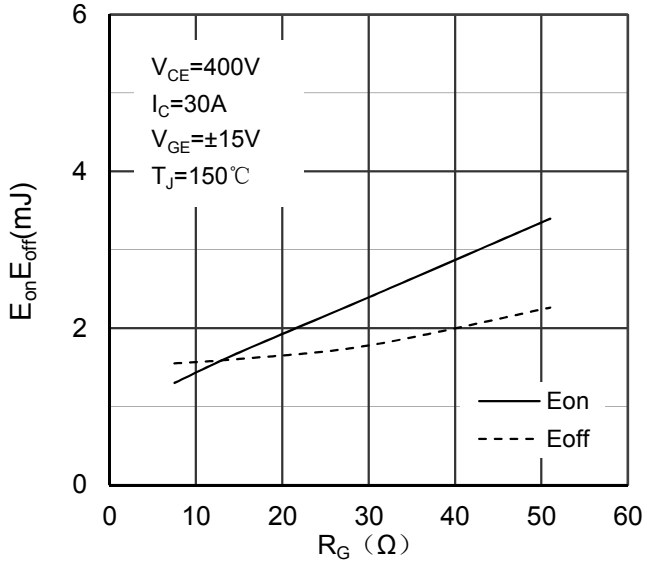



Figure 14. Switching Energy vs Gate Resistor Neutral Point IGBT

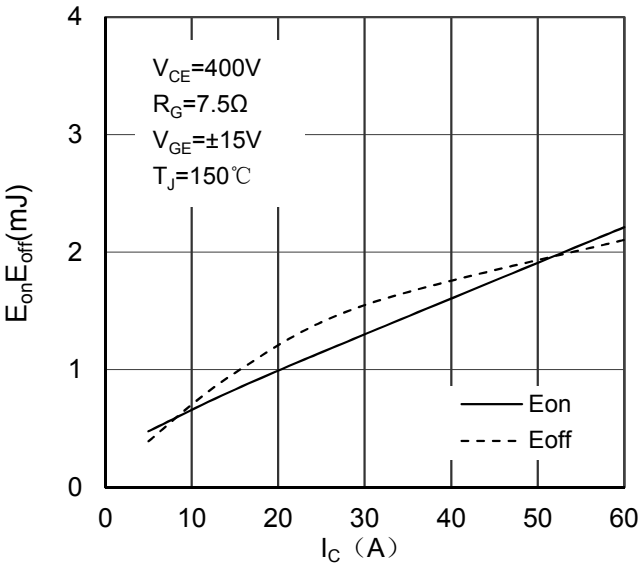



Figure 15. Switching Energy vs Collector Current Neutral Point IGBT

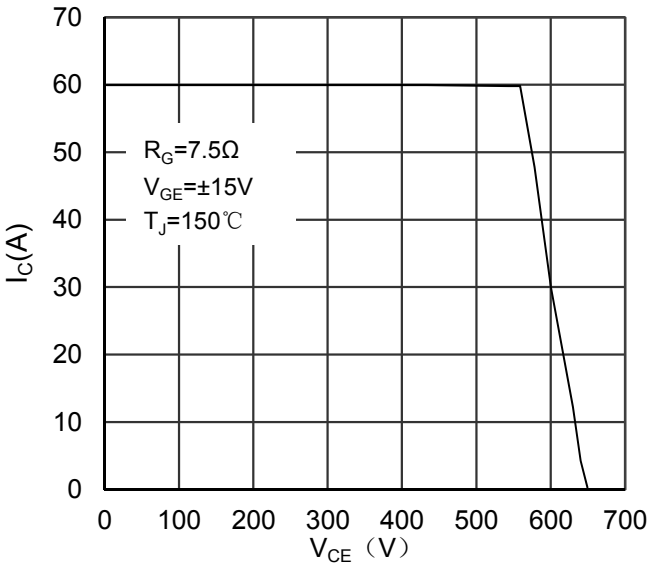



Figure 16. Reverse Biased Safe Operating Area Neutral Point IGBT

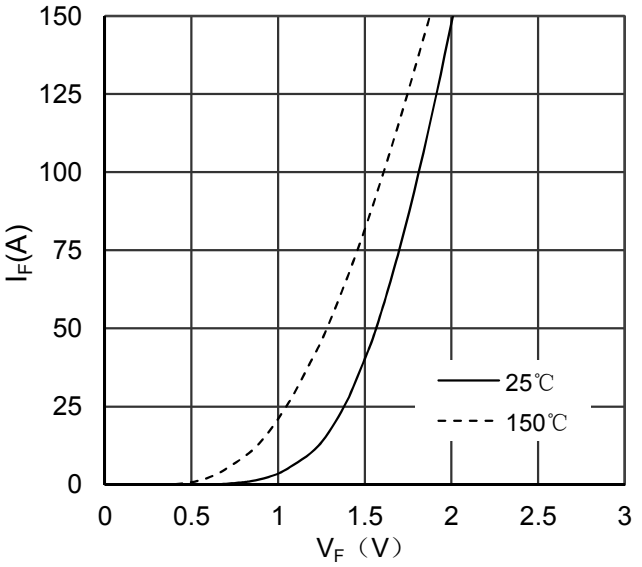



Figure 17. Diode Forward Characteristics Neutral Point Diode

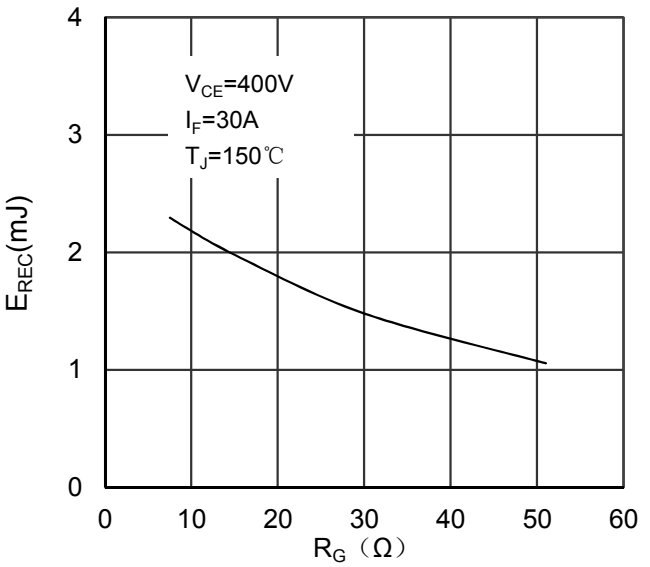



Figure 18. Switching Energy vs Gate Resistor Neutral Point Diode

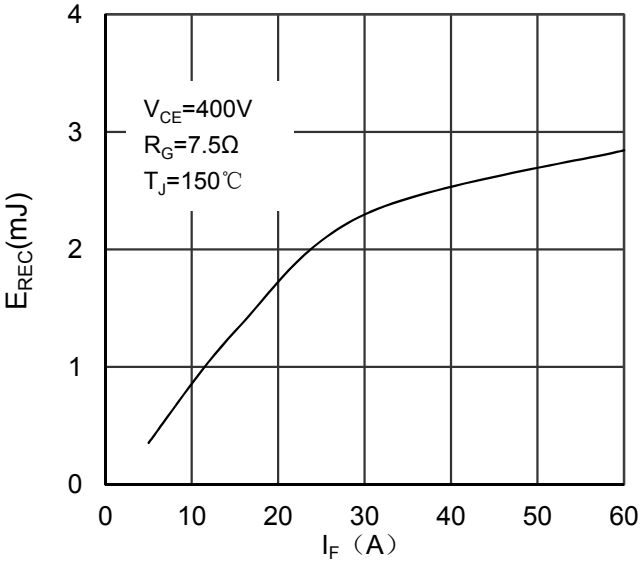



Figure 19. Switching Energy vs Forward Current Neutral Point Diode

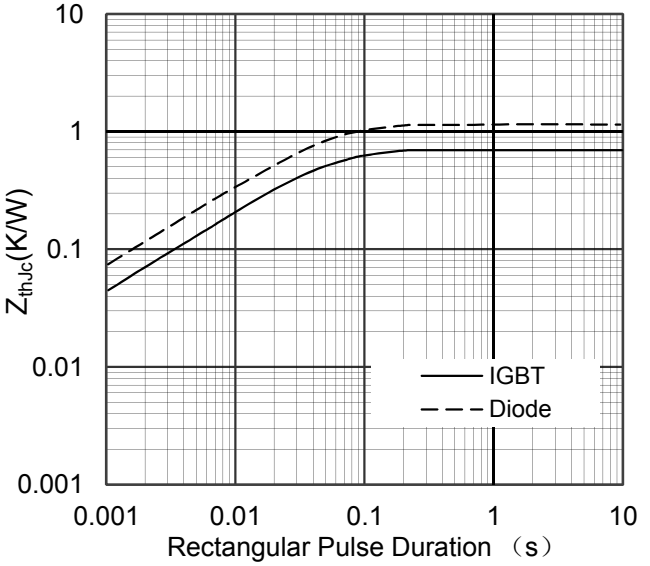



Figure 20. Transient Thermal Impedance of Neutral Point-Diode and IGBT

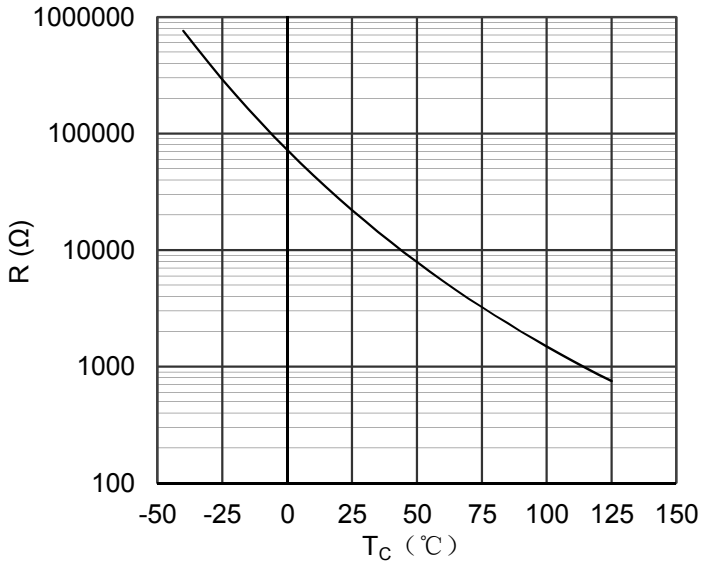



Figure 21. NTC Characteristics

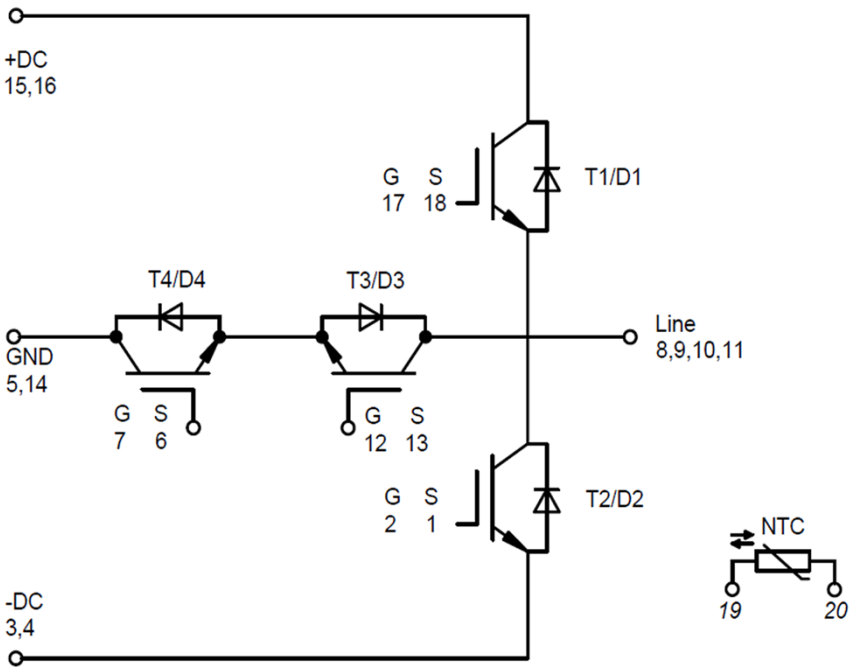
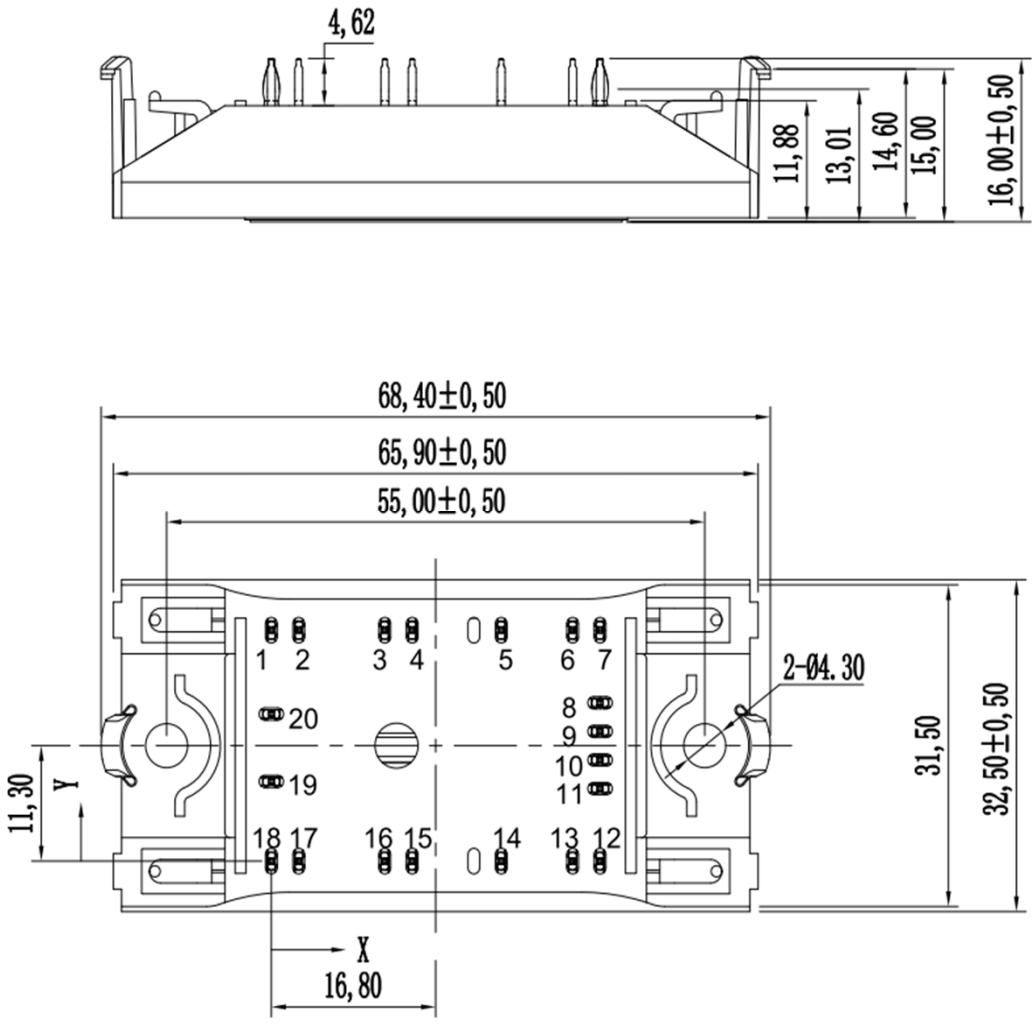



Figure 22. Circuit Diagram




| Pin table | | |
|---|---|---|
| Pin | X | Y |
| 1 | 0 | 22.6 |
| 2 | 2.8 | 22.6 |
| 3 | 11.6 | 22.6 |
| 4 | 14.4 | 22.6 |
| 5 | 23.5 | 22.6 |
| 6 | 30.8 | 22.6 |
| 7 | 33.6 | 22.6 |
| 8 | 33.6 | 15.5 |
| 9 | 33.6 | 12.7 |
| 10 | 33.6 | 9.9 |
| 11 | 33.6 | 7.1 |
| 12 | 33.6 | 0 |
| 13 | 30.8 | 0 |
| 14 | 23.5 | 0 |
| 15 | 14.4 | 0 |
| 16 | 11.6 | 0 |
| 17 | 2.8 | 0 |
| 18 | 0 | 0 |
| 19 | 0 | 7.8 |
| 20 | 0 | 14.4 |

Dimensions in (mm)

Figure 23. Package Outline