BYD Microelectronics Co., Ltd.

# BG100B12UX3-I

## IGBT Power Module

$V_{CE}$=1200V $I_C$=100A

## General Description

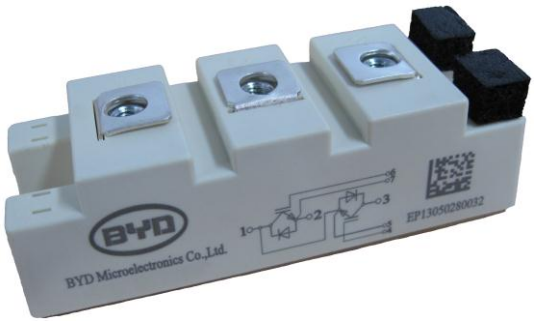
BYD IGBT Power Module BG100B12UX3-I provides fast switching characteristic as well as high short circuit capability, which introduce the advanced IGBT chip/FWD and improved connection.

## Features

- High speed IGBT technology
- Including ultra fast & soft recovery anti-parallel FWD
- Low inductance
- Standard package
- High short circuit capability
- Fast switching and short tail current

## Applications

- High frequency drivers
- AC motor control
- Inverters
- Servo
- UPS (Uninterruptible Power Supplies)
- Electric welding




## Characteristic Values

| Parameter | Symbol | Conditions | Temperature | Value | Unit |
|---|---|---|---|---|---|
| **Absolute Maximum Ratings** | | | | | |
| Collector-emitter voltage | $V_{CES}$ | $V_{GE}$=0V | $T_j$=25℃ | 1200 | V |
| Continuous collector current | $I_C$ | — | $T_C$=80℃ | 100 | A |
| Peak collector current | $I_{CRM}$ | $I_{CRM}$ =2$I_C$,tp=1ms | — | 200 | A |
| Gate-emitter voltage | $V_{GES}$ | — | — | +/-20 | V |
| Total power dissipation | $P_{tot}$ | per switch (IGBT) | $T_C$=25℃ | 500 | W |
| IGBT short circuit SOA | $t_{psc}$ | $V_{CC}$=600V, $V_{GE}$≤15V $V_{CES}$≤1200V | $T_{vj}$≤125℃ | 10 | us |
| Max. junction temperature | $T_{vj\ max}$ | — | — | 150 | ℃ |
| Operation junction temperature | $T_{vj\ op}$ | — | — | -40~125 | ℃ |
| Storage temperature range | $T_{stg}$ | — | — | -40~125 | ℃ |
| Diode DC forward current | $I_F$ | — | $T_C$=80℃ | 100 | A |
| Peak forward current | $I_{FRM}$ | $I_{FRM}$=2$I_F$,tp=1ms | — | 200 | A |
| $I^2t$-value, Diode | $I^2t$ | $V_R$=0V,t=10ms | $T_j$=125℃ | — | $A^2s$ |
| Isolation voltage | $V_{isol}$ | t=1min,f=50Hz | — | 2500 | V |

| Parameter | Symbol | Conditions | Temperature | Value | | | Unit |
|---|---|---|---|---|---|---|---|
| **Characteristics** | | | | | | | |
| **IGBT** | | | | **min.** | **typ.** | **max.** | |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | $V_{GE}=V_{CE}$, $I_C$= 3mA | $T_{vj}$=25℃ | 5.0 | 5.8 | 6.5 | V |
| Collector-emitter cut-off current | $I_{CES}$ | $V_{CE}$=1200V,$V_{GE}$=0V | $T_{vj}$=25℃ | — | — | 1 | mA |
| | | | $T_{vj}$=125℃ | — | — | 10 | mA |
| Gate-emitter cut-off current | $I_{GES}$ | $V_{CE}$=0V,$V_{GE}$=±20V | $T_{vj}$=25℃ | -400 | — | 400 | nA |
| Collector-emitter saturation voltage | $V_{CE(sat)}$ | $I_C$=100A,$V_{GE}$=15V | $T_{vj}$=25℃ | — | 2.7 | — | V |
| | | | $T_{vj}$=125℃ | — | 3.5 | — | V |
| Integrated gate resistor | $R_{Gint}$ | — | $T_{vj}$=25℃ | — | tbd | — | Ω |
| Total Gate Charge | $Q_g$ | $V_{CE}$=600V,$I_C$=100A, $V_{GE}$=0V…+15V | — | — | 0.64 | — | uC |
| Gate-Emitter Charge | $Q_{ge}$ | | — | — | 0.11 | — | uC |
| Gate-Collector Charge | $Q_{gc}$ | | — | — | 0.40 | — | uC |
| Input capacitance | $C_{ies}$ | $V_{CE}$=25V,$V_{GE}$ =0V, f=1MHz | $T_{vj}$=25℃ | — | tbd | — | nF |
| Output capacitance | $C_{oes}$ | | | — | tbd | — | nF |
| Reverse transfer capacitance | $C_{res}$ | | | — | tbd | — | nF |
| Turn-on delay time | $t_{d(on)}$ | $V_{CC}$=600V,$I_C$=100A, $R_{Gon}$=$R_{Goff}$=3.3Ω, $V_{GE}$=±15V, $L_\sigma$=80nH, Inductive load | $T_{vj}$=25℃ | — | 160 | — | ns |
| | | | $T_{vj}$=125℃ | — | 150 | — | ns |
| Rise time | $t_r$ | | $T_{vj}$=25℃ | — | 65 | — | ns |
| | | | $T_{vj}$=125℃ | — | 60 | — | ns |
| Turn-off delay time | $t_{d(off)}$ | | $T_{vj}$=25℃ | — | 285 | — | ns |
| | | | $T_{vj}$=125℃ | — | 330 | — | ns |
| Fall time | $t_f$ | | $T_{vj}$=25℃ | — | 100 | — | ns |
| | | | $T_{vj}$=125℃ | — | 150 | — | ns |
| Energy dissipation during turn-on time | $E_{on}$ | $V_{CC}$=600V, $I_C$=100A, $R_{Gon}$ =3.3Ω, $V_{GE}$=±15V, $L_\sigma$=80nH, Inductive load | $T_{vj}$=25℃ | — | 4.5 | — | mJ |
| | | | $T_{vj}$=125℃ | — | 8.9 | — | mJ |
| Energy dissipation during turn-off time | $E_{off}$ | $V_{CC}$=600V,$I_C$=100A, $R_{Goff}$ =3.3Ω,$V_{GE}$=±15V $L_\sigma$=80nH, Inductive load | $T_{vj}$=25℃ | — | 4.9 | — | mJ |
| | | | $T_{vj}$=125℃ | — | 7.3 | — | mJ |

| Parameter | Symbol | Conditions | Temperature | Value | | | Unit |
|---|---|---|---|---|---|---|---|
| **Diode** | | | | **min.** | **typ.** | **max.** | |
| Forward voltage | $V_F$ | $I_F$=100A | $T_{vj}$=25℃ | — | 1.7 | — | V |
| | | | $T_{vj}$=125℃ | — | 1.7 | — | V |
| Peak reverse recovery current | $I_{RR}$ | $I_F$=100A,$V_R$=600V, $di_F/dt$=1100A/us | $T_{vj}$=125℃ | — | 135 | — | A |
| Recovered charge | $Q_{rr}$ | | $T_{vj}$=125℃ | — | 17.5 | — | uC |
| Reverse recovery time | $t_{rr}$ | | $T_{vj}$=125℃ | — | 260 | — | ns |
| Reverse recovery energy | $E_{rec}$ | | $T_{vj}$=125℃ | — | 8.5 | — | mJ |
| **Thermal-Mechanical Specifications** | | | | | | | |
| IGBT thermal resistance junction to case | $R_{th(j-c)}$ | per IGBT | | — | — | 0.25 | K/W |
| Diode thermal resistance junction to case | $R_{th(j-c)}$ | per diode | | — | — | 0.34 | K/W |
| Thermal resistance case to heat-sink | $R_{th(c-s)}$ | per module | | — | 0.03 | — | K/W |
| Dimensions | L x W x H | Typical , see outline drawing | | 94.0×34.0×30.5 | | | mm |
| Clearance distance in air | da | according to IEC 60664-1 and EN 50124-1 | Term. to base: | — | — | 17 | mm |
| | | | Term. to term: | — | — | 9.5 | |
| Surface creepage distance | ds | according to IEC 60664-1 and EN 50124-1 | Term. to base: | — | — | 17 | mm |
| | | | Term. to term: | — | — | 20 | |
| Mass | m | — | — | — | 160 | — | g |

Thermal and mechanical properties according to IEC 60747–15

Specification according to the valid application note.

# Characterization Curves

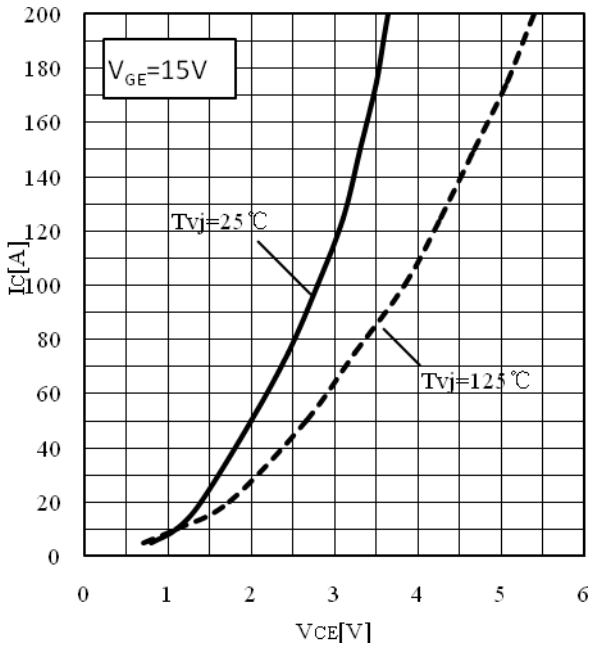



Fig.1 Typ. On-state Characteristics

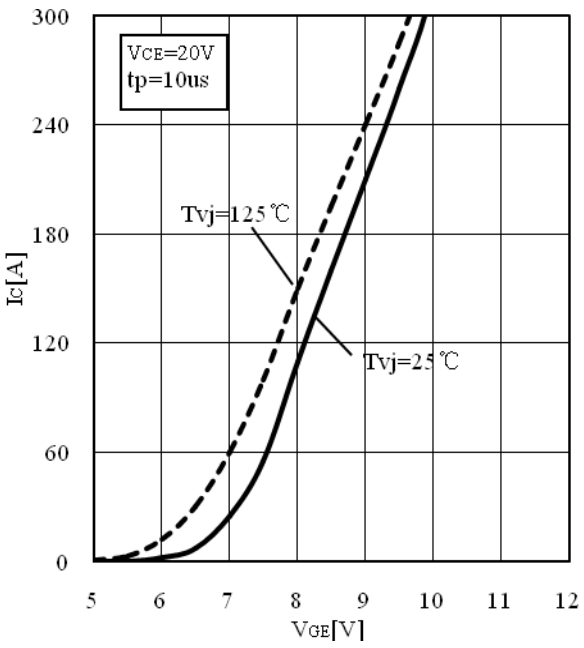



Fig.2 Typ. Transfer Characteristics

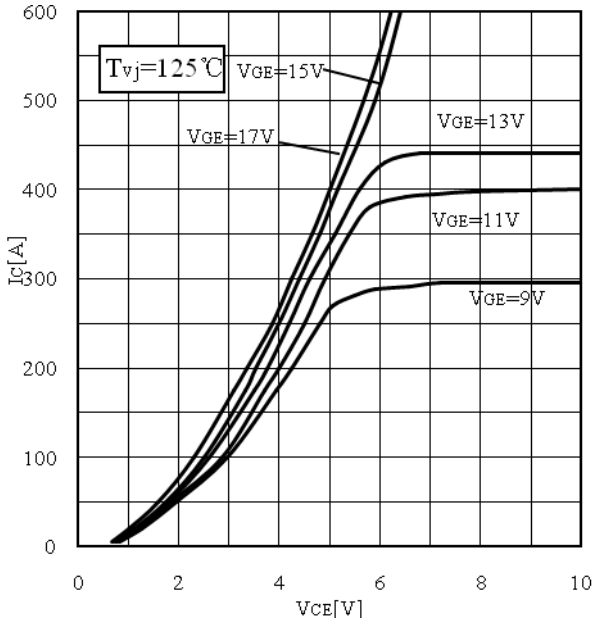



Fig.3 Typ. Output Characteristics

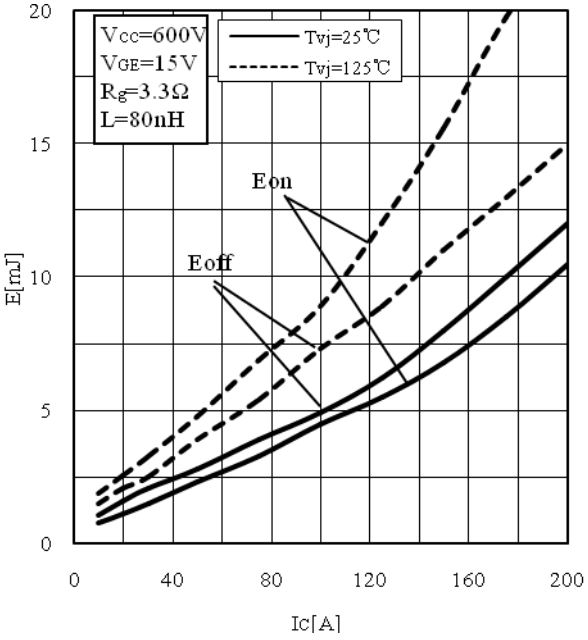



Fig.4 Switching Loss vs. Collector Current

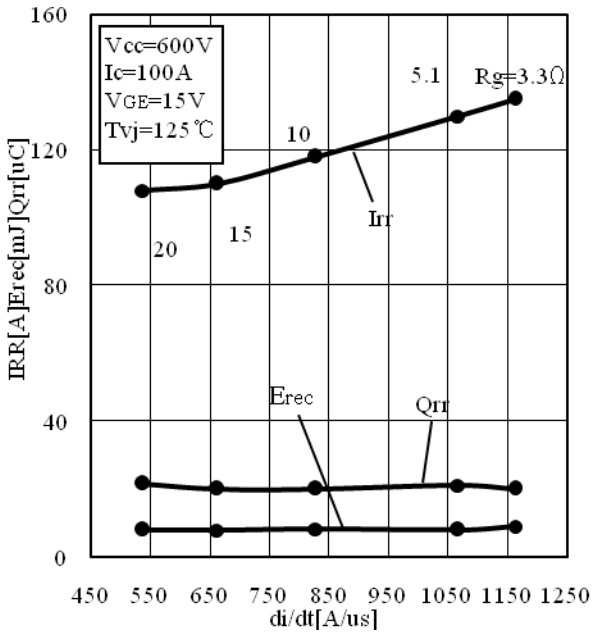



Fig.5 Typ. Reverse Recovery Characteristics vs di/dt

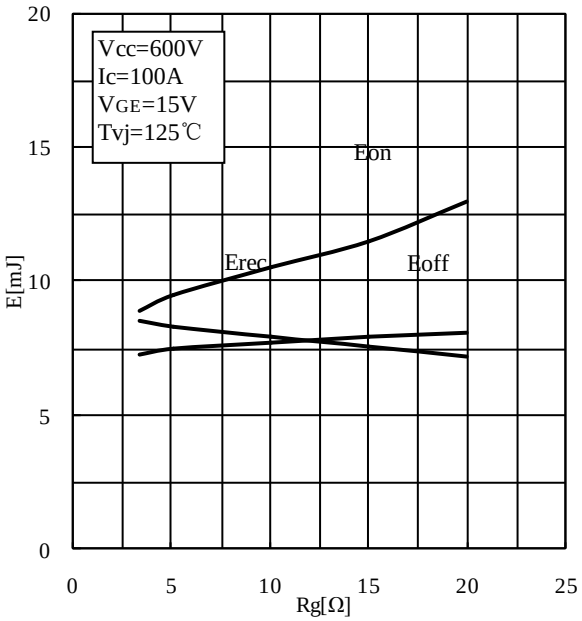



Fig.6 Switching Loss vs. Gate Resistor

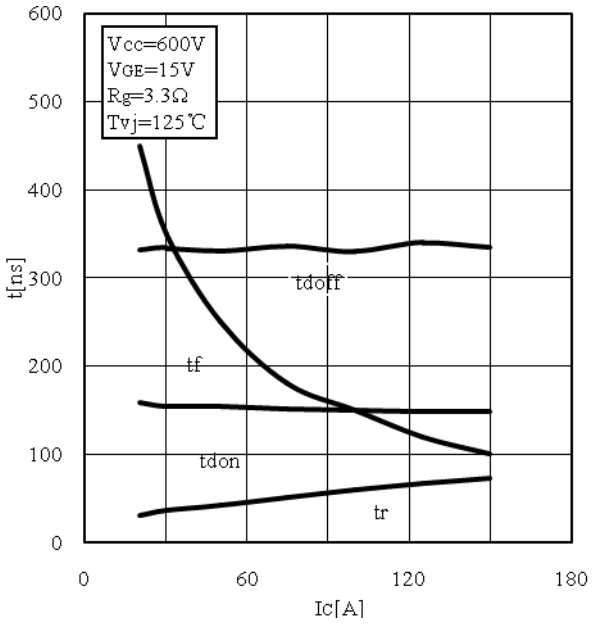



Fig.7 Typ. Switching Times vs. Ic

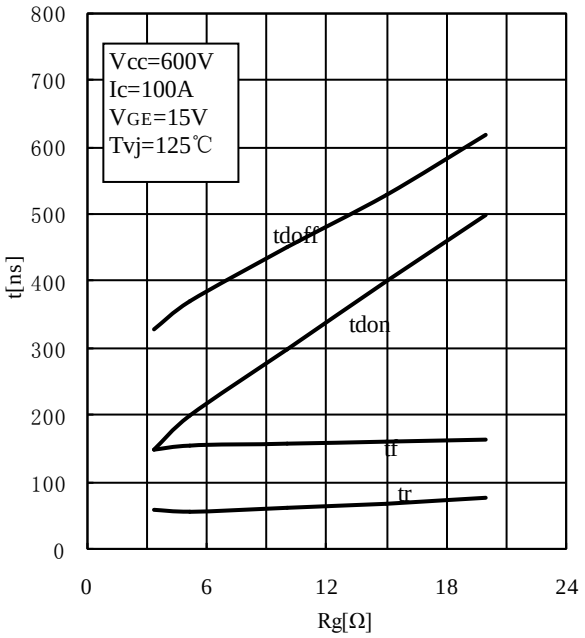



Fig.8 Typ. Switching Times vs. Gate Resistor RG

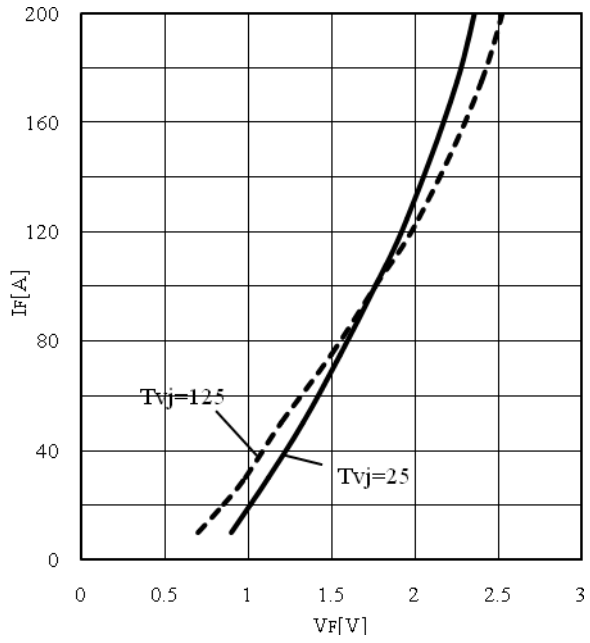



Fig.9 FWD Forward Characteristics.

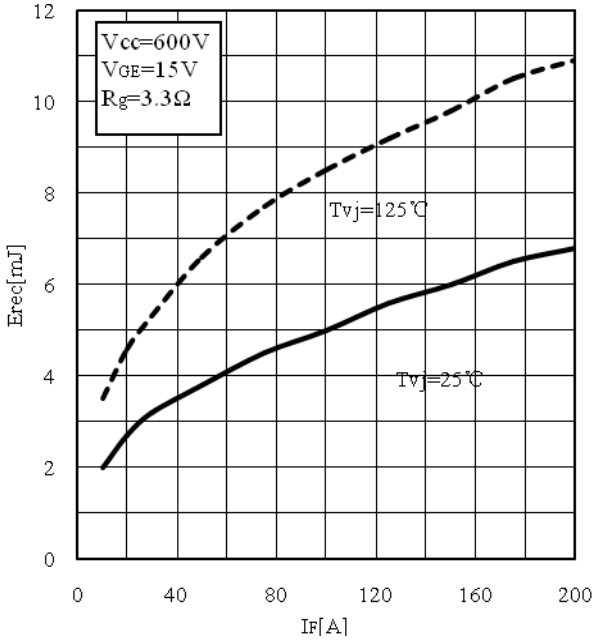



Fig.10 Typ. Switching Losses Diode-Inverter

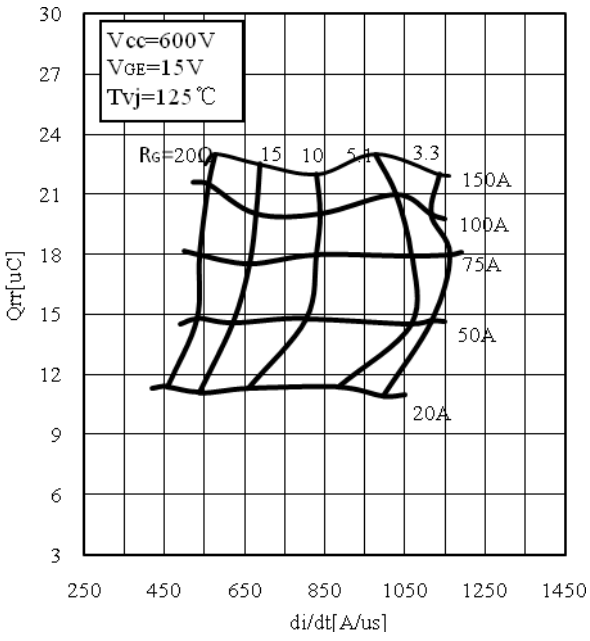



Fig.11 Typ. FRD Recovery Charge

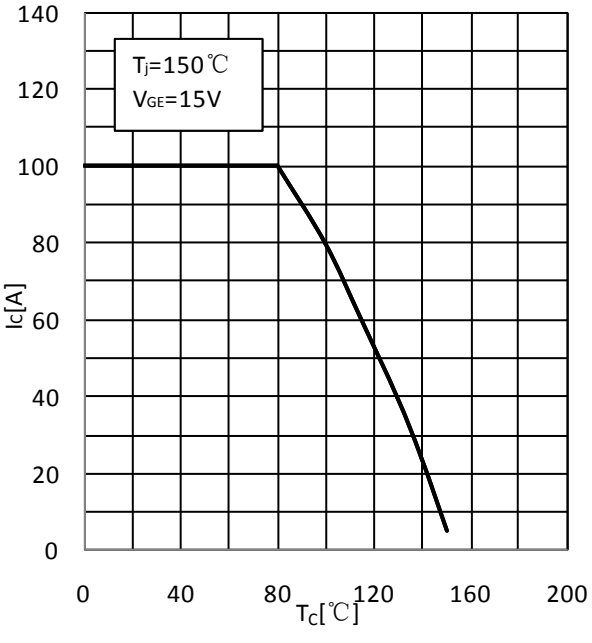



Fig. 12 Rate Current vs. Temperature ($T_C$)

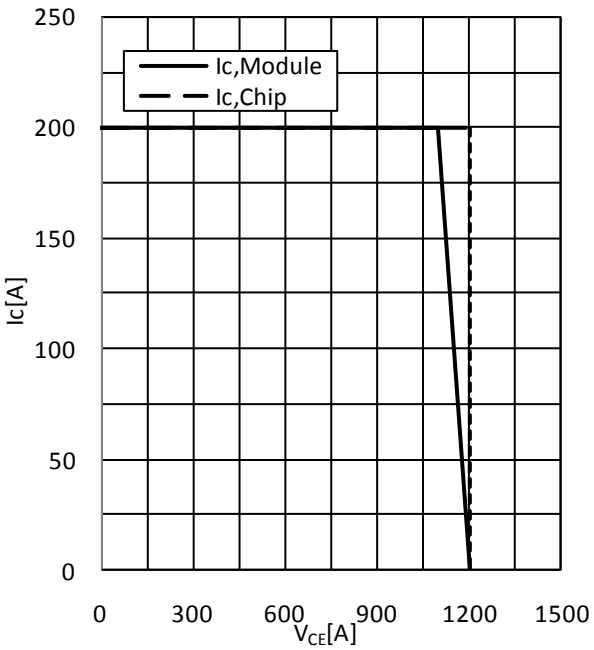
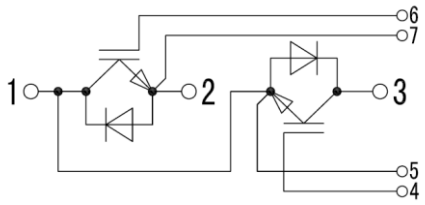


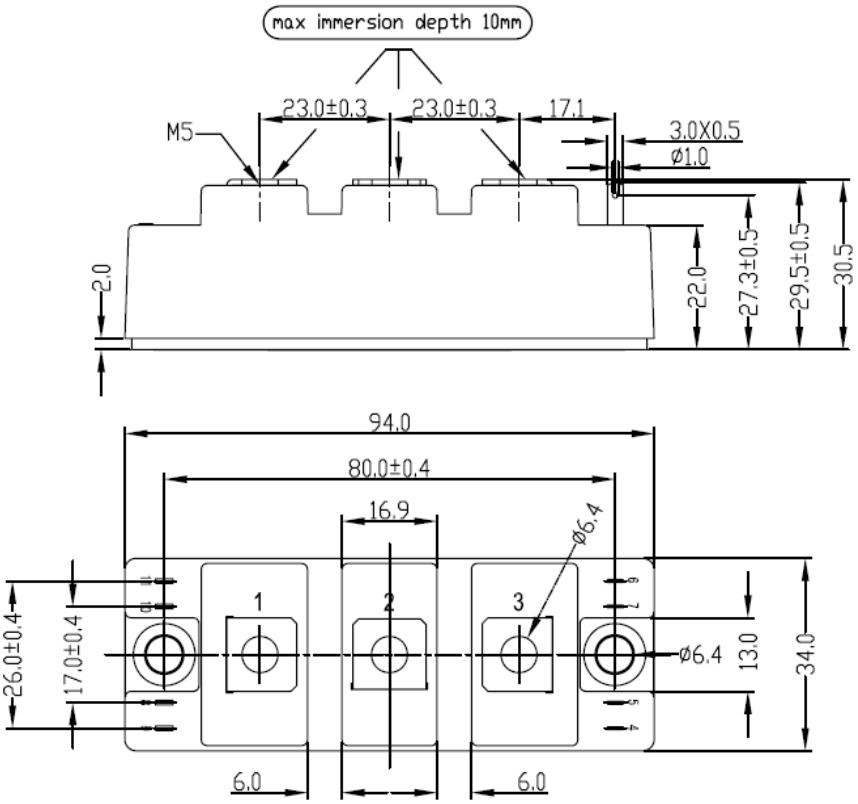

Fig.13 Reverse Bias Safe Operating Area IGBT-inv(RBSOA)

## Circuit Diagram




## PackageOutlines

## Dimensions in mm




## Attached (recommended torque):

$M_S$ : (to heat sink M6) 3~5 Nm  $M_t$ : (to terminals M5) 2.5~4 Nm

## Attention

1. In order to reduce the contact resistance, we suggest add thermal grease between base and heat-sink, which thickness is about 0.1mm.
2. When installing the module, please wear a electrostatic bracelet to prevent the gate breakdown and the imbalance power may damage the internal chip, even to damage the module.
3. This is an electrostatic sensitive device, please observe the international standard IEC 60747-1, chap. IX.

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