STARSEA

# MG40P12E2A

RoHS COMPLIANT



## IGBT Modules

$V_{CES}$ 1200V
$I_C$ 40A

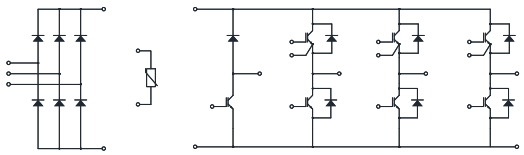
## Applications

- Motor Drivers
- AC and DC servo drive amplifier
- UPS (Uninterruptible Power Supplies)

## Features

- Low switching losses
- Low $V_{CE(sat)}$ with positive temperature coefficient
- Including fast & soft recovery anti-parallel FWD
- Low inductance case
- High short circuit capability(10us)
- Maximum junction temperature 175℃

**Circuit**



## IGBT- inverter

Absolute Maximum Ratings

| Parameter | Symbol | Conditions | Value | Unit |
|---|---|---|---|---|
| Collector-Emitter Voltage | $V_{CES}$ | $V_{GE}$=0V, $I_C$=1mA, $T_{vj}$=25℃ | 1200 | V |
| Continuous Collector Current | $I_C$ | $T_C$=100℃, $T_{vjmax}$=175℃ | 40 | A |
| Repetitive Peak Collector Current | $I_{CRM}$ | $t_p$=1ms | 80 | A |
| Gate-Emitter Voltage | $V_{GES}$ | $T_{vj}$=25℃ | ±20 | V |
| Total Power Dissipation | $P_{tot}$ | $T_C$=25℃<br>$T_{vjmax}$=175℃ | 210 | W |

## IGBT- inverter

Characteristic Values

| Parameter | Symbol | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Gate-Emitter Threshold Voltage | $V_{GE(th)}$ | $V_{GE}=V_{CE}$, $I_C$=1.4mA,$T_{vj}$=25℃ | 5.2 | 5.8 | 6.5 | V |
| Collector-Emitter Cut-off Current | $I_{CES}$ | $V_{CE}$=1200V,$V_{GE}$=0V, $T_{vj}$=25℃ | | | 1.0 | mA |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | $I_C$=40A,$V_{GE}$=15V, $T_{vj}$=25℃ | | 1.85 | 2.30 | V |
| | | $I_C$=40A,$V_{GE}$=15V, $T_{vj}$=125℃ | | 2.00 | | |
| | | $I_C$=40A,$V_{GE}$=15V, $T_{vj}$=150℃ | | 2.10 | | |
| Gate Charge | $Q_G$ | | | 0.27 | | uC |
| Input Capacitance | $C_{ies}$ | $V_{CE}$=25V,$V_{GE}$=0V, f=1MHz, $T_{vj}$=25℃ | | 2.5 | | nF |
| Reverse Transfer Capacitance | $C_{res}$ | | | 0.087 | | nF |
| Gate-Emitter Leakage Current | $I_{GES}$ | $V_{CE}$=0V, $V_{GE}$=20V,$T_{vj}$ =25℃ | | | 400 | nA |
| Turn-on Delay Time | $t_{d(on)}$ | $I_C$=40A $V_{CE}$=600V $V_{GE}$=±15V $R_G$=20Ω $T_{vj}$=25℃ | | 20 | | ns |
| Rise Time | $t_r$ | | | 42 | | ns |
| Turn-off Delay Time | $t_{d(off)}$ | | | 141 | | ns |
| Fall Time | $t_f$ | | | 250 | | ns |
| Energy Dissipation During Turn-on Time | $E_{on}$ | | | 4.45 | | mJ |
| Energy Dissipation During Turn-off Time | $E_{off}$ | | | 1.95 | | mJ |
| Turn-on Delay Time | $t_{d(on)}$ | $I_C$=40A $V_{CE}$=600V $V_{GE}$=±15V $R_G$=20Ω $T_{vj}$=150℃ | | 18 | | ns |
| Rise Time | $t_r$ | | | 46 | | ns |
| Turn-off Delay Time | $t_{d(off)}$ | | | 155 | | ns |
| Fall Time | $t_f$ | | | 275 | | ns |
| Energy Dissipation During Turn-on Time | $E_{on}$ | | | 5.28 | | mJ |
| Energy Dissipation During Turn-off Time | $E_{off}$ | | | 2.27 | | mJ |
| SC Data | $I_{sc}$ | $t_p$≤10us,$V_{GE}$=15V,$T_{vj}$=150℃, $V_{CC}$=900V,$V_{CEM}$≤1200V | | 160 | | A |

## Diode-inverter

Absolute Maximum Ratings

| Parameter | Symbol | Conditions | Value | Unit |
|---|---|---|---|---|
| Repetitive Peak Reverse Voltage | $V_{RRM}$ | $T_{vj}$=25℃ | 1200 | V |
| Continuous DC Forward Current | $I_F$ | | 40 | A |
| Repetitive Peak Forward Current | $I_{FRM}$ | $t_p$=1ms | 80 | A |

Characteristic Values

| Parameter | Symbol | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Forward Voltage | $V_F$ | $I_F$=40A,$T_{vj}$=25℃ | | 2.10 | 2.80 | V |
| | | $I_F$=40A,$T_{vj}$=125℃ | | 1.95 | | |
| | | $I_F$=40A,$T_{vj}$=150℃ | | 1.85 | | |
| Recovered Charge | $Q_{rr}$ | $I_F$=40A<br>$V_R$=600V<br>-di$_F$/dt =900A/us<br>$T_{vj}$=25℃ | | 0.85 | | uC |
| Peak Reverse Recovery Current | $I_{rr}$ | | | 23 | | A |
| Reverse Recovery Energy | $E_{rec}$ | | | 0.95 | | mJ |
| Recovered Charge | $Q_{rr}$ | $I_F$=40A<br>$V_R$=600V<br>-di$_F$/dt =900A/us<br>$T_{vj}$=150℃ | | 4.75 | | uC |
| Peak Reverse Recovery Current | $I_{rr}$ | | | 25 | | A |
| Reverse Recovery Energy | $E_{rec}$ | | | 1.72 | | mJ |

## IGBT-brake-chopper

Absolute Maximum Ratings

| Parameter | Symbol | Conditions | Value | Unit |
|---|---|---|---|---|
| Collector-Emitter Voltage | $V_{CES}$ | $V_{GE}$=0V, $I_C$=1mA, $T_{vj}$=25℃ | 1200 | V |
| Continuous Collector Current | $I_C$ | $T_C$=100℃, $T_{vjmax}$=175℃ | 25 | A |
| Repetitive Peak Collector Current | $I_{CRM}$ | $t_p$=1ms | 50 | A |
| Gate-Emitter Voltage | $V_{GES}$ | $T_{vj}$=25℃ | ±20 | V |
| Total Power Dissipation | $P_{tot}$ | $T_C$=25℃<br>$T_{vjmax}$=175℃ | 165 | W |

Characteristic Values

| Parameter | Symbol | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Gate-Emitter Threshold Voltage | $V_{GE(th)}$ | $V_{GE}$=$V_{CE}$, $I_C$=1.2mA,$T_{vj}$=25℃ | 5.2 | 5.8 | 6.5 | V |
| Collector-Emitter Cut-off Current | $I_{CES}$ | $V_{CE}$=1200V,$V_{GE}$=0V, $T_{vj}$=25℃ | | | 1.0 | mA |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | $I_C$=25A,$V_{GE}$=15V, $T_{vj}$=25℃ | | 1.95 | 2.50 | V |
| | | $I_C$=25A,$V_{GE}$=15V, $T_{vj}$=125℃ | | 2.15 | | |
| | | $I_C$=25A,$V_{GE}$=15V, $T_{vj}$=150℃ | | 2.25 | | |
| Gate Charge | $Q_G$ | | | 0.20 | | uC |
| Input Capacitance | $C_{ies}$ | $V_{CE}$=25V,$V_{GE}$=0V, f=1MHz, $T_{vj}$=25℃ | | 1.67 | | nF |
| Reverse Transfer Capacitance | $C_{res}$ | | | 0.056 | | nF |
| Gate-Emitter Leakage Current | $I_{GES}$ | $V_{CE}$=0V, $V_{GE}$=20V,$T_{vj}$ =25℃ | | | 400 | nA |
| Turn-on Delay Time | $t_{d(on)}$ | $I_C$=25A<br>$V_{CE}$=600V<br>$V_{GE}$=±15V<br>$R_G$=20Ω<br>$T_{vj}$=25℃ | | 10 | | ns |
| Rise Time | $t_r$ | | | 26 | | ns |
| Turn-off Delay Time | $t_{d(off)}$ | | | 82 | | ns |
| Fall Time | $t_f$ | | | 222 | | ns |
| Energy Dissipation During Turn-on Time | $E_{on}$ | | | 2.59 | | mJ |
| Energy Dissipation During Turn-off Time | $E_{off}$ | | | 1.13 | | mJ |

| | | | | | | |
|---|---|---|---|---|---|---|
| Turn-on Delay Time | $t_{d(on)}$ | $I_C$=25A<br>$V_{CE}$=600V<br>$V_{GE}$=±15V<br>$R_G$=20Ω<br>$T_{vj}$=150℃ | | 18 | | ns |
| Rise Time | $t_r$ | | | 27 | | ns |
| Turn-off Delay Time | $t_{d(off)}$ | | | 89 | | ns |
| Fall Time | $t_f$ | | | 262 | | ns |
| Energy Dissipation During Turn-on Time | $E_{on}$ | | | 2.92 | | mJ |
| Energy Dissipation During Turn-off Time | $E_{off}$ | | | 1.43 | | mJ |
| SC Data | $I_{sc}$ | $t_p$≤10us,$V_{GE}$=15V,$T_{vj}$=150℃,<br>$V_{CC}$=900V,$V_{CEM}$≤1200V | | 100 | | A |

## ● Diode-Brake-Chopper

Absolute Maximum Ratings

| Parameter | Symbol | Conditions | Value | Unit |
|---|---|---|---|---|
| Repetitive Peak Reverse Voltage | $V_{RRM}$ | $T_{vj}$=25℃ | 1200 | V |
| Continuous DC Forward Current | $I_F$ | | 15 | A |
| Repetitive Peak Forward Current | $I_{FRM}$ | $t_p$=1ms | 30 | A |

Characteristic Values

| Parameter | Symbol | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Forward Voltage | $V_F$ | $I_F$=15A,$T_{vj}$=25℃ | | 2.00 | 2.80 | V |
| | | $I_F$=15A,$T_{vj}$=125℃ | | 1.80 | | |
| | | $I_F$=15A,$T_{vj}$=150℃ | | 1.70 | | |
| Recovered Charge | $Q_{rr}$ | $I_F$=15A<br>$V_R$=600V<br>-$di_F$/dt =550A/us<br>$T_{vj}$=25℃ | | 1.20 | | uC |
| Peak Reverse Recovery Current | $I_{rr}$ | | | 10 | | A |
| Reverse Recovery Energy | $E_{rec}$ | | | 0.35 | | mJ |
| Recovered Charge | $Q_{rr}$ | $I_F$=15A<br>$V_R$=600V<br>-$di_F$/dt =550A/us<br>$T_{vj}$=150℃ | | 1.60 | | uC |
| Peak Reverse Recovery Current | $I_{rr}$ | | | 15 | | A |
| Reverse Recovery Energy | $E_{rec}$ | | | 1.20 | | mJ |

## Diode-Rectifier

Absolute Maximum Ratings

| Parameter | Symbol | Conditions | Value | Unit |
|---|---|---|---|---|
| Repetitive Peak Reverse Voltage | $V_{RRM}$ | $T_{vj}$=25℃ | 1600 | V |
| Average Output Current 50/60Hz, Sine Wave | $I_{F(AV)}$ | $T_C$=100℃ | 40 | A |
| Maximum RMS Current At Rectifier Output | $I_{RMSM}$ | $T_C$=100℃ | 80 | A |
| Surge Forward Current | $I_{FSM}$ | $V_R$=0V,$t_p$=10ms,$T_{vj}$=25℃ | 420 | A |
| | | $V_R$=0V,$t_p$=10ms,$T_{vj}$=150℃ | 350 | A |
| $I^2t$-value | $I^2t$ | $V_R$=0V,$t_p$=10ms,$T_{vj}$=25℃ | 880 | $A^2s$ |
| | | $V_R$=0V,$t_p$=10ms,$T_{vj}$=150℃ | 610 | $A^2s$ |

Characteristic Values

| Parameter | Symbol | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Diode Forward Voltage | $V_F$ | $I_F$=40A,$T_{vj}$=150℃ | | 1.0 | | V |
| Reverse Current | $I_R$ | $T_{vj}$=125℃,$V_R$=1600V | | | 1.5 | mA |

## NTC-Thermistor

Characteristic Values

| Parameter | Symbol | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Rated Resistance | $R_{25}$ | | | 5.0 | | kΩ |
| Deviation of R100 | ΔR/R | $T_C$=100,$R_{100}$=493.3Ω | -5 | | 5 | % |
| Power Dissipation | $P_{25}$ | | | | 20.0 | mW |
| B-value | $B_{25/50}$ | $R_2=R_{25}\exp[B_{25/50}(1/T_2-1/(298.15\ K))]$ | | 3375 | | K |

## Module Characteristics $T_C$=25°C unless otherwise specified

| Parameter | Symbol | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Isolation Voltage | $V_{isol}$ | t=1min,f=50Hz | 2500 | | | V |
| Maximum Junction Temperature | $T_{jmax}$ | | | | 175 | ℃ |
| Operating Junction Temperature | $T_{vj\ op}$ | | -40 | | 150 | ℃ |
| Storage Temperature | $T_{stg}$ | | -40 | | 125 | ℃ |
| Stray-inductance-module | $L_{SCE}$ | | | 60 | | nH |
| Module Lead Resistance, Terminals-chip | $R_{CC'+EE'}$ | $T_C$=25℃, per switch | | 4.0 | | mΩ |
| | $R_{AA'+CC'}$ | | | 3.0 | | |
| Thermal Resistance Junction to Case | $R_{\theta JC}$ | per IGBT-inverter | | | 0.70 | K/W |
| | | per Diode-inverter | | | 1.30 | |
| | | per IGBT-brake-chopper | | | 0.90 | |
| | | per Diode-chopper | | | 1.50 | |
| | | per Diode-rectifier | | | 0.75 | |
| Thermal Resistance Case to Sink | $R_{\theta CS}$ | per IGBT-inverter | | 0.29 | | K/W |
| | | per Diode-inverter | | 0.44 | | |
| | | per IGBT-brake-chopper | | 0.32 | | |
| | | per Diode-chopper | | 0.33 | | |
| | | per Diode-rectifier | | 0.70 | | |
| | | per Module | | 0.009 | | |
| Module-to-Sink Torque | Ms | | 3.0 | | 6.0 | N·m |
| Weight of Module | G | | | 300 | | g |

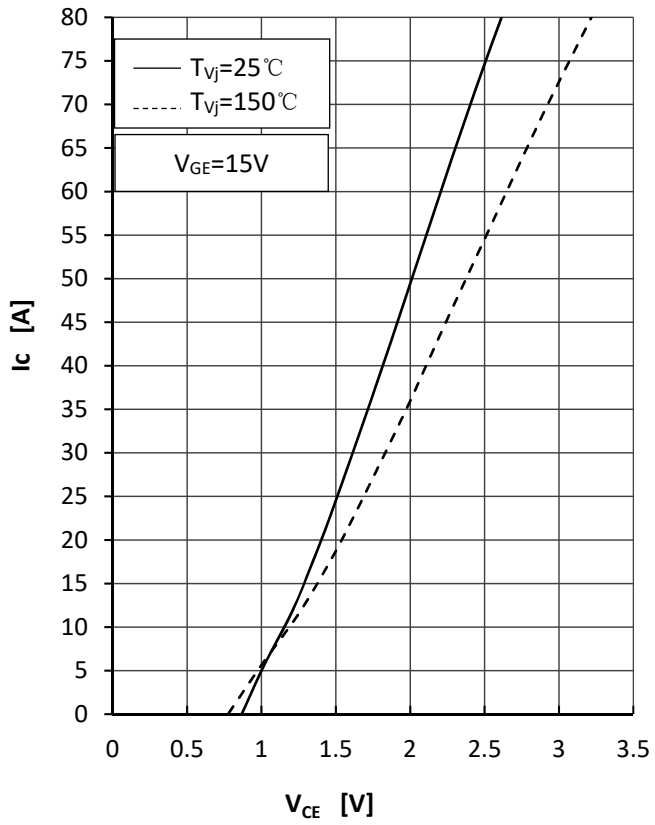



Fig1.IGBT Output Characteristics

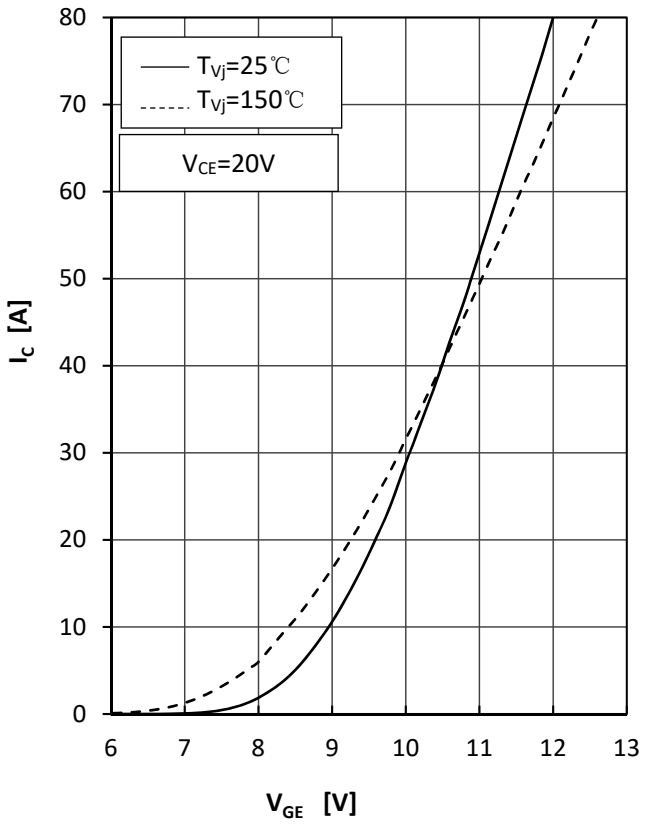



Fig2.IGBT Transfer Characteristics

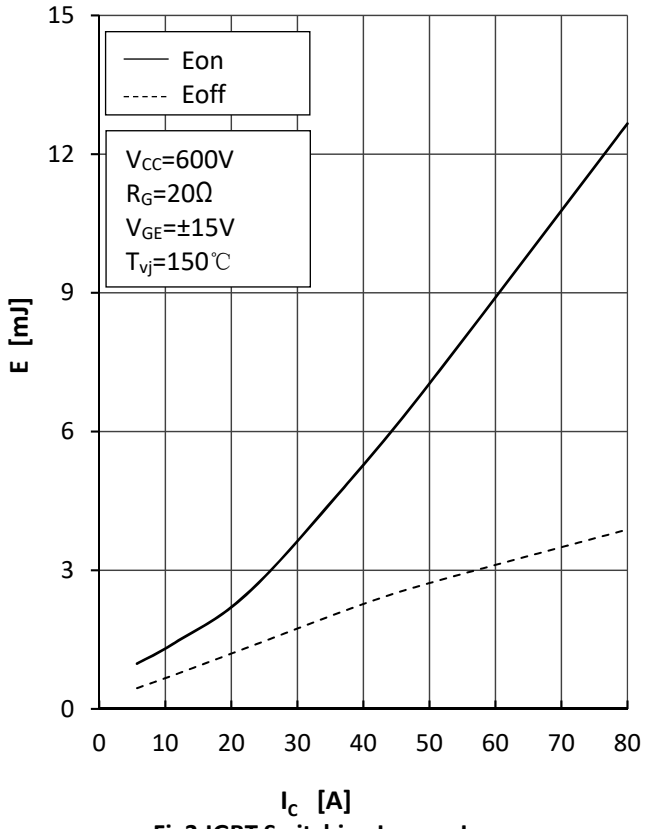



Fig3.IGBT Switching Loss vs.Ic

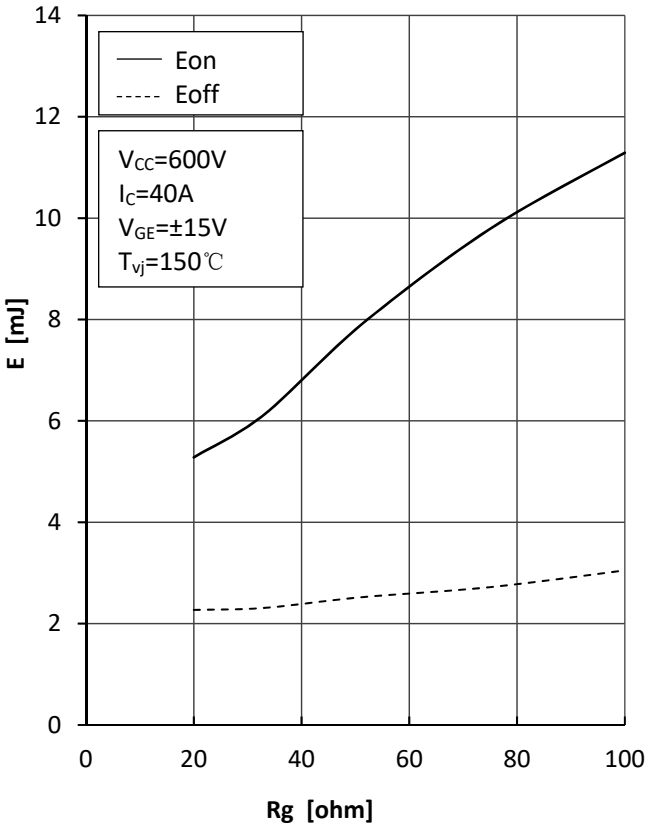



Fig4.IGBT Switching Loss vs.Rg

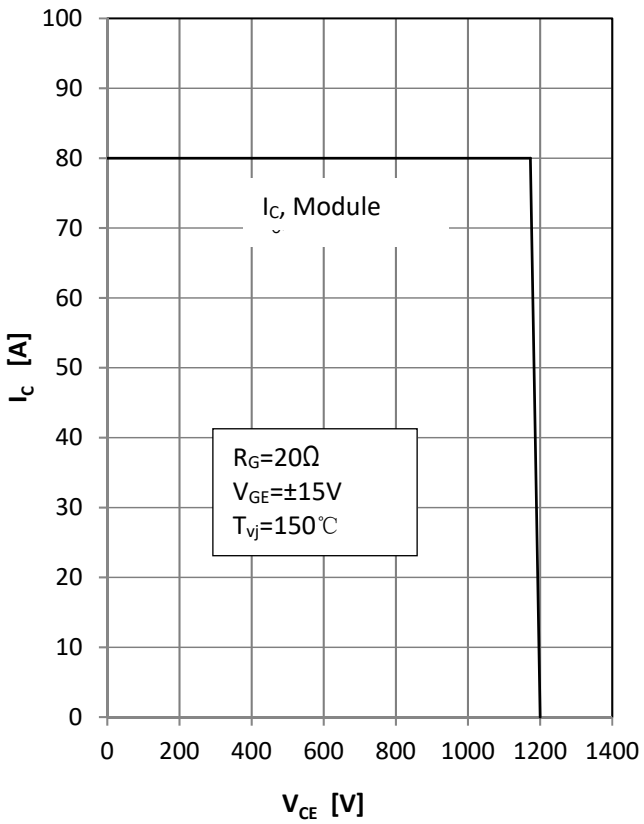



Fig5. RBSOA

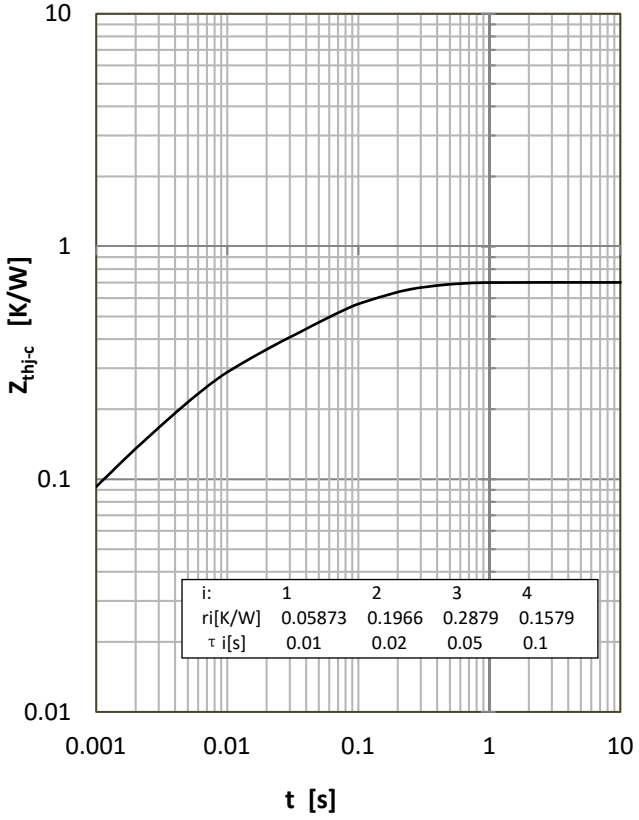



Fig 6. IGBT Transient Thermal Impedance

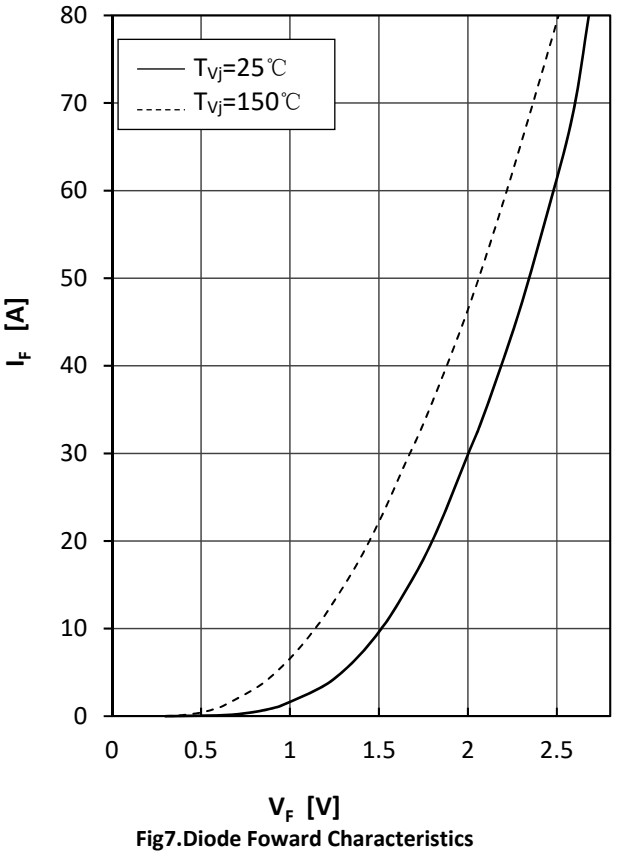



Fig7.Diode Foward Characteristics

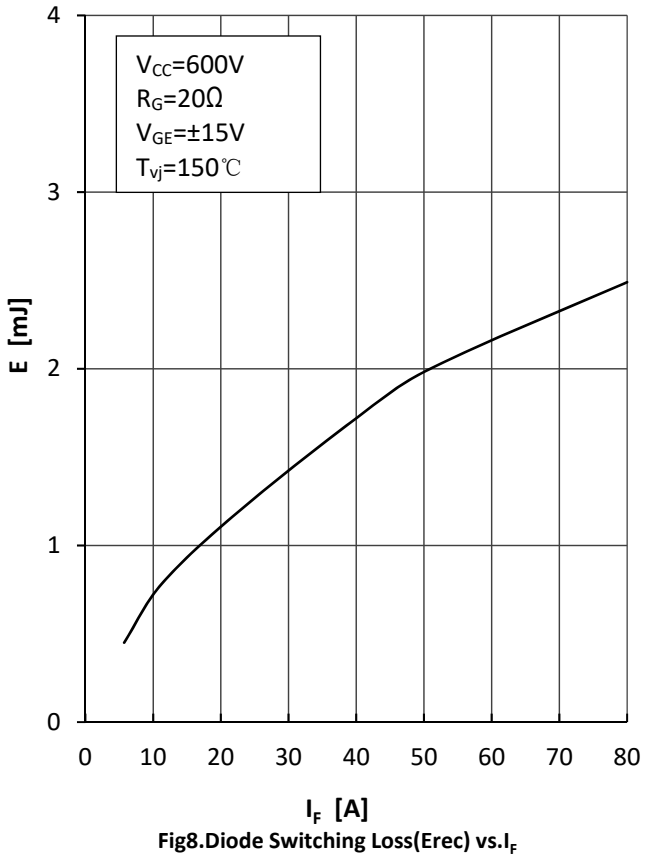



Fig8.Diode Switching Loss(Erec) vs.$I_F$

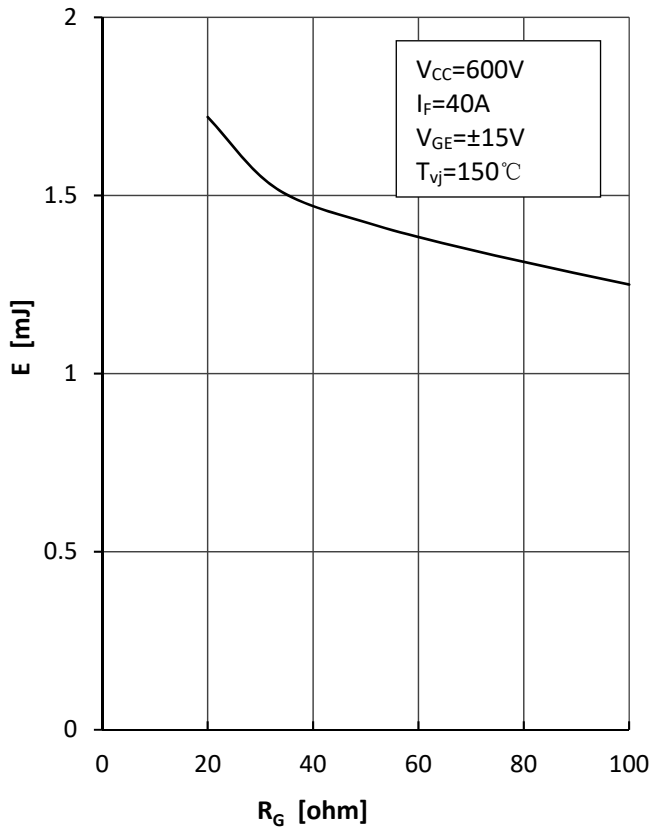



Fig9.Diode Switching Loss(Erec) vs.Rg

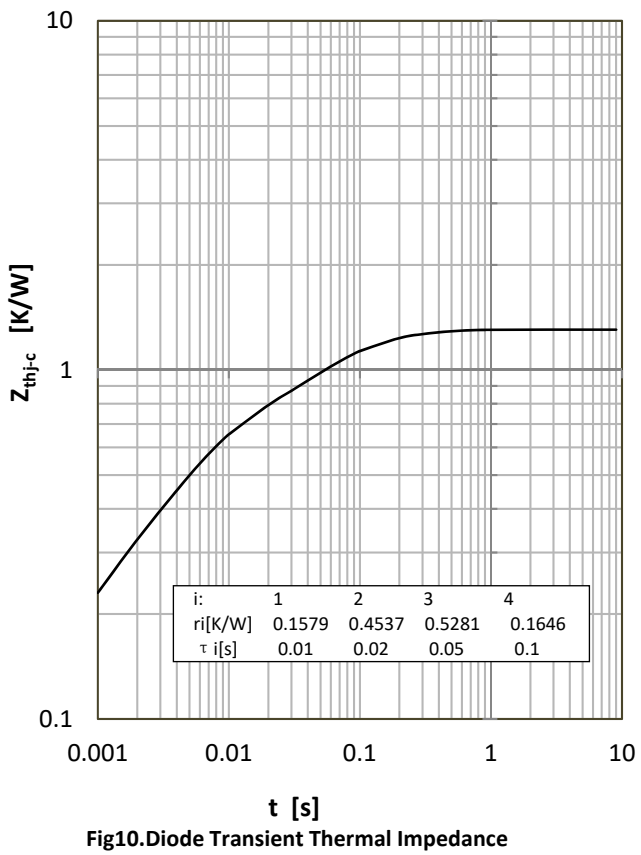



Fig10.Diode Transient Thermal Impedance

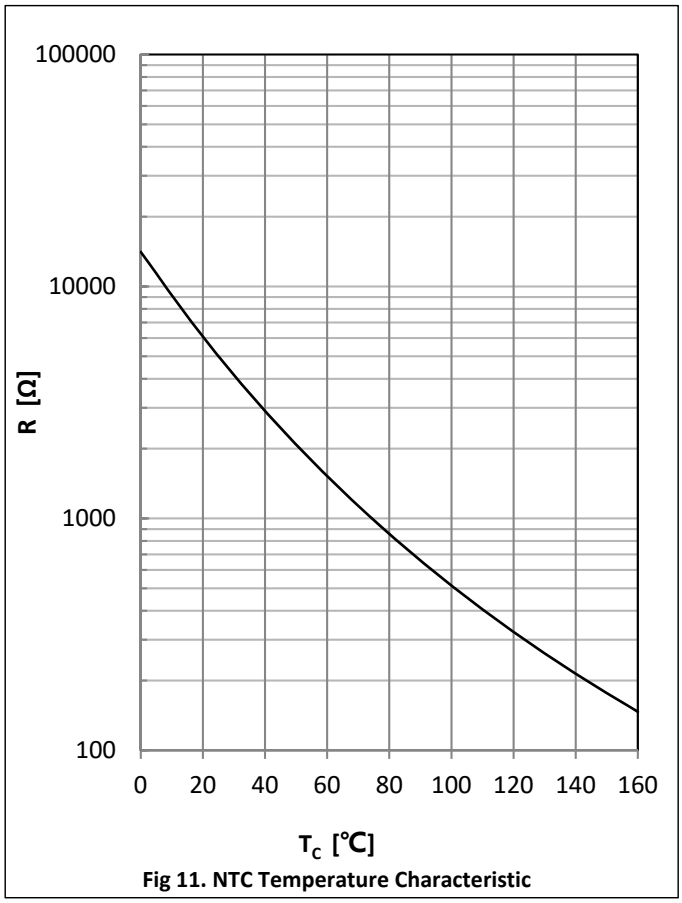



Fig 11. NTC Temperature Characteristic

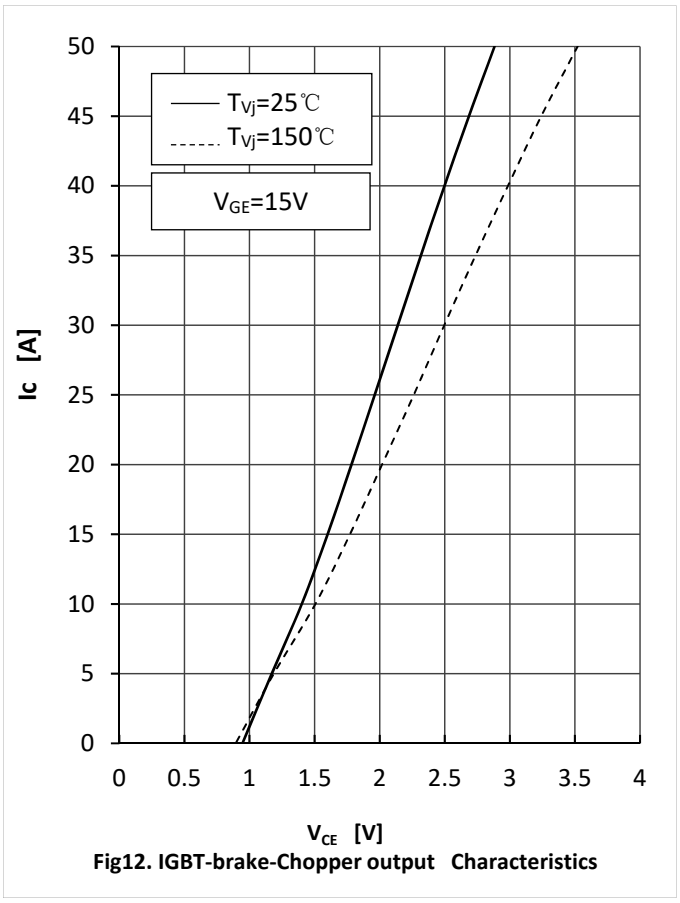



Fig12. IGBT-brake-Chopper output Characteristics

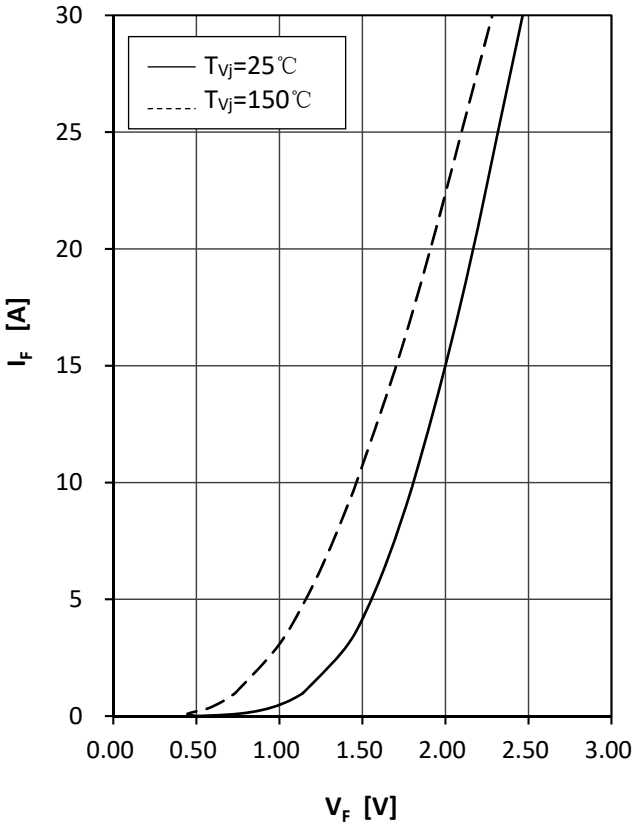
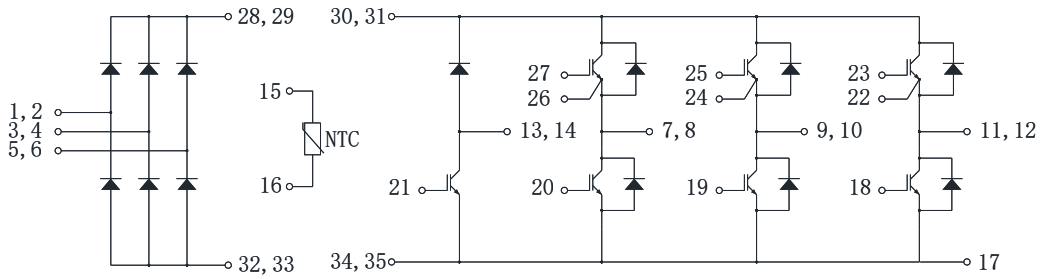
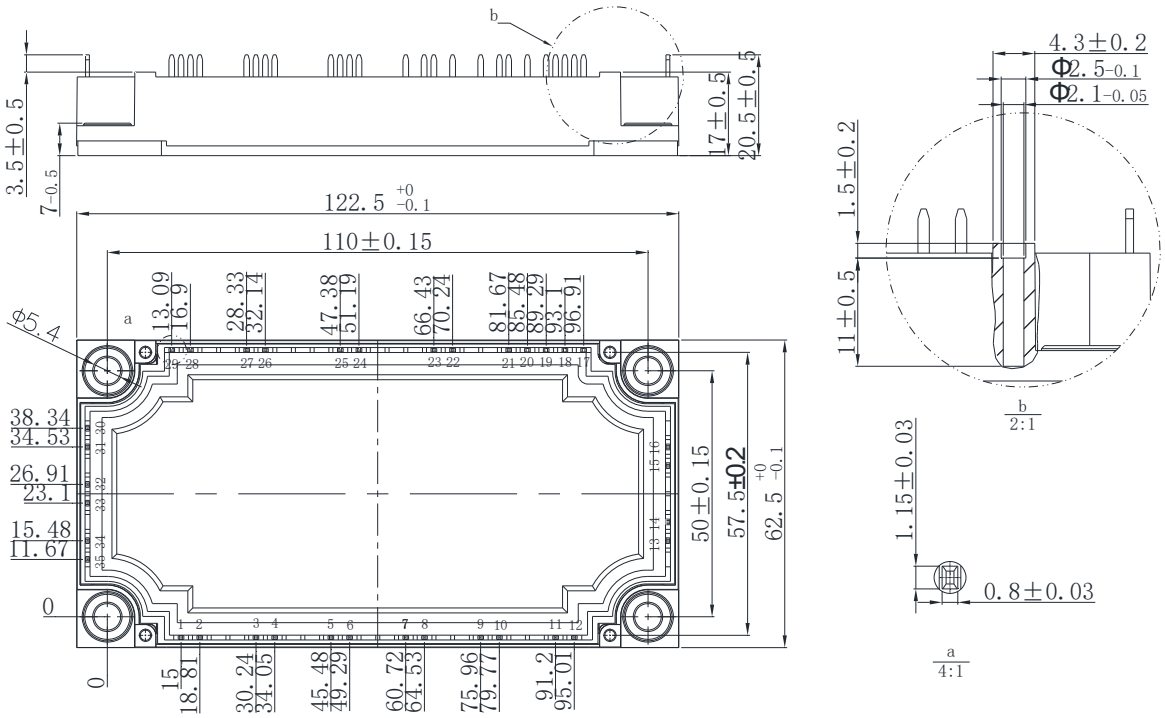



Fig13.Diode-brake-chopper Forward Characteristics

## Circuit Diagram




## Package Outline Information



## Notice

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