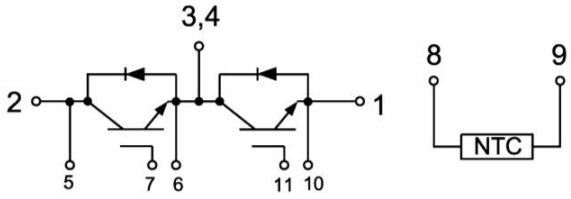
# GT600HF120T9H
## IGBT Module

**Features:**

- Trench & Field Stop IGBT
- Short Circuit Rated>10μs
- Low Switching Loss
- 100% RBSOA Tested(2×Ic)
- Low Stray Inductance
- Lead Free, Compliant with RoHS Requirement

**Circuit Diagram**




**Applications:**

- Hybrid Electrical Vehicles(H)EV
- Automotive Applications
- Commercial Agriculture Vehicles
- Motor Drives

### IGBT, Inverter
### Maximum Rated Values

| | | | | |
|---|---|---|---|---|
| $V_{CES}$ | Collector-Emitter Blocking Voltage | $T_J$=25℃ | 1200 | V |
| $V_{GES}$ | Gate-Emitter Voltage | | ±20 | V |
| $I_C$ | Continuous Collector Current | $T_C$=100℃ | 600 | A |
| | | $T_C$=25℃ | 1200 | A |
| $I_{CM}$ | Peak Collector Current Repetitive | $t_p$=1ms | 1200 | A |
| $t_{SC}$ | Short Circuit Withstand Time | | >10 | μs |
| $P_D$ | Maximum Power Dissipation (IGBT) | $T_C$=25℃<br>$T_{Jmax}$=150℃ | 2770 | W |

## Electrical Characteristics of IGBT

Static Characteristics

| Symbol | Description | Conditions | | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|---|
| $V_{GE(th)}$ | Gate-Emitter Threshold Voltage | $I_C$=72mA, $V_{CE}$=$V_{GE}$, $T_J$=25℃ | | 5.0 | 5.7 | 6.8 | V |
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage | $I_C$=600A, $V_{GE}$=15V | $T_J$=25℃ | | 2.00 | 2.20 | V |
| | | | $T_J$=125℃ | | 2.35 | | V |
| | | | $T_J$=150℃ | | 2.40 | | V |
| $I_{CES}$ | Collector-Emitter Leakage Current | $V_{GE}$=0V, $V_{CE}$=$V_{CES}$, $T_J$=25℃ | | | | 1 | mA |
| $I_{GES}$ | Gate-Emitter Leakage Current | $V_{GE}$=±20V, $V_{CE}$=0V, $T_J$=25℃ | | | | 600 | nA |
| $C_{ies}$ | Input Capacitance | $V_{CE}$=25V, $V_{GE}$=0V, f=100kHz,$T_J$=25℃ | | | 86.8 | | nF |
| $C_{oes}$ | Output Capacitance | | | | 3.49 | | nF |
| $C_{res}$ | Reverse Transfer Capacitance | | | | 1.84 | | nF |

Switching Characteristics

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $t_{d(on)}$ | Turn-on Delay Time | $V_{CC}$=600V, $I_C$=600A, $R_{Gon}$=1Ω, $V_{GE}$=±15V, Inductive Load | $T_J$=25℃ | | 997 | | ns |
| | | | $T_J$=125℃ | | 987 | | |
| | | | $T_J$=150℃ | | 982 | | |
| $t_r$ | Rise Time | | $T_J$=25℃ | | 307 | | ns |
| | | | $T_J$=125℃ | | 313 | | |
| | | | $T_J$=150℃ | | 306 | | |
| $t_{d(off)}$ | Turn-off Delay Time | $V_{CC}$=600V, $I_C$=600A, $R_{Goff}$=1Ω, $V_{GE}$=±15V, Inductive Load | $T_J$=25℃ | | 851 | | ns |
| | | | $T_J$=125℃ | | 898 | | |
| | | | $T_J$=150℃ | | 894 | | |
| $t_f$ | Fall Time | | $T_J$=25℃ | | 168 | | ns |
| | | | $T_J$=125℃ | | 198 | | |
| | | | $T_J$=150℃ | | 200 | | |
| $E_{on}$ | Turn-on Switching Loss | $V_{CC}$=600V, $I_C$=600A, $R_{Gon}$=1Ω, $V_{GE}$=±15V, di/dt=1640A/μs ($T_J$=150℃) Inductive Load | $T_J$=25℃ | | 53.2 | | mJ |
| | | | $T_J$=125℃ | | 75.9 | | |
| | | | $T_J$=150℃ | | 78.9 | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $E_{off}$ | Turn-off Switching Loss | $V_{CC}$=600V, $I_C$=600A, $R_{Goff}$=1Ω, $V_{GE}$= ±15V, du/dt=3600V/μs ( $T_J$=150℃) Inductive Load | $T_J$=25℃ | | 82.1 | | mJ |
| | | | $T_J$=125℃ | | 91.8 | | |
| | | | $T_J$=150℃ | | 95.3 | | |
| $Q_g$ | Total Gate Charge | $V_{GE}$=+15V…-15V | $T_J$=25℃ | | 5.89 | | uC |
| $R_{g\ internal}$ | Internal Gate Resistance | | $T_J$=25℃ | | 0 | | Ω |
| RBSOA | $I_C$=1200A, $V_{CC}$=1050V, Vp=1200V, $R_G$=1Ω, $V_{GE}$=+15V to 0V, $T_J$=125°C | | | Trapezoid | | | |
| $I_{SC}$ | $V_{CC}$=600V, $V_{GE}$=±15V, $R_{Gon}$=1Ω, $R_{Goff}$=1Ω, tp=10us,$T_J$=125℃, Inductive Load | | | | 4180 | | A |
| $R_{\theta JC}$ | IGBT Thermal Resistance: Junction-to-Case(per IGBT) | | | | | 0.045 | ℃/W |

## Diode, Inverter
## Maximum Rated Values of Diode

| | | | | |
|---|---|---|---|---|
| $V_{RRM}$ | Repetitive Peak Reverse Voltage | $T_J$=25℃ | 1200 | V |
| $I_F$ | Diode Continuous Forward Current | | 600 | A |
| $I_{FM}$ | Diode Maximum Forward Current | $t_p$=1ms | 1200 | A |
| $I^2t$ | $I^2t$ - Value | $V_R$=0V, $t_P$=10ms, $T_J$=125℃ | 40000 | $A^2s$ |
| | | $V_R$=0V, $t_P$=10ms, $T_J$=150℃ | 37500 | $A^2s$ |

## Electrical Characteristics of Diode

| Symbol | Description | Conditions | | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|---|
| $V_{FM}$ | Forward Voltage | $I_F$=600A | $T_J$=25℃ | | 2.30 | 2.60 | V |
| | | | $T_J$=125℃ | | 2.45 | | |
| | | | $T_J$=150℃ | | 2.45 | | |
| $t_{rr}$ | Reverse Recovery Time | $I_F$=600A, -diF/dt=1840A/μs($T_J$=150℃), $V_R$=600V, $V_{GE}$=-15V | $T_J$=25℃ | | 246 | | ns |
| | | | $T_J$=125℃ | | 367 | | |
| | | | $T_J$=150℃ | | 403 | | |
| $I_{rr}$ | Peak Reverse Recovery Current | | $T_J$=25℃ | | 169 | | A |
| | | | $T_J$=125℃ | | 238 | | |
| | | | $T_J$=150℃ | | 263 | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $Q_{rr}$ | Reverse Recovery Charge | $I_F$=600A, -diF/dt=1840A/μs($T_J$=150℃), $V_R$=600V, $V_{GE}$=-15V | $T_J$=25℃ | | 25.5 | | μC |
| | | | $T_J$=125℃ | | 55.8 | | |
| | | | $T_J$=150℃ | | 65.2 | | |
| $E_{rec}$ | Reverse Recovery Energy | | $T_J$=25℃ | | 9.78 | | mJ |
| | | | $T_J$=125℃ | | 20.9 | | |
| | | | $T_J$=150℃ | | 25.8 | | |
| $R_{\theta JC}$ | Diode Thermal Resistance: Junction-to-Case (per Diode) | | | | | 0.064 | ℃/W |

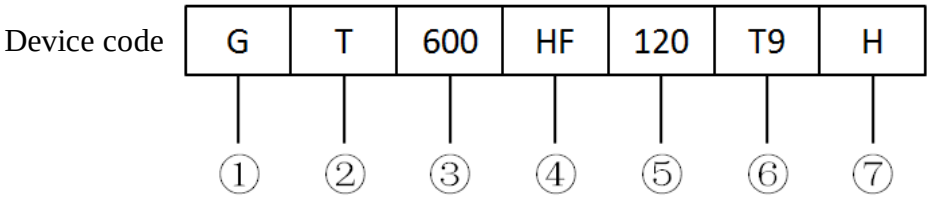
## Internal NTC-Thermistor Characteristics

| Symbol | Description | | Min. | Typ. | Max. | Units. |
|---|---|---|---|---|---|---|
| $R_{25}$ | Rated Resistance | $T_C$=25℃ | | 5 | | kΩ |
| △R/R | Deviation of R100 | $T_C$=100℃，$R_{100}$=481Ω | -5 | | 5 | % |
| $P_{25}$ | Power Dissipation | $T_C$=25℃ | | | 10 | mW |
| $B_{25/50}$ | B-Value | $R_2=R_{25}\exp[B_{25/50}(1/T_2-1/(298.15K))]$ | | 3380 | | K |
| $B_{25/80}$ | B-Value | $R_2=R_{25}\exp[B_{25/80}(1/T_2-1/(298.15K))]$ | | 3440 | | K |

### Module

| Symbol | Description | | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| $V_{iso}$ | Isolation Voltage (All Terminals Shorted) | RMS, f=50Hz, 1minute | 2500 | | | V |
| $L_{sCE}$ | Stray Inductance Module | | | 20 | | nH |
| $T_J$ | Maximum Junction Temperature | | | | 150 | ℃ |
| $T_{JOP}$ | Maximum Operating Junction Temperature Range | | -40 | | +150 | ℃ |
| $T_{stg}$ | Storage Temperature | | -40 | | +125 | ℃ |
| CTI | Comparative Tracking Index | | 200 | | | |
| $R_{\theta CS}$ | Case-to-Sink Thermally (Conductive Grease Applied) | | | | 0.02 | ℃/W |
| M | Terminals Connection Torque | Screw M6-Mounting according to valid application note | 3.0 | | 6.0 | N·m |
| M | Mounting Torque for Module Mounting | Screw M5--Mounting according to valid application note | 3.0 | | 6.0 | N·m |
| G | Weight | | | 330 | | g |

## Ordering Information Table




① - IGBT Module
② - Field Stop Trench Gate IGBT
③ - Rated Current (600=600A)
④ - Circuit Configuration (HF=Half Bridge)
⑤ - Rated Voltage (120=1200V)
⑥ - Package Type
⑦ - Test Level (Pass the Important Reliability Test-Industrial Grade)

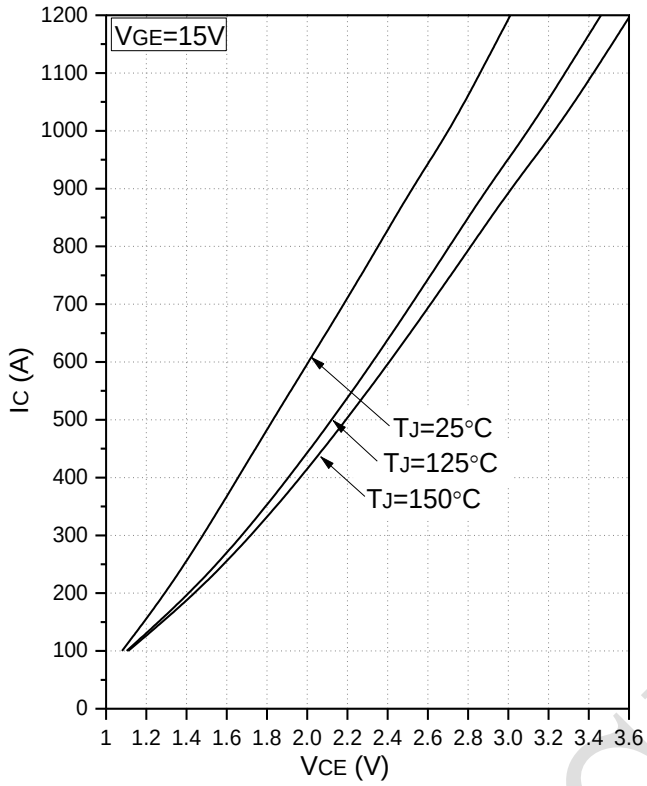



Fig.1 Typical Saturation Voltage Characteristics

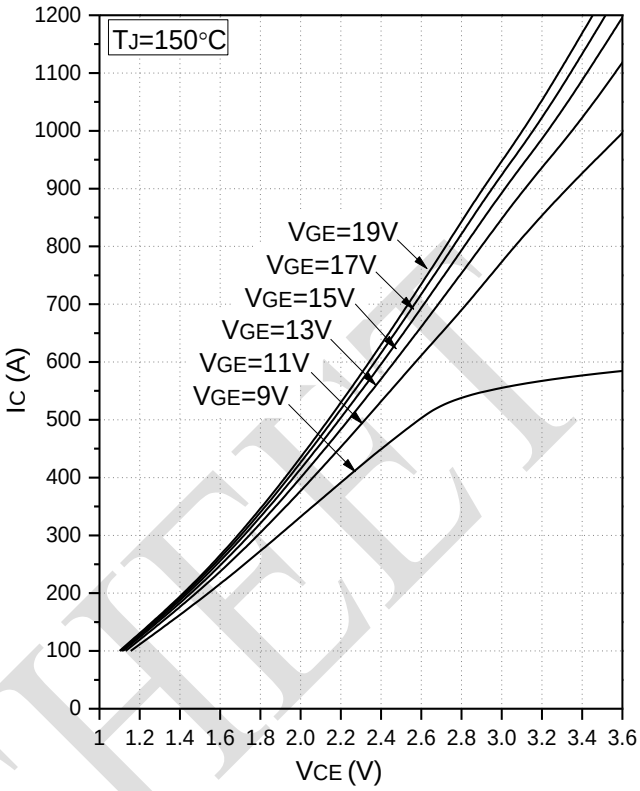



Fig.2 Typical Output Characteristics

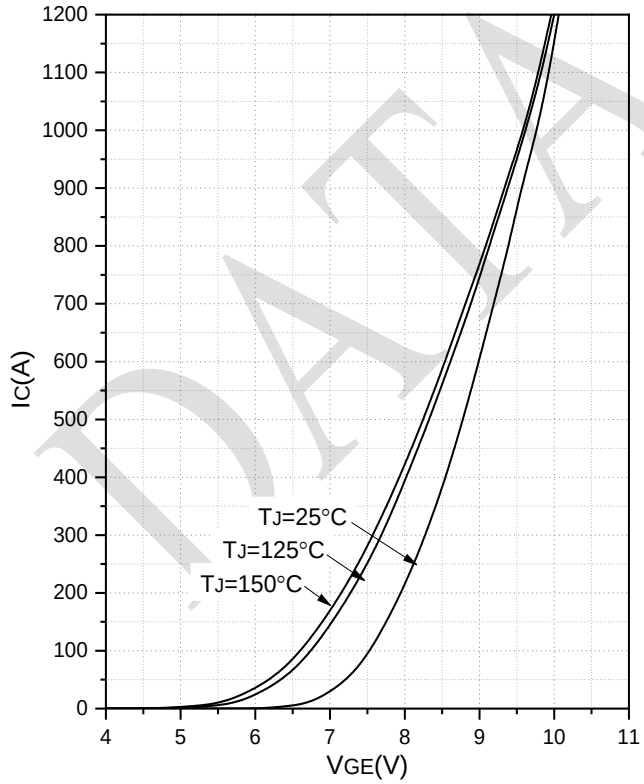



Fig.3 Transfer Characteristic

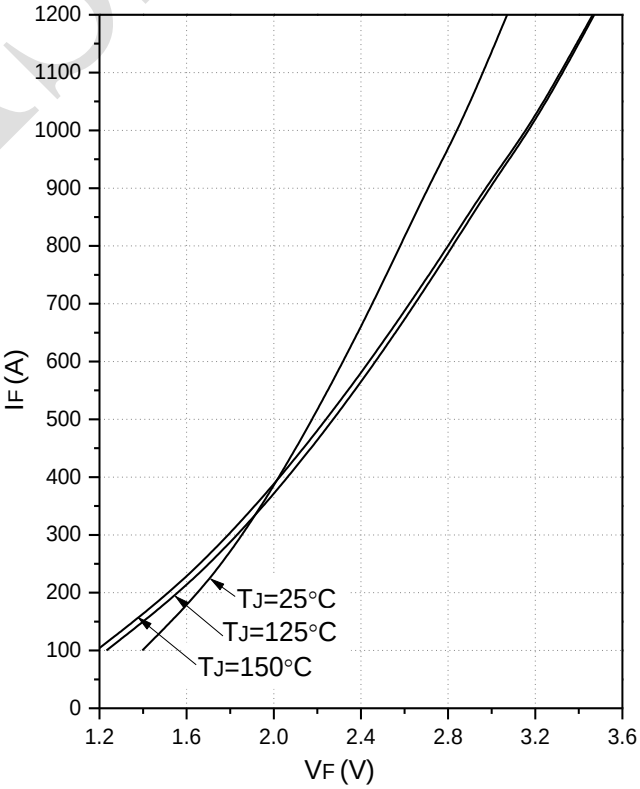



Fig.4 Forward Characteristics of Diode

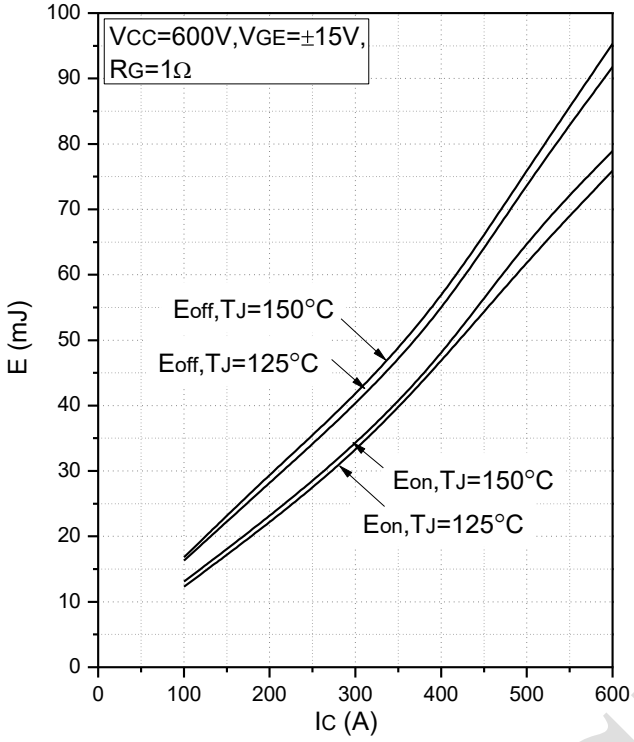



Fig.5 Typical Switching Loss vs. Collector Current

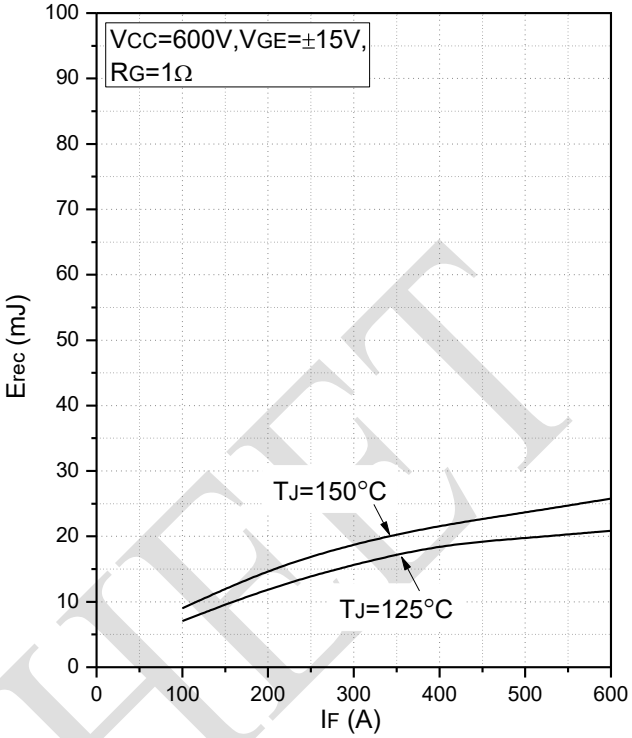



Fig.6 Typical Switching Loss vs. Forward Current

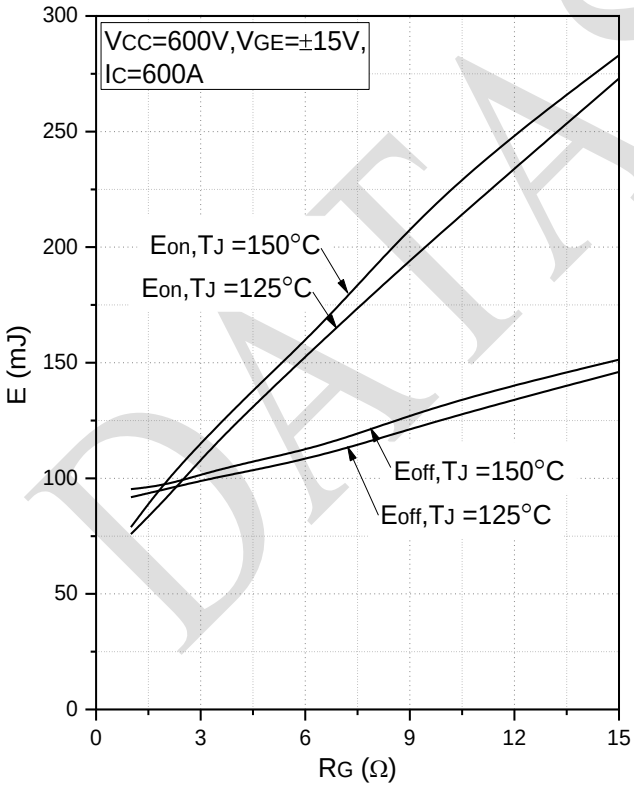



Fig.7 Typical Switching Loss vs. Gate Resistance

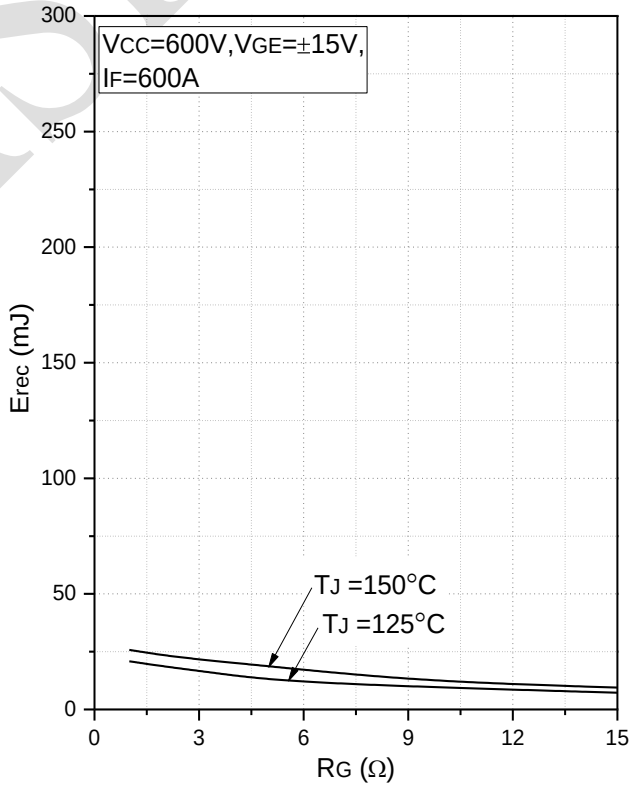



Fig.8 Typical Switching Loss vs. Gate Resistance

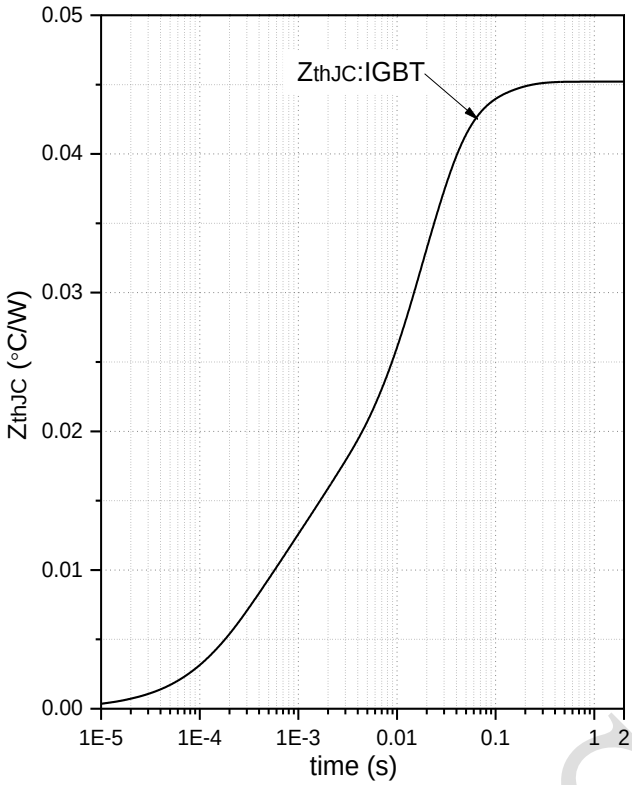



Fig.9 Transient Thermal Impedance (IGBT)

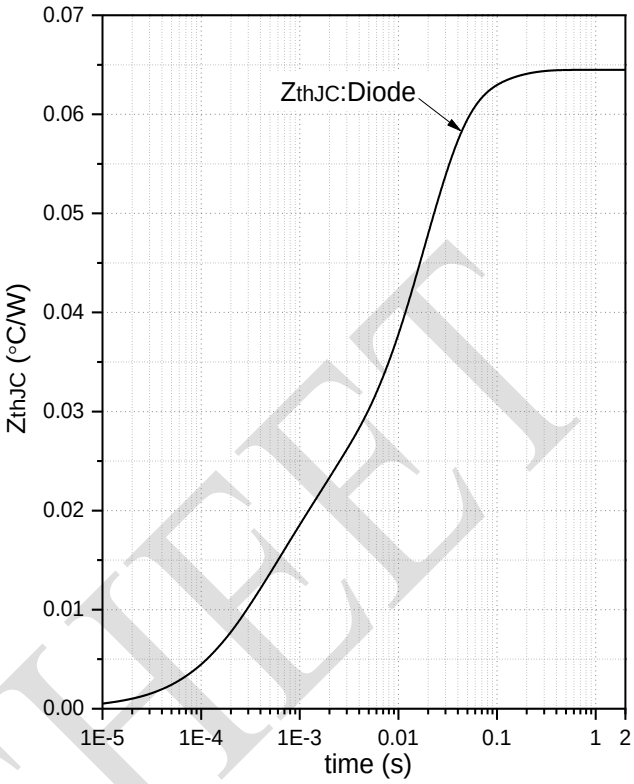



Fig.10 Transient Thermal Impedance (Diode)

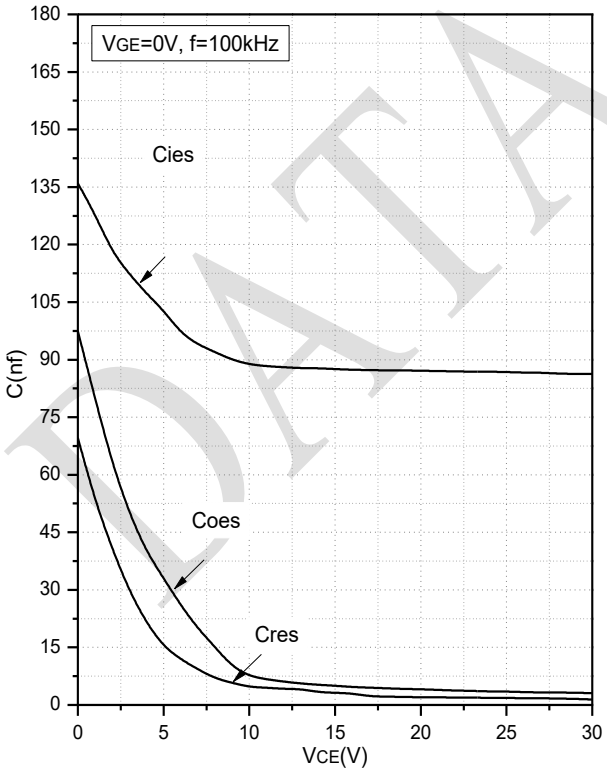



Fig.11 Capacitance Characteristics

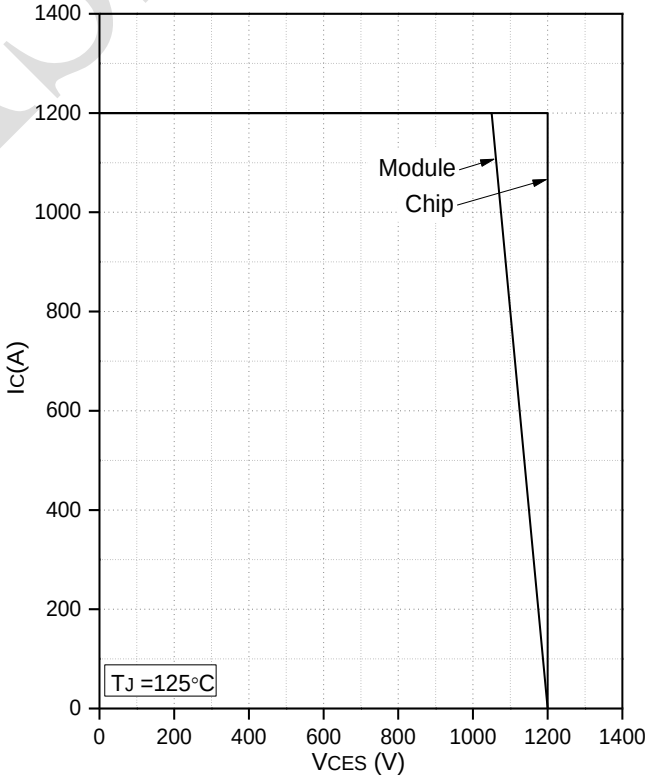



Fig.12 Reverse Bias Safe Operation Area (RBSOA)

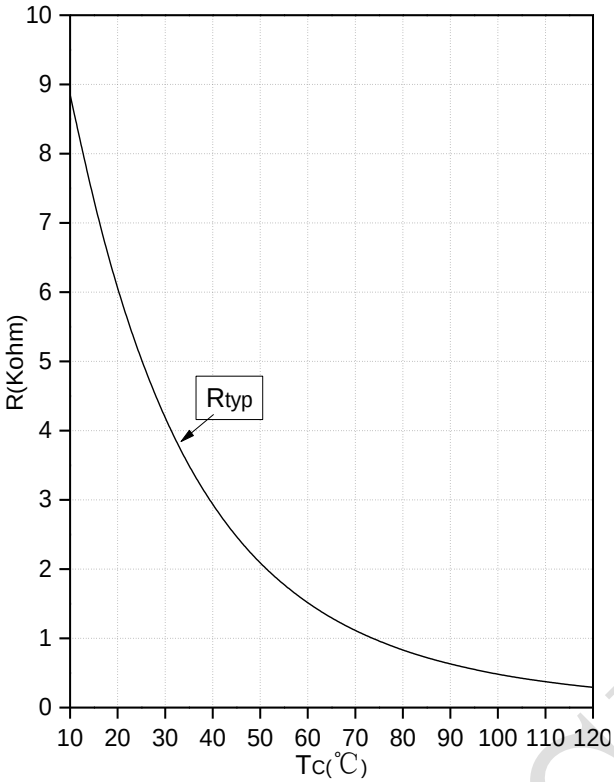
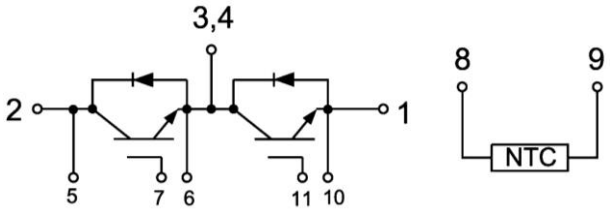
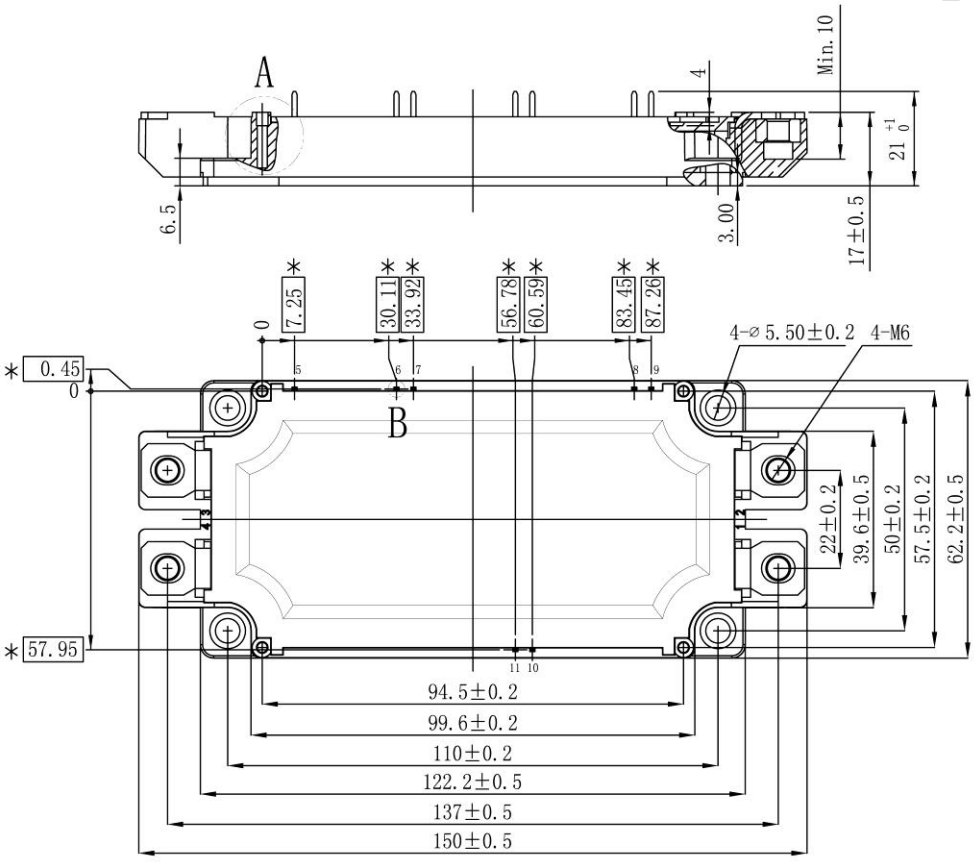


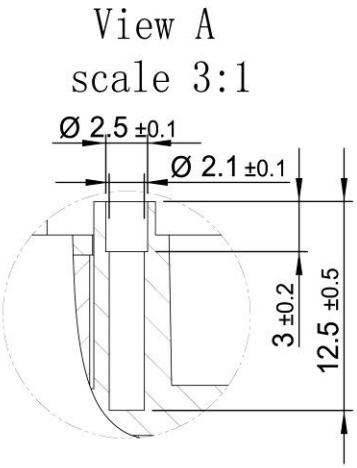

Fig.13 NTC Temperature Characteristics

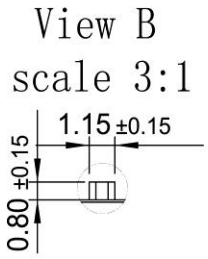
**Internal Circuit:**




**Package Outline (Unit: mm):**



| Date | Revision | Notes |
|---|---|---|
| 05/08/2019 | A | Final Version |
| 09/10/2021 | B | Add "$I_{SC}$" Value |
| 08/11/2022 | C | Add "$I^2t$" Value |
| 09/15/2022 | D | Update Electrical Characteristics Value |

## Announcement

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