

STARPOWER

SEMICONDUCTOR

IGBT

GD600HFX65C6H

650V/600A 2 in one-package

General Description

STARPOWER IGBT Power Module provides ultra low conduction loss as well as short circuit ruggedness.

They are designed for the applications such as inverters and UPS.

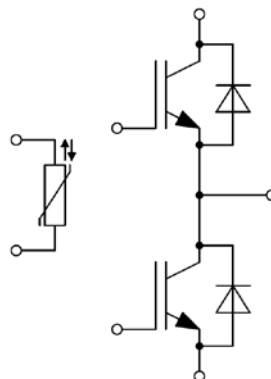
Features

- Low $V_{CE(sat)}$ Trench IGBT technology
- $V_{CE(sat)}$ with positive temperature coefficient
- 6 μ s short circuit capability
- Maximum junction temperature 175°C
- Low inductance case
- Fast & soft reverse recovery anti-parallel FWD
- Isolated copper baseplate using DBC technology

Typical Applications

- Inverter for motor drive
- AC and DC servo drive amplifier
- Uninterruptible power supply

Equivalent Circuit Schematic



Absolute Maximum Ratings $T_C=25^{\circ}\text{C}$ unless otherwise noted**IGBT**

| Symbol | Description | Values | Unit |
|-----------|---|----------|------|
| V_{CES} | Collector-Emitter Voltage | 650 | V |
| V_{GES} | Gate-Emitter Voltage | ± 20 | V |
| I_C | Collector Current @ $T_C=25^{\circ}\text{C}$ | 700 | A |
| | @ $T_C=60^{\circ}\text{C}$ | 600 | |
| I_{CM} | Pulsed Collector Current $t_p=1\text{ms}$ | 1200 | A |
| P_D | Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$ | 1648 | W |

Diode

| Symbol | Description | Values | Unit |
|-----------|--|--------|------|
| V_{RRM} | Repetitive Peak Reverse Voltage | 650 | V |
| I_F | Diode Continuous Forward Current | 600 | A |
| I_{FM} | Diode Maximum Forward Current $t_p=1\text{ms}$ | 1200 | A |

Module

| Symbol | Description | Values | Unit |
|------------|--|-------------|--------------------|
| T_{jmax} | Maximum Junction Temperature | 175 | $^{\circ}\text{C}$ |
| T_{jop} | Operating Junction Temperature | -40 to +150 | $^{\circ}\text{C}$ |
| T_{STG} | Storage Temperature Range | -40 to +125 | $^{\circ}\text{C}$ |
| V_{ISO} | Isolation Voltage RMS, $f=50\text{Hz}$, $t=1\text{min}$ | 2500 | V |

IGBT Characteristics $T_c=25^\circ\text{C}$ unless otherwise noted

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit | |
|---------------|---|---|------|------|------|---------------|----|
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | $I_C=600\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$ | | 1.45 | 1.90 | V | |
| | | $I_C=600\text{A}, V_{GE}=15\text{V}, T_j=125^\circ\text{C}$ | | 1.60 | | | |
| | | $I_C=600\text{A}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}$ | | 1.70 | | | |
| $V_{GE(th)}$ | Gate-Emitter Threshold Voltage | $I_C=9.60\text{mA}, V_{CE}=V_{GE}, T_j=25^\circ\text{C}$ | 5.1 | 5.8 | 6.5 | V | |
| I_{CES} | Collector Cut-Off Current | $V_{CE}=V_{CES}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$ | | | 5.0 | mA | |
| I_{GES} | Gate-Emitter Leakage Current | $V_{GE}=V_{GES}, V_{CE}=0\text{V}, T_j=25^\circ\text{C}$ | | | 400 | nA | |
| R_{Gint} | Internal Gate Resistance | | | 0.67 | | Ω | |
| C_{ies} | Input Capacitance | $V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$ | | 35.1 | | nF | |
| C_{res} | Reverse Transfer Capacitance | | | | 1.04 | | nF |
| Q_G | Gate Charge | $V_{GE}=-15 \dots +15\text{V}$ | | 5.85 | | μC | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}=300\text{V}, I_C=600\text{A}, R_G=2.4\Omega, V_{GE}=\pm 15\text{V}, T_j=25^\circ\text{C}$ | | 80 | | ns | |
| t_r | Rise Time | | | 72 | | ns | |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 402 | | ns | |
| t_f | Fall Time | | | 60 | | ns | |
| E_{on} | Turn-On Switching Loss | | | | 5.3 | | mJ |
| E_{off} | Turn-Off Switching Loss | | | | 19.4 | | mJ |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}=300\text{V}, I_C=600\text{A}, R_G=2.4\Omega, V_{GE}=\pm 15\text{V}, T_j=125^\circ\text{C}$ | | 88 | | ns | |
| t_r | Rise Time | | | 76 | | ns | |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 426 | | ns | |
| t_f | Fall Time | | | 64 | | ns | |
| E_{on} | Turn-On Switching Loss | | | | 5.9 | | mJ |
| E_{off} | Turn-Off Switching Loss | | | | 22.5 | | mJ |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}=300\text{V}, I_C=600\text{A}, R_G=2.4\Omega, V_{GE}=\pm 15\text{V}, T_j=150^\circ\text{C}$ | | 96 | | ns | |
| t_r | Rise Time | | | 80 | | ns | |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 438 | | ns | |
| t_f | Fall Time | | | 64 | | ns | |
| E_{on} | Turn-On Switching Loss | | | | 6.3 | | mJ |
| E_{off} | Turn-Off Switching Loss | | | | 23.9 | | mJ |
| I_{SC} | SC Data | $t_p \leq 6\mu\text{s}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}, V_{CC}=360\text{V}, V_{CEM} \leq 650\text{V}$ | | 3000 | | A | |

Diode Characteristics $T_C=25^\circ\text{C}$ unless otherwise noted

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit | | |
|-----------|-------------------------------|---|-----------|-------------------------------|------|---------------|--|----|
| V_F | Diode Forward Voltage | $I_C=600\text{A}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$ | | 1.55 | 2.00 | V | | |
| | | $I_C=600\text{A}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$ | | 1.50 | | | | |
| | | $I_C=600\text{A}, V_{GE}=0\text{V}, T_j=150^\circ\text{C}$ | | 1.45 | | | | |
| Q_r | Recovered Charge | $V_R=300\text{V}, I_F=600\text{A},$ $-di/dt=6600\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^\circ\text{C}$ | | 18.7 | | μC | | |
| I_{RM} | Peak Reverse Recovery Current | | | 226 | | A | | |
| E_{rec} | Reverse Recovery Energy | | | 4.4 | | mJ | | |
| Q_r | Recovered Charge | $V_R=300\text{V}, I_F=600\text{A},$ $-di/dt=6600\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^\circ\text{C}$ | | 39.6 | | μC | | |
| | | | I_{RM} | Peak Reverse Recovery Current | | 330 | | A |
| | | | E_{rec} | Reverse Recovery Energy | | 10.2 | | mJ |
| Q_r | Recovered Charge | $V_R=300\text{V}, I_F=600\text{A},$ $-di/dt=6600\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=150^\circ\text{C}$ | | 46.2 | | μC | | |
| | | | I_{RM} | Peak Reverse Recovery Current | | 363 | | A |
| | | | E_{rec} | Reverse Recovery Energy | | 11.6 | | mJ |

NTC Characteristics $T_C=25^\circ\text{C}$ unless otherwise noted

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------|------------------------|--|------|------|------|------------------|
| R_{25} | Rated Resistance | | | 5.0 | | $\text{k}\Omega$ |
| $\Delta R/R$ | Deviation of R_{100} | $T_C=100^\circ\text{C}, R_{100}=493.3\Omega$ | -5 | | 5 | % |
| P_{25} | Power Dissipation | | | | 20.0 | mW |
| $B_{25/50}$ | B-value | $R_2=R_{25}\exp[B_{25/50}(1/T_2-1/(298.15\text{K}))]$ | | 3375 | | K |
| $B_{25/80}$ | B-value | $R_2=R_{25}\exp[B_{25/80}(1/T_2-1/(298.15\text{K}))]$ | | 3411 | | K |
| $B_{25/100}$ | B-value | $R_2=R_{25}\exp[B_{25/100}(1/T_2-1/(298.15\text{K}))]$ | | 3433 | | K |

Module Characteristics $T_c=25^\circ\text{C}$ unless otherwise noted

| Symbol | Parameter | Min. | Typ. | Max. | Unit |
|---------------|--|------------|-------------------------|----------------|------------|
| L_{CE} | Stray Inductance | | 20 | | nH |
| $R_{CC'+EE'}$ | Module Lead Resistance, Terminal to Chip | | 1.10 | | m Ω |
| R_{thJC} | Junction-to-Case (per IGBT) Junction-to-Case (per Diode) | | | 0.091 0.152 | K/W |
| R_{thCH} | Case-to-Heatsink (per IGBT) Case-to-Heatsink (per Diode) Case-to-Heatsink (per Module) | | 0.028 0.052 0.009 | | K/W |
| M | Terminal Connection Torque, Screw M6 Mounting Torque, Screw M5 | 3.0 3.0 | | 6.0 6.0 | N.m |
| G | Weight of Module | | 350 | | g |

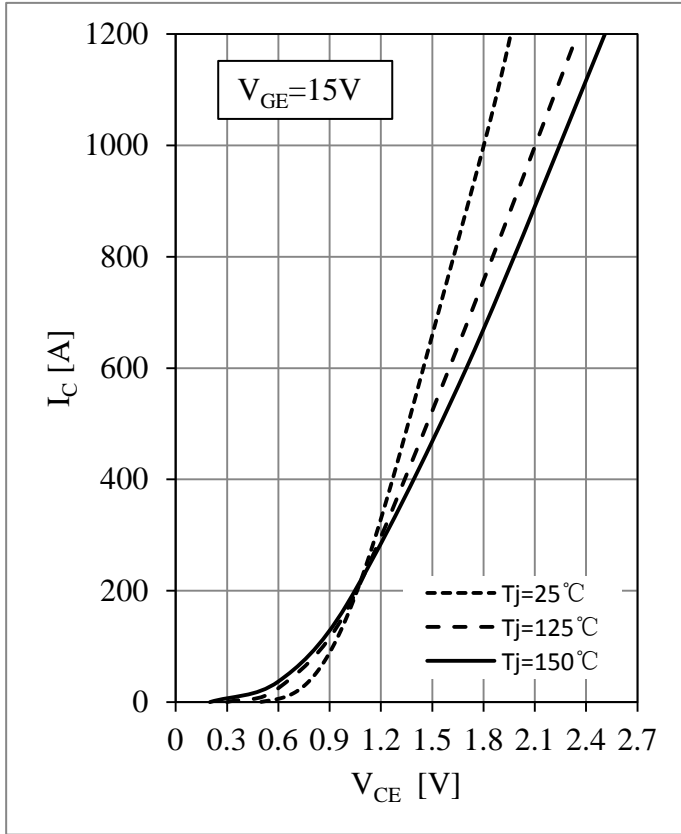


Fig 1. IGBT Output Characteristics

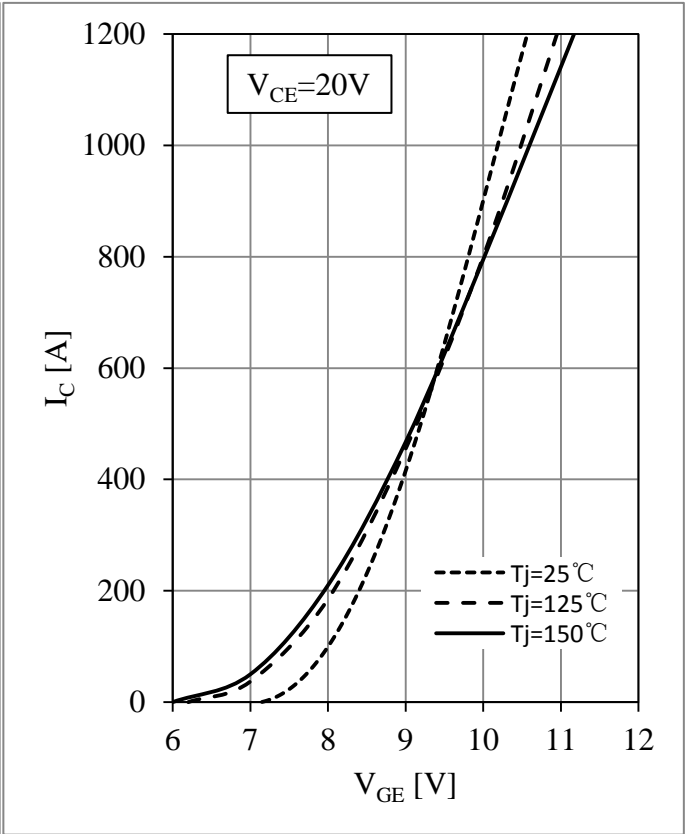


Fig 2. IGBT Transfer Characteristics

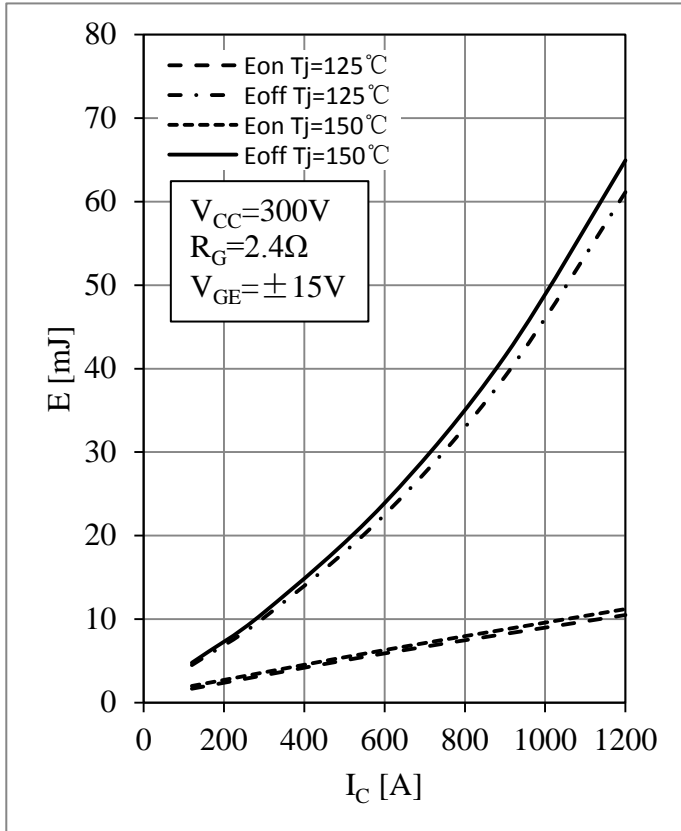


Fig 3. IGBT Switching Loss vs. I_C

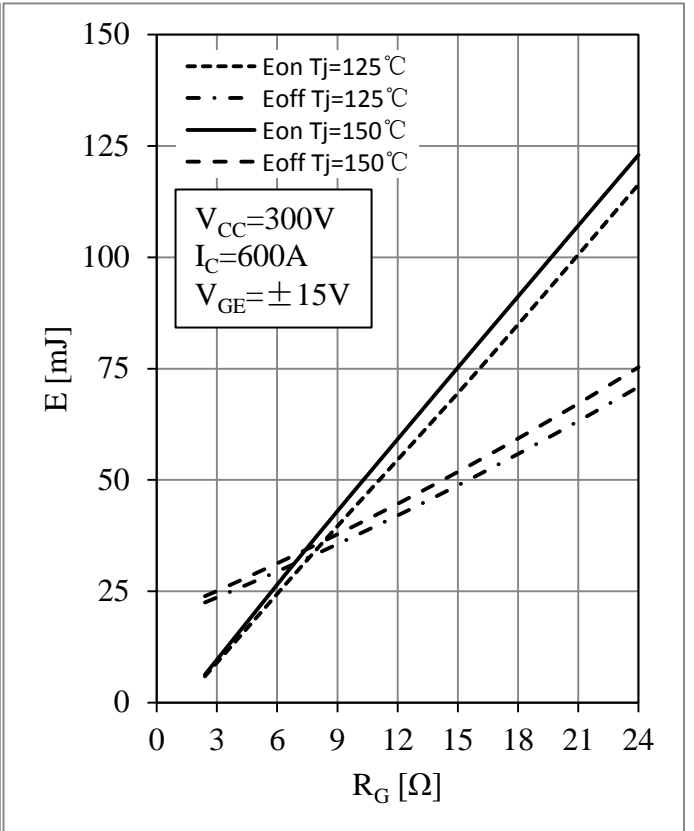


Fig 4. IGBT Switching Loss vs. R_G

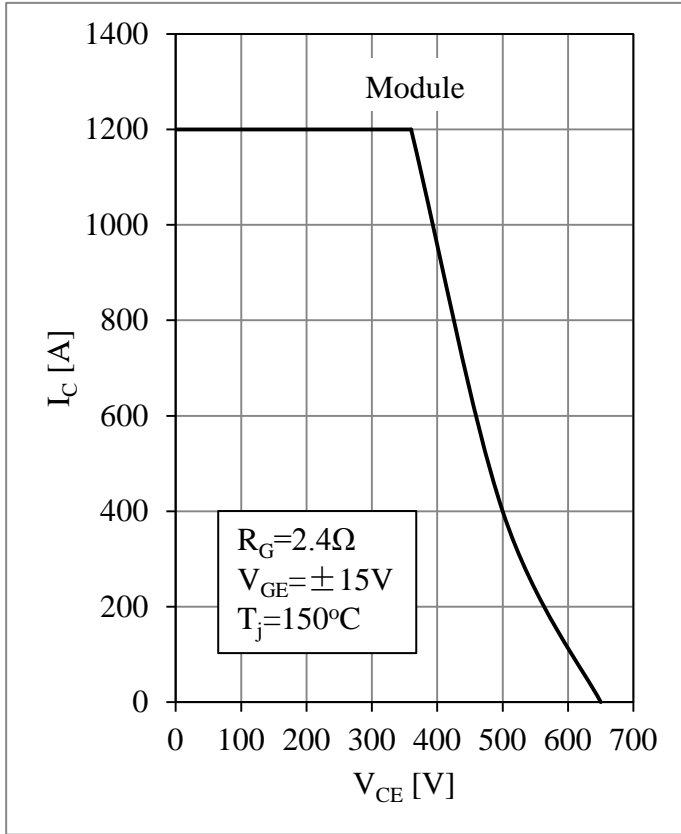


Fig 5. RBSOA

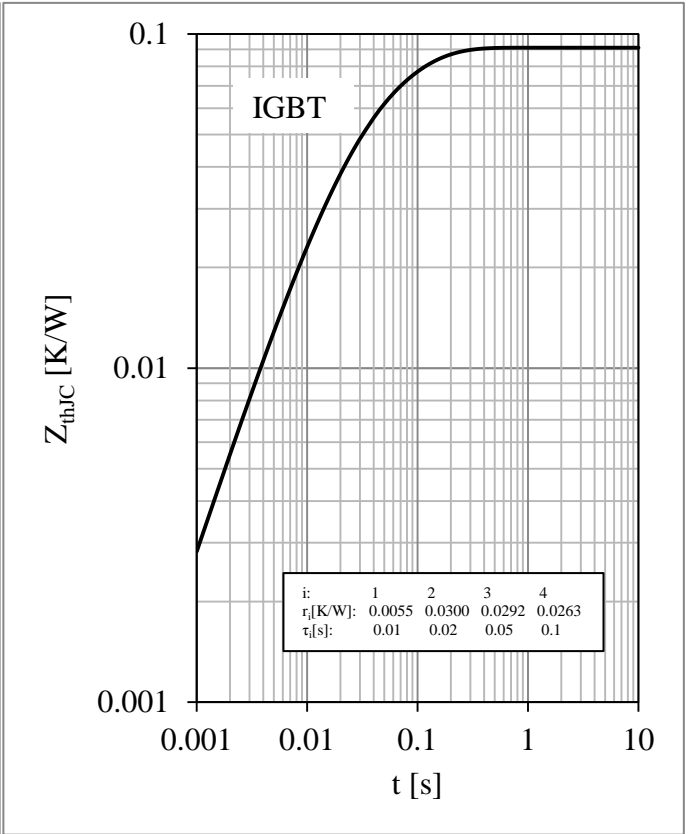


Fig 6. IGBT Transient Thermal Impedance

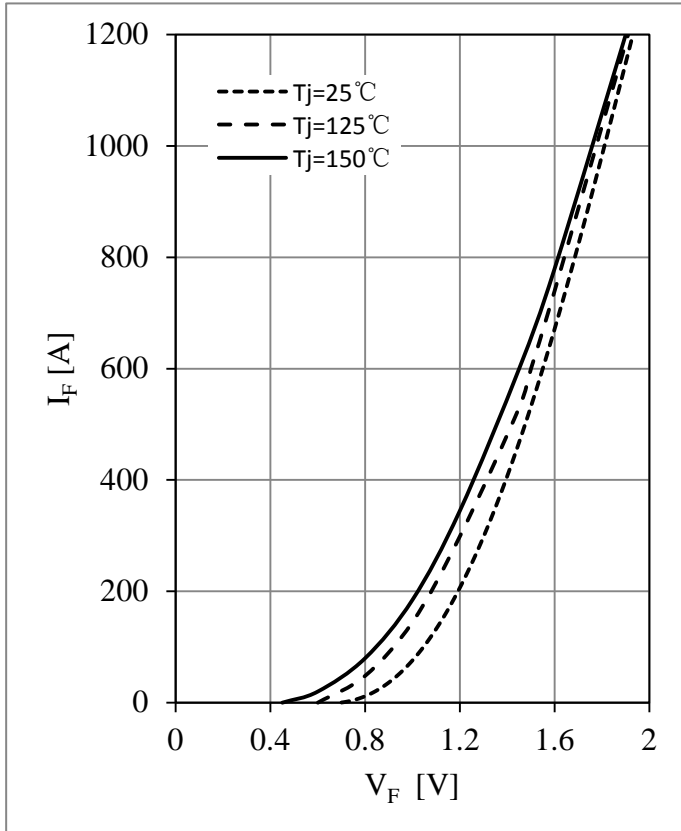


Fig 7. Diode Forward Characteristics

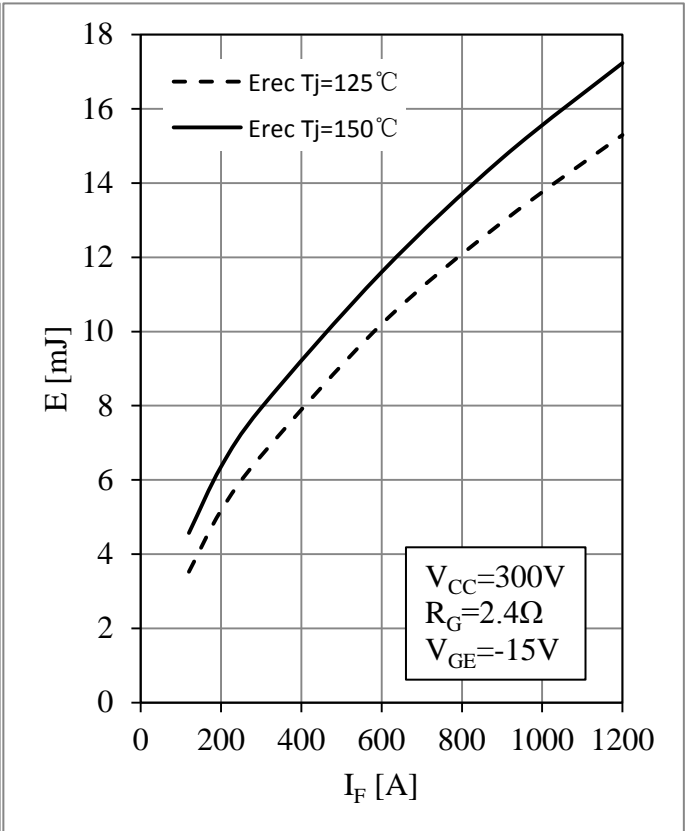


Fig 8. Diode Switching Loss vs. I_F

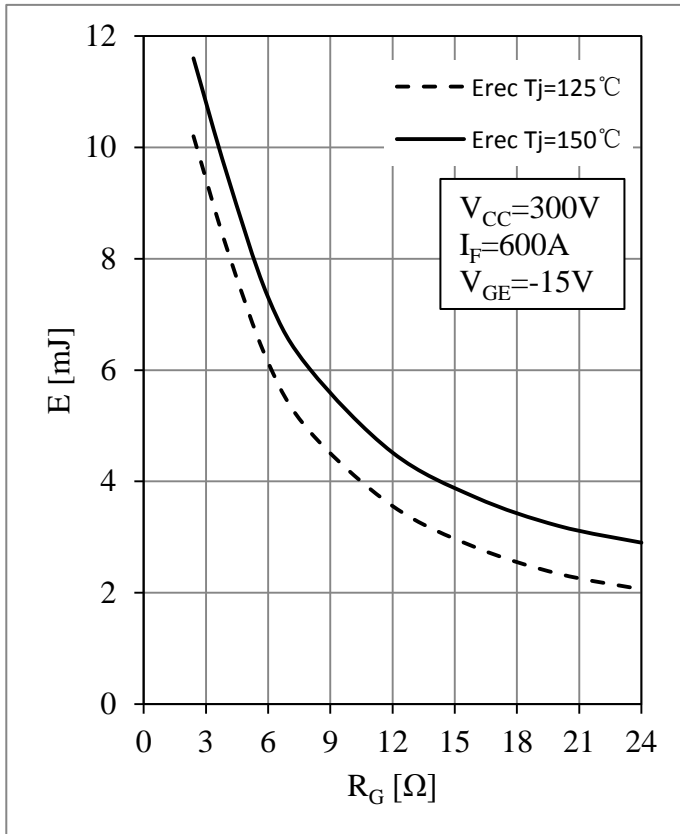


Fig 9. Diode Switching Loss vs. R_G

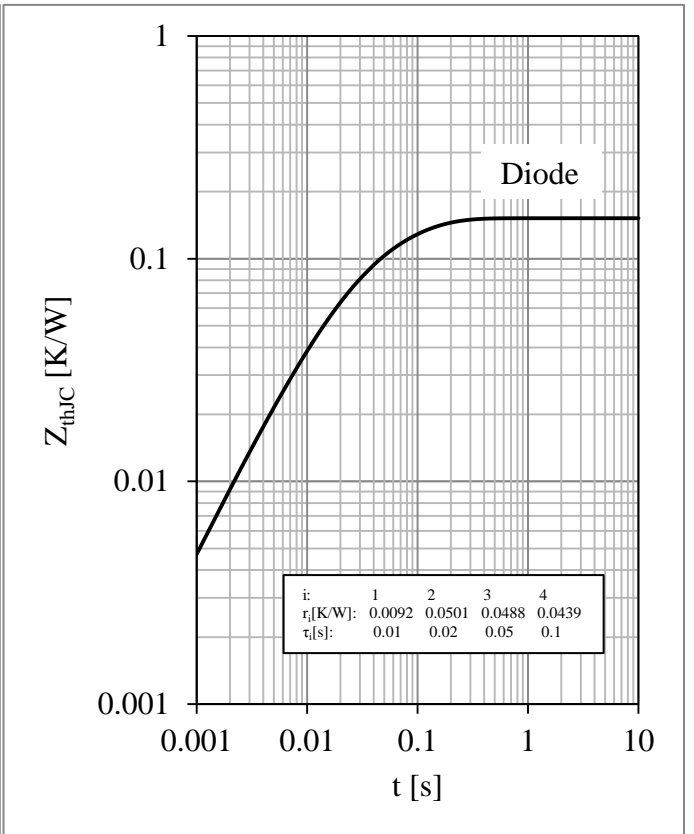


Fig 10. Diode Transient Thermal Impedance

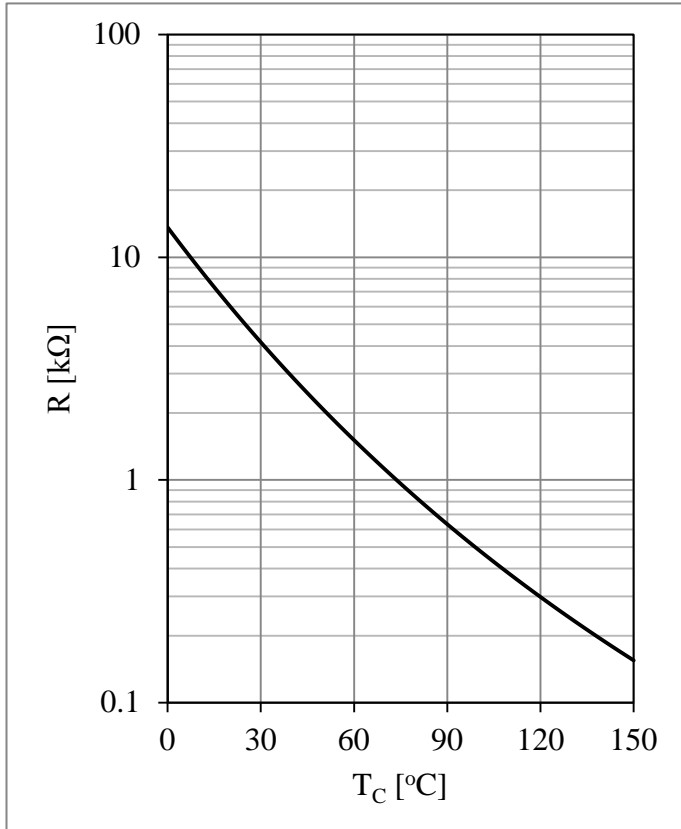
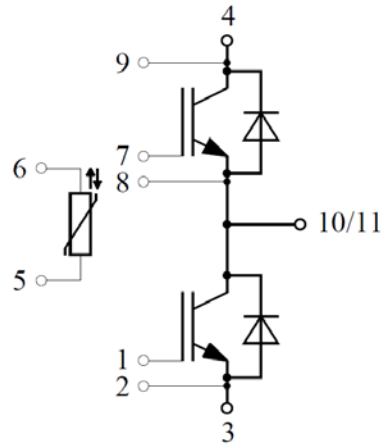


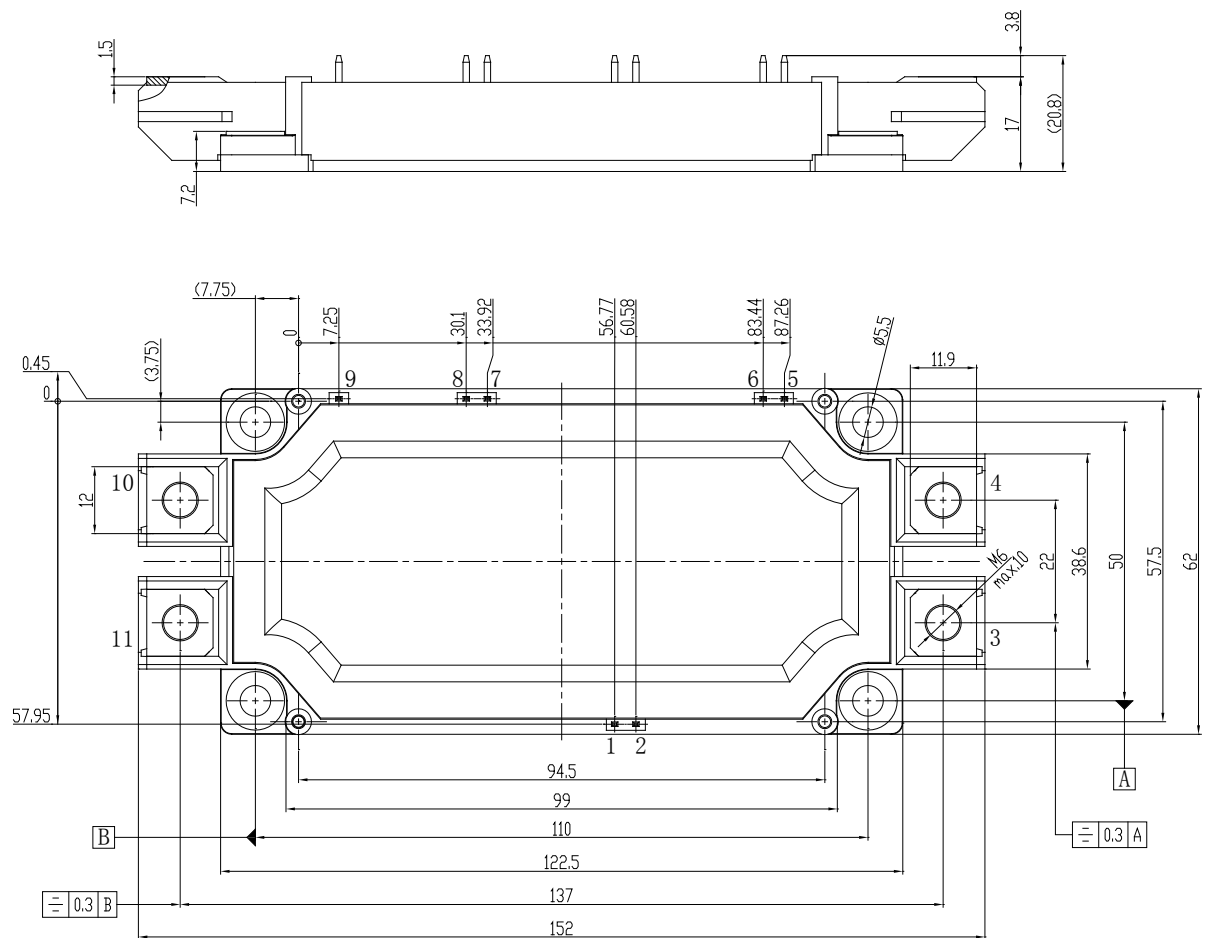
Fig 11. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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