# STARPOWER

SEMICONDUCTOR **IGBT**

# GD1200HFX170C3S

**1700V/1200A 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 high power converters.

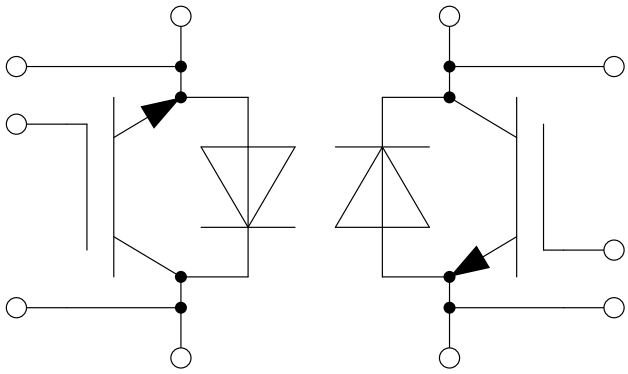
## Features

- Low $V_{CE(sat)}$ Trench IGBT technology
- 10μs short circuit capability
- $V_{CE(sat)}$ with positive temperature coefficient
- Maximum junction temperature 175°C
- Low inductance case
- Fast & soft reverse recovery anti-parallel FWD
- Isolated copper baseplate using DBC technology

## Typical Applications

- High Power Converters
- Motor Drives
- Wind Turbines

## Equivalent Circuit Schematic



## Absolute Maximum Ratings $T_C$=25°C unless otherwise noted

### IGBT

| Symbol | Description | Value | Unit |
|---|---|---|---|
| $V_{CES}$ | Collector-Emitter Voltage | 1700 | V |
| $V_{GES}$ | Gate-Emitter Voltage | ±20 | V |
| $I_C$ | Collector Current @ $T_C$=25°C<br>@ $T_C$=70°C | 1562<br>1200 | A |
| $I_{CM}$ | Pulsed Collector Current $t_p$=1ms | 2400 | A |
| $P_D$ | Maximum Power Dissipation @ $T_j$=175°C | 5.19 | kW |

### Diode

| Symbol | Description | Value | Unit |
|---|---|---|---|
| $V_{RRM}$ | Repetitive Peak Reverse Voltage | 1700 | V |
| $I_F$ | Diode Continuous Forward Current | 1200 | A |
| $I_{FM}$ | Diode Maximum Forward Current $t_p$=1ms | 2400 | A |

### Module

| Symbol | Description | Value | Unit |
|---|---|---|---|
| $T_{jmax}$ | Maximum Junction Temperature | 175 | °C |
| $T_{jop}$ | Operating Junction Temperature | -40 to +150 | °C |
| $T_{STG}$ | Storage Temperature Range | -40 to +125 | °C |
| $V_{ISO}$ | Isolation Voltage RMS,f=50Hz,t=1min | 4000 | V |

## IGBT Characteristics $T_C$=25°C unless otherwise noted

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | $I_C$=1200A,$V_{GE}$=15V, $T_j$=25°C | | 1.85 | 2.30 | V |
| | | $I_C$=1200A,$V_{GE}$=15V, $T_j$=125°C | | 2.25 | | |
| | | $I_C$=1200A,$V_{GE}$=15V, $T_j$=150°C | | 2.35 | | |
| $V_{GE(th)}$ | Gate-Emitter Threshold Voltage | $I_C$=48.0mA,$V_{CE}$=$V_{GE}$, $T_j$=25°C | 5.6 | 6.2 | 6.8 | V |
| $I_{CES}$ | Collector Cut-Off Current | $V_{CE}$=$V_{CES}$,$V_{GE}$=0V, $T_j$=25°C | | | 5.0 | mA |
| $I_{GES}$ | Gate-Emitter Leakage Current | $V_{GE}$=$V_{GES}$,$V_{CE}$=0V, $T_j$=25°C | | | 400 | nA |
| $R_{Gint}$ | Internal Gate Resistance | | | 1.6 | | Ω |
| $C_{ies}$ | Input Capacitance | $V_{CE}$=25V,f=100kHz, $V_{GE}$=0V | | 142 | | nF |
| $C_{res}$ | Reverse Transfer Capacitance | | | 3.57 | | nF |
| $Q_G$ | Gate Charge | $V_{GE}$=-15…+15V | | 11.8 | | μC |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}$=900V,$I_C$=1200A, $R_G$=1.5Ω, $V_{GE}$=-9/+15V, $L_S$=65nH,$T_j$=25°C | | 647 | | ns |
| $t_r$ | Rise Time | | | 225 | | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 1657 | | ns |
| $t_f$ | Fall Time | | | 180 | | ns |
| $E_{on}$ | Turn-On Switching Loss | | | 363 | | mJ |
| $E_{off}$ | Turn-Off Switching Loss | | | 401 | | mJ |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}$=900V,$I_C$=1200A, $R_G$=1.5Ω, $V_{GE}$=-9/+15V, $L_S$=65nH,$T_j$=125°C | | 815 | | ns |
| $t_r$ | Rise Time | | | 294 | | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 2231 | | ns |
| $t_f$ | Fall Time | | | 235 | | ns |
| $E_{on}$ | Turn-On Switching Loss | | | 733 | | mJ |
| $E_{off}$ | Turn-Off Switching Loss | | | 549 | | mJ |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}$=900V,$I_C$=1200A, $R_G$=1.5Ω, $V_{GE}$=-9/+15V, $L_S$=65nH,$T_j$=150°C | | 860 | | ns |
| $t_r$ | Rise Time | | | 312 | | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 2422 | | ns |
| $t_f$ | Fall Time | | | 247 | | ns |
| $E_{on}$ | Turn-On Switching Loss | | | 850 | | mJ |
| $E_{off}$ | Turn-Off Switching Loss | | | 586 | | mJ |
| $I_{SC}$ | SC Data | $t_P$≤10μs,$V_{GE}$=15V, $T_j$=150°C,$V_{CC}$=1000V, $V_{CEM}$≤1700V | | 4800 | | A |

## Diode Characteristics $T_C$=25°C unless otherwise noted

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_F$ | Diode Forward Voltage | $I_F$=1200A,$V_{GE}$=0V,$T_j$=25°C | | 1.80 | 2.25 | V |
| | | $I_F$=1200A,$V_{GE}$=0V,$T_j$=125°C | | 1.90 | | |
| | | $I_F$=1200A,$V_{GE}$=0V,$T_j$=150°C | | 1.95 | | |
| $Q_r$ | Recovered Charge | $V_{CC}$=900V,$I_F$=1200A, -di/dt=4950A/μs,$V_{GE}$=-9V, $L_S$=65nH,$T_j$=25°C | | 249 | | μC |
| $I_{RM}$ | Peak Reverse Recovery Current | | | 922 | | A |
| $E_{rec}$ | Reverse Recovery Energy | | | 153 | | mJ |
| $Q_r$ | Recovered Charge | $V_{CC}$=900V,$I_F$=1200A, -di/dt=3780A/μs,$V_{GE}$=-9V, $L_S$=65nH,$T_j$=125°C | | 418 | | μC |
| $I_{RM}$ | Peak Reverse Recovery Current | | | 959 | | A |
| $E_{rec}$ | Reverse Recovery Energy | | | 242 | | mJ |
| $Q_r$ | Recovered Charge | $V_{CC}$=900V,$I_F$=1200A, -di/dt=3520A/μs,$V_{GE}$=-9V, $L_S$=65nH,$T_j$=150°C | | 563 | | μC |
| $I_{RM}$ | Peak Reverse Recovery Current | | | 990 | | A |
| $E_{rec}$ | Reverse Recovery Energy | | | 321 | | mJ |

## Module Characteristics $T_C$=25°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 | | 0.37 | | mΩ |
| $R_{thJC}$ | Junction-to-Case (per IGBT)<br>Junction-to-Case (per Diode) | | | 28.9<br>46.8 | K/kW |
| $R_{thCH}$ | Case-to-Heatsink (per IGBT)<br>Case-to-Heatsink (per Diode)<br>Case-to-Heatsink (per Module) | | 19.4<br>31.4<br>6.0 | | K/kW |
| M | Terminal Connection Torque, Screw M4<br>Terminal Connection Torque, Screw M8<br>Mounting Torque, Screw M6 | 1.8<br>8.0<br>4.25 | | 2.1<br>10<br>5.75 | N.m |
| G | Weight of Module | | 1500 | | g |

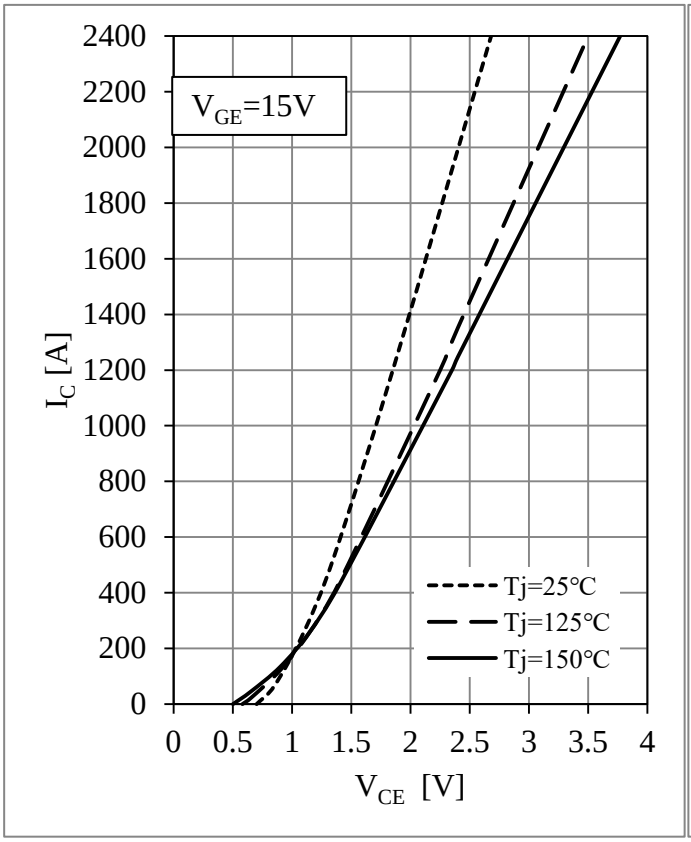



Fig 1. IGBT Output Characteristics

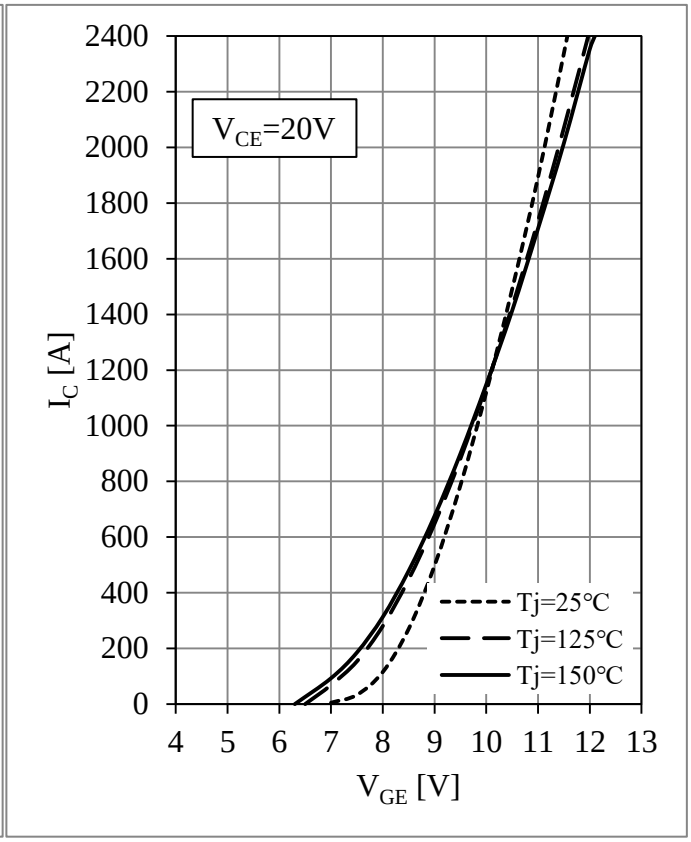



Fig 2. IGBT Transfer Characteristics

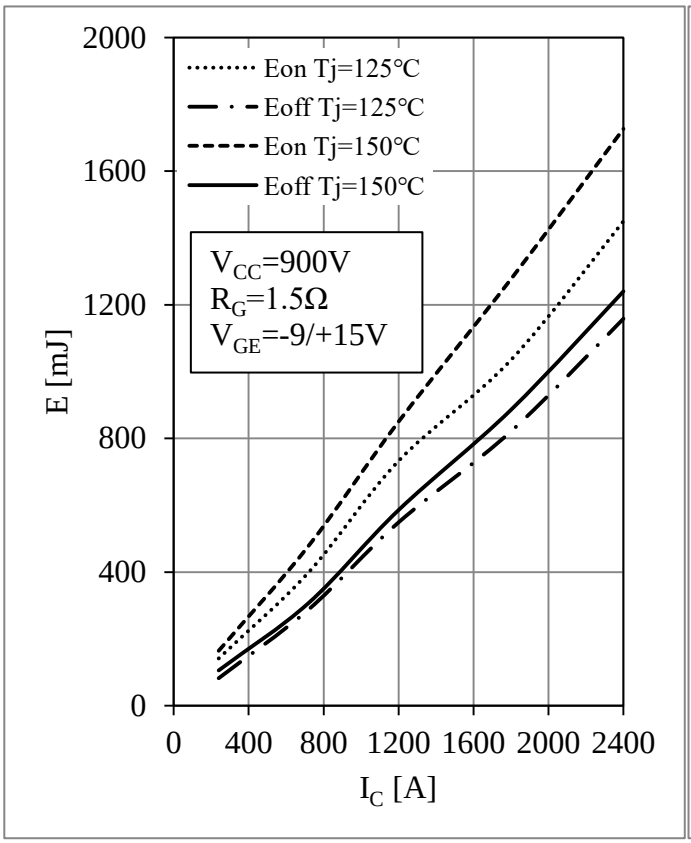



Fig 3. IGBT Switching Loss vs. $I_C$

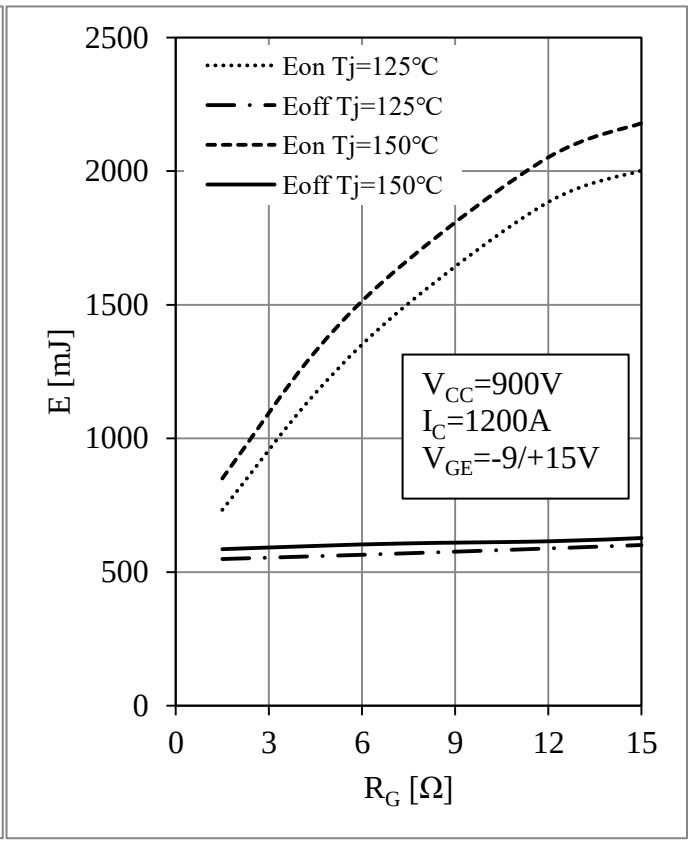



Fig 4. IGBT Switching Loss vs. $R_G$

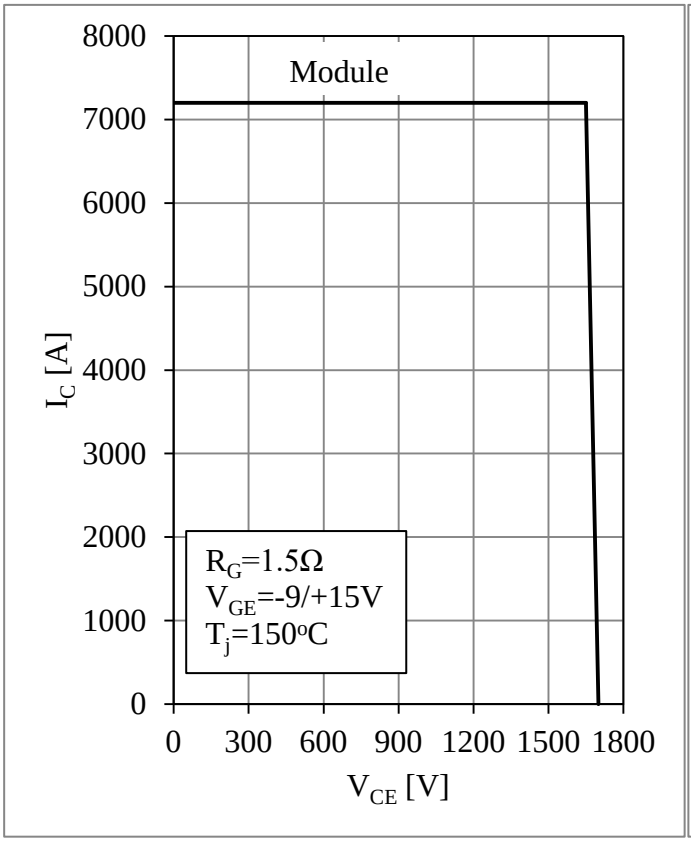



Fig 5. RBSOA

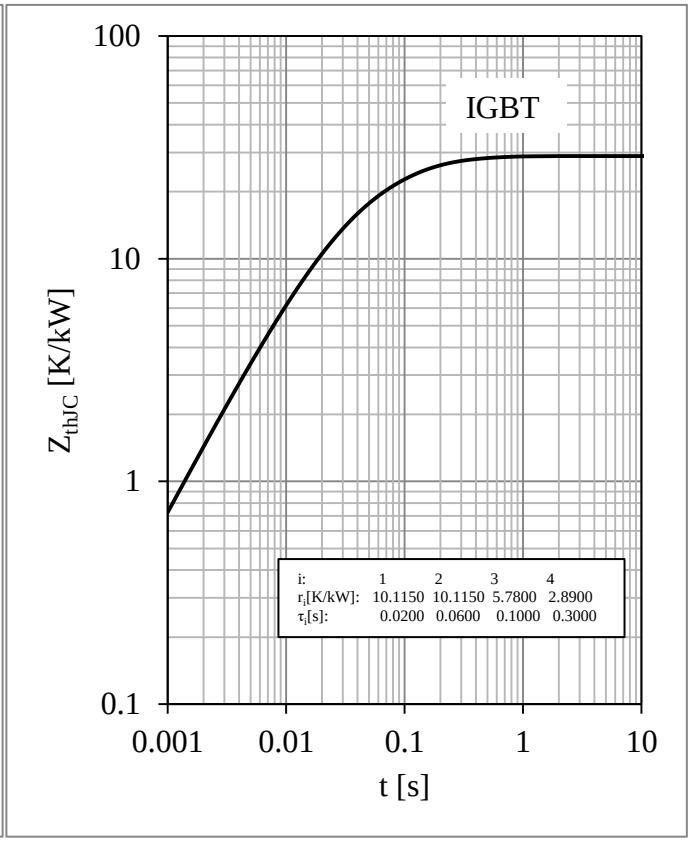



Fig 6. IGBT Transient Thermal Impedance

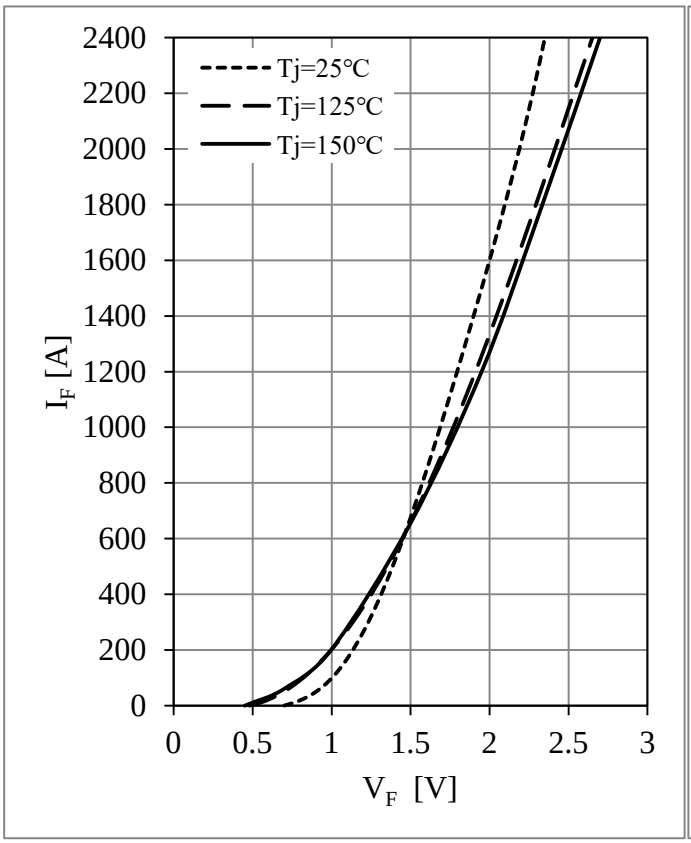



Fig 7. Diode Forward Characteristics

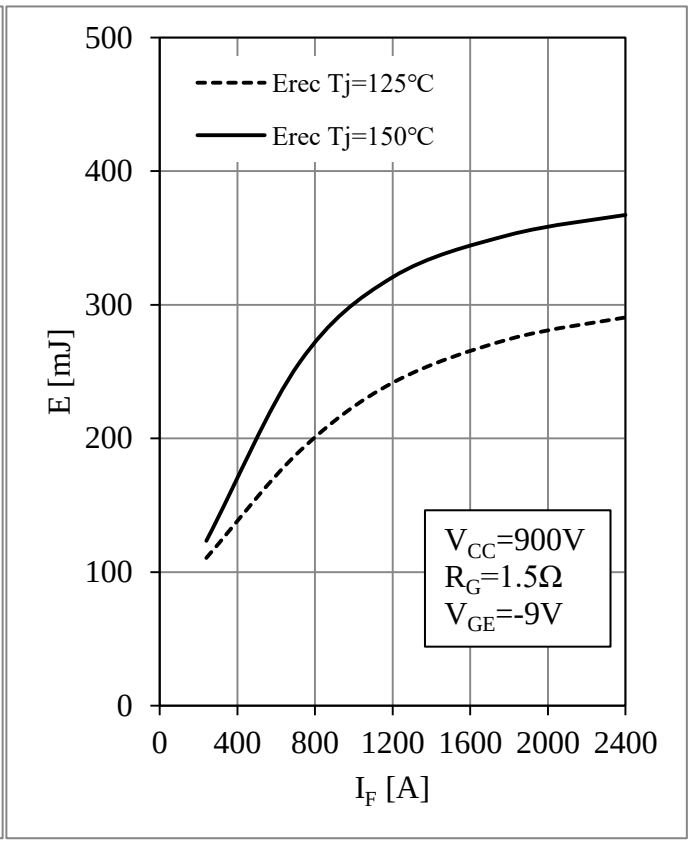



Fig 8. Diode Switching Loss vs. $I_F$

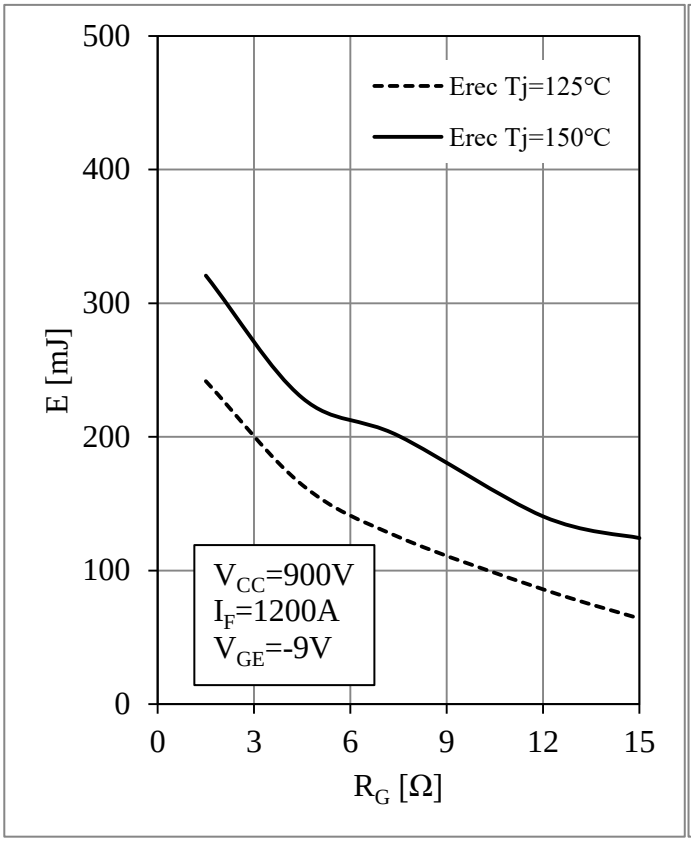



Fig 9. Diode Switching Loss vs. $R_G$

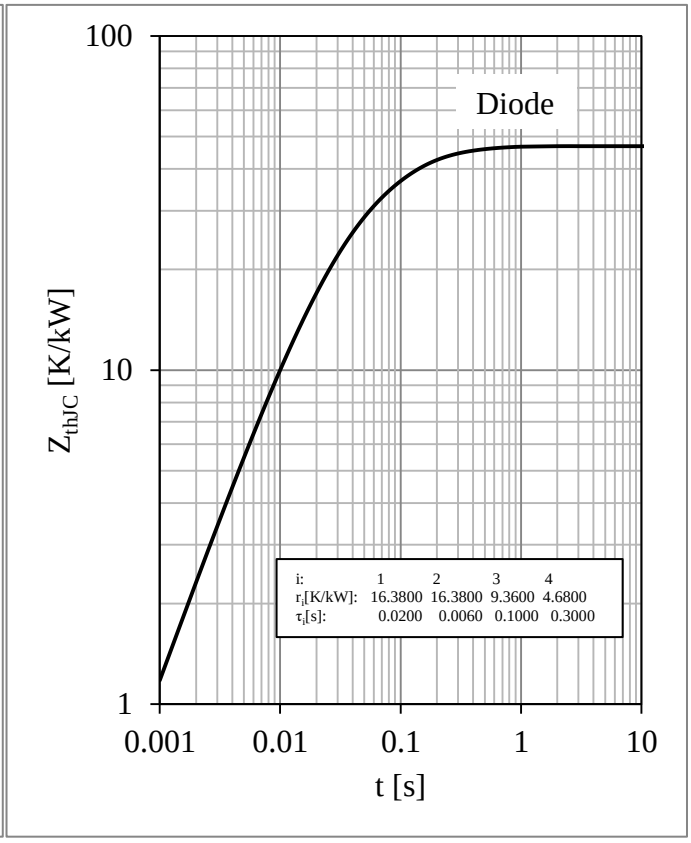
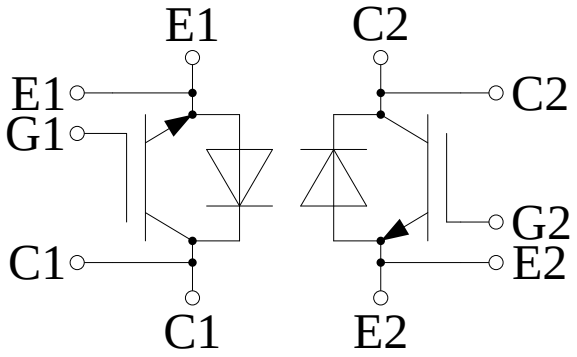


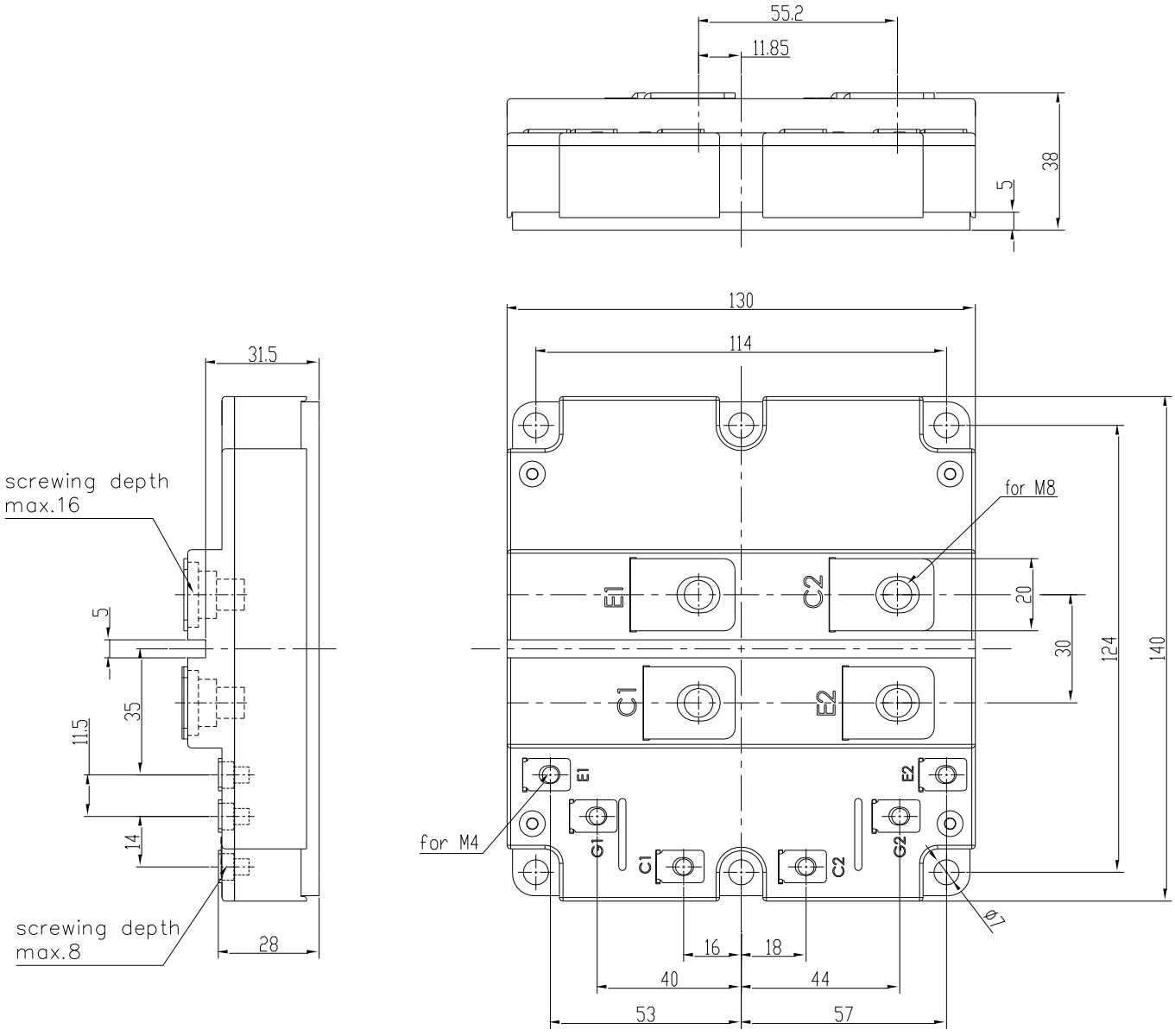

Fig 10. Diode Transient Thermal Impedance

## Circuit Schematic




## Package Dimensions

Dimensions in Millimeters



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