

STARPOWER

SEMICONDUCTOR

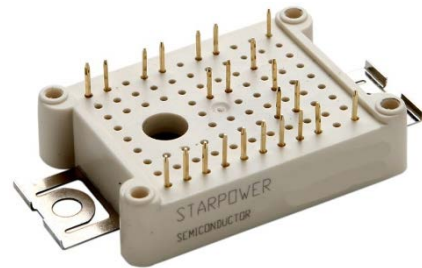
IGBT

GD50FSX65L2S

650V/50A 6 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 general inverters and UPS.



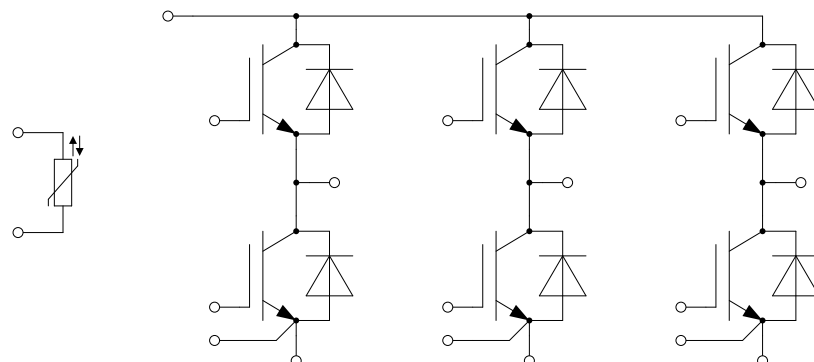
Features

- Low $V_{CE(sat)}$ Trench IGBT technology
- 6 μ s 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 heatsink 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 | Value | Unit |
|-----------|---|----------|------|
| V_{CES} | Collector-Emitter Voltage | 650 | V |
| V_{GES} | Gate-Emitter Voltage | ± 20 | V |
| I_C | Collector Current @ $T_C=25^{\circ}\text{C}$ | 89 | A |
| | @ $T_C=100^{\circ}\text{C}$ | 50 | A |
| I_{CM} | Pulsed Collector Current $t_p=1\text{ms}$ | 100 | A |
| P_D | Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$ | 258 | W |

Diode

| Symbol | Description | Value | Unit |
|-----------|--|-------|------|
| V_{RRM} | Repetitive Peak Reverse Voltage | 650 | V |
| I_F | Diode Continuous Forward Current | 50 | A |
| I_{FM} | Diode Maximum Forward Current $t_p=1\text{ms}$ | 100 | A |

Module

| Symbol | Description | Value | 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 | $I_C=50\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$ | | 1.45 | 1.90 | V | |
| | | $I_C=50\text{A}, V_{GE}=15\text{V}, T_j=125^\circ\text{C}$ | | 1.60 | | | |
| | | $I_C=50\text{A}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}$ | | 1.70 | | | |
| $V_{GE(th)}$ | Gate-Emitter Threshold Voltage | $I_C=0.80\text{mA}, V_{CE}=V_{GE}, T_j=25^\circ\text{C}$ | 5.1 | 5.8 | 6.5 | V | |
| I_{CES} | Collector Cut-Off Current | $V_{CE}=V_{CES}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$ | | | 1.0 | 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 | | Ω | |
| C_{ies} | Input Capacitance | $V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$ | | 5.80 | | nF | |
| C_{res} | Reverse Transfer Capacitance | | | 0.11 | | nF | |
| Q_G | Gate Charge | $V_{GE}=-15\dots+15\text{V}$ | | 0.35 | | μC | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}=300\text{V}, I_C=50\text{A}, R_G=6.8\Omega, V_{GE}=\pm 15\text{V}, T_j=25^\circ\text{C}$ | | 18 | | ns | |
| t_r | Rise Time | | | 15 | | ns | |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 136 | | ns | |
| t_f | Fall Time | | | 24 | | ns | |
| E_{on} | Turn-On Switching Loss | | | 0.32 | | mJ | |
| E_{off} | Turn-Off Switching Loss | | | 0.96 | | mJ | |
| $t_{d(on)}$ | Turn-On Delay Time | | $V_{CC}=300\text{V}, I_C=50\text{A}, R_G=6.8\Omega, V_{GE}=\pm 15\text{V}, T_j=125^\circ\text{C}$ | | 18 | | ns |
| t_r | Rise Time | | | | 18 | | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 152 | | ns | |
| t_f | Fall Time | | | 32 | | ns | |
| E_{on} | Turn-On Switching Loss | | | 0.46 | | mJ | |
| E_{off} | Turn-Off Switching Loss | | | 1.28 | | mJ | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}=300\text{V}, I_C=50\text{A}, R_G=6.8\Omega, V_{GE}=\pm 15\text{V}, T_j=150^\circ\text{C}$ | | | 18 | | ns |
| t_r | Rise Time | | | | 18 | | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 160 | | ns | |
| t_f | Fall Time | | | 40 | | ns | |
| E_{on} | Turn-On Switching Loss | | | 0.51 | | mJ | |
| E_{off} | Turn-Off Switching Loss | | | 1.36 | | mJ | |
| I_{SC} | SC Data | | $t_p \leq 6\mu\text{s}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}, V_{CC}=300\text{V}, V_{CEM} \leq 600\text{V}$ | | 250 | | 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 | $I_F=50\text{A}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$ | | 1.55 | 2.05 | V |
| | | $I_F=50\text{A}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$ | | 1.50 | | |
| | | $I_F=50\text{A}, V_{GE}=0\text{V}, T_j=150^\circ\text{C}$ | | 1.45 | | |
| Q_r | Recovered Charge | $V_R=300\text{V}, I_F=50\text{A},$ $-di/dt=2420\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^\circ\text{C}$ | | 2.2 | | μC |
| I_{RM} | Peak Reverse Recovery Current | | | 55 | | A |
| E_{rec} | Reverse Recovery Energy | | | 0.55 | | mJ |
| Q_r | Recovered Charge | $V_R=300\text{V}, I_F=50\text{A},$ $-di/dt=2420\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^\circ\text{C}$ | | 4.3 | | μC |
| I_{RM} | Peak Reverse Recovery Current | | | 66 | | A |
| E_{rec} | Reverse Recovery Energy | | | 1.10 | | mJ |
| Q_r | Recovered Charge | $V_R=300\text{V}, I_F=50\text{A},$ $-di/dt=2420\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=150^\circ\text{C}$ | | 4.8 | | μC |
| I_{RM} | Peak Reverse Recovery Current | | | 72 | | A |
| E_{rec} | Reverse Recovery Energy | | | 1.27 | | 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 | | k Ω |
| $\Delta R/R$ | 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 | | 25 | | nH |
| $R_{CC'+EE'}$ | Module Lead Resistance, Terminal to Chip | | 4.50 | | m Ω |
| R_{thJC} | Junction-to-Case (per IGBT-inverter) | | 0.527 | 0.580 | K/W |
| | Junction-to-Case (per Diode-inverter) | | 0.825 | 0.907 | |
| R_{thCH} | Case-to-Sink (per IGBT-inverter) | | 0.571 | | K/W |
| | Case-to-Sink (per Diode-inverter) | | 0.892 | | |
| | Case-to-Sink (per Module) | | 0.058 | | |
| F | Mounting Force Per Clamp | 20 | | 50 | N |
| G | Weight of Module | | 24 | | g |

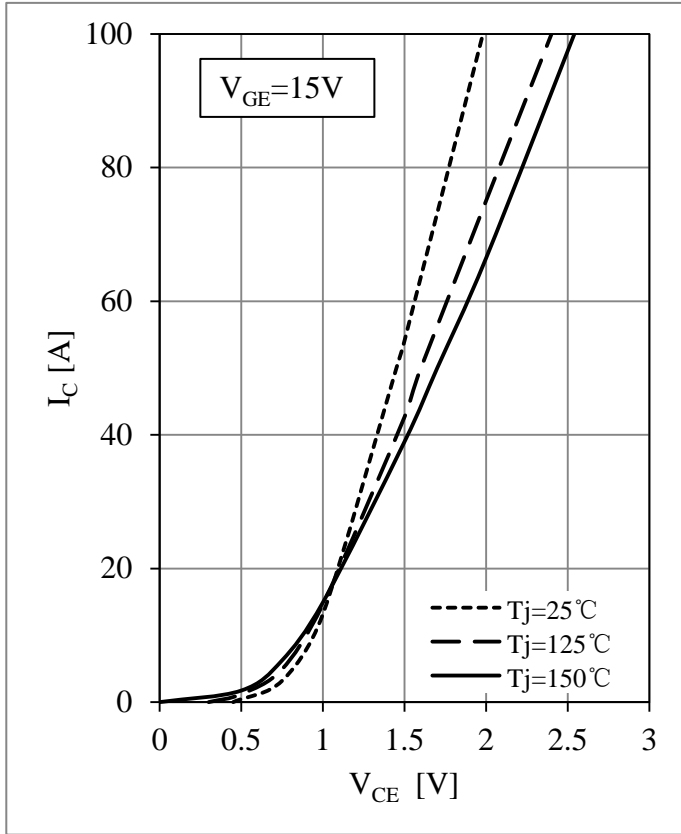


Fig 1. IGBT Output Characteristics

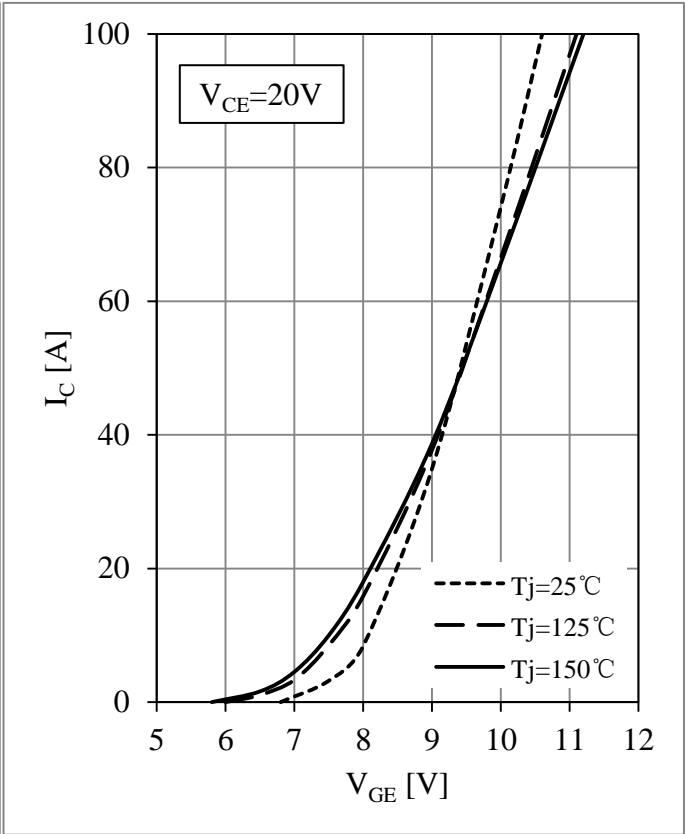


Fig 2. IGBT Transfer Characteristics

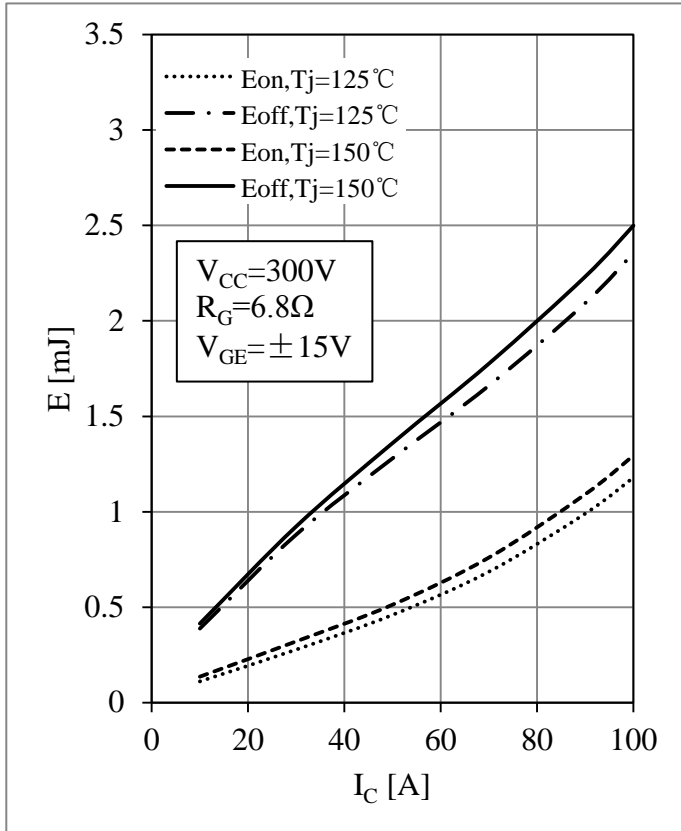


Fig 3. IGBT Switching Loss vs. I_C

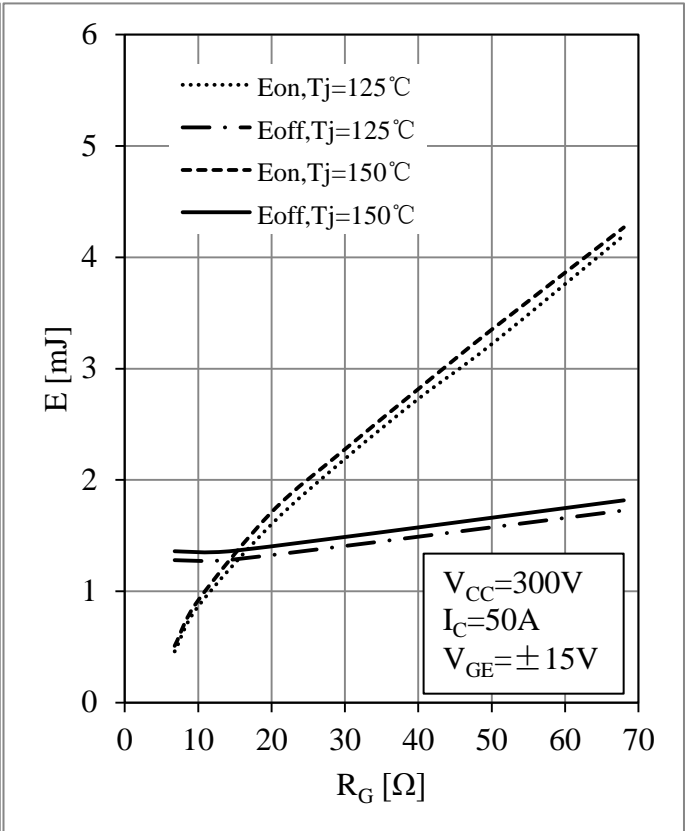


Fig 4. IGBT Switching Loss vs. R_G

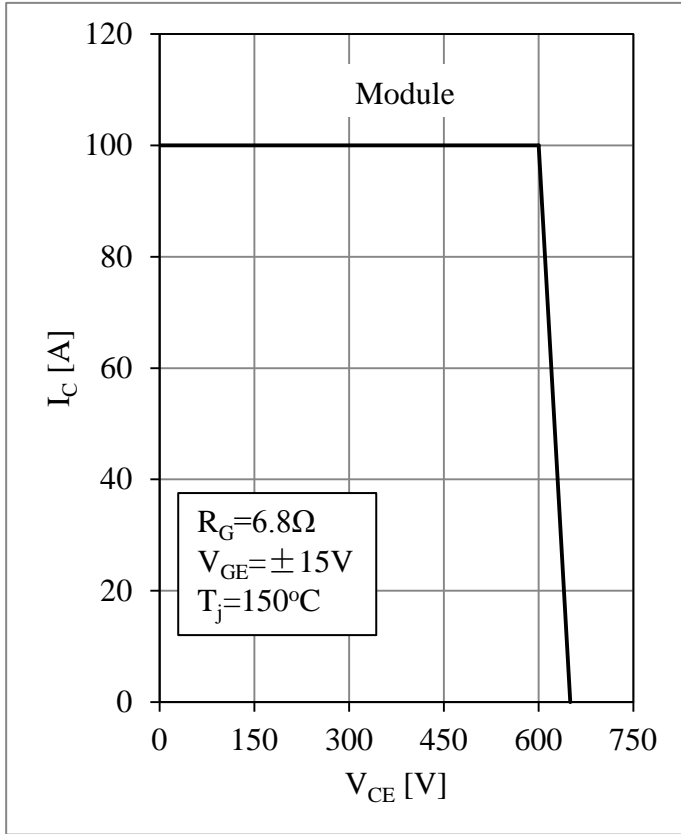


Fig 5. RBSOA

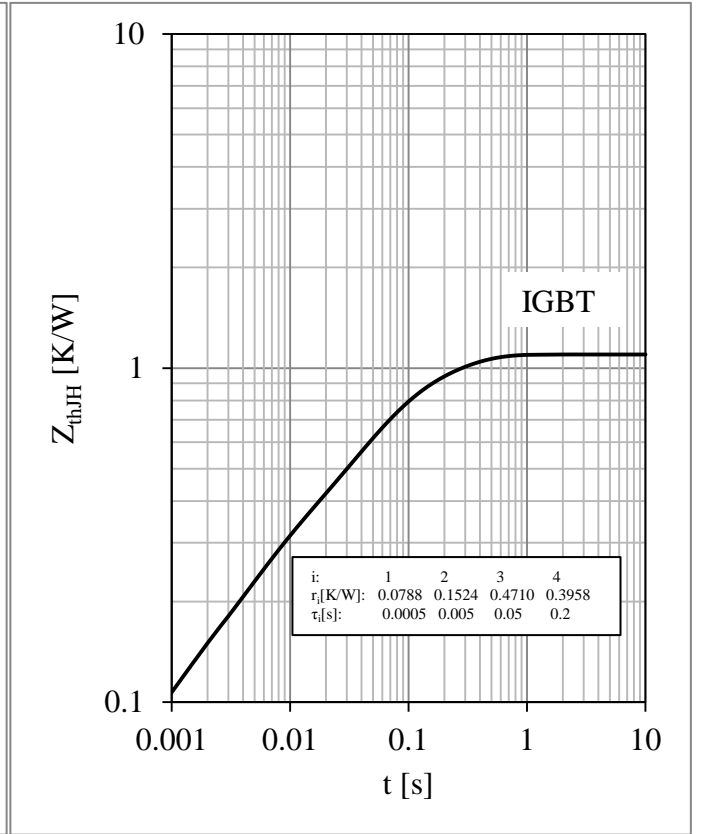


Fig 6. IGBT Transient Thermal Impedance

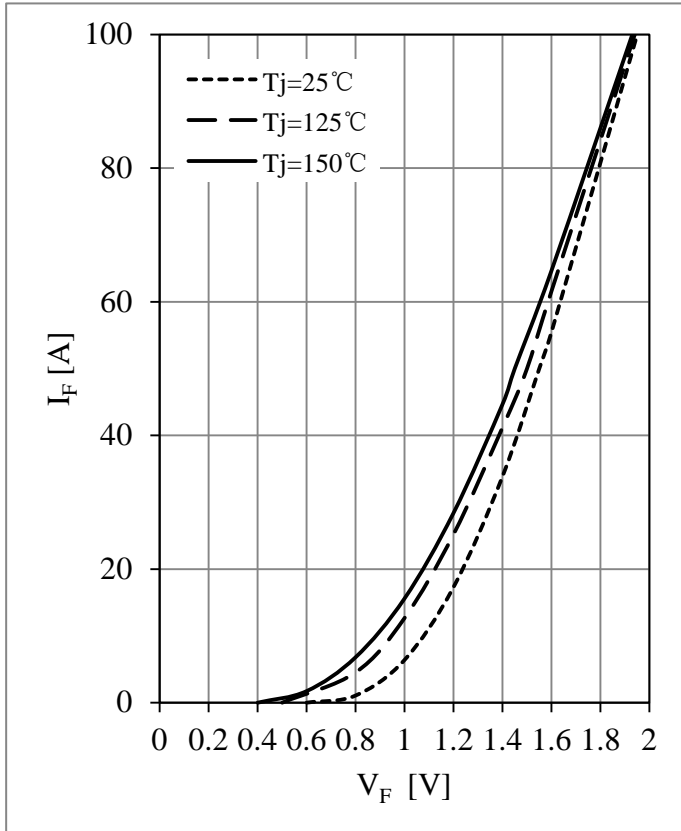


Fig 7. Diode Forward Characteristics

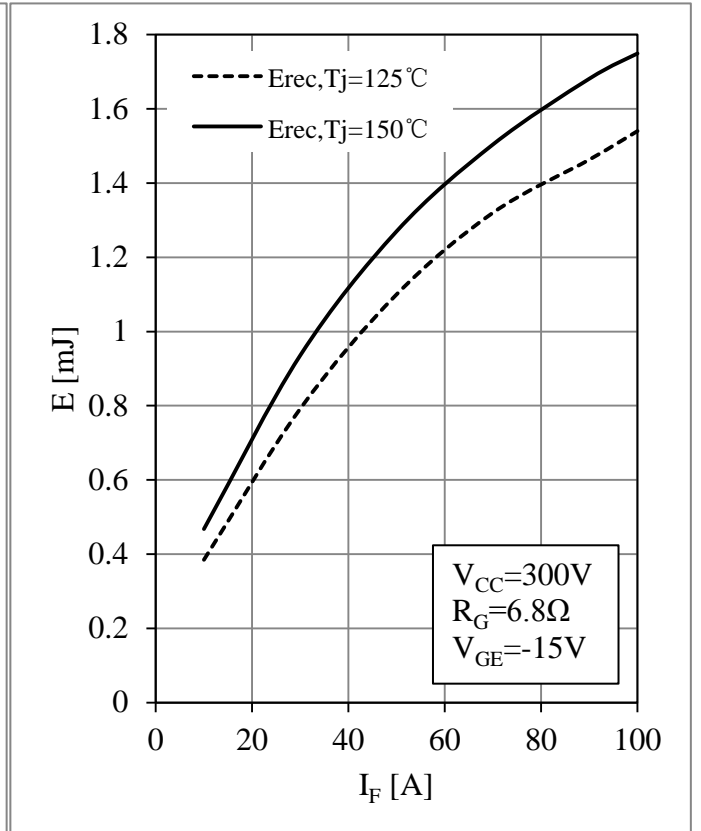


Fig 8. Diode Switching Loss vs. I_F

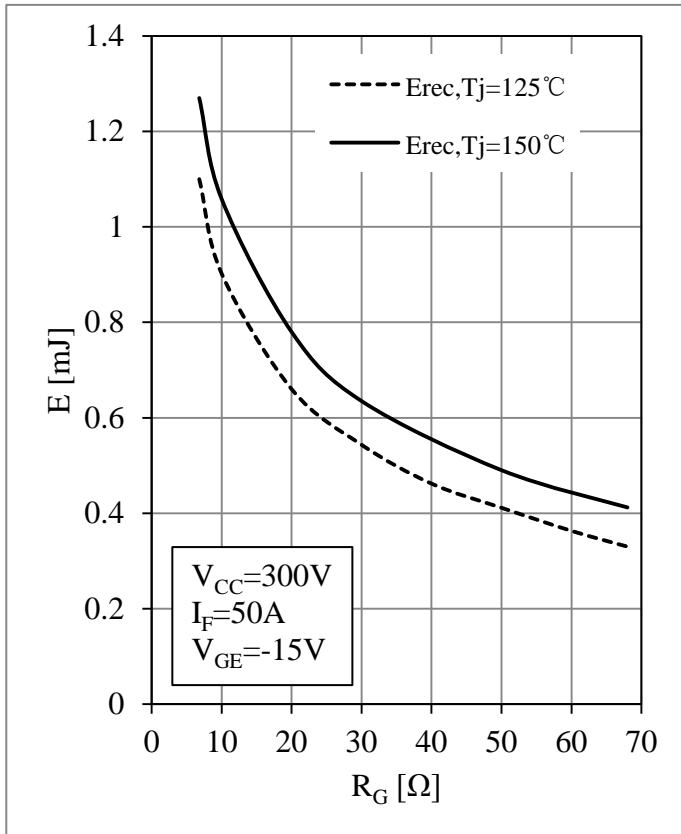


Fig 9. Diode Switching Loss vs. R_G

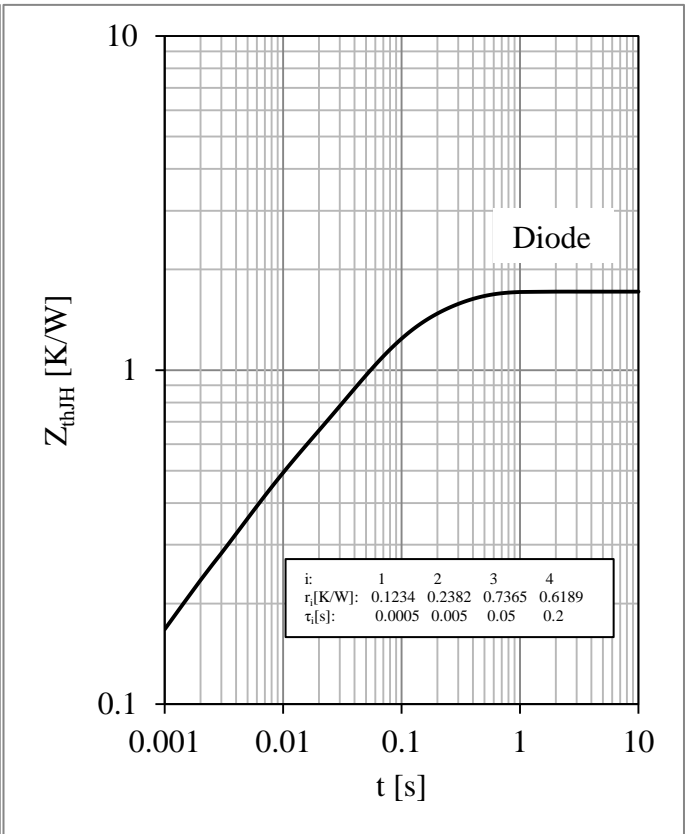


Fig 10. Diode Transient Thermal Impedance

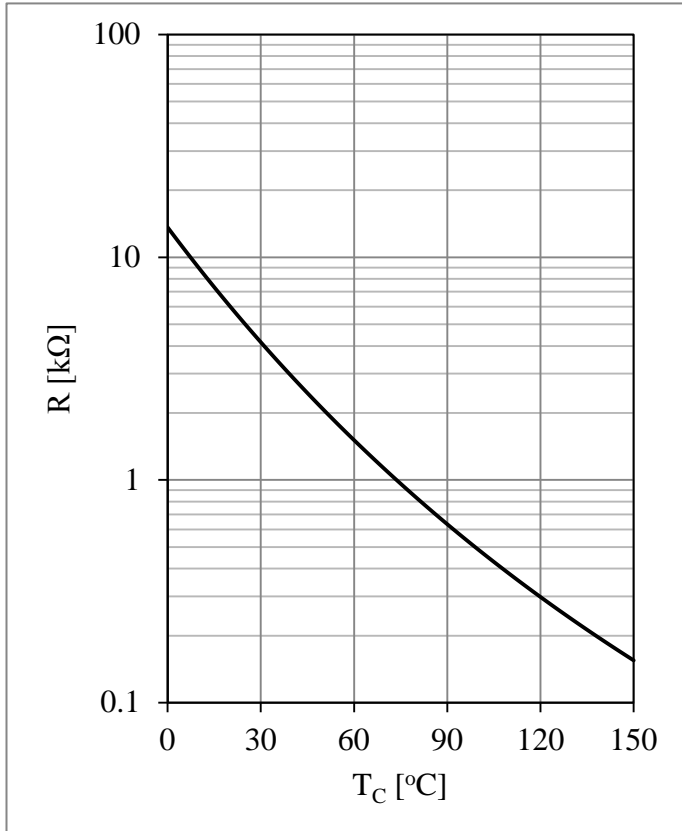
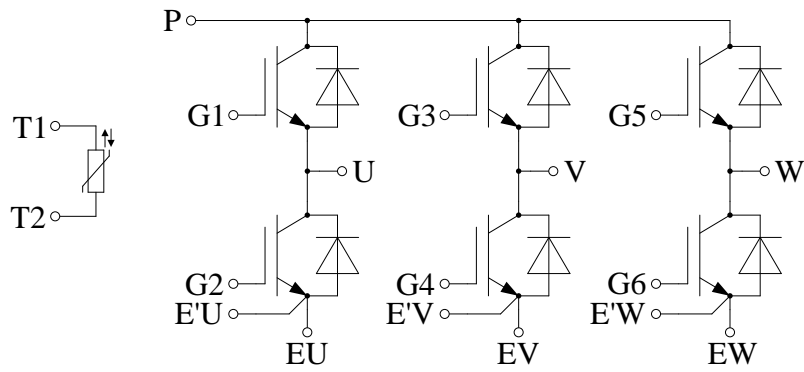


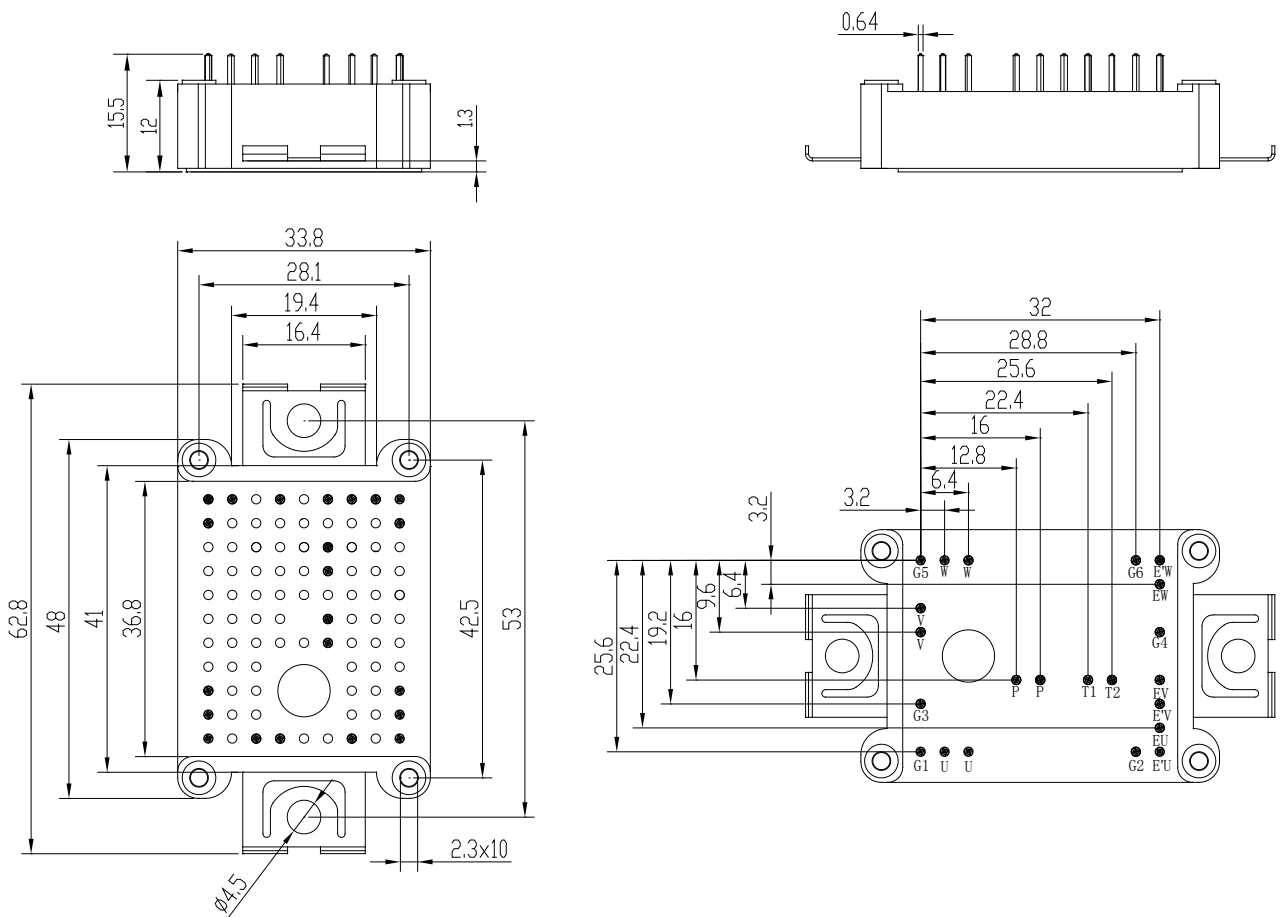
Fig 11. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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