# STARPOWER

SEMICONDUCTOR **IGBT**

# GD100TLT120C2S_T4

**1200V/100A 3-level 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 UPS.

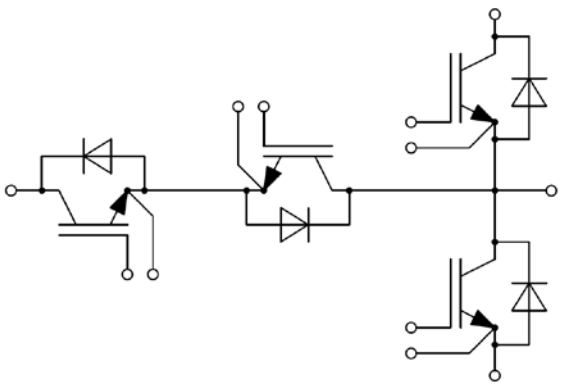
## Features

- Low $V_{CE(sat)}$ Trench IGBT technology
- $V_{CE(sat)}$ with positive temperature coefficient
- Low switching loss
- Maximum junction temperature 175℃
- Low inductance case
- Fast & soft reverse recovery anti-parallel FWD
- Isolated copper baseplate using DBC technology

## Typical Applications

- Inverter for motor drive
- Uninterruptible power supply
- Solar power

## Equivalent Circuit Schematic



# Absolute Maximum Ratings $T_C$=25℃ unless otherwise noted

## T1,T2 IGBT

| Symbol | Description | Values | Unit |
|---|---|---|---|
| $V_{CES}$ | Collector-Emitter Voltage | 1200 | V |
| $V_{GES}$ | Gate-Emitter Voltage | ±20 | V |
| $I_C$ | Collector Current @ $T_C$=25℃<br>@ $T_C$=100℃ | 150<br>100 | A |
| $I_{CM}$ | Pulsed Collector Current $t_p$=1ms | 200 | A |
| $P_D$ | Maximum Power Dissipation @ $T_j$=175℃ | 560 | W |

## D1,D2 Diode

| Symbol | Description | Values | Unit |
|---|---|---|---|
| $V_{RRM}$ | Repetitive Peak Reverse Voltage | 1200 | V |
| $I_F$ | Diode Continuous Forward Current | 100 | A |
| $I_{FM}$ | Diode Maximum Forward Current $t_p$=1ms | 200 | A |

## T3,T4 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℃<br>@ $T_C$=80℃ | 138<br>100 | A |
| $I_{CM}$ | Pulsed Collector Current $t_p$=1ms | 200 | A |
| $P_D$ | Maximum Power Dissipation @ $T_j$=175℃ | 353 | W |

## D3,D4 Diode

| Symbol | Description | Values | Unit |
|---|---|---|---|
| $V_{RRM}$ | Repetitive Peak Reverse Voltage | 650 | V |
| $I_F$ | Diode Continuous Forward Current | 100 | A |
| $I_{FM}$ | Diode Maximum Forward Current $t_p$=1ms | 200 | A |

## Module

| Symbol | Description | Values | Unit |
|---|---|---|---|
| $T_{jmax}$ | Maximum Junction Temperature | 175 | ℃ |
| $T_{jop}$ | Operating Junction Temperature | -40 to +150 | ℃ |
| $T_{STG}$ | Storage Temperature Range | -40 to +125 | ℃ |
| $V_{ISO}$ | Isolation Voltage RMS,f=50Hz,t=1min | 4000 | V |
| M | Terminal Connection Torque, Screw M6<br>Mounting Torque, Screw M6 | 2.5 to 5.0<br>3.0 to 5.0 | N.m |

## T1,T2 IGBT Characteristics $T_C$=25℃ unless otherwise noted

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | $I_C$=100A,$V_{GE}$=15V, $T_j$=25℃ | | 1.75 | 2.20 | V |
| | | $I_C$=100A,$V_{GE}$=15V, $T_j$=125℃ | | 2.05 | | |
| | | $I_C$=100A,$V_{GE}$=15V, $T_j$=150℃ | | 2.10 | | |
| $V_{GE(th)}$ | Gate-Emitter Threshold Voltage | $I_C$=3.8mA,$V_{CE}$=$V_{GE}$, $T_j$=25℃ | 5.1 | 5.8 | 6.4 | V |
| $I_{CES}$ | Collector Cut-Off Current | $V_{CE}$=$V_{CES}$,$V_{GE}$=0V, $T_j$=25℃ | | | 1.0 | mA |
| $I_{GES}$ | Gate-Emitter Leakage Current | $V_{GE}$=$V_{GES}$,$V_{CE}$=0V, $T_j$=25℃ | | | 400 | nA |
| $R_{Gint}$ | Internal Gate Resistance | | | 7.5 | | Ω |
| $C_{ies}$ | Input Capacitance | $V_{CE}$=25V,f=1MHz, $V_{GE}$=0V | | 6.30 | | nF |
| $C_{res}$ | Reverse Transfer Capacitance | | | 0.27 | | nF |
| $Q_G$ | Gate Charge | $V_{GE}$=-15…+15V | | 0.80 | | μC |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}$=600V,$I_C$=100A, $R_G$=1.6Ω,$V_{GE}$=±15V, $T_j$=25℃ | | 161 | | ns |
| $t_r$ | Rise Time | | | 29 | | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 330 | | ns |
| $t_f$ | Fall Time | | | 78 | | ns |
| $E_{on}$ | Turn-On Switching Loss | | | 5.48 | | mJ |
| $E_{off}$ | Turn-Off Switching Loss | | | 5.52 | | mJ |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}$=600V,$I_C$=100A, $R_G$=1.6Ω,$V_{GE}$=±15V, $T_j$=125℃ | | 169 | | ns |
| $t_r$ | Rise Time | | | 40 | | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 429 | | ns |
| $t_f$ | Fall Time | | | 152 | | ns |
| $E_{on}$ | Turn-On Switching Loss | | | 8.49 | | mJ |
| $E_{off}$ | Turn-Off Switching Loss | | | 8.51 | | mJ |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}$=600V,$I_C$=100A, $R_G$=1.6Ω,$V_{GE}$=±15V, $T_j$=150℃ | | 170 | | ns |
| $t_r$ | Rise Time | | | 41 | | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 448 | | ns |
| $t_f$ | Fall Time | | | 170 | | ns |
| $E_{on}$ | Turn-On Switching Loss | | | 9.50 | | mJ |
| $E_{off}$ | Turn-Off Switching Loss | | | 9.50 | | mJ |
| $I_{SC}$ | SC Data | $t_P$≤10μs,$V_{GE}$=15V, $T_j$=150℃,$V_{CC}$=900V, $V_{CEM}$≤1200V | | 400 | | A |

## D1,D2 Diode Characteristics $T_C$=25℃ unless otherwise noted

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| $V_F$ | Diode Forward Voltage | $I_C$=100A,$V_{GE}$=0V,$T_j$=25℃ | | 1.70 | 2.15 | V |
| | | $I_C$=100A,$V_{GE}$=0V,$T_j$=125℃ | | 1.65 | | |
| | | $I_C$=100A,$V_{GE}$=0V,$T_j$=150℃ | | 1.65 | | |
| $Q_r$ | Recovered Charge | $V_R$=600V,$I_F$=100A, $R_G$=1.6Ω,$V_{GE}$=-15V $T_j$=25℃ | | 9.4 | | μC |
| $I_{RM}$ | Peak Reverse Recovery Current | | | 116 | | A |
| $E_{rec}$ | Reverse Recovery Energy | | | 3.48 | | mJ |
| $Q_r$ | Recovered Charge | $V_R$=600V,$I_F$=100A, $R_G$=1.6Ω,$V_{GE}$=-15V $T_j$=125℃ | | 17.6 | | μC |
| $I_{RM}$ | Peak Reverse Recovery Current | | | 124 | | A |
| $E_{rec}$ | Reverse Recovery Energy | | | 6.02 | | mJ |
| $Q_r$ | Recovered Charge | $V_R$=600V,$I_F$=100A, $R_G$=1.6Ω,$V_{GE}$=-15V $T_j$=150℃ | | 20.5 | | μC |
| $I_{RM}$ | Peak Reverse Recovery Current | | | 130 | | A |
| $E_{rec}$ | Reverse Recovery Energy | | | 7.50 | | mJ |

## T3,T4 IGBT Characteristics $T_C$=25℃ unless otherwise noted

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | $I_C$=100A,$V_{GE}$=15V, $T_j$=25℃ | | 1.45 | 1.90 | V |
| | | $I_C$=100A,$V_{GE}$=15V, $T_j$=125℃ | | 1.60 | | |
| | | $I_C$=100A,$V_{GE}$=15V, $T_j$=150℃ | | 1.70 | | |
| $V_{GE(th)}$ | Gate-Emitter Threshold Voltage | $I_C$=1.6mA,$V_{CE}$=$V_{GE}$, $T_j$=25℃ | 5.1 | 5.8 | 6.4 | V |
| $I_{CES}$ | Collector Cut-Off Current | $V_{CE}$=$V_{CES}$,$V_{GE}$=0V, $T_j$=25℃ | | | 1.0 | mA |
| $I_{GES}$ | Gate-Emitter Leakage Current | $V_{GE}$=$V_{GES}$,$V_{CE}$=0V, $T_j$=25℃ | | | 400 | nA |
| $R_{Gint}$ | Internal Gate Resistance | | | 2.0 | | Ω |
| $C_{ies}$ | Input Capacitance | $V_{CE}$=25V,f=1MHz, $V_{GE}$=0V | | 6.16 | | nF |
| $C_{res}$ | Reverse Transfer Capacitance | | | 0.18 | | nF |
| $Q_G$ | Gate Charge | $V_{GE}$=-15…+15V | | 1.10 | | μC |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}$=300V,$I_C$=100A, $R_G$=3.3Ω,$V_{GE}$=±15V, $T_j$=25℃ | | 49 | | ns |
| $t_r$ | Rise Time | | | 25 | | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 241 | | ns |
| $t_f$ | Fall Time | | | 50 | | ns |
| $E_{on}$ | Turn-On Switching Loss | | | 0.54 | | mJ |
| $E_{off}$ | Turn-Off Switching Loss | | | 2.48 | | mJ |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}$=300V,$I_C$=100A, $R_G$=3.3Ω,$V_{GE}$=±15V, $T_j$=125℃ | | 59 | | ns |
| $t_r$ | Rise Time | | | 30 | | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 260 | | ns |
| $t_f$ | Fall Time | | | 65 | | ns |
| $E_{on}$ | Turn-On Switching Loss | | | 0.86 | | mJ |
| $E_{off}$ | Turn-Off Switching Loss | | | 3.36 | | mJ |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}$=300V,$I_C$=100A, $R_G$=3.3Ω,$V_{GE}$=±15V, $T_j$=150℃ | | 65 | | ns |
| $t_r$ | Rise Time | | | 31 | | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 268 | | ns |
| $t_f$ | Fall Time | | | 76 | | ns |
| $E_{on}$ | Turn-On Switching Loss | | | 0.95 | | mJ |
| $E_{off}$ | Turn-Off Switching Loss | | | 3.50 | | mJ |
| $I_{SC}$ | SC Data | $t_P$≤6μs,$V_{GE}$=15V, $T_j$=150℃,$V_{CC}$=360V, $V_{CEM}$≤650V | | 500 | | A |

## D3,D4 Diode Characteristics $T_C$=25℃ unless otherwise noted

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| $V_F$ | Diode Forward Voltage | $I_C$=100A,$V_{GE}$=0V,$T_j$=25℃ | | 1.55 | 2.00 | V |
| | | $I_C$=100A,$V_{GE}$=0V,$T_j$=125℃ | | 1.50 | | |
| | | $I_C$=100A,$V_{GE}$=0V,$T_j$=150℃ | | 1.45 | | |
| $Q_r$ | Recovered Charge | $V_R$=300V,$I_F$=100A, $R_G$=3.3Ω,$V_{GE}$=-15V $T_j$=25℃ | | 4.2 | | μC |
| $I_{RM}$ | Peak Reverse Recovery Current | | | 88 | | A |
| $E_{rec}$ | Reverse Recovery Energy | | | 1.19 | | mJ |
| $Q_r$ | Recovered Charge | $V_R$=300V,$I_F$=100A, $R_G$=3.3Ω,$V_{GE}$=-15V $T_j$=125℃ | | 7.7 | | μC |
| $I_{RM}$ | Peak Reverse Recovery Current | | | 111 | | A |
| $E_{rec}$ | Reverse Recovery Energy | | | 2.16 | | mJ |
| $Q_r$ | Recovered Charge | $V_R$=300V,$I_F$=100A, $R_G$=3.3Ω,$V_{GE}$=-15V $T_j$=150℃ | | 9.0 | | μC |
| $I_{RM}$ | Peak Reverse Recovery Current | | | 115 | | A |
| $E_{rec}$ | Reverse Recovery Energy | | | 2.40 | | mJ |

## Module Characteristics $T_C$=25℃ unless otherwise noted

| Symbol | Parameter | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| $R_{\theta JC}$ | Junction-to-Case (per T1,T2 IGBT)<br>Junction-to-Case (per D1,D2 Diode)<br>Junction-to-Case (per T3,T4 IGBT)<br>Junction-to-Case (per D3,D4 Diode) | | | 0.268<br>0.449<br>0.425<br>0.705 | K/W |
| $R_{\theta CS}$ | Case-to-Sink (per T1,T2 IGBT)<br>Case-to-Sink (per D1,D2 Diode)<br>Case-to-Sink (per T3,T4 IGBT)<br>Case-to-Sink (per D3,D4 Diode) | | 0.183<br>0.306<br>0.289<br>0.480 | | K/W |
| $R_{\theta CS}$ | Case-to-Sink | | 0.035 | | K/W |
| G | Weight of Module | | 340 | | g |

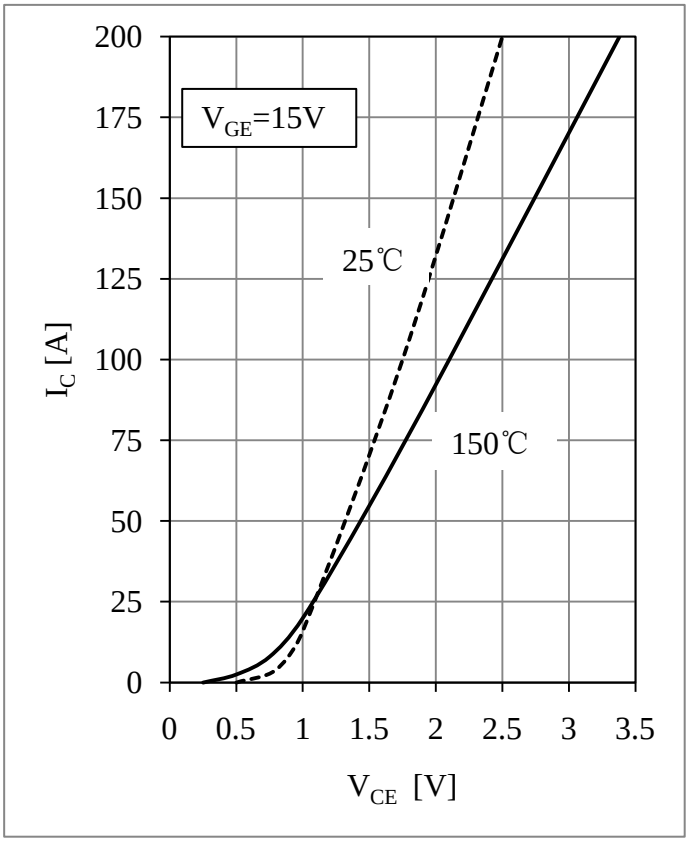



Fig 1. T1,T2 IGBT Output Characteristics

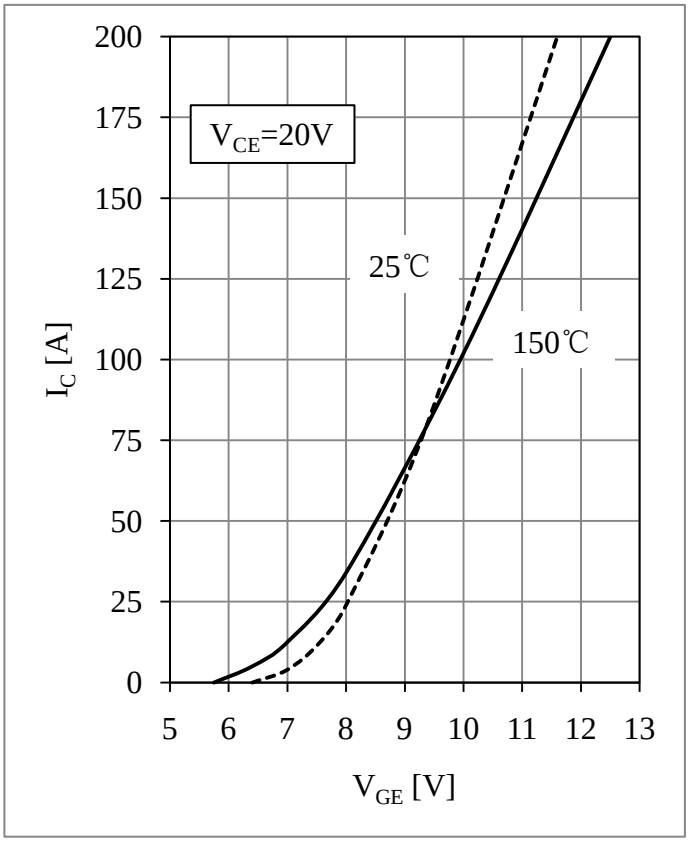



Fig 2. T1,T2 IGBT Transfer Characteristics

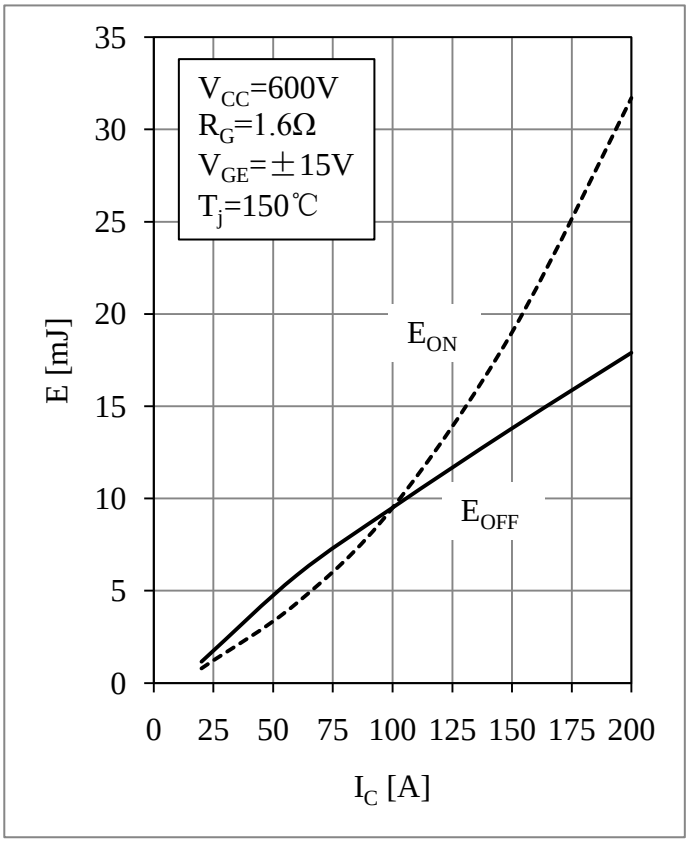



Fig 3. T1,T2 IGBT Switching Loss vs. $I_C$

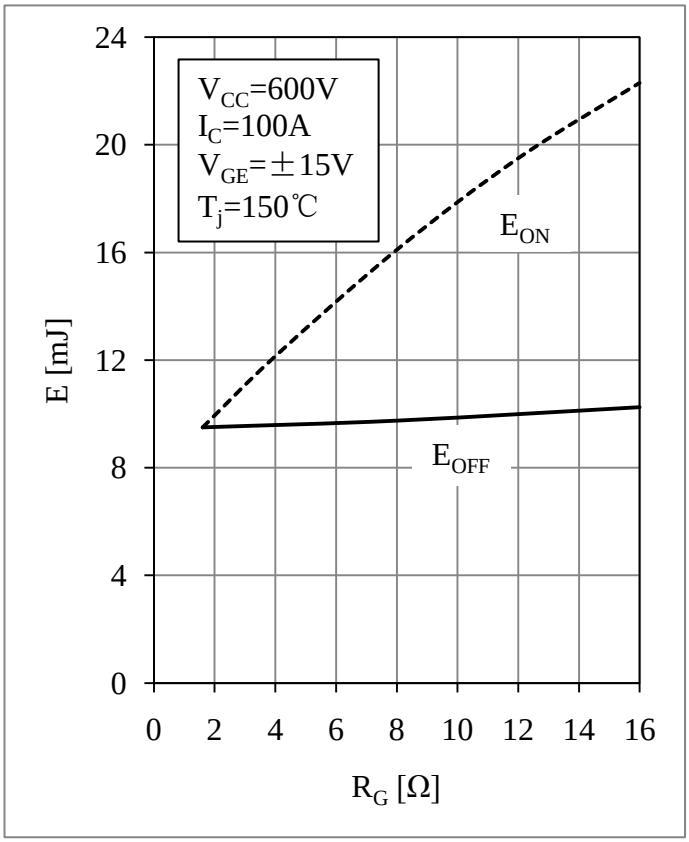



Fig 4. T1,T2 IGBT Switching Loss vs. $R_G$

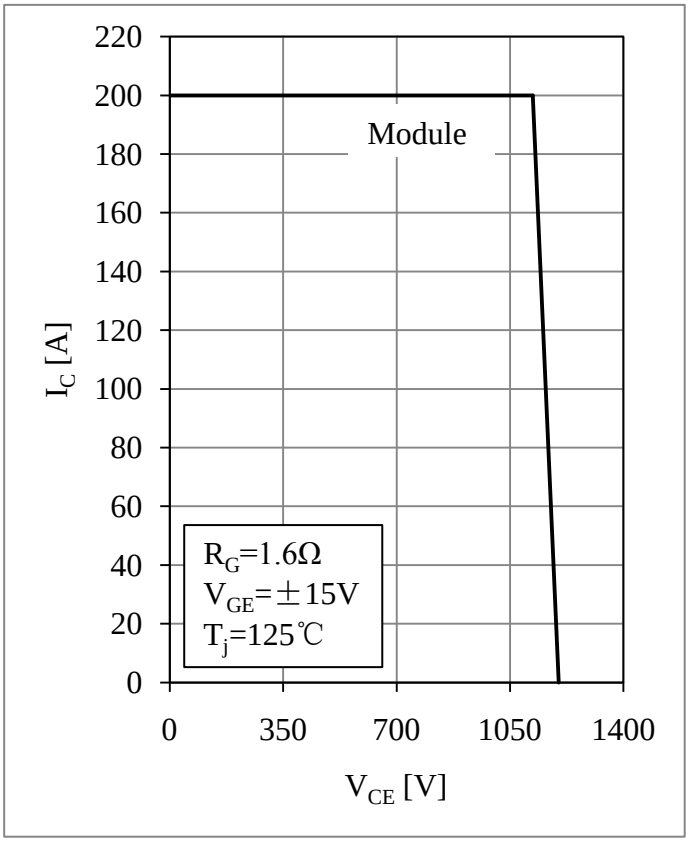



Fig 5. T1,T2 RBSOA

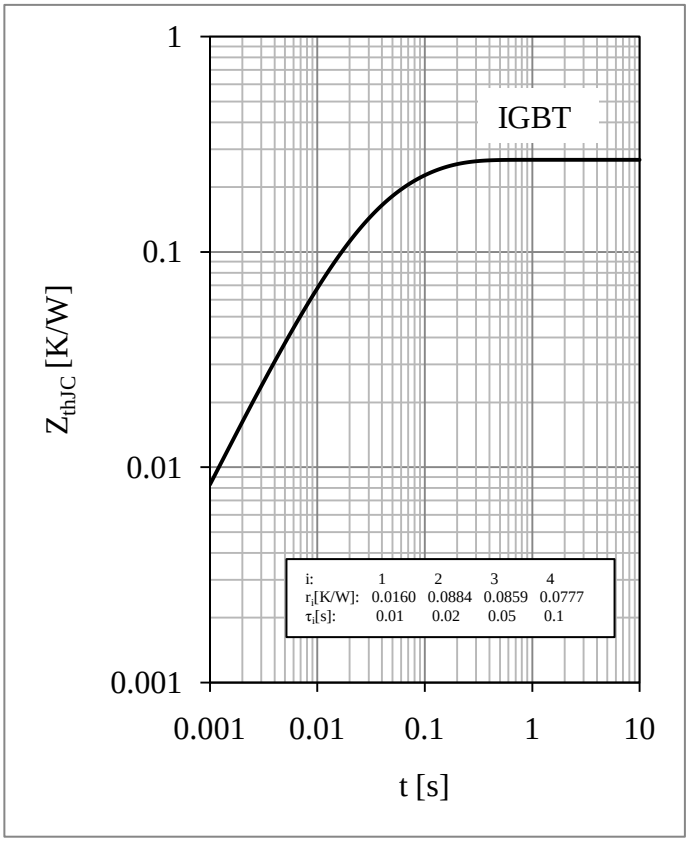



Fig 6. T1,T2 IGBT Transient Thermal Impedance

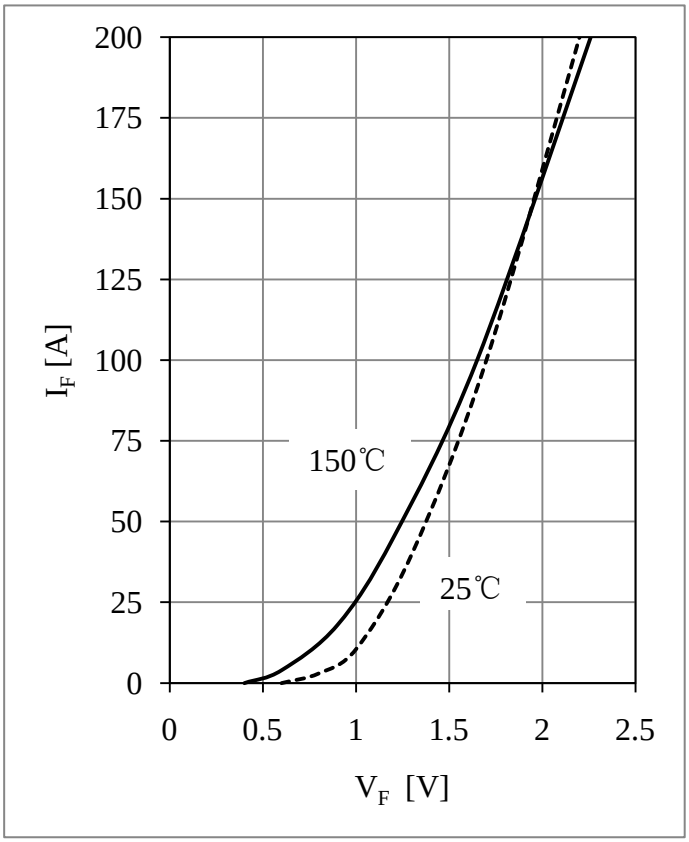



Fig 7. D1,D2 Diode Forward Characteristics

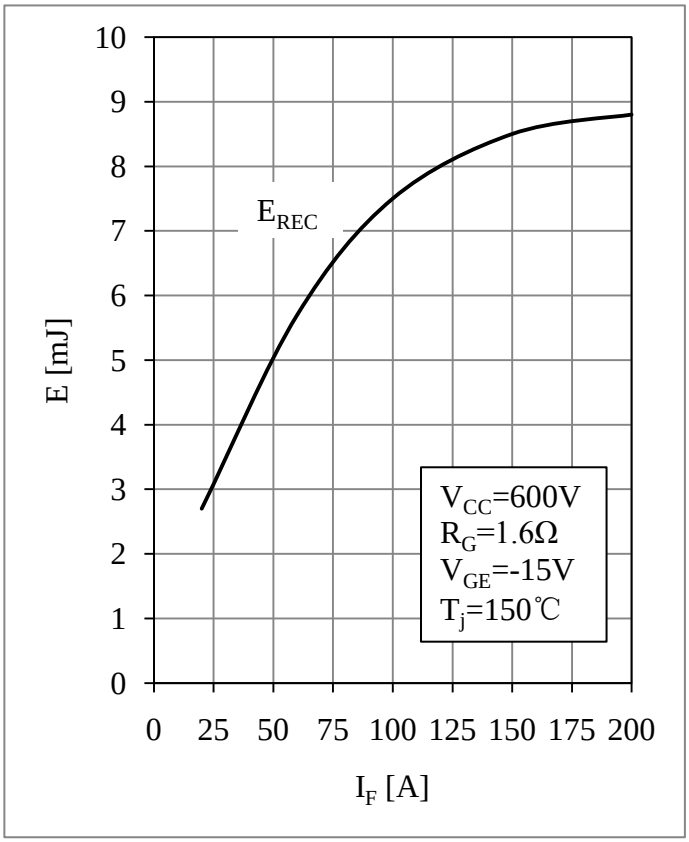



Fig 8. D1,D2 Diode Switching Loss vs. $I_F$

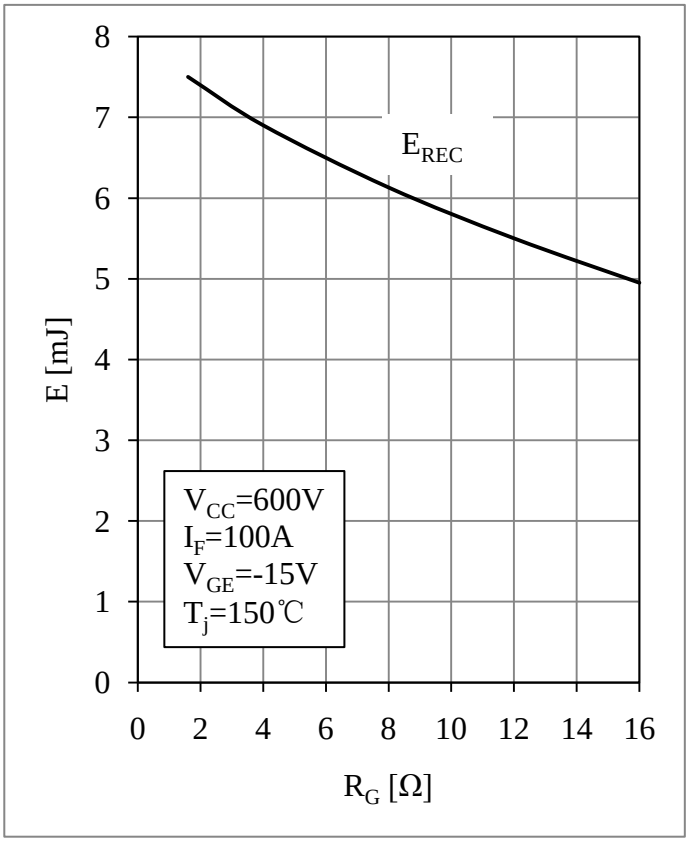



Fig 9. D1,D2 Diode Switching Loss vs. $R_G$

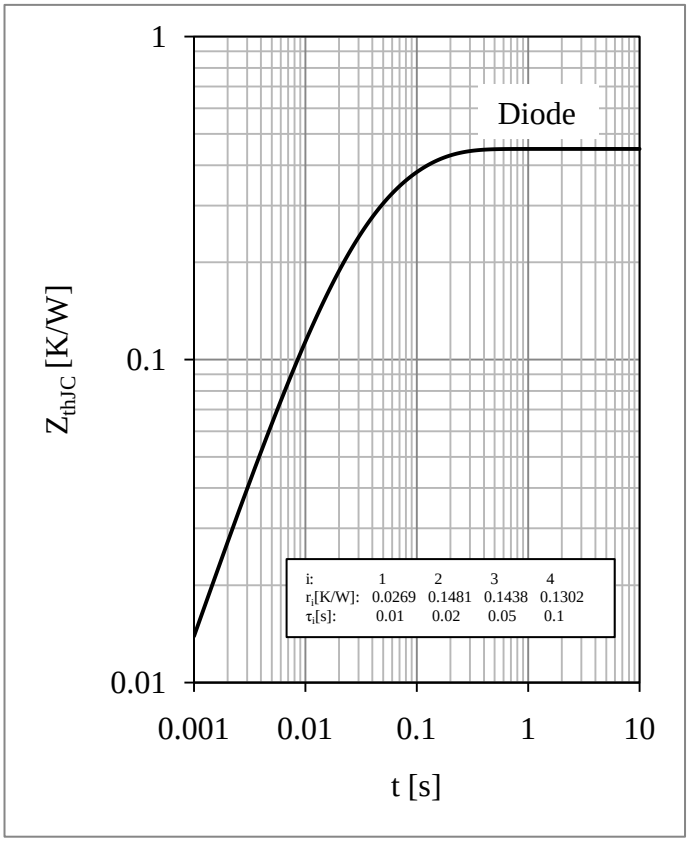



Fig 10. D1,D2 Diode Transient Thermal Impedance

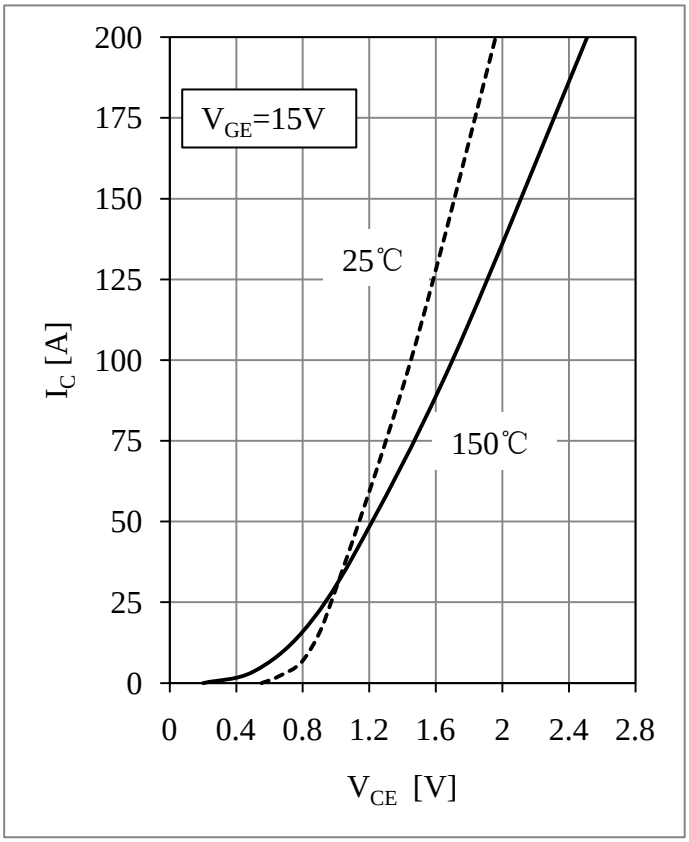



Fig 11. T3,T4 IGBT Output Characteristics

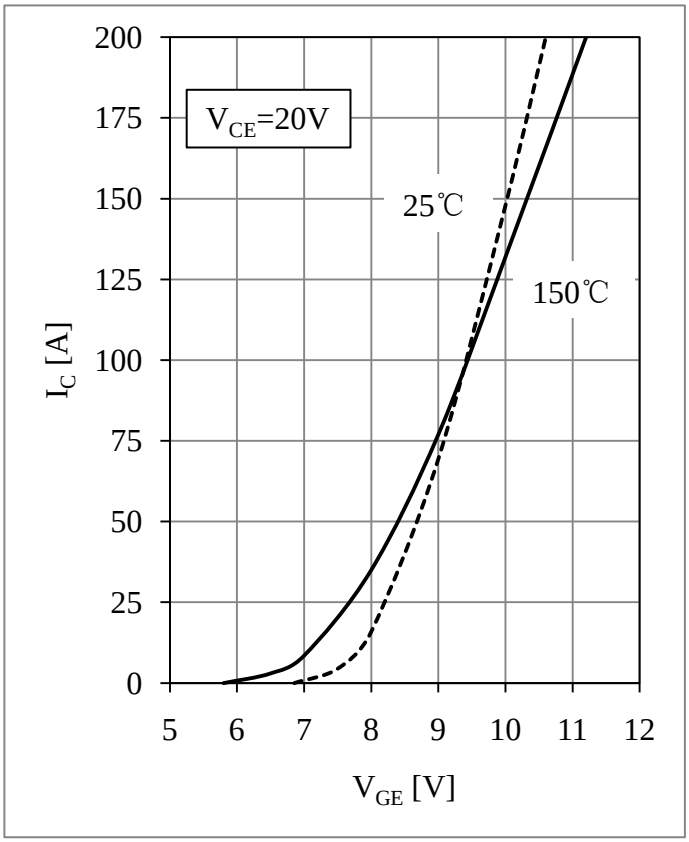



Fig 12. T3,T4 IGBT Transfer Characteristics

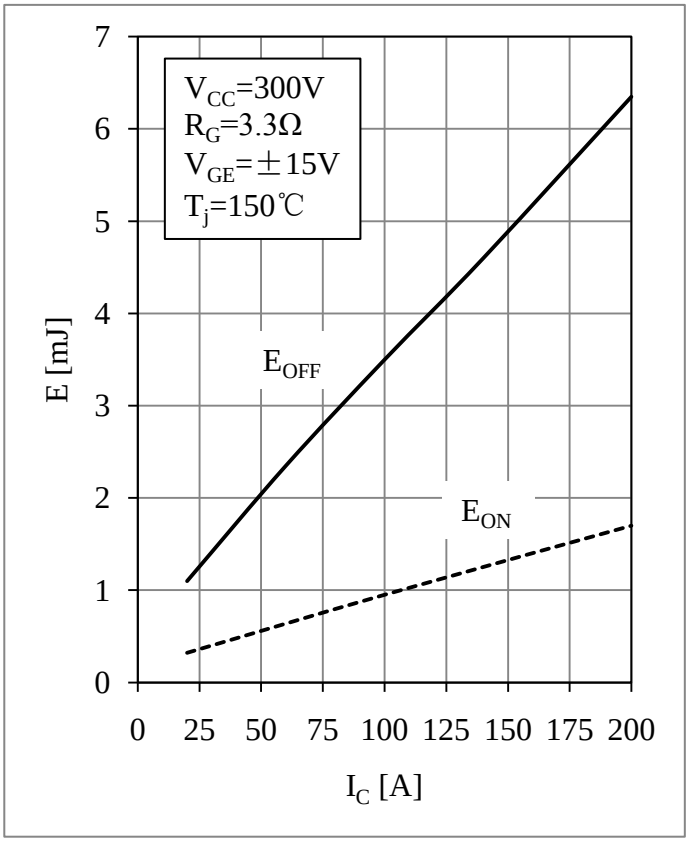



Fig 13. T3,T4 IGBT Switching Loss vs. $I_C$

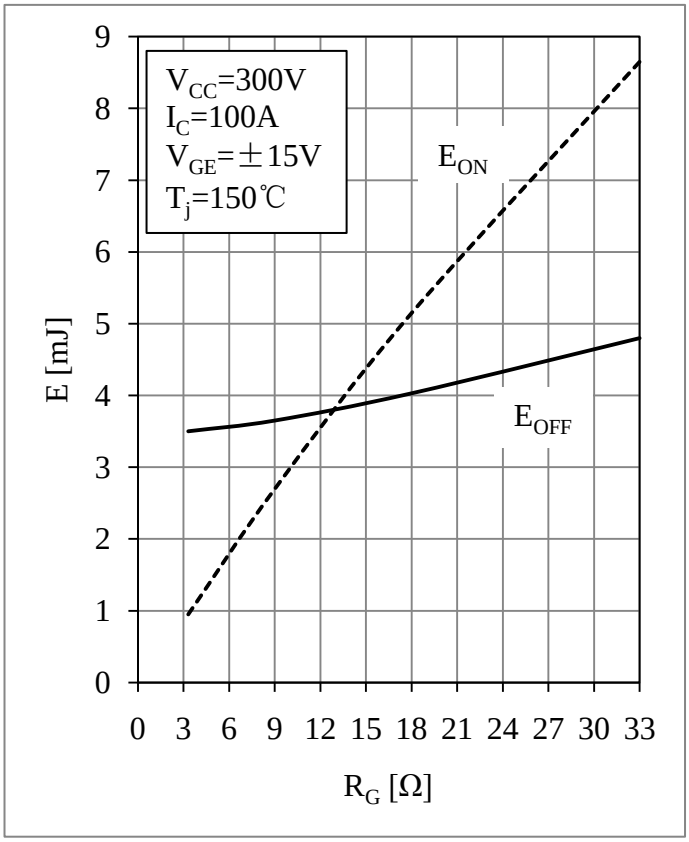



Fig 14. T3,T4 IGBT Switching Loss vs. $R_G$

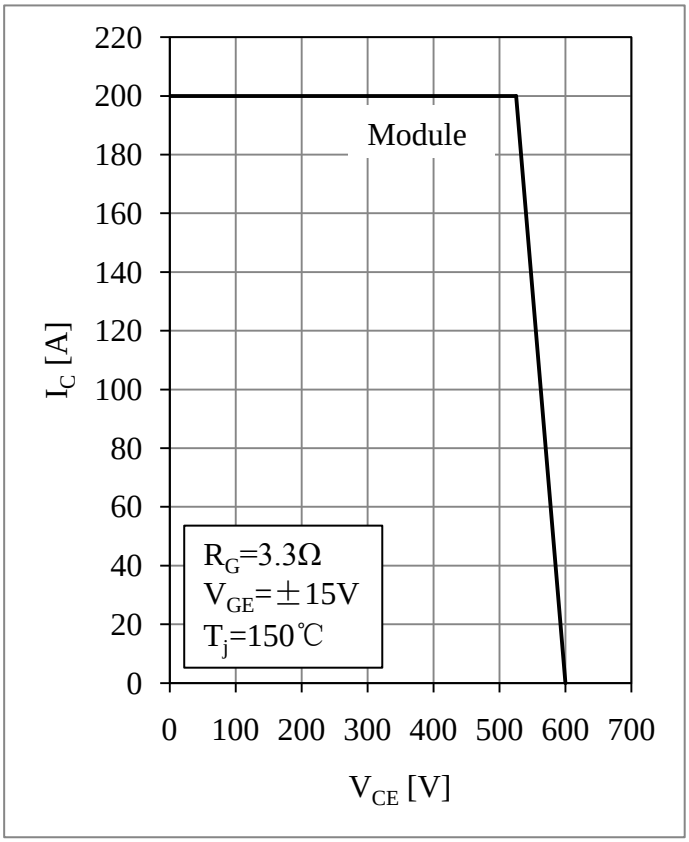



Fig 15. T3,T4 RBSOA

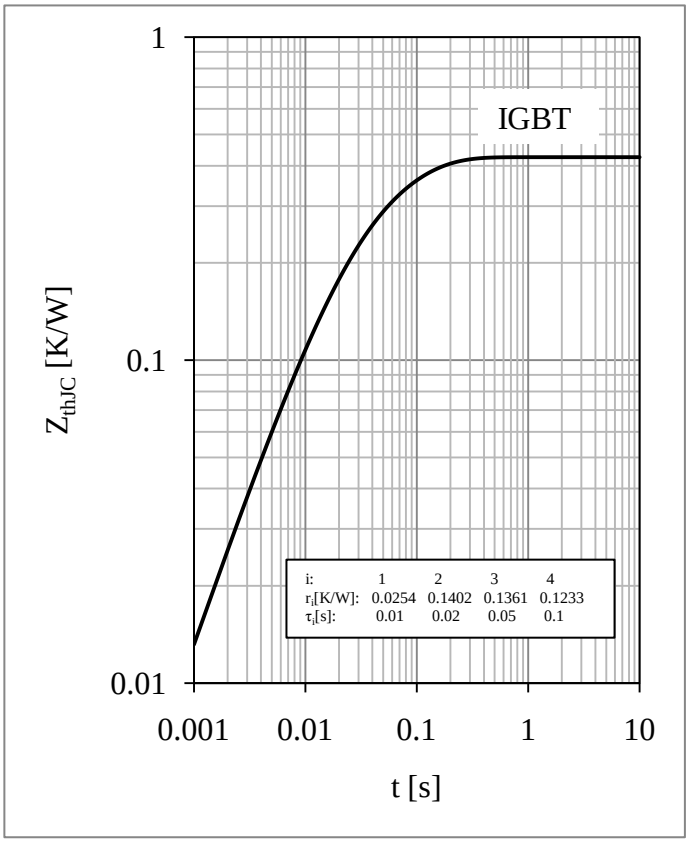



Fig 16. T3,T4 IGBT Transient Thermal Impedance

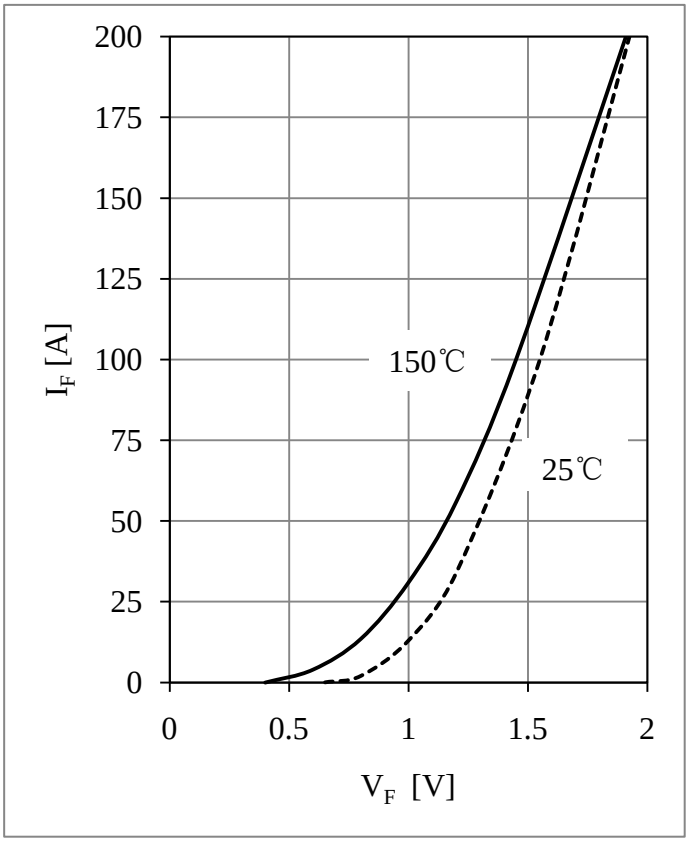



Fig 17. D3,D4 Diode Forward Characteristics

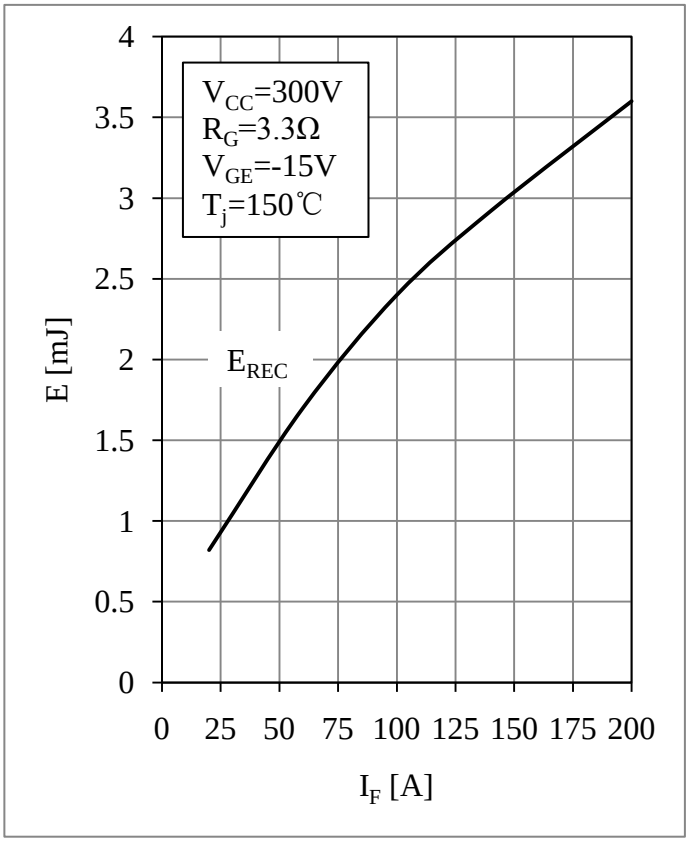



Fig 18. D3,D4 Diode Switching Loss vs. $I_F$

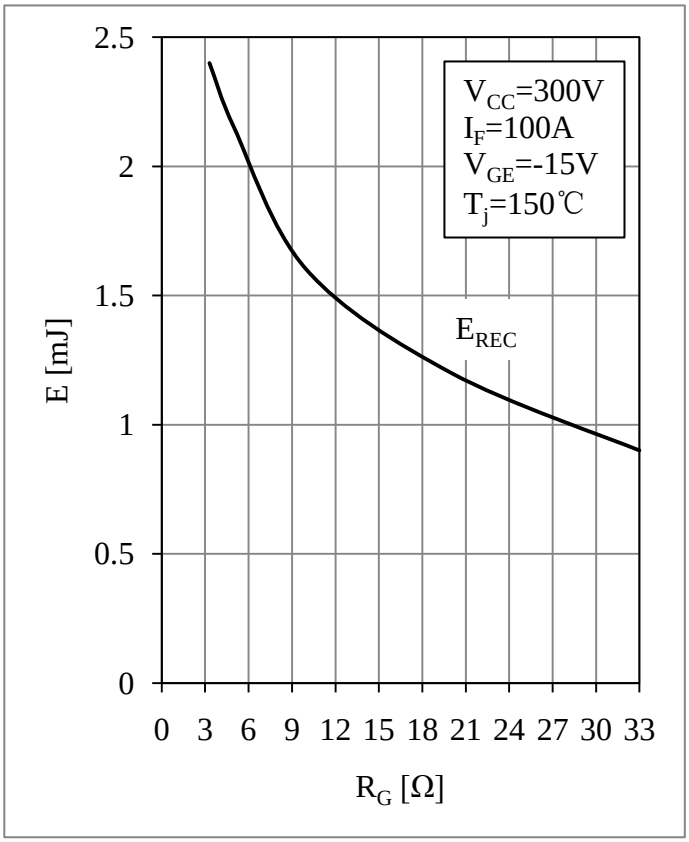



Fig 19. D3,D4 Diode Switching Loss vs. $R_G$

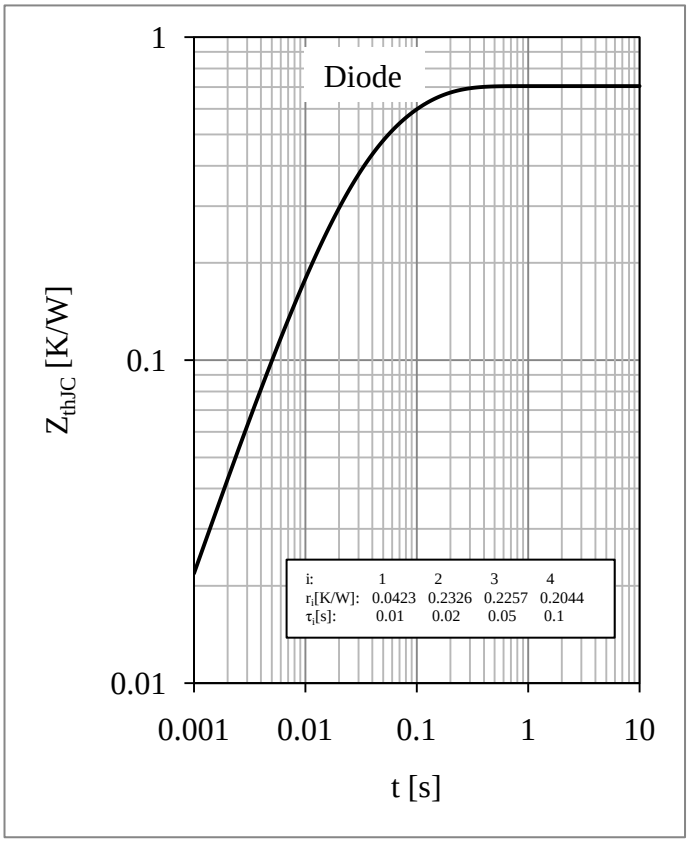
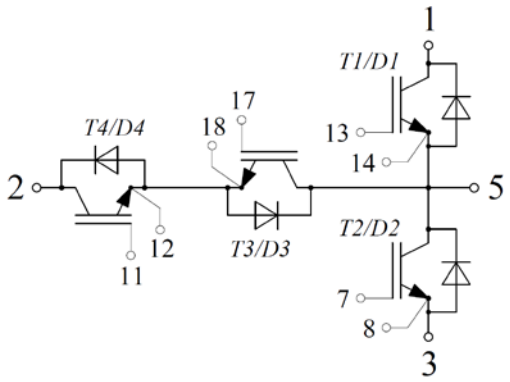


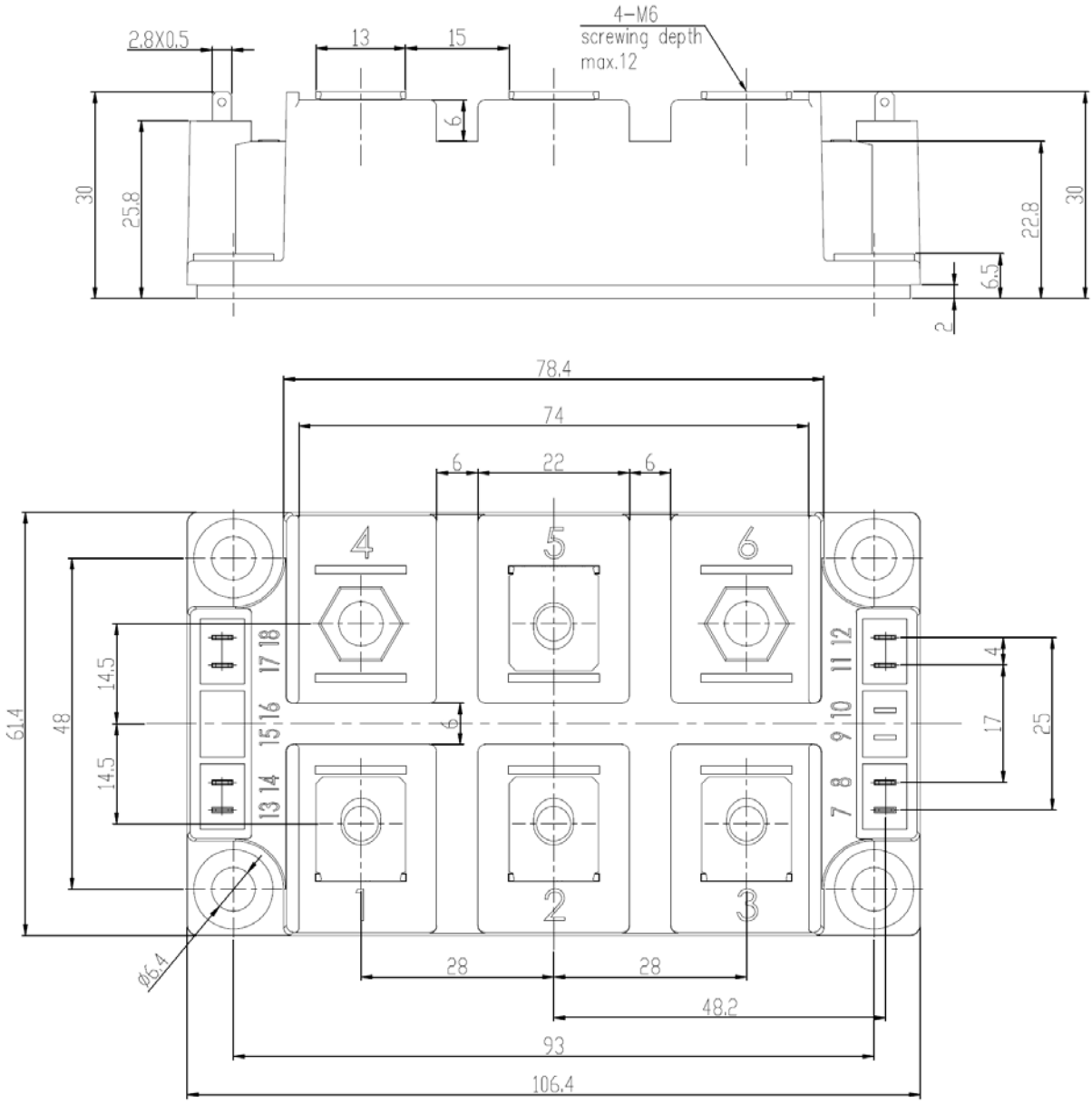

Fig 20. D3,D4 Diode Transient Thermal Impedance

## Circuit Schematic




## Package Dimensions

Dimensions in Millimeters



## Terms and Conditions of Usage

The data contained in this product datasheet is exclusively intended for technically trained staff. you and your technical departments will have to evaluate the suitability of the product for the intended application and the completeness of the product data with respect to such application.

This product data sheet is describing the characteristics of this product for which a warranty is granted. Any such warranty is granted exclusively pursuant the terms and conditions of the supply agreement. There will be no guarantee of any kind for the product and its characteristics.

Should you require product information in excess of the data given in this product data sheet or which concerns the specific application of our product, please contact the sales office, which is responsible for you (see www.powersemi.cc), For those that are specifically interested we may provide application notes.

Due to technical requirements our product may contain dangerous substances. For information on the types in question please contact the sales office, which is responsible for you.

Should you intend to use the Product in aviation applications, in health or live endangering or life support applications, please notify.

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