# STARPOWER

SEMICONDUCTOR **IGBT**

# GD100PIT120C6SN

**Molding Type Module**

**1200V/100A PIM 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
- 10μs short circuit capability
- $V_{CE(sat)}$ with positive temperature coefficient
- 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
- AC and DC servo drive amplifier
- Uninterruptible power supply

# IGBT-inverter $T_C$=25℃ unless otherwise noted

## Maximum Rated Values

| Symbol | Description | GD100PIT120C6SN | Units |
|---|---|---|---|
| $V_{CES}$ | Collector-Emitter Voltage @ $T_j$=25℃ | 1200 | V |
| $V_{GES}$ | Gate-Emitter Voltage @ $T_j$=25℃ | ±20 | V |
| $I_C$ | Collector Current @ $T_C$=25℃<br>@ $T_C$=100℃ | 165<br>100 | A |
| $I_{CM}$ | Pulsed Collector Current $t_p$=1ms | 200 | A |
| $P_{tot}$ | Total Power Dissipation @ $T_j$=175℃ | 577 | W |

## Off Characteristics

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| $V_{(BR)CES}$ | Collector-Emitter Breakdown Voltage | $T_j$=25℃ | 1200 | | | V |
| $I_{CES}$ | Collector Cut-Off Current | $V_{CE}$=$V_{CES}$,$V_{GE}$=0V, $T_j$=25℃ | | | 5.0 | mA |
| $I_{GES}$ | Gate-Emitter Leakage Current | $V_{GE}$=$V_{GES}$,$V_{CE}$=0V, $T_j$=25℃ | | | 400 | nA |

## On Characteristics

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| $V_{GE(th)}$ | Gate-Emitter Threshold Voltage | $I_C$=4.0mA,$V_{CE}$=$V_{GE}$, $T_j$=25℃ | 5.0 | 5.8 | 6.5 | V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | $I_C$=100A,$V_{GE}$=15V, $T_j$=25℃ | | 1.70 | 2.15 | V |
| | | $I_C$=100A,$V_{GE}$=15V, $T_j$=125℃ | | 2.00 | | |

## Switching Characteristics

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}$=600V,$I_C$=100A, $R_G$=3.9Ω,$V_{GE}$=±15V, $T_j$=25℃ | | 265 | | ns |
| $t_r$ | Rise Time | | | 32 | | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 430 | | ns |
| $t_f$ | Fall Time | | | 65 | | ns |
| $E_{on}$ | Turn-On Switching Loss | | | 6.66 | | mJ |
| $E_{off}$ | Turn-Off Switching Loss | | | 8.10 | | mJ |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}$=600V,$I_C$=100A, $R_G$=3.9Ω,$V_{GE}$=±15V, $T_j$=125℃ | | 300 | | ns |
| $t_r$ | Rise Time | | | 52 | | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 530 | | ns |
| $t_f$ | Fall Time | | | 88 | | ns |
| $E_{on}$ | Turn-On Switching Loss | | | 9.80 | | mJ |
| $E_{off}$ | Turn-Off Switching Loss | | | 12.1 | | mJ |
| $C_{ies}$ | Input Capacitance | $V_{CE}$=25V,f=1Mhz, $V_{GE}$=0V | | 7.21 | | nF |
| $C_{oes}$ | Output Capacitance | | | 0.38 | | nF |
| $C_{res}$ | Reverse Transfer Capacitance | | | 0.33 | | nF |
| $Q_G$ | Gate Charge | $V_{CC}$=600V,$I_C$=100A, $V_{GE}$=-15…+15V | | 0.90 | | μC |
| $R_{Gint}$ | Internal Gate Resistor | | | 7.5 | | Ω |
| $I_{SC}$ | SC Data | $t_P$≤10μs,$V_{GE}$=15V, $T_j$=125℃,$V_{CC}$=900V, $V_{CEM}$≤1200V | | 400 | | A |

# Diode-inverter $T_C$=25℃ unless otherwise noted

## Maximum Rated Values

| Symbol | Description | GD100PIT120C6SN | Units |
|---|---|---|---|
| $V_{RRM}$ | Repetitive Peak Reverse Voltage @ $T_j$=25℃ | 1200 | V |
| $I_F$ | DC Forward Current @ $T_C$=100℃ | 100 | A |
| $I_{FRM}$ | Repetitive Peak Forward Current $t_p$=1ms | 200 | A |

## Characteristics Values

| Symbol | Parameter | Test Conditions | | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|---|
| $V_F$ | Diode Forward Voltage | $I_F$=100A, $V_{GE}$=0V | $T_j$=25℃ | | 1.65 | 2.10 | V |
| | | | $T_j$=125℃ | | 1.65 | | |
| $Q_r$ | Recovered Charge | $I_F$=100A, $V_R$=600V, $R_G$=3.9Ω, $V_{GE}$=-15V | $T_j$=25℃ | | 10.1 | | μC |
| | | | $T_j$=125℃ | | 21.0 | | |
| $I_{RM}$ | Peak Reverse Recovery Current | | $T_j$=25℃ | | 125 | | A |
| | | | $T_j$=125℃ | | 142 | | |
| $E_{rec}$ | Reverse Recovery Energy | | $T_j$=25℃ | | 5.00 | | mJ |
| | | | $T_j$=125℃ | | 9.02 | | |

# Diode-rectifier $T_C$=25℃ unless otherwise noted

## Maximum Rated Values

| Symbol | Description | GD100PIT120C6SN | Units |
|---|---|---|---|
| $V_{RRM}$ | Repetitive Peak Reverse Voltage @ $T_j$=25℃ | 1600 | V |
| $I_F$ | DC Forward Current @ $T_C$=80℃ | 100 | A |
| $I_{RMSM}$ | Maximum RMS Current At Rectifier Output @ $T_C$=80℃ | 150 | A |
| $I_{FSM}$ | Surge Forward Current $V_R$=0V,$t_p$=10ms,$T_j$=45℃ | 1100 | A |
| $I^2t$ | $I^2t$-value,$V_R$=0V,$t_p$=10ms,$T_j$=45℃ | 6050 | $A^2s$ |

## Characteristics Values

| Symbol | Parameter | Test Conditions | | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|---|
| $V_F$ | Diode Forward Voltage | $I_F$=100A | $T_j$=150℃ | | 1.10 | | V |
| $I_R$ | Reverse Current | $T_j$=150℃,$V_R$=1600V | | | | 2.0 | mA |

# IGBT-brake-chopper $T_C$=25℃ unless otherwise noted

## Maximum Rated Values

| Symbol | Description | GD100PIT120C6SN | Units |
|---|---|---|---|
| $V_{CES}$ | Collector-Emitter Voltage @ $T_j$=25℃ | 1200 | V |
| $V_{GES}$ | Gate-Emitter Voltage @ $T_j$=25℃ | ±30 | V |
| $I_C$ | Collector Current @ $T_C$=25℃<br>@ $T_C$=100℃ | 85<br>50 | A |
| $I_{CM}$ | Pulsed Collector Current $t_p$=1ms | 100 | A |
| $P_{tot}$ | Total Power Dissipation @ $T_j$=175℃ | 323 | W |

## Off Characteristics

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| $V_{(BR)CES}$ | Collector-Emitter Breakdown Voltage | $T_j$=25℃ | 1200 | | | V |
| $I_{CES}$ | Collector Cut-Off Current | $V_{CE}$=$V_{CES}$,$V_{GE}$=0V, $T_j$=25℃ | | | 5.0 | mA |
| $I_{GES}$ | Gate-Emitter Leakage Current | $V_{GE}$=$V_{GES}$,$V_{CE}$=0V, $T_j$=25℃ | | | 400 | nA |

## On Characteristics

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| $V_{GE(th)}$ | Gate-Emitter Threshold Voltage | $I_C$=2.4mA,$V_{CE}$=$V_{GE}$, $T_j$=25℃ | 5.0 | 6.1 | 7.5 | V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | $I_C$=50A,$V_{GE}$=15V, $T_j$=25℃ | | 1.90 | 2.35 | V |
| | | $I_C$=50A,$V_{GE}$=15V, $T_j$=125℃ | | 2.30 | | |

## Switching Characteristics

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}$=600V,$I_C$=50A, $R_G$=15Ω,$V_{GE}$=±15V, $T_j$=25℃ | | 148 | | ns |
| $t_r$ | Rise Time | | | 83 | | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 245 | | ns |
| $t_f$ | Fall Time | | | 251 | | ns |
| $E_{on}$ | Turn-On Switching Loss | | | 5.51 | | mJ |
| $E_{off}$ | Turn-Off Switching Loss | | | 2.70 | | mJ |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}$=600V,$I_C$=50A, $R_G$=15Ω,$V_{GE}$=±15V, $T_j$=125℃ | | 263 | | ns |
| $t_r$ | Rise Time | | | 84 | | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 256 | | ns |
| $t_f$ | Fall Time | | | 292 | | ns |
| $E_{on}$ | Turn-On Switching Loss | | | 6.63 | | mJ |
| $E_{off}$ | Turn-Off Switching Loss | | | 3.25 | | mJ |
| $C_{ies}$ | Input Capacitance | $V_{CE}$=30V,f=1Mhz, $V_{GE}$=0V | | 6.24 | | nF |
| $C_{oes}$ | Output Capacitance | | | 0.23 | | nF |
| $C_{res}$ | Reverse Transfer Capacitance | | | 0.15 | | nF |
| $Q_G$ | Gate Charge | $V_{CC}$=600V,$I_C$=50A, $V_{GE}$=0-15V | | 290 | | nC |
| $I_{SC}$ | SC Data | $t_P$≤10μs,$V_{GE}$=15 V, $T_j$=125℃,$V_{CC}$=900V, $V_{CEM}$≤1200V | | 500 | | A |

# Diode-brake-chopper $T_C$=25℃ unless otherwise noted

## Maximum Rated Values

| Symbol | Description | GD100PIT120C6SN | Units |
|---|---|---|---|
| $V_{RRM}$ | Repetitive Peak Reverse Voltage @ $T_j$=25℃ | 1200 | V |
| $I_F$ | DC Forward Current @ $T_C$=100℃ | 30 | A |
| $I_{FRM}$ | Repetitive Peak Forward Current $t_p$=1ms | 60 | A |

## Characteristics Values

| Symbol | Parameter | Test Conditions | | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|---|
| $V_F$ | Diode Forward Voltage | $I_F$=30A,$V_{GE}$=0V | $T_j$=25℃ | | 1.90 | 2.30 | V |
| | | | $T_j$=125℃ | | 1.80 | | |
| $Q_r$ | Recovered Charge | $I_F$=30A, $V_R$=600V, $R_G$=15Ω, $V_{GE}$=-15V | $T_j$=25℃ | | 2.6 | | μC |
| | | | $T_j$=125℃ | | 4.2 | | |
| $I_{RM}$ | Peak Reverse Recovery Current | | $T_j$=25℃ | | 20 | | A |
| | | | $T_j$=125℃ | | 23 | | |
| $E_{rec}$ | Reverse Recovery Energy | | $T_j$=25℃ | | 1.31 | | mJ |
| | | | $T_j$=125℃ | | 2.08 | | |

## Electrical Characteristics of NTC $T_C$=25℃ unless otherwise noted

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| $R_{25}$ | Rated Resistance | | | 5.0 | | kΩ |
| ΔR/R | Deviation of $R_{100}$ | $T_C$=100℃,$R_{100}$=493.3Ω | -5 | | 5 | % |
| $P_{25}$ | Power Dissipation | | | | 20.0 | mW |
| $B_{25/50}$ | B-value | $R_2=R_{25}\exp[B_{25/50}(1/T_2-1/(298.15K))]$ | | 3375 | | K |

## IGBT Module

| Symbol | Parameter | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| $V_{ISO}$ | Isolation Voltage RMS,f=50Hz,t=1min | 2500 | | | V |
| $L_{CE}$ | Stray Inductance | | 40 | | nH |
| $R_{CC'+EE'}$<br>$R_{AA'+CC'}$ | Module Lead Resistance,Terminal to Chip<br>@ $T_C$=25℃ | | 4.00<br>3.00 | | mΩ |
| $R_{\theta JC}$ | Junction-to-Case (per IGBT-inverter)<br>Junction-to-Case (per Diode-inverter)<br>Junction-to-Case (per Diode-rectifier)<br>Junction-to-Case (per IGBT-brake-chopper)<br>Junction-to-Case (per Diode-brake-chopper) | | | 0.260<br>0.482<br>0.543<br>0.464<br>1.045 | K/W |
| $R_{\theta CS}$ | Case-to-Sink (Conductive grease applied) | | 0.009 | | K/W |
| $T_{jmax}$ | Maximum Junction Temperature(inverter, brake)<br>Maximum Junction Temperature(rectifier) | | | 175<br>150 | ℃ |
| $T_{jop}$ | Operating Junction Temperature | -40 | | 150 | ℃ |
| $T_{STG}$ | Storage Temperature Range | -40 | | 125 | ℃ |
| Mounting Torque | Mounting Screw:M5 | 3.0 | | 6.0 | N.m |
| G | Weight of Module | | 300 | | g |

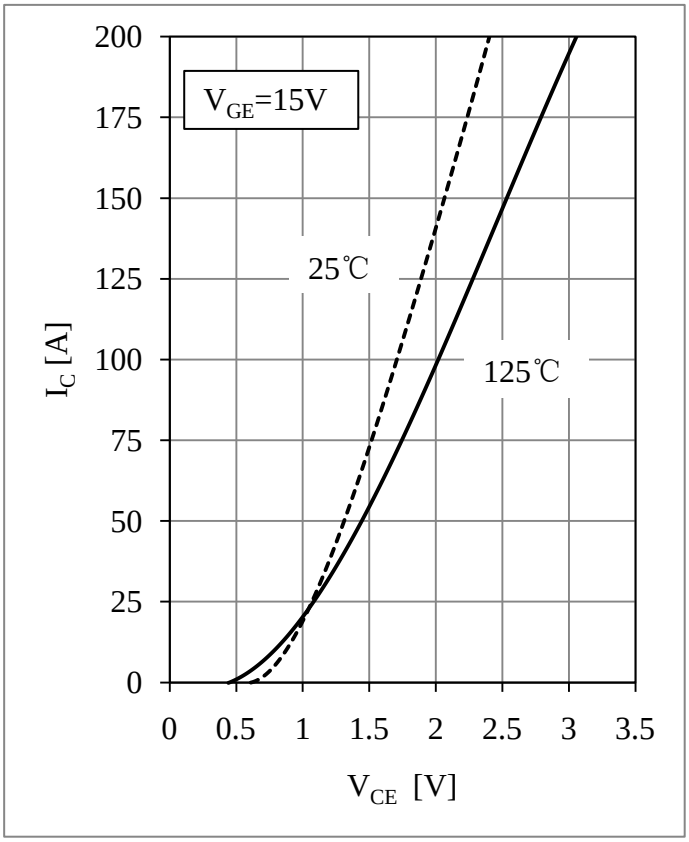



Fig 1. IGBT-inverter Output Characteristics

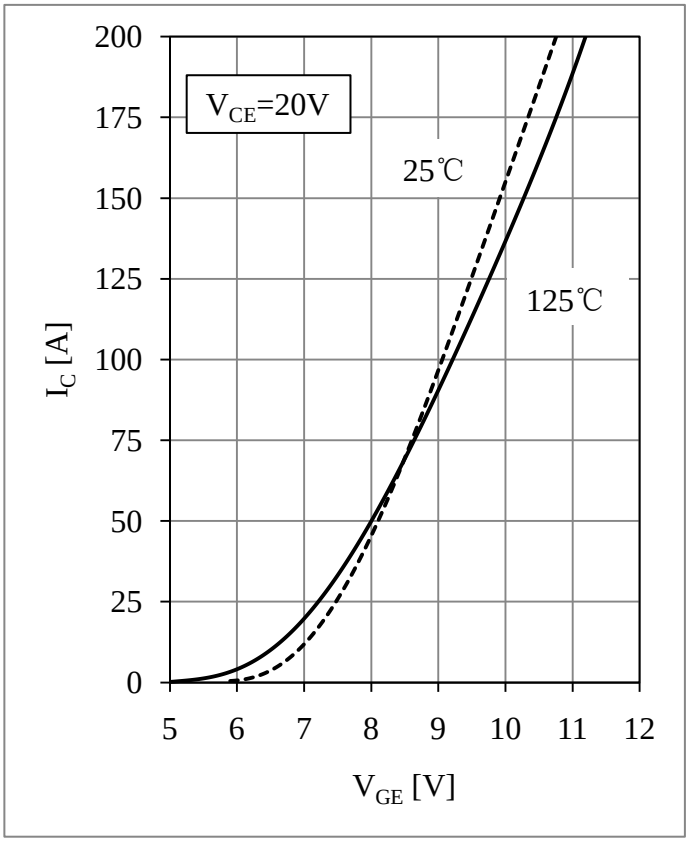



Fig 2. IGBT-inverter Transfer Characteristics

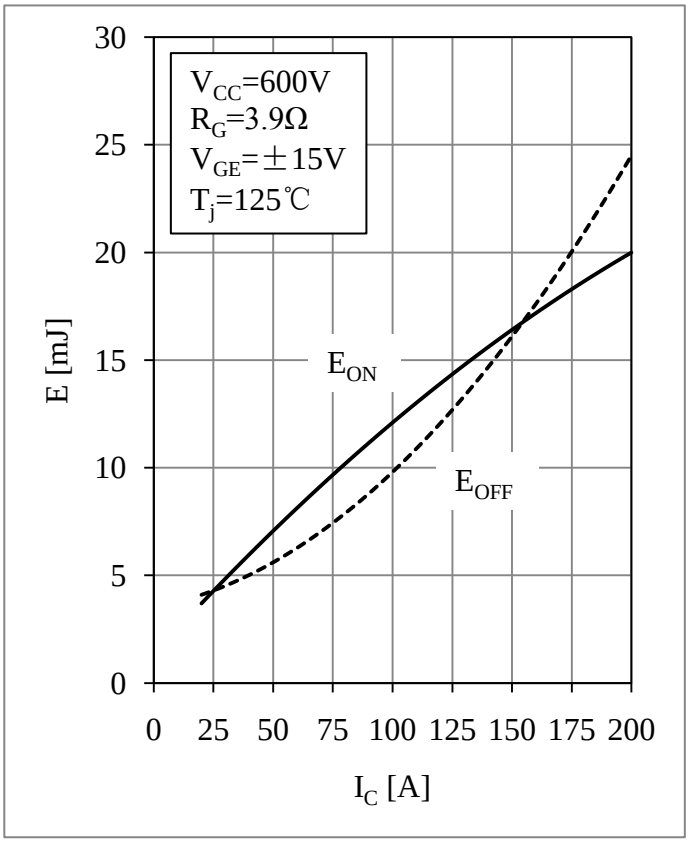



Fig 3. IGBT-inverter Switching Loss vs. $I_C$

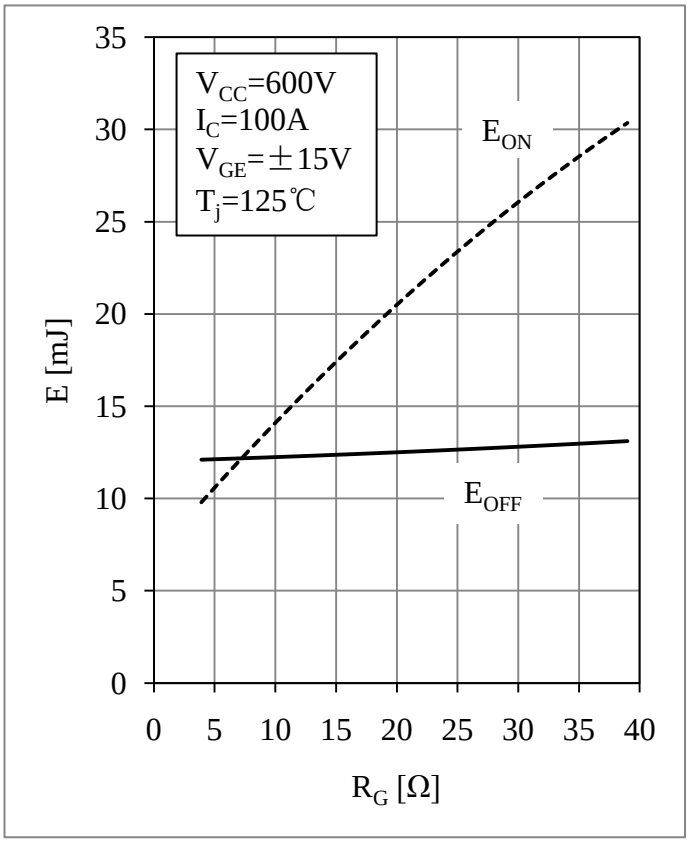



Fig 4. IGBT-inverter Switching Loss vs. $R_G$

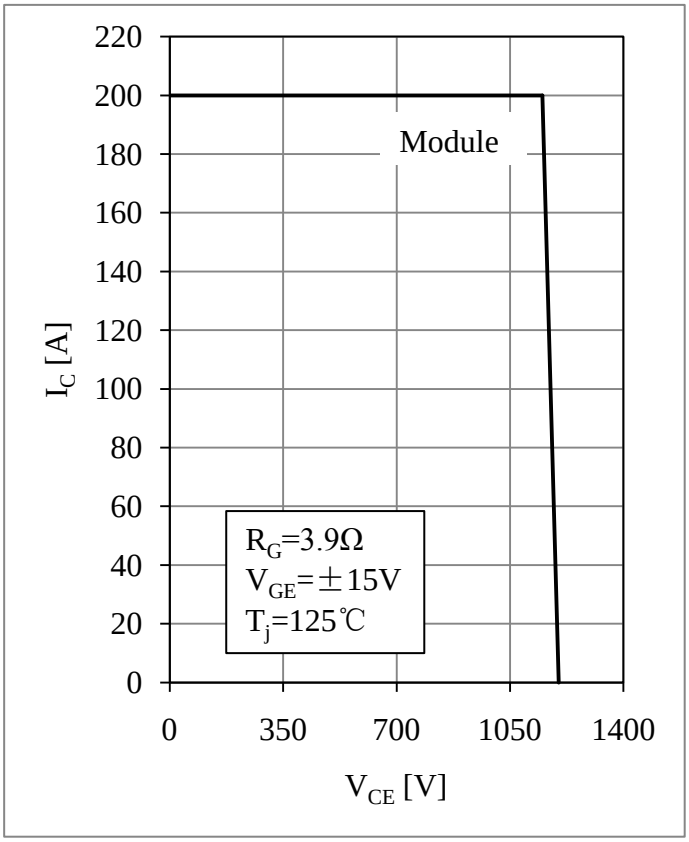



Fig 5. IGBT-inverter RBSOA

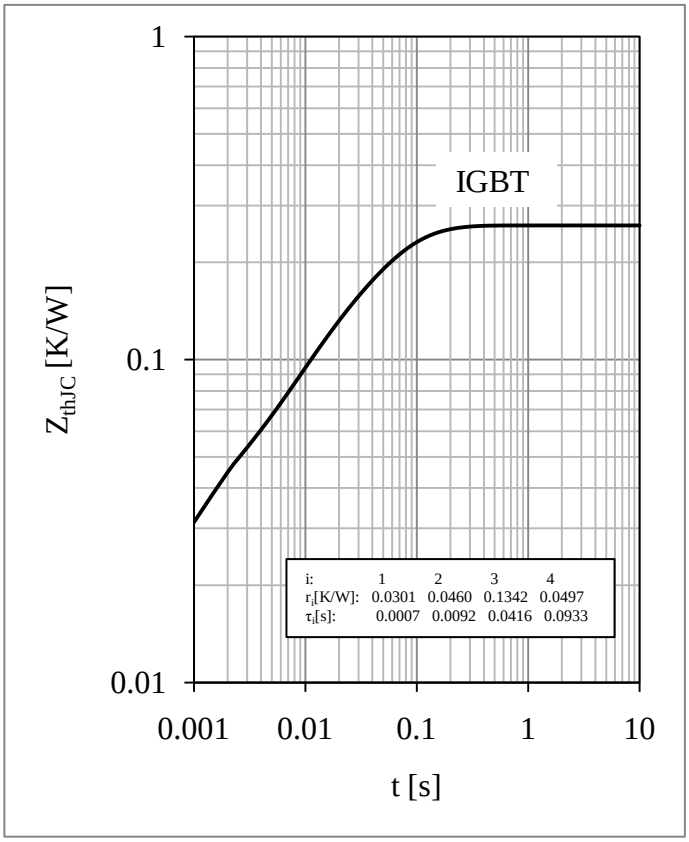



Fig 6. IGBT-inverter Transient Thermal Impedance

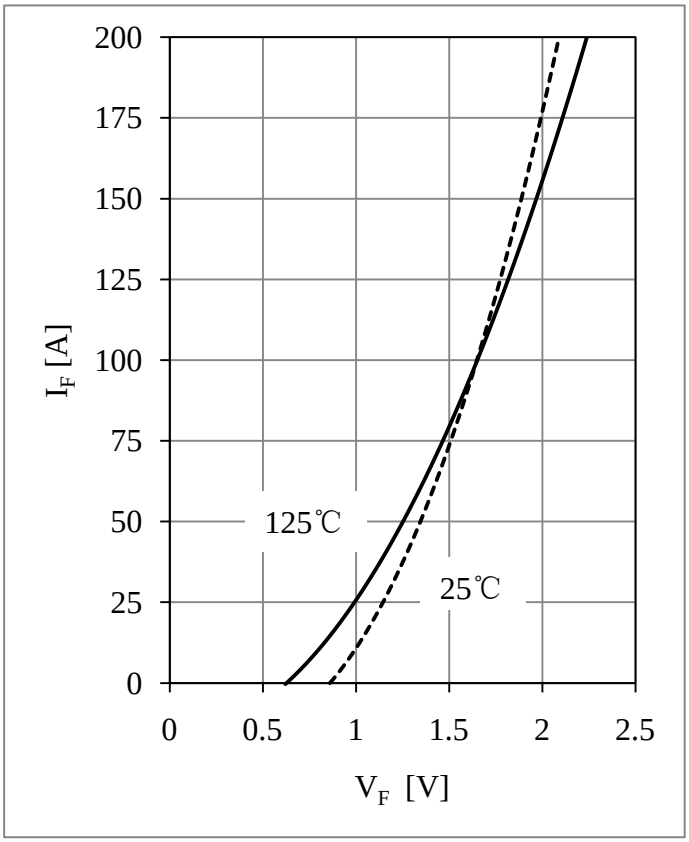



Fig 7. Diode-inverter Forward Characteristics

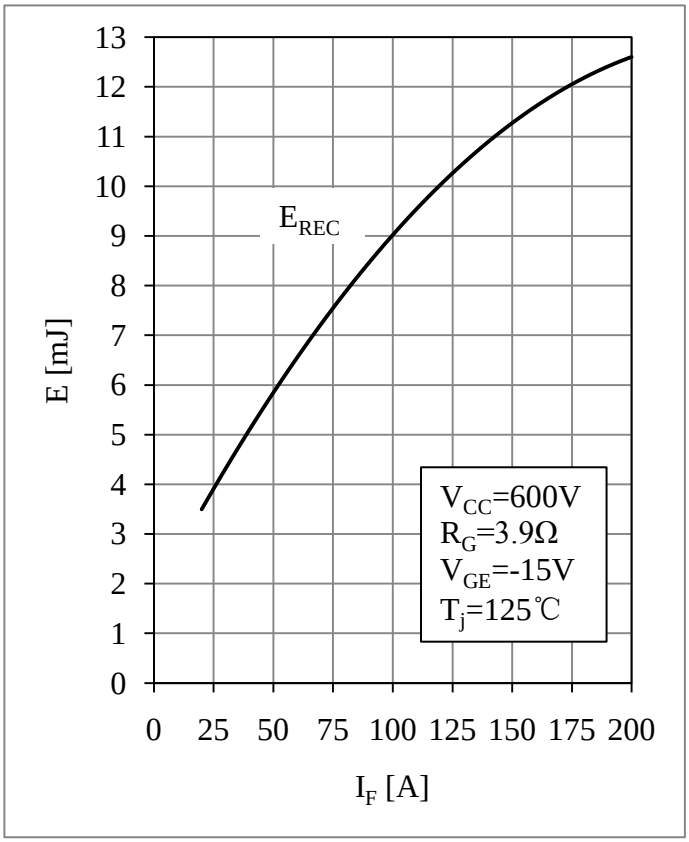



Fig 8. Diode-inverter Switching Loss vs. $I_F$

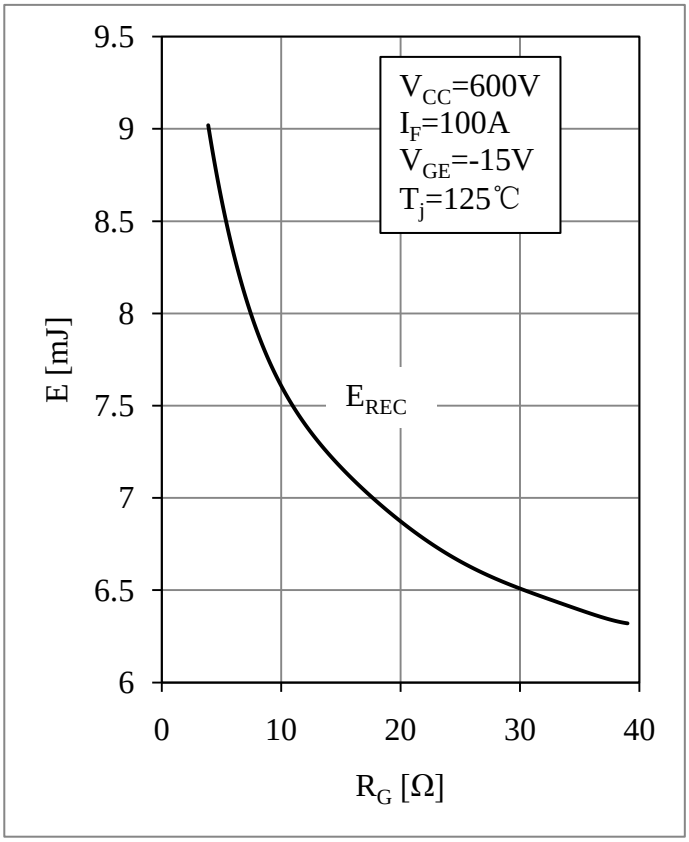



Fig 9. Diode-inverter Switching Loss vs. $R_G$

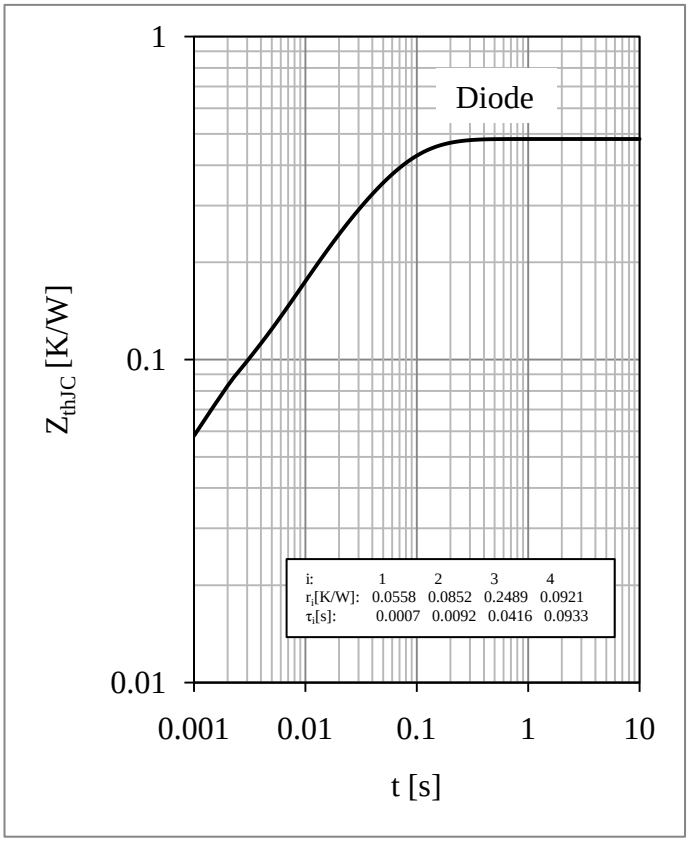



Fig 10. Diode-inverter Transient Thermal Impedance

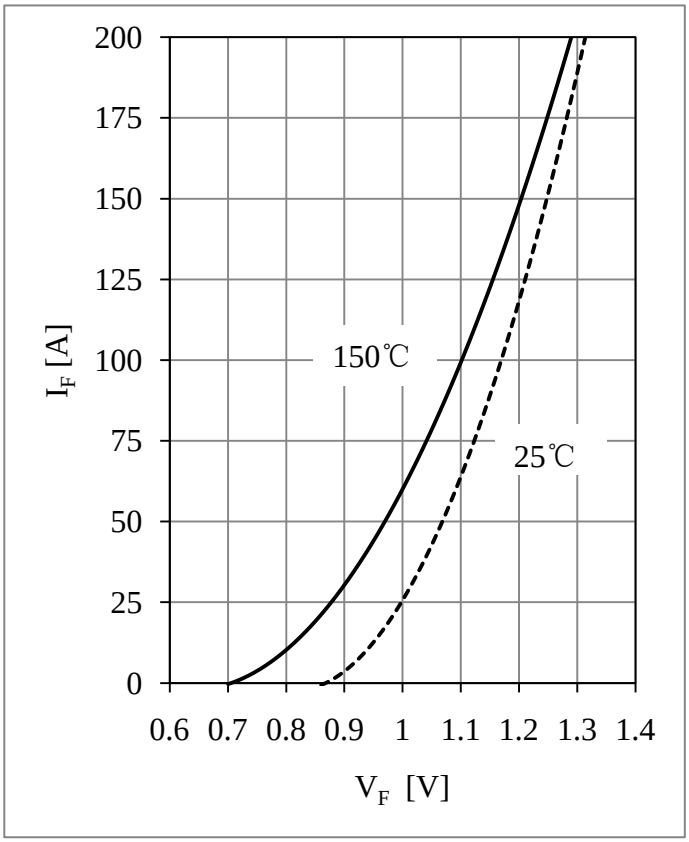



Fig 11. Diode-rectifier Forward Characteristics

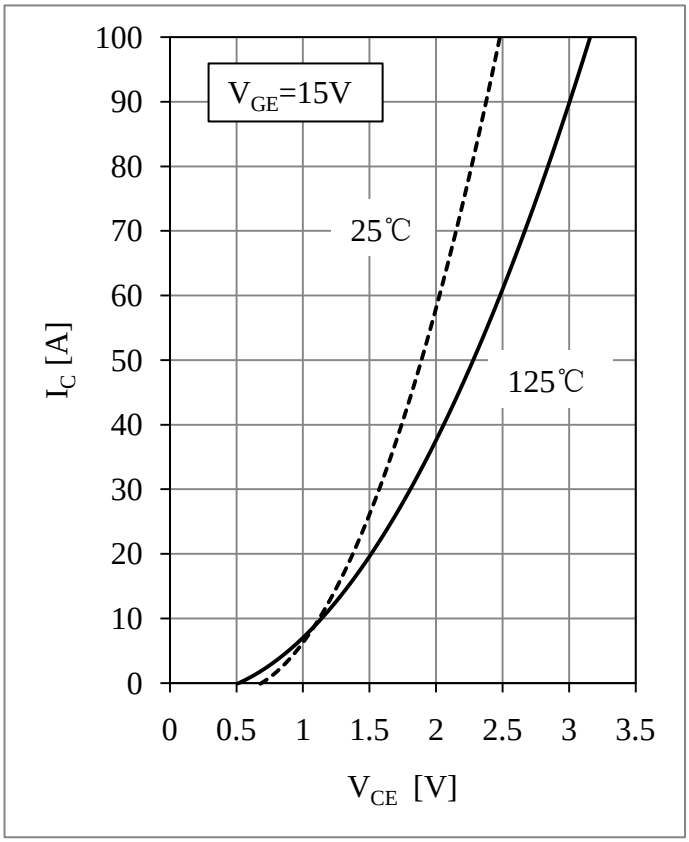



Fig 12. IGBT-brake-chopper Output Characteristics

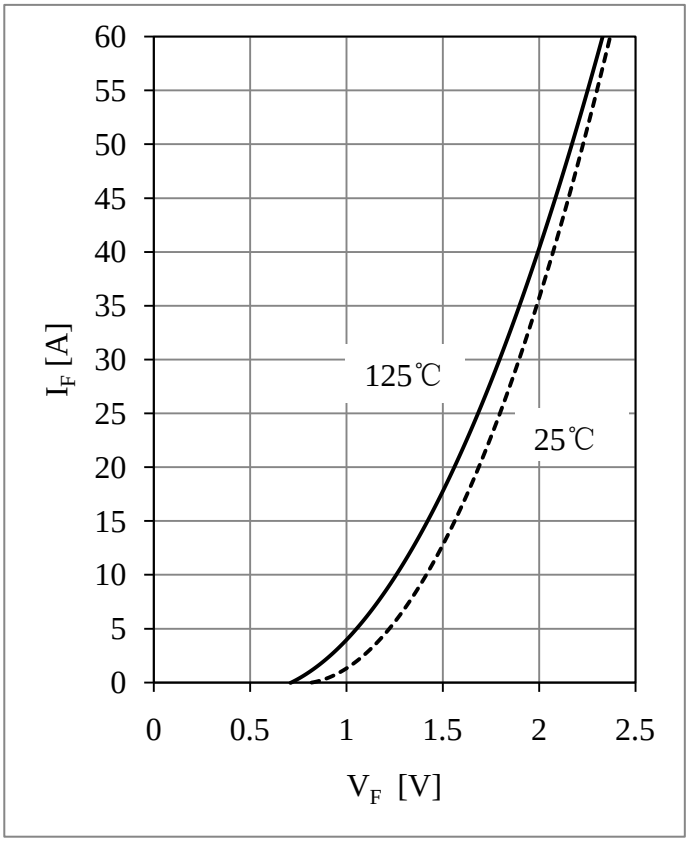



Fig 13. Diode-brake-chopper Forward Characteristics

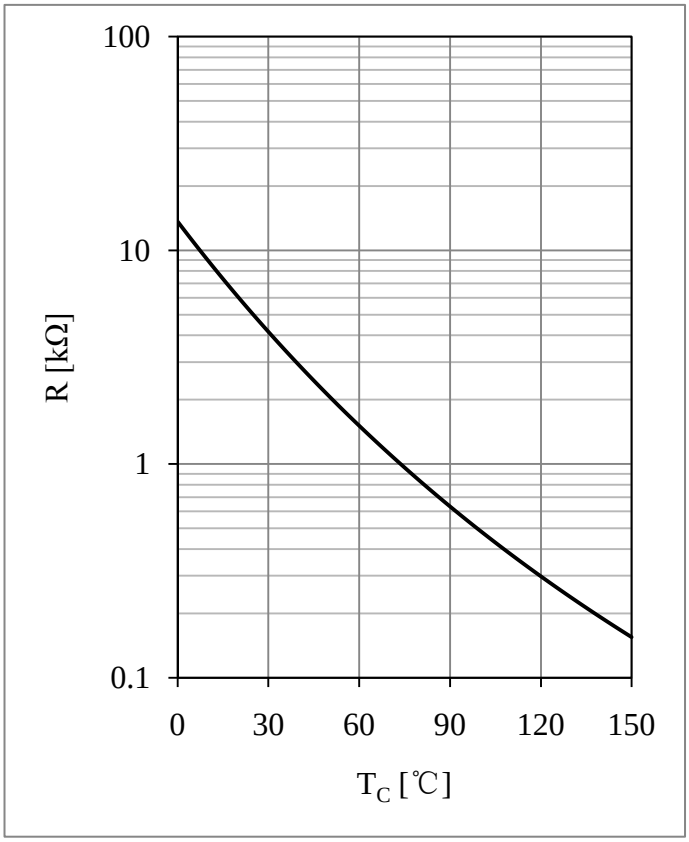
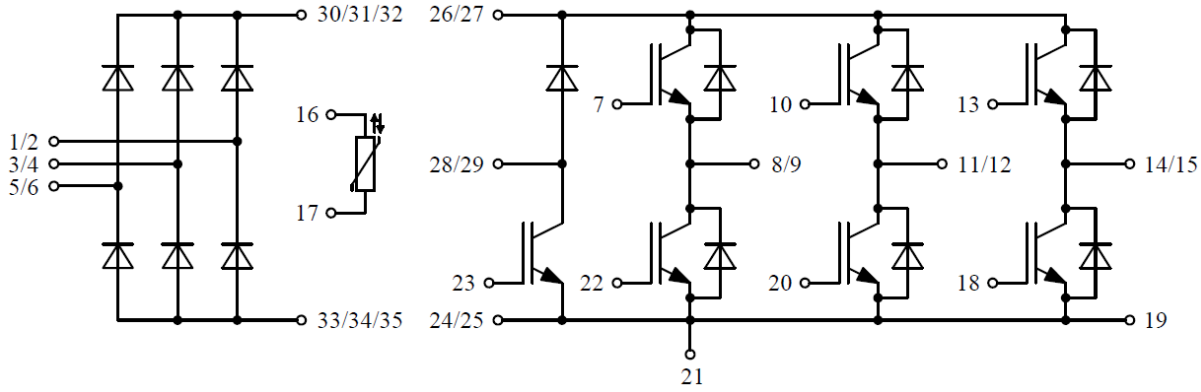


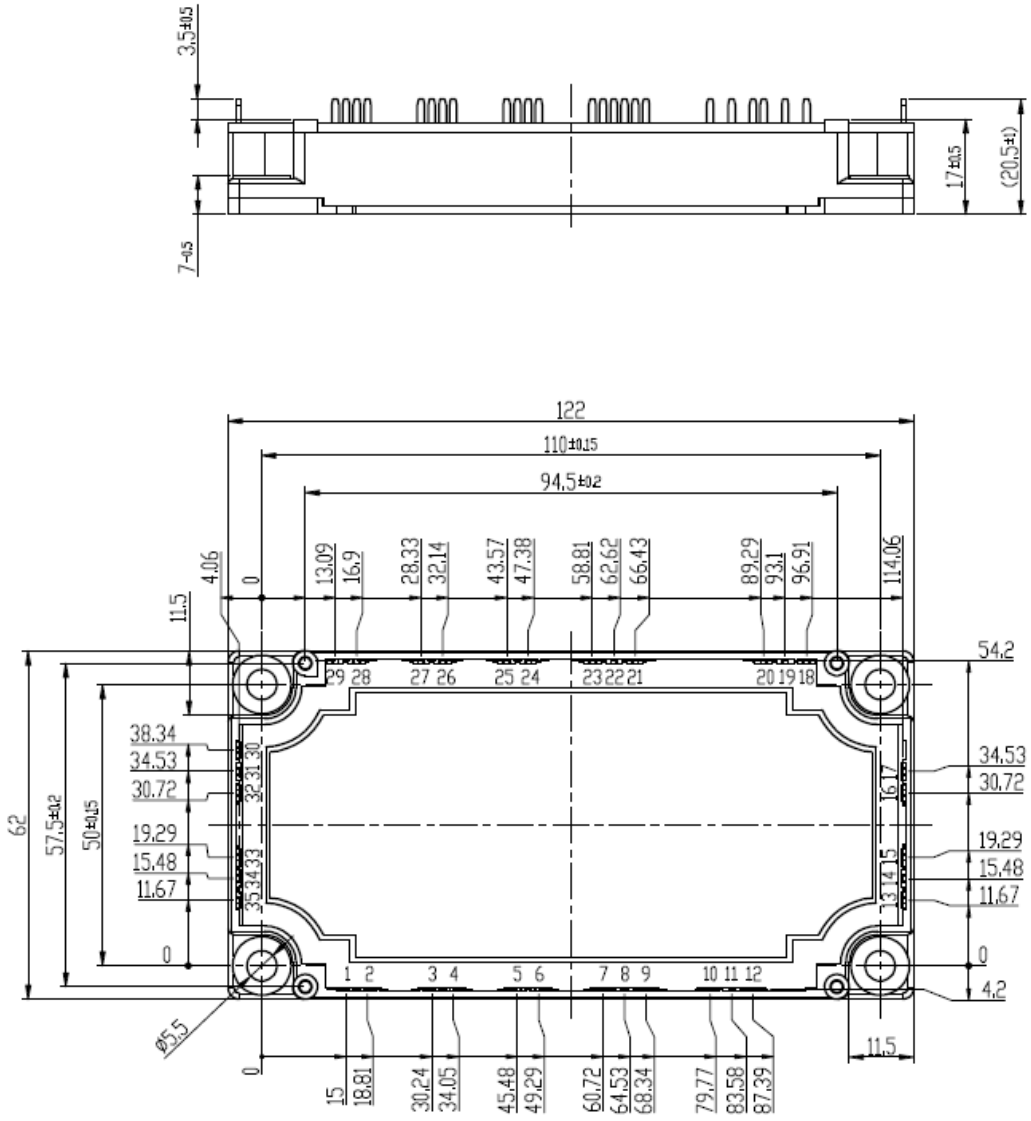

Fig 14. NTC Temperature Characteristic

## Equivalent Circuit Schematic




## Package Dimensions

Dimensions in Millimeters



## Terms and Conditions of Usage

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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.

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