

# STARPOWER

SEMICONDUCTOR

# IGBT

## GD15PIK120C5S

**1200V/15A 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

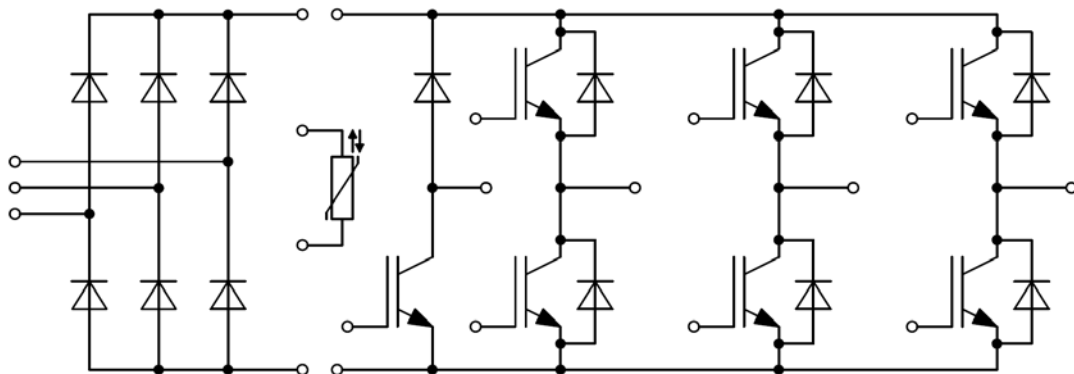
- Low  $V_{CE(sat)}$  NPT IGBT technology
- Low switching loss
- 10 $\mu$ s short circuit capability
- $V_{CE(sat)}$  with positive temperature coefficient
- Fast & soft reverse recovery anti-parallel FWD
- Isolated copper baseplate using DBC technology



### 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-inverter**

Symbol	Description	Value	Unit
$V_{CES}$	Collector-Emitter Voltage	1200	V
$V_{GES}$	Gate-Emitter Voltage	$\pm 20$	V
$I_C$	Collector Current @ $T_C=25^{\circ}\text{C}$	30	A
	@ $T_C=100^{\circ}\text{C}$	15	A
$I_{CM}$	Pulsed Collector Current $t_p=1\text{ms}$	30	A
$P_D$	Maximum Power Dissipation @ $T_j=150^{\circ}\text{C}$	176	W

**Diode-inverter**

Symbol	Description	Value	Unit
$V_{RRM}$	Repetitive Peak Reverse Voltage	1200	V
$I_F$	Diode Continuous Forward Current	15	A
$I_{FM}$	Diode Maximum Forward Current $t_p=1\text{ms}$	30	A

**Diode-rectifier**

Symbol	Description	Value	Unit
$V_{RRM}$	Repetitive Peak Reverse Voltage	1600	V
$I_O$	Average Output Current 50Hz/60Hz,sine wave	15	A
$I_{FSM}$	Surge Forward Current $V_R=0\text{V}, t_p=10\text{ms}, T_j=45^{\circ}\text{C}$	270	A
$I^2t$	$I^2t$ -value, $V_R=0\text{V}, t_p=10\text{ms}, T_j=45^{\circ}\text{C}$	360	$\text{A}^2\text{s}$

**IGBT-brake**

Symbol	Description	Value	Unit
$V_{CES}$	Collector-Emitter Voltage	1200	V
$V_{GES}$	Gate-Emitter Voltage	$\pm 20$	V
$I_C$	Collector Current @ $T_C=25^{\circ}\text{C}$	20	A
	@ $T_C=100^{\circ}\text{C}$	10	A
$I_{CM}$	Pulsed Collector Current $t_p=1\text{ms}$	20	A
$P_D$	Maximum Power Dissipation @ $T_j=150^{\circ}\text{C}$	108	W

**Diode-brake**

Symbol	Description	Value	Unit
$V_{RRM}$	Repetitive Peak Reverse Voltage	1200	V
$I_F$	Diode Continuous Forward Current	10	A
$I_{FM}$	Diode Maximum Forward Current $t_p=1\text{ms}$	20	A

**Module**

Symbol	Description	Value	Unit
$T_{jmax}$	Maximum Junction Temperature	150	$^{\circ}\text{C}$
$T_{jop}$	Operating Junction Temperature(inverter,brake)	-40 to +125	$^{\circ}\text{C}$
	Operating Junction Temperature(rectifier)	-40 to +150	$^{\circ}\text{C}$
$T_{STG}$	Storage Temperature Range	-40 to +125	$^{\circ}\text{C}$
$V_{ISO}$	Isolation Voltage RMS, $f=50\text{Hz}, t=1\text{min}$	4000	V

**IGBT-inverter 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	$I_C=15\text{A}, V_{GE}=15\text{V}, T_j=25^{\circ}\text{C}$		2.05	2.50	V	
		$I_C=15\text{A}, V_{GE}=15\text{V}, T_j=125^{\circ}\text{C}$		2.40			
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=1.0\text{mA}, V_{CE}=V_{GE}, T_j=25^{\circ}\text{C}$	5.0	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		$\Omega$	
$C_{ies}$	Input Capacitance			0.99		nF	
$C_{res}$	Reverse Transfer Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		0.07		nF	
$Q_G$	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		156		nC	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=15\text{A}, R_G=68\Omega, V_{GE}=\pm 15\text{V}, T_j=25^{\circ}\text{C}$		182		ns	
$t_r$	Rise Time			64		ns	
$t_{d(off)}$	Turn-Off Delay Time			306		ns	
$t_f$	Fall Time			335		ns	
$E_{on}$	Turn-On Switching Loss				2.98		mJ
$E_{off}$	Turn-Off Switching Loss				1.17		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=15\text{A}, R_G=68\Omega, V_{GE}=\pm 15\text{V}, T_j=125^{\circ}\text{C}$		186		ns	
$t_r$	Rise Time			64		ns	
$t_{d(off)}$	Turn-Off Delay Time			321		ns	
$t_f$	Fall Time			383		ns	
$E_{on}$	Turn-On Switching Loss				3.32		mJ
$E_{off}$	Turn-Off Switching Loss				1.65		mJ
$I_{SC}$	SC Data	$t_P \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_j=125^{\circ}\text{C}, V_{CC}=900\text{V}, V_{CEM} \leq 1200\text{V}$		150		A	

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_F$	Diode Forward Voltage	$I_F=15\text{A}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$		2.05	2.45	V
		$I_F=15\text{A}, V_{GE}=0\text{V}, T_j=125^{\circ}\text{C}$		2.20		
$Q_r$	Recovered Charge	$V_R=600\text{V}, I_F=15\text{A},$ $-di/dt=500\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^{\circ}\text{C}$		0.9		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			10		A
$E_{rec}$	Reverse Recovery Energy			0.41		mJ
$Q_r$	Recovered Charge			1.8		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current	$V_R=600\text{V}, I_F=15\text{A},$ $-di/dt=500\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^{\circ}\text{C}$		12		A
$E_{rec}$	Reverse Recovery Energy			0.74		mJ

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_F$	Diode Forward Voltage	$I_F=15\text{A}, V_{GE}=0\text{V}, T_j=150^{\circ}\text{C}$		0.96		V
$I_R$	Reverse Current	$T_j=150^{\circ}\text{C}, V_R=1600\text{V}$			1.0	mA

**IGBT-brake 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	$I_C=10\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$		2.45	2.90	V
		$I_C=10\text{A}, V_{GE}=15\text{V}, T_j=125^\circ\text{C}$		2.75		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=125\mu\text{A}, V_{CE}=V_{GE}, T_j=25^\circ\text{C}$	4.4	5.0	6.0	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		$\Omega$
$C_{ies}$	Input Capacitance			0.80		nF
$C_{res}$	Reverse Transfer Capacitance	$V_{CE}=30\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		0.03		nF
$Q_G$	Gate Charge	$V_{GE}=15\text{V}$		48		nC
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=10\text{A}, R_G=100\Omega, V_{GE}=\pm 15\text{V}, T_j=25^\circ\text{C}$		172		ns
$t_r$	Rise Time			55		ns
$t_{d(off)}$	Turn-Off Delay Time			189		ns
$t_f$	Fall Time			312		ns
$E_{on}$	Turn-On Switching Loss			2.34		mJ
$E_{off}$	Turn-Off Switching Loss			0.74		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=10\text{A}, R_G=100\Omega, V_{GE}=\pm 15\text{V}, T_j=125^\circ\text{C}$		176		ns
$t_r$	Rise Time			58		ns
$t_{d(off)}$	Turn-Off Delay Time			199		ns
$t_f$	Fall Time			443		ns
$E_{on}$	Turn-On Switching Loss			2.71		mJ
$E_{off}$	Turn-Off Switching Loss			0.98		mJ
$I_{SC}$	SC Data	$t_P \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_j=125^\circ\text{C}, V_{CC}=900\text{V}, V_{CEM} \leq 1200\text{V}$		72		A

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_F$	Diode Forward Voltage	$I_F=10\text{A}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$		1.85	2.30	V
		$I_F=10\text{A}, V_{GE}=0\text{V}, T_j=125^{\circ}\text{C}$		2.05		
$Q_r$	Recovered Charge	$V_R=600\text{V}, I_F=10\text{A},$ $-di/dt=190\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^{\circ}\text{C}$		0.98		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			6.8		A
$E_{rec}$	Reverse Recovery Energy			0.36		mJ
$Q_r$	Recovered Charge			1.51		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current	$V_R=600\text{V}, I_F=10\text{A},$ $-di/dt=190\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^{\circ}\text{C}$		8.0		A
$E_{rec}$	Reverse Recovery Energy			0.53		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

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

Symbol	Parameter	Min.	Typ.	Max.	Unit
$L_{CE}$	Stray Inductance		60		nH
$R_{CC'+EE'}$ $R_{AA'+CC'}$	Module Lead Resistance, Terminal to Chip		4.00 3.00		$\text{m}\Omega$
$R_{\theta JC}$	Junction-to-Case (per IGBT-inverter)			0.710	K/W
	Junction-to-Case (per Diode-inverter)			1.500	
	Junction-to-Case (per Diode-rectifier)			1.300	
	Junction-to-Case (per IGBT-brake-chopper)			1.160	
	Junction-to-Case (per Diode-brake-chopper)			1.890	
$R_{\theta CS}$	Case-to-Sink (per IGBT-inverter)		0.262		K/W
	Case-to-Sink (per Diode-inverter)		0.554		
	Case-to-Sink (per Diode-rectifier)		0.480		
	Case-to-Sink (per IGBT-brake-chopper)		0.428		
	Case-to-Sink (per Diode-brake-chopper)		0.698		
$R_{\theta CS}$	Case-to-Sink		0.02		K/W
M	Mounting Torque, Screw:M5	3.0		6.0	N.m
G	Weight of Module		200		g

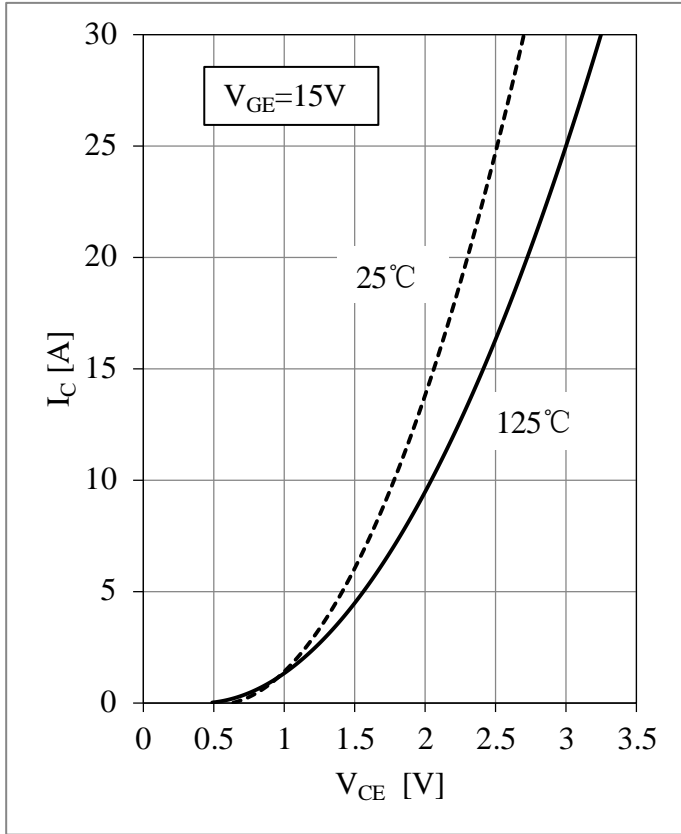


Fig 1. IGBT-inverter Output Characteristics

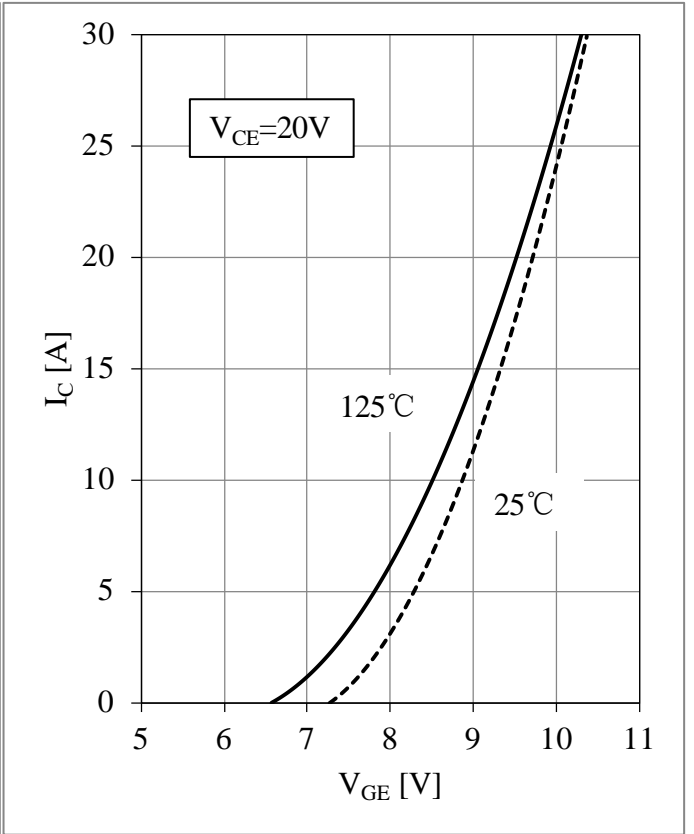


Fig 2. IGBT-inverter Transfer Characteristics

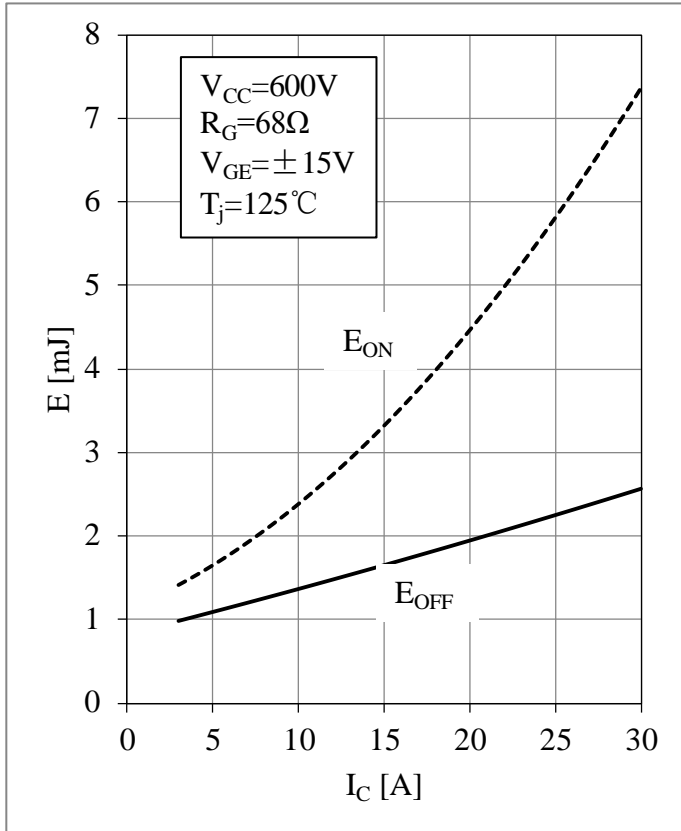


Fig 3. IGBT-inverter Switching Loss vs.  $I_C$

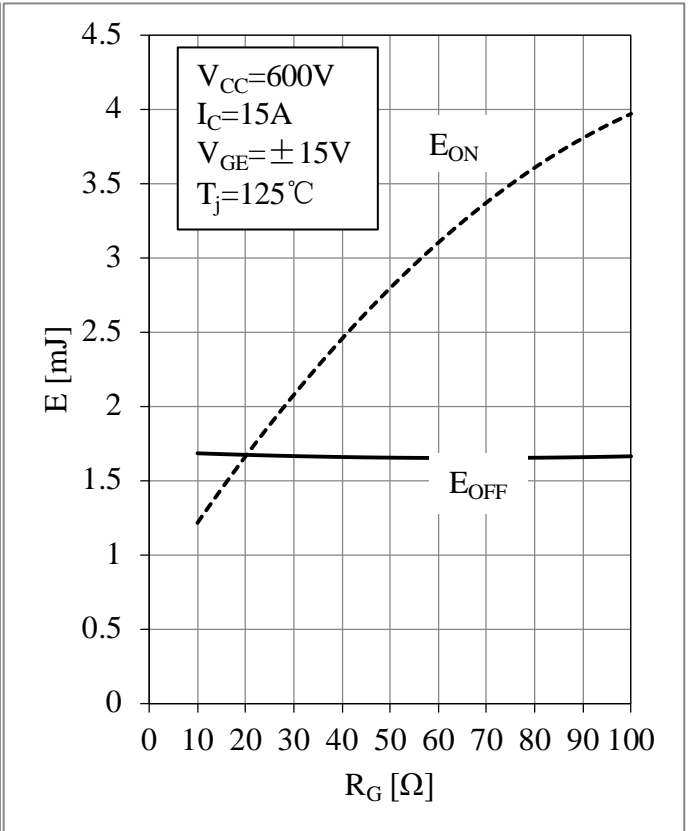


Fig 4. IGBT-inverter Switching Loss vs.  $R_G$

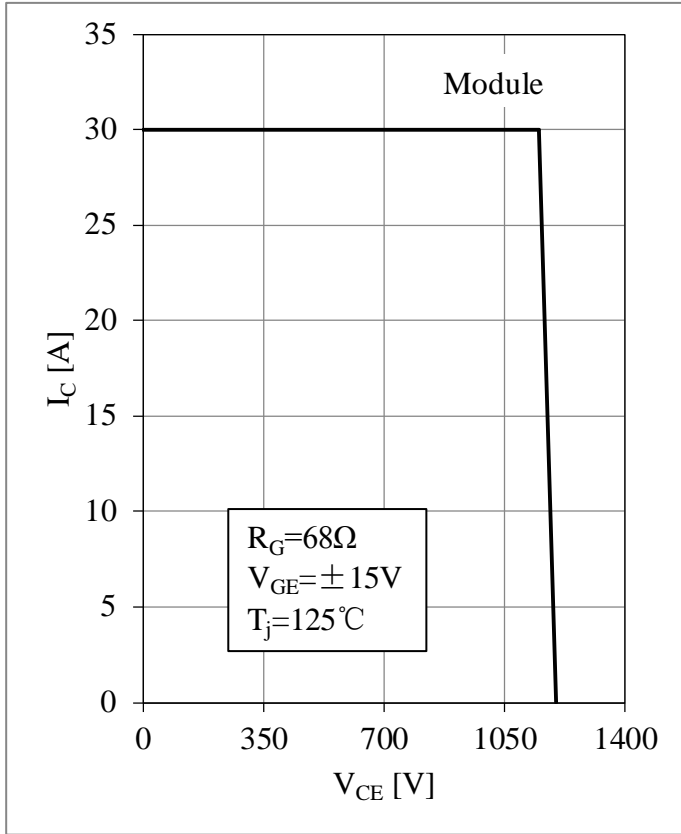


Fig 5. IGBT-inverter RBSOA

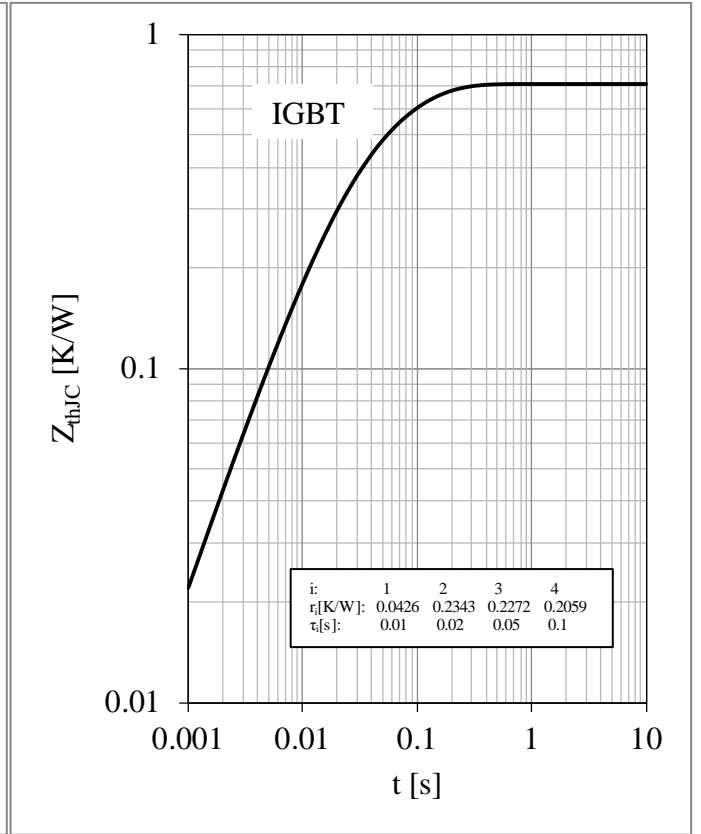


Fig 6. IGBT-inverter Transient Thermal Impedance

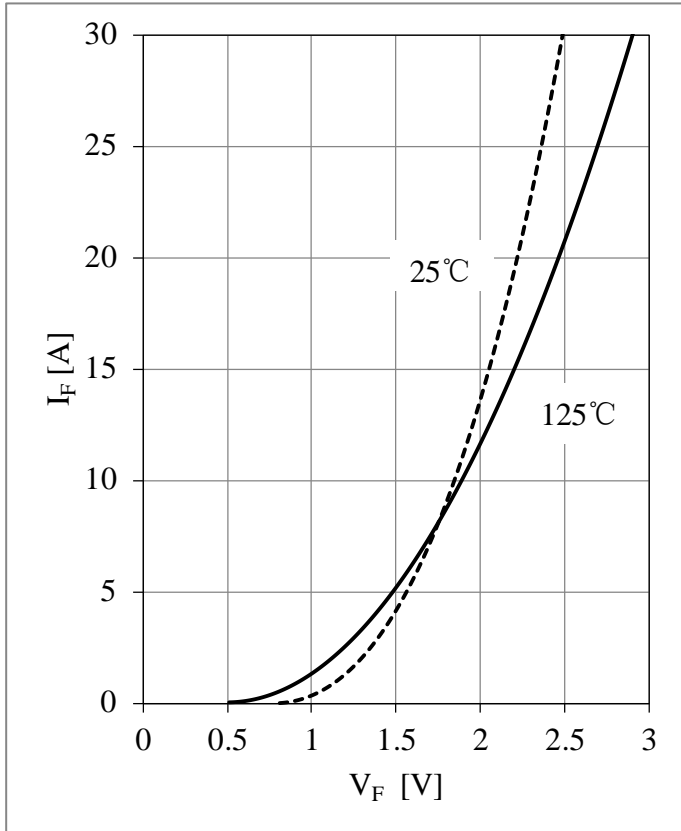


Fig 7. Diode-inverter Forward Characteristics

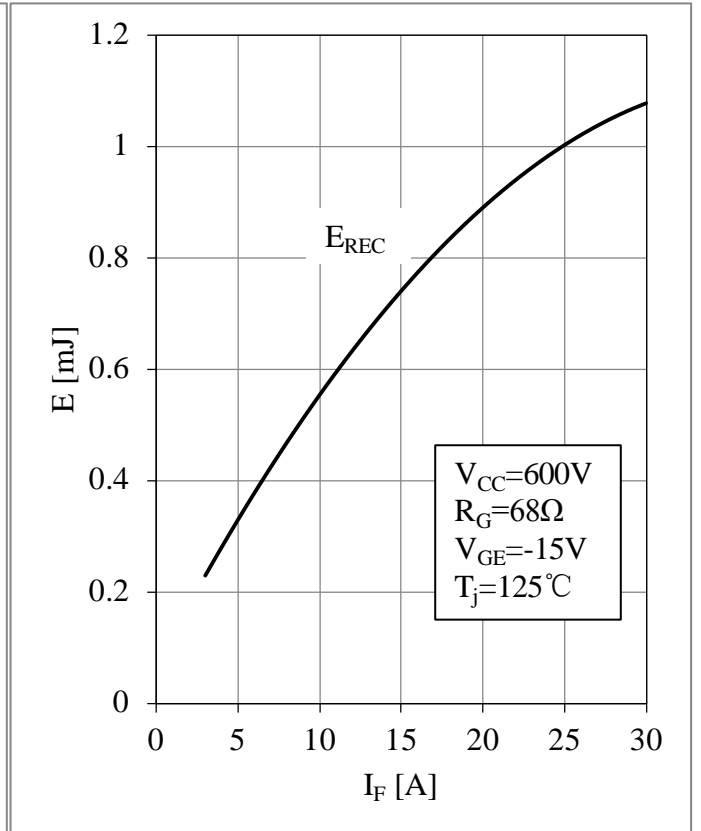


Fig 8. Diode-inverter Switching Loss vs.  $I_F$



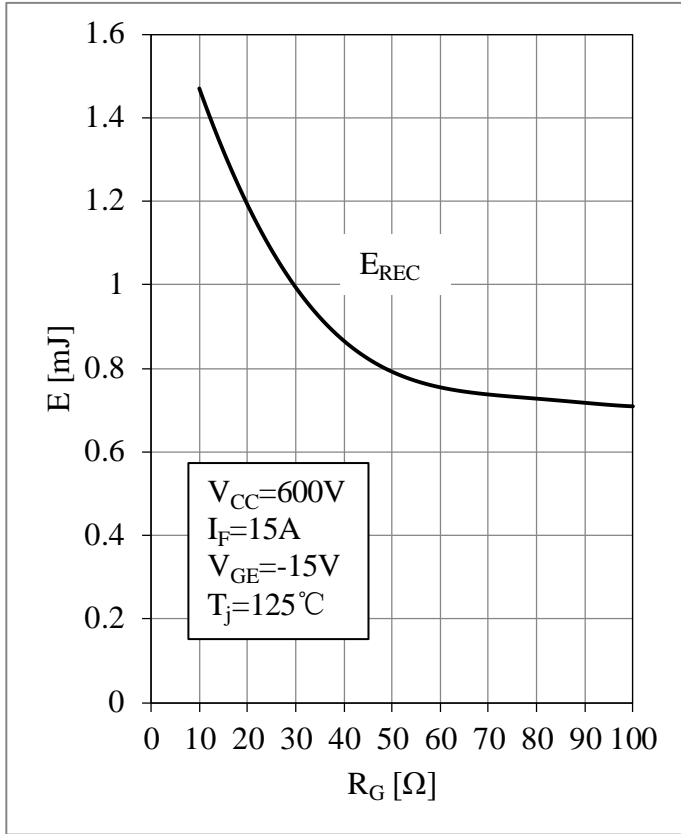


Fig 9. Diode-inverter Switching Loss vs.  $R_G$

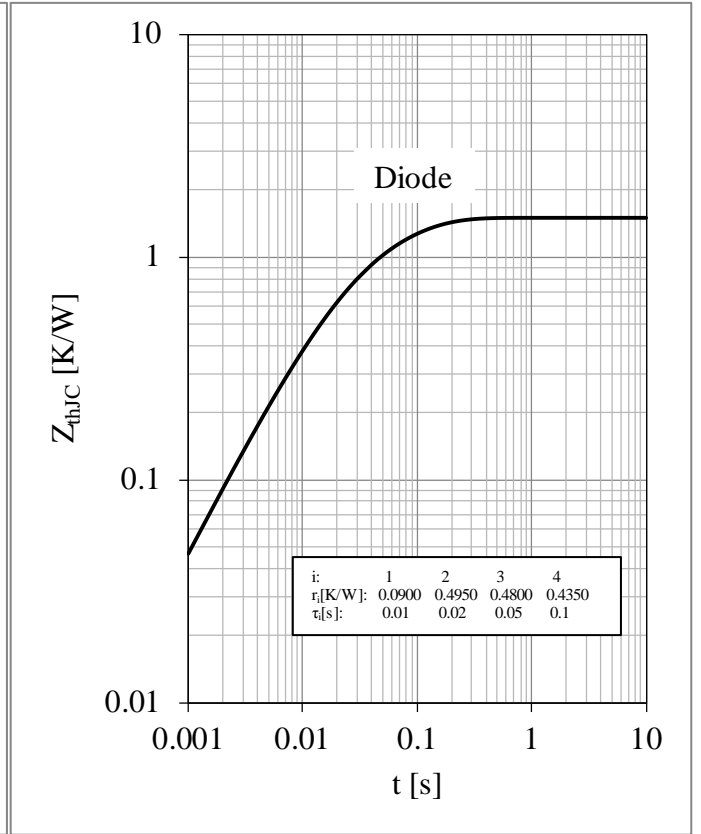


Fig 10. Diode-inverter Transient Thermal Impedance

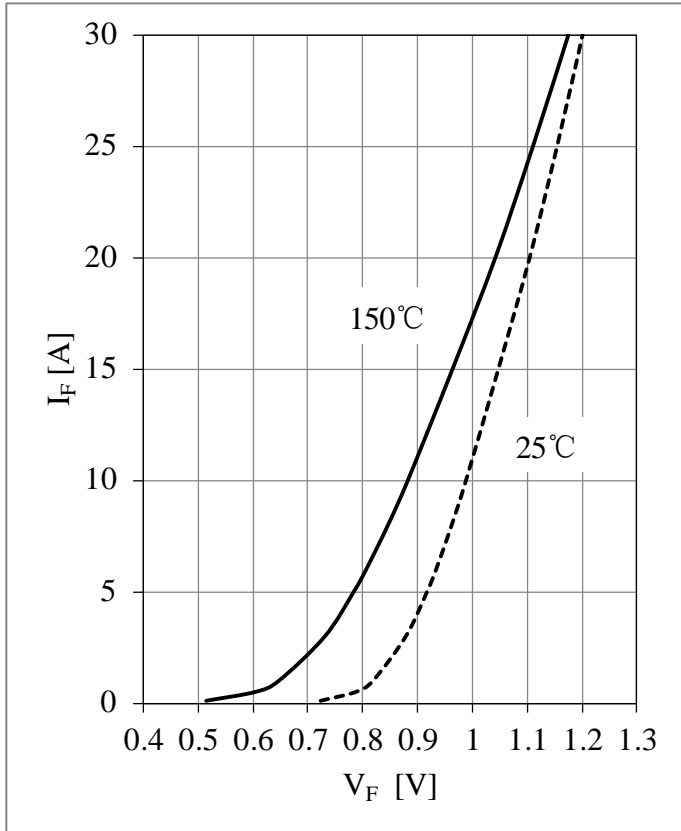


Fig 11. Diode-rectifier Forward Characteristics

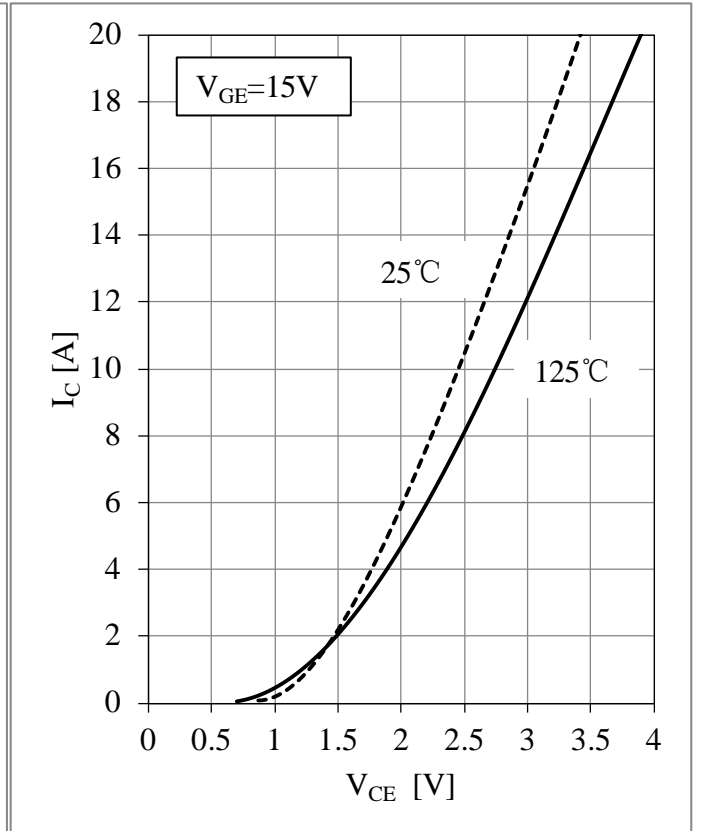


Fig 12. IGBT-brake-chopper Output Characteristics

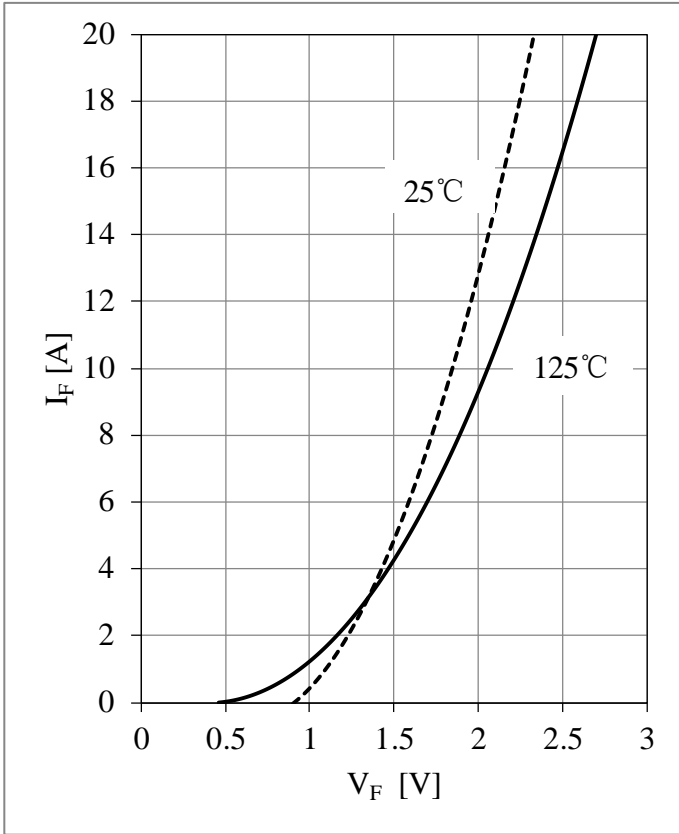


Fig 13. Diode-brake-chopper Forward Characteristics

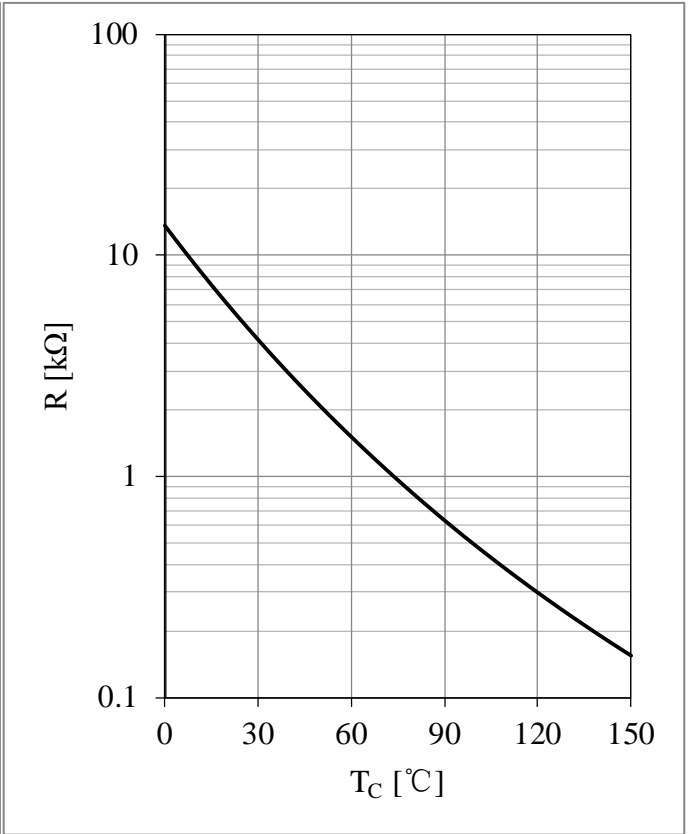


Fig 14. NTC Temperature Characteristic



## 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](http://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.

If and to the extent necessary, please forward equivalent notices to your customers.  
Changes of this product data sheet are reserved.