

# STARPOWER

SEMICONDUCTOR

**IGBT**

## GD10PJA120L2S

**1200V/10A 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.

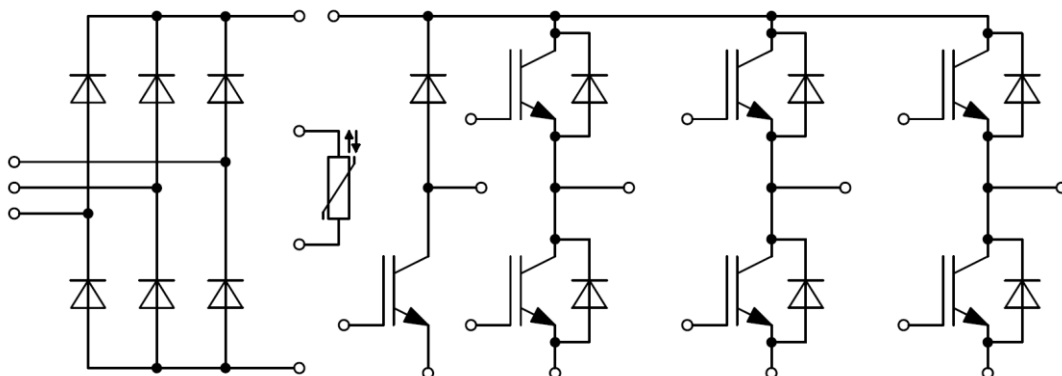
### Features

- Low  $V_{CE(sat)}$  Trench IGBT technology
- 8 $\mu$ 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**  $T_H=25^{\circ}\text{C}$  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 @ $T_H=100^{\circ}\text{C}$	10	A
$I_{CRM}$	Repetitive Peak Collector Current tp limited by $T_{vjop}$	20	A

**Diode-inverter**

Symbol	Description	Value	Unit
$V_{RRM}$	Repetitive Peak Reverse Voltage	1200	V
$I_F$	Diode Continuous Forward Current	10	A
$I_{FRM}$	Repetitive Peak Forward Current tp limited by $T_{vjop}$	20	A
$I_{FSM}$	Surge Forward Current $t_p=10\text{ms}$ @ $T_{vj}=125^{\circ}\text{C}$ @ $T_{vj}=150^{\circ}\text{C}$	76	A
		53	
$I^2t$	$I^2t$ -value, $t_p=10\text{ms}$ @ $T_{vj}=125^{\circ}\text{C}$ @ $T_{vj}=150^{\circ}\text{C}$	29	$\text{A}^2\text{s}$
		14	

**Diode-rectifier**

Symbol	Description	Value	Unit
$V_{RRM}$	Repetitive Peak Reverse Voltage	1600	V
$I_{FRMSM}$	Maximum RMS Forward Current per Chip @ $T_H=100^{\circ}\text{C}$	25	A
$I_{RMSM}$	Maximum RMS Current at Rectifier Output @ $T_H=100^{\circ}\text{C}$	25	A
$I_{FSM}$	Surge Forward Current $t_p=10\text{ms}$ @ $T_{vj}=25^{\circ}\text{C}$ @ $T_{vj}=150^{\circ}\text{C}$	300	A
		245	
$I^2t$	$I^2t$ -value, $t_p=10\text{ms}$ @ $T_{vj}=25^{\circ}\text{C}$ @ $T_{vj}=150^{\circ}\text{C}$	450	$\text{A}^2\text{s}$
		300	

**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 @ $T_H=100^{\circ}\text{C}$	10	A
$I_{CRM}$	Repetitive Peak Collector Current tp limited by $T_{vjop}$	20	A

**Diode-brake**

Symbol	Description	Value	Unit
$V_{RRM}$	Repetitive Peak Reverse Voltage	1200	V
$I_F$	Diode Continuous Forward Current	10	A
$I_{FRM}$	Repetitive Peak Forward Current tp limited by $T_{vjop}$	20	A
$I_{FSM}$	Surge Forward Current $t_p=10\text{ms}$ @ $T_{vj}=125^{\circ}\text{C}$ @ $T_{vj}=150^{\circ}\text{C}$	53	A
		53	
$I^2t$	$I^2t$ -value, $t_p=10\text{ms}$ @ $T_{vj}=125^{\circ}\text{C}$ @ $T_{vj}=150^{\circ}\text{C}$	14	$\text{A}^2\text{s}$
		14	

**Module**

<b>Symbol</b>	<b>Description</b>	<b>Value</b>	<b>Unit</b>
$T_{vjmax}$	Maximum Junction Temperature(inverter,brake)	175	°C
	Maximum Junction Temperature (rectifier)	150	
$T_{vjop}$	Operating Junction Temperature	-40 to +150	°C
$T_{STG}$	Storage Temperature Range	-40 to +125	°C
$V_{ISO}$	Isolation Voltage RMS,f=50Hz,t=1 min	2500	V

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit	
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C=10\text{A}, V_{GE}=15\text{V}, T_{vj}=25^\circ\text{C}$		1.50	1.95	V	
		$I_C=10\text{A}, V_{GE}=15\text{V}, T_{vj}=125^\circ\text{C}$		1.70			
		$I_C=10\text{A}, V_{GE}=15\text{V}, T_{vj}=150^\circ\text{C}$		1.80			
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=0.20\text{mA}, V_{CE}=V_{GE}, T_{vj}=25^\circ\text{C}$	5.4	6.2	7.0	V	
$I_{CES}$	Collector Cut-Off Current	$V_{CE}=V_{CES}, V_{GE}=0\text{V}, T_{vj}=25^\circ\text{C}$			50	$\mu\text{A}$	
$I_{GES}$	Gate-Emitter Leakage Current	$V_{GE}=V_{GES}, V_{CE}=0\text{V}, T_{vj}=25^\circ\text{C}$			100	nA	
$R_{Gint}$	Internal Gate Resistance			0		$\Omega$	
$C_{ies}$	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		0.88		nF	
$C_{res}$	Reverse Transfer Capacitance				0.01		nF
$Q_G$	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		0.06		$\mu\text{C}$	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=10\text{A}, R_G=22\Omega, L_S=35\text{nH}, V_{GE}=\pm 15\text{V}, T_{vj}=25^\circ\text{C}$		21		ns	
$t_r$	Rise Time			14		ns	
$t_{d(off)}$	Turn-Off Delay Time			150		ns	
$t_f$	Fall Time			237		ns	
$E_{on}$	Turn-On Switching Loss			0.51		mJ	
$E_{off}$	Turn-Off Switching Loss			0.75		mJ	
$t_{d(on)}$	Turn-On Delay Time		$V_{CC}=600\text{V}, I_C=10\text{A}, R_G=22\Omega, L_S=35\text{nH}, V_{GE}=\pm 15\text{V}, T_{vj}=125^\circ\text{C}$		22		ns
$t_r$	Rise Time				16		ns
$t_{d(off)}$	Turn-Off Delay Time			192		ns	
$t_f$	Fall Time			340		ns	
$E_{on}$	Turn-On Switching Loss			0.70		mJ	
$E_{off}$	Turn-Off Switching Loss			1.05		mJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=10\text{A}, R_G=22\Omega, L_S=35\text{nH}, V_{GE}=\pm 15\text{V}, T_{vj}=150^\circ\text{C}$			23		ns
$t_r$	Rise Time				16		ns
$t_{d(off)}$	Turn-Off Delay Time			197		ns	
$t_f$	Fall Time			365		ns	
$E_{on}$	Turn-On Switching Loss			0.75		mJ	
$E_{off}$	Turn-Off Switching Loss			1.08		mJ	
$I_{SC}$	SC Data		$t_p \leq 8\mu\text{s}, V_{GE}=15\text{V}, T_{vj}=150^\circ\text{C}, V_{CC}=600\text{V}, V_{CEM} \leq 1200\text{V}$		30		A

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_F$	Diode Forward Voltage	$I_F=10\text{A}, V_{GE}=0\text{V}, T_{vj}=25^\circ\text{C}$		1.60	2.05	V
		$I_F=10\text{A}, V_{GE}=0\text{V}, T_{vj}=125^\circ\text{C}$		1.65		
		$I_F=10\text{A}, V_{GE}=0\text{V}, T_{vj}=150^\circ\text{C}$		1.65		
$Q_r$	Recovered Charge			0.86		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current	$V_R=600\text{V}, I_F=10\text{A},$ $-\text{di}/\text{dt}=842\text{A}/\mu\text{s}, L_S=35\text{nH},$ $V_{GE}=-15\text{V}, T_{vj}=25^\circ\text{C}$		15		A
$E_{rec}$	Reverse Recovery Energy			0.31		mJ
$Q_r$	Recovered Charge			1.57		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current	$V_R=600\text{V}, I_F=10\text{A},$ $-\text{di}/\text{dt}=731\text{A}/\mu\text{s}, L_S=35\text{nH},$ $V_{GE}=-15\text{V}, T_{vj}=125^\circ\text{C}$		16		A
$E_{rec}$	Reverse Recovery Energy			0.63		mJ
$Q_r$	Recovered Charge			1.76		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current	$V_R=600\text{V}, I_F=10\text{A},$ $-\text{di}/\text{dt}=715\text{A}/\mu\text{s}, L_S=35\text{nH},$ $V_{GE}=-15\text{V}, T_{vj}=150^\circ\text{C}$		16		A
$E_{rec}$	Reverse Recovery Energy			0.71		mJ

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_F$	Diode Forward Voltage	$I_F=10\text{A}, V_{GE}=0\text{V}, T_{vj}=150^\circ\text{C}$		0.80		V
$I_R$	Reverse Current	$T_{vj}=150^\circ\text{C}, V_R=1600\text{V}$			3.0	mA

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit	
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C=10\text{A}, V_{GE}=15\text{V}, T_{vj}=25^\circ\text{C}$		1.50	1.95	V	
		$I_C=10\text{A}, V_{GE}=15\text{V}, T_{vj}=125^\circ\text{C}$		1.70			
		$I_C=10\text{A}, V_{GE}=15\text{V}, T_{vj}=150^\circ\text{C}$		1.80			
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=0.20\text{mA}, V_{CE}=V_{GE}, T_{vj}=25^\circ\text{C}$	5.4	6.2	7.0	V	
$I_{CES}$	Collector Cut-Off Current	$V_{CE}=V_{CES}, V_{GE}=0\text{V}, T_{vj}=25^\circ\text{C}$			50	$\mu\text{A}$	
$I_{GES}$	Gate-Emitter Leakage Current	$V_{GE}=V_{GES}, V_{CE}=0\text{V}, T_{vj}=25^\circ\text{C}$			100	nA	
$R_{Gint}$	Internal Gate Resistance			0		$\Omega$	
$C_{ies}$	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		0.88		nF	
$C_{res}$	Reverse Transfer Capacitance				0.01		nF
$Q_G$	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		0.06		$\mu\text{C}$	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=10\text{A}, R_G=22\Omega, L_S=35\text{nH}, V_{GE}=\pm 15\text{V}, T_{vj}=25^\circ\text{C}$		21		ns	
$t_r$	Rise Time			14		ns	
$t_{d(off)}$	Turn-Off Delay Time			150		ns	
$t_f$	Fall Time			237		ns	
$E_{on}$	Turn-On Switching Loss			0.51		mJ	
$E_{off}$	Turn-Off Switching Loss			0.75		mJ	
$t_{d(on)}$	Turn-On Delay Time		$V_{CC}=600\text{V}, I_C=10\text{A}, R_G=22\Omega, L_S=35\text{nH}, V_{GE}=\pm 15\text{V}, T_{vj}=125^\circ\text{C}$		22		ns
$t_r$	Rise Time				16		ns
$t_{d(off)}$	Turn-Off Delay Time			192		ns	
$t_f$	Fall Time			340		ns	
$E_{on}$	Turn-On Switching Loss			0.70		mJ	
$E_{off}$	Turn-Off Switching Loss			1.05		mJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=10\text{A}, R_G=22\Omega, L_S=35\text{nH}, V_{GE}=\pm 15\text{V}, T_{vj}=150^\circ\text{C}$			23		ns
$t_r$	Rise Time				16		ns
$t_{d(off)}$	Turn-Off Delay Time			197		ns	
$t_f$	Fall Time			365		ns	
$E_{on}$	Turn-On Switching Loss			0.75		mJ	
$E_{off}$	Turn-Off Switching Loss			1.08		mJ	
$I_{SC}$	SC Data		$t_p \leq 8\mu\text{s}, V_{GE}=15\text{V}, T_{vj}=150^\circ\text{C}, V_{CC}=600\text{V}, V_{CEM} \leq 1200\text{V}$		30		A

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_F$	Diode Forward Voltage	$I_F=10\text{A}, V_{GE}=0\text{V}, T_{vj}=25^{\circ}\text{C}$		1.60	2.05	V
		$I_F=10\text{A}, V_{GE}=0\text{V}, T_{vj}=125^{\circ}\text{C}$		1.65		
		$I_F=10\text{A}, V_{GE}=0\text{V}, T_{vj}=150^{\circ}\text{C}$		1.65		

**NTC Characteristics**  $T_H=25^{\circ}\text{C}$  unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$R_{25}$	Rated Resistance			5.0		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
$B_{25/80}$	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**  $T_H=25^{\circ}\text{C}$  unless otherwise noted

Symbol	Parameter	Min.	Typ.	Max.	Unit
$L_{CE}$	Stray Inductance		30		nH
$R_{CC'+EE'}$ $R_{AA'+CC'}$	Module Lead Resistance, Terminal to Chip		8.00 6.00		m $\Omega$
$R_{thJH}$	Junction-to-Heatsink (per IGBT-inverter)		2.050		K/W
	Junction-to-Heatsink (per Diode-inverter)		2.450		
	Junction-to-Heatsink (per Diode-rectifier)		1.540		
	Junction-to-Heatsink (per IGBT-brake)		2.050		
	Junction-to-Heatsink (per Diode-brake)		2.450		
F	Mounting Force Per Clamp	20		50	N
G	Weight of Module		24		g

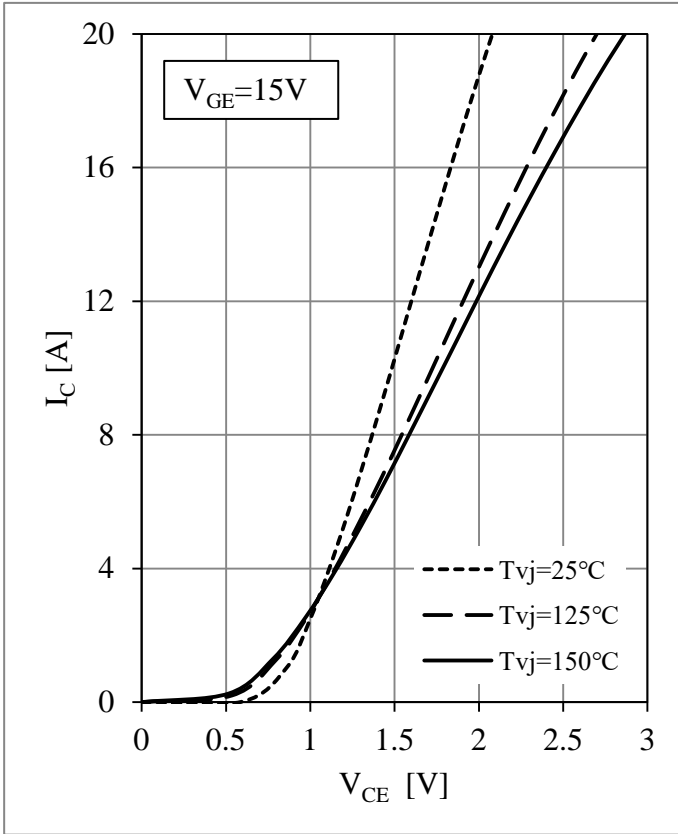


Fig 1. IGBT-inverter Output Characteristics

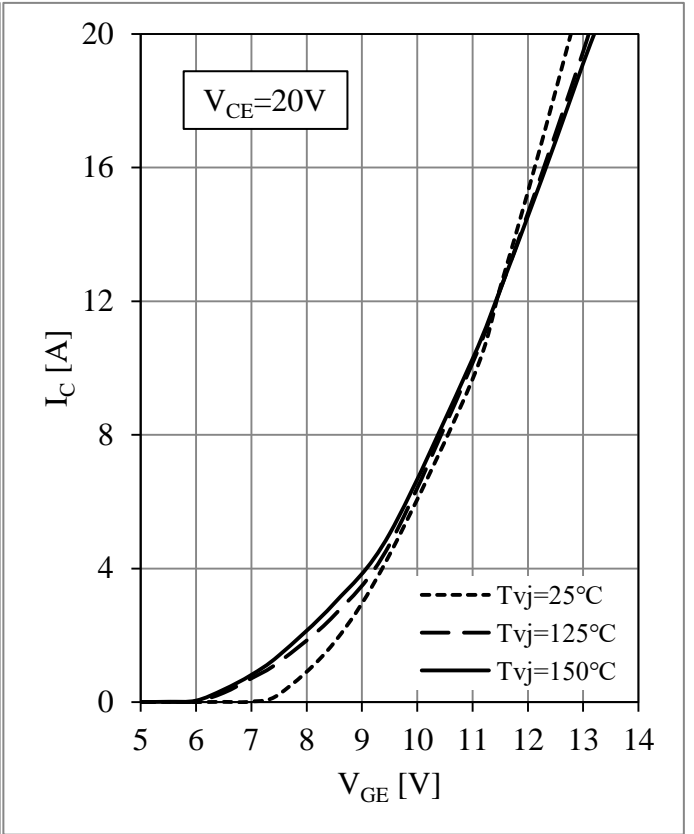


Fig 2. IGBT-inverter Transfer Characteristics

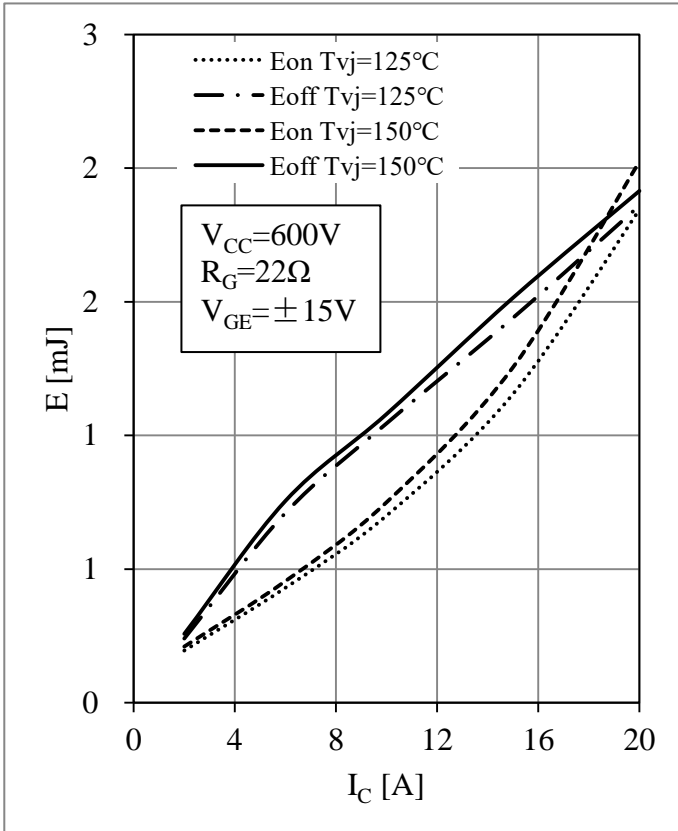


Fig 3. IGBT-inverter Switching Loss vs.  $I_C$

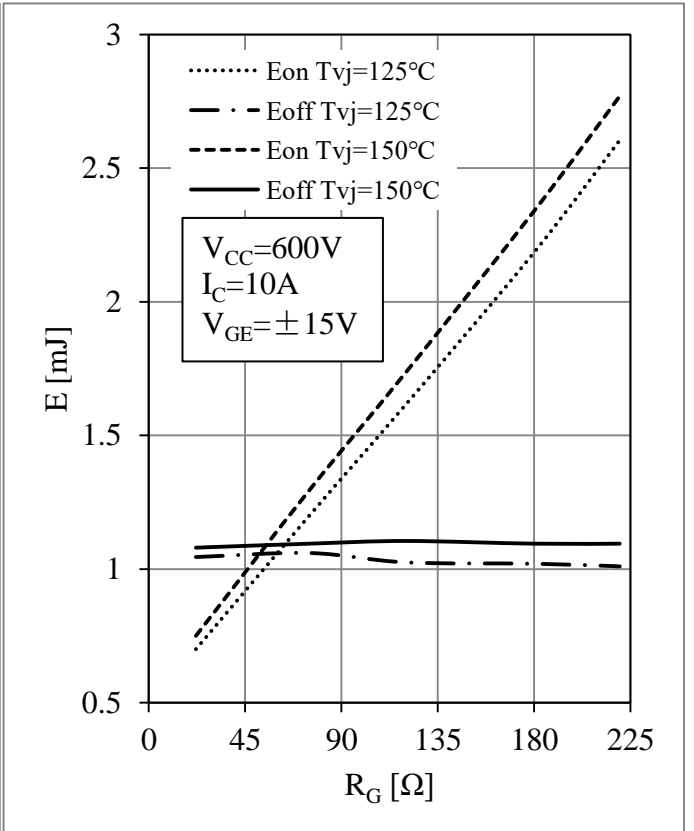


Fig 4. IGBT-inverter Switching Loss vs.  $R_G$



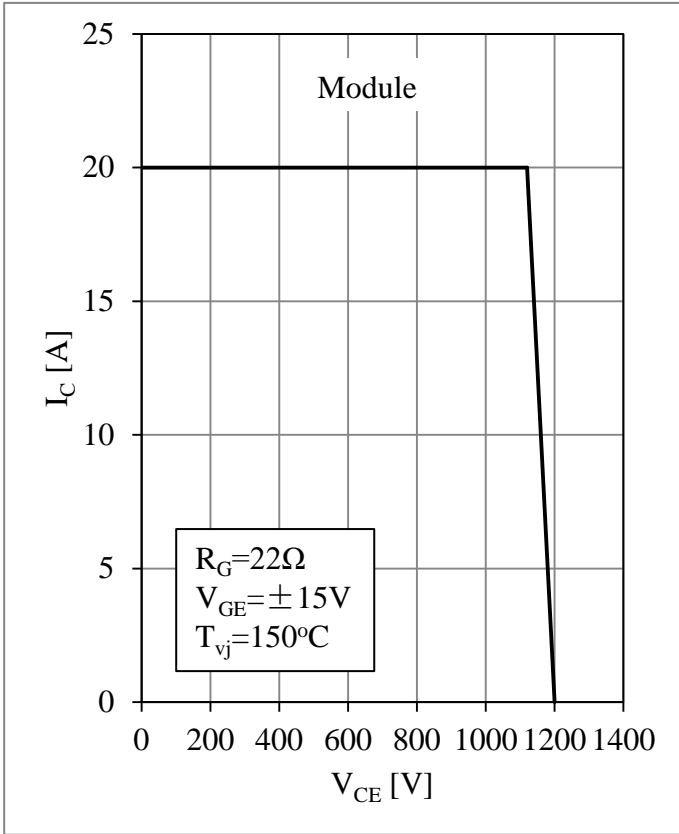


Fig 5. IGBT-inverter RBSOA

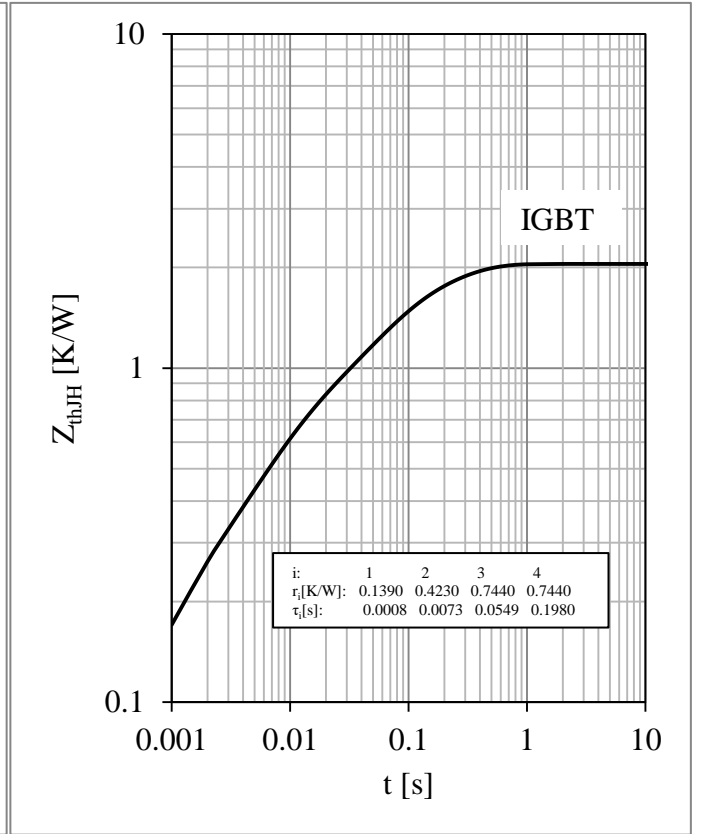


Fig 6. IGBT-inverter Transient Thermal Impedance

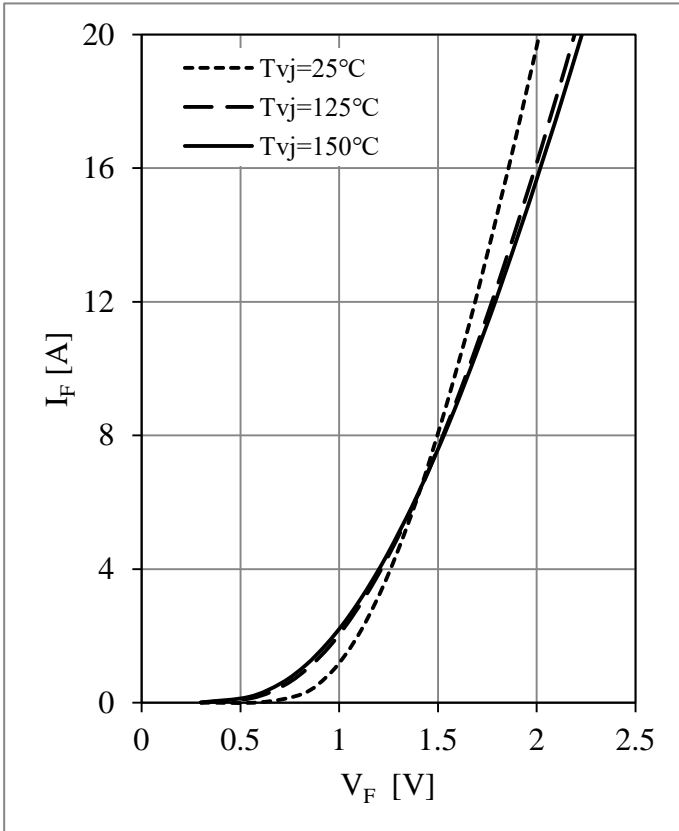


Fig 7. Diode-inverter Forward Characteristics

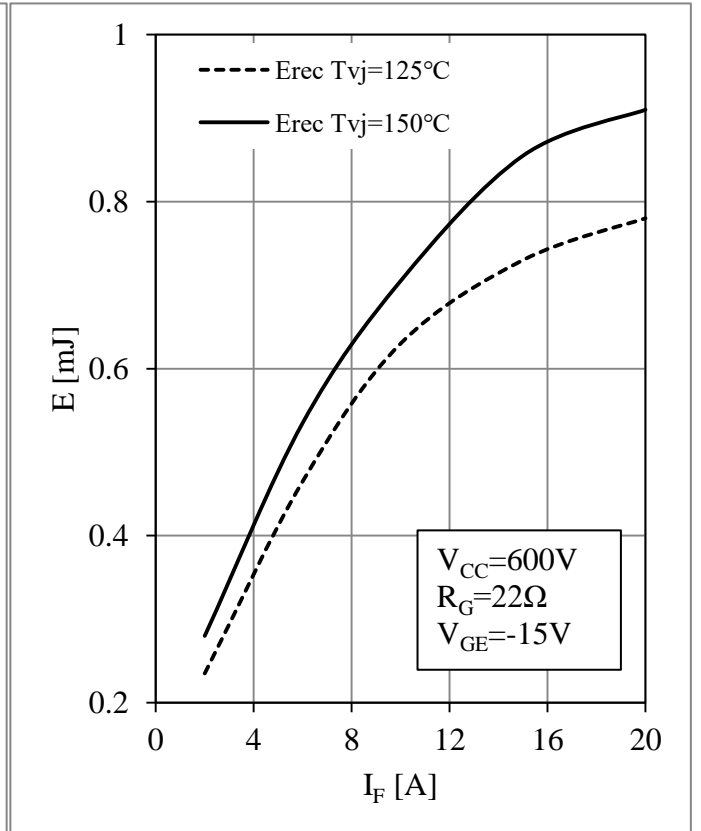


Fig 8. Diode-inverter Switching Loss vs.  $I_F$

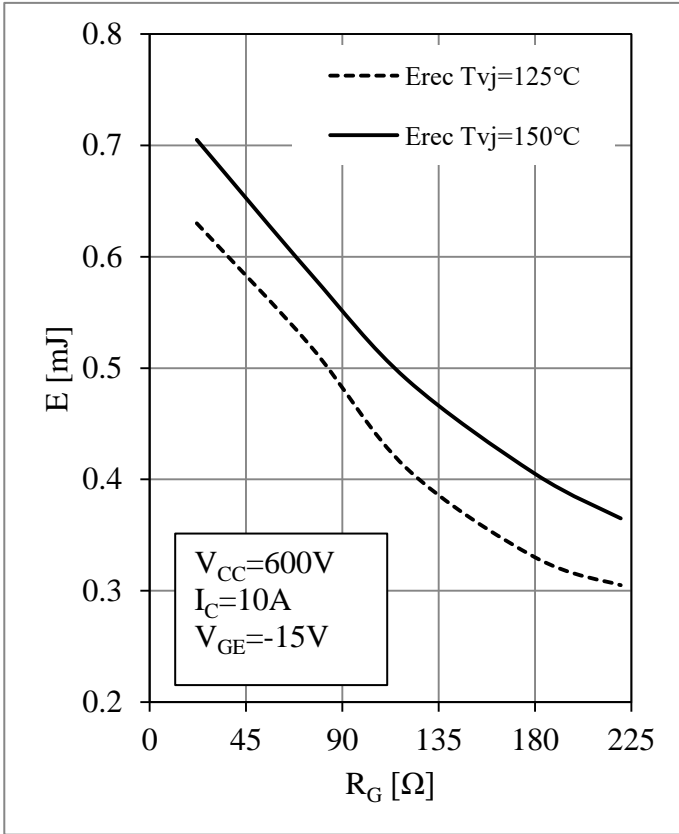


Fig 9. Diode-inverter Switching Loss vs.  $R_G$

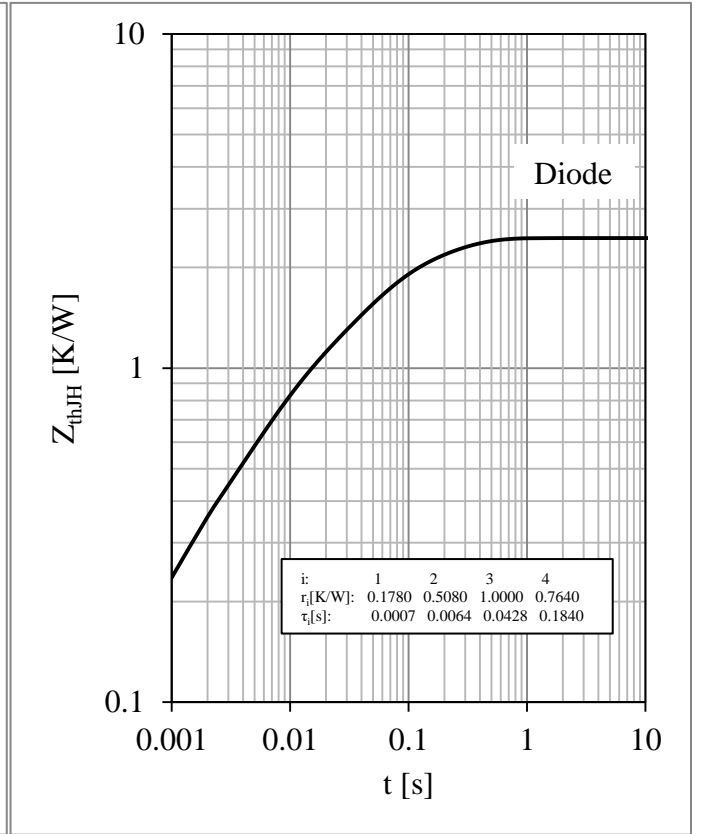


Fig 10. Diode-inverter Transient Thermal Impedance

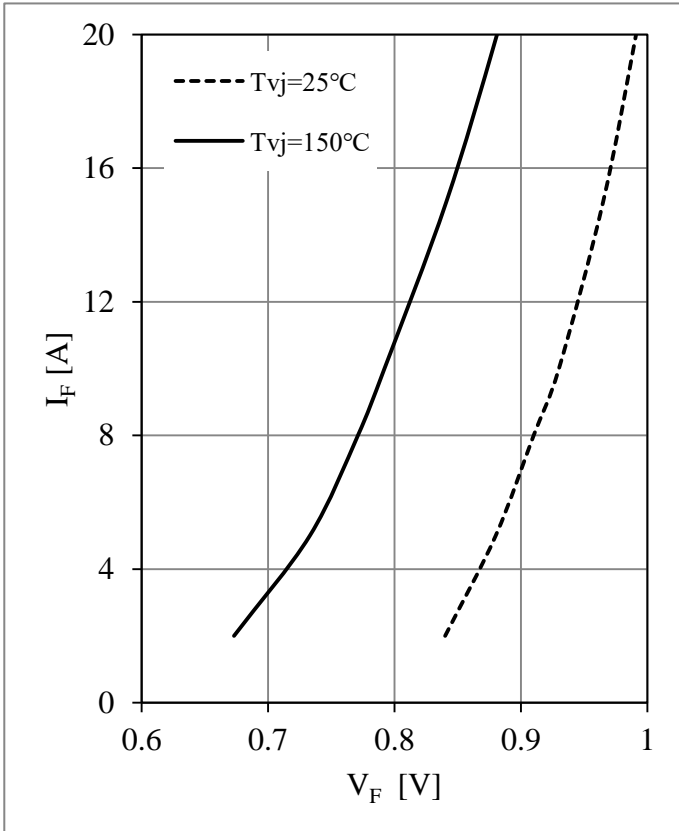


Fig 11. Diode-rectifier Forward Characteristics

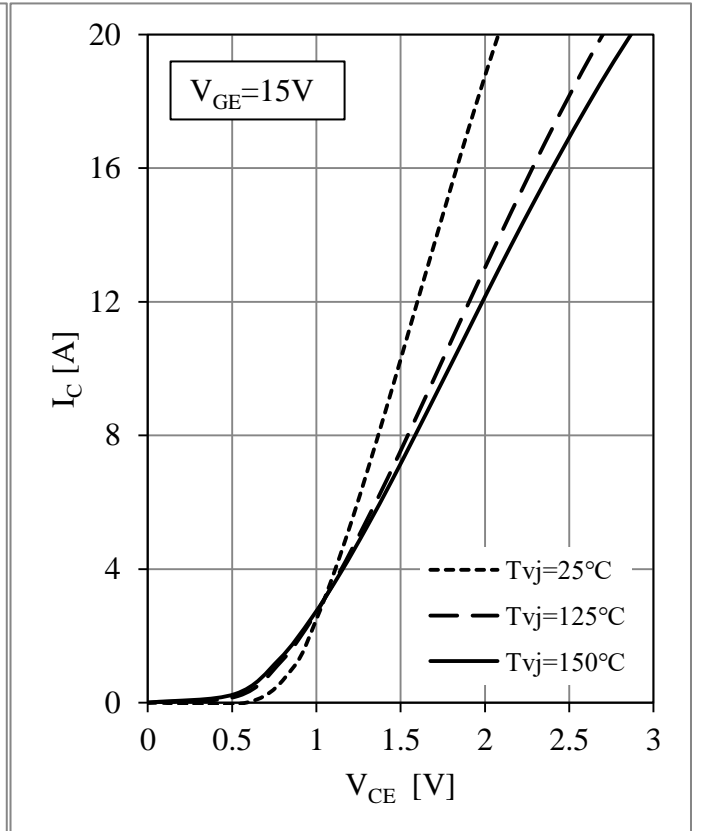


Fig 12. IGBT-brake-chopper Output Characteristics

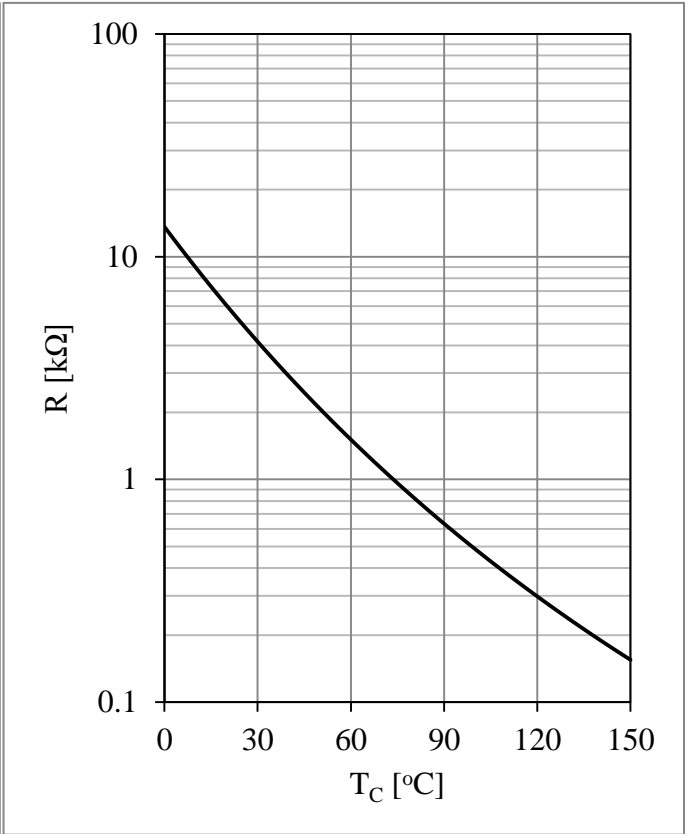
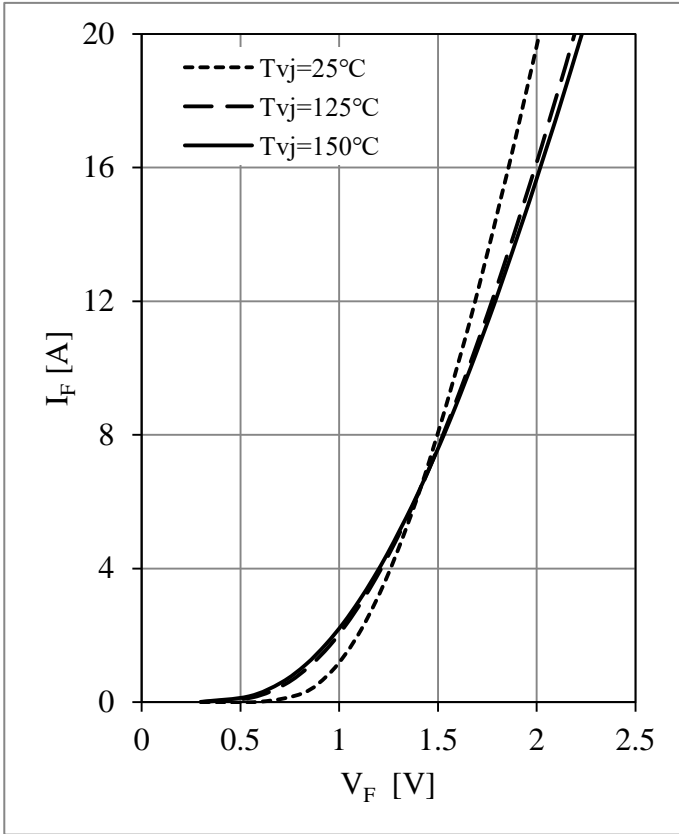
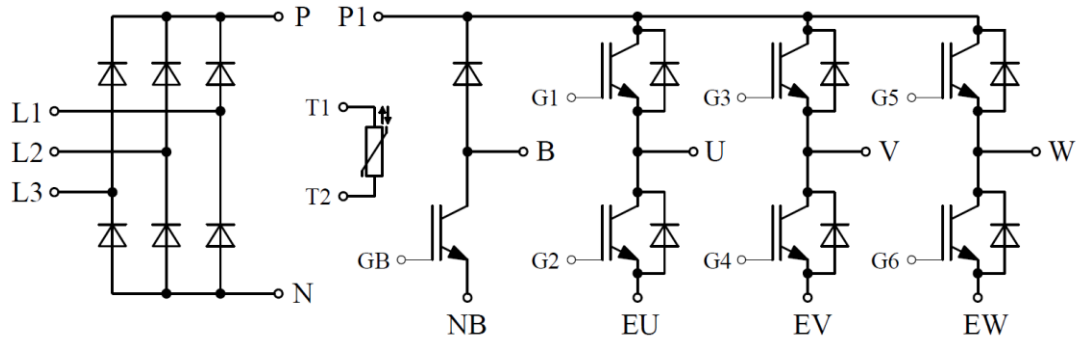


Fig 13. Diode-brake-chopper Forward Characteristics

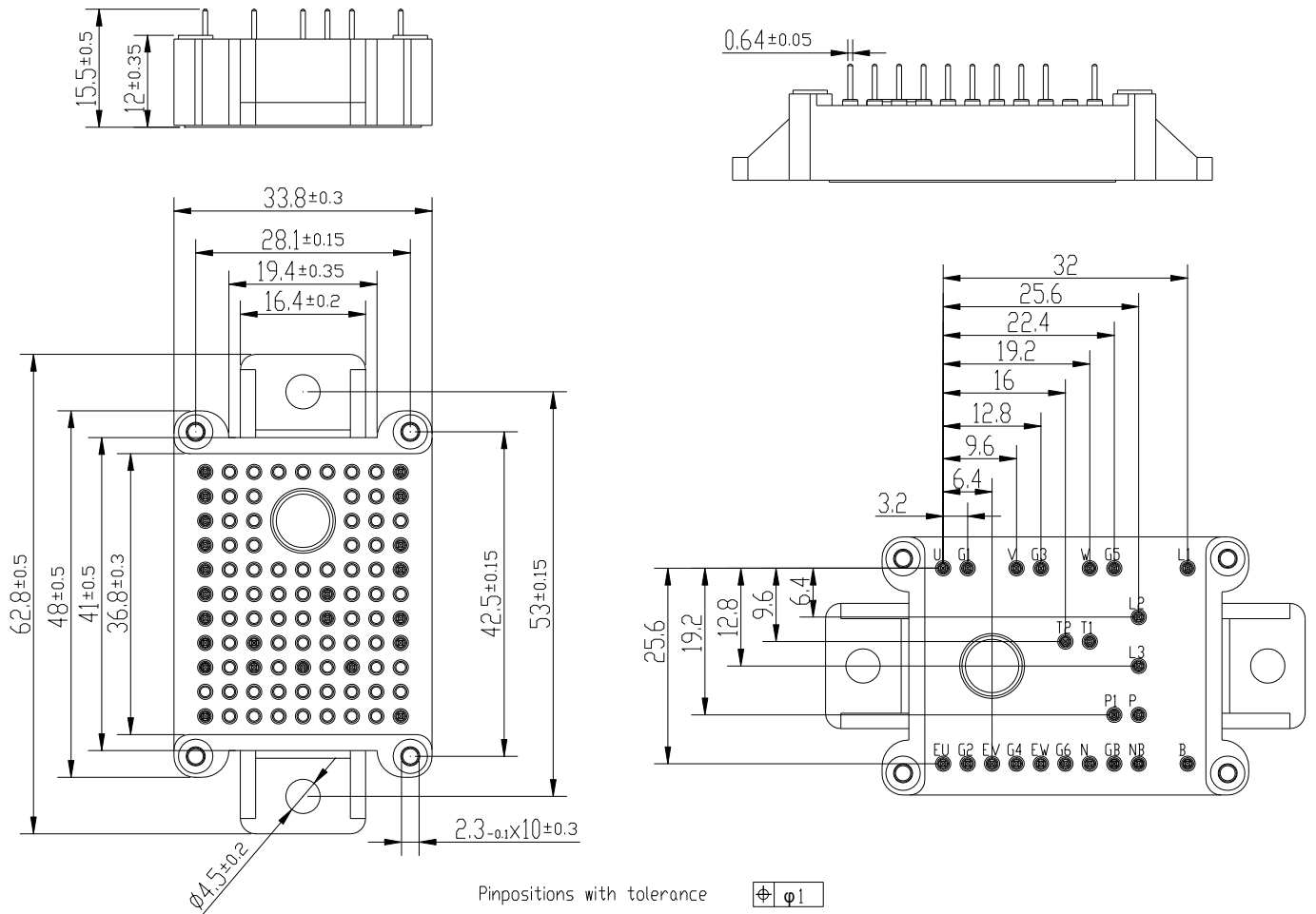
Fig 14. NTC Temperature Characteristic

**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](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.