

# STARPOWER

SEMICONDUCTOR

**IGBT**

## GD20FSX65L2S

**650V/20A 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.

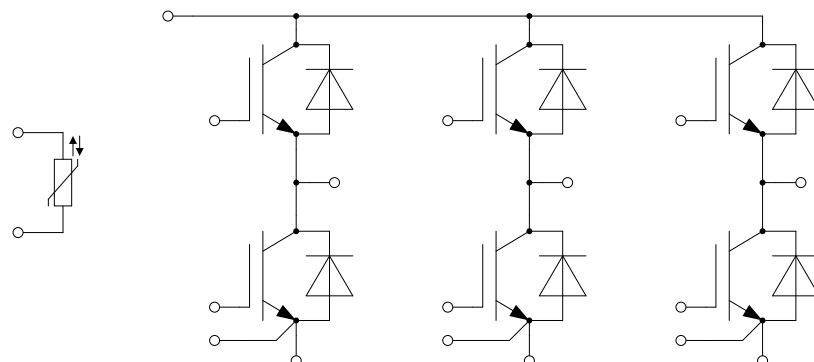
### Features

- Low  $V_{CE(sat)}$  Trench IGBT technology
- 6 $\mu$ 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**  $T_C=25^{\circ}\text{C}$  unless otherwise noted**IGBT**

Symbol	Description	Value	Unit
$V_{CES}$	Collector-Emitter Voltage	650	V
$V_{GES}$	Gate-Emitter Voltage	$\pm 20$	V
$I_C$	Collector Current @ $T_C=25^{\circ}\text{C}$	40	A
	@ $T_C=100^{\circ}\text{C}$	20	A
$I_{CM}$	Pulsed Collector Current $t_p=1\text{ms}$	40	A
$P_D$	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	129	W

**Diode**

Symbol	Description	Value	Unit
$V_{RRM}$	Repetitive Peak Reverse Voltage	650	V
$I_F$	Diode Continuous Forward Current	20	A
$I_{FM}$	Diode Maximum Forward Current $t_p=1\text{ms}$	40	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	$I_C=20\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$		1.45	1.90	V	
		$I_C=20\text{A}, V_{GE}=15\text{V}, T_j=125^\circ\text{C}$		1.60			
		$I_C=20\text{A}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}$		1.70			
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=0.32\text{mA}, V_{CE}=V_{GE}, T_j=25^\circ\text{C}$	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		$\Omega$	
$C_{ies}$	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		2.32		nF	
$C_{res}$	Reverse Transfer Capacitance				0.05		nF
$Q_G$	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		0.14		$\mu\text{C}$	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=300\text{V}, I_C=20\text{A}, R_G=18\Omega, V_{GE}=\pm 15\text{V}, T_j=25^\circ\text{C}$		15		ns	
$t_r$	Rise Time			13		ns	
$t_{d(off)}$	Turn-Off Delay Time			96		ns	
$t_f$	Fall Time			56		ns	
$E_{on}$	Turn-On Switching Loss			0.32		mJ	
$E_{off}$	Turn-Off Switching Loss			0.35		mJ	
$t_{d(on)}$	Turn-On Delay Time		$V_{CC}=300\text{V}, I_C=20\text{A}, R_G=18\Omega, V_{GE}=\pm 15\text{V}, T_j=125^\circ\text{C}$		15		ns
$t_r$	Rise Time				16		ns
$t_{d(off)}$	Turn-Off Delay Time			112		ns	
$t_f$	Fall Time			76		ns	
$E_{on}$	Turn-On Switching Loss			0.44		mJ	
$E_{off}$	Turn-Off Switching Loss			0.45		mJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=300\text{V}, I_C=20\text{A}, R_G=18\Omega, V_{GE}=\pm 15\text{V}, T_j=150^\circ\text{C}$			15		ns
$t_r$	Rise Time				17		ns
$t_{d(off)}$	Turn-Off Delay Time			120		ns	
$t_f$	Fall Time			80		ns	
$E_{on}$	Turn-On Switching Loss			0.49		mJ	
$E_{off}$	Turn-Off Switching Loss			0.47		mJ	
$I_{SC}$	SC Data		$t_p \leq 6\mu\text{s}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}, V_{CC}=360\text{V}, V_{CEM} \leq 650\text{V}$		100		A

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_F$	Diode Forward Voltage	$I_C=20\text{A}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$		1.60	2.05	V
		$I_C=20\text{A}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$		1.55		
		$I_C=20\text{A}, V_{GE}=0\text{V}, T_j=150^\circ\text{C}$		1.50		
$Q_r$	Recovered Charge	$V_R=300\text{V}, I_F=20\text{A},$ $-di/dt=1800\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^\circ\text{C}$		1.00		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			30.0		A
$E_{rec}$	Reverse Recovery Energy			0.21		mJ
$Q_r$	Recovered Charge	$V_R=300\text{V}, I_F=20\text{A},$ $-di/dt=1800\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^\circ\text{C}$		1.75		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			32.0		A
$E_{rec}$	Reverse Recovery Energy			0.37		mJ
$Q_r$	Recovered Charge	$V_R=300\text{V}, I_F=20\text{A},$ $-di/dt=1800\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=150^\circ\text{C}$		2.20		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			34.0		A
$E_{rec}$	Reverse Recovery Energy			0.47		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 $\Omega$
$\Delta R/R$	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**  $T_C=25^\circ\text{C}$  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 $\Omega$
$R_{thJC}$	Junction-to-Case (per IGBT-inverter)		1.055	1.160	K/W
	Junction-to-Case (per Diode-inverter)		1.687	1.856	
$R_{thCH}$	Case-to-Sink (per IGBT-inverter)		0.566		K/W
	Case-to-Sink (per Diode-inverter)		0.905		
	Case-to-Sink (per Module)		0.058		
F	Mounting Force Per Clamp	20		50	N
G	Weight of Module		24		g

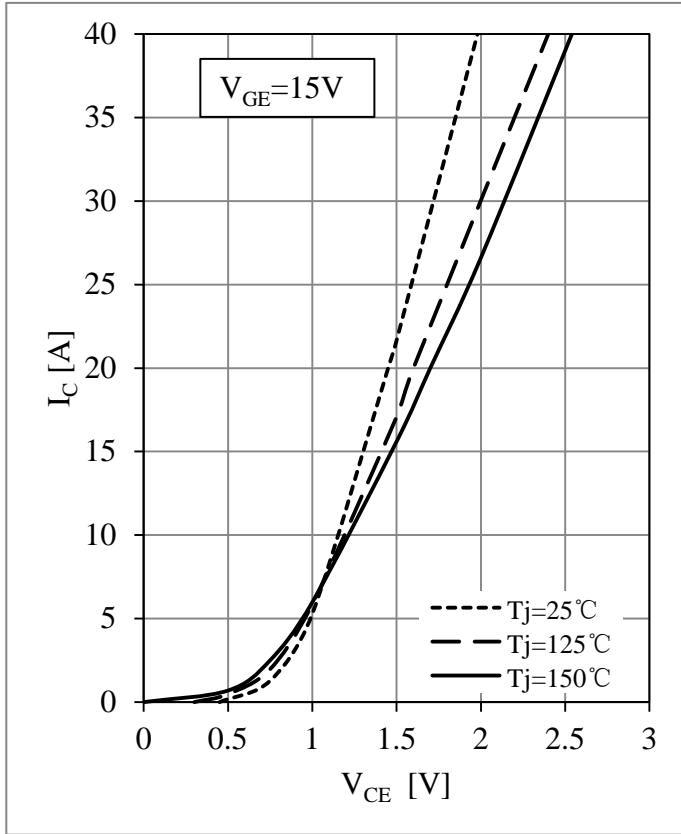


Fig 1. IGBT Output Characteristics

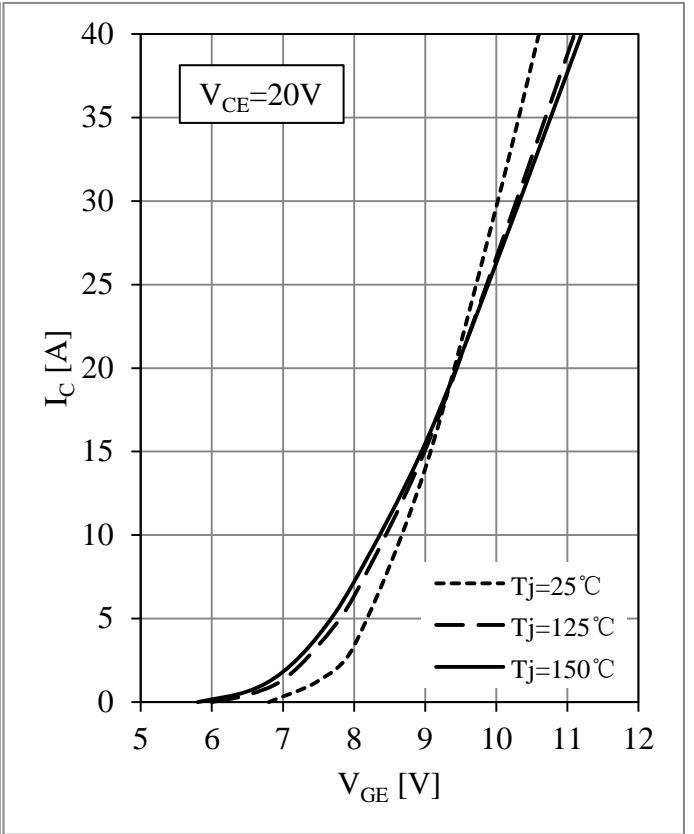


Fig 2. IGBT Transfer Characteristics

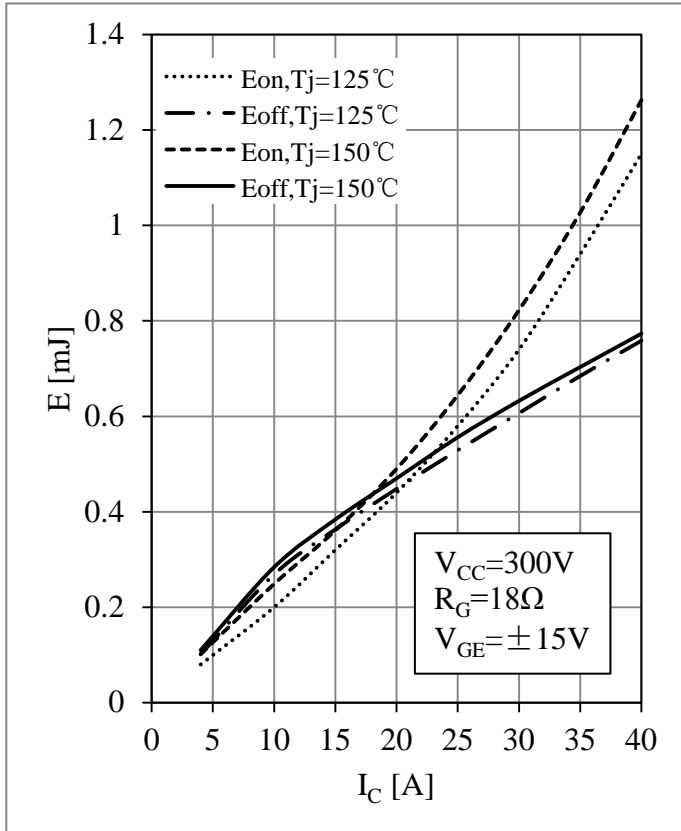


Fig 3. IGBT Switching Loss vs.  $I_c$

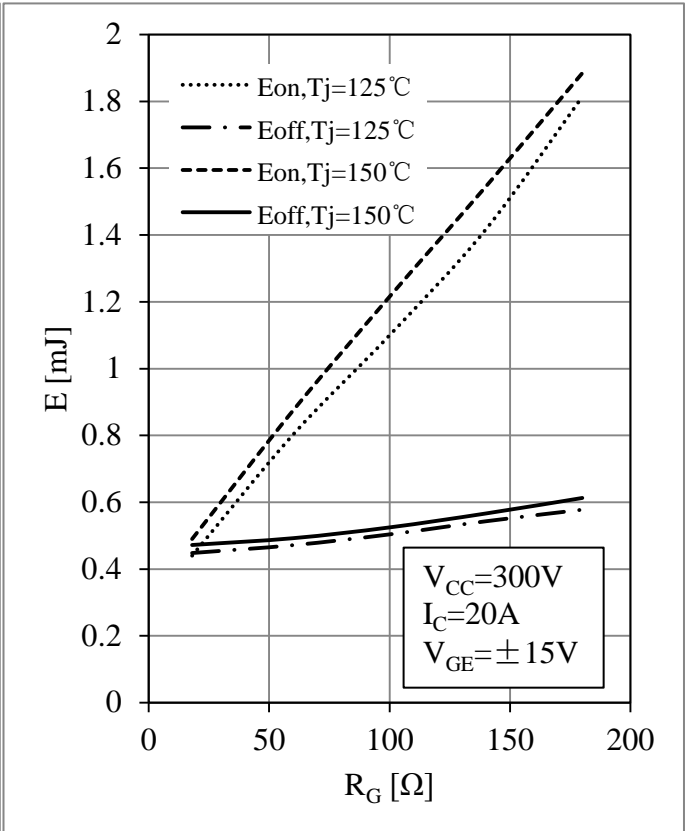


Fig 4. IGBT Switching Loss vs.  $R_G$

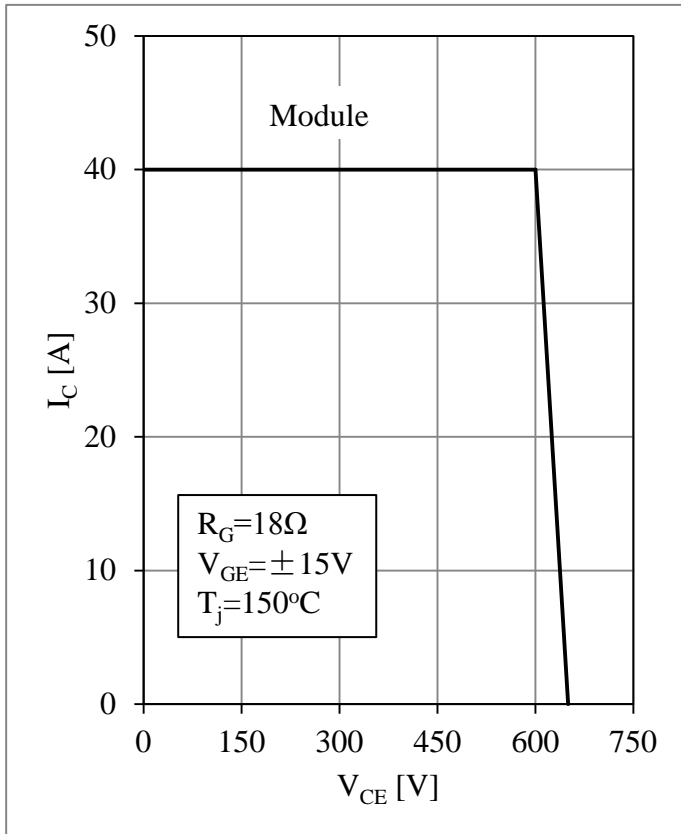


Fig 5. RBSOA

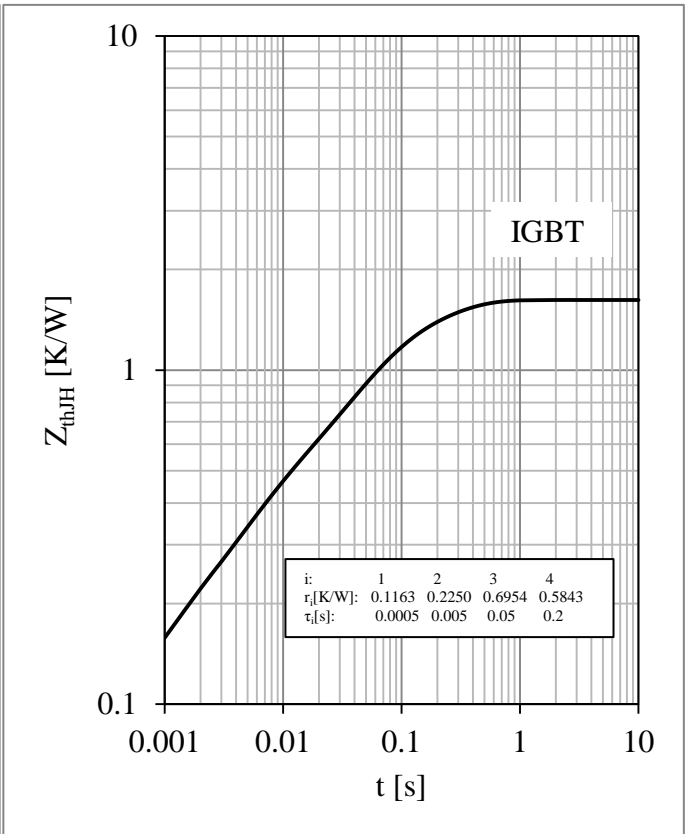


Fig 6. IGBT Transient Thermal Impedance

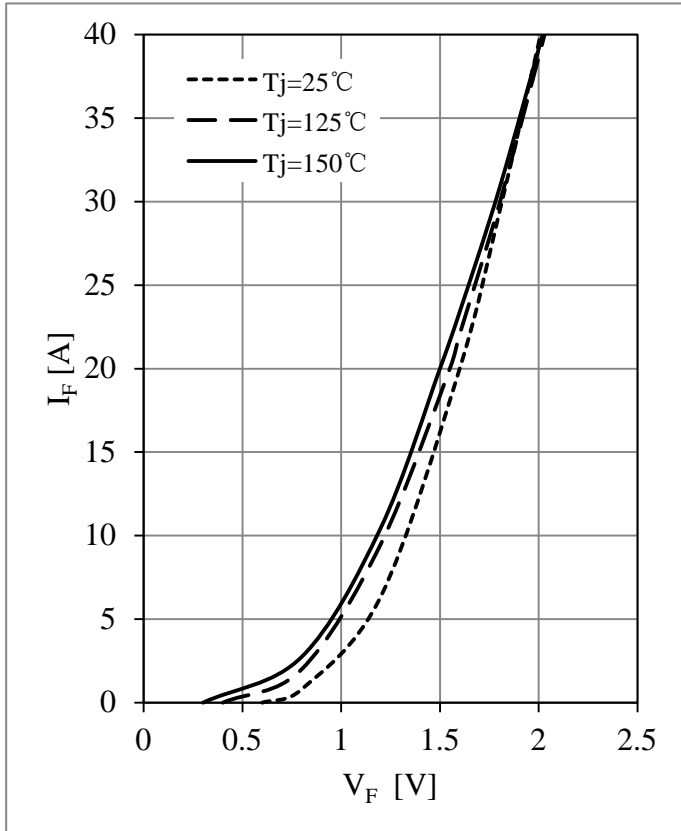


Fig 7. Diode Forward Characteristics

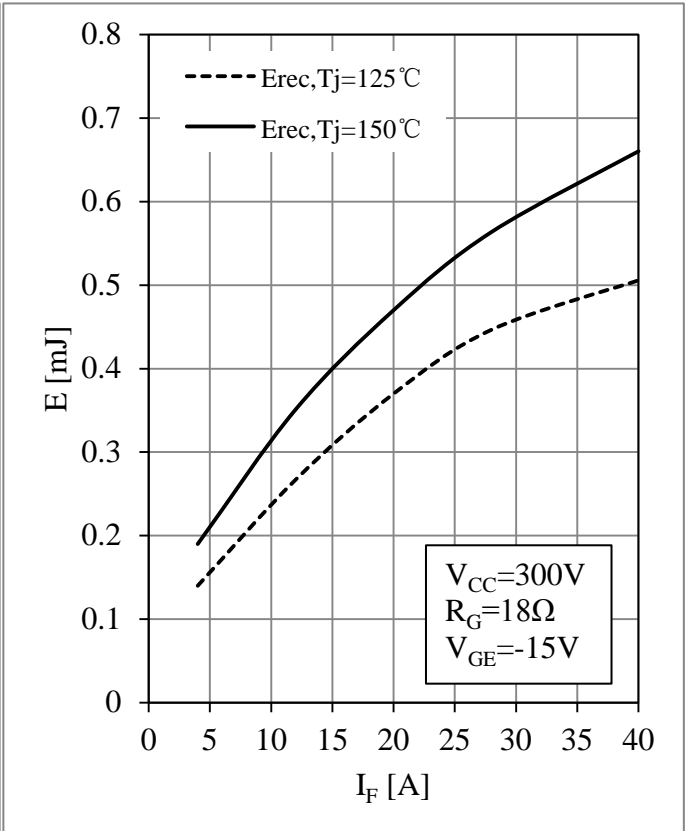


Fig 8. Diode Switching Loss vs.  $I_F$

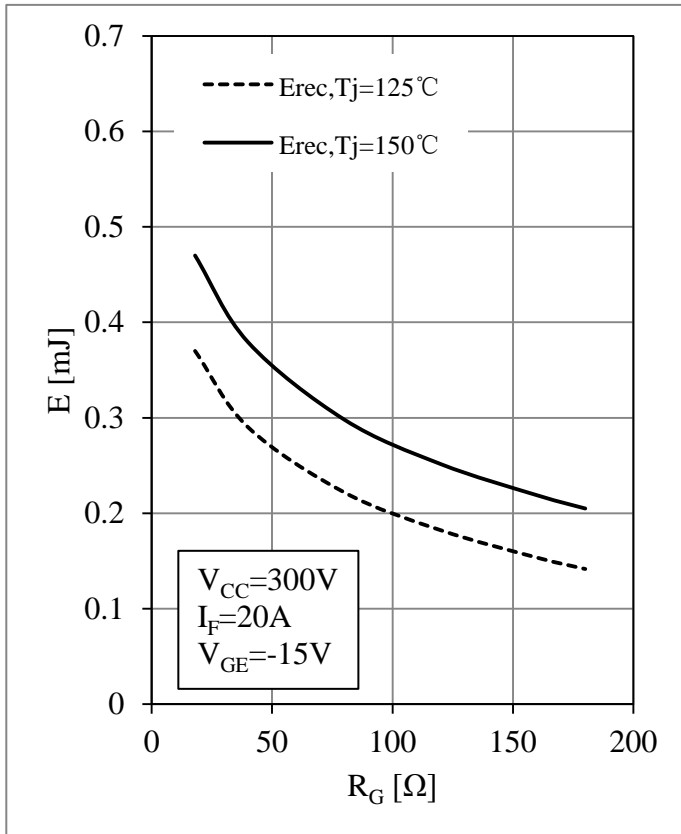


Fig 9. Diode Switching Loss vs.  $R_G$

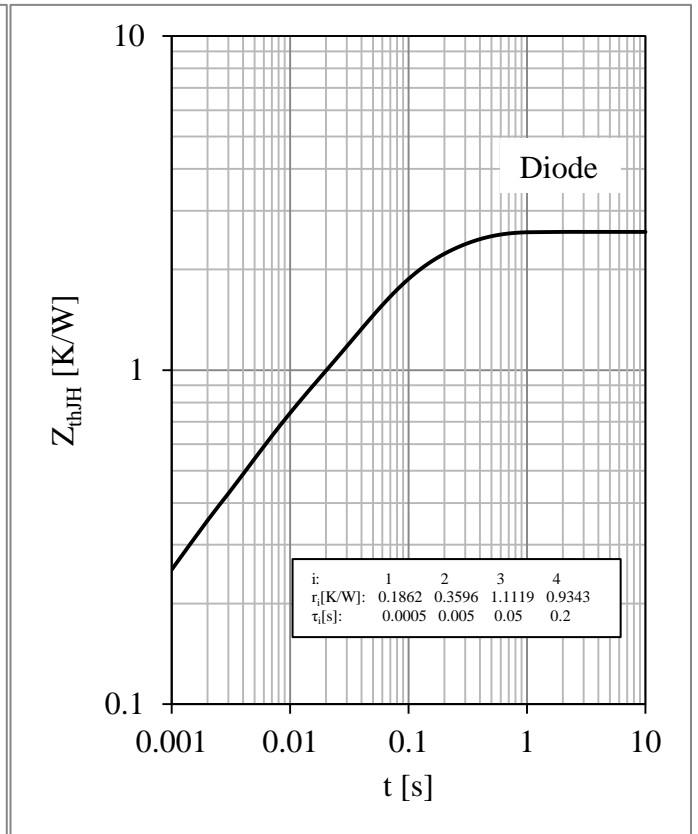


Fig 10. Diode Transient Thermal Impedance

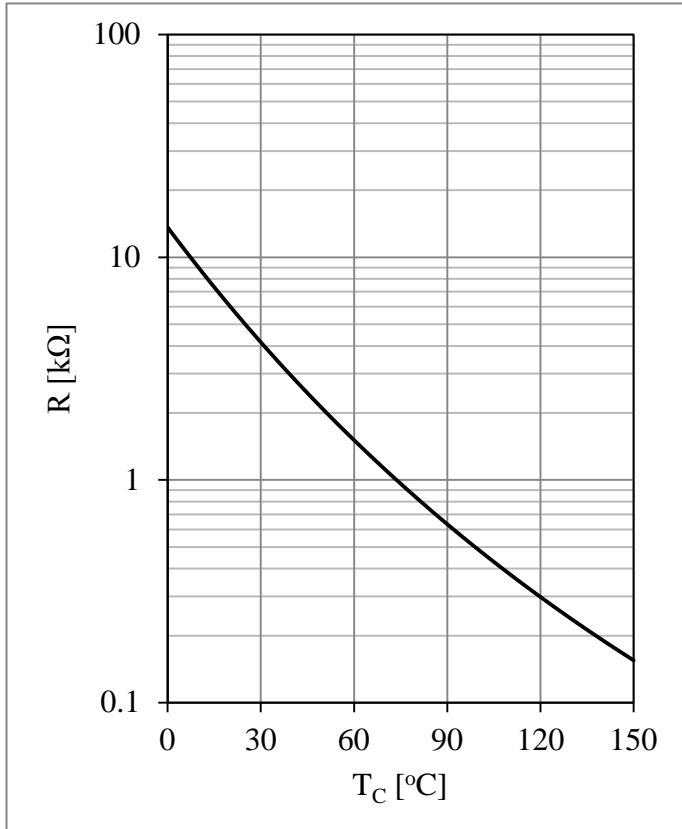
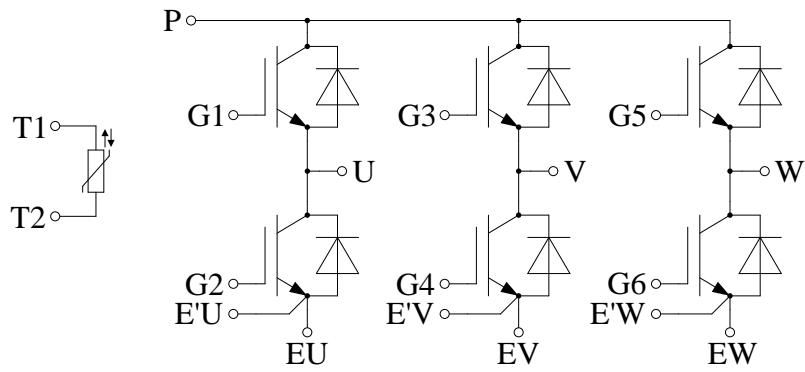


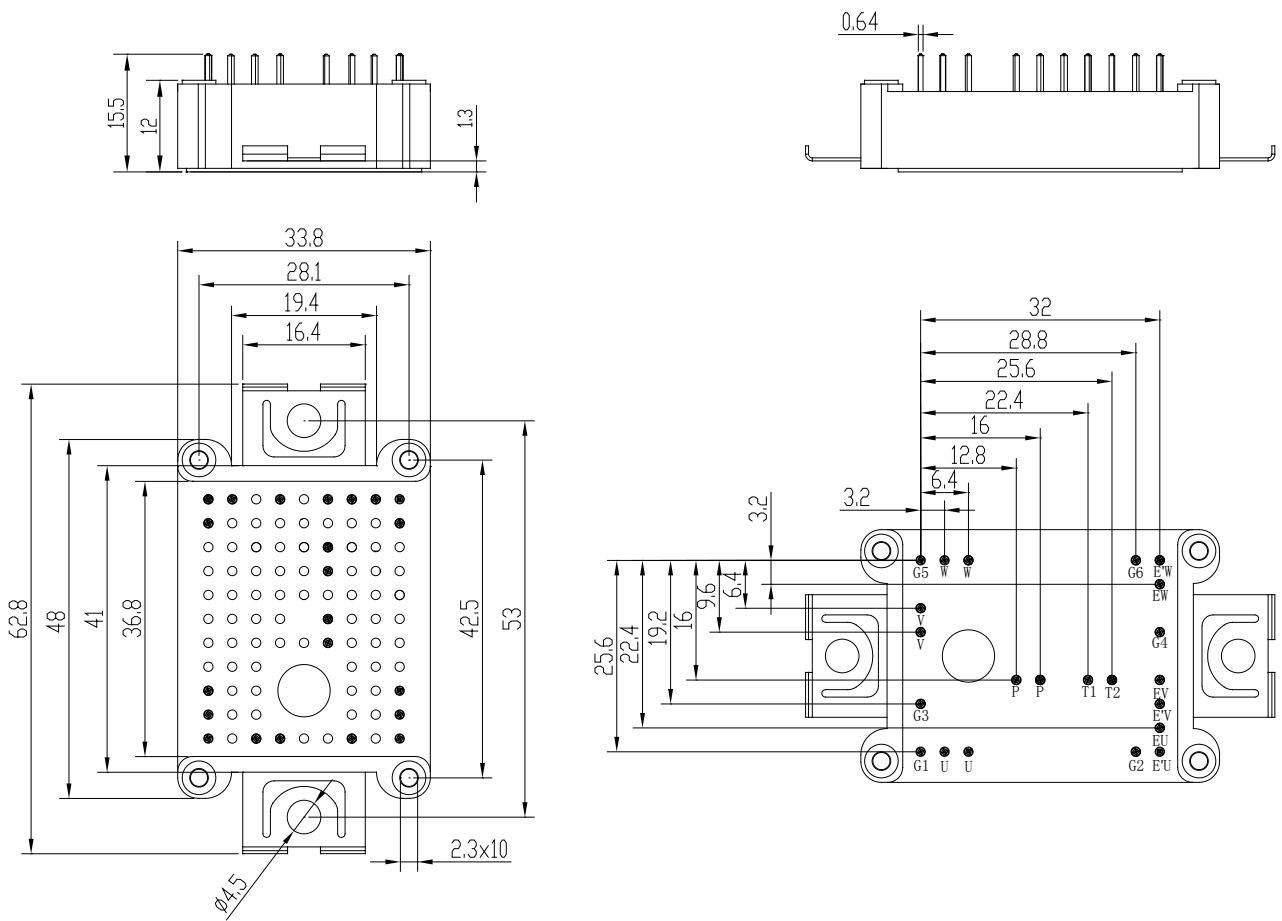
Fig 11. NTC Temperature Characteristic

**Circuit Schematic**



**Package Dimensions**

Dimensions in Millimeters





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