

# STARPOWER

SEMICONDUCTOR

**IGBT**

## GD300MLX65B3ST

**650V/300A 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 3-level-applications.

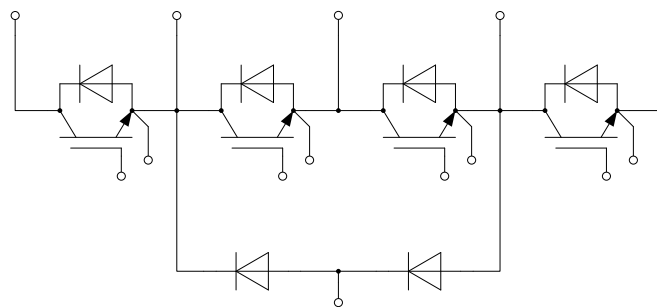
### Features

- 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 copper baseplate using DBC technology

### Typical Applications

- Solar power
- UPS
- 3-level-applications

### Equivalent Circuit Schematic



**Absolute Maximum Ratings**  $T_C=25^{\circ}\text{C}$  unless otherwise noted**T1-T4 IGBT**

Symbol	Description	Value	Unit
$V_{CES}$	Collector-Emitter Voltage	650	V
$V_{GES}$	Gate-Emitter Voltage	$\pm 20$	V
$I_C$	Collector Current @ $T_C=25^{\circ}\text{C}$	354	A
	@ $T_C=60^{\circ}\text{C}$	300	
$I_{CM}$	Pulsed Collector Current $t_p=1\text{ms}$	600	A
$P_D$	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	857	W

**D1-D4 Diode**

Symbol	Description	Value	Unit
$V_{RRM}$	Repetitive Peak Reverse Voltage	650	V
$I_F$	Diode Continuous Forward Current	200	A
$I_{FM}$	Diode Maximum Forward Current $t_p=1\text{ms}$	400	A

**D5,D6 Diode**

Symbol	Description	Value	Unit
$V_{RRM}$	Repetitive Peak Reverse Voltage	650	V
$I_F$	Diode Continuous Forward Current	300	A
$I_{FM}$	Diode Maximum Forward Current $t_p=1\text{ms}$	600	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

**T1-T4 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	$I_C=300\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$		1.45	1.80	V	
		$I_C=300\text{A}, V_{GE}=15\text{V}, T_j=125^\circ\text{C}$		1.60			
		$I_C=300\text{A}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}$		1.70			
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=4.80\text{mA}, V_{CE}=V_{GE}, T_j=25^\circ\text{C}$	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			1.0		$\Omega$	
$C_{ies}$	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		34.8		nF	
$C_{res}$	Reverse Transfer Capacitance			0.69		nF	
$Q_G$	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		2.08		$\mu\text{C}$	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=300\text{V}, I_C=300\text{A}, R_G=2.4\Omega, V_{GE}=\pm 15\text{V}, T_j=25^\circ\text{C}$		110		ns	
$t_r$	Rise Time			50		ns	
$t_{d(off)}$	Turn-Off Delay Time			392		ns	
$t_f$	Fall Time			40		ns	
$E_{on}$	Turn-On Switching Loss			1.96		mJ	
$E_{off}$	Turn-Off Switching Loss			6.40		mJ	
$t_{d(on)}$	Turn-On Delay Time		$V_{CC}=300\text{V}, I_C=300\text{A}, R_G=2.4\Omega, V_{GE}=\pm 15\text{V}, T_j=125^\circ\text{C}$		120		ns
$t_r$	Rise Time				60		ns
$t_{d(off)}$	Turn-Off Delay Time			416		ns	
$t_f$	Fall Time			56		ns	
$E_{on}$	Turn-On Switching Loss			3.10		mJ	
$E_{off}$	Turn-Off Switching Loss			9.60		mJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=300\text{V}, I_C=300\text{A}, R_G=2.4\Omega, V_{GE}=\pm 15\text{V}, T_j=150^\circ\text{C}$			130		ns
$t_r$	Rise Time				60		ns
$t_{d(off)}$	Turn-Off Delay Time			424		ns	
$t_f$	Fall Time			56		ns	
$E_{on}$	Turn-On Switching Loss			3.30		mJ	
$E_{off}$	Turn-Off Switching Loss			10.0		mJ	
$I_{SC}$	SC Data		$t_p \leq 6\mu\text{s}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}, V_{CC}=360\text{V}, V_{CEM} \leq 650\text{V}$		1500		A

**D1-D4 Diode Characteristics**  $T_C=25^\circ\text{C}$  unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_F$	Diode Forward Voltage	$I_F=200\text{A}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$		1.55	2.00	V
		$I_F=200\text{A}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$		1.50		
		$I_F=200\text{A}, V_{GE}=0\text{V}, T_j=150^\circ\text{C}$		1.45		
$Q_r$	Recovered Charge	$V_R=300\text{V}, I_F=200\text{A},$ $-di/dt=5700\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^\circ\text{C}$		10.0		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			160		A
$E_{rec}$	Reverse Recovery Energy			3.00		mJ
$Q_r$	Recovered Charge	$V_R=300\text{V}, I_F=200\text{A},$ $-di/dt=5700\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^\circ\text{C}$		17.0		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			230		A
$E_{rec}$	Reverse Recovery Energy			5.20		mJ
$Q_r$	Recovered Charge	$V_R=300\text{V}, I_F=200\text{A},$ $-di/dt=5700\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=150^\circ\text{C}$		20.0		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			240		A
$E_{rec}$	Reverse Recovery Energy			5.80		mJ

**D5,D6 Diode Characteristics**  $T_C=25^\circ\text{C}$  unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_F$	Diode Forward Voltage	$I_F=300\text{A}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$		1.55	2.00	V
		$I_F=300\text{A}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$		1.50		
		$I_F=300\text{A}, V_{GE}=0\text{V}, T_j=150^\circ\text{C}$		1.45		
$Q_r$	Recovered Charge	$V_R=300\text{V}, I_F=300\text{A},$ $-di/dt=7150\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^\circ\text{C}$		14.3		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			209		A
$E_{rec}$	Reverse Recovery Energy			3.74		mJ
$Q_r$	Recovered Charge	$V_R=300\text{V}, I_F=300\text{A},$ $-di/dt=7150\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^\circ\text{C}$		26.4		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			259		A
$E_{rec}$	Reverse Recovery Energy			6.82		mJ
$Q_r$	Recovered Charge	$V_R=300\text{V}, I_F=300\text{A},$ $-di/dt=7150\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=150^\circ\text{C}$		30.8		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			275		A
$E_{rec}$	Reverse Recovery Energy			7.70		mJ

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

Symbol	Parameter	Min.	Typ.	Max.	Unit
$R_{thJC}$	Junction-to-Case (per T1-T4 IGBT)			0.175	K/W
	Junction-to-Case (per D1-D4 Diode)			0.367	
	Junction-to-Case (per D5,D6 Diode)			0.299	
$R_{thCH}$	Case-to-Heatsink (per T1-T4 IGBT)		0.248		K/W
	Case-to-Heatsink (per D1-D4 Diode)		0.520		
	Case-to-Heatsink (per D5,D6 Diode)		0.423		
	Case-to-Heatsink (per Module)		0.035		
M	Terminal Connection Torque, Screw M6	2.5		5.0	N.m
	Mounting Torque, Screw M6	3.0		5.0	
G	Weight of Module		340		g

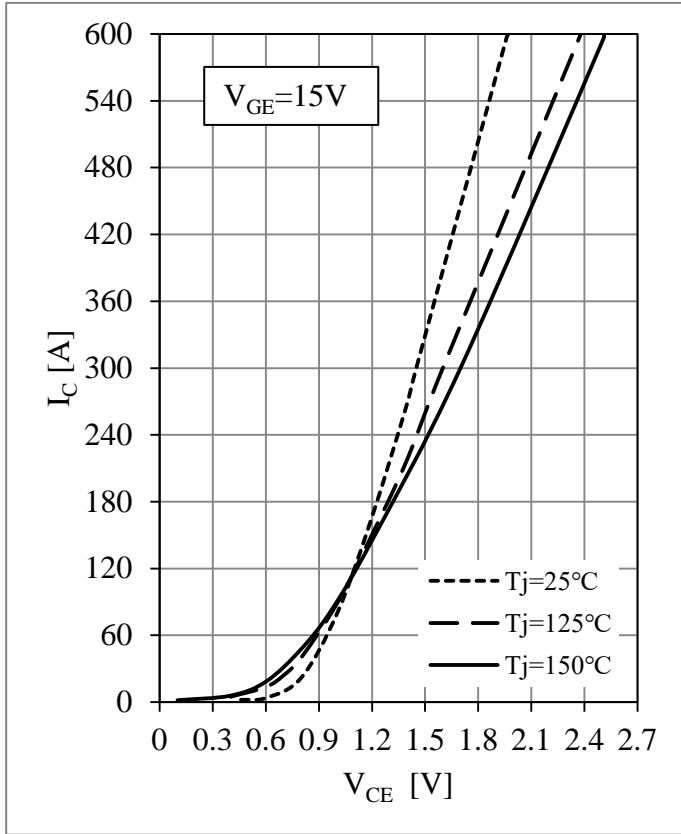


Fig 1. T1-T4 IGBT Output Characteristics

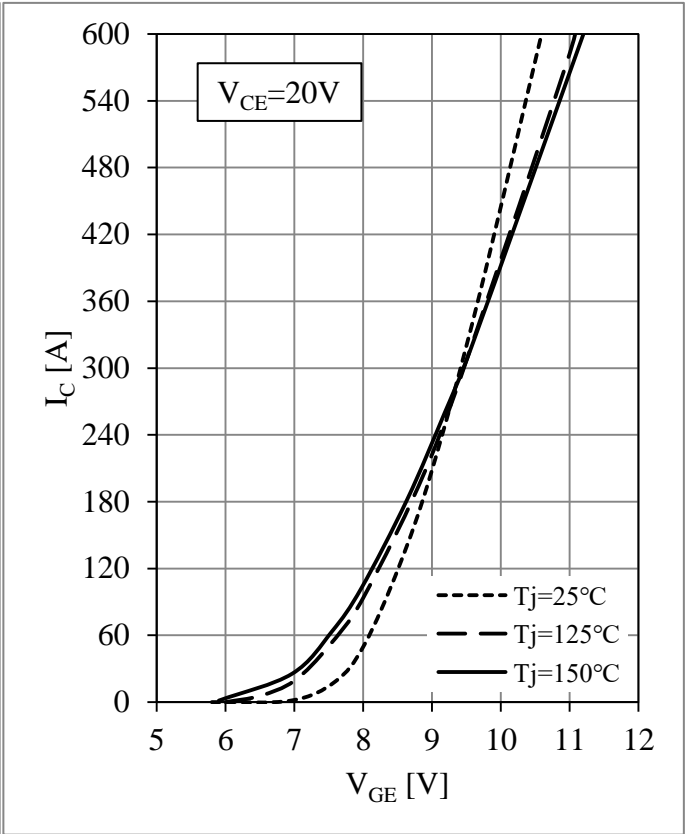


Fig 2. T1-T4 IGBT Transfer Characteristics

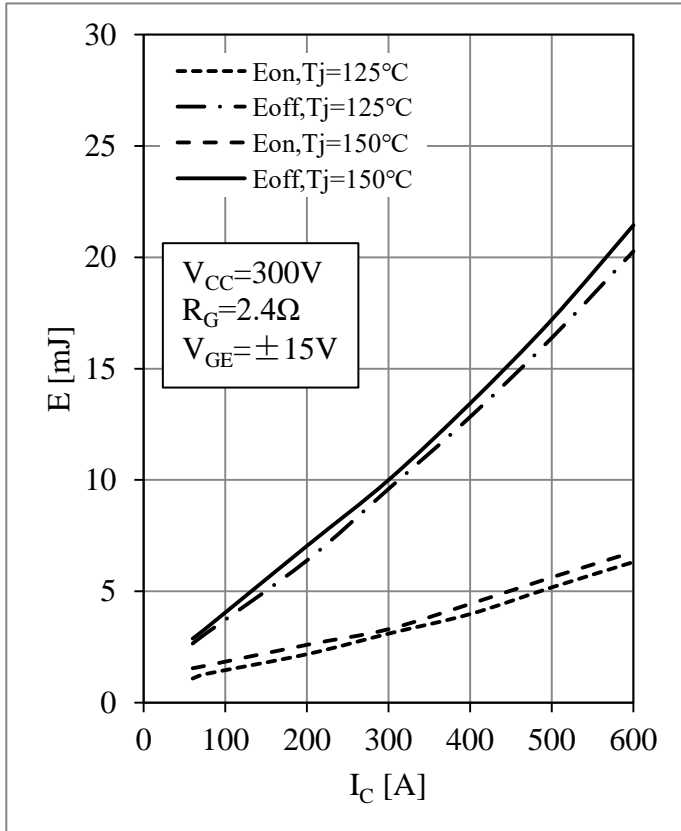


Fig 3. T1-T4 IGBT Switching Loss vs.  $I_C$

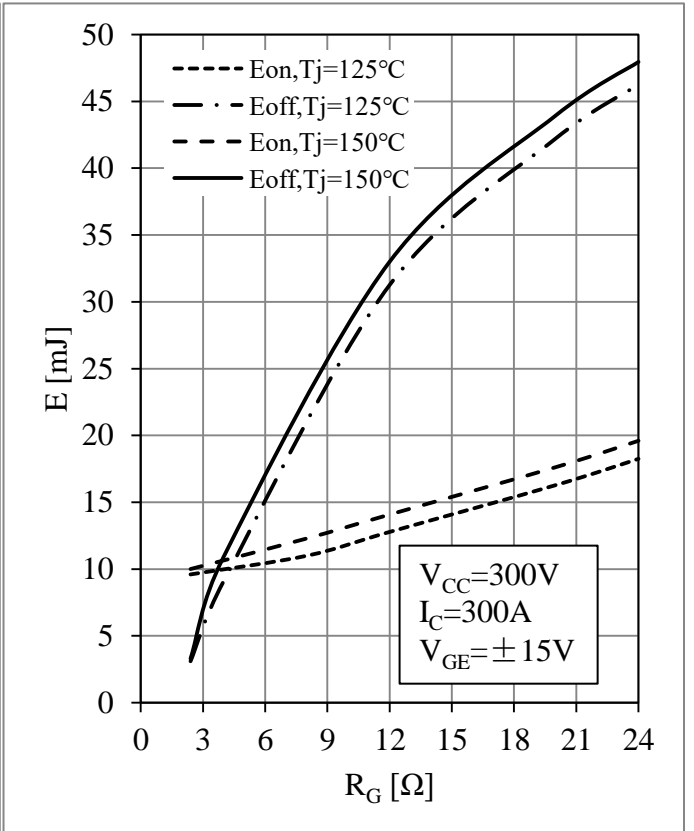


Fig 4. T1-T4 IGBT Switching Loss vs.  $R_G$

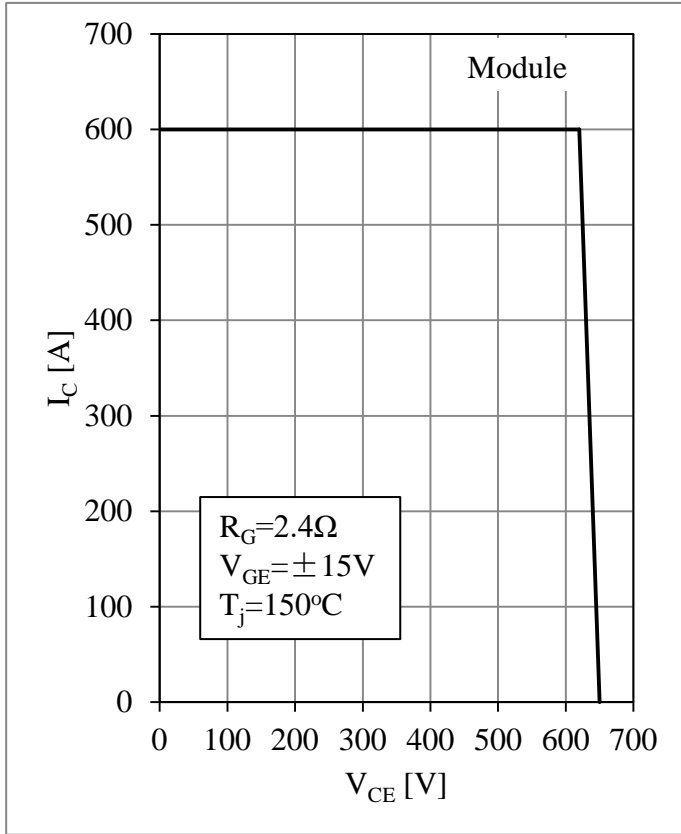


Fig 5. T1-T4 RBSOA

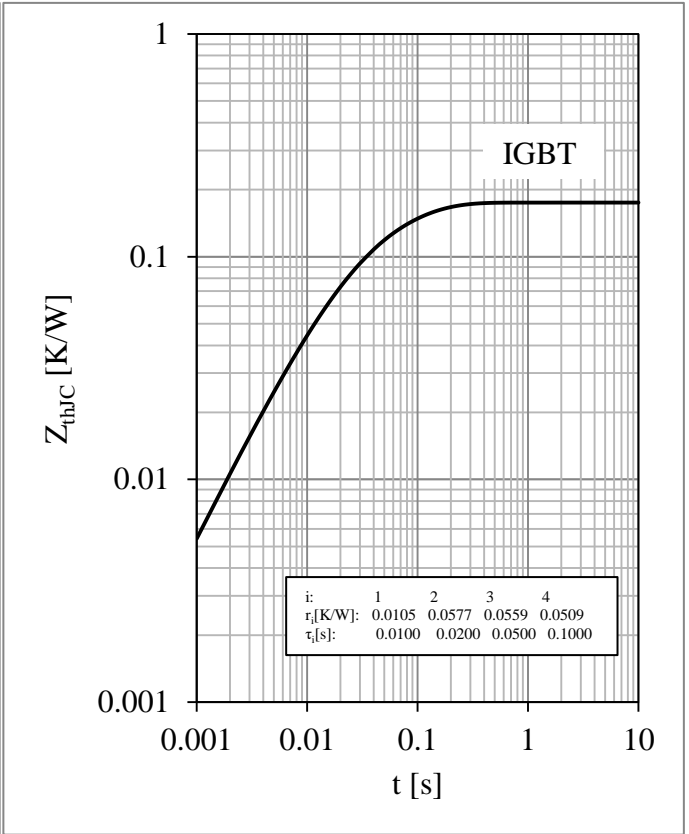


Fig 6. T1-T4 IGBT Transient Thermal Impedance

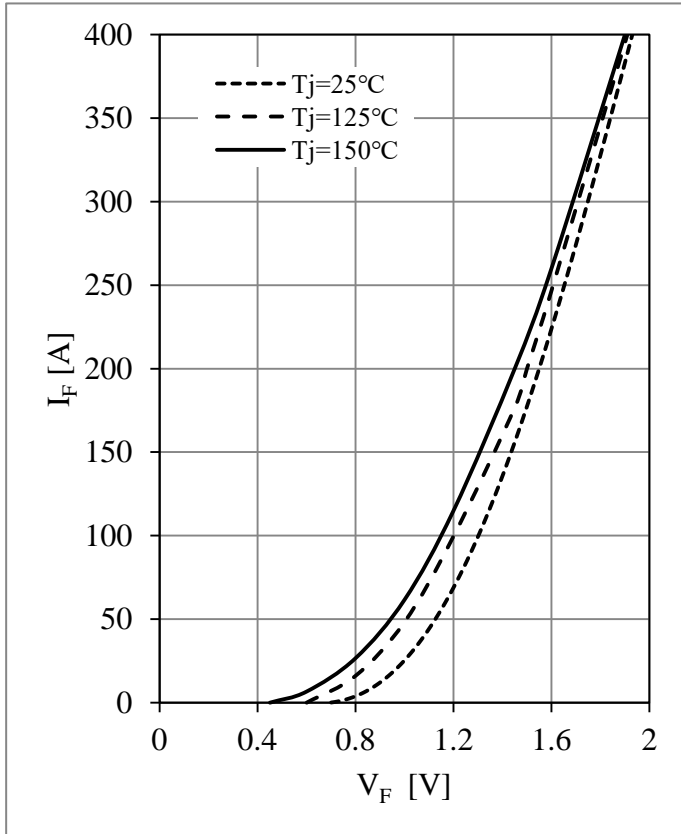


Fig 7. D1-D4 Diode Forward Characteristics

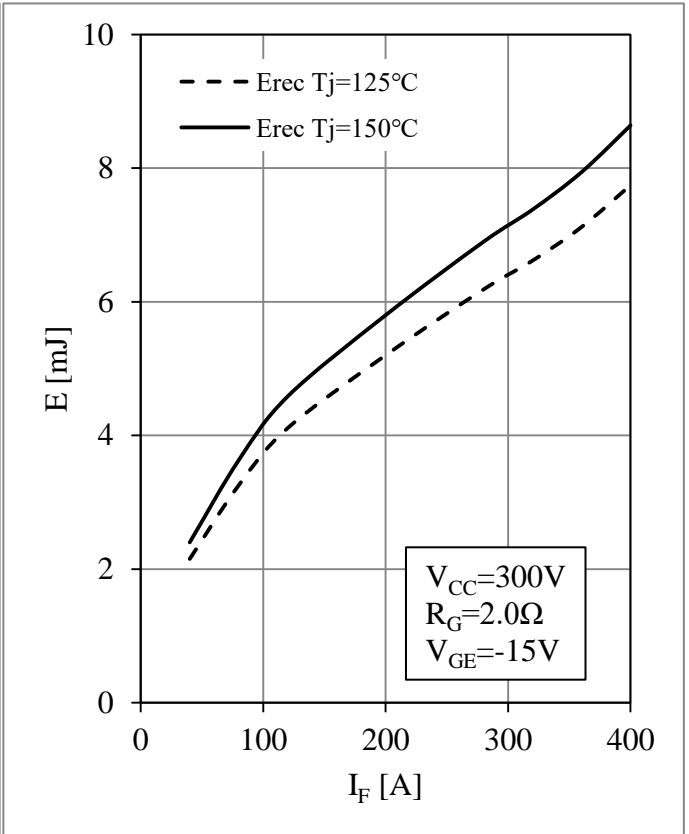


Fig 8. D1-D4 Diode Switching Loss vs. I<sub>F</sub>

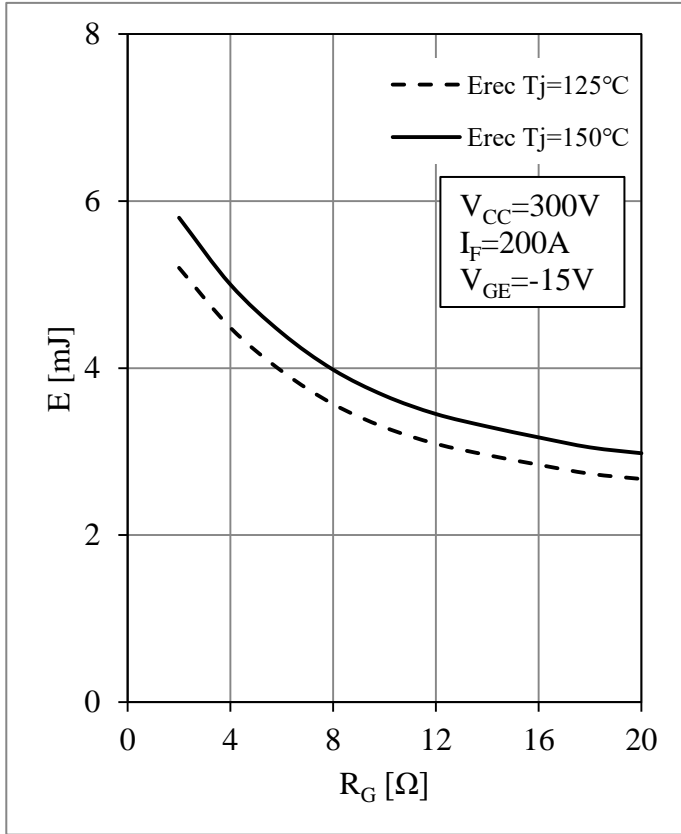


Fig 9. D1-D4 Diode Switching Loss vs.  $R_G$

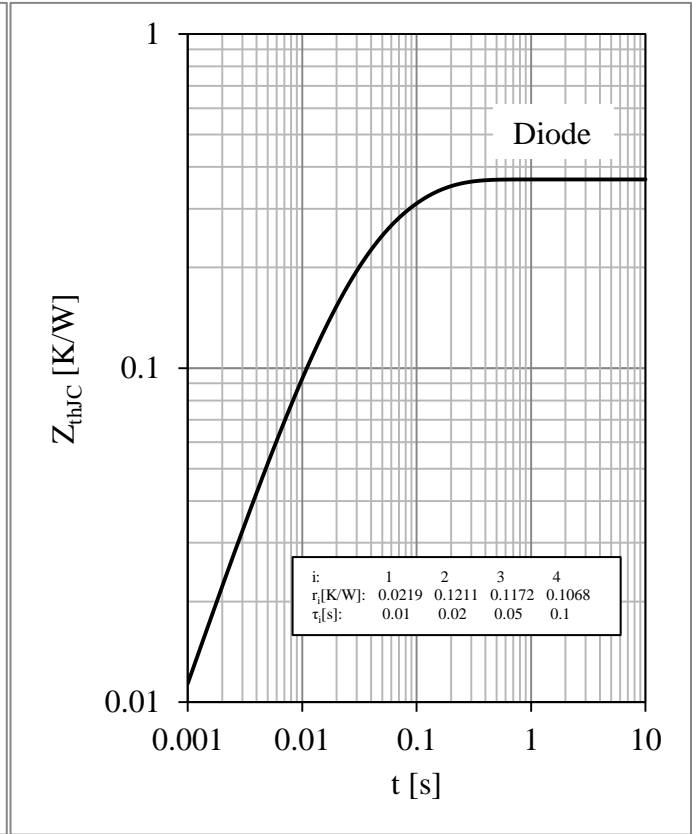


Fig 10. D1-D4 Diode Transient Thermal Impedance

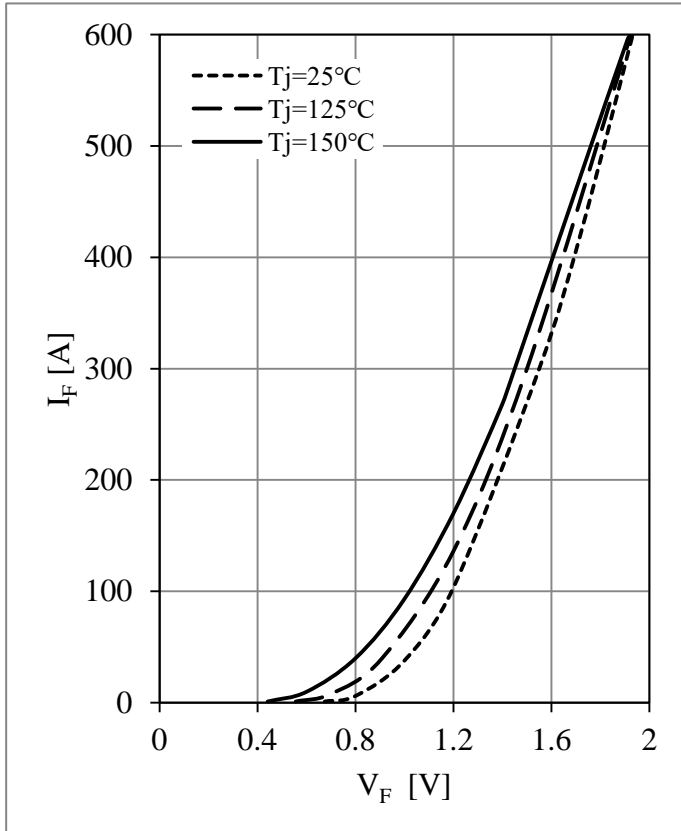


Fig 11. D5,D6 Diode Forward Characteristics

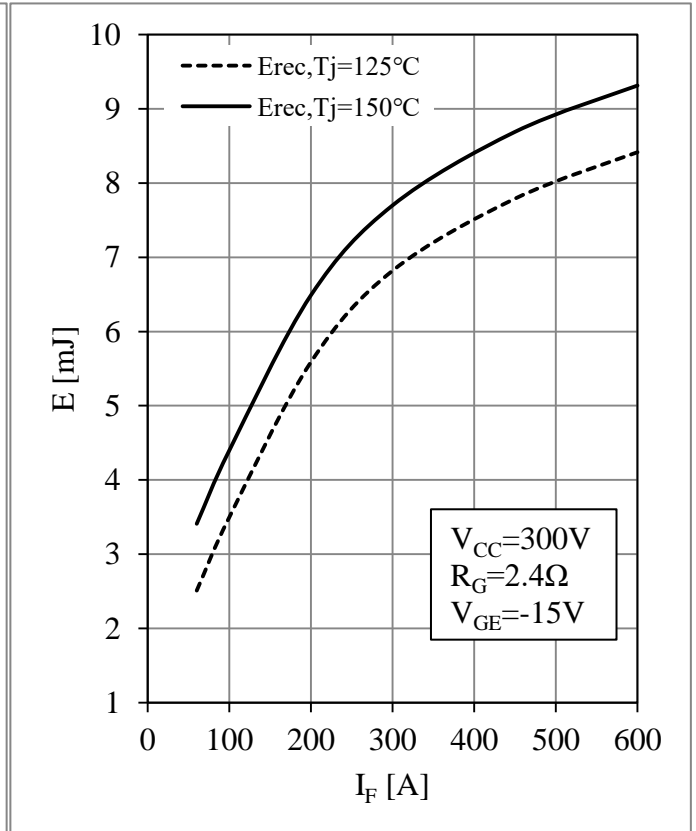


Fig 12. D5,D6 Diode Switching Loss vs.  $I_F$



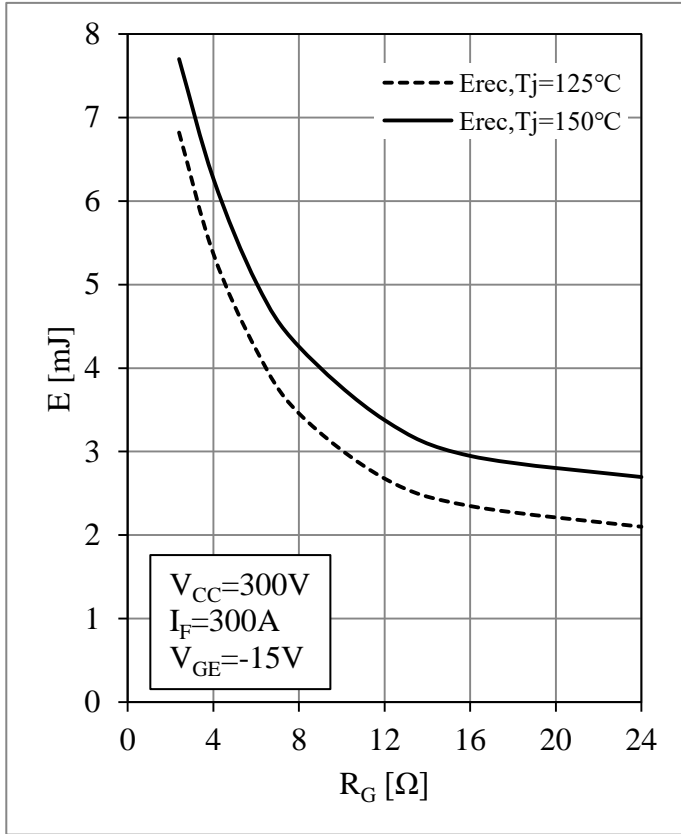


Fig 13. D5,D6 Diode Switching Loss vs.  $R_G$

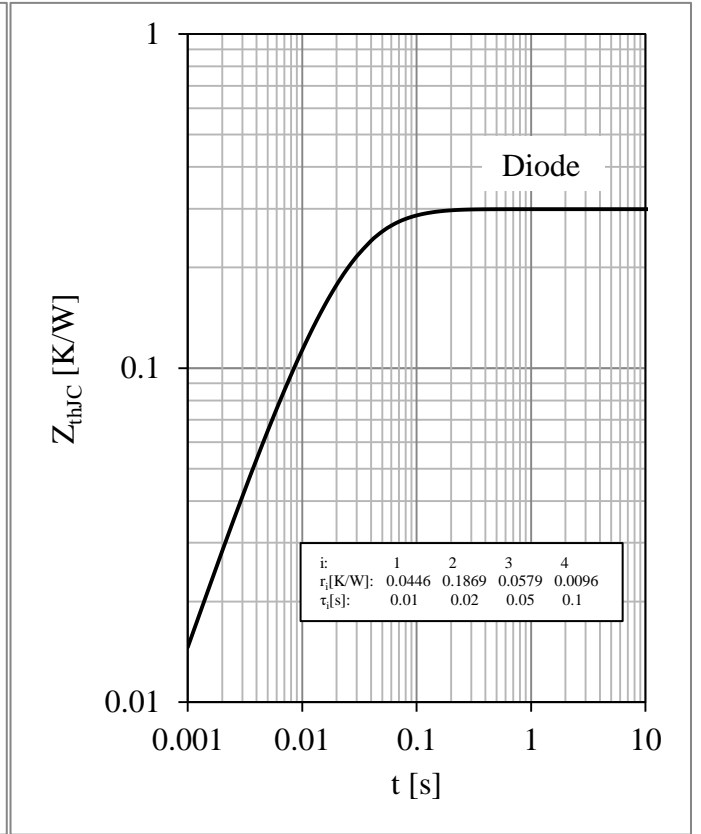
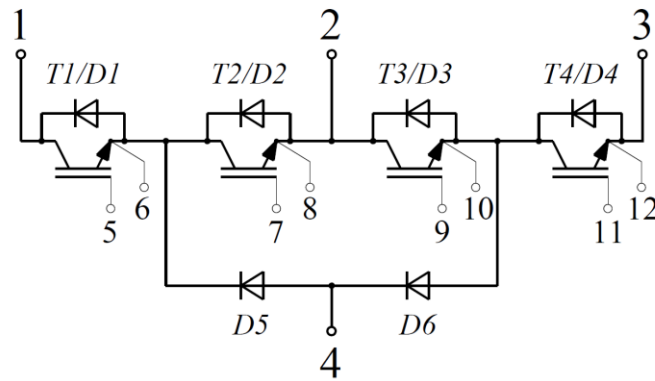


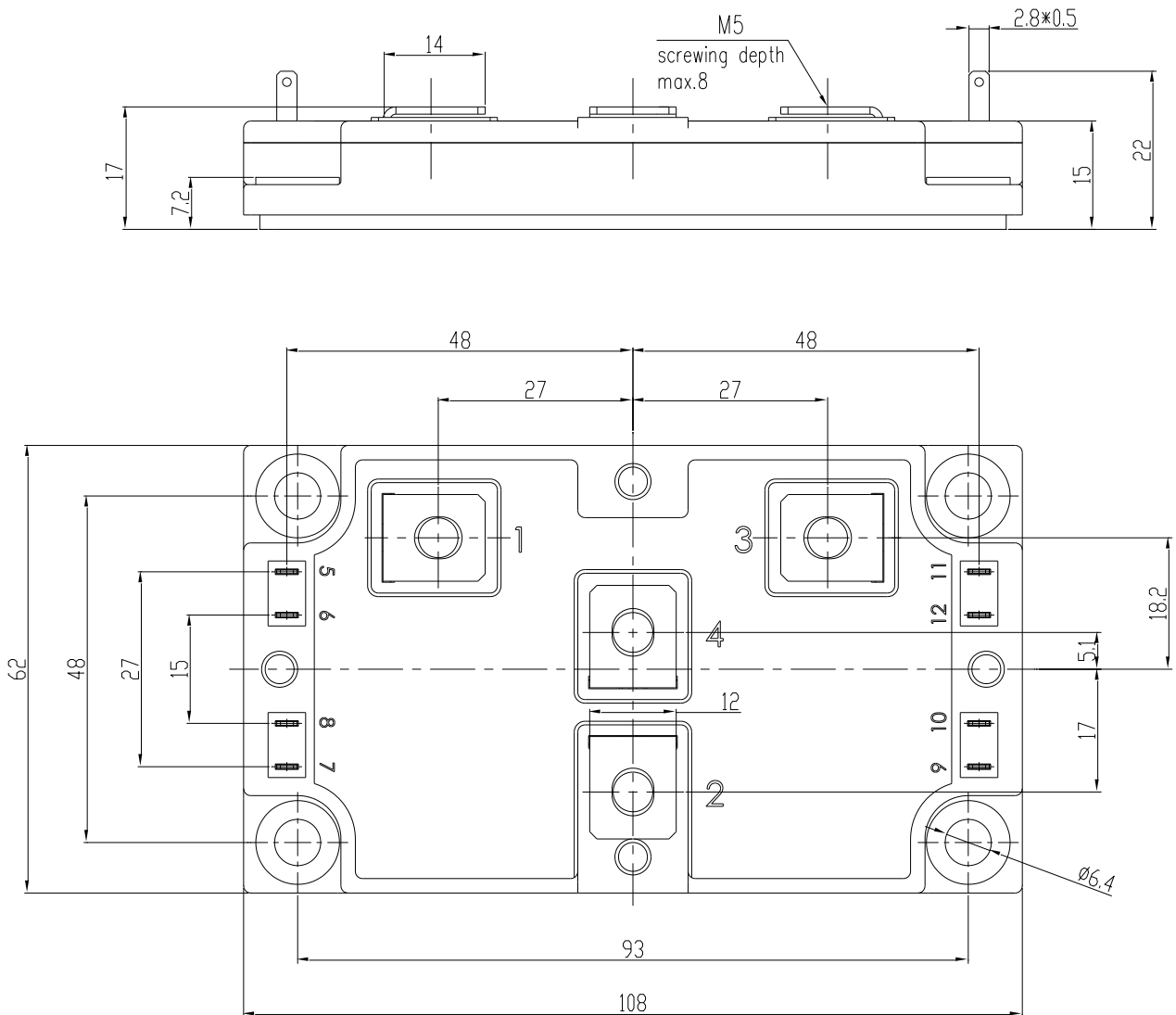
Fig 14. D5,D6 Diode Transient Thermal Impedance

**Circuit Schematic**



**Package Dimensions**

Dimensions in Millimeters



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