STARPOWER

SEMICONDUCTOR **IGBT**

GD400MLX65B3ST

650V/400A 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.

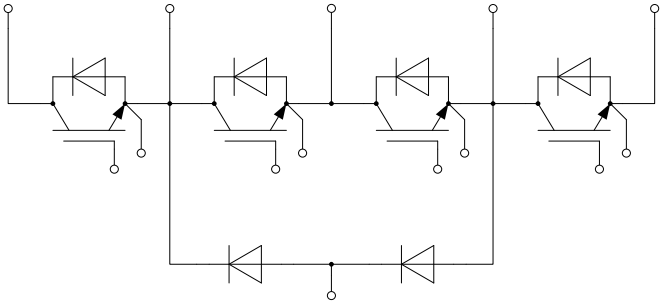
Features

- Low $V_{CE(sat)}$ trench IGBT technology
- 6μs 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°C unless otherwise noted

T1-T4 IGBT

Symbol	Description	Value	Unit
V_{CES}	Collector-Emitter Voltage	650	V
V_{GES}	Gate-Emitter Voltage	±20	V
I_C	Collector Current @ T_C=25°C @ T_C=60°C	484 400	A
I_{CM}	Pulsed Collector Current t_p=1ms	800	A
P_D	Maximum Power Dissipation @ T_j=175°C	1136	W

D1-D4 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=1ms	600	A

D5,D6 Diode

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	650	V
I_F	Diode Continuous Forward Current	400	A
I_{FM}	Diode Maximum Forward Current t_p=1ms	800	A

Module

Symbol	Description	Value	Unit
T_{jmax}	Maximum Junction Temperature	175	°C
T_{jop}	Operating Junction Temperature	-40 to +150	°C
T_{STG}	Storage Temperature Range	-40 to +125	°C
V_{ISO}	Isolation Voltage RMS,f=50Hz,t=1min	2500	V

T1-T4 IGBT Characteristics T_C=25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	I_C=400A,V_{GE}=15V, T_j=25°C		1.45	1.80	V
		I_C=400A,V_{GE}=15V, T_j=125°C		1.60		
		I_C=400A,V_{GE}=15V, T_j=150°C		1.70		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	I_C=6.40mA,V_{CE}=V_{GE}, T_j=25°C	5.1	5.8	6.5	V
I_{CES}	Collector Cut-Off Current	V_{CE}=V_{CES},V_{GE}=0V, T_j=25°C			1.0	mA
I_{GES}	Gate-Emitter Leakage Current	V_{GE}=V_{GES},V_{CE}=0V, T_j=25°C			400	nA
R_{Gint}	Internal Gate Resistance			1.0		Ω
C_{ies}	Input Capacitance	V_{CE}=25V,f=1MHz, V_{GE}=0V		46.4		nF
C_{res}	Reverse Transfer Capacitance			0.91		nF
Q_G	Gate Charge	V_{GE}=-15…+15V		2.77		μC
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=300V,I_C=400A, R_G=2.0Ω,V_{GE}=±15V, T_j=25°C		134		ns
t_r	Rise Time			64		ns
$t_{d(off)}$	Turn-Off Delay Time			286		ns
t_f	Fall Time			60		ns
E_{on}	Turn-On Switching Loss			0.86		mJ
E_{off}	Turn-Off Switching Loss			9.77		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=300V,I_C=400A, R_G=2.0Ω,V_{GE}=±15V, T_j=125°C		148		ns
t_r	Rise Time			68		ns
$t_{d(off)}$	Turn-Off Delay Time			307		ns
t_f	Fall Time			75		ns
E_{on}	Turn-On Switching Loss			1.63		mJ
E_{off}	Turn-Off Switching Loss			11.8		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=300V,I_C=400A, R_G=2.0Ω,V_{GE}=±15V, T_j=150°C		160		ns
t_r	Rise Time			71		ns
$t_{d(off)}$	Turn-Off Delay Time			312		ns
t_f	Fall Time			84		ns
E_{on}	Turn-On Switching Loss			2.08		mJ
E_{off}	Turn-Off Switching Loss			12.3		mJ
I_{SC}	SC Data	t_P≤6μs,V_{GE}=15V, T_j=150°C,V_{CC}=360V, V_{CEM}≤650V		2000		A

D1-D4 Diode Characteristics T_C=25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_F	Diode Forward Voltage	I_F=300A,V_{GE}=0V,T_j=25°C		1.55	2.00	V
		I_F=300A,V_{GE}=0V,T_j=125°C		1.50		
		I_F=300A,V_{GE}=0V,T_j=150°C		1.45		
Q_r	Recovered Charge	V_R=300V,I_F=300A, -di/dt=5230A/μs,V_{GE}=-15V T_j=25°C		6.64		μC
I_{RM}	Peak Reverse Recovery Current			192		A
E_{rec}	Reverse Recovery Energy			2.52		mJ
Q_r	Recovered Charge	V_R=300V,I_F=300A, -di/dt=5200A/μs,V_{GE}=-15V T_j=125°C		11.9		μC
I_{RM}	Peak Reverse Recovery Current			240		A
E_{rec}	Reverse Recovery Energy			4.76		mJ
Q_r	Recovered Charge	V_R=300V,I_F=300A, -di/dt=5190A/μs,V_{GE}=-15V T_j=150°C		14.5		μC
I_{RM}	Peak Reverse Recovery Current			256		A
E_{rec}	Reverse Recovery Energy			5.37		mJ

D5,D6 Diode Characteristics T_C=25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_F	Diode Forward Voltage	I_F=400A,V_{GE}=0V,T_j=25°C		1.65	2.10	V
		I_F=400A,V_{GE}=0V,T_j=125°C		1.65		
		I_F=400A,V_{GE}=0V,T_j=150°C		1.65		
Q_r	Recovered Charge	V_R=400V,I_F=400A, -di/dt=4700A/μs,V_{GE}=-15V T_j=25°C		10.5		μC
I_{RM}	Peak Reverse Recovery Current			216		A
E_{rec}	Reverse Recovery Energy			3.52		mJ
Q_r	Recovered Charge	V_R=400V,I_F=400A, -di/dt=4300A/μs,V_{GE}=-15V T_j=150°C		21		μC
I_{RM}	Peak Reverse Recovery Current			276		A
E_{rec}	Reverse Recovery Energy			7.80		mJ
Q_r	Recovered Charge	V_R=400V,I_F=400A, -di/dt=4200A/μs,V_{GE}=-15V T_j=175°C		23.6		μC
I_{RM}	Peak Reverse Recovery Current			288		A
E_{rec}	Reverse Recovery Energy			8.84		mJ

Module Characteristics T_C=25°C unless otherwise noted

Symbol	Parameter	Min.	Typ.	Max.	Unit
R_{thJC}	Junction-to-Case (per T1-T4 IGBT) Junction-to-Case (per D1-D4 Diode) Junction-to-Case (per D5,D6 Diode)			0.132 0.273 0.228	K/W
R_{thCH}	Case-to-Heatsink (per T1-T4 IGBT) Case-to-Heatsink (per D1-D4 Diode) Case-to-Heatsink (per D5,D6 Diode) Case-to-Heatsink (per Module)		0.071 0.147 0.122 0.010		K/W
M	Terminal Connection Torque, Screw M5 Mounting Torque, Screw M6	2.5 3.0		5.0 5.0	N.m
G	Weight of Module		340		g

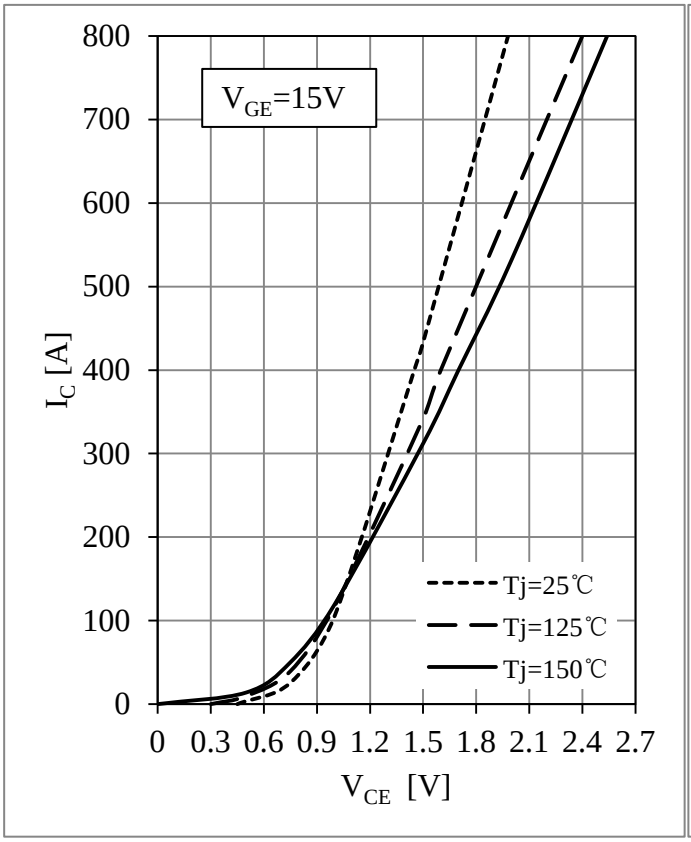


Fig 1. T1-T4 IGBT Output Characteristics

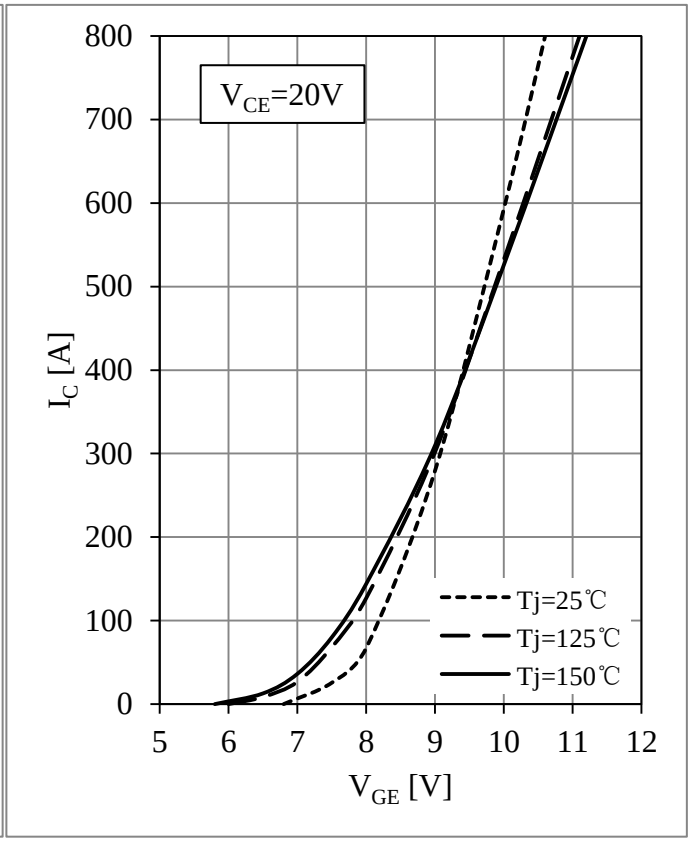


Fig 2. T1-T4 IGBT Transfer Characteristics

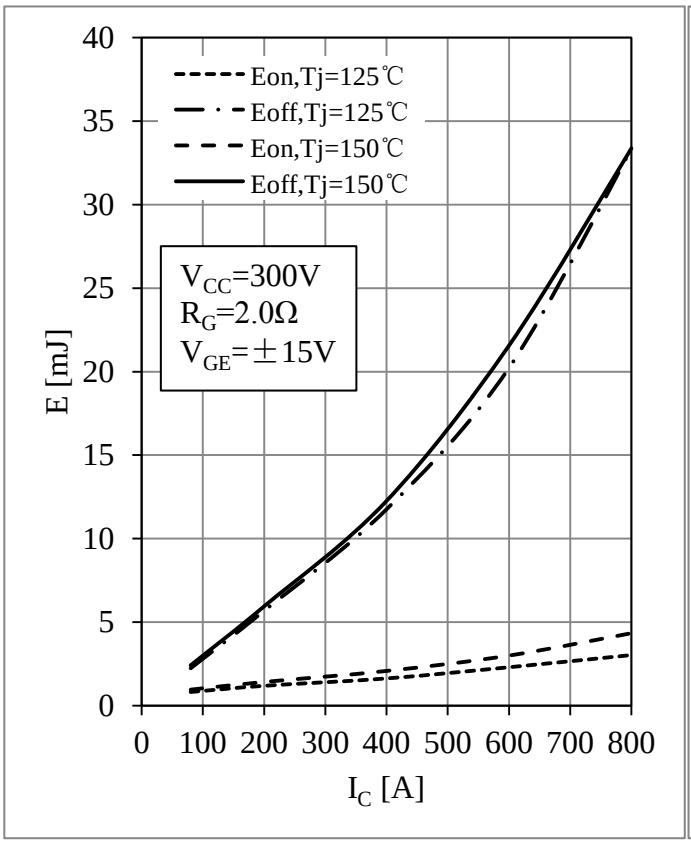


Fig 3. T1-T4 IGBT Switching Loss vs. I_C

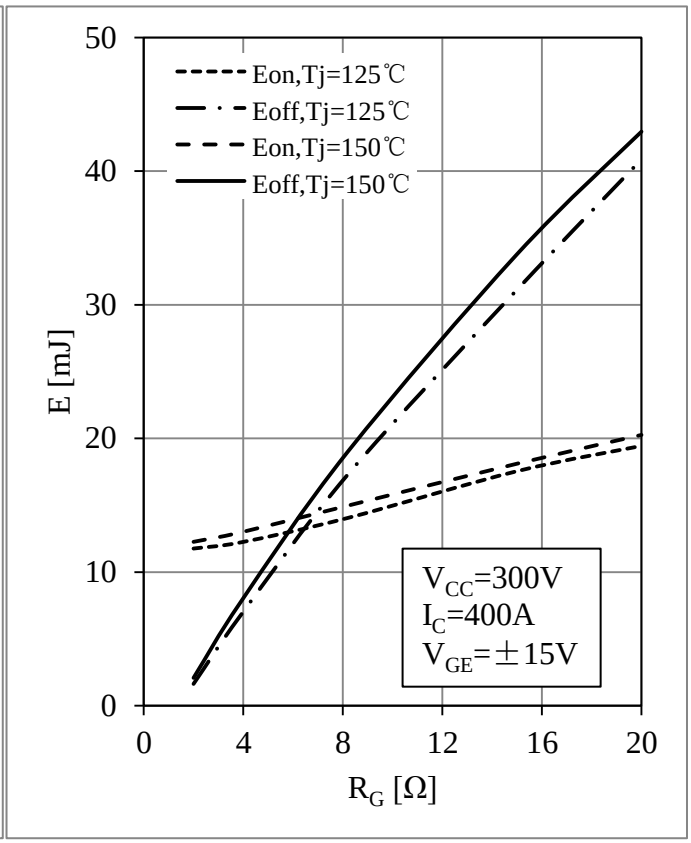


Fig 4. T1-T4 IGBT Switching Loss vs. R_G

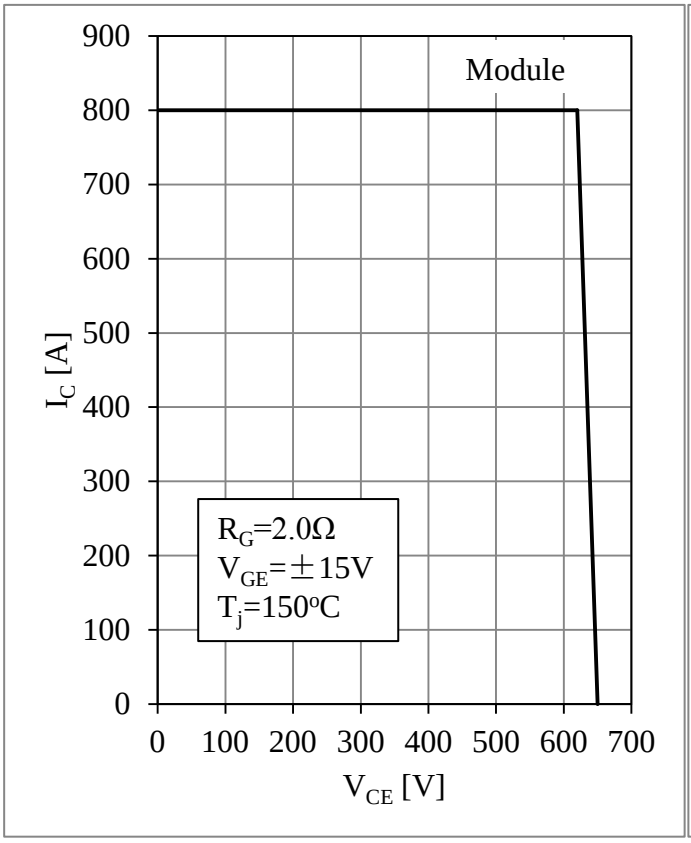


Fig 5. T1-T4 RBSOA

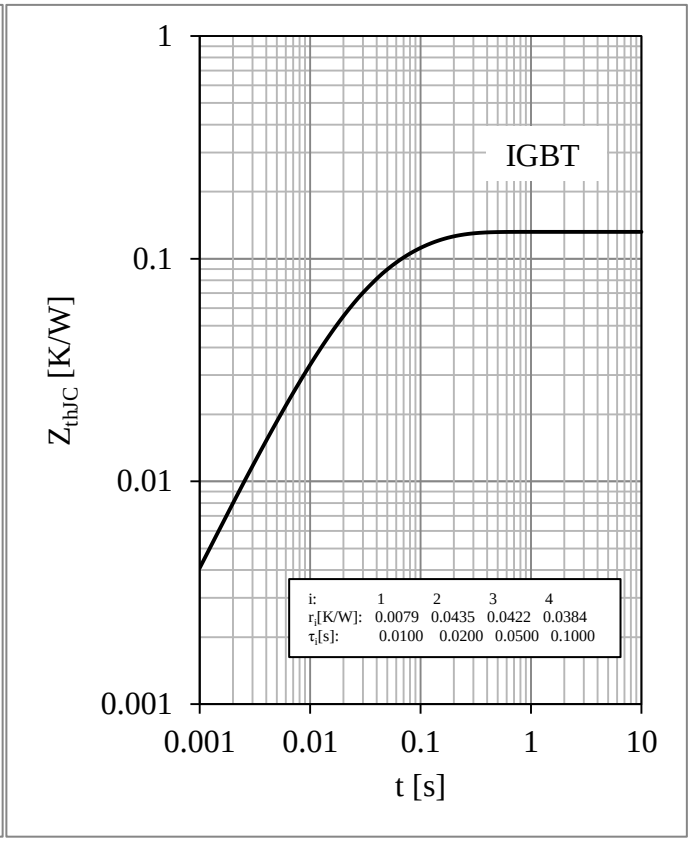


Fig 6. T1-T4 IGBT Transient Thermal Impedance

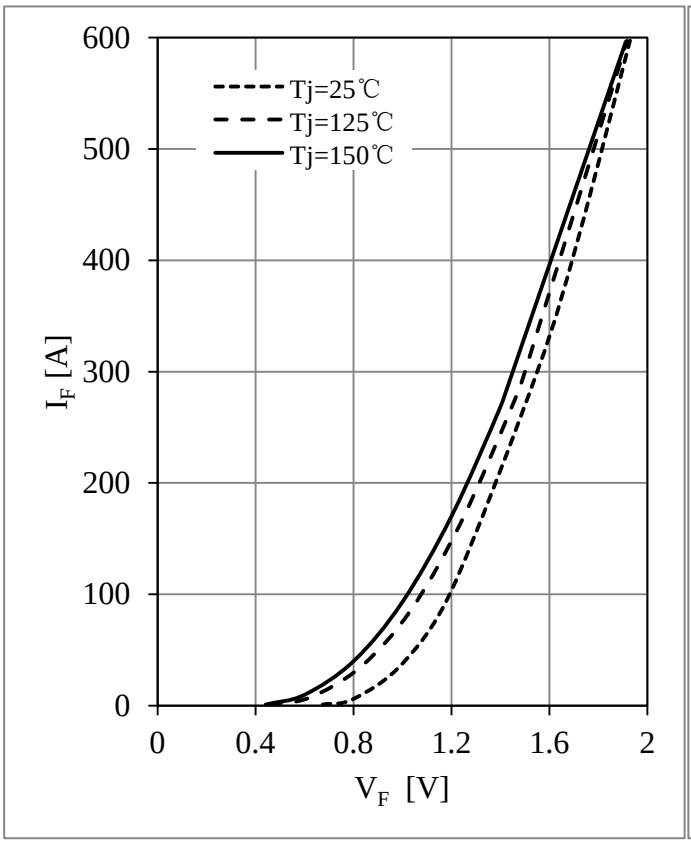


Fig 7. D1-D4 Diode Forward Characteristics

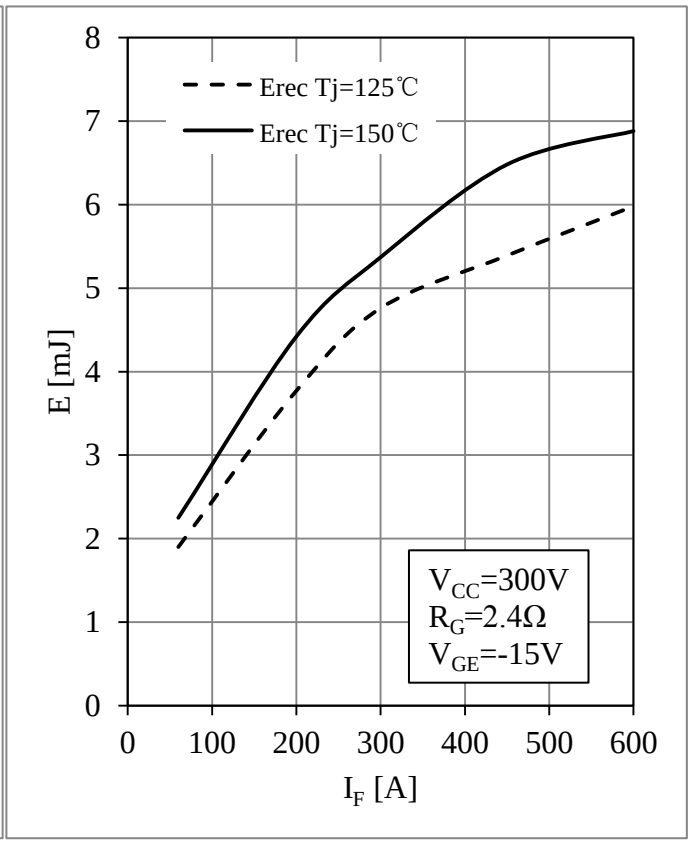


Fig 8. D1-D4 Diode Switching Loss vs. I_F

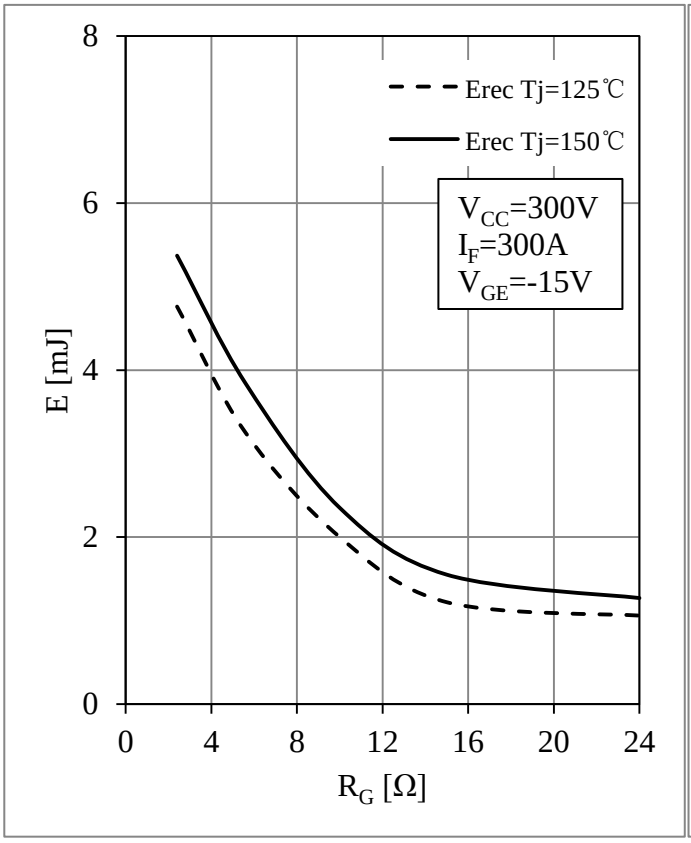


Fig 9. D1-D4 Diode Switching Loss vs. R_G

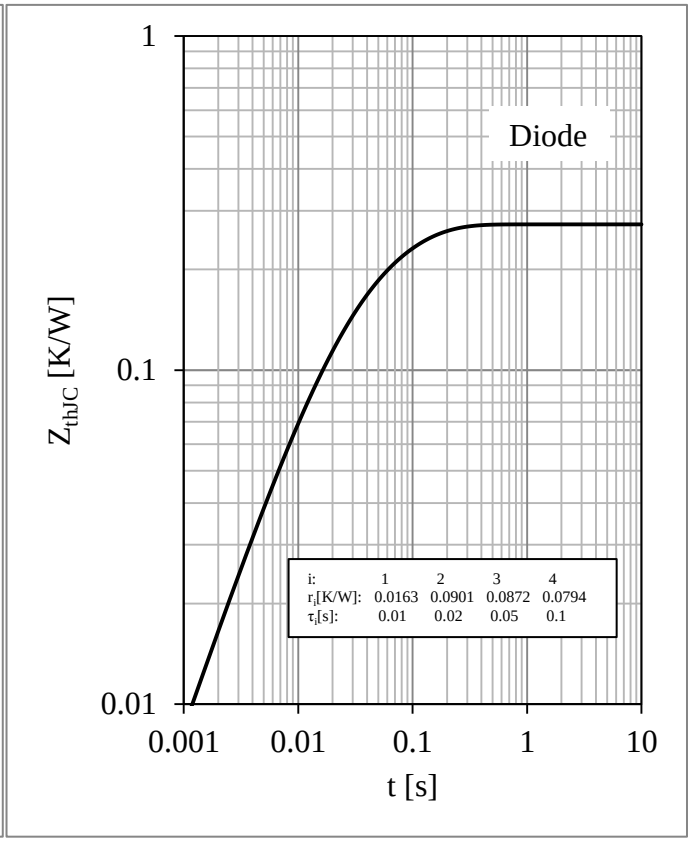


Fig 10. D1-D4 Diode Transient Thermal Impedance

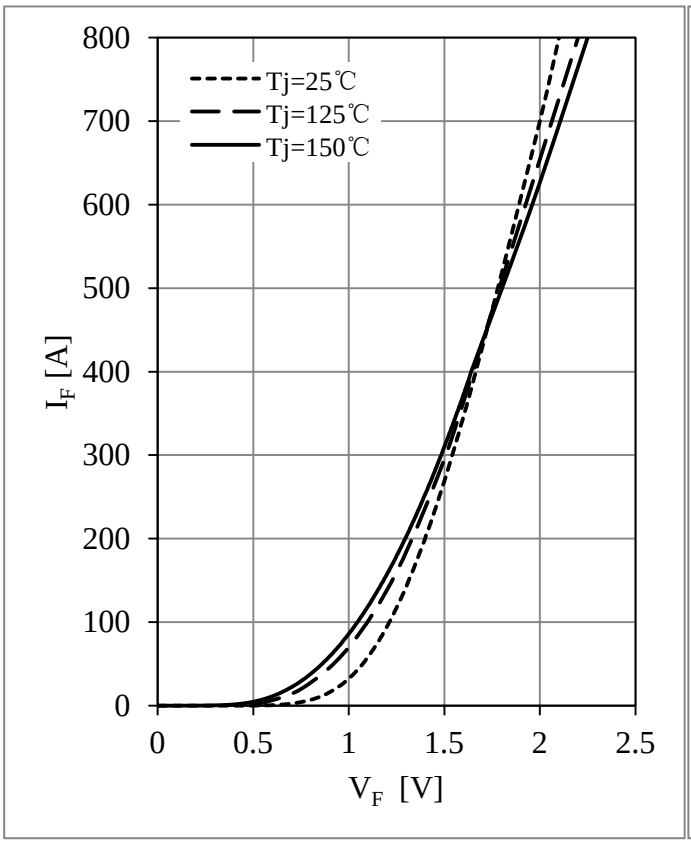


Fig 11. D5,D6 Diode Forward Characteristics

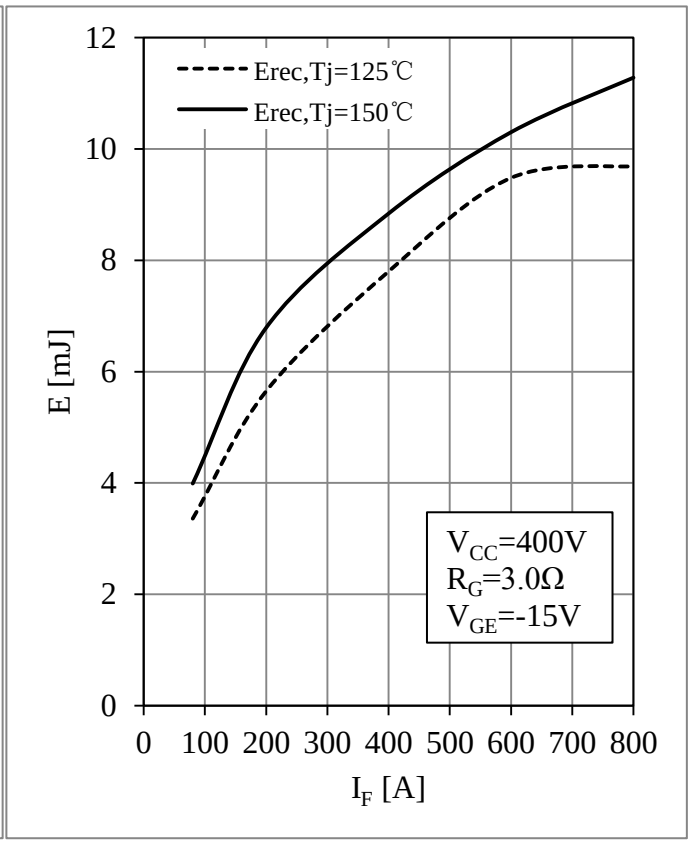


Fig 12. D5,D6 Diode Switching Loss vs. I_F

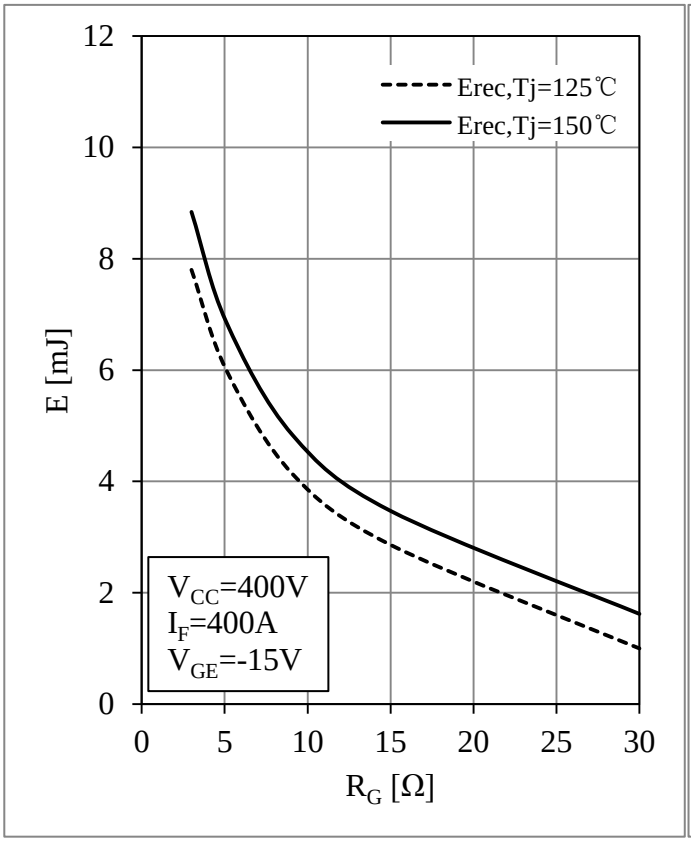


Fig 13. D5,D6 Diode Switching Loss vs. R_G

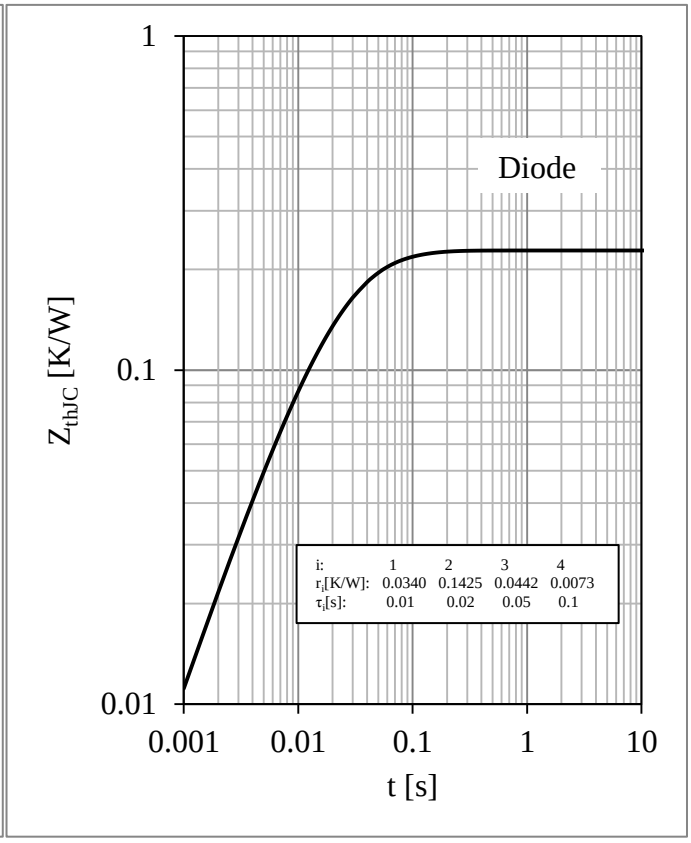
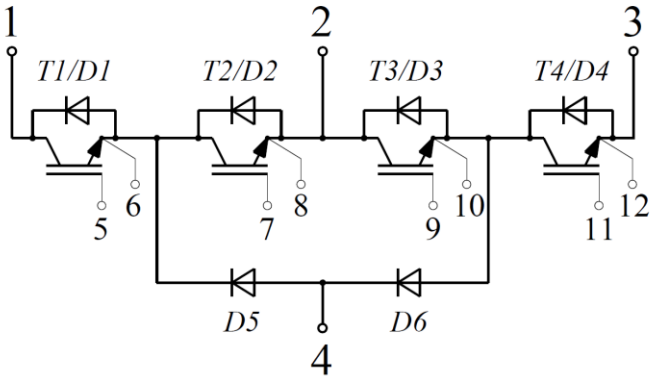


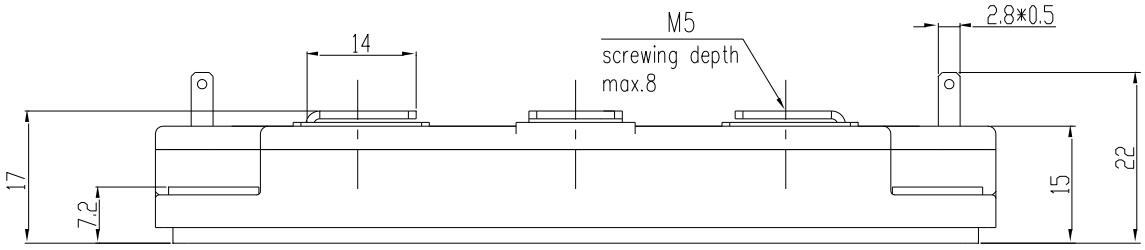
Fig 14. D5,D6 Diode Transient Thermal Impedance

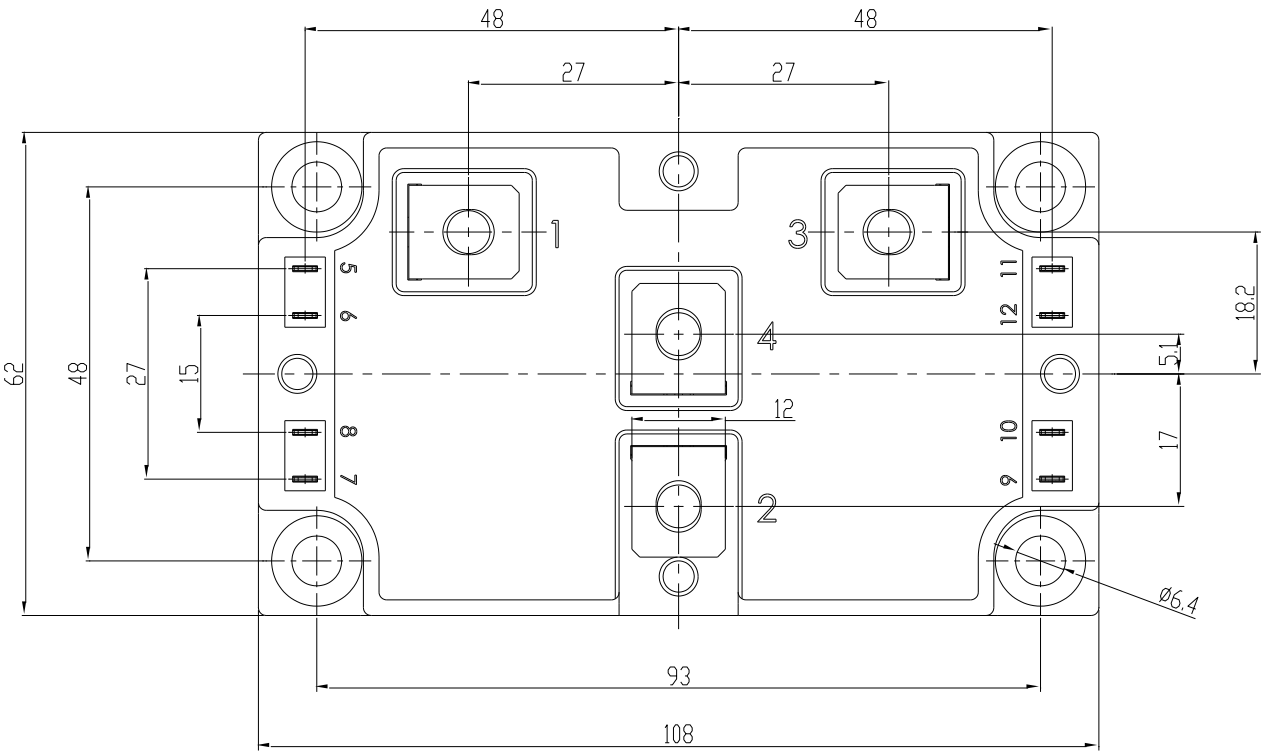
Circuit Schematic



Package Dimensions

Dimensions in Millimeters





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), 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.