

STARPOWER

SEMICONDUCTOR

SiC MOSFET

MD22HTC120P6HEF

1200V/2.15mΩ 6 in one-package

General Description

STARPOWER SiC MOSFET Power Module provides very low $R_{DS(on)}$ as well as high blocking voltage.

It's designed for the applications such as hybrid and electric vehicle.

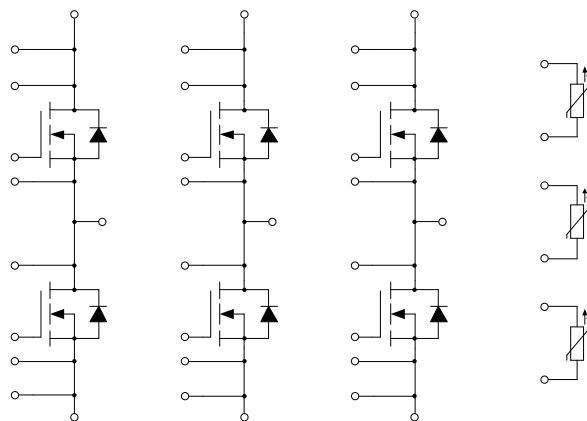
Features

- SiC power MOSFET
- High blocking voltage with low $R_{DS(on)}$
- Easy to parallel and simple to drive
- Low inductance case avoid oscillations
- Isolated copper pinfin baseplate using Si_3N_4 AMB technology

Typical Applications

- Automotive application
- Hybrid and electric vehicle
- Inverter for motor drive

Equivalent Circuit Schematic



Absolute Maximum Ratings $T_F=25^{\circ}\text{C}$ unless otherwise noted**MOSFET**

Symbol	Description	Value	Unit
V_{DSS}	Drain-Source Voltage	1200	V
V_{GSSmax}	Gate-Source Voltage	-8/+19	V
V_{GSSop}	Gate-Source Voltage	-4/+15	V
I_D	Drain Current @ $T_F=75^{\circ}\text{C}$	435	A
I_{DM}	Pulsed Drain Current, t_p limited by T_{jmax}	870	A
P_D	Maximum Power Dissipation @ $T_F=75^{\circ}\text{C}$ $T_j=175^{\circ}\text{C}$	900	W

Body Diode

Symbol	Description	Value	Unit
I_S	Source Current @ $T_F=75^{\circ}\text{C}$	242	A

Module

Symbol	Description	Value	Unit
T_{jmax}	Maximum Junction Temperature	175	$^{\circ}\text{C}$
T_{jop}	Operating Junction Temperature	-40 to +175	$^{\circ}\text{C}$
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
D_{Creep}	Terminal to Heatsink	9.0	mm
	Terminal to Terminal	9.0	
D_{Clear}	Terminal to Heatsink	4.5	mm
	Terminal to Terminal	4.5	

MOSFET Characteristics $T_F=25^{\circ}\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$R_{DS(on)}$	Static Drain-Source On-Resistance	$I_D=600\text{A}, V_{GS}=15\text{V}, T_j=25^{\circ}\text{C}$	1.50	2.15	2.75	$\text{m}\Omega$
		$I_D=600\text{A}, V_{GS}=15\text{V}, T_j=175^{\circ}\text{C}$		3.70	4.75	
$V_{GS(th)}$	Gate-Source Threshold Voltage	$I_D=167\text{mA}, V_{DS}=V_{GS}, T_j=25^{\circ}\text{C}$	1.8	2.5	3.6	V
I_{DSS}	Drain-Source Leakage Current	$V_{DS}=V_{DSS}, V_{GS}=0\text{V}, T_j=25^{\circ}\text{C}$			500	μA
I_{GSS}	Gate-Source Leakage Current	$V_{GS}=19\text{V}, V_{DS}=0\text{V}, T_j=25^{\circ}\text{C}$			600	nA
R_{Gint}	Internal Gate Resistance			0.45		Ω
C_{iss}	Input Capacitance	$V_{GS}=0\text{V}, V_{DS}=800\text{V}, f=100\text{kHz}$		49.8		nF
C_{oss}	Output Capacitance			2.64		nF
C_{rss}	Reverse Transfer Capacitance			0.13		nF
Q_g	Total Gate Charge	$I_D=600\text{A}, V_{DS}=800\text{V}, V_{GS}=-4/+15\text{V}$		1.25		μC
$t_{d(on)}$	Turn-On Delay Time	$V_{DS}=800\text{V}, I_D=600\text{A}, R_G=4.7\Omega, L_S=25\text{nH}, V_{GS}=-4/+15\text{V}, T_j=25^{\circ}\text{C}$		174		ns
t_r	Rise Time			101		ns
$t_{d(off)}$	Turn-Off Delay Time			388		ns
t_f	Fall Time			57		ns
E_{on}	Turn-On Switching Loss			43.5		mJ
E_{off}	Turn-Off Switching Loss			32.2		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{DS}=800\text{V}, I_D=600\text{A}, R_G=4.7\Omega, L_S=25\text{nH}, V_{GS}=-4/+15\text{V}, T_j=150^{\circ}\text{C}$		152		ns
t_r	Rise Time			92		ns
$t_{d(off)}$	Turn-Off Delay Time			433		ns
t_f	Fall Time			65		ns
E_{on}	Turn-On Switching Loss			38.9		mJ
E_{off}	Turn-Off Switching Loss			35.8		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{DS}=800\text{V}, I_D=600\text{A}, R_G=4.7\Omega, L_S=25\text{nH}, V_{GS}=-4/+15\text{V}, T_j=175^{\circ}\text{C}$		147		ns
t_r	Rise Time			91		ns
$t_{d(off)}$	Turn-Off Delay Time			440		ns
t_f	Fall Time			79		ns
E_{on}	Turn-On Switching Loss			38.3		mJ
E_{off}	Turn-Off Switching Loss			36.0		mJ

Body Diode Characteristics $T_F=25^{\circ}\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{SD}	Diode Forward Voltage	$I_S=300\text{A}, V_{GS}=-4\text{V}, T_j=25^{\circ}\text{C}$	3.90	4.90	5.90	V
		$I_S=300\text{A}, V_{GS}=-4\text{V}, T_j=175^{\circ}\text{C}$		4.20		
Q_r	Diode Reverse Recovery Charge	$V_R=800\text{V}, I_S=600\text{A}, -di/dt=6520\text{A}/\mu\text{s}, L_S=25\text{nH}, V_{GS}=-4\text{V}, T_j=25^{\circ}\text{C}$		1.96		μC
I_{rrm}	Peak Reverse Recovery Current			102		A
E_{rec}	Reverse Recovery Energy			0.89		mJ
Q_r	Diode Reverse Recovery Charge	$V_R=800\text{V}, I_S=600\text{A}, -di/dt=7180\text{A}/\mu\text{s}, L_S=25\text{nH}, V_{GS}=-4\text{V}, T_j=150^{\circ}\text{C}$		5.61		μC
I_{rrm}	Peak Reverse Recovery Current			186		A
E_{rec}	Reverse Recovery Energy			2.98		mJ
Q_r	Diode Reverse Recovery Charge	$V_R=800\text{V}, I_S=600\text{A}, -di/dt=7250\text{A}/\mu\text{s}, L_S=25\text{nH}, V_{GS}=-4\text{V}, T_j=175^{\circ}\text{C}$		6.88		μC
I_{rrm}	Peak Reverse Recovery Current			217		A
E_{rec}	Reverse Recovery Energy			3.74		mJ

NTC Characteristics $T_F=25^{\circ}\text{C}$ 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}	$T_1=100^{\circ}\text{C}, R_{100}=493.3\Omega$	-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 $T_F=25^{\circ}\text{C}$ unless otherwise noted

Symbol	Parameter	Min.	Typ.	Max.	Unit
L_{CE}	Stray Inductance		8		nH
Δp	$\Delta V/\Delta t=10.0\text{dm}^3/\text{min}, T_F=75^{\circ}\text{C}$		64		mbar
p	Maximum Pressure In Cooling Circuit			2.5	bar
R_{thJF}	Junction-to-Cooling Fluid (per MOSFET) $\Delta V/\Delta t=10.0\text{dm}^3/\text{min}, T_F=75^{\circ}\text{C}$		0.101	0.111	K/W
M	Terminal Connection Torque, Screw M5 Mounting Torque, Screw M4	3.6 1.8		4.4 2.2	N.m
G	Weight of Module		750		g

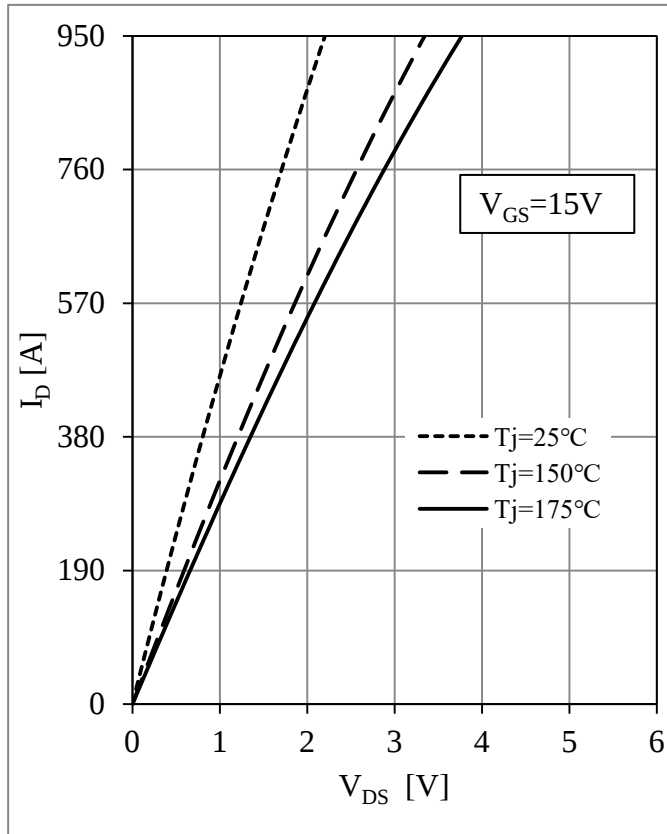


Fig 1. MOSFET Output Characteristics

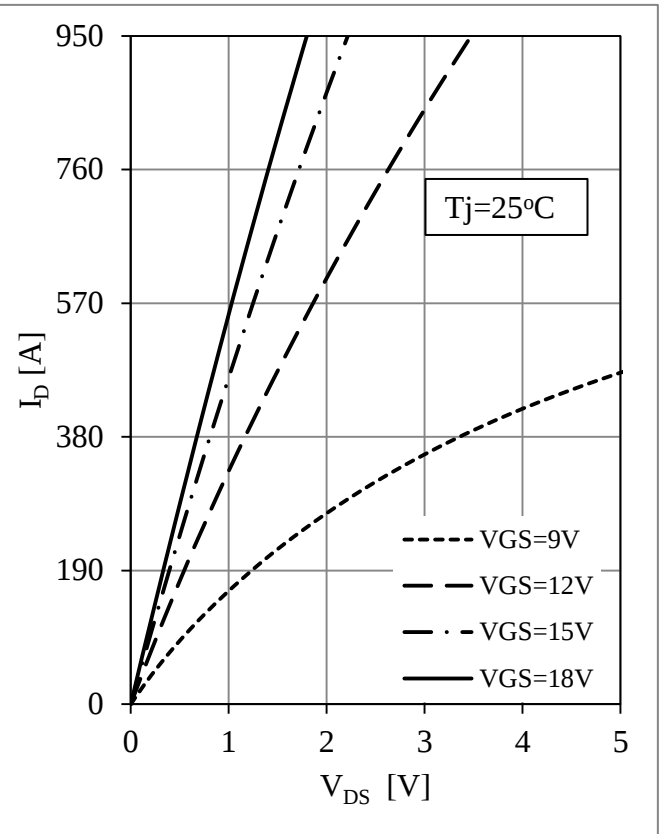


Fig 2. MOSFET Output Characteristics

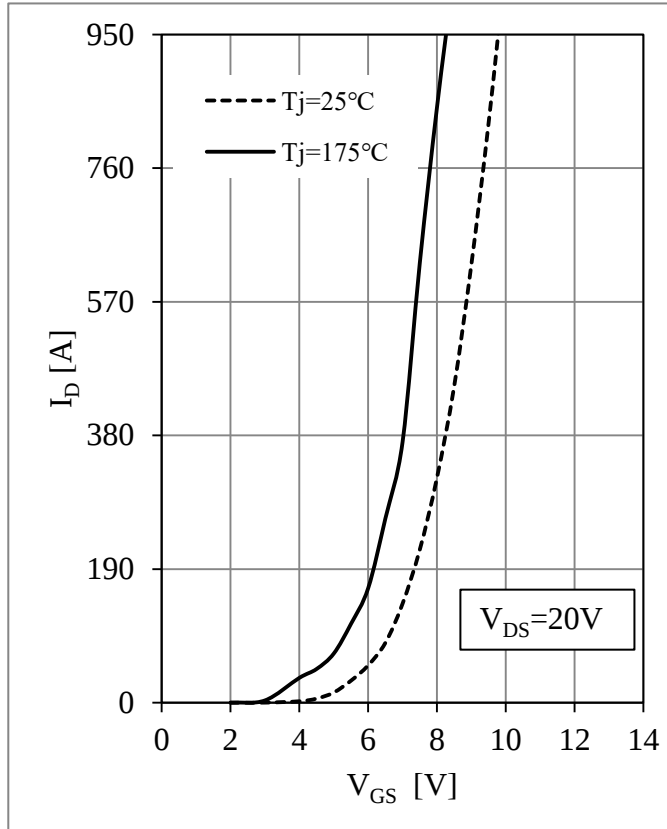
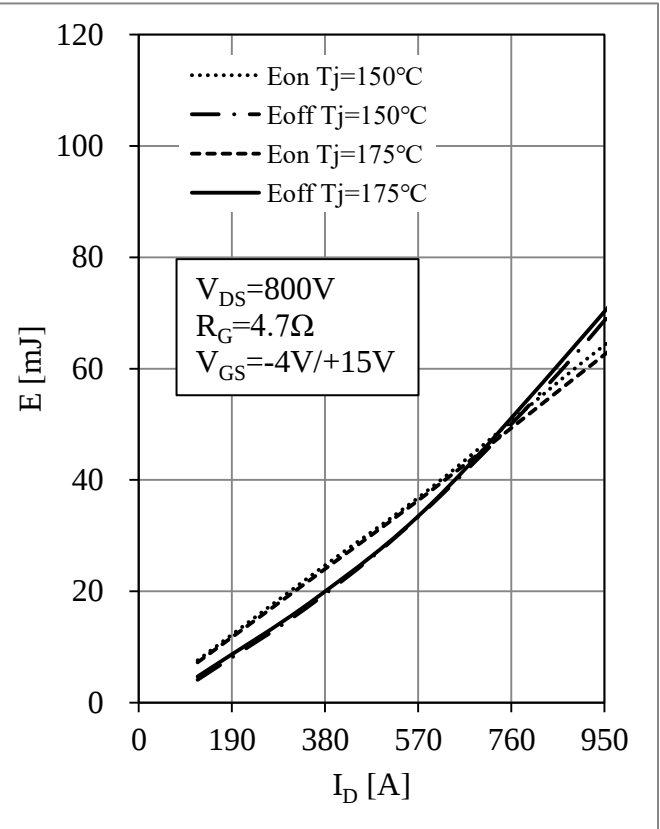


Fig 3. MOSFET Transfer Characteristics

Fig 4. MOSFET Switching Loss vs. I_{DS}

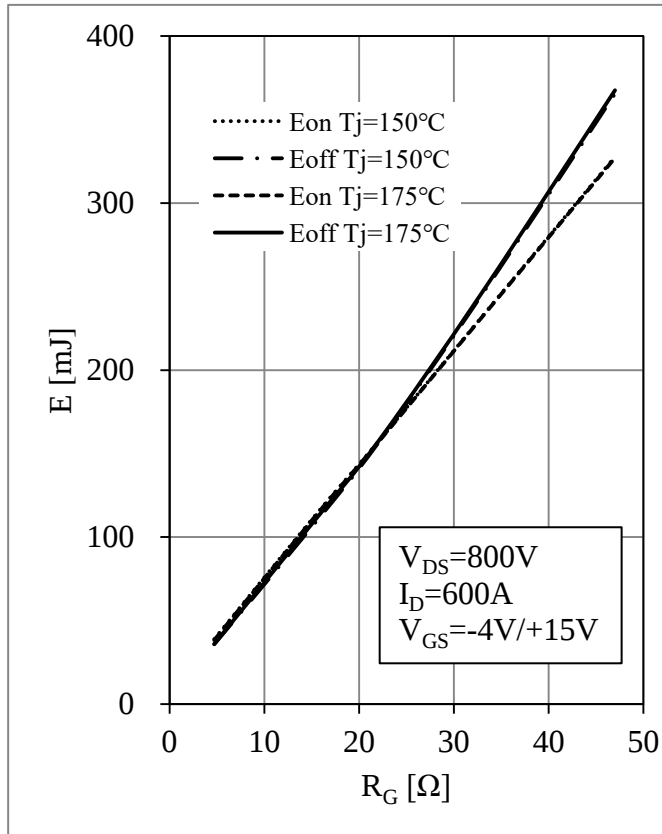
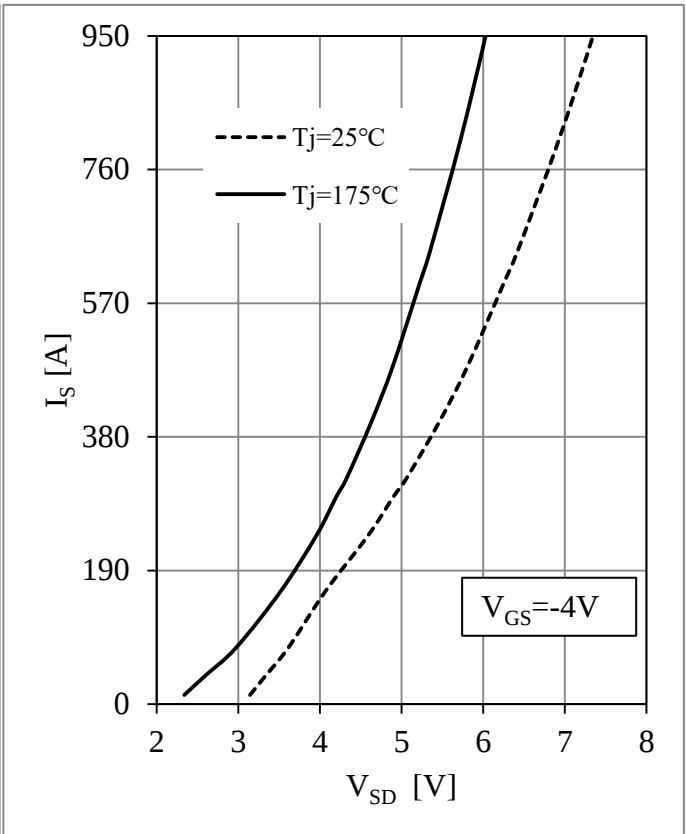
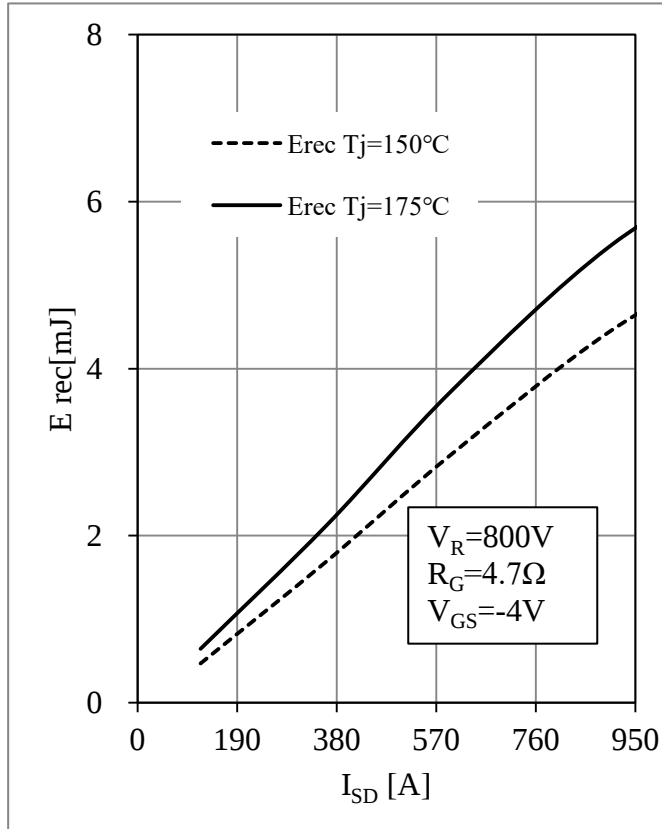
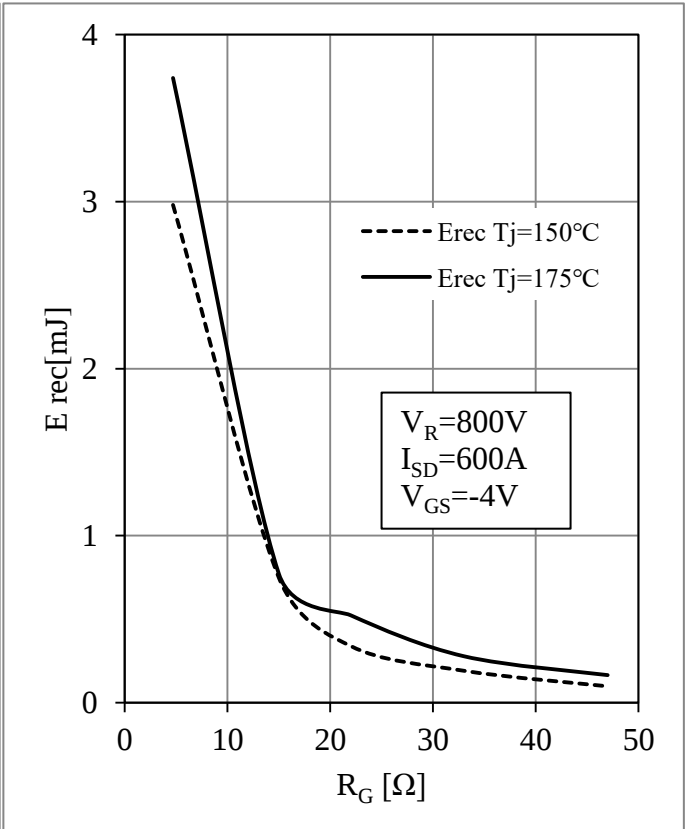
Fig 5. MOSFET Switching Loss vs. R_G 

Fig 6. Body Diode Characteristics

Fig 7. Body Diode Switching Loss vs. I_S Fig 8. Body Diode Switching Loss vs. R_G

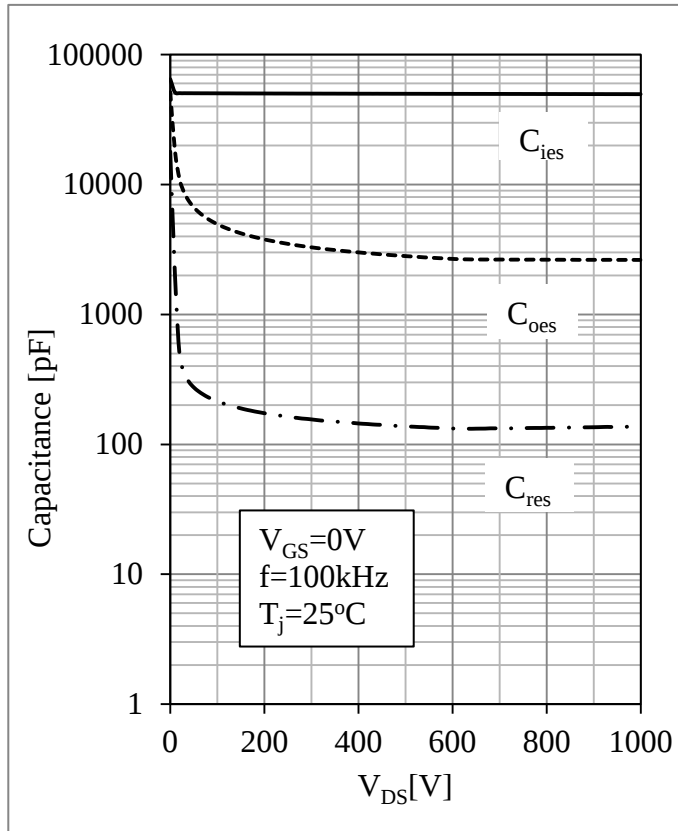
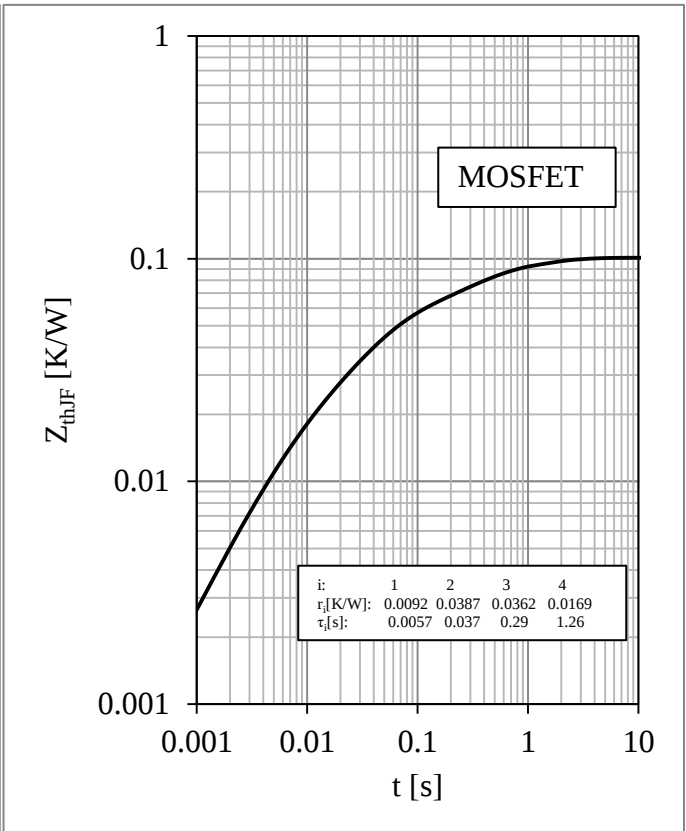
Fig 9. Capacitance vs. V_{DS} 

Fig 10. MOSFET Transient Thermal Impedance

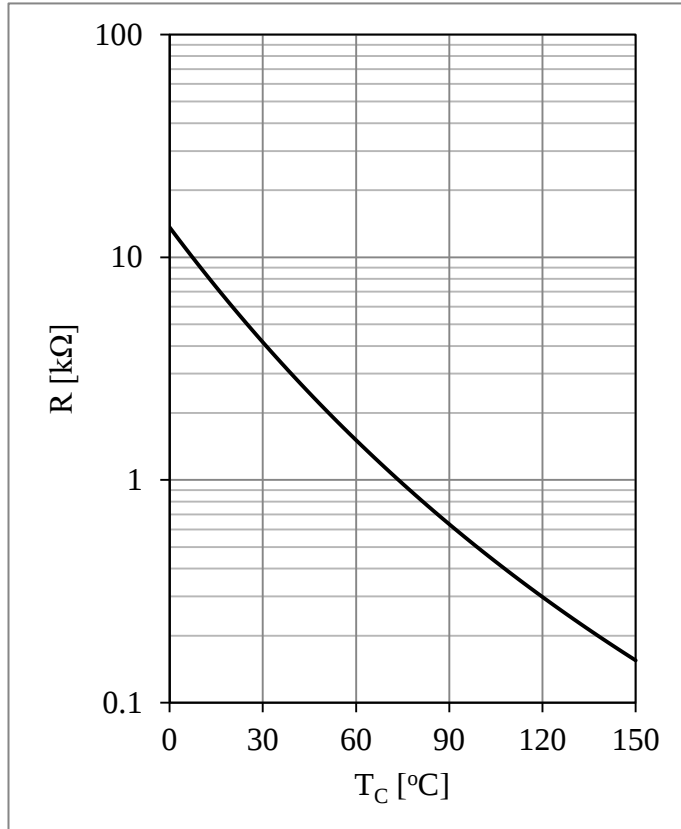
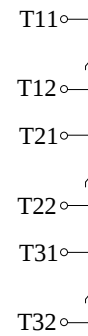
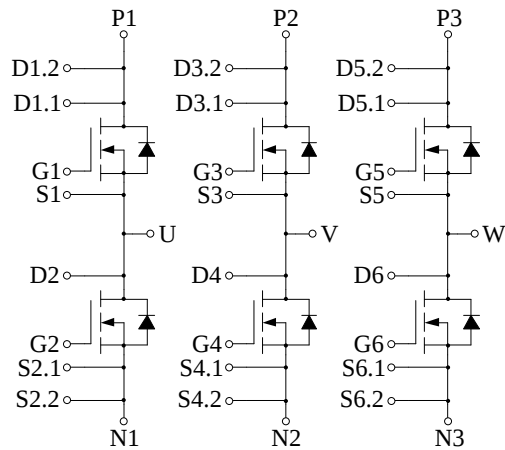


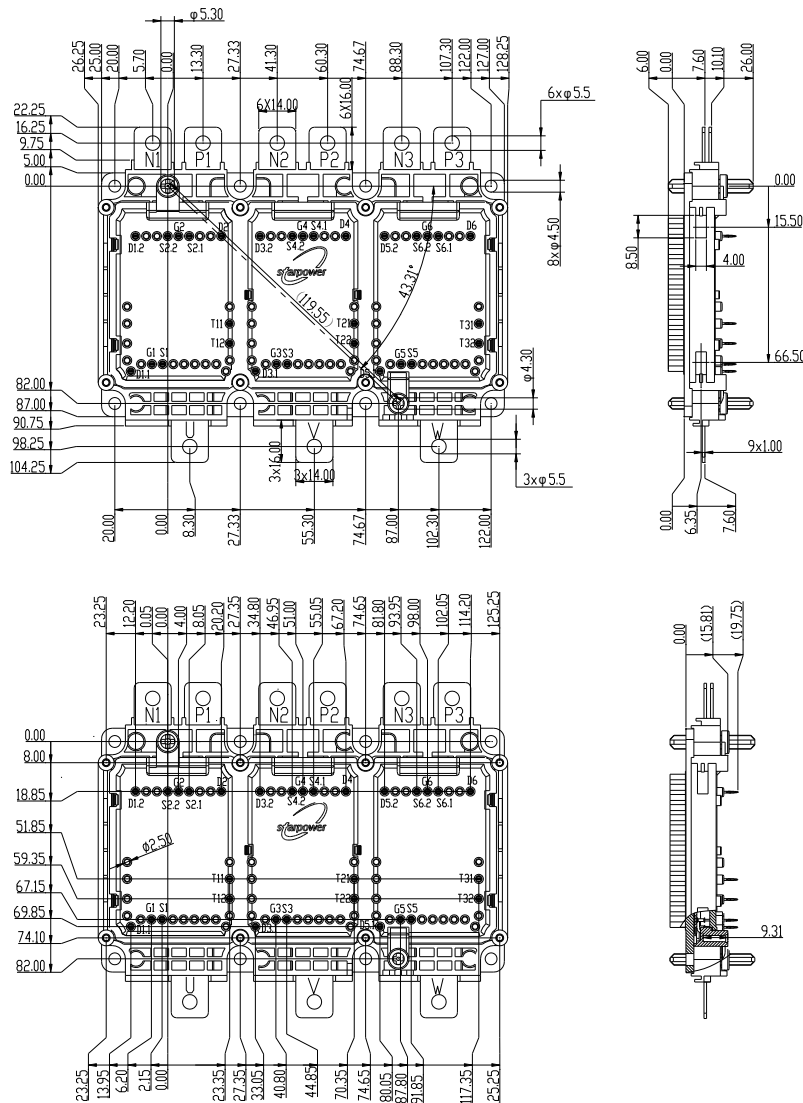
Fig 11. NTC Temperature Characteristic

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), 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.