

STARPOWER

SEMICONDUCTOR

SiC MOSFET

MD22HTC120P6HE

1200V/2.18mΩ 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.

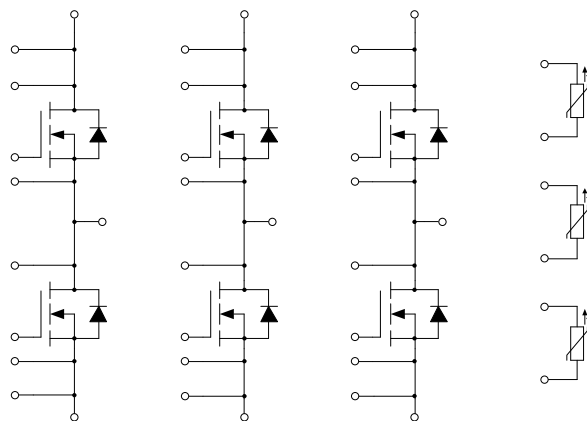
Features

- 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 @ $T_F=65^{\circ}\text{C}$	490	A
I_{DM}	Pulsed Drain Current, t_p limited by T_{jmax}	980	A
P_D	Maximum Power Dissipation @ $T_F=75^{\circ}\text{C}$ $T_j=175^{\circ}\text{C}$	952	W

Body Diode

Symbol	Description	Value	Unit
I_S	Source Current @ $T_F=65^{\circ}\text{C}$	279	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

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	$I_D=600\text{A}, V_{GS}=15\text{V}, T_j=25^\circ\text{C}$		2.25		m Ω
		$I_D=600\text{A}, V_{GS}=15\text{V}, T_j=150^\circ\text{C}$		3.30		
		$I_D=600\text{A}, V_{GS}=15\text{V}, T_j=175^\circ\text{C}$		3.70		
$V_{GS(th)}$	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	$I_D=600\text{A}, V_{DS}=800\text{V}, V_{GS}=-4/+15\text{V}$		1.60		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	$I_S=600\text{A}, V_{GS}=-4\text{V}, T_J=25^{\circ}\text{C}$		4.35		V
		$I_S=600\text{A}, V_{GS}=-4\text{V}, T_J=150^{\circ}\text{C}$		4.00		
		$I_S=600\text{A}, V_{GS}=-4\text{V}, T_J=175^{\circ}\text{C}$		3.90		
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		k Ω
$\Delta R/R$	Deviation of R_{100}	$T_i=100^{\circ}\text{C}, R_{100}=493.3\Omega$	-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	$\Delta V/\Delta t=10.0\text{dm}^3/\text{min}, T_F=60^{\circ}\text{C}$		64		mbar
p	Maximum Pressure In Cooling Circuit			2.5	bar
R_{thJF}	Junction-to-Cooling Fluid (per MOSFET) $\Delta V/\Delta t=10.0\text{dm}^3/\text{min}, T_F=60^{\circ}\text{C}$			0.101	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

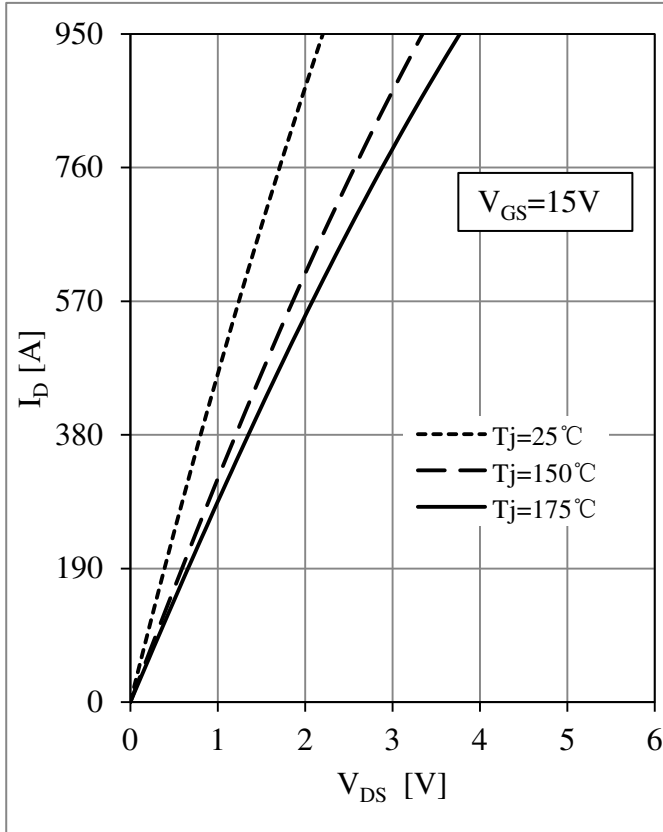


Fig 1. MOSFET Output Characteristics

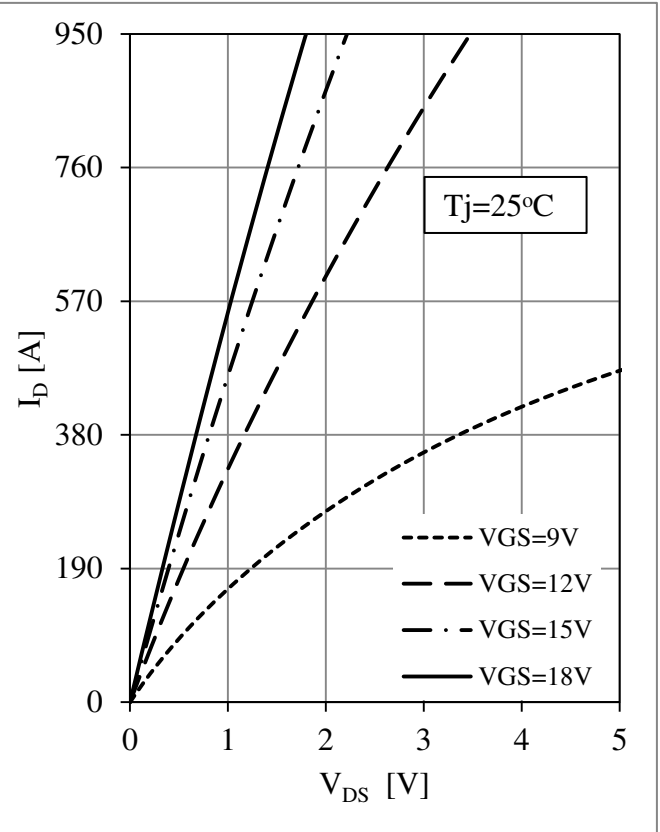


Fig 2. MOSFET Output Characteristics

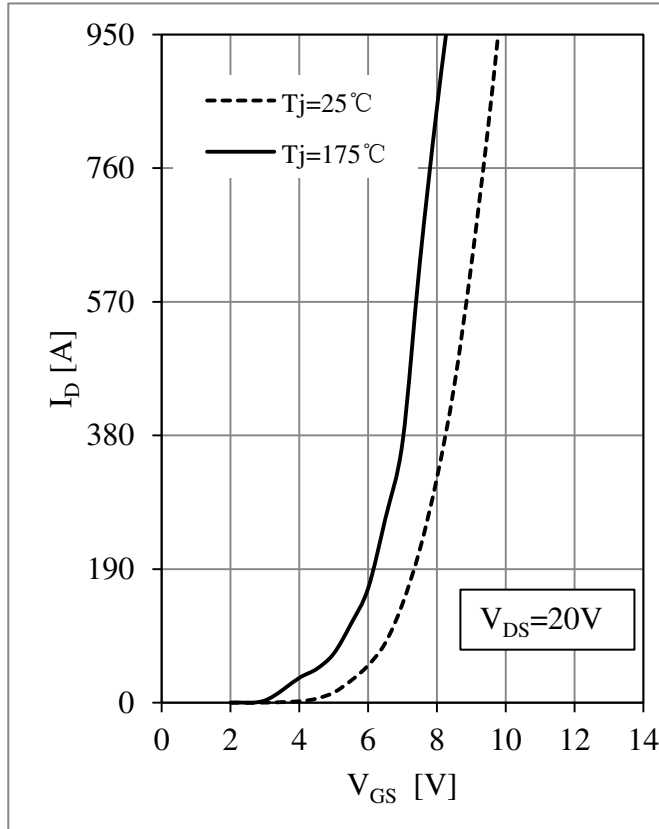
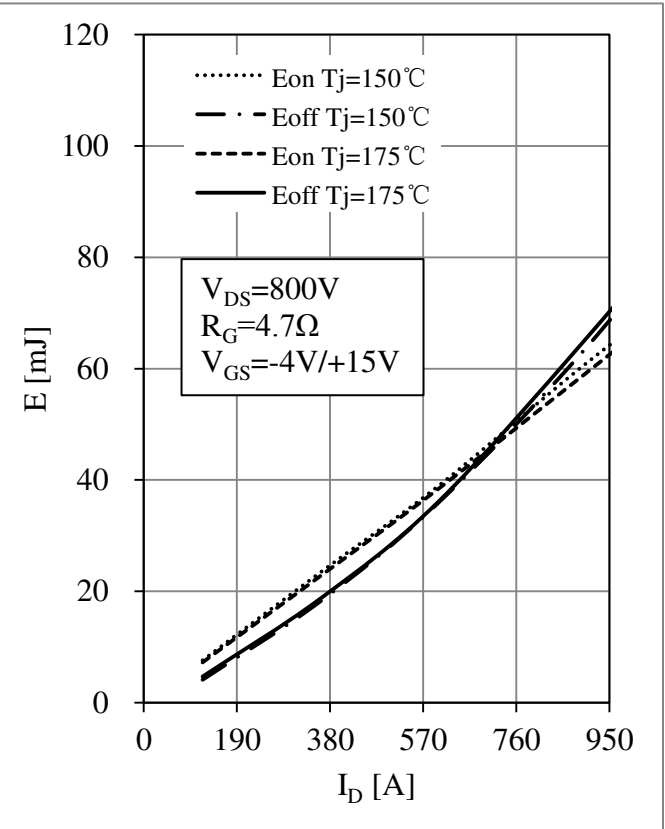


Fig 3. MOSFET Transfer Characteristics

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

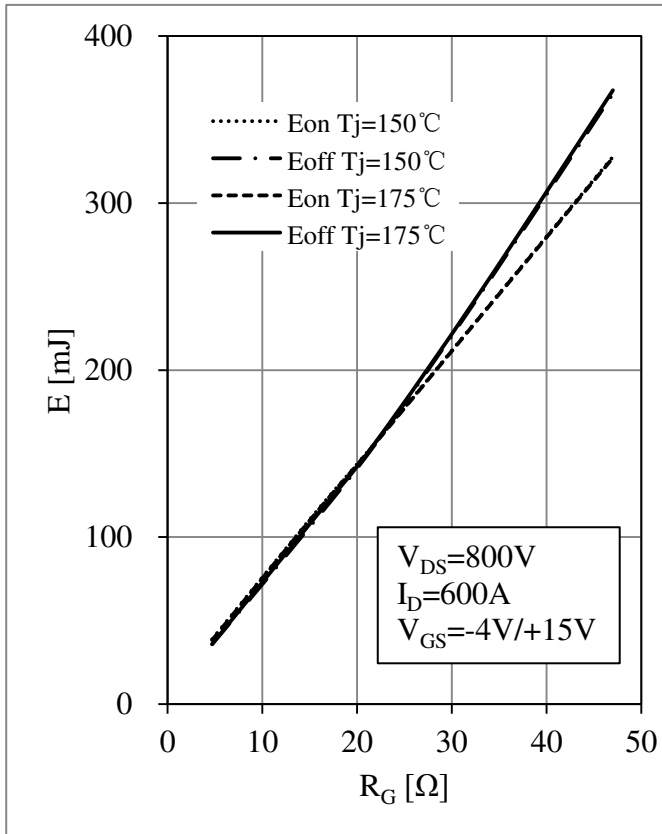
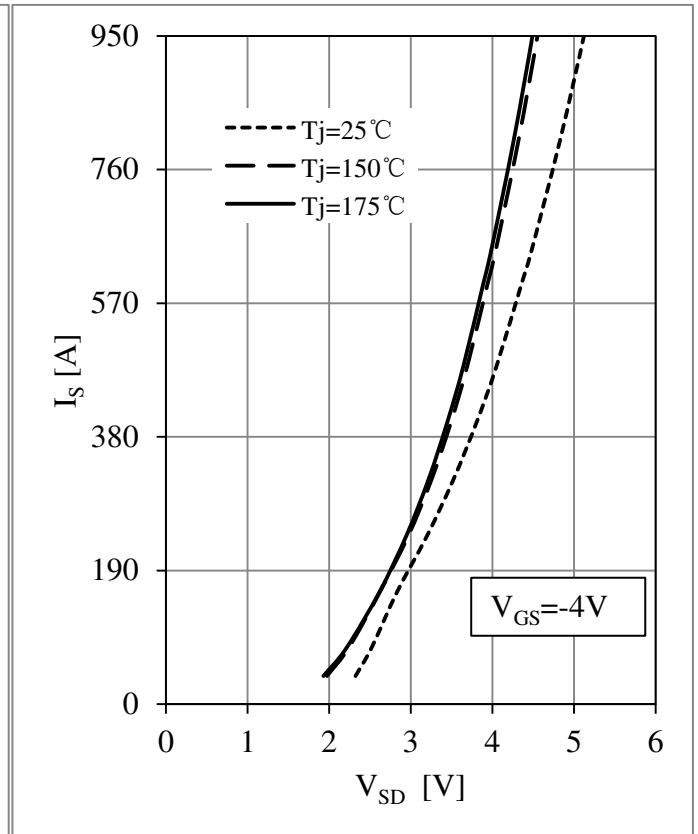
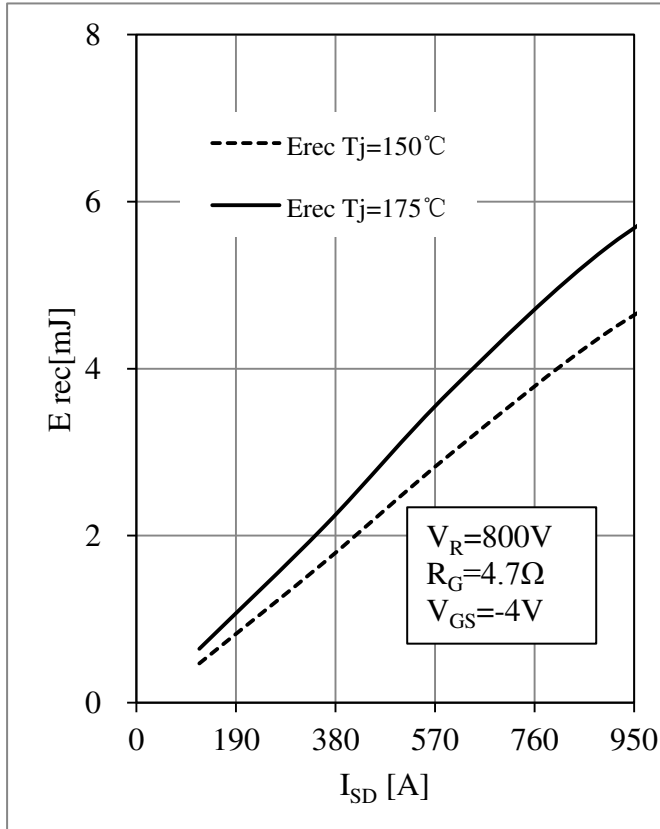
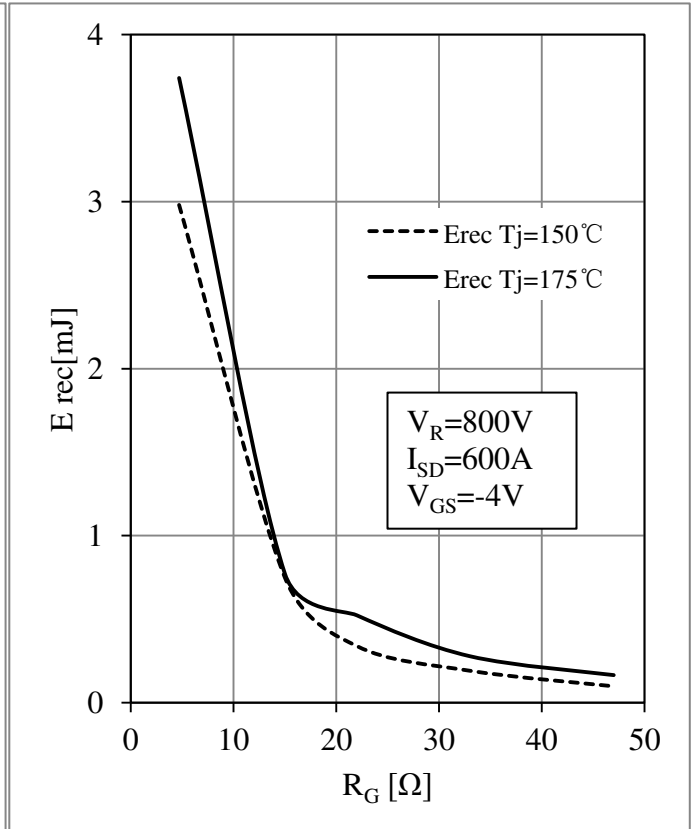
Fig 5. MOSFET Switching Loss vs. R_G 

Fig 6. Body Diode Characteristics

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

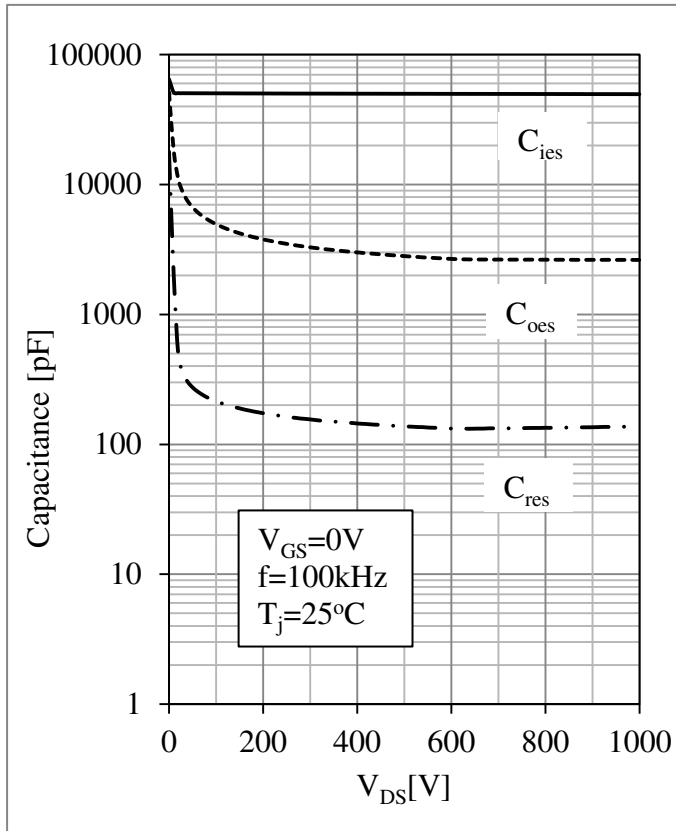
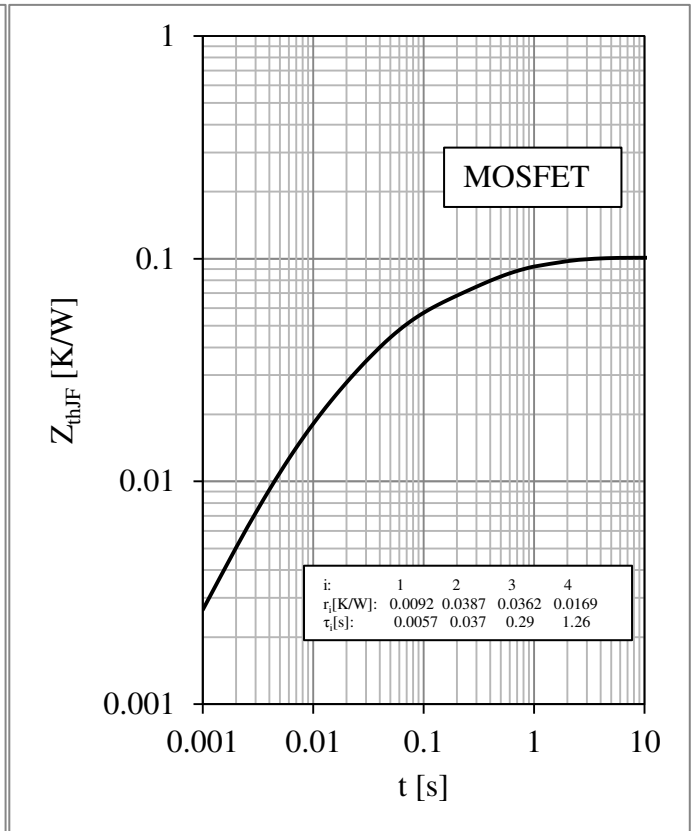
Fig 9. Capacitance vs. V_{DS} 

Fig 10. MOSFET Transient Thermal Impedance

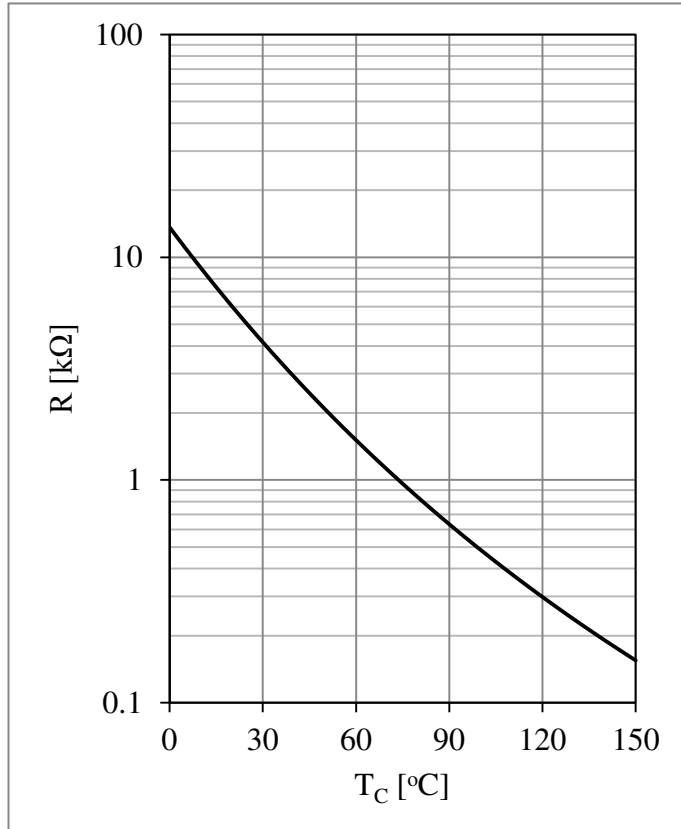
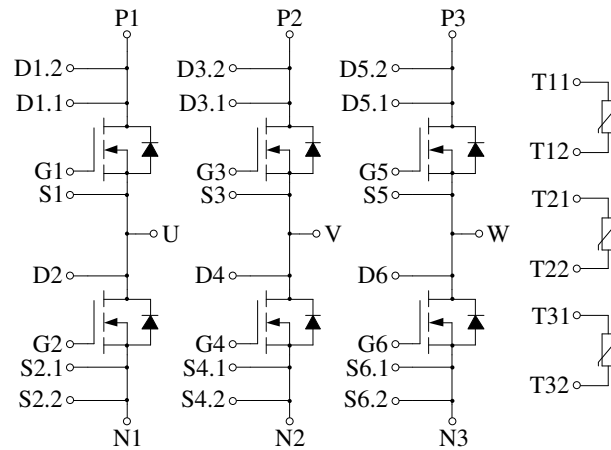


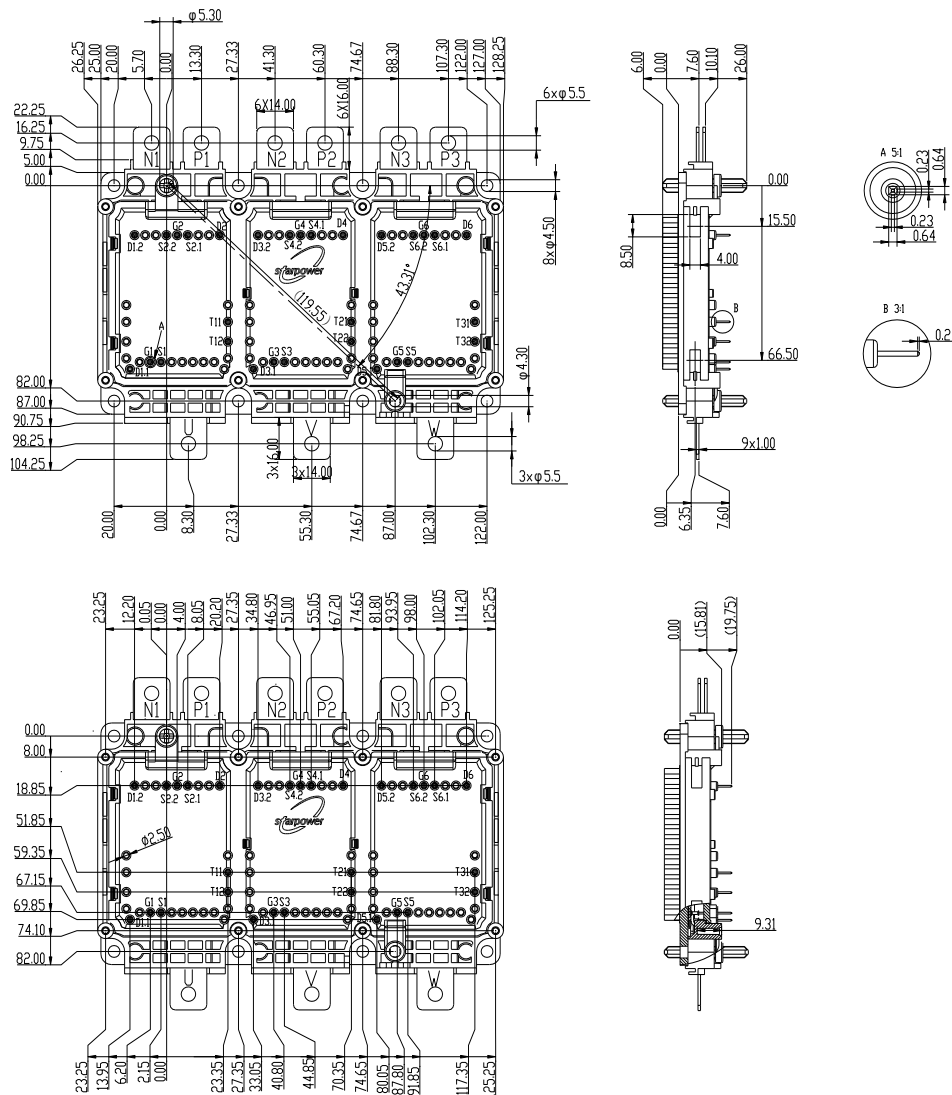
Fig 11. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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