

STARPOWER

SEMICONDUCTOR

SiC MOSFET

MD29HTC120P6HET

1200V/2.83mΩ 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.

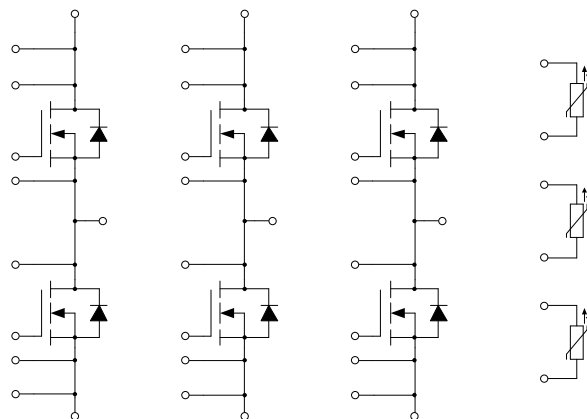
Features

- 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 @ $T_F=60^{\circ}\text{C}$	375	A
I_{DM}	Pulsed Drain Current, t_p limited by T_{jmax}	750	A
P_D	Maximum Power Dissipation @ $T_F=60^{\circ}\text{C}$ $T_j=175^{\circ}\text{C}$	891	W

Body Diode

Symbol	Description	Value	Unit
I_S	Source Current @ $T_F=60^{\circ}\text{C}$	190	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	$I_D=450\text{A}, V_{GS}=15\text{V}, T_j=25^\circ\text{C}$	2.00	2.83	3.67	$\text{m}\Omega$
		$I_D=450\text{A}, V_{GS}=15\text{V}, T_j=150^\circ\text{C}$		4.40		
		$I_D=450\text{A}, V_{GS}=15\text{V}, T_j=175^\circ\text{C}$		4.90	6.33	
$V_{GS(th)}$	Gate-Source Threshold Voltage	$I_D=125\text{mA}, V_{DS}=V_{GS}, T_j=25^\circ\text{C}$	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			0.93		Ω
C_{iss}	Input Capacitance	$V_{GS}=0\text{V}, V_{DS}=800\text{V}, f=100\text{kHz}$		37.4		nF
C_{oss}	Output Capacitance			1.98		nF
C_{rss}	Reverse Transfer Capacitance			0.10		nF
Q_g	Total Gate Charge	$I_D=450\text{A}, V_{DS}=800\text{V}, V_{GS}=-4/15\text{V}$		1.32		μC
$t_{d(on)}$	Turn-On Delay Time	$V_{DS}=800\text{V}, I_D=450\text{A}, R_{Gon}=2.35\Omega, R_{Goff}=3.3\Omega, L_S=26\text{nH}, V_{GS}=-4/15\text{V}, T_j=25^\circ\text{C}$		94		ns
t_r	Rise Time			58		ns
$t_{d(off)}$	Turn-Off Delay Time			262		ns
t_f	Fall Time			40		ns
E_{on}	Turn-On Switching Loss			16.7		mJ
E_{off}	Turn-Off Switching Loss			17.3		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{DS}=800\text{V}, I_D=450\text{A}, R_{Gon}=2.35\Omega, R_{Goff}=3.3\Omega, L_S=26\text{nH}, V_{GS}=-4/15\text{V}, T_j=150^\circ\text{C}$		90		ns
t_r	Rise Time			58		ns
$t_{d(off)}$	Turn-Off Delay Time			306		ns
t_f	Fall Time			42		ns
E_{on}	Turn-On Switching Loss			17.2		mJ
E_{off}	Turn-Off Switching Loss			18.1		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{DS}=800\text{V}, I_D=450\text{A}, R_{Gon}=2.35\Omega, R_{Goff}=3.3\Omega, L_S=26\text{nH}, V_{GS}=-4/15\text{V}, T_j=175^\circ\text{C}$		90		ns
t_r	Rise Time			56		ns
$t_{d(off)}$	Turn-Off Delay Time			318		ns
t_f	Fall Time			44		ns
E_{on}	Turn-On Switching Loss			17.9		mJ
E_{off}	Turn-Off Switching Loss			18.9		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	$I_{SD}=220\text{A}, V_{GS}=-4\text{V}, T_j=25^{\circ}\text{C}$	3.90	4.90	5.90	V
		$I_{SD}=220\text{A}, V_{GS}=-4\text{V}, T_j=175^{\circ}\text{C}$		4.20		
Q_r	Diode Reverse Recovery Charge	$V_R=800\text{V}, I_{SD}=450\text{A}, -di/dt=10080\text{A}/\mu\text{s}, L_S=26\text{nH}, V_{GS}=-4\text{V}, T_j=25^{\circ}\text{C}$		2.67		μC
I_{rrm}	Peak Reverse Recovery Current			168		A
E_{rec}	Reverse Recovery Energy			0.23		mJ
Q_r	Diode Reverse Recovery Charge	$V_R=800\text{V}, I_{SD}=450\text{A}, -di/dt=9660\text{A}/\mu\text{s}, L_S=26\text{nH}, V_{GS}=-4\text{V}, T_j=150^{\circ}\text{C}$		5.24		μC
I_{rrm}	Peak Reverse Recovery Current			264		A
E_{rec}	Reverse Recovery Energy			0.85		mJ
Q_r	Diode Reverse Recovery Charge	$V_R=800\text{V}, I_{SD}=450\text{A}, -di/dt=9370\text{A}/\mu\text{s}, L_S=26\text{nH}, V_{GS}=-4\text{V}, T_j=175^{\circ}\text{C}$		6.12		μC
I_{rrm}	Peak Reverse Recovery Current			300		A
E_{rec}	Reverse Recovery Energy			0.95		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	$\Delta V/\Delta t=10.0\text{dm}^3/\text{min}, T_F=60^{\circ}\text{C}$		64		mbar
p	Maximum Pressure In Cooling Circuit			2.5	bar
R_{thJF}	Junction-to-Cooling Fluid (per MOSFET) $\Delta V/\Delta t=10.0\text{dm}^3/\text{min}, T_F=60^{\circ}\text{C}$		0.117	0.129	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

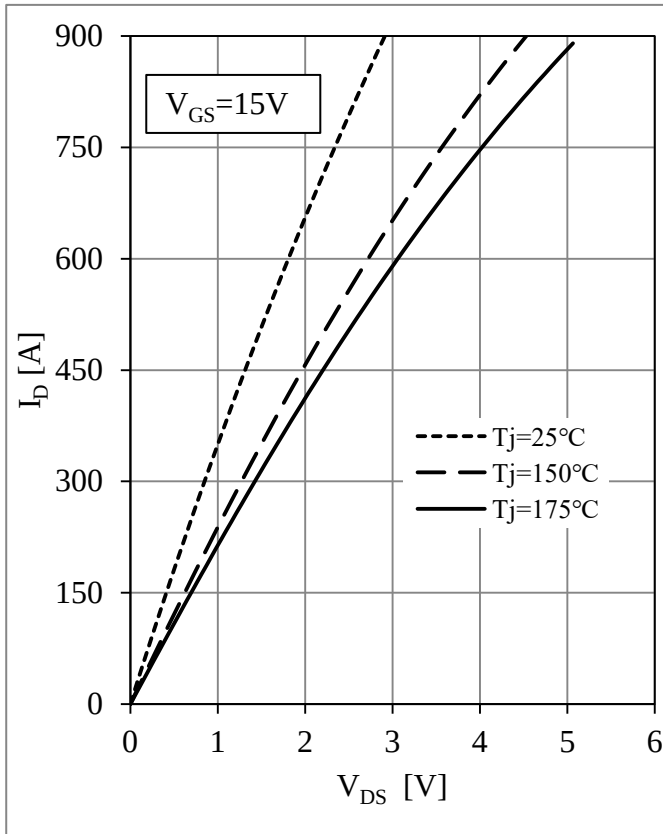


Fig 1. MOSFET Output Characteristics

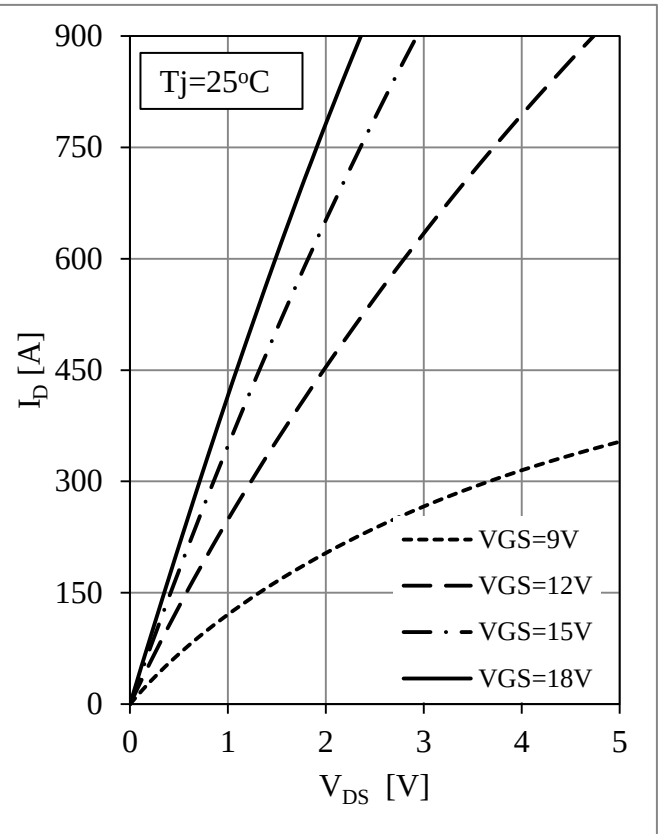


Fig 2. MOSFET Output Characteristics

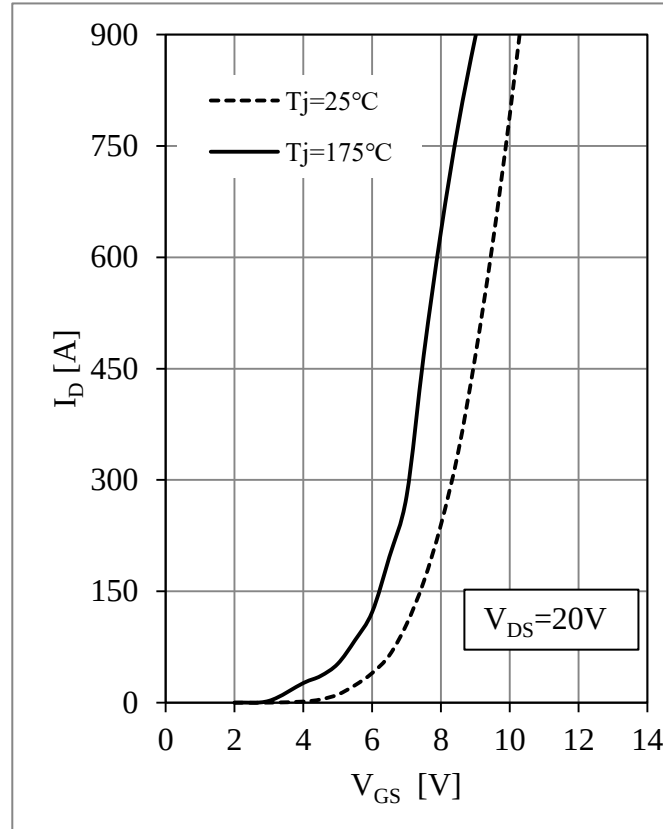
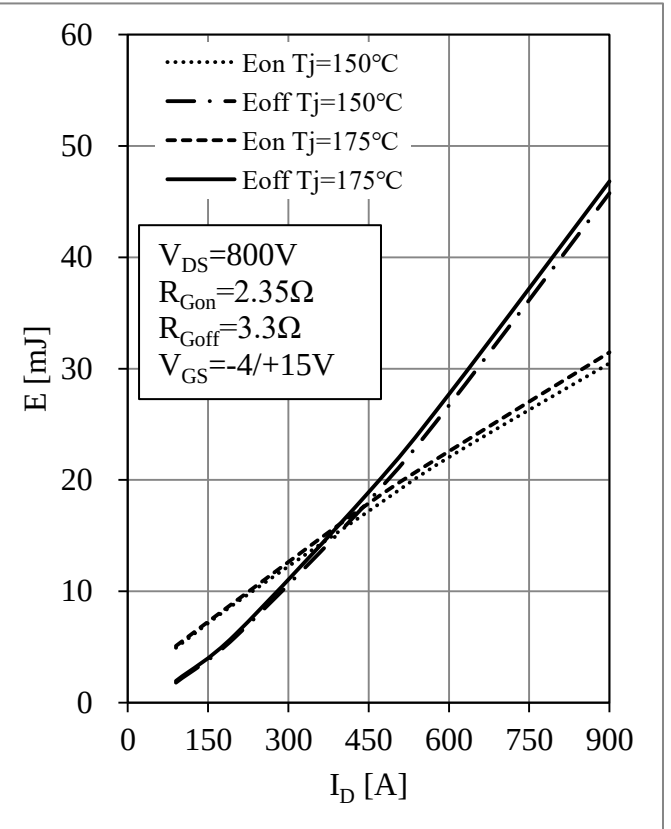


Fig 3. MOSFET Transfer Characteristics

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

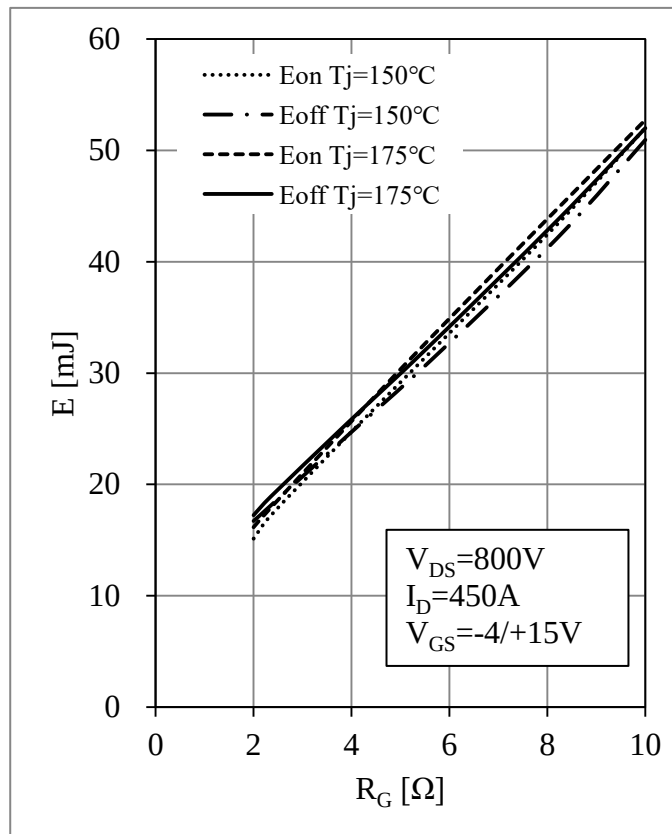
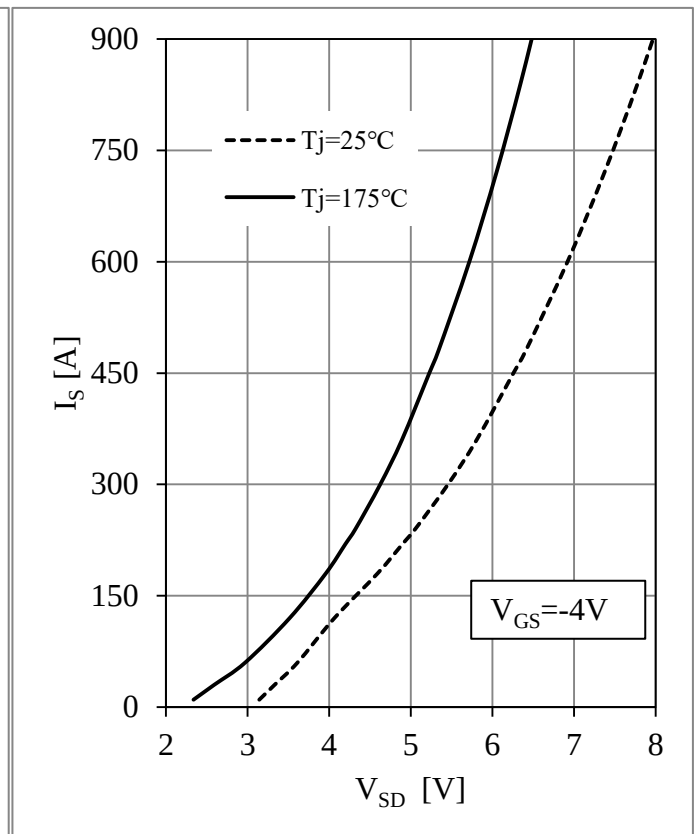
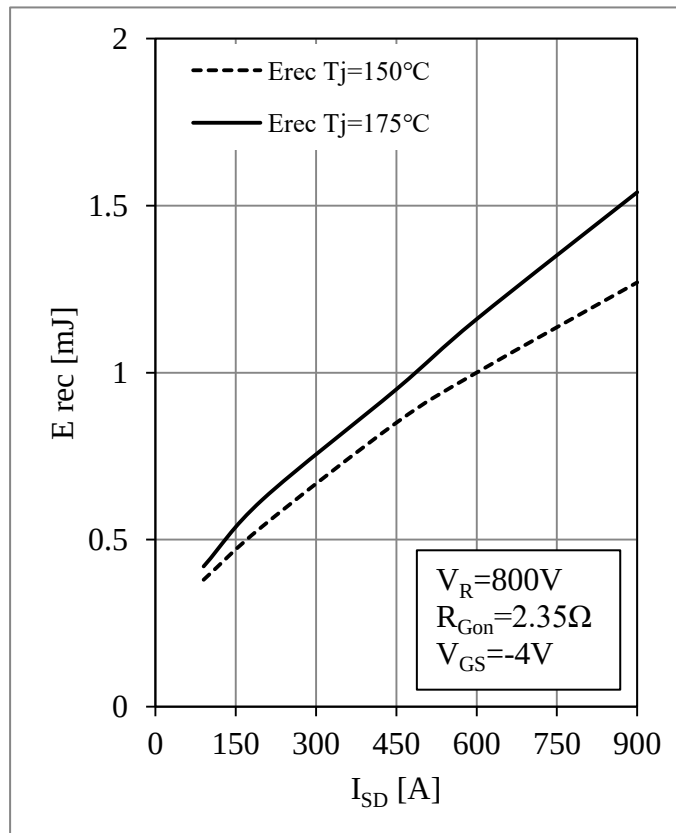
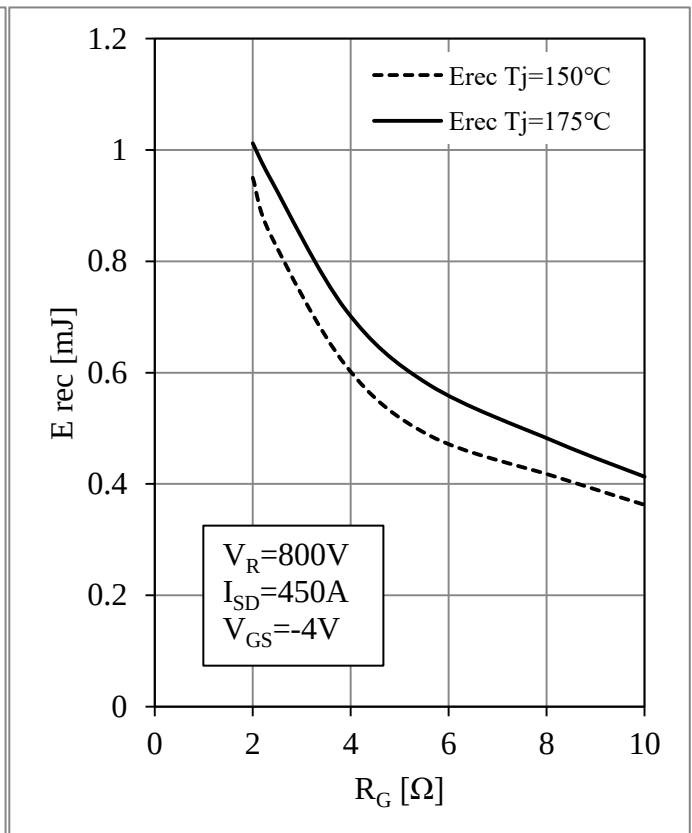
Fig 5. MOSFET Switching Loss vs. R_G 

Fig 6. Body Diode Characteristics

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

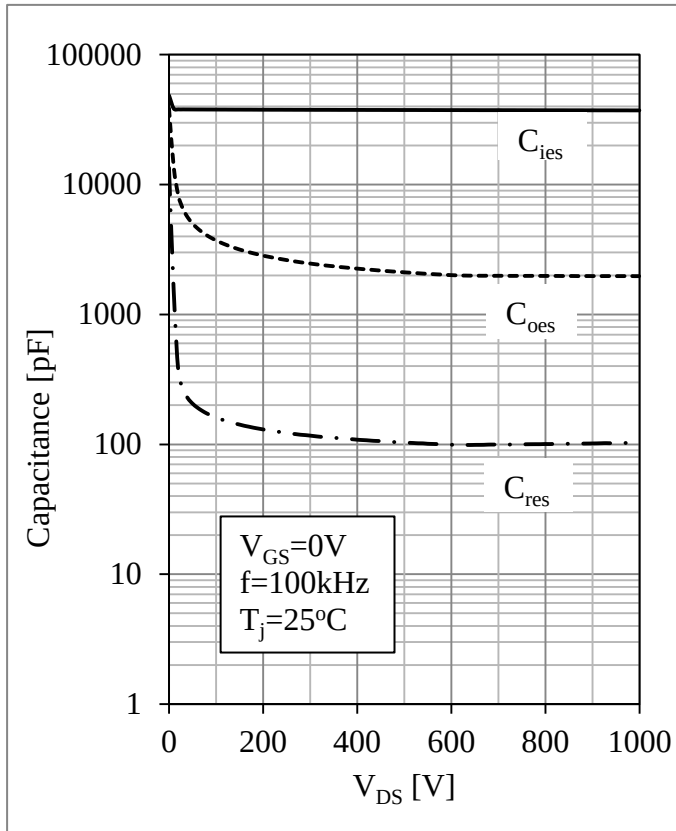
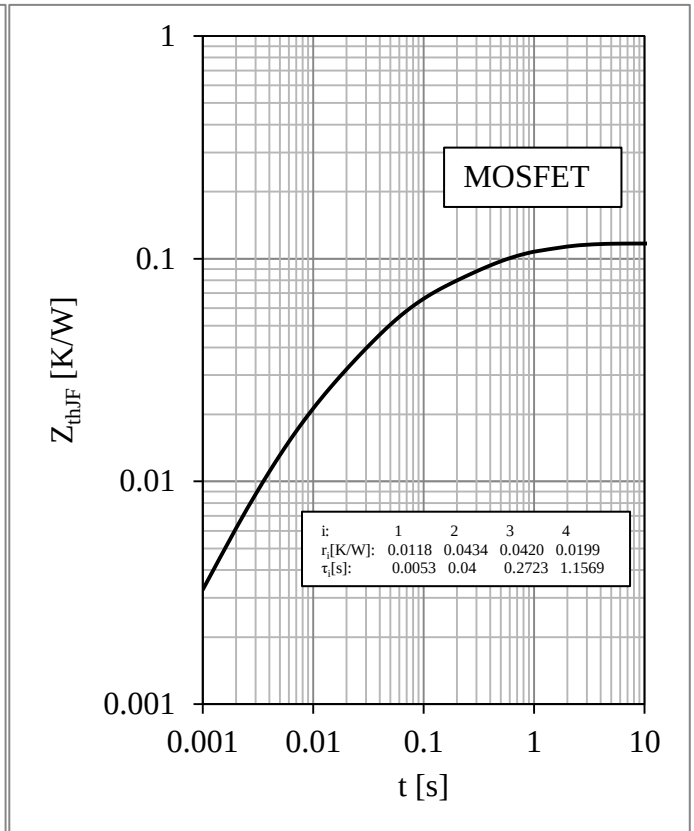
Fig 9. Capacitance vs. V_{DS} 

Fig 10. MOSFET Transient Thermal Impedance

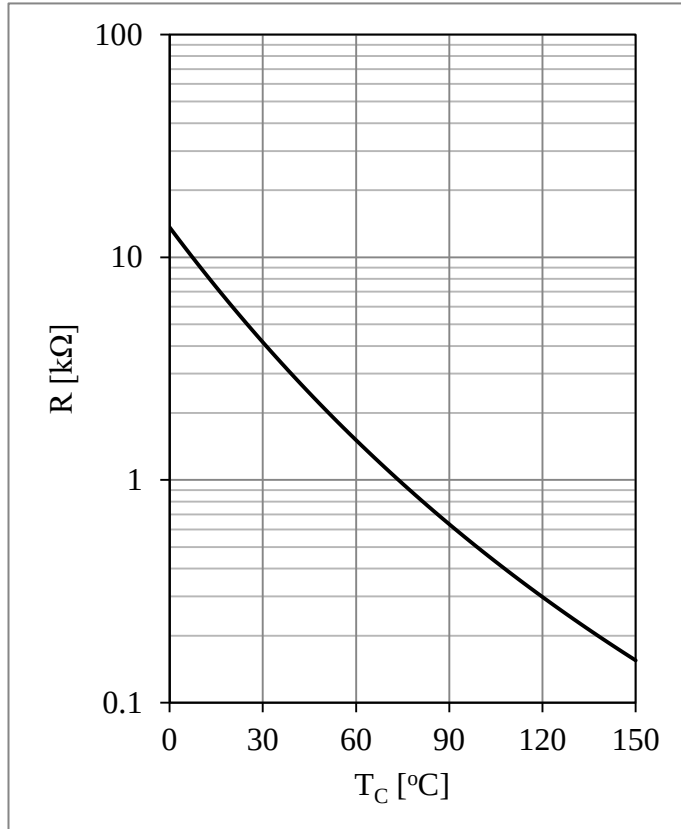
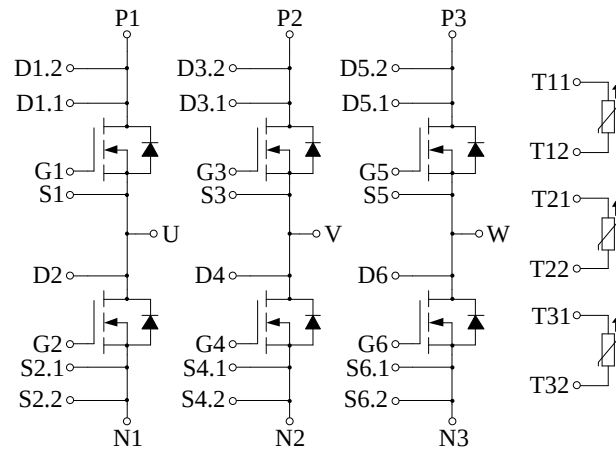


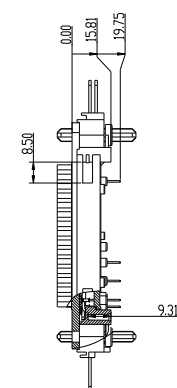
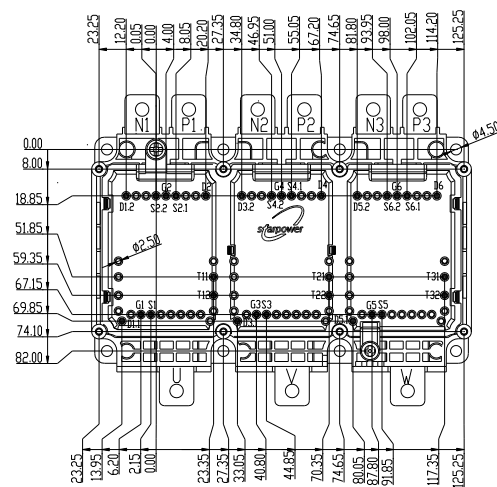
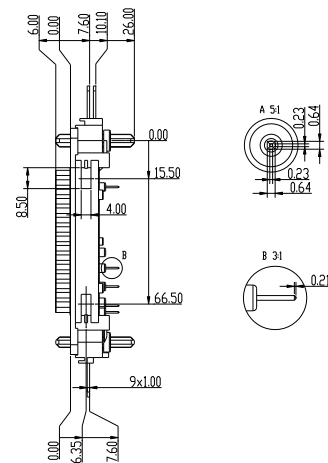
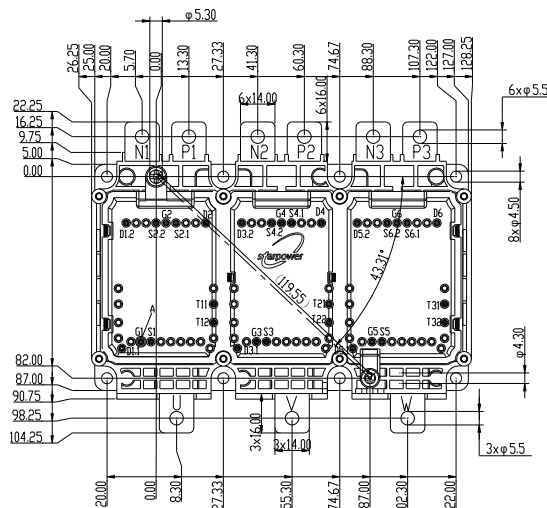
Fig 11. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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