

STARPOWER

SEMICONDUCTOR

SiC MOSFET

MD13HTC75P6HE

750V/1.25mΩ 6 in one-package

General Description

STARPOWER MOSFET Power Module provides very low $R_{DS(on)}$ as well as optimized intrinsic diode. It's designed for the applications such as hybrid and electric vehicle.

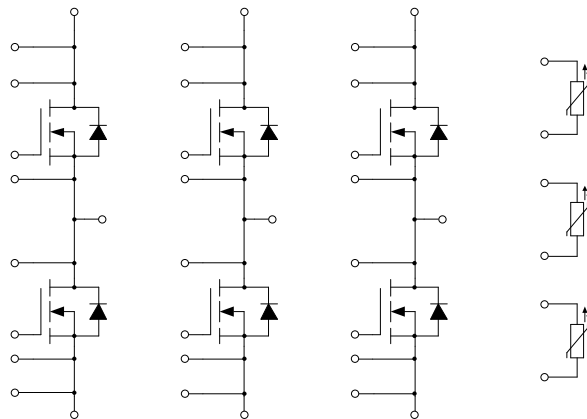
Features

- SiC power MOSFET
- Low $R_{DS(on)}$
- Optimized intrinsic reverse diode
- 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	750	V
V_{GSSmax}	Gate-Source Voltage	-8/+19	V
V_{GSSop}	Gate-Source Voltage	-4/+15	V
I_D	Drain Current @ $T_F=75^{\circ}\text{C}$	630	A
I_{DM}	Pulsed Drain Current, t_p limited by T_{jmax}	1260	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 @ $T_F=75^{\circ}\text{C}$	222	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	$I_D=660\text{A}, V_{GS}=15\text{V}, T_j=25^\circ\text{C}$		1.25	1.70	m Ω
		$I_D=660\text{A}, V_{GS}=15\text{V}, T_j=175^\circ\text{C}$		1.85		
$V_{GS(th)}$	Gate-Source Threshold Voltage	$I_D=180\text{mA}, V_{DS}=V_{GS}, T_j=25^\circ\text{C}$	1.8	2.4	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	$V_{GS}=19\text{V}, V_{DS}=0\text{V}, T_j=25^\circ\text{C}$			800	nA
R_{Gint}	Internal Gate Resistance			0.40		Ω
C_{iss}	Input Capacitance			57.5		nF
C_{oss}	Output Capacitance	$V_{GS}=0\text{V}, V_{DS}=470\text{V}, f=100\text{kHz}$		3.71		nF
C_{rss}	Reverse Transfer Capacitance			0.31		nF
Q_g	Total Gate Charge	$I_D=660\text{A}, V_{DS}=470\text{V}, V_{GS}=-4/+15\text{V}$		1.19		μC
$t_{d(on)}$	Turn-On Delay Time	$V_{DS}=470\text{V}, I_D=660\text{A}, R_{Gon}=1.5\Omega, R_{Goff}=4.7\Omega, L_S=25\text{nH}, V_{GS}=-4/+15\text{V}, T_j=25^\circ\text{C}$		92		ns
t_r	Rise Time			64		ns
$t_{d(off)}$	Turn-Off Delay Time			628		ns
t_f	Fall Time			89		ns
E_{on}	Turn-On Switching Loss				5.56	
E_{off}	Turn-Off Switching Loss			41.6		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{DS}=470\text{V}, I_D=660\text{A}, R_{Gon}=1.5\Omega, R_{Goff}=4.7\Omega, L_S=25\text{nH}, V_{GS}=-4/+15\text{V}, T_j=150^\circ\text{C}$		85		ns
t_r	Rise Time			59		ns
$t_{d(off)}$	Turn-Off Delay Time			688		ns
t_f	Fall Time			98		ns
E_{on}	Turn-On Switching Loss				4.49	
E_{off}	Turn-Off Switching Loss			41.9		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{DS}=470\text{V}, I_D=660\text{A}, R_{Gon}=1.5\Omega, R_{Goff}=4.7\Omega, L_S=25\text{nH}, V_{GS}=-4/+15\text{V}, T_j=175^\circ\text{C}$		84		ns
t_r	Rise Time			58		ns
$t_{d(off)}$	Turn-Off Delay Time			720		ns
t_f	Fall Time			104		ns
E_{on}	Turn-On Switching Loss				4.40	
E_{off}	Turn-Off Switching Loss			42.1		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	$I_S=325\text{A}, V_{GS}=-4\text{V}, T_j=25^\circ\text{C}$		4.20		V
		$I_S=325\text{A}, V_{GS}=-4\text{V}, T_j=175^\circ\text{C}$		3.80		
Q_r	Diode Reverse Recovery Charge	$V_R=470\text{V}, I_S=660\text{A}, -di/dt=11690\text{A}/\mu\text{s}, L_S=25\text{nH}, V_{GS}=-4\text{V}, T_j=25^\circ\text{C}$		4.50		μC
I_{rrm}	Peak Reverse Recovery Current			172		A
E_{rec}	Reverse Recovery Energy			2.57		mJ
Q_r	Diode Reverse Recovery Charge	$V_R=470\text{V}, I_S=660\text{A}, -di/dt=12560\text{A}/\mu\text{s}, L_S=25\text{nH}, V_{GS}=-4\text{V}, T_j=150^\circ\text{C}$		6.75		μC
I_{rrm}	Peak Reverse Recovery Current			238		A
E_{rec}	Reverse Recovery Energy			3.84		mJ
Q_r	Diode Reverse Recovery Charge	$V_R=470\text{V}, I_S=660\text{A}, -di/dt=12700\text{A}/\mu\text{s}, L_S=25\text{nH}, V_{GS}=-4\text{V}, T_j=175^\circ\text{C}$		6.99		μC
I_{rrm}	Peak Reverse Recovery Current			244		A
E_{rec}	Reverse Recovery Energy			4.20		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}	$T_j=100^\circ\text{C}, R_{100}=493.3\Omega$	-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

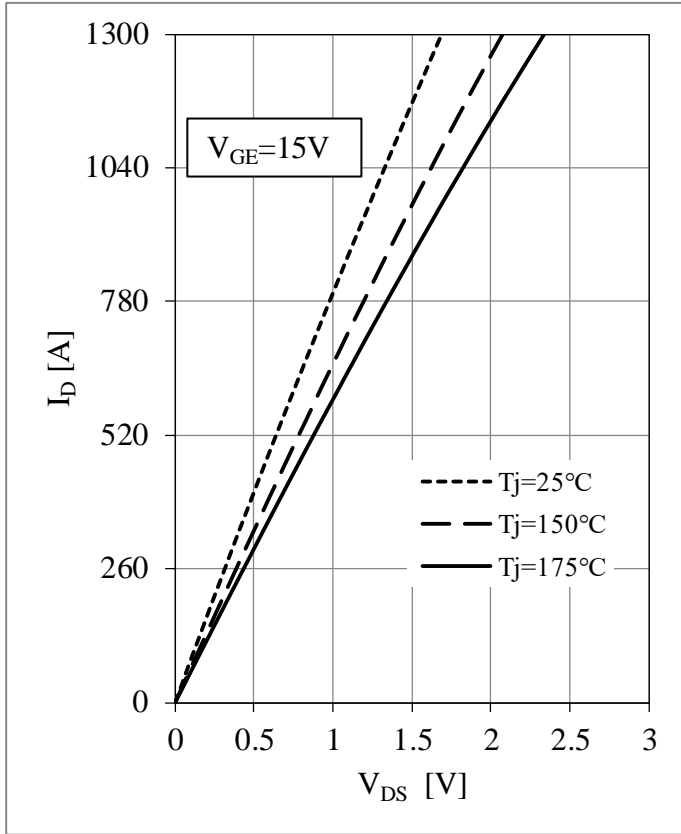


Fig 1. MOSFET Output Characteristics

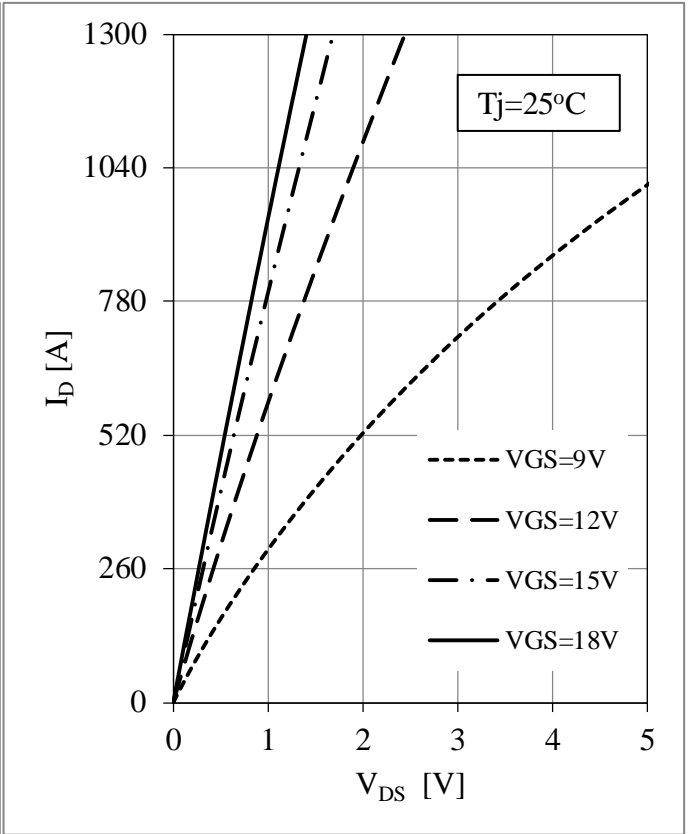


Fig 2. MOSFET Output Characteristics

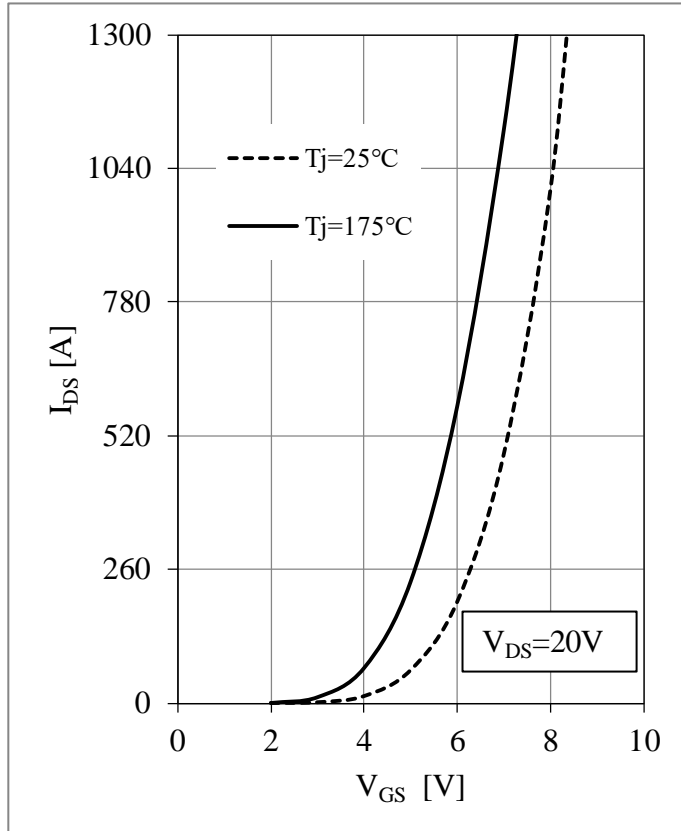


Fig 3. MOSFET Transfer Characteristics

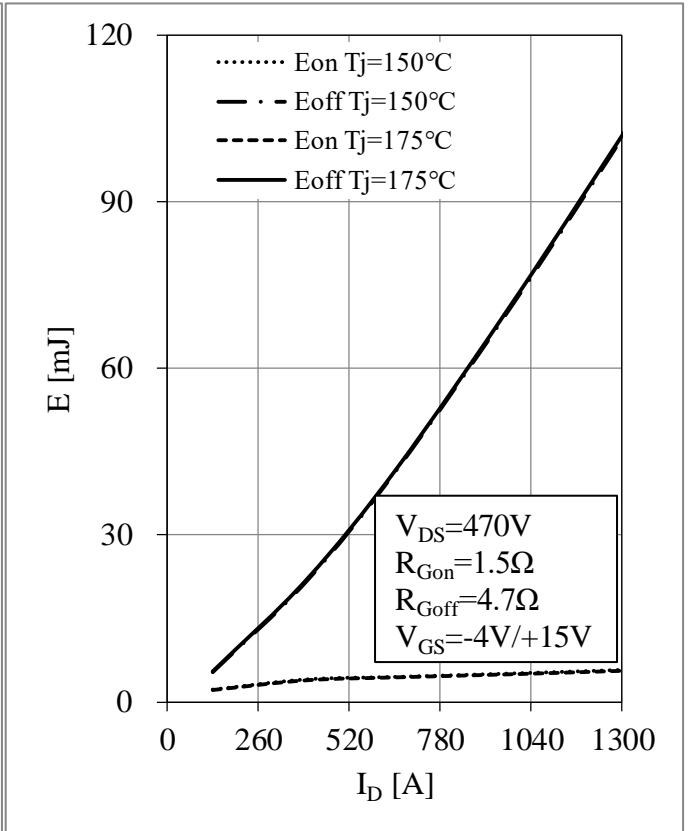


Fig 4. MOSFET Switching Loss vs. I_{DS}

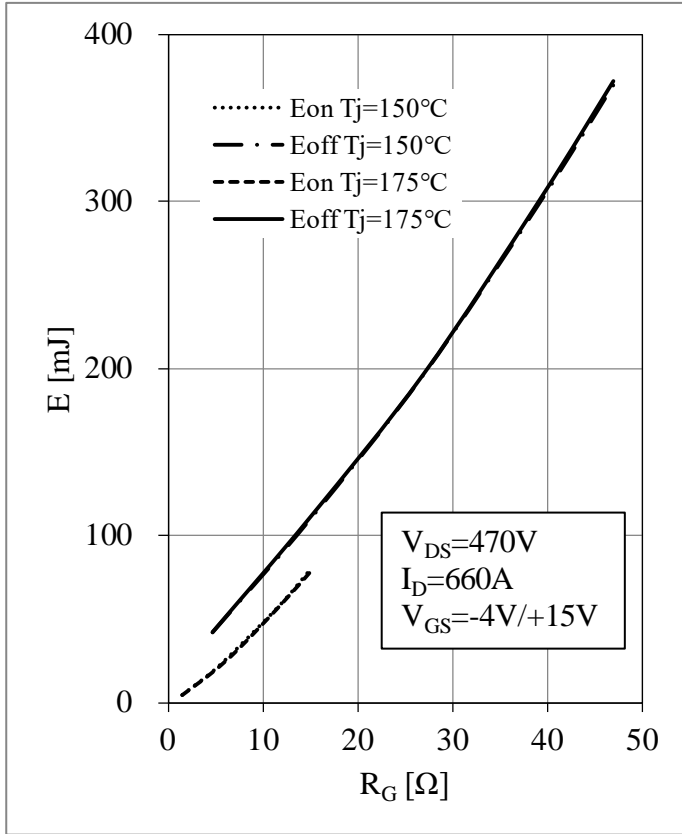


Fig 5. MOSFET Switching Loss vs. R_G

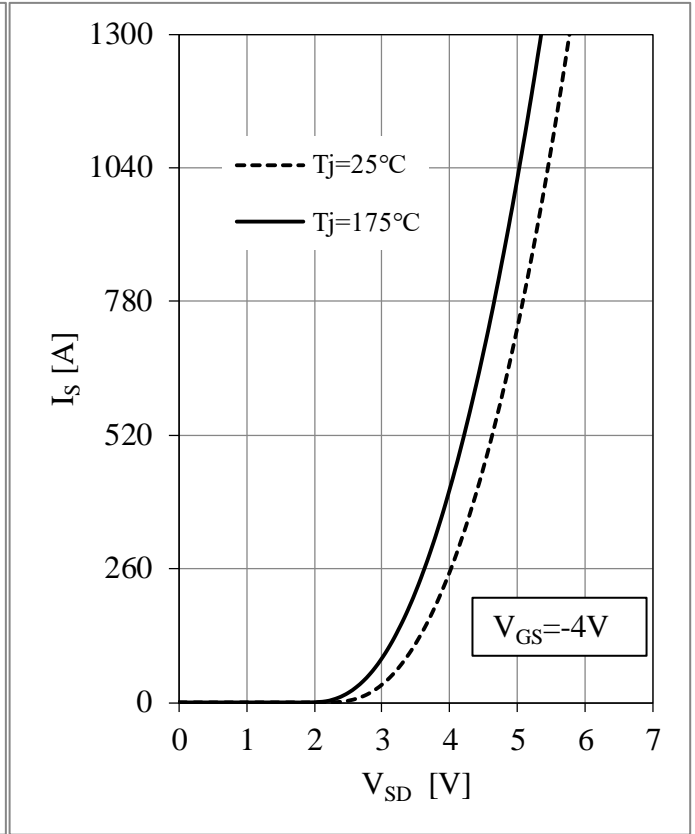


Fig 6. Body Diode Characteristics

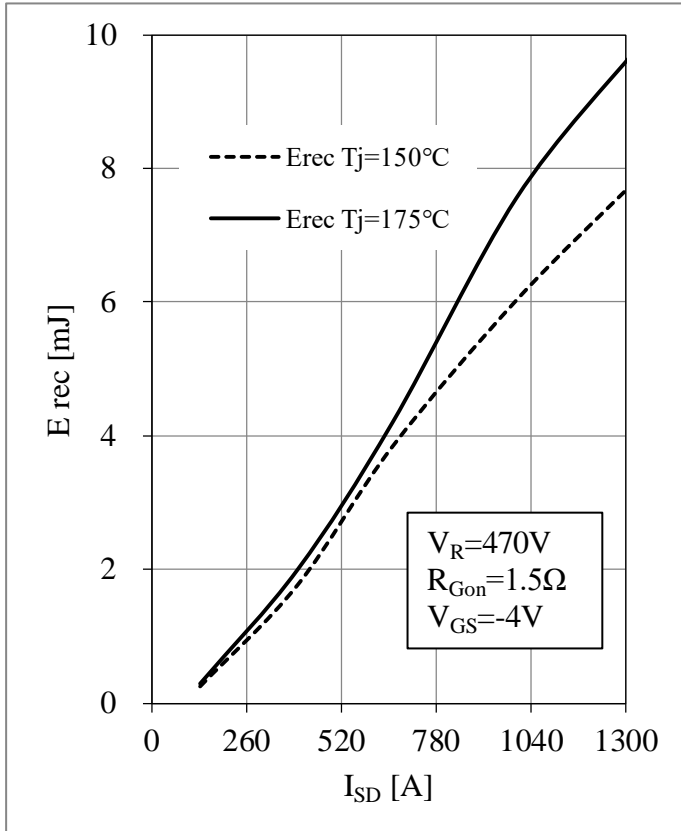


Fig 7. Body Diode Switching Loss vs. I_S

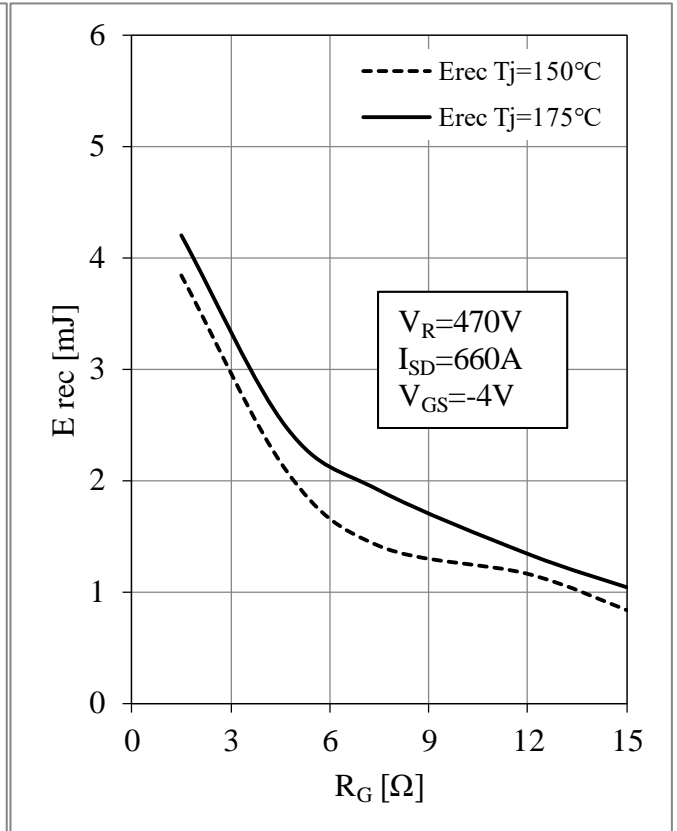


Fig 8. Body Diode Switching Loss vs. R_G

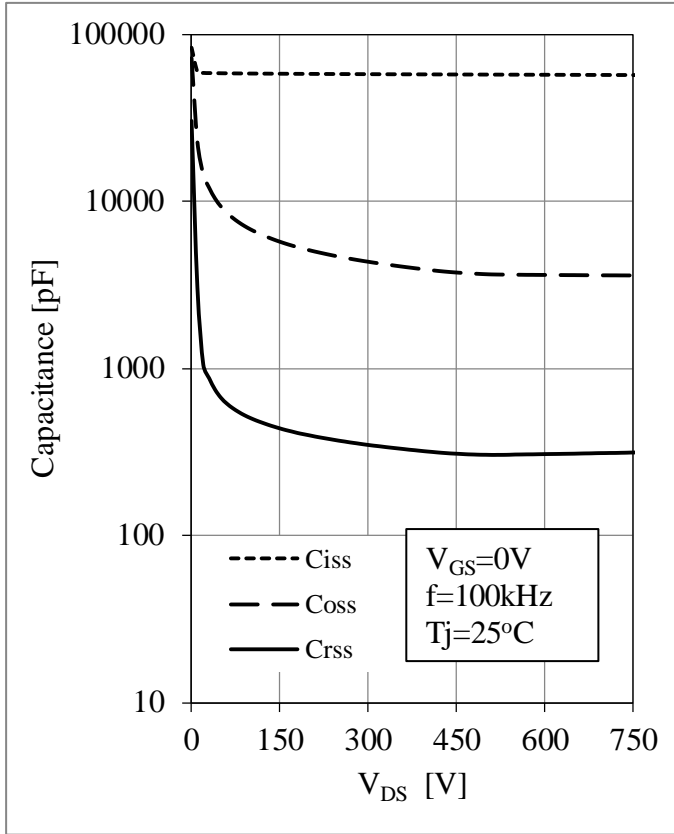


Fig 9. Capacitance vs. V_{DS}

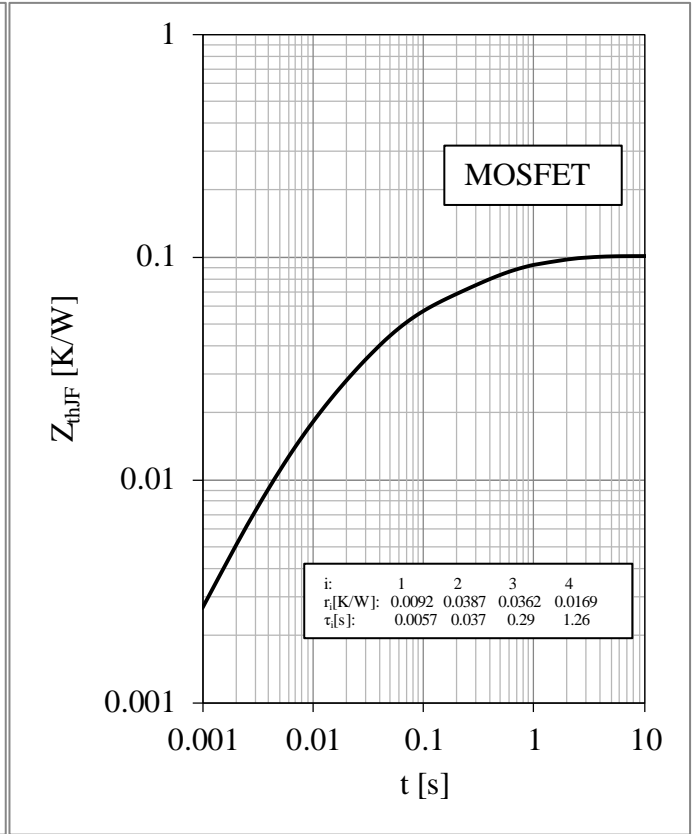


Fig 10. MOSFET Transient Thermal Impedance

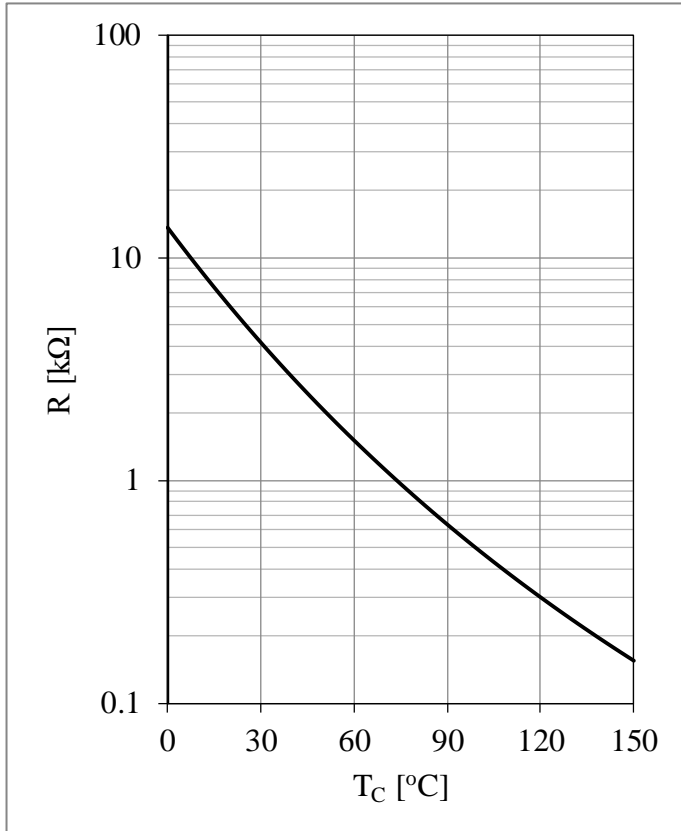
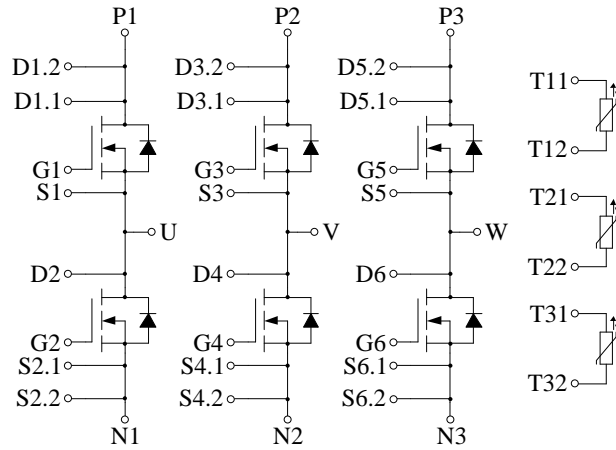


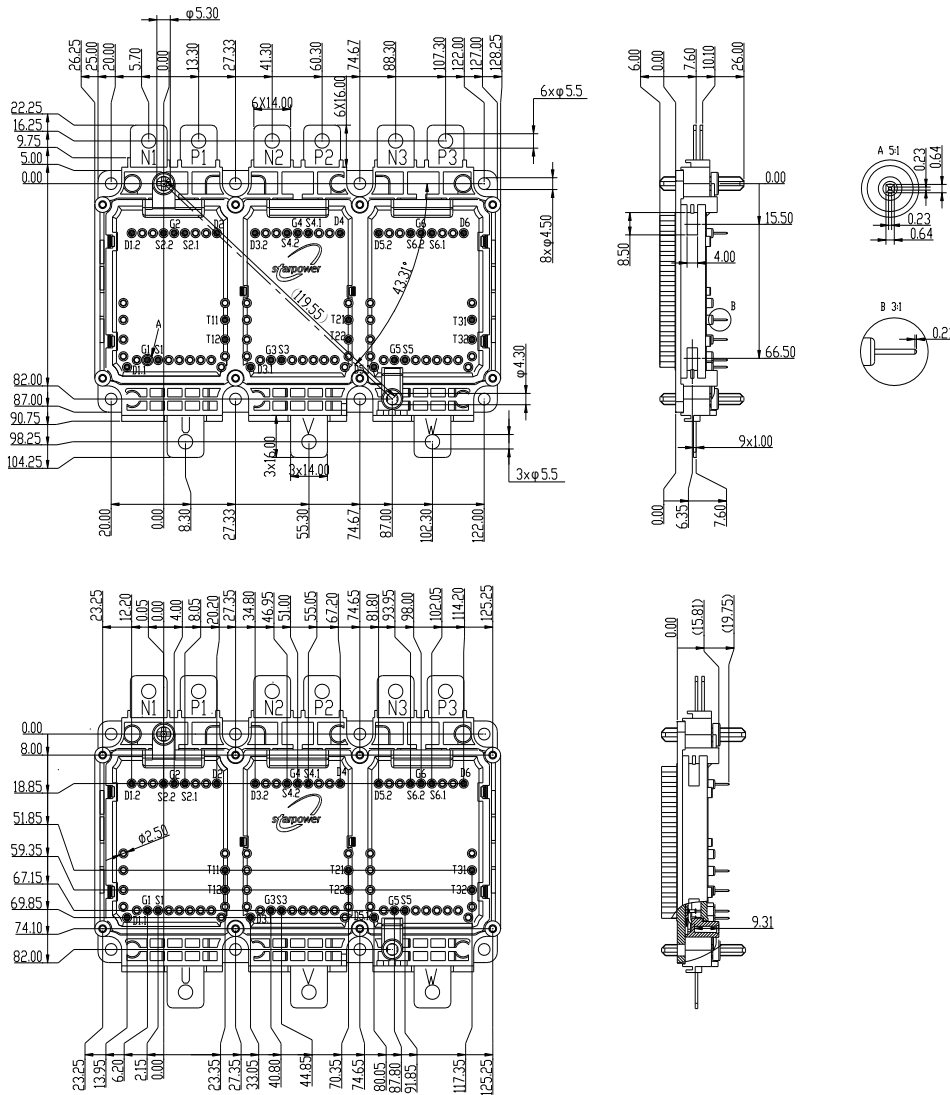
Fig 11. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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