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.

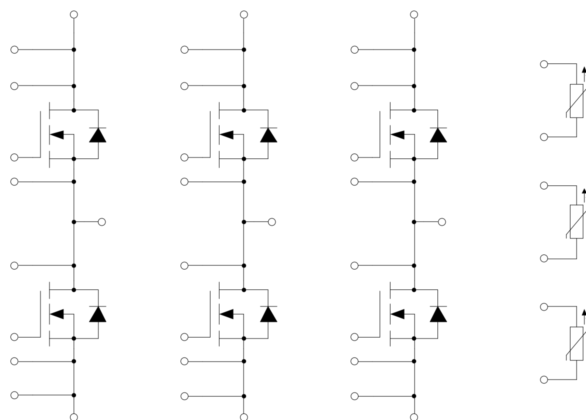
Features

- 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°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°C	490	A
I_{DM}	Pulsed Drain Current, t_P limited by T_{jmax}	980	A
P_D	Maximum Power Dissipation @ T_F=75°C T_j=175°C	952	W

Body Diode

Symbol	Description	Value	Unit
I_S	Source Current @ T_F=65°C	279	A

Module

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

MOSFET Characteristics T_F=25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$R_{DS(on)}$	Static Drain-Source On-Resistance	I_D=600A, V_{GS}=15V, T_j=25°C		2.25		mΩ
		I_D=600A, V_{GS}=15V, T_j=150°C		3.30		
		I_D=600A, V_{GS}=15V, T_j=175°C		3.70		
$V_{GS(th)}$	Gate-Source Threshold Voltage	I_D=167mA, V_{DS}=V_{GS}, T_j=25°C	1.8	2.5	3.6	V
I_{DSS}	Drain-Source Leakage Current	V_{DS}=V_{DSS}, V_{GS}=0V, T_j=25°C			500	μA
I_{GSS}	Gate-Source Leakage Current	V_{GS}=19V, V_{DS}=0V, T_j=25°C			600	nA
R_{Gint}	Internal Gate Resistance			0.45		Ω
C_{iss}	Input Capacitance	V_{GS}=0V, V_{DS}=800V, f=100kHz		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=600A, V_{DS}=800V, V_{GS}=-4/+15V		1.60		μC
$t_{d(on)}$	Turn-On Delay Time	V_{DS}=800V, I_D=600A, R_G=4.7Ω, L_S=25nH, V_{GS}=-4/+15V, T_j=25°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}=800V, I_D=600A, R_G=4.7Ω, L_S=25nH, V_{GS}=-4/+15V, T_j=150°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}=800V, I_D=600A, R_G=4.7Ω, L_S=25nH, V_{GS}=-4/+15V, T_j=175°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°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{SD}	Diode Forward Voltage	I_S=600A,V_{GS}=-4V, T_j=25°C		4.35		V
		I_S=600A,V_{GS}=-4V, T_j=150°C		4.00		
		I_S=600A,V_{GS}=-4V, T_j=175°C		3.90		
Q_r	Diode Reverse Recovery Charge	V_R=800V,I_S=600A, -di/dt=6520A/μs, L_S=25nH, V_{GS}=-4V, T_j=25°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=800V,I_S=600A, -di/dt=7180A/μs, L_S=25nH, V_{GS}=-4V, T_j=150°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=800V,I_S=600A, -di/dt=7250A/μs, L_S=25nH, V_{GS}=-4V, T_j=175°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°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
R_{25}	Rated Resistance			5.0		kΩ
ΔR/R	Deviation of R_{100}	T_j =100 °C,R_{100}=493.3Ω	-5		5	%
P_{25}	Power Dissipation				20.0	mW
$B_{25/50}$	B-value	$R_2=R_{25}\exp[B_{25/50}(1/T_2-1/(298.15K))]$		3375		K
$B_{25/80}$	B-value	$R_2=R_{25}\exp[B_{25/80}(1/T_2-1/(298.15K))]$		3411		K
$B_{25/100}$	B-value	$R_2=R_{25}\exp[B_{25/100}(1/T_2-1/(298.15K))]$		3433		K

Module Characteristics T_F=25°C unless otherwise noted

Symbol	Parameter	Min.	Typ.	Max.	Unit
L_{CE}	Stray Inductance		8		nH
Δp	$\Delta V/\Delta t$=10.0dm^3/min,T_F=60°C		64		mbar
p	Maximum Pressure In Cooling Circuit			2.5	bar
R_{thJF}	Junction-to-Cooling Fluid (per MOSFET) $\Delta V/\Delta t$=10.0dm^3/min,T_F=60°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

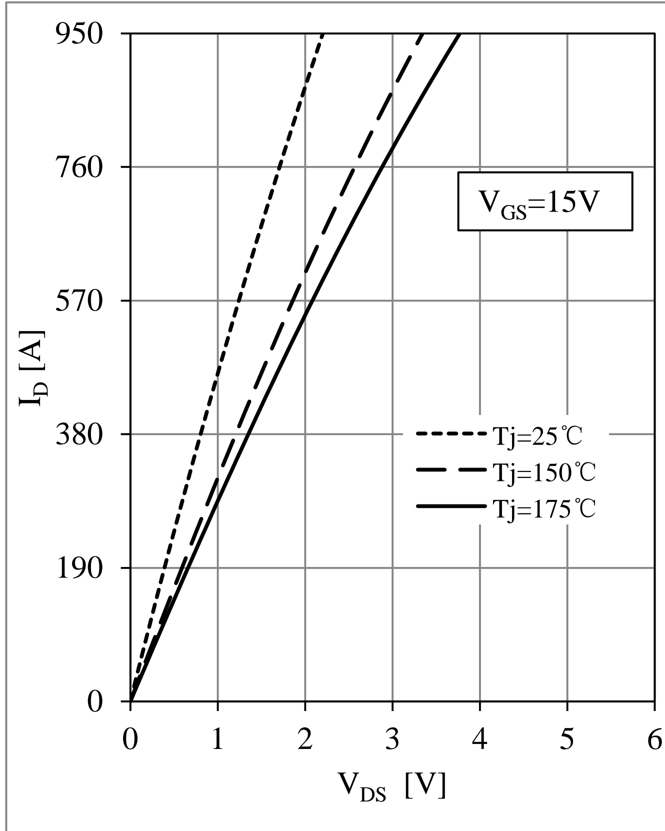


Fig 1. MOSFET Output Characteristics

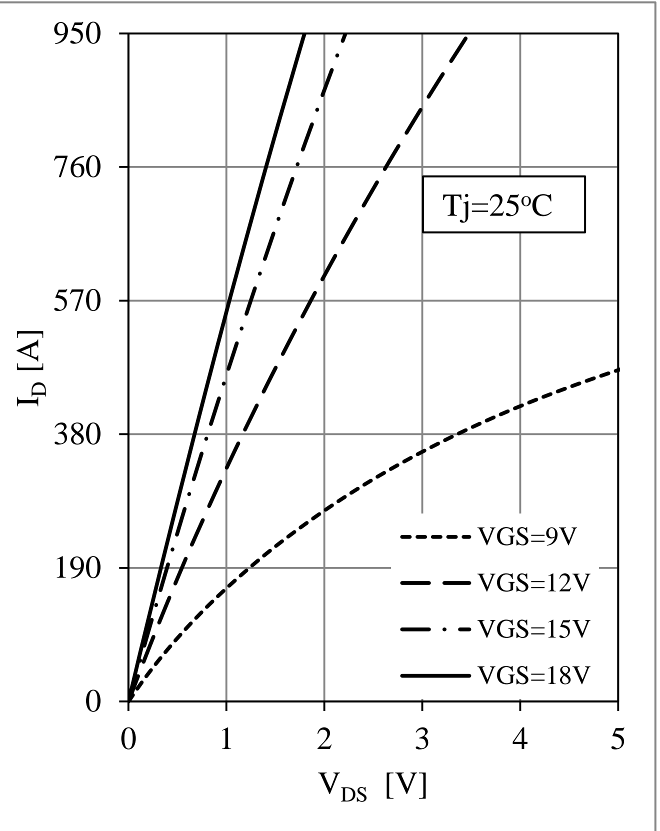


Fig 2. MOSFET Output Characteristics

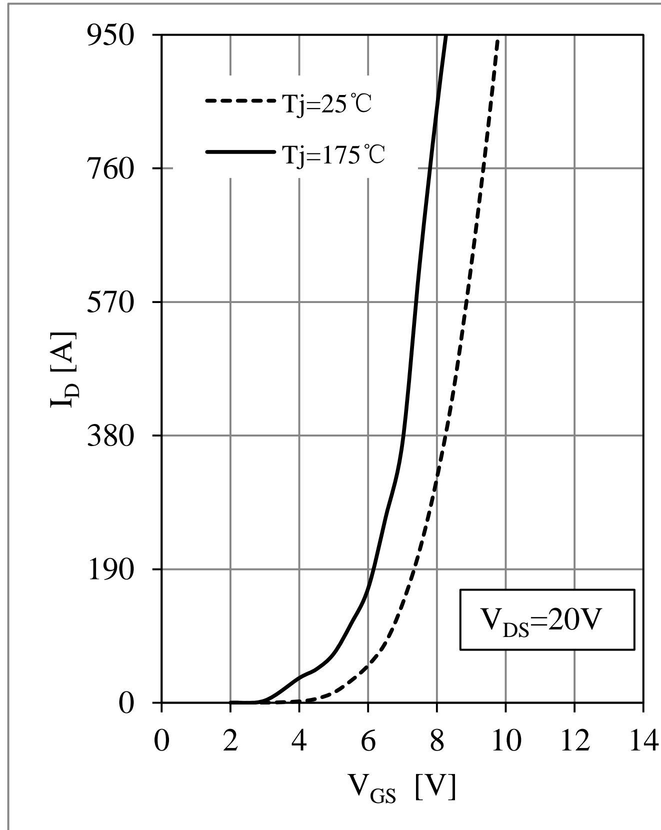


Fig 3. MOSFET Transfer Characteristics

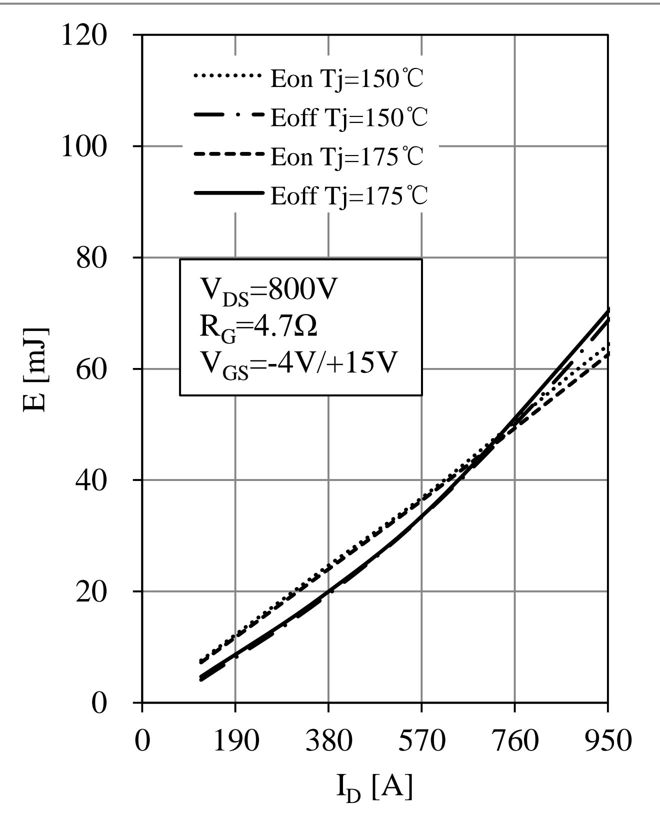
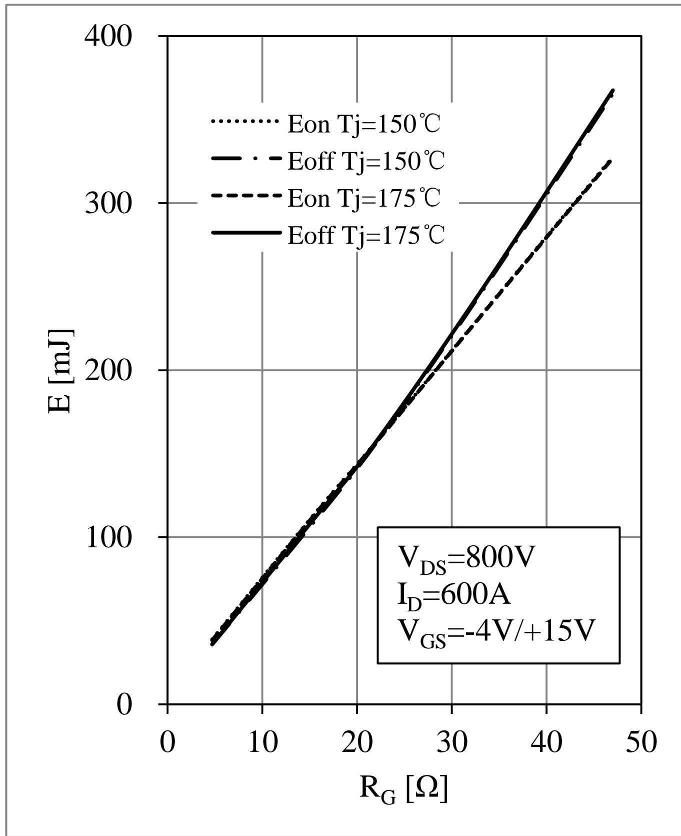


Fig 4. MOSFET Switching Loss vs. I_{DS}



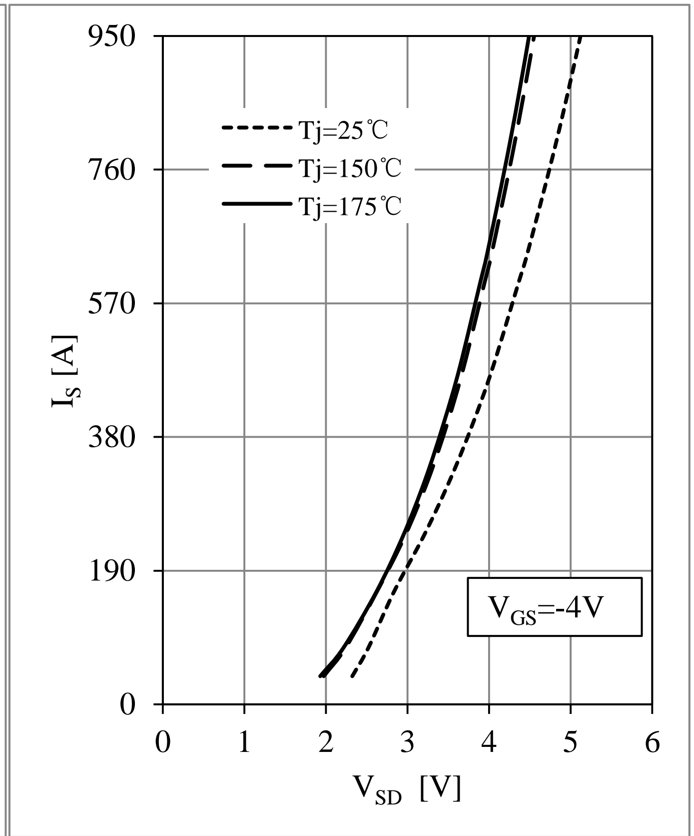
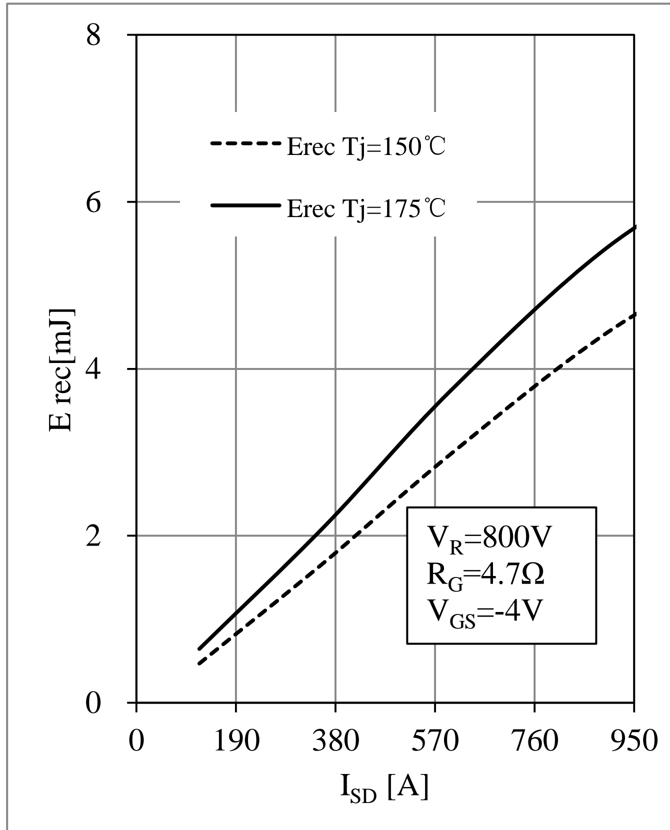


Fig 5. MOSFET Switching Loss vs.R_G

Fig 6. Body Diode Characteristics



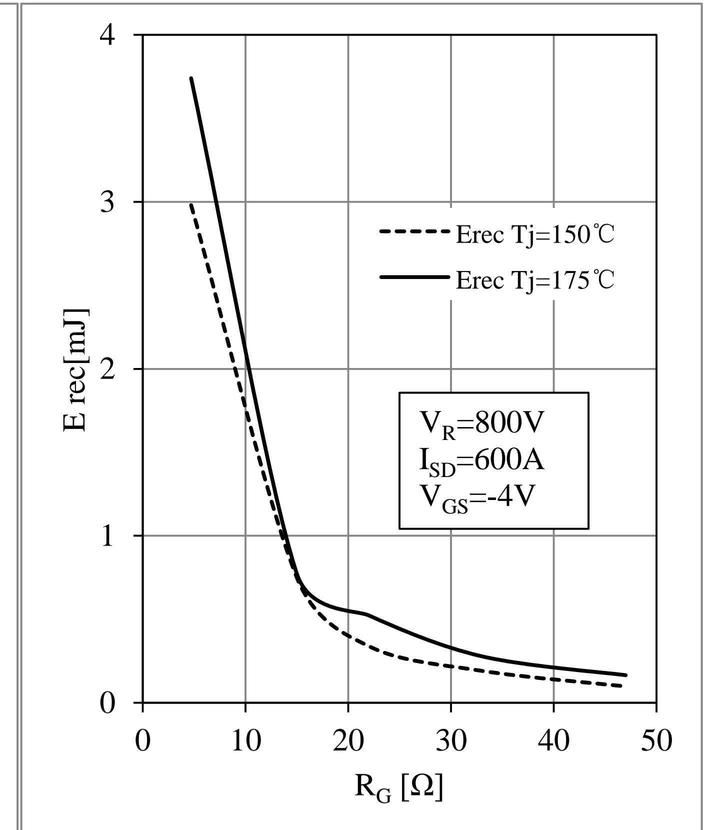


Fig 7. Body Diode Switching Loss vs. I_S

Fig 8. Body Diode Switching Loss vs. R_G

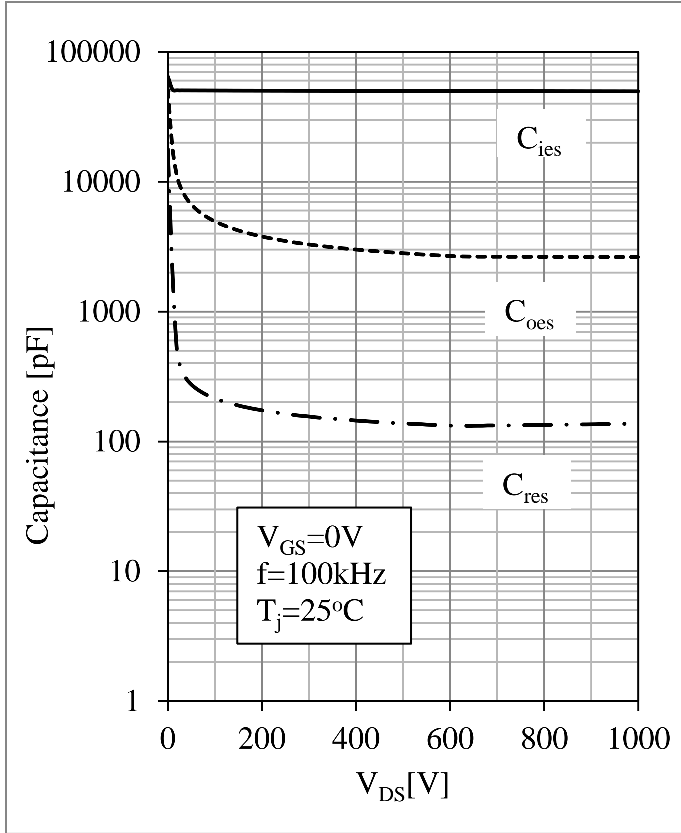


Fig 9. Capacitance vs.V_{DS}

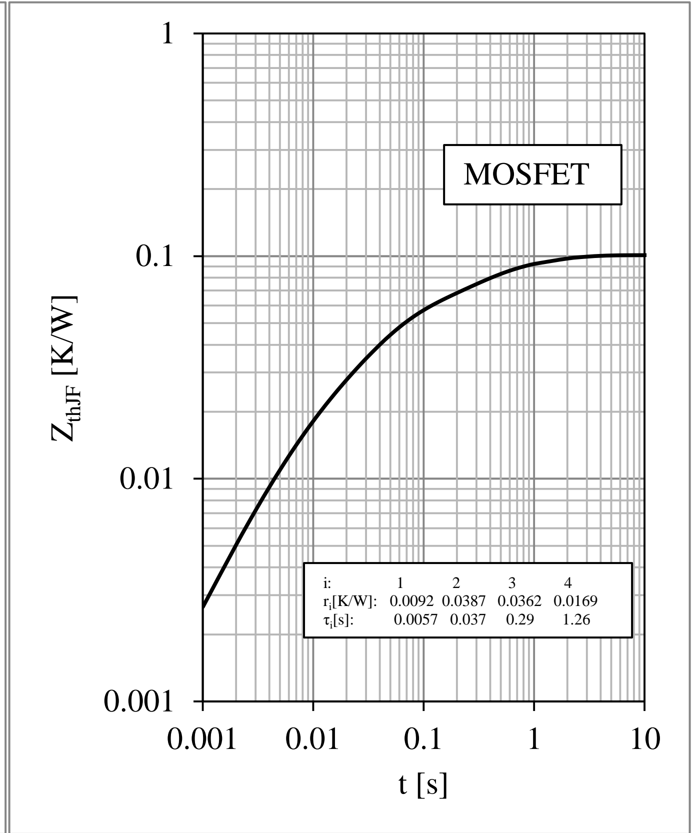


Fig 10. MOSFET Transient Thermal Impedance

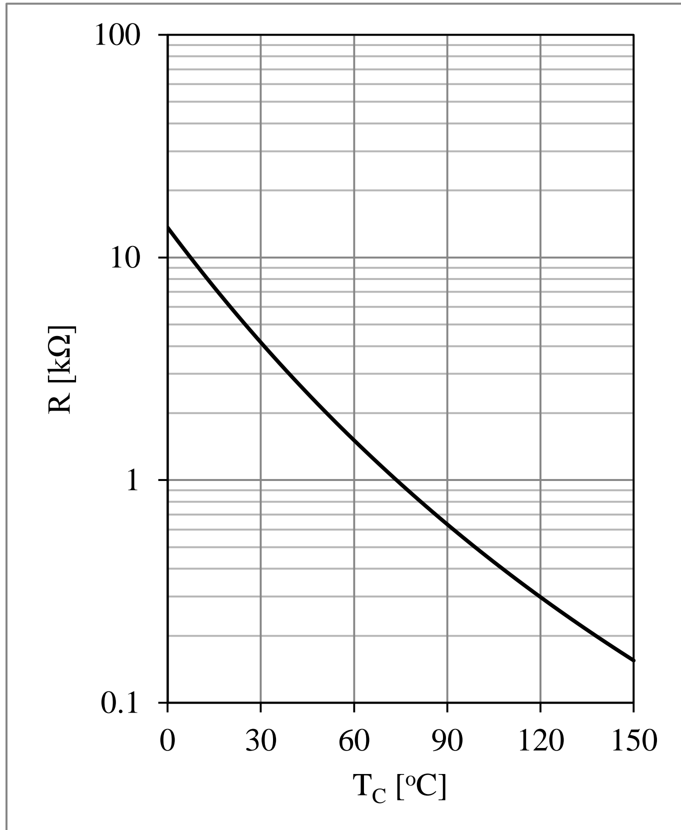
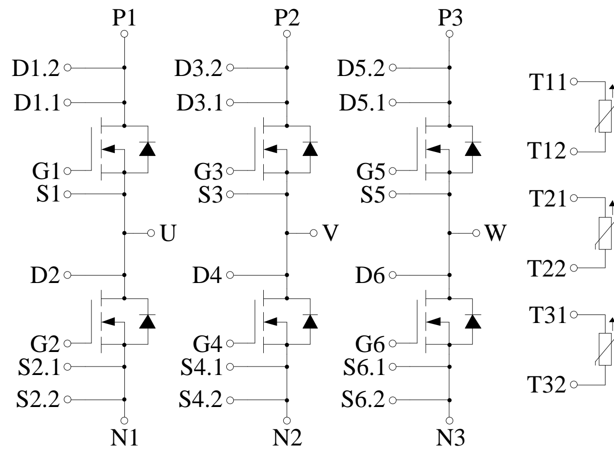


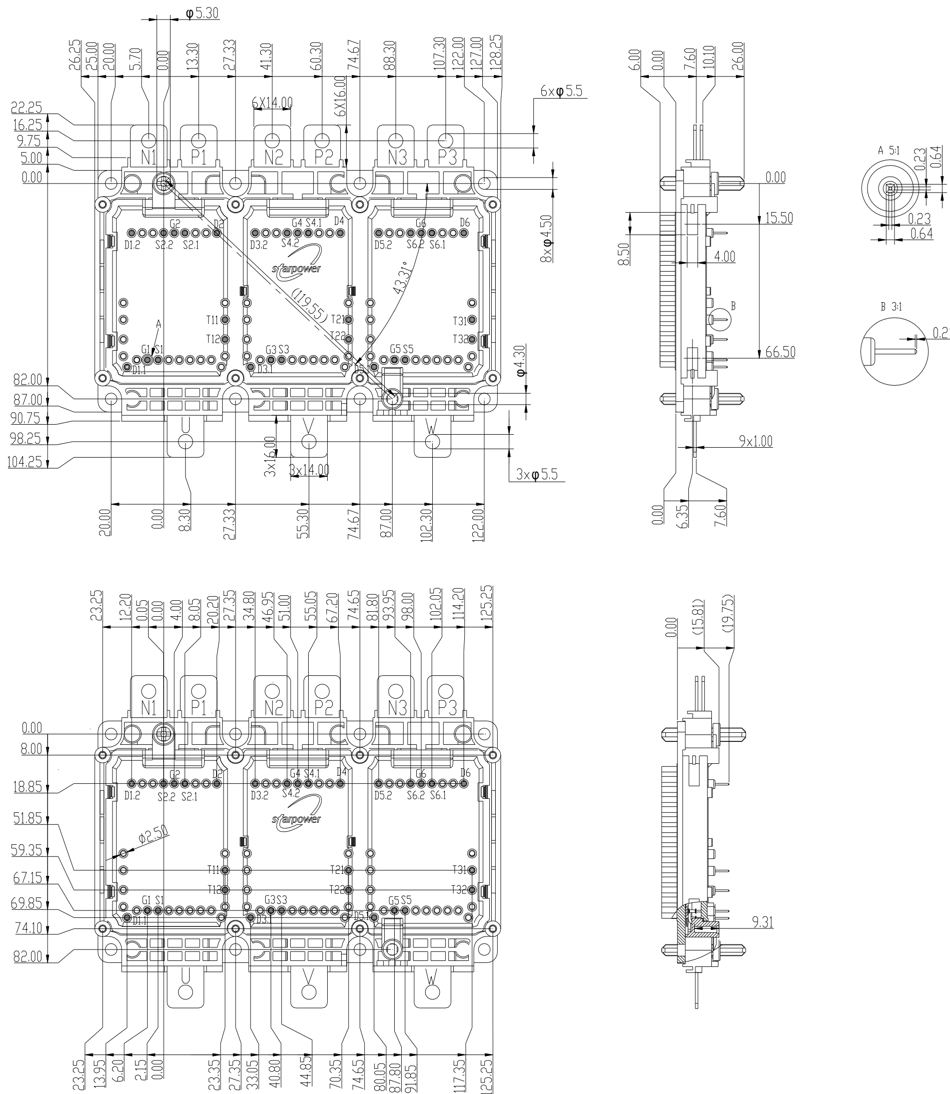
Fig 11. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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