

STARPOWER

SEMICONDUCTOR

SiC MOSFET

MD22HTS120P6HET

1200V/2.20mΩ 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.

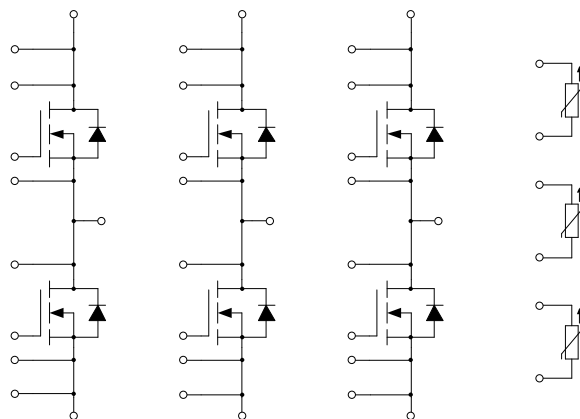
Features

- 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 @ $T_F=75^{\circ}\text{C}$	475	A
I_{DM}	Pulsed Drain Current, t_p limited by T_{vjmax}	950	A
P_D	Maximum Power Dissipation @ $T_F=75^{\circ}\text{C}$ $T_{vj}=175^{\circ}\text{C}$	977	W

Body Diode

Symbol	Description	Value	Unit
I_S	Source Current @ $T_F=75^{\circ}\text{C}$	263	A

Module

Symbol	Description	Value	Unit
T_{vjmax}	Maximum Junction Temperature	175	$^{\circ}\text{C}$
T_{vjop}	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, $f=50\text{Hz}$, $t=1\text{min}$	3000	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	$I_D=600\text{A}, V_{GS}=15\text{V}, T_{vj}=25^\circ\text{C}$		2.20		m Ω	
		$I_D=600\text{A}, V_{GS}=15\text{V}, T_{vj}=150^\circ\text{C}$		3.40			
		$I_D=600\text{A}, V_{GS}=15\text{V}, T_{vj}=175^\circ\text{C}$		3.58			
$V_{GS(th)}$	Gate-Source Threshold Voltage	$I_D=167\text{mA}, V_{DS}=V_{GS}, T_{vj}=25^\circ\text{C}$		2.6		V	
I_{DSS}	Drain-Source Leakage Current	$V_{DS}=V_{DSS}, V_{GS}=0\text{V}, T_{vj}=25^\circ\text{C}$			500	μA	
I_{GSS}	Gate-Source Leakage Current	$V_{GS}=19\text{V}, V_{DS}=0\text{V}, T_{vj}=25^\circ\text{C}$			600	nA	
R_{Gint}	Internal Gate Resistance			0.50		Ω	
C_{iss}	Input Capacitance	$V_{GS}=0\text{V}, V_{DS}=800\text{V}, f=100\text{kHz}$		52.4		nF	
C_{oss}	Output Capacitance			1.71		nF	
C_{rss}	Reverse Transfer Capacitance			0.07		nF	
Q_g	Total Gate Charge	$I_D=600\text{A}, V_{DS}=800\text{V}, V_{GS}=-4/+15\text{V}$		1.51		μC	
$t_{d(on)}$	Turn-On Delay Time	$V_{DS}=800\text{V}, I_D=600\text{A}, R_{Gon}=6.8\Omega, R_{Goff}=5.1\Omega, L_S=25\text{nH}, V_{GS}=-4/+15\text{V}, T_{vj}=25^\circ\text{C}$		236		ns	
t_r	Rise Time			122		ns	
$t_{d(off)}$	Turn-Off Delay Time			380		ns	
t_f	Fall Time			63		ns	
E_{on}	Turn-On Switching Loss			44.3		mJ	
E_{off}	Turn-Off Switching Loss			32.7		mJ	
$t_{d(on)}$	Turn-On Delay Time		$V_{DS}=800\text{V}, I_D=600\text{A}, R_{Gon}=6.8\Omega, R_{Goff}=5.1\Omega, L_S=25\text{nH}, V_{GS}=-4/+15\text{V}, T_{vj}=150^\circ\text{C}$		238		ns
t_r	Rise Time				124		ns
$t_{d(off)}$	Turn-Off Delay Time				466		ns
t_f	Fall Time				71		ns
E_{on}	Turn-On Switching Loss			44.8		mJ	
E_{off}	Turn-Off Switching Loss			36.6		mJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{DS}=800\text{V}, I_D=600\text{A}, R_{Gon}=6.8\Omega, R_{Goff}=5.1\Omega, L_S=25\text{nH}, V_{GS}=-4/+15\text{V}, T_{vj}=175^\circ\text{C}$			239		ns
t_r	Rise Time				125		ns
$t_{d(off)}$	Turn-Off Delay Time				495		ns
t_f	Fall Time				75		ns
E_{on}	Turn-On Switching Loss			45.0		mJ	
E_{off}	Turn-Off Switching Loss			38.3		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	$I_{SD}=304\text{A}, V_{GS}=-4\text{V}, T_{vj}=25^\circ\text{C}$		4.35		V
		$I_{SD}=304\text{A}, V_{GS}=-4\text{V}, T_{vj}=175^\circ\text{C}$		3.80		

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
$R_{CC'+EE'}$	Module Lead Resistance, Terminal to Chip		0.43		$\text{m}\Omega$
p	Maximum Pressure In Cooling Circuit			2.5	bar
R_{thJF}	Junction-to-Cooling Fluid (per MOSFET) $\Delta V/\Delta t=10.0\text{dm}^3/\text{min}, T_F=75^\circ\text{C}$		0.093		K/W
M	Terminal Connection Torque, Screw M5	3.6		4.4	N.m
	Mounting Torque, Screw M4	1.8		2.2	
G	Weight of Module		792		g

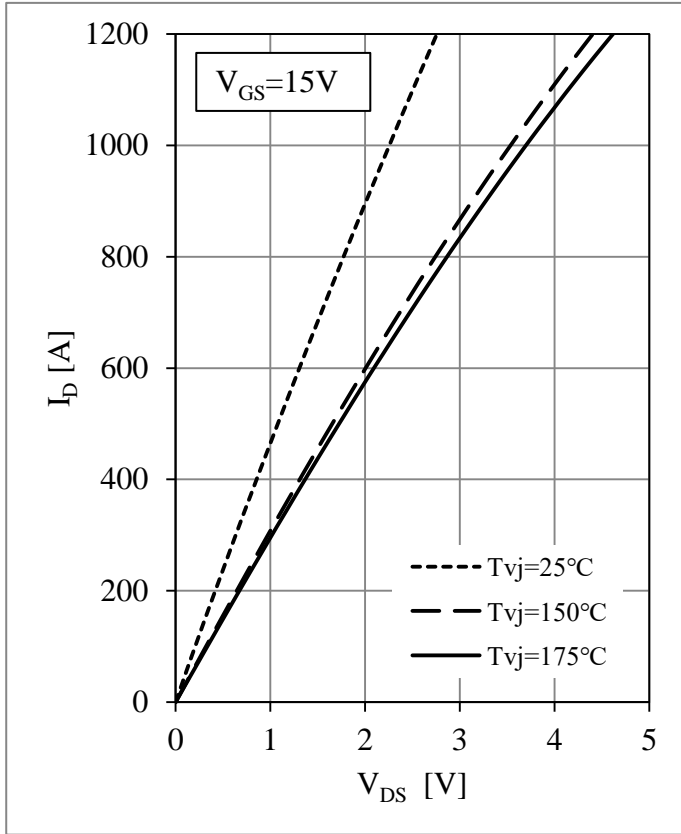


Fig 1. MOSFET Output Characteristics

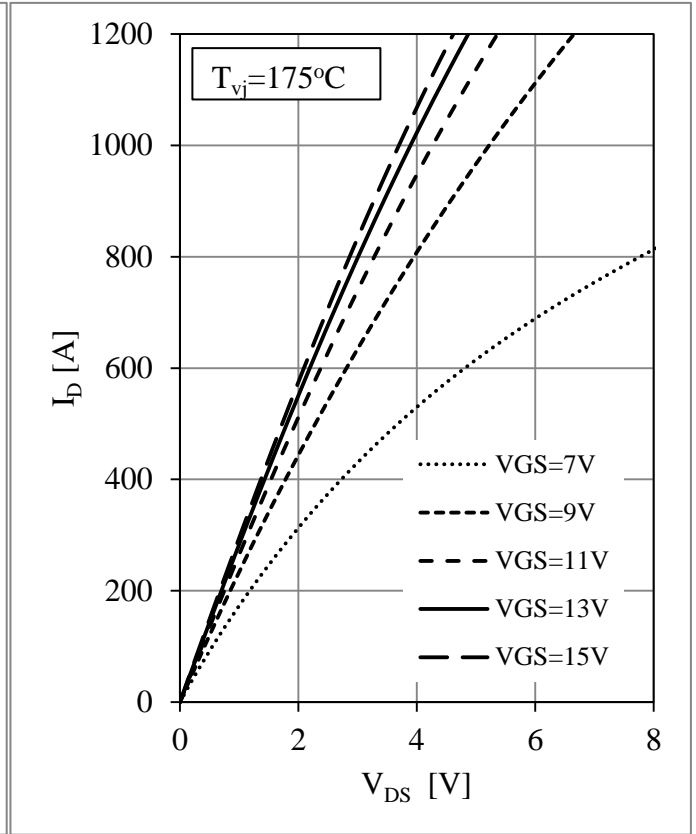


Fig 2. MOSFET Output Characteristics

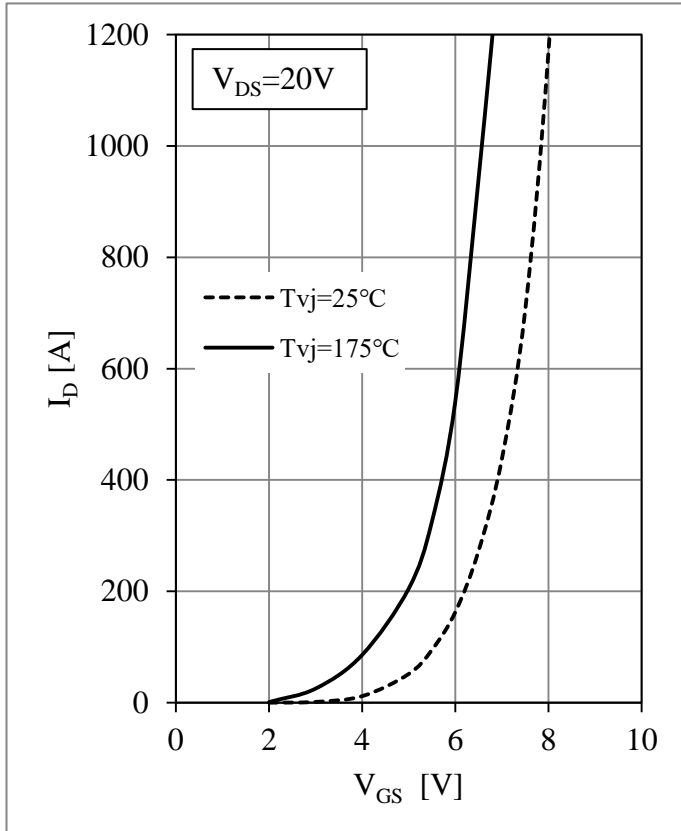


Fig 3. MOSFET Transfer Characteristics

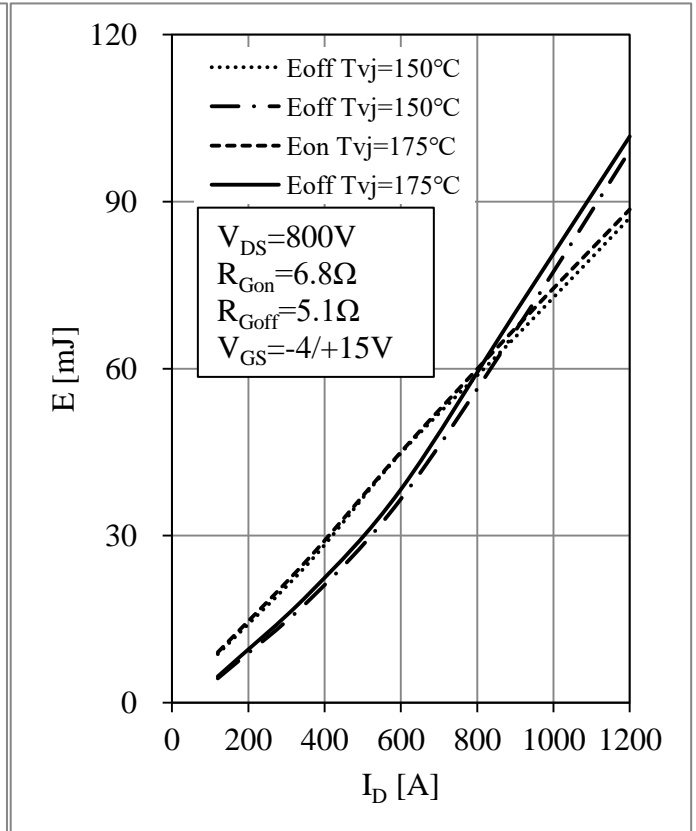


Fig 4. MOSFET Switching Loss vs. I_{DS}

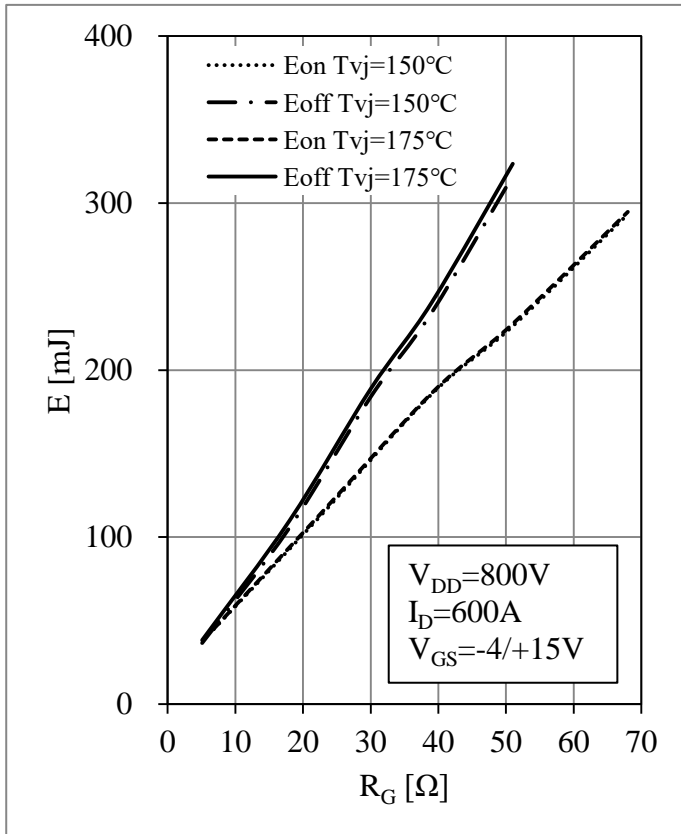


Fig 5. MOSFET Switching Loss vs. R_G

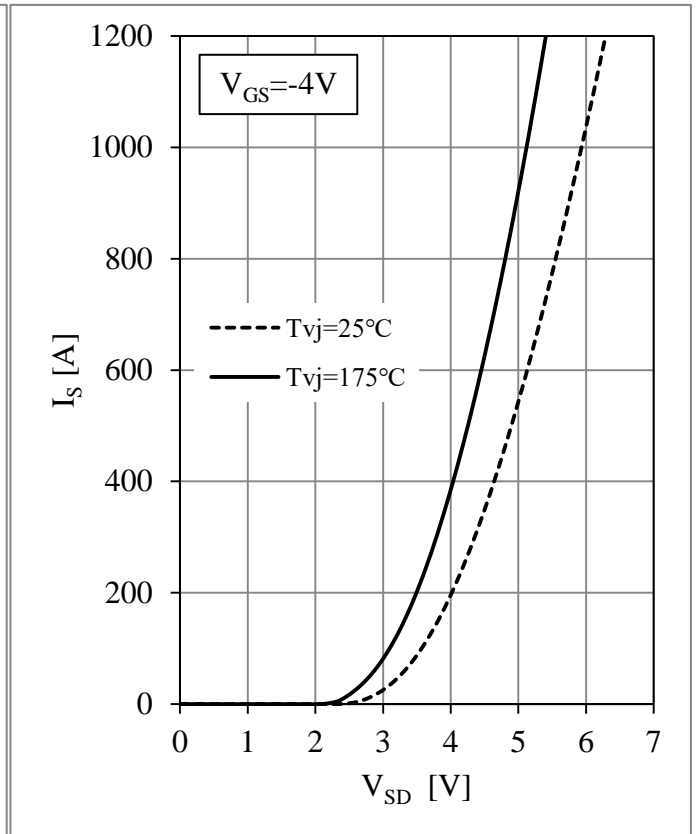


Fig 6. Body Diode Characteristics

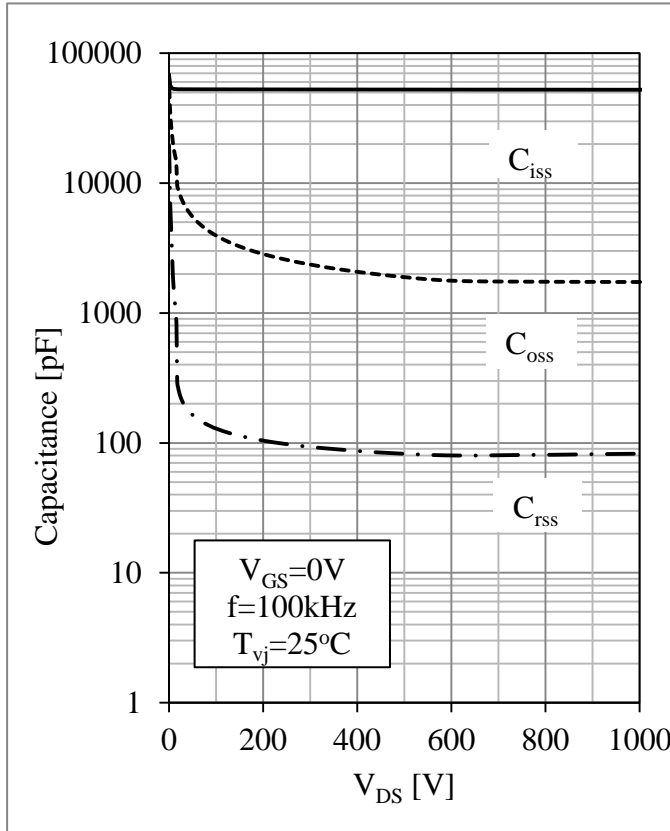


Fig 7. Capacitance vs. V_{DS}

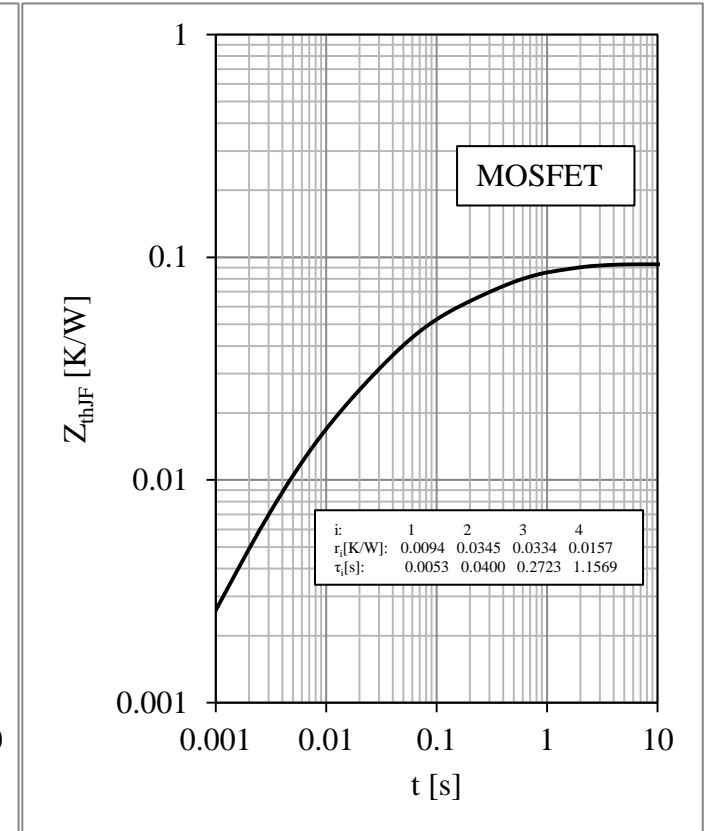


Fig 8. MOSFET Transient Thermal Impedance

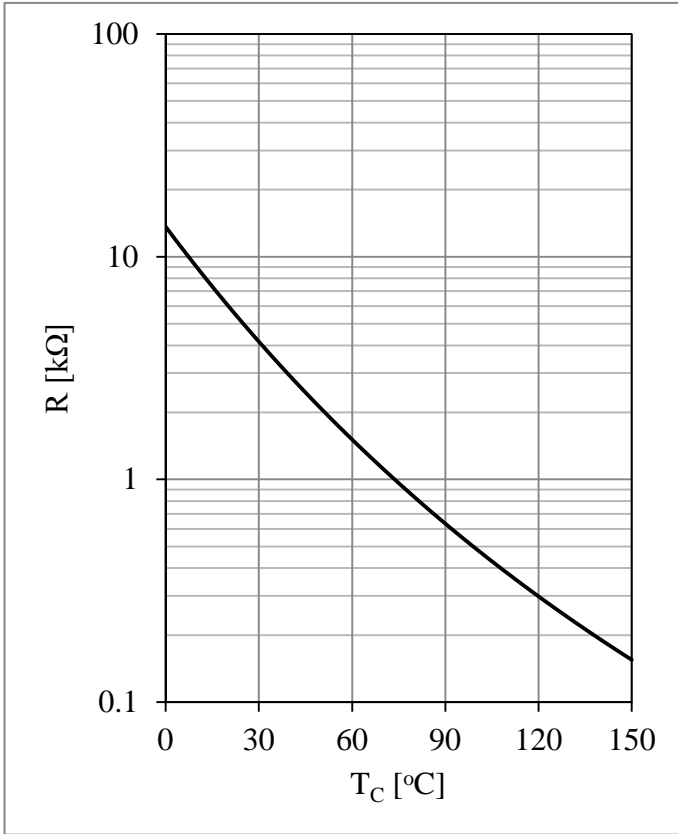
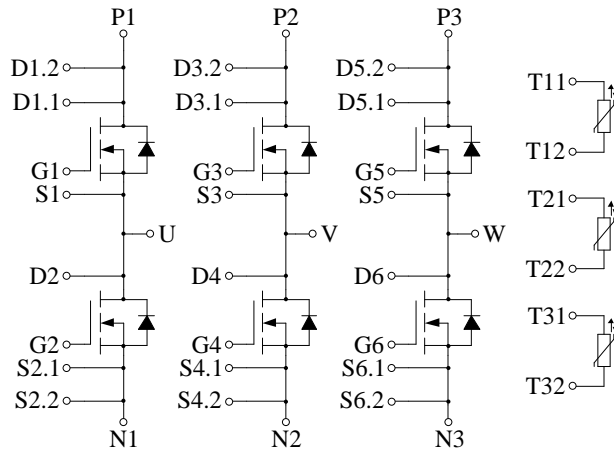


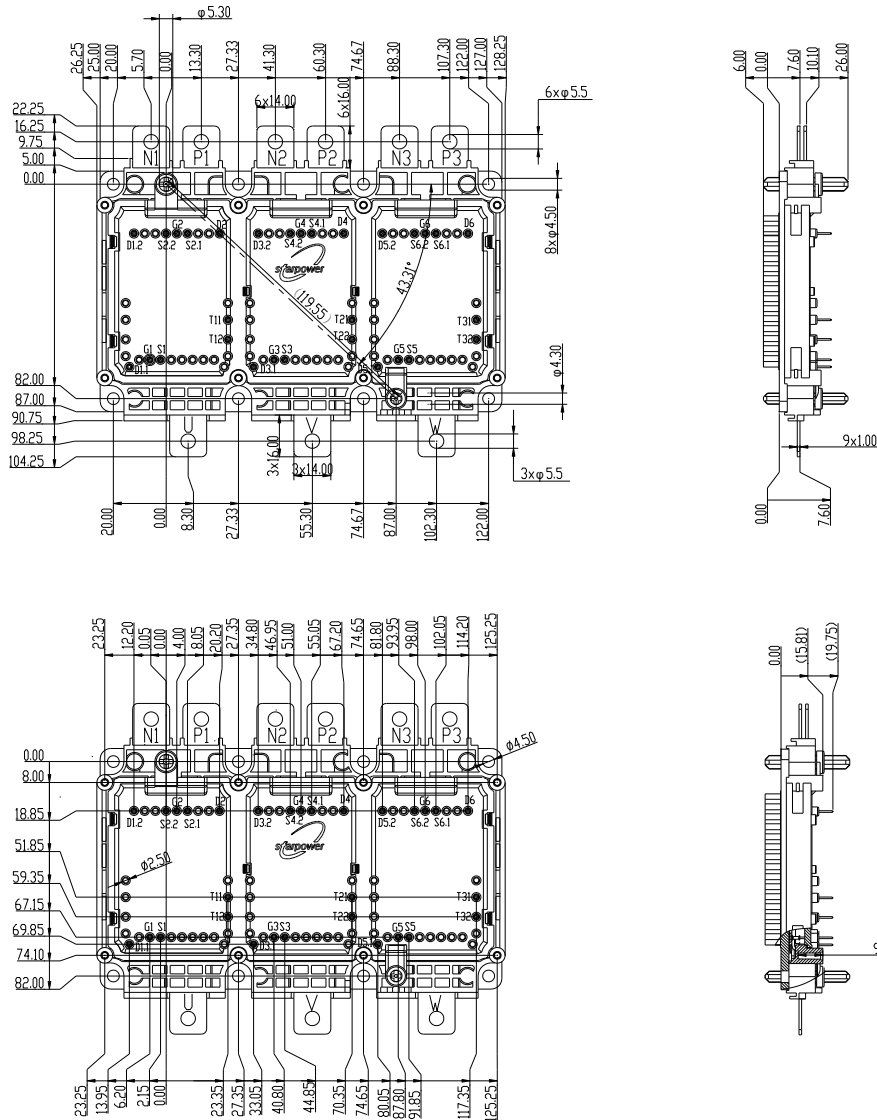
Fig 9. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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