STARPOWER

SEMICONDUCTOR **SiC MOSFET**

MD24HTL120P12HLT

1200V/2.40mΩ 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.

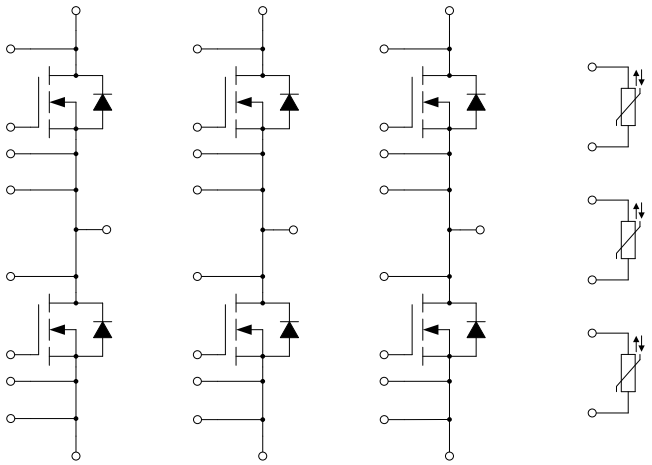
Features

- SiC power MOSFET
- 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=75°C T_{vj}=175°C	430	A
I_{DRM}	Repetitive Peak Drain Current t_p=1ms	860	A
P_D	Maximum Power Dissipation @ T_F=75°C T_{vj}=175°C	850	W

Body Diode

Symbol	Description	Value	Unit
I_S	Source Current @ T_F=75°C T_{vj}=175°C	212	A

Module

Symbol	Description	Value	Unit
T_{vjmax}	Maximum Junction Temperature	185	°C
T_{vjop}	Operating Junction Temperature continuous For 10s within a period of 30s,occurrence maximum 3000 times over lifetime	-40 to +185 +185 to +200	°C
T_{STG}	Storage Temperature Range	-40 to +125	°C
V_{ISO}	Isolation Voltage RMS,f=50Hz,t=1min	3000	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=380A,V_{GS}=15V, T_{vj}=25°C		2.40		mΩ
		I_D=380A,V_{GS}=15V, T_{vj}=150°C		3.56		
		I_D=380A,V_{GS}=15V, T_{vj}=175°C		3.84		
$V_{GS(th)}$	Gate-Source Threshold Voltage	I_D=100mA,V_{DS}=V_{GS}, T_{vj}=25°C	1.8	2.5	3.2	V
I_{DSS}	Drain-Source Leakage Current	V_{DS}=V_{DSS},V_{GS}=0V, T_{vj}=25°C			1.0	mA
I_{GSS}	Gate-Source Leakage Current	V_{GS}=V_{GSS},V_{DS}=0V, T_{vj}=25°C			400	nA
R_{Gint}	Internal Gate Resistance			1.8		Ω
C_{iss}	Input Capacitance	V_{GS}=0V,V_{DS}=800V, f=100kHz		34.2		nF
C_{oss}	Output Capacitance			1.24		nF
C_{rss}	Reverse Transfer Capacitance			41.7		pF
Q_g	Total Gate Charge	I_D=380A,V_{DS}=800V, V_{GS}=-4/+15V		1.07		μC
$t_{d(on)}$	Turn-On Delay Time	V_{DS}=800V,I_D=400A, R_{Gon}=5.6Ω,R_{Goff}=3.3Ω L_S=7nH, V_{GS}=-4/+15V, T_{vj}=25°C		160		ns
t_r	Rise Time			75		ns
$t_{d(off)}$	Turn-Off Delay Time			275		ns
t_f	Fall Time			43		ns
E_{on}	Turn-On Switching Loss			24.3		mJ
E_{off}	Turn-Off Switching Loss			14.3		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{DS}=800V,I_D=400A, R_{Gon}=5.6Ω,R_{Goff}=3.3Ω L_S=7nH, V_{GS}=-4/+15V, T_{vj}=150°C		163		ns
t_r	Rise Time			77		ns
$t_{d(off)}$	Turn-Off Delay Time			392		ns
t_f	Fall Time			44		ns
E_{on}	Turn-On Switching Loss			24.5		mJ
E_{off}	Turn-Off Switching Loss			17.0		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{DS}=800V,I_D=400A, R_{Gon}=5.6Ω,R_{Goff}=3.3Ω L_S=7nH, V_{GS}=-4/+15V, T_{vj}=175°C		165		ns
t_r	Rise Time			78		ns
$t_{d(off)}$	Turn-Off Delay Time			416		ns
t_f	Fall Time			45		ns
E_{on}	Turn-On Switching Loss			24.9		mJ
E_{off}	Turn-Off Switching Loss			17.5		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_{SD}=193A,V_{GS}=-4V, T_{vj}=25°C		4.25		V
		I_{SD}=193A,V_{GS}=-4V, T_{vj}=150°C		3.80		
		I_{SD}=193A,V_{GS}=-4V, T_{vj}=175°C		3.75		
t_{rr}	Diode Reverse Recovery Time	V_R=800V,I_S=400A, -di/dt=5540A/μs,L_S=7nH, V_{GS}=-4V,T_{vj}=25°C		31		ns
Q_r	Recovered Charge			1.07		μC
I_{RM}	Peak Reverse Recovery Current			62		A
E_{rec}	Reverse Recovery Energy			0.15		mJ
t_{rr}	Diode Reverse Recovery Time	V_R=800V,I_S=400A, -di/dt=5950A/μs,L_S=7nH, V_{GS}=-4V,T_{vj}=150°C		44		ns
Q_r	Recovered Charge			3.10		μC
I_{RM}	Peak Reverse Recovery Current			114		A
E_{rec}	Reverse Recovery Energy			0.55		mJ
t_{rr}	Diode Reverse Recovery Time	V_R=800V,I_S=400A, -di/dt=6250A/μs,L_S=7nH, V_{GS}=-4V,T_{vj}=175°C		49		ns
Q_r	Recovered Charge			4.09		μC
I_{RM}	Peak Reverse Recovery Current			138		A
E_{rec}	Reverse Recovery Energy			0.78		mJ

NTC Characteristics T_{vj}=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_C=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
$R_{CC'+EE'}$	Module Lead Resistance, Terminal to Chip		0.43		mΩ
p	Maximum Pressure In Cooling Circuit			2.5	bar
R_{thJF}	Junction-to-Cooling Fluid (per MOSFET) $\triangle V/\triangle t=10.0dm^3/min, T_F=75°C$		0.107	0.123	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		792		g

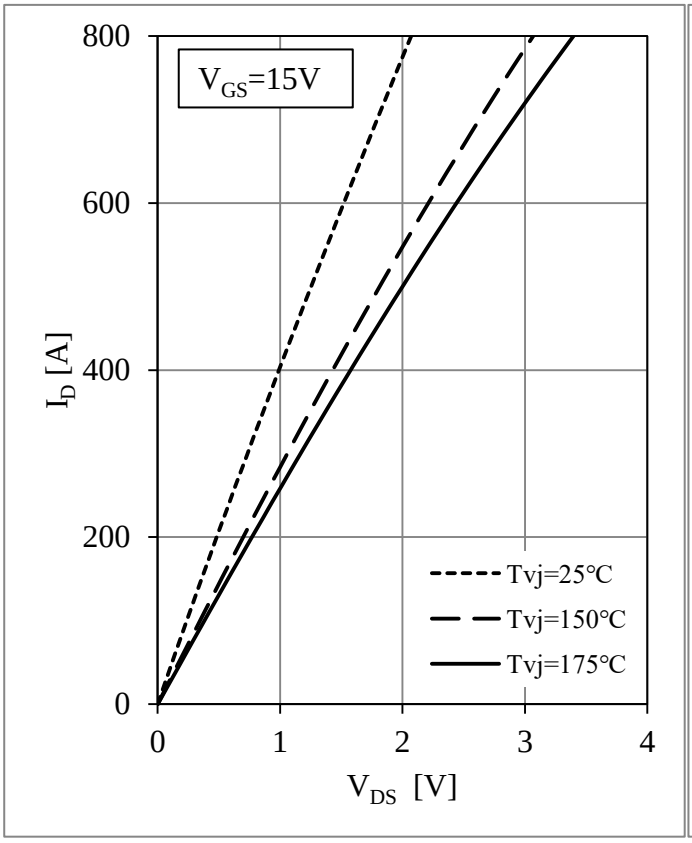


Fig 1. MOSFET Output Characteristics

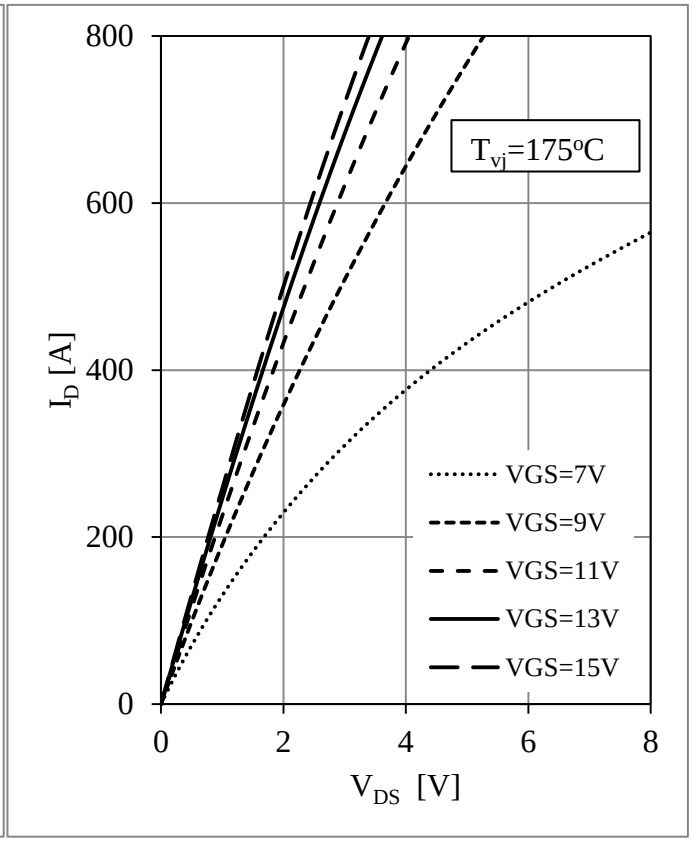


Fig 2. MOSFET Output Characteristics

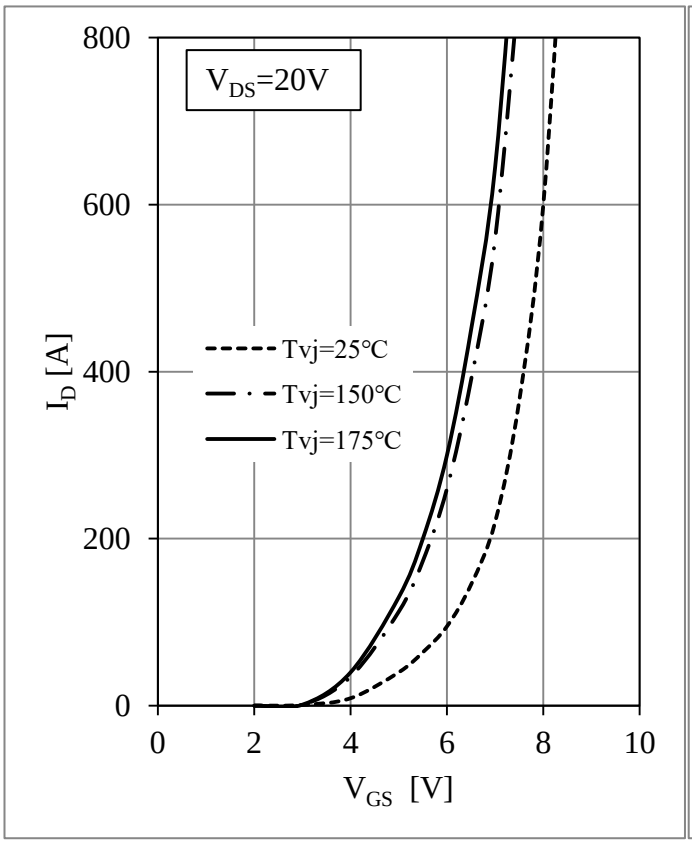


Fig 3. MOSFET Transfer Characteristics

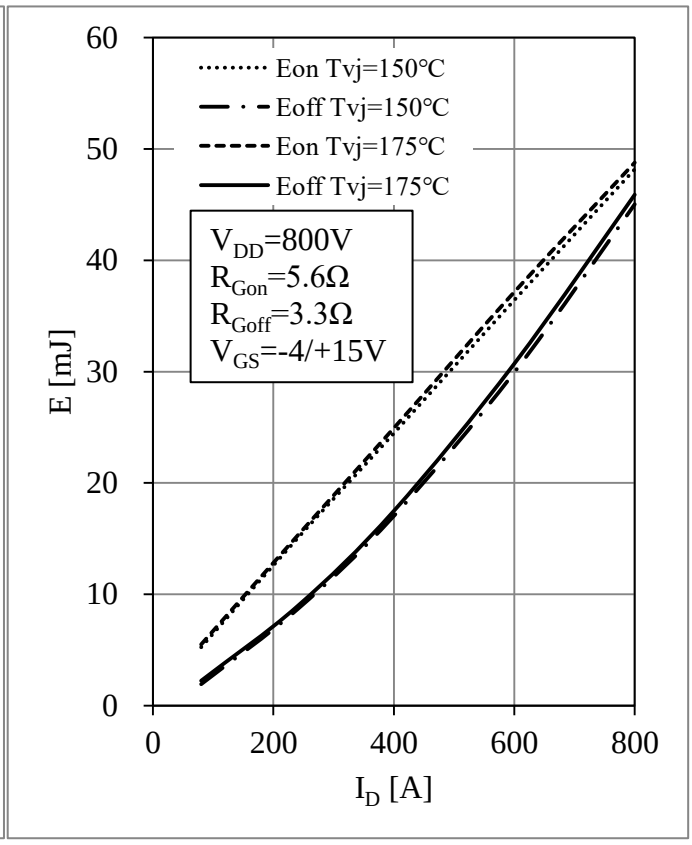


Fig 4. MOSFET Switching Loss vs. I_{DS}

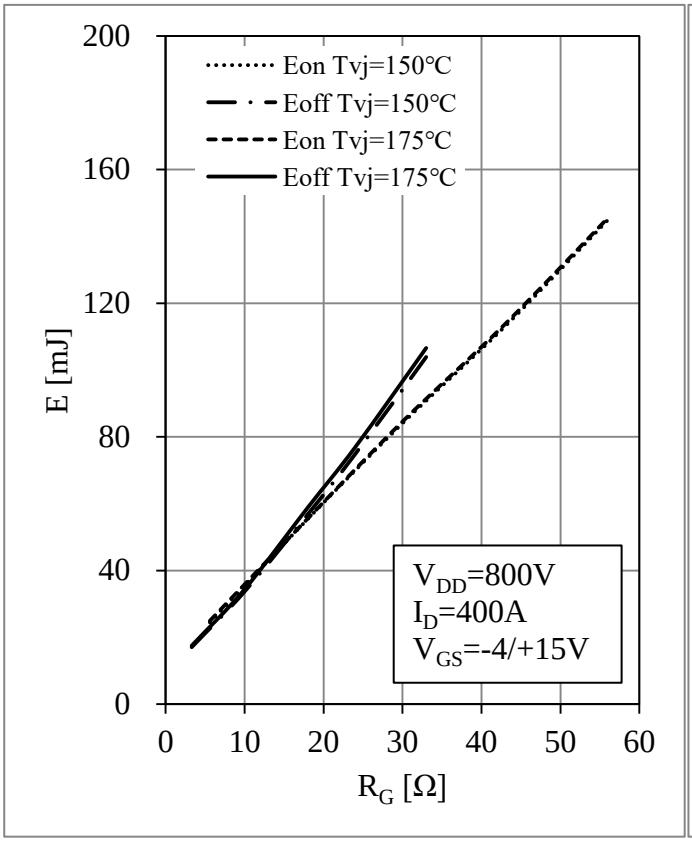


Fig 5. MOSFET Switching Loss vs.R_G

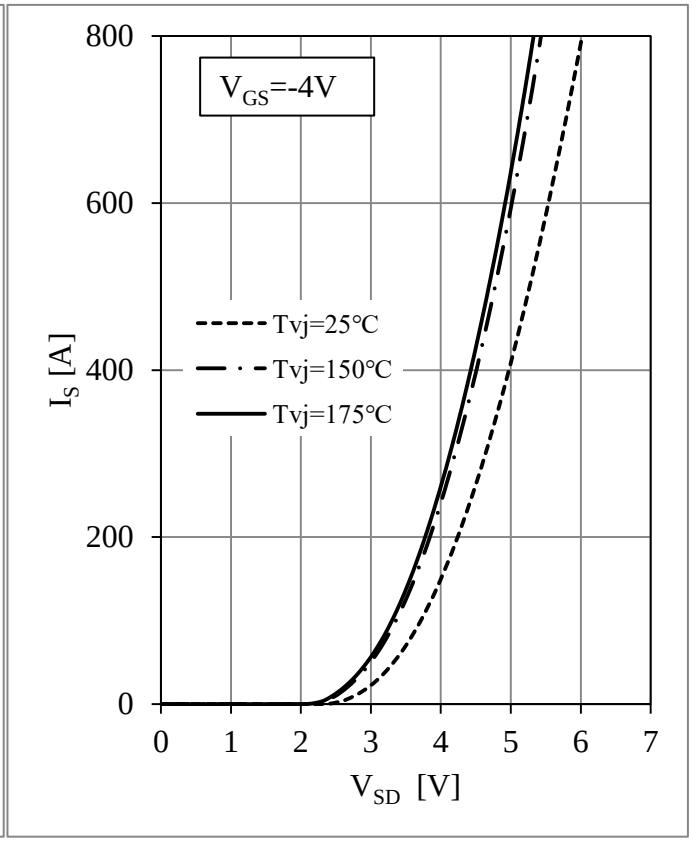


Fig 6. Body Diode Characteristics

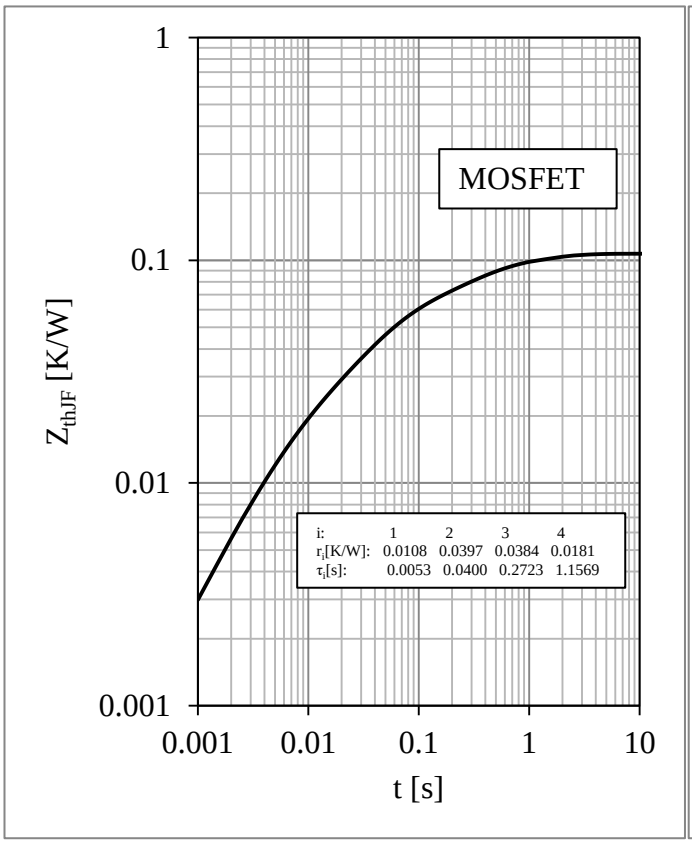


Fig 7. MOSFET Transient Thermal Impedance

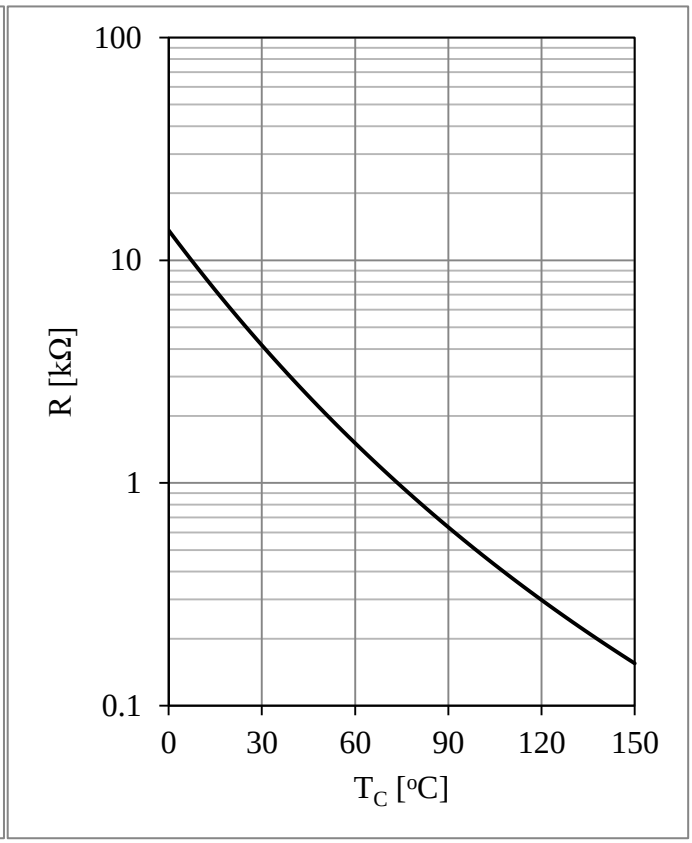
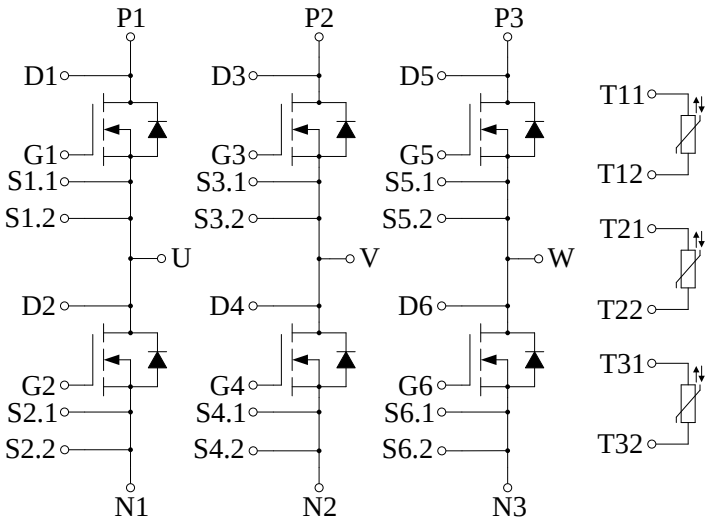


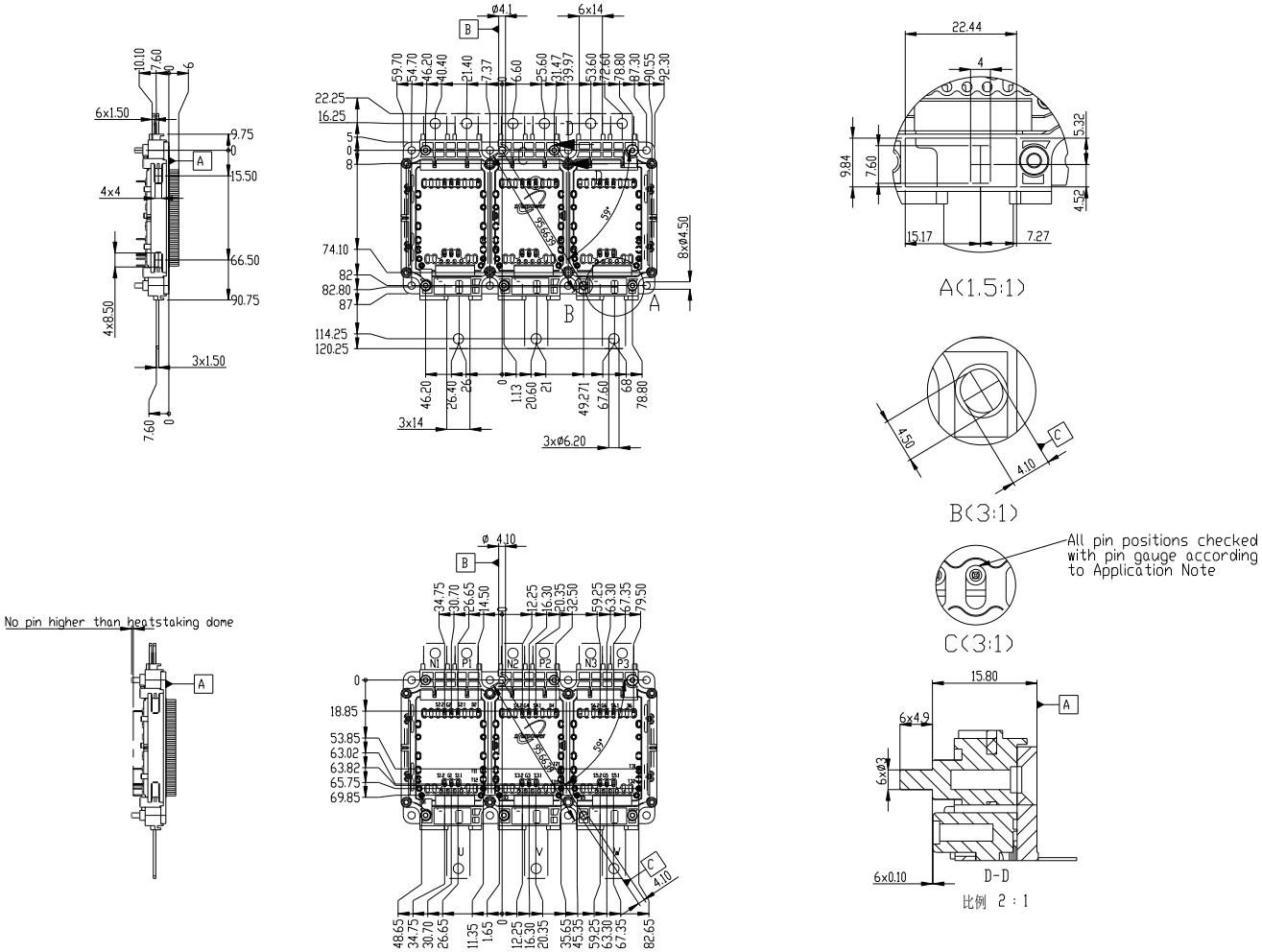
Fig 8. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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