STARPOWER

SEMICONDUCTOR **MOSFET**

MD400CUR120C2S

1200V/400A chopper 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 SMPS and DC drives.

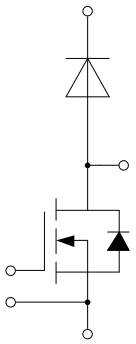
Features

- SiC power MOSFET
- Low $R_{DS(on)}$
- Optimized intrinsic reverse diode
- Chip sintering technology
- Low inductance case avoid oscillations
- Isolated copper baseplate using AlN DBC technology

Typical Applications

- Main and auxiliary AC drives of electric vehicles
- DC servo and robot drives
- Battery vehicles
- UPS equipment
- Plasma cutting

Equivalent Circuit Schematic



Absolute Maximum Ratings T_C=25°C unless otherwise noted

MOSFET

Symbol	Description	Value	Unit
V_{DSS}	Drain-Source Voltage	1200	V
V_{GSS}	Gate-Source Voltage	-4/+22	V
I_D	Drain Current @ T_C=25°C @ T_C=90°C	542 400	A
I_{DM}	Pulsed Drain Current	1644	A

Inverse Diode

Symbol	Description	Value	Unit
I_S	Source Current	400	A
I_{SM}	Pulsed Source Current	1644	A

Series Diode

Symbol	Description	Values	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1200	V
I_F	Diode Continuous Forward Current	400	A
I_{FM}	Diode Maximum Forward Current t_p=1ms	800	A

Module

Symbol	Description	Value	Unit
T_{jmax}	Maximum Junction Temperature	175	°C
T_{jop}	Operating Junction Temperature	-40 to +150	°C
T_{STG}	Storage Temperature Range	-40 to +125	°C
V_{ISO}	Isolation Voltage RMS,f=50Hz,t=1min	2500	V

MOSFET Characteristics T_C=25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$R_{DS(on)}$	Static Drain-Source On-Resistance	I_D=240A,V_{GS}=18V, T_j=25°C		3.3	4.4	mΩ
		I_D=240A,V_{GS}=18V, T_j=125°C		5.0		
$V_{GS(th)}$	Gate-Source Threshold Voltage	I_D=120mA,V_{DS}=V_{GS}, T_j=25°C	2.7		5.6	V
g_{fs}	Forward Transconductance	V_{DS}=10V,I_D=240A		99.6		S
I_{DSS}	Drain-Source Leakage Current	V_{DS}=V_{DSS},V_{GS}=0V, T_j=25°C			120	μA
I_{GSS}	Gate-Source Leakage Current	V_{GS}=V_{GSS},V_{DS}=0V, T_j=25°C			1.2	μA
R_{Gint}	Internal Gate Resistance			0.75		Ω
C_{iss}	Input Capacitance	V_{GS}=0V,V_{DS}=800V, f=1MHz		16.0		nF
C_{oss}	Output Capacitance			0.90		nF
C_{rss}	Reverse Transfer Capacitance			0.33		nF
Q_g	Total Gate Charge	I_D=240A,V_{DS}=600V, V_{GS}=18V		1284		nC
Q_{gs}	Gate-Source Charge			264		nC
Q_{gd}	Gate-Drain ("Miller") Charge			492		nC
$t_{d(on)}$	Turn-On Delay Time	V_{DS}=900V,I_D=400A, R_G=1.6Ω, V_{GS}=0/+18V, T_j=25°C		93		ns
t_r	Rise Time			93		ns
$t_{d(off)}$	Turn-Off Delay Time			296		ns
t_f	Fall Time			78		ns
E_{on}	Turn-On Switching Loss			8.47		mJ
E_{off}	Turn-Off Switching Loss			31.5		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{DS}=900V,I_D=400A, R_G=1.6Ω, V_{GS}=0/+18V, T_j=125°C		95		ns
t_r	Rise Time			95		ns
$t_{d(off)}$	Turn-Off Delay Time			336		ns
t_f	Fall Time			78		ns
E_{on}	Turn-On Switching Loss			8.60		mJ
E_{off}	Turn-Off Switching Loss			33.1		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{DS}=900V,I_D=400A, R_G=1.6Ω, V_{GS}=0/+18V, T_j=150°C		100		ns
t_r	Rise Time			95		ns
$t_{d(off)}$	Turn-Off Delay Time			343		ns
t_f	Fall Time			82		ns
E_{on}	Turn-On Switching Loss			8.65		mJ
E_{off}	Turn-Off Switching Loss			33.3		mJ

Inverse Diode Characteristics T_C=25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{SD}	Diode Forward Voltage	I_S=240A,V_{GS}=0V,T_j=25°C		3.20		V
t_{rr}	Diode Reverse Recovery Time	V_R=600V,I_S=240A, -di/dt=13200A/μs, T_j=25°C		25		ns
Q_r	Diode Reverse Recovery Charge			1.32		μC
I_{RM}	Peak Reverse Recovery Current			108		A

Series Diode Characteristics T_C=25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_F	Diode Forward Voltage	I_F=400A,V_{GE}=0V,T_j=25°C		1.40	1.85	V
		I_F=400A,V_{GE}=0V,T_j=125°C		1.80		
		I_F=400A,V_{GE}=0V,T_j=150°C		1.90		
t_{rr}	Diode Reverse Recovery Time	V_R=900V,I_S=400A, -di/dt=4550A/μs, V_{GS}=0V, T_j=25°C		34.8		ns
Q_r	Diode Reverse Recovery Charge			2.75		μC
I_{rrm}	Peak Reverse Recovery Current			79		A
E_{rec}	Reverse Recovery Energy			0.23		mJ
t_{rr}	Diode Reverse Recovery Time	V_R=900V,I_S=400A, -di/dt=4600A/μs, V_{GS}=0V, T_j=125°C		37.2		ns
Q_r	Diode Reverse Recovery Charge			3.05		μC
I_{rrm}	Peak Reverse Recovery Current			82		A
E_{rec}	Reverse Recovery Energy			0.51		mJ
t_{rr}	Diode Reverse Recovery Time	V_R=900V,I_S=400A, -di/dt=4650A/μs, V_{GS}=0V, T_j=150°C		38.4		ns
Q_r	Diode Reverse Recovery Charge			3.19		μC
I_{rrm}	Peak Reverse Recovery Current			83		A
E_{rec}	Reverse Recovery Energy			0.53		mJ

Module Characteristics T_C=25°C unless otherwise noted

Symbol	Parameter	Min.	Typ.	Max.	Unit
R_{thJC}	Junction-to-Case(Mosfet) Junction-to-Case(Diode)			0.074 0.061	K/W
R_{thCH}	Case-to-Heatsink (Mosfet) Case-to-Heatsink (Diode) Case-to-Heatsink (per Module)		0.022 0.018 0.010		K/W
M	Terminal Connection Torque, Screw M6 Mounting Torque, Screw M6	2.5 3.0		5.0 5.0	N.m
G	Weight of Module		300		g

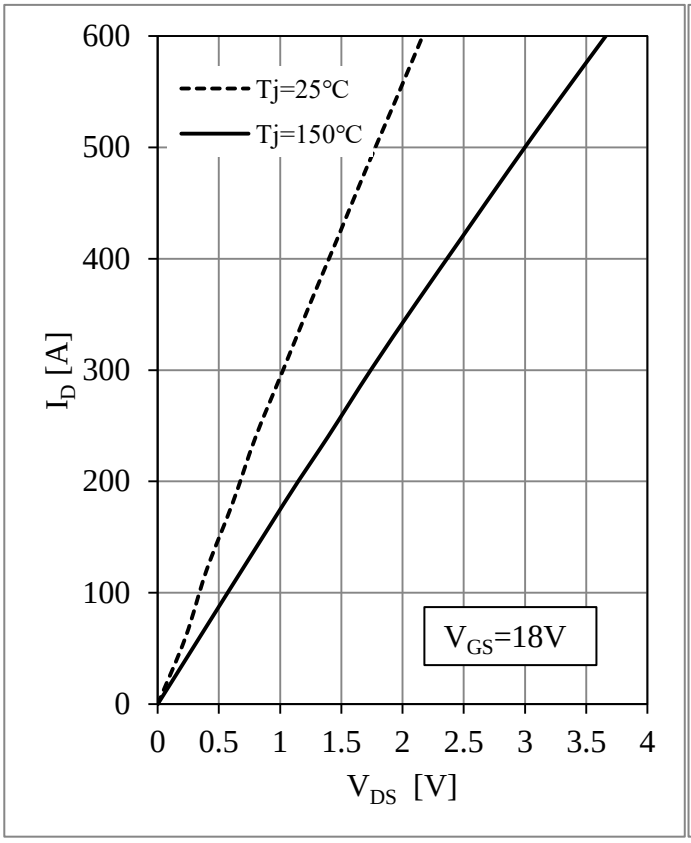


Fig 1. MOSFET Output Characteristics

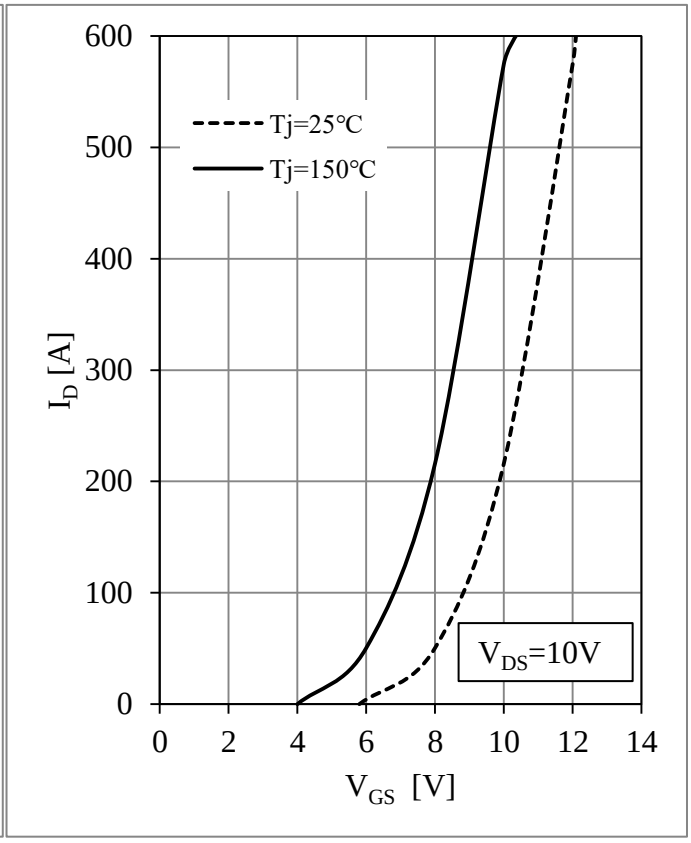


Fig 2. MOSFET Transfer Characteristics

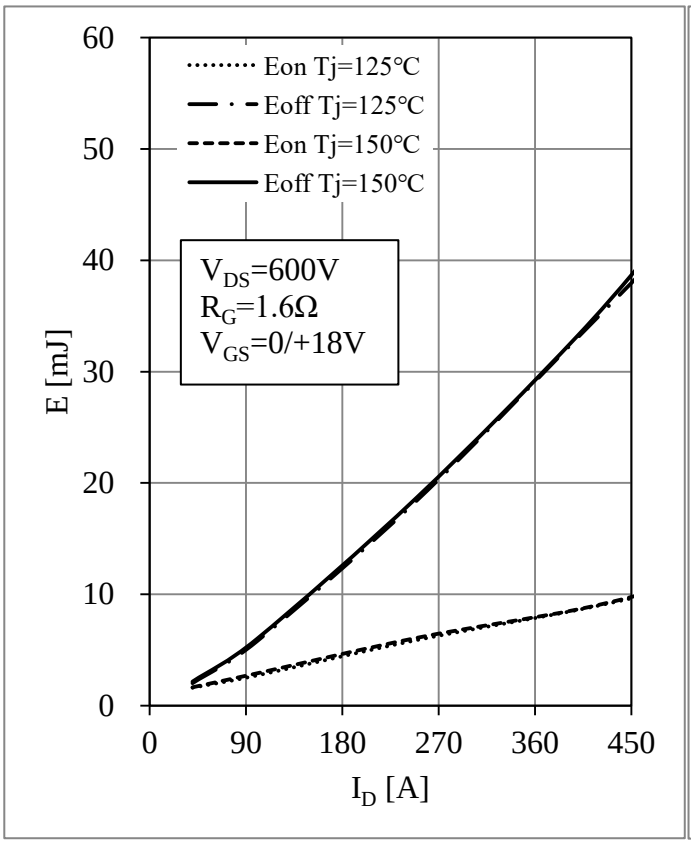


Fig 3. MOSFET Switching Loss vs. I_D

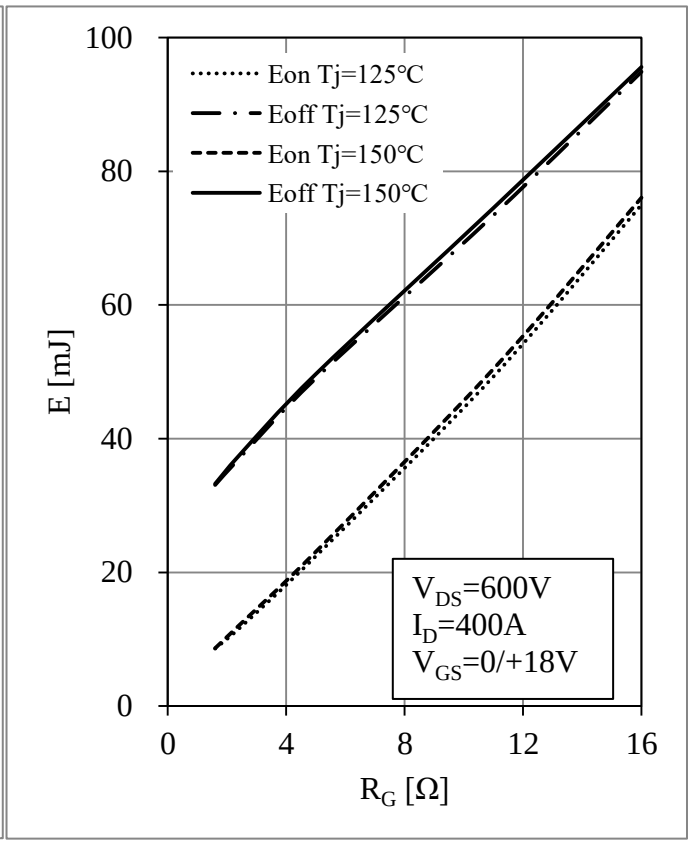


Fig 4. MOSFET Switching Loss vs. R_G

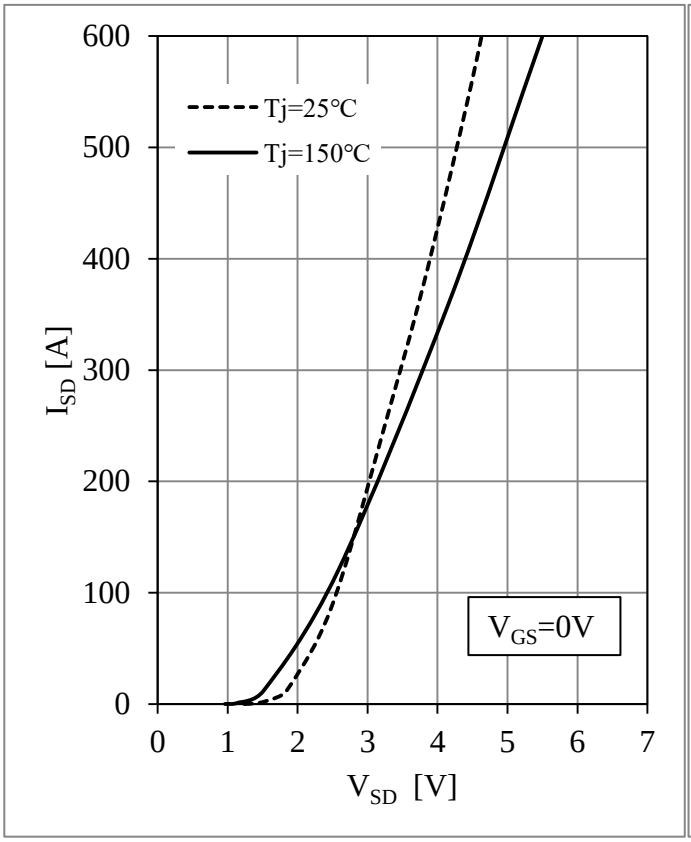


Fig 5. Body Diode Output Characteristics

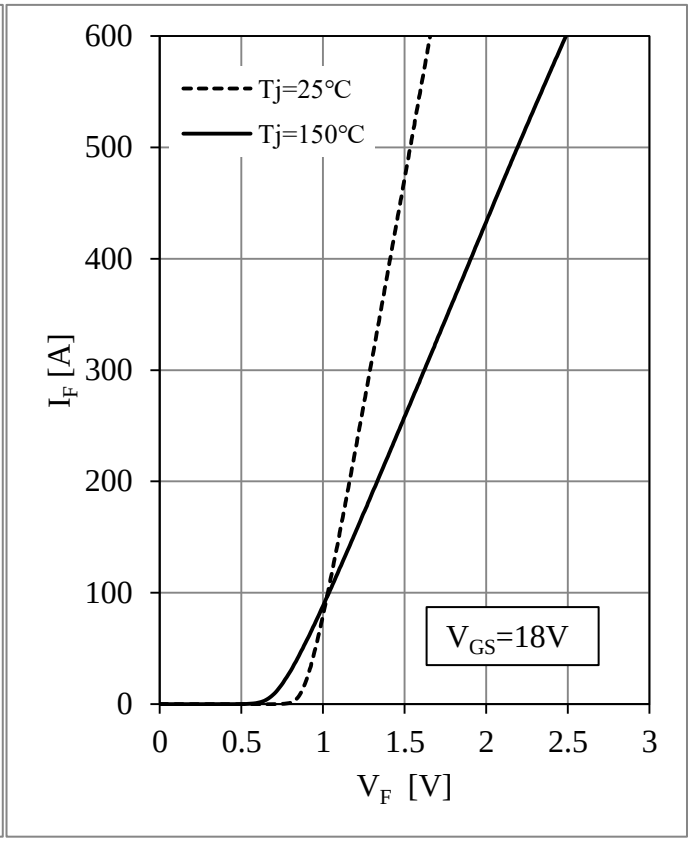


Fig 6. Diode Output Characteristics

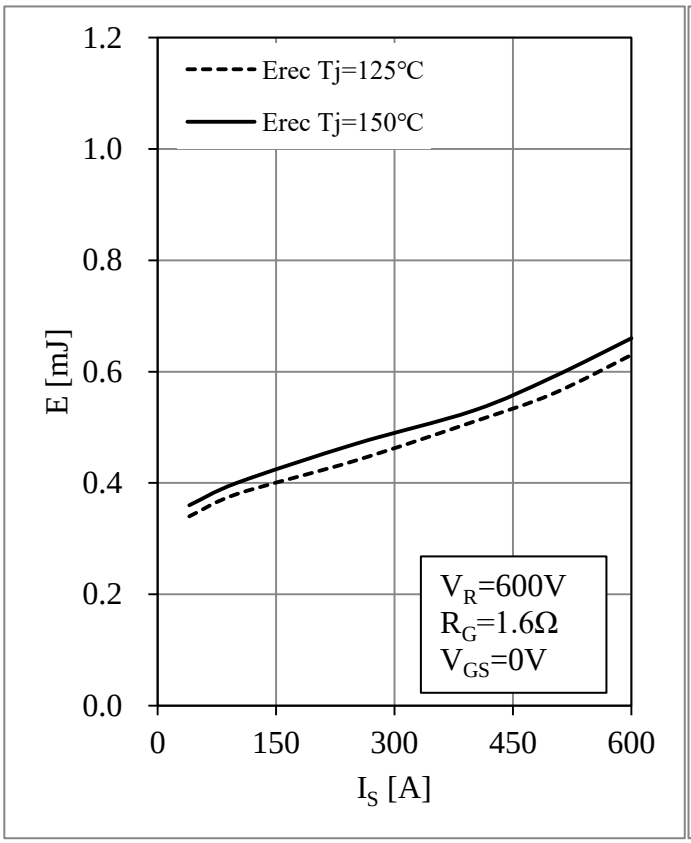


Fig 7. Diode Switching Loss vs. I_S

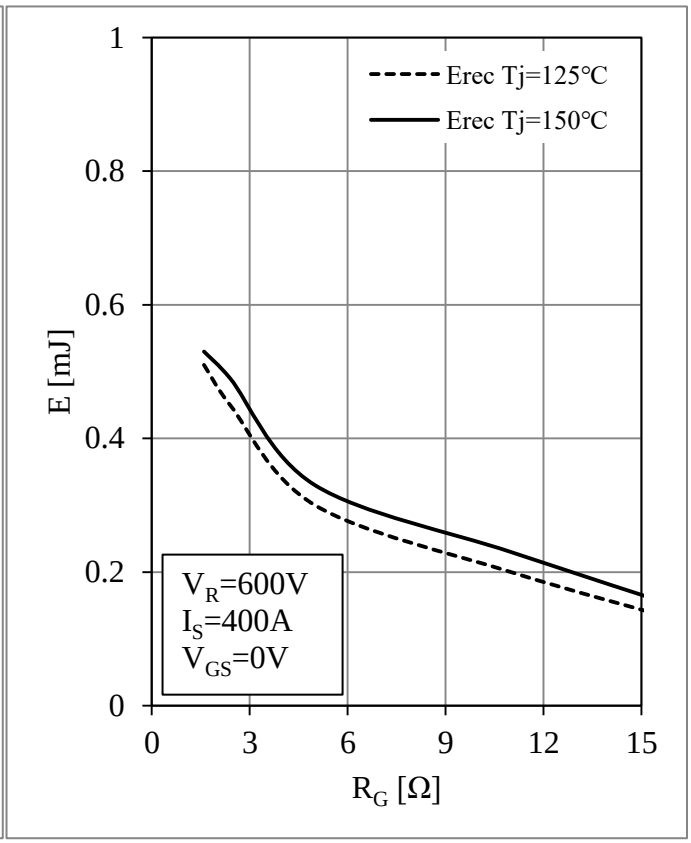


Fig 8. Diode Switching Loss vs. R_G

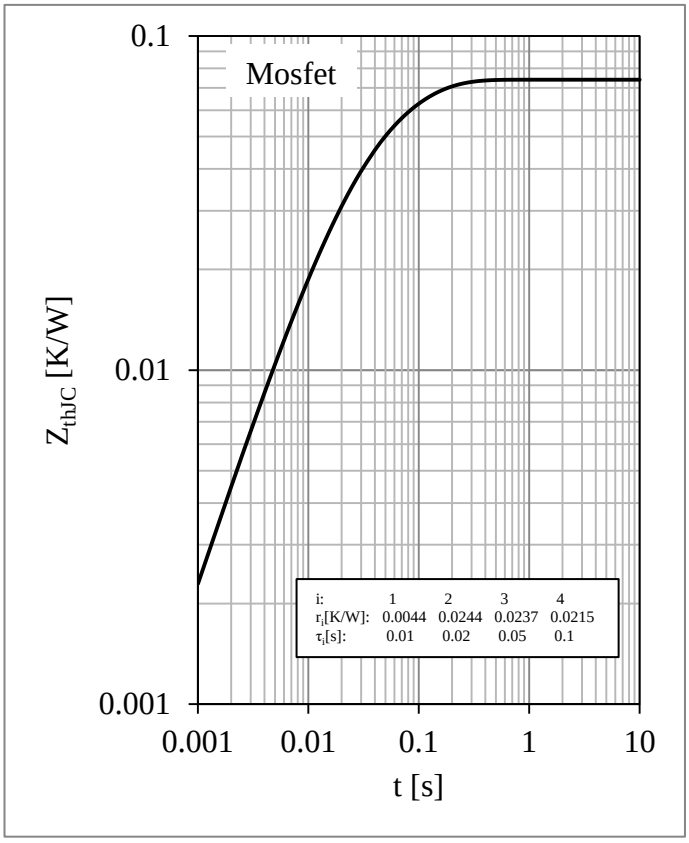
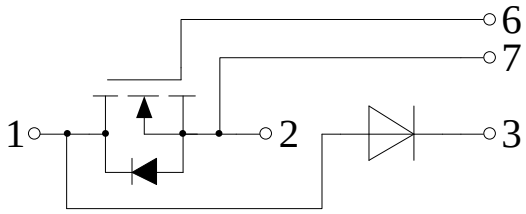


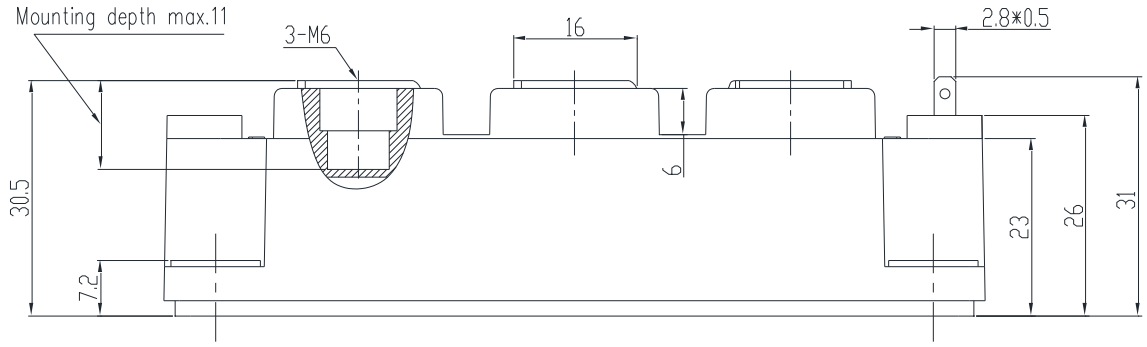
Fig 9. MOSFET Transient Thermal Impedance

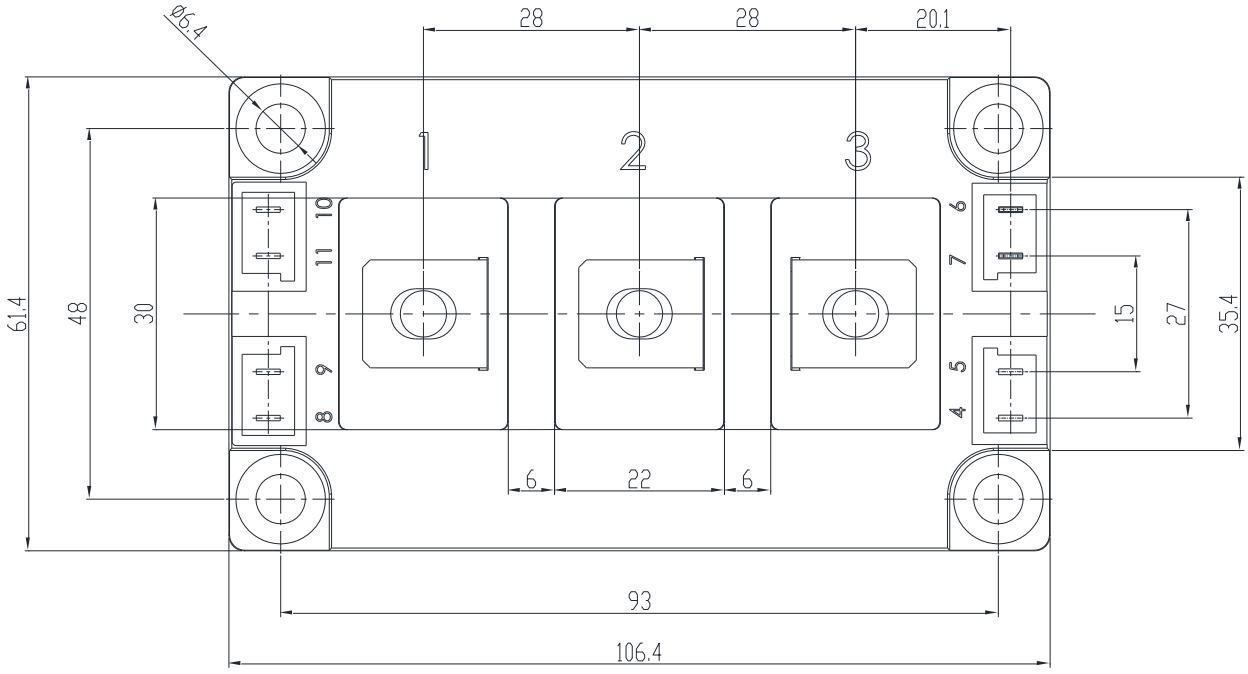
Circuit Schematic



Package Dimensions

Dimensions in Millimeters





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