

# STARPOWER

SEMICONDUCTOR

# MOSFET

## MD300HFR120C2S

**1200V/300A 2 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.

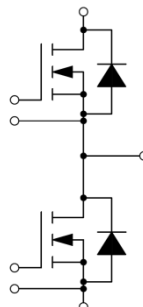
### Features

- 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

### MOSFET

Symbol	Description	Value	Unit
$V_{DSS}$	Drain-Source Voltage	1200	V
$V_{GSS}$	Gate-Source Voltage	-4/+22	V
$I_D$	Drain Current @ $T_C=25^{\circ}C$ @ $T_C=80^{\circ}C$	381 300	A
$I_{DM}$	Pulsed Drain Current	1096	A

### Inverse Diode

Symbol	Description	Value	Unit
$I_S$	Source Current	300	A
$I_{SM}$	Pulsed Source Current	1096	A

### Module

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

**MOSFET Characteristics**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit	
$R_{DS(on)}$	Static Drain-Source On-Resistance	$I_D=160A, V_{GS}=18V, T_j=25^\circ C$		5.0	6.5	m $\Omega$	
		$I_D=160A, V_{GS}=18V, T_j=125^\circ C$		7.5			
$V_{GS(th)}$	Gate-Source Threshold Voltage	$I_D=80mA, V_{DS}=V_{GS}, T_j=25^\circ C$	2.7		5.6	V	
$g_{fs}$	Forward Transconductance	$V_{DS}=10V, I_D=160A$		66.4		S	
$I_{DSS}$	Drain-Source Leakage Current	$V_{DS}=V_{DSS}, V_{GS}=0V, T_j=25^\circ C$			80	$\mu A$	
$I_{GSS}$	Gate-Source Leakage Current	$V_{GS}=V_{GSS}, V_{DS}=0V, T_j=25^\circ C$			0.8	$\mu A$	
$R_{Gint}$	Internal Gate Resistance			1.13		$\Omega$	
$C_{iss}$	Input Capacitance	$V_{GS}=0V, V_{DS}=800V, f=1MHz$		10.7		nF	
$C_{oss}$	Output Capacitance			0.60		nF	
$C_{rss}$	Reverse Transfer Capacitance			0.22		nF	
$Q_g$	Total Gate Charge	$I_D=160A, V_{DS}=600V, V_{GS}=18V$		856		nC	
$Q_{gs}$	Gate-Source Charge			176		nC	
$Q_{gd}$	Gate-Drain ("Miller") Charge			328		nC	
$t_{d(on)}$	Turn-On Delay Time	$V_{DS}=600V, I_D=300A, R_G=1.6\Omega, V_{GS}=0/+18V, T_j=25^\circ C$		58		ns	
$t_r$	Rise Time			66		ns	
$t_{d(off)}$	Turn-Off Delay Time			170		ns	
$t_f$	Fall Time			64		ns	
$E_{on}$	Turn-On Switching Loss				13.6		mJ
$E_{off}$	Turn-Off Switching Loss				10.7		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{DS}=600V, I_D=300A, R_G=1.6\Omega, V_{GS}=0/+18V, T_j=125^\circ C$		59		ns	
$t_r$	Rise Time			68		ns	
$t_{d(off)}$	Turn-Off Delay Time			191		ns	
$t_f$	Fall Time			73		ns	
$E_{on}$	Turn-On Switching Loss				13.8		mJ
$E_{off}$	Turn-Off Switching Loss				11.7		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{DS}=600V, I_D=300A, R_G=1.6\Omega, V_{GS}=0/+18V, T_j=150^\circ C$		59		ns	
$t_r$	Rise Time			68		ns	
$t_{d(off)}$	Turn-Off Delay Time			197		ns	
$t_f$	Fall Time			75		ns	
$E_{on}$	Turn-On Switching Loss				14.0		mJ
$E_{off}$	Turn-Off Switching Loss				12.1		mJ

### Inverse Diode Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{SD}$	Diode Forward Voltage	$I_S=160A, V_{GS}=0V, T_j=25^{\circ}C$		3.2		V
$t_{rr}$	Diode Reverse Recovery Time	$V_R=600V, I_S=300, -di/dt=4500A/\mu s, V_{GS}=0V, T_j=25^{\circ}C$		296		ns
$Q_r$	Diode Reverse Recovery Charge			68		$\mu C$
$I_{rrm}$	Peak Reverse Recovery Current			402		A
$E_{rec}$	Reverse Recovery Energy			38.2		mJ
$t_{rr}$	Diode Reverse Recovery Time	$V_R=600V, I_S=300A, -di/dt=4500A/\mu s, V_{GS}=0V, T_j=125^{\circ}C$		297		ns
$Q_r$	Diode Reverse Recovery Charge			69		$\mu C$
$I_{rrm}$	Peak Reverse Recovery Current			407		A
$E_{rec}$	Reverse Recovery Energy			39.0		mJ
$t_{rr}$	Diode Reverse Recovery Time	$V_R=600V, I_S=300A, -di/dt=4500A/\mu s, V_{GS}=0V, T_j=150^{\circ}C$		298		ns
$Q_r$	Diode Reverse Recovery Charge			69		$\mu C$
$I_{rrm}$	Peak Reverse Recovery Current			409		A
$E_{rec}$	Reverse Recovery Energy			39.7		mJ

### Module Characteristics $T_C=25^{\circ}C$ unless otherwise noted

Symbol	Parameter	Min.	Typ.	Max.	Unit
$R_{thJC}$	Junction-to-Case(Mosfet)			0.100	K/W
$R_{thCH}$	Case-to-Heatsink (Mosfet) Case-to-Heatsink (per Module)		0.020 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

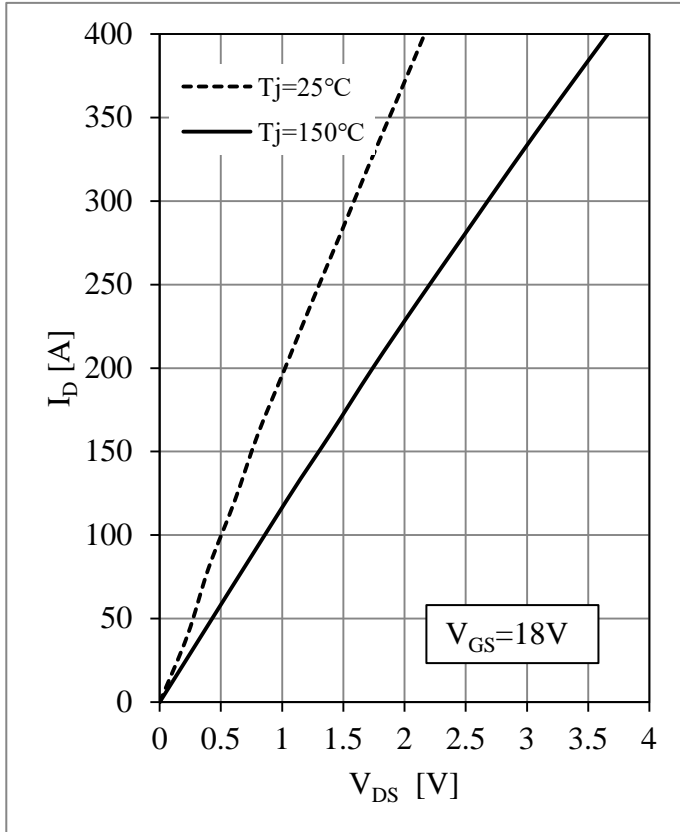


Fig 1. MOSFET Output Characteristics

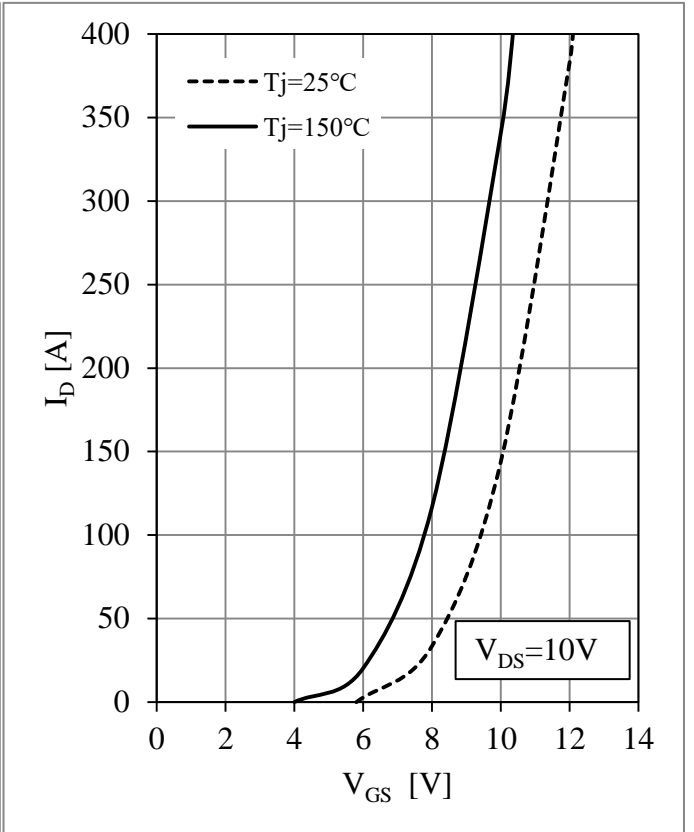


Fig 2. MOSFET Transfer Characteristics

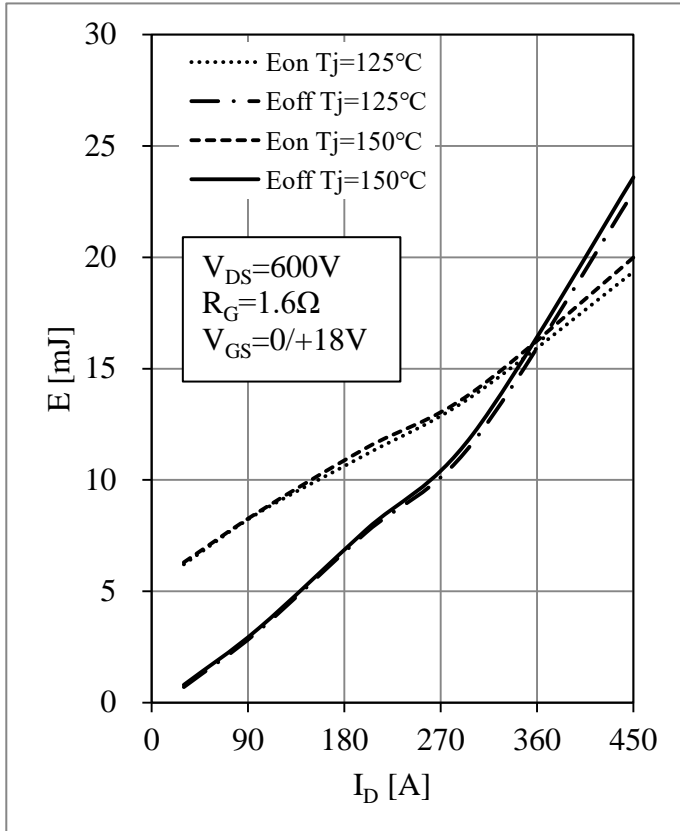


Fig 3. MOSFET Switching Loss vs.  $I_D$

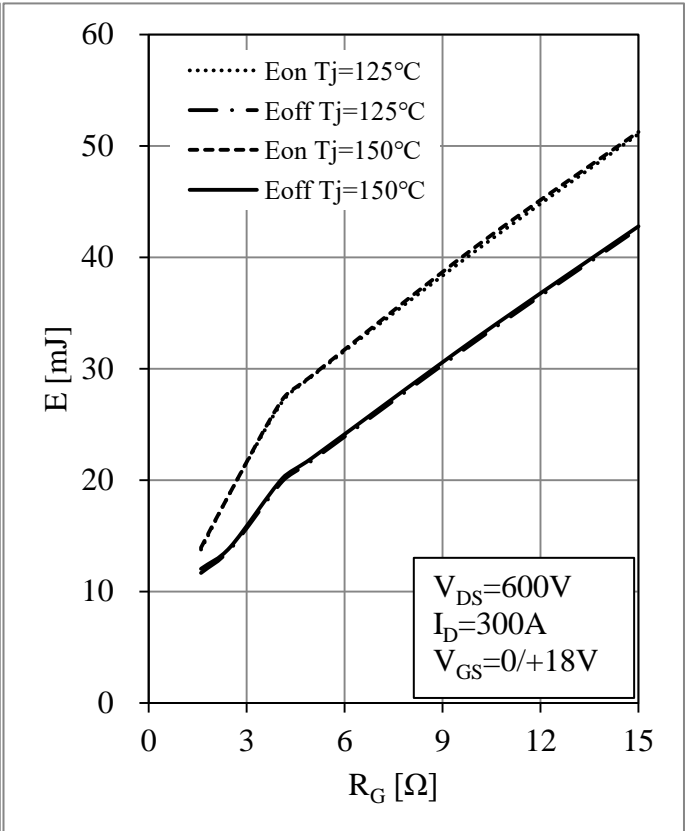


Fig 4. MOSFET Switching Loss vs.  $R_G$

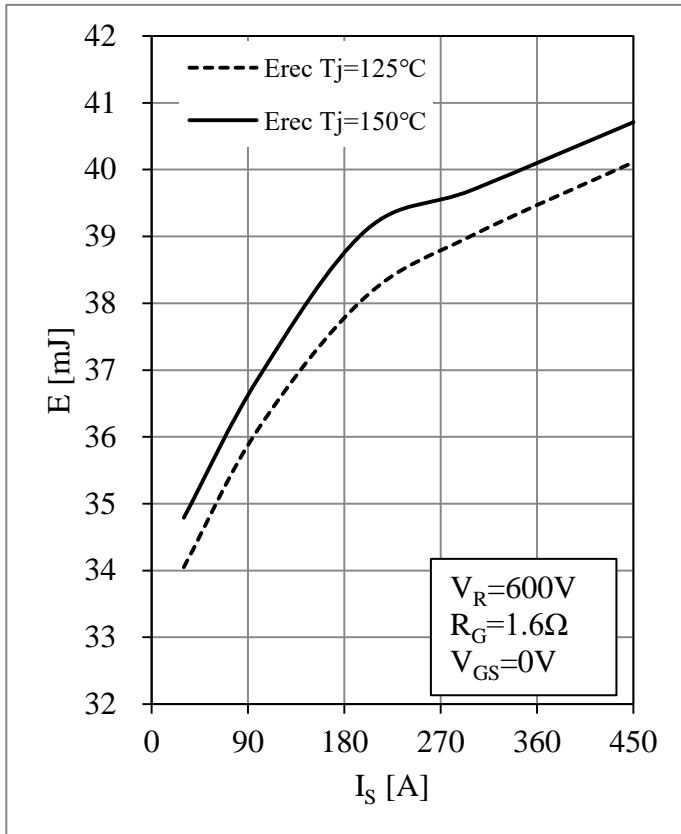


Fig 5. Body Diode Switching Loss vs.  $I_S$

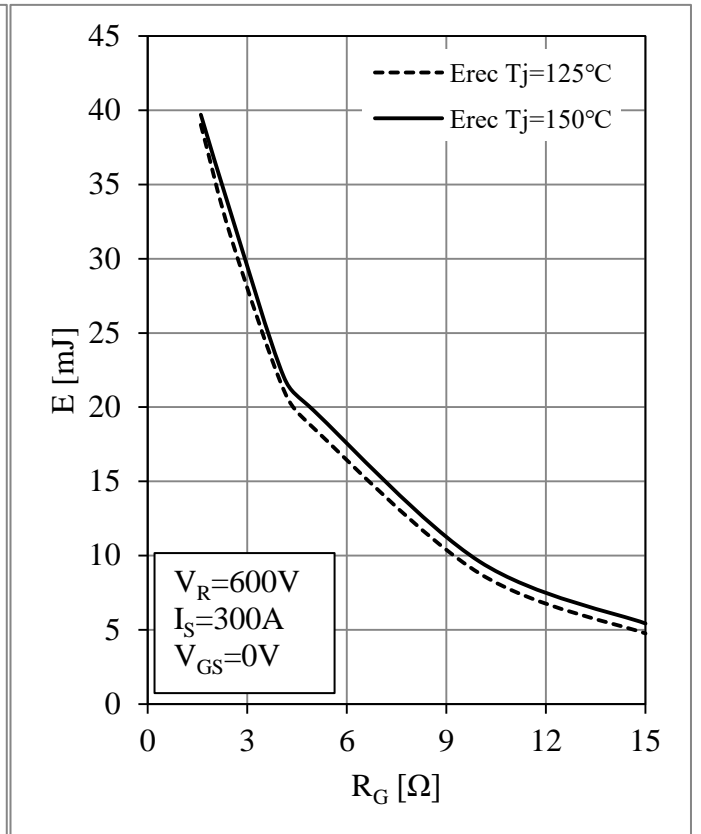


Fig 6. Body Diode Switching Loss vs.  $R_G$

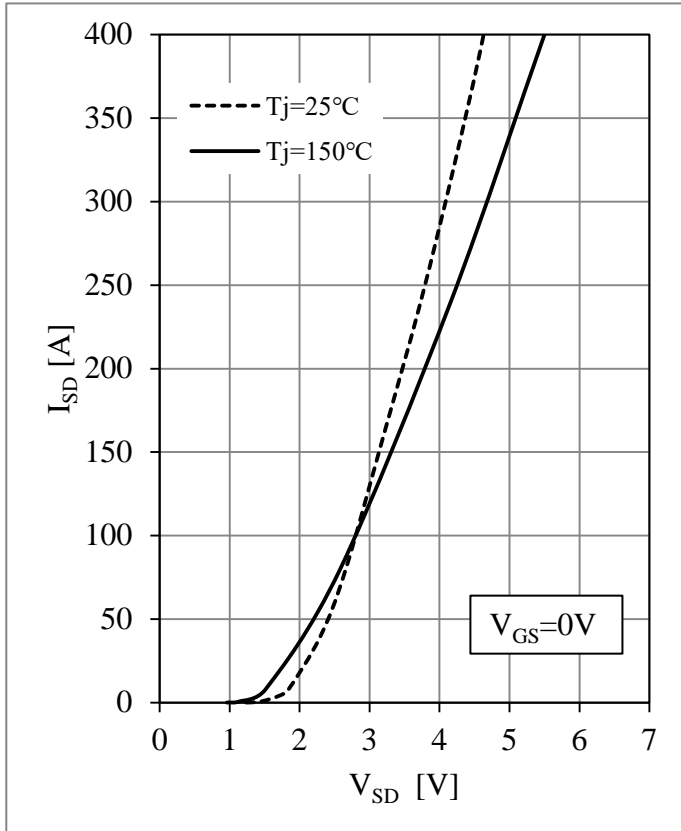


Fig 7. Body Diode Output Characteristics

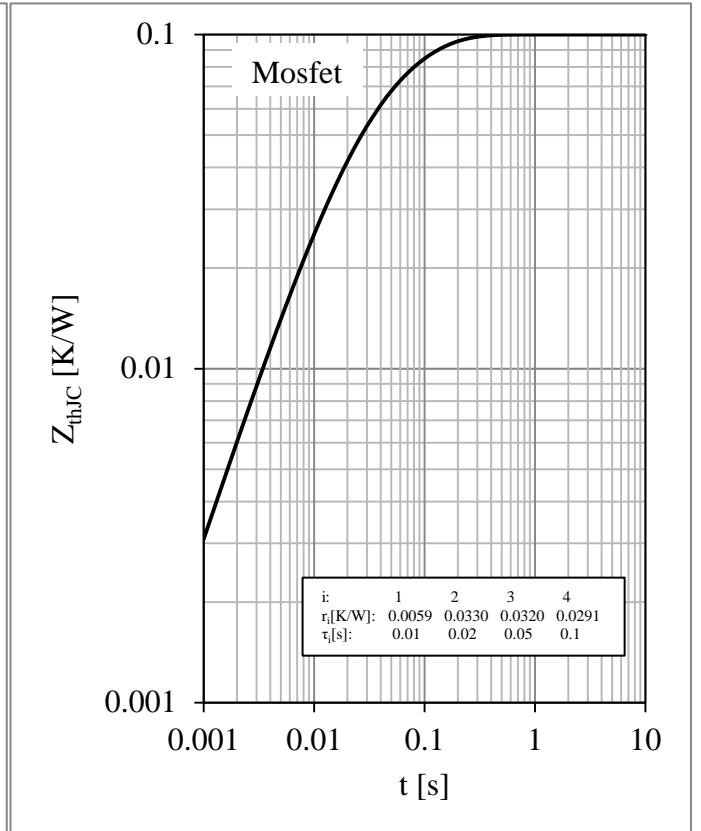
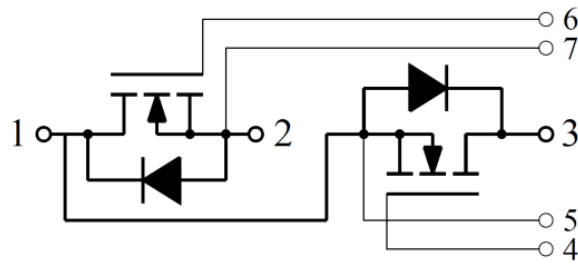


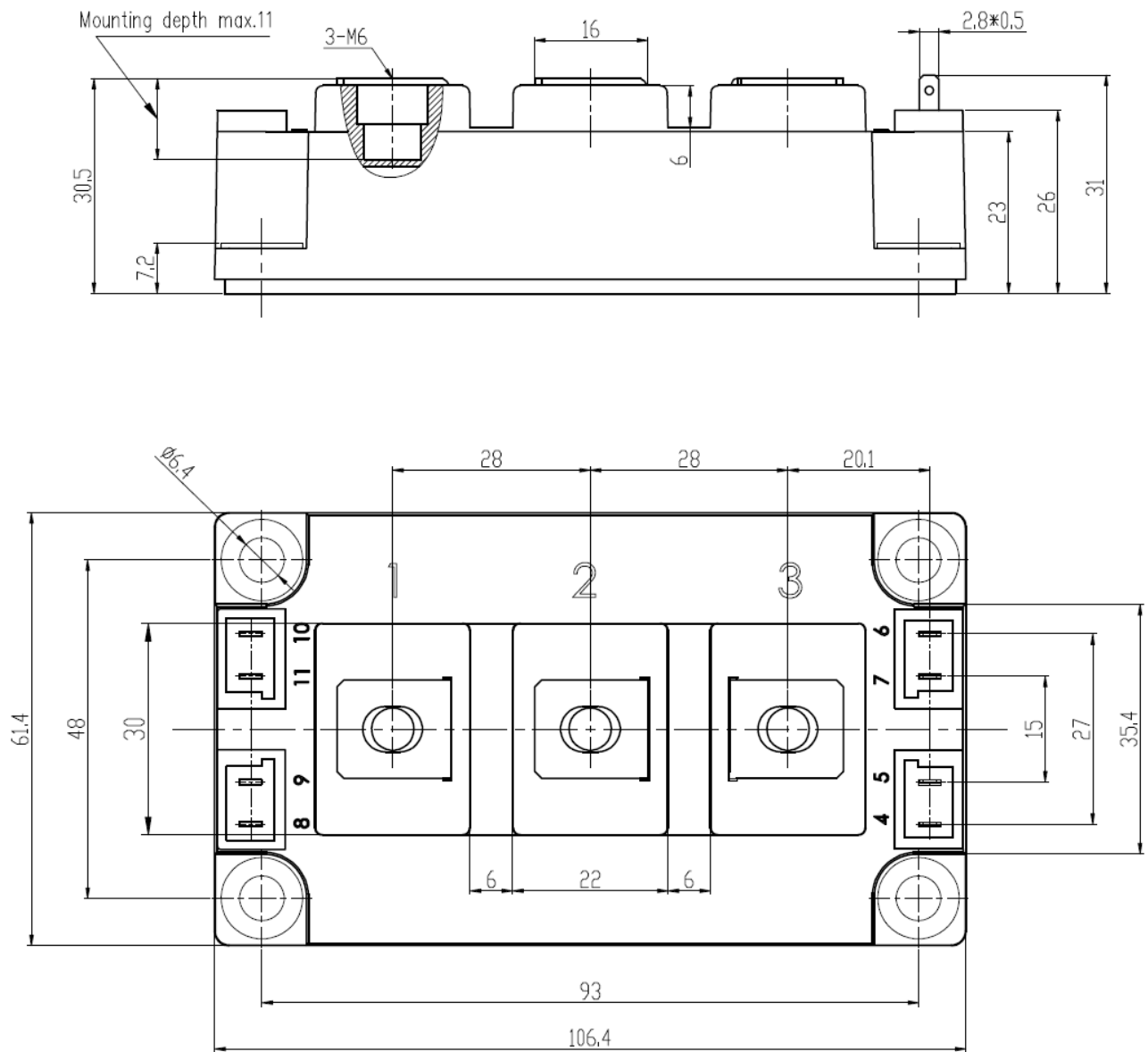
Fig 8. MOSFET Transient Thermal Impedance

**Circuit Schematic**



**Package Dimensions**

Dimensions in Millimeters



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