

# STARPOWER

SEMICONDUCTOR

# MOSFET

## MD300HFC120C2S

**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 as SMPS and DC drives.

### Features

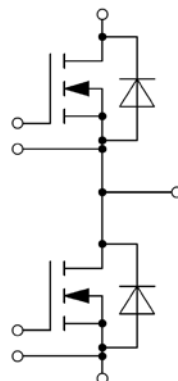
- SiC power MOSFET
- Low  $R_{DS(on)}$
- Optimized intrinsic reverse diode
- Low inductance case avoid oscillations
- Kelvin source terminals for easy drive
- Isolated copper baseplate using DBC technology



### Typical Applications

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

### Equivalent Circuit Schematic



**Absolute Maximum Ratings**  $T_C=25^{\circ}\text{C}$  unless otherwise noted**MOSFET**

Symbol	Description	Value	Unit
$V_{DSS}$	Drain-Source Voltage	1200	V
$V_{GSS}$	Gate-Source Voltage	-6/+22	V
$I_D$	Drain Current @ $T_C=25^{\circ}\text{C}$ @ $T_C=100^{\circ}\text{C}$	480	A
		300	A
$I_{DM}$	Pulsed Drain Current	960	A
$P_D$	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	892	W

**Body Diode**

Symbol	Description	Value	Unit
$I_S$	Source Current	480	A
$I_{SM}$	Pulsed Source Current	960	A

**Module**

Symbol	Description	Value	Unit
$T_{jmax}$	Maximum Junction Temperature	175	$^{\circ}\text{C}$
$T_{jop}$	Operating Junction Temperature	-40 to +150	$^{\circ}\text{C}$
$T_{STG}$	Storage Temperature Range	-40 to +125	$^{\circ}\text{C}$
$V_{ISO}$	Isolation Voltage RMS, $f=50\text{Hz}$ , $t=1\text{min}$	4000	V

**MOSFET Characteristics**  $T_C=25^\circ\text{C}$  unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit	
$R_{DS(on)}$	Static Drain-Source On-Resistance	$I_D=120\text{A}, V_{GS}=18\text{V}, T_j=25^\circ\text{C}$		6.67	9.75	$\text{m}\Omega$	
		$I_D=120\text{A}, V_{GS}=18\text{V}, T_j=125^\circ\text{C}$		10.4			
$V_{GS(th)}$	Gate-Source Threshold Voltage	$I_D=52.8\text{mA}, V_{DS}=10\text{V}, T_j=25^\circ\text{C}$	1.6		4.0	V	
$g_{fs}$	Forward Transconductance	$V_{DS}=10\text{V}, I_D=120\text{A}, T_j=25^\circ\text{C}$		44.4		S	
$I_{DSS}$	Drain-Source Leakage Current	$V_{DS}=V_{DSS}, V_{GS}=0\text{V}, T_j=25^\circ\text{C}$			1.0	mA	
$I_{GSS}$	Gate-Source Leakage Current	$V_{GS}=V_{GSS}, V_{DS}=0\text{V}, T_j=25^\circ\text{C}$			400	nA	
$R_{Gint}$	Internal Gate Resistance			0.69		$\Omega$	
$C_{iss}$	Input Capacitance	$V_{GS}=0\text{V}, V_{DS}=800\text{V}, f=1.0\text{MHz}$		25.0		nF	
$C_{oss}$	Output Capacitance			0.92		nF	
$C_{rss}$	Reverse Transfer Capacitance			1.96		nF	
$Q_g$	Total Gate Charge	$I_D=120\text{A}, V_{DS}=400\text{V}, V_{GS}=18\text{V}$		1272		nC	
$Q_{gs}$	Gate-Source Charge			324		nC	
$Q_{gd}$	Gate-Drain ("Miller") Charge			372		nC	
$t_{d(on)}$	Turn-On Delay Time	$V_{DS}=600\text{V}, I_D=120\text{A}, R_G=0\Omega, V_{GS}=0/18\text{V}, T_j=25^\circ\text{C}$		35		ns	
$t_r$	Rise Time			36		ns	
$t_{d(off)}$	Turn-Off Delay Time			76		ns	
$t_f$	Fall Time			22		ns	
$E_{on}$	Turn-On Switching Loss				2.09		mJ
$E_{off}$	Turn-Off Switching Loss				0.61		mJ

**Body Diode Characteristics**  $T_C=25^\circ\text{C}$  unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit	
$V_{SD}$	Diode Forward Voltage	$I_S=120\text{A}, V_{GS}=0\text{V}, T_j=25^\circ\text{C}$		4.60		V	
$t_{rr}$	Diode Reverse Recovery Time	$V_R=400\text{V}, I_S=120\text{A}, di/dt=1800\text{A}/\mu\text{s}, V_{GS}=0\text{V}, T_j=25^\circ\text{C}$		31		ns	
$Q_r$	Diode Reverse Recovery Charge				528		nC
$I_{RM}$	Peak Reverse Recovery Current				27.6		A

**Module Characteristics**  $T_c=25^{\circ}\text{C}$  unless otherwise noted

Symbol	Parameter	Min.	Typ.	Max.	Unit
$R_{thJC}$	Junction-to-Case(per MOSFET)			0.168	K/W
$R_{thCH}$	Case-to-Heatsink (per MOSFET)		0.070		K/W
	Case-to-Heatsink (per Module)		0.035		
M	Terminal Connection Torque, Screw M5	2.5		5.0	N.m
	Mounting Torque, Screw M6	3.0		5.0	
G	Weight of Module		300		g

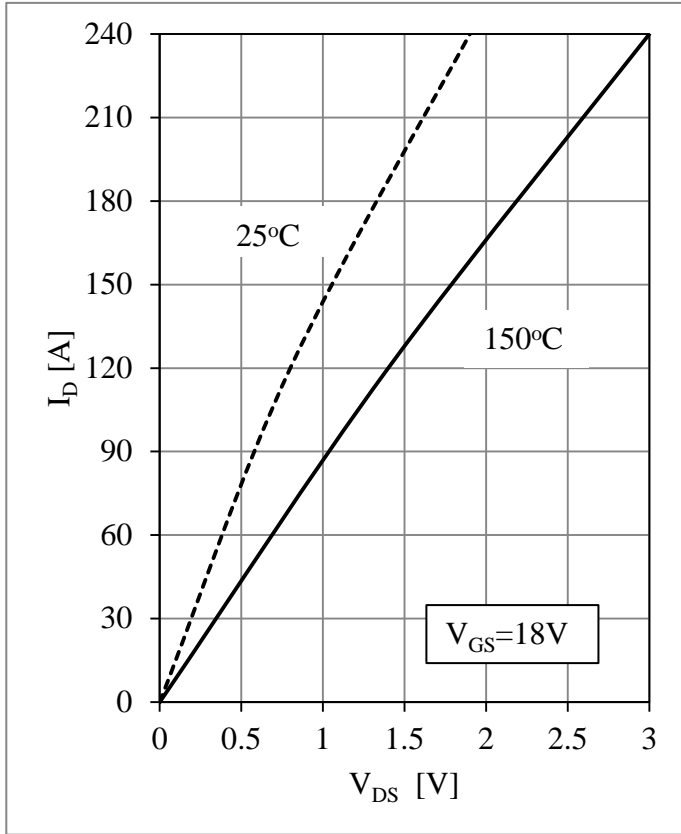


Fig 1. MOSFET Output Characteristics

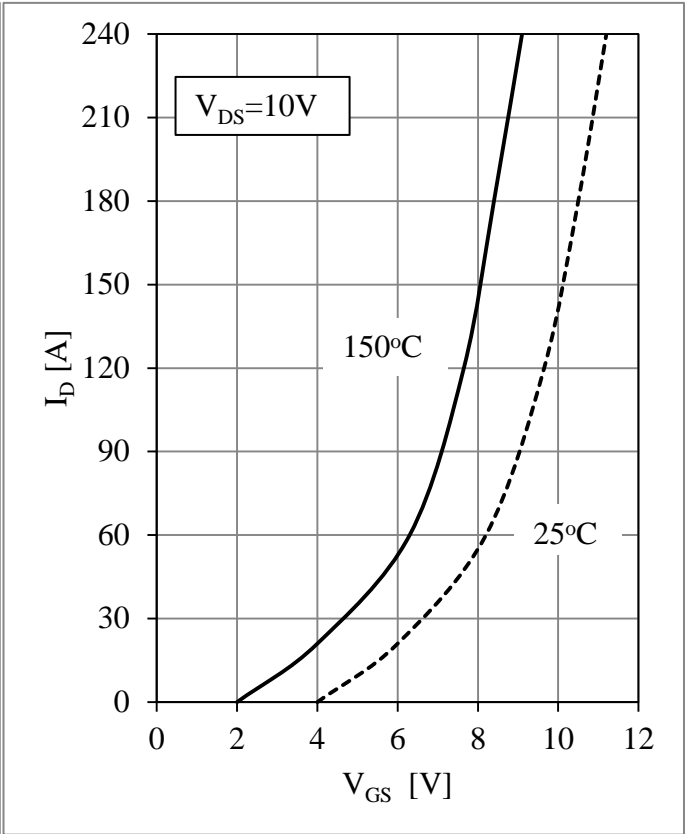


Fig 2. MOSFET Transfer Characteristics

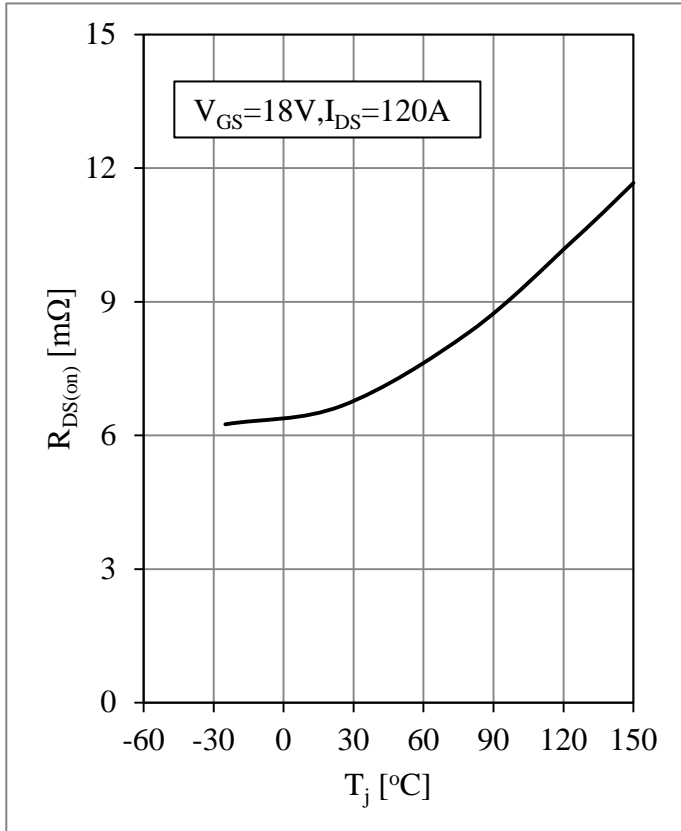


Fig 3. MOSFET On-Resistance vs. Temperature

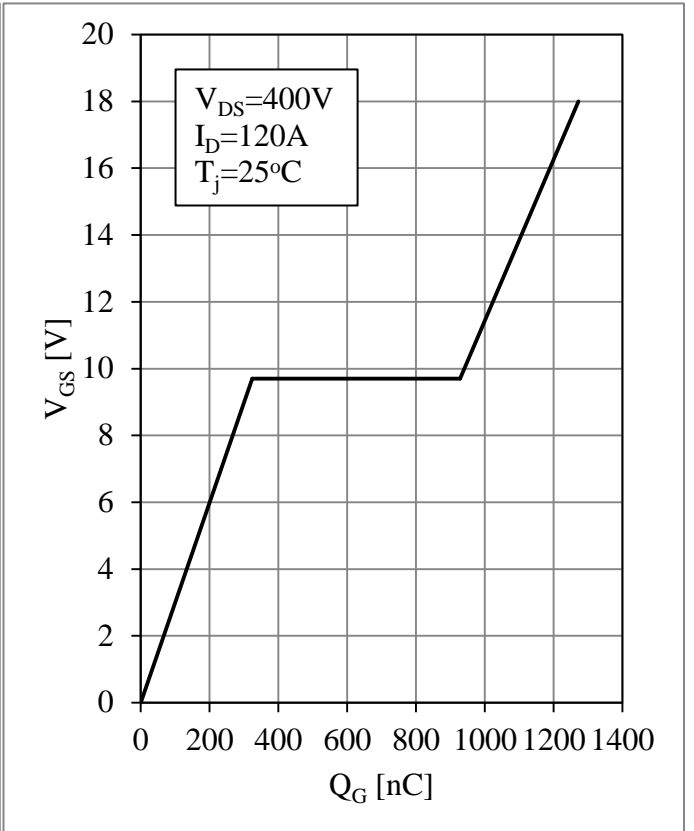


Fig 4. MOSFET Gate Charge Characteristic

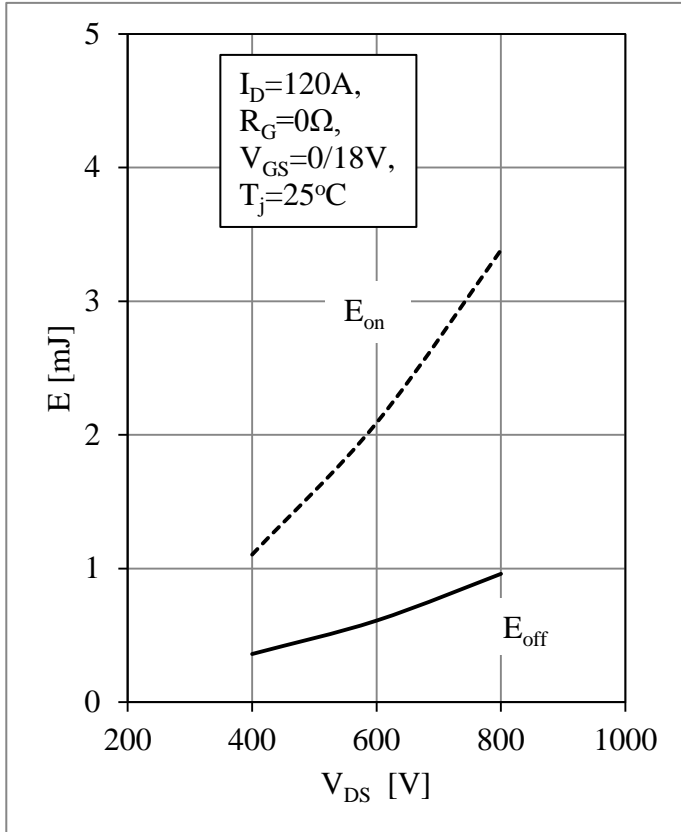


Fig 5. MOSFET Switching Loss vs.  $V_{DS}$

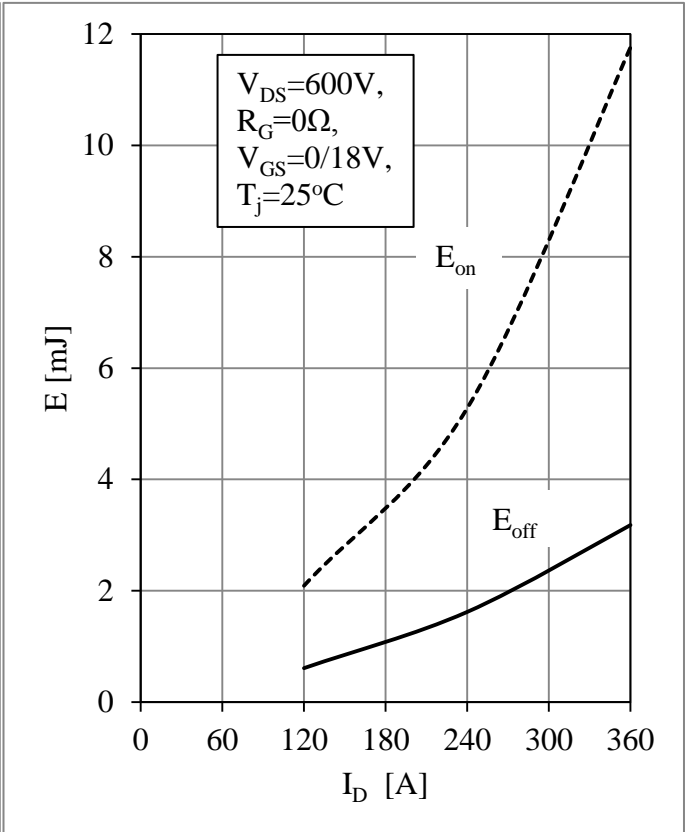


Fig 6. MOSFET Switching Loss vs.  $I_D$

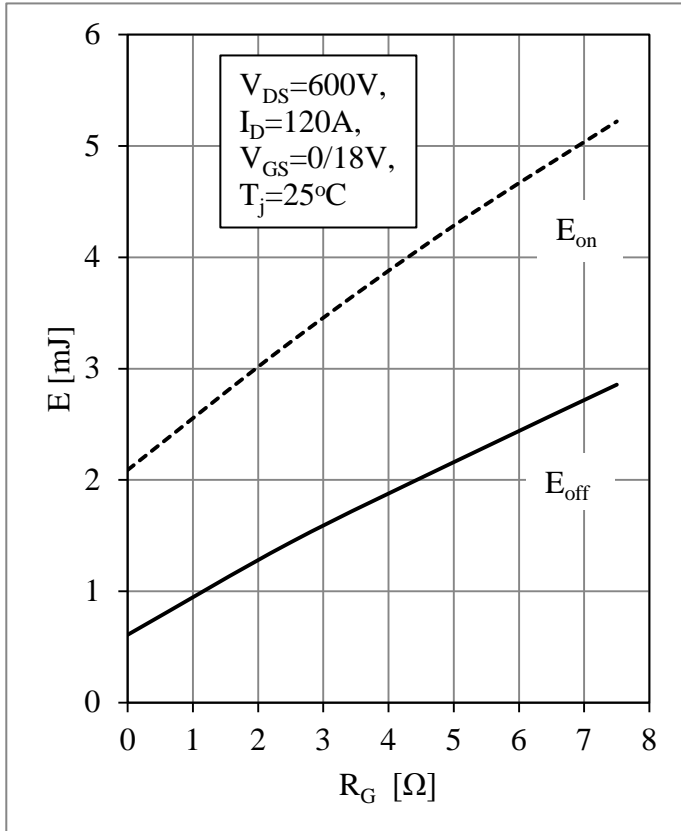


Fig 7. MOSFET Switching Loss vs.  $R_G$

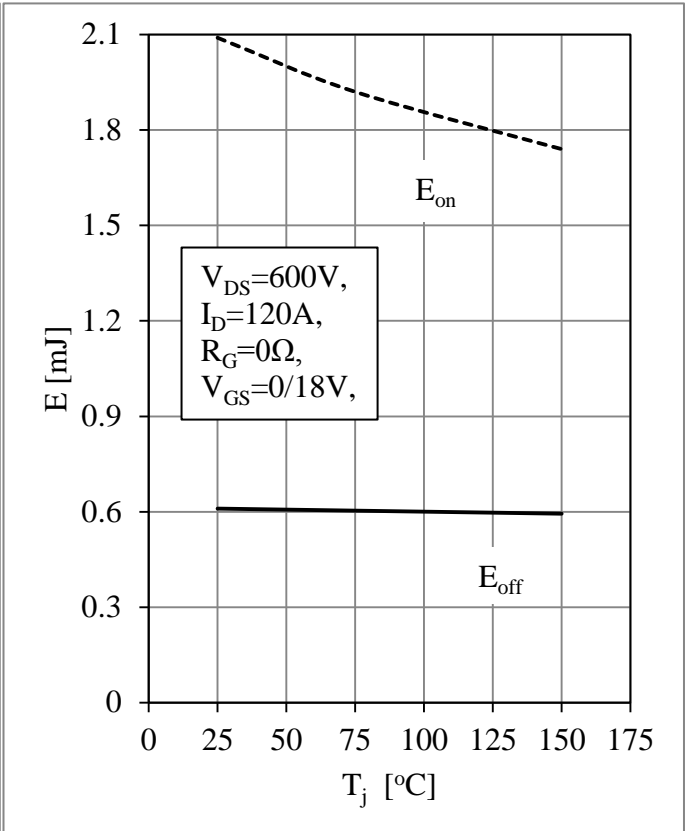


Fig 8. MOSFET Switching Loss vs. Temperature

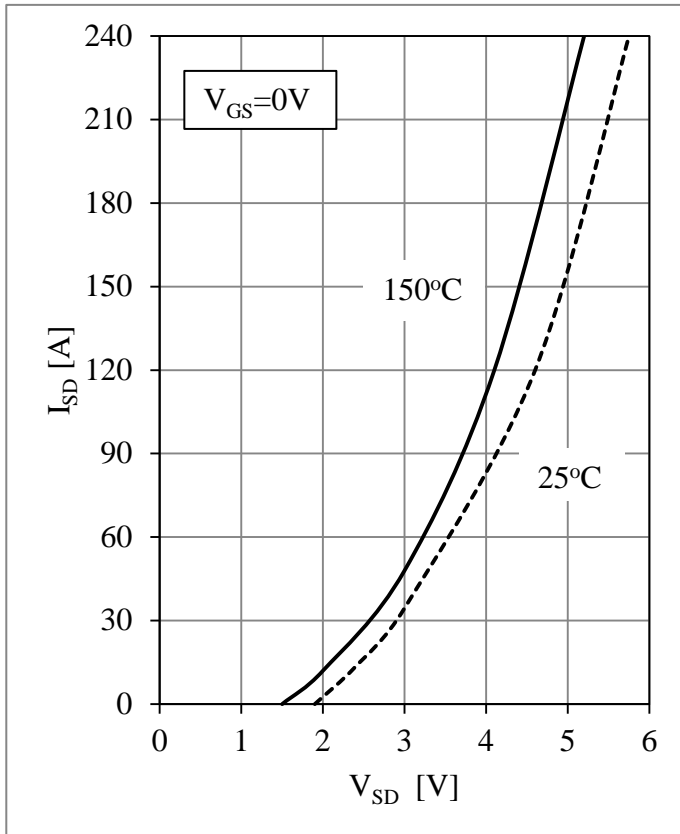


Fig 9. Body Diode Output Characteristics

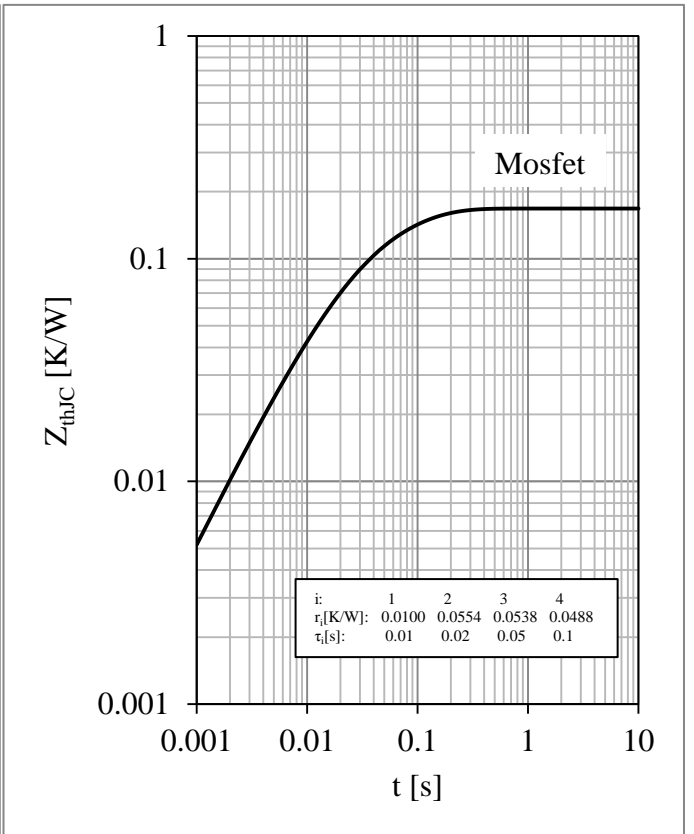
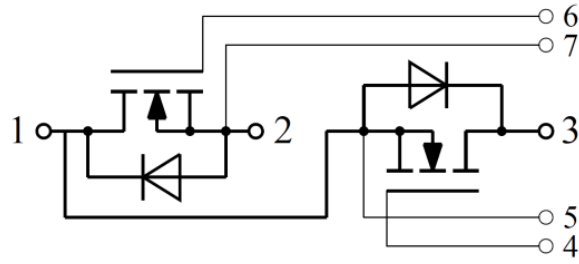


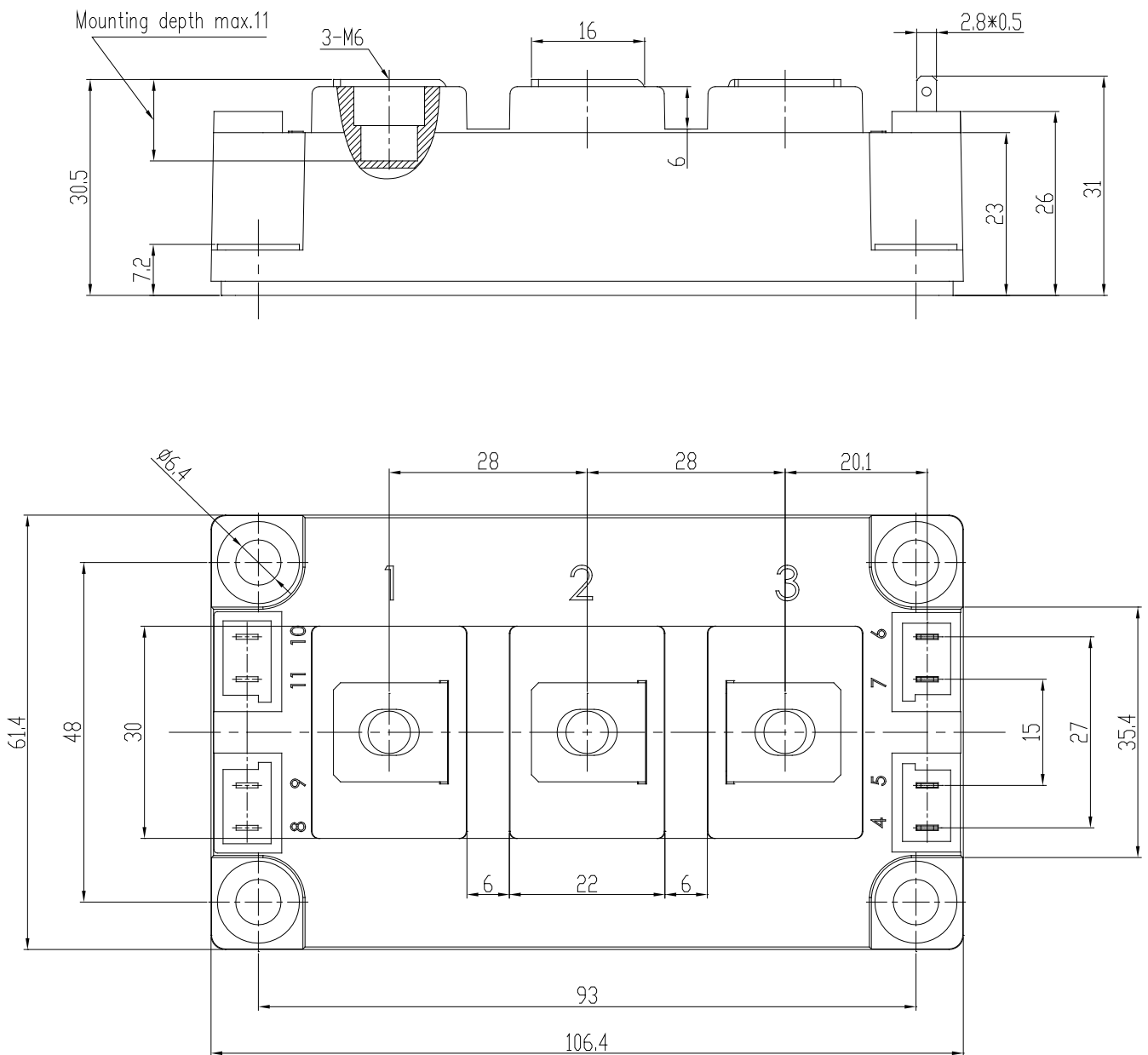
Fig 10. MOSFET Transient Thermal Impedance

### Circuit Schematic



### Package Dimensions

Dimensions in Millimeters





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