

# STARPOWER

SEMICONDUCTOR

**MOSFET**

## MD40HFC120C2S

**1200V/4.00mΩ 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.

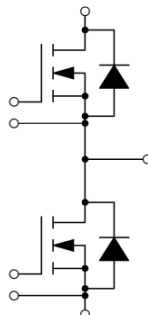
### Features

- SiC power MOSFET
- Low  $R_{DS(on)}$
- Optimized intrinsic reverse diode
- Chip sintering technology
- Low inductance case avoid oscillations
- Isolated copper baseplate using  $Si_3N_4$  AMB 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
$V_{GSSmax}$	Gate-Source Voltage	-8/+19	V
$V_{GSSop}$	Gate-Source Voltage	-4/+15	V
$I_D$	Drain Current @ $T_C=25^\circ\text{C}$	526	A
	@ $T_C=85^\circ\text{C}$	400	A
$I_{DM}$	Pulsed Drain Current, $t_p$ limited by $T_{vjmax}$	800	A
$P_D$	Maximum Power Dissipation @ $T_{vj}=175^\circ\text{C}$	2142	W

**Body Diode**

Symbol	Description	Value	Unit
$I_S$	Source Current @ $T_C=100^\circ\text{C}$	219	A

**Module**

Symbol	Description	Value	Unit
$T_{vjmax}$	Maximum Junction Temperature	175	$^\circ\text{C}$
$T_{vjop}$	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, $f=50\text{Hz}, t=1\text{min}$	2500	V

**MOSFET Characteristics**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit	
$R_{DS(on)}$	Static Drain-Source On-Resistance	$I_D=320A, V_{GS}=15V, T_{vj}=25^\circ C$		4.00	5.20	m $\Omega$	
		$I_D=320A, V_{GS}=15V, T_{vj}=175^\circ C$		7.20			
$V_{GS(th)}$	Gate-Source Threshold Voltage	$I_D=92mA, V_{DS}=V_{GS}, T_{vj}=25^\circ C$	1.8	2.5	3.6	V	
$I_{DSS}$	Drain-Source Leakage Current	$V_{DS}=V_{DSS}, V_{GS}=0V, T_{vj}=25^\circ C$			152	$\mu A$	
$I_{GSS}$	Gate-Source Leakage Current	$V_{GS}=V_{GSS}, V_{DS}=0V, T_{vj}=25^\circ C$			2000	nA	
$R_{Gint}$	Internal Gate Resistance			0.53		$\Omega$	
$C_{iss}$	Input Capacitance			26.9		nF	
$C_{oss}$	Output Capacitance	$V_{GS}=0V, V_{DS}=1000V, f=100kHz$		1.03		nF	
$C_{rss}$	Reverse Transfer Capacitance			0.06		nF	
$Q_g$	Total Gate Charge			944		nC	
$Q_{gs}$	Gate-Source Charge	$I_D=320A, V_{DS}=800V, V_{GS}=-4/+15V$		320		nC	
$Q_{gd}$	Gate-Drain ("Miller") Charge			272		nC	
$t_{d(on)}$	Turn-On Delay Time	$V_{DS}=600V, I_D=400A, R_G=5.1\Omega, V_{GS}=-4/+15V, T_{vj}=25^\circ C$		118		ns	
$t_r$	Rise Time			67		ns	
$t_{d(off)}$	Turn-Off Delay Time			258		ns	
$t_f$	Fall Time			44		ns	
$E_{on}$	Turn-On Switching Loss			12.8		mJ	
$E_{off}$	Turn-Off Switching Loss		13.5		mJ		
$t_{d(on)}$	Turn-On Delay Time	$V_{DS}=600V, I_D=400A, R_G=5.1\Omega, V_{GS}=-4/+15V, T_{vj}=125^\circ C$		117		ns	
$t_r$	Rise Time			70		ns	
$t_{d(off)}$	Turn-Off Delay Time			306		ns	
$t_f$	Fall Time			48		ns	
$E_{on}$	Turn-On Switching Loss			14.4		mJ	
$E_{off}$	Turn-Off Switching Loss			12.7		mJ	
$t_{d(on)}$	Turn-On Delay Time		$V_{DS}=600V, I_D=400A, R_G=5.1\Omega, V_{GS}=-4/+15V, T_{vj}=150^\circ C$		119		ns
$t_r$	Rise Time				69		ns
$t_{d(off)}$	Turn-Off Delay Time			318		ns	
$t_f$	Fall Time			48		ns	
$E_{on}$	Turn-On Switching Loss			13.4		mJ	
$E_{off}$	Turn-Off Switching Loss			12.6		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	$I_{SD}=160\text{A}, V_{GS}=-4\text{V}, T_{vj}=25^\circ\text{C}$		4.60		V
		$I_{SD}=160\text{A}, V_{GS}=-4\text{V}, T_{vj}=175^\circ\text{C}$		4.00		
$t_{rr}$	Diode Reverse Recovery Time	$V_R=600\text{V}, I_{SD}=400\text{A}, -di/dt=7480\text{A}/\mu\text{s}, V_{GS}=-4/+15\text{V}, T_{vj}=25^\circ\text{C}$		37		ns
$I_{rrm}$	Peak Reverse Recovery Current			134		A
$E_{rec}$	Reverse Recovery Energy			0.53		mJ
$t_{rr}$	Diode Reverse Recovery Time	$V_R=600\text{V}, I_{SD}=400\text{A}, -di/dt=8060\text{A}/\mu\text{s}, V_{GS}=-4/+15\text{V}, T_{vj}=125^\circ\text{C}$		48		ns
$I_{rrm}$	Peak Reverse Recovery Current			277		A
$E_{rec}$	Reverse Recovery Energy			1.90		mJ
$t_{rr}$	Diode Reverse Recovery Time	$V_R=600\text{V}, I_{SD}=400\text{A}, -di/dt=8160\text{A}/\mu\text{s}, V_{GS}=-4/+15\text{V}, T_{vj}=150^\circ\text{C}$		52		ns
$I_{rrm}$	Peak Reverse Recovery Current			312		A
$E_{rec}$	Reverse Recovery Energy			2.32		mJ

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

Symbol	Parameter	Min.	Typ.	Max.	Unit
$R_{thJC}$	Junction-to-Case(Mosfet)			0.070	K/W
$R_{thCH}$	Case-to-Heatsink (Mosfet)		0.020		K/W
	Case-to-Heatsink (per Module)		0.010		
M	Terminal Connection Torque, Screw M6	2.5		5.0	N.m
	Mounting Torque, Screw M6	3.0		5.0	
G	Weight of Module		300		g

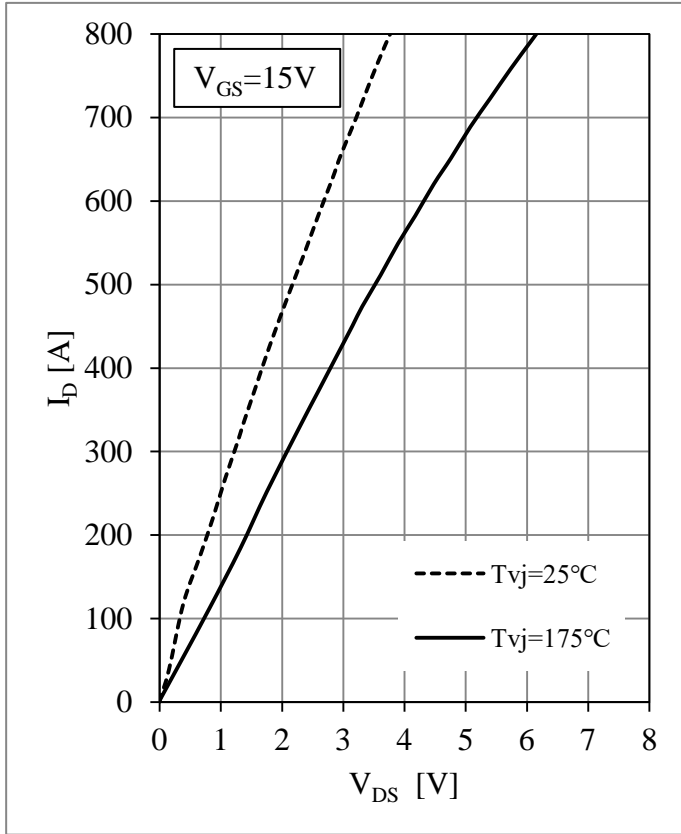


Fig 1. MOSFET Output Characteristics

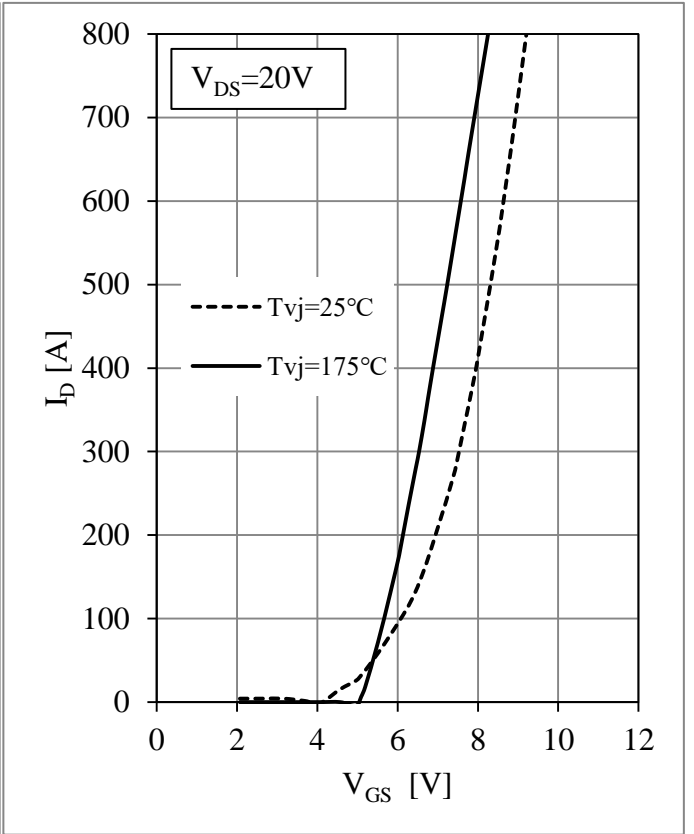


Fig 2. MOSFET Transfer Characteristics

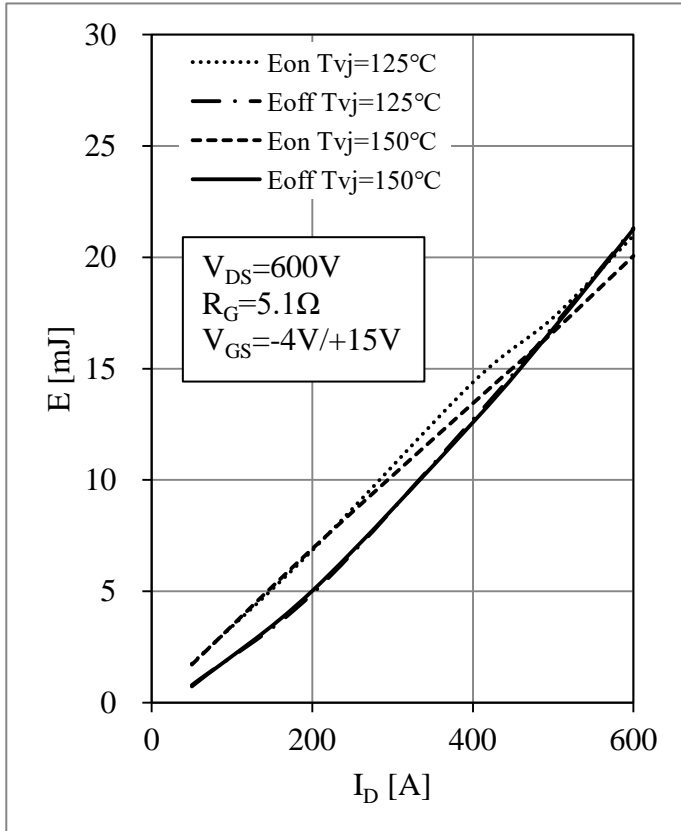


Fig 3. MOSFET Switching Loss vs.  $I_D$

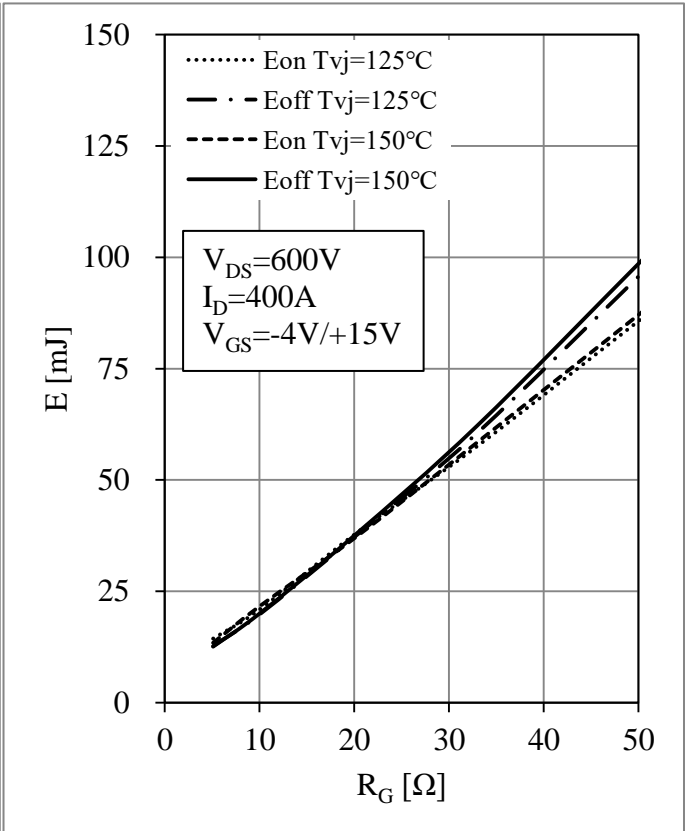


Fig 4. MOSFET Switching Loss vs.  $R_G$

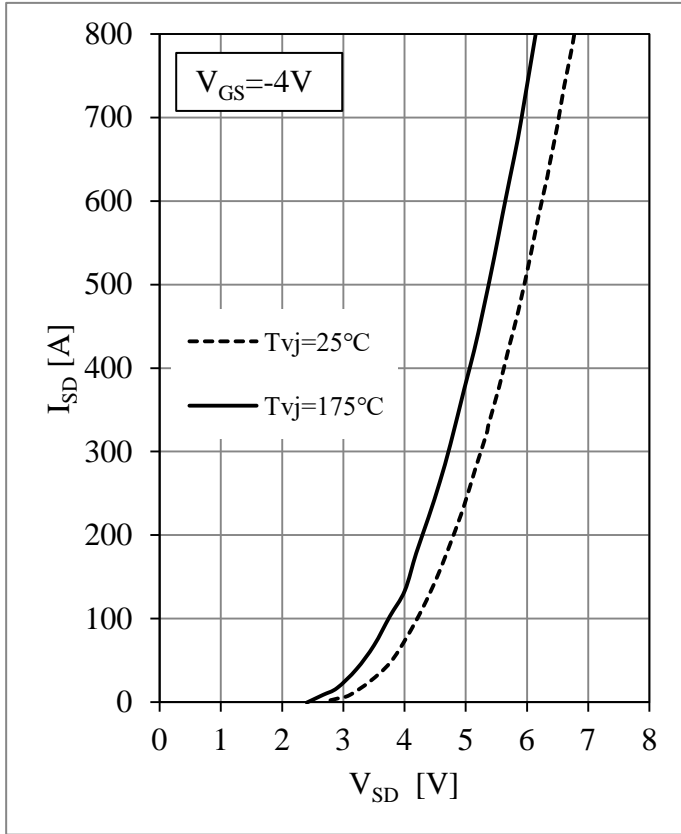


Fig 5. Body Diode Characteristics

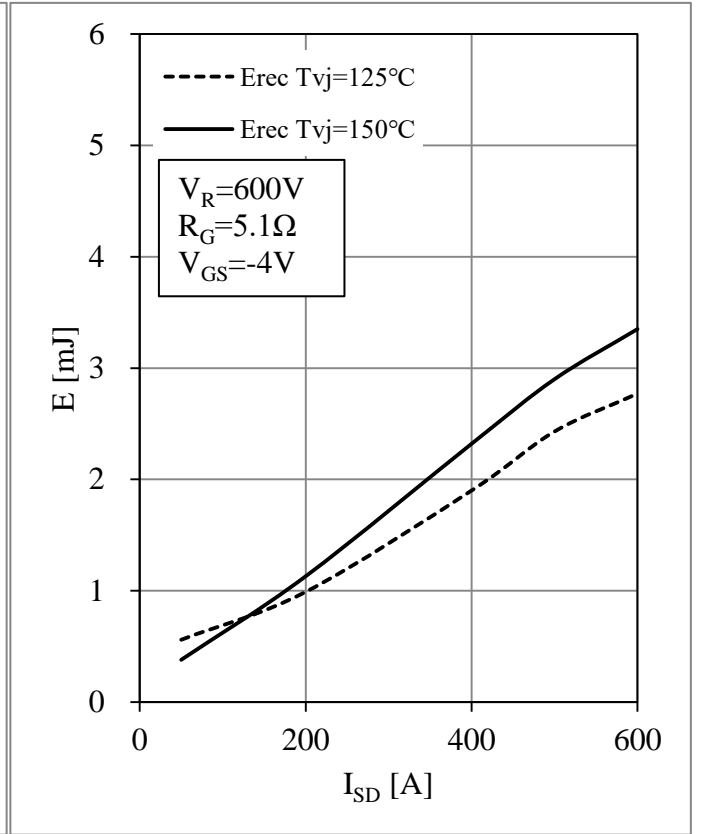


Fig 6. Body Diode Switching Loss vs.  $I_{SD}$

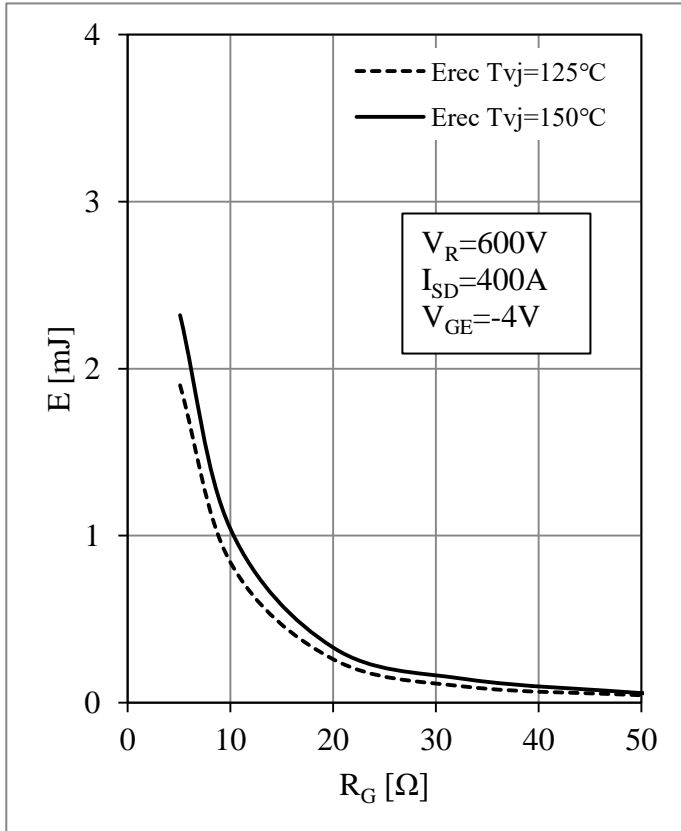


Fig 7. Body Diode Switching Loss vs.  $R_G$

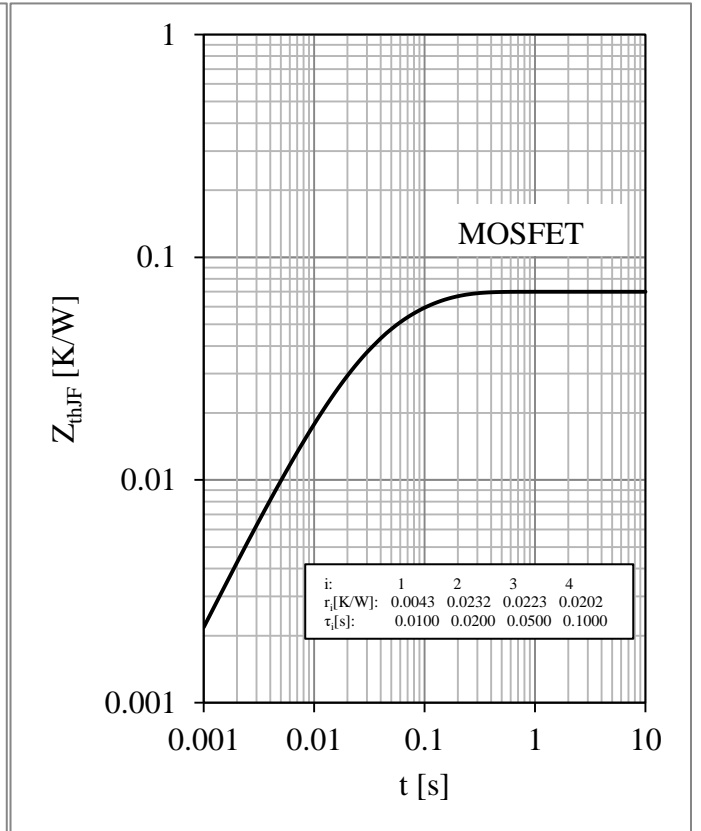
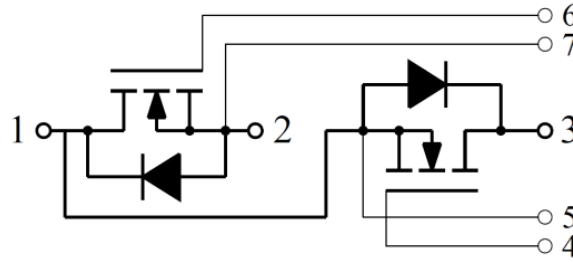


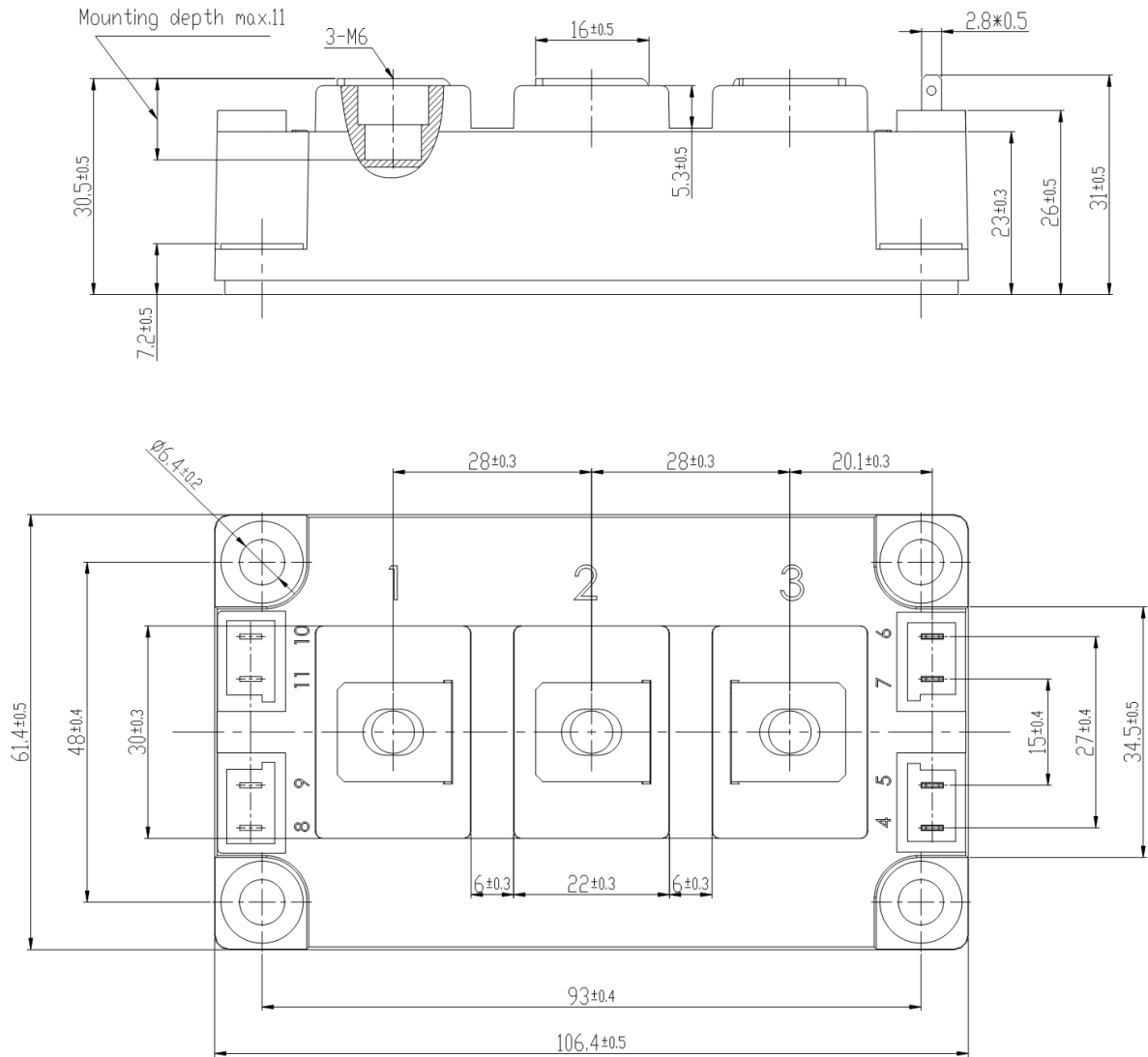
Fig 8. MOSFET Transient Thermal Impedance

**Circuit Schematic**



**Package Dimensions**

Dimensions in Millimeters



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