

STARPOWER

SEMICONDUCTOR

SiC MOSFET

MD43HFS120C2S_B20

1200V/4.3mΩ 2 in one-package

General Description

STARPOWER MOSFET Power Module provides very low $R_{DS(on)}$ as well as optimized intrinsic diode. They are designed for the applications such as SMPS and DC drives.

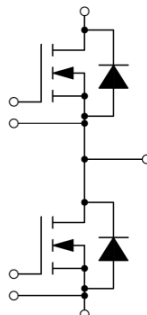
Features

- SiC power MOSFET
- Low $R_{DS(on)}$
- Optimized intrinsic reverse diode
- Chip sintering technology
- Low inductance case avoid oscillations
- Isolated copper baseplate using 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 $T_C=25^{\circ}\text{C}$ 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 $T_{vjmax}=175^{\circ}\text{C}$	309	A
P_D	Maximum Power Dissipation $T_{vjmax}=175^{\circ}\text{C}$	789	W

Body Diode

Symbol	Description	Value	Unit
I_S	Source Current $T_{vjmax}=175^{\circ}\text{C}$	207	A

Module

Symbol	Description	Value	Unit
T_{vjmax}	Maximum Junction Temperature	175	$^{\circ}\text{C}$
T_{vjop}	Operating Junction Temperature	-40 to +175	$^{\circ}\text{C}$
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 $T_C=25^{\circ}\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$R_{DS(on)}$	Static Drain-Source On-Resistance	$I_D=300\text{A}, V_{GS}=15\text{V}, T_{vj}=25^{\circ}\text{C}$		4.30		$\text{m}\Omega$
		$I_D=300\text{A}, V_{GS}=15\text{V}, T_{vj}=150^{\circ}\text{C}$		6.70		
		$I_D=300\text{A}, V_{GS}=15\text{V}, T_{vj}=175^{\circ}\text{C}$		7.00		
$V_{GS(th)}$	Gate-Source Threshold Voltage	$I_D=83\text{mA}, V_{DS}=V_{GS}, T_{vj}=25^{\circ}\text{C}$		2.6		V
I_{DSS}	Drain-Source Leakage Current	$V_{DS}=V_{DSS}, V_{GS}=0\text{V}, T_{vj}=25^{\circ}\text{C}$			500	mA
I_{GSS}	Gate-Source Leakage Current	$V_{GS}=19\text{V}, V_{DS}=0\text{V}, T_{vj}=25^{\circ}\text{C}$			600	nA
R_{Gint}	Internal Gate Resistance			2.7		Ω
C_{iss}	Input Capacitance	$V_{GS}=0\text{V}, V_{DS}=800\text{V}, f=100\text{kHz}$		26.2		nF
C_{oss}	Output Capacitance			0.88		nF
C_{rss}	Reverse Transfer Capacitance			0.04		nF
Q_g	Total Gate Charge	$I_D=300\text{A}, V_{DS}=800\text{V}, V_{GS}=-4/+15\text{V}$		0.76		μC
$t_{d(on)}$	Turn-On Delay Time	$V_{DS}=600\text{V}, I_D=320\text{A}, R_{Gon}=3.9\Omega, R_{Goff}=1.5\Omega, L_S=42\text{nH}, V_{GS}=-4/+15\text{V}, T_{vj}=25^{\circ}\text{C}$		122		ns
t_r	Rise Time			67		ns
$t_{d(off)}$	Turn-Off Delay Time			134		ns
t_f	Fall Time			36		ns
E_{on}	Turn-On Switching Loss			10.8		mJ
E_{off}	Turn-Off Switching Loss			5.82		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{DS}=600\text{V}, I_D=320\text{A}, R_{Gon}=3.9\Omega, R_{Goff}=1.5\Omega, L_S=42\text{nH}, V_{GS}=-4/+15\text{V}, T_{vj}=150^{\circ}\text{C}$		135		ns
t_r	Rise Time			80		ns
$t_{d(off)}$	Turn-Off Delay Time			240		ns
t_f	Fall Time			44		ns
E_{on}	Turn-On Switching Loss			14.3		mJ
E_{off}	Turn-Off Switching Loss			8.71		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{DS}=600\text{V}, I_D=320\text{A}, R_{Gon}=3.9\Omega, R_{Goff}=1.5\Omega, L_S=42\text{nH}, V_{GS}=-4/+15\text{V}, T_{vj}=175^{\circ}\text{C}$		138		ns
t_r	Rise Time			83		ns
$t_{d(off)}$	Turn-Off Delay Time			267		ns
t_f	Fall Time			45		ns
E_{on}	Turn-On Switching Loss			15.6		mJ
E_{off}	Turn-Off Switching Loss			9.32		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	$I_{SD}=152\text{A}, V_{GS}=-4\text{V}, T_{vj}=25^\circ\text{C}$		4.35		V
		$I_{SD}=152\text{A}, V_{GS}=-4\text{V}, T_{vj}=175^\circ\text{C}$		3.80		
t_{rr}	Diode Reverse Recovery Time	$V_R=600\text{V}, I_{SD}=320\text{A}, -di/dt=4630\text{A}/\mu\text{s}, L_S=42\text{nH}, V_{GS}=-4\text{V}, T_{vj}=25^\circ\text{C}$		28		ns
Q_r	Recovered Charge			0.70		μC
I_{RM}	Peak Reverse Recovery Current			42		A
E_{rec}	Reverse Recovery Energy			0.09		mJ
t_{rr}	Diode Reverse Recovery Time	$V_R=600\text{V}, I_{SD}=320\text{A}, -di/dt=3910\text{A}/\mu\text{s}, L_S=42\text{nH}, V_{GS}=-4\text{V}, T_{vj}=150^\circ\text{C}$		51		ns
Q_r	Recovered Charge			2.16		μC
I_{RM}	Peak Reverse Recovery Current			74		A
E_{rec}	Reverse Recovery Energy			0.35		mJ
t_{rr}	Diode Reverse Recovery Time	$V_R=600\text{V}, I_{SD}=320\text{A}, -di/dt=3810\text{A}/\mu\text{s}, L_S=42\text{nH}, V_{GS}=-4\text{V}, T_{vj}=175^\circ\text{C}$		57		ns
Q_r	Recovered Charge			2.92		μC
I_{RM}	Peak Reverse Recovery Current			86		A
E_{rec}	Reverse Recovery Energy			0.48		mJ

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

Symbol	Parameter	Min.	Typ.	Max.	Unit
R_{thJC}	Junction-to-Case (per MOSFET)			0.190	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		320		g

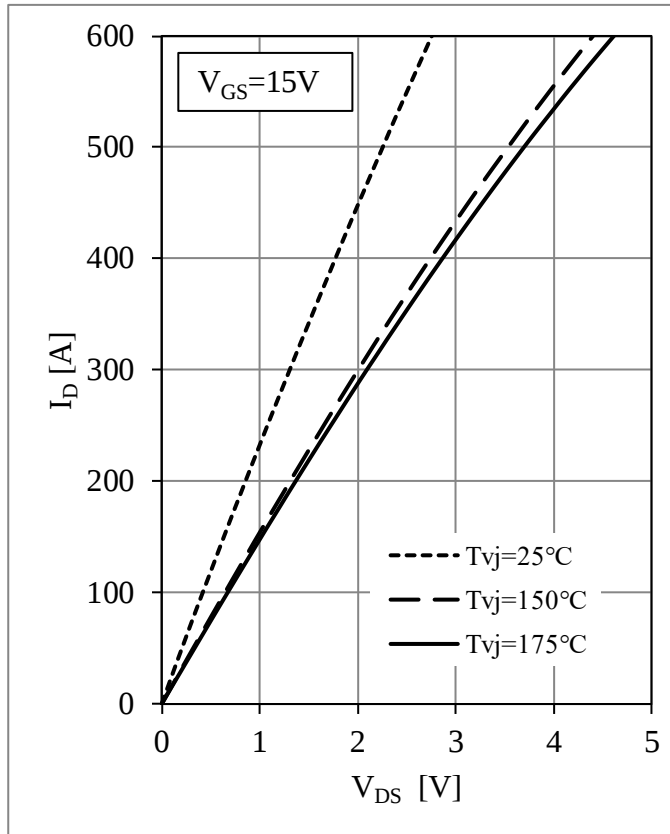


Fig 1. MOSFET Output Characteristics

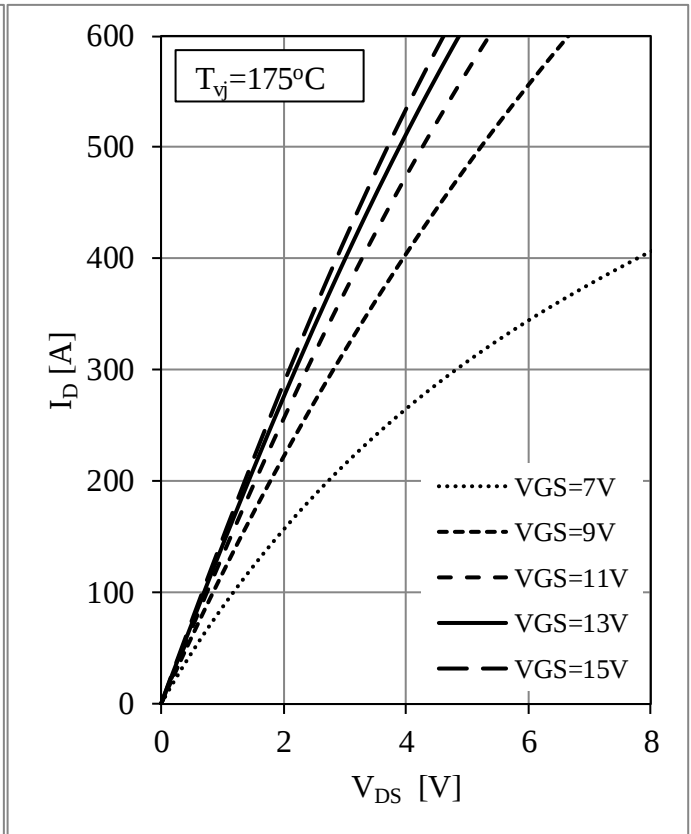


Fig 2. MOSFET Output Characteristics

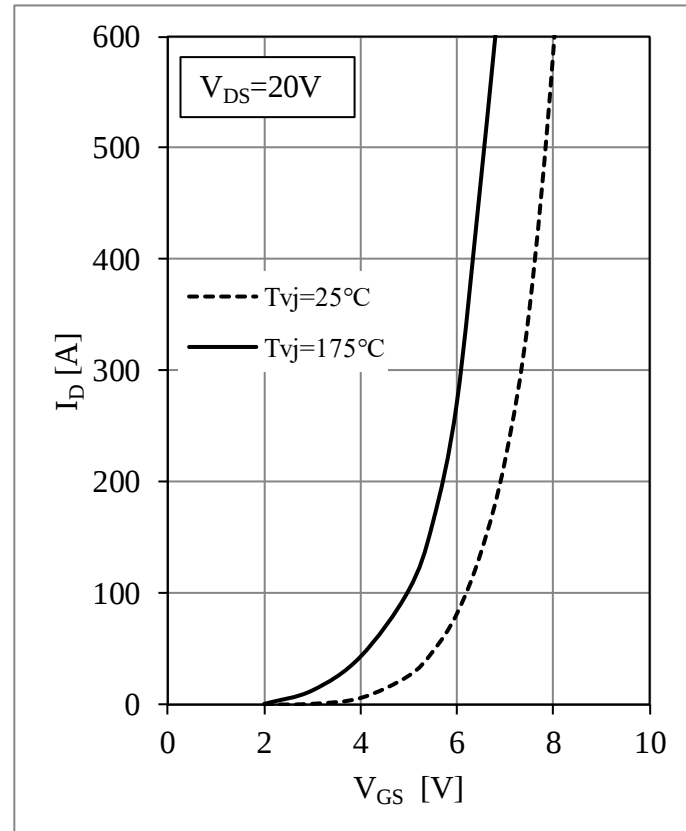
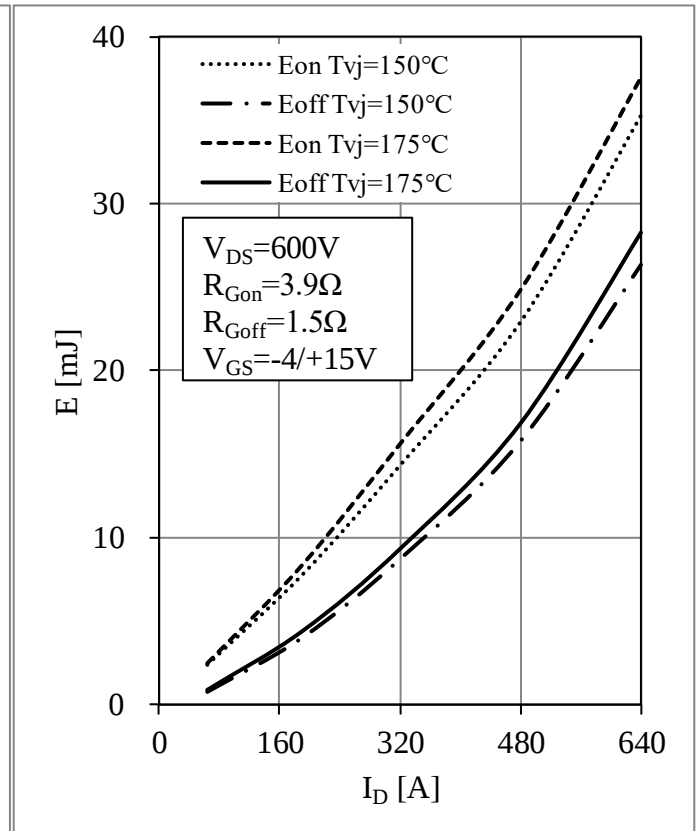


Fig 3. MOSFET Transfer Characteristics

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

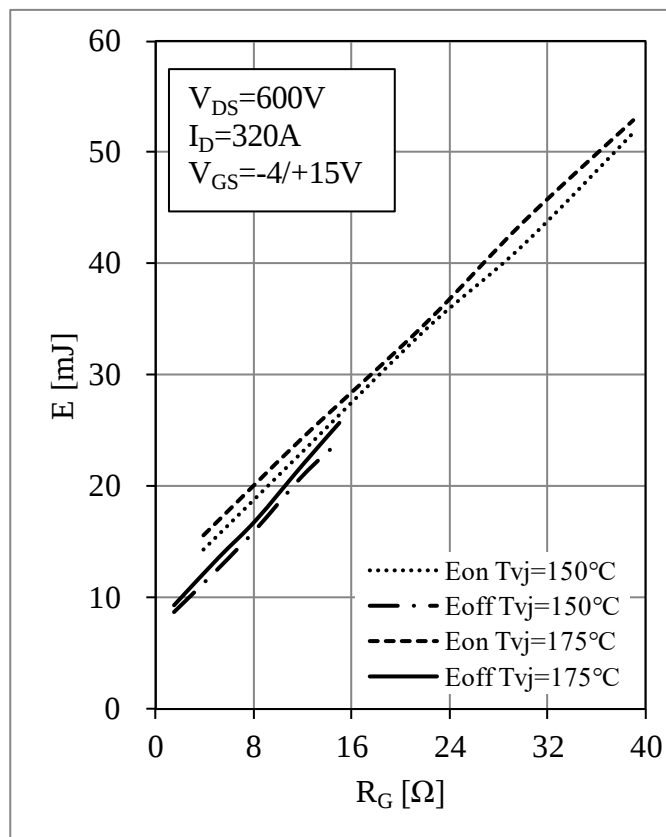
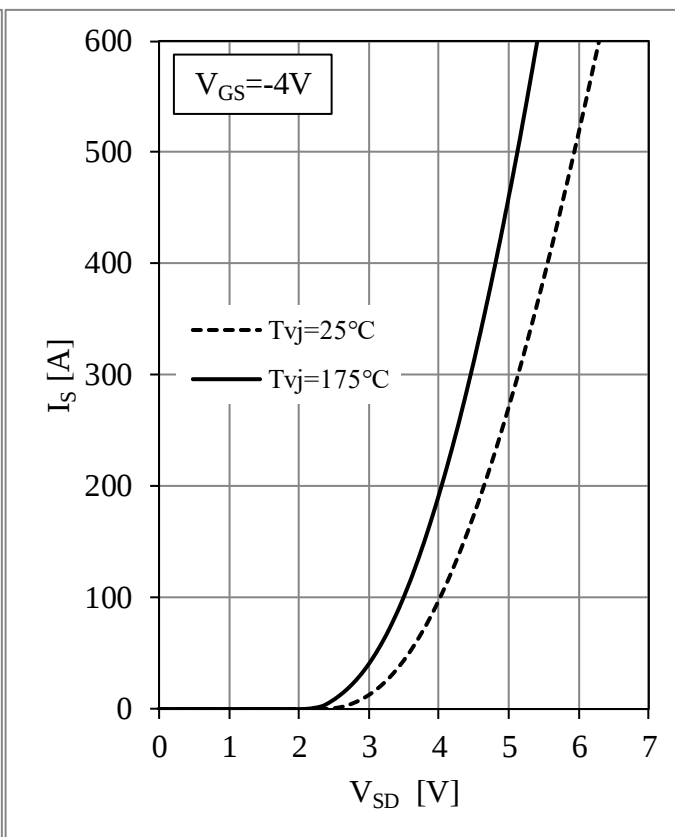
Fig 5. MOSFET Switching Loss vs. R_G 

Fig 6. Body Diode Characteristics

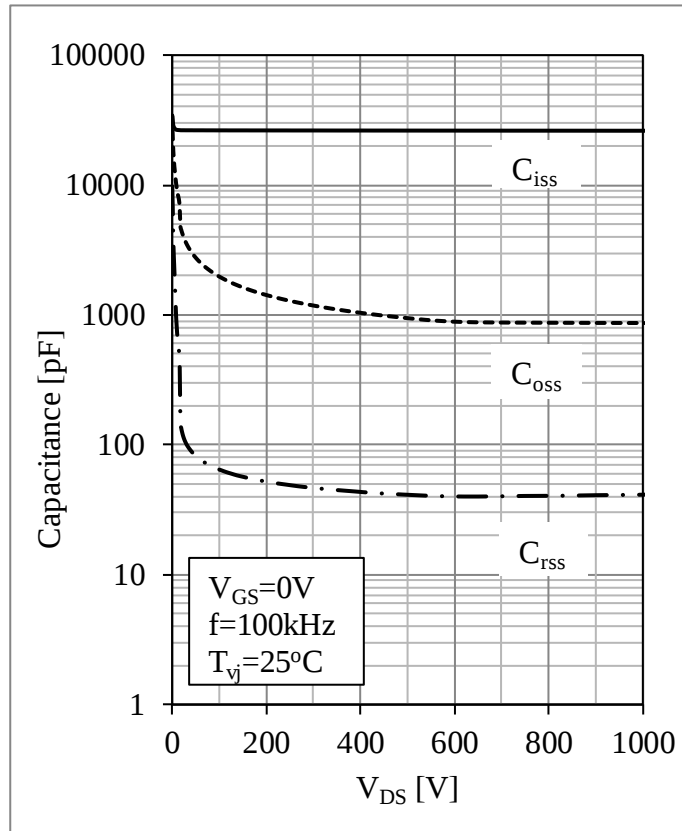
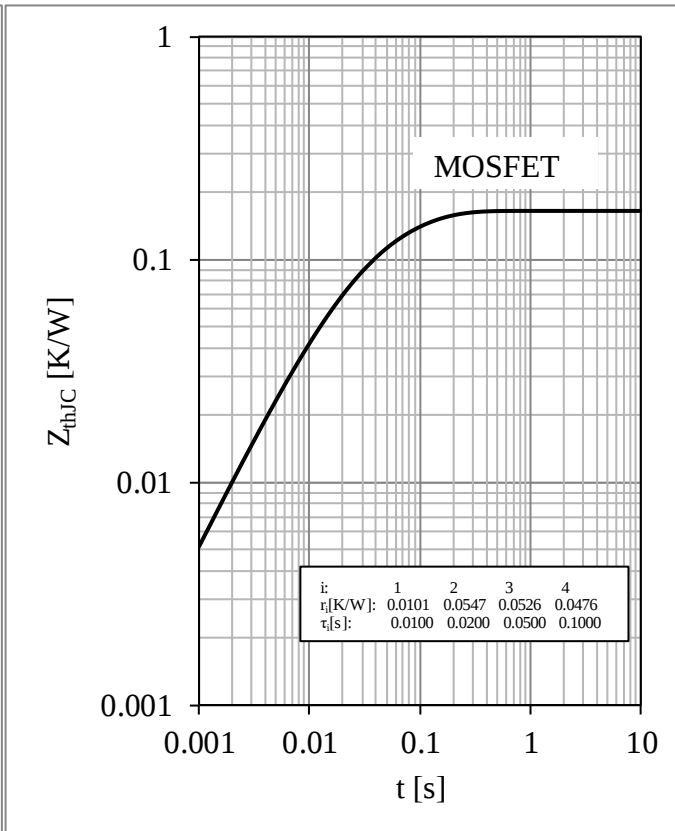
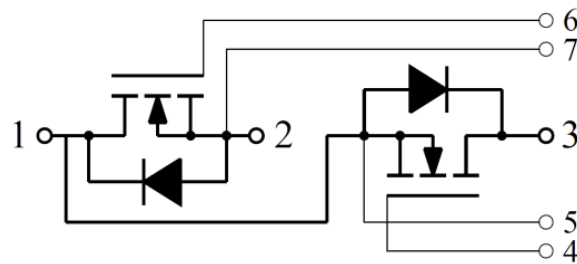
Fig 7. Capacitance vs. V_{DS} 

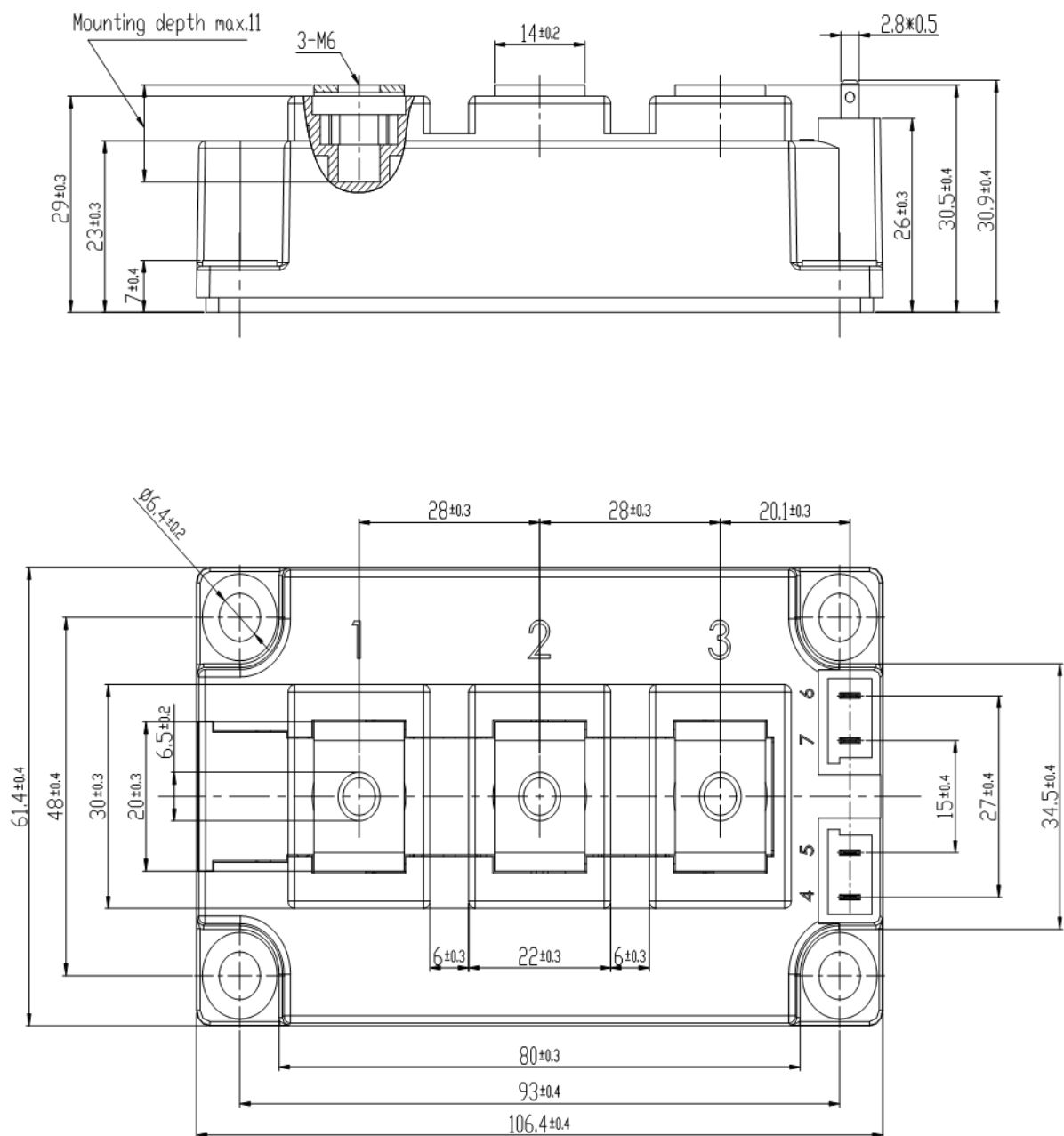
Fig 8. MOSFET Transient Thermal Impedance

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



Terms and Conditions of Usage

The data contained in this product datasheet is exclusively intended for technically trained staff. you and your technical departments will have to evaluate the suitability of the product for the intended application and the completeness of the product data with respect to such application.

This product data sheet is describing the characteristics of this product for which a warranty is granted. Any such warranty is granted exclusively pursuant the terms and conditions of the supply agreement. There will be no guarantee of any kind for the product and its characteristics.

Should you require product information in excess of the data given in this product data sheet or which concerns the specific application of our product, please contact the sales office, which is responsible for you (see www.powersemi.com), For those that are specifically interested we may provide application notes.

Due to technical requirements our product may contain dangerous substances. For information on the types in question please contact the sales office, which is responsible for you.

Should you intend to use the Product in aviation applications, in health or live endangering or life support applications, please notify.

If and to the extent necessary, please forward equivalent notices to your customers.
Changes of this product data sheet are reserved.