

STARPOWER

SEMICONDUCTOR

MOSFET

MD250HFR170C2S

1700V/250A 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.

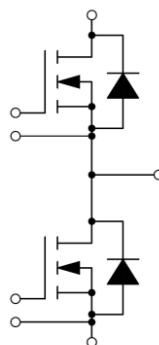
Features

- SiC power MOSFET
- Low $R_{DS(on)}$
- Optimized intrinsic reverse diode
- Low inductance case avoid oscillations
- Isolated heatsink 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**MOSFET**

Symbol	Description	Value	Unit
V_{DS}	Drain-Source Voltage	1700	V
V_{GS}	Gate-Source Voltage	-6/+22	V
I_D	Drain Current @ $T_C=25^{\circ}\text{C}$ @ $T_C=90^{\circ}\text{C}$	340 250	A
I_{DM}	Pulsed Drain Current	960	A

Inverse Diode

Symbol	Description	Value	Unit
I_S	Source Current	250	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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$R_{DS(on)}$	Static Drain-Source On-Resistance	$I_D=156A, V_{GS}=18V, T_j=25^\circ C$		8.3	10.4	$m\Omega$
		$I_D=156A, V_{GS}=18V, T_j=125^\circ C$		12.1		
$V_{GS(th)}$	Gate-Source Threshold Voltage	$I_D=56.4mA, V_{DS}=V_{GS}, T_j=25^\circ C$	1.6	2.8	4.0	V
g_{fs}	Forward Transconductance	$V_{DS}=10V, I_D=156A$		50.4		S
I_{DSS}	Drain-Source Leakage Current	$V_{DS}=V_{DSS}, V_{GS}=0V, T_j=25^\circ C$			120	μA
I_{GSS}	Gate-Source Leakage Current	$V_{GS}=V_{GSS}, V_{DS}=0V, T_j=25^\circ C$			1.2	μA
R_{Gint}	Internal Gate Resistance			0.92		Ω
C_{iss}	Input Capacitance	$V_{GS}=0V, V_{DS}=800V, f=1MHz$		27		nF
C_{oss}	Output Capacitance			0.86		nF
C_{rss}	Reverse Transfer Capacitance			0.16		nF
Q_g	Total Gate Charge	$I_D=156A, V_{DS}=500V, V_{GS}=18V$		1272		nC
Q_{gs}	Gate-Source Charge			360		nC
Q_{gd}	Gate-Drain ("Miller") Charge			396		nC
$t_{d(on)}$	Turn-On Delay Time	$V_{DS}=900V, I_D=250A, R_G=2.4\Omega, V_{GS}=0/+18V, T_j=25^\circ C$		123		ns
t_r	Rise Time			94		ns
$t_{d(off)}$	Turn-Off Delay Time			340		ns
t_f	Fall Time			55		ns
E_{on}	Turn-On Switching Loss	$V_{DS}=900V, I_D=250A, R_G=2.4\Omega, V_{GS}=0/+18V, T_j=125^\circ C$		28.4		mJ
E_{off}	Turn-Off Switching Loss			19.2		mJ
$t_{d(on)}$	Turn-On Delay Time			108		ns
t_r	Rise Time			83		ns
$t_{d(off)}$	Turn-Off Delay Time	$V_{DS}=900V, I_D=250A, R_G=2.4\Omega, V_{GS}=0/+18V, T_j=125^\circ C$		400		ns
t_f	Fall Time			73		ns
E_{on}	Turn-On Switching Loss			28.8		mJ
E_{off}	Turn-Off Switching Loss			21.5		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{DS}=900V, I_D=250A, R_G=2.4\Omega, V_{GS}=0/+18V, T_j=150^\circ C$		108		ns
t_r	Rise Time			83		ns
$t_{d(off)}$	Turn-Off Delay Time			412		ns
t_f	Fall Time			78		ns
E_{on}	Turn-On Switching Loss	$V_{DS}=900V, I_D=250A, R_G=2.4\Omega, V_{GS}=0/+18V, T_j=150^\circ C$		30.3		mJ
E_{off}	Turn-Off Switching Loss			22.2		mJ

Inverse Diode Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{SD}	Diode Forward Voltage	$I_S=156A, V_{GS}=0V, T_j=25^{\circ}C$		4.5		V
t_{rr}	Diode Reverse Recovery Time	$V_R=900V, I_S=250A,$ $-di/dt=2600A/\mu s,$ $V_{GS}=0V,$ $T_j=25^{\circ}C$		118		ns
Q_r	Diode Reverse Recovery Charge			4.1		μC
I_{rrm}	Peak Reverse Recovery Current			70		A
E_{rec}	Reverse Recovery Energy			11.1		mJ
t_{rr}	Diode Reverse Recovery Time	$V_R=900V, I_S=250A,$ $-di/dt=3100A/\mu s,$ $V_{GS}=0V,$ $T_j=125^{\circ}C$		175		ns
Q_r	Diode Reverse Recovery Charge			12.2		μC
I_{rrm}	Peak Reverse Recovery Current			139		A
E_{rec}	Reverse Recovery Energy			24.5		mJ
t_{rr}	Diode Reverse Recovery Time	$V_R=900V, I_S=250A,$ $-di/dt=3200A/\mu s,$ $V_{GS}=0V,$ $T_j=150^{\circ}C$		188		ns
Q_r	Diode Reverse Recovery Charge			15.7		μC
I_{rrm}	Peak Reverse Recovery Current			167		A
E_{rec}	Reverse Recovery Energy			28.0		mJ

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

Symbol	Parameter	Min.	Typ.	Max.	Unit
R_{thJC}	Junction-to-Case(Mosfet)			0.069	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

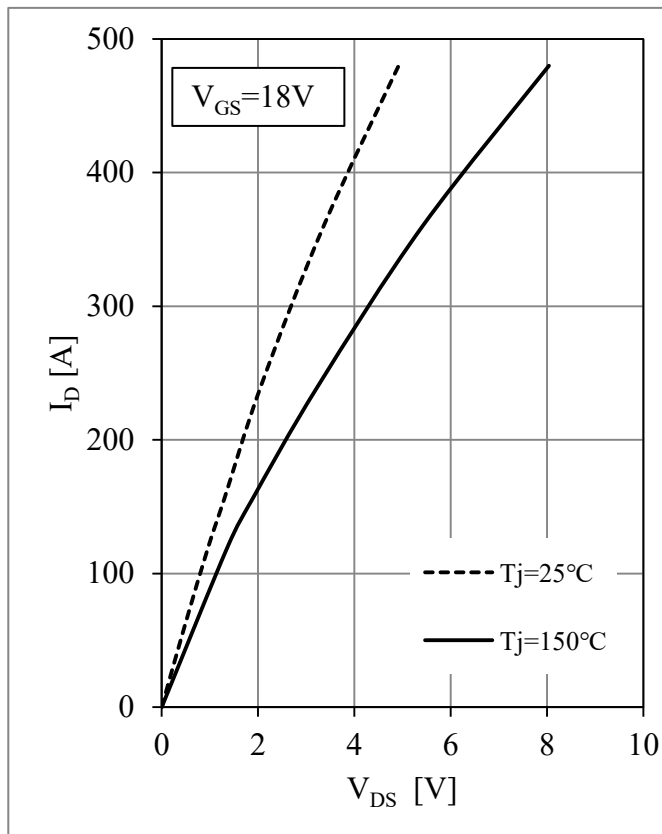


Fig 1. MOSFET Output Characteristics

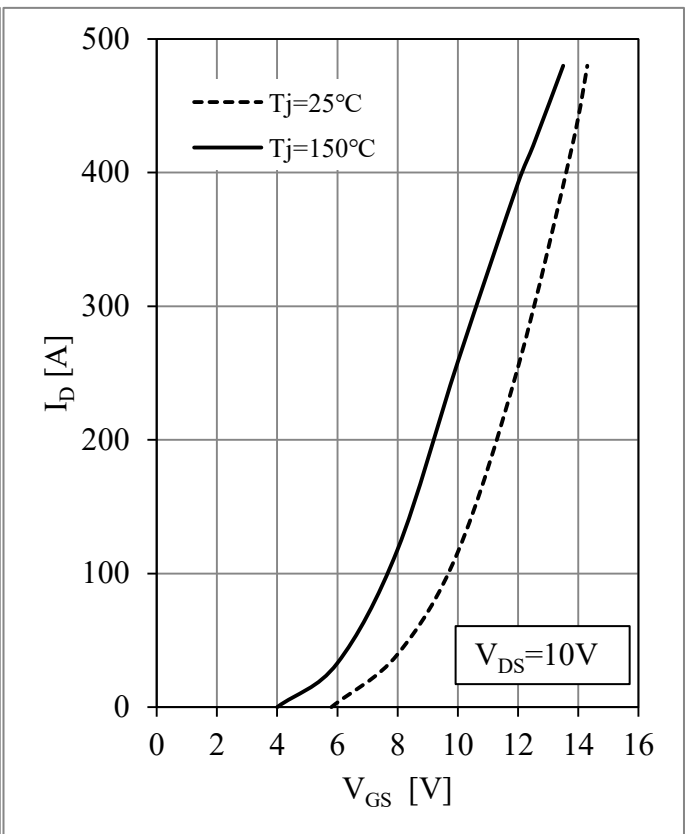
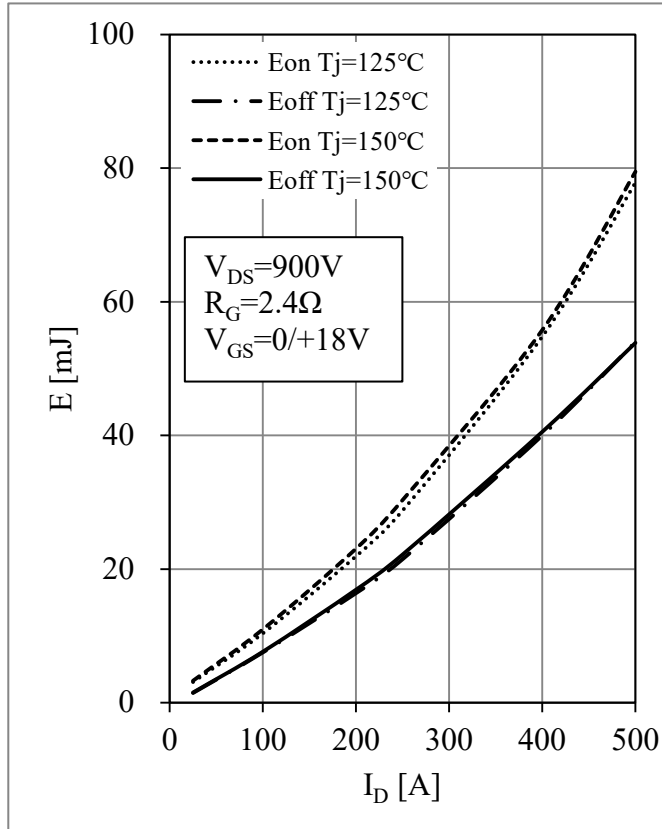
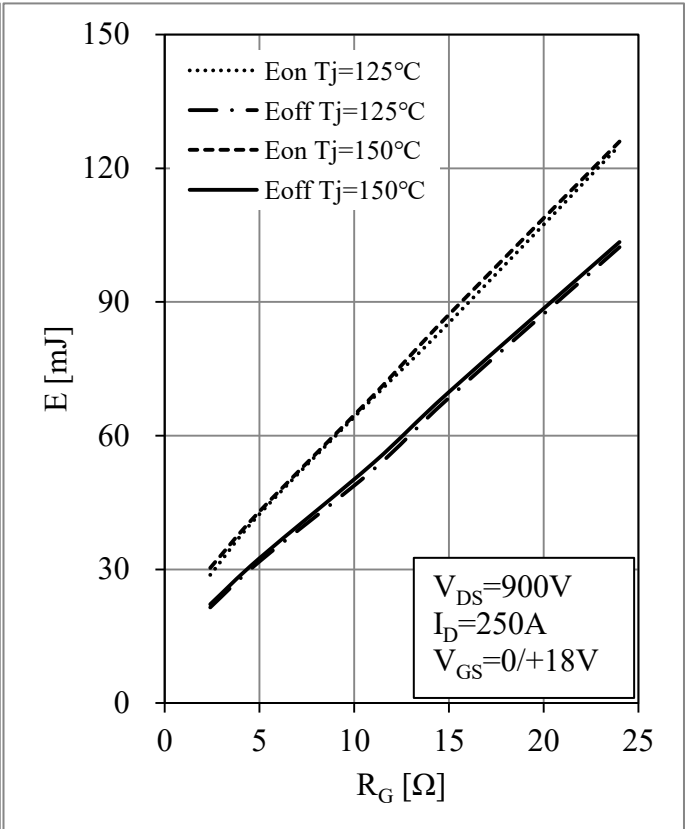
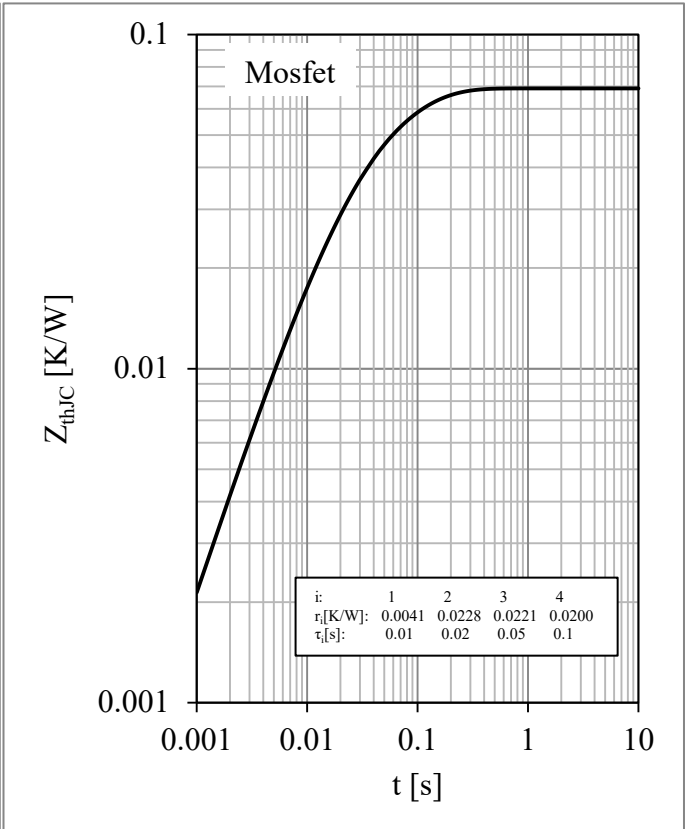
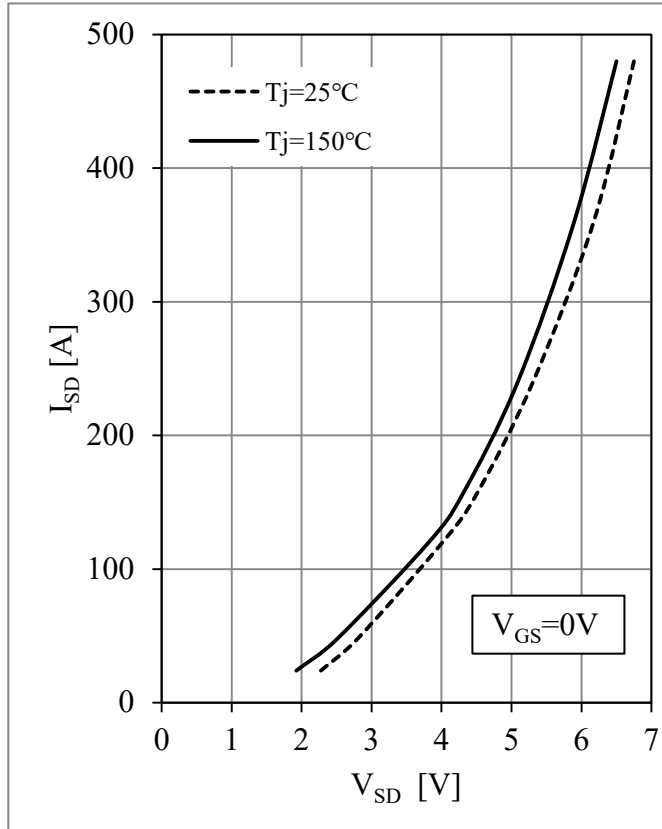
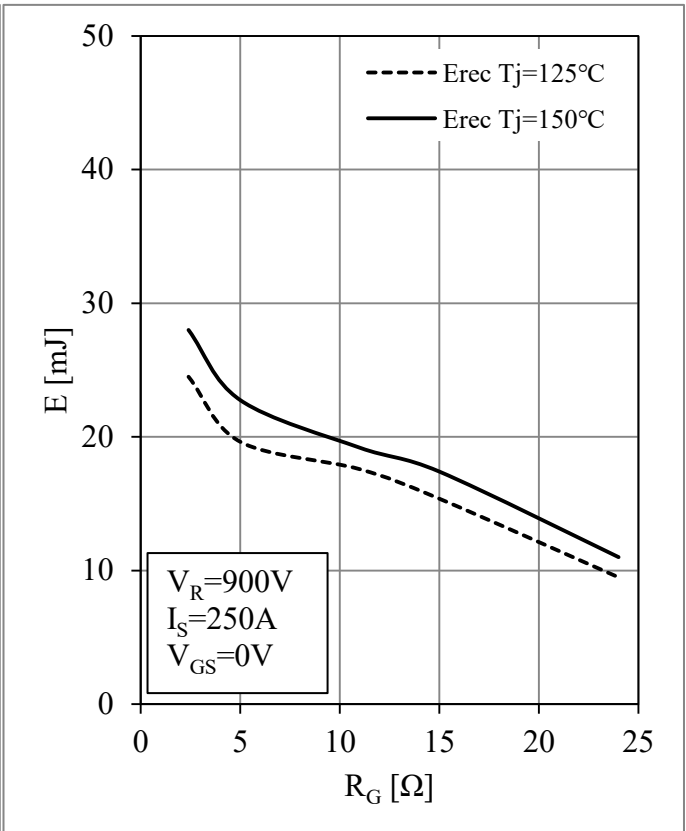
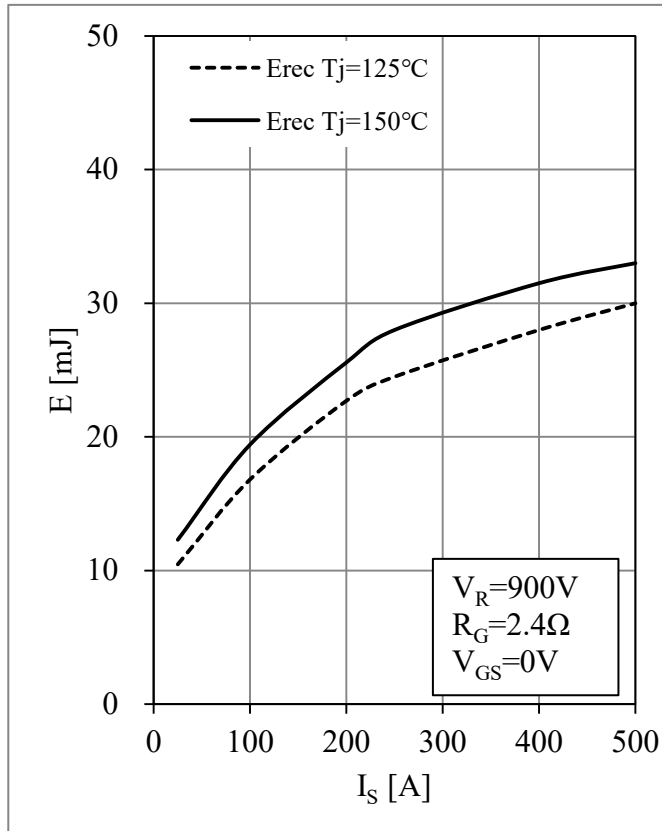
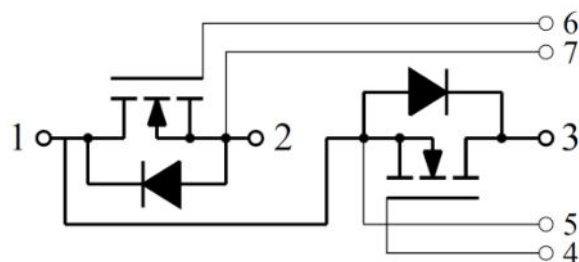


Fig 2. MOSFET Transfer Characteristics

Fig 3. MOSFET Switching Loss vs. I_D Fig 4. MOSFET Switching Loss vs. R_G

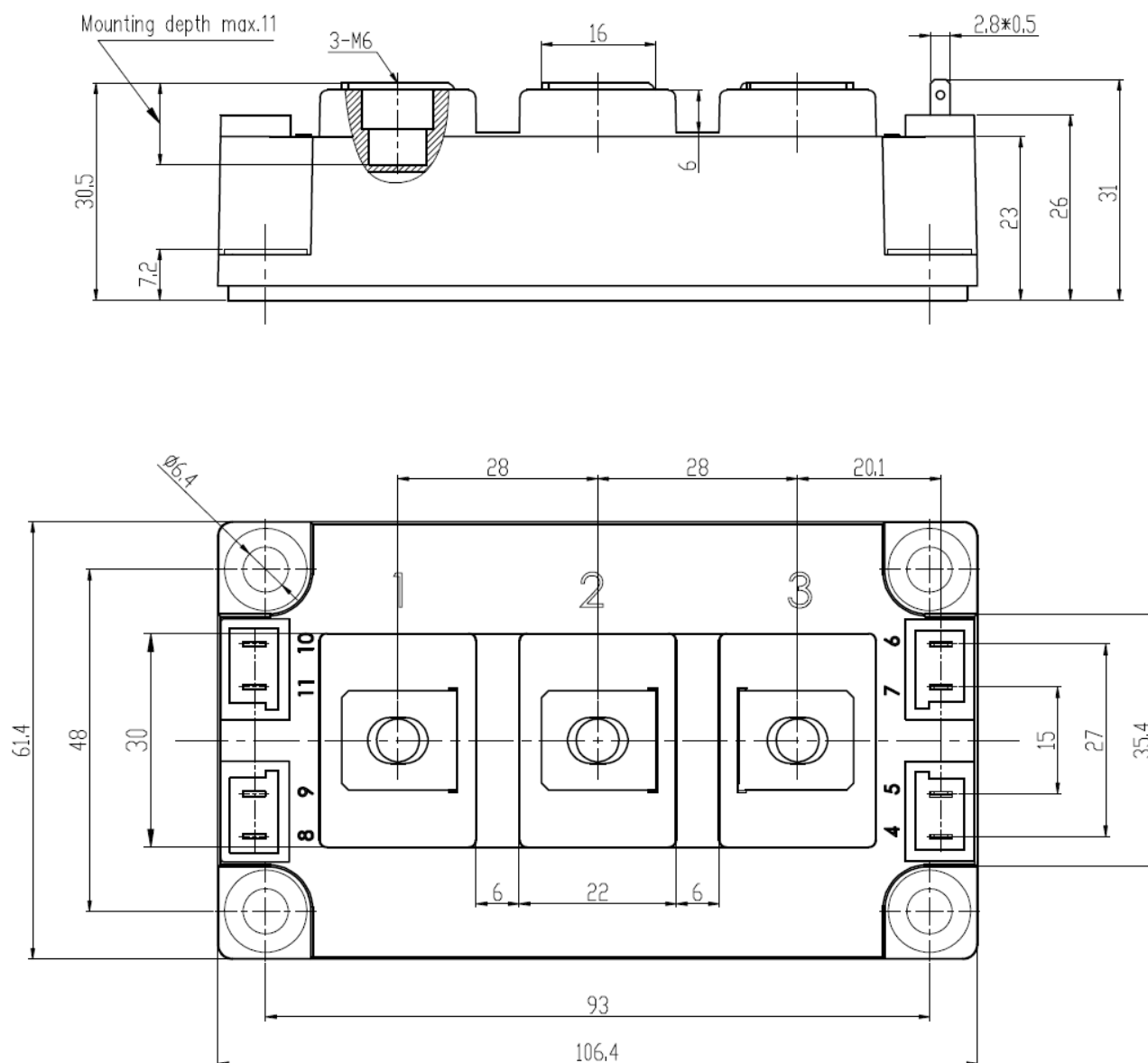


Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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