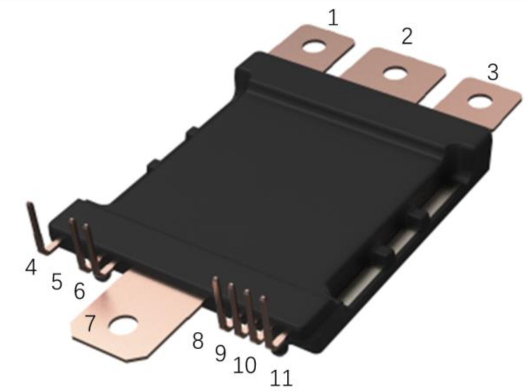
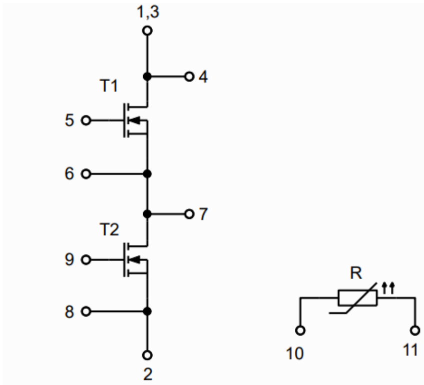
SYSM480HF12DCM V1.0

Preliminary

1200V，480A　SiC MOSFET MODULE





FEATURES

Electrical features

- V_{ds}=1200V
- R_{dson}≤2.2mohm
- New semiconductor material - Silicon Carbide
- Low Switching Losses
- Low Inductive Design≤6.6nH
- Low Qg and C_{rss}
- T_{vj} op = 175°C

Mechanical Features

- High Performance Si3N4 Ceramic
- Direct Cooled PinFin Base Plate
- Hight Tg EMC Transfer Molding
- Copper wire bonding
- Ag sintering
- RoHS compliant
- UL 94 V0 module frame
- AQG324 qualified

Potential applications

- Automotive Applications
- Hybrid Electrical Vehicles (H)EV
- Motor Drives
- Commercial Agriculture Vehicles

DESCRIPTION

The module can further improve the power density of the main drive inverter of new energy vehicles, and it is specially designed for wide bandgap devices (such as SiC Mosfet) in the main drive inverter application, which is the power module solution required for future new energy vehicles. The package features low stray inductance, high current density, excellent thermal management, and high reliability. Using the internationally mature SiC chip, with excellent performance, low loss, high robustness, can significantly improve system efficiency, passed the AQG324 standard test, to meet the EV/HEV high power density, high reliability, high-voltage electric drive requirements, to achieve higher output power and charging capacity.

The main drive inverter is the heart of the electric vehicle, providing torque and acceleration capabilities to the vehicle. The response speed of the inverter directly affects the driving experience and consumer satisfaction, and the M1 module can make new energy vehicles have strong transient explosiveness and long-lasting endurance.

ORDERING INFORMATION

Part No.	Package	Marking	Packing
SYSM480HF12M1TPA	M1	SYSM480HF12M1TPA	Tray

Content

1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	AC, f = 50 Hz, t = 1 min	2.7	kV
Material of module baseplate			Cu	
Internal isolation		basic insulation (class 1, IEC 61140)	Si_3N_4	
Creepage distance	d_{Creep}	terminal to heatsink	7.3	mm
Creepage distance	d_{Creep}	terminal to terminal	7.3	mm
Clearance	d_{Clear}	terminal to heatsink	7.3	mm
Clearance	d_{Clear}	terminal to terminal	4	mm
Comparative tracking index	*CTI*		> 400	

Table 2 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Stray inductance module	L_{SDS}			6.5		nH
Module lead resistance, terminals - chip	R_{module}			0.5		mΩ
Storage temperature	T_{stg}		-40		125	°C
Mounting torque	*M*	Screw M4 baseplate to heatsink	5.4		6.6	Nm
Weight	*G*			220		g

2 MOSFET

Table 3 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Drain-source voltage	V_{DS}		T_{vj} = 25 °C	1200	V
DC drain current	I_D nom	T_{vjmax} = 175 °C ,V_{GS} = 15 V, T_F = 60 °C		480	A
Pulsed drain current	I_D pulse	verified by design, t_p limited by T_{vjmax}		960	A
Gate-source voltage	V_{GSS}			-5/+18	V

Table 4 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Drain-source on resistance	$R_{DS(on)}$	I_D = 435.6 A, V_{GS} = 18 V	T_{vj} = 25 °C		2.5		mΩ
			T_{vj} = 175 °C		4.6		
Gate threshold voltage	$V_{GS(th)}$	I_D = 40 mA, V_{GS} = V_{DS}	T_{vj} = 25 °C	1.9	2.6	4.4	V
Total gate charge	QG	V_{DS} = 800 V, V_{GS} = -5/+18 V,I_D=436A			944		nC
Internal gate resistor	R_{Gint}		T_{vj} = 25 °C		1.2		Ω
Input capacitance	C_{iss}	f = 0.1MHz, V_{DS} = 1000 V, V_{GS} = 0 V	T_{vj} = 25 °C		21.2		nF
Output capacitance	C_{oss}	f = 0.1 MHz, V_{DS} = 1000 V, V_{GS} = 0 V	T_{vj} = 25 °C		1.1		nF
Reverse transfer capacitance	C_{rss}	f = 0.1MHz, V_{DS} = 1000 V, V_{GS} = 0 V	T_{vj} = 25 °C		0.14		nF
Drain-source leakage current	I_{DSS}	V_{GS} = -10 V, V_{DSS} = 1200 V	T_{vj} = 25 °C			100	µA
Gate-source leakage current	I_{GSS}	V_{GS} = 22 V, V_{DS} = 0 V	T_{vj} = 25 °C			100	nA
Turn-on delay time, inductive load	$T_{d(on)}$	I_D = 414 A, R_{Gon} = 10 Ω, V_{GS} = -5/+18 V, V_{DS} = 800 V	T_{vj} = 25 °C		131		ns
			T_{vj} = 175 °C		135		
Rise time (inductive load)	t_r	I_D = 414 A, R_{Gon} = 10 Ω, V_{GS}=-5/+18 V, V_{DS} = 800 V	T_{vj} = 25 °C		265		ns
			T_{vj} = 175 °C		221		

Turn-off delay time, inductive load	$T_{d(off)}$	I_D = 414 A, R_{Goff} = 6.8 Ω, V_{GS} = -5/+18 V, V_{DS} = 800 V	T_{vj} = 25 °C		282		ns
			T_{vj} = 175 °C		360		
Fall time (inductive load)	t_f	I_D = 414 A, R_{Goff} = 6.8 Ω, V_{GS} = -5/+18 V, V_{DS} = 800 V	T_{vj} = 25 °C		118		ns
			T_{vj} = 175 °C		121		
Turn-on energy loss per pulse	E_{on}	I_D = 414 A, R_{Gon} = 10 Ω, V_{GS} = -5/+18 V, V_{DS} = 800 V	T_{vj} = 25 °C, *di/dt* = 3.0 kA/µs		26.9		mJ
			T_{vj} = 175 °C, *di/dt*=3.4 kA/µs		22.9		
Turn-off energy loss per pulse	E_{off}	I_D = 414 A, R_{Goff} = 6.8 Ω, V_{GS} = -5/+18 V, V_{DS} = 800 V,	T_{vj} = 25 °C, du/dt = 5.4 kV/µs		28.7		mJ
			T_{vj} = 175 °C, du/dt = 5.1 kV/µs		35.0		
Thermal resistance, junction to cooling fluid	R_{thJF}	per MOSFET, ΔV/Δt = 2.67 l/min; fluid = 50% water / 50% ethylenglycol, T_F = 65 °C			0.1079		K/W
Temperature under switching conditions	T_{vj} op			-40		175	°C

3 Body diode

Table 5 Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
DC body diode forward current	I_{SD}	T_{vjmax} = 175 °C, V_{GS} = -5 V, T_F = 65 °C	480	A
Pulsed body diode current	I_{SD} pulse	verified by design, t_p limited by T_{vjmax}	960	A

Table 6 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_{DSR}	I_{SD} = 414 A, V_{GS} = -5 V	T_{vj} = 25 °C		3.05		V
			T_{vj} = 175 °C		3.7		
Peak reverse recovery current	I_{rrm}	I_{SD} = 414 A, V_r = 800 V, V_{GS} = -5 V	T_{vj} = 25 °C		37.8		A
			T_{vj} = 175 °C		122.7		
Recovered charge	Q_{rr}	I_{SD} = 414 A, V_r = 800 V, V_{GS} = -5 V	T_{vj} = 25 °C		1.95		µC
			T_{vj} = 150 °C		5.2		

Reverse recovery energy	E_{rec}	I_{SD} = 414 A, V_r = 800 V, V_{GS} = -5 V	T_{vj} = 25 °C, $-di/dt$ = 5.9 kA/µs		0.36		mJ
			T_{vj} = 150 °C, $-di/dt$ = 6.9 kA/µs		1.54		

4 NTC-Thermistor

Table 7 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	R_{25}	T_{NTC} = 25 °C		4.7		kΩ
Deviation of R_{100}	$\Delta R/R$	T_{NTC} = 100 °C, R_{100} = 493 Ω	-1		1	%
Power dissipation	P_{25}	T_{NTC} = 25 °C			50	mW
$B_{25/85}$-value	$B_{25/85}$	$R_2 = R_{25}\ \exp[B_{25/50}(1/T_2-1/(298,15\ K))]$		3435		K
T_{jop}		Operating temperature range	-55		175	℃

5 Characteristic diagrams

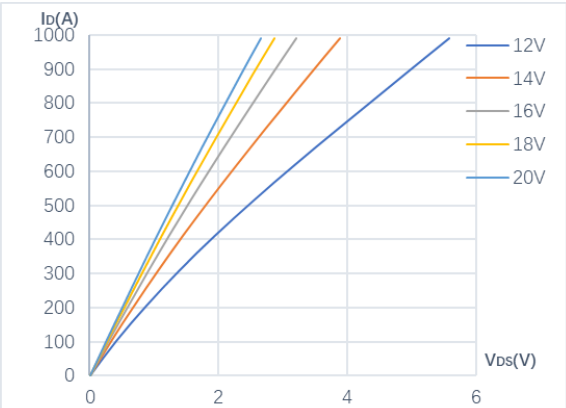


Figure 1 Typical output characteristics(Tj=25℃)

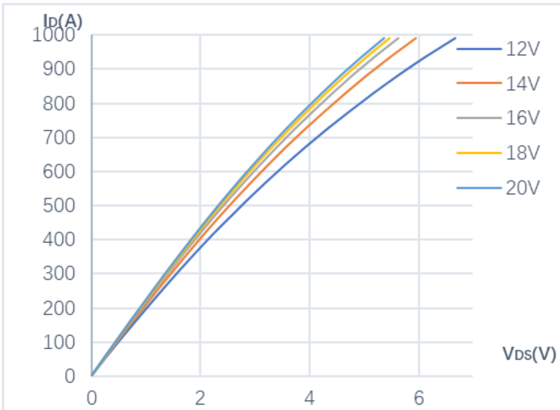


Figure 2 Typical output characteristics(Tj=175℃)

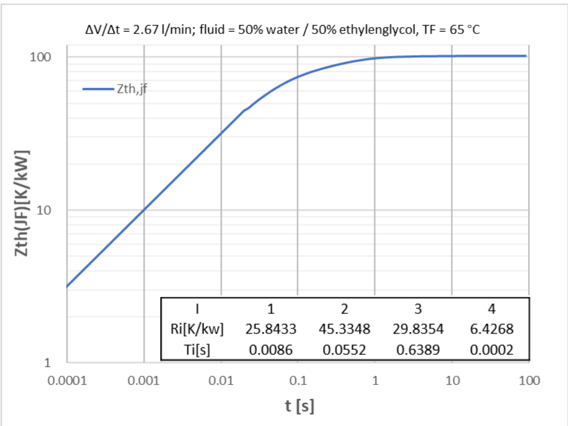


Figure 3 Transient thermal impedance

6 Circuit diagram

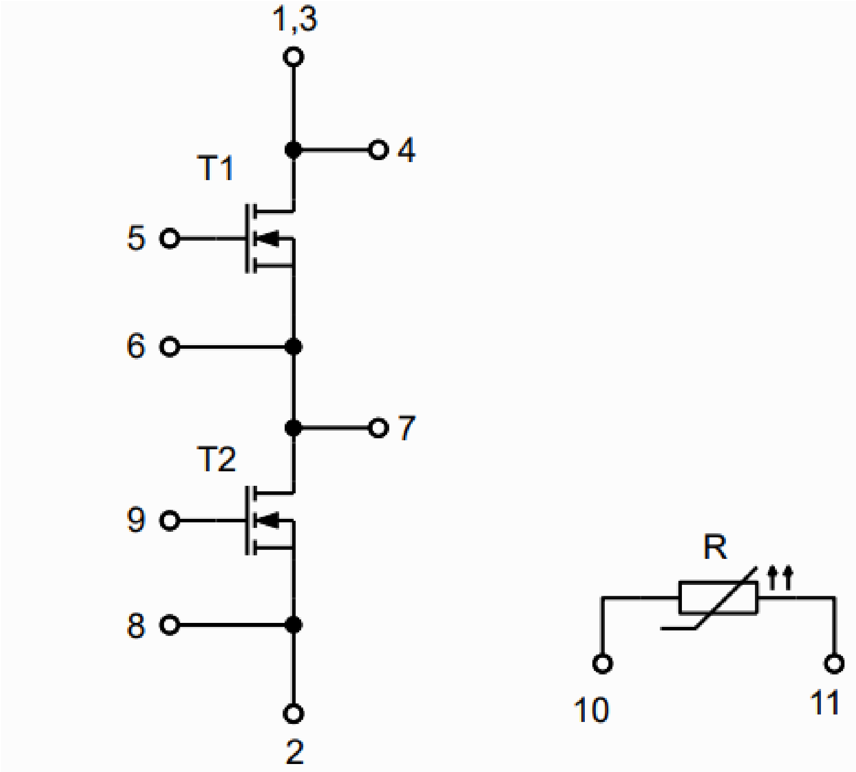


Figure 3 Topology, pin description and position

7 Package outlines

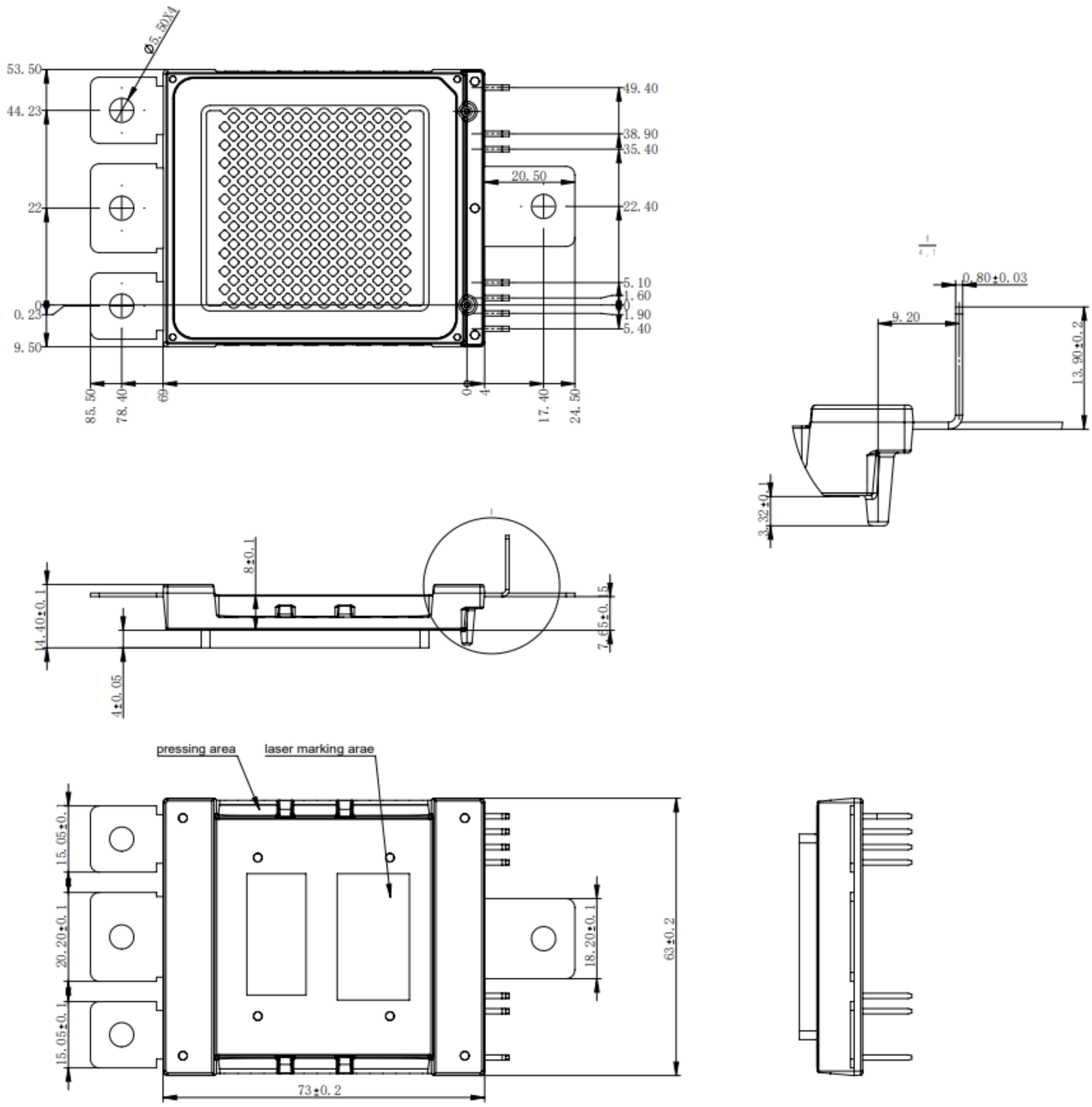


Figure 4 M1 short tab package outline (dimensions are mm.)