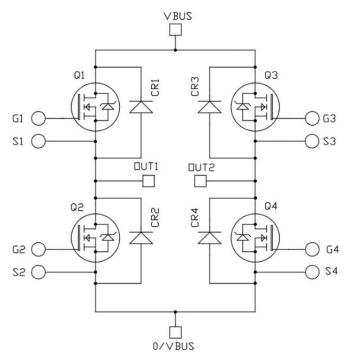
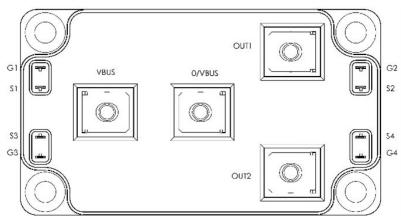
MSCSM70HM05CAG

Full Bridge SiC Power Module

Product Overview

The MSCSM70HM05CAG device is a full bridge 700 V, 349 A silicon carbide (SiC) power module.





All ratings at T_J = 25 °C, unless otherwise specified.

Caution: These devices are sensitive to electrostatic discharge. Proper handling procedures must be followed.

Features

The following are key features of the MSCSM70HM05CAG device:

- · SiC Schottky Diode
 - Zero reverse recovery
 - Zero forward recovery
 - Temperature independent switching behavior
 - Positive temperature coefficient on VF
- · SiC Power MOSFET
 - Low R_{DS(on)}
 - High temperature performance
- · Kelvin emitter for easy drive
- · Low stray inductance
- · AIN substrate for improved thermal performance
- · M5 power connectors

Benefits

The following are benefits of the MSCSM70HM05CAG device:

- · High efficiency converter
- · Outstanding performance at high frequency operation
- · Stable temperature behavior
- · Direct mounting to heatsink (isolated package)
- · Low junction-to-case thermal resistance
- · RoHS compliant

Application

The MSCSM70HM05CAG device is designed for the following applications:

- · Welding converters
- · Switched mode power supplies
- · Uninterruptible power supplies
- EV motor and traction drive

1. Electrical Specifications

This section provides the electrical specifications of the MSCSM70HM05CAG device.

1.1 SiC MOSFET Characteristics

The following table lists the absolute maximum ratings per SiC MOSFET of the MSCSM70HM05CAG device.

Table 1-1. Absolute Maximum Ratings

Symbol	Parameter		Maximum Ratings	Unit	
V_{DSS}	Drain-Source vol	tage	700	V	
I _D		T _C = 25 °C	349	А	
	drain current	T _C = 80 °C	278		
I _{DM}	Pulsed drain curr	ent	700		
V _{GS}	Gate-Source volt	Gate-Source voltage		V	
R _{DS(on)}	Drain-Source ON resistance		6.4	mΩ	
P_D	Power dissipation	T _C = 25 °C	966	W	

The following table lists the electrical characteristics per SiC MOSFET of the MSCSM70HM05CAG device.

Table 1-2. Electrical Characteristics

Symbol	Characteristics	Test Conditions		Min	Тур	Max	Unit
I _{DSS}	Zero gate voltage drain current	V _{GS} = 0 V; V _{DS} = 700 V		_	_	300	μА
R _{DS(on)}			T _J = 25 °C	_	5	6.4	mΩ
	on resistance	$I_D = 120 \text{ A}$ $T_J = 175 ^{\circ}\text{C}$			6.3		
V _{GS(th)}	Gate threshold voltage	$V_{GS} = V_{DS}$, $I_D = 12 \text{ mA}$		1.9	2.4	_	V
I _{GSS}	Gate–Source leakage current	V _{GS} = 20 V, V _{DS} =	0 V	_	_	300	nA

The following table lists the dynamic characteristics per SiC MOSFET of the MSCSM70HM05CAG device.

Table 1-3. Dynamic Characteristics

Symbol	Characteristics	Test Conditions		Min	Тур	Max	Unit
C _{iss}	Input capacitance	V _{GS} = 0 V		_	13.5	_	nF
C _{oss}	Output capacitance	V _{DS} = 700 V		_	1.5	_	
C _{rss}	Reverse transfer capacitance	f = 1 MHz		_	0.09	_	
Q_g	Total gate charge	V _{GS} = -5 V/20 V		_	645	_	nC
Q _{gs}	Gate-Source charge	V _{Bus} = 470 V		_	174	_	
Q_{gd}	Gate-Drain charge	I _D = 120 A		_	105	_	
T _{d(on)}	Turn-on delay time	V _{GS} = -5 V/20 V		_	78	_	ns
T _r	Rise time	V _{Bus} = 400 V		_	125	_	
T _{d(off)}	Turn-off delay time	$I_D = 240 \text{ A}; T_J = 1$	50 °C	_	214	_	
T _f	Fall time	$R_{G(ON)} = 9.4 \Omega; R$	$G(OFF) = 5.4 \Omega$	_	92	_	
E _{on}	Turn-on energy	V _{GS} = -5 V/20 V	T _J = 150 °C	_	3	_	mJ
E _{off}	Turn-off energy	$V_{Bus} = 400 \text{ V}$ $I_{D} = 240 \text{ A}$ $R_{G(ON)} = 9.4 \Omega$ $R_{G(OFF)} = 5.4 \Omega$	T _J = 150 °C	_	5.3	_	mJ
R _{Gint}	Internal gate resistanc	_	1.9	_	Ω		
R _{thJC}	Junction-to-case therm	nal resistance		_	_	0.155	°C/W

The following table lists the body diode ratings and characteristics per SiC MOSFET of the MSCSM70HM05CAG device

Table 1-4. Body Diode Ratings and Characteristics

Symbol	Characteristics	Test Conditions	Min	Тур	Max	Unit
V _{SD}	Diode forward	V _{GS} = 0 V; I _{SD} = 120 A	_	3.4	_	V
	voltage	$V_{GS} = -5 \text{ V}; I_{SD} = 120 \text{ A}$	_	3.8	_	
t _{rr}	Reverse recovery time	I _{SD} = 120 A	_	40	_	ns
	unic	$V_{GS} = -5 V$				
Q _{rr}	Reverse recovery charge	V _R = 400 V	_	1.5	_	μC
I _{rr}	Reverse recovery current	di _F /dt = 3000 A/μs	_	57	_	А

1.2 SiC Schottky Diode and Characteristics

The following table lists the SiC diode ratings and characteristics per SiC diode of the MSCSM70HM05CAG device.

Table 1-5. SiC Schottky Diode Ratings and Characteristics

Symbol	Characteristics	Test Conditions		Min	Тур	Max	Unit
V _{RRM}	Peak repetitive revers	e voltage		_	_	700	V
I _{RRM}	Reverse leakage	V _R = 700 V	T _J = 25 °C	_	45	600	μΑ
	current		T _J = 175 °C	_	750	_	
I _F	DC forward current	_	T _C = 65 °C	_	150	_	Α
V _F	Diode forward	I _F = 150 A	T _J = 25 °C	_	1.5	1.8	V
	voltage		T _J = 175 °C	_	1.9	_	
Q _C	Total capacitive charge	V _R = 400 V	_	_	399	_	nC
С	Total capacitance f = 1 MHz, V _R = 200 V		_	744	_	pF	
		f = 1 MHz, V _R	= 400 V	_	648	_	
R _{thJC}	Junction-to-case therr	nal resistance		_	_	0.326	°C/W

1.3 Thermal and Package Characteristics

The following table lists the thermal and package characteristics of MSCSM70HM05CAG device.

Table 1-6. Thermal and Package Characteristics

Symbol	Characteristics	Min	Max	Unit		
V _{ISOL}	RMS isolation v	oltage, any termi	nal to case t =1 min,	4000	_	V
	50 Hz/60 Hz					
T_J	Operating juncti	on temperature r	ange	–40	175	°C
T_JOP	Recommended conditions	-40	T _{Jmax} –25			
T _{STG}	Storage temper	-40	125			
T _C	Operating case	temperature		-40	125	
Torque	Mounting	To heatsink	M6	3	5	N.m
	torque	For terminals	M5	2	3.5	
Wt	Package weight		_	300	g	

1.4 Typical SiC MOSFET Performance Curve

This section shows the typical SiC MOSFET performance curves of the MSCSM70HM05CAG device.

Figure 1-1. Maximum Thermal Impedance

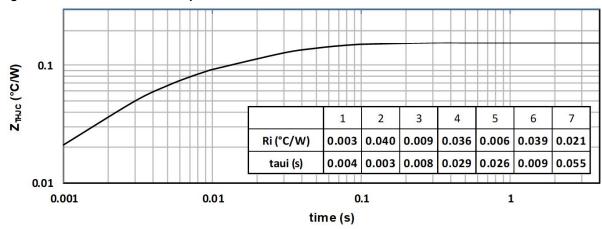


Figure 1-2. Output Characteristics, $T_J = 25$ °C

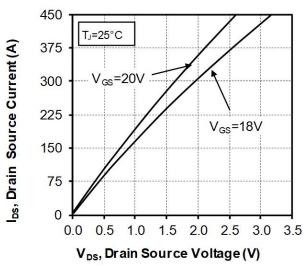


Figure 1-3. Output Characteristics, T_J = 175 °C

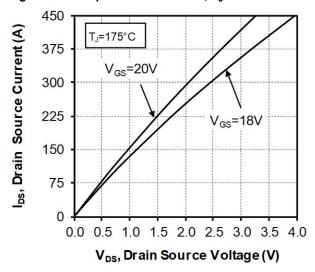


Figure 1-4. Normalized R_{DS(on)} vs. Temperature

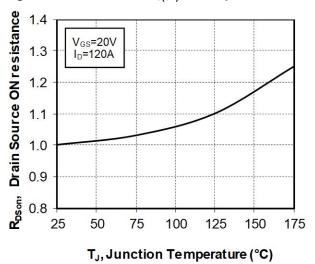


Figure 1-5. Transfer Characteristics

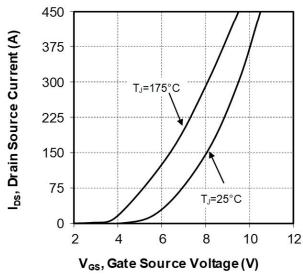


Figure 1-6. Capacitance vs. Drain Source Voltage

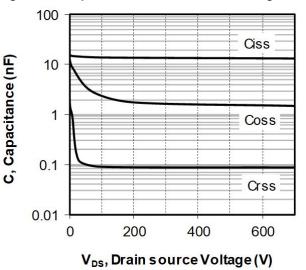


Figure 1-7. Gate Charge vs. Gate Source Voltage

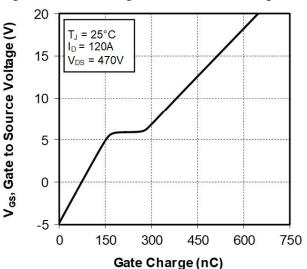


Figure 1-8. Body Diode Characteristics, T_J = 25 °C

-5.0 -4.5 -4.0 -3.5 -3.0 -2.5 -2.0 -1.5

(Y)

V_{GS}=-5V

-75

V_{GS}=-2V

-300

V_{DS}, Drain s ource voltage (V)

Figure 1-10. Body Diode Characteristics, T_J = 175 °C

Figure 1-9. 3rd Quadrant Characteristics, T_J = 25 °C -5 -2 0 T_J=25°C l_{DS}, Drain source current (A) -75 V_{GS}=0V -150 V_{GS}=5V -225-300 V_{GS}=18V V_{GS}=20V -375 -450V_{DS}, Drain source voltage (V)

-4.5 -4.0 -3.5 -3.0 -2.5 -2.0 -1.5 -1.0

V_{GS}=-5V

V_{GS}=-2V

-300

V_{DS}, Drain source voltage (V)

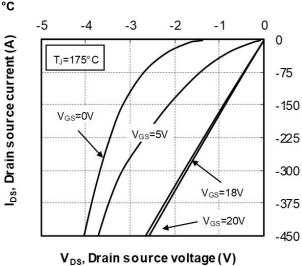


Figure 1-11. 3rd Quadrant Characteristics, $T_J = 175$

Figure 1-12. Switching Energy vs. Current

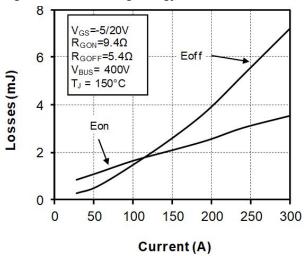


Figure 1-13. Turn On Energy vs. Rg

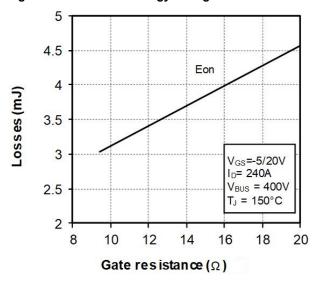


Figure 1-14. Turn Off Energy vs. Rg

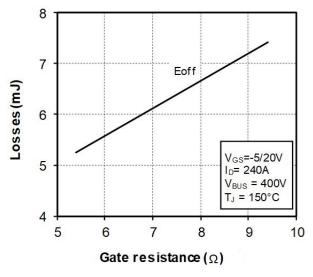
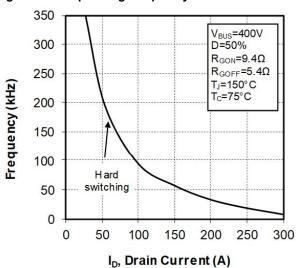


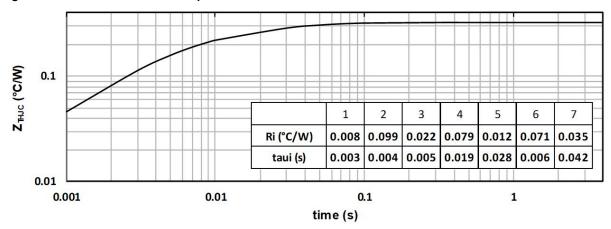
Figure 1-15. Operating Frequency vs. Drain Current



1.5 Typical SiC Diode Performance Curve

This section shows the typical SiC diode performance curves of MSCSM70HM05CAG device.

Figure 1-16. Maximum Thermal Impedance



C, Capacitance (nF)

Figure 1-17. Forward Characteristics

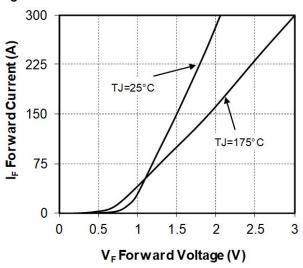
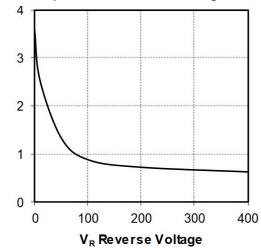


Figure 1-18. Capacitance vs. Reverse Voltage



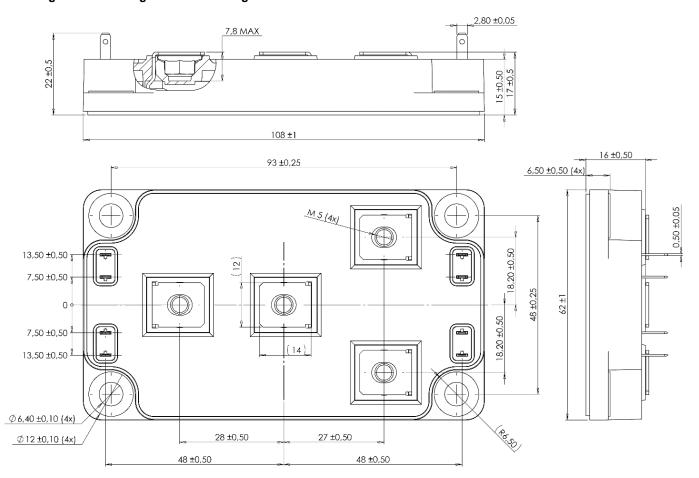
2. Package Specifications

The following section shows the package specification of MSCSM70HM05CAG device.

2.1 Package Outline

The following figure shows the package outline drawing of MSCSM70HM05CAG device. The dimensions are in millimeters.

Figure 2-1. Package Outline Drawing



Note: See application note APT0601—Mounting instructions for SP6 Power Modules for more information.

3. Revision History

Revision	Date	Description
A	04/2021	This is the first publication of this document.

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Dallas	Tel: 630-285-0071	Tel: 86-21-3326-8000		Fax: 49-89-627-144-44
Dallas	Fax: 630-285-0075	China - Shenyang	Taiwan - Hsin Chu	Germany - Rosenheim
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