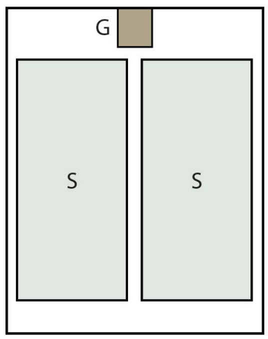
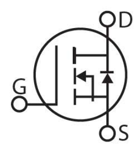
MSC025SMA330D/S

Silicon Carbide N-Channel Power MOSFET Die

Product Overview

The silicon carbide (SiC) power MOSFET product line from Microchip increases the performance over silicon MOSFET and silicon IGBT solutions while lowering the total cost of ownership for high-voltage applications. The MSC025SMA330D/S device is a 3300 V, 25 mΩ SiC MOSFET.





G—Gate
S—Source
D—Drain (backside connection)

Features

The following are key features of the MSC025SMA330D/S device:

- Low capacitances and low gate charge
- Fast switching speed due to low internal gate resistance (ESR)
- Stable operation at high junction temperature, $T_{J(max)}$ = 150 °C
- Fast and reliable body diode
- Superior avalanche ruggedness
- RoHS compliant

Benefits

The following are benefits of the MSC025SMA330D/S device:

- High efficiency to enable lighter, more compact system
- Simple to drive and easy to parallel
- Improved thermal capabilities and lower switching losses
- Eliminates the need for external freewheeling diode
- Lower system cost of ownership

Applications

The MSC025SMA330D/S device is designed for the following applications:

- PV inverter, converter, and industrial motor drives
- Smart grid transmission and distribution
- Induction heating and welding
- H/EV powertrain and EV charger
- Power supply and distribution

1. Device Specifications

This section shows the specifications of the MSC025SMA330D/S device.

1.1 Absolute Maximum Ratings

The following table shows the absolute maximum ratings of the MSC025SMA330D/S device.

Table 1-1. Absolute Maximum Ratings

Symbol	Parameter	Ratings	Unit
V_{DSS}	Drain source voltage	3300	V
I_D	Continuous drain current at T_C = 25 °C[1]	104	A
	Continuous drain current at T_C = 100 °C[1]	66	
I_{DM}	Pulsed drain current[2]	240	
V_{GS}	Gate-source voltage	23 to –10	V

Notes:
1. I_D values for < 0.38 °C/W die to heatsink thermal resistance based on TO-247 package.
2. Repetitive rating: pulse width and case temperature limited by maximum junction temperature.

The following table shows the thermal and mechanical characteristics of the MSC025SMA330D/S device.

Table 1-2. Thermal and Mechanical Characteristics

Symbol	Characteristic/Test Conditions	Min	Typ	Max	Unit
T_J	Operating junction temperature	–55		150	°C
T_{STG}	Storage temperature	–55		150	°C
T_{proc}	Assembly soldering temperature (10 minutes maximum)			325	°C

Recommended storage: The die should be stored (as shipped) in dry nitrogen with an ambient temperature of 25 °C. ESD practices should comply with JESD-625.

1.2 Electrical Performance

The following table shows the static characteristics of the MSC025SMA330D/S device. T_J = 25 °C unless otherwise specified.

Table 1-3. Static Characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	V_{GS} = 0 V, I_D = 100 µA	3300			V
$R_{DS(on)}$	Drain-source on resistance[1,2]	V_{GS} = 20 V, I_D = 40 A		25	31	mΩ
$V_{GS(th)}$	Gate-source threshold voltage	V_{GS} = V_{DS}, I_D = 7 mA	1.9	2.7		V
I_{DSS}	Zero gate voltage drain current	V_{DS} = 3300 V, V_{GS} = 0 V			100	µA
		V_{DS} = 3300 V, V_{GS} = 0 V, T_J = 125 °C			500	
I_{GSS}	Gate-source leakage current	V_{GS} = 20 V/–10 V			±100	nA

Notes:
1. Pulse test: pulse width < 380 µs, duty cycle < 2%.
2. Based on TO-247 packaged die measurements.

The following table shows the dynamic characteristics of the MSC025SMA330D/S device. T_J = 25 °C unless otherwise specified. The dynamic characteristics are based on TO-247 packaged die measurements.

Table 1-4. Dynamic Characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
C_{iss}	Input capacitance	V_{GS} = 0 V, V_{DD} = 2640 V, V_{AC} = 25 mV, f = 200 kHz		8720		pF
C_{rss}	Reverse transfer capacitance			11		
C_{oss}	Output capacitance			194		
Q_g	Total gate charge	V_{GS} = –5 V/20 V, V_{DD} = 2640 V, I_D = 70 A		410		nC
Q_{gs}	Gate-source charge			138		
Q_{gd}	Gate-drain charge			133		
ESR	Gate equivalent series resistance	f = 1 MHz, 25 mV, drain short		0.4		Ω
SCWT	Short circuit withstand time	V_{DS} = 2640 V, V_{GS} = 20 V		1.3		µs
		V_{DS} = 1650 V, V_{GS} = 20 V		6		

The following table shows the body diode characteristics of the MSC025SMA330D/S device. T_J = 25 °C unless otherwise specified. The body diode characteristics are based on TO-247 packaged die measurements.

Table 1-5. Body Diode Characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
V_{SD}	Diode forward voltage	I_{SD} = 40 A, V_{GS} = 0 V		3.55		V
		I_{SD} = 40 A, V_{GS} = –5 V		3.65		
t_{rr}	Reverse recovery time	I_{SD} = 100 A, V_{GS} = –5 V, V_{DD} = 2310 V, dI/dt = –15500 A/µs, Drive Rg = 4.0 Ω		35		ns
Q_{rr}	Reverse recovery charge			4400		nC
I_{RRM}	Reverse recovery current			210		A

Note: Based on scaled measurements, dI/dt and I_{RRM} will be lower in typical applications.

1.3 Typical Performance Curves

This section shows the typical performance curves of the MSC025SMA330D/S device. The performance curves are based on TO-247 packaged die measurements.

Figure 1-1. Drain Current vs. V_{DS} at T_J

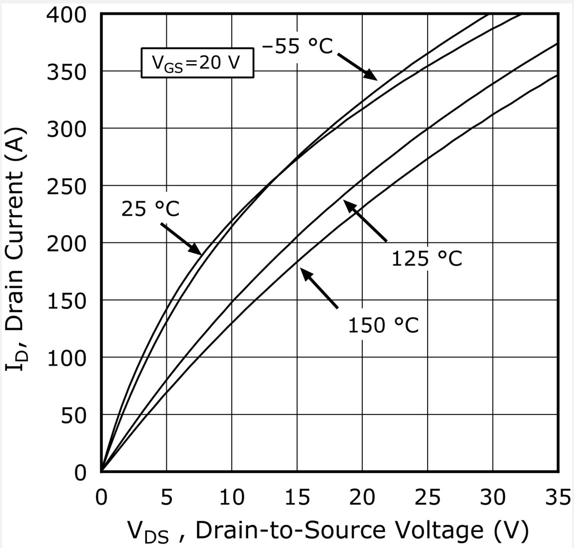


Figure 1-2. Drain Current vs. V_{DS} at V_{GS}

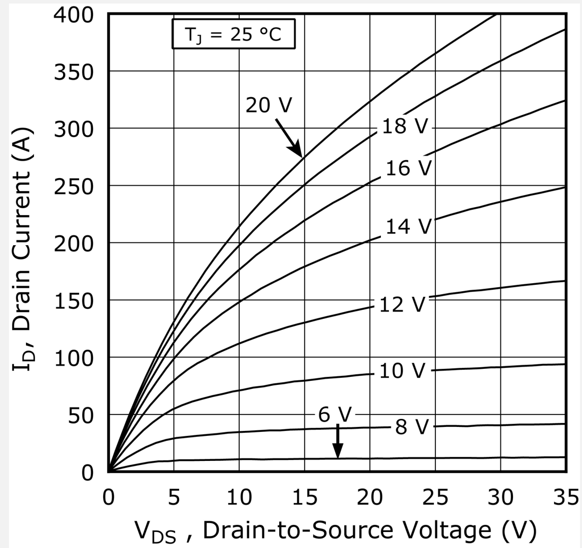


Figure 1-3. Drain Current vs. V_{DS} at V_{GS}

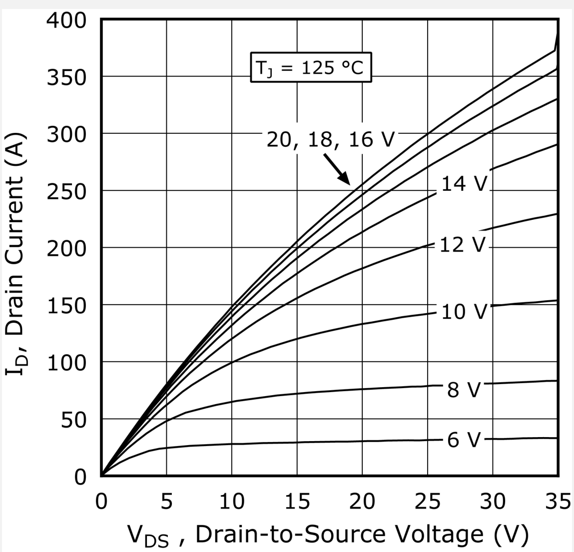


Figure 1-4. Drain Current vs. V_{DS} at V_{GS}

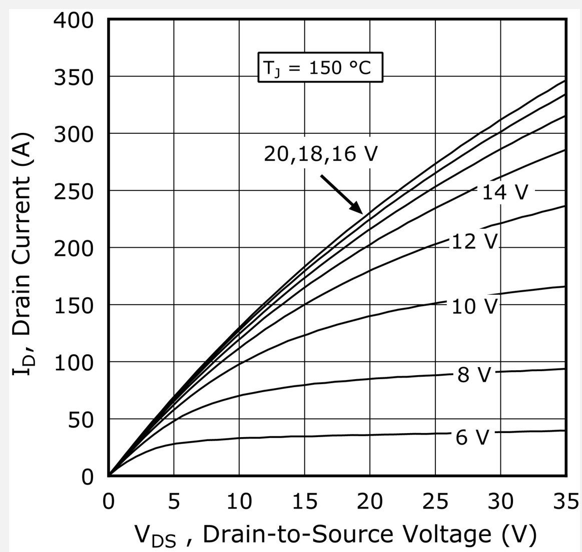


Figure 1-5. $R_{DS(on)}$ vs. Junction Temperature

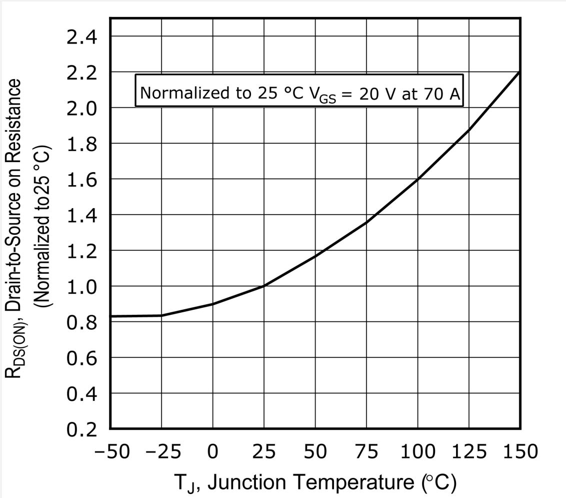


Figure 1-6. Gate Charge Characteristics

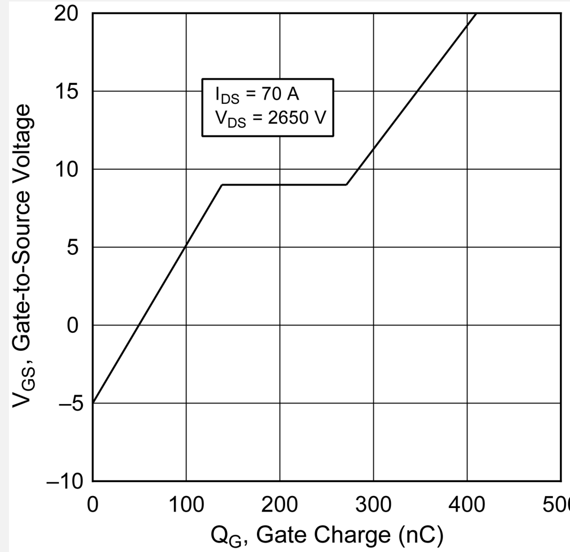


Figure 1-7. Capacitance vs. Drain-to-Source Voltage

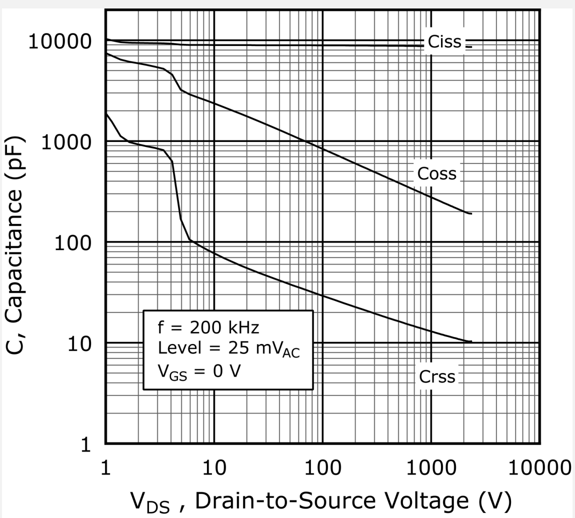


Figure 1-8. I_D vs. V_{DS} 3rd Quadrant Conduction

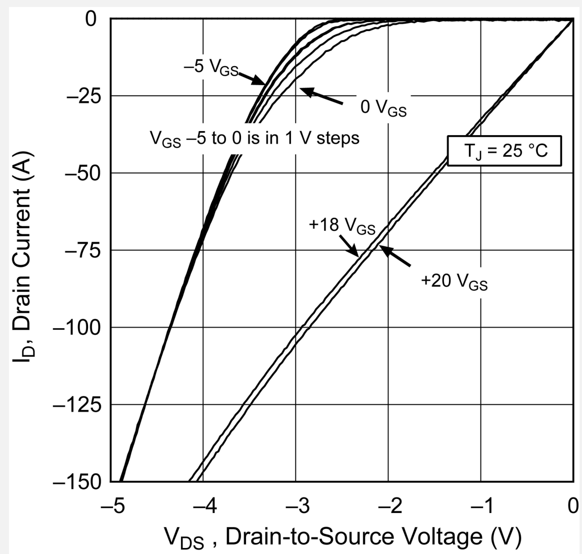


Figure 1-9. I_D vs. V_{DS} 3rd Quadrant Conduction

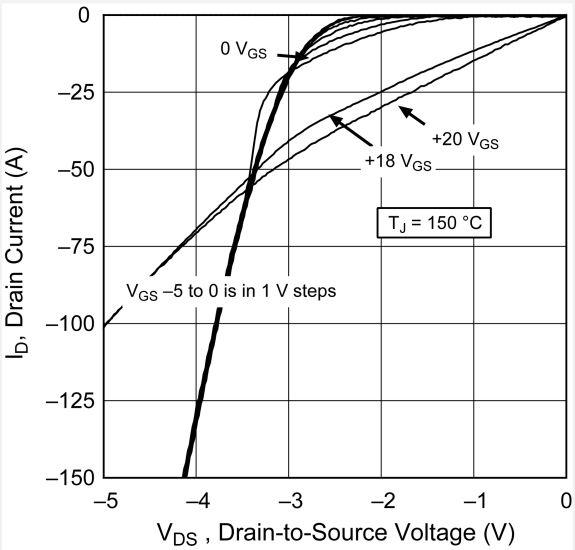
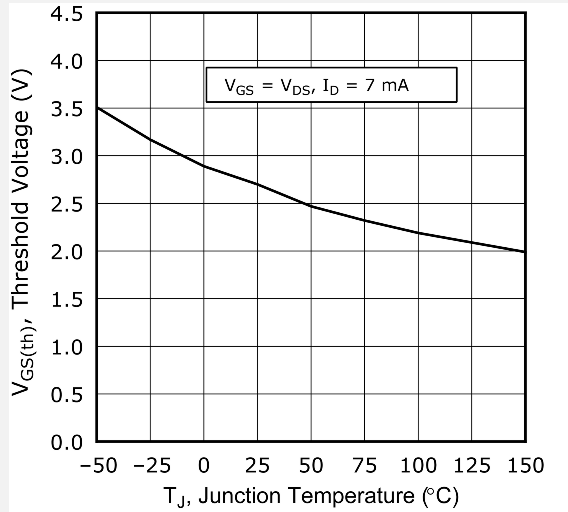


Figure 1-10. Threshold Voltage vs. Junction Temp.



2. Die Specification

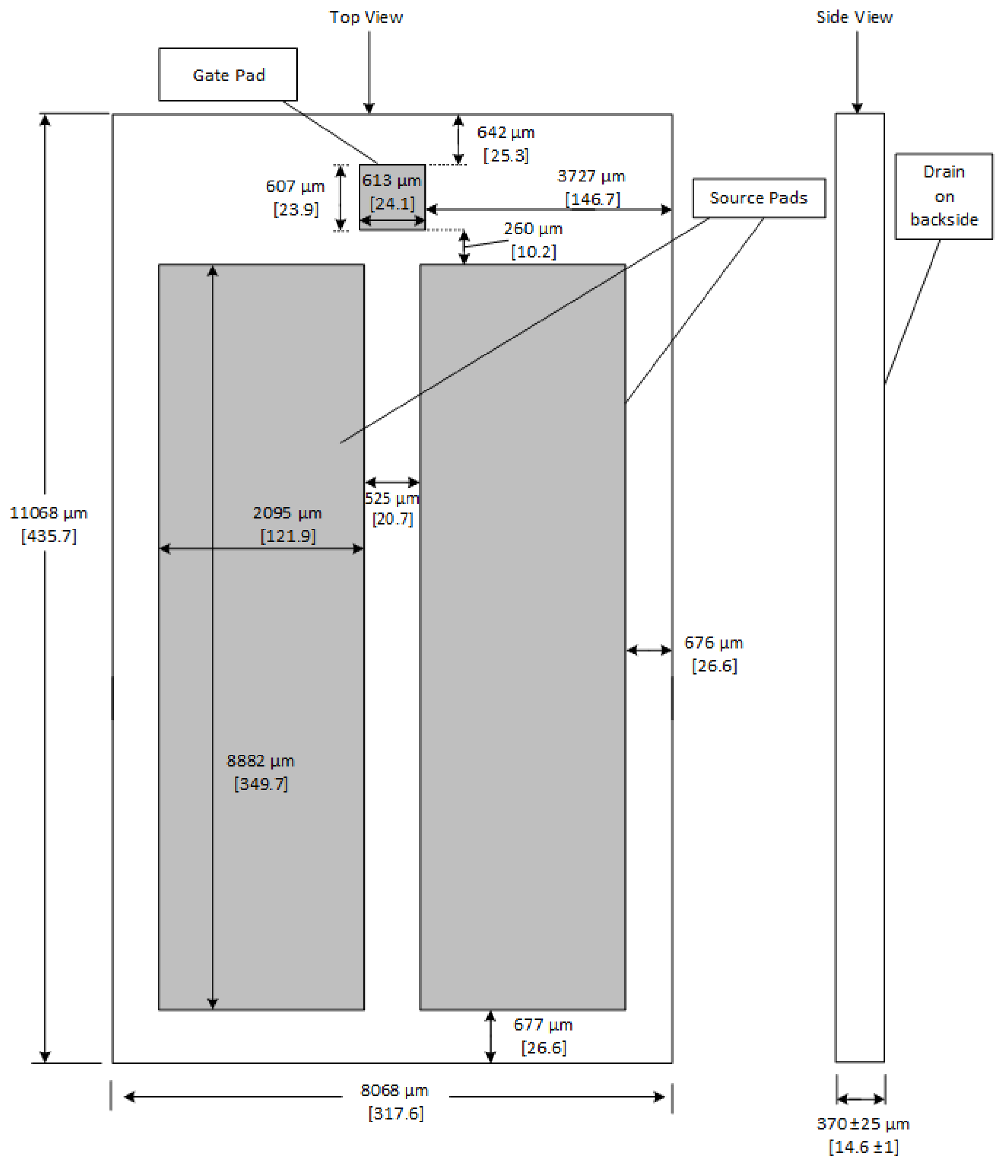
This section shows the die specification of the MSC025SMA330D/S device.

2.1 Die Layout

The Microchip SiC MOSFET die are designed such that all source pads should evenly distribute the package current. The dimensions in this drawing are the nominal dimensions including the scribe street. The final die dimensions are determined by the scribe frame at each fabrication location and the dicing process at each assembly location.

The dimensions in the figure below are in µm and [mils].

Figure 2-1. Die Outline Drawing



Die Layout

Description	Thickness	Component
Top metal	5.0 µm	Al/Cu
Backside metal	1.0 µm	Ag

3. Revision History

Table 3-1. Revision History

Revision	Date	Description
A	11/2021	Document created.

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ISBN: 978-1-5224-9123-1

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