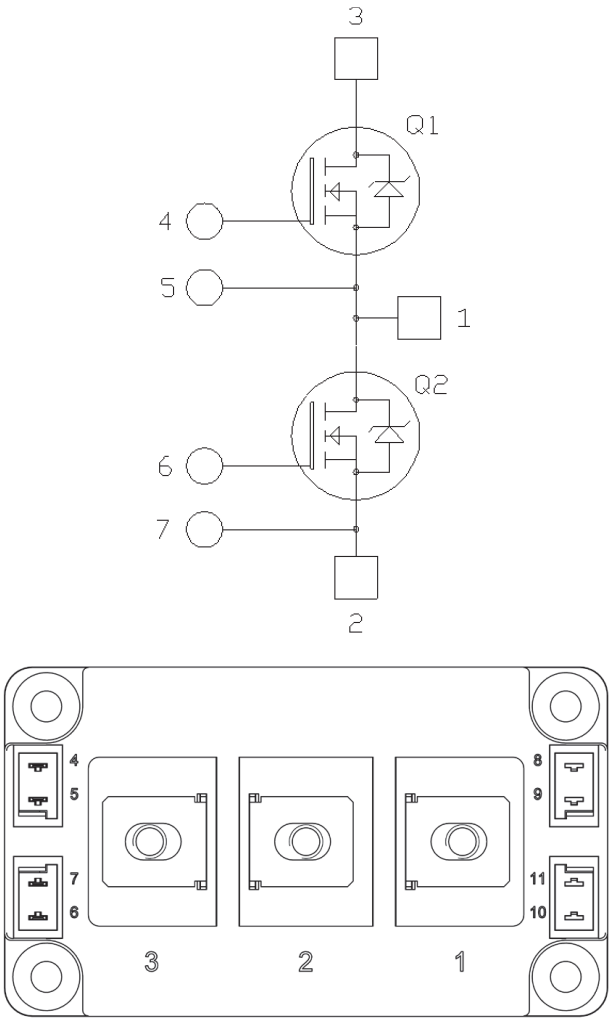
MSCSM120AM027D3AG

Phase Leg SiC Power Module

Product Overview

The MSCSM120AM027D3AG device is a full bridge 1200V, 733A phase leg silicon carbide (SiC) MOSFET power module.



Note: 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 the key features of the MSCSM120AM027D3AG device:

- SiC Power MOSFET
  - Low $R_{DS(on)}$
  - High temperature performance
- Kelvin source for easy drive
- High level of integration
- M6 power connectors
- Aluminum Nitride (AlN) substrate for improved thermal performance

Benefits

The following are the benefits of MSCSM120AM027D3AG device:

- High efficiency converter
- Stable temperature behavior
- Direct mounting to heatsink (isolated package)
- Low junction-to-case thermal resistance
- RoHS compliant

Application

The MSCSM120AM027D3AG 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 MSCSM120AM027D3AG device.

1.1 SiC MOSFET Characteristics (Per SiC MOSFET)

The following table lists the absolute maximum ratings per SiC MOSFET of the MSCSM120AM027D3AG device.

Table 1-1. Absolute Maximum Ratings

Symbol	Parameter		Maximum Ratings	Unit
V_{DSS}	Drain-Source voltage		1200	V
I_D	Continuous drain current	T_C = 25 °C	733[1]	A
		T_C = 80 °C	584[1]	
I_{DM}	Pulsed drain current		1400	
V_{GS}	Gate-Source voltage		–10/23	V
$R_{DS(on)}$	Drain-Source ON resistance		3.5	mΩ
P_D	Power dissipation	T_C = 25 °C	2970	W

Note:

1. SiC MOSFET device specification, but the output current must be limited due to the size of the power connectors.

The following table lists the electrical characteristics per SiC MOSFET of the MSCSM120AM027D3AG device.

Table 1-2. Electrical Characteristics

Symbol	Characteristic	Test Conditions		Min.	Typ.	Max.	Unit
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0V V_{DS} = 1200V		—	90	900	µA
$R_{DS(on)}$	Drain–Source on resistance	V_{GS} = 20V I_D = 360A	T_J = 25 °C	—	2.8	3.5	mΩ
			T_J = 175 °C	—	4.5	—	
$V_{GS(th)}$	Gate threshold voltage	V_{GS} = V_{DS} I_D = 27 mA		1.8	2.8	—	V
I_{GSS}	Gate–Source leakage current	V_{GS} = 20V; V_{DS} = 0V		—	—	900	nA

The following table lists the dynamic characteristics per SiC MOSFET of the MSCSM120AM027D3AG device.

Table 1-3. Dynamic Characteristics

Symbol	Characteristic	Test Conditions		Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{GS} = 0V		—	27	—	nF
C_{oss}	Output capacitance	V_{DS} = 1000V		—	2.43	—	
C_{rss}	Reverse transfer capacitance	f = 1 MHz		—	0.23	—	
Q_g	Total gate charge	V_{GS} = –5V/20V		—	2088	—	nC
Q_{gs}	Gate-Source charge	V_{Bus} = 800V		—	369	—	
Q_{gd}	Gate-Drain charge	I_D = 360A		—	450	—	
$T_{d(on)}$	Turn-on delay time	V_{GS} = –5V/20V	T_J = 150°C	—	74	—	ns
T_r	Rise time	V_{Bus} = 600V		—	96	—	
$T_{d(off)}$	Turn-off delay time	I_D = 450A		—	150	—	
T_f	Fall time	$R_{G(on)}$ = 4.7Ω			51	—	
		$R_{G(off)}$ = 1.8Ω					
E_{on}	Turn-on energy	V_{GS} = –5V/20V	T_J = 150 °C	—	16	—	mJ
E_{off}	Turn-off energy	V_{Bus} = 600V	T_J = 150 °C	—	9.2	—	
		I_D = 450A					
		$R_{G(on)}$ = 4.7Ω					
		$R_{G(off)}$ = 1.8Ω					
R_{Gint}	Internal gate resistance			—	0.65	—	Ω
R_{thJC}	Junction-to-case thermal resistance			—	—	0.051	°C/W

The following table lists the body diode ratings and characteristics per SiC MOSFET of the MSCSM120AM027D3AG device.

Table 1-4. Body Diode Ratings and Characteristics

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
V_{SD}	Diode forward voltage	V_{GS} = 0V; I_{SD} = 360A	—	4	—	V
		V_{GS} = –5V; I_{SD} = 360A	—	4.2	—	
t_{rr}	Reverse recovery time	I_{SD} = 360A; V_{GS} = –5V	—	90	—	ns
Q_{rr}	Reverse recovery charge	V_R = 600V; di_F/dt = 9000 A/µs	—	4950	—	nC
I_{rr}	Reverse recovery current		—	122	—	A

1.2 Thermal and Package Characteristics

The following table lists the thermal and package characteristics of the MSCSM120AM027D3AG device.

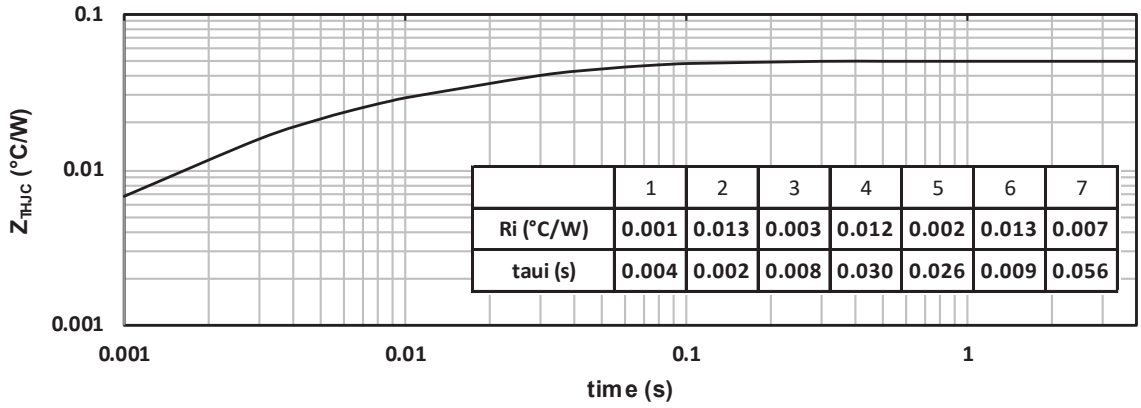
Table 1-5. Thermal and Package Characteristics

Symbol	Characteristics			Min.	Max.	Unit
V_{ISOL}	RMS isolation voltage, any terminal to case t =1 min, 50 Hz/60 Hz			4000	—	V
T_J	Operating junction temperature range			–40	175	°C
T_{JOP}	Recommended junction temperature under switching conditions			–40	T_{Jmax}–25	
T_{STG}	Storage temperature range			–40	125	
T_C	Operating case temperature			–40	125	
Torque	Mounting torque	For terminals	M6	3	5	N.m
		To heatsink	M6	3	5	
Wt	Package weight			—	350	g

1.3 Typical SiC MOSFET Performance Curve

This section shows the typical SiC MOSFET performance curves of the MSCSM120AM027D3AG device.

Figure 1-1. Maximum Thermal Impedance



	1	2	3	4	5	6	7
Ri (°C/W)	0.001	0.013	0.003	0.012	0.002	0.013	0.007
taui (s)	0.004	0.002	0.008	0.030	0.026	0.009	0.056

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

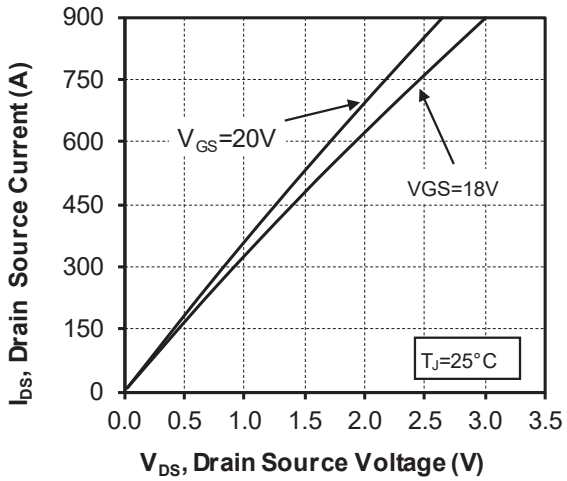


Figure 1-3. Output Characteristics, T_J = 175 °C

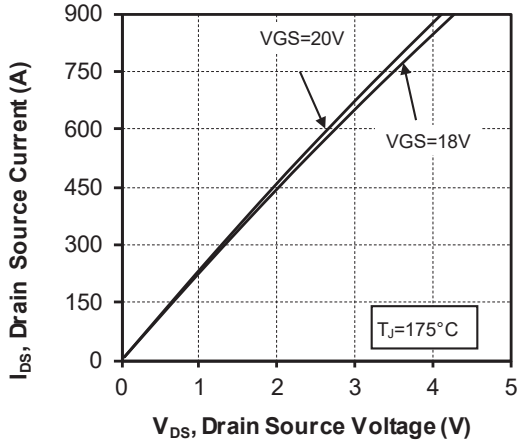


Figure 1-4. Normalized $R_{DS(on)}$ vs. Temperature

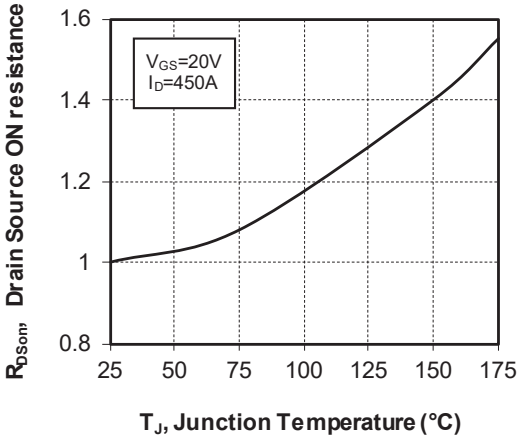


Figure 1-5. Transfer Characteristics

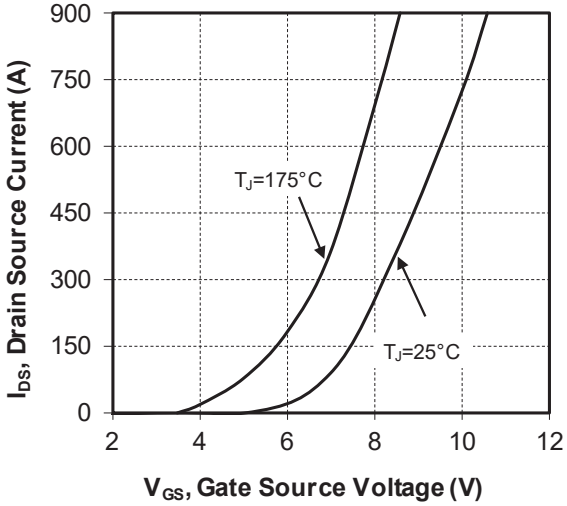


Figure 1-6. Switching Energy vs. Current

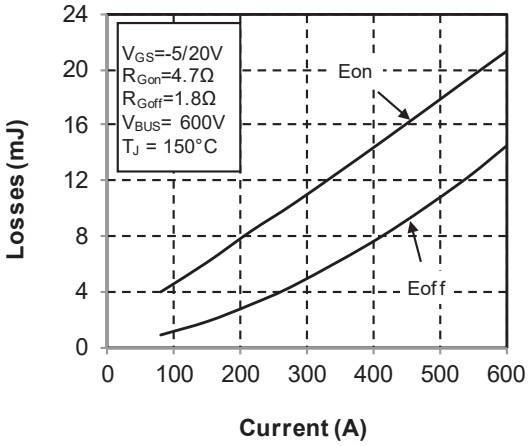


Figure 1-7. Switching Energy vs. Rg

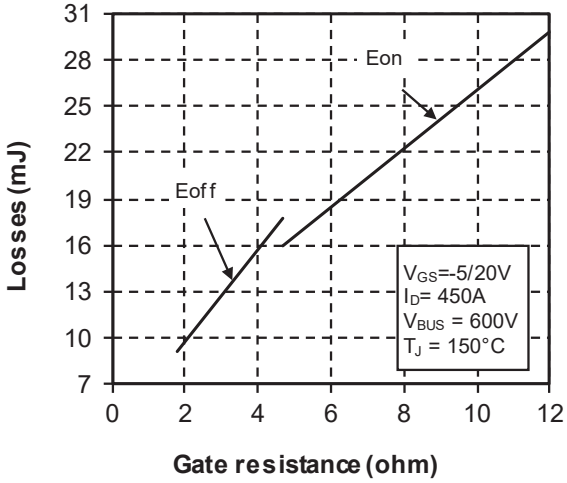


Figure 1-8. Capacitance vs. Drain Source Voltage

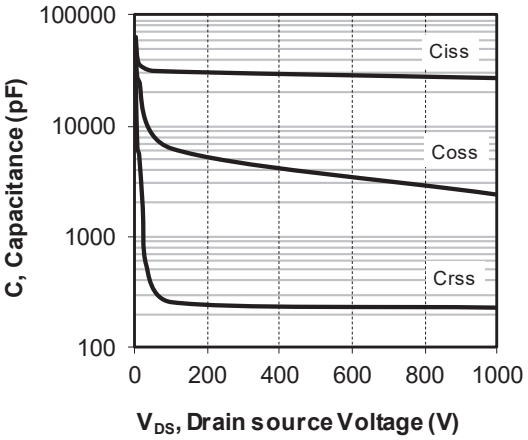


Figure 1-9. Gate Charge vs. Gate Source Voltage

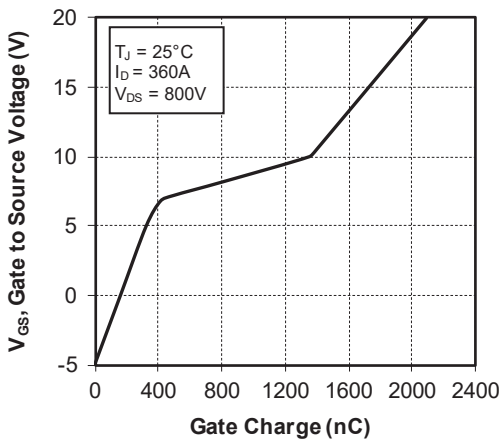


Figure 1-10. Body Diode Characteristics, T_J = 25 °C

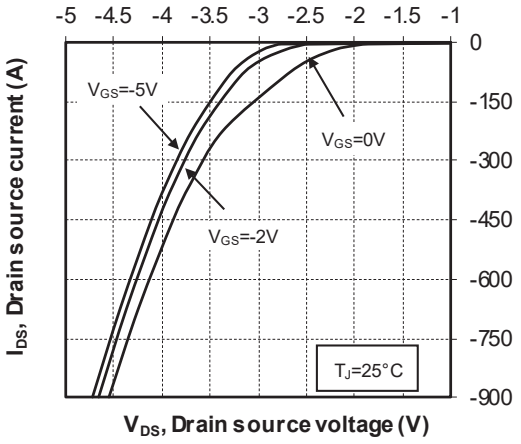


Figure 1-11. 3rd Quadrant Characteristics, T_J = 25 °C

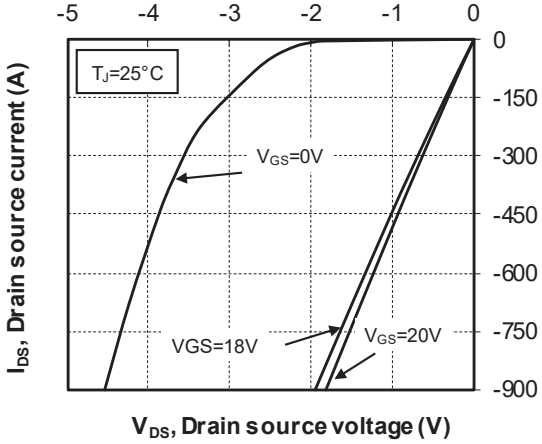


Figure 1-12. Body Diode Characteristics, T_J = 175 °C

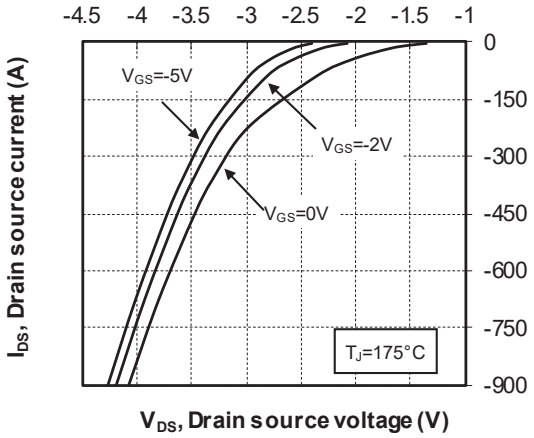


Figure 1-13. 3rd Quadrant Characteristics, T_J = 175 °C

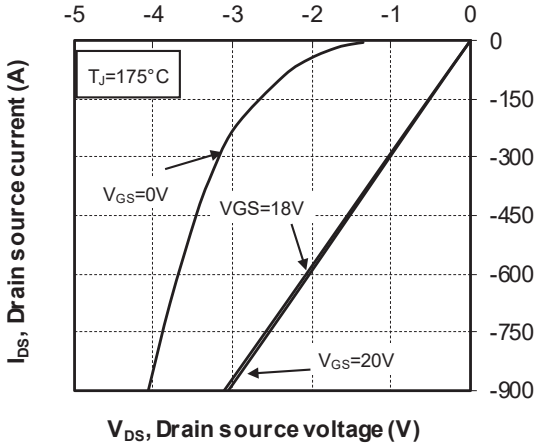
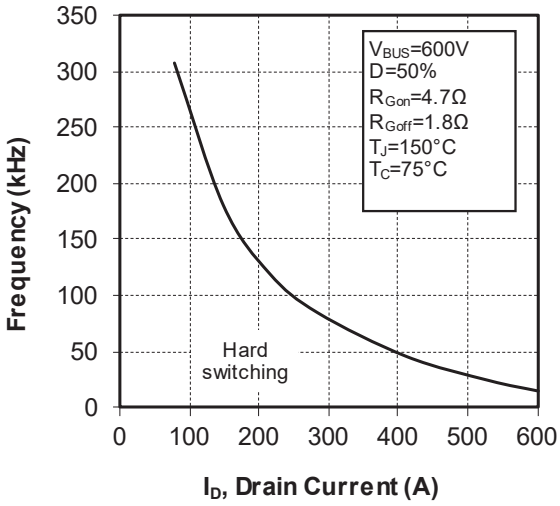


Figure 1-14. Operating Frequency vs Drain Current



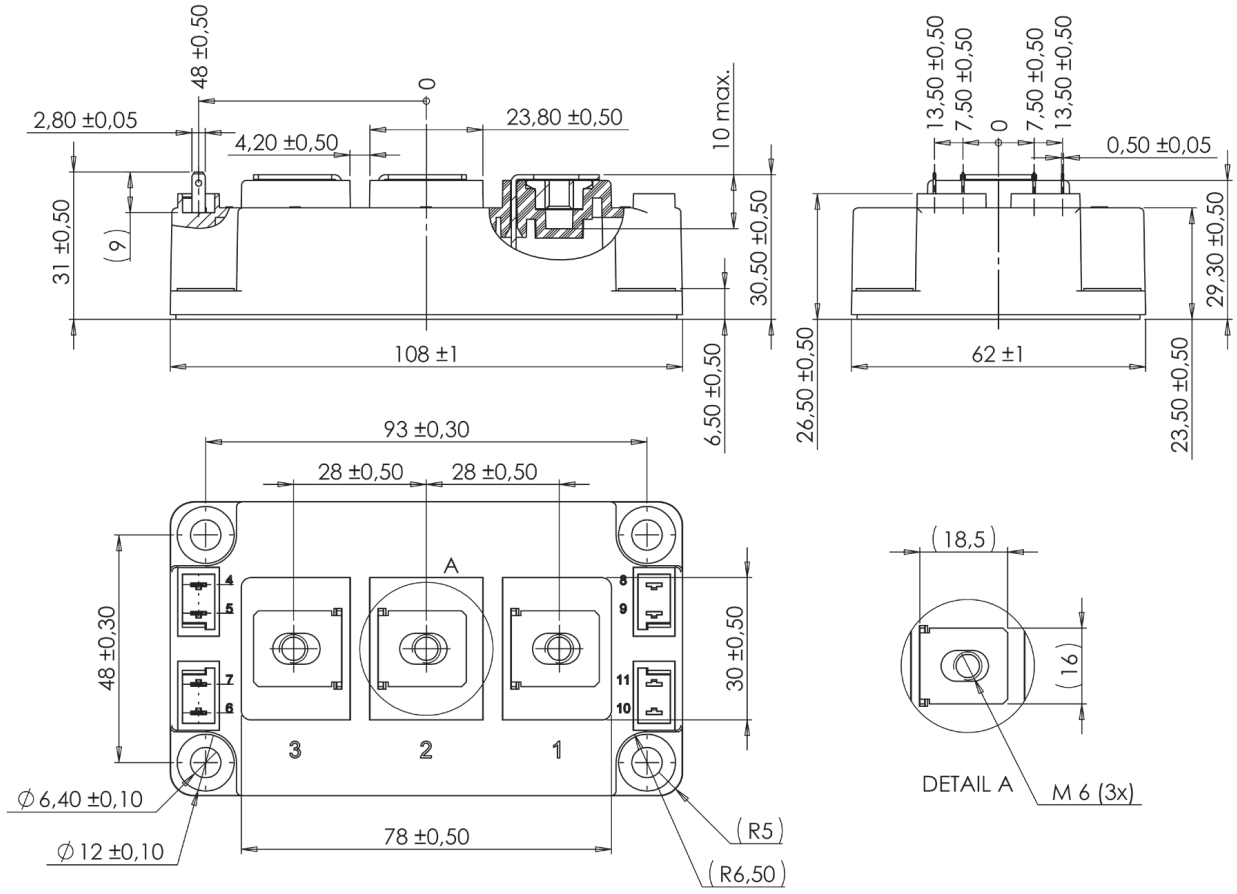
2. Package Specifications

The following section shows the package specification of the MSCSM120AM027D3AG device.

2.1 Package Outline

The following figure shows the package outline drawing of the MSCSM120AM027D3AG device. The dimensions in the following figure are in millimeters.

Figure 2-1. Package Outline Drawing



Note: See AP1908—Mounting instruction for D3 and D4 Power Modules for more information.

3. Revision History

Revision	Date	Description
A	06/2022	Initial Revision.

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