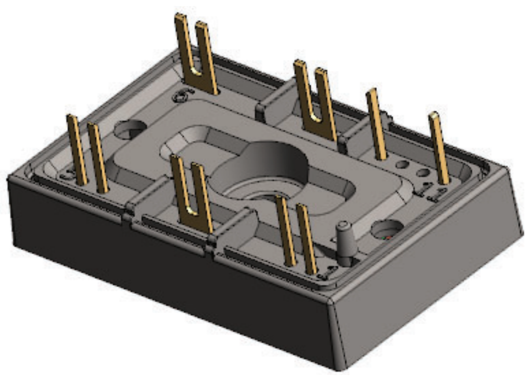
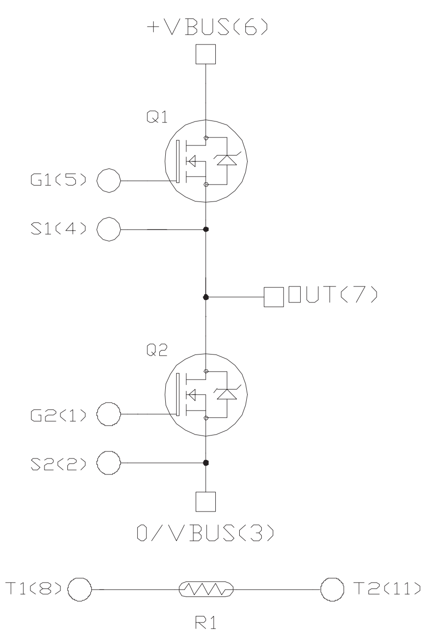
MSCSM120AM31TBL1NG

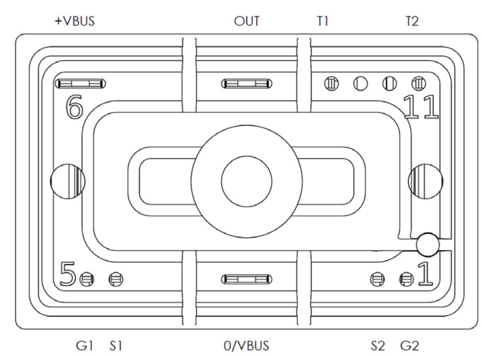
Phase Leg SiC MOSFET Power Module

Product Overview

The MSCSM120AM31TBL1NG device is a phase leg 1200V, 79A 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 MSCSM120AM31TBL1NG device:

- SiC Power MOSFET
  - High speed switching
  - Low $R_{DS(on)}$
- Very low stray inductance
- Ultra-low weight and profile
- Kelvin source for easy drive
- Si_3N_4 substrate with thick copper for improved thermal performance
- Internal thermistor for temperature monitoring
- Extended temperature range

Benefits

The following are the benefits of MSCSM120AM31TBL1NG device:

- High efficiency converter
- Outstanding performance at high frequency operation
- Direct mounting to heatsink (isolated package)
- Low junction-to-heatsink thermal resistance
- Solderable terminals both for power and signal for easy PCB mounting
- Very integrated power conversion system
- Low profile
- RoHS Compliant

Application

The following are the applications of MSCSM120AM31TBL1NG device:

- High reliability power systems
- High efficiency AC/DC and DC/AC converters
- Motor control

1. Electrical Specifications

This section provides the electrical specifications of the MSCSM120AM31TBL1NG device.

1.1 SiC MOSFET Characteristics (Per SiC MOSFET)

The following table lists the absolute maximum ratings per SiC MOSFET of the MSCSM120AM31TBL1NG 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_H = 25 °C	79	A
		T_H = 80 °C	63	
I_{DM}	Pulsed drain current		160	
V_{GS}	Gate-Source voltage		–10/23	V
$R_{DS(on)}$	Drain-Source ON resistance		31	mΩ
P_D	Power dissipation	T_H = 25 °C	310	W

The following table lists the electrical characteristics per SiC MOSFET of the MSCSM120AM31TBL1NG 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		—	10	100	µA
$R_{DS(on)}$	Drain–Source on resistance	V_{GS} = 20V I_D = 40A	T_J = 25 °C	—	25	31	mΩ
			T_J = 175 °C	—	40	—	
$V_{GS(th)}$	Gate threshold voltage	V_{GS} = V_{DS}; I_D = 3 mA		1.8	2.8	—	V
I_{GSS}	Gate–Source leakage current	V_{GS} = 20V; V_{DS} = 0V		—	—	150	nA

The following table lists the dynamic characteristics per SiC MOSFET of the MSCSM120AM31TBL1NG device.

Table 1-3. Dynamic Characteristics

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{GS} = 0V V_{DS} = 1000V f = 1 MHz	—	3020	—	pF
C_{oss}	Output capacitance		—	270	—	
C_{rss}	Reverse transfer capacitance		—	25	—	
Q_g	Total gate charge	V_{GS} = –5V/20V V_{Bus} = 800V I_D = 40A	—	232	—	nC
Q_{gs}	Gate-Source charge		—	41	—	
Q_{gd}	Gate-Drain charge		—	50	—	

...........continued

Symbol	Characteristic	Test Conditions		Min.	Typ.	Max.	Unit
$T_{d(on)}$	Turn-on delay time	V_{GS} = –5V/20V V_{Bus} = 600V I_D = 50A $R_{G(on)}$ = 8Ω $R_{G(off)}$ = 4.7Ω		—	30	—	ns
T_r	Rise time			—	30	—	
$T_{d(off)}$	Turn-off delay time			—	50	—	
T_f	Fall time			—	25	—	
E_{on}	Turn-on energy	V_{GS} = –5V/20V V_{Bus} = 600V I_D = 50A R_{Gon} = 8Ω R_{Goff} = 4.7Ω	T_J = 150 °C	—	1.2	—	mJ
E_{off}	Turn-off energy		T_J = 150 °C	—	0.66	—	
R_{Gint}	Internal gate resistance			—	0.88	—	Ω
R_{thJH}	Junction-to-heatsink thermal resistance		λ = 3.4 W/mK	—	0.483	—	°C/W

The following table lists the body diode ratings and characteristics per SiC MOSFET of the MSCSM120AM31TBL1NG 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} = 40A	—	4	—	V
		V_{GS} = –5V; I_{SD} = 40A	—	4.2	—	
t_{rr}	Reverse recovery time	I_{SD} = 40A; V_{GS} = –5V V_R = 800V; di_F/dt = 1000 A/μs	—	90	—	ns
Q_{rr}	Reverse recovery charge		—	550	—	nC
I_{rr}	Reverse recovery current		—	13.5	—	A

1.2 Thermal and Package Characteristics

The following table lists the thermal and package characteristics of the MSCSM120AM31TBL1NG device.

Table 1-5. Thermal and Package Characteristics

Symbol	Characteristic			Min.	Typ.	Max.	Unit
V_{ISOL}	RMS isolation voltage, any terminal to case t = 1 min, 50 Hz/60 Hz			2500	—	—	V
T_J	Operating junction temperature range			–55	—	175	°C
T_{JOP}	Recommended junction temperature under switching conditions			–55	—	T_{Jmax}–25	
T_{STG}	Storage case temperature			–55	—	125	
T_C	Operating case temperature			–55	—	125	
Torque	Mounting torque	To heatsink	M4	1.5	—	2	N.m
Wt	Package weight			—	13.5	—	g

The following table lists the temperature sensor NTC of the MSCSM120AM31TBL1NG device.

Table 1-6. Temperature Sensor NTC

Symbol	Characteristic		Min.	Typ.	Max.	Unit
R_{25}	Resistance at 25 °C		—	50	—	kΩ
$\Delta R_{25}/R_{25}$	—		—	5	—	%
$B_{25/85}$	T_{25} = 298.15K		—	3952	—	K
ΔB/B	—	T_C = 100 °C	—	4	—	%

$$R_T = \frac{R_{25}}{\exp\left[B_{25/85}\left(\frac{1}{T_{25}} - \frac{1}{T}\right)\right]}$$

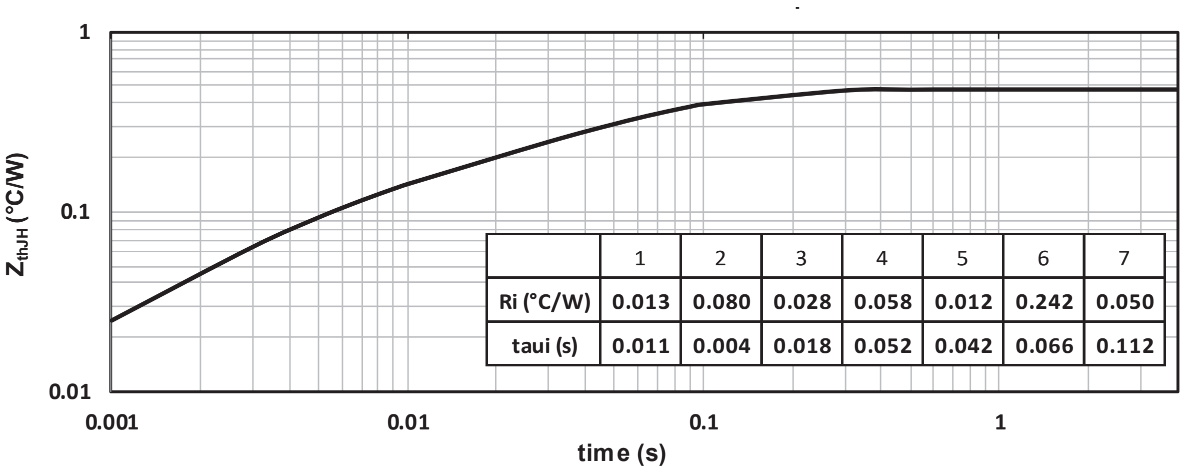
T: Thermistor temperature
R_T: Thermistor value at T

Note: See APT0406—Using NTC Temperature Sensor Integrated into Power Module for more information.

1.3 Typical SiC MOSFET Performance Curve

This section shows the typical SiC MOSFET performance curves of the MSCSM120AM31TBL1NG device.

Figure 1-1. Junction-to-Heatsink Thermal Impedance



	1	2	3	4	5	6	7
Ri (°C/W)	0.013	0.080	0.028	0.058	0.012	0.242	0.050
taui (s)	0.011	0.004	0.018	0.052	0.042	0.066	0.112

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

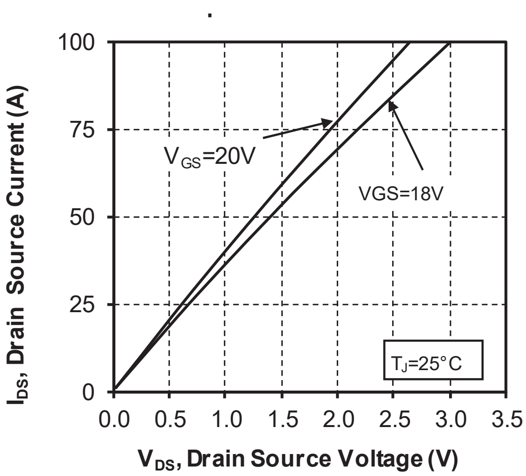


Figure 1-3. Output Characteristics, T_J = 175 °C

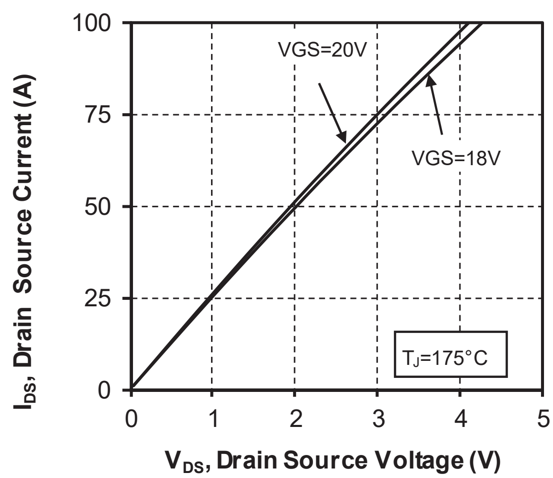


Figure 1-4. Normalized $R_{DS(on)}$ vs. Temperature

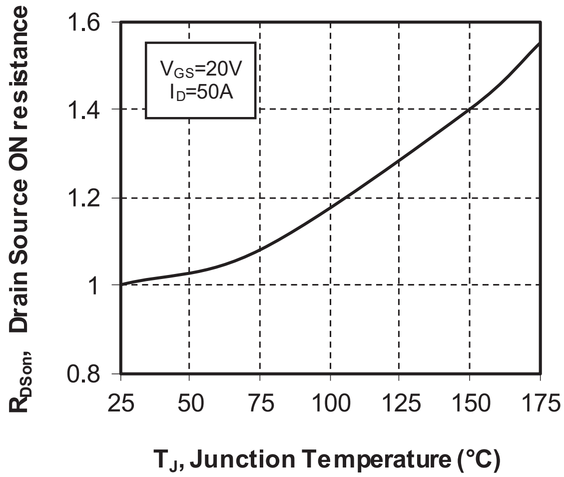


Figure 1-5. Transfer Characteristics

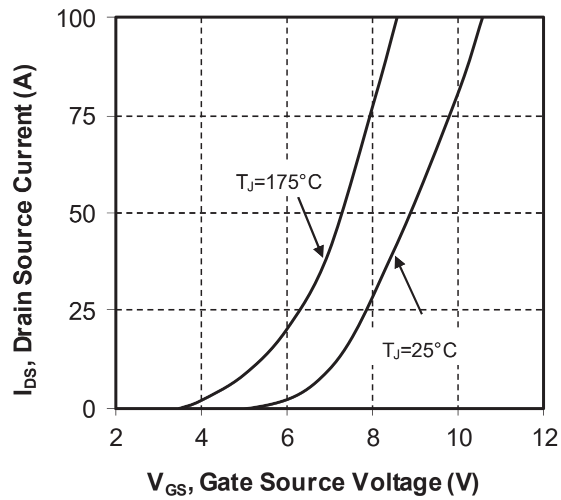


Figure 1-6. Switching Energy vs. Rg

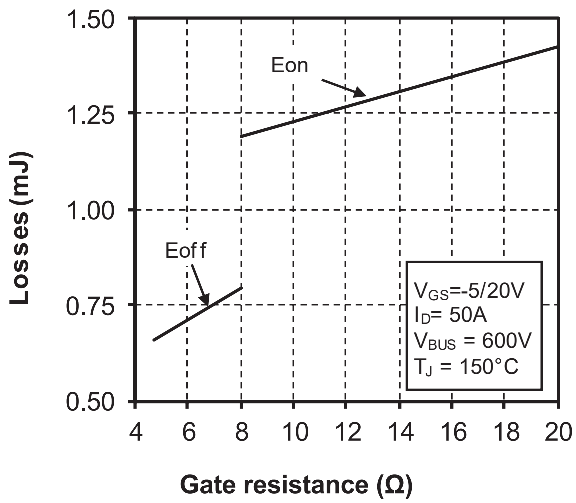


Figure 1-7. Switching Energy vs. Current

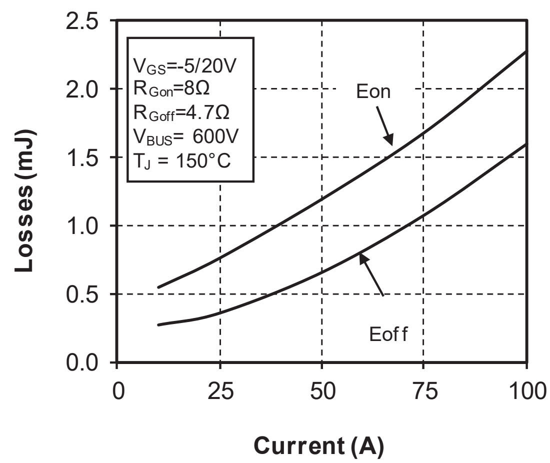


Figure 1-8. Capacitance vs. Drain Source Voltage

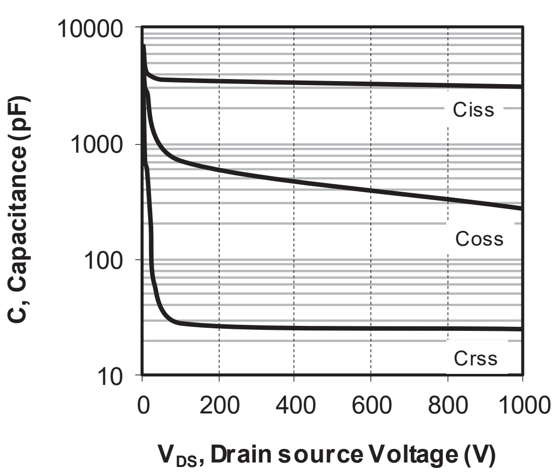


Figure 1-9. Gate Charge vs. Gate Source Voltage

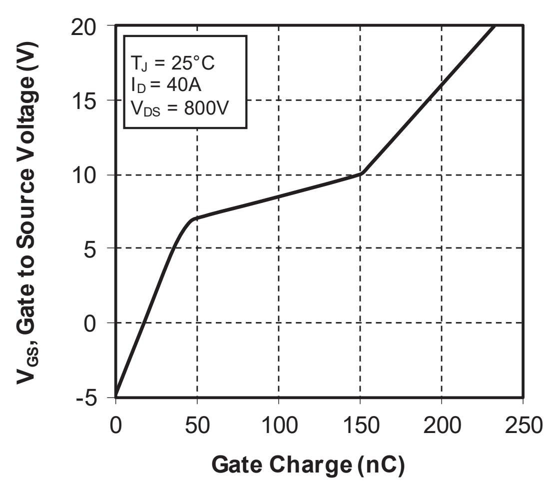


Figure 1-10. Body Diode Characteristics, T_J = 25 °C

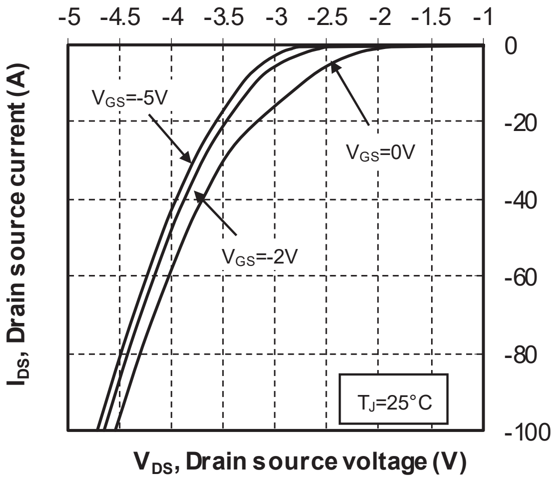


Figure 1-11. 3rd Quadrant Characteristics, T_J = 25 °C

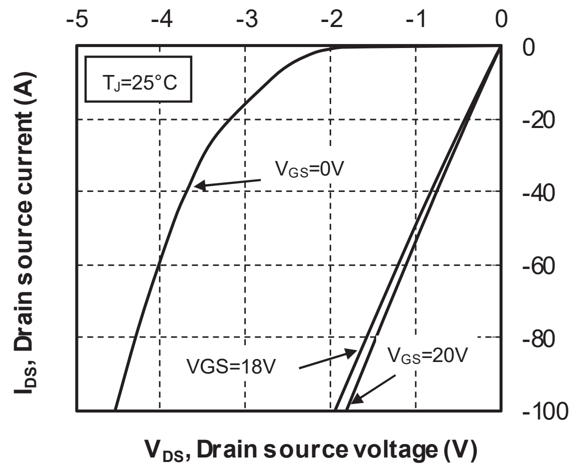


Figure 1-12. Body Diode Characteristics, T_J = 175 °C

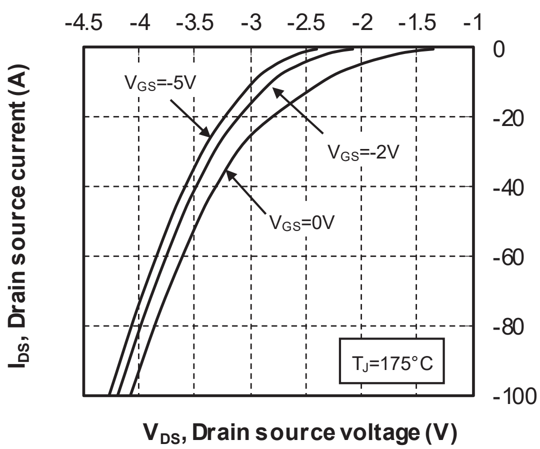


Figure 1-13. 3rd Quadrant Characteristics, T_J = 175 °C

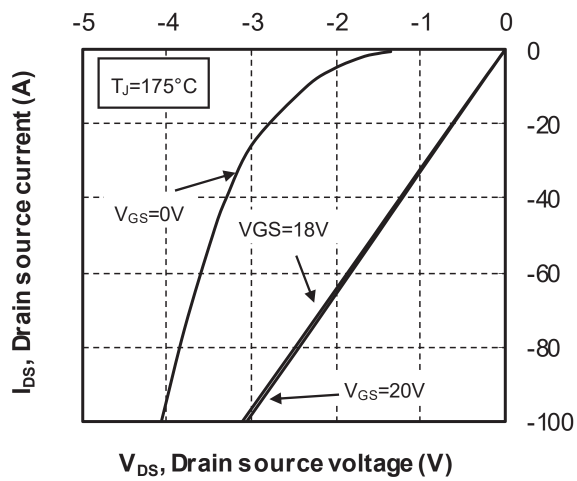
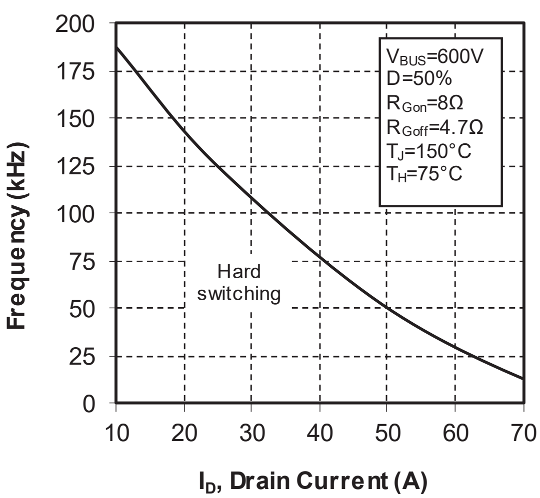


Figure 1-14. Operating Frequency vs Drain Current



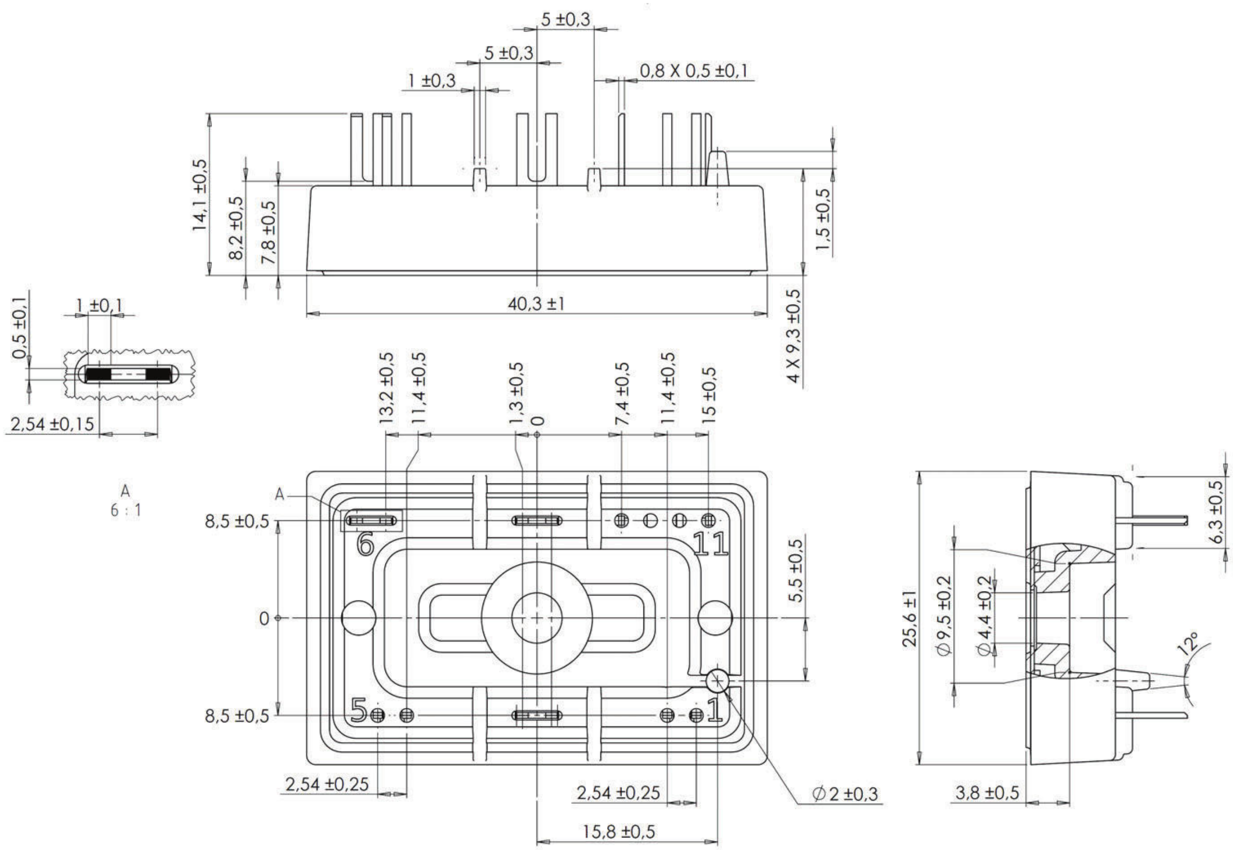
2. Package Specifications

The following section shows the package specification of the MSCSM120AM31TBL1NG device.

2.1 Package Outline

The following figure shows the package outline drawing of the MSCSM120AM31TBL1NG device. The dimensions in the following figure are in millimeters.

Figure 2-1. Package Outline Drawing



Note: See AN4306 - Mounting instructions for baseless power module for more information.

3. Revision History

Revision	Date	Description
A	06/2022	Initial Revision

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