

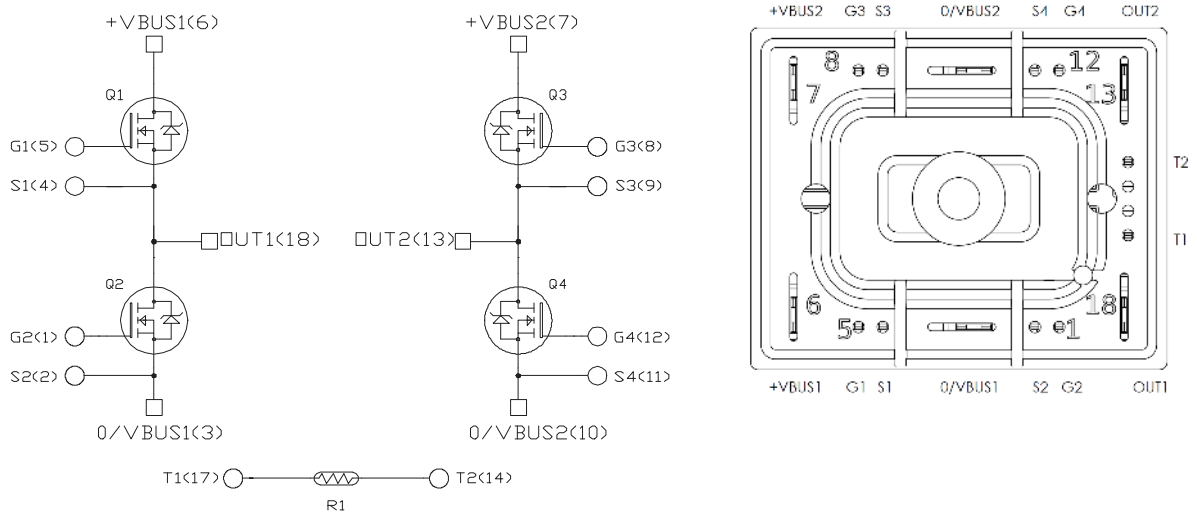
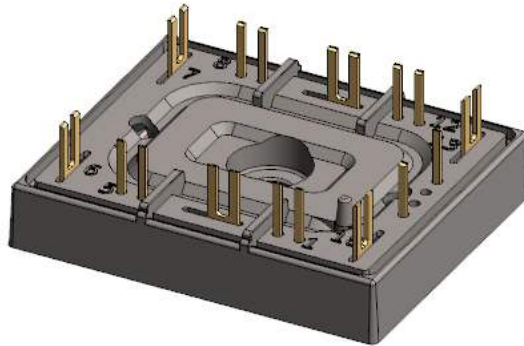


# MSCSM120HM31TBL2NG

## Full Bridge SiC MOSFET Power Module

### Product Overview

The MSCSM120HM31TBL2NG device is a phase leg 1200V, 79A silicon carbide (SiC) MOSFET power module.



**Note:** All ratings at  $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise specified.



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

## Features

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The following are the key features of MSCSM120HM31TBL2NG 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

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The following are the benefits of MSCSM120HM31TBL2NG device:

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

## Application

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The following are the applications of MSCSM120HM31TBL2NG device:

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

## Electrical Specifications

This section provides the electrical specifications of the MSCSM120HM31TBL2NG device.

### 1.1 SiC MOSFET Characteristics (Per SiC MOSFET)

The following table lists the absolute maximum ratings per SiC MOSFET of the MSCSM120HM31TBL2NG device.

**Table 1. Absolute Maximum Ratings**

Symbol	Parameter	Maximum Ratings	Unit
$V_{DSS}$	Drain-Source voltage	1200	V
$I_D$	Continuous drain current	$T_H = 25\text{ °C}$	79
		$T_H = 80\text{ °C}$	63
$I_{DM}$	Pulsed drain current	160	
$V_{GS}$	Gate-Source voltage	-10/23	V
$R_{DS(on)}$	Drain-Source ON resistance	31	m $\Omega$
$P_D$	Power dissipation	$T_H = 25\text{ °C}$	310

The following table lists the electrical characteristics per SiC MOSFET of the MSCSM120HM31TBL2NG device.

**Table 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	$\mu A$	
$R_{DS(on)}$	Drain-Source on resistance	$V_{GS} = 20V$ $I_D = 40A$	$T_J = 25\text{ °C}$	—	25	31	m $\Omega$
			$T_J = 175\text{ °C}$	—	40	—	
$V_{GS(th)}$	Gate threshold voltage	$V_{GS} = V_{DS}$ ; $I_D = 3\text{ mA}$	1.8	2.8	—	V	
$I_{GSS}$	Gate-Source leakage current	$V_{GS} = 20V$ ; $V_{DS} = 0V$	—	—	150	nA	

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## Electrical Specifications

The following table lists the dynamic characteristics per SiC MOSFET of the MSCSM120HM31TBL2NG device.

**Table 3. Dynamic Characteristics**

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{GS} = 0V$	—	3020	—	pF
$C_{oss}$	Output capacitance	$V_{DS} = 1000V$	—	270	—	
$C_{rss}$	Reverse transfer capacitance	$f = 1\text{ MHz}$	—	25	—	
$Q_g$	Total gate charge	$V_{GS} = -5V/20V$	—	232	—	nC
$Q_{gs}$	Gate-Source charge	$V_{Bus} = 800V$	—	41	—	
$Q_{gd}$	Gate-Drain charge	$I_D = 40A$	—	50	—	
$T_{d(on)}$	Turn-on delay time	$V_{GS} = -5V/20V$	—	30	—	ns
$T_r$	Rise time	$V_{Bus} = 600V$	—	30	—	
$T_{d(off)}$	Turn-off delay time	$I_D = 50A$	—	50	—	
$T_f$	Fall time	$R_{G(on)} = 8\Omega$ $R_{G(off)} = 4.7\Omega$	—	25	—	
$E_{on}$	Turn-on energy	$V_{GS} = -5V/20V$	—	1.2	—	mJ
$E_{off}$	Turn-off energy	$V_{Bus} = 600V$ $I_D = 50A$ $R_{G(on)} = 8\Omega$ $R_{G(off)} = 4.7\Omega$				
$R_{Gint}$	Internal gate resistance		—	0.88	—	$\Omega$
$R_{thJH}$	Junction-to-heatsink thermal resistance	$\lambda = 3.4\text{ W/mK}$	—	0.483	—	$^{\circ}\text{C/W}$

The following table lists the body diode ratings and characteristics per SiC MOSFET of the MSCSM120HM31TBL2NG device.

**Table 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	$I_{SD} = 40A; V_{GS} = -5V$	—	90	—	ns
$Q_{rr}$	Reverse recovery charge	$V_R = 800V; di_F/dt = 1000\text{ A}/\mu\text{s}$	—	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 MSCSM120HM31TBL2NG device.

**Table 5. Thermal and Package Characteristics**

Symbol	Characteristic	Min.	Typ.	Max.	Unit		
V <sub>ISOL</sub>	RMS isolation voltage, any terminal to case t = 1 min, 50 Hz/60 Hz	2500	—	—	V		
T <sub>J</sub>	Operating junction temperature range	-55	—	175	°C		
T <sub>JOP</sub>	Recommended junction temperature under switching conditions	-55	—	T <sub>Jmax</sub> -25			
T <sub>STG</sub>	Storage case temperature	-55	—	125			
T <sub>C</sub>	Operating case temperature	-55	—	125			
Torque	Mounting torque	To heatsink	M4	1.5	—	2	N.m
Wt	Package weight	—	21.5	—	g		

The following table lists the temperature sensor NTC of the MSCSM120HM31TBL2NG device.

**Table 6. Temperature Sensor NTC**

Symbol	Characteristic	Min.	Typ.	Max.	Unit	
R <sub>25</sub>	Resistance at 25 °C	—	50	—	kΩ	
ΔR <sub>25</sub> /R <sub>25</sub>	—	—	5	—	%	
B <sub>25/85</sub>	T <sub>25</sub> = 298.15K	—	3952	—	K	
ΔB/B	—	T <sub>C</sub> = 100 °C	—	4	—	%

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

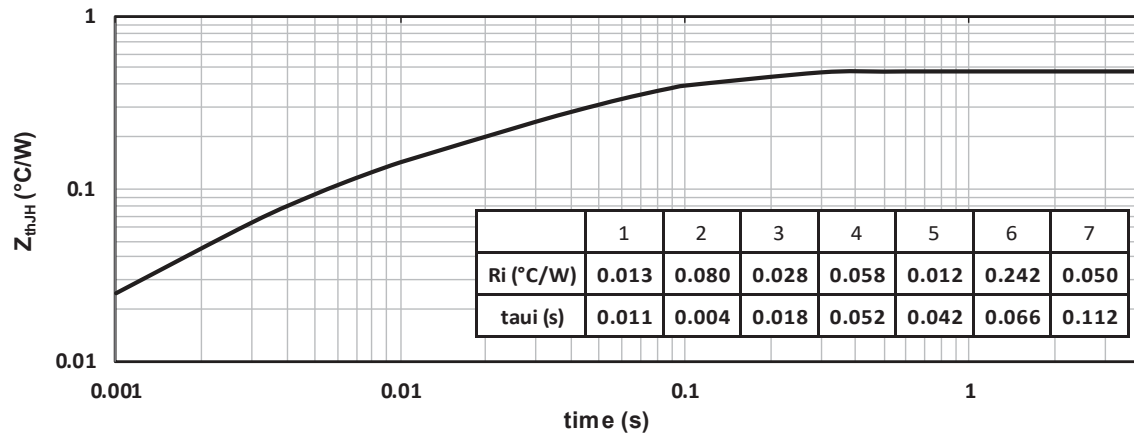
T: Thermistor temperature  
R<sub>T</sub>: Thermistor value at T

**Note:** See [APT0406—Using NTC Temperature Sensor Integrated into Power Module](#) for more information.

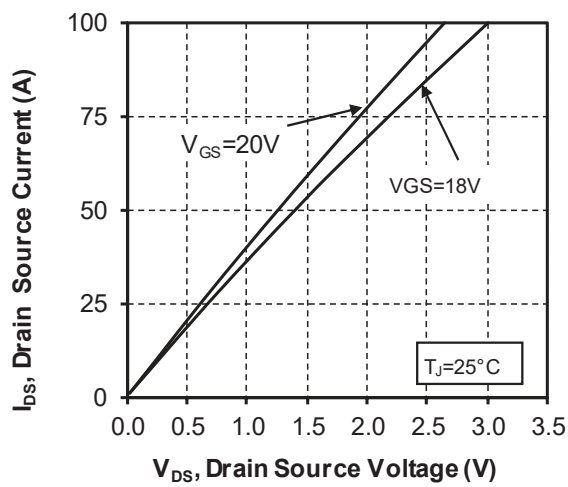
### 1.3 Typical SiC MOSFET Performance Curve

This section shows the typical SiC MOSFET performance curves of the MSCSM120HM31TBL2NG device.

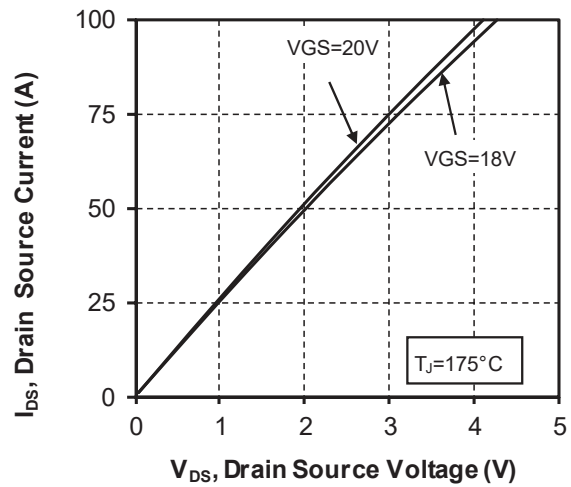
**Figure 1. Junction-to-Heatsink Thermal Impedance**



**Figure 2. Output Characteristics,  $T_J = 25^\circ\text{C}$**



**Figure 3. Output Characteristics,  $T_J = 175^\circ\text{C}$**



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## Electrical Specifications

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

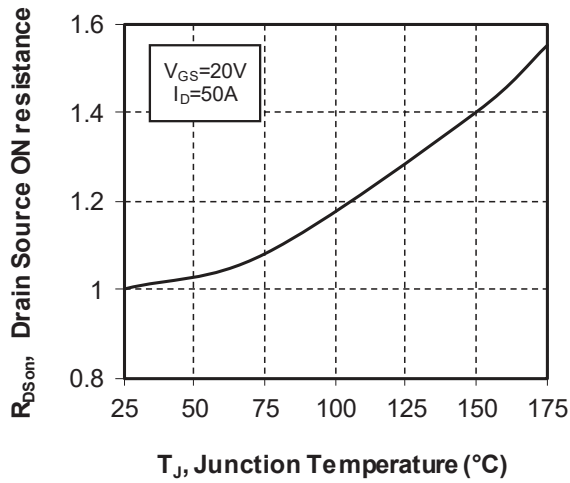


Figure 5. Transfer Characteristics

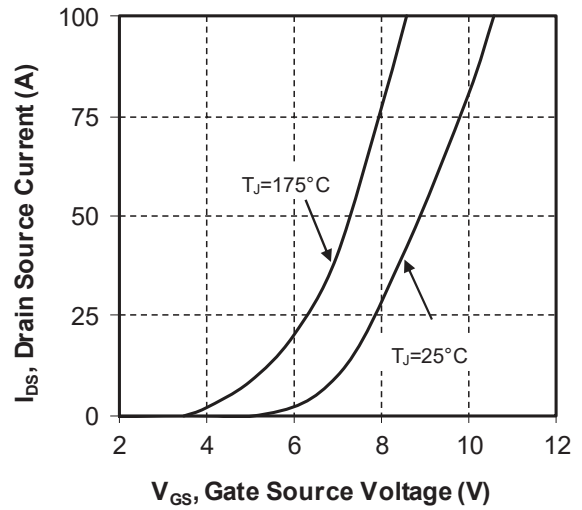


Figure 6. Switching Energy vs.  $R_g$

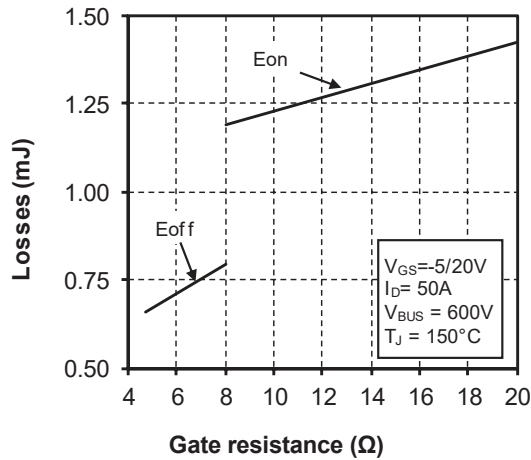


Figure 7. Switching Energy vs. Current

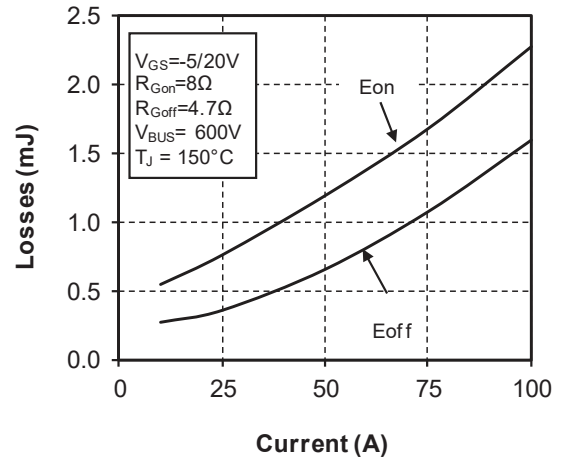


Figure 8. Capacitance vs. Drain Source Voltage

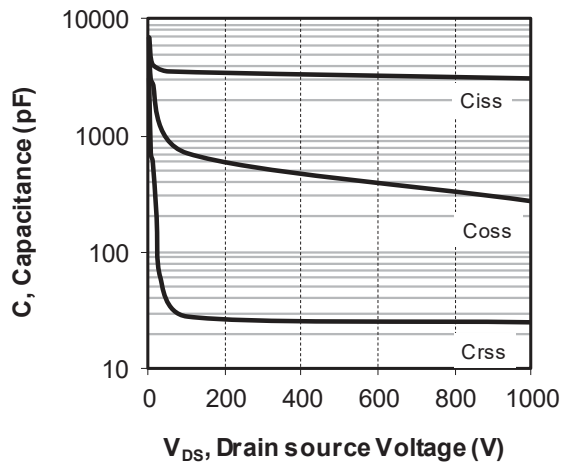
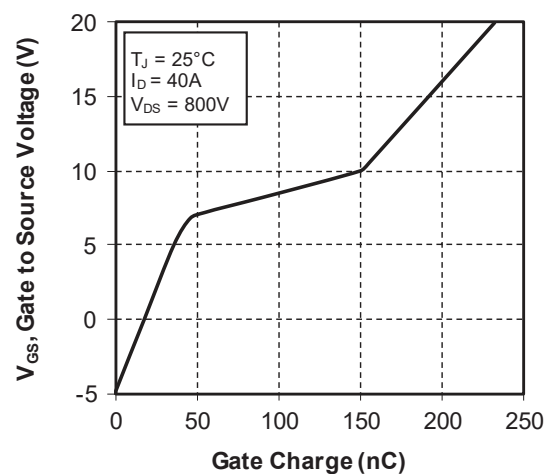


Figure 9. Gate Charge vs. Gate Source Voltage



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## Electrical Specifications

Figure 10. Body Diode Characteristics,  $T_J = 25^\circ\text{C}$

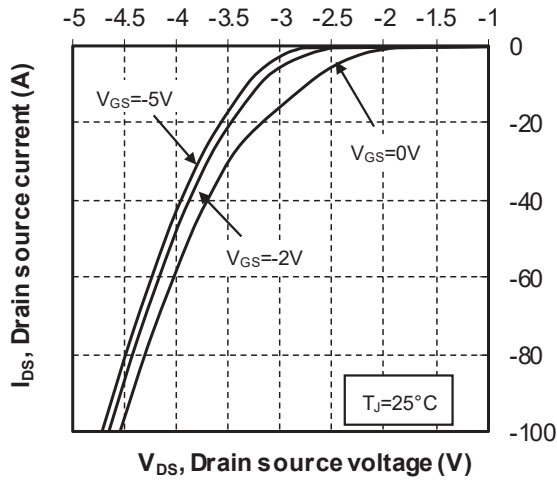


Figure 11. 3<sup>rd</sup> Quadrant Characteristics,  $T_J = 25^\circ\text{C}$

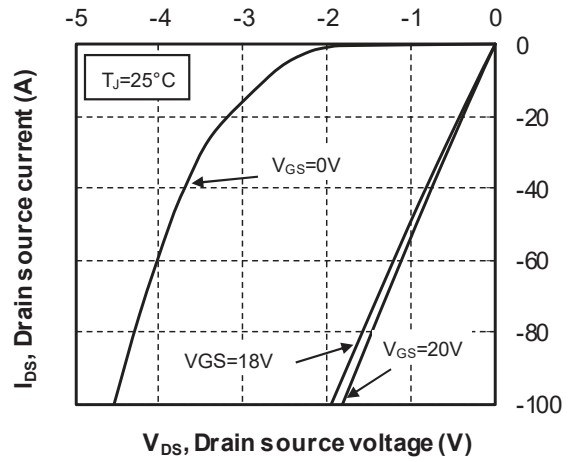


Figure 12. Body Diode Characteristics,  $T_J = 175^\circ\text{C}$

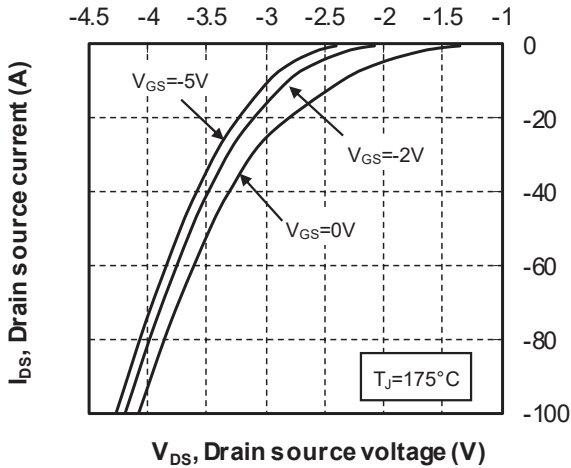


Figure 13. 3<sup>rd</sup> Quadrant Characteristics,  $T_J = 175^\circ\text{C}$

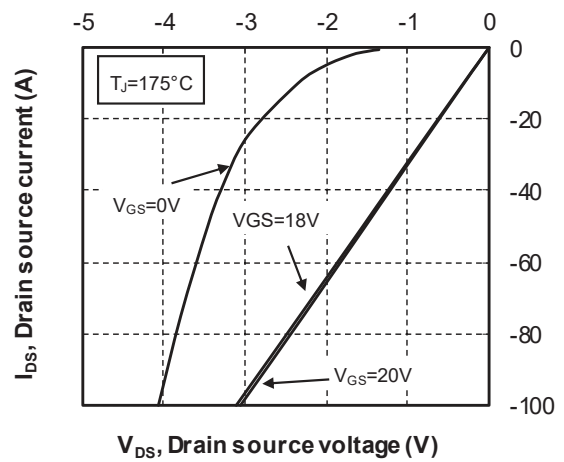
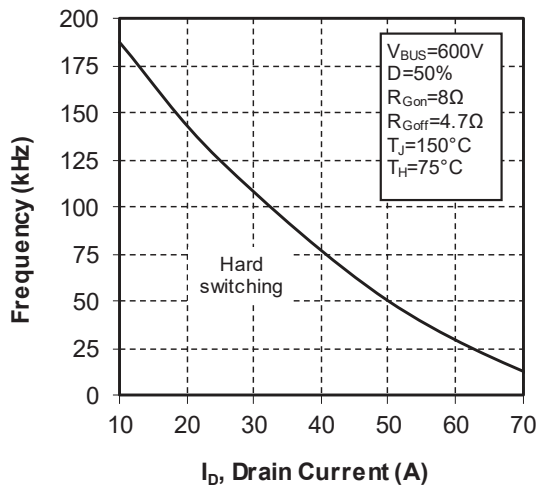


Figure 14. Operating Frequency vs Drain Current





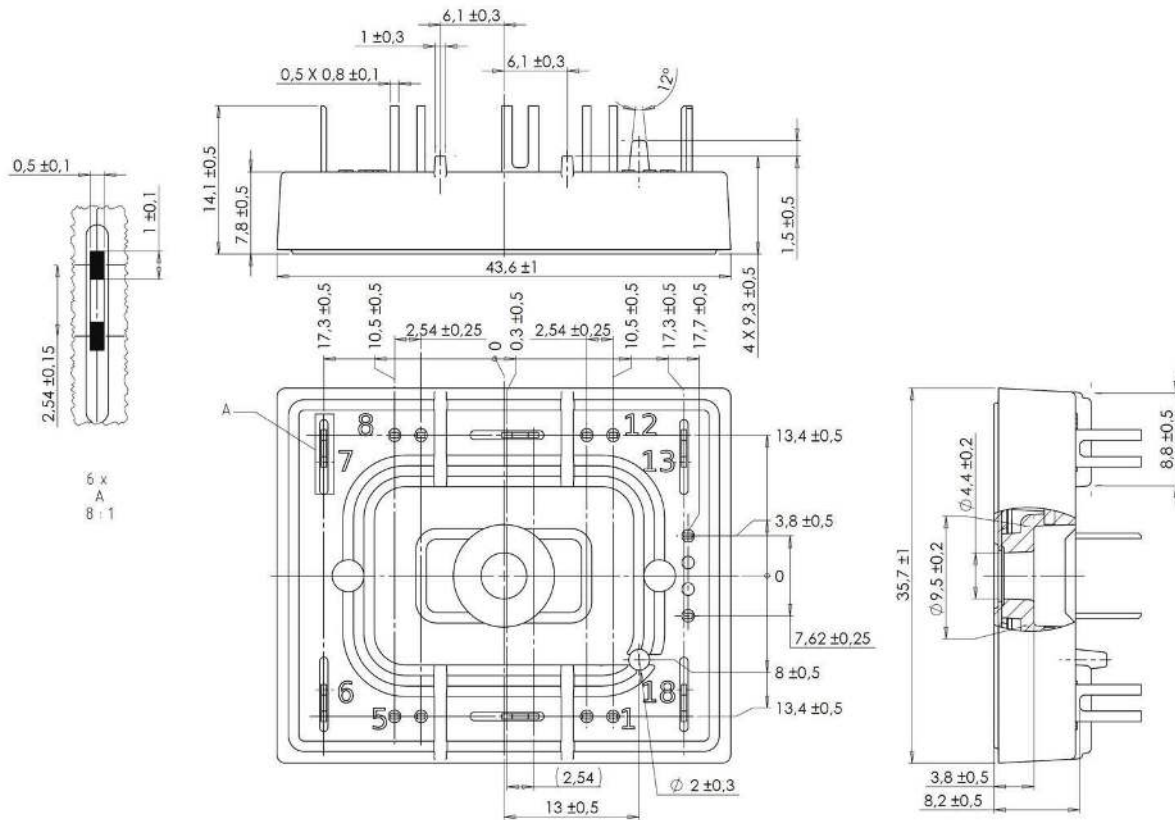
### Package Specifications

The following section shows the package specification of the MSCSM120HM31TBL2NG device.

#### 2.1 Package Outline

The following figure shows the package outline drawing of the MSCSM120HM31TBL2NG device. The dimensions in the following figure are in millimeters.

**Figure 15. Package Outline Drawing**



**Note:** See [AN4306 - Mounting instructions for baseless power module](#) for more information.

### Revision History

Revision	Date	Description
A	06/2022	Initial Revision

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