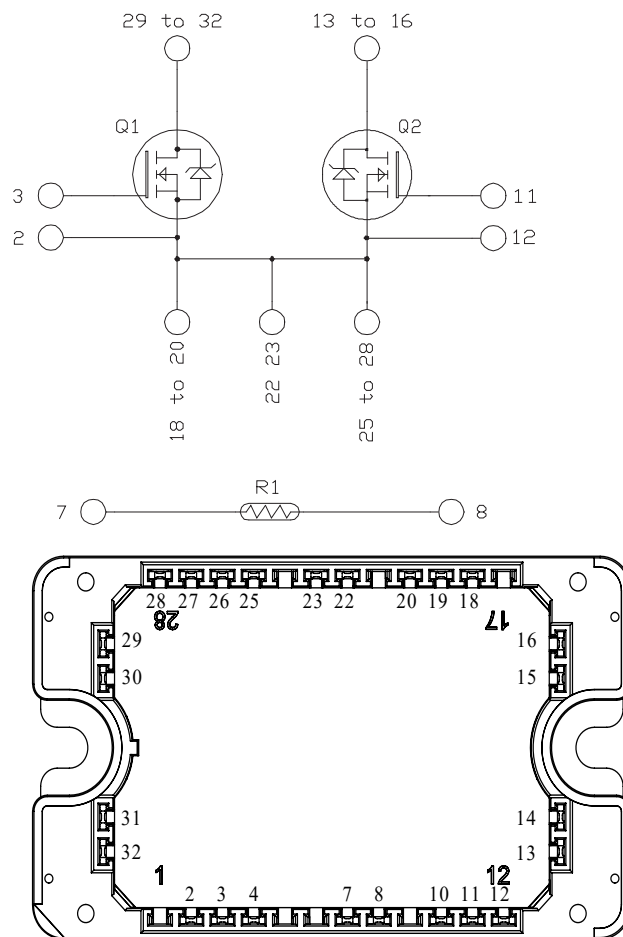


## Dual Common Source SiC MOSFET Power Module

### Product Overview

The MSCSM170DUM23T3AG device is a 1700V/124A dual common source silicon carbide (SiC) MOSFET power module.



#### Notes:

1. All ratings at  $T_J = 25^\circ\text{C}$ , unless otherwise specified.
2. All multiple inputs and outputs must be shorted together 13/14/15/16; 18/19/20/22/23/25/26/27/28; 29/30/31/32



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 MSCSM170DUM23T3AG device:

- SiC Power MOSFET
  - Low  $R_{DS(on)}$
  - High temperature performance
- Kelvin source for easy drive
- Low stray inductance
- High level of integration
- Aluminum Nitride (AlN) substrate for improved thermal performance
- Internal thermistor for temperature monitoring

## Benefits

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The following are the benefits of MSCSM170DUM23T3AG device:

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

## Application

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The following are the applications of MSCSM170DUM23T3AG device:

- AC switches

## 1. Electrical Specifications

This section provides the electrical specifications of the MSCSM170DUM23T3AG device.

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

The following table lists the absolute maximum ratings of MSCSM170DUM23T3AG device.

**Table 1-1. Absolute Maximum Ratings**

Symbol	Parameter		Maximum Ratings	Unit
$V_{DSS}$	Drain-Source voltage		1700	V
$I_D$	Continuous drain current	$T_C = 25\text{ }^{\circ}\text{C}$	124	A
		$T_C = 80\text{ }^{\circ}\text{C}$	98	
$I_{DM}$	Pulsed drain current		240	
$V_{GSmax}$	Gate-Source voltage		-10/23	V
$R_{DS(on)}$	Drain-Source ON resistance		22.5	m $\Omega$
$P_D$	Power dissipation	$T_C = 25\text{ }^{\circ}\text{C}$	602	W

The following table lists the electrical characteristics of MSCSM170DUM23T3AG device.

**Table 1-2. Electrical Characteristics**

Symbol	Characteristic	Test Conditions		Min.	Typ.	Max.	Unit
$I_{DSS}$	Zero gate voltage drain current	$V_{GS} = 0V$ $V_{DS} = 1700V$		—	20	200	$\mu A$
$R_{DS(on)}$	Drain-Source on resistance	$V_{GS} = 20V$ $I_D = 60A$	$T_J = 25\text{ }^{\circ}\text{C}$	—	17.5	22.5	m $\Omega$
			$T_J = 175\text{ }^{\circ}\text{C}$	—	31	—	
$V_{GS(th)}$	Gate threshold voltage	$V_{GS} = V_{DS}$ $I_D = 5\text{ mA}$		1.8	3.2	—	V
$I_{GSS}$	Gate-Source leakage current	$V_{GS} = 20V$ $V_{DS} = 0V$		—	—	200	nA

The following table lists the dynamic characteristics of MSCSM170DUM23T3AG device.

**Table 1-3. Dynamic Characteristics**

Symbol	Characteristic	Test Conditions		Min.	Typ.	Max.	Unit
C <sub>iss</sub>	Input capacitance	V <sub>GS</sub> = 0V		—	6600	—	pF
C <sub>oss</sub>	Output capacitance	V <sub>DS</sub> = 1000V		—	300	—	
C <sub>rss</sub>	Reverse transfer capacitance	f = 1 MHz		—	20	—	
Q <sub>g</sub>	Total gate charge	V <sub>GS</sub> = -5V/20V		—	356	—	nC
Q <sub>gs</sub>	Gate-Source charge	V <sub>Bus</sub> = 850V		—	98	—	
Q <sub>gd</sub>	Gate-Drain charge	I <sub>D</sub> = 60A		—	54	—	
T <sub>d(on)</sub>	Turn-on delay time	V <sub>GS</sub> = -5V/20V	T <sub>J</sub> = 150 °C	—	24	—	ns
T <sub>r</sub>	Rise time	V <sub>Bus</sub> = 900V		—	17	—	
T <sub>d(off)</sub>	Turn-off delay time	I <sub>D</sub> = 100A		—	35	—	
T <sub>f</sub>	Fall time	R <sub>Gon</sub> = 2.4Ω R <sub>Goff</sub> = 1.4Ω		—	19	—	
E <sub>on</sub>	Turn-on energy	V <sub>GS</sub> = -5V/20V	T <sub>J</sub> = 150 °C	—	2.6	—	mJ
E <sub>off</sub>	Turn-off energy	V <sub>Bus</sub> = 900V I <sub>D</sub> = 100A R <sub>Gon</sub> = 2.4Ω R <sub>Goff</sub> = 1.4Ω	T <sub>J</sub> = 150 °C	—	0.33	—	
R <sub>Gint</sub>	Internal gate resistance			—	2.93	—	Ω
R <sub>thJC</sub>	Junction-to-case thermal resistance			—	—	0.25	°C/W

The following table lists the body diode ratings and characteristics of MSCSM170DUM23T3AG device.

**Table 1-4. Body Diode Ratings and Characteristics**

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
V <sub>SD</sub>	Diode forward voltage	V <sub>GS</sub> = 0V I <sub>SD</sub> = 60A	—	3.7	—	V
		V <sub>GS</sub> = -5V I <sub>SD</sub> = 60A	—	3.9	—	
t <sub>rr</sub>	Reverse recovery time	I <sub>SD</sub> = 60A	—	27	—	ns
Q <sub>rr</sub>	Reverse recovery charge	V <sub>GS</sub> = -5V	—	1300	—	nC
I <sub>rr</sub>	Reverse recovery current	V <sub>R</sub> = 900V di <sub>F</sub> /dt = 2000A/μs	—	92	—	A

### 1.2 Thermal and Package Characteristics

The following table lists the thermal and package characteristics of the MSCSM170DUM23T3AG device.

**Table 1-5. Thermal and Package Characteristics**

Symbol	Characteristic			Min.	Max.	Unit
V <sub>ISOL</sub>	RMS isolation voltage, any terminal to case t = 1 min, 50 Hz/60 Hz			4000	—	V
T <sub>J</sub>	Operating junction temperature range			−40	175	°C
T <sub>JOP</sub>	Recommended junction temperature under switching conditions			−40	T <sub>Jmax</sub> −25	
T <sub>STG</sub>	Storage case temperature			−40	125	
T <sub>C</sub>	Operating case temperature			−40	125	
Torque	Mounting torque	To heatsink	M4	2	3	N.m
Wt	Package weight			—	110	g

The following table lists the temperature sensor NTC of the MSCSM170DUM23T3AG device.

**Table 1-6. 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> = 298.15 K		—	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 (Per SiC MOSFET)

This section shows the typical SiC MOSFET performance curves of the MSCSM170DUM23T3AG device.

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

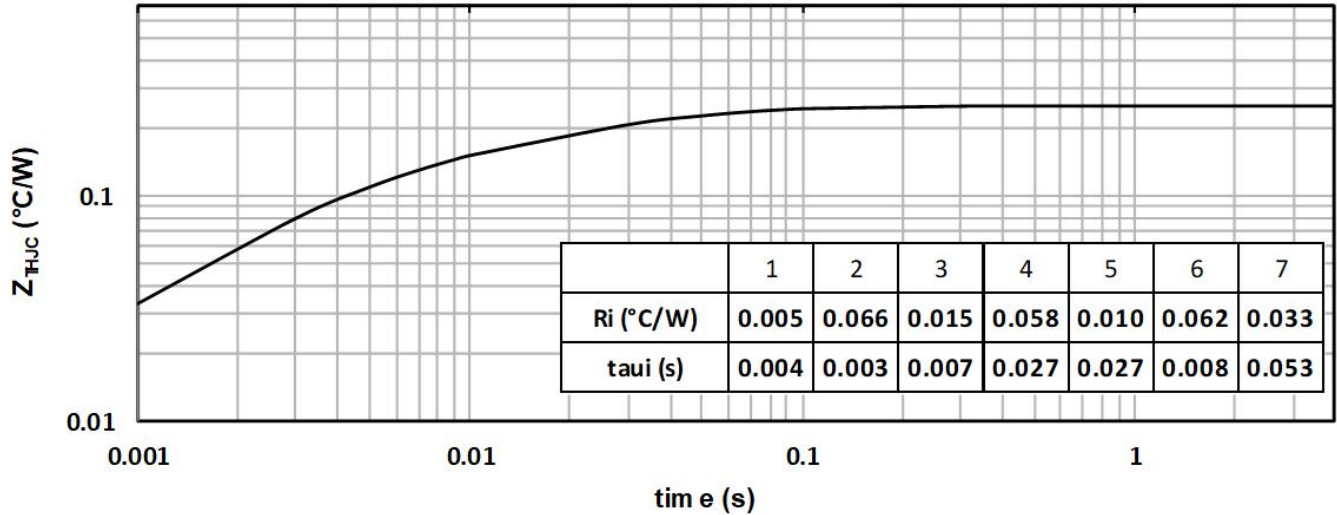


Figure 1-2. Output Characteristics,  $T_J = 25^\circ\text{C}$

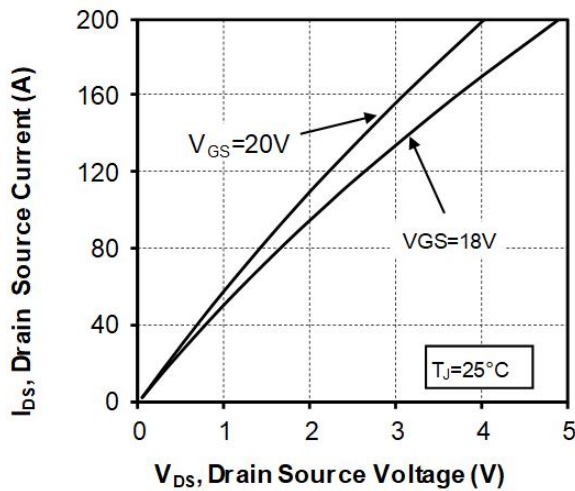


Figure 1-3. Output Characteristics,  $T_J = 175^\circ\text{C}$

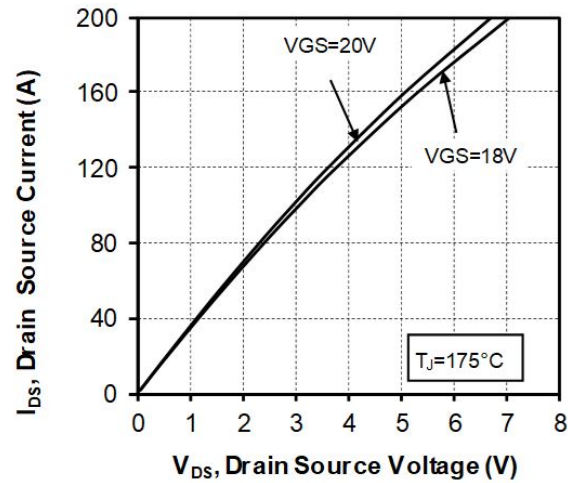


Figure 1-4. Normalized  $R_{DS(on)}$  vs. Temperature

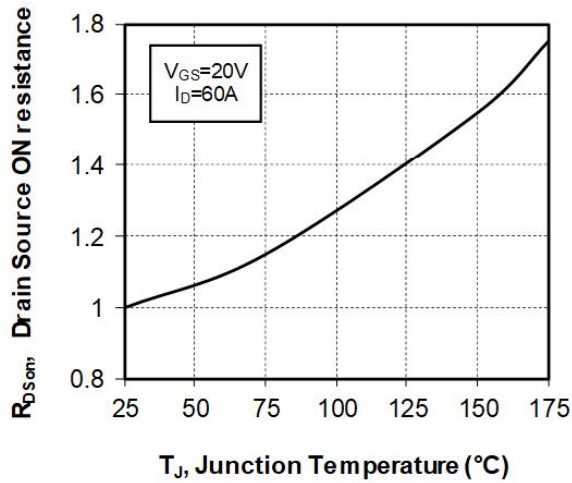


Figure 1-5. Transfer Characteristics

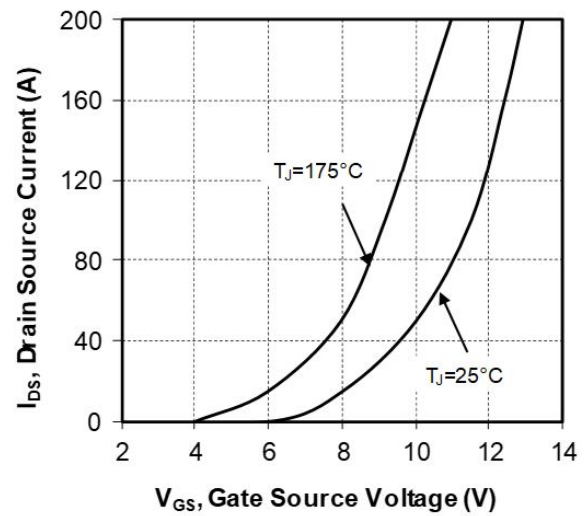


Figure 1-6. Switching Energy vs.  $R_g$

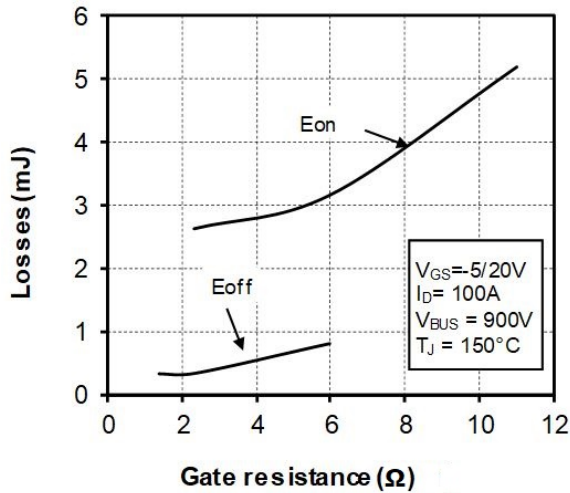


Figure 1-7. Switching Energy vs. Current

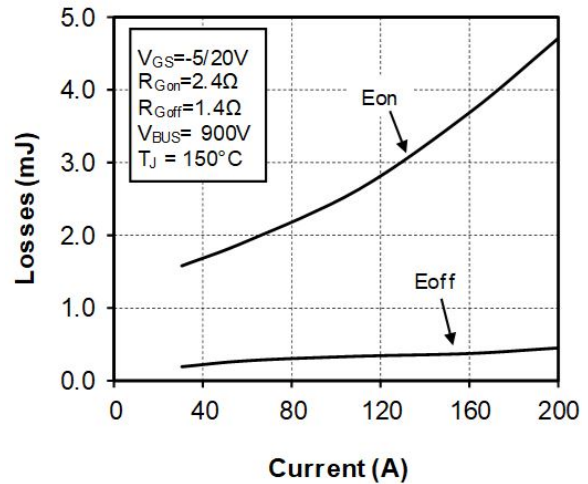


Figure 1-8. Capacitance vs. Drain Source Voltage

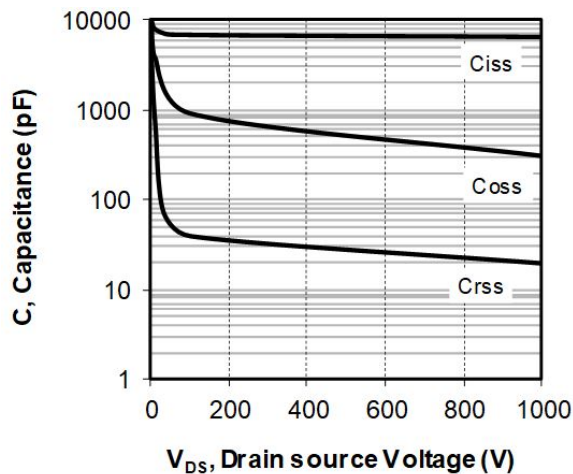


Figure 1-9. Gate Charge vs. Gate Source Voltage

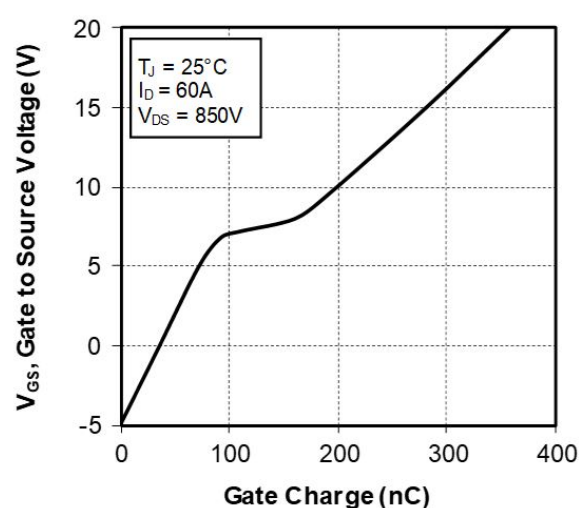


Figure 1-10. Body Diode Characteristics,  $T_J = 25^\circ\text{C}$

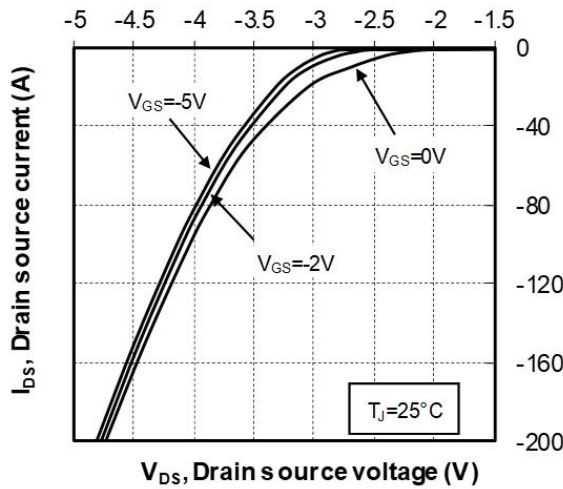


Figure 1-11. 3<sup>rd</sup> Quadrant Characteristics,  $T_J = 25^\circ\text{C}$

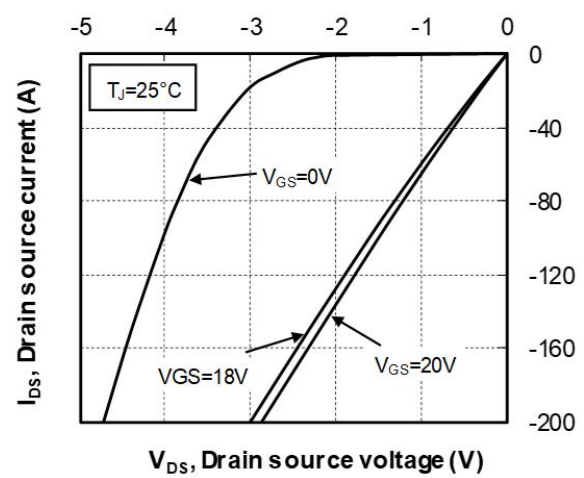


Figure 1-12. Body Diode Characteristics,  $T_J = 175^\circ\text{C}$

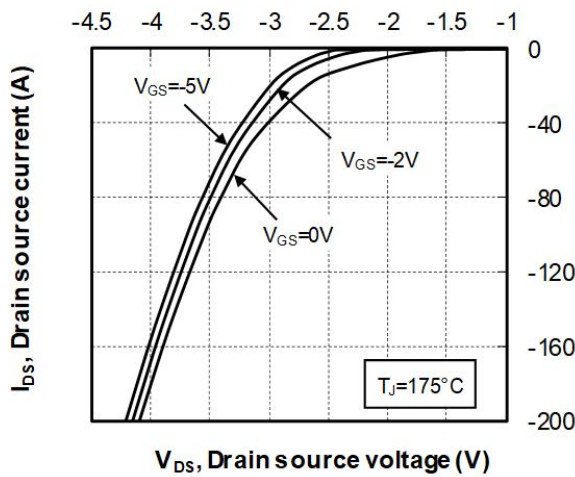


Figure 1-13. 3<sup>rd</sup> Quadrant Characteristics,  $T_J = 175^\circ\text{C}$

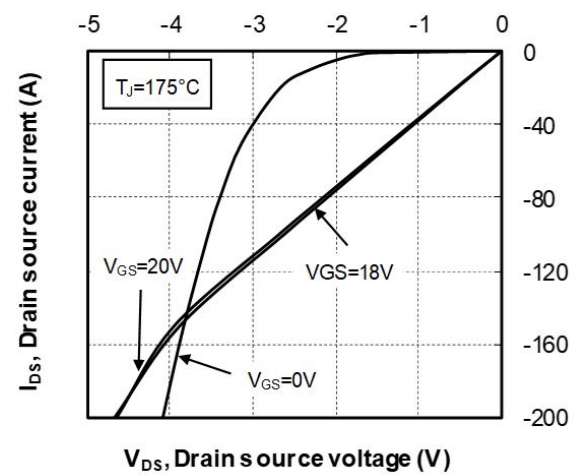
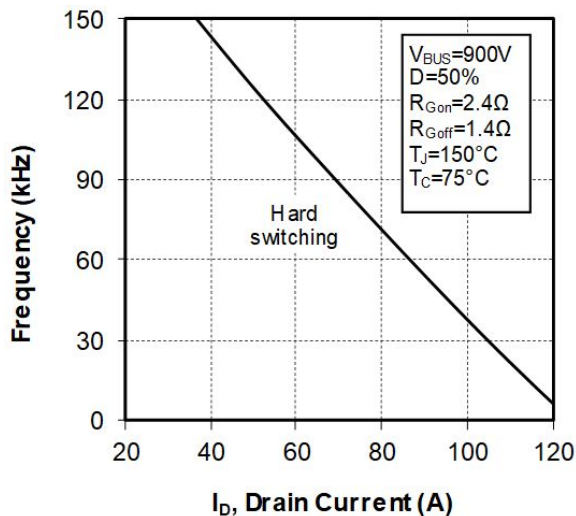


Figure 1-14. Operating Frequency vs. Drain Current





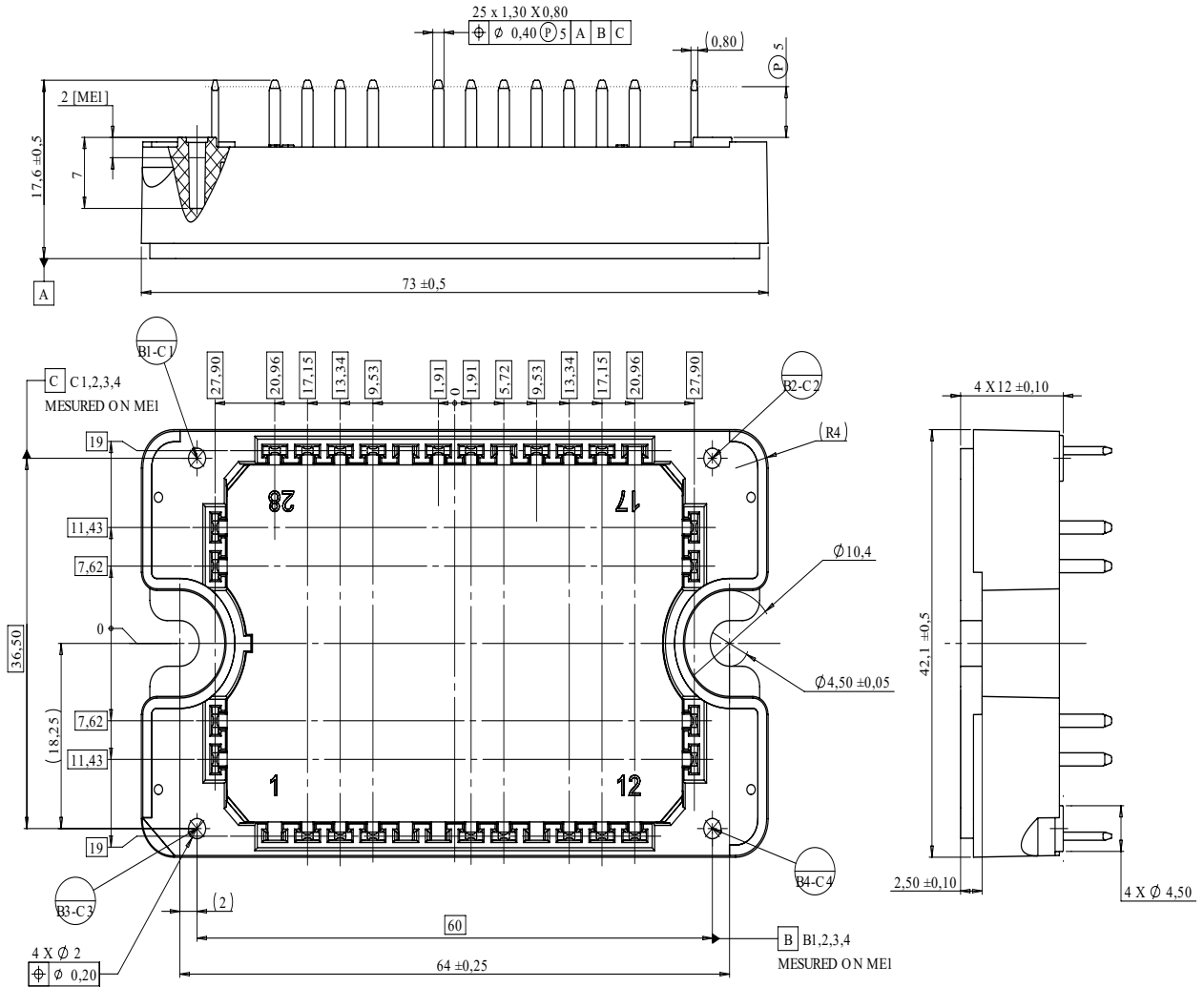
## 2. Package Specifications

The following section shows the package specification of the MSCSM170DUM23T3AG device.

### 2.1 Package Outline

The following figure shows the package outline drawing of the MSCSM170DUM23T3AG device. The dimensions in the following figure are in millimeters.

Figure 2-1. Package Outline Drawing



**Note:** See application note [AN3500A—Mounting Instructions for SP1F and SP3F Power Modules](#) for more information.

**3. Revision History**

Revision	Date	Description
A	12/2021	Initial Revision

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