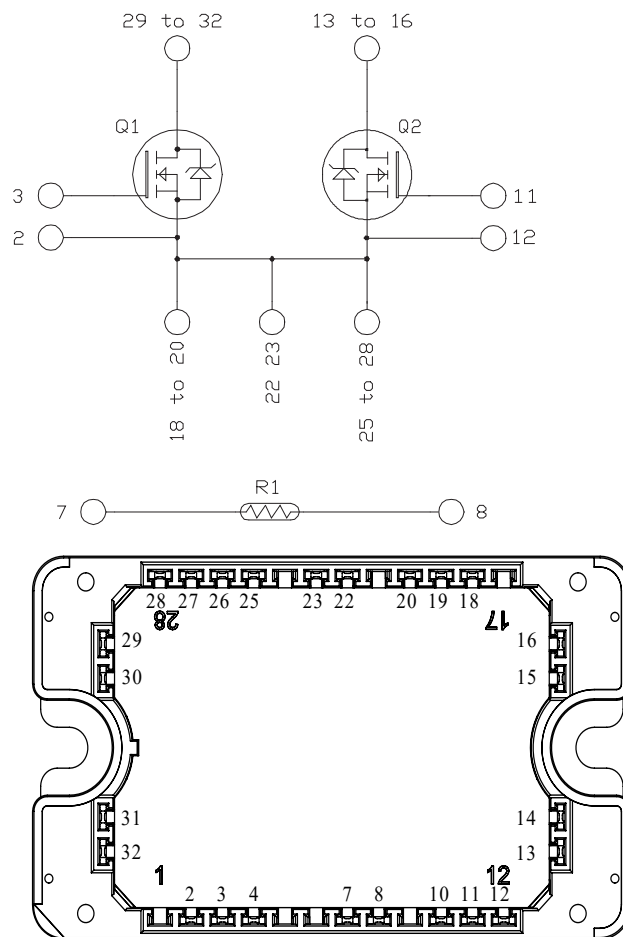


Dual Common Source SiC MOSFET Power Module

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

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

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

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 Ω
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	μA
$R_{DS(on)}$	Drain-Source on resistance	$V_{GS} = 20V$ $I_D = 60A$	$T_J = 25\text{ }^{\circ}\text{C}$	—	17.5	22.5	m Ω
			$T_J = 175\text{ }^{\circ}\text{C}$	—	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 _{iss}	Input capacitance	V _{GS} = 0V		—	6600	—	pF
C _{oss}	Output capacitance	V _{DS} = 1000V		—	300	—	
C _{rss}	Reverse transfer capacitance	f = 1 MHz		—	20	—	
Q _g	Total gate charge	V _{GS} = -5V/20V		—	356	—	nC
Q _{gs}	Gate-Source charge	V _{Bus} = 850V		—	98	—	
Q _{gd}	Gate-Drain charge	I _D = 60A		—	54	—	
T _{d(on)}	Turn-on delay time	V _{GS} = -5V/20V	T _J = 150 °C	—	24	—	ns
T _r	Rise time	V _{Bus} = 900V		—	17	—	
T _{d(off)}	Turn-off delay time	I _D = 100A		—	35	—	
T _f	Fall time	R _{Gon} = 2.4Ω R _{Goff} = 1.4Ω		—	19	—	
E _{on}	Turn-on energy	V _{GS} = -5V/20V	T _J = 150 °C	—	2.6	—	mJ
E _{off}	Turn-off energy	V _{Bus} = 900V I _D = 100A R _{Gon} = 2.4Ω R _{Goff} = 1.4Ω	T _J = 150 °C	—	0.33	—	
R _{Gint}	Internal gate resistance			—	2.93	—	Ω
R _{thJC}	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 _{SD}	Diode forward voltage	V _{GS} = 0V I _{SD} = 60A	—	3.7	—	V
		V _{GS} = -5V I _{SD} = 60A	—	3.9	—	
t _{rr}	Reverse recovery time	I _{SD} = 60A	—	27	—	ns
Q _{rr}	Reverse recovery charge	V _{GS} = -5V	—	1300	—	nC
I _{rr}	Reverse recovery current	V _R = 900V di _F /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 _{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 case temperature			−40	125	
T _C	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 ₂₅	Resistance at 25 °C		—	50	—	kΩ
ΔR ₂₅ /R ₂₅	—		—	5	—	%
B _{25/85}	T ₂₅ = 298.15 K		—	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 (Per SiC MOSFET)

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

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

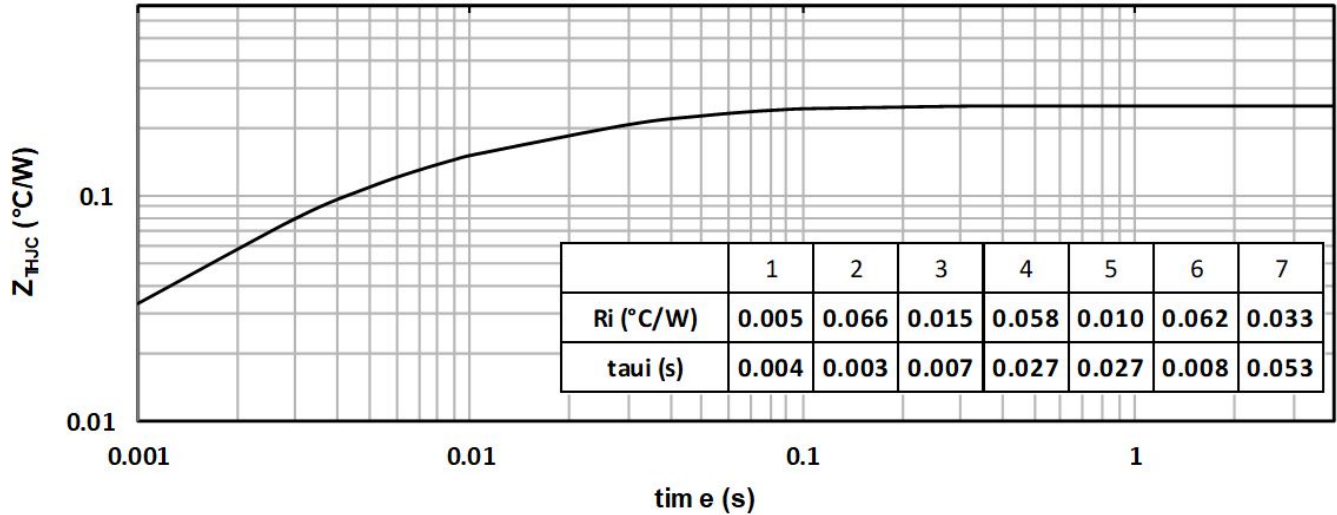


Figure 1-2. Output Characteristics, $T_J = 25^\circ\text{C}$

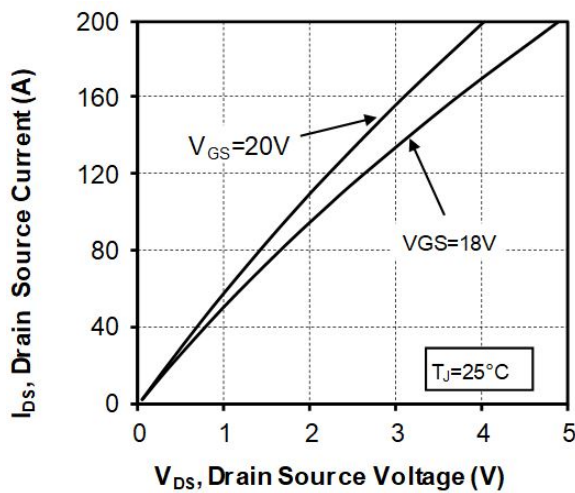


Figure 1-3. Output Characteristics, $T_J = 175^\circ\text{C}$

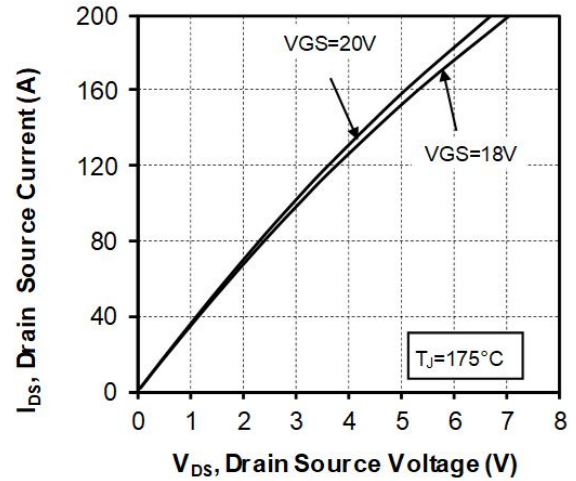


Figure 1-4. Normalized $R_{DS(on)}$ vs. Temperature

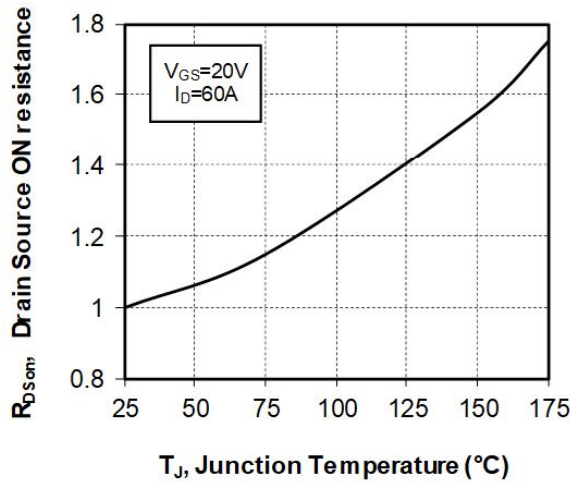


Figure 1-5. Transfer Characteristics

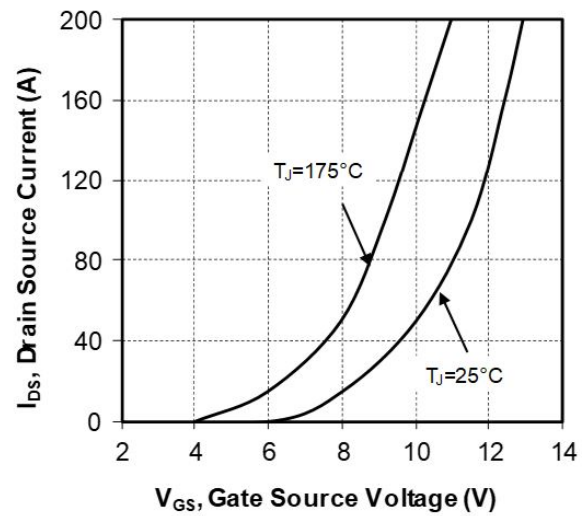


Figure 1-6. Switching Energy vs. R_g

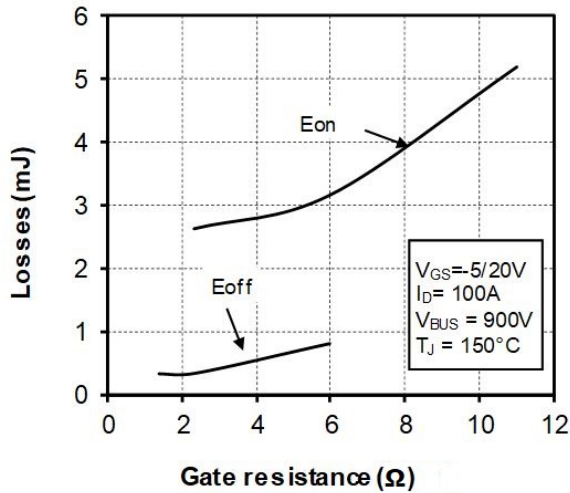


Figure 1-7. Switching Energy vs. Current

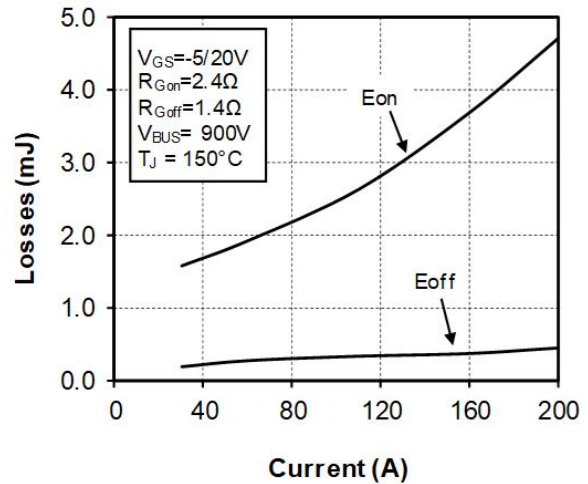


Figure 1-8. Capacitance vs. Drain Source Voltage

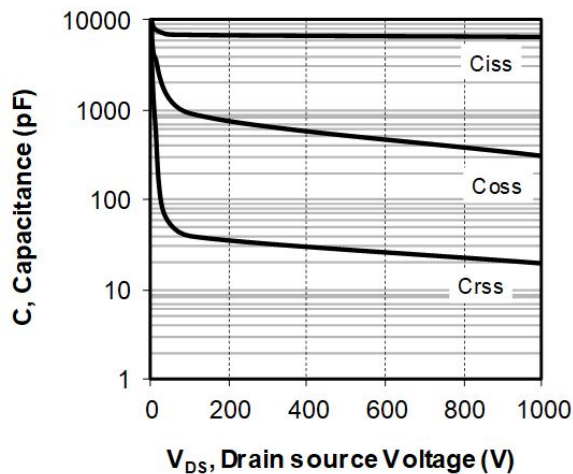


Figure 1-9. Gate Charge vs. Gate Source Voltage

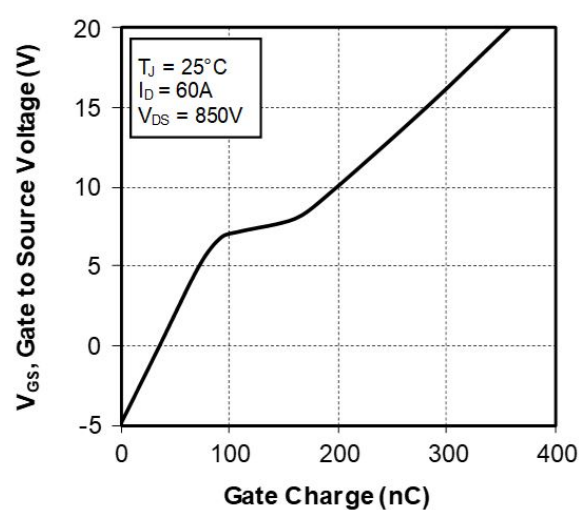


Figure 1-10. Body Diode Characteristics, $T_J = 25^\circ\text{C}$

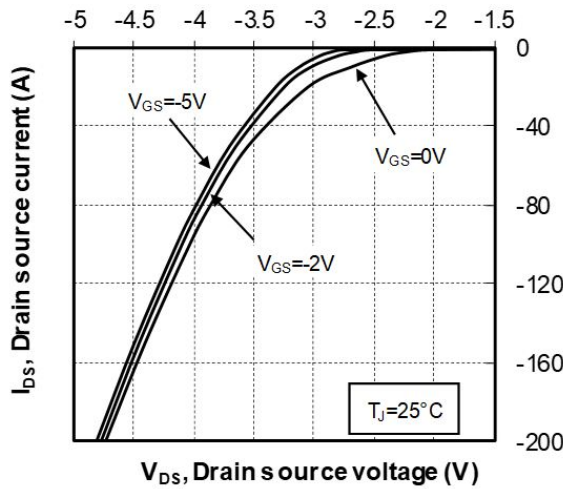


Figure 1-11. 3rd Quadrant Characteristics, $T_J = 25^\circ\text{C}$

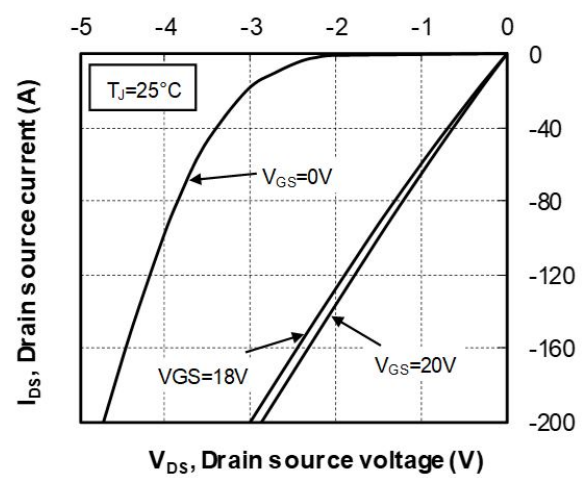


Figure 1-12. Body Diode Characteristics, $T_J = 175^\circ\text{C}$

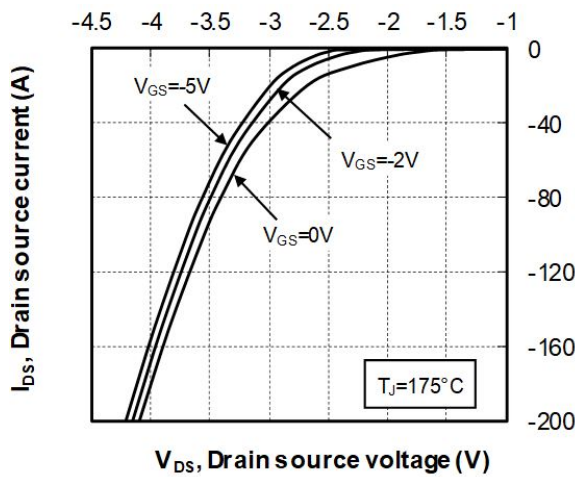


Figure 1-13. 3rd Quadrant Characteristics, $T_J = 175^\circ\text{C}$

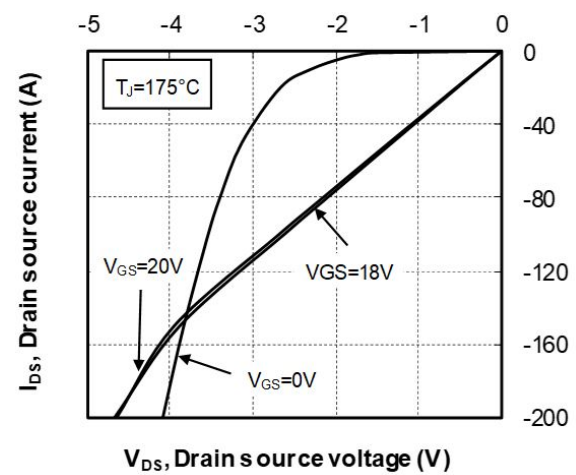
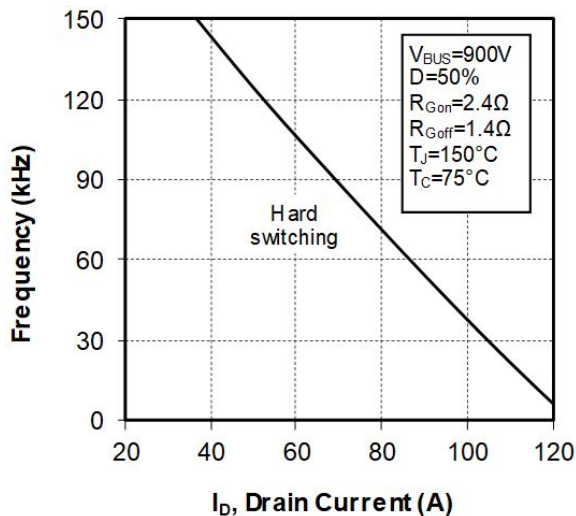


Figure 1-14. Operating Frequency vs. Drain Current



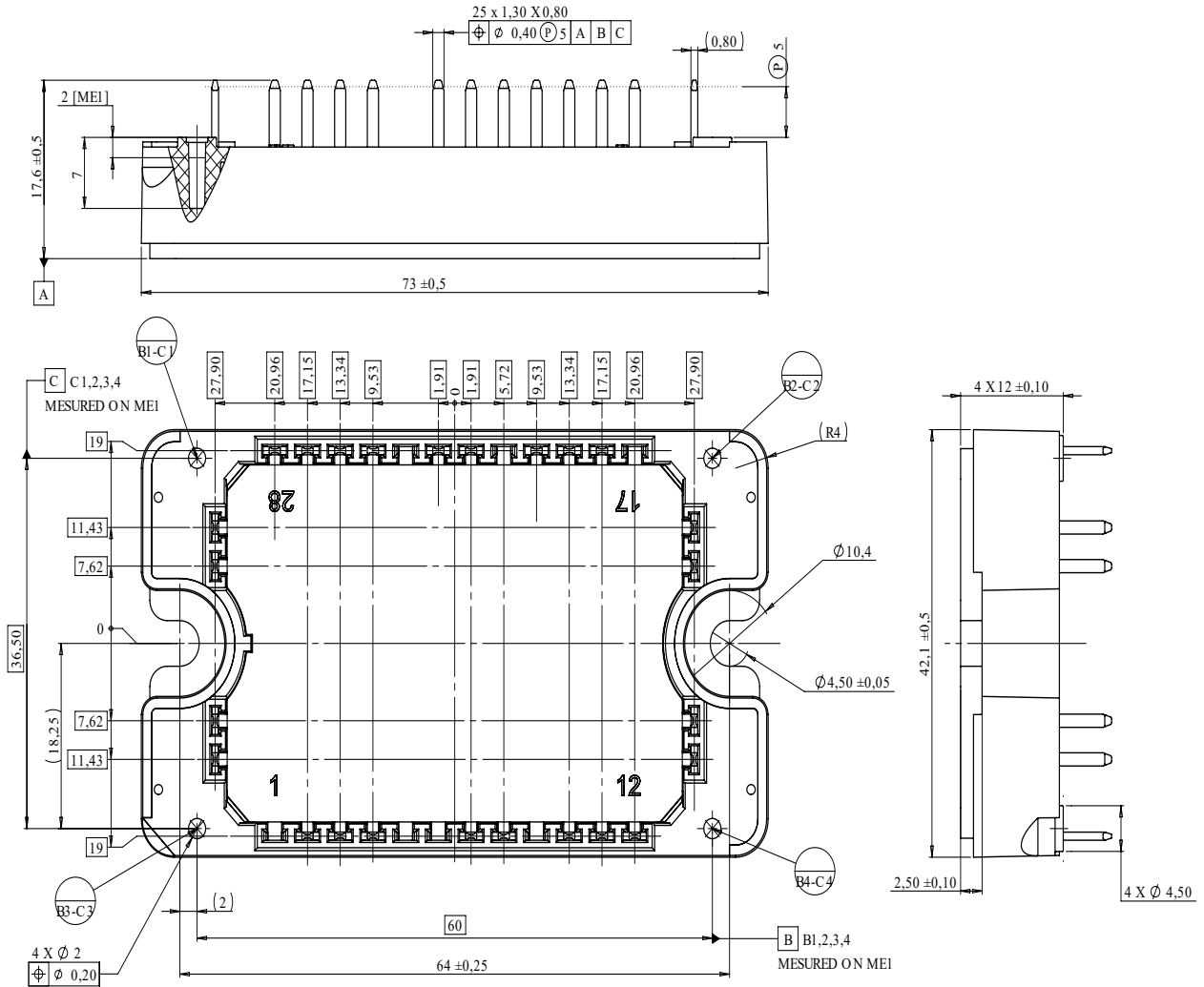
2. Package Specifications

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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