

**MSC100SM70JCU3**  
**Datasheet**  
**Buck Chopper SiC MOSFET Power Module**

April 2020



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a  **MICROCHIP** company

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# 1 Revision History

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The revision history describes the changes that were implemented in the document. The changes are listed by revision, starting with the most current publication.

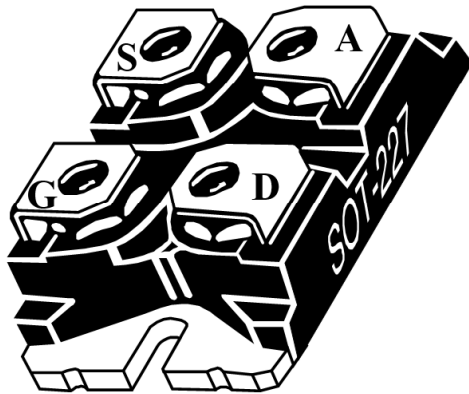
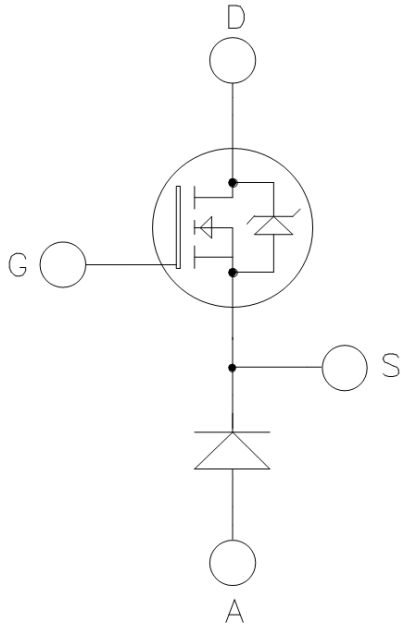
## 1.1 Revision 1.0

Revision 1.0 was published in April 2020. It is the first publication of this document.

## 2 Product Overview

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The MSC100SM70JCU3 device is a buck chopper 700 V, 124 A full Silicon Carbide (SiC) power module.



All ratings at  $T_j = 25^\circ\text{C}$ , unless otherwise specified.

**Caution:** These devices are sensitive to electrostatic discharge. Proper handling procedures should be followed.

## 2.1 Features

The following are key features of the MSC100SM70JCU3 device:

- Silicon carbide (SiC) Schottky diode
  - Zero reverse recovery
  - Zero forward recovery
  - Temperature-independent switching behavior
  - Positive temperature coefficient on VF
- SiC Power MOSFET
  - High-speed switching
  - Low  $R_{DS(on)}$
  - Ultra low loss

## 2.2 Benefits

The following are benefits of the MSC100SM70JCU3 device:

- High-efficiency converter
- Very low stray inductance
- Outstanding performance at high-frequency operation
- Stable temperature behavior
- Direct mounting to heatsink (isolated package)
- Low junction-to-case thermal resistance
- RoHS compliant

## 2.3 Applications

The MSC100SM70JCU3 device is designed for the following applications:

- AC and DC motor control
- Switched mode power supplies

## 3 Electrical Specifications

This section provides the electrical specifications for the MSC100SM70JCU3 device.

### 3.1 SiC MOSFET Characteristics

The following table shows the absolute maximum ratings per SiC MOSFET of the MSC100SM70JCU3 device.

**Table 1 • Absolute Maximum Ratings**

Symbol	Parameter	Max Ratings	Unit
$V_{DSS}$	Drain-source voltage	700	V
$I_D$	Continuous drain current	$T_c = 25\text{ }^\circ\text{C}$	124 <sup>1</sup>
		$T_c = 80\text{ }^\circ\text{C}$	98 <sup>1</sup>
$I_{DM}$	Pulsed drain current	250	
$V_{GS}$	Gate-source voltage	-10/25	V
$R_{Dson}$	Drain-source ON resistance	19	m $\Omega$
$P_D$	Power dissipation	$T_c = 25\text{ }^\circ\text{C}$	365

**Note:**

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

The following table shows the electrical characteristics of MSC100SM70JCU3 device.

**Table 2 • Electrical Characteristics**

Symbol	Characteristics	Test Conditions	Min	Typ	Max	Unit
$I_{DSS}$	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$ ; $V_{DS} = 700\text{ V}$			100	$\mu\text{A}$
$R_{DS(on)}$	Drain-source on resistance	$V_{GS} = 20\text{ V}$ $I_D = 40\text{ A}$	$T_J = 25\text{ }^\circ\text{C}$	15	19	m $\Omega$
			$T_J = 175\text{ }^\circ\text{C}$	18.8		
$V_{GS(th)}$	Gate-threshold voltage	$V_{GS} = V_{DS}$ , $I_D = 4\text{ mA}$	1.9	2.4		V
$I_{GSS}$	Gate-source leakage current	$V_{GS} = 20\text{ V}$ , $V_{DS} = 0\text{ V}$			150	nA

The following table shows the dynamic characteristics of MSC100SM70JCU3 device.

**Table 3 • Dynamic Characteristics**

Symbol	Characteristics	Test Conditions	Min	Typ	Max	Unit
$C_{iss}$	Input capacitance	$V_{GS} = 0\text{ V}$ $V_{DS} = 700\text{ V}$ $f = 1\text{ MHz}$		4500		pF
$C_{oss}$	Output capacitance			510		
$C_{rss}$	Reverse transfer capacitance			29		
$Q_g$	Total gate charge	$V_{GS} = -5/20\text{ V}$ $V_{BUS} = 470\text{ V}$ $I_D = 40\text{ A}$		215		nC
$Q_{gs}$	Gate-source charge			58		
$Q_{gd}$	Gate-drain charge			35		
$T_{d(on)}$	Turn-on delay time	$V_{GS} = -5/20\text{ V}$ $V_{BUS} = 400\text{ V}$ $I_D = 80\text{ A}$ $T_J = 150\text{ }^\circ\text{C}$ $R_{GON} = 27\text{ }\Omega$ $R_{GOFF} = 4.7\text{ }\Omega$		40		ns
$T_r$	Rise time			35		
$T_{d(off)}$	Turn-off delay time			50		
$T_f$	Fall time			20		
$E_{on}$	Turn on energy	$V_{GS} = -5/20\text{ V}$ $V_{BUS} = 400\text{ V}$ $I_D = 80\text{ A}$ $R_{GON} = 27\text{ }\Omega$ $R_{GOFF} = 4.7\text{ }\Omega$	$T_J = 150\text{ }^\circ\text{C}$	545		$\mu\text{J}$
$E_{off}$	Turn off energy		$T_J = 150\text{ }^\circ\text{C}$	186		$\mu\text{J}$
$R_{Gint}$	Internal gate resistance			0.69		$\Omega$
$R_{thJC}$	Junction-to-case thermal resistance				0.41	$^\circ\text{C/W}$

The following table shows the body diode ratings and characteristics of MSC100SM70JCU3 device.

**Table 4 • Body diode ratings and characteristics**

Symbol	Characteristics	Test Conditions	Min	Typ	Max	Unit
$V_{SD}$	Diode forward voltage	$V_{GS} = 0\text{ V}; I_{SD} = 40\text{ A}$		3.4		V
		$V_{GS} = -5\text{ V}; I_{SD} = 40\text{ A}$		3.8		
$t_{rr}$	Reverse recovery time	$I_{SD} = 40\text{ A}$ $V_{GS} = -5\text{ V}$ $V_R = 400\text{ V}$ $di_F/dt = 1000\text{ A}/\mu\text{s}$		38		ns
$Q_{rr}$	Reverse recovery charge			318		nC
$I_{rr}$	Reverse recovery current				14.8	

### 3.2 SiC Chopper Diode Ratings and Characteristics

The following table shows the SiC chopper diode ratings and characteristics of MSC100SM70JCU3 device.

**Table 5 • SiC Schottky Diode Ratings and Characteristics**

Symbol	Characteristics	Test Conditions	Min	Typ	Max	Unit
$V_{RRM}$	Peak repetitive reverse voltage				700	V
$I_{RRM}$	Reverse leakage current	$V_R = 700\text{ V}$	$T_J = 25\text{ °C}$	30	400	$\mu\text{A}$
			$T_J = 175\text{ °C}$	500		
$I_F$	DC forward current			60		A
$V_F$	Diode forward voltage	$I_F = 60\text{ A}$	$T_J = 25\text{ °C}$	1.5	1.8	V
			$T_J = 175\text{ °C}$	1.9		
$Q_C$	Total capacitive charge	$V_R = 400\text{ V}$		166		nC
C	Total capacitance	$f = 1\text{ MHz}, V_R = 200\text{ V}$		300		pF
		$f = 1\text{ MHz}, V_R = 400\text{ V}$		256		
$R_{thJC}$	Junction-to-case thermal resistance				0.742	$^{\circ}\text{C}/\text{W}$

### 3.3 Thermal and Package Characteristics

The following table shows the thermal and package characteristics of MSC100SM70JCU3 device.

**Table 6 • Thermal and Package Characteristics**

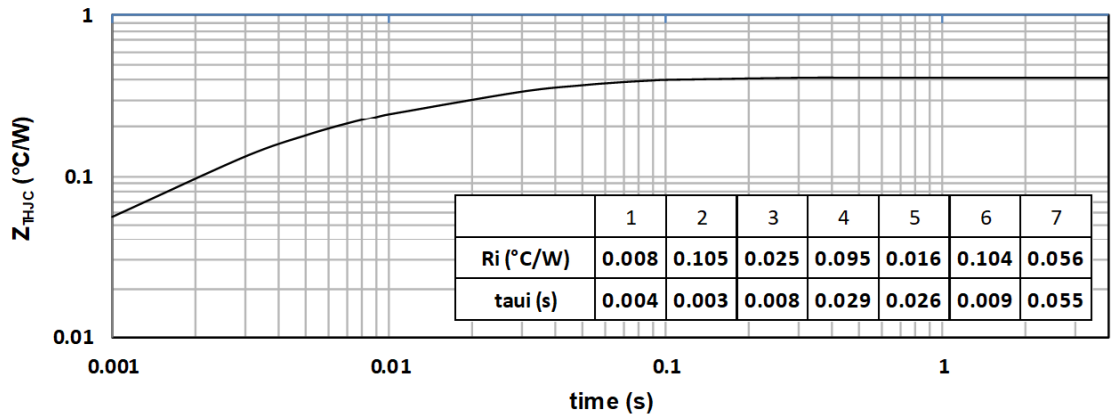
Symbol	Characteristics	Min	Typ	Max	Unit
$V_{ISOL}$	RMS isolation voltage, any terminal to case $t = 1\text{ min}$ , 50 Hz/60 Hz	2500			V
$T_{STG}$	Storage temperature range	-55		175	$^{\circ}\text{C}$
$T_J$	Operating junction temperature range	-55		175	
$T_{JOP}$	Recommended junction temperature under switching conditions	-55		$T_{Jmax} - 25$	
Torque	Terminals and mounting screws			1.1	N.m
Wt	Package weight		29.2		g



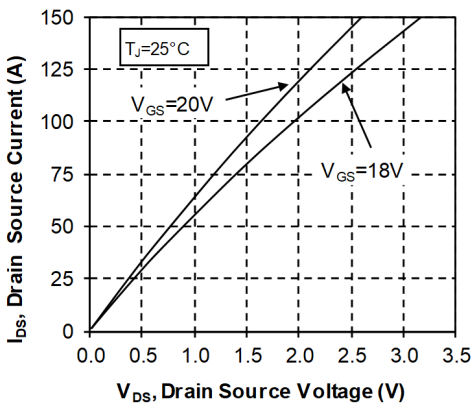
### 3.4 Typical SiC MOSFET Performance Curves

This section shows the typical SiC MOSFET performance curves of the MSC100SM70JCU3 device.

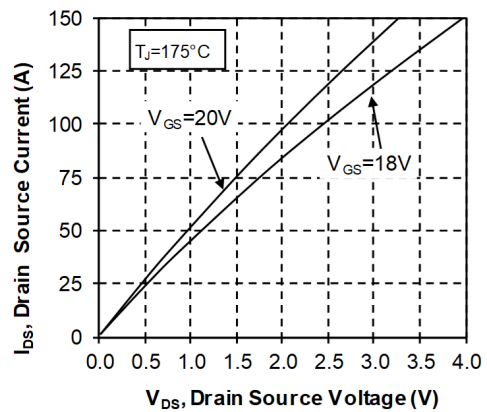
**Figure 1 • Maximum Thermal Impedance**



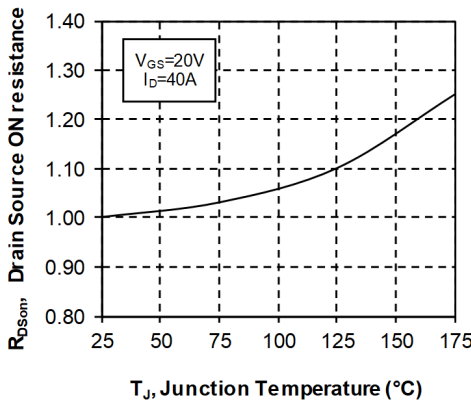
**Figure 2 • Output Characteristics, T<sub>J</sub>=25 °C**



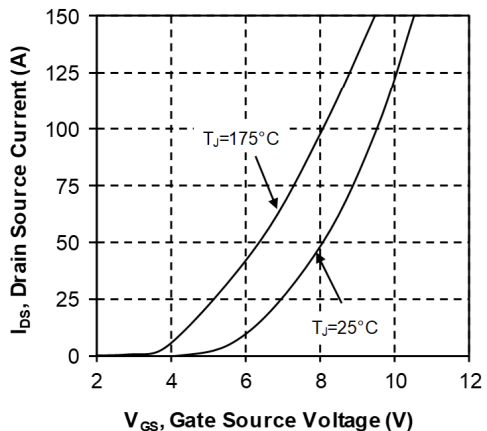
**Figure 3 • Output Characteristics, T<sub>J</sub>=175 °C**



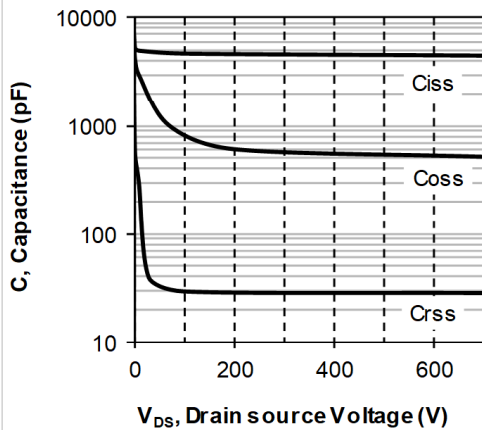
**Figure 4 • Normalized R<sub>DS(on)</sub> vs. Temperature**



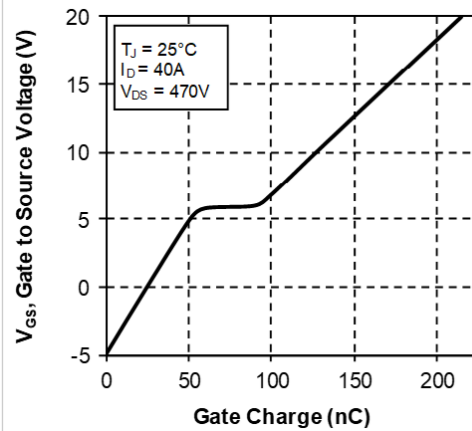
**Figure 5 • Transfer Characteristics**



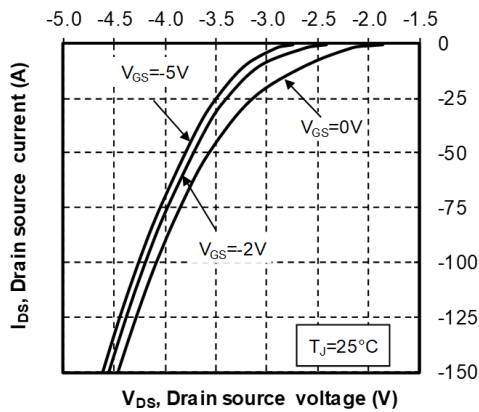
**Figure 6 • Capacitance vs. Drain Source Voltage**



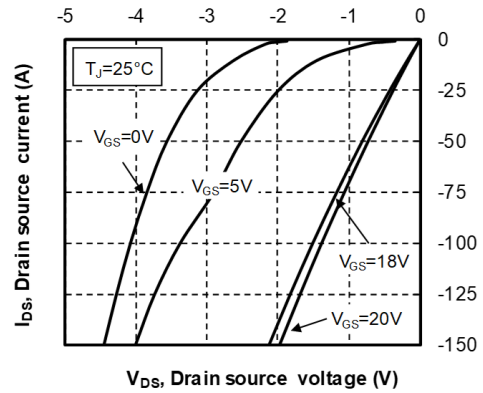
**Figure 7 • Gate Charge vs. Gate Source Voltage**



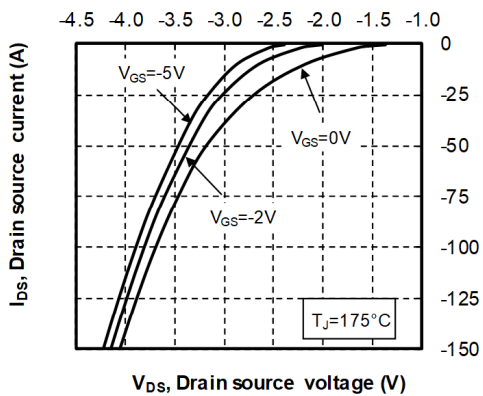
**Figure 8 • Body Diode Characteristics,  $T_J=25^\circ\text{C}$**



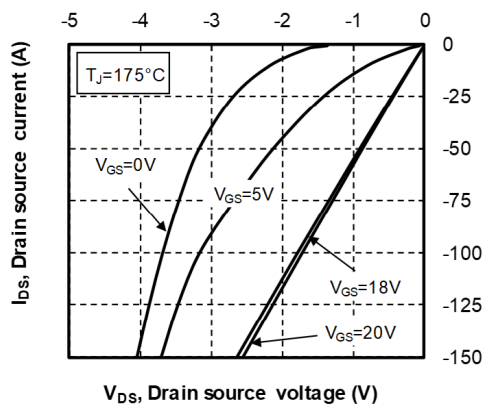
**Figure 9 • 3<sup>rd</sup> Quadrant Characteristics,  $T_J=25^\circ\text{C}$**



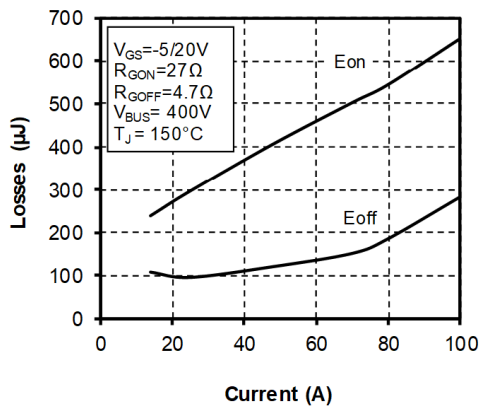
**Figure 10 • Body Diode Characteristics,  $T_J=175^\circ\text{C}$**



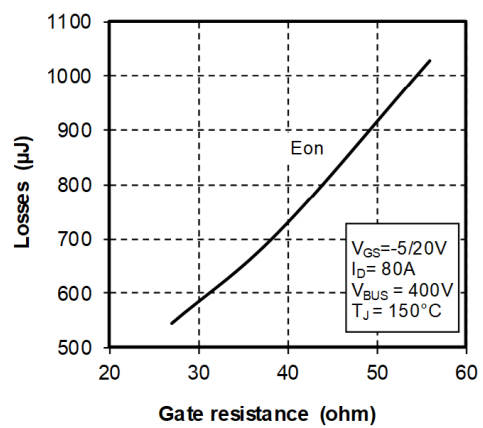
**Figure 11 • 3<sup>rd</sup> Quadrant Characteristics,  $T_J=175^\circ\text{C}$**



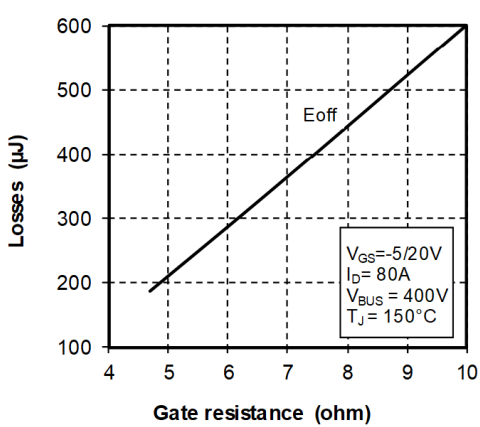
**Figure 12 • Switching Energy vs. Current**



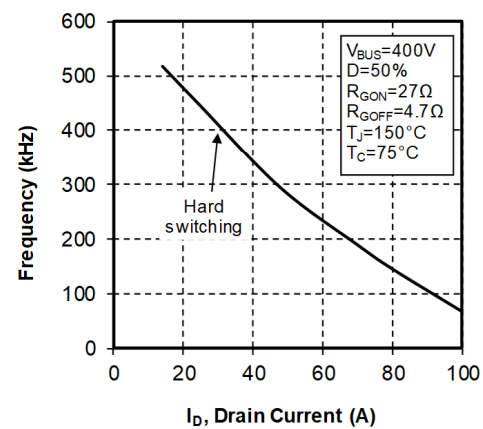
**Figure 13 • Turn on Energy vs. Rg**



**Figure 14 • Turn off Energy vs. Rg**



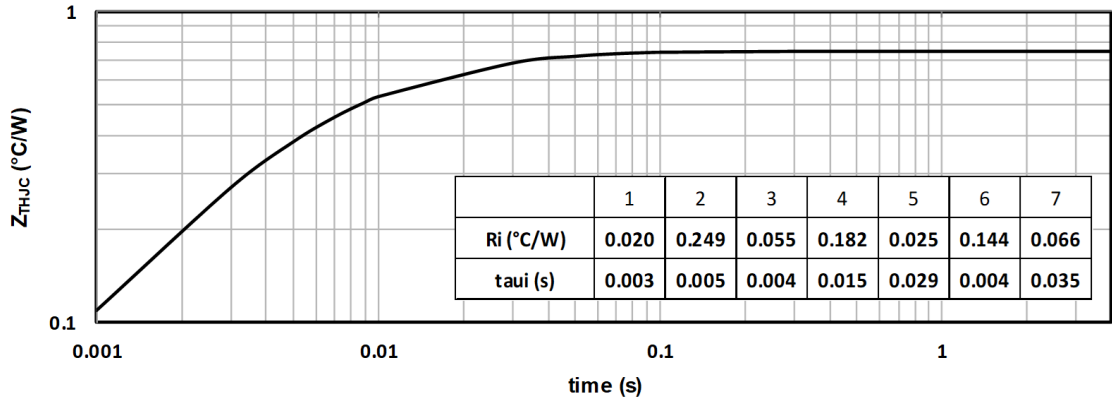
**Figure 15 • Operating Frequency vs. Drain Current**



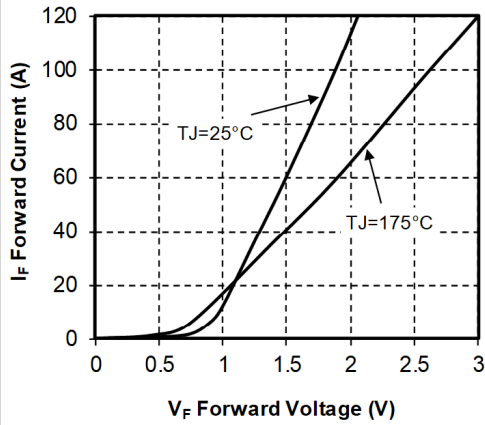
### 3.5 Typical SiC Diode Performance Curves

This section shows the typical SiC diode performance curves of MSC100SM70JCU3 device.

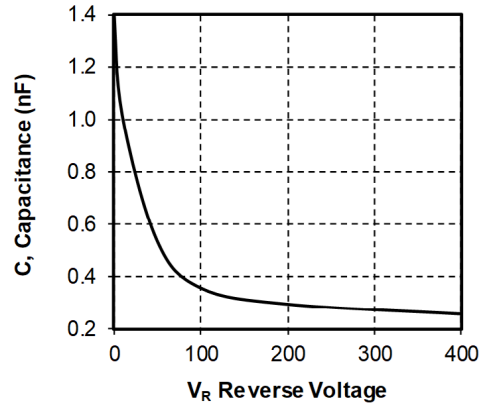
**Figure 16 • Maximum Thermal Impedance**



**Figure 17 • Forward Characteristics**



**Figure 18 • Capacitance vs. Reverse Voltage**



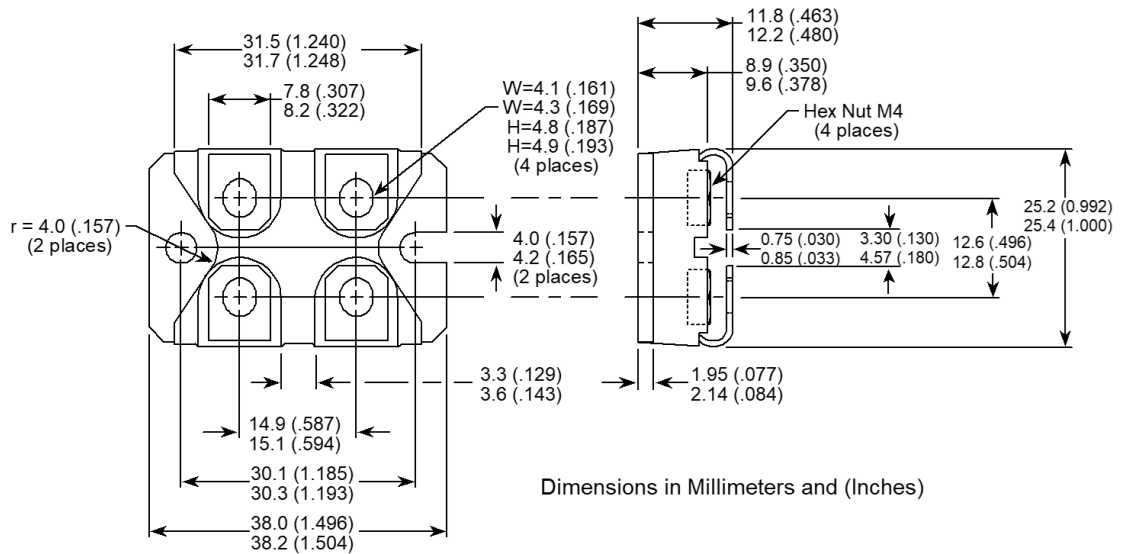
## 4 Package Specifications

The following section shows the package specification of MSC100SM70JCU3 device.

### 4.1 Package Outline Drawing

The following image illustrates the package outline drawing of MSC100SM70JCU3 device. The dimensions are in millimeters and (inches).

**Figure 19 • Package Outline Drawing**



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