Preliminary 100V N-Channel Radiation-Hardened MOSFET

MRH10N22U3SR/JANSR2N7587U3

Product Overview

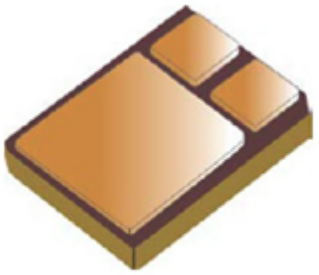
MRH10N22U3SR

150°C, 100V, 19A, N-CHANNEL

2N7587 100V 22A B5498-1

Microchip's new M6™ technology has been developed to provide extreme reliability and enhanced radiation hardness for hermetic power MOSFETs targeted for space and military applications. Microchip Rad-Hard MOSFETs feature low RDS(on) and low total gate charge. The devices have been developed for Total Ionizing Dose (TID) and Single Event environments (SEE). M6™ performs in extreme-environment applications and remains within specification in radiation environments up to 300 Krad TID.

Figure 1. MRH10N22U3SR-2N7587



U3 (SMD-0.5) Package

Features

- Low $R_{DS(on)}$
- Fast Switching
- Single Event Hardened
- Low Gate Charge
- Simple Drive
- Ease Of Paralleling
- Hermetically Sealed
- Surface Mount
- Ceramic Package

Applications

- DC–DC Converters
- Motor Control
- Switch Mode Power Supplies
- HVAC Linear Applications

1. Electrical Specifications

This section shows the electrical specifications of the MRH10N22U3SR device.

1.1 Absolute Maximum Ratings

The following table shows the absolute maximum ratings.

Table 1-1. Absolute Maximum Ratings Pre-Irradiation

Symbol	Parameter	Ratings	Unit
I_D	Continuous Drain Current @ T_c = 25° C	22	A
	Continuous Drain Current @ T_c = 100° C	19	
I_{DM}	Pulsed Drain Current [1]	88	
V_{GS}	Gate-Source Voltage	±20	V
dv/dt	Peak Diode Recovery	5.0	V/ns
P_D	Total Power Dissipation @ T_C = 25° C	75	W
	Linear Derating Factor	0.6	W/°C
T_J,T_{STG}	Operating and Storage Junction Temperature Range	-55 to 150	°C
T_L	Soldering Temperature for 5 Seconds (1.6mm from case)	300	
W_T	Package Weight	1.0	g
Torque	Mounting Torque (TO-254 Package), 4-40 or M3 screw	1.1	N-m

1.2 Electrical Performance

The following table shows the static characteristics of the MRH10N22U3SR device

Table 1-2. Static Characteristics TJ = 25°C unless otherwise specified Pre-Irradiation

Symbol	Parameter	Test Conditions		Min	Typ	Max	Unit
$V_{BR(DSS)}$	Drain-Source Breakdown Voltage	V_{GS} = 0V, I_D = 1.0mA		100			V
$R_{DS(on)}$	Drain-Source On Resistance [2]	V_{GS} = 12V, I_D = 19A			0.038		Ω
$V_{GS(th)}$	Gate-Source Threshold Voltage	V_{GS} = V_{DS}, I_D = 1.0mA			4.48		V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 100V, V_{GS} = 0V	T_J=25°C		10		µA
			T_J=125°C		25		
I_{GSS}	Gate-Source Leakage Current	V_{GS} = ±20V			±100		nA

The following table shows the dynamic characteristics.

Table 1-3. Dynamic Characteristics TJ = 25° C unless otherwise specified Pre-Irradiation

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
C_{iss}	Input Capacitance	V_{GS} = 0V, V_{DS} = 25V, ƒ = 1MHz		2165		pF
C_{rss}	Reverse Transfer Capacitance			38		
C_{oss}	Output Capacitance			520		
Q_g	Total Gate Charge	V_{GS} = 12V, I_D = 22A, V_{DS} = 50V		34		nC
Q_{gs}	Gate-Source Charge			16		
Q_{gd}	Gate-Drain (“Miller”) Charge			6		

The following table shows the source-drain characteristics of the MRH10N22U3SR device.

Table 1-4. Source-Drain Characteristics Pre-Irradiation

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
I_S	Continuous Source Current (Body Diode)	Integral Reverse P-N Junction Diode		22		A
I_{SM}	Pulsed Source Current (Body Diode)			88		
V_{SD}	Diode Forward Voltage	I_{SD} = 22A, T_J=25°C V_{GS} = 0V		1.02		V
$R_{\theta JC}$	Junction to Case Thermal Resistance			1.67		°C/W

The following table shows the static characteristics.

Table 1-5. Static Characteristics TJ = 25° C unless otherwise specified Post Total Dose Irradiation

Symbol	Parameter	Test Conditions		Min	Typ	Max	Unit
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} = 0V, I_D = 1.0mA		100			V
$R_{DS(on)}$	Drain-Source On Resistance [2]	V_{GS} = 12V, I_D = 19A			.038		Ω
$V_{GS(th)}$	Gate-Source Threshold Voltage	V_{GS} = V_{DS}, I_D = 1.0mA			4.48		V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 100V, V_{GS} = 0V	T_J=25°C		10		µA
			T_J=125°C		25		
I_{GSS}	Gate-Source Leakage Current	V_{GS} = ±20V			±100		µA
V_{SD}	Diode Forward Voltage	I_{SD} = 22A, T_J=25°C V_{GS} = 0V			1.02		V

Notes:

1. Repetitive Rating: Pulse width and case temperature limited by maximum junction temperature.
2. Pulse test: Pulse Width < 300µs, duty cycle < 2%.

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2. Single Event Effects

The Microchip MRH10N22U3SR device is being characterized for Heavy Ion responses at the Texas A&M cyclotron. Devices have been characterized up to VDS=100V and VGS=-5V. Additional characterization beyond that voltage point is pending.

Microchip Radiation-Hardened MOSFETs are tested in a manner to provide maximum observability during heavy ion exposure. The filtering circuits of MIL-STD-750F Method 1080 are not used.

A VGS/VDS point is accepted on the prior plot if all of the following conditions are met:

1. A fluence of 3x105 ± 20% ions/cm2 is delivered to each sample.
2. No Single Event Burnout is detected via continuous monitoring of the drain current.
3. No Single Event Gate Rupture is detected via continuous monitoring of the gate current.
4. Post-Exposure IDSS tests continue to pass specification.
5. Post-Exposure IGSS tests continue to pass specification.
6. Three randomly selected samples from different production lots are used for observation.

It should be noted that total energy levels are considered to be a factor in SEE characterization.

Comparisons to other data sets should not be based on LET alone.

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3. Revision History

Revision	Date	Description
A	9/2023	Initial Revision

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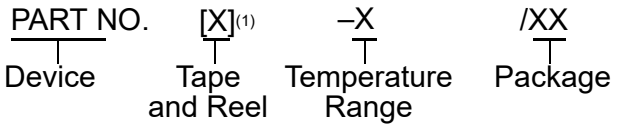

Device:	Device A, Device B, etc	
Tape and Reel Option:	Blank	= Standard packaging (tube or tray)
	T	= Tape and Reel(1)
Temperature Range:	I	= -40°C to +85°C (Industrial)
	E	= -40°C to +125°C (Extended)
Package:(2)	JQ	= UQFN
	P	= PDIP
	ST	= TSSOP
	SL	= SOIC-14
	SN	= SOIC-8
	RF	= UDFN
Pattern:	QTP, SQTP^{SM} (Serial Quick Turn Programming capability), Code or Special Requirements (blank otherwise)	

- Device A - I/P Industrial temperature, PDIP package
- Device B - E/SS Extended temperature, SSOP package

PIS_NOTES

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