

150V, 19A N-Channel Radiation-Hardened MOSFET
Surface Mount TO-263AB Plastic Package
MNSR2N7589P2



Product Overview

Developed on Microchip’s new M6™ technology, the plastic MNSR2N7589P2 radiation hardened N-channel MOSFET provides high performance and radiation tolerance for space and defense applications. The proprietary M6 technology is designed to perform in extreme-environment applications and has shown to remain within specification in radiation environments greater than 100 krad(Si) total ionizing dose (TID). Low $R_{DS(ON)}$, high current capability, and improved safe operating area (SOA) make this device ideal for DC-DC converters, power distribution, and motor control. Products screened within the Microchip New Space flow offer a balance between reliability and cost optimization.

Table 1. Ordering Options

Part Number	Screening Level	$R_{DS(ON)}$, max	$I_{DS\ DCmax}$	Q_G , max	Package	TID Level
MNSR2N7589P2	MNS	0.088Ω	19A	50nC	TO-263AB	100 krad(Si)

Features

- Single Event Effect (SEE) hardened to 90 MeV·cm²/mg per MIL-STD-750 TM 1080
- TID measured performance according to MIL-STD-750 TM 1019 Condition A
- ESD Rating: Class 3B MIL-STD-750, TM 1020
- Tin-lead plated lead finish (minimum 3% lead content)
- Qualified for MSL1 per J-STD-020
- Vacuum outgassing tested per ASTM E595 for space applications (under 1% TML and 0.1% CVCM)
- Rugged design with measured SOA and single pulse avalanche characterization
- Simple voltage control drive requirements

Applications

- Satellite power
- Isolated/non-isolated DC-DC converters
- Motor control
- Power distribution/protection

Figure 1. Package and Pin Description

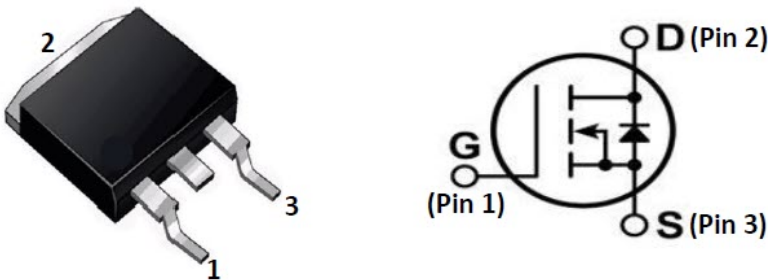


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1. Electrical Specifications

1.1. Absolute Maximum Ratings

Table 1-1. Absolute Maximum Ratings Pre-Irradiation

Symbol	Parameter	Ratings	Unit
I_{DS}	Continuous Drain Current at $T_C = 25\text{ }^{\circ}\text{C}$	19	A
	Continuous Drain Current at $T_C = 100\text{ }^{\circ}\text{C}$	12	
I_{DM}	Pulsed Drain Current ¹	76	
V_{GS}	Gate-Source Voltage	± 20	V
d_v/d_t	Peak Diode Recovery ²	5	V/ns
P_D	Total Power Dissipation at $T_C = 25\text{ }^{\circ}\text{C}$	75	W
	Linear Derating Factor	0.6	
T_J, T_{STG}	Operating and Storage Junction Temperature Range	-55 to 150	$^{\circ}\text{C}$
T_L	Soldering Temperature for 5 Seconds (1.6 mm from case)	300	
W_T	Typical Package Mass	1.7	g
E_{AS}	Single Pulse Avalanche Energy ³	60	mJ
I_{AR}	Avalanche Current ¹	19	A

Notes:

1. Repetitive rating; pulse width and case temperature limited by maximum junction temperature.
2. $I_{DS} \leq -19\text{ A}$, $di/dt \leq 100\text{ A}/\mu\text{s}$, $V_{DD} \leq 30\text{ V}$, $T_J \leq 150\text{ }^{\circ}\text{C}$
3. $V_{DD} = 25\text{ V}$, starting $T_J = 25\text{ }^{\circ}\text{C}$, $L = 277\text{ }\mu\text{H}$, Peak $I_L = 19\text{ A}$, $V_{GS} = 12\text{ V}$

1.2. Electrical Performance

Table 1-2. Static Characteristics ($T_A = 25\text{ }^{\circ}\text{C}$) unless otherwise noted

Symbol	Parameter	Test Conditions	Ratings			Unit
			Min	Typ	Max	
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}$, $I_{DS} = 1.0\text{ mA}$	150	—	—	V
$R_{DS(ON)}$	Drain-Source On Resistance ¹	$V_{GS} = 12\text{ V}$, $I_{DS} = 12\text{ A}$	—	—	0.088	Ω
$V_{GS(TH)}$	Gate-Source Threshold Voltage	$V_{GS} \leq V_{DS}$, $I_{DS} = 1.0\text{ mA}$	2.0	—	4.0	V
G_{FS}	Forward Transconductance ¹	$V_{DD} = 15\text{ V}$, $I_{DS} = 12\text{ A}$	13	—	—	S
I_{GSS}	Gate-Source Leakage Current	$V_{GS} = \pm 20\text{ V}$	—	—	± 100	nA
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 120\text{ V}$, $T_A = 25\text{ }^{\circ}\text{C}$	—	—	10	μA
		$V_{GS} = 0\text{ V}$, $T_A = 125\text{ }^{\circ}\text{C}$	—	—	25	

Note:

1. Pulse test: pulse width < 300 μs , duty cycle < 2%.

Table 1-3. Dynamic Characteristics Pre-Irradiation ($T_A = +25\text{ }^{\circ}\text{C}$)

Symbol	Parameter	Test Conditions	Ratings			Unit
			Min	Typ	Max	
C_{ISS}	Input Capacitance	$V_{GS} = 0\text{ V}$	—	1950	—	pF
C_{RSS}	Reverse Transfer Capacitance	$V_{DS} = 25\text{ V}$	—	14	—	
C_{OSS}	Output Capacitance	$f = 1\text{ MHz}$	—	354	—	

Table 1-3. Dynamic Characteristics Pre-Irradiation ($T_A = +25^\circ\text{C}$) (continued)

Symbol	Parameter	Test Conditions	Ratings			Unit
			Min	Typ	Max	
Q_G	Total Gate Charge	$V_{GS} = 12\text{V}$ $I_{DS} = 12.4\text{A}$ $V_{DD} = 125\text{V}$	—	28	50	nC
Q_{GS}	Gate-Source Charge		—	13	15	
Q_{GD}	Gate-Drain ("Miller") Charge		—	2	20	
$t_{D(ON)}$	Turn-On Delay Time	$V_{GS} = 12\text{V}$, $I_{DS} = 12.4\text{A}$, $V_{DD} = 125\text{V}$, $R_{G(EXT)} = 7.5\Omega$	—	14	25	ns
t_R	Voltage Rise Time		—	5.5	30	
$t_{D(OFF)}$	Turn-Off Delay Time		—	20	60	
t_F	Voltage Fall Time		—	10	30	

Table 1-4. Source-Drain Characteristics Pre-Irradiation ($T_A = +25^\circ\text{C}$)

Symbol	Parameter	Test Conditions	Ratings			Unit
			Min	Typ	Max	
I_S	Continuous Source Current (Body Diode)	—	—	—	19	A
I_{SM}	Pulsed Source Current (Body Diode) ¹	—	—	—	76	
V_{SD}	Diode Forward Voltage	$I_{DS} = -19\text{A}$ $V_{GS} = 0\text{V}$	—	0.9	1.2	V
t_{RR}	Reverse Recovery Time ²	$I_{DS} = -19\text{A}$, $di/dt \leq 100\text{ A}/\mu\text{s}$, $V_{DD} \leq 50\text{V}$	—	250	350	ns
Q_{RR}	Reverse Recovery Charge ²		—	2.0	—	μC

Notes:

1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Pulse test: pulse width $< 300\text{ }\mu\text{s}$, duty cycle $< 2\%$.

1.3. Typical Performance Curves Pre-Irradiation

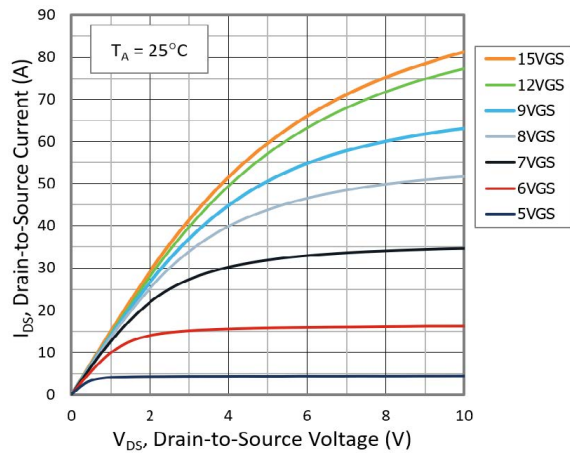
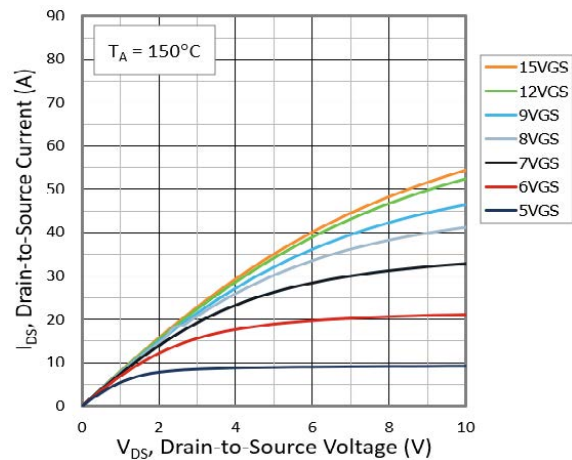
Figure 1-1. Typical Output Characteristics

Figure 1-2. Typical Output Characteristics


Figure 1-3. Typical Transfer Characteristics

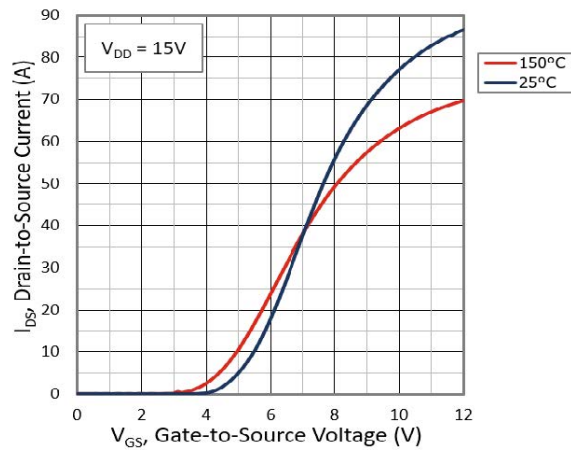


Figure 1-4. Typical $V_{GS(TH)}$ vs T_J

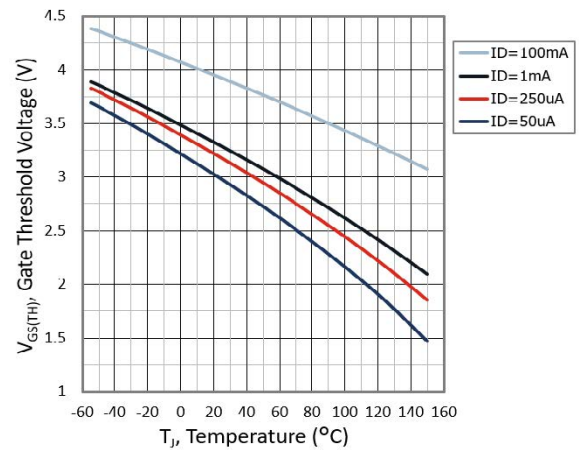


Figure 1-5. Typical $R_{DS(ON)}$ vs V_{GS}

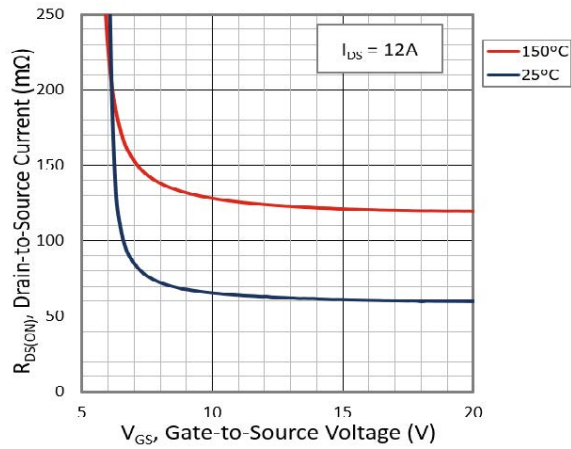


Figure 1-6. Typical $R_{DS(ON)}$ vs I_{DS}

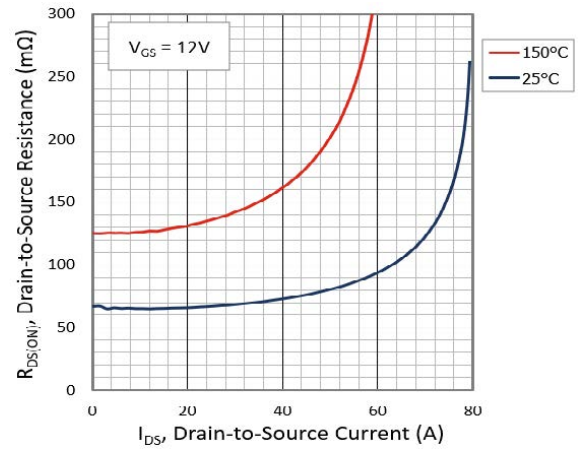


Figure 1-7. Normalized $R_{DS(ON)}$ vs T_J

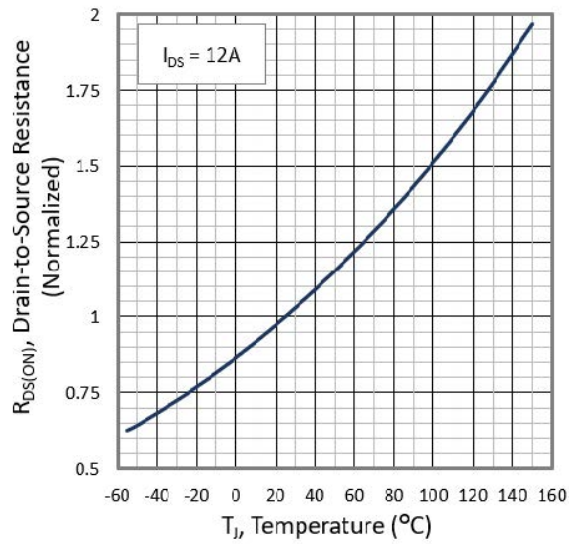


Figure 1-8. $V_{BR(DSS)}$ vs T_J

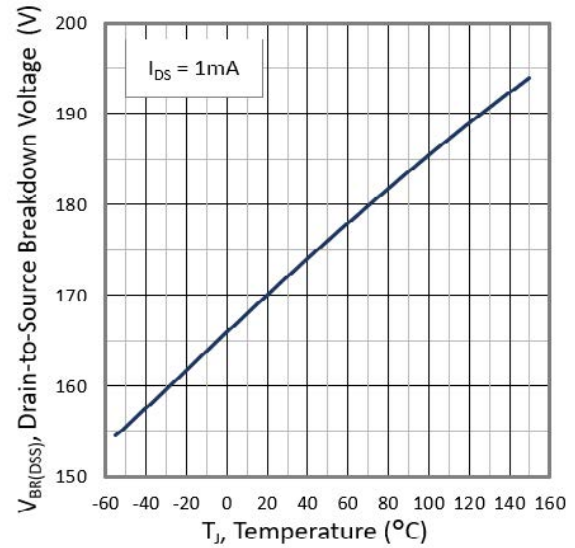


Figure 1-9. Typical Capacitance vs V_{DS}

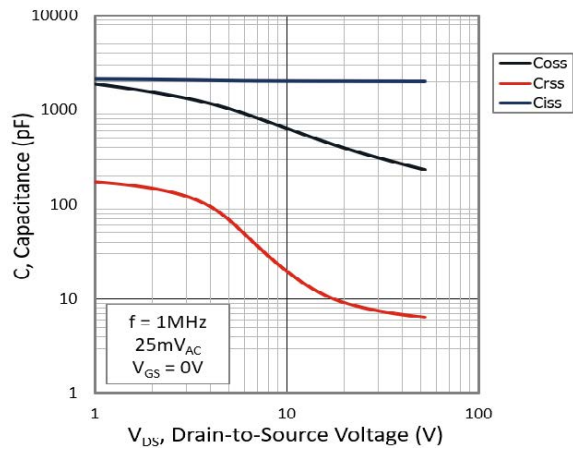


Figure 1-10. Typical V_{GS} vs Q_G

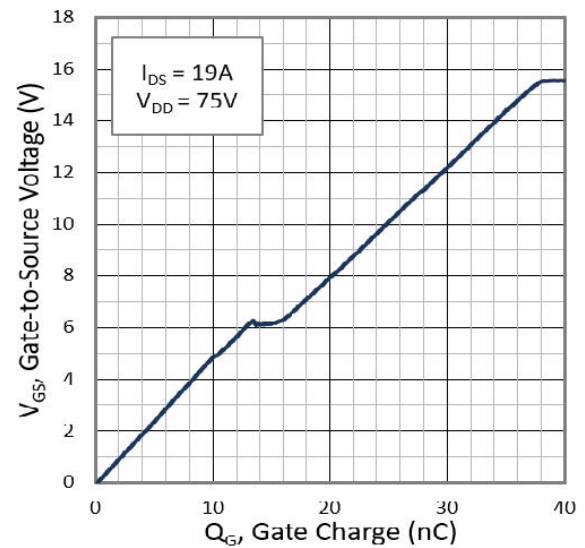


Figure 1-11. Typical Source-Drain Diode Conduction

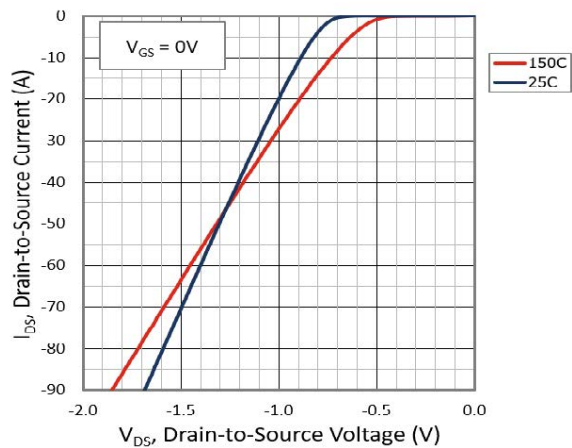


Figure 1-12. I_{DS} vs Case Temperature

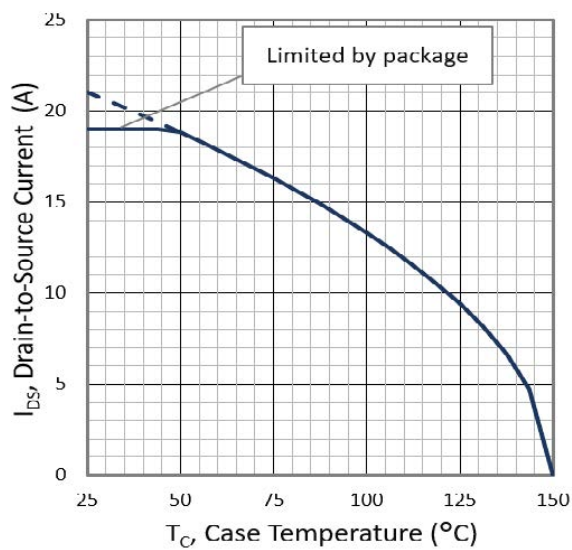
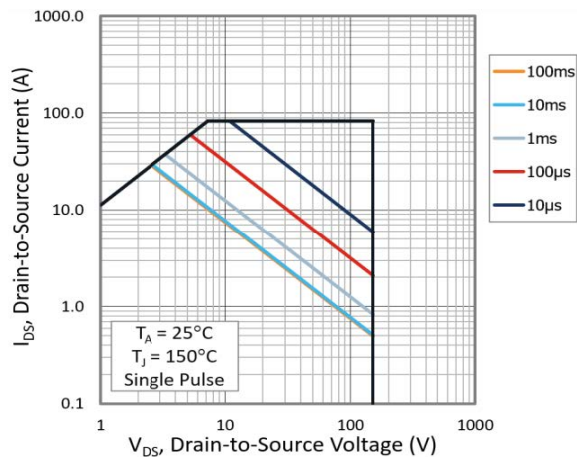


Figure 1-13. Maximum Safe Operating Area



2. Thermal Specifications

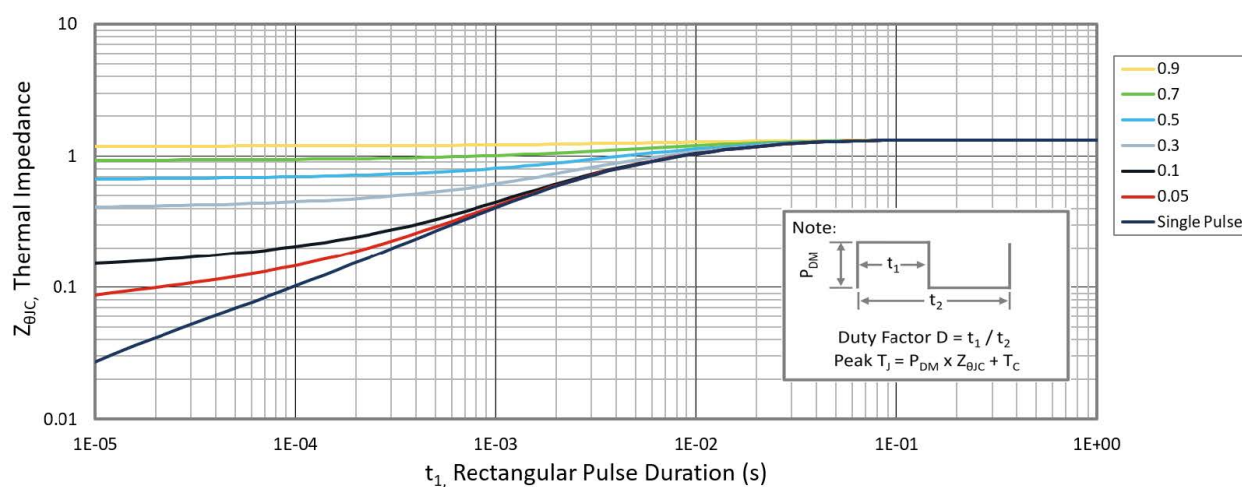
2.1. Thermal Performance

Table 2-1. Thermal Resistance

Symbol	Parameter	Test Conditions	Ratings			Unit
			Min	Typ	Max	
$R_{\theta JC}$	Junction-to-case thermal resistance	—	—	—	1.32	°C/W

2.2. Thermal Performance Curves

Figure 2-1. Maximum Transient Thermal Impedance



3. Radiation Performance

3.1. Post Total Dose Irradiation Electrical Performance

Table 3-1. Static Characteristics $T_A = 25\text{ }^{\circ}\text{C}$, 100 krad(Si), 50–300 rad(Si)/s, unless otherwise noted

Symbol	Parameter	Test Conditions	Ratings			Unit
			Min	Typ	Max	
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0V$, $I_{DS} = 1.0\text{ mA}$	150	—	—	V
$R_{DS(ON)}$	Drain-Source On Resistance ¹ (SMD-0.5)	$V_{GS} = 12V$, $I_{DS} = 12A$	—	—	0.088	Ω
$V_{GS(TH)}$	Gate-Source Threshold Voltage	$V_{GS} \leq V_{DS}$, $I_{DS} = 1.0\text{ mA}$	2.0	—	4.0	V
V_{SD}	Diode Forward Voltage	$I_{SD} = 19A$, $V_{GS} = 0V$	—	0.9	1.2	V
I_{GSS}	Gate-Source Leakage Current	$V_{GS} = \pm 20V$	—	—	± 100	nA
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 120V$, $V_{GS} = 0V$, $T_A = 25\text{ }^{\circ}\text{C}$	—	—	10	μA
		$T_A = 125\text{ }^{\circ}\text{C}$	—	—	25	

Note:

1. Pulse test: pulse width < 300 μs , duty cycle < 2%

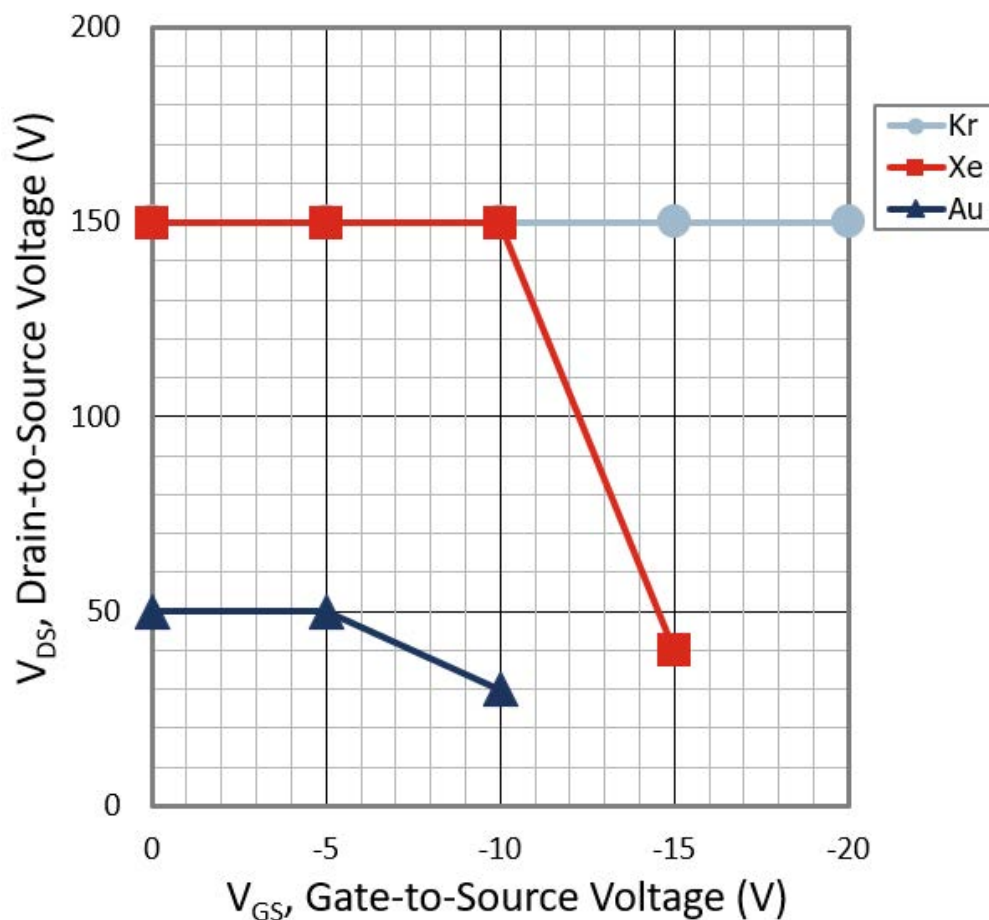
3.2. Single Event Effects (SEE) Performance

This device has been characterized for SEE with heavy ions. The following SEE safe-operating area profile has been established using the ions, linear energy transfer (LET), range and total energy conditions shown.

Table 3-2. SEE Safe-Operating Area

Ion Species	Eff. Surface LET (MeV·cm ² /mg)	Ion Energy (MeV)	Eff. Range (μm)	V_{DS}				
				$V_{GS} = 0\text{ V}$	$V_{GS} = -5\text{ V}$	$V_{GS} = -10\text{ V}$	$V_{GS} = -15\text{ V}$	$V_{GS} = -20\text{ V}$
Kr	38.6 ($\pm 5\%$)	410 ($\pm 5\%$)	50.8 ($\pm 10\%$)	150	150	150	150	150
Xe	64.0 ($\pm 5\%$)	942 ($\pm 5\%$)	69.9 ($\pm 7.5\%$)	150	150	150	40	—
Au	90.0 ($\pm 5\%$)	1489 ($\pm 5\%$)	83.2 ($\pm 5\%$)	50	50	30	—	—

Figure 3-1. SEE Safe-Operating Area



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.

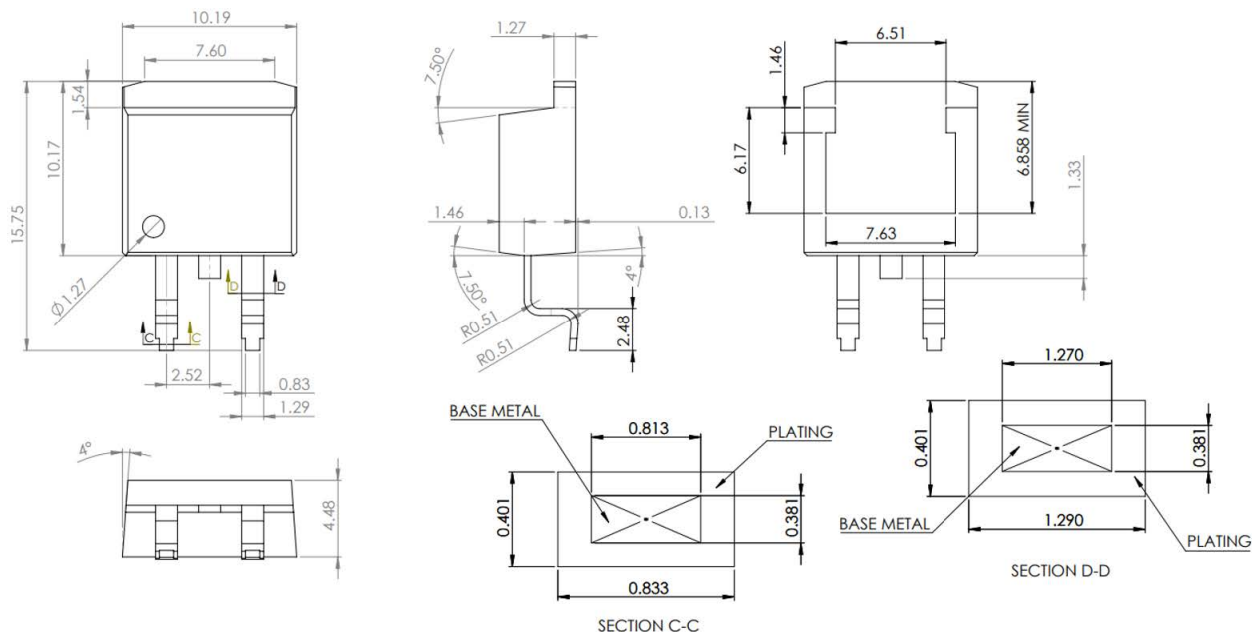
A V_{GS}/V_{DS} point is accepted on the prior plot if all of the following conditions are met:

1. A fluence of $3 \times 10^5 \pm 20\%$ 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 I_{DSS} tests continue to pass specification.
5. Post-exposure I_{GSS} tests continue to pass specification.

4. Package Details

4.1. Package Outline Drawing

Figure 4-1. Package Outline Drawing



Notes:

1. Controlling dimensions in mm.
2. Lead frame: Copper alloy.
3. Plating: Sn-Pb, minimum 3% Pb.
4. Mold compound, die attach method, wire bonds, and semiconductor die will vary by part number.
5. Dimensions do include mold flash. Mold flash shall not exceed 0.127 mm per side, these dimensions are measured at the outermost extreme of the plastic body.
6. Dimensions define a zone where stamping and singulation irregularities are allowed.
7. Center cut tab is electrically connected to drain of device.

5. Part Nomenclature

5.1. Qualified Packaged Devices

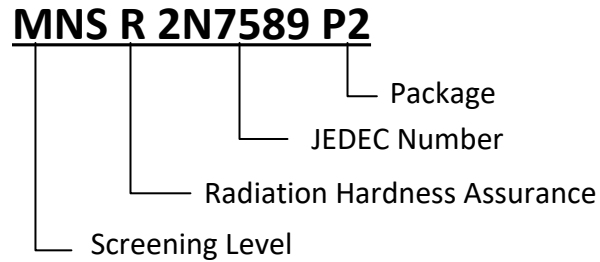


Table 5-1. Qualified Package Devices Description

Term	Initial	Option
Screening Level	MNS	Microchip New Space
Radiation Hardness Assurance	R	100 krad(Si)
JEDEC Number	2N7589	
Package	P2	TO-263AB

Example:

MNSR2N7589P2: Microchip New Space 2N7589 MOSFET with 100 krad(Si) rating in a TO-263AB package.

6. Additional Product Resources

6.1. Product Webpages

[MNSR2N7589P2-MOSFET | Microchip Technology](#)

Main webpage for this product

[Radiation-Hardened Power MOSFETs | Microchip Technology](#)

Main webpage for this product family.

7. Revision History

Revision	Date	Description
C	06/2026	• Redid plots for visual consistency • Added Additional Product Resources • Added reverse recovery and single pulse avalanche energy • Added tin-lead, MSL rating, vacuum outgassing in product features
B	12/2025	Removed JANSF
A	09/2025	Initial version

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