

Extreme-Environment Exposure Solutions for Military and Space Applications

Summary

Finding high-quality MOSFETs that have been thoroughly tested to withstand the harsh environments found in aerospace and defense applications can be challenging for any design engineer. But locating a reputable company that has a long history of providing devices for the aerospace and defense industry is even more essential to a successful design. Recognizing these requirements, we have developed our portfolio of hermetic power MOSFETs with our M6 technology to provide extreme reliability and enhanced radiation hardness for space and military applications. These radiation-hardened MOSFETs feature low RDS (on) and a low total gate charge to meet the requirements of an even wider array of applications. We also offer the largest selection of JANS-qualified products in the world. JANS is the most rigorous level of screening and acceptance requirements available to ensure the performance, quality and reliability of discrete semiconductors intended for space flight.

Microchip's radiation-hardened M6 MOSFET provides the primary switching element in power conversion circuits including point-of-load converters, DC-DC converters, motor drives and controls and general-purpose switching. The MOSFET withstands the harsh environments of space, extends reliability of power circuitry and meets all requirements of MIL-PRF19500/746 with enhanced performance.

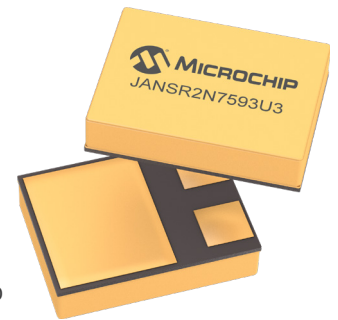
Radiation-Hardened Power MOSFET Products

Our power MOSFETs meet the requirements of total-dose and single-event environments, and the M6 technology allows them to perform well in extreme-environment applications.

JANSR2N7593U3 MOSFET MIL-PRF-19500/746

Non-JANS Version:
MRH25N12U3SR

- 250V, 12.4A MOSFET
- RDS(on) of 0.21 Ohms
- Qualified to 100K Total Ionizing Dose (TID)
- M6 technology will remain within specification in radiation environments of up to 300 Krad TID and greater

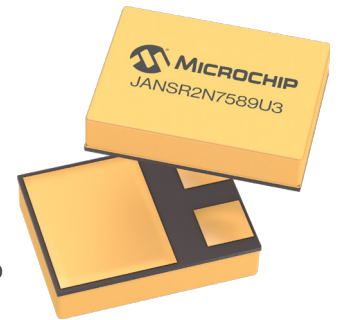


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JANSR2N7589U3 MOSFET MIL-PRF-19500/746

Non-JANS Version:
MRH15N19U3SR

- 150V, 19A MOSFET
- RDS(on) of 0.088 Ohms
- Qualified to 100K TID
- M6 technology will remain within specification in radiation environments of up to 100 Krad TID and greater



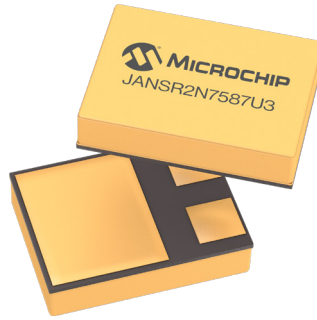
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JANSR2N7587U3 MOSFET MIL-PRF-19500/746

Non-JANS Version:

MRH10N22U3SR

- 100V, 22A MOSFET
- RDS(on) of 0.038 Ohms
- Qualified up to 100K TID
- M6 technology will remain within specification in radiation environments up to 300 Krad TID and greater

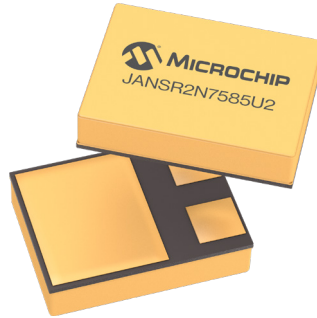


JANSR2N7585U2 MOSFET MIL-PRF-19500/760

Non-JANS Version:

MRH25N50U2SR

- 250V, 50A MOSFET
- RDS(on) of 0.10 Ohms
- Qualified up to 100K TID
- M6 technology will remain within specification in radiation environments up to 100 Krad TID and greater



Key Features of Our Rad-Hard MOSFETs

- Screened to MIL-PRF-19500 and JANS-qualified specifications
- Low RDS(on)
- Fast switching
- Single event-hardened
- Low gate charge
- Simple drive
- Ease of paralleling
- Hermetically sealed
- Surface-mount design
- Ceramic package
- ESD rating: Class 3B MIL-STD-750, TM 1020
- Added robustness for extreme conditions
- Tested to maintain specified values in all environments

Applications

These device is designed for the following applications:

- DC-DC converters
- Motor control
- Switch mode power supplies

For More Information

Products & Solutions Search: <https://www.microchip.com/en-us/solutions/aerospace-and-defense/products/high-reliability-discrete-and-power-management/radiation-hardened-mosfets>

Parametric Search: https://www.microchip.com/en-us/parametric-search.html/chartno_433

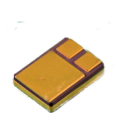
N-Channel Products Portfolio

Bvdss (V)	ID1 (A)	Similar JEDEC Number	MIL-PRF-19500/SS	Microchip Part Number	DLA Part Numbers
100	22	2N7587U3	746	MRH10N22U3SR	JANSR2N7587U3
150	19	2N7589U3	746	MRH15N19U3SR	JANSR2N7589U3
200	16	2N7591U3	746	MRH20N16U3SR	JANSR2N7591U3
250	12.4	2N7593U3	746	MRH25N12U3SR	JANSR2N7593U3

Bvdss (V)	ID1 (A)	JEDEC Number	MIL-PRF-19500/SS	Microchip Part Number	DLA Part Numbers
100	45	2N7580T1	753	MRH10N45T1SR	JANSR2N7580T1
100	56	2N7579U2	760	MRH10N56U2SR	JANSR2N7579U2
150	45	2N7582T1	753	MRH15N45T1SR	JANSR2N7582T1
150	56	2N7581U2	760	MRH15N56U1SR	JANSR2N7581U2
200	45	2N7584T1	753	MRH20N45T1SR	JANSR2N7584T1
200	56	2N7583U2	760	MRH20N56U1SR	JANSR2N7583U2
250	45	2N7586T1	753	MRH25N45T1SR	JANSR2N7586T1
250	50	2N7585U2	760	MRH25N56U1SR	JANSR2N7585U2

N-Ch, Sz 3

SMD0.5

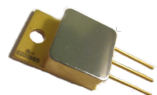


N-Ch, Sz 6

SuperSMD



TO-254



TO-254AA

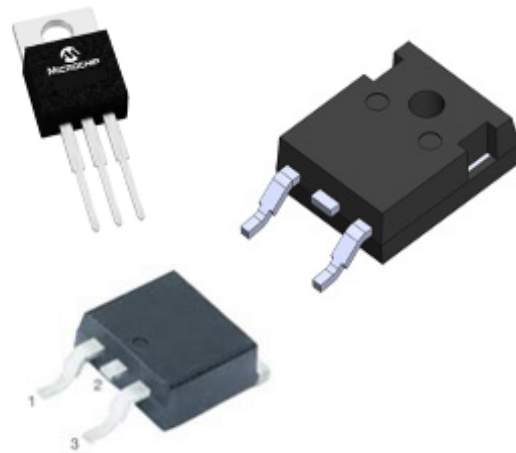
SMD 2



Microchip Plastic RH MOSFET Offering

Objective

- To offer plastic packaged RAD Hard MOSFET for New Space/LEO markets
- Product will use our MIL qualified JANSR die
- Will be Screened and Fully Qualified in Microchip Ireland
- Plan to certify with DLA under MIL-PRF-19500 (see next slide)
- Have received license approval from US Dept of Commerce for this process flow
- Cost effective solution for growing LEO applications and New Space markets - e.g. Blue Origin and Space X
- It will be 12-part numbers with 2 different Die sizes which we will qualify as part of our road map for Plastic RH MOSFET



Package – various, off the shelf packages

- Both through hole and surface mount package
- Already use these packages or similar for Microchip's SiC MOSFET's
- Similar packages are already in use for Microchip's SiC MOSFET's

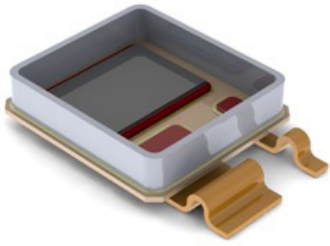
M6 Rad Hard MOSFET Part Numbers – DLA Qual Plan

N- Ch, Size 3.5 &6

Bvdss (V)	ID1 (A)	Microchip Part numbers	Engineering Sample	Rdson	Package type	Package
100	22	MNSR2N7587K	Q3 2024	0.042	Leaded	TO-220
100	22	MNSR2N7587P2	Q3 2024	0.042	SMD	TO-263AB
150	19	MNSR2N7589K	Q2 2024	0.088	Leaded	TO-220
150	19	MNSR2N7589P2	Q2 2024	0.088	SMD	TO-263AB
200	16	MNSR2N7591K	Q3 2024	0.130	Leaded	TO-220
200	16	MNSR2N7589P2	Q3 2024	0.130	SMD	TO-263AB
250	12.4	MNSR2N7593K	Now	0.210	Leaded	TO-220 or
250	12.4	MNSR2N7593P2	Now	0.210	SMD	TO-263AB

Bvdss (V)	ID1 (A)	Microchip Part numbers	Engineering Samples	Rdson	Package type	Package
100	45	MNSR2N7582SA	Q4 2024	0.010	SMD	SMD TO-247
150	56	MNSR2N7581SA	Q4 2024	0.018	SMD	SMD TO-247
200	56	MNSR2N7583SA	Q2 2024	0.028	SMD	SMD TO-247
250	50	MNSR2N7585SA	Q3 2024	0.040	SMD	SMD TO-247

Microchip Super SMD Package Design



Objective

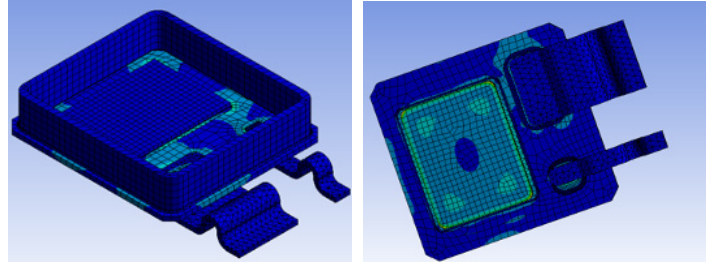
- Develop more mechanically robust and thermally efficient SMD package (comparable to SMD 2, or size 6 die)
- Evaluate thermal stress and power/heat dissipation of package variations
- Minimize CTE difference between component pieces
- Simulate stress during temperature cycling and vibration
- Directly mounted to the PCB. Will fit the SMD2.0 PCB Lay out without any changes or adding carrier.
- Lower profile than current design in the market
- Offers optimum power dissipation as well as lower stress areas where packages may be susceptible to failure
- Simulated stress response to temperature cycling
- Evaluate package variations / material selection to improve performance
- Simulate vibration and board mounting
- Identify material suppliers and gauge potential market for SMD package variants

Super SMD (Patent)

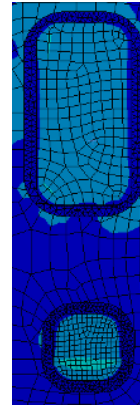
- OFHC Cu leads for stress buffer✓
- Zirconium Oxide Substrate✓
- Copper Tungsten isolated button pads ✓
- Low R_{THJC}✓
- Low package profile design ✓

Microchip Super SMD – Analysis Results

Stress Results – locations of high concentration



Package backside – OHFC Cu leads brazed to W85/Cu15 buttons; Stress build up around buttons/ cusil braze/ Silicon nitride Ceramic substrate



Thermal Response – Heat Dissipation

