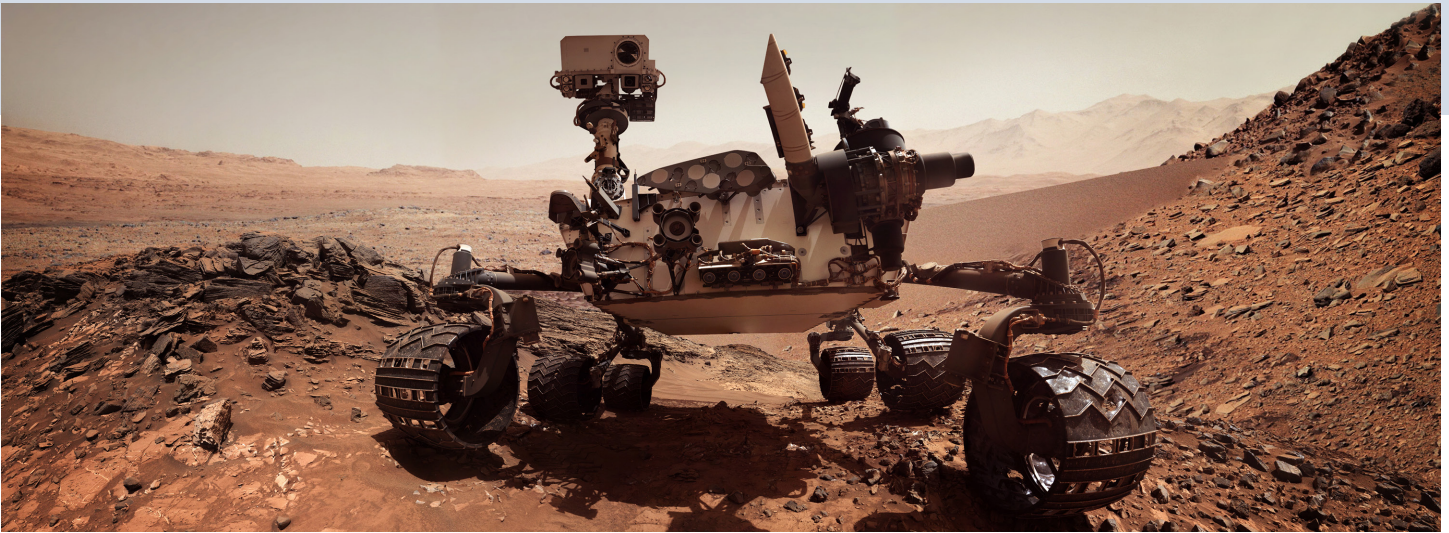


# Space Solutions

Explore the Broadest Product Portfolio  
for Space Applications







## Microchip Is Space

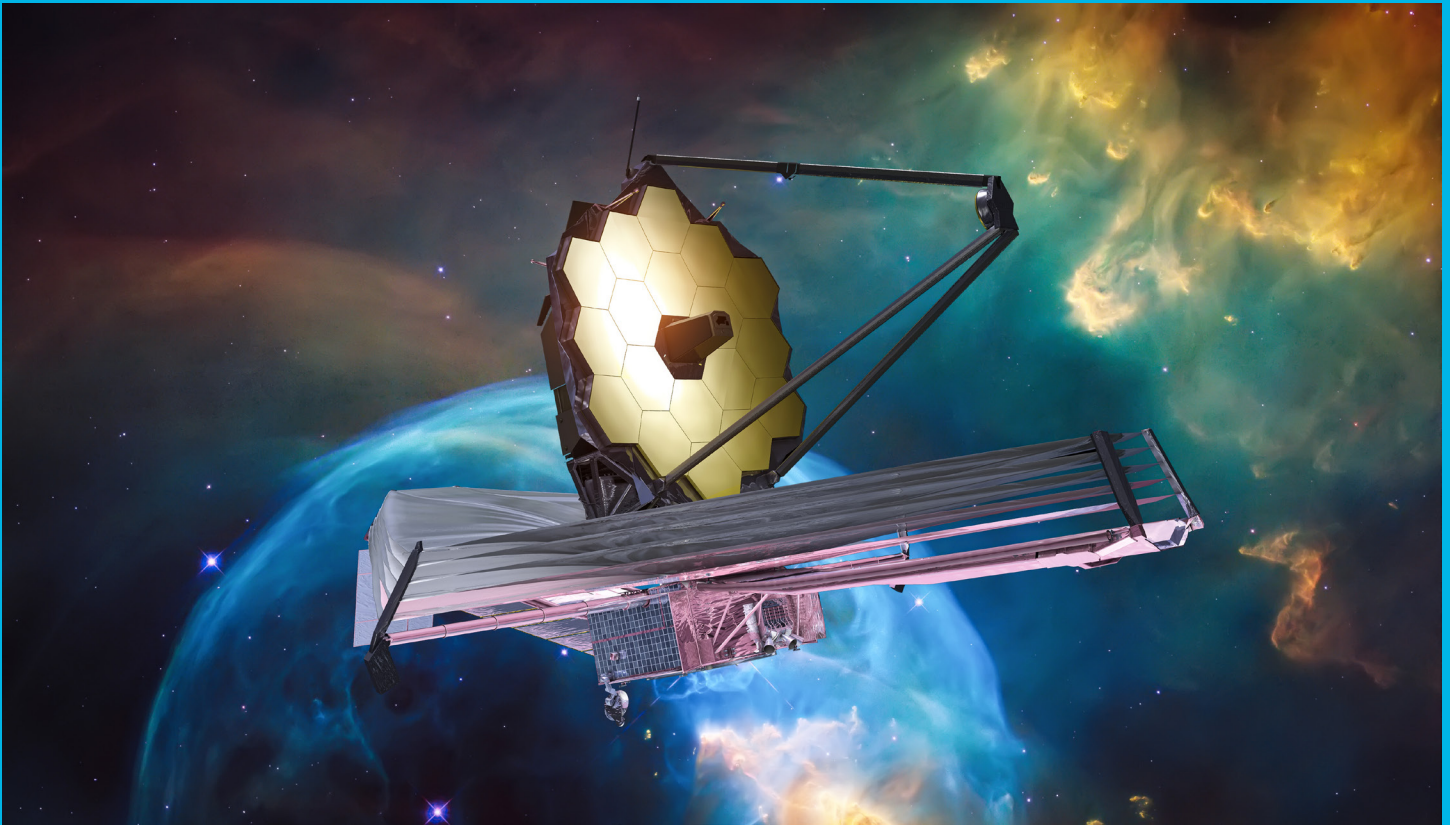
### Committed to Supporting Space Missions for Over 60 Years

- Leading semiconductor supplier with products embedded in Low Earth Orbit (LEO) satellites to deep space missions
- Recognized for flight heritage
- The broadest portfolio of products
- Scalable solutions for New Space applications

We are proud to say that our products have been used in over 90 space missions. When we acquired Vectron®, we also acquired an extensive flight heritage. Our frequency control devices were on board the first successful US space mission in 1958 and the first lunar landing in 1969. Our products are also used in Voyager 1, the furthest man-made object from Earth.

More recently, we have been very proud to provide many products to support Mars exploration, including the Curiosity Rover and Perseverance Rover.

**From Apollo 11 to the Artemis series, we are here to provide long-term support to the space industry with our semiconductor solutions.**



## Explore our Radiation-Tolerant and Radiation-Hardened Solutions Qualified for Space Applications

- High-performance microprocessors
- FPGAs
- Microcontrollers
- Communication interfaces and memories
- Oscillators and timing solutions
- Power solutions and space-qualified discretes
- Mixed-signal solutions
- RF products with space screening

We continue to innovate in areas such as semiconductor materials, high-density integrated circuits and advanced packaging technologies at MMT, our qualified hermetic packaging assembly site. Our products are qualified to the highest government, DLA, NASA and ESA standards, and their reliability has been independently verified by multiple agencies.

As your supply partner for electronic systems in space, we can solve problems at all stages of design and implementation, including power conversion and distribution, radio and radar signal processing, system telemetry and control, digital logic integration and semiconductor packaging. We invite you to explore our solutions and engage with us to help solve your most difficult space system design challenges.







### Solutions for New Space

The accelerating deployment of large constellations of CubeSats and NanoSats in LEO is transforming how the space industry evaluates its supply chain and component reliability requirements. Higher volumes, reduced development time, cost reduction and adaptation to various types of missions have provided new challenges for the space industry and space semiconductor suppliers.

To help you find the right solution to meet your specific design requirements, we offer two options.

The first option provides a top-down method of cutting costs by selecting devices from our Radiation-Hardened By Design (RHBD) portfolio, which has evolved from our extensive space heritage. We screen the selected devices through sub-QML process flows, with packaging available in ceramic or plastic. These sub-QML products reduce overall costs and limit redesign efforts by providing known space-qualified performance coupled with extensive flight heritage.

The second option is to upgrade our COTS devices to a space-qualified level. This COTS-to-Radiation-Tolerant (RT) process allows you to create designs based on our original COTS devices with added radiation tolerance to provide full Single Event Latch-up (SEL) immunity in space. These upgraded COTS devices are offered in 20K to 100K Total Ionizing Dose (TID) immunity with a low Single Effect Upset (SEU) error rate.

With this unique and scalable approach, you can use the same hardware and software ecosystem that supports our COTS devices with your RT and RHBD devices.





## Explore Our Space Portfolio

Space exploration has been evolving and so have our solutions. Some of the latest applications include On-Board Computing (OBC), Telemetry Tracking and Control (TT&C) and Guidance Navigation and Control (GN&C).

We offer a wide variety of reliable solutions for processing, interface, control, communications, RF, time and frequency and power delivery for your space system designs.

### FPGAs

- RT PolarFire® FPGAs
- RT PolarFire SOC FPGAs
- RTG4™ FPGAs
- RT ProASIC® 3 FPGAs
- RTAX™ and RTSX-SU FPGAs

### Advanced Microprocessors

- PIC64-HPSC microprocessors (MPUs)

### Microcontrollers

- 8-bit AVR® microcontrollers (MCUs)
- 32-bit SPARC v8, Arm® Cortex®-M0, M3 and M7 based MCUs and MPUs
- GNSS System on Chip (SoC)

### Communication Interface and Memories

- SpaceWire, Ethernet, CAN
- SRAM
- Nonvolatile Memory (NVM)

### Mixed-Signal Integrated Circuits

- Telemetry and motor control space system managers
- Power supply protection

### Power Solutions

- JANS power discretes: rectifiers and diodes, bipolar transistors
- Radiation-hardened MOSFETs
- Radiation-hardened and radiation-tolerant isolated DC-DC converters
- Radiation-hardened regulators including hybrid switching regulators with integrated FETs and inductors, Low Dropout (LDO) and linear voltage regulators

### Timing Solutions and Oscillators

- Ovenized quartz oscillators
- Hybrid voltage-controlled and temperature-compensated crystal oscillators
- Cesium clocks
- Chip Scale Atomic Clock (CSAC)

### RF Products

- Packaged and bare die silicon and Gallium Arsenide (GaAs) RF diodes
- RF and microwave filters: Surface Acoustic Wave (SAW) filters, modules and oscillators
- GaAs and GaN on SiC Monolithic Microwave Integrated Circuits (MMICs)
- GaN on SiC HEMT transistors and pallets





## Scalable, High-Performance Processing Units

### Radiation-Tolerant FPGAs

Our wide range of RT FPGAs lets you select the right device to hit your power, size, cost and reliability targets. Based on our history of providing the most reliable, robust and low-power SONOS-, Flash- and antifuse-based FPGAs in the industry, we can offer you the best combination of features, performance and radiation tolerance.

- RT PolarFire FPGAs
- RT PolarFire SOC FPGAs
- RTG4 FPGAs
- RT ProASIC 3 FPGAs
- RTAX and RTSX-SU FPGAs

### Advanced MPUs

The PIC64 High-Performance Spaceflight Computing (PIC-HPSC) series of 64-bit MPUs represents a revolutionary step forward in radiation-hardened and radiation-tolerant processors. Offering a 100× improvement in processing capability compared to traditional space processors and bringing new capabilities to space such as virtualization, AI, TSN Ethernet, RDMA over Converged Ethernet v2, PCIe®, Compute Express Link® (CXL®) 2.0 and post-quantum cryptography, the PIC64-HPSC series of MPUs redefines what is possible for the future of space exploration and space processing. The PIC64-HPSC family includes multiple device versions in the same hardware and software footprint to meet mission profiles ranging from LEO to deep space.

### Radiation-Hardened MCUs

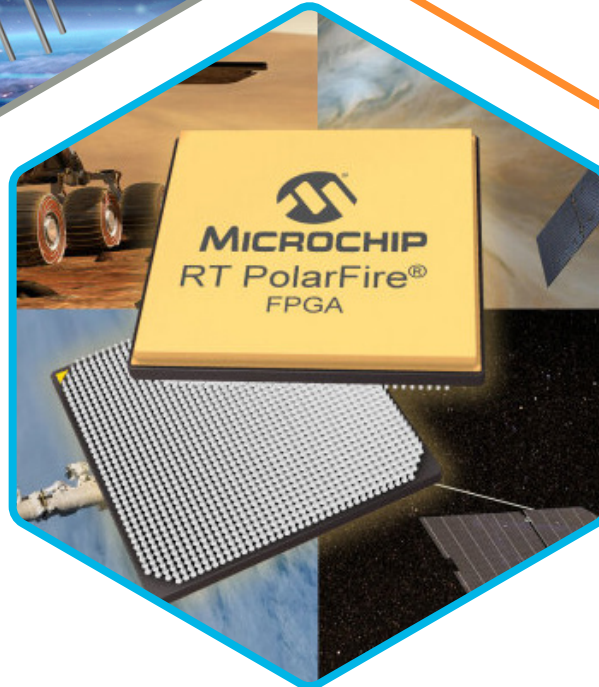
Our SPARC processor-based MPUs have an unrivalled flight heritage, and we continue to meet the advanced requirements of a new generation of space applications with our Arm Cortex core-based radiation-hardened solutions:

- SAMRH707F18 Arm Cortex-M7 based MCU
- SAMRH71F20 Arm Cortex-M7 based MCU
- AT697F SPARC v8-based MCU

### Radiation-Tolerant MCUs

Our radiation-tolerant portfolio of MCUs and MPUs is based on our widely deployed COTS AVR® and SAM devices. These radiation-tolerant devices feature proven and industry-leading cores and peripherals that are reused from our COTS devices. They are robust against radiation effects, are latch-up immune and can survive in critical environments.

- ATmegaS128 8-bit AVR MCU
- ATmegaS64M1 8-bit AVR MCU
- SAMD21RT Arm Cortex-M0 based MCU
- SAM3X8ERT Arm Cortex-M3 based MCU
- SAMV71Q21RT Arm Cortex-M7 based MCU





## Companion Chips

### Interface and Connectivity ICs

From supporting sophisticated connectivity protocols to offering simpler interface options, our comprehensive portfolio of SpaceWire, MIL-STD-1553 and Ethernet solutions enables you to develop robust and highly reliable embedded systems.

- AT7910 SpaceWire routing switch
- VSC8541RT 1-port Gigabit Ethernet copper PHY
- VSC8540RT 1-port Fast Ethernet copper PHY
- VSC8574RT 4-port Gigabit Ethernet copper/fiber PHY

### Mixed-Signal Solutions

We provide successful and reliable custom and standard radiation-hardened-by-design mixed-signal Integrated Circuits (ICs), including our highly integrated telemetry and motor controllers as well as our power switch family, which includes current limiters, drivers and e-Fuse ICs.

- LX7720 motor controller with position sensing
- LX7730 64-analog-input telemetry controller
- AAHS298B 8-channel source driver
- LX7710 125V octal series diode pairs array
- LX7712 programmable current limiting power switch
- LX7714 quad fault-tolerant power bus controller

### Radiation-Hardened Memories

Our flight heritage includes supporting space applications that require SRAM memories. To meet the space industry's requirements, we offer robust devices that can withstand radiation effects. These products also optimize power consumption and are available in small-footprint packages.

- AT65609 1 Mbit SRAM
- AT60142 4 Mbit SRAM
- AT68166 16 Mbit SRAM
- AT7910 4 Mbit Serial EEPROM

### Radiation-Tolerant Memories

Our radiation-tolerant memory portfolio is based on our widely deployed commercial and automotive memories. Featuring industry-proven technologies, these radiation-tolerant devices stand up to radiation effects and ensure latch-up immunity and survivability in critical environments.

- SST26LF064RT 64 Mbit serial Flash
- SST38LF6401RT 64 Mbit parallel Flash
- AT17LV010 1 Mbit serial EEPROM
- AT28C010 1 Mbit parallel EEPROM





## Space System Design Applications

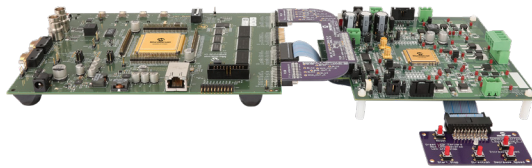
We offer a wide range of mission-specific and application-specific solutions that deliver complete end-to-end performance. These include on-board computing, motor control, telemetry tracking and control, and guidance and navigation solutions. If your system requires processing, interface, control, communications, RF, time and frequency or power delivery, we offer products with the reliability and performance required to accomplish your mission.

Your development is supported by our global team of Field Application Engineers (FAEs) and in-house radiation effects experts for modelling, simulation, and testing.

We also offer a suite of system application examples, evaluation cards, software IP and an Integrated Development Environment (IDE) that will jump start your development. For example, the integrated motor control solution shown below offers in-flight reprogramming and telemetry control.

You can also explore a variety of reference designs based on our products that will help speed up your development. Visit [www.microchip.com/referencedesigns](http://www.microchip.com/referencedesigns) to see the complete list of available designs.

## Motor Control with SAMRH71 and LX7720



## In-Flight Reprogramming SAMRH71 and RT FPGA



## Telemetry with RTG4 and LX7730





## Power Management

### Space-Grade Isolated DC-DC Converters

Space-grade DC-DC converters are specialized power conversion devices that are designed to operate reliably in the harsh conditions of outer space, including extreme temperature variations and radiation. They efficiently convert a spacecraft's DC power from one voltage level to another, which ensures consistent performance of critical onboard systems.

- SA50 family: Radiation-hardened DC-DC converter
- LE50 family: Radiation-tolerant DC-DC converter

The radiation-tolerant LE50-28 series of isolated DC-DC converters targets New Space applications. Designed to serve 28V bus systems, LE50-28 isolated DC-DC power converters can be integrated with our PolarFire® FPGAs, MCUs and LX7720-RT motor control sensors to create a complete electrical system solution.

### Radiation-Tolerant LDO Voltage Regulator

The MIC69303RT is a radiation-tolerant, low-voltage, low-dropout 3A output current regulator. It drives digital circuits based on PLDs, DSP, MCUs and other devices that require low voltage at high currents

- MIC69303RT radiation-tolerant LDO regulator

### Radiation-Hardened Discretes

Our discrete solutions are qualified to MIL-PRF 19500, and we have more DLA slash sheet qualifications than any other manufacturer of space-level discrete products. We were the first diode manufacturer selected by the U.S. military services as a source of supply to qualify products to the highest specified reliability level. We have expanded our offering to include a growing range of space and New Space solutions and capabilities including:

- Radiation-hardened bipolar transistors; MOSFETs; Zener, TVS and other diodes; and rectifiers
- JAN-, JANTX-, JANTXV- and JANS-qualified products with high-dose-rate and low-dose-rate (ELDRS) testing
- Solar cell blocking and bypass diodes

### High-Reliability Electromechanical Relays

For over 60 years, we have established a formidable reputation for delivering high-quality, mission-critical electromechanical power relays for aerospace applications. Our space-grade relays have a proven flight history in groundbreaking projects such as Mars rovers and the International Space Station. We adhere to strict MIL-STD-approved materials and maintain an ISO 5-compliant environment during manufacturing. Our extensive testing laboratory and manufacturing expertise allow us to offer custom solutions that meet the rigorous NASA-EEE-INST-002 standards and provide exceptional protection against harsh environments, pollutants and contaminants.





## Timing Solutions

### Space-Qualified Oscillators and Atomic Clock

Our portfolio of frequency control products includes a broad range of space-qualified Oven-Controlled Crystal Oscillators (OCXOs) with stabilities up to 0.3 ppb and radiation tolerance ranging from 50–300 krad. We also offer space-qualified Evacuated Miniature Crystal Oscillators (EMXOs) for low-power applications, and we are the only manufacturer of the space-qualified Chip-Scale Atomic Clock (CSAC).

### Radiation-Tolerant Oscillators for New Space

The need for economically priced oscillators for LEO applications presents a challenge for high-reliability designs. It is important to balance the need for reliability, cost and performance for oscillators in LEO environments.

To meet these requirements, we have taken oscillator designs that have proven track records for performance, yields and design margins and improved them to handle TID and single event latch-up levels anticipated for LEO environments. This approach has resulted in our L-series portfolio of robust oscillators that can meet the LEO requirements for mission life, launch conditions, radiation tolerance and lower cost.

## Reference Clock Application Notes

When a radiation-tolerant reference clock or oscillator (REFCLK) is needed to drive a Microchip radiation-tolerant FPGA, PHY or MPU, we provide application notes to save you time in identifying the correct clock or oscillator. Each application note provides all the technical information needed to characterize our oscillators as an appropriate reference clock, which saves you time and money during your initial design phase. A table of part numbers provides the model number, frequency, supply voltage, screening levels and component pedigree that makes the steps of ordering prototype and flight models quick and easy for your procurement team.

## RF Solutions

### Space Screening for RF Products

Our diodes and Surface Acoustical Wave (SAW) products have a 40+ year space heritage and are fabricated in house. Our GaN HEMT transistors and GaN on SiC and GaAs MMICs are developed on processes capable of radiation-hardened screening in the range of 100 krad and are inherently immune to SEL. These components can be screened per MIL-PRF-38534, EEE-INST-002 or to your provided specifications. We offer our RF components as die or in plastic or hermetic packages.



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