

Leading Space Innovation

Space Solutions



FPGAs

Mixed-Signal ICs

Space System Manager ICs

Precise Timing and Frequency Solutions

DC-DC Converters and Relays

Discrete Power Components

RF Integrated Solutions



a  MICROCHIP company

Contents

Leading Space Innovation for 60 Years	3
Microsemi Space Heritage	4
Space System Solutions	6
Radiation-Tolerant FPGAs	6
Precise Timing and Frequency Solutions	7
Radiation-Tolerant Mixed-Signal Integrated Circuits	8
Space System Manager Integrated Circuits	8
Space-Grade DC to DC Converters	9
Space-Grade Relays	9
Point-of-Load Space Hybrids	10
Radiation-Hardened Bipolar Transistors, Diodes, Zeners, TVS, Solar Diodes, and Rectifiers	10
Radiation-Hardened MOSFETs	10
RF Integrated Solutions	11
Microsemi's Quality and Space Related Certifications	11
Leading-Edge Solutions for Space Applications	12
Telemetry Tracking and Control	12
Electrical Power System	13
Remote Sensing Payload	14
Microsemi Space Forum	15
Microsemi Space Brief Newsletter	15

Leading Space Innovation for over 60 Years

Extensive Space Heritage

Microsemi has been developing space solutions for over sixty years and has played an important role in a wide variety of global space programs. The company has a proven track record of innovation, quality, and reliability, and continues to build on that legacy with an impressive portfolio of industry-leading new products and technology innovations.

A Partner for the Long Run

Microsemi's high-reliability products and solutions have been used in applications that require high levels of radiation-hardness for trips to the moon, Mars, and beyond. Microsemi has always responded to the specific needs of space applications and has a longstanding commitment to the space market.

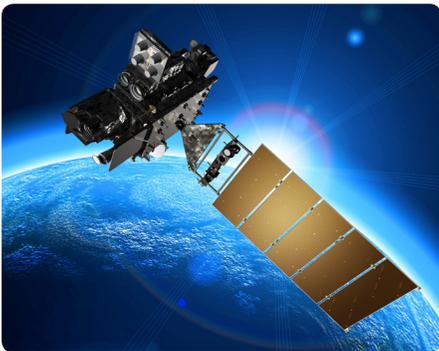
Broad Solutions Portfolio

With one of the industry's most comprehensive space products portfolios, Microsemi provides radiation-hardened and radiation-tolerant solutions including high-performance FPGAs, precise frequency and timing solutions with space-

grade oscillators, mixed-signal ICs, isolated DC-DC converter modules, custom power supplies, hybrid solutions, MOSFETs, diodes, transistors, RF components, and custom solutions. We are committed to supporting our products throughout the lifetime of our customers' programs.

Continuous Innovation

We continue to innovate in areas such as semiconductor materials, advanced packaging technologies, and high-density integrated circuits. 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, Microsemi 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 Microsemi's solutions and engage with us to help solve your most difficult space system design challenges.



Satellites

- Attitude and orbit control system
- Electrical power system
- TT&C/C&DH system
- Communications payload
- Remote sensing payload
- Solar array and power conditioning
- Active and passive image payload
- Solid state recorder



Launchers

- Navigation and guidance system
- Electrical power system
- TT&C/C&DH system
- Propulsion control system



Landers

- Navigation and guidance system
- Electrical power system
- TT&C/C&DH system
- Science experiment payloads
- RF communications subsystems
- Cameras and imagers
- Motor control systems

Microsemi's Space Heritage



LEADING SPACE INNOVATION SINCE 1957

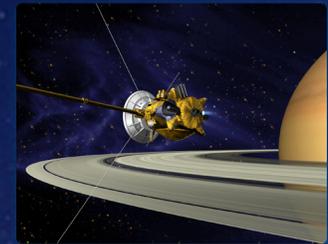
Microsemi technology has been used in many major U.S. and international space initiatives since 1957. A selection of programs that have chosen Microsemi products is presented here.



Atlas
NASA



International
Space Station
NASA



Cassini-Huygens
NASA/ESA

Apollo
Atlas
Centaur
Delta
Mercury
NST-2
Termination
Polaris
Poseidon
Surveyor
Titan

1957-1970

FLTSATCOM
GPS I and II/IA
Landsat-D
Leasat
Mission 34
Telstar 4

1971-1990

Cassini
Envisat
GPS Block IIF
Intelsat 8
International
Space Station
ORBCOMM
QuickBird 1
and 2
SBIRS HIGH
SBIRS LOW

1991-2000

CloudSat
Envisat
GOCE
Hayabusa
Lunar Recon.
Orbiter
Mars Exploration
Rovers
Mars Express
Mars Recon.
Orbiter
MESSENGER
MUOS
Rosetta
SAR-2000
SBIRS
STEREO
Venus Express

2001-2005

Microsemi's Space Heritage



Mars Recon. Orbiter
NASA



GOCE
ESA



GOES-R
NASA



Juno
NASA



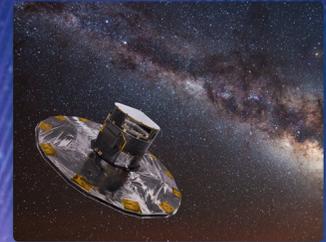
Cygnus
NASA



Mars Rovers
NASA



Mars Science Lab
NASA



Gaia
ESA

AEHF	MetOp
ALOS	MUOS FS3-5
Astro-F (IRIS/Akari)	New Horizons
CHIRP	PAN
Columbus	SBIRS
Cosmo IV	HIGH 3 and 4
GOSAT/IBUKI	SDS-1
GPS III	SELENE
INTELSAT	WINDS/KIZUNA
KOMPSAT	WorldView II

ALOS 2 (DAICHI-2)	GOES-R	Orbcomm Gen 2
ASNARO	Hayabusa 2	PAN 2
ATV	Himawari 8	SAOCOM 1A and 1B
Chandrayaan I	Iridium Next	SBIRS 5 and 6
CLIO (PAN II)	IRNSS Series	Sentinel 1, 2, 3, 4
Cygnus	Juno	Skyfox
DSAC	JPSS-1	Terrasar and Tandem X
Gaia	Mangalyaan	WorldView III
Galileo	Mars Science Lab	
GCOM-W (SHIZUKU)	MetOp SG	

2006–2010

2011–2020

Space System Solutions

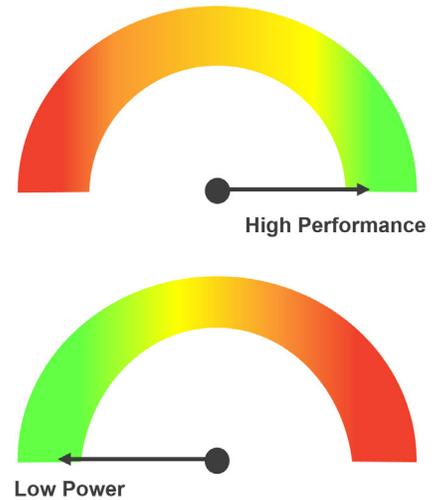
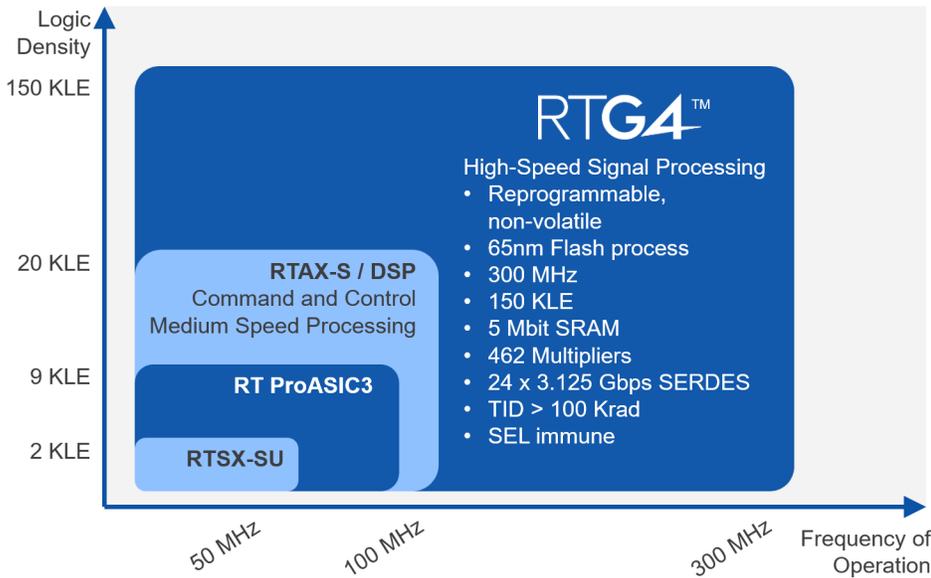
Radiation-Tolerant FPGAs

Microsemi's space-proven, radiation-tolerant FPGAs provide a wide range of gate counts, hardwired multiply-accumulate blocks for fast, efficient digital signal processing, and high-speed serial interfaces such as SerDes. They also feature QML qualification to classes Q and V, and are available in a variety of package types and sizes. Our FPGAs have survived more than 33 million device-hours of reliability data from flight and commercially equivalent units, and performed flight-critical functions in space systems orbiting around the Earth, the moon, Venus, and the sun. They have also been used on missions to the surface of Mars, and into the furthest reaches of the solar system. Microsemi's innovations include radiation-hardening techniques that protect against single event upset (SEU) radiation effects, novel packaging technologies to enable integration of FPGAs into hybrids and multi-chip modules, and high-density ceramic column grid array packaging. Product family specifications include:

- Up to 300 kRad (Si) functional TID
- Up to 150K LEs, 5 Mbits SRAM, 462 multipliers
- Up to 840 I/Os and 24 x 3.125 Gbps SerDes
- Reprogrammable flash or permanently programmed anti-fuse interconnects



RTG4™ Radiation-Tolerant FPGA



Space System Solutions

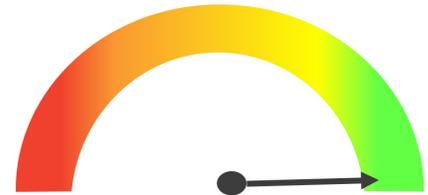
Precise Timing and Frequency Solutions

Microsemi has a long history of supplying space-qualified oscillators and cesium clocks for both domestic and international space applications.

Small size, low power consumption, fast warm-up, excellent stability, and superior spectral purity make our products ideal for satellite timing, navigation, metrology, and communication functions.

We maintain ISO 9001-2000 and MIL-STD certifications to assure the highest-quality design, manufacturing, and test facilities available in the industry today. We are also AS9100 registered, and our workmanship standards include NASA and J-STD-001DS. Capabilities include:

- Ovenized quartz oscillators
- Hybrid voltage-controlled and temperature-compensated crystal oscillators
- Cesium clocks
- Custom build-to-print capabilities

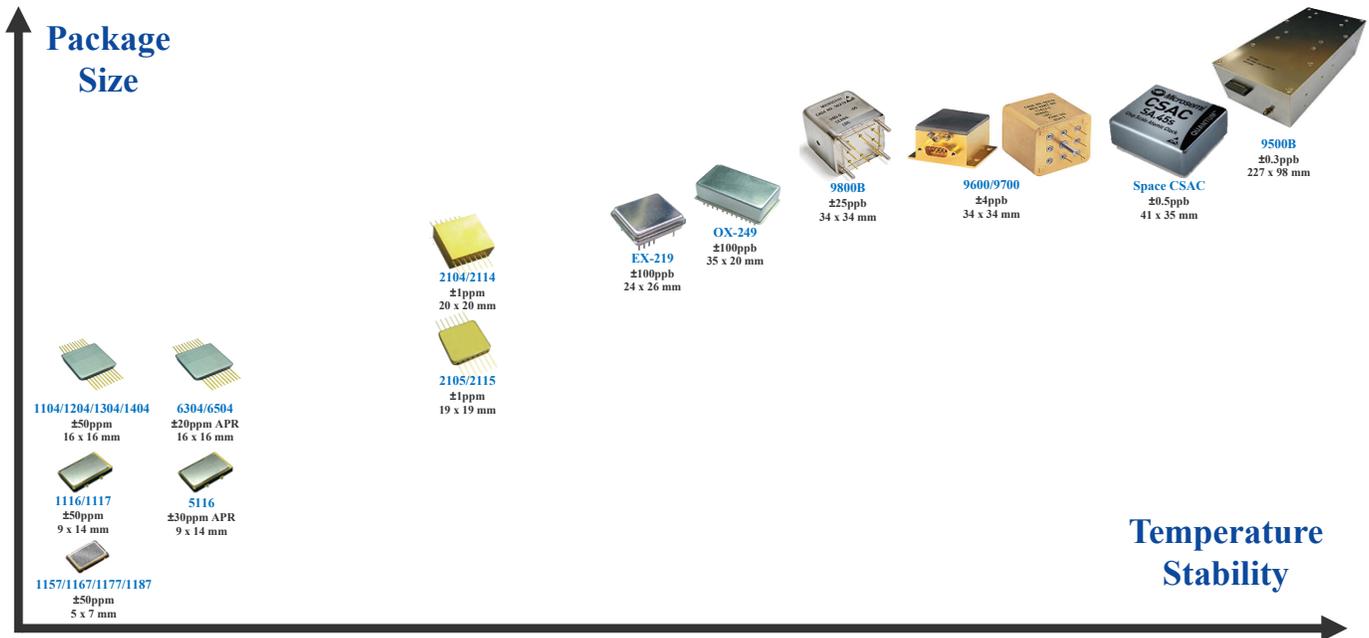


Solution Size



Frequency Stability

Timing Section Space Brochure



 Standard Documentation

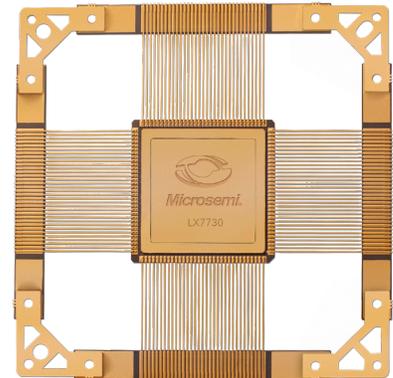
 Broadest portfolio

Space System Solutions

Radiation-Tolerant Mixed-Signal Integrated Circuits

Microsemi has a long history of providing successful and reliable industry-standard, radiation-tolerant by design integrated circuits (ICs), including:

- Space system managers
- High-side drivers
- Diode arrays
- Voltage regulators and reference ICs
- PWM controllers
- Operational amplifiers
- Driver arrays



LX7730 Radiation-Tolerant Telemetry Controller

Custom Mixed-Signal Solutions for Space

Our access to several process technologies and expertise in radiation-tolerant circuit design has enabled us to offer custom solutions for embedded satellite functions. These ICs provide space-saving solutions with voltages ranging up to 120 V, and deliver vital integrated functions such as high-side drivers, motor control, and telemetry.

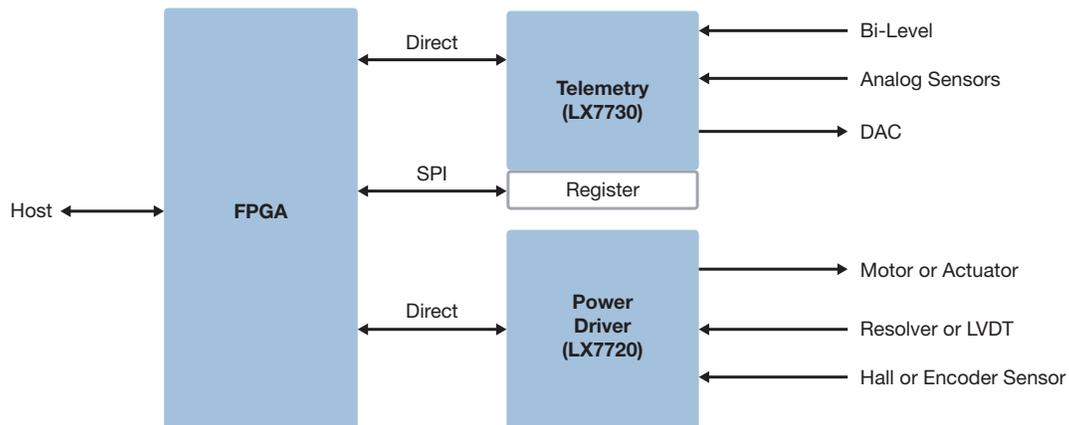
<https://www.microsemi.com/product-directory/services/1043-mixed-signal-asic-design-services>
www.microsemi.com/product-directory/radiation-tolerant-devices/3574-space-system-managers

- ↓ Reduced Board Space
- ↓ Reduced Weight
- ↑ Increased Reliability

Space System Manager Integrated Circuits

Microsemi continues to build on its history with groundbreaking additions to our radiation-tolerant by design IC portfolio. Our new Space System Manager (SSM) family integrates commonly used mixed-signal satellite functions into space-saving Integrated Circuits. The SSM IC interfaces with an FPGA to offer a complete application-specific solution that allows our customers to achieve aggressive weight and space requirements. Key features of the SSM family are:

- Radiation-tolerance: 100 krad TID, 50 krad ELDRS, SEU
- 132-pin, ceramic quad flat pack
- MIL-PRF-38535 Class V and Class Q qualified
- LX7730: 64-channel telemetry controller
- LX7720: power driver/motor controller



www.microsemi.com/product-directory/space-system-managers/3575-telemetry-controller-ic
<https://www.microsemi.com/product-directory/space-system-managers/3708-position-motor->

Space System Solutions

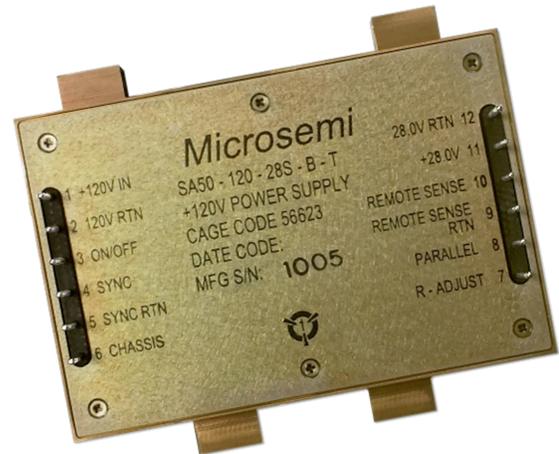
Space-Grade DC to DC Converters

Microsemi has delivered thousands of highly reliable standard and custom radiation-hardened DC to DC power supplies to support space missions as well as military and commercial aviation system development programs. We offer:

- Standard modules: 50 W; 120 V inputs; single, dual, and triple outputs
- Full custom design of power supply and power distribution systems
- DC to DC custom power solutions for various input voltages (28 V, 50 V, 70 V, 100 V, and 120 V)
- Outputs of 1.2 V, 1.5 V, 3.3 V, 5 V, 12 V, 15 V, 28 V, or a custom specification

www.microsemi.com/product-directory/modules-a-hybrids/1450-dc-to-dc-converters#overview

- Power outputs capabilities from 5 W to over 10 kW
- Radiation hardness to TID= 100 krad (Si) and SEE immune to 82 MeV



Space-Grade Relays

Microsemi has been delivering space-grade relays since the space race began in 1957. We have products on NASA's Voyager program that continue to operate reliably after 37 years. Voyager is now in interstellar space, over 11.6 billion miles from Earth, and takes over 17 hours to communicate back. We offer:

- 1 Amp to 30 Amp relays, up to 6,000 V isolation
- Latching and non-latching
- SPST to 4PDT configuration
- Multiple mounting and lead configurations
- Extensive in-house shock and vibration testing capabilities

www.microsemi.com/product-directory/relays-a-contactors/969-relays



Space System Solutions

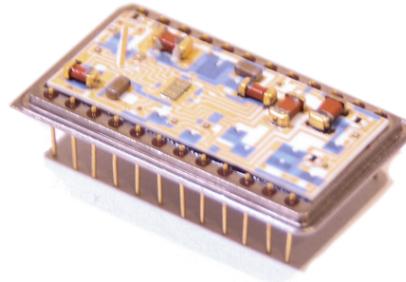
Point-of-Load Space Hybrids

Microsemi designs and manufactures high-reliability micro-circuits qualified to MIL-PRF-3853 Class H or K. The portfolio includes standard and custom power conversion products such as linear regulators and switching converters that offer the following capabilities:

- Space-qualified products to Class H and K (MIL-PRF-38534)
- Radiation qualifications up to 100 krad (Si) TID

Rad-Hard Non-Isolated Switching Regulators—
www.microsemi.com/product-directory/switching-regulators/1773-non-isolated

- Single-event-rated products up to LET= 82 MeV
- Custom build-to-print capabilities
- DBC, thick, and thin film technologies
- Assemblies with low thermal resistance



Radiation-Hardened Bipolar Transistors, Diodes, Zeners, TVS, Solar Diodes, and Rectifiers

Microsemi's discrete solutions are qualified to MIL-PRF-19500, and the company has more DLA slash sheet qualifications than any other manufacturer of space-level discrete products (over 60% of the QPL/QML). 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 offerings to include a growing range of space solutions and capabilities including:

- Radiation-hardened bipolar transistors, diodes, rectifiers, zeners, transient voltage suppressors (TVS)
- Low dose rate guaranteed bipolar transistors
- JAN, JANTX, JANTV, and JANS-qualified products

Radiation-Hardened Bipolar Transistors—
www.microsemi.com/product-directory/transistors/3274-bjt-bipolar-junction-transistor

Diodes—www.microsemi.com/product-directory/discretes/607-diodes

Zeners—www.microsemi.com/product-directory/diodes/630-zener

- Radiation-qualified products (TID, ELDRS, SEE)
- Solar cell blocking and bypass diodes
- Radiation testing services
- Customized devices



Transient Voltage Suppressors—
www.microsemi.com/product-directory/discretes/682-transient-voltage-suppressors

Rectifiers—www.microsemi.com/product-directory/diodes/666-rectifier-diodes

Radiation-Hardened MOSFETs

Microsemi currently offers nearly 30 radiation-hardened MOSFETs qualified to Defense Logistics Agency (DLA) slash sheets 601, 603, 614, 615, and 630. We offer numerous customer benefits including:

- Single event effect (SEE) testing performed at Texas A&M University to 85.4 MeV using Au ions
- JAN Class S-qualified product up to TID 300 krad (Si)
- Surface-mount and through-hole packages
- Voltage range from 60 V to 200 V

www.microsemi.com/product-directory/transistors/3275-mosfet



Space System Solutions

RF Integrated Solutions

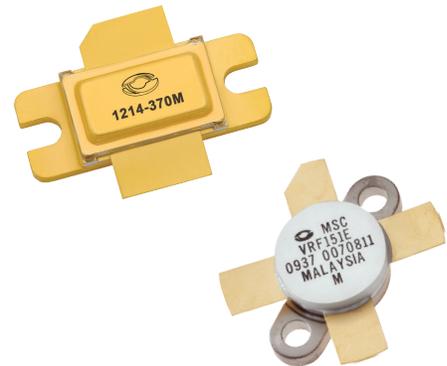
Microsemi has a long history of supplying custom RF and microwave diodes, transistors, and control devices for domestic and international space applications. We offer dedicated service and provide the necessary performance, packaging, and testing required for these demanding applications. Our components have been deployed in GPS, Galileo, and TerraSAR satellites, performing a wide variety of clock, navigation, telemetry, power amplification, and signal control functions.

Key features include:

- Proven silicon and gallium arsenide diodes covering a broad frequency range (up to Ka band)
- Silicon bipolar junction transistors covering UHF, VHF, L-Band, and S-Band frequency bands
- Product screening to JAN Class S requirements per MIL-PRF-19500, MIL-PRF-38534, ESA ESCC 5010
- Tailored screening flows to individual customer specifications

Our latest generation of RF microwave transistors is based on gallium nitride (GaN) wide-bandgap material. These innovative devices allow manufacturers to reduce component count and achieve smaller transmitter footprints with less weight and improved power density and efficiency. Microsemi pulsed and CW GaN transistors are available in frequency bands between 50 MHz to X-band, making them ideal for satellite applications.

www.microsemi.com/product-directory/973-rf-microwave-a-millimeter-wave

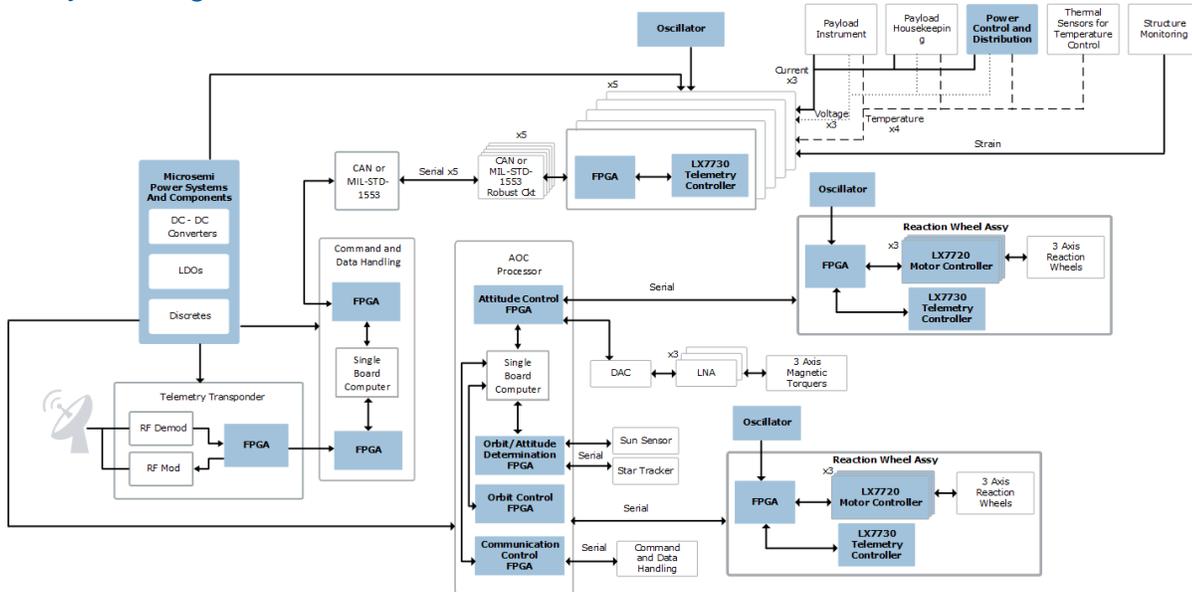


Microsemi's Quality and Space Related Certifications

- AS9100D:2015
- MIL-PRF-19500, MIL-PRF-38534, and QML MIL-PRF-38535
- DOD Trusted Source
- STACK International Supplier Certification
- Laboratory Suitability MIL-STD-883
- ISO 9001-2015
- ISO14001
- DMEA Accredited
- PURE Certificate

Leading-Edge Solutions for Space Applications

Telemetry Tracking and Attitude & Orbit Control



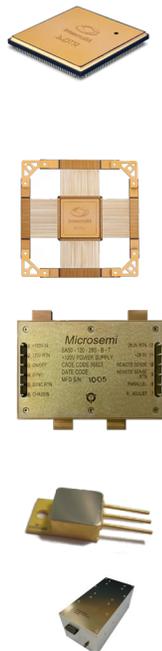
Microsemi FPGA's Families complement each other for different applications:

- RTG4: <https://www.microsemi.com/product-directory/rad-tolerant-fpgas/3576-rtg4>
- RTAX: <https://www.microsemi.com/product-directory/rad-tolerant-fpgas/1694-rtax-s-si>
- RT ProASIC3: <https://www.microsemi.com/product-directory/rad-tolerant-fpgas/1696-rt-proasic3>
- RTSX-SU: <https://www.microsemi.com/product-directory/rad-tolerant-fpgas/1696-rt-proasic3>

For more information on our mixed-signal products:

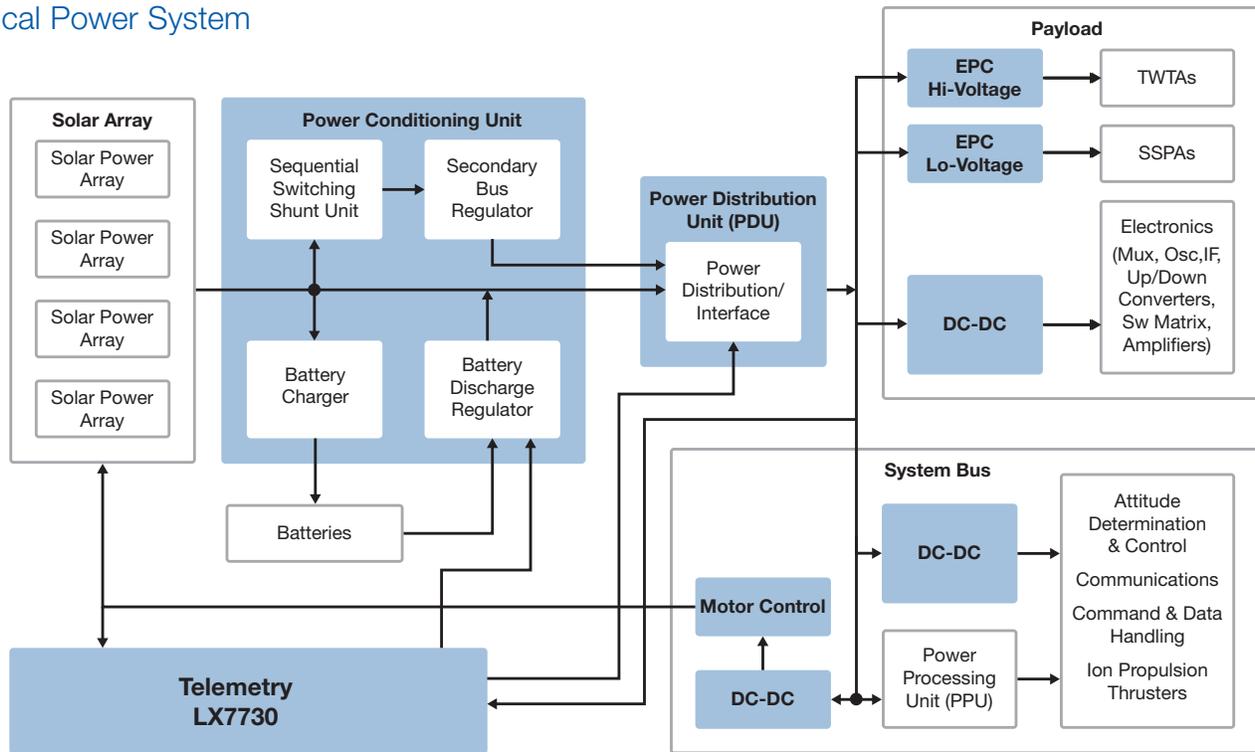
- LX7730: <https://www.microsemi.com/product-directory/space-system-managers/3575-telemetry-controller-ic>
- LX7720: <https://www.microsemi.com/product-directory/space-system-managers/3708-position-motor-controller-ic>

Product	Target Application/Sub-System	Key Differentiation
Radiation-Tolerant FPGAs	<ul style="list-style-type: none"> • Data processing • Interface functions • Single board computing 	<ul style="list-style-type: none"> • High performance, high density, low power • TID up to 300 Krad, SEL immune • RTG4 FPGAs: up to 300 MHz and 150K LEs, QML qualified
Radiation-Tolerant Telemetry Controller: LX7730	<ul style="list-style-type: none"> • Sensor monitoring • Attitude and payload control • Telemetry acquisition 	<ul style="list-style-type: none"> • Highly integrated, radiation-tolerant by design • Significant weight reduction and board space savings • High reliability, interfaces with radiation-tolerant FPGAs
Radiation-Tolerant Motor/ Position Controller: LX7720	<ul style="list-style-type: none"> • Rotation and position sensing • Control actuators in the thrusters • Control motors in the reaction wheels 	<ul style="list-style-type: none"> • Highly integrated, radiation-tolerant by design • Significant weight reduction and board space savings • High reliability interfaces with radiation-tolerant FPGAs
Rad-Hard Power Solutions: Isolated DC-DC Converters, POL Hybrids, JANS Diodes, BJTs, MOSFETs, LDOs	<ul style="list-style-type: none"> • Power conversion • Power regulation 	<ul style="list-style-type: none"> • Broad range complementary technology • Highest output power • Highest efficiency, high reliability, greatest flexibility
Space Crystal Oscillators	<ul style="list-style-type: none"> • Timing for communication and navigation functions • Low-noise frequency generator for up and down conversions • Scientific applications 	<ul style="list-style-type: none"> • High accuracy performance • Unsurpassed combination of small size, low power, and performance • Best performance for frequency stability and phase noise



Leading-Edge Solutions for Space Applications

Electrical Power System



Product	Target Application/Sub-System	Key Differentiation
Rad-Hard Isolated DC to DC Converters	<ul style="list-style-type: none"> Power conditioning unit Power distribution unit Ion propulsion thrusters 	<ul style="list-style-type: none"> Highest output power, highest efficiency Robust SMT construction, high reliability Greatest customization flexibility, shortest lead-times
Rad-Hard Power Discretes: JANS Diodes, Bi-Polar SST, MOSFETs	<ul style="list-style-type: none"> Power conditioning unit Up converter blocks Shunt regulator block Power distribution unit System bus (DC to DC) 	<ul style="list-style-type: none"> Broadest JANS QPL portfolio ELDRS-guaranteed bi-polar transistors I²MOS™ best SEE performance, highest avalanche capability
RAD-Hard Hybrids: Linear and POL	<ul style="list-style-type: none"> Ion propulsion thrusters 	<ul style="list-style-type: none"> DLA MIL-PRF-38534-certified facility High level of integration, highest current High efficiency
Radiation-Tolerant Motor/ Position Controller: LX7720	<ul style="list-style-type: none"> Rotation and position sensing Control actuators in the thrusters Control motors in the reaction wheels 	<ul style="list-style-type: none"> Highly integrated, radiation-tolerant by design Significant weight reduction and board space savings High reliability interfaces with radiation-tolerant FPGAs
Radiation-Tolerant Telemetry Controller: LX7730	<ul style="list-style-type: none"> Sensor monitoring Attitude and payload control Telemetry acquisition 	<ul style="list-style-type: none"> Highly integrated, radiation-tolerant by design Significant weight reduction and board space savings High reliability, interfaces with radiation-tolerant FPGAs
Radiation-Tolerant FPGAs	<ul style="list-style-type: none"> Power distribution Power conditioning units Shunt regulator block 	<ul style="list-style-type: none"> High performance, high density, low power TID up to 300 Krad, SEL immune RTG4 FPGAs up to 300 MHz and 150K LE, QML qualified

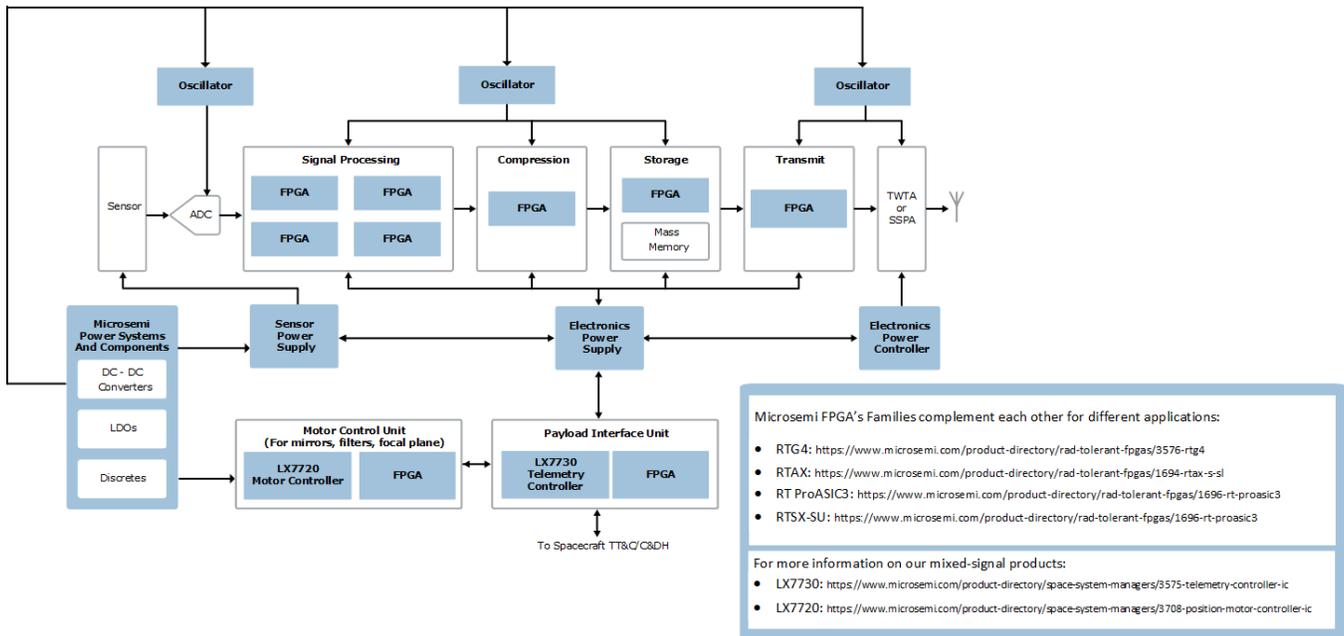


Leading-Edge Solutions for Space Applications

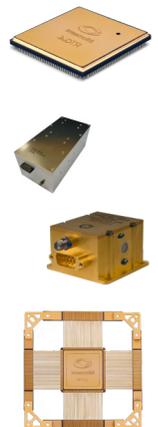
Remote Sensing Payload

Microsemi FPGAs have achieved flight heritage on many programs in command and control applications that require limited amounts of logic and modest performance levels. The RTG4™ family has much greater logic density and much higher performance, that combine to give up to 20 times improvement in signal processing throughput. Now, designers of high-speed

data paths in space payloads can use RTG4 to take advantage of the flexibility and ease-of-use of programmable logic. This is particularly important for remote sensing payload instruments that are required to perform rapidly increasing amounts of on-board processing as sensor resolution is increasing more quickly than downlink bandwidth.



Product	Target Application/Sub-System	Key Differentiation
Radiation-Tolerant FPGAs	<ul style="list-style-type: none"> • High-density, high-performance for board payload processing • High resolution imagery missions • Compression of signal processing 	<ul style="list-style-type: none"> • High performance, high density, low power • TID up to 300 Krad, SEL immune • RTG4 FPGAs up to 300 MHz and 150K LE, QML Qualified
Space Crystal Oscillators	<ul style="list-style-type: none"> • Timing for communication and navigation functions • Low-noise frequency generator for up and down conversions • Scientific applications 	<ul style="list-style-type: none"> • High accuracy performance • Unsurpassed combination of small size, low power, and performance • Best performance for frequency stability and phase noise
Radiation-Tolerant Telemetry Controller IC: LX7730	<ul style="list-style-type: none"> • Sensor monitoring • Attitude and payload control 	<ul style="list-style-type: none"> • Highly integrated space system manager • Significant weight reduction and board space savings • High reliability
Rad-Hard Power Solutions: Isolated DC-DC Converters, POL Hybrids, JANS Diodes, BJTs, MOSFETs, LDOs	<ul style="list-style-type: none"> • Electronic power conditioning units for TWTA or SSPA • High voltage and low voltage DC to DC • Power conversion for multiple output voltages 	<ul style="list-style-type: none"> • Broad range complementary technology • Highest output power, greatest flexibility • Highest efficiency, high reliability





Microsemi

SPACE FORUM

**You can be part of our global
space events!**

Stay updated on future Microsemi Space Forum events by visiting
<https://www.microsemi.com/details/306-space-forum-2017#overview>



SPACE BRIEF

Microsemi's Space Brief eNewsletter

is a quarterly email that will keep you updated on the latest news
about Microsemi space products and solutions.

To view, visit
<https://www.microsemi.com/applications/space#space-brief-newsletter-archives>

To stay up to date on Microsemi's space solution products, email sales.support@microsemi.com or visit our Space Applications Website: www.microsemi.com/applications/space

Microsemi is continually adding new products to its industry-leading portfolio.

For the most recent updates to our product line and for detailed information and specifications, please call us, email, or visit our website.

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