



Mixed Signal Solutions for Space Space Forum 2017

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Product Marketing Manager

Company Overview



- Leading-edge semiconductor solutions differentiated by:
 - Performance
 - Reliability
 - Security
 - Power
- Solid financial foundation
 - FY2016 Revenue: \$1.6B
 - 4800 employees today
- Major focus products
 - FPGAs and ASICs
 - Timing and OTN
 - Mixed-signal and RF
 - Switches and PHYs
 - Storage controllers
 - Discretes and integrated power solutions

Microsemi's Space Pedigree



Extensive Space Heritage

- Developing space solutions for six decades
- Proven track record of innovation, quality, and reliability

Broad Solutions Portfolio










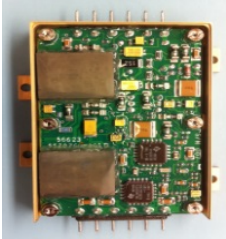
- Power, mixed-signal, and digital, for bus and payload applications

Expanding our Product Portfolio through Continuous Innovation

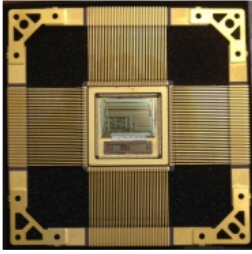
A Partner for the Long Run

- 60-year space heritage

Delivering A Comprehensive Space Portfolio

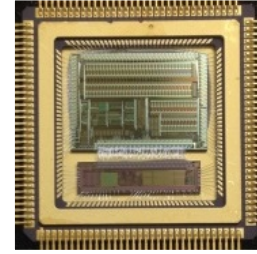
Radiation-Tolerant FPGAs	High performance, high density, low power TID up to 300 Krad, SEL immune RTG4 FPGAs up to 300 MHz and 150K LE RTProASIC3, RTAX, and RTSX-SU QML qualified	  
Rad-Hard Mixed Signal Integrated Circuits	Telemetry and motor control space system managers High-side drivers Regulators and PWMs Extensive custom IC capability	
Space-Qualified Oscillators	Ovenized Quartz oscillators Hybrid voltage controlled and temperature-compensated crystal oscillators Cesium clocks	 
Rad-Hard Power Solutions	Rad-hard JANS diodes, bi-polar small signal transistors, and MOSFETs Rad-hard isolated DC-DC converter modules Custom power supplies: 2 W to > 5 KW Linear and POL hybrids Electromechanical relays	   

Mixed-Signal Space Portfolio



New Products

- SSM
- Telemetry
- Motor control
- High-side driver
- Diode array
- Latchable current limiter
- QML listed



Custom

- 20+ years
- Drivers
- Controllers
- Amplifiers
- Relays
- Telemetry
- Sensor interface
- Motor control

Microsemi Analog Mixed-Signal ICs for Space Applications

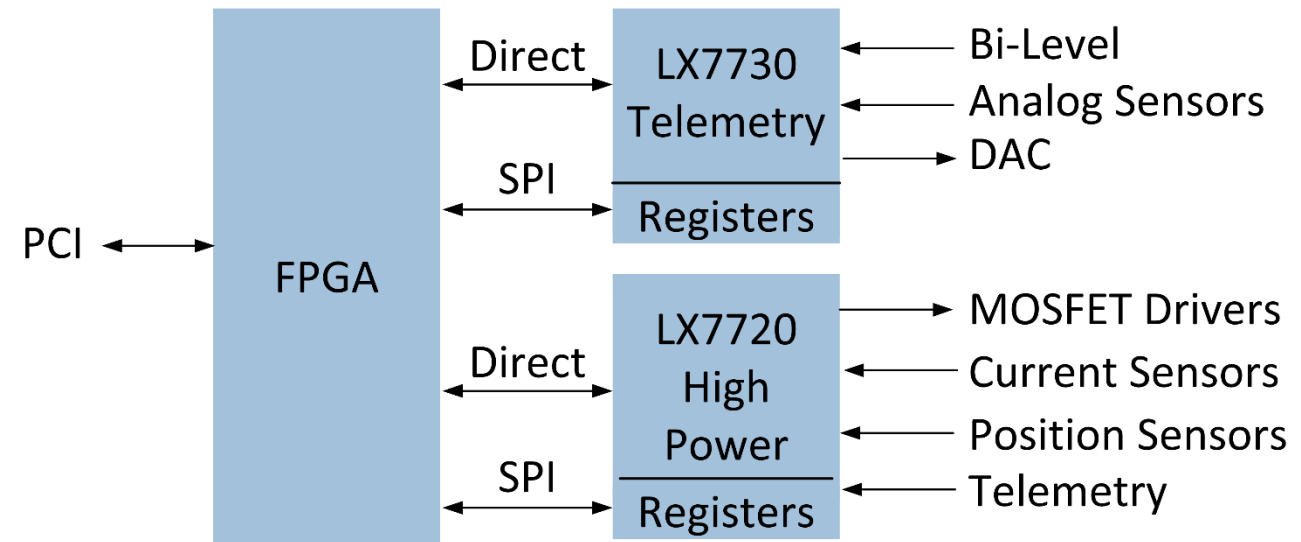
Part Number	Description	Status
In Production		
LX7730	RT telemetry controller SSM	Qual complete
AAHS298B	RT 8 channel high side driver	QML certified Q & V
LX7710	RT 8 pair diode array	QML certified Q & V
Legacy and derivatives	SGR117, SGR137 voltage regulators, SGR1845, SGR1846 PWM controllers	Production
In Qual		
LX7720	RT motor/position controller SSM	First silicon
Sneak Peak	What's In Development	
LX7712	RT power line protection device	In design
LX7714	Fault tolerant satellite power bus controller	In design

Space System Managers

Space System Manager Concept

- The Space System Manager (SSM) is a special purpose analog mixed-signal IC that is used with an FPGA
- The SSM ICs add power and mixed-signal capability to supplement the digital functionality and flexibility of the FPGA
- SSMs provide a higher level of integration than basic devices by specifically focusing on common spacecraft interfaces
- The goal is to reduce part count for a smaller size and weight and increased reliability
- We have two products:

LX7730 Telemetry	V flow in production—Qual complete.
LX7720 Motor Control	First silicon sampled. Final rev silicon sampling October.



SSM—Weight and Board Space Reduction



Reduced Board Space

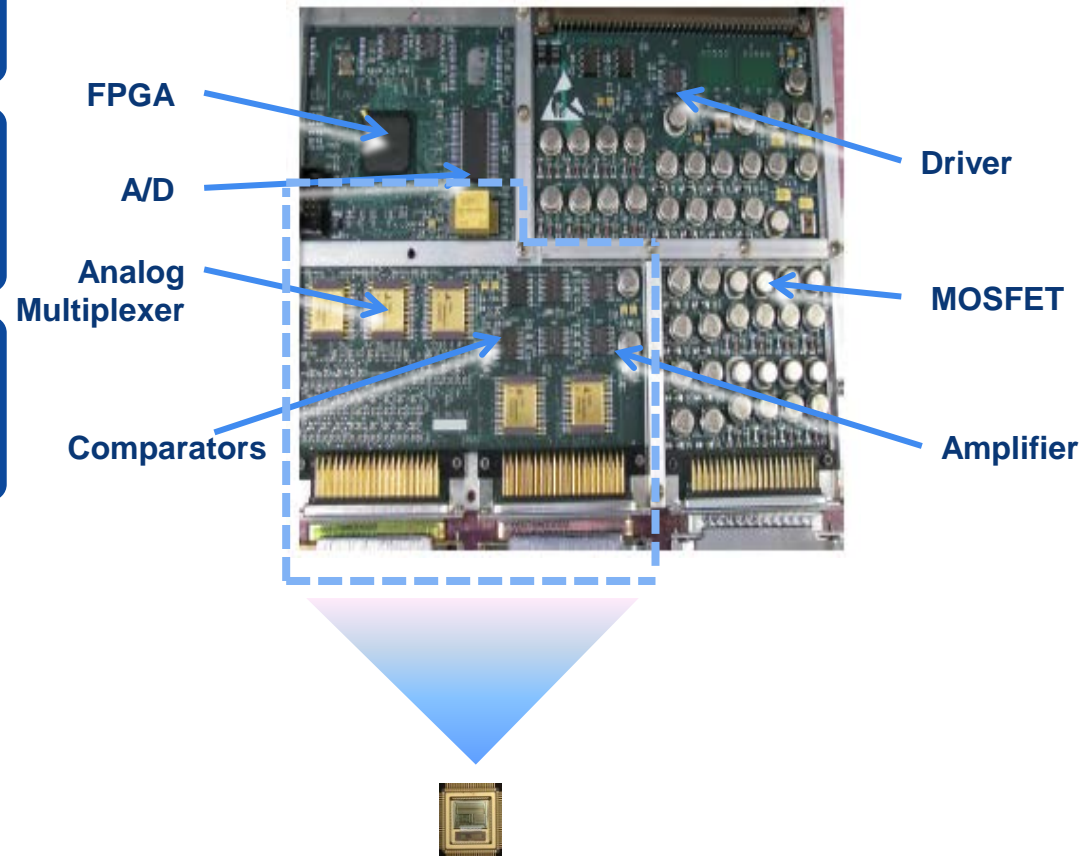
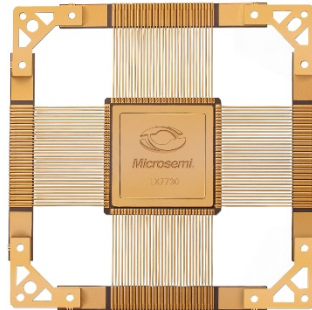
• 50–75%



Reduced Weight



Increased Reliability

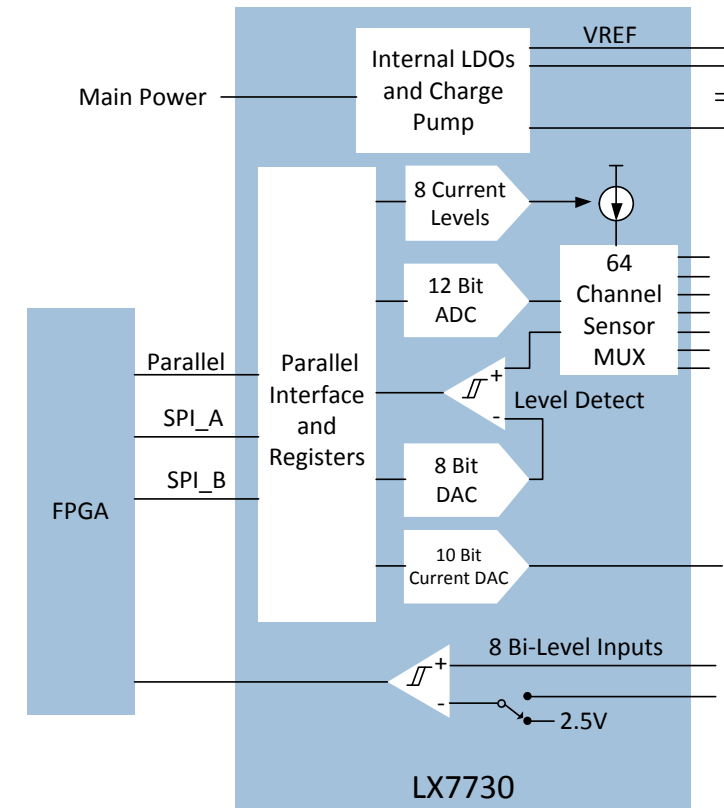


LX7730 Overview

64 Analog Input Telemetry Controller

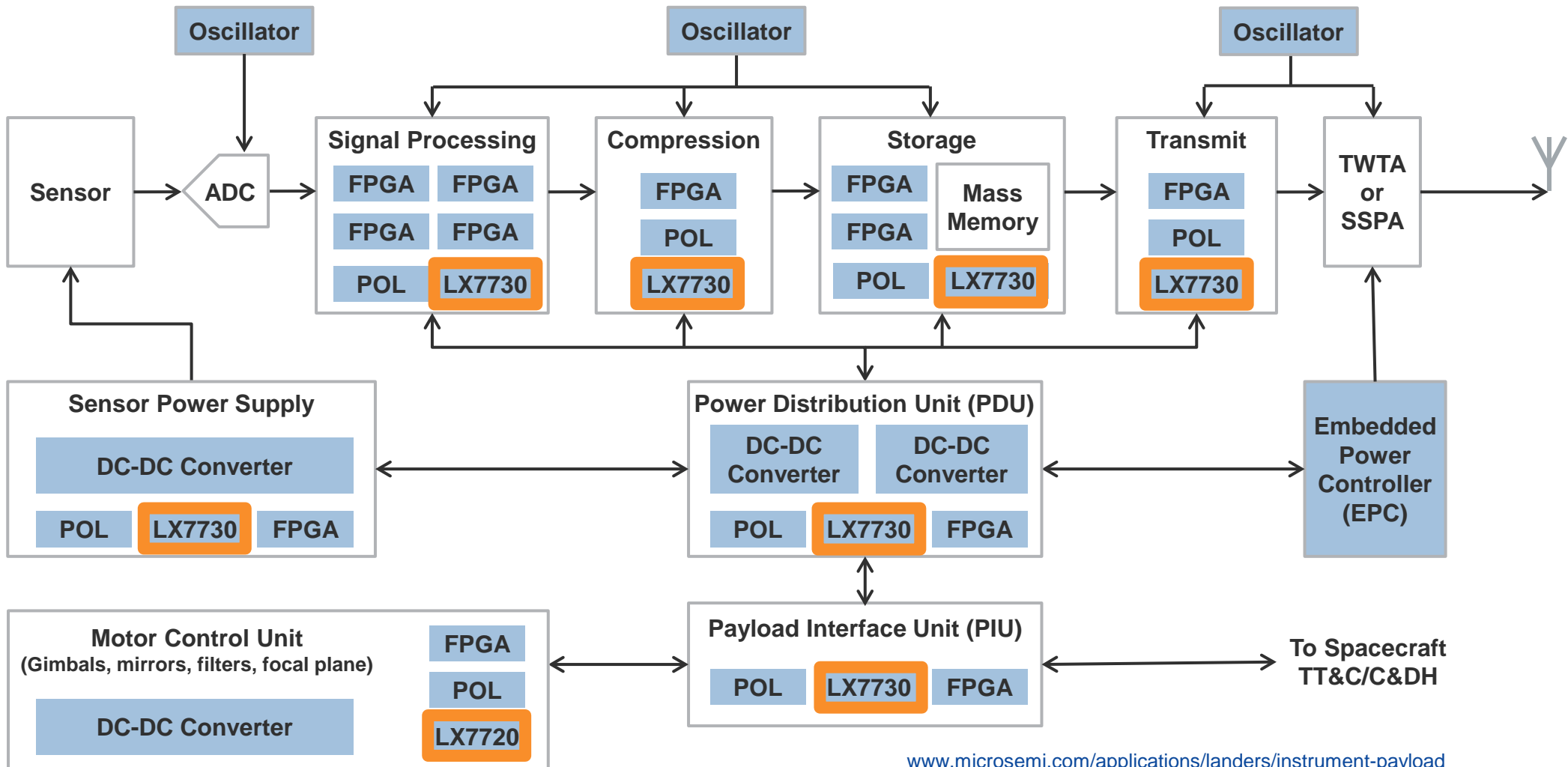
■ Features

- 64-channel MUX
- Break-before-make switching
- 13 kSPS 12-bit ADC
- 2% precision adjustable current source
- 1% precision 5.00 V source
- Threshold monitoring
- 8x bi-level logic
- 10-bit DAC
- Parallel or dual SPI interface
- Radiation tolerant: 100 krad TID, 50 krad ELDRS
- **In Production.** Class V qual report, sample eval board and dev board are available



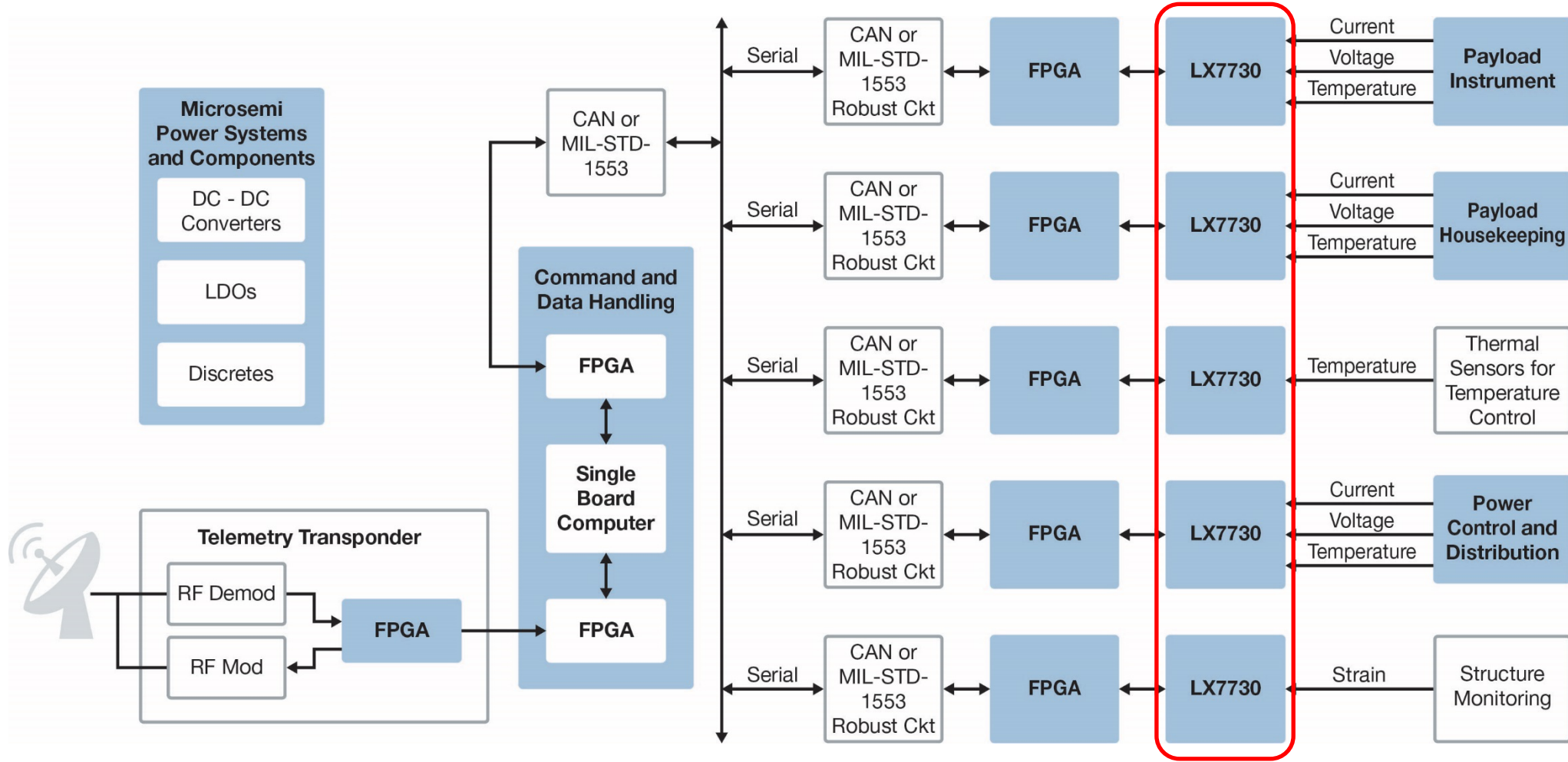
Portfolio Breadth: Example Signal Processing Payload

- Mixed Signal ICs



www.microsemi.com/applications/landers/instrument-payload

Telemetry Tracking and Control Application



LX7730 Availability Update





- In production
- Space—Level (V flow) qual with life test of 4000 hours complete
- Qual report available

Part Number	Silicon	Availability
LX7730-ES, -EVB, and -DB	Engineering samples	Now
LX7730MFQ-EV Class V flow	Qual complete/production	Now
LX7730MFQ-EQ Class Q flow	Qual complete/production	6/30/17

- Lead times—can be up to 26–30 weeks ARO.
- We are submitting qual data to the DLA for QML-V certification. Dependent on DLA lead time.
- Product numbers will change to LX7730MFQ-V and LX7730MFQ-Q once QML listing is given.

LX7730MFQ-EV Qualification Results: Pass



Group	Subgroup	Comment	Result
B	1	Resistance to solvents	 Pass (0 Reject)
	2	Bond strength, die shear/substrate attach	
	3	Solderability	
C	1	Steady state life (initial 4000 hrs, recurring 1000 hrs) End point electrical	 Pass (0 Reject)
D	1	Physical dimensions	 Pass (0 Reject)
	2	Lead integrity, Seal (fine/gross)	
	3	Thermal shock, temp cycling, moisture res, visual, lead Integrity, seal (fine/gross)	
	4	Mech shock, vibration, variable freq, constant accel, seal, visual, end point electrical	
	5	Pre-seal, salt, visual, post-seal	
	6	Water vapor (RGA)	
	7	Adhesion to lead finish	
	9	Solder heat, seal, visual, end point electrical	
E	2	TID 100 krad, end point electrical ELDRS 50 krad, end point electrical	 Pass (0 Reject)
	5	Single event	

LX7730 Radiation Test Results

- TID to minimum of 100 krad
- ELDRS to minimum of 50 krad
- Single event:
 - All blocks evaluated after exposure up to 83 MeV.cm²/mg including internally regulated currents and voltages and the complete telemetry chain
 - SEL immune up to 87 MeV.cm²/mg and 125°C (fluence of 1e8 particles/cm²)
- Radiation reports are on the product webpage at <https://www.microsemi.com/product-directory/space-system-managers/3575-telemetry-controller-ic#radiation-data>

LX7730 Ordering Part Numbers

Part number	Description
LX7730MFQ-ES	Engineering samples (using production silicon).
LX7730MFQ-EQ	Built per QML-Q flow. This will convert to LX7730MFQ-Q once QML certification is achieved and parts will also be orderable by SMD number.
LX7730MFQ-EV	Built per QML-V flow. This will convert to LX7730MFQ-V once QML certification is achieved and parts will also be orderable by SMD number.
LX7730-EVB	Evaluation board. Allows user to exercise LX7730 features when coupled with USB to serial interface. Application software provided. Includes cable assembly.
LX7730-DB	Daughter board for RTG4 development kit. Allows user to connect the LX7730 to the RTG4 FPGA dev kit and evaluate key functions.

LX7730 Support Material

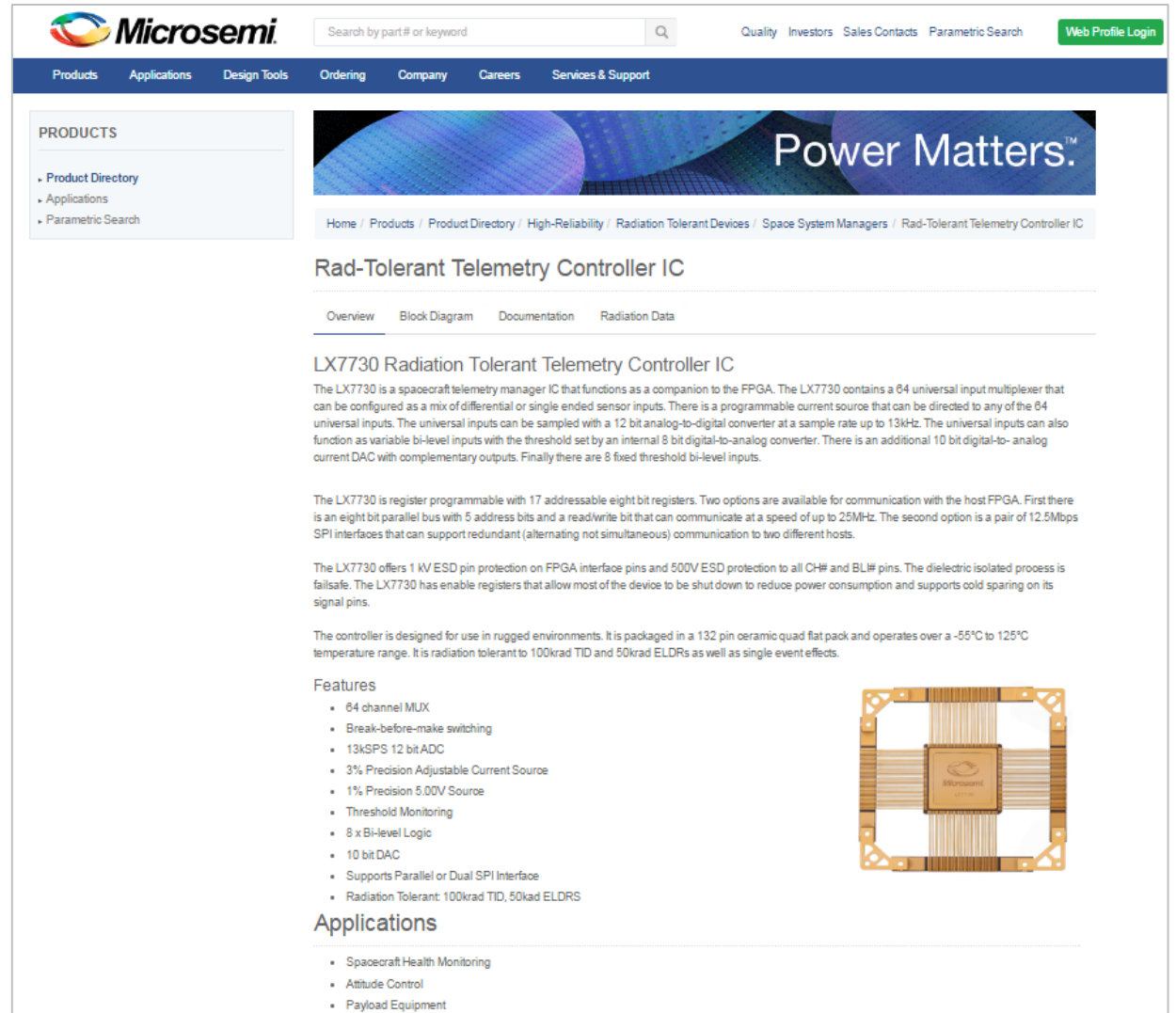
Product Webpage:

<http://www.microsemi.com/product-directory/space-system-managers/3575-telemetry-controller-ic>

Documentation Available:

- [LX7730 Datasheet](#)
- [LX7730 Application Note: Eval Board User Guide](#)
- [Analog Front End Integrated Circuits for Mixed Signal Spacecraft Applications](#)
- [LX7730 TID Report](#)
- [LX7730 Single Event Radiation Test Report](#)
- [LX7730 Grounding Architecture & Notes](#)
- [SSM Availability](#)
- [RADECS 2016 - Total Dose and Single Event Effects Hardening and Testing on Mixed Signal Telemetry LX7730 Controller](#)

For technical help, submit questions to AMSTech@microsemi.com



The screenshot shows the Microsemi website for the LX7730 Rad-Tolerant Telemetry Controller IC. The page features a navigation bar with links for Products, Applications, Design Tools, Ordering, Company, Careers, and Services & Support. A search bar is located in the top right. The main content area includes a 'PRODUCTS' sidebar with links to Product Directory, Applications, and Parametric Search. The main heading is 'Rad-Tolerant Telemetry Controller IC', with sub-links for Overview, Block Diagram, Documentation, and Radiation Data. The 'Overview' section provides a detailed description of the IC, its features, and its applications. A diagram of the IC package is shown on the right side of the page.

Microsemi Search by part# or keyword Quality Investors Sales Contacts Parametric Search [Web Profile Login](#)

Products Applications Design Tools Ordering Company Careers Services & Support

PRODUCTS

- Product Directory
- Applications
- Parametric Search

Power Matters.™

Home / Products / Product Directory / High-Reliability / Radiation Tolerant Devices / Space System Managers / Rad-Tolerant Telemetry Controller IC

Rad-Tolerant Telemetry Controller IC

Overview Block Diagram Documentation Radiation Data

LX7730 Radiation Tolerant Telemetry Controller IC

The LX7730 is a spacecraft telemetry manager IC that functions as a companion to the FPGA. The LX7730 contains a 64 universal input multiplexer that can be configured as a mix of differential or single ended sensor inputs. There is a programmable current source that can be directed to any of the 64 universal inputs. The universal inputs can be sampled with a 12 bit analog-to-digital converter at a sample rate up to 13kHz. The universal inputs can also function as variable bi-level inputs with the threshold set by an internal 8 bit digital-to-analog converter. There is an additional 10 bit digital-to-analog current DAC with complementary outputs. Finally there are 8 fixed threshold bi-level inputs.

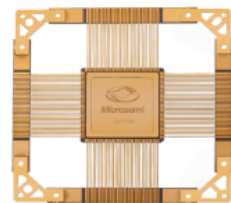
The LX7730 is register programmable with 17 addressable eight bit registers. Two options are available for communication with the host FPGA. First there is an eight bit parallel bus with 5 address bits and a read/write bit that can communicate at a speed of up to 25MHz. The second option is a pair of 12.5Mbps SPI interfaces that can support redundant (alternating not simultaneous) communication to two different hosts.

The LX7730 offers 1 kV ESD pin protection on FPGA interface pins and 500V ESD protection to all CH# and BL# pins. The dielectric isolated process is fail-safe. The LX7730 has enable registers that allow most of the device to be shut down to reduce power consumption and supports cold sparing on its signal pins.

The controller is designed for use in rugged environments. It is packaged in a 132 pin ceramic quad flat pack and operates over a -55°C to 125°C temperature range. It is radiation tolerant to 100krad TID and 50krad ELDRs as well as single event effects.

Features

- 64 channel MUX
- Break-before-make switching
- 13kSPS 12 bit ADC
- 3% Precision Adjustable Current Source
- 1% Precision 5.00V Source
- Threshold Monitoring
- 8 x Bi-level Logic
- 10 bit DAC
- Supports Parallel or Dual SPI Interface
- Radiation Tolerant: 100krad TID, 50krad ELDRS



Applications

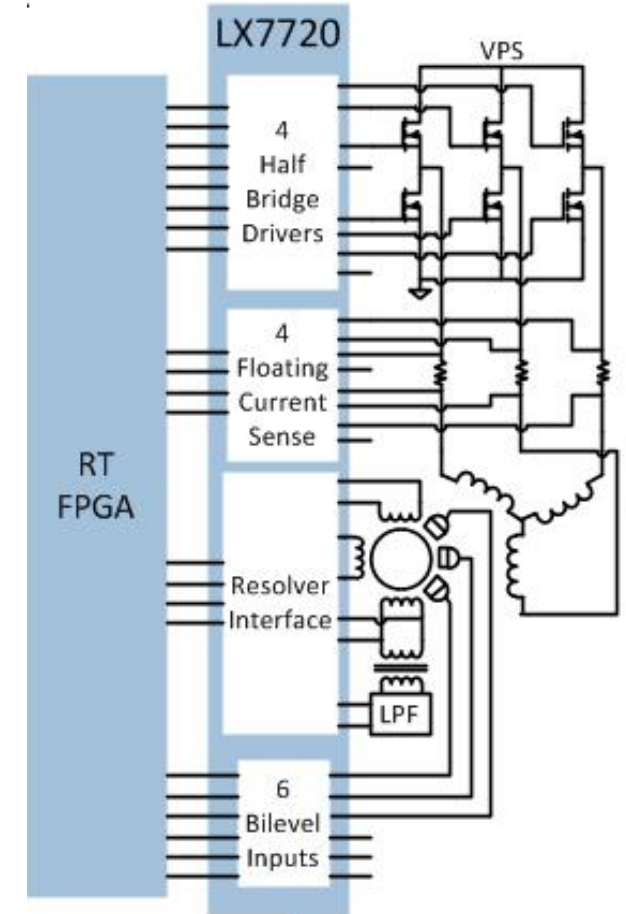
- Spacecraft Health Monitoring
- Attitude Control
- Payload Equipment

LX7720 Overview

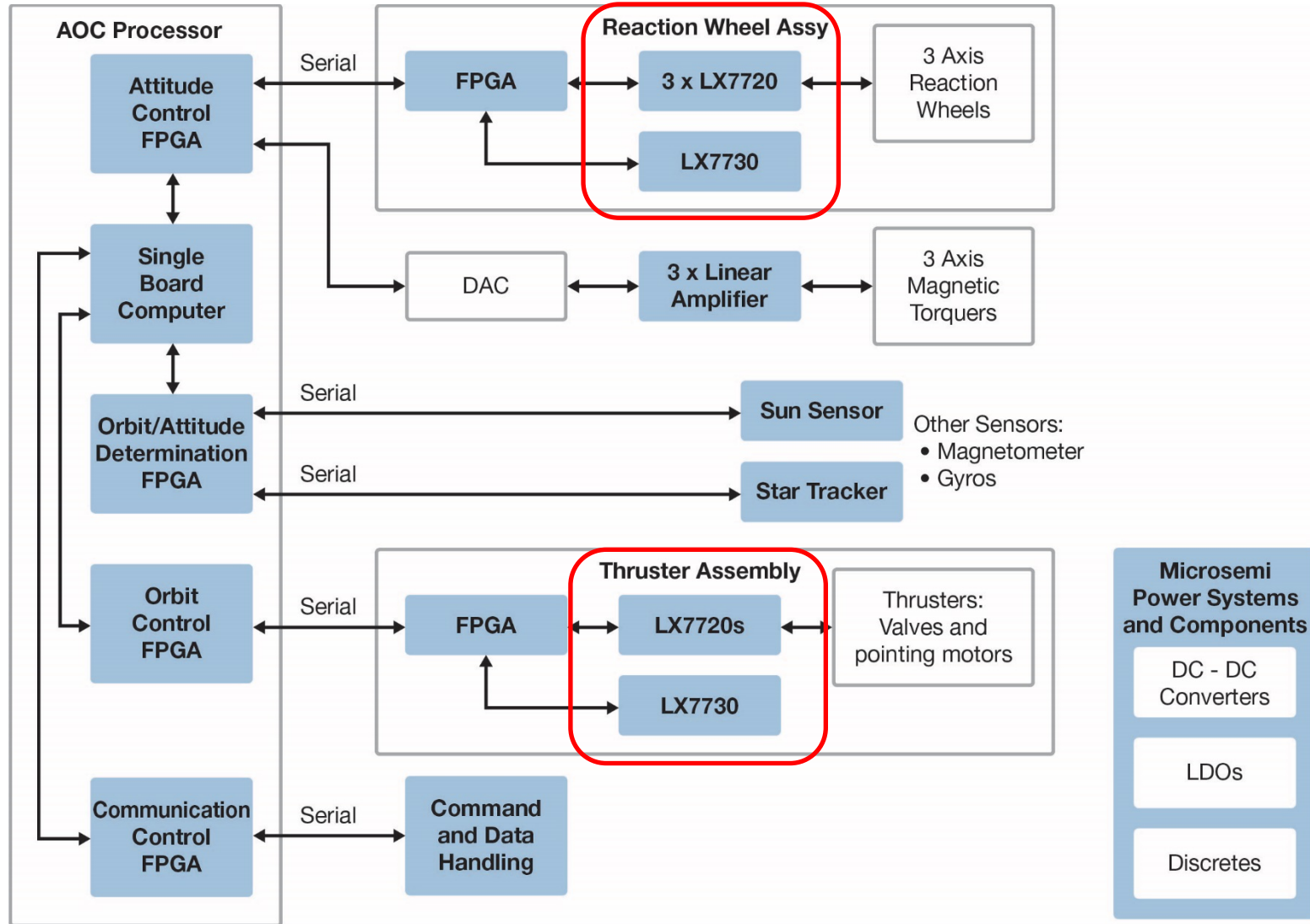
Power Driver with Rotation and Position Sensing

■ Features

- Four half-bridge N-ch MOSFET drivers
- Four floating differential current sensors
- Pulse modulated resolver transformer driver
- Three differential resolver sense inputs
- Six bi-level logic inputs
- Fault detection
- Radiation tolerant: 100 krad TID, 50 krad ELDRS
- Preliminary silicon sampled. Production silicon sampling October.



Attitude and Orbit Control Application



LX7720 Availability Update

Part Number	Silicon	Availability
LX7720-ES and DB	Engineering samples using production version silicon	CQ4 2017
LX7720MFQ-EQ	Production. Qual complete. Consult factory for lead times ARO*	CQ2 2018
LX7720MFQ-EV	Production. Qual complete. Consult factory for lead times ARO*	CQ4 2018

- Lead times ARO are 26–30 weeks.
- As with the LX7730, we will submit qual data and seek QML certification.
- Product numbers will change to LX7720MFQ-V and LX7720MFQ-Q once QML listing is given.

LX7720 Ordering Part Numbers

Part number	Description
LX7720MFQ-ES	Engineering samples.
LX7720MFQ-EQ	Built per QML-Q flow. This will convert to LX7720MFQ-Q once QML certification is achieved and parts will also be orderable by SMD number.
LX7720MFQ-EV	Built per QML-V flow. This will convert to LX7720MFQ-V once QML certification is achieved and parts will also be orderable by SMD number.
LX7720-DB	Daughter board for RTG4 development kit. Allows user to connect the LX7720 to the RTG4 FPGA dev kit and evaluate key functions.

LX7720 Support Material

Product Webpage:

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

Documentation Available:

- [LX7720 Full-Prelim Specification](#)
- [LX7720 Product Brief](#)
- [SSM Availability](#)
- [White Paper: Challenges of Designing a Radiation Tolerant Motion Control System on Chip](#)

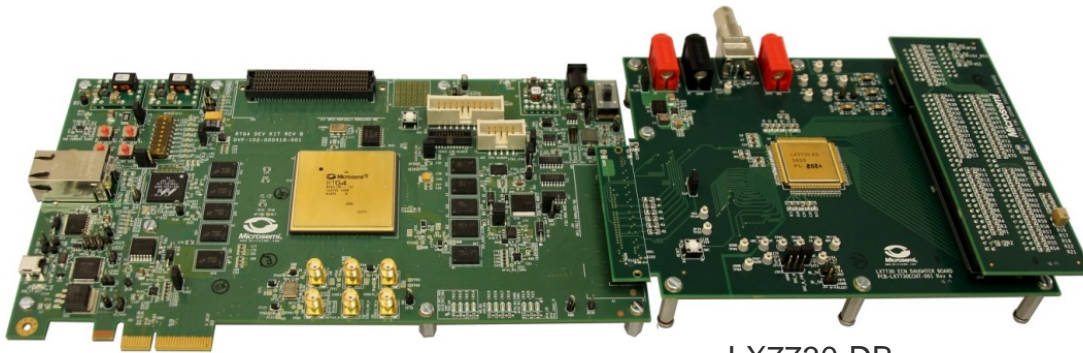
For technical help, submit questions to AMSTech@microsemi.com

The screenshot shows the Microsemi website for the LX7720 product. The header includes the Microsemi logo, a search bar, and navigation links for Quality, Investors, Sales Contacts, Parametric Search, and Web Profile Login. The main navigation bar lists Products, Applications, Design Tools, Ordering, Company, Careers, and Services & Support. The left sidebar shows a 'PRODUCTS' section with links to Product Directory, Applications, and Parametric Search. The main content area features a 'Power Matters.™' banner, a breadcrumb trail (Home / Products / Product Directory / High-Reliability / Radiation Tolerant Devices / Space System Managers / Rad-Tolerant Position Sensing and Motor Controller), and the product title 'Rad-Tolerant Position Sensing and Motor Controller'. Below the title are tabs for Overview, Product Highlight, and Documentation. The 'Overview' tab is active, displaying the product description: 'LX7720 Rad Tolerant Spacecraft Motor Controller with Position Sensing'. The text describes the device's capabilities, including four half-bridge drivers, six bi-level inputs, and support for various motor types. It also mentions the device's radiation tolerance and temperature range. A 'Features' section lists: Four half-bridge NCH MOSFET drivers, Four floating differential current sensors, Sigma-delta resolver transformer driver, Three differential resolver sense inputs, Six bi-level logic inputs, Fault detection, and Radiation Tolerant: 100krad TID, 50kad ELDRS, Single Event. An 'Applications' section lists: Motor driver servo control, Linear actuator servo control, and Stepper, BLDC, PMSM motor driver. The footer contains a link to the product page and a copyright notice for 2017 Microsemi Corporation.

Space System Manager Development Tools

Daughter boards for use with RTG4 Development Kit

Allows user to connect the LX7730 and LX7720 to the RTG4 development board and evaluate key functions.



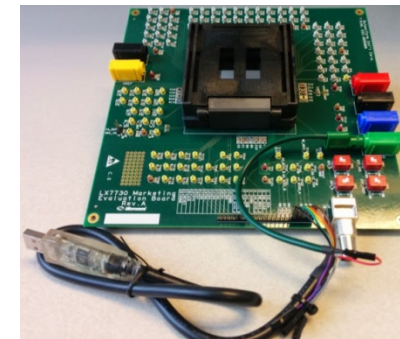
LX7730-DB



LX7720-DB

LX7730 Evaluation Board

Allows user to exercise LX7730 features when coupled with a USB to serial interface. Application software is provided and includes cable assembly.



In Production

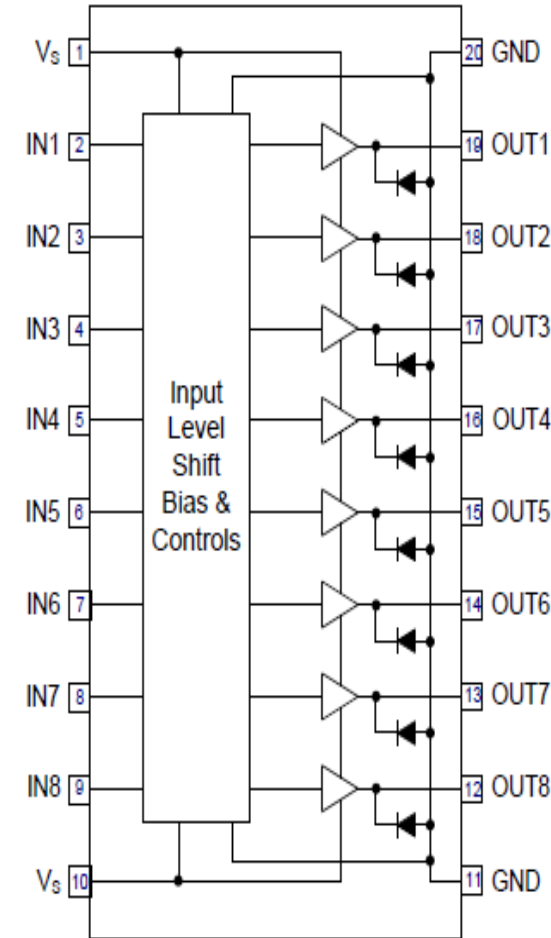
LX7798 (AAHS298B)—Rad Tolerant 8-Channel Source Driver

■ Features

- 700 mA per output source current
- Fully isolated channels with DI process
- 100 krad TID, SEL immune
- 80 V minimum output breakdown
- Low quiescent current consumption
- Internal ground clamp diodes
- Internal thermal shutdown
- TTL, 5 V, and 12 V logic compatible
- DLA certified with 4 SMDs
 - SMD 5962-1523101VXC, SMD 5962-1523101VYC(V)
 - SMD 5962-1523101QXC, SMD 5962-1523101QYC(Q)

■ Applications

- Relay/solenoid drivers
- Lamp/LED drivers
- Stepper and/or servo motor drivers



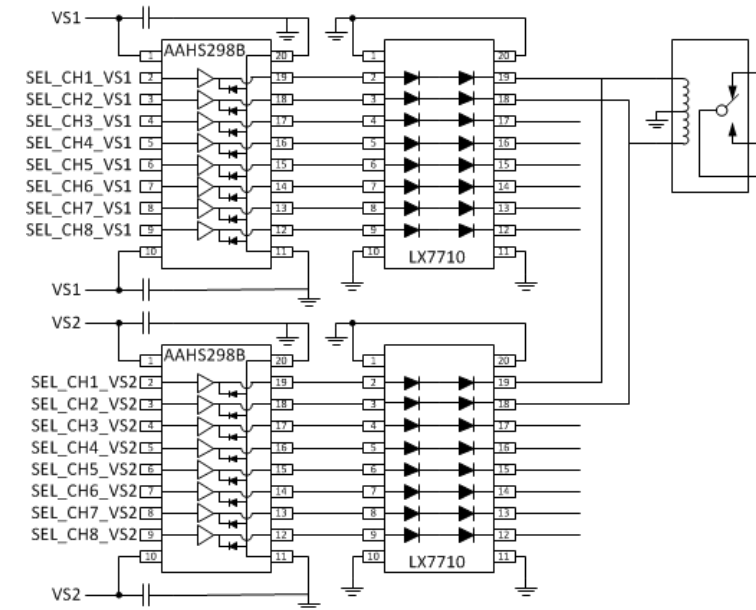
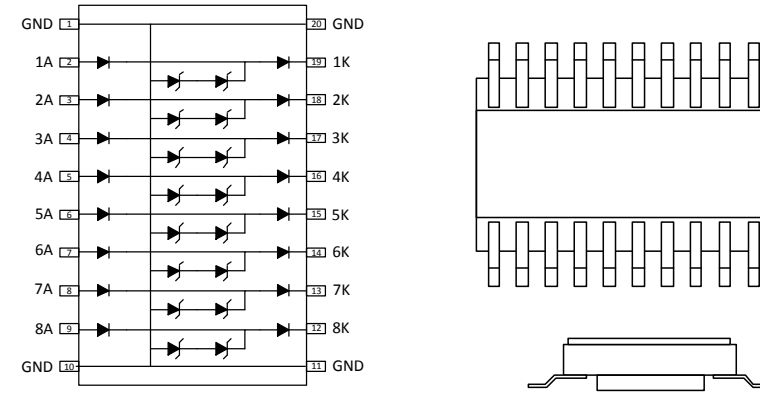
LX7710—Rad-Tolerant Octal Diode Array with Redundancy

■ Features

- 125 V min breakdown voltage
- 1 A current rating/diode
- 2800 mA combined rating
- Redundancy if one diode fails
- Discharge path for inductive kick
- -55 °C to 125 °C ambient
- 20 lead ceramic SOIC
- DLA certified
 - 5962-1621001QXC
 - 5962-1621001VXC

■ Applications

- Relay driver
- Uninterruptable power
- Redundant power sourcing
- Prevents channel backflow



Hi-Rel Industry Standard ICs—Overview

Linear Voltage Regulators

SG109	Positive, Fixed
SG117/SG117A	Positive, Adjustable
SGR117/SGR117A	Positive, Adjustable, Rad Hard
SG120/SG120A	Negative, Fixed
SG137/SG137A	Negative, Adjustable
SG140/SG140A	Positive, Fixed
SG723	Precision, Positive or Negative Adjustable
SG1532	Precision, Positive or Negative Adjustable
SG78xx/SG78xxA	Positive, Fixed
SG79xx/SG79xxA	Negative, Fixed

PWM Controllers

SG1524/SG1524B	Voltage Mode
SG1525A	Voltage Mode, Dual Sink/Source
SG1526/SG1526B	Voltage Mode, Dual Sink/Source
SG1527	Voltage Mode, Regulating, Dual Sink/Source
SG1529	Voltage Mode, Regulating
SG1731	DC Motor Controller
SG1825C	High Speed, Current Mode
SG1842	Off-line, Current Mode, 16V UVLO, 100% Max Duty Cycle
SG1843	Off-line, Current Mode, 8V UVLO, 100% Max Duty Cycle
SG1844	Off-line, Current Mode, 16V UVLO, 50% Max Duty Cycle
SG1845	Off-line, Current Mode, 8V UVLO, 50% Max Duty Cycle
SG1846	Current Mode, Dual Sink/Source

Linear Circuits

Interface	
SG2000 Series	Driver Array - 7 NPN
SG2800 Series	Driver Array - 8 NPN
MOSFET Drivers	
SG1626	Dual High-Speed, Inverting
SG1644	Dual High-Speed, Non-inverting
Op Amps	
SG143	High-Voltage, Low-Current
SG1436	High-Voltage, Low-Current
SG1536	High-Voltage, Low-Current, Low-Offset
SG2101	Dual, Compensated
Voltage Reference	
SG1503	Precision 2.5V Reference
Supervisory	
SG1543	Power Supply Output Control Circuit
SG1544	Low-Voltage Power Supply Output Control Circuit
SG1548	Quad Power Fault Monitor
SG1549	Current Sense Latch, 100mV Input Threshold, 180nS delay

SGR Product Offerings

Microsemi offers new radiation-tolerant enhancements to our popular industry-standard products: SGR1846, SGR1845, SGR117, and SGR137

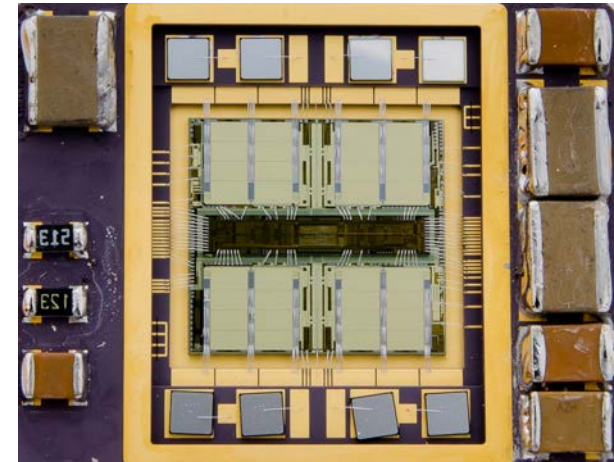
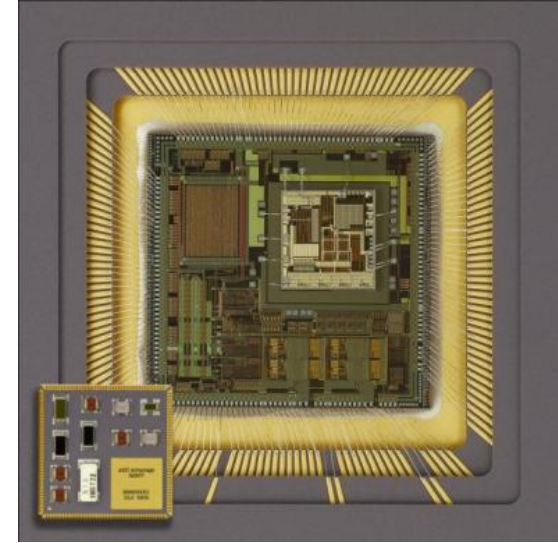
- Guaranteed radiation tolerance performance—(test data available)
 - TID to a minimum of 100 krad(Si)
 - ELDRS to a minimum of 50 krad(Si)
 - SEL immunity to a minimum of 87 MeV cm²/mg
- EV= Microsemi equivalent QML-V flow
- Fit, form, and function (FFF) equivalent of industry-standard SG product
 - Process change only*
 - No design change*
- No changes to SG product line. Still fully supported.
- Currently sampling and in production.

**The SGR117 is a design change from the SG117 and has extensive space heritage.*

Custom Capabilities

Custom Integrated Solutions

- Full custom designs from specification to production
 - 20 years of custom ASIC development
 - Expertise in Space and Aviation applications
 - Over 9 years of flight heritage
- Challenging operating conditions
 - Radiation tolerance by design for 100 kRad TID minimum, SEL/SEU immunity
 - Cold-sparing on I/Os for redundant applications
 - Extreme temperature environment (225 °C)
- Screening to MIL-PRF requirements
 - (Class Q, Class V, etc. as specified by customer)
- Custom packaging



Business Guidelines and History

Custom Development Rqmt

Development + production commit

Customer funded NRE

Strategic alignment

Technology alignment

Past Developments

RT telemetry controller

RT high-side drivers

RT motor controller with 2 A driver

RT RS485 transceiver

Aircraft LVDT controller

Navigation gyro controllers

Solid-state LED drivers

Solid-state circuit breakers

Pin-diode drivers

Solid-state relays

ARINC 429 TX/RX/ID

Cockpit light dimmers

5-MHz oscillator driver

15 A SiC JFET driver

MOSFET RF driver

55-MHz buffer amplifier

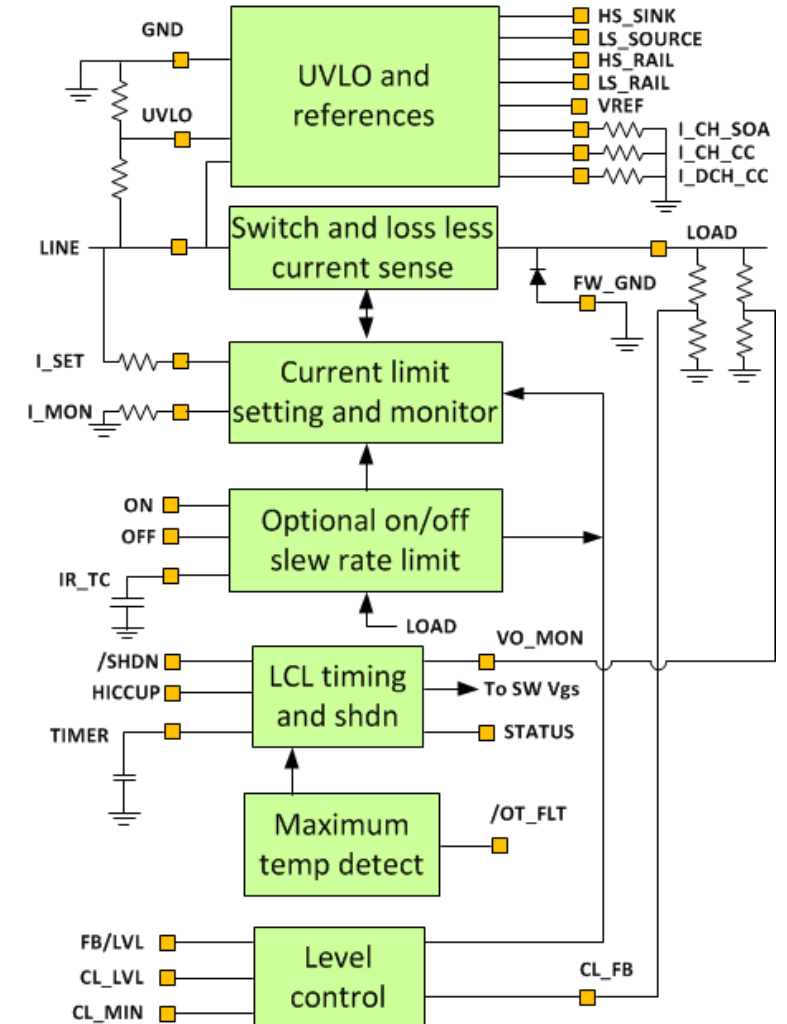
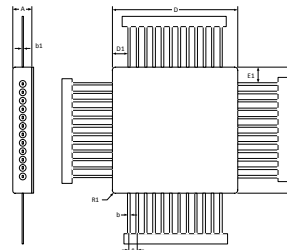
Log amplifier

What's Next? In-Development and Concept Products

LX7712: Power Line Protection Device

Latchable Current Limiter

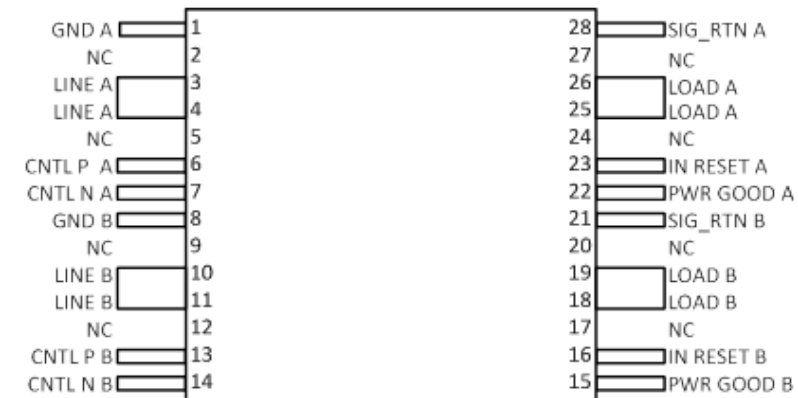
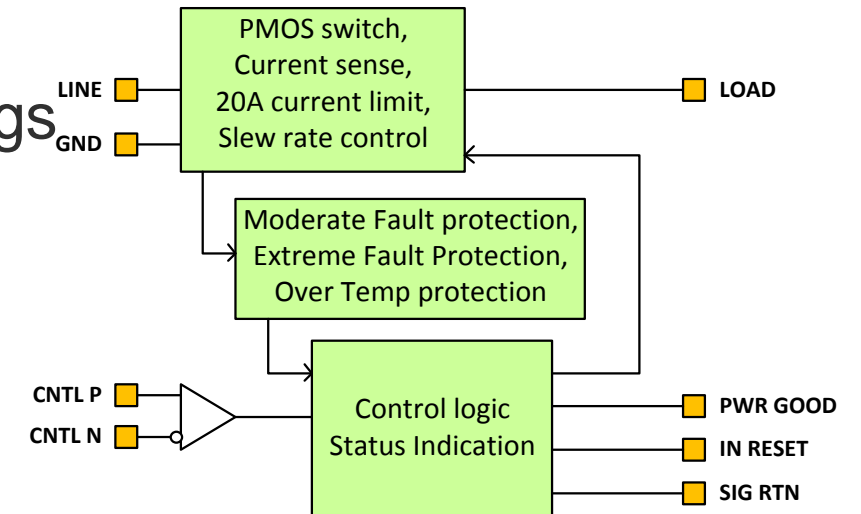
- Internal 5 A PMOS switch and diode
- 120 V rated
- LCL or FCL configurable
- ON, OFF, and STATUS pins
- Programmable UVLO and STATUS
- Parallel-able for higher currents
- Current limit and monitor
- Current slew rate limit: on and off
- Chip temp monitor
- 48-lead metal HTF package
- Test chip evaluated. In design



LX7714: RT Satellite Power Bus Controller

Resettable Fuse + Relay

- Internal 5 A/125 V rated power switch and fuse
- Mimics fuse melting point with 1, 2, 3, 4, or 5 A ratings
- Hiccup mode to enable recovery from shorts
- Efficient current sharing when paralleled
- Internal output rise time control
- LVTTL and TTL on/off control
- Power Good and In-Reset status telemetry
- Thermal shutdown for back-up protection
- 4 devices per package
- Radiation tolerant



New Mixed Signal ICs for Space Brochure

Topics covered:

- Leading Space Innovation for Sixty Years
- Space System Manager ICs
- Development Tools
- Radiation-Tolerant Source Drivers and Diode Arrays
- Radiation-Tolerant Voltage Regulators and PWM Controllers
- Custom Solutions for Space

Find it on our website at:

http://www.microsemi.com/index.php?option=com_docman&task=doc_download&gid=136900



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