FPGAs for Space Applications

Key Features

- Total Dose Capabilities Up to 1 Mrad
- Latch-Up Immune
- New Hardened SEU Latch Good to 74 LET th
- Device Capacities from 4,000 to 72,000 Available Gates
- Highly Reliable, Nonvolatile Antifuse Technology Meets the Most Stringent Quality Requirements
- Low Power Consumption

Uncompromising in the Extreme

For over ten years, Actel Corporation, the world's largest supplier of aerospace quality FPGAs, has been dedicated to providing designers of space applications with products that meet the stringent radiation and quality requirements of the space community. Actel continues to introduce new devices with improved radiation tolerance, higher speed, and increased density. The wide variety of Actel space products ensures that every space systems designer can find an Actel device to meet the most demanding system requirements.

Civilian/Scientific Exploration

Deep Space 1

Mars Pathfinder

Mars Surveyor

Mars ‘98

Mars ‘03, ‘05

Seawinds

SIRTF

HIRDLS

Lunar Prospector

GALEX

Genesis

TIROS

Landsat VII

EOS-AM1

EOS-PM1

EOS-CHEM 1

Cassini

TDRS

Space Shuttle

Hubble Space Telescope

GOES

Mars Climate Orbiter

International Missions

ACeS EnviSat

ATV

BIRD

Chandra

Cluster II

ETS VIII

Integral

International Space Station

L-Star

METOP

MTSat

N-Star

Poseidon

Rosetta

SILEX

SOHO

Stentor

Commercial Satellites

Echostar

FAISat

GE-1, 2, 3, 6, 7, 8

Globalstar

Ikonos II

Intelsat IX

Orbcomm

Orbview

SuperBird

Telstar

Military Satellites

Clementine

FSED

HESSI

Mighty Sat

SBIRS-High

SBIRS-Low

Launch Vehicles

Ariane

Atlas

Delta

EELV

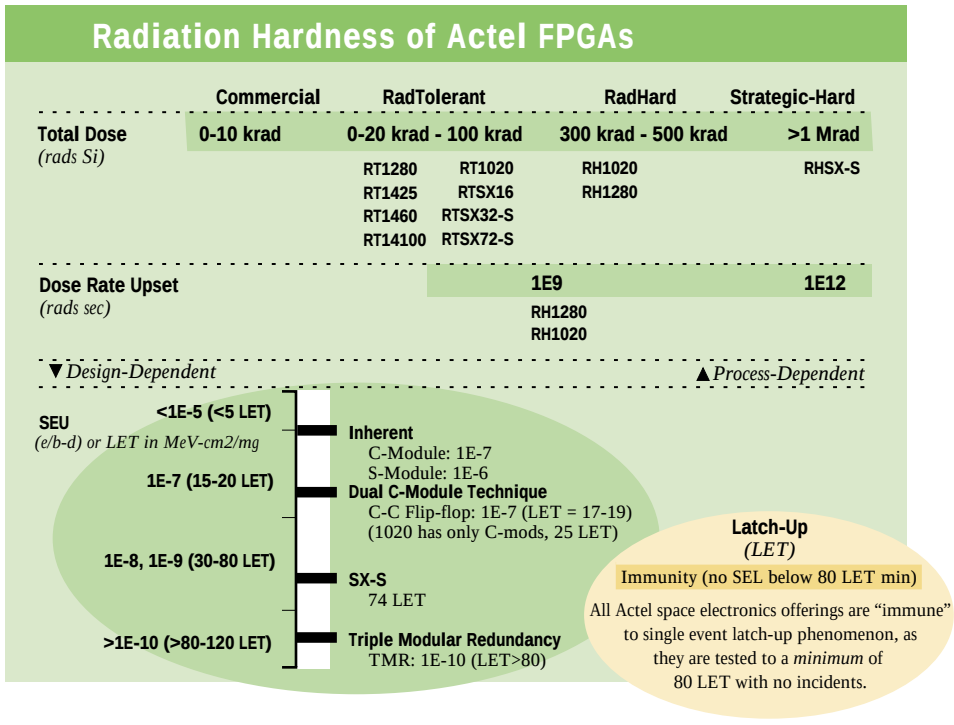
SeaLaunch

The Actel Space Heritage

From launch vehicles to commercial and military satellites, civilian exploration to deep space missions and high-flying aircraft, Actel is committed to being the leading supplier of radiation tolerant devices and is continuously designing, testing, and developing new and improved products for use in space. Since 1990, Actel has been designed into subsystems such as command and data handling, attitude reference and control, communication payload, and scientific instruments. Since the creation of Actel space-qualified FPGAs, they have been on board more than 100 launches and have been accepted for flight-unit applications on over 300 satellites. Actel is dedicated to providing space systems designers the necessary tools to get the job done.

RadHard FPGAs

Suitable for even the most flight critical functions, RadHard FPGAs are guaranteed to a minimum of 300 krads (Si), total dose, to satisfy the rigorous requirements of military and commercial satellite systems and sub-systems. RadHard devices are manufactured using the radiation-hardened processes at British Aerospace North America Space Electronics and Communications, in Manassas, VA. They are offered in a space level V/Q flow, combining Class V screening on the shippable units with the cost savings of generic QCI data. Two RadHard devices are currently available, the RH1020 and RH1280, both guaranteed to 300 krads (Si).



RadTolerant RT54SX-S FPGAs

The RT54SX-S family of devices offers the unique combination of programmable logic gates and additional SEU-hardened flip-flops (LET>74). The enhanced SEU practical immunity is achieved without consuming available programmable user gates for hardware TMR implementation or host CPU machine cycles for a software-based solution. The SEU-hardened flip-flops are not sensitive to place-and-route locations and offer immunity to disruptions over 100 krad (Si) Total Dose Immunity. This device allows users to employ conventional COTS software and conventional design techniques, eliminating the need for specialized design practices when designing for the space environment.

The RTSX-S family offers input buffers with four level selections, LVTTL, 3.3V PCI, 5.0V CMOS and 5.0V PCI/TTL with 2.5V core operation. Each input is selectable on an individual basis and is 5.0V tolerant. Output buffers can be individually selected to drive either 3.3V or 5.0V. During power-up, pull-ups and pull-downs are individually selectable. In addition, the I/Os have a "hot swap" and cold sparing capability. These features allow the RTSX-S family to be integrated with a combination of components with differing interface voltages. They also allow the devices to be turned off for minimal power consumption during long space missions, and activated only when their functionality is required for mission completion. Standby power is a low 72 mW.

Pin compatibility with the SX-A family enables prototyping to be completed with commercial SX-A devices, converting to RTSX-S family components to fly the mission.

Reliability Data	Device Hours @ temperature	FIT
1.0um CMOS FPGA	5.94E+08 Tj @ 55° C	12.36
0.8um CMOS FPGA	1.56E+08 Tj @ 55° C	12.95
0.6um CMOS FPGA (RTSX)	3.11E+07 Tj @ 55° C	4.95
0.35um CMOS FPGA	5.50E+07 Tj @ 55° C	16.67
0.25um CMOS FPGA	2.34E+07 Tj @ 55° C	39.12

RadTolerant FPGAs

A wide variety of RadTolerant devices are available from Actel for applications with total dose requirements up to 100 krads. Five RadTolerant devices are available, the RT1020, RT1280A, RT1425A, RT1460A, and RT14100A. Lot specific total dose radiation data and reports are available.

Pin Compatibility and Commercial Samples

From fully guaranteed RadHard devices to commercial prototypes, Actel offers extensive pin compatibility between FPGA families to address a variety of environmental and operational requirements. This pin compatibility also allows designers to begin their designs before the final environmental requirements are known, with easy migration to the appropriate device without a redesign.

Pin Compatibility

Rad hard	Rad Tolerant	Prototype
RH1020	RT1020	A1020B
RH1280	RT1280A	A1280A
	RT1425A	A1425A
	RT1460A	A1460A
	RT14100A	A14100A
	RT54SX16	A54SX16
	RT54SX32S/72S	A54SX32A/72A

Design Tools to Minimize SEU in Non SX-S Devices

To further support space system designers in applications not requiring the full capabilities of the RTSX-S family, Actel has created design tools to help minimize SEU rates in a design and ensure that design targets are met. This includes TMR support in ACTgen and a triple voting circuit in the Actel libraries. The RTSX-S family ranges in density from 32,000 to 72,000 typical gates, and offers system performance in excess of 250 MHz. Additionally, Synopsys and Synplicity design tools support both the TMR and Error Detection and Correction (EDAC) for the User SRAM implementation. And all tools allow block level design so designers can tune SEU for different functions and SEU requirements.

Quality and Reliability

All Actel RadHard and RadTolerant devices deliver reliable and secure performance through our nonvolatile antifuse technology. This one-time-programmable element configures the device in a fixed state, eliminating any chance of in-system downloading errors. For over a decade, Actel has been manufacturing devices for high reliability applications with ratings of less than 13 failures-in-time (FITs), corresponding to a useful life of more than 40 years. Actel Corporation has achieved ISO9002 and QML certification and has consistently maintained the highest quality standards for all of our devices. All subcontractors are required to meet stringent requirements prior to acceptance for use on Actel devices.

Design Tools

Design Environment

The RadHard and RadTolerant FPGA families are fully supported by Actel's line of FPGA development tools, including Actel Designer Software and Libero Integrated Design Environment (IDE). Actel's Designer software provides a comprehensive suite of back-end development tools for FPGA design. Designer software includes timing-driven place and route, a world-class static timing analyzer and constraints editor, a design netlist viewer, and SmartPower, a tool that allows the user to quickly estimate the power consumption in a design. Additionally, our back-annotation flow is compatible with all the major simulators and the simulation results can be cross-referenced with our Silicon Explorer II in-system probes. Another tool included in the Designer software is the ACTgen macro builder.

Libero IDE is a design management environment that streamlines the design flow. Libero IDE provides a design manager that seamlessly integrates design tools while guiding the user through the design flow, managing all design and log files, and passing necessary design data among tools. Additionally, Libero IDE allows users to integrate both schematic and HDL synthesis into a single flow and verify the entire design in a single environment. Libero IDE includes Synplicity's Synplify, Innoveda's ViewDraw for Actel, Actel Designer software, Model Technology's ModelSim HDL Simulator, and SynaptiCAD's WaveFormer Lite.

Programming

Programming support is provided through Actel's Silicon Sculptor II, a single-site programmer driven via a PC-based GUI. Programming with Silicon Sculptor II is as easy as pushing a button. There is minimal interaction between the device programmer and the user, which reduces the chances of error. Factory programming is also available for high-volume production needs.

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Actel Space Level Products		Speed Grade	Typical Gates	Logic Modules	Available I/Os	DSCC SMD
RadHard	RH1020-CQ84V	Std	4,000	547	69	5962F90965
	RH1280-CQ172V	Std	16,000	1,232	140	5962F92156
RadTolerant SX and SX-S	RT54SX16-CQ208	Std, -1	16,000	1,452	174	5962-99569
	RT54SX16-CQ256	Std, -1	16,000	1,452	179	5962-99569
	RT54SX32S-CQ208B	Std, -1	32,000	2,880	173	5962-01508
	RT54SX32S-CQ256B	Std, -1	32,000	2,880	227	5962-01508
	RT54SX72S-CQ208B	Std, -1	72,000	6,036	170	5962-01515
	RT54SX72S-CQ256B	Std, -1	72,000	6,036	212	5962-01515
RadTolerant	RT1020-CQ84	Std	4,000	547	69	None
	RT1280A-CQ172	Std, -1	16,000	1,232	140	5962-92156
	RT1425A-CQ132	Std, -1	5,000	310	100	5962-95520
	RT1460A-CQ196	Std, -1	12,000	848	168	5962-95508
	RT14100A-CQ256	Std, -1	20,000	1,377	228	5962-95521

For more information regarding Actel's FPGAs for Space Applications, please contact your local Actel sales representative.

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