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## Atmel Aerospace Integrated Circuits— Space Rad-Hard ICs



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## Company Experience

### Long-term Commitment to the Aerospace

For more than 26 years, Atmel has been a leading provider of highly integrated solutions to the **Aerospace Industry**. Thanks to its dual-use strategy, Atmel gives customers access to the latest commercial technology innovations through radiation hardening by design. The Atmel offering of Aerospace integrated circuits (ICs) is one of the **most attractive** and **competitive** on the market. It includes:

- From 0.18µm to 90 nm CMOS processes
- 180µm ASIC libraries
- 100 MIPS RISC rad-hard microprocessors
- 4-Mbit SRAM and EEPROM
- Memory modules
- SEU-hardened reprogrammable FPGAs

Thanks to advanced products, dedicated packaging (which supports stacked dies or module techniques), QML-certified lines and world-class quality, Atmel is paving the way to full-system integration and System On Chip. The complexity of future systems solutions requires partnership with government agencies and aerospace equipment manufacturers. Strong partnerships with these key market contributors enable Atmel to validate products/services in actual system environments. Atmel is committed for the long term to supporting the aerospace industry.

### Quality Management

The ultimate goal is to reach **full customer satisfaction** through a continuous improvement of Atmel products and services. To achieve this objective, Atmel has developed a Corporate Quality Management System that includes:

- A worldwide Quality Organization with dedicated resources for Space offerings
- A robust Corporate Quality System that, beyond the traditional ISO9001-V2000 registrations, complies either with MIL-PRF-38535 or ESCC-QML. Atmel facilities are fully QML qualified by the U.S. DSCC (Defense Supply Center Columbus) and the European Space Agency (ESA), covering a wide range of technologies, including the most advanced silicon and high pin count assembly techniques. This system is periodically ranked by the most demanding Aerospace customers, as well as prestigious national and international space agencies, such as ESA, CNES (Centre National d'Etudes Spatiales) and NASA (National Aeronautics and Space Administration)
- The Atmel 0.35µm ASIC is the first-ever ESCC-QML qualified process for space
- A policy of systematic Continuous Improvement, supported by state-of-the-art approaches, techniques and methodologies (self-assesmeny against Business Excellence models, "Six Sigma," Hoshin, etc.)
- Periodic reporting and review of actual performance by top management
- Customer satisfaction is regularly measured by using periodic business reviews, score cards and customer surveys



QML



ISO14001



ESCC

# Atmel Aerospace Integrated Circuits— Space Rad-Hard ICs

## Microprocessors for Space: Atmel Rad-Hard SPARC

Over the last 16 years, Atmel has been steadily building a space microprocessor strategy based on the SPARC® architecture. The single-chip Sparc V8 processor—the Atmel AT697—is the latest release developed with ESA support to serve the increasing demand for on-board processing.

The Atmel AT697F processor implements the LEON2-FT (Fault Tolerant) VHDL model owned by ESA. It includes a SPARC V8 Integer Unit, a Floating Point Unit, separate instruction and data caches, a PCI interface and a flexible memory controller that can interface with SRAM, PROM and SDRAM.

It delivers 90 MIPs and 23 MFlops at 100 MHz with a power consumption of 0.7W. The ratio between performance and power consumption reaches a value as high as 150 MIPs/W.

Based on the SPARC V7 architecture, the well proven TSC695F microprocessor is used in flight on most European missions, including scientific and telecommunication satellites, as well as moon and deep space probes. The TSC695F is the most widely used processor with more than 2300 flight models (FM) delivered worldwide, and the Atmel AT697 is following with more than 250 FM already delivered.



	TSC695F	TSC695FL	AT697E	AT697F
<b>Description</b>	32-bit SPARC Single-chip V7	32-bit SPARC Single-chip V7	32-bit SPARC Single-chip V8 LEON2-FT	32-bit SPARC Single-chip V8 LEON2-FT
<b>Performance</b>	≈ 20 MIPs/5 MFlops (double precision) @ SYSCLK = 25 MHz	≈ 12 MIPs/5 MFlops (double precision) @ SYSCLK = 15 MHz	85 MIPs @ SYSCLK = 100 MHz	90 MIPs @ SYSCLK = 100 MHz
<b>Consumption</b>	1.0W typ.@20 MIPs 0.7W typ.@8 MIPs	0.3W typ.@12 MIPs	0.7W typ.@100 MHz	0.7W typ.@100 MHz
<b>Operation Voltage</b>	4.5V to 5.5V	3.15V to 3.45V	1.65V to 1.95V (Logic) 3V to 3.6V (Buffers)	1.65V to 1.95V (Logic) 3V to 3.6V (Buffers)
<b>TID; Latch-up</b>	>300Krad; 70MeV/mg/cm <sup>2</sup>	>300Krad; 70MeV/mg/cm <sup>2</sup>	>200Krad; 90MeV/mg/cm <sup>2</sup>	>300Krad; 95MeV/mg/cm <sup>2</sup> @125°C
<b>Availability</b>	Now; ESCC & QMLV	Now; ESCC & QMLV	Now; QMLQ	Now; ESCC & QMLV

## Atmel AT697 Evaluation Board and Development Kit

To help designers in developing their applications, Atmel offers an evaluation board that includes:

- Demo-board with a Atmel AT697F engineering sample
- On-board Atmel rad-hard 4-Mbit SRAM (40-Mbits)

When delivered with the GRMON debug monitor, the evaluation board can be used as a development kit.

**Hotline:** [sparc-applab.hotline@nto.atmel.com](mailto:sparc-applab.hotline@nto.atmel.com)



Atmel AT697 Evaluation Board and Development Kit



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## Atmel Rad-Hard DSPs for Space

### Not For New Designs

For years, Atmel has been the only company to offer a DSP for space applications. The Atmel 32-bit floating point DSP TSC21020F is pin and code compatible with the ADI Product ADSP-21020, allowing for cost-effective and straightforward system development by using existing development tools and application algorithms. It features 32-bit single-precision and 40-bit extended-precision IEEE® floating-point data formats, and 32-bit fixed-point formats—integer and fraction—with 80-bit accumulators (Not for new designs).

**Hotline:** 21020-applab.hotline@nto.atmel.com

## Atmel 8032E Microcontrollers

### Not For New Designs

Part Number	Description	Availability
<b>80C32E</b>	80C51, Radiation Tolerant 8-bit ROMless Microcontroller	Now

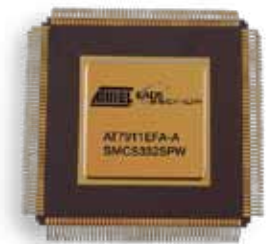
## Atmel Communication ICs

Atmel works with some of its key customers to make their ASIC designs available as standard ASICs when they correspond to commonly used functions on the market.

With this approach, Atmel offers space customers a set of SpaceWire dedicated products that make it possible to build a complete SpaceWire network based on rad-hard devices. These products include SpaceWire links High Speed Controllers (SMCS), a SpaceWire Router and a SpaceWire Remote Terminal Controller. Atmel also offers a CAN controller and the SCTMTC chip, which provides on-board telemetry and telecommand services via standardized interfaces.



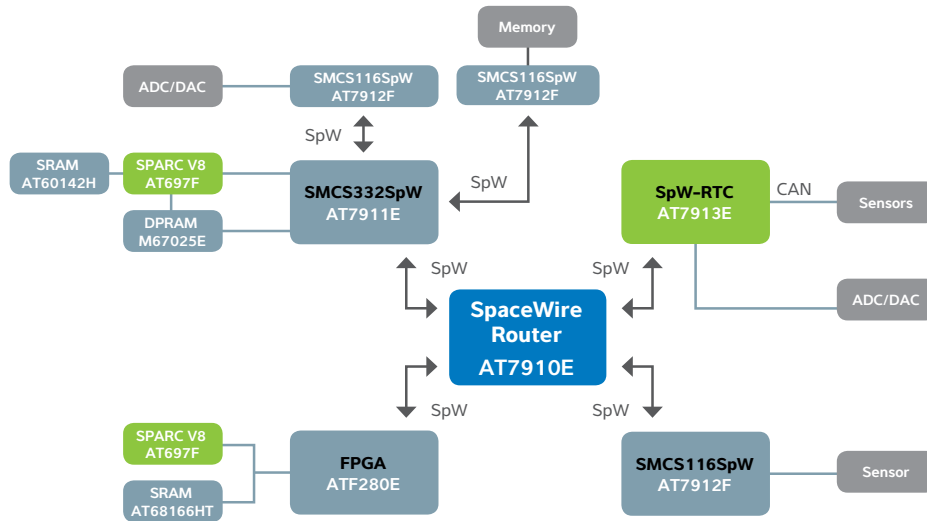
Atmel SMCS116SpW device



Atmel SMCS332SpW device

Part Number	Description	Availability
<b>29C516E</b>	16-bit Flow through EDAC Error Detection And Correction unit	Not for new designs
<b>TSS901E</b>	Triple Point-to-Point IEEE 1355 High Speed Controller (SMCS332)	Not for new designs
<b>AT7906E</b>	Single point-to-Point IEEE 1355 High Speed Controller (SMCS116)	Not for new designs
<b>AT7908E</b>	CAN Controller	Not for new designs
<b>AT7909E</b>	Single Chip TeleMetry and TeleCommand (SCTMTC)	Not for new designs
<b>AT7910E</b>	SpaceWire Router	Now
<b>AT7911E</b>	Triple SpaceWire links High Speed Controller (SMCS332SpW)	Now
<b>AT7912F</b>	Single SpaceWire links High Speed Controller (SMCS116SpW)	Now
<b>AT7913E</b>	SpaceWire Remote Terminal Controller	Now

# Atmel Aerospace Integrated Circuits— Space Rad-Hard ICs



SpaceWire Network based on Atmel Rad-Hard Products

## Memories for Space

Atmel has a long track record with memories (SRAM, DPRAM, FIFO and EEPROM), and its current offering supports the space industry's efforts regarding standardization of part variations with respect to:

- Size and format
- Package
- Power consumption and speed

Part Number	Type	Process Feature Size ( $\mu\text{m}$ )	Format	Operating Voltage (V)	Prime Speed Spec (ns/mA)	TID (Krad)	Package
M65608E	SRAM	0.6	128K x 8	4.5 – 5.5	30/130	30	FP32.4
M65609E	SRAM	0.35	128K x 8	3.0 – 3.6	40/50	300	FP32.4
AT60142HT*	SRAM	0.25	512K x 8	3.0 – 3.6*	17/170	300	FP36.5
AT60142H	SRAM	0.25	512K x 8	3.0 – 3.6	15/180	300	FP36.5
AT68166HT*	MCP SRAM	0.25	512K x 32	3.0 – 3.6*	20/170	300	MQFP68
AT68166H	MCP SRAM	0.25	512K x 32	3.0 – 3.6	18/180	300	MQFP68
M67025E**	DPRAM	0.6	8K x 16	4.5 – 5.5	30/200	30	MQFP84
M67204H**	FIFO	0.6	4K x 9	4.5 – 5.5	15/120	30	FP28.4
M67206H**	FIFO	0.6	16K x 9	4.5 – 5.5	15/120	30	FP28.4
M672061H**	FIFO with programmable HFF	0.6	16K x 9	4.5 – 5.5	15/120	30	FP28.4
AT28C010-12DK	EEPROM	0.6	128K x 8	4.5 – 5.5	120/80	30	FP32.4
AT17LV010-10DP	EEPROM	0.35	1M x 1	3.0 – 3.6	100/10	60	FP18.3
AT69170E	EEPROM	0.18	4M x 1	3.0 – 3.6	70/10	60	FP18.3
AT65647***	SRAM	0.09	1M x 40	3 – 3.6 (IO) 1 – 1.2 (Core)	15/500	300	MQFP 132
M65609EHV	SRAM	0.35	128K x 8	4.5 – 5.5	40/50	300	FP32.4
M65609EHW	SRAM	0.35	8K x 8	4.5 – 5.5	40/80	300	DIL28

\* 5V tolerant / \*\* Not for new designs / \*\*\* Availability 2012



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## Atmel ASICs for Space

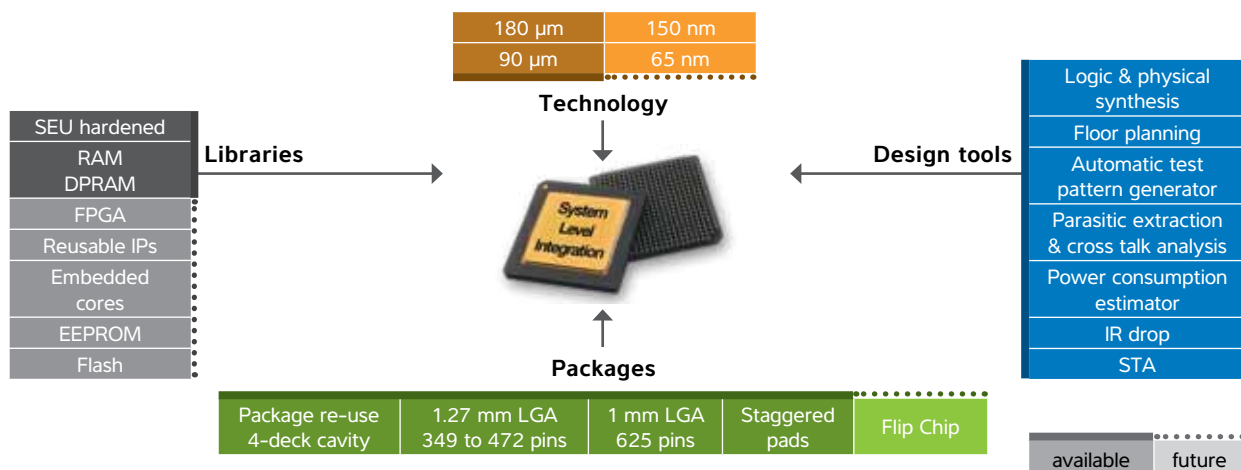
The Atmel Aerospace ASIC offering is enriched with new libraries each time the latest generation technology is introduced. As an example, the ninth generation of Aerospace ASIC technologies, the ATC18RHA series is a standard cell library characterized on the Atmel 0.18µm CMOS technology.

Combined with these libraries are multiple options for embedding dedicated blocks, as well as a large choice of complex hermetic packages. A MPW (Multi Project Wafer) service allows the users to lower the NRE.

	ATC18RHA	65µm (*)
<b>CMOS Process</b>		
Feature Size (µm)	0.18	0.065
Metal Layers	6	7
<b>Library</b>		
SoG/Std Cell Design Gates Complexity	Std Cell 6.5 M gates	Std Cell 20M gates
Used Gates/mm <sup>2</sup>	50K	800K
Pad Count	>900	>1000
I/O Libraries Supply	3.3/2.5V	1.8/2.5/3.3
Cell Libraries Supply	1.8V ± 0.15V	1.2V
Cold Sparring	Yes	Yes
Power Consumption (nW/gate/MHz)	10 @ 1.8V	0.5 @ 1.2V
NAND2 typ. prop. delay (ps)	100 @ 1.8V	70 @ 1.2V
<b>Rad Hardness</b>		
Functional TID (Krad)	300 @ 3.3V	100 @ 1.2V
Latch up (MeV/mg/cm <sup>2</sup> )	>95 @ 125°C	>95 @ 125°C
Availability	now	2013

\* Targets

The development of the tenth generation of space ASIC libraries is already on its way and will allow tackling the 20 M gates barrier, with more embedded features that will include, among others, very high speed serial links. Higher pin count packages will also be available.



Hotline: [aerospace@nto.atmel.com](mailto:aerospace@nto.atmel.com)

# Atmel Aerospace Integrated Circuits— Space Rad-Hard ICs

## FPGA Conversion

Converting to ASIC means benefiting from the technical advantages of ASICs, such as having a faster and smaller chip and lower power consumption while maintaining the original functionality. In the aerospace domain, it also means better reliability and radiation performance. Atmel is building a proprietary automatic FPGA Conversion offering aimed at fast bread boarding, optimized production performance and reduced cost.

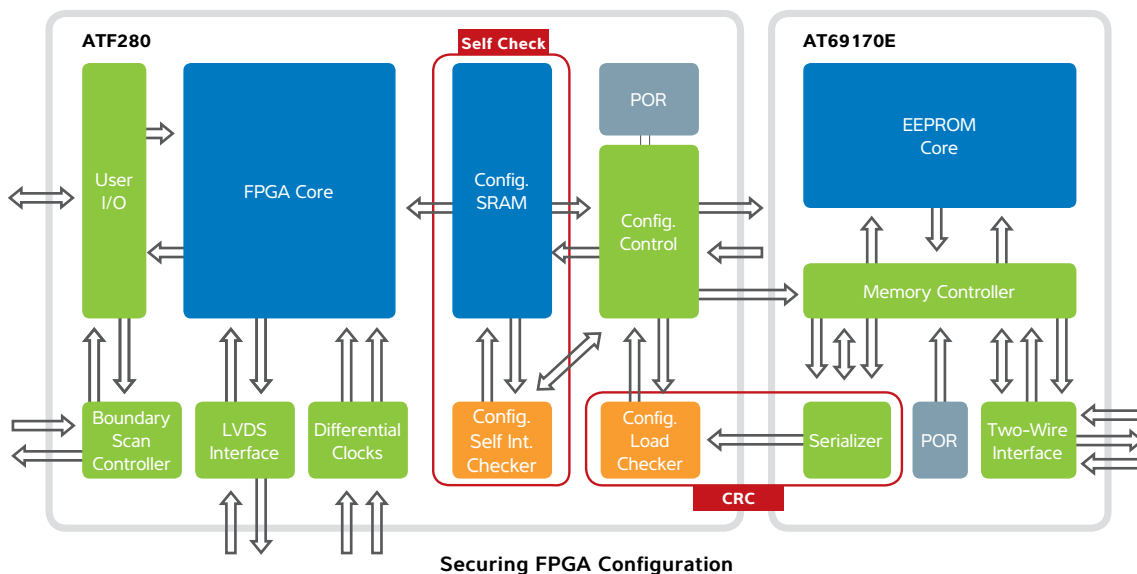
**Hotline:** [aerospace@nto.atmel.com](mailto:aerospace@nto.atmel.com)

## SEU-Hardened Reprogrammable FPGAs

For low gate count ASIC, the aerospace market trends toward FPGA. Capitalizing on its expertise in advanced architectures, Atmel offers new alternatives to the aerospace market with the reprogrammable FPGA series. These devices support an innovative built-in SEU protection, which allows users to design applications **without using mitigation techniques** that can triple FPGA design gate count. This approach saves expensive development resources and FPGA cost.

The Atmel FPGA series is specifically designed for compute-intensive DSP functions such as efficient and ultra-fast array multipliers. Being reprogrammable, multiple

design iterations can be implemented at no additional cost: i.e., post programming burn-in is not necessary, while spare and attrition parts can be used for new projects, thus saving huge costs. Atmel is achieving the architecture migration of the Atmel AT40KEL040 series on the 0.18  $\mu\text{m}$  rad-hard technology. This will allow an increase in complexity from 46K equivalent ASIC gates to 288K and the embedded memory from 18-Kbit to 115-Kbit. In addition, Atmel has added a new protection: a check of the FPGA configuration during its operation (Self Check in below figure). The Atmel ATF280 FPGA series is available now. An SOI version, which is SEU/SET-free and hosts 450K ASIC gates, will be available in 2011.



## Serial EEPROM for FPGA Configuration

	Process Feature Size ( $\mu\text{m}$ )	Format (bit)	Operating Voltage (V)	Packages	Availability
AT17LV010-10DP	0.35	1M x 1	3.0 – 3.6	FP28.4	Now
AT69170E	0.18	4M x 1	3.0 – 3.6	FP18.3	2012



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## Reprogrammable FPGAs for Space Applications

	AT40KEL040	ATF280	ATFS450 (*)
Core cells / HDFS	2304	14400	23104
Equivalent ASIC gates complexity	46K	288K	450K
I/O supply voltage (V)	3.0-3.6, 5V. tol.	3.0-3.6	3.0-3.6
Core supply voltage (V)	3.0-3.6	1.65-1.95	1.35-1.65
System Speed (MHz)	20	50	70
FreeRAM™ (bits)	18432	115200	184832
Packages (programmable IOs)	MQFPF160 (130) MQFPF256 (240)	MQFPF256 (150) MCGA472 (308)	MQFPF256 MQFPF352
LVDS	N.A.	8 Rx & 8 Tx	8 Rx & 8 Tx
Process Feature Size	0.35µm CMOS	0.18µm CMOS	0.15µm SOI
Quality Level	QMLQ/V & ESCC	QMLQ/V & ESCC	QMLQ/V & ESCC
Availability	Now	Now	2012

\*Co-development with JAXA and HIREC, Japan, using OSC Japan SOI technology (target).

## Atmel Design Kits

To help designers in developing their applications, Atmel offers a design kit for each series. These kits include an evaluation board with the FPGA and its configuration memory engineering samples, as well as the appropriate design and programming tools.

Description	Part Number
AT40KEL040 design kit (MQFP160 based)	AT40KEL-DK
MQFP256 adaptation kit for AT40KEL040 design kit	ATDH40D256M
ATF280 design kit	ATF280E-DK



Atmel ATF280F Design Kit

**Hotline:** [radhard-fpga@nto.atmel.com](mailto:radhard-fpga@nto.atmel.com)

**Atmel Corporation**  
2325 Orchard Parkway  
San Jose, CA 95131  
USA  
Tel: (+1) (408) 441-0311  
Fax: (+1) (408) 487-2600  
[www.atmel.com](http://www.atmel.com)

**Atmel Asia Limited**  
Unit 01-5 & 16, 19F  
BEA Tower, Millennium City 5  
418 Kwun Tong Road  
Kwun Tong, Kowloon  
HONG KONG  
Tel: (+852) 2245-6100  
Fax: (+852) 2722-1369

**Atmel Munich GmbH**  
Business Campus  
Parking 4  
D- 85748 Garching bei Munich  
GERMANY  
Tel: (+49) 89-31970-0  
Fax: (+49) 89-3194621

**Atmel Japan**  
9F, Tonetsu Shinkawa Bldg.  
1-24-8 Shinkawa  
Chuo-ku, Tokyo 104-0033  
JAPAN  
Tel: (+81) (3) 3523-3551  
Fax: (+81) (3) 3523-7581

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