

GR740 Development Status

GR740 User Day 2022

GR740 - Quad-core LEON4FT Processor



Quad-Core LEON4F7

System-on-Chip

Value proposition

- Highest performance, wide range of interfaces ٠
- Quad-Core LEON4: SPARC V8, Rad-hard and Fault-Tolerant
- Designed as ESA's Next Generation Microprocessor, NGMP ٠
- LEON Technology re-use of Development and Software ecosystem ۰
- SEU errors corrected without software interruption •
- Low risk, off-the-shelf product
- QML Q/V qualified ٠
- Excellent performance/watt ratio
 - Very low power, < 3 W (core typical) •
 - Performance 1700 DMIPS (1000 MIPS) •

Applications

- High-performance general-purpose processing
- Symmetric and asymmetric multiprocessing ٠
- Shared resources can be monitored to support mixed-criticality applications

For more information -> GR740 webpage



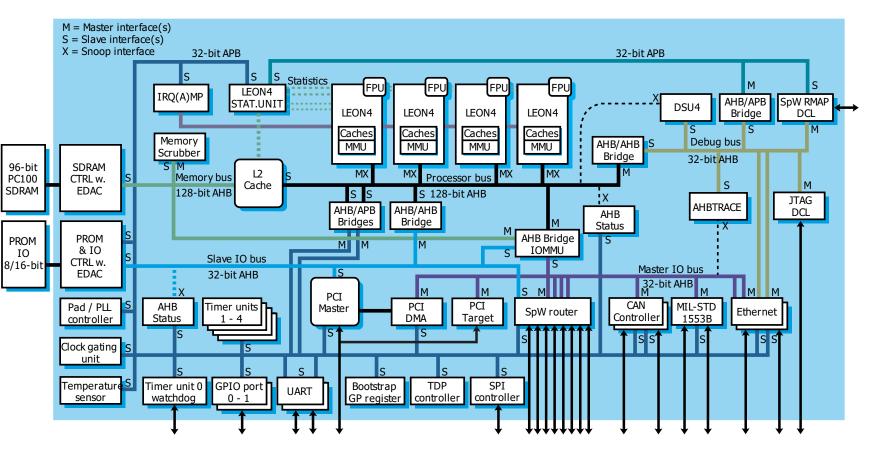


GR740 - Quad-core LEON4FT Processor



Features

- Fault-Tolerant quad-core LEON4 processor
 - SPARC V8 integer unit with 7-stage pipeline
 - 8 register windows
 - 4x4 KiB instruction and 4x4 KiB data caches, EDAC protected
- Double-precision IEEE-754 FPU (1 FPU/Core)
- 250 MHz system frequency
- >1700 DMIPS (1000 MIPS)
- Typical core power consumption < 3W
- 2 MiB Level-2 cache
- 64-bit PC100 SDRAM memory interface with Reed-Solomon EDAC
- 8/16-bit PROM/IO interface with EDAC
- CPU and I/O memory management units
- Multi-core and multi-thread support (SMP & AMP)
- Support for time synchronisation with SpaceWire TDP controller



Interfaces

- SpaceWire router with 8 SpaceWire links (300 MHz)
- 2x 10/100/1000 Mbit Ethernet interfaces
- MIL-STD-1553B interface
- 2x CAN 2.0 controller interface

- 2x UART, SPI, Timers and watchdog, 16+22 pin GPIO
- PCI Initiator/Target interface
- JTAG

GR740 - QML-V qualified!

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SCD V8

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European Space Agency

PIONEERING ADVANCED ELECTRONICS

GR740 - Quad-core LEON4FT Processor



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GR740 SMD: 5962- 21204	Quad- Core LEON4FT	250	>1700 *	300	> 125	< 2W at 40 °C*	625-Pin Ceramic Land Grid Array	-40°C / +125°C (junction)	QML Q/V	Now	
GR740 SMD: 5962- 21204	Quad- Core LEON4FT	250	>1700 *	300	> 125	< 2W at 40 °C*	625-Pin Ceramic Column Grid Array	-40°C / +125°C (junction)	QML Q/V	Now	<u>GR-CPCI-GR740</u> <u>GR-VPX-GR740</u>
GR740 PBGA	Quad- Core LEON4FT	250	>1700 *	300	> 125	< 2W at 40 °C*	625, PBGA	-40°C / +105°C (case)	ESCC-Q-60-13C class 2 evaluation ongoing	Prototypes availableFlight Models in LAT	

* For more information:

https://www.gaisler.com/doc/gr740/GR740-VALT-0010.pdf



GR-CPCI-GR740 and GR-VPX-GR740







Gaisler.com/GR-CPCI-GR740

Gaisler.com/GR-VPX-GR740



Software

- Complete ecosystem
- A combination of Gaisler and 3rd party software

Tool chains, Operating systems and compilers

- Bare-C
- Linux
- RTEMS
- VxWorks
- Zephyr

Partner software

Time-and-Space Partitioning:

- FentISS XNG
- SYSGO PikeOS
- Wind River VxWorks RTOS

Boot loaders

- GRBOOT
- GRBOOT-STANDBY
- MKPROM2

Development tools

TSIM3 simulator

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- GRMON3 debugger
- GCC compilers
- LLVM/Clang compilers







Imbedded Wi

RTEMS







GRMON 3.3 released in Q4 2022



GRMON 3.3 introduces C/C++ language debugging support in Graphical User Interface

- Based on Eclipse CDT and TCF familiar
- No dependency on GDB
- GDB still supported
- C/C++ source level debugging
 - Extended existing Views
 - New Views
 - Not in Command Level Interface
- C/C++ source code view
- Mixed Disassembly/C/C++ mode view
- C/C++ line execution control (step, step into, ..)
- Line breakpoints and watchpoint View
- C/C++ line display in Function call back trace
- C/C++ Variables View
 - Global Variables
 - Local stack frame Variables
- Symbols view listing global C/C++ symbols

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GRBOOT - Flight Software Boot Loader

GRBOOT is a flight system software suite targeting LEON based systems. It provides initialization, self-test and application loading functionality to payload and on-board computers

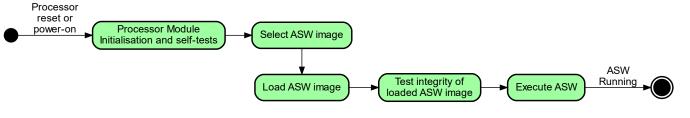
Features

- Implements ESA "SAVOIR Flight Computer Initialization Sequence" (SAVOIR-GS-002)
- Developed in accordance with ESA software engineering standards ECSS-E-ST-40C and ECSS-Q-ST-80C, criticality category B.
- Multiprocessor support (AMP, SMP)
- · Self-testing of external memory and internal caches, register files
- Support for user extension point
 - GRBOOT-STANDBY extension point based on SAVOIR Standby mode
 - Run application from extension point (ROM resident application)
- Loader with ASW image integrity check and fallback image(s)
- Generates Boot Report for ASW or external access
- Prepares environment compatible with multiple operating system:
 - RTEMS, VxWorks, Linux, PikeOS, BCC, SMP, AMP, etc.
- Support for GR740, GR712RC and UT700 devices (support for GR765 planned)
- Supports in-flight patching by ASW (ASW image not linked to boot loader)

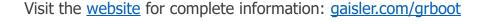
Test and validation

- Fully automated test suites
- Unit tests executing on target hardware and with TSIM3 LEON simulator.
- Code coverage captured using TSIM3 LEON
- Validation test suite executes on target hardware, checks software and system behavior













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GR740 Software Summary

- Major new items from CAES Gaisler
 - GRMON-3.3 C/C++ language debugging GUI integration
 - TSIM-3 TLIB for integration and improved GR740 models
 - RCC-1.3 RTEMS-5.1 stable release
 - VxWorks SR0650 support with improved GR740 driver support
 - New Linux 5.10 LTS kernel, GLIBC, toolchain and stand-alone buildroot
 - Common GCC-10 toolchain with DWARF4 support
 - STANDBY remote SpaceWire/PUS terminal
 - Zephyr RTOS support
- Ecosystem for GR740 evolving with new software becoming available
- Thanks to partners and 3rd parties for the added value
- Sign up to <u>CAES Gaisler Newletter</u> for updates





GR740 Development Status



Completed:

- Activities from specification to QML-V approval
 - Final presentation with qualification results and lessons learned: https://escies.org/download/webDocumentFile?id=68442
- GR740 plastic package development completed
- Two capable developments boards available

Development does not stop here:

- Increased allocation of product marketing and engineering resources to improve and expand collateral
- GR740 evaluation board development in progress
- Continuous extensions and improvements of the software ecosystem – GR740 also benefiting from efforts put into successor components
- Lessons still being learned from users designing with the GR740, leading future app and technical notes

