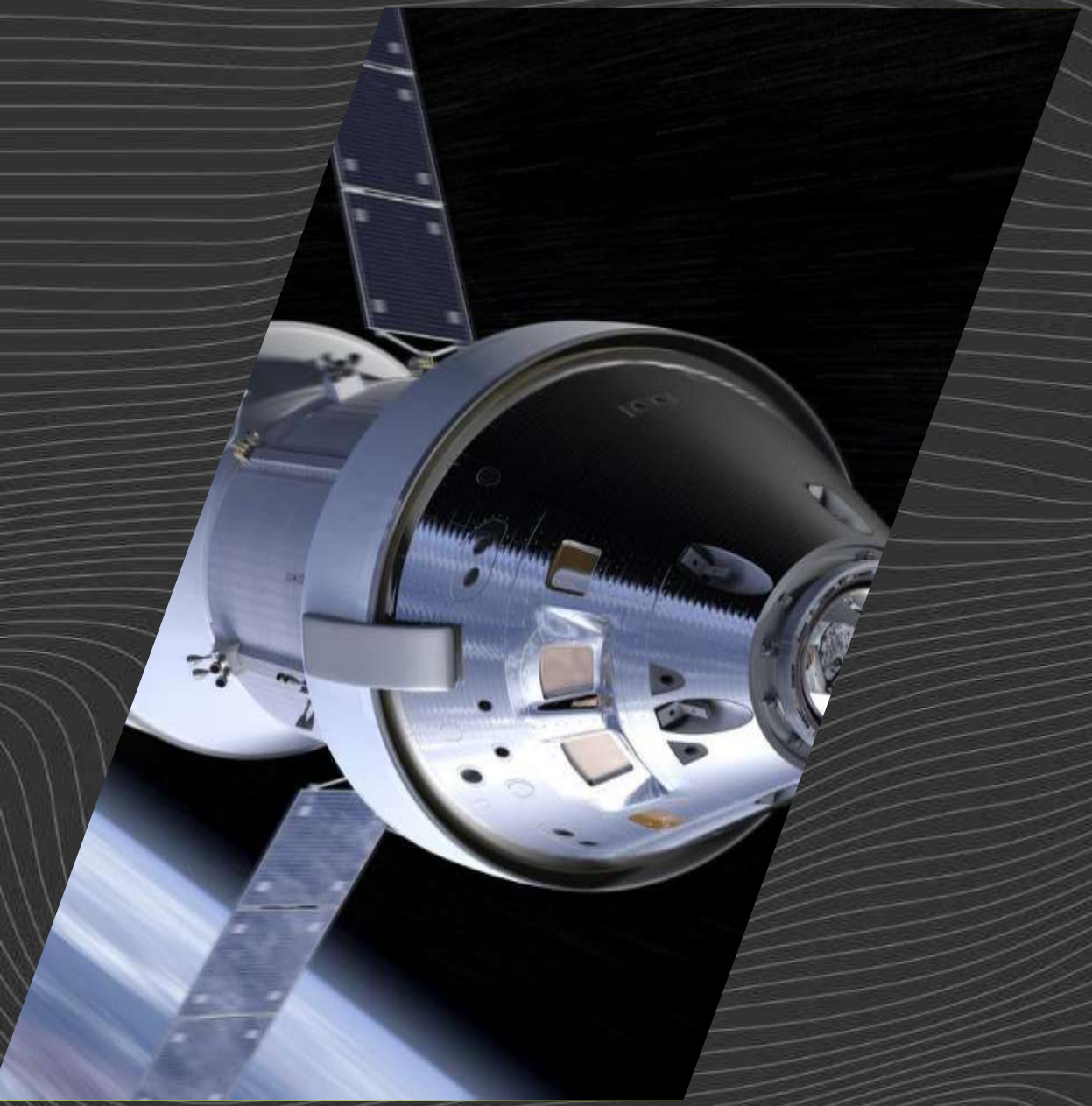


CAES PIONEERING ADVANCED ELECTRONICS

GR740 Development Status

GR740 User Day 2022

GR740 - Quad-core LEON4FT Processor

Value proposition

- Highest performance, wide range of interfaces
- Quad-Core LEON4: SPARC V8, Rad-hard and Fault-Tolerant
- Designed as ESA's Next Generation Microprocessor, NGMP
- LEON Technology – re-use of Development and Software ecosystem
- SEU errors corrected without software interruption
- Low risk, off-the-shelf product
- QML Q/V qualified
- 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
- Shared resources can be monitored to support mixed-criticality applications

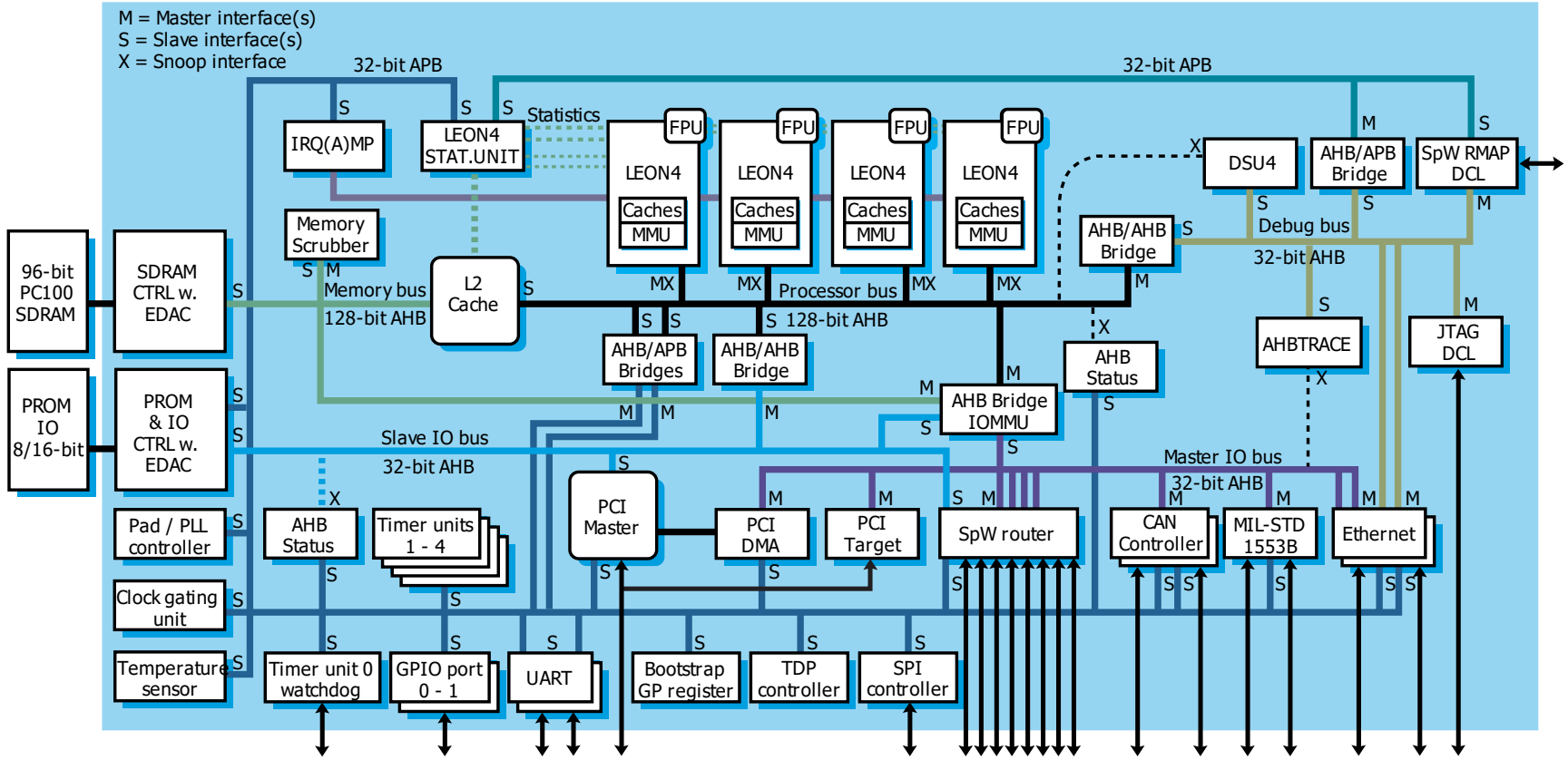
For more information -> GR740 webpage

GR740 - Quad-core LEON4FT Processor

CAES PIONEERING ADVANCED ELECTRONICS

Features

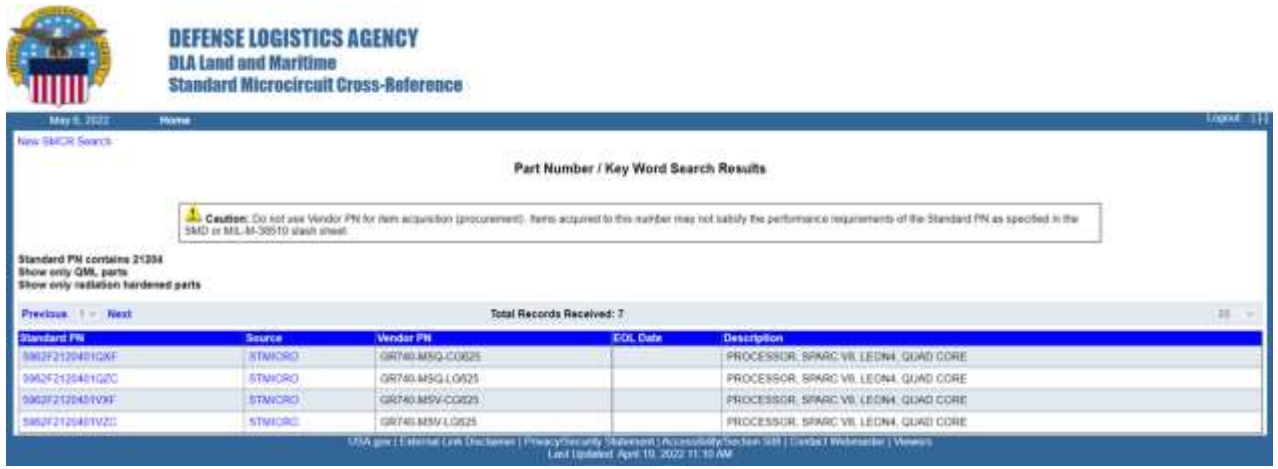
- Fault-Tolerant quad-core LEON4 processor
  - SPARC V8 integer unit with 7-stage pipeline
  - 8 register windows
  - 4x4 KiB instruction and 4x4 KiB data caches, EDAC protected
- Double-precision IEEE-754 FPU (1 FPU/Core)
- 250 MHz system frequency
- >1700 DMIPS (1000 MIPS)
- Typical core power consumption < 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!



esa

LEON

SPARC Compliant SCD V8

GR740 - PBGA available

ESCC-Q-60-13C class 2 screening and lot acceptance tests ongoing

European Space Agency

GR740 - Quad-core LEON4FT Processor

Part no.	Processor core	Clock freq. (MHz)	Perf. (DMIPS)	TID krad (Si)	SEL LET (MeV-cm^2/mg)	Power cons.	Package	Temp. range	Qualification status	Availability	Development board
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	GR-CPCI-GR740 GR-VPX-GR740
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	
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 available • Flight 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

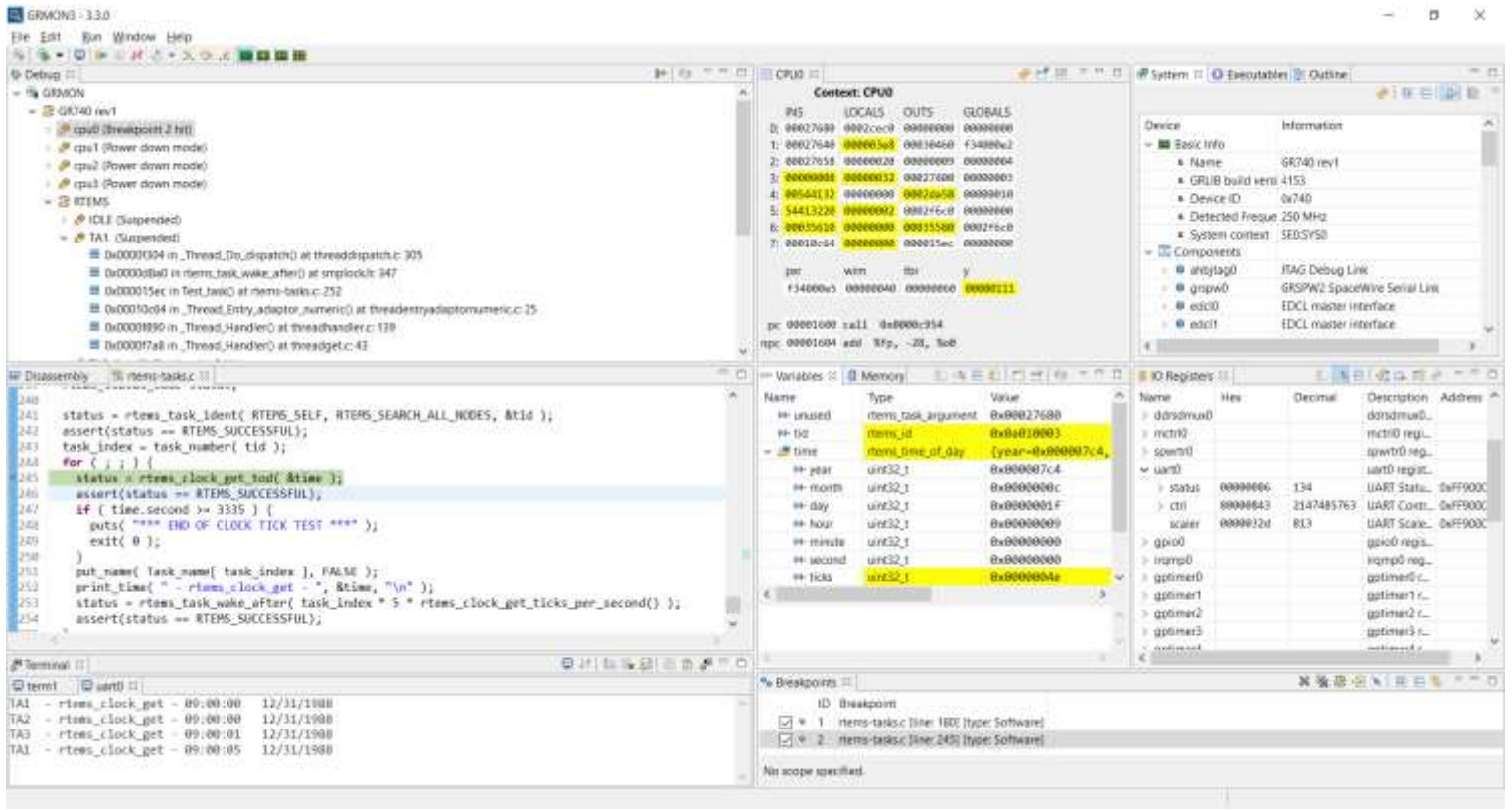
Development tools

- TSIM3 simulator
- GRMON3 debugger
- GCC compilers
- LLVM/Clang compilers

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



debugging made easy

GRBOOT - Flight Software Boot Loader

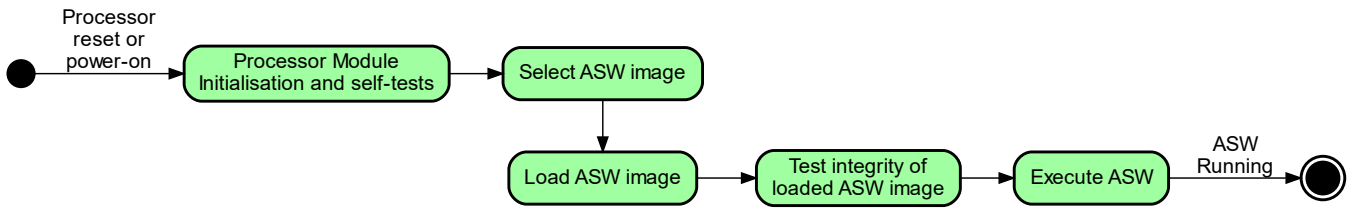
GRBOOT is a flight system software suite targeting LEON based systems. It provides initialization, self-test and application loading functionality to payload and on-board computers

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



GRBOOT boot sequence

Visit the website for complete information: gaisler.com/grboot

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 CAES Gaisler Newletter for updates

GR740 USER DAY | 2022

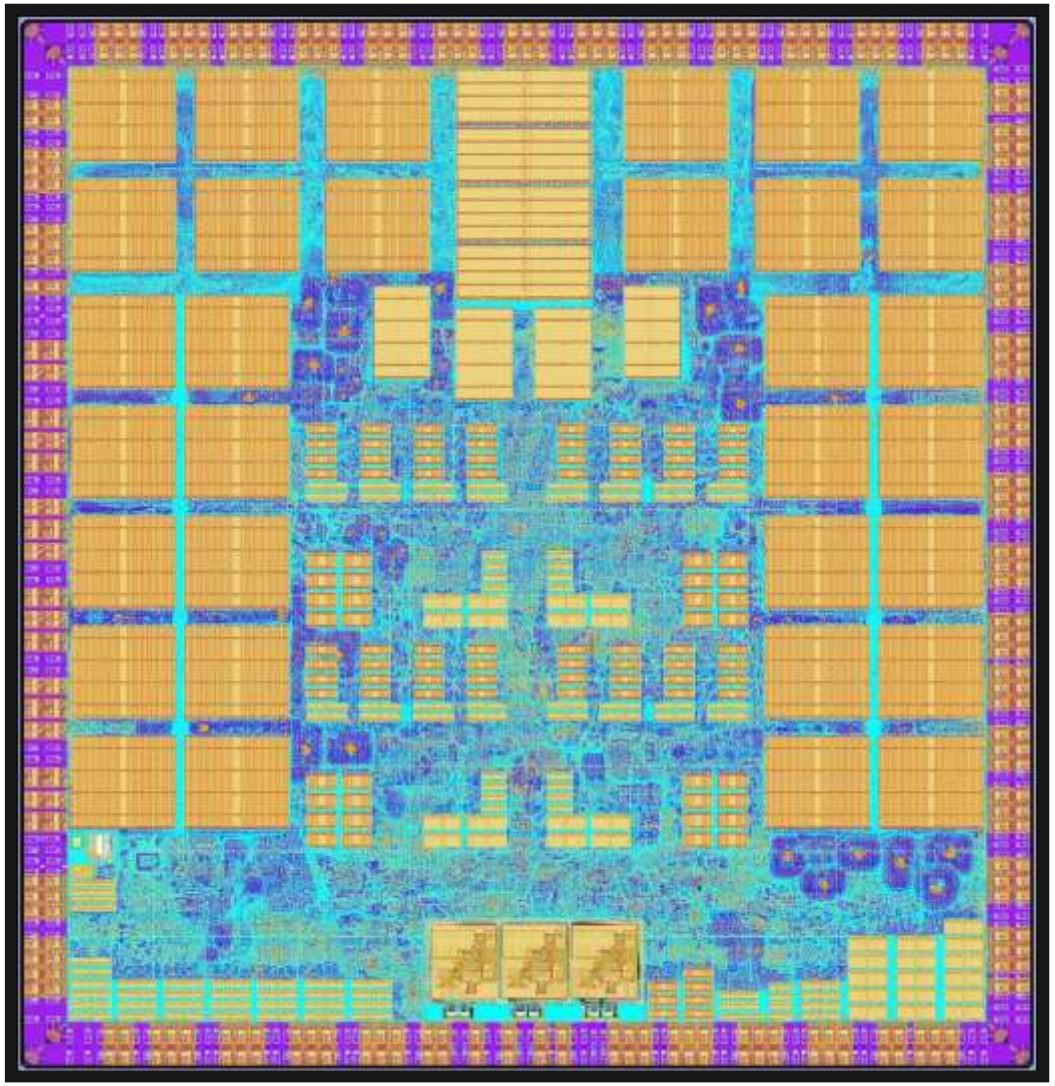
GR740 Development Status

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




CAES
PIONEERING ADVANCED ELECTRONICS