

Mixed-Signal Solutions for Space



A Leading Provider of Smart, Connected and Secure Embedded Control Solutions



SMART | CONNECTED | SECURE

A banner for the AMICSA 2025 workshop. The background is a deep blue space scene with a satellite in orbit and the Earth's horizon. The ESA logo is centered. Text on the right provides event details, and the Microchip logo is in the bottom right corner.

AMICSA
June 16–18, 2025
10th International Workshop on
Analogue and Mixed-Signal Integrated
Circuits for Space Applications
Rectorate of NOVA University
Lisbon, Portugal
Booth 1



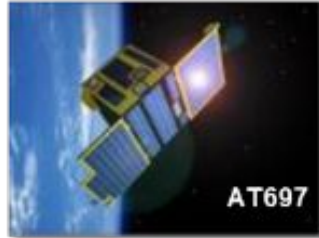
Mixed-Signal Solutions for Space

- **Microchip in Europe: Products and Competencies for Space**
- **Scalable Solutions for Space Applications**
- **Mixed Signals Microcontroller Overview**
- **Typical Mixed Signal Applications**

Processing: An Unrivalled Flight Heritage



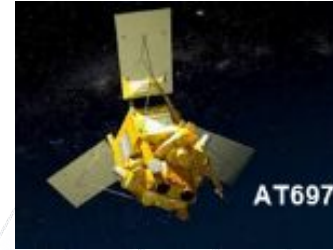
Colombus
2008



Proba2
2009



JUNO (Nasa)
2011



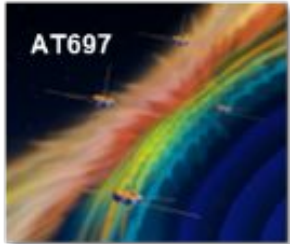
SPOT6
2012



Sentinels &
Alphasat
2013



SVOM/Eclair
2013



MMS (Nasa)
2014



Exomars
2016



Solar Orbiter
2017



Bepi-Colombo
2018



Perseverance 2021



Mega Constellation
LEO Sat -2019



ASBM 2024



IRIDE 2025

Thousands of flight models
delivered worldwide



Capella Sequoia
Earth Obs 2020



ANGELS Nanosat
2020

A&D Product Lines in Europe



- **ADG France**
 - Processors and Microcontrollers
 - Com Interfaces and Memories
 - ASIC Mixed Signals

- **DPG France**
 - Power Modules

- **DPG Ireland**
 - Hi-Reliability Discrete
 - Power Modules

- **Vectron Germany**
 - Oscillators
 - RF SAW Filters

- **RF Microwave UK**
 - Amplifiers

- **Advanced Packaging UK**
 - Size, Power and Reliability



Nantes, France



Rousset, France



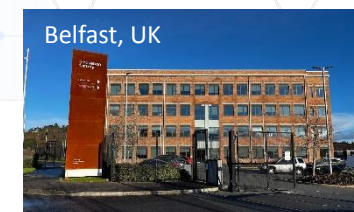
Bordeaux, France



Ennis, Ireland



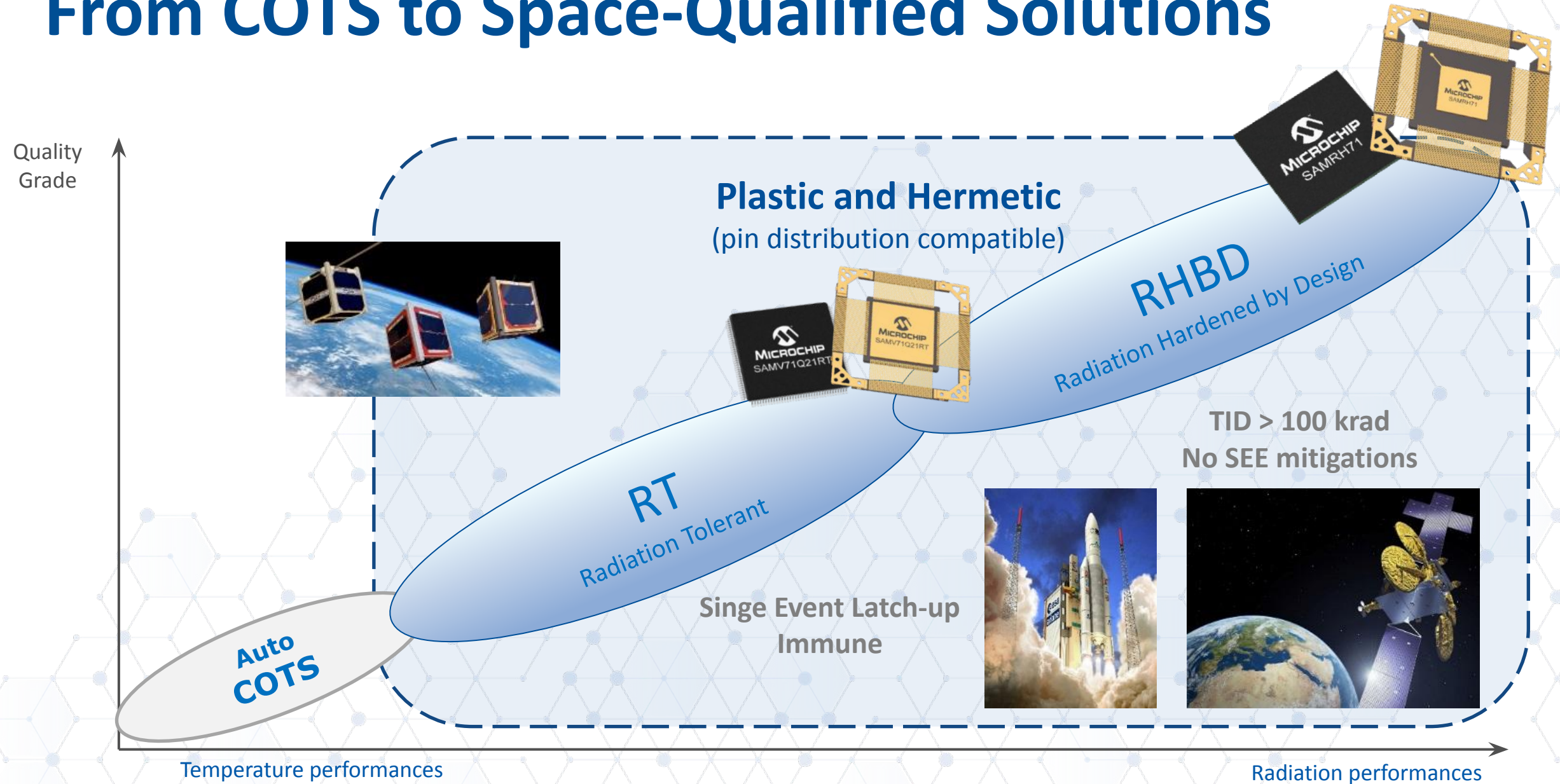
Teltow & Neckarbischofsheim, Germany



Belfast, UK

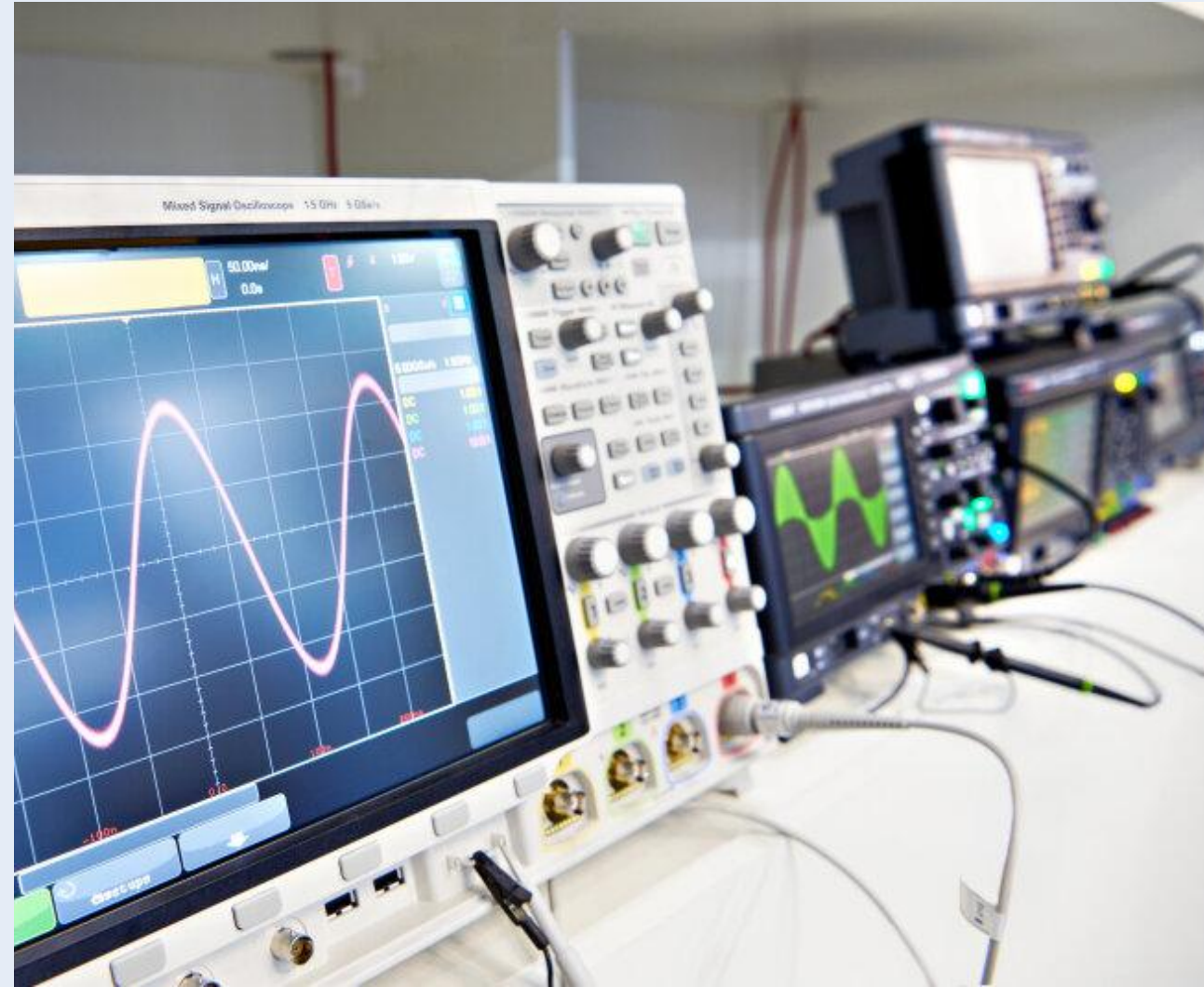


From COTS to Space-Qualified Solutions



Mixed-Signal Microcontrollers (MCUs)

- Mixed-signal microcontrollers advantages in space applications:
 - Integration of analog and digital functions
 - Reduced power consumption
 - Enhanced signal processing
 - Simplified design and development
 - Improved reliability
 - Cost efficiency



SAMRH707 Rad-Hard MCU

ES Available
FM Available

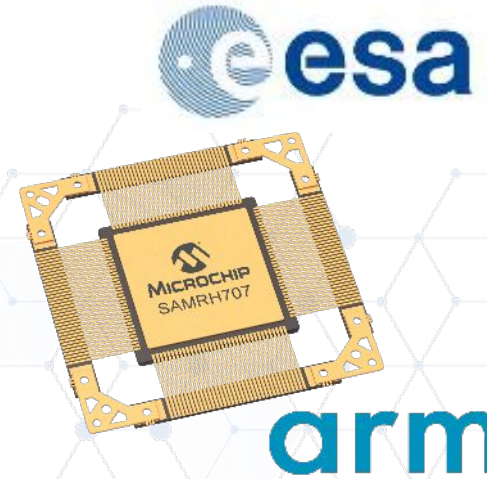
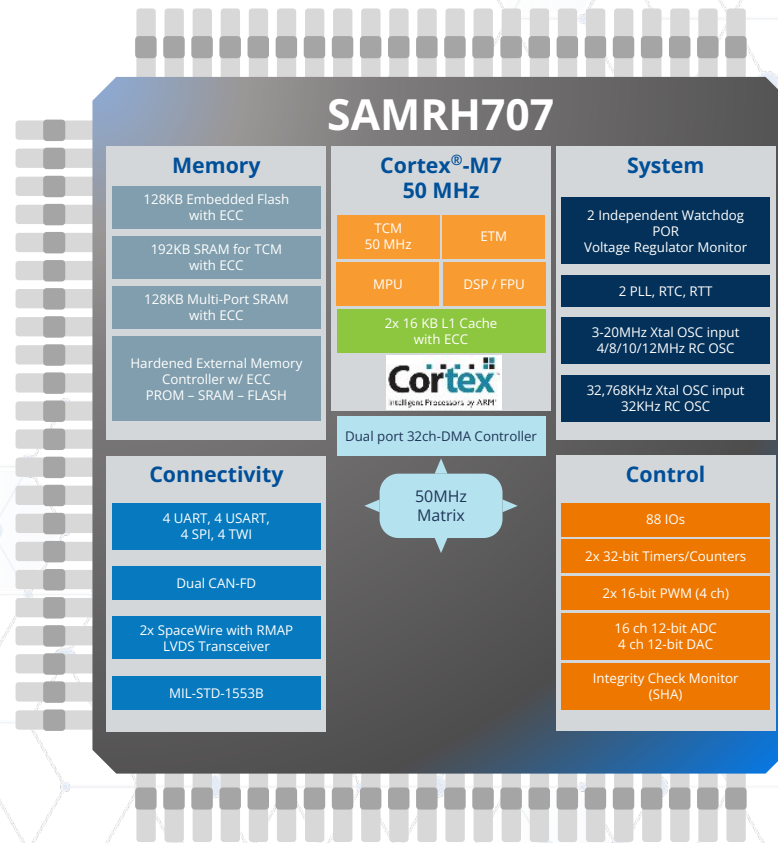
128KB Flash
320KB SRAM
(192KB TCM)
Int/Ext Mem

ECC
ECC
ECC
ECC

- SEL immune up to 78Mev.cm2/mg
- TID >100 krad, Embedded Flash at 40 krad
- SEU LET >30Mev.cm2/mg, Xsection <10⁻⁹ cm2/word
- No SEFI, No Flash SBU nor MBU

•CQFP 164
•BGA 484

-55°C / +125°C



>100 DMIPS
TCM / MPU / ICM
FPU / DSP
Dual CAN FD
SpaceWire 200Mb x2
Mil Std 1553 BC/RT
Analog integration
ADC and DAC 12-bit

SAMD21J17RT Radiation-Tolerant MCU

Arm® Cortex®-M0+ MCU

128 kB Flash
16 kB SRAM
52 GPIOs

Small package
QFP64

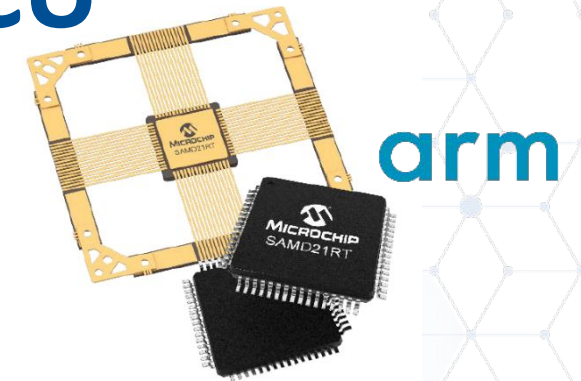
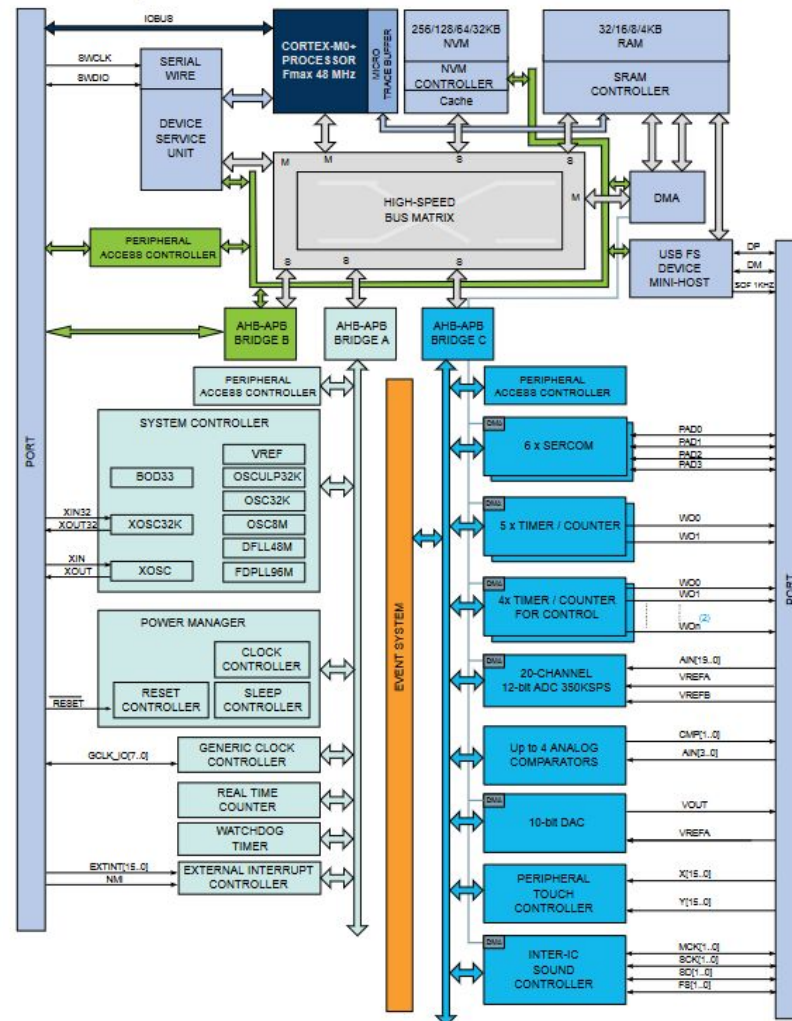
-40°C/125°C

3V to 3.6V

Radiation

TID >50 krad
SEL immune up to 78MeV

Samples and Flight Models Available



~50 DMIPS

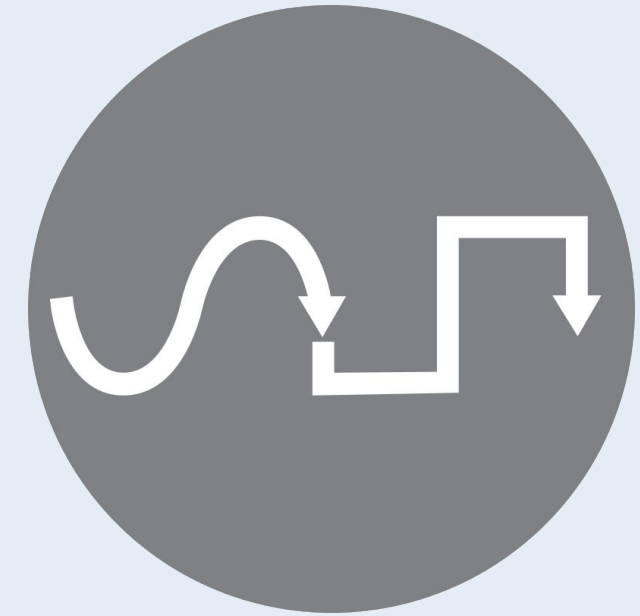
Hmatrix with DMA

350 ksps ADC, 12-bit
10-bit DAC
14 PWM motor control
Analog comparator

SERCOM
6 UART/SPI/TWI

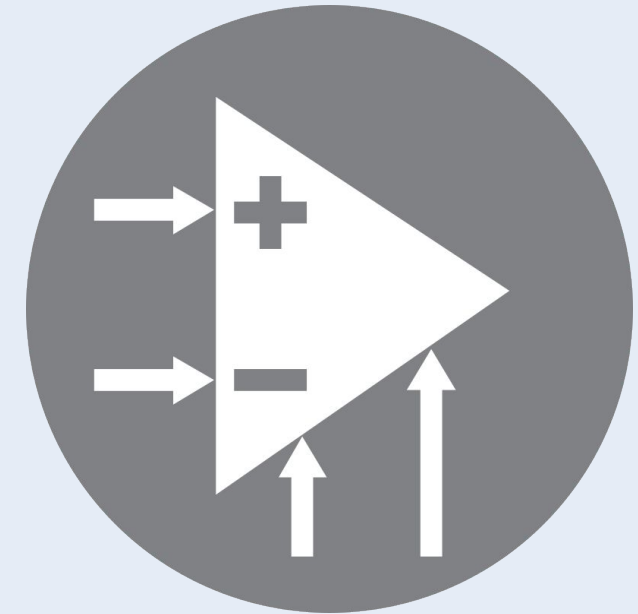
Differential and Single-Ended Embedded ADC

- Advantage of having both differential and single-ended embedded Analog-to-Digital Converters (ADCs) in a microcontroller
- Single-End
 - Occupies only one analog microcontroller pin per input
 - In most cases conceptually simple and easy to use
 - Sensitive to noise along the analog signal path and common-mode noise
 - The signal path should be as short as possible to minimize noise
- Differential
 - Rejects noise along the signal path and common-mode noise
 - Double dynamic range compared to single-ended operation
 - Occupies two analog microcontroller pins per input
 - Somewhat more complex to connect and use



Embedded Analog Comparators

- Analog comparators are not common peripherals on microcontrollers and can be of great value in digital power applications
 - Analog comparators can quickly detect overcurrent or overvoltage conditions
 - In AC power applications, analog comparators are used to detect the zero-crossing points of the AC waveform
 - Comparators can be used to implement fault detection and diagnostic features
- Key advantages
 - Analog comparators offer fast response times, which are essential for real-time monitoring and control in power applications
 - By integrating analog comparators within the MCU, designers can reduce the need for external components

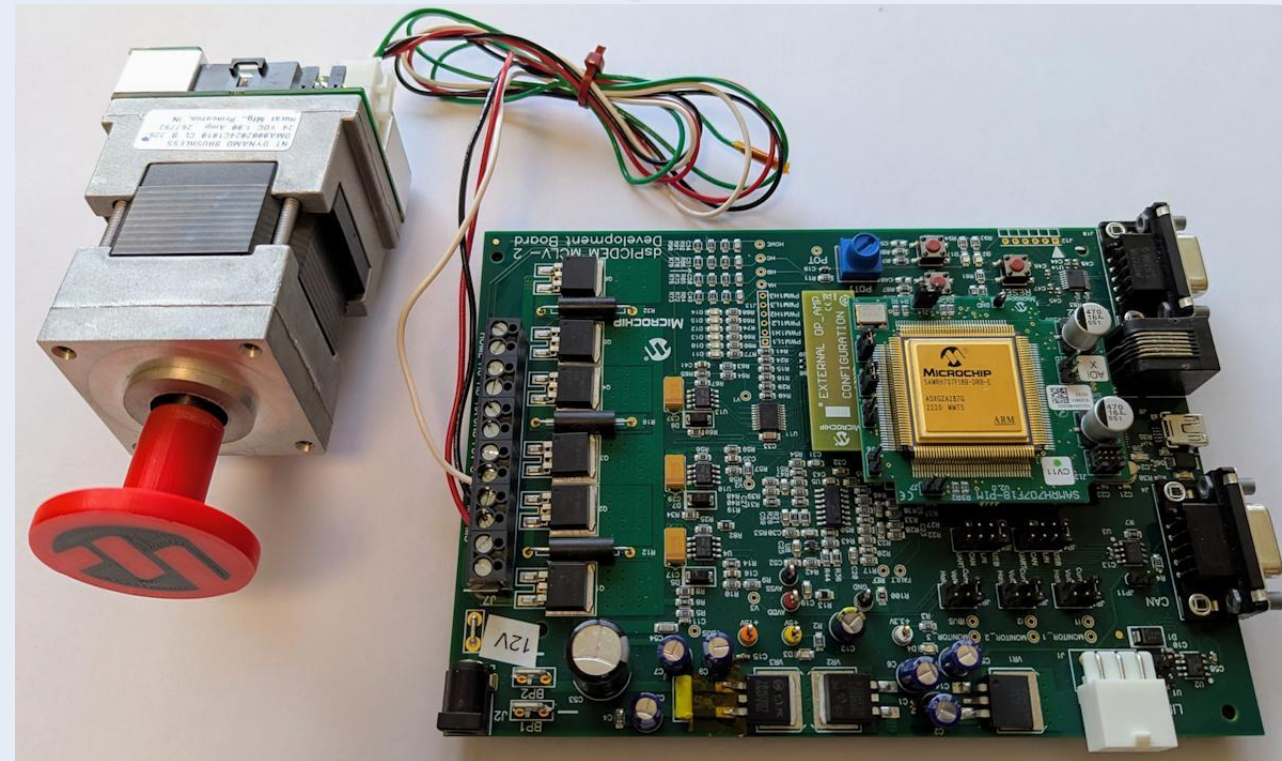


Motor Control

- Electric motors, mostly PMSM (Permanent Magnet Synchronous Motor) and stepper motors are widely used in space. Mixed signal microcontrollers are ideal to control such motors
- Where stepper motors could be simple to use, PMSM motors require more complex driving algorithms like Field Oriented Control (FOC).
 - FOC is a sophisticated and highly efficient method for controlling the torque and speed of electric motors, enabling independent control of torque and flux

FOC requires powerful microcontrollers such as Microchip Arm® Cortex®-M

Visit Microchip at booth 1



Field Oriented Control (FOC)

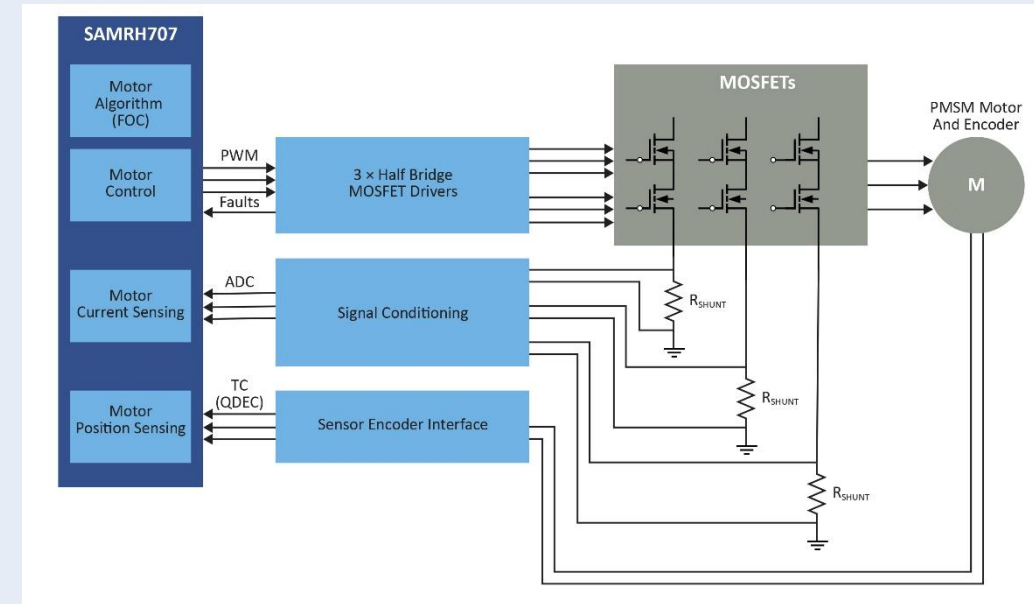
- There are several types of FOC algorithms, each with its own approach to achieving precise motor control
 - **Sensored**

A position sensor is required, which can be a quadrature encoder or a resolver

 - Less computer intensive
 - Require extra hardware
 - **Sensorless**

No need for a position sensor, rotor position is computed based on the back EMF currents.

 - Reduces cost and complexity by eliminating sensors
 - Requires sophisticated algorithms to accurately estimate rotor position and speed



MPLAB®Harmony QuickSpin PMSM FOC Configurator

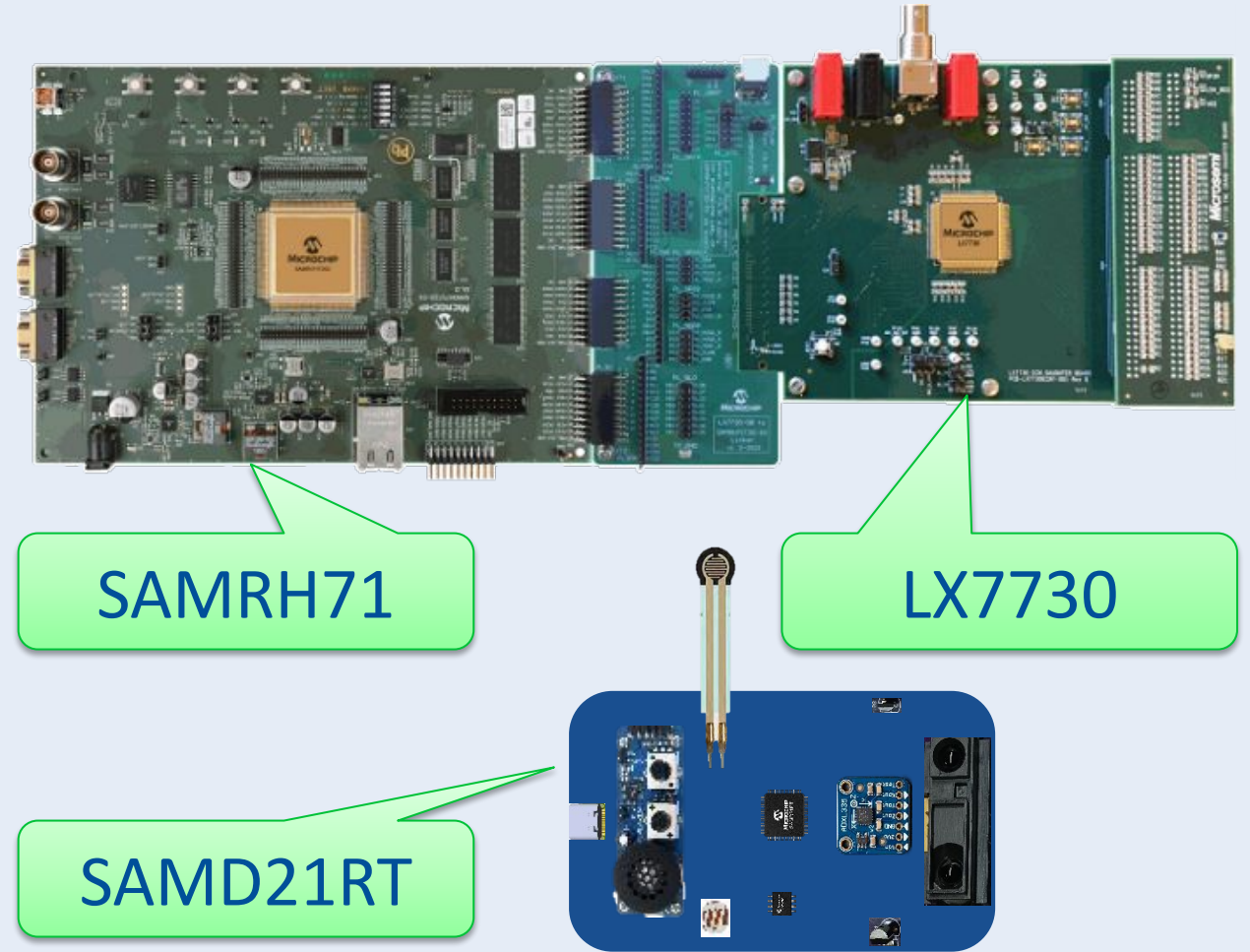
- **MPLAB® Harmony QuickSpin** is a software library within Microchip's MPLAB Harmony framework that provides motor control algorithms and tools specifically designed for sensorless and sensed control of PMSM motors
- QuickSpin simplifies the development of efficient, real-time motor control applications on Microchip microcontrollers by offering pre-implemented algorithms, configuration tools, and integration with MPLAB X IDE

Works with the SAMRH707



Telemetry

- Telemetry in space applications is the process of automatically measuring and collecting data from spacecraft systems, instruments or payloads
- Mixed-signals microcontroller are well suited for compact telemetry applications where the MCU can collect and process the data.



Where to Learn More

Web pages to access [link](#)

- Products, applications
- Reference designs on product pages
- Webinars and video, blogs
- Newsletters



Space Applications

Find the Right Solution for Your Space Application Design



Comprehensive Solutions for Space Applications

We offer a suite of use cases, evaluation cards, software IP and IDEs to accelerate your motor control, in-flight reprogramming and telemetry control designs.

[Explore Our Applications](#)



Scalable Products

We offer one of the industry's most comprehensive product portfolios for space applications, which includes radiation-hardened and radiation-tolerant products.

Our unique, scalable approach allows us to cover a wide range of quality levels with the same product. You can upgrade from COTS to QML of sub-screen from QML to high-reliability plastic.

[Explore Our Products](#)



60 Years of Flight Heritage

Our portfolio represents more than 60 years of flight heritage. We are proud that our product lines have been embedded in over 90 space missions.

[Learn More About Our Heritage](#)



or visit microchip.com/en-us/campaigns/space



Aerospace and Defense Applications

Building secure, robust and reliable electronic systems for space, aviation and defense applications is critical. We have a long history and proven track record of providing innovative, reliable and high-quality solutions for these types of applications. In 1957, we supplied the electromechanical relays for the Atlas launch vehicle. Voyager 1, the furthest manmade object from Earth, has been utilizing our frequency control products to aid in the transmission of data from a distance of 13 billion miles. We have continuously expanded our product offerings to deliver the largest portfolio of aerospace and defense semiconductor solutions in the market to give you the freedom to innovate.

- Our high-reliability, radiation-tolerant and radiation-hardened products are designed and qualified for the harshest environments
- Many of our products are designed to fit small footprints, consume very little power and operate reliably in high-temperature and electromagnetic environments
- We offer a wide variety of packaging and quality screening options, including hermetically sealed and non-hermetic/plastic products screened to various qualification levels
- Our COTS-to-radiation-tolerant devices are tailored to withstand levels of Total Ionizing Dose (TID) and Single Event Effects (SEE) for lower earth orbits and new-space applications
- Our radiation-hardened devices are Rad-Hard By Design (RHBD), offering the highest levels of TID and SEE radiation performance for the most demanding applications

You can take advantage of our extensive expertise and technical support to reduce your integration risk and development time. Our development ecosystem includes IP licenses, a variety of demonstration and evaluation kits, reference designs, software, application notes and detailed documentation. Our team of engineering, sales, marketing, logistics and quality experts provide the specialized support that you need to solve your most difficult design challenges.

Explore These Application Areas



Aviation

[Learn More](#)



Defense

[Learn More](#)



Space

[Learn More](#)

Explore our Portfolio of Products

ASICs	Communication Interfaces	Discretes	Electromechanical Relays
FPGAs	Frequency and Timing	MCUs and MPUs	Memory
Mixed-Signal ICs	Power Management	RF, Microwave, Millimeter Wave	Synchronization Systems

Thank You

<https://www.microchip.com/en-us/solutions/aerospace-and-defense>