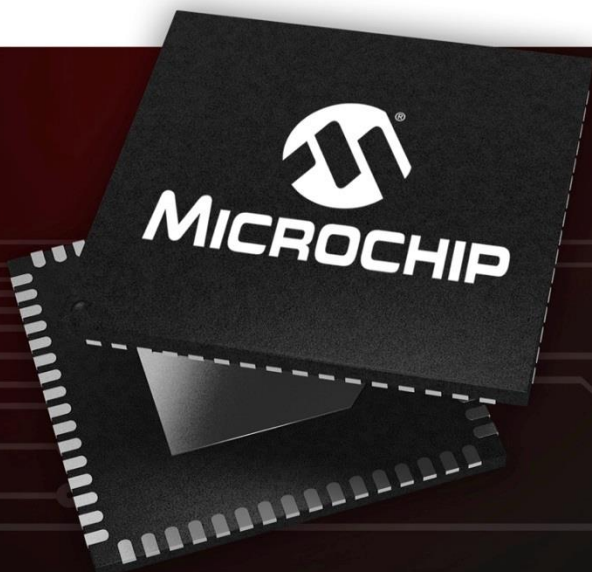
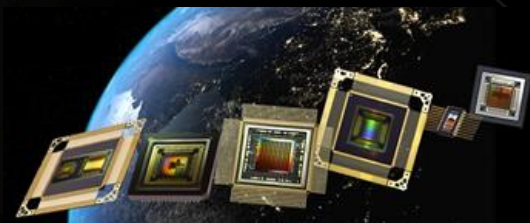




MICROCHIP



A Leading Provider of Microcontroller,
Mixed-Signal, Analog & Flash-IP Solutions



Aerospace & Defense

OBDP 2019

From COTS to Rad-Hard by Design ARM System-on-Chips

- **Microchip A&D**
- **Scalable ARM SoC**
- **Other Products update**

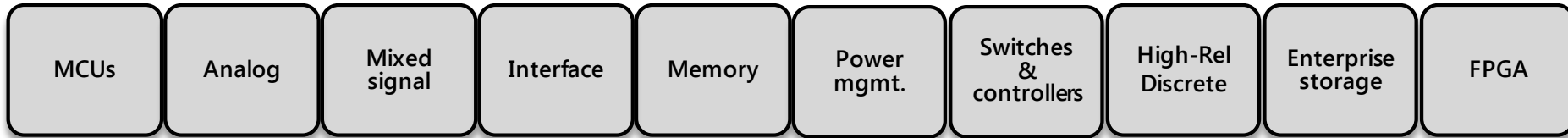


- **Microchip A&D**
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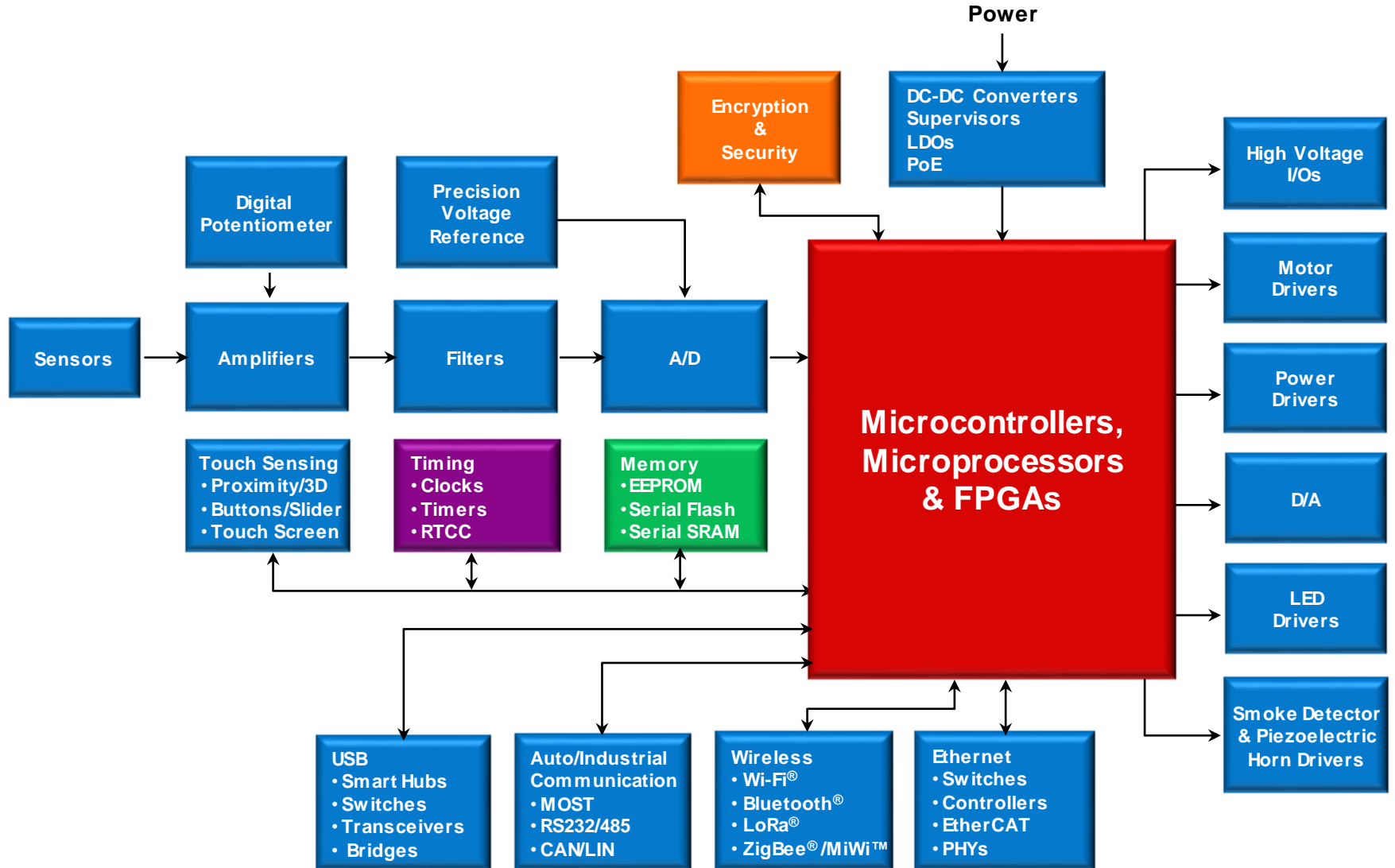




Extensive Combined Portfolio Across End Markets



Providing Total System Solutions



Long product life times – customer driven obsolescence



- **Committed to High Reliability and Long Term Supply**
 - Delivering Aerospace ICs for more than 30 years
 - Strong Flight Heritage in Space & Avionics applications
 - Leverage from Automotive solutions for “New Space” challenges :
Volumes, Costs and Time To Market
- **Major Products Focus**
 - ASICs
 - Processors & Microcontrollers
 - Communication Interfaces and Memories
- **Internal Qualified Supply Chain**
 - DLA / ESCC : Wafer lot to Qualified parts (France)
 - DLA : Assembly line (Thailand)
- **Long term cooperation with European agencies:**
 - ESA, CNES, DGA, DLR....



- **Microchip A&D**
- Scalable ARM SoC
- Other Products update



Use of COTS in Space

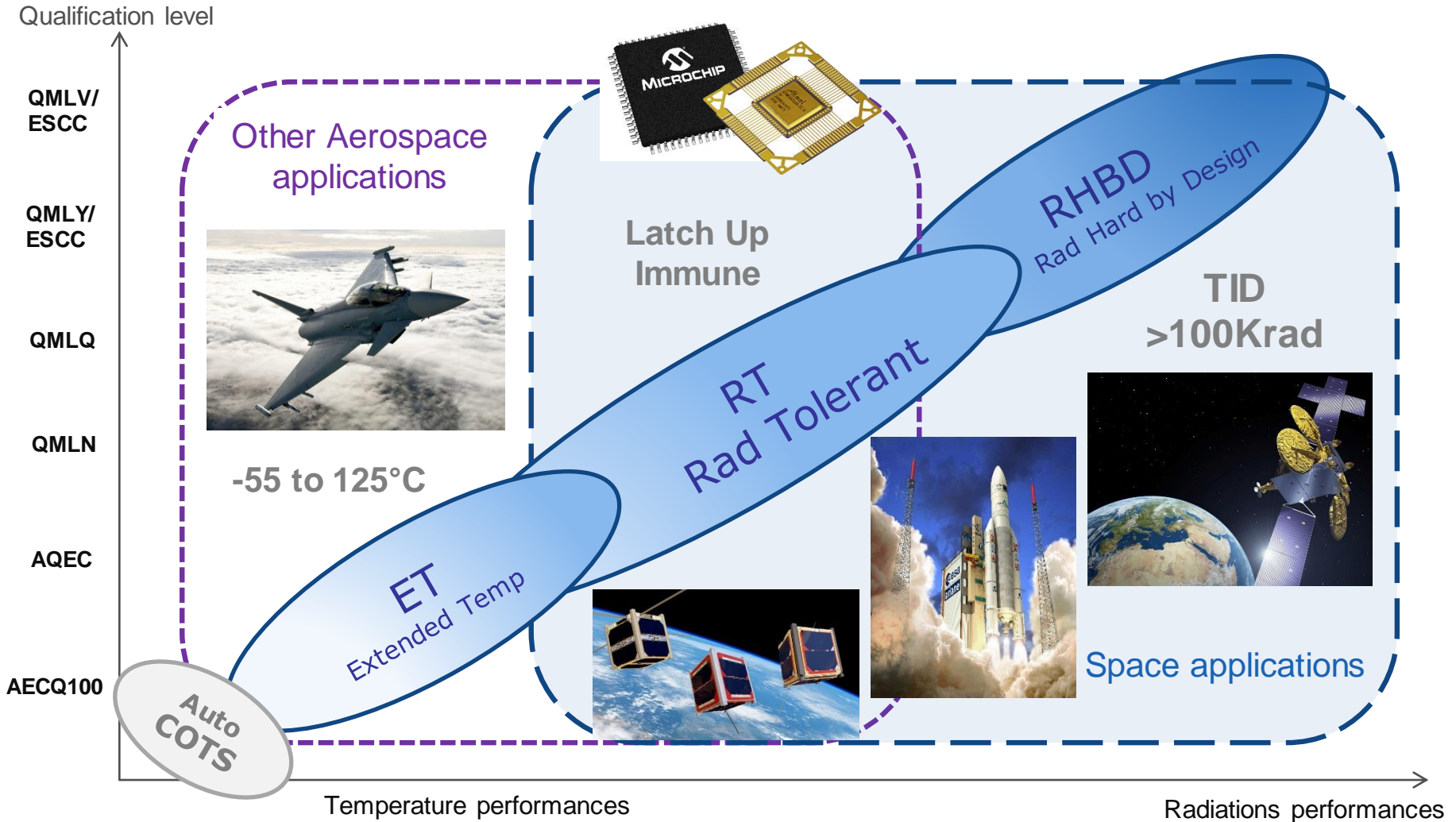
Advantages

- Easy access and costs effective (volume)
- AECQ100 Automotive qualified parts
- Reliability linked to high volumes & high nb of users
- Wide access to State of art technologies & architectures
- Access to free ecosystem and benefit from community

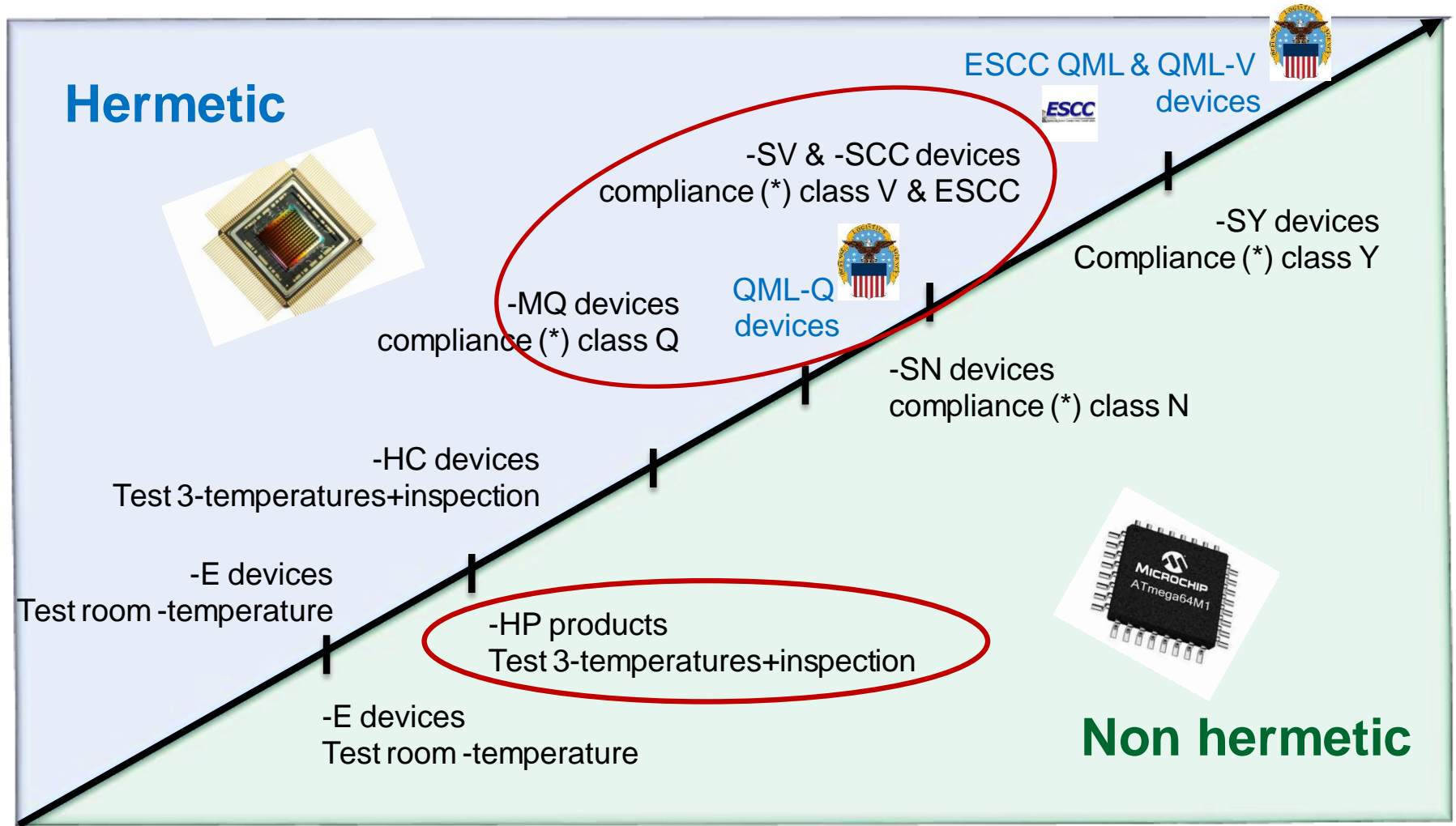
Drawbacks

- No traceability, No SLDC, High silicon lots discrepancy
- Limited access to qualification & supply chain data
=> PPAP only for “specific” auto customers / volumes
- Products turnover, versioning & obsolescence (EOL)
- Weak or Unknown radiations performances. Not always lucky.
- Product knowledge & costs for radiations testing/screening
- No FM support from silicon provider, no guarantee & RMA

Scalable Solutions for Aerospace



RHBD and RT devices – quality levels

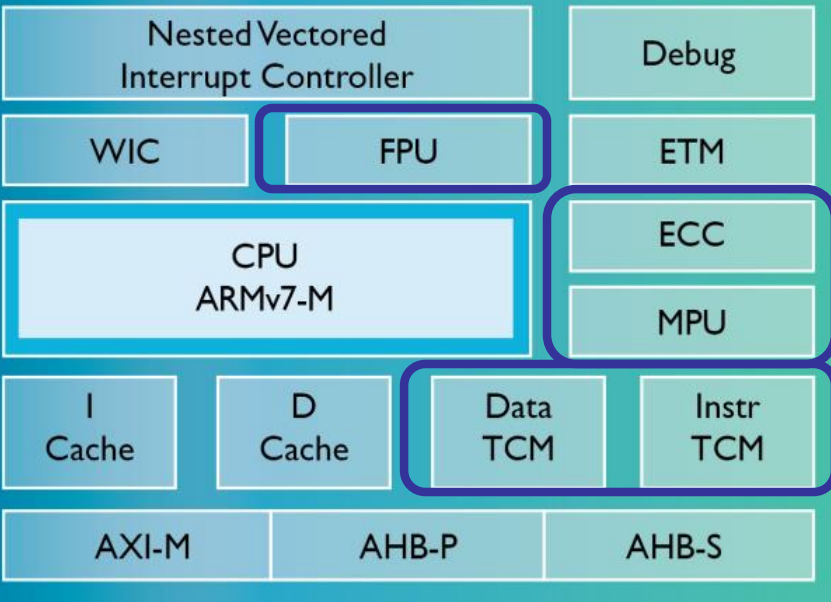


(*) compliance = Qualification testing, screening testing, and TCI/QCI inspections meet MIL-PRF 38535 or ESCC9000 requirements

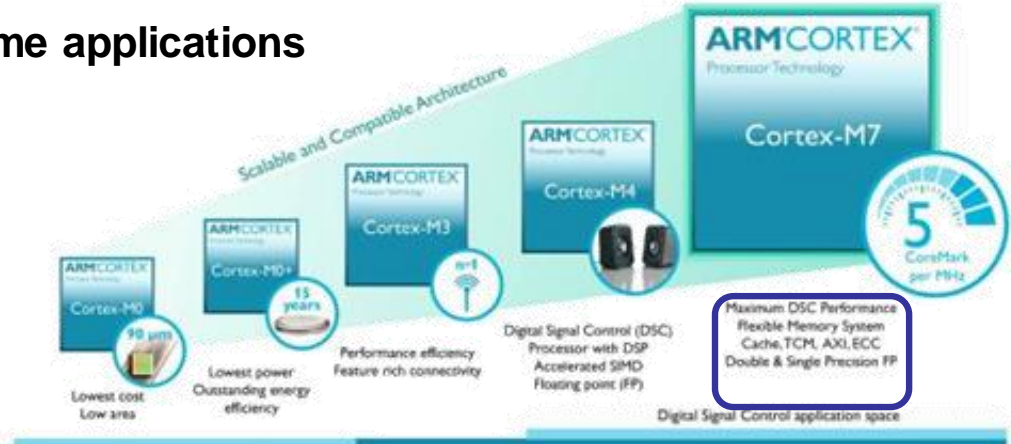
ARM Cortex-M7 Architecture

Designed for Safety and Powerful real time applications

ARM® Cortex®-M7

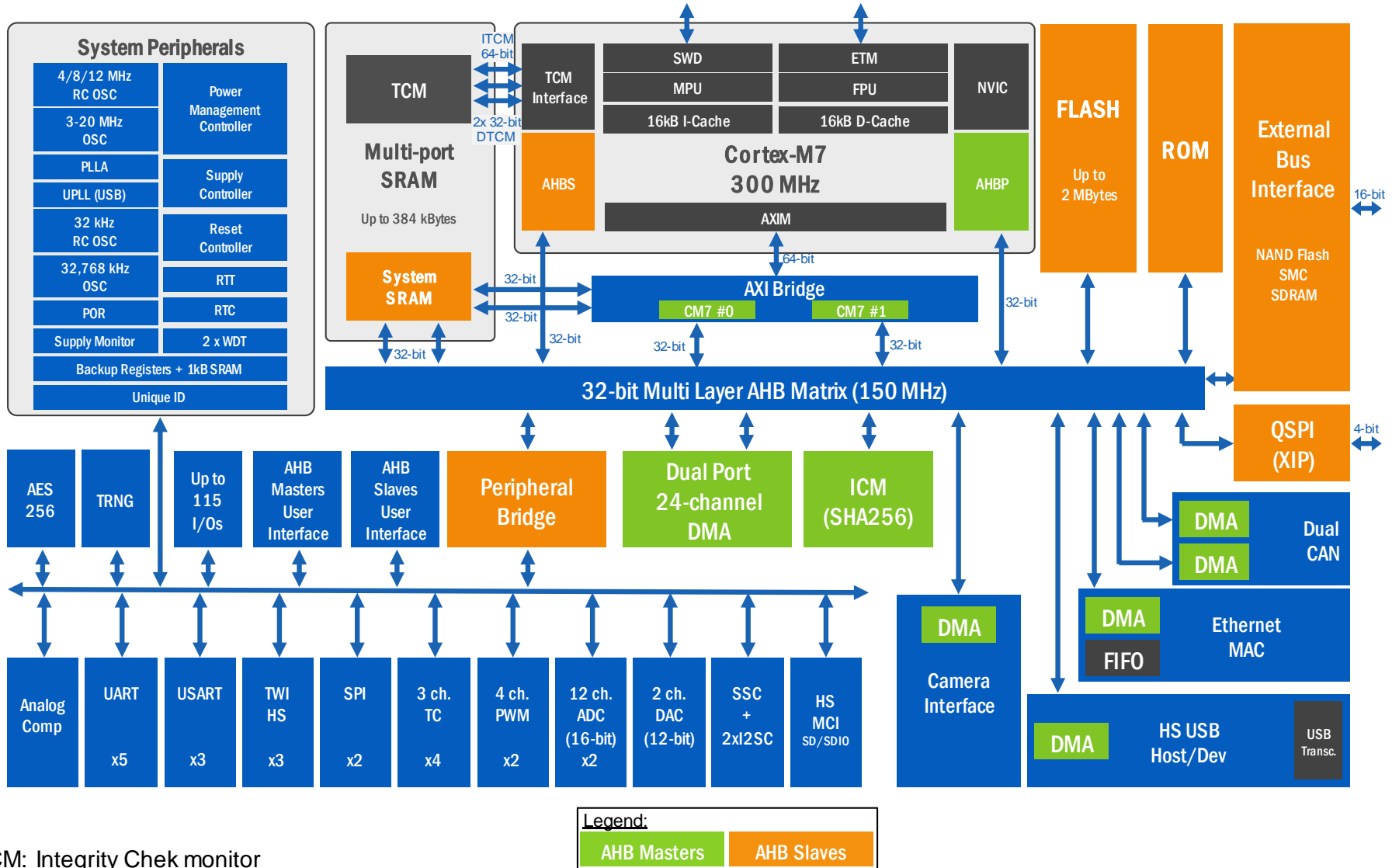


MPU : Memory Protection Unit
 ECC: Error Checking & Correction
 FPU: Floating Point Unit
 TCM: Tightly Coupled Memory



"16-bit" Traditional application space				"16/32-bit" Traditional application space				
Cortex Core	Architecture	Pipeline	Thumb / Thumb 2	MPU	DSP	FPU	Performances (DMIPS/MHz)	Dynamic Power consumption (uW/MHz)
M0	Von Neumann	3	Most / Subset	No	No	No	0.84	16.4
M0+	Von Neumann	2	Most / Subset	Opt.	No	No	0.93	9.8
M3	Harvard	3	All / All	Opt.	No	No	1.25	32
M4	Harvard	3	All / All	Opt.	Yes	Opt.	1.25	33
M7 Multicore	Harvard	6	All / All	Opt.	Yes	Opt.	2.14	33
A5 Multicore	Harvard	8	All / All	MMU Trust Zone	Yes	Opt.	1.57	
A7 Multicore	Harvard	8	All / All	MMU Trust Zone	Yes	Opt.	1.9	

Embedded in **SAMV71** High End Automotive SoC



ICM: Integrity Chek monitor

SAMV71 Scalable Unique Solution

Qualification level

ARM Cortex M7 SoC

Other Aerospace applications

Hirel & RT

Auto COTS

RHBD



QMLV/
ESCC

QMLY/
ESCC

QMLQ

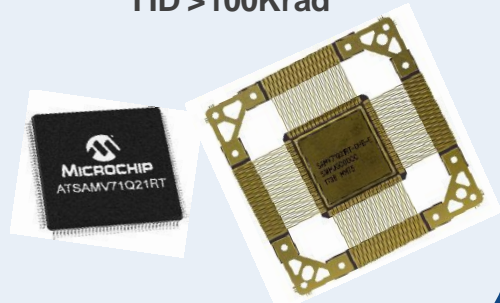
QMLN

AQEC

AECQ100

SAMV71		
Memory Up to 2MB Embedded Flash 18MB Multi-port SRAM Static Memory Controller SRAM Controller	Cortex[®]-M7 300 MHz 200k DWTs 200k DWTs 200k DWTs	System 7 AC, 0 DC, 2 Hal OSC, 2 PLL, PLL, 2 Watchdog Backup SRAM - 1KB Voltage Regulator - POR
1 HS USB Dev-Port w/ PHY 1 HS USB2.0 w/ PHY 5 UART, 3 USART, 2 SPI, 1 I2C 1 QSPI	24ch DMA Controller 100MHz 100MHz 100MHz	Security AES-128 Memory Checksum (CRC) TRNG Memory Scrubbing
EMMC w/ DR 2 CAN-FD EMMC w/ DR	114 IO 8x 16-bit PWM 12x 16-bit PWM 2x 12-bit 12-bit ADC 2x 12-bit 12-bit DAC	Connectivity 16 QSPI / TDM 16 QSPI / TDM
Connectivity	Control	User Interface

SAMRH71
>200DMIPS
Rad Hard
TID >100Krad



Space applications

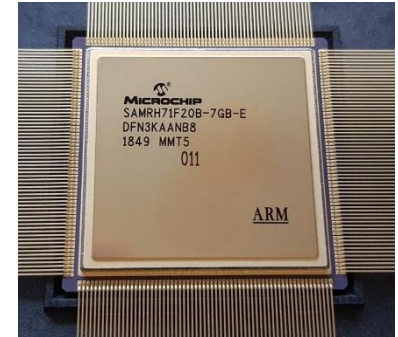
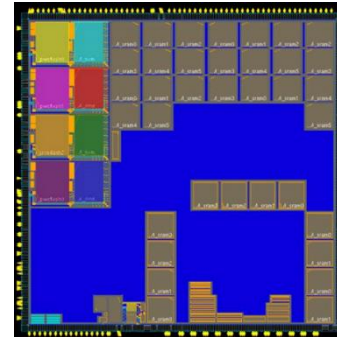
SAMV71		
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1 HS USB Dev-Port w/ PHY 1 HS USB2.0 w/ PHY 5 UART, 3 USART, 2 SPI, 1 I2C 1 QSPI	24ch DMA Controller 100MHz 100MHz 100MHz	Security AES-128 Memory Checksum (CRC) TRNG Memory Scrubbing
EMMC w/ DR 2 CAN-FD EMMC w/ DR	114 IO 8x 16-bit PWM 12x 16-bit PWM 2x 12-bit 12-bit ADC 2x 12-bit 12-bit DAC	Connectivity 16 QSPI / TDM 16 QSPI / TDM
Connectivity	Control	User Interface

SAMV71Q21RT
600DMIPS
Rad Tolerant
Latch Up Immune

Radiations performances

SAMRH71 Status

- N2 final ES now available
- 100Mhz & Spacewire 200Mbit/s confirmed, non reg. ongoing
- 1st Radiations Results confirm Rad Hard expected level
 - SEU LET >20Mev
 - SEL immune, TID to come
- Benchmark results confirm SoC architecture benefits
- Customer engagement Q119 w full ecosystem HW & SW



	AT697F	LEON3 FT	SAMRH71
Dhrystone (DMIPs/MHz)	0.86	1.38	>2.14
CoreMark (Coremark/MHz)		1.8	>5

=> AT697F/ SAMRH71 ~9mW/DMIPs



Targeted application: Geostationary orbit application

Customer Algorithms used:

- Algo 1: Basic correlation algorithm on a small pixel matrix 21x21
- Algo 2: Advanced correlation algorithm on a large pixel matrix 512x128

Execution time of customer algorithms running @ 48 MHz	Algo 1	Algo 2
LEON3-FT (UT699)	4,3 ms	2600 ms
Cortex-M7 (SAMRH71)	1,4 ms	548 ms

SAMRH71 is 3 to 5 time more performant

ARM Cortex M7 SoC

Benefits from same HW/SW ecosystem

Xplained board

Ordering Code: ATSAMV71-XULT



SW Tools suite



Atmel SAM-ICE Emulator

Ordering Code: AT91SAM-ICE



Atmel ICE programmer and debugger

Ordering code P/N: ATATMEL-ICE

Ready to SW use example projects

- [demo with detailed documentation](#)
- [samv71 softpack 1.5 for astudio](#)
- [exist for other software environment \(IAR, EWARM, KEIL, XULT GNU\)](#)

Already ported OS for M7 SoC (V71)



On going BSP projects : RTEMS, Xstratum



- **Microchip A&D**
- **Scalable ARM SoC**
- **Other Products update**



RTG4 Availability and Qualification Schedule

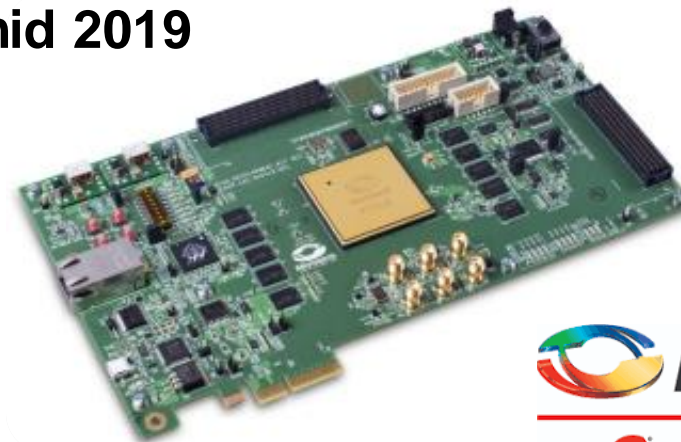
- QML class Q and V qualification: **Completed!**
 - RTG4 can be ordered to DLA SMD part number
 - DLA SMD part numbers on [Microsemi web site](#)
- RT4G150 PROTO FPGAs: Now
- RT4G150 development kit: Now
- CG1657 B, E, and V-flow flight units: Available to lead time now
- CG1657 daisy chain packages: Now
- CQ352 B-flow flight units: mid 2019
- CQ352 engineering models: Available to lead time now



RT4G150-
CQ352



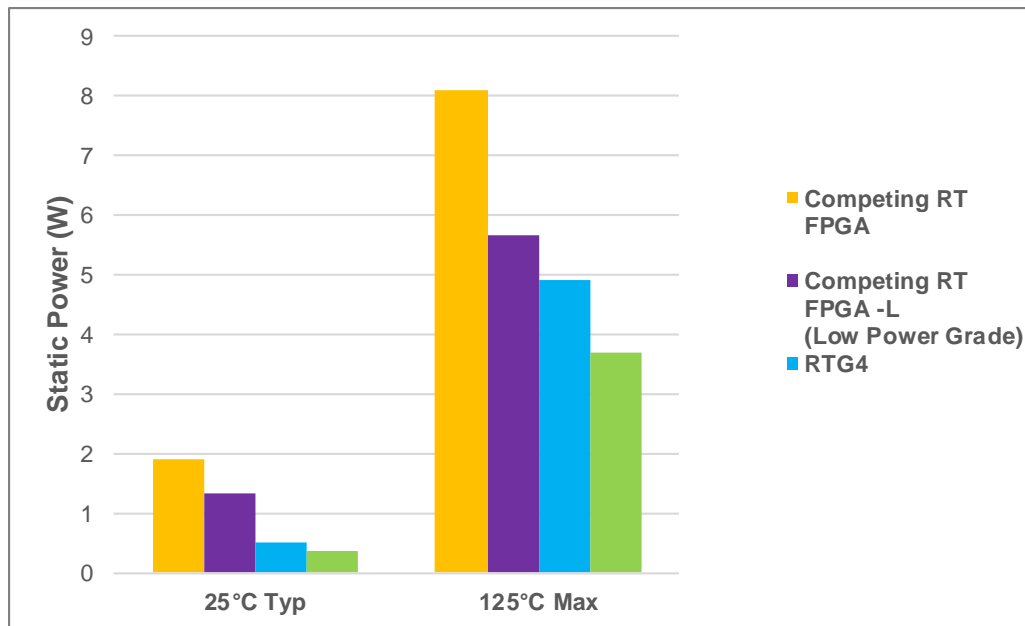
RT4G150-
CG1657



RTG4
Development Kit

RTG4 Low Power Grade

- **Low power grade (-L) for RTG4 standard speed (-STD) available NOW**
 - 25% quiescent supply current reduction: from 4.1 A to 3.1 A at 125 °C
 - RT4G150L device setting available in Libero SoC v12.0 and power calculator
 - RTG4 continues to be **best in class**



- **Free and open Instruction Set Architecture (ISA)**
 - 32-bit instructions, optional 16-bit compressed instructions
 - 32-bit, 64-bit, and 128-bit address-space options
 - Quad floating point, virtualization, many cores, heterogeneous computing
- **RISC-V software tools**
 - GNU GCC, binutils, newlib stdc library, gdb JTAG/OpenPCD debug
 - LLVM/Clang
 - Linux and Windows dev environment
 - Verification Suite
- **RTG4 support**
 - Soft RISC-V IP is free of charge
 - Preliminary IP is running at 70 MHz in RT4G150 “-1”
 - Sample RISC-V project for RTG4 dev kit available now on [GitHub website](#)
 - For details, refer to [RISC-V website](#)





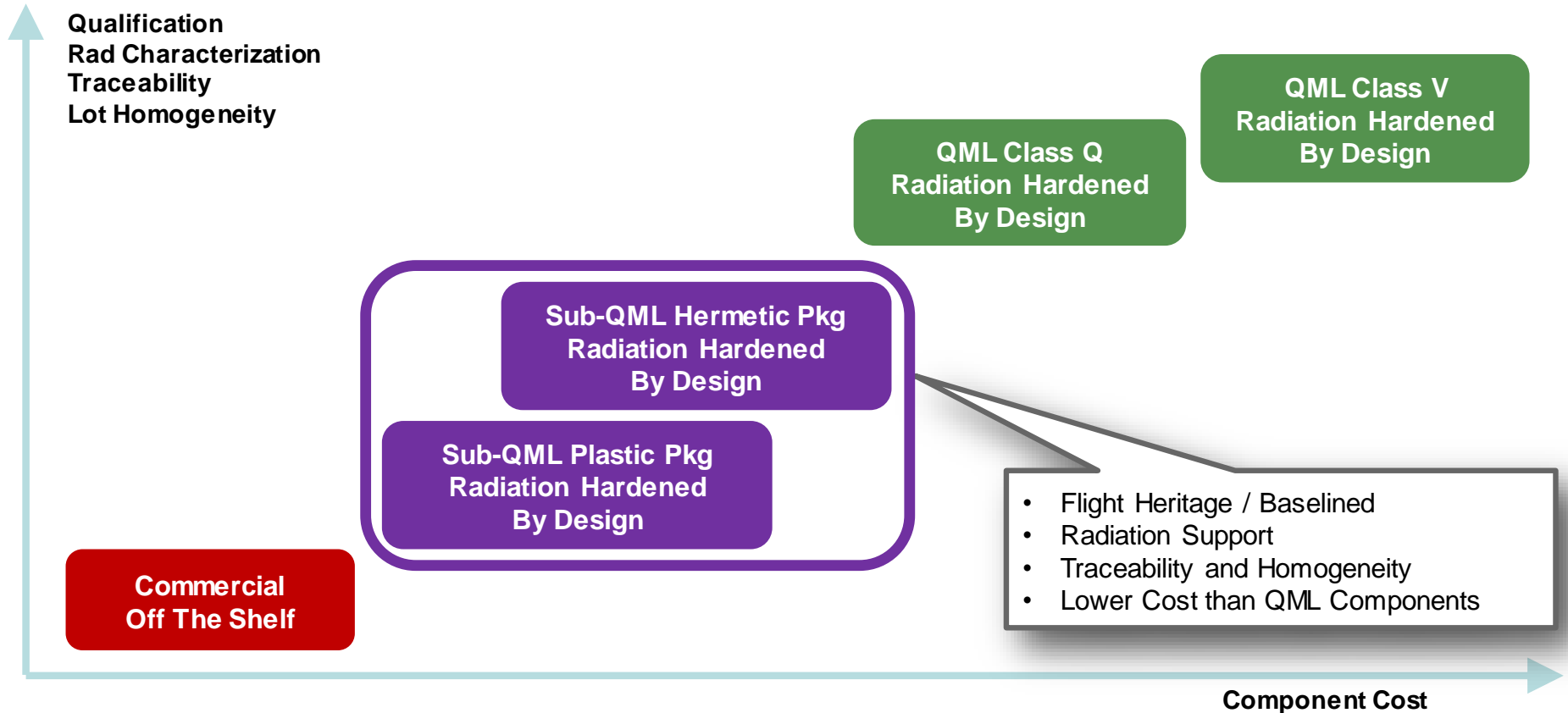
A Comprehensive Space Portfolio

<p>Radiation-Tolerant FPGAs</p>	<p>High Performance, High Density, Low Power TID up to 300 Krad, SEL Immune RTG4 FPGAs up to 300 MHz and 150K LE RTProASIC3, RTAX and RTSX-SU QML Qualified</p>	
<p>Rad-Hard Mixed Signal Integrated Circuits</p>	<p>Telemetry and Motor Control Space System Managers High Side Drivers Regulators and PWMs Extensive Custom IC Capability</p>	
<p>Space Qualified Oscillators</p>	<p>Ovenized Quartz Oscillators Hybrid Voltage Controlled and Temperature Compensated Crystal Oscillators Cesium Clocks</p>	
<p>Rad-Hard Power Solutions</p>	<p>Rad-hard JANS Diodes, Bi-Polar Small Signal Transistors, and MOSFETs Rad-hard Isolated DC-DC Converter Modules Custom Power Supplies 2 W to > 5 KW Point of Load Hybrid Solutions Electromechanical Relays</p>	
<p>Space Screening capability on RF Products</p>	<p>Surface Acoustic Wave (SAW) Filters Packaged and Chip Si Diodes Si Bipolar Transistors GaAs pHEMT MMICs</p>	



a MICROCHIP company

Sub-QML: Bridging the Gap Between QML and COTS





MICROCHIP

THANK YOU!

