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

● Scalable ARM SoC

● Other Products update
Extensive Combined Portfolio Across End Markets

<table>
<thead>
<tr>
<th>MCUs</th>
<th>Analog</th>
<th>Mixed signal</th>
<th>Interface</th>
<th>Memory</th>
<th>Power mgmt.</th>
<th>Switches &amp; controllers</th>
<th>High-Rel Discrete</th>
<th>Enterprise storage</th>
<th>FPGA</th>
</tr>
</thead>
</table>

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<tr>
<th>Industrial</th>
<th>Automotive</th>
<th>Consumer</th>
<th>Communication</th>
<th>Computing</th>
<th>A&amp;D</th>
</tr>
</thead>
<tbody>
<tr>
<td>27%</td>
<td>17%</td>
<td>16%</td>
<td>13%</td>
<td>12%</td>
<td>11%</td>
</tr>
</tbody>
</table>

COMBINED CAPABILITIES
Providing Total System Solutions

Microcontrollers, Microprocessors & FPGAs

- Sensors
- Amplifiers
- Filters
- A/D
- Encryption & Security
- DC-DC Converters
- Supervisors
- LDOs
- PoE

- D/A
- LED Drivers
- Smoke Detector & Piezoelectric Horn Drivers
- Power Drivers
- Motor Drivers
- High Voltage I/Os

Power

Digital Potentiometer
- Precision Voltage Reference
- Power Drivers

Encryption & Security

- USB
  - Smart Hubs
  - Switches
  - Transceivers
  - Bridges

- Auto/Industrial Communication
  - MOST
  - RS232/485
  - CAN/LIN

- Wireless
  - Wi-Fi®
  - Bluetooth®
  - LoRa®
  - ZigBee®/MiWi™

- Ethernet
  - Switches
  - Controllers
  - EtherCAT
  - PHYs

- Timing
  - Clocks
  - Timers
  - RTCC

- Memory
  - EEPROM
  - Serial Flash
  - Serial SRAM

- Sensors
- Amplifiers
- Filters
- A/D

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- Sensors
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Long product life times – customer driven obsolescence
Aerospace & Defense
Product line (Microchip)

- 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 datas
  - => 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

- Temperature performances
  - ET: Extended Temp (-55 to 125°C)

- Radiations performances
  - Latch Up Immune
  - RHBD: Rad Hard by Design (>100Krad)

Other Aerospace applications

Qualification level

- QMLV/ESCC
- QMLY/ESCC
- QMLQ
- QMLN
- AQEC
- AECQ100

Space applications

Auto COTS
RHBD and RT devices – quality levels

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

Hermetic

- MQ devices compliance (*) class Q
- SV & SCC devices compliance (*) class V & ESCC
- HC devices
  Test 3-temperatures+inspection
- E devices
  Test room -temperature

Non hermetic

- SN devices
  Compliance (*) class N
- SY devices
  Compliance (*) class Y
- HP products
  Test 3-temperatures+inspection
- E devices
  Test room -temperature
- HP products
  Test 3-temperatures+inspection
ARM Cortex-M7 Architecture

Designed for Safety and Powerful real time applications

Embedded in SAMV71 High End Automotive SoC
SoC Architecture

SAMV71Q21 ARM Cortex-M7

Legend:
- AHB Masters
- AHB Slaves
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

<table>
<thead>
<tr>
<th></th>
<th>AT697F</th>
<th>LEON3 FT</th>
<th>SAMRH71</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dhrystone (DMIPS/MHz)</td>
<td>0.86</td>
<td>1.38</td>
<td>&gt;2.14</td>
</tr>
<tr>
<td>CoreMark (Coremark/MHz)</td>
<td>1.8</td>
<td></td>
<td>&gt;5</td>
</tr>
</tbody>
</table>

=> 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

<table>
<thead>
<tr>
<th>Execution time of customer algorithms running @ 48 MHz</th>
<th>Algo 1</th>
<th>Algo 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEON3-FT (UT699)</td>
<td>4.3 ms</td>
<td>2600 ms</td>
</tr>
<tr>
<td>Cortex-M7 (SAMRH71)</td>
<td>1.4 ms</td>
<td>548 ms</td>
</tr>
</tbody>
</table>

SAMRH71 is 3 to 5 time more performant
ARM Cortex M7 SoC
Benefits from same HW/SW ecosystem

Xplained board
Ordering Code: ATSAMV71-XULT

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)

Atmel SAM-ICE Emulator
Ordering Code: AT91SAM-ICE

On going BSP projects: RTEMS, Xstratum

Atmel ICE programmer and debugger
Ordering code P/N: ATATMEL-ICE

SW Tools suite
● 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](http://www.microsemi.com)
- 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
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
RISC-V for RTG4

- **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](https://github.com)
  - For details, refer to [RISC-V website](https://riscv.org)
### A Comprehensive Space Portfolio

| Radiation-Tolerant FPGAs | 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 |
|-------------------------|--------------------------------------------------------------------------------|
| Rad-Hard Mixed Signal Integrated Circuits | Telemetry and Motor Control Space System Managers  
High Side Drivers  
Regulators and PWMs  
Extensive Custom IC Capability |
| Space Qualified Oscillators | Ovenized Quartz Oscillators  
Hybrid Voltage Controlled and  
Temperature Compensated Crystal Oscillators  
Cesium Clocks |
| Rad-Hard Power Solutions | 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 |
| Space Screening capability on RF Products | Surface Acoustic Wave (SAW) F**  
Packaged and Chip Si Diodes  
Si Bipolar Transistors  
GaAs pHEMT MMICs |
Sub-QML: Bridging the Gap Between QML and COTS

- Qualification
- Rad Characterization
- Traceability
- Lot Homogeneity

- QML Class Q
  - Radiation Hardened
  - By Design

- QML Class V
  - Radiation Hardened
  - By Design

- Sub-QML Hermetic Pkg
  - Radiation Hardened
  - By Design

- Sub-QML Plastic Pkg
  - Radiation Hardened
  - By Design

- Commercial Off The Shelf

- Component Cost
  - Flight Heritage / Baselined
  - Radiation Support
  - Traceability and Homogeneity
  - Lower Cost than QML Components
Thank You!

Microchip