AVR SD—Functional Safety Enhanced Microcontroller Family

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AVR SD

Designed in compliance with the ISO 26262 functional safety standard for ASIL C / SIL 2 applications

- **Dual core lockstep CPU**
- **20 MHz CPU clock speed**
- **Error Controller**
- **ECC on Flash/SRAM/EEPROM**
- **512B User row**
- **256B Key storage**
- **2.7V – 5.5V Supply Voltage Range**
- **-40°C to 125°C Temp range**

- **Special features**
  - Multi-Voltage IO (MVIO) – Integrated level shifters on Port C
  - Event system (EVSYS)
  - Custom Configurable Logic (CCL)
  - Programming and debug interface disable (PDID)
- **Analog**
  - 2x 10-bit single ended ADCs
  - 1x 10-bit DAC
  - 3x Analog Comparators
  - 2x Zero-Cross Detectors (ZCD)
- **Watchdogs**
  - Asynchronous Window Watchdog (WDT)
  - Synchronous Window Watchdog (SWDT)

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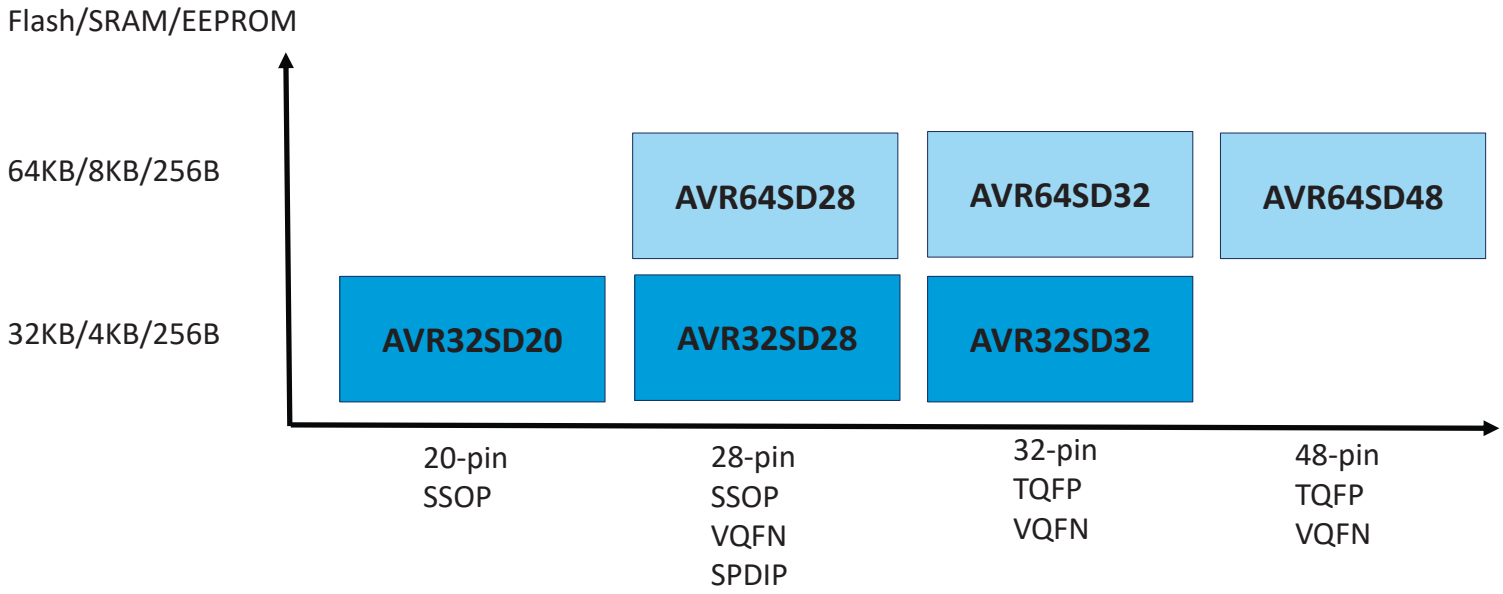
Family Overivew

- 32/64KB Flash
- 4/8KB SRAM
- 256KB EEPROM
- 20 to 48 pins



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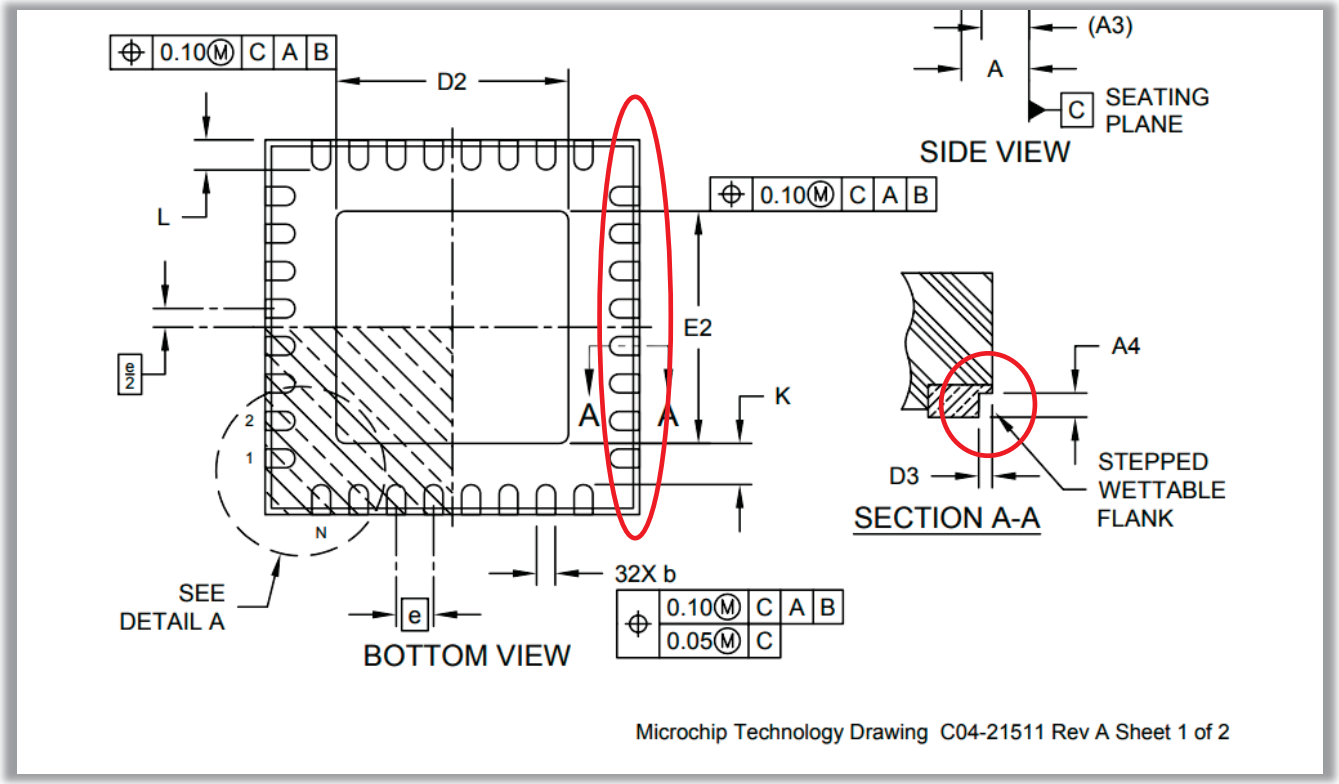
VQFN with Wettable Flanks

- **Enabling optical inspection of the soldering**
- **Usually required by automotive customers**



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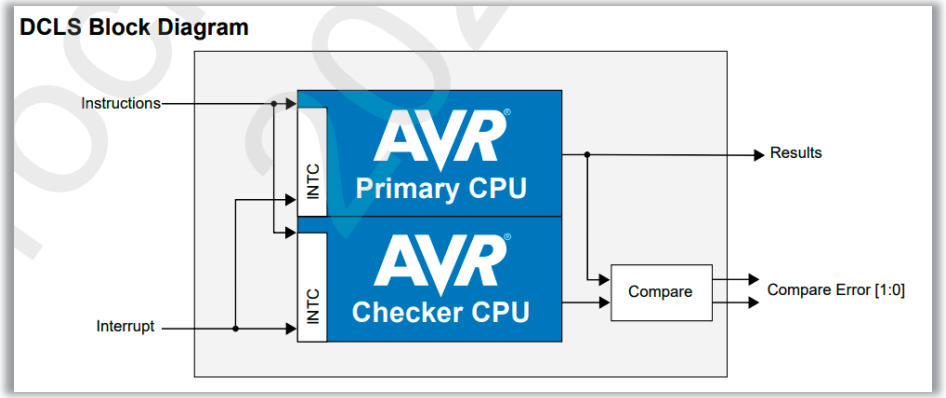
Dual Core Lockstep CPU

- **20MHz AVR dual-core lock-step CPU**
  - Same design, different realization by synthesis tool (no I/O delay between cores)
  - Physically separated on die
- **Diagnostics mechanism**
  - Full redundancy (>99% coverage)
- **Fault injections**
  - Yes, CPU comparators can be forced to generate a fault
- **Benefit**
  - Reduce diagnostics code for CPU by 3.5KB
  - Reduce diagnostics CPU load by 3.3k CPU clock cycles (per run)
  - Increase coverage from 72% to > 99%
  - Fault detection time reduced to 1 clock cycle



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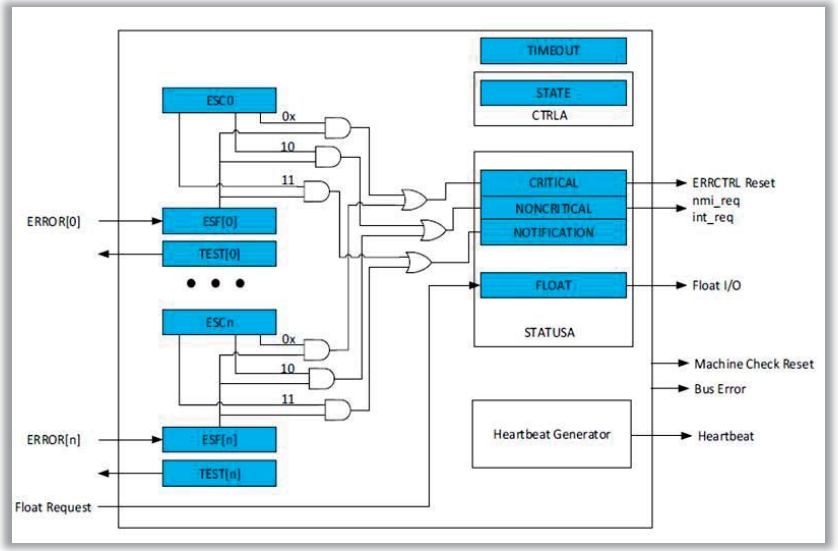
Error Controller

- **Error Controller define response to critical faults**
  - Flag, Interrupt, non-maskable Interrupt, MCU system reset
  - Can be locked after configuration
- **Hardware diagnostics**
  - Critical hardware is redundant
- **Fault injection**
  - Test mode to trigger faults from software
- **Benefit**
  - System integrator controls recovery attempts and error mode response



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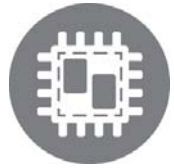
Error Correcting Code (ECC) on Flash, EEPROM and SRAM



- **SECDED ECC (Single Error Corrected (SEC) or Double Error Detected (DED))**
  - Detects / corrects data bit faults
  - Parity on program data and address BUS bit faults
  - Notification on corrected and detected faults

- **Diagnostics mechanism**
  - Redundancy (>99% coverage)

- **Fault injections**
  - Single- and double-bit fault can be injected in data and address

- **Benefit**
  - Allow system to continue uninterrupted operation with single bit faults per data word
  - Allow repair of single bit faults (soft faults only)
  - Can be used to detect and correct memory retention issues e.g., accelerated by high-temp operation (Flash only)

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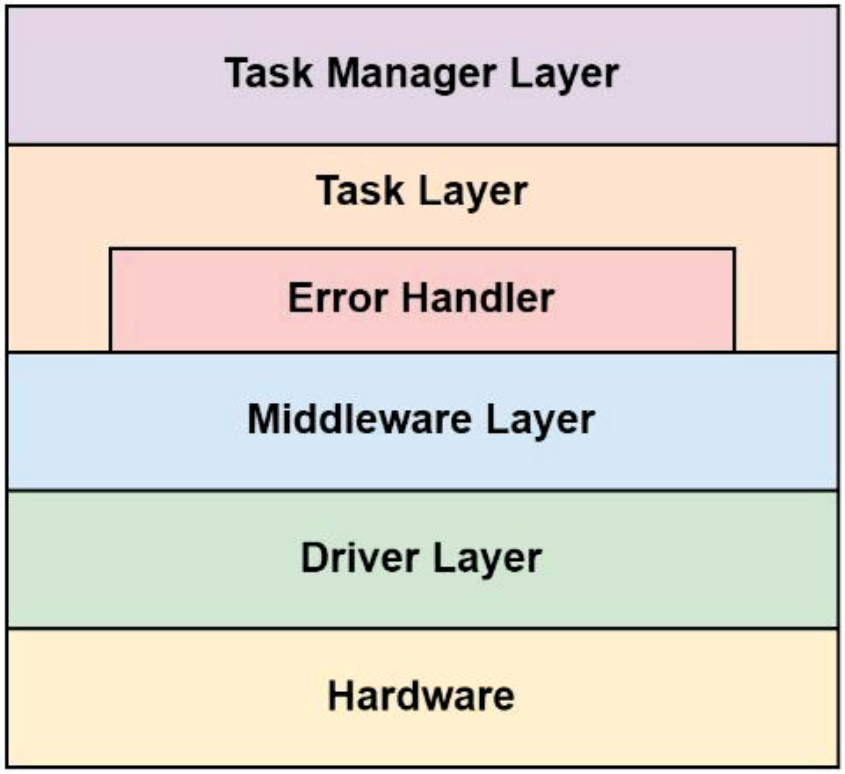
Software Saftey Framework (ASIL C/ SIL2/ ASPISE L3)

- **Safety mechanism diagnostics**
  - Error injection/latent fault checks
- **Central error handling manager/unit**
- **Reset (Fault) Handling**
- **Middleware to use safety mechanisms**
- **Scheduling to ensure FDTI and safety system monitoring**



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Target Applications

- Battery monitor (current, temperature) for electrical vehicles (ASIL B(D) – ASIL D)
- Primary/secondary airbag controller (ASIL C – ASIL D)
- Sensor nodes (position sensor, pressure, engine knock, etc.) (ASIL B – ASIL C, SIL 1 – SIL 3)
- User Interface buttons for steering wheel/levers/joysticks (ASIL B – ASIL D)
- Electronic-fuse (ASIL B – ASIL C, SIL 1 – SIL 3)
- Safety co-processor (fundamantal IO monitor) (ASIL B – ASIL C, ASIL B(D) – ASIL C(D), SIL 1 – SIL 3)
- Appliances/HVAC using flammable gas – flame detection, monitor gas concentration, pressure/temperature sensing (Class B – Class C)

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Simplify Certification Process and Reduce Time to Market

- **Curiosity Nano Evaluation Kit**
- **MPLAB X Integrated Development Environment (IDE)**
- **MPLAB Code Configurator (MCC) Melody drivers and code examples**
- **Certified MPLAB XC8 Functional Safety Compiler license**
- **ASIL C-compliant software package**
- **Safety documentation and reports**
  - Safety manual
  - FMEDA report
  - Dependent Failure Analyses (DFA)
  - Software test report

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Summary

- **Family Product Brief**
  - AVR32/64SD20/28/32/48 Product Brief (microchip.com)
- **Product pages (Live by end of the 2024)**
  - AVR32SD32: https://www.microchip.com/en-us/product/AVR32SD32
  - AVR32SD28: https://www.microchip.com/en-us/product/AVR32SD28
  - AVR32SD20: https://www.microchip.com/en-us/product/AVR32SD20
- **Presentation and sell sheet available at the BU Information Portal**
- **For more information reach out to stian.sogstad@microchip.com**
- **Marketing Samples: Available Now**
- **Release to Production: CQ1 2025**

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Thank You

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