Agenda

- Introduction to SmartFusion
- Deeper Look inside SmartFusion
- SmartFusion Software & Eco-System
- SmartFusion Hardware Kits
- SmartFusion Solutions
SmartFusion: Innovative, Intelligent, Integration

- Proven FPGA fabric
- Complete ARM® Cortex™-M3 MCU subsystem...& it’s ‘hard’
- Programmable analog
- In a flash-based device
- In production now!

Offers full customization, IP protection and ease-of-use
## The Actel Embedded Advantage

<table>
<thead>
<tr>
<th>Flash-based FPGA</th>
<th>SRAM-based FPGA</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARM Cortex-M3 processor with its own embedded flash memory</td>
<td>Needs external flash memory</td>
</tr>
<tr>
<td>On-chip nonvolatile FPGA configuration</td>
<td>Needs external configuration devices</td>
</tr>
<tr>
<td>High-voltage analog co-exists with digital circuits</td>
<td>Standard CMOS process not conducive to high voltage analog</td>
</tr>
</tbody>
</table>

*Flash Technology Enables Innovative, Intelligent Integration*
# Target Applications & Market Segments

<table>
<thead>
<tr>
<th>Applications</th>
<th>Segments</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Management</td>
<td>Industrial</td>
</tr>
<tr>
<td>Power Management</td>
<td>Medical</td>
</tr>
<tr>
<td>Motor Control</td>
<td>Energy</td>
</tr>
<tr>
<td>Industrial Networking</td>
<td>Communications</td>
</tr>
<tr>
<td>....and more</td>
<td>....and more</td>
</tr>
</tbody>
</table>

Motor Control  
Diagnostic  
Imaging  
Datacenter  
Medical Low Vision Viewers
Customer Engagement To-Date: Some Applications

- Battery Operated EKG/ECG
- Servers and Switches
- Ind controllers: Motion, Process & Safety
- Synchronized Train Computers
- System Management for ATCA boards
- Point-of-Sale Touch Screen
An Inside Look at SmartFusion
No-Compromise FPGA Fabric

- Proven flash-based FPGA fabric
- 60,000 to 500,000 system gates
- 350 MHz system performance
- Embedded SRAMs and FIFOs
- Up to 128 FPGA I/Os
No-Compromise Microcontroller Subsystem (MSS)

- 100 MHz 32-bit ARM Cortex-M3 processor
- Bus matrix with up to 16 Gbps throughput
- 10/100 Ethernet MAC
- SPI, I²C, UART, 32-bit Timers
- Up to 512 KB flash and 64 KB of SRAM
- External memory controller
- 8-channel DMA controller
- Up to 41 MSS I/Os
Programmable Analog

- Analog compute engine (ACE) offloads CPU from analog tasks
- Voltage, current and temp monitors
- 12-bit (SAR) ADCs @ up to 600 Ksps
- Sigma-Delta DACs
- Up to ten 15 ns high-speed comparators
- Up to 32 analog inputs and 3 outputs
Innovative Intelligent Integration
Why SmartFusion is a Smart Decision?
SmartFusion Benefits: Integration

- Reliability
- Power savings
- Flexibility
- Smaller footprint
- Fewer vendors
- Lower TCO

Actual SmartFusion Die
SmartFusion Benefits: Full Customization

- Build a system with exactly the features you need

- Easy design partitioning
  - For performance
  - For efficient silicon usage
  - For power management

- Innovate and differentiate in both software and hardware

- Extend product life
  - In-field upgrades
  - One platform for multiple products
SmartFusion Benefits: Unparalleled IP Protection

- **True nonvolatile single chip (FPGA+MCU+Analog)**
  - No bitstream communicated from external configuration device

- **FlashLock® technology**
  - Controls access to the security settings of the device
  - Used to lock the device with a 128-bit key
  - Device unlocked & reprogrammed by providing the same 128-bit key
  - Permanent lock is possible, which disables programming access

- **Physical design of the device**
  - Security key distributed throughout the device and below several metal layers
  - Very difficult to microprobe flash FPGAs

- **Data security**
  - IP cores available that provide AES or DES encryption or decryption of data
SmartFusion Prevents IP Theft in Manufacturing

**Secured Manufacturing Flow**

- 128-bit AES Encryption
- AES-encrypted programming file sent to manufacturer
- Devices pre-programmed with matching AES key sold direct to manufacturer

**Protection Against:**
- Overbuilding
- Cloning
- Reverse engineering
- Tampering
# SmartFusion Family: Key Features

<table>
<thead>
<tr>
<th>Device</th>
<th>A2F060*</th>
<th>A2F200</th>
<th>A2F500</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Gates (Kgates)</td>
<td>60</td>
<td>200</td>
<td>500</td>
</tr>
<tr>
<td>Tiles (D-flip-flops)</td>
<td>1,536</td>
<td>4,608</td>
<td>11,520</td>
</tr>
<tr>
<td>RAM Blocks (4,608 bits)</td>
<td>8</td>
<td>8</td>
<td>24</td>
</tr>
<tr>
<td>MSS</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>10/100 Ethernet MAC</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>eNVM</td>
<td>128K</td>
<td>256K</td>
<td>512K</td>
</tr>
<tr>
<td>eSRAM</td>
<td>16K</td>
<td>64K</td>
<td>64K</td>
</tr>
<tr>
<td>Analog Compute Engine (ACE)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>ADCs (8-/10-/12-bit SAR)</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>DACs (12-bit Sig-Del)</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Comparators</td>
<td>2</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Current Monitors</td>
<td>1</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Temperature Monitors</td>
<td>1</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Bipolar HV Monitors</td>
<td>2</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Direct Analog Input</td>
<td>8</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>Total Analog Input</td>
<td>12</td>
<td>24</td>
<td>32</td>
</tr>
<tr>
<td>Total Analog Output</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>MSS I/O</td>
<td>25</td>
<td>41</td>
<td>41</td>
</tr>
<tr>
<td>FPGA I/O</td>
<td>66</td>
<td>94</td>
<td>128</td>
</tr>
<tr>
<td>Total I/O</td>
<td>104</td>
<td>161</td>
<td>204</td>
</tr>
</tbody>
</table>

* Under definition. Subject to change.

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## MCU Sub-System (MSS)

### Analog Front End

- ProASIC3 Fabric
- MSS Common to all Family Members
  - Cortex M3 (100MHz)
  - 2 – SPI
  - 2 – UART
  - 2 - I2C
  - 2 – 32-bit Timers
  - DMA
  - Watch Dog
  - RTC
  - External Memory Controller

## Availability:

- Now: A2F200
- June: A2F500
- Q4: A2F060
## SmartFusion Package Offering

<table>
<thead>
<tr>
<th>Device</th>
<th>A2F060*</th>
<th>A2F200</th>
<th>A2F500</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS281 (11x11; 0.5mm pitch)*</td>
<td>✅</td>
<td>✅</td>
<td>✅</td>
</tr>
<tr>
<td>FG256 (17x17 mm; 1mm pitch)</td>
<td>✅</td>
<td>✅</td>
<td>✅</td>
</tr>
<tr>
<td>FG484 (23 x 23 mm; 1mm pitch)</td>
<td>✅</td>
<td>✅</td>
<td>✅</td>
</tr>
</tbody>
</table>

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### Packages currently under consideration
- 208PQFP (28 mm x 28mm; 0.5mm pitch; 3.4mm height)
- 128VQFP (14 mm x 14mm; 0.4mm pitch; 1.0mm height)
Programmable Analog: A Closer Look

- Typical SmartFusion analog building block: 1 ADC, 1 DAC, 2 SCBs
Programmable Analog: A Closer Look

SmartFusion analog building block: 1 ADC, 1 DAC, 2 SCBs
(A2F200 has 2 of these)

- SDD = Sigma-Delta DAC
- TM = temp. monitor
- CM = current monitor
- ABPS = active bi-polar pre-scaler
SmartFusion Design Environment

- Full-featured traditional FPGA design flow
- Industry-leading software IDEs for embedded design
- Simulation, timing and power analysis reduce debug time
- Debug through FlashPro or standard RealView® header
MSS Configurator

- Configure the MSS peripherals and I/Os
- Create or import hardware configuration
- Automatically generate drivers for peripherals
- Configure programmable analog components

*MSS configurator enables co-design between multiple users*
SmartFusion Software Stack

Application Layer
- Customer Secret Sauce

Middleware
- TCP/IP, HTTP, SMTP, DHCP, LCD

OS/RTOS
- μC/OS-III, RTX, FreeRTOS

Drivers
- I²C Driver
- SPI Driver
- UART Driver
- Ethernet Driver
- Timer Driver
- eNVM Driver

Hardware Abstraction Layer
- Actel CMSIS-based HAL

Hardware Platform
- Actel SmartFusion

SmartFusion stack accelerates application development
Industry Leading Ecosystem Partners

- **Actel**
  - HAL, drivers and IDE

- **ARM Cortex-M3 processor**
  - Leverage ARM ecosystem

- **GNU, Keil and IAR**
  - Compilers and debuggers

- **Micrium**
  - RTOS, TCP/IP and middleware

- **Mentor and Synopsys**
  - Synthesis and simulation
SmartFusion:
Hardware & Solution Kits
Evaluation and Development Kits

- $99 – evaluate SmartFusion
- Evaluate and debug the entire system
- Tutorials and sample code
to accelerate learning curve

- $999 Development Kit
- More on-board memory
- I/O expansion header
- External memory expansion header
- Industrial automation interfaces
SmartFusion Evaluation Kit Board

- Work with standalone FPGA-based design
- Work with ARM Cortex-M3 processor and peripherals
- Add peripherals to the FPGA fabric used by the Cortex-M3 processor
- Experiment with programmable analog
- Create examples using full integration
SmartFusion Development Kit Board

- Add additional interfaces and peripherals
- Add more SRAM and Flash when more code space is required
- Develop complex systems with complete RTOS
Mixed-Signal Power Management (MPM)

- Demonstrates power management using SmartFusion
  - Power-up, monitor, voltage trim, data log and power-down
  - All configurable via standalone GUI tool on PC
  - Configuration changes via changing register values

- SmartFusion MPM solution includes
  - MPM daughter card: attaches to Evaluation kit
  - SmartFusion MPM design example
  - Standalone graphical configurator PC tool: Simplifies analog design
System Management

Fewer components, less board space, fewer vendors
System Management

Fewer components, less board space, fewer vendors
SmartFusion-based solutions for the xTCA™ market

- IPM Controllers (IPMCs) for ATCA boards
- Carrier IPMCs for ATCA AMC carrier boards
- Module Management Controllers for AMC modules

a dominant supplier of hardware platform management
Motor Control: Co-processing Benefit

Efficient co-processing performance between FPGA and MCU
Motor Control: Integration Benefit

SmartFusion replaces:
- ARM9
- SRAM FPGA
- Analog acquisition device array
SmartFusion Motor Control Partners

- Power and Control Design, Incorporated (PCD)
  www.powerandcontroldesign.com

- TRINAMIC Motion Control GmbH & Co.
  www.trinamic.com
Summary

- SmartFusion is the only device of its kind
  - FPGA + MCU subsystem + programmable analog

- Innovative, intelligent, integration made possible by Actel’s unique flash technology

- Easy-to-use tools for both FPGA and embedded designers

- In production now

For more information:  [www.actel.com/SmartFusion](http://www.actel.com/SmartFusion)
For Hands-on & Online Trainings : [www.actel.com/training](http://www.actel.com/training)