MSP Portfolio for Industrial Applications
Agenda

• MSP portfolio overview
• General purpose MCUs for simple applications
• Analog Integration
  – Signal chain integrated MCUs with op amps, DACs, etc.
  – Capacitive touch sensing MCUs
  – Ultrasonic sensing MCUs
• System Level Solutions
• Technical support
# MSP430™ MCU portfolio

General-purpose MCUs with broad analog signal chains options to meet your systems needs

<table>
<thead>
<tr>
<th>General purpose</th>
<th>Analog signal chain</th>
<th>Ease of Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowest cost GP MCUs offering</td>
<td>Configurable analog building blocks: DAC, OA, ADC</td>
<td>Full ecosystem of resources to accelerate every step of your design</td>
</tr>
<tr>
<td>Scalable portfolio from 0.5kB to 512kB of memory</td>
<td>Lowest power capacitive touch with best-in-class noise immunity to EMC disturbance</td>
<td>Get started quickly with LaunchPad™ kits &amp; MSP430Ware</td>
</tr>
<tr>
<td>25 functions for $0.25 with code examples</td>
<td>Ultrasonic sensing MCUs with analog front end</td>
<td>Develop and configure your designs with GUIs and countless technical contents &amp; reference designs</td>
</tr>
</tbody>
</table>
MSP430 General Purpose MCUs

Broad portfolio with integrated signal chain elements
MSP430 ultra low power mixed-signal MCUs offer a broad portfolio with varying levels of analog signal chain integration for addressing a wide range of applications.
MSP for building-block functions

- 25+ function replacements
- Cost-optimized general-purpose MCU
- Ready-to-use code
- E-book & videos to design faster

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<table>
<thead>
<tr>
<th>Memory</th>
<th>Primary Feature</th>
<th>Part Number</th>
<th>ti.com price</th>
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<tbody>
<tr>
<td>2KB</td>
<td></td>
<td>MSP430FR2110</td>
<td>$0.24</td>
</tr>
<tr>
<td>4KB</td>
<td></td>
<td>MSP430FR2111</td>
<td>$0.30</td>
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<tr>
<td>8KB</td>
<td></td>
<td>MSP430FR2422</td>
<td>$0.32</td>
</tr>
<tr>
<td>8KB</td>
<td>CapTIvate</td>
<td>MSP430FR2512</td>
<td>$0.52</td>
</tr>
<tr>
<td>16KB</td>
<td></td>
<td>MSP430FR2433</td>
<td>$0.50</td>
</tr>
<tr>
<td>32KB</td>
<td></td>
<td>MSP430FR2155</td>
<td>$0.62</td>
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<tr>
<td>64KB</td>
<td></td>
<td>MSP430FR2476</td>
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<tr>
<td>64KB</td>
<td>LCD</td>
<td>MSP430FR6972</td>
<td>$1.66</td>
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<tr>
<td>128KB</td>
<td></td>
<td>MSP430F5244</td>
<td>$1.94</td>
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<tr>
<td>128KB</td>
<td>LCD</td>
<td>MSP430F6726A</td>
<td>$2.38</td>
</tr>
<tr>
<td>256KB</td>
<td></td>
<td>MSP430FR5964</td>
<td>$2.13</td>
</tr>
</tbody>
</table>
Analog Integration
**MSP430 General Purpose MCUs**

### CapTIvate™ Technology

**Features/Benefits**

- **Noise Immune**
  - IEC61000-4-6 certified touch solution
- **Lowest Power**
  - 5uA wake-on-touch
- **High Resolution**
  - 30 cm slider with 1000 point resolution
- **Versatile**
  - Self and mutual capacitance
  - Up to 64 buttons, sliders, wheels or proximity sensing
  - Plastic, glass and metal overlays supported
- **Ease of use**
  - Set-up a design in five minutes with CapTIvate Design Center

### Ultrasonic Subsystem

**Features/Benefits**

- **Best in Class Performance**
  - 20yr battery life w/ lowest average power ~3uA
  - Best in class measurement accuracy in Zero Flow conditions; < 25ps accuracy
  - Reduced calibration time with standard deviation <32ps
  - Reduced external components allowing you to connect directly to your transducer
- **Ease of use**
  - GUI based configuration and calibration

### Smart Analog Combo

**Features/Benefits**

- **Flexible Analog Components**
  - Configurable Op-Amp
  - x33 PGA mode
  - 12-bit DAC
- **Reduced System Size**
  - BOM cost optimization
  - No or few external components required
  - Smaller PCB outline
- **Easy to use**
  - Straightforward software configuration
  - Can be changed on the fly

---

**Features/Benefits**

- **12-bit Reference DAC**
  - From Paired SAC Output
  - To Other Peripherals Reference

**Smart Analog Combo**

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**TI Information – Selective Disclosure**

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System-Level Solutions
MSP430 MCUs

Solves any applications in any markets

BUILDING AUTOMATION
- Door keypad and readers
- Video doorbell
- Intruder Detection
- Elevator Panels
- Camera

GRID INFRASTRUCTURE
- Gas Meter
- Water Meter
- Circuit Breaker
- Heat Meter
- 3Ph Meter
- Sub Meter
- Fault indicator
- Power Analyzers

FACTORY AUTOMATION
- Flow Measurement
- Temp Sensor
- Vibration Sensor
- Position Sensing
- Level Sensor
- Proximity Sensor
- Touch HMI

CONSUMER
- Headphones
- Refrigerator
- Stovetop
- Remote
- Speakers
- Garden Tools

TI Information – Selective Disclosure
IR Thermometer Overview

• An infrared thermometer can measure temperature without contact, which can help ease the spread of a contact infection.
• High performance ADC is required to samples high-precision signals collected by the analog infrared temperature sensor—typically single pixel thermomopile sensor

Product Benefits:

• Contactless temperature reading
• Portability to screen patients & gauge health
• Limits tester’s exposor risk
• Can provide instant on the spot readings

Key Care Abouts:

• Accuracy/Precision of sensing
• Number of readings per battery life
• Distance from thermometer to measurement surface
• Time to take measurement
• Battery shelf life (Iq)
Designing MSP430 for IR Thermometer

TI Information – Selective Disclosure
# MSP430 MCUs for IR Thermometers

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Non-volatile Memory (FRAM/Flash)</th>
<th>ADC</th>
<th>LCD</th>
<th>Packages</th>
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</thead>
<tbody>
<tr>
<td>MSP430FR4133</td>
<td>16KB FRAM</td>
<td>10-bit SAR</td>
<td>4 x 36 or 8 x 32 segments</td>
<td>TSSOP48, TSSOP56, LQFP64</td>
</tr>
<tr>
<td>MSP430FR2433</td>
<td>16KB FRAM</td>
<td>10-bit SAR</td>
<td>N/A</td>
<td>VQFN24, DSBGA24</td>
</tr>
<tr>
<td>MSP430F42x0</td>
<td>16-32KB Flash</td>
<td>16-bit Sigma-Delta</td>
<td>4 x 14 segments</td>
<td>SSOP48, VQFN48</td>
</tr>
<tr>
<td>MSP430I204x</td>
<td>16-32KB Flash</td>
<td>24-bit Sigma-Delta</td>
<td>N/A</td>
<td>TSSOP28, VQFN32</td>
</tr>
<tr>
<td>MSP430F6723A</td>
<td>64KB Flash</td>
<td>24-bit Sigma-Delta</td>
<td>320 segments</td>
<td>LQFP80, LQFP100</td>
</tr>
</tbody>
</table>

[Blog](#) on IR Thermometers
TI Smoke Alarm Solutions

UL217 8th edition will go into effect in 2020
• Detection of smoldering Polyurethane fires, which can burn hotter and faster leading to a reduction in escape time from 17 to 4 minutes
• Distinguish between real fire and false alarms (cooking, dust, etc)

Three TI solutions shown below:

### Discrete analog sensing

**Target subfamily:** General purpose amplifiers, MSP430 MCUs

**Collateral:**
- TIDA-010014: Photoelectric IR LED driver
- Transimpedance amplifier blog series
- TIDA-00756: CO detector
- MSP430™ ultra-low-power sensing & measurement MCUs

### Integrated analog sensing

**Target subfamily:** Custom, MSP430 MCUs

**Collateral:**
- TPS880x + MSP430 reference design
- MSP430™ ultra-low-power sensing & measurement MCUs

### Integrated analog sensing and digital

**Target subfamily:** MSP430 MCUs

**Collateral:**
- MSP430 MCUs Smart Analog Combo training
- Why design with MSP430FR2355?
- MSP-EXP430FR2355 LaunchPad Training
  Have your cake and eat it too: Analog solutions within a digital microcontroller
- How to Use the Smart Analog Combo in MSP430™ MCUs
Technical Support Resources
# More Efficient Product Development with MSP430™ MCUs

<table>
<thead>
<tr>
<th>EVALUATE</th>
<th>LEARN</th>
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<tbody>
<tr>
<td><strong>LaunchPads</strong></td>
<td><strong>EVM Platform:</strong> MSP-EXP430FR5969, MSP-EXP430FR2355, MSP-EXP430F5529LP</td>
</tr>
<tr>
<td><strong>BoosterPack Plug-ins</strong></td>
<td><strong>Sensors, Kentec LCD Display, Infrared Transceiver</strong></td>
</tr>
<tr>
<td><strong>Cloud Resources</strong></td>
<td><strong>CCS, GUI Composer, TI Resource Explorer, Energia</strong></td>
</tr>
<tr>
<td><strong>Trainings Videos</strong></td>
<td><strong>Getting started with MSP430 Sensing, analog signal-chain, and solution-centric training modules All training all easily found via TI Resource Explorer &amp; TI Training Portal</strong></td>
</tr>
<tr>
<td><strong>Technical Content</strong></td>
<td><strong>Technical articles and White Papers:</strong> FRAM or FLASH: How to select the right MCU for your application Migration Guides: MSP430F2xxx/G2xxx to MSP430FR4xxx</td>
</tr>
</tbody>
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**Rapid Learning**

with included training and examples

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**LEARNING**

Evaluate & Learn

Prototype & Develop

Debug & Optimize

Manufacture

**PRODUCT LIFE CYCLE**
## More Efficient Product Development with MSP430™ MCUs

### PROTOTYPE & DEVELOP

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
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<tbody>
<tr>
<td>EVMs</td>
<td>Target socket boards, Application specific EVMs: Capacitive Sensing, Ultrasonic, E-Meter</td>
</tr>
<tr>
<td>MSP430Ware</td>
<td>Low-level Code examples, Driver Library, and RTOS support</td>
</tr>
<tr>
<td>SW Libraries</td>
<td>PMBus, IQMATH, FRAM Utilities, USB Stack, etc. (Most available in MSP430Ware as well)</td>
</tr>
<tr>
<td>TI Designs</td>
<td>Application and sub-system specific reference designs available (TIDM Voice Band Audio)</td>
</tr>
<tr>
<td>Application Notes</td>
<td>System Level ESD Considerations, Random Number Generation, MSP Code Protection Features, Designing with Segment LCDs</td>
</tr>
</tbody>
</table>

### ROBUST FOUNDATION

Of design resources speeds prototyping and development

- **TI Cloud Dev Tools**
- **FOUNDATION**
- **Prototype & Develop**
- **Evaluate & Learn**
- **Debug & Optimize**
- **Manufacture**

**PRODUCT LIFE CYCLE**
More Efficient Product Development with MSP430™ MCUs

### DEBUG & OPTIMIZE

<table>
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<tr>
<th>IDEs</th>
<th>TI Code Composer Studio, and 3rd party: IAR, GCC</th>
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<tbody>
<tr>
<td>Debug Probes</td>
<td>MSP-FET, ez-FET (LaunchPad on board debugger), &amp; 3rd party tools</td>
</tr>
<tr>
<td>Utilities</td>
<td>Ultra Low Power Advisor &amp; EnergyTrace to optimize current consumption</td>
</tr>
<tr>
<td>Design Centers</td>
<td>Optimize and Validate whole applications: CapTIvate, Ultrasonic, Energy Measurement</td>
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### NEW INSIGHTS

discovered with analytic & design tools

### INSIGHTS

- **Design Centers**
  - Optimize and Validate whole applications: CapTIvate, Ultrasonic, Energy Measurement

- **Utilities**
  - Ultra Low Power Advisor & EnergyTrace to optimize current consumption

- **Debug Probes**
  - MSP-FET, ez-FET (LaunchPad on board debugger), & 3rd party tools

- **IDEs**
  - TI Code Composer Studio, and 3rd party: IAR, GCC

- **NEW INSIGHTS**
  - discovered with analytic & design tools

- **PRODUCT LIFE CYCLE**
  - Evaluate & Learn
  - Prototype & Develop
  - Debug & Optimize
  - Manufacture
More Efficient Product Development with MSP430™ MCUs

<table>
<thead>
<tr>
<th>Mass Production</th>
<th>Production Programmer</th>
<th>MSP-GANG Programmer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Custom Programming</td>
<td>High-volume customized programming/production</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Firmware Updates</th>
<th>HW Support</th>
<th>MSPBSL, USB FW Updates</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW Support</td>
<td>MSP-Boot, MSP-FRBOOT, Secure FW Updates, CryptoBSL</td>
<td></td>
</tr>
</tbody>
</table>

SCALABLE PRODUCTION
with multiple production programming options and field firmware update capabilities

Flexibility & Scalability

Evaluate & Learn

Prototype & Develop

Debug & Optimize

Manufacture

PRODUCT LIFE CYCLE
Slides Available ➔ training.ti.com/npu (later today)

New Product Updates for Industrial Applications

Join our webinar series, as we explore different industry trends and technologies across our diverse product portfolio.

Welcome to our New Product Update webinar series! Join in every Thursday as we explore different industry trends and technologies across our diverse product portfolio. Our experts cover the latest analog and embedded processing topics for industrial applications.

**Thursday, 9:00 AM Central US Time**

**Click to join Webex meeting**

**How to join:**
- Meeting number: 356 235 123
- When joining the Webex, please click Audio—Call Using Computer—Connect Audio.
- NOTE: Webex Audio is used for this webinar series
# Upcoming New Product Updates

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
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<tbody>
<tr>
<td>6/4/2020</td>
<td>Brushed &amp; Stepper Motor Solutions</td>
</tr>
<tr>
<td>6/11/2020</td>
<td>Boost Converters &amp; Controllers</td>
</tr>
<tr>
<td>6/18/2020</td>
<td>High Power Drivers</td>
</tr>
<tr>
<td>6/25/2020</td>
<td>Clock &amp; Timing Solutions</td>
</tr>
<tr>
<td>7/2/2020</td>
<td>Power Interface- USB</td>
</tr>
<tr>
<td>7/9/2020</td>
<td>Switching Regulators- Wide Vin &lt;100V</td>
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