MSP430 Day

Ultra-Low Power | High Integration | Easy-to-Use

Embedded Series 2011
MSP430
MCUs

Ultra-Low Power

World’s Lowest Power MCU
• Ultra-Low Power Active Mode
• 7 Low Power Modes
• Instant Wakeup
• All MSP430 devices are Ultra-Low Power

Integration

Intelligent Analog & Digital Peripherals
• Peripherals operate in low power modes
• Minimize physical footprint and Bill of Materials
• Featuring USB, RF, Capacitive Touch I/O, Metrology Engines, LCD, ADC, DAC, & MORE

Extensive Portfolio, Low Cost Options

Find the right MCU for you
• 300+ devices
• Up 256kB Flash, 18kB RAM, 24 package options
• Devices starting at $0.25 with Value Line
• Various levels of performance & integration

Easy to Get Started

Low cost and simple point of entry
• Complete kits starting @ $4.30
• One tool for all MSP430 devices
• GUI-based coding & debugging tools available
• Code, documentation & other resources online
MSP430-Enabled Applications

Thousands of applications are enabled by MSP430 MCUs

Differentiation is possible with MSP430 MCU’s Ultra-Low Power performance, high analog & digital peripheral integration, and easy-to-use tool chain.
MSP430 – Always Innovating

And we’re just getting started…

1971 – The Beginning
TI Invents the microcontroller

1994 – Hello World
MSP430 is born

1996 – 1 MU
MSP430 ships 1 Million Units

2000 – 1xx
First 8MHz devices

2004 – 2xx
First 16MHz devices

2006 – 100MU
MSP430 ships 100 Million units

2006 – eZ
Revolutionized tools with eZ430-F2013

2009 – Chronos
World’s first wearable development kit

2009 – 5xx
25MHz, Integrated USB

2009 – 200+ devices
Growing portfolio

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25MHz, Integrated USB

2010 – RF SoC
CC430 embedded RF

2010 – 0.9V
World’s first Native 0.9V microcontroller

2010 – 300+ devices
Largest ULP portfolio

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Largest ULP portfolio

2010 – $4.30
LaunchPad, world’s lowest cost tool released

2011 – 90k
90k LaunchPads shipped

2011 – FRAM
First catalog MCU with FRAM

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MSP430 Accolades and Awards

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<tr>
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<th>Best New Products of 2011</th>
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<td>ECN’s 2010 Reader’s Choice Winner</td>
<td>Boards, Modules &amp; Embedded Systems</td>
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<tr>
<td>EDN’s Hot 100 Products of 2010</td>
<td>Development Kits – MSP430 LaunchPad</td>
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<td>Embedded Computing Design Award 2010</td>
<td>Editor’s Choice - MSP430 Value Line</td>
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<tr>
<td>EDN’s 20th Annual Innovation Awards</td>
<td>Software/Embedded Tools - 2010</td>
</tr>
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</table>

MSP430 is paving the way for Ultra-Low Power and Easy-to-Use development.

- 2007 Manufacturer of the Year Global Design Chain Excellence
- 2007 EDN Innovation Development Kits
- 2006 Embedded System Design AdPower Award
- 2005 Electronic Products Product of the Year
- 2005 EE Times Ultimate Products

Continuing innovation…
MSP430 Key Values

Outlast your battery with MSP430 Microcontrollers

- Ultra-Low Power Active Mode
- 7 Flexible Low Power Modes
- Instant Wakeup from Low Power Modes
- Intelligent and autonomous peripherals

Ultra-Low Power
Ultra-Low Power Profile

- Low Power Active Mode
- 7 Flexible Low Power Modes
- <1µs wakeup time
- Autonomous, integrated peripherals

All Peripherals are available in Low Power Modes!

MSP430 was designed from the ground up for ULP performance
Ultra-Low Active Power

Ultra-Low Power Active Mode
@2.2V, 1MHz, Flash operation

F2xx (Gen purpose, max 16MHz)
  • 220uA

F4xx (w/LCD, max 16MHz)
  • 200uA

F5xx (Gen Purpose + USB, max 25MHz)
  • 160uA

MSP430 device with FRAM
  • <100uA

Nothing to hide! Baseline current includes:
• Zero-Power Brown Out Reset
• All peripherals are clocked and accessible
• All peripherals are available in Low Power Mode
• Ports are enabled
• Timers, WDT
• All interrupt sources

uA/MHz improves as CPU speed increases

Active Mode Leader

Minimize Active Current Consumption

Energy = Power * Time
7 Configurable Low Power Modes

Optimize your power profile and minimize average current consumption

<table>
<thead>
<tr>
<th>MSP430</th>
<th>Active</th>
<th>LPM0</th>
<th>LPM1</th>
<th>LPM2</th>
<th>LPM3</th>
<th>LPM3.5</th>
<th>LPM4</th>
<th>LPM4.5</th>
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<tbody>
<tr>
<td>CPU</td>
<td>ON</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SMCLK (Hi-Freq peripheral clk)</td>
<td>Avail.</td>
<td>Avail.</td>
<td>Avail.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>ACLK (Low Freq peripheral clk)</td>
<td>Avail.</td>
<td>Avail.</td>
<td>Avail.</td>
<td>Avail.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Autonomous peripherals</td>
<td>Avail.</td>
<td>Avail.</td>
<td>Avail.</td>
<td>Avail.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>RAM Retention</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>-</td>
</tr>
<tr>
<td>Brown Out Reset</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

Most Applications spend 99 to 99.9% of the time in a Low Power Mode

MSP430 has the most Low Power Modes for increased flexibility

---

Zero-Power BOR

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Best-in-Class Wake Up Time

Quick wake up from any of MSP430’s Low Power Modes

F2xx (Gen purpose, max 16MHz)
  • <1us
F4xx (w/LCD, max 16MHz)
  • <5us
F5xx (Gen Purpose + USB, max 25MHz)
  • <6us

Get back to Low Power Modes faster with MSP430’s instant wakeup!
Always-on Brownout Reset

BOR is always-on and active in all operation modes for robust solutions.

• Brown-out reset (BOR) forces the MCU to reset both on power-up/down
  – When $V_{CC}$ rises and when $V_{CC}$ falls below normal operating range, a POR is triggered. This enables robust solutions, and ensures the device has stable power before executing code.
• Zero-power Brown Out Reset
Can grapes power a microcontroller?

YES! With MSP430

MSP430 is the world’s lowest power MCU family, designed for ULP from the ground up.

- Ultra-Low Power Active Mode
- 7 Flexible Low Power Modes
- Instant wake up
- Integrated, intelligent peripherals

MSP430 can run a real-time clock and drive a 7-segment LCD off of a couple of grapes!

Learn more @ www.ti.com/ulp
What’s more important – Standby vs Active

It depends on your application!

<table>
<thead>
<tr>
<th></th>
<th>F241x</th>
<th>F543x</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active @ 8MHz</td>
<td>4.25 mA</td>
<td>1.32 mA</td>
</tr>
<tr>
<td>LPM3</td>
<td>0.8 uA</td>
<td>1.1 uA</td>
</tr>
</tbody>
</table>

- MSP430x2xx has lower LPM3 consumption
- MSP430F5xx has lower active power consumption

The crossover is at $\sim 0.04\%$ Active

Or about 35 seconds/day

This means that if the CPU is Active $>0.04\%$ of the time (or $>35$ seconds per day), the lower Active Mode power of the F5xx outweighs the lower LPM3 current advantage of the F2xx device.
ULP is Easy!

• Using our Low Power Modes are easy

```c
void main(void)
{
    WDT_init(); // initialize Watchdog Timer
    while(1)
    {
        __bis_SR_register(LPM3_bits + GIE); // Enter LPM3, enable interrupts
        activeMode(); // in active mode. Do stuff!
    }
}

#pragma vector=WDT_VECTOR
__interrupt void watchdog_timer (void)
{
    __bic_SR_register_on_exit(LPM3_bits); // Clear LPM3 bits from 0(SR), Leave LPM3, enter active mode
}
```
MSP430 for Energy Harvesting
“Self or Perpetual - Power” Apps

- **Energy harvesting** is the process by which energy is captured and stored.
- Can substitute batteries that are costly to maintain and can extend system uptime.
- Only possible with ultra-low power components.
- Solar, kinetic, thermal, RF, salinity gradients, pH difference and other ambient sources available.

**Ambient energy:** light, heat, motion, RF, etc.

**Perpetually Powered Sensor**

- **Energy Harvester**
- **Energy Storage & Power Mgmt**
- **Sensor(s)**
- **Ultra Low Power Microcontroller**
- **Low Power Transceiver**

**Environment:** temperature, status, position, etc.

- Body worn monitoring devices powered by body heat, movement.
- Monitor conditions on farm, winery, etc.
- Mesh networking for environmental monitoring (e.g. forest fire detection).
- Automotive monitoring (e.g. tire pressure gauges powered by vibration).

**Energy Harvesting Made Easy – MSP430 Solutions**

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Battery Life when 1% Active

MSP430 lasts 2 years longer than closest competitor!

MSP430’s Ultra-Low Power Active Mode mode plays an important part in keeping average current consumption is at a minimum.

• 1% Active ~ 14.4 minutes/day
• Application examples: Portable Medical, Blood Glucose Meters, thermometers, etc.

MSP430’s Ultra-Low Power Active Mode maximizes your customer’s battery life!
Battery Life when 0.1% Active

MSP430 lasts 33% longer than closest competitor!

Low Power Modes play an important part in keeping average current down.
• 0.1% Active ~ 1.4 minutes/day
• Application examples: Wireless Sensor Networks, Smoke Detectors
• OUTLAST Battery Leakage!
Largest, most-scalable ULP portfolio

- 300+ Devices
- Various levels of integration
- Do more with less
- Devices starting @ $0.25USD
- Mature portfolio
High analog and digital integration

**300+ Device Configurations**
- **Flash**: Up to 256kB Flash, 512kB on the way
- **RAM**: Up to 18kB RAM
- **Package/Pin Count**: 24 packages, up to 113 pins
- **Cost effective**: MSP430 Value Line MCUs @ $0.25

**Innovative Integration**
- **FRAM** – the future of Embedded Memory
- **Capacitive touch I/O** – directly interface with pads
- **Hi-Resolution Timer** – 4ns resolution
- **A-POOL** – Configurable analog blocks
- **USB** – High Speed 2.0
- **RF** – Sub-1GHz (433, 868, 915MHz)
- **ESP430** – 2nd core for eMetering algorithms

**Full peripheral set**
- **Devices integrated with**:
  - 10, 12-bit ADC
  - 16-bit Sigma Delta
  - 12-bit DAC
  - 16-bit Timers
  - I2C, SPI, UART
  - LCD Driver
  - USB
  - Integrated RF
  - Comparator
  - OpAmps
  - Direct Memory Access Module
  - Hardware Multipliers
    - AES128 Encrypt/Decrypt module
- **Watchdog Timer**
- **Brown-Out Reset**
- **Capacitive Touch I/O ports**
- **Real-Time Clock**
- **Power Management Module**
MORE…

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Intelligent, autonomous peripherals allow developers to do all of this and more without the CPU.

Do More in Low Power Modes

Productive Low Power Modes allow:
- Take ADC Samples
- Transfer data throughout memory range
- Output PWM signal
- Update LCD
- Send & receive serial communication

Intelligent, autonomous peripherals allow developers to do all of this and more without the CPU.

Stay in Low Power Mode longer!
Fast Flexible 10- and 12-bit ADCs

**Features**
- 10-bit & 12-bit ADCs at the rate of 200ksps
- Autoscan
- Single, Sequence, Repeat-single, Repeat-sequence
- Timer triggers
- Data Transfer Controller (DTC)
- DMA Enabled

**Benefits**
- Fast sample/conversions for greater accuracy
- Sample data autonomously in Low Power standby modes – without the CPU!
- Stay in Low Power Modes, minimizing current consumption
- Transfer samples to anywhere in memory using the DTC and DMA – all while in Low Power standby modes!
16-bit Sigma Delta

**Features**
- 2nd order 16-bit sigma-delta architecture
- Multiple channels
- 30kHz to 1.1MHz modulation frequency
- Modulation frequency divider
- Up to 1024 OSR
- Temperature sensor
- AVCC measure
- Up to 4096 samples/sec
- Gain amplifier to support wide range of current measurements
- SW selectable internal/external reference

**Benefits**
- High accuracy and resolution!
- Capable of implementing anti-tampering needs in applications such as utility metering.
- Same Low Power capabilities as ADC10 and ADC12
**DAC12**

**Features**
- 12-bit monotonic
- 8/12-bit voltage output
- Programmable settling time versus power
- Int/ext reference
- Binary or 2’s compliment
- Self-calibration
- Group sync load
- DMA enabled

**Benefits**
- Configurable balance between performance and power
- Allows synchronous update operations when multiple modules are available
- Output waves while in Low Power standby modes to minimize current consumption!
Analog Comparators

Features
- ~100nA operation (Comp_B)
- Hysteresis generator (B)
- Input multiplexer
- Reference generator
- Low-pass filter
- Battery detect
- Interrupt source
- Timer_A capture
- Multiplexer short for sample-and-hold

Benefits
- Ultra-Low Power operation extends battery life
- Enables monitoring of external analog signals
- Supports precision slope Analog to Digital Conversions
LCD Controllers

Features
- Fully automatic
- 4/3/2/1 mux
- Up to 160-bit display
- Internal regulated voltage generator
- Internal or external bias generation
- Contrast control
- 1/2 bias for 3 or 4 mux
- Internal clock generation
- Auto segment blinking

Benefits
- Ultra-Low Power functionality
- Easy integration
- Flexible LCD support
USCI: Serial Communication I/F

**USCI_A**

- UART with IrDA/LIN support or SPI
- Baud-rate generator with auto-baud rate detect
- Double buffered TX/RX

**USCI_B**

- I2C master/slave up to 400kHz or SPI
- Bit clock generator
- Double buffered TX/RXs
MSP430 Package Options

- Ranging from 14 – 113 pins
- Die-sized BGA now available!
  - F2370: 3.232x3.232mm (49 pins)
  - F22xx: 3.33x3.49mm (49 pins)

25+ packages!
MSP430 Portfolio at a glance

300+ Ultra-Low Power Devices Starting @ $0.25USD
Featuring: Up to 256kB Flash, 18kB RAM, 24 Package Options, Up to 113 pins, High integration

MSP430
16-bit RISC CPU

All devices feature:
- 16-bit timers
- Watchdog Timer
- Internal Digitally Controlled Oscillator
- External 32-kHz crystal support
- <50 nA pin leakage
- <6 µs wakeup

L092
0.9V-1.65V
Speed 4Mhz
ROM to 2kB
RAM to 2kB
GPIO 11

G2xx
Speed 16Mhz
Flash 0.5-8kB
RAM to 256kB
GPIO 10-16

F2xx
Speed 16Mhz
Flash 1-120kB
RAM to 8kB
GPIO 10-64

F4xx
Speed 8/16Mhz
Flash 4-120kB
RAM to 8k
GPIO 14-80

F5xx
Speed 25Mhz
Flash 8-256kB
512kB coming soon.
RAM to 18kB
GPIO 32-83

CC430
Speed 20Mhz
Flash 8-32kB
RAM to 4kB
GPIO 40

$0.25

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MSP430 Portfolio at a glance

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### Ultra-Low Power Performance
- **L092**
  - 0.9V-1.65V
  - Speed 4MHz
  - ROM to 2kB
  - RAM to 2kB
  - GPIO 11
- **F1xx**
  - Speed 8Mhz
  - Flash 1-60kB
  - RAM to 10kB
  - GPIO 14-48

### Analog Integration
- **F2xx**
  - Speed 16Mhz
  - Flash 0.5-8kB
  - RAM to 256kB
  - GPIO 10-16

### Easy-to-Use
- **CC430**
  - Speed 20Mhz
  - Flash 8-32kB
  - RAM to 4kB
  - GPIO 40

The **MSP430F1xx** is a general purpose, flash-based microcontroller family.
- Up to 8MHz CPU speed
- Flash size up to 60kB
- RAM size up to 10kB
- GPIO: 14 – 48

**MSP430**
- 16-bit RISC CPU

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- 16-bit timers
- Watchdog Timer
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MSP430 Portfolio at a glance

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Featuring: Up to 256kB Flash, 18kB RAM, 24 Package Options, Up to 113 pins, High integration

The MSP430F2xx generation features ultra-low power, general purpose, flash-based microcontrollers.
- Up to 16MHz CPU speed
- Flash size up to 120kB
- RAM size up to 8kB

Speed 16Mhz
Flash 1-120kB
RAM to 8kB
GPIO 10-68

All Devices
Some Devices

Ultra-Low Power Performance
Analog Integration
Easy-to-Use

MSP430
16-bit RISC CPU

All devices feature:
- 16-bit timers
- Watchdog Timer
- Internal Digitally Controlled Oscillator
- External 32-kHz crystal support
- <50 nA pin leakage
- <6 μs wakeup

L092
0.9V-1.65V
Speed 4Mhz
ROM to 2kB
RAM to 2kB
GPIO 11

G2xx
BOR
DAC8
Comp
SVS
SVS
BOR
A-POOL
ADC8

F2xx
Speed 16Mhz
Flash 1-60kB
RAM to 10kB
GPIO 14-48

The MSP430F2xx generation features ultra-low power, general purpose, flash-based microcontrollers.
- Up to 16MHz CPU speed
- Flash size up to 120kB
- RAM size up to 8kB

Speed 16Mhz
Flash 1-120kB
RAM to 8kB
GPIO 14-80

F5xx
Speed 25Mhz
Flash 8-256kB
512kB coming soon.
RAM to 18kB
GPIO 32-83

CC430
Speed 20Mhz
Flash 8-32kB
RAM to 4kB
GPIO 40

Ultra-Low Power Performance
Analog Integration
Easy-to-Use

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What’s New in 2xx
MSP430AFE2xx
Metrology Analog Front End

Performance
• 16-bit RISC architecture, 62.5ns instruction cycle time
• Ultra-Low-Power, Integrated Analog, and Easy-to-Use

Features
• Low supply voltage range 1.8-3.6V
• Ultra-low power in active and sleep modes and ultrafast wake-up from standby mode in <1 μs
• 3 independent ΣΔ convertors with 8ch each
• USART communication
• 24-pin TSSOP (PW)

Benefits
• Cost optimized for analog front end in metering, power monitors, high-precision measurements
• <0.1% metering accuracy for precise energy measurements with a 2400:1 dynamic range with ΣΔ convertors
• Anti-tampering capabilities with an additional ΣΔ convertor
• Lower system power due to world’s lowest power MCU
• Small Footprint of 24-pin (35-50sqmm) enables solutions for in-system power monitoring and industrial sensing
• More robust performance and software development with simultaneous sampling

Tools
• Development/ Target Board MSP-TS430PW24
• 1-phase EVM in works – to be available 1Q2011
• Complete metering software available with EVM

Applications include:
• Single phase e-meter (with anti-tampering)
• Power Monitoring (Servers, Appliances, Branch Meters)
• High-precision measurements and Sensors

MSP430F2043 Microcontroller
16-bit RISC Orthogonal MCU
16 MHz

Memory
16/8/4 kB Flash
512/512/256 B RAM

Debug
Real-time JTAG / SBW
Embedded Emulation

Clock System:
• High Freq Crystal Osc
• Digitally Controlled Osc (DCO)
• VLO

Power on Reset
Brownout Reset
Supply Volt Supervisor

Peripherals
16-bit Multiplier
15/16 bit Watch Dog Timer

Serial Interface
USART (UART, SPI) @8MHz

Connectivity
11 I/Os
### MSP430 Portfolio at a glance

#### 300+ Ultra-Low Power Devices
Starting @ $0.25USD

**Featuring:** Up to 256kB Flash, 18kB RAM, 24 Package Options, Up to 113 pins, High integration

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#### MSP430

**16-bit RISC CPU**

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All devices feature:
- 16-bit timers
- Watchdog Timer
- Internal Digitally Controlled Oscillator
- External 32-kHz crystal support
- <50 nA pin leakage
- <6 µs wakeup

---

**The MSP430G2xx Value Line generation features ultra-low power, general purpose, flash-based microcontrollers. starting at just $0.25!**

- Up to 16MHz CPU speed
- Flash size up to 8kB (16kB coming!)
- RAM size up to 256B (512B coming!)
- GPIO: 10 – 16
- Featuring Capacitive Touch I/O ports

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<table>
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<tr>
<th>Device</th>
<th>Speed</th>
<th>Flash</th>
<th>RAM</th>
<th>GPIO</th>
</tr>
</thead>
<tbody>
<tr>
<td>L092</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>G2xx</td>
<td>16MHz</td>
<td>0.5-8kB</td>
<td>256B</td>
<td>10-16</td>
</tr>
<tr>
<td>F4xx</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F5xx</td>
<td></td>
<td></td>
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<tr>
<td>CC430</td>
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</tbody>
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**Starting @ $0.25USD**

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**Embedded Series**

MAKE THE SWITCH

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[Image of MSP430 Portfolio]
MSP430G2xx Value Line MCUs deliver 16-bit performance & ultra-low power at 8-bit price

<table>
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<tr>
<th>Safety &amp; Security</th>
<th>Lighting</th>
<th>Touch pads</th>
<th>Consumer Electronics</th>
<th>Personal Health &amp; Fitness</th>
<th>Intelligent Sensors</th>
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<td>PIC10F202</td>
<td>MSP430G2001</td>
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<table>
<thead>
<tr>
<th>Price</th>
<th>$0.25</th>
<th>$0.25</th>
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<tbody>
<tr>
<td>Flash</td>
<td>512B Ext 12V</td>
<td>512B In System</td>
</tr>
<tr>
<td>RAM</td>
<td>25B</td>
<td>128B</td>
</tr>
<tr>
<td>Timers</td>
<td>8-bit counter</td>
<td>16-bit multifunction</td>
</tr>
<tr>
<td>Emulation</td>
<td>0</td>
<td>2-pin In System</td>
</tr>
<tr>
<td>GPIO/Interrupts</td>
<td>6 0</td>
<td>10 22</td>
</tr>
<tr>
<td>MIPS</td>
<td>1x 8-bit</td>
<td>16x 16-bit</td>
</tr>
<tr>
<td>Power Modes</td>
<td>2</td>
<td>5</td>
</tr>
</tbody>
</table>

- **Flexible**
- **Agile**
- **More Functionality**
- **Faster Development**
- **No Compromise**
- **Hi-Performance**
- **MSP430 is lower power in all modes of operation**

**150+ new devices**

**Phase 1 – Now!**
- 27 devices, 2kB
- Flash, 10 GPIO, 128B RAM

**Phase 2 – Now!**
- 60+ devices, 8kB
- Flash, 16 GPIO, 512B RAM, CapTouch I/O

**Phase 3 – April ‘11**
- 60+ devices, 16kB
- Flash, 24 GPIO, 1kB RAM, Cap Touch I/O, UART

**ARROW ELECTRONICS AND TEXAS INSTRUMENTS**

**Embedded Series**

**MAKE THE SWITCH**
MSP430 Capacitive Touch Sense

**Benefits & Features**

- **Reduced System Size and Cost**
  - Does not require external components to interface with capacitive touch pads
  - Oscillation circuitry is integrated into the MCU

- **Easy to Get Started**
  - Complete hardware and software reference design avail.
  - Supported by full software library with intuitive API calls
  - Provides instant differentiation! Replace any physical button with capacitive touch buttons, sliders, wheels, etc!

**Devices, Tools, SW available today!**

- MSP430G2xx2: Now!
- MSP430G2xx3: April. 2011

Start Today!

www.ti.com/capacitivetouch
Complete HW & SW solutions

The MSP430G2xx2/2xx3 devices are the first to include an integrated Capacitive Touch Sense I/O ports.

• Lowest power, lowest cost solution
• No external components needed
• Full support from Capacitive Touch Sense Library

Add instant differentiation with Capacitive Touch for just $4.30

Learn more @ www.ti.com/ulp
For more information on the MSP430G2xx Value Line family, visit www.ti.com/430value
**MSP430 Portfolio at a glance**

300+ Ultra-Low Power Devices Starting @ $0.25USD

**Featuring:** Up to 256kB Flash, 18kB RAM, 24 Package Options, Up to 113 pins, High integration

---

### MSP430

16-bit RISC CPU

All devices feature:
- 16-bit timers
- Watchdog Timer
- Internal Digitally Controlled Oscillator
- External 32-kHz crystal support
- <50 nA pin leakage
- <6 µs wakeup

The **MSP430F4xx** generation features ultra-low power, highly-integrated, flash-based microcontrollers:
- Up to 16MHz CPU speed
- Flash size up to 120kB
- RAM size up to 8kB
- GPIO: 14 – 80
- Ideal for metering and medical-specific apps
- Featuring SD16, OpAmps, ESP430, LCD, and more

---

### Ultra-Low Power Performance

<table>
<thead>
<tr>
<th>Speed</th>
<th>Flash Size</th>
<th>RAM Size</th>
<th>GPIO</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/16MHz</td>
<td>4-120kB</td>
<td>8kB</td>
<td>14-80</td>
</tr>
</tbody>
</table>

### Analog Integration

<table>
<thead>
<tr>
<th>Comp_A</th>
<th>DAC12</th>
<th>DMA</th>
<th>OpAmp</th>
<th>SVS</th>
<th>USCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temp</td>
<td>SVM</td>
<td>MPY</td>
<td>USCI</td>
<td>USCI</td>
<td></td>
</tr>
<tr>
<td>USCI</td>
<td>ESP430</td>
<td>USCI</td>
<td>USCI</td>
<td>WATCH</td>
<td></td>
</tr>
<tr>
<td>SCAN_IF</td>
<td>Basic Timer</td>
<td>WDT</td>
<td>WDT</td>
<td>WDT</td>
<td></td>
</tr>
<tr>
<td>WDT</td>
<td>WDT+</td>
<td>WDT</td>
<td>WDT</td>
<td>WDT</td>
<td></td>
</tr>
<tr>
<td>RTC_C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### F5xx

Speed 25MHz
Flash 8-256kB
RAM to 8kB
GPIO 14-80

### CC430

Speed 20MHz
Flash 8-32kB
RAM to 4kB
GPIO 40

---

**ARROW ELECTRONICS AND TEXAS INSTRUMENTS**

Embedded Series

MAKE THE SWITCH
eMetering-specific devices from MSP430 are integrated with the unique ESP430 peripheral.

- **Embedded Signal Processor (ESP)**
- **ESP430** - Energy metrology engine running parallel to MSP430 CPU activity
- Dedicated use of SD16s and Hardware multiplier
- Combines analog and digital signal processing
- Returns energy, power, voltage, current and power factor measurements
- Offload the MSP430 CPU by allowing the ESP430 to handle eMetering specific algorithms.
- Black box operation
ESP: Single-Chip E-Meter

**Features**

- An embedded SoC dedicated to E-metering function
- Measures 2 or 3 wire, single phase energy and automatically calculates energy, power factor, etc.

**Benefits**

- Minimize system size with true SoC functionality
- Reduce total system chip count by 80%
- Maximize CPU offload with true encapsulated single phase e-meter module
- ESP430 offers black box operation, which simplifies eMetering application development.
### MSP430 Portfolio at a glance

**300+ Ultra-Low Power Devices** Starting @ $0.25USD

**Featuring:** Up to 256kB Flash, 18kB RAM, 24 Package Options, Up to 113 pins, High integration

---

**MSP430**

16-bit RISC CPU

All devices feature:
- 16-bit timers
- Watchdog Timer
- Internal Digitally Controlled Oscillator
- External 32-kHz crystal support
- <50 nA pin leakage
- <6 µs wakeup

The **MSP430F5xx** generation features ultra-low power, high-performance, flash-based microcontrollers

- Up to 25MHz CPU speed
- Flash size up to 256kB (512kB coming!)
- RAM size up to 18kB
- GPIO: 32 – 83
- Ideal for general purpose, consumer electronics, point of sales
- Featuring integrated USB, LCD, and more

---

**F5xx**

Speed 25Mhz
Flash 8-256kB
512kB coming soon.
RAM to 18kB
GPIO 32-83

**CC430**

Speed 20Mhz
Flash 8-32kB
RAM to 4kB
GPIO 40

---

**ARROW Electronics and Texas Instruments**

**Embedded Series**

**MAKE THE SWITCH**
5xx Key Features

• Ultra-Low Power
  – <200 μA/MIPS
  – 1.2 μA standby mode
  – Integrated LDO, BOR, WDT+, RTC
  – 12 MHz @ 1.8V
  – Wake up from standby in <5 μs

• Increased Performance
  – Up to 25 MHz
  – 1.8V ISP Flash erase and write
  – Fail-safe, flexible clocking system
  – User-defined Bootstrap Loader
  – Up to 1MB linear memory addressing

• Innovative Features
  – Multi-channel DMA supports data movement in standby mode
  – Industry leading code density
  – More design options including USB, RF, encryption, LCD interface
  – Unique Power Management Module
  – USB Options
What’s New in 5xx?

MSP430F51xx
HiResPWM, CompB, 5V I/O

Performance
- 16-bit RISC architecture, 40ns instruction cycle time
- Ultra-Low-Power, Integrated Analog, and Easy-to-Use

Features
- F5xx Architecture
- Ultra-low power in active and sleep modes
- Ultrastandby mode in <1 μs
- Low supply voltage range 1.8-3.6V
- Timer_D supporting Hi-resolution PWM
- Comp_B with 16 inputs
- 5V tolerant push and pull IOs
- 38-pin DA (TSSOP); 40-pin RHA (QFN) (6mm x 6mm)

Benefits
- Precise control applications such as LED lighting or motor control
  due to 4ns Hi-res timer
- Cap touch applications such as cell phone keypad, legacy button
  replacements, PC mouse – enabled by 16 input comparator
  optimized for RO cap touch
- Driving Bright LEDs and ideal for battery operated devices due to
  world’s lowest power MCU
- Small Footprint of QFN package

Tools
- MSP-TS430RSB40 Target Board - with a mounted 40-pin ZIF
  socket to fit MSP430 F51x2 40pin WQFN package
- TBD - Lighting Demo Kit showing PFC Buck, DC/DC buck boost
  capabilities, wireless control, and DALI, DMX512 protocols

Applications include:
- LED lighting Applications with AC inputs
- Portable LED Back Light solutions
- Battery powered LED spatial lighting
- High resolution Cap Touch
Embedded full-speed USB 2.0 (12 Mbps)
High flexibility with configurable 2K data buffers that can be used as RAM
Unused USB interface pins can function as high-current I/O pins (5 volt tolerant)

Ultra-low power MCUs + USB for smarter connectivity

Multiple analog options with 12-bit ADC, DAC, comparator
Integrated 3.3V LDO for use with 5V USB bus power
Uses low-cost crystal for USB clock, with flexible, integrated PLL

Analog and peripheral integration reduces system cost

Integrated 160 segmented LCD driver
Higher flash memory options up to 256KB
Battery back-up switch and Enhanced Data Integrity (EDI) feature for added reliability

Added features within MSP430 devices
MSP430 w/USB Roadmap

- **F552x / F551x**
  - 25 MHz
  - 32 -128 KB Flash
  - ADC12, Comp, USB
  - From $2.15

- **F550x/F5510**
  - 25 MHz
  - 8-32 KB Flash
  - ADC10, Comp, USB
  - From $0.96

- **F663x / F563x**
  - 20 MHz
  - Upto 256KB Flash
  - ADC12, DAC12
  - USB, EDI, LCD
  - From $3.49

- **10 Devices**
  - F550x

- **13 Devices**
  - F552x/1x

- **18 Devices**
  - F66xx/56xx

- **Ultra-low power with USB**

- **Performance & integration More Flash**

- **Cost efficient w/ reduced features**

ARROW ELECTRONICS AND TEXAS INSTRUMENTS

Embedded Series

MAKE THE SWITCH
MSP-EXP430F5529 USB Experimenter Board

- Development platform for USB applications.
- 102x64 dot-matrix LCD
- microSD card slot
- 3-axis accelerometer
- 5 cap touch pads
- Built-in interface for Low Power Wireless RF modules (CCxxxxEMK)
- 9 LEDs
- analog thumb-wheel
- easy access to spare pins
- standard JTAG access
- integrated eZ-FET Spy Bi-Wire debug interface (USB FET not required for programming and debugging)

Available Now: $149  $75

www.ti.com/usbexp
USB Software Tools

MSP430 Software Tools make USB development EASY

USB Developer’s Package

Includes SW Tools, Documentation & Examples

• **MSP430 API Code Stacks**  All necessary APIs & examples to start USB development

• **USB Field Firmware Updater**  Project template for building a GUI-based tool that upgrades MSP430 firmware in the field using MSP430’s on-chip USB BSL.

• **Windows HID API**  API enabling USB communication between PC and MSP430 MCU

• **USB Descriptor Tool**  Code generation tool for configuring the USB API stack for various interfaces.

Learn more @ www.ti.com/430usb
For more information on F5xx and the USB Ecosystem, visit:

www.ti.com/5xx
MSP430 Portfolio at a glance

300+ Ultra-Low Power Devices Starting @ $0.25USD
Featuring: Up to 256kB Flash, 18kB RAM, 24 Package Options, Up to 113 pins, High integration

The CC430 generation features ultra-low power, MCU+RF, flash-based system-on-chip microcontrollers
• Up to 20MHz CPU speed
• Flash size up to 32kB
• RAM size up to 4kB
• GPIO: 40
• Ideal for wireless, smart sensors, asset tracking
• Featuring monolithic, sub-1GHz integrated RF, LCD, AES128-bit encryption
MSP430 – Your Low Power RF Protocol/Applications Microcontroller

<table>
<thead>
<tr>
<th>Application</th>
<th>RF Systems-on-Chip</th>
<th>Application MCU RF Radio</th>
<th>Application MCU+ RF Protocol Processor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application</td>
<td>RF SoC (CC430, CC2430, CC2510, CC1110)</td>
<td>MSP430 (F54xx, F24xx, F26xx)</td>
<td>MSP430</td>
</tr>
<tr>
<td>Wireless Protocols</td>
<td>Protocol processor (CC2480, CC430)</td>
<td>Transceiver (CC1101, CC2500, CC2520)</td>
<td></td>
</tr>
<tr>
<td>Radio</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

http://focus.ti.com/apps/docs/appcategory.tsp?appId=171&DCMP=TIHeaderTracking&HQS=Other+OT+hdr_a_wireless
CC430 | MCU with integrated RF (SoC)

MSP430™ Microcontroller
- Industry’s lowest power MCU
- 16-bit RISC architecture
- 20 MHz processor
- High-performance analog
- Sensor interface

CC1101 RF Transceiver SoC
- High sensitivity
- Low current consumption
- Excellent blocking performance
- Flexible data rate & modulation format

Intelligent Peripherals
- 100 nA comparator
- 8ch 12-bit ADC offering 200-ksp
- 96 segment LCD controller
- 128-bit AES security encryption/decryption coprocessor

48/64-Pin QFN Package
- 7x7 mm² / 9x9 mm² area
CC430 derivatives

<table>
<thead>
<tr>
<th>With LCD module</th>
<th>Without LCD module</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CC430F6137</strong></td>
<td><strong>CC430F5137</strong></td>
</tr>
<tr>
<td>(LCD, ADC, Comparator B, 64-Pin)</td>
<td>(ADC, Comparator B, 48-Pin)</td>
</tr>
<tr>
<td>32KB+512B FLASH</td>
<td>32KB+512B FLASH</td>
</tr>
<tr>
<td>4KB RAM</td>
<td>4KB RAM</td>
</tr>
<tr>
<td><strong>CC430F6135</strong></td>
<td><strong>CC430F5135</strong></td>
</tr>
<tr>
<td>(LCD, ADC, Comparator B, 64-Pin)</td>
<td>(ADC, Comparator B, 48-Pin)</td>
</tr>
<tr>
<td>16KB+512B FLASH</td>
<td>16KB+512B FLASH</td>
</tr>
<tr>
<td>2KB RAM</td>
<td>2KB RAM</td>
</tr>
<tr>
<td><strong>CC430F6127</strong></td>
<td><strong>CC430F5133</strong></td>
</tr>
<tr>
<td>(LCD, Comparator B, 64-Pin)</td>
<td>(ADC, Comparator B, 48-Pin)</td>
</tr>
<tr>
<td>32KB+512B FLASH</td>
<td>8KB+512B FLASH</td>
</tr>
<tr>
<td>4KB RAM</td>
<td>2KB RAM</td>
</tr>
<tr>
<td><strong>CC430F6125</strong></td>
<td></td>
</tr>
<tr>
<td>(LCD, Comparator B, 64-Pin)</td>
<td></td>
</tr>
<tr>
<td>16KB+512B FLASH</td>
<td></td>
</tr>
<tr>
<td>2KB RAM</td>
<td></td>
</tr>
</tbody>
</table>
CC430 Offers Unique Peripherals

**LCD_B**

- Blinking of individual segments, Programmable frame frequency, Software-driven contrast control
- Regulated charge pump
- Integrated drivers

**AEC 128**

- **Encryption and decryption** according to AES FIPS PUB 197 with 128-bit keys
- Key expansion for en- and decryption
- Off-line key generation for decryption

**Comparator_B**

- Flexible - Selectable ref. voltage & voltage hysteresis generator
- High-speed, normal, and ultra-low power 100nA modes
- Internal output to Timer A capture
- Selectable RC filter for comparator output
Broad range of applications benefit from low power networking

**Consumer / personal networking**
- Watch/shoe combination for monitoring of miles and calories
- Enough processing for wireless networking and batteries that 10+ years

**Industrial remote monitoring**
- Low power sensor networks for innovative applications like remote monitoring for stress cracks
- Harvest energy from motion, vibration and heat

**Shipment monitoring**
- Information transmitted wirelessly is protected via encryption for more secure systems
- Location, tamper detection and temperature monitoring
Strong, Vibrant Ecosystem & Solutions

- **sensinode • 6LoWPAN**
  - IPv6 over low-power wireless area networks
  - Highly efficient use of code and memory
  - Direct end-to-end Internet integration
    - Multiple topology options

- **Wireless M-BUS**
  - Meter-to-meter communication
  - Enables a simple star network topology that fits very well to the applications’ requirements.
  - Sub 1 GHz band (868 MHz)
    - Quality and low power consumption of the transmission critical

- **DASH7**
  - Ultra-Low Power, Low Bandwidth space
    - Range is scalable, 10 - 2000 m (1.2 mi)
      - 433 MHz, 28 kbps
  - Mandated by U.S. Department of Defense, allied militaries
  - Asset Tracking, Tire pressure monitoring → sensors, security

Home automation & Lighting Control

Meter-to-Meter communication

Asset Tracking & Tire Pressure Monitor

Embedded Series

ARROW ELECTRONICS AND TEXAS INSTRUMENTS

MAKE THE SWITCH
RF Software Tools

MSP430 Software Tools make USB development EASY

SmartRF Studio

- Intuitive tool for evaluating TI’s Low Power RF ICs and SoCs
- Generates device register values
- Tests RF performance and tune customer-specific hardware solutions.

Packet Sniffer

- Analyze RF packets in real-time to greatly simplify RF debugging
- Display and store RF packets captured with a listening RF device
- Filters and decodes packets and displays them in a convenient way!

Spectrum Analyzer (sub-1GHz) – coming soon
EM430F6137RF900 Sample Kit
CC430 Experimenter’s kit

CC430F6137 base board:
• With custom LCD
• eZ430 emulator with backchannel
• All CC430 I/Os accessible
• 4 LEDs & 4 buttons, small soldering area
• Light Sensor + small F5137 base board

CC430F5137 satellite board
• Small off-the-shelf amber wireless module on carrier PCB
• Can be debugged/programmed with base board
• Satellite board based on off-the-shelf module from Amber-Wireless

In the box
• 1x Baseboard with batteries
• 1x satellite with batteries
• 1x USB cable
• wire antenna in addition to chip antenna + spare caps to select antenna (have to be soldered)

Pricing: US  $149 Coming soon!
Chronos | World’s first wearable development kit

- 3D Accelerometer
- Pressure & Altitude Sensor
- Temperature Sensor
- Voltage & Battery Sensor
- CR2032 Battery
- <1GHz RF
- CC430F6137 MCU
- 96 segment LCD
- Buzzer
- 2-Wire JTAG Access
- eZ430 Programmer
- RF Access Point
- Chronos Disassembly Tool
Demo Break | Chronos

World’s first wearable development tool

Get started with RF development

Integrated with the CC430 MCU + RF SoC

- Sub 1GHz RF
- Integrated with LCD, 3 axis Accelerometer, pressure & temp sensor
- Comes with USB programmer and RF dongle

Integrated, innovative, and unique development available for $49 $25

Learn more @ www.ti.com/chronoswiki
For more information on CC430 & the RF Ecosystem, visit:
www.ti.com/cc430
The **L092 device family** is the world’s first native 0.9V microcontroller
- Up to 4MHz CPU speed
- ROM size up to 2kB
- RAM size up to 2kB
- GPIO: 11

• Features native 0.9V operation, which enables all analog and digital logic to run at 0.9V without boosting components; Analog pool

[www.ti.com/lowvoltagewiki](http://www.ti.com/lowvoltagewiki)
Analog Pool (A-POOL)

Maximum flexibility with Analog Pool

Features

- A Software-configurable peripheral that can implement a complete signal chain
  - Comparator
  - 8-bit elementary DAC
  - 8-bit ADC
  - Supply Voltage Monitor
  - Temperature Sensor
  - Ultra–low-voltage (256 mV) reference

Benefits

- Enable flexible and diverse designs
- Reduce board size
- Form a complete signal chain using one peripheral

MSP430L092:

- MSP430 16-bit Core
- RAM
- ROM
- TIMER
- I/O PORT
- Watch Dog
- APOOL
For more information on the world’s first Native 0.9V microcontroller, visit: www.ti.com/lowvoltagewiki
The Future of MSP430

Embedded FRAM
FRAM | The Future of Embedded Memory

FRAM provides maximum design flexibility
- **Universal memory**: Flexible use of work and data memory
- Maximizes value of PCB designs and customer product qualifications

FRAM enables extreme ULP applications
- **High-speed (1000x), Low-voltage (10x) writes** for maximized battery lifetime
- **Lowest Active Power** in the Industry (<100uA/MHz) for autonomous nodes

FRAM is reliable
- Endures in severe operating conditions, including radioactive environment
- FRAM is not affected by electromagnetic fields

FRAM excels in Security applications
- Low-voltage High-speed writes minimize vulnerability to hacker attacks
- Drives new applications in Security by combining Security with Low-power

FRAM is the best option for Data loggers
- **Maximized endurance of 10^{14} write cycles** facilitates data logging
- Reduces BOM by avoiding EEPROM chip

TI is 10 years ahead with the tech of the future
- Leveraging 10 years of RAMTRON experience
- No scaling roadblocks on the horizon as in Flash memory

**• Universal Memory**
- 100 Trillion cycles
- 100x faster write
- 250x lower power
FRAM is Faster and Lower Power

Enable more effective & efficient applications
• Up to 250x lower power
• Up to 1000x faster

FRAM offers unseen write endurance

• Data Logging without compromise!
• Superior Realtime performance due to fast write!
FRAM (Ferroelectric Random Access Memory)

Welcome to the future of embedded memory...

Universal Memory
- Reconfigurable Memory block as cache (RAM), program or data memory
- Unparalleled Flexibility for developers
- Improved inventory efficiency

100 Trillion Read/Write cycle
- Best-in-class write endurance
- Datalogging without compromise
- 100 Billion times more cycles than Flash
- Best-in-class data reliability and radiation resistance

New Realm of ULP
- Writes @ 250x lower power than Flash
- No charge pump! 1.5V low voltage writes
- Enables industry-best 82uA/MHz Active Mode current consumption
- ULP Standby Mode with Self wakeup: 0.5uA

Ultra-Fast read/write speeds
- Up to 1000x faster writes than Flash
- Increased data throughput at much lower power
- Minimize risk window of data hacks

Coming soon @ Embedded Systems Conference San Jose
- Broad Samples: May 2011
- RTM: July 2011

ARROW ELECTRONICS AND TEXAS INSTRUMENTS Embedded Series
MAKE THE SWITCH
Demo Break | Meet FRAM

A new memory technology to meet the requirements of today and tomorrow...

Improve existing solutions and enable new applications with FRAM

• Enable lowest power active modes
• Up to 250x lower power
• Up to 1000x faster
• $10^{14}$ write cycles

Welcome to the future of Embedded Memory

Learn more @ www.ti.com/fram
MSP430 Key Values

MSP430 is Easy. Get started today.
- Easy-to-use development tools
- Intuitive software tools
- Complete code library
- Get started at just $4.30!

Easy and Affordable Tool Chain
Easy and affordable tool chain

Get started at just $4.30

MSP430 offers the world’s most affordable development kits!
Start developing today with MSP430’s $4.30 LaunchPad development kit! Or start using our eZ430 evaluation modules ($49 and under)!

These development kits include all of the hardware and software you need to get started today!

$4.30 LaunchPad
MSP-EXP430G2
Easy development kit for MSP430G2xx MCUs. Includes all the HW/SW needed to start today!

- FEATURES:
  - Integrated emulator for programming and debugging via USB
  - 20-pin DIP target socket
  - 2 switches / 2 LEDs
  - Includes 2 MSP430G2xx devices, USB cable, PCB headers, quick start guide

- PRICE: $4.30

eZ430 Evaluation Kits

- eZ430-F2013
  Based on MSP430F2013.
  Integrated emulator, 1 target
  Price: $20

- eZ430-RF2500
  Based on MSP430F2274
  Includes CC2500 2.4GHz RF
  Integrated emulator, 2 targets
  Price: $49

- eZ430-Chronos
  Based on CC430F6137
  Sub-1GHz SoC
  Integrated sensors, emulator
  Price: $49

Experimenters Boards

Experimenters boards are complete development kits that enable developers to explore the full features of an MSP430 device.

MSP430 has experimenter boards for Metering, USB, RF, and General Purpose applications.

- MSP-EXP430FG4618
- MSP-EXP430F5529
- MSP-EXP430F6137
- MSP-EXP430F5438A

Price: $149 each
Meet the new LaunchPad (MSP-EXP430G2)

Everything you need to Launch your applications!

+ **Embedded emulation**
  Includes mini USB Cable

+ **14 and 20-pin DIP Socket**
  Supports all MSP430 Value Line devices

+ **Includes 2x MSP430 Devices**
  MSP430G2231 & MSP430G2211

+ **2 Pushbuttons**

+ **2 LEDs**

+ **FREE software Compiler/Debugger**
  Code Composer Studio Ver 4
  IAR Embedded Workbench

$4.30 & for a limited time only
FREE SHIPPING!
Capacitive Touch BoosterPack

Part Number: 430BOOST-SENSE1

• Capacitive Touch plug-in for LaunchPad
• Touch button, scroll wheel & proximity sensor
• Includes MSP430G2452 with Cap Touch I/O module
• Example design for scroll wheels & Proximity sensor
• Free Software Library
  – Free library for all MSP430 devices
  – Consumes as little as 1KB of Flash
  – Library supports various Touch Sensing algorithms
• www.ti.com/capacitivetouch

Only $4.30 *for a limited time
Blast off with **LaunchPad (MSP-EXP430G2)**

**ABSOLUTELY**, but only with the LaunchPad Development Kit!

Get started today, with the industry’s lowest cost microcontroller development kit.

- Everything you need for $4.30!
- Includes 2 MSP430G2xx devices
- Integrated Flash Emulation Tool for programming/debugging
- Supports 150+ MSP430G2xx Value Line microcontroller devices

Can I get started in 5 minutes, under $5

Learn more @ www.ti.com/launchpadwiki
Scalable tool chain

One Flash Emulation Tool for all 300+ MSP430 devices!

- MSP430 Flash Emulation Tool (FET) offers real-time debug and programming
- Supports *ALL* MSP430 devices when paired with appropriate Target Board
  - 4-wire JTAG or 2-wire Spy Bi-Wire

Support for all MSP430 IDEs

One Flash Emulation Tool (FET) to rule them all

A target board is available for all of MSP430’s 24 package options

- MSP-FET430UIF
  - Price $99

- MSP-TS430xxxx
  - Price $75

MSP-FET430Uxxxx (FET + Target bundle)
  - Price $149
  - $75
Complete Software Suite

Free Integrated Development Environments (IDE) available

**Code Composer Studio** version 4
- Eclipse-based IDE (Compiler, debugger, linker and more) for all TI embedded processors
- Unrestricted version available for $445
- Free versions are available!
  - Free 16kB code-limited version available for download
  - Free, full-featured, 120-day trial version available

**IAR Embedded Workbench**
- Strong third-party IDE offering with project management tools and editor. Includes config files for all MSP430 devices.
- Unrestricted version available for $3200
- Free versions are available!
  - Free 4/8/16kB code-limited Kickstart version available for download
  - Free, full-featured, 30-day trial version available

MSPGCC GNU IDE & other MSP430 IDE options are available! Learn more @ www.ti.com/msp430tools
Meet Grace

Grace is a graphical user interface (GUI) for enabling and configuring MSP430F2xx and G2xx peripherals. Navigate through buttons, drop down menus, and text fields to generate C code that properly enables and configures peripherals for your application.

• Spend less time enabling/configuring peripherals and spend more time in the application layer
• Various layers of abstraction – Basic View, Power User View, and Register View
• Helpful hints and hover overs guide developers through the configuration process
• Untap the full functionality of MSP430’s integrated peripherals!
• Free plugin for Code Composer Studio.
GUI-based programming with **Grace**

Is there a GUI-based C code generation tool?

Yes! The Grace graphical user interface generates fully commented C code.

Quicken time to market and promote more focus on the application layer!

- Enable and configure MSP430F2xx and G2xx peripherals using an intuitive user interface
- Navigate buttons, drop-down menus & text fields to generate fully-commented C code
- Free plug-in for CCS

Learn more @ www.ti.com/grace
**Other Software Tools**

**MSP430 Software Tools make USB and RF development EASY**

**RF Software Tools**

- **SmartRF Studio 7**
  - Intuitive tool for evaluating TI’s Low Power RF ICs and SoCs
  - Generates device register values
  - Tests RF performance and tune customer-specific hardware solutions.

- **Packet Sniffer**
  - Analyze RF packets in real-time to greatly simplify RF debugging
  - Display and store RF packets captured with a listening RF device
  - Filters and decodes packets and displays them in a convenient way!

**USB Tools**

- **USB Developer’s Package** (SW Tools, Documentation & Examples)
  - **MSP430 API Code Stacks** All necessary APIs & examples to start USB development
  - **USB Field Firmware Updater** Project template for building a GUI-based tool that upgrades MSP430 firmware in the field using MSP430’s on-chip USB BSL.
  - **Windows HID API** API enabling USB communication between PC and MSP430 MCU
  - **USB Descriptor Tool** Code generation tool for configuring the USB API stack for various interfaces.

**Spectrum Analyzer (sub-1GHz) – coming soon**
Get Started Today

@ www.ti.com/msp430
www.ti.com/msp430

- User’s Guides
- Datasheets
- TI Community Forum
- 100+ Application Reports
- 1000+ Code Examples
- Product Brochure
- MCU Selection Tool
- Latest Tool Software
- 3rd Party Listing
- Silicon Errata
Extensive Community Support

E2E Community

- Videos, Blogs, Forums
- Extensive community support and idea exchange
- Global customer support
- http://e2e.ti.com

Processor Wiki

- Growing collection of technical wiki articles
- Tips & tricks, common pitfalls, and design ideas
- http://wiki.msp430.com
## Beyond MSP430 TI’s Processing Portfolio

### TI Embedded Processors

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<td>32-bit ARM Cortex™-M3 MCUs</td>
<td>DSP</td>
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<td>32-bit real-time MCUs</td>
<td>ARM Cortex-A8 MPUs</td>
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<td>C2000™ Delfino™ Piccolo™</td>
<td>Sitara™ ARM® Cortex™-A8 &amp; ARM9</td>
<td>Multi-core DSP</td>
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<td>C6000™ DaVinci™ video processors OMAP™</td>
<td>Ultra Low power DSP</td>
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### ARM®-Based Processors

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<th>Processor</th>
<th>Frequency</th>
<th>Features</th>
<th>Applications</th>
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<tr>
<td>MSP430™</td>
<td>Up to 25 MHz</td>
<td>Flash, RAM, 0.5 KB to 256</td>
<td>Measurement, Sensing, General Purpose</td>
</tr>
<tr>
<td>C2000™</td>
<td>40MHz to 300 MHz</td>
<td>Flash, RAM, 16 KB to 512</td>
<td>Industrial computing, POS &amp; portable data terminals</td>
</tr>
<tr>
<td>Sitara™</td>
<td>Up to 100 MHz</td>
<td>Cache, RAM, ROM</td>
<td>Industrial computing, POS &amp; portable data terminals</td>
</tr>
<tr>
<td>C6000™</td>
<td>300MHz to &gt;1GHz</td>
<td>USB, ENET, PCIe, SATA, SPI</td>
<td>Telecom test &amp; meas., media gateways, base stations</td>
</tr>
<tr>
<td>C5000™</td>
<td>Up to 300 MHz</td>
<td>Cache, RAM, ROM</td>
<td>Audio, Voice, Medical, Biometrics</td>
</tr>
</tbody>
</table>

### Digital Signal Processors (DSPs)

<table>
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<tr>
<th>Processor</th>
<th>Frequency</th>
<th>Features</th>
<th>Applications</th>
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<tbody>
<tr>
<td>DSP+ARM</td>
<td></td>
<td>USB, ADC, ROM, 0.5 KB to 256</td>
<td>Medical, Biometrics</td>
</tr>
<tr>
<td>C6000™</td>
<td>24.000 MMACS</td>
<td>USB, ENET, PCIe, SATA, SPI</td>
<td>Industrial computing, POS &amp; portable data terminals</td>
</tr>
<tr>
<td>C5000™</td>
<td>Up to 320KB RAM</td>
<td>USB, ADC, McBSP, SPI, I2C</td>
<td>Audio, Voice, Medical, Biometrics</td>
</tr>
</tbody>
</table>

### Software & Dev. Tools

- **ARROW ELECTRONICS AND TEXAS INSTRUMENTS**
- **Embedded Series MAKE THE SWITCH**
THANK YOU!

MSP430
Ultra-Low Power MCUs

Ultra-Low Power

\[ \int 430(x) \, dx \] High Analog & Digital Integration

Easy and Affordable Tool Chain
Make the Switch to TI Microcontrollers

Interested in designing with TI microcontrollers? Already using a TI MCUs but want to learn more? It’s easy!

With a portfolio of 500+ MCUs, robust software options, 24/7 support, and more it’s easy to switch to TI MCUs!

For more information, visit: www.ti.com/make-the-switch
EXCLUSIVE MSP430 and Stellaris Tool Discounts!

Pick up a promo card and take advantage of these great deals!

Codes will be live for a month after the event and will expire May 31st

Presentations will be posted on www.ti.com/embeddedseries
the day of the event
BACKUP
Direct Memory Access (DMA)

**Features**
- Edge/level triggers
- Single Block
- Burst-block
- Byte/word or mixed transfer
- Requires just two MCLK cycles

**Benefits**
- Allows data to be transferred throughout ENTIRE address range.
- Transfer data from ADC conversions to RAM without CPU
- Maximize CPU offloading for lower power and max MIPS throughput
Power Management Module (PMM)

**Features**

- Integrated LDO
- $V_{\text{CORE}}$ level programmable
- Flexibility in processing performance vs. power
- Integrated *supervision & monitoring*
- Zero-power BOR
- Five integrated supervisors
  - SVSH, SVSL, SVMH, SVML & BOR

**Benefits**

- Ultra-Low Power Functionality
- Ensure proper operation in power on and off sequences
FRAM enables 100x faster writes!

Max. Throughput:

- FRAM: 1,400kBps
- Flash: 13kBps
FRAM – Endurance outperformance!
Count the zeros!

114,000 years

6.6 min

FRAM

Flash
FRAM consumes 250x less power than flash while writing!
MSP430: it’s what’s on the inside that counts. ...most of the time
Need more _______ ?

• Functionality, Precision, Power Management, Interface….
  – Sometimes you just need more, and the TI analog portfolio offers it.
• We make it easy for you to find more “____”:
  • www.ti.com/mcu4analog
    – Summary of complementary analog and mcu components, sorted by End Equipments and Specific Analog Function.
  • www.ti.com/processorpower
    – Reference designs for your power needs.
  • www.ti.com/plus1
    – Season your design with “salt and pepper” logic.