

Microcontrollers for Universities

MSP430 tools for Laboratories and Projects

MSP430 microcontrollers are well suited to both teaching labs and student projects. With a RISC-based instruction set and a von-Neumann architecture, the MSP430 16 bit processor is easy to program. The choice of programming in C or assembler is up to you. Develop code quickly and easily with a choice of software platforms, and debugging utilities included. There is up to 25MIPS of performance available, on-chip flash memory and a completely integrated signal-chain. The MSP430 offers a genuine single-chip solution for academia.



Key Features

- Ultra-low-power architecture
- Up to 25MIPS performance
- Complete signal chain on chip
- Modern 16-bit RISC CPU
- 7 addressing modes usable with all instructions
- Programmable in C or assembler
- Choice of development environments
- Complete debugging environment
 - Allows single stepping code
 - Watch memory locations
 - View registers
 - Set breakpoints
- Dedicated technical support
- Low-cost development tools

MSP430 Architecture and Features

MSP430 Modular Architecture

A 16-bit RISC CPU, peripherals and flexible clock system are combined by using a von-Neumann common memory address bus (MAB) and memory data bus (MDB). The MSP430 partners a modern CPU with modular memory-mapped analog and digital peripherals.

Modern 16-Bit RISC CPU

The MSP430 CPUs fully orthogonal architecture provides the flexibility of 16 fully addressable, single-cycle 16-bit CPU registers and the power of a RISC. The modern design of the CPU offers versatility through simplicity using only 51 easy-to-understand instructions and seven consistent addressing modes. This results in a 16-bit low-power CPU that has more effective processing, is smaller-sized, and more code-efficient than other 8 or 16-bit microcontrollers.

Intelligent Peripherals

With purely software-driven functions, the CPU is 100% active and consuming power. The intelligent peripherals allow the CPU to be turned off to save power or work on other activities to achieve the highest performance.

MSP430 Product Portfolio

MSP430x1xx: The MSP430x1xx family of MCUs offers a wide range of capabilities from a simple low power controller with a comparator, to complete systems on a chip including high-performance data converters, interfaces and a multiplier.

MSP430F2xx: The ultra-low-power MSP430F2xx family increases performance up to 16 MHz. Additional enhancements of MSP430F2xx, include a software-selectable integrated $\pm 1\%$ on-chip digitally controlled oscillator, internal pull-up/pull-down resistors and increased number of analog inputs. The in-system programmable Flash has also been improved with smaller 64-byte segments and a lower 2.2-V programming voltage allowing the elimination of external EEPROMs in most systems.

MSP430x4xx: The ultra-low-power MSP430x4xx family has an integrated LCD controller for low power metering and medical applications. Several devices offer application-based peripherals to provide single-chip solutions for flow and electricity metering.

MSP430F5xx: The new Flash-based family features the lowest active power consumption alongside processing up to 25 MIPS, 1.8V-3.6V operation. These devices include an innovative Power Management Module for optimal power consumption.

MSP430 Teaching ROM

This CD-ROM has been created to provide the vital core materials to enable educators and academics to teach microcontrollers (MCUs), using devices from the Texas Instruments MSP430 family. The materials include slides, labs, tests, programs and application examples, written in an academic style that is both interesting and technically detailed. In addition, the tutorials can be used as student guides to a series of modules and laboratory exercises. Each module is dedicated to a specific aspect of the device, including detailed descriptions of how to use a range of peripherals. A step-by-step project guide to using different software development tools, with instructions on how to use the available hardware starter kits to perform the laboratory exercises, is also included.

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 University of Beira Interior, Electromechanical Engineering Department, Portugal, 2009.

Request your Teaching ROM at: https://www-a.ti.com/apps/dspuniv/teaching_rom_request.asp

Hardware Development Tools

MSP430 Experimenter Board

Part#: **MSP-EXP430FG4618**

\$49.50

<http://focus.ti.com/docs/toolsw/folders/print/msp-exp430fg4618.html>

This versatile MSP430 Experimenter Board features a tiny MSP430F2013 and the highly-integrated MSP430FG4618, providing nearly every combination of peripherals available from the MSP430 family. The integrated TI wireless evaluation module header and the large amounts of RAM on the MSP430FG4618 makes it an ideal platform for wireless applications. The wide range of integrated peripherals and hardware connectivity allows for nearly infinite development possibilities and makes it the ideal learning platform the MSP430 MCU architecture.

Features:

- Integrated peripherals: 12-bit DAC, 12-bit SAR ADC, 16-bit $\Sigma\Delta$ ADC, Operational Amplifiers, DMA, Multiplier, LCD Controller, Comms Interfaces: SPI, UART, I2C, IrDA
- Wireless expansion: Compatible with TI Wireless CCxxx0EMK Evaluation Modules
- Board Features: Microphone, buzzer, LCD, capacitive touch-pad, 2x push buttons,
- Prototyping space, RS232 connector, 2x JTAG Programming Interfaces, 3.5mm headphone jack (audio output)

A TI Flash Emulation Tool, like the MSP-FET430FUIF, is required to program and debug the MSP430 devices on the experimenter board.



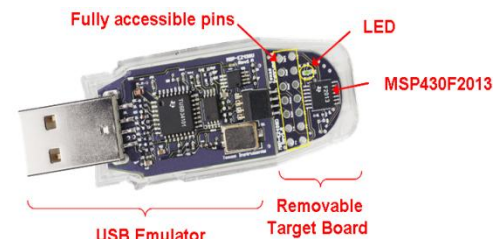
MSP430 USB Stick Development Tool

Part#: **EZ430-F2013**

\$20

<http://focus.ti.com/docs/toolsw/folders/print/ez430-f2013.html>

The eZ430-F2013 is a complete MSP430 development tool including all the hardware and software to evaluate the MSP430F2013 and develop a complete project in a convenient USB stick form factor. The eZ430-F2013 uses the IAR Embedded Workbench Integrated Development Environment (IDE) to provide full emulation with the option of designing with a stand-alone system or detaching the removable target board to integrate into an existing design. The USB port provides enough power to operate the ultra-low-power MSP430 so no external power supply is required.



Features:

- eZ430-F2013 development tool including a USB debugging interface and detachable MSP430F2013 target board
- LED indicator
- Removable USB stick enclosure
- Debugging interface supports development with all MSP430F20xx devices
- Integrated IAR kick start user interface which includes an assembler, linker, simulator, source-level debugger and limited C-compiler
- Full documentation on CD-ROM

eZ430 RF Kits

The new eZ430 RF kits provide a complete low-cost development platform. The target board can be removed from the programmer, and can be powered using the battery adapter. The target boards include a MSP430 MCU, CC2xxx device (depending on the kit ordered), chip-antenna, switch and access to the MSP430 pins. Further target boards can also be ordered separately. For more information visit:

<http://www.ti.com/corp/docs/landing/mcu/index.htm?DCMP=MSP430&HQS=Tools+OT+ez430>

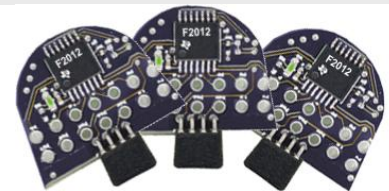
MSP430 USB Stick Target Board

Part#: EZ430-T2012

\$10

<http://focus.ti.com/docs/toolsw/folders/print/ez430-t2012.html>

The eZ430-T2012 includes three MSP430F2012-based target boards for the eZ430-F2013 Development Tool. The T2012 can be used to develop your personal project or to evaluate the MSP430 MCU. The T2012 gives you all the same capabilities and peripherals of the MSP430F2013 on the eZ430, but includes a high-speed, 8-channel 10-bit ADC.



Features:

- 3 eZ430-T2012 target boards with a 4-pin connector to fit the eZ430-F2013 USB Development Tool
- MSP430F2012-based target board
- Fully accessible pins
- LED indicator

MSP430 USB Debugging Interface

Part#: MSP-FET430UIF

\$49.50

<http://focus.ti.com/docs/toolsw/folders/print/msp-fet430uif.html>

The MSP-FET430U14 is a powerful flash emulation tool to quickly begin application development on the MSP430 MCU. It includes USB debugging interface used to program and debug the MSP430 in-system through the JTAG interface or the pin saving Spy Bi-Wire (2-wire JTAG) protocol. The flash memory can be erased and programmed in seconds with only a few keystrokes, and since the MSP430 flash is ultra-low power, no external power supply is required.



The debugging tool interfaces the MSP430 to the included integrated software environment and includes code to start your design immediately. The MSP-FET430UIF development tools supports development with all MSP430 flash devices.

Features:

- USB debugging interface (MSP-FET430UIF) connects a flash-based MSP430 MCU to a PC for real-time, in-system programming and debugging
- Technical specifications:
 - Software configurable supply voltage between 1.8 and 3.6 volts at 100mA
 - Supports JTAG Security Fuse blow to protect code
 - Supports all MSP430 boards with JTAG header
 - Supports both JTAG and Spy-Bi-Wire (2-wire JTAG) debug protocols
- USB cable and a 14-pin conductor cable is provided
- Includes IAR Kickstart and Code Composer Essentials integrated development environments which includes an assembler, linker, simulator, source-level debugger, and code limited C-compiler
- Full documentation on CD

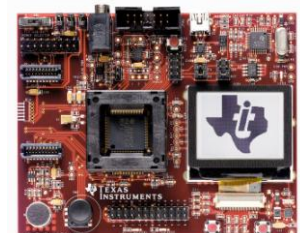
MSP430F5438 Experimenter Board

Part#: MSP-EXP430F5438

\$74.99

<http://focus.ti.com/docs/toolsw/folders/print/msp-exp430f5438.html>

The MSP430F5438 Experimenter Board is a development platform for the latest generation MSP430 MCUs. It is compatible with many TI low-power RF wireless evaluation modules such as the CC2520EMK. The Experimenter Board provides the lowest active power consumption, more memory and leading integration for applications such as energy harvesting, wireless sensing and automatic metering infrastructure (AMI). A TI Flash Emulation Tool, like the MSP-FET430UIF, is required to program and debug the MSP430 devices on the experimenter board.





For more information about the University Program
<http://www.ti.com/europe/university>

Features:

- 100-pin socket for MSP430F5438
- Power Supply sources: USB, FET, 2x AA batteries
- Accessible analog inputs (12-bit ADC): 5
- Clock Speed (MSP430F5438): 25 MHz
- Communication (MSP430F5438):
 -4x UART/LIN/IrDA/SPI
 -4x I2C/SPI
- PWM outputs: 12
- Flash Memory (MSP430F5438): 256KB
- RAM (MSP430F5438): 16KB
- 5-position joystick (up, down, left, right, push down)
- 138x110 grayscale, dot-matrix LCD
- JTAG header for real-time, in-system programming
- USB connectivity for data transfer

MSP430 Development Kits

<http://focus.ti.com/mcu/docs/mcuprodtoolsw.tsp?sectionId=95&tabId=1203&familyId=342&toolTypeId=1#FETkits>

MSP430 Development Kits come with everything required to complete an entire project including a socketed target board, a Flash Emulation Tool (FET) debugger and programming interface, cables and free code-size limited CCS Code Composer Studio and IAR (4/8 KB) software. For a full list of MSP430 Development Kits, See the table at the link above.

Software Development Tools

**Code Composer Studio
Version 4**

<http://focus.ti.com/docs/toolsw/folders/print/ccstudio.html>

Code Composer Studio v4 is a major new release of Code Composer Studio (CCS) that is based on the Eclipse open source software framework. The Eclipse software framework is used for many different applications but it was originally developed as an open framework for creating development tools. We have chosen to base CCSv4 on Eclipse as it offers an excellent software framework for building software development environments and is becoming a standard framework used by many embedded software vendors. CCSv4 combines the advantages of the Eclipse software framework with advanced embedded debug capabilities from TI resulting in a compelling rich development environment for embedded developers.

New Features and Improvements:

- A comprehensive windowing solution that allows you to maximize the available screen space.
- Ability to create different perspectives that have the windows that you use most for a given development activity readily available
- CCSv4 includes an excellent editor with equivalent functionality to the majority of commercial editors
- CCSv4 allows you to have a single IDE window and to change the debug context of the IDE to any of the cores in the system.
- You can also “pin” the context of a debug display to a specific core.
- If desired you can open a top level IDE for any core
- CCSv4 allows you to set the version of the compiler and DSP/BIOS that each individual project will use. Allowing projects in maintenance mode to continue to use the tools they were deployed with and enabling new projects to use the latest high performance tools
- CCSv4 is based on Eclipse which has a huge selection of 3rdparty plug-ins available (code analysis, source code control, modeling, Perl development...)
- The Eclipse plug-in development environment allows for the creation of your own custom tooling Wizards for creating plug-ins quickly
- CCSv4 has a complete scripting environment allowing for the automation of repetitive tasks such as testing and performance benchmarking.
- The CCSv4 Scripting Console allows you to type commands or to execute scripts within the IDE.
- Integration of FlexNET licensing allows for a variety of licensing options (node locked, floating, time based...).
- **On request, TI will usually donate the FULL version of CCS to Universities for academic use.**

**IAR Embedded
Workbench Kickstart**

Part#: IAR-KICKSTART

FREE

<http://focus.ti.com/docs/toolsw/folders/print/iar-kickstart.html>

IAR is a leading member of our third party program. Their Embedded Workbench Kickstart for MSP430 is an integrated development environment (IDE) for building and debugging embedded applications for MSP430 microcontrollers.

Features:

- Integrated development environment with project management tools and editor
- Highly optimizing MSP430 compiler supporting C and C++
- FET debugger support and Run-time libraries
- C-SPY debugger with MSP430 simulator and support for RTOS-aware debugging on hardware

Product Support:

Europe, Middle East and Africa

www.ti.com/europe/csc



Prices Valid as of 1st August 2009

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