MSP430 Ultra-Low-Power Microcontrollers

Third Quarter 2000

MSP430 Microcontrollers—The Solution for Battery-Powered Measurement

Key Benefits

- Lowest system power extends battery life
- Integrated analog data conversion accelerates time to market
- Communications peripherals enable easy connectivity
- Pricing starting at $0.99 each

The increasing demand to integrate features and processing capabilities into battery powered products has created a need for microcontrollers that are both powerful and highly integrated, while only requiring minute amounts of energy to operate. Using its leadership in both mixed-signal and digital technologies, Texas Instruments (TI) has met this challenge. The result is the MSP430 line of ultra-low-power microcontrollers, which enables system designers to simultaneously interface to analog signals, sensors, and digital components while maintaining unmatched ultra-low-power performance.

The MSP430 achieves its high performance through a revolutionary architecture that integrates a powerful 16-bit RISC CPU for fast execution of code and a design that makes extensive use of standby modes to minimize current consumption when the CPU is not active. The MSP430 architecture includes an array of powerful and highly flexible peripherals that are also optimized for ultra-low-power operation.

A key to the MSP430 performance is its unique ultra-low-power modes. The MSP430 is able to switch from ultra-low-power standby mode, where it only draws 0.8 µA of current, to full active mode in a maximum of 6 µs. This ultra-fast start up allows the MSP430 to stay in standby mode longer, eliminating the unnecessary current other microcontrollers use in ramping to active mode. In addition, while in active mode, the MSP430 only requires 250 µA in a typical 3 V system. The time the MSP430 stays in active mode is minimized by its powerful 16-bit CPU, which ensures high speed and efficient code execution.

All MSP430's peripherals are able to run independently of the CPU. This allows them to remain active even while in ultra-low-power standby mode. For example, an external 32 kHz crystal can increment a counter for a real-time clock function, while the part is drawing just 0.8 µA. The MSP430 can also maintain an LCD display and await external key switch interrupts while in standby mode. This allows the user interface to be fully active while simultaneously maximizing the battery life. The MSP430 is even capable of accepting external interrupts while it is in RAM retention/off mode. While in off mode, the MSP430 requires a mere 0.1 µA of current.

When battery life, processing power and hardware flexibility are major design concerns, TI's MSP430 offers an unbeatable combination of features. For applications such as, security systems, utility metering, portable medical devices and handheld instrumentation, the MSP430 line of ultra-low-power microcontrollers offer solutions that enable product ideas to become reality.

MSP430 16-Bit RISC CPU

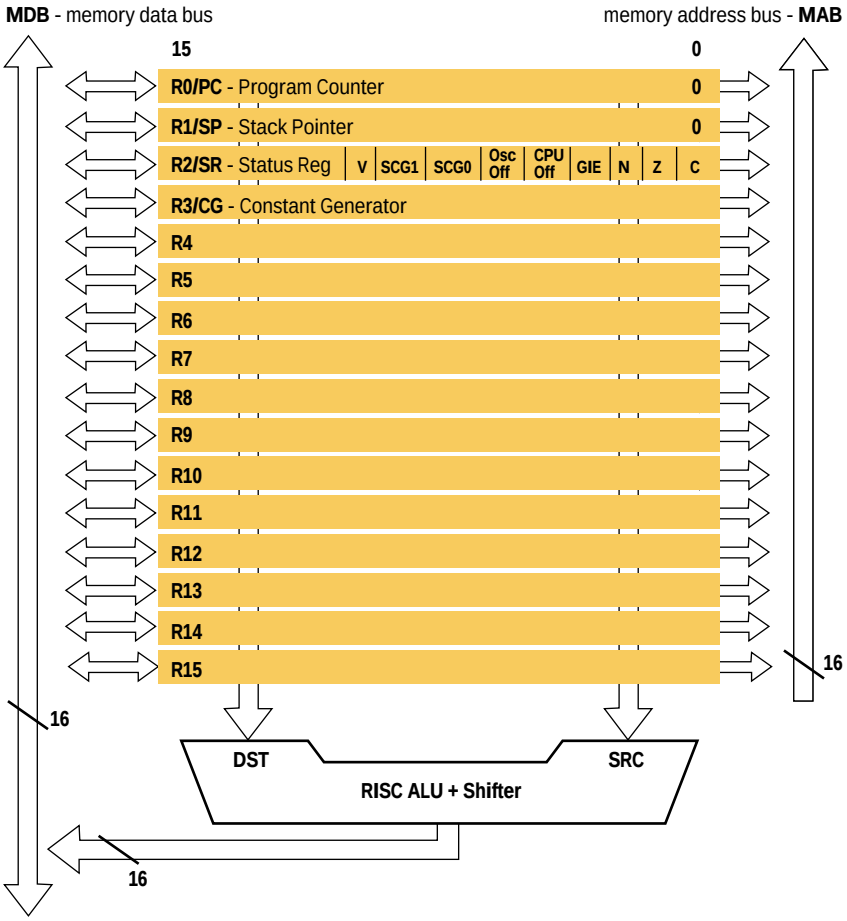
The MSP430's powerful 16-bit RISC core offers many advantages over competing 4- and 8-bit microcontrollers. The MSP430 CPU features the ease of use of a RISC instruction set and the flexibility of numerous 16-bit CPU registers. These and other features result in a revolutionary architecture that is highly orthogonal by design.

The MSP430 has a RISC instruction set that consists of a mere 27 core instructions, and to facilitate more intuitive programming, 24 additional emulated instructions are included to further simplify the code generation process. For example, a common instruction such as enable interrupts (EINT) is included in the instruction set. The assembler automatically substitutes the emulated instruction with the correct RISC instruction (BIS #8, SR). This combination of RISC and emulated instructions minimizes code space while also simplifying programming.

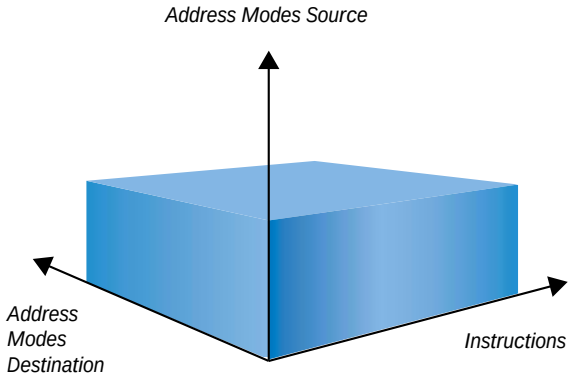
All instructions can be used with all seven addressing modes across the entire MSP430 architecture. There are no special instructions or modes required to work with RAM, peripherals, the CPU, registers or any other part of the MSP430. This feature greatly increases the efficiency of the 16-bit RISC instruction set and forms the basis for the orthogonal design of the MSP430.

There are 16 registers in the CPU core of the MSP430. Four of the registers have the dedicated functions of Program Counter (PC), Status Register (SR), Stack Pointer (SP) and Constant Generator (CG). The remaining 12, 16-bit registers, are completely user definable.These general-purpose registers in the CPU allow often-used variables, pointers and other data to be directly accessed by the CPU without performing memory fetches. The number and flexibility of the CPU registers further contributes to the high code efficiency of the MSP430.

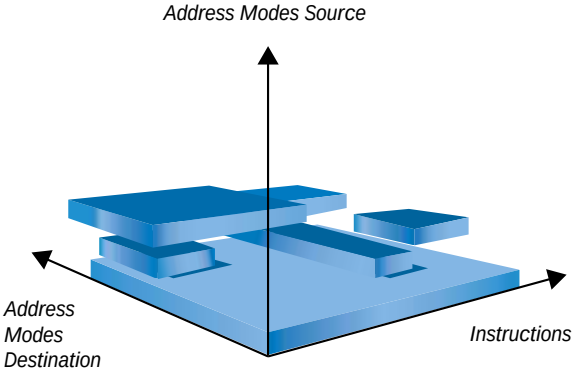
Simplified MSP430 CPU



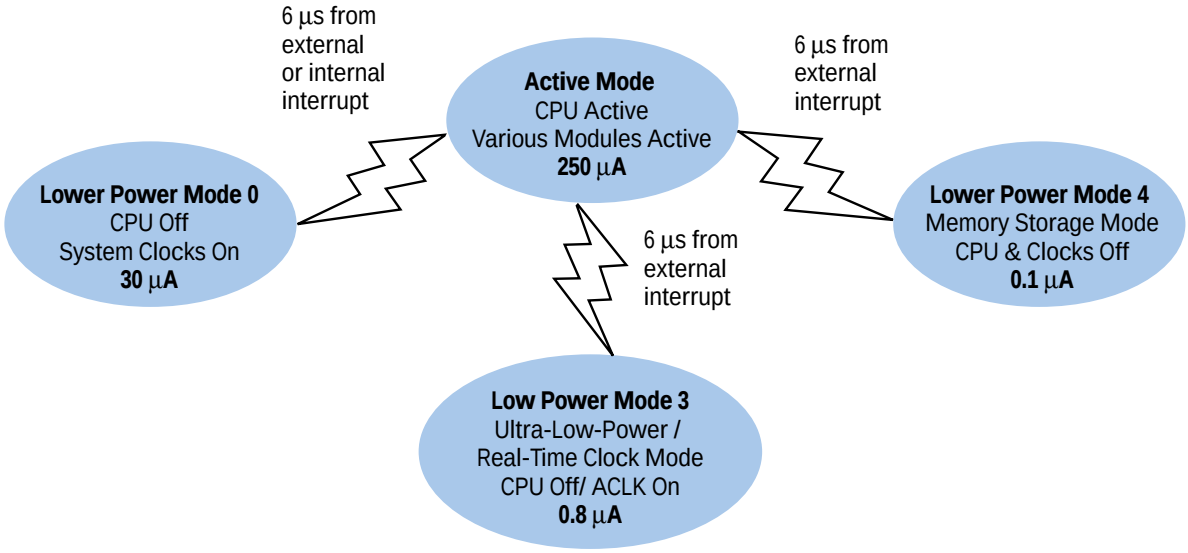
MSP430 Orthogonal Architecture



Non-Orthogonal Architecture



MSP430 Low-Power Modes (LPM)



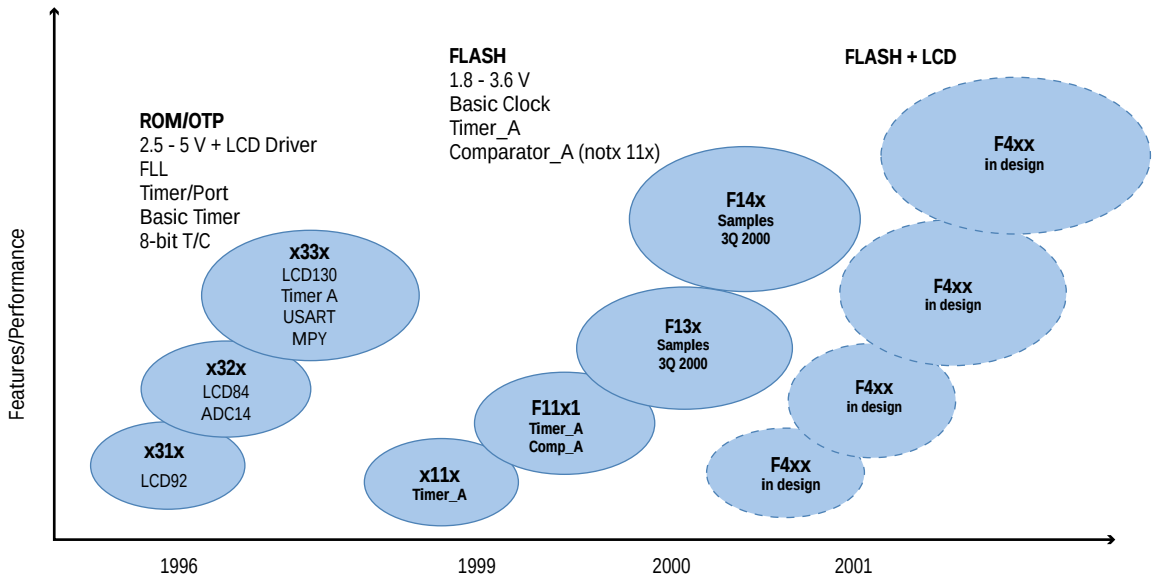
MSP430 Clock Modules

The clock modules of the MSP430 are fully programmable and offer system designers an array of clocking options. The Digital Controller Oscillator (DCO) can be programmed to supply a system frequency of 1 to 8 MHz. Typically the MSP430 only needs a single external 32 kHz crystal to generate an accurate high-speed system frequency. Additional advantages of the 32 kHz crystal include low cost, direct division to real-time using a single counter and the elimination of high frequency PCB layout. The 32 kHz signal is available both internally and externally when low frequency is a requirement. The MSP430 parts that include the Frequency Locked Loop (FLL) circuit, automatically regulate the system frequency to a multiple of the crystal.

The DCO in all MSP430 products starts operation in a maximum of 6 µs when an interrupt or reset occurs. This allows the processor to stay in a low-power mode much longer and greatly reduces the time required to bring the part to an active state, saving battery power.

The MSP430 has a failsafe feature that allows the processor to start operation using the DCO even if the crystal fails. So even if the crystal fails or is missing, the processor will still begin executing code. This feature makes it possible to design MSP430 circuits that do not include a crystal.

MSP430 Product Roadmap



MSP430 Selection Guide

Device	OTP	Flash	ROM	RAM	Peripherals	Pins/Package
MSP430P112*	4KB			256 bytes	15-bit Watchdog/Timer	20 SOP
MSP430C111			2KB	128 bytes	16-bit Timer_A, 3 CC registers	20 SOP
MSP430C112			4KB	256 bytes	I/O Ports P1 & P2	20 SOP
MSP430F1101		1KB		128 bytes	15-bit Watchdog/Timer	20 SOP, TSSOP
MSP430F1121		4KB		256 bytes	16-bit Timer_A, 3 CC registers	20 SOP, TSSOP
MSP430C1111			2KB	128 bytes	Analog Comparator_A, references	20 SOP, TSSOP
MSP430C1121			4KB	256 bytes	I/O Ports P1 & P2	20 SOP, TSSOP
MSP430F133		8KB		256 bytes	15-bit Watchdog/Timer	64 QFP
MSP430F135		16KB		512 bytes	16-bit Timer_A, 3 CC registers	64 QFP
					16-bit Timer_B, 3 CC/shadow registers	
					Analog Comparator_A, references	
					12-bit, 12-channel high-speed ADC	
					HW USART, UART/SPI capabilities	
					I/O Ports P1-P6	
MSP430F147		32KB		1 KB	15-bit Watchdog/Timer	64 QFP
MSP430F148		48KB		2 KB	16-bit Timer_A, 3 CC registers	64 QFP
MSP430F149		60KB		2 KB	16-bit Timer_B, 7 CC/shadow registers	64 QFP
					Analog Comparator_A, references	
					12-bit, 12-channel high-speed ADC	
					Two HW USART, UART/SPI capabilities	
					8x8 to16x16 HW MPY/MAC	
					I/O Ports P1-P6	
MSP430P315*	16KB			512 bytes	15-bit Watchdog/Timer	56 SSOP
MSP430P315S*	16KB			512 bytes	8-/16-bit Timer_Port	48 SSOP
MSP430C311S			2KB	128 bytes	64 or 92-segment LCD driver	48 SSOP
MSP430C312			4KB	256 bytes	Low-Power UART HW	56 SSOP
MSP430C313			8KB	256 bytes	I/O Port P0	56 SSOP
MSP430C314			12KB	512 bytes		56 SSOP
MSP430C315			16KB	512 bytes		56 SSOP
MSP430P325A*	16KB			512 bytes	15-bit Watchdog/Timer	64 QPF, PLCC
MSP430C323			8KB	256 bytes	8-/16-bit Timer_Port	64 QPF, PLCC
MSP430C325			16KB	512 bytes	84-segment LCD driver	64 QPF, PLCC
					Low-Power UART HW	
					14-bit HW ADC	
					I/O Port P0	
MSP430P337A*	32KB			1KB	15-bit Watchdog/Timer	100 QFP
MSP430C336			24KB	1KB	8-/16-bit Timer_Port	100 QFP
MSP430C337			32KB	1KB	120-segment LCD driver	100 QFP
					Low-Power UART HW	
					HW USART, UART/SPI capabilities	
					8x8 to16x16 HW MPY/MAC	
					I/O Ports P0-P4	

* UV-EPROM (E) versions available for prototyping - PMS430E112, PMS430E315, PMS430E325A and PMS430E337A

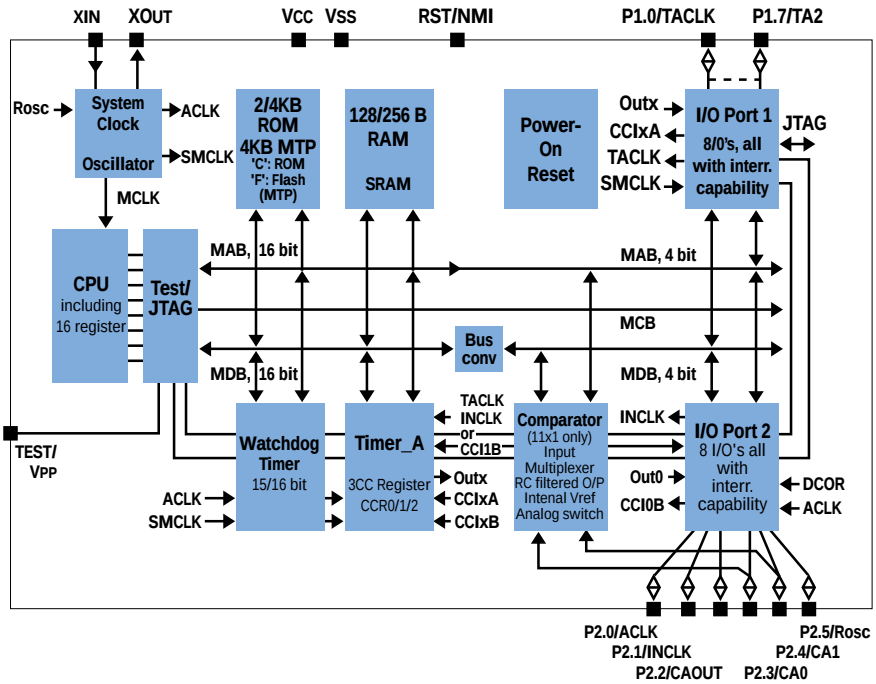
MSP430x11x(1) Configurations

The low pin-count versions of the MSP430 products, the MSP430x11x and MSP430x11x1 families, offer an unmatched combination of ultra-low-power consumption, Flash memory, 16-bit RISC performance and low cost. These devices consume as little 250 µA in active mode, 0.8 µA in standby mode and 0.1 µA in off (RAM-retention) mode. With 1k flash, and volume 4k ROM prices starting as low as $0.99, the 11x(1) devices are quickly becoming the benchmark in this price/performance category.

The 16-bit RISC core operates at up to 8 MHz, allowing most of the 27 core instructions to be executed within a 125 ns cycle. The 11x(1) devices are fully code compatible with all other members of the MSP430 family.

Among the peripherals integrated into the 11x and 11x1 devices are the 16-bit Timer_A with three capture/compare registers, 14 individual I/O signals, the flexible Basic Clock system, analog Comparator_A with references (11x1 only), Watchdog/Timer, and JTAG interface. The Basic Clock system allows standby times of up to 128 seconds. Program/data memory sizes are 1 to 4K bytes.

MSP430x11x(1) Configuration

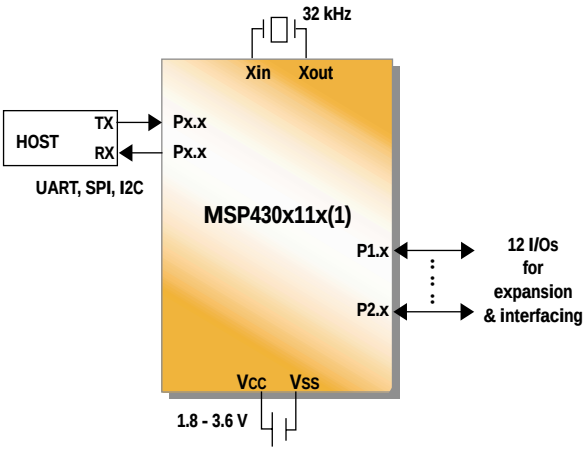


MSP430x11x(1) Application Examples

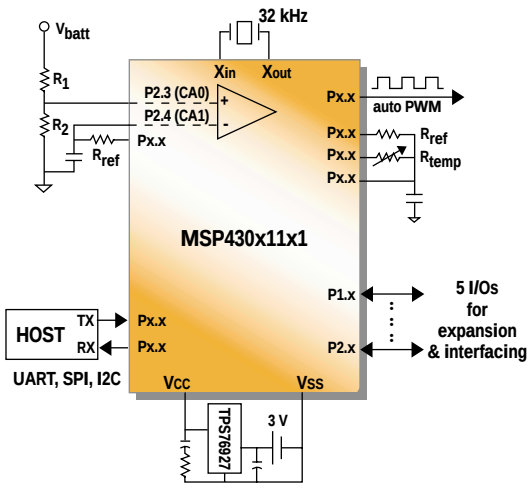
The MSP430x11x(1) series has expanded the reach of low-cost system design. A real-time clock (RTC) or battery monitor/charger, with as much as 10 years of battery life, are just two applications where a MSP430 device minimizes system cost while dramatically simplifying design and reducing development time.

These applications operate primarily in low-power mode 3 (LPM3), with the device interrupt timing coming from an external 32 kHz crystal oscillator. The 11x(1) device periodically wakes up to update the time or to measure and adjust the charging conditions. The pulse-width modulation (PWM) for the charger is automatically generated even while the device is in LPM3. The extensive use of low-power modes allows system design engineers to design applications that only require an average current of 1.52 µA.

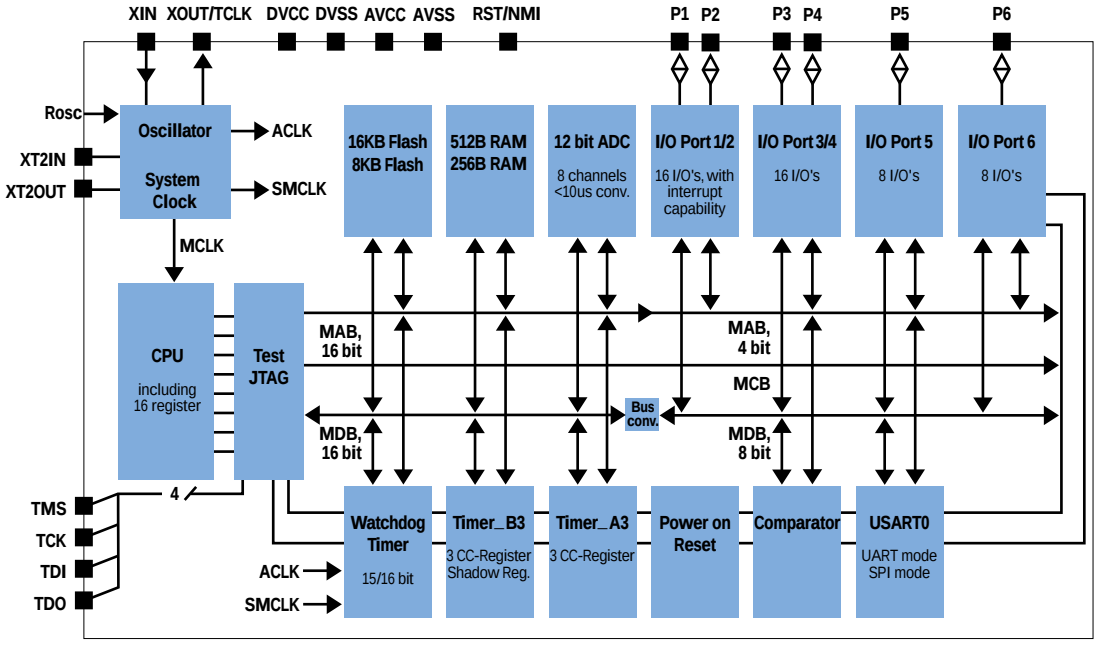
Real-Time Clock/Timer



Battery Monitor/Charger



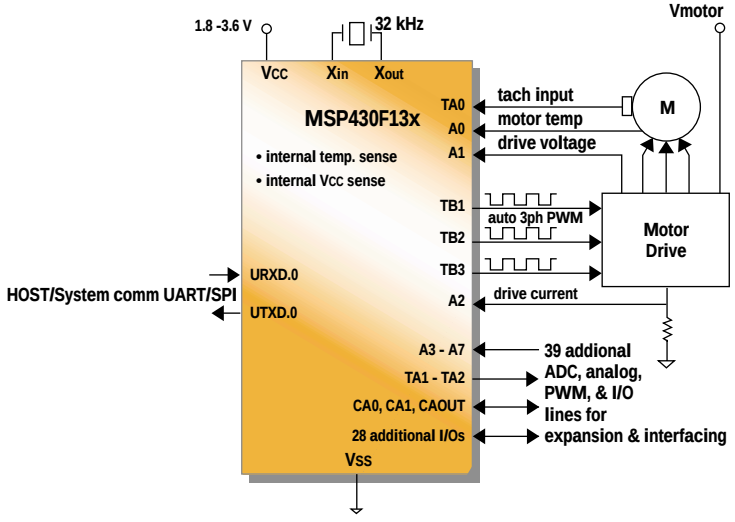
MSP430F13x Configuration



MSP430F13x Configuration

The new MSP430F13x family expands the number of applications that can take advantage of the MSP430's ultra-low-power performance. The family adds new modules and features to enable more applications to become true system-on-a-chip designs. The 12-channel, 12-bit high-speed ADC incorporates buffer memory, autoscan, internal voltage references, a temperature sensor and battery monitor. The Timer_B module includes three capture/compare registers with shadow capability. These work with the integrated 8-, 10-, 12- or 16-bit Timer_B counter, which can operate independently of the CPU. The 13x family also retains the powerful Timer_A in addition to Timer_B. The Basic Clock module has been expanded to allow a high-speed crystal to be used in addition to, or substituted for, the standard 32 kHz crystal. The dedicated hardware USART module with UART/SPI capability is also included. Flash memory options have been extended to 16K bytes in the 13x family.

3-Phase Motor Controller

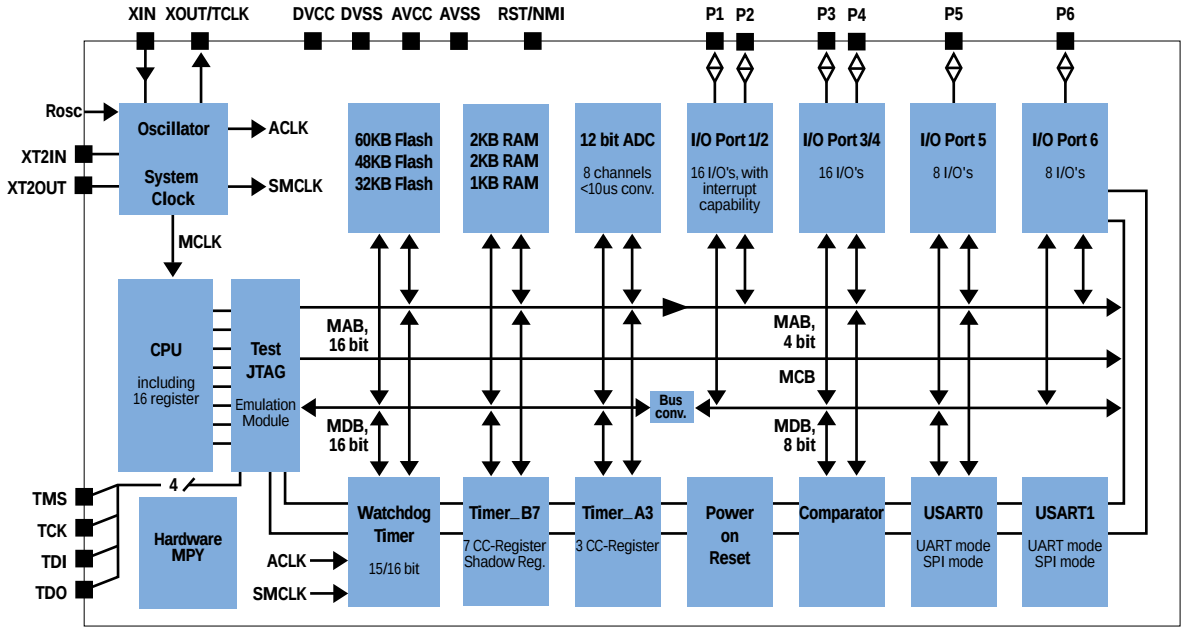


MSP430F13x Application Example

The new Timer_B with shadow capability allows three PWM signals to be changed simultaneously, making the 13x devices ideal for many motor control applications. The high-speed ADC allows up to eight channels to monitor sensors for closed-loop control.

The hardware USART module allows straightforward interfacing via UART or Serial Peripheral Interface (SPI) to a host or other system components.

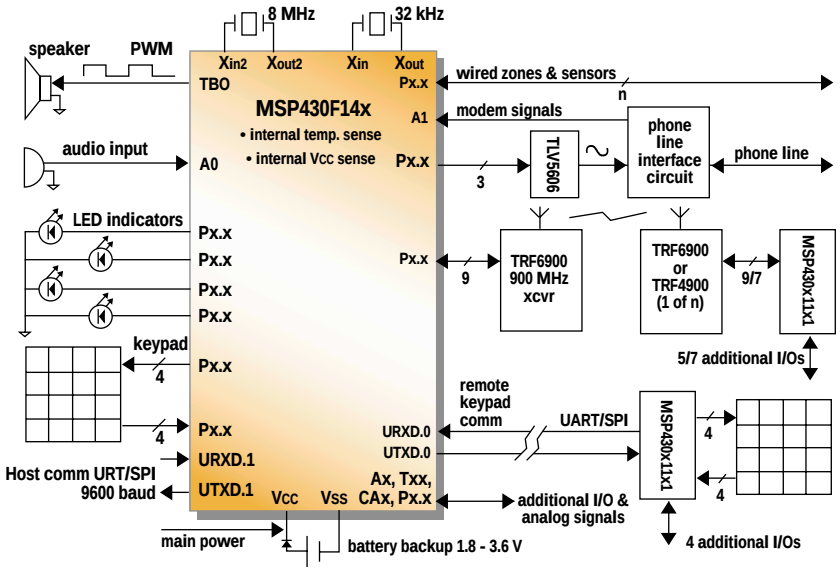
MSP430F14x Configuration



MSP430F14x Configuration

The new MSP430F14x family further expands on the capabilities of the 13x family and is currently the high-end solution of the non-LCD devices. Additional capabilities of the 14x family include: four capture/compare/shadow registers added to Timer_B for a total of seven, a second hardware USART module, with UART/SPI capabilities, the single-cycle, 16-bit hardware multiplier module is included, Flash memory options of up to 60K bytes and static RAM memory of up to 2K bytes are available.

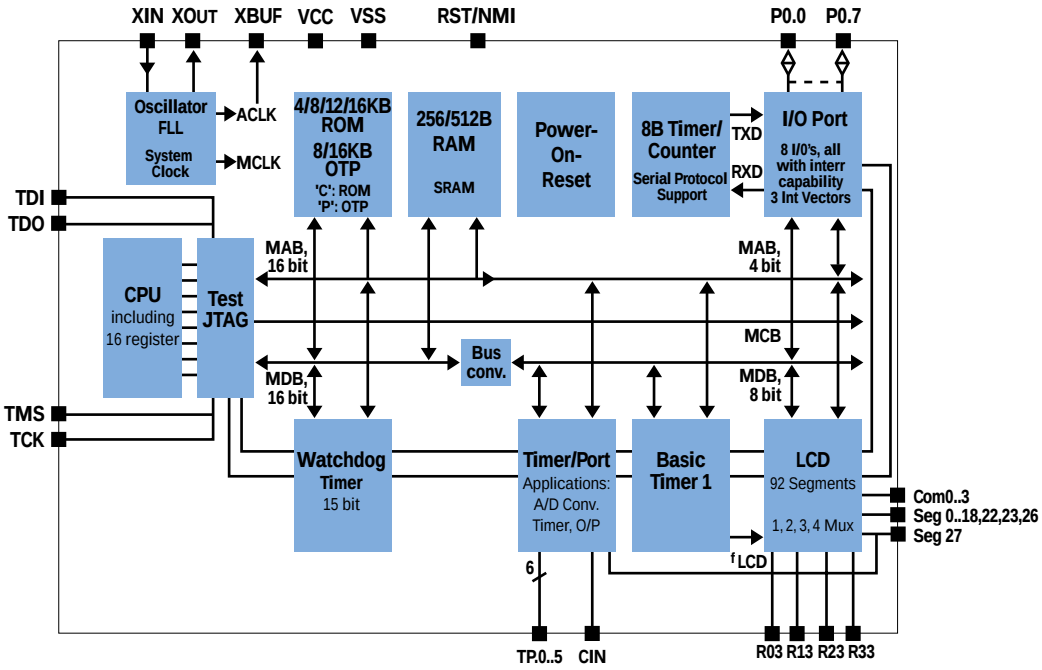
High-End Security Panel



MSP430F14x Application Example

The large selection of peripherals on the 14x devices make it well suited for many high-end control and monitoring applications. The second hardware USART module allows for simultaneous communications with a host and other system components, as shown in the example. The high frequency crystal option on the Basic Clock enables the 14x to generate stable clock signals for applications such as RF communications. The high-frequency crystal can be turned off to save power when not in use. The MSP430 is still able to operate from its fast-start, high- frequency, internal DCO. The large number of high-speed ADC, analog comparator and I/O pins allow a wide array of sensors, switches and other signals to be interfaced directly to the 14x.

MSP430x31x Configuration



MSP430x31x Configuration

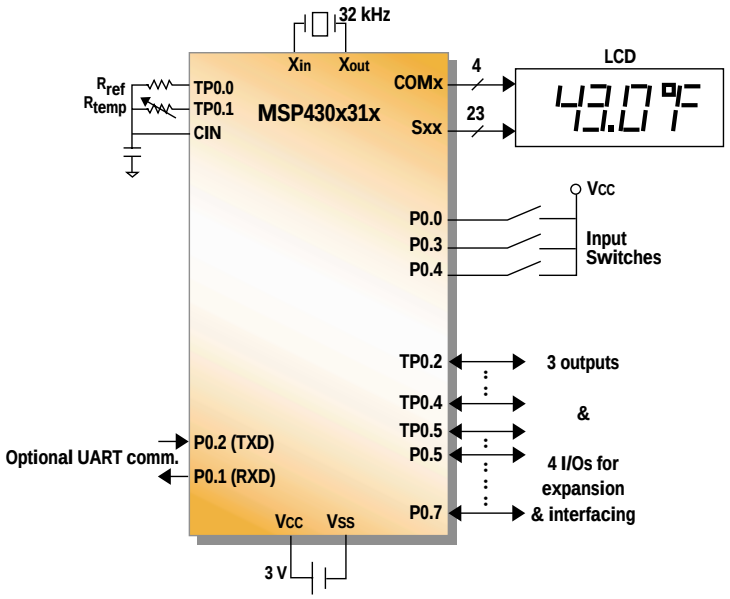
The MSP430x31x family is the most cost-optimized version with a LCD driver in the MSP430 product line.

It can be used for sensor applications by measuring resistive values. The Timer/Port module can perform this resistive-to-digital conversion by measuring the charge/discharge time of an external capacitor. Where this function is not required, the module can be used as a 16-bit timer or as two 8-bit timers.

The Watchdog/Timer module can be configured as a 15-bit watchdog or as a 15-bit general-purpose timer. The Basic Timer includes two 8-bit timers for general-purpose use. It generates the basic LCD frequency and supports the real-time clock function.

The LCD driver module can drive up to 92 segments in 1-to-4 MUX mode. Each pin of the I/O port can be individually configured and each has interrupt capability. The 8-bit Timer/Counter supports serial communication protocols like UART or I²C bus on the I/O port. The necessary software routines for this and many other modules are listed in the *MSP430 Application Report* book.

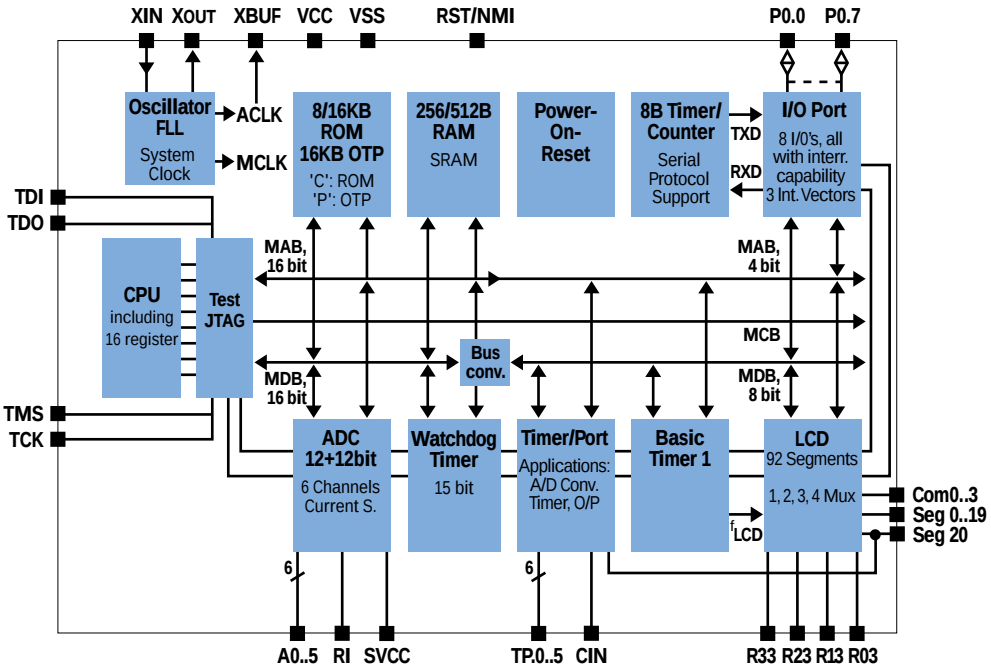
Digital Thermometer/Thermostat



MSP430x31x Application Example

The MSP430 requires very few external components to form a complete system. The low component count of the digital thermometer shown here ensures fast design cycle, maximum flexibility and very competitive system cost. For resistive sensors, such as thermistors, the 16-bit single-slope A/D converter, implemented using the Timer/Port module is ideal. Three additional external components, a crystal (optional), the battery and the LCD display, are all that are needed for a complete system with the MSP430.

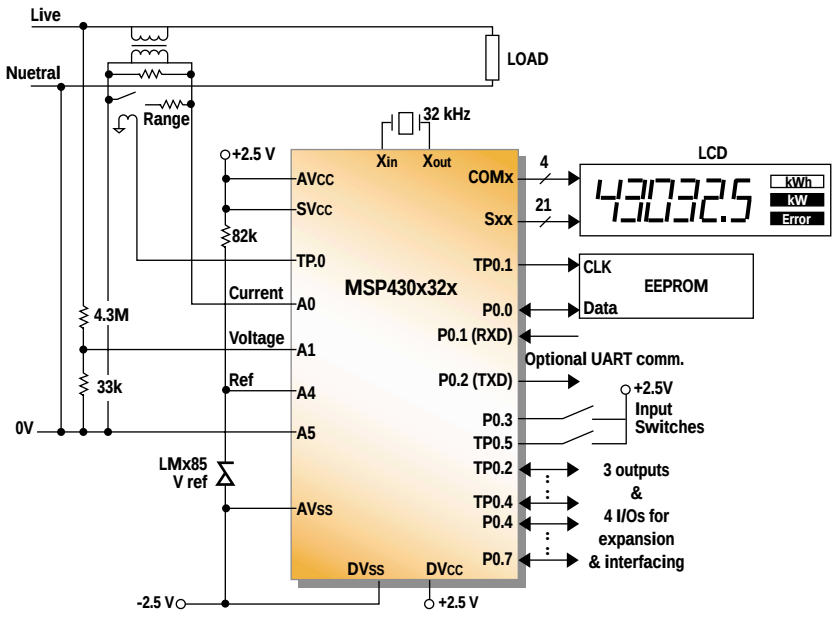
MSP430x32x Configuration



MSP430x32x Configuration

The MSP430x32x series offers a high-resolution A/D converter in addition to the peripherals of the MSP430x31x configuration. This 14-bit A/D converter has six inputs to convert analog signals to 14-bit digital values over the full supply voltage range or to provide 12-bit resolution in each of four separate ranges. The integrated current source can be programmed with an external resistor to connect current-driven sensors.

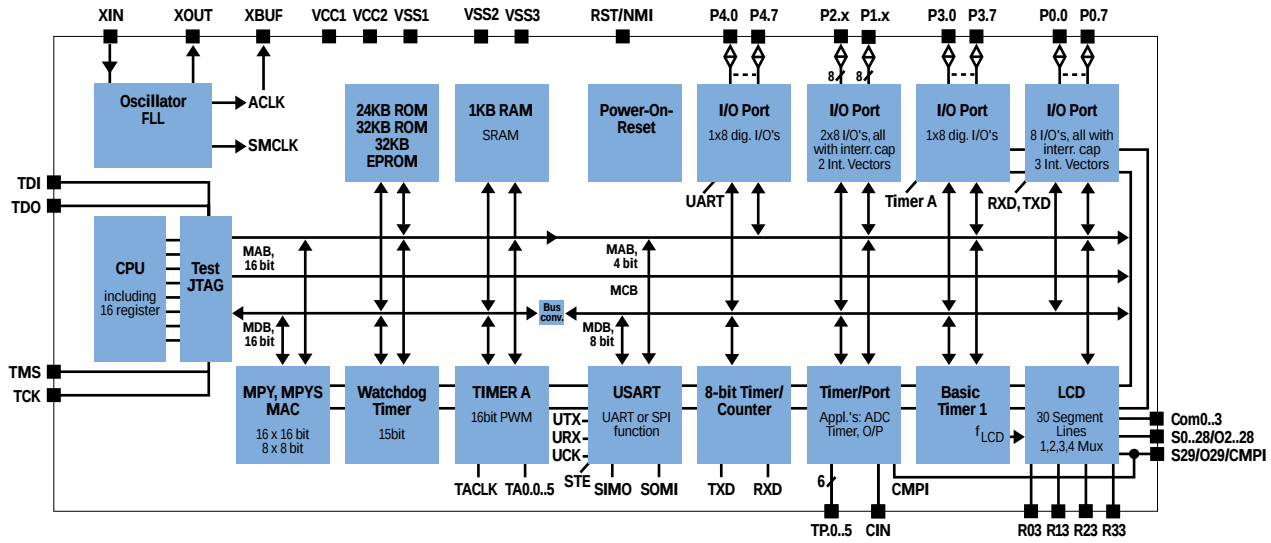
Single-Phase Electricity Meter



MSP430x32x Application Example

One of many application areas where the MSP430 proves very effective is single-phase electricity meters. The cost-competitive single-chip solution shown here uses the 14-bit on-chip A/D converter to convert the current (via a current transformer on A0) and voltage (via a voltage divider on A1) into digital values. The symmetrical supply voltage enables signed measurement, while the LMx85 creates a reference voltage. The amount of energy consumed is calculated by the CPU and the value displayed on the LCD or transmitted via the optional UART connection. Nonvolatile data storage is possible with an optional external EEPROM. A detailed application note is available for this as well as many other applications.

MSP430x33x Configuration



MSP430x33x Configuration

The MSP430x33x series focuses on high-end applications. It includes several additional, powerful modules.

The hardware (HW) multiplier module performs 16x16, 16x8, 8x16 and 8x8 multiplication and accumulations (signed, unsigned). After loading both operands into the multiplier, the result is available after a single cycle.

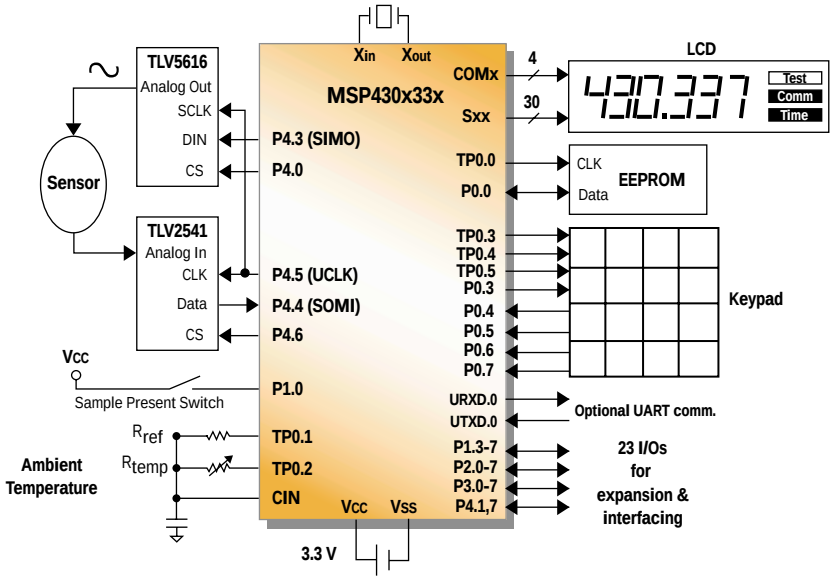
The Timer_A module includes a 16-bit timer/counter and five capture/compare registers, which can be fully configured by software. The capture mode is primarily used to measure external or internal events from any combination of positive and/or negative edges. The compare mode is primarily used to generate timing for software or application hardware or to generate PWM output signals for various purposes. Examples are D/A conversion functions and motor control applications. Timer_A can run independently of the CPU, allowing it to still be active in LPM3.

The USART module features two serial communication modes, a standard asynchronous communication protocol (UART, up to 115.2 kBaud) and a SPI function. The mode is selectable by software via a control register. The 33x series' LCD module offers 30 segment lines to drive up to 120 segments in 4MUX mode.

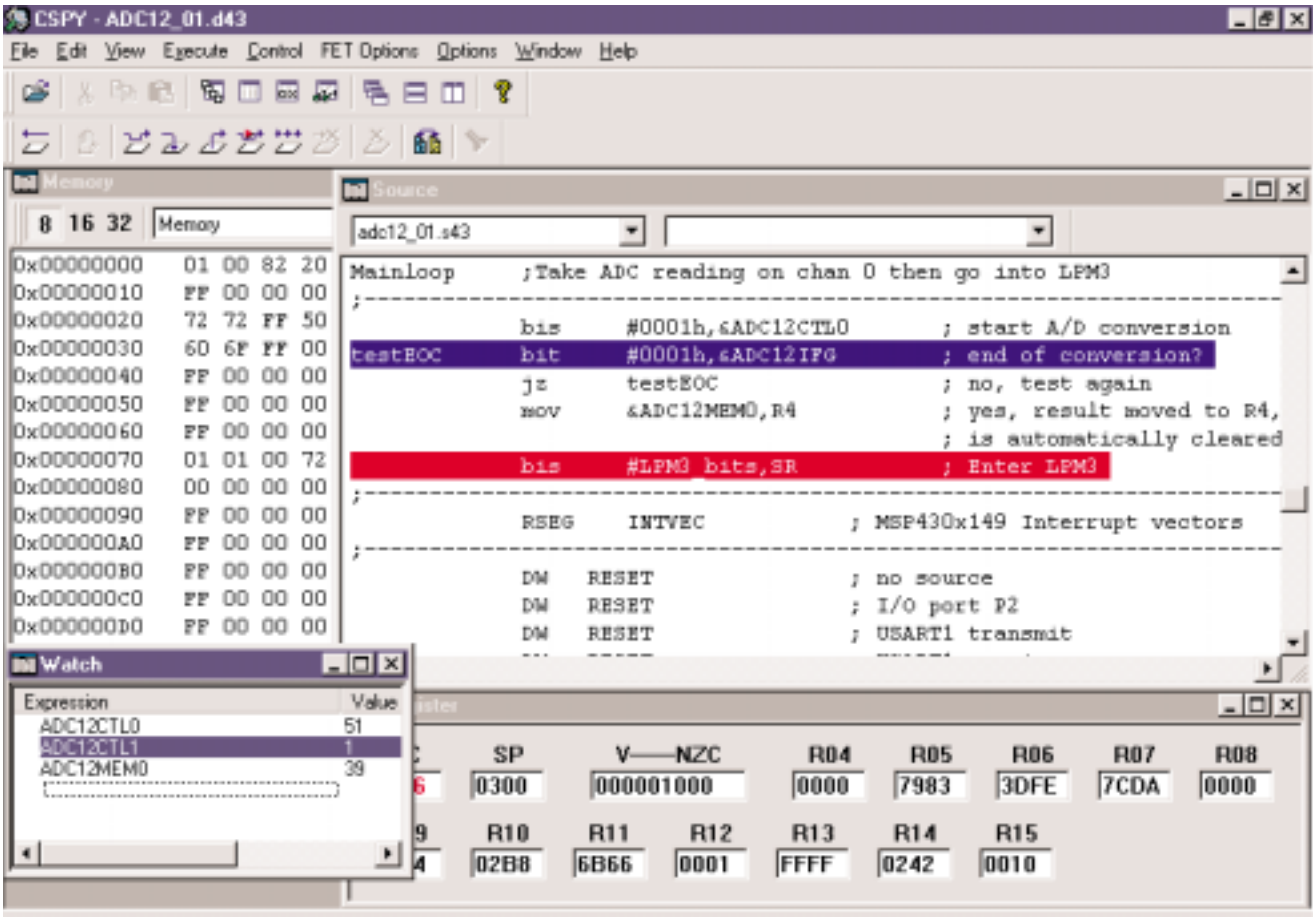
MSP430x33x Application Example

The array of modules and number of I/Os on the MSP430x33x make it well suited for high-end applications that require demanding user and hardware interfaces. The example circuit shown here can maintain the LCD display and await keypad interrupts while operating in LPM3. When interrupted, the circuit switches to active mode, with the high-speed MCLK running, in less than 6 µs. While in LPM3 the circuit is fully operational from a user's perspective, but the MSP430 is drawing less than 2 µA of current.

Personal Medical Device



Kickstart User Interface



MSP430 Design Support

Kickstart Environment

Kickstart is a fully integrated Windows-based development environment. It is derived from the popular IAR Workbench user interface. This one interface allows the user to develop code, simulate operation, download software and debug applications for all MSP430 derivatives. Kickstart allows the setting of breakpoints and the monitoring of special function registers, memory, the stack, as well as other useful information.

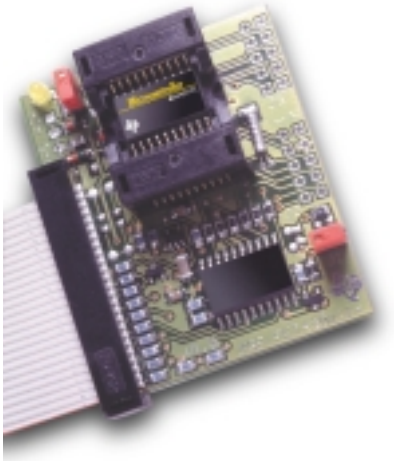
Kickstart includes the IAR assembler, a software simulator, a limited version of the IAR C compiler and the C-SPY debugger. Upgrading to the full version of IAR C is simple and does not require the user to learn a new interface. MSP430 devices with Flash, OTP or UV-EPROM memory can be programmed directly from Kickstart using either a Flash Evaluation Tool (FET) or the serial programming adapter.

MSP430 Flash Evaluation Tools

MSP-FET430x110, MSP-FET430P140

The new Flash evaluation tools, combined with the IAR Kickstart environment, enable system designers to quickly update, download, run and debug their code without ever disconnecting the MSP430 from the PC. This greatly speeds the development and debug portions of the application development cycle.

MSP - FET430x110 Flash Evaluation Tool



The FET tools allow designers the flexibility of operating the device under JTAG control, running to internal breakpoints or free running the MSP430. Each FET comes with an evaluation board, two Flash devices, PC parallel connection, development software and the MSP430 CD-ROM. The MSP-FET430x110 is a complete low-cost application development for MSP430F11x1 products.

The MSP-FET430P140 supports application development for both the MSP430F13x and MSP430F14x product families. It includes a parallel interface that also allows direct in-circuit programming of MSP430 Flash devices.

MSP430 Evaluation Kits

MSP-EVK430S320 and MSP-EVK430S330

The MSP430 evaluation kits (EVK) are powerful development tools that include much of the hardware and software required to complete your application development. Each EVK comes with an evaluation board, two UV-EPROM devices, serial programming adapter, development software and CD-ROM. The MSP-EVK430S320 EVK supports the MSP430x32x and MSP430x31x families of devices. The MSP-EVK430S330 EVK supports the MSP430x33x and MSP430x31x families of devices.

MSP430 Serial Programming Adapter

MSP-PRGS430

The serial programming adapter is a second-generation programming tool that can program any MSP430 Flash, OTP or UV-EPROM device. Devices can be programmed in stand-alone sockets or in-circuit. Software is included to facilitate device programming.

MSP430 Development Tools*

	Development Environment	C Compliler	Programmers	Evaluation/ Emulation
MSP430P112**	Kickstart	IAR	MSP-PRGS430, BP, Data I/O	MSP-EVK430S330
MSP430F11x1	Kickstart	IAR	MSP-PRGS430, BP, Data I/O	MSP-FET430x110
MSP430F13x	Kickstart	IAR	MSP-PRGS430, BP, Data I/O	MSP-FET430P140
MSP430F14x	Kickstart	IAR	MSP-PRGS430, BP, Data I/O	MSP-FET430P140
MSP430P315**	Kickstart	IAR	MSP-PRGS430, BP, Data I/O	MSP-EVK430S330
MSP430P325A**	Kickstart	IAR	MSP-PRGS430, BP, Data I/O	MSP-EVK430S320
MSP430P337A**	Kickstart	IAR	MSP-PRGS430, BP, Data I/O	MSP-EVK430S330

*Third party tools are sold and supported by the third party companies offering them

**UV-EPROM (E) versions available for prototyping - PMS430E112, PMS430E315, PMS430E325A AND PMS430E337A

MSP430 Third-Party Support

TI maintains a dedicated MSP430 third-party program for hardware and software tooling as well as for programming support. These third-party developers have the engineering expertise to provide application-specific software tools, helping our customers achieve their design goals. Links from TI's MSP430 web site will direct you to each company's home page:
www.ti.com/sc/msp430

BP Microsystems Inc.

BP Microsystems Inc. designs and manufactures device programmers for both engineering and production applications. Leading the industry in device support, performance and cost of ownership, BP provides complete device programming solutions to customers worldwide. The company offers a full line of single-site device programmers and Universal Programmers, and multi-site Concurrent Programming Systems.

The MSP430 can be programmed using any of BP's universal engineering programmers (BP-1200 and BP-1400), BP's manual or multi-site Concurrent Programming Systems. For more information, visit the BP web site:
www.bpmicro.com

Data I/O Corporation
Universal Programming System - Sprint

Data I/O has invested heavily in the steadily growing market of microcontroller devices by considerably expanding its device library. The universal programming systems of the Sprint family not only standout from most other programming systems through the variety of supported devices, but also by guaranteeing its customers the use of vendor approved algorithms with maximal programming yields and minimal programming times. Data I/O supports TI's MSP430 devices with the universal programmers Sprint Multisystem as well as with the automatic programming systems PP100. With the latest version of the Sprint software, the following devices are supported: MSP430x31x, MSP430x32x, MSP430x33x and MSP430x11x(1). All these controllers are supported with flexible TOPs or adapters for different packages like PLCC, SSOP or QFP. Special software functions of the devices, such as UserID, Watchdog Timer or Code Protection can be activated via a simple menu. For more information, visit the Data I/O web site:
www.dataio.com

Hitex Emulator in an Affordable Quality Concept

With the DProbe430, Hitex offers a modular emulation system which is specifically designed to develop, test and optimize MSP430 applications. Starting with the entry-level system DProbe430, up to the high-end system DBox16, real-time debugging at the highest frequencies and with all the power saving modes is now possible without restrictions. Changing from one derivative to another can be done by an easy and low-cost exchange of the derivative specific part. This also allows an upgrade to future derivatives.
For reliable adaptation to the target hardware, adapters for all available microcontroller packages are supported.

With the convenient and easy to learn HiTOP user interface, all the processor internals and application structures are made transparent. Symbolic high-level language debugging, as well as examination down to assembler code, can be done to speed up the development and ensure quality in the application. The high-end features of the DBox16 allow the user to find and eliminate even the most complex bugs. With the features coverage and performance analysis you can optimize your MSP430 product and its competitiveness in today's difficult markets. For more information visit the Hitex web site at:
www.hitex.com

C-Cross-Compiler and C/ASM-Debugger

IAR is a leading provider of C compilers and development tools for programming embedded applications. IAR provides the Kickstart environment that is now the standard interface for MSP430 development.

The EW430 is a fully integrated development environment that includes the full C compiler, linker, librarian and assembler in a seamless interface with easy-to-use project and option handling. The CW430 is an HLL debugger incorporating a complete C expression analyzer and full C-type knowledge. It combines detailed control of code execution required for embedded development debugging with the flexibility and power of the C language. The source window can display C source code and mix it with assembler code.

The CW430 simulator allows an unlimited number of breakpoints on C statements, assembler instructions and on any address with a read, write or opcode fetch access type. An interrupt simulation implements commands to launch specific interrupts, either periodically or at a specified cycle-count. For interrupt simulation with intermittent interrupts, the same algorithm as in the target hardware will be selected for choosing the highest priority interrupt. For more information, please visit the IAR web site: **www.iar.com**

Documentation

TI provides extensive documentation support for the MSP430, including user's guides, applications books, data sheets and brochures.

- *MSP430x3xx Family User's Guide* (SLAU012)
- *MSP430x1xx Family User's Guide* (SLAU049)
- *MSP430 Application Report* book (SLAA024)
- MSP430 CD-ROM (SLAC001B)

The *MSP430 Application Report* book (SLAA024) includes many hardware and software examples using the MSP430 for low-power metering and high-precision applications. This report contains examples of developing code and circuitry for most of the hardware modules found on the MSP430. It will assist the system designer in developing code for ADC, UART, I^2C bus, battery check, digital motor control, as well as arithmetic routines, table processing and much more.

For More Information

For pricing and availability, contact your local TI field sales office or authorized TI distributor. For datasheets and the latest information about TI's ultra-low-power mixed-signal processors, visit: **www.ti.com/sc/msp430**

Notes

TI Worldwide Technical Support

Internet

TI Semiconductor Home Page
www.ti.com/sc

TI Distributors
www.ti.com/sc/docs/general/distrib.htm

Product Information Centers

Americas

Phone	+1(972) 644-5580
Fax	+1(214) 480-7800
Internet	www.ti.com/sc/ampic

Europe, Middle East, and Africa

Phone	
Belgium (English)	+32 (0) 27 45 55 32
France	+33 (0) 1 30 70 11 64
Germany	+49 (0) 8161 80 33 11
Israel (English)	1800 949 0107
Italy	800 79 11 37
Netherlands (English)	+31 (0) 546 87 95 45
Spain	+34 902 35 40 28
Sweden (English)	+46 (0) 8587 555 22
United Kingdom	+44 (0) 1604 66 33 99
Fax	+44 (0) 1604 66 33 34
Email	epic@ti.com
Internet	www.ti.com/sc/epic

Japan

Phone	
International	+81-3-3344-5311
Domestic	0120-81-0026
Fax	
International	+81-3-3344-5317
Domestic	0120-81-0036
Internet	
International	www.ti.com/sc/jpic
Domestic	www.tij.co.jp/pic

Asia

Phone		
International	+886-2-23786800	
Domestic	Local Access Code	TI Number
Australia	1-800-881-011	-800-800-1450
China	00-800-8800-6800	-
Hong Kong	800-96-1111	-800-800-1450
India	000-117	-800-800-1450
Indonesia	001-801-10	-800-800-1450
Korea	001-800-8800-6800	-
Malaysia	1-800-800-011	-800-800-1450
New Zealand	000-911	-800-800-1450
Philippines	105-11	-800-800-1450
Singapore	800-0111-111	-800-800-1450
Taiwan	080-006800	-
Thailand	0019-991-1111	-800-800-1450
Fax	886-2-2378-6808	
Email	tiasia@ti.com	
Internet	www.ti.com/sc/apic	

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