Medical

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Electronic Solutions for Medical and Fitness

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Table of Contents

Applications

Electronic Solutions for Medical and Fitness

Today's Challenges to Medical and Fitness Device Manufacturers

The medical and fitness device market is currently undergoing a time of revolutionary change. Many traditional medical devices have evolved into home health and fitness devices. Devices that were primarily used in hospitals are now available for in-home use, worn on the body and even implanted in the body. The demographics of those who purchase medical devices have also changed. Previously, medical device manufacturers only needed to focus their marketing efforts towards committees of doctors and administrators who made the purchasing decisions. In today's environment, they now must also market their products to consumers who require medical and fitness devices that are:

- Portable or wearable
- Lower cost
- Have more powerful feature sets
- Easier to use
- Have a longer battery life
- Reliable and can connect in several ways to smartphones and tablets

Since consumers are constantly upgrading their smartphones and tablets, manufacturers of medical devices will need to decrease their design cycle and develop new products to keep up with the latest trends in consumer electronic devices.

This rapid evolution in medical and fitness device technology may seem overwhelming, but it can also be embraced as an exciting design challenge. Where can you turn to help you meet this challenge? Microchip offers you powerful technology solutions and outstanding support as you create new product designs for the medical and fitness markets.

Microchip: An Experienced Partner to Medical and Fitness Device Manufacturers

Hundreds of leading medical and fitness device manufacturers have experienced the benefits of partnering with Microchip to take their next generation products from concept to market. Microchip is committed to providing value-added solutions that drive innovation and enable our customers to succeed. Our customers count on us to deliver technology solutions and world-class support for applications such as implanted cardioverters, patient monitors, CPAP machines, disposable pregnancy testers and wearable fitness devices. Find out how our special combination of devices, value and support make us an ideal partner for your next medical or fitness device design.

A Broad Portfolio of Solutions for Medical and Fitness Applications

We offer a number of products and solutions which are designed to meet the rapidly changing medical and fitness device markets. Our broad portfolio of microcontrollers, mixed-signal, analog, secure data, wireless, sensor fusion, Flash semiconductors and modules are enabling designers and manufacturers to keep up with the latest trends and deliver their products to market more quickly.

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Lowest-Power Microcontrollers for Portable and Wearable Devices

Medical and fitness devices that are intended to be portable or wearable must be designed to consume minimal power and, in some cases, run for years on a single battery. Microchip's eXtreme Low Power (XLP) technology offers the industry's lowest currents for Run and Sleep for maximum battery lifetime and minimum product size. Microchip's eXtreme Low Power (XLP) technology features:

- Sleep currents down to 9 nA and run currents down to 30 µA/MHz
- Lowest-power sleep modes with flexible wake-up sources
- Industry-leading integrated USB, LCD, hardware encryption and mTouch® capacitive sensing peripherals with low power
- Consistent low-power features, peripherals and tools for ease of migration
- Longest battery life with robust and reliable features
- Most efficient performance across battery voltage range

A Connected Healthcare World

In today's connected world, there is a growing need for remote medical care services and wireless fitness monitoring capabilities. The latest advances in smartphone, wired and wireless communication technologies are making this connectivity possible. Microchip offers a broad portfolio of wired and wireless communication solutions such as USB, Ethernet, Wi-Fi®, Bluetooth®, Bluetooth Smart and ZigBee® products.

Microchip's connectivity products include solutions that are integrated into microcontrollers, as well as external transceivers, modules, switches, controllers and hubs. Its agency-certified surface mount, low-power Wi-Fi, Bluetooth and Bluetooth Smart modules allow you to quickly and seamlessly add wireless connectivity to medical and fitness devices. We offer you all the resources you need to get your connected medical or fitness product to market faster.

Touch Sensing for Medical and Fitness Devices

Microchip's award-winning technology covers a broad range of implementations for touch and other input sensing applications. Microchip offers both turnkey products for a "no code" development plug-and-play solution, as well as proven robust firmware that leverages our vast PIC® microcontroller portfolio. In addition to low power touchpads and touchscreens we offer unique technologies such as metal-over-capacitive, which enables products to have a completely waterproof stainless steel front panel. Also, our 3D position and gesture sensing products make it easy to add innovative human interfaces to any medical or fitness application.

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Intelligent Healthcare Device Design Starts with Intelligent Analog PIC MCUs

Analog design for medical and fitness devices tends to be difficult and can consume precious development time. Microchip's intelligent PIC MCUs integrate analog functions such as high-performance Analog-to-Digital Converters (ADCs), Digital-to-Analog Converters (DACs) and operational amplifiers (op amps), providing simple-to-use interfaces that ease analog design.

Microchip's Intelligent Analog PIC MCUs

- Eliminate the complicated task of debugging the noise sources that reduce analog signal integrity. This results in reduced system noise and shorter design cycles.
- Remove the bottleneck of communicating to the microcontroller from analog. This can result in a faster data path.
- Provide consistent analog performance that can be leveraged from design to design, eliminating analog design rework. This can lower product cost and result in designs getting to market faster.
- Provide full software control of the analog through intelligent connections made inside the chip, thus simplifying board design.
- Enable a simplified design cycle, board space savings, faster throughput and better signal integrity

Our scalable portfolio of PIC MCUs with analog functions ranges from low-cost and low-power 8-bit and 16-bit families to our powerful dsPIC® Digital Signal Controllers which offer high-performance levels of digital control. These MCUs are well suited to implement single-chip applications such as glucose meters, blood pressure meters, portable ECG equipment and pulse oximeters. Our Intelligent Analog PIC MCU solutions enable reduced system noise and provide higher throughput, while dramatically reducing design time and cost.

Higher Performance at a Lower Cost

Core Independent Peripherals

Traditionally, each additional function supported by an MCU requires additional Flash memory to store variables, more RAM to execute code and higher processing speeds to ensure that system timing is within specification. Unfortunately, this type of integration requires larger, more power-hungry and more expensive MCUs than many design budgets can sustain.

New medical and fitness designs must support an increase in functional integration, as well as offer a reduction in overall power consumption, cost, and physical footprint. These cost-sensitive embedded designs require a move away from the traditional "arms race" of MIPS, Bytes and Megahertz, and a paradigm shift into the era of function enablement.

Microchip is leading the way in adding functionality and flexibility to embedded designs. Our PIC MCUs with Core Independent Peripherals incorporate on-chip peripherals that can operate without supervision from the CPU and are able to communicate directly with other peripherals to create flexible feedback loops. These peripherals deliver blocks of function-specific hardware intelligence which require little to no code, consume very little power, and require much less RAM and Flash to implement a given function within the core processor. Our integrated solutions enable flexible, power-efficient designs with the capability to perform the same tasks as much larger and more expensive MCUs without the added cost.

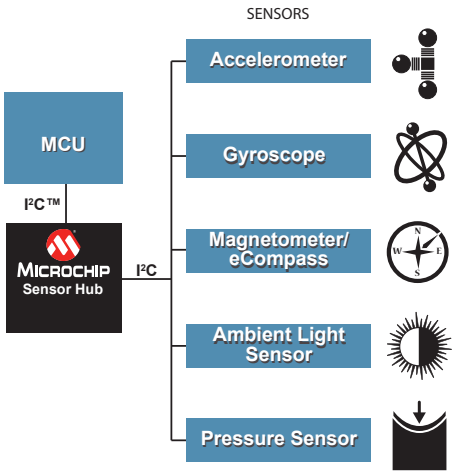
Our MPLAB® Code Configurator tool makes it easy to implement custom functional building blocks with these Core Independent Peripherals. Just select your desired function, and the MPLAB Code Configurator will provide the code to set up the PIC MCU's external pins as well as the internal peripheral interconnections. Designing powerful, cost-efficient medical and fitness devices has never been easier.

Electronic Solutions for Medical and Fitness

Sensor Fusion: The Next Step in Advanced Medical and Fitness Designs

Due to their small cost and size, sensors are now being added to a vast number of applications, including medical and fitness devices. As this trend grows, system requirements are moving from simple monitoring to providing complex information about our health, environment and activities. Data from multiple sensors—such as motion/location (accelerometers, magnetometers, gyroscopes) and environmental (light, temperature, pressure)—need to be incorporated or "fused" into one system. Microchip's flexible and turnkey sensor hub solutions support different types of sensors, making it easy to implement sensor fusion in your design.

When coupled with our applications support solutions for medical and fitness designs, this sensor fusion capability allows you to create a variety of innovative products. These include wearable and portable devices used for fitness, patient tracking, remote diagnostic monitoring, clinical sleep studies, artificial limb gate analysis and clinical stress/fitness evaluation.



Security Solutions for Medical and Fitness Devices

Are you concerned about the security of your medical device design? In today's vast interconnected world, the need to provide greater security in medical designs is quickly becoming a standard requirement. Whenever there is a communication link, there is an opportunity for the data to be intercepted by an unauthorized party. This is clearly unacceptable if the data being transmitted is sensitive medical information. Medical professionals and patients alike are also concerned about the possibility of unauthorized access and control of life-saving medical devices.

As a designer of medical devices, you face the challenge of providing more complex systems with security features which allow users to stay one step ahead of the criminal element. Adding secure encryption to the programming of MCUs allows every link in the data chain to be secured, increasing the confidence of users of connected medical devices. For example, data encryption algorithms—such as Microchip's KEELOQ® advanced codehopping technology—can protect data during transmission by rendering it unreadable to unauthorized receivers.

Since no system is 100% secure, medical device and system designers must implement multiple techniques to make their systems as difficult as possible to break. Microchip offers both cryptographic and non-cryptographic resources which can be merged to build a total system security solution. Our high-performance, cost-effective security and authentication products and development tools can simplify and accelerate your development of secure medical devices.

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Electronic Solutions for Medical and Fitness

Quickly Integrate Designs with Smartphones and Tablets

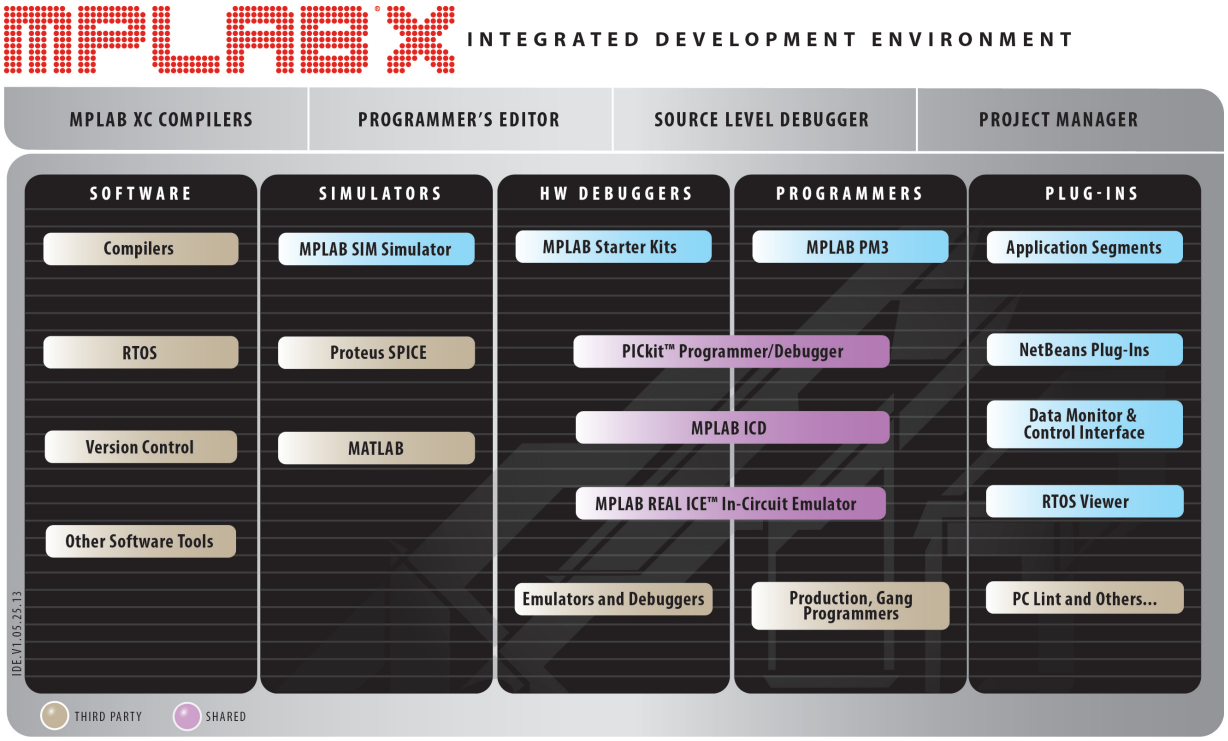
Whether a medical or fitness device design needs to work with Apple® Made-For-iPod® (MFi) or Android™ devices, Microchip has the development kits and libraries that help you get your product to market quickly and easily.

In many areas of the world, medical devices such as a blood pressure meters or portable ECG machines need to send information over a mobile data link. When a medical device has the ability to dock to an Apple iOS or Android smartphone-based device, critical data can be sent over a mobile network, which minimizes the investment in a networking infrastructure for small clinics or doctors' offices.

To implement this type of application, portable medical device designers need resources which allow them to quickly and easily develop products that work properly with Apple iOS or Android smartphone technology. They also need hardware development systems that have stable and mature software libraries for the design of either iPhone®- or Android-based devices. Microchip offers these stable development tools and the necessary technical support to help you get your smartphone- or tablet-enabled medical device into production and to market quickly.

Scalability and Faster Time to Market with Microchip Development Systems

Recognizing that designers need more than the latest silicon devices to bring their designs to production, Microchip also offers a comprehensive set of world-class, easy-to use, low-cost application development tools. Our development platforms enable you to quickly scale existing or multiple designs up or down across many of our 8-bit, 16-bit, 32-bit PIC MCUs and dsPIC DSCs. In addition, many of the common third-party development tools that you may already have at your disposal are compatible for use with Microchip's devices. This means that you can not only re-use existing code across multiple microcontroller designs, but you can also use the development systems that you are already comfortable with for your medical and fitness device designs. We also offer all of the tools that you need to do your analog design, software development, in-circuit emulation, debugging and system level evaluation. This includes tools from our third party partners. Support for embedded designs includes free tutorials and webinars, a full range of documentation, free software downloads and evaluations, and a 24/7 support center. Microchip gives medical and fitness designers the right tools and support to make their project development easier and help companies get their products to market more quickly.



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Electronic Solutions for Medical and Fitness

Support for Regulatory Compliance

Medical device manufacturers are constantly dealing with government regulatory issues. Their regulatory burden can be significantly increased when a semiconductor supplier discontinues a product used in designs that are going through or that have already gone through the regulatory compliance process. Microchip's documented change control process and unmatched history of long product lifetimes offer an uncommon stability which can help lighten the regulatory burden of medical device manufacturers.

No Compromise on Quality

A critical aspect of an electronic medical device's reliability is the quality system used by the semiconductor supplier. Microchip's culture embraces quality at every level. The company's quality systems and operations are periodically examined by independent outside auditors to verify conformance to the stringent standards of the International Standards Organization (ISO). Microchip's strict adherence to the ISO/TS-16949 quality standard aligns well with the requirements of medical device manufacturers for stability and high reliability. Microchip's quality systems are designed to address the ZERO DEFECTS challenge for every product that we sell.

World-Class Global Support

In addition to hundreds of dedicated field applications engineers located around the world, Microchip's 24/7 global technical support line offers technical support resources any time help is needed. Medical and fitness device designers can also take advantage of technical seminars from Microchip Regional Training Centers, standard code libraries, medical reference designs and application notes. These resources support the needs of a large base of customers who produce a wide range of medical and fitness devices.

Medical and Fitness Application Design Center

For medical and fitness design ideas, solution information, applications notes and other helpful resources, please visit Microchip's medical and fitness design center at www.microchip.com/medical.

Many other Microchip on-line design centers are available with complete technical resources including circuit diagrams, application notes, web seminars, development tools, recommended products and device samples. For more information please see www.microchip.com/designcenters.

Microchip design centers include:

- Audio and Speech
- Automotive
- Battery Management
- CAN
- Graphical Displays
- Segmented LCD
- Ethernet
- High Temperature
- Home Appliance
- Intelligent Power
- Lighting
- LIN
- Low Power
- Medical
- Metering
- Motor Control and Drive
- Smart Energy
- Smartphone Accessories
- Proximity, Keys and Sliders
- Touch Screen and Touch Pad Controllers
- 3D Tracking and Gesture Sensing
- Haptics
- USB
- Wireless Audio
- Bluetooth
- Embedded Security
- Personal Area Networks
- Wi-Fi

Microchip Certified Medical Design Partner Specialists

Do you need to add medical-grade device design expertise to your own design efforts or are you looking to have a total medical solution designed for you? Our certified medical design partner specialists have proven capabilities and are uniquely qualified to support Microchip customers through all phases of medical device development.

Applications

Wearable Fitness and Medical Devices

Wearable fitness and medical devices are becoming an integral part of personal fitness programs and home medical treatment. These devices measure a broad range of biometric and physiological data as well as sync with smartphones, tablets, PCs and home-health hubs.

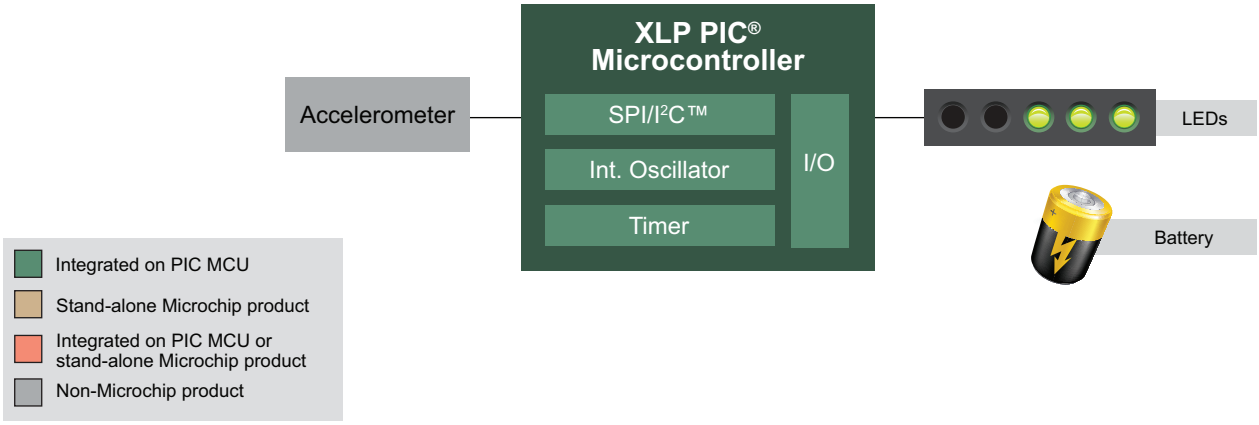
Wearable devices can include many combinations of biometric and physiological sensors depending upon the data that they are designed to collect. These data can include distance walked, calories burned, heart rate, temperature, blood oxygen level, sleep quality, location, perspiration, pressure and other data. The specifics of what is being measured drive the selection of MCUs, signal conditioning components and connectivity chips that are used in a wearable device.

Low power is a key factor in the design of wearable devices. MCUs with low run currents, multiple low-power sleep modes, flexible wake-up sources and intelligent power management are critical to the success of these designs.

Wireless connectivity allows wearable devices to interface with smartphones, tablets, PCs and other intelligent healthcare devices. Agency-certified, low-power Bluetooth, Bluetooth Smart and Wi-Fi modules offer significant time savings in RF design and regulatory approval.

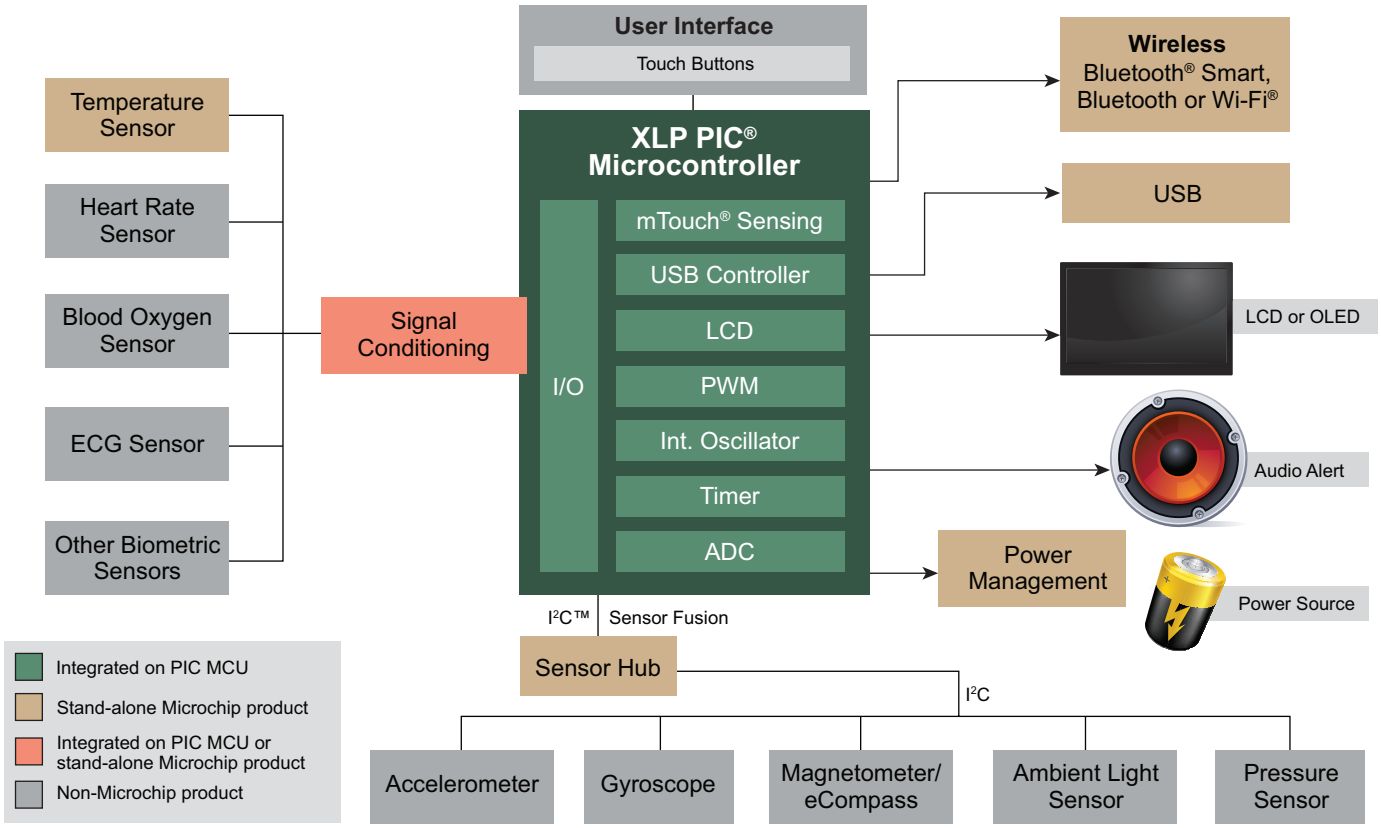
The demand for higher-accuracy location processing in low-cost wearable devices is increasing. These high-accuracy wearable devices will typically need to receive inputs from multiple sensors such as accelerometers, magnetometers, gyroscopes, light sensors and pressure sensors. Traditionally these types of designs would need high-power MCUs and correspondingly long software development times. The use of a sensor fusion chip can significantly reduce the MCU size and software development time in high-accuracy location tracking designs.

Wearable Basic Consumer Activity Tracker



Applications

Wearable High-End Consumer Activity Tracker or Wearable Medical Home Health Monitor



Microchip has what fitness activity tracker and medical home health activity monitor designers need:

- Reduced product power consumption enables wearable monitors to use smaller batteries, run longer between re-charging and offer an overall smaller product footprint. Our portfolio of eXtreme Low Power (XLP) Technology PIC microcontrollers feature sleep currents as low as 9 nA and run currents down to 30 µA/MHz.
- Designing wireless connectivity into wearable devices is a formidable challenge. RF circuit design, antenna design and government regulatory approvals are common sources of major time and cost overruns. Our full range of agency-certified Wi-Fi, Bluetooth, Bluetooth Smart and other wireless modules gives you the ability to quickly develop wireless solutions that connect to smartphones, tablets, PCs or the cloud.
- The next generation of wearable medical devices will measure biometrics such as heart rate, blood oxygen and blood pressure. This capability demands high-performance signal processing and filtering. Our dsPIC Digital Signal Controllers and digital filter design tool make implementing embedded signal processing fast, easy and intuitive.
- In a connected world a wearable device must be protected from the threat of data interception or unauthorized control. We can simplify and accelerate the development of secure healthcare devices with our high-performance, cost-effective security and authentication products and development tools.
- Fitness and diagnostic users now desire better movement and location data from their wearable activity monitors. This can be achieved by combining data from accelerometers, magnetometers, gyroscopes, light sensors and pressure sensors. However, doing this typically means using a large, costly, power-hungry MCU for the design along with a correspondingly long software development time. Our low-power sensor hubs efficiently process data from multiple sensors, lowering the BOM cost of wearable devices and providing maximum flexibility in an easy-to-implement solution.

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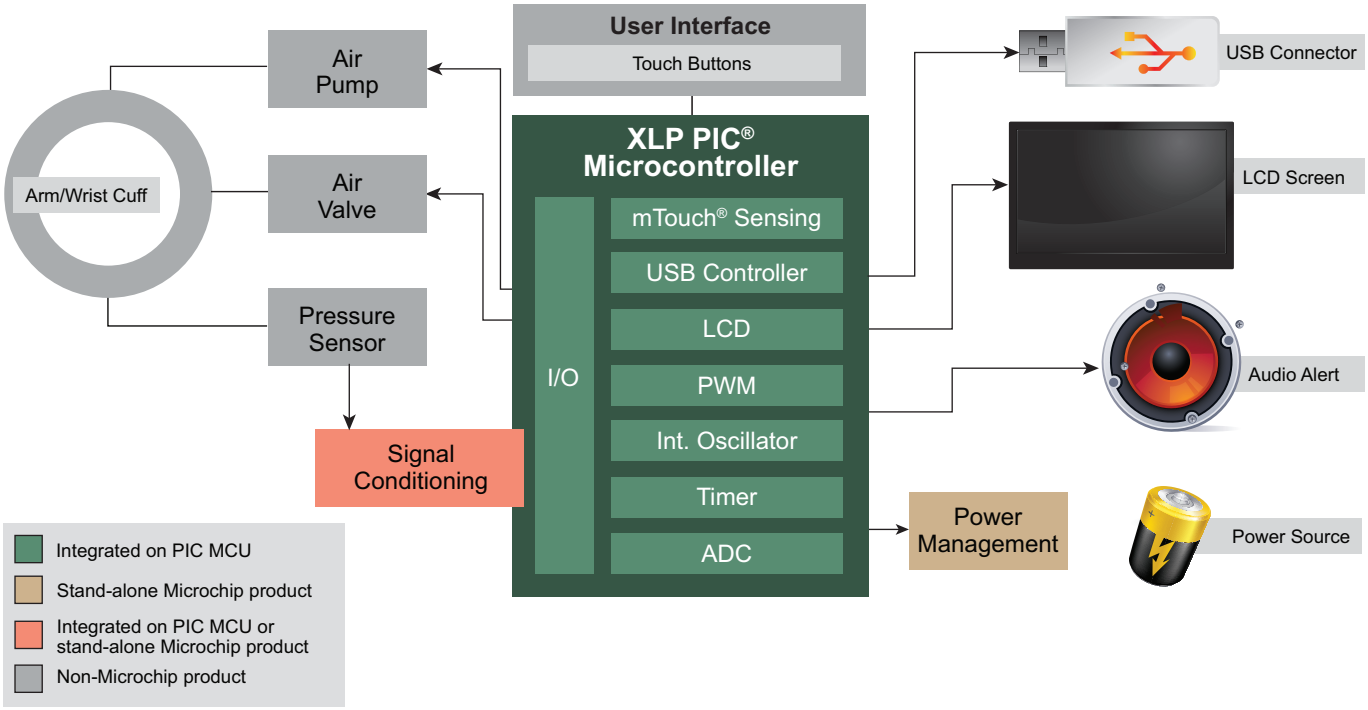
Applications

Blood Pressure Meter

A **blood pressure meter,** or sphygmomanometer, is a device that is used to measure blood pressure. The meter is used with an inflatable cuff for restricting blood flow and a pump to inflate the cuff. Digital blood pressure meters typically measure both systolic and diastolic pressures by an oscillometric detection method, using a piezoelectric pressure sensor.

A digital blood pressure meter allows easy monitoring of blood pressure at home, in a doctor's office or in a hospital. Today's blood pressure meters must meet the demands of measuring, storing and transmitting blood pressure, pulse and other medical data. To meet these demands, Microchip offers a broad portfolio of highly integrated microcontrollers, semiconductors, software and development solutions. These include integrated products with low-noise analog signal conditioning, touch technology, LCD control, wired/wireless connectivity, motor control, multiple low-power modes and high-speed memory.



Microchip has what blood pressure meter designers need:

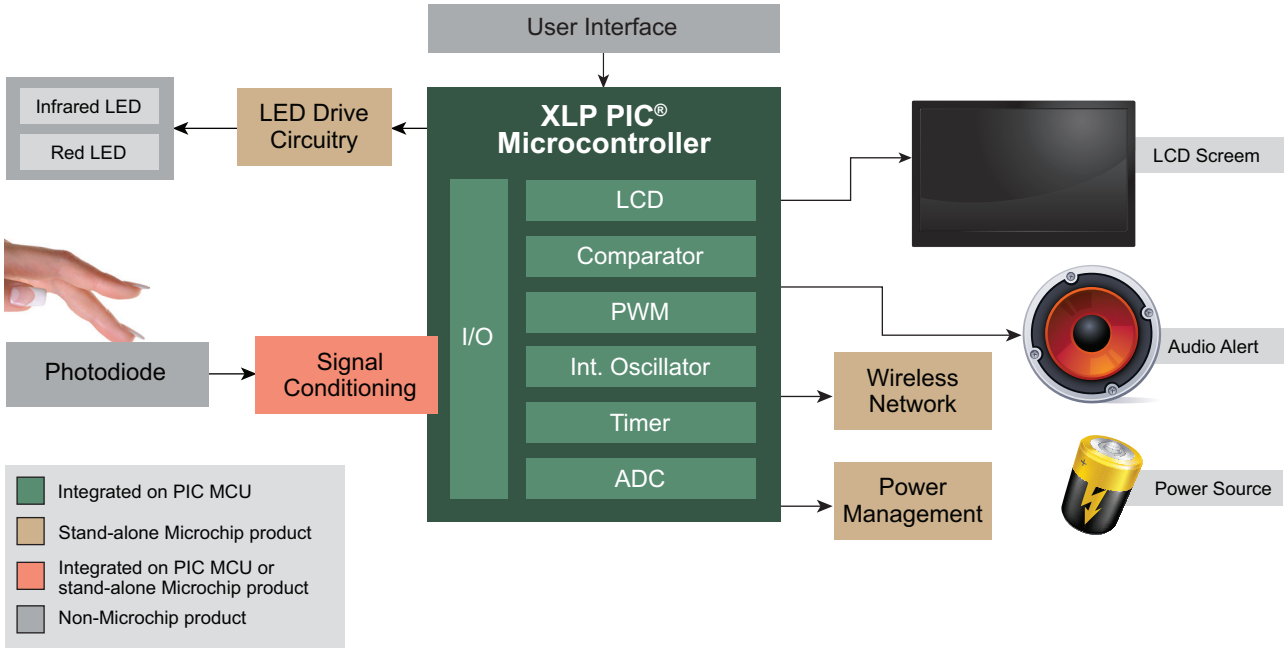
- Our cost-efficient, highly integrated PIC microcontrollers can lower the BOM cost of digital blood pressure meter designs. High-end integration features include analog, USB, LCD control, touch input sensing, motor control and Core Independent Peripherals.
- Analog components, such as low-offset/low-noise op amps, can be used for amplification and conditioning of the pressure sensor output.
- Agency-certified Bluetooth, Bluetooth Smart and Wi-Fi modules allow for fast integration with existing wireless networks.

Applications

Pulse Oximeter

A **pulse oximeter** is a non-invasive electro-optical device for measuring both the heart rate and the degree to which the hemoglobin in one's blood has been saturated with oxygen. This quantity is inferred by measuring the optical transmittance of perfused skin in different wavelengths of light. Red, green and infrared LEDs are convenient and common light sources. Blood oxygen saturation can be determined by comparing the values of Oxy-hemoglobin to Deoxy-hemoglobin. One method for doing this is by shining both a red LED and an infrared LED into a body part (such as a finger or wrist), and then measuring and comparing the relative intensities of the light from each LED in terms of a ratio. This ratio is then typically expressed as the percentage of oxygen saturation.

Pulse oximeter designs call for low power consumption and extensive analog and digital filtering. They are often implemented both as stand-alone medical and fitness devices as well as components of more comprehensive vital sign monitoring systems.



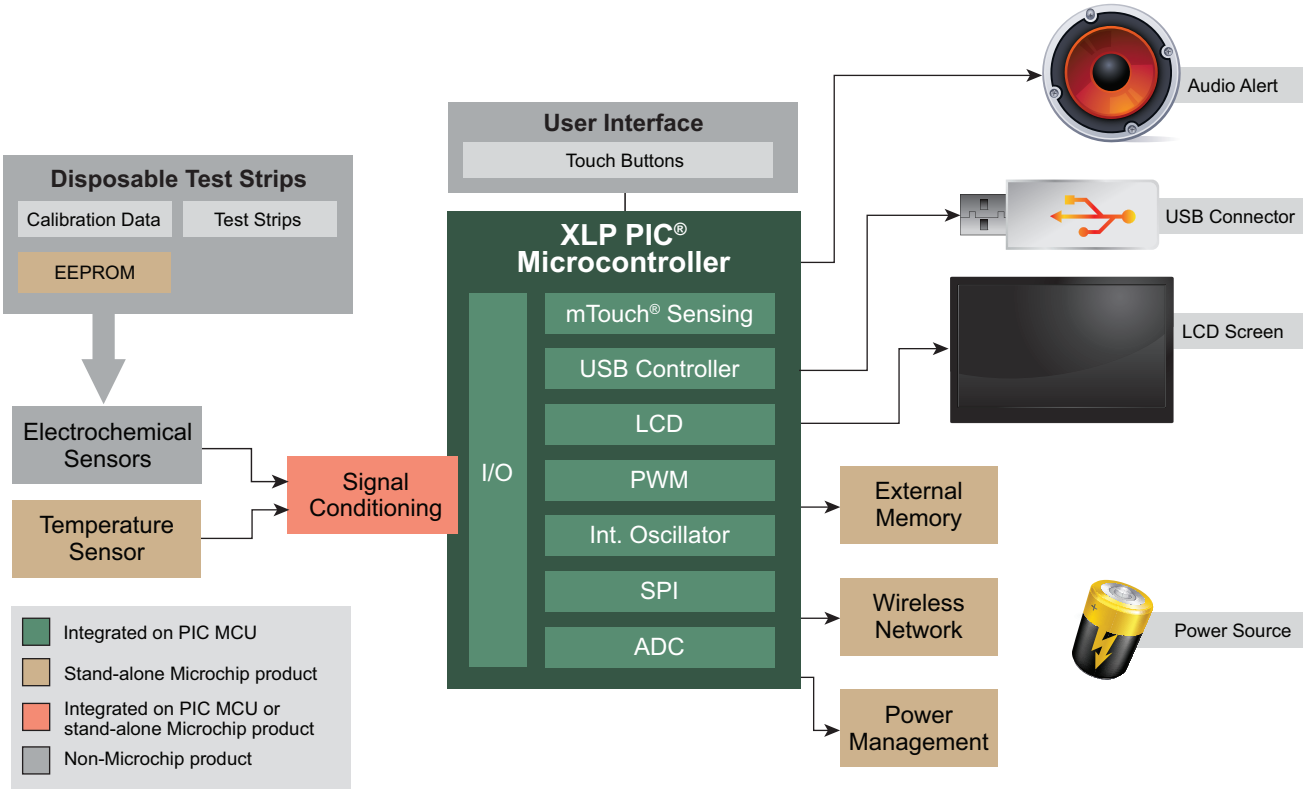
Microchip has what pulse oximeter designers need:

- Our dsPIC Digital Signal Controllers provide high performance digital filtering of optical noise from external light sources and movement.
- Lower cost of development with our world-class integrated development tools, MPLAB X IDE, which encapsulates coding, debugging, software simulation, hardware emulation and device programming in a single interface.
- Low-offset, low-noise op amps for amplification and conditioning of photodiode output.
- Agency-certified Bluetooth, Bluetooth Smart and Wi-Fi modules for fast integration with existing wireless networks.

Applications

Glucose Meter

Blood Glucose Meters are used to determine the concentration of glucose in a patient's blood. Glucose concentration is an important quantity for the management of diabetes. Key differentiators include ease of use, convenient size and low power consumption.



Microchip has what glucose meter designers need:

- Lowest power (sleep currents down to 9 nA, run currents down to 30 µA/MHz) PIC MCUs enable long battery life designs.
- Sleep mode flexibility: RAM retention, fast wake up and flexible wake up sources.
- Analog components, such as low-offset/low-noise op amps and high-resolution ADCs, can be used for amplification, conditioning and conversion of the test strip socket output.
- Cost-efficient, highly integrated PIC microcontrollers that can lower the BOM cost of glucose meter designs. Integration features include analog signal conditioning, LCD control and mTouch input sensing.
- Other peripherals integrated into Microchip's MCUs include:
  - A Charge Time Measurement Unit (CTMU) which can provide a constant current source with a range from 0.55 µA to 550 µA.
  - Real-Time Clock/Calendars (RTCC) with functions for timekeeping, alarms and calendar applications. These devices offer highly configurable alarms and have the ability to wake up external devices without CPU intervention.

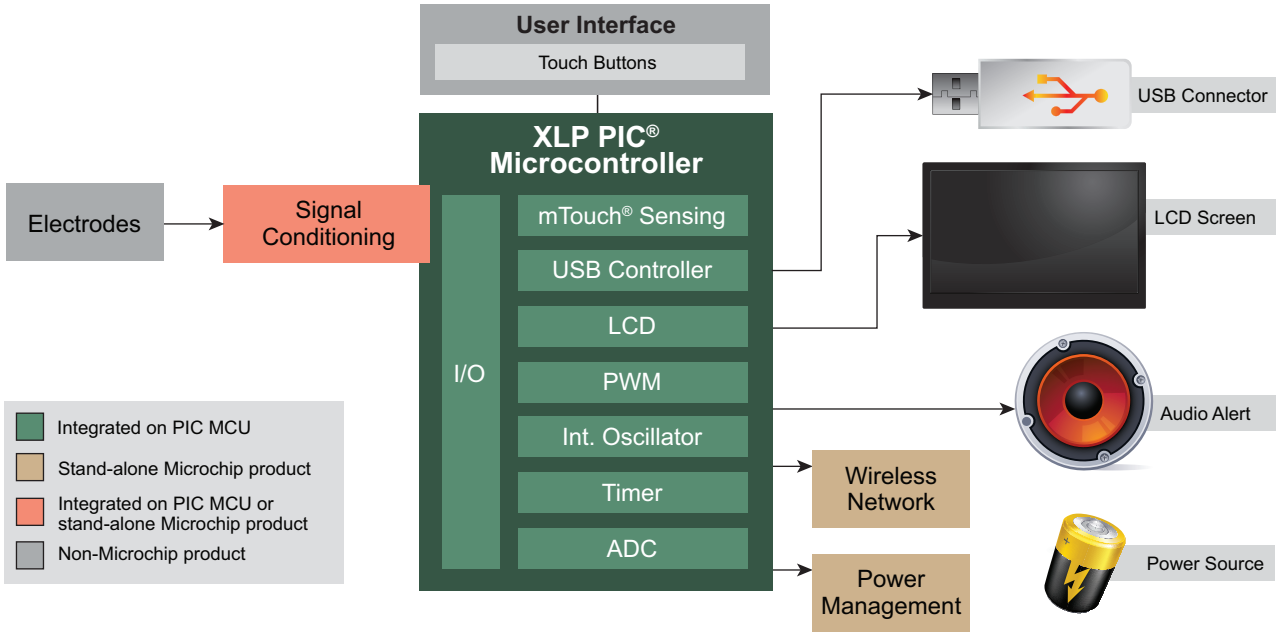
Applications

Electrocardiogram (ECG)

An **electrocardiogram**, or ECG machine, is a device that is used to monitor and record the electrical activity of the heart. Since each heartbeat produces an electrical impulse in the heart, the generated cardiac electrical potentials can be measured with sensors placed on the body at different locations. Abnormal electrical activity can indicate conditions such as heart attack, chest trauma or reduced blood flow to the heart, arrhythmia or heart deformities.

The demand for portable and accurate ECG monitoring has grown substantially both in medical and fitness devices. Despite the smaller size of these portable products, ECG devices still require precision filtering, high-performance processing power and integrated high-resolution graphics control that is separate from the main microcontroller core.

Microchip meets these design requirements while also offering the flexibility to add more extensive features with its broad portfolio of highly integrated microcontrollers, semiconductors, software and development solutions. Our solutions include digital filtering, low-noise analog signal conditioning, graphics controllers, touch technology, wired/wireless connectivity and multiple low-power modes.



Microchip has what ECG designers need:

- Our dsPIC DSCs offer powerful processing and digital filtering and our digital filter design tool makes designing FIR and IIR filters easy and intuitive.
- Low-noise analog components for amplification and precision filtering of the sensor lead output.
- Powerful microcontrollers bring high-resolution graphics control to portable ECG devices with compact displays. Available graphics libraries and design tools help get ECG designs to market quickly.
- Cost-effective microcontrollers with integrated analog for smaller heart rate and ECG device applications.
- Agency-certified Wi-Fi modules for fast integration with existing wireless networks.

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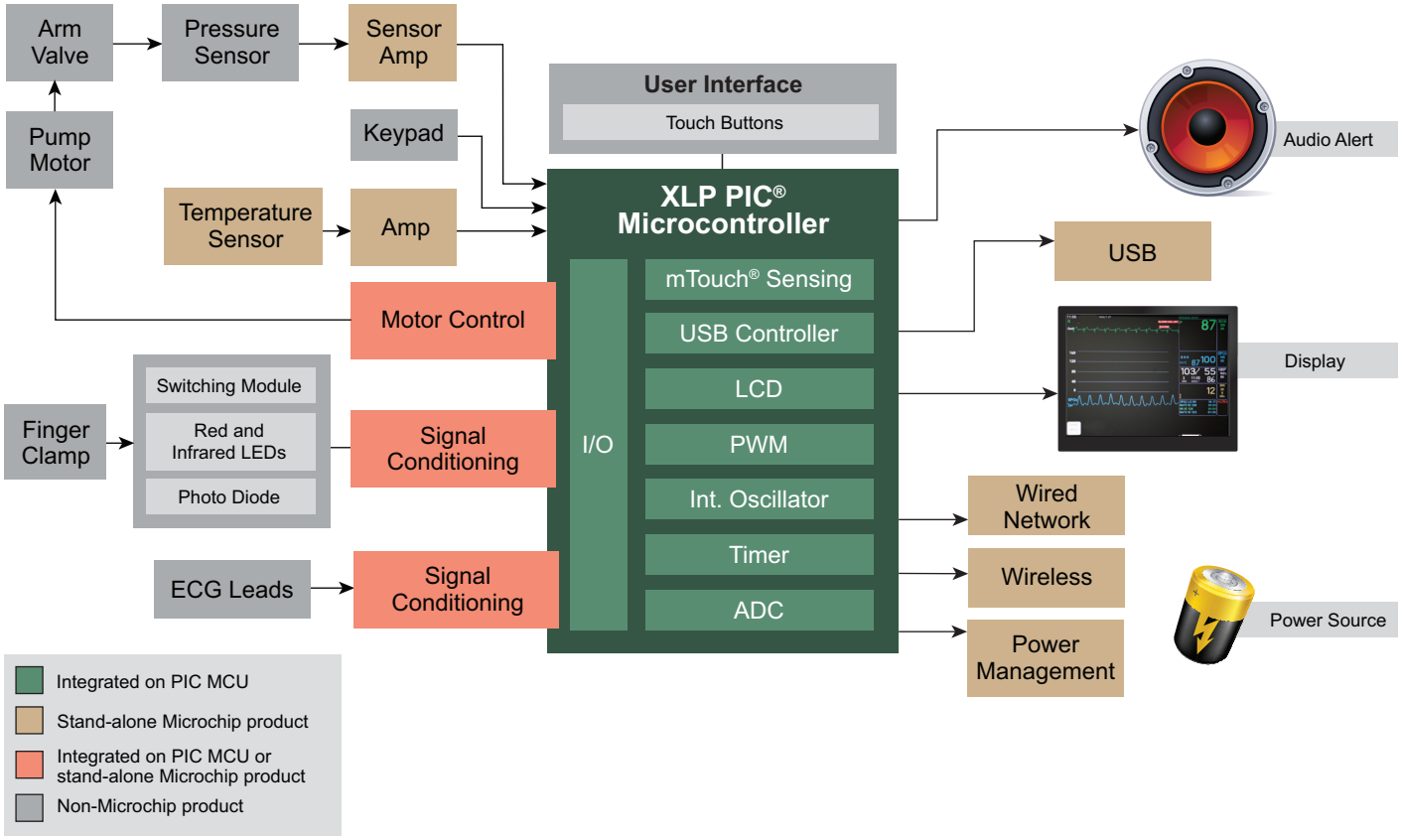
Applications

Patient Monitor

Patient monitors measure, record, distribute and display combinations of biometric values such as heart rate, SPO_2, blood pressure, temperature and more. High-capability, multi-function monitors are typically used in hospitals and clinics to ensure a high level of quality patient care. Portable patient monitors are designed to be compact and power-efficient. This allows them to be used in remote areas or by paramedics to aid diagnosis in the field and to enable monitoring and transmitting data to health care providers in other locations.

To meet the demands faced by designers of patient monitors, Microchip offers a broad portfolio of highly integrated MCUs, graphics technology, software libraries, and connectivity solutions. This broad offering also enables innovation in the design of stand-alone biometric devices such as blood pressure monitors, pulse oximeters and ECG/EKG. We deliver solutions for low-noise analog signal conditioning, touch sensing technology, LCD control, wired and wireless connectivity, motor control and high-speed memory to support patient monitoring functions.



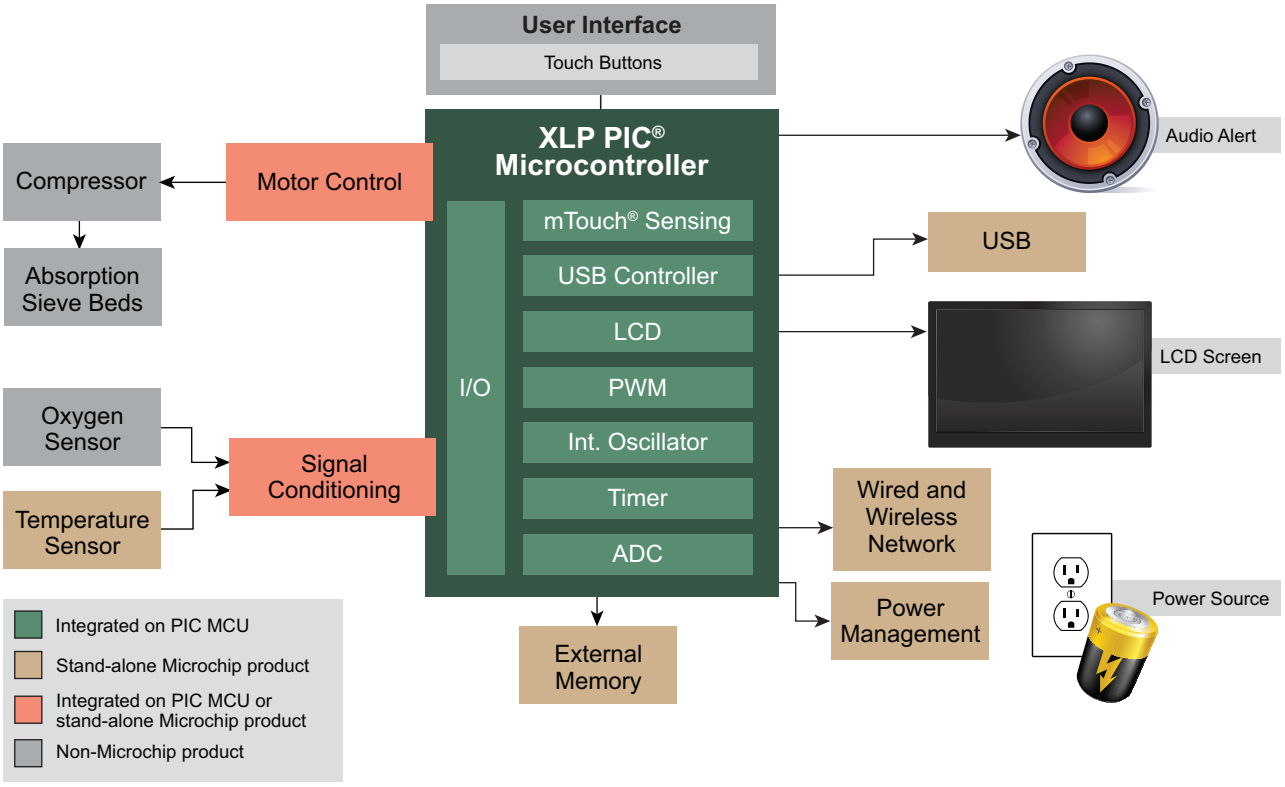
Microchip has what patient monitor designers need:

- Powerful, highly-integrated 32-bit PIC MCUs with flexible integrated graphics, USB, and 10/100 Ethernet enable the design of every kind of patient monitor for use in hospitals, doctors' offices or in the field.
- A broad range of 8-, 16-, and 32-bit PIC MCUs and other solutions enable the design of blood pressure monitors, pulse oximeters, ECG and other sub-sections of a patient monitor design.
- Signal conditioning components such as low-offset/low-noise op amps and high-resolution ADCs for accurate and reliable signal capture and conversion from sensors.
- Agency-certified Wi-Fi, Bluetooth, Bluetooth Smart, and ZigBee solutions for fast integration with existing networks.

Applications

Continuous Positive Airway Pressure (CPAP)

Continuous Positive Airway Pressure (CPAP) machines deliver therapy for obstructive sleep apnea. Essentially an air pump, a CPAP device continually adjusts its output to the user's breathing pattern in order to maintain a constant pressure. To meet system objectives, CPAP designers use various types of motors, all of which can be controlled by Microchip's PIC microcontrollers with flexible integrated motor control peripherals.



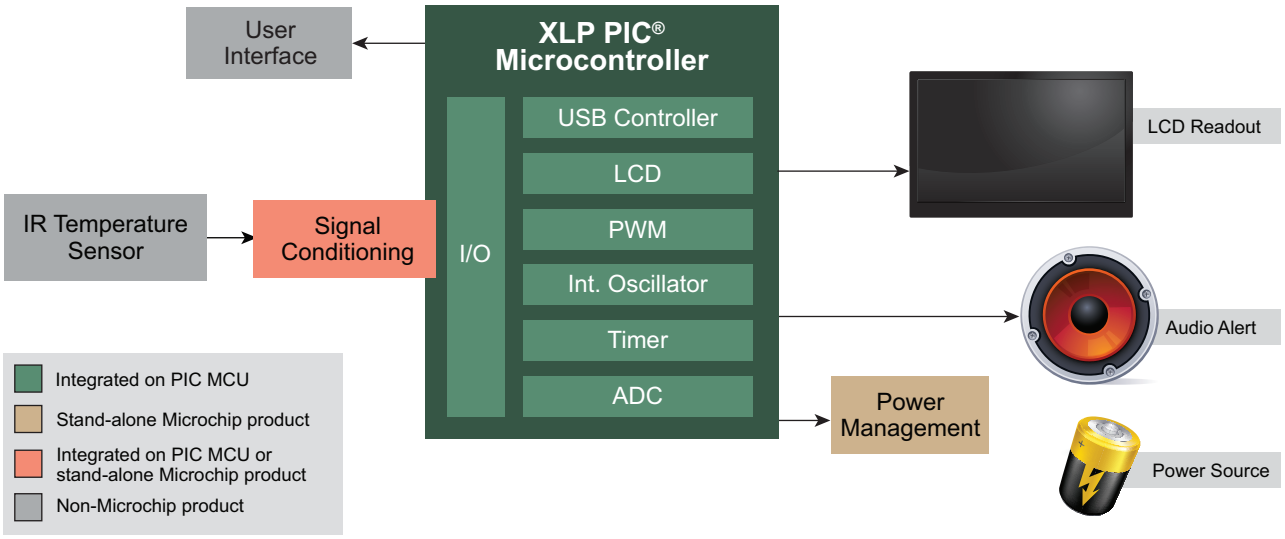
Microchip has what CPAP designers need:

- dsPIC Digital Signal Controllers with integrated peripherals to implement numerous motor control strategies, including sensorless BLDC control.
- A portfolio of free and low-cost code examples, software libraries and development tools to reduce motor control system design time and risk.
- High-accuracy temperature sensors to maintain comfortable delivered air temperature.
- Low-offset, low-noise op amps to amplify and condition signals from temperature and pressure sensors before analog-to-digital conversion.
- Hardware and software mTouch solutions for touch, proximity and free-space gesture-based control for systems that are easy to use in the dark.

Applications

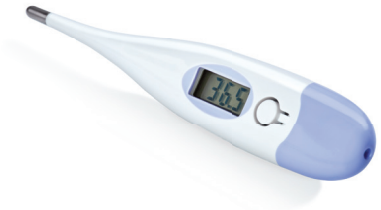
Digital Thermometer

There is now an increased market demand for temperature measurement capability in both medical and fitness devices. Power consumption is the one of the major factors in **digital thermometer** design. The need for extended battery life, along with high precision, fast response time and low-cost is critical. Microchip's PIC microcontrollers with eXtreme Low Power (XLP) Technology, along with our wide-range of analog components, offer extensive flexibility and performance to designers of digital thermometers.



Microchip has what digital thermometer designers need:

- A complete family of eXtreme Low Power (XLP) Technology PIC microcontrollers with sleep currents as low as 9 nA and the flexibility of integrated 8-bit, 10-bit and 12-bit ADCs.
- Lower cost of development with our world-class integrated development tool, MPLAB X IDE, which encapsulates coding, debugging, software simulation, hardware emulation and device programming in a single interface.
- Lower BOM cost and less design complexity enabled by integration of coherent peripherals, like built-in LCD drive, touch-sensing capability and other associated features in most of our popular MCU families.
- Cost-effective, low-risk options to add wireless capability using our wireless controllers and modules.

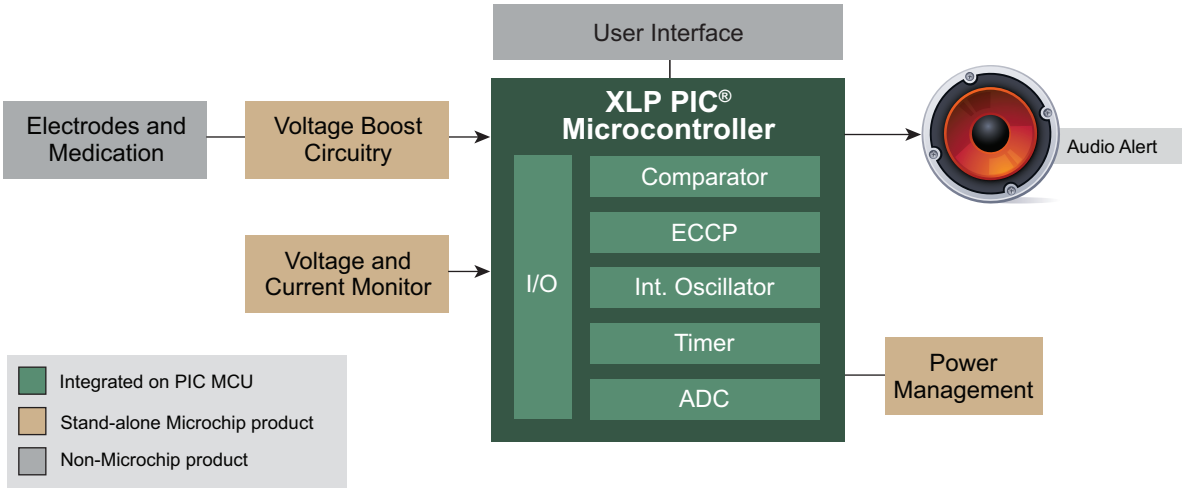


Applications

Iontophoresis

Iontophoresis is a process used to deliver a specially formulated, transdermal medication through the skin into the body. This transdermal medication is a charged compound driven through the skin by the flow of electrical current. For some diseases and conditions this method of drug delivery has significant advantages over oral, hypodermic, or topical medication.

One of the biggest challenges that designers face when creating devices such as iontophoresis patches is that the critical electronics need to be placed in the wearable portion of the device, which is meant to be used once and then thrown away. This scenario creates intense pressure for the patch electronics to be small and for the overall BOM costs to be lower. Since this is a small, disposable item, battery cost and energy capacity impose further constraints on the design. Finally, the design needs to be easily modified for additional features, such as changes in the medication dose and duration. Medical device designers can use Microchip components to create safe, cost-effective iontophoresis device designs.



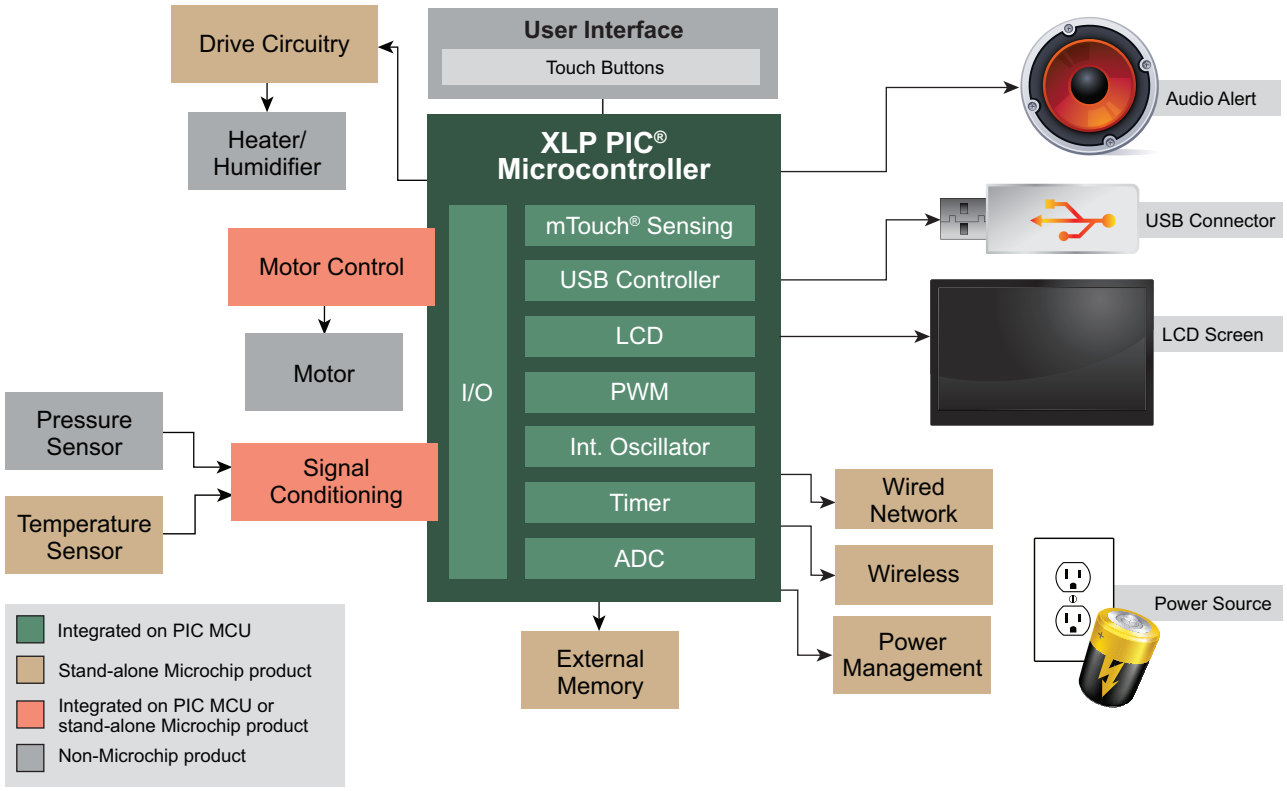
Microchip has what iontophoresis device designers need:

- Small footprint microcontrollers in packages such as SOT-23 and 2 × 3 DFN for wearable patch-based iontophoresis devices.
- We offer the lowest power parts, with sleep currents down to 9 nA and run currents down to 30 µA/MHz which allow the design to use a smaller-sized and lighter-weight battery and reduce overall size and weight of the design.
- PIC microcontrollers with Core Independent Peripherals, such as configurable logic cells and PWM, enable innovative wearable medical devices.

Applications

Oxygen Concentrator

An **oxygen concentrator** provides oxygen-enriched air by pressurizing ambient air through a molecular sieve which filters out nitrogen under pressure. The removed nitrogen is vented back to air by releasing the pressure. An oxygen concentrator offers a portable and lower-maintenance alternative to oxygen tanks. The various components of the oxygen concentrator, such as the motor control/drive circuitry for the air compressor, signal control circuitry for sensors, power management circuitry and the user interface, need to work in careful coordination to achieve maximum efficiency.



Microchip has what oxygen concentrator designers need:

- Motor drive circuitry: Our high performance 16-bit dsPIC33F family of digital signal controllers and other PIC MCUs offer dedicated peripherals to simplify control and operation of various types of motor used in the compressor.
- Signal processing: Our digital signal controllers and other PIC MCUs feature sophisticated high-resolution ADCs to work with a diverse range of sensors. The ADCs can also be tightly integrated with the versatile PWM controllers in the same MCU.
- Signal Conditioning: A broad range of analog components for signal conditioning of sensor outputs prior to analog to digital conversion.
- User Interface: Our mTouch for sensing technologies provide a cost-effective and reliable user interface that can be efficiently integrated with dsPIC DSCs and PIC MCUs.

Support

Microchip is committed to supporting its customers in developing products faster and more efficiently. We maintain a worldwide network of field applications engineers and technical support ready to provide product and system assistance. In addition, the following service areas are available at **www.microchip.com:**

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