From Concept to Prototype in Minutes
SHOWCASE

4 From Concept to Prototype in Minutes
Free code configuration plug-in for MPLAB® X IDE makes developing firmware on 8- and 16-bit PIC® microcontrollers faster and easier

NEW PRODUCTS

7 It’s a Breeze
New controller with GestIC® technology enables one-step design-in of 3D gesture recognition in embedded devices

9 Speedy and Reliable
Latest additions to low-power 1.8V Serial Quad I/O™ family of SuperFlash® technology memory devices offer 4-Mbit and 8-Mbit of memory

TECHNOLOGY

11 Whole Home Audio
Fourth generation JukeBlox® platform delivers the ultimate streaming audio entertainment experience

DESIGN ARTICLES

16 How Fast Is Your Memory?
19 Securing Internet of Things Communication
24 Constant, Off-Time, Buck-Based LED Drivers Using the HV9910B
28 Designing a Glucose Meter Using an 8-bit Microcontroller
33 Decoding Windows Media® Audio in PIC32-Based Designs
34 A Multi-Screen Approach to Your Digital Strategy
35 Ready, Set, Go!

FEATURES

13 Product Spotlight
14 Heartwarming Deals
Looking Back on 2014

Thank you for making MicroSolutions so successful in 2014. As a quick review, we'd like to share some highlights of our product coverage over the past year. While space doesn't permit too much detail, you can visit our MicroSolutions archive to catch up on any articles you may have missed the first time around.

A year ago, we asked if you were ready for the Internet of Things, and based on market trends, you are. The explosive growth of products catering to IoT means designers have had to deal with some challenges though. To keep up with the latest trends and minimize the challenges you face, we introduced a variety of solutions including a turnkey sensor hub for Windows® 8 based systems and our RN4020 Bluetooth® Low Energy Module. The new PIC24F GB2 family of MCUs offers an integrated hardware encryption engine to enable secure data transfer and storage, perfect solutions for IoT-based designs. We also named our first Mobile App Developer Specialist; you'll read about our second partner in this issue.

Meanwhile, featured new devices in our 8-bit PIC® MCU portfolio continued to lead the industry in innovation with on-chip Intelligent Analog modules and Core Independent Peripherals. We also showed you how to “Perform Under Pressure” using 16-bit dsPIC® Digital Signal Controllers (DSCs), including the new dsPIC33 EV family which is designed to deal with a variety of harsh environments. Our portfolio of 32-bit MCUs now offers larger Flash and RAM memory, smaller footprints and lower prices.

To meet the latest requirements touch- and gesture-sensing applications, we introduced you to our innovative 3DTouchPad and the MTCH6102 family of projected-capacitive touch controllers. Other articles featured new devices added to our already-vast portfolio of Analog and Interface products and to our SuperFlash® technology family of memory products. We introduced a USB power delivery solution and described some new additions to the chipKIT™ embedded platform ecosystem. There was so much more, including a wide range of design articles and the latest development tool deals.

We look forward to continuing to serve you in 2015 and wish you much success in all your design endeavors. As always, we would be happy to get your feedback on MicroSolutions. Feel free to email us at MSFeedback@microchip.com.
Embedded system requirements are growing as the feature set of many new end products is increasing at an exponential rate. Wireless communications, advanced control techniques and new human interfaces are becoming common across all embedded markets. This change is driven by evolving consumer demand and enabled by massive advances in semiconductor technology. Each new feature or function added to an end product requires a corresponding increase in system complexity and more sophistication from its control elements.

These increasingly complex control elements place an immense burden on product designers, as each new function requires additional code and debugging time. For highly integrated systems, the bulk of an engineer’s design budget is often spent eliminating timing concerns caused by the feature integration. Because of this, managing the cost of software development has become a top priority for many companies.

Our PIC microcontrollers (MCUs) are designed to support increasing levels of functional integration without concern for timing issues or increased power consumption. By integrating flexible, intelligent hardware peripherals, PIC MCUs enable you to create functional building blocks that operate efficiently with and autonomously of the CPU. These intelligent hardware peripherals can now be easily configured to perform desired functions using the MPLAB Code Configurator, which simplifies software development and ultimately accelerates your time to market.

The MPLAB Code Configurator is a free, user-friendly plug-in tool for the MPLAB X Integrated Development Environment (IDE) that generates drivers for controlling and driving the peripherals inside 8- and 16-bit PIC MCUs, based on the settings and selections made in its intuitive Graphical User Interface (GUI). It is easy to change peripheral configurations or add/remove peripherals from your project. Also, the generated code is reliable and designed for efficient use of CPU and memory resources.

Originally released with support for our 8-bit products, the latest version has been expanded to include support for more than 50 of our 16-bit devices in six of our PIC24F families. In addition, more than 140 8-bit PIC MCU products are supported in the latest release including the
Configurator generates easy-to-read code that includes peripheral configuration setup, drivers and pin mapping to efficiently solve application development obstacles.

MPLAB Code Configurator Is:
Flexible—You can use it for simple in-system configuration of your microcontroller or to create complex functions with groups of integrated peripherals. Many PIC MCUs and their peripherals are supported, with new devices added regularly.

(continued on page 6)
Intelligent—It can alert you of a potential pin or function conflict. It creates efficient code with a small memory footprint.

Easy to Use—The intuitive GUI provides a visual representation of your selected PIC MCU, with an “aerial view” of the package. Pin selection and configuration is done via a mouse click.

A Time Saver—It generates simple, clearly documented APIs without the hassle of register-level setup. Its C code output can be easily modified for quick platform-level development.

FREE—It’s available as a plug-in for the free MPLAB X IDE.

If you are struggling with ever-shorter product design schedules and decreasing budgets, this easy-to-use code development solution is sure to give you a head start on your project. Visit the MPLAB Code Configurator page on our website to download this free tool and to find more helpful information.

FREE code development tool for PIC® MCUs
Eliminates the need for register-level setup and configuration
Generates ready-to-compile application code
Enables complex functions with just a few clicks!
Figure 1 - MGC3030 Block Diagram

Gesture recognition has become a highly sought-after feature that can make a product more functional, intuitive and fun for end users. Our award-winning and patented GestIC technology implements robust, sophisticated and advanced 3D hand gesture recognition in a wide range of applications. The second device in our family of GestIC technology controllers—the new MGC3030 3D gesture controller—features simplified user-interface options focused on gesture detection to enable true one-step design-in of 3D gesture recognition in consumer and embedded devices.

Housed in an easy-to-manufacture SSOP28 package, the MGC3030 expands the use of 3D gesture control features to high-volume cost-sensitive applications such as toys, audio and lighting. Integration of gesture detection into your design is further simplified with Microchip’s free, downloadable AUREA Graphical User Interface (GUI) and the MGC3030’s easily configurable general-purpose I/O ports that even allow for host-free usage. The on-chip 32-bit digital signal processor executes real-time gesture processing, eliminating the need for external cameras or controllers for host processing and allowing for faster design-in.

(continued on page 8)
The MGC3030 makes full use of the GestIC technology's portfolio of development tools, easing the design process and accelerating your time to market. For example, the on-board Microchip Colibri Gesture Suite is an extensive on-chip software library of sophisticated yet easy-to-use gesture features that recognizes the intuitive and natural movements of the human hand. Features such as flick gestures, air wheel and proximity detection are able to perform commands such as changing audio tracks, adjusting volume or backlighting and many others. All gestures are processed on-chip, allowing you to create powerful user interfaces with very low development effort.

The programmable Auto Wake-Up On Approach feature, which is unique to GestIC technology, begins operating in the range of sub 100 microwatts power consumption, enabling always-on gesture sensing in power-constrained applications. If user interaction is detected, the system automatically switches into full sensing mode and alternates back to auto wake-up mode once the user leaves the sensing area.

These combined features and capabilities provide you with the ability to quickly integrate gesture detection features into your product. Priced at under $2 in high volumes, the MGC3030 provides the lowest-cost entry point for robust, sophisticated and advanced 3D hand gesture recognition.

Development Support
The Woodstar MGC3030 Development Kit (DM160226) includes the AUREA Graphical User Interface. It allows you to build a complete reference system, which can be used for the evaluation and design-in of MGC3030-based 3D gesture input sensing systems.

The MGC3030 featuring GestIC technology is available today and can be ordered for sampling and volume production from microchipDIRECT or from Microchip's worldwide distribution network.
**Speedy and Reliable**

**Latest Additions to Low-Power 1.8V Serial Quad I/O™ Family of SuperFlash® Technology Memory Devices Offer 4-Mbit and 8-Mbit of Memory**

Small Form Factor and Low Power Consumption Support the Next Generation of Portable Embedded Designs

Portable battery-powered applications for the wearables and Internet of Things (IoT) markets continue to expand at a rapid pace. Designers are pressed to find high-quality and reliable memory solutions that can meet the space- and cost-constrained demands of these applications.

The SST26WF080B and SST26WF040B are the newest additions to the 1.8V Serial Quad I/O (SQI) family of SuperFlash technology memory devices. These devices offer 4-Mbit and 8-Mbit of memory and are manufactured with our high-performance SuperFlash technology, which provides the industry’s fastest erase times and superior reliability.

Learn more about SuperFlash technology in the separate article found on page 16.

Providing the fastest erase times of any competing device, the SST26WF080B/040B can complete sector and block erase commands in just 18 ms and a full chip erase operation in 35 ms. Competing devices require in the range of 5 to 15 seconds to complete a full chip erase operation, making the SST26WF080B/040B approximately 300 times faster. The fast erase times can provide you with a significant cost savings by minimizing the time required for testing and firmware updates, therefore increasing your manufacturing throughput.

The SQI interface is a high-speed 104 MHz quad I/O serial interface which allows for high data throughput in a low-pin-count package. This interface enables low latency execute-in-place (XIP) capability, allowing programs to be stored and executed directly from the Flash memory and eliminating the need for code shadowing on a RAM device. The SST26WF080B/040B provides faster data throughput than a comparable x16 parallel Flash device without the associated high cost and high pin count of parallel Flash. The SQI interface also offers full command-set backwards compatibility to the traditional Serial Peripheral Interface (SPI) protocol.

Designed for low power consumption, the SST26WF080B/040B helps maximize battery life in portable applications. Standby current consumption is 10 µA typical, and a deep power-down mode further reduces current consumption to 1.8 µA typical. Active read current at 104 MHz is 15 mA typical. The combination of 1.8V operation with low power consumption and small form factor packaging makes the SST26WF080B/040B an excellent choice for battery-powered applications.

(continued on page 10)
choices for a number of applications such as mobile handsets, Bluetooth® headsets, GPS, camera modules, hearing aids and any battery-powered devices.

The SST26WF080B/040B offers excellent quality and reliability with 100 years data retention and device endurance of over 100,000 erase/write cycles. Enhanced safety features include software write protection of individual blocks for flexible data/code protection and a One-Time Programmable (OTP) 2 Kbyte Secure ID area. These features protect against unauthorized access and malicious read, program and erase intentions. The device also includes a JEDEC-compliant Serial Flash Discoverable Parameter (SFDP) table, which contains identifying information about the function and capability of the SST26WF080B/040B in order to simplify software design.

The SST26WF080B and SST26WF040B devices are available in 8-contact WSON, 8-lead SOIC, 8-contact USON and 8-ball XFBGA (Z-Scale) packages. They can be ordered for sampling and volume production from microchipDIRECT or from Microchip's worldwide distribution network.

**NEW PRODUCT**

**Improve Noise Immunity and Robustness**

*with 5V dsPIC33EV Family*

- Automotive sensor
- Motor control
- Touch interface
A n early pioneer in the streaming-audio market, the JukeBlox wireless audio platform enables the development of high-quality, low-latency products such as stand-alone or multi-room wireless speakers, AV receivers, mini and micro systems and sound bars. With over eight million modules shipped to date, it has been adopted by more audio brands than any other platform available for Wi-Fi® audio connectivity.

The fourth generation JukeBlox platform has been recently launched and is in production now with lead customers. The JukeBlox 4 Software Development Kit (SDK)—in combination with the CY920 Wi-Fi and Bluetooth® Network Media Module—includes next-generation, dual-band Wi-Fi technology, Multi-Zone/multi-room features, AirPlay® and DLNA® connectivity plus integrated music services to enhance the consumer’s listening experience. Additional cost-saving features reduce the bill of materials and enable competitively priced consumer products.

The certified CY920 Wi-Fi and Bluetooth Network Media Module is based on our new, low-cost DM920 Wi-Fi Network Media Processor, which integrates 2.4 GHz and 5 GHz 802.11a/b/g/n Wi-Fi, high-speed USB 2.0 and Ethernet connectivity. Speakers utilizing the 5 GHz band avoid the RF congestion found in the 2.4 GHz band, resulting in fewer audio drops and the ability to use a greater number of speakers in multi-room/whole-home audio systems.

The DM920 Wi-Fi Network Media Processor also features integrated dual 300 MHz Digital Signal Processing (DSP) cores that can reduce or eliminate the need for costly stand-alone DSP chips. An easy-to-use, PC-based Graphical User Interface (GUI) simplifies the use of a pre-developed suite of standard speaker-tuning DSP algorithms, including a 15-band equalizer, multi-band dynamic range compression, equalizer presets and various filter types. This allows you to easily implement DSP into your design, even if you have no DSP code-writing experience. If you are experienced with DSP, the DM920 lets you harness the full power of an industry-standard DSP architecture.

The JukeBlox 4 platform allows you to build solutions that are equipped to directly stream cloud-based music services—such as Spotify® Connect, Qobuz®, Rhapsody®, Deezer® and many others—and that can use mobile
devices as remote controls. This allows mobile devices to move anywhere in the Wi-Fi network without interrupting music playback. It also increases battery life significantly. JukeBlox technology continues to offer seamless cross-platform support for iOS, Android™, Windows® 8 and Mac® operating systems, along with a complete range of audio codecs and ease-of-use features to simplify network setup.

With its whole-home audio (Multi-Zone/multi-room) functionality, the SDK enables simultaneous audio streaming to, and control of, multiple JukeBlox platform-enabled devices in the home. The combination of new hardware and software technology improves synchronization and reduces network bandwidth utilization to achieve a robust audio streaming implementation.

**Qobuz Connect Support**

Another new enhancement to the JukeBlox platform is its support for Qobuz Connect, which delivers HD and true CD quality audio directly to wireless speakers and AV receivers for an enjoyable music listening experience.

**Qobuz** is the first online music service that gives access to all the major and independent music labels and all artists in all genres of music in Hi-Fi audio streaming. Qobuz Hi-Fi service is currently available in United Kingdom, Germany, France, The Netherlands, Belgium, Luxembourg, Ireland, Austria and Switzerland. Qobuz offers subscriptions to unlimited music streaming in True CD quality (16-bit/44.1 kHz), lossless downloads in True CD quality (16-bit/44.1 kHz) of its entire catalog (more than 24 million titles), HD downloads in 24-bit up to 192 kHz of over 25,000 albums.

Qobuz Connect enables an audio stream to be delivered directly from Qobuz’s cloud servers to the wireless speaker instead of sustained streaming from a phone, tablet and audio devices. This frees up the user’s handheld device for other activities and prevents battery depletion. Users are free to move throughout the Wi-Fi network without interrupting music playback. It also increases battery life significantly. JukeBlox technology continues to offer seamless cross-platform support for iOS, Android™, Windows® 8 and Mac® operating systems, along with a complete range of audio codecs and ease-of-use features to simplify network setup.

With its whole-home audio (Multi-Zone/multi-room) functionality, the SDK enables simultaneous audio streaming to, and control of, multiple JukeBlox platform-enabled devices in the home. The combination of new hardware and software technology improves synchronization and reduces network bandwidth utilization to achieve a robust audio streaming implementation.

The JukeBlox 4 SDK, paired with the JukeBlox CY920 module, is available today. For additional information, contact your local Microchip sales representative.
New Power MOSFET Drivers Feature Thermally Efficient, Small Packages for Improved Efficiency

The MCP14A005X and MCP14A015X are the first devices in the new MCP14A family of power MOSFET drivers. These devices feature an entirely new driver architecture for high-speed operation at lower voltages. Their small SOT-23 and 2 × 2 mm DFN packaging enables higher power densities and smaller solutions, while their design targets fast transitions and short delay times that allow for responsive circuit operation. These MOSFET drivers include low input threshold voltages that are compatible with low-voltage microcontrollers and controllers, while still maintaining strong noise immunity and hysteresis. More Information.

Linux® Driver Enables MOST® Technology for Linux Ecosystem

Linux adoption for the in-vehicle-infotainment (IVI) market is growing because it provides automotive designers with an open-source platform that allows them to maximize the reuse of existing work, while making their own incremental improvements. Our new Linux driver now enables you to use the Linux operating system with our portfolio of MOST network interface controllers. The combination of MOST technology and Linux provides a solution for the increasing complexity of IVI and advanced-driver-assistance systems (ADAS), accelerating development via open-source software and the automotive-industry-proven MOST networking technology. More Information.

Cost-Effective 8-bit PIC® Microcontroller Family Named Finalist for Golden Mousetrap Award

We are honored that the PIC16(L)F170X and PIC16(L)F171X family—which combines a rich set of Intelligent Analog and Core Independent Peripherals along with cost-effective pricing and eXtreme Low Power (XLP) technology—has been selected as a Finalist in the 14th Annual Golden Mousetrap Awards in the Electronics & Test category for Embedded Computing/Processing. The winners will be announced on February 10 at the live Golden Mousetrap Awards Ceremony being held during the Pacific Design & Manufacturing Show in Anaheim, California. More Information.
Heartwarming Deals

While the weather outside might be frosty, our February Dev Tool Deals can warm your heart as well as inspire your creativity. To take advantage of these special sale prices, go to microchipdirect.com and add the item to your cart. Add the coupon code during checkout. These are limited time offers so act quickly to get yours while the deals are still available and supplies last.

**PIC32MX Audio Development Board**

**microchipDIRECT Coupon Code: TP1505**

Save $50.00 on the PIC32MX Audio Development Board which is a perfect solution for developing speech and audio recording/playback products. It features an 80 MIPS PIC32 MCU, a 24-bit Wolfson audio codec, a 2" color LCD, a USB interface and an on-board microphone. It is supported by Microchip’s free software libraries to help you get started right away with your product development.

**Beginner’s Guide to Programming the PIC32**

**microchipDIRECT Coupon Code: TP1506**

The Beginner’s Guide to Programming the PIC32 is an outstanding book by Thomas Kibalo, author of many articles for Nuts & Volts magazine. Using the low-cost Microstick II starter kit with its PIC32MX250F128B MCU and the free MPLAB® XC32 Compiler to provide programming examples, Kibalo makes it easy for beginners to learn about the PIC32 architecture. It’s on sale now for 10% off the regular price.

**XLP 16-bit Development Board**

**microchipDIRECT Coupon Code: TP1507**

The XLP 16-bit Development Board provides a low-cost, highly configurable development system for our eXtreme Low Power (XLP) PIC24F microcontrollers, enabling designs with sleep currents as low as 20 nA. It can be used for prototyping many low-power applications including RF sensors, data loggers, temperature sensors, electronic door locks, metering sensors, remote controls, security sensors, smart cards and energy harvesting. Save $25.00 off the regular price.
PCAP Touch Pad Development Kit with Gestures
microchipDIRECT Coupon Code: TP1508
Create a rich user interface for your design with our Projected Capacitive (PCAP) Touch Pad with Gestures Development Kit. Supported by our MTCH6301 turnkey projected capacitive touch controller, it includes everything you need to easily integrate multi-touch and gestures into your next project. It’s on sale now for $74.99.

Digitally-Enhanced Power Analog PWM Controller
MCP19119

- Synchronous buck controller
  4.5–40V operation
- Efficient, accurate, configurable
- Integrated PIC® MCU and high-performance analog control
How Fast Is Your Memory?

SuperFlash® Technology Delivers Unmatched Speed With Superior Performance

Invented by Silicon Storage Technologies (SST) and later acquired by Microchip, SuperFlash technology is an innovative and versatile type of NOR Flash memory providing erase times that are significantly faster than competing Flash memory technologies. It uses a proprietary split-gate cell architecture which provides superior performance, data retention and reliability over conventional stacked-gate Flash memory. Recognizing the many advantages of SuperFlash technology, designers have increasingly turned to our portfolio of serial and parallel Flash memory devices to meet their critical design challenges.

Split-Gate Cell Design

The unique split-gate cell design, illustrated in Figure 1 below, allows products with SuperFlash technology to provide the fastest sector, block and chip erase times available. While a typical 64 Mb Flash memory device can take as long as 100 seconds to perform a full chip erase, equivalent Microchip memory products with SuperFlash technology can complete the same operation in less than 100 ms.

Figure 1 - SuperFlash® Technology vs. Conventional Flash Memory Cell Structures

(continued on page 17)
As shown in Figure 2 above, chip erase times become more significant as the density increases in competitor devices. With SuperFlash technology, the chip erase speed remains extremely fast regardless of density.

Over-erase is a condition which affects traditional stacked-gate Flash memory. An over-erased cell creates a leakage current path between the drain and floating gate, which can result in read failures. In order to combat this effect, stacked-gate Flash memory requires multiple erase pulses, soft-programming and erase verification cycles to ensure a tight threshold voltage window of the Flash memory cell. Over-erase and the resulting cell leakage do not affect the split-gate cell design of SuperFlash technology because the floating gate is isolated from the drain. Therefore, the additional soft-programming and erase verification steps during cell erase are not required. The result is a Flash memory device that can perform a full chip erase up to a thousand times faster than typical Flash memory devices.

High Reliability and Data Retention
SuperFlash technology utilizes a much thicker oxide layer than traditional stacked-gate Flash memory. The thicker oxide layer is much less susceptible to defects and damage which can create a leakage path and eventual cell data loss. The floating gate of the SuperFlash technology cell also has a hook or notch at the edge. This hook creates a strong electric field which improves the performance and reliability of erase operations.

Microchip’s Serial and Parallel Flash Memory Portfolios
Devices in our SuperFlash technology serial and parallel Flash memory portfolios come in a variety of bus interfaces, speeds, voltages and packages to meet a broad range of application requirements. They all feature the industry’s fastest program and erase times, excellent reliability and data retention, low power consumption, small package offerings, and integrated security and memory protection features.
Our SST25 and SST26 series of Serial Flash memory devices are designed for a wide variety of applications in consumer electronics, computing, networking and industrial spaces. Small form factor, standard pinouts and command sets make these Serial Flash memory devices cost competitive and easy to design into your product.

The SST39 and SST38 series of Parallel Flash memory devices deliver high performance, low power consumption, superior reliability and small sector size. They are ideal for GPS/navigation and other mobile designs that require Execution In Place (XIP) performance as well as for demanding industrial and automotive applications.

Visit our SuperFlash Technology page or contact your local Microchip sales office for more information on selecting the right serial or parallel Flash memory device for your latest application.

For a limited time, Microchip is offering a program to upgrade your old programmers and debuggers to our latest tools. If you currently own a PICkit 2 Debugger, MPLAB® ICD 2 Debugger or PRO MATE II Programmer, you can trade it in for a PICkit 3 Debugger, MPLAB ICD 3 Debugger or PM 3 Programmer for 50% off the retail price.

Click to learn more and upgrade your tool today!
We see them everywhere now: diagrams of devices and clouds, connected to each other with an assortment of ambiguously defined dots and lines. Those lines represent bi-directional communication over the Internet, or more accurately, the sending and receiving of data between devices in broadcast or unicast fashion.

If only implementing inter-device communication was as easy as drawing a line. More importantly, once we’ve connected those devices, how do we secure that communication? The bottom line is that we know unprotected devices on the Internet will be attacked. With the explosive growth of connected devices and the Internet of Things (IoT), we cannot afford to address the challenges of IoT communication security as an afterthought.

We need a security model that works across the different paradigms of device communication. The key to this model is a secure publish/subscribe (pub/sub) paradigm, and a vital component of this strategy is to move security onto the network. This article describes design patterns for implementing a secure publish/subscribe network for bi-directional communication for the Internet of Things. It also explains the critical security requirements of an IoT communication network, each of which plays a unique role in securing IoT applications and connected devices.

(continued on page 20)
Concern #1: Hacker Intrusion

The Network Needs No Open Ports

To push data, a device has to be listening. An open port is when a device connection has ready listeners waiting to receive inbound data. The security risks of leaving ports open include malware infections, modification or theft of data, DoS attacks and arbitrary code execution.

Devices connected to a secure IoT network should only make outbound connections. To do this, we need a publish/subscribe design where devices can communicate bi-directionally. By only making outbound connections, the door is closed to accessing the applications and services behind those open ports. But how do we build a highly scalable IoT communication network with no open ports?

Secure and reliable communication that uses protocols like MQTT, CoAP, WebSockets and HTTP 2.0 are able to power publish/subscribe communication between devices with no open ports. Regardless of which protocol is used, opening a connection outward and leaving it open is of primary importance, followed by using pub/sub as the paradigm for communication for that connection. To address the needs of IoT scale, the publish/subscribe connection should be managed.

(continued on page 21)
DESIGN ARTICLE

by high-performance servers distributed throughout the world (a data stream network) with multiple points of presence.

Concern #2: MITM Attacks
The Network Needs More Than TLS Encryption
Transport Layer Security (TLS) and its predecessor, Secure Socket Layer (SSL), were once viable standalone protocols used to provide communication security for devices. TLS/SSL protects the top level of data being streamed between devices, encrypting the data from device to device as it is transferred. While TLS/SSL is suitable for data transmission security, there is more you can do with that data. It can be taken a step further with the Advanced Encryption Standard (AES) encryption specification.

AES encryption works in conjunction with distribution of keys to devices in order to achieve end-to-end data protection. These keys can be encrypted at the endpoint, and only devices with the encryption keys can decrypt the encrypted data as it is pushed and received. Some pretty dynamic things can be done with AES. The concept of a body and envelope of a message comes into play. In this case, the entire body of the message is encrypted with TLS. Those with TLS rights can access data on the outside of the envelope. Digging deeper, the rest of the message is encrypted with AES, including the data inside the envelope. Those with AES and TLS authorization can get data from both the envelope and the body. This gives different security levels to data that is being streamed between devices.

AES, working hand-in-hand with TLS pub/sub encryption, offers a great way to encrypt Internet of Things communication. The implementation of encryption protocols and specifications onto your communication network eliminates the burden of maintaining and orchestrating this massive undertaking.

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Concern #3: Access Control
The Network Needs Access Control to Grant/Revoke Permissions
While AES and TLS/SSL can be used to encrypt the data as it is being transferred, another major challenge is granting and revoking access to data streams, down to the individual channel or topic. In the paradigm of publish/subscribe, an access control/token-based approach can be used to distribute tokens to devices for access to data channels. This enables fine-grained access control.

(continued on page 22)
control over which tokens are created, which devices receive tokens, and to which data those tokens grant/revoke access.

In doing so, the network effectively serves as a traffic cop in that it handles device authorization and manages which devices can speak and listen on the network based on the tokens it distributes. This is an effective way to grant and revoke access to bi-directional data streams among connected devices.

**Concern #4: Device Status**

*The Network Needs a Finger on the Pulse*

When a device such as a remote door lock, oil field sensor or a home appliance disappears or stops sending and receiving data, we have no idea that it has gone offline. This is because presence functionality is often an afterthought when building IoT device communication and might not be implemented in the first place.

IoT metadata tracking requires a separate data channel to stream presence data for each device, which can be customized to stream online/offline status as well as other custom states. The separate channel is created when the network stops “feeling a heartbeat,” and presence data for the device is streamed. This creates a secure design paradigm for streaming information such as the device’s online/offline status, the triggering of a sensor or a power drain. From a security standpoint, it can provide up-to-the-second device status and send alerts about changes in state as they happen. It’s a sideways stream of metadata, where the network handles the monitoring.

**Concern #5: Provisioning**

*Dynamic, Real-Time Security in the Field*

A customer buys a home automation solution and tries to set it up on his or her home network. However, the firewall blocks the connection which enables remote access. This is just one of the roadblocks users encounter when setting up IoT applications.

A pub/sub paradigm makes it easy to securely provision IoT devices. The device wakes up, subscribes to a designated tracker channel and announces itself. The server then returns back a private channel on which the device and server can communicate. It sets access rules on the channel and provisions from there.

(continued on page 23)
To an end user, this streamlines the process of buying a device, hooking it up and having it auto provision, all on a secure, private channel. Once a device is provisioned, it’s also important to implement a way to securely update firmware for that device. Security is essential when pushing firmware updates to protect devices from downloading malicious updates from unauthorized sources. To counter this, use end-to-end TLS encryption in client-server communication, as well as access control with tokens down to the individual device level.

The design model for real-time firmware updates in the field starts with the server broadcasting a firmware alert message on a channel that all devices can read. This gives all devices access to the data. If the device is offline, it receives that data from the network as soon as it boots back up. Online devices install firmware updates immediately.

**Where Do You Go from Here?**

In IoT applications, the selection of a security model really revolves around the notion of “build versus buy.” Should you build your IoT communication networks and leave the security in the hands of the IoT project team, or should you connect into an IoT network offered as a service? Applying standards—from the hardware level to the network—isn’t enough. If an IoT team is building its security model from scratch there will be holes. Implementing hardened security measures that are designed, built, and tested from scratch is an unrealistic task for many developers.

Offloading security challenges to the network offers you many benefits. Your IoT project team can customize the security implementation to meet your application’s needs, but allow the network to securely manage open ports, data encryption, metadata tracking and meeting global regulations. Why reinvent the wheel every time?

PubNub publishes a Microchip PIC32 Client Software Development Kit (SDK) for both stand-alone and MPLAB® Harmony software development frameworks. This SDK enables IoT connectivity for client devices based on the PIC32 microcontroller by interfacing to the PubNub Data Stream Network so you can take advantage of all of the security innovations described in this article. For more information visit [www.pubnub.com/developers](http://www.pubnub.com/developers) or send an email to support@pubnub.com.

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**Figure 7 - Firmware Design Pattern**

1. **Server broadcasts “firmware alert” message**
2. **Online devices respond & download immediately**
3. **Offline devices pull data from channel cache on boot**
Constant, Off-Time, Buck-Based LED Drivers Using the HV9910B

Constant-frequency, peak-current-controlled buck converters, as shown in Figure 1, are an excellent choice for driving LEDs for a number of reasons. They offer reasonable regulation of LED current over wide variations in input and output voltages, they are simple to design as no feedback compensation is required and the PWM dimming response of the converters is almost instantaneous.

However, peak-current-controlled buck converters go into sub-harmonic oscillations at duty cycles over 50%. These oscillations cause the average output current to drop, while the output ripple current increases. The only way to avoid these problems is by adding slope compensation circuitry externally. The slope compensation adds an upward slope on to the current sense signal and the converter can be stabilized by varying the slope of the added ramp (see Figure 2). This added ramp causes an error between the sensed current (as seen at the CS pin of the HV9910B) and the actual LED current.

(continued on page 25)
Although this error can be compensated for by changing the sensed resistor appropriately, the converter’s rejection of the input and output voltage variations will be significantly degraded. Thus, changing the input or output voltage will significantly change the LED current, without additional feedback circuitry for regulating the LED current. This makes the peak-current-controlled buck converter practically useless for cases where the input voltage is less than twice the output voltage.

This problem can be overcome by changing the control method to a constant off-time operation. In this case, the off-time is fixed by design, the on-time is based on the current sense signal and the switching time-period adjusts to be equal to the on-time plus the off-time. This change will allow the converter to work with greater than 50% duty cycles and still offer the advantages of the peak-current-controlled buck converter mentioned above.

The unique design of the oscillator in the HV9910B allows the IC to be configured for either constant frequency or constant off-time based on how one resistor, connected to the RT pin, is wired. For normal operation as a constant-frequency converter, the resistor at the RT pin is connected to GND (Figure 3a). For operation as a constant-off-time converter, the resistor is connected between the RT and GATE pins (Figure 3b). In both cases, the equation to determine the resistor is given by:

\[ T_{osc} (\mu) = \frac{R_T (k\Omega) + 22}{25} \]

For constant-frequency operation, \( T_{osc} \) is set to the switching time period and for constant off-time operation, \( T_{osc} \) is set to the required off-time.

An example detailing the design of a constant off-time buck converter is shown in Figure 4.
Input Voltage:
\( V_{\text{in, min}} = 9\text{V} \)
\( V_{\text{in, nom}} = 12\text{V} \)
\( V_{\text{in, max}} = 16\text{V} \)

Output Voltage (corresponds to two 1W LEDs):
\( V_{\text{o, min}} = 4.6\text{V} \)
\( V_{\text{o, nom}} = 6.8\text{V} \)
\( V_{\text{o, max}} = 8\text{V} \)

LED Current:
\( I_o = 350\text{ mA} \)

Expected Efficiency:
\( \eta = 0.85 \)

**Step 1: Choose the Nominal Switching Frequency**

Although the switching frequency is variable, a nominal switching frequency can be chosen. The actual frequency will vary around this nominal value based on the actual input and output conditions. A larger switching frequency will typically result in a smaller inductor, but will increase the switching losses in the circuit.

A typical switching frequency: \( f_{\text{s, nom}} = 100\text{ kHz} \) is a good compromise, which corresponds to a time period of:

\[
T_{\text{s, nom}} = \frac{1}{f_{\text{s, nom}}} = 10\mu\text{s}
\]

(Equation 1)

**Step 2: Compute the Off-Time and Resistor R1**

The off-time can be calculated as:

\[
t_{\text{off}} = \left( 1 - \frac{V_{\text{o, nom}}}{V_{\text{in, nom}}} \right) \times T_{\text{s, nom}}
\]

(Equation 2)

This off-time will then be set by the resistor \( R_1 \) based on the following equation:

\[
R_1(\text{k}\Omega) = (t_{\text{off}}(\mu\text{s}) \times 25) - 22
\]

(Equation 3)

In this case, \( t_{\text{off}} = 4.33\mu\text{s} \) and \( R_1 = 86.25\text{ k}\Omega \). Note that in this case, the converter is operating at 56.7% duty cycle.

**Step 3: Choose the Required Inductor L1**

The value of the inductor \( L_1 \) will depend on the peak-to-peak ripple desired in the output current. Assuming a 30% peak to peak ripple in the LED current,

\[
L_1 = \frac{V_{\text{o, nom}} \times t_{\text{off}}}{(0.3 \times I_0)} = 280\mu\text{H}
\]

(Equation 4)

The peak current rating of the inductor should be greater than \( 1.3 \times I_0 \) and the rms current rating of the inductor should be at least \( I_0 \). For this example, the closest inductor available is a 330 \( \mu\text{H} \) inductor with a 0.6A rms current rating and a 0.6A saturation current rating.

(continued on page 27)
Step 4: Choose the Sense Resistor (R2)

The peak current sensed by the HV9910B corresponds to the average output current plus one half of the actual current ripple. The peak current is given by:

\[ I_{PK} = I_o + \frac{V_{O,NOM} \times t_{OFF}}{2 \times L1} \]  
(Equation 5)

The sense resistor can be then be computed as:

\[ R_2 = \frac{0.25}{I_{PK}} \]  
(Equation 6)

if the internal voltage threshold is being used. Otherwise, substitute the voltage at the LD pin instead of the 0.25V in Equation 6. The power rating required for the sense resistor can be computed using:

\[ P_{SENSE} = (I_o)^2 \times \left( \frac{V_{O,MAX}}{V_{IN,MIN}} \right) \times R_2 \]  
(Equation 7)

For this design, \( I_{PK} = 0.394A \), \( R_2 = 0.633\Omega \) and \( P_{SENSE} = 0.069W \). Note: Capacitor C2 is a bypass capacitor. A typical value of 1 μF, 16V ceramic capacitor is recommended.

Step 5: Choose the FET (Q1) and Diode (D1)

The peak voltage seen by the FET is equal to the maximum input voltage. Using a 50% safety rating:

\[ V_{FET} = 1.5 \times V_{IN,MAX} = 24V \]  
(Equation 8)

The maximum rms current through the FET is:

\[ I_{FET} = I_o \times \sqrt{\frac{V_{O,MAX}}{V_{IN,MIN}}} \]  
(Equation 9)

Typically a FET with about three times the current is chosen to minimize the resistive losses in the switch. For this application, choose a 40V, 1Ω FET such as Microchip’s TN2504, which is available in a SOT-89 package.

The peak voltage rating of the diode is the same as the FET. Hence:

\[ V_{DIODE} = V_{FET} = 24V \]  
(Equation 10)

The average current through the diode is:

\[ I_{DIODE} = I_o \times \left( 1 - \frac{V_{O,MIN}}{V_{IN,MAX}} \right) = 0.25A \]  
(Equation 11)

Choose a 30V, 1A schottky diode.

Step 6: Analysis of the Switching Frequency Variation

The two extremes of the switching frequency can be approximately computed as:

\[ f_{S,MIN} = \frac{1}{T_{S,MAX}} = \frac{1}{t_{OFF}} \left( 1 - \frac{V_{O,MAX}}{V_{IN,MIN}} \right) \]  
(Equation 12)

\[ f_{S,MAX} = \frac{1}{T_{S,MIN}} = \frac{1}{t_{OFF}} \left( 1 - \frac{V_{O,MIN}}{V_{IN,MAX}} \right) \]  
(Equation 13)

In this case, the switching frequency varies from 25 kHz (\( V_{IN} = 9V, V_O = 8V \)) to 164 kHz (\( V_{IN} = 16V, V_O = 4.6V \)).
According to the World Health Organization (WHO), approximately 9% of the worldwide adult population has diabetes, and it is the eighth leading cause of death. In recent years the number of deaths from diabetes has been steadily increasing, rising from approximately one million deaths in 2000 to 1.5 million deaths in 2012. One of the primary methods of managing diabetes is keeping the level of glucose in the blood as close to normal as possible. This has led to an increase in the use of glucose meters.

A glucose meter is a medical device used to determine the concentration of glucose in a solution. The glucose concentration is measured in units of milligram per decilitre (mg/dl) or millimole per litre (mmol/l). Glucose meters have become key elements of home blood glucose monitoring devices used by people with diabetes mellitus. The measurements can be taken multiple times in a single day.

Most glucose meters use electrochemical test strips to perform the measurement. A small drop of the solution to be tested is placed on a disposable test strip that the glucose meter uses for the glucose measurement. The two most common methods used in electrochemical measurement of glucose are the colorimetric and the amperometric methods.

In the colorimetric method, sensors such as LEDs or photo sensors form the analog interface. A transimpedance amplifier is used to measure the glucose concentration. The color reflectance principle is used to determine the color intensity in the reaction layer of the test strip by photometry. The meter generates a numerical value that is a measure of the glucose concentration.

In the amperometric method, a capillary is used to draw in the solution placed at one end of the test strip. The test strip also contains an enzyme electrode containing a reagent such as glucose oxidase. The glucose undergoes a chemical reaction in the presence of enzymes, and electrons are produced during the chemical reaction. The charge passing through the electrode is measured and this is proportional to the concentration of glucose in the solution. An ambient temperature measurement is also made to compensate for the effect of temperature on the rate of the reaction. Most glucose meters use this method.

(continued on page 29)
The test strip forms the main biochemical sensor where the sample of solution is placed. It contains three electrodes. Electrons are produced in the working electrode during the chemical reaction. This electrode is connected to the current-to-voltage amplifier. The reference electrode is held at a constant voltage with respect to the working electrode to push the desired chemical reactions. The counter electrode supplies current to the working electrode. Most glucose meter designs use only the reference and working electrodes.

A precise reference voltage \( V_{\text{REF}} \) should be applied to the reference electrode and a precise bias voltage \( V_{\text{BIAS}} \) to the op amp. This way, the precise potential difference is maintained across the working and reference electrodes. This voltage is the stimulus that drives the test strip’s output current, the magnitude of which is then used to calculate the number of electrons produced.

The solution sample is placed on the test strip, and the reaction of the glucose with the enzyme takes place. The flow of electrons will correspond to the flow of current through the working and the reference electrodes. This current will change according to the glucose concentration. The current is measured using a transimpedance amplifier (current-to-voltage converter) and an Analog-to-Digital Converter (ADC). The output of the transimpedance amplifier will be seen as a variation in the voltage with varying glucose concentrations in the solution.

**Digital Implementation**

A digital implementation of the glucose meter can be achieved using an 8-bit PIC16LF178X microcontroller (MCU). This PIC® MCU features eXtreme Low-Power (XLP) operation. It contains two op amps, two 8-bit DACs, a 12-bit ADC, an internal EEPROM, I^2C™ and a 16-bit timer.

The flow of electrons can be measured with the help of the current-to-voltage conversion using the internal op amp of the PIC MCU and the filtering of high-frequency signals. The filtered signal is then fed to the 12-bit ADC module.

The PIC MCU should start capturing the voltage at the ADC channel after about 1.5s of placing the solution sample. About 2048 ADC readings were taken. The average value from these was substituted into the regression equation \( Y = mX + C \), where \( Y \) is the glucose concentration. (continued on page 30)
concentration in mg/dl, \(m\) is the slope, \(X\) is the average ADC reading of the op amp output voltage and \(C\) is a constant.

The glucose concentration can be determined using this regression equation and the value displayed on the LCD in units of mg/dl or mmol/l. Up to 32 glucose readings can be stored in the internal EEPROM and can be viewed later on the LCD. The power to the glucose meter demo board can be supplied from the on-board lithium battery (3V, 225 mAH, CR2032).

The time to start capturing the ADC values (1 to 1.5s) and the number of ADC readings taken should be modified to match the type and characteristics of the test strip used.

**Hardware Design**

The design specifications for this glucose meter require a glucose measurement range of 20 to 600 mg/dl, equivalent to 1 to 33 mmol/l. Test results need to be displayed within five seconds; the most recent 32 glucose readings should be automatically stored with date and time stamp. No test strip coding is needed as the generic regression equation will be implemented and modified based on the test strip characteristics.

**Firmware Features**

The firmware needs to sense the test strip current using the PIC MCU’s internal op amp, DAC and ADC. ADC readings need to be captured after the test strip is inserted and these checked for a rise above 450 mV. Firmware modules are available for the LCD interface and display routines, configuration of the op amp, configuration of the DAC, storing glucose readings into the internal EEPROM, reading the ADC channel, calculating glucose concentration, and implementing the Real-Time Clock.

(continued on page 31)
and Calendar (RTCC) using the timer for time-stamping.

**Configuration**

The voltage reference of the DAC is connected to the internal fixed voltage reference, configured for 2.048V. The op amp output (current-to-voltage converter output) is measured with ADC channel 0. ADC channel 3 is used to measure the battery voltage to indicate a low-battery condition. The output of the temperature sensor is connected to the ADC channel 8 to read the temperature.

Glucose readings are stored in the internal EEPROM. During sleep mode, if switch S1 is pressed, the PIC MCU enters memory mode and the stored glucose reading is displayed on the LCD. To view the previous glucose readings, switch S3 needs to be pressed. Pressing switch S1 again exits memory mode.

A 16 × 2 character LCD is used for displaying the glucose readings and text messages. Power to the LCD is cut off during sleep mode by controlling the Vss of the LCD through the port pin of the microcontroller.

The timer along with the external 32.768 kHz watch crystal is used to implement the RTCC. The current date and time can be set for the RTCC using switches S1 and S3.

The non-inverting input channel of the op amp is connected to the DAC output set at 400 mV. The inverting terminal of the op amp is connected to the working electrode. The current-to-voltage converter is formed with the help of the external resistor and the capacitor. The output of the op amp is connected to the ADC channel of the PIC MCU.

The current consumption of the glucose meter in active mode is about 1.1 mA, and it consumes 3 µA during sleep mode. The glucose meter is in sleep mode about 99.5% of the time.

**Conclusion**

The glucose measurements were affected by external factors such as temperature, humidity, altitude and so on, because the rate of the enzyme reaction depends on these and other factors. In addition, test strips with different chemistries will require variations in the regression equation determined using MATLAB® or Microsoft® Excel. These factors must be considered when designing a glucose meter for use with any particular test strip.

The PIC16LF178X MCU’s op amp, 12-bit ADC, DAC and EEPROM makes a suitable combination for this type of battery-operated application needing precision measurement and lower current consumption. This means that the PIC MCU can be used to implement a flexible and low-cost glucose meter design. Visit our [Glucose Meter Design](#) page for additional information and resources, including the design files for our glucose meter demo. Contact your local [Microchip sales representative](#) to see a working example of the Low Cost Glucose Meter demo.
Energizer Application Support offers free design assistance for your portable power design. The task of selecting the right power source for your application can be challenging. Energizer brings over 100 years of experience in the battery industry to make this easier and to ensure the success of your device design.

**Battery Basics**
- What is the voltage profile?
- How much capacity is available?
- What characteristics will affect performance?
- What is the internal resistance?
- How well can it handle pulse currents?
- How long is the shelf life?

**Application Specifics**
- How do I choose the right battery for my application?
- How long will each battery type run in my device?
- How do I avoid abusive battery conditions?
- How do I maximize battery runtime in a lower power design?
- How do I enable my system to run from a single battery?

Can't find the answer to your specific question? Please don’t hesitate to contact us by email at:

Application.Support@Energizer.com

For more technical information from Energizer, visit:

http://data.energizer.com
Decoding Windows Media® Audio in PIC32-Based Designs

When you need to add digital audio to your design, the PIC32 family of microcontrollers (MCUs) offers you the right mix of performance and price—plus a variety of powerful tools—to make your job easier. They are supported by a variety of software libraries to help you develop professional and high-quality connected audio applications.

Developed by Microsoft®, the Windows Media Audio (WMA) digital audio format uses the lossy compression algorithm to create .wma files. If you are creating an audio device which requires support for the WMA format, the Microchip WMA Decoder Library is C/ASM optimized and available for use with all PIC32MX devices. It can decode audio signals sampled at up to 48 kHz with up to two discrete channels. The WMA Decoder Library also supports Variable Bit Rate (VBR) and Constant Bit Rate (CBR) encoded audio streams. In most circumstances, .wma files are stored in Advanced Systems Format (ASF), which is also supported by the WMA Decoder Library.

The Microchip WMA Decoder Library is only available in binary format. The binary file (WMA_decoder.a) was targeted and tested using MPLAB® X IDE and the MPLAB XC32 C/C++ Compiler on a PIC32MX470F512L device (Test Vector: 44 kHz, Stereo channel, CBR, 192.106 kbps bit rate).

### Table 1: Resource Requirements for WMA Decoder Library

<table>
<thead>
<tr>
<th>Module</th>
<th>Flash (KB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Memory</td>
<td>53.60</td>
</tr>
<tr>
<td>Table Memory (ROM)</td>
<td>44.85</td>
</tr>
<tr>
<td>Decoder State Memory</td>
<td>0.43</td>
</tr>
<tr>
<td>Decoder Stack Memory</td>
<td>0.8</td>
</tr>
<tr>
<td>Decoder Heap Memory</td>
<td>31</td>
</tr>
</tbody>
</table>

The Microchip WMA Decoder Library costs $199.97, and you must be a Windows Media Component Licensee to purchase it. Please visit the Microsoft WMA Decoder Library for PIC32 page on our website for more information and to complete a form to request additional purchasing details from the MCU32 Product Marketing team.
A Multi-Screen Approach to Your Digital Strategy

Contributed by Haneke Design

If the consumerism of IT was the last wave of innovation driven by the Internet and user behavior, the next wave is quickly evolving into a technology tsunami. For the foreseeable future, there will be growing groundswell of need in connecting ‘things’ such as everyday consumer objects and industrial equipment onto the network, enabling data gathering and management of these devices via a software interface (often mobile).

Today’s users are able to access and manage more data and devices via mobile or web applications than ever before. And it’s growing at a furious pace. Business Insider Intelligence research estimates that by 2019, the Internet of Things market will be more than double the size of the smartphone, PC, tablet, connected car and the wearable market combined.

Haneke Design specializes in creating custom, engaging and interactive user experiences for desktop, mobile phone, wearable and tablet devices. Our award-winning design and development methodologies result in intuitive, personalized applications enabling secure access to IoT-enabled devices and systems at any time and from anywhere. This leads to increased business efficiencies, enablement of new services, or the ability to attain other health, safety or environmental benefits for a plethora of users across all industries and demographics.

As a recent addition to Microchip’s Design Partner Program and designated an App Developer Specialist, Haneke Design is already collaborating closely with Microchip Design Partners on holistic, end-to-end IoT solutions for various industries, as well as supporting some of the world’s leading brands and advertising agencies to deliver multi-platform, cross-device application initiatives.

To learn more about how Haneke Design can work with you on the user-interfacing components of your IoT projects or other business applications, visit our website at www.hanekedesign.com. Visit Microchip’s Internet of Things page for additional resources to get you started with connecting your embedded system to the cloud.
Ready, Set, Go!
High-Performance Electric Motorcycle Project Uses 8-bit PIC® Microcontroller

Demonstrating our on-going commitment to education, we partner with learning institutions so that our technology and products can help the engineers of tomorrow drive future innovations in embedded applications. Unique benefits and resources that our Academic Program offers to university educators, researchers and students worldwide include sponsorships for programs such as the Rochester Institute of Technology Electric Vehicle Team. Read more about this project in this summary provided by Derek Gutheil, one of the team's leaders.

Electric Vehicles for the Real World
The Rochester Institute of Technology Electric Vehicle Team is a student-run organization dedicated to promoting the viability of electric vehicles through real-world demonstrations of electric drivetrains in action. The team aims to educate people on the principles of electric vehicle design by engaging students in challenging and rewarding projects that cover a wide variety of academic disciplines. Our main project is to design, build and race a high-performance electric motorcycle for competition in the 2015 eMotoRacing all-electric race series. The current bike is based off of the frame from a 2005 Kawasaki Ninja ZX6RR, and utilizes a Zero Z-Force 75-7 motor paired...
with a Sevcon Size 6 controller and XALT Energy Lithium Ion batteries. In-house engineering includes the design and fabrication of a battery management system, advanced data collection and analysis software, battery containment modules and structural framing for the mounting of the powertrain.

Battery Management System

The Battery Management System (BMS) being developed by the RIT Electric Vehicle Team is a complex system intended to effectively mitigate the risks associated with lithium ion batteries. Its purpose is to constantly monitor the individual cells in the battery pack in order to prevent dangerous conditions such as under-voltage, over-voltage, and elevated temperatures or pressures. It has the ability to balance the charge across all of the cells in the battery pack by dissipating excess energy in individual cells, and operate a safety cutoff switch across the whole pack.

Other Controllers

The BMS is just one controller in a network of Microchip PIC® MCU-based controllers that are constantly monitoring many aspects of our motorcycle. Other controllers, such as our inertial measurement unit, will be measuring many other performance aspects of the bike including speed, acceleration, braking and cornering forces, allowing us to study and improve our performance at the track.

While all of this data would be useless in isolation, where the PIC18 family really shines is in its simple communications interfaces. Connecting to all of our required peripherals was easy with the great SPI support, and the built-in CAN interface greatly simplified our data reporting and inter-controller communications.

Data Collection and Analysis

All of the controllers communicate vital performance information on a CAN bus to our gateway which relays their information to our servers. We are then able to organize, archive and display this information for team members to analyze, allowing for better management and interactive operation of the motorcycle. This data will help us learn from our mistakes and improve our motorcycle much faster than would otherwise be possible, giving us a valuable competitive advantage during the race season.

Controller Updates

Another feature of the PIC18 family that has proven to be quite useful is the self-programming capability. By writing a simple bootloader that takes advantage of the CAN interface, it is possible to remotely update any of our PIC18F-based controllers via our gateway. This allows us to develop and make changes in an agile manner and under conditions where it would not normally be possible. Whether our race motorcycle is in our lab or on its way to the track, we can continue adding features and support.

Development

Among others, one of the most critical features we were looking for in our microcontroller was the level of support available to developers. The quickly approaching race season meant we needed to be able to develop fast and efficient firmware to suit our needs. The less time we spend debugging and bringing up core features and hardware interfaces, the more time we would have to refine, improve, and add features to our system. Microchip’s extensive user base, documentation and drivers were just what we needed to get up and running and quickly developing our own application.
The power conversion market is constantly evolving, with a focus on increased efficiencies and higher integration.

The devices you used in your last power conversion design may already be old news. No matter which topology or approach you choose, Microchip can support your design with our comprehensive portfolio of Intelligent Power products, which covers the spectrum from discrete analog solutions to sophisticated and flexible power conversion using our digital signal controllers (DSCs).

The dsPIC® “GS” family of DSCs is optimized to provide full digital control of power conversion stages. Compensation loops implemented in software offer the ultimate in flexibility, enabling designs leveraging numerous topologies to be tailored for energy efficiency over widely varying load or environmental conditions. Complete reference designs for AC/DC and DC/DC power conversion are available to enable faster time-to-market and simplify designs.