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Are You Up to a Challenge?

With the ongoing expansion of the Internet of Things (IoT), developers are increasingly turning to Low Power Wide Area Network (LPWAN) technology to enable connectivity in a growing number of battery-operated sensor and other end-node applications. LPWANs enable long-range, low-power, and low-cost implementations for Machine-to-Machine (M2M) and IoT applications that might otherwise be constrained by budget and power issues. To meet the demands of emerging applications, the LoRaWAN™ network protocol is optimized for low power consumption and can support large networks consisting of many devices.

If you have developed or have a concept for creating an innovative LoRaWAN-enabled solution, we encourage you to enter the LoRaWAN™ Challenge, a special prize of the IOT/WT Innovation World Cup that is powered by the LoRa Alliance™. Not only does this competition offer prizes worth over $500,000, the winner of the LoRaWAN Challenge will also have these opportunities to help fast track the success of their solution:

- Transportation to and accommodations for two people at the Pitch & Award Ceremony
- Free one-year LoRa Alliance Adopter Membership
- Free key sponsorship place at the Open Market Place at an upcoming LoRa Alliance All Members Meeting and Open House of the winner’s choice
- Key company highlight in the LoRa Alliance newsletter and on the LoRa Alliance website
- A joint press release with the LoRa Alliance featuring the winning solution

As a member of the LoRa Alliance, Microchip is supporting this challenge by providing our Arduino® based SODAQ ExpLoRer development kit that is powered by a SAM D21 microcontroller. It will be available free of charge to help entrants create amazing LPWAN applications. To be eligible for the kit, visit the LoRaWAN Challenge website and register your LPWAN solution today. Good luck!

As always, we would be happy to get your feedback on MicroSolutions. Feel free to email us at MSFeedback@microchip.com.

Microchip Technology Inc.
2355 W. Chandler Blvd. | Chandler, AZ 85224 | www.microchip.com
Discover the Perfect Platform to Harness the Power of 8-, 16- and 32-bit PIC® MCUs

Offers Seamless Integration with Microchip’s Comprehensive Development Ecosystem

It began about two years ago with the spark of a concept: offer a cost-effective and fully integrated development platform targeted at first-time users, makers and others who wanted to harness the power of 8-bit PIC® microcontrollers (MCUs). This solution, called the Curiosity Development Board, would enable them to quickly get started with creating lower-power and more cost-effective designs for the Internet of Things (IoT) and other innovative applications.

(continued on page 5)
Fast forward to today. Building on this original platform, Microchip now offers a total of six Curiosity Development Boards for the same types of users. However, while there are two boards that support the development of projects using 8-bit PIC MCUs, a new board supporting 16-bit PIC24F MCUs is available and three new boards are offered for use with 32-bit PIC32 MCUs. Whether you are a first-time PIC MCU user or a professional with years of experience, you can now step into a world of unlimited possibilities for your next design.

Ranging in price from $20 to just under $50, the Curiosity Development Boards are the perfect platform to launch your design. Their layout and external connections offer unparalleled access to the advanced peripherals on many newer PIC MCUs. These Core Independent Peripherals and Intelligent Analog modules enable you to integrate various system functions onto a single MCU, simplifying your design and keeping system power consumption and BOM cost low.

Curiosity can help you make your creative concept a reality. Out of the box, the development boards offer several options for user interface, including physical switches, mTouch® capacitive sensing and on-board potentiometers. An on-board mikroBUS™ interface makes it easy to add sensors and other functionality using the many click boards™ that are available from MikroElectronika, a Microchip third-party provider. These add-on boards give you countless options for customizing your design.

To address the security requirements in IoT designs, select families of 16- and 32-bit PIC MCUs supported on Curiosity boards come equipped with an integrated hardware cryptographic engine for data encryption/decryption and authentication. In addition, some members of the Curiosity family include Wi-Fi® and Bluetooth® connectivity.

The Curiosity platform was designed from the ground up to take full advantage of an easy-to-start ecosystem that includes MPLAB® X and MPLAB Xpress Integrated Development Environments and MPLAB Code Configurator (MCC). The boards also include an integrated programmer/debugger and require no additional hardware to get started. If you need some ideas to begin building your design, some helpful examples, complete with bill of materials, user code and application notes, are available to simplify the process. We also encourage you to join the Microchip forums and become part of the Curiosity community. Sharing and acquiring new ideas is part of the fun.

Here’s a brief introduction to each of the Curiosity Development Boards that Microchip currently offers:

**Curiosity (8-bit)**

The original Curiosity Development Board (DM164137) continues to be one of our most popular development boards. It is designed to support 8-, 14-, and 20-pin 8-bit PIC MCUs with low-voltage programming capability.

**Curiosity (8-bit) HPC**

The Curiosity High Pin Count (HPC) Development Board (DM164136) supports 8-bit PIC MCUs in an expanded range of pin counts. With two DIP sockets on board, Curiosity 8-bit HPC is designed for development with 28- and 40-pin PIC MCUs with low-voltage programming capability.

**PIC24F Curiosity**

The PIC24F Curiosity Development Board (DM240004) is a low-cost platform with an integrated programmer and debugger. It offers easy expandability via a mikroBUS™ interface to utilize click boards™ for customizing your application.

**Curiosity PIC32MZEF**

The Curiosity PIC32MZEF Development Board (DM320104) is a fully integrated 32-bit development platform featuring the high-performance PIC32MZ2048EFM MCU with 2 MB Flash, 512 KB RAM, integrated FPU, crypto accelerator and excellent connectivity options.

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Curiosity PIC32MX470

The Curiosity PIC32MX470 Development Board (DM320103) highlights the capabilities of PIC32MX MCUs (PIC32MX470F512H) with 120 MHz clock speed, an on-chip full-speed USB interface and multiple expansion options.

Curiosity PIC32MM

The Curiosity PIC32MM Development Board (DM320101) features the new XLP PIC32MM “GPL” family (PIC32MM0064GPL036) of low-cost microcontrollers. This board is a simple and easy-to-use platform that facilitates quick PIC32MM evaluation, experimentation and application prototyping.

Some new Curiosity boards are currently in development and will be available soon. If these boards have sparked your curiosity, visit our Curiosity web page to sign up for exclusive discounts and get started with developing your innovative design today.

Want More Information?
Visit the website at: www.microchip.com/curiosity

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Microchip's Product Marketer “The Communicator”
Microchip's Engineer Genius “The Brains”
Good Things Come in Small Packages

New SAM R30 System-in-Chip Package Combines an Ultra-Low-Power MCU with an 802.15.4 Radio

Enables Long-Lasting Battery Life for Wirelessly Connected Devices

As the demand for battery-powered wirelessly connected systems continues to rise, designers are looking for compact, reliable and cost-effective solutions that can also help meet the extremely power-conscious needs of their target markets. To fulfill these challenging requirements, Microchip has recently unveiled a new low-power, single-chip RF microcontroller (MCU) with features that extend battery life in connected devices for multiple years. The SAM R30 System in Package (SiP) delivers design flexibility and proven reliability all in a small package, making it ideally suited for connected home, smart city and industrial applications.

Offering an excellent migration path from a discrete MCU and radio to a single-chip solution, the SAM R30 SiP incorporates an ultra-low-power SAM L21 MCU with an 802.15.4 sub-GHz radio in a compact 5 x 5 mm package. The MCU leverages the Cortex® M0+ architecture, the most energy-efficient ARM®-based architecture available. As a result, the SAM R30 features ultra-low-power sleep modes, with wake from serial communication or General-Purpose Input/Output (GPIO) while consuming a mere 500 nA.

With the ability to operate within the 769-935 MHz range, the SAM R30 SiP gives you the flexibility to implement a point-to-point, star or mesh network. You can get started immediately with our free MiWi™ point-to-point/star network protocol stack. Mesh networking capabilities will be available later this year. Nodes outfitted with the SAM R30 SiP can be positioned as far as one kilometer apart, with the ability to double the range in a star topology. When used in a mesh network, the SAM R30 delivers reliable wide-area coverage for applications such as street lighting or wind and solar farms.

The SAM R30 delivers reliable wide-area coverage.

Development Support

Begin prototyping your SAM R30-based application immediately with the SAM R30 Xplained Pro Evaluation Kit (ATSAMR30-XPRO), a convenient USB-interfaced development board that is supported by our easy-to-use Atmel Studio 7 Integrated Development Platform (IDP).

The SAM R30 SiP is available in two QFN packages: the ATSAMR30E18 comes in a 32-pin QFN package and the ATSAMR30G18 comes in a 48-pin QFN package. Both versions can be ordered from microchipDIRECT or from Microchip’s worldwide distribution network.
T
donday’s car buyers are looking for the same user experience that they enjoy with their mobile devices when they interact with their vehicle’s center stacks, navigation systems and rear seat entertainment systems. To meet this growing demand for user-friendly Human Machine Interfaces (HMIs), car designers are incorporating larger screens that feature capacitive touch capability into their newest models. Microchip’s portfolio of automotive-qualified touchscreen controllers offers developers full scalability to support a large range of screen sizes in their automotive HMI designs.

Designed for these large-screen automotive applications, the MXT1665T-A family of automotive-qualified maXTouch® touchscreen controllers brings the user experience of multi-touch HMI, such as on a mobile phone, to car drivers and passengers. Supporting screen sizes from 8 to 15 inches, the MXT1665T-A family carries Microchip’s adaptive touch technology that utilizes self-capacitive touch as well as mutual capacitive touch scanning. This combination provides a multi-touch experience even with thick cover lenses, thick gloves or in the presence of moisture and water. Devices in this product family are fully AEC Q100 qualified to address all the unique needs of automotive system designs.

The MXT1665T-A family complements the very successful MXT641T-A family of products. It shares many of the same features developed for the automotive industry, but is able to address larger screen sizes over 10 inches. It also supports smaller multi-finger pinch separation. With support for a large range of screen size options, these devices enable you to design multiple platforms—from small to large display sizes—with the same quality user experience and interface. This scalability will ultimately shorten your design time and lower your system and development cost.

The MXT1665T-A family consists of three parts. The ATMXT1665T-A supports 1664 touch node sensors, the ATMXT1189-A supports 1188 touch node sensors and the ATMXT799T-A supports 798 touch node sensors.

Development Support
An evaluation kit is available for each device in the MXT1665T-A family. It includes a PCB with a maXTouch touchscreen controller, a touch sensor on a glass/plastic lens, the FPC to connect to the sensor display, a converter PCB to connect this kit to the host PC via USB, as well as cables, software and documentation. The devices are also supported by maXTouch Studio.

All parts in the MXT1665T-A family are available in a 144-pin LQFP package. Please contact your Microchip sales office for pricing and information on ordering these products.
Adding intelligence to analog power control offers many advantages to a wide range of applications. As one of just a few companies that understand both analog power control and digital controllers, Microchip offers a portfolio of Digitally Enhanced Power Analog (DEPA) controllers that feature a novel combination of digital management and analog power control methods. The latest addition to this portfolio is a buck controller for DC-DC power conversion that offers more flexibility than any other analog control architecture available today.

This single-chip solution, the **MCP19122/3**, controls DC-DC converters and is capable of accepting a high-voltage input of up to 42V, while simultaneously regulating a wide output voltage range of 0.3V to 16V without any external components or drivers. The internal 8-bit PIC® microcontroller can dynamically adjust the operating frequency, over- and under-voltage lockout thresholds, current limits, soft-start, voltage or current output setpoints and maximum duty cycle. This level of configurability offers many application benefits. For example, the MCP19123 can dynamically adjust the voltage output to meet USB Power Delivery requirements, while also adjusting the output over-voltage lockout to maintain tight protection limits corresponding to each output voltage level.

**A MCP19122/3 DC-DC converter implementation can maintain an initial 0.5 percent or better output voltage accuracy.**

The MCP19123 buck controller offers many unique capabilities, including a programmable differential input amplifier used to optimize performance and minimize system voltage error. This configurability allows for a wide output voltage range commonly seen in USB power and battery charger applications. Improving integration in larger systems, the device can synchronize to an external clock and voltage reference or provide the internal system clock and reference to other devices for synchronization.

In server or communications equipment, this allows for seamless power up and accurate tracking of power consumption throughout the board. For high-power applications, multiple
outputs can operate in parallel, providing system redundancy for improved system reliability. With its on-board programmable diagnostic and fault detection capability that is unmatched in the industry, the MCP19122/3 is ideal for high-performance intelligent power applications.

It also offers excellent accuracy for an adjustable output power supply. A MCP19122/3 DC-DC converter implementation can maintain an initial 0.5 percent or better output voltage accuracy. In addition to the tight voltage regulation, the MCP19122/3 is designed to deliver industry-leading current measurement by using a lossless inductor current sense method with specialized internal measurement calibrations. It can directly accept a common mode signal up to 16V and report the load current to within 5 percent accuracy for most applications, with an emulated average current mode control for hardware-based cycle-by-cycle current limiting.

Development Support
The MCP19122/3 is supported by our suite of programming and development tools that includes MPLAB® X Integrated Development Environment (IDE) and the MPLAB XC8 compiler. The MCP19122 is available in a 4 × 4 QFN package while the MCP19123 is available in a 5 × 5 QFN package. They can both be ordered from microchipDIRECT or from Microchip's worldwide distribution network.

Want More Information?
Visit the website at:
www.microchip.com/MCP19123

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The Quickest Way to Get Started with Your Embedded Design
Now supporting 8- & 16-bit PIC® MCUs & dsPIC® DSCs
Are you ready to make the move from an 8- or 16-bit microcontroller (MCU) to a more powerful 32-bit solution for your motor control or industrial application? Then you should check out the new PIC32MK family of PIC MCUs. This family features four highly integrated MCUs for precision dual Motor Control applications (PIC32MK MC) and eight MCUs packed with serial communication modules for General Purpose (PIC32MK GP) applications. All MC and GP devices feature a 120 MHz 32-bit core that supports Digital Signal Processor (DSP) instructions. A double-precision floating point unit is integrated into the MCU core to ease control algorithm development and to enable you to utilize floating-point based modeling and simulation tools for code development.

To increase efficiency and decrease the number of discrete devices needed in motor control applications, the high-performance PIC32MK MC devices combine 32-bit processing with advanced analog peripherals such as a quad 10 MHz op amp, high-speed comparators and motor-control optimized Pulse Width Modulation (PWM) modules. They also have Analog-to-Digital Converter (ADC) modules capable of total throughput of 25.45 Mega-Samples Per Second (Msps) in 12-bit mode or 33.79 Msps in 8-bit mode, enabling higher precision in motor control applications. The devices come with up to 1 MB Live Update Flash, 4 KB of EEPROM and 256 KB SRAM.

With class-leading connectivity integration, the PIC32MK devices have up to four independent CAN 2.0 ports as well as six Universal Asynchronous Receiver/Transmitter (UART) modules, Local Interconnect Network (LIN) 1.2 and six Serial Peripheral Interface (SPI) or Inter-IC Sound (I2S) modules. Additionally, two complete full-speed USB modules are included on select devices, enabling simultaneous USB host and USB device to be active at the same time. A single MCU can be used to communicate to multiple bus protocols for reduced design complexity and cost, making PIC32MK devices ideal for dual-USB applications such as digital audio or CAN-based implementations in the automotive and industrial markets.

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Development Support

As with all PIC32 devices, the PIC32MK family is supported by the MPLAB® Harmony Integrated Software Framework, MPLAB X Integrated Development Environment (IDE), MPLAB XC32 Compiler, MPLAB ICD 3 In-Circuit Debugger and MPLAB REAL ICE™ In-Circuit Emulator. The following additional tools are also available to make it easy to begin your development with the PIC32MK family:

- **PIC32MK GP Development Kit** (DM320106)
- **PIC32MK Motor Control Plug-In Module** (MA320024) compatible with dsPICDEM™ MCLV-2 Low Voltage Motor Control Kit (DM330021-2)

These PIC32MK devices have peripheral block support for MathWorks® MATLAB® and Simulink®, as well as open-source-based Scilab® for customers interested in numerical computation computing environments for engineering and scientific applications.

Devices in the PIC32MK family are offered with up to 1 MB Flash and 256 KB SRAM in 64- and 100-pin TQFP and QFN packaging options and can be ordered from microchipDIRECT or from Microchip’s worldwide distribution network.

Want More Information?

Visit the website at: [www.microchip.com/PIC32MK](http://www.microchip.com/PIC32MK)
NEW PRODUCTS

Amazing Displays
PIC16F19197 Family Simplifies the Design of Low-Power LCD Applications

The PIC16F19197 family of 8-bit MCUs is optimized for popular low-power and battery-powered, touch-enabled LCD applications.

Applications using segmented displays can be found in a variety of products, from meters to portable medical devices to thermostats to exercise equipment and more. Since many of these items are battery powered, designers need a flexible microcontroller (MCU) that can not only directly drive Liquid Crystal Displays (LCDs) but can also meet low-power requirements to extend battery life in their end applications.

A new family of eXtreme Low-Power (XLP) MCUs that features Core Independent Peripherals (CIPs) and intelligent analog is now available to simplify the design of low-power LCD applications. The nine devices in the PIC16F19197 family include a battery-friendly LCD drive charge pump, 12-bit Analog-to-Digital Converter with computation (ADC²), a low-power comparator and active clock tuning of its high-frequency oscillator. Consisting of 28- to 64-pin devices with up to 56 KB Flash and 4 KB RAM, they are the first 8-bit MCUs optimized for popular low-power and battery-powered, touch-enabled LCD applications.

The charge pump ensures that LCD screens maintain consistent contrast even as battery voltage drops. The ADC² automates signal acquisition and processing tasks, making it easy to implement robust touch buttons and sliders. Additionally, the Active Clock Tuning feature provides an extremely stable oscillator across the entire voltage and temperature operating range. The PIC16F19197 family is able to accomplish this entirely in hardware rather than relying upon software.

These new MCUs also feature a Real-Time Clock and Calendar (RTCC) with battery backup and high-current I/O pins to directly drive the LCD backlighting. Their IDLE/DOZE low-power modes and Peripheral Module Disable (PMD) extend battery life. In addition to all of these features, the PIC16F19197 MCUs are able to drive up to 360 LCD segments.

Development Support

You can evaluate the many features of the PIC16F19197 family of MCUs with the LCD XLP Explorer Development Board (DM240314). These MCUs are also supported by MPLAB® Code Configurator (MCC), a free plug-in for MPLAB X and MPLAB Xpress Integrated Development Environments.

The first members of the PIC16F19197 family are available now from microchipDIRECT or from Microchip’s worldwide distribution network.

Want More Information?
Visit the website at:
www.microchip.com/PIC16F19197Family
Upgrade Your Graphics

PIC32MZ DA Microcontrollers Simplify Graphics Design for 24-bit Color and Large Display Sizes

Integrated Development Environment (IDE) and MPLAB Harmony Integrated Software Framework. These tools provide a visual graphics design environment, custom display driver creation, graphics libraries and an asset converter that can take a custom graphic and optimize it for your chosen display size.

Take a custom graphic and optimize it for your chosen display size.

The PIC32MZ DA devices feature:

- A three-layer graphics controller capable of driving 24-bit color Super eXtended Graphics Array (SXGA) displays
- A high-performance 2D GPU
- 32 MB integrated SDRAM or 128 MB externally addressable SDRAM option providing expansive storage
- Ample on-chip Flash, SRAM and connectivity options
- 12-bit ADC throughput at 18 Msps
- Full-featured hardware crypto engine with Random Number Generator (RNG) for data encryption/decryption and authentication

The addition of DDR2 memory enables faster throughput and large graphics buffers and/or storage for increasingly complex communications protocol stacks and algorithms. The result...

Industry's First MCUs with Integrated 2D GPU and Integrated DDR2 Memory

The PIC32MZ DA series of MCUs offers you MPU-like graphics capabilities with easy-to-use MCU-based resources and tools.

A re you looking to upgrade the performance and quality of the Graphical User Interface (GUI) in your design, but daunted by the challenge of working with a microprocessor (MPU)? The new PIC32MZ DA series of microcontrollers (MCUs) breaks through perceived GUI design barriers by offering you MPU-like graphics capabilities with Microchip’s easy-to-use MCU-based resources and tools so that you don’t have to increase your board’s complexity or add new programming resources to your design.

Bridging the performance gap between MCUs and MPUs, the 32-bit PIC32MZ DA devices are the industry’s first MCUs with an integrated 2D Graphics Processing Unit (GPU) and up to 32 MB of integrated DDR2 memory. This combination allows you to increase your application’s color resolution and display size—up to 12 inches—while working within the seamless and familiar PIC32 design environment that includes MPLAB® X...
is smooth, striking interfaces and fewer product variants in a crowded communications control market. Offering the largest total integrated memory in the industry, these MCUs give you the memory space you need for your application at twice the memory speed of any other solution that is currently available in the market.

Development Support

In addition to being supported by the MPLAB Harmony Integrated Software Framework and MPLAB X IDE, the PIC32MZ DA MCUs are also supported by the MPLAB XC32 Compiler, MPLAB ICD 3 In-Circuit Debugger (DV164035) and MPLAB REAL ICE™ In-Circuit Emulation System (DV244005).

Additional hardware tools include:

- PIC32MZ Embedded Graphics with Stacked DRAM (DA) Starter Kit (DM320010)
- PIC32MZ Embedded Graphics with Stacked DRAM (DA) Starter Kit (Crypto) (DM320010-C)
- PIC32MZ Embedded Graphics with External DRAM (DA) Starter Kit (DM320008)
- PIC32MZ Embedded Graphics with External DRAM (DA) Starter Kit (Crypto) (DM320008-C)

Devices in the PIC32MZ DA family are offered in a variety of package options including a 169-ball BGA, a 176-pin LQFP and a 288-ball BGA for external DDR2 applications. They can be purchased from microchipDIRECT or from Microchip’s worldwide distribution network.

Want More Information?

Visit the website at: www.microchip.com/PIC32MZDA
Centralized Control

UNICENS Software Makes Interfacing to High-Speed Infotainment In-Vehicle Networks Easy

Modern cars offer drivers and passengers advanced audio and video capabilities to enhance their in-vehicle experiences. However, this evolving trend is full of challenges for automotive designers. Handling multiple audio or video sources that can be dynamically distributed to multiple sinks requires complex hardware and software implementations to ensure high quality, perfect synchronization and low latency. Car makers are also using in-vehicle networks to transfer an ever-increasing amount of data for performing updates and other applications. System engineers and applications engineers now need expert knowledge about each bus technology to enable communication over automotive networks. Application code has become more complex and development cycles have become longer to meet these many challenges.

Setting a new standard for handling complex infotainment networks within a single software framework, Unified Centralized Network Stack (UNICENS) is a new high-speed network solution for in-vehicle infotainment, supporting Ethernet frames and device control over Internet Protocol (IP). This software module is compatible with Microchip’s OS81118 Intelligent Network Interface Controller (INIC), and will also be compatible with future INICs. The combination of UNICENS with INICs offers you the mechanisms of an Ethernet-based network without the challenges of managing bandwidth reservation protocol for audio and video data.

This new technology encapsulates many of the network specifics so you can focus on your application development rather than being burdened by network management details. You can choose your preferred device control method including Media Oriented Systems Transport (MOST®) technology’s FBlock, Ethernet IP or your own custom control method. UNICENS also supports the configuration and control of all network participants from one central node, which can eliminate the need for microcontrollers (MCUs) and software management in all other nodes in the network, resulting in cost savings and faster time to market. If your application requires intelligence and processing power on remote nodes, then UNICENS can be used with a variety of microprocessors and microcontrollers.

Under the Linux® operating system, you can use standardized software interfaces (cdv, ALSA, V4L2) and Ethernet device control with the free UNICENS software and our proven MOST technology INICs. You do not need extensive knowledge of MOST technology or to commit to an extensive MOST technology network to use a UNICENS-based network.

UNICENS is available as free and open-source software for Microchip customers. For more information, visit the UNICENS web page or contact your local Microchip representative.
Welcome Home

Microchip’s Wi-Fi® SDK with Apple® HomeKit™ Support Now Available

The Wi-Fi SDK combines hardware cryptography suites within the CEC1702, a full-featured ARM® Cortex®-M4-based microcontroller (MCU), with the industry-proven ATWINC1510, a low-power 802.11 b/g/n certified Wi-Fi module. The hardware-based security engines within this solution greatly reduce system calculation times, resulting in a fast and friendly end-user experience. The dramatic reduction in execution time for HomeKit commands such as pairing—with pair setup in 0.95 seconds and pair verify in less than one tenth of a second—accelerates system reaction for seamless consumer experiences such as instantly unlocking a front door.

The reduced time of system activity enabled by the Wi-Fi SDK results in lower system power consumption. The power consumption of the Wi-Fi SDK while performing critical commands such as pairing is so low that it’s on par with Bluetooth® low energy-based systems while still retaining the enhanced functionality of a Wi-Fi solution.

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The hardware cryptography-enabled MCU allows the Wi-Fi SDK to also offer unrivaled hardware security features. The CEC1702, a low-power but powerful, programmable 32-bit MCU, offers security measures such as secure boot which allows equipment manufacturers to establish a hardware-based root of trust to protect against a security breach. You can also leverage integrated security features such as easy-to-use encryption, authentication, private and public key capabilities and customer programming flexibility to minimize application risk. The CEC1702 also features 480 KB SRAM code plus data, which gives you ample code space for the HomeKit protocol as well as your application-specific code.

Development Support
If you are a MFi licensee, you can begin designing your application with the new SecureIoT1702 Demo Board (DM990012), which includes the CEC1702 MCU, a compact, high-contrast, serial graphic LCD display module, push buttons and two expansion headers compatible with the MikroElektronika mikroBUS™ expansion interface. When combined with a MikroElektronika WiFi 7 click, featuring an ATWINC1510-MR210PB module and a separately available MFi chip, the SecureIoT1702 board and Wi-Fi SDK provide the basic building blocks to create HomeKit applications.

If you would like to get started with developing products for the smart home market, please note that the Wi-Fi SDK is available to MFi licensees only. To get more information on the platform or to request access to the Wi-Fi SDK, contact applesupport@microchip.com for verification of your MFi license. You can order the SecureIoT1702 Demo Board, the CEC1702Q-B1-SX MCU and the ATWINC1510 Wi-Fi module from microchipDIRECT or from Microchip’s worldwide distribution network.

Want More Information?
Visit the website at: www.microchip.com/promo/homekit
Embedded systems have become an indispensable part of life. The latest technological innovations have opened up exciting new business opportunities for industry giants as well as startups. Enthusiastic about the potential of significant financial success, many companies are motivated to invest in developing future products that feature these emerging technologies. This creates intense competition in many market sectors. To differentiate in this crowded space, companies need to enhance their product offerings and cost-optimize their designs.

The need to meet these market demands puts embedded designers under constant pressure to innovate. Their go-to solution, the microcontroller (MCU), also must keep up with the challenge of evolving system needs. Over the past several years, Microchip has been introducing PIC® MCUs with new levels of integration to deliver the right combination of features and functionality a designer needs for a specific project. These new PIC MCUs with on-chip Core Independent Peripherals (CIPs) offer flexibility, scalability and enhanced performance, while still remaining low-power and cost-competitive solutions for many applications. Some of the special attributes of CIPs include:

- Independent modules that function without the constant supervision of the central processing unit (CPU)
- Dedicated hardware for high throughput and near-zero latency
- Direct interaction with other on-chip peripherals to implement self-sustaining closed-loop systems, offering higher integration
- Intelligent modules that require almost no processor resources to function
- Low power consumption with the capability to operate in power-saving modes, making them ideal for low-power designs

CIPs are designed in hardware to cost effectively implement the target functionality. The incremental cost of designing a system function using CIPs is much lower than that of similar implementations, such as user firmware requiring Flash, RAM, necessary processor bandwidth and external components.

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CIPs allow PIC MCUs to perform extremely complex and dedicated tasks with little to no interaction with the CPU. This lowers overall power consumption while also freeing up the CPU to perform other tasks. In addition, replacing off-chip discrete components with these integrated peripherals results in significant BOM cost savings. By freeing up processor resources, CIPs enable parallel processes to be implemented together with the CPU without the need for a costly MCU with higher processing power.

**Peripheral Integration**

CIPs are found on many PIC MCUs including PIC16, PIC18, PIC24, dsPIC33 and PIC32MM families. Some of the CIPs available on some families of 16-bit PIC24 MCUs and dsPIC® Digital Signal Controllers (DSCs) and 32-bit PIC32MM MCUs include a Peripheral Trigger Generator (PTG), Configurable Logic Cells (CLC), crypto engine with Random Number Generator (RNG), high-speed comparators with blanking and digital filter functions, and Multiple Capture/Compare/PWM (MCCP).

**Enhanced Performance Using CIPs**

CIPs reduce processor resource requirements and allow for the implementation of parallel processes, which leads to enhanced performance. For example, the crypto engine is capable of supporting AES, DES and 3DES symmetric encryption and decryption. Implementing these routines in software requires about 1–6 KB of Flash and 100–400 Bytes of RAM. The crypto engine CIP requires almost no Flash or RAM, so these resources are available to perform other functions required by the application.

As a hardware module, the crypto engine has a very high throughput as compared to a similar implementation in software. It carries out encryption and decryption approximately ten times faster than a software crypto implementation, while consuming almost the same amount of power. This improves the overall energy efficiency of the application by approximately ten times. These are important factors for power-sensitive applications that require highly secure data throughput. Since this CIP is also capable of operating in low-power modes when the CPU is in standby, it reduces system power consumption in battery-powered Internet of Things (IoT) applications that require security.

**System Capability Extension and Cost Savings**

As design requirements evolve, CIPs can extend system capabilities to enable more innovative designs. The Peripheral Trigger Generator (PTG) is a user-programmable sequencer that generates triggers with complex inputs to coordinate the operation of other peripherals and addresses multiple system needs. It reduces the need for CPU intervention and offers the flexibility and scalability to interface multiple peripherals into a closed-loop system, extending the capability of the overall system.

The PTG can be effectively used in implementing applications like integrated Power Factor Correction (PFC) in motor control. This application requires three PWM channels to control the motor functioning and an additional PWM to control the PFC operation. A simple Output Compare (OC) peripheral can be used to augment the number of PWM channels available on the device beyond the high-speed PWM channels. In a PFC
application, however, completing the following tasks within a given window of time is very important:

- Synchronizing motor control PWM and PFC PWM
- Triggering Analog-to-Digital Converter (ADC) actions and switching ADC channels used for motor control and PFC signals

Both of these requirements are effectively handled by a single PTG module. When the PTG is used to enable the integration of PFC with motor control, a two-chip design is eliminated, which significantly reduces the system-level cost.

**Energy Efficiency**

Portables, handheld devices, wearables and home security are some of the most popular IoT applications. These battery-powered applications must offer extended life between recharging or replacement. MCUs used in these applications must be power optimized and flexible enough to implement energy-efficient designs. The new generation of **eXtreme Low Power (XLP) PIC MCUs** with CIPs offers the industry’s best low-power specifications to tackle low-power design requirements.

![Figure 3: 16-bit XLP PIC® MCUs Offer Best-in-Class Power Specifications](image)

These XLP MCUs offer a range of low-power modes to address various design requirements. The XLP modes keep different resources of the MCU active as configured by the designer, while the remaining modules are powered down. To aid in achieving a low-power implementation, the CIPs in XLP PIC MCUs also consume minimal power.

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**Enhancing Product Offerings**

To counter intense competition, many companies are on a quest to differentiate their products and enhance their product offerings, all while minimizing costs. Versatile CIPs enable product enhancements without additional overhead. For instance, to improve the load-bearing capability of drones, a higher Rotation-Per-Minute (RPM) motor is needed. A higher RPM motor control application typically demands an MCU with higher processing power and advanced analog features like high sampling rate and multi-channel ADC. However, a CIP like the High-Speed Comparator (HS Comparator), with blanking and digital filter, functions with the precision voltage reference module in an MCU. This eliminates the need to migrate to an advanced, more costly MCU. This peripheral combination acts as a threshold signal monitor to efficiently supervise the motor parameters. Since the HS Comparator does not have the lower sampling rate limitation of a normal ADC, it eliminates the need for a high-speed ADC in the MCU.

Another example of product enhancement is improving the accuracy of utility energy meters. The accuracy of energy measurement in a utility meter depends on the accuracy of monitoring the phase difference between voltage and current signals to calculate the load power factor. The most common method of measuring the phase difference between two signals is by comparing the time lapse between the two signals’ zero crossing and extrapolating the phase angles. For an accurate estimate of the phase difference, the sampling rate should be sufficiently

![Figure 4: Power Savings Modes of XLP PIC® MCUs](image)
high to minimize the extrapolation errors that occur with a high-speed ADC. The scenario gets even more complicated when a single ADC needs to sample all three signals—voltage, current and neutral—in a time division multiplexing scenario. In this case, the effective sampling rate requirement increases threefold.

CIPs such as the Configurable Logic Cell (CLC) help improve the accuracy of phase difference measurement by extending its capability to implement the hardware phase detector. A combination of the CLC and the Input Capture (IC) peripheral can measure the phase difference between two signals of the same frequency. This implementation offers better resolution and gives lead/lag information as well. It extends the functionality of CLC-enabled enhancements without the need to migrate to a more expensive, higher-performance MCU.

Design Optimization

Although differentiation may be a primary focus of many designers, system-level cost optimization cannot be compromised. PIC MCUs offer a variety of features to assist with this goal. Some include highly integrated analog modules including an on-chip sigma-delta ADC, high-speed SAR ADC, and integrated operational amplifiers in a single chip. These integrated analog modules eliminate the need to create a multi-chip design. A single-chip solution significantly reduces system-level cost and saves PCB real estate for better optimization of space-constrained designs such as wearables and sensor applications.

On-chip CIPs also help in implementing extended applications and offloading many of the deterministic routines from the CPU. As a result, an application implementation using CIPs requires fewer processor resources like bandwidth, Flash and RAM. By removing the load from the CPU, CIPs enable multiple parallel processes to be implemented without expensive multi-core MCUs. As hardware modules, CIPs respond faster to stimuli and implement a target function with a higher throughput. These attributes eliminate the need to migrate to higher-memory, higher-processing-capability MCUs, thereby optimizing design costs.

As the requirements and business challenges for embedded systems continue to evolve, the Core Independent Peripherals in our PIC MCUs will be ready to not only meet your present requirements, but also to help you offer innovative new designs in the future. Visit www.microchip.com to discover how our wide range of products and outstanding technical support can help you stay ahead of tomorrow’s design trends.
Optimize Your Battery-Powered Designs with Energy-Efficient 32-bit Microcontrollers

Saving power to extend battery life is a pressing design requirement for developers of the latest solutions for the consumer, industrial, medical and personal care market segments. This is especially important in applications that target the Internet of Things (IoT) such as wearable devices, smart locks, thermostats, industrial sensors, portable EKG monitors and connected cosmetics. Power consumption is also a concern in LPWAN nodes that are intended for use on LoRaWAN™ or Sigfox networks.

To meet the needs of power-constrained applications that also require high functionality, Microchip offers a broad range of low-power and ultra-low-power 32-bit microcontrollers (MCUs) that effectively balance power consumption and performance. Devices in this portfolio range from the smallest SAM D to the ultra-low-power SAM L to the higher-performing SAM G and the eXtreme Low Power (XLP) PIC32MX MCUs, each offering features that will cater to the specific needs of a low-power embedded design.

The SAM devices are designed from the ground up to utilize low leakage processes and libraries and provide industry-leading low power consumption. As a result, they feature active currents of under 35μA/MHz and sleep currents of 200nA. They also offer a variety of innovative power-saving features such as multiple power domains, performance levels, SleepWalking peripherals and an Event system.

Getting started with your low-power design is quick and easy with our comprehensive development resources that include hardware and software tools and reference designs that will help you understand and evaluate the innovative low-power features these MCUs offer. These low-power evaluation kits will make it easy to prototype your design using SAM and PIC32 MCUs:

- SAM L21 Xplained Pro Evaluation Kit
- SAM L22 Xplained Pro Evaluation Kit
- SAM G55 Xplained Pro Evaluation Kit
- SAM D21 Xplained Pro Evaluation Kit
- SAM D11 Xplained Pro Evaluation Kit
- PIC32MX274 XLP Starter Kit

The Power Debugger (ATPOWERDEBUGGER) and Data Visualizer GUI allow you to analyze and monitor your SAM MCU-based application’s real-time power profile, while the XLP Battery Life Estimator allows you to estimate the battery life of batteries that are most commonly used in SAM and PIC® MCU-based embedded applications.

Take advantage of our proven ultra-low-power technology along with our many support resources to develop cutting-edge, energy-efficient designs using 32-bit MCUs. They offer you the flexibility to easily create a highly optimized low-power solution in no time. Visit our 32-bit MCUs web page to get started today.
Using High-Speed PECL and LVPECL Termination to Improve Bandwidth in Your Design

When high-speed clock and data systems have reached the bandwidth limits of single-ended CMOS/TTL logic, designers need devices that are better suited to support higher data rates, noise immunity and superior jitter performance. High-speed Emitter Coupled Logic (ECL) is a great choice that provides differential I/O and superior skew and rise/fall times as compared to CMOS/TTL logic. Positive ECL (PECL) is the most common ECL implementation method in today’s low-voltage and high-speed clock distribution systems. PECL logic levels are referenced to the most positive rail (Vcc), making the translation from ECL to PECL easy. PECL supports 5V systems, while Low-Voltage PECL (LVPECL) supports +2.5V and +3.3V systems. Microchip offers an extensive high-speed clock and data distribution portfolio with ECL, PECL and LVPECL logic to address your design needs.

Termination

Because of its very low output impedance (Open Emitter), differential I/O, high input impedance and small signal swing (and thus, its low EMI), PECL/LVPECL is perfect for driving 50Ω and 100Ω controlled impedance transmission lines. In some applications, if the distance between two devices is short enough, termination may not be necessary. However, when the signal’s rise/fall time is faster than a trace’s round-trip propagation delay, a signal trace is considered a transmission line, thus requiring termination.

Another way to express this is:

If, \( \text{trise}(\text{signal}) < 2 \times \text{tpd}(\text{trace}) \), then the trace is a transmission line and proper termination is required.

In this expression, \( \text{trise}(\text{signal}) \) is the rise time of the PECL/LVPECL output signal and \( \text{tpd}(\text{trace}) \) is the one-way propagation delay of the signal.

Also, given that PECL/LVPECL output circuit impedance is low and it will typically drive a high-impedance load, the impedance mismatch can cause reflections, including overshoot and undershoot. This can result in false data clocking, clock signal degradation and higher jitter, which increases the Bit Error Rate (BER) of the system. Therefore, proper termination should be applied to take advantage of all the performance benefits of PECL/LVPECL.

There are several PECL/LVPECL termination methods. Figures 1 through 8 illustrate different termination schemes. For optimal performance in high-frequency applications where an SY58xxx or SY89xxx series PECL/LVPECL receiver is used, you can minimize board space and cost by taking advantage of the patented three-pin AnyIn™ input structure as shown in Figures 7 and 8.

If the receiver does not have a three-pin AnyIn input structure, parallel termination can be used as shown in Figures 3, 4, and 5. Tapping off an existing output (driver) is not recommended for fanning out to multiple locations because mismatches in the transmission lines cause signal degradation. A better option is
Many applications will not use all of a device's outputs. In most cases, a PECL/LVPECL output pair on a Microchip buffer, multiplexer, crosspoint switch or translator may be left floating (exceptions are noted in the product datasheet). When termination is required for an unused output, the output must be terminated, as shown in Figure 6.

The circuit should have the same load on both outputs, even with single-ended applications. The unused input must be set to the proper threshold level for single-ended input applications. The correct level for DC-coupled and AC-coupled applications is $V_{cc} - 2V$ and $V_{cc} - 1.3V$ ($V_{bb}$ equivalent), respectively. Many devices in Microchip's SY100XXXX series include a $V_{bb}$ reference voltage pin as shown in Figure 6. $V_{bb}$ is intended for two applications: unused inputs (shown in Figure 6) and AC-coupled inputs. For AC-coupled inputs, the $V_{bb}$ reference level ($V_{cc} - 1.3V$) is intended to be the termination point via 50Ω resistors on each input.

**Summary of Termination Techniques**

- **Figure 1: No Termination**
  - Only works for very short trace lengths, <1", and low frequencies <100 MHz
  - Pull-down resistor ($R_{pd}$) is typically 180Ω to 250Ω
  - Pull-down resistor ($R_{pd}$) is required to set current drive for open-emitter outputs
  - Typically not recommended due to overshoot/undershoot and reflections

- **Figure 2: Low-Frequency, Series Termination**
  - Only for low-frequency applications <100 MHz
  - For long, uncontrolled impedance traces, $R_S$ acts as series damping resistor
  - $R_s \cong Z_o – driver output impedance = 50\Omega – 7\Omega \cong 43\Omega$
  - Parallel loading is not recommended for high-frequency (>100 MHz) applications. Instead, use a multi-output buffer/multiplexer (SY58xxxx or SY89xxxx series recommended)

To use a multi-output high-speed buffer such as an SY58021U 1:4 LVPECL fanout buffer as shown in Figure 2.
• Microchip recommended termination without receiver internal termination
• Resistor divider tracks power-supply fluctuations
• For Vcc = +5V systems, R1 = 82Ω, R2 = 130Ω
• For Vcc = +3.3V systems, R1 = 2.5 x Z0, R2 = 1.67 x Z0
• For Vcc = +2.5V systems, R1 = 1.67 x Z0, R2 = 2.5 x Z0
• Place termination as close to the destination pins as possible
• For parallel loading applications, use a multi-output buffer/multiplexer (SY58xxxx or SY89xxxx series recommended)

Figure 3: Parallel Termination (Thevenin Equivalent)

• Power saving alternative to four-resistor, Thevenin termination
• Place termination resistors close to destination inputs
• Rb resistor sets the DC bias voltage:
  • For Vcc = +5V systems, Rb = 110Ω
  • For Vcc = +3.3V systems, Rb = 50Ω
  • For Vcc = +2.5V systems, Rb = 19Ω
• Three-resistor networks exist: small package, 1% accuracy, low cost

Figure 4: Parallel Termination (3-Resistor)

• For best t/t performance, AC-coupling capacitors should be low ESR, low inductance at targeted clock frequency
• AC-coupling is only recommended for clock applications (50% duty cycle)
• If ringing occurs (overshoot/undershoot), adding a series resistor (Rs) will dampen the ringing. Typical value is approximately 10Ω. Place resistors as close to source pins as possible.
• Since the AC capacitor blocks the “pull-down” effect of the emitter follower, $V_1 \cong V_{CC} - 1.3V$
• For Vcc = +3.3V systems, Rpd = 100Ω, R1 = 1 kΩ
• For Vcc = +2.5V systems, Rpd = 50Ω, R2 = 1.6 kΩ
• If a Vbb reference is included, terminate each AC-coupling input with 50Ω to Vbb. Bypass the Vbb pin with a 0.01 μF capacitor to Vcc, as PECL is referenced to Vcc.
• If a three-pin input structure is included in the receiver, terminate each AC-coupling input as shown in Figure 8.

Figure 5: Termination AC-Coupled Transmission Lines

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Unused output (/Q) must be terminated to balance output.
- Microchip’s differential I/O logic devices include a VBB pin $V_{BB} \equiv V_{CC} - 1.3V$.
- Connect unused input through 50Ω to VBB. Bypass with a 0.01 μF capacitor to Vcc, not GND, as PECL is referenced to Vcc.

**Figure 6: Terminating Unused I/O**

For $V_{CC} = +3.3V$ systems, $R_p = 50Ω$.
- For $V_{CC} = +2.5V$ systems, $R_p = 19Ω$.
- Transmission line impedance = 50Ω.
- Eliminates external components and stubs and reduces board space by 75%.

**Figure 7: Microchip Three-pin AnyIn™ Input Termination vs. Parallel Termination (DC-Coupling)**

**Figure 8: Terminating Microchip Three-pin AnyIn™ Input (AC-Coupling)**

Visit our Clock and Data Distribution page for more information about selecting the right device for your design’s requirements.
Implementing a Cost-Efficient, Robust and Scalable Physical Layer Solution for High-Speed Networked Automotive Infotainment Systems

Historically, high-bandwidth In-Vehicle Infotainment (IVI) systems with data rates higher than 100 Mbps have been offered in high-end cars. However, an increasing number of economical and high-volume passenger vehicles are also beginning to offer high-bandwidth IVI capabilities. Although IVI systems can offer various software-based features, all of them share a common base: the need for an underlying physical layer technology that is robust and supports high-bandwidth data transfer.

In recent years, the optical MOST150 network has successfully served as this infotainment physical layer, meeting all of the challenging OEM requirements with its high bandwidth, scalability, low weight, robustness, electromagnetic compatibility (EMC) performance and its ability to fit into the limited space available in vehicles. However, in spite of these features, its cost has been a barrier to its adoption by some high-volume car manufacturers.

To respond to the market’s demand for a lower-cost IVI physical layer that is still capable of meeting challenging automotive requirements, a new, standardized physical layer for IVI networks has been introduced that is based on coaxial cables. Coaxial cables have many design merits, including:

- Support for high-bandwidth data transfer
- High shielding effectiveness – robust EMC performance
- An available automated connectors assembly process
- Satisfying demanding mechanical requirements such as bending capability and high temperature range
- Cost effective for an automotive-grade solution
- Tightly controlled impedance, enabling full-duplex mode of operation
- Enabling power transmission as well as data transmission over the same cable

Coaxial cables have been used in the automotive industry for decades with a proven track record for point-to-point connections. For example, they have been used to connect the antenna and radio and to connect the antenna to a Global System for Mobile (GSM) communication module. As a result, the existing infrastructure for highly automated production and the corresponding supply chain is well established. Coaxial cables meet automotive temperature range and mechanical requirements. They are supported by a standard for automotive connector models—known as FAKRA—that has been adopted by different

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suppliers. FAKRA connectors exist in many different shapes and are available with different color and mechanical coding schemes, allowing easy and efficient assembly on the vehicle production line. FAKRA connectors can also be produced using highly automated processes.

A cross section of a coaxial cable is shown in Figure 1, illustrating the primary advantage of a coaxial cable. The electric signal is transmitted via the inner conductor (1), which is surrounded by a layer of insulation (2) and then by a metallic shield (3). An outer plastic layer (4) protects the cable. This design neutralizes the amount of energy that the coaxial cable leaks externally. The metallic shield contains the electric field generated by the signal transmitted on the inner conductor and also protects the inner conductor from interference from external electric fields, resulting in high signal immunity. These properties contribute to the robust EMC performance that enables coaxial cable to be suitable for use in a vehicle. Since there is no need to implement special routing or observe strict positioning limitations, using coaxial cables in automotive networking also reduces car assembly costs.

Coaxial cables offer features that are not available in a classic optical system using Media Oriented Systems Transport (MOST®) technology. The controlled impedance of coaxial cables makes Dual Simplex (DS) communication as well as bidirectional Full Duplex (FD) communication possible. This allows the implementation of additional network topologies along with the classic ring used in MOST networks, an important innovation in IVI networks. For special applications, a combination of DS communication and FD communication can also be easily implemented. Table 1 summarizes the possible topologies that can be supported using a coaxial physical layer.

<table>
<thead>
<tr>
<th>Communications</th>
<th>Topology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dual Simplex</td>
<td>Ring</td>
</tr>
<tr>
<td>Full Duplex</td>
<td>Point-to-point Connection</td>
</tr>
<tr>
<td>Full Duplex</td>
<td>Daisy Chain</td>
</tr>
<tr>
<td>Full Duplex</td>
<td>Star</td>
</tr>
<tr>
<td>Dual Simplex and Full Duplex</td>
<td>Hybrid</td>
</tr>
</tbody>
</table>

Table 1: Network Topology Options for Coaxial Cable-Based IVI Systems

The classic ring topology on a coaxial physical layer can be implemented as shown in Figure 2. This type of network topology is based on a unidirectional DS communication that requires a return cable to close the ring structure.

![Figure 2: Infotainment System Consisting of Three Nodes Connected in a Ring Topology Based on Dual Simplex Coaxial Physical Layer](image)

Using FD communication over a coaxial cable allows you to implement topologies that would otherwise not be possible. For example, applying it in a two-node system enables a pure point-to-point connection as shown in Figure 3. There is no need to include a return cable because the bidirectional communication is implemented over a single coaxial cable. This topology can result in a system cost savings of up to 50% as compared to a classic optical MOST network ring with just two nodes. This cost savings option is very appealing to high-volume car manufacturers because it enables them to implement a basic, but powerful, two-node infotainment system consisting of a head unit and an amplifier.

![Figure 3: Infotainment System Consisting of Two Nodes in Point-to-Point Connection Based on a Full Duplex Coaxial Physical Layer](image)

For more complex IVI architectures comprised of three or more nodes, FD communication allows you to implement a daisy chain topology. An example of a three-node infotainment system in a daisy chain topology is shown in Figure 4. The absence of a
return cable simplifies the car assembly process to contribute to the overall reduction of system costs.

The hub configuration is another option that is possible when three or more nodes are connected to a coaxial physical layer using FD communication. Figure 5 illustrates an in-car display unit acting as a hub is connected point-to-point with two rear view cameras that replace the external mirrors.

The combination of DS and FD communication allows you to add new applications to an existing infotainment system that is based on the ring topology. For example, it could be used to add an audio subdomain with a microphone array network to an existing system that was originally developed without this functionality.

All these topologies optionally support the transmission of power over the coaxial data line. This allows you to eliminate the need for dedicated power lines and connectors for each node in the network, resulting in cost and weight savings as well as simplifying the vehicle assembly process. The architectures shown in Figure 5 and Figure 6 are excellent examples of how the transmission of power over the coaxial cable can be advantageous. Because of their small form factor, the camera and microphone array modules can be designed to use a single connector that supports data as well as power transmission.

A comparison of physical layer costs for IVI networks based on a two-node system is shown in Table 2. This clearly demonstrates that a network based on a coaxial physical layer offers the best performance-to-cost ratio.

<table>
<thead>
<tr>
<th>Physical Layer Technology</th>
<th>Relative Cost</th>
<th>Bandwidth</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coaxial Cable Supporting Full Duplex</td>
<td>1</td>
<td>Multi-Gbps</td>
<td>(2x Chokes + 2x Connector + 6m Coax Cable)</td>
</tr>
<tr>
<td>Optical Supporting Dual Simplex</td>
<td>4</td>
<td>Multi-Gbps</td>
<td>(2x FOT + 2x POF-Connector + 2x 6m POF Cable)</td>
</tr>
</tbody>
</table>

Table 2: Cost Comparison Between Coaxial and Optical Physical Layer Technologies

The advantages of adopting a high-speed networked infotainment system based on coaxial physical layer are obvious. Automotive OEM adoption of this technology will begin rolling out this year, and we expect to see the market welcoming it as a valuable solution for reducing costs and simplifying automotive infotainment designs.

For more information about our solutions for implementing MOST technology over coaxial cable in automotive infotainment systems, please visit our MOST Technology Design Center or contact your local Microchip representative.
Institutions of all sizes are excited about the potential benefits of the Internet of Things (IoT). The availability of data to optimize processes and monitor critical business “levers” holds a lot of promise, impacting top and bottom line growth. Therefore, a large number of companies are implementing IoT devices as part of a trend broadly called “digital transformation.” The same companies, however, are also concerned about the security implications of connecting devices that control or otherwise monitor aspects of their business to the Internet. Indeed, if the use of big data is an essential part of digital transformation, then a discussion of IoT security is an equally important part of that transformation.

IoT Security Challenges
The push to develop secure products has put a spotlight on the challenges many OEMs face. While security technologies are available, getting security right is challenging. It requires deep knowledge and the ability to invest time and money, which puts it out of reach of many OEMs. The primary security challenge is, therefore, not the availability of these technologies, but their accessibility. Making it easy for the “mass market” to deploy available security technologies will incentivize security deployments.

Advanced Security Capabilities—Out of the Box
The Sequitur IoT Security Suite is a solution from Microchip and Sequitur Labs that addresses this very challenge. What differentiates the Suite from other security products is that it delivers a solution which is preconfigured to use the security hardware assets of the SAMA5D2 microprocessor unit (MPU) along with software functions designed to accomplish the most commonly requested security tasks. The solution enables device OEMs to easily use hardware-based isolation and cryptography available in the SAMA5D2 MPU. This includes the ability to implement a secure enclave based on proven ARM® TrustZone® technology. The Suite addresses security needs of device OEMs across many product categories and industries. Developers of products such as IoT gateways, thermostats, cleaning robots, access control and alarm systems can use the Suite to implement secure processes for device pairing and communicating with IoT cloud platforms.

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The Suite dramatically lowers the learning curve and cost of implementing advanced security. Developers work within a familiar environment, such as Linux®, while using the APIs supplied by the Suite to implement the above-mentioned capabilities.

Evaluation and Pricing
IoT Security Suite is targeted for Microchip’s SAMA5D2 Xplained Ultra Rev B Board (ATSAMA5D2-XULT). The software evaluation kit is available as a free download from Sequitur Labs’ website. A commercial license for initial product development on the target hardware and an additional one for volume production purposes are available from Sequitur Labs for $5,000 and $15,000, respectively. The production license is valid for unlimited production volumes of a single product.

For more information, contact a Microchip sales representative or Sequitur Labs at info@sequiturlabs.com.

About Sequitur Labs
Sequitur Labs is developing seminal technologies to improve trust in a connected world, reducing the cost and complexity to build secure embedded and IoT devices. Sequitur’s products span a range of disciplines required for trusted computing, from boot through the full device lifecycle. Sequitur’s security solutions provide real business value to device makers, such as reducing BoM costs, protecting revenue by thwarting IP theft, improving product reliability and reducing liability, and improving device lifecycle management processes. To learn more about Sequitur’s security platform, visit www.sequiturlabs.com or send an email to info@sequiturlabs.com.
Optimize Your Inventory Management with microchipDIRECT’s Resources for the Semiconductor Purchasing Process

Keeping production lines rolling along smoothly to get products to market on time is a serious concern for OEMs. During the pre-production and production stages of their projects, they rely on vendors such as semiconductor manufacturers to provide them with accurate data on when the components they need will be available and shipped to them.

One of the vital—and yet often misinterpreted and mismanaged—aspects of scheduling a project is working with lead times. Frequently, OEMs will use the lead time quoted by a component manufacturer at the beginning of the procurement phase as a fixed-time scale. They enter this data into their resource planning system, and it is often left unchanged throughout the various stages of production. However, the semiconductor manufacturer has a different perspective on lead times. The quote they provide at the beginning of a project is accurate as of that moment, but is subject to change due to fluctuations in demand from other customers over the same period of time. If several high-volume orders come in for the same device, this may push their lead times out by several weeks.

The more realistic option for OEMs is to consider lead times as changeable trend indicators rather than fixed timescales. For example, if a lead time that was originally quoted at eight weeks is extended to 12 weeks, they should update their MRP system with this new information to make sure that they are working with the most accurate data. If they notice that the change in lead time is very large over a short space of time, they should question their supplier to get a clearer indication of future trends in product availability.

Managing the process of requesting updated lead times from multiple manufacturers can be time consuming. To assist you with getting the latest information about the status of your order, microchipDIRECT, Microchip’s e-commerce platform, offers you the ability to subscribe to weekly lead-time updates on the parts that you are purchasing. You can also access your sales order history and invoices online. When used in conjunction with backlog reports, these weekly lead-time updates provide you with a more intelligence-led, trend-oriented approach to managing your procurement process.

On the other end of the supply chain is the industry-standard practice of suppliers holding buffer stock. While this helps OEM customers balance the cost of holding inventory against fluctuations in demand from the own end customers, it can be difficult for OEMs to have clear visibility into future demand. Another helpful resource that microchipDIRECT provides is a 30-day cancellation window to help overcome the risk of forward planning. This will make it easier for you to better manage your

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buffer stock, allowing you to cancel or push out a delivery of any standard product at any time up to 30 days before the product is scheduled to be shipped. For example, if you place an order on microchipDIRECT on September 19 for delivery on November 19, it can be canceled or pushed out at any time before October 19. As each new shipment date is reached, the 30-day window is rolled forward. A weekly backlog report is available to indicate which products are scheduled for shipment within the cancellation window. This allows you to focus on imminent shipments and adjust your schedules to reflect any changes in demand.

microchipDIRECT offers these procurement tools to help you take your inventory management to a new level. Our resources can not only reduce your inventory costs and ensure a continuity of supply of the products that you need, they also give you greater flexibility and responsiveness to your own end customers. Visit microchipDIRECT to learn more about the many ways we make ordering products from Microchip easy.

Seamless Authentication and Encryption
CEC1702 Hardware Cryptography-Enabled Microcontroller

Go Smaller with Your Drug Delivery Devices
Complete Solutions for Medical Device Designers
Industry Experts, Makers and Entrepreneurs Gather in San Diego to Discuss Bringing Innovative Projects to the Marketplace

On June 8, 2017, Microchip brought its “Get Launched” incubator initiative to sunny San Diego. The University of California San Diego was host to the event, with more than a hundred aspiring entrepreneurs, engineers, and academics touring the exhibits and listening to keynote presenters. The event was kicked off by Kathy Giori, VP of operations for Arduino®, and the day got into high gear with exhibits, presentations and parallel workshop tracks starting at the same time.

The workshops drew attendees of varying skill levels who were engaged in learning the tricks of bringing hardware from concept to production. Of particular interest to students was Arduino’s series of workshops. Titled “Arduino Fun” and “Arduino Exploration”, each class offered a hands-on learning opportunity for those interested in basic Arduino concepts all the way up to building Wi-Fi® enabled applications. Another crowd pleaser was the “Advanced Arduino Debugging” workshop—taught by Microchip’s Bob ‘the Wizard of Make’ Martin—that takes the user one step beyond the basics by demonstrating how to import simple Arduino sketches into Atmel Studio 7.0 as lower level C++ programs.

The “Get Launched” exhibition included Microchip partner companies who came from as far away as Santa Barbara to display their products to curious attendees. Spincraft’s Don Seidenspinner took his Hacker Hive idea and conducted a live meet-up during his presentation to the crowd. He gave his audience a taste of Hacker Hive’s openness and ability to

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tackle even the most daunting hardware design issues. Don also attended Bob Martin’s workshop and couldn’t hold back his excitement as he commented, “I am broadcasting Spincraft through BLE and monitoring the power consumption via Atmel Studio. It can’t get any cooler than this!”

As evening approached, Microchip’s in-house “Opportunity Creator”, Sneha Murali, hosted a panel consisting of experts from across the industry. The panel tackled questions from aspiring entrepreneurs on everything from funding to successfully launching Kickstarter campaigns. Key among the panelists was Opus-V’s Sunny Trinh, who brings years of expertise fostering start-up companies to the table. Another special guest panellist was Quin Etnyre, who started Qtechknow from home and has achieved a massive following among the maker community for his interesting hardware solutions to everyday problems.

Our “Get Launched” event in San Diego was a great success. Microchip hopes to bring the event to many different cities from coast to coast across the USA. We are currently mapping out locations in the Midwest and along the East Coast. We’d love to meet up with you in your hometown someday soon.

For more information about our “Get Launched” program go to www.microchip.com/getlaunched.
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