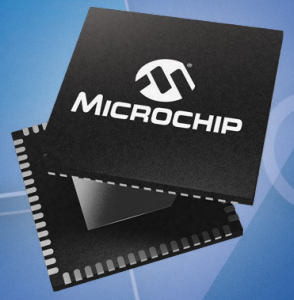
MICROCHIP

European MASTERS Workshop Days

Workshop Guide

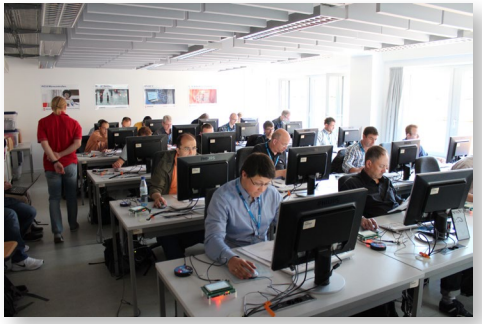
January–March 2017



What are MASTERs Workshop Days?

Getting into its 21st consecutive year, Microchip's MASTERs Conference has become the premiere technical training conference for embedded control engineers. The Conference has now expanded to locations in eight countries and provides training classes at all technical levels. Engineers can choose from classes about both Microchip and former Atmel products, as well as general embedded control topics such as C programming, motor control, power supply design, lighting control, graphic display technolgies, touch sensing methods, analog system design, and wired and wireless communication protocols including Bluetooth®, LoRa®, USB and TCP/IP. Most of these classes are taught by the same application and design engineers who create the products, application notes and demo boards that are used in the classrooms. Come join us for the unique engineer-to-engineer experience that Microchip's MASTERs Conference provides.

With our MASTERs Workshop Days, we want to expand the opportunity for you to participate in the MASTERs program. We use the content of select MASTERs classes and combine those to fill a full day of training on a specific topic. These workshop days are offered in different regions throughout the year. You are invited to join us and move your design idea into a working solution much faster!



Regional Training Centers (RTCs)

Microchip has established a network of Regional Training Centers to provide workshops and seminars on a year-round basis for our customers. By learning in small groups, we can focus on your specific needs. As an engineer, you need to continuously improve your knowledge base and skill set. Learning about new design methodologies, board-level “tips and tricks” and hands-on training with a group of like-minded engineers is one of the most effective ways to advance your professional skills.

We understand that your time is valuable. Attending an off-site training can be a challenge in a world where any information is just a simple mouse click away. The last thing you want is to attend a class that turns out to be a thinly veiled marketing commercial. Our Workshop Days are lead by real engineers and members of our Function Groups. We want to make sure that you walk away armed with specific new skills that can be applied immediately to increase your productivity and get your design to market faster!

Visit the microchip website at www.microchip.com/RTC.

RTC Locations in Europe

Locations

Microchip is currently hosting RTC training days in following European locations:

- Wokingham, UK
- Haan, Germany North
- Karlsruhe, Germany South / West
- Ismaning, Germany Munich Area
- Paris, France
- Milan, Italy

On-Site Group Training

For organizations who desire to have a number of employees attend a course at the same time, Microchip can offer training days at your location. Our engineers will arrive at your location with all the materials and equipment needed. For more information contact your local Microchip sales office.

Microchip European MASTERs Conference

Our next European MASTERs conference is scheduled for September 12-14 at the HTW Berlin.

For more details visit techtrain.microchip.com/eumasters.

Request and Additional Class/Training Day

We care about your training needs. There is a form on our RTC site you can request to schedule of an existing class in your area, or suggest a topic for a new class. If a class is scheduled meeting your request, you will be contacted via email.

Workshop Days for Q1 2017

January–March 2017

MWD1701: Tools and Techniques for Developing with Microchip 8-bit PIC® Microcontrollers

During this full-day workshop we will start with an introduction of our development tools based around MPLAB® X IDE and go through the creation, editing, compiling, running and simulating a project. You will get a chance to practice this on our toolsets.

This will be the foundation to get into our MPLAB Code Configurator where we demonstrate how powerful this tool is to get your application ready for production quickly. This training day is based on material from our MASTERs Classes **20012 DEV1**, **20013 DEV2** and **20015 DEV4**. We will also have time to get into your individual questions.

MWD1702: Tools and Techniques for Developing with Microchip 32-bit PIC Microcontrollers

During this full-day workshop we will start with an introduction of our development tools based around MPLAB X IDE and go through the creation, editing, compiling, running and simulating a project. You will get a chance to practice this on our toolsets.

This will be the foundation to dive deeper into our MPLAB Harmony Framework where we demonstrate how powerful this tool is to enable you to quickly develop complex embedded systems. This training day is based on material from our MASTERs Classes **20013 DEV2** and **20016 DEV5**. We will also have time to get into your individual questions.

MWD1703: Advanced Tools for Developing with Microchip Microcontrollers

During this full-day workshop we will start with diving deeper into programming in C, using interrupts and avoiding data corruption even without having to implement a full RTOS. We will also show you how to effectively use our debugging tools. This training day is based on material from our MASTERs Classes **20023 FRM3**, **20024 FRM4** and **20026 FRM6**. It will combine lecture and hands-on sessions. We will also have time to get into your individual questions.

MWD1704: Tools and Techniques for Developing with Microchip 8-bit AVR® Microcontrollers

During this full-day workshop we will start with an introduction of our development tools based around Atmel Studio 7 and go through the creation, editing, compiling, running and simulating a project. You will get a chance to practice this on our toolsets.

This will be the foundation to design with our latest AVR and Tiny product range. We will also introduce our QTouch® composer and demo advanced debugging on ATmega328PB using power profiler and data visualizer. This training day is based on material from our MASTERs Classes **20112 ATM2**. There will be time for your individual questions.

MWD1705: Tools and Techniques for Developing with Microchip ARM®-based MCUs

During this full-day workshop we will start with an introduction of our development tools based around Atmel Studio 7 and Atmel START and go through the creation, editing, compiling, running and simulating a project. You will get a chance to practice this on our toolsets and use a low-power IoT application as an example. The training day will also cover architectural discussions around our Cortex® MCUs with scalable performance. This training day is based on material from our MASTERs Classes **20114 ATM4**, **20115 ATM5** and other training modules. There will be time to address your individual questions.

MWD1706: Implementing EtherCAT®

During this workshop we will give you an introduction to implementing both simple and complex EtherCAT Slaves based on the Microchip LAN9252 controller. We will discuss and demonstrate the implementation of an EtherCAT Master based on a Raspberry Pi® and controlling slaves from this platform. We will also demonstrate interfaces to a simple actuator, digital I/O, USB bridging, remote analogue sensors and the use of Distributed Clocks to reduce overall network jitter, as required in a real-time distributed control system. This training day is based on material from our MASTERs Classes **20063 NET5**. It will combine lecture and hands on sessions. We will also allocate time for a questions and answers forum.

MWD1707: Intelligent Power Conversion

During this full-day workshop we will start with the fundamentals of Switch Mode Power Converters from energy storage to feedback and control loops. This will be our foundation to get into details on how this can be implemented utilizing Core Independent Peripherals (CIPs) to create a more intelligent-controlled solution. This training day is based on material from our MASTERs Classes **20091 PC1**, **20092 PC2** and **20097 PC7**. We will also have time to get into your individual questions and run demo applications.

MWD1708: Motor Control

This Workshop day focuses on the evolution of complex motor control with emphasis on Field-Oriented Control (FOC) methods for PMSM/BLDC motor variants. Trends are towards intelligent solutions which can provide auto tuning of a complete system and simulation/code generation from an accurate model. These are addressed by Microchip through the new motorBench™ motor control application generator and block sets for Matlab™ plus Scilab™, which will be presented along with practical usage demonstrations. A review of FOC combined with some specific refinements that enable extended performance and control efficiency will also be covered. Scalable hardware solutions, including intelligent MOSFET drivers/companion chips and highly integrated devices incorporating analogue support and drivers will be reviewed. There will also be time to discuss your individual questions and run several other demos from the wide portfolio of scalable solutions.

MWD1709: Signal Chain and Analog

During this full-day workshop on Analog and Signal Chain, we start by taking a closer look on different techniques based on op amps or instrumentation amplifiers in order to optimize the overall accuracy of your system. One of the case studies will be on precision temperature sensing. To finish the day, we also cover the fundamentals of battery charging to address various battery chemistries and study solutions for your battery-powered application. This training day is based on material from our MASTERs Classes **20075 AMS1**, **20078 AMS4**, **20079 AMS5** and **20105 BAT2**. We will also have time to get into your individual questions and run demo applications.

MWD1710: TCP/IP, Ethernet, Wi-Fi®, IoT, Cloud and Security

This training consists of two days which can be taken in whole or parts.

Day 1: TCP/IP Fundamentals and Operation. This will provide you with a good understand of TCP/IP and how it works. Followed by hands-on use of the TCP/IP stack utilising Microchip's MPLAB Harmony TCP/IP Stack to create connected embedded applications.
Day 2: Security, IoT and Cloud. This session will focus on the importance of a secure element and the use of low-power, high-performance crypto accelerators in your connected design. This will be followed by a hands-on class using Microchip's MPLAB Harmony TCP/IP Stack and Amazon AWS IoT Cloud service to create a secure IoT system.

These classes will require a good working knowledge of C. These classes are based on material from our MASTERs Classes **20059 NET1**, **20060 NET2** plus **20113 ATM3**, **20074 SEC3** and **20067 IoT1**. We will also have time to discuss your individual questions.

MWD1711: LoRaWAN™

This is a full one-day workshop which will explain the fundamental operation of a LoRaWAN network and discuss the operation of the gateway and how the node, gateway and server interact within the network. We will perform hands-on classes using the ASCII command interface of Microchip's RN2483 LoRa® Radio Module, connecting to and interacting with a network.

We will follow this with details on how to utilise the MCU on-board the module so users can, where appropriate, program this MCU to perform their system tasks. This will utilise the MPLAB Code Configurator and LoRaWAN Library Plug-In and will require a knowledge of C to complete.

This training day is based on material from our MASTERs Classes **20069 IoT3**, **20064 NET6** and **20065 NET7**. We will also have time to discuss your individual questions.

MWD1712: Bluetooth

This training consists of two days which can be taken in whole or parts.

Day 1: Bluetooth Low Energy for Embedded Devices. This sessions consist of hands-on workshops using Microchip's BM70 and ATBTLC1000 Bluetooth Low Energy modules. You will be able to understand the operation of Bluetooth Low Energy and how to setup devices to interact with other devices. A knowledge of C will be required.
Day 2: App Development. This hands-on section helps you understand how to create an Android™ App and interact with a Bluetooth Low Energy device in an embedded system. This is aimed at the embedded developer creating proof-of-concept apps to interact with their Bluetooth Low Energy-enabled product. It will also highlight the differences and need for interaction with Pro App developers. We will also discuss iOS App development through demonstration only.

These training days are based on material from our MASTERs Classes **20055 BLU1**, **20114 ATM4**, **20056 BLU2** and **20057 BLU3**. We will also have time to discuss your individual questions.

MWD1713: Implementing Touch Solutions

Microchip offers complete 1D, 2D touch and 3D gesture solutions. This workshop day will not only present our product/solution portfolio, but also show how these technologies can improve your application. Demonstrations including touch keys, sliders, proximity, touchpad/touchscreen and 3D gesture. Get some experience with the on-chip dedicated peripherals Capacitive Voltage Divider (CVD) and Peripheral Touch Controller (PTC), which offload the main CPU from simple touch tasks. You will be able to start a project with the MPLAB Code Configurator with the Touch Library, and Atmel START with the QTouch Library. This training day is based on material from our MASTERs Classes **20036 TAG1** and **20121 ATM10**. There will be time to address your individual questions.

MWD1714: Security Solutions

During this full-day workshop we will start with the fundamentals of Security and how it can be applied to open and closed ecosystems. This will also cover disposable authentication and secure IoT. The training day will be interactive—we will run demos and allow hands-on experience. This class will use elements of our MASTERs Classes **20073 SEC2** and **20074 SEC3**. We will also go into details of CryptoAuthentication™ devices like the ATSHA204 and ATECC508A.

MWD1715: Unload your Microcontroller Utilizing Intelligent Core Independent Peripherals

This full day Workshop will explore the usage of Microchip's Core Independent Peripherals (CIPs). This training will explore the usage of Microchip's CIPs to implement mixed-signal circuits to process analog and digital signals. Examples of CIPs are shown on 8-bit and 16-bit MCU and dsPIC® DSC devices. You will understand the advantage of using CIPs to boost the performance of your application. Furthermore you learn the benefits of interconnecting these new peripherals. This class will use elements of our MASTERs Classes **20008 CIP2**, **20010 CIP4** and **20011 CIPL**. We will also have time to discuss your individual questions.

Schedule and Booking

All of our sessions and prices are listed online at www.microchip.com/RTC.

Further Information

Our European MASTERs Workshop Days are based on the Microchip MASTERs Program. Material is updated every year to keep up with our fast-changing industry. Many of our Workshop Days either refer to or directly use MASTERs class material. In the following pages you can find details of all the classes we used during the 2016 MASTERs Conference.

Class	Title	Abstract	Tech Level
Products and Peripherals			
20008 CIP2	**Motor Control Using Core Independent Peripherals (CIPs)**	This class will explore the usage of Microchip's Core Independent Peripherals (CIPs) in motor control applications. These CIPs, present on 8-bit and 16-bit MCU and DSC devices, provide several alternate methods of implementing different building blocks and generating signals that are required for low-cost and efficient motor control applications. The peripherals discussed will include 16-bit PWM, complementary waveform generator, angular timer, hardware limit timer, MCCP/SCCP, PTG, CLC, Comparator and Op-amp. The extensive configurable features provided by these peripherals enable efficient implementation of applications with minimal processor overhead. Participants will be presented with several application case studies using creative combinations of these peripherals, thereby gaining a deeper understanding and appreciation of the flexibility and ease-of-use of these modules. This is a lecture class, but attendees can optionally attend the 20011 CIPL "Open Lab" session, which will provide the opportunity to complete self-paced hands-on lab exercises that reinforce concepts learned in this class as well offer the opportunity for attendees to ask experts how to use CIPs to solve their own application problems. Exact times for Open Lab evening sessions will be provided in class.	1
20010 CIP4	**Implementing Mixed Analog and Digital Circuits Using Core Independent Peripherals (CIPs)**	This class will explore the usage of Microchip's Core Independent Peripherals (CIPs) to implement mixed-signal circuits to process analog and digital signals. These CIPs, present on 8-bit and 16-bit MCU and dsPIC® DSC devices, provide several alternate methods of implementing vital mixed-signal circuits and functions that are required for a variety of user applications. The peripherals discussed will include PTG, CLC, PGA, comparator, op-amp, temperature indicator, signal measurement timer and hardware limit timer. The extensive configurable features provided by these peripherals enable efficient implementation of applications with minimal processor overhead. Participants will be presented with several application case studies using creative combinations of these peripherals, thereby gaining a deeper understanding and appreciation of the flexibility and ease-of-use of these modules. This is a lecture class, but attendees can optionally attend the 20011 CIPL "Open Lab" session, which will provide the opportunity to complete self-paced hands-on lab exercises that reinforce concepts learned in this class as well offer the opportunity for attendees to ask experts how to use CIPs to solve their own application problems. Exact times for Open Lab evening sessions will be provided in class.	1
20011 CIPL	**Optional Lab Session Supporting Classes 20007 CIP1-20010 CIP4**	This optional lab session provides attendees who have taken any of the CIP1-CIP4 classes a chance to run through a series of lab exercises showing how to configure and use the CIPs in different application examples. In addition, attendees are encouraged to come to the CIP workshop room with their own application examples and get help from Microchip experts on how to implement CIPs to solve their own individual problems. Lab sessions will be available in the some evenings. Exact times for the evening CIP Lab Sessions will be provided in class.	1

Tech Levels
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Class	Title	Abstract	Tech Level
Development Tools			
20012 DEV1	**MPLAB® X IDE and Development Tools: Today and Tomorrow**	This introductory-level course offers an overview of Microchip Development Tool solutions and a quick review of new features in MPLAB® X IDE, MPLAB XC C Compilers, starter kits, programmers, debuggers, and other new products. Third party hardware and software tools will also be covered, along with information on Microchip's academic program. Presented by a team of Development Tools engineers and management, it is an interactive session, where attendee participation is crucial and mutually beneficial to both presenters and attendees.	1
20013 DEV2	**Getting Started with Microchip Development Tools: MPLAB® X IDE, Simulators, Debuggers, and Plug-Ins**	This lecture class covers the basics of getting started with Microchip development tools. Following an introduction to all Microchip tools, the instructor will go through the step-by-step creation of a project, editing and compiling a program, running a program and using the simulator. Basic debugging techniques are described, such as how to set a breakpoint, etc. Attendees will leave with a basic knowledge of Microchip tools which can be used to develop applications for all 8, 16, and 32-bit Microchip MCUs. This is a lecture class but attendees can optionally attend the 20013 DEV2L "Open Lab" session which will provide the opportunity to complete self-paced hands-on lab exercises that reinforce concepts learned in this class. The Open Lab sessions will run some evenings. Open Lab evening sessions will be provided in class.	1
20015 DEV4	**MPLAB® Code Configurator (MCC) for Simplified Embedded Software Development**	The MPLAB® Code Configurator (MCC) is a user-friendly plug-in that seamlessly integrates with your existing MPLAB X Integrated Development Environment to provide an easy setup and configuration experience with a wide array of 8 and 16-bit PIC® microcontrollers. In the past year, MCC has been re-architected from the ground up to enhance functionality and provide library support for our latest MCUs and Core Independent Peripherals. MCC can now configure over 300 MCUs to your specific application without opening a product data sheet.This hands-on class will utilize MCC for MPLAB® X IDE to generate seamless, easy-to-understand drivers and libraries for PIC MCUs with Core Independent Peripherals. These drivers are optimized for each CPU and can be tailored to fit almost any application and function. The available libraries like TCP/IP Lite, mTouch® technology, LIN and Boot Loader help further simplify setting up a complete solution. Learn how to leverage the MCC's power to quickly develop an embedded application and get your project off the ground in minimal time. With just basic knowledge of the C programming language and some knowledge of Microchip's powerful MPLAB X IDE tool suite, you will be generating driver functions for an array of peripherals in minutes.	2
20016 DEV5	**Creating PIC32 Embedded Applications with the Help of MPLAB® Harmony, Middleware and Software Ecosystem from Microchip**	MPLAB® Harmony is a modular framework that provides interoperable firmware libraries for PIC32 peripherals, drivers, services, and middleware. It uses a flexible architecture to enable development of a wide variety of embedded solutions whether they are based on a Real-Time Operating System (RTOS) or not. This class introduces attendees to MPLAB Harmony's key concepts and fundamentals, and demonstrates its benefits, including the ability to quickly develop complex embedded systems that utilize multiple middleware stacks.	2
Touch and Gesture Sensing			
20036 TAG1	**Introduction to Microchip's Touch and 3D Gesture Technologies**	Microchip offers complete 1D, 2D touch and 3D gesture solutions. This introductory class will not only present the product/solution portfolio, but also show how these technologies can improve your application. Demonstrations including touch keys, sliders, proximity, touchpad/ touchscreen and 3D gesture will be shown in the class.	2

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Class	Title	Abstract	Tech Level
Firmware Design and Compilers			
20023 FRM3	**Taming Embedded C**	The enigmas of the C programming language will be explained. The hidden secrets of Microchip debugging tools will be revealed. The mysteries of masterful design and coding practice will be laid bare! This class in programming microcontrollers focuses heavily on technique and practical methods. This class is targeted at attendees who have some facility with programming microcontrollers in C, debugging real-world applications and solving difficult programming challenges. Attendees will take their programming, debugging and problem solving to the next level using best practice advice from the best programming minds at Microchip.	3
20024 FRM4	**Interrupts and Task Scheduling – No RTOS Required !**	Interrupts are an important part of embedded system programming. This class will explain how interrupts work as well as how to avoid pitfalls when using interrupts. This class will explain what concurrency is and demonstrate how to resolve concurrency problems. Ultimately, the attendees in this class will learn how to use interrupts to create a task scheduler that behaves just like an RTOS. The provided hands-on lab exercises will reinforce concepts learned in this class.	3
20026 FRM6	**Methods to Avoid Data Corruption via Interrupt Processes**	In systems where interrupts are utilized, the volatile qualifier is often used as a method of instructing the compiler to treat variables delicately by forcing all reads and writes to occur. Unfortunately, many programmers make assumptions about its application to shared data and the ability to protect this data. The purpose of this class is to help attendees understand why using the volatile qualifier may cause more harm than good, and why accessor functions should be used for atomic data and shared hardware ports. Additionally, the class will cover why atomic (non-interruptable) access is not guaranteed for any access or operation, and the vital importance of atomic data and their protection when utilizing interrupts.The course will show code examples and analyze the disassembly of the C compiler to demonstrate the importance of assumptions about methods used during compilation. Also, state-based systems will be shown with nested/enabled interrupts to show how they may unintentionally affect the operation of ports and variables. Note: This class will be taught by a representative from Occam Medical Design.	4
Bluetooth®			
20055 BLU1	**Getting Started with Bluetooth® Low Energy Development**	Bluetooth® Low Energy (BLE) is the low-power extension to the Bluetooth 4.x Core Specification, extending the standard to cover low-power, low-latency use-cases. This hands-on course focuses on the key design considerations you should be aware of in adding BLE connectivity to your embedded application. Lab exercises will interface a Microchip PIC® MCU with an agency-certified Microchip BLE module.	1
20056 BLU2	**Creating Proof-of-Concept Android™ Apps for Bluetooth® Low Energy**	Creating professional mobile apps might be beyond the scope of most embedded design engineers, but if you just want to get started and learn to create simple proof-of-concept apps, then this class is for you. You will learn what development tools to use, how Android apps are structured, touch on key features of the Java language, and go into Bluetooth® LE support in more detail.The class will use Android tablets to connect to Microchip Bluetooth® LE modules. The hands-on labs will cover the steps required to scan, connect, discover services, and send and receive data over a Bluetooth LE connection.	2
20057 BLU3	**Developing iOS™ Applications to Control Bluetooth® Low Energy Accessories**	Learn the development process for creating iOS™ applications to communicate with the RN487x Bluetooth® Low Energy module. This class explains which development tools are used for iOS application development, the languages used, and how the operating system supports Bluetooth Low Energy interfaces. Note: This class does NOT cover Bluetooth audio applications.	3

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Class	Title	Abstract	Tech Level
Networking			
20059 NET1	**TCP/IP Networking Fundamentals**	If you need to add network connectivity to your product, but you don't know how TCP/IP works, this class is for you. You will learn the basics of TCP/IP including how IP addresses are assigned and used, and how the data packetization process works. We will then use this knowledge to demonstrate how an embedded device communicates on your local network or across the world using the Internet. We will teach you what ports and sockets are, and how applications use them to create TCP/IP connections. We will also describe how some common TCP/IP applications (DHCP, DNS, etc.) work. We will show you how the client-server model works and will discuss the trade-offs to consider when choosing to locate a server on a local network vs. the internet. Last, we will show you Microchip's solutions for embedded TCP/IP designs.	1
20060 NET2	**Introduction to the MPLAB® Harmony TCP/IP Stack**	Welcome to the MPLAB® Harmony TCP/IP Stack! If you plan to use a PIC32 in an embedded TCP/IP application, you will need to know how to use the MPLAB Harmony TCP/IP stack. You will learn the parts of the stack fundamental to all TCP/IP applications, how to configure the stack, and how to interface your application to the stack. This class will show you the supported protocols, example demo code, and support utilities provided by the stack. We will describe the architecture of the stack and how it works and show some common stack APIs used to interface your application with the stack (socket programming). You will get hands on experience with configuring the stack using the MPLAB Harmony Configuration (MHC) Tool, and creating a TCP/IP application using a "bare metal" implementation.Note: This class is not relevant for Microchip's stand-alone RN Wi-Fi® modules.	2
20063 NET5	**An Introduction to EtherCAT® and the Microchip LAN9252 Slave Controller**	EtherCAT® is probably the fastest growing industrial field bus. The protocol is based on Ethernet layer 1, so it offers the leverage of standard infrastructure hardware, thus allowing the deployment of cost-effective solutions. Because it employs on-the-fly as opposed to store-and-forward packet processing, it provides fast node update speeds and offers real-time synchronous I/O control over a distributed control system to well within 1us. It is its own protocol and requires dedicated master and slave controllers. The LAN9252 is an example of such a slave controller. This class familiarizes the attendee with implementing a Raspberry Pi EtherCAT master to control slaves based on the LAN9252, and introduces the tools required to implement an EtherCAT network.	1
20064 NET6	**Getting Up and Running with LoRaWAN™ Long-Range Networking**	With the growing Internet of Things, Microchip's LoRa® Technology wireless solution addresses the increasing demands on end-devices for long range connectivity, low power for battery operation, and low infrastructure cost for volume deployment, enabling Internet of Things (IoT) and Machine-to-Machine (M2M) wireless communication. Microchip's LoRa Technology solution is ready to run out of the box and comes with the complete LoRaWAN™ protocol stack. Leveraging its integration with the MPLAB® Code Configurator (MCC), it drastically reduces time to market and saves development costs. In this class we will start by presenting an overview of the LoRa Technology (architecture and characteristics) and Microchip's LoRaWAN Library. We will then show how to enable and configure the Microchip LoRaWAN library in their applications. Finally, we will cover what the hardware prerequisites are, and what configuration is needed to have a functional LoRa Technology based application. During the hands-on labs, the attendees will have the opportunity to experience a bring-up of a LoRaWAN Class A based application by using the Microchip LoRaWAN library generated from the MPLAB Code Configurator (MCC).	3
20065 NET7	**Connecting Things Using Microchip's MCC LoRaWAN™ Library**	With the growing Internet of Things, Microchip's LoRa® Technology wireless solution addresses the increasing demands on end-devices for long range connectivity, low power for battery operation, and low infrastructure cost for volume deployment, enabling Internet of Things (IoT) and Machine-to-Machine (M2M) wireless communication. Microchip's LoRa Technology solution is ready to run out of the box and comes with the complete LoRaWAN™ protocol stack. Leveraging its integration with the MPLAB® Code Configurator (MCC), it drastically reduces time to market and saves development costs. In this class we will start by presenting an overview of the LoRa Technology (architecture and characteristics) and Microchip's LoRaWAN Library. We will then show how to enable and configure the Microchip LoRaWAN library in their applications. Finally, we will cover what the hardware prerequisites are, and what configuration is needed to have a functional LoRa Technology based application. During the hands-on labs, the attendees will have the opportunity to experience a bring-up of a LoRaWAN Class A based application by using the Microchip LoRaWAN library generated from the MPLAB Code Configurator (MCC).	3

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Internet of Things (IoT)			
20067 IoT1	**Connecting to the Cloud with the Internet of Things (IoT) Family of Development Tools from Microchip**	As embedded design engineers look to make that next great connected, or Internet of Things (IoT), product, knowing where to start can be a challenge. There are natural firewalls between a company's IT or cloud development department and the engineering department that need to be overcome. The objectives of this class are to introduce the family of IoT development kits developed by Microchip and discuss how to connect these kits to the Amazon Web Services IoT service. Engineers will learn how to leverage the demo to connect to a cloud-based system. The skills acquired in this class will help the embedded engineer communicate effectively with their IT or cloud development department.	2
20069 IoT3	**Utilizing the Microchip LoRa® Technology Gateway Radio Module**	As the IoT universe grows, secure communications with geographically dispersed, battery powered, embedded devices becomes a necessity. This class will offer insight, setup and demonstration of the new LoRa® Technology Gateway Radio Module and the Microchip LoRa Technology Gateway Reference Evaluation Board as a host for a swarm of RN2903 LoRa Technology Transceiver Modules. At the conclusion of the class, the participant will have the knowledge necessary to setup and monitor their own long distance IoT constellation.	2
Security/Encryption			
20073 SEC2	**Microchip Security Solutions**	Security and cryptography are increasingly important in today's world. Microchip provides a variety of hardware and software solutions to address security issues. This class examines these solutions with examples on utilizing them.	2
20074 SEC3	**Using Hardware-Based Devices to Secure and Authenticate Embedded Applications: An Introduction to Microchip's CEC1XXX Crypto Engine Controllers**	Microchip's CEC1XXX Family of Crypto Engine Controllers ensure that embedded designs are not cloned, counterfeited or tampered, helping risk mitigation to OEMs by ensuring that only legitimate products and firmware upgrades work in the host system. Learn about privacy, authentication, attestation and hardware key management to help repel aggressive attacks against your system. Cryptography is mathematically complex and highly detailed with constantly emerging standards, algorithms, processes, definitions and methodologies. Microchip makes it easy to secure your design using the CEC1XXX Family of Crypto Engine Controllers, eliminating the need for resource intensive expertise on your side. Come see how Microchip has simplified the cost and risk of adding hardware security to your embedded designs.	1

Tech Levels
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Class	Title	Abstract	Tech Level
Analog and Mixed Signal			
20075 AMS1	**Signal Conditioning Techniques Using Precision Instrumentation Amplifier**	The primary challenge of sensing in industrial environments is conditioning low-level sensor signals in the presence of high-noise environments. While this is an ideal application for a precision Instrumentation Amplifier (INA), simple mistakes can quickly compromise the precision performance. This course starts with an introduction to the Instrumentation Amplifier by comparing the common architectures and their individual advantages. We will then focus on how to apply the Instrumentation Amplifier effectively using select signal chain application examples and discuss how to avoid common mistakes.	2
20078 AMS4	**High-Precision Analog Applications Using Op Amps**	Are you interested in designing high-precision circuits? How can you take advantage of a PIC® MCU's capabilities? This class covers precision op amp fundamentals, their application to circuit design, and design tips and tricks. Circuits with traditional, reduced analog content and mixed signal architectures are illustrated. This is an analog class for users at Analog Technical Level 3 (some experience).	2
20079 AMS5	**Precision Remote Temperature Sensing for Embedded Systems**	Embedded systems with precision thermal management require high-accuracy instrumentation. Several temperature sensors are available in the market to measure temperature at remote locations such as Silicon IC sensors, diode sensors, thermistors, RTDs and thermocouples. This session demonstrates the various discrete and non-discrete thermal management solutions for precision remote sensing applications. Attendees will explore the pros, cons and implementation techniques of each sensor and identify the appropriate cost-effective solution for the embedded system application.	1

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Class	Title	Abstract	Tech Level
Power Supply and Power Conversion			
20091 PC1	**Fundamentals of Switch-Mode Power Converters**	This class is the first of four classes presenting the basics of switch mode power conversion. The goal of this class is present the principles and concepts of switch mode power converters. This class provides the needed foundation for the classes that provide the details of designing and using switch mode power converters. The class starts with a description of the basic components and circuits used in switch mode converters. Next, the fundamental principles of energy storage and processing common to all switch mode converters, inductor volt-second and capacitor charge balance, are presented. Using these principles, the operation of the most common switch mode converters is explained. Converters discussed in some detail include the buck, the boost, the forward, and the flyback converters. The class concludes with a survey of other common and important switch mode power converter topologies. After this class it is suggested than those interested in switch mode power take class 20092 PC2, which provides an introduction to feedback and control loops for switch mode power converters.	1
20092 PC2	**Fundamentals of Switch-Mode Power Converters: Control**	This class is the second of three classes presenting the basics of switch mode power conversion. While 20091 PC1 not a prerequisite, this class builds on the concepts presented in that class. The goal of this class is to present the principles and concepts of feedback control of switch mode power converters. This introductory class focuses more on the concepts and principles than detailed design. Each of the elements of analog feedback controllers are presented and discussed: the error amplifier, the compensator, and the modulator. Particular attention is paid to loop compensation and how loop compensation is designed to achieve both stability and good performance. An overview of current mode control and its advantages is then presented. After this class, those interested in designing power converter control loops with digital control should take class 20093 PC3, which provides in-depth information on how to design digital controllers for switch mode power converters.	1
20097 PC7	**Designing Intelligent Power Converters Using Freely Programmable Hybrid Switching Controllers**	Intelligent power converter design adds intelligence and automation to generic DC/DC and AC/DC converters, AC/DC power factor correction, DC/AC power inverters and is of special interest for non-linear operation in LED lighting and battery charging. The integration of programmable logic and the basic building blocks of switch-mode controllers onto a single die extents the level of controllability, visibility and flexibility to better support non-standard features and functions while also covering standard tasks like monitoring, house-keeping and protection. This lecture class will discuss the design of intelligent power converters using Microchip's latest Programmable Hybrid PWM Controller families with integrated MCU and Core Independent Peripherals (CIPs). It will explore basic designs concepts of digitally supported, analog voltage and current mode feedback loop design, fixed and variable frequency switching waveform in single and multi-phase converters as well as the trade-offs in isolated designs. These concepts will then be applied in a guided step-by-step design example of a 15W SEPIC LED driver with an independent, high-performance hardware dimming engine.	4
Batteries			
20105 BAT2	**Battery Charging Fundamentals, Hardware Solutions, and Firmware Support for Real Products in the Market Today**	This class will introduce manufacturer's recommended charge profiles for several chemistries including Li-Ion, LiFePO4, NiMH and SLA. With the charge algorithms identified, several charging topologies will be introduced that support a wide range of batteries. A review of each topology and component selection summary will be presented. Finally a multi-chemistry and multi-topology firmware solution with PC based GUI will be demonstrated. Real end-products will be highlighted and their charging requirements discussed including suggested solutions for each one.	2

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Atmel Products			
20112 ATM2	**Getting started with AVR Microcontrollers using Atmel Studio 7 and the QTouch Composer for the Peripheral Touch Controller**	This class will teach you how to program and debug Atmel AVR Microcontrollers using Atmel Studio 7 Development Tools. You will understand the basics of the AVR architecture and know how to best use the hardware and software tools available. Attendees will also learn how to use the Power Debugger and Data Visualizer for measuring and optimizing the power consumption of a design (power profiling). Finally, we will create an application project from scratch and use the QTouch composer and library to setup code for implementing a capacitive Touch button.	2
20113 ATM3	**Deployment Management & Logistics for the ECC508A Crypto Co-Processor in IoT Applications**	Authentication of IoT nodes is a critical part of IoT security and involves deployment of secrets in a secure element or crypto co-processor in the IoT device. Programming, or provisioning, of these secure elements with private keys, certificates, signatures, and other secrets requires a carefully orchestrated process to maintain confidentiality of the secrets throughout the supply chain without burdening it with impractical restrictions that would interfere with high volume manufacturing. This session will cover process steps and flows of creating unique customer certificates, signatures, key generation, and secure provisioning, and will also provide a live demo of actual provisioning and operation of an ECC crypto co-processor in a secure IoT application.	1
20114 ATM4	**Building an Ultra-Low Power IoT application around Atmel Smart SAM L21 Cortex-M0+ Flash microcontroller**	This class will teach you how to optimize power consumption of the SAM L21 microcontroller and benefits from its unique Sleepwalking with Dynamic Power Gating feature. Attendees will also learn how to build Ultra-Low Power IoT application around SAM L21 microcontroller using Atmel Studio 7 Development Tools and Atmel Start code configurator to add Wireless Bluetooth Smart functionality with Atmel BTLC1000 Bluetooth Smart chip and Environmental Sensors.	1
20115 ATM5	**Maximizing performance with the Atmel Smart SAM E70 Cortex-M7 Flash Microcontroller**	This class will teach you how to properly configure the SAM E70 in order to benefit from its architecture to maximize performance using a concrete example around FFT computation. You will understand how to configure the Memory Protection Unit (MPU) and use memory barrier to avoid potential memory access ordering issues or race conditions. You will compare the execution time and CPU load when running FFT computation from different internal memories to optimize usage of the Tightly Coupled Memory (TCM). Attendees will also learn how to deal with potential cache coherency issues when using DMA.	1
20121 ATM10	**Introduction to Atmel Touch solutions**	This session will detail Atmel's Touch solution for button & sliders based on the on-chip dedicated peripheral PTC (peripheral Touch controller) to offload the main CPU from simple touch tasks as well as the industry leading touchscreen solution based on the maxTouch family for industrial application incl. the go-to-market model with dedicated Touch module partners in EMEA.	1

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