



MASTERS 24

EMPOWERING INNOVATION

Conference Event Guide

www.microchip.com/usmasters

MICROCHIP'S MASTERS CONFERENCE

24 years of technical training

Welcome to the 24th MASTERS Conference! Our goal is that after this week you will be equipped to go out and use Microchip products to their full advantage, while in turn helping to make your business even more successful. Learn, network and enjoy your week at MASTERS.

What's Included in the Conference Fee?

- Conference meals, conference classes & digital class material
- Digital Certificate upon completion
- Discounted development tools
- Overnight Accommodations with tax and gratuities
 - Nights included are August 12th & 13th
- Meals (Dinner, Wednesday, August 12th through lunch Wednesday, August 14th)
- Unlimited basic internet access in guest rooms and resort public areas (wired and wireless)
- Access to 24-hour Fairmont Fitness Center with your room key

Addition Room Occupants: A charge of \$30.00 per person, per night will be added to the folio for each guest over double occupancy. There will be no charge for children up to and including the age of 18 years who share the room with their parents. Maximum occupancy per room: 4. This extra charge will be collected directly by the hotel.

Cost

\$1,797

Early Registration
April 17th-May 17th

\$1,997

Standard Registration
May 18th-July 17th

*See website for Cancellation, Refund and Transfer Policy

Available Discount Pricing

Early Bird - \$1,797
Register by May 17.

Alumni - \$1,797
Repeat MASTERS Attendees. Must register by June 1.

Design Partner - \$1,498 (or less depending on your level)
Must be Authorized Design Partner within Microchip's Design Partner Program.

Arizona Resident - \$1,498
Overnight hotel room will not be provided.

Group - Cost Varies
Must be from the same company.

Special Requirements

If you have any special dietary requirements or access requirements then please let us know when you register on this website, or as soon as possible thereafter with an email to masters.conference@microchip.com. We will do our best to accommodate your needs.

Microchip On-site Office

Have questions about registration, schedules, evening events or classroom locations? Whatever you can't find on our website can be answered by our friendly staff located around the conference or in our on-site Microchip office. Our staff is waiting to help you make the most of your MASTERS Conference experience. *(Located in Bourbon 10 conference room)*

Development Tools Store

Microchip offers a wide selection of the most popular development tools at discounted prices for MASTERS attendees during the Conference. Select tools will be available on hand for purchase. Orders will be processed through our microchipDIRECT site at www.microchipdirect.com. *(Located in the Princess North Foyer)*.

MASTERS Merchandise Store

Want to take something home to show that you attended the 2024 Masters Conference? Or maybe a gift for someone? Then be sure to visit our MASTERS Merchandise Store where we will have an assortment of Microchip branded items for purchase. We accept Visa, MasterCard, American Express or US currency. *(Located in the Princess East Foyer)*

Printed Class Material

There is a FedEx Office on-site where printed class material can be purchased.

Waiver

Microchip reserves the right to refuse registration or entry to anyone for any reason. Microchip is dedicated to providing a friendly and educational conference experience for everyone.

Photography Waiver

Microchip may elect to take photographs or video of people and events during the MASTERS Conference. By attending this MASTERS Conference, you agree to permit Microchip to use your likeness in these photos and videos in furtherance of its business. This Release indicates that you agree that Microchip shall be the copyright owner of the photographs and video and may use and publish these photographs/videos. Microchip is released from any and all claims and causes of action that you may have now or in the future based upon or in connection with the photographs/videos and Microchip's use of the photographs/videos in any manner. All rights granted to Microchip by you in this Release are irrevocable and perpetual. You waive all rights to any equitable relief in connection with this Release and the subject matter of this Release.

CONFERENCE AGENDA

Monday, August 12th, 2024

Registration	8:00-1:30 PM
Class Session 1	1:30-2:30 PM
Break	2:30-2:45 PM
Class Session 2	2:45-3:45 PM
Break	3:45-4:00 PM
Class Session 3	4:00-5:00 PM
Break	5:00-5:30 PM
Microchip Keynote	5:30-6:30 PM
Dinner	6:30-8:30 PM

Tuesday, August 13th, 2024

Breakfast	7:00-8:30 AM
Class Session 1	8:30-9:30 AM
Break	9:30-9:45 AM
Class Session 2	9:45-10:45 AM
Break	10:45-11:00 AM
Class Session 3	11:00-12:00 PM
Lunch	12:00-1:30 PM
Class Session 4	1:30-2:30 PM
Break	2:30-2:45 PM
Class Session 5	2:45-3:45 PM
Break	3:45-4:00 PM
Class Session 6	4:00-5:00 PM
Dinner	6:00-7:30 PM
Casino Night	7:30-10:00 PM

Wednesday, August 14th, 2024

Breakfast	7:00-8:30 AM
Class Session 1	8:30-9:30 AM
Break	9:30-9:45 AM
Class Session 2	9:45-10:45 AM
Break	10:45-11:00 AM
Class Session 3	11:00-12:00 PM
Lunch	12:00-1:30 PM
Class Session 4	1:30-2:30 PM
Break	2:30-2:45 PM
Class Session 5	2:45-3:45 PM
Break	3:45-4:00 PM
Class Session 6	4:00-5:00 PM



2½ DAYS OF TRAINING

August 12th- 14th, 2024

Check-in

For attendees participating in MASTERS, registration will take place on:

Monday, August 12th, 8:00AM-1:30 PM
(Registration Desk in the East Foyer)

Classes

Begin on Monday, August 12th at 1:30pm

Conference Meals

All attendee meals for Monday-Wednesday are included in the cost. Meals include dinner on Monday, August 12th through lunch on Wednesday, August 14th.

EVENING EVENTS

Keynote Speech

Join Ganesh Moorthy, the President & CEO of Microchip Technology Inc., along with your colleagues as we officially kick off the Annual MASTERS Conference on Monday, August 12th. Dinner immediately follows the Keynote.
(Monday, 5:30pm in Palomino Ballrooms 1-7)



Casino Night

Join us on Tuesday evening for a night filled with games of skill and chance. We will have casino games, sports bar games a bar for drinks. At the end of the night we will have a grand drawing where you could win fantastic prizes. Be sure to stick around until the end! *(Tues, 7:30pm in the Princess Ballrooms H & I)*

Ask The Experts

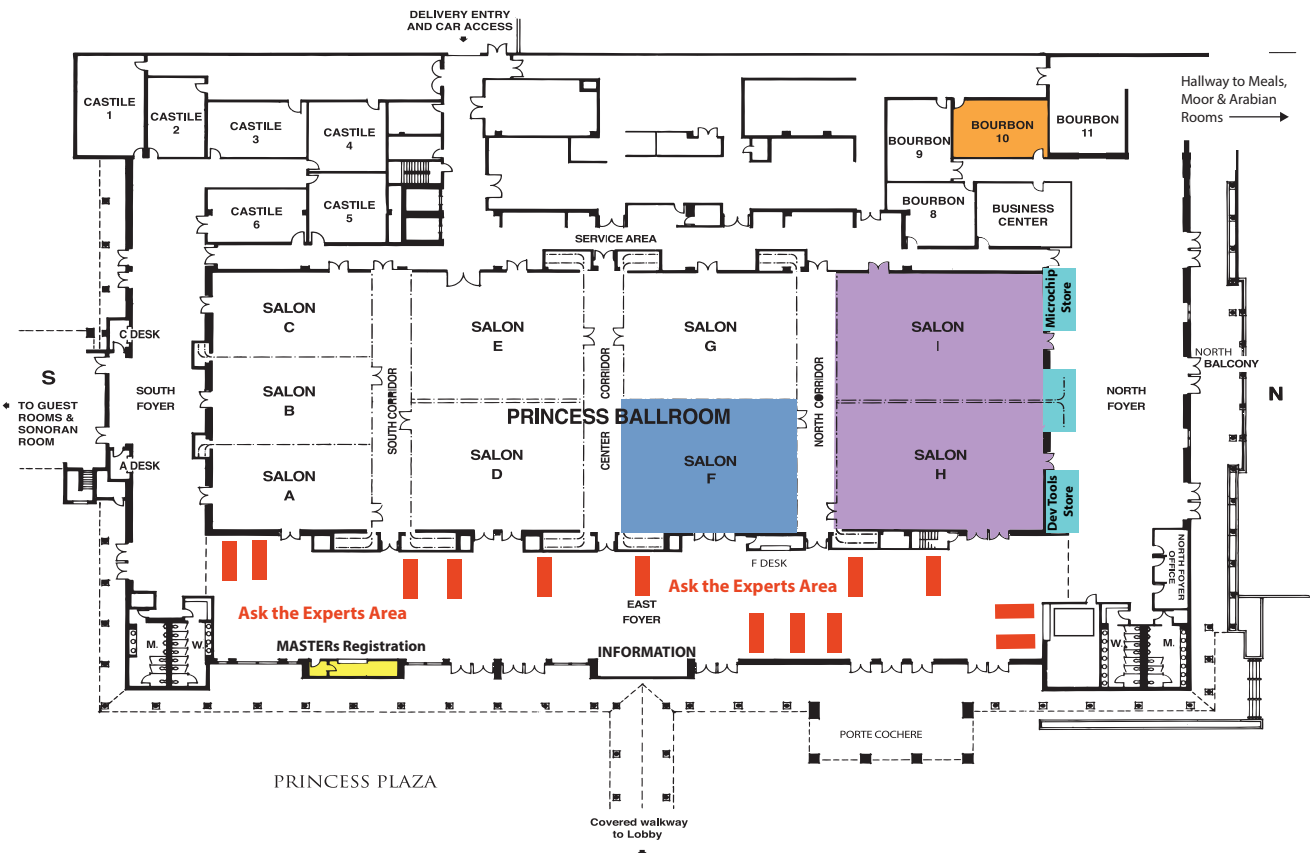
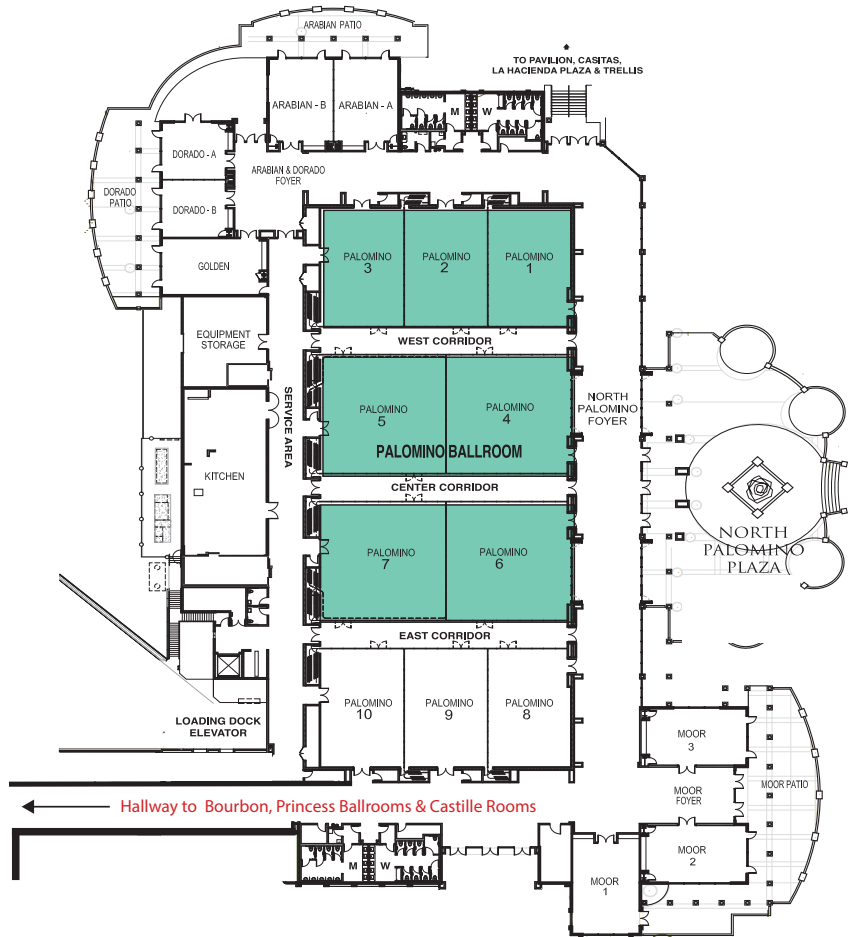
Here's your chance to check out some awesome demos as well ask our engineers how to best use our products and tools in your own applications. Experts from all over the company will be available to help answer your most pressing questions. Be sure to stop by during lunch or after classes. Draft beer available after classes. *(Located in Princess East Foyer.)*

First Robotics

Microchip is a proud sponsor of the FIRST robotics competition and VEX Robotics. Combining the excitement of sports with science and technology, students build and program robots to play a difficult field game against like-minded competitors. Come meet the teams and check out some of their amazing robots! *(Located in Princess Ballroom F)*

MASTERS 2024 VENUE MAP

- Registration
- Microchip Office
- Mon/Tues/Wed - All Meals
- Monday- Keynote Speech (Ganesh Moorthy)
- Tues Evening - Casino Night
- Tues Evening - First Robotics
- Ask the Experts



2024 MASTERS CONFERENCE CLASS LIST

Class	Title	Abstract	Hours	Tech Level	Type	Prerequisites
Products And Peripherals						
24001 PNP1	Microchip Is... Microcontroller, Microprocessor, Memory and FPGA products	Curious about the advanced features and applications of our latest MCUs and MPUs? Interested in a brief overview of our cutting-edge memory products and their role in various applications? Eager to gain insight into the flexibility and scalability offered by our FPGA innovations? This session will provide a high-level understanding of our latest and upcoming products. We'll cover everything from advanced PIC® and AVR® MCUs to sophisticated dsPIC® Digital Signal Controllers (DSCs), SAM MCUs, and MPUs and also delve into Memory Products and FPGAs. Attendees will receive a broad understanding of our latest products across multiple technology domains and a high-level insight into potential integration opportunities and applications in their projects. It's an opportunity to broaden your understanding and explore the possibilities these innovations bring.	1	1	New	None
24002 PNP2	Microchip Is... Analog, Power, Silicon Carbide, Discrete, Timing and Power over Ethernet Products	This class provides an overview of Microchip's latest Analog, Power, Silicon Carbide, Discrete, Timing and Power over Ethernet products. Attendees will receive a broad understanding of our latest products across multiple technology domains and a high-level insight into potential integration opportunities and applications in their projects.	1	1	New	None
24003 PNP3	Microchip Is... Security, Wireless, Wired and Touch Products	This class provides an overview of Microchip's latest security, touch and connectivity products, both wireless and wired. Attendees will receive an introduction to new features, new technologies and new products from Microchip.	1	1	New	None
24004 PNP4	Introduction to dsPIC33A Architecture	This class introduces the features and architecture of the dsPIC33A family of devices. Content includes core features and use of select peripherals including 40 MPSP ADC, floating point unit, and high resolution PWM. Differences and advantages from earlier dsPIC33 devices are presented along with application examples. Attendees will gain understanding of the dsPIC33A family of devices and their capabilities.	2	1	New	None
24005 PNP5	Signal Acquisition and Processing using the new dsPIC33A Floating Point Digital Signal Controller (DSC)	In this class you will see and experience the latest innovations in a new 200 MHz DSC including double precision floating point unit, 32-bit instruction and data paths with dual 72-bit accumulators together with a suite of fast peripherals designed to accelerate your real-time applications. This class will explore fast signal acquisition and related signal processing in a new and robust manner with Microchip's latest dsPIC® DSC family of devices. Material included will utilize this device for a rudimentary digital storage oscilloscope and then process these input into the frequency domain using FFTs using this processor core.	2	2	New	Introduction to the dsPIC33A recommended



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24006 PNP6 Hands-On	Unlocking the Power of the SAM M0+, M23, and M4 Arm Microcontroller Architecture and Peripherals	Do you want to be able to quickly write code for an Arm-based 32-bit microcontroller to get your proof-of-concept designs running in less than one day, even if you have not previously used an ARM based device? This course offers a quick-start guide to coding for Microchip Arm® Cortex® 32-bit microcontrollers, including M0+, M23, and M4 microcontrollers. It is designed to expedite the development process of embedded Arm-based projects, even for those unfamiliar with Arm-based devices. The course covers a wide range of topics, including SAM system architecture, communication buses, clock synchronization, compiler register access, port and pin control, and interrupts. Practical application is provided through hands-on labs using the Microchip MPLAB® Code Configurator (MCC) and MPLAB Harmony, ATSAME54 M4 microcontroller, and MPLAB X Integrated Development Environment (IDE). Attendees should have some experience with C programming for embedded microcontrollers. This is not a detailed course on Arm Cortex hardware architecture, but it does cover the basics.	2	2	New	The clients should have a basic understanding of MCC and MPLAB Harmony. They should also have a working knowledge of C programming.
24007 PNP7 Hands-On	Using the Powerful Direct Memory Access Controller (DMAC) and Event System in the Microchip Arm Cortex Microcontrollers to Make Your Designs More Powerful and Flexible	Would you like to have completely separate microcontroller functionality being executed behind your application code? Do you want to increase the performance of your microcontroller designs and expedite sensor data acquisitions with no user-intervention? This class will enable you to set up and use the flexible Direct Memory Access Controller (DMAC) and Event System on the SAM ARM microcontrollers. These two peripherals used together will reduce your overall code bandwidth with hands-off data acquisitions and transfers. You will understand all of the architectural specifics of the DMAC and event system peripherals. You will use the MPLAB X IDE integrated Development Environment and MCC/ Harmony to set up the DMAC and event system on actual hardware. The hands-on labs are instructor-led and show in-depth operation of both peripherals using the SAME54 ARM microcontroller. You should have a working knowledge of C programming before taking this course.	2	3	New	The attendee must have a working knowledge of C programming. They should also have a working knowledge of MPLAB X IDE and MCC and MPLAB Harmony setup with an emphasis on the SAM architecture. The "Getting Started with Arm Microcontrollers" class will provide the working knowledge of the SAM microcontroller setup that satisfies the previous knowledge requirement.
24008 PNP8 Hands-On	Meet the Configurable Logic Block - Microcontroller With Programmable Logic Combining the Best of Both Worlds	Do you want to implement a logic circuit in your application without adding extra parts? Are you curious about the flexibility provided by the Configurable Logic Block (CLB) on creating custom peripherals and protocols? This class will teach how to enhance applications with complex logic designs using the new PIC peripheral – Configurable Logic Block. This will include a quick run through the advantages of the CLB environment by deep-diving into some typical use-cases. Hands on labs will provide opportunities to practice:	2	2	New	Basic knowledge of combinational and sequential logic Basic knowledge of C programming language Familiarity with MPLAB X IDE and MPLAB Code Configurator (MCC) Melody.


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24009 PNP9	Introducing PolarFire® SoC FPGAs - the First System-on-Chip FPGA With a Deterministic, Coherent RISC-V CPU Cluster	<p>This class will introduce the low power, robust security and thermal efficient PolarFire SoC FPGAs with integrated coherent and deterministic 64-bit RISC-V CPU cluster, peripherals and deterministic L2 memory subsystem for creating Linux® and real-time (RTOS) applications.</p> <p>The instructor led demo will demonstrate the FPGA Libero® SoC tools design flow, PolarFire SoC features, and running applications on the PolarFire SoC Icicle kit.</p>	2	2	New	Attendees registering for this course should be familiar with Microchip's PolarFire FPGA family or review the Microchip University "Hello FPGA" or "Using Microchip PolarFire FPGAs in Low Power Applications" courses on the Microchip University site.
24010 PNP10	Understand the Importance of Clock Precision and Stability, and How to Achieve It Using a Mems-Based Clock Generator	<p>The importance of clock precision and stability in various applications is emphasized, with a focus on the use of StarLite™ (DSC50x), a MEMS-based clock generator, as a replacement for multiple crystal oscillators. The benefits of using StarLite, which can output multiple clock signals, are highlighted through a side-by-side comparison with six different crystal oscillators. The discussion also covers the use of the multi-output, multi-format, and multi-frequency MEMS-based generator in a subsystem. The concept of clock stability is introduced, with an understanding of phase noise and ADEV. The use of Microchip Technology's 53100A Phase Noise Analyzer to measure and interpret these metrics is discussed, along with their relevance to various applications like radar and communications. The session concludes with a comparison of the stability metrics of various DSC50x outputs.</p>	2	2	New	None
Dev Tools						
24011 DEV1 	Next Generation MPLAB® IDE	<p>The next-generation MPLAB IDE is based on Microsoft Visual Studio Code and Eclipse Theia™, providing existing VS Code® users with a familiar development environment. This class will provide a hands-on experience on how to use VS Code extensions for MPLAB IDE to create, build and debug embedded applications.</p>	2	2	New	Attendees registering for this class should have basic embedded application development skills. C programming skills are necessary, as we will be using C code projects.
24012 DEV2 	Run Time debugging, verification and application tuning using the Data Visualizer Run Time (DVRT)	<p>Does your application seem to work, when debugging with breakpoints, but something is just not quite right when it runs? Wouldn't you like the ability to look at, plot or update application variables at run time? The Data Visualizer Run Time (DVRT) solves this problem and is a highly effective tool for application debugging, verification and tuning. In this class you will examine various practical use cases where the DVRT is particularly effective. Compare functionality between Data Streamer protocol and the DVRT protocol. Learn how to view, visualize and update variables and MCU special function registers at run-time, including tips and tricks when using different MCU architectures. Explore support for both MCC Melody and MPLAB Harmony, and take a deep dive into using DVRT with MCC Melody.</p>	2	1	New	The Visual Debugging with MPLAB Data Visualizer course on MU will give attendees an overview of the MPLAB Data Visualizer and its capabilities, which would be beneficial.

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24013 DEV3	Advanced Debugging Techniques Using MPLAB X IDE and MPLAB XC Compilers	<p>Have you ever been frustrated with debugging your embedded code? Have you ever spent days or weeks trying to track down an intermittent bug in your project? Would you like to learn more about the free useful debug tools that Microchip has to offer, which can save you time and frustration when going through the debug phase of your embedded code design?</p> <p>This class will go over many of the advanced features of our compilers and tools.</p> <p>Through Instructor lead labs, we will cover: MPLAB XC Compiler tips and tricks, such as the C Startup, placing a function/variable at a given memory location, and using traps.c to debug code which has caused a trap interrupt</p> <p>Tools such as the Call Graph, Stack Guidance, Call Stack, Compiler Advisor, and Code Coverage</p> <p>The latest tool enhancements such as Live Connect, SWO (Single Wire Output) ITM (Instrumentation Trace Macrocell) support for the Arm Cortex-M7 and Cortex-M4 families, and console debug support using printf.</p>	2	2	New	Familiarity with MPLAB X IDE
24014 DEV4	Automated Build and Test System with MPLAB X IDE and MPLAB XC Compilers	<p>How to set up an automated build and test system using MPLAB X IDE and MPLAB XC Compilers and Git source repository. The CICD wizard in MPLAB X IDE will be used to generate tailored scripts for automation. This will help you improve your code quality by continuously validating code changes to get fast feedback and catch bugs earlier. In this course we will create a Jenkins build and test pipeline setup. We will use Docker containers to get consistency, scalability and portability in the build and test setup. We will show how HW-in-the-loop testing can be done when using Docker containers.</p>	3	1	New	None
Firmware Design and Compilers						
24015 FRM1 	Using Object Oriented C Principles to Make Your C Code Efficient and Portable	<p>Have you ever wanted to make your code more portable and easier to maintain? Have you ever wanted to make your code easier to modify when new features are requested? If so, this class will show you how to move from procedural coding to object-oriented programming (OOP) using embedded C. You will see how encapsulation, inheritance, and polymorphism can take your embedded code to new levels. Object-oriented constructs that you see in languages like C++ and Python are created in C to give your projects the best of both procedural programming and OOP constructs. Many object-oriented principles will be covered, including virtual pointer tables, data abstraction, void pointers, opaque pointers, class and object constructors, and dynamic vs. static memory allocation. Your overall thinking about embedded firmware will be challenged with the topics discussed in this class. You will run instructor-led labs using MPLAB X IDE that clearly demonstrate these OOP principles. A sensor class will be demonstrated using external sensors to show an actual application. This class is an advanced C class, and you should have a thorough understanding of C programming and function pointers.</p>	3	4	New	Attendees registering for this class should have a thorough knowledge of embedded C programming, including advanced structures and function pointers.

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24016 FRM2 Hands-On	Advanced Embedded C Programming Tricks and Cautions to Keep Your Code from Crashing	Are you tired of trying to find firmware bugs, and then find that you were not writing correct C code? This course aims to enhance your C programming skills by addressing common issues such as firmware bugs, unexpected large memory usage, and incorrect compiler operation assumptions. It will provide insights into common mistakes made by programmers, such as confusion in variable comparisons, neglect of implicit conversions and sequence points, misuse of variable type mixing and macros, and ignoring code side effects. The course will also introduce concepts to reduce code size and improve readability, including using floating point math without hardware floating point units or firmware libraries. Instructor-led labs will use MPLAB X IDE to demonstrate many of these topics. The material assumes familiarity with fundamental embedded C programming concepts.	2	2	New	The attendee must have a good understanding of embedded C programming.
24017 FRM3 Hands-On	Build better prototypes in less time with MCC Melody	Have you struggled to use example snippets to build up application functionality, but can't find an easy way to make them work together? Do you just want a simple blocking implementation to show that something works, but all the examples are too integrated and complex? Or the opposite, you have a basic structure of your application in place, so can't use any blocking code. This class covers how to quickly build up application functionality, using MCC Melody example building blocks. An overview is given of the MCC Melody Design Patterns for Control Flow. Then an example application is put together, showing how various example building blocks, of a given implementation, can be used together, to build up more interesting functionality.	3	2	New	Recommend going through (at least part of) either one of the following MU classes: - MCC Melody API Reference for AVR MCUs - MCC Melody API Reference for PIC MCUs
24018 FRM4 Hands-On	Creating Bare Metal and RTOS based Applications for 32-bit MCUs/MPUs with few easy steps using MPLAB Harmony	MPLAB Harmony v3 provides graphical tools and easy to understand peripheral libraries that simplify the use of Microchip's 32-bit microcontrollers and microprocessors. In this hands-on class, you will learn to navigate and manage project settings with MPLAB Code Configurator (MCC), set up and configure peripherals, and generate optimized code tailored to your requirements, which is automatically integrated into new or existing embedded projects. MPLAB Harmony is a modular framework that provides inter-operable firmware libraries for 32-bit microcontroller and microprocessor application development. This class shows how you can develop RTOS based applications using the MPLAB Harmony drivers, system services and middleware in a few easy steps. Learn how to leverage the MPLAB Harmony power to quickly develop an embedded application and get your project off the ground in minimal time!	3	2	Updated	Attendees registering for this class should have a basic understanding of C language programming for SAM/PIC32 systems using Microchip's MPLAB X IDE, debugger, and GCC language tools.
24019 FRM5	Microchip Device Firmware Update Ecosystem / Bootloader Client	Many embedded system designs require a mechanism for updating processor firmware using standard communications busses (i.e., UART, I2C, SPI, ...). Microchip has developed a device firmware update protocol and host ecosystem which uses a file transfer approach to update firmware. This class will provide an overview of the Microchip Device Firmware Update ecosystem and protocol. Instructor led labs will demonstrate how to update a client processor's firmware and execute that client firmware using a client bootloader.	2	2	New	Attendees registering for this class should have a basic understanding of firmware updates and bootloaders.

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24020 FRM6 Hands-On	Getting Started with Zephyr® OS and Microchip devices	Zephyr OS is an open source RTOS targeted towards embedded systems that includes community support for many Microchip development boards. This class will introduce an engineer to the coding environment, SDK, and debug tools available within the Zephyr OS Ecosystem. Using hands-on examples, the engineer will gain experience with useful OS primitives and tasks, explore the hardware's Device Tree, build and deploy to target hardware (as well as QEMU emulated hardware), and use twister to create a unit test suite to catch potential code defects.	3	2	New	Attendees registering for this class should have previous knowledge of RTOS fundamentals in embedded systems.
Linux						
24021 LNX1 Hands-On	Exploring Linux® Build Systems: Creating an Embedded Linux System with Buildroot	Does your next embedded project require one or more complex software building blocks like networking and cloud connectivity, filesystems, graphics, and more? Do you need to get all of it done quickly with robust, mature and stable software? Maybe embedded Linux is for you! In this hands-on class you will configure and create a bootable embedded Linux image and project development environment for a Microchip development board using the Buildroot build automation tool. You will explore the basics of Buildroot and more advanced features allowing you to set up a production-ready build environment to target your own hardware. You will also see how to use the build system for application development. We will cover concepts such as build environment configuration, target package selection and customization, patching, filesystem overlays, addition of custom packages, as well as tips, tricks, and pitfalls to watch out for. You will be able to use what you learn and create as a starting point for your next embedded Linux application!	3	4	Repeat	Attendees registering for this class should have some prior working knowledge of Linux and be comfortable working in a command-line environment.
24022 LNX2 Hands-On	Introduction to Embedded Linux distribution creation using Yocto Project®	The Yocto Project is an open source collaboration project that helps developers create custom Linux-based systems regardless of the hardware architecture. The project provides a flexible set of tools and a space where embedded developers worldwide can share technologies, software stacks, configurations, and best practices that can be used to create tailored Linux images for embedded and IOT devices, or anywhere a customized Linux OS is needed. This class will explain how Yocto Project is organized, and how you can create a custom distribution for a multitude of embedded systems.	3	1	New	Attending students should come to the class with an ability to use common Linux command line utilities like sh, ls, vi, nano, etc.
24023 LNX3 Hands-On	Fusing intelligence into your Microchip Graphics Suite for Linux application using AI	This class empowers participants to design and implement gesture-driven GUI and running AI on Microchip MPUs. Attendees will gain hands-on experience in using MGC and EGT on Linux, crafting custom GUIs and implement UI features using the Ensemble Graphics Toolkit framework to run on our MPU's. The class also delves into integrating AI functionalities like object detection and face recognition, helps user to develop interactive applications like UI selection on face recognition. In addition, attendees will explore gesture control of the GUI using MGC3130 sensor, enabling hands-free interaction with the LCD.	3	3	New	Attendees registering for this class should have some basic working knowledge of Linux and comfortable working in command-line environment.

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24024 LNX4 Hands-On	Securing Over the Air Updates in Linux	Are you concerned about regulations requiring deploying updates safely and securely? Do you feel like you don't know where to start? In this class you will learn the concepts of how OTA updates with SWUpdate work from both a client and server perspective. You will see how important security is to the OTA update ecosystem and learn how to implement a solution using secure TLS authentication with a secure element protected key. You will deploy a full image OTA update and a delta update to an embedded Linux target running on a Microchip development board using the Eclipse hawkBit™ management console.	3	2	New	Working knowledge of Linux
Application Design						
24025 APD1	Low-Power Microcontroller Design Techniques/Application Example	Low-power microcontrollers offer a number of operating modes, power management systems, and techniques for reducing system power consumption including microcontroller sleep modes, automatic clock request systems, power domains/regulator selection, core independent peripheral operation, and inter-peripheral communication/triggering. The class starts with an active mode light sensor application example (no low power techniques utilized) and progressively applies microcontroller sleep modes, power management systems, and peripheral automation of tasks to reduce power consumption. Attendees will observe the reduction in power consumption obtained from utilizing low-power techniques in the instructor-led labs.	2	2	New	None
24026 APD2 Hands-On	Analog MCU Cookbook: Design Examples Exploiting Advanced Integrated Analog MCU Features	A series of small demos demonstrating integrated analog on recent PIC® and AVR® MCUs solving various common problems. Examples will demonstrate easy setup in MCC Melody, the interconnectivity of analog peripherals to digital peripherals, and integrated logic to automate response. Also demonstrated will be the ability to reconfigure integrated analog at runtime on the fly.	2	2	New	None

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24027 APD3 Hands-On	Microchip Graphics Suite (MGS) Remastered	This two-hour course covers the Microchip Graphics Suite, focusing on the MGS Harmony Desktop Emulator, and MGS Harmony Web Simulator. The first part provides a hands-on guide to the MGS Composer, exploring its redesigned interface and features for creating professional embedded GUIs. Students will learn to create widgets like images, text, and buttons. The second part introduces the MGS Harmony Desktop Emulator and Web Simulator tools, detailing their use in graphics creation and their role in enhancing the GUI development process. By the end, attendees will understand how to use the MGS tools to create industry-standard embedded GUIs.	2	3	New	Attendees registering for this class should have viewed Getting Started with a New Harmony Graphics Application (https://mu.microchip.com/getting-started-with-a-new-harmony-graphics-application) and should have familiarized themselves with the MPLAB Harmony Graphics Suite (MHGS) (https://www.microchip.com/en-us/tools-resources/configure/mplab-harmony/graphics-suite).
24028 APD4 Hands-On	Shining a light on Artificial Intelligence/Machine Learning (AIML)	Are you intrigued or concerned by the possibilities of artificial intelligence? Whilst we are not going to attempt to build the next Terminator, this class will take a journey through artificial intelligence and machine learning and how you can use it in a simple classification application. We will begin by looking at the perceived benefits of AIML and apply it to a simple case study where we teach the microcontroller to detect what sort of light is shining on a sensor. We will cover techniques for capturing and processing the sampled signals on a typical microcontroller and the factors that you should consider in your design. Having captured the data, attendees will have the opportunity to use the Microchip MPLAB Machine Learning Development Suite to process it and build a ML model able to discriminate between the various modes of a light source. You will then get the opportunity to test your model on hardware and evaluate its performance under real conditions. Once completed, attendees will be able to add artificial intelligence to their own designs, "I'll be back".....	3	2	New	None

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24029 APD5	Smart Embedded Vision AI, with real-time object detection using Microchip's FPGAs VectorBlox™ Accelerator Software Development Kit (SDK)	<p>Are you interested in higher performance and low power inference of Artificial Intelligence (AI) models such as classification, object detection, pose estimation, or multiple model tasks such as facial recognition, and license plate recognition?</p> <p>The class will show the fundamentals of the SDK that target the most power-efficient FPGA-based Convolutional Neural Network (CNN)-based Artificial Intelligence/ Machine Learning inference accelerator with PolarFire SoC FPGAs and PolarFire. The instructor will lead demos showcasing:</p> <ul style="list-style-type: none"> • The fundamentals of the SDK and solution. • Show download, configure, and steps to use the SDK. • Show the import of models, optimize, compile, and run networks runtime objects generated in the SDK on a PolarFire SoC Video Kit 	2	2	New	Basic Knowledge of Artificial Intelligence/ Machine learning is recommended
24030 APD6	Intelligent embedded video capturing, processing and streaming using H.264 Video Compression pipeline on PolarFire SoC FPGA	<p>This class will explain the basics of MIPI® CSI-2® image sensor interface, image processing, H.264 compression, and streaming encoded video over Ethernet. An intelligent Ethernet camera implementation with H.264 compression will be demonstrated using embedded vision application. An instructor-led demo along with a live video streaming demo that will show:</p> <ul style="list-style-type: none"> • A typical video pipeline is implemented on FPGA • Demonstration of a real-world implementation of H.264 compression • Explanation of the H.264 Software Stack showing WebUI flow utilizing Linux Software on PolarFire SoC FPGA 	1	2	New	The attendees can attend the webinar Intro to Smart Embedded Vision (SEV) using a PolarFire FPGA available at https://event.on24.com/wcc/r/3141845/
24031 APD7	Implementing Multiple Embedded Applications on a Single CPU Cluster using PolarFire SoC FPGA in Asymmetric Multi Processing (AMP) Mode	<p>This class will explain and demonstrate the setup and implementation of independent embedded applications on Microchip PolarFire SoC FPGA 64-bit RISC-V CPU cluster. One deterministic bare metal / Real Time Operating System (RTOS) running as one context and the Linux operating system running as the second context. Both systems run on the same CPU cluster but are completely independent. This class will also show the advantages of using Asymmetric Multi Processing (AMP) and how it can be used to potentially improve system performance, reliability, safety and security.</p>	1	2	New	None
24032 APD8	From concept to prototype design expansion using mikroBUS™ Click boards™ with Microchip FPGAs as base	<p>Want to find out how easy it is to expand your design and create a development environment to take your idea from concept to prototype using mikroBUS Click boards with a Microchip FPGA base board? This class will show Microchip based mikroBUS Click boards or Add-On boards along with a Microchip FPGA base board to utilize and expand your design. You will learn the basics of enabling / adding a peripheral controller to an FPGA fabric, connecting I/Os and writing embedded software to access registers on a device.</p>	2	2	New	None

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Functional Safety						
24033 FS1 Hands-On	Functional Safety Introduction and Architecture	Functional safety standards have been developed and adopted in many markets. From automotive to nuclear power, functional safety is changing the way we develop systems. This class provide a brief introduction to functional safety and focus on developing a system architecture that can meet functional safety requirements. Through hands-on safety analysis we will show that the architecture we develop can meet the required safety integrity level and provide a launch to the next level of hardware and software development.	2	1	New	None
24034 FS2 Hands-On	Functional Safety Hardware and Software Development	Functional safety standards have been developed and adopted in many markets. From automotive to nuclear power, functional safety is changing the way we develop systems. This class builds on the Functional Safety Introduction and Architecture class and delves deeper into product development at the hardware and software level with a functional safety focus. We will ensure the hardware meets the architectural requirements and that required safety diagnostic are implemented in software. We will use Microchip's functional safety libraries to provide diagnostic coverage and ensure that we achieved the required safety integrity level with a final safety analysis.	2	2	New	Recommend FS1 class
Human Interface: Touch & Gesture						
24035 HIF1	Innovations in Capacitive Touch: Buttons, Sliders, Touchpads, Touch Screens and Proximity Sensing.	What is possible with capacitive touch these days? Will I be able to sense a full keypad with low power? How speedy can my small touch pads become? What are my options for integrating a touchscreen into my system? Can I easily accommodate safety certification requirements? Can I easily add a capacitive touch interface into my existing system design? Which tools will I need and where do I find guidance/help to use them? Microchip's portfolio of touch solutions can address more challenging applications than ever before. In this lecture and live demo class, we will provide answers to all these questions and more as we guide you through creating a stellar user experience with Microchip capacitive touch solutions.	1	1	New	While no prerequisites are technically required, it would be helpful to have a working knowledge of capacitive touch interfaces.
24036 HIF2 Hands-On	Creating and Tuning a Capacitive Touch Project for Reliable Operation Using Data Visualizer	Today's electronic gadgets are expected to provide users with the same touch experience they have with the average cell phone. To this end, Microchip has developed highly functional MCUs with integrated peripherals that provide that experience. The Microchip Touch Library demonstrates the highest configurability, sensitivity, and noise immunity required for these applications. In this laboratory class, the student will create a touch project using MPLAB X IDE and MCC Harmony Code Configurator. The student will then experience the touch tuning process using MPLAB Data Visualizer and its two-way communication capabilities, the student will learn how to interactively characterize and tune the touch system for sensitivity and application tuning. Additionally, the student will use a noise generator to see the impact of noise countermeasure tuning in real-time on the MPLAB Data Visualizer. Join us in learning how easy it really is.	3	2	Updated	Guide to Tuning Touch Sensors - Developer Help (microchipdeveloper.com) https://microchipdeveloper.com/xwiki/bin/view/applications/touch-gesture/start-qtouch-capacitive-sensing-library/design-guides/sensor-tuning-guide/




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Networking						
24037 NET1 Hands-On	Unlocking the Potential of 10BASE-T1S: A Comprehensive Guide to Understanding, Developing and Evaluating Single Pair Ethernet with MCC Harmony for Automotive and Industrial Networking	Time to put your hands-on the new 10BASE-T1S technology! Do you need to add 10BASE-T1S connectivity to your industrial or automotive application? Do you want to learn more about 10BASE-T1S and the brand-new media access method PLCA (physical layer collision avoidance) offering maximum bandwidth utilization? After attending this class you will understand the important features of the 10Base-T1S standard and how it compares to other legacy and wired Ethernet interfaces, as well as the key design considerations for replacing legacy field bus solutions in order to realize the benefits of migrating legacy Information and Operation Technology buses to 10BASE-T1S. Learn that the 10Base-T1S standard offers support for Precision Time Protocol, Time Sensitive Networks, Wake and Sleep, Network Discovery...and in the future Remote Control and Layer-2 Security that are still being standardized. This class will teach you how to configure PLCA network parameters, and how to setup a physical 10BASE-T1S network using MPLAB X IDE and MCC Harmony microcontroller boards, and the latest LAN867x/5x PHYs and MAC-PHYs for 10BASE-T1S. Examine and explain the effects of different network configurations on the available bandwidth and communication.	3	2	New	None
24038 NET2 Hands-On	Developing your first managed Ethernet switch. A hands-on introduction to Linux Switchdev and an overview of switch operating systems.	<p>Developing a managed Ethernet switch can be achieved either by bare metal programming, using Linux Switchdev or a commercial off-the-shelf operating system.</p> <p>Switchdev is a suite of Linux tools which allows offloading the task of data forwarding from the host CPU to the switch ASIC itself. This class will introduce the concepts of adding IP addresses to devices, bridging and an introduction to VLANs and implementing them with Switchdev. This part of the class will be hands-on using the LAN9662 evaluation tools.</p> <p>The class will also demonstrate the implementation of the PTP4L Precision Time Protocol stack on the LAN9662 and introduce bringing up a device as an IEEE1588 synchronized device and demonstrate timing accuracy between networked devices. Additional freely available software libraries will also be introduced to further expand the use of Switchdev, time and Linux to build the feature set of a switch.</p> <p>Finally the class will give an overview of a switch operating system (IStaX) and a pragmatic overview of where each of the solutions may offer the most technically and commercially viable solution based on the requirements of the switch design.</p>	3	1	New	None
24039 NET3	Harnessing the Power of PCI Express® (PCIe®) in Embedded Systems	Within embedded systems there is a growing trend to streamline processors by reducing the different I/O available. Throughout this, PCIe, a high-speed, adaptable, and scalable interface for linking peripheral devices, remains a constant. This interface can extend an embedded host's I/O capabilities. This course will guide you on the fundamentals of PCIe and then dive into more detail on adjusting the runtime parameters of a connected PCIe device, such as link speed/width and power management, hot-swapping PCIe devices in an embedded system, and utilizing PCIe bridges to expand the I/O capabilities of an embedded system.	2	1	New	None

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Class	Title	Abstract	Hours	Tech Level	Type	Prerequisites
Security/Encryption						
24040 SEC1	Crypto Primer: Everything you ever wanted to know about Cryptography; the Why and How.	Curious about the secrets of cryptographic security in the digital realm? Our "Crypto Primer" class is just the adventure you need. Imagine delving into the world of digital security, starting with the crucial role of security and the significance of microchips in protecting our digital treasures. Picture yourself uncovering the mysteries of private keys and navigating through the labyrinth of cryptographic principles, algorithms, and technologies. Demos will bring to life the concepts of data integrity, confidentiality, and authentication, along with a certificate-based TLS connection. This journey concludes with advanced explorations and demos in secure boot processes and firmware upgrades, equipping you to safeguard your digital realm. So, are you ready to unlock the secrets of cryptography?	2	1	Updated	None
24041 SEC2 	Hacking the Badge: Researching Vulnerabilities in Embedded Systems	In this class you will dive into the role of a white hat security researcher. As recommended pre-work you will receive code and schematics for a security badge that will actually be used at the conference. You will review carefully using your current knowledge to try to find any vulnerabilities ranging from default passwords to advanced fault injection attacks. During the class you can volunteer to present your findings to everyone. In the class you individually (or in groups of three) will walk through discovering and exploiting all vulnerabilities in the badge using a lab manual to guide you. You will use side-channel analysis and fault injection tools and even a soldering iron. After completing this lab you will have a new perspective on what attacks you should be concerned about when designing an embedded system.	3	3	New	None
24042 SEC3 	IoT device in-field provisioning and dynamic remote management of your PKI with keySTREAM™ Software as a Service (SaaS) from Kudelski IoT and ECC608	Embark on a journey into IoT security with our class on in-field provisioning and dynamic remote management using keySTREAM SaaS and ECC608. This course tackles the challenges of setting up and managing a cost-effective, production-grade PKI, and updating cryptographic credentials in a vast IoT fleet. Learn to effortlessly establish robust PKI policies and integrate keySTREAM key management into embedded systems. The class splits into two parts: theoretical concepts with transaction diagrams between keySTREAM SaaS and ECC608, followed by a hands-on session utilizing keySTREAM SaaS for PKI provisioning, certificate management, and key lifecycle events using the latest IoT tools. This course is your guide to mastering scalable and secure IoT device management.	3	2	New	https://mu.microchip.com/cryptography-primer https://mu.microchip.com/trust-platform-design-suite-v2-introduction https://mu.microchip.com/securely-connecting-to-aws-iot-core-with-the-atecc608b-course-in-development
24043 SEC4 	Authenticate and securely start your application (Secure Boot) on Microchip's 32-bit MCUs	By the end of this hands-on class the attendee will understand the process of creating a Public/Private key pair using Microchip's security tools, Provisioning the public key to the device and using the Private key to sign an application and enable the secure boot functionality of the device. This class will demonstrate how to perform secure boot on different 32-bit architectures.	3	2	New	Attendees registering for this class should have basic knowledge of how to use MPLAB development ecosystem (IDE, Compiler and Debugger)

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24044 SECS	Are you ready for the Cyber Regulatory freight train? – Designing for Global CyberSecurity Regulations.	Cyber security is now a critical part of product design. This is driven by market need and will be enforced by product legislation across the world. Designing a product to meet these requirements can be a daunting task as it requires many changes to how we think, what we deliver and how we maintain a product over its lifecycle. It is imperative that security is considered from the outset of product design but it is key to understand that security is a whole of business risk rather than 'just' a problem for engineering and IS to solve. It affects everyone in the business and all have a role to play. If you want to understand the tangled web of global cyber regulations, understand about different attack and defence scenarios, learn about threat modelling, software bill of materials (SBOM), product security incident response team (PSIRT), Software Composition Analysis, Key management and bunch of other terms you may never have heard of. Plus, how Microchip can help you gain compliance, reduce your development burden and company risk then this class is for you. This is an interactive lecture and hands-on group exercise based class with demos and (hopefully) discussion.	2	1	New	Attendees registering for this class should have... an open mind.
Internet of Things (IoT)						
24045 IoT1 Hands-On	Multi-Protocol Sensor Network using Bluetooth® Low Energy and 802.15.4	Ever wonder how to connect a wireless sensor to your phone via BLE? How about multiple sensor nodes in a wireless network? In this class, we will build a complete plant health sensor monitoring system that interfaces with a smart phone over BLE and to a wireless data gateway. The class will make use of Microchips multiprotocol wireless solutions to create a data link from the sensors to the connected smartphone app and a data gateway. Students will have opportunities to practice: <ul style="list-style-type: none"> Developing an application using wireless building blocks in code Reading and transmitting key sensor values Adding a second protocol to the wireless system Reading and transmitting key sensor values to a wireless gateway over a separate protocol. Further Development if you also are interested in extending this functionality using a cloud service, consider coming by the wireless booth at ask the experts to see more demos 	3	1	New	None
24046 IoT2 Hands-On	WiFi IOT made simple with new Revised Native Wi-Fi (RNWF)	Are you overwhelmed at the complexity required to connect a sensor to your cloud application? Simplify the task by eliminating the complicated stack development process. Connect your application to a Microchip network controller and accelerate your design using our AT command solution. In this class we will use the new RNWF modules and their cloud-friendly AT command set. Using just five simple AT+CMD to connect to a Secure Access Point (AP), six AT+CMD to securely connect over TLS to an MQTT Cloud broker (Amazon Web Services (AWS) IoT, Microsoft Azure, or Eclipse Mosquitto™), and just a couple more commands to exchange data with MQTT brokers. The beginning of the class will show easy techniques to explore the features of RNWF modules. After we cover the basics, we will show how to connect an 8-bit embedded device to AWS IoT and exchange data using MQTT.	3	1	New	None

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24047 IoT3 Hands-On	Rapid Prototyping of IoT Solutions using MicroPython	Have you considered MicroPython for your next wireless design? In this class we demonstrate how to integrate the MicroPython (by Python) MPLAB Harmony middleware component in a Microchip 32 bit MCU. A full wireless IOT cloud application will be developed using MicroPython. By the end of the class you will be able to build and see your data on a cloud system. The hands on labs will provide opportunities to practice setting up the micro python, hardware and software development environment, reading and transmitting a simple sensor value to a cloud as well as receiving control commands via the cloud. If you are interested in extending this functionality, come by the wireless table in the Ask-the-Experts area to see some more advanced demos.	3	1	New	None
Analog and Mixed Signal						
24048 AMS1 Hands-On	Mitigate signal noise and improve analog system precision using simulation techniques	Got noise in your signal? Having a hard time choosing the correct signal conditioning topology? Do you want to increase the accuracy and precision in your system? Then this hands-on class is for you. Together, we will use the MPLAB Mindi™ analog simulator tool for making design decisions.	3	2	New	Working knowledge of MPLAB Mindi analog simulator (or similar tools) and familiarity with its analysis tools. The following Microchip University classes are extremely helpful in preparing for this class 1. Mindi Analog Simulator Applications 2. Mastering Analog Simulations Using the MPLAB Mindi Analog Simulator
24049 AMS2 Hands-On	Small signal processing for medical and consumer (VR/gaming) applications, an experimental approach.	Are you interested in learning how myoelectric control for smart prosthetics or VR/gaming works? Do you want to assemble and experiment with the analog / digital circuits involved? Then you must attend the Lab sessions of "An experimental approach to myoelectric sensing for medical and consumer (VR/gaming) applications". We will build together better and better signal processing chains, we will make mistakes, will discuss and understand what the issues are and correct them until we will be able to use the sensor channel to control an Atom Limbs VR model with our own myoelectric signals.	3	2	New	Attendees registering for this class should have previous exposure to design with OPAMPs and ADC and should understand SNR, differential / common mode. Links to general available materials content will be available from your instructor.
24050 AMS3 Hands-On	High accuracy sensors for linear and rotary position measurement	Accurate, safe, robust linear or rotary position measurement technologies are vital to industrial, electric vehicles, appliance and factory automation products. Leading edge sensors are critical to first class products. However, it is time consuming and expensive for product design engineers to learn the intricacies of a new position sensing technology. Get a hands on experience with a linear sensor that you can calibrate with in person guidance and support, that only requires a metal target and a printed circuit board. This experience will give an application space overview, sensor technology comparisons, and demonstrate how easy it really is to jump start your next position sensor design with inductive position sensors.	3	1	New	Microchip.com Account. - If you are using your own computer you will need the latest IPCE software downloaded - Suggested Prerequisite- ""Designing Your First Inductive Position Sensor"" MU class at https://mu.microchip.com/sensors-i-designing-your-first-inductive-position-sensor .

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Motor Control						
24051 MC1 Hands-On	3-phase Sinusoidal Motor Control with AVR MCUs	Interactive hands-on class presenting a novel Motor Control solution with AVR MCUs for low-cost and low-noise motor solutions. Configure the new hardware peripherals of the AVR® EB using MCC in four modes of operation: trapezoidal or sinusoidal drive, both with sensed or sensorless feedback. Learn about the new drive and Back-Electromotive Force (BEMF) acquisition method that makes sinusoidal sensorless commutation on AVR® possible without FOC. Spin a BLDC/PMSM Motor with the help of the new Multi-Phase Power Board and see the limitations and differences between the trapezoidal and sinusoidal solutions.	3	2	New	None
24052 MC2 Hands-On	Brushless Motor Control Workshop from forced commutation to sensorless field oriented control including Microchips dedicated tools.	Upon completion of this course, you will be proficient in utilizing the specialized Motor Control Peripherals, understanding the basics of a Brushless BLDC motor, and implementing various methods to control a Brushless BLDC Motor. You will also be able to employ the high-speed X2CScope Virtual Oscilloscope interface for real-time debugging and successfully operate a BLDC motor within your application. Additionally, this course will familiarize you with our QSpin MPLAB Harmony3-based tool designed for configuring motor control algorithms.	3	2	Updated	Attendees registering for this class should have basic knowledge in using MPLAB X IDE and debuggingAttendees registering for this class should have basic knowledge in using interface toolsAttendees registering for this class should have basic knowledge in "C" programming
24053 MC3 Hands-On	Enter Complexity with Ease: Model-Based Field-Oriented Motor Control	Microchip's model-based solutions simplify the complexities of field-oriented motor control, making it accessible to individuals regardless of their programming or motor control expertise. These solutions allow for easy customization and integration of advanced motor control algorithms into embedded applications. The training class offers a hands-on approach, starting with an introduction to supported modeling solutions like Matlab® and Scilab, followed by practical implementation on a demo board. The course further explores advanced motor control models, including hardware implementation and run-time signal measurements, with a focus on fine-tuning the current control loop. The class concludes with a demonstration of Microchip's most advanced algorithm, the Zero-Speed/Maximum-Torque (ZS/MT), showcasing the potential of cutting-edge motor control applications.	3	2	Updated	Attendees registering for this class should have:Basic knowledge of embedded C programming. Familiarity with PWM, ADC, Timer, and interrupt peripherals.A recommended but optional prerequisite is completion of the "dsPIC® Digital Signal Controllers (DSCs) Motor Control Workshop" (Class ID: 16).
24054 MC4 Hands-On	Predictive Maintenance in Motor Control Applications	Predictive Maintenance solutions can help to detect anomalies in your motor control application. Two different solutions for field oriented controlled PMSM motors will be presented that don't required any additional sensor. Statistical or Neural Network models will be created based on captured data and depending on the selected solution ether deployed as a library or instantaneously online.	3	2	New	The attendee should have good knowledge of Microchip tools, C programming and field oriented motor control.
24055 MC5	Introduction to Zero-Speed/Maximum-Torque (ZS/MT) algorithm using Microchips dedicated tools motorBench® Development Suite or QSpin.	Introduction to Zero Speed Maximum Torque (ZS/MT) algorithm over motorBench Development Suite and Qspin. This algorithm allows you to start your PMSM motor from zero speed with maximum torque in closed loop. Use cases, requirements and limitations will be discussed. motorBench Development Suite and QSpin will be used to showcase different demos.	2	5	New	None

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Power Supplies and Power Conversion						
24056 PC1 Hands-On	Power Design with the Microchip Analog Tools Ecosystem	<p>This course will demonstrate how the Microchip Analog Tools Ecosystem can make power design, and other analog functions, more efficient and less error prone. The instructor will demonstrate and provide opportunities for hands-on investigation by the attendee for each step of the tool chain:</p> <ul style="list-style-type: none"> Find It, Design It - Use MAD to find a power solution and customize it for their application Simulate It - Export/download a schematic from MAD to simulate in the Mindi analog simulator Build It - Instructor will demonstrate how to find and use CAD/CAE models for the components Check It - Instructor will demonstrate how to submit a design to have Microchip engineers review it 	2	1	New	None
24057 PC2	Analog Control of DC-DC Converters	<p>The Buck DC-DC converter (step-down converter) is a popular solution for today's point-of-load (POL) applications. The main control architectures are Voltage Mode, Current Mode, and Constant On-Time (COT) control modes. This course delves into these converter control schemes through a data-driven lens, focusing on stability, performance, and an analysis of component variations. The primary objective is to empower designers with the knowledge and skills necessary to make informed decisions in selecting the optimal control system for DC-DC converters tailored to specific application needs.</p>	3	2	Updated	None
24058 PC3	Fundamentals of Digital Power Supply Control	<p>This class is aimed at hardware as well as firmware engineers and embedded systems programmers who need to learn the fundamental principles of designing and implementing stable, high-performance digital switch-mode power supply control loops using DSC.</p> <p>After reviewing fundamental principles of discrete time domain control systems, and how to create custom compensation filters and derive their respective linear difference equation coefficients, this session will guide attendees through the typical design process in consecutive live demos, starting with utilizing dedicated switch-mode power supply peripherals, such as high-speed ADCs and high-resolution PWM logic, deriving the plant transfer function of the power supply in bench measurements and closing and tuning the feedback loop using available design tools such as the MPLAB® PowerSmart Development Suite.</p> <p>The topics covered in this class will also be beneficial to follow contents of other digital power conversion related sessions at the conference.</p>	3	2	Updated	Attendees registering for this class should have basic knowledge of common switch-mode power supply topologies and control theory or may attend class 24057 PC2 Analog Control of DC-DC Converters at the conference.

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Class	Title	Abstract	Hours	Tech Level	Type	Prerequisites
24059 PC4	Advanced Digital Average Current Mode Control	<p>Average Current Mode Control (ACMC) of switch-mode power supplies has substantial, practical advantages over common Voltage Mode Control (VMC) or Peak Current Mode Control (PCMC) implementations in terms of robustness, reliability, and flexibility. Especially in non-static applications, such as battery chargers, bidirectional converters, multiphase converters, power factor correction stages and inverters, ACMC solves key design challenges from low-level stability issues to high-level feature integration and therefore plays a major role in enabling and evolving modern power converter applications in fields such as renewable energies, automotive electrification as well as high-performance data center and telecommunication systems. In this class, we will review the complex nature of conventional, loosely coupled, non-serial cascaded feedback loops, which are prone to inner oscillations and hidden instability, before introducing a new type of average current mode control based on a tightly coupled, phase-locked, sequential cascaded control scheme. This session will walk attendees through the feedback loop design process of a phase-locked, cascaded feedback loop of a 2 kW interleaved, bidirectional DC/DC converter using bench measurements and design tools such as MPLAB PowerSmart Development Suite, showing how to tackle design challenges, how to avoid common pitfalls and how to tailor and extend control features to meet specific application requirements.</p>	2	4	New	<p>This class is intended for hardware as well as firmware engineers and embedded systems programmers who have experience in designing and implementing digital control feedback loops in switch-mode power supplies. Attendees registering for this class should have a good understanding of analog and digital power supply control theory and its practical application. Attendance of class 24058 PC3 Fundamentals of Digital Power Supply Control is recommended.</p>
24060 PC5	Enabling the Green Revolution with Bidirectional High-Efficiency Digital Power Factor Correction	<p>The need for smart AC/DC and DC/AC power conversion is becoming increasingly vital as we move towards the electrification of everything. Efficient Power Factor Correction (PFC) is a critical part of this story. In this course, we first introduce the fundamentals of power delivery and power quality, before moving onto Power Factor Correction and why it is so important.</p> <p>We deep-dive into the bridgeless Totem Pole Topology. With its exceptional efficiency and capacity for bi-directional power transfer enabling Vehicle-to-Grid (V2G), Vehicle-to-Load (V2L) and Vehicle-to-Home (V2H), Totem Pole PFC is becoming increasingly popular. This course utilizes Microchip's latest dsPIC33C-based 11 kW Totem Pole Demonstration Application as a tool to provide attendees with the necessary knowledge and skills to employ this topology effectively. We will review single phase and three-phase totem pole power factor correction circuits and the advantages of Silicon Carbide switches. Isolation and gate drive circuits will be discussed. Basic waveforms and power calculations will be reviewed. An on-line power simulator will be used to perform detailed analysis of the power dissipation and temperature rise for the discrete power devices in the circuit.</p> <p>Participants will learn how to implement both AC/DC (PFC) and DC/AC (Inverter) functions using this platform, with an emphasis on the practical hardware and firmware-based techniques required to achieve the highest power factor, lowest distortion, and highest efficiency possible.</p>	3	2	New	None

Level	Description
1	No prior knowledge on the topic necessary
2	Basic knowledge of the topic is necessary
3	Previous hands-on working experience with the topic is necessary
4	Thorough knowledge and working experience with the topic is necessary
5	Advanced – attendees should already have expertise in the topic before attending

2024 MASTERS CONFERENCE CLASS LIST

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24061 PC6	Why SiC? Why Now?	Are you curious about the sudden prevalence of SiC power devices in trade articles, papers and recent designs? This class will teach you the advantages of using SiC over Si based power devices. Actual high voltage switching loss testing will be performed. The class will give you the opportunity to utilize an online simulation tool to view relevant waveforms and calculate power dissipation and temperature rise of the power devices.	2	2	New	None
Signal Integrity and PCB Design						
24062 SIG1	Noise Reduction and Robust Hardware Design	<p>This class unravels the mystery noise reduction and its impact on embedded systems design, with particular emphasis on microcontroller based applications. Intuitive relationships, rules of thumb, and a minimum of math are used to guide the participant through the fundamentals of EMC from both an RF emission and immunity perspective. The effects of noise on microcontroller and circuit performance are presented and demonstrated through case studies and live demos. Various hardware and software techniques to help avoid and/or resolve real world EMC problems are discussed. After this class, participants will be able to design new products with noise reduction and robustness in mind. They will also be able to better understand and mitigate EMC and noise immunity problems in existing product designs.</p> <p>A series of progressively improved board designs will be presented to demonstrate the effects of noise reduction techniques.</p>	2	2	Updated	EMC compatibility class in MU
24063 SIG2	What really is EMI and How do I Tackle it?	After attending this class, passing EMC testing won't seem impossible! We will explore the fundamental principles of EMI, and understand the impact of it on your final design. Learn the art of designing robust EMI filters by understanding the filter topologies that best fit your product. Finally, we will guide you through the crucial steps of pre-compliance testing, and equip you with the knowledge to evaluate the test results before you go to an accredited test laboratory.	3	2	New	None

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