Microchip MASTERs 2018

European Conference Preview Guide

MICROCHIP

www.microchip.com/eumasters

Microchip's European MASTERs Conference 2018

22 Years of Technical Training Worldwide

11 - 13 September 2018

over 80 classes for all skill levels

Contents

Introducing
Microchip's European MASTERs Conference 2018
11 - 13 September - Berlin, Germany

Microchip invites you to sign up for our 2018 European MASTERs Conference and experience the premier technical training event for embedded control engineers. The U.S. MASTERs Conference is in its 22nd consecutive year, with training also being offered Worldwide. MASTERs continues to give system design engineers at every level extensive product information and hands-on training to help you climb the learning curve and get your products to market faster. Berlin MASTERs continues to grow and is now in its 4th consecutive year.

Classes

We run a selection of more than 80 classes that cover a broad range of topics, taught by Microchip's application and design engineers as well as selected industry experts. Come and learn from these experts and leave with everything you need to get up and running on your new design. We offer lecture, hands-on classes and our Get Launched Event that covers a wide range of embedded control topics including new products and peripherals, C programming, firmware design, connectivity sessions on TCP/IP, USB, CAN and Bluetooth®, graphics and capacitive-touch interface development, intelligent power supplies, motor control, selecting op-amps for sensor applications using an RTOS and low-power system design.

Our Experts On-Site

During lunch time and in the early evenings you will have an opportunity to meet with our experts from the different function groups to learn about our latest projects or discuss your own ideas. In addition, one-to-one expert Face Time can be requested during the registration for the event. You need to be specific on what you would like to discuss with us and we will assign time with a selected expert to address your request. If we can't meet your request on site, we will make arrangements to address this with a follow up call or visit.

Conference Registration

Registration on Tuesday 11th September 2018 from 07:30 – 13:00.

At registration you will receive your badge, which must be worn throughout the Conference during classes, meals and events.

Get Launched at European MASTERs

Welcome to 'Get Launched' with Microchip at our 2018 MASTERs event.

As a leading semiconductor manufacturer, we take pride in working with small businesses and start-up companies. Very often, these are the clients breaking new grounds, disrupting existing products and markets. 'Get Launched' is a program that works specifically with start-up companies, helping them move beyond the professional Maker stage and into the industry. This is often the trickiest part of starting a new venture and as a semiconductor company, we are here to help!

A program like 'Get Launched' cannot exist alone. Microchip is partnered with companies that specialize in online marketing, for example: on crowd-funding platforms. We are also associated with companies that specialize in easy IoT design and prototyping solutions, like Arduino and Mozilla. This comprehensive coverage, along with Microchip's industry leading product lines, provides the start-up company with strategic resources other semiconductor manufacturers do not offer. This is the Microchip advantage. Further details on this event will be released at a later stage.

Conference Agenda

MASTERs Conference Agenda

Tuesday, 11th September, 2018		Wednesday, 12th September, 2018		Thursday, 13th September, 2018	
Registration	07:30-13:00				
Training slot 1	09:00-11:00	Training Slot 5	09:00-11:00	Training Slot 9	09:00-11:00
Training slot 2	11:00-13:00	Training Slot 6	11:00-13:00	Training Slot 10	11:00-13:00
Lunch	13:00-14:00	**Lunch**	13:00-14:00	**Lunch**	13:00-14:00
Training Slot 3 - *Get Launched Session*	14:00-16:00	Training Slot 7	14:00-16:00	Training Slot 11	14:00-16:00
Training Slot 4 - *Get Launched Session*	16:00-18:00	Training Slot 8	16:00-18:00	Training Slot 12	16:00-18:00
Get Launched Sessions	18:00-19:00	**Boat Cruise to Müggelsee**	18:00-19:00		
Get Launched Sessions	19:00-22:00				
Get Launched Dinner	19:00-22:00	**Dinner at Rübezahl, Müggelsee**	19:00-22:00		

Conference Details

Get Launched Event and Exhibition

Join us for the additional sessions we are offering within the Get Launched Event or visit the Get Launched Exhibition on Tuesday night. Come and meet the experts in the Mensa area of Building G. Here you can chat with the Microchip team and selected third party experts and see all of the latest tools and solutions. Further details on this event will be released at a later stage.

Lunch and Dinner with an Expert

In addition one-to-one expert Face Time can be requested during the registration for the event. You will need to be specific on what you would like to discuss with us and we will assign time with a selected expert to address your request. These meetings will be arranged as a working lunch or working dinner.

Development Tools Store

Microchip offers a wide selection of the most popular development tools at discounted prices for MASTERs attendees during the Conference. Using this discount at MASTERs to purchase your tools could help offset your cost for the conference. Orders will be processed through our microchipDIRECT site at www.microchipdirect.com.

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 team in the Microchip on-site office. Our team is waiting to help you make the most of your MASTERs Conference experience. We're here to help!

Conference Certificates

Certificates will be available on Thursday, 13th September from Reception. If you leave the Conference without your certificate, a PDF certificate can be emailed to you to print on your own.

Internet Access

Conference Attendees will have the ability to check email on site with a free wireless access code. The code will be supplied from the IT office.

Meals Included in the Conference Fee

- Lunch on 11th, 12th, 13th September 2018
- Get Launched Dinner at HTW on 11th September 2018
- Cruise and Dinner on 12th September 2018

Dress Code

Dress code for all classes and events is business casual.

Location

HTW - University of Applied Sciences - Berlin, Germany

Location

This event will be held at HTW Berlin, University of Applied Sciences at their Wilhelminenhof Campus.

With a student body of more than 13,000, the Hochschule für Technik und Wirtschaft (HTW) Berlin is the largest University of Applied Sciences in the City. With around 70 Bachelor's and Master's courses in Engineering, Economics, Information Technology, Culture and Design the study programme offers a wide range. The compact studies of applied sciences leads towards professional practice. Degree courses can be supplemented by instruction in foreign languages and key skills. University rankings have consistently established HTW as one of the leading providers of a modern and professional education.

http://www.htw-berlin/de/en

About HTW Berlin

The Hochschule für Technik und Wirtschaft HTW is located in one of the most important industrial quarters of Berlin.

This district was one of Berlin's first industrial centers, the site of the former cable factory of the Kabelwerk Oberspree. There, the workers manufactured cables, assembled cars and designed transmitters. They were decisive in giving the city its reputation as an electric city.

At the end of the 19th century AEG, the Allgemeine Elektricitäts Gesellschaft or literally the General Electricity Company, one of the first companies in the electrical industry, took over the complex and within just a few decades would play a decisive role in advancing the electrification of society.

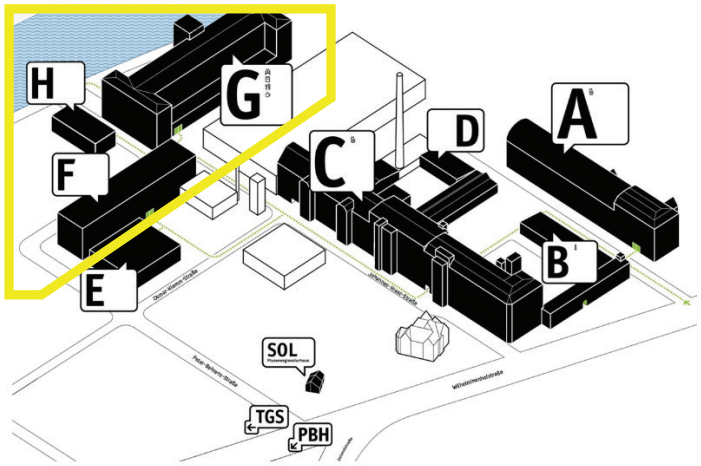
Every day, thousands of workers arrived by tram and flocked into the tightly packed factories that were clad in yellow clinker stone and lined Wilhelminenhofstrasse. Now in the 21st century this area has been through a period of regeneration and today, mostly you will find students disembarking from the trams, heading for the yellow-bricked buildings on the University Campus.

Microchip MASTERs will be located in buildings F, G & H

htw

Hochschule für Technik
und Wirtschaft Berlin

University of Applied Sciences



Travel & Accommodation

Accommodation

Overnight Accommodation is NOT INCLUDED in the Conference Fee.

This year, Microchip has blocked a number of rooms at the nearby Abacus hotel. You can book this by contacting the hotel directly. Use 'Microchip' as booking reference:
http://abacus-hotel.de/

Alternatively, you can search for nearby hotel options in Köpenick or Koepenick - Berlin at:
www.hrs.com
or
www.hotels.com

Airport Information

Berlin Tegel is 25km away from the Conference
http://www.berlin-airport.de/en/travellers-txl/index.php

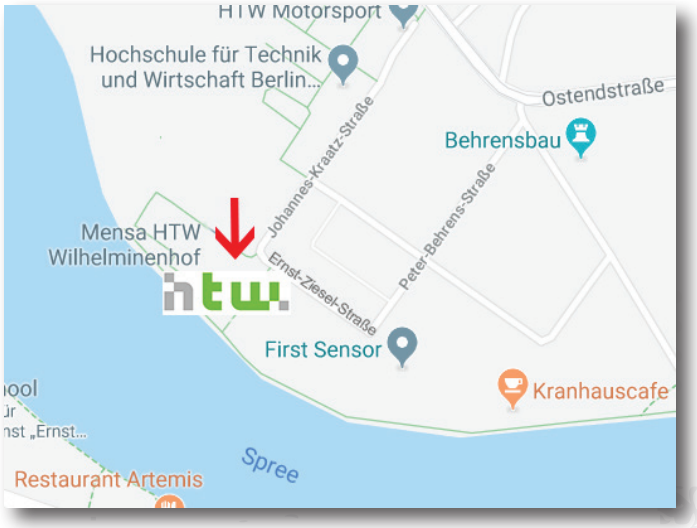
Berlin Schoenefeld is 13km away from the Conference
http://www.berlin-airport.de/en/travellers-sxf/index.php

Public Transportation

Tramway Stop Rathenaustr./ HTW
Lines 21, 27, 63, 67, M17
http://www.bvg.de/en

Taxi or Car

Wilhelminenhofstraße 75A, 12459 Berlin
Navigation: Ernst Ziesel Straße, Berlin



What's included at European MASTERs...

Conference Fees

Early Bird Special - Register by 15 June 2018
EUR 441 (excluding VAT)

Regular Price- Register from 16 June 2018
EUR 490 (excluding VAT)

Discounts Available

Early Bird Discount
Register by 15 June 2018
10% off regular price
Final cost is EUR 441 (excluding VAT)

Additional Fees
There will be a EUR 25 (excluding VAT) *charge for payment via Purchase Order*

Design Partner Discount
Must be Authorized Design Partner within Microchip's Design Partner Program as of August 2018. For registration, make sure that you have access to your Design Partner Program number (DP#).
Minimum 25% off regular price
Final cost varies by status

Academic Discount
Must be a Professor in the Microchip Academia Program. For registration, make sure that you have access to your Academic Discount Number (AP#).
25% off regular price
Final cost is EUR 368 (excluding VAT)

Group Discount
Must be from the same company.
Discount varies. Contact EUMASTERs@microchip.com

Waiver

Microchip reserves the right to refuse registration or entry to anyone for any reason.

Special Events

Get Launched Event & Exhibition
Come and join us at our Get Launched exhibition starting Tuesday afternoon.

Boat Trip to the Müggelsee with Dinner at Rübezahl
Enjoy a boat trip to the nearby Müggelsee and a dinner at the Rübezahl Restaurant with its nice waterfront terrace.

What's Included

- Entry to the MASTERs Conference classes
- Get Launched event on Tuesday
- USB Flash Drive with all Class Material including Classes of the Worldwide MASTERs 2018 Conference that are not presented at the European Conference
- Computers and development tools on loan during the hands-on classes
- FREE internet during conference hours
- Significant discounts on all Microchip development tools when ordered during the conference days
- All lunches, refreshments and snacks during the conference days
- Dinner on Tuesday night
- Boat trip and Dinner on Wednesday night
- Access to our European MASTERs Workshop Days Program

Photograph Disclaimer

Microchip may elect to take photographs 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 in furtherance of its business. This release indicates that you agree that Microchip shall be the copyright owner of the photographs and may use and publish these photographs. 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 and Microchip's use of the photographs 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 or this Release.

Attractions & Sights in Berlin

Berlin is more than 775 years old and over the decades, all generations have left their monuments and landmarks in the city. The densest array of sights in Berlin lies east of the Brandenburg Gate, on either side of Unter den Linden.

Brandenburg Gate

Brandenburg Gate is Berlin's most famous landmark. A symbol of Berlin and German division during the Cold War, it is now a national symbol of peace and unity.

Reichstag

The Reichstag building with the famous glass dome is one of the most frequently visited sights in Berlin. It is the seat of the German parliament, the Bundestag.

Alexanderplatz

Alexanderplatz is a central square and traffic junction in Berlin's Mitte district. One of the city's most visited squares; it is the site of many attractions and sights in Berlin.

Berlin TV Tower

The TV Tower at Alexanderplatz is Berlin's most prominent landmark and the tallest building in Germany. Its steel sphere contains a visitor platform and a revolving restaurant.

Trabi Safari

For something a little different why not take a guided tour in an old Trabi (the 2 stroke engine cars from East Germany with CB based audio guide)
http://www.trabi-safari.de/

Müggelsee

The Müggelsee, also known as the Großer Müggelsee, is a lake in the eastern suburbs of Berlin, the capital city of Germany. Visitors can enjoy the beach, paddling, hiking and renting watercraft. You can also tour fishermen's town Rahnsdorf on the Southeast side or visit the 'Museum im Wasserwerk' on the North side of the lake.

For more details about all of the above and more please visit:
http://www.visitacity.com/en/berlin/activities/all-activities

MASTERs Workshop Days

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 host 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! Signing up for European MASTERs means that you can get access to all of our MASTERs Workshop days free of charge.

Schedules are subject to change. Classes are limited to a certain number of seats, so availability will vary.

Class Stream 1

Products, Modules / Solutions - Digital and Analog

This class selection will give you a good overview of Microchips Products, Solutions and Technologies

	Date and Slot	Tuesday, September 11				Wednesday, September 12				Thursday, September 13			
		1	2	3	4	5	6	7	8	9	10	11	12
Class	Title												
22001 PNP1	The Latest MCUs, MPUs, and Analog Products from Microchip: 12 Months Ahead	■											
22002 PNP2	The Latest Security, Wireless, USB and Ethernet Networking Products from Microchip		■										
22003 PNP3	Technical Introduction to AVR® Microcontrollers and Peripherals							■					
22004 PNP4	Enhance Current Designs with CIPs for Cost and Performance						■						
22009 PNP9	Dive Into the Cortex® M Controller Cores						■						
22012 PNP12	Reliable Data Storage with Non-Volatile Memories											■	
22014 PNP14	Choosing Clock Solutions for Smart, Connected Appliances												■
22015 DEV1	Microchip Development Tools: Today and Tomorrow					■							
22042 TNG1	Why Touch? Which Touch?	■								■			
22088 AMS1	Robust Analog/Mixed-Signal Design for Embedded Applications										■		
22089 AMS2	Analog Circuit Simulation Using the Mindi™ Simulation Environment											■	
22090 AMS3	Choosing the Right Analog-to-Digital Converter (ADC) For Your Applications												■
22094 MC1	A Holistic View of Motors, Their Applications and Control	■							■				
22110 BAT1	Battery Charging Fundamentals, Charging Solutions, and Firmware Support		■								■		
22115 SIG1	EMC Demystified					■	■			■	■		
22116 SIG2	Successful High-Speed PCB Design for Today's Fast Protocols							■	■				

See additional content from the Get Launched Event
Lecture Class

Class Stream 2

Building Blocks for Embedded Designs

This class selection will help embedded design engineers working with our 8/16 Bit Products and Solutions

Date and Slot		Tuesday, September 11				Wednesday, September 12				Thursday, September 13			
		1	2	3	4	5	6	7	8	9	10	11	12
Class	Title												
22004 PNP4	Enhance Current Designs with CIPs for Cost and Performance												
22005 PNP5	CIP Workshop for 8-bit AVR® MCUs												
22006 PNP6	CIP Workshop for 8-bit PIC® MCUs												
22012 PNP12	Reliable Data Storage with Non-Volatile Memories												
22015 DEV1	Microchip Development Tools: Today and Tomorrow												
22018 DEV4	Rapid Prototyping using Microchip Code Generation Tools: START and MCC												
22021 FRM2	Begin Programming PIC16F1XXX in C Like a Pro												
22026 FRM7	Cortex® M0+ Basic Peripherals Bare Metal C Code Training												
22027 FRM8	Cortex® M0+ Advanced Peripherals Bare Metal C Code Training												
22028 FRM9	A Systematic Approach to Embedded System Design												
22039 FS1	Software Development for Functional Safety Systems												
22040 BTL1	8-bit Bootloaders Using MCC												
22041 BTL2	Easy Bootloader Library (EZBL)												
22042 TNG1	Why Touch? Which Touch?												
22043 TNG2	Designing Robust, Low-Power Capacitive Touch Systems												
22044 TNG3	Implementing and Tuning 1D Touch Using Microchip Tools and Libraries												
22045 TNG4	Implementing 2D (touchscreen) and 3D (air gesture) Solutions												
22048 AN1	CAN and CAN-FD Protocols and Physical Layer Basics												
22049 AN2	Implementing a CAN FD Node Using An External CAN FD Controller												
22051 SER1	Choosing the Right Serial Bus for Adding Peripherals to Your Embedded Control Application												
22079 IoT1	Using 8-bit MCUs in IoT Designs												
22110 BAT1	Battery Charging Fundamentals, Charging Solutions, and Firmware Support												

See additional content from the Get Launched Event
Lecture Class
Hands On Class

Class Stream 3

Solutions for System Integration

This class selection will help embedded design engineers working with our 32 Bit Products and Solutions

	Date and Slot	Tuesday, September 11				Wednesday, September 12				Thursday, September 13			
		1	2	3	4	5	6	7	8	9	10	11	12
Class	Title												
22008 PNP8	ARM® CPUs Designed for MPUs												
22009 PNP9	Dive Into the Cortex® M Controller Cores												
22010 PNP10	Cortex® A5 MPU System and PCB Design Pitfalls and Solutions												
22019 DEV5	Creating Embedded Applications with 32-bit (SAM/PIC32) Microcontrollers Using MPLAB® Harmony												
22026 FRM7	Cortex® M0+ Basic Peripherals Bare Metal C Code Training												
22027 FRM8	Cortex® M0+ Advanced Peripherals Bare Metal C Code Training												
22030 FRM11	Getting Started with FreeRTOS Using 32-bit Microcontrollers												
22032 LNX2	Introduction to Embedded Linux												
22033 LNX3	Advanced Topics in Embedded Linux												
22034 LNX4	Developing Linux Applications												
22039 FS1	Software Development for Functional Safety Systems												
22046 GFX1	Embedded Graphical Applications with the MPLAB® Harmony Graphics Composer Suite and Aria Graphics Library												
22047 GFX2	PIC32 Graphics Development: Advanced Concepts and Techniques												
22056 USB4	USB Type-C™ Interface - Technical Overview and Design												
22058 USB6	Developing USB Host and Device Applications with MPLAB® Harmony USB Stack												

See additional content from the Get Launched Event
Lecture Class
Hands On Class

Class Stream 4

IoT and Connected World

This class selection will help embedded design engineers to connect their devices to the world

	Date and Slot	Tuesday, September 11				Wednesday, September 12				Thursday, September 13			
		1	2	3	4	5	6	7	8	9	10	11	12
Class	Title												
22048 AN1	CAN and CAN-FD Protocols and Physical Layer Basics												
22049 AN2	Implementing a CAN FD Node Using An External CAN FD Controller												
22050 AN3	LIN (Local Interconnect Network) Low-Cost Serial Bus Design for Industrial and Automotive Applications												
22051 SER1	Choosing the Right Serial Bus for Adding Peripherals to Your Embedded Control Application												
22052 SER2	Practical I2C: Introduction, Implementation and Troubleshooting												
22055 USB3	Introduction to USB 2.0 Part C: USB Physical Layer, Practical Design Methods, Test, and Debugging												
22056 USB4	USB Type-C™ Interface - Technical Overview and Design												
22059 BLU1	Getting Started With Bluetooth® Low Energy (BLE) Development												
22060 BLU2	Creating Embedded Applications Using Bluetooth® Low Energy Devices												
22062 BLU4	Creating Proof-of-Concept Android Apps for Bluetooth® Low Energy (BLE)												
22063 BLU5	Creating Proof-of-Concept iOS Apps for Bluetooth® Low Energy (BLE)												
22064 LAN1	Ethernet Hardware Design, Test, and Debug From Schematic to First Packet												
22065 LAN2	A Practical Introduction to Designing with Microchip Ethernet Switches												
22066 LAN3	An Introduction to EtherCAT®, EtherCAT P and the Microchip LAN9252 Slave Controller												
22067 NET1	Introduction to the MPLAB® Harmony TCP/IP Stack												
22068 NET2	Adding Connectivity to a Linux/RTOS Based Gateway/IoT System Using a Wi-Fi®/BLE Link Controller												
22070 SEC1	Cryptography Primer Class												
22071 SEC2	Security Challenges and Chip Attack Methods												
22072 SEC3	Developing Secure Applications with CryptoAuthentication Devices												
22073 SEC4	Authentication and Secure Communications for IoT Projects using AWS IoT												
22074 SEC5	ARM® TrustZone® – What is it? What isn't it?												
22075 SEC6	Developing Secure Applications with Microchip Cortex®-M23 Flash MCUs TrustZone® Enabled Devices												
22077 SEC8	Security of MPU-based Embedded Systems and Microchip Solutions												
22079 IoT1	Using 8-bit MCUs in IoT Designs												
22080 IoT2	Connecting Your IoT Device with LoRaWAN™ to The Things Network - A Global IoT Data Network												
22081 IoT3	Controlling Your Embedded IoT Device Using Amazon Alexa												
22085 IoT7	Integrating Wi-Fi®/BLE IoT Gateway and Sensors for Voice-Enabled Home Automation Applications												
22086 IoT8	Creating IoT Applications Using Microchip's Wi-Fi®/BLE Wireless Network Controllers												

See additional content from the Get Launched Event
Lecture Class
Hands On Class

Class Stream 5 & 6

Security

This class selection will help you to understand how to deal with the secure elements of your design

Date and Slot		Tuesday, September 11				Wednesday, September 12				Thursday, September 13			
		1	2	3	4	5	6	7	8	9	10	11	12
Class	Title												
22070 SEC1	Cryptography Primer Class												
22071 SEC2	Security Challenges and Chip Attack Methods												
22072 SEC3	Developing Secure Applications with CryptoAuthentication Devices												
22073 SEC4	Authentication and Secure Communications for IoT Projects using AWS IoT												
22074 SEC5	ARM® TrustZone® – What is it? What isn't it?												
22075 SEC6	Developing Secure Applications with Microchip Cortex®-M23 Flash MCUs TrustZone® Enabled Devices												
22077 SEC8	Security of MPU-based Embedded Systems and Microchip Solutions												

Power Electronics

This class selection will help you with your Power Supply and Motor Control designs

Date and Slot		Tuesday, September 11				Wednesday, September 12				Thursday, September 13			
		1	2	3	4	5	6	7	8	9	10	11	12
Class	Title												
22088 AMS1	Robust Analog/Mixed-Signal Design for Embedded Applications												
22089 AMS2	Analog Circuit Simulation Using the Mindi™ Simulation Environment												
22090 AMS3	Choosing the Right Analog-to-Digital Converter (ADC) For Your Applications												
22094 MC1	A Holistic View of Motors, Their Applications and Control												
22098 MC5	dsPIC® Digital Signal Controllers (DSCs) Motor Control Workshop												
22099 MC6	Sensored and Sensorless Field Oriented Control of PMSM Motors Using SAME70 (32-bit ARM® Cortex® M7)												
22200 MC7	SCILAB/X2C												
22201 MC8	Scilab/X2C Hands On												
22100 PC1	Fundamentals of Switch-Mode Power Converters												
22101 PC2	Fundamentals of Switch-Mode Power Converter Control												
22102 PC3	Fundamentals of Digital Switched-Mode Power Converter Control												
22103 PC4	Fundamentals of Power Integrity in Embedded Systems												
22105 PC6	Hybrid Power Controllers: Advanced SMPS Design Using Programmable Mixed Signal Controllers												
22106 PC7	LED-Lighting I: Fundamentals of Solid State Lighting												
22107 PC8	LED Lighting II: Single and Multi String LED Driver Design												
22109 PC10	Powering USB Power Delivery Applications												
22115 SIG1	EMC Demystified												
22116 SIG2	Successful High-Speed PCB Design for Today's Fast Protocols												

See additional content from the Get Launched Event
Lecture Class
Hands On Class

2018 MASTERs Conference Class List

Class	Title	Abstract	Hours	Tech Level	Type	Prerequisites
Products and Peripherals						
22001 PNP1	The Latest MCUs, MPUs, and Analog Products from Microchip: 12 Months Ahead	This class provides an overview of Microchip's latest and future PIC® and AVR® MCUs, SAM MCUs and MPUs, as well as analog products. Attendees will receive an introduction to new features, new technologies, and what new products they can expect from Microchip in the next 12 months.	1.75	1	New	
22002 PNP2	The Latest Security, Wireless, USB and Ethernet Networking Products from Microchip: 12 Months Ahead	This class provides an overview of Microchip's latest and future wireless, security, USB and Ethernet networking products. Attendees will receive an introduction to new features, new technologies and what new products they can expect from Microchip in the next 12 months.	1.75	1	Updated	
22003 PNP3	Technical Introduction to AVR® Microcontrollers and Peripherals	This class provides a technical introduction to the high-performance, low-power AVR® microcontroller architecture, including core features such as clocks, interrupts, event system and power management. An overview of the product line will be discussed as well as a walk-through of key features designed to improve system reliability and an overview of the standard and advanced digital and analog peripherals available.	1.75	1	Updated	
22004 PNP4	Enhance Current Designs with CIPs for Cost and Performance	This class will teach the user the advantages of the Core Independent Peripherals (CIP) found in Microchip MCUs. These CIPs can be used to improve real-time performance, reduce the code size and increase system reliability. This class will cover the options available from PIC® and AVR® MCUs, and provide some guidance on how to make the best system choice.	1.75	2	New	Basic C knowledge. Some experience using microcontrollers to build complex systems.
22005 PNP5	CIP Workshop for 8-bit AVR® MCUs	Increase your familiarity with Microchip's AVR® XMEGA® Core Independent Peripherals by developing an example application. You will build an application from scratch using Atmel Studio without libraries - only direct peripheral register manipulation. You will become familiar with Clock System, Timer, Event System, I/O Ports, Enhanced DMA, Interrupts and XMEGA Custom Logic. This will enable you to fully understand how the peripherals function at a low level, increase your skills in using many different peripherals together and enable you to build your own applications with them in the future. You will also learn how to use the Power Debugger and Data Visualizer in Atmel Studio to view and verify the waveform outputs, just like a logic analyzer. This class is suitable for those familiar with low level embedded C programming.	4	2	Repeat	
22006 PNP6	CIP Workshop for 8-bit PIC® MCUs	Experience the full capability of the 8-bit PIC® MCU's most popular Core Independent Peripherals (CIPs) using MPLAB® Code Configurator to develop an example application. You will familiarize yourself with the benefits of freeing up the core by outsourcing tasks using the CIPs to handle timing, communication, custom logic, and more to build a custom application requiring only minimal additional code. Low level embedded C programming is recommended for this class.	4	2	New	

2018 MASTERs Conference Class List

Class	Title	Abstract	Hours	Tech Level	Type	Prerequisites
22008 PNP8	ARM® CPUs Designed for MPUs	In this class, you will explore the architecture of ARM® CPUs used in MPUs. You will study the features of the APB, AHB and AXI AMBA buses that interconnect the CPU to memories and peripherals, and the purpose of barrier instructions. The class will describe the Cortex® -A memory system that supports both L1 and L2 caches. The compatibilities between ARM, Thumb1 and Thumb2 instruction sets will be detailed. You will learn the operation of two important units: the Memory Management Unit and the Generic Interrupt Controller. The class will also focus on the security features specified in the V7-A architecture enabling the CPU to support secure and non-secure partitions.	1.75	1	New	
22009 PNP9	Dive Into the Cortex® M Controller Cores	This class will teach you the architectural differences between the ARM® Cortex® M0+, M4, and M7 cores. This class will discuss the hardware and architecture associated with each of these cores and how they apply to Microchip's SAM microcontrollers. You will be able to apply hardware concepts of these microcontrollers to your embedded designs. The architecture topics that are discussed include instruction sets and pipelining, flash access, clock cycles, memory protection unit, debug and trace features, nested vector interrupt controller tail chaining and vector table relocation, SRAM Quality of Service, Cortex M4 bit banding and unaligned data access, privileged operating modes, Cortex M7 multiport SRAM, and tightly coupled memory, and other architecture features. This is not a programming class. Peripheral initialization and setup is not discussed. However, these concepts will greatly help you to understand the clocking and peripheral setup that is discussed in the Bare Metal Basic Peripheral and Advanced Peripheral classes.	1.75	1	New	
22010 PNP10	Cortex® A5 MPU System and PCB Design Pitfalls and Solutions	This class will guide you through the hostile terrain of implementing high-speed/high-end MPU devices within an electronic system. Following a pragmatic and chronological approach, you will explore the different considerations to be taken at each stage of the project, from architecture definition to PCBA manufacturing. This class will review practical design cases, covering the following topics: board layout, high-speed memory layout, high-speed communication interfaces, line balancing, impedance matching, power sequencing, low-power considerations, decoupling, power integrity, signal integrity and EMC considerations. For each topic, design options will be explored, tips given, and pitfalls highlighted. Ultimately, ways of alleviating the MPU system design burden will be shown, exploring the MPU system solutions provided by SiP (System in Package) and SOM (System On a Module) devices.	1.75	2	New	Practical experience of microcontroller systems design, ability to read and understand electrical schematics, and some familiarity with signal integrity concepts.

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Class	Title	Abstract	Hours	Tech Level	Type	Prerequisites
22012 PNP12	Reliable Data Storage with Non-Volatile Memories	Many embedded applications must keep an account of what is going on in their world. From tabulating sensor records to taking a detailed snapshot of the moment, data that is collected over time and is needed for the short or long term must be kept complete and error-free so that it can be processed for its designed purpose. Recording data over a long time can take its toll on memory through unplanned wear. Common mistakes in how data is stored can cause premature memory failures. This class will explain the mechanisms of wear, how to model its effects, and some techniques in how to reduce wear in order to maximize memory endurance.	1.75	2	Repeat	Attendees should be familiar with data storage in non-volatile memories, such as Flash and EEPROMs.
22014 PNP14	Choosing Clock Solutions for Smart, Connected Appliances	Smart, connected appliances are undergoing explosive growth. With the advent of connectivity in mobile and consumer products, designers need low power and low jitter clocking solutions to achieve reliable wired or wireless network access. Equally, in the internet infrastructure, routers and switches with increasing data rates demand very high-quality clocks. In this class, you'll learn about clock solutions beyond the internal RC oscillator provided in microcontrollers and microprocessors. We will study system architectures for various applications, and alternative clock solutions, including quartz crystals, self-contained quartz clocks, and MEMS-based clocks. EMI is a key concern of manufacturers, and we'll use a real-life case study to show how we achieved clock and data signal integrity in PCB design with a reduction of EMI-causing radiation. Finally, we will demonstrate Microchips tools, TimeFlash and Clockworks Configurator, that enable rapid creation and prototyping of customized clock solutions.	1.75	1	Repeat	
Dev Tools						
22015 DEV1	Microchip Development Tools: Today and Tomorrow	This introductory-level course offers an overview of Microchip's development tool offerings, a quick review of integration roadmaps and of new features in IDEs, 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.	1.75	1	Updated	
22018 DEV4 	Rapid Prototyping using Microchip Code Generation Tools: START and MCC	In this class we will show how START and MCC can be used to rapidly bring up boards and build prototypes through a series of extremely cool and interesting hands-on examples using our Curiosity hardware platform in combination with various sensor Click boards.	4	1	New	

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Class	Title	Abstract	Hours	Tech Level	Type	Prerequisites
22019 DEV5 	Creating Embedded Applications with 32-bit (SAM/PIC32) Microcontrollers Using MPLAB® Harmony	MPLAB® Harmony is a modular framework that provides inter-operable firmware libraries for SAM/PIC32 application development. These include easy-to-understand peripheral libraries, drivers, system services and middleware. In this class, you will be introduced to the concepts and benefits of MPLAB Harmony Framework. You will learn how easy it is to create embedded applications using MPLAB Harmony framework and MPLAB Harmony Configuration tools. This class shows how the MPLAB Harmony framework enables you to rapidly develop bare-metal and RTOS applications.	4	3	New	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.
Firmware Design and Compilers						
22021 FRM2 	Begin Programming PIC16F1XXX in C Like a Pro	Starting a PIC16 project? Need to know if you are starting off on the right foot, using the best practices and most current tools available for your development? Then this class is for you! After completing this class, you will understand the basics of the PIC16F1XXX architecture and know how to best use the hardware and software tools available from Microchip to develop your project. During the course of the class, we will cover 8-bit MCU basics and use the best techniques in C to create a good application program. Next, we will create an application project from scratch and use the MPLAB® Code Configurator (MCC) to set up code for some basic PIC16F1XXX peripherals (GPIO, Timers, USART, PWM and ADC). Using standard demo hardware and software tools, we will create best practice State Machine-based code for a PIC16F1XXX project. We will incorporate and use the peripherals mentioned above in this simple application. By learning these best practices and techniques, you will be able to start your own application with your best foot forward and develop a well-structured and bug-free application.	4	2	Updated	Attendees registering for this class must have prior knowledge of C.

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Class	Title	Abstract	Hours	Tech Level	Type	Prerequisites
22026 FRM7 	Cortex® M0+ Basic Peripherals Bare Metal C Code Training	The objective of this class is to enable you to quickly get started with creating embedded designs using the SAMD ARM® Cortex® M0+ microcontrollers. This four-hour lecture and instructor-led hands-on class will enable you to begin writing C code for these microcontrollers while becoming familiar with the CORE specification of the Cortex® Microcontroller Software Interface Standard (CMSIS). The lecture and instructor-led labs focus on writing bare metal C code without using any software framework libraries or code "configurators". You will be able to write firmware for the ARM architecture and basic SAM peripherals to access clock generators, clock buses, interrupts, general purpose I/O, timers, hardware PWM, analog-to-digital converters, and I2C serial communications. You will be able to read and write the SAM ARM microcontroller registers directly without having to work with hardware abstraction layers. You will also create real projects that perform PWM control of a LED based on digital inputs, analog light-level readings, and serial I2C temperature sensor readings. The SAM D21 and I/O Xplained boards are used for the hands-on labs. This is not an in-depth Cortex® hardware architecture class, but many architecture basics will be covered. Attendees registering for this class should have some experience using the C programming language to write firmware for embedded microcontrollers.	4	3	Updated	Attendees registering for this class should have some experience using the C programming language to write firmware for embedded microcontrollers.
22027 FRM8 	Cortex® M0+ Advanced Peripherals Bare Metal C Code Training	The objective of this class is to enable you to quickly get started using the advanced peripherals in the SAM ARM® Cortex® M0+ microcontrollers. You will also be able to setup and use the clocking structure on SAML and SAMC devices. This four-hour lecture and instructor-led hands-on class focuses on using bare metal C code (no code configurator or library framework) to configure and use the advanced peripherals on these devices. The SAML family of microcontrollers is used in this class, but the material also applies to the advanced peripherals on all SAM Cortex® M0+ microcontrollers. You will know how to access (read and write) flash memory using the Non-Volatile Memory Controller peripheral. You will be able to use the Direct Access Memory Controller to transfer data between memories and peripherals. You will also learn how to use the powerful Event System to perform complex functionality without any intervention from the CPU. This is not an in-depth Cortex® hardware architecture class, but many architecture basics will be covered. Attendees registering for this class should have some experience using the C programming language to write firmware for embedded microcontrollers. The “Cortex M0+ Basic Peripherals Bare Metal C Code Training” class covers the basic peripherals and bare metal coding in greater detail and it is recommended (but not absolutely necessary) to attend that class as a prerequisite. A short review of that class is presented in this class.	4	3	New	Attendees registering for this class should have some experience using the C programming language to write firmware for embedded microcontrollers. The FRM7 class covers the basic peripherals and bare metal coding in greater detail and it is recommended (but not absolutely necessary) that attendees attend that class as a prerequisite.

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Class	Title	Abstract	Hours	Tech Level	Type	Prerequisites
22028 FRM9	A Systematic Approach to Embedded System Design	Have you ever gotten deep into a design project only to find that you have exceeded some critical resource like running out of pins or memory or timers or speed or have exceeded the power budget? By presenting a systematic design approach and reviewing case studies of real products, this mid-level class in systematic firmware development presents important considerations necessary to avoid these situations. This class is targeted at attendees who have some experience with programming microcontrollers and are looking for guidance from a systematic approach to design tradeoffs and decision-making strategies. Attendees will improve their understanding of why to make particular design decisions using several classes of common challenges, and how to ensure that those decisions will result in a properly and reliably operating system. Best practice approaches and solutions to common system design and performance problems will be presented with suggestions on how to avoid common pitfalls.	1.75	3	Updated	
22030 FRM11 	Getting Started with FreeRTOS Using 32-bit Microcontrollers	This class will introduce you to the process of creating FreeRTOS applications from scratch on 32-bit Microcontrollers. It will cover FreeRTOS essentials including nomenclature, API and kernel as well as discuss key concepts such as stack, heap, tasks and context switch. To achieve the desired real-time performance we will demonstrate appropriate design patterns and how to implement them within MPLAB® Harmony. The Percepio analyzer tools will be used to debug common timing issues with RTOS applications.	4	2	New	Attendees registering for this class should have experience using the MPLAB® Harmony framework.
Linux						
22032 LNX2 	Introduction to Embedded Linux	In this class, you will explore embedded Linux on a Microchip ATSAMA5D27-SOM1-EK1 evaluation platform. You will be introduced to the embedded Linux boot sequence, the different components that make up a board support package, and the differences between kernel and user space. You will be introduced to the Microchip wiki and discuss the ecosystem available to new users for embedded development with Microchip MPUs. This class includes hands-on exercises where you will explore the underlying hardware using different Linux tools and sub-systems. Specifically, I2C, gpio, network, device tree, udev, run-levels, start-up scripts, Linux virtual file system: procfs, sysfs and debugfs will be covered. You will see how to access different peripherals using python scripts and MPIO. Finally, you will see how to draw onto an LCD screen using libplanes.	4	2	Updated	Attendees should be comfortable using Linux.

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Class	Title	Abstract	Hours	Tech Level	Type	Prerequisites
22033 LNX3 	Advanced Topics in Embedded Linux	In this class, you will explore Linux concepts important to embedded system designers. You will explore bootloaders, Linux device drivers, kernel configuration and build, device tree, deploying images on non-volatile memory, and peripheral interfaces. For the hands-on exercises, you will start with a fully functional embedded Linux distribution running on a SAMA5D27-SOM1-EK1 evaluation board. You will then connect a daughter card containing a variety of devices. You will add device driver support for these devices to the Linux kernel, modify the device tree to add the new devices to the board configuration, and write and execute user-space scripts to exercise these new peripherals.	4	4	Updated	Attendees registering for this class should have working knowledge of the Linux command line environment and basic knowledge of peripherals on an embedded system. While not required, prior participation in class "LNX2 - Introduction to Embedded Linux" is beneficial.
22034 LNX4 	Developing Linux Applications	The world of Linux development presents many options to the developer and the use of complex command line tools can cause confusion in the new developer. This class is aimed at identifying and demonstrating the best techniques for Linux solution development. Attendees will explore how to configure and deploy their development system. They will then move on to application design using the popular Eclipse IDE and learn how to correctly configure all of the libraries and tools for remote deployment and debug.	4	3	New	Attendees registering for this class should have working knowledge of the Linux command line environment and basic knowledge of peripherals on an embedded system. While not required, prior participation in class "LNX2 - Introduction to Embedded Linux" is beneficial.
Functional Safety						
22039 FS1	Software Development for Functional Safety Systems	Embedded engineers in a variety of industries are currently facing the task of not only adding a number of functional safety routines to their application software, but to also comply with development practices in order to successfully submit their application for certification. This class provides an overview of the general requirements for functional safety, what it entails, what it does not cover and the development guidelines to follow when designing an embedded system with functional safety in mind. This Functional Safety class also introduces features of microcontrollers aimed at enabling functional safety and robustness; including Watchdog Timer (WDT), Cyclic Redundancy Check (CRC), Brown-out Detection (BOD), Voltage Level Monitoring (VLM), Power-on Reset (POR), and Timer/Counter type D (TCD) fault detection.	1.75	2	New	
Bootloaders						
22040 BTL1 	8-bit Bootloaders Using MCC	This class will focus on incorporating a bootloader into your application and covers the resources required, along with a review of common "gotchas" to avoid. The material in this class will also cover advanced bootloader features such as checking for an existing valid application, methods for switching between application/bootloader modes, calculation of the checksum over a specific range of memory, and fail-safe bootloading. The class will focus on MCC and MPLAB® X IDE, however similarities and differences with AVR® MCU and Studio will be explored.	4	3	Updated	

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Class	Title	Abstract	Hours	Tech Level	Type	Prerequisites
22041 BTL2	Easy Bootloader Library (EZBL)	The Microchip Easy Bootloader Library (EZBL) delivers a common software platform for creating bootloaders on PIC24, dsPIC33 and PIC32MM devices with varying requirements ranging from simple UART bootloaders to complex staged bootloaders using mass storage memories or alternate flash partitions with concurrent interrupts. In this class, attendees will learn what's possible with the EZBL feature set and the approximate resource footprint of various bootloading topologies. An EZBL Bootloader project will be dissected to understand what structure glues it with application projects. With the power of compile-time processing, the attendee will observe how applications can seamlessly re-link to existing bootloader APIs and gain flash erase/write, timer, and communications services without "double paying" for their program code footprint.	1.75	2	Repeat	Attendees registering for this class should have experience writing application projects for a PIC24, dsPIC33, or PIC32MM product with the MPLAB® XC16 or XC32 compiler.
Touch/Gesture Sensing						
22042 TNG1	Why Touch? Which Touch?	In this class we will explore the value a solid user interface design brings to your customer's overall user experience, how the overall system design impacts the user interface, and how Microchip's touch and gesture solutions can be used to create an intuitive interface your users will love. We will provide an introductory overview to all of Microchip's capacitive sensing solutions for buttons/sliders/proximity (1D), touchscreens (2D), and air gestures (3D), including silicon, development boards, and software driver support.	1.75	1	Updated	
22043 TNG2	Designing Robust, Low-Power Capacitive Touch Systems	In this lecture only class, attendees will learn how systems physics impact the functionality of capacitive touch sensor designs. Attendees will learn basic design rules, tricks to overcome design challenges, and methods to avoid common pitfalls. Once the basic foundation has been formed, we will then cover more advanced topics like low-power design techniques, how to design for water tolerance, and how to work around EMC requirements.	1.75	2	Updated	Attendees should have attended the TNG1 class.
22044 TNG3	Implementing and Tuning 1D Touch Using Microchip Tools and Libraries (MCC+mTOUCH Library or START+QTouch Modular Library)	This class will allow and help you develop a touch design using a low-cost MCU and Microchip touch libraries. The hands-on labs and real life examples will show you how to implement, debug and interface 1D touch buttons into your design. We will cover initial touch sensor set up and then work into more detailed tuning so attendees will better understand how to work with the various parameters needed to achieve robust touch performance. START, MCC and Data Visualizer tools will all be used in the hands-on exercises. The provided touch libraries for both mTouch® and QTouch® solutions will be explained for ease of use for the embedded design engineer.	4	2	Updated	Attendees should have should basic knowledge of capacitive touch as well as a basic understanding of C, 8-bit PIC® MCU development, and be comfortable with the use of MPLAB® Code Configurator (MCC) and Atmel START.

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Class	Title	Abstract	Hours	Tech Level	Type	Prerequisites
22045 TNG4	Implementing 2D (touchscreen) and 3D (air gesture) Solutions to Create Intuitive User Interfaces	This introductory class will ease your mind by walking you through the implementation options for 2D, 3D, and some 2D+3D applications including maXTouch® and GestIC® technology solutions. You will learn how to integrate robust touchscreen modules that are water resistant and allow users to wear gloves while operating the interface. Additionally, you will learn how Microchip module partners combined with available driver code can simplify the process to move your designs from prototypes to production faster.	1.75	4	New	A basic understanding of touchscreen designs, and, while not required, the TNG1 and TNG 2 would be beneficial.
Display Technologies						
22046 GFX1	Developing Embedded Graphical Display Applications Quickly and Easily with the MPLAB® Harmony Graphics Composer Suite and Aria Graphics Library	Looking to add a Graphical User Interface (GUI) to your embedded system? Then this is the right class for you! Attendees will use lecture material and hands-on exercises to learn how to harness the power of the MPLAB® Harmony Graphics Composer Suite and the MPLAB Harmony Aria Graphics Library to create a professional and modern embedded graphical user interface. The focus will be on learning to use the PC-based tools to create the graphical application with little to no code writing required. A basic understanding of the elements and terminology of graphical applications would be helpful but not required, i.e., What is a pixel? What is a widget?Hardware design considerations of an embedded graphics system will be discussed as time and class interest permits. However, that information will be included as an appendix in the class materials for the benefit of all to refresh their knowledge at a later time. For the hands-on exercises, attendees will use the PIC32MZ DA Starter Kit along with the PIC32 Multimedia Expansion Board II.	4	2	Updated	Attendees should have a strong working knowledge of the C programming language.
22047 GFX2	PIC32 Graphics Development: Advanced Concepts and Techniques	Want to know how to leverage the capabilities of MPLAB® Harmony Composer Suite to maximize the capability of your PIC32 device to create rich modern graphics? Want to know about the latest applications and widget additions to MPLAB Harmony Aria Graphics Library? Then this is the right class for you! During the lecture, attendees will be exposed to features and concepts such as 8-bit palette, parallax, video, animation, multi-lingual support, input system service, display driver prototyping, image compression pros-and-cons, heap estimation, and image pre-rendering. Hands-on exercises will include advanced techniques such as frame buffer compression using 8-bit LUT, adding multi-lingual support, and leveraging the GPU for animation and parallax. The lecture will include a preview of the latest MPLAB® Harmony development.	4	4	New	Attendees should have a strong working knowledge of the C programming language, and familiarity with the MPLAB® Harmony Graphics Composer Suite. Attending the GFX1 class is recommended.
Automotive Networking - CAN/LIN						
22048 AN1	CAN and CAN-FD Protocols and Physical Layer Basics	This class discusses the basic operation of the CAN (Controller Area Network) and CAN-FD (CAN Flexible Data rate) protocols. From there, the class will drill down to specific areas such as bit timing, arbitration, error detection and recovery, as well as other areas which contribute to the overall robustness of the CAN protocol. Beyond, attendees will be introduced to CAN transceivers and PCB board design considerations.	1.75	1	Updated	

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Class	Title	Abstract	Hours	Tech Level	Type	Prerequisites
22049 AN2	Implementing a CAN FD Node Using An External CAN FD Controller	Does your next design require CAN FD? Do you want to re-use a microcontroller that lacks an integrated CAN FD peripheral? Did you know that CAN FD is NOT backwards compatible to classic CAN? If you are familiar with classic CAN and want to learn about the new requirements for CAN FD and how to consider them in your next design, then this course is for you. The course will guide you through the development process of a CAN FD node by adding the MCP2517FD, a stand-alone CAN FD controller, to a microcontroller that does not support CAN FD. It will start with design requirements, teach you about considerations that are new to CAN FD, explain how CAN FD message databases are developed, and walk you through a typical CAN FD firmware application. The instructor will demonstrate how the physical layer can affect CAN FD communication, and how to debug some of the most common configuration mistakes.	1.75	3	Repeat	Attendees registering for this class should have attended the "AN1-CAN and CAN-FD Protocols and Physical Layer Basics" class or have experience with the CAN protocol.
22050 AN3	LIN (Local Interconnect Network) Low-Cost Serial Bus Design for Industrial and Automotive Applications	If you need low-cost, standardized network connectivity, LIN (Local Interconnect Network) is a UART-based serial communication system that could be just right. Intended to be used for distributed electronic systems, it is finding homes in the industrial, consumer and automotive markets. We will teach you the basics of the LIN bus including the definition of the protocol and the physical layer, and also the definition of interfaces for development tools and application software. An open lab session will be offered to try out your new LIN skills.	1.75	1	Updated	
Serial Communication						
22051 SER1	Choosing the Right Serial Bus for Adding Peripherals to Your Embedded Control Application	So you have selected your microcontroller but what's the best way to choose your embedded peripherals? In this class you will learn about the bit-level detail of the SPI, I2C, and UNI/O® buses, including the implementation options on a PIC® microcontroller. You will learn about the advantages and disadvantages of each bus in terms of I/O requirements, number of interconnects, code space, and other considerations. You'll understand how the features of each bus contribute to a robust system design, with key design tips being discussed along the way. We'll briefly cover the various types of peripherals that are available for each bus. Serial EEPROMs, Serial SRAM, temperature sensors and application examples will be used to illustrate the concepts.	1.75	2	Repeat	
22052 SER2	Practical I2C: Introduction, Implementation and Troubleshooting	Why am I not receiving an acknowledge from my slave device? Help! I cannot write to my I2C EEPROM. I always read 0xFF. What is wrong? These are some of the comments we hear and this class will provide useful insights about I2C. It will start with an I2C introduction and key concepts, continue with configuring the PIC® and AVR® Microcontroller as an I2C Master or Slave, and end with demos showing common I2C communications failures and how to troubleshoot them. This class is recommended for anyone using I2C, planning to use I2C or who just wants to learn more about I2C.	1.75	1	Repeat	

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Class	Title	Abstract	Hours	Tech Level	Type	Prerequisites
USB						
22055 USB3	Introduction to USB 2.0 Part C: USB Physical Layer, Practical Design Methods, Test, and Debugging	This course covers the USB 2.0 HS/FS/LS protocol, HSIC, USB BC1.2 Battery Charging, the USB Type-C™ Connector, and power delivery all within the scope of the physical layer. Guidelines are discussed for USB high speed system design including common best practices for layout, debugging, and USB logo compliance. Potential sources of noise and other pitfalls that can degrade performance and affect USB and EMC compliance are reviewed.	1.75	1	Repeat	
22056 USB4	USB Type-C™ Interface - Technical Overview and Design	USB Type-C™ is a new standard that can provide a designer the ability to supply system power up to 100W, high-speed data of 10Gbps and beyond, as well as high-definition video and audio, all while using a single low-cost cable. This course is tailored to engineers who want to understand the USB Type-C interface and how to incorporate it into existing or new designs. Attendees will be introduced to a range of USB-C features such as Alternate Modes and Power Delivery, port and cable types, and product design requirements.	1.75	2	Repeat	
22058 USB6	Developing USB Host and Device Applications with MPLAB® Harmony USB Stack	USB is now a standard serial communication channel to connect embedded systems to PCs or other USB devices. The USB Stack in MPLAB® Harmony allows you to easily develop a USB application on PIC32 and ATSAM USB microcontrollers. In addition to USB Device and Host Mode applications, the MPLAB Harmony USB Stack now supports Dual Role Operations. In this class you will learn how to configure the USB Stack and use the provided APIs to create an MPLAB Harmony USB Device and Host application for Microchip's ATSAM Cortex® M7 microcontrollers. You will also learn how to create a Dual Role USB Application on a PIC32MZ microcontroller.	4	4	New	Attendees should be familiar with the USB 2.0 protocol and MPLAB® Harmony applications. MPLAB X IDE, XC32 and C language are used in this class and attendees need to be familiar with them.
Bluetooth						
22059 BLU1	Getting Started With Bluetooth® Low Energy (BLE) 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.	4	2	Updated	Attendees registering for this should have some background using the MPLAB® X IDE tool chain, as well as some experience in C programming.
22060 BLU2	Creating Embedded Applications Using Bluetooth® Low Energy Devices	In this hands-on class, the attendees will learn the key concepts needed to create Bluetooth® Low Energy (BLE) applications on programmable Bluetooth data modules. Topics include a brief introduction to the tool chain used to create custom applications for the SAMB11, creating basic BLE functions, such as advertising, connecting to a peer device and communicating data. The hands-on labs will be centered around building a BLE-based application, which uses the SAMB11 as the MCU. The lab, which uses the SAMB11 Xplained Pro development tool will focus on programming the SAMB11 to connect a BT app and have bidirectional data transfer with the app.	4	3	New	Attendees registering for this class should have basic knowledge of BLE Data protocols or should have taken the BLU1 class.

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Class	Title	Abstract	Hours	Tech Level	Type	Prerequisites
22062 BLU4 	Creating Proof-of-Concept Android Apps for Bluetooth® Low Energy (BLE)	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® Low Energy (BLE) support in more detail. The class will use Android phones to connect to Microchip BLE modules. The hands-on labs will cover the steps required to scan, connect, discover services, and send and receive data over a BLE connection.	4	3	Updated	Attendees registering for this class should have a working knowledge of Bluetooth® Low Energy, preferably having taken the BLU1 class.
22063 BLU5	Creating Proof-of-Concept iOS Apps for Bluetooth® Low Energy (BLE)	Many embedded engineers find the leap to mobile application development difficult. The aim of this class is to simplify the concepts and learning curve for iOS® applications. The class is focused on applications using iOS to communicate to Bluetooth® Low Energy (BLE) devices. Students will be provided with an introduction to development tools, code structure, swift programming language and overall application/design flow. The final result of the class will be a wearable application including hardware/software and app.	1.75	2	Updated	Attendees registering for this class should have a working knowledge of Bluetooth® Low Energy, preferably having taken the BLU1 class.
LAN						
22064 LAN1	Ethernet Hardware Design, Test, and Debug From Schematic to First Packet	This class will enable an engineer with no prior Ethernet knowledge to successfully design with Ethernet PHYs, controllers, and switches. The material explained in this class will reduce time to market and board respins for 10/100/1000 Mbps Ethernet hardware designs. The functional blocks which make up the physical and MAC layers (layers 1 and 2) will be explained along with the hardware interfaces between those building blocks and your embedded system. Schematic design, board layout, test, debug, and drivers will be explained while referencing lessons learned from years of Microchip's Ethernet hardware design.	1.75	1	Repeat	
22065 LAN2	A Practical Introduction to Designing with Microchip Ethernet Switches	This course will introduce the features of an Ethernet switch, its standard interfaces, and how to add a switch to your hardware design. In addition to the hardware design, we will discus how to properly connect an MCU or MPU to the switch and configure the host networking stack. We will explain how to use the most common Ethernet switch management features like VLANs, QOS Control, Spanning Tree Protocol, and IGMP and how practical examples of how these features can be used in real-world applications.	1.75	2	New	Attendees should have and understanding of LAN fundamentals or have taken the LAN1 class.

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Class	Title	Abstract	Hours	Tech Level	Type	Prerequisites
22066 LAN3	An Introduction to EtherCAT®, EtherCAT P and the Microchip LAN9252 Slave Controller	EtherCAT® is a robust, industrial, real-time field bus protocol based on Ethernet layer 1, which offers extremely low latency and real-time synchronous I/O control distributed across a wired Ethernet network. This class will discuss the key features of EtherCAT and demonstrate the functionality of the Microchip LAN9252 EtherCAT slave controller and its use in deterministic, real-time Ethernet-based control systems. The class will also explain how EtherCAT can be used for ANY low-cost distributed embedded system that requires high-speed, real-time, time-sensitive networked communication and control, and compare its benefits to and present compelling reasons for considering its deployment over standard Ethernet. EtherCAT P is a new standard for delivering power along and communications over a single cable, thus reducing wiring complexity. This technology will also be presented and discussed during the class. The course will cover the implementation of an EtherCAT master based on a Raspberry Pi® and walk through the implementation of slaves for real-time motor control and analog and digital I/O, demonstrating the speed and ease of bringing a system up. The class will also introduce and demonstrate the use of some of the key software tools that will assist in bringing your products to market.	1.75	1	Updated	
Networking						
22067 NET1	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 Microchips stand-alone RN Wi-Fi® modules.	4	2	Updated	Attendees registering for this class should have a basic understanding of both TCP/IP protocol suite and the MPLAB® Harmony Framework.
22068 NET2	Adding Connectivity to a Linux/ RTOS Based Gateway/IoT System Using a Wi-Fi® /BLE Link Controller	This course focuses on systems running Linux and/or RTOS running its own network stack on an MPU/MCU, and shows how to use the family of link controllers with built-in wireless (Wi-Fi® or Wi-Fi + BT) to add gateway capability or wireless connectivity. Attendees of this class will understand the functionality that should be available on the host MCU to enable smooth integration with the Link Controller. They will also understand the functionality that is provided by the WILC devices. The class is a lecture format and is accompanied by demos to help understand how to use the Link Controllers with Linux/RTOS, steps that need to be followed to get the source code, and the tools that need to be used.	1.75	2	Updated	Attendees registering for this class should have basic knowledge of TCP/ IP, and basic understanding of the keywords used while explaining technologies like Wi-Fi and BLE.

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Class	Title	Abstract	Hours	Tech Level	Type	Prerequisites
Security/Encryption						
22070 SEC1	Cryptography Primer Class	This interesting and engaging class introduces the fundamentals of cryptography for embedded systems. No math will be discussed. No prior knowledge or cryptographic functions are needed or expected. We introduce industry standard terminology and create the basic understanding needed to engage in a meaningful conversation about security; its applications and use cases. Both symmetric and asymmetric cryptography are discussed. After this class attendees will know how embedded cryptography works. This class, or prior knowledge of cryptography, is a prerequisite for our Developing Secure Applications with CryptoAuthentication Devices (SEC3).	1.75	1	Repeat	
22071 SEC2	Security Challenges and Chip Attack Methods	This class explains why it is critical to protect core cryptographic key and secret material in modern connected devices. We will show how key protection is related to communication, authentication, passwords and anti-counterfeiting. There will also be an overview of the various methods by which attackers can retrieve keys, secrets, code and other information from integrated circuits and why software security implementations so often fail. We will show how example solutions, including hardware security elements such as the ATECC608A, can protect the keys while simplifying the system design.	1.75	1	New	
22072 SEC3 	Developing Secure Applications with CryptoAuthentication Devices	The lecture portion of this class will introduce several common use cases for embedded cryptography. We will introduce our CryptoAuthLib, a portable, extensible, powerful, and easy-to-use library for working with the ATSHA and ATECC family devices. The lab will cover how to implement low-level, fundamental, cryptographic primitives into higher-level cryptographic functions. You will learn how to design using our CryptoAuthLib, communicate with and control, the ATECCx08A CryptoAuthentication devices. You will leave with a completed real-world application example.	4	2	Repeat	Attendees registering for this class should have attended "SEC1: Cryptography Primer Class", or possess an understanding of cryptographic fundamentals used in symmetric and asymmetric cryptography as well as familiarity of Diffie-Hellman anonymous key agreement.
22073 SEC4 	Authentication and Secure Communications for IoT Projects using AWS IoT	This hands-on course addresses the security side of Internet of Things (IoT) projects, focusing on the authentication and secure communications issues that need to be considered when bringing a project from concept through production.	4	2	Updated	Attendees registering for this class should have a basic knowledge of Internet of Things and Internet Security.

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Class	Title	Abstract	Hours	Tech Level	Type	Prerequisites
22074 SEC5	ARM® TrustZone® – What is it? What isn't it?	In this era of rampant hacking of embedded products, ARM® TrustZone® can be a very powerful tool for increasing the security of a system. However, most engineers don't know what it does or how to use it properly. This class will introduce the architecture of TrustZone and then apply that knowledge to real-world security vulnerabilities like Heartbleed and Meltdown and evaluate how well TrustZone would have mitigated the attacks. It will be found that some attacks will not be adequately mitigated by TrustZone and in these cases additional security measures will be applied. It will be shown how the best security solution is a suite of security measures to apply when designing a system for security. Learning about TrustZone and all the other best practices will help prevent your design from being vulnerable to the next yet unknown attack.	1.75	1	New	
22075 SEC6	Developing Secure Applications with Microchip Cortex® -M23 Flash MCUs TrustZone® Enabled Devices	The lecture portion of this class will introduce our new ultra-low power ARM® Cortex® -M23 Flash MCUs Family with optional TrustZone® capability. After an overview of TrustZone for ARMv8-M security principles, we will present our numerous added security features which perfectly complement TrustZone technology. The lab will cover how to create and deploy a TrustZone-based software solution under Atmel Studio 7 IDE. You will understand how a secure application can coexist with a non-secure one and learn how to use the different secure and non-secure resources of the system. You will leave with a completed real-world secure solution application example.	4	2	New	
22077 SEC8	Security of MPU-based Embedded Systems and Microchip Solutions	In this class we will discuss the security threat of embedded systems and the methods system designers can use to mitigate them. We will define the key issues designers have to address in order to build a trustworthy product safe from remote and physical attacks. We will introduce the root of trust concept, secure boot strategies, key generation and storage, code protection and integrity, TrustZone, physical protection and tamper detection. We will explain the added value of the Microchip secure element combined with MPU. Finally, we will look at practical examples using the SAM A5D2 MPU in secure applications such as a point-of-sale terminal, a secure gateway or any objects connected to the Cloud, going through the different solutions offered by the Microchip portfolio.	1.75	1	Repeat	
Internet of Things (IoT)						
22079 IoT1	Using 8-bit MCUs in IoT Designs	The class will demonstrate how to add secure connectivity using Ethernet, Wi-Fi® or Bluetooth® to an 8-bit IoT edge node and integrate it with an IoT Cloud Solution with secure connection over SSL. A dedicated crypto chip provides digital certificate-based authentication. This results in a modular and flexible design of an embedded system built around a cost efficient 8-bit microcontroller.	4	3	New	Medium knowledge of Microchip Tools and coding: Atmel Studio, Atmel START, MPLAB® X IDE, MCC and Embedded C.

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Class	Title	Abstract	Hours	Tech Level	Type	Prerequisites
22080 IoT2 	Connecting Your IoT Device with LoRaWAN™ to The Things Network - A Global IoT Data Network	Microchip's LoRa® Technology wireless solution connected to The Things Network IoT data network provides an end-to-end IoT solution. The long range and low-power capability of LoRaWAN™ combined with the flexibility and ease-of-use of The Things Network's open source data network makes this one of the easiest ways for an embedded engineer to complete an end-to-end IoT solution. During the course, attendees will learn how to send sensor data from a low-cost, low-power sensor all the way to a web application. The class will walk through connecting a LoRaWAN-enabled endpoint through a LoRaWAN gateway to The Things Networks servers and finally to an end application. Upon completion, attendees will be equipped to deploy each piece of this IoT solution.	4	2	Updated	
22081 IoT3 	Controlling Your Embedded IoT Device Using Amazon Alexa	This class will show how to use a voice-controlled digital assistant (Amazon's "Alexa" or Google's "Google Assist") to control your custom, Wi-Fi® based embedded device. The class will focus on the Amazon AWS ecosystem and will show you how to enable any embedded Wi-Fi "end device" to be controlled by a voice digital assistant (the lab will use the Amazon Echo or Amazon Dot for the voice control). You will learn how to create voice "skills" for your end device (turning things on/off, up down, etc.). You will develop the skills using Amazon's voice simulator and then use voice commands to a local Amazon Echo/Dot to control your Wi-Fi based end device during this lab. During this class you will be exposed to elements including MQTT, JSON/Javascript, and the overall Amazon AWS ecosystem.	4	2	New	Basic understanding of Wi-Fi® terminology and fundamentals. Previous experience with an IDE "Integrated Development Environment" like Atmel Studio or MPLAB® X IDE will be helpful but not required. Attendees who take this class may also be interested in class 22073 SEC4.
22085 IoT7	Integrating Wi-Fi® /BLE IoT Gateway and Sensors for Voice-Enabled Home Automation Applications (Alexa, Google Home)	In this class you will learn how to develop a complete home automation system that integrates a voice-enabled home automation device (such as Amazon Alexa or Google Home) with a Wi-Fi® /BLE gateway and end nodes. The class will focus on the system blocks and how the end node can be controlled via either the Amazon Alexa or Google Home. The class is in a lecture format and is accompanied by a demo to drive home the concepts and the integration path.	1.75	2	New	Attendees registering for this class should have a basic understanding of Wi-Fi® and BLE concepts and basic IoT concepts.
22086 IoT8 	Creating IoT Applications Using Microchip's Wi-Fi® /BLE Wireless Network Controllers	In this class you will get a brief introduction to the Wi-Fi® and BLE wireless standards basics. This course focuses on the key design considerations you should be aware of in adding Wi-Fi connectivity to your embedded application. Focus will be on the family of network controllers with built-in wireless (Wi-Fi or Wi-Fi + BT) that are driving a higher degree of integration in IoT applications. Attendees will get the basics of how to start with design and gain an understanding of how to add an application on a Microchip MCU to work with network controllers. The class is lecture format and accompanied by a hands-on class where the attendee will be able to create an IoT application to easily commission IoT nodes and securely send data to a web server.	4	2	New	Basic knowledge of Wi-Fi® terminology and fundamentals.

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Class	Title	Abstract	Hours	Tech Level	Type	Prerequisites
Analog and Mixed Signal						
22088 AMS1	Robust Analog/Mixed-Signal Design for Embedded Applications	Do you want to improve your ability to take a signal chain design from start to finish? Would you be interested in effectively connecting design requirements to performance metrics? Are you interested in seeing simple ways to trade off multiple conflicting requirements? This class will use design examples to show simple and intuitive ways to accomplish these goals. The focus will be on practical, and easy to remember, methods. We will also discuss limitations of these methods.	1.75	1	New	
22089 AMS2	Analog Circuit Simulation Using the Mindi™ Simulation Environment	Designing precision analog circuitry and complex power management systems is greatly simplified by today's powerful simulation tools and a device's model provided by semiconductor manufacturers. The MPLAB® Mindi™ simulation environment is based on the Simetrix/Simplis platform, and provides an easy, powerful way to reduce design cycle time. Many different analyses can be performed on linear circuitry within the Simetrix environment, but much quicker results can be achieved by running sampled data (switching) systems within the Simplis environment. Specific Microchip analog and power management devices' models are provided for both Simetrix and Simplis environments: just place them on the graphical user interface window and build your circuit around them. In this lecture class, you will learn how to build linear and switching circuit models with MPLAB Mindi Simetrix Mode and how to run the different kind of analyses available. You will also learn how to build switching circuit models with Simplis Mode, and you will touch how much faster simulation times can be achieved with Simplis. To achieve that, simulation and actual hardware will be compared for different sensors' signal conditioning and DC/DC conversion topologies. Simulation files for this class will then be available on your MASTERs flash Drive.	1.75	2	New	Attendees registering for this class should have at least a basic knowledge of simulation tools used for analog and power management design.
22090 AMS3	Choosing the Right Analog-to-Digital Converter (ADC) For Your Applications	When you are in the system design phase for sensor data collection, you have to make a decision on which ADC is a right choice for your application. There are many different types of ADCs in the marketplace, and each ADC architecture has its own merits and uniqueness. Signal conversion speed, throughput, resolution, static and dynamic performance, and reference selection are all important criteria when you are selecting an ADC. This class will guide you through choosing the right ADC for your applications, and discuss how to improve the accuracy of the signal acquisition and data conversion. This class will also discuss the advantages of stand-alone ADCs vs. MCU-integrated ADCs.	1.75	1	New	

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Class	Title	Abstract	Hours	Tech Level	Type	Prerequisites
Motor Control						
22094 MC1	A Holistic View of Motors, Their Applications and Control	This class is for those who want to appreciate the fundamentals of most motor types and where they fit in the applications and target equipment domains. Starting from the basis of the motors spectrum, control complexity will be reviewed from the lowest to the highest, and will be supplemented through guidance on what uC resources and support circuitry are required. Trends and tips on smarter motor control will be covered. The aim is to provide a good understanding of general principles, algorithms, application refinements and where Microchip's extensive solutions portfolio aligns. Graphic simulations will be shown to assist in visualizing key concepts. Demos will use oscillograms to show motor signatures and behavior.	1.75	2	New	Ideally the attendees will appreciate the rudiments of electromagnetics and motion, e.g., Faraday's and Newton's Laws.
22098 MC5	dsPIC® Digital Signal Controllers (DSCs) Motor Control Workshop	This 4 hour workshop class is for those aiming for a clear understanding of 3-phase brushless permanent magnet motors and their control at the fundamental level. BLDC (Brushless DC) and Permanent Magnet Synchronous Motor (PMSM) designs are reviewed along with the classic control algorithms used for each. The material covers the dsPIC33xx architecture and motor control peripherals, along with an in-depth look at the Microchip demo board, MCLV-2. The workshop will also provide three hands-on labs using a dsPIC33xx256M506, which will cover sensored BLDC (six step) control, sensorless BLDC (six step) control and sensorless PMSM (Field Oriented) control. These labs will also use a new high-speed "X2CScope" virtual oscilloscope for tuning and control purposes. This class provides a foundation from which further motor control refinements and control techniques can be explored with confidence.	4	1	Updated	Attendees should have previous experience with Embedded C, dsPIC® DSCs, a basic understanding of motor control peripherals like ADC, PWM, Comparator, OP-AMP, a basic knowledge of brushless motor structure and some understanding of analog topologies such as a 3 phase bridge.
22099 MC6	Sensored and Sensorless Field Oriented Control of PMSM Motors Using SAME70 (32-bit ARM® Cortex® M7)	The primary objective of this class is to explain the sensored and sensorless implementation of Field Oriented Control of PMSM motors using the SAME70 MCU. This session will cover several topics including architectural highlights of the SAME70 architecture, motor control peripherals on the SAME70, sensored implementation of field oriented control of a PMSM motor using an encoder, and sensorless implementation of field oriented control of a PMSM motor using a PLL based estimator.	4	3	Updated	Attendees attending this class should have previous experience with Embedded C, a basic understanding of peripherals like the ADC and PWM, and basic knowledge of a permanent magnet synchronous motor (PMSM).

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Class	Title	Abstract	Hours	Tech Level	Type	Prerequisites
22200 MC7	Open Source Graphical Programming and Rapid Prototyping using SCILAB/X2C for 8/16 and 32 bit MCUs from Microchip	This class is for those who want to model & simulate systems and then run auto generated code on a target microcontroller from the same tool set. It scales across many target uCs and system types but is particularly relevant to motor control. The powerful combination of tool features enables rapid development and verification of practical system performance against the theoretical prediction. An introduction into SCILAB/X2C and the capabilities of the tools is given. Then, motor control demos for different uC platforms are shown to simulate and then spin brushless motors running advanced sensor-less algorithms. The integrated real time X2C virtual oscilloscope (available separately as a MPLABX Plugin) will be used to measure target variables, aid debugging and verify practical system performance. The efficient, scalable tool set can be used to develop numerous systems. Participants will learn how to configure the tools, develop a model, simulate an application, generate code and verify system performance.	1.75			
22201 MC8 	Open Source Graphical Programming and Rapid Prototyping hands-on class using SCILAB/X2C for 8/16 and 32 bit MCUs from Microchip	In this class you will do a hands on training based on what you have learned in the SCILAB/X2C lecture class. In the first part you will work with a basic demo to get familiar with the software packages and the capabilities of the tools. You will learn how to setup a framework project in MPLAB X using MCC, how to develop a model, simulate the model on the PC and how to generate code that executes on the target platform. X2C will be used to tune parameters online in real-time and verify the behavior of the real application. In the second example a high end motor control demo of a sensorless field oriented control PMSM motor will be used to simulate a complete motor control application. Once the model is programmed onto the MCLV-2 board realtime signals are monitored and controller and observer parameters are tuned for optimal performance.	4			
Power Supplies and Power Conversion						
22100 PC1	Fundamentals of Switch-Mode Power Converters	Switch mode power converters are widely used primarily because of their high efficiency and small size. To some, switch mode converters are mysterious devices, yet the basic principles of switch mode converters are fairly simple. This introductory class presents the principles and concepts of switch mode converters and lays the foundation needed for the more advanced power conversion classes. 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 that those interested in switch mode power take class PC2, which provides an introduction to feedback and control loops for switch mode power converters.	1.75	1	Updated	

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Class	Title	Abstract	Hours	Tech Level	Type	Prerequisites
22101 PC2	Fundamentals of Switch-Mode Power Converter Control	This class provides an introduction to applying feedback and control concepts to make practical control circuits for switch mode power converters. While 22100 PC1 is not a prerequisite, this class builds on the concepts presented in that class. The class starts with a review, feedback and the characteristics of a stable and fast control loop. Using these characteristics, the control circuit for a buck converter is derived. The effect of how our assumptions affect the actual performance is briefly discussed. The K-factor method is introduced as a way to quickly get a stable and well performing feedback loop. The last part of the class is an overview of current mode control and its advantages. While there is a fair amount of algebra, the focus of the discussion is on understanding the concepts and principles. After this class those interested in designing power converter control loops with digital control should take class PC3, which provides in-depth information on how to design digital controllers for switch mode power converters.	1.75	1	Updated	
22102 PC3	Fundamentals of Digital Switched-Mode Power Converter Control	This technical session is aimed at firmware engineers and embedded systems programmers who need to learn the foundation principles needed for fully digital compensator design and implementation. This session covers all topics necessary to design stable digital control loops on dsPIC® DSC devices. Topics such as discrete time control systems, Z transforms and linear difference equation coefficient calculations are presented in a step-by-step manner and additional, specific aspects and challenges of discrete time domain signal generation, sampling processes and number conversion are discussed and supported by live demos. The material covered will also be necessary for understanding many of the other technical sessions at the conference.	1.75	2	Updated	Basic knowledge of switched-mode power supply control fundamentals is required. Attendees should have basic understanding of power supply topologies and control concepts covered by the classes PC1 and PC2.
22103 PC4	Fundamentals of Power Integrity in Embedded Systems	Technology in the digital world continues to move swiftly towards higher performance and capabilities. Even relatively simple user interfaces today are equipped with SuperSpeed USB or Gigabit Ethernet interfaces in conjunction with powerful graphics controllers interconnected with high performance MPUs or FPGAs and their external high-speed memory blocks in extremely small footprints. With increasing complexity and performance, the dominance of high-frequency specific aspects are significantly impacting the design of the entire power distribution network (PDN). Complementary to classes SIG2 on signal integrity and PNP10 about specific pitfalls in MPU designs, this class is introducing fundamental power integrity related design aspects covering PCB and chip-level influences, component selection of individual voltage regulator modules (VRM) and decoupling aspects of their high-speed loads to achieve maximum system reliability and performance. Modelling and physical dependencies will be shown on live demonstrators.	1.75	3	Updated	Attendees should have basic understanding of power supply topologies and control concepts covered by the classes PC1 and PC2.

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Class	Title	Abstract	Hours	Tech Level	Type	Prerequisites
22105 PC6	Hybrid Power Controllers: Advanced SMPS Design Using Programmable Mixed Signal Controllers	Many new fields of application such as advanced lighting, energy storage or advanced cross-system power management in industry 4.0 applications, require power supply solutions, which are more intelligent, adaptive to their environments and helping system integrators to reduce cost by increasing reliability and reducing efforts for maintenance. In these fields of play, power converters need more adaptability than provided by highly deterministic analog circuits, but less than provided by hyper-flexible, high-end full digital systems. This wide gap is more than sufficiently covered by digitally enhanced, intelligent hybrid power supply platforms. In this class we will focus on software-configurable analog PWM controller architectures, their target applications and design tools provided to build customized single- and multi-block switched-mode power supply stages using Microchip's latest graphical design tools. After briefly introducing and comparing discrete designs with highly integrated Digitally Enhanced Power Analog (DEPA) and modular Core Independent Power Peripheral (CIPP) devices, this course will guide you step by step through the design process of creating customized on-chip power control blocks for advanced applications focusing on two specific examples covering conventional DC/DC converters, architectures for advanced charging and LED lighting. All design steps are run as live demonstrations and attendees are welcome to follow the process using their own computers. This highly practical lecture builds on the fundamentals classes PC1 to PC4 and is dedicated to designers of advanced power conversion systems across all industries.	4	3	New	Attendees of this class should have knowledge of switch-mode power supply topologies, PWM controller architectures and control concepts or should at least have attended the classes PC1, PC2 and PC4.
22106 PC7	LED-Lighting I: Fundamentals of Solid State Lighting	This class is for the engineer who wants to take his/her general technical knowledge and expand it to include modern lamp and light fixture design. The first section will deal with LEDs and lighting essentials, particularly to establish the necessary vocabulary for further discussions. Next, there will be an overview of the drivers for LEDs (linear and switching), and how they can, and can't, deal with lighting challenges. The final topic will be controls, both analog and digital, both wired and wireless. There will be a few digressions along the way on contemporary issues and interests (warm dimming, lasers, and MEMS, for example).	1.75	1	New	

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Class	Title	Abstract	Hours	Tech Level	Type	Prerequisites
22107 PC8	LED Lighting II: Single and Multi String LED Driver Design	Ever wondered about the amazing shape and brightness of the latest LED lights? Thanks to new LED technology, darkness does not stand a chance and a new array of styling opportunities has opened up. But all this remains useless without the right power technology to control multiple individual LED strings. This class is designed to introduce power converters for LED lighting control, some topologies for multi and single LED strings, and their implementation on demo designs. Attendees will learn about controlling multiple converters with a dsPIC® Digital Signal Controller, and CIP hybrid controller including multiple control loops for automotive matrix headlights and general lighting for RGB mixing and tunable white.In practice, the monitoring and parameter settings are shown through interfaces like CAN, UART and PMBus. This class will discuss the implementation on different applications.	1.75	2	Updated	Attendees registering for this class should have basic knowledge in Digital Power Conversion topologies and the control techniques based on previous classes. Attendees registered for this class should have prior knowledge in PIC® MCU and dsPIC® DSC architecture and peripherals. Attendees registered for this class should have basic knowledge in PIC16F architecture and peripherals.
22109 PC10	Powering USB Power Delivery Applications	Wouldn't it be great if any mobile device could be optimally charged from any charger? Or even better, mobile devices could power each other on demand using a standardized interface? This is what USB Power Delivery (PD) is accomplishing at power levels up to 100W. USB PD is proliferating rapidly as more and more devices such as phones, tablets, laptops and cars support the USB PD standard. While USB PD provides simplifications at the user level, it creates significant power conversion design challenges. This class provides a brief overview of how USB PD works and follows with a deeper dive into power conversion specific specifications and how they impact power converter design. Design concepts are reinforced through several real-world PD applications and demos.	1.75	2	Updated	
Batteries						
22110 BAT1	Battery Charging Fundamentals, Charging Solutions, and Firmware Support for Real Products in the Market Today	This class will introduce you to standard charge profiles for several common battery chemistries including Li-Ion, LiFePO4, NiMH and Lead Acid. We will then dismantle a number of real-world products and discuss their charging and battery requirements. Next we will review several charging topologies and the pros/cons of each. Applications of charging will be discussed including the unique challenges of using USB, wireless power, and solar panels as the charging source. Finally a multi-chemistry and multi-topology firmware solution with PC-based GUI will be demonstrated.	1.75	1	Updated	

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Class	Title	Abstract	Hours	Tech Level	Type	Prerequisites
Signal Integrity and PCB Design						
22115 SIG1	EMC Demystified	This class unravels the mystery behind the discipline of EMC 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 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 EMC in mind, reducing the likelihood of EMC related issues later in the process. They will also be able to better understand and mitigate EMC problems in existing product designs.	4	2	Updated	
22116 SIG2	Successful High-Speed PCB Design for Today's Fast Protocols	Rising protocol speeds and tight design constraints present tough challenges to engineers and designers. Super Speed USB (3.0 & 3.1), 10 Gigabit Ethernet, Display Port, and other protocols are 5 Gb/s or faster. Even the older High Speed USB (2.0) and Gig-E run at hundreds of Mb/s and can cause serious signal integrity heartaches. The protocol specifications may cover how the signals travel through the system in great detail, but the details of getting the signal from the IC to the connector over a PCB tend to be glossed over. This design step is often crucial to the system success. This session will reveal some practical "secrets" and best practices of executing these interfaces on PCB designs. We will review some High-Speed PCB basics plus we'll share many new design rules and best practice details that can greatly improve and simplify doing these multi-GHz PCB circuits – even while using standard PCB materials like FR-4.	1.75	2	Updated	Attendees registering for this class should have a working understanding of PCB design and that PCB layout does have effects on signals.

Tech Levels
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

2018 Get Launched Class List

Class	Company	Title	Abstract	Hours	Tech Level
22300 AWS	Amazon Web Services AWS	Amazon Web Services, solutions from node to gateway	There is no one-size-fits-all approach to developing cloud-connected systems. To enable the creation of smart, connected and secure designs, Microchip has expanded its collaboration with Amazon Web Services (AWS) to support cloud-connected embedded systems from the node to the cloud. Supporting Amazon Greengrass, Amazon FreeRTOS and AWS Internet of Things (IoT), Microchip provides all the components, tools, software and support needed to rapidly develop secure cloud-connected systems. Learn how this collaboration builds end-to-end IoT solutions for everything from edge node applications to the gateway.devices deployed across many locations. This remote management includes over-the-air (OTA) updates to device software.	1.75	2
22301 ARD	Arduino	An introduction to the Arduino ATmega4908 board	Arduino is using our ATmega Architecture on their boards. During this session the advantages of the next gerneration hardware and the adoption of the new 'Chainsaw' middleware will be explained. Arduino will also explain how this solution is positioned within the education world. Some real worls use cases will be presented	1.75	2
22302 IQI	IQI	IQRF® is the wireless technology enabling things to simply connect IoT via wireless mesh networks.	Reliable, bidirectional and low power communication behind barriers is just one of many reasons why IoT needs mesh networks. This results in their reincarnation. The IQRF® demonstrates how simple can be to make things smarter, talking wirelessly to other devices or being connected to Internet resources.	1.75	2
22303 LDRA	LDRA	Concentrate on project functionality. Automate functional safety and security certification.	The overheads involved in certified critical projects can be daunting. Maintaining requirements traceability traditionally means lots of spreadsheets or databases which quickly fall out of date when the pressure is on. Then there is the requirement to generate a full set of artefacts as evidence of adherence to a huge list of test and validation processes. But help is at hand. This presentation will outline how requirements traceability to these and other artefacts can be automated, and how the use of automated test and validation tools can help de-stress the whole business of generating them.	1.75	2
22304 MIK	MicroE	From Fast Prototyping to Volume Production	Skip steps and instantly get ahead with your projects by using large portfolio of MikroElektronika hardware and software tools: click boards, various host development boards, software development framework... Hundreds of standardized add-on boards with all kinds of sensors, actuators and transceivers are available. No soldering, no wires, no time-wasting. Just pick a click, plug it into a compatible socket on your host development board, and start building your prototype.	1.75	2
22305 MOZ	Mozilla	Building Things for the Web	The Mozilla Gateway is part of Mozilla's "Project Things" which has a goal of driving IoT products toward the W3C Web of Things standard. The Mozilla Gateway demonstrates that when things become "web things" millions of web developers can write services and applications for them. IoT device manufacturers no longer need to be burdened with developing cloud services, mobile app discovery and control, and the associated ongoing development and maintenance. With Project Things, Mozilla envisions an open and decentralized Internet of Things that puts people first, where individuals can shape their own experience and are empowered, safe, and independent. By giving things URLs on the web, they become linkable and discoverable, and by defining a standard data model and APIs, we can finally tackle one of the biggest problems holding back IoT — interoperability.	1.75	2
22306 ZRN	Zerynth	Introduction of the Zerynth Phyton - hybrid C/Phython tool chain	Embedded technologies based on connectivity/low-power modules are rapidly improving in terms of performance and unit costs. There is a need to make the embedded world easily accessible for programmers who are skilled in using high level programming languages like Python to develop IoT solutions. This session will introduce Zerynth, an official Microchip 3rd party set of development tools that enables Python or hybrid C/Python programmability on 32bit MCUs for the development of IoT solutions. The class will show the toolchain and the process to rapidly develop a firmware using the high-level features of Python like modules, classes, multithreading, callbacks, timers and exceptions, along with the possibility to perform data forwarding, Over-The-Air Updates, Remote Procedure Calling and integration with IoT Cloud Services.	1.75	2
22307 DVL	Develer	Developing embedded GUI applications with Develboard and Qt	During this session, Develer will talk about Develboard, a SoC module based on the SAMA5 Cortex-A5 Processor, and Qt framework, the de-facto standard to create user interfaces on embedded systems. It will be shown how to create a Linux BSP starting from scratch in a matter of minutes and then we will proceed to create a flashy user interface using QtQuick. At the end of the talk, Develer will give you some advice on how to optimize your Qt application to run smoothly even on GPU-less systems.	1.75	2

Build your own Schedule

Use the boxes below to create your individual EU MASTERs schedule

		Tuesday, September 11				Wednesday, September 12				Thursday, September 13			
		1	2	3	4	5	6	7	8	9	10	11	12
Class	**Title**												
22001 PNP1	The Latest MCUs, MPUs, and Analog Products from Microchip: 12 Months Ahead												
22002 PNP2	The Latest Security, Wireless, USB and Ethernet Networking Products from Microchip: 12 Months Ahead												
22003 PNP3	Technical Introduction to AVR® Microcontrollers and Peripherals												
22004 PNP4	Enhance Current Designs with CIPs for Cost and Performance												
22005 PNP5	CIP Workshop for 8-bit AVR® MCUs												
22006 PNP6	CIP Workshop for 8-bit PIC® MCUs												
22008 PNP8	ARM® CPUs Designed for MPUs												
22009 PNP9	Dive Into the Cortex® M Controller Cores												
22010 PNP10	Cortex® A5 MPU System and PCB Design Pitfalls and Solutions												
22012 PNP12	Reliable Data Storage with Non-Volatile Memories												
22014 PNP14	Choosing Clock Solutions for Smart, Connected Appliances												
22015 DEV1	Microchip Development Tools: Today and Tomorrow												
22018 DEV4	Rapid Prototyping using Microchip Code Generation Tools: START and MCC												
22019 DEV5	Creating Embedded Applications with 32-bit (SAM/PIC32) Microcontrollers Using MPLAB® Harmony												
22021 FRM2	Begin Programming PIC16F1XXX in C Like a Pro												
22026 FRM7	Cortex® M0+ Basic Peripherals Bare Metal C Code Training												
22027 FRM8	Cortex® M0+ Advanced Peripherals Bare Metal C Code Training												
22028 FRM9	A Systematic Approach to Embedded System Design												
22030 FRM11	Getting Started with FreeRTOS Using 32-bit Microcontrollers												
22032 LNX2	Introduction to Embedded Linux												
22033 LNX3	Advanced Topics in Embedded Linux												
22034 LNX4	Developing Linux Applications												
22039 FS1	Software Development for Functional Safety Systems												
22040 BTL1	8-bit Bootloaders Using MCC												
22041 BTL2	Easy Bootloader Library (EZBL)												
22042 TNG1	Why Touch? Which Touch?												
22043 TNG2	Designing Robust, Low-Power Capacitive Touch Systems												
22044 TNG3	Implementing and Tuning 1D Touch Using Microchip Tools and Libraries												
22045 TNG4	Implementing 2D (touchscreen) and 3D (air gesture) Solutions to Create Intuitive User Interfaces												
22046 GFX1	Graphical Applications with the MPLAB® Harmony Graphics Composer Suite and Aria Graphics Library												
22047 GFX2	PIC32 Graphics Development: Advanced Concepts and Techniques												
22048 AN1	CAN and CAN-FD Protocols and Physical Layer Basics												
22049 AN2	Implementing a CAN FD Node Using An External CAN FD Controller												
22050 AN3	LIN (Local Interconnect Network) Low-Cost Serial Bus Design for Industrial and Automotive Applications												
22051 SER1	Choosing the Right Serial Bus for Adding Peripherals to Your Embedded Control Application												
22052 SER2	Practical I2C: Introduction, Implementation and Troubleshooting												
22055 USB3	Introduction to USB 2.0 Part C: USB Physical Layer, Practical Design Methods, Test, and Debugging												
22056 USB4	USB Type-C™ Interface - Technical Overview and Design												
22058 USB6	Developing USB Host and Device Applications with MPLAB® Harmony USB Stack												
22059 BLU1	Getting Started With Bluetooth® Low Energy (BLE) Development												
22060 BLU2	Creating Embedded Applications Using Bluetooth® Low Energy Devices												
22062 BLU4	Creating Proof-of-Concept Android Apps for Bluetooth® Low Energy (BLE)												
22063 BLU5	Creating Proof-of-Concept iOS Apps for Bluetooth® Low Energy (BLE)												
22064 LAN1	Ethernet Hardware Design, Test, and Debug From Schematic to First Packet												
22065 LAN2	A Practical Introduction to Designing with Microchip Ethernet Switches												

Build your own Schedule continued...

Class	Title	Tuesday, September 11				Wednesday, September 12				Thursday, September 13			
		1	2	3	4	5	6	7	8	9	10	11	12
22066 LAN3	An Introduction to EtherCAT®, EtherCAT P and the Microchip LAN9252 Slave Controller								○				
22067 NET1	Introduction to the MPLAB® Harmony TCP/IP Stack	○	○					○	○				
22068 NET2	Adding Connectivity to a Linux/RTOS Based Gateway/IoT System Using a Wi-Fi®/BLE Link Controller				○								
22070 SEC1	Cryptography Primer Class	○					○					○	
22071 SEC2	Security Challenges and Chip Attack Methods		○						○				○
22072 SEC3	Developing Secure Applications with CryptoAuthentication Devices			○	○			○	○				
22073 SEC4	Authentication and Secure Communications for IoT Projects using AWS IoT	○	○							○	○		
22074 SEC5	ARM® TrustZone® – What is it? What isn't it?					○				○			
22075 SEC6	Developing Secure Applications with Microchip Cortex®-M23 Flash MCUs TrustZone® Enabled Devices					○	○					○	○
22077 SEC8	Security of MPU-based Embedded Systems and Microchip Solutions							○			○		
22079 IoT1	Using 8-bit MCUs in IoT Designs			○	○					○	○		
22080 IoT2	Connecting Your IoT Device with LoRaWAN™ to The Things Network - A Global IoT Data Network	○	○					○	○				
22081 IoT3	Controlling Your Embedded IoT Device Using Amazon Alexa					○	○					○	○
22085 IoT7	Integrating Wi-Fi®/BLE IoT Gateway and Sensors for Voice-Enabled Home Automation Applications					○							
22086 IoT8	Creating IoT Applications Using Microchip's Wi-Fi®/BLE Wireless Network Controllers			○	○					○	○		
22088 AMS1	Robust Analog/Mixed-Signal Design for Embedded Applications										○		
22089 AMS2	Analog Circuit Simulation Using the Mindi™ Simulation Environment											○	
22090 AMS3	Choosing the Right Analog-to-Digital Converter (ADC) For Your Applications												○
22094 MC1	A Holistic View of Motors, Their Applications and Control	○							○				
22098 MC5	dsPIC® Digital Signal Controllers (DSCs) Motor Control Workshop					○	○			○	○		
22099 MC6	Sensored and Sensorless Field Oriented Control of PMSM Motors Using SAME70 (32-bit ARM® Cortex® M7)							○	○			○	○
22200 MC7	SCILAB/X2C		○										
22201 MC8	Scilab/X2C Hands On			○	○								
22100 PC1	Fundamentals of Switch-Mode Power Converters	○											
22101 PC2	Fundamentals of Switch-Mode Power Converter Control		○										
22102 PC3	Fundamentals of Digital Switched-Mode Power Converter Control			○									
22103 PC4	Fundamentals of Power Integrity in Embedded Systems				○								
22105 PC6	Hybrid Power Controllers: Advanced SMPS Design Using Programmable Mixed Signal Controllers					○	○						
22106 PC7	LED-Lighting I: Fundamentals of Solid State Lighting								○				
22107 PC8	LED Lighting II: Single and Multi String LED Driver Design									○			
22109 PC10	Powering USB Power Delivery Applications							○					
22110 BAT1	Battery Charging Fundamentals, Charging Solutions, and Firmware Support		○								○		
22115 SIG1	EMC Demystified					○	○			○	○		
22116 SIG2	Successful High-Speed PCB Design for Today's Fast Protocols							○	○				

Build your own Get Launched Schedule

Class	Company	Title	Tuesday, September 11			
			1	2	3	4
22300 AWS	Amazon Web Services AWS	Amazon Web Services, solutions from node to gateway				○
22301 ARD	Arduino	An introduction to the new UNO Wi-Fi board			○	
22302 IQI	IQI	IQRF® is the wireless technology enabling things to simply connect IoT via wireless mesh networks			○	
22303 LDRA	LDRA	Concentrate on project functionality. Automate functional safety and security certification			○	
22304 MIK	MicroE	From Fast Prototyping to Volume Production				○
22305 MOZ	Mozilla	Building Things for the Web			○	
22306 ZRN	Zerynth	Introduction of the Zerynth Phyton - hybrid C/Phython tool chain				○
22307 DVL	Develer	Developing embedded GUI applications with Develboard and Qt				○

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