

2017

Microchip's European MASTERs Conference

The Premier Technical Training Conference
for Embedded Control Engineers

12 - 14 September 2017

Conference Guide



MICROCHIP

www.microchip.com/eumasters

Microchip's European MASTERs Conference 2017

21 Years of Technical Training Worldwide


12th - 14th September 2017

Over 76 classes for all skill levels

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Introducing Microchip's European MASTERS Conference 2017 12th - 14th September - Berlin, Germany

Microchip invites you to sign up for our 2017 European MASTERS Conference and experience the premier technical training event for embedded control engineers. Now in its 21st consecutive year, the MASTERS Conference in the U.S. 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. We continue to offer a version of this event in Europe.

Classes

We run a selection of more than 76 classes that cover a broad range of topics, taught by Microchip's application and design engineers as well as selected industry experts. Come learn from these experts and leave with everything you need to get up and running on your new design. We offer both lecture, hands-on classes and a unique Open Expert Forum 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.

Open Expert Forum

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 12th September 2017 from 07:30 – 13:00.

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



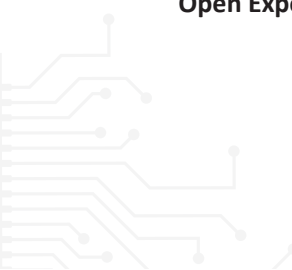
MASTERS Conference Agenda

Tuesday 12th September 2017

Wednesday 13th September 2017

Thursday 14th September 2017

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	14.00-16.00	Training Slot 7	14.00-16.00	Training Slot 11	14.00-16.00
Training Slot 4	16.00-18.00	Training Slot 8	16.00-18.00	Training Slot 12	16.00-18.00
Keynote Address	18.00-19.00	Boat Cruise to Müggelsee	18.00-19.00		
Dinner at HTW	19.00-22.00	Dinner at Rübenzahl, Müggelsee	19.00-22.00		
Open Expert Forum	19.00-22.00				



Conference Details

Microchip Open Expert Forum

Come and meet the experts in the lobby area of Building G and H. Here you can chat to the Microchip team and see all of the latest tools and solutions. The Expert Area will be staffed during lunch and at the end of the day after classes, giving you plenty of time to visit the experts.

Lunch and Dinner with an Expert

In addition one to one expert facetime 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. 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, 14th 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 on the first floor of Building G.

Meals Included in the Conference Fee

- Lunch on 12th, 13th, 14th September 2017
- Dinner at HTW on 12th September 2017
- Cruise and Dinner on 13th September 2017

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. Berlin's largest University of Applied Sciences.

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 Berlin. 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>



The Hochschule für Technik und Wirtschaft HTW; or the University of Applied Sciences campus is located in one of the most important industrial quarters of Berlin.

This district was one of Berlin's first industrial centres, 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 Elektrizitäts 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.

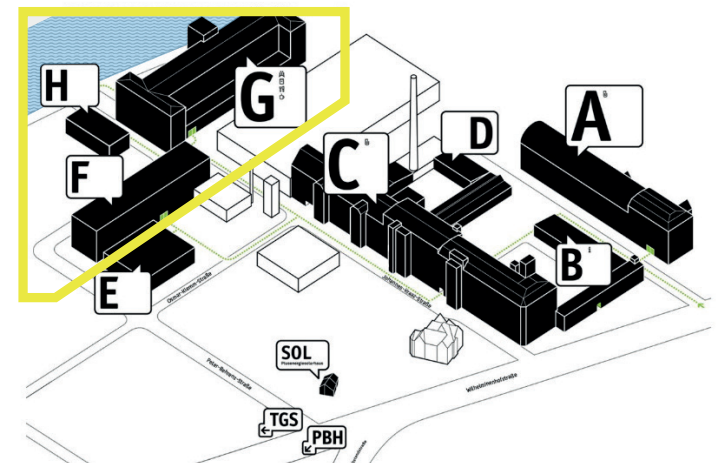
Every day, thousands of workers arrived by tram and flocked into the tightly packed factories that were clad in yellow clinker stone and lined Wilhelminenhofstrasse. Now in the 21st century this area has been through a period of regeneration and today, mostly you will find students disembarking from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

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



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 block booked a number of rooms at nearby hotels. This include a free shuttle to HTW and back.

To book these rooms please contact Jana Buhl

Email: jana@reiseagentin.de

Phone# +49 (0)30 297 728 20

Quote: Microchip



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

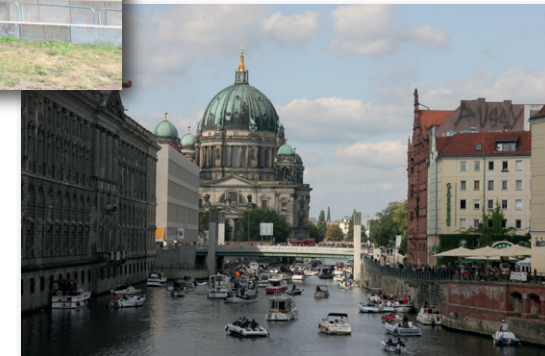
<http://www.berlin-airport.de/en/travellers-sxf/index.php>

Public Transportation

Tramway Stop Rathenastr./ HTW

Lines 21, 27, 63, 67, M17

<http://www.bvg.de/en>



What's included at European MASTERs...

Conference Fees

Early Bird Special - Register by 2nd June 2017
EUR 441 (excluding VAT)

Regular Price- Register from 3rd June 2017
EUR 490 (excluding VAT)

Discounts Available

Early Bird Discount
Register by 2nd June 2017
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 31st December, 2016. For registration make sure that you have access to your Design Partner Program number (DP#).
Minimum 20% 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#).
30% off regular price
Final cost is EUR 343 (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

Dinner at HTW
Come and join us for a themed dinner on Tuesday night at HTW.

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

What's Included

- Entry to the MASTERs Conference classes
- Open Expert Forum
- USB Flash Drive with all Class Material including Classes of the Worldwide

MASTERs 2017 Conference that are not presented at the European Conference

- Computers and development tools as loaners 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
- Boat trip and Dinner on Wednesday night
- 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 of 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.



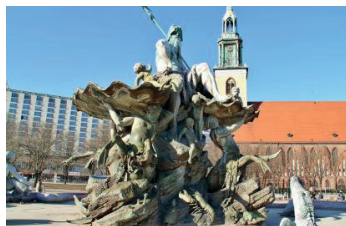
Reichstag

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 city's the 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

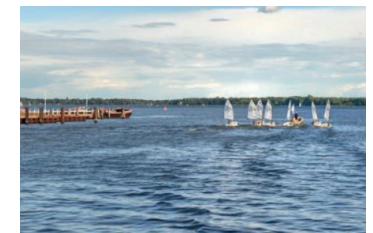
For something a little different why not take a guided tour in an old Trabi (the 2 stroke engine cars from East Germany with CB based audio guide)

<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?

What Are They?

With our MASTERS Workshop Days, we want to expand the opportunity for you to participate in the MASTERS program. We use the content of select MASTERS classes and combine those to fill a full day of training on a specific topic. These workshop days are offered in different regions throughout the year. You are invited to join us and move your design idea into a working solution much faster! Signing up for European MASTERS means that you can get access to all of our MASTERS Workshop days free of charge.* We are planning on offering up to 100 such training days throughout the year spread over various locations in Europe.



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

CLASS LISTINGS

Class	Page	Class	Page
Products and Peripherals	13 - 15	Analog and Mixed Signal	32
Development Tools	16 - 17	Automotive Networking CAN/LIN	25 - 26
Firmware Design and Compliers	18 - 19	Batteries	38
Linux	20	Bootloaders	22
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Bootloaders	22	Development Tools	16 - 17
Touch and Gesture Sensing	23	Display Technologies	24
Display Technologies	24	Firmware Design and Compliers	18 - 19
Automotive Networking CAN/LIN	25 - 26	Functional Safety	21
Bluetooth	27	Internet of Things (IoT)	30 - 31
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Analog and Mixed Signal	32	Motor Control	33
Motor Control	33	Power Supplies and Power Conversion	34 - 37
Power Supplies and Power Conversion	34 - 37	Products and Peripherals	13 - 15
Batteries	38	Security / Encryption	29
Low Power Design	39	Signal integrity and PCB Design	40
Signal Integrity and PCB Design	40	Touch and Gesture Sensing	23

EUROPEAN MASTERS CONFERENCE 2017 STREAM LIST

Stream	Topic	Description
1	Products / Modules / Solutions	This class selection will give you a good overview of the Microchip and Atmel product range and related technologies. Most classes stay in Tech Level 1
2	Building Blocks for Embedded Designs	In this class selection you will find the content for a typical embedded design engineer. Here we offer the classes on the μ Controller tool chain , including hands-on for MPLABX [®] , Microchip Codeconfigurator (MCC) and also the Atmel Studio. Further we discuss usual tasks like IRQ's, scheduler on complex designs and how to break it down. Of course we will offer classes for Bootloader and CAN/CAN-FD as well as serial EEproms.
3	Solutions for System Integration	In this class selection we will dive deeper into programming, debugging, and higher level protocols.
4	IoT and Connected World	This class selections covers the building blocks for the connected world. Datacommunication over wired and wireless networks, related security needs and infrastructure.
5	Analog and Mixed Signal	This class selection does address the processing of signals from the sensor level up to the output devices. It also covers PCB design topics, EMI and EMC.
6	Power Electronics	This class selection covers power conversion and motor control related topics

MASTERS 2017 Classes

Class	Title	Abstract	Hours	Tech Level	Type	Hands on	Prerequisites	Time slot	Stream
Product and Peripherals									
21001 PNP1	The Latest MCUs, MPUs, USB and Ethernet Networking 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, 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			1	1
21002 PNP2	The Latest Wireless, Analog, and Touch-Interface Products: 12 Months Ahead	This class provides an overview of Microchip's latest and future wireless, analog, and touch-interface products. Attendees will receive an introduction to new product families, new technologies and what new products they can expect from Microchip in the next 12 months.	1.75	1	Updated			2	1
21003 PNP3	Choosing the best Architecture MCU/MPU for your design	Microchip now has a wide variety of MCU/MPU cores. With so many choices how do you decide which family of devices would be best suited to his project? This class will cover the fundamentals of AVR®, PIC® and SAM (ARM®) MCU architectures to help you choose the optimal processor core for your next design.	1.75	1	New			3	1
								7	3
21004 PNP4	Using the Core Independent Peripherals (CIPs) on Microchip's 16-bit microcontrollers	This class will explore the usage of the various Core Independent Peripheral (CIP) modules present on Microchips 16-bit microcontrollers in designing a variety of efficient applications such as low-cost motor control, communication protocols and implementation of mixed-signal circuits. The peripherals discussed will include Peripheral Trigger Generator (PTG), Configurable Logic Cell (CLC), Multiple and Single Capture/Compare/PWM (MCCP and SCCP), Comparator/Op-amp, Programmable Gain Amplifier (PGA), Single Edge Nibble Transmission (SENT) and Cyclic Redundancy Check (CRC).The extensive configurable features provided by these CIPs enable effective implementation of applications with minimal processor overhead. For example, the PTG module provides several features that enable close integration, synchronization and reconfiguration of other peripheral modules. Participants will be presented with several application case studies using creative combinations of these peripherals, thereby gaining a deeper understanding and appreciation of the flexibility and ease-of-use of these modules. In addition, there will be several hands-on lab exercises using a combination of these peripherals and the easy-to-use MPLAB Code Configurator (MCC) software tool, to reinforce the concepts learned in this class.	4	2	Updated	Yes	Some Knowledge of Microchip's 16-bit architecture and Peripherals and a basic familiarity with C programming and MPLAB® IDE	5 & 6	2
								11 & 12	

Class	Title	Abstract	Hours	Tech Level	Type	Hands on	Prerequisites	Time slot	Stream
Product and Peripherals									
21005 PNP5	Technical Introduction to AVR Microcontrollers and Peripherals	This class provides a technical introduction to the high-performance, low-power AVR® microcontrollers 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			4	1
21006 PNP6	Learn How to Use AVR Core Independent Peripherals (CIPs) by Developing an Infrared Transmitter	This class introduces the AVR® XMEGA family, its specialized peripherals and infrared signal theory, all taught in an application-based approach. Firmware will be developed for an IR transmitter, which can be later used for a search-and-collect game. AVR Core Independent Peripherals (CIPs) such as the Enhanced Direct Memory Access (EDMA), Event System (EVSYS) and XMEGA Custom Logic (XCL) modules will be set up to operate autonomously without intervention from the CPU. This leaves the CPU available for relevant high load processing without interruption. This class is recommended for embedded developers comfortable with building applications from scratch using low level register manipulation in C.	4	2	New	Yes	Attendees should have attended 21005 PNP5 technical induction to AVR Microcontrollers and Peripherals basic knowledge	3&4	1
								9&10	2
21007 PNP7	Avoid 8 Bit Real Time Constraints with the Configurable Custom Logic (CCL)	This presentation provides an in-depth presentation and demo about using AVR® Core Independent Peripherals (CIPs) to implement an Ultrasonic Distance Measurement application. The presentation will have a light explanation of the theory behind ultrasonic distance measurement, however with the main focus on the AVR peripherals used, challenges overcome during implementation and an overall view on the finished solution.	1.75	1	New			10	1
21010 PNP10	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 EEPROM's	11	2



Class	Title	Abstract	Hours	Tech Level	Type	Hands on	Prerequisites	Time slot	Stream
Product and Peripherals									
21011 PNP11	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	New			12	2



Class	Title	Abstract	Hours	Tech Level	Type	Hands on	Prerequisites	Time slot	Stream
Development Tools									
21013 DEV2	Getting Started with Microchip Development Tools: MPLAB® X IDE, Simulators, Debuggers, and Plug-Ins	This lecture class covers the basics of getting started with Microchip development tools. Following an introduction to all Microchip tools, the instructor will go through the step-by-step creation of a project, editing and compiling a program, running a program and using the simulator. Basic debugging techniques are described, such as how to set a breakpoint, etc. Attendees will leave with a basic knowledge of Microchip tools which can be used to develop applications for all 8, 16, and 32-bit Microchip MCUs. This is a lecture class but attendees can optionally attend the 20013 DEV2L "Open Lab" session which will provide the opportunity to complete self-paced hands-on lab exercises that reinforce concepts learned in this class. Open Lab sessions will run some afternoons and some evenings. Exact times and locations for the Open Lab evening sessions will be provided in class.	1.75	1	Updated			1	2
									3
21015 DEV4	MPLAB® Code Configurator (MCC) for Simplified Embedded Software Development	The MPLAB® Code Configurator (MCC) is a user-friendly plug-in that seamlessly integrates with your existing MPLAB X Integrated Development Environment to provide an easy setup and configuration experience with a wide array of 8, 16 and 32-bit PIC® microcontrollers. In the past year, MCC has been re-architected from the ground up to enhance functionality and provide library support for our latest MCUs and Core Independent Peripherals. MCC can now configure over 600 MCUs to your specific application without opening a product data sheet. This hands-on class will utilize MCC for MPLAB® X IDE to generate seamless, easy-to-understand drivers and libraries for PIC MCUs with Core Independent Peripherals. These drivers are optimized for each CPU and can be tailored to fit almost any application and function. The available libraries like TCP/IP Lite, mTouch® technology, LIN, LoRa and Boot Loader help further simplify setting up a complete solution. Learn how to leverage the MCC's power to quickly develop an embedded application and get your project off the ground in minimal time. With just basic knowledge of the C programming language and some knowledge of Microchip's powerful MPLAB X IDE tool suite, you will be generating driver functions for an array of peripherals in minutes.	1.75	2	Updated	Yes	Attendees resigstering for this class should have a basic understanding of C, 8, 16 and 32bit PIC® MCU development and the use of MPLAB® X IDE	1 & 2	2
21016 DEV5	Creating simple PIC32 embedded applications using MPLAB® Harmony	MPLAB® Harmony is a modular framework that provides interoperable firmware libraries for PIC32 application development. These libraries include drivers, system services and middleware. In this class, you will be introduced to the basic concepts and benefits of MPLAB Harmony Framework. You will learn how easy it is to create simple embedded applications using MPLAB Harmony framework and MPLAB Harmony Configuration tools.	1.75	2	Updated	Yes		1 & 2	2
									7 & 8



Class	Title	Abstract	Hours	Tech Level	Type	Hands on	Prerequisites	Time slot	Stream
Development Tools									
21017 DEV6	Creating Advanced PIC32 Embedded Applications using MPLAB Harmony	MPLAB® Harmony is a modular framework that provides interoperable firmware libraries for PIC32 application development. These libraries include drivers, system services and middleware. In this class, you will be introduced to the basic concepts and benefits of MPLAB Harmony Framework. You will learn how easy it is to create simple embedded applications using MPLAB Harmony framework and MPLAB Harmony Configuration tools.	4	3	Updated	Yes	Attendees should have basic understanding of C language programming for PIC32 systems	3 & 4	2
								11 & 12	3
21018 DEV7	Getting Started with AVR and SAM Tools, a context based design-cycle walk through	Atmel START is a solution composer and code configurator for AVR® and SAM microcontrollers. Atmel Studio 7 is the IDE supporting all Atmel MCU families. Xplained Pro is a platform of hardware development kits and extensions, designed to work seamlessly with Atmel Studio 7. In this class, the requirements definition phase demonstrates the efficient use of Atmel START as an entry point to AVR or SAM development, filtering MCU selection, based on both SW & HW requirements, or re-configuring a relevant example project. Learn about HW prototyping possibilities with the Xplained platform & other extensions. In the Proof of concept & development phases of your project, you will need to know how to use START configuration screens. Opening Atmel Studio 7, we first demonstrate basic studio features for bare-metal AVR/SAM development, before handling some of the features to work with projects from START. While debugging, with Atmel Studio 7, we will use the Data Visualizer to understand the example project and code correlation with the Power Debugger. Learn about the software content that Atmel START generates, AVR Code for AVR and ASF4 for SAM.	1.75	1	New			2	2
21019 DEV8	AVR Tools: Bare metal and START-based AVR development in Studio 7	This hands-on teaches a typical development process, based on Atmel START (Solution composer and code configurator), Atmel Studio 7 (IDE), the Xplained Pro platform (hardware development kits & extensions), as well as the Power Debugger. A practical an efficient use and access of relevant programming references in various design-decision contexts, is emphasized throughout both parts of this hands-on session. Bare-metal development with AVR® microcontrollers in Atmel Studio 7 is the first part of this hands-on session and serves as a getting started with AVR, as well as a simple context to introduce core Atmel Studio features, use of key programming references and debugging features. AVR development with Atmel START focuses on understanding the design process between START and the Studio 7 IDE. Finding a suitable example project as a starting point and using Studio 7's Data Visualizer to understand the application. Using AVR low power picoPower technology, to reduce application power consumption, then confirming these power savings using the Power Debugger.	4	1	New	Yes		1 & 2	2
								7 & 8	

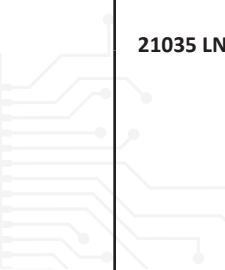


Class	Title	Abstract	Hours	Tech Level	Type	Hands on	Prerequisites	Time slot	Stream
Firmware Design and Compilers									
21025 FRM3	Embedded Firmware Design Fundamentals	This class will introduce you to the science of programming embedded systems by addressing the differences between good and bad code. Attendees will be introduced to the first 4 code smells and the SOLID architectural principles which can be used to overcome these smells, and we will be looking at a series of common pitfalls which cause embedded code to fail, and what can be done to avoid these.	1.75	3	Updated	Yes	Attendees should have a working understanding of C language. Recommended prerequisite Classes 21023/21024	9	3
21026 FRM4	Taming Embedded C	Using practical, concrete examples, the enigmas of the C programming language will be explained. The hidden secrets of Microchip debugging tools will be revealed. The mysteries of masterful design and coding practice will be laid bare! This class in programming microcontrollers focuses heavily on technique and practical methods. This class is targeted at attendees who have some facility with programming microcontrollers in C, debugging real-world applications and solving difficult programming challenges. Attendees will take their programming, debugging and problem solving to the next level using best practice advice from the best programming minds at Microchip.	4	3	Updated			1 & 2	3
								9 & 10	3
21028 FRM6	Bare Metal C Coding for SAM ARM® Cortex® M0+ Microcontrollers	The objective of this class is to enable you to quickly get started with creating embedded designs using the SAM 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 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 using the integrated compiler in the Studio Integrated Development Environment. You will also use Studio to 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 some architecture basics will be covered. Attendees registering for this class should have some experience using the C programming language to program microcontrollers.	4	3	New			1 & 2	3
								7 & 8	

Class	Title	Abstract	Hours	Tech Level	Type	Hands on	Prerequisites	Time slot	Stream
Firmware Design and Compilers									
21029 FRM7	Maximizing performance with the 32-bit Cortex-M7 Flash Microcontrollers	This class will teach you how to properly configure the 32-bit SAM ARM® Cortex-M7 Flash Microcontrollers in order to benefit from its architecture to maximize overall system performance. You will learn how to configure the advanced memory architectures and optimize the usage of the Tightly Coupled Memory (TCM) delivering zero wait state access at 300MHz. This class will also explore the benefits of the Multi Port SRAM, the system DMA and finally the Memory Protection Unit (MPU) to avoid potential memory access ordering issues or race conditions.	1.75	3	New			8	3
21031 FRM9	Methods to Avoid Data Corruption via Interrupt Processes	In systems where interrupts are utilized, the volatile qualifier is often used as a method of instructing the compiler to treat variables delicately by forcing all reads and writes to occur. Unfortunately, many programmers make assumptions about its application to shared data and the ability to protect this data. The purpose of this class is to help attendees understand why using the volatile qualifier may cause more harm than good, and why accessors functions should be used for atomic data and shared hardware ports. Additionally, the class will cover why atomic (non-interruptable) access is not guaranteed for any access or operation, and the vital importance of atomic data and their protection when utilizing interrupts. The course will show code examples and analyse the disassembly of the C compiler to demonstrate the importance of assumptions about methods used during compilation. Also, state-based systems will be shown with nested/enabled interrupts to show how they may unintentionally affect the operation of ports and variables. Note: This class will be taught by a representative from Occam Medical Design.	1.75	4	Repeat			6	2
									3
21032 FRM10	Understanding and Meeting real-time constraints in a Harmony RTOS application	The MPLAB® Harmony framework provides a toolbox for developing feature rich applications on embedded devices yet satisfying timing constraints with complex applications can be difficult. A common method to achieve this is to use a Real Time Operating System such as FreeRTOS. However to achieve the best real-time performance requires an understanding of the most appropriate design patterns and how to implement them within Harmony. The course will focus on meeting those needs and will use the Percepio analyser tools to debug common timing issues with RTOS applications.	4	4	New	Demo		3 & 4	3
								9 & 10	



Class	Title	Abstract	Hours	Tech Level	Type	Hands on	Prerequisites	Time slot	Stream
Linux									
21033 LNX1	Introduction to Linux	The best way to develop embedded Linux solutions is on a Linux workstation. The best way to use MPLAB® X is on a Linux workstation. This hands-on class will provide the opportunity to complete several labs while running native Linux on the desktop. The goal of the class is to provide you with the working knowledge of Linux and how to use the operating system. You will complete the class with the knowledge of how to navigate the file system, simple account management, using and writing scripts, as well as how to compile applications. This course is a great first course on Linux or as a refresher before taking the embedded Linux classes.	4	2	Updated	Yes		1 & 2	3
								7 & 8	
21034 LNX2	Introduction to Embedded Linux	In this class, you will explore embedded Linux on a Microchip SAM A5D2 Xplained evaluation board. 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. We will discuss the tools available for development and debug, and the importance of targeting mainline with our code. In the hands-on exercises, you will exercise the network, audio, i2c and gpio peripheral interfaces. We will discuss and explore the procs, sysfs and debugfs Linux kernel interfaces. Finally, you will build, deploy, and debug your own C application using free, open-source tools.	4	2	Updated	Yes		3 & 4	3
								9 & 10	
21035 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 SAM A5D2 Xplained evaluation board. You will then connect a daughter card containing a variety of sensors. You will add device driver support for these sensors to the Linux kernel, modify the Device Tree to add the new sensors to the board configuration, and write and execute user-space scripts to exercise these new peripherals.	4	4	New	Yes	Attendees should have working knowledge of the Linux command line environment and basic knowledge of peripherals on an embedded system	5 & 6	3
								11 & 12	





Class	Title	Abstract	Hours	Tech Level	Type	Hands on	Prerequisites	Time slot	Stream
Functional Safety									
21040 FS1	Functional Safety - Developing a safe motor control	This class will explain the functional safety standards (software) in developing a motor control solution. The class will address the challenges involved with respect to time constraints of the software involved. In conclusion, the class will address the functional safety aspects in automotive domain and how to approach a product with SEooC (Safety Element out of Context). A motor control driver will be the chosen example.	1.75	1	New			4	6
								10	





Class	Title	Abstract	Hours	Tech Level	Type	Hands on	Prerequisites	Time slot	Stream
Bootloaders									
21041 BTL1	8-bit Bootloaders Using MCC	Have you ever wished for a simple way to add functionality or correct a bug within firmware already released to the field? If so, then a bootloader solves the problem. 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.	1.75	2	Updated			3 & 4	2
								9 & 10	



Class	Title	Abstract	Hours	Tech Level	Type	Hands on	Prerequisites	Time slot	Stream
Touch / Gesture Sensing									
21043 TNG1	Introduction to Microchip's Touch Solutions - Buttons, sliders, wheels, proximity, touch pads.	Microchip offers complete 1D (buttons, sliders, wheels), 2D touch (touch pad/screens) and 3D gesture solutions. This introductory class will not only present the product/solution portfolio, introduce the tools and support available but also cover common challenges in touch. Common design rules and strategies to avoid pitfalls will be shared to lower the entry barriers to touch.	1.75	2	Updated			5	1
21044 TNG2	Implementing touch Buttons and Sliders using Microchip Tools and libraries (MCC+m-TOUCH library or START+QTouch library) START+QTouch library)	This class will allow and help you to develop a touch design using a low cost controller and Microchip touch libraries. The examples will show you how to implement, debug and interface to button and sliders for your design. The provided libraries will be explained for ease of use for the embedded design engineer.	1.75	2	New	Demo	Attendees should have a basic understanding of C, 8-bit PIC® MCU Development and the use of MPLAB®X IDE	6	2
21045 TNG3	Noise - no problem! Water - no problem! How to design ultra-robust capacitive touch interfaces	The accelerating use of capacitive touch is rapidly changing the way humans interact with products in replacing mechanical controls with capacitive buttons, sliders, and trackpads. Until recently, the biggest technological hurdles to overcome in this transition has been achieving reliable operation in the presence of electromagnetic noise and/or water. This class teaches how Microchip's innovations in capacitive touch designs eliminate these design concerns and make it easy to achieve outstanding performance and highly differentiating user experiences in the most difficult environments.	1.75	3	New			7	2
21046 TNG4	2D maXTouch: Multi touch Touchscreen design, integration and sourcing	This presentation will begin by explaining the basics of mutual and self-capacitance sensing and provide details of which model to choose for your touch panel. Adding a touchscreen to a design requires many decisions from initial design for the panel size and button requirements to testing for final production. In this presentation we will show you the workflow and how Microchip can help in this process together with our sensor design partners. We will also demonstrate the software required to design and debug a maXTouch design.	1.75	1	Updated			8	2

Class	Title	Abstract	Hours	Tech Level	Type	Hands on	Prerequisites	Time slot	Stream
Display Technologies									
21048 GFX1	PIC32 Graphics Development with MPLAB® Harmony Graphics Composer Suite	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 to create an professional and modern embedded graphical user interface. For the hands-on exercises, attendees will use the PIC32MZ DA Starter Kit along with the PIC32 Multimedia Expansion Board II.	4	2	Updated	Yes	Attendees should have a strong working knowledge of the C programming language	5 & 6 9 & 10	3
21049 GFX2	Developing accelerated graphics applications with PIC32MZ Graphics (DA) Family and MPLAB® Harmony	This class will cover PIC32MZ DA graphics technology and how it works to accelerate 2D graphics tasks. Different types of acceleration will be described as well as how to make use of them through MPLAB® Harmony GFX2 Graphics Composer Suite. We will explain the APIs, hardware and software tools available and create a practical application.	4	3	New	Demo	Attendees would benefit from taking PIC32 basic Graphics Principals class. Attendees should be familiar with the MPLAB(R) Harmony GFX2 Graphics Composer suit and MPLAB(R) Harmony Applications.	11 & 12	3



Class	Title	Abstract	Hours	Tech Level	Type	Hands on	Prerequisites	Time slot	Stream
Automotive Networking - CAN/LIN									
21050 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			3	2
21053 AN4	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. This is a lecture class but attendees can optionally attend the 21053 AN4L "Open Lab" session which will provide the opportunity to complete self-paced hands-on lab exercises that reinforce concepts learned in this class. The Open Lab sessions will run some afternoons and some evenings. Exact times and locations for Open Lab evening sessions will be provided in class.	1.75	1	Updated			4	2



Class	Title	Abstract	Hours	Tech Level	Type	Hands on	Prerequisites	Time slot	Stream
Automotive Networking - CAN/LIN									
21056 USB1	Introduction to USB 2.0 Part A: Basic Concepts and Tools	This class will provide an introduction to the basic concepts and tools of USB 2.0 such as topology, enumeration, endpoints, transfer types and classes. Protocol analysers, used to capture USB traffic, will also be introduced.	1.75	1	New	Yes		1	1
21058 USB3	Introduction to USB2.0 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			2	1
21059 USB4	USB Type-C™ Interface - Technical Overview and Design	This course is tailored to the USB designer who wants to understand the USB Type-C/USB-C interface and how to incorporate it into existing or new designs. Attendees will become experts in the range of USB-C features, port and cable types, and product design requirements, by example.	1.75	2	Repeat			3	2
								11	
21061 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 an USB application on PIC32 USB microcontrollers. You can configure the USB Stack to implement an USB Device or to implement an USB Embedded Host that is able to support different USB device types, including the support of multiple USB Devices through a USB Hub. In this class you will learn how to configure the USB Stack using the MPLAB Harmony Configuration (MHC) Tool and how to use the provided APIs to send and receive data between a USB Embedded Host and a USB Device. You will also learn how to add Hub support to an Embedded USB Host application.	4	4	New	Demo	Attendees should be familiar with the USB 2.0 protocol and MPLAB®Harmony applications.	11 & 12	4



Class	Title	Abstract	Hours	Tech Level	Type	Hands on	Prerequisites	Time slot	Stream
Bluetooth									
21062 BLU1	Getting Started with Bluetooth® Low Energy Development	Bluetooth® Low Energy (BLE) is the low-power extension to the Bluetooth 4.x Core Specification, extending the standard to cover low-power, low-latency use-cases. This hands-on course focuses on the key design considerations you should be aware of in adding BLE connectivity to your embedded application. Lab exercises will interface a Microchip PIC® MCU with an agency-certified Microchip BLE module.	4	2	Updated	Yes	Attendees should have some background using the MPLAB® X IDE Tool Chain, as well as some experience in C programming	1& 2	4
								7 & 8	
21063 BLU2	Creating Proof-of-Concept Android™ Apps for Bluetooth® Low Energy	Creating professional mobile apps might be beyond the scope of most embedded design engineers, but if you just want to get started and learn to create simple proof-of-concept apps, then this class is for you. You will learn what development tools to use, how Android apps are structured, touch on key features of the Java language, and go into Bluetooth® 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		Yes	Attendees should have working knowledge of Bluetooth®Low Energy Preferable takers Class-21062	3 &4	4
								9 & 10	
21064 BLU3	Developing iOS™ Applications to Control Bluetooth® Low Energy Accessories	Learn the development process for creating iOS applications to communicate with the RN487x Bluetooth® Low Energy (BLE) module. This class explains which development tools are used for iOS application development, the languages used, and how the operating system supports Bluetooth® Low Energy interfaces. Note: This class does NOT cover Bluetooth audio applications.	1.75	1			Attendees should have taken class-21062	5	4
								11	

Class	Title	Abstract	Hours	Tech Level	Type	Hands on	Prerequisites	Time slot	Stream
LAN									
21068 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 (Layer 1 &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 Microchips Ethernet hardware design.	1.75	1	New			8	4
21069 LAN2	An Introduction to EtherCAT® and the Microchip LAN9252 Slave Controller	EtherCAT® is an industrial real-time field bus protocol based on Ethernet layer 1, and 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 effective real time networked communication and control . A demonstration using a Raspberry Pi® will show an EtherCAT master controlling a real-time network based on the Microchip slave controller, and serves as an introduction to tools which can be used to implement an EtherCAT network.	1.75	1	Updated			7	4
21070 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	Yes	Attendees should have a basic understanding of both TCP/IP and the MPLAB®Harmony Framework Or attend Classes - 21016 & 21068	1 & 2 3 & 4	4
21071 NET2	Adding wireless functionality to a host using a network controller	Getting Started with WiFi® introduction to 802.11 b/g/n standard basics. This course focuses on the key design considerations you should be aware of in adding WiFi connectivity to your embedded application. Focus will be on the family of Network Controllers with built-in wireless (WiFi or WiFi + BT) that are driving a higher degree of integration in IoT applications. Attendees will get the basics of how to start with WiFi design & gain understanding of how to add application on Host MCU to work with WINC15X0 and WINC3400. They will also understand the differences and use cases where a standalone WiFi vs. WiFi-BLE combo fit in day-to-day use cases. The class is a lecture format and accompanied by a hands-on class to help understand the integration process and the design decisions that need to be taken during the integration.	4	2	New	Yes		5 & 6 11 & 12	4

Class	Title	Abstract	Hours	Tech Level	Type	Hands on	Prerequisites	Time slot	Stream
Security/Encryption									
21073 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 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 (21074 SEC2).	1.75	1	New			1	4
								12	
21074 SEC2	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 these low level fundamental blocks (random number generation, hashing, symmetric & asymmetric authentication, and anonymous key exchange) into higher level cryptographic functions. You will learn how to start a design from scratch using our CryptoAuthLib, communicate with, and control the ATSHA204A and ATECC508A CryptoAuthentication devices. You will leave with a completed real-world application example.	4	2	New	Yes	Attendees should have attended Class 21073	3 & 4	2
								9 & 10	4
21075 SEC3	Learn How to Easily Develop and Deploy Secure IoT Solutions From Concept to Production	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. Collaboratively taught by Microchip Technology Inc. and Amazon Web Services (AWS), a leader in cloud solutions, we explore provisioning, securing credentials, authentication, and secure communications from a secure element to the cloud using AWS IoT services.	4	2	New	Yes	Attendees should have basic knowledge of IoT	5 & 6	4
								11 & 12	
21076 SEC4	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 Microchip secure element combined with MPU. Finally, we will look at practical examples of 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	2	New			5	3



Class	Title	Abstract	Hours	Tech Level	Type	Hands on	Prerequisites	Time slot	Stream
Internet of Things (IoT)									
21078 IoT1	Ethernet Connectivity Enablement 1:8-bit devices using Lite TCP/IP stack	This class will give an overview of our lite TCP/IP library, including a brief introduction to the protocols included in the stack, their features and limitations. We will showcase our easy to use MPLAB® Code Configurator (MCC) to generate most of the code and show how quickly one can have a working project to build upon. We will go through the UDP and TCP APIs needed to create and extend the user application. A brief introduction to CoAP will also be presented. Hands-on labs will provide attendees the experience of creating real life applications based upon the information presented. Last but not least, in order to bring the presented ideas and concepts home, a couple of demos will be shown.	1.75	2	Updated	Demo	Attendees should have a basic knowledge of the Ethernet drivers and TCP/IP Networking fundamentals	9	4
21079 IoT2	Ethernet Connectivity Enablement 2:Implementation of "Cisco's Digital Building" as a path to vendor interoperability of connected things	Introducing a complete connectivity solution using Cisco's Digital Building and Microchip's TCPIP, CoAP stackWith Cisco's Digital Building implementation we are already on our way to achieving vendor interoperability. The attendees will get a full experience from conception to the working of the system using lights and wall control (actuators/sensors) as examples of one of the many scenarios where this solution can be used. Using MCC, the generic implementation is ready to run in minutes. This class will also teach the attendees how to customize their model according to their needs and dynamically add or remove resources. At the end of the class we will be able to create a system to control lights using actuators and sensors, a good example of smart building automation	1.75	3	New	Demo	Attendees should attend class 21078	10	4
21080 IoT3	Connecting your IoT Device with LoRaWAN™ to The Things Network – A Global IoT Data Network	Microchips 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	New	Yes		7 & 8	4
								9 & 10	



Class	Title	Abstract	Hours	Tech Level	Type	Hands on	Prerequisites	Time slot	Stream
Internet of Things (IoT)									
21085 IoT8	Introduction to SIGFOX Low Power Wide Area Networking	Low Power Wide Area Network technologies (LPWAN) continue to play an important and growing role in the spread of Internet of Things (IoT). SIGFOX is one such LPWAN technology where low power, long distance, and extended battery life are paramount, while bandwidth and speed are secondary. In this class, the system architecture of a SIGFOX network will be described, along with the key technical features that comprise an ultra-narrow-band Sub-GHz network. Additionally, an overview of Microchip's LPWAN technology offerings will be presented as well as comparisons between two leading LPWAN technologies LoRa® and SIGFOX. This class will be a combination of formal lecture and in-class demos, using Microchip's SIGFOX development kits. The overall aim of the class is to help the students gain an understanding of how long distance communications is achieved, and how SIGFOX and IoT applications coexist seamlessly in real-life applications as diverse as energy grid management and crop yield improvements.	1.75	3	New		Attendees should have working knowledge of networking terminology	2	4
								6	



Class	Title	Abstract	Hours	Tech Level	Type	Hands on	Prerequisites	Time slot	Stream
Analog and Mixed Signal									
21087 AMS1	Signal Conditioning Techniques Using Precision Instrumentation Amplifiers	The primary challenge of sensing in industrial environments is conditioning low-level sensor signals in the presence of high-noise environments. While this is an ideal application for a precision Instrumentation Amplifier (INA), simple mistakes can quickly compromise the precision performance. This course starts with an introduction to the Instrumentation Amplifier by comparing the common architectures and their individual advantages. We will then focus on how to apply the Instrumentation Amplifier effectively using select signal chain application examples and discuss how to avoid common mistakes.	1.75	2	Repeat		Attendees should have working knowledge of operational amplifiers	3	5
21088 AMS2	High-Precision Analog Applications Using Amplifiers	Are you interested in designing high-precision circuits? How can you take advantage of a PIC® MCU's capabilities? This class covers precision amplifier fundamentals, their application to circuit design, and design tips and tricks. Circuits with traditional, reduced analog content and mixed signal architectures are illustrated. This is an analog class for users at Analog Technical Level 3 (some experience).	1.75	2	Updated		Attendees should have some analog design experience	4	5
21089 AMS3	Sensing and Communicating with an Analog World	This class covers a group of real-world sensor applications. The lecture highlights both digital and analog sensors and the signal conditioning required to achieve accurate and useful sensor data. The lecture also covers the new Analog-to-Digital Converter (ADCC), analog and digital filtering, and signal processing theorems.	4	4	Updated			5 & 6	5
21090 AMS4	Precision Remote Temperature Sensing for Embedded Systems	Embedded systems with precision thermal management require high-accuracy instrumentation. Several temperature sensors are available in the market to measure temperature at remote locations such as silicon IC sensors, diode sensors, thermistors, RTDs and thermocouples. This session demonstrates the various discrete and non-discrete thermal management solutions for precision remote sensing applications. Attendees will explore design consideration pros and cons of each sensor and identify the appropriate cost-effective solution for the embedded system application.	1.75	1	Updated			12	5

Class	Title	Abstract	Hours	Tech Level	Type	Hands on	Prerequisites	Time slot	Stream
Motor Control									
21091 MC1	motorBench™ Development Suite: Part 1 – Introduction	The motorBench™ Development Suite is an advanced GUI-based software development tool for motor control with accurate measurement of critical motor parameters (self-commissioning) automatic tuning of feedback control gains (auto-tuning) for dsPIC33EP Digital Signal Controllers. This class introduces the attendees to key concepts of the Microchip motorBench Development Suite, its usage model and its development environment. Attendees will learn the benefits of this tool and how to leverage it in order to simplify and shorten the design cycle of their motor control application. The class will also show how attendees can use the tool by starting with basic information about their application hardware, make well-informed choices about algorithms and estimators within the tool to obtain fully-functional motor control application code within minutes.	1.75	2	Updated		Attendees should have basic knowledge of Motor Control	1	6
								5	
21092 MC2	motorBench™ Development Suite: Part 2 – New Motor Control Algorithms	This class builds upon what was covered in the prerequisite class, motorBench™ Development Suite: Part 1, by introducing attendees to the new architecture, development environment and implementation overview of the Motor Control source code. The class will also present additional details about the newly-developed run-time algorithms that are included with the Microchip motorBench Development Suite.	1.75	4	Updated		Attendees should have taken Class 20091	2	6
								6	
21093 MC3	Developing Motor Control Algorithms on 32-bit Cortex Flash Microcontrollers	The class introduces 32-bit ARM® Cortex® M-based microcontrollers and its features for developing motor control applications. The lecture will focus on core variants (M0+, M4 and M7) and peripherals, including clock generators, EVENT system, timers, timer counters, quadrature decoder, ADC and PWM units. The lecture will also present the different motor control algorithms and how to use the peripherals. An example application for sensor-less FOC will be discussed on how to configure and use the peripherals.	1.75	4	New		Attendees should have basic understanding of Motor control	3	6
								9	
21096 MC6	Analysis and Simulation of DC Motor power stages	This intermediate level class focuses on the analysis and simulation of DC motor drive power stages using an Excel spreadsheet and the Mindi circuit simulator. Participants will learn how to use an Excel spreadsheet to calculate power dissipation of the MOSFETs and MOSFET driver in a half bridge and 3-phase power stage. They will also be shown how to use the Mindi circuit simulator to run open loop simulations for startup, steady state, dynamic loading and stall conditions. Modelling of parasitic effects, such as shoot-through, reverse recovery and ringing will also be demonstrated. A comparison between the calculated, simulation and measured values will be presented to show the strengths and weaknesses between spreadsheet calculations and circuit modelling.	1.75	2	New		Attendees should have practical knowledge of DC Motor drive	7	6
								11	



Class	Title	Abstract	Hours	Tech Level	Type	Hands on	Prerequisites	Time slot	Stream
Power Supplies and Power Conversion									
21097 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 21098 PC2 which provides an introduction to feedback and control loops for switch mode power converters.	1.75	1	Updated			1	5
21098 PC2	Fundamentals of Switch-Mode Power Converters: Control	This class presents the basics of feedback and control loops for switch mode power converters. While 21097 PC1 is not a prerequisite, this class builds on the concepts presented in that class. This introductory class focuses more on the concepts and principles than detailed design. The class starts with a review of describing systems in the frequency domain, transfer functions, and feedback loop characteristics that govern stability and performance. Then each element of analog feedback controllers are presented and discussed: the error amplifier, the compensator, and the modulator. Particular attention is paid to designing the control loop frequency response to achieve both stability and good performance. While there is a fair amount of algebra used the focus of the discussion is on understanding the concepts and principles. The last part of the class is an overview of current mode control and its advantages. After this class those interested in designing power converter control loops with digital control should take class 21099 PC3 which provides in-depth information on how to design digital controllers for switch mode power converters.	1.75	1	Updated			2	5

Class	Title	Abstract	Hours	Tech Level	Type	Hands on	Prerequisites	Time slot	Stream
Power Supplies and Power Conversion									
21099 PC3	Fundamentals of Power Integrity in Embedded Systems	Technology in the digital world continues to move on 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). This class is introducing fundamental 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.	1.75	3	New		Attendees should have basic Understanding of power supply topologies and control concepts Covered by the classes 21097 and 21098	3	6
21100 PC4	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. The session concludes with a short, high-level introduction to adaptive and model predictive control concepts utilizing the newly gained flexibility of a digital control system.	4	2	New			5 & 6	6

Class	Title	Abstract	Hours	Tech Level	Type	Hands on	Prerequisites	Time slot	Stream
Power Supplies and Power Conversion									
21101 PC5	Digitally Enhanced Power Analog ,what is it and how can I take advantage of this unique approach to developing configurable, intelligent power systems	This class introduces a unique approach to solving medium to high complex power system challenges by using an 8-bit microcontroller with integrated high performance power analog peripherals dedicated for switch mode power conversion. This hybrid approach utilizes an embedded 8-bit microcontroller to customize the high performance analog power peripherals that provide the cycle by cycle control and protection of the power system. Once customized, the microcontroller resources are available to the system for adding intelligence, communication, diagnostics, measurements etc.. The phrase Digitally Enhanced Power Analog or DEPA describes how the high performance analog controller is enhanced by the integrated digital capability. DEPA will be compared with full digital control to address any confusion between the two distinct methods of switch mode power design. This class will introduce the newest products that support DEPA and how to take advantage of their capability by presenting several common application examples such as driving LEDs, charging batteries, meeting USB power requirements and developing unique features for ac/dc designs. If you are in need of solutions to new power system problems this class is for you.	1.75	2	New		Attendees should have attended 21097 PC1 and 21098 PC2	6	5
21102 PC6	Hybrid Power II: Designing Intelligent Power Converter Using Hybrid Switching Controllers	Intelligent power converter design adds intelligence and automation to generic DC/DC and AC/DC converters, AC/DC power factor correction,DC/AC power inverters and is of special interest for non-linear operation in LED lighting and battery charging. The integration of programmable logic and the basic building blocks of switch-mode controllers onto a single die extends the level of controllability, visibility and flexibility to better support non-standard features and functions while also covering standard tasks like monitoring, house-keeping and protection. This class will discuss the design of intelligent power converters using Microchips latest Programmable Hybrid PWM Controller families with integrated MCU and Core Independent Peripherals (CIPs). It will explore basic designs concepts of digitally supported, analog voltageand current mode feedback loop design. These concepts will then be applied in a guided step-by-step design example of a 15W SEPIC LED driver with anindependent, high-performance hardware dimming engine.	4	2	New	Demo		7 & 8	6



Class	Title	Abstract	Hours	Tech Level	Type	Hands on	Prerequisites	Time slot	Stream
Power Supplies and Power Conversion									
21103 PC7	Powering USB Power Delivery Applications	Wouldn't it be great if any mobile device in your household and office could be charged from any other stationary device? Or even better - all mobile devices could power each other on demand using a standardized interface? This is what USB Power Delivery (PD) is trying to do for devices up to 100 W of power consumption. With the USB PD standardization is moving forward, more and more devices are supporting this standard as well as generic USB PD power sources are provided in cars, wall sockets and consumer products. These simplifications introduced on system level, however, entail a significant list of design challenges on converter level. This class is introducing the most relevant, power conversion specific USB PD specifications as well as design concepts supporting the fully-blown, programmable, bi-directional 100 W power control and application specific, simplified subsets.	1.75	2	New			4	6
								12	
21104 PC8	LEDs And LED Drivers For General Lighting	This class will start with the electrical properties of LEDs and the requirements for lamps/fixtures in residential and commercial lighting applications. These various parameters and constraints will be translated into design requirements/targets for LED lamps/fixtures. Both linear and switching LED drivers will be covered, with topologies, tradeoffs, analog and digital implementations, and examples discussed. Topics will include AC power conversion, Power Factor Correction (PFC), electrical isolation, thermal, dimming, efficacy, Color Rendering Index (CRI), Color Temperature (CCT), and flicker.	1.75	1	Updated			7	5
21105 PC9	Advanced Digital Power Supply Control Applied: Intelligent 2-Quadrant Converters (Em) Powering New Technologies	With digital power being one of the fastest growing power electronics market segments today, it enables a wide range of new applications from electric and hybrid vehicles over backup-power energy storage systems down to low(er) power USB 3.0 Power Delivery converters and pocket-sized "everything" battery packs. Although the converters used in these applications may look very different at a first glance, there is actually a large overlap in terms of features, functions and related challenges. While earlier classes on advanced digital control taught at this conference had their major focus on derivation and implementation of specific algorithms, this new class focuses on solving typical, practical trade-offs regarding their application in a real-world product environment, such as fundamental firmware architecture challenges in high-speed control systems and the application of adaptive and model predictive control concepts in conjunction with chaotic spread spectrum modulation for optimized EMC. Separated in theoretical blocks supported by live demos attendees will learn how to establish seamless bi-directional operation with optimized reliability, dynamic response and EMC on the example of a 1,600 W 48-to-12 V DC/DC multiphase converter.	4	5	New		Attendees should have basic knowledge of the dsPIC® DSC architecture and SMPS peripherals of the dsPIC DSC GS family	9 & 10	6



Class	Title	Abstract	Hours	Tech Level	Type	Hands on	Prerequisites	Time slot	Stream
Batteries									
21108 BAT1	Developing the power behind portable systems by understanding key trade-offs in battery technology and low power design.	Proper battery selection, recharging strategies and power management techniques are critical to the successful development of portable systems that result in a good user experience. This class will introduce fundamentals focusing on why many battery chemistries exist and when to select one over another. The proper charge restoration algorithms for secondary (rechargeable batteries) will be discussed resulting in an understanding of the trade-offs between charge time, cycle life and cost. Additional topics include selecting the correct battery and power management system for common system loading requirements resulting in increased run time.	1.75	1	Updated			8	5
21109 BAT2	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 SLA. With the charge algorithms identified, several charging topologies will be introduced that support a wide range of batteries. A review of each topology and component selection summary will be presented. Finally a multi-chemistry and multi-topology firmware solution with PC based GUI will be demonstrated. Real end-products will be dismantled and their charging requirements discussed including suggested solutions for each one.	1.75	2	Updated			11	5



Class	Title	Abstract	Hours	Tech Level	Type	Hands on	Prerequisites	Time slot	Stream
Low Power Designs									
21110 LPD1	Using 8-bit Microcontrollers in Battery Powered Devices: Techniques for Optimizing Power Consumption, Pin Count, Performance, and Precision	In this class you will learn how to efficiently use 8-bit PIC® and AVR® microcontrollers in battery powered devices. Tradeoffs between power consumption, pin count, performance, and precision will be explained. The following topics will be taught and explored hands-on using the AVR ATtiny416 microcontroller (4K of Flash, 20 pins): 8-bit MCU oscillators and their power, pin, performance, and precision tradeoffs -- Using 8-bit MCU oscillators and switching between them on-the-fly -- Using RTC to keep track of time while minimizing power by sleeping -- Using 1 pin to both drive an LED and detect a pushbutton -- Using the ADC to monitor battery voltage (without using an extra pin) -- Using 3 pins to drive a 128x64 OLED display via I2C with character expansion on-the-fly -- Switching off part of the circuit to minimize power without accidental reset	4	1	New	Yes	Attendees registering for this class should have some embedded C knowledge.	5 & 6	1
								11 & 12	2
21111 LPD2	Developing Ultra Low-Power applications with 32-bit Cortex-M0+ Flash Microcontrollers	This class will explore the usage of the various technological breakthroughs present on 32-bit ARM® Cortex®-M0+ Flash microcontrollers to solve power challenges for battery-powered applications and extend battery life from years to decades. The features discussed will include Best-in-class active mode current, Sleep modes that do not only gate away the clock signal to stop switching consumption, but also remove power from sub domains to fully eliminate leakage. Peripherals that support Sleepwalking, a technology that enables peripherals to request a clock when needed to wake-up from sleep modes and perform tasks without having to power-up the core and other support systems. Event System that allows peripherals to work together to solve complex tasks using minimal gates and also the lowest possible power. Attendees will be using Atmel Studio 7 Development Tools and Atmel Start code configurator to first build complete application with interrupt-based implementation and then using a combination of the low-power innovations; Dynamic Power Gating, DMA, Peripheral Event and Sleepwalking around RTC and ADC. Real time power consumption will be measured using powerful Data Visualizer Tool.	4	1	New	Yes		5 & 6	1
								11 & 12	2



Class	Title	Abstract	Hours	Tech Level	Type	Hands on	Prerequisites	Time slot	Stream
Signal Integrity and PCB Design									
21112 SIG1	Electromagnetic Compatibility (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	1	Repeat			7 & 8	5
								9 & 10	





Class	Title	Abstract	Hours	Tech Level	Type	Hands on	Prerequisites	Time slot	Stream
21200 MC7	OPEN SOURCE Graphical Programming and Rapid Prototyping using SCILAB/X2C for 8/16 and 32 bit MCUs from Microchip	This class will introduce the attendees into Graphical Programming and Rapid Prototyping for Microchips 8, 16 and 32 bit devices (incl. Atmel) using open source software packages SCILAB and X2C. The first part will give an introduction into SCILAB/X2C and the capabilities of the tools. In the second part high end motor control demos for different uC platforms are shown to simulate, spin and verify PMSM motors running sensorless algorithms. Participants will learn how to configure the tools, develop a model, simulate an application and generate code. In the final part PI/PID controler and sensorless observer parameters will be tuned and verified with X2C integrated realtime debugging tools.						8	6
								12	



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Class	Tuesday 12 September						Wednesday 13 September						Thursday 14 September						
	1	2	3		4		5	6	7		8		9	10	11		12		
	9:00	11:00	13:00	14:00	16:00	18:00	9:00	11:00	13:00	14:00	16:00	18:00	9:00	11:00	13:00	14:00	16:00	18:00	
21001 PNP1	█																		
21002 PNP2		█								█									
21003 PNP3				█						█									
21004 PNP4 (Hands On)							█	█								█	█		
21005 PNP5					█														
21006 PNP6 (Hands On)				█	█								█	█					
21007 PNP7														█					
21010 PNP10																█			
21011 PNP11																		█	
21013 DEV2	█																		
21015 DEV4 (Hands on)	█	█								█	█								
21016 DEV5 (Hands On)	█	█								█	█								
21017 DEV6 (Hands On)				█	█											█	█		
21018 DEV7		█																	
21019 DEV8 (Hands On)	█	█								█	█								
21025 FRM3													█						
21026 FRM4	█	█											█	█					
21028 FRM6 (Hands On)	█	█								█	█								
21029 FRM7											█								
21031 FRM9								█											
21032 FRM10 (Demo)				█	█								█	█					
21033 LNX1 (Hands On)	█	█								█	█								

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Class	Tuesday 12 September						Wednesday 13 September						Thursday 14 September					
	1	2	3		4		5	6	7		8		9	10	11		12	
	9:00	11:00	13:00	14:00	16:00	18:00	9:00	11:00	13:00	14:00	16:00	18:00	9:00	11:00	13:00	14:00	16:00	18:00
21034 LNX2 (Hands On)				█									█					
21035 LNX3 (Hands On)							█									█		
21040 FS1					█									█				
21041 BTL1 (Hands On)				█									█					
21043 TNG1							█											
21044 TNG2 (Demo)								█		█								
21045 TNG3										█								
21046 TNG4											█							
21048 GFX1 (Hands On)							█						█					
21049 GFX2 (Demo)																█		
21050 AN1				█														
21053 AN4					█													
21056 USB1	█																	
21058 USB3		█																
21059 USB4				█													█	
21061 USB6 (Demo)																	█	
21062 BLU1 (Hands On)	█									█								
21063 BLU2 (Hands On)				█									█					
21064 BLU3							█										█	
21068 LAN1											█							

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Slot number	Tuesday 12 September						Wednesday 13 September						Thursday 14 September												
	1		2		3		4		5		6		7		8		9		10		11		12		
	9:00	11:00	13:00	14:00	16:00	18:00	9:00	11:00	13:00	14:00	16:00	18:00	9:00	11:00	13:00	14:00	16:00	18:00	9:00	11:00	13:00	14:00	16:00	18:00	
21069 LAN2																									
21070 NET1 (Hands On)																									
21071 NET2 (Hands On)																									
21073 SEC1																									
21074 SEC2 (Hands On)																									
21075 SEC3 (Hands On)																									
21076 SEC4																									
21078 IoT1 (Demo)																									
21079 IoT2 (Demo)																									
21080 IoT3 (Hands On)																									
21085 IoT8																									
21087 AMS1																									
21088 AMS2																									
21089 AMS3																									
21090 AMS4																									
21091 MC1																									
21092 MC2																									
21093 MC3																									
21096 MC6																									
21097 PC1																									

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Slot number	Tuesday 12 September						Wednesday 13 September						Thursday 14 September					
	1	2	3		4		5	6	7		8		9	10	11		12	
	9:00	11:00	13:00	14:00	16:00	18:00	9:00	11:00	13:00	14:00	16:00	18:00	9:00	11:00	13:00	14:00	16:00	18:00
21098 PC2																		
21099 PC3																		
21100 PC4																		
21101 PC5																		
21102 PC6 (Demo)																		
21103 PC7																		
21104 PC8																		
21105 PC9																		
21108 BAT1																		
21109 BAT2																		
21110 LPD1 (Hands On)																		
21111 LPD2 (Hands On)																		
21112 SIG1																		
21200 MC7																		

Build Your Own Agenda
Use the Tables Below To Create Your European MASTERS Agenda

Tuesday 12 th September			
Start Time	Class Name	Class Number	Duration
09.00- 11.00			
11.00-13.00			
14.00-16.00			
16.00-18.00			

Wednesday 13th September

Start Time	Class Name	Class Number	Duration
09.00- 11.00			
11.00-13.00			
14.00-16.00			
16.00-18.00			

Thursday 14th September

Start Time	Class Name	Class Number	Duration
09.00- 11.00			
11.00-13.00			
14.00-16.00			
16.00-18.00			

2017

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