Milwaukee Tech Day: Thursday, September 19, 2019

Time	EP/Wireless	Interface and Sensing	Precision Labs Analog	Signal Chain	Power
Room Names	Woodland C/D	Woodland A/B	Hearthside	Fieldstone West	Fieldstone East
8:00 - 9:00	**Registration and Exhibits Open**				
9:00 - 10:00am	Ultra-low power sensing IoT applications with CC13x2/CC26x2	Top 10 gate driver pitfalls and how To address them	Robust design of ADC system inputs for EOS immunity	Battery fuel gauging deep dive: Characterization, programming, and going to production with TI's Impedance Track algorithm.	Understanding, measuring, and reducing output noise in DC/DC switching regulators
	Toby Pan	John Geiger	Dale Li	Joe Venable	Jason Arrigo/Alejandro Iraheta
10:00-10:30	**Break / Exhibits**				
10:30 - 11:30am	Battery-less Z-Stack 3.x using the Green Power feature for home automation a.k.a. Zigbee Green Power: Enable IoT battery-less devices	TI mmWave solutions	Understanding OpAmp stability intuitively and with SPICE simulations	TI clocking and time sync in real-time Ethernet	GaN power devices: Characteristics, design considerations, and applications
	Toby Pan	Brad Caldwell	Marek Lis	Thomas Mauer	Serkan Dusmez
11:30-12:30	**Lunch**				
12:30-1:30	Leveraging Yocto for embedded Linux development	How to isolate signal and power in industrial and automotive systems	An intuitive approach to fully differential amplifiers	Industrial load protection and diagnostics using smart high-side switches	EMI considerations for isolated power supplies: How to test, troubleshoot & resolve problems
	Brad Griffis	Manuel Chavez	Jacob Freet	Cameron Phillips	Ben Lough
1:30-1:45pm	**Break / Exhibits**				
1:45-2:45pm	SimpleLink Wi-Fi®: Empowering 2.4/5GHz IoT WiFi with strong security and low power	Predictive maintenance for high-reliability equipment	WEBENCH® Power Designer: Design custom power supplies, optimized for your requirements, in seconds	Designing the right amplifier into a current-sensing application	USB Type-C and TI redriver solutions
	Michael Reymond	Brian Dempsey	Arnod Vaze	Jacob Freet	Chris Griffith
2:45-3:00pm	**Break / Exhibits**				
3:00-4:00pm	Essential steps for successfully implementing innovative capacitive touch user interfaces	RS-485 system overview and the latest applications (including Power-Over-RS-485)	Comprehensive sensing solutions	PCB thermal design with ultra-small flip-chip packages (without thermal pad)	Control of Switch Mode Power Supplies (SMPS): A refresher on stability analysis
	Yiding Luo	Hao Liu	Mark Pearson	Arief Hernadi	Ben Lough

Track	Title	Abstract
EP/Wireless	Ultra-low power sensing IoT applications with CC13x2/CC26x2	This session showcases how the updated Sensor Controller in CC13x2/CC26x2 can be leveraged for ultra-low power sensing applications. By using the ULP-Sense BoosterPack with a CC1352 LaunchPad, several application examples are discussed as well as demonstrated to showcase the ultra-low power consumption. There will also be a hands-on training to get familiarized with how the Sensor Controller works.
EP/Wireless	Battery-less Z-Stack 3.x using the Green Power feature for home automation a.k.a. Zigbee Green Power: Enable IoT battery-less devices	Battery life is tremendously valued by consumers because it cuts down the bill of materials and the associated costs of battery replacement, while also enabling convenience of use and ease of maintenance. In parallel with the increased environmental concerns, regulatory authorities around the world continue to introduce mandatory power requirements for connected devices when their primary function is off. But what if no battery was required? Zigbee is a worldwide standard for low power, self-healing, mesh networks offering a complete and interoperable IoT solution for home and building automation. Built on the Zigbee PRO specification, Zigbee 3.0 enhances this IEEE 802.15.4 standard by adding security layers along with a Green Power feature that allows battery-less device operation. TI's newest implementation of the Zigbee Standard, Z-Stack 3.x, is part of the CC13x2/CC26x2 SimpleLink SDK. Every Zigbee 3.0 device with routing capabilities implements the Green Power Basic Proxy functionality for forward compatibility. However, Z-Stack 3.x also includes Green Power Device (GPD) sample projects for battery-less end device solutions along with Green Power Sink (GPS) applications to process the Green Power Data Frames (GPDF). In this session, we will demonstrate an applicable use case scenario involving a battery-less switch wirelessly communicating to a light using Z-Stack 3.x . The GPD will be powered by the mechanical energy harvested from a physical switch used in an energy harvesting reference design. After actuation, the GPD sends a GPDF to toggle an LED on the GPS. Zigbee 3.0 is interoperable and backwards compatible so devices such as the Amazon Echo Plus can be used in the network to either proxy the GPDF or directly control the status of the light.
EP/Wireless	Leveraging Yocto for embedded Linux development	A common question from users of TI's Processor SDK Linux is, "How do I add software <xyz> to the target file system?" This session is aimed at customers with basic to intermediate embedded Linux development knowledge that are looking to take the next step of building and customizing the file system for their end product. We will start by discussing how to build the file system from Processor SDK Linux. Then we will move into making your own customizations. This includes how to create your own layer, anatomy of a Yocto recipe, and image customization. The presentation will highlight common stumbling blocks to help you get started more quickly.
EP/Wireless	SimpleLink Wi-Fi®: Empowering 2.4/5GHz IoT WiFi with strong security and low power	This training will provide a system-level overview of embedded security for internet connected applications and show how SimpleLink Wi-Fi is setting a new standard for security in Wi-Fi SoCs. Security has recently become one of the main focuses for Internet of Things (IoT) products and is often cited as one of the toughest concepts for engineers to master. TI is leading the industry by integrating multi-layered security features in its SimpleLink Wi-Fi devices which enable developers to implement smart security solutions and create robust designs. SimpleLink Wi-Fi's wide range of security enablers give TI an advantage by reducing time to market and lowering the investment customers need to make to protect sensitive information such as intellectual property and personal data. In this training, we will examine multiple specific security challenges and discuss how they can be addressed with features built into the CC31xx/CC32xx SimpleLink Wi-Fi devices. We will compare these solutions to alternatives in the market and show how our advantage insecurity helps us win more in industrial IoT.

EP/Wireless	Essential steps for successfully implementing innovative capacitive touch user interfaces	Capacitive touch sensing is a unique human-machine interface technology that enables the creation of differentiated user interfaces that can bring value to a wide variety of products. Unfortunately, these aesthetic and functional improvements come with a different set of challenges to product designers. However, the reality is that capacitive touch isn't extremely challenging- it's just new and different. The challenges and risks associated with getting a capacitive touch design concept through the development pipeline and into production on time can be significantly reduced by having a proven design flow in place. This training will walk you through several essential steps on how to design a capacitive touch human machine interface (HMI). And this step-by-step design process matches a typical flow of a product design cycle from defining the system requirements to production readiness.

Interface and Sensing	Top 10 gate driver pitfalls and how To address them	Power conversion is at the heart of every system, and the trend towards higher currents and frequencies demands better gate driver ICs. We'll show some common blocks used for this conversion, what role the gate driver plays, and key concerns, followed with an interactive discussion on the 10 common gate driver pitfalls we see, and how to prevent them from happening in your designs.
Interface and Sensing	TI mmWave solutions	TI's single-chip mmWave sensor is changing the landscape of sensing technology by integrating RF, digital processing, MCU and antenna in a single SoC. This training introduces Antenna-on-Package technology and how to design hardware without mmWave antenna design expertise. Antenna-on-Package technology can be used for hardware design in applications such as Building Surveillance and Security, Safety Guards, Occupancy Detection, Gesture, Robotics, and more. Additionally, this training will cover general 60 GHz hardware development guidelines, Power-over-Ethernet, and production manufacturing considerations. It will introduce various prototype platforms (starter kits,data capture, and more) from the unified EVM ecosystem. The Power-over-Ethernet concepts for single-wire sensors in Building and Factory Automation will explore PoE topology, data connectivity and application demonstration for People Counting and Occupancy Detection market.
Interface and Sensing	How to isolate signal and power in industrial and automotive systems	In this session we will provide an overview of isolation terminology, concepts, and common isolation standards. TI's capacitive isolation technology along with the new offerings in our isolation portfolio (digital isolators, isolated interface, isolated power) will be covered. To help you solve design challenges in signal and power applications, we will also review new application notes and reference designs involving isolation devices.
Interface and Sensing	Predictive maintenance for high-reliability equipment	As the wheels of technology continue to roll forward, advances in the HVAC industry are shifting away from historically mechanical improvements and innovations to more electronic-based advances. One of the emerging technologies found in systems today is focused on predictive and preventative maintenance, extending the life of a typical HVAC system and reducing unnecessary wear and tear as well as time down. This course will introduce some of the predictive and preventative maintenance designs developed in TI, and help to create an overall understanding of the term. Preventive maintenance is the inspection, detection, and correction of developing failures either before they occur or before they develop into major defects. To prevent equipment and machinery breakdown; tests, measurements, adjustments, parts replacement, and cleaning are specifically performed. Smart ecosystem integration is composed of: record measurement data, analyze trends, diagnose problems and anticipate future malfunction.
Interface and Sensing	RS-485 system overview and the latest applications (including Power-Over-RS-485)	This training covers the RS-485 overview of key physical layer parameters, implementation challenges, and reference circuits. The most frequent questions encountered by designers during implementation are discussed. Each topic comes with an application note or lab measurement data for further investigation. The newly developed power over RS-485 system design is also discussed in detail.

Precision Labs Analog	Robust design of ADC system inputs for EOS immunity	Electrical overstress (EOS) damage is one of the most common issues that affects product reliability. The EOS failures that occur from improperly designed circuits damage reputation, cause revenue loss, and may even present legal issues. The overstress susceptibility issue may be detected during compliance testing, but is often only seen in the end equipment user's application. This presentation will show you how to design EOS protection circuitry that will prevent damage to the device from large transient input signals with little to no impact on the circuit performance. A detailed example of an ADC acquisition system design will be presented with consideration of internal device structures and proper selection of external protection circuitry. Design techniques will include hand calculations, TINA SPICE analysis, and real world measured results. The design will consider the impact of parasitic from the protection circuitry, and their effects on system performance. For example, many protection diodes have parasitic capacitance and leakage current that can impact accuracy. The methods covered will enable you to a first-pass, robust PCB design to avoid any EOS issues in the future.
Precision Labs Analog	Understanding OpAmp stability intuitively and with SPICE simulations	In this presentation, we will discuss the common causes of op-amp stability issues as well as how to identify stability issues in the lab using common equipment. We will review Bode plots, basic stability theory, how to simulate op amp stability in SPICE, and address specific compensation techniques with detailed analysis of the solutions. We will discuss the types of issues that op amp stability can cause in production systems as well as how to identify issues in the lab. We will cover Bode plots and basic stability theory using phase margin, small-signal overshoot and rate of closure analysis. We will explain how to perform open-loop SPICE simulations to obtain the rate of closure and phase margin of op amp circuits. We will also discuss why capacitive loads cause stability issues and will present the first capacitive load compensation technique using an isolation resistor and discuss Riso with dual-feedback stability compensation method.
Precision Labs Analog	An intuitive approach to fully differential amplifiers	With the increasing use of ADCs with differential inputs, fully differential amplifiers (FDAs) are becoming more important in high-fidelity signal chain design. FDAs provide significant benefits over other methods (discrete amplifiers, baluns) for converting single ended signals into differential signals, as well as for differential signal amplification/attenuation. This session will cover when to use FDAs, what they do, how do they work, where they are applicable, and what their benefits are. The session will be presented in an intuitive and easy to understand visual demonstration of signal inputs and differential outputs. Participants will leave with a greater understanding of FDA circuits/benefits and how to use them to win sockets in their customers' applications.
Precision Labs Analog	WEBENCH® Power Designer: Design custom power supplies, optimized for your requirements, in seconds	WEBENCH® Power Designer helps you create and optimize custom power supply circuits based on your requirements. WEBENCH® supports both DC-DC and AC-DC design needs through a variety of switching power supply topologies from the tiniest nanopower Modules to the isolated and high power Flyback and LLC controllers. Powerful and intuitive tool helps you in end to end power supply design in four simple steps: Select-Customize-Simulate-Export, saving time during all phases of your design process. Join us to learn more about solving your power supply design challenges using WEBENCH® and several design 'walk-throughs.'
Precision Labs Analog	Comprehensive sensing solutions	Learn more about TI sensing solutions for applications involving temperature, humidity, current, magnetic/hall and ultrasonic/time-of-flight

Signal Chain	Battery fuel gauging deep dive: Characterization, programming, and going to production with TI's Impedance Track algorithm.	So many systems today are designed to be portable, using a wide variety of battery chemistries, form factors and use cases. Accurately gauging these batteries is of utmost concern in some systems. TI has been developing and refining our "Impedance Track" (IT) algorithm for almost 2 decades. Unlike coulomb counting gauges (CEDV) that require a full discharge and charge to full in order to learn State of Charge (SOC), the IT algorithm constantly learns new cell impedance and capacity dynamically over time providing an extremely accurate SOC over the entire life of the product. IT also eliminates the need to do any charge & discharge cycling in production (which is time consuming and costly). Additionally we expanded IT into other end applications, for example in rarely discharged or high-reliability systems where packs cannot be cycled.
Signal Chain	TI clocking and time sync in real-time Ethernet	This presentation discusses the state of the art clocking and time synchronization methods used in today's industrial Ethernet networks (IEEE 1588, PTCP, EtherCAT distributed clocks, Sercos MDT0 synchronization). Those enable an application jitter of 40 to 100ns. Many end equipments (CNC control, position encoder, injection molding, laser cutting)) need a better clock accuracy of below 15 ns. As a second part this presentation discusses possible ways to reduce the application jitter to below 15ns (e.g., synchronous Ethernet, Ethernet frame bridge delay measurement with clock synchronization updates).
Signal Chain	Industrial load protection and diagnostics using smart high-side switches	As industrial electronics become more compact, connected, and high power it is important to ensure that power is supplied to remote loads efficiently and safely. This means a push towards high-side switches with lower resistance, more diagnostic features, easier controllability, and higher reliability. TI’s family of Smart Power Switches offer features to meet these requirements, with adjustable current limiting and accurate diagnostics that enable customers to ensure safe levels of output current while improving thermal performance and increasing the ability to implement predictive maintenance functionality. This presentation will discuss Smart Power Switch system advantages for off-board load driving in various industrial applications (PLC, Remote I/O, Motor Driver), with an emphasis on addressing the requirements, trends, and meeting the standards specific to industrial markets (IEC61000-4-x, IEC61131, IEC61800)
Signal Chain	Designing the right amplifier into a current-sensing application	Given the broad range of circuit designs that engineers can use to implement current sensing in their system and the diverse set of devices TI has in its portfolio to perform this function, it can be challenging to know where to start when engaging with customers on this portion of their design. In this training session we will walk through the key care-abouts in several different current sensing circuits and highlight specific situations where the various solutions offered by TI’s amplifier product portfolio are best suited. We will go into the detailed design of each of these systems and how to best take advantage of the key device specifications and features of TI’s products to optimize the overall design for the customer’s end system.
Signal Chain	PCB thermal design with ultra-small flip-chip packages (without thermal pad)	As ICs get smaller and smaller, new and innovative packaging techniques are required. In the past for a package with DAP, it was simple enough to get the θJA for a package and calculate out your expected die temperature. Now we must use different temperature parameters like θJC , ΨJB and ΨJT to accurately analyze a circuit. This presentation is a deep dive into thermal modeling and layout best practice, with emphasis on these ultra small packages. Many examples are shown using the evaluation board layout along with actual thermal camera images. A head-to-head design design challenge between a traditional SOIC-8 package with DAP and TI's new "Hotrod" packaging is discussed.

Power	Understanding, measuring, and reducing output noise in DC/DC switching regulators	This presentation addresses several common concerns about applications requiring ultra low noise power supplies (e.g. medical imaging, test and measurement, wearables/sensors, etc.). The agenda will include a quick review of understanding, measuring, and reducing noise in power supplies.Then we will look into the difference in noise performance of shielded vs unshielded inductors along with inductor SRF specifications and the effect on filtering ability. Further, we will discuss mixing capacitors of different types and the effect on overall output noise. This particular topic can be relevant with the ongoing shortage of ceramic capacitors in the industry. We will then compare the output noise reduction levels with two differen tapproaches: using low noise LDOs and second stage filtering techniques. This is a common approach used by customers and we want to show the tradeoffs of each implementation. We will also discuss the tradeoffs of light load efficiency and low noise. Normally these two don't mix, but we want to show ways to achieve both.
Power	GaN power devices: Characteristics, design considerations, and applications	This session explores in detail the characteristics of GaN power devices from material properties to construction differences. The design considerations of GaN devices in power conversion applications are examined in some detail. The differentiating features of TI's LMG3410 device are explained. In the latter part of the presentation, a typical application of GaN power device in a Zero Voltage Switched Interleaved Critical Conduction Mode Totem pole Bridgeless PFC is discussed. The circuit, basic operation, design challenges and test results of this design (TIDA-00961) will be discussed.
Power	EMI considerations for isolated power supplies: How to test, troubleshoot & resolve problems	Every application/end-equipment requires power. EMI is an essential part of every power supply design, but too often gets relegated to latter stages of design flow, where resolving issues can be time consuming, costly, and have a big impact on efficiency. A major objective of this topic is to dispel FAE fears of EMI, allowing them to converse with customers on EMI issues, and be able to help the customer directly in solving them. The topic will begin with a fundamental review of EMI standards and measurement methods, explaining associated terminology and standard practices. It will outline majors causes and sources of EMI issues. Fundamentally EMI is all about component parasitics that are not even represented in design schematics – parasitics cause EMI – bulk cap esr causes Differential-Mode (DM) interference; transformer input-output parasitic capacitance causes Common-Mode (CM) interference. EMI filter components have parasitic capacitance and inductance that limit their useful frequency range, and can even make EMI worse. The topic will then go on to show how to design for low EMI at source. Different transformer internal structures are analysed for their relative impacts on CM interference – not all structures are equal, and careful transformer layer structure and arrangement can reduce CM. With additional cancellation windings and clever shielding arrangements, the CM can even be nulled to almost zero. Practical techniques are shown for measuring and assessing the CM performance, separating DM from CM, etc., to show how to debug and root cause power supply EMI issues. Practical examples will be shown to highlight the techniques, solutions, and benefits. Finally, a summary example is shown of a compact, high-density 65-W USB-PD adaptor, showing how a few basic changes resulted in a 60 dB improvement at the fundamental switching frequency, without needing a major sacrifice in efficiency.
Power	USB Type-C and TI redriver solutions	USB compliance is a hard requirement for many system designs that have USB ports, whether it is USB2, USB3 or USB Type-C. Due to the high speed nature of the USB signal, it is inevitable that signal will suffer signal integrity degradation when USB signal traverse through long PCB trace or cable, causing USB compliance failure. USB redriver are simple and easy to use solution to solve this system pain point. This presentation introduces various USB redrivers are solutions for USB2, USB3 and USB Type-C to achieve USB compliance.

Power	Control of Switch Mode Power Supplies (SMPS): A refresher on stability analysis	This presentation provides a qualitative review of how Switched Mode Power Supplies (SMPS) are controlled. It will be quite general but I'll use many TI SMPS controllers to illustrate particular points. For example, the UCC28180 PFC controller will be used to show how leading edge modulation allows power factor correction without direct line voltage sensing. The main point is that control of SMPS is sometimes difficult to understand. Many sources use a theoretical approach with an emphasis on Loop Gain, complex frequency, H(s), G(s) and so on. The aim of this presentation is to review analog control theory in an intuitive manner without using too much mathematics and using visual aids to help understanding. It will also highlight the benefits and drawbacks of some of the most popular control methods.