Minneapolis Tech Day - October 24, 2017

Time	Session	Sensors and Solutions	Signal Chain	Power	Interface	Embedded Processing	Wireless Connectivity
8:00 - 9:00		Registration and Exhibits Open					
9:00 - 10:00	1	Becoming a Jedi Master - Gesture Control Using 3D Time-of-Flight Sensor for Industrial and Automotive	Driving a SAR ADC – Part 1: Selecting the Amplifier	Webench: Modern DCDC simulation tool (Vs. LTSpice)	Industrial Ethernet Buses: Understanding the Requirements and Choosing the Correct PHY	Captivate Capacitive Touch	RF Basics
10:00-10:30		Breaks / Exhibits					
10:30 -11:30	2	Optical Light and Proximity Sensors	Driving a SAR ADC – Part 2: Optimizing the Design with TINA	Optimizing and mitigating EMI, Thermals, noise in Automotive DC/DC converters	Testing and Troubleshooting Your Ethernet Phy Design Using TI's Embedded Phy Diagnostic Tools	mmWave for Industrial Sensing	Demystifying Radio Certification for TI Wireless Devices
11:30-12:00		Lunch					
12:00 - 1:00	3	TI's Wide World of Sensing – Temperature, Humidity, and Current Sensing Overview	BLDC motor Driver: Integration Advantages and System Improvements	Dynamic Limitations of Switched Mode Power Supplies	USB Type C overview	SimpleLink SDK TI RTOS	Designing long range Sub 1-GHz connected networks with TI's 15.4 Stack
1:00 - 1:15		Breaks / Exhibits					
1:15 - 2:15	4	Design considerations and applications for capacitive and inductive based sensing systems.	The Multiple-Ins-And-Outs of Multiplexers	Battery Technology And Portable Power Management Overview	Isolation Products: Benefits, Applications & Systems Considerations	IOT Sensor to Cloud	What is new in Bluetooth 5
2:15 - 2:45		Breaks / Exhibits					
2:45 - 3:45	5	Ultrasonic sensing based level, concentration and flow measurement	We could all use a little more bandwidth: A Closer Look at Bandwidth of Operational Amplifiers	Survey of Step-Down Regulator Control Architectures for TPS and LM Devices	Design & Protection of Analog Outputs for Industrial Automation	Voice Recognition	SimpleLink WiFi

Track	Session Title	Abstract
Sensors and Solutions	Becoming a Jedi Master - Gesture Control Using 3D Time-of-Flight Sensor for Industrial and Automotive	3D Time of Flight is a fast growing technology that is suitable for various applications and use cases such as Robotic navigation, occupancy sensing, obstacle avoidance and Gesture control. In this training you will learn about basics of 3D time-of-flight, key care about and solutions that we offer. In specific, we will also talk about one use case of gesture control and how it is applied in various applications, and see a video demo of gesture control using OPT8320 time-of-flight sensor.
Sensors and Solutions	Optical Light and Proximity Sensors	Smart and efficient sensors are rapidly transforming many sectors within the Industrial and Automotive markets such as building automation, factory automation, appliances and lighting, to name a few. In this seminar, we will discuss how our portfolio of light sensors can help with uses cases like smart lighting, display backlighting, automotive lighting etc. We will also cover the latest on the upcoming optical proximity/distance measurement device that is a great fit for presence detection, ranging, level measurement, coarse gesture control and others.
Sensors and Solutions	TI's Wide World of Sensing – Temperature, Humidity, and Current Sensing Overview	TI has a growing portfolio of sensing technologies for measuring the world around us. In this session we will review a number of environmental and magnetic sensing technologies, and how TI solutions can help simplify the most demanding sensing applications.
Sensors and Solutions	Design considerations and applications for capacitive and inductive based sensing systems.	In this session, we will introduce and compare capacitive sensing with Inductive sensing technologies and show how to select the right technology for various applications. A review of design considerations like sensor design, PCB layout and data filtering will be covered and will include TI Designs and demos that show implementation of touch-on-metal buttons, encoders for control knobs, fan speed measurement, proximity sensing, and door/window sensors.
Sensors and Solutions	Ultrasonic sensing based level, concentration and flow measurement	There is a need to accurately measure fluid level, concentration and flow in medical equipment, gas/fluid metering, home appliances and automotive applications. Because these systems often require high accuracy and are in remote locations requiring monitoring powered by a battery source, ultrasonic sensing enables a low power and high accuracy sensing technology. In this session we will do a deep dive on the technology, how it works and its capabilities and limitations over other solutions. We will walk through the piezo selection process depending on what you are measuring(level, concentration, flow) and in what medium (air, fluid etc) and how to mount the piezo to ensure no acoustic gaps. We will talk about how to select the time-of-flight measurement and what "stop-watch" (microcontroller, C2000 vs TDC7200) to use depending the use case and designing the software for your application, and discuss what design tools are available from TI today.
Signal Chain	Driving a SAR ADC – Part 1: Selecting the Amplifier	SAR converters are common in many different system level designs. Motor control, test and measurement, and process control are just a few examples of common SAR applications. The heart of any end equipment signal chain is the amplifier and SAR ADC signal path. The main difficulty in designing a SAR converter into a system is to select the driving amplifier and its associated filter circuit. Texas Instruments has thousands of different op amps to choose from and each amplifier has 30 or more different specifications in the data sheet table. With this in mind, the process of selecting the amplifier can seem overwhelming even to experienced engineers. This presentation will help identify the key op amp parameters important in driving a SAR converter. For example, the presentation will consider the linear input and output range of the amplifier as well as the SAR converter. We will also look at how different amplifier configurations such as inverting and non-inverting impact ADC performance. Also, we will look at how features such as rail-to-rail input and zero input crossover topologies affect ac accuracy. We will also cover how to interface fully differential amplifiers and instrumentation amplifiers into SAR inputs. Some key parameters for op amps for interfacing to SAR ADC will be discussed and how to verify their accuracy in TINA SPICE will be covered. Designers can use the methods covered in this presentation to reach design goals on first pass PCB design. Note that this is part 1 of a two part series and both parts are needed to get a full understanding of the subject.
Signal Chain	Driving a SAR ADC – Part 2: Optimizing the Design with TINA	The drive circuit for a SAR ADC consists of and amplifier and an RC input filter. This seemingly simple circuit can be challenging to optimize. Traditionally, many engineers have selected the components through trial and error in the lab and still not achieved their accuracy target. This approach is time consuming and will not yield optimal results. In this presentation, we will learn how to model any SAR ADC input. We will also provide an algorithm for selecting the initial values of the input RC filter. The algorithm will also provide guidance in selecting the amplifier. Furthermore, we will learn how to optimize the selection of the RC filter through TINA SPICE simulation. The SPICE simulation will also confirm that the amplifier has the required dynamic performance to drive the switched capacitor input and settle to the data converter's resolution. We will also cover a number of SPICE simulation "tricks" that will help to improve the accuracy of your result. This presentation will show a definition by example of optimizing and verifying the SAR ADC drive circuit. Designers can use the methods covered in this presentation to reach design goals on first pass PCB design. Note that this is part 1 of a two part series and both parts are needed to get a full understanding of the subject.
Signal Chain	BLDC motor Driver: Integration Advantages and System Improvements	The presentation will help designers and engineering managers understand the key technologies used in BLDC motor drivers. The motor drive technologies that will be discussed are sensored, sensorless, single hall operation, adaptive drive angle advance, initial position detection and acoustic improvements. This background is useful for determining the improvements that can be made using TI's integrated motor drive solutions.

Signal Chain	The Multiple-Ins-And-Outs of Multiplexers	Did you know that distortion can be impacted by multiplexer on-resistance flatness? Do you know how input signal settling is impacted by multiplexer on-capacitance? In addition to answering those questions, we will show you nearly everything you ever wanted to know about the ac and dc characteristics of multiplexers: * Learn how MUX on-resistance effects gain and non-linearity when used with amplifier circuits. * Use simulation to see how the settling behavior of multiplexers is affected by MUX on capacitance. * Study how leakage current can impact the offset error and how source impedance impacts this problem. * Understand how charge injection can introduce errors, and how this is impacted by the size of the load capacitance.
Signal Chain	We could all use a little more bandwidth: A Closer Look at Bandwidth of Operational Amplifiers	In this amplifier session, we'll discuss gain and how it's represented linearly and in decibels. Poles, zeros, bode plots, cutoff frequency, and the definition of bandwidth will also be discussed. TINA-TI will be used to correlate bandwidth simulation results with our theoretical calculations. We'll discuss open and closed loop gain, gain bandwidth product, and quiescent current vs. bandwidth. We will also simulate the bandwidth of a circuit and show that it correlates to our calculated results and talk about why you should always use the non-inverting gain to calculate bandwidth and secondary effects (namely high-frequency pole location) on bandwidth.
Power	Webench: Modern DCDC simulation tool (Vs. LTSpice)	This presentation will provide an overview of all Webench tools and then provide a deeper demonstration of the capabilities of the power webench tools. The demonstrations and examples will focus on common challenges and how to address these via simulations in the webench environment.
Power	Optimizing and mitigating EMI, Thermals, noise in Automotive DC/DC converters	The presentation focuses largely on EMI management and mitigation. An understanding of EMI propagation modes – conducted, capacitive (electric field) and inductive (magnetic field) coupling – is provided, and recommended measurement techniques for EMI are detailed. A procedure to predict EMI with simulation tools is also described. Recognizing that transient voltage (dv/dt) and transient current (di/dt) waveforms generated during power MOSFET switching are the central to EMI, a comprehensive illustration of the parasitic elements that affect switching performance and EMI behaviors is provided. By understanding the contribution of circuit parasitics, suggestions are offered for their minimization to reduce the EMI signature at high frequencies. Also, an emphasis on compact, optimized power stage layout is provided that lowers EMI for easier regulatory compliance. Results are presented for several DC/DC circuits that highlight system-level and IC features used to lower EMI.
Power	Dynamic Limitations of Switched Mode Power Supplies	For several reasons power supplies are limited in dynamic behavior in response to load changes; this short presentation explains those physical reasons in depth. One non-linear effect will be presented followed by 4 effects which limit maximum allowed speed (or Bandwidth) of overall control. For the non-linear effect time domain analysis will give the best understanding of its behavior. For the 4 effects that limit practical control bandwidth, both time domain and frequency domain will be used to better understand them. With frequency domain the phase shift of each of these 4 effects can be quantified to allow evaluation of systems where more than one of these effects are active.
Power	Battery Technology And Portable Power Management Overview	In this session, we will cover the basic characteristics of different battery systems, and compare their performance. Emphasis will be placed on Li-Ion systems which are the most popular for portable devices due to their high energy density and small / lightweight form factors. From there, we will review how to properly select the key components around the battery pack which are essential for ensuring safety, efficient fast charging, and accurate capacity monitoring in the system. And ultimately, we will review some technology developments from TI such as universal input Buck-Boost charging solutions for USB Type-C / PD power sources.
Power	Survey of Step-Down Regulator Control Architectures for TPS and LM Devices	Presentation will begin with an overview of key elements of switching power supply controllers. Fixed frequency linear control schemes will then be presented starting with the basic voltage mode control and following with current mode control and enhancements of both approaches. Then variable frequency approaches starting with the basic hysteretic controller will be presented. Then enhancements to stabilize frequency and simplify design will be presented. It will conclude with a "Best to Use When" summary and pointers to additional resources on the Web.
Interface	Industrial Ethernet Buses: Understanding the Requirements and Choosing the Correct PHY	This course will focus around TI's 10/100/1G Ethernet Phys for industrial markets. We begin with an introduction to Ethernet and a review of the different electrical signal/encoding schemes for 10/100/1G. We will dive into the various features that make TI Phys flexible and robust for industrial Ethernet. We will review the different industrial Ethernet protocols and tips for good Ethernet EMC/EMI design.
Interface	Testing and Troubleshooting Your Ethernet Phy Design Using TI's Embedded Phy Diagnostic Tools	Getting a new Phy design up and running can be challenging. Fortunately, TI Phys have embedded tools to make this job easier. We will show you how to access these features using the "USB-2-MDIO" tool for register level control during debug and testing of the TI Phy. This handy utility can help during EMC tests or signal integrity testing. We also discuss some simple fixtures and debug procedures for TI Phys.

Interface	USB Type C overview	In this seminar we will review USB Type-C terminology, what is Type-C / PD, and what it isn't. We will look at the Type-C cable and signal lines and review what 'PD' means and the related power profiles. Lastly , we will touch on implementation and protection circuitry.
Interface	Isolation Products: Benefits, Applications & Systems Considerations	Isolation products are used in a variety of applications like Factory Automation, Industrial Motor Drives, Medical equipment, EV and HEVs, Grid Infrastructure and Renewable energy, Industrial Power Supplies and many more. The isolation needs for each end application is different from the others. This presentation aims at explaining the isolation use and requirements for key end equipment, while highlighting released and roadmap products that are most suited for each equipment sector. We'll also talk about key system level considerations, such as EMC, and how they impact isolated systems differently from non-isolated systems. Along the way, we'll briefly revisit key isolation terminologies and standards.
Interface	Design & Protection of Analog Outputs for Industrial Automation	Analog outputs in industrial automation come in a variety of configurations that each must deliver strong precision while passing stringent EMI / EMC certification tests. This session will address these systems and their challenges by explaining each configuration, walking through example designs for analog outputs, and a discussion of immunity tests and the design of protection circuits for these tests. We will also take a look at the HART communication protocol, which is growing in popularity world-wide, and the benefits that it provides to these systems.
Embedded Processing	Captivate Capacitive Touch	It's not uncommon to hear about delays in a product development schedule due to issues with the capacitive touch user interface. While some issues are unpredictable and affect development schedules, many issues can be mitigated by asking the right questions at the right point in the capacitive touch design process. Attend this seminar to learn a solid capacitive touch development process that identifies risks to reliability early, so that electrical and mechanical design changes are not required late in the product development process when changes become expensive. Along the way, you will see a demonstration of how to get started on a new design quickly using the CapTIvate Design Center and Code Composer Studio. Time for questions will be allotted.
Embedded Processing	mmWave for Industrial Sensing	mmWave sensors is a recently announced, innovative technology from TI that brings environmentally robust, high accuracy, single-chip sensing to a wide variety of industrial applications across sectors like building automation, factory automation, and industrial transport. This presentation will introduce TI mmWave as a sensing technology and the value it can bring into sensing systems, review the fundamentals of FMCW radar on which mmWave sensing is based, and then finally walk through an example of how radar data is collected, processed, and visualized using the EVM out-of-box (OOB) demo.
Embedded Processing	SimpleLink SDK TI RTOS	SimpleLink SDK RTOS Integration: We'll take a detailed look at how both TI-RTOS and FreeRTOS are supported in the SimpleLink SDKs. Items to be covered include features, configuration, footprint, tools and support.
Embedded Processing	IOT Sensor to Cloud	In this presentation we will introduce the long range SimpleLink Sub-1 GHz Sensor-to-Cloud IoT Gateway solution. We will present the key elements of the whole system, which revolves around the dual-band CC1350 device. Using TI's own new SimpleLink Long Range mode and our royalty-free Sub-1 networking stack (based on 802.15.4 standard), we will present a solution which enable devices operating in a Sub-1 GHz network to connect directly to popular cloud services (such as AWS and IBM Bluemix) using an IoT gateway. We will present both the Industrial Linux gateway solution based on the BeagleBone Black AM335x platform as well as the RTOS gateway solution based on SimpleLink Wi-Fi CC3220 platform. This gives customers a unified approach to easily create fully-managed end to end long range networks using TI technology. Leveraging on the dual band and flexi-radio capabilities of CC1350, headless devices can also directly interact with Smartphones as an extended display (or a commissioning tool) for a complete device-to-cloud/device-mobile communication experience.
Embedded Processing	Voice Recognition	Texas Instruments provides scalable embedded solutions enabling the next generation of voice activated products. The rapid increase in voice activated applications has created a demand for systems that can extract clear voice from noisy environments. Frequently these systems will combine multi-microphone arrays with digital signal processing to enable a superior user experience by removing ambient noise, cancelling echo and focusing on the individual giving voice commands. TI provides DSP libraries and application examples implementing key algorithms such as hot-word detection, beamforming, multiple source selection and echo cancellation, to name a few. Texas Instruments' family of Digital Signal Processors excels in these applications, offloading the complex real-time computation from the main applications processor. This session will discuss the C55xx and C6747 series of TI DSPs, associated software algorithm libraries for processing microphone array data, tools for microphone array design and example reference systems that are featured as published TI Designs.
Wireless Connectivity	RF Basics	A typical digital wireless communication system contains a transmitter, receiver, filtering and matching circuitry and an antenna. How these are put together in a working RF system requires an understanding of fundamental parameters required in RF system design. These parameters and basic RF aware PCB layout techniques are presented in this session. A variety of tools and RF products suitable for wide range of wireless applications are also presented.

Wireless Connectivity	Demystifying Radio Certification for TI Wireless Devices	The radio frequency spectrum is a finite and increasingly precious world resource, and needs to be managed effectively. TI customers for wireless devices are typically working in the ISM bands where rules for fair sharing of the limited bandwidth are getting tighter as the spectrum increasingly gets over crowded. There are more newcomers to the wireless product market as companies venture into the IoT, and they are looking for ways to qualify their product without having to understand the nuances of the spectrum access or endure the costs of certification.
Wireless Connectivity	Designing long range Sub 1-GHz connected networks with TI's 15.4 Stack	TI 15.4-Stack makes designing long range Sub1-Ghz cloud connected or ad-hoc networks easy. It is an implementation of IEEE 802.15.4e/g specification allowing for star-based based network solutions. In addition it, implements the WiSun based Frequency hopping scheme for better link reliability and allows to transmit at higher transmit power in FCC band. The software stack provide the link controller module that makes the task of creating, joining and managing networks a breeze. Using the Out of box sensor and collector example applications quickly see Sub-1GHz to IP communication. Use these application as a starting point for your application development and get to market faster with reliable, robust, and secure wireless networking solution. Join the class to learn more and visit: http://www.ti.com/tool/simplelink-cc13x0-sdk to get the software and get started.
Wireless Connectivity	What is new in Bluetooth 5	Overview of the new Bluetooth® 5 protocol including detailed dive into the new features of high speed 2Mbps mode, long range Coded PHYs, and Advertising Extensions. Learn about the Bluetooth 5 implementation, top considerations for a new design, and many use-cases in industrial, building automation, appliances and more. Easily launch your first Bluetooth 5 design with TI’s SimpleLink CC2640R2F wireless MCU.
Wireless Connectivity	SimpleLink WiFi	TI's SimpleLink Wi-Fi CC3220 wireless MCU and CC3120 Wireless Networking Processor are the lowest power Wi-Fi products for Internet of Things (IoT) applications. This session will have information on product offering, technical details on key use cases(including reference designs and software. We will also cover some key topics for this platform including: power management, OTA, and provisioning.