



# Texas Instruments

## Tech Day: Philadelphia – Oct. 28

### Session Titles and Abstracts

Track and Course	Abstracts
<b>Track 1 – Sensors and Instrumentation</b>	
Design Considerations for the Analog Front End of ECG Systems	An electrocardiogram (ECG) measures the electric potential generated by the heart during a contraction. The electrodes that touch the skin communicate a unique electrical signature based on their position with respect to the heart, which is useful when diagnosing problems such as abnormal heart rhythms, hypertrophy, myocardial infarction and heart-valve blockages. Accurately acquiring these electric signals presents an interesting challenge at the board and system level in the midst of dynamic electrode contact resistance, noise and motion artifacts from the patient. This presentation will provide biomedical background information on the critical nodes of the heart; 12 different lead configurations of interest in an ECG measurement; and a survey of techniques used in the analog electronics domain to condition ECG signals, including noise rejection, optimizing the signal-to-noise ratio (i.e. amplifying and conditioning $\mu\text{V}$ of signal in the presence of $\text{V}$ of 50- to 60-Hz noise), filtering, dynamic adjustment of gain and the optimum ADC interface.
High-Speed Op-Amp Design Considerations	Voltage feedback (VFB) and current feedback (CFB) amplifiers are the two most common high-speed op-amp architectures in use today. This presentation develops VFB and CFB models from simplified schematics; shows the impact on amplifier circuit design, feedback and stability; and highlights the similarities and differences. Application comparisons are shown to point designers to the right type of op amp given the application they are developing. The presentation then shows how these principles are applied to high-speed op-amp PCB layouts, giving practical dos and don'ts of high-speed layout.
Op-Amp Stone Soup: A "Cookbook" Collection of Single-Supply Op-Amp Circuits	This presentation offers a "stone soup" collection of useful op-amp circuits to solve linear application problems on a daily basis. Each op-amp circuit (prebuilt in the included TINA-TI™ SPICE schematic) is presented as a definition-by-example, with a brief overview of its functionality, applicable transfer function and/or waveforms and key equations for rescaling the function to your exact application. A sampling of the ingredients include the following circuits: voltage-to-current conversion; drive circuits (bridge-tied load, parallel op amps, high-current cascade reference buffer); translation circuits (single-ended to differential, differential to single-ended, differential in to differential out); conditioning circuits (full-wave rectifier, supply splitter, integrator amp in feedback, isolation amplifier, $G = 1/G = -1$ amp); and comparator circuits (AC coupled, comparator with hysteresis).
Sensors and the Analog Interface	In this presentation, we will discuss how to monitor many different physical phenomena, such as temperature, air flow, humidity and power. We will discuss numerous sensor characteristics and the various styles of sensor signal conditioning that you can implement in your systems. Throughout this presentation, the output of every sensor circuit will be suitable for conversion to a digital signal. You will leave this session fully armed to tackle your on-board or remote sensor challenges.
Instrumentation Amplifier Noise Analysis	In this presentation, you'll learn about the calculation, simulation and measurement of intrinsic noise in an instrumentation amplifier. Intrinsic noise is noise generated by resistors, op amps and other active devices in the circuit. The presentation does not cover extrinsic noise (e.g. RFI and EMI pick-up) but does cover specific real-world examples where the peak-to-peak output noise is predicted, simulated and measured. Using an instrumentation amplifier correctly to avoid internal node saturation will also be discussed.
<b>Track 2 – Embedded Processing</b>	
Embedded Web Server-Enabled Design Made Easy with Stellaris® MCUs (Part 1)	This presentation will demonstrate the Stellaris® LM3S6965 Ethernet evaluation kit with Code Red Technologies' Red Suite tools to set up embedded Web solutions for a remote control application. The Stellaris LM3S6965 is an ARM Cortex-M3 microcontroller with integrated 10/100 Ethernet MAC+PHY. The Stellaris LM3S6965 Ethernet evaluation kit features several different implementations of embedded Web servers. The fully functional Red Suite evaluation tools also feature real-time code and interrupt trace capability with the Red Trace feature. The Web server application will demonstrate how the provided royalty-free Stellaris libraries make it painless to have networking up and running in minutes, whether using an RTOS or not. Attendees will get a good understanding of how they can start building even the most advanced applications with Stellaris microcontrollers quickly and easily.
Embedded Web Server-Enabled Design Made Easy with Stellaris® MCUs (Part 2)	This presentation will demonstrate the Stellaris® LM3S6965 Ethernet evaluation kit with Code Red Technologies' Red Suite tools to set up embedded Web solutions for a remote control application. The Stellaris LM3S6965 is an ARM Cortex-M3 microcontroller with integrated 10/100 Ethernet MAC+PHY. The Stellaris LM3S6965 Ethernet evaluation kit features several different implementations of embedded Web servers. The fully functional Red Suite evaluation tools also feature real-time code and interrupt trace capability with the Red Trace feature. The Web server application will demonstrate how the provided royalty-free Stellaris libraries make it painless to have networking up and running in minutes, whether using an RTOS or not. Attendees will get a good understanding of how they can start building even the most advanced applications with Stellaris microcontrollers quickly and easily.
MSP430F5xx: Bigger, Faster, Lower Power – the Next-Generation MSP430™ MCU	The next generation in MSP430™ technology is here, delivering enhanced performance and deeper integration. This session provides an overview of the feature set and modules of the new MSP430F5xx device family. These devices feature a clocking system with new clock sources and fail-safe features, deliver increased 16-bit performance, enable new on-chip power supervision, and provide enhanced features for simpler code and lower power. The 5xx family will also enable integration of powerful new peripheral modules.



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Introduction to TI's Latest High-Performance Processors with Speeds of 1 GHz and Beyond	In this overview presentation, see how TI combines 1 GHz + ARM Cortex-A8 and 1 GHz + fixed-/floating-point DSP cores with sophisticated memory and display subsystems and high-speed peripherals to provide optimized system-on-chip solutions for leading-edge applications. Learn how to create compelling user interfaces with 3-D graphics and to manage high-bandwidth data flows with a range of connectivity options. Find out how TI's latest software development kit (SDK) makes it easy to harness the flexibility and scalability of TI SOCs by reducing development time while protecting your software investment.
Getting Started with Android Today and Maximizing Your Effectiveness	With the availability of Android for the Texas Instruments OMAP35x, developers are now able to utilize the unique power of the Android application framework to create new, compelling designs. Attend this session to learn about the fundamentals of the Android architecture, the advantages of Android for designs relative to Linux, Mentor developer tools to assist Android developers, and how Android and TI OMAP35x work together.
<b>Track 3 – Application Solutions</b>	
Compensating for Sensor Drift and Nonlinearity	This presentation will introduce Texas Instruments devices designed for sensor signal conditioning: the PGA308/309 are integrated, programmable bridge sensor conditioners. Detailed reference designs will illustrate how to make the design reliable, robust and accurate through input/output filtering, EOS protection, and other tips and tricks. Practical mathematics needed to calibrate drift and nonlinearity of sensors will be discussed, along with calibration techniques for the PGA309. Finally, we will introduce different Texas Instruments hardware and software tools that can be used to help engineers develop their sensor product.
TINA-TI™ Software: Analog and Power Simulation Made Easy	Design cycles are shorter than ever, and you have to be sure your design works the first time. Today, circuit simulation plays an important role in assuring that design effort succeeds. Having the right simulator is an important element in that effort. Several years ago, TI and DesignSoft teamed up to provide our customers a powerful yet easy to learn and use tool called TINA-TI™ software. TINA-TI simulation software has a highly intuitive graphical interface that allows most users to be up and simulating their first circuits in 15 to 20 minutes. TINA-TI software provides many of the capabilities and power of DesignSoft's TINA Pro and industrial versions, but is provided free of charge to TI customers. This session will introduce you to TINA-TI software, how to connect circuits in TINA-TI software, and how to fully utilize the analysis capabilities the program provides. DC, AC, transient, noise and Fourier analyses will be explored in detail using actual circuit simulation results. Interactive examples will be demonstrated as time permits. Don't miss this opportunity to learn about TINA-TI
TI Lighting Power Solutions Overview	This training will present an overview of the LED general lighting products available from Texas Instruments for residential, commercial, outdoor and infrastructure lighting. Both AC/DC and DC/DC solutions in the forms of reference designs, EVMs and products will be discussed from both analog and embedded processing.
Contactless Charging	This presentation provides an overview of contactless charging principles based on e-coupled technology targeted at low-power (<5-W) applications. Success of this emerging technology depends on a universal standard that enables interoperability between various transmitters and receiver solutions. This session will also provide an overview of the Wireless Power Consortium (WPC) and its efforts to create a standard focused on delivering interoperable solutions.
How to Get the Best Performance Out of Your High-Speed Data Converter	This session deals with some of the common issues that haunt the proper application of high speed ADCs. This is meant for the engineer that has a working understanding of data conversion fundamentals already. We will treat subjects such as clocking and jitter, driving the analog input, driving/capturing digital data effectively and layout considerations. The session will focus more on real-world practical issues and their solutions, and less on theoretical or mathematical derivations.



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<b>Track 4 – Wireless Connectivity</b>	
Customer Design Considerations for the Low-Power RF System	This course will go through the design considerations and trade-offs a designer would need to go through for LPRF systems. Network topology, available standards, frequency bands, sustainable data rates and power considerations will be covered in this training. Competitive info will also be covered.
Range Considerations for RF Networks	This course will cover the theories behind antennas and RF range and discuss what occurs when line of sight is not an option. Antenna types and sizes will be compared, as well as when elements in near field (plastic enclosures) and far field (a wall) are introduced into a system. Finally, these considerations will be applied to a link budget example.
Bringing TI's <i>Bluetooth</i> ® Technology to Embedded MCU Platforms	As TI expands the reach of our connectivity platforms, we are putting new tools in the hands of customers to quickly and easily add connectivity to products based on TI embedded processors such as the MSP430™ MCU. In this session, we will introduce the newest platform offering that integrates TI's BlueLink™ product family with the MSP430 solution. You will learn about the platform's features, capabilities, differentiators and how to position this offering with your customers. You will also get to see the platform in action as we demonstrate a gaming and a health care sample application running on an MSP430F5438 experimenter board.
What is RF4CE and Would My Customer Use It?	This course goes through the RemoTI™ RF4CE network protocol stack and how the network functions. It also covers the RemoTI network protocol demo and how quickly and easily it can be set up.
Simple Point-to-Point Communication Using the CC11xx/CC25xx Radio	In applications where maximum data rate, minimum latency or small code size is required, using the hardware of the CC25xx/CC11xx radios can accomplish quite a bit. This session discusses the registers of these radios and covers how they can be used to set up a robust and versatile point-to-point wireless network.
<b>Track 5 – Signal Integrity and Layout Issues</b>	
High-Speed Layout Considerations	This topic will discuss the high-speed models of common components and the key points to address in high-speed layout. When to use ground planes and when to clear them is discussed, along with optimum circuit routing, bypass capacitors, avoiding ground loops, vias, and controlling impedance with transmission-line techniques. Many high-speed signal chains will involve a mixed-signal boundary where the analog domain will cross into the digital domain, and will require clocking to make it work. This seminar will provide guidance on how to ensure best analog signal integrity; the factors to consider when crossing domains; how to route digital signals to avoid data errors; and how to route clock signals for best performance, including EMI considerations. The goal is to give you guidance on creating a successful high-speed design using TI amplifiers, data converters and clocking solutions.
Signal Integrity Modeling and Simulation Capabilities Available to TI Customers	There are many customers who would like to use high-speed TI devices in their designs but have little high-speed design experience and limited or no in-house modeling and simulation capabilities. TI's signal integrity modeling and simulation capabilities can be used by customers to validate the usefulness of TI devices in their systems, provide estimated performance parameters, provide system design rules, suggest possible changes to the system architecture, and provide simulation test benches to customers so that they can re-use them in future designs with TI devices. This paper provides an overview of the signal integrity modeling and simulation capabilities that TI provides to customers for high-speed devices.
Understanding Clock Basics and Portfolio – the Capabilities and Limitations of Frequency Generation and Meeting Jitter/Phase Noise Requirements	Selecting a clock driver for a system consisting of single or multiple ICs should be a simple task. If only a single frequency from an oscillator or a crystal is needed, then it really is a simple matter - just select the frequency, tolerance, and signaling level. When a system becomes more sophisticated, it may require a clock driver to support various digital and analog ICs and then things can get a little complicated. As additional requirements come into play, it can become frustrating when the specifications of the receivers don't match explicitly with those of the clock driver. Some requirements are very obvious such as supply voltage, propagation delay, temperature range, etc... while others such as jitter, pulse skew or duty cycle, rise/fall time, and power dissipation can be application and configuration dependent. Even for programmable clock drivers, frequency generation and/or jitter number can be little perplexing. If we have a basic knowledge of clock drivers and the typical parameters associated with the clock drivers, and the system requirements then it would be easier to
Class-D PCB Layout	This presentation demonstrates three key areas needed to successfully layout a PCB for Class-D amplifiers: audio quality, electromagnetic compatibility (EMC) and thermal performance.
Minimizing Noise from Switch-Mode Power Supplies	Some designers experience high-frequency noise problems when introducing switching power supplies in their systems. This presentation will explain how and where high-frequency noise is generated in switch-mode power supplies. The presentation will explain and show design methods to reduce or eliminate noise during the design and layout phases of the project. Topics such as part selection, board layout, clock synchronization, power supply ripple rejection and post filtering will be covered.



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#### Track and Course

#### Abstracts

#### Track 6 – Power Supply Design: SEM1900

Incorporating Active-Clamp Technology to Maximize Efficiency in Flyback **and** Forward Designs and Under the Hood of Flyback SMPS Designs

For telecom and PoE applications up to 25 W, single-ended forward and flyback topologies offer the lowest potential cost; however, utilizing active-clamp technology can increase the efficiency of both, particularly when synchronous rectification is appropriate for the outputs. Subjects to be addressed in this topic include obtaining zero-voltage switching; selection and driving of synchronous rectifier FETs; optimizing transformer design; and a side-by-side comparison of equivalent forward and flyback solutions, emphasizing the performance benefits of each topology that can be achieved as a trade-off against circuit complexity and cost.

A basic review of the flyback switching topology as applied to low-voltage DC/DC converters will be presented in the second part of the session, with an emphasis on not-so-obvious design issues, including the effects of parasitics, fault protection and EMI mitigation. Modeling and analysis will be demonstrated and compared with physical hardware measurements. A major subtopic will be the understanding and characterization of the flyback transformer, considering leakage inductance, cross regulation, parasitic capacitance and other performance-defin

Designing an LLC Resonant Half-Bridge Power Converter

Although half-bridge power stages have commonly been used for isolated, medium-power applications, efficiency requirements with high-voltage inputs encourage the use of resonant switching, an improvement that comes with added design complexity. However, the LLC half-bridge converter topology offers several performance benefits. This session provides detailed design information on its implementation, eased with a unique analysis tool for frequency modulation control, that of first harmonic approximation (FHA). This FHA method is used to define circuit parameters and predict performance, which is then verified through comprehensive laboratory measurements.

Power Factor Correction Using the Buck Topology: Efficiency Benefits and Practical Design Considerations **and** New Product Offerings from Texas Instruments

Although active power factor correction is typically accomplished with a boost power topology, this topic will show that there are significant efficiency advantages offered by a buck power stage, particularly when universal line operation is required. Specific design and performance issues such as bus voltage choice, achievable total harmonic distortion and power factor, control algorithms, and design practicalities will be discussed. Design choices and their implications will be illustrated with a practical buck PFC design example based on a 90-W high-density notebook power adapter demonstrating a PF >0.9 over a 20- to 90-W load range and >96 percent full load efficiency over a 100-230 Vac line.

In the second part of this session, information on significant new power control products will be solicited from TI business managers, with the criteria for selection that a data sheet and samples will be available by September 2010.

Designing Magnetic Components for Optimum Performance in Low-Cost, AC/DC Converter Applications

With the assumption that the attendee is familiar with basic magnetic design theory, this session provides design guidance to achieve high efficiency, low EMI and ease of manufacturing for the magnetic components found in typical offline power converters. Magnetic component designs for a 90-W notebook adapter and a 300-W "silver-box" power supply are used as examples. Applications to be considered include the input EMI filter, PFC inductor, high-voltage level-shifting gate drives, and single- and multiple-output forward-mode transformers in both wound and planar formats. The techniques are also applied to flyback transformers and will enable lower profile designs with lower intrinsic common-mode noise generation.

A New Dual Half-Bridge DC/DC Converter with Wide-Range ZVS and Zero Circulating Current **and** Designing a Solar-Cell-Driven LED Outdoor Lighting System: A Comparison of Digital and Analog Power Control Solutions

A new digitally controlled high-power converter topology combines two half-bridge inverters to operate as a full-bridge power stage using phase-shifting control, but with zero circulating current. Each power switch operates with a nominal 50 percent duty cycle to achieve zero-voltage switching over a widely varying load, but can also function in PWM mode for increased voltage range. A 1-kW, 400-V/48-V converter designed to validate the concept will be shown achieving a 96+ percent efficiency and a high power density.

The second part of this session will use a medium-power solution to illustrate the many considerations of designing a complete solar-powered LED light, homing in on the unique demands of both the solar array and LED lamps and integrating them with a storage battery, charger and control circuitry. Both analog and digital solutions will be proposed and compared on the basis of functionality, complexity and cost.

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