



Texas Instruments

Technology Day Boston 2009

Session Titles and Abstracts

Track & Course

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Track 1 – 32-Bit Microcontrollers

TMS320F28027 Piccolo™ Mini
Workshop
(Two hour class)

In this workshop, you will be using the F28027 Piccolo controlSTICK™ to perform initialization of the MCU and program some of the key peripherals. You will gain a key understanding of the F28027 architecture and its peripherals and how to use the pre-defined peripheral register structures to efficiently program the device in a real application. During the labs, you will practice using some of these structures and also observe the debugging features in Code Composer Studio™. You will experiment with the watchdog, interrupts, ADC, and generate and graph a PWM waveform.

Introduction to Stellaris® ARM
Cortex™-M3 MCUs

TI's Stellaris MCUs pair the ARM Cortex-M3 core along with advanced communication capabilities, including 10/100 Ethernet MAC+PHY, CAN, USB On-The-Go, USB Host/Device, SSI/SPI, UARTs, and I²C. TI also provides an extensive range of over 20 superb reference design, evaluation and development kits starting at \$49. Stellaris MCUs are targeted at highly-connected applications including monitoring, building controls, network appliances and switches, factory automation, electronic point-of-sale machines, test and measurement equipment, medical instrumentation and gaming equipment. This presentation provides an overview of Stellaris MCUs, software tools and kits, StellarisWare™ software, and applications. The session will close with a free-form Q&A session to handle your questions on the more than 140 microcontrollers in TI's Stellaris family of MCUs.

Embedded Web Server-Enabled
Design Made Easy with Stellaris
MCUs (Two
hour class)

This presentation will demonstrate using 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. The attendees will get a good understanding of how they can start building even the most advanced applications with Stellaris microcontrollers quickly and with low risk.



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Track 2 – Innovations in Embedded Processing

Power Consumption of Embedded Processors and the Advantages of Smart Reflex

The OMAP35x is a high-performance multimedia and applications processor that also introduces a highly flexible combination of power-management features that provide large savings in system power consumption. A unique on-chip power-reset and clock-management architecture enables drastic optimizations of power consumption in the device's full-on and sleep states. This session will present an overview of the OMAP power-management architecture and explain details of the OMAP35x processor's power-saving features such as adaptive voltage scaling (SmartReflex™), dynamic voltage and frequency scaling, standby leakage management, and dynamic power switching. This presentation will also explain how to interface various power-regulator options—from highly integrated power-manager ICs to discrete I²C-programmable switch-mode power supplies (SMPSs)—available from TI's OMAP35x portfolio to meet diverse design requirements.

Linux Development Tutorial on TI Processors

This presentation will explore the various Linux development options available for TI's embedded processors such as DaVinci™ and OMAP™. Both community and commercial offerings will be discussed including the benefits of each.

HD Digital Video Recorder Using TI DM6467

Presented by Ingenient

TI's DM6467 is finely tuned to handle complex video applications. The DM6467 can offload video encoding/decoding tasks from the DSP core to the HD Video Imaging CoProcessor (HD-VICP) allowing more DSP MIPS to be available for common video and imaging algorithms. This session will cover the capabilities of encoding/decoding HD content along with information on available libraries to reduce time to market for video applications. A demo will be shown during this session.

Exploring Windows Embedded CE 6.0 on the OMAP35xx

Presented by Bsquare

In this session, attendees will learn how to build an OS image using Platform Builder and Visual Studio 2005. The presentation will also cover some of the unique attributes of the OMAP 3 platform as it relates to the DSP and graphics accelerator, all running under Windows CE. Each attendee will receive an evaluation copy of Platform Builder with Visual Studio 2005.

Digital Motion Control System Design – From the Ground Up

Presented by D3 Engineering

D3 Engineering staff will present a design outline and demonstrate working hardware for a 400-W PMSM controller. Topics covered include processor selection, isolation, interfaces (USB, CAN, RS-232) and driver electronics (power module vs. discrete FETs). The design is controlled through a TI F2806 DSP. D3 will demonstrate how to create a project for a custom board with MATLAB real-time workshop tools. The demos will include both sensed and sensorless control algorithms.



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Track 3 – Microcontroller Topics

MSP430F5xx Hands-On Workshop
(Two hour class)

This hands-on workshop is intended to educate the experienced MCU designer on the capabilities of the MSP430F5xx and learn first hand how to use them. You will experience embedded design with the MSP430, get familiar with an MSP430 development environment, learn where to find and how to use resources and better understand the MSP430 low-power concept. The course is perfect for those getting started or wanted a refresher on MSP430. Basic experience with general MCUs and knowledge of assembler and C language programming is assumed.

Introduction to Targeted Code
Generation for TMS320C2000™
MCUs
Presented by MathWorks

In this session, MathWorks engineers will show how to develop power conversion applications for TI's C2000™ microcontrollers using MATLAB, Simulink, and Target Support Package™ TC2 for TI's C2000 MCUs. The steps illustrated in this presentation, depicted as incremental model refinements, suggest an example workflow for designing and implementing a DC to DC Buck Converter application on an embedded platform. This presentation highlights advanced processor-specific capabilities of Target Support Package TC2.

FRAM: The Future of Embedded
Memory for Microcontrollers

FRAM (Ferroelectric Random Access Memory) is the next generation low power, fast non-volatile memory technology for embedded microcontroller applications. Requiring no battery to retain data, it enables easy data access and features fast write capability like DRAM. In addition, its ability to perform write operations at 1.5V eliminates the need for an expensive charge capacitor that other current non-volatile memory technologies such as Flash or EEPROM require. FRAM supports practically unlimited data write cycles unlike EEPROM or Flash and this combined with its low power consumption and high reliability makes it ideal for sensing, datalogging, motor control and security applications. Texas Instruments has over 9 years of experience with FRAM and has successfully produced large FRAM memory modules up to 4 Mbytes.

Integrated USB Connectivity with
MSP430 MCUs

Modern MSP430s have integrated USB peripherals allowing for serial communication over a single plug and play cable, intelligent human interface devices like mice and keyboards that don't require driver installation, or mass storage devices for data retention. MSP430 devices that feature a USB peripheral will be discussed as well as the software USB stacks required to create USB applications.



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Track 4 – Innovations in Applications Processing

10 Reasons You Should Use
OMAP™ 3 in Your Next Design

OMAP applications processors offer a variety of combinations of the Cortex-A8 core, multimedia- rich peripherals, OpenGL® ES 2.0 compatible graphics engine, video accelerators and TMS320C64x+™ DSP core. The modular and extensible OMAP35x Evaluation Module (EVM) provides all the components needed to start developing today on the OMAP3503 processor including an OMAP3503 Linux board support package based on the 2.6.22 kernel. Join this session to get an overview of this device's features and capabilities. The attendee will learn how to evaluate OMAP3 fit for their application (processor and accelerator performance benchmarks, throughput analysis, peripherals, drivers, etc.)

Using the Zoom OMAP34x-II MDP as
a Building Block for Your Embedded
Design
Presented by Logic

Join us as we tear down the Zoom OMAP34x-II Mobile Development Platform (MDP) highlighting our integration of the OMAP™ 3 processor, 802.11 wireless, GPS, and full QWERTY keypad. Logic will discuss how these building blocks could be used in your design. In addition, we will show how the product-ready OMAP35x system on module can help you accelerate your time-to-market.

Hands-On OMAP-L1x Boot-Camp
(Three hour class)

The OMAP-L137 is a low-power applications processor based on an ARM926EJ-S™ and a C674x DSP core. The OMAP-L137 features robust operating systems support, rich user interfaces, and high processing performance life through the maximum flexibility of a fully integrated mixed processor solution. This hands-on workshop will provide attendees with a detailed technical overview of the device's architecture and will cover supporting hardware/software such as the Linux Boot process and Codec Engine/ DSPLink functionality.



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Track 5 – Power Supply Design

Understanding Power-Supply Efficiency

Most designers demand high efficiency from their power supplies, but their demands often exceed power supply capabilities. This paper explains the factors that affect power supply efficiency and provides the design engineer with an understanding of the major contributing factors that affect power supply efficiency. It shows the tradeoffs between many system level parameters that affect power supply efficiency. This knowledge is presented with both theory and practical examples.

NexFET™, How To Design with Highly Efficient MOSFETs

TI's NexFET™ power MOSFETs are the next macro-generation of low voltage power MOSFETs, with incredibly low gate charge and resistance. These devices enable high-efficiency and high-frequency DC/DC converter designs. The presentation will cover device structure, characteristics, layout and gate drive recommendations and results.

Power-Supply Layout Considerations

This topic will address methods for keeping circuit parasitic components from degrading the operation of your designs. Techniques to minimize the impact of parasitic inductance and capacitance of filter components and PWB traces will be discussed, together with a description of the impact that PWB trace resistance can have on power supply regulation and current capacity. A general overview of thermal design is also included as well as sample temperature rise calculations in a natural and forced-air environment. Finally, some practical examples of power stage and control IC layouts are reviewed.

Power Beginner's Hands-On Workshop

As the requirements for powering processors become more and more stringent, it can be confusing trying to decide between all of the available power supply options. Starting with the basics, this lab is designed to help you understand the benefits of different DC/DC converter topologies, discussing specs and why they are important. TI has several tools available to assist you in your designs, including design software and reference designs. We will walk through several examples, showing you how to use each tool. Finally, we'll cover the basics of battery technologies and how to identify the appropriate TI device for these applications.

ESD Protection: Protecting the Complete System

System level ESD protection at the interface connector is particularly challenging. Semiconductor chips based off advanced low voltage, small geometry process nodes enable miniaturization, more power savings, and better economy of scale. But it poses an even bigger challenge to provide ESD immunity since it becomes more difficult to design robust ESD solutions as the process geometry gets smaller. External ESD clamp circuits or integrated protection devices are a popular choice to enhance system level ESD protection. This presentation will cover key system level ESD challenges, common techniques to improve overall system level ESD performances, TI's IPD solutions, and selecting the right ESD clamps for a given application



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Track 6 – Signal Chain and Battery Power Design Considerations

Basic PWM Technique for Amplifiers

This presentation will cover key system level ESD challenges, common techniques to improve overall system level ESD performances, TI's IPD solutions, and selecting the right ESD clamps for a given application

Design Considerations for High-Performance Audio A/D Converters

The high range of the professional audio market demands analog-to-digital conversion with 120dB or better dynamic range. To realize this performance level, careful attention must be paid to circuit board layout, reference and supply bypassing, clocking, and analog input buffering. The purpose of this presentation is to address these technical challenges, utilizing the new PCM4222 124dB ADC as a test case. Evaluation module test results are included to reinforce the technical discussion, and to help illustrate proper design practice. The concepts presented here may also be applied to other high performance audio and industrial data converters.

Li-Ion Technology and Battery Management

Li-Ion, Li-Ion Polymer Technology and future development trends; Theory/concepts of battery gas gauge systems, introduction to ImpedanceTrack™ Technology

Aftermarket Battery Packs – Revelations from Product Tear-Downs

Presented by MicroPower Electronics, Inc.

Aftermarket battery packs are available for most portable devices. MicroPower will present the results of several product tear-downs on aftermarket battery packs, and explain how substandard aftermarket packs can cut corners on cost, safety mechanisms, and battery performance. These tear-downs expose electronic and mechanical design issues, as well as good manufacturing and regulatory violations. A discussion will also discuss TI solutions for OEMs to manage and control their ecosystem of aftermarket battery pack suppliers. This session is applicable to OEMs of consumer and industrial electronic products susceptible to aftermarket batteries, such as medical, handheld radio, and data collection devices

Energy Harvesting

Presented by Cymbet

This session provides an overview of how to design autonomous wireless sensors using various energy harvesting transducers, energy conversion circuits, energy storage, sensors and the TI MSP430 and CC2500. Various configurations of autonomous self-power sensors based on energy harvesting will be detailed. Low power EH RF system architectures will be discussed and design examples will be shown. An example of a Zero Power Wireless Sensor will be demonstrated using the eZ430-RF2500-SEH Demo Kit.



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Track 7 – Analog Board Level

An Overview of TI's Next-Generation Clock Synthesizers, Jitter Cleaners and Synchronizers

TI's focus on high performance clock products has generated a pair of innovative clocking solutions with a nice roadmap for the future. This presentation will highlight the features and functions of four of these devices. VCO clock generation, jitter cleaning, and clock distribution, buffering, and synchronization will be discussed as well as the requirements of the industry and how TI is addressing them.

Tackling EMI and RFI at the Board and System Level

Electromagnetic Interference (EMI) and Radio Frequency Interference (RFI) can affect any system in an undesirable manner as the proliferation of unintentional radiators and receptors continue to increase. EMI and RFI, an undesirable byproduct of electrical systems, produce a wide range of frequency spectra that can affect otherwise properly operating circuits. During this seminar hour, we will review the fundamental principles of radiated interference and coupled interference, along with the respective allowed limits for both of these interference sources. In this discussion, we will describe transmitters and receivers along with techniques to mitigate the effects of both culprits. The solutions we will cover will be effective power-line filtering, proper filtering for input signals of high-gain circuits, and details on key components. Finally, we will discuss the common rules of thumb for wire and PCB routing to minimize EMI and RFI effects. With this seminar you will see some basic methods that will help reduce sources and receptors of EMI and RFI events in and near your circuits.

Why Use a 24-Bit Converter When You Only Need 12-Bits?

Many times a lower cost higher performance system can be built by using a 24-bit converter than using the combination of amplifiers and 12-bit solutions. Some typical applications for load cell and temperature will be evaluated and both approaches compared. The wide dynamic range of the 24-bit solution provides an approach that may not require any external amplification and gives a lower noise result. Additionally these higher resolution solutions can usually be done for a lower cost.

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 (pre-built in the included TINA 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 re-scaling 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).



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The New THS4521 Fully Differential
Amp Driving ADCs

Abstracts

Signal-conditioning high-voltage input signals to drive ADCs from high-voltage sources can be challenging. Given a signal source that provides higher level signals (like $\pm 10V$) that you want to interface to a lower-voltage ADC with significantly lower differential and common mode voltage input requirements, how do you go about it? How do you attenuate and level shift the voltage levels of the signal to match the input requirements of the ADC? In this session we will propose an architecture utilizing a fully differential op amp to accomplish the task. Circuit analysis is performed to aid understanding of the key design points, and a design methodology is presented for calculating the required component values. Spreadsheet examples will be shown along with TINA Spice model examples to show how to implement the design methodology using computer aided tools. This topic will also include a short presentation of test procedure and performance results using the THS4521 as input amplifier to drive the ADS1278 24-bit $\Delta\Sigma$ ADC and the THS4521 as input amplifier to drive the ADS8324 16-bit SAR ADC.



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Track 8 – Low-Power Wireless and Circuit Isolation

Circuit Isolation Techniques and Implementations

Multiple options are now available to electronics designers to implement galvanic isolation. Apart from isolation technologies like capacitive, optical and inductive/magnetic to choose from, they must also contend with the various isolation standards regarding voltage ratings and creepage/clearance distances. This discussion intends to simplify the decision making associated with choosing the right isolation solution.

6 Things You Need to Know to Design Wireless
Presented by Venture Technologies

If you are an engineer interested in low power wireless design, come learn the tricks you need to successfully design wireless products. We will use real world wireless product design examples to drill down on issues like 1) How to choose the right frequency of operation, considering required communication distances and regulations in different countries, 2) How to avoid message confirmation and still operate reliably, 3) How to add years to battery life by communicating **more**, 4) How to make the right choice between WiFi, *BlueTooth®*, ZigBee, or proprietary disciplines, 5) How to determine which unit should initiate communication, and 6) More importantly, see how to avoid some wrong choices along the way.

Compliance by Design
Presented by LS Research

This session will outline the importance of RF component selection and PCB layout techniques and how they can be instrumental in achieving regulatory approval and optimal design performance. This will include a brief discussion on the pros and cons of using RF modules, reducing risk with compliance prescans and the insight provided through measurement of antenna radiation patterns.

Antenna Design with Physware's PhysWAVE EM simulation tool

Antenna design and optimization is a critical part of getting wireless analog systems to function with appropriate power, efficiency, and reliability. Physware, Inc, presents PhysWAVE with Antenna-Assist. PhysWAVE is Physware's flagship 3D electromagnetic simulator with capabilities of handling large-scale systems such as chip-package-board ecosystems. With Antenna-Assist, antenna designers can quickly setup antenna designs, and observe and modify near and far field behavior, impedance, gain, directivity, 3d radiation plots, etc..Antenna behavior in the presence of the entire system can be predicted including effects of reflection, improper ground planes, shielding, interference etc. Physware also offers a scaled down version where users can choose from selected antenna types such as inverted-F's, monopoles, dipoles, patches, etc and observer parametrized field, power, and impedance behavior. In the presentation, we will demonstrate the complete simulation and design flow and show how designers can go from conceptualization to complete design in dramatically short times by utilizing Physware's fast, user friendly, easy to use 3D EM simulation technology.

RF4CE / RemoTI™ Technical Overview

Technical Overview of the ZigBee RF4CE (Radio Frequency for Consumer Electronics) protocol and TI's RemoTI solution.

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