



Texas Instruments

Technology Day San Jose 2010

Session Titles and Abstracts

Track and Course

Abstracts

Microcontroller Hands-On Labs

MSP430F5xx Hands-On Workshop
(Two hours)

This hands-on workshop is intended to educate experienced MCU designers on the capabilities of the MSP430F5xx. You will experience embedded design with the MSP430™ MCU, 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 who need a refresher on MSP430 microcontrollers. Basic experience with general MCUs and knowledge of assembler and C language programming is assumed.

Embedded Web Server-Enabled Design Made Easy with Stellaris® MCUs
(Three hours)

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 ARM Cortex™-M3 microcontroller has an integrated 10/100 Ethernet MAC+PHY. The 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, 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.

Microcontroller

TI C2000™ MCU Family Crash Course: How You Can Take Your Application to the Next Level in Energy Efficiency

Are you looking to maximize power efficiency in your control applications? Are you frustrated that the MCUs available today are not giving you the performance benefits you need to reach your efficiency goals? TI has the MCU family for you. For the past 15 years, the C2000™ MCU family has been winning in control applications that require minimum power loss. With a 32-bit DSP core embedded in an MCU architecture (unified memory map, flash, ADCs and PWMs), C2000 MCUs have been able to address multiple control applications. These applications include motor control for all types of motors and digital power applications such as renewable energy and lighting. Come learn what C2000 MCUs have to offer your application to make it as energy-efficient as possible and see what development tools and software are available to jump-start your application.

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 more than 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.

Bringing TI's *Bluetooth*® Technology to the MSP430™ MCU Platform

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™ microcontroller. 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 to 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.

Designing for Ultra-Low Power Using the MSP430F5xx Family

Realizing a low-power system design when every microampere counts is rarely an easy task to achieve. Such an effort requires detailed knowledge of everything your MCU offers in the way of enabling ULP, as well as the features of any external components. This course gives practical instructions of how to realize an ultra-low-power application using the MSP430™ MCU family. Special focus is given to specific ULP features, how to select components for ULP applications, and coding techniques that reduce the power consumption of your embedded application.

FRAM: Opening New Horizons for Embedded Developers

FRAM (Ferroelectric Random Access Memory) is the next generation non-volatile memory technology for ultra-low-power embedded microcontrollers. It's fast write capability (like DRAM), practically unlimited write endurance (>10¹⁴ cycles) and ultra-low power consumption benefits developers and end users alike. The presentation will describe FRAM's ability to function as universal memory helping ease the life of developers, reducing development time (faster time to market) and costs. In addition, FRAM enables several new, exciting ultra-low-power applications such as batteryless, intelligent sensors. The presentation will include a look at the power consumption advantages of FRAM in one such application. FRAM also offers significant advantages over incumbent technologies in several other applications such as energy harvesting, sensing, datalogging, motor control, etc.



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Applications Processors

OMAP Architectures for Smart Grid and Power-Line Communication Applications

Abstracts

One of the biggest challenges designers face as they approach developing today's increasingly complex smart grid systems including power monitoring/analytics and power line communication is determining the appropriate mix of processing elements and discrete components to use to optimize the system performance. The SOC (system-on-a-chip) integration that makes today's smart grid innovations possible often involves combining different processing elements on a single device, for example TI OMAP L13x. These elements can include programmable functions, such as general-purpose (usually RISC) microprocessors and DSPs, and fixed function PWMs. These elements are important for designers to efficiently develop a smart grid system that runs a high level operating system and supports different power line communication protocols and smart power algorithms such as THD, RMS voltage/current, transient detection, etc.

Implementing Skype Video Conferencing on the DM36x

Skype has changed the videophone industry. OEMs and manufactures are now able to directly connect to the consumer without interoperability and operator concerns. To meet this challenge, TI offers a DM365-based D1 videophone that runs Skype software stacks for encryption and streaming. This session will address some of the unique challenges facing hardware and software designers, such as how to share the hardware design with the DM365-based USB camera to maximize hardware reuse, challenges when running Skype software on the DM365, how to solve acoustic echo-cancellation issues, and audio and video synchronization.

Getting Started with Android Today and Maximizing Your Effectiveness
(Two hours)

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.

Introducing New Low-Power DSPs for Your Application

There are a wide range of low-power processors available from Texas Instruments. It can get challenging to determine which processor is the right processor for your customer's low-power application. There are many factors that influence this processor selection: use case of the application, performance requirements, battery type, battery life and many others. This presentation gives an overview of the various low-power processors from TI, including MSP430™, C5000™, C6000™ and OMAPL1/OMAP3 processors. Both static power and active power consumption of the processors will be compared with performance. Use cases of several power-sensitive applications will be analyzed and the processor selection process explained in detail.



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Power

Component Selection, Layout and Thermal Design Considerations for DC/DC Converters

DC/DC converters with internal transistors and compensation have become very popular given their relative ease of use. This topic covers how to select the external components and properly lay out the circuit to achieve the maximum performance of the converter. Several good and bad layout examples will be provided to show how layout impacts sensitive circuits. Thermal layout for linear regulators is also explored.

Energy Harvesting
Presented by Cymbet

This session provides an overview of how to design autonomous wireless sensors using various energy-harvesting (EH) transducers, energy conversion circuits, energy storage with permanent thin-film battery technology, sensors, and TI's MSP430™ MCU, CC2500 and CC430. 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 and the new DigiKey self-powered CC430 weather station reference design.

TI Lighting Power Solutions Overview

This session will present an overview of the Texas Instruments LED lighting solutions available today. The solutions will be 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. Solutions from both Analog and Embedded Processing will be presented.

Battery Characteristics, Safety, Cell Balancing and Cell-Based Thermal Sensing

The lithium-ion (Li-ion) battery has gained great popularity in recent years as the market for battery-powered portable devices grows rapidly. It has superior characteristics, including high gravimetric and volumetric energy density, low self-discharge and no memory effect. On the other hand, a Li-ion battery pack requires mandatory safety features because of the battery's sensitivity to overcharge and high temperature. This paper aims to discuss the characteristics and safety of rechargeable batteries and emerging chemistries such as LiFePO4 and LiMn2O4 batteries. It will also present design considerations on connecting battery cells in parallel or in series in applications. New trends toward designing safer battery solutions and longer battery life, such as advanced cell-balancing technologies and cell-based thermal monitoring, will be discussed.

Rechargeable Batteries and Their Optimized Chargers

Battery-operated portable power devices have been growing significantly. Safely and efficiently charging a Li-ion battery has become a challenging task. This training session first discusses NiMH, Li-ion and LiFePO4 battery-charging requirements and how our charger implementation meets these requirements as USB gradually becomes a main power source to charge a battery and power adapters start to share the same connector with the USB. Various USB battery chargers will be presented with and without power-path management functions. A 3-MHz synchronous-switching single-cell charger (bq24150/1) increases the effective charging current, reduces heat generated from the charger, and minimizes charging time compared with linear battery chargers. Finally, a few switching-mode battery chargers will be presented to charge multicell LiFePO4 and Li-ion batteries.



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Signal Chain

Op-Amp Stone Soup: A Cookbook Collection of Single-Supply Op-Amp Circuits

Abstracts

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™ software 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).

Benefits and Trade-Offs of Using Programmable PLLs to Configure Frequencies and Reduce EMI

System designers are looking not only for higher speeds but also for flexibility to ease development time and find cost-effective solutions. TI's new programmable clock generator family allows designers to generate multiple frequencies from one clock source, customize the device (EEPROM), tweak the system clock without redesigning the board, or have only one device fitting for several boards.

ESD Protection: Protecting the Complete System

System-level ESD protection at the interface connector is particularly challenging. Semiconductor chips based off of advanced low-voltage, small-geometry process nodes enable miniaturization, more power savings and better economy of scale. But this poses an even bigger challenge to providing ESD immunity, since it becomes more difficult to design robust ESD solutions as process geometries get smaller. External ESD clamp circuits or integrated protection devices are popular choices 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.

Audio Codec Solutions with miniDSP and PurePath™ Studio Software
Presented by Critical Link

The latest generation of TI audio codecs, processors, touch-screen controllers and ADCs have specialized miniDSPs built in for increased functionality and flexibility. Learn the capabilities of this audio processing technology and see a demonstration of PurePath Studio™ configuration software. Just drag and drop popular audio algorithms into the GUI interface and create your own solutions without any programming. Let your codec do more of the processing work.

Learn How New DLP® Development Platforms Enable 3-D Measurement and Digital Exposure Applications

Machine vision, rapid prototyping, 3-D biometrics and phototherapy are a few of a growing array of applications using DLP® technology. Until recently, however, developing a proof-of-concept for these applications was a significant barrier to entry for DLP technology. To solve this problem, TI, together with our DLP design houses DLI, LogicPD, Visitech and ViALUX, developed three DLP technology-based development platforms. This session provides an overview of these development platforms: the Discovery 4100 (D4100), LightCommander and Pico Projector development kits. Participants will learn how to quickly start up each platform and develop a custom project on the new DLP LightCommander.



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Low-Power Wireless

Low-Power RF Basics

Abstracts

This presentation gives an introduction to RF systems. The presentation gives an overview of a complete RF system as well as an introduction to the different building blocks in an RF system. Important parameters such as sensitivity, selectivity, output power and link budget will be discussed in detail. Finally, compliance to frequency regulations around the world will be discussed.

Low Power RF Protocol Overview

Texas Instruments Low Power RF (LPRF) offers RF solutions (transceivers and SoCs) that target many different RF frequencies and standards. For some of them, TI provides the hardware (sub-1 GHz and 2.4 GHz) and software (SimpliciTI™ software, MAC 802.15.4 standard, RemoTI™ network protocol and Z-Stack™ software for the ZigBee® standard). For others, it provides the hardware only and cooperates with partners to provide the software (Wireless M-Bus, 6LoWPAN, SP100, WHART). This training helps attendees understand which questions to ask when making the decision on which software (RF protocol) to use. Although the main topic is software, hardware-related questions like "Which frequency is targeted?" will be discussed, as they have an influence on which software protocols one can choose from. The advantages and disadvantages of the different protocols will be discussed in more detail by looking at two different use cases: a point-to-point connection for a remote control and a multinode network to control the temperature in a house.

What is SuperSpeed USB (USB 3.0) and What Can I Do With It?

With the announcement of the next evolution in USB wired connectivity, SuperSpeed USB, the questions become: what is this? and what can I do with it? The first part of this session will look at what is new and better with SuperSpeed USB. How is it different than USB 2.0 beyond the obvious speed increase? How is backward compatibility being maintained, as this will be critical to continue the success of USB with end-users who believe "USB is USB"? The second half of the session will discuss what applications will benefit from this new technology. How will the new interface benefit end-users and why should they care? Finally, an early look at the SuperSpeed USB product roadmap will be presented.

CC430: MCUs for Space-Constrained Ultra-Low-Power Wireless Applications

The CC430 platform is a highly integrated monolithic SoC based on the industry-leading MSP430™ MCU architecture and TI's ultra-low-power RF solutions. By making RF design easy, small, performance-rich and power-efficient, the CC430 platform helps advance applications including RF networking, energy harvesting, industrial monitoring and tamper detection, personal wireless networks, automatic metering infrastructure (AMI), and heat-cost allocators.

Design Considerations for Connecting Consumer Products to Internet Web Applications and Browsers
Presented by Arrayent, Inc.

The rapid adoption of smart phones (smart phones exceeded laptop shipments in 2008) is driving many companies to explore ways to connect their products to smart phones and Web applications. By attending this seminar, you will better understand that choosing a wireless LAN protocol is just the first step in enabling Internet connectivity to your product. Three components are required to connect a product to Web applications on the Internet: RF wireless, a gateway and a server back-end. Other Tech Day tracks will discuss RF wireless design trade-offs, so this session will focus on the gateway and server design considerations. Using a design example, we will cover a simple set up, NAT firewall traversal, asymmetric protocols for low power consumption, Web server in the product endpoint vs. gateway vs. cloud, network state storage in the gateway or server, caching vs. SQL queries, and number of open TCP sessions.



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ARM® Microprocessors

Introduction to TI's Cortex-A8 Family of Devices

TI has introduced many new processors based on Cortex-A8 architectures. This session provides an overview of the ARM-based MPU options and guides you through the decision-making process while learning more about the scalability of the different architectures.

ARM Microprocessor Hands-On Workshop
(Four hours)

This is a combined lecture and hands-on lab session. The discussion will begin with an overview of TI's devices and software development kits (SDKs). The heart of the presentation will examine TI's Linux options, from an overview of Linux itself to where you can get versions of Linux for TI platforms (including Arago, TI's open embedded Linux distro) and how to build within the Linux environment. The discussion will end with a brief, practical examination into using Linux on embedded platforms. After booting the system with an SD/MMC card, the lab gets you working with the Linux graphical user environment, just as if you were working on a desktop computer. If you have time after exploring the GUI environment, there are further, optional exercises to explore Linux's networking applications, boot environment and mounting various file systems.

Designing with Beagleboard

Developing Sophisticated User Interfaces on
Embedded Devices Featuring TI's Beagleboard
(OMAP™ Processor) Development Board
(Five hours)

The TI OMAP™ application processor family provides the CPU horsepower and connectivity required to deliver sophisticated rich multimedia user interfaces while addressing the cost requirements of mass-market devices. The capability to deliver sophisticated user interfaces is a new experience for most embedded software developers, who are used to dealing with very basic and static user interfaces because of cost or performance constraints. The objective of this tutorial is to provide an accelerated day of learning about new user interface options on embedded multimedia devices. After attending this session, developers will have built and debugged on a TI Beagleboard, a C++-based media player application that combines a user interface built with the Qt cross-platform application and UI framework from Nokia, along with Digiplayer software from Digilink Software. In addition to building a sample application, attendees will understand the next steps required to develop even more sophisticated user interfaces and rich multimedia systems.

A TI Beagleboard will be used to help illustrate course concepts. Attendees will receive a preconfigured, bootable, SDHC flash memory card. Once they boot their Beagleboard with this card, students will be able to develop their application on the Beagleboard and display their results on their own laptop using VNC. Students should bring their own Beagleboard and laptop with VNC installed. They will be provided the other cables they need by the instructor.