MSP430 WORKSHOP

Gill Instruments
General Instrumentation Logic Labs

Two Day Workshop Agenda	Day-1	Day-2

Overview: This hands-on workshop is intended to educate the experienced MCU designer on the capabilities of the MSP430 and how to use them. The material is intended for the design engineer to use MSP430 in the new project. Basic experience with general MCUs and knowledge of assembler and C language programming is assumed. This workshop runs approximately 9 hours per day and consists of presentations, demonstrations and hands on lab.

Class runs 9:00 a.m. to 6:45 p.m.

Why MSP430?	9:00 Am / Day-1

This presentation describes the use of MSP430 microcontroller family at wireless sensor network, advanced instrumentation and automotive electronics Area. This device was chosen due to its characteristics and capabilities, low-cost, easy to use development tools and large variety of devices and peripherals within the MSP430 family. Applications developed by the microprocessors working group at Gill Instruments Bangalore will be shown. Those applications includes real time protocols, implementations in sensors, devices for patient monitoring and the development of a MSP430 advanced learning kit with extended capabilities like USB, wireless and Ethernet communications.

Outline

- Why MSP430?
- Choosing hardware
- Introduction to MSP430
- Design and Development tools

Getting Started with the MSP430	11:00 Am / Day-1

New to the MSP430 or looking for a refresher? This is the place to start. Learn the basics of the instruction set, addressing modes, unified memory model and development tools. Exercise your new knowledge with the "starting from a blank screen" lab, where you will enter the few lines of code required to flash the LED on a demonstration board

Outline

- What is the MSP430?
- MSP430 architecture
- MSP430 CPU, instruction set and addressing modes
- MSP430 I/O

Lunch Break	1:00 Pm to 1:45 Pm

Introduction to Ultra-Low-Power with the MSP430	1:45 Pm / Day-1

Pick up where "Getting Started with the MSP430" left off and learn about the ultra-low-power (ULP) techniques and architecture of the MSP430. Starting with an interrupt-driven-architecture concept this class walks you through interrupt handling and low power modes on the MSP430. Next dive into the heart of ULP – the MSP430 clock system and learn how to leverage it to the fullest extent for the lowest power consumption possible. Finally experience the MSP430 low power by programming a demonstration board for ultra-low-power modes.

Outline ULP defined

- Stand-by
- Wake-up
- Exploiting low-power modes
  - Low-power modes
  - Clocking options
  - Entering and exiting modes
- Interrupts
- MSP430 clock system
- Overview of the Comparator peripheral

Tips and Tricks with Timer A	3:00 Pm / Day-1

Explore Timer_A one of the MSP430's most widely used and versatile peripheral. Use this module in ways you may have never previously considered. See how the synchronized capture feature can be used to implement a Tone decoder with very little CPU overhead. Extend the 16-bit range with software to precisely capture and generate longer time intervals with high precision. Generate three independent PWM signals, learn about the timer's trigger capabilities for controlling sample and hold and see how easily Manchester coding/decoding can be achieved. Leave with the techniques to most fully utilize the capabilities of Timer A.

Outline

- Overview of Timer A
- Timer block functionality
  - Interrupt handling
  - Extending the 16-bit range
  - Compare and capture modes
- Generating PWM signals
  - Different output frequencies from one timer
  - Adjusting the duty cycle
  - Mixing PWM with other modes
- Low-overhead UART implementation
  - Signal and timing considerations
  - Timer A synchronized latch feature
- Lab: Extended range and using efficient interrupt handling

Exploiting MSP430 Flash and LCD	9:00 Am /Day-2

MSP430 is endowed with very high quality, byte writable, small sector flash. The unique capabilities of the MSP430 Flash provide the ability for many new applications in smart instrumentation, security and automotive. Working on a user interface? Discover how the LCD can simplify your Monitor and control applications without the need for external components. Gain knowledge configuring and using the LCD module in hands-on labs.

Outline

- LCD Module
  - Introduction to LCD 16x2
  - Writing to LCD in command and Data mode
  - Configuring and using the LCD module
  - Biasing options
  - Timing
- Flash Controller
  - Initializing Flash
  - Self test of Flash

12 bit A/D Conversion with speed of > 200Ksps	10:00 Am /Day-2

Expand your knowledge of the newly enhanced ADC12 peripheral. Witness the new features of the module including an input multiplexer for up to 8 channels and the ability for sample-and-hold. You will also learn numerous application using ADC12 including speech storage and generation. Real-world examples and demonstrations, including a smoke detector application, will be shown.

Outline

- Discussion of the new Applications
  - Utility metering
  - Portable instrumentation
  - Intelligent sensors
- Using the ADC12 in MSP430 (speech quality)
  - Programmable Sample/hold
  - Single channel single conversion mode
  - Auto scan with Data transfer controller
  - On chip Temperature sensor and reference
  - Repeat-sequence-of-channels mode

Real world implementation: Temperature monitor / Smoke detector application

Lunch Break	1:00 Pm to 1:45 Pm

High-Performance, Dual Communication Module –USART	1:45 Pm /Day-2

Experience the added performance and flexibility present in the MSP430's newest communication module, USART. The USART features a wide breadth of communication options for higher-end systems including SPI, I2C, UART/USCI, LIN and IrDA. Also included is a dual simultaneous communication channel option. See how the USART/USCI module expands communication capabilities and learn which communication bus is best suited to your application.

Outline

- Introduction to USART/USCI
  - Feature overview
  - UART/USCI communication modes
  - Device Selection
- SPI
  - Modes of communication
  - Data and clocking options
- I2C
  - Hardware features
  - Interrupts and software flow
- RS-232/RS-485
  - Master/slave bus configuration
  - Host interface using Visual Basic
  - Addressing and error handling application

MSP430 FIR digital Filter	02:45 Pm/Day-2

When higher order filters are combined with faster sampling rates, the demand on the processor becomes very high. This limits typical MCU's to handle a real-time FIR filter algorithm only at low sample rates and with a reduced number of filter taps.
The MSP430F1611 with its rich peripheral set handles the FIR filter algorithm in a different manner compared to conventional MCUs. This device has a three channel DMA peripheral that handles the required data, coefficient and result movement between the memory and the MAC, dramatically improving the computation efficiency of the real-time FIR filter algorithm running on-chip. This allows the same filter program to be used for any type of FIR filter implementation such as high-pass, low-pass, band-pass and band-reject filters. The integrated digital-to-analog converter, DAC12, can be used for converting the filter output back into the analog domain if required.

Outline

- Introduction to 3 channel DMA , MAC and 2 channel DAC
- FIR Filter Software Algorithm
- Calculating the FIR Filter Coefficients
- DMA-MACS-Memory Combination

Real world implementation: High-pass, low-pass, band-pass and band-reject filters.

Certificate Distribution	04:45 Pm/Day-2