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/*****
*
*      LabVIEW Interface for LaunchPad (LILP_MSP430G2553) v4
*
* Description:
*
*      This code provides an example for using the 10 bit ADC
*      and Digital in the MSP430G2553.
*      Depending on which ascii character is sent to the device,
*      and the results sent to the computer.
*
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* Email: gmaxsonic at gmail.com
* Date: Mar-01-2012
*
* Reference Source Code from "A Simple ADC Example on the LaunchPad"
* Author: Nicholas J. Conn - http://msp430launchpad.com
* Email: webmaster at msp430launchpad.com
* Date: 08-29-2010
*
* Release Note : add temperature sampling and toggle LED P1.0
*
*      modify for Scratch Booster Pack v1 hardware spec
*****/

#include      <msp430g2553.h>
#include      <stdbool.h>

#define          TXD          BIT1    // TXD on P1.1
#define          RXD          BIT2    // RXD on P1.2

#define          Bit_time     104     // 9600 Baud, SMCLK=1MHz (1MHz/9600)=104
#define          Bit_time_5   52      // Time for half a bit.
// ASCII values for the commands
#define          M_D0          0x30    // Char ASCII "0"
#define          M_A4          0x34    // Char ASCII "4"
#define          M_A5          0x78    // Char ASCII "x"
#define          M_A6          0x79    // Char ASCII "y"
#define          M_A7          0x7A    // Char ASCII "z"
#define          M_TEMP        0x54    // Char ASCII "T"
#define          M_VCC         0x56    // Char ASCII "V"

unsigned char    BitCnt;                // Bit count, used when transmitting byte
unsigned int     TXByte;                // Value sent over UART when Transmit() is called
unsigned int     RXByte;                // Value recieved once hasRecieved is set

unsigned int     i;                    // 'for' loop variable

bool             isReceiving;           // Status for when the device is receiving
bool             hasReceived;           // Lets the program know when a byte is received

bool             ADCDone;               // ADC Done flag
unsigned int     ADCValue;              // Measured ADC Value

/*****
* Function Definitions
*****/

void Transmit(void);
void Receive(void);

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void Measure(unsigned int);
void Measure_REF(unsigned int, unsigned int);
void main(void)
{
    WDTCTL = WDTPW + WDTHOLD;          // Stop WDT

    BCSCTL1 = CALBC1_1MHZ;              // Set range
    DCOCTL = CALDCO_1MHZ;              // SMCLK = DCO = 1MHz

    P1SEL |= TXD;                      // Connected TXD to timer pin
    P1DIR |= TXD;

    P1IES |= RXD;                      // RXD Hi/lo edge interrupt
    P1IFG &= ~RXD;                    // Clear RXD (flag) before enabling interrupt
    P1IE |= RXD;                      // Enable RXD interrupt
    P1DIR |= BIT0;
    P1OUT &= ~BIT0;                   // Turn off LED at P1.0

    isReceiving = false;               // Set initial values
    hasReceived = false;
    ADCDone = false;
    __bis_SR_register(GIE);           // interrupts enabled\

    while(1)
    {
        if (hasReceived)               // If the device has recieved a value
        {
            Receive();
        }
        if(ADCDone)                   // If the ADC is done with a measurement
        {
            ADCDone = false;           // Clear flag
            TXByte = ADCValue & 0x00FF; // Set TXByte
            Transmit();                // Send
            TXByte = (ADCValue >> 8);  // Set TXByte to the upper 8 bits
            TXByte = TXByte & 0x00FF;
            Transmit();
            // P1OUT ^= BIT0;          // Toggle LED on/off P1.0

        }
        if (~(hasReceived && ADCDone)) // Loop again if either flag is set
            __bis_SR_register(CPUOFF + GIE);

        // LPM0, the ADC interrupt will wake the processor up.
    }
}

/*****
* Handles the received byte and calls the needed functions
*****/
void Receive()
{
    hasReceived = false;              // Clear the flag
    switch(RXByte)                    // Switch depending on command value received
    {
        case M_D0:
            P1OUT ^= BIT0;            // Toggle LED on/off P1.0
    }
}

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        break;

    case M_A4:
        Measure(INCH_4);                // Reads A4
        break;

    case M_A5:
        Measure(INCH_5);                // Reads A5
        break;

    case M_A6:
        Measure(INCH_6);                // Reads A6
        break;

    case M_A7:
        Measure(INCH_7);                // Reads A7
        break;

    case M_TEMP:
        Measure_REF(INCH_10,0);          // Reads the temperature sensor, ref 1.5V
        P1OUT ^= BIT0;                  // Toggle LED on/off P1.0
        break;

    case M_VCC:
        Measure_REF(INCH_11, REF2_5V);   // Reads VCC once (VCC/2 internally)
        break;

    default:;
}

}

/*****
* Reads ADC 'chan' once using AVCC as the reference.
*****/
void Measure(unsigned int chan)
{
    ADC10CTL0 &= ~ENC;                  // Disable ADC
    ADC10CTL0 = ADC10SHT_3 + ADC10ON + ADC10IE;

    // 16 clock ticks,
    ADC On, enable ADC interrupt
    ADC10CTL1 = ADC10SSEL_3 + chan;      // Set 'chan', SMCLK
    ADC10CTL0 |= ENC + ADC10SC;         // Enable and start conversion
}

/*****
* Reads ADC 'chan' once using an internal reference, 'ref' determines if the
* 1.5V reference is used.
*****/
void Measure_REF(unsigned int chan, unsigned int ref)
{
    ADC10CTL0 &= ~ENC;                  // Disable ADC
    ADC10CTL0 = SREF_1 + ADC10SHT_3 + REFON + ADC10ON + ref + ADC10IE;
    // Use reference,
    // 16 clock ticks, internal reference on
    // ADC On, enable ADC interrupt, Internal = 'ref'
    ADC10CTL1 = ADC10SSEL_3 + chan;     // Set 'chan', SMCLK

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        __delay_cycles (128);                // Delay to allow Ref to settle
        ADC10CTL0 |= ENC + ADC10SC;          // Enable and start conversion
    }

/*****
* Transmits the value currently in TXByte. The function waits till it is
* finished transmitting before it returns.
*****/

void Transmit()
{
    while(isReceiving);                      // Wait for RX completion
    CCTL0 = OUT;                             // TXD Idle as Mark
    TACTL = TASSEL_2 + MC_2;                 // SMCLK, continuous mode

    BitCnt = 0xA;                            // Load Bit counter, 8 bits + ST/SP
    CCR0 = TAR;                              // Initialize compare register

    CCR0 += Bit_time;                        // Set time till first bit
    TXByte |= 0x100;                         // Add stop bit to TXByte (which is logical 1)
    TXByte = TXByte << 1;                   // Add start bit (which is logical 0)

    CCTL0 = CCIS0 + OUTMOD0 + CCIE;
    // Set signal, initial value, enable interrupts
    while ( CCTL0 & CCIE );                  // Wait for previous TX completion
}

/*****
* ADC interrupt routine. Pulls CPU out of sleep mode for the main loop.
*****/
#pragma vector=ADC10_VECTOR
__interrupt void ADC10_ISR (void)
{
    ADCValue = ADC10MEM;                     // Saves measured value.
    ADCDone = true;                         // Sets flag for main loop.
    __bic_SR_register_on_exit(CPUOFF); // Enable CPU so the main while loop continues
}

/*****
* Port 1 interrupt service routine. Starts the receive timer, and disables any
* current transmission.
*****/
#pragma vector=PORT1_VECTOR
__interrupt void Port_1(void)
{
    isReceiving = true;

    PL1IE &= ~RXD;                          // Disable RXD interrupt
    PL1IFG &= ~RXD;                         // Clear RXD IFG (interrupt flag)

    TACTL = TASSEL_2 + MC_2;                 // SMCLK, continuous mode
    CCR0 = TAR;                             // Initialize compare register
    CCR0 += Bit_time_5;                     // Set time till first bit

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        CCTLO = OUTMOD1 + CCIE;                // Dissable TX and enable interrupts

        RXByte = 0;                            // Initialize RXByte
        BitCnt = 0x9;                          // Load Bit counter, 8 bits + ST
    }

    /*****
    *Timer A0 interrupt service routine. This handles transmitting and receiving bytes.
    *****/
    #pragma vector=TIMER0_A0_VECTOR
    __interrupt void Timer_A (void)
    {
        if(!isReceiving)
        {
            CCR0 += Bit_time;                  // Add Offset to CCR0
            if ( BitCnt == 0)                  // If all bits TXed
            {
                TACTL = TASSEL_2;
                // SMCLK, timer off (for power consumption)
                CCTLO &= ~ CCIE ;              // Disable interrupt
            }
            else
            {
                CCTLO |= OUTMOD2;              // Set TX bit to 0
                if ( TXByte & 0x01)
                    CCTLO &= ~ OUTMOD2; // If it should be 1, set it to 1
                TXByte = TXByte >> 1;
                BitCnt --;
            }
        }
        else
        {
            CCR0 += Bit_time;                  // Add Offset to CCR0
            if ( BitCnt == 0)
            {
                TACTL = TASSEL_2;
                // SMCLK, timer off (for power consumption)
                CCTLO &= ~ CCIE ;              // Disable interrupt

                isReceiving = false;

                P1IFG &= ~RXD;                 // clear RXD IFG (interrupt flag)
                P1IE |= RXD;                   // enabled RXD interrupt

                if ( (RXByte & 0x201) == 0x200)

                //Validate the start&stop bits are correct
                {
                    RXByte = RXByte >> 1; // Remove start bit
                    RXByte &= 0xFF;        // Remove stop bit
                    hasReceived = true;
                }
                __bic_SR_register_on_exit(CPUOFF);
                // Enable CPU so the main while loop continues
            }
            else
            {

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        if ( (P1IN & RXD) == RXD)    // If bit is set?
            RXByte |= 0x400; // Set the value in the RXByte
        RXByte = RXByte >> 1;        // Shift the bits down
        BitCnt --;
    }
}
```