DEEPAK GUPTA


# MSP430 Interface to LCD

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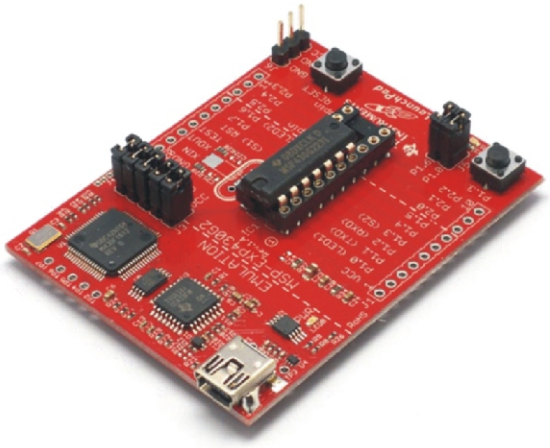
The MSP-EXP430G2 LaunchPad is an easy-to-use flash programmer and debugging tool for the MSP430G2xx Value Line microcontrollers from Texas Instruments. Built around a 16-bit CPU, the MSP430 is designed for low cost and, specifically, low power consumption embedded applications.

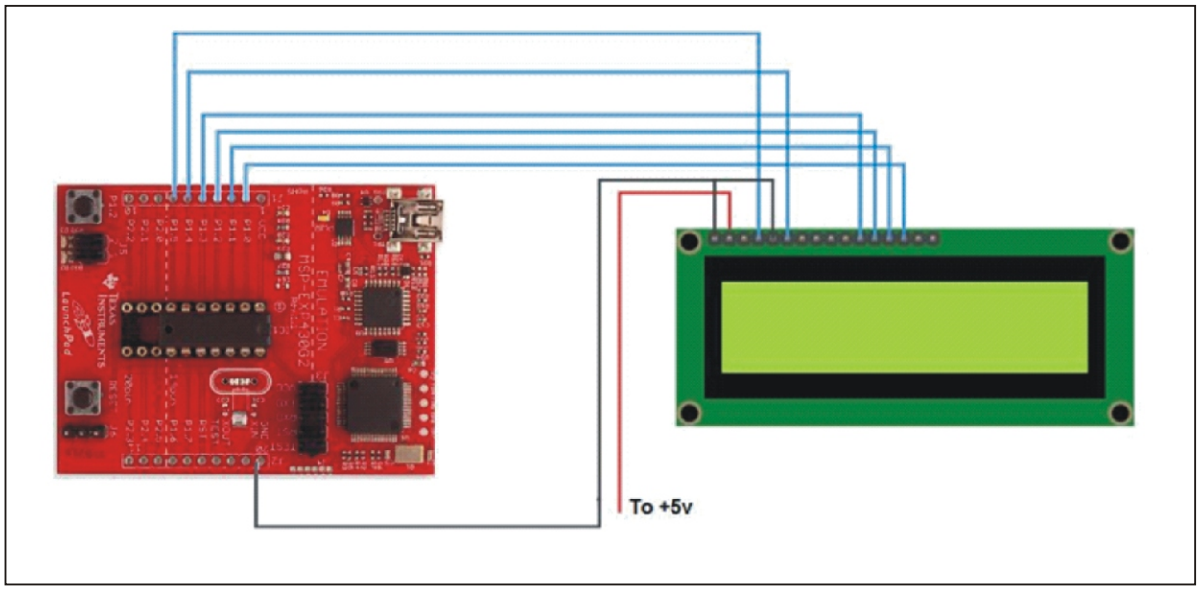
The affordable MSP430 MCU Value Line devices offer a 16-bit architecture, higher precision timers and improved peripheral integration and interfacing, enabling improved performance and lower power consumption. The implementation of 16-bit MCUs enable up to 10 times improved performance and 10 times lower power when compared to many low-cost 8-bit applications.

The LaunchPad kit includes a development board with an integrated USB-powered flash emulation tool for programming and debugging any of the existing MSP430 MCU Value Line devices. Any MSP430G2xx MCU in a DIP package can be dropped into the DIP target socket of LaunchPad, which allows easy evaluation of any MSP430 MCU Value Line device. The flexible target socket allows developers to remove their freshly programmed and



debugged MSP430G2xx MCU to be plugged into a custom breadboard or PCB so that customers are not constrained to the form factor of the LaunchPad board.

Alternatively, developers can use LaunchPad as a standalone system, by leaving the MSP430G2xx device plugged into the board to leverage on-board and programmable push buttons and LEDs.



Additionally, every pin of the MSP430G2xx device is fully accessible, allowing easy interfacing of external components or custom daughter cards.
Since the launchpad works at 3.6v, we need to provide an external 5v supply to power the LCD module. But we can directly connect the port bits of MSP430 to LCD.
Port 1 pins are connected to the LCD.Pins 1.0-1.3 are used as data pins. Pins P1.4 & P1.5 are used as enable and reset pins.The LCD is connected in 4 bit mode.
Some points to be considered while making connections:

- Never forget to provide a connection between both the grounds of launchpad and external supply.
- Never connect the Vcc of MSP430 to anywhere on the LCD
- Ground the R/W pin of LCD
- Pull down the VEE of LCD with a 1K resistor or use a POT .
- Use a 470 ohm resistor to provide the supply for the backlight LED.

## Component Used

### MSP 430

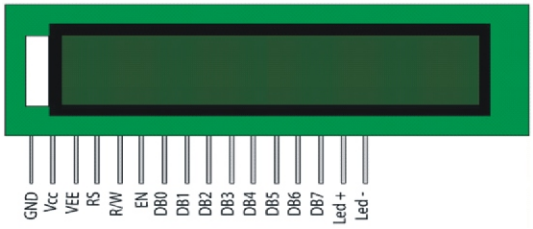
It has on-board emulation for programming and debugging and features a 14/20-pin DIP socket, on-board buttons and LEDs & BoosterPack-compatible pinouts that support a wide range of plug-in modules for added functionality such as wireless, displays & more.
The MSP-EXP430G2 LaunchPad also comes with 2 MSP430 device, with up to 16kB Flash, 512B RAM, 16MHz CPU speed and integrated peripherals such as 8ch 10-bit ADC, timers, serial communication (UART, I2C & SPI). The architecture, combined with five low-power modes, is optimized to achieve extended battery life in portable measurement applications. The device features a powerful 16-bit RISC CPU, 16-bit registers, and constant generators that contribute to maximum code efficiency. The digitally controlled oscillator (DCO) allows wake-up from low-power modes to active mode in less than 1 $\mu$s. The MSP430G2xx series are ultra-low-power mixed signal microcontrollers with built-in 16-bit timers, up to 24 I/O touch-sense-enabled pins, a versatile analog comparator, and built-in communication capability using the universal serial communication interface.

## Features

- Low Supply-Voltage Range: 1.8 V to 3.6 V
- Ultra-Low Power Consumption
  - Active Mode: 230 $\mu$A at 1 MHz, 2.2 V
  - Standby Mode: 0.5 $\mu$A
  - Off Mode (RAM Retention): 0.1 $\mu$A
- Five Power-Saving Modes
- Ultra-Fast Wake-Up From Standby Mode in Less Than 1 $\mu$s
- 16-Bit RISC Architecture, 62.5-ns Instruction Cycle Time
- Basic Clock Module Configurations o Internal Frequencies up to 16 MHz With Four Calibrated Frequency
  - Internal Very-Low-Power Low-Frequency (LF) Oscillator
  - 32-kHz Crystal
  - External Digital Clock Source
- Two 16-Bit Timer A With Three Capture/Compare Registers
- Up to 24 Touch-Sense-Enabled I/O Pins
- Universal Serial Communication Interface (USCI) o Enhanced UART Supporting Auto Baudrate Detection (LIN)
  - IrDA Encoder and Decoder
  - Synchronous SPI
  - I2C™
- On-Chip Comparator for Analog Signal Compare Function or Slope Analog-to-Digital (A/D) Conversion
- 10-Bit 200-ksps Analog-to-Digital (A/D) Converter With Internal Reference, Sample-and-Hold, and Autoscan
- Brownout Detector
- Serial Onboard Programming, No External Programming Voltage Needed, Programmable Code Protection by Security Fuse
- On-Chip Emulation Logic With Spy-Bi-Wire Interface

### 16 X 2 LCD

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred



| Pin No | Function | Name |
|---|---|---|
| 1 | Ground (0V) | Ground |
| 2 | Supply voltage; 5V (4.7V – 5.3V) | Vcc |
| 3 | Contrast adjustment; through a variable resistor | VEE |
| 4 | Selects command register when low; and data register when high | Register Select |
| 5 | Low to write to the register; High to read from the register | Read/write |
| 6 | Sends data to data pins when a high to low pulse is given | Enable |
| 7 | 8-bit data pins | DB0 |
| 8 | | DB1 |
| 9 | | DB2 |
| 10 | | DB3 |
| 11 | | DB4 |
| 12 | | DB5 |
| 13 | | DB6 |
| 14 | | DB7 |
| 15 | Backlight VCC (5V) | Led+ |
| 16 | Backlight Ground (0V) | Led- |

over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of a LCD.

Pin Description:

## Program Code

```
#include <msp430g2211.h>
#include "lcd16.h"
#define EN BIT4
#define RS BIT5
void Delay(volatile unsigned int x)
{
volatile unsigned int i;
for (x ;x>1;x--)
{
for (i=0;i<=110;i++);
}
}
void lcdcmd(unsigned char Data)
{
P1OUT &= ~RS; //because sending command
P1OUT  &=~EN;
P1OUT &= 0xF0;
P1OUT |= ((Data >> 4) & 0x0F);
P1OUT  |=EN;
Delay (2);
P1OUT  &=~EN;
P1OUT &= 0xF0;
P1OUT  |= (Data & 0x0F);
P1OUT  |=EN;
Delay (2);
P1OUT  &=~EN;
}
void lcdData(unsigned char l)
{
P1OUT |=RS;  //because sending data
P1OUT  &=~EN;
P1OUT &= 0xF0;
P1OUT |=((l >> 4) & 0x0F);
P1OUT  |=EN;
Delay (2);
P1OUT  &=~EN;
P1OUT &=  0xF0;
P1OUT  |= (l & 0x0F);
P1OUT  |=EN;
Delay (2);
P1OUT  &=~EN;
}

void prints(char *s)
 {
   while (*s)
     {
              Delay (*s);
              s++;
     }
 }
            void lcdinit(void)
{
P1OUT &=~RS;
P1OUT  &=~EN;
P1OUT |= 0x3;
Delay (40);
P1OUT  |=EN;
P1OUT  &=~EN;
Delay (5);
P1OUT  |=EN;
P1OUT  &=~EN;
Delay (5);
P1OUT  |=EN;
P1OUT  &=~EN;
Delay (2);
P1OUT &= 0xF2;
P1OUT  |=EN;
P1OUT  &=~EN;
lcdcmd(0x28);   //set data length 4 bit 2 line
Delay (250);
lcdcmd(0x0E);   // set display on cursor on blink on
Delay (250);
lcdcmd(0x01); // clear lcd
Delay (250);
lcdcmd(0x06);  // cursor shift direction
Delay (250);
lcdcmd(0x80);  //set ram address
Delay (250);
}
void main(void)
{
WDTCTL = WDTPW + WDTHOLD;
P1DIR = 0xFF;
P1OUT = 0x00; lcdinit();
prints("EM MEDIA");
gotoXy(0,1);
while(1);
}
```