Keywords: Solomon SSD2805, SSD2805 evaluation kit, 1.54" MIPI display LG LH154Q01, Microchip PIC32MX250F128D

SSD2805 MIPI Bridge Evaluation Kit
User's Guide

TechToys Company
Unit 12, 9/F, Block B
Sun Fung Centre
88 Kwok Shui Road
Tsuen Wan
Hong Kong
Tel: 852-28576267
Fax: 852-28576216
Web site: www.TechToys.com.hk

Table of Contents

Chapter 1. Overview

1.1 Introduction

The MIPI Alliance (MIPI) is an open membership organization that develops interface specifications for mobile industries. It was founded by industry leaders including ARM, Intel, Nokia, Samsung, STMicroelectronics and Texas Instruments.[i] In year 2003, the MIPI Alliance has proposed a new interface standard known as Display Serial Interface[ii] (DSI) to replace traditional RGB interface for mobile gadgets. The main goal of the new standard is to develop a new high-speed interface to minimize peripheral pincount, power comsumption, lower electromagnetic interference, and lower product cost.
Ten years afterwards, electronic devices using MIPI displays include the following (just to name few of those.)

Apple iPod Nano6 1.54" MIPI display of 240x240 	**Some interesting link** http://hackaday.com/2013/12/14/reverse-engineering-an-lcd-display/
Apple iPod Touch3 3.54" MIPI display of 320x480 	**ebay** http://www.ebay.com/itm/iPod-Touch-3rd-Gen-LCD-display-screen-replacement-part-/120745780161?pt=US_Replacement_Parts_Tools&hash=item1c1d0263c1
Raspberry Pi 	**Wiki** http://en.wikipedia.org/wiki/File:RaspberryPi_Display_Serial_Interface.jpg
Samsung Galaxy S3 4.8" Super AMOLED 	**Some manual leaked** http://www.uswitch.com/mobiles/news/2012/04/samsung_galaxy_s3_device_render_and_manual_leaked/
Nokia N9 3.9" AMOLED 480x854 MIPI 	**Alibaba** http://www.alibaba.com/product-gs/1333905221/New_3_5_IPS_wvga_480.html

Although there are high-end processors with built-in MIPI driver, tons of microcontrollers and microprocessors with traditional parallel LCD interfaces (RGB and MCU interface) are still alive in the market, especially for low-range MCUs a MIPI interface is not standard.

Solomon Systech MIPI Master Bridge Chips SSD2805 is an IC that converts traditional MCU & RGB interface to MIPI interface.

Evaluation kit described in this manual provides a reference design for SSD2805.

1.2 Evaluation Kit Layout

Representations of the board layout are shown in Figure 1.

Key features include:

1. SSD2805 MIPI Bridge IC.
2. On-board oscillator (Y1) for an active clock signal at 20MHz.
3. Selection switch (S1) for different interface options.
4. MOSFET switch (Q1) to control VDDIO.
5. Linear regulator (U1) XC6206(1.8V) for VDDA and VDDD.
6. 40 pins 2.54mm header (P1) wiring all input signals for SSD2805.
7. 8 pins 2.54mm header (P2) is a jumper switch for the desired pin to drive VSYNC/WRX of SSD2805 from Samtec MEC1-160-02 edge mount socket (J1). The reason for this is to make this board compatible with Microchip's Explorer 16.
8. 20 pins 2.54mm header (P3) wires all differential output from SSD2805 plus 3.3V, 1.8V, EXT_5V, VDDIO and GND.
9. FPC connector (J2) in 0.5mm pitch. This is a down contact connector for DSI signal of SSD2805 together with peripherals (UART/SPI/I2C) routed directly from J1.
10. Samtec MEC1-160-02 edge mount socket (J1) is a high speed socket routed to P1for all SSD2805 input signals. Peripherals and GPIOs described in point 9 above are routed directly from J1 to J2. With compatibility with Microchip's Explorer 16 board in mind, socket J1 gives a clean and low-noise interface for the host MCU/microprocessor. One may design his own host board with specification given by the document (Revision E - recommended mating card layout for MEC1-XX-XX-XX-D-EMX-XX) released by Samtec.

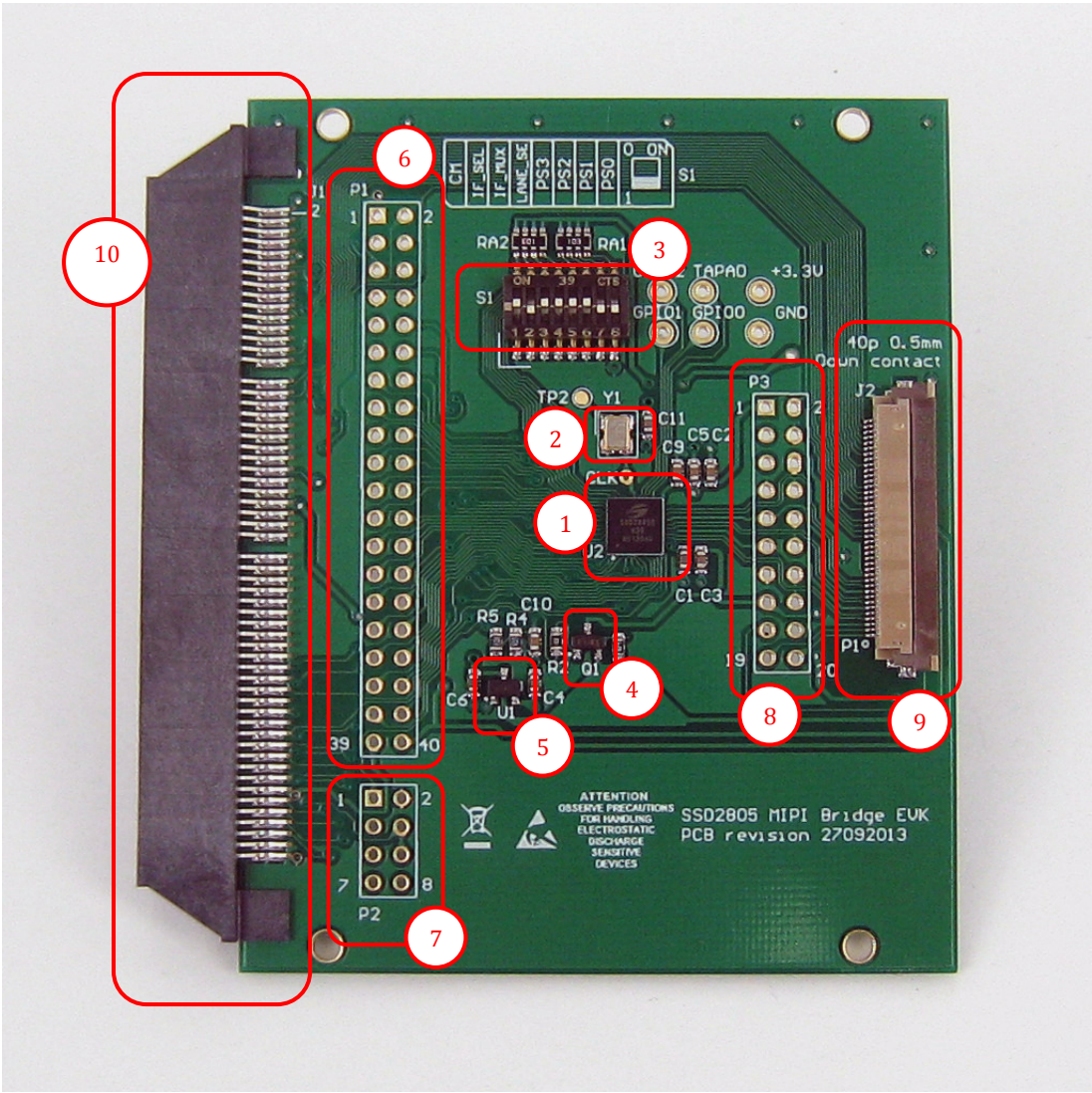


Figure 1-1 Board Layout

1.3 Modes of operation

There are two modes of operation with DSI: Video Mode and Command Mode. SSD2805 supports both operations with configuration selected by PS[3:0] and IF_SEL pins.

In Video Mode (Figure 2) there is no frame buffer on the display panel. This is similar to traditional RGB display in which hsync, vsync, pclk signals should be supplied by the host processor to refresh the display with RGB data continuously. SSD2805 receives pixel data from the host processor through the RGB interface in real-time and configuration data is transmitted through the SPI interface for setup and control.

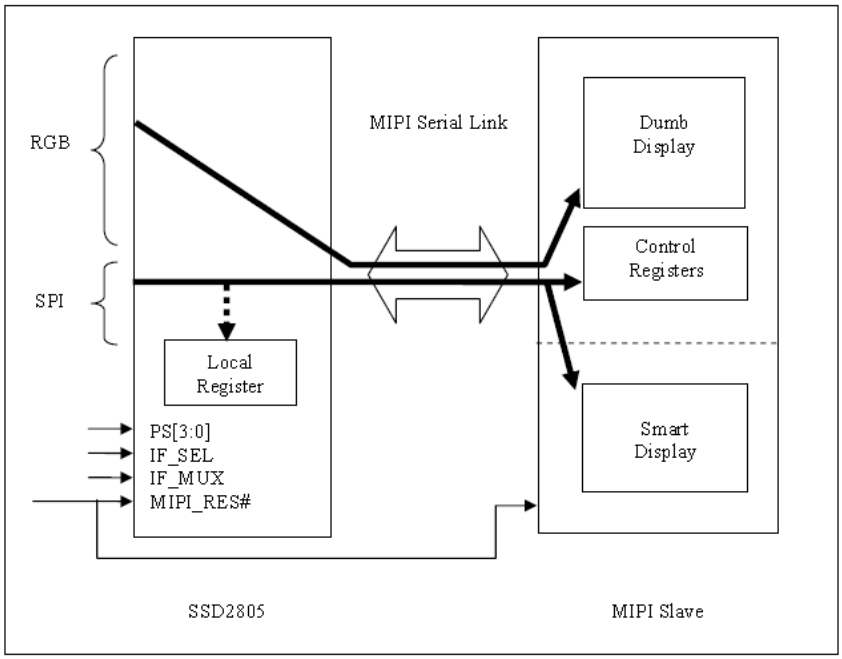


Figure 1-2 Video Mode

In Command Mode (Figure 3) there is an internal display controller with frame buffer on the display panel. This mode is similar to traditional MCU model in which CS#, DC, WR#, RD#, and DATA should be supplied by the host processor. SSD2805 supports 8-bit and 16-bit MCU interface with CSX as the chip select, DCX for data/command select, WRX for write enable and RDX as read enable.

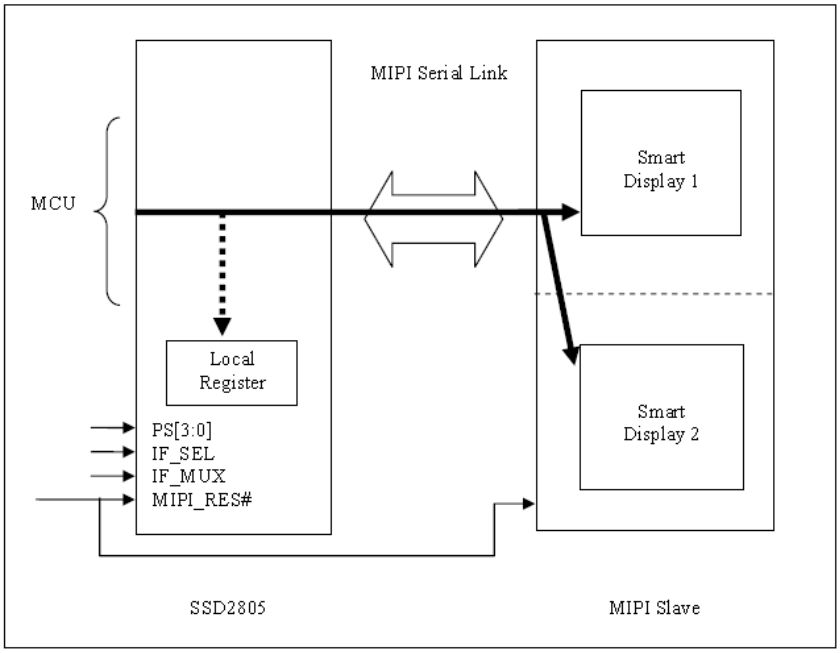


Figure 1-3 Command Mode

Table 1-1 shows settings for different interface modes. When to use Video Mode or Command Mode depends entirely on the display.

For example, to drive the 1.54" iPod Nano 6 display Command Mode should be chosen with IF_SEL high 1 for MCU interface.

On the other hand, 3.54" iPod Touch 3 uses Video Mode therefore the host processor shall be sending RGB signal with IF_SEL set 0 for RGB_SPI mode.

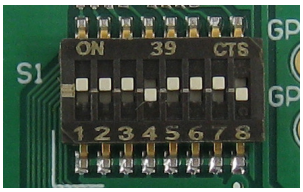
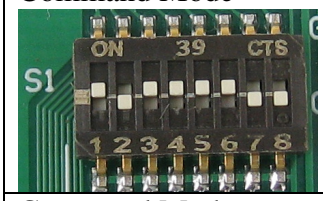
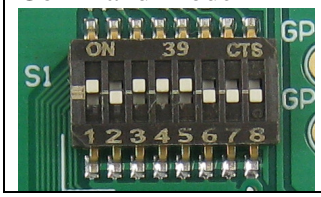
Mode	Control Pins
Video Mode 	PS[1:0] = 01 (8-bit SPI 3 wire) IF_SEL = 0 (RGB + SPI) LANE_SEL = 1 (2 data lanes)
Command Mode 	PS[1:0] = 11 (no SPI) PS[3:2] = 00 (8 bit 8080 MCU interface) IF_SEL = 1(MCU interface) IF_MUX = 0 (MUX scheme 1) LANE_SEL = 0 (1 data lane)
Command Mode 	PS[1:0] = 11 (no SPI) PS[3:2] = 01 (16 bit 8080 MCU interface) IF_SEL = 1(MCU interface) IF_MUX = 0 (MUX scheme 1) LANE_SEL = 0 (1 data lane)

Table 1-1 Selection switch setup for different interface mode

1.4 Connecting to Host Processor

Mate with the Samtec edge mount socket (Figure 4). Footprint of the mating card can be downloaded from Samtec web site from the web link below.

http://www.samtec.com/technical-specifications/Default.aspx?SeriesMaster=MEC1-EM

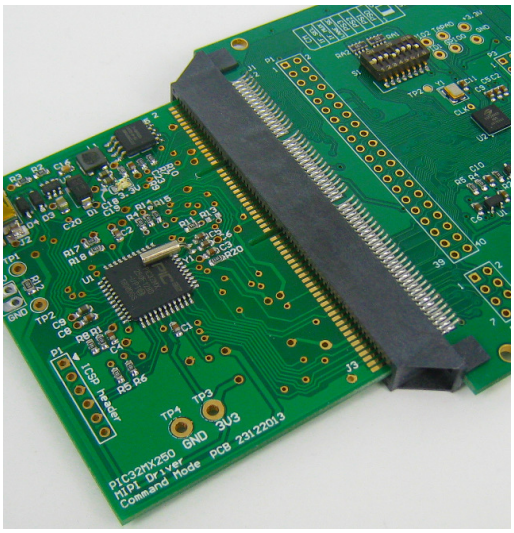


Figure 1-4 **Mating card for Samtec socket**

1.5 Connecting to MIPI Display

Connect J2 to LH154Q01 MIPI Display module with the FPC cable supplied. J2 is a down contact connector so metal contacts of the FPC cable should be facing down.

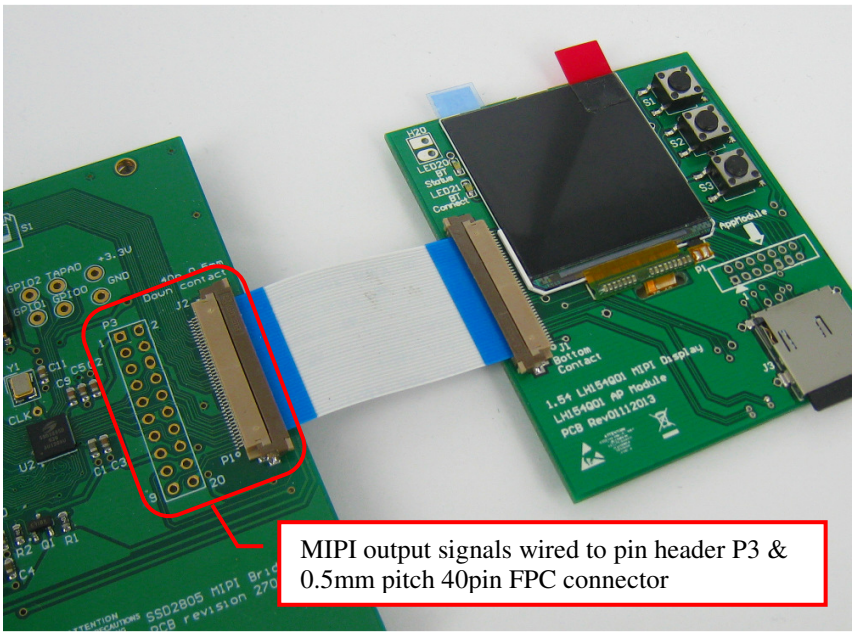


Figure 1-5 Connecting to MIPI Display

Chapter 2. Getting Started

2.1 Display the First Pixel

This section focuses on software to drive SSD2805. There are two interface modes possible: MCU mode and RGB mode. Program described in this chapter uses MCU mode with no operating system or graphics library assumed.

2.2 Hardware required

- PCB with Microchip PIC32MX250F128D 32-bit microcontroller as the host processor (PCB version 23122013)
- SSD2805 MIPI Bridge EVK (PCB rev 27092013)
- 1.54" MIPI display LH154Q01 on PCB, LH154Q01 AP Module (PCB Rev 01112013)
- Debugger device Microchip ICD3 or PICKit3
- PC compatible system with one USB port, or a powered USB hub

2.3 Software required

- MPLAB X Integrated Development Environment (IDE) version 2.00 or later
- XC32 C compiler v1.20 or later. Because XC32 is an ANSI C compiler, this program applies other microcontroller with C compiler as well
- Program source code from the same web page you have downloaded this guide under Doc 08.

2.4 Procedures to Start Programming

Launch MPLAB X, open project PIC32MX250F128DPrimitiveDemo.X from the path ..\Firmware29012014\Graphics\Primitive Demo, click Open Project.

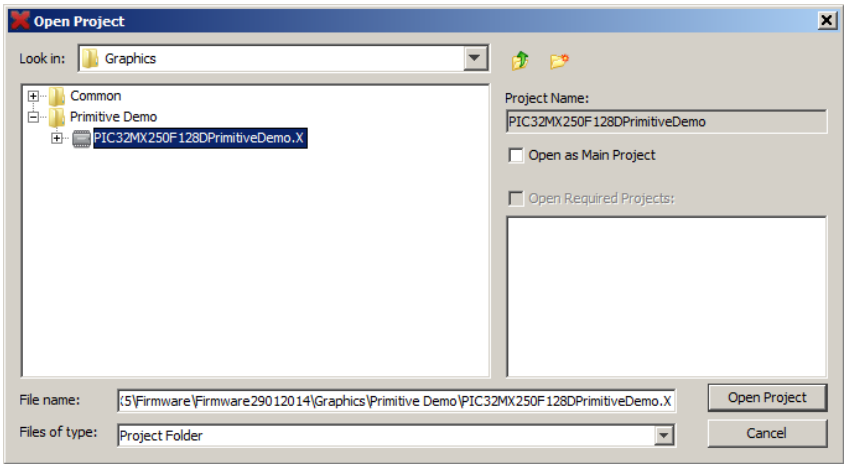


Figure 2-1 Open project PIC32MX250F128DPrimitiveDemo.X

Under Run→Clean and Build Project, the project should be compiled with no error.

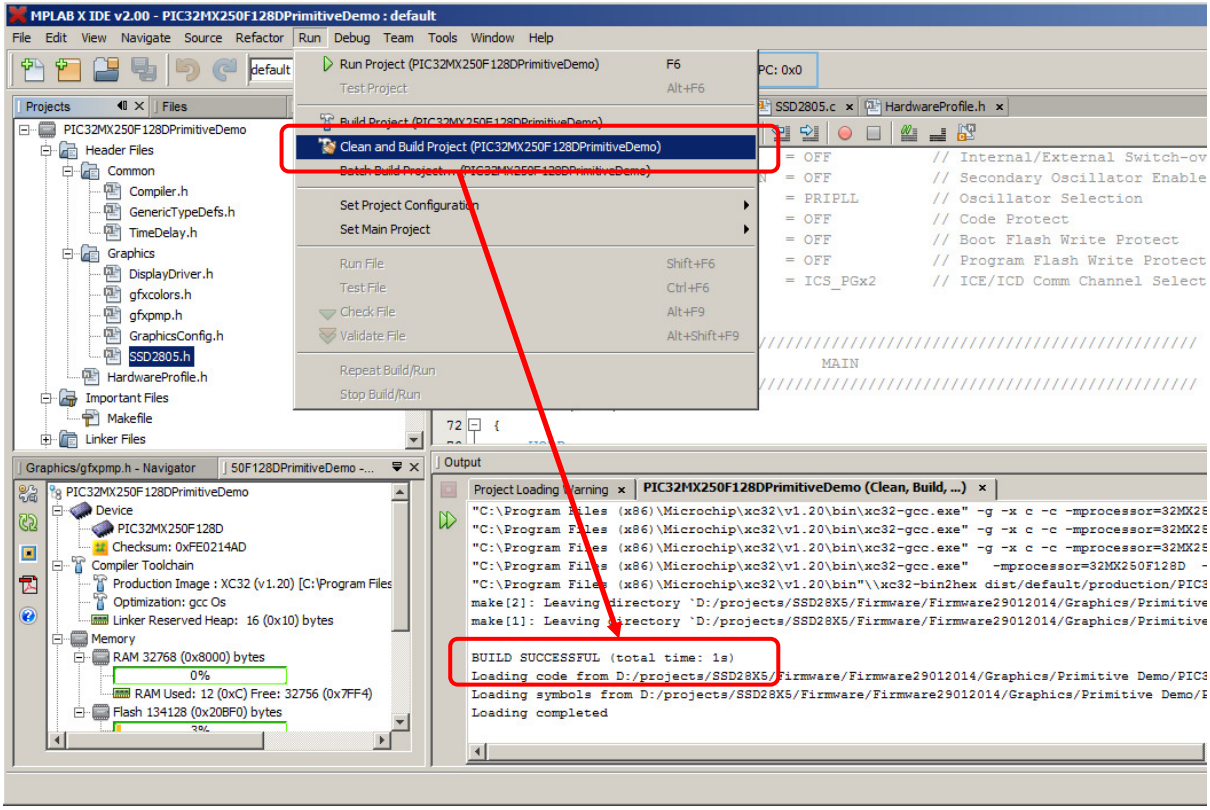


Figure 2-2 Clean & build the project

Put up the boards as shown in Figure 2-3 below. Make sure jumper P2 and S1 are correctly set.

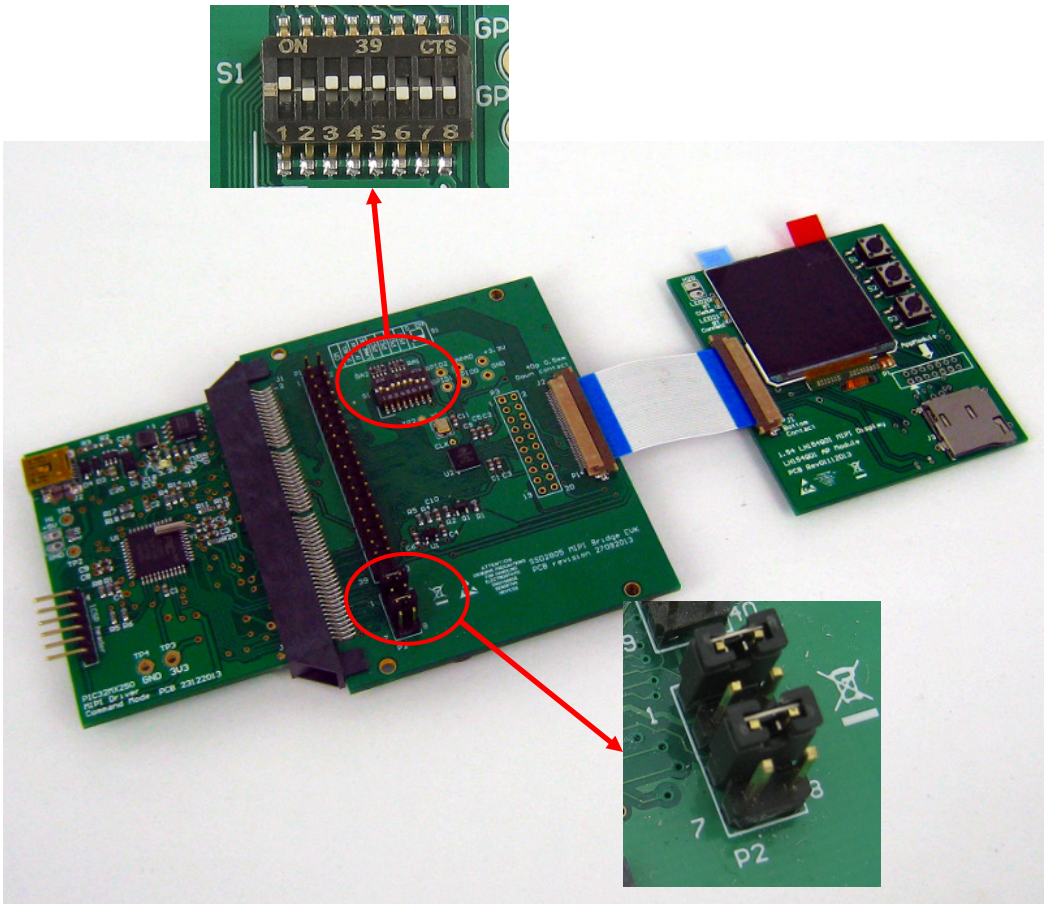


Figure 2-3 Jumper and selection switch settings

Connect a debugger to P1. It is possible to use a PICKit 3 (Figure 2-4) or ICD3 via an adapter (Figure 2-5). Finally, supply 5V with USB port.

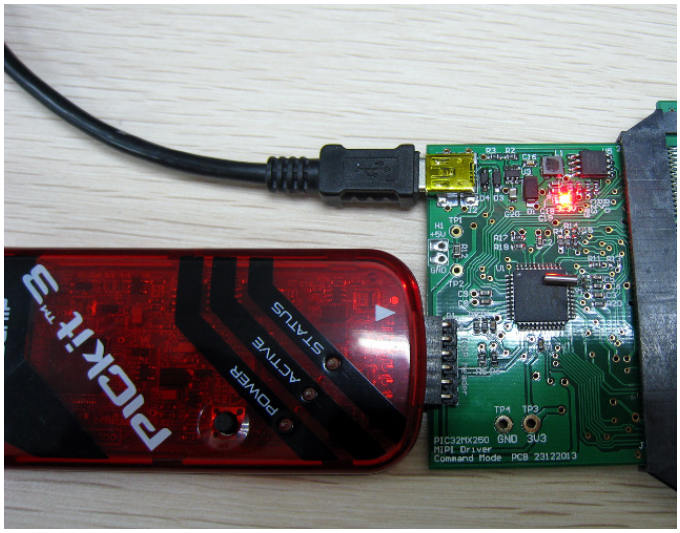


Figure 2-4 Connect to PICKit 3

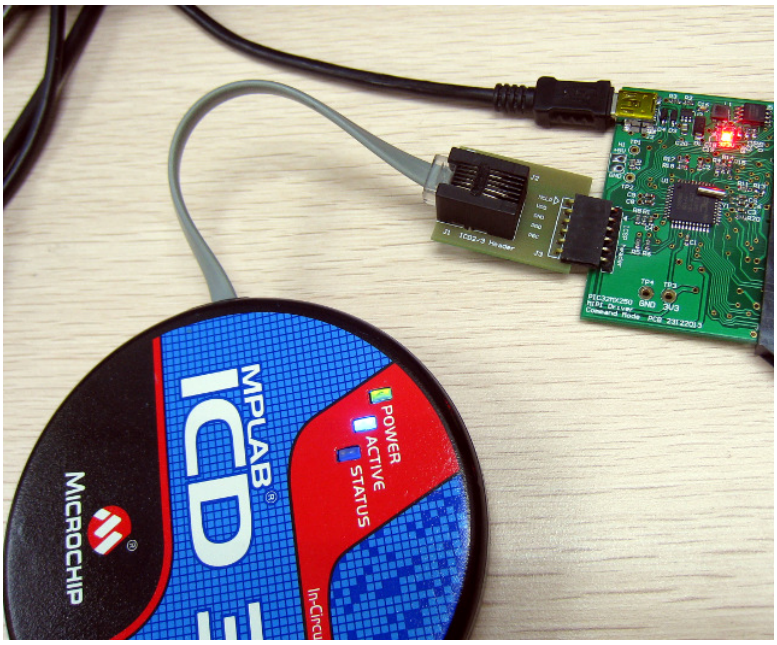


Figure 2-5 Connect to ICD3

From MPLAB X, click Debug Project.

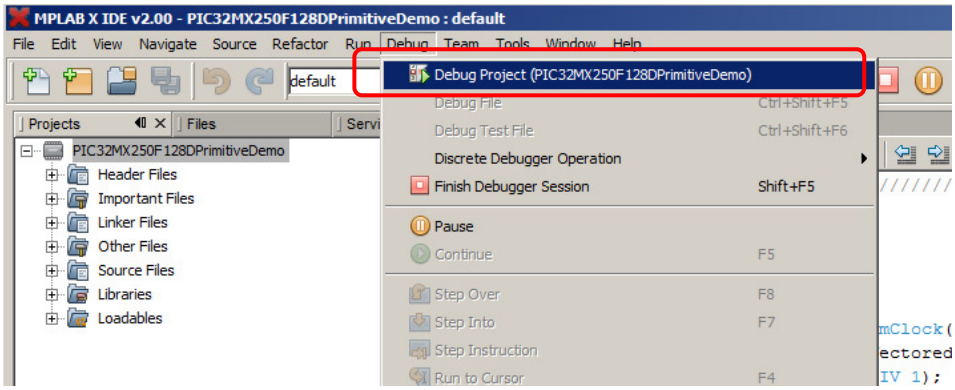


Figure 2-6 Debug Project

The MIPI display will be refreshed with blue and yellow color.

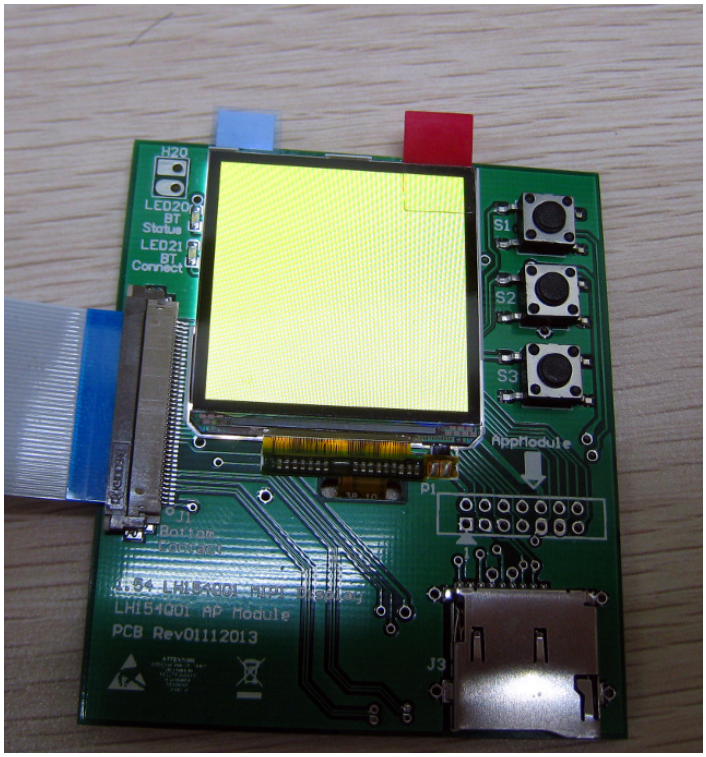


Figure 2-7 MIPI display refreshed with a single color

APPENDIX A Something about MIPI

There are two useful sources to understand DSI.

1. MIPI Alliance Standard for Display Serial Interface V1.0 : 79 pages
2. MIPI Alliance Standard for Display Command Set : 131 pages

An extract from the first document is summarized below:

"The Display Serial Interface (DSI) specification defines protocols between a host processor and peripheral devices that adhere to MIPI Alliance specifications for mobile device interfaces.....
By standardizing this interface, components may be developed that provide higher performance, lower power, less EMI and fewer pins than current devices, while maintaining compatibility across products from multiple vendors."
"For display modules with a display controller and frame buffer, DSI shares a common command set with MIPI Alliance Standard for Display Bus Interface."

Standardization leads to a common command set defined in the second document. An extract of the second document is summarized below:

"The Display Command Set (DCS) specification defines display module behavior for devices that adhere to the MIPI specifications for mobile device host processor, and display interfaces in an abstract, device independent way....
Implementing the DCS standard reduces the time-to-market and design cost of mobile devices by simplifying the interconnection of products from different manufacturers."

What it really means to programmers is that, the command written to a MIPI is the same across different MIPI displays or different vendors.

Table below gives an example comparing commands for three MIPI displays for Sleep In/Out, Display ON/OFF against the Display Command Set laid on the specification.

Operation	DCS Specification	LH350H01 3.54" MIPI display for iPod Touch3	LH154Q01 1.54" MIPI display for iPod Nano 6	7" MIPI display for a tablet
Soft Reset	0x01	-	0x01	0x01
Sleep Out	0x11	0x11	0x11	0x11
Sleep In	0x10	0x10	0x10	0x10
Display On	0x29	0x29	0x29	-
Display Off	0x28	0x28	0x28	-

References

[i] Mobile Industry Processor Interface from Wikipedia
Web site: http://en.wikipedia.org/wiki/Mobile_Industry_Processor_Interface

[ii] Display Serial Interface from Wiki
http://en.wikipedia.org/wiki/Display_Serial_Interface