Keywords: Solomon SSD1963, SSD1963 evaluation kit, SSD1963 demo board, 4.3", 5", 7" TFT interface with SSD1963, SSD1963 demo program, SSD1963 interface PIC, ARM, MSP, AVR

SSD1963 Evaluation Kit Ultima Rev4.1
User Guide

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1. Introduction

SSD1963 Evaluation Kit Ultima Rev4.1 (SSD1963 EVK Ultima) is a development board for Solomon SSD1963 display controller. It provides 1,215K byte frame buffer with parallel MCU interfaces for RAM-less LCD panels up to 864x480 at 24-bit per pixel resolution. All necessary circuits including voltage regulators and a backlight circuit are all onboard to facilitate testing the chip. On top there are bonuses such as VS1003B MP3 codec[i], a microSD card socket for mass storage, Hirose (FX10A-120S[ii]) and Samtec (MEC1-160-02-X-D-EMX[iii]) connectors compatible with Microchip PIC32 starter kits[iv] and Microchip Explorer 16[v] as well as development boards from third parties.

Basically, only two components are required to finish the setup for a content-rich graphical user interface (GUI): a microcontroller to contain the GUI firmware and a TFT panel to display the GUI.

The board layout is shown in Figure 1.1 with key features on next page.

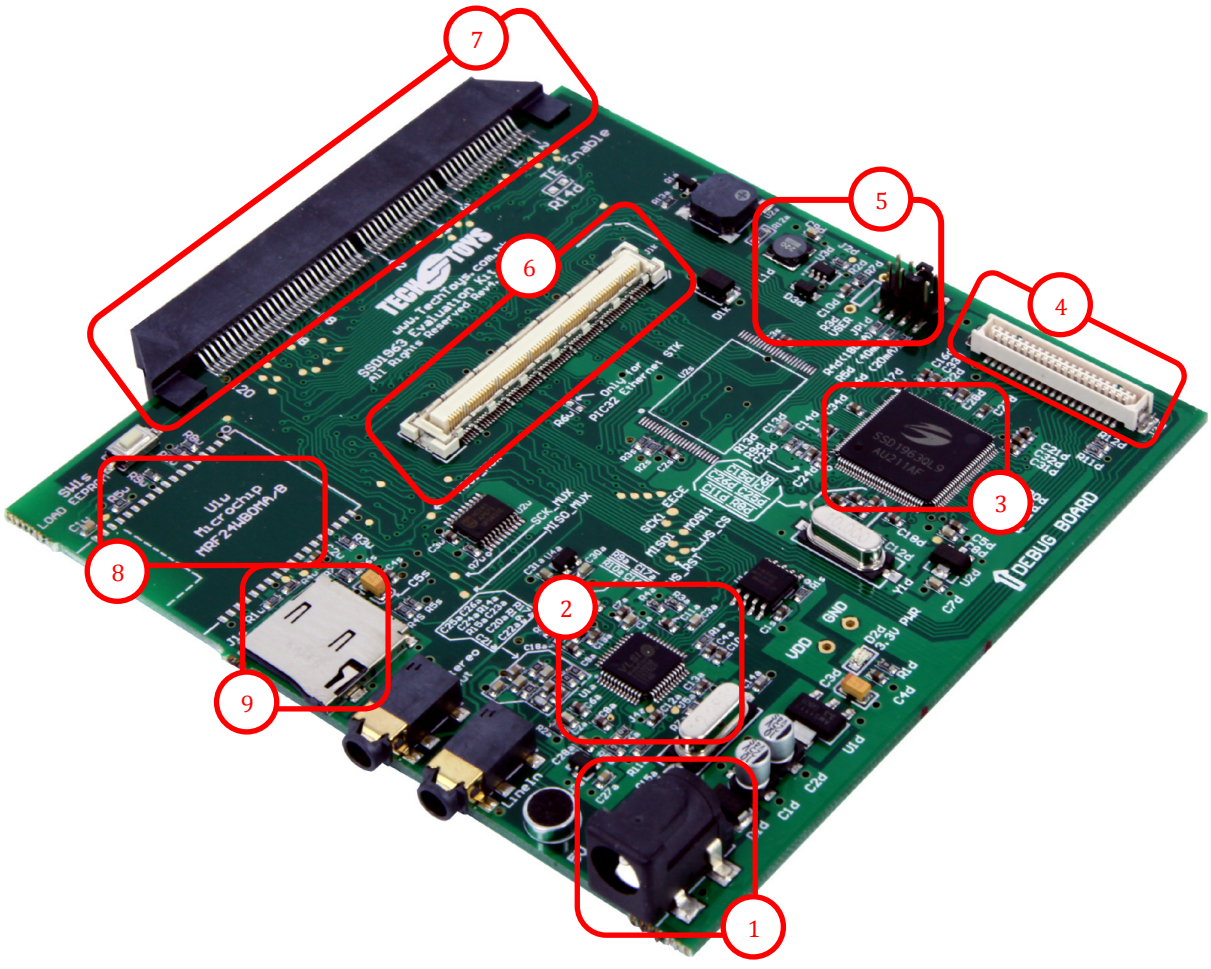


Figure 1.1 Board Layout

1. J1d is a 2.1mm DC power input. A 5V 1A regulated DC voltage with pin positive is recommended for most operations.

2. U1a is the VS1003B MP3 & WMA decoder chip manufactured by VLSI Solution of Finland. By including an audio decoder chip, it is possible to create multimedia applications for visual and audio.

3. U4d is the SSD1963 in TQFP128 package with an external crystal of 10MHz. The oscillation frequency is multiplied by PLL for an operation frequency up to 120MHz. This is the core of this development board.

4. J3d is the Hirose 1mm pitch board-to-board connector (part# DF9-41P-1V) of 41 pins. There are hundreds of TFT manufacturers in the world without a unique standard for TFT interface connections. Thus, an adapter is provided with each evaluation kit sold for TFT panels available from us.

5. LED backlight circuit with jumper selectable current settings. CAT4139 (U3d) is a 22V high current boost white LED driver chip. LEDs connected in series are driven with a regulated current set by an external resistor connected to FB pin. CAT4139 is capable of driving parallel strings of up to five white LEDs in series or up to 22V. A jumper (JP1d) in 2.00mm pitch is provided to select among three resistors to regulate constant LED current of 180mA, 40mA, and 20mA to fit most panels' backlight rating requirement. A footprint of axial, through-hole resistor (R3d-USER) is provided for your TFT panel if it has a different LED current rating from above.

6. J1k is Hirose FX10A-120S receptacle designed for compatibility with PIC32 starter kits of Microchip 32-bit MCU series. The choice of Microchip product has been made because of the free, open-source Microchip Graphics Library which supports pre-made graphics objects (buttons, slider, edit box etc), multiple fonts and languages, user interface for touch panels, image and animation at no royalty fee[vi].

7. Footprint J4k is the Samtec MEC1-160-02-X-D-EMX receptacle. This edge connector is included for compatibility with Microchip Explorer 16 development board as well as boards from third parties.

8. The footprint for WiFi module MRF 24WB0MA/B is provided for wireless LAN applications[vii].

9. MicroSD card socket for storage of images and audio files.

2. Connecting a TFT Panel

SSD1963 supports up to 864x480x24bit RAM-less TFT panels. Common TFT sizes are 3.5" of 320x240 pixels, 4.3" of 480x272 pixels, 5" & 7" of 800x480 pixels. At time of writing, there are three options available from us.

	Part number
7" WVGA TFT panel of resolution 800x480 with resistive Touch Panel	TY700TFT800480_TP_Rev03
5" WVGA TFT panel of resolution 800x480 with resistive Touch Panel	TY500TFT800480Rev01
4.3" WQVGA TFT panel of resolution 480x272 with resistive Touch Panel	TY430TFT480272Rev04

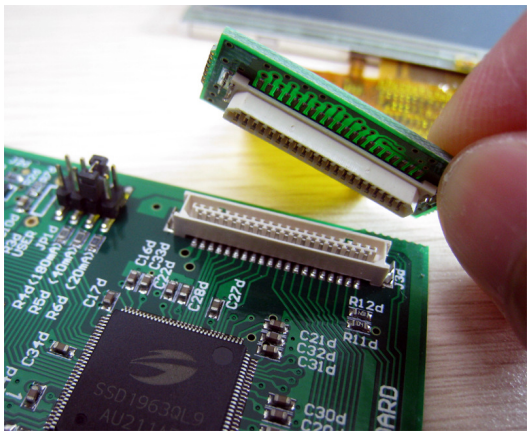


Figure 2.1 Connect TFT panel with adapter

TFT panel is connected by an adapter provided with each evaluation kit sold. Schematic of the adapter can be downloaded from Doc 03 under the same page you have got this manual. The same adapter is used for all of our TFT models since they share the same FPC specifications.

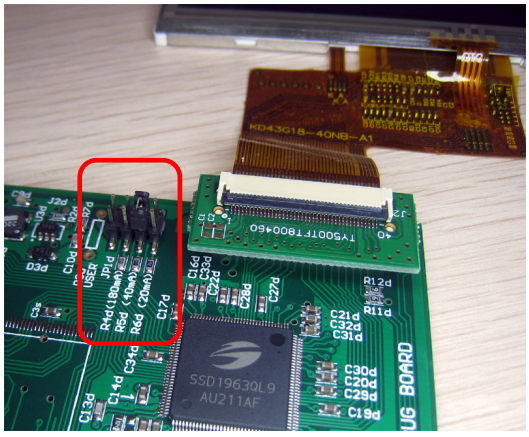


Figure 2.2 Select different resistor for the correct backlight current

Backlight current rating for each TFT model is different. For small panel sizes like 3.5" – 4.3" the common current rating is 20mA-40mA whereas for larger panels like 5" – 7", current rating could be higher. A LED current of 40mA is required for the backlight of TY500TFT800480 & TY430TFT480272 therefore we need to shunt the 2.00mm jumper cap at R5d for 40mA. Similarly if a TY700TFT800480 7" TFT panel is connected, we have to shunt R4d to enable a backlight current of 180mA.

2.1 Universal adapter for your TFT panel

A universal adapter is provided if you want to use your own TFT screen other than our offer. This adapter kit consists of two PCBs: an adapter to stack on J3d and a bare PCB with footprints for major connectors in 0.5mm, 1.00m, and 0.3mm pitch for pin 1 to pin 60.
Strip wires are required to connect the boards.

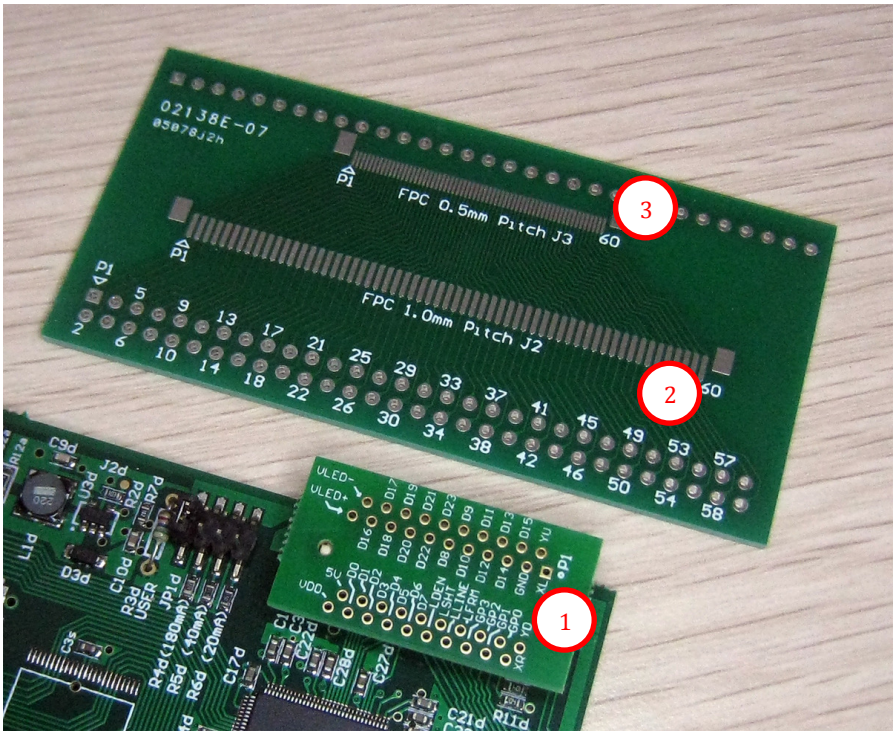


Figure 2.1.1 Adapter kit for other TFT panels
(1) Adapter board with DF9-41S receptacle
(2) Connector footprint of 1.00mm pitch from pin 1 to pin 60
(3) Connector footprint of 0.5mm pitch from pin 1 to pin 60
(4) Connector footprint of 0.3mm pitch from pin 1 to pin 61 in double row on the bottom side (not shown)

A footprint for resistor in axial, through-hole package (R3d-USER) is available for setting backlight current other than the default choices onboard.

CAT4139 is capable of driving parallel strings of up to five white LEDs in series or up to 22V.

FB feedback pin is regulated at 0.3V. A resistor connected between the FB pin and ground sets the LED current according to the formula:

I_{LED} = 0.3V / R3d

Say, you want to set the I_{LED} at 80mA for your TFT,
R3d = 0.3V/80mA = 3.75Ohm.

Therefore soldering a resistor of 3.3 or 3.9Ohm of 1% precision will suit your application. Finally, close jumper at pin 7 & pin 8 to complete the circuit.

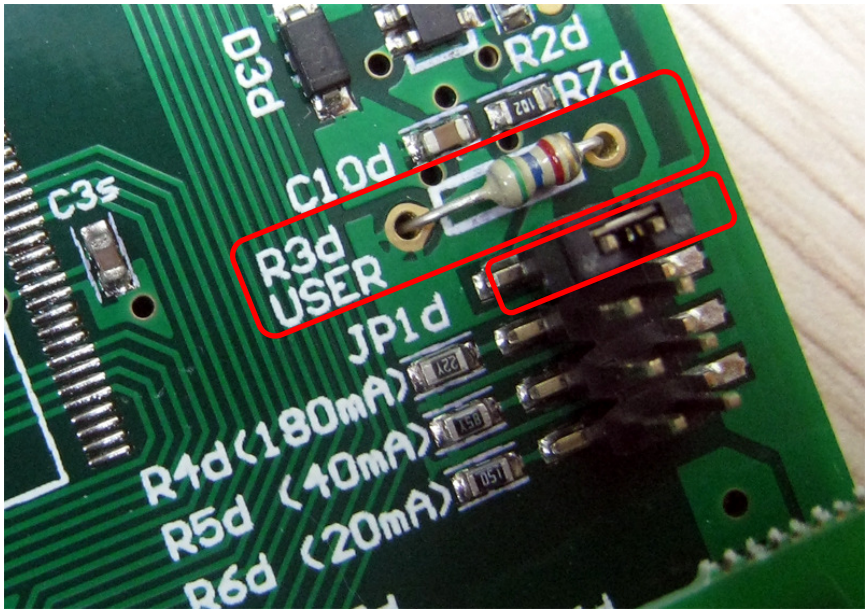


Figure 2.1.2 Solder a resistor for user selectable backlight current and close jumper at pin 7&8 to complete the circuit.

3. Connecting a MCU

There are two receptacles for MCU connection:

1. Hirose FX10A-120S socket. At time of writing there are three PIC32 Starter Kits available from Microchip. Please refer to web site at hyperlink below for details of the Starter Kits.

   http://www.microchip.com/stellent/idcplg?IdcService=SS_GET_PAGE&nodeId=2519&param=en535764&page=wwwdevPIC32BoardKits

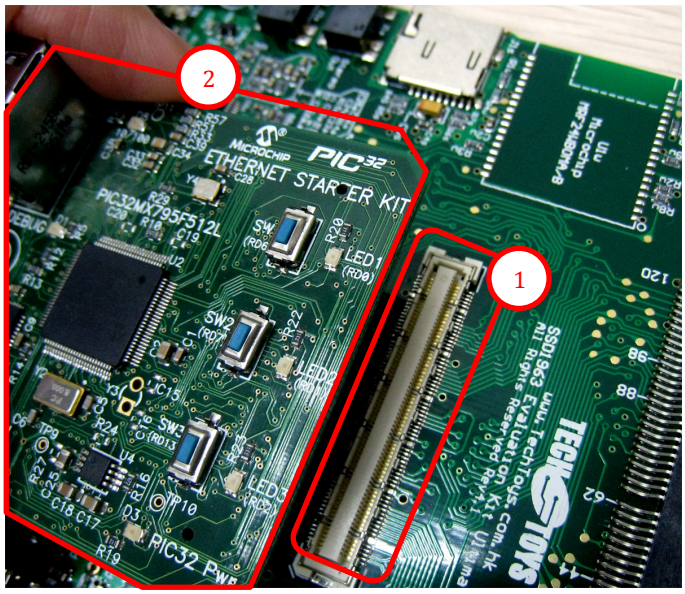


Figure 3.1 (1) FX10A-120S receptacle
(2) Microchip PIC32 GP/USB/ETH Starter Kit

2. Samtec MEC1-160-02-X-D-EMX receptacle.

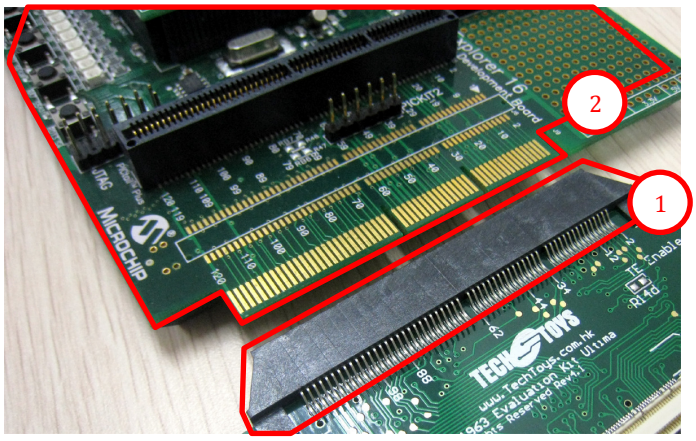


Figure 3.2 (1) Samtec MEC1-160-02-X-D-EMX receptacle
(2) Microchip Explorer 16 evaluation board

By following the specifications of the mating card layout for MEC1-160-02-X-D-EMX, we have made two evaluation boards compatible with SSD1963 EVK Ultima. One of them is the General Purpose evaluation board for 100-pin PIC24 and PIC32 MCUs. At time of writing, two MCU options as PIC32MX360F512L and PIC24F256GA110 are available.

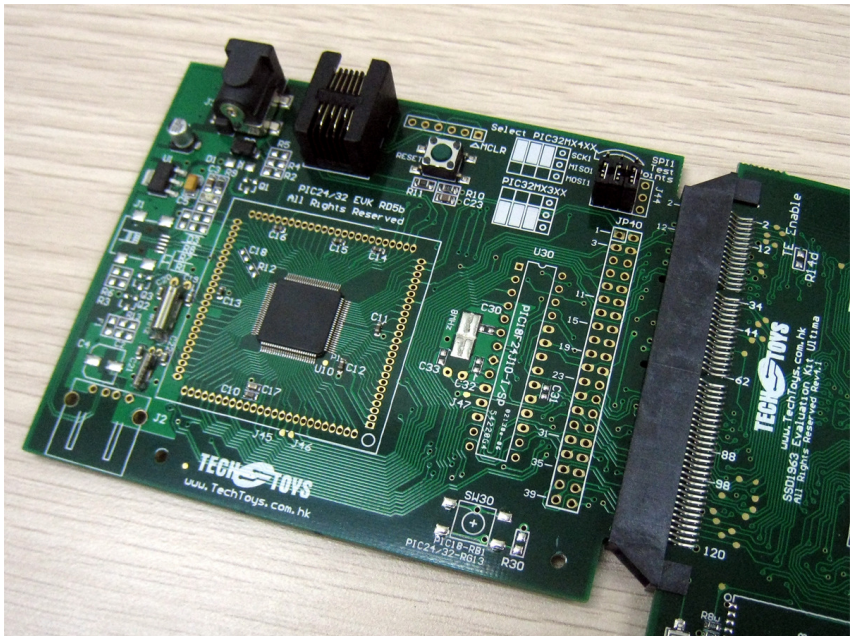


Figure 3.3 Evaluation board for Microchip 100-pin MCU compatible with SSD1963 EVK Ultima

Another MCU board (EVK PIC28PDIP) is a simple PCB with a 8-bit MCU of Microchip PIC18F24J10 in 28 PDIP package inserted. This board is included with each SSD1963 EVK Ultima kit sold to serve two purposes. One of them is an out of the box demo to turn on a TFT with the first pixel, which we will go into full details in separate application note. Another purpose of this board is to provide a PCB with all necessary MCU interface signals in 2.54mm headers to drive SSD1963. The schematic of this MCU board is provided under Doc 02 of the same page you have got this manual.

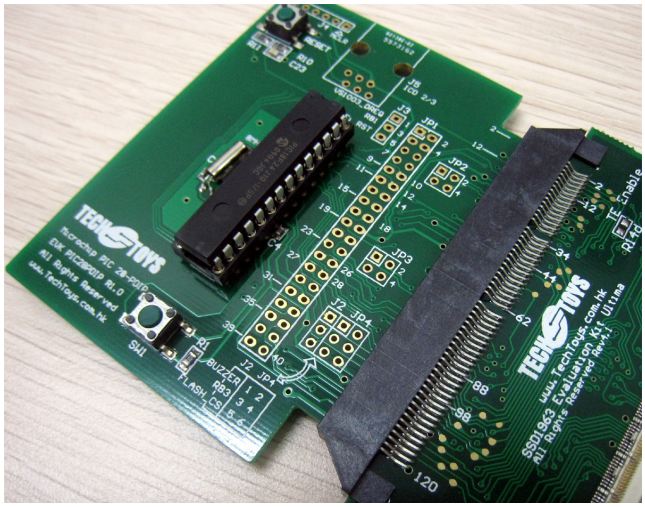


Figure 3.4 Evaluation board for 28-pin MCU in PDIP is included for each SSD1926 EVK Ultima sold

An important feature of EVK PIC28PDIP is to allow you to connect SSD1926 EVK Ultima to the MCU (other than Microchip) you would like to test with SSD1963. By removing the 28-pin MCU one may use 2.54mm pin headers with solder-less jumper cables to connect to a target MCU board.
An example is shown in Figure 3.5 to show the connection with an ARM MCU LPC2103.

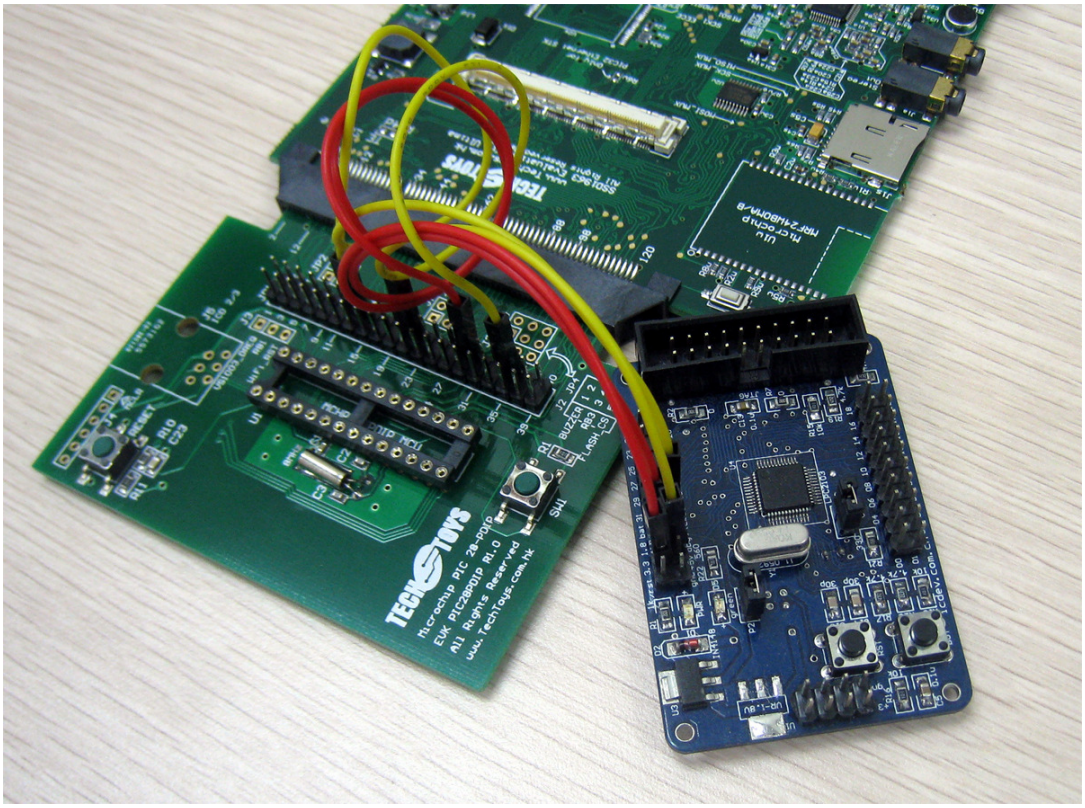


Figure 3.5 Connect an ARM LPC2103 with SSD1963 EVK Ultima

4. Software

4.1 Development Environment

Open source demo programs are provided for startup. These programs have been developed under Microchip Graphics Library version 3.0.x with a low level driver for SSD1963 developed by us.

It is not restricted to Microchip's microcontrollers to interface the SSD1963. Any microcontroller or processor that is able to generate the required control signal (CS#, DC, RD#, WR#, and D[23:0]) will be able to drive it. There are few Graphical Libraries such as:

- Luminary (now belongs to Texas Instruments) Micro Graphics Library
  - http://www.luminarymicro.com/products/stellaris_graphics_library.html
- Renesas Graphics Library
  - http://america.renesas.com/fmwk.jsp?cnt=sw_lib_child.htm&fp=/products/mpumcu/h8_family/h8_lcd/child_folder/&title=Graphic%20Animation%20Software
- PEG embedded Graphical User Interface
  - http://swellsoftware.com/products/
- Easy GUI by IBIS Solution ApS
  - http://www.easygui.com
- emWin supplied by Segger Microcontroller GmbH & Co. KG
  - www.segger.com

Some of these libraries are free as long as you would use their products while the others provide port to various MCUs at a certain cost. User may select his favorite host and decide which GUI is the best for the application. Microchip Graphics Library has been chosen because it is free as long as the library will be embedded to Microchip products.

All applications for this evaluation kit have been prepared under the following environment. The following components are required prior to development.

1. Microchip MPLAB Integrated Development Environment (IDE) version 8.83.

At time of writing, the latest software version is v8.87. MPLAB can be downloaded from this hyperlink

http://www.microchip.com/stellent/idcplg?IdcService=SS_GET_PAGE&nodeId=1406&dDocName=en019469&part=SW007002

By following the installation procedure for default settings, MPLAB was installed under ***C:\Program Files\Microchip\MPLAB IDE\Core\MPLAB.exe***.

2. MPLAB C Complier for PIC32 MCUs version 2.02.

The MPLAB C Compiler for PIC32 (C32) is a full-featured ANSI compliant C compiler for Microchip's PIC32 family of 32-bit microcontrollers. A free evaluation is available by downloading the Evaluation Edition. It has no code size limit and provides complete functionality for 60 days. The compiler is completely usable after 60 days other than certain optimization levels are disabled.

The hyperlink for downloading C32 is
http://www.microchip.com/stellent/idcplg?IdcService=SS_GET_PAGE&nodeId=2615&dDocName=en532454.

By following the installation procedure for default settings, C32 was installed under ***C:\Program Files\Microchip\mplabc32\v2.02***. All example programs are working on the Evaluation Edition before and after 60 days.

3. The firmware package with applications and drivers developed and modified for SSD1963. This can be downloaded from the same web page you have got this user guide under Doc 04.

The origin of the firmware package is the Microchip Application Libraries version v2011-07-14. The main page of the libraries is found from this web page.
http://www.microchip.com/stellent/idcplg?IdcService=SS_GET_PAGE&nodeId=2680&dDocName=en547784

The Microchip Application Libraries includes full source code for the following software libraries: USB, Graphics, Memory Disk Drive, TCP/IP Stack, mTouch Capacitive Touch Library, and Smart Card Library. This is a big library collection of 639MB for not only PIC32 MCUs, but also other MCU series of Microchip. Install as usual by following the default installation path. A new folder under the path C:\Microchip Solutions v2011-07-14 was installed. We have not used all of them but only few of those for our hardware.

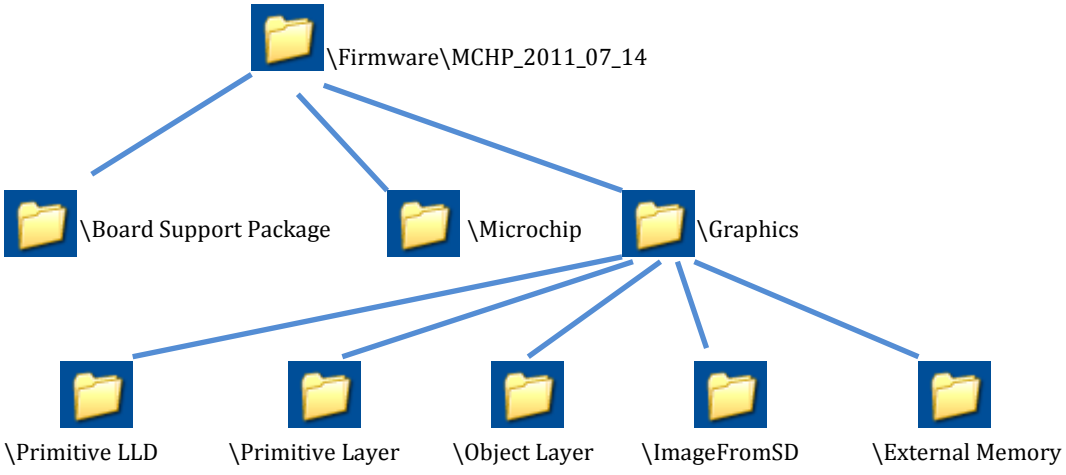
Individual versions of the Microchip Application Libraries are shown in Figure 4.1 as a reference. We will be using the Graphics Library and Memory Disk Drive (MDD) only.

Microchip Application Libraries download includes the following:

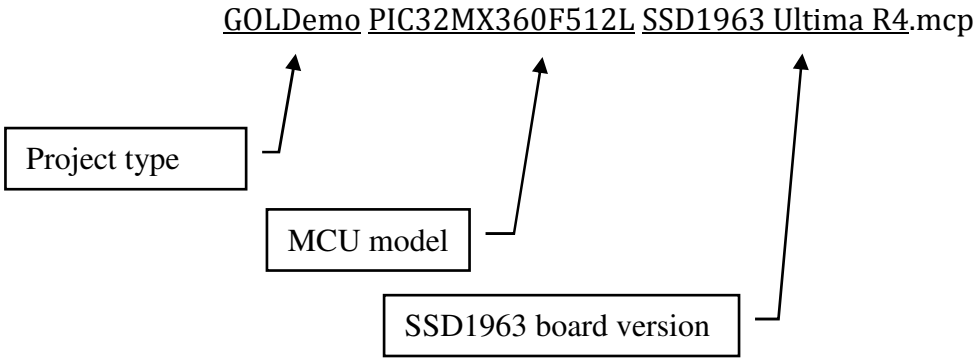
Library	Current Version	PIC16F (8-bit)	PIC18F (8-bit)	PIC24/dsPIC (16-bit)	PIC32 (32-bit)
USB Framework	2.9a		x	x	x
Graphics Library	3.01			x	x
Memory Disk Drive (MDD)	1.3.2		x	x	x
TCP/IP Stack	5.36.2		x	x	x
mTouch Capacitive Touch Library	1.31	x	x	x	x
Smart Card Library	1.02.2		x	x	x
MiWi™ Development Environment	4.2.2		x	x	x
Accessory Framework for Android™	1.0.1			x	x

Figure 4.1 Microchip Application Libraries versions

4. Hierarchy of projects is shown as below.



Inside each project folder, there are various projects with project name matching the hardware combinations respectively. The name for each project is different but pattern is the same with example as below.



A wide hardware combination is supported with summary in Table 4.1 on next page.

Matrix of demonstration

	Hardware combination	Primitive Low Level Display (\Primitive LLD)	Primitive Demo (\Primitive Later)	Object layer Demo with TP (\Object Layer)	Image display from SD card with or w/o MP3 decoder (\ImageFromSD)	External Memory (\External Memory)
1	PIC18F24J10on EVK PIC28PDIP	√ 8bit	X	X	X	X
2	PIC32MX360F512L on Explorer 16	X	√ 16bit	√ 16bit with USE_SST25VF016	r/w SD card OK MP3 OK	√
3	PIC32_GP_SK on SSD1963 Ultima board	√ 16bit	√ 16bit	√ 16bit with USE_SST25VF016	r/w SD card OK MP3 OK	X
4	PIC32MX360F512L_EVK_RD5B	√ 16bit	√ 16bit	√ 16bit with USE_SST25VF016	r/w SD card OK MP3 OK	X
5	PIC32MX460F512L on Explorer 16	X	√ 8bit[1]	√ 8bit with USE_MCHP25LC256	r/w SD card OK no MP3	X
6	PIC32_USB_SK on SSD1963 Ultima board	√ 16bit	√ 16bit	√ 16bit with USE_SST25VF016	r/w SD card OK MP3 OK	√
7	PIC32MX795F512L on Explorer 16	X	√ 8bit	√ 8bit with USE_MCHP25LC256	r/w SD card OK no MP3	X
8	PIC32_ETH_SK on SSD1963 Ultima board	√ 16bit	√ 16bit	√ 16bit with USE_SST25VF016	r/w SD card OK MP3 OK	√

Table 4.1 Matrix of demonstration

[1] It is possible to use 8-bit addressing but it is not recommended for speed issue.

4.2 Procedure to get started

Four MCU variants are supported for each project. At time of writing, they are

(a) Microchip PIC18F24J10 low pin-count MCU. This is a very useful example to show the way to display the first pixel by bit-bang. No complicated GUI library is available and it is more easy to follow.
(b) Microchip PIC32MX360F512L general purpose 32-bit MCU. Full examples with Microchip Graphic Library are given starting from this.
(c) Microchip PIC32MX460F512L MCU with USB connectivity.
(d) Microchip PIC32MX795F512L MCU with Ethernet & USB connectivity.

First select the right project suiting your MCU model. The project name belongs to SSD1963 Ultima board always end with * SSD1963 Ultima R4.mcp as shown below.

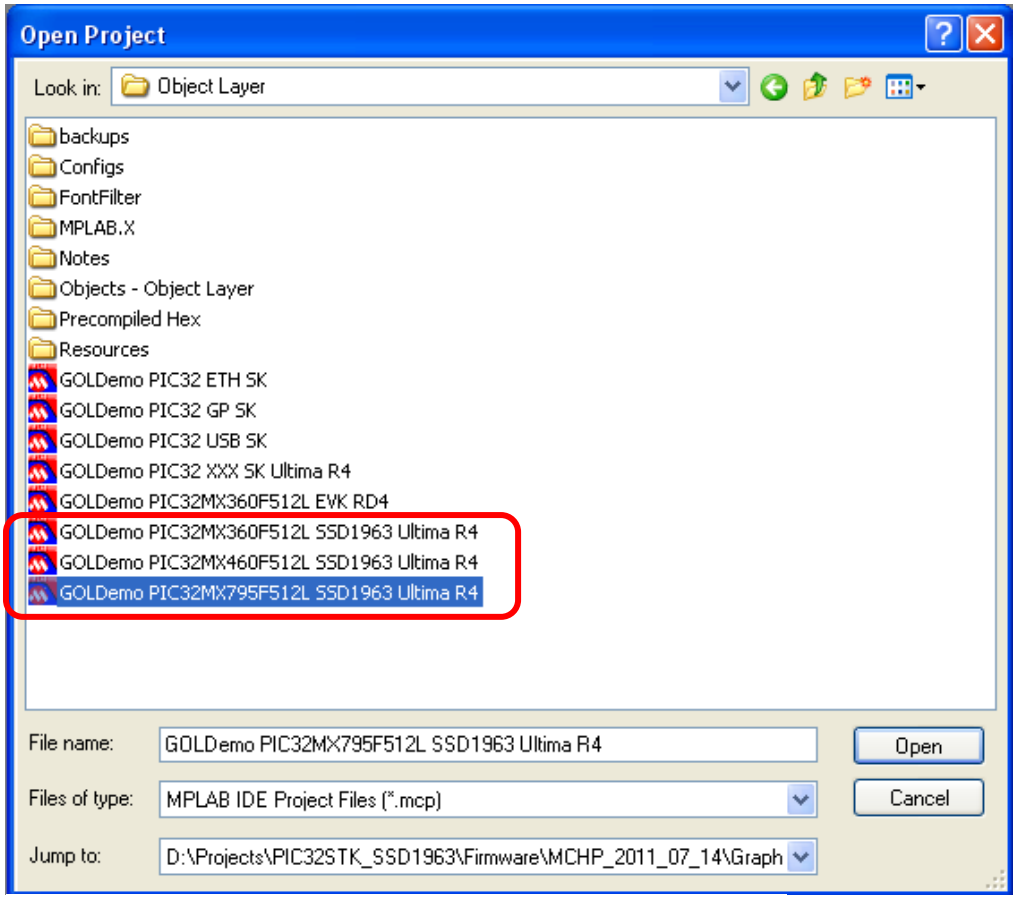
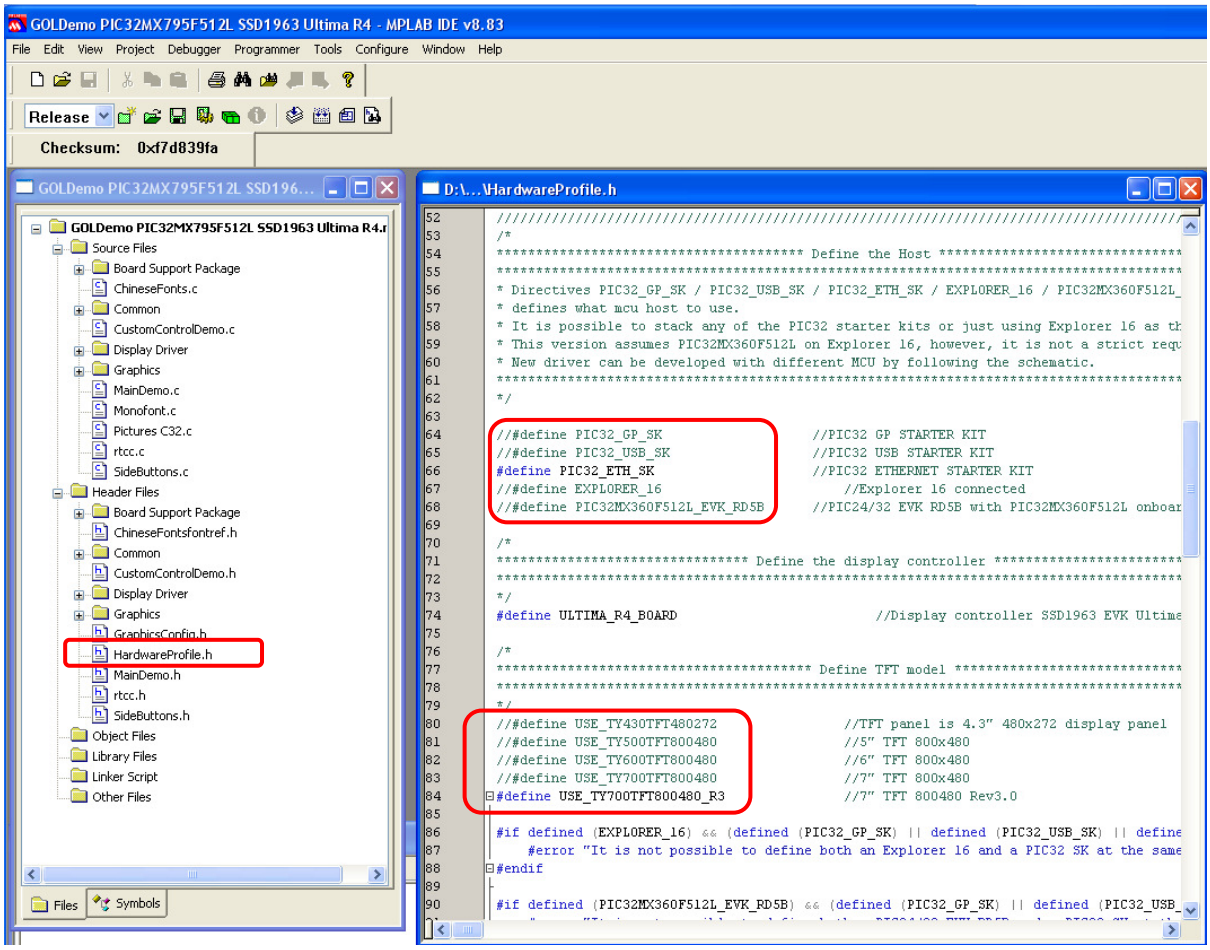


Figure 4.2 Project names for SSD1963 Ultima board Rev4.1

From workspace open the file HardwareProfile.h. There are only two parameters to change to suit your hardware. The first parameter is the MCU host which can be PIC32 XXX SK standing for individual starter kits or Explorer 16 if you are using a PIC32MXxxxF512L PIM on it. Suppose we are using a PIC32 Ethernet Starter Kit, we need to make sure PIC32_ETH_SK has been chosen.
The next parameter is to choose the correct display panel. There are three different models with size 4.3", 5", and 7" available from us. That's all for customerization. Finally, rebuild and program.



5. End Notes

[i] http://www.vlsi.fi/en/products/vs1003.html

[ii] http://www.hirose-connectors.com/connectors/H205SeriesGaiyou.aspx?c1=FX10&c3=3

[iii] http://www.samtec.com/ProductInformation/TechnicalSpecifications/Overview.aspx?series=MEC1

[iv] http://www.microchip.com/stellent/idcplg?IdcService=SS_GET_PAGE&nodeId=2519&param=en535764&page=wwwdevPIC32BoardKits

[v] http://www.microchip.com/stellent/idcplg?IdcService=SS_GET_PAGE&nodeId=1406&dDocName=en024858&part=DM240001

[vi] http://www.microchip.com/stellent/idcplg?IdcService=SS_GET_PAGE&nodeId=2680&dDocName=en543091

[vii] http://www.microchip.com/pagehandler/en-us/technology/wifi