

**S5U13781R00C100**  
**Demonstration Manual**  
**for STM32 F4-Discovery**  
**and XIAMEN ZETTLER ATM0430D5**  
**Panel**

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# 1 Introduction

## 1.1 General Description

This manual describes following two types of demonstration systems using the S5U13781R00C100 reference board.

- (1) A demonstration (demo) system consisting of a microcontroller evaluation board and an LCD panel.
- (2) A demonstration (demo) system consisting of a personal computer and an LCD panel.

The instructions in this manual allow you to realize the above two types of demonstration system easily.

For a detailed specification of the S5U13781R00C100 reference board, please refer to the *S5U13781R00C100 Reference Board User Manual*, document number X94A-G-004-xx.

This user manual is updated as appropriate. Please check the Seiko Epson Website at [http://www.epson.jp/device/semicon\\_e/product/lcd\\_controllers/reference\\_design/index.htm](http://www.epson.jp/device/semicon_e/product/lcd_controllers/reference_design/index.htm) for the latest revision of this document before beginning any development.

We appreciate your comments on our documentation. Please contact us via email at [vdc-documentation@ea.epson.com](mailto:vdc-documentation@ea.epson.com).

## 1.2 Terminology

SPI: Serial Peripheral Interface

LUT: Look Up Table

ppm format: portable pixmap format

bpp: bits per pixel

URL: Uniform Resource Locator

PIP: Picture In Picture

LED: Light Emitting Diode

### 1.3 Required Materials for Demonstration System

#### ■ Hardware

Following components are required to establish the demonstration system.

1. S5U13781R00C100 (LCDC reference board from Epson)
2. STM32 F4-Discovery (CPU evaluation board from STMicroelectronics)
3. ATM0430D5  
(4.3 inch, 480x272 dots, 24 bit full color TFT LCD panel from XIAMEN ZETTLER)
4. UM232H (USB-Serial conversion board from FTDI)
5. AC power supply ( e.g. General purpose DC5V2A output, 100V – 240V input, inner diameter 2.1mm)
6. AC power supply ( e.g. General purpose DC3.3V2A output, 100V – 240V input, inner diameter 2.1mm)
7. DC jack ( e.g. General purpose inner diameter 2.1mm)
8. Pin header (e.g. General purpose 2x25 2.54mm pitch)
9. Jumper pin (e.g. General purpose 2.54mm pitch)
10. USB cable A female – mini-B male (General purpose A to mini-B)
11. Personal computer

For programming of STM32 F4-Discovery and UM232H control.

Required software is available on the internet.

Demonstrations explained in this manual are confirmed operating on a personal computer configured as follows.

OS: Microsoft Windows 7 Professional Service Pack 1

CPU: Intel(R) Core(TM) i5-2520M CPU@2.5GHz

On board memory: 4GB

Capacity of hard disk: 162GB capacity of C: drive. (Disk space required for the software tools is less than 5GB.)

#### ■ Software (Demo)

The sample software package (includes image data for demo and configuration information for LCD) is available on the Epson web site.

## ■ **Software (Development Tool)**

The following tools are required.

1. IAR Embedded Workbench for ARM, v. 6.30, 32K Kickstart Edition from IAR systems
2. STM32F4DISCOVERY board firmware package from ST Microelectronics
3. Visual C++ 2010 Express from Microsoft
4. Driver and MPSSE-SPI library for UM232H from FTDI

These tools are available without charge on the web site of each vendor.

## 2 Preparation of Demo

This section describes the tool set up and data package for the demo.

### 2.1 Instruction for Tool Download and Install

1. IAR Embedded Workbench for ARM, v. 6.309, 32K Kickstart Edition from IAR systems

Download from the following URL and install according to the introduction provided from the company.

EWARM 32K size limited version for evaluation (KS version) Ver 6.309. File size: 782MB.  
[http://ftp.iarsys.co.jp/~download/KH\\_forSE\\_EWARMKS6.30\\_P/EWARM-KS-CD-6309.exe](http://ftp.iarsys.co.jp/~download/KH_forSE_EWARMKS6.30_P/EWARM-KS-CD-6309.exe)

#### Note:

Install the IAR Embedded Workbench and Driver (ST-Link) in the ARM Kickstart installer window.

2. ST Microelectronics STM32F4DISCOVERY board firmware package

The firmware package is available from the following URL.

<[http://www.st.com/internet/com/SOFTWARE\\_RESOURCES/SW\\_COMPONENT/FIRMWARE/stm32f4discovery\\_fw.zip](http://www.st.com/internet/com/SOFTWARE_RESOURCES/SW_COMPONENT/FIRMWARE/stm32f4discovery_fw.zip)>

3. Microsoft™ Visual C++ 2010 Express from Microsoft.

Download Microsoft™ Visual C++ 2010 Express from the following URL and install according to the introduction provided by Microsoft.

<<http://www.microsoft.com/visualstudio/en-us/products/2010-editions/visual-cpp-express/>>

4. Driver and MPSSE-SPI library for UM232H from FTDI

Download the Driver and MPSSE-SPI library from the following URLs.

Driver for UM232H

<<http://www.ftdichip.com/Drivers/D2XX.htm>>

D2XX driver for Windows can be downloaded from the following URL (located on the above web page).

<[http://www.ftdichip.com/Drivers/CDM/CDM20814\\_WHQL\\_Certified.zip](http://www.ftdichip.com/Drivers/CDM/CDM20814_WHQL_Certified.zip)>

MPSSE-SPI library

<<http://www.ftdichip.com/Support/SoftwareExamples/MPSSE/LibMPSSE-SPI.htm>>

The MPSSE-SPI library (file name: libMPSSE-SPI.zip) can be downloaded from the following URL (located on the above web page).

<<http://www.ftdichip.com/Support/SoftwareExamples/MPSSE/LibMPSSE-SPI/libMPSSE-SPI.zip>>

## 2.2 Instruction for Demo Sample Software Download

The LCDC reference sample software package “epson\_lcdc\_demo\_stmf4\_psp1\_rev2.zip” is downloadable from the [EPSON LCDC reference Web site](#).

Verify that the files described in Table 2-1, *ATM0430D5 Download File*, are in the downloaded file.

*Table 2-1 ATM0430D5 Download File*

For ATM0430D5 (4.3 inch, 480x272 dots, 24 bit full color TFT panel from XIAMEN ZETTLER)

Download File	Contents
demo_stm32f4_psp1.zip	Firmware project file for STM32F4-Discovery Target tool: EWARM
flash_psp1.zip	Project file for data writing to M25P16 (SPI flash ROM) Target tool: Visual C++ 2010 Express
demo_um232h_psp1.zip	Project file for UM232H demo Target tool: Visual C++ 2010 Express

### 2.3 Unzip Downloaded Files

#### (1) Preparation for display demo using STM32 F4-Discovery

1. Make the project folder “demo\_stm32f4\_psp” and place the file “stm32f4discovery\_fw.zip” into this folder.
2. Unzip the file “stm32f4discovery\_fw.zip”. The folder “STM32F4-Discovery\_FW\_Vx.x.x” will be created.
3. Unzip the file “demo\_stm32f4\_psp1.zip” described in the Table 2-1, *ATM0430D5 Download File*. The folder “S1D13781”, “STM32F4\_s1d13781\_Demo” and “STM32F4\_s1d13781\_Demo\_embFlash” will be created.
4. Move folder “S1D13781” to the following folder.  
“\demo\_stm32f4\_psp\STM32F4-Discovery\_FW\_Vx.x.x\Libraries\”
5. Move folder “STM32F4\_s1d13781\_Demo” and “STM32F4\_s1d13781\_Demo\_embFlash” to the following folder.  
“\demo\_STM32 F4\_psp\STM32F4-Discovery\_FW\_Vx.x.x\Project\”  
\*Vx.x.x shows version number.

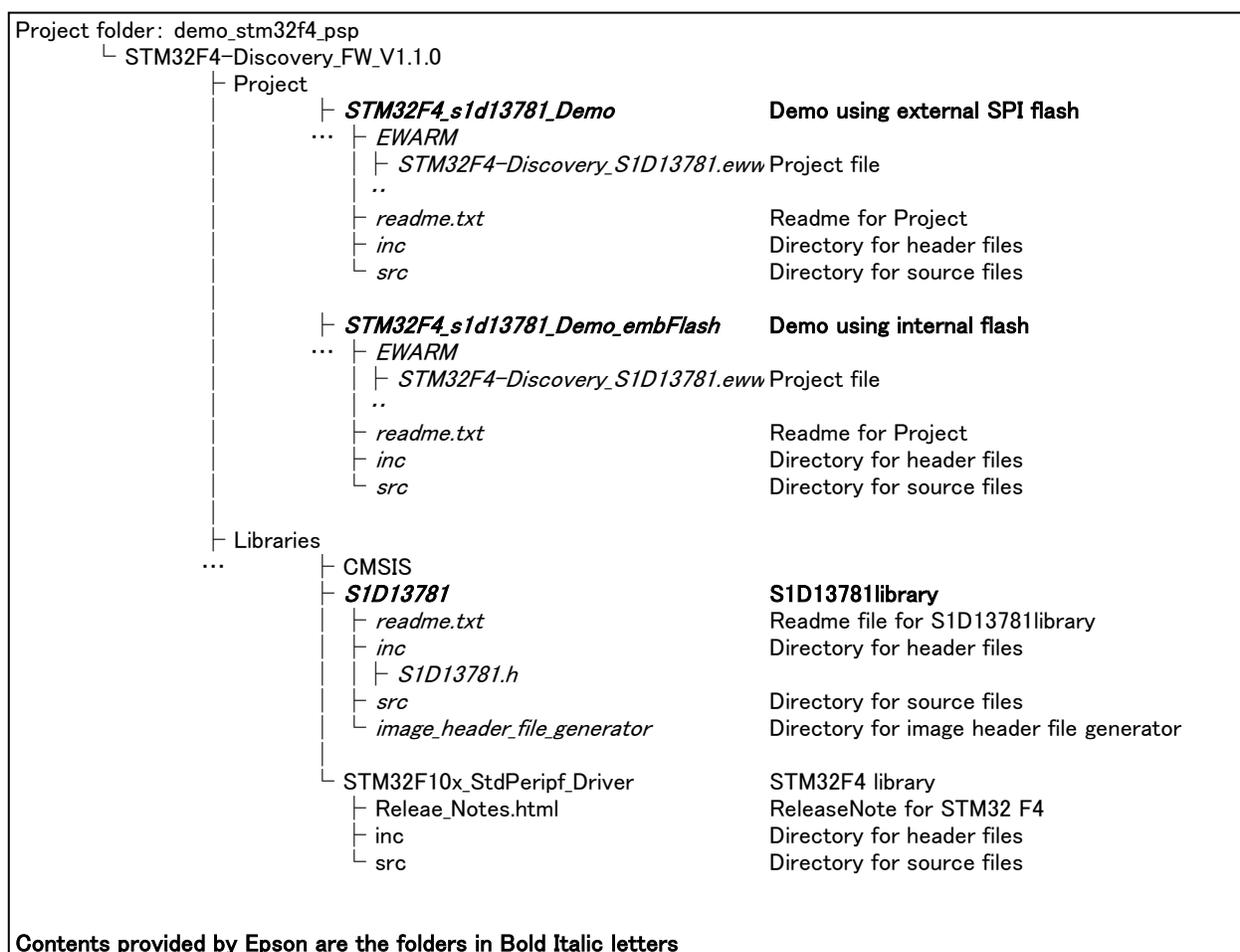


Figure 2-1 Structure of the Project Folder (STM32)

**(2) Preparation for writing data into flash memory**

1. Unzip the file “flash\_psp1.zip“ described in the Table 2-1, *ATM0430D5 Download File*. The project folder “flash\_psp” is created.
2. Unzip the MPSSE-SPI library “libMPSSE-SPI.zip” downloaded in Section 2.1, Instruction for Tool Download and Install. The folder “libMPSSE-SPI” will be created.
3. Double click the “b.bat” icon in the folder “\libMPSSE-SPI\Release-SPI\samples”.

A command window is opened. Type “3” to select “SPI-Static”.

Copy following three files from the folder “\libMPSSE-SPI\Release-SPI\samples\SPI” into the project folder: “flash\_psp”.

```
ftd2xx.h
libMPSSE.a
libMPSSE_spi.h
```

This completes embedding the MPSSE-SPI library into the M25P16 write project folder: “flash\_psp”.

Project folder: flash_psp	Contents
<i>ReadMe.txt</i>	
<i>EPSON_LCDC_REF.sln</i>	Solution file
<i>***.cpp</i>	Source file
<i>***.h</i>	Header file
libMPSSE.a	MPSSE library from FTDI
libMPSSE.h	MPSSE header file from FTDI
ftd2xx.h	D2XX header file from FTDI
<i>pix</i>	Directory for demo image data
...       <i>image*_480x272.ppm</i>	Demo image data for PSP panel (in PPM format)
...	
<i>image*_320x240.ppm</i>	Demo image data for QVGA panel (in PPM format)
...	

Contents provided by Epson are written in Italic letter.

Figure 2-2 Structure of the Project Folder (Flash)

## Preparation of Demo

### (3) Preparation for display demo using PC

1. Unzip the file “demo\_um232h\_psp1.zip” described in Table 2-1, *ATM0430D5 Download File*. The Project folder “demo\_um232h\_psp” is created.
2. Unzip the MPSSE-SPI library “libMPSSE-SPI.zip” downloaded in Section 2.1, Instruction for Tool Download and Install. Then the folder “libMPSSE-SPI” will be created.
3. Double click the “b.bat” icon in the folder “\libMPSSE-SPI\Release-SPI\samples”.

A command window is opened. Then type “3” to select “SPI-Static”.

Copy following three files from the folder “\libMPSSE-SPI\Release-SPI\samples\SPI” into the project folder: “demo\_um232h\_psp”.

ftd2xx.h  
libMPSSE.a  
libMPSSE\_spi.h

This completes embedding the MPSSE-SPI library into the UM232H demo project folder: “demo\_um232h\_psp”.

Project folder: demo_um232h_psp	Contents
<i>ReadMe.txt</i>	
<i>EPSON_LGDC_REF.sln</i>	Solution file
<i>***.cpp</i>	Source file
<i>***.h</i>	Header file
libMPSSE.a	MPSSE library from FTDI
libMPSSE.h	MPSSE header file from FTDI
ftd2xx.h	D2XX header file from FTDI
<i>pix</i>	Directory for demo image data
...	
<i>image*_480x272.ppm</i>	Demo image data for PSP panel (in PPM format)
...	
<i>image*_320x240.ppm</i>	Demo image data for QVGA panel (in PPM format)
...	

Contents provided by Epson are written in Italic letter.

Figure 2-3 Structure of the project folder (UM232H)

### 3 Explanation of the Demo using STM32 F4-Discovery

This section describes the contents and instructions for the display demo using the STM32 F4-Discovery.

Section 3.1 explains the demo which uses the STM32F407 built-in 1MB flash memory on STM32 F4-Discovery board as display image storage.

Section 3.2 explains the demo which uses the 16Mbit SPI NOR Flash standard memory (M25P16) on the S5U13781R00C100 reference board as display image storage.

#### 3.1 Demo using STM32F407 Built-in 1MB Flash Memory

##### 3.1.1 Summary

The STM32 F4-Discovery is the evaluation board for ARM Cortex-M4 on board STM32F4xx microcontroller from ST Microelectronics (hereafter STM). This board is reasonably priced and includes an ICE feature, making it suitable for this evaluation.

The demo displays a still image on an LCD panel. Hardware consists of following items.

LCD controller: S5U13781R00C100 reference board

Microcontroller: STM32 F4-Discovery

LCD panel:

ATM0430D5 from XIAMEN ZETTLER (4.3 inch, 480x272 dots, 24 bit full color TFT LCD panel)

The firmware for the STM32 F4-Discovery is written using “IAR Embedded Workbench for ARM, 6.309, 32K Kickstart Edition” from IAR systems.

## Explanation of the Demo using STM32 F4-Discovery

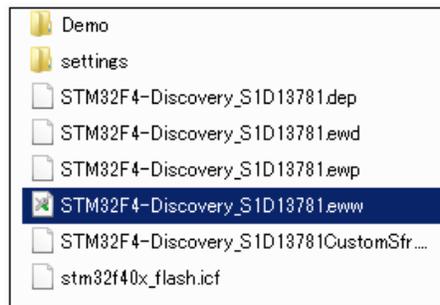
### 3.1.2 Write Demo Sample Software into STM32 F4-Discovery

Connect the STM32 F4-Discovery to the PC via USB.



Launch the project file for IAR Embedded Workbench.

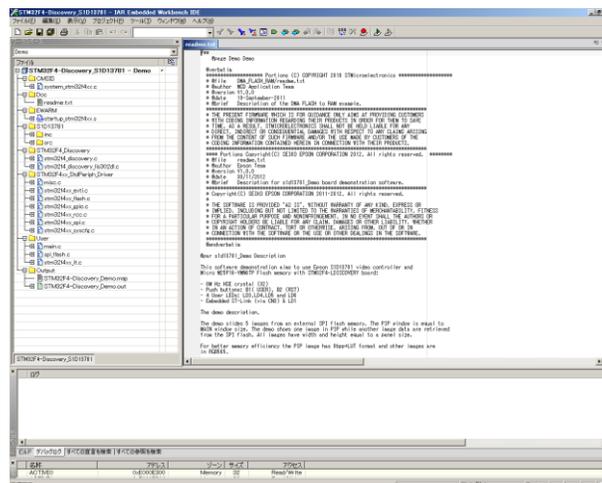
Double click “STM32F4-Discovery\_S1D13781.eww” located in the project folder: “\STM32F4-Discovery\_FW\_Vx.x.x\project\STM32F4\_s1d13781\_Demo\_embFlash\EWARM\”.



Here, if the window opens which states “Can not open this file”, then launch “IAR Embedded Workbench” from the Windows start menu.



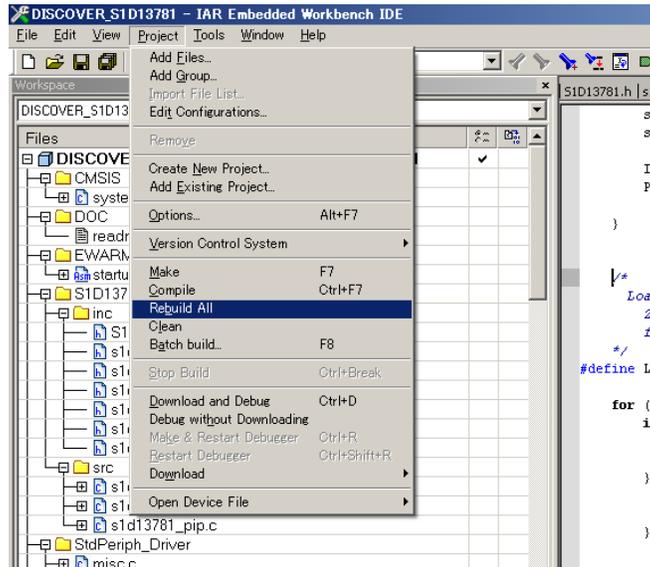
EWARM is launched and project file is opened.



## Explanation of the Demo using STM32 F4-Discovery

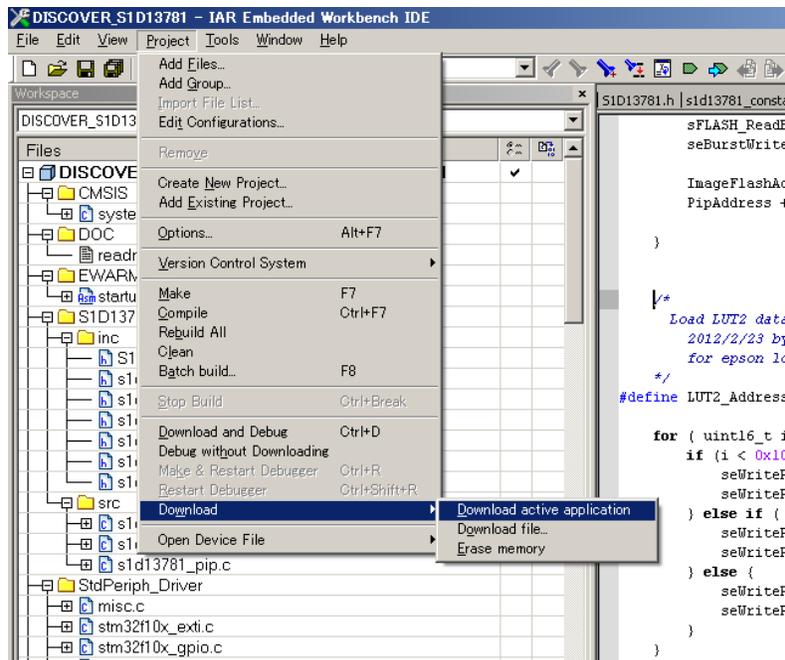
Build the project file.

Select “Project” from the menu → “Rebuild All” from the sub menu.



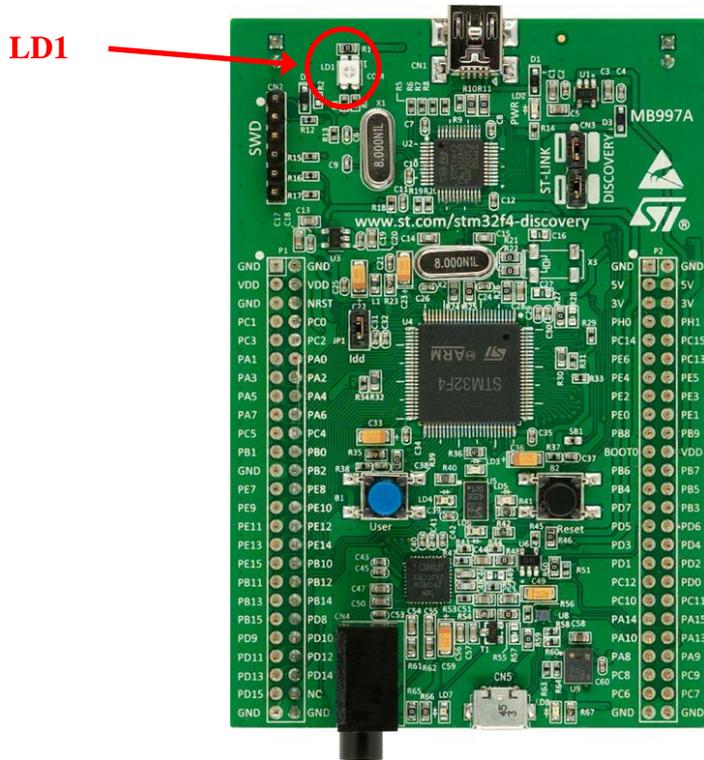
Download the code to the STM32 F4-Discovery and write it into Flash.

Select “Project” from the menu → “Download” from the sub menu → “Download active application”



## Explanation of the Demo using STM32 F4-Discovery

The red LED (LD1) blinks and the code will be written.



### 3.1.3 Connect the S5U13781R00C100 with the STM32 F4-Discovery

A connection example for the S5U13781R00C100 reference board and the STM32 F4-Discovery via SPI is shown in Figure 3-2, *Connection Example for STM32 F4-Discovery (via SPI)*.

If noise on the SPI signal causes problems, place a resistor of several hundred ohms between the S5U13781R00C100 and STM 32 F4-Discovery SPI port for the purpose of noise damping.

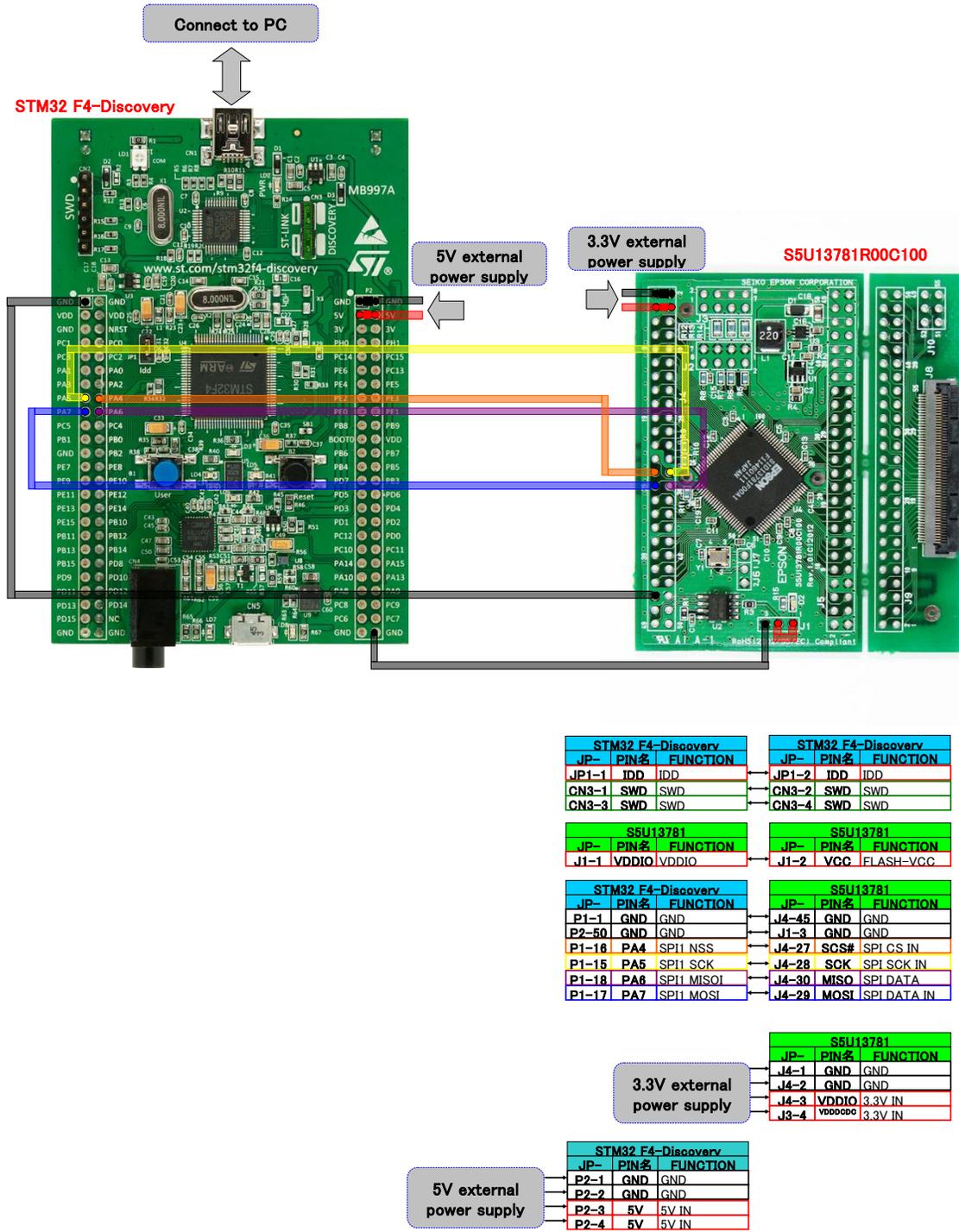


Figure 3-1 Connection Example for STM32 F4-Discovery (via SPI)

# Explanation of the Demo using STM32 F4-Discovery

## 3.1.4 Connect the S5U13781R00C100 with LCD Panel

This section describes the TFT panel connection to the S5U13781R00C100 reference board using the ATM0430D5.

The ATM0430D5 is a 4.3 inch, 480x272 dot, 24-bit full color TFT LCD panel from XIAMEN ZETTLER.

A connection example between the S5U13781R00C100 reference board and the ATM0430D5 is shown in Figure 3-2, *ATM0430D5 Connection Example*.

Table 3-1, *ATM0430D5 Connection Example (1 of 2)*, and Table 3-2, *ATM0430D5 Connection Example (2 of 2)*, show detailed connection information for each signal.

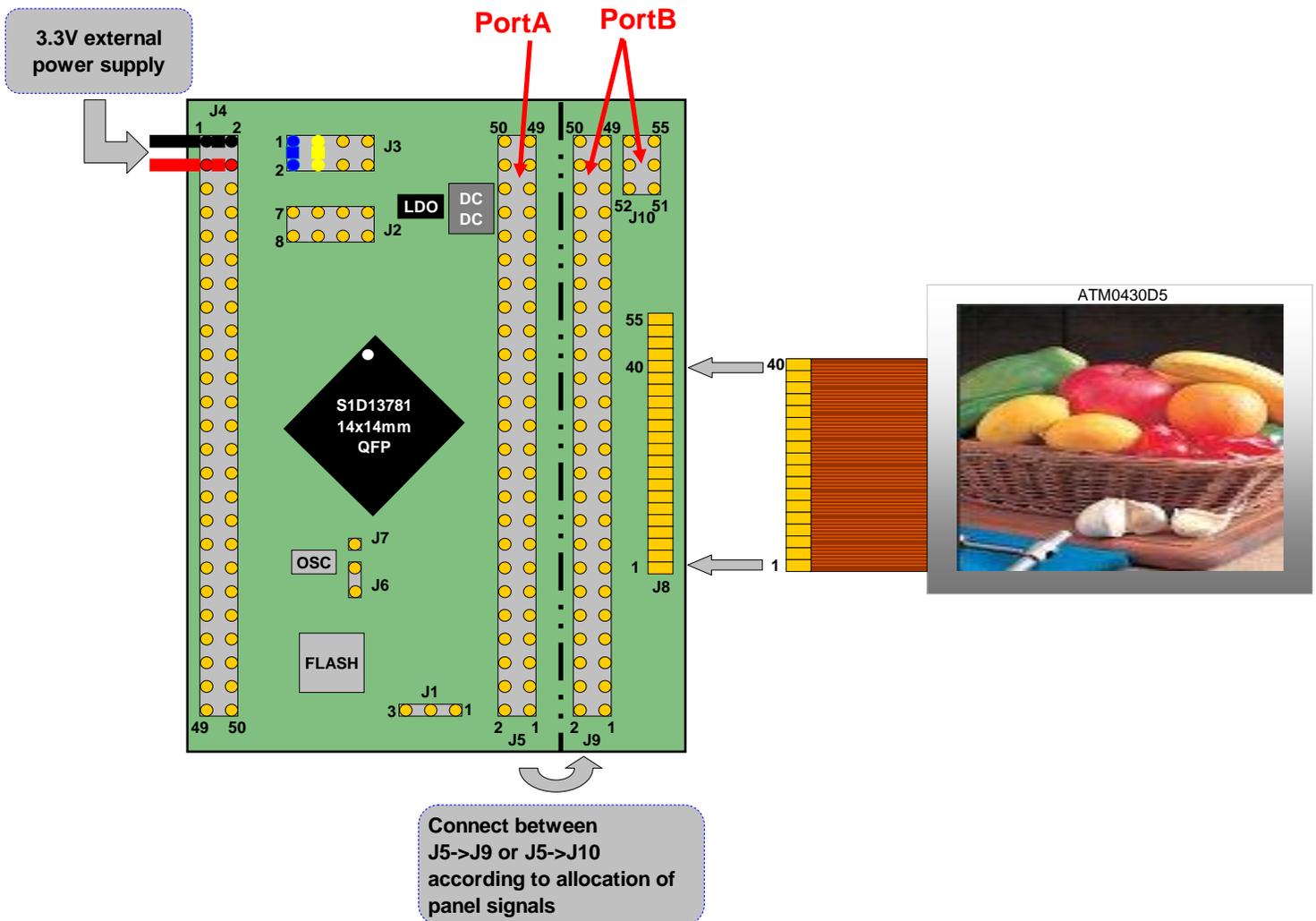


Figure 3-2 *ATM0430D5 Connection Example*

## Explanation of the Demo using STM32 F4-Discovery

*Table 3-1 ATM0430D5 Connection Example (1 of 2)*

S5U13781R00C100 reference board				ATM0430D5 TFT panel	
Pin name	PortA	→	PortB	Pin name	Pin number
GND	J5-1	→	J9-36	GND	36
DE	J5-5	→	J9-34	DE	34
PCLK	J5-6	→	J9-30	CLK	30
GND	J5-7	→	J9-29	GND	29
PDT0	J5-9	→	J9-21	B0	21
PDT1	J5-10	→	J9-22	B1	22
PDT2	J5-11	→	J9-23	B2	23
PDT3	J5-12	→	J9-24	B3	24
PDT4	J5-13	→	J9-25	B4	25
PDT5	J5-14	→	J9-26	B5	26
PDT6	J5-15	→	J9-27	B6	27
PDT7	J5-16	→	J9-28	B7	28
PDT8	J5-17	→	J9-13	G0	13
PDT9	J5-18	→	J9-14	G1	14
PDT10	J5-19	→	J9-15	G2	15
PDT11	J5-20	→	J9-16	G3	16
PDT12	J5-21	→	J9-17	G4	17
PDT13	J5-22	→	J9-18	G5	18
PDT14	J5-23	→	J9-19	G6	19
PDT15	J5-24	→	J9-20	G7	20
PDT16	J5-25	→	J9-5	R0	5
PDT17	J5-26	→	J9-6	R1	6
PDT18	J5-27	→	J9-7	R2	7
PDT19	J5-28	→	J9-8	R3	8
PDT20	J5-29	→	J9-9	R4	9
PDT21	J5-30	→	J9-10	R5	10
PDT22	J5-31	→	J9-11	R6	11
PDT23	J5-32	→	J9-12	R7	12
VDDIO	J5-39	→	J9-4	VDD	4
VDDIO	J5-39	→	J9-31	DISP	31
LED+	J5-46	→	J9-2	VLED+	2
LED-	J5-48	→	J9-1	VLED-	1
GND	J5-50	→	J9-3	GND	3

*Table 3-2 ATM0430D5 Connection Example (2 of 2)*

S5U13781R00C100 reference board	Description
Connect J3-1 and J3-2	Set DC-DC converter enable
Connect J3-3 and J3-4	Set DC-DC converter output current = 20mA
Connect GND of power source to J4-1 and J4-2	Connect power source GND
Connect 3.3V of power source to J4-3 and J4-4	Connect power source 3.3V to VDDIO and VDDDCDC

## Explanation of the Demo using STM32 F4-Discovery

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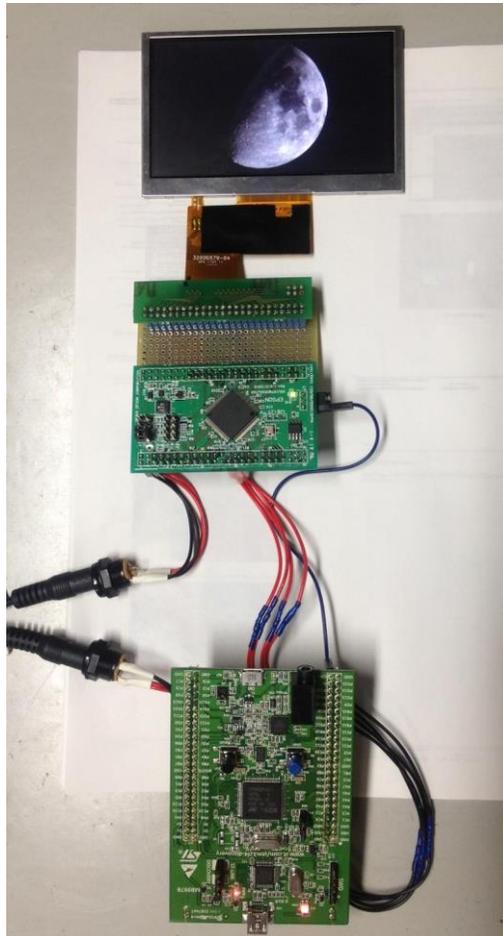
### 3.1.5 Running Demo

#### Connect the S5U13781R00C100 with the STM32 F4-Discovery and ATM0430D5

Refer to Section 3.1.3, Connect the S5U13781R00C100 with the STM32 F4-Discovery, and Section 3.1.4, Connect the S5U13781R00C100 with LCD Panel, for further information.

#### Power ON Starts the Demo

Supplying power to the STM32 F4-Discovery (from USB or 5V external power supply) and to the S5U13781R00C100 (from 3.3V external power supply) starts the demo automatically.



**Connection image**

The demo proceeds as shown in figure 3-3, *Demo Flow Diagram*.

The alphanumeric image (PIP window) and photo image (Main window) will alternately be changed. The alphanumeric image will be overlaid on the photo image and repeats fade-in and fade-out.

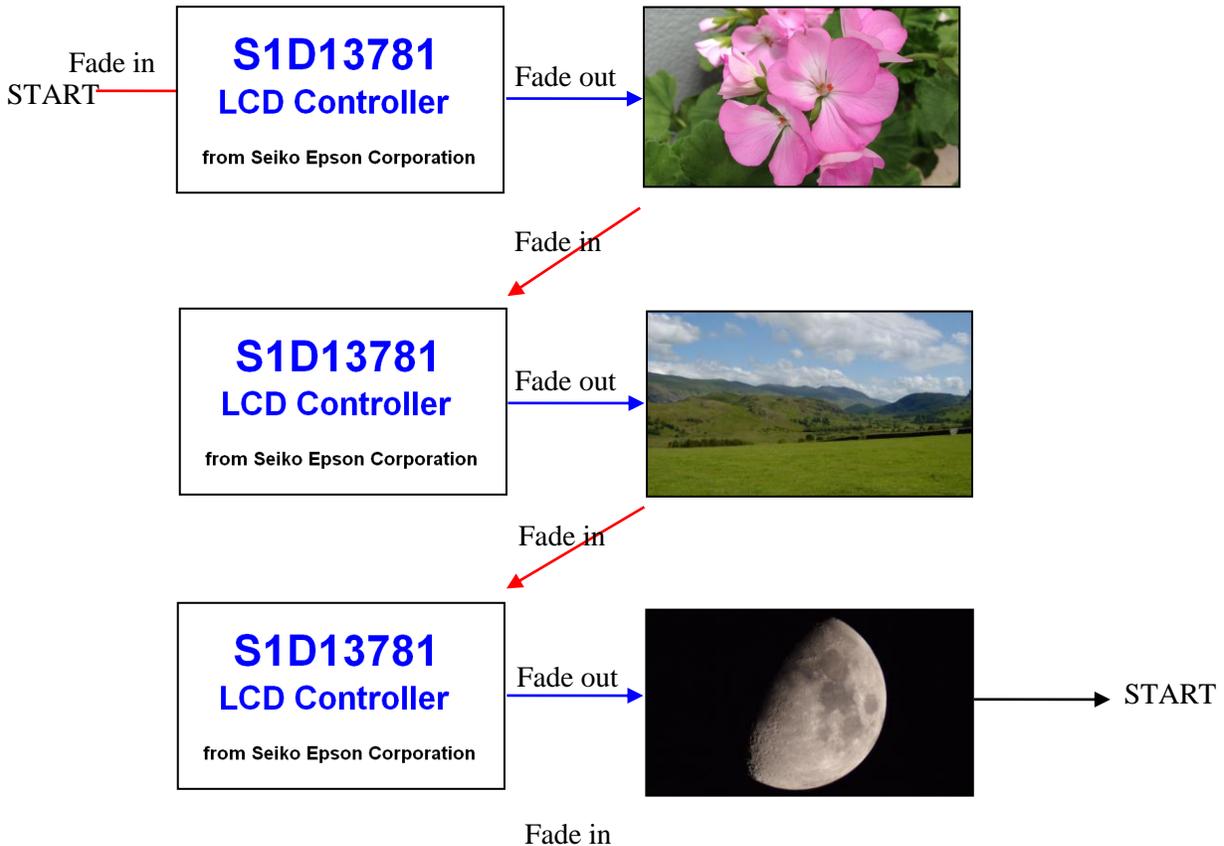


Figure 3-3 Demo Flow Diagram

Here, the display image data of the alphanumeric screen is in 8bpp 256-color and by using the Look Up Table (LUT), the S1D13781 expands this to a color image. The photo image is in 16bpp.

Using the above data formats enables the S1D13781 to process the display with its built-in 384kbytes of SRAM.

## Additional Information on Display Image Data

Allocation of demo image data

The image data which will be displayed in the demo are in following directory.

Directory name:

STM32F4-Discovery\_FW\_V1.1.0\Project\STM32F4\_s1d13781\_Demo\_embFlash\inc

File name:

image\_001.h <- Image data 1 for main window (480x272 dot, 16bpp(RGB565))

image\_002.h <- Image data 2 for main window (480x272 dot, 16bpp(RGB565))

## Explanation of the Demo using STM32 F4-Discovery

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image\_003.h <- Image data 3 for main window (480x272 dot, 16bpp(RGB565))

image\_pip.h <- Image data for pip window (480x272 dot, 8bpp)

image\_pip\_lut.h <- LUT setting data of 256-color image source for pip window

Explanation of demo image data generation:

Demo image data can be generated from bitmap file by using BmpFile2CppArray.exe.

Directory name:

STM32F4-Discovery\_FW\_V1.1.0\Libraries\S1D13781\image\_header\_file\_generator

Utility name:

BmpFile2CppArray.exe

Procedure:

1) Prepare bitmap files

Following three files can be made by software such as GIMP by storing file in 16bit(RGB565) format.

image\_001.bmp <- Bitmap file 1 for main window (480x272 dot, 16bpp(RGB565))

image\_002.bmp <- Bitmap file 2 for main window (480x272 dot, 16bpp(RGB565))

image\_003.bmp <- Bitmap file 3 for main window (480x272 dot, 16bpp(RGB565))

The following file can be made with software such as Windows paint tool by storing the file in 256 color format.

image\_pip.bmp <- Bitmap file for PIP window (480x272 dot, 8bpp)

2) Generate image data from bitmap file

Place above bitmap files into the same directory as BmpFile2CppArray.exe is placed.

Double click of BmpFile2CppArray.exe icon generates following files.

image\_001.h

image\_002.h

image\_003.h

image\_pip.h

image\_pip\_lut.h

### 3.2 Demo Using External 2MB Standard SPI Flash Memory (M25P16)

#### 3.2.1 Summary

The demo displays a still image on an LCD panel. Hardware consists of following items.

LCD controller: S5U13781R00C100 reference board

Microcontroller: STM32 F4-Discovery

LCD panel:

ATM0430D5 from XIAMEN ZETTLER (4.3 inch, 480x272 dots, 24 bit full color TFT LCD panel)

Display image data on the PC will be written into the 16Mbit SPI NOR Flash standard memory (M25P16) on the S5U13781R00C100 reference board by using UM232H\*.

\* The UM232H Single Channel USB Hi-Speed FT232H Development Module is a one chip USB-serial conversion IC from Future Technology Devices International. This board is reasonably priced, making it suitable for this evaluation.

The firmware for the STM32 F4-Discovery is written using “IAR Embedded Workbench for ARM, 6.309, 32K Kickstart Edition” from IAR systems.

## 3.2.2 Write Image Data into Flash Memory

### 3.2.2.1 S5U13781R00C100 Connection with UM232H

A connection example for the S5U13781R00C100 reference board and the UM232H via SPI for writing image data into the M25P16 is described in Figure 3-4, *Connection with UM232H (via SPI)*.

If noise on the SPI signal causes problems, place a resistor of several hundred ohms between the UM232H and STM 32 F4-Discovery SPI port for the purpose of noise damping.

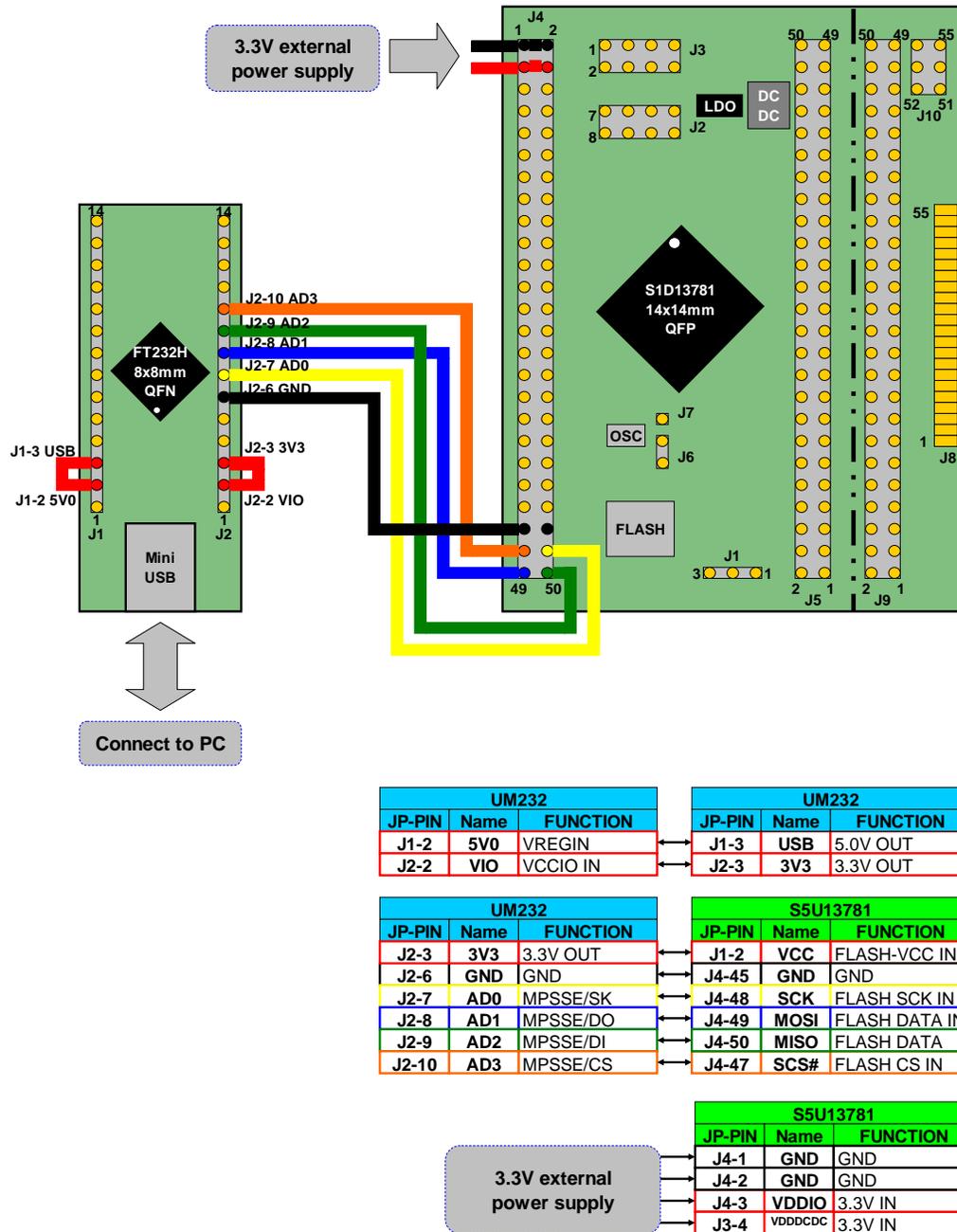


Figure 3-4 Connection with UM232H (via SPI)

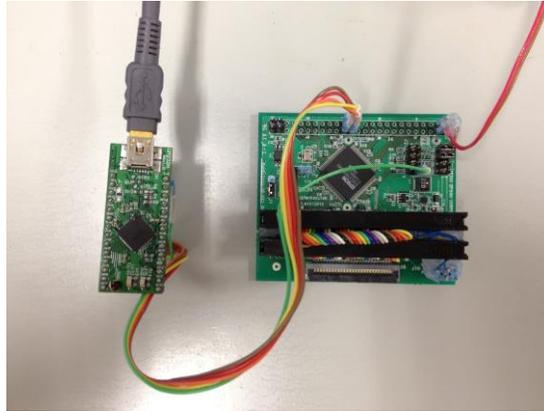
### 3.2.2.2 Procedure for Writing Image Data into Flash Memory

This section describes the image data writing procedure to the M25P16 (SPI flash ROM) for the demo using the ATM0430D5 (4.3 inch, 480x272 dots, 24 bit full color TFT LCD panel from XIAMEN ZETTLER).

To start, connect the S5U13781R00C100 reference board to the UM232H via SPI, and connect the UM232H to the PC via USB.

See Section 3.2.2.1, Connection with UM232H (Control S1D13781 via SPI), for connection information.

Unzip and apply the UM232H driver prepared in Section 2.1, Instruction for Tool Download and Install.

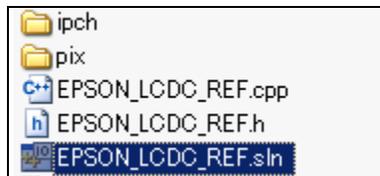


**Note:** the S5U13781R00C100 requires an external power supply.



Launch the project file for Visual C++ 2010 Express.

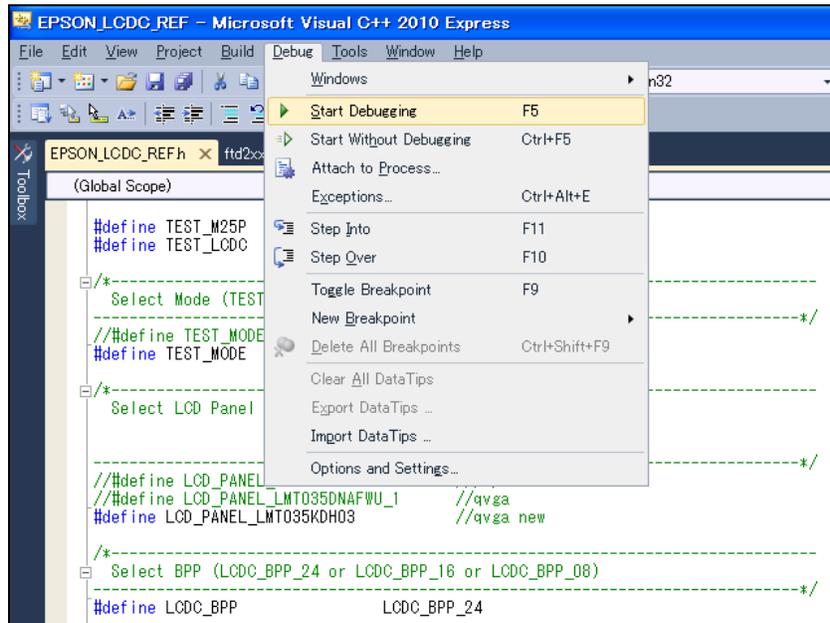
Double click the “EPSON\_LCDC\_REF.sln” icon in the project folder for writing M25P16: “flash\_psp” which is prepared at 2-3-(2): “Preparation for writing data into flash memory”.



## Explanation of the Demo using STM32 F4-Discovery

Proceed with writing data to the M25P16.

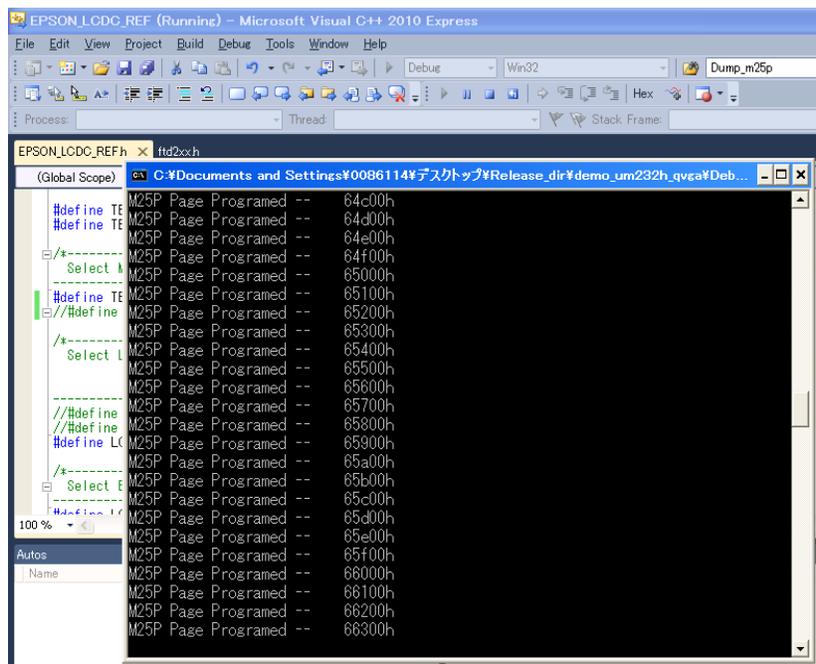
Select “Debug” from the menu → “Start Debugging” from the sub menu.



Here, if the window opens which asks “This project is changed. Will you build?”, select “Yes”.



A command window is opened and the data write starts.

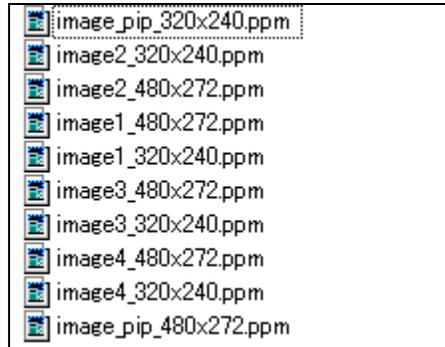


\*It may take several minutes (up to 10) to write the alphanumeric image and the four photo images. Once writing completes, the command window will be closed automatically.

### Supplemental Information

The alphanumeric image and four photograph images data are on the PC have a color depth of 24bpp.

The stored folder is “flash\_psp\pix”.



The software writes each image to the M25P16 in the format used for the demo.

Alphanumeric image (PIP window): Written as 8bpp gray scale and by using  
the Look Up Table (LUT)

the S1D13781 expands this to a color image

Four photo images (Main window): Written as 16bpp image data

## Explanation of the Demo using STM32 F4-Discovery

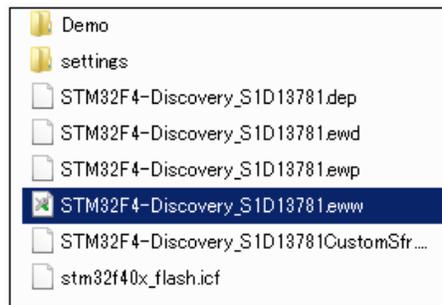
### 3.2.3 Write Demo Sample Software into STM32 F4-Discovery

Connect the STM32 F4-Discovery to the PC via USB.



Launch the project file for IAR Embedded Workbench.

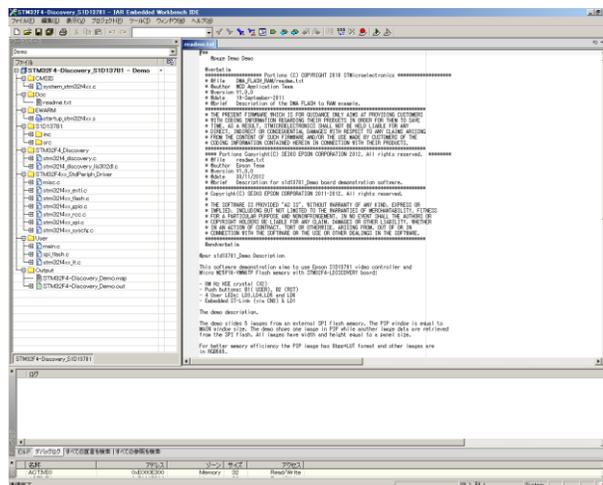
Double click “STM32F4-Discovery\_S1D13781.eww” located in the project folder: “\STM32F4-Discovery\_FW\_Vx.x.x\project\STM32F4\_s1d13781\_Demo\EWARM\”.



Here, if the window opens which states “Can not open this file”, then launch “IAR Embedded Workbench” from the Windows start menu.



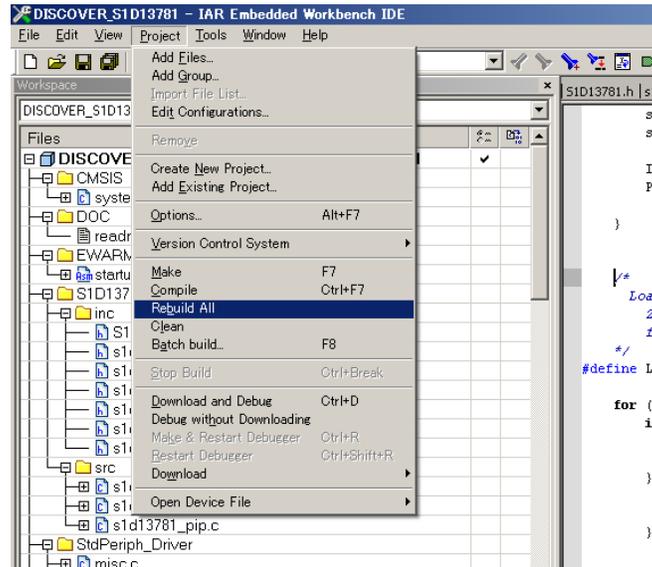
EWARM is launched and project file is opened.



## Explanation of the Demo using STM32 F4-Discovery

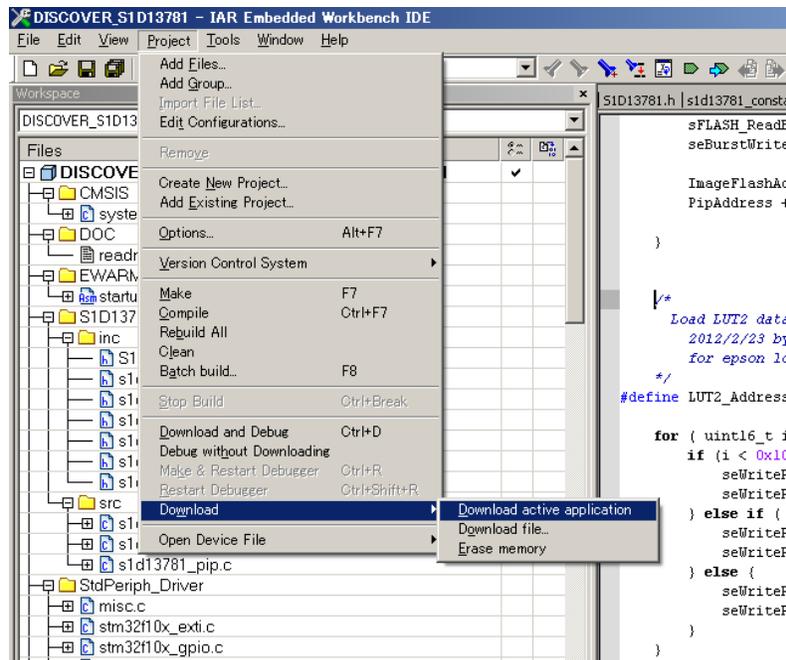
Build the project file.

Select “Project” from the menu → “Rebuild All” from the sub menu.



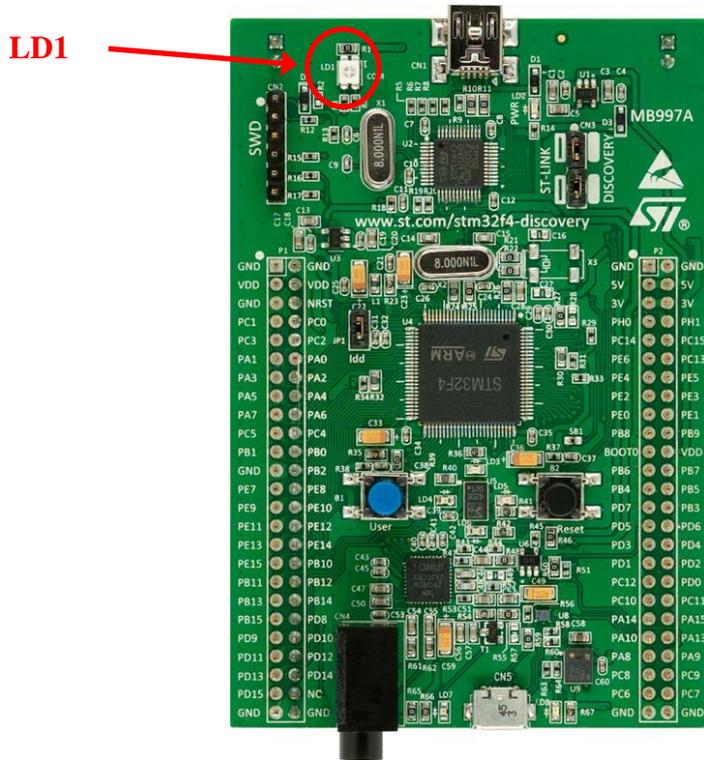
Download the code to the STM32 F4-Discovery and write it into Flash.

Select “Project” from the menu → “Download” from the sub menu → “Download active application”



## Explanation of the Demo using STM32 F4-Discovery

The red LED (LD1) blinks and the code will be written.



### 3.2.4 Connect the S5U13781R00C100 with the STM32 F4-Discovery

A connection example for the S5U13781R00C100 reference board and the STM32 F4-Discovery via SPI is shown in Figure 3-5, *Connection Example for STM32 F4-Discovery (via SPI)*.

If noise on the SPI signal causes problems, place a resistor of several hundred ohms between the S5U13781R00C100 and STM 32 F4-Discovery SPI port for the purpose of noise damping.

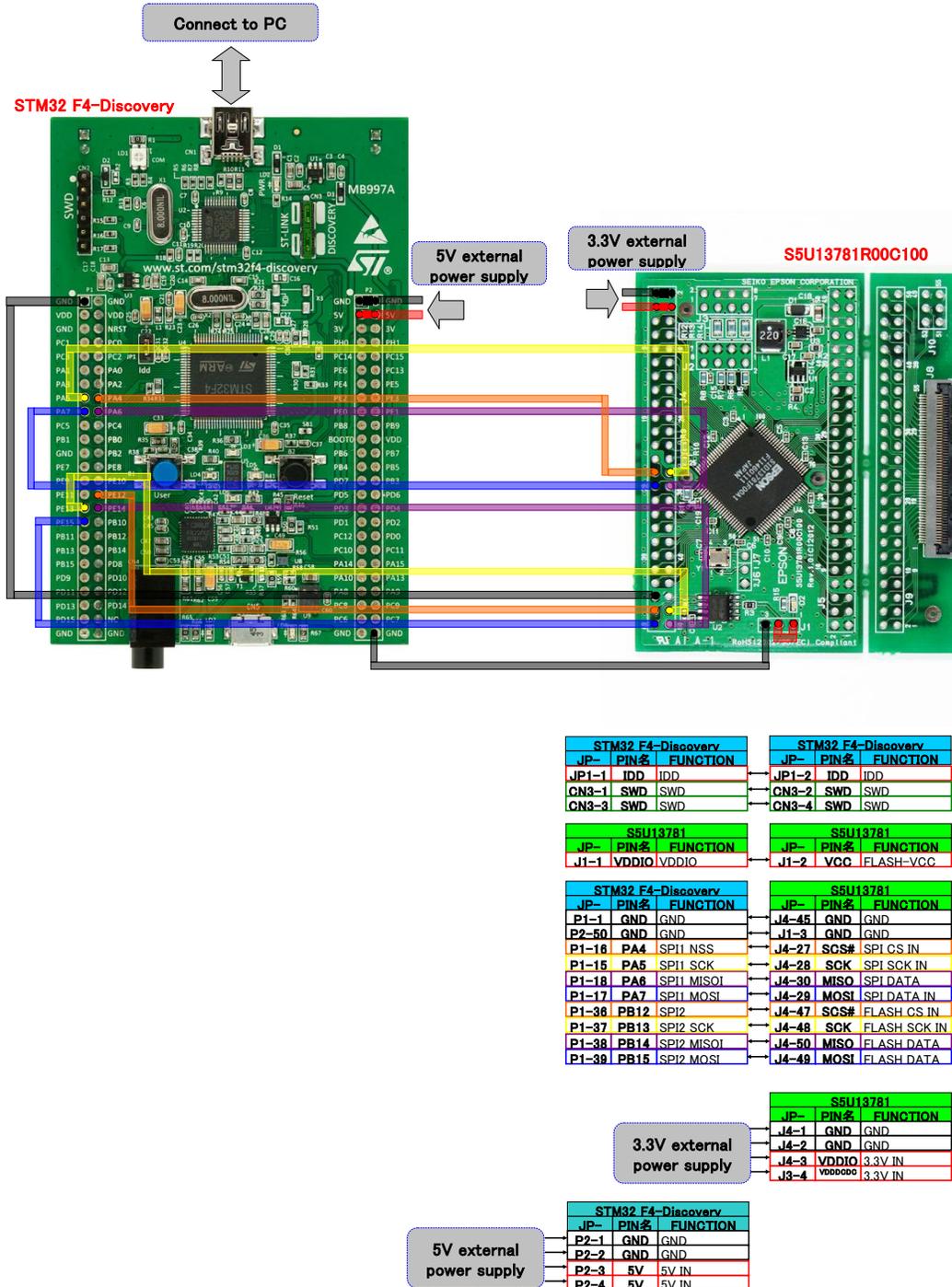


Figure 3-5 Connection Example for STM32 F4-Discovery (via SPI)

## Explanation of the Demo using STM32 F4-Discovery

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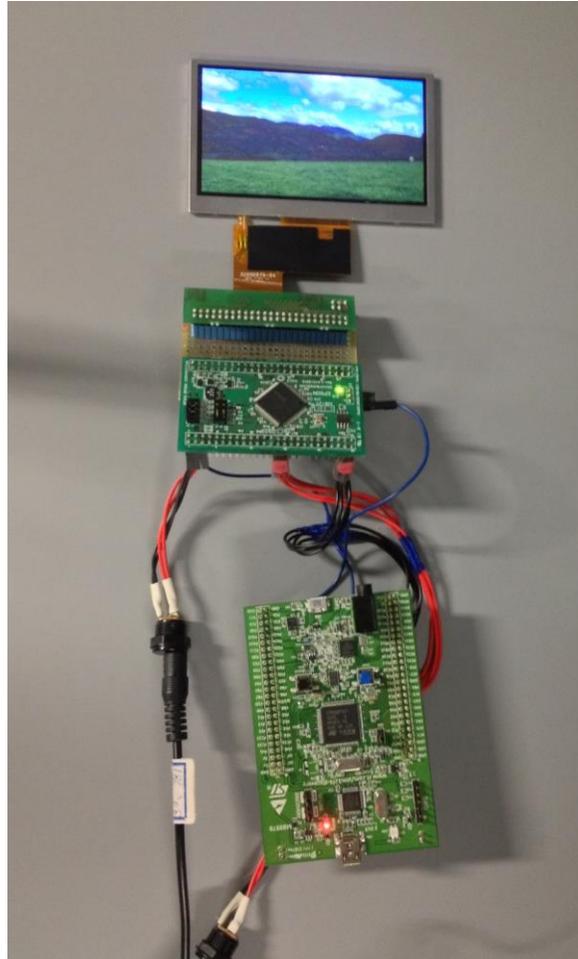
### 3.2.5 Running the Demo

#### Connect the S5U13781R00C100 with the STM32 F4-Discovery and ATM0430D5

Refer to Section 3.2.4, Connect the S5U13781R00C100 with the STM32 F4-Discovery, and Section 3.1.4, Connect the S5U13781R00C100 with LCD Panel, for further information.

#### Power ON starts the demo

Supplying power to the STM32 F4-Discovery (from USB or 5V external power supply) and to the S5U13781R00C100 (from 3.3V external power supply) starts the demo automatically.



**Connection image**

The demo proceeds as shown in figure 3-6, *Demo Flow Diagram*.

The alphanumeric image (PIP window) and photo image (Main window) will alternately be changed. The alphanumeric image will be overlaid on the photo image and repeats fade-in and fade-out.

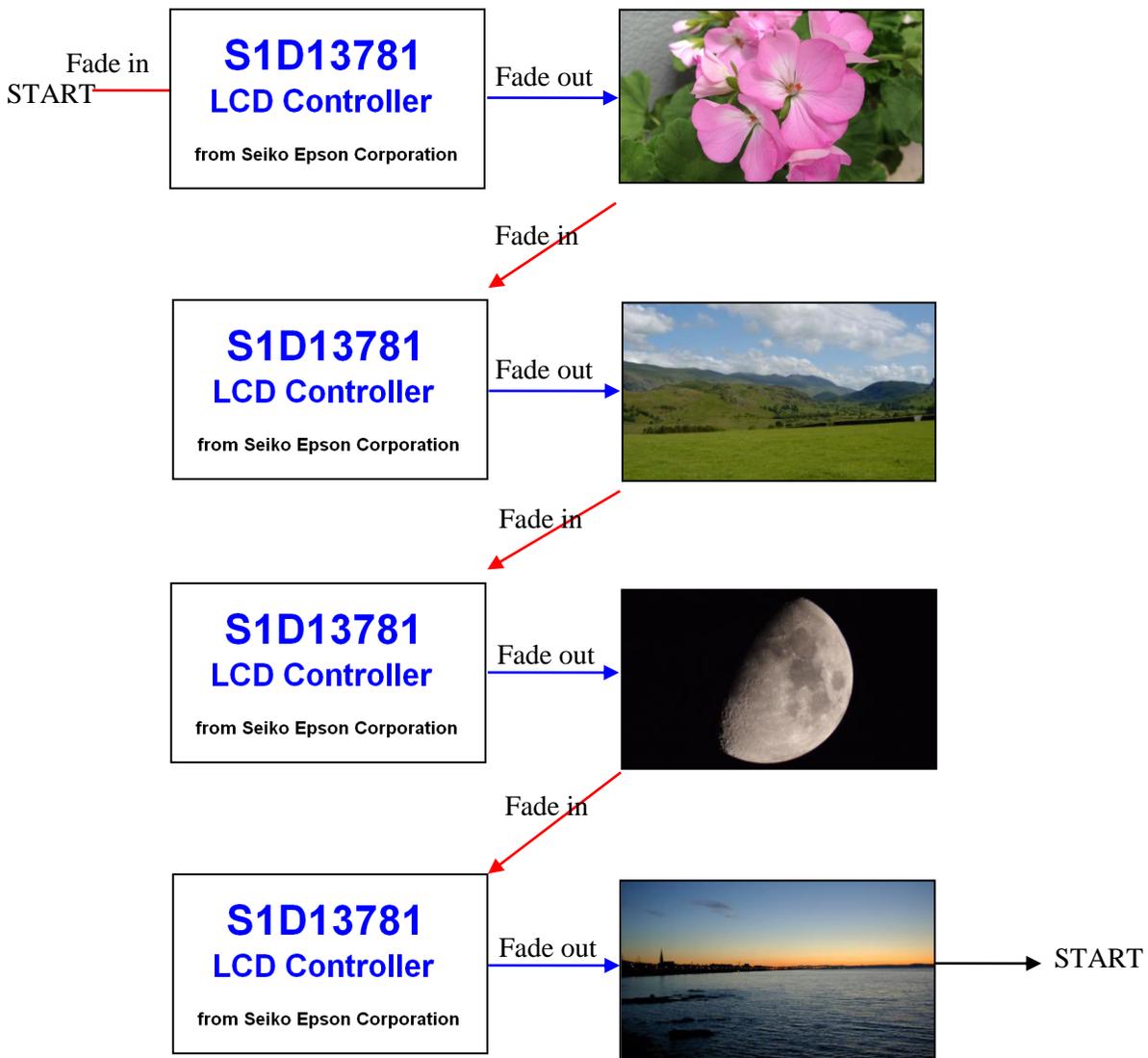


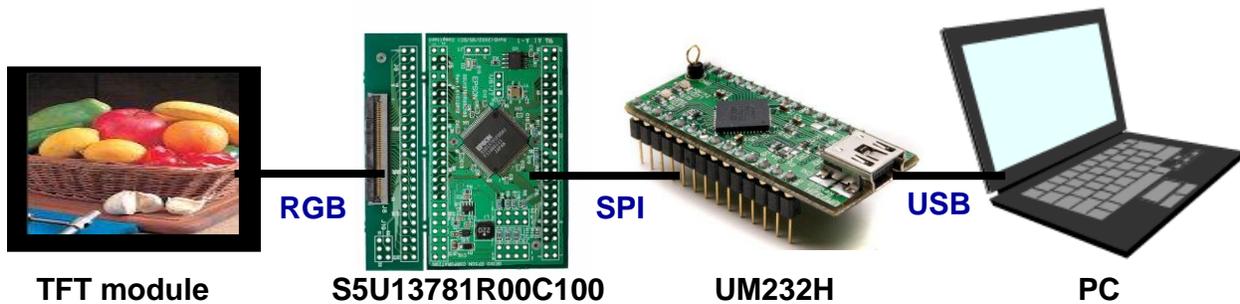
Figure 3-6 Demo Flow Diagram

Here, the display image data of the alphanumeric image is 8bpp gray scale and by using the Look Up Table (LUT), the S1D13781 expands this to a color image. The photo image is 16bpp.

Using the above data formats enables S1D13781 to process display with its built-in 384kbytes SRAM.

### 4 Explanation of the Demo using a PC

This section describes the display demo using the UM232H USB-SPI conversion board connected to a PC. Hardware configuration for the demo is shown in the following figure.



*Figure 4-1 Constitution of Display Demo using a PC*

For this demo, the display system consists of the following hardware.

- PC
- LCD controller: S5U13781R00C100 reference board
- USB-SPI conversion board: UM232H
- ATM0430D5 from XIAMEN ZETTLER  
(4.3 inch, 480x272 dots, 24 bit full color TFT LCD panel)

The demo is as follows.

1. Color gradation bar display demo using the S1D13781 2D BitBLT feature
2. Still image display

In this demo, a PPM format image stored in a PC will be used as the demo still image.

The sample project provided on the EPSON web site is verified in its compilation and operation with Microsoft Visual C++ 2010 Express compiled.

### 4.1 Connection with USB Serial Conversion Board: UM232H (Control S1D13781 via SPI)

A connection example to control the S1D13781 by connecting the S5U13781R00C100 reference board and the UM232H via SPI is described in Figure 4-2, *Connecting the UM232H to S1D13781 via SPI*.

If noise on the SPI signal causes problems, place a resistor of several hundred ohms between the S5U13781R00C100 and UM232H SPI port for the purpose of noise damping.

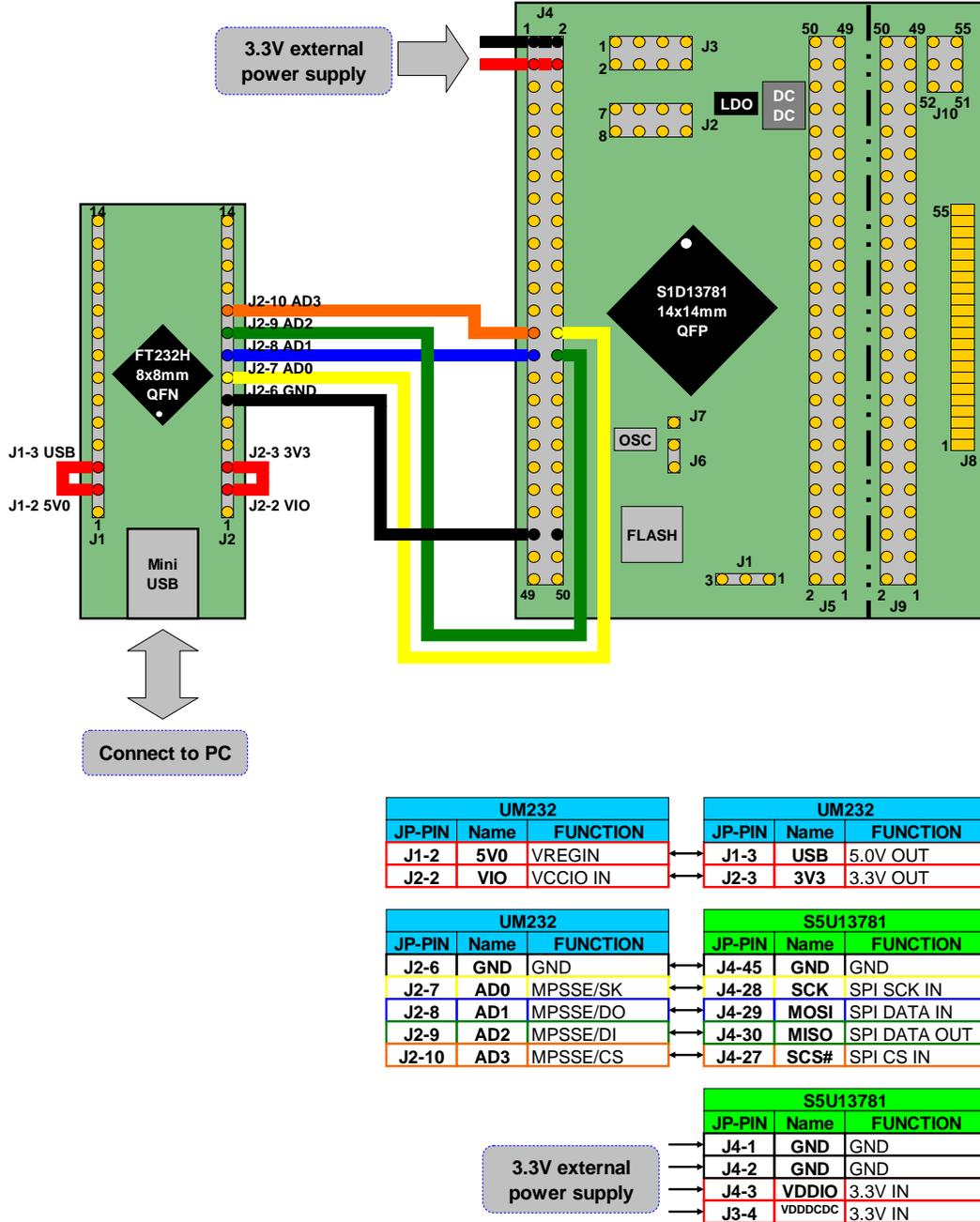


Figure 4-2 Connecting the UM232H to S1D13781 via SPI

## Explanation of the Demo using a PC

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### 4.2 Connection with LCD panel

See Section 3.5, Connect the S5U13781R00C100 with LCD panel, for further information.

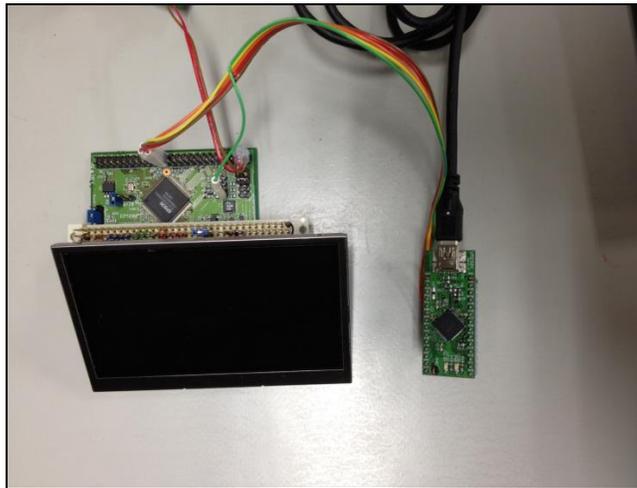
### 4.3 Displaying an Image on LCD

#### Displaying a Still Image using the ATM0430D5 (4.3 inch, 480x272 dots, 24 bit full color TFT panel) from XIAMEN ZETTLER

Connect the S5U13781R00C100 reference board and the UM232H via SPI and connect the UM232H to PC via USB.

See Section 4.1, Connection with UM232H (Control S1D13781 via SPI), for connection information.

Unzip and apply the UM232H driver prepared in Section 2.1, Instruction for Tool Download and Install.

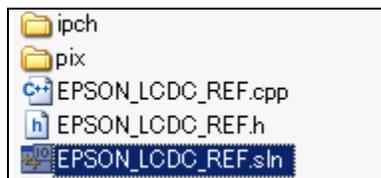


Connection image

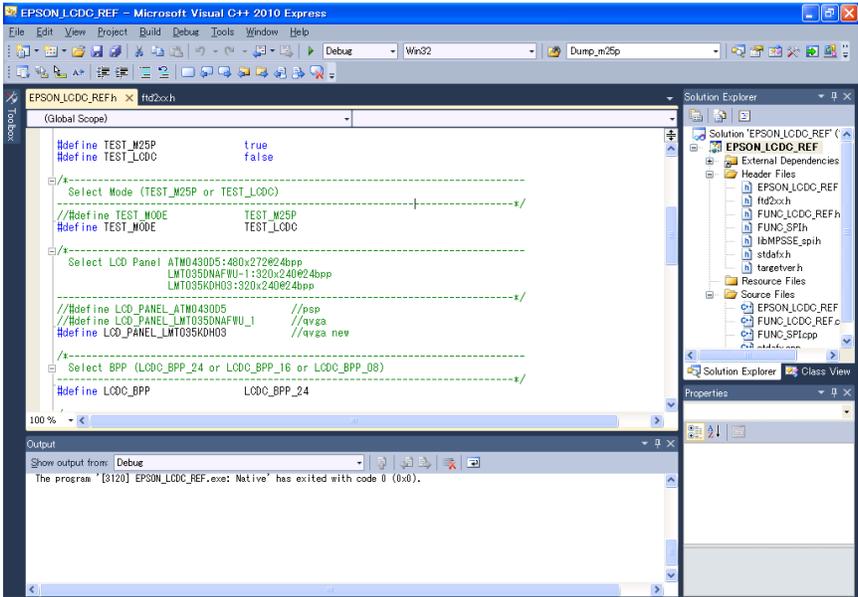


Launch project file for Visual C++ 2010 Express.

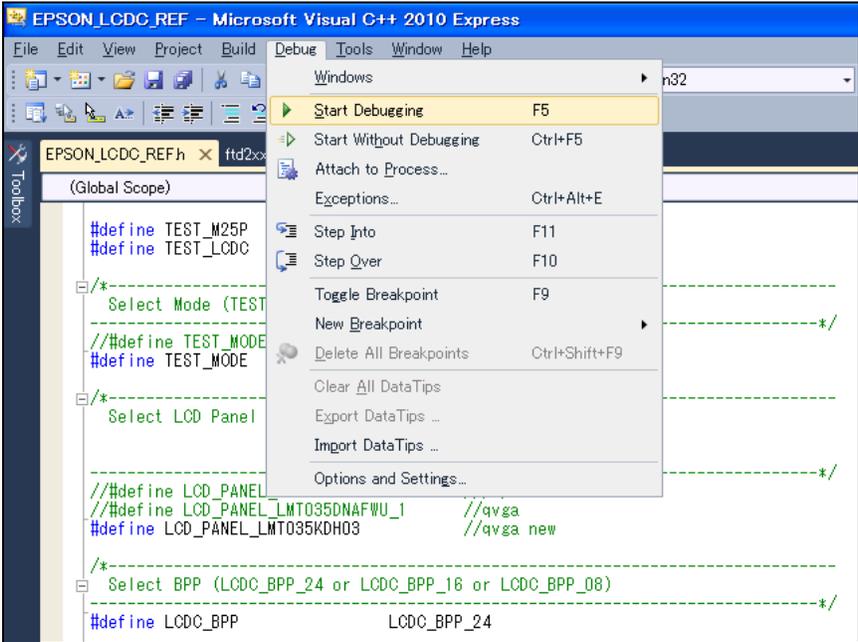
Double click the “EPSON\_LCDC\_REF.sln” icon in the UM232H demo project folder: “demo\_um232h\_psp” prepared at 2-3-(3): “Preparation for display demo using PC”.



The Visual C++ 2010 Express window is opened.



Start the demo by selecting “Debug” from the menu → “Start Debugging” from the sub menu

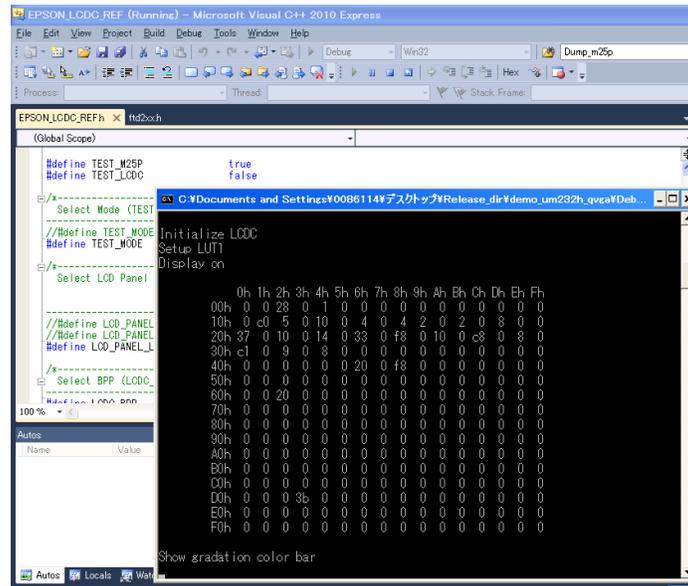


Here, if the window opens which asks “This project is changed. Will you build?”, select “Yes”.

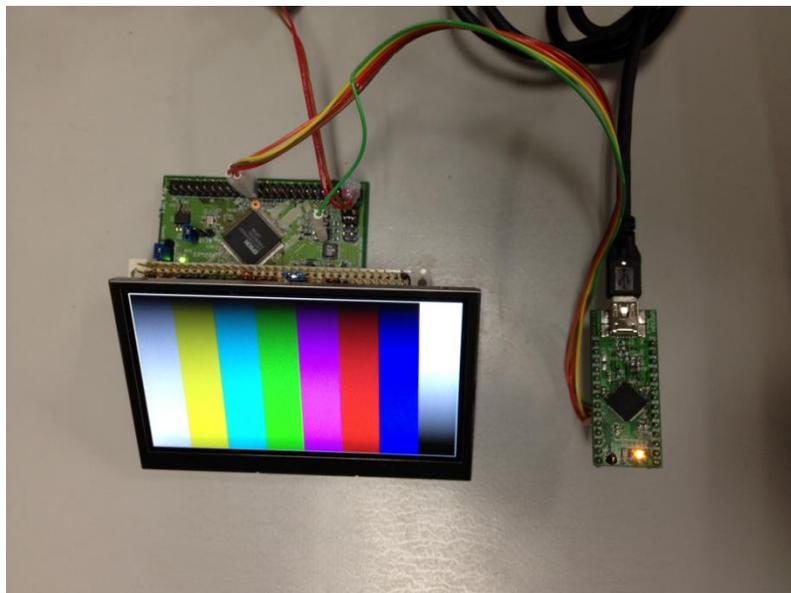


## Explanation of the Demo using a PC

A command window is opened and the data write starts.



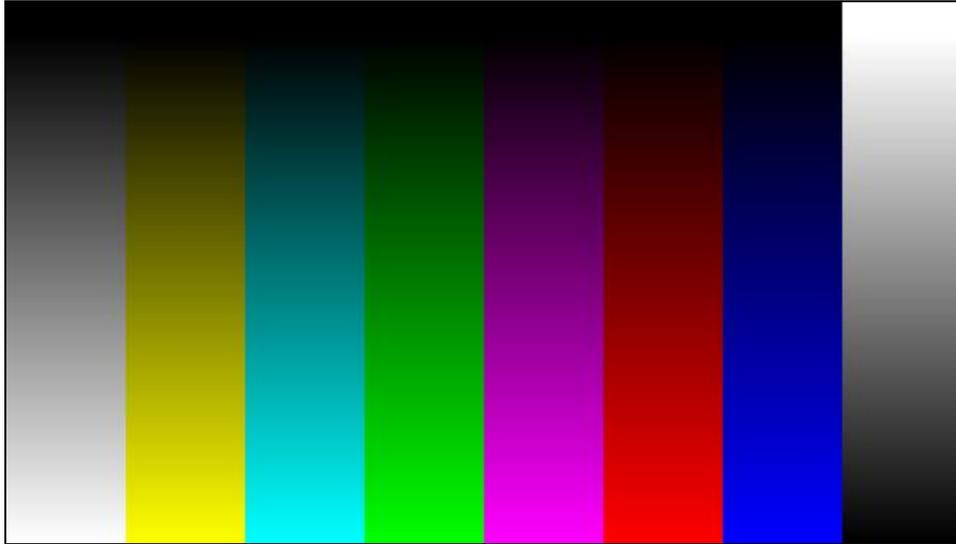
```
EPSON_LCD.REF (Running) - Microsoft Visual C++ 2010 Express
File Edit View Project Build Debug Tools Window Help
Debug | Win32 | Dump_m25p
Process: Thread: Stack Frame:
EPSON_LCD.REF x fd2xx.h
(Global Scope)
#define TEST_M25P true
#define TEST_LCD false
-----
Select Mode (TEST)
//#define TEST_MODE Initialize LCDC
#define TEST_MODE Setup LUT1
//#define TEST_MODE Display on
-----
Select LCD Panel
//#define LCD_PANEL
//#define LCD_PANEL
#define LCD_PANEL_L
-----
Select BPP (LCDC)
#define LCDC_BPP
-----
Show gradation color bar
-----
00h 0 0 28 0 1 0 0 0 0 0 0 0 0 0 0 0 0
10h 0 c0 5 0 10 0 4 0 4 2 0 2 0 8 0 0
20h 37 0 10 0 14 0 33 0 f8 0 10 0 c8 0 8 0
30h c1 0 9 0 8 0 0 0 0 0 0 0 0 0 0 0
40h 0 0 0 0 0 0 20 0 f8 0 0 0 0 0 0 0
50h 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
60h 0 20 0 0 0 0 0 0 0 0 0 0 0 0 0 0
70h 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
80h 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
90h 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
A0h 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
B0h 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
C0h 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
D0h 0 0 0 3b 0 0 0 0 0 0 0 0 0 0 0 0
E0h 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
F0h 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
```



Connection image

This demo displays the images on the LCD in the following order.

- (1) Color gradation bar image using 2D BitBLT feature



- (2) Displays the image “image1\_480x272.ppm” located in the folder “demo\_um232h\_psp\pix”.



Return to (1)

### 5 Change Record

X94A-G-009-02      Revision 2.1 - Issued: March 30, 2018

- Updated address/contact page
- Updated Epson email address
- Minor formatting changes

X94A-G-009-02      Revision 2.0 - Issued: February 21, 2013

- Added explanation on the sample software which uses STM32 F4 built-in 1MB flash memory as a display image data storage

X94A-G-009-01      Revision 1.0 - Issued: December 21, 2012

- Re-format and edit document

## 6 Sales and Technical Support

For more information on Epson Display Controllers, visit the Epson Global website.

[https://global.epson.com/products\\_and\\_drivers/semicon/products/display\\_controllers/](https://global.epson.com/products_and_drivers/semicon/products/display_controllers/)



For Sales and Technical Support, contact the Epson representative for your region.

[https://global.epson.com/products\\_and\\_drivers/semicon/information/support.html](https://global.epson.com/products_and_drivers/semicon/information/support.html)

