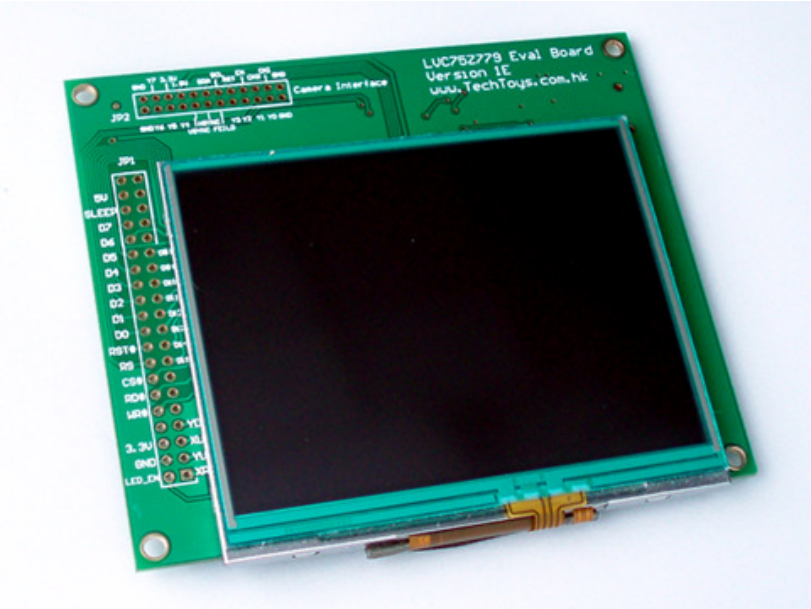
3.5” QVGA 16.7M color TFT LCD module with Touch Panel integrated



TechToys Company
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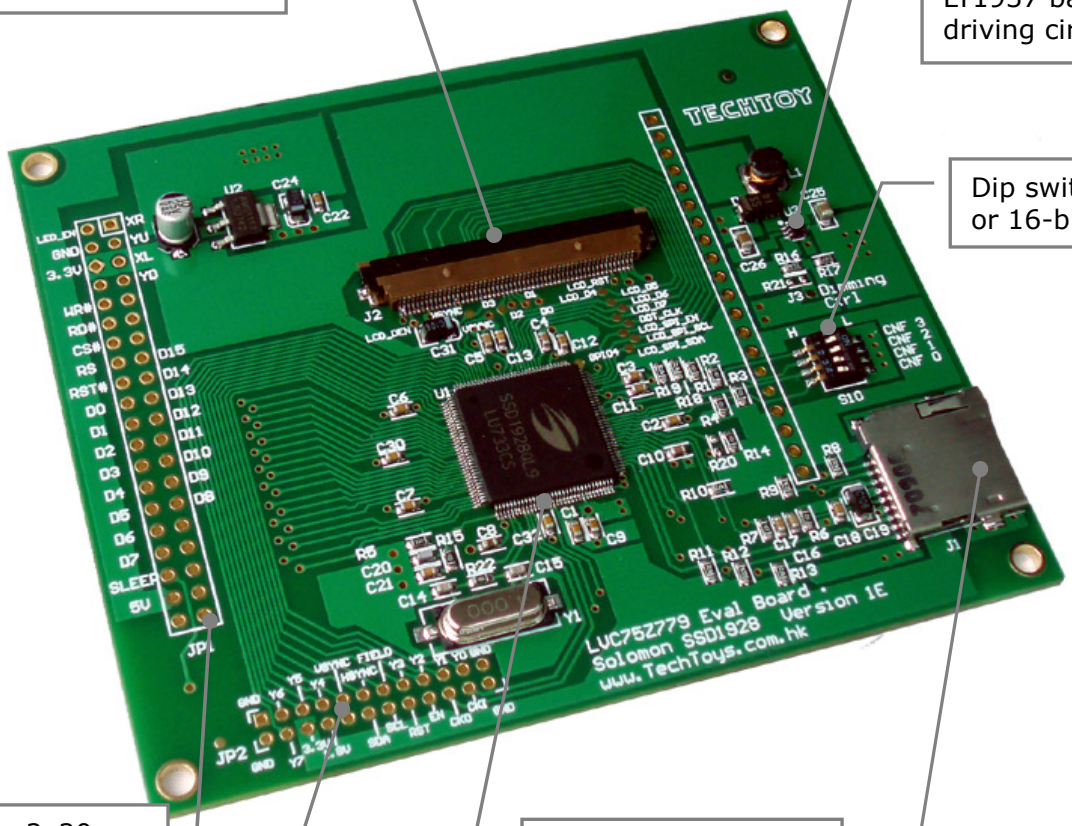
Version 31122008

Written by: John Leung

INTRODUCTION

The part number LVC75Z779 Eval Board (Version 1E) is a development board for 3.5” 16.7m color QVGA TFT-LCD module with Touch Panel integrated. It is completed with an external image processor Solomon SSD1928, microSD card connector, header for CMOS camera module, and backlight driving circuit. Standardized footprint for 2.54mm PCB header is provided to allow you to do prototype in a handy way. SSD1928 is able to interface with different type of generic microcontrollers as low as an 8-bit, low-pin-count microcontroller without paying much attention to generation of timing signals that are required to drive larger LCD displays. On top, there are the hardware JPEG codec and camera interface built-in the image processor which make this development board ideal for design of hand-held Digital Photo Viewer, GPS, PDA, and a lot more small-sized control devices.

Below please find an illustration of all components in details.



J2: 0.5mmPitch SMT Bottom contact FPC

LT1937 backlight driving circuit

Dip switch for 8-bit or 16-bit addressing

microSD Connector

JP1: footprint for 2x20 2.54mm receptacle/header for host control (mcu)

JP2: 2x12 2.00mm receptacle/header for camera input

SSD1928 Image Processor

Written by: John Leung

INSTALLATION

The flat cable connector J2 is a bottom contact type. Please make sure the signal contacts of the LCD module are facing down the connector as shown in Figure 1 and you are using the least force to open the connector in the proper direction.

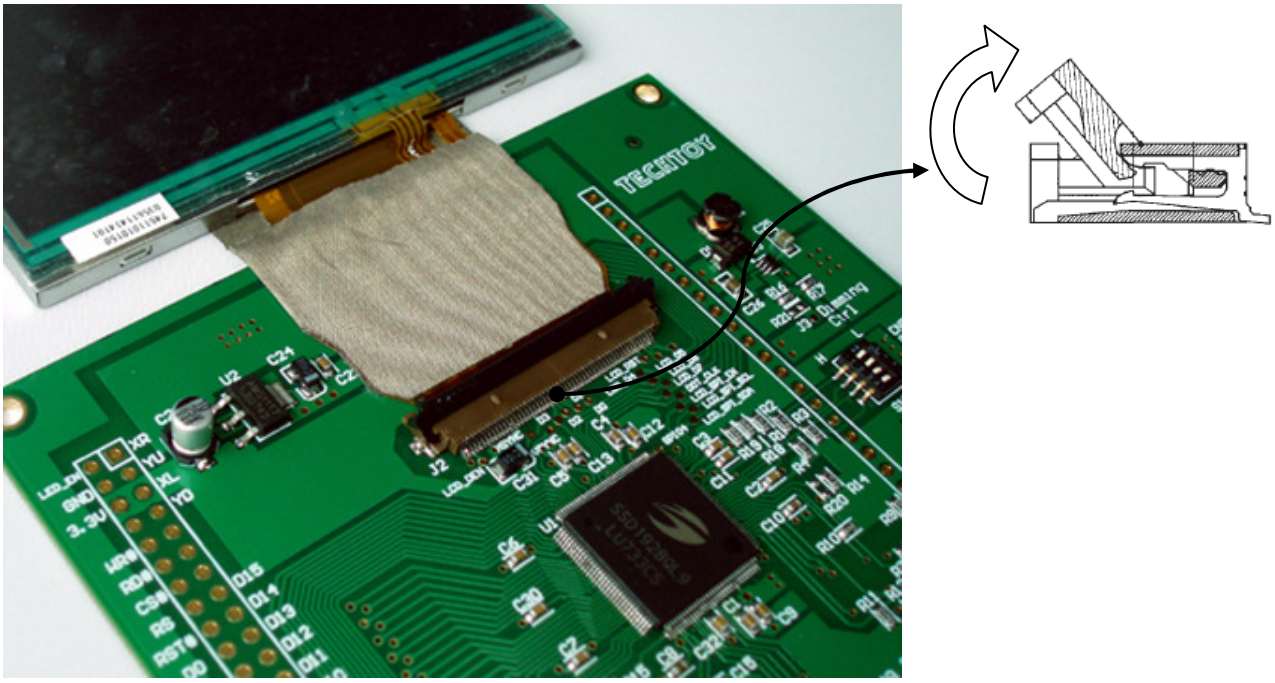


Figure 1 Signal contacts of LCD module face down for J2 FPC

JP1 provides a footprint for 2x20 2.54mm header for host microcontroller connection.

There are two orientations to use the kit:

1. Component face up leaving LCD module's flat cable straight (Figure 1)
2. Component face down with LCD flipped over (Figure 2)

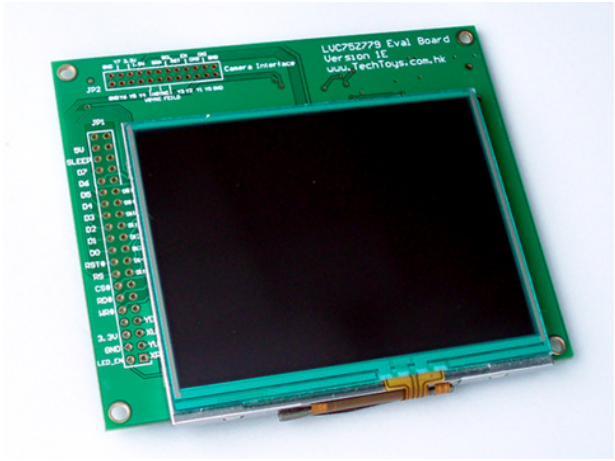


Figure 2 LCD flipped over bottom side of PCB

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Orientation 1 (Figure 1) offers the flexibility to expose all test points onboard for hardware debug. Look closely J2 FPC, you will find all test points for LCD module including LCD_RST, LCD_D0~D7, LCD_CLK, VSYNC, HSYNC, etc. These 1mm-diameter gold plates offer convenient test points for DSO probe. It is like everything is put on table for hardware development.

Orientation 2[1] (Figure 2) offers a plug-n-play method for stacking with our development boards such as the ARM LPC2103 evaluation board, PIC18LF4550 board, and PIC24 evaluation board. With a 2x20 2.54mm receptacle soldered to the component side of the PCB, one may use our evaluation boards for immediate compatibility and example code for out-of-the-box evaluation.

Figure 3 below shows how LVC75Z779 Eval Board is stacked on PIC18LF4550 evaluation board. A CMOS camera module also installed for illustration purpose.

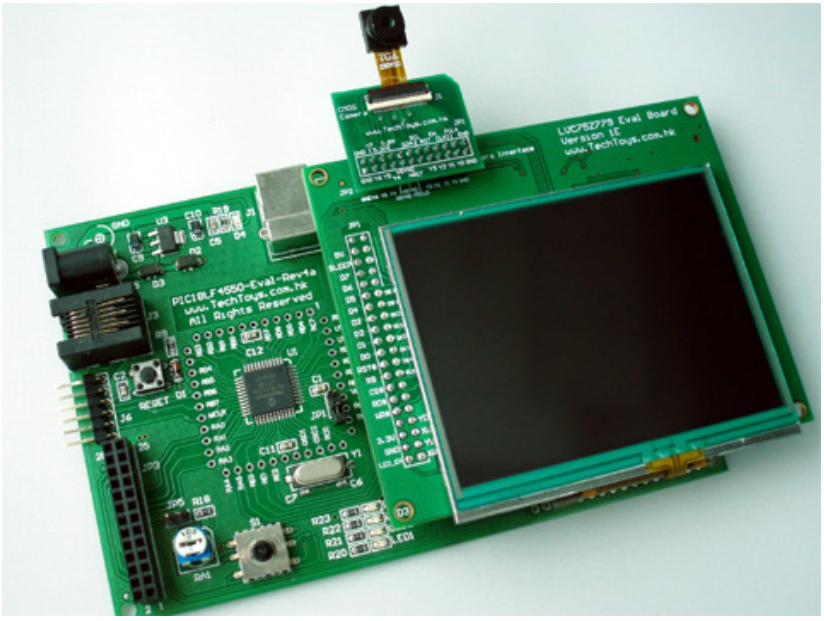

Figure 3 LVC75Z779 Eval Board stacks with PIC18LF4550 Eval Board

[1] Pay attention to insulation of LCD's metallic enclosure to bottom side of the PCB

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Before leaving this section, it is important to mention that there is a footprint for 1x20 2.54mm receptacle near the right edge of the PCB. This receptacle does not provide any connection to any of the components. It is just for keeping the PCB in a nicely horizontal position thus it is optional.

However, after all headers got soldered, one must use a plastic sheet to cover the PCB (or covering the metallic enclosure of the LCD module) to avoid short-circuit between vias and the metallic enclosure.

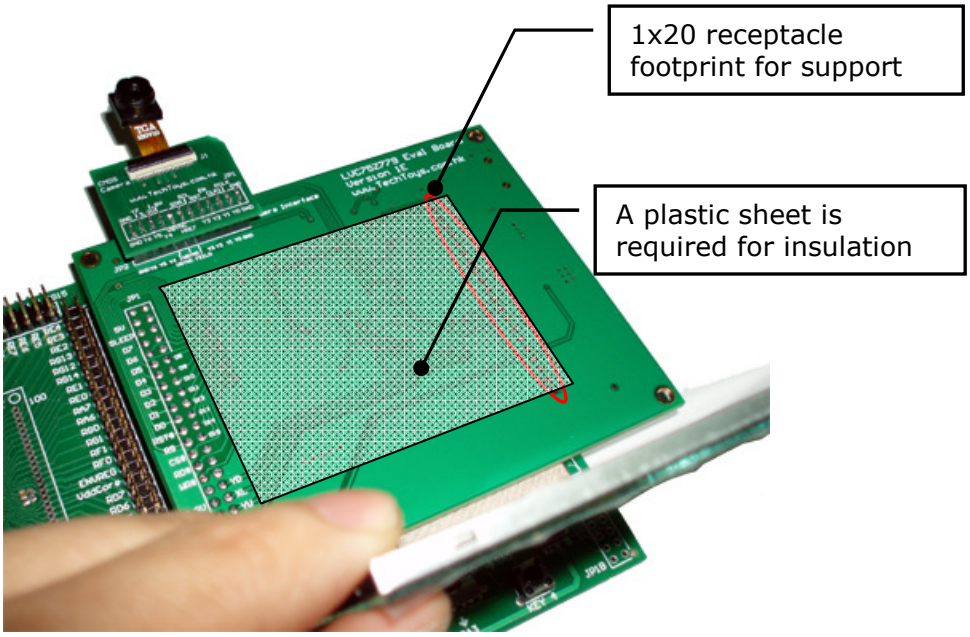

Figure 4 A plastic sheet is required to cover the bottom PCB to avoid short-circuit between vias of PCB to the metallic enclosure of LCD module.

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FEATURES

There are various solutions to drive a LCD module, two of them are described in Microchip's web site at this address
http://www.microchip.com/stellent/idcplg?IdcService=SS_GET_PAGE&nodeId=2608&param=en533860

Built-in controller is usually for smaller display (less than 3"). For panel larger than 3.5", external graphic controller is required.

External graphic/LCD controllers relieve the microcontroller from graphics manipulation and image rendering. Some of the controllers not only give you basic LCD panel interface, but also equipped with more advanced features such as double buffer for multi-pages and instantaneous screen update, Picture-in-Picture support, and JPEG codec, just to mention few of them. There are a number of famous manufacturers of such external controller for example, Epson, Himax, Solomon-Systech Ltd. Our board uses SSD1928 Image Processor of Solomon-Systech for the following features.

- The LCD controller of SSD1928 supports digital LCD panels with configurable timing signals VSYNC, HSYNC, and PCLK or DOTCLK
- Camera input for still picture capture and image preview in form of a life video
- Hardware JPEG codec to encode and decode JPEG images. This feature evolves the consumer market of Digital Photo Viewer and Handheld GPS by opening the gate for low-end microcontrollers (e.g. 8-bit microcontrollers) to interface with LCD panels of size 3 inches or larger. It is because such panels usually require timing signals which are not built-in with most low-end microcontrollers. Furthermore, JPEG files require complicated algorithm to decompress and decode headers and tables to extract pixel information for LCD panel. Software encode and decode libraries are not needed because these would be handled by hardware of SSD1928
- Files can be saved into SD/MMC card through SD interface. The JPEG file is retrieved back from SD/MMC card, decoded and displayed on LCD panel
- Support various interface types, including 8-bit or 16-bit 8080 indirect addressing (e.g. Microchip PIC18/24/32, ATMEL AVR-series, 8051, etc.), SRAM interface for ARM core type microcontroller, and ISA interface like NEC MIPS.

For further information on SSD1928, please consult its datasheet for reference. If you want to know more about its application, there is a technical brief about using SSD192x series for Digital Photo Viewer and Handheld GPS from our web site at the following hyperlink (Doc12).

http://www.techtoys.com.hk/Displays/LVC75Z779%20Eval/LVC75Z779%20Eval%20Board.htm

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BLOCK DIAGRAM

Looking at the block diagram (Figure 5) on next page, you may be puzzled by HX8238 built-in the LCD module. Isn't it the controller for the LCD glass? Why should we still need another external graphic controller? I was confused at the beginning, too. HX8238 supplies the LCD glass with source and gate driving output voltages to generate every pixel. However, digital 8-bits serial / 24-bits parallel RGB input data together with timing signals HSYNC, VSYNC, and pixel clock (DOTCLK) are still needed to synchronize every display line, and hence every frame in every 1/50 second (say), if the display has been set to a frame frequency of 50Hz.

ADDRESSING MODE

Although there are four addressing modes possible with SSD1928, only 8-bits or 16-bits indirect addressing are supported with our development board due to a substantial difference in hardware design to support the other two generic modes.

On SSD1928, there are six configuration pins[78:83] with pin assignment as CNF[4:0] and CNF6 for addressing mode selection. The following table is an extract from SSD1928 datasheet about configuration pins. Because CNF6, CNF4 and AD_MODE have been wired to IOV_{SS} and IOV_{DD}, respectively, only the configurations with grey color are supported with our hardware with selection switch S10 wiring CNF[0:3] for high/low states.

SSD1928 Configuration Input	**Combination**				
	HIGH (IOV_{DD})			**LOW (IOV_{SS})**	
CNF[2:0] & AD_MODE	**AD_MODE**	**CNF2**	**CNF1**	**CNF0**	**BUS**
	0	0	1	1	Generic#1
	0	1	0	0	Generic#2
	1	0	1	1	Indirect 8-bit 8080
	1	1	0	0	Indirect 16-bit 8080
CNF3	GPIO pins as inputs at power-on			GPIO pins as outputs at power-on	
CNF4	Big endian bus interface			Little endian bus interface	
CNF6	MCLK = PLL_CLK/4			MCLK = PLL_CLK	

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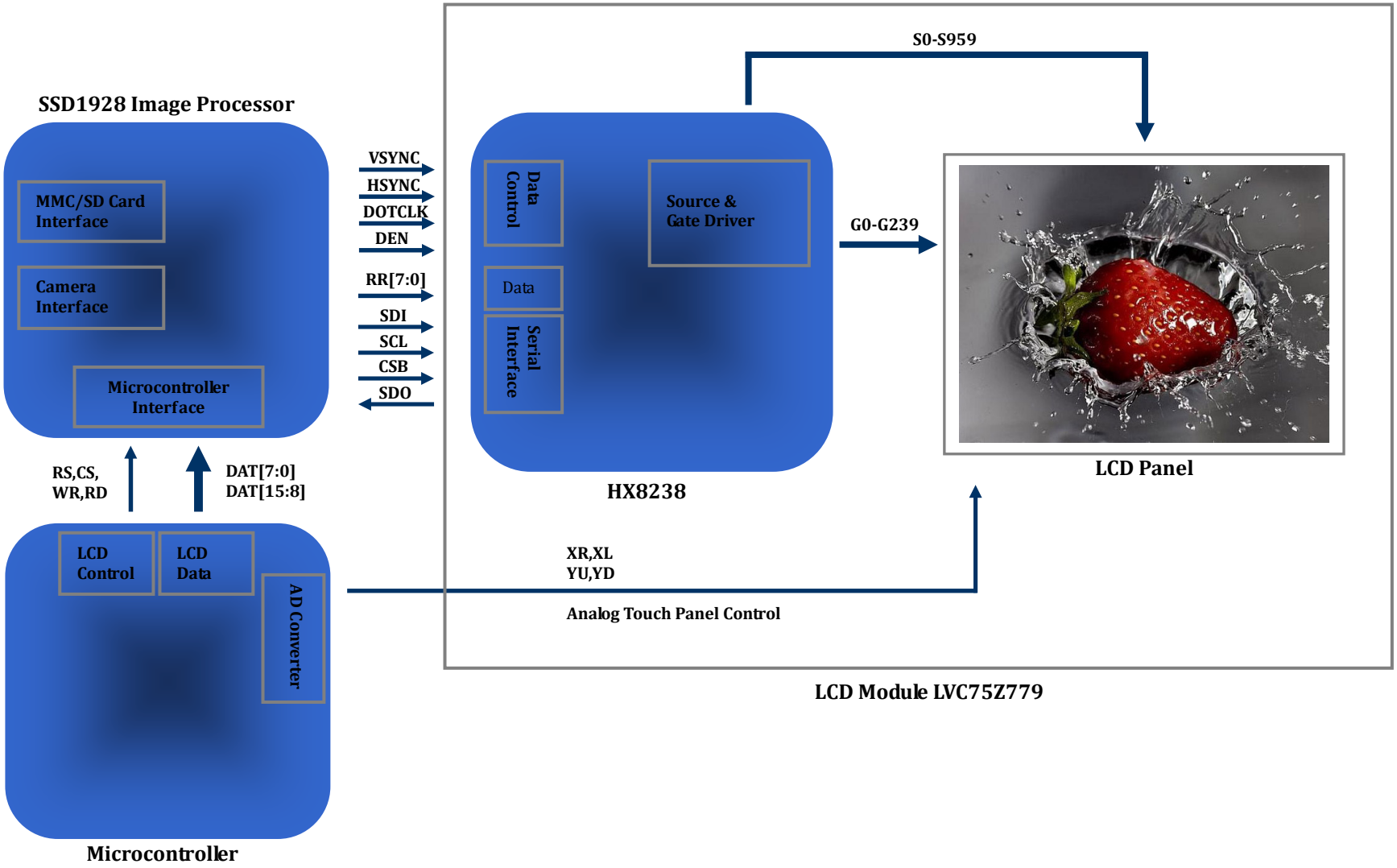

Figure 5 BLOCK Diagram

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EXAMPLE PROGRAM

This section finalizes the manual by giving examples to perform the following functions:

1. Generation of clock signals for digital LCD panel
2. Configuration of HX8238 registers
3. Modify Free Microchip Graphics Library (version 1.4) for primitive functions
4. Using a CMOS digital camera for life video
5. Begin development on sdCard library for microSD card I/O.

The full source code can be found at Doc 05. The hardware platform is PIC24-Eval-B2 Rev B with microcontroller being the Microchip 16-bit microcontroller: PIC24FJ128GA010. This example demonstrates primitive graphic support such as pixel read/write, font writing, screen clear, CMOS camera (OmniVision OV9650) initialization and image output, and a preliminary version of SD Card interface development.

Another example is found at Doc 08 with microcontroller being the Microchip 8-bit PIC18LF4550. Because there is not enough Flash space, only primitive graphic is supported with font removed. However, you still can see life video from this example with the low-cost hardware platform - PIC18LF4550-Eval-Rev 4A.

These are by no means a complete picture of what SSD1928 Image Processor is capable of doing. Unfinished tasks include JPEG images encode/decode, snapshot features with camera interface, and DVD video interface, etc. I sincerely wish you will find this kit useful and funny for your own project.

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NOTE:

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