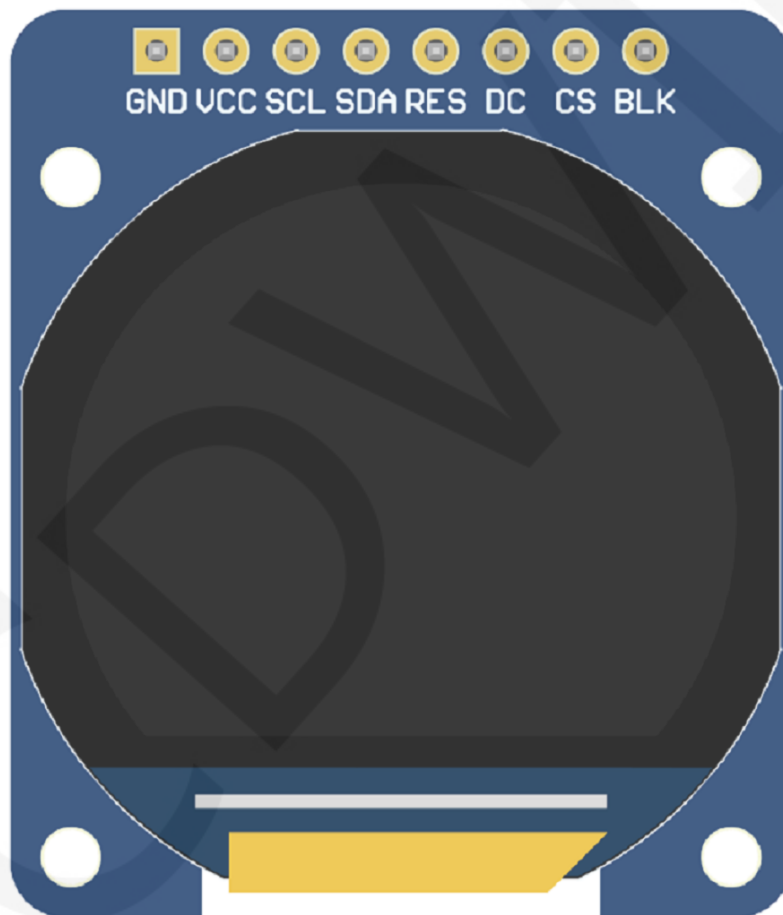


# MSP0964

## 0.96inch IPS TFT SPI Display Module User Manual



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## 1. Rsource Description

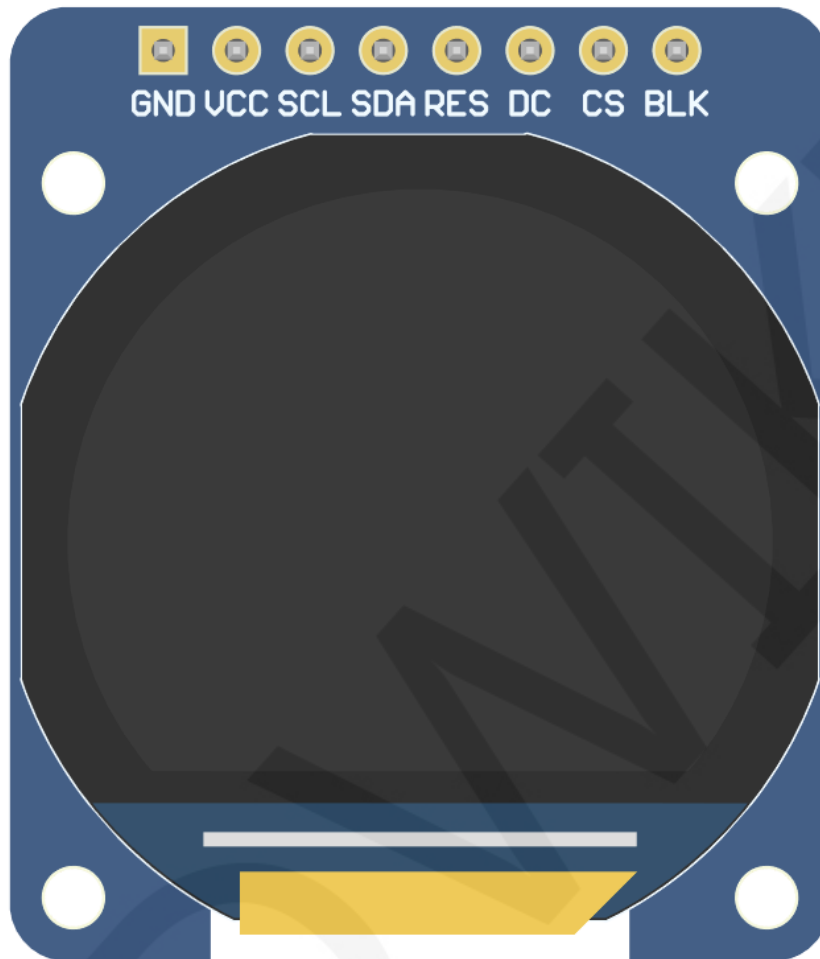
The resource directory is shown in the following figure:



Directory	Content Description
1-Demo	Contains sample programs and usage instructions for various platforms
2-Specification	Including LCD screen specifications, product specifications, and initialization of LCD screen driver IC
3-Structure_Diagram	Including product size structure documents
4-Driver_IC_Data_Sheet	Including LCD screen driver IC Datasheet and Touch Screen driver IC Datasheet
5-Schematic	Including product hardware schematic diagram, LCD Altium component diagram, and PCB packaging
6-User_Manual	Contains product user instructions document
7-Character&Picture_Molding_Tool	Contains image extraction software, character extraction software, and software usage instructions. The image and text display tests in the sample program require the use of these two software for mold taking.

## 2. Interface Description

The front interface of the module is shown in the following figure:



Number	Module Pin	Pin Function Description
1	<b>GND</b>	LCD Power ground
2	<b>VCC</b>	LCD power positive(It is recommended to connect to 5V. When connected to 3.3V, the backlight brightness will be slightly dim)
3	<b>SCL</b>	LCD SPI bus clock signal
4	<b>SDA</b>	LCD SPI bus write data signal
5	<b>RES</b>	LCD reset control signal, Low level reset
6	<b>DC</b>	LCD command / data selection control signal High level: data, low level: command
7	<b>CS</b>	LCD selection control signal, Low level active
8	<b>BLK</b>	LCD backlight control signal (If you need control, please connect the pins. If you don't need control, you can skip it)

### 3. Working principle

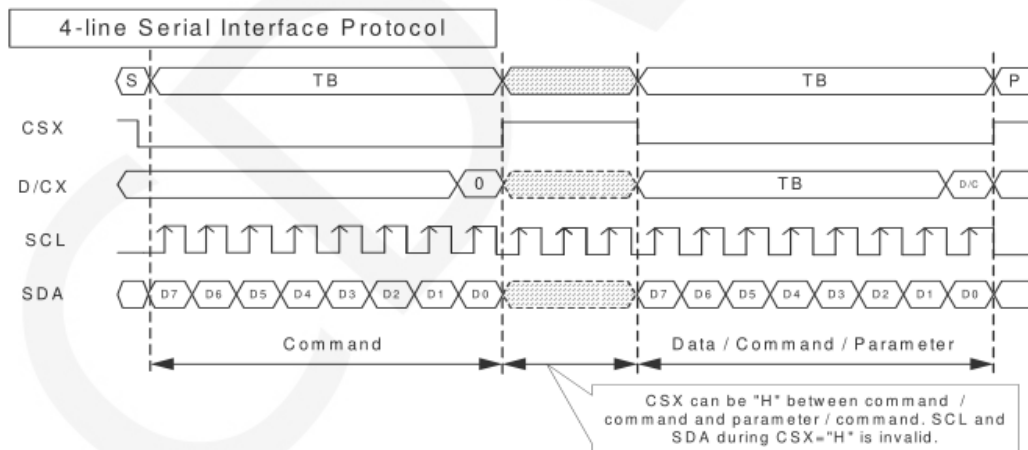
#### 3.1. Introduction to ST7789H2 Controller

The ST7789H2 controller supports a maximum resolution of 240 \* 320 and has a GRAM of 172800 bytes in size. Simultaneously supports 8-bit, 9-bit, 16-bit, and 18-bit parallel port data buses, as well as 3-wire and 4-wire SPI serial ports. Due to the large number of IO ports required for parallel control, SPI serial port control is the most commonly used. ST7789H2 also supports 65K and 262K RGB color display, with rich display colors. It also supports rotation and scrolling display, as well as video playback, with various display methods.

The ST7789H2 controller uses 16bit (RGB565) to control the display of one pixel, so each pixel can be displayed display up to 65K colors. The pixel address is set in the order of rows and columns, with the increasing and decreasing direction determined by the scanning method fixed. The ST7789H2 display method follows the process of setting the address first and then setting the color value.

#### 3.2. Introduction to SPI Communication Protocol

The writing mode timing of the 4-wire SPI bus is shown in the following figure:



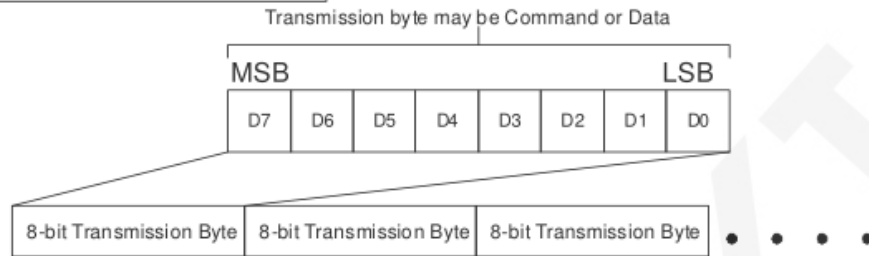
CSX is a slave chip selection, and the chip will only be enabled when CSX is at low power level.

D/CX is the data/command control pin of the chip. When DCX is writing commands at low levels, data is written at high levels

SCL is the SPI bus clock, with each rising edge transmitting 1 bit of data;

SDA is the data transmitted by SPI, which transmits 8 bits of data at once. The data format is shown in the following figure:

Data Format for 4-line Serial Interface



High bit first, transmit first.

For SPI communication, data has a transmission timing, with a combination of real-time clock phase (CPHA) and clock polarity (CPOL):

The level of CPOL determines the idle state level of the serial synchronous clock, with CPOL=0, indicating a low level. CPOL pair transmission protocol

The discussion did not have much influence;

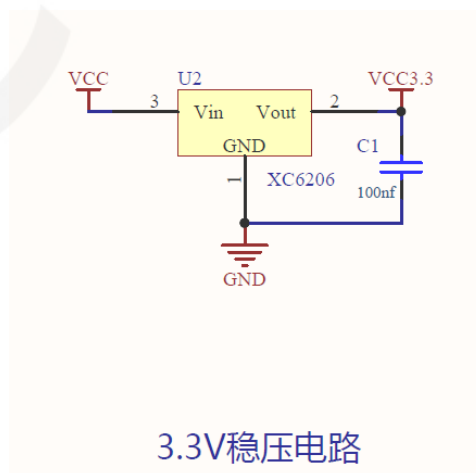
The height of CPHA determines whether the serial synchronous clock collects data on the first or second clock jump edge,

When CPHL=0, perform data collection at the first transition edge;

The combination of these two forms four SPI communication methods, and SPI0 is commonly used in China, where CPHL=0 and CPOL=0

## 4. Hardware Description

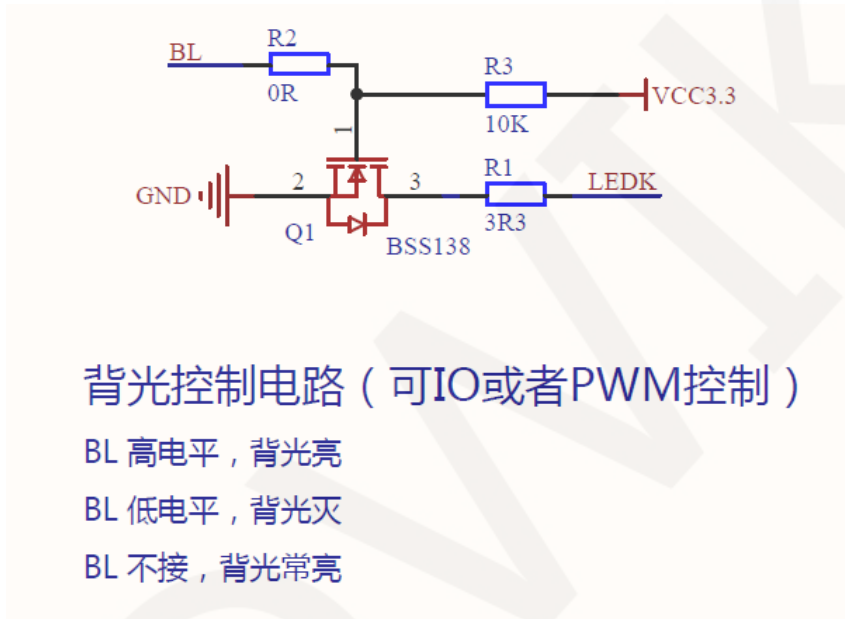
### 4.1. Power supply voltage stabilizing circuit



3.3V稳压电路

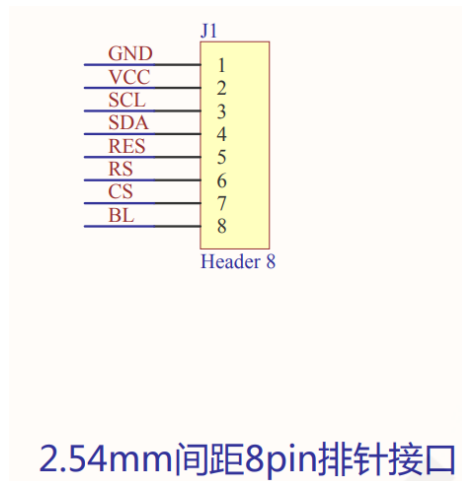
This circuit is used to stabilize the input voltage of the module, where VCC is the external input voltage, VCC3.3V is the module input voltage, and C1 is the bypass filter capacitor. VCC can be connected to 5V or 3.3V, and it is recommended to connect to 5V because only by connecting to 5V can VCC3.3 output 3.3V. If connected to 3.3V, VCC3.3 output voltage will be less than 3.3V, which will cause the backlight brightness of the LCD screen to darken.

#### 4.2. Backlight control circuit



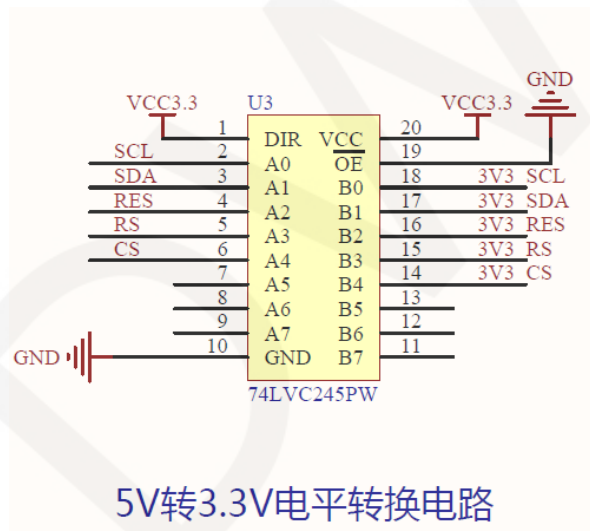
R2 is reserved for compatibility with J3Y control circuits, directly using a 0 ohm resistor. R1 is the backlight current limiting resistor, R3 is the pull-up resistor, and Q1 is the BSS138 N-channel field-effect transistor. LED is the control signal, and LEDK is connected to the negative pole of the backlight. When the LED is suspended (without a control signal), due to R3 pull-up, the source of BSS138 is at a high level, with its gate and drain conducting, LEDK grounded, and the backlight circuit conducting, thus turning on the light. When the LED input is low, the source of BSS138 is low, its gate and drain are cut off, LDEK is suspended, and the backlight circuit is cut off, thus turning off the light; When the LED input is at a high level, the source of BSS138 is at a high level, its gate and drain are conductive, LDEK is grounded, and the backlight circuit is conductive, thus turning on the light;

### 4.3. 8P pin interface



J1 is an 8P pin interface with a spacing of 2.54mm, used to connect the DuPont line to the main control.

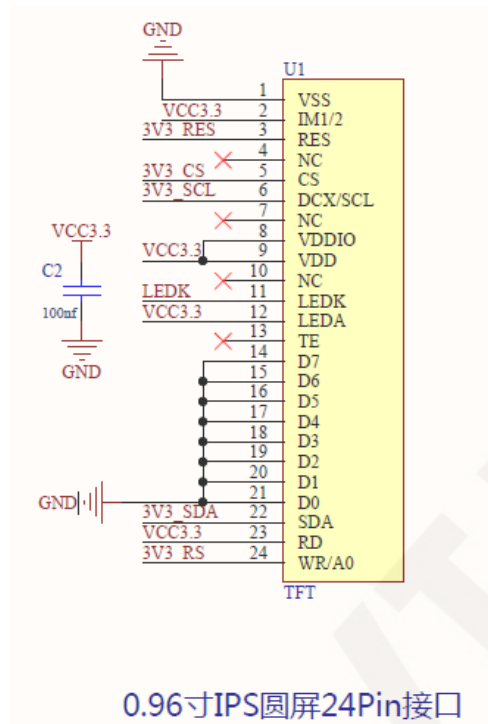
### 4.4. Control signal level conversion circuit



U3 is a level conversion IC that converts between 5V and 3.3V. This circuit only uses the unidirectional function of 5V to 3.3V, and the 5V or 3.3V level signals input by the main control are converted through this circuit and then output to the LCD screen.

### 4.5. 24P LCD screen connector interface





U1 is a 24P narrow spacing (0.4mm) double row connector base. It is used to connect to the FPC cable of the LCD, so that the LCD can receive signals from the main control. C2 is the bypass filter capacitor of the LCD power supply.

## 5. Example program usage instructions

For specific instructions, please refer to the example program usage instructions document in the example program directory.

- A. Connect the display module to the main control board (directly plug in, use DuPont cable or FPC cable connection);
- B. Connect the main control board to the PC (it needs to be connected according to the download method) and power on the main control board;
- C. Modify, compile, and download sample programs;
- D. Check the display of the module and check if the program runs successfully;

## 6. Common tool software

The example program needs to display both Chinese and English, symbols, and images, so it requires the use of mold taking software. There are two types of mold

taking software: Image2Lcd and PCtoLCD2002. Image2Lcd is used for color image extraction, while PCtoLCD2002 is used for text or monochrome image extraction.

The **PCtoLCD2002** mold taking software is set as follows:

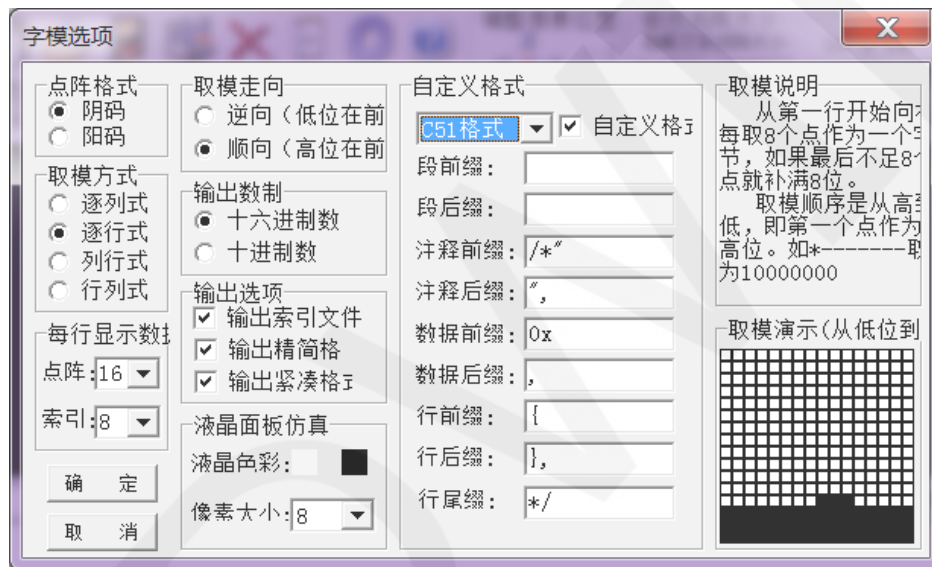
Dot Matrix Format Selection **Yin Code**

Select **row by row mode for mold** taking

Select **the direction of the mold taking direction** in the clockwise direction (with the higher position in front)

Output Number System Selection **Hexadecimal Number**

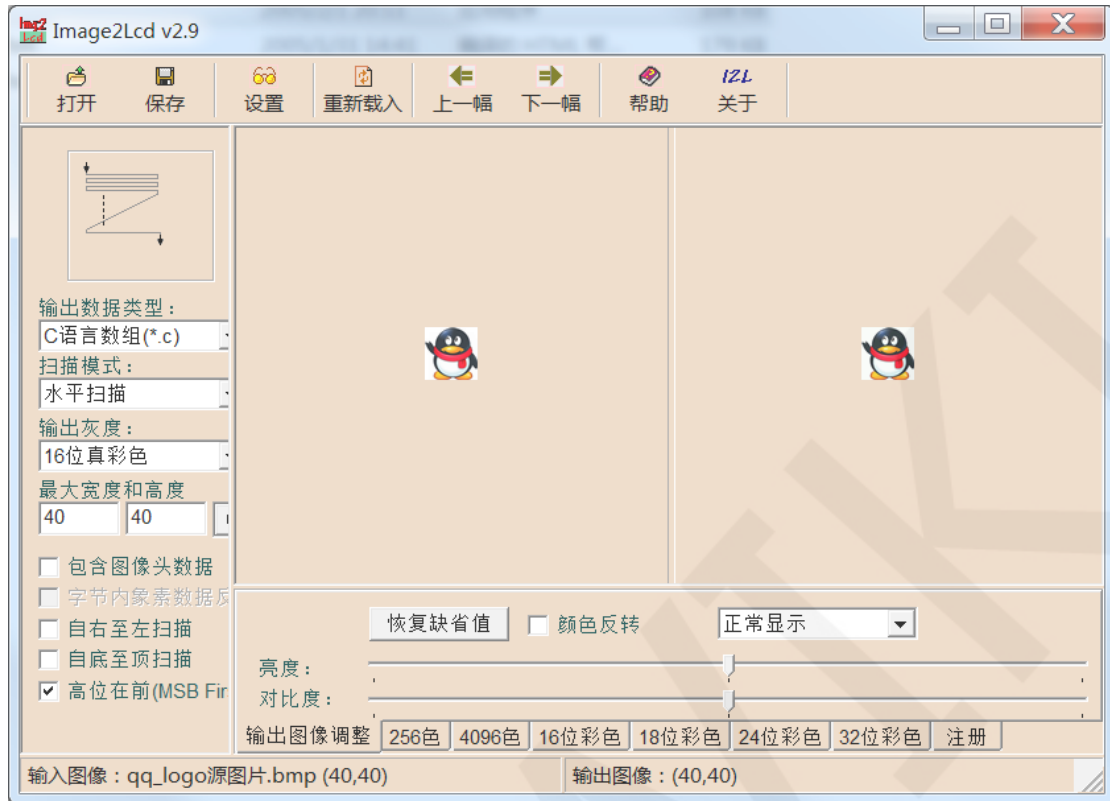
Custom Format Selection **C51 Format**



The specific setting method can be found on the following webpage:

[http://www.lcdwiki.com/Chinese\\_and\\_English\\_display\\_modulo\\_settings](http://www.lcdwiki.com/Chinese_and_English_display_modulo_settings)

The **Image2Lcd** mold taking software settings are shown in the following figure:



The Image2Lcd software needs to be set to scan horizontally, from left to right, from top to bottom, and with high bits in front.