LCD TFT Module Specification

Riverdi

our pixels behave

RVT28AEFNWN00

LCD TFT Datasheet

Rev.1.1

2015-10-06

ITEM	CONTENTS	UNIT
LCD Type	TFT/Transmissive/Normally white	/
Size	2.83	Inch
Viewing Direction	6:00 (without image inversion)	O' Clock
Gray Scale Inversion Direction	12:00	O' Clock
LCM (W × H × D)	50.2 x 69.3 x 6.22	mm3
Active Area (W × H)	43.2 × 57.6	mm2
Dot Pitch (W × H)	0.18 × 0.18	mm2
Number Of Dots	240 x (RGB) × 320	/
Driver IC	FT800	/
Backlight Type	4 LEDs	/
Surface Luminance	300	cd/m2
Interface Type	SPI/I2C	/
Color Depth	262k	/
Pixel Arrangement	RGB Vertical Stripe	/
Surface Treatment	Anti-glare	
Input Voltage	2.8	V
With/Without TSP	Without Touch Panel	/
Weight	31.07	g

Note 1: RoHS compliant

Note 2: LCM weight tolerance: ± 5%.

REVISION RECORD

REV NO.	REV DATE	CONTENTS	REMARKS
1.0	2015-08-24	Initial Release	
1.1	2015-10-06	Update PCB position in mechanical drawing	

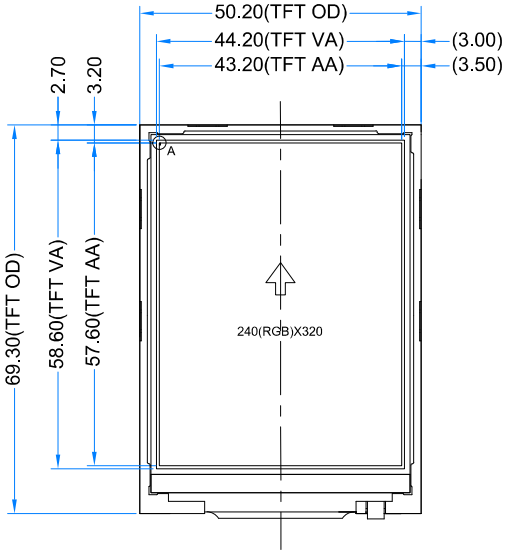
CONTENTS

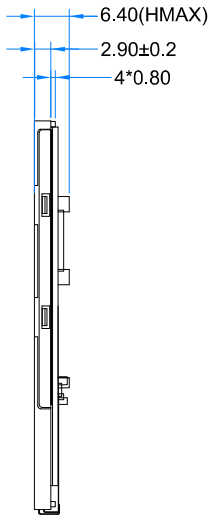
1 MODULE CLASSIFICATION INFORMATION

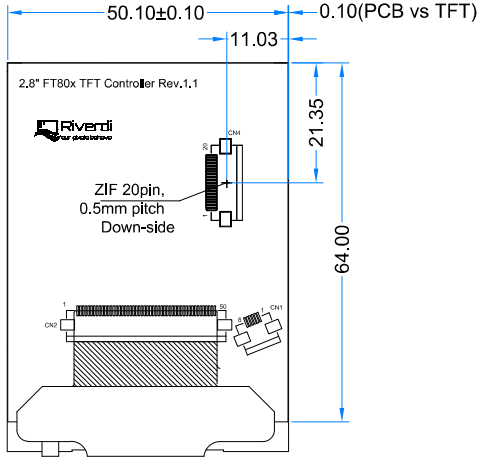
RV	T	28	A	E	F	N	W	N	00
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.

1.	**BRAND**	**RV** – Riverdi
2.	**PRODUCT TYPE**	**T – TFT Standard** **F** – TFT Custom
3.	**DISPLAY SIZE**	**28 – 2.83”** **35** – 3.5” **43** – 4.3” **70** – 7.0”
4.	**MODEL SERIAL NO.**	**A (A-Z)**
5.	**RESOLUTION**	**E – 240x320 px**
6.	**INTERFACE**	**T** – TFT LCD, RGB **L** – TFT LCD, LVDS **S** – TFT + Controller SSD1963 **F – TFT + Controller FT800**
7.	**FRAME**	**N – No Frame** **F –** Mounting Frame
8.	**BACKLIGHT TYPE**	**W – LED White**
9.	**TOUCH PANEL**	**N – No Touch Panel** **R –** Resistive Touch Panel **C –** Capacitive Touch Panel
10.	**VERSION**	**00 (00-99)**

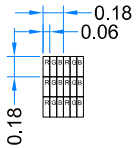
PIN	DESC
1	VDD
2	GND
3	SPI_SCLK/ I2C_SCL
4	MISO/I2C_SDA
5	MOSI/I2C_SA0
6	CS/I2C_SA1
7	INT
8	PD
9	MODE
10	AUDIO_OUT
11	NC
12	NC
13	NC
14	NC
15	NC
16	NC
17	BLVDD
18	BLVDD
19	BLGND
20	BLGND



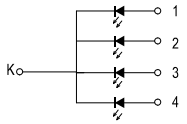




DETAIL A
SCALE 20:1



INTERNAL BACKLIGHT CIRCUIT DIAGRAM



NOTES:
1. DISPLAY TYPE: TFT, TRANSMISSIVE, NORMALY WHITE
2. VIEWING DIRECTION: 6 O'CLOCK
3.OPERATION VOLTAGE: VDD= 2.8V
4. IC CONTROLLER: FT800
5. LED BACKLIGHT: 4-LED WHITE, BUILT-IN INVERTER
6. OPERATING TEMP: -20°C ~ +70°C
7. STORAGE TEMP: -30°C ~+80°C
8. SURFACE LUMINNCE: 300 cd/m^2
9. GENERAL TOLERANCE: ±0.20
10. RoHS COMPLIANT

Rev.	DESCRIPTION	DATE
1.1	Update PCB position	2015.10.06
1.0	Initial case	2015.08.21

CUSTOMER		DATE	2015/10/06
DRAWN	SCALE 1:1	TITLE	RVT28AEFNWN00
DFTG CHK	UNIT mm		
ENGR CHK		MODEL	
APPROVAL	Riverdi our pixels behave	DWG NO Rev.1.1	PAGE 1/1

3 ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	MIN	MAX	UNIT
Supply Voltage For Logic	VDD	-0.3	4.6	V
Input Voltage For Logic	VIN	-0.3	VDD	V
Operating Temperature	T_{OP}	-20	70	°C
Storage Temperature	T_{ST}	-30	80	°C
Humidity	RH	-	90% (Max 60°C)	RH

4 ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
Supply Voltage For Logic	VDD	2.5	2.8	3.3	V
Input Current	IDD	-	18	-	mA
Input Voltage ' H ' level	V_{IH}	0.7VDD	-	VDD	V
Input Voltage ' L ' level	V_{IL}	VSS	-	0.3VDD	V

5 BACKLIGHT CHARACTERISTICS

ITEM	SYMBOL	MIN	TYP	MAX	UNIT
Voltage for LED backlight	V_I	-	3.2	3.4	V
Current for LED backlight	I_I	-	89	-	mA
LED Life Time	-	30000	40000	-	Hrs

Note:

1.The LED life time is defined as the module brightness decrease to 50% original brightness at Ta=25°C.

2. The LED ‘s driver mode needs to be constant current mode.

3. Permanent damage to the device may occur if maximum values are exceeded or reverse voltage is loaded .Functional operation should be restricted to the conditions described under normal operating conditions.

6 ELECTRO-OPTICAL CHARACTERISTICS

ITEM		SYMBOL	CONDITION	MIN	TYP	MAX	UNIT	REMARK	NOTE
Response Time		Tr+Tf	θ=0° Ø=0° Ta=25	-	25	30	ms	Figure 1	4
Contrast Ratio		Cr		-	500	-	---	Figure 2	1
Luminance Uniformity		δ WHITE		80	90.8	-	%	Figure 2	3
Surface Luminance		Lv		187	300	-	cd/m^2	Figure 2	2
Viewing Angle Range		θ	Ø = 90°	-	70	-	deg	Figure 3	6
			Ø = 270°	-	57	-	deg	Figure 3	
			Ø = 0°	-	70	-	deg	Figure 3	
			Ø = 180°	-	70	-	deg	Figure 3	
CIE (x, y) Chromaticity	Red	x	θ=0° Ø=0° Ta=25	-	0.6368	-	Figure 2		5
		y		-	0.3329	-			
	Green	x		-	0.3397	-			
		y		-	0.6138	-			
	Blue	x		-	0.1433	-			
		y		-	0.0807	-			
	White	x		-	0.2886	-			
		y		-	0.3194	-			
NTSC	-	S	-	55	67	-	%		-

Note 1. Contrast Ratio(CR) is defined mathematically as below, for more information see Figure 1.

$$\text{Contrast Ratio} = \frac{\text{Average Surface Luminance with all white pixels (P1, P2, P3, P4, P5)}}{\text{Average Surface Luminance with all black pixels (P1, P2, P3, P4, P5)}}$$

Note 2. Surface luminance is the LCD surface from the surface with all pixels displaying white. For more information see Figure 2.

Lv = Average Surface Luminance with all white pixels (P1, P2, P3, P4, P5)

Note 3. The uniformity in surface luminance δ WHITE is determined by measuring luminance at each test position 1 through 5, and then dividing the maximum luminance of 5 points luminance by minimum luminance of 5 points luminance. For more information see Figure 2.

$$\delta \text{ WHITE} = \frac{\text{Minimum Surface Luminance with all white pixels (P1, P2, P3, P4, P5)}}{\text{Maximum Surface Luminance with all white pixels (P1, P2, P3, P4, P5)}}$$

Note 4. Response time is the time required for the display to transition from white to black (Rise Time, Tr) and from black to white (Decay Time, Tf). For additional information see FIG 1. The test equipment is Autronic-Melchers's ConoScope series.

Note 5. CIE (x, y) chromaticity, the x, y value is determined by measuring luminance at each test position 1 through 5, and then make average value.

Note 6. Viewing angle is the angle at which the contrast ratio is greater than 2. For TFT module the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see Figure 3.

Note 7. For viewing angle and response time testing, the testing data is based on Autronic-Melchers's ConoScope series. Instruments for Contrast Ratio, Surface Luminance, Luminance Uniformity, CIE the test data is based on TOPCON's BM-5 photo detector.

Figure 1. The definition of response time

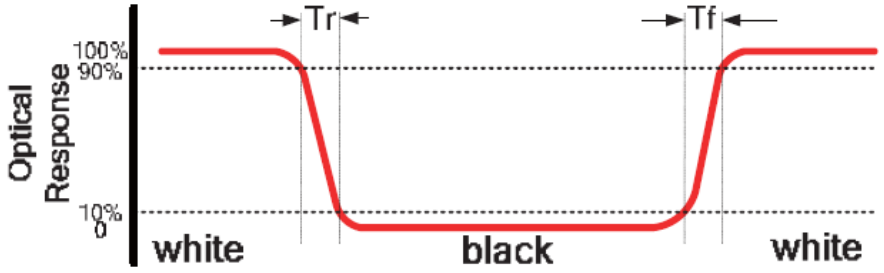


Figure 2. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity

A : 5 mm
B : 5 mm
H, V : Active Area
Light spot size ∅=5mm, 500mm distance from the LCD surface to detector lens
measurement instrument is TOPCON's luminance meter BM-5

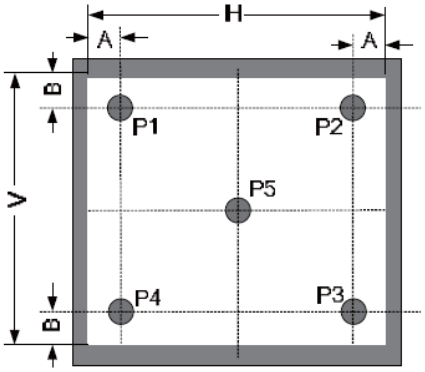
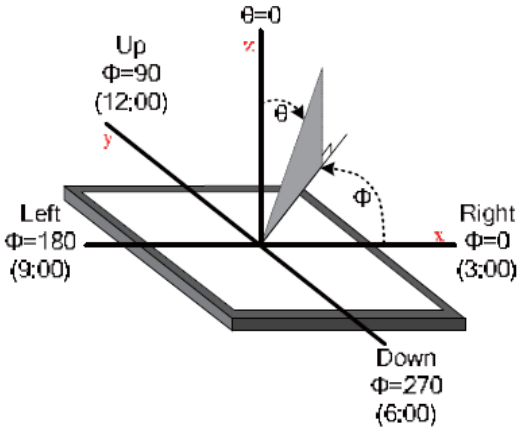


Figure 3.The definition of viewing angle



7 INTERFACE DESCRIPTION

PIN NO.	SYMBOL	DESCRIPTION
1	VDD	Power Supply
2	GND	Ground
3	SPI_SCLK/ I2C_SCL	SPI SCK Signal / I2C SCL Signal, Internally 47k Pull UP
4	MISO/ I2C_SDA	SPI MISO Signal / I2C SDA Signal, Internally 47k Pull UP
5	MOSI/ I2C_SA0	SPI MOSI Signal / I2C Slave Address Bit 0, Internally 47k Pull UP
6	CS/I2C_SA1	SPI Chip Select Signal / I2C Slave Address Bit 1, Internally 47k Pull UP
7	INT	Interrupt Signal, Active Low, Internally 47k Pull UP
8	PD	Power Down Signal, Active Low, Internally 47k Pull UP
9	MODE	Host Interface SPI(Pull Low) or I2C(Pull Up) Mode Select Input, Internally 10k Pull DOWN
10	AUDIO_OUT	Audio Out Signal
11	NC	Not Connected
12	NC	Not Connected
13	NC	Not Connected
14	NC	Not Connected
15	NC	Not Connected
16	NC	Not Connected
17	BLVDD	Backlight Power Supply, Can Be Connected to VDD
18	BLVDD	Backlight Power Supply, Can Be Connected to VDD
19	BLGND	Backlight Ground, Internally connected to GND
20	BLGND	Backlight Ground, Internally connected to GND

8 FT800 CONTROLLER SPECIFICATIONS

FT800 or EVE (Embedded Video Engine) simplifies the system architecture for advanced human machine interfaces (HMIs) by providing functionality for display, audio, and touch as well as an object oriented architecture approach that extends from display creation to the rendering of the graphics.

8.1 Serial host interface

Figure 4.SPI interface connection

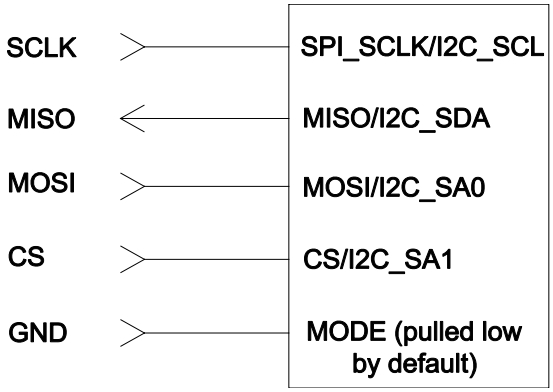
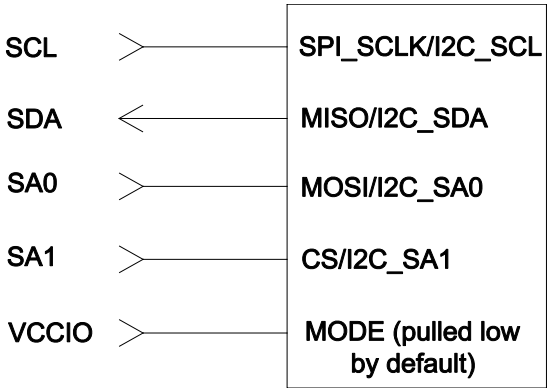


Figure 5.I2C interface connection



SPI Interface – the SPI slave interface operates up to 30MHz.

Only SPI mode 0 is supported. The SPI interface is selected by default (MODE pin is internally pulled low by 47k resistor).

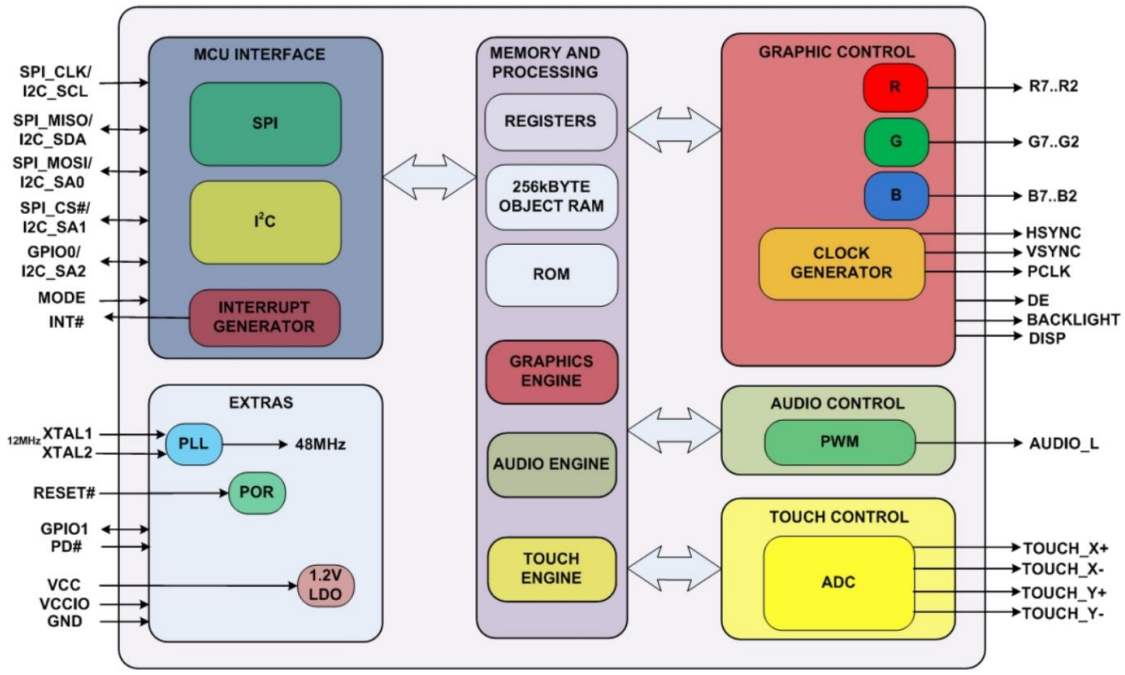
I²C Interface – the I²C slave interface operates up to 3.4MHz, supporting standard-mode, fast-mode, fast-mode plus and high-speed mode.

The I²C device address is configurable between 20h to 23h depending on the I²C_SA[1:0] pin setting, i.e. the 7-bit I²C slave address is 0b'01000A1A0.

The I²C interface is selected when the MODE pin is tied to VDDIO.

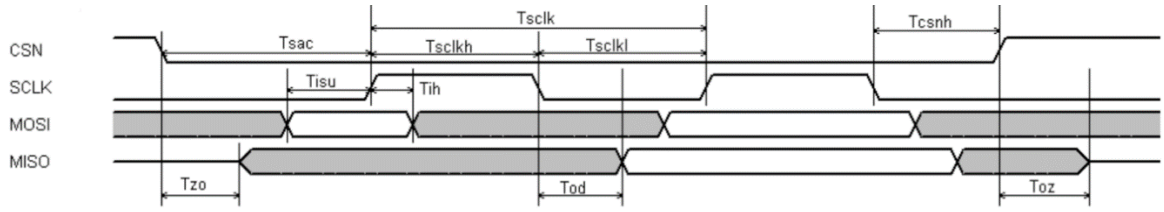
8.2 Block Diagram

Figure 6. FT800 Block diagram



8.3 Host interface SPI mode 0

Figure 7. SPI timing diagram

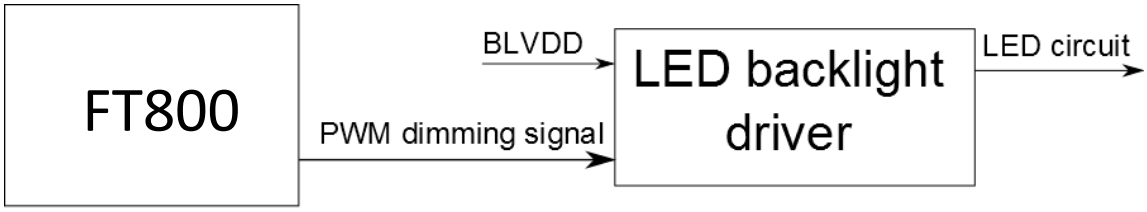


For more information about FT801 controller please go to official FT800 Datasheet.
http://www.ftdichip.com/Support/Documents/DataSheets/ICs/DS_FT800.pdf

8.4 Backlight driver block diagram

Backlight enable signal is internally connected to FT800 Backlight control pin. This pin is controlled by two FT800's registers. One of them specifies the PWM output frequency, second one specifies the duty cycle. Refer to FT800 datasheet for more information.

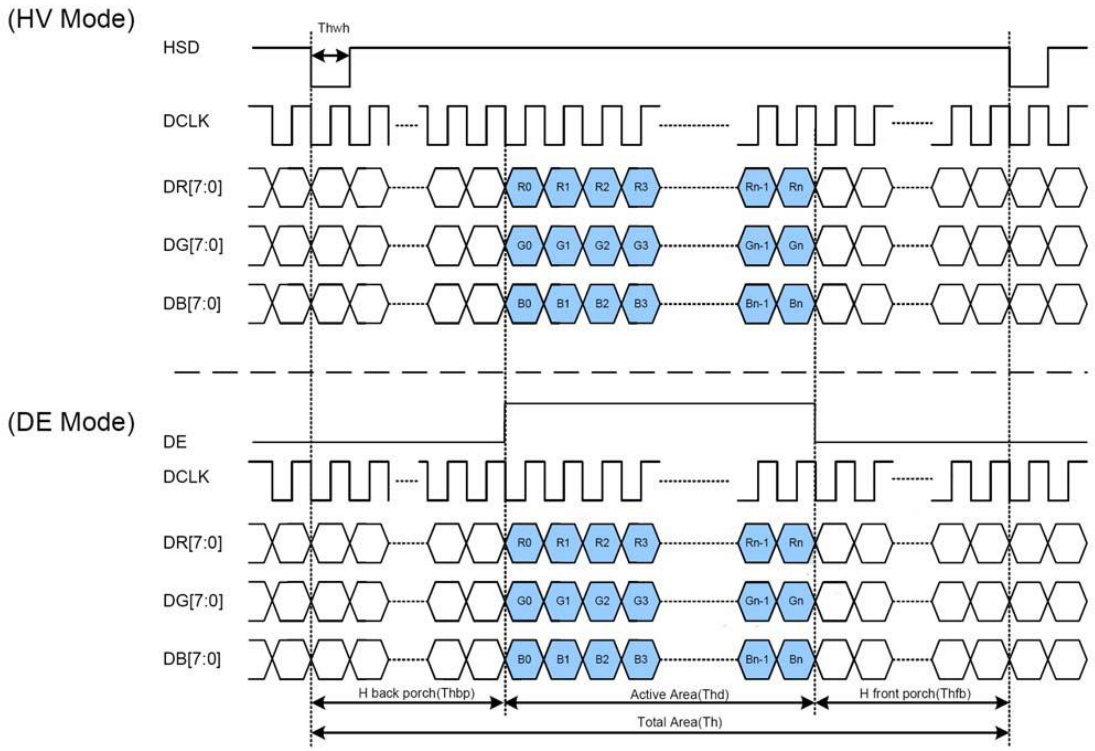
Figure 8. Backlight driver block diagram



9 LCD TIMING CHARACTERISTICS

9.1 Clock and data input time diagram

Figure 9. Clock and data input time diagram



9.2 Parallel RGB input timing table

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
DCLK Frequency	Fclk	-	6.35	-	MZH
VSD Period Time	Tv	324	326	320	H
VSD Display Area	Tvd		320		H
VSD Back Porch	Tvb	1	2	-	H
VSD Front Porch	Tvfp	3	4	-	H
HSD Period Time	Th	244	270	280	DCLK
HSD Display Area	Thd		240		DCLK
HSD Back Porch	Thbp	2	20	24	DCLK
HSD Front Porch	Thfp	2	10	16	DCLK

10 INITIAL CODE

```
#define REG_GPIO     1057936UL
#define REG_GPIO_DIR 1057932UL

//Function which sends SPI (8-bit) data to FT80X
void SPI_FT_Send(uint8_t data)

{
	unsigned char m=0x80;

	for(i=0;i<8;i++)
	{
		GPIO_WriteBit(CLK,0);
		if(data&m)
		{
			GPIO_WriteBit(SDO,1);
		}
		else
		{
			GPIO_WriteBit(SDO,0);
		}
		GPIO_WriteBit(CLK,1);

		m=m>>1;
		GPIO_WriteBit(CLK,0);
	}
}

//Function which sets the CS for ILI9341 through FT80X registers
void CS_ILI(uint8_t mode)

{
	switch (mode) {
		case 0:
			GPIO_WriteBit(FT_CS,0);

			SPI_FT_Send((REG_GPIO >> 16) & 0xBF | 0x80));
			SPI_FT_Send((REG_GPIO & 0xFF00) >> 8);
			SPI_FT_Send((REG_GPIO & 0xFF));

			SPI_FT_Send(0x00);

			GPIO_WriteBit(FT_CS,1);
			break;
		case 1:
			GPIO_WriteBit(FT_CS,0);

			SPI_FT_Send((REG_GPIO >> 16) & 0xBF | 0x80));
			SPI_FT_Send((REG_GPIO & 0xFF00) >> 8);
			SPI_FT_Send((REG_GPIO & 0xFF));

			SPI_FT_Send(0x83);

			GPIO_WriteBit(GPIOA,FT_CS,1);
			GPIO_WriteBit(SDO,0);
			GPIO_WriteBit(CLK,0);
			break;
	}
}

//Function which sends SPI (9-bit) data to ILI9341
void ILI_Send(DC type, uint8_t data)
{
	unsigned char m=0x80;
	uint8_t i, test;
	if(type == COMMAND)
```

```
        {
                GPIO_WriteBit(CLK,0);
                GPIO_WriteBit(SDO,0);
                GPIO_WriteBit(CLK,1);
        }
        else if(type == DATA)
        {
                GPIO_WriteBit(CLK,0);
                GPIO_WriteBit(SDO,1);
                GPIO_WriteBit(CLK,1);
        }
       for(i=0;i<8;i++)
        {
                GPIO_WriteBit(CLK,0);
                if(data&m)
                {
                        GPIO_WriteBit(SDO,1);
                }
                else
                {
                        GPIO_WriteBit(SDO,0);
                }
                GPIO_WriteBit(CLK,1);

                m=m>>1;
        }
        delay_ms(1);
}
void ILI_init()
{
        FT80X_init();                //FT80X initialization
        Ft_Gpu_Hal_Sleep(5000);
       CS_ILI(0);
       ILI_Send(COMMAND,0x01);      //software reset
        delay_ms(5);
        CS_ILI(1);

        CS_ILI(0);
        ILI_Send(COMMAND,0x28);    //display off
        CS_ILI(1);
//-------------------------------------------------------------
         CS_ILI(0);
        ILI_Send(COMMAND,0xcf);
         ILI_Send(DATA,0x00);
        ILI_Send(DATA,0x81);
        ILI_Send(DATA,0x30);
        CS_ILI(1);

        CS_ILI(0);
        ILI_Send(COMMAND,0xed);
         ILI_Send(DATA,0x64);
        ILI_Send(DATA,0x03);
        ILI_Send(DATA,0x12);
        ILI_Send(DATA,0x81);
        CS_ILI(1);

        CS_ILI(0);
        ILI_Send(COMMAND,0xe8);
       ILI_Send(DATA,0x85);
        ILI_Send(DATA,0x01);
        ILI_Send(DATA,0x79);
        CS_ILI(1);

        CS_ILI(0);
        ILI_Send(COMMAND,0xcb);
       ILI_Send(DATA,0x39);
        ILI_Send(DATA,0x2c);
        ILI_Send(DATA,0x00);
```

```
       ILI_Send(DATA,0x34);
       ILI_Send(DATA,0x02);
       CS_ILI(1);

       CS_ILI(0);
      ILI_Send(COMMAND,0xF6);//Interface Control
       ILI_Send(DATA,0x01);
       ILI_Send(DATA,0x00);
       ILI_Send(DATA,0x06);
       CS_ILI(1);

      CS_ILI(0);
      ILI_Send(COMMAND,0xf7);
      ILI_Send(DATA,0x20);
      CS_ILI(1);

      CS_ILI(0);
      ILI_Send(COMMAND,0xea);
      ILI_Send(DATA,0x06);
      ILI_Send(DATA,0x00);
      CS_ILI(1);
//------------power control------------------------------

      CS_ILI(0);
      ILI_Send(COMMAND,0xc0);   //power control
      ILI_Send(DATA,0x26);
      CS_ILI(1);

     CS_ILI(0);
     ILI_Send(COMMAND,0xc1);    //power control
     ILI_Send(DATA,0x11);
     CS_ILI(1);
//--------------VCOM ---------

     CS_ILI(0);
     ILI_Send(COMMAND,0xc5);    //vcom control
     ILI_Send(DATA,0x35);
     ILI_Send(DATA,0x3E);
     CS_ILI(1);

     CS_ILI(0);
     ILI_Send(COMMAND,0xc7);   //vcom control
     ILI_Send(DATA,0xBE);
     CS_ILI(1);
//------------memory access control------------------------

    CS_ILI(0);
    ILI_Send(COMMAND,0x36);
    ILI_Send(DATA,0x40);
    CS_ILI(1);

    CS_ILI(0);
    ILI_Send(COMMAND,0x3a);   //pixel format set
    ILI_Send(DATA,0x60);   //18bit /pixel
    CS_ILI(1);
//----------------- frame rate------------------------------

    CS_ILI(0);
    ILI_Send(COMMAND,0xb0);  //RGB Interface Signal Control
    ILI_Send(DATA,0xC0);    //0x1c0 DE mode
    CS_ILI(1);

    CS_ILI(0);
    ILI_Send(COMMAND,0xb1);   //frame rate
    ILI_Send(DATA,0x00);
    ILI_Send(DATA,0x1B);
    CS_ILI(1);
//----------------Gamma---------------------------------
```

```
    CS_ILI(0);
    ILI_Send(COMMAND,0xf2);  //3Gamma Function Disable
    ILI_Send(DATA,0x02);
    CS_ILI(1);

    CS_ILI(0);
    ILI_Send(COMMAND,0x26);
    ILI_Send(DATA,0x01);   //gamma set 4 gamma curve 01/02/04/08
    CS_ILI(1);

    CS_ILI(0);
    ILI_Send(COMMAND,0xE0);  //positive gamma correction
    ILI_Send(DATA,0x1f);
    ILI_Send(DATA,0x1a);
    ILI_Send(DATA,0x18);
    ILI_Send(DATA,0x0a);
    ILI_Send(DATA,0x0f);
    ILI_Send(DATA,0x06);
    ILI_Send(DATA,0x45);
    ILI_Send(DATA,0x87);
    ILI_Send(DATA,0x32);
    ILI_Send(DATA,0x0a);
    ILI_Send(DATA,0x07);
    ILI_Send(DATA,0x02);
    ILI_Send(DATA,0x07);
    ILI_Send(DATA,0x05);
    ILI_Send(DATA,0x00);
    CS_ILI(1);

    CS_ILI(0);
    ILI_Send(COMMAND,0xE1);  //negamma correction
    ILI_Send(DATA,0x00);
    ILI_Send(DATA,0x25);
    ILI_Send(DATA,0x27);
    ILI_Send(DATA,0x05);
    ILI_Send(DATA,0x10);
    ILI_Send(DATA,0x09);
    ILI_Send(DATA,0x3a);
    ILI_Send(DATA,0x78);
    ILI_Send(DATA,0x4d);
    ILI_Send(DATA,0x05);
    ILI_Send(DATA,0x18);
    ILI_Send(DATA,0x0d);
    ILI_Send(DATA,0x38);
    ILI_Send(DATA,0x3a);
    ILI_Send(DATA,0x1f);
    CS_ILI(1);

    CS_ILI(0);
    ILI_Send(COMMAND,0x11);   //sleep out
    delay_ms(100);
    CS_ILI(1);

    CS_ILI(0);
    ILI_Send(COMMAND,0x29);   //display on
    delay_ms(50);
    CS_ILI(1);
}
```

11 RELIABILITY TEST

NO.	TEST ITEM	TEST CONDITION	INSPECTION AFTER TEST
1	High Temperature Storage	80±2°C/96 hours	Inspection after 2~4 hours storage at room temperature and humidity. The condensation is not accepted. The sample shall be free from defects: 1. Air bubble in the LCD 2. Seal leak 3. Non-display 4. Missing segments 5. Glass crack
2	Low Temperature Storage	-30±2°C/96 hours	
3	High Temperature Operating	70±2°C/96 hours	
4	Low Temperature Operating	-20±2°C/96 hours	
5	Temperature Cycle	-30±2°C ~ 25~ 80± 2°C × 10 cycles (30 min.) (5min.) (30min.)	
6	Damp Proof Test	60°C ±5°C × 90%RH/96 hours	
7	Vibration Test	Frequency 10Hz~55Hz Stroke: 1.5mm Sweep: 10Hz~150 Hz~10Hz 2 hours For each direction of X, Y, Z	
8	Shock Test	Half-sine, wave, 300m/s	
9	Packing Drop Test	Height: 80 cm 1 corner, concrete floor	
11	Electrostatic Discharge Test	C=150pF, R=330 Ω Air: ±8KV 150pF/330Ω 30 times Contact: ±4KV,20 times	

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