



深圳市一众显示科技有限公司

SHEN ZHEN TEAM SOURCE DISPLAYTECH. CO, TD.

# TFT-LCD Module Specification

**Module NO.:** TST043WQHS-105

**Version:** V1.0

☐ APPROVAL FOR SPECIFICATION

☐ APPROVAL FOR SAMPLE

For Customer' s Acceptance:	
Approved by	Comment

TSD		
Presented by	Reviewed by	Approved by
Hcr	Aron	Aron

Version No.	Date	Content	Remark
V1.0	2021-5-26	Initial Release	

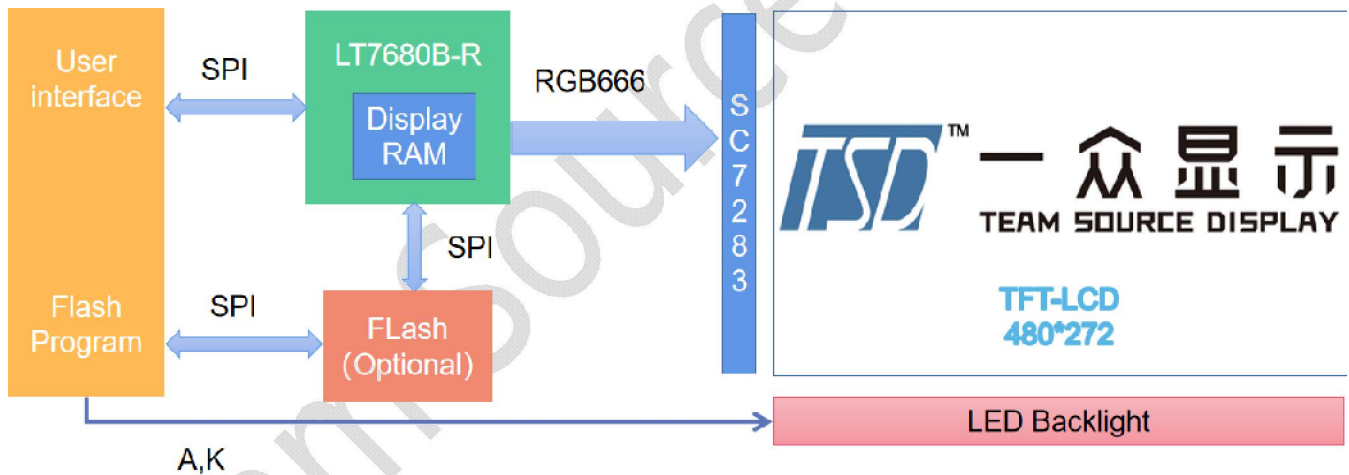
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## 1 Product feature

- **TST043WQHS-105** with a high-performance TFT-LCD graphics accelerated display chip—LT7680. Its main function is to assist MCU to display the contents of the TFT screen to the TFT Driver. It provides graphics acceleration, PIP (picture-in-picture), geometry graphics and other functions, in addition to enhance the display efficiency, also greatly reduces the MCU processing graphics display time spent.
- 4-wire SPI,support up to 50MHz transmit ;
- Embedded 128Mb Display RAM,Support Multiple Display Buffer;
- Embedded 8\*16, 12\*24, 16\*32 Character Sets of ISO/IEC 8859-1/2/4/5,and User-defined Characters Support Half Size & Full Size for 8\*16, 12\*24 and 16\*32(Need External Serial Flash );
- Provide DMA Function: Support Direct Data Transfer from External Serial Flash to Frame Buffer;
- Provide Smart Drawing Features: Line, Rectangle, Triangle, Polygon, Poly-Line, Circle, Ellipse, Arc, Rounded-Rectangle and Circle-Rectangle;
- Horizontal/Vertical Flip Display , Mirror and Rotation Functions are Available for Image Data Writes;
- Bit Block Transfer Engine (BTE);
- Other function please refer to LT768x Datasheet and Application Note.

## 2 Block Diagram



### 3 General Characteristics

ITEM	Specification	Unit
LCD Type	a-Si TFT, Transmissive, Normally black	-
LCD Size	4.3	inch
Resolution (W x H)	480(RGB) × 272	pixel
LCM size	105.4(H) x 67.1(V) x 2.9(T)	mm
Active Area	95.04 (H) x 53.86 V)	mm
Dot Pitch	0.198(H)x0.198(V)	mm
Viewing Direction	All o'clock	-
Gray Scale Inversion Direction	/	-
Color Depth	16.7M	-
Pixel Arrangement	RGB-stripe	-
Backlight Type	16 LED, 40mA	-
Surface Luminance	Min 900, Typ 1000	cd/m <sup>2</sup>
Surface Treatment	Hardness: 3H	-
Interface Type	SPI	-
Input Voltage	3.3	V
With/Without TP	Without	-
Weight	TBD	g

Note 1: RoHS compliant

Note 2: LCM weight tolerance: ± 5%.

## 4 Product drawings



## 5 Interface description

### 5.1 LCM interface description

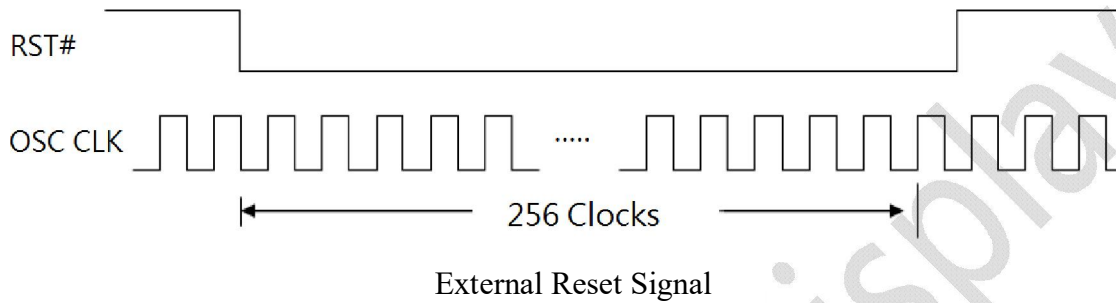
PIN NO.	Symbol	Description
1	LEDA	Backlight A Anode input pin.
2	LEDK	Backlight K Cathode input pin.
3	GND	System Ground. (0V)
4	GND	System Ground. (0V)
5	VDD	Power supply +3.3V
6	VDD	Power supply +3.3V
7	GND	System Ground. (0V)
8	DISP	Standby mode control. (Normally pull high) DISP="L", enter standby mode for power saving. Timing controller and source driver will turn off, all outputs are Hi-Z. DISP="H", normal operation.
9	L_RST	Reset Signal Input. This is a active low Reset pin for LT7680.
10	L_SPI_CS	Chip select pin for 4-wire serial I/F of the LT7680
11	L_SPI_MISO	Data output pin of 4-wire SPI I/F of the LT7680. Connect to MCU's
12	L_SPI_MOSI	Data input pin of 4-wire SPI I/F of the LT7680. Connect to MCU's
13	L_SPI_SCK	SPI Clock input. Clock of 4-wire SPI I/F of the LT7680 .
14	GND	System Ground. (0V)
15	F_CS	SPI Chip select pin for serial Flash device.(option)
16	F_DO	Data output of serial Flash device.(option)
17	F_CLK	Serial clock input for serial Flash device.(option)
18	F_DI	Data input of serial Flash device.(option)
19	GND	System Ground. (0V)
20	YU	The RTP PIN(option). NO connect
21	XL	
22	YD	
23	XR	
24	GND	System Ground. (0V)

## 6 Timing Characteristics

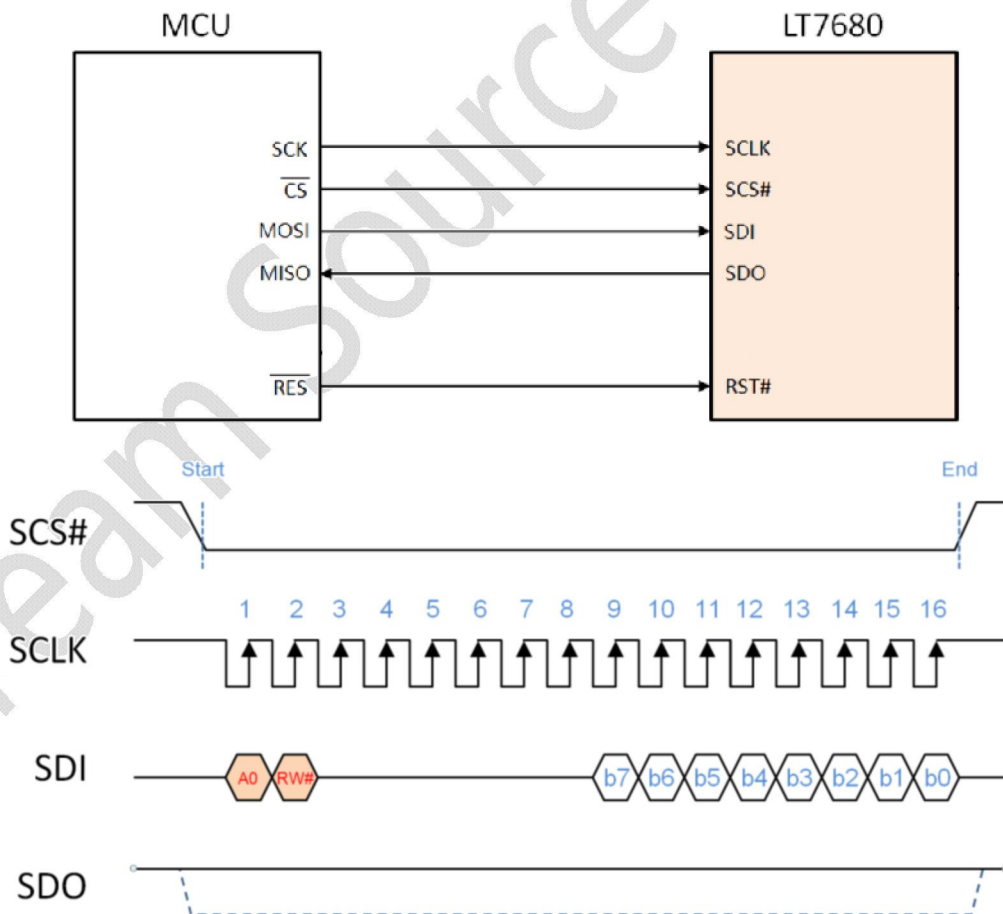
### 6.1 Rest timing

LT7680 has capability to receive external reset(RST#) event to synchronize with external system. The external reset event will be admitted when RST# keep low and stable at least 256 OSC clocks.

Before the start to access LT768x, Host should check it's Status Register(STSR) bit [1], i.e. operation mode status bit, and make sure it's in "Normal operation state".

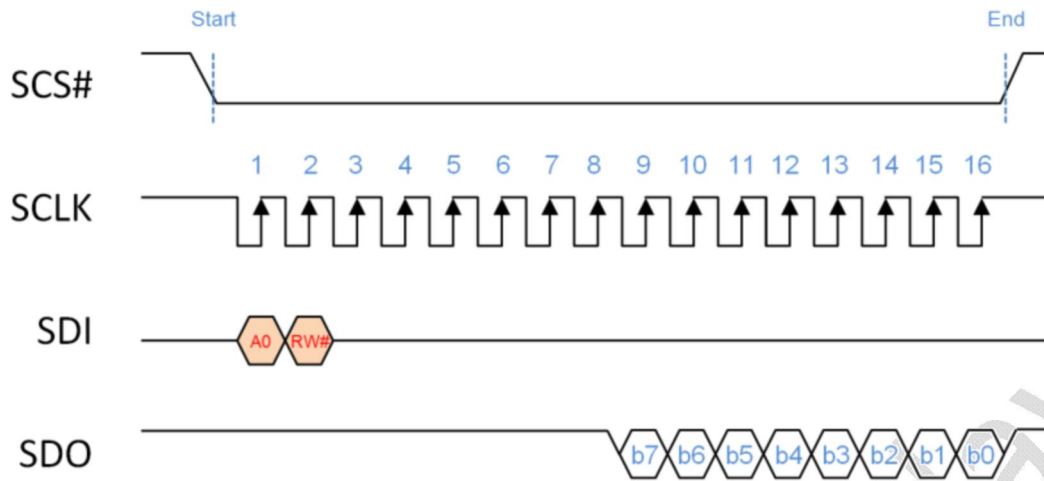


### 6.2 SPI timing



4-Wire SPI Interface Write Timing



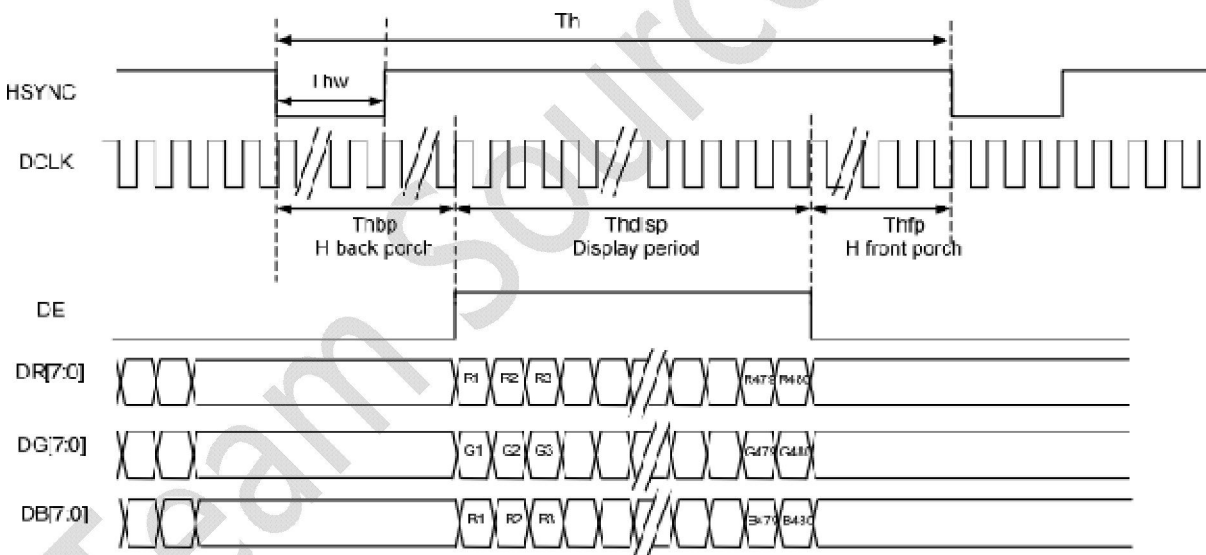


### 4-Wire SPI Interface Read Timing

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
<b>Serial Host Interface</b>						
CLK <sub>SPI</sub>	SPI Input Clock				50	MHz

## 6.3 LCD Panel RGB timing

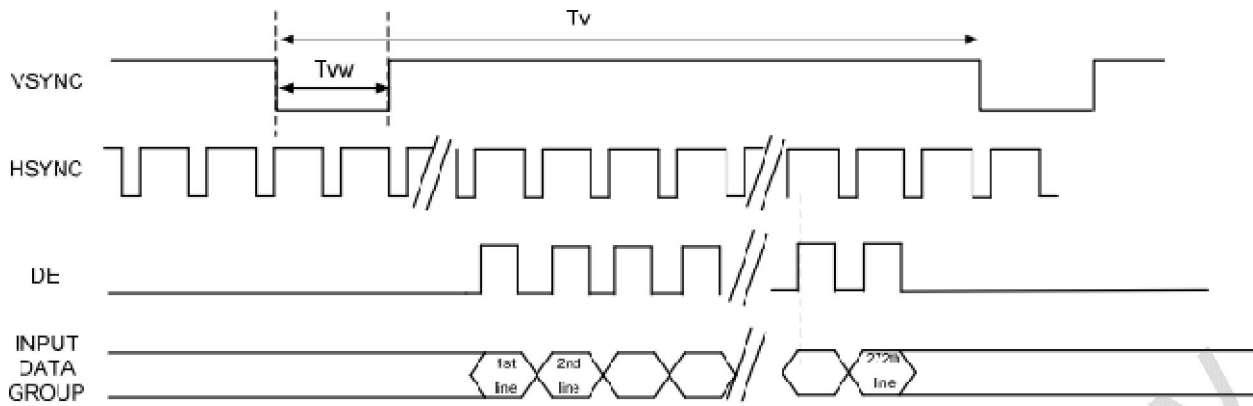
### DE Mode Timing Diagram



### Horizontal Input Timing

Parameter	Symbol	min	Typ.	max	Unit
Horizontal display area	tHD	-	480	-	CLKIN
CLKIN frequency	f <sub>clk</sub>	8	9	12	MHz
1 Horizontal line period	Th	485	531	598	CLKIN
HSD pulse width	Thw	2	4	43	
HSD back porch	Thbp	3	43	43	
HSD front porch	Thfp	2	8	75	





Vertical Input Timing

Parameter	Symbol	min	Typ.	max	Unit
Vertical display area	t <sub>VD</sub>	-	272	-	HSD
VSD period time	t <sub>v</sub>	276	292	321	
VSD pulse width	T <sub>VPW</sub>	2	4	12	
VSD back porch	t <sub>VBP</sub>	2	12	12	
VSD front porch	t <sub>VFP</sub>	2	8	37	

## 7 Absolute Maximum Ratings

PARAMETER	SYMBOL	MIN	MAX	UNIT
Supply Voltage (Analog)	VDD~GND	-0.3	4.0	V
Logic signal voltage(I/O)	IOVDD~GND	-0.3	4.0	V
Operating Temperature	TOP	-30	80	°C
Storage Temperature	TST	-30	80	°C
Humidity	RH	-	90%(Max 60°C)	RH

## 8 Electrical Characteristics

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
system operating voltage	VDD	3.0	3.3	3.6	V
Logic operating voltage	VDDI	3.0	3.3	VDD	
Input Voltage 'H' level	VIH	2	-	3.6	
Input Voltage 'L' level	VIL	-0.3	-	0.8	
Output Voltage 'H' level	VOH	2.4	-	-	
Output Voltage 'L' level	VOL	-	-	0.4	

## 9 Backlight Characteristics

ITEM	SYMBOL	MIN	TYP	MAX	UNIT
Voltage for LED backlight	V <sub>f</sub>	-	24.8	-	V
Current for LED backlight	I <sub>f</sub>	-	40	-	mA
Power consumption	W <sub>bl</sub>	-	992	-	mW
Uniformity	Avg	80	-	-	%
LED Life Time	-	30000	50000	-	Hrs

Note:

- 1.The LED life time is defined as the module brightness decrease to 50% original brightness at Ta=25°C, 60%RH ±5 %.
2. The life time of LED will be reduced if LED is driven by high current, high ambient temperature and humidity conditions.
3. Typical operating life time is an estimated data.
4. 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.

## 10 LCD Optical specifications

Item	Symbol	Condition	Specification			Unit	Remark
			Min	Typ	Max		
Response time (By Quick)	Tr+Tf	$\theta = 0^\circ$	-	30	40	ms	Note 5
Contrast ratio	CR	$\theta = 0^\circ$	640	800	-		Note 2,6
Luminance	Lu	$\theta = 0^\circ$	900	1000	-	cd/m <sup>2</sup>	
Viewing angle	Top	CR ≥ 10	70	80	-	Deg.	Note 2,6,7
	Bottom	CR ≥ 10	70	80	-		
	Left	CR ≥ 10	70	80	-		
	Right	CR ≥ 10	70	80	-		
Color Filter Chromaticity with C light	Wx	$\theta = 0^\circ$	Typ -0.03	0.325	Typ +0.03		Note 3
	Wy			0.361			
	Rx			0.610			
	Ry			0.341			
	Gx			0.359			
	Gy			0.598			
	Bx			0.151			
	By			0.108			
NTSC			45	50	%		Note 3

Note 1: Ambient temperature = 25°C.

Note 2: To be measured with a viewing cone of 2°by Topcon luminance meter BM-7.

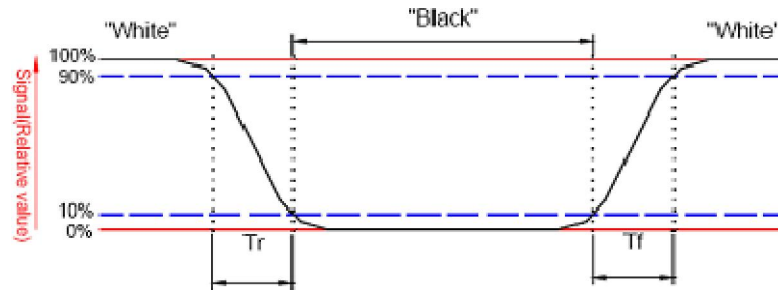
Note 3: To be measured with Otsuta chromaticity meter BM-7 .

Note 4: shipping status is cell without polarizer. Transmittance of Specification is cell with polarizer.

The tolerance of Transmittance is ±10%.

Note 5: Definition of response time:

The output signals of TRD-100 are measured when the input signals are changed to “White” (falling time) and from “White” to “Black” (rising time), respectively. The interval is between the 10% and 90% of amplitudes. Refer to figure as below.

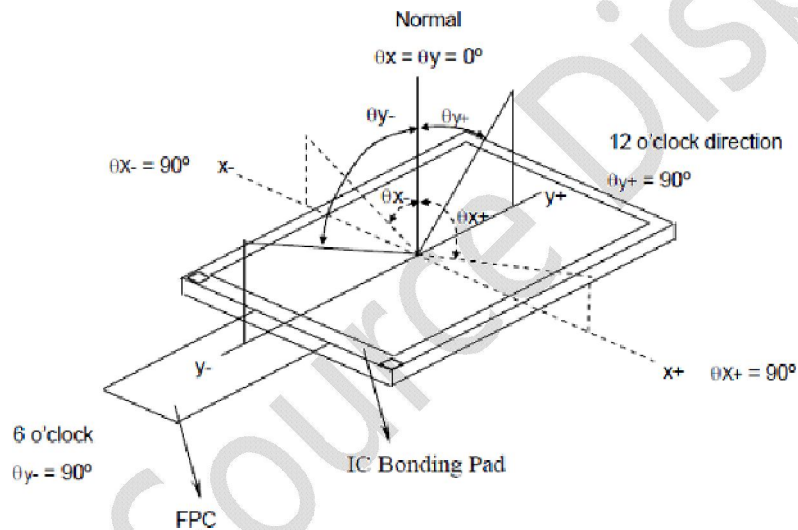


Note 6: Definition of contrast ratio:

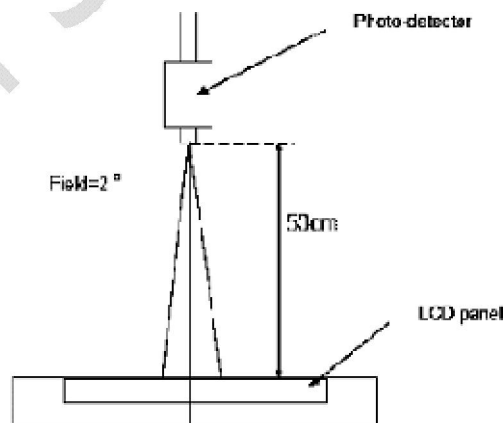
Contrast ratio is calculated by the following formula.

$$\text{Contrast ratio (CR)} = \frac{\text{Brightness on the "white" state}}{\text{Brightness on the "black" state}}$$

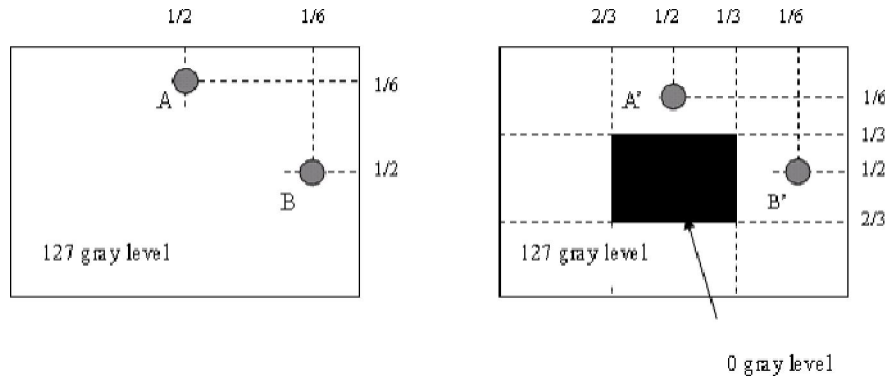
Note 7: Definition of viewing angle



Note 8: Optical characteristic measurement setup.



Note 9:



$1 \text{ LA-LA}' / \text{LA} \times 100\% = 2\% \text{ max.}$ , LA and LA' are brightness at location A and A'.

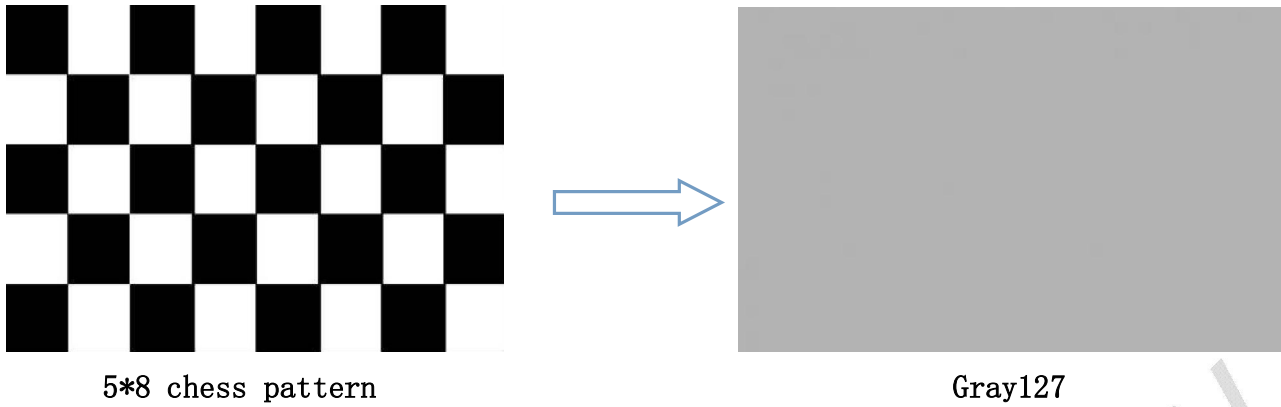
$1 \text{ LB-LB}' / \text{LB} \times 100\% = 2\% \text{ max.}$ , LB and LB' are brightness at location B and B'.

## 11 RELIABILITY TEST

### 11.1 Test condition

NO.	TEST ITEM	TEST CONDITION	INSPECTION AFTER TEST
1	High Temperature Storage	$80 \pm 2^\circ\text{C}/96 \text{ hours}$	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	$-30 \pm 2^\circ\text{C}/96 \text{ hours}$	
3	High Temperature Operating	$80 \pm 2^\circ\text{C}/96 \text{ hours}$	
4	Low Temperature Operating	$-30 \pm 2^\circ\text{C}/96 \text{ hours}$	
5	Temperature Cycle	$-30 \pm 2^\circ\text{C} \sim 25 \sim 80 \pm 2^\circ\text{C} \times 10 \text{ cycles}$ (30 min.) (5min.) (30min.)	
6	Damp Proof Test	$60^\circ\text{C} \pm 5^\circ\text{C} \times 90\% \text{RH}/96 \text{ hours}$	
7	Vibration Test	Frequency 10Hz~55Hz Stroke: 1.5mm Sweep: 10Hz~150 Hz~10Hz 2 hours For each direction of X, Y, Z	
8	Packing Drop Test	Height: 60 cm 1 corner, concrete floor	
9	Electrostatic Discharge Test	C=150pF, R=330 $\Omega$ Air: $\pm 8\text{KV}$ 150pF/330 $\Omega$ 9 times Contact: $\pm 4\text{KV}$ , 9 times	
10	Image Sticking	$25^\circ\text{C}, 60\% \text{RH}$ (ref.to Remark(1))/30 minutes	

**Remark (1):** Switch the image to Grey 127 after displaying the 5\*8 chess pattern for 30 minutes, the afterimage disappears within 10 seconds.



## 11.2 About Image Sticking

### 11.2.1 What is Image Sticking?

If you remain a fixed image on LCD Display for a long period of time, you may experience a phenomenon called Image Sticking. Image Sticking - sometimes also called “image retention” or “ghosting” - is a phenomenon where a faint outline of a previously displayed image remains visible on the screen when the image is changed. It can occur at variable levels of intensity depending on the specific image makeup, as well as the amount of time the core image elements are allowed to remain unchanged on the screen. In POS applications, for example, a button menu which remains fixed, or in which the “frame” elements (core image) remain fixed and the buttons may change, may be susceptible to image sticking. It is important to note that if the screen is used exclusively for this application, the user may never notice this phenomenon since the screen never displays other content. It is only when an image other than the “retained” image is shown on the screen that this issue becomes evident. Image sticking is different than the “burn-in” effect commonly associated with phosphor based devices.

### 11.2.2 What causes Image Sticking?

Image sticking is an intrinsic behavior of LCD displays due to the susceptibility to polarization of the interior materials (liquid crystals) when used under static, charged conditions (continuously displaying the same image). The individual liquid crystals in an LCD panel have unique electrical properties. Displaying a fixed pattern - such as the POS menu described above - over prolonged periods can cause a parasitic charge build-up (polarization) within the liquid crystals which affects the crystals’ optical properties and ultimately prevents the liquid crystal from returning to its normal, relaxed state when the pattern is finally changed. This effect takes place at a cellular level within the LCD, and the effect can cause charged crystal alignment at the bottom or top of a crystal cell in the “z” axis, or even crystal migration to the edges of a cell, again based on their polarity. These conditions can cause image sticking over an entire area, or at boundaries of distinct color change respectively. In either case, when the liquid crystals in the pixels and sub-pixels utilized to display the static image are polarized such that they can not return fully to their “relaxed” state upon deactivation, the result is a faint, visible, retained image on the panel upon presentation of a new, different image. The actual rate of image retention depends on variation factors such as the specific image, how long it is displayed unchanged, the temperature within the panel and even the specific panel brand due to manufacturing differences amongst panel manufacturers.

### 11.2.3 How to Avoid Image Sticking?

- Try not to operate the LCD with a “fixed” image on the screen for more than 1 hours.
- If you are operating the monitor in an elevated temperature environment and with a displayed image which is contrary to the recommendations in “For Software Developers” below, image stick can occur in as little as 30 minutes. Adjust your screen saver settings accordingly.
- Power down the unit during prolonged periods of inactivity such as the hours a store is closed or a shift during which the piece of equipment isn’t used.
- Use a screensaver with a black or medium gray background that is automatically set to come on if the device is inactive for more than 5-10 minutes.
- Avoid placing the monitor in poorly ventilated areas or in areas that will create excess heat around the monitor for software developers.
- In defining the icons, buttons, or windows in the screen, try to utilize block patterns instead of distinct lines as borders for dividing the display into distinct areas.
- If it is necessary to display a static image, try to use colors that are symmetric to the middle grey level at the boundary of two different colors, and slightly shift the borders line once in a while.
- Try to utilize medium gray hues for those areas that will have prolonged display times or remain static as other menu elements change.

### 11.2.4 How to Fix the Image Sticking?

Unlike the usually irreversible “burn-in” effects commonly associated with direct view phosphor display devices such as CRTs, an image retained on an LCD display can be reversed – often to a point of total invisibility. However, the severity of the underlying causes (as described above) of the image retained on a specific display, as well as the variation factors (see “For Software Developers” above) under which the retained image was created, will dictate the final level of retention reversal. One way to erase a retained image on a panel is to run the screen (monitor “on” ) in an “all black” pattern for 4-6 hours. It is also helpful to do this in an elevated temperature environment of approximately 35° to 50° C. Again, utilizing a dynamic screen saver with an all black background during prolonged idle display periods is a good way to avoid image retention issues.

### 11.2.5 Is Image Sticking Covered by TSD RMA Warranty?

Image sticking is a phenomenon inherent to LCD Display technology itself, and as such, the occurrence of this “ghosting” effect is considered normal operation by the manufacturers of the LCD display modules which are integrated into today’s monitor solutions. TSD does not warrant any display against the occurrence of image sticking. We strongly advise that you follow the operating recommendations listed above to avoid the occurrence of this phenomenon.

### 11.3 Others

1. Issues that are not defined in this document shall be discussed and agreed with both parties. (Customer and supplier)
2. Unless otherwise agreed upon in writing, the criteria shall be applied to both parties. (Customer and supplier)



## 12 Suggestions for using LCD modules

### 12.1 Handling of LCM

1. The LCD screen is made of glass. Don't give excessive external shock, or drop from a high place.
2. If the LCD screen is damaged and the liquid crystal leaks out, do not lick and swallow. When the liquid is attach to your hand, skin, cloth etc, wash it off by using soap and water thoroughly and immediately.
3. Don't apply excessive force on the surface of the LCM.
4. If the surface is contaminated, clean it with soft cloth. If the LCM is severely contaminated, use Isopropyl alcohol/Ethyl alcohol to clean. Other solvents may damage the polarizer. The following solvents is especially prohibited: water , ketone Aromatic solvents etc.
5. Exercise care to minimize corrosion of the electrode. Corrosion of the electrodes is accelerated by water droplets, moisture condensation or a current flow in a high-humidity environment.
6. Install the LCD Module by using the mounting holes. When mounting the LCD module make sure it is free of twisting, warping and distortion. In particular, do not forcibly pull or bend the I/O cable or the backlight cable.
7. Don't disassemble the LCM.
8. To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.
  - Be sure to ground the body when handling the LCD modules.
  - Tools required for assembling, such as soldering irons, must be properly grounded.
  - To reduce the amount of static electricity generated, do not conduct assembling and other work under dry conditions.
  - The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.
9. Do not alter, modify or change the the shape of the tab on the metal frame.
10. Do not make extra holes on the printed circuit board, modify its shape or change the positions of components to be attached.
11. Do not damage or modify the pattern writing on the printed circuit board.
12. Absolutely do not modify the zebra rubber strip (conductive rubber) or heat seal connector
13. Except for soldering the interface, do not make any alterations or modifications with a soldering iron.
14. Do not drop, bend or twist LCM.

### 12.2 Storage

1. Store in an ambient temperature of 5 to 45 °C, and in a relative humidity of 40% to 60%. Don't expose to sunlight or fluorescent light.
2. Storage in a clean environment, free from dust, active gas, and solvent.
3. Store in antistatic container.

## 13 Limited Warranty

1. Our warranty liability is limited to repair and/or replacement. We will not be responsible for any consequential loss.
2. If possible, we suggest customer to use up all LCD modules as soon as possible. If the LCD module storage time over twelve months, we suggest to recheck it before being used.
3. Any product issues must be feedback to TSD within 12 months since delivery, otherwise, we will not be responsible for the subsequent or consequential events.



## 14 Additional information

- **LT768x Datasheet (English);**
- **LT768x Application Note (English);**
- **LT768\_Lib\_V1.3.rar (General C library);**
- **STM32F407 Demo Project;**
- **LT768x\_Arduino library.**