深圳市一众显示科技有限公司

SHEN ZHEN TEAM SOURCE DISPLAY TECH. CO, TD.

TFT-LCD Module Specification

Module NO.：TST024QVHS-31

Version： V1.1

☐ **APPROVAL FOR SPECIFICATION**   ☐ **APPROVAL FOR SAMPLE**

For Customer's Acceptance：	
Approved by	**Comment**
	Distributed by:

Team Source Display：		
Presented by	**Reviewed by**	**Organized by**

Version No.	Date	Content	Remark
V1.0	2019-07-08	Initial Release	
V1.1	2021-08-17	Update absolute maximum rating	

CONTENTS

1   General Characteristics

ITEM	Specification	Unit
LCD Type	a-Si TFT,Transmissive,Normally black,IPS	-
LCD Size	2.4	inch
Resolution (W x H)	240 x (RGB) × 320	pixel
LCM (W × H × D)	42.72W) x 60.26(H) x 2.3(D)	mm
Active Area (W × H)	36.72 (W) x 48.96 (H)	mm
Dot Pitch (W × H)	0.051 (W) x 0.153 (H)	mm
Viewing Direction	Free	-
Color Depth	65K/262K	-
Pixel Arrangement	RGB Vertical stripe	-
Backlight Type	4 LEDs	-
Surface Luminance	400	cd/m2
Surface Treatment	Anti-glare	-
Driver IC	ST7789V	-
Interface Type	MCU/SPI/SRI+RGB	-
Input Voltage	2.8	V
With/Without TP	without	-
Weight	TBD.	g

Note 1: RoHS compliant

Note 2: LCM weight tolerance: ± 5%.

2 Product drawings

Specifications table (left side, rotated):

Parameter	Value
LCD Type	2.4″TFT, Transmissive, Normally black, IPS
Resolution	240(RGB)*320
View Direction	Free
Driver IC	ST7789V
Color Depth	65K
Interface Types	MCU/SPI/SRI+RGB
Operating voltage	2.8V
TP/Lens	Without
Backlight LEDs	4 LEDs, 20mA,12.4V
Surface luminance	400 cd/m²
Operating temperature	-20 ℃~70 ℃
Storage Temperature	-30 ℃~80 ℃
Storage Humidity	60℃ 90% max

"✎" Need to pay attention to the key size with *

Backlight circuit
20mA, 11.6-12.4V

Change History (变更记录):

版本(Version)	变更记录(Change History)	日期(Date)
A0	New issue	
A1		
A2		

视 角(View):	⊕
单 位 (Unit):	M M
产品型号 (Product Type):	TST024QVHS-31
图纸版本 (Version):	A0
页 面 (Page):	
比例(Proportion):	1 : 1
设 计(DESIGN):	Bill 2019.5.30
审 核(AUDITING):	Aron 2019.5.30
批 准(APPROVED):	

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DONG GUAN TEAM SOURCE DISPLAY TECH. CO. LTD.

- Select the MCU interface mode

IM3	IM2	IM1	IM0	MCU-Interface Mode	DB Pin in use Register/Content	GRAM
0	0	0	0	80 MCU 8-bit bus interface Ⅰ	D[7:0]	D[7:0]
0	0	0	1	80 MCU 16-bit bus interface Ⅰ	D[7:0]	D[15:0]
0	0	1	0	80 MCU 9-bit bus interface Ⅰ	D[7:0]	D[8:0]
0	0	1	1	80 MCU 18-bit bus interface Ⅰ	D[7:0]	D[17:0]
0	1	0	1	3-wire 9-bit data serial interface Ⅰ		SDA: In/OUT
0	1	1	0	4-wire 8-bit data serial interface Ⅰ		SDA: In/OUT
1	0	0	0	80 MCU 16-bit bus interface Ⅱ	D[8:1]	D[17:10], D[8:1]
1	0	0	1	80 MCU 8-bit bus interface Ⅱ	D[17:10]	D[17:10]
1	0	1	0	80 MCU 18-bit bus interface Ⅱ	D[8:1]	D[17:0]
1	0	1	1	80 MCU 9-bit bus interface Ⅱ	D[17:10]	D[17:9]
1	1	0	1	3-wire 9-bit data serial interface Ⅱ		SDI: In SDO: Out
1	1	1	0	4-wire 8-bit data serial interface Ⅱ		SDI: In SDO: Out

MPU Parallel interface bus and serial interface select
If use RGB Interface must select serial interface.
* : Fix this pin at VDDI or VSS.

FPC Bend and pack in bags

TST024QVHS-31

Pin assignment:

PIN	DESCRIPTION
1	NC
2	IM0
3	IM1
4	IM2
5	IM3
6	RESET
7	VSYNC
8	HSYNC
9	DOTCLK
10	ENABLE
11	DB17
12	DB16
13	DB15
14	DB14
15	DB13
16	DB12
17	DB11
18	DB10
19	DB9
20	DB8
21	DB7
22	DB6
23	DB5
24	DB4
25	DB3
26	DB2
27	DB1
28	DB0
29	SDI
30	SDO
31	RD
32	WR/RS
33	RS/SCL
34	CS
35	FMARK
36	VCC
37	VCC
38	GND
39	GND
40	LED-K
41	LED-A
42	XRKNC)
43	YDKNC)
44	XL(NC)
45	YU(NC)

3 Interface description

PIN NO.	Symbol	description
1	NC	No Connect
2-5	IM0-IM3	Interface select
6	RESET	Reset input signal
7	VSYNC	Vertical sync signal
8	HSYNC	Horizontal sync signal
9	DOTCLK	Pixel clock
10	ENABLE	Data enable
11-28	DB17-DB0	Data BUS
29	SDO	Serial data output
30	SDI	Serial data input
31	RD	Read signal
32	RS/SCL	Data/Command selection pin
33	WR	Write signal
34	CS	Chip select signal
35	FMARK	Tearing effect output signal
36-37	VCC	Power supply +2.8V
38-39	GND	System Ground
40	LED-A	Backlight A Anode input pin
41	LED-K	Backlight K Cathode input pin
42	XR/NC	No Connect
43	YD/NC	No Connect
44	XL/NC	No Connect
45	YU/NC	No Connect

Note: "0"connect to GND; "1"connect to IOVCC.

4 LCM Interface Timing

4.1 Reset Timing
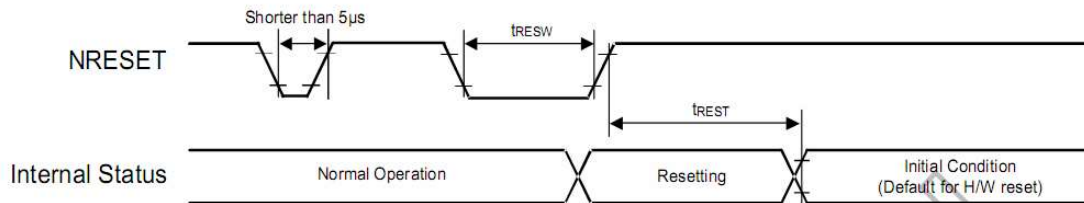
Signal	Symbol	Parameter	Min	Max	Unit
NRESET	tRESW	Reset low pulse width	10	-	us
	tREST	Reset complete time	5 (note 1)	-	ms
			120(note 2)	-	ms

Note: (1) When reset applied during SLPIN mode;

(2) When reset applied during SLPOUT mode.

4.2 MCU Read/Write Timing
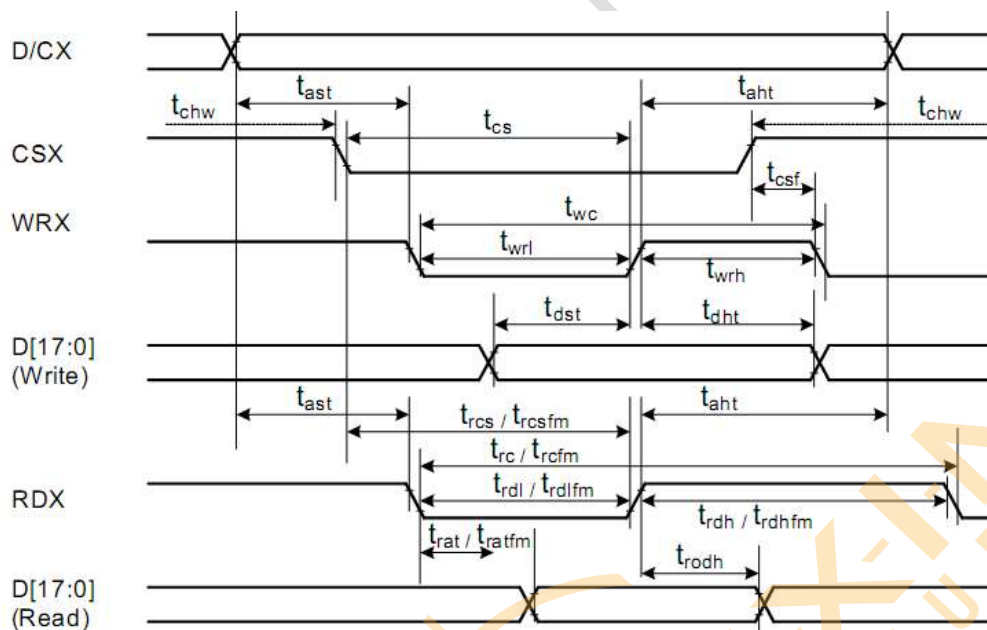
(VSSA=0V, VDD1=1.8V, VDD3=2.8V, TA=25°C)

Signal	Symbol	Parameter	Min.	Max.	Unit	Description
DCX	tAST	Address setup time	0	-	ns	-
	tAHT	Address hold time (Write/Read)	0	-		
CSX	tCS	Chip select setup time (Write)	15	-	ns	-
	tRCS	Chip select setup time (Read register)	45	-		
	tRCSFM	Chip select setup time (GRAM)	355	-		
	tCSF	Chip select wait time (Write/Read)	10	-		
WRX	tWC	Write cycle (write register)	66	-	ns	-

	tWRH	Control pulse "H" duration	15	-		
	tWRL	Control pulse "L" duration	15	-		
RDX	tRC	Read cycle (read register)	160	-	ns	-
	tRC	Read cycle (GRAM)	450	-		
	tRDH	Control pulse "H" duration	90	-		
	tRDL	Control pulse "L" duration(read register)	45	-		
	tRDL	Control pulse "L" duration(GRAM)	355	-		
DB[23:0]	tDST	Data setup time	10	-	ns	For maximum CL=30pF For minimum CL=8pF
	tDHT	Data hold time	10	-		
	tRAT	Read access time(read register)	-	40		
	tRAT	Read access time(GRAM)	-	340		
	tODH	Output disable time	20	80		

Note: The input signal rise time and fall time (tr, tf) is specified at 15 ns or less.

Logic high and low levels are specified as 30% and 70% of VDD1 for Input signals.
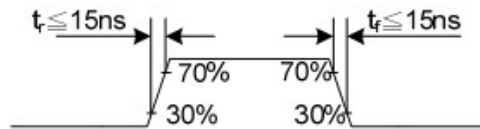
5   Absolute Maximum Ratings

PARAMETER	SYMBOL	MIN	MAX	UNIT
Supply Voltage (Analog)	VCC~GND	-0.3	4.6	V
Logic signal voltage(I/O)	IOVCC~GND	-0.3	4.6	V
Operating Temperature	TOP	-20	70	°C
Storage Temperature	TST	-30	80	°C
Humidity	RH	-	90%(Max 60°C)	RH

6   Electrical   Characteristics

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
Analog operating voltage	VCC	2.4	2.8	3.3	V
Logic operating voltage	IOVCC	1.65	1.8	3.3	V
Input Current	IDD	-	TBD	-	mA
Input Voltage ' H ' level	VIH	0.7IOVCC	-	IOVCC	
Input Voltage ' L ' level	VIL	GND	-	0.3IOVCC	V
Output Voltage ' H ' level	VOH	0.8IOVCC	-	IOVCC	
Output Voltage ' L ' level	VOL	GND	-	0.2IOVCC	

7   Backlight   Characteristics

ITEM	SYMBOL	MIN	TYP	MAX	UNIT
Voltage for LED backlight	V_f	-	12	12.4	V
Current for LED backlight	I_f	-	20	-	mA
Power consumption	Wbl	-	240	-	mW

Uniformity	Avg	80	-	-	%
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, 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.

8 LCD Optical specifications

Item	Symbol	Condition	Specification			Unit	Remark
			Min.	Typ.	Max.		
Response time (By Quick)	Tr+Tf	θ = 0°	-	35	-	ms	Note 5
Contrast ratio	CR	θ = 0°	-	800	-		Note 2,6
Viewing angle	Top	CR≧10	-	80	-	Deg.	Note 2,6,7
	Bottom	CR≧10	-	80	-		
	Left	CR≧10	-	80	-		
	Right	CR≧10	-	80	-		
Color chromaticity (CF only with ITO, light source is C light, CIE 1931)	Wx	θ = 0°	0.290	0.310	0.330		Note 3
	Wy		0.316	0.336	0.356		
	Rx		0.627	0.647	0.667		
	Ry		0.297	0.317	0.337		
	Gx		0.255	0.275	0.295		
	Gy		0.562	0.582	0.602		
	Bx		0.120	0.140	0.160		
	By		0.068	0.088	0.108		
NTSC				60%			Note 3
Transmittance (with Polarizer)	T(%)	θ = 0°	-	4.65	-	%	

Note 1: Ambient temperature = 25°C.

Note 2: To be measured with a viewing cone of 2°by Topcon luminance meter BM-5A.

Note 3: To be measured with Otsuta chromaticity meter LCF-2100M, CF only measure under C light simulation.

Note 4: CTC 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.
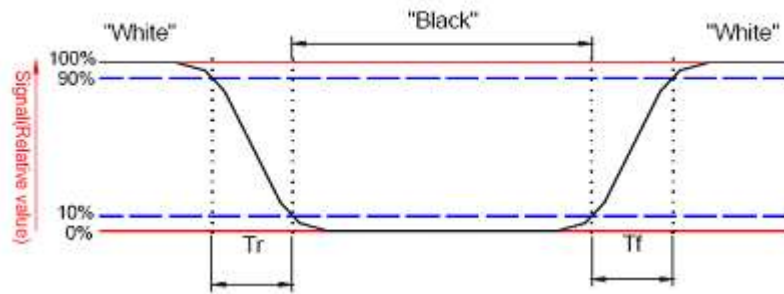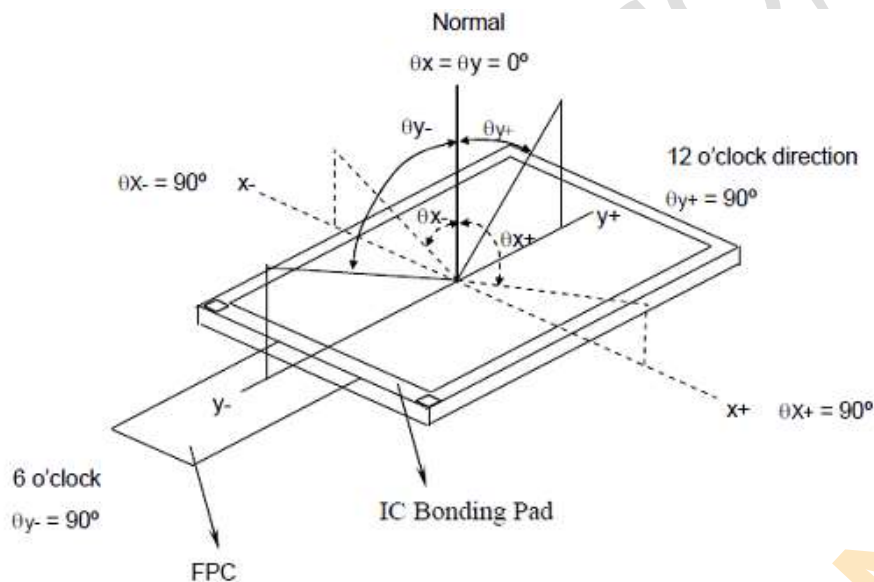
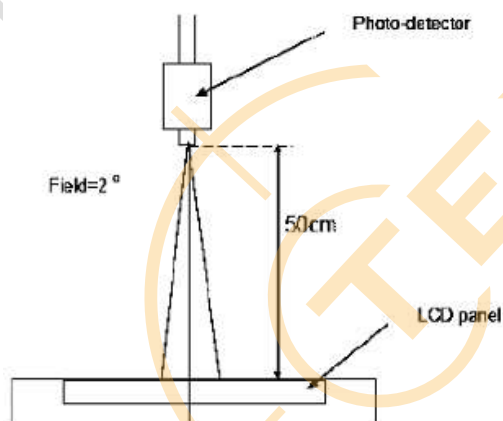Note 6: Definition of contrast ratio:

Contrast ratio is calculated by the following formula.

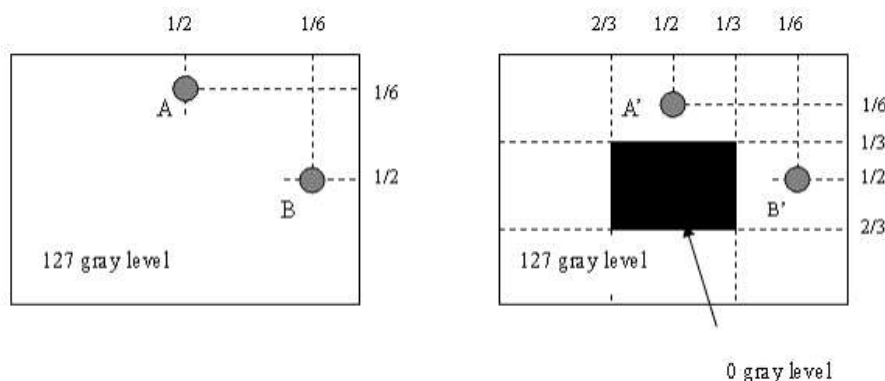$$\text{Contrast ratio (CR)} = \frac{\text{Brightness on the "white" state}}{\text{Brightness on the "black" state}}$$

Note 7: Definition of viewing angle

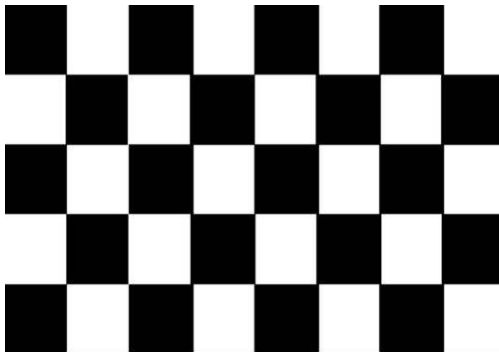Note 8: Optical characteristic measurement setup.

Note 9:

l LA-LA'l / LA x 100%= 2% max., LA and LA' are brightness at location A and A'.

l LB-LB'l / LB x 100%= 2% max., LB and LB' are brightness at location B and B'.

9   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	
10	Electrostatic Discharge Test	C=150pF, R=330 Ω Air: ±8KV 150pF/330Ω 30 times Contact: ±4KV,20 times	
11	Image Sticking	25℃,60%RH (ref.to Remark(1))	30mins

`5*8 chess pattern`

10 Image Sticking

10.1 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 that the "burn-in" effect commonly associated with phosphor based devices.

10.2 What cause 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.

10.3 How to avoid image sticking?

- Try not to operate the LCD with a "fixed" image on the screen for more than 2 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.

10.4 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 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 35º to 50ºC. 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.

10.5 Is image sticking covered by TSD 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.

10.6 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)

11 Suggestions for using LCD modules

11.1 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.

11.2 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.

12 Limited Warranty

12.1

Our warranty liability is limited to repair and/or replacement. We will not be responsible for any consequential loss.

12.2

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.

12.3

Any product issues must be feedback to TSD within twelve months since delivery,   otherwise, we will not be responsible for the subsequent or consequential events.

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Please contact us if you have any questions about the contents of the datasheet.

This may not be the latest version of the datasheet. Please check with us if a later version is available.

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