



一众显示科技有限公司

TEAM SOURCE DISPLAY TECH. CO, LTD.

# TFT-LCD Module Specification

**Module NO.:** ProLCD-T035N01

**Version:** V1.0

APPROVAL FOR SPECIFICATION

APPROVAL FOR SAMPLE

<b>For Customer' s Acceptance:</b>	
<b>Approved by</b>	<b>Comment</b>

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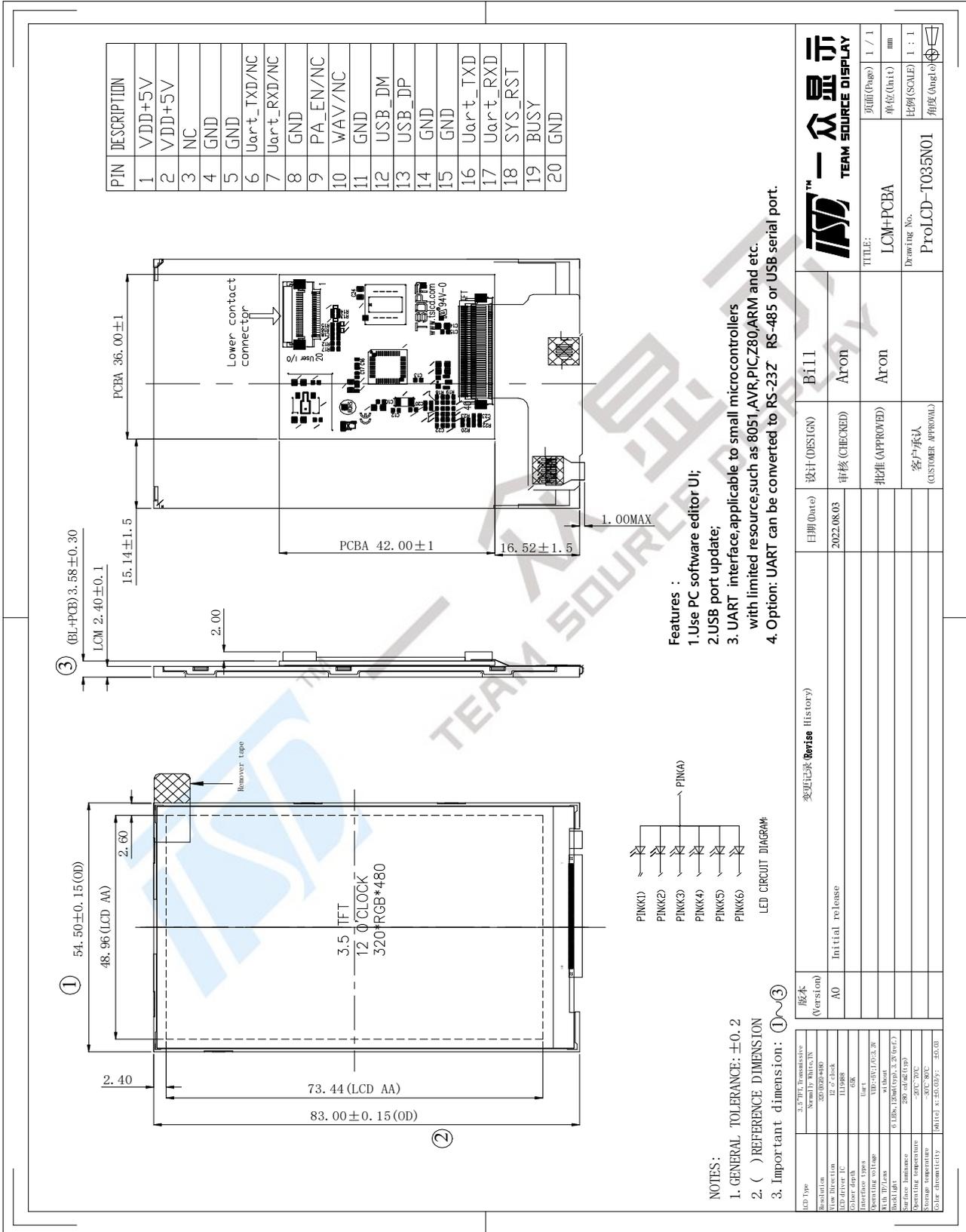
## 1 General Characteristics

ITEM	Specification	Unit
LCD Type	a-Si TFT,Transmissive,Normally white,TN	-
LCD Size	3.5	inch
Resolution (W x H)	320x (RGB) × 480	pixel
LCM size	54.5(H) x 83.0(V) x2.4(T)	mm
Active Area	48.96 (H) x 73.44 (V)	mm
Dot Pitch	0.0502(H) × 0.1432(V)	mm
Viewing Direction	12 o'clock	-
Color Depth	65K	-
Pixel Arrangement	RGB-stripe	-
Backlight Type	6 leds, 120mA, 3.2V	-
Surface Luminance	280TYP	cd/m <sup>2</sup>
Surface Treatment	-	-
LCD Driver IC	ILI9488	-
Interface Type	Uart	-
Input Voltage	5	V
With/Without TP	Without	-
Weight	TBD	g

**Note 1: RoHS compliant**

**Note 2: LCM weight tolerance: ± 5%.**

## 2 Product drawings



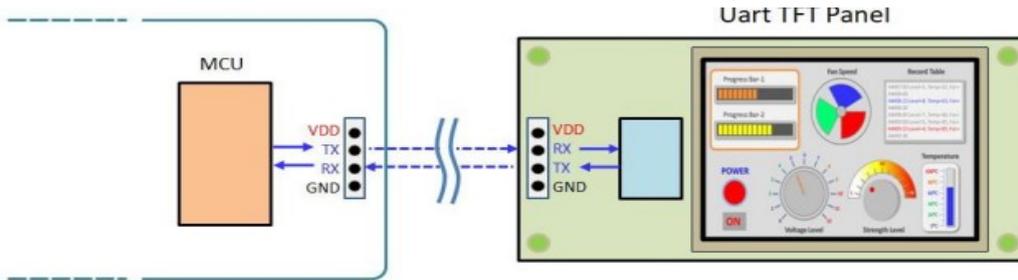
### 3 Interface description

PIN NO.	Symbol	description
1~2	VDD+5V	Power voltage +5V
3	NC	No connect
4~5	GND	Power ground
6~7	NC	No connect
8	GND	Power ground
9	NC	No connect
10	NC	No connect
11	GND	Power ground
12	USB_DM	This is the signal of USB data terminal DM. It can be updated via USB interface MCU program and external SPI Flash data.
13	USB_DP	This is the signal of USB data terminal DP. It can be updated via USB interface MCU program and external SPI Flash data.
14~15	GND	Power ground
16	Uart_TXD	This is the data output port of the Uart serial communication interface, which is used to transmit command signals to the master RX of control terminal MCU
17	Uart_RXD	This is the data input port of the Uart serial communication interface, which is used to receive the TX sends command signal.
18	SYS_RST	Global reset pin
19	BUS	This pin is the busy status output of the serial port screen, and the master control terminal can know whether the serial port screen is No is busy.
20	GND	Power ground

## 4 Application Circuit

Serial Uart interface panel is added MCU and TFT controller on the TFT display module, the MCU is responsible for receiving from the remote mainboard interface port (Uart) command, then based on the defined commands to show images or animations, remote motherboard MCU don't need to write complex applications for showing images.

TFT Panel and remote MCU mainly communicate through RS232 or RS485 interface. If the distance between the remote MCU and TFT Panel is very close (~30cm), the Uart output and input of the remote MCU can be directly connected to the TFT panel, as shown in the following diagram:



## 5 Software User Guide

In order to enable the remote system or motherboard to easily display images or information on the TFT panel through serial ports such as UART and SPI, a instruction set is planned on the TFT panel of MCU, and the TFT panel is changed through the defined command codes.

### 5.1 Command table

Function	Detail	Command code(1 Byte)
Pictures	Single/Multiple	80h,8Ah,8Fh
	Loop display	81h,84h
	Gif	88h,89h
	Pop-up	D8h
Button	Single icon	A0h,A1h
	Virtual area	A2h,A3h
	Slide	B4h
Drawing	Progress bar	B0h
	Pointer	B1h
	Arc	DCh
	QR code	98h
	Cursor	86h,87h
Font		C0h,C1h,C2h,C3h
Backlight	Set backlight	BAh
Advanced features		Refer to command list SPEC

### 5.2 MCU send one command

Start code	Command code	Command number	Parameters	CRC	End code
0XAA	1 Byte	1 Byte	n Byte	2 Byte	0xE4, 0x1B, 0x11, 0xEE

### 5.3 UI editor

UI\_Editor.exe is a visual UI compiler provided by TSD. Its function is to package images, text, configuration data and other information to be used by the UI to generate BIN files according to customer requirements. Customers can use UI\_Editor to make UI easily and quickly.

Notice: UI\_Editor is written in the environment of Microsoft.net Framework 4.6.2, so the computer system must be installed with Microsoft.net Framework 4.6.2 to work properly.

The interface for UI\_Editor consists of various buttons and screen frame, as shown below:



## 6 Electrical Characteristics

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
Analog operating voltage	VDD+5V	4.8	5	7.5	V
Logic operating voltage	-	-	3.3	-	
Input Voltage ' H ' level	VIH	0.7VDDI	-	VDDI	
Input Voltage ' L ' level	VIL	GND	-	0.3VDDI	
Output Voltage ' H ' level	VOH	VDDI-0.4	-	VDDI	
Output Voltage ' L ' level	VOL	GND	-	GND+0.4	

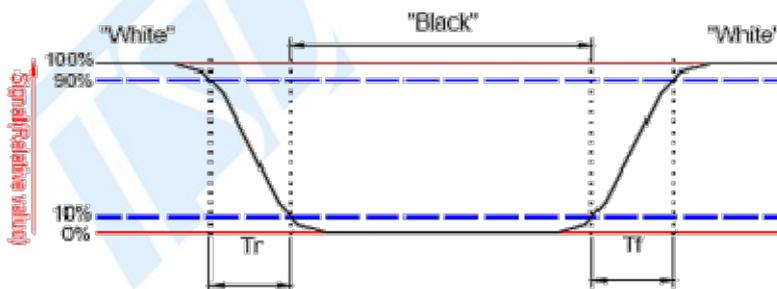
## 7 LCD Optical specifications

Item	Symbol	Condition	Specification			Unit	Remark
			Min	Typ	Max		
Response time (By Quick)	Tr+Tf	-	-	20	40	ms	Note 2
Contrast ratio	CR	-	-	500	-	-	Note 3
Surface luminance	Lv	$\theta=0^\circ$	-	280	-	cd/m <sup>2</sup>	Note 4
Luminance uniformity	Yu	$\theta=0^\circ$	80	-	-	%	Note 6
NTSC	-	$\theta=0^\circ$	57	60	-	%	Note 6
Viewing angle	Top	$CR \geq 10$	-	25	-	Deg.	Note 7
	Bottom	$CR \geq 10$	-	50	-		
	Left	$CR \geq 10$	-	60	-		
	Right	$CR \geq 10$	-	60	-		
CIE(x,y) chromaticity	Wx	$\theta=0^\circ$	Typ -0.04	0.302	Typ +0.04		Note 5
	Wy			0.338			
	Rx			0.612			
	Ry			0.337			
	Gx			0.344			
	Gy			0.598			
	Bx			0.150			
	By			0.102			

Note 1: Ambient temperature = 25°C.

Note 2: 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 3: Definition of contrast ratio:

Contrast ratio is calculated by the following formula.

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

Measured at the center area of the LCD.

Note 4: Definition of surface luminance

Surface luminance is the luminance with all pixels displaying white

Note 5: For contrast ratio, Surface Luminance, Luminance uniformity and CIE,the testing data is base on TOPCON' s BM-7 photo detector or compatible.

Size :  $S \leq 4.3''$  (see Figure A B)

H,V : Active area

Light spot size=7.7mm (BM-7)50cm distance or compatible distance from the LCD surface to detector lens.

test spot position : see Figure B.

measurement instrument : TOPCON' s luminance meter BM-7 or compatible.

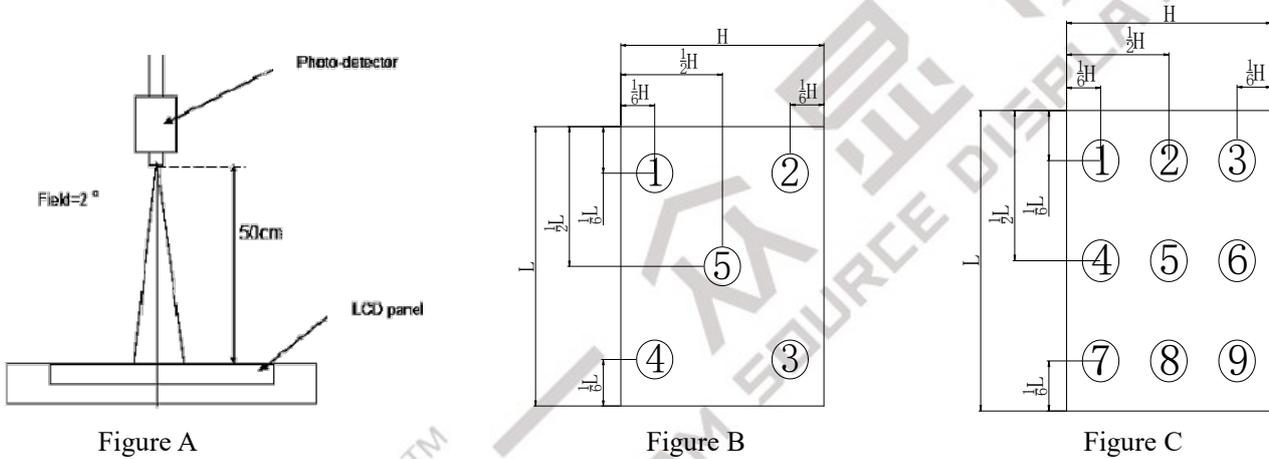
Size :  $4.3 < S \leq 12.3''$  (see Figure A C)

H,V : Active area

Light spot size=7.7mm (BM-7)50cm distance or compatible distance from the LCD surface to detector lens.

test spot position : see Figure C.

measurement instrument : TOPCON' s luminance meter BM-7 or compatible.



Note 6:Definition of Luminance Uniformity

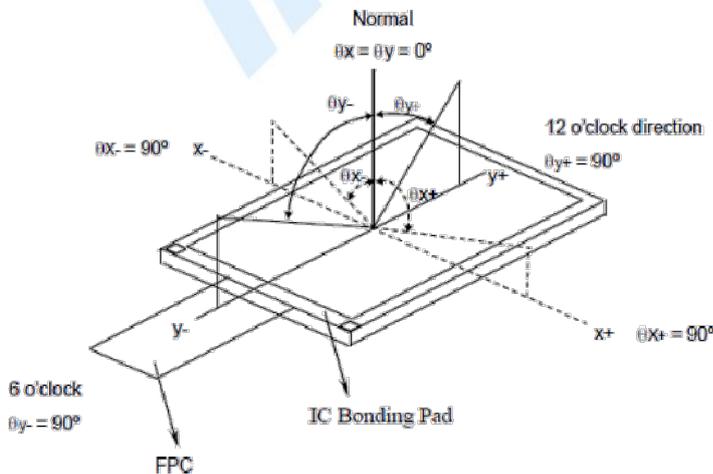
Active area is divided into 5 or 9 measuring areas,Every measuring point is placed at the center of each measuring area

Bmax: The measured maximum luminance of all measurement position.

Bmin: The measured minimum luminance of all measurement position.

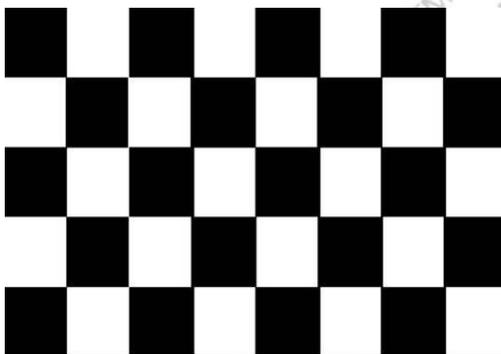
**Luminance Uniformity (Yu)= (Bmin/Bmax)x100%**

Note 7: Definition of viewing angle



## 8 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	-20±2°C ~ 25~ 70± 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	Packing Drop Test	Height: 50 cm 1 corner, concrete floor	
9	Electrostatic Discharge Test	C=150pF, R=330 Ω Air: ±8KV 150pF/330Ω 30 times Contact: ±4KV,20 times	
10	Image Sticking	25°C, 60%RH (ref. to Remark(1))	



5\*8 chess pattern

## 9 Image Sticking

### 9.1 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.

## 9.2 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.

## 9.3 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.

## 9.4 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 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.

## 9.5 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.

## 9.6 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)

## 10 Suggestions for using LCD modules

### 10.1 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.

## 10.2 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.

## 11 Limited Warranty

### 11.1

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

### 11.2

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.

### 11.3

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.