SPECIFICATION

VXT021MCSA-02

☐ Preliminary Specification

☐ Final Specification

Approved By:
Date:

RECORD OF REVISION

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V00	2024/12/4		New issue.	Solon

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1. Scope

This specification defines general provisions as well as inspection standards for TFT module supplied by Victronix.

If the event of unforeseen problem or unspecified items may occur, naturally shall negotiate and agree to solution.
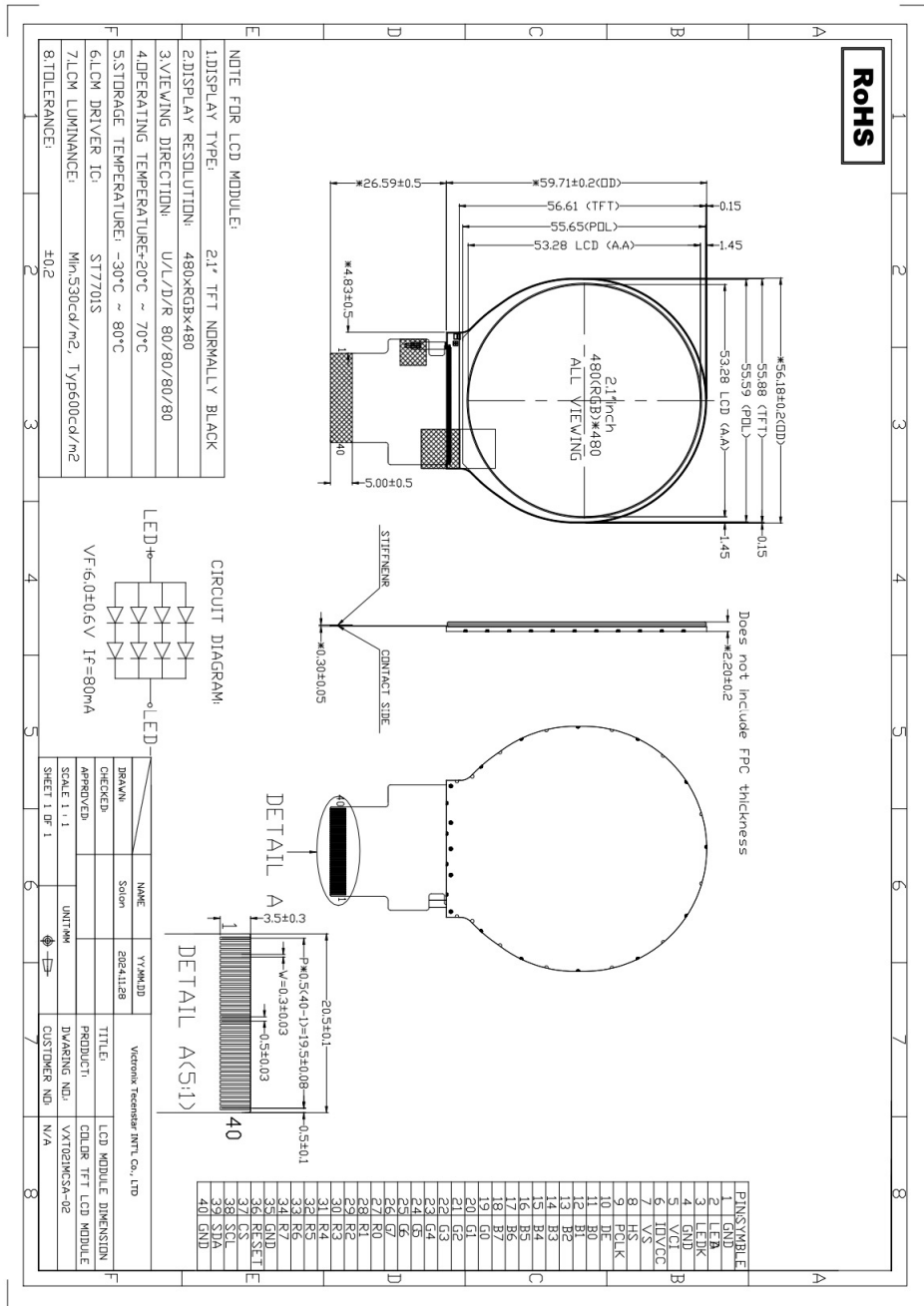
2. General Specifications

2.1 LCD Parameter

Item	Contents	Unit	Note
LCD Type	TFT	-	
Display color	16.7M		
Viewing Direction	ALL	O'Clock	
Operating temperature	-20~+70	℃	
Storage temperature	-30~+80	℃	
Module size	2.1	inch	
Active Area(W×H)	53.28x53.28	mm	
Number of Dots	480x480	dots	
Controller	ST7701S	-	
Power Supply Voltage	3.3	V	
Outline Dimensions	56.18x59.71x2.2	mm	
Backlight	2X4-LEDs (white)	pcs	
Weight	---	g	
Interface	RGB	-	

Note 1:   Color tune is slightly changed by temperature and driving voltage.

Note 2:   Without FPC and Solder.

3.Outline Drawing

RoHS

NOTE FOR LCD MODULE:
1.DISPLAY TYPE: 2.1" TFT NORMALLY BLACK
2.DISPLAY RESOLUTION: 480×RGB×480
3.VIEWING DIRECTION: U/L/D/R 80/80/80/80
4.OPERATING TEMPERATURE:-20°C ～ 70°C
5.STORAGE TEMPERATURE: -30°C ～ 80°C
6.LCM DRIVER IC: ST7701S
7.LCM LUMINANCE: Min.530cd/m2, Typ600cd/m2
8.TOLERANCE: ±0.2

CIRCUIT DIAGRAM:
LED+ LED-
VF:6.0±0.6V IF=80mA

2.1inch
480(RGB)×480
ALL VIEWING

26.59±0.5
59.71±0.2(OD)
56.61 (TFT)
55.65(POL)
53.28 LCD (A.A)
4.83±0.5
5.00±0.5
56.18±0.2(OD)
55.88 (TFT)
55.59 (POL)
53.28 LCD (A.A)
0.15
1.45
1.45
0.15

STIFFNENR
CONTACT SIDE
0.30±0.05
2.20±0.2
Does not include FPC thickness

DETAIL A
DETAIL A(5:1)
3.5±0.3
20.5±0.1
P=0.54(40-1)=19.5±0.08
W=0.3±0.03
0.5±0.03
0.5±0.1
40

DRAWN:
CHECKED:
APPROVED:
SCALE 1:1
SHEET 1 OF 1
NAME
Salon
YY.MM.DD
2024.11.28
UNIT:MM
Victronix Tecenstar INT'L Co., LTD
TITLE: LCD MODULE DIMENSION
PRODUCT: COLOR TFT LCD MODULE
DWARING NO.: VXT021MCSA-02
CUSTOMER NO. N/A

PIN	SYMBLE
1	GND
2	LEDA
3	LEDK
4	GND
5	VCI
6	IOVCC
7	VS
8	HS
9	DE
10	PCLK
11	B0
12	B1
13	B2
14	B3
15	B4
16	B5
17	B6
18	B7
19	G0
20	G1
21	G2
22	G3
23	G4
24	G5
25	G6
26	G7
27	R0
28	R1
29	R2
30	R3
31	R4
32	R5
33	R6
34	R7
35	GND
36	RESET
37	CS
38	SCL
39	SDA
40	GND

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4.Interface Description

4.1 LCD interface

Pin No.	Symbol	I/O	Function
1	GND	P	Ground
2	LEDA	P	LED back light(Anode)
3	LEDK	P	LED back light(Cathode)
4	GND	P	Ground
5	VCI	P	Power supply for digital circuits
6	IOVCC	P	Power supply for I/O System
7	VS	I	Vertical sync input signal
8	HS	I	Horizontal sync input signal
9	PCLK	I	Clock for Input Data
10	DE	I	Data Input Enable.Normally pull low
11-18	B0-B7	I	Red data input
19-26	G0-G7	I	Green data input
27-34	R0-R7	I	Blue data input
35	GND	P	Ground
36	RESET	I	Reset pin,active "L"
37	CS	I	Chip select signal,active"L"
38	SCL	I	Serial clock input for SPI interface
39	SDA	I	Serial data input pin for SPI interface
40	GND	P	Ground

5. Absolute Maximum Ratings(Ta=25℃)

5.1 Electrical Absolute Maximum Ratings.(Vss=0V ,Ta=25℃)

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	VCI	-0.3	4.6	V	1，2
	IOVCC				
	VGH-VGL	-0.3	+30		

Notes:

1. If the module is above these absolute maximum ratings. It may become permanently damaged. Using the module within the following electrical characteristic conditions are also exceeded, the module will malfunction and cause poor reliability.

2. $V_{DD} > V_{SS}$ must be maintained.

5.2 Environmental Absolute Maximum Ratings.

Item	Storage		Operating		Note
	MIN.	MAX.	MIN.	MAX.	
Ambient Temperature	-30℃	80℃	-20℃	70℃	1,2
Humidity	-	-	-	-	3

1. The response time will become lower when operated at low temperature.

2. Background color changes slightly depending on ambient temperature.

   The phenomenon is reversible.

3. Ta<=40℃:85%RH MAX.

   Ta>=40℃:Absolute humidity must be lower than the humidity of 85%RH at 40℃.

6. Electrical Specifications and Instruction Code

6.1 Electrical characteristics(Vss=0V ,Ta=25℃)

Parameter		Symbol	Condition	Min	Typ	Max	Unit	Note
Power supply		VCI	Ta=25℃	2.5	3.3	3.6	V	-
		IOVCC		1.65	1.8	3.3		
Input voltage	'H'	V_{IH}	IOVCC=1.8V	0.7_{IOVCC}	-	IOVCC	V	-
	'L'	V_{IL}		-0.3	-	0.3_{IOVCC}	V	-
Output voltage	'H'	V_{OH}	IOH= -1.0mA	0.8_{IOVCC}	-	IOVCC	V	-
	'L'	V_{OL}	IOL= +1.0mA	0	-	0.2_{IOVCC}	V	-
Current Consumption		I_{CC}	Normal mode	-	30	-	mA	2
		I_{CC2}	Sleep mode	-	230	-	uA	2

Note:

1:When an optimum contrast is obtained in transmissive mode.

2: Tested in 1✕1 chessboard pattern.

7. Timing Characteristics

7.1 POWER ON/OFF SEQUENCE

VDDI and VDDA can be applied or powered down in any order. During the Power Off sequence, if the LCD is in the Sleep Out mode, VDDA and VDDI must be powered down with minimum 120msec. If the LCD is in the Sleep In mode, VDDA and VDDI can be powered down with minimum 0msec after the RESX is released.

CSX can be applied at any timing or can be permanently grounded. RESX has high priority over CSX.

Notes:

1. There will be no damage to the ST7701S if the power sequences are not met.

2. There will be no abnormal visible effects on the display panel during the Power On/Off Sequences.

3. There will be no abnormal visible effects on the display between the end of Power On Sequence and before receiving the Sleep Out command, and also between receiving the Sleep In command and the Power Off Sequence.

4. If the RESX line is not steadily held by the host during the Power On Sequence as defined in Sections 9.1 , then it will be necessary to apply the Hardware Reset (RESX) after the completion of the Host Power On Sequence to ensure correct operations. Otherwise, all the functions are not guaranteed.

5. When VDDA is in power off State , the MIPI must set in Ultra Low Power Mode (GND Level).

The power on/off sequence is illustrated below
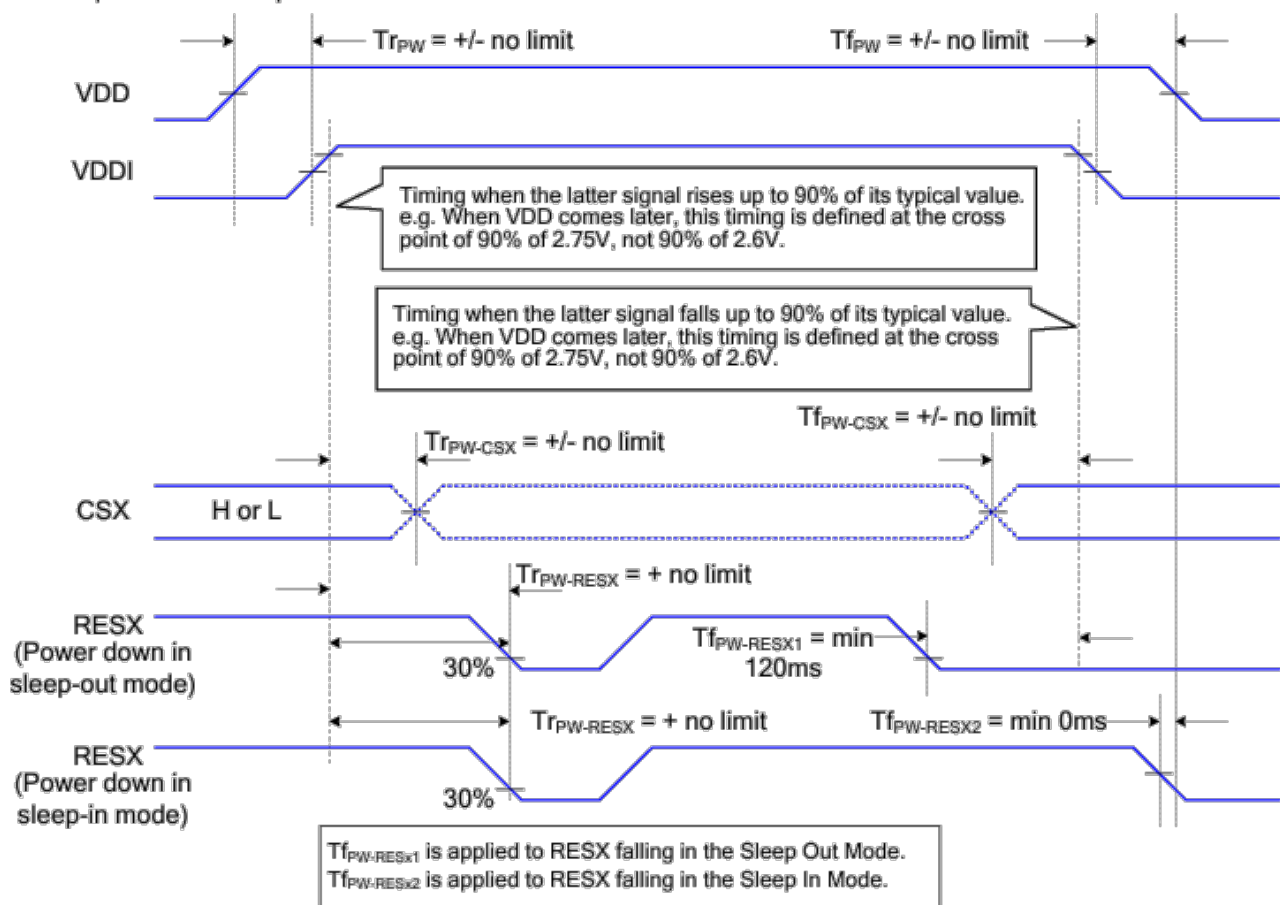
7.2 RGB Interface Timing
7.2.1 DE MODE
The timing chart of RGB interface DE mode is shown as follows.
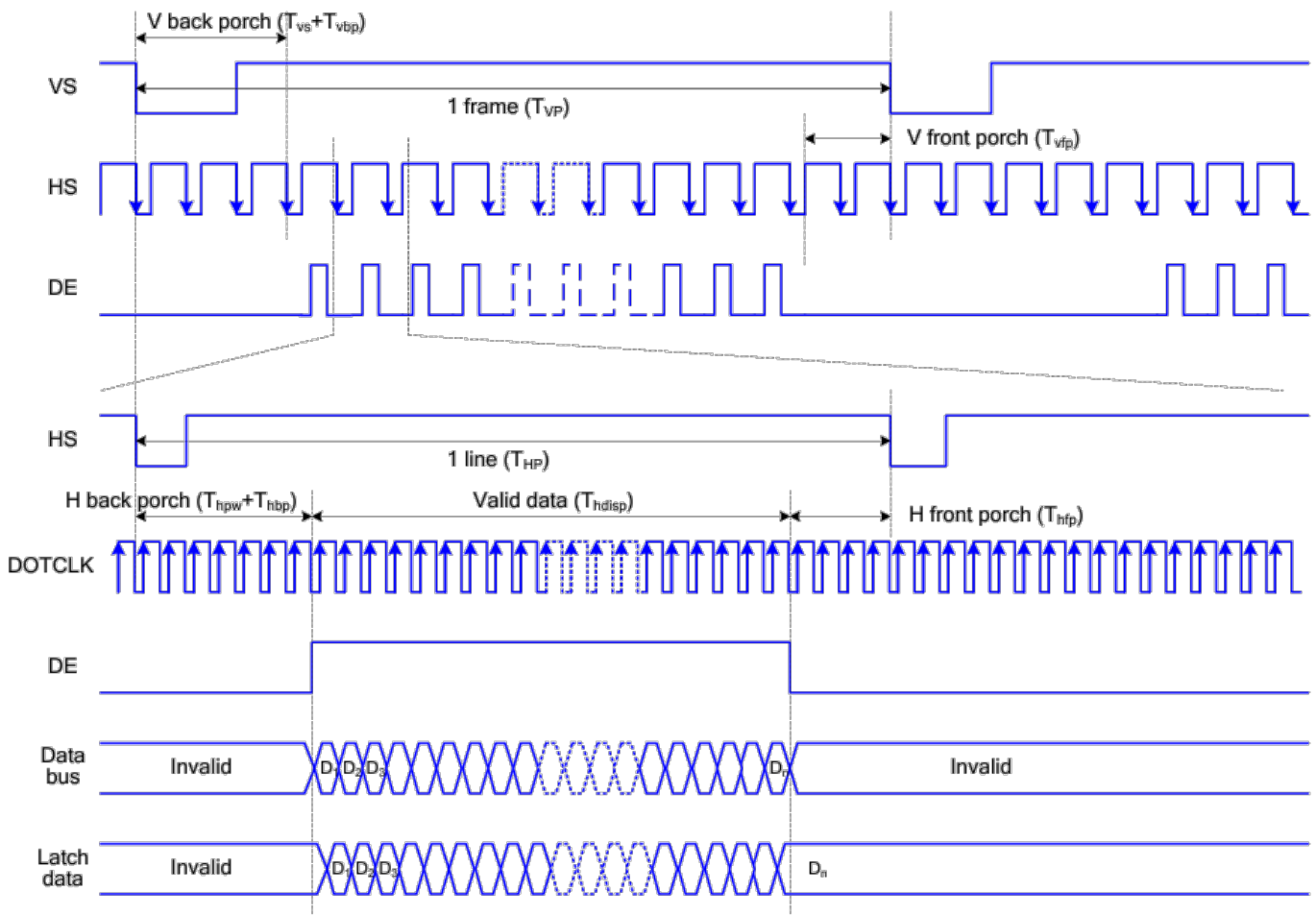
Note: The setting of front porch and back porch in host must match that in IC as this mode.

Figure:Timing Chart of Signals in RGB Interface DE Mode

7.2.2 HV MODE

The timing chart of RGB interface HV mode is shown as follows.
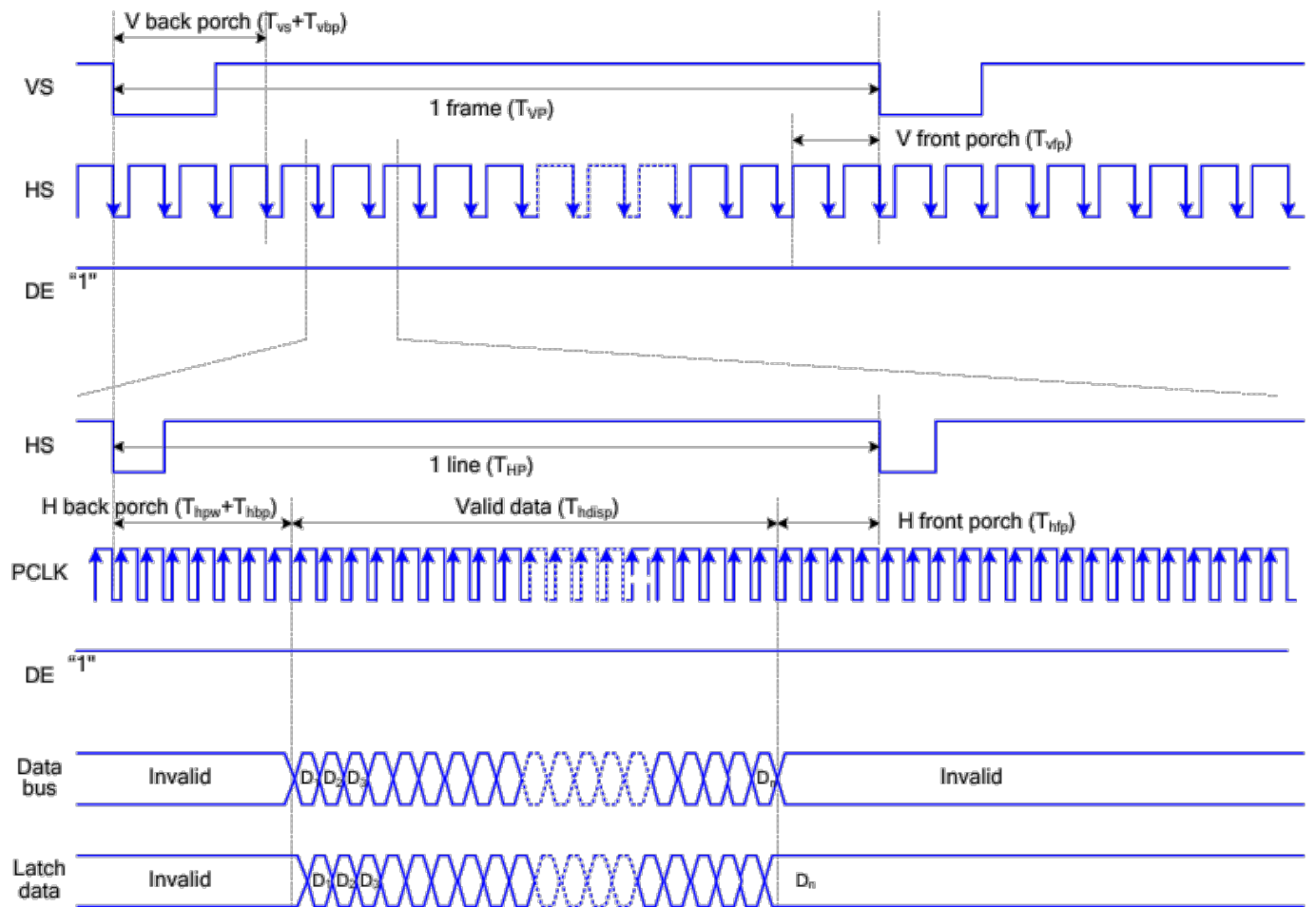
Figure : Timing chart of RGB interface HV mode

7.3 RGB Interface Characteristics :
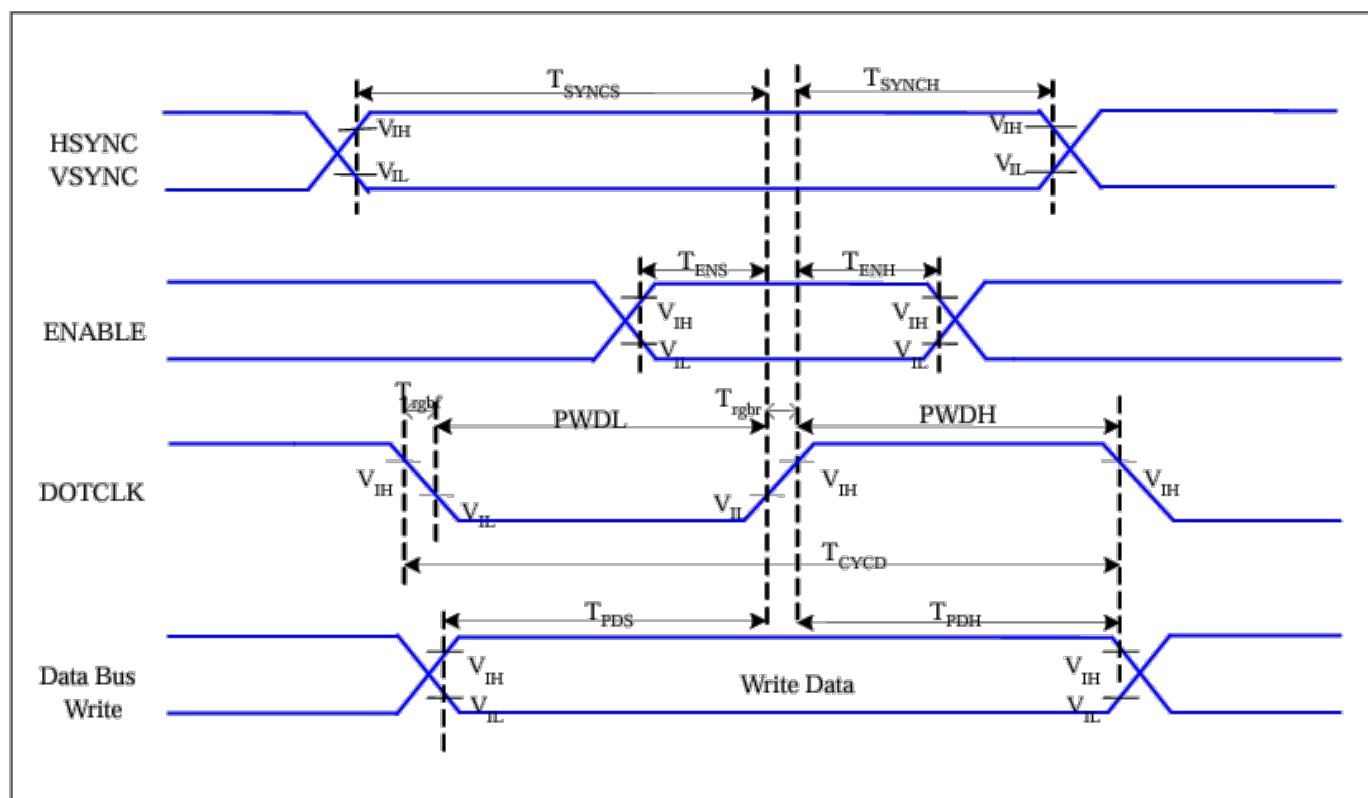
Figure : RGB Interface Timing Characteristics

VDDI=1.8,VDD=2.8, AGND=DGND=0V, Ta=25 ℃

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
HSYNC, VSYNC	T$_{SYNCS}$	VSYNC, HSYNC Setup Time	5	-	ns	
ENABLE	T$_{ENS}$	Enable Setup Time	5	-	ns	
	T$_{ENH}$	Enable Hold Time	5	-	ns	
DOTCLK	PWDH	DOTCLK High-level Pulse Width	15	-	ns	
	PWDL	DOTCLK Low-level Pulse Width	15	-	ns	
	T$_{CYCD}$	DOTCLK Cycle Time	33	-	ns	
	Trghr, Trghf	DOTCLK Rise/Fall time	-	15	ns	
DB	T$_{PDS}$	PD Data Setup Time	5	-	ns	
	T$_{PDH}$	PD Data Hold Time	5	-	ns	

Table 6 18/16 Bits RGB Interface Timing Characteristics

7.4AC Characteristics

7.4.1 Serial Interface Characteristics (3-line serial):
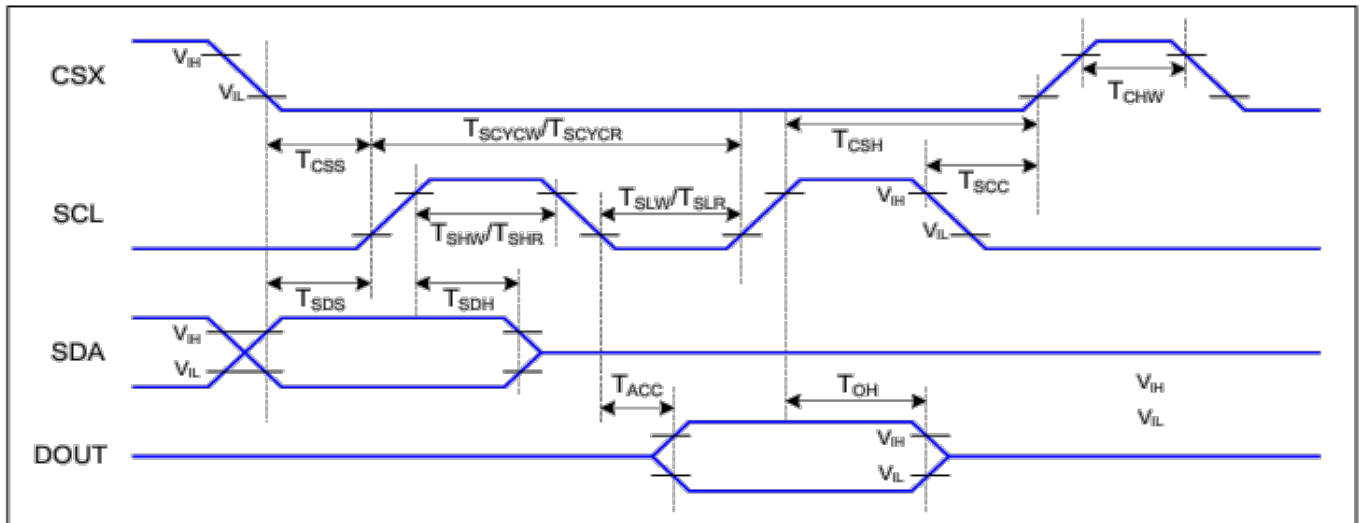
VDDI=1.8,VDD=2.8, AGND=DGND=0V, Ta=25℃

Signal	Symbol	Parameter	Min	Max	Unit	Description
CSX	T_{CSS}	Chip select setup time (write)	15		ns	
	T_{CSH}	Chip select hold time (write)	15		ns	
	T_{CSS}	Chip select setup time (read)	60		ns	
	T_{SCC}	Chip select hold time (read)	60		ns	
	T_{CHW}	Chip select "H" pulse width	40		ns	
SCL	T_{SCYCW}	Serial clock cycle (Write)	66		ns	
	T_{SHW}	SCL "H" pulse width (Write)	15		ns	
	T_{SLW}	SCL "L" pulse width (Write)	15		ns	
	T_{SCYCR}	Serial clock cycle (Read)	150		ns	
	T_{SHR}	SCL "H" pulse width (Read)	60		ns	
	T_{SLR}	SCL "L" pulse width (Read)	60		ns	
SDA (DIN)	T_{SDS}	Data setup time	10		ns	
	T_{SDH}	Data hold time	10		ns	

Table 4 3-line serial Interface Characteristics

Note : The rising time and falling time (Tr, Tf) of input signal are specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

7.4.2 Reset Timing
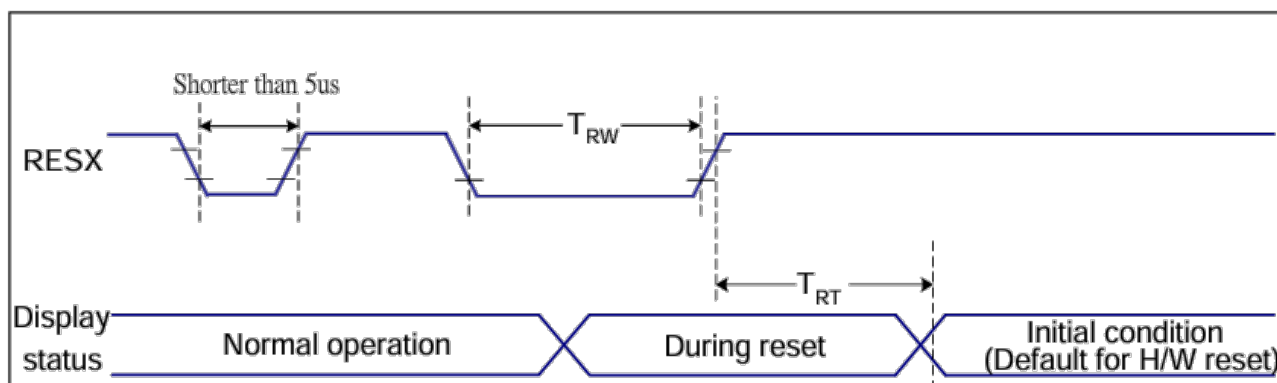
Figure 9 Reset Timing

VDDI=1.8,VDD=2.8, AGND=DGND=0V, Ta=25 ℃

Related Pins	Symbol	Parameter	MIN	MAX	Unit
RESX	TRW	Reset pulse duration	10	-	us
	TRT	Reset cancel	-	5 (Note 1, 5)	ms
				120(Note 1, 6, 7)	ms

Table 9 Reset Timing

Notes:

1. The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NVM (or similar device) to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5 ms after a rising edge of RESX.

2. Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the table below:

RESX Pulse	Action
Shorter than 5us	Reset Rejected
Longer than 9us	Reset
Between 5us and 9us	Reset starts

3. During the Resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120 ms, when Reset Starts in Sleep Out –mode. The display remains the blank state in Sleep In –mode.) and then return to Default condition for Hardware Reset.

4. Spike Rejection also applies during a valid reset pulse as shown below:

8.0 Backlight Characteristic

VF: 6.0±0.6V If=80mA
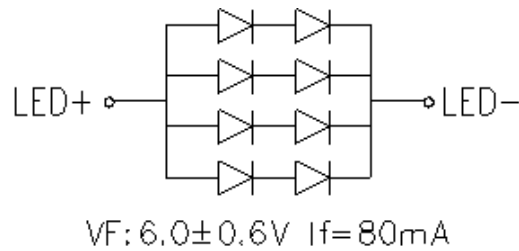
Item	Symbol	Min	Typ	Max	Unit	Test Condition
Supply Voltage	Vf	5.4	6	6.6	V	Note 1
Supply Current	If	-	80	-	mA	Note 2
Power dissipation	P_{BL}	-	0.48	-	W	
Life Time	-	30000	-	-	Hr	Note 3,4
Backlight Color	White					

Note 1: The LED Supply Voltage is defined by the number of LED at Ta=25℃ and If =80mA.

Note 2: LED current is measured by utilizing a high frequency current meter as shown below:
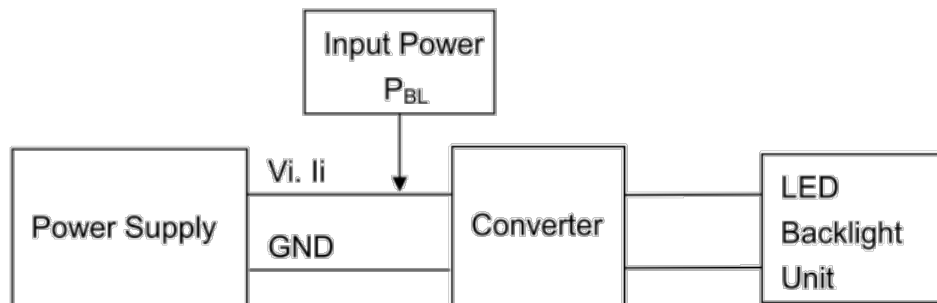
Note 3: The "LED life time" is defined as the module brightness decrease to 50% original brightness at Ta=25℃ and If =80mA. The LED lifetime could be decreased if operating If is larger than80mA.
Note 4: LED light bar circuit:

9. Optical Characteristics

Item	Symbol		Condition	Min.	Typ.	Max.	Unit	Note
Brightness	Bp		If=80mA	530	600	-	Cd/m^2	1
Uniformity	⊿Bp			-	80	-	%	1,2
Viewing Angle	3:00		Cr≥10	-	80	-	Deg	1,2
	6:00			-	80	-		
	9:00			-	80	-		
	12:00			-	80	-		
Contrast Ratio	Cr		θ=0° Φ=0°	800	1000	-	-	3,4
Response Time	T_r+T_f			-	30	35	ms	4,5
Color of CIE Coordinate	W	x	θ=0° Φ=0°	0.2818	0.3318	0.3818	-	1,6
		y		0.3185	0.3685	0.4185	-	
	R	x		0.5819	0.6319	0.6819	-	
		y		0.3051	0.3551	0.4051	-	
	G	x		0.2999	0.3499	0.3999	-	
		y		0.5619	0.6119	0.6619	-	
	B	x		0.0935	0.1435	0.1935	-	
		y		0.0401	0.0901	01401	-	
NTSC Ratio	S			-	63	-	%	

*The parameter is slightly changed by temperature, driving voltage and materiel

Note 1: The data are measured after LEDs are turned on for 5 minutes. LCM displays full white. The brightness is the average value of 9 measured spots. Measurement equipment CA310 Measuring condition:-Measuring surroundings: Dark room.-Measuring temperature: Ta=25℃.-Adjust operating voltage to get optimum contrast at the center of the display.

The measured value is more than 5 minutes at the center point of the LCD panel, and the backlight is turned on at the same time.
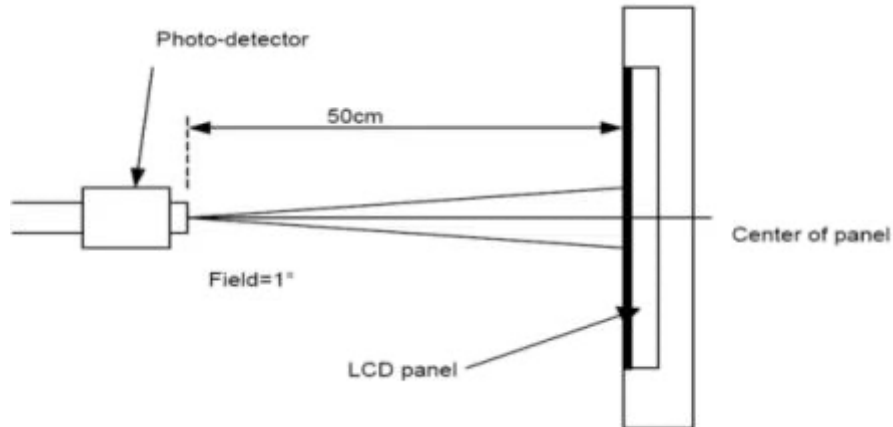
Note 2: The luminance uniformity is calculated by using following formula.

$\varDelta Bp = Bp \text{ (Min.)} / Bp \text{ (Max.)} \times 100 \text{ (%)}; Bp \text{ (Max.)} = \text{Maximum brightness in 9 measured spots } Bp \text{ (Min.)} = \text{Minimum brightness in 9 measured spots.}$
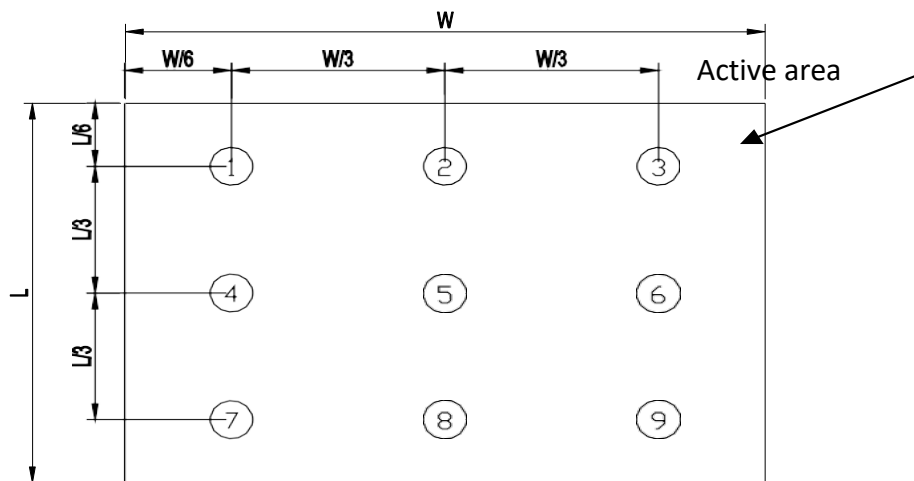
Note 3: The definition of viewing angle:Refer to the graph below marked by θ and Φ
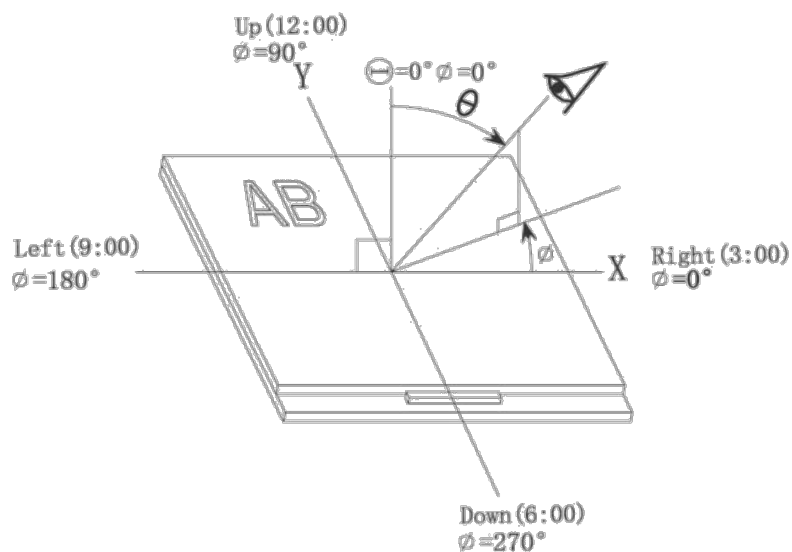
Note 4: Definition of contrast ratio Contrast measurements shall be made at viewing angle of Θ= 0 and at the center of the LCD surface.Luminance shall be measured with all pixels in the view field set first to white, then to the dark (black) state.

$$CR = \frac{\text{Luminance when displaying a white raster}}{\text{Luminance when displaying a black raster}}$$

Note 5: Definition of Response time The output signals of photo detector are measured when the input signals are changed from "white" to "black"(Tf) and from "black" to "white"(Tr), respectively. The response time is defined   as the time interval   between the 10% and 90% of amplitudes. Refer to figure as below.
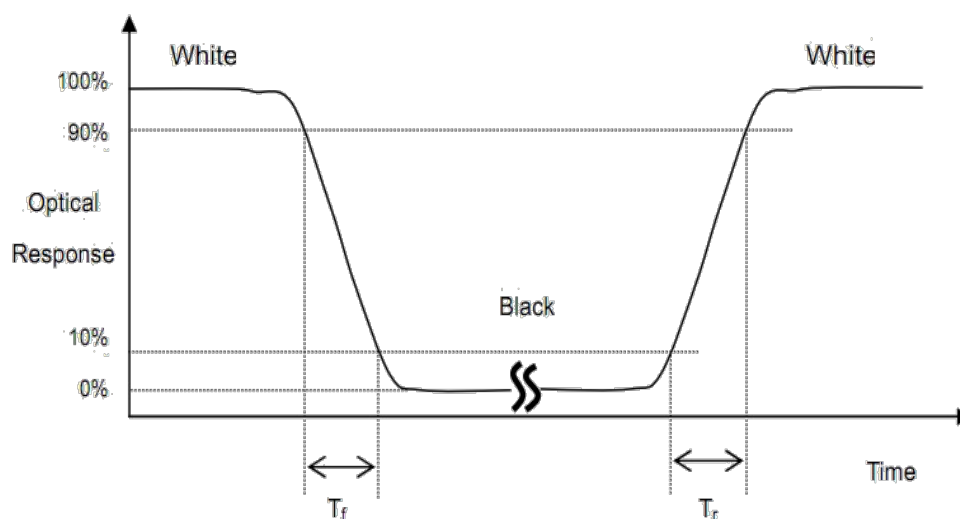
10. Reliability Test Conditions and Methods

No.	Test Items	Test Condition	Inspection After Test
①	High Temperature Storage	80°C±2°C×240Hours	Inspection after 2~4hours storage at room temperature, the samples should be free from defects: 1, Air bubble in the LCD. 2, Seal leak. 3, Non-display. 4, Missing segments. 5, Glass crack. 6, Current IDD is twice higher than initial value. 7, The surface shall be free from damage. 8, The electric characteristic requirements shall be satisfied.
②	Low Temperature Storage	-30°C±2°C×240Hours	
③	High Temperature Operating	70°C±2°C×240Hours	
④	Low Temperature Operating	-20°C±2°C×240Hours	
⑤	Temperature Cycle(Storage)	-30°C ⟷ 80°C (30min) (5min) (30min) 1cycle Total 10cycle.	
⑥	Damp Proof Test (Storage)	60°C±5°C×90%RH×240Hours	

REMARK:

1, The Test samples should be applied to only one test item.

2, Sample side for each test item is 5~10pcs.

3, For Damp Proof Test, Pure water(Resistance＞10MΩ)should be used.

4, In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judge as a good part.

5, EL evaluation should be accepted from reliability test with humidity and temperature: Some defects such as black spot/blemish can happen by natural chemical reaction with humidity and Fluorescence EL has.

6, Failure Judgment Criterion: Basic Specification Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.

11. Inspection Standard

11.1 Scope

Specifications contain
11.1.1 Display Quality Evaluation
11.1.2 Mechanics Specification

11.2 Sampling Plan

Unless there is other agreement, the sampling plan for incoming inspection shall follow
MIL-STD-105E.
11.2.1 Lot size: Quantity per shipment as one lot (different model as different lot).
11.2.2 Sampling type: Normal inspection, single sampling.
11.2.3 Sampling level: Level II.
11.2.4 AQL: Acceptable Quality Level
Major defect: AQL=0.65
Minor defect: AQL=1.5

11.3 Panel Inspection Condition

11.3.1 Environment:
Room Temperature: 25±5℃.
Humidity: 65±5% RH.
Illumination: 300 ~ 700 Lux.

11.3.2 Inspection Distance:
35±5 cm

11.3.3 Inspection Angle:
The vision of inspector should be perpendicular to the surface of the Module.
11.3.4 Inspection time：
Perceptibility Test Time: 20 seconds max.
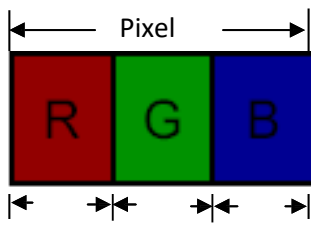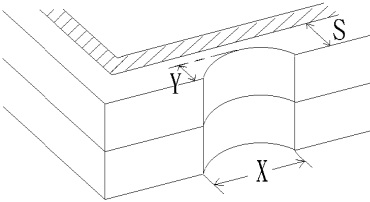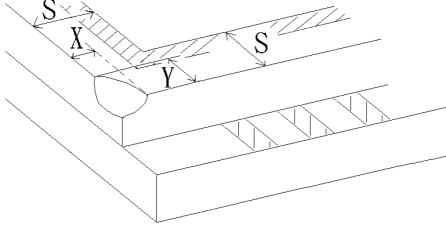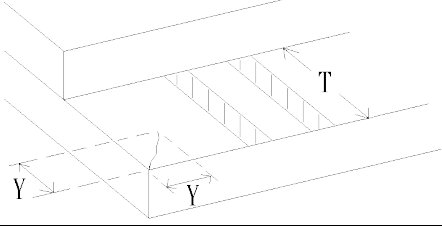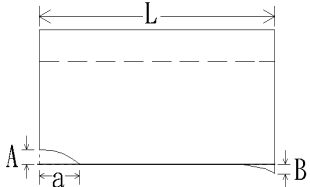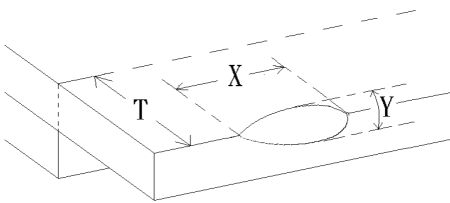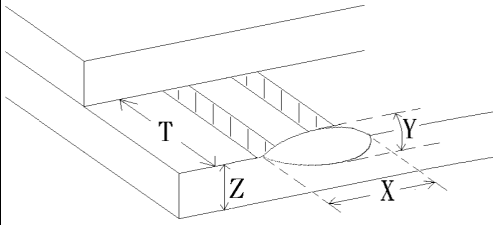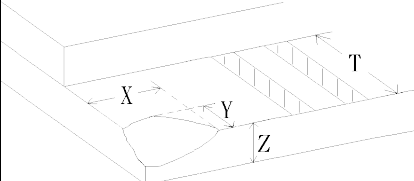
11.4 Inspection Plan

Class	Item	Judgment	Class
Packing & Indicate	1. Outside and inside package.	"MODEL NO.", "LOT NO." and "QUANTITY" should indicate on the package.	Minor
	2. Model mixed and quantity.	Other model mixed Quantity short or over	Major
	3. Product indication.	"MODEL NO." should indicate on the product.	Major
Assembly	4. Dimension, LCD glass scratch and scribe defect.	According to specification or drawing.	Major
Appearance	5. Viewing area.	Polarizer edge or LCD's sealing line is visible in the viewing area.......Rejected.	Minor
	6. Blemish, black spot, white spot in the LCD and LCD glass cracks.	According to standard of visual inspection.(inside viewing area)	Minor
	7. Blemish, black spot, white spot and scratch on the polarizer.	According to standard of visual inspection.(inside viewing area)	Minor
	8. Bubble in polarizer.	According to standard of visual inspection.(inside viewing area)	Minor
	9. LCD's rainbow color.	Strong deviation color (or newton ring) of LCD…………………………...Rejected. Or according to limited sample.(if needed, and inside viewing area)	Minor
Electrical	10. Electrical and optical characteristics.(contrast Vop chromaticity….etc)	According to specification or drawing.(inside viewing area)	Major
	11. Missing line.	Missing dot line character	Major
	12.Short circuit. Wrong pattern display.	No display, wrong pattern display, current consumption. Out of specification	Major
	13. Dot defect.(for color and TFT)	According to standard of visual Inspection.	Minor

11.5 Standard Of Visual Inspection

NO.	CLASS	ITEM	JUDGMENT		
11.5.1	Minor	Black and white spot. Foreign materiel. Dust. Blemish. Scratch.	(A) Round type: Unit: mm		

(A) Round type: Unit: mm

Diameter (mm.)	Acceptable Q'ty
Φ≦0.1	Disregard
0.1 < Φ≦0.2	2(Distance>10mm)
0.20 < Φ	0

Note: Φ = (length+width)/2

(B) Linear type: Unit: mm

Length	Width (mm.)	Acceptable Q'ty
--	W≦0.03	Disregard
L≦3.0	0.03< W≦0.05	1(Distance>10mm)
--	0.05 < W	Not allow

11.5.2 Minor — Dent on polarizer.

Unit: mm.

Diameter	Acceptable Q'ty
Φ≦0.1	Disregard
0.1 < Φ≦0.2	2(Distance>10mm)
0.2 < Φ	0

11.5.3 Minor — Bubble in polarizer.

Unit: mm.

Diameter	Acceptable Q'ty
Φ≦0.1	Disregard
0.1< Φ≦0.25	2(Distance>10mm)
0.2 < Φ	0

11.5.4 Minor — Dot defect

Items	Acceptable Q'ty
Bright dot	N ≦3
Dark dot	N ≦3
Total dot	N ≦6

Pixel define :

Note1: The definition of dot: The size of a defective dot over 1/2 of whole dot is regarded as one defective dot.
Note 2: Bright dot: Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.
Note 3: The bright dot defect must be visible through 2% ND filter
Note 4: Dark dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue

11.5.5	Minor	LCD glass chipping.		Y>S Reject
11.5.6	Minor	LCD glass chipping.		X or Y>S Reject
11.5.7	Major	LCD glass crack.		Y>(1/2) T Reject
11.5.8	Major	LCD glass scribe defect.		1. a>L/3, A>1.5mm Reject 2. B : According to dimension
11.5.9	Minor	LCD glass chipping. (on the terminal area)		Φ = (x+y)/2>2.5mm Reject
11.5.10	Minor	LCD glass chipping. (on the terminal surface)		Y>(1/3)T Reject
11.5.11	Minor	LCD glass chipping.		Y>T Reject

12. Handling Precautions

12.1 Mounting method

The LCD panel of Victronix TFT module consists of two thin glass plates with polarizes which easily be damaged. And since the module in so constructed as to be fixed by utilizing fitting holes in the printed circuit board.

Extreme care should be needed when handling the LCD modules.

12.2 Caution of LCD handling and cleaning

When cleaning the display surface, Use soft cloth with solvent

[Recommended below] and wipe lightly.

- Isopropyl alcohol.
- Ethyl alcohol.
  Do not wipe the display surface with dry or hard materials that will damage the polarizer surface.
  Do not use the following solvent:
- Water.
- Aromatics.
  Do not wipe ITO pad area with the dry or hard materials that will damage the ITO patterns
  Do not use the following solvent on the pad or prevent it from being contaminated:
- Soldering flux.
- Chlorine (Cl) , Sulfur (S).

If goods were sent without being silicon coated on the pad, ITO patterns could be damaged due to the corrosion as time goes on.

If ITO corrosion happen by miss-handling or using some materials such as Chlorine (CI), Sulfur (S) from customer, Responsibility is on customer.

12.3 Caution against static charge

The LCD module use C-MOS LSI drivers, so we recommended that you:

Connect any unused input terminal to POWER or GROUND, do not input any signals before power is turned on, and ground your body, work/assembly areas, and assembly equipment to protect against static electricity.

12.4 packing

- Module employs LCD elements and must be treated as such.
- Avoid intense shock and falls from a height.
- To prevent modules from degradation, do not operate or store them exposed direct to sunshine or high temperature/humidity.

12.5 Caution for operation

- It is an indispensable condition to drive LCD's within the specified voltage limit since the higher voltage then the limit cause the shorter LCD life.
- An electro chemical reaction due to direct current causes LCD's undesirable deterioration, so that the use of direct current drive should be avoided.
- Response time will be extremely delayed at lower temperature then the operating temperature range and on the other hand at higher temperature LCD's how dark color in them. However those phenomena do not mean malfunction or out of order with LCD's, which will come back in the specified operation temperature.
- If the display area is pushed hard during operation, some font will be abnormally displayed but it resumes normal condition after turning off once.
- Slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit.

   Usage under the maximum operating temperature, 50%Rh or less is required.

12.6 storing

In the case of storing for a long period of time for instance, for years for the purpose or replacement use, the following ways are recommended.

- Storage in a polyethylene bag with the opening sealed so as not to enter fresh air outside in it. And with no desiccant.
- Placing in a dark place where neither exposure to direct sunlight nor light's keeping the storage temperature range.
- Storing with no touch on polarizer surface by the anything else.

   [It is recommended to store them as they have been contained in the inner container at the time of delivery from us.

12.7 Safety

- It is recommendable to crash damaged or unnecessary LCD's into pieces and wash off liquid crystal by either of solvents such as acetone and ethanol, which should be burned up later.
- When any liquid leaked out of a damaged glass cell comes in contact with your hands, please wash it off well with soap and water.

13. Precaution for Use

13.1

    A limit sample should be provided by the both parties on an occasion when the both parties agreed its necessity. Judgment by a limit sample shall take effect after the limit sample has been established and confirmed by the both parties.

13.2

    On the following occasions, the handing of problem should be decided through discussion and agreement between responsible of the both parties.
- When a question is arisen in this specification
- When a new problem is arisen which is not specified in this specifications
- When an inspection specifications change or operating condition change in customer is reported to **Disea** TFT , and some problem is arisen in this specification due to the change
- When a new problem is arisen at the customer's operating set for sample evaluation in the customer site.

- END