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.: TST035HVQI-54

Version: V1.1

☐ APPROVAL FOR SPECIFICATION ☐ APPROVAL FOR SAMPLE

For Customer's Acceptance:	
Approved by	Comment

Team Source Display:		
Presented by	Reviewed by	Organized by

Document Revision History

Version	Date	Page	Description	Changed By
V1.0	2018-01-24	-	First issue	
V1.1	2020-09-01	6，7	Correct some mistakes	Aron

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1. LCM Specification

1.1 Description

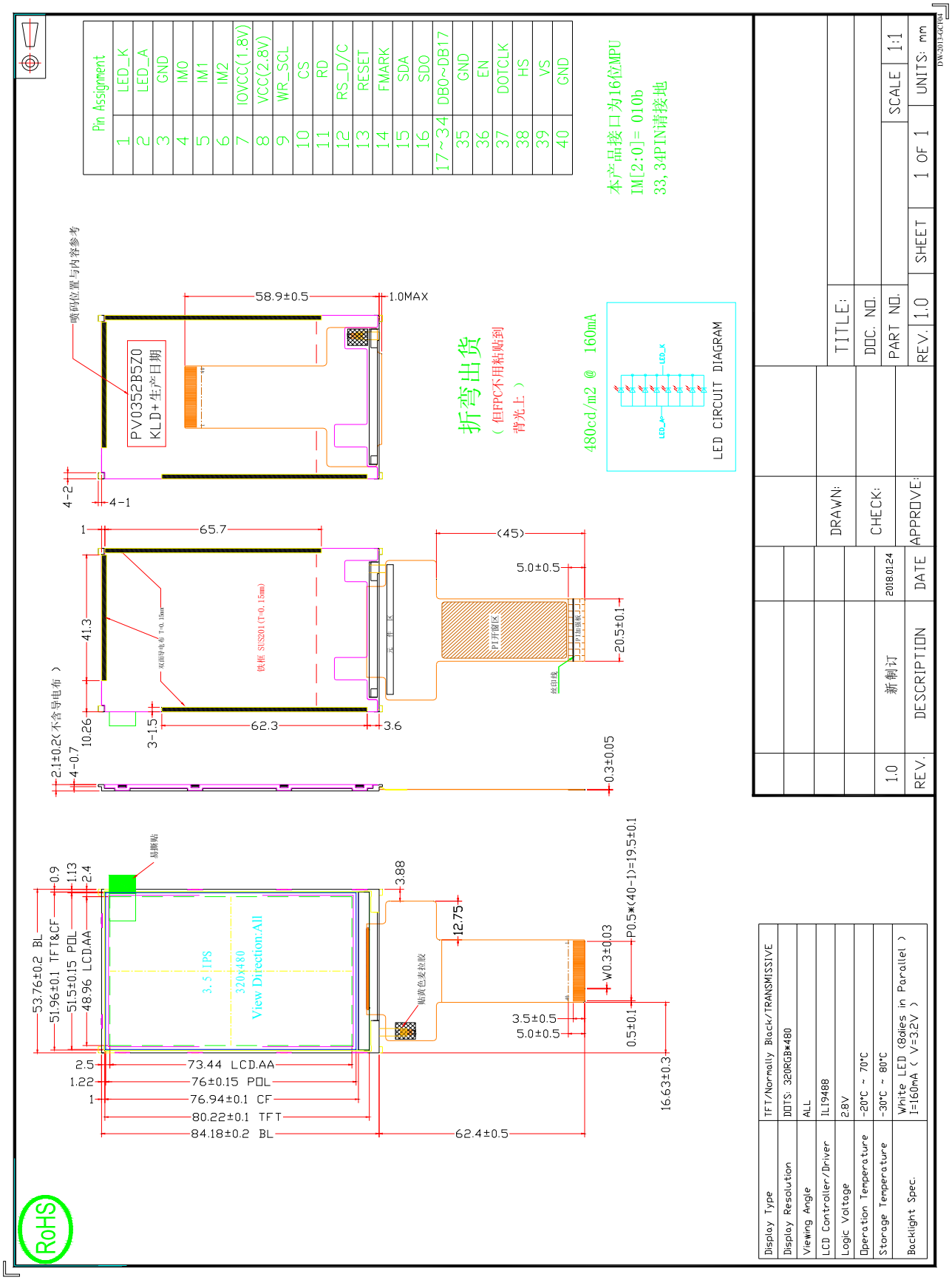
TST035HVQI-54 is a transmissive type color active matrix liquid crystal display(LCD) which uses amorphous thin film transistor(TFT) as switching devices. This product is composed of a TFT LCD panel, a drive IC, a FPC and a LED-backlight unit. The active display area is 3.5 inches diagonally measured and the native resolution is 320*RGB*480.Features of this product are listed in the following table.

1.2 Functions & Features

Table 1.1 Module Functions & Features

Parameter	Value	Unit
LCD Mode	TFT/Transmissive	-
Color Depth	262 K color	-
Display Resolution	320RGB*480	pixels
Module Size	53.76(W)*84.18(H)*2.1(T)(Exclude FPC)	mm
Active Area (A.A)	48.96(W)*73.44(H)	mm
Pixel Arrangement	RGB-stripe	-
Viewing Direction	ALL	
Display Mode	Normally Black	
LCD Controller/Driver	ILI9488	-
IC Package Type	COG	-
Interface	**16-Bit MCU**	-
Power Supply Voltage	2.8~3.3	V
LCM Brightness	480	cd /㎡
Back-light	White LED*8	PCS

2. Mechanical Specification



3. Pin Descriptions

3.2 LCM PIN Descriptions

Pin No.	Symbol	I/O	Functional	Remark
1	LEDK	P	LED Power supply -	
2	LEDA	P	LED Power supply +	
3-4	GND	P	System ground.	
5	IOVCC	P	Power supply, 1.65~3.3V	
6	GND	P	System ground.	
7	IOVCC	P	Power supply, 1.65~3.3V	
8	VCC	P	Power supply, 2.5~3.3V	
9	WR	I	bus interface operation.	
10	CS	I	Chip select input pin	
11	RD	I	bus interface operation.	
12	RS	I	Selects register.	
13	RESET	I	RESX pin	
14	FMARK	I	Tearing effect output.	
15	GND	P	System ground.	
16	NC	-	-	
17~32	DB0~DB15	I/O	16-bit interface: DB0-DB15 are used	
33-36	GND	P	System ground.	
37	IOVCC	P	Power supply, 1.65~3.3V	
38-40	GND	P	System ground.	

3.2 TP PIN Descriptions

TBD.

4. Electrical Units

4.1 Absolute Maximum Ratings

The absolute maximum ratings are list on Table 4.1. When used out of the absolute maximum ratings, the LCM may be permanently damaged. Using the LCM within the following electrical characteristics limit is strongly recommended for normal operation. If these electrical characteristic conditions are exceeded during normal operation, the LCM will malfunction and cause poor reliability.

Table 4.1 Module Absolute Maximum Ratings

Item	Symbol	Unit	Value	Note
Input power supply	Vdd	V	-0.3 to +4.6	
Analog power supply	Avdd	V	-0.3 to +4.6	
Operating Temperature	Top	°C	-20 to +70	
Storage Temperature	Tst	°C	-30 to +80	
Operating Humidity	Hop	%(RH)	90	

(VSS=0V)

4.2 Electrical characteristics

Table 4.2:DC Characteristic

Item		Symbol	Condition	Min.	Type.	Max.	Unit
Supply Voltage	Logic	IOVCC	---	1.65	1.8	3.3	V
Analog power supply	Logic	VCC	---	2.5	2.8	3.3	V
Input Voltage	H level	V_{IH}	---	0.7IOVdd	---	IOVdd	V
	L level	V_{IL}		DGND	---	0.3IOVdd	
Output Voltage	H level	V_{oH}	---	0.8IOVdd	---	IOvdd	V
	L level	V_{ol}	---	DGND	---	0.2IOVdd	

4.3 Back-light Specification

Table 4.3 Back-light Characteristics

Item	Symbol	Conditions	Min.	Type.	Max.	Unit
Supply Voltage	VF	Only Backlight	2.8	3.0	3.3	V
Supply Current	IF			160		mA
Average Brightness	IV	Backlight Current IF=120mA	6500	--	--	Cd/ m^2
CIE Color Coordinate (Without LCD)	X	Backlight Current IF=120mA	0.220	--	0.260	–
	Y		0.220	--	0.260	
Uniformity	B	Backlight Current IF=120mA	--	80%	–	%
Color	White					

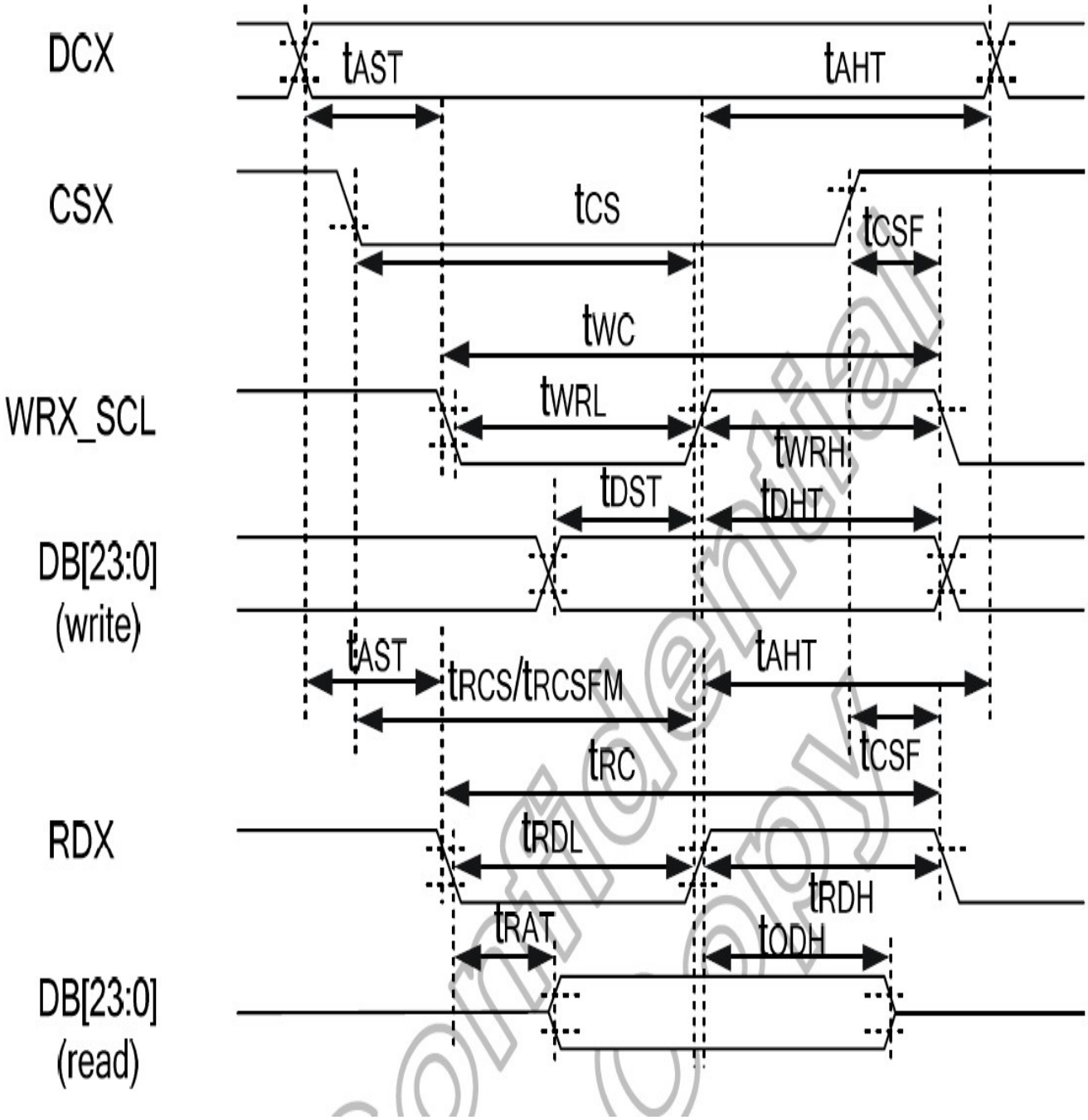
Note: 8 LEDs in Parallel connection.

4.4 TP Specification

TBD.

5. AC Characteristics

5.1 16-Bit MCU Interface



＊ (VSSA=0V, IOVCC=1.8V, VCI=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)	10	–		
CSX	Tcs	Chip select setup time (Write)	10	–	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)	50	–	ns	
	Twc	Write cycle (write GRAM@SLPOUT)	47	–		
	Twc	Write cycle (write GRAM@SLPIN)	100	–		
	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)	35	–		
	Trdl	Control pulse “L” duration(GRAM)	345	–		
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		

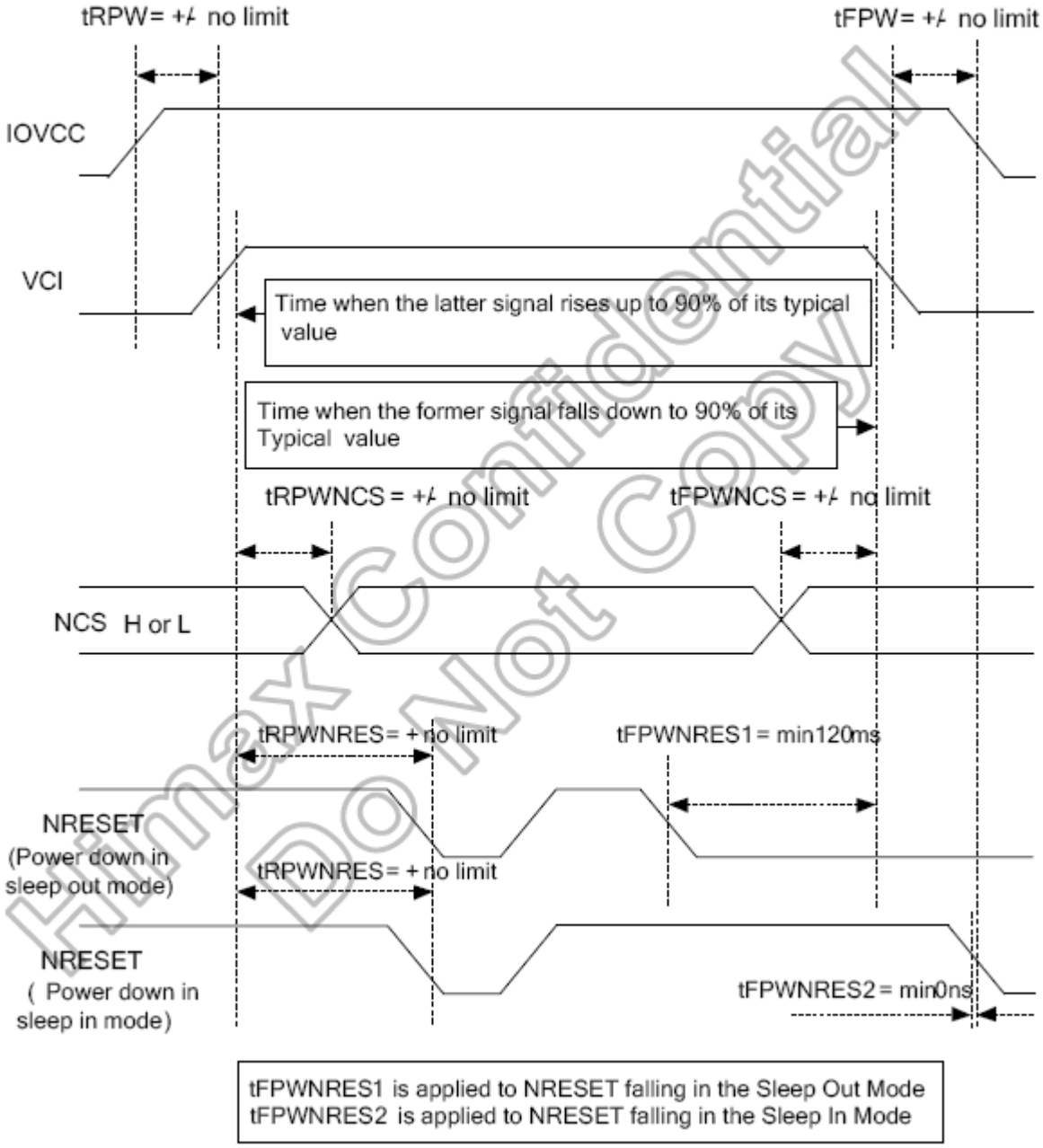
Note: The input signal rise time and fall time (tr, tf) is specified at 15 ns or less.

Logic high and low levels are specified as 30% and 70% of IOVCC for Input signals.

6. Power On/Off Sequence

6.1 Case 1 – RESX line is held high or Unstable by Host at Power –On

If NRESET line is held high or unstable by the host during Power On, then a Hardware Reset must be applied after both IOVCC, VCI have been applied, otherwise correct functionality is not guaranteed. There is no timing restriction upon this hardware reset.

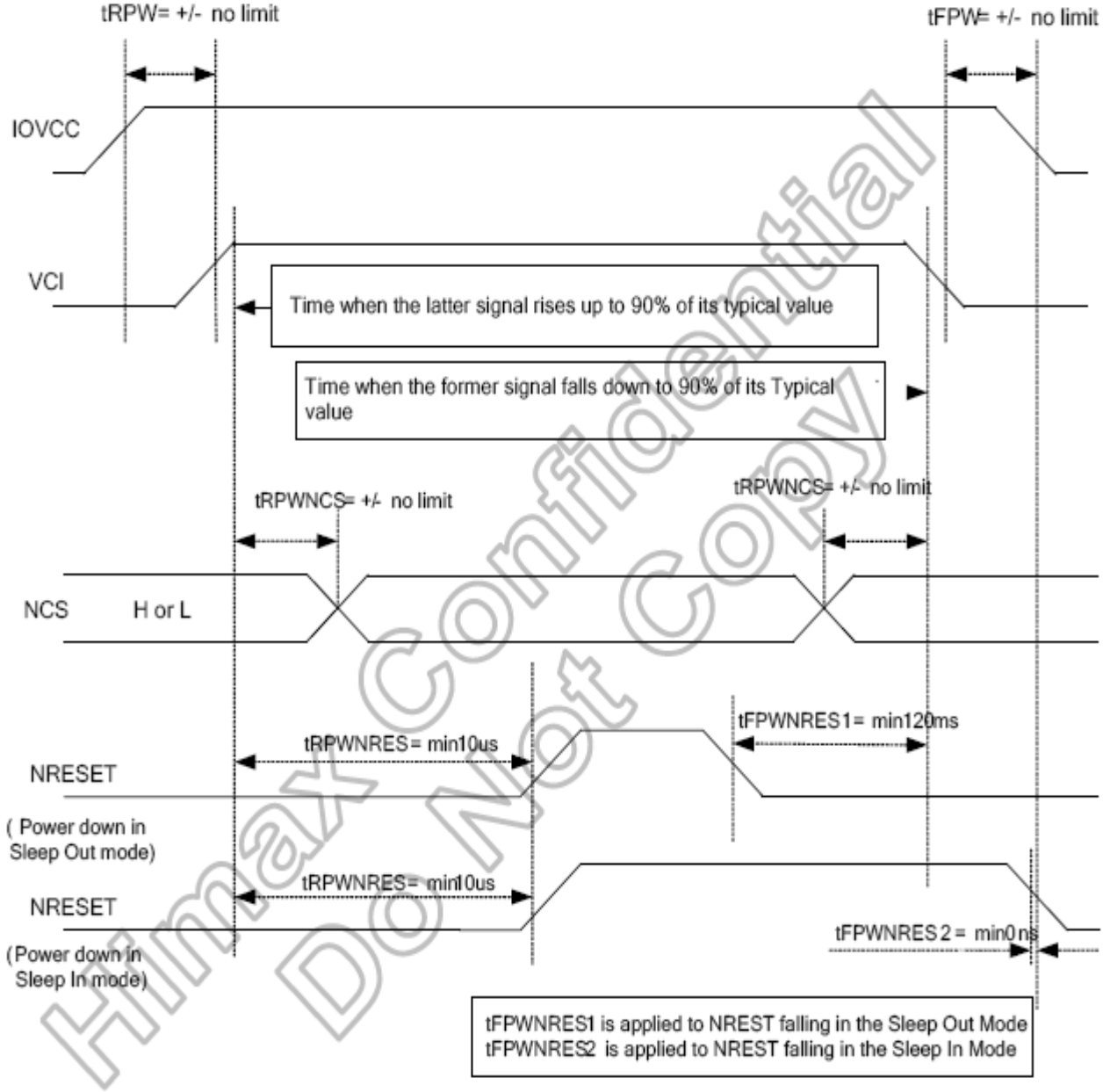


Note: Unless otherwise specified timings herein show cross point at 50% of signal/power level

Figure 5.31: Case 1 – NRESET line is held high or unstable by host at power on

6.2 Case 2 – RESX line is held Low by Host at Power On

If NRESET line is held Low (and stable) by the host during Power On, then the NRESET must be held low for minimum 10µsec after VCI have been applied.



Note: Unless otherwise specified timings herein show cross point at 50% of signal/power level

Figure 5.32: NRESET line is held low by host at power on

7. Optical Specification

7.1 Optical Specification

Light Source: C-light

(With UP Polarizer: APCFH4CVT, Down Polarizer: NPFCVT1764FCUARC9) Ta=25℃

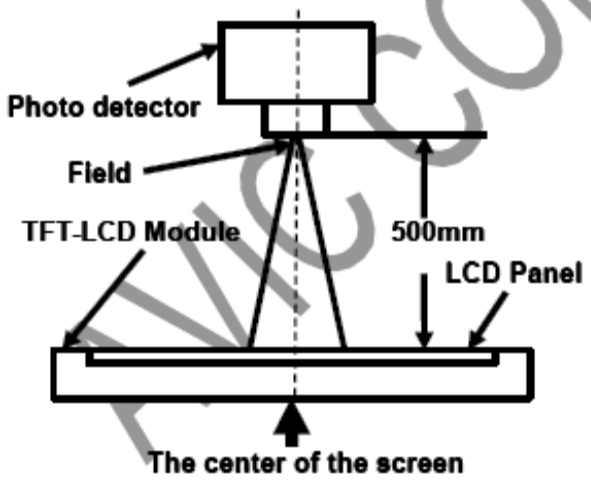
Item		Symbol	Condition	Min	Typ	Max	Unit	Remark
View Angle		θT	CR≧10	80	-	-	Degree	Note 2
		θB		80	-	-		
		θL		80	-	-		
		θR		80	-	-		
Contrast Ratio		CR	θ=0°	400	800	--		Note1 Note3
Response Time		T_{ON}	25℃ θ=0°	-	25	35	ms	Note1 Note4
		T_{OFF}						
Color Filter Chromaticity	White	x	θ=0°	0.27	0.31	0.35		
		y		0.28	0.32	0.36		
	Red	x		-	-	-		
		y		-	-	-		
	Green	x		-	-	-		
		y		-	-	-		
	Blue	x		-	-	-		
		y		-	-	-		
NTSC		-	θ=0°	-	72.8	-	%	Note 5
Transmittance		T	θ=0°	-	4.4	-	%	Note1 Note5

Test Conditions:

1. The ambient temperature is 25℃.
2. The test systems refer to Note 1 and Note 2.
3. The Transmittance and NTSC are the emulated values base on the panel with normal polarizer and C-Light, and when using LED back light they will be to decrease about 0.3%.

Note 1: Definition of optical measurement system.

The optical characteristics should be measured in dark room. After 5 minutes operation, the optical properties are measured at the center point of the LCD screen. All input terminals LCD panel must be ground when measuring the center area of the panel.



Item	Photo detector	Field
Contrast Ratio	SR-3A	1°
Chromaticity		
Response Time	BM-7A	2°

Note 2: Definition of viewing angle range and measurement system, viewing angle is measured at the center point of the LCD by CONOSCOPE (ergo-80).

Viewing angle is measured With EWV Polarizer.

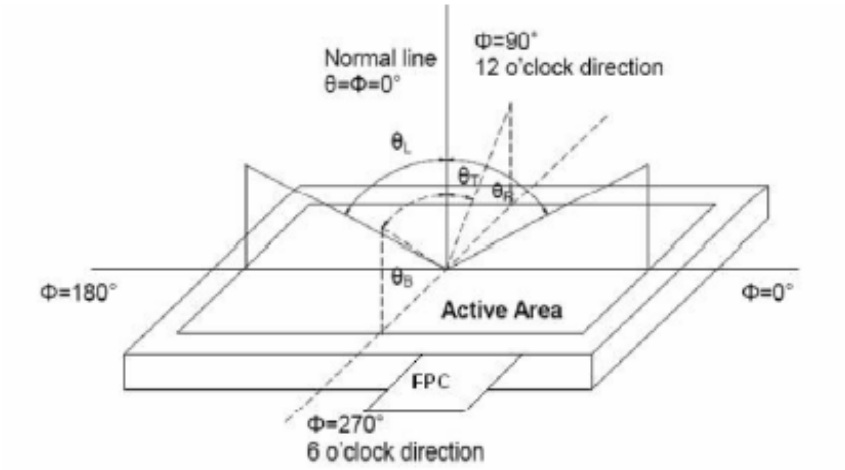


Fig. 1 Definition of viewing angle

Note 3: Definition of contrast ratio

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD is on the "White" state}}{\text{Luminance measured when LCD is on the "Black" state}}$$

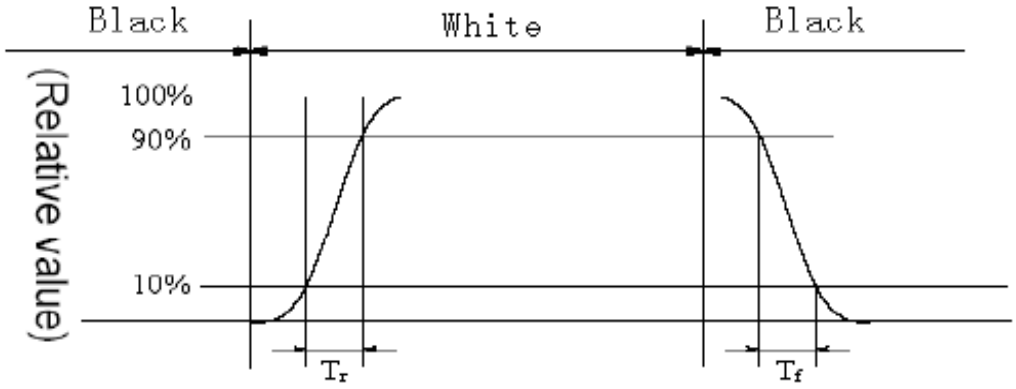
"White state ": The state is that the LCD should driven by Vwhite.

"Black state": The state is that the LCD should driven by Vblack.

Vwhite: To be determined Vblack: To be determined.

Note 4: Definition of Response time

The response time is defined as the LCD optical switching time interval between "White" state and "Black" state. Rise time (T_{ON}) is the time between photo detector output intensity changed from 90% to 10%. And fall time (T_{OFF}) is the time between photo detector output intensity changed from 10% to 90%.



Note 5: Definition of color chromaticity (CIE1931)

8. Reliability Test Items

No.	Test Item	Test Condition
1	High Temperature Operation	Ts = +70℃, 96 hours
2	ILow Temperature Operation	Ts = -20℃, 96 hours
3	High Temperature Storage	Ta = +80℃, 96 hours
4	Low Temperature Storage	Ta = -30℃, 96 hours
5	Storage at HighTemperature and Humidity	Ta = +60℃, 90% RH,48hours

NOTE :

1. All judgement of display are performed after temperature of panel return to room temperature.
2. Display function should be no change under normal operating condition.
3. Under no condensation of dew.
4. CMI only guarantee the above 5 test items, and without guarantee the others.

9.Handling Precautions

9.1 Handling Precautions

9.1.1 The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.

9.1.2 If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes,promptly wash it off using soap and water.

9.1.3 Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

9.1.4 If the display surface is contaminated, breathe on the surface and gently wipe it with a softdry cloth. If still not completely clear, moisten cloth with one of the following solvents:

- Isopropyl alcohol
- Ethyl alcohol

Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:

- Water
- Ketone
- Aromatic solvents

9.1.5 Do not attempt to disassemble the LCD.

9.1.6 If the logic circuit power is off, do not apply the input signals.

9.1.7 To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

9.1.7.1 Be sure to ground the body when handling the LCD.

9.1.7.2 Tools required for assembly, such as soldering irons, must be properly ground.

9.1.7.3 To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.

9.2 Storage precautions

9.2.1 When storing the LCD, avoid exposure to direct sunlight or to the light of fluorescent lamps.

9.2.2 The LCD should be stored under the storage temperature range. If the LCD will be stored for a long time, the recommend condition is:

Temperature : 0℃ ～ 40℃ Relatively humidity: ≤80%

9.2.3 The LCD should be stored in the room without acid, alkali and harmful- lgas.

9.3 Transportation Precautions:

The LCD should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.

10. QC

10.1 Purpose

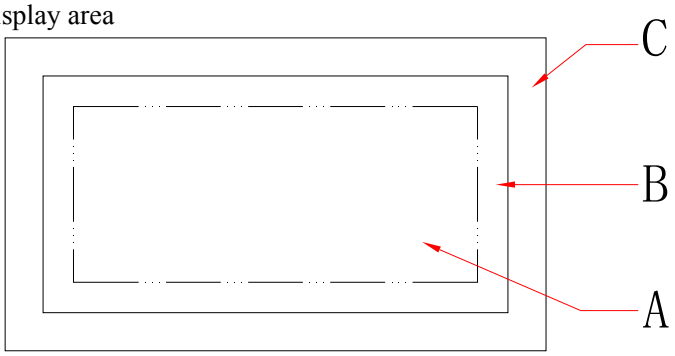
To ensure the stability of our product and standardize our inspection

10.2 Application Range

This standard is applied to all 4.3 inch and smaller sized LCM product from Elsun Technology Co.Ltd

10.3 Definition of inspection area

C area: The area covered after installation
B area: visible area
A area: display area

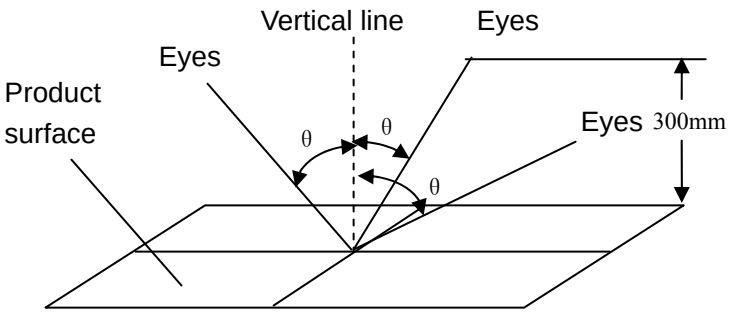


10.4 The environmental condition of inspection

Lighting conditions should be 20 ~ 40W fluorescent lamp (illumination at 1000 ± 200 lux)

Test ambient temperature should be 23 ± 5 ℃, humidity at 50 ± 20% RH

The tested products should be placed 300mm away from the examiner's eye, and 30 degrees in the vertical direction observed within the region



10.5 Identification

10.5.1 Bright dot: dots appearing bright and unchanged in size when the LCD panel is under black pattern.

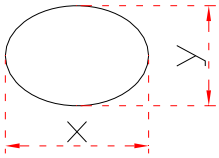
10.5.2 Dark dot: dots appearing dark and unchanged size when the LCD panel is under RGB picture.

10.6 Inspection items and criteria

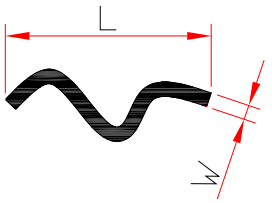
10.6.1 Serious defect

No	inspection item	inspection criteria	defect grade
10.6.1.1	function failure	1) Non-display not allowed 2) Line missing not allowed 3) Invalid touch and drift not allowed (if need)	main defect
10.6.1.2	break	broken display not allowed	main defect
10.6.1.3	dimension	Dimension tolerance out of specified in the drawing not allowed.	main defect

10.6.2 Appearance defect

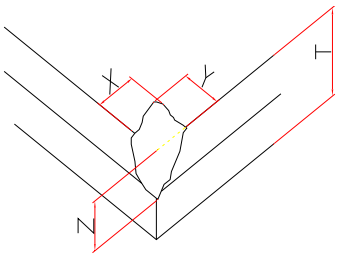
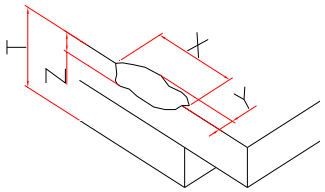
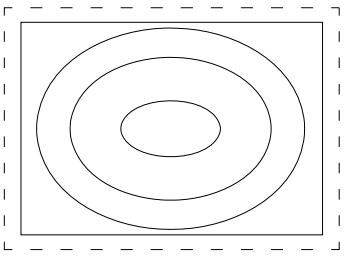
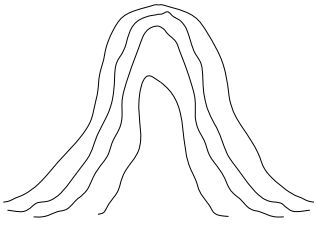
<table>
<tr><th>No</th><th>Inspection item</th><th>inspection criteria</th><th>defect grade</th></tr>
<tr><td rowspan="2">10.6.2.1</td><td rowspan="2">Dot defect
black dot, white dot, dirt on surface, stain, bubble</td><td>1. dot defect identification:
$\Phi = \frac{(\chi + \gamma)}{2}$  </td><td rowspan="2">Minor defect</td></tr>
<tr><td>2. inspection criteria range
<table>
<tr><th rowspan="2">Area and quantity / dimension(mm)</th><th colspan="3">quantity allowed</th></tr>
<tr><th>A area</th><th>B area</th><th>C area</th></tr>
<tr><td>Φ ≤0.15</td><td colspan="2">ignore</td><td rowspan="4">ignore</td></tr>
<tr><td>0.15＜ Φ ≤0.20</td><td colspan="2">2 （spacing>=10mm ）</td></tr>
<tr><td>0.20＜ Φ ≤0.3</td><td colspan="2">1</td></tr>
<tr><td>Φ ＞0. 3</td><td colspan="2">0</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>No</th><th>Inspection item</th><th>inspection criteria</th><th>defect grade</th></tr>
<tr><td>10.6.2.2</td><td>line defect
visible
black/white line</td><td>
1. identification of line dimension

L: length
W: width
 

2. inspection criteria
<table>
<tr><th colspan="2">dimension(mm)</th><th colspan="3">quantity allowed（total 3 pcs ）</th></tr>
<tr><th rowspan="2">L (length)</th><th rowspan="2">W (width)</th><th colspan="3">area</th></tr>
<tr><th>A area</th><th>B area</th><th>C area</th></tr>
<tr><td>ignore</td><td>W≤0.03</td><td colspan="2">ignore</td><td rowspan="4">ignore</td></tr>
<tr><td>L≤3. 0</td><td>0.03＜W≤ 0. 05</td><td colspan="2">2</td></tr>
<tr><td>L≤3. 0</td><td>0.05＜W≤ 0. 08</td><td colspan="2">1</td></tr>
<tr><td></td><td>W＞0. 08</td><td colspan="2">count according to dot defect</td></tr>
</table>
</td><td>Minor defect</td></tr>
<tr><td>10.6.2.3</td><td>scratch</td><td>
1-If the scratch is visible after installation or at work, refer to 10.6.2.2
2-If the scratch is visible at special angel or at non-working status, refer to the following standards

<table>
<tr><th colspan="2">dimension（mm）</th><th colspan="3">Quantity allowed</th></tr>
<tr><th rowspan="2">L（length）</th><th rowspan="2">W（width）</th><th colspan="3">area</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>ignore</td><td>W≤0.03</td><td colspan="2">ignore</td><td rowspan="4">ignore</td></tr>
<tr><td>5.0＜L≤10. 0</td><td>0.03＜W≤ 0. 05</td><td colspan="2">2</td></tr>
<tr><td>L≤5. 0</td><td>0.05＜W≤ 0. 08</td><td colspan="2">1</td></tr>
<tr><td></td><td>W＞0. 08</td><td colspan="2">Not allowed</td></tr>
</table>
</td><td>Minor defect</td></tr>
</table>

No	Inspection item	inspection criteria	defect grade
10.6.2.4	Glass defect	1. broken angle X 不计 Y≤2.0mm or X≤2.0mm Y 不计 Meanwhile Z＜T ignore  2. other broken part X≤5.0mm Y≤0.8mm Meanwhile Z≤T ignore 	Minor defect
10.6.2.5	Newton ring	1.regular Newton ring  ① Newton ring area>1/3 T/P area; not acceptable. ② Newton ring area≤1/3 T/P area and doesn't affect the display result and no line distortion; acceptable 2. Non-regular Newton ring  ① Newton ring area>1/2 T/P area, or no matter how big as long as it affects the display result; not acceptable Newton ring area≤1/2 T/P area, and doesn't affect the display result and witouth line distortion; acceptable	Minor defect

NO	Inspection item	inspection criteria	defect grade
10.6.2.6	FPC	1. copper foil off, warping, crack and oxidation are not allowed 2. FPC crack, break, serious scratch and crease are not allowed	main defect
		3. if no special requirements, no release paper on double-sided adhesive FPC is not allowed. 4. Slight creases and scratches not exposed from the copper foil and with no affect to appearance and function are allowed. 5. if no special requirements, no insulating tape at welding part on backlight and touch-screen is not allowed.. 6. Parts off, breakage and deform are not allowed. 7. print on the surface should be clear and correct.	Minor defect
10.6.2.7	basic appearance requirements	1. clean appearance, no dirt, fingerprints and other traces. 2. ITO circuit on COG coating area should not be exposed. 3. Rust, sever scratch, deformation, obvious burrs and color dirt are not allowed. 4. Mis-assembly, part missing are not allowed. 5. Bubble caused by mis-pasted polaroid refers to 10.6.2.1 6. For watermark, the criteria is upon agreed by both parties.	Minor defect

10.6.3 electric defect

No	Inspection item	inspection criteria	defect grade
10.6.3.1	picture defect	Non-display, more or less image and display defect are not allowed.	main defect
10.6.3.2	bright/dark line	Not allowed.	main defect
10.6.3.3	display dot defect	1. one dot is acceptable. 2. Under bright status, 2 dark dots with more than 5mm distance is allowed. 3. Totally 2 bright or dark dots are acceptable. 4. The other defect under bright status refers to 10.6.2.1 Note: Electric bright/dark dot means one pixel; less than 1/2 of 1 pixel can be ignored.	Minor defect
10.6.3.4	connected dot/line defect	1. Two continuous defect pixel connected dots are not allowed. 2. Line defect refers to 10.6.2.2	Minor defect
10.6.3.5	wrong view direction	Wrong view directions, such as opposite view angle, are not allowed.	main defect
10.6.3.6	back light defect	1. Backlight off are not allowed. 2. Uneven light, dead light, flicker light, dark angle, light leakage are not allowed. 3. Brightness should comply with drawing	main defect