PALM TECHNOLOGY CO., LTD.

The LCD(M) Specialist

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PART NO. : PT0434827T-A413-F

FOR MESSRS. : _____

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15.08.21
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ACCEPTED BY : _____ PROPOSED BY : _____

RECORD OF REVISION

DATE	PAGE	MMARY
2012/03/08	ALL	-
2012/04/23	P13	Modify Interface Pins Definition
2012/05/29	P5	Modify 5.1. Backlight Characteristics a. Modify the Min(18→27), Typ(19.2→27.9) & Max(21→28.8) of Forward Voltage, please refer to. b. Modify the VF from 19.2V to 27.9V of Forward Current, please refer to c. Add the LED Lifetime, please refer to
	P21	Modify 16. Assembly Drawing a. Modify the FPC tolerance, please refer to
2013/12/25	P3 P4 P5 P6 P7	Modify Display Colors 32.768K → 16M ADD DC Characteristics Modify Forward Voltage 27.9 → 28.8 Modify Terminal Resistance Modify Activation Force Modify Brightness 370 → 440
2015/08/21	P7	Modify Optical characteristics

3. General specifications

3.1 General specifications

It is a color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses the amorphous silicon TFT as a switching devices. This model is composed of a Transmissive type TFT-LCD Panel, a driver circuit and a back-light unit and a touch panel.

3.2 Features

- High image quality a-Si TFT LCD module.
- 16.7M color number.
- Support 24-bit parallel (RGB) input mode
- High contrast, high brightness
- Low power consumption.

4. Mechanical data

No	Item	Specification	Remark
1	Type	Transmissive	--
2	Display Mode	Normally White	--
3	Pixel Element	a-Si TFT	--
4	Screen Size	4.3inch	--
5	Resolution	480(RGB) x 272	--
6	Module Outline	105.50 (W) x 67.20 (L) (mm)	--
7	TP Viewing Area	98.70 (W) x 57.50 (L) (mm)	--
8	TP Active Area	96.70 (W) x 55.50 (L) (mm)	--
9	Active Area	95.04 (W) x 53.85 (L) (mm)	--
10	Pixel Size	0.198 x 0.198 (mm)	--
11	Color Arrangement	RGB-stripe	--
12	Assembly Type	COG	--
13	Back Light	LED	--
14	Good Viewing Direction	12 o'clock	--
15	Gray Scale Inversion Direction	6 o'clock	--
16	Weight	TBD	g
17	Panel Maker	CMI	--

5. Absolute maximum ratings

5.1 Electrical absolute maximum ratings

(1) TFT-LCD Panel Absolute Maximum Ratings

Ta=25℃

Item	Symbol	Condition	Standard Value		Unit	Remark
			Min.	Max.		
Power supply voltage	VDD	GND=0V	-0.3	4.5	V	--
Logic Input Signal	Vin		-0.3	4.5	V	--

* If the LSI is used above these absolute maximum ratings, it may become permanently damaged. Using the LSI within the following electrical characteristics limit is strongly recommended for normal operation. If these electrical characteristic conditions are also exceeded, the LSI will malfunction and cause poor reliability.

(2) Back-Light Unit

Ta=25℃

Item	Symbol	Min.	Max.	Unit	Remark
Current	I_{LED}	--	25	mA	--

5.2 Environmental absolute maximum ratings

Item	Symbol	Min.	Max.	Unit	Remark
Operation temperature range	Top	-20	70	℃	Ambient
Storage temperature range	Tst	-30	80	℃	Ambient

(1) Corrosive gas environment is not acceptable.
(2) TFT-LCD color will change slightly depending on environment temperature. This phenomenon is reversible.

6. Electrical characteristics

(1) TFT-LCD Module

Ta=25℃

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Power Supply	VDD	3.1	3.3	3.5	V	--
Operating Current	IDD	--	--	25	mA	--
High level input voltage	VIH	0.8VDD	--	VDD	V	NOTE (1)
Low level input voltage	VIL	0	--	0.2VDD	V	

NOTE(1)：CLK , DE , R0~R7 , G0~G7 , B0~B7

(2) Back-Light Unit

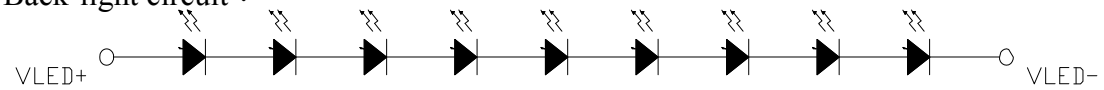
Ta=25℃

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Forward Voltage	VLED	25.2	27.0	30.6	V	NOTE (1)
Forward current	ILED	--	20	--	mA	--
Life Time	Lf	25,000	(50,000)	--	Hrs	NOTE (2)

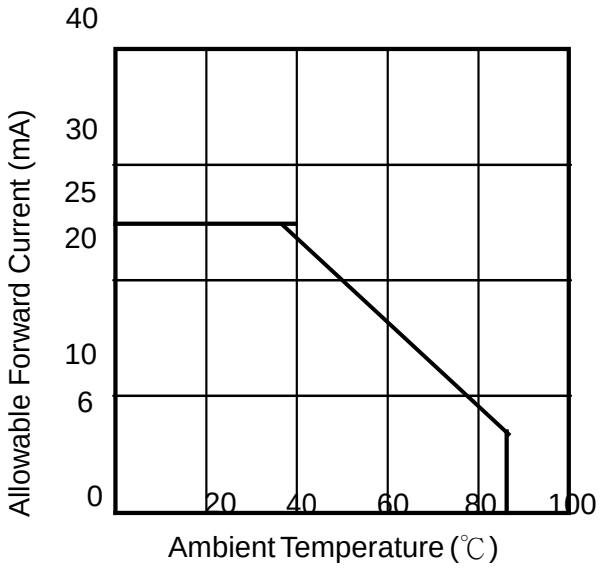
NOTE (1)：The LEDs is serial type.

NOTE (2)：The LED operating life means brightness goes down to maximum 30% of initial brightness, typical operating life time is estimated data.
The LED lifetime could be decreased if operating ILED is larger than 20mA.

NOTE (3)：Back-light circuit：



NOTE (4)：Current reduction rate of LED backlight is according to the graph indicated below：



7. Touch screen panel specifications

7.1 Electrical characteristics

Circuit grade：5V(DC),1mA
Transparency：film with glass model≥80%
Haze：6.5%±2.0
Reflection（@550nm）：11%
Insulation resistan1ce : Analog type — 25V(DC) 、20MΩ↑
Up circuit resistance：400±50Ω
Lower circuit resistance：500±50Ω
X1-X2：100Ω~500 Ω
Y1-Y2：500 Ω~ 1100 Ω
Chattering Time：≤15ms
Linearity：≤1.5%
Punching Life：≥1000000（with the R3.0 silicon rubber）
Life with pen touch：≥100000

7.2 Mechanical Specification

Operation force: 30-100g
Transparency：film with glass model≥80%
Surface Hardness： >3H
Heat Seal Strength: FX>2 ㎏、FY＞500g、FZ＞150g, after three directions pulling force tests the product function is normal.
Testing method:
With manual pulls the Ergometer separately to carry on the testing for X.Y.Z three directions, and test again the product's function.

7.3 Durability

Operation temperature：-20℃～+70℃
Deposited temperature：-30℃～+80℃
High temperature：70℃,72Hr.
Constant temperature and humidity：60℃, 90%/RH, 72 Hr.

8. Optical characteristics

Ta=25℃ , ILED=20mA

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Brightness		B	θ=0° Normal viewing angle At the center of panel	380	420	--	cd/m^2	(1)
Contrast Ratio		C/R		--	500	--	--	(2)
Response Time		Tr		--	5	--	ms	(3)
		Tf		--	15	--		
Color chromaticity	White	Wx		(0.267)	(0.317)	(0.367)	--	--
		Wy		(0.304)	(0.354)	(0.404)		
	Red	Rx		(0.544)	(0.594)	(0.644)	--	--
		Ry		(0.326)	(0.376)	(0.426)		
	Green	Gx		(0.314)	(0.364)	(0.414)	--	--
		Gy		(0.538)	(0.588)	(0.638)		
	Blue	Bx		(0.091)	(0.141)	(0.191)	--	--
		By		(0.072)	(0.122)	(0.172)		
Viewing Angle	Top	θ_U	C/R≧10 Backlight On	60	70	--	Deg.	(4)
	Bottom	θ_D		40	50	--		
	Left	θ_L		60	70	--		
	Right	θ_R		60	70	--		
Uniformity		Un	θ=0° Normal viewing angle	80	--	--	%	(5)

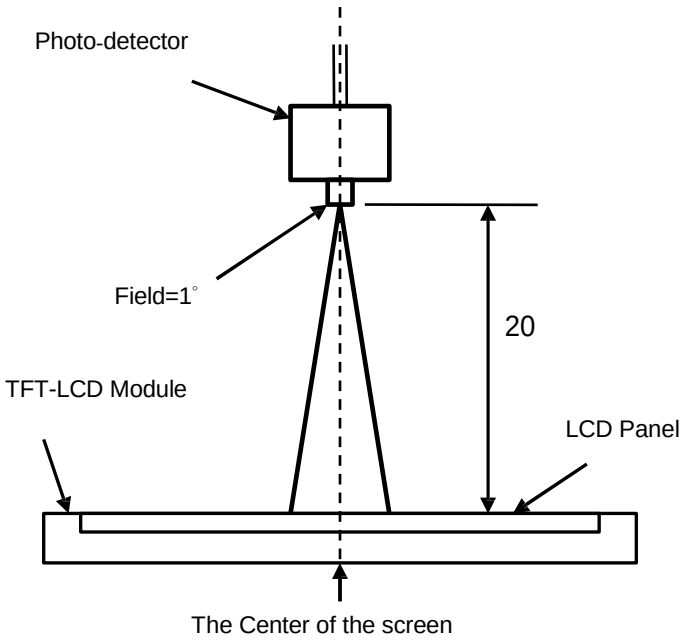
Note 1: The brightness test equipment setup

BM7

I_{LED}=20mA, Field=1°

(As measuring "black" image, field=1°

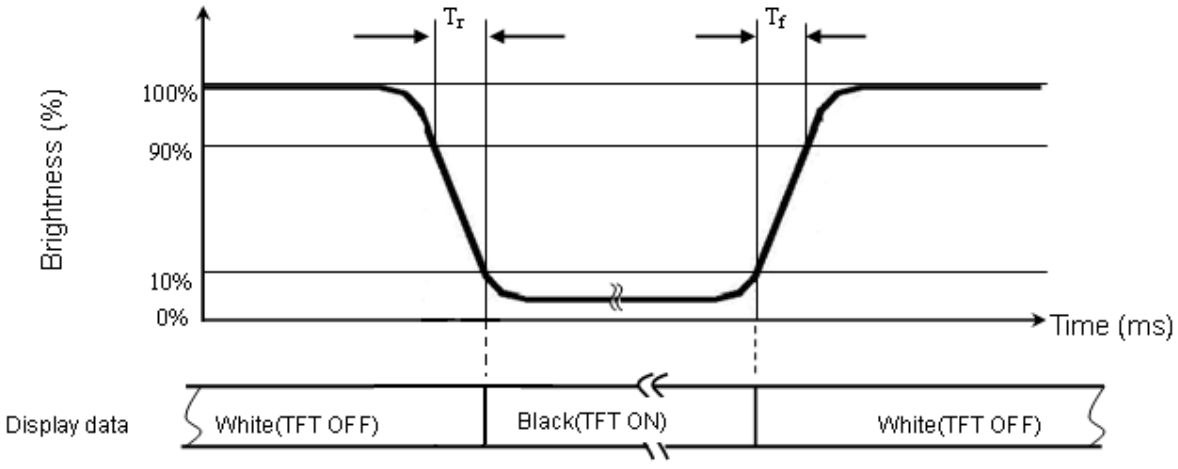
Is the best testing condition.)



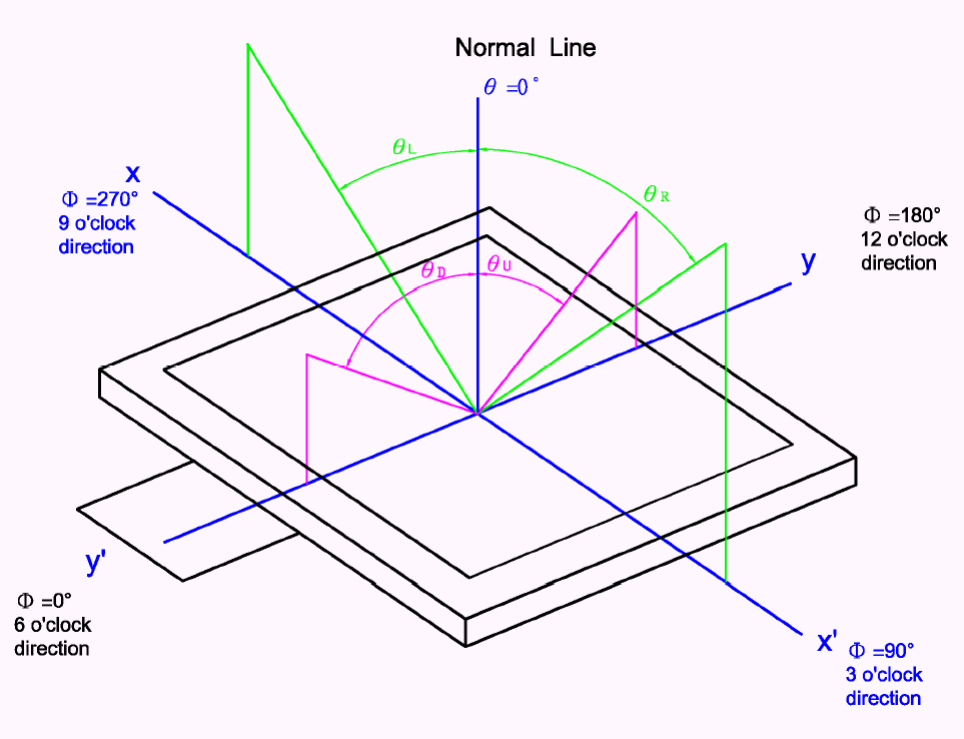
Note 2: Definition of contrast Ratio (C/R)

$$C/R = \frac{\textbf{Brightness When LCD is at "White" State}}{\textbf{Brightness When LCD is at "Black" State}}$$

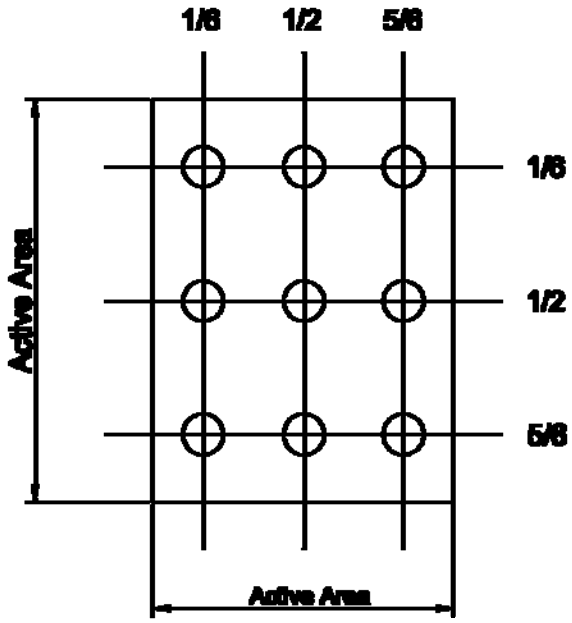
Note 3: Definition of response time



Note 4: Definition of viewing angle

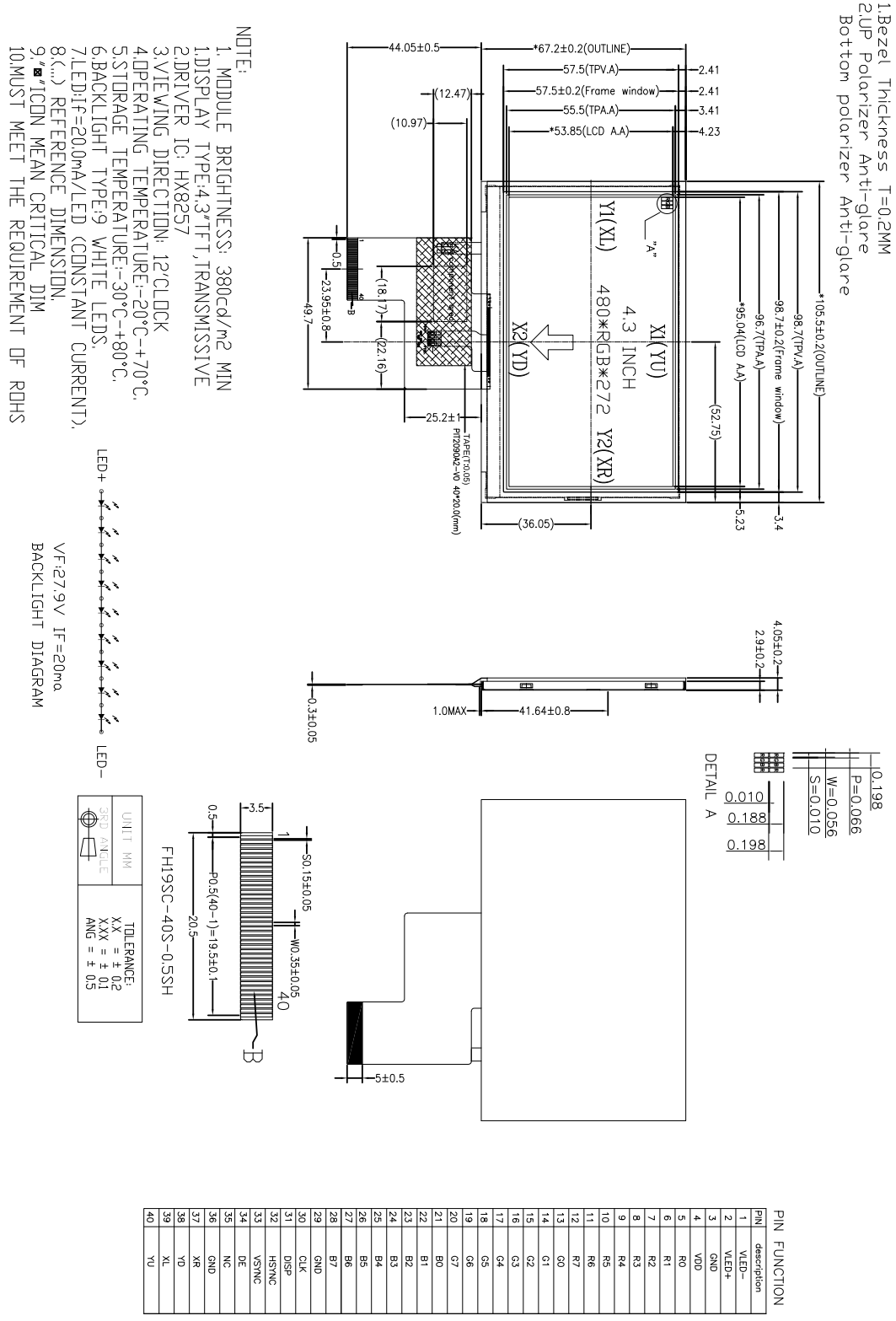


Note 5: Definition of uniformity (Un)



$$Un = \frac{Bmin}{Bmax}$$

9. Outline dimension

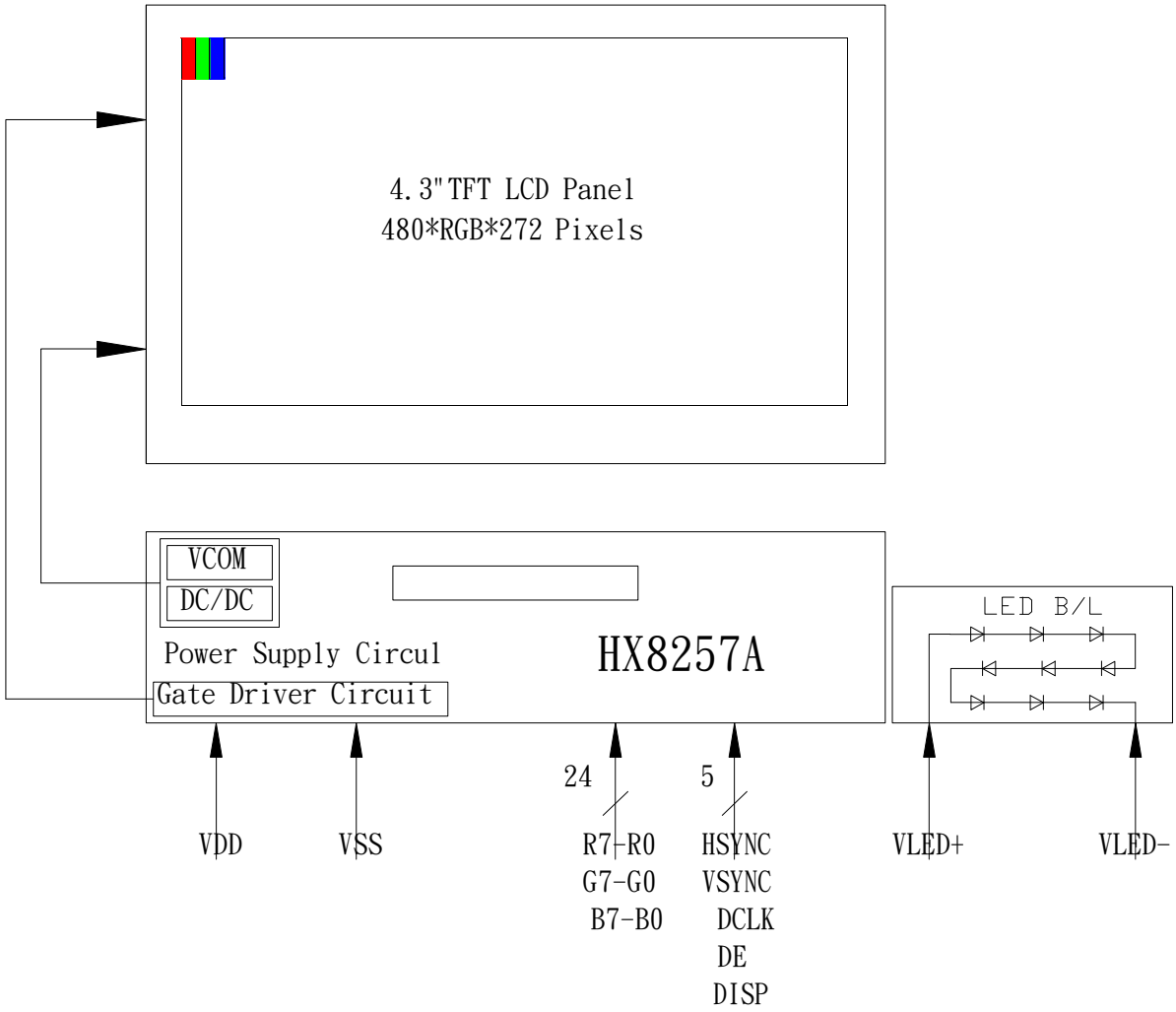


PIN FUNCTION

PIN	description
1	VLED-
2	VLED+
3	GND
4	VDD
5	R0
6	R1
7	R2
8	R3
9	R4
10	R5
11	R6
12	R7
13	G0
14	G1
15	G2
16	G3
17	G4
18	G5
19	G6
20	G7
21	B0
22	B1
23	B2
24	B3
25	B4
26	B5
27	B6
28	B7
29	GND
30	CLK
31	DISP
32	HSYNC
33	VSYNC
34	DE
35	NC
36	GND
37	XR
38	YD
39	XL
40	YU

10. Block diagram

10.1 TFT-LCD Module (Interface System Structure)



11. Input Terminal Pin Assignment

11.1 Input Signal & Power

Pin no	Symbol	Description	Remark
1	VLED-	LED Ground	-
2	VLED+	LED Power	-
3	GND	Ground	-
4	VDD	Digital Power	-
5	R0	Red data bit 0	-
6	R1	Red data bit 1	-
7	R2	Red data bit 2	-
8	R3	Red data bit 3	-
9	R4	Red data bit 4	-
10	R5	Red data bit 5	-
11	R6	Red data bit 6	-
12	R7	Red data bit 7	-
13	G0	Green data bit 0	-
14	G1	Green data bit 1	-
15	G2	Green data bit 2	-
16	G3	Green data bit 3	-
17	G4	Green data bit 4	-
18	G5	Green data bit 5	-
19	G6	Green data bit 6	-
20	G7	Green data bit 7	-
21	B0	Blue data bit 0	-
22	B1	Blue data bit 1	-
23	B2	Blue data bit 2	-
24	B3	Blue data bit 3	-
25	B4	Blue data bit 4	-
26	B5	Blue data bit 5	-
27	B6	Blue data bit 6	-
28	B7	Blue data bit 7	-
29	GND	Ground	-
30	DCLK	Clock signal for data latching and internal counter of the timing controller	-

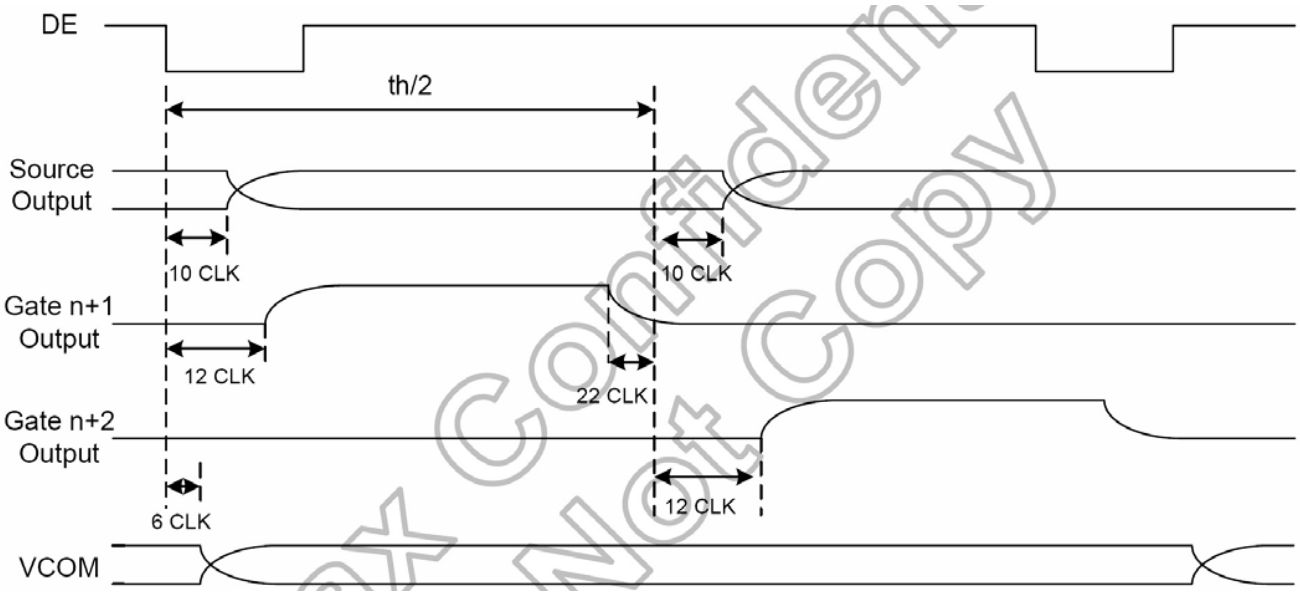
Pin no	Symbol	Description	Remark
31	DISP	Display on/off mode control	-
32	HSYNC	Horizontal sync input	-
33	VSYNC	Vertical sync input	-
34	DE	Data Enable Control	-
35	NC	NO CONNECT	-
36	GND	Ground	-
37	XR	Right	-
38	YD	Down	-
39	XL	Left	-
40	YU	Up	-

12. Timing Characteristics

12.1 AC Characteristics

The HX8257-A both supports DE mode and Sync mode timing. The mode was decided by DE signal internally. When DE is pulled low, the HX8257-A uses HS+VS for timing control and this timing mode is sync mode. When DE is pulled high for active data and pulled low for blanking data , the HX8257-A uses DE for timing control and this timing mode is DE mode. The detail timing chart showed below.

Clock and Data Input Timing Diagram



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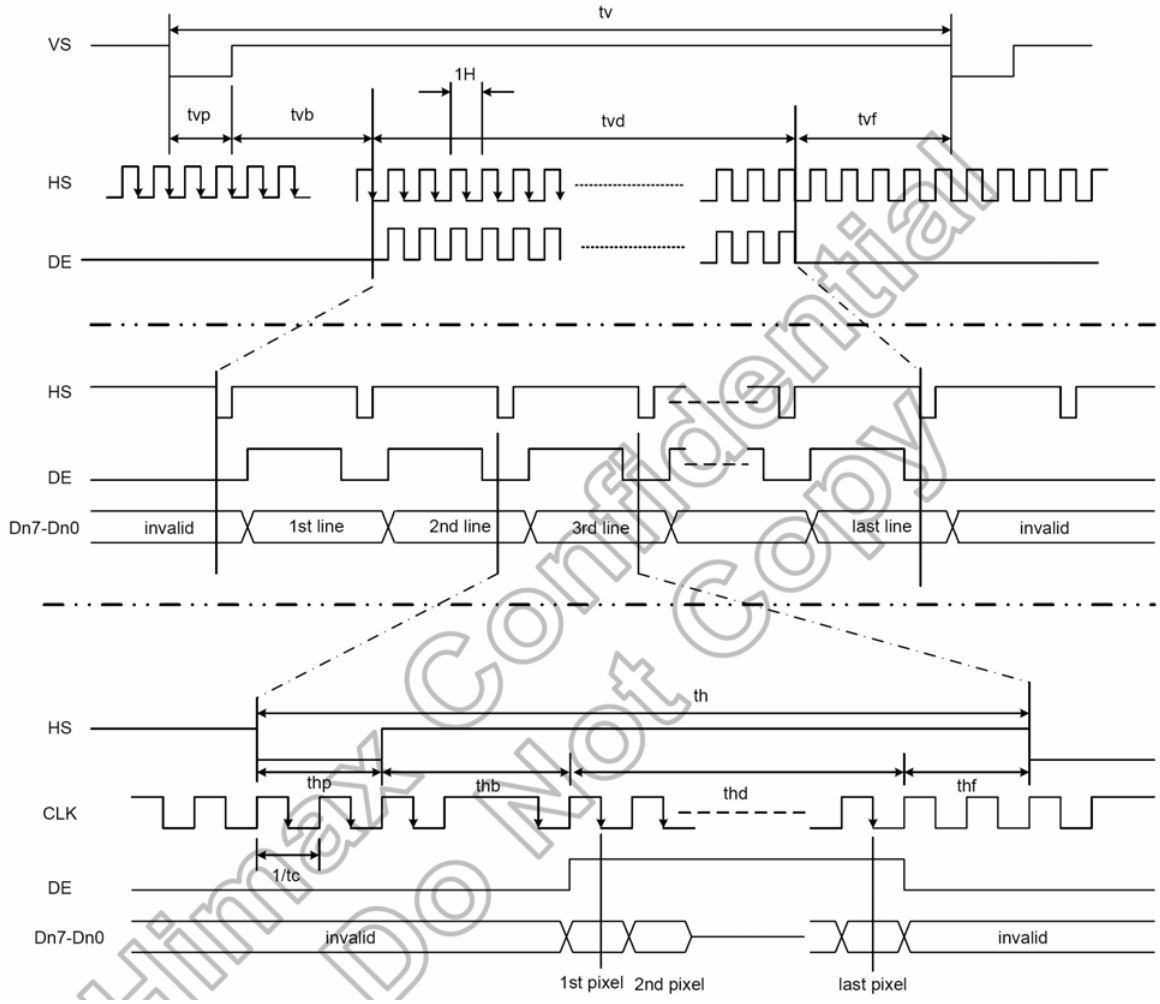
12.2 Timing Conditions

Parallel RGB Input Timing Table

Parameter	Symbol	Spec.			Unit
		Min.	Typ.	Max.	
Clock cycle	f_{CLK} (1)	-	9	15	MHz
Hsync cycle	1/th	-	17.14	-	KHz
Vsync cycle	1/tv	-	59.94	-	Hz
Horizontal Signal					
Horizontal cycle	th	525	525	605	CLK
Horizontal display period	thd	480	480	480	CLK
Horizontal front porch	thf	2	2	82	CLK
Horizontal pulse width	thp (2)	2	41	41	CLK
Horizontal back porch	thb (2)	2	2	41	CLK
Vertical Signal					
Vertical cycle	tv	285	286	399	H (1)
Vertical display period	tvd	272	272	272	H (1)
Vertical front porch	tvf	1	2	227	H (1)
Vertical pulse width	tvp (2)	1	10	11	H (1)
Vertical back porch	tvb (2)	1	2	11	H (1)

Note: (1) Unit: CLK=1/ f_{CLK} , H= th,
(2) It is necessary to keep tvp+tvb=12 and thp+thb=43 in sync mode. DE mode is unnecessary to keep it.

RGB Input Timing Diagram



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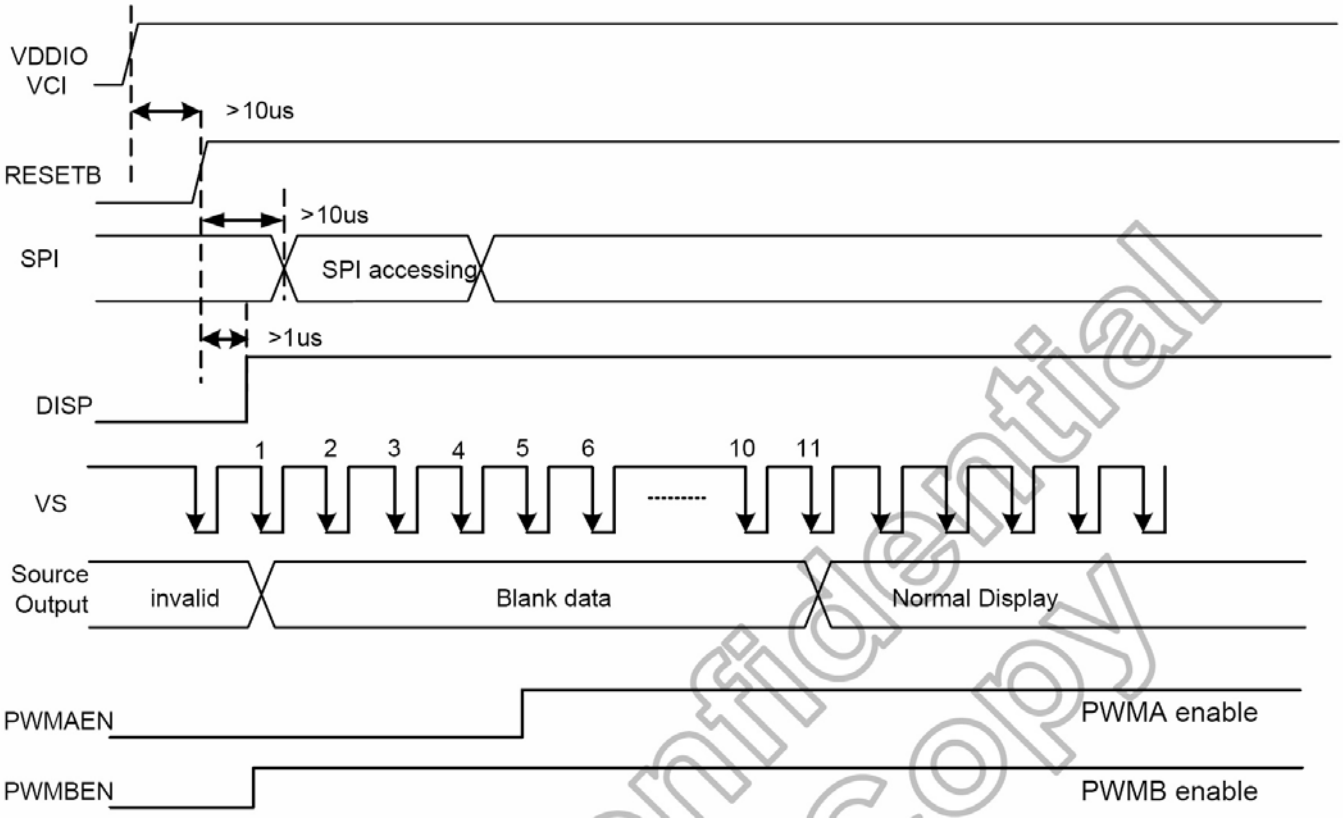
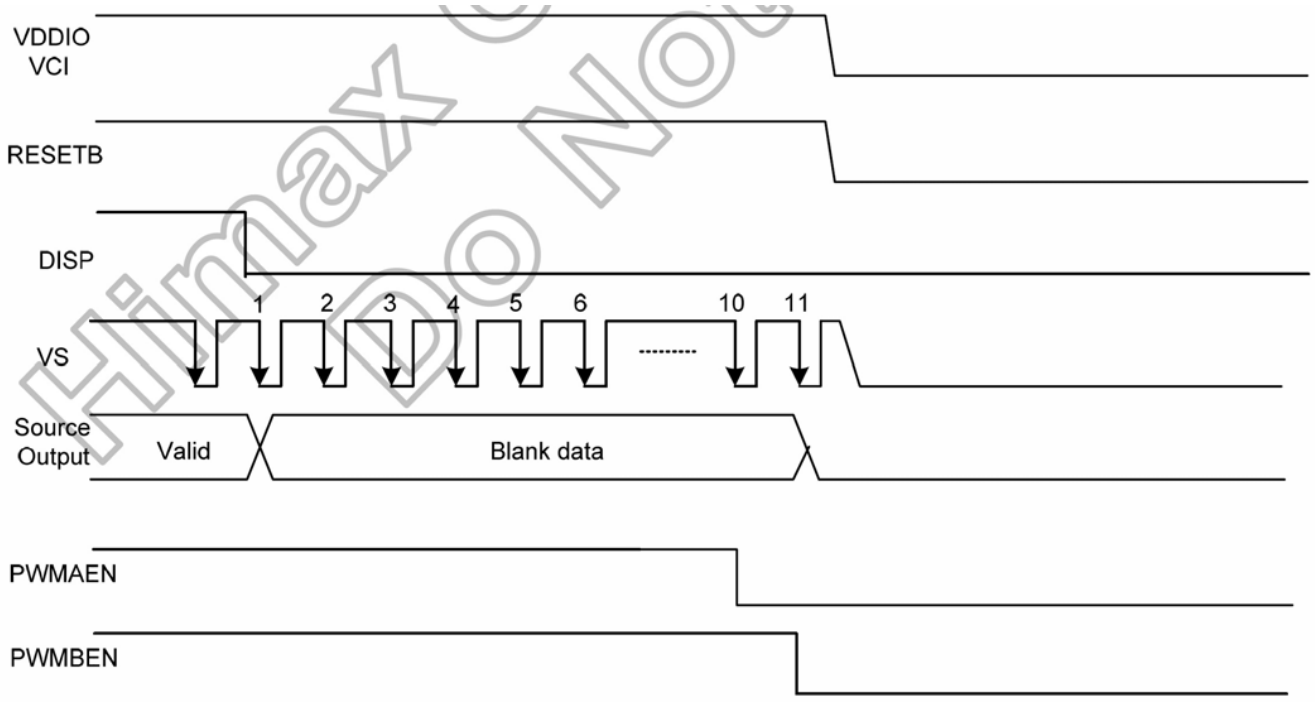
12.3 Power On/Off Sequence

Power On



Power Off



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13. Driver IC Control Algorithms

Refer to the data Sheet of LCD DRIVER HX8257A

14. Reliability Test Items

No.	Test items	Conditions	Remark
1	High temperature operation	70℃ , 240hours	--
2	Low temperature operation	-20℃ , 240hours	--
3	High temperature storage	80℃ , 240hours	
4	Low temperature storage	-30℃ , 240hours	
5	High temperature & high humidity storage	60℃ , 90% RH , 240hours	--
6	Thermal Shock storage	-20℃ , 30min. ~ 70℃ , 30min. , 100 Cycles	--
7	Vibration test	Freq.:10~55~10~55~10 Hz, Amplitude：1.5 mm. 2 hours for each direction of X, Y, Z	Non-operation
8	Electrostatic discharge	±2KV, Human Body Mode, 100pF / 1500Ω	Non-operation

Criterion: There should be no change which might affect the practical display function when the display quality test is conducted under normal operating condition.

15. Quality Assurance

15.1 Purpose

This standard for Quality Assurance assures the quality of LCD module products supplied to customer

15.2 Agreement Items

Customer shall negotiate if the following situation occurs:

15.2.1 Discrepancies between Palm Tech's QA standards and customer's QA standards.

15.2.2 Additional requirement to be added in product specification.

15.2.3 Any other special problem.

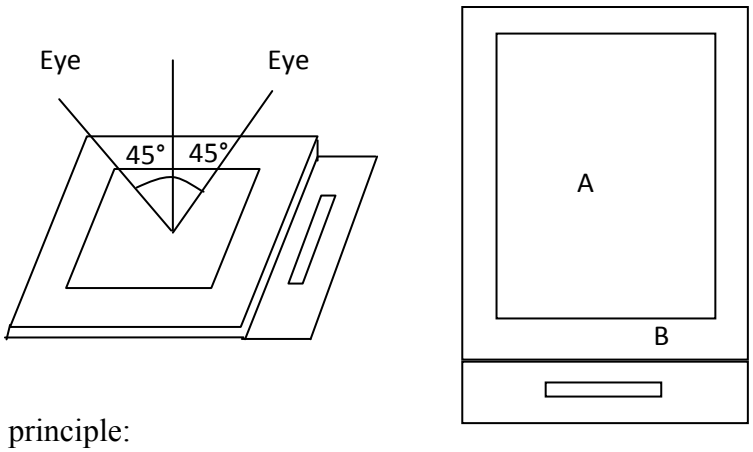
15.3 Standard of the Product Visual Inspection

15.3.1 Appearance inspection:

15.3.1.1 The inspection must be under illumination about 1000 – 1500 lx, and the distance of view must be at 30cm ± 2cm.

15.3.1.2 The viewing angle should be 45° from the vertical line without reflection light or follows customer's viewing angle specifications.

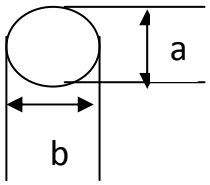
15.3.1.3 Definition of area: A Zone: Active Area, B Zone: Viewing Area,

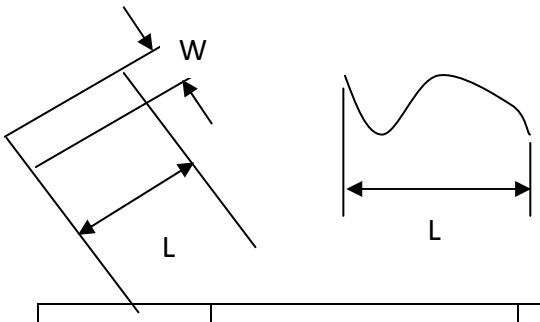


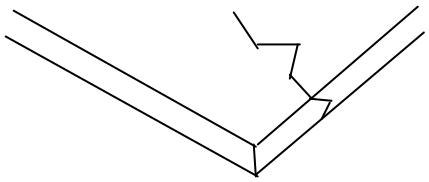
15.3.2 Basic principle:

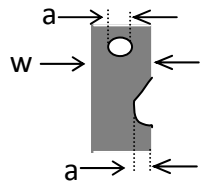
15.3.2.1 A set of sample to indicate the limit of acceptable quality level must be discussed by when there is any dispute happened.

15.4. Inspection Specification

<table>
<tr><th>No.</th><th>Item</th><th>Criteria (Unit: mm)</th></tr>
<tr><td>01</td><td>Black / White spot
Foreign material
(Round type)
Pinholes
Stain
Particles inside cell.
(Minor defect)</td><td> 

φ= (a + b) /2
Distance between 2 defects should more than 3mm apart.
<table>
<tr><th>Area / Size</th><th>Acc. Qty</th></tr>
<tr><td>φ≤0.10</td><td>Ignore</td></tr>
<tr><td>0.10<φ≤0.20</td><td>2</td></tr>
<tr><td>0.20<φ≤0.25</td><td>1</td></tr>
<tr><td>0.25<φ</td><td>0</td></tr>
<tr><td>Total</td><td>2 no include φ≤ 0.10</td></tr>
</table></td></tr>
<tr><td>02</td><td>Black and White line
Scratch
Foreign material
(Line type)
(Minor defect)</td><td> 

<table>
<tr><th>Length</th><th>Width</th><th>Acc. Qty</th></tr>
<tr><td>/</td><td>W ≦ 0.03</td><td>Ignore</td></tr>
<tr><td>L ≦ 2</td><td>0.03 < W ≦ 0.05</td><td>1</td></tr>
<tr><td>/</td><td>0.05 < W</td><td>0</td></tr>
<tr><td colspan="2">Total</td><td>1</td></tr>
</table>
Distance between 2 defects should more than 3mm apart. Scratches not viewable through the back of the display are acceptable.</td></tr>
<tr><td>03</td><td>Glass Crack
(Minor defect)</td><td> 
LCD with extensible crack line is unacceptable(When press the cracked LCD area, the line will expand, we define it is extensible crack line)</td></tr>
</table>

<table>
<tr><td>04</td><td>FPC Defect:
(Minor defect)
  </td><td>4.1 Dent, pinhole width a<w/3.
(w: circuitry width.)
4.2 Open circuit is unacceptable.
4.3 No oxidation, contamination and distortion.</td></tr>
<tr><td>05</td><td>Bubble on Polarizer
(Minor defect)</td><td colspan="2"><table><tr><th>Diameter</th><th>Acc. Qty</th></tr><tr><td>φ≤0.20</td><td>Ignore</td></tr><tr><td>0.20 <φ≤0.30</td><td>2</td></tr><tr><td>0.30 < φ</td><td>None</td></tr></table></td></tr>
<tr><td>06</td><td>Dent on Polarizer
(Minor defect)</td><td colspan="2"><table><tr><th>Diameter</th><th>Acc. Qty</th></tr><tr><td>φ≤0.20</td><td>Ignore</td></tr><tr><td>0.20 <φ≤0.30</td><td>2</td></tr><tr><td>0.30 < φ</td><td>None</td></tr></table></td></tr>
<tr><td>07</td><td>Bezel</td><td colspan="2">7.1 No rust, distortion on the Bezel.
7.2 No visible fingerprints, stains or other contamination.</td></tr>
<tr><td>08</td><td>Touch Panel</td><td colspan="2">D: Diameter W: width L: length
8.1 Spot: D≤0.20 is acceptable
0.20<D≤0.3, acceptable QTY, 3
2dots are acceptable and the distance between defects should more than 10 mm.
D>0.3 is unacceptable
8.2 Dent: D>0.30 is unacceptable
8.3 Scratch: W≤0.03, L≤10 is acceptable,
0.03<W≤0.10, L≤10 ,acceptable QTY, 3
Distance between 2 defects should more than 10 mm.
W>0.10 is unacceptable.</td></tr>
<tr><td>09</td><td>PCB</td><td colspan="2">9.1 No distortion or contamination on PCB terminals.
9.2 All components on PCB must same as documented on the BOM/component layout.
9.3 Follow IPC-A-600F.</td></tr>
<tr><td>10</td><td>Soldering</td><td colspan="2">Follow IPC-A-610C standard</td></tr>
</table>

11	Electrical Defect (Major defect)	The below defects must be rejected. 11.1 Missing vertical / horizontal segment, 11.2 Abnormal Display. 11.3 No function or no display. 11.4 Current exceeds product specifications. 11.5 LCD viewing angle defect. 11.6 No Backlight. 11.7 Dark Backlight. 11.8 Touch Panel no function. 11.9 Dark Dot –one Allowed. 11.10 Bright Dot – one Allowed. Remark: 1. A pixel defect is acceptable if one color is none functional and causes a bright dot. The display may have one case where one color is out and cause a dark dot. 2. Bright dot caused by scratch and foreign object accords to item 1.

Remark: Visual and cosmetic defects are rejectable only if these fall within the LCD viewing area.

15.5. Classification of Defects

15.5.1 Visual defects (Except no / wrong label) are treated as minor defect and electrical defect is major.

15.5.2 Two minor defects are equal to one major in lot sampling inspection.

15.6. Identification/marking criteria

Any unit with illegible / wrong /double or no marking/ label shall be rejected.

15.7. Packing

15.7.1 There should be no damage of the outside carton box, each packaging box should has label in the correct location per packing drawing requirement.

15.7.2 All direct package materials shall offer ESD protection.

16. General Precautions

Please pay attentions to the followings as using the LCD module.

16.1 Handling

(a) Do not apply strong mechanical stress like drop, shock or any force to LCD module. It may cause improper operation, even damage.

(b) Because the polarizer is very fragile and easy to be damaged, do not hit, press or rub the display surface with hard materials.

(c) Do not put heavy or hard material on the display surface, and do not stack LCD modules.

(d) If the display surface is dirty, please wipe the surface softly with cotton

(e) swab or clean cloth.

(f) Avoid using Ketone type materials (e.g. Acetone), Toluene, Ethyl acid or Methyl chloride to clean the display surface. It might damage the polarizer permanently. The recommended solvents are water and Isopropyl alcohol.

(g) Wipe off water droplets or oil immediately.

(h) Protect the LCD module from ESD. It will damage the LSI and the electronic circuit.

(i) Do not touch the output pins directly

with bare hands. (I) Do not disassemble the

LCD module.

16.2 Storage

(a) Do not leave the LCD modules in high temperature, especially in high humidity for a long time.

(b) Do not expose the LCD modules to sunlight directly.

(c) The liquid crystal is deteriorated by ultraviolet. Do not leave it in strong ultraviolet ray for a long time.

(d) Avoid condensation of water. It may cause improper operation.

(e) Please stack only up to the number stated on carton box for storage and transportation.
Excessive weight will cause deformation and damage of carton box.

16.3 Operation

(a) When mounting or dismounting the LCD modules, turn the power off.

(b) Protect the LCD modules from electric shock.

(c) The Driver IC control algorithms should always obeyed to avoid damaging the LSI and electronic circuit.

(d) Be careful to avoid mixing up the polarity of power supply for backlight.

(e) Absolute maximum rating specified above has to be always kept in any case. Exceeding it may cause non-recoverable damage of electronic components or, nevertheless, burning.

(f) When a static image is displayed for a long time, remnant image is likely to occur.

(g) Be sure to avoid bending the FPC to an acute shape, it might break FPC.

16.4 Others

(a) If the liquid crystal leaks from the panel, it should be kept away from the eyes or mouth.

(b) For the fragility of polarizer, it is recommended to attach a transparent protective plate over the display surface.

(c) It is recommended to peel off the protection film on the polarizer slowly so that the electrostatic charge can be minimized.