Display Elektronik GmbH

DATA SHEET

TFT MODULE

DEM 480800A1 VMH-PW-N

4,0" TFT

Product Specification   Ver.: 2

14.09.2016

Revision History

Revision	Date	Detail	Remarks
0	25.07.2016	Initial Release	-
1	02.08.2016	Modify IC & Timing	P4 / P11
2	14.09.2016	Add Weight Modify Current Modify Pin Definition	P4 P5 P10

Table of Contents

1.   General Description

The specification 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, driver Ics, a backlight unit.

2.   Module Parameter

Features	Details	Unit
Display Size (Diagonal)	4.0"	-
LCD Type	IPS TFT	-
Display Mode	Transmissive / Normally Black	-
Resolution	480 x RGB x 800	Pixels
View Direction	Full Viewing	Best Image
Module Outline	56.14 x 95.50 x 1.80 (Note1)	mm
Active Area	51.84 x 86.40	mm
Pixel Pitch	0.108 x 0.108	mm
Pixel Arrangement	RGB Vertical Stripe	-
Display Colors	16.7 Million	-
Interface	24-Bit-RGB + 9-Bit-SPI Interface	-
Driver IC	ILI9806 (Ilitek)	-
With or without the touch panel	without	-
Operating Temperature	-20 to +70	℃
Storage Temperature	-30 to +80	℃
Weight	22	g

Note 1: Inclusive hooks, posts, FFC/FPC tail etc.

3.   Absolute Maximum Ratings

V_{SS}=0V, Ta=25℃

Item	Symbol	Min.	Max.	Unit
Supply Voltage	VCC	-0.3	4.6	V
Storage Temperature	T_{STG}	-30	80	℃
Operating Temperature	T_{OP}	-20	70	℃

Note 1: If Ta below 50℃, the maximal humidity is 90%RH, if Ta over 50℃, absolute humidity should be less than 60%RH.

Note 2: The response time will be extremely slow when the operating temperature is around -10°C, and the back ground will become darker at high temperature operating.

4.　DC Characteristics

Item		Symbol	Min.	Typ.	Max.	Unit
Supply Voltage		VCC	2.5	2.8	3.3	V
Logic Low Level Input Voltage		VIH	0.7 VCC		VCC	
Logic Low Level Input Voltage		VIL	-0.3		0.3 VCC	
Logic Low Level Input Voltage		VOH	0.8 VCC		VCC	
Logic Low Level Input Voltage		VOL	0		0.2 VCC	
Current Consumption All Black	Logic	$I_{CC+}\ I_{IN}$	-	70	-	mA
	Analog					

5.　Backlight Characteristic

5.1.　Backlight Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward Voltage	V_F	Ta=25 ºC, I_F=15mA/LED	2.8	3.2	3.4	V
Forward Current	I_F	Ta=25 ºC, V_F=3.2V/LED	-	120	-	mA
Power Dissipation	P_D	-	-	384	-	mW
Uniformity	Avg	-	70	80	-	%
LED Lifetime (25°C)			20000	30000	-	Hrs
Drive Method	Constant Current					
LED Configuration	8 White LEDs (8 LEDs in parallel)					

Note1：LED life time defined as follows: The final brightness is at 50% of original brightness.

The environmental conducted under ambient air flow, at Ta=25±2 ºC, 60%RH±5%, I_F=15mA

5.2.　Backlighting Circuit
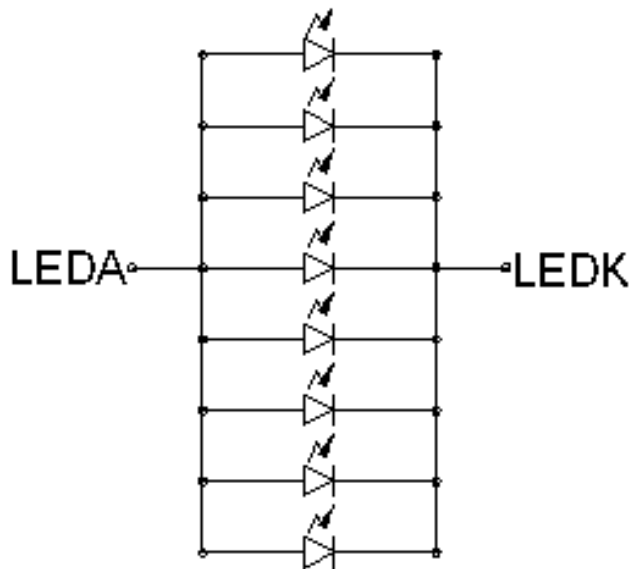
6. Optical Characteristics

6.1. Optical Characteristics

Ta=25ºC, VCC=2.8V, TN LC+ Polarizer

Item		Symbol	Condition	Specification			Unit
				Min.	Typ.	Max.	
Backlight On (Transmissive Mode)	Luminance on TFT(I_f=15mA/LED)	Lv		200	250	-	cd/m²
	Contrast Ratio(See 6.3)	CR		600	700	-	
	Response Time (See 6.2)	T_R+T_F		-	35	-	ms
	Chromaticity Transmissive (See 6.5) — Red	X_R		0.605	0.655	0.705	
	Red	Y_R		0.285	0.335	0.385	
	Green	X_G		0.255	0.305	0.355	
	Green	Y_G		0.594	0.644	0.694	
	Blue	X_B		0.091	0.141	0.191	
	Blue	Y_B		0.045	0.095	0.145	
	White	X_W		0.247	0.297	0.347	
	White	Y_W		0.312	0.362	0.412	
	Viewing Angle (See 6.4) — Horizontal	θ_{X+}	Center CR≥10	-	85	-	Deg.
	Horizontal	θ_{X-}	Center CR≥10	-	85	-	
	Vertical	φ_{Y+}	Center CR≥10	-	85	-	
	Vertical	φ_{Y-}	Center CR≥10	-	85	-	
	NTSC ratio（Color gamut）			-	69	-	%

6.2. Definition of Response Time
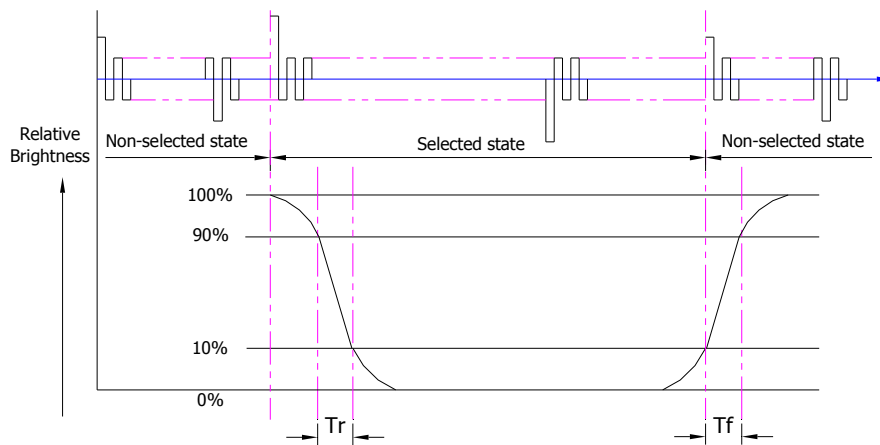
6.2.1. Normally Black Type (Negative)
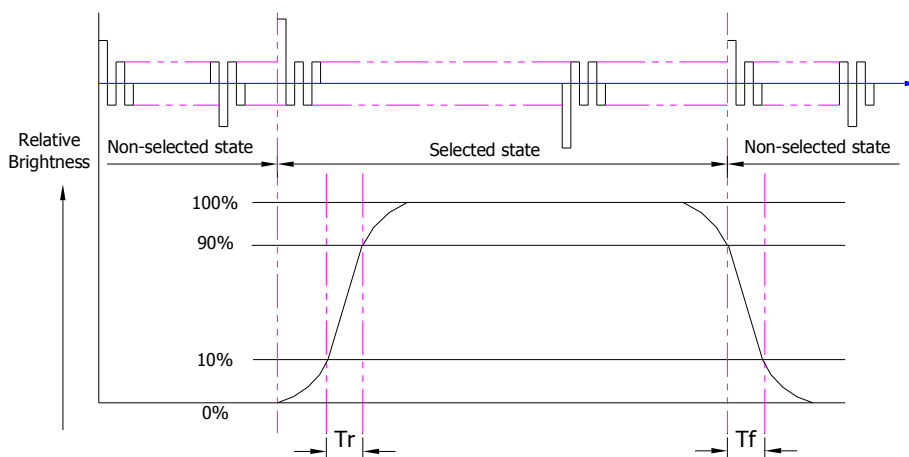
Tr is the time it takes to change form non-selected stage with relative luminance 10% to selected state with relative luminance 90%;

Tf is the time it takes to change from selected state with relative luminance 90% to non-selected state with relative luminance 10%.

Note: Measuring machine: LCD-5100

6.2.2. Normally White Type (Positive)

Tr is the time it takes to change form non-selected stage with relative luminance 90% to selected state with relative luminance 10%;

Tf is the time it takes to change from selected state with relative luminance 10% to non-selected state with relative luminance 90%;

Note: Measuring machine: LCD-5100 or EQUI

6.3. Definition of Contrast Ratio

Contrast is measured perpendicular to display surface in reflective and transmissive mode.

The measurement condition is:

Measuring Equipment	Eldim or Equivalent
Measuring Point Diameter	3mm//1mm
Measuring Point Location	Active Area centre point
Test pattern	A: All Pixels white
	B: All Pixel black
Contrast setting	Maximum

Definitions: CR (Contrast) = Luminance of White Pixel / Luminance of Black Pixel
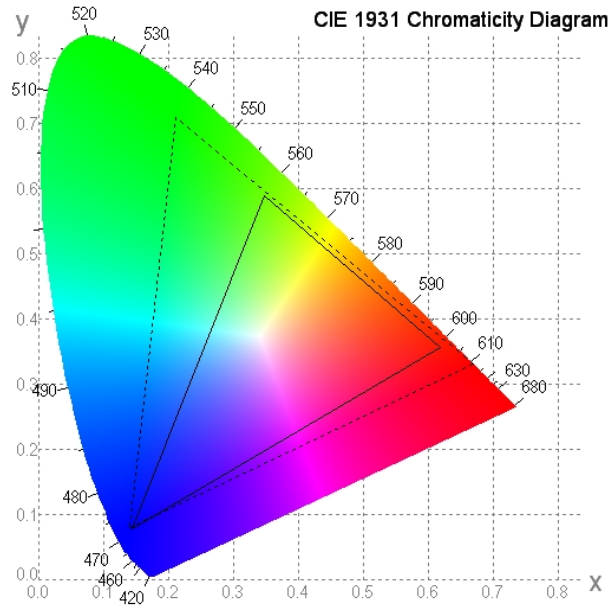
6.4. Definition of Viewing Angles
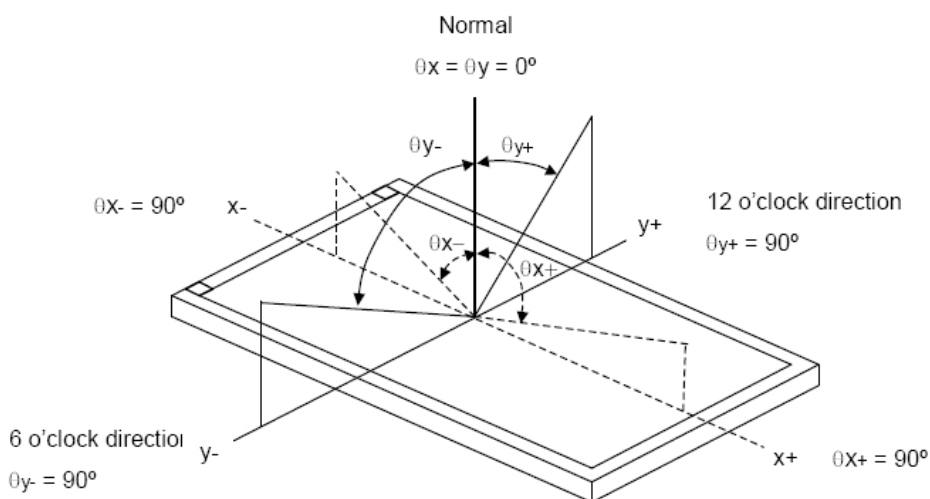
Measuring machine: LCD-5100 or EQUI

6.5. Definition of Color Appearance

R,G,B and W are defined by (x, y) on the IE chromaticity diagram

NTSC=area of RGB triangle/area of NTSC triangleX100%

Measuring picture: Red, Green, Blue and White (Measuring machine: BM-7)

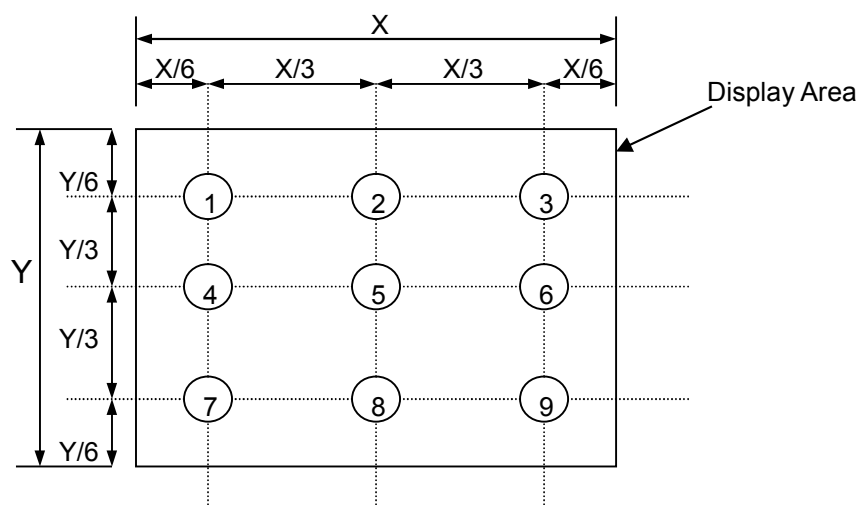### 6.6. Definition of Surface Luminance, Uniformity and Transmittance

Using the transmissive mode measurement approach, measure the white screen luminance of the display panel and backlight.
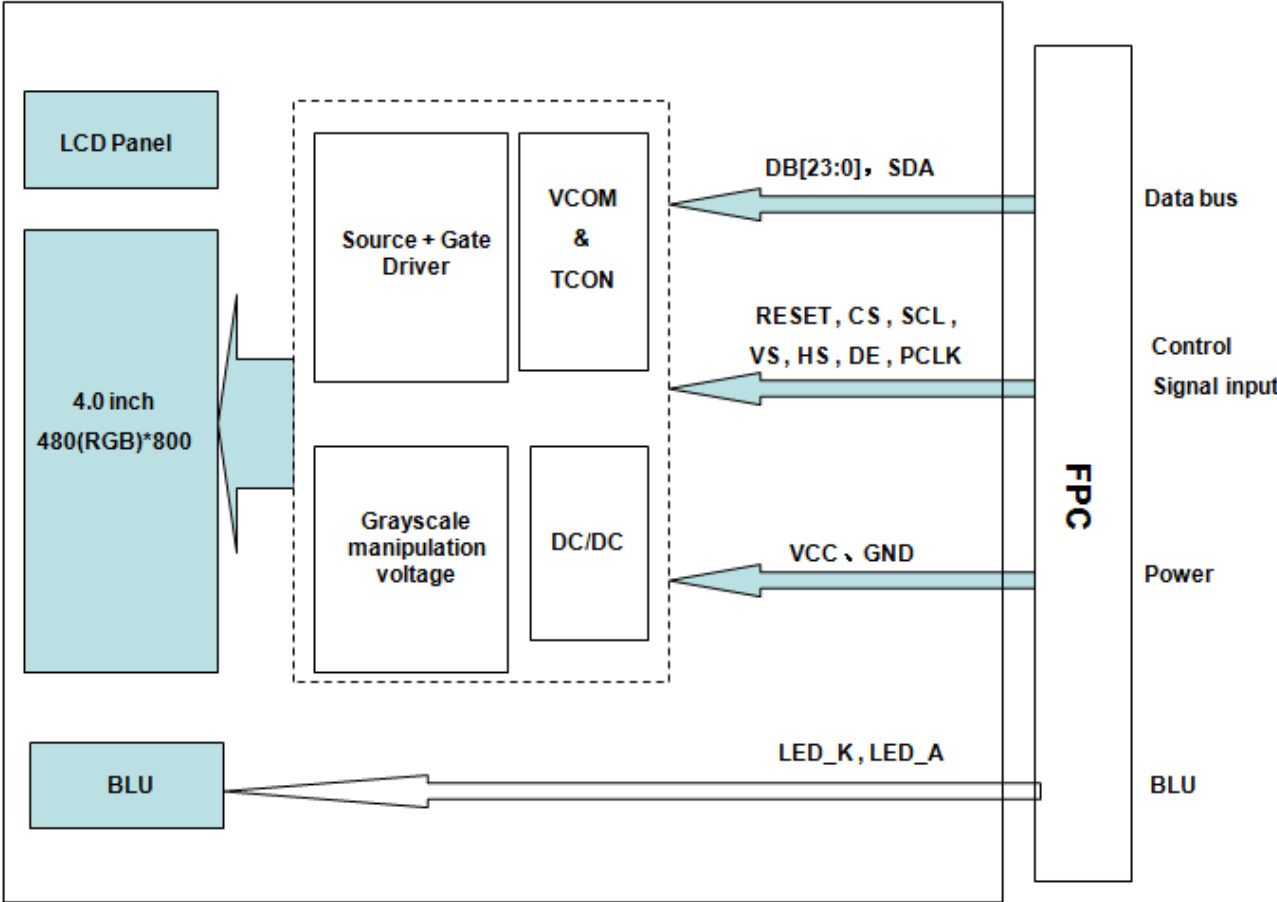
6.6.1.   Surface Luminance: L_V = average ($L_{P1}:L_{P9}$)

6.6.2.   Uniformity = Minimal ($L_{P1}:L_{P9}$) / Maximal ($L_{P1}:L_{P9}$) * 100%

6.6.3.   Transmittance = L_V on LCD / L_V on Backlight * 100%

Note: Measuring machine: BM-7

7. Block Diagram and Power Supply

8. Interface Pins Definition

Connector on TFT FPC: AXK8L40124B (Panasonic, or equivalent)

| No.	Symbol	Function	Note
1	LED-A	Anode	
2	LED-K	Cathode	
3	RESET	The external reset input	
4	VCC	Power supply	
5	CS	A chip select signal. Low: the chip is selected and accessible	
6	SCL	Serial Clock	
7	SDA	Serial data input/output bidirectional pin for SPI Interface	
8	GND	Ground	
9	PCLK	Dot clock signal for RGB interface operation	
10	VS	Frame synchronizing signal for RGB interface operation	
12	HS	Line synchronizing signal for RGB interface operation	
13	DE	Data enable signal for RGB interface operation	
14	GND	Ground	
15	DB0		
16	DB1		
17	DB2		
18	DB3		
19	DB4		
20	DB5		
21	DB6		
22	DB7		
23	DB8		
24	DB9		
25	DB10		
26	DB11	24-bit parallel data bus for RGB Interface	
27	DB12		
28	DB13		
29	DB14		
30	DB15		
31	DB16		
32	DB17		
33	DB18		
34	DB19		
35	DB20		
36	DB21		
37	DB22		
38	DB23		
39	GND	Ground	
40	GND	Ground	

9. AC Characteristics

9.1. Serial Interface Characteristics (3-line serial)
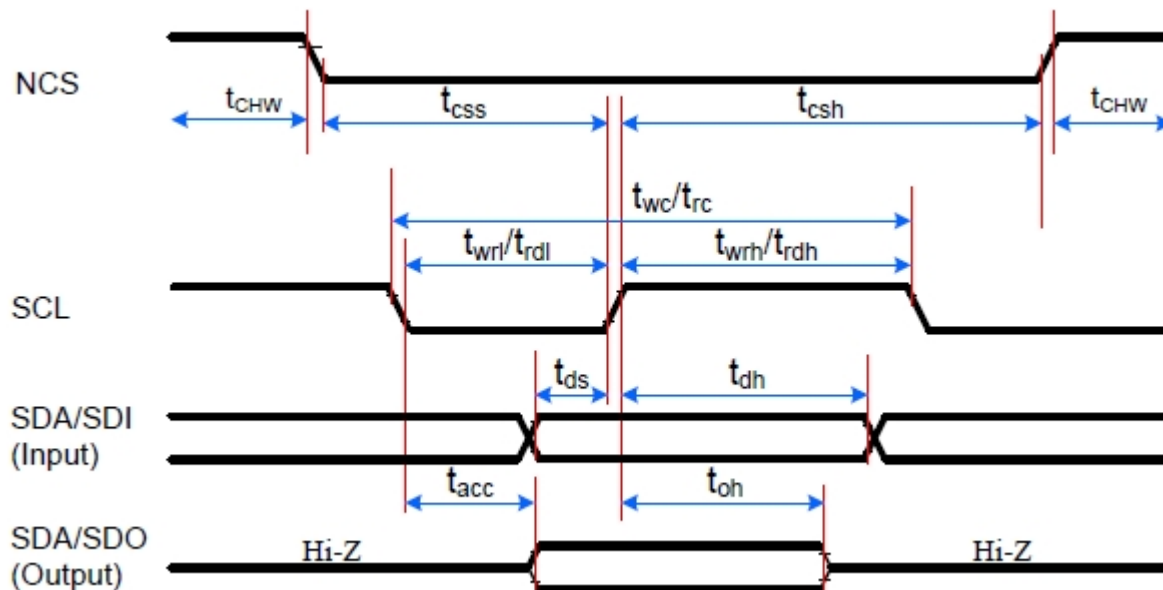
Signal	Symbol	Parameter	min	max	Unit	Description
CSX	tcss	Chip select time (Write)	15	-	ns	
	tcsh	Chip select hold time (Read)	15	-	ns	
	tCHW	CS "H" pulse width	40	-	ns	
SCL	twc	Serial clock cycle (Write)	30	-	ns	
	twrh	SCL "H" pulse width (Write)	10	-	ns	
	twrl	SCL "L" pulse width (Write)	10	-	ns	
	trc	Serial clock cycle (Read)	150	-	ns	
	trdh	SCL "H" pulse width (Read)	60	-	ns	
	trdl	SCL "L" pulse width (Read)	60	-	ns	
SDA/SDO (Output)	tacc	Access time (Read)	10	100	ns	For maximum CL=30pF
	toh	Output disable time (Read)	15	100	ns	For minimum CL=8pF
SDA/SDI (Input)	tds	Data setup time (Write)	10	-	ns	
	tdh	Data hold time (Write)	10	-	ns	

9.2. RGB Interface Characteristics
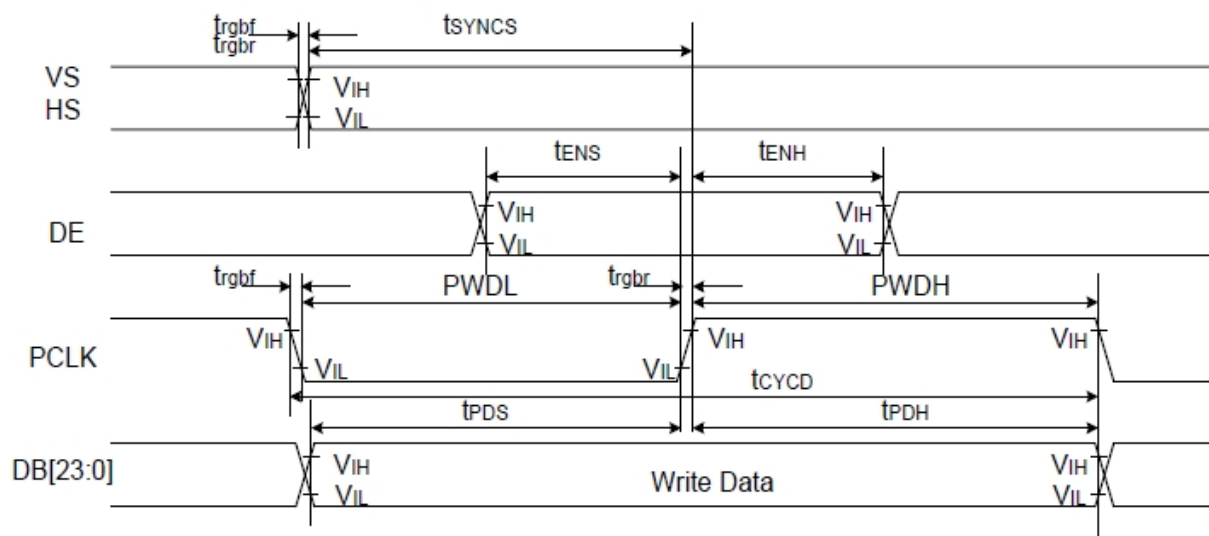
Signal	Symbol	Parameter	min	max	Unit	Description
VS/	t_{SYNCS}	VS/HS setup time	5	-	ns	
HS	t_{SYNCH}	VS/HS hold time	5	-	ns	
DE	t_{ENS}	DE setup time	5	-	ns	
	t_{ENH}	DE hold time	5	-	ns	
DB[23:0]	t_{PDS}	Data setup time	5	-	ns	24/18/16-bit bus RGB interface mode
	t_{PDH}	Data hold time	5	-	ns	
PCLK	PWDH	PCLK high-level period	13	-	ns	
	PWDL	PCLK low-level period	13	-	ns	
	t_{CYCD}	PCLK cycle time	28	-	ns	
	t_{rgbr} , t_{rgbf}	PCLK,HS,VS rise/fall time	-	15	ns	

9.3. Reset Timing
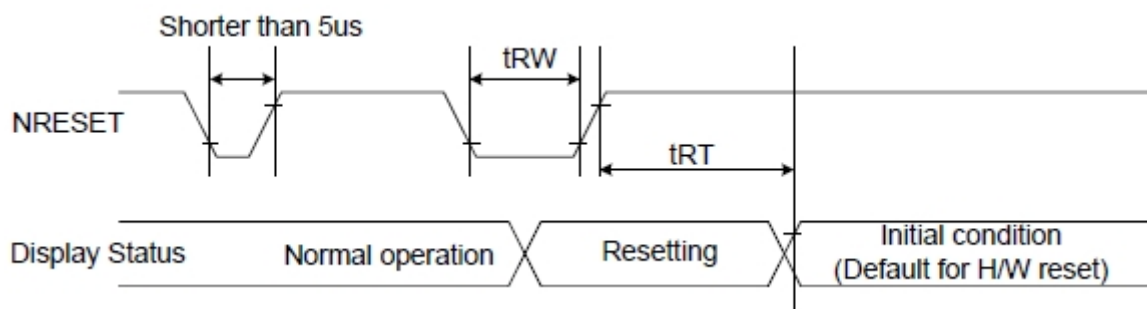
Signal	Symbol	Parameter	Min	Max	Unit
RESX	tRW	Reset pulse duration	10		us
	tRT	Reset cancel		5(note 1,5)	ms
				120 (note 1,6,7)	ms

Note:

1. The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from OTP to registers. This loading is done every time when there is H/W 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 42.

Table 42 Reset Descript

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:
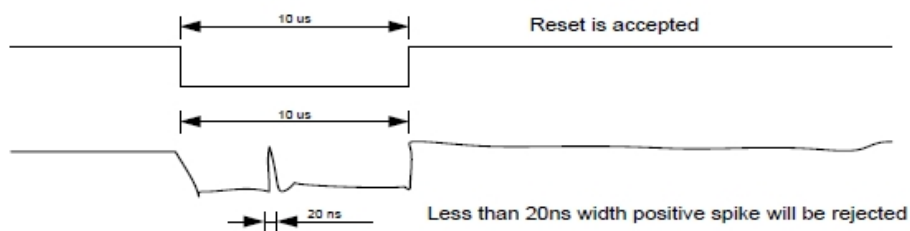
5. When Reset applied during Sleep In Mode.

6. When Reset applied during Sleep Out Mode.

7. It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec.

10. Quality Assurance

10.1. Purpose

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

10.2. Standard for Quality Test

10.2.1 Sampling Plan:

GB2828.1-2012

Single sampling, general inspection level II

10.2.2 Sampling Criteria:

Visual inspection: AQL 1.5%

Electrical functional: AQL 0.65%.

10.2.3 Reliability Test:

Detailed requirement refer to Reliability Test Specification.

10.3. Nonconforming Analysis & Disposition

10.3.1 Nonconforming analysis:

10.3.1.1 Customer should provide overall information of non-conforming sample for their complaints.

10.3.1.2 After receipt of detailed information from customer, the analysis of nonconforming parts usually should be finished in one week.

10.3.1.3 If cannot finish the analysis on time, customer will be notified with the progress status.

10.3.2 Disposition of nonconforming:

10.3.2.1 Non-conforming product over PPM level will be replaced.

10.3.2.2 The cause of non-conformance will be analyzed. Corrective action will be discussed and implemented.

10.4. Agreement Items

Shall negotiate with customer if the following situation occurs:

10.4.1 There is any discrepancy in standard of quality assurance.

10.4.2 Additional requirement to be added in product specification.

10.4.3 Any other special problem.

10.5. Standard of the Product Visual Inspection

10.5.1 Appearance inspection:

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

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

  10.5.1.3 Definition of area: A Zone: Active Area, B Zone: Viewing Area,
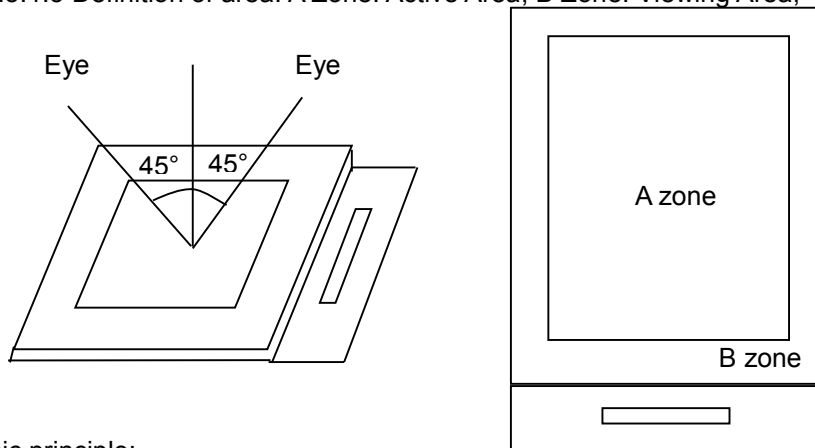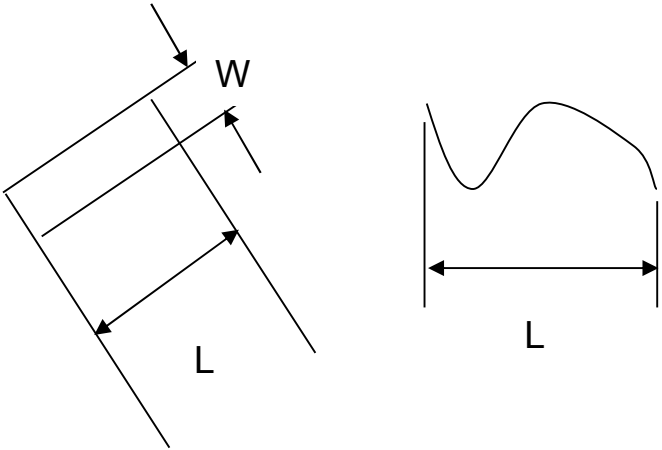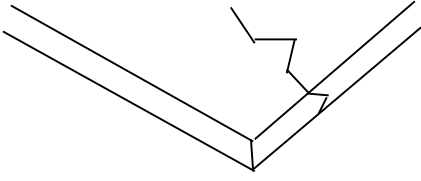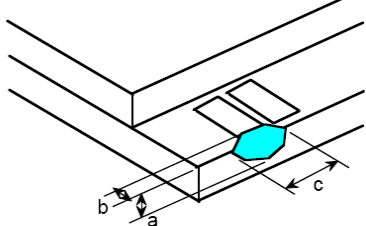
10.5.2 Basic principle:
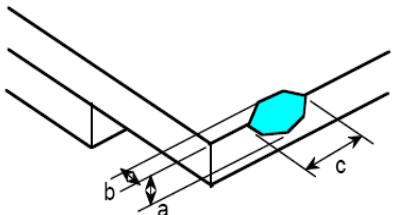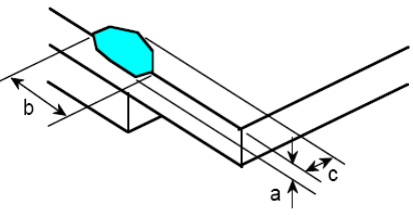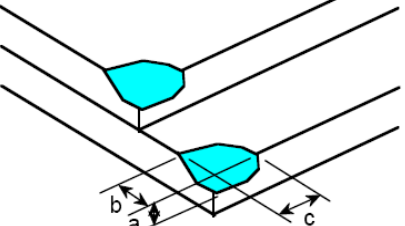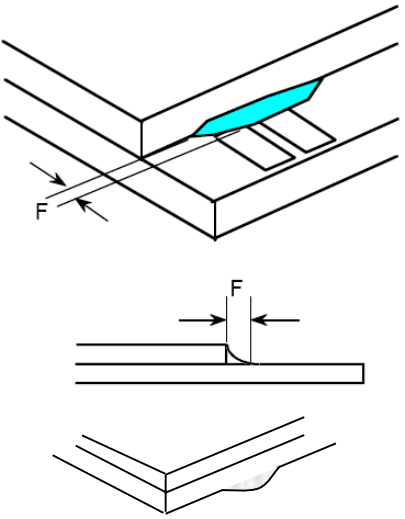
  10.5.2.1 A set of sample to indicate the limit of acceptable quality level must be discussed by both us and customer when there is any dispute happened.
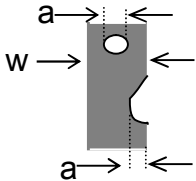
  10.5.2.2 New item must be added on time when it is necessary.

10.6. Inspection Specification

No.	Item	Criteria (Unit: mm)		
01	Black / White spot Foreign material (Round type) Pinholes Stain Particles inside cell. (Minor defect)	$\varphi = (a + b)/2$		

Black / White spot table:

Size \ Area	Acc. Qty
$\varphi \leq 0.10$	Ignore
$0.10 < \varphi \leq 0.15$	2
$0.15 < \varphi \leq 0.25$	1
$0.25 < \varphi$	0
Total	2 no include $\varphi \leq 0.10$

Distance between 2 defects should more than 3mm apart.

Item		Display Area	Total	
02 Electrical Defect (Minor defect)	Bright dot	0	0	Note1
	Dark dot	N≤2	N≤2	
	Total dot	N≤2	N≤2	
	Mura	Not visible through 5% ND filters.		Note 2

Remark:

  1. Bright dot caused by scratch and foreign object accords to item 1.

| 03 | Black and White line
Scratch
Foreign material
(Line type)
(Minor defect) | |

Length	Width	Acc. Qty
/	W $\leq$ 0.03	Ignore
L $\leq$ 2.5	0.03 $<$ W $\leq$ 0.05	3
L $\leq$ 2.5	0.05 $<$ W $\leq$ 0.10	2
/	0.1 $<$ W	0
Total		3

Distance between 2 defects should more than 3mm apart. Scratches not viewable through the back of the display are acceptable.

| 04 | Glass Crack
(Minor defect) |

Crack is potential to enlarge, any type is not allowed.

| 05 | Glass   Chipping Pad Area:
(Minor defect) |

Length and Width	Acc. Qty
c > 3.0, b< 1.0	1
c< 3.0, b< 1.0	3
a<Glass Thickness	

06	Glass　Chipping Rear of Pad Area: (Minor defect)	<table><tr><th>Length and Width</th><th>Acc. Qty</th></tr><tr><td>c > 3.0, b< 1.0</td><td>1</td></tr><tr><td>c< 3.0, b< 1.0</td><td>2</td></tr><tr><td>c< 3.0, b< 0.5</td><td>4</td></tr><tr><td colspan="2">a<Glass Thickness</td></tr></table>
07	Glass　Chipping Except Pad Area: (Minor defect)	<table><tr><th>Length and Width</th><th>Acc. Qty</th></tr><tr><td>c > 3.0, b< 1.0</td><td>1</td></tr><tr><td>c< 3.0, b< 1.0</td><td>2</td></tr><tr><td>c< 3.0, b< 0.5</td><td>4</td></tr><tr><td colspan="2">a<Glass Thickness</td></tr></table>
08	Glass Corner Chipping: (Minor defect)	<table><tr><th>Length and Width</th><th>Acc. Qty</th></tr><tr><td>c < 3.0, b< 3.0</td><td>Ignore</td></tr><tr><td colspan="2">a<Glass Thickness</td></tr></table>
09	Glass Burr: (Minor defect)	<table><tr><th>Length</th><th>Acc. Qty</th></tr><tr><td>F < 1.0</td><td>Ignore</td></tr></table> Glass burr don't affect assemble and module dimension.

10	FPC Defect: (Minor defect)	10.1 Dent, pinhole width a<w/3. (w: circuitry width.) 10.2 Open circuit is unacceptable. 10.3 No oxidation, contamination and distortion.
11	Bubble on Polarizer (Minor defect)	<table>
12	Dent on Polarizer (Minor defect)	<table>
13	Bezel	13.1 No rust, distortion on the Bezel. 13.2 No visible fingerprints, stains or other contamination.
14	Touch Panel	D: Diameter W: width L: length 14.1 Spot: D<0.25 is acceptable ...
15	PCB	...
16	Soldering	Follow IPC-A-610C standard

Item 11 – Bubble on Polarizer:

Diameter	Acc. Qty
φ≤0.20	Ignore
0.20 <φ≤0.30	4
0.30 < φ	None

Item 12 – Dent on Polarizer:

Diameter	Acc. Qty
φ≤0.20	Ignore
0.20 <φ≤0.30	4
0.30 < φ	None

Item 14 – Touch Panel:

D: Diameter   W: width   L: length

14.1 Spot: D<0.25 is acceptable

$\qquad$ 0.25≤D≤0.4

2dots are acceptable and the distance between defects should more than 10 mm.

$\qquad$ D>0.4 is unacceptable

14.2 Dent: D>0.40 is unacceptable

14.3 Scratch: W≤0.03, L≤10 is acceptable,

$\qquad$ 0.03<W≤0.10, L≤10 is acceptable

Distance between 2 defects should more than 10 mm.

$\qquad$ W>0.10 is unacceptable.

Item 15 – PCB:

15.1 No distortion or contamination on PCB terminals.

15.2 All components on PCB must same as documented on the BOM/component layout.

15.3 Follow IPC-A-600F.

17	Electrical Defect (Major defect)	The below defects must be rejected. 17.1 Missing vertical / horizontal segment, 17.2 Abnormal Display. 17.3 No function or no display. 17.4 Current exceeds product specifications. 17.5 LCD viewing angle defect. 17.6 No Backlight. 17.7 Dark Backlight. 17.8 Touch Panel no function.

Remark: LCD Panel Broken shall be rejected. Defect out of LCD viewing area is acceptable.

10.7 Classification of Defects

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

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

10.8 Identification/marking criteria

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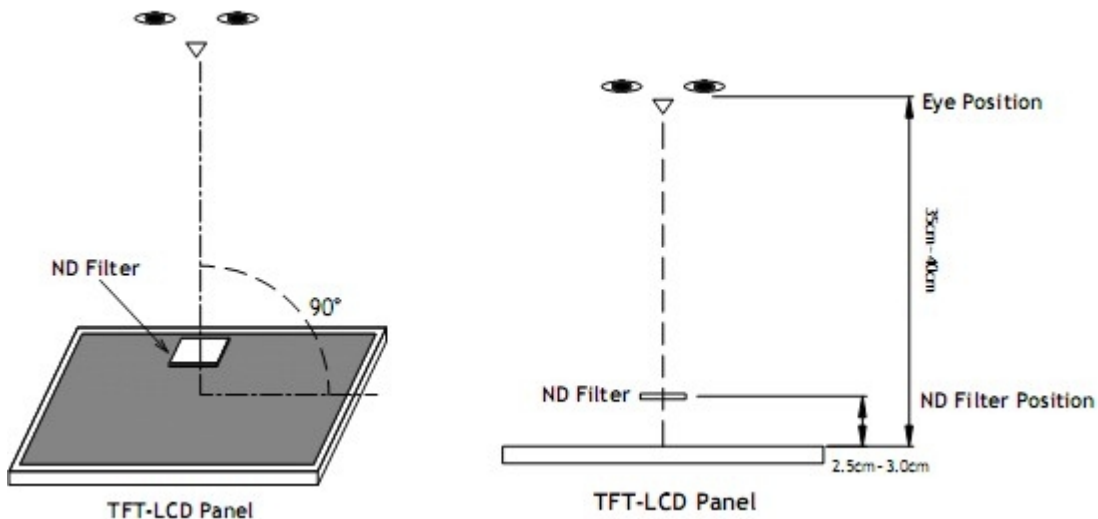
10.9 Packaging

    10.9.1 There should be no damage of the outside carton box, each packaging box should have one identical label.

    10.9.2 Modules inside package box should have compliant mark.

    10.9.3 All direct package materials shall offer ESD protection

Note1: Bright dot is defined as the defective area of the dot is larger than 50% of one sub-pixel area.

Bright dot: The bright dot size defect at black display pattern. It can be recognized by 2% transparency of filter when the distance between eyes and panel is 350mm±50mm.

Dark dot: Cyan, Magenta or Yellow dot size defect at white display pattern. It can be recognized by 5% transparency of filter when the distance between eyes and panel is 350mm±50mm.

Note2: Mura on display which appears darker / brighter against background brightness on parts of display area.

11. Reliability Specification

No	Item	Condition	Quantity	Criteria
1	High Temperature Operating	70°C, 96Hrs	2	GB/T2423.2 -2008
2	Low Temperature Operating	-20°C, 96Hrs	2	GB/T2423.1 -2008
3	High Humidity	50°C, 90%RH, 96Hrs	2	GB/T2423.3 -2006
4	High Temperature Storage	80°C, 96Hrs	2	GB/T2423.2 -2008
5	Low Temperature Storage	-30°C, 96Hrs	2	GB/T2423.1 -2008
6	Thermal Cycling Test	-20°C, 60min~70°C, 30min, 20 cycles.	2	GB/T2423.22 -2012
7	Packing vibration	Frequency range:10Hz~50Hz Acceleration of gravity:5G X, Y, Z 30 min for each direction.	2	GB/T5170.14 -2009
8	Electrical Static Discharge	Air:±4KV 150pF/330Ω 5 times Contact:±2KV 150pF/330Ω 5 times	2	GB/T17626.2 -2006
9	Drop Test (Packaged)	Height:80 cm,1 corner, 3 edges, 6 surfaces.	2	GB/T2423.8 -1995

Note1.　No defection cosmetic and operational function allowable.

Note2.　Total current Consumption should be below double of initial value.

12. Precautions and Warranty

12.1. Safety

12.1.1. The liquid crystal in the LCD is poisonous. Do not put it in your mouth. If the liquid crystal touches your skin or clothes, wash it off immediately using soap and water.

12.1.2. Since the liquid crystal cells are made of glass, do not apply strong impact on them. Handle with care.

12.2. Handling

12.2.1. Reverse and use within ratings in order to keep performance and prevent damage.

12.2.2. Do not wipe the polarizer with dry cloth, as it might cause scratch. If the surface of the LCD needs to be cleaned, wipe it swiftly with cotton or other soft cloth soaked with petroleum IPA, do not use other chemicals.

12.3. Storage

13.3.1 Do not store the LCD module beyond the specified temperature ranges.

12.4. Metal Pin (Apply to Products with Metal Pins)

12.4.1. Pins of LCD and Backlight

12.4.1.1. Solder tip can touch and press on the tip of Pin LEAD during the soldering

12.4.1.2. Recommended Soldering Conditions

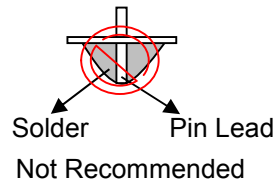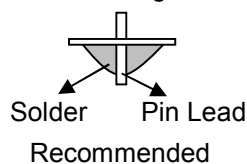Solder Type: Sn96.3~94-Ag3.3~4.3-Cu0.4~1.1

Maximum Solder Temperature: 370℃

Maximum Solder Time: 3s at the maximum temperature

Recommended Soldering Temp: 350±20℃

Typical Soldering Time: ≤3s

12.4.1.3. Solder Wetting

Solder	Pin Lead		Solder	Pin Lead
Recommended			Not Recommended	

12.4.2. Pins of EL

12.4.2.1. Solder tip can touch and press on the tip of EL leads during soldering.

12.4.2.2. No Solder Paste on the soldering pad on the motherboard is recommended.

12.4.2.3. Recommended Soldering Conditions

Solder type: Nippon Alimit Leadfree SR-34, size 0.5mm
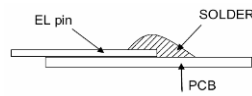
Recommended Solder Temperature: 270～290℃

Typical Soldering Time: ≤2s

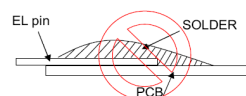Minimum solder distance from EL lamp (body):2.0mm

12.4.2.4. No horizontal press on the EL leads during soldering.

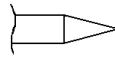12.4.2.5. 180° bend EL leads three times is not allowed.
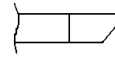
12.4.2.6. Solder Wetting

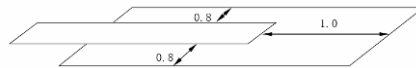Recommended   Not Recommended

12.4.2.7. The type of the solder iron:

Recommended   Not Recommended

12.4.2.8. Solder Pad

12.5. Operation

12.5.1.   Do not drive LCD with DC voltage

12.5.2.   Response time will increase below lower temperature

12.5.3.   Display may change color with different temperature

12.5.4.   Mechanical disturbance during operation, such as pressing on the display area, may cause the segments to appear "fractured".
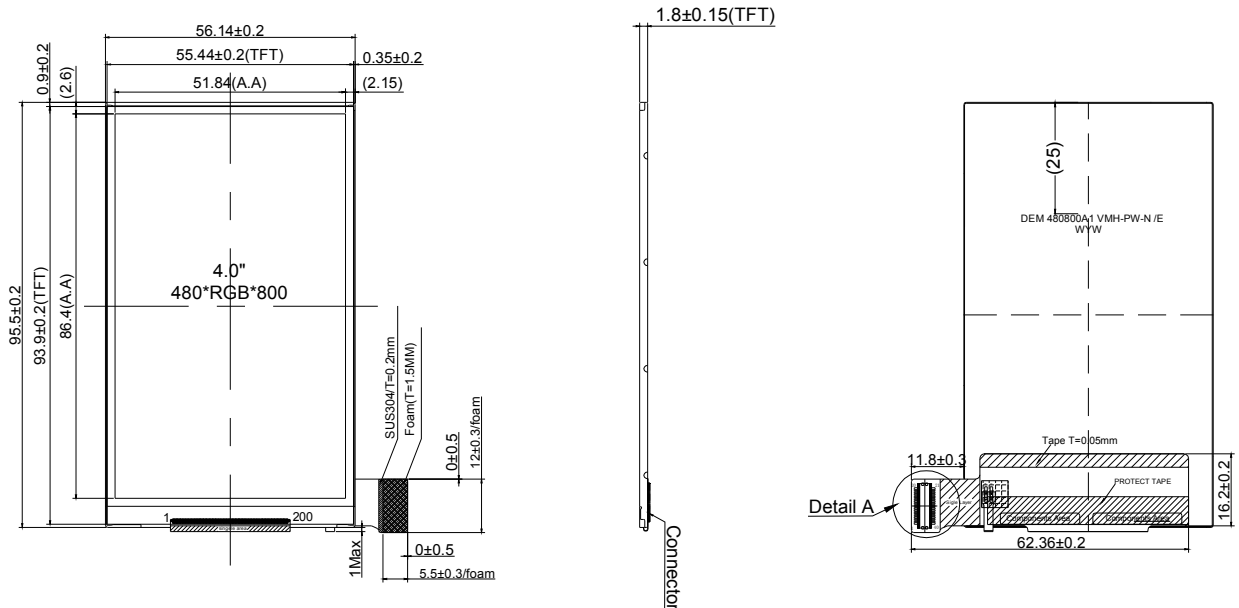
12.6. Static Electricity

12.6.1.   CMOS LSIs are equipped in this unit, so care must be taken to avoid the electro-static charge, by ground human body, etc.

12.6.2.   The normal static prevention measures should be observed for work clothes and benches.

12.6.3.   The module should be kept into anti-static bags or other containers resistant to static for storage.
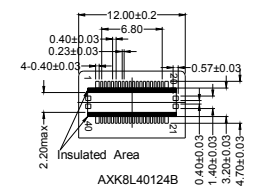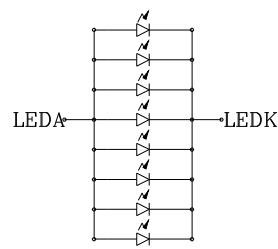
12.7. Limited Warranty

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

12.7.2.   If possible, we suggest customer to use up all modules in six months. If the module storage time over twelve months, we suggest that recheck it before the module be used

12.7.3.   . After the product shipped, any product quality issues must be feedback within three months, otherwise, we will not be responsible for the subsequent or consequential events.

13. Outline Drawing

NOTES:
1. Display Size: 4.0" IPS - TFT
2. Viewing Direction: FULL VIEWING
3. Polarizer Mode: Transmissive / Normal Black
4. Operation Temperature: -20°C to +70°C
5. Storage Temperature: -30°C to +80°C
6. Driver IC: ILI9806 (Ilitek)
7. Power Supply Voltage: 2.8Volt (typ.)
8. Backlight: White (8xLEDs) / 120mA / 3.2 Volt (typ.)

* Unspecification tolerance are: ±0.2mm

Detail A (2:1)

IM3	IM2	IM1	IM0	Interface
1	0	1	0	9bit SPI+RGB

PIN DESCRIPTION

1	LED_A	21	DB6
2	LED_K	22	DB7
3	RESET	23	DB8
4	VCC	24	DB9
5	CS	25	DB10
6	SCL	26	DB11
7	SDA	27	DB12
8	GND	28	DB13
9	PCLK	29	DB14
10	GND	30	DB15
11	VS	31	DB16
12	HS	32	DB17
13	DE	33	DB18
14	GND	34	DB19
15	DB0	35	DB20
16	DB1	36	DB21
17	DB2	37	DB22
18	DB3	38	DB23
19	DB4	39	GND
20	DB5	40	GND