PRODUCT SPECIFICATION

DESCRIPTION
TFT Module – 7.0" WVGA
800 x (RGB) x 480
Full viewing angle High brightness
Cap touch with Atmel driver

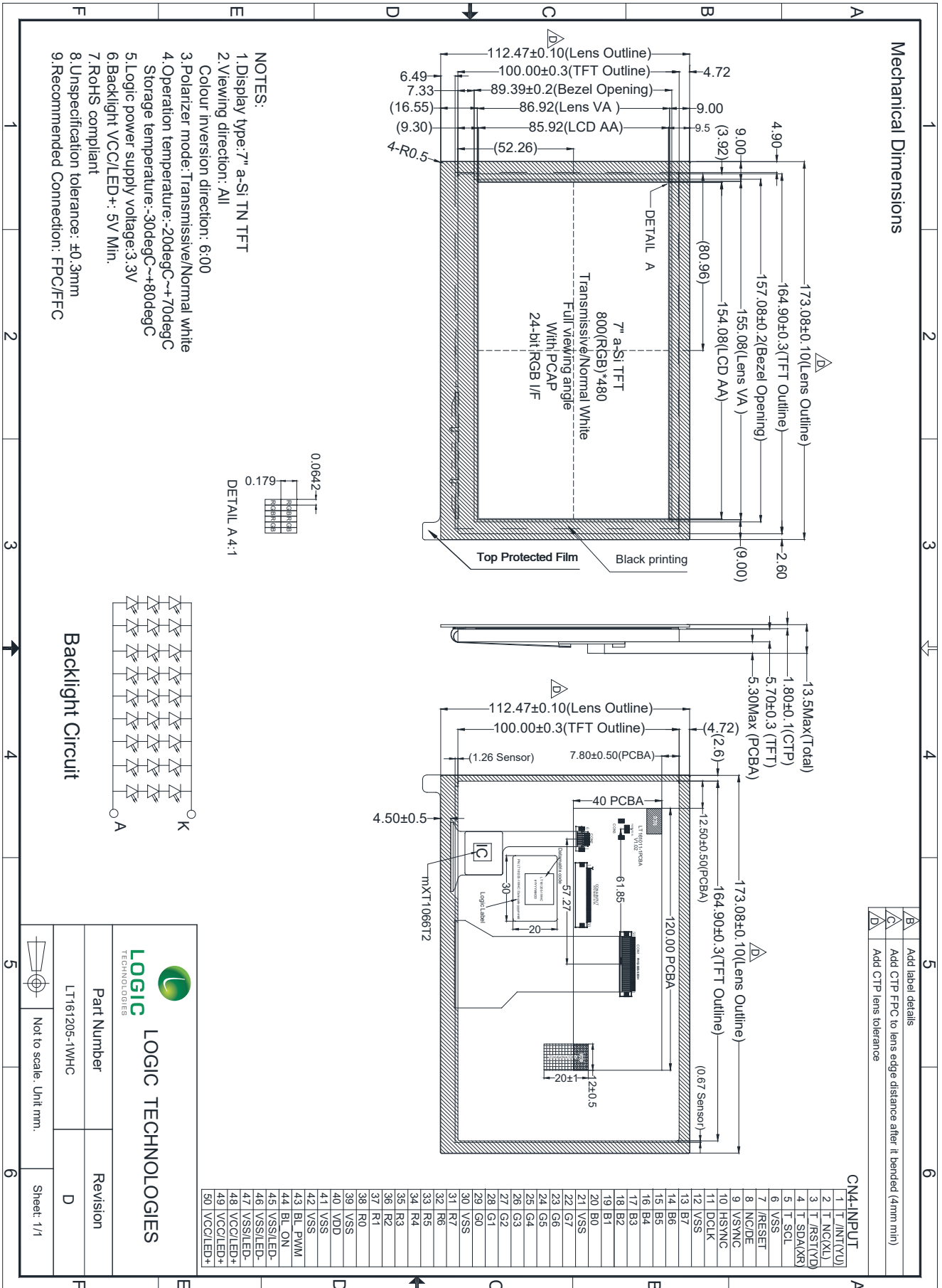## PART NUMBER
LT161205-1WHC

VERSION
1.1

ROHS COMPLIANT

Revision Status

Revision	Revision Date	Page	Content	Notes
1.0	28.07.2017		Initial release	
1.1	20.06.2018		1. Add CTP FPC to lens edge distance and the lens tolerance on drawing_Page5 2. Correct brightness on page7 and backlight driver max input voltage on page6 3. Add more details on page11 note1 4. Update the package drawing to enlarge their size a little._Page17	

Table of Contents

- GENERAL INFORMATION

Item	Contents	Unit
LCD Type	TFT Transmissive, anti-glare	/
Technology	a-Si TFT	-
Viewing Direction	All	O'clock
Viewing Angle (Gray Scale Inversion Direction)	6:00	O'clock
Module dimensions (W x H x T)	173.1 x 112.5 x 13.0(Max)	mm
Active area (W x H)	154.08 x 85.92	mm
Number of pixels	800 x 3 (RGB) x 480	/
Pixel pitch (W x H)	0.1926 x 0.179	mm2
Colours	16.7M	/
Contrast ratio	500 (typical)	/
Backlight	LED (27; 3x serial, 9 x parallel)	/
Backlight Brightness	500(typical)	cd/m2
Interface	RGB 24bit + TCON	/
Touch solution	With Cap Touch	/
Touch driver	Atmel mXT1066T2	/
Touch Interface	I2C	/
Operating temperature	-20 to +70	°C
Storage temperature	-30 to +80	°C

- ## MECHANICAL DIMENSIONS

Mechanical Dimensions

112.47±0.10(Lens Outline)
100.00±0.3(TFT Outline)
6.49
7.33
89.39±0.2(Bezel Opening)
(16.55)
86.92(Lens VA)
(9.30)
85.92(LCD AA)
4-R0.5
(52.26)
4.72
9.00
9.5
4.90
9.00
(3.92)
173.08±0.10(Lens Outline)
164.90±0.3(TFT Outline)
157.08±0.2(Bezel Opening)
155.08(Lens VA)
154.08(LCD AA)
(80.96)
(9.00)
2.60

DETAIL A

7" a-Si TFT
800(RGB)*480
Transmissive/Normal White
Full viewing angle
With PCAP
24-bit:RGB I/F

Top Protected Film   Black printing

0.0642
0.179
RGB|RGB
RGB|RGB

DETAIL A 4:1

13.5Max(Total)
1.80±0.1(CTP)
5.70±0.3 (TFT)
5.30Max (PCBA)

112.47±0.10(Lens Outline)
100.00±0.3(TFT Outline)
(4.72)
(2.6)
(1.26 Sensor)
7.80±0.50(PCBA)
40 PCBA
4.50±0.5
LT16011-1PCBA
V1.02
12.50±0.50(PCBA)
173.08±0.10(Lens Outline)
164.90±0.3(TFT Outline)
120.00 PCBA
IC
mXT1106T2
30
Logic Label
57.27
61.85
20
20±1
2±0.5
(0.67 Sensor)

Backlight Circuit

A   K

LOGIC TECHNOLOGIES

Part Number	Revision
LT161205-1WHC	D
Not to scale. Unit mm.	Sheet: 1/1

CN4-INPUT
1	T /INT(YU)
2	T NC(XL)
3	T /RST(YD)
4	T SDA(XR)
5	T SCL
6	VSS
7	/RESET
8	NC/DE
9	VSYNC
10	HSYNC
11	DCLK
12	VSS
13	B7
14	B6
15	B5
16	B4
17	B3
18	B2
19	B1
20	B0
21	VSS
22	G7
23	G6
24	G5
25	G4
26	G3
27	G2
28	G1
29	G0
30	VSS
31	R7
32	R6
33	R5
34	R4
35	R3
36	R2
37	R1
38	R0
39	VSS
40	VDD
41	VSS
42	VSS
43	BL_PWM
44	BL_ON
45	VSS/LED-
46	VSS/LED-
47	VSS/LED-
48	VCC/LED+
49	VCC/LED+
50	VCC/LED+

Add label details
Add CTP FPC to lens edge distance after it bended (4mm min)
Add CTP lens tolerance

- ABSOLUTE MAXIMUM RATING

Parameter	Symbol	Min.	Max.	Unit	Note
Power Voltage	VDD	- 0.5	5.0	V	---
Backlight LED Forward Current	I_F	---	25	mA	One LED
Operating Temperature	T_{OPR}	- 20	70	°C	---
Storage temperature	T_{ST}	- 30	80	°C	---

- ELECTRICAL CHARACTERISTICS (Ta = 25℃)

Parameter	Symbol	Min	Typ.	Max	Unit	Remark
Digital Supply Voltage	VDD	3.0	3.3	3.6	V	---
Backlight Supply Voltage	VCC/LED+	4.5	5	6	V	
Input Signal Voltage	V_{IL}	0	---	0.3xDVDD	V	R0-R7, G0-G7, B0-B7, DE, DCLK, HSD, VSD, RESET
	V_{IH}	0.7xDVDD	---	DVDD	V	
Current of supply voltage	IVDD		82	120	mA	
	IVCC		456	593		
Power Consumption	Panel and Gamma		271	432	mW	All pixels on and black
	Backlight		2.28	2.96	W	
	Total		2.55	3.36	W	

- BACKLIGHT UNIT CHARACTERISTICS

Item	Symbol	Min.	Typ.	Max.	Unit	Condition
Driver Input Voltage	VCC/LED+	---	5	6	V	
Current of driver IC	I_{VLED}	---	456	550		
Power Consumption	P_{BL}	---	2.28	2.96	W	Notes
PWM Frequency	PWM	100	150	200	Hz	
Forward Current	IF	---	180	200	mA	Notes
Forward Current Voltage	VF	---	9.9	10.8	V	Notes
LED Lifetime	---	30k	---	---	Hrs	Notes

NOTES:

Backlight drive conditions: constant current driving method.

- The LED driving condition is defined for each LED module (3 LED Serial, 9 LED Parallel).
- The LED driving condition is defined for total backlight consumption.
- Forward Voltage adjustment depends on the Forward Current setting.
- One LED : max IF = 25mA, VF = 3.3V
- The LED lifetime is estimated data at 25degC operating.
- I_F defined for whole backlight without driver.
- If the LEDs are driven by high current, high ambient temperature & humidity condition the lifetime of the LEDs will be reduced.
- Operating life means brightness reduces to 50% of initial brightness.
- Backlight diagram.
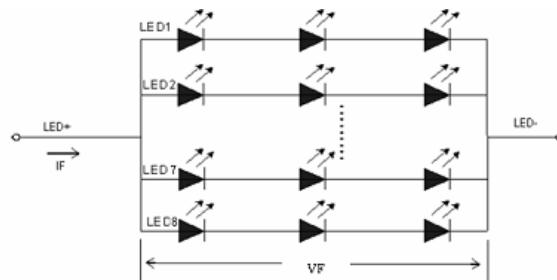
- ELECTRO-OPTICAL CHARACTERISTICS

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Refer	Note
Response Time		T_{ON}	25°C	---	10	15	Ms	Fig 1	1
		T_{OFF}		---	15	20			
Contrast ratio		Cr	$\theta = 0°$	400	500	---	---	Fig 2	1
Uniformity		U	---	---	75	---	%	Fig 2	3
Surface Luminance		Lv	---	400	500	---	cd/m^2	Fig 2	2
Viewing Angle ratio		θ	$\varnothing = 90°$	60	75	---	---	Fig 3	6
			$\varnothing = 270°$	60	75	---			
			$\varnothing = 0°$	60	75	---			
			$\varnothing = 180°$	60	75	---			
CIE (x,y) chromaticity	Red	x	Backlight On	0.559	0.609	0.659	---	Fig 2.	5
		y		0.305	0.355	0.405			
	Green	x		0.277	0.315	0.364			
		y		0.505	0.555	0.605			
	Blue	x		0.089	0.136	0.189			
		y		0.089	0.139	0.189			
	White	x		0.254	0.304	0.354			
		y		0.294	0.344	0.394			

Optical performance should be evaluated at Ta=25℃.

Note

1. Contrast ratio (CR) is defined mathematically in Figure 2.

Contrast Ratio = $\dfrac{\text{Average Surface Luminance with all white pixels (P1, P2, P3, P4, P5)}}{\text{Average Surface Luminance with all black pixels (P1, P2, P3, P4, P5)}}$

Note 2. Surface luminance is the LCD surface from the surface with all pixels displaying white. For more information see figure 2.

Lv = Average Surface Luminance with all white pixels (P1, P2, P3, P4, P5…)

Note 3. Uniformity of surface luminance,   White, is defined mathematically in figure 2.

White = $\dfrac{\text{Minimum Surface Luminance with all white pixels (P1, P2, P3, P4, P5)}}{\text{Maximum Surface Luminance with all white pixels (P1, P2, P3, P4, P5)}}$

Note 4. Response time is the time required for the display to transition form white to black (rise time Tr) and from black to white (decay or fall time, Tf). The industry standard test equipment used is the Autronic-Melcher's Conoscope.

Note 5. CIE (x,y) chromaticity. The x,y value is determined by measuring luminance at each test position 1 through 5, then calculating the average value.

Note 6. The Viewing angle is the angle at which the contrast ratio is greater than 2. For a TFT module, the contrast ratio is greater than 10. The angles are determined for the horizontal or 'x' axis and the vertical or 'y' axis with respect to the 'z' axis, being the LCD surface reference. Also see figure 3.

Note 7. For viewing angle and response time testing, the testing data is based on Autronic-Melcher's BM-7A. For the contrast ratio, surface luminance, luminance uniformity and chromaticity (CIE), the test data is based on the industry's standard SR-3A photo detector.

Note 8. For TFT modules, grey scale reversing occurs in the direction of the panel viewing angle.

Figure 1. Definition of response time
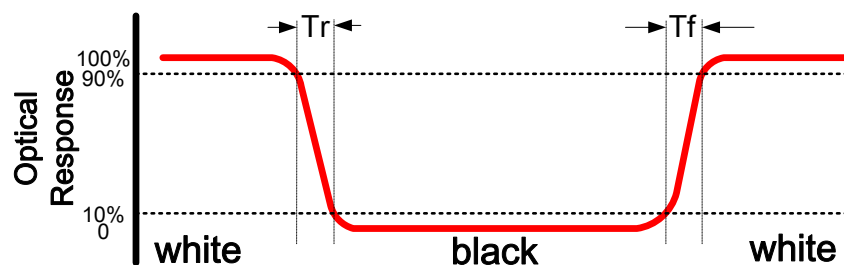
Figure 2. Measuring contrast ratio, surface luminance, luminance uniformity and CIE (chromaticity.)

   A : 5mm, B : 5mm, H, V : Active area, Light spot size q = 7mm, 500mm distance from the LCD surface to the   detector lens.
  Measurement instrument is Topcon's luminance meter BM-5.

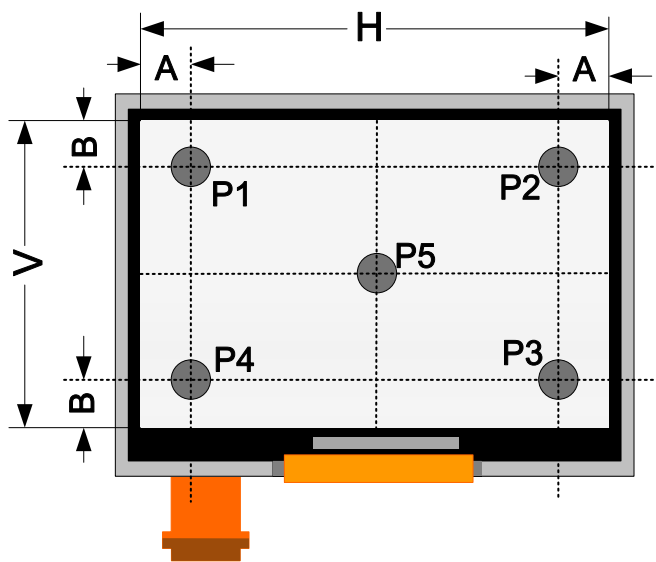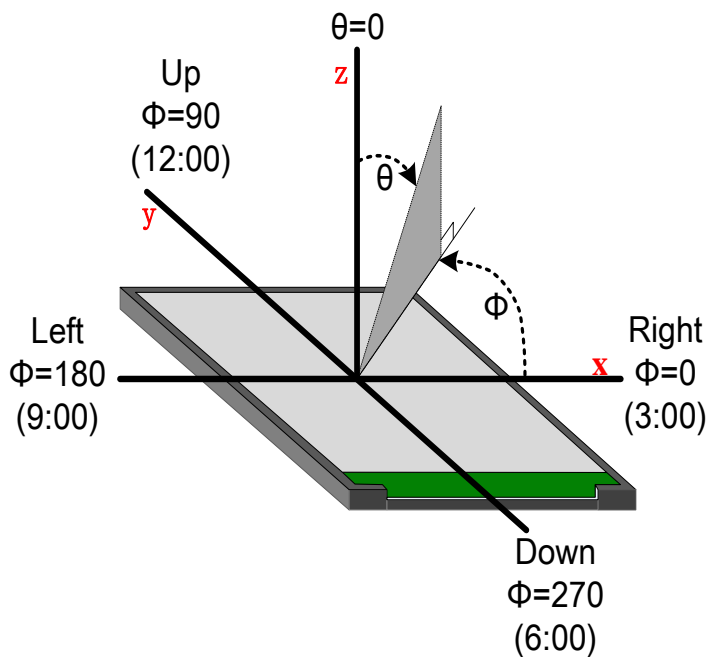

Figure 3. Definition of viewing angle

- INTERFACE DESCRIPTION

Pin	Symbol	I/O	Description	Note
1	T_/INT(YU)	I/O	Cap touch wake up /Interrupt; Resistive touch YU terminal; NC when no touch.	
2	T_NC(XL)	I/O	Resistive touch XU terminal; NC when with cap touch or no touch.	
3	T_/RST(YD)	I/O	Cap touch /Reset pin; Resistive touch YD terminal; NC when no touch.	
4	T_SDA(XR)	I/O	Cap touch I2C data input/output pin; Resistive touch XR terminal; NC when no touch.	
5	T_SCL	I	Cap touch I2C clock input pin;; NC when with resistive touch or no touch.	
6	VSS	P	TFT&CTP Ground	
7	/RESET	I	TFT display system reset	
8	NC/DE	I	Data Input Enable when in DE mode. DE/SYNC mode set by R6&R14. R6=10K, R14=NC:DE mode; R6=NC, R14=10K: SYNC mode	
9	VSYNC	I	Vertical Synch Input	
10	HSYNC	I	Horizontal Synch Signal	
11	DCLK	I	Display Pixel Clock	
12	VSS	I	TFT&CTP Ground	
13	B7	I	Blue data signal (MSB)	
14	B6	I	Blue data signal	
15	B5	I	Blue data signal	
16	B4	I	Blue data signal	
17	B3	I	Blue data signal	
18	B2	I	Blue data signal	
19	B1	I	Blue data signal	
20	B0	I	Blue data signal (LSB)	
21	VSS	P	TFT&CTP Ground	
22	G7	I	Green data signal (MSB)	
23	G6	I	Green data signal	
24	G5	I	Green data signal	
25	G4	I	Green data signal	

26	G3	I	Green data signal	
27	G2	I	Green data signal	
28	G1	I	Green data signal	
29	G0	I	Green data signal (LSB)	
30	VSS	P	TFT&CTP Ground	
31	R7	I	Red data signal (MSB)	
32	R6	I	Red data signal	
33	R5	I	Red data signal	
34	R4	I	Red data signal	
35	R3	I	Red data signal	
36	R2	I	Red data signal	
37	R1	I	Red data signal	
38	R0	I	Red data signal (LSB)	
39	VSS	P	TFT&CTP Ground	
40	VDD	P	TFT&CTP Power supply, 3.3V	
41	VSS	P	TFT&CTP Ground	
42	VSS	P	TFT&CTP Ground	
43	BL_PWM	I	PWM signal to control backlight diming. 100~200Hz	
44	BL_ON	I	Backlight on/off control pin. H: On ; L: Off	
45	VSS/LED-	P	Backlight Ground which is LED Cathode. R19=0ohm to connect it to TFT&CTP Ground	
46	VSS/LED-	P		
47	VSS/LED-	P		
48	VCC/LED+	P	Backlight supply voltage input, 5V typical	
49	VCC/LED+	P		
50	VCC/LED+	P		

I -Input only;   O   -Output only;   I/O -Input /output;   P -Power or Ground.

Suggested connector for this connector is 0.5pitch 50pins FFC or FPC

Note 1: Default R6=NC, R14=10K and mode is set to SYNC mode
In SYNC mode, MODE= "0", which means DE must be grounded.
When select DE mode, MODE="1", VS and HS must be pulled high.
(Above is the suggestion follows IC specification. In our testing, actually no matter DE or SYNC mode, those signals which do not using can be open, connect to VDD or GND and display still works ok.)

Note 2: When input 18 bits RGB data, the two low bits of R,G and B data must be grounded.

Note 3: Data shall be latched at the falling edge of DCLK.

Note 4: Global reset pin, low active. Suggest it connect with an RC reset circuit for stability. Normally pull high.

Block Diagram

```
┌─────────────────┐        ┌──────────────┐      ┌─────────────────┐
│                 │        │  Cap touch   │◄─────│ T /INT(YU)      │
│  Touch Panel    │◄───────│  driver IC   │      │ T_NC(XL)        │
│                 │        │              │      │ T /RST(YD)      │
└─────────────────┘        └──────────────┘      │ T SDA(XR)       │
                                                  │ T SCL           │
┌─────────────────┐        ┌──────────────┐      │                 │
│                 │        │              │      │ /RESET          │
│  LCD Panel      │◄───────│ Gate driver  │◄─────│ NC/DE           │
│  7.0 inch       │        │    IC        │      │ VSYNC           │
│ 800(RGB)X480    │        └──────────────┘      │ HSYNC           │
│                 │                              │ DCLK            │
│                 │        ┌──────────────┐      │ B[7:0]          │
│                 │        │ Source driver│      │ G[7:0]          │
│                 │◄───────│   IC + TCON  │◄─────│ R[7:0]          │
│                 │        │              │      │ VSS             │
└─────────────────┘        └──────────────┘      │ VDD             │
                                                  │                 │
┌─────────────────┐        ┌──────────────┐      │ BL_PWM          │
│  Back light     │◄───────│  Backlight   │◄─────│ B_ON            │
│                 │        │  driver IC   │      │ VLED-           │
└─────────────────┘        └──────────────┘      │ VCC             │
                                                  └─────────────────┘
```
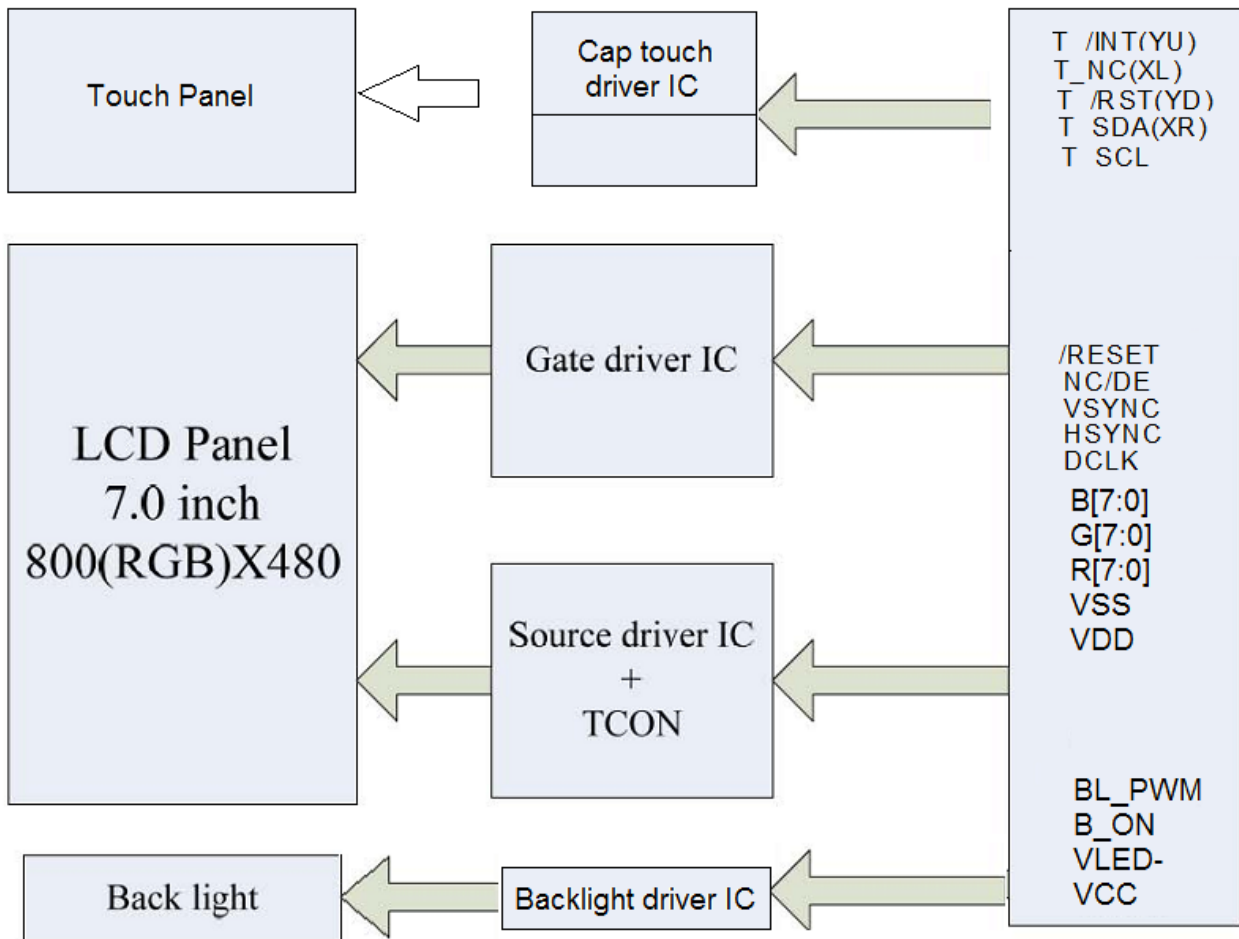
- ## RESET TIMING CHARACTERISTICS
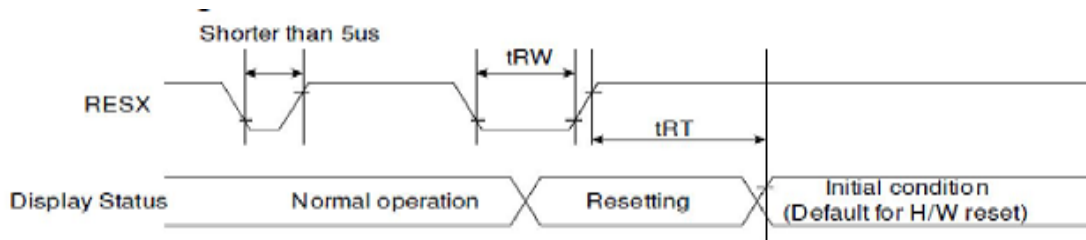
Signal	Symbol	Parameter	Min	Max	Unit
RESX	tRW	Reset pulse duration	10		uS
	tRT	Reset cancel		5 (note 1,5)	mS
				120 (note 1,6,7)	mS

- ## RGB TIMING CHARACTERISTICS
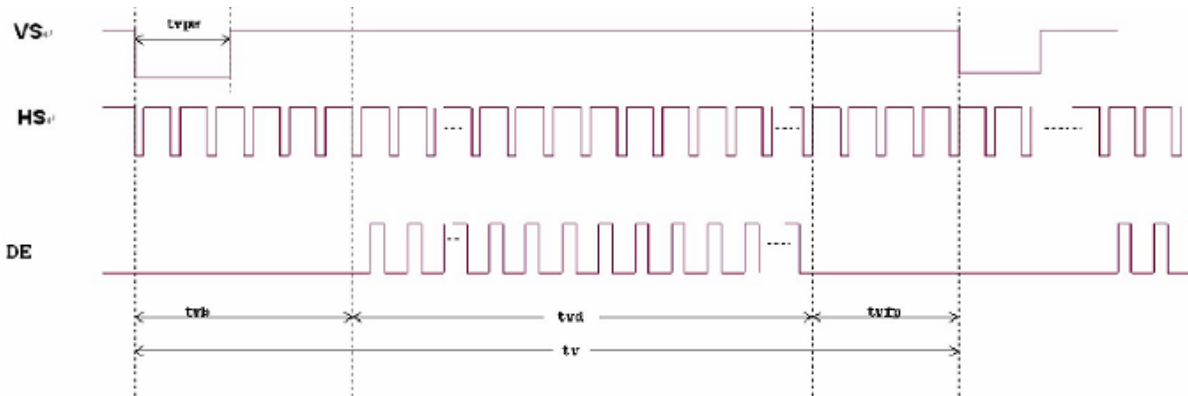
TCON (Embedded In Source IC) Input Timing (DCLK, HS, VS, DE)

VCC=3.3V, GND=0V, Ta=25℃

Parameter	Symbol	Min	Typ	Max	Unit	Remark
DCLK	F_{clk}	26.4	33.3	46.8	MHZ	
	t_{clk}	21.4	30	37.8	ns	
HS	t_h	862	1056	1200	t_{clk}	
	t_{hd}		800		t_{clk}	
	t_{hpw}	1		40	t_{clk}	
	t_{hb}	46	46	46	t_{clk}	
	t_{hfp}	16	210	354	t_{clk}	
VS	t_v	510	525	650	t_h	
	t_{vd}		480		t_h	
	t_{vpw}	1		20	t_h	
	t_{vb}	23	23	23	t_h	
	t_{vfp}	7	22	147	t_h	

Note 1: DE timing refer to HS, VS input timing.

- **AC TIMING CHARACTERISTICS**
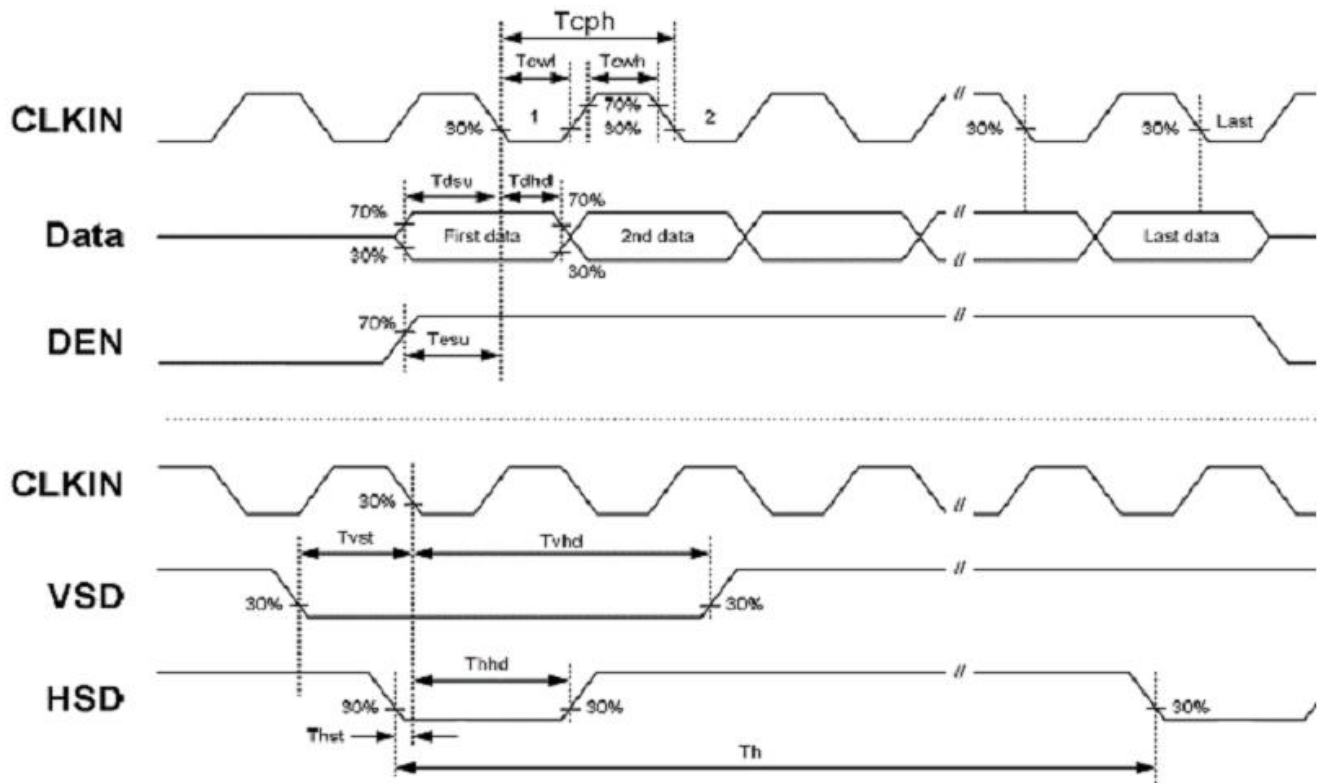
Parameter	Symbol	Min	Typ	Max	Unit	Note
DCLK Frequency	Fclk	---	33.3	46.8	MHz	
DCLK Cycle Time	Tcph	20			ns	
DCLK Pulse Width	Tcw	40	50	60	Tcph	
VSD Setup Time	Tvst	8	---	---	ns	
VSD Hold Time	Tvhd	8	---	---	ns	
HSD Setup Time	Thst	8	---	---	ns	
HSD Hold Time	Thhd	8	---	---	ns	
Data Setup Time	Tdsu	8	---	---	ns	Data to DCLK
Data Hold Time	Tdhd	8	---	---	ns	Data to DCLK
DE Setup Time	Tesu	8	---	---	ns	
DE Hold Time	Tehd	8	---	---	ns	

- **TOUCH PANEL CHARACTERISTICS**

    - **CONSTRUCTION – 4mm glass cover +Lens + OCA + ITO + OCA + ITO + FPC (See Note 1)**

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Overall dimensions	---	173.1x112.5x1.9			mm	
Viewing Area	---	155.1x86.9			mm	
Total Thickness	---	---	1.9	---	mm	+/- 0.15mm
Lens thickness	---	---	1.1	---	mm	+/- 0.15mm
Lens surface hardness	---	6	---	---	H	JIS K 5600

Note 1

(i)   Lens = 6H surface hardness + black mask area

(ii)   OCA = Optically Clear Adhesive

(iii)   ITO = Indium Tin Oxide (touch sensor layer)

(iv)   FPC = Flexible Printed Circuit (includes Atmel MXT1066T2 controller IC)

The minimum test force is 80g.

    - **TOUCH PANEL INTERFACING (Connector CN2)**

Touch Panel Pin	Symbol	Description	Note
1	GND	Ground	
2	ATTN/INT	Wake up/Interrupt, equal to /CHG	
3	NC	Not connected	
4	VDD	Input voltage	
5	SCL	Serial Clock	
6	SDA	Serial Data	

Note: Suggested connector for CN2 is HIROSE FH12-6S-1SH or equal.(FPC need bend to under the module)

    - TOUCH PANEL BLOCK DIAGRAM

- PACKAGE DRAWING

Mechanical Dimensions

Module

120.87

173.48

13.1

① Module

Electrostatic Bag
Size: 180x230x0.1

②

③ Add label on bag top side

Put in inner box

④ 460 480

Cover Inner Box

195

⑤

NO.	Content	Qty
4	Foam inner box	1PC
5	Foam inner box cover	2PCS
6	Inner box cover2	1PC
7	Outer Box	1PC

Put in outer box and seal

485

505

220

PartNO. : ....
Q'ty : ....PCS
N.W : ....KG
G.W : ....KG
MADE IN CHINA

⑥

NO.	Content	Qty
1	Module	30 PCS
2	Electrostatic bag	30 PCS
3	LT161205-1WHC label	60PCS

LOGIC TECHNOLOGIES

LOGIC
TECHNOLOGIES

Part Number	LT161205-1WHC package	Revision	B
	Not to scale. Unit mm.		Sheet: 1/1

- RELIABILITY TESTING

NO.	Item	Condition	Criteria
1	High Temperature Operating	70°C +/-2°C, 240Hrs	IEC60068-2-1, GB2423.2
2	Low Temperature Operating	-20°C +/-2°C, 240Hrs	IEC60068-2-1 GB2423.1
3	High Temperature Storage	80°C +/-2°C, 240Hrs	IEC60068-2-1 GB2423.2
4	Low Temperature Storage	-30°C +/-2°C, 240Hrs	IEC60068-2-1 GB2423.2
5	Hi Temperature & High Humidity Operation	50°C, 90%RH max, 240Hrs	IEC60068-2-78 GB/T2423.3
6	Vibration (non operating)	Frequency range:10 ~ 55Hz, Stroke:1.5mm Sweep:10Hz ~ 55Hz ~ 10Hz2hours for each direction of x.y.z (6 hours for total)	IEC60068-2-6 GB/T2423.10
7	Package Vibration Test	Random Vibration: 0.015GxG/Hz for 5-200Hz, -6dB/Octave from 200-500Hz 2 hours for each direction of X,Y,Z (6 hours for total)	IEC60068-2-34 GB/T2423.11
8	Thermal Shock (non operating)	-30°C to 30min to 80℃, 30min Change time: 5min, 100 cycles	Start with cold temperature, End with high temperature, IEC60068-2-14:1984,GB2423.22
9	Drop Test (packaged)	Height:80 cm,1 corner, 3 edges, 6 surfaces	IEC60068-2-32 GB/T2423.8
10	Shock (non-operation)	80G 6ms, ±X,±Y,±Z 3 times for each direction	IEC60068-2-27 GB/T2423.5
11	ESD (operation)	C=150pF,R=330Ω, Air:±15Kv, Contact:±8Kv, 10times/terminal	IEC61000-4-2 GB/T17626.2

Notes:

1. Test samples are applied to one test item.

2. Sample size for each test item is 2-10pcs.

3. For humidity testing, a pure water resistance of >10MW   should be used.

4. (a) In the case of a malfunction caused by ESD damage, if the LCM returns to it's normal state after resetting, the item is considered to have passed the ESD test.

    (b) It is recommended to use an anti-static blower (ioniser) to reduce the electro-static voltage in the working area.

    (c) When removing the protection film from the LCM panel, peel off the film slowly (more than 1sec) while blowing the ioniser towards the peeling area to minimize ESD. This will reduce the risk of damaging the electrical circuitry.

5. EL backlights are exempt from the reliability testing with respect to temperature   and humidity. Some defects many occur such as black spots or blemishes due to the inherent chemical reaction of humidity with fluorescent EL.

6. If it is installed, please use the automatic test mode on the LCM &/or demonstration box when testing.

- INSPECTION CRITERIA

This specification is designed to be used as the standard acceptance/rejection criteria for normal LCM products.

1. Sampling plan.

    The sampling plan according to GB/T 2828.1-2003 / ISO2859-16 1999 and ANSI/ASQC Z1.4 1993, normal level 2 and based on:

    - Major defect: AQL 0.65
    - Minor defect: AQL 1.5

2. Inspection condition

    - The viewing distance for cosmetic inspection is approximately 30cm with the naked eye, and under an environment of 20-40W light intensity, in all directions, within 45° against a perpendicular line. (Normal temperature 20-25°C and normal humidity 60+/-15 RH.)

    - Driving voltage - The Vop value from which the most optimal contrast can be obtained near the specified Vop in the specification (within +/-0.5V of the typical value at 25°C.)

3. Definition of inspection zone in LCD.   Figure 4

Zone A : active pixel area
Zone B : viewing area except Zone A (Zone A + Zone B = Minimum viewing area)
Zone C : Outside viewing area (invisible area after assembling customer's product.

Figure 4 inspection zones in an LCD
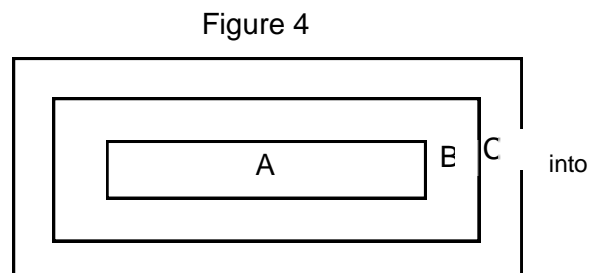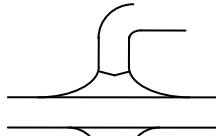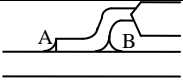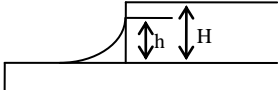
Note: As a general rule visual defects in Zone C are permissible when there is no visual effect once assembled into the customer's product.

- INSPECTION STANDARD

MAJOR CRITERIA

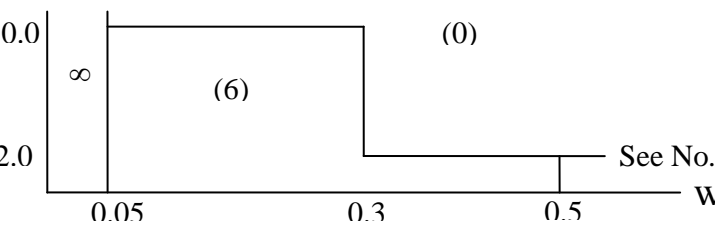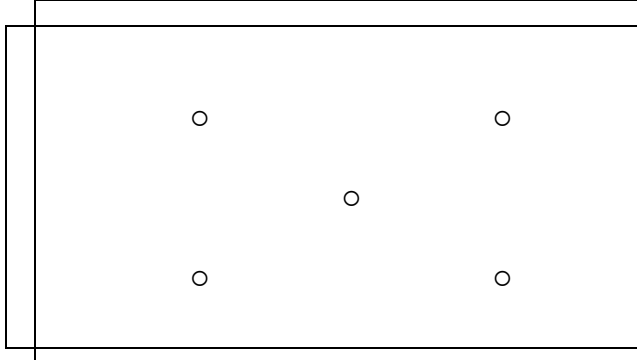| Item No	Item to be inspected	Inspection standard	Classification
1	All functional defects	1) No display 2) Display abnormal 3) Missing vertical or horizontal segment 4) Short circuit 5) Backlight not working, flickering and abnormal light	Major
2	Missing	Missing component	
3	Outline dimension	Overall outline dimension beyond the drawing dimension is not allowed	

COSMETIC CRITERIA
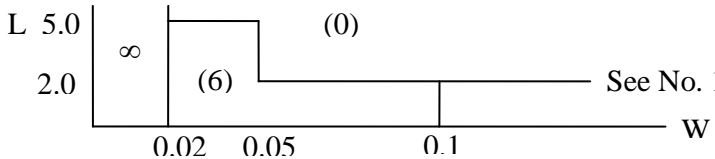
No.	Item	Judgment Criteria	Partition
1	Difference in Spec.	None allowed	Major
2	Pattern peeling	No substrate pattern peeling and floating	Major
3	Soldering defects	No soldering missing No soldering bridge No cold soldering	Major Major Minor
4	Resist flaw on substrate	Invisible copper foil ($\varnothing$0.5mm or more) on substrate pattern	Minor
5	Accretion of metallic Foreign matter	No soldering dust No accretion of metallic foreign matters (Not exceed $\varnothing$0.2mm)	Minor Minor
6	Stain	No stain to spoil cosmetic badly	Minor
7	Plate discoloring	No plate fading, rusting and discoloring	Minor

8	Solder amount
	
	1. Lead parts
		a. Soldering side of PCB
		   Solder to form a 'Filet'
		   all around the lead.
		   Solder should not hide the
		   lead form perfectly. (too much)
		b. Components side
		   (In case of 'Through Hole PCB')
		
		Solder to reach the Components side of PCB.
			Minor

	2. Flat packages	Either 'toe' (A) or 'heal' (B) of the lead to be covered by 'Filet'. Lead form to be assume over solder.	Minor
	3. Chips	$(3/2) H \geq h \geq (1/2) H$	Minor
9	Solder ball/solder splash	a) The spacing between solder ball and the conductor or solder pad h $\geq$ 0.13mm. The diameter of the solder ball d $\leq$ 0.15mm. b) The quantity of solder balls or solder splashes isn't more than 5 in 600mm2. c) Solder balls / splashes do not violate minimum electrical clearance d) Solder balls/splashes must be not be able to be dislodged with normal product usage	Minor Minor Major Minor

COSMETIC CRITERIA (non-operating)

No.	Defect	Judgment Criteria	Classification
1	Spots	In accordance with Screen Cosmetic Criteria (Operating) No.1.	Minor
2	Lines	In accordance with Screen Cosmetic Criteria (Operating) No.2.	Minor
3	Bubbles in polarizer	<table><tr><td>Size : d mm</td><td>Acceptable Qty in active area</td></tr><tr><td>d ≤ 0.3</td><td>Disregard</td></tr><tr><td>0.3 < d ≤ 1.0</td><td>3</td></tr><tr><td>1.0 < d ≤ 1.5</td><td>1</td></tr><tr><td>1.5 < d</td><td>0</td></tr></table>	Minor
4	Scratch	In accordance with spots and lines operating cosmetic criteria. When the light reflects on the panel surface, the scratches are not to be remarkable.	Minor
5	Allowable density	Above defects should be separated more than 30mm each other.	Minor
6	Coloration	Not to be noticeable coloration in the viewing area of the LCD panels. Back-lit type should be judged with back-lit on state only.	Minor
7	Contamination	Not to be noticeable.	Minor

COSMETIC CRITERIA (operating)

No.	Defect	Judgment Criteria	Classification
1	Spots	A) Clear <table><tr><td>Size : d mm</td><td>Acceptable Qty in active area</td></tr><tr><td>d ≤ 0.1</td><td>Disregard</td></tr><tr><td>0.1 < d ≤ 0.2</td><td>6</td></tr><tr><td>0.2 < d ≤ 0.3</td><td>2</td></tr><tr><td>0.3 < d</td><td>0</td></tr></table> Note : Including pin holes and defective dots which must be within one pixel size. B) Unclear <table><tr><td>Size : d mm</td><td>Acceptable Qty in active area</td></tr><tr><td>d ≤ 0.2</td><td>Disregard</td></tr><tr><td>0.2 < d ≤ 0.5</td><td>6</td></tr><tr><td>0.5 < d ≤ 0.7</td><td>2</td></tr><tr><td>0.7 < d</td><td>0</td></tr></table>	Minor

2	Lines	A) Clear	Minor

Note :( ) - Acceptable Qty in active area
L - Length (mm)
W - Width (mm)
∞ - Disregard

B) Unclear

3	Rubbing line	Not to be noticeable.	
4	Allowable density	Above defects should be separated more than 10mm each other.	Minor
5	Rainbow	Not to be noticeable.	Minor
6	Dot size	To be 95% ~ 105% of the dot size (Typ.) in drawing. Partial defects of each dot (ex. pin-hole) should be treated as 'spot'. (see Screen Cosmetic Criteria (Operating) No.1)	Minor
7	Uneven brightness (only back-lit type module)	Uneven brightness must be BMAX / BMIN ≤ 2 - BMAX : Max. value by measure in 5 points - BMIN : Min. value by measure in 5 points Divide active area into 4 vertically and horizontally. Measure 5 points shown in the following figure.	Minor

O : Measuring points

Note :
(1) Size : d = (long length + short length) / 2
(2) The limit samples for each item have priority.
(3) Complex defects are defined item by item, but if the number of defects are defined in above table, the total number should not exceed 10.
(4) In case of 'concentration', even the spots or the lines of 'disregarded' size should not allowed.

Following three situations should be treated as 'concentration'.
- 7 or over defects in circle of ∅5mm.
- 10 or over defects in circle of ∅10mm.
- 20 or over defects in circle of ∅20mm.

PRECAUTIONS FOR USING LCD MODULES

Handing Precautions

(1) The display panel is made of glass. Do not subject it to a mechanical shock by dropping it or impact.
(2) If the display panel is damaged and the liquid crystal substance leaks out, be sure not to get any in your mouth. If the substance contacts your skin or clothes, wash it off using soap and water.
(3) Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.
(4) The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.
(5) If the display surface becomes contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is heavily contaminated, moisten cloth with one of the following solvents :
    - Isopropyl alcohol
    - Ethyl alcohol
(6) Solvents other than those above-mentioned may damage the polarizer. Especially, do not use the following.
    - Water
    - Ketone
    - Aromatic solvents
(7) Exercise care to minimize corrosion of the electrode. Water droplets, moisture condensation or a current flow in a high-humidity environment, accelerate corrosion of the electrodes.
(8) Install the LCD Module by using the mounting holes. When mounting the LCD module ensure it is free of twisting, warping or distortion. In particular, do not forcibly pull or bend the I/O cable or the backlight cable.
(9) Do not attempt to disassemble or process the LCD module.
(10) NC terminal should be open. Do not connect anything.
(11) If the logic circuit power is off, do not apply the input signals.
(12) To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.
    - Be sure to ground the body when handling the LCD modules.
    - Tools required for assembling, such as soldering irons, must be properly grounded.
    - To reduce the amount of static electricity generated, do not conduct assembling and other work under dry conditions.
    - The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.

Storage Precautions

When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps. Keep the modules in bags (avoid high temperature / high humidity and low temperatures below the stated storage temperature of the LCM specification).

Others

Liquid crystals solidify under low temperature (below the storage temperature range) leading to defective orientation or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subject to a low temperature.
If the LCD modules have been operating for a long time showing the same display patterns, the display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. A normal operating status can be regained by suspending use for some time. It should be noted that this phenomenon does not adversely affect performance reliability.
To minimize the performance degradation of the LCD modules resulting from destruction caused by static electricity etc., exercise care to avoid holding the following sections when handling the modules.

      - Exposed area of the printed circuit board.
      - Terminal electrode sections.

USING LCD MODULES

Liquid Crystal Display Modules

      LCD is composed of glass and polarizer. Pay attention to the following items when handling.
      (1) Please keep the temperature within specified range for use and storage. Polarization degradation, bubble generation or polarizer peel-off may occur with high temperature and high humidity.
      (2) Do not touch, push or rub the exposed polarisers with anything harder than an HB pencil lead (glass, tweezers, etc.).
      (3) N-hexane is recommended for cleaning the adhesives used to attach front/rear polarisers and reflectors made of organic substances that may be damaged by chemicals such as acetone, toluene, ethanol and isopropyl alcohol.
      (4) When the display surface becomes dusty, wipe gently with absorbent cotton or other soft material like chamois soaked in petroleum benzene. Do not scrub hard to avoid damaging the display surface.
      (5) Wipe off saliva or water drops immediately, contact with water over a long period of time may cause deformation or color fading.
      (6) Avoid contacting oil and fats.
      (7) Condensation on the surface and contact with terminals due to cold will damage, stain or dirty the polarisers. After products are tested at low temperature they must be warmed up in a container before coming is contacting with room temperature air.

      (8) Do not put or attach anything on the display area to avoid leaving marks on.
      (9) Do not touch the display with bare hands. This will stain the display area and degrade the insulation between the terminals.
      (10) As glass is fragile. It tends to become chipped during handling especially on the edges.
      (11) Mounting Method
          The panel of the LCD Module consists of two thin glass plates with polarizes, which easily get damaged. Since the Module is fixed by utilizing fitting holes in the printed circuit board.
          Extreme care should be taken when handling the LCD Modules.
      (12) Caution against static charge
          The LCD Module use C-MOS LSI drivers, so we recommend that you connect any unused input terminal to VDD or VSS, do not input any signals before power is turned on. And ground your body, Work/assembly table. And assembly equipment to protect against static electricity.

Precaution for Soldering the LCM

	Manual Soldering	Machine Drag Soldering	Machine Pre-soldering
Non ROHS Product	290°C ~ 350°C Speed : 3 ~ 5 mm/s	330°C ~ 350°C Speed : 4 ~ 8mm/s	300°C ~ 330°C Time : 3 ~ 6S Pressure : 0.8 to 1.2Mpa
RoHS Product	340°C ~ 370°C Time : 3 ~ 5S.	350°C ~ 370°C Time : 4 ~ 8 mm/S.	330°C ~ 360°C Time : 3 ~ 6S. Pressure : 0.8 ~ 1.2Mpa.

    (1) If solder flux is used, be sure to remove any remaining flux after finishing the soldering process. (This does not apply in the case of a non-halogen type of flux.) It is recommended that your protect the LCD surface with a cover during the soldering process to prevent any damage due to the flux sparks.
    (2) When soldering a backlight panel and PCB, the panel and PCB should not be detached more than 3 times. The temperature determines this number and time conditions as mentioned in the

above table, although there may be some variance depending on the actual temperature of the soldering iron.

(3) When removing a backlight panel from the PCB, ensure the solder has completely melted, otherwise the solder pads on the backlight panel and/or PCB may be damaged.

Caution for operation

(1) It is recommended to drive LCDs within their specified voltage limit since the higher voltage than the upper limit shortens the LCD life. An electrochemical reaction due to direct current causes the LCD to deteriorate. Therefore, avoid the use of direct current drive.

(2) Response time will be extremely delayed at lower temperatures than the operating temperature range. At higher temperatures LCD's will experience a dark color. However those phenomena do not mean a malfunction or the LCD's. Once the LCDs are returned to the specified operating temperature range, the response time and colouration should return to the normal state.

(3) If the display area is physically pressed hard during it's operation, some pixels may be abnormally displayed, but should return to their normal condition after resetting the LCM.

(4) Moisture sitting on the LCM terminals is a cause for an electro-chemical reaction resulting in a terminal open circuit. Usage under the relative condition of 40°C, 50%RH or less is therefore required.

Safety

(1) It is recommended to crush any damaged or unnecessary LCDs into pieces and wash off the liquid crystal by using solvents such as acetone and ethanol, which should then be burned up later.

(2) When any liquid crystal has leaked out of a damaged glass cell and comes in contact with skin, please wash it off well with soap and water.

Warranty

Unless otherwise agreed between Logic Technologies Ltd and the customer, Logic Technologies will replace or repair any of its products that are found to be functionally defective when inspected in accordance with Logic Technologies' acceptance criteria (copies available upon request) for a period of one year from date of shipment. Cosmetic/visual defects must be returned to Logic Technologies within 90 days of shipment. Confirmation of such date shall be based on freight documents. The warranty liability of Logic Technologies is limited to the repair and/or replacement on the terms set forth above. Logic Technologies will not be responsible for any subsequent or consequential losses and/or events.

Returning products under warranty

No warranty can be granted if the precautions stated above have been disregarded. The typical examples of violations are:
- Broken LCD glass.
- PCB eyelet's damaged or modified.
- PCB conductors damaged.
- Circuit modified in any way, including addition of components.
- PCB tampered with by grinding, engraving or painting varnish.
- Soldering to or modifying the bezel in any manner.

Product repairs will be invoiced to the customer upon mutual agreement. Products must be returned with sufficient description of the failures and/or defects. Any connectors or cable installed by the customer must be removed completely without damaging the PCB eyelet's, conductors and terminals.