PRODUCT SPECIFICATION

DESCRIPTION

TFT Module – 3.5”
320 x (RGB) x 240
High brightness display

PART NUMBER

LTTD320240035-L3-HB

VERSION

1.0

ROHS COMPLIANT

Revision Status

Revision	Revision Date	Page	Content	Notes
1.0	16.12.2015		Initial release,	

Table of Contents

- GENERAL INFORMATION

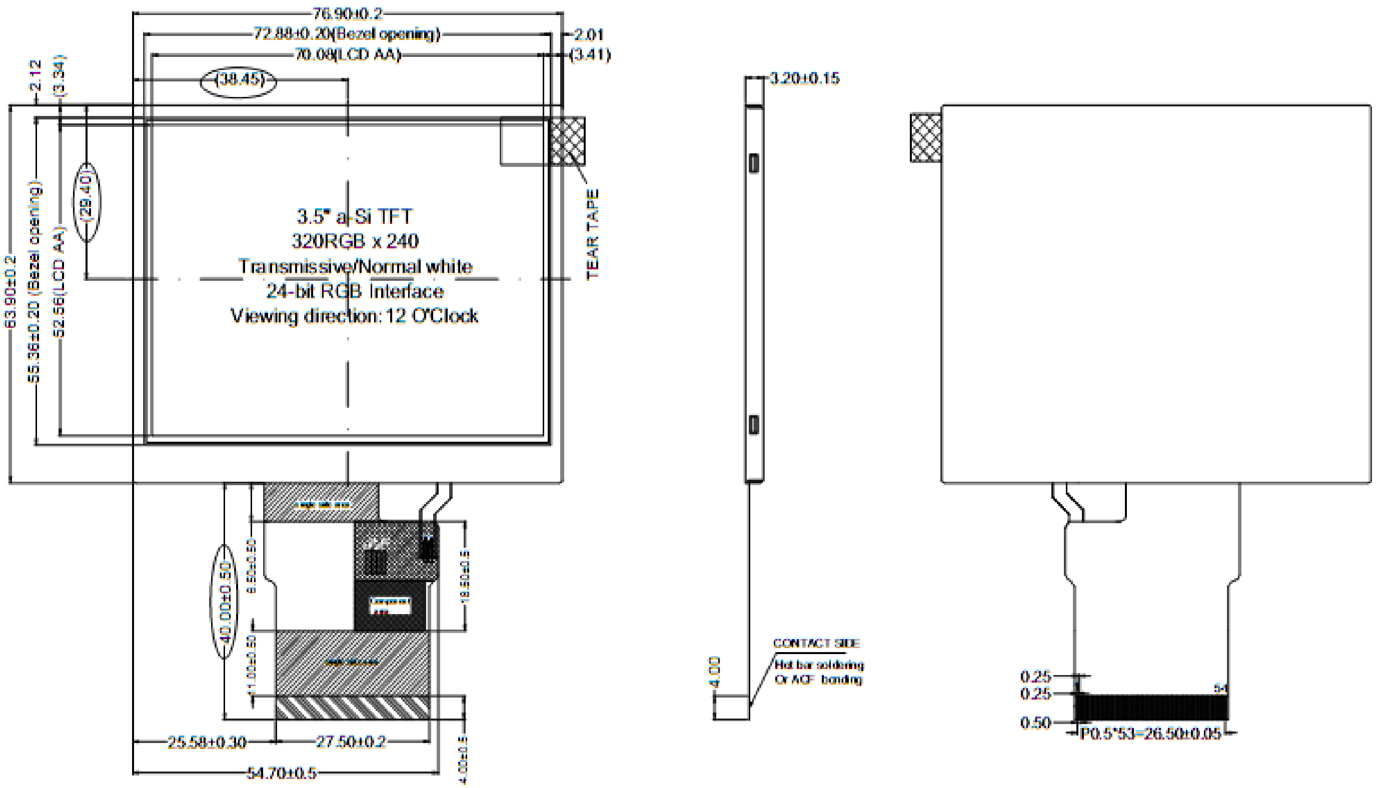
Item	**Contents**	**Unit**
LCD Type	Transmissive / Normal white	---
Technology	a-Si TFT	-
Viewing Direction	12:00	O'clock
Viewing Angle (Grayscale Inversion Direction)	6:00	O'clock
Module dimensions (W x H x T)	76.9 x 63.9 x 3.20 (Note)	mm
Active area (W x H)	70.08 x 52.56	mm
Number of pixels	320 x 3 (RGB) x 240	---
Pixel pitch (W x H)	0.219 x 0.219	mm2
Colours	16.7M	---
Contrast ratio	350	---
Backlight	LEDs (6 in series)	---
Controller IC	HX8238D or equivalent	---
Interface	24-bits RGB + 3 SPI	---
Operating temperature	-20 to +70	°C
Storage temperature	-30 to +80	°C
Weight	32	g

Note: Except FPC and bumps.

- MECHANICAL DIMENSIONS

Mechanical Dimensions

A First Issue



NOTES:
1.Display size:3.5" a-Si TFT
2.Viewing direction:12 O'Clock
Gary Scale inversion direction:6 O'Clock
3.Display mode:Transmissive/Normal white
4.Operation temperature:-20degC~+70degC
Storage temperature:-30degC~+80degC
5.Driver IC:HX8238D
6.Power supply voltage:3.3V
7.Backlight :White(6 LED)/19.2(Type)V/20mA
Luminance:500cd/m2(Type)
8.RoHS compliant
9.General tolerance: ±0.20

Backlight Circuit

Pin assignment	
PIN	SYMBOL
1	LED_K
2	LED_K
3	LED_A
4	LED_A
5	NC
6	RESET
7	NC
8	NC(YU)
9	NC(XR)
10	NC(YD)
11	NC(XL)
12	R0
13	R1
14	R2
15	R3
16	R4
17	R5
18	R6
19	R7
20	G0
21	G1
22	G2
23	G3
24	G4
25	G5
26	G6
27	G7
28	B0
29	B1
30	B2
31	B3
32	B4
33	B5
34	B6
35	B7
36	HSYNC
37	VSYNC
38	CLK
39	NC
40	NC
41	VDD
42	VDD
43	SPICS
44	NC
45	NC
46	NC
47	NC
48	NC
49	SPICLK
50	SPISDI
51	NC
52	DE
53	GND
54	GND

LOGIC TECHNOLOGIES

Part Number	Revision
LTTD320240035-L3-HB	A
Not to scale. Unit mm.	Sheet: 1/1

• ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Min.	Max.	Unit	Note
Power Voltage	V_{DD}	- 0.3	4.6	V	GND = 0
Input voltage	IOV_{DD}	- 0.5	VCI+0.3	V	
LED Forward Voltage	V_F	---	3.4	V	If = 25mA
LED Forward Current	I_F	---	25	mA	Per LED
Operating Temperature	T_{OPR}	- 20	70	°C	
Storage temperature	T_{ST}	- 30	80	°C	

Note: Response time will be slower (delayed) at lower temperatures approaching the maximum operating temperature. At temperatures approaching the maximum operating temperature the LCD will experience a darker color. However this phenomena is an inherent property of LCDs and in no way means the LCD has malfunctioned.

• ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Min	Typ.	Max	Unit	Remark
Supply Voltage	V_{DD}	3.0	3.3	3.6	V	
Input Voltage High	V_{IH}	0.8 V_{DD}	---	V_{DD}	V	
Input Voltage Low	V_{IL}	GND	---	$0.2V_{DD\ I}$	V	
Power Consumption LCD Panel + Controller IC	$W_{LCD + IC}$	--	100	---	mW	Note 1

Note 1: V_{CI}= 3.3V, Ta=25°C, Frame Rate = 70Hz, all pixels black. Not include backlight.

• BACKLIGHT CHARACTERISTICS

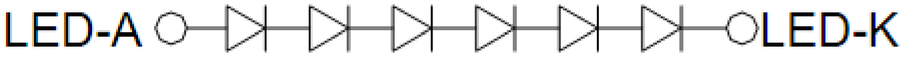
Item	Symbol	Min.	Typ.	Max.	Unit	Condition
Forward Current Voltage	V_F	17.4	19.2	20.4	V	
Forward Current	I_F	---	20	25	mA	
Backlight Power Consumption	W_{BL}	---	384	510	mW	
LED Lifetime	---	20000	---	---	Hrs	Note 3

Notes

- **Backlight drive conditions : constant current driving method.**

- The LED driving condition is defined for the total backlight consumption.
- Forward Voltage adjusting should depend on Forward Current setting.
- Optical performance should be evaluated at Ta=25℃only.
- 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.
- Typical operating lifetime is estimated data.

- BACKLIGHT SCHEMATIC



- ELECTRO-OPTICAL CHARACTERISTICS (backlight on)

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Refer	Note
Response Time		T_{ON}	25°C	---	15	20	ms	Fig 1	1
		T_{OFF}		---	20	30			
Contrast ratio		Cr	θ=0°	300	350	---	---	Fig 2	1
NTSC		---	---	---	53	---	%		
Surface Luminance		Lv		400	500	---	cd/m^2	Fig 2	2
Viewing angle ratio (Cr>=10)			∅=90°	40	50	---	deg	Fig 3	6
			∅=270°	60	70	---			
			∅=0°	60	70	---			
			∅=180°	60	70	---			
CIE (x,y) chromaticity	Red	x	Backlight On	0.537	0.587	0.637	---	Fig 2.	5
		y		0.287	0.337	0.387			
	Green	x		0.269	0.319	0.369			
		y		0.572	0.622	0.672			
	Blue	x		0.093	0.143	0.193			
		y		0.053	0.103	0.153			
	White	x		0.243	0.293	0.343			
		y		0.305	0.355	0.405			

Note1. Contrast ratio (CR) is defined mathematically in Figure 2.

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

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.

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

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

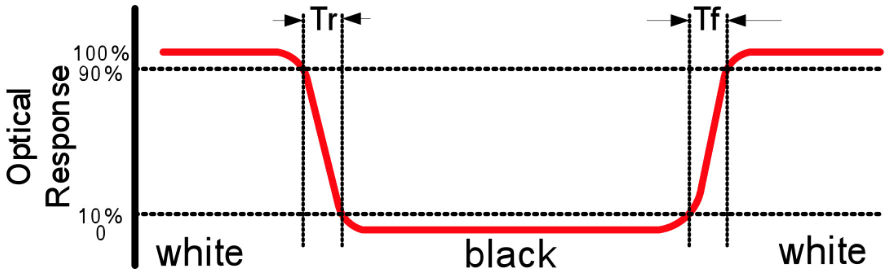


Figure 2. Measuring contrast ratio, surface luminance, luminance uniformity and CIE (chromaticity.)

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

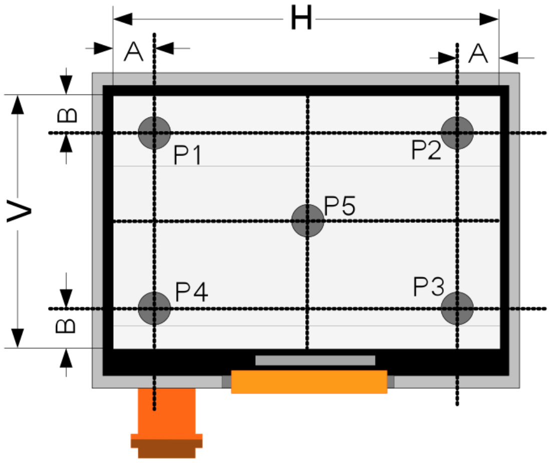
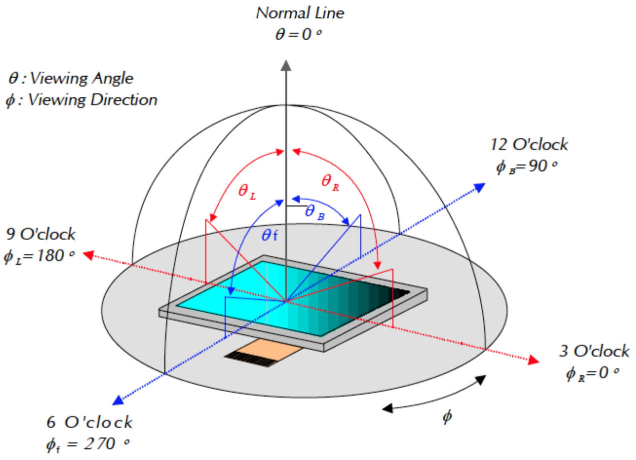


Figure 3. Definition of viewing angle

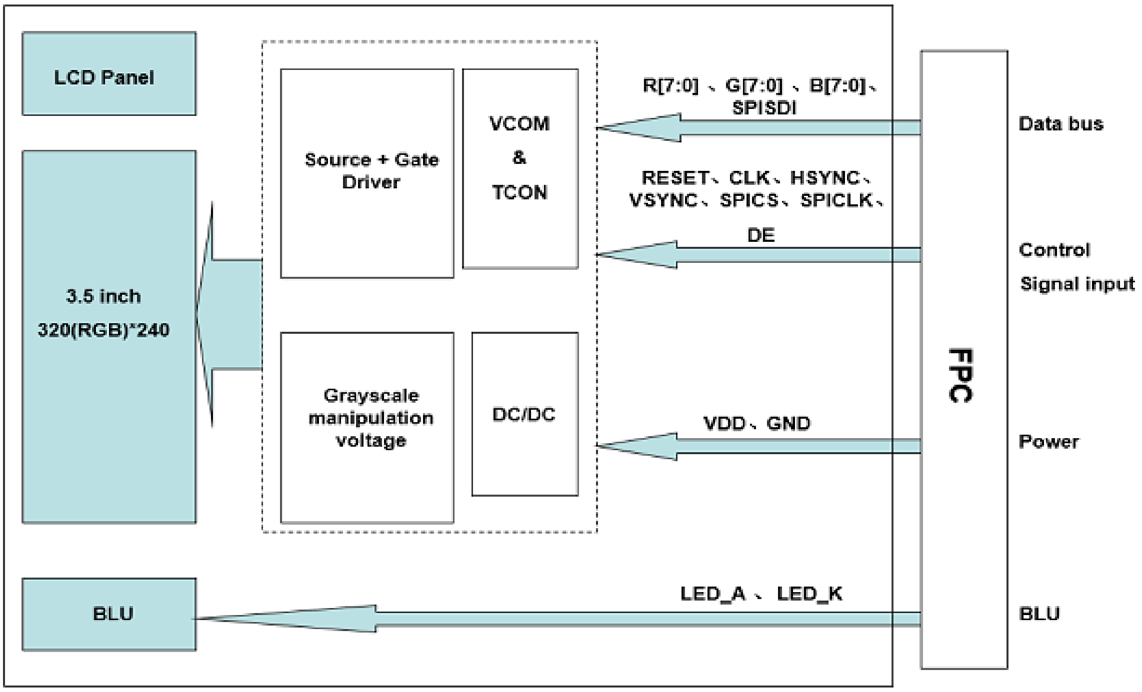


- INTERFACE DESCRIPTION

No.	Symbol	Function Description	Remark
1	LED_ K	LED backlight cathode	
2	LED_ K	LED backlight cathode	
3	LED_ A	LED backlight anode	
4	LED_ A	LED backlight anode	
5	NC	Not connect	
6	RESET	Reset signal, Low active	
7	NC	Not connect	
8	NC(YU)	Not connect	
9	NC(XR)	Not connect	
10	NC(YD)	Not connect	
11	NC(XL)	Not connect	
12	R0	Red Data bus	
13	R1	Red Data bus	
14	R2	Red Data bus	
15	R3	Red Data bus	
16	R4	Red Data bus	
17	R5	Red Data bus	
18	R6	Red Data bus	
19	R7	Red Data bus	
20	G0	Green Data bus	
21	G1	Green Data bus	
22	G2	Green Data bus	
23	G3	Green Data bus	
24	G4	Green Data bus	
25	G5	Green Data bus	
26	G6	Green Data bus	
27	G7	Green Data bus	
28	B0	Blue Data bus	
29	B1	Blue Data bus	
30	B2	Blue Data bus	
31	B3	Blue Data bus	
32	B4	Blue Data bus	
33	B5	Blue Data bus	

34	B6	Blue Data bus	
35	B7	Blue Data bus	
36	HSYNC	Horizontal Synchronous Signal	
37	VSYNC	Vertical Synchronous Signal	
38	CLK	Data Clock	
39	NC	Not connect	
40	NC	Not connect	
41	VDD	Power Supply	
42	VDD	Power Supply	
43	SPICS	SPI Serial Chip select	
44	NC	Not connect	
45	NC	Not connect	
46	NC	Not connect	
47	NC	Not connect	
48	NC	Not connect	
49	SPICLK	SPI Serial Clock	
50	SPISDI	SPI Serial Data Input	
51	NC	Not connect	
52	DE	Data enabling signal	
53	GND	Ground	
54	GND	Ground	

Block Diagram



- AC CHARACTERISTICS

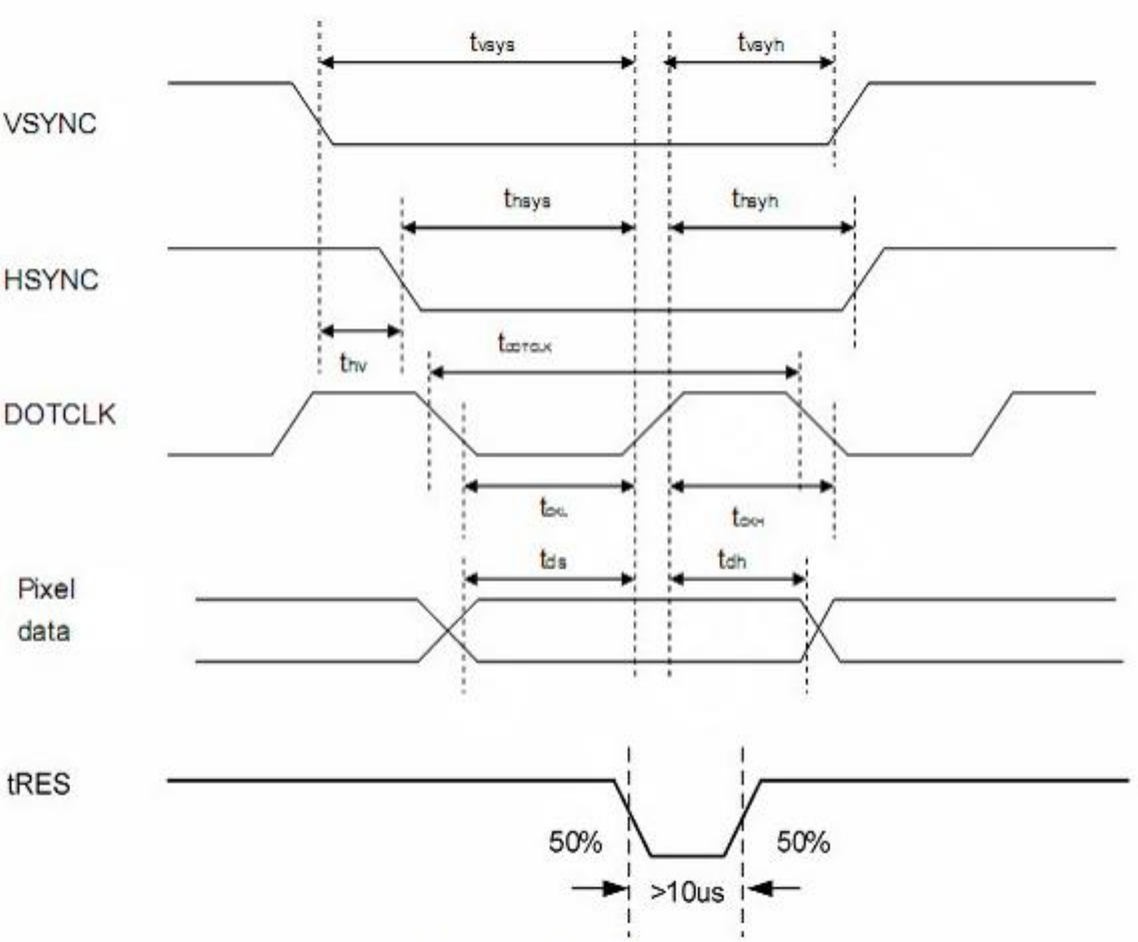
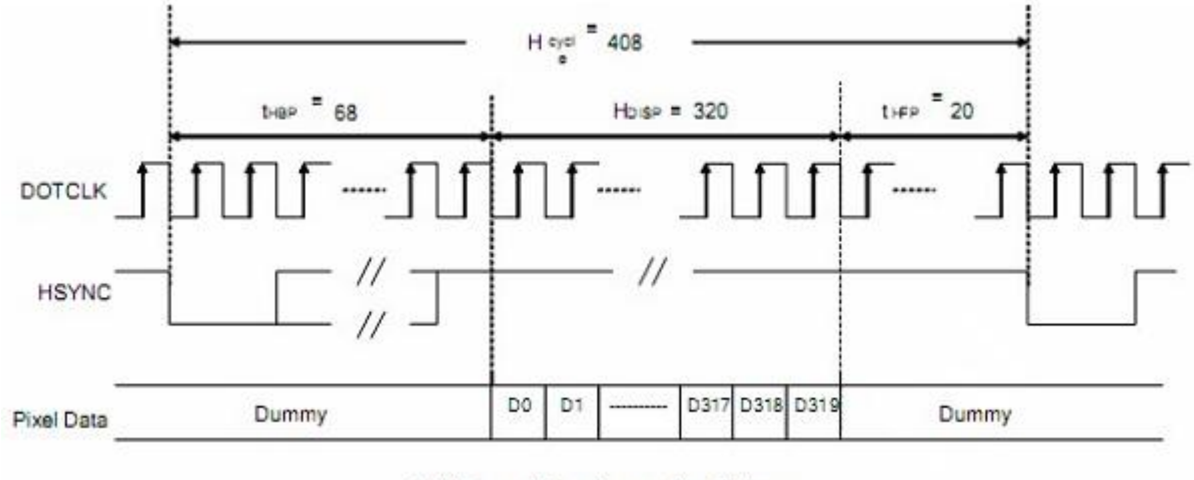


Figure 1: Pixel Timing

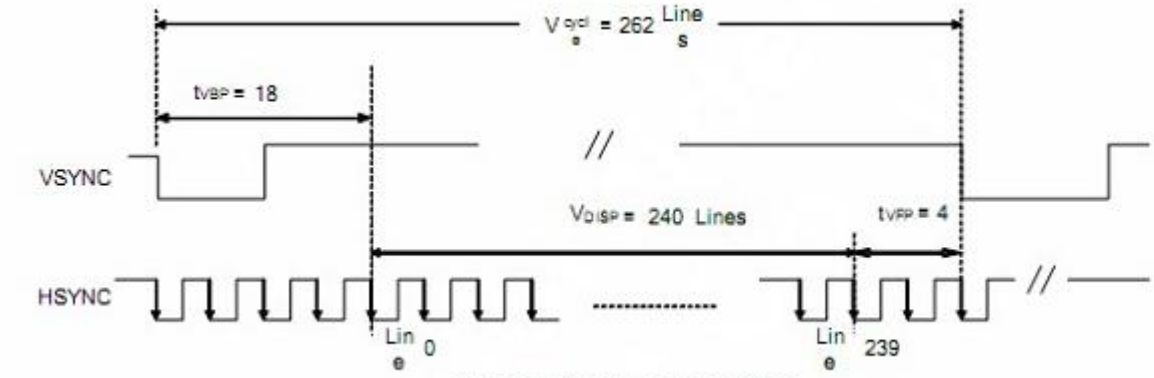
Characteristics	Symbol	Min.		Typ.		Max.		Unit
		24 bit	8 bit	24 bit	8 bit	24 bit	8 bit	
DOTCLK Frequency	fDOTCLK	-	-	6.5	19.5	10	30	MHz
DOTCLK Period	tDOTCLK	100	33.3	154	51.3	-	-	ns
Vertical Sync Setup Time	tvsys	20	10	-	-	-	-	ns
Vertical Sync Hold Time	tvsyh	20	10	-	-	-	-	ns
Horizontal Sync Setup Time	thsys	20	10	-	-	-	-	ns
Horizontal Sync Hold Time	thsyh	20	10	-	-	-	-	ns
Phase difference of Sync Signal Falling Edge	thv	1		-		240		tDOTCLK
DOTCLK Low Period	tCKL	50	15	-	-	-	-	ns
DOTCLK High Period	tCKH	50	15	-	-	-	-	ns
Data Setup Time	tds	12	10	-	-	-	-	ns
Data hold Time	tdh	12	10	-	-	-	-	ns
Reset pulse width	tRES	10		-		-		µs

Note: External clock source must be provided to DOTCLK pin of HX8238-D. The driver will not operate if absent of the docking signal.

Table 1: Pixel Timing



(a) Horizontal Data Transaction Timing



(b) Vertical Data Transaction Timing

Figure 2: Data Transaction Timing in Parallel RGB (24 bit) Interface(SYNC Mode)

Characteristics		Symbol	Min.		Typ.		Max.		Unit
			24 bit	8 bit	24 bit	8 bit	24 bit	8 bit	
DOTCLK Frequency		fDOTCLK	-	-	6.5	19.5	10	30	MHz
DOTCLK Period		tDOTCLK	100	33.3	154	51.3	-	-	ns
Horizontal Frequency (Line)		fH	-		14.9		22.35		KHz
Vertical Frequency (Refresh)		fV	-		60		90		Hz
Horizontal Back Porch		tHBP	-	-	68	204	-	-	tDOTCLK
Horizontal Front Porch		tHFP	-	-	20	60	-	-	tDOTCLK
Horizontal Data Start Point		tHBP	-	-	68	204	-	-	tDOTCLK
Horizontal Blanking Period		tHBP + tHFP	-	-	88	264	-	-	tDOTCLK
Horizontal Display Area		HDISP	-	-	320	960	-	-	tDOTCLK
Horizontal Cycle		Hcycle	-	-	408	1224	450	1350	tDOTCLK
Vertical Back Porch		tVBP	-		18		-		Lines
Vertical Front Porch		tVFP	-		4		-		Lines
Vertical Data Start Point		tVBP	-		18		-		Lines
Vertical Blanking Period		tVBP + tVFP	-		22		-		Lines
Vertical Display Area	NTSC	VDISP	-		240		-		Lines
	PAL				280(PALM=0)				
	PAL				288(PALM=1)				
Vertical Cycle	NTSC	Vcycle	-		262		350		Lines
	PAL				313				

Table 2: Data Transaction Timing in Normal Operating Mode

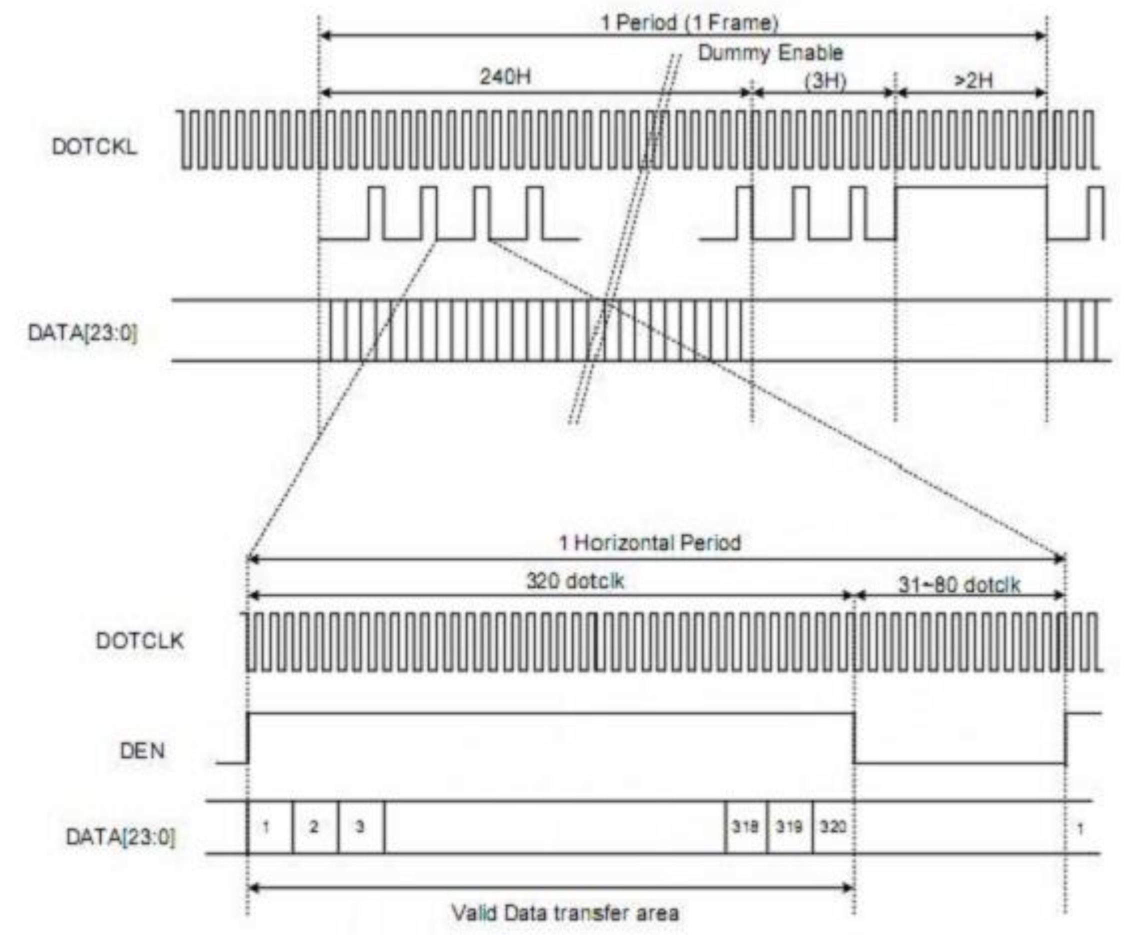


Figure 3: Signal Timing in DE Mode

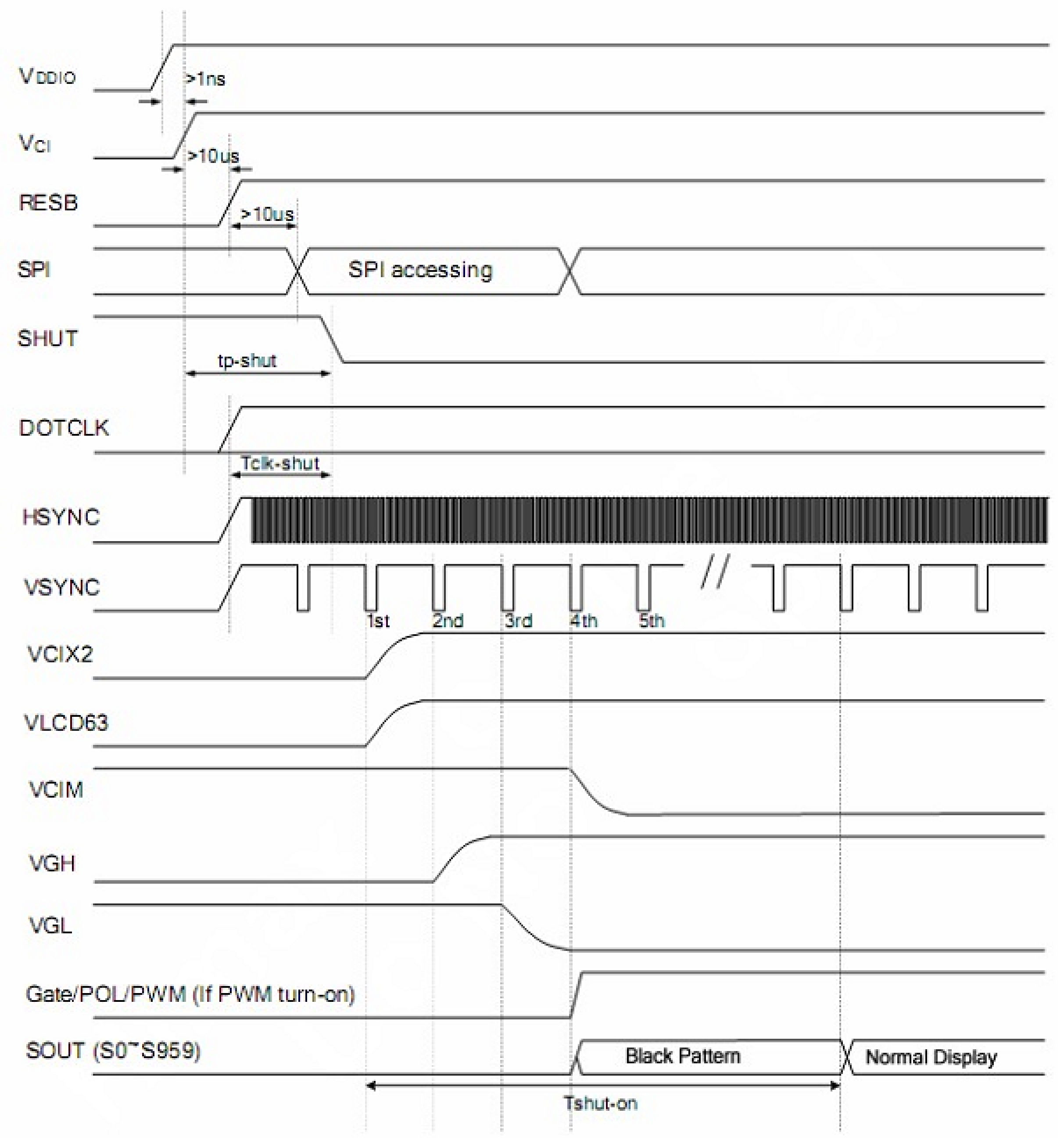


Figure 4: Power Up Sequence

Characteristics	Symbol	Spec.			Unit
		Min.	Typ.	Max.	
VDDD / VDDIO on to falling edge of SHUT	tp-shut	1	-	-	µs
DOTCLK	tclk-shut	1	-	-	clk
Falling edge of SHUT to display start - 1 line: 408 clk - 1 frame: 262 line -DOTCLK = 6.5MHz	tshut-on	-	-	14	frame
		-	166	232.4	ms

Note: It is necessary to input DOTCLK before the falling edge of SHUT.
Display starts at 10th falling edge of VSTNC after the falling edge of SHUT.

Table 3: Power Up Sequence

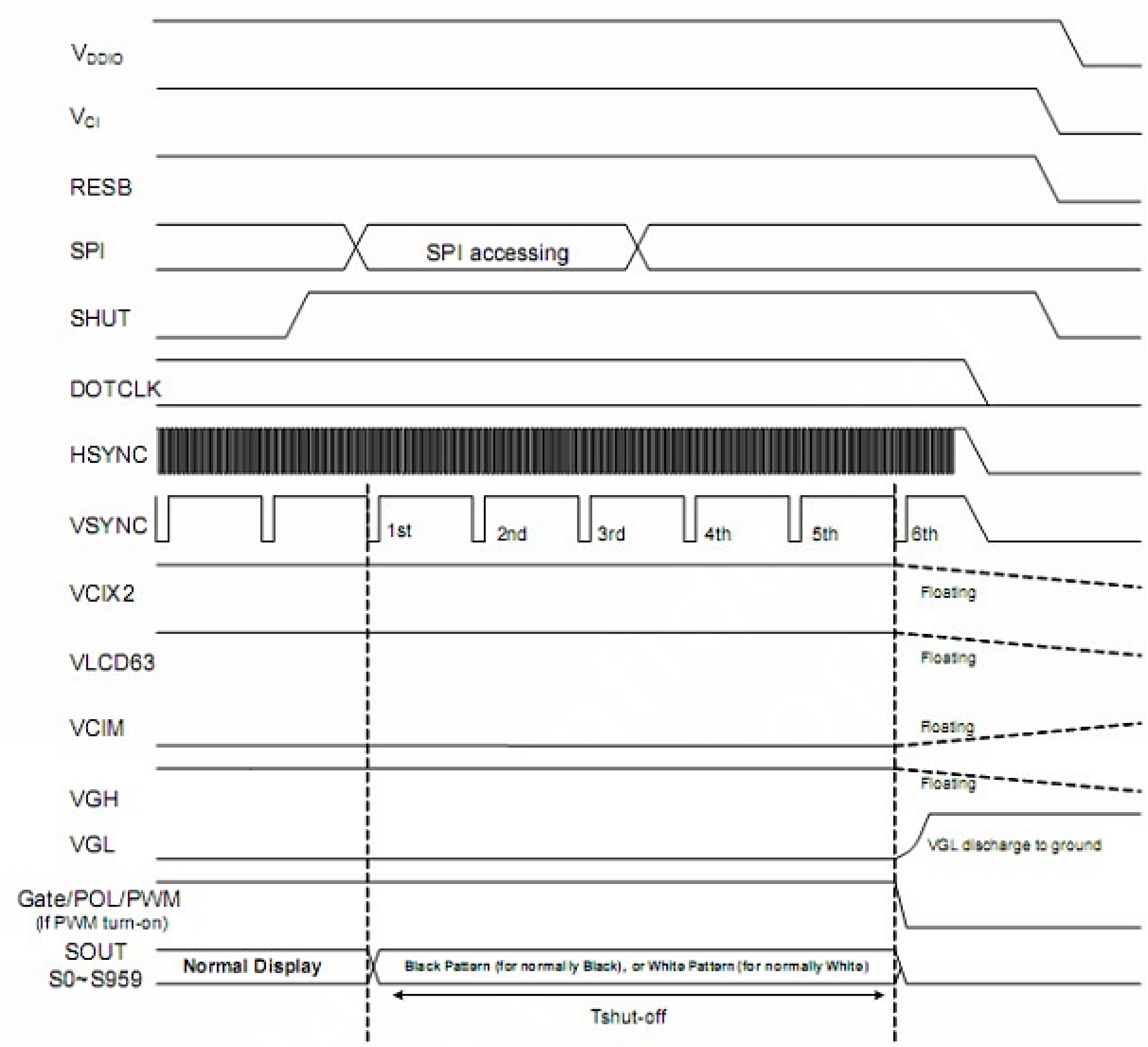


Figure 5: Power Down Sequence

Characteristics	Symbol	Spec.			Unit
		Min.	Typ.	Max.	
Rising edge of SHUT to display off - 1 line: 408 clk - 1 frame: 262 line - DOTCLK = 6.5MHz	tshut-off	2	-	-	frame
		33.4	-	-	ms

Note: DOTCLK must be maintained at lease 2 frames after the rising edge of SHUT.
Display become off at the 2nd falling edge of VSTNC after the falling edge of SHUT.
If RESET signal is necessary for power down, provide it after the 2-frames-cycle of the SHUT period.

Table 4: Power Down Sequence

Note: For more details, please refer to the HX8238D driver IC specification.

- 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)	-20°C to 30min to 70°C, 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

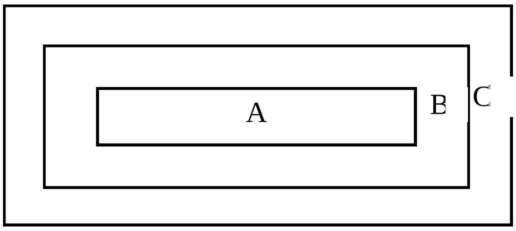
- The viewing distance for cosmetic inspection is approximately 30cm with the naked eye, and under an environment of 20-40W light intensity, in all directions, within 45° against a perpendicular line. (Normal temperature 20-25°C and normal humidity 60+/-15 RH.)
- Driving voltage - The Vop value from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

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

Figure 4



into

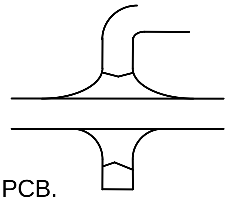
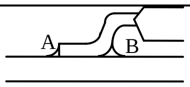
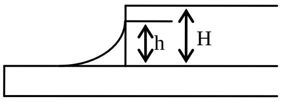
Note: As a general rule visual defects in Zone C are permissible when there is no visual effect once assembled into the customer's product.

- 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

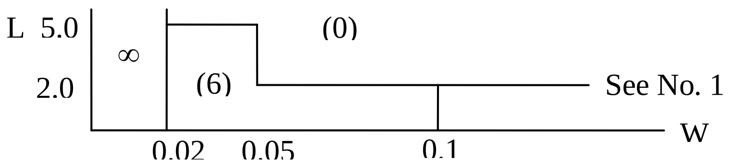
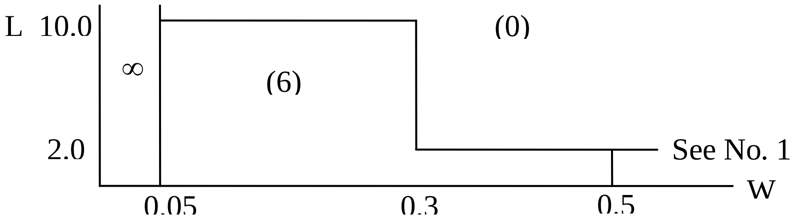
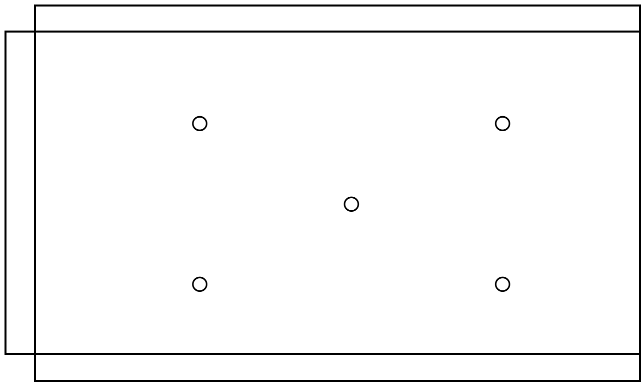
No.	Item	Judgment Criteria	Partition
1	Difference in Spec.	None allowed	Major
2	Pattern peeling	No substrate pattern peeling and floating	Major
3	Soldering defects	No soldering missing No soldering bridge No cold soldering	Major Major Minor
4	Resist flaw on substrate	Invisible copper foil (∅0.5mm or more) on substrate pattern	Minor
5	Accretion of metallic Foreign matter	No soldering dust No accretion of metallic foreign matters (Not exceed ∅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 ≥ h ≥ (1/2) H 	Minor
9	Solder ball/solder splash	a) The spacing between solder ball and the conductor or solder pad h ≥ 0.13mm. The diameter of the solder ball d ≤ 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)

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

- COSMETIC CRITERIA (operating)

<table>
<tr><th>No.</th><th>Defect</th><th>Judgment Criteria</th><th>Classification</th></tr>
<tr><td>1</td><td>Spots</td><td>A) Clear
<table>
<tr><th>Size : d mm</th><th>Acceptable Qty in active area</th></tr>
<tr><td>$d \leq 0.1$</td><td>Disregard</td></tr>
<tr><td>$0.1 < d \leq 0.2$</td><td>6</td></tr>
<tr><td>$0.2 < d \leq 0.3$</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><th>Size : d mm</th><th>Acceptable Qty in active area</th></tr>
<tr><td>$d \leq 0.2$</td><td>Disregard</td></tr>
<tr><td>$0.2 < d \leq 0.5$</td><td>6</td></tr>
<tr><td>$0.5 < d \leq 0.7$</td><td>2</td></tr>
<tr><td>$0.7 < d$</td><td>0</td></tr>
</table></td><td>Minor</td></tr>
</table>

2	Lines	A) Clear  Note :( ) - Acceptable Qty in active area L - Length (mm) W - Width (mm) ∞ - Disregard B) Unclear  	Minor
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.  ○ : Measuring points	Minor

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 make sure it is free of twisting, warping and 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.