LIQUID CRYSTAL DISPLAY MODULE

Product Specification

PRODUCT NUMBER	84-0168-001

INTERNAL APPROVALS		
Product Manager	Engineering	Document Control
Gregory Hayes		
Date:10/7/2014	Date:	Date:

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REVISION RECORD

Rev.	Date	Page	Par.	Comment	ECN no.
A	10/07/2014	--	--	Preliminary DCA Release	

1 GENERAL SPECIFICATIONS

ITEM	DESCRIPTION	UNIT
Module Outline Dimensions	164.05 (H) x 100.86(V) x 2.35 (T) (Not including cable)	mm
Active Display Area	153.6(H) x 90.0 (V)	mm
Pixel Configuration Format / Resolution	1024 (H) x 600 (V)	pixels
LCD Type	Transmissive / Normally Black	--
Backlight Type	Bottom edge side, 1-LED lighting Bar type (20*LED array)	--
Weight	90 Max	gram
Interface	1 Channel LVDS Interface with 1 pixel /clock	--
Pixel Arrangement	Pixels RGB stripe arrangement	--
Pixel pitch	50(H)X150(V)xRGB	um
Display Color	16.7M(6bits+H-FRC)	--
RoHS Compliant	Yes	--
Surface Treatment	Hard coating, 3H, Low reflection (Front polarizer)	--

2 FEATURES

This module has a 7.0 inch diagonally measured active area with WSVGA resolutions
(**1024** horizontal by **600** vertical pixel array). Each pixel is divided into RED, GREEN,
BLUE dots which are arranged in vertical stripe and this module
can display 16.7M colors.

The TFT-LCD panel used for this module is adapted for a low reflection and
higher color type.an 7" diagonal WSVGA supported TFT-LCD and can display
16.7M colors (Hi FRC).

3 MECHANICAL DRAWING

Front View

Rear View

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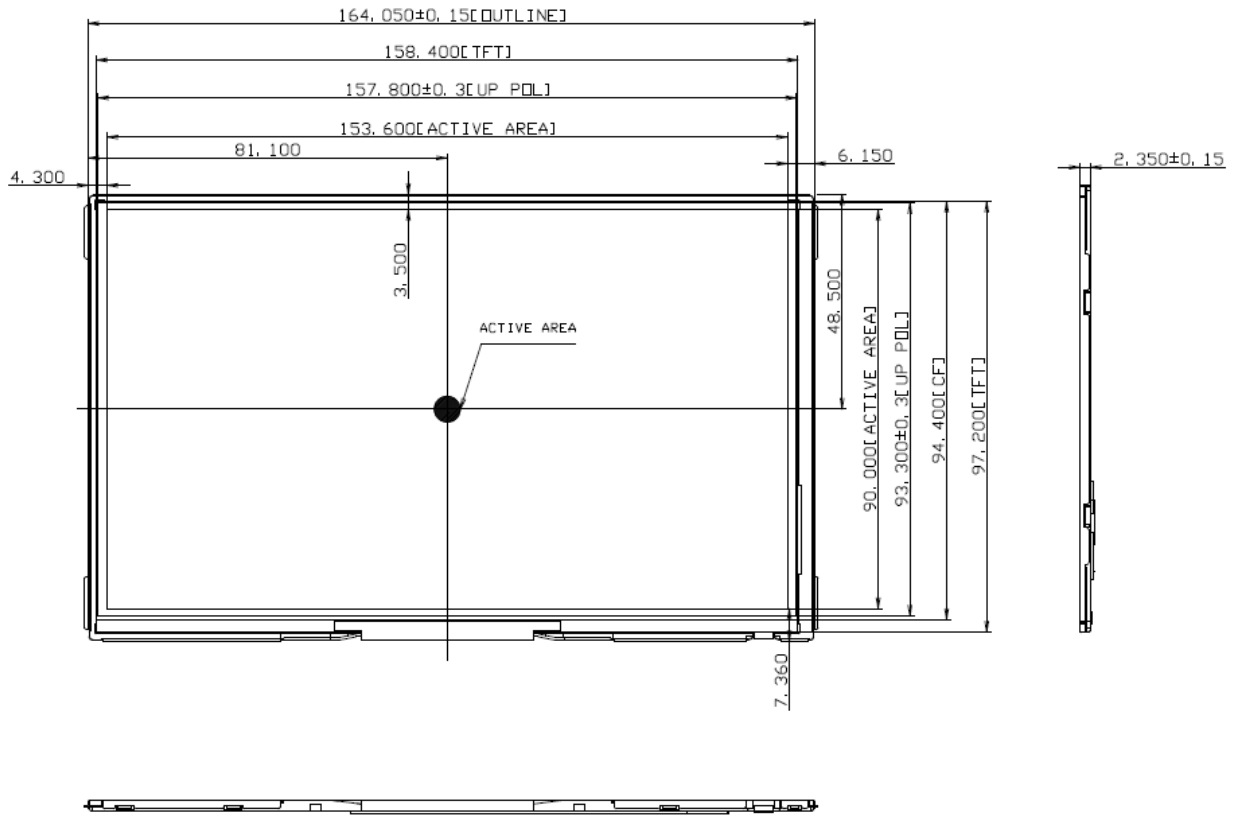
4 ABSOLUTE MAXIMUM RATINGS

If the operating condition exceeds the following absolute maximum ratings, the TFT LCD module may be damaged permanently.

(Ta=25±2°C,)

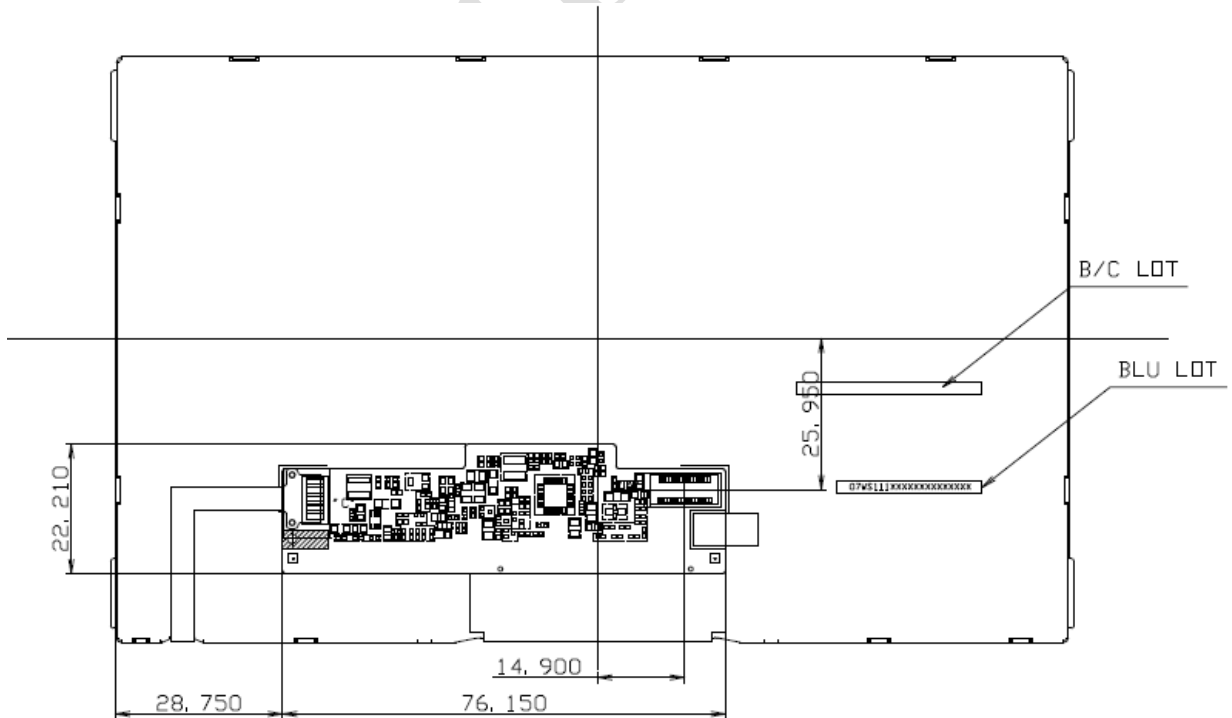| Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage (LCD module)	V_{DD}	-0.3	4.2	V	
Backlight Power supply voltage	HV_{DD}	-0.3	40	V	
Backlight LED Current (Each)	I_{LED}	-	20	mA	
Backlight LED Reverse Coltage	V_R	-	2	V	
Storage temperature	T_{STG}	-40	+85	°C	(1)
Operating temperature	T_{OPR}	-20	+65	°C	(1)

Note (1) Temperature and relative humidity range are shown in the figure below.
Wet bulb temperature should be 39°C max. and no condensation of water.
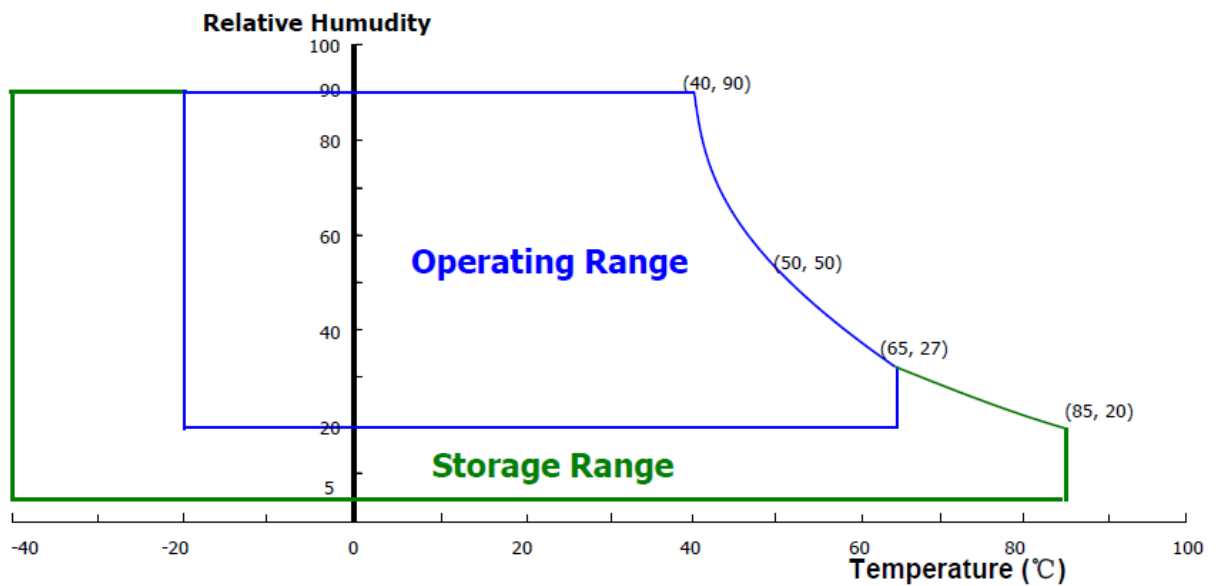
5 ELECTRICAL CHARACTERISTICS

TFT-LCD Module

(Ta=25±2°C)

Item	Symbol	Value			Unit	Condition
		Min.	Typ.	Max.		
Power supply input voltage	V_{DD}	3.2	3.7	4.2	V	
Power Supply Current	I_{DD}	-	151	-	mA	Note 1
Backlight Power Supply Voltage	HV_{DD}	3.2	3.7	4.2	V	
Backlight power supply current	I_{HVDD}	-	405	-	mA	
LED driver Efficiency	η	-	84	-	%	Note 2

	Symbol	Min	Typ	Max	Unit	Note
Positive-Going Input Threshold Voltage	V_{IT+}	-	-	+100	mV	
Negative-going Input Threshold voltage	V_{IT-}	-100	-	-	mV	V_{COM} = 1.2V Typ
Differential input common mode voltage	V_{COM}	-	1.2	-	V	V_{IH}=100mV V_{IL}=100mV
	P_D	-	0.56	0.65	W	@white
	P_{BL}	-	1.50	1.55	W	@white
Power Consumption	P_{Total}	-	2.06	2.20	W	@white

Note1:   The supply voltage is measured and specified at the interface connector of LCM.

The current draw and power consumption specified is for 3.7V at 25℃

Note 2: Calculated value for reference (VLED X ILED)

6 Recommended Driving CHARACTERISTICS for backlight

ITEM	Symbol	Min	Typ	Max	Unit	Note
Current for each LED	I_{LED}	-		20	mA	
Voltage for each LED	V_{LED}		3	3.3	V	
Input Current	I_B	-		80	mA	Total 20 LEDs, 4 Srings,5 EA each sring
Input Voltage	V_B		15	16.5	V	
Power Consumption for Backlight	P_B		1.50	1.55	W	

(Ta=25±2°C)

Note (1) Calculated Value for reference I_{LED} X V_{LED} = P_{LED}.

(2) The LED life-time defines as the estimated time to 50% degradation of initial luminous.

7 BLOCK DIAGRAM
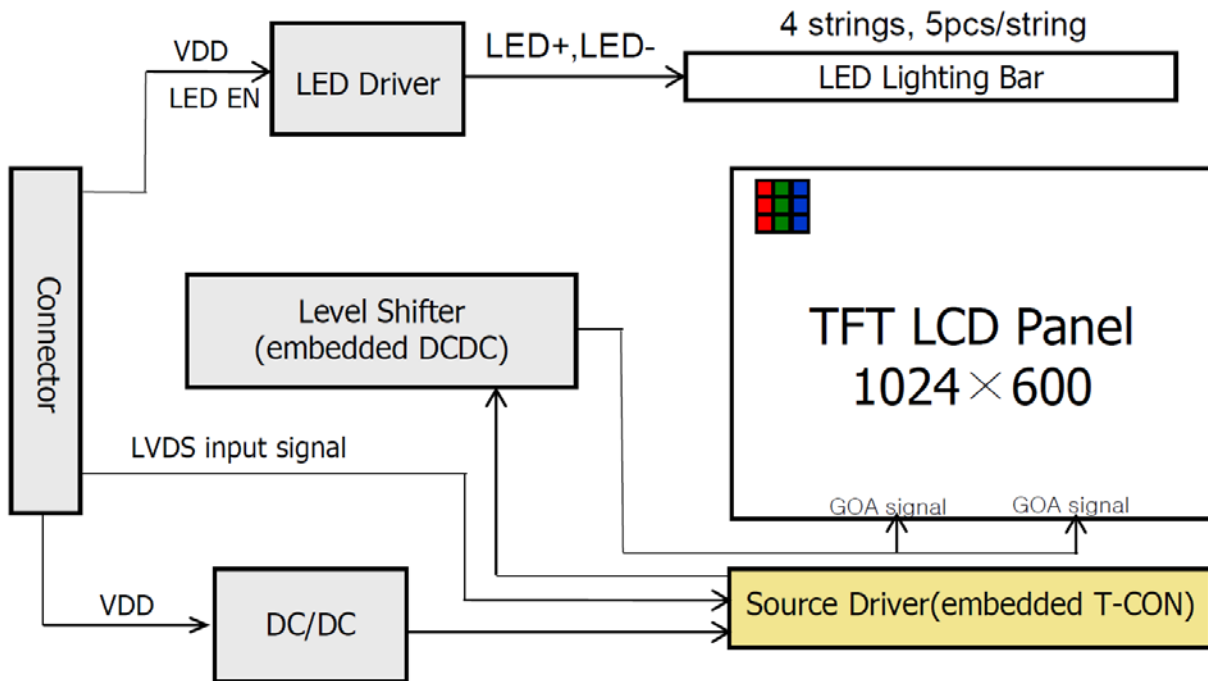
8 ELECTRO-OPTICAL CHARACTERISTICS

The test of view angle range shall be measured in a dark room (ambient luminance ≤ 1lux and temperature = 25±2℃) with the equipment of Luminance meter system (Goniometer system and TOPCON BM-5A) and test unit shall be located at an approximate distance 50cm from the LCD surface at a viewing angle of θ and Φ equal to 0°. We refer to θØ=0 (=θ3) as the 3 o'clock direction (the "right"), θØ=90 (= θ12) as the 12 o'clock direction ("upward"), θØ=180 (= θ9) as the 9 o'clock direction ("left") and θØ=270(= θ6) as the 6 o'clock direction ("bottom"). While scanning θand/or Ø, the center of the measuring spot on the Display surface shall stay fixed. The luminance, color and uniformity should be tested by CA210. The backlight should be operating for 30 minutes prior to measurement. VDD shall be 3.7 ± 0.5V at 25°C. Optimum viewing angle direction is 6 'clock.

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing Angle range	Horizontal	Θ_3	CR > 10	-	80	-	Deg.	Note 1
		Θ_9		-	80	-	Deg.	
	Vertical	Θ_{12}		-	80	-	Deg.	
		Θ_6		-	80	-	Deg.	
Color Temperature				6000	7000	8000	K	
Color Gamut				46.7	51.7	-	%	
Luminance Contrast ratio		CR	$\Theta = 0°$	700	900			Note 2
Luminance of White	9 Points	Y_w	$\Theta = 0°$	320	400	-	cd/m^2	Note 3
White Luminance uniformity	9 Points	$\Delta Y9$		80	90	-		Note 4
White Chromaticity		W_x	$\Theta = 0°$	Typ. -0.02	0.303	Typ. +0.02		Note 5
		W_y			0.333			
Reproduction of color	Red	R_x	$\Theta = 0°$	Typ. -0.03	0.600	Typ. +0.03		
		R_y			0.340			
	Green	G_x			0.315			
		G_y			0.565			
	Blue	B_x			0.145			
		B_y			0.125			
Response Time (Rising + Falling)		T_{RT}	Ta= 25° C $\Theta = 0°$	-	30	-	ms	Note 6
Cross Talk		CT	$\Theta = 0°$	-	-	2.0	%	Note 7

Prelim

Notes : 1. Viewing angle is the angle at which the contrast ratio is greater than 10. The viewing angles are determined for the horizontal or 3, 9 o'clock direction and the vertical or 6, 12 o'clock direction with respect to the optical axis which is normal to the LCD surface (see FIGURE 1).

2. Contrast measurements shall be made at viewing angle of Θ= 0 and at the center of the LCD surface. Luminance shall be measured with all pixels in the view field set first to white, then to the dark (black) state . (see FIGURE 1) Luminance Contrast Ratio (CR) is defined mathematically.

$$CR = \frac{\text{Luminance when displaying a white raster}}{\text{Luminance when displaying a black raster}}$$

3. Center Luminance of white is defined as luminance values of 9 point average across the LCD surface. Luminance shall be measured with all pixels in the view field set first to white. This measurement shall be taken at the locations shown in FIGURE 2 for a total of the measurements per display. the LED current is setting at 20mA.

4. The White luminance uniformity on LCD surface is then expressed as : ΔY = Minimum Luminance of 9 points / Maximum Luminance of 9 points (see FIGURE 2).

5. The color chromaticity coordinates specified in Table 5 shall be calculated from the spectral data measured with all pixels first in red, green, blue and white. Measurements shall be made at the center of the panel.

6. The electro-optical response time measurements shall be made as FIGURE 3 by switching the "data" input signal ON and OFF. The times needed for the luminance to change from 10% to 90% is Tr, and 90% to 10% is Td.

7. Cross-Talk of one area of the LCD surface by another shall be measured by comparing the luminance (YA) of a 25mm diameter area, with all display pixels set to a gray level, to the luminance (YB) of that same area when any adjacent area is driven dark. (See FIGURE 4).

Optical measurements

Figure 1. Measurement Set Up

Photo detector
(TOPCON BM-5A)

Field = 1°

TFT-LCD module

50 cm

LCD panel

Center of the screen
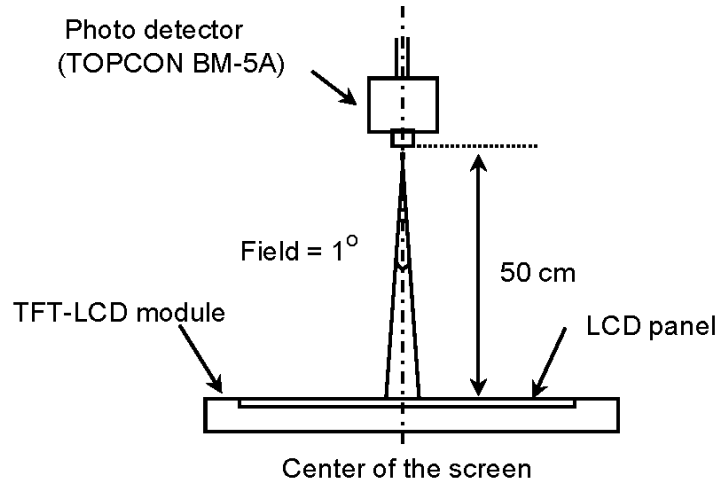
Optical characteristics measurement setup

Figure 2. White Luminance and Uniformity Measurement Locations (9 points)
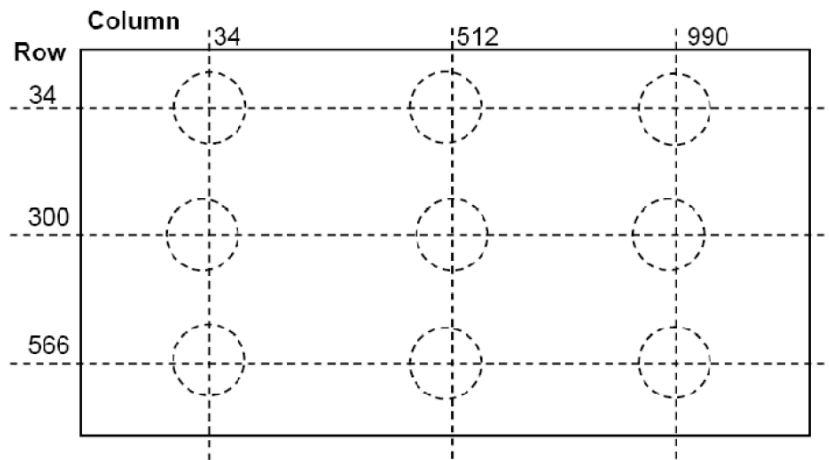
Center Luminance of white is defined as luminance values of center 9 points across the LCD surface. Luminance shall be measured with all pixels in the view field set first to white. This measurement shall be taken at the locations shown in FIGURE 2 for a total of the measurements per display.
The White luminance uniformity on LCD surface is then expressed as : ΔY9 = Minimum Luminance of five points / Maximum Luminance of nine points (see FIGURE 2).

Figure 3. Response Time Testing

Display data: Black (TFT OFF) | White (TFT ON) | Black (TFT OFF)

Optical Response

100%
90%

10%
0%

T_R T_F
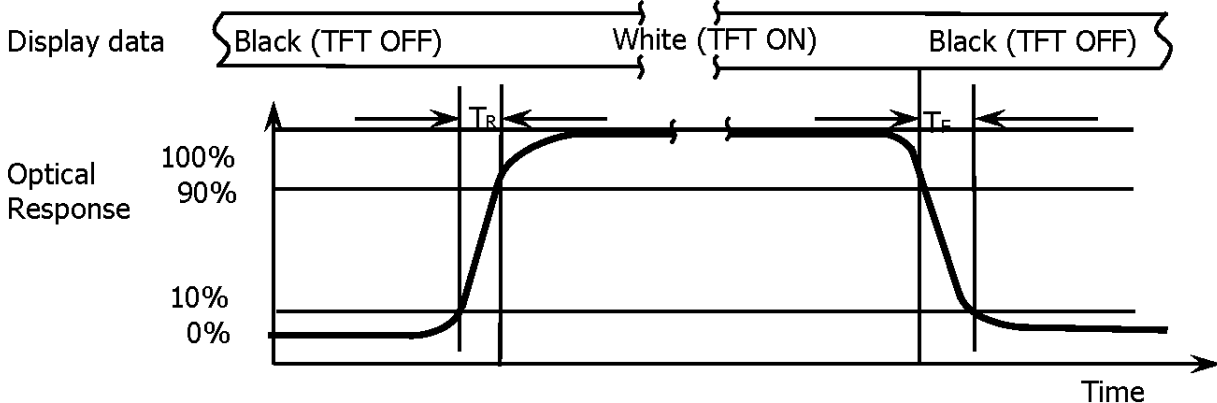
Time

The electro-optical response time measurements shall be made as shown in FIGURE 3 by switching the "data" input signal ON and OFF. The times needed for the luminance to change from 10% to 90% is Tr and 90% to 10% is Td.

Figure 4. Cross Modulation Test Description

VIEW AREA

Y_A (768,300)

VIEW AREA

256,150   768,150

256,450   768,450

L31

L0

Y_B(768, 300)
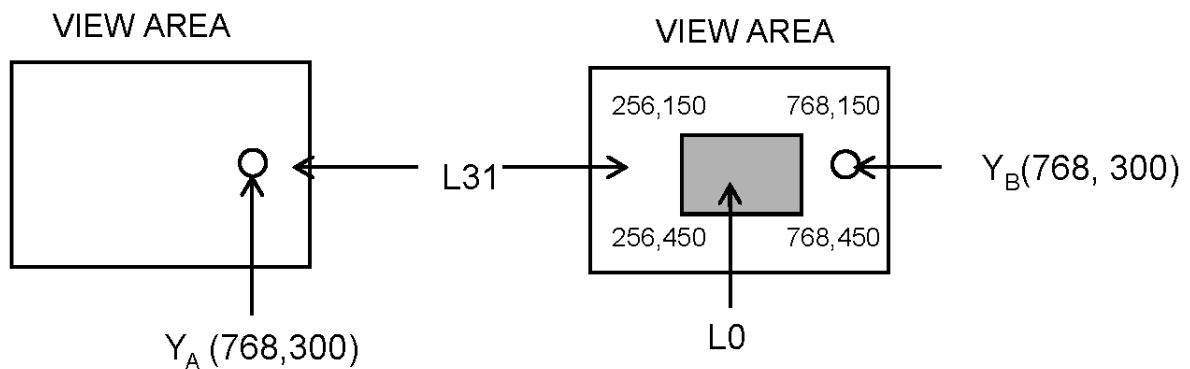
$$\text{Cross-Talk (\%)} = \left| \frac{Y_B - Y_A}{Y_A} \right| \times 100$$

Where:

Y_A = Initial luminance of measured area (cd/m^2)
Y_B = Subsequent luminance of measured area (cd/m^2)

The location measured will be exactly the same in both patterns

Cross-Talk of one area of the LCD surface by another shall be measured by comparing the luminance (YA) of a 25mm diameter area, with all display pixels set to a gray level, to the luminance (YB) of that same area when any adjacent area is driven dark (Refer to FIGURE 4).

9 INPUT/OUTPUT TERMINALS PIN ASSIGNMENT

The electronics interface connector is PF030-B31B-N09.
The connector interface pin assignments are listed below

Terminal	Symbol	Functions
Pin No.	Symbol	Description
1	VDDIN	Power supply VDDIN=3.7V (Typ.)
2	VDDIN	
3	VDDIN	
4	VDDIN	
5	VDDIN	
6	VDDIN	
7	VDDIN	
8	NC	Non Connection
9	NC	Non Connection
10	NC	Non Connection
11	GND	GROUND
12	GND	GROUND
13	RIN0-	LVDS Negative data signal (-)
14	RIN0+	LVDS Positive data signal (+)
15	GND	GROUND
16	RIN1-	LVDS Negative data signal (-)
17	RIN1+	LVDS Positive data signal (+)
18	GND	GROUND
19	RIN2-	LVDS Negative data signal (-)
20	RIN2+	LVDS Positive data signal (+)
21	GND	GROUND
22	LVDS_CLK-	LVDS Negative CLK signal (-)
23	LVDS_CLK+	LVDS Positive CLK signal (+)
24	GND	GROUND
25	RIN3-	LVDS Negative data signal (-)
26	RIN3+	LVDS Positive data signal (+)
27	GND	GROUND
28	LED_EN	LED enable
29	GND	GROUND
30	DVDDT	Only for SEC test. Other custormers NC
31	GND	GROUND

10 BASIC DISPLAY COLOR AND GRAY SCALE

Color & Gray Scale		Input Data Signal																							
		Red Data								Green Data								Blue Data							
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Gray Scale of Red	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	△	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Darker	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	△				↑								↑								↑				
	▽				↓								↓								↓				
	Brighter	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	▽	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gray Scale of Green	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	△	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Darker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	△				↑								↑								↑				
	▽				↓								↓								↓				
	Brighter	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
	▽	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Gray Scale of Blue	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	△	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Darker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	△				↑								↑								↑				
	▽				↓								↓								↓				
	Brighter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1
	▽	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
Gray Scale of White	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	△	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
	Darker	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0
	△				↑								↑								↑				
	▽				↓								↓								↓				
	Brighter	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1
	▽	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

11 LVDS INPUT SIGNAL

Data input Format

1 Pixel = 3 Dots

Display Position of Input Data (V-H)
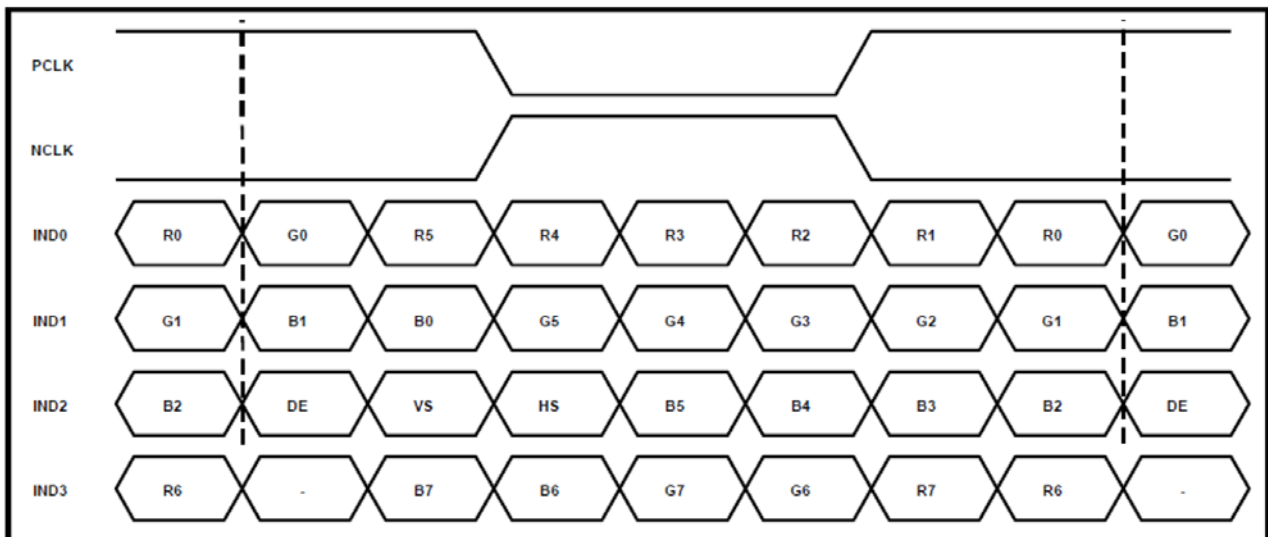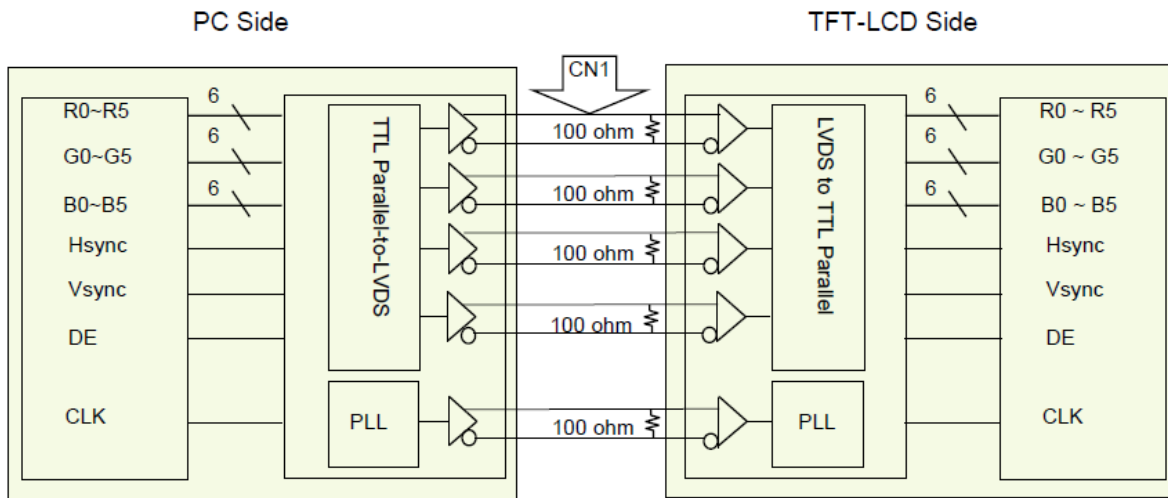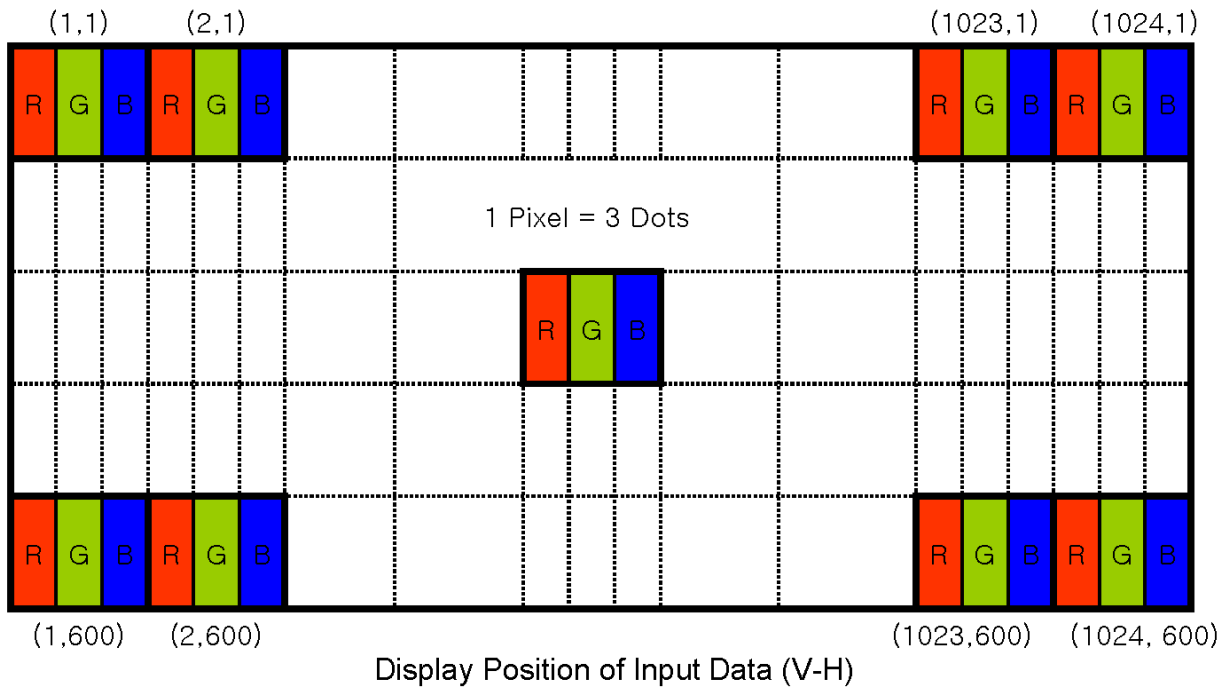
12 SIGNAL TIMING SPECIFICATION

The Display is operated by DE only.

Item		Symbols	Min	Typ	Max	Unit
Clock	Frequency	1/Tc	40.8	51.2	67.2	MHz
	High Time	Tch	40%	50%	60%	Tc
	Low Time	Tcl	60%	50%	40%	Tc
Frame Period		Tv	610	635	800	lines
			60	60	60	Hz
			16.6	16.6	16.6	ms
Vertical Display Period		Tvd	600	600	600	lines
One line Scanning Period		Th	1114	1344	1400	clocks
Horizontal Display Period		Thd	1024	1024	1024	clocks

LVDS Rx Interface timing Parameter

The specification of the LVDS Rx interface timing parameter is shown in Table 8.
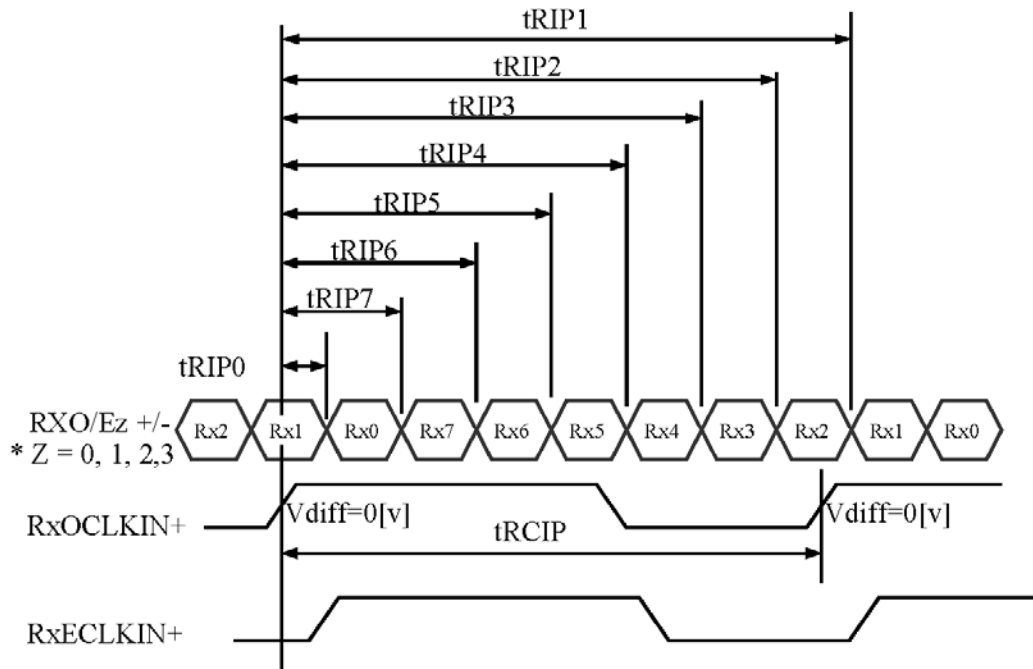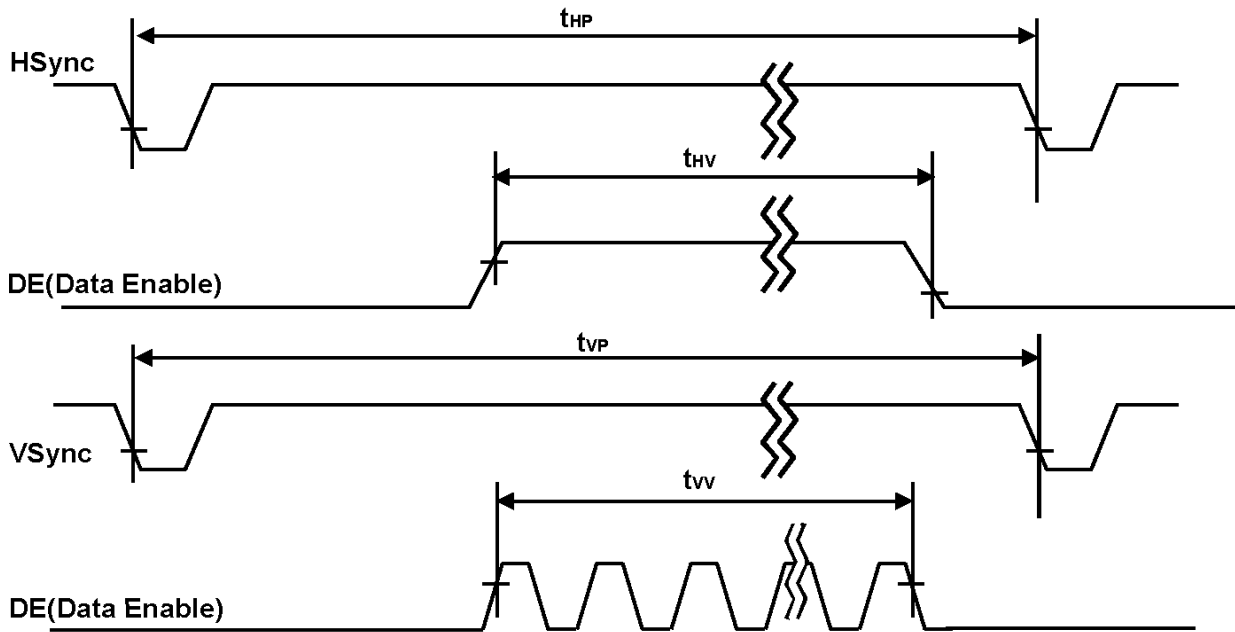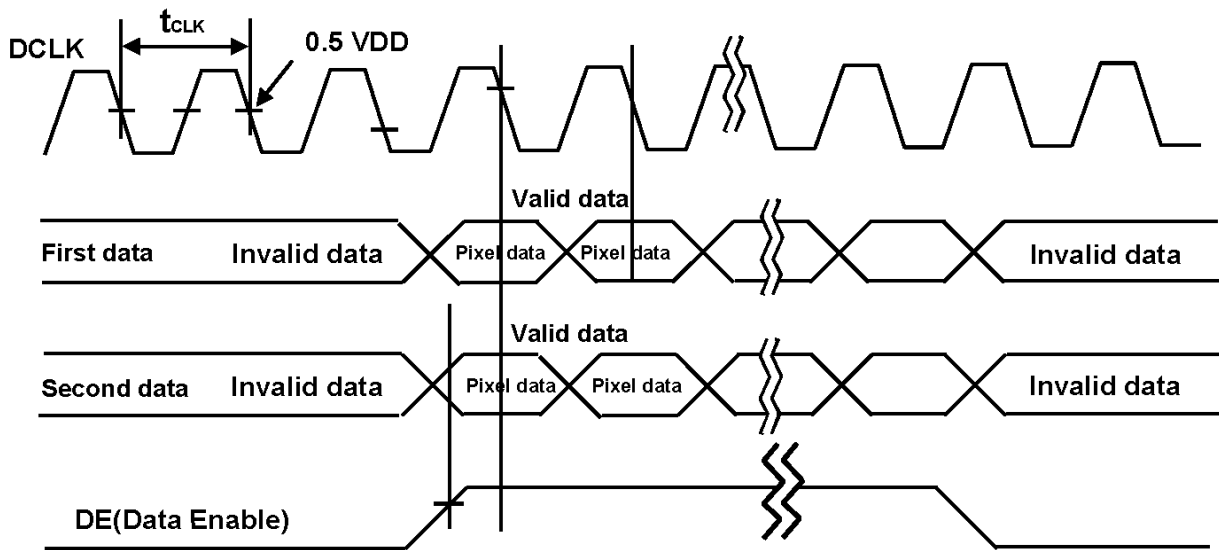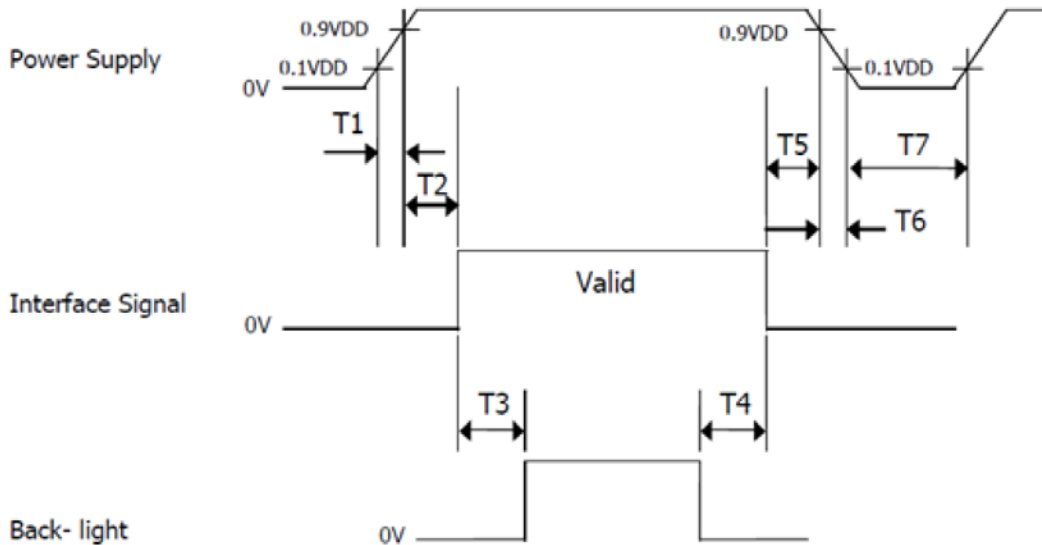
<Table 8. LVDS Rx Interface Timing Specification>

Item	Symbol	Min	Typ	Max	Unit	Remark
CLKIN Period	tRCIP	14.88	19.53	24.51	nsec	
Input Data 0	tRIP1	-0.4	0.0	+0.4	nsec	
Input Data 1	tRIP0	tRICP/7-0.4	tRICP/7	tRICP/7+0.4	nsec	
Input Data 2	tRIP7	2 × tRICP/7-0.4	2 × tRICP/7	2 × tRICP/7+0.4	nsec	
Input Data 3	tRIP6	3 × tRICP/7-0.4	3 × tRICP/7	3 × tRICP/7+0.4	nsec	
Input Data 4	tRIP5	4 × tRICP/7-0.4	4 × tRICP/7	4 × tRICP/7+0.4	nsec	
Input Data 5	tRIP4	5 × tRICP/7-0.4	5 × tRICP/7	5 × tRICP/7+0.4	nsec	
Input Data 6	tRIP3	6 × tRICP/7-0.4	6 × tRICP/7	6 × tRICP/7+0.4	nsec	
Input Data 7	tRIP2	7 × tRICP/7-0.4	7 × tRICP/7	7 × tRICP/7+0.4	nsec	

* Vdiff = (RXO/Ez+)-(RXO/Ez-),…. ,(RXO/ECLK+)-(RXO/ECLK-)

13 SIGNAL TIMING WAVEFORMS OF INTERFACE SIGNAL

14 POWER SEQUENCE

To prevent a latch-up or DC operation of the LCD module, the power on/off sequence shall be as shown in below

Parameter	Values			Units
	Min	Typ	Max	
T1	0.5	-	10	ms
T2	0	-	50	ms
T3	200	-	-	ms
T4	200	-	-	ms
T5	0.5	-	50	ms
T6	0	-	10	ms
T7	500	-	-	ms

Notes:
1. When the power supply VDD is 0V, keep the level of input signals on the low or keep high impedance.
2. Do not keep the interface signal high impedance when power is on. Back Light must be turn on after power for logic and interface signal are valid.

15 CONNECTOR DESCRIPTION

Physical interface is described as for the connector on LCM.
These connectors are capable of accommodating the following signals and will be following components.

TFT LCD Module

Connector Name /Description	For Signal Connector
Manufacturer	UJU or Compatible
Type/ Part Number	PF030-B31B-N09 or Compatible

LED connector

Pin No.	Symbol	For Signal Connector
1	VLEDP	LED Anode Power Supply
2	VLEDN1	LED Cathode Power Supply
3	VLEDN2	
4	VLEDN3	
5	VLEDN4	

FORM No. DT-029 V2

16 RELIABILITY TEST

No.	Test Item	Test Condition
1	High Temperature Storage	85 ℃ / 24 hours
2	Low Temperature Storage	-40 ℃ / 24 hours
3	High Temperature Operation	60 ℃ 24 hours
4	Low Temperature Operation	-20 ℃ / 24 hours
5	Temperature Cycle	-40 ℃ ~ 85 ℃ (2hr.) X 30 Cycles
Inspection after Test		The sample is tested for the following defects after 2 ~ 4 hours of storage at room temperature: 1. Air bubbles in the LCD 2. Leaking Seal 3. No Display 4. Missing Segments 5. Glass Cracks 6. Idd current is higher than twice the initial value

Remarks:
1. The test samples are applicable to only one test group.
2. Sample size for each test group is 5 ~ 10 pieces.
3. In case of a malfunction caused by ESD test, if it recovers to the normal state after resetting, it would be judged as a good part.
4. EL backlights can produce black spots/blemishes in humidity and temperature test due to natural chemical reactions and fluorescence. This is checked for.
5. Please use automatic switch menu (or roll menu) in test mode.

17 INCOMING INSPECTION STANDARDS

17.1 THE ENVIRONMENTAL CONDITION FOR INSPECTION

The environmental condition and visual inspection shall be conducted as below.

(1) Ambient temperature: 23 ± 2 ℃

(2) Humidity: 65 ± 20% RH

(3) Viewing distance: 30 ~ 50 cm approx.

(4) Viewing angle: Normal to the LCD panel as shown below

(5) Ambient Illumination: 300 ~ 700 Lux. for external appearance inspection (Normal: 500 LUX).

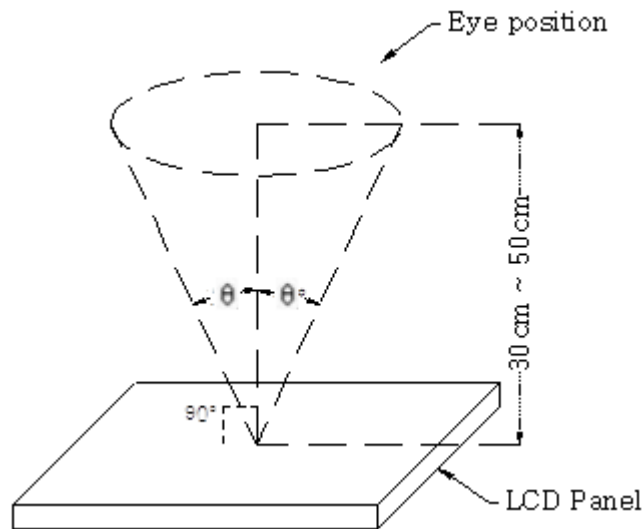| Product No.	84-0168-000	REV. A		Page	22 / 28

(6) Viewing Angle
Performing in front of the panel
[Vertical   ] +/- 25 degree
[Horizontal] +/- 40 degree
7) Inspection Area: Display Area (Active Area)

17.2 CLASSIFICATION OF DEFECTS AND AQL

Class of defects	AQL	Definition
Major	1.0%	It is a defect that is likely to result in failure or to reduce materially the usability of the intended function.
Minor	1.5%	It is a defect that will not result in a functioning problem with deviation classified.

Note: Sampling plan according to GB / T2828.1-2003 / ISO 2859-1:1999 and ANSI/ASQC Z1.4-1993, Normal level 2.

17.3 INSPECTION PARAMETERS

Definitions

Dark / Bright Spots
Points on the display which appear dark/bright and usually result from
the contamination. These defects do not vary in size or intensity
(contrast) when contrast is varied.

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Dark / Bright Lines

Lines on the display which appear dark/bright and usually result from the contamination.

Polarizer Scratch

Lines on display which are seen across a darker background and do not vary in size.

Polarizer Dent

White spots on display which appear against a darker background and do not vary in size

Bright Dot Defects

Dots(sub-pixels) on the display which appear bright in the display area and visible through the 5%ND filter at Black Pattern.

Dark Dot Defects

Dots(sub-pixels) on the display which appear dark in the display area at R,G,B Color Pattern.

Line Defects

All line defects on display which appear bright/dark such as vertical, horizontal, or cross lines.

Mura

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

BM Defects

Bright (white) Points on display which are off BM (Black Matrix).

Visual Inspection

      Inspection for LCM when the unit turns on.

Appearance Inspection

      External inspection of the LCM when the unit is turned off.
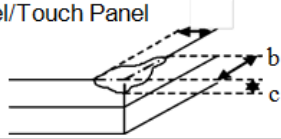
Others

      Defects which cannot be classified into the above defect definitions.

Note1) Bright & Dark dots are not smaller than a sub-pixel.
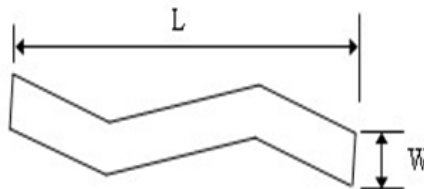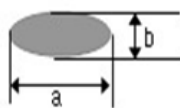   (Dots smaller than a sub-pixel are not counted as defect dots)

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Visual Inspection Criteria

ITEMS	DETAILS	INSPECTION CRITERIA
Sub Pixel Defects	Bright Sub Pixel Defect	N ≤ 0
	Dark Sub Pixel Defect	N ≤ 2
	Bright + Dark Sub Pixel Defect	N ≤ 2
	Defect Distance Bright & Bright Dark & Dark	- Distance≥2mm
	2 Adjacent Bright Sub Pixel Defect	N ≤ 0
	2 Adjacent Dark Sub Pixel Defect	N ≤ 1
	3 Adjacent Bright Sub Pixel Defect	N ≤ 0
	3 Adjacent Dark Sub Pixel Defect	N ≤ 0
Line Defects	Bright Line, Dark Line	N = 0
Displayed Screen	Black/Bright Spot Circular Type (Hair, Lint, Etc.) Linear Type :	0.1mm<D≤0.3mm, N≤2, 0.03mm<W≤0.08mm, L≤3mm, N≤2 ,Distance≥ 2mm
	Polarizer Dent/Bubble Polarizer Scratch Glass Broken, Stain	0.1<D≤0.3, N≤4; Distance≥2mm 0.03<W≤0.08 and L≤3mm, N≤2; Could not be seen by human eye
	Circular White Mura, Lumination Mura, Black/White Mura, etc.	If necessary, refer to limit sample;
	Chipping on Panel/Touch Panel	a≦3.0mm、b≦3.0mm、c≦t(Bottom glass thickness)
Flicker		No flicker at the center of display area

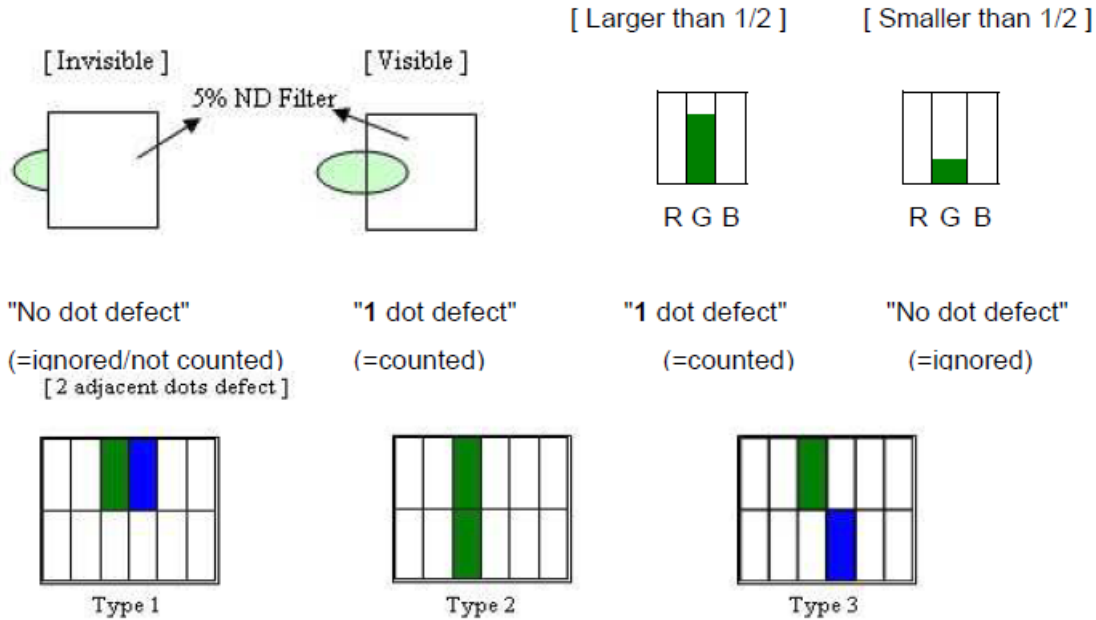Note 2) D = Diameter, L = Length, W = Width, N = Number

D = (a+b)/2

Note 3) Dot which is invisible through 5% ND filter or smaller than 1/2 of sub-pixel size

will not counted as "1 dot" defect.

[Invisible] [Visible] [Larger than 1/2] [Smaller than 1/2]

5% ND Filter

R G B   R G B

"No dot defect" "1 dot defect" "1 dot defect" "No dot defect"

(=ignored/not counted) (=counted) (=counted) (=ignored)

[2 adjacent dots defect]

Type 1   Type 2   Type 3

APPEARANCE INSPECTION CRITERIA

ITEMS	DETAILS	INSPECTION CRITERIA
Bezel	Scratch, Contamination	Could not be seen by human eye
	Assembly	Should be assembled correctly with panel
	Bending Area	Should be in mechanical spec.
	Color Change, Bent	Nothing
Plastic	Break, Modification	Not allowed
	Scratch	Could not be seen by human eye
	Burr	Not allowed
Cable	Scratch	Could not be seen by human eye
	Cable Position, Connecting Method	Should be in correct position
Signal / Power Input Connector	Break	Not allowed
Connector Others	Looseness	Not allowed
Screw	Improperness, Looseness	Not allowed
Label	No Label, Reversed Label Attach, Long Distance Attach	Not allowed
	Split, Contamination, Vagueness	At least, it should be legible character by character

18 HANDLING PRECAUTIONS

Safety
If the LCD panel breaks, be careful not to get the liquid crystal fluid in your mouth or in your eyes.
If the liquid crystal touches your skin or clothes, wash it off immediately using soap and plenty of water.

Mounting and Design
Place a transparent plate (e.g. acrylic, polycarbonate or glass) on the display surface to protect the display from external pressure. Leave a small gap between the transparent plate and the display surface.
When assembling with a zebra connector, clean the surface of the pads with alcohol and keep the surrounding air very clean. Design the system so that no input signal is given unless the power supply voltage is applied.

Caution during LCD cleaning
Lightly wipe the display surface with a soft cloth soaked with Isopropyl alcohol, Ethyl alcohol or Trichlorotrifluoroethane. Do not wipe the display surface with dry or hard materials that will damage the polarizer surface. Do not use aromatic solvents (toluene and xylene), or ketonic solvents (ketone and acetone).

Caution against static charge
As the display uses C-MOS LSI drivers, connect any unused input terminals to VDD or VSS. Do not input any signals before power is turned on. Also, ground your body, work / assembly table and assembly equipment to protect against static electricity.

Packaging
Displays use LCD elements, and must be treated as such. Avoid strong shock and drop from a height.
To prevent displays from degradation, do not operate or store them exposed directly to sunlight or high temperature / humidity.

Caution during operation
It is indispensable to drive the display within the specified voltage limit since excessive voltage shortens its life. Direct current causes an electrochemical reaction with remarkable deterioration of the display quality. Give careful consideration to prevent direct current during ON/OFF timing and during operation. Response time is extremely delayed at temperatures lower than the operating temperature range while, at high temperatures, displays become dark. However, this phenomenon is reversible and does not mean a malfunction or a display that has been permanently damaged. If the display area is pushed on hard during operation, some graphics will be abnormally displayed but returns to a normal condition after turning off the display once. Even a small amount of condensation on the contact pads (terminals) can cause an electro-chemical reaction which causes missing rows and columns. Give careful attention to avoid condensation.

Storage
Store the display in a dark place where the temperature is $25°C \pm 10°C$ and the humidity below 50% RH.
Store the display in a clean environment, free from dust, organic solvents and corrosive gases.
Do not crash, shake or jolt the display (including accessories).