LIQUID CRYSTAL DISPLAY MODULE

Product Specification

PRODUCT NUMBER	84-0209-000

INTERNAL APPROVALS		
Product Manager	Engineering	Document Control
Date:	Date:	Date:

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REVISION RECORD

Rev.	Date	Page	Par.	Comment	ECN no.
A	03/4/14	--	--	New DCA Release	E4934
B	03/07/14	8	--	Viewing angle updated	E4935

1 GENERAL SPECIFICATIONS

| ITEM	DESCRIPTION	UNIT
Module Outline Dimensions	105.24 (W) x 34.0 (H) x 3.6 (D) (Not including cable)	mm
Active Display Area	95.04 (W) x 21.75 (H)	mm
Pixel Configuration Format / Resolution	480 RGB (W) x 110(min) (H)	pixels
Backlight Type	Edge LED / White	--
Viewing Direction	Full View Angle	O'Clock
Interface	24-Bit Parallel RGB	--
Pixel Arrangement	RGB Vertical Strip	--
Display Color	16.7M	--
RoHS Compliant	Yes	--

2 FEATURES

- The display module is a 1U rack mount supported TFT-LCD and can display 16 million colours.

3 MECHANICAL DRAWING

PIN	SYMBOL
1	GND
2	GND
3	VCC
4	VCC
5	R0
6	R1
7	R2
8	R3
9	R4
10	R5
11	R6
12	R7
13	G0
14	G1
15	G2
16	G3
17	G4
18	G5
19	G6
20	G7

PIN	SYMBOL
21	B0
22	B1
23	B2
24	B3
25	B4
26	B5
27	B6
28	B7
29	GND
30	DOTCLK
31	DISPLAY
32	HSYNC
33	VSYNC
34	NC
35	NC
36	NC
37	NC
38	NC
39	K
40	A

1	Operating Voltage:	Vcc=3.3V typ.
2	Resolution:	480RGB*(110min.)
3	Color:	16M
4	Interface:	24-bits RGB
5	Display type:	Transmissive
6	polarizer surface treatment	
7	Viewing Direction:	Full view
8	Operating Temp:	-20°C~70°C
9	Storage Temp:	-30°C~80°C
10	Driver IC:	HX8257
11	Backlight:	high brightness
12	Unspecified tolerance:	±0.2
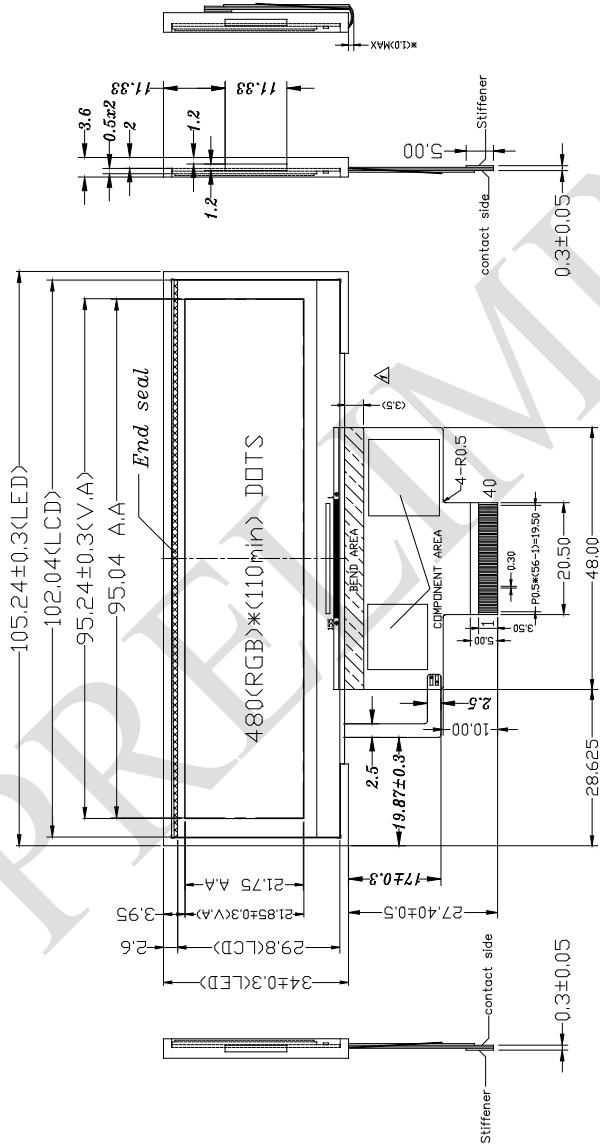
4 ABSOLUTE MAXIMUM RATINGS

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

(Ta=25±2°C, V_{SS}=GND=0)

Item	Symbol	Min.	Max.	Unit	Note
Storage temperature	T_{STG}	-30	80	°C	(1)
Operating temperature	T_{OPR}	-20	70	°C	(1,2,3)

Note (1) 95 % RH Max. (40 °C ≥ Ta). Maximum wet-bulb temperature at 39 °C or less. (Ta > 40 °C) No condensation.

Note (2) In case of below 0°, the response time of liquid crystal (LC) becomes slower and the color of panel becomes darker than normal one. Level of retardation depends on temperature, because of LC's character

Note (3) Only operation is guaranteed at operating temperature. Contrast, response time, another display quality are evaluated at +25°C.

4.1 Electrical Absolute Rating

4.2.1 TFT-LCD Module

(Ta=25±2°C, V_{SS}=GND=0)

Item	Symbol	Value		Unit	Condition
		Min.	Max.		
Power supply voltage	DV_{DD}	-0.3	4.0	V	

4.2.2 Back-Light Unit

(Ta=25±2°C)

Item	Symbol	Min.	Max.	Unit	Note
Current of One LED	I_{LED}	--	(25)	mA	(1)

Note (1) Permanent damage to the device may occur if maximum values are exceeded or reverse voltage is loaded. Functional operation should be restricted to the conditions described under normal operating conditions.

5 ELECTRICAL CHARACTERISTICS

TFT-LCD Module

(Ta=25±2°C, V_{DD} =3.3V)

Item		Symbol	Value			Unit	Condition
			Min.	Typ.	Max.		
Power supply voltage		V_{DD}	3.0	3.3	3.6	V	
Input Voltage for logic	H Level	VIH	0.7xVdd	-	Vdd	V	
	L Level	VIL	0	-	0.3xVdd	V	
Digital Current		I_{DD}	-	(15)	(18)	mA	

Note (1) The specified power consumption is under the conditions at V_{CC}=3.3V , F_V=60Hz, whereas a Power dissipation check pattern below is displayed.

Black Pattern / 0 Gray
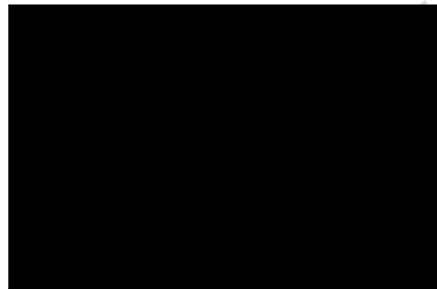
Active Area

6 BACKLIGHT CHARACTERISTICS

The back-light system is an edge-lighting type with 10 white LED (Light Emitting Diode)s.

(Ta=25±2°C)

Item	Symbol	Value			Unit	Condition
		Min.	Typ.	Max.		
LED Voltage	Vf	14	16	18	V	
LED Current	If	-	(40)	-	mA	
Luminous intensity	Lv	8000	-	-	Cd/m2	
Chromaticity Coordinates	X	X=0.26	-	X=0.32		
	Y	Y=0.26	-	Y=0.32		

Note (1) The LED supply voltage is defined by the number of LED as Ta=25°C and If=40mA.
(2) The operating life time is defined as the module brightness decrease to 50% original brightness at a Ta=25°C and If=40mA. The LED lifetime could be decreased if operating If is greater than 40mA.
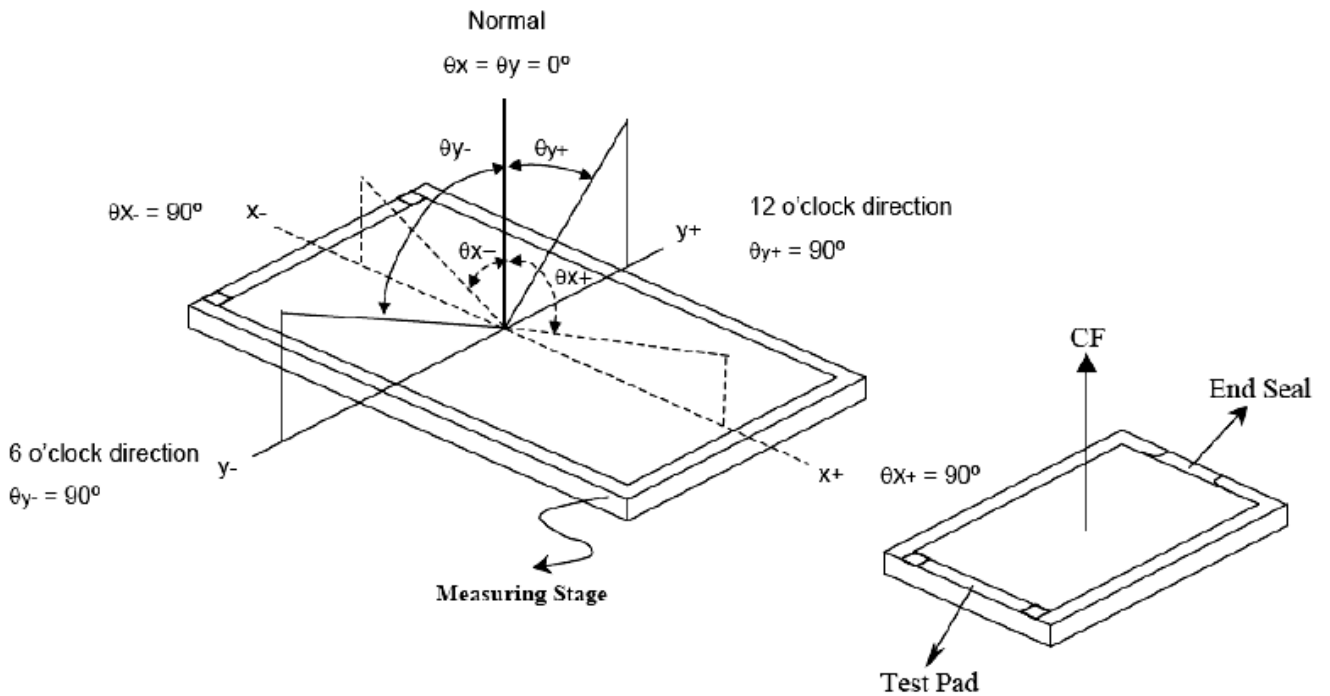
7 ELECTRO-OPTICAL CHARACTERISTICS

Item		Symbol	Condition	Min	Typ.	Max	Unit	Remark
View Angles		θ L	CR≥10	-	60	-	Degree	Note 2
		θ R		-	60	-		
		θ T		-	60	-		
		θ B		-	60	-		
		θ L	CR≥100	-	40	-	Degree	
		θ R		-	40	-		
		θ T		-	40	-		
		θ B		-	40	-		
Image Inverse		θ L	visual	-	80	-	Degree	
		θ R		-	80	-		
		θ T		-	80	-		
		θ B		-	80	-		
Contrast Ratio		CR	$\theta = 0°$	-	250	-	-	Note 1 Note 3
Response Time		T_{ON}	25° C	-	5	-	ms	Note 1
		T_{OFF}		-	15	-		Note 4
Chromaticity	W_x	x		0.281	0.311	03.41		Note 1
	W_y	y		0.319	0.349	0.379		Note 5
Luminance		L		300	-	-	cd/m^2	Note 1 Note 5

Test Conditions:

1. If= 40 mA(Backlight current), VCC = 3.3 V, the ambient temperature is 25° C.
2. The test systems refer to Note 2.

Note (1): Definition of Viewing Angle (θx, θy):

Normal

$\theta x = \theta y = 0^{\circ}$

$\theta y-$ $\theta y+$

$\theta X- = 90^{\circ}$ x-

12 o'clock direction

$\theta y+ = 90^{\circ}$

$\theta x-$

y+

$\theta x+$

CF

End Seal

6 o'clock direction   y-

$\theta y- = 90^{\circ}$

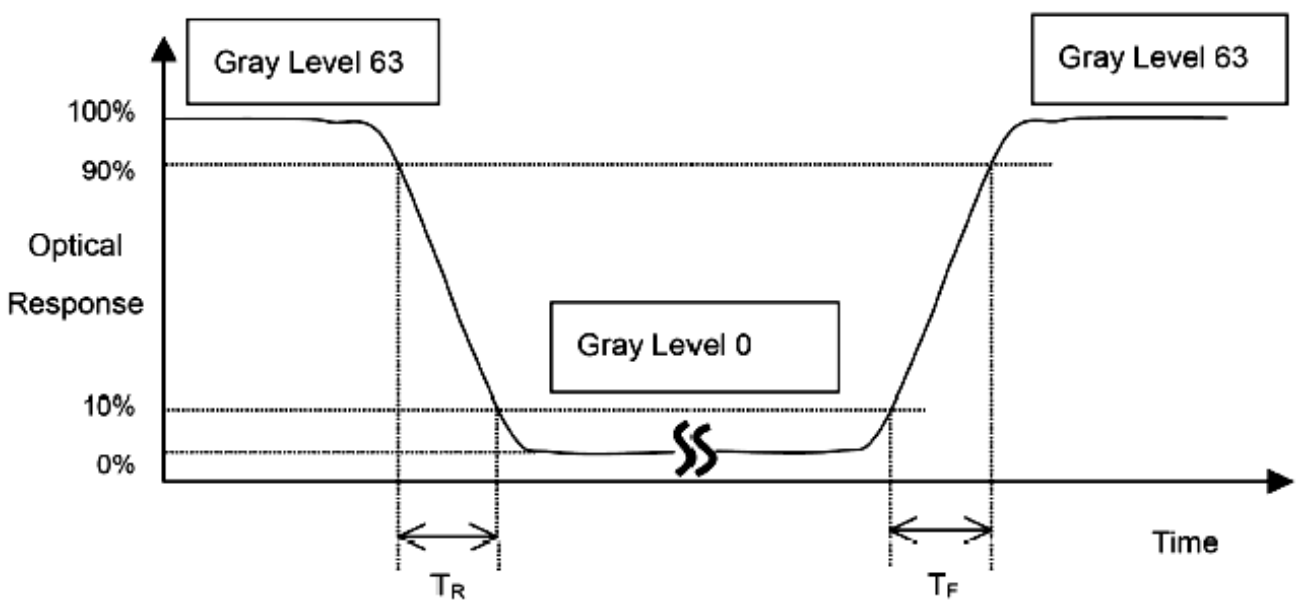x+ $\theta X+ = 90^{\circ}$

Measuring Stage

Test Pad

Note (2): Definition of Contrast Ratio (CR):

$$CR = \frac{\text{Luminance of Gray Level 63 (L63)}}{\text{Luminance of Gray Level 0 (L0)}}$$

CR (X) defines the Contrast Ratio at one of the points as shown in Note 5.

Note (3): Definition of Response Time (T_R, T_F):

Gray Level 63

Gray Level 63

100%

90%

Optical
Response

Gray Level 0
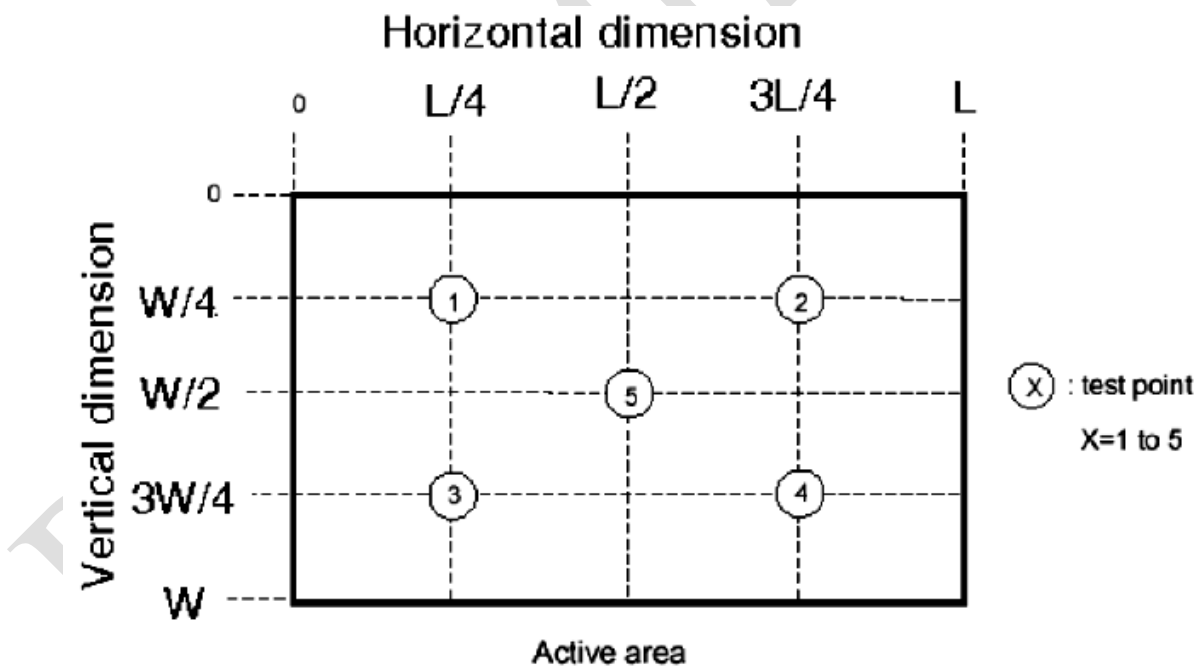
10%

0%

T_R

T_F

Time

Note (4): Measurement Set-Up:

The LCD module should be stabilized at a given temperature for 20 minutes to avoid abrupt temperature changes during measuring. In order to stabilize the luminance, the measurement should be executed after lighting the backlight for 20 minutes in a windless room.
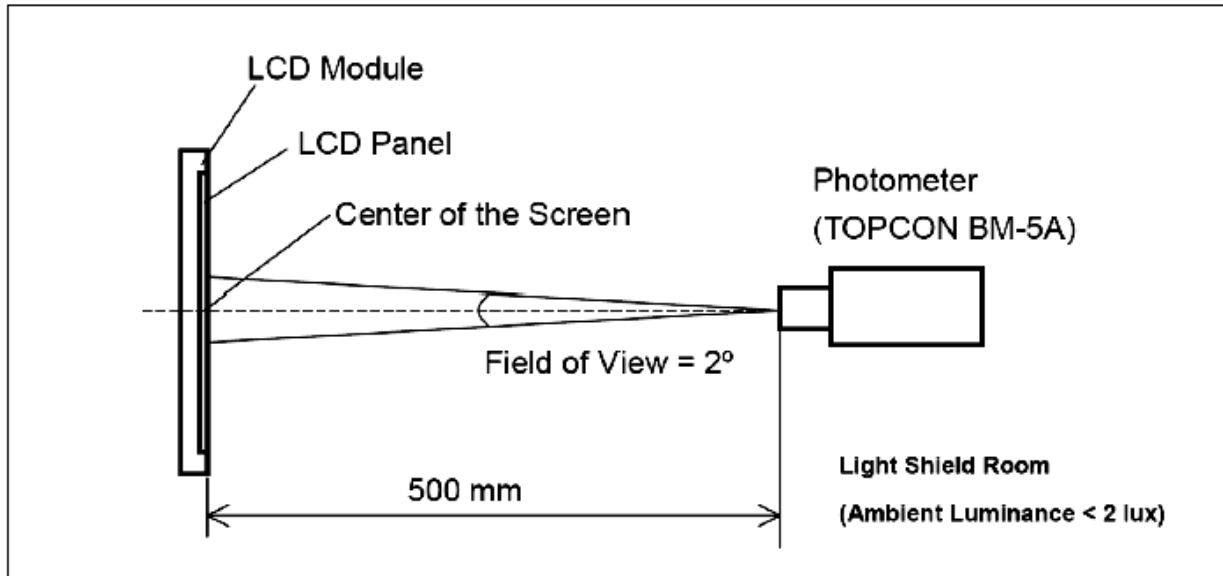
Note (5): Definition of Test point X:

8 INPUT/OUTPUT TERMINALS PIN ASSIGNMENT

6.1 CN1 Pin Assignment

(Reference Connector: Hirose Electric Co., LTD. Product No. FH12A-40S-0.5SH(55) Top contact type)

Pin No.	Symbol	I/O	Function	Remark
1	VSS	P	Ground	
2	VSS	P	Ground	
3	DV_{DD}	P	Logic power supply(+3.0~3.6V)	
4	DV_{DD}	P	Logic power supply(+3.0~3.6V)	
5	R0	I	Red Data Bit 0(LSB)	
6	R1	I	Red Data Bit 1	
7	R2	I	Red Data Bit 2	
8	R3	I	Red Data Bit 3	
9	R4	I	Red Data Bit 4	
10	R5	I	Red Data Bit 5	
11	R6	I	Red Data Bit 6	
12	R7	I	Red Data Bit 7(MSB)	
13	G0	I	Green Data Bit 0(LSB)	
14	G1	I	Green Data Bit 1	
15	G2	I	Green Data Bit 2	
16	G3	I	Green Data Bit 3	
17	G4	I	Green Data Bit 4	
18	G5	I	Green Data Bit 5	
19	G6	I	Green Data Bit 6	
20	G7	I	Green Data Bit 7(MSB)	
21	B0	I	Blue Data Bit 0 (LSB)	
22	B1	I	Blue Data Bit 1	
23	B2	I	Blue Data Bit 2	
24	B3	I	Blue Data Bit 3	
25	B4	I	Blue Data Bit 4	
26	B5	I	Blue Data Bit 5	
27	B6	I	Blue Data Bit 6	
28	B7	I	Blue Data Bit 7(MSB)	
29	VSS	P	Ground	
30	P_{CLK}	I	Dot Data Clock	
31	DISP	I	Display on/off	
32	H_{SYNC}	I	Horizontal Sync Input	(1)

33	V$_{SYNC}$	I	Vertical Sync Input	(1)
34	NC	-	No Connect	
35	NC	-	No Connect	
36	NC	-	No Connect	
37	NC	-	No Connect	
38	NC	-	No Connect	
39	LEDK	P	Backlight Cathode	
40	LEDA	P	Backlight Anode	

9 BASIC DISPLAY COLOR AND GRAY SCALE

	Color & Gray Scale	Data Signal																							
		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 Color	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
	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
	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
	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
	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
	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
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
	Red(1)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(2)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red(127)	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red(254)	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(255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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
	Green(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Green(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green(127)	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green(254)	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(255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
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
	Blue(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Blue(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(127)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(254)	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(255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

0 : Low level voltage, 1 :High level voltage

Each basic color can be displayed in 256 gray scales from 8 bit data signals. With the combination of total 24 bit data signals, the 16,777,216-color display can be achieved on the screen.

10 TIMING

AC Characteristics

(480RGBx272, T_A=25°C, VDDIO=1.8V to 3.6V, DVSS= 0V)

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

Note: (1) Unit: CLK=1/ f_{CLK} , H= th,

(2) It is necessary to keep tvp+tvb=12 and thp+thb=43 in sync mode. DE mode is unnecessary to keep it.

DC Characteristics

Symbol	Parameter	Test condition	Spec. Min.	Spec. Typ.	Spec. Max.	Unit
VDDIO	Power supply pin of IO pins	Recommend Operating Voltage Possible Operating Voltage	1.8	-	3.6	V
VCI	Booster Reference Supply Voltage Range	Recommend Operating Voltage Possible Operating Voltage	$\geq$ VDDIO & $\geq$ 3	-	3.6	V
I_{sleep}	Sleep mode current	-	-	50		μA
I_{VCI}	VCI Operating mode current	VCI=3.3V、VDDIO=3.3V at Black Pattern with 4.3" Panel	-	13	16	mA
VCL	Negative V_{CI} Output Voltage	No panel loading	- VCI	-	- VCI+0.7	V
VCIX2	VCIX2 primary booster efficiency[3]	No panel loading, ITO for VCIX2,VCI and VCHS = 10 Ohm	5.2	5.4	5.6	V
VDC	VDC Output Voltage	VDC[3:0]=1011	4.9	5	5.1	V
VGH	Gate driver High Output Voltage Booster efficiency[1]	No panel loading; 3x booster	84	89.5	-	%
		No panel loading; 4x booster	80	88.5	-	%
VGL	Gate driver Low Output Voltage	VGL= -2 x VDC VDC[3:0]=1011	-10	-10	-9	V
COMH	VCOM High Output Voltage[2]	-	-3%	COMC+COMPP	3%	V
COML	VCOM Low Output Voltage[2]	-	-3%	COMC-COMPP	3%	V
VLCD	VLCD Output Voltage	VRH[5:0]=110011	5.0	5.1	5.2	V
V_{OH1}	Logic High Output Voltage	I out = -100μA	0.9*VDDIO	-	VDDIO	V
V_{VD}	Source Output Voltage Deviation	-	-	±20	±30	mV
V_{OS}	Source Output Voltage Offset	-	-	-	±30	mV
V_{OL1}	Logic Low Output Voltage	I out = 100μA	0	-	0.1*VDDIO	V
V_{IH1}	Logic High Input voltage	2.5V < VDDIO < 3.6V / 1.8V < VDDIO ≤ 2.5V	0.7*VDDIO / 0.8*VDDIO	-	VDDIO	V
V_{IL1}	Logic Low Input voltage	2.5V < VDDIO < 3.6V / 1.8V < VDDIO ≤ 2.5V	0	-	0.3*VDDIO / 0.2*VDDIO	V
I_{OH}	Logic High Output Current Source	V out = VDD – 0.4V	50	-	-	μA
I_{OL}	Logic Low Output Current Drain	V out = 0.4V	-	-	-50	μA
I_{OZ}	Logic Output Tri-state Current Drain Source	-	-1	-	1	μA
$I_{IL/IH}$	Logic Input Current	-	-1	-	1	μA

Note : (1) VGH efficiency = VGH / (VDC x n) x 100% (where n = booster factor)
(2) COML < 0V, COMH < VCIX2J, COMH > VCI
(3) VCIX2 voltage is related with VCI voltage & VCIX2 loading.Figure10.1 shows the estimated VCIX2 voltage under different VCIX2 current loading when ITO for VCIX2、VCI and VCHS = 10Ω.
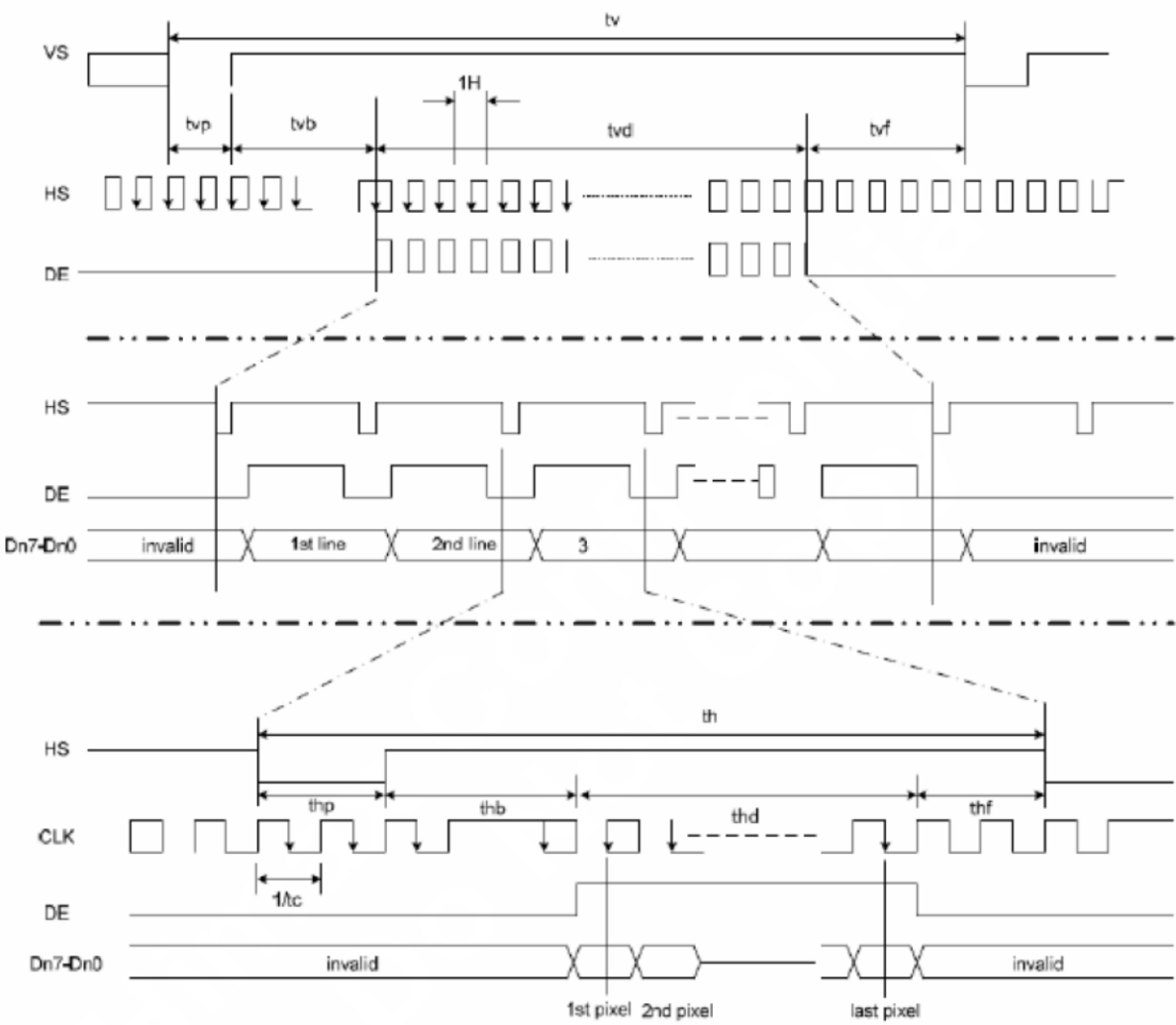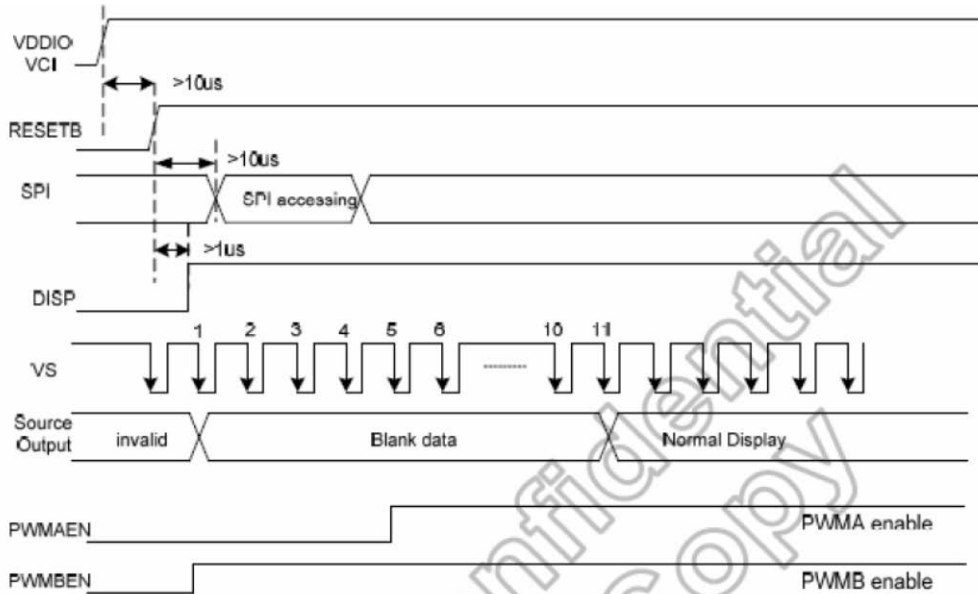
POWER ON/OFF SEQUENCE
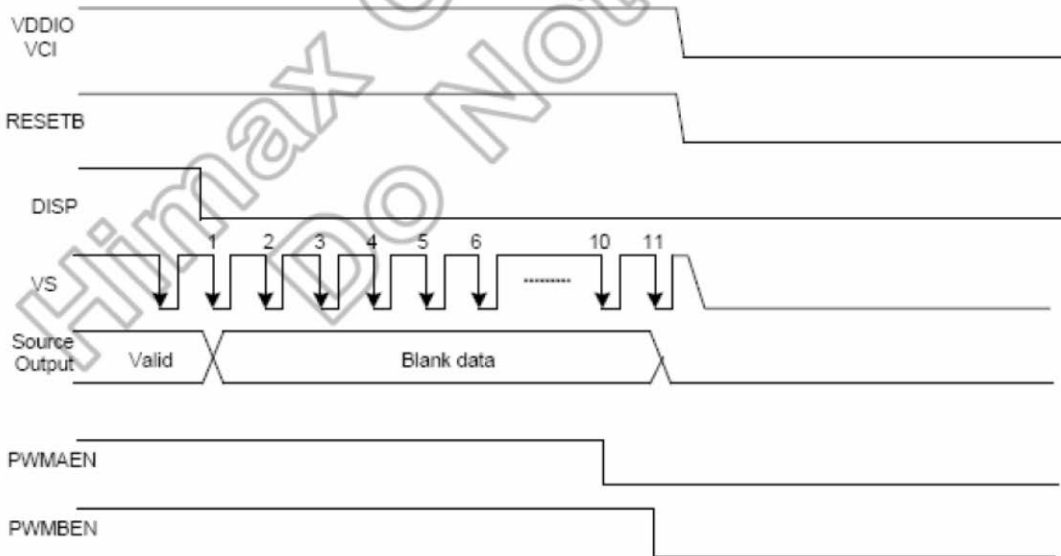
Power ON Sequence

Power ON Sequence

Power OFF Sequence

Power OFF Sequence

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11 RELIABILITY TEST

No.	Test Item	Test Condition
1	High Temperature Storage	80 ± 2 ℃ / 200 hours
2	Low Temperature Storage	-30 ± 2 ℃ / 200 hours
3	High Temperature Operation	70 ± 2 ℃ / 200 hours
4	Low Temperature Operation	-20 ± 2 ℃ / 200 hours
5	Temperature Cycle	-10 ± 2 ℃ (30 min.) ~ 25 ℃ (5 min.) ~ 70 ± 2 ℃ (30 min.) X 10 Cycles
6	Proof against Dampness	50 ± 5 ℃ X 90% RH / 120 hours; Pure Water Used (Resistance > 10 MΩ)
7	Vibration Test	Frequency: 10 Hz ~ 55 Hz ~ 10 Hz Amplitude: 1.5 mm X,Y & Z directions for a total of 3 hours
8	Dropping Test	Dropped to the ground from 1 m height, one time and tested on all sides of the carton when packed.
9	ESD Test	Voltage: ± 8 kV; R: 330 Ω; C: 150 pF Air Discharged, 10 Times
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.

12 INCOMING INSPECTION STANDARDS

12.1 THE ENVIRONMENTAL CONDITION FOR INSPECTION

The environmental condition and visual inspection shall be conducted as below.
(1) Ambient temperature: 25 ± 5 ℃
(2) Humidity: $60 \pm 5\%$ RH
(3) Viewing distance: 35 ~ 40 cm approx.
(4) Viewing angle: Normal to the LCD panel as shown below
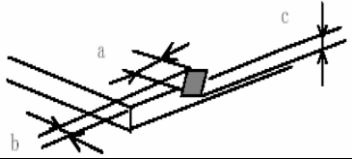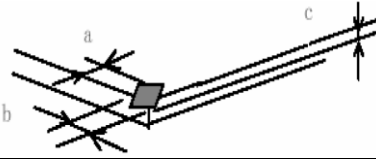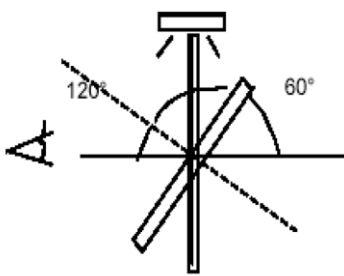(5) Ambient Illumination: 300 ~ 500 Lux. for external appearance inspection.
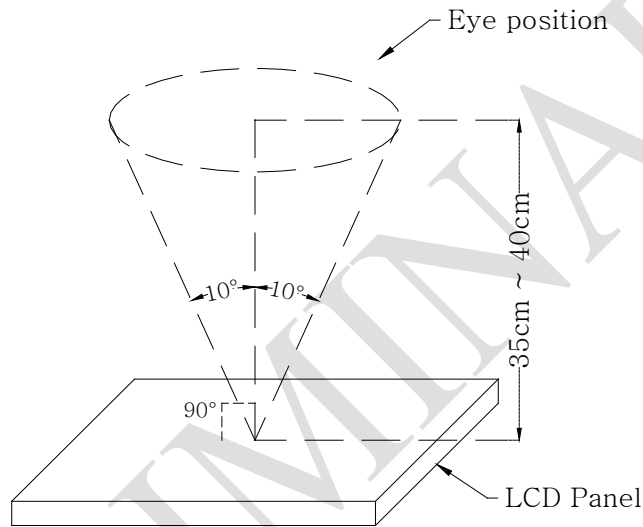
12.2 CLASSIFICATION OF DEFECTS AND AQL

Class of defects	AQL	Definition
Major	0.65%	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.

12.3 INSPECTION PARAMETERS

Item		Specification / Description				Note
Display	Function	No display				-
		Malfunction				-
Operating	Contrast ratio	Out of spec.				-
	Line defect	No obvious Vertical and Horizontal line defects for the bright, dark and colored.				-
	Point defect (red, green, blue, black, white)	Item	Acceptable number			1, 4, 5, 6
			A	B	Total	
		Bright dot	N ≤ 2	N ≤ 2	N ≤ 7	
		Black / dark dot	N ≤ 3	N ≤ 4		
		Total dots	N ≤ 4	N ≤ 5		
		Two adjacent dots	Not allowed			
		Three or more adjacent dots	Not allowed			
External Inspection (Non-operating)	Scratch on the Polarizer	L (mm)	W (mm)	Acceptable number		2
		L ≤ 2.5	W ≤ 0.1	4		
		L > 2.5	W > 0.1	0		
	Dent or bubble on the polarizer	Dimension (mm)	Acceptable number			3
		D ≤ 0.5	4			
		D ≤ 0.15	Disregard			
	Foreign material on the polarizer	Dimension (mm)	Acceptable number			3
		D ≤ 0.5	4			
		D ≤ 0.15	Disregard			

Item		Specification / Description			Note
Touch Panel (If Present)	Scratch	L (mm)	W (mm)	Acceptable number	2
		L ≤ 10	W < 0.05	Disregard	
			0.05 ≤ W < 0.1	N ≤ 4	
			W ≥ 0.1	0	
	Foreign materials (Linear shape)	L ≤ 10	W < 0.05	Disregard	2
			0.05 ≤ W < 0.1	N ≤ 3	
			W ≥ 0.1	0	
	Foreign materials (Circular shape)	Dimension (mm)		Acceptable number	3
		D ≤ 0.25		Disregard	
		0.25 < D ≤ 0.5		N ≤ 6	
		D > 0.5		0	
	Glass chips			a ≤ 5mm b ≤ 3mm c ≤ t (t: Glass Thickness)	7
				a ≤ 3mm b ≤ 3mm c ≤ t (t: Glass thickness)	
	Newton's rings	(In case of doubtful situations only) Observe at 60° from the product surface for a while under a Fluorescent lamp. (3-Wavelength lamp)		If Average Diameter ≤ (1/3) Touch Panel Area, Disregard.	7

Note 1: The definition of dot defect: The dot defect was judged after repair and the size of a defective dot with size over 1/2 of one standard dot is regarded as one defective dot.
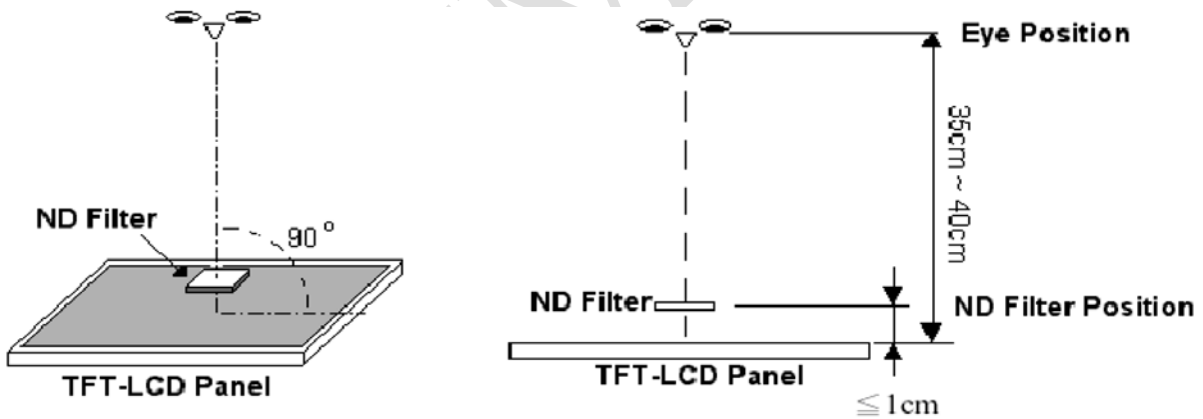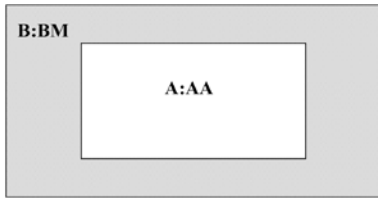
Note 2:

W

L
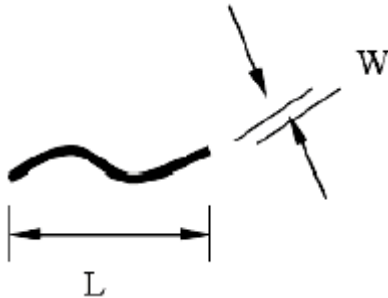
Note 3: Diameter - D = (a + b) / 2

b

a

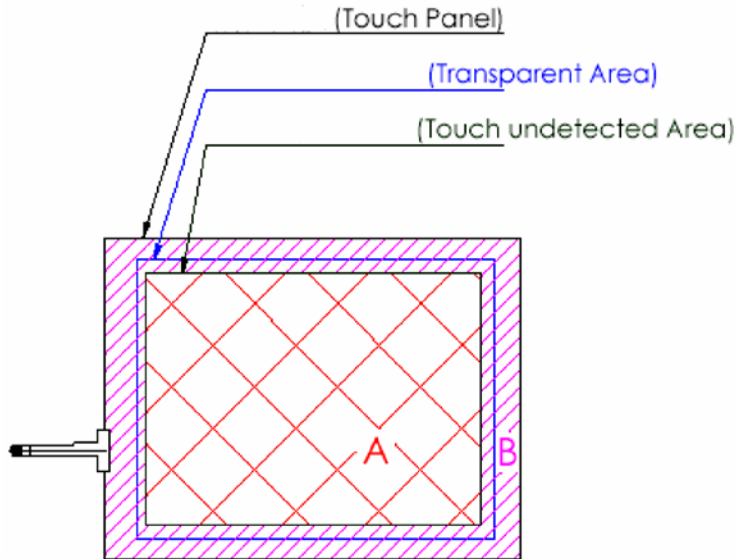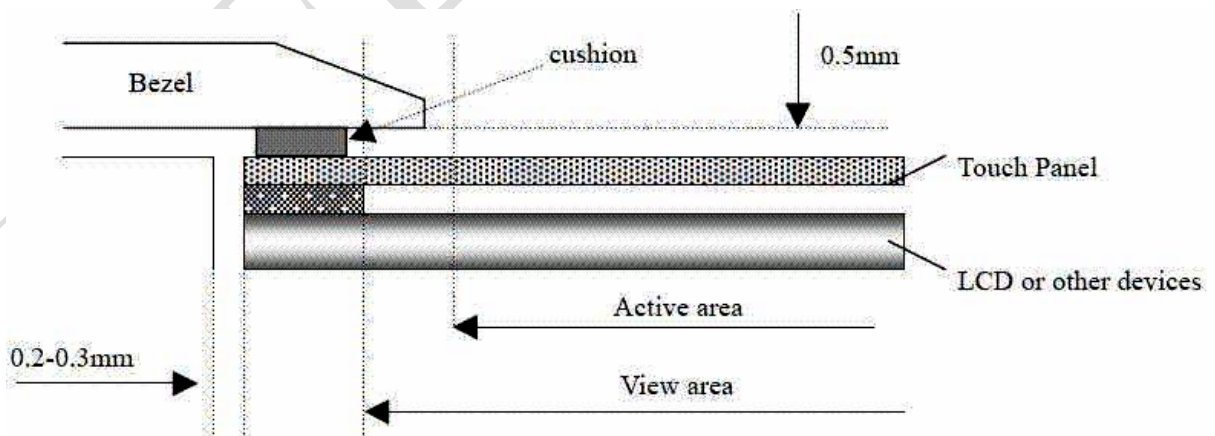Note 4: A bright dot is defined with 6% transmission ND filter as shown below:

Eye Position

35cm ~ 40cm

ND Filter

90°

ND Filter

ND Filter Position

TFT-LCD Panel

TFT-LCD Panel

≦1cm

Note 5: Adjacent Dots:

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Note 6:

Note 7:

A: Area without any defect point effect on normal operation
B: Defects are not specified in this area

GENERAL INSTALLATION AND ASSEMBLY DIAGRAM:

13 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 ± 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).