

# LIQUID CRYSTAL DISPLAY MODULE

## Product Specification

<b>PRODUCT NUMBER</b>	<b>84-0101-000T</b>
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INTERNAL APPROVALS		
Product Manager	Engineering	Document Control
Date:	Date:	Date:

## TABLE OF CONTENTS

<b>1</b>	<b>GENERAL SPECIFICATIONS .....</b>	<b>4</b>
<b>2</b>	<b>FEATURES.....</b>	<b>4</b>
<b>3</b>	<b>MECHANICAL DRAWING.....</b>	<b>5</b>
<b>4</b>	<b>ABSOLUTE MAXIMUM RATINGS .....</b>	<b>6</b>
4.1	ABSOLUTE RATINGS OF ENVIRONMENT .....	6
4.2	ELECTRICAL ABSOLUTE RATINGS.....	6
<b>5</b>	<b>ELECTRICAL CHARACTERISTICS.....</b>	<b>7</b>
5.1	TFT-LCD MODULE.....	7
5.2	BACKLIGHT UNIT.....	7
<b>6</b>	<b>TRANSPARENT SAW TOUCH PANEL SPECIFICATIONS.....</b>	<b>8</b>
<b>7</b>	<b>BLOCK DIAGRAM.....</b>	<b>9</b>
<b>8</b>	<b>INPUT/OUTPUT TERMINALS PIN ASSIGNMENT.....</b>	<b>10</b>
8.1	TFT-LCD MODULE.....	10
8.2	BACKLIGHT UNIT.....	11
8.3	TRANSPARENT SAW TOUCH PANEL .....	11
8.4	COLOR DATA INPUT ASSIGNMENT .....	12
<b>9</b>	<b>INTERFACE TIMING.....</b>	<b>13</b>
9.1	INPUT SIGNAL CHARACTERISTICS.....	13
9.2	WAVEFORM.....	14
<b>10</b>	<b>OPTICAL CHARACTERISTICS.....</b>	<b>15</b>
<b>11</b>	<b>RELIABILITY TEST .....</b>	<b>18</b>
<b>12</b>	<b>INCOMING INSPECTION STANDARDS.....</b>	<b>19</b>
12.1	THE ENVIRONMENTAL CONDITION FOR INSPECTION .....	19
12.2	CLASSIFICATION OF DEFECTS AND AQL .....	19
12.3	INSPECTION PARAMETERS .....	20
<b>13</b>	<b>HANDLING PRECAUTIONS.....</b>	<b>24</b>

**REVISION RECORD**

Rev.	Date	Page	Par.	Comment	ECN no.
A	02/20/09	--	--	Preliminary DCA Release	E4000

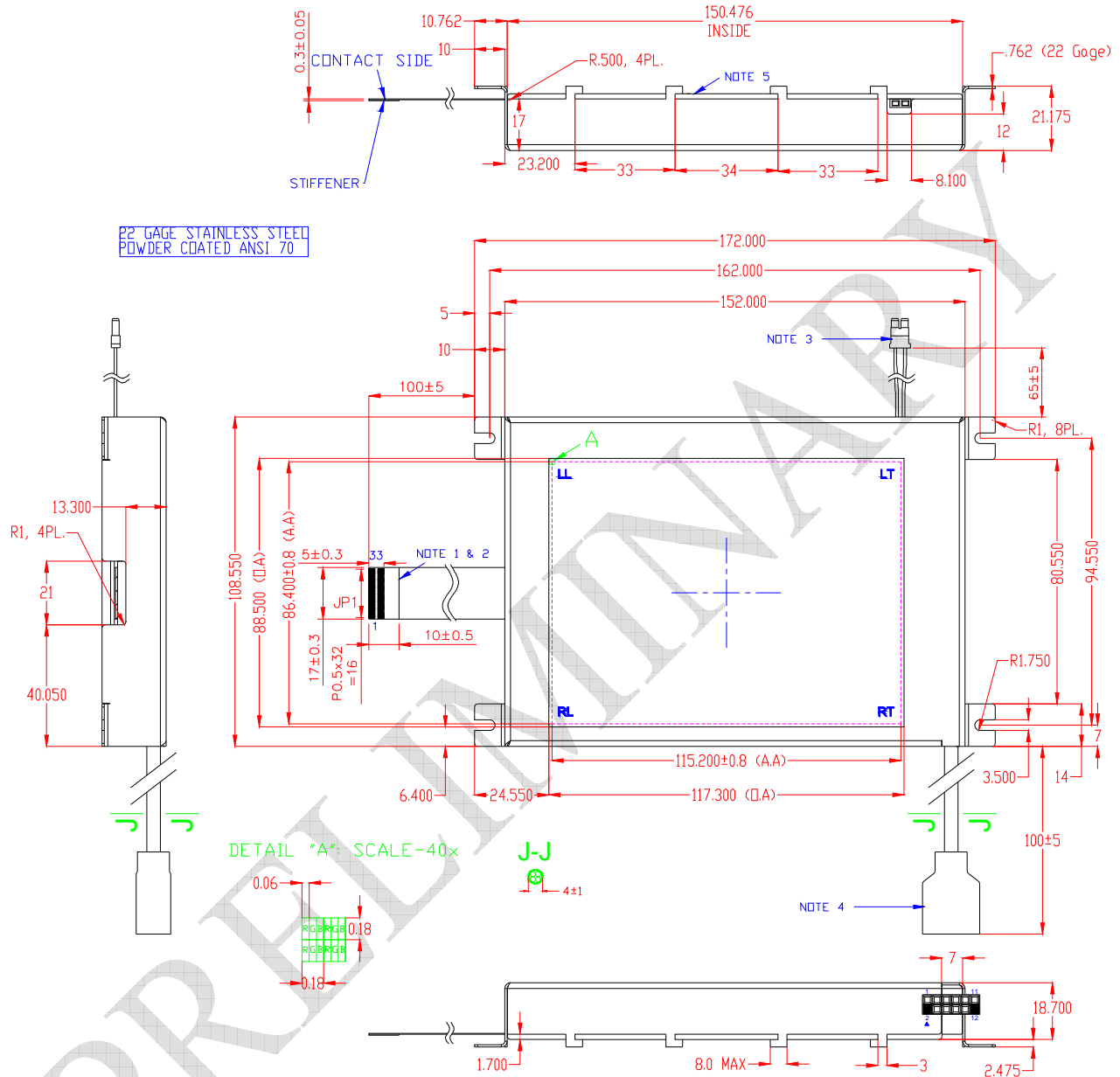
## 1 GENERAL SPECIFICATIONS

ITEM	DESCRIPTION	UNIT
Module Outline Dimensions	172.00 (W) x 108.55 (H) x 21.20 (D) (Not including cable and connector)	mm
Active Display Area	115.2 (W) x 86.4 (H)	mm
Pixel Configuration Format / Resolution	640 RGB (W) x 480 (H)	pixels
Dot Dimensions	0.060 (W) x 0.180 (H)	mm
Pixel Arrangement	RGB Vertical Stripe with Dot Inversion	--
LCD Type	TN Fluid Type / Transmissive / Normally White	--
Backlight Type	Edge LED / White	--
Viewing Direction	6:00 (The Gray Inversion will appear in this direction)	O'Clock
Interface	Digital 18-Bit Parallel RGB	--
LCD Surface Treatment	Anti-Glare	V
Weight	250	g
RoHS Compliant	Yes	--

## 2 FEATURES

- The display module is a 5.7" diagonal VGA supported TFT-LCD which can display 262,144 colors. (6 bits / color)
- The module comes with a Surface Acoustic Wave (SAW) touch panel, all enclosed, with gaskets, into a Stainless Steel bezel.

### 3 MECHANICAL DRAWING



NOTES:

1. FFC Cable: 31-0004-000 (33pin, 178mm); Connects to Driving Board
2. Recommended Mating Connectors for LCM:  
Molex 0541323397  
Molex 5022443330
3. JST BHSR-02VS-1(N), RED(Anode)/BLACK(Cathode), B/L Connector
4. To Touch Panel Controller: TSC800-25
5. Underside of TFT-LCD

Product No.	84-0101-000T	REV. A
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Page	5 / 24
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## 4 ABSOLUTE MAXIMUM RATINGS

### 4.1 ABSOLUTE RATINGS OF ENVIRONMENT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Storage Temperature	Tst	-30	+80	°C	(1)
Operating Ambient Temperature	Top	-20	+70	°C	(1)

Note (1): Temperature and Relative humidity range are as follows:

- (a) 90% RH Max. ( $T_a \leq 40^\circ\text{C}$ ).
- (b) Wet-bulb temperature should be  $39^\circ\text{C}$  Max. ( $T_a > 40^\circ\text{C}$ ).
- (c) No condensation.

### 4.2 ELECTRICAL ABSOLUTE RATINGS

#### 4.2.1 TFT-LCD Module

( $T_a = 25 \pm 2^\circ\text{C}$ , GND =  $V_{SS} = 0\text{ V}$ )

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Digital Power Supply Voltage	Vcc	-0.3	4.3	V	-

#### 4.2.2 Backlight Unit

( $T_a = 25 \pm 2^\circ\text{C}$ )

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Current of Backlight Unit	Ib	-	175	mA	(1)
Reverse Voltage	Vr	-	15	V	(1)

Note (1): Permanent damage to the device may occur if maximum values are exceeded or reverse voltage is loaded.

## 5 ELECTRICAL CHARACTERISTICS

### 5.1 TFT-LCD MODULE

(Ta = 25±2 °C)

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Power Supply Voltage	Vcc	3.0	3.3	3.6	V	-
Power Supply Current	Icc	-	261	365	mA	(1)
Input High Threshold Voltage	Vih	0.7Vcc	-	Vcc	V	-
Input Low Threshold Voltage	Vil	0	-	0.3Vcc	V	-
Power Consumption	Pl	-	0.86	1.2	W	(1)
Frame Frequency	Fv	-	60	-	Hz	-
Dot Clock	DCLK	-	25.175	-	MHz	-

Note (1): The specified power consumption is under the conditions at Vcc = 3.3V and Fv = 60 Hz, whereas a Power dissipation check pattern below is displayed.

Black Pattern / 0 Gray



Active Area

### 5.2 BACKLIGHT UNIT

(Ta = 25±2 °C)

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Current of Backlight Unit	Ib	-	140	-	mA	-
Voltage of Backlight Unit	Vb	-	9.9	-	V	Ib = 140 mA
Power Consumption	Pbl	-	1.39	-	W	Ib = 140 mA
LED Life Time (at 25 °C)	-	40,000	50,000	-	Hrs.	(1)

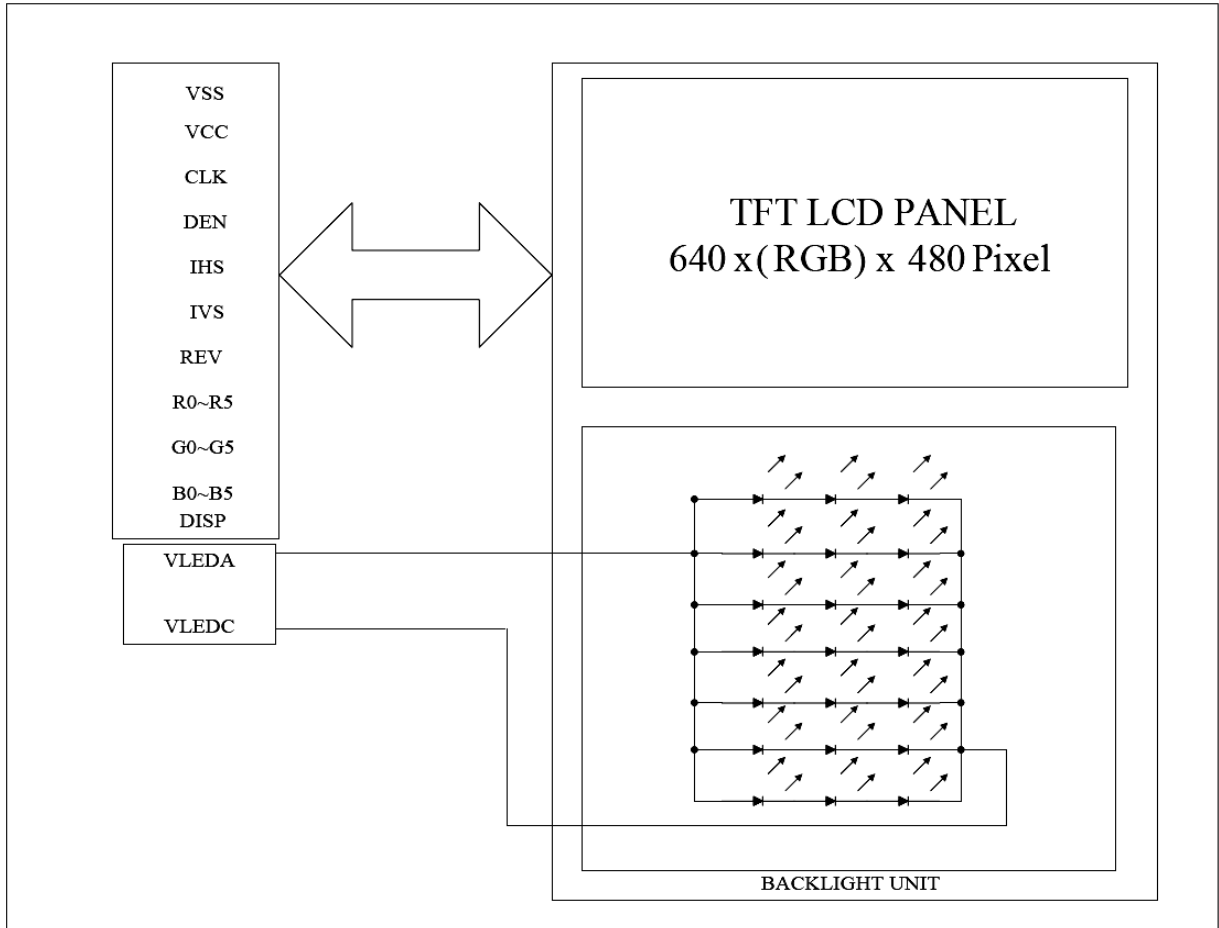
Note (1): LED life time is defined at 25±2 °C, when the average brightness decreases to 50% of the original brightness.

## 6 TRANSPARENT SAW TOUCH PANEL SPECIFICATIONS

Item	Description
Positional Accuracy	±1% on most displays
Transmittance	Up to 90%
Surface Durability	7 Mohs Hardness rating
Touch Activation force	< 85 gf
Life	More than 50 million touches
Altitude resistance	4,000 m during operation 18,000 m during storage / transport
Chemical resistance	Resistant to a variety of chemicals such as Acetone, Toluene, Methyl Ethyl Ketone, Isopropyl alcohol, Methyl Alcohol, Ethyl acetate, Ammonia based glass cleaners, Gasoline, Kerosene, and Vinegar.
CE and FCC Class B Compliant	

## 7 BLOCK DIAGRAM

### TFT-LCD Module with Backlight Unit



## 8 INPUT/OUTPUT TERMINALS PIN ASSIGNMENT

### 8.1 TFT-LCD MODULE

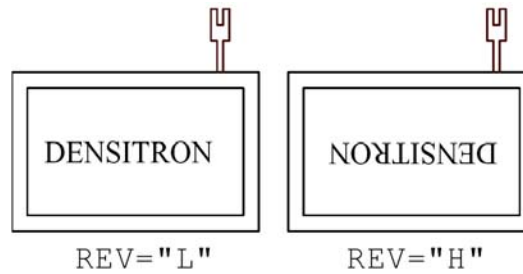
Connector: CVILUX CF25331D0R0-05

Pin No.	Symbol	I/O	Description
1	VSS	I	Ground
2	CLK	I	Clock signal
3	IHS	I	Horizontal synchronous signal
4	IVS	I	Vertical synchronous signal
5	VSS	I	Ground
6	R0	I	RED data (LSB)
7	R1	I	RED data
8	R2	I	RED data
9	R3	I	RED data
10	R4	I	RED data
11	R5	I	RED data (MSB)
12	VSS	I	Ground
13	G0	I	GREEN data (LSB)
14	G1	I	GREEN data
15	G2	I	GREEN data
16	G3	I	GREEN data
17	G4	I	GREEN data
18	G5	I	GREEN data (MSB)
19	VSS	I	Ground
20	B0	I	Blue data (LSB)
21	B1	I	Blue data
22	B2	I	Blue data
23	B3	I	Blue data
24	B4	I	Blue data
25	B5	I	Blue data (MSB)
26	VSS	I	Ground
27	DEN	I	Input data enable control
28	VCC	I	+3.3 V power supply
29	VCC	I	+3.3 V power supply
30	REV	I	Selection signal for horizontal / vertical scanning direction. *Note (1)
31	VSS	I	Ground
32	NC	I	No connection
33	VSS	I	Ground

Product No.	84-0101-000T	REV. A
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Page	10 / 24
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\*Note (1):



## 8.2 BACKLIGHT UNIT

Connector: JST BHSR-02VS-1(N)

Pin No.	Symbol	I/O	Description	Wire Color
1	VLEDA	I	Backlight LED Anode	Red
2	VLEDC	I	Backlight LED Cathode	Black

## 8.3 TRANSPARENT SAW TOUCH PANEL

CONNECTION CHART	
PIN	SIGNAL
1	GROUND
2	KEY
3	Y RECEIVE (+)
4	Y TRANSMIT (+)
5	Y RECEIVE (-)
6	Y TRANSMIT (-)
7	GROUND
8	X TRANSMIT (-)
9	X RECEIVE (-)
10	X TRANSMIT (+)
11	X RECEIVE (+)
12	KEY

### 8.4 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 6-bit gray scale data input for the color. The higher the binary input, the brighter the color. The table provides the assignment of color versus the data input.

Color		Data Signal																	
		Red						Green						Blue					
		D05	D04	D03	D02	D01	D00	D15	D14	D13	D12	D11	D10	D25	D24	D23	D22	D21	D20
Basic Colors	Black	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	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	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
Gray Scale Of RED	Red(0) / Dark	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	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(2)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red(61)	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(62)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Gray Scale Of Green	Green(0) / Dark	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	1	0	0	0	0	0	0
	Green(2)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green(61)	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0
	Green(62)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	Green(63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Gray Scale Of Blue	Blue(0) / Dark	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	1
	Blue(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(61)	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	1
	Blue(62)	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0
	Blue(63)	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1

## 9 INTERFACE TIMING

### 9.1 INPUT SIGNAL CHARACTERISTICS

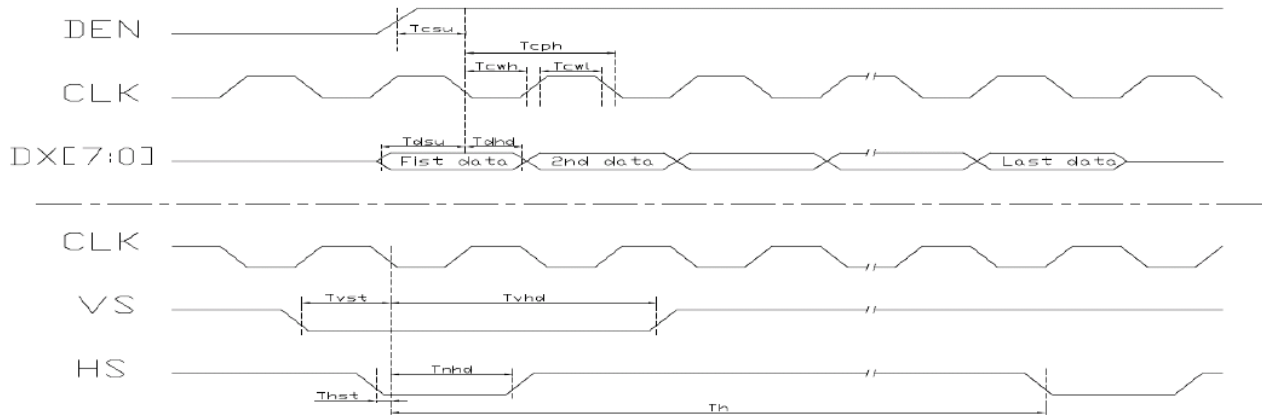
Item	Symbol	Min.	Typ.	Max.	Unit
HS Setup time	$T_{hst}$	10	-	-	ns
HS Hold time	$T_{hhd}$	10	-	-	ns
VS Setup time	$T_{vst}$	10	-	-	ns
VS Hold time	$T_{vhd}$	10	-	-	ns
Data setup time	$T_{dsu}$	10	-	-	ns
Data hold time	$T_{dhd}$	10	-	-	ns
DEN setup time	$T_{esu}$	10	-	-	ns
VS falling to HS falling time on odd field @ RGB mode	$T_{HVO}$	-4	0	+4	$T_{CPH}$
VS falling to HS falling time on even field @ RGB mode	$T_{HVE}$	0.4	0.5	0.6	$T_H$

Item	Symbol	Min.	Typ.	Max.	Unit
CLK Frequency	$F_{CPH}$	-	25.175	-	MHz
CLK Period	$T_{CPH}$	-	39.7	-	ns
CLK Pulse duty	$T_{CWH}$	40	50	60	%
HS Period	$T_H$	-	800	-	$T_{CPH}$
HS Pulse width	$T_{WH}$	5	30	-	$T_{CPH}$
HS-DEN Time	$T_{HS}$	112	144	175	$T_{CPH}$
DEN Pulse width	$T_{EP}$	-	640	-	$T_{CPH}$
VS Pulse width	$T_{WV}$	1	3	5	$T_H$
VS-DEN Time	$T_{STV}$	-	35	-	$T_H$
VS Period	$T_V$	-	525	-	$T_H$

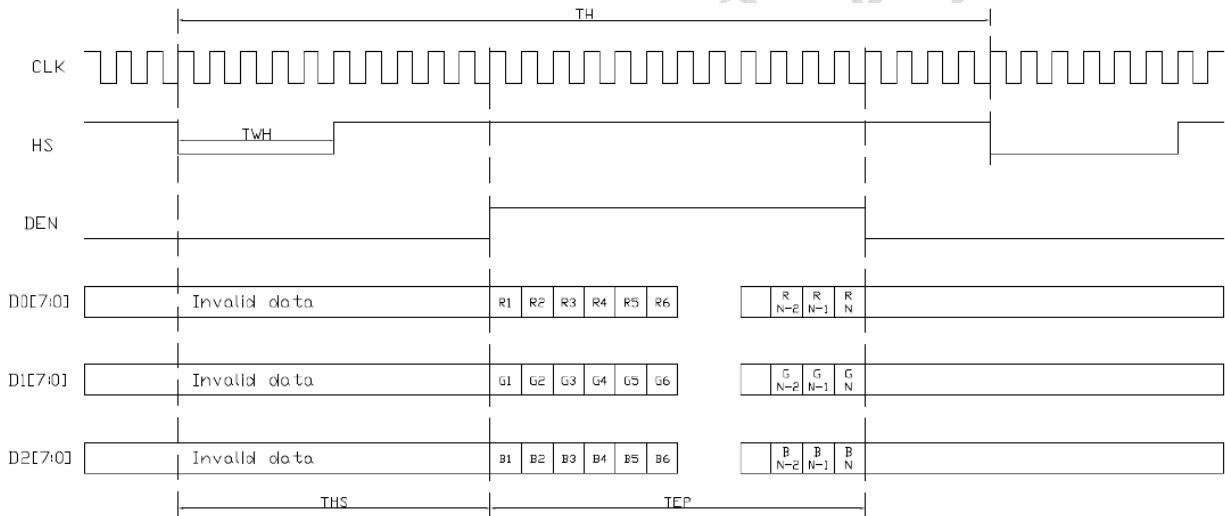
Note: When SYNC mode is used, 1<sup>st</sup> data starts from 144th CLK after HS falling. (When STHD [5:0] = 00000)

## 9.2 WAVEFORM

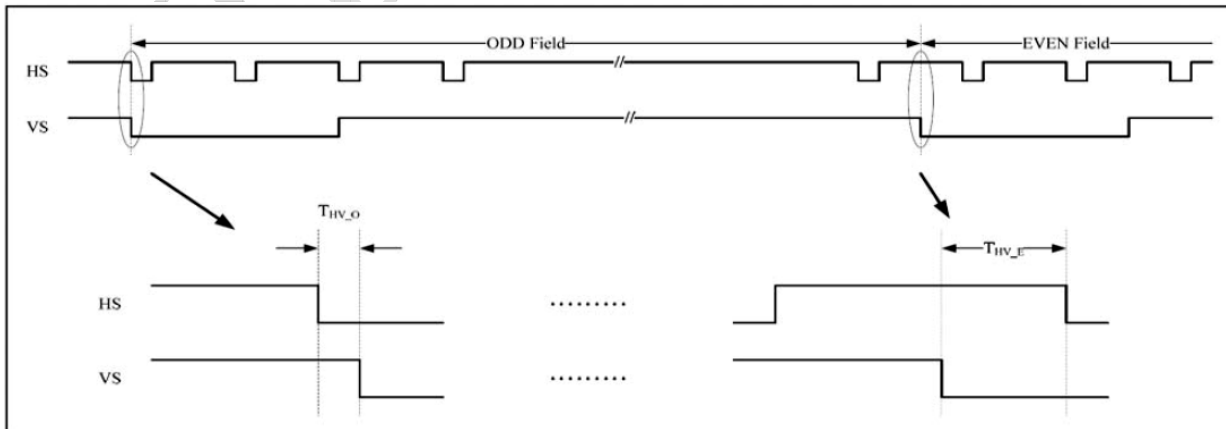
### 9.2.1 Clock and Data Input Waveforms



### 9.2.2 Data Input Format for RGB Mode



### 9.2.3 The HS & VS Timing of the ODD/EVEN Field

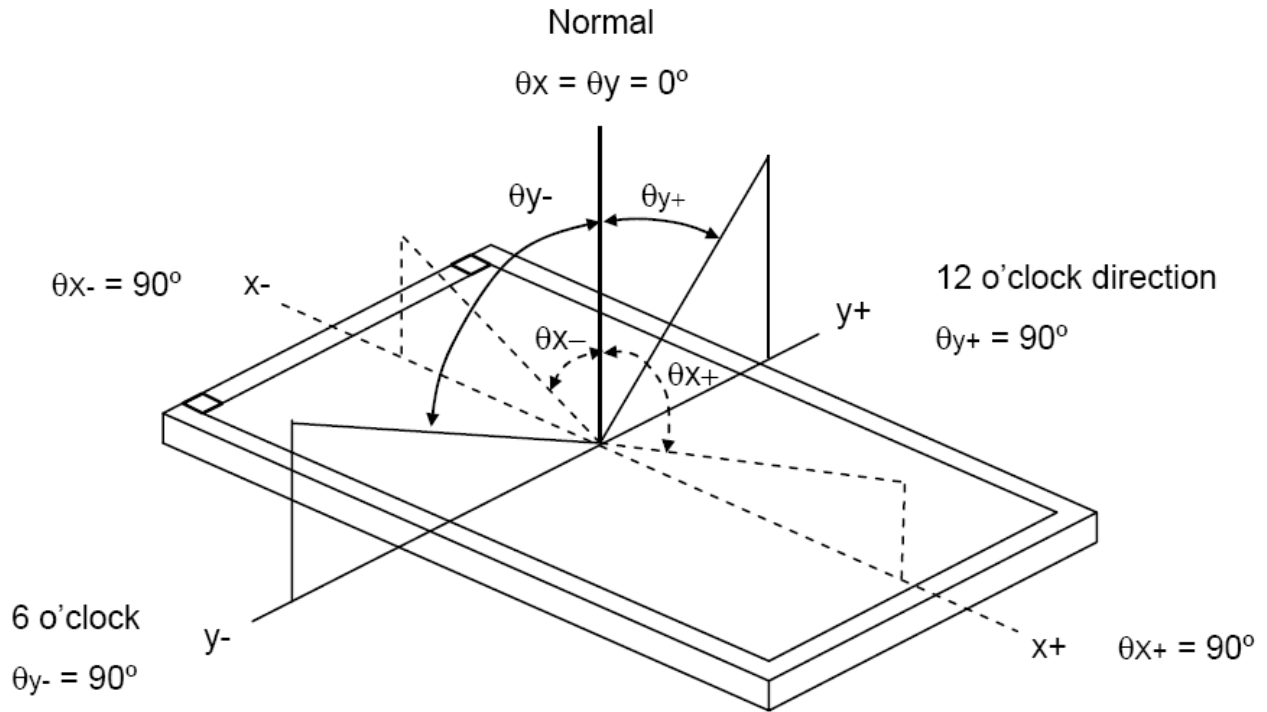


## 10 OPTICAL CHARACTERISTICS

The optical characteristics should be measured in a dark environment ( $\leq 1$  lux.) or an equivalent state with the procedure shown in Note (4).

Item		Symbol	Conditions	Min.	Typ.	Max.	Unit	Note
Contrast Ratio		CR		200	350	-	-	(2)
Response Time		T <sub>R</sub>	$\theta_x = 0^\circ$	-	15	-	ms	(3)
		T <sub>F</sub>		-	35	-	ms	
Luminance (Centre)		Y		350	450	-	cd/m <sup>2</sup>	(4)
Brightness uniformity		BUNI		80	85	-	%	(5)
Color Chromaticity	Red	R <sub>x</sub>	Viewing Normal Angle	0.562	0.615	0.665	-	(1), (4)
		R <sub>y</sub>		0.302	0.352	0.402	-	
	Green	G <sub>x</sub>		0.281	0.331	0.381	-	
		G <sub>y</sub>		0.520	0.570	0.620	-	
	Blue	B <sub>x</sub>		0.093	0.143	0.193	-	
		B <sub>y</sub>		0.053	0.103	0.153	-	
	White	W <sub>x</sub>		0.279	0.329	0.379	-	
		W <sub>y</sub>		0.315	0.365	0.415	-	
Viewing Angle	Horizontal	$\theta_{x+}$	CR $\geq 10$	55	65	-	deg.	
		$\theta_{x-}$		55	65	-		
	Vertical	$\theta_{y+}$		55	60	-		
		$\theta_{y-}$		55	70	-		

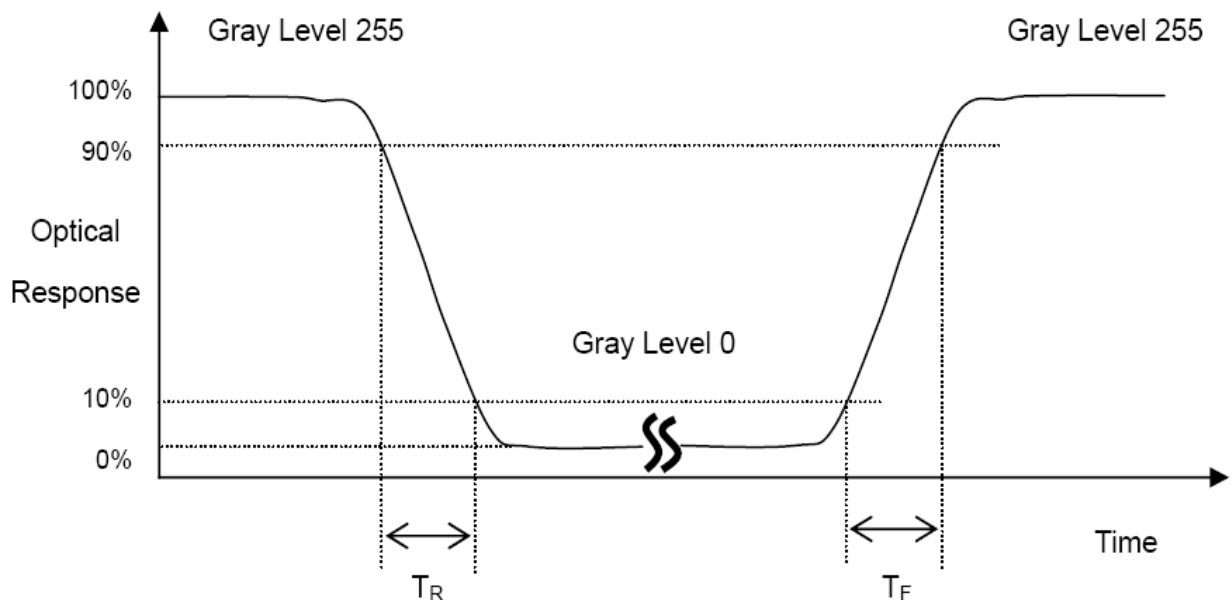
Note (1): Definition of Viewing Angle ( $\theta_x, \theta_y$ ):



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

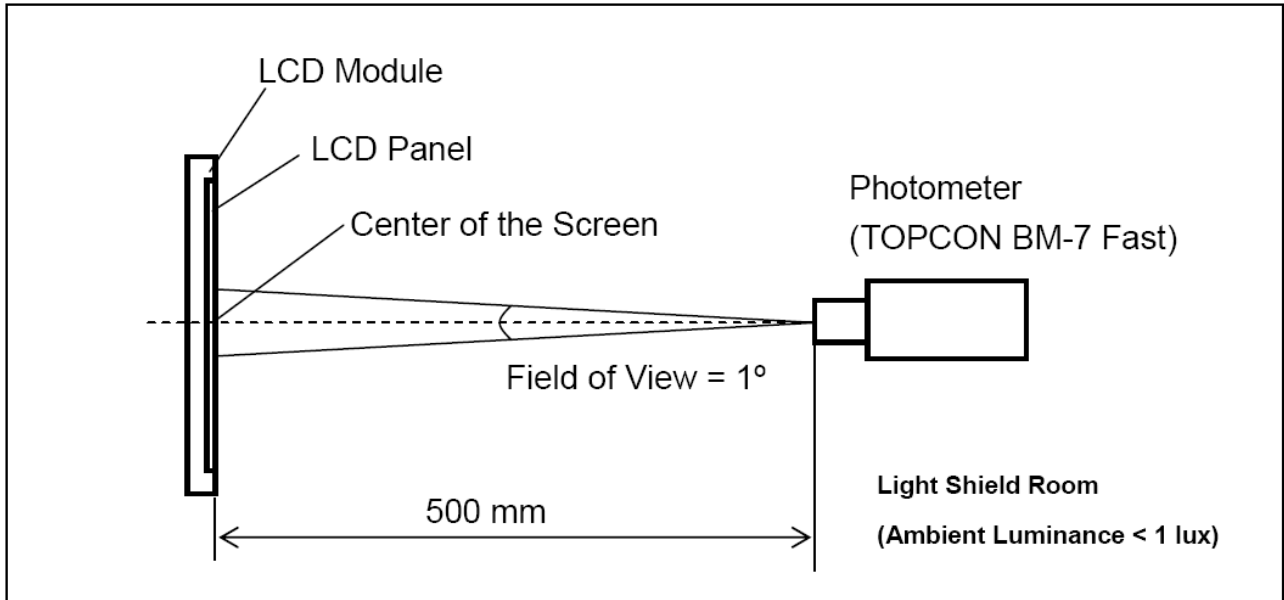
$$CR = \frac{\text{Luminance (brightness) of all pixels "White"}}{\text{Luminance (brightness) of all pixels "Dark"}}$$

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



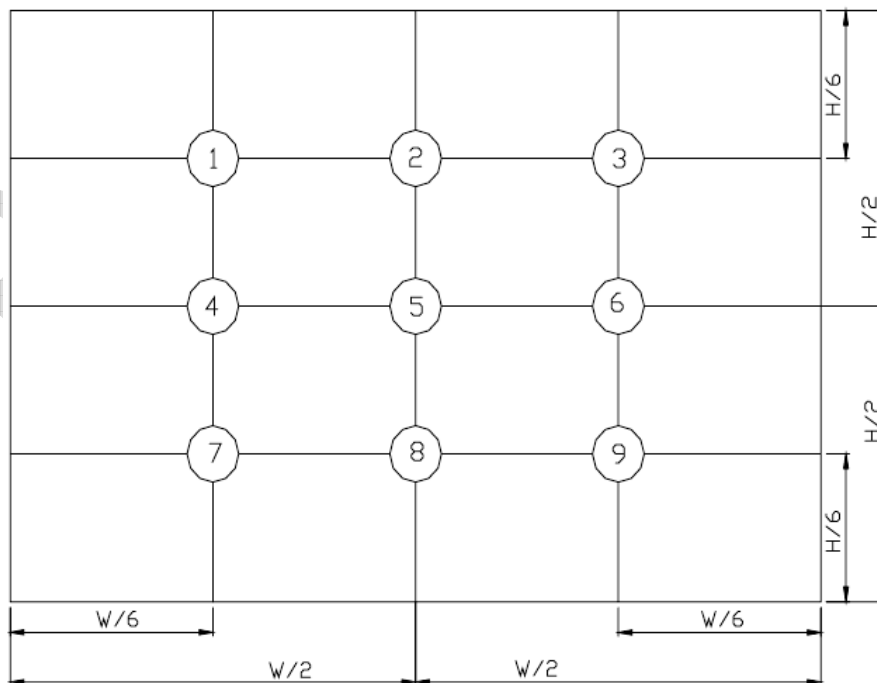
Note (4): Measurement Set-Up:

The LCD module should be stabilized at a given temperature for 30 minutes to avoid abrupt temperature changes during measuring. In order to stabilize the luminance, the measurement should be executed after lighting the backlight for 30 minutes in a windless room.



Note (5): Definition of brightness uniformity: (Unit - mm)

Brightness uniformity = [(Min. Luminance of 9 points) / (Max. Luminance of 9 points)] x 100%



## 11 RELIABILITY TEST

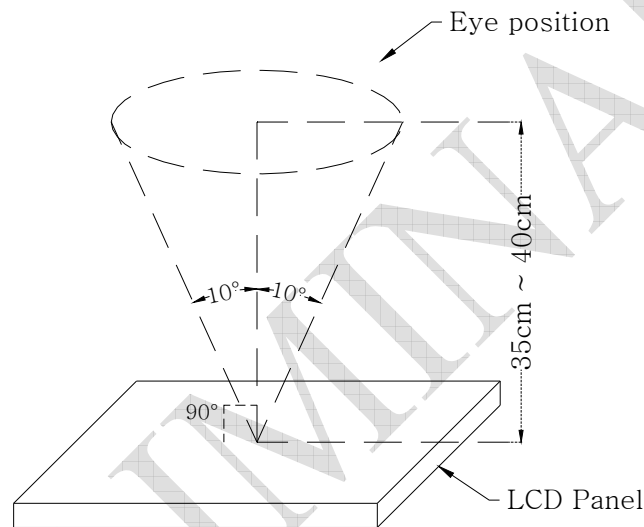
Test Items	Test Conditions
High Temperature Storage Test	Ta = 80 °C / 240 hours
Low Temperature Storage Test	Ta = -30 °C / 240 hours
High Temperature Operation Test	Ta = 70 °C / 240 hours
Low Temperature Operation Test	Ta = -20 °C / 240 hours
High Temperature and High Humidity Operation Test	Ta = 60 °C / 90% RH / 240 hours
Electro-static Discharge Test (non-operating)	Panel Surface / Top Case: 150 pF, 330 Ω Air: ±15 kV, Contact: ±8 kV
Mechanical Shock Test (non-operating)	Half-sine wave, 80G, 11 ms 3 times shock tested on each of the six surfaces
Vibration Test (non-operating)	Sine wave, 10 ~ 55 ~ 10 Hz 3 axes, 2 hours / axis
Thermal Shock Test (non-operating)	-20°C (30 min) ~ 70°C (30 min) 100 cycles
Drop Test (with Carton)	Height: 80cm 1 corner, 3 edges, 6 surfaces

## 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:  $25 \pm 5$  °C
- (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.

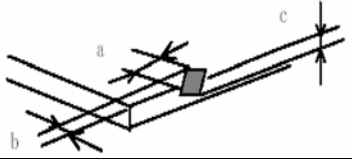
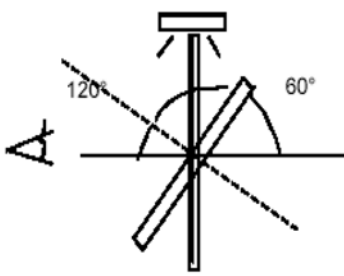


### 12.2 CLASSIFICATION OF DEFECTS AND AQL

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.

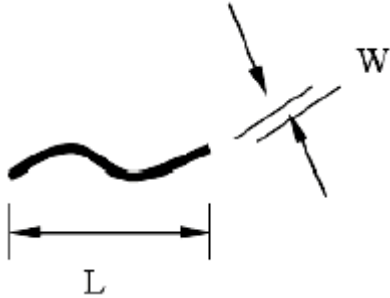
**12.3 INSPECTION PARAMETERS**

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	$N \leq 2$	$N \leq 2$	$N \leq 7$	
		Black / dark dot	$N \leq 3$	$N \leq 4$		
		Total dots	$N \leq 4$	$N \leq 5$		
		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	
		$L \leq 2.5$	$W \leq 0.1$	4		
		$L > 2.5$	$W > 0.1$	0		
	Dent or bubble on the polarizer	Dimension (mm)		Acceptable number	3	
		$D \leq 0.5$		4		
		$D \leq 0.15$		Disregard		
	Foreign material on the polarizer	Dimension (mm)		Acceptable number	3	
		$D \leq 0.5$		4		
		$D \leq 0.15$		Disregard		

Item		Specification / Description			Note
Touch Panel	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)			7	
		If Average Diameter ≤ (1/3) Touch Panel Area, Disregard.			

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.

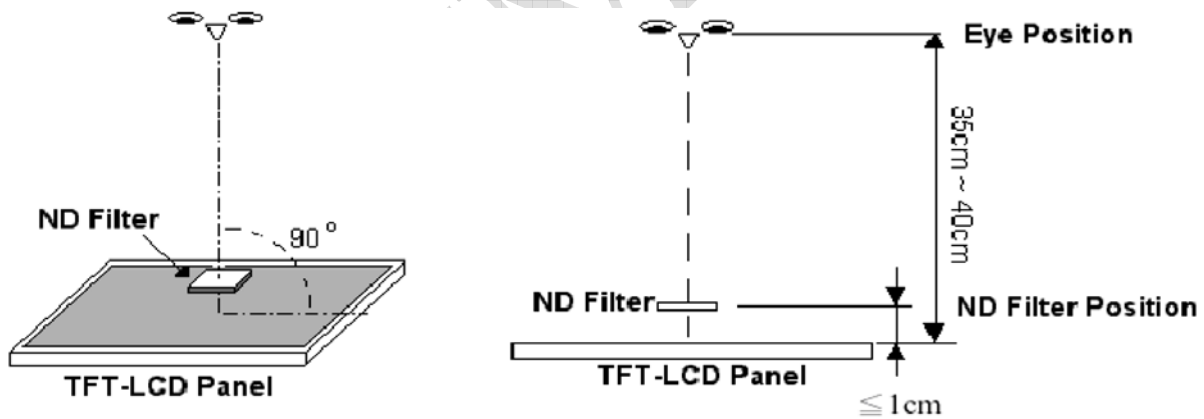
Note 2:



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



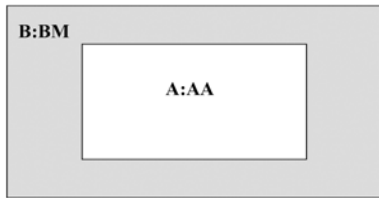
Note 4: A bright dot is defined with 6% transmission ND filter as shown below:



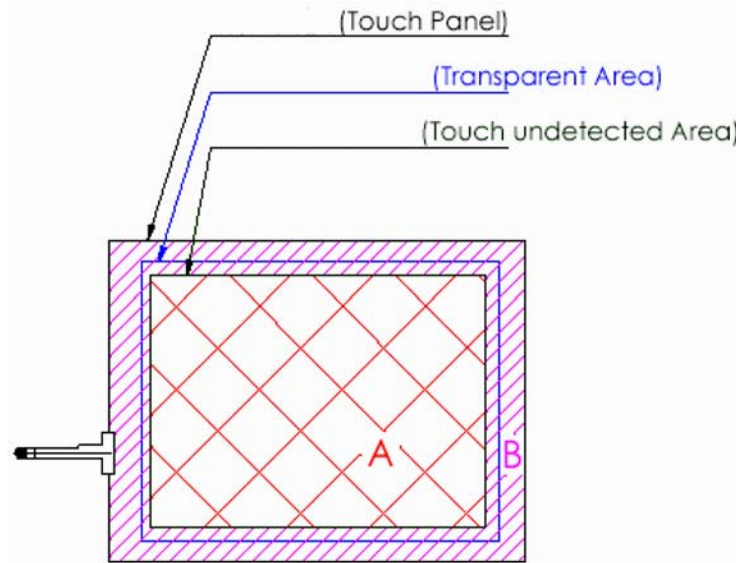
Note 5: Adjacent Dots:



Note 6:

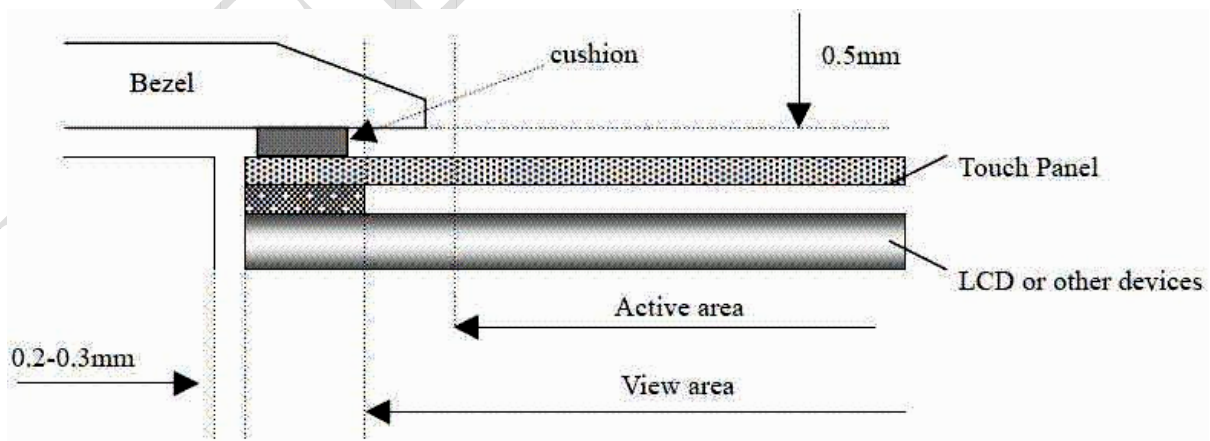


Note 7:



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).

Product No.	84-0101-000T	REV. A
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Page	24 / 24
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