

# **INNOLUX DISPLAY CORPORATION**

## **LCD MODULE**

# **SPECIFICATION**

**Customer:** \_\_\_\_\_

**Model Name:** CT024TN02 V.8(Suez-T4)

**Spec. No.:** C024-02-TT-01

**Date:** 2007/08/14

**Version:** 1.0

- Preliminary Specification**
- Final Specification**

**For Customer's Acceptance**

Approved by	Comment

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# 1. General Specifications

## 1.1 Description

The CT024TN02 V.8 is a color active matrix Thin Film Transistor (TFT) Liquid Crystal Display(LCD) that uses amorphous silicon(a-Si) TFT as a switching device. This model is composed of a single 2.4 inches transmissive type main TFT-LCD panel and a resistive touch screen display. The resolution of the panel is 240x320 pixels and can display up to 65K color.

## 1.2 Features

- TM type for main TFT-LCD panel
- Resistive type touch panel
- One backlight with 4 white LEDs
- 80-system 16-bit parallel bus
- Full, Still, Partial & Standby modes are available

## 1.3 Application

- Display terminals for cellular phone

## 1.4 General Specification

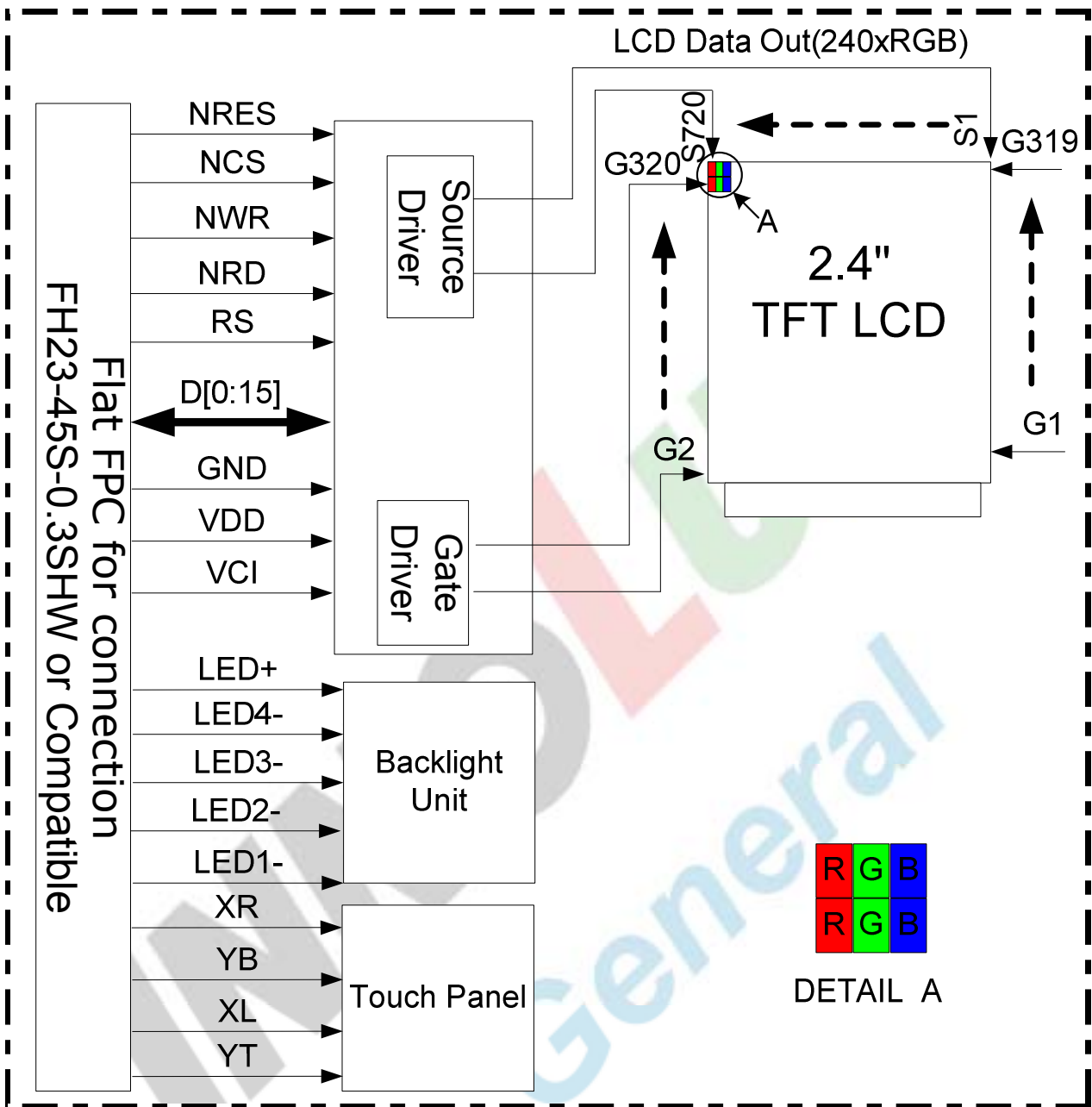
No.	Item	Specification	Unit	Remark
1	LCD Size	2.4	inch	-
2	Panel Type	a-Si TFT active matrix	-	-
3	Touch Panel Type	4-wire Analog Resistive	-	-
4	Resolution	240 x RGB x 320	pixel	-
5	Display Mode	Normally white, Transmissive	-	-
6	Display Number of Colors	65K	-	-
7	Viewing Direction	12 o'clock	-	Note 1
8	Contrast Ratio	300	-	-
9	Luminance	160 (typ)	cd/m <sup>2</sup>	Note 2
10	Module Size	44.52(W) x 63.38(L) x 3.55 (T)	mm	Note 1
11	Panel Active Area	36.72(W) x 48.96(L)	mm	Note 1
12	Touch Panel Active Area	37.72(W) x 49.96(L)	mm	Note 1
13	Touch Panel View Area	39.72(W) x 51.96(L)	mm	Note 1
14	Pixel Pitch	0.153(W ) x 0.153(L)	mm	-
15	Weight	TBD	-	-
16	Driver IC	HX8347	-	-
17	Driver IC RAM Size	240 x 18 x320	bit	-
18	Light Source	4 white LEDs	-	-
19	Interface	80-system 16 bits parallel bus	-	-
20	Operating Temperature	-20~70	°C	-
21	Storage Temperature	-30~80	°C	-

Note 1: Please refer to the mechanical drawing.

Note 2: Luminance is measured with touch panel attached.

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## 2. Block Diagram



### 3. Pin Assignments

Pin No.	Symbol	I/O	Function	Remark
1	GND	P	Ground	-
2	GND	P	Ground	-
3	VCI	P	Analog/Logic supply voltage	-
4	VCI	P	Analog/Logic supply voltage	-
5	VDD	P	I/O circuit supply voltage	-
6	VDD	P	I/O circuit supply voltage	-
7	NCS	I	Chip select signal (Low: active)	-
8	RS	I	Register select signal	-
9	NWR	I	Write signal (Low: active)	-
10	NRD	I	Read signal (Low: active)	-
11	D0	I/O	Data bus (Bit 0)	-
12	D1	I/O	Data bus (Bit 1)	-
13	D2	I/O	Data bus (Bit 2)	-
14	D3	I/O	Data bus (Bit 3)	-
15	D4	I/O	Data bus (Bit 4)	-
16	D5	I/O	Data bus (Bit 5)	-
17	D6	I/O	Data bus (Bit 6)	-
18	D7	I/O	Data bus (Bit 7)	-
19	D8	I/O	Data bus (Bit 8)	-
20	D9	I/O	Data bus (Bit 9)	-
21	D10	I/O	Data bus (Bit 10)	-
22	D11	I/O	Data bus (Bit 11)	-
23	D12	I/O	Data bus (Bit 12)	-
24	D13	I/O	Data bus (Bit 13)	-
25	D14	I/O	Data bus (Bit 14)	-
26	D15	I/O	Data bus (Bit 15)	-
27	NC	-	NC	-
28	NC	-	NC	-
29	NRES	I	Reset signal (Low: active)	-
30	BS2	-	NC	-
31	BS1	-	NC	-
32	BS0	-	NC	-
33	GND	P	Ground	-

34	LED+	-	LED anode	-
35	LED+	-	LED anode	-
36	LED4-	-	LED cathode 4	-
37	LED3-	-	LED cathode 3	-
38	LED2-	-	LED cathode 2	-
39	LED1-	-	LED cathode 1	-
40	GND	P	Ground	-
41	XL	-	Touch panel signal (X+)	-
42	YT	-	Touch panel signal (Y-)	-
43	XR	-	Touch panel signal (X-)	-
44	YB	-	Touch panel signal (Y+)	-
45	GND	P	Ground	-

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## 4. Electrical Specifications

### 4.1 Absolute Maximum Rating

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

Item	Symbol	Values		Unit	Remark	
		Min.	Max.			
TFT Module	I/O circuit Supply Voltage	VDD	-0.3	+4.6	V	Note 1
	Analog/Logic Supply Voltage	VCI	-0.3	+4.6	V	Note 1
Backlight Unit	Current	$I_B$	-	120	mA	Note 2
	Power Consumption	$P_{BL}$	-	480	mW	Note 2

Note1: Permanent damage to the device may occur if maximum values are exceeded or reverse voltage is applied.

Note2: Without LED driver IC, please refer to 4.3.

### 4.2 Typical Operation Conditions

#### 4.2.1 DC Characteristics

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
I/O circuit Supply Voltage	VDD	2.5	2.8	3.3	V	Ta=25°C
Analog/ Logic Supply Voltage	VCI	2.5	2.8	3.3	V	
Input High Voltage	$V_{IH}$	0.8 VDD	-	VDD	V	
Input Low Voltage	$V_{IL}$	0	-	0.2VDD	V	
Output Low Voltage	$V_{OH}$	-	-	0.2VDD	V	
Output High Voltage	$V_{OL}$	0.8 VDD	-	-	V	
Frame Frequency	$f_{FRAME}$	-	80	-	Hz	

Note: To prevent IC latch up or DC operation in LCD panel, the power on/off sequence should follow the driver IC specification.



### 4.2.2 Current Consumption

Item	Symbol	Values		Unit	Remark
		Typ.	Max.		
MCU Interface (80-system 16 bits parallel bus)					
Standby Mode	VDD	2	3	uA	Note1, Note2
	VCI	1	2	uA	
Still Mode	VDD	0.95	1.5	uA	Note1
	VCI	5	6.5	mA	

Note1: Test Condition

Typ: VDD=2.8V

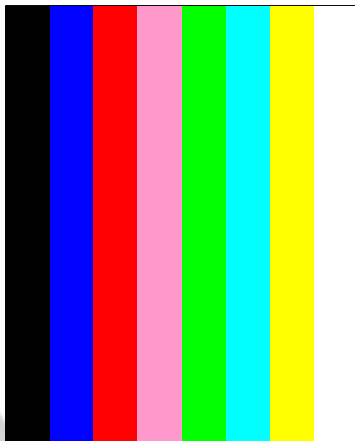
VCI=2.8V

Display Pattern: 8 Color Bar

Frame Rate=80Hz at Line Inversion

Operating Temperature: 25°C

**Typ. current check pattern:**



**8-Color Bar**

Max: VDD=3.3V

VCI=3.3V

Display Pattern: All Pixel Black

Frame Rate=80Hz at Line Inversion

Operating Temperature: 25°C

**Max. current check pattern:**

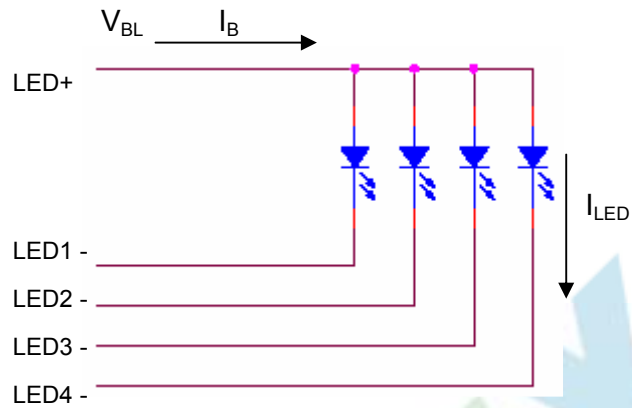


**Black**

Note2: In the standby mode, all the internal display operations are suspended including the internal R-C oscillator.

### 4.3 Backlight Unit

The backlight system is an edge lighting type with 4 white LEDs.



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

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Current	$I_B$	-	80	-	mA	Note 1
Power Consumption	$P_{BL}$	-	270	-	mW	Note 2

Note1: 4 LEDs are connected in parallel; each LED's current consumption is 20 mA

Note2: Where  $I_B = 80 \text{ mA}$ ,  $P_{BL} = I_B \times V_{BL}$

### 4.4 Instruction List

TBD

### 4.5 Instruction Setting Flow

TBD

### 4.6 Display RAM Data Format and Input Bus

TBD

### 4.7 Timing Characteristic

TBD

## 5 Touch Panel Specifications

### 5.1 Electrical Characteristics

Item	Value			Unit	Remark
	Min.	Typ.	Max.		
Linearity	-1.5	-	1.5	%	After environment and life test
Terminal Resistance	180	-	560	$\Omega$	X
	250	-	570	$\Omega$	Y
Insulation resistance	25	-	-	M $\Omega$	DC 25V
Operating Voltage	-	5	-	V	DC

### 5.2 Optical Characteristics

Item	Value			Unit	Remark
	Min.	Typ.	Max.		
Response Time	-	-	10	ms	100k $\Omega$ pull-up
Light Transparency	80	-	-	%	-

### 5.3 Mechanical Characteristics

Item	Value			Unit	Remark
	Min.	Typ.	Max.		
Active Force	-	-	80	gf	Note1
Surface Hardness	3	-	-	H	-
Pen Sliding Durability	100,000	-	-	time	Note 2
Hitting Durability	1,000,000	-	-	time	Note 3

Note 1: Do not operate it with a stylus other than a polyacetal pen (tip R0.8mm or less) or a finger, especially those with hard or sharp tips such as a ball point pen or a mechanical pencil.

Note 2: Measurement for surface area.

-Scratch 100,000 times of straight line on the screen with a stylus which is changed every 20,000 times.

-Force: 150gf.

-Speed: 150mm/sec.

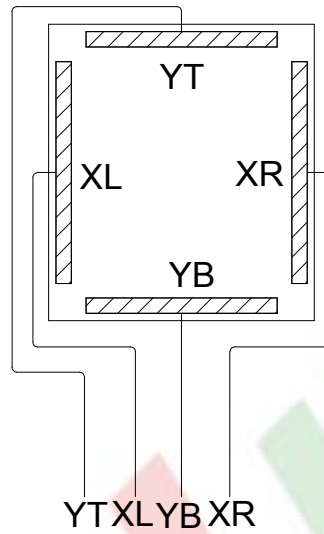
-Stylus: R0.8 polyacetal tip.

Note 3: Hit 1,000,000 times on the screen with a R0.8mm tip and R8mm tip.

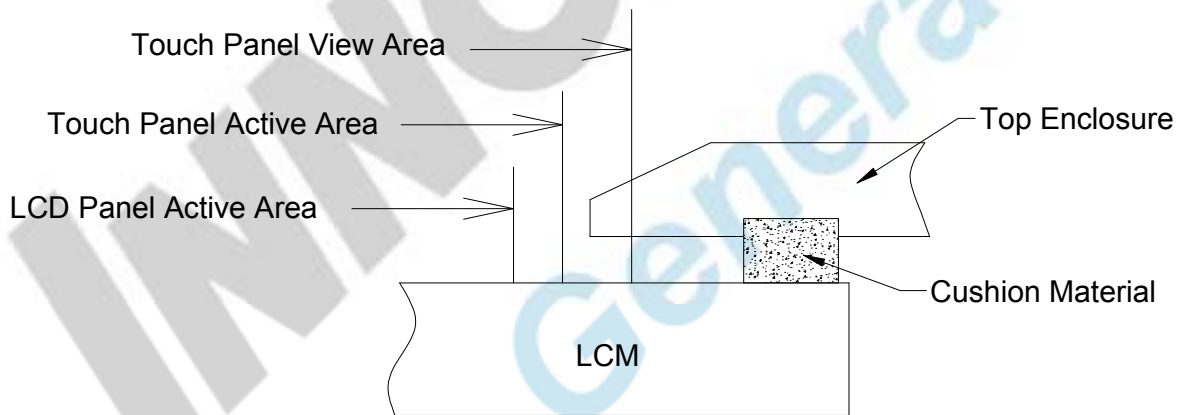
-Force: 250gf.

-Speed: 5times/sec.

### 5.4 Touch Panel Circuit Block



### 5.5 Mounting Condition Example



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## 6 Optical Specifications

(Ta=+25°C, VCI=VDD=+2.8V, I<sub>B</sub>=80mA)

Item	Symbol	Condition	Values			Unit	Remark	
			Min.	Typ.	Max.			
Viewing Angle Range	Left	$\theta_L$	CR $\geq$ 10	40	45	-	degree	Note 1,2
	Right	$\theta_R$		40	45	-		
	Top	$\theta_T$		45	50	-		
	Bottom	$\theta_B$		15	20	-		
Response Time	T <sub>on</sub> + T <sub>off</sub>	Normal $\theta = \phi = 0^\circ$	-	30	40	ms	Note 2,3	
Contrast Ratio	CR	Normal $\theta = \phi = 0^\circ$	250	300	-	-	Note 2,4	
Luminance	L	Normal $\theta = \phi = 0^\circ$	120	160	-	cd/m <sup>2</sup>	Note 2,5	
Color Chromaticity (CIE1931)	White	W <sub>x</sub>	Normal $\theta = \phi = 0^\circ$	0.23	0.28	0.33	-	Note 2,6
		W <sub>y</sub>		0.24	0.29	0.34		
	Red	R <sub>x</sub>		0.54	0.59	0.64		
		R <sub>y</sub>		0.29	0.34	0.39		
	Green	G <sub>x</sub>		0.29	0.34	0.39		
		G <sub>y</sub>		0.53	0.58	0.63		
	Blue	B <sub>x</sub>		0.09	0.14	0.19		
		B <sub>y</sub>		0.01	0.06	0.11		
Color Gamut	NTSC	CIE1931	-	60	-	%	-	
Luminance Uniformity	U <sub>L</sub>	Normal $\theta = \phi = 0^\circ$	75	80	-	%	Note 2,7	
Flicker	-	-	No Visible			-	Note 8	
Crosstalk	-	-	No Visible			-	Note 9	

Note 1: Definition of viewing angle

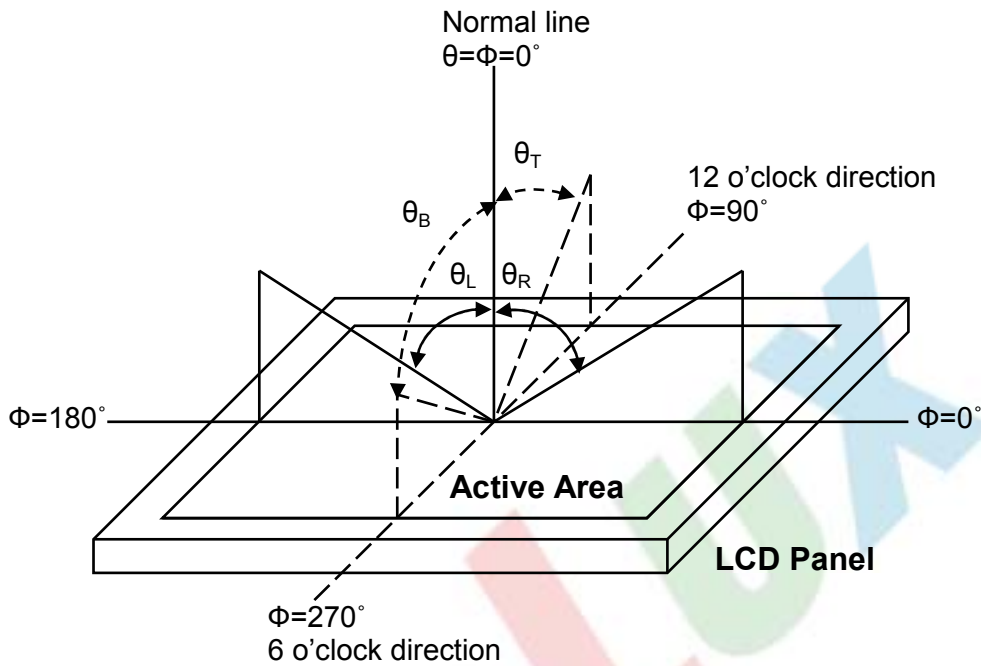


Fig. 1 Definition of viewing angle

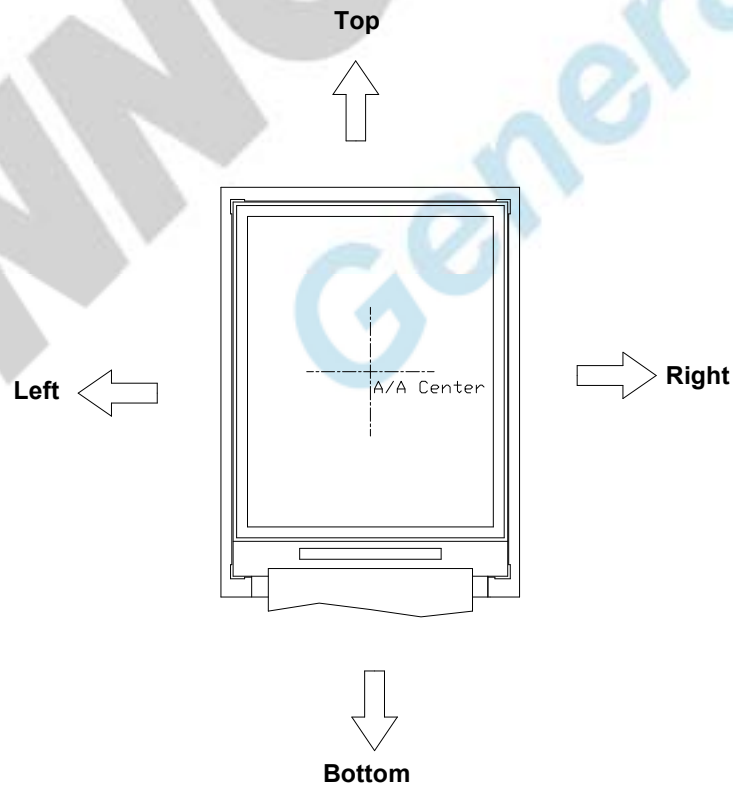


Fig. 2 Definition of viewing angle for display

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## Note 2: Definition of optical measurement system

The optical characteristics should be measured in a dark room with ambient temperature  $T_a=+25^{\circ}\text{C}$ . The optical properties are measured at the center point of the LCD screen after 5 minutes operation. (Equipment: Photo detector TOPCON BM-5A or BM-7 /Field of view:  $1^{\circ}$  /Height: 500mm.)

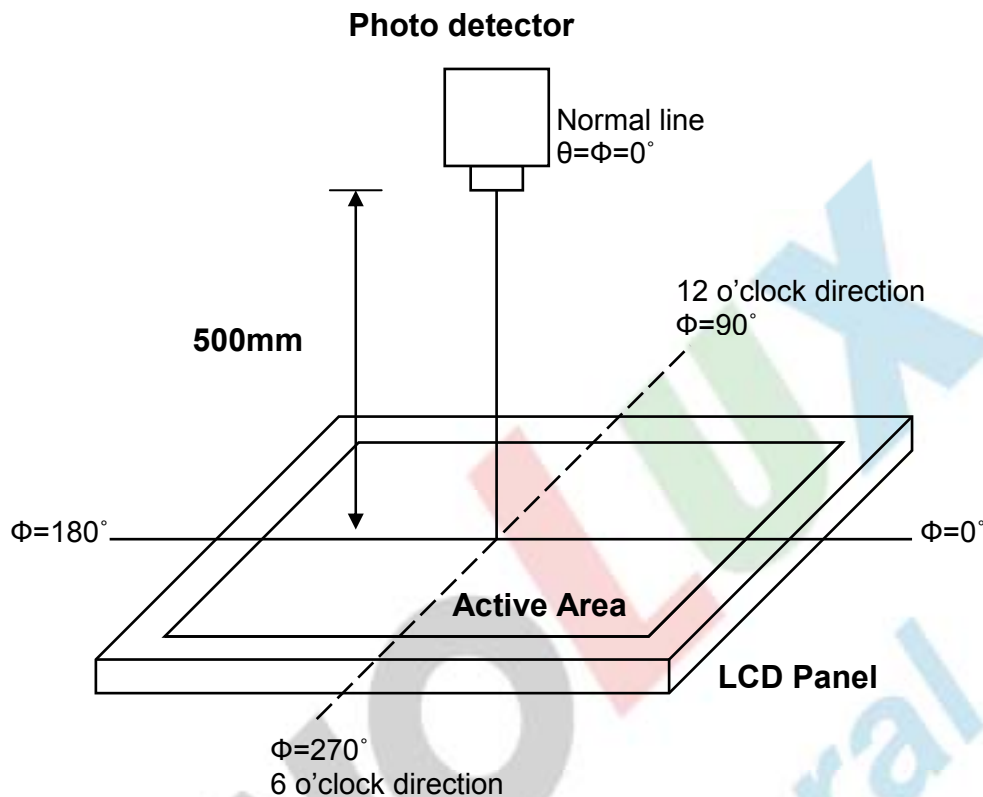


Fig. 3 Optical measurement system setup

## Note 3: Definition of response time

The response time is defined as the LCD optical switching time interval between “White” state and “Black” state. Rise time ( $T_{on}$ ) is the time between photo detector output intensity changed from 90% to 10%, and fall time ( $T_{off}$ ) is the time between photo detector output intensity changed from 10% to 90%.

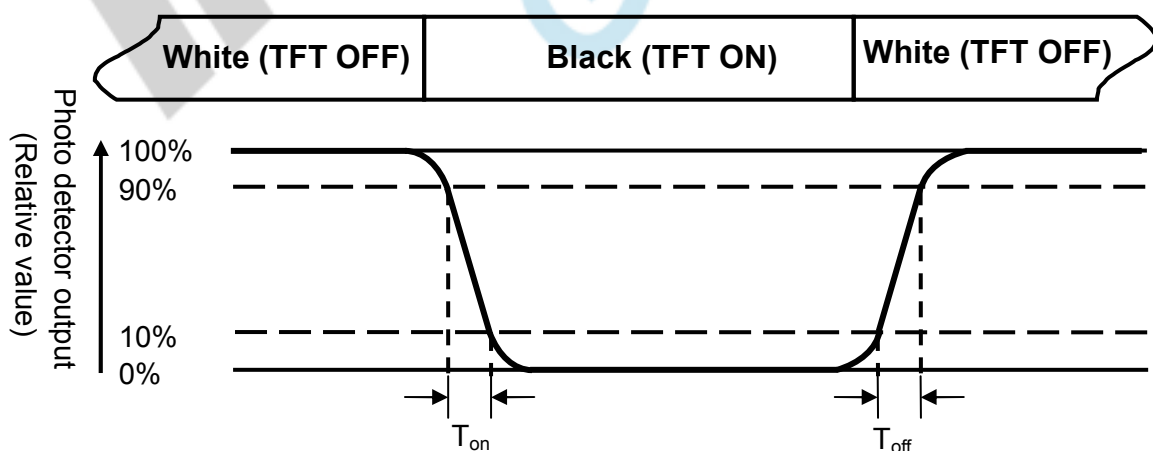


Fig. 4 Definition of response time

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Note 4: Definition of contrast ratio

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD on the "White" state}}{\text{Luminance measured when LCD on the "Black" state}}$$

Note 5: Definition of luminance

Measured at the center area of the panel when LCD panel is driven at "white" state.

Note 6: Definition of color chromaticity (CIE1931)

Color coordinates measured at the center point of LCD when panel is driven at "White", "Red", "Green" and "Blue" state respectively.

Note 7: Definition of luminance uniformity

To test for uniformity, the tested area is divided into 3 rows and 3 columns. The measurement spot is placed at the center of each circle as below.

$$\text{Luminance Uniformity (U}_L\text{)} = \frac{L_{\min}}{L_{\max}}$$

L-----Active area length      W----- Active area width

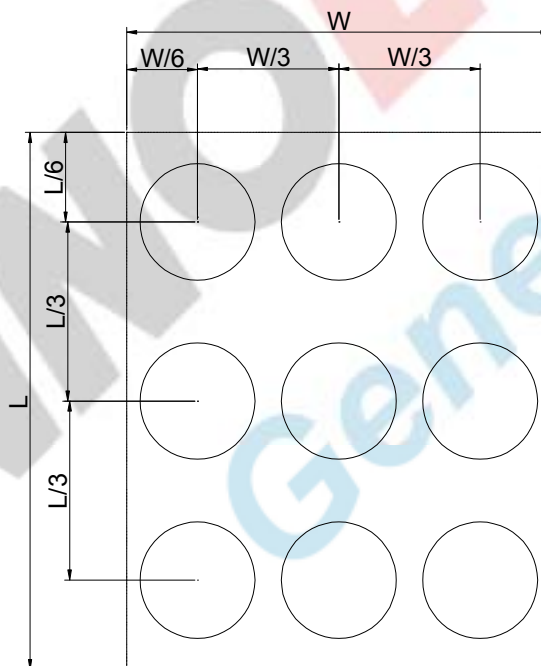


Fig. 5 Definition of luminance uniformity

$L_{\max}$  : The measured maximum luminance of all measurement position.

$L_{\min}$  : The measured minimum luminance of all measurement position.

Note 8: Definition of Flicker

Flicker is the pattern usually used to describe the visual sensation produced by a rapidly varying light intensity. There should be no visible flicker in normal direction of the display when the following figure are loaded.

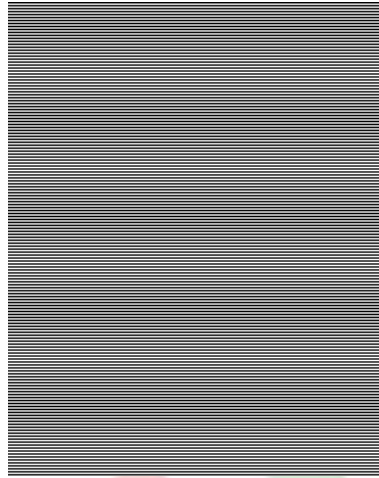


Fig.6 Flicker checker pattern

Note9: Definition of crosstalk

There should be no visible in normal direction of the display when the following figures are loaded.

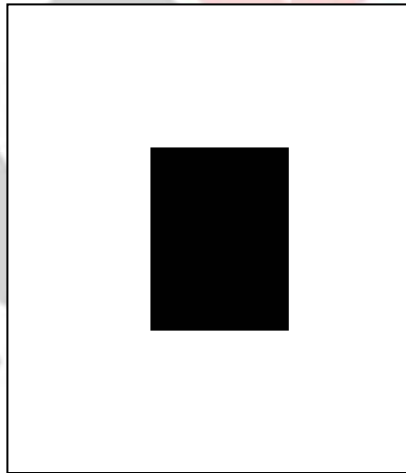


Fig.7 Crosstalk checker pattern

## 7 Reliability Test Items

Test Items	Test Conditions	Remark
High Temperature Storage	+80°C±3°C for 240 hours	-
Low Temperature Storage	-30°C±3°C for 240 hours	-
High Temperature Operation	+70°C±3°C for 240 hours	-
Low Temperature Operation	-20°C±3°C for 240 hours	-
High Temperature and Humidity Operation	+60°C±3°C, 90%±3%RH max. for 240 hours	-
Thermal Shock	-30°C/0.5h ~ +80°C/0.5h for a total 100 cycles, Start with cold temp and end with high temp	-
Vibration Test	Frequency range:10~55Hz Stoke:1.5mm Sweep:10Hz~55Hz~10Hz 2 hours for each direction of X. Y. Z. (6 hours for total)	-
Mechanical Shock	100G 6ms,±X, ±Y, ±Z 3 times for each direction	-
Package Vibration Test	Random Vibration : 0.015G <sup>2</sup> /Hz from 5-200Hz, -6dB/Octave from 200-500Hz 1 hour for each direction of X. Y. Z. (3 hours for total)	-
Package Drop Test	Height :72cm(Weight ≤ 10kg); 60cm(Weight > 10kg) 1 corner, 3 edges, 6 surfaces	-
Electro Static Discharge	± 2KV, Human Body Mode, 100pF/1500Ω	-

Note1: During the display practical test under normal operation condition, there shall be not change or effect to the display function.

Note2: Before function check, the test sample requires 2 hours storage at room temperature.

## 8 Handling Precautions

### 8.1. Safety

- 8.1.1 The liquid crystal in the LCD is poisonous. **DO NOT** put it in your mouth. If the liquid crystal touches your skin or clothes, wash it off immediately using soap and water.

### 8.2. Handling

- 8.2.1 The LCD and touch panel is made of plate glass. **DO NOT** subject the panel to mechanical shock or to excessive force on its surface.
- 8.2.2 Do not handle the product by holding the flexible pattern portion in order to assure the reliability
- 8.2.3 Transparency is an important factor for the touch panel. Please wear clear finger sacks, gloves and mask to protect the touch panel from finger print or stain and also hold the portion outside the view area when handling the touch panel.
- 8.2.4 Provide a space so that the panel does not come into contact with other components.
- 8.2.5 To protect the product from external force, put a covering lens (acrylic board or similar board) and keep an appropriate gap between them.
- 8.2.6 Transparent electrodes may be disconnected if the panel is used under environmental conditions where dew condensation occurs.
- 8.2.7 Property of semiconductor devices may be affected when they are exposed to light, possibly resulting in IC malfunctions.
- 8.2.8 To prevent such IC malfunctions, your design and mounting layout shall be done in the way that the IC is not exposed to light in actual use.

### 8.3. Static Electricity

- 8.3.1 Ground soldering iron tips, tools and testers when they are in operation.
- 8.3.2 Ground your body when handling the products.
- 8.3.3 Power on the LCD module **BEFORE** applying the voltage to the input terminals.
- 8.3.4 **DO NOT** apply voltage which exceeds the absolute maximum rating.
- 8.3.5 Store the products in an anti-electrostatic bag or container.

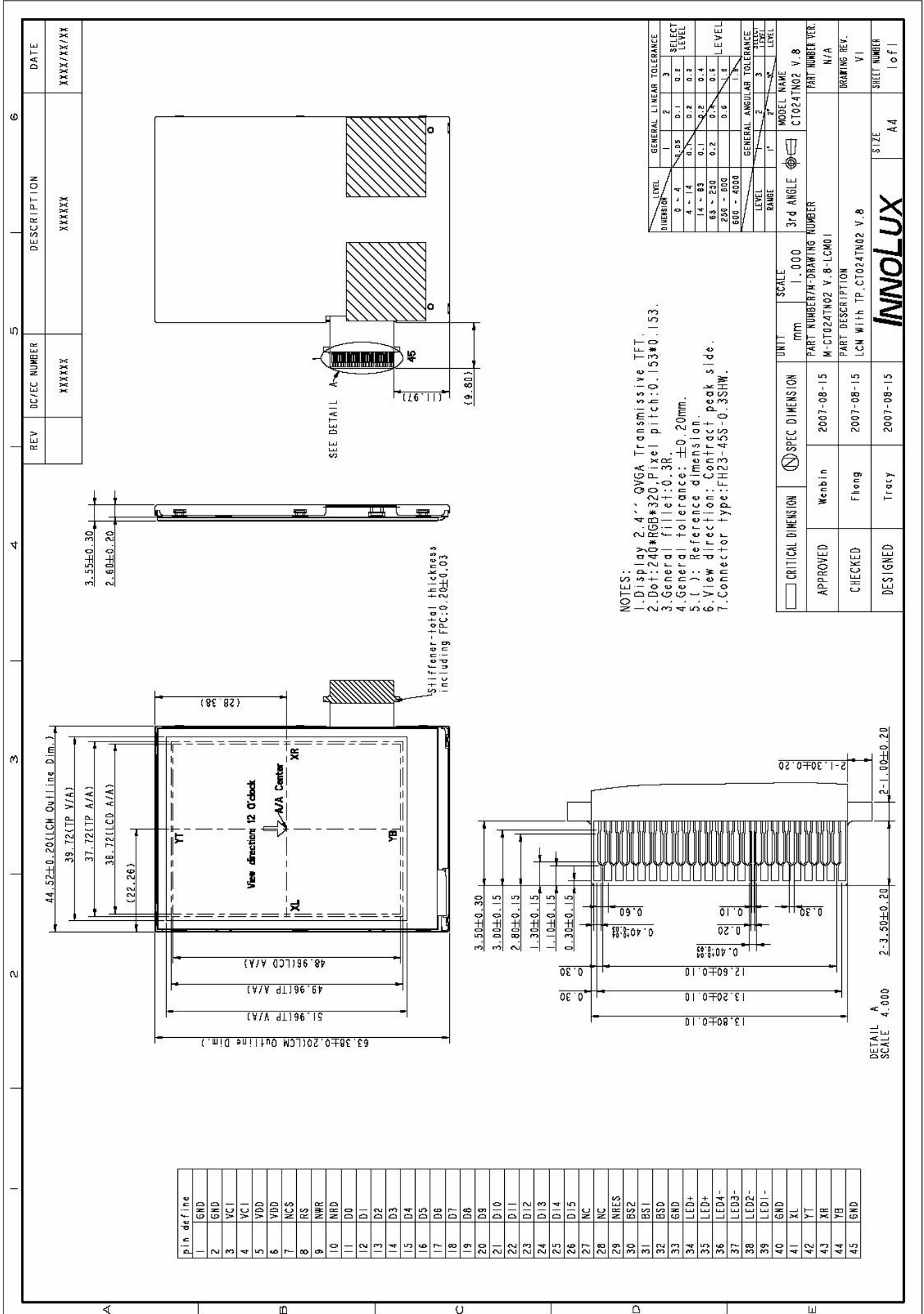
### 8.4. Storage

- 8.4.1 Store the products in a dark place at  $+25^{\circ}\text{C} \pm 10^{\circ}\text{C}$  with low humidity (65%RH or less).
- 8.4.2 **DO NOT** store the products in an atmosphere containing organic solvents or corrosive gas.

### 8.5. Cleaning

- 8.5.1 **DO NOT** wipe the touch panel with dry cloth, as it may cause scratch.
- 8.5.2 Wipe off the stain on the product by using soft cloth moistened with ethanol. **DO Not** allow ethanol to get in between the upper film and the bottom glass. It may cause peeling issue or defective operation. **Do not** use any organic solvent or detergent other than ethanol.

# 9 Mechanical Drawing



## 10. Package Drawing

TBD

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