INNOLUX DISPLAY CORPORATION

LCD MODULE

SPECIFICATION

Customer: _____

Model Name: AT020TN01

SPEC NO.: A020-01-TT-02

Date: 2006/01/19

Version: 02

■ Preliminary Specification

□ Final Specification

For Customer's Acceptance

Approved by	Comment

Approved by	Reviewed by	Prepared by
06.1.26	1/23/06	1/19/06

INNOLUX

Record of Revision

Version	Revise Date	Page	Content
01	2005/12/22		Initial release(draft)
02	2006/01/19		Preliminary SPEC

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Contents:

1. General Specifications

No.	Item	Specification	Remark
1	LCD size	2.0 inch(Diagonal)	
2	Driver element	a-Si TFT active matrix	
3	Resolution	240X3(RGB)X160	
4	Display mode	Normally White, Transmissive	
5	Dot pitch	0.059(W)X0.177(H) mm	
6	Active area	42.48(W)X28.32(H) mm	
7	Module size	49.70(W)X40.70(H)X3.11(D) mm	Note 1
8	Surface treatment	(Hard Coating)	
9	Color arrangement	B,G,R Vertical stripe	
10	Interface	Digital	
11	Backlight power consumption	198mW(Typ.)	
12	Panel power consumption	12.42mW(Typ.)	
13	Weight	12g±10%	

Note 1: Refer to Mechanical Drawing.

2. Pin Assignment

2.1. TFT LCD Panel Driving Section

Pin No.	Symbol	I/O	Function	Remark
1	PS	I	Power save signal	
2	REV	I	Polarity control signal	
3	DGND	P	Digital Ground	
4	R5	I	Red Data (MSB)	
5	R4	I	Red Data	
6	R3	I	Red Data	
7	R2	I	Red Data	
8	R1	I	Red Data (LSB)	
9	LP	I	Latches the Polarity of Outputs and Switches the New Data to Outputs	
10	V_{CC}	P	Power Supply for Digital Circuit	
11	MOD	I	Control Signal of Gate Driver	
12	STHL	I/O	Source Driver Start Pulse Signal	
13	DCLK	I	Data Sampling Clock Signal	
14	DGND	P	Digital Ground	
15	G5	I	Green Data (MSB)	
16	G4	I	Green Data	
17	G3	I	Green Data	
18	G2	I	Green Data	
19	G1	I	Green Data	

20	G0	I	Green Data (LSB)	
21	B5	I	Blue Data (MSB)	
22	B4	I	Blue Data	
23	B3	I	Blue Data	
24	B2	I	Blue Data	
25	B1	I	Blue Data (LSB)	
26	CKV	I	Clock Signal of Gate Driver	
27	STVL	I	Gate Driver Sampling Start Signal	
28	REVOUT	O	Frame Polarity Output for Panel Vcom	
29	AV_{DD}	P	Power Supply for Analog Circuit	
30	V_{COM}	I	Common Voltage Input	
31	AGND	P	Analog Ground	
32	AGND	P	Analog Ground	
33	V_{GH}	P	Gate On Voltage (High)	
34	V_{GL}	P	Gate Off Voltage (Low)	

I: input, O: output, P: Power

2.2. Backlight Unit Section

Pin No.	Symbol	I/O	Function	Remark
1	LED-	-	LED Supply Voltage(GND)	-
2	LED-	-	LED Supply Voltage(GND)	-
3	LED+	-	LED Supply Voltage(High Voltage)	-
4	LED+	-	LED Supply Voltage(High Voltage)	-

3. Operation Specifications

3.1. Absolute Maximum Rating

(DGND=AGND=0V, Note 2)

Item	Symbol	Values		Unit	Remark
		Min.	Max.		
Power voltage	V_{CC}	-0.3	6.0	V	
	AV_{DD}	-0.3	6.0	V	
	V_{GH}	-0.3	11.0	V	
	V_{GL}	-6.0	0.3	V	
	V_{GH}-V_{GL}	-0.6	17	V	
Input signal voltage	V_I	-0.3	V_{CC}+0.3	V	Note 1
Operation temperature	T_{OP}	-20	70	℃	
Storage temperature	T_{ST}	-30	80	℃	

Note 1: MOD,STVL,CKV,R1~R5,G0~G5,B1~B5,STHL,LP,DCLK, PS, REV
Note 2: The absolute maximum rating values of the module should not be exceeded. Once exceeded absolute maximum rating values, the characteristics of the module may not be recovered. Even in an extreme condition, may result in module permanently destroyed.

3.1.1. Typical Operation Conditions

(DGND=AGND=0V, Note 3)

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Power voltage	V_{CC}	3.1	3.3	3.5	V	
	AV_{DD}	4.8	5.0	5.2	V	
	V_{GH}	9.5	10.0	11.0	V	
	V_{GL}	-5.5	-5.0	-4.5	V	
V_{COM}	V_{CAC}	-	5.0	-	V	Note 1
	V_{CDC}	0.8	1.0	1.2	V	Note 2
Input logic high voltage	V_{IH}	0.7Vcc	-	Vcc	V	Note 3
Input logic low voltage	V_{IL}	0	-	0.3Vcc	V	

Note 1: The brightness of LCD panel could be changed by adjusting the AC component of V_{COM}.
Note 2: DCLK,STHL,LP,PS,R1~R5,G0~G5,B1~B5,REV,CKV,STVL,MOD terminals are applied.
Note 3: GND, V_{CC}, and V_{GL} are applied to LCD first and then V_{GH} is applied.

3.1.2. Current Consumption

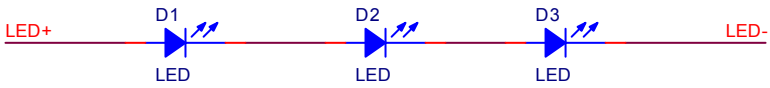
(DGND=AGND=0V)

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Current for Driver	I_{GH}	-	0.12	1.0	mA	V_{GH} =10V
	I_{GL}	-1.0	-0.15	-	mA	V_{GL} = -5V
	I_{CC}	-	0.9	3.0	mA	V_{CC} =3.3V
	I_{DD}	-	1.5	5.0	mA	AV_{DD} =5V

3.1.3. Backlight Driving Conditions

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
LED Current	I_L	-	20	-	mA	Note 1
LED Voltage	V_L	-	9.9	12	V	Note 1
LED life time	-	20,000	-	-	Hr	Note 2

Note 1: The LED driving condition is defined for each LED module. (See the figure)



Note 2: The “LED life time” is defined as the module brightness decrease to 50% original brightness that the ambient temperature is 25℃ and I_L =20mA.

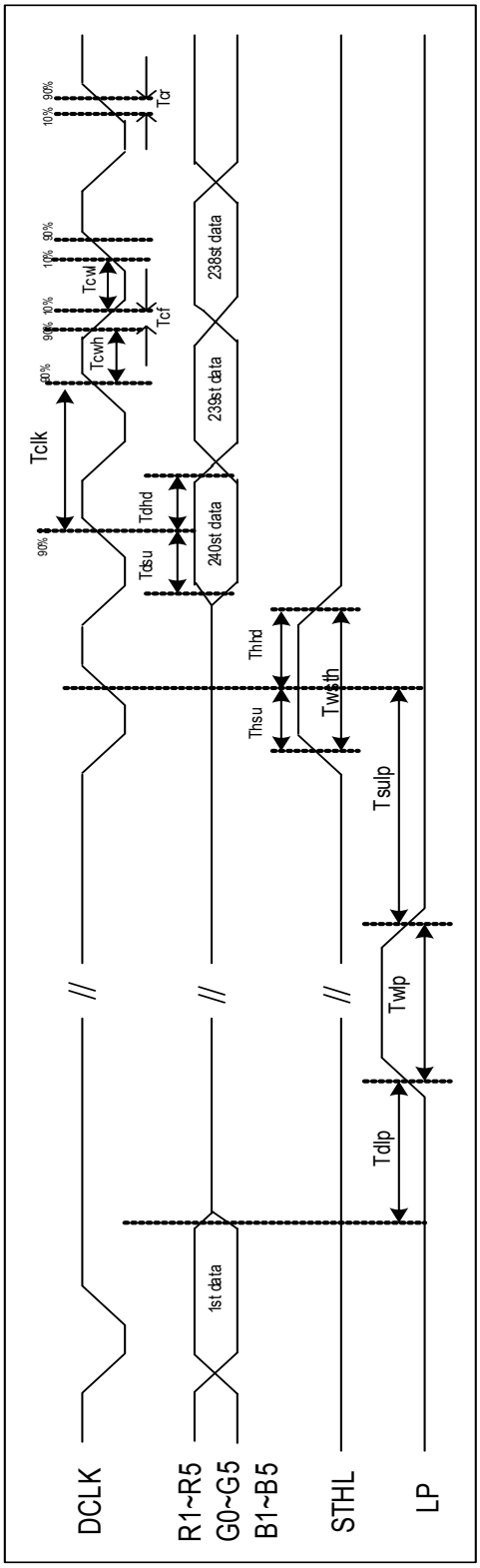
3.2. Timing Characteristics

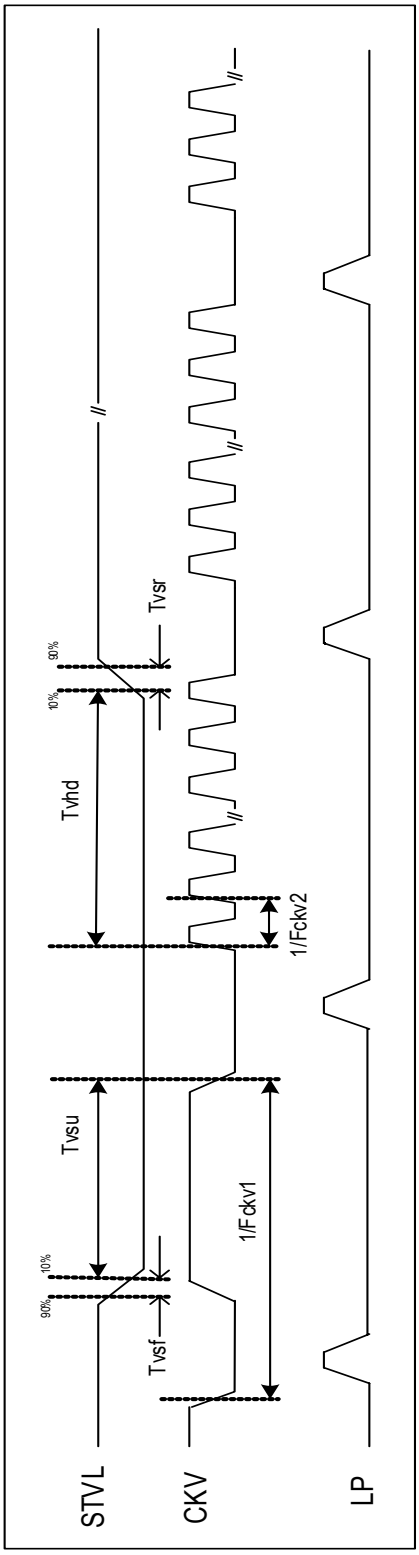
3.2.1. Timing Conditions

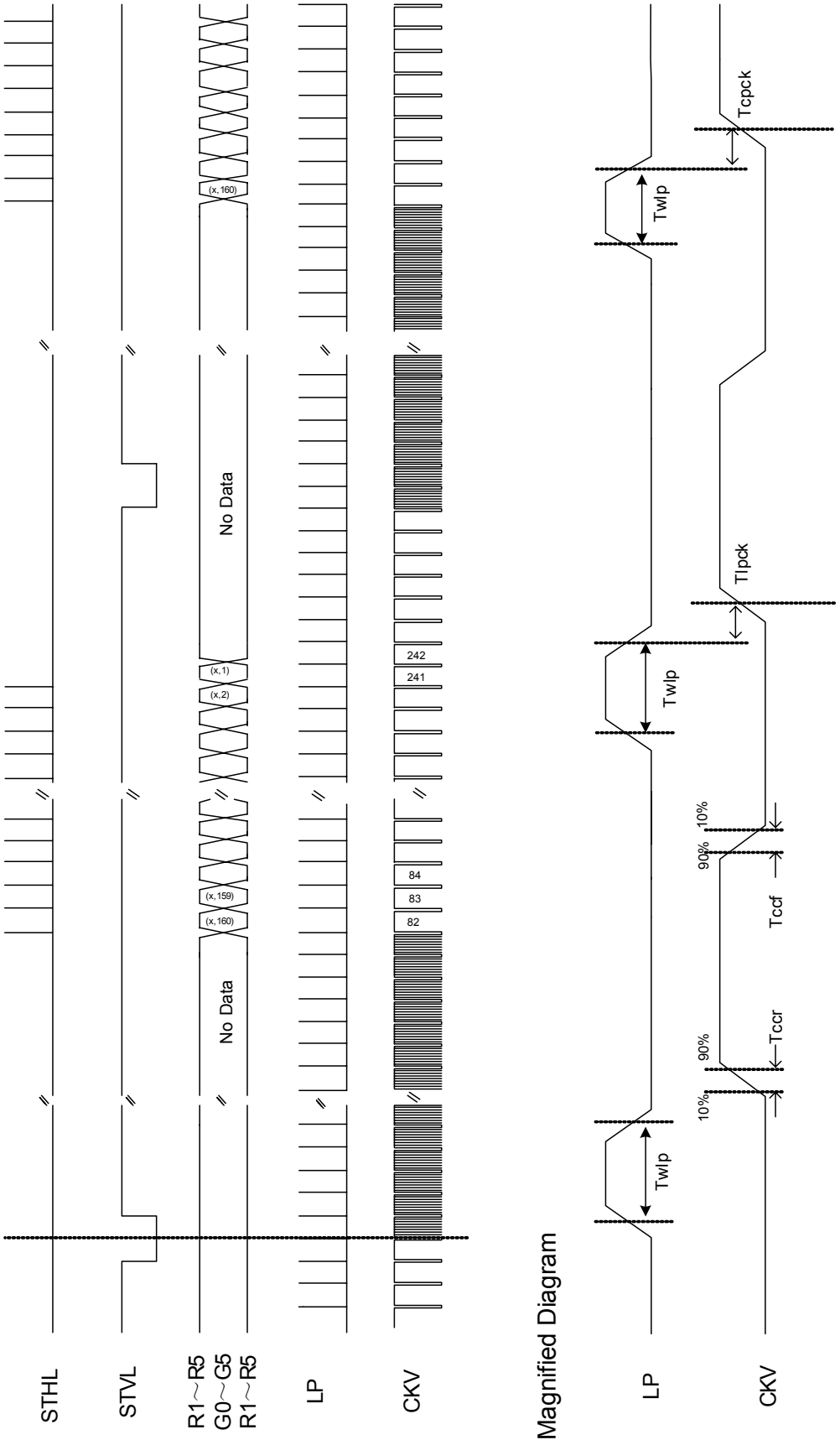
(AV_{DD}=5.0V, V_{CC}=3.3V, Ta=25°C)

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
DCLK clock frequency	F_{CIK}	2.0	4.2	5.0	MHZ	
DCLK clock time	T_{clk}	500	238	100	ns	
DCLK cycle time	T_{cph}	40	50	60	%	$T_{cph}=T_{cwh}:T_{clk}$
DCLK rising time	T_{cr}	-	-	49	ns	DCLK =4.2MHZ
DCLK falling time	T_{cf}	-	-	49	ns	DCLK =4.2MHZ
DCLK high pulse width	T_{cwh}	70	-	-	ns	DCLK =4.2MHZ
DCLK low pulse width	T_{cwl}	70	-	-	ns	DCLK =4.2MHZ
Data set-up time	T_{dsu}	10	-	-	ns	
Data hold time	T_{dhd}	10	-	-	ns	
STHL frequency	F_{sthl}	8.1	13.6	20	KHZ	
STHL set-up time	T_{hsu}	10	-	-	ns	
STHL hold time	T_{hhd}	0	-	-	ns	
STHL pulse width	T_{wsth}	-	-	1.5	DCLK	
STVL frequency	F_{stvl}	50	59.7	100	HZ	
STVL set-up time	T_{vsu}	100	-	-	ns	
STVL hold time	T_{vhd}	300	-	-	ns	
STVL signal rising time	T_{vsr}	-	-	100	ns	
STVL signal falling time	T_{vsf}	-	-	100	ns	
CKV frequency(display)	F_{ckv1}	8.0	13.6	20	KHZ	Scanning CKV
CKV frequency(blanking)	F_{ckv2}	-	-	250		Non-Scanning
CKV clock rising time	T_{ccr}	-	-	100	ns	
CKV clock falling time	T_{ccf}	-	-	100	ns	
LP falling to CKV	T_{lpck}	0	-	-	ns	
LP to DCLK	T_{sulp}	1			DCLK	
LP pulse width	T_{wlp}	1			DCLK	
Last data to LP delay	T_{dlp}	0			DCLK	

3.2.2. Timing Diagram







4. Optical Specifications

Item	Symbol	Condition	Values			Unit	Remark
			Min.	Typ.	Max.		
Viewing angle (CR≥10)	θ_L	Φ=180°(9 o'clock)	55	60	-	degree	Note 1
	θ_R	Φ=0°(3 o'clock)	55	60	-		
	θ_T	Φ=90°(12 o'clock)	55	60	-		
	θ_B	Φ=270°(6 o'clock)	35	40	-		
Response time	T_{ON}	Normal θ=Φ=0°	-	15	30	msec	Note 3
	T_{OFF}		-	20	40	msec	Note 3
Contrast ratio	CR		200	300	-	-	Note 4
Color chromaticity	W_X		(0.25)	(0.30)	(0.35)	-	Note 2 Note 5 Note 6
	W_Y		(0.26)	(0.31)	(0.36)	-	
Luminance	L		200	250	-	cd/m²	Note 6
Luminance uniformity	Y_U		70	75	-	-	Note 7

Test Conditions:

1. V_{CC}=3.3V, AV_{DD}=5V, I_L=20mA (Backlight current), the ambient temperature is 25℃.
2. The test systems refer to Note 2.

Note 1: Definition of viewing angle range

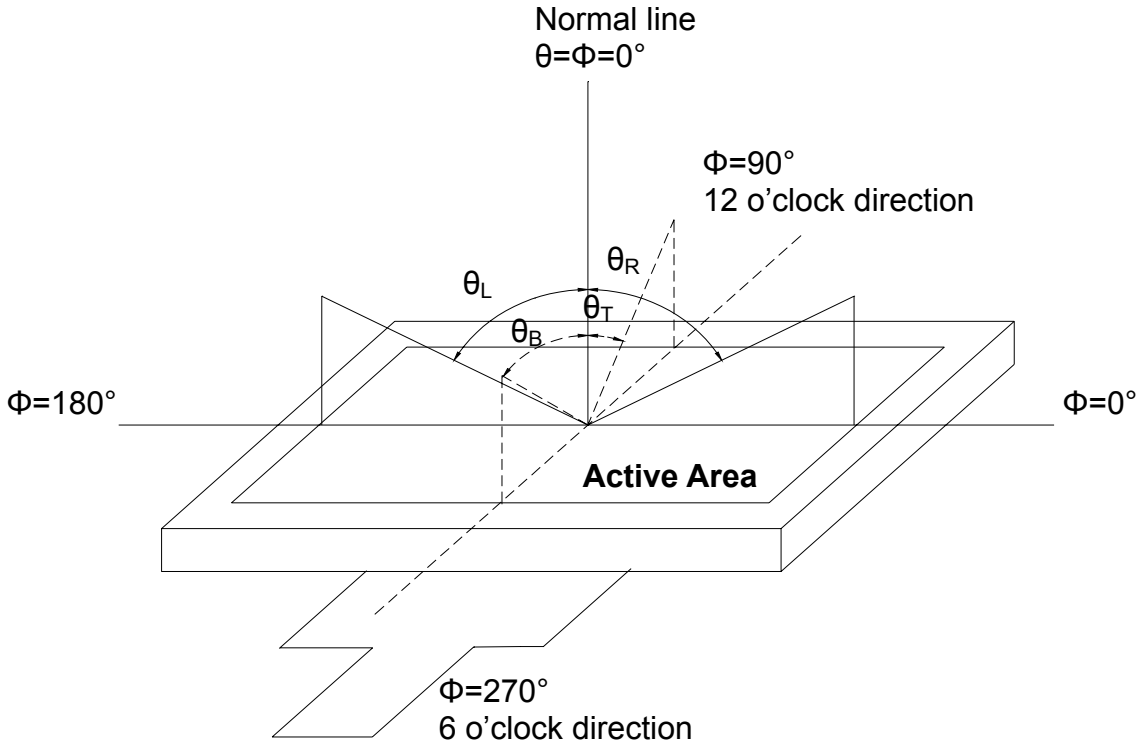


Fig. 4-1 Definition of viewing angle

Note 2: Definition of optical measurement system.

The optical characteristics should be measured in dark room. After 30 minutes operation, the optical properties are measured at the center point of the LCD screen. (Response time is measured by Photo detector TOPCON BM-7, other items are measured by BM-5A/Field of view: 1° /Height: 350mm.)

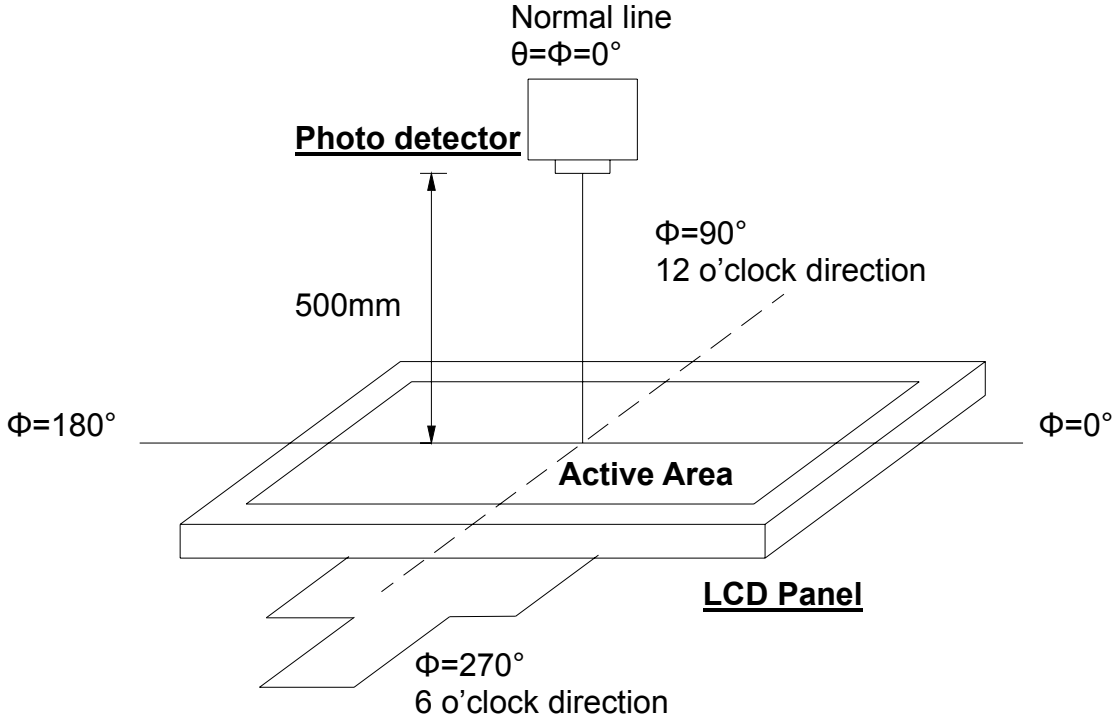


Fig. 4-2 Optical measurement system setup

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%.

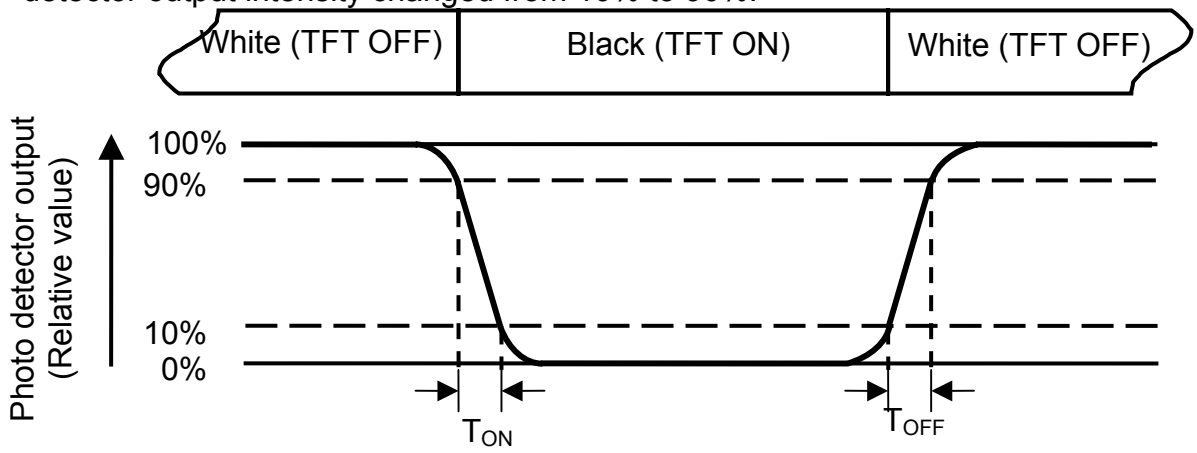


Fig. 4-3 Definition of response time

Note 4: Definition of contrast ratio

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

GS0: R1~R5="0",G0~G5="0",B1~B5="0".
GS63: R1~R5="1",G0~G5="1",B1~B5="1".

Note 5: Definition of color chromaticity (CIE1931)
Color coordinates measured at center point of LCD.

Note 6: L_A : The average measuring luminance of all measuring points.
All input terminals LCD panel must be ground when measuring the center of each measuring area. (Please refer to Fig.4-4)

Note 7: Definition of Luminance Uniformity

Active area is divided into 9 measuring areas (Refer to Fig. 4-4).Every measuring point is placed at the center of each measuring area.

$$Luminance\ \ Uniformity\ (Yu) = \frac{B_{min}}{B_{max}}$$

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

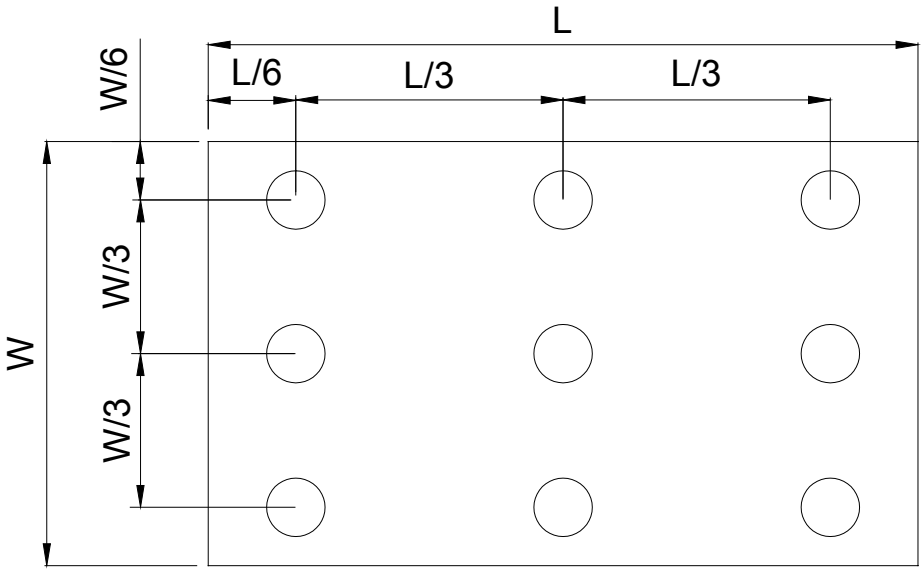


Fig. 4-4 Definition of measuring points

$\mathbf{B_{max}}$: The measured maximum luminance of all measurement position.
$\mathbf{B_{min}}$: The measured minimum luminance of all measurement position.

5. Reliability Test Items

(Note3)

Item	Test Conditions	Remark
High Temperature Storage	Ta = 80℃ 240 hrs	Note 1
Low Temperature Storage	Ta = -30℃ 240hrs	Note 1
High Temperature Operation	Ts = 70℃ 240hrs	Note 2
Low Temperature Operation	Ta = -20℃ 240hrs	Note 1
Operate at High Temperature and Humidity	+40℃, 90%RH 240 hrs	
Thermal Shock	-30℃/30 min ~ +80℃/30 min for a total 100 cycles, Start with cold temperature and end with high temperature	
Vibration Test	Frequency range:10~55Hz Stroke: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*G/Hz from 5-200HZ, -6dB/Octave from 200-500HZ 2 hours for each direction of X. Y. Z. (6 hours for total)	
Package Drop Test	Height:60 cm 1 corner, 3 edges, 6 surfaces	
Electro Static Discharge	± 2KV, Human Body Mode, 100pF/1500Ω	

Note 1: Ta is the ambient temperature of samples.
Note 2: Ts is the temperature of panel's surface.
Note 3: In the standard condition, there shall be no practical problem that may affect the display function.

6. General Precautions

6.1. Safety

Liquid crystal is poisonous. Do not put it in your mouth. If liquid crystal touches your skin or clothes, wash it off immediately by using soap and water.

6.2. Handling

1. The LCD panel is plate glass. Do not subject the panel to mechanical shock or to excessive force on its surface.
2. The polarizer attached to the display is easily damaged. Please handle it carefully to avoid scratch or other damages.
3. To avoid contamination on the display surface, do not touch the module surface with bare hands.
4. Keep a space so that the LCD panels do not touch other components.
5. Put cover board such as acrylic board on the surface of LCD panel to protect panel from damages.
6. Transparent electrodes may be disconnected if you use the LCD panel under environmental conditions where the condensation of dew occurs.
7. Do not leave module in direct sunlight to avoid malfunction of the ICs.

6.3. Static Electricity

1. Be sure to ground module before turning on power or operating module.
2. Do not apply voltage which exceeds the absolute maximum rating value.

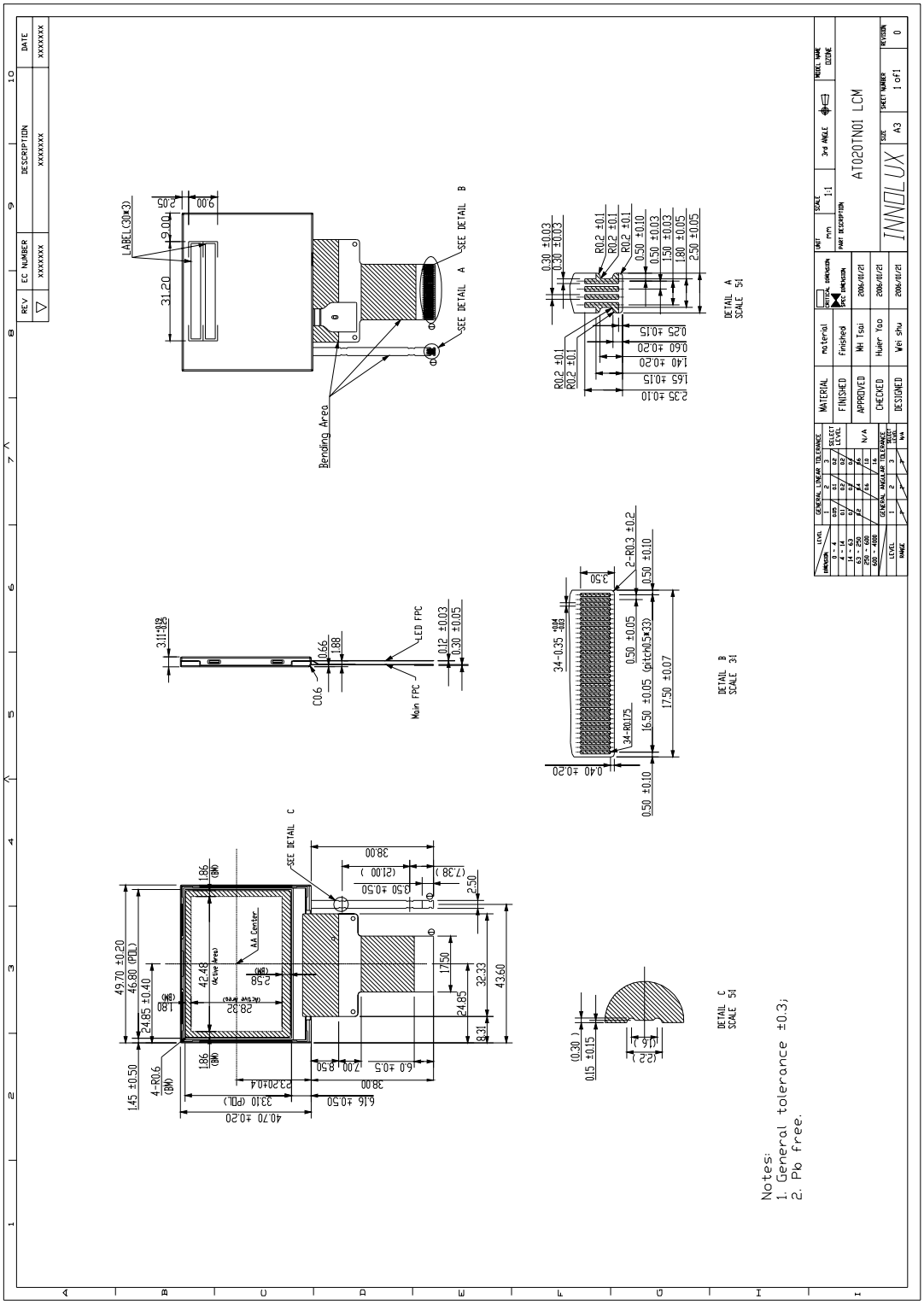
6.4. Storage

1. Store the module in a dark room where must keep at +25±10℃ and 65%RH or less.
2. Do not store the module in surroundings containing organic solvent or corrosive gas.
3. Store the module in an anti-electrostatic container or bag.

6.5. Cleaning

1. Do not wipe the polarizer with dry cloth. It might cause scratch.
2. Only use a soft sloth with IPA to wipe the polarizer, other chemicals might permanent damage to the polarizer.

7. Mechanical Drawing



8. Package Drawing

8.1. Packaging Material Table

No.	Item	Model (Material)	Dimensions(mm)	Unit Weight (kg)	Quantity	Remark
1	LCM module	AT020TN01	49.7*78.7*3.11 (including the dimensions of all parts)	0.012	342	
2	Tray	PET	510*335*15.8	0.18	20	Anti-static
3	DUST-PROOF BAG	PE	700*530	0.06	1	
4	Partition	CORRUGATED PAPER	512*350*225	0.5	1	
5	Carton	CORRUGATED PAPER	530*355*255	1.1	1	
6	Total weight	9.3±5% Kg				

8.2. Packaging Quantity

(1) LCM quantity per tray : 3 row x 6 column = 18
(2) Total LCM quantity in Carton: NO. of PS trays 19 x quantity per tray 18 = 342
Note: Please refer to the data from “estimated report about the dimension and stack of Carton” about stacking carton

8.3. Packaging Drawing