

INNOLUX DISPLAY CORPORATION

LCD MODULE SPECIFICATION

Customer: Garmin
Model Name: AT043TN25 V.1
SPEC NO.: A043-25-TT-11
Date: 2010/01/20
Version: _____

☒ **Preliminary Specification**
☐ **Final Specification**

For Customer's Acceptance

Approved by	Comment

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Record of Revision

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1. General Specifications

No.	Item	Specification	Remark
1	LCD size	4.3 inch(Diagonal)	
2	Driver element	a-Si TFT active matrix	
3	Resolution	480 × 3 (RGB) × 272	
4	Display mode	Normally White, Transmissive	
5	Dot pitch	0.066(W) × 0.198(H) mm	
6	Active area	95.04(W) × 53.856(H) mm	Note 1
7	Module size	105.5(W) × 67.2(H) × 3.05(D) mm	Note 1
8	Surface treatment	Anti-Glare	
9	Color arrangement	RGB-stripe	
10	Viewing Direction	6 o'clock	
11	Interface	Digital	
12	Backlight Power consumption	0.576 W(Typ.)	
13	Panel Power consumption	0.046 W(Typ.)	
14	Weight	TBD	

Note 1: Refer to Mechanical Drawing.

2. Pin Assignment

2.1. TFT LCD Panel Driving Section

FPC connector is used for the module electronics interface. The recommended model is "FH26G-67S-0.3SHBW(05)" manufactured by Hirose.

Pin No.	Symbol	I/O	Function	Remark
1	V _{LED-}	P	Power for LED backlight cathode	
2	V _{LED+}	P	Power for LED backlight anode	
3	DGND	P	Grounding for digital circuit	
4	NC	-	No connection	
5	NC	-	No connection	
6	NC	-	No connection	
7	NC	-	No connection	
8	AGND	P	Grounding for analog circuit	
9	VGH	C	Stabilizing capacitor (2.2u/16V)	
10	C5M	C	Booster capacitor(2.2u/6.3V)	
11	C5P	C		
12	C1AP	C	Booster capacitor(2.2u/6.3V)	
13	C1AM	C		
14	VGL	C	Stabilizing capacitor (2.2u/16V+Schottky Diode: Turn on voltage=0.2V)	
15	C1BP	C	Booster capacitor(2.2u/6.3V)	
16	C1BM	C		
17	AGND	P	Grounding for analog circuit	
18	VCC25	C	Stabilizing capacitor (2.2u/6.3V)	
19	C4P	C	Booster capacitor(1uf/16V)	

20	C4M	C	Booster capacitor(1u/16V)	
21	AV _{DD}	P	Digital and Charge Pump Supply Voltage input pin for booster circuit (3.3V)+(4.7u/6.3V)	
22	ID2	I/O	Connect to VDD on FPC	
23	AGND	P	Grounding for analog circuit	
24	VCC	C	Stabilizing capacitor (2.2u/6.3V)	
25	C3P	C	Booster capacitor(1u/16V)	
26	C3M	C		
27	ID1	I/O	Connect to PGND on FPC	
28	GRB	I	System reset pin(active low)	
29	PGND	P	Grounding for booster circuit	
30	DV _{DD}	P	Digital interface Supple Voltage input (1.8V/3.3V)+(2.2u/6.3V)	
31	CAV _{DD}	C	Stabilizing capacitor (4.7u/10V)	
32	PGND	P	Grounding for booster circuit	
33	STB	I	Standby control signal	
34	CSB	I	Chip select pin of serial interface	
35	SDA	I	Data input pin in serial mode	
36	SCL	I	Clock input in serial mode	
37	VINT2	C	Stabilizing capacitor (2.2u/16V)	
38	DEN	I	Display enable pin from controller	
39	B7	I	Blue data	
40	B6	I	Blue data	
41	B5	I	Blue data	
42	B4	I	Blue data	
43	B3	I	Blue data	

44	B2	I	Blue data	
45	G7	I	Green data	
46	G6	I	Green data	
47	G5	I	Green data	
48	G4	I	Green data	
49	G3	I	Green data	
50	G2	I	Green data	
51	R7	I	Red data	
52	R6	I	Red data	
53	R5	I	Red data	
54	R4	I	Red data	
55	R3	I	Red data	
56	R2	I	Red data	
57	NC	-	No connection	
58	NC	-	No connection	
59	DCLK	I	Dot-clock and oscillator source	
60	VINT1	C	Stabilizing capacitor(4.7u/10v)	
61	PGND	P	Grounding for booster circuit	
62	VINT3	C	Stabilizing capacitor(4.7u/10v)	
63	VCOMH	C	Stabilizing capacitor(4.7u/6.3v)	
64	VCOML	C	Stabilizing capacitor(4.7u/6.3v)	
65	DGND	P	Grounding for digital circuit	
66	C2P	C	Booster capacitor(1u/10V)	
67	C2M	C		

I: Input, O: Output, P: Power, C: Capacitor, I/O: In/output

3.Operation Specifications

3.1. Absolute Maximum Ratings

(Note 1)

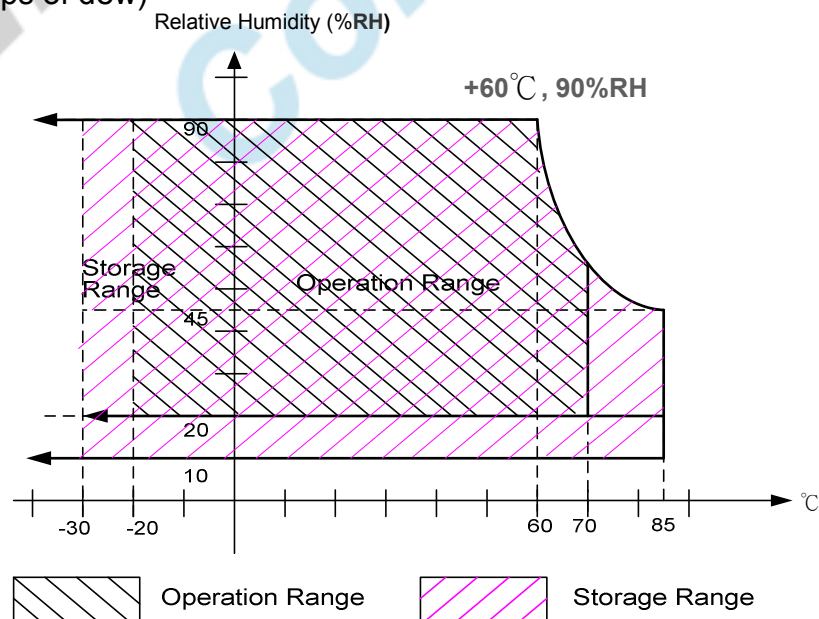
Item	Symbol	Values		Unit	Remark
		Min.	Max.		
Power voltage	AV_{DD}	-0.5	5.0	V	
	DV_{DD}	-0.5	5.0	V	
Input signal voltage	Logic input	-0.5	5.0	V	
Operation temperature	T_{OP}	-20	70	°C	Note 3, 4
Storage temperature	T_{ST}	-30	85	°C	Note 3, 4
LED Reverse Voltage	V_R	-	5	V	Each LED Note 2
LED Forward Current	I_F	-	35	mA	Each LED

Note 1: The absolute maximum rating values of this product are not allowed to be exceeded at any times. A module should be used with any of the absolute maximum ratings exceeded, the characteristics of the module may not be recovered, or in an extreme condition, the module may be permanently destroyed.

Note 2: V_R Conditions: Zener Diode 20mA

Note 3: 90% RH Max. (Max wet temp. is 60°C)

Maximum wet-bulb temperature is at 60°C or less. And No condensation (no drops of dew)



Note 4: In case of temperature below 0°C, the response time of liquid crystal (LC) becomes

slower and the color of panel darker than normal one.

3.2. Typical operation conditions

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Power voltage	AV_{DD}	3.1	3.3	3.5	V	
	DV_{DD}	1.7	1.8	AV_{DD}	V	
Current for Driver	IAV_{DD}	-	14	21-	mA	$AV_{DD} = 3.3V$
	IDV_{DD}	-	0.04	0.06-	mA	$DV_{DD} = 1.8V$
Input logic high voltage	V_{IH}	0.8 DV_{DD}	-	DV_{DD}	V	Note 1
Input logic low voltage	V_{IL}	GND	-	0.2 DV_{DD}	V	

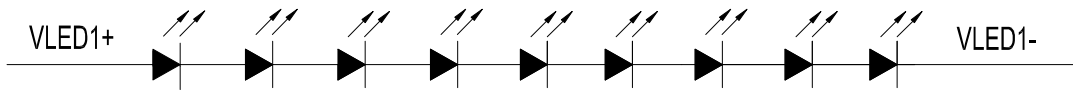
Note1: CLK, DE, R2~ R7, G2~ G7, B2~ B7.

3.3 Backlight Driving Conditions

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Voltage for LED Backlight	V_L	-	28.8	31.5	V	Note 2
Current for LED Backlight	I_L	18	20	22	mA	
LED life time	-	20,000	-	-	Hr	Note 1

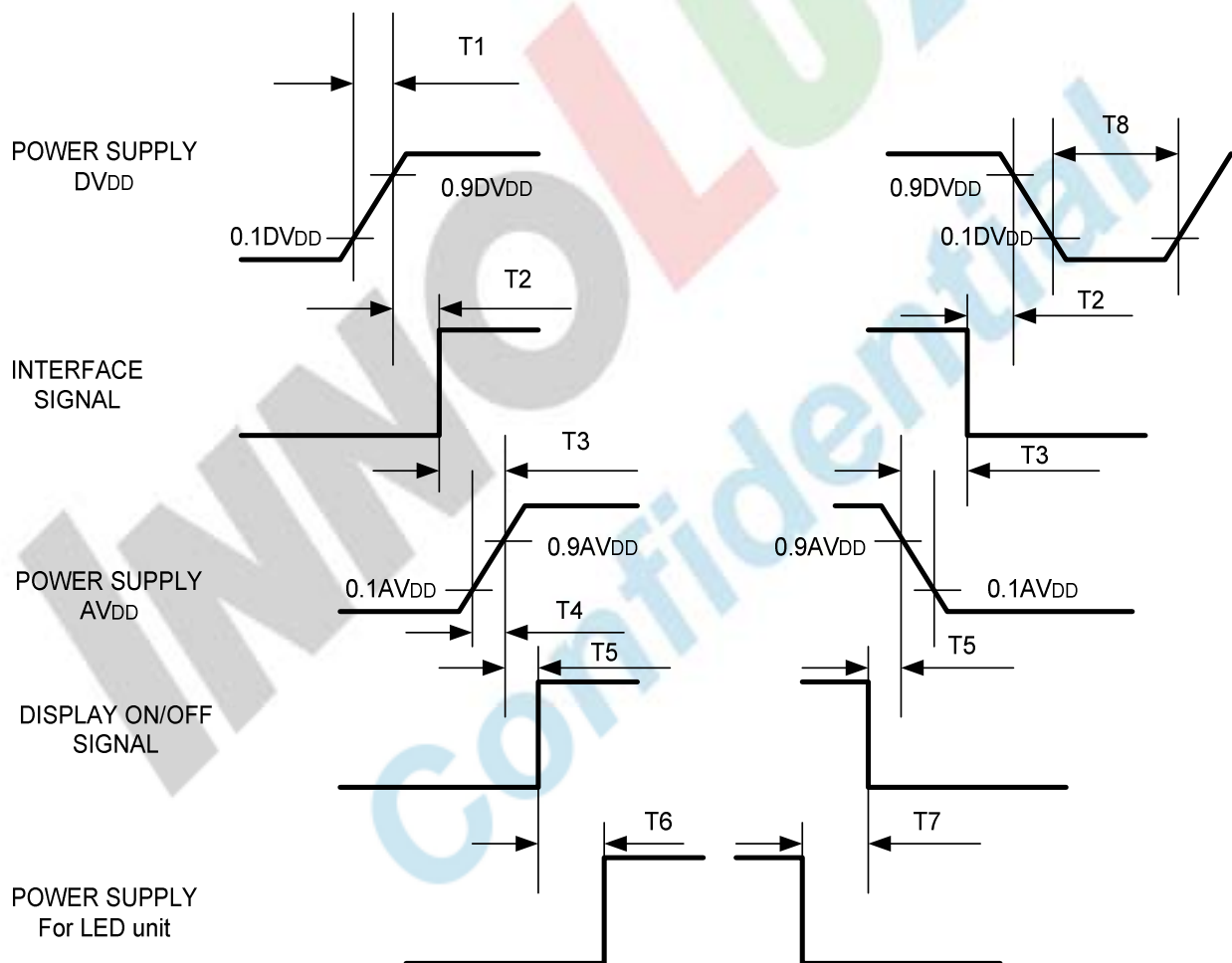
Note 1: The "LED life time" is defined as the module brightness decrease to 50% original brightness that the ambient temperature is 25°C and $I_L = 20mA$. The LED lifetime could be decreased if operating I_L is larger than 20 mA.

Note 2: The LED Supply Voltage is defined by the number of LED at $T_a = 25^\circ C$ and $I_L = 20mA$.



3.4. Power Sequence

To prevent a latch-up or DC operation of the LCD module, the power on/off sequence should be as the diagram below.



Symbol	Specification	Symbol	Specification
T1	$0 \leq T1 \leq 10 \text{ msec}$	T5	$0 \leq T5 \leq 160 \text{ msec}$
T2	$0 \leq T2 \leq 100 \text{ msec}$	T6	$160 \text{ msec} \leq T6$
T3	$0 \leq T3 \leq 50 \text{ msec}$	T7	$160 \text{ msec} \leq T7$
T4	$0 \leq T4 \leq 10 \text{ msec}$	T8	$1 \text{ msec} \leq T8$

3.5. Timing Characteristics

3.5.1. Timing Conditions

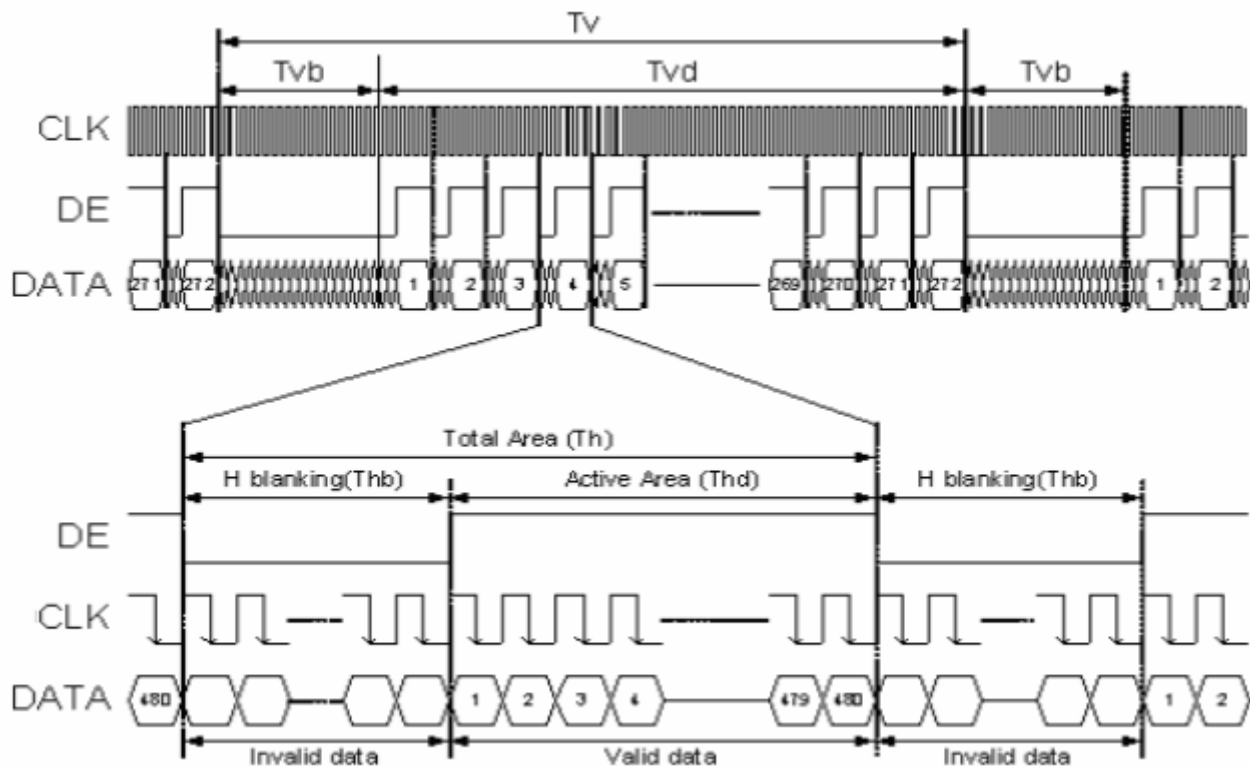
Parallel DE mode RGB input timing table

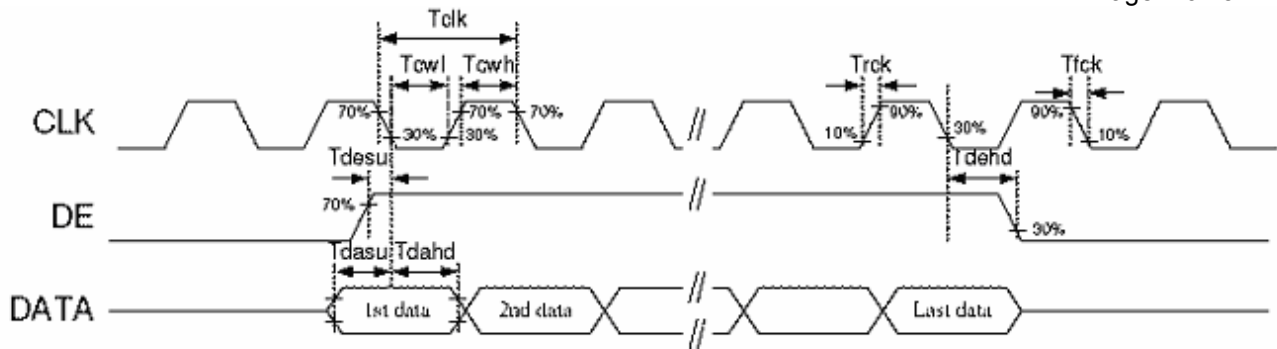
Parameter	Symbol	Value			Unit
		Min.	Typ.	Max.	
CLK frequency	fclk	7	9	12	MHz
DEV period time	Tv	277	288	400	H
DEV display area	Tvd	272			H
DEV blanking	Tvb	5	16	128	H
DEH period time	Th	520	525	800	CLK
DEH display area	Thd	480			CLK
DEH blanking	Thb	40	45	320	CLK
Clock Period	Tclk	66.7	-	-	ns
Clock Pulse High Period	Tcwh	26.7	-	-	ns
Clock Pulse Low Period	Tcwl	26.7	-	-	ns
Clock rising time	tr		-	9	ns
Clock falling time	tr		-	9	ns
Data Setup Time	tds	10	-	-	ns

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Data Hold Time	t_{dh}	10	-	-	ns
DE Setup Time	t_{des}	10	-	-	ns
DE Hold Time	t_{deh}	10	-	-	ns

3.5.2. Timing Diagram

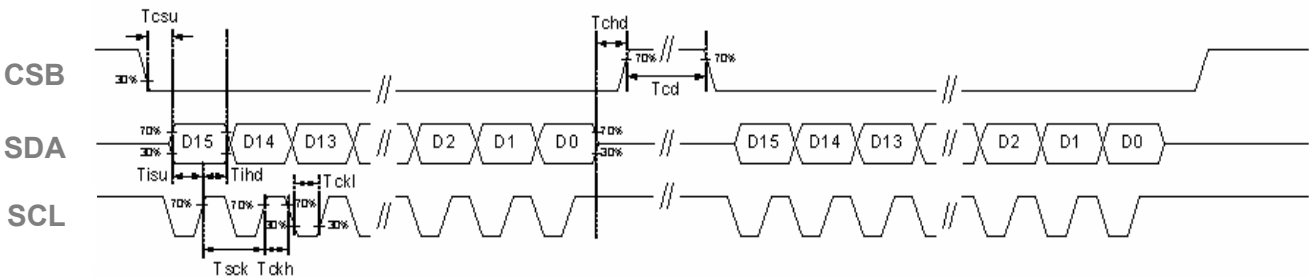




3.5.3. 3-wire serial communication AC timing

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Serial clock	Tsck	200	-	-	ns	
SCL pulse duty	Tscdut	40	50	60	%	
Serial data setup time	Tisu	50	-	-	ns	
Serial data hold time	Tihd	50	-	-	ns	
Serial clock high/low	Tssw	50	-	-	ns	
CSB distinguish time	Tcd	400	-	-	ns	
CSB input setup time	Tcsu	50	-	-	ns	
CSB input hold time	Tchd	50	-	-	ns	
Serial clock	Tsck	200	-	-	ns	

3.5.4. 3-wire Timing Diagram



3.5.5. 3-wire Writer Format

MSB															LSB	
D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	
Register Address [5:0]						0	X	DATA(Issue by external controller)								

Note: D9 : "0" for Write; "1" for Read.
 D8: Don't care.

3.5.6. 3-wire Control Registers List

3-Wire Register		Register Description		
D[15:10]	Name	Init	R/W	Function Description
000000b	R00	00h	R/W	Timing controller function register
000001b	R01	1Fh	R/W	System control register

4. Optical Specifications

Item	Symbol	Condition	Values			Unit	Remark
			Min.	Typ.	Max.		
Viewing angle (CR≥ 10)	θ_L	$\Phi=180^\circ$ (9 o'clock)	60	70	-	degree	Note 1
	θ_R	$\Phi=0^\circ$ (3 o'clock)	60	70	-		
	θ_T	$\Phi=90^\circ$ (12 o'clock)	40	50	-		
	θ_B	$\Phi=270^\circ$ (6 o'clock)	60	70	-		
Response time	T_{ON}	Normal $\theta=\Phi=0^\circ$	-	10	20	msec	Note 3
	T_{OFF}		-	15	30	msec	Note 3
Contrast ratio	CR		400	500	-	-	Note 4
Color chromaticity	W_X		0.27	0.31	0.35	-	Note 2 Note 5
	W_Y		0.29	0.33	0.37	-	
	R_X		0.52	0.56	0.60	-	
	R_Y		0.32	0.36	0.40	-	
	G_X		0.32	0.36	0.40	-	
	G_Y		0.53	0.57	0.61	-	
	B_X		0.10	0.14	0.18	-	
	B_Y		0.06	0.10	0.14	-	
Luminance	L		400	500	-	cd/m ²	Note 6
Luminance uniformity	Y_U		70	75	-	%	
NTSC			45	50	-	%	
Flicker			-	-	-30	dB	

Test Conditions:

1. $AV_{DD}=3.3V$, $DV_{DD}=1.8V$, $I_L=20mA$ (Backlight current), the ambient temperature is 25°C .
2. The test systems refer to Note 2.

Note 1: Definition of viewing angle range

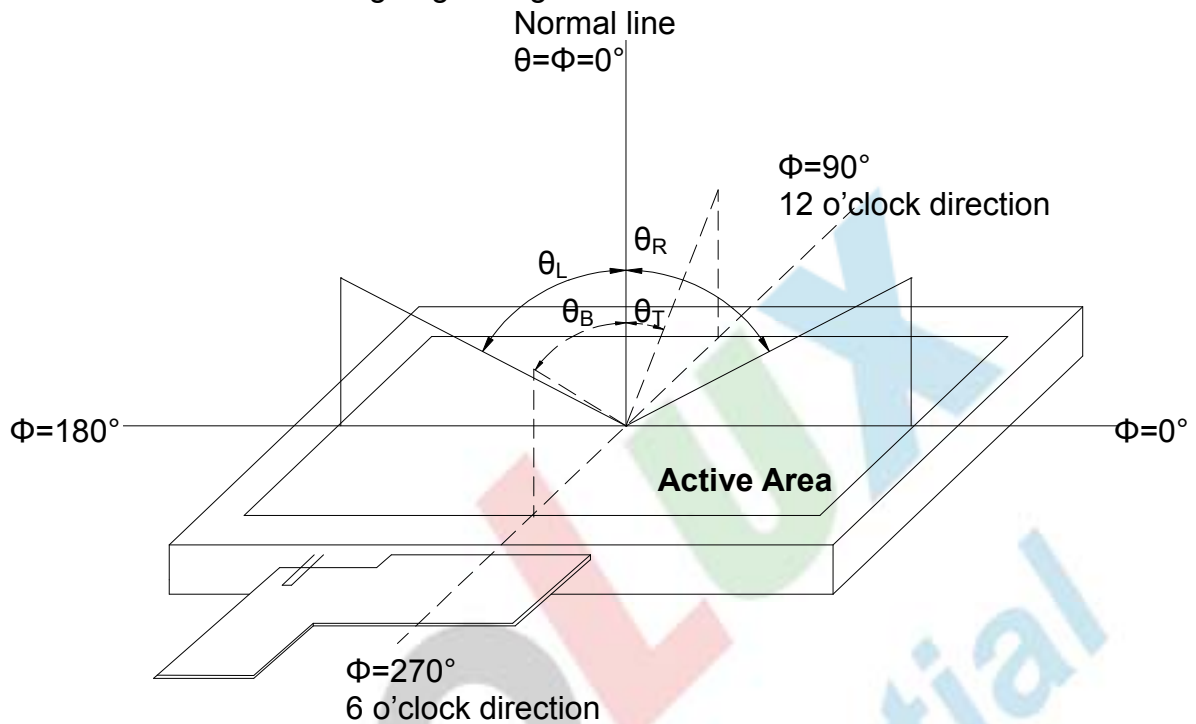


Fig. 4-1 Definition of viewing angle

Note 2: Definition of optical measurement system.

The optical characteristics should be measured in dark room. After 10 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: 500mm.)

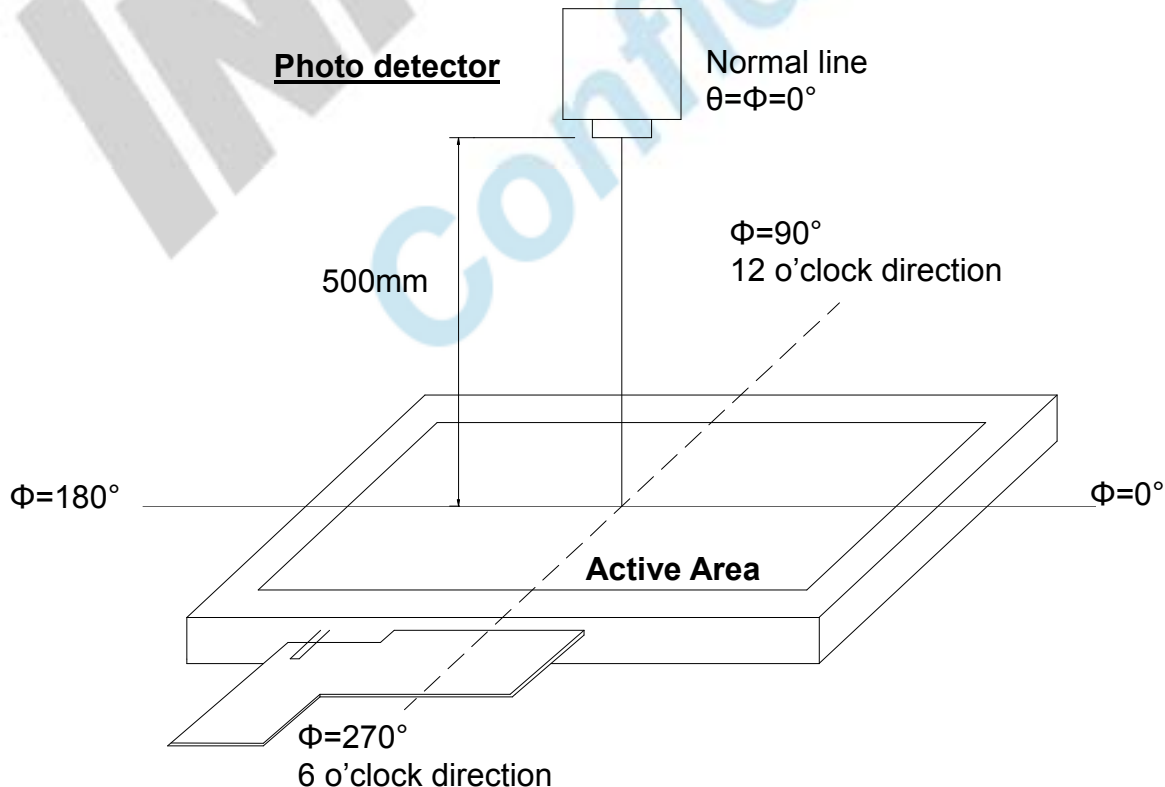


Fig. 4-2 Optical measurement system setup

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%.

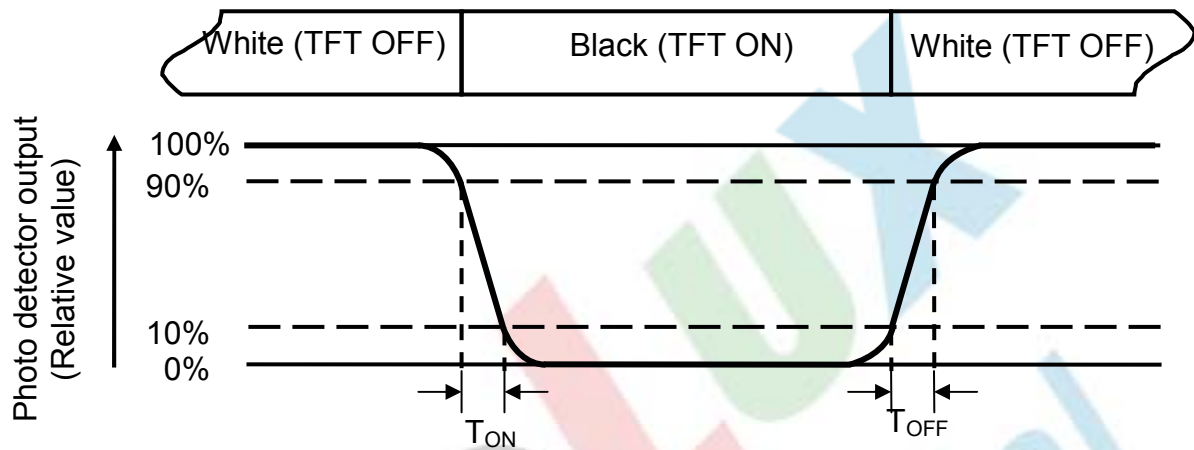


Fig. 4-3 Definition of response time

Note 4: Definition of contrast ratio

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

Note 5: Definition of color chromaticity (CIE1931)

Color coordinates measured at center point of LCD.

Note 6: Measured the center of panel by Photo detector K8.

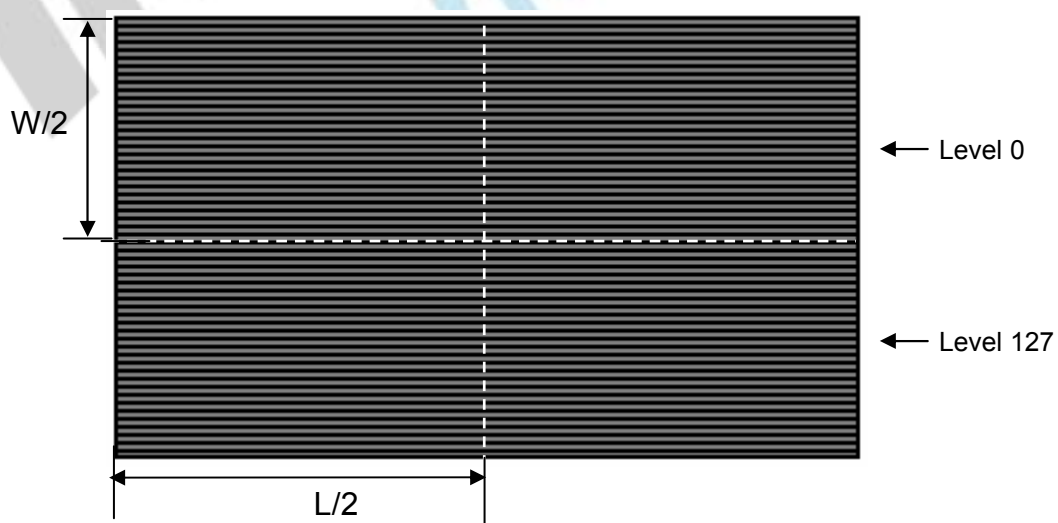


Fig. 4-5 Definition of flicker

5. Reliability Test Items

(Note3)

Item	Test Conditions	Remark
High Temperature Storage	Ta = 85°C 240hrs	Note 1,Note 4
Low Temperature Storage	Ta = -30°C 240hrs	Note 1,Note 4
High Temperature Operation	Ts = 70°C 240hrs	Note 2,Note 6
	Ts = 85°C 72hrs	Note 2,Note 7
Low Temperature Operation	Ta = -20°C 240hrs	Note 1,Note 4
Operate at High Temperature and Humidity	+60°C, 90%RH 240hrs	Note 5
Thermal Shock	-30°C/30 min ~ +80°C/30 min for a total 100 cycles, Start with cold temperature and end with high temperature	Note 4
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. After the reliability test, the product only guarantees operation, but doesn't guarantee all the cosmetic specification.

Note 4: Before cosmetic and function test, the product must have enough recovery time, at least 2 hours at room temperature.

Note 5: Before cosmetic and function test, the product must have enough recovery time, at least 24 hours at room temperature.

Note 6: Before cosmetic tests, the product must have enough recovery time, at least 2 hours at room temperature.

Note 7: After the reliability test, the product only guarantees operation. Before the cosmetic and linearity of touch screen panel test, the product must have enough recovery time, at least 24 hours at room temperature.

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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.

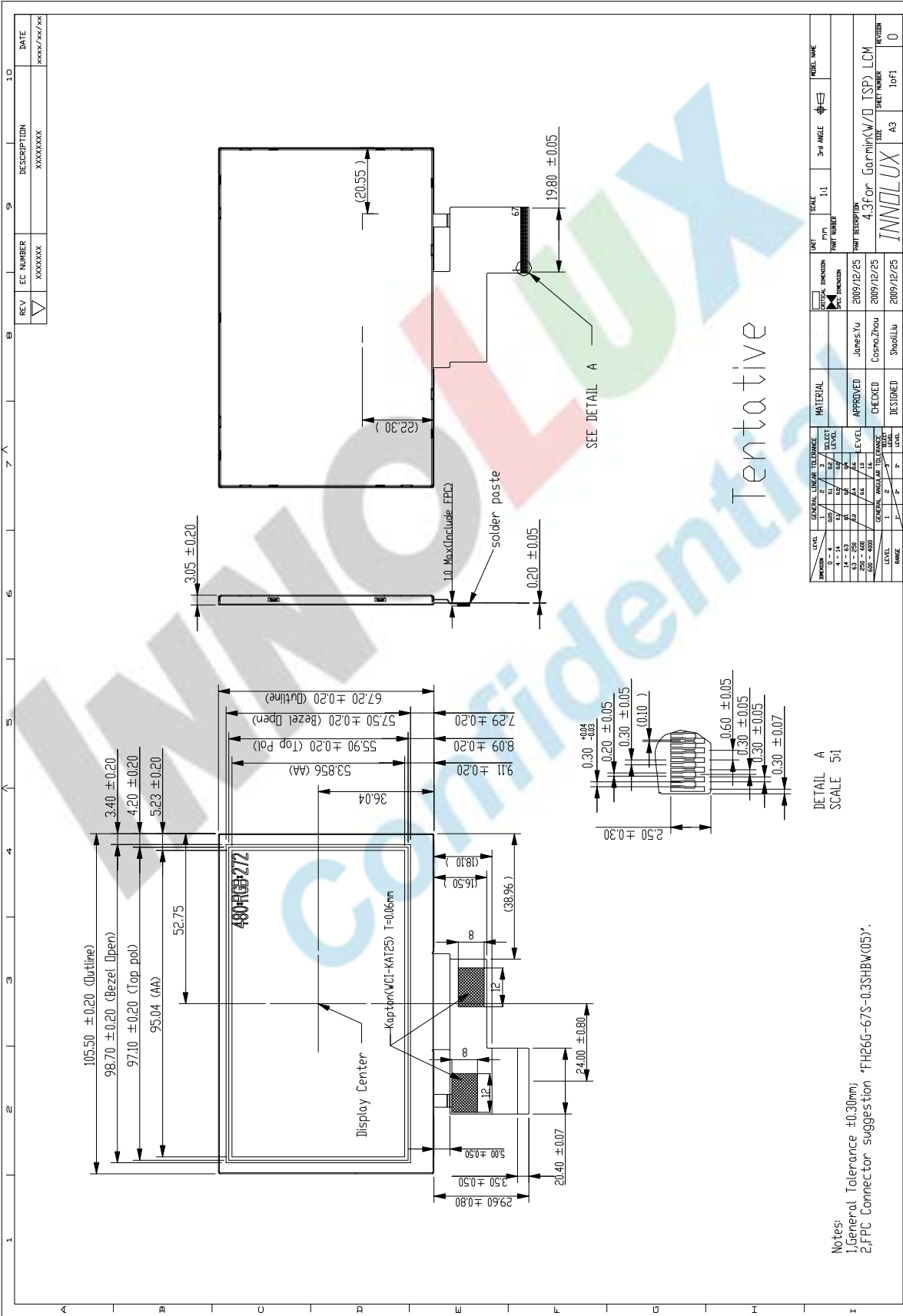
6.4. Storage

1. Store the module in a dark room where must keep at $25\pm 10^{\circ}\text{C}$ 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 (pcs)	Remark
1	LCM module	AT043TN25 V.1	105.5 x 67.2 x TBD	TBD	112	
2	Tray	PET	505 x 338 x 19.8	0.300	15	Anti-static
3	DUST-PROOF BAG	PE	700 x 530	0.060	1	
4	Partition	CORRUGATED PAPER	512 x 350 x 225	0.500	1	
5	Carton	CORRUGATED PAPER	530 x 355 x 255	1.100	1	
6	Total weight	TBD				

8.2. Packaging Quantity

(1) LCM quantity per tray(pcs) :	2 row x 4 column = 8
(2) Total LCM quantity in Carton(pcs): NO. of PS trays	14 x quantity per tray 8 = 112

8.3. Packaging Drawing

