

INNOLUX DISPLAY CORPORATION

LCD MODULE SPECIFICATION

Customer: _____

Model Name: AT043TN13 V.10

SPEC NO.: A043-13-TT-101

Date: 2006/08/02

Version: 02

Preliminary Specification

Final Specification

For Customer's Acceptance

| Approved by | Comment |
|--------------------|----------------|
| | |

| Approved by | Reviewed by | Prepared by |
|--------------------|--------------------|--------------------|
| | | |

INNOLUX DISPLAY CORPORATION

LCD MODULE SPECIFICATION

Customer: _____

Model Name: AT043TN13 V.10

SPEC NO.: A043-13-TT-101

Date: 2006/08/02

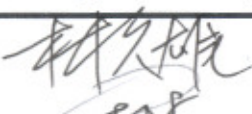
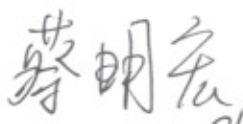
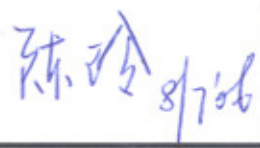
Version: 02

Preliminary Specification

Final Specification

For Customer's Acceptance

| Approved by | Comment |
|-------------|---------|
| | |

| Approved by | Reviewed by | Prepared by |
|--|---|---|
|  1061549 |  8/8/06 |  8/7/06 |

Contents

| | | |
|--------|--|----|
| 1. | General Specifications | 1 |
| 2. | Pin Assignment | 2 |
| 2.1. | TFT LCD Panel Driving Section..... | 2 |
| 2.2. | Backlight Unit Section..... | 4 |
| 3. | Operation Specifications | 5 |
| 3.1. | Absolute Maximum Rating..... | 5 |
| 3.1.1. | Typical Operation Conditions..... | 6 |
| 3.1.2. | Current Consumption | 7 |
| 3.1.3. | Backlight Driving Conditions..... | 7 |
| 3.2. | Power Sequence | 8 |
| 3.3. | Timing Characteristics | 9 |
| 3.3.1. | Timing Conditions | 9 |
| 3.3.2. | Timing Diagram | 11 |
| 4. | Touch Screen Panel Specifications | 13 |
| 4.1. | Electrical Characteristics | 13 |
| 4.2. | Mechanical & Reliability Characteristics | 13 |
| 4.3. | Touch Screen Panel Block..... | 14 |
| 4.4. | Touch Screen Panel Pin Definition | 14 |
| 5. | Optical Specifications..... | 15 |
| 6. | Reliability Test Items | 19 |
| 7. | General Precautions | 20 |
| 7.1. | Safety | 20 |
| 7.2. | Handling | 20 |
| 7.3. | Static Electricity | 20 |
| 7.4. | Storage | 20 |
| 7.5. | Cleaning | 20 |
| 8. | Mechanical Drawing..... | 21 |
| 9. | Package Drawing..... | 22 |

1. General Specifications

| No. | Item | Specification | Remark |
|-----|-----------------------------|------------------------------|--------|
| 1 | LCD size | 4.3 inch(Diagonal) | |
| 2 | Driver element | a-Si TFT active matrix | |
| 3 | Resolution | 480X3(RGB)X272 | |
| 4 | Display mode | Normally White, Transmissive | |
| 5 | Dot pitch | 0.066(W)X0.198(H) mm | |
| 6 | Active area | 95.04(W)X53.856(H) mm | |
| 7 | Module size | 105.5(W)X67.2(H)X4.95(D) mm | Note 1 |
| 8 | Surface treatment | Anti-Glare | |
| 9 | Color arrangement | RGB-stripe | |
| 10 | Interface | Digital | |
| 11 | Backlight Power consumption | TBD | |
| 12 | Panel Power consumption | TBD | |
| 13 | Weight | TBD | |

Note 1: Refer to Mechanical Drawing.

2. Pin Assignment

2.1. TFT LCD Panel Driving Section

| Pin No. | Symbol | I/O | Function | Remark |
|---------|-----------------|-----|------------------|--------|
| 1 | GND | P | Power ground | |
| 2 | GND | P | Power ground | |
| 3 | V _{DD} | P | Power supply | |
| 4 | V _{DD} | P | Power supply | |
| 5 | R0 | I | Red data (LSB) | |
| 6 | R1 | I | Red data | |
| 7 | R2 | I | Red data | |
| 8 | R3 | I | Red data | |
| 9 | R4 | I | Red data | |
| 10 | R5 | I | Red data | |
| 11 | R6 | I | Red data | |
| 12 | R7 | I | Red data (MSB) | |
| 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 | |
| 19 | G6 | I | Green data | |
| 20 | G7 | I | Green data (MSB) | |

| | | | | |
|----|------------------|---|------------------------|--|
| 21 | B0 | I | Blue data (LSB) | |
| 22 | B1 | I | Blue data | |
| 23 | B2 | I | Blue data | |
| 24 | B3 | I | Blue data | |
| 25 | B4 | I | Blue data | |
| 26 | B5 | I | Blue data | |
| 27 | B6 | I | Blue data | |
| 28 | B7 | I | Blue data (MSB) | |
| 29 | GND | P | Power ground | |
| 30 | PCLK | P | Pixel clock | |
| 31 | DISP | I | Display on/off | |
| 32 | HSYNC | I | Horizontal Sync Signal | |
| 33 | VSYNC | I | Vertical Sync Signal | |
| 34 | DE | I | Data Enable | |
| 35 | AV _{DD} | P | Power supply (+5V) | |
| 36 | AV _{DD} | P | Power supply (+5V) | |
| 37 | NC | - | No connection | |
| 38 | NC | - | No connection | |
| 39 | GND | P | Power ground | |
| 40 | GND | P | Power ground | |

I: input, O: output, P: Power

2.2. Backlight Unit Section

| Pin No. | Symbol | I/O | Function | Remark |
|---------|---------|-----|----------------------------|--------|
| 1 | VLED 1- | P | Ground (cathode) | |
| 2 | VLED 2- | P | Ground (cathode) | |
| 3 | VLED 2+ | P | LED Input terminal (anode) | |
| 4 | VLED 1+ | P | LED Input terminal (anode) | |

3. Operation Specifications

3.1. Absolute Maximum Rating

(GND=AV_{SS}=0V, Note 1)

| Item | Symbol | Values | | Unit | Remark |
|-----------------------|------------------|--------|----------------------|------|--------|
| | | Min. | Max. | | |
| Power voltage | V _{DD} | -0.3 | 6.0 | V | |
| | AV _{DD} | -0.3 | 6.0 | V | |
| Input signal voltage | Logic input | -0.3 | V _{DD} +0.3 | V | |
| Operation Temperature | T _{OP} | (-20) | (70) | °C | |
| Storage Temperature | T _{ST} | (-30) | (80) | °C | |

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

3.1.1. Typical Operation Conditions

(GND=AV_{SS}=0V, Note 1)

| Item | Symbol | Values | | | Unit | Remark |
|--------------------------|------------------|--------------------|------|--------------------|------|--------|
| | | Min. | Typ. | Max. | | |
| Power voltage | V _{DD} | 2.3 | 2.5 | 2.7 | V | Note 2 |
| | | 3.1 | 3.3 | 3.5 | V | |
| | AV _{DD} | 4.8 | 5.0 | 5.2 | V | |
| Input logic high voltage | V _{IH} | 0.7V _{DD} | - | V _{DD} | V | |
| Input logic low voltage | V _{IL} | 0 | - | 0.3V _{DD} | V | |

Note 1: Be sure to apply V_{DD} and V_{GL} to the LCD first, and then apply V_{GH}.

Note 2: You should choose only one from the typical values of V_{DD}.

3.1.2. Current Consumption

(GND=AV_{SS}=0V)

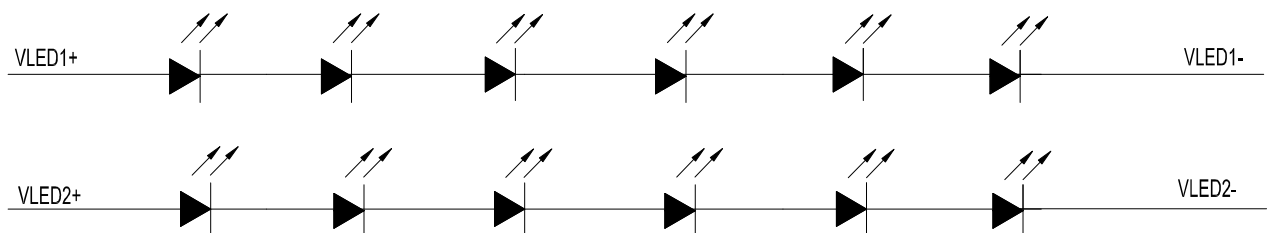
| Item | Symbol | Values | | | Unit | Remark |
|--------------------|------------------------------|--------|------|------|------|------------------------|
| | | Min. | Typ. | Max. | | |
| Current for Driver | I _{DD} | - | TBD | TBD | mA | V _{DD} =2.5V |
| | I _{AV_{DD}} | - | TBD | TBD | mA | AV _{DD} =5.0V |

3.1.3. Backlight Driving Conditions

| Item | Symbol | Values | | | Unit | Remark |
|---------------|----------------|--------|------|------|------|--------|
| | | Min. | Typ. | Max. | | |
| LED voltage | V _L | - | 19.8 | 21.0 | V | Note 2 |
| LED current | I _L | - | (16) | - | mA | Note 2 |
| LED life time | - | 20,000 | - | - | Hr | Note 1 |

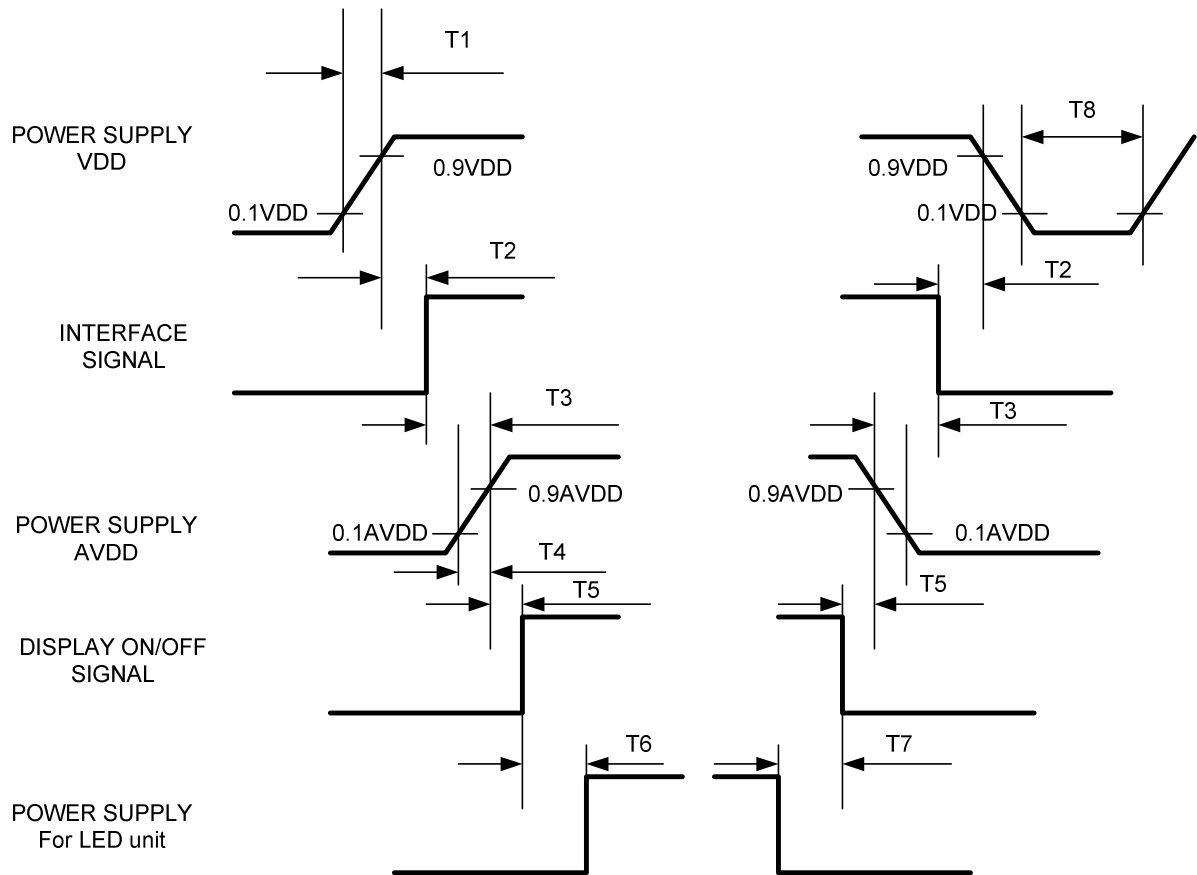
Note 1: The “LED life time” is defined as the module brightness decrease to 50% original brightness that the ambient temperature is 25°C and I_L =16mA.

Note 2: The LED driving condition is defined for each LED module (6 LED Serial).



3.2. 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 | $1 \text{ msec} \leq T8$ |

3.3. Timing Characteristics

3.3.1. Timing Conditions

(TA = 25°C, VDD = 2.3V~3.5V, GND = 0V)

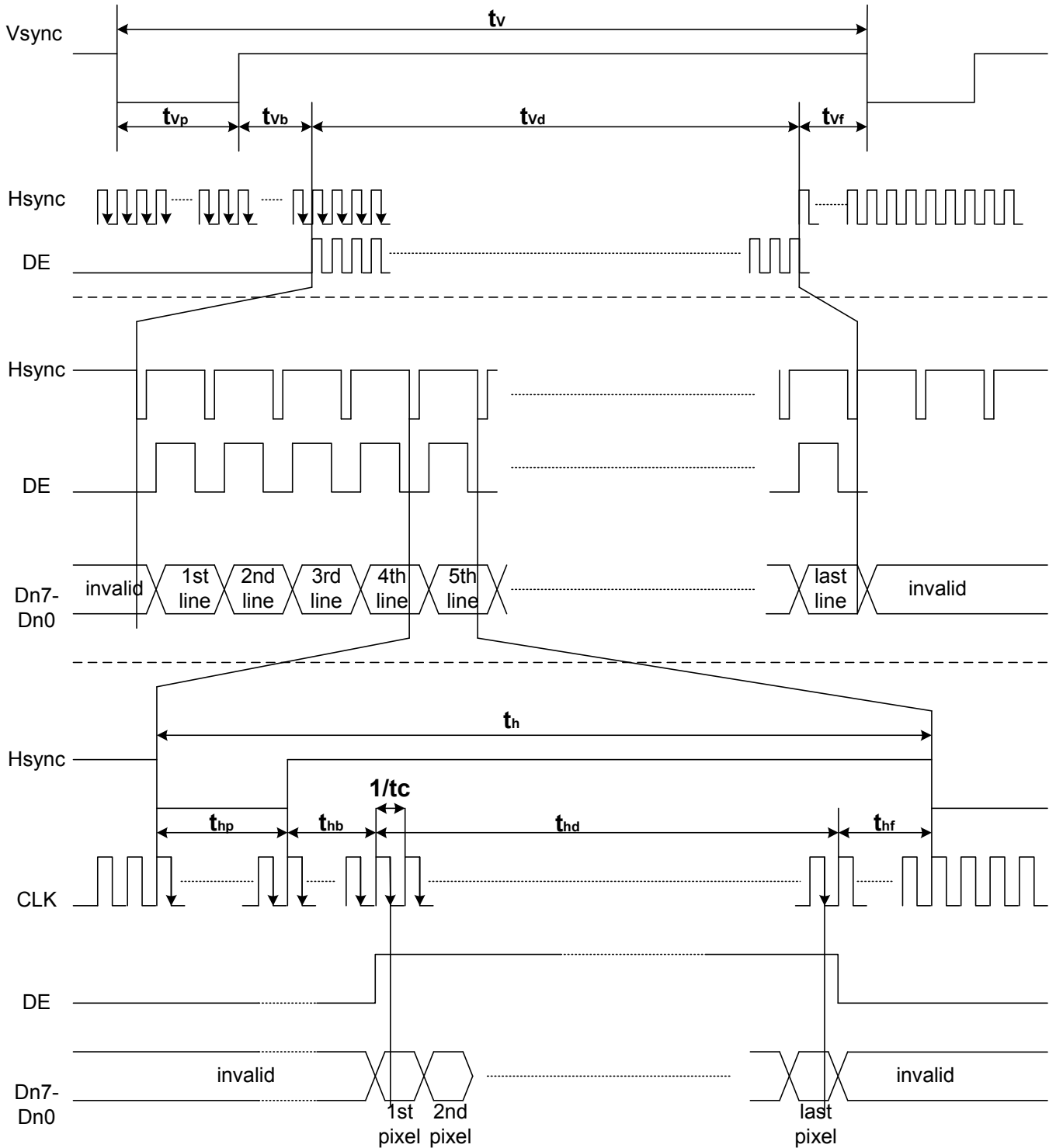
| Item | Symbol | Values | | | Unit | Remark |
|---------------------------|-------------------|--------|-------|------|------|--------|
| | | Min. | Typ. | Max. | | |
| Clock cycle | 1/tc | - | 9.00 | 15 | MHz | |
| Hsync cycle | 1/fH | - | 17.14 | - | KHz | |
| Vsync cycle | 1/fv | - | 59.94 | - | Hz | |
| Horizontal signal | t _h | - | 525 | - | CLK | Note 1 |
| Horizontal display period | t _{hd} | - | 480 | - | CLK | |
| Horizontal Front porch | t _{hf} | 2 | - | - | CLK | Note 2 |
| Horizontal Pulse width | t _{hp} | 2 | 41 | - | CLK | Note 2 |
| Horizontal Back porch | t _{hb} | 2 | - | - | CLK | Note 2 |
| Vertical cycle | t _v | - | 286 | - | H | |
| Vertical display period | t _{vd} | - | 272 | - | H | |
| Vertical Front porch | t _{vf} | 2 | 2 | - | H | |
| Vertical Pulse width | t _{vp} | 2 | 10 | - | H | |
| Vertical Back porch | t _{vb} | 2 | 2 | - | H | |
| DISP Setup Time | t _{diss} | 10 | - | - | ns | |
| DISP Hold Time | t _{dish} | 10 | - | - | ns | |
| Clock Period | PW CLK | 66.7 | - | - | ns | |
| Clock Pulse High Period | PWH | 26.7 | - | - | ns | |
| Clock Pulse Low Period | PWL | 26.7 | - | - | ns | |
| Hsync Setup Time | t _{hs} | 10 | - | - | ns | |
| Hsync Hold Time | t _{hh} | 10 | - | - | ns | |

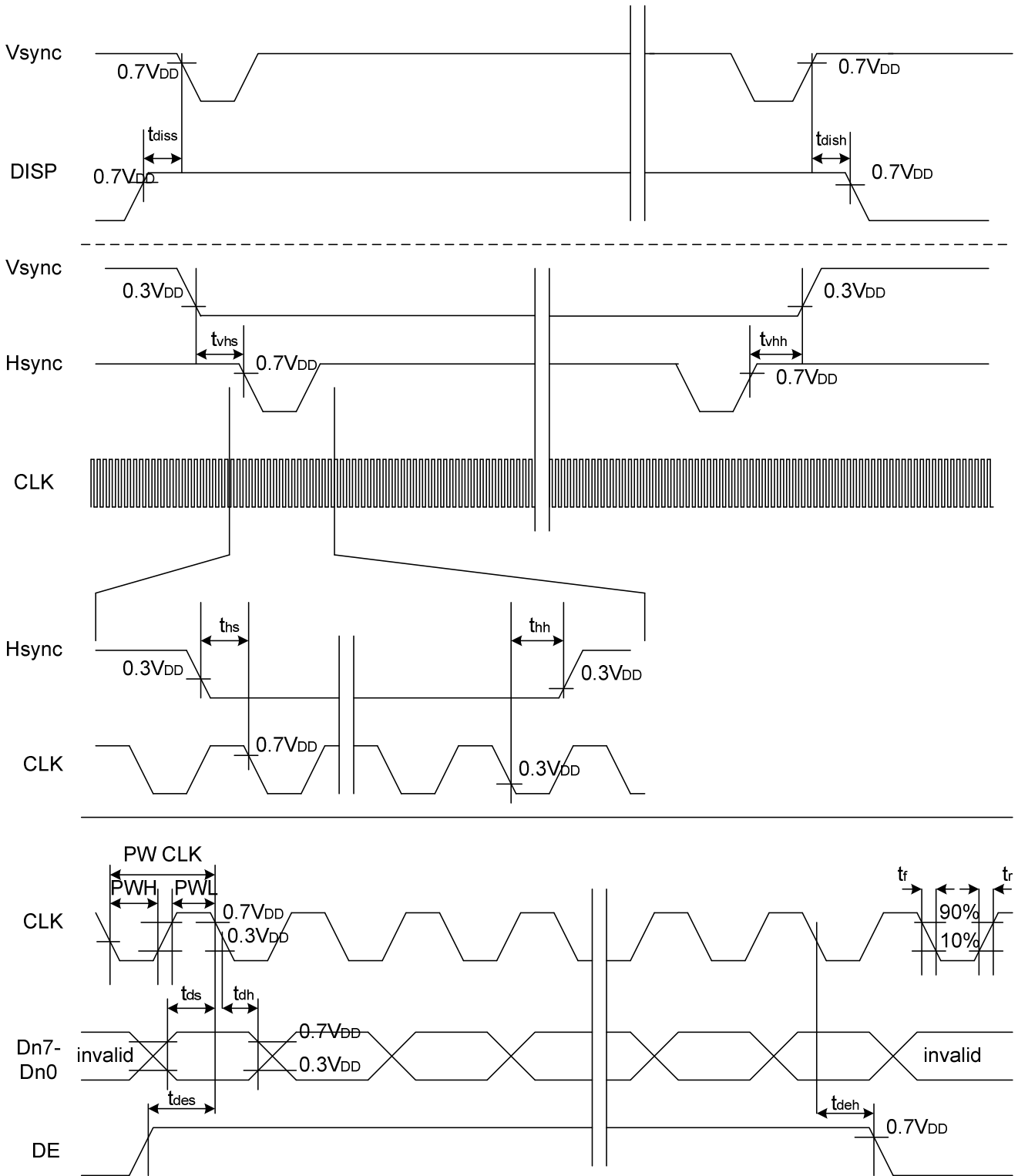
| | | | | | | |
|------------------|-------------------|----|---|---|----|--|
| Data Setup Time | t _{ds} | 10 | - | - | ns | |
| Data Hold Time | t _{dh} | 10 | - | - | ns | |
| DE Setup Time | t _{des} | 10 | - | - | ns | |
| DE Hold Time | t _{desh} | 10 | - | - | ns | |
| Vsync Setup Time | t _{vhs} | 10 | - | - | ns | |
| Vsync Hold Time | t _{vhh} | 10 | - | - | ns | |

Note 1: t_{hd}=480CLK, t_{hf}= 2CLK, t_{hp}= 41CLK, t_{hb}= 2CLK
 525CLK=480CLK + 2CLK + 41CLK + 2CLK

Note 2: t_{hf}+ t_{hp}+ t_{hb}> 44 CLK

3.3.2. Timing Diagram





4. Touch Screen Panel Specifications

4.1. Electrical Characteristics

| Item | Value | | | Unit | Remark |
|-----------------------|-------|------|------|------|---------------------------|
| | Min. | Typ. | Max. | | |
| Linearity | -1.5 | - | 1.5 | % | Analog X and Y directions |
| Terminal Resistance | 100 | - | 900 | Ω | X(Film side) |
| | 100 | - | 900 | Ω | Y(Glass side) |
| Insulation resistance | 25 | - | - | MΩ | DC 25V |
| Voltage | - | 5 | 7 | V | DC |
| Chattering | - | - | 10 | ms | 100kΩ pull-up |
| Transparency | 79 | - | - | % | JIS K7105 |

Note: Do not operate it with a thing except 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.

4.2. Mechanical & Reliability Characteristics

| Item | Value | | | Unit | Remark |
|-------------------------------|------------------|------|------|------------|-----------|
| | Min. | Typ. | Max. | | |
| Activation force | 80 | - | - | g | Note 1 |
| Durability-surface scratching | Write 100,000 | - | - | characters | Note 2 |
| Durability-surface pitting | 1,000,000 | - | - | touches | Note 3 |
| Surface hardness | 3 | - | - | H | JIS K5400 |

Note 1: Stylus pen input: R0.8mm polyacetal pen or finger.

Note 2: Measurement for surface area.

-Scratch 100,000 times straight line on the film with a stylus change every 20,000

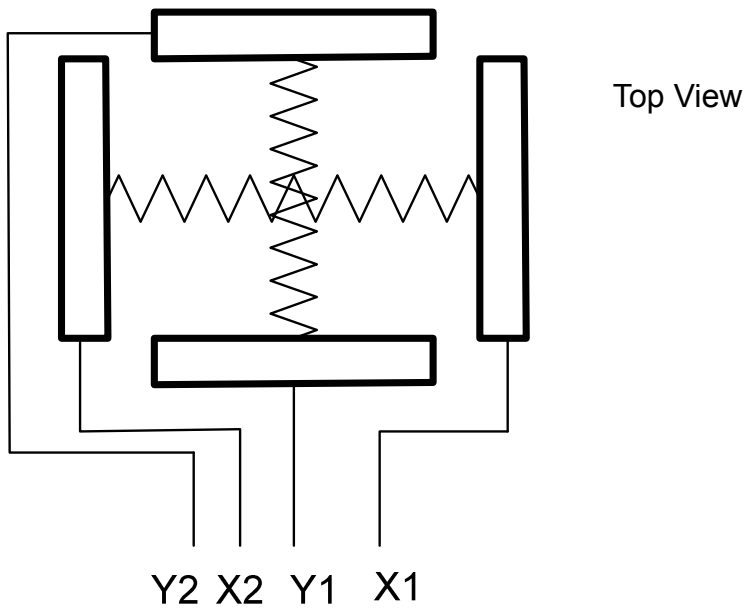
The copyright belongs to InnoLux. Any unauthorized use is prohibited.

- times.
- Force: 250gf.
- Speed: 60mm/sec.
- Stylus: R0.8 polyacetal tip.

Note 3: Pit 1,000,000 times on the film with a R0.8 silicon rubber.

- Force: 250gf.
- Speed: 2times/sec.

4.3. Touch Screen Panel Block



4.4. Touch Screen Panel Pin Definition

| Pin No. | Symbol | I/O | Function | Remark |
|---------|--------|--------|--|--------|
| 1 | Y2 | Top | Top electrode – differential analog | |
| 2 | X2 | Left | Left electrode – differential analog | |
| 3 | Y1 | Bottom | Bottom electrode – differential analog | |
| 4 | X1 | Right | Right electrode – differential analog | |

5. 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 | | (0.26) | (0.31) | (0.36) | - | Note 2 Note 5 Note 6 |
| | W_Y | | (0.28) | (0.33) | (0.38) | - | |
| Luminance | L_1 | | (230) | (280) | - | cd/m ² | Note 6 (With touch screen) |
| | L_2 | | (300) | (350) | - | cd/m ² | Note 6 (Without touch screen) |
| Luminance uniformity | Y_U | | 70 | 75 | - | % | Note 7 |

Test Conditions:

1. $V_{DD}=3.3V$, $I_L=16mA$ (Backlight current), the ambient temperature is $25^\circ C$.
2. The test systems refer to Note 2.

Note 1: Definition of viewing angle range

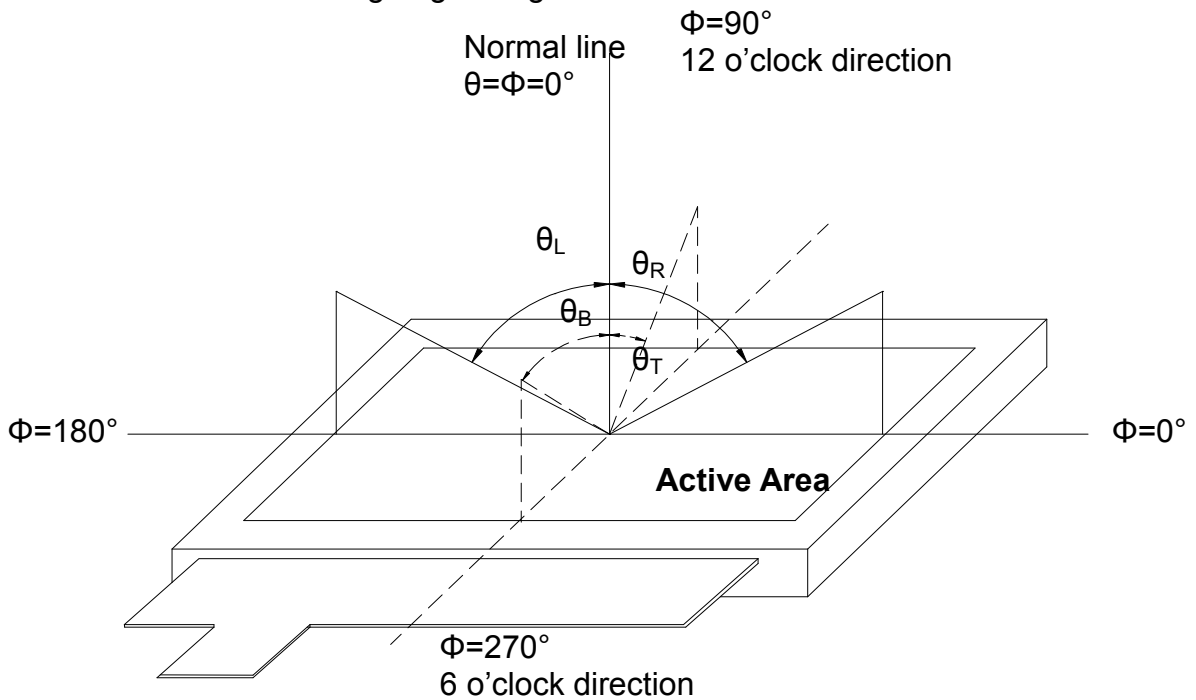


Fig. 4-1 Definition of viewing angle

Note 2: Definition of optical measurement system.

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

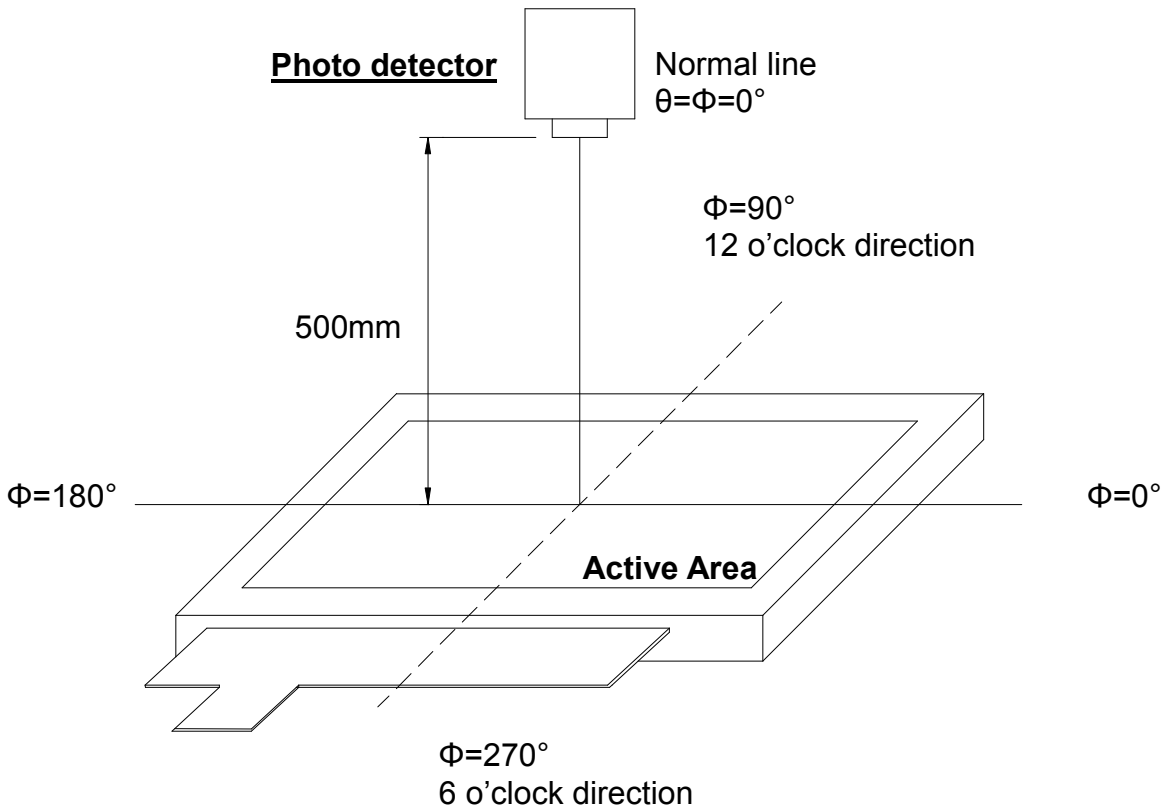


Fig. 4-2 Optical measurement system setup

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%.

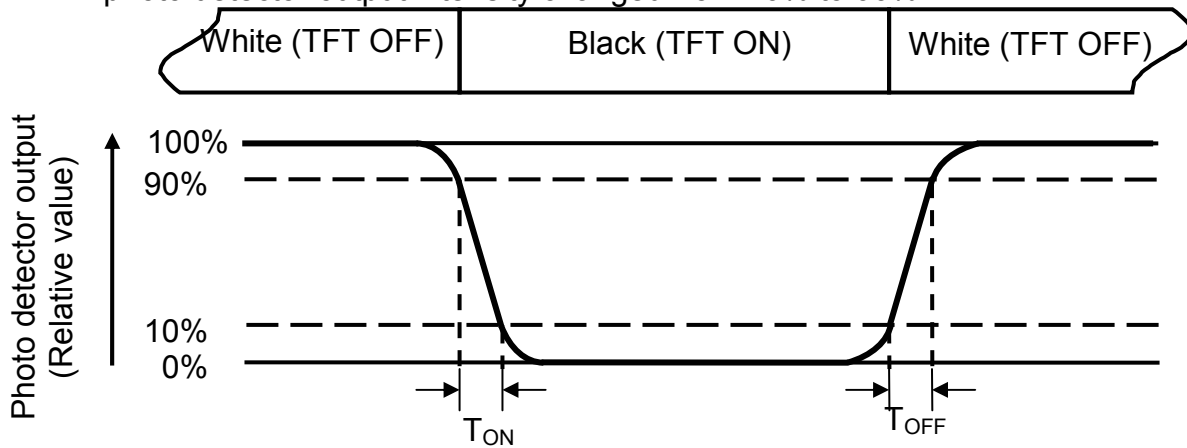


Fig. 4-3 Definition of response time

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: All input terminals LCD panel must be ground while measuring the center area of the panel.

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.

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

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

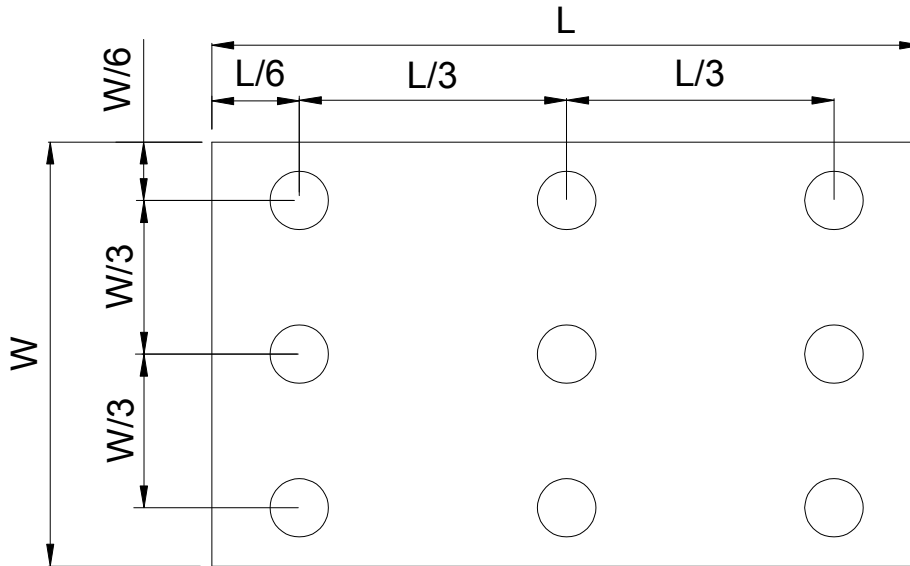


Fig. 4-4 Definition of measuring points

- B_{max}**: The measured maximum luminance of all measurement position.
- B_{min}**: The measured minimum luminance of all measurement position.

7. General Precautions

7.1. 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.

7.2. 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.

7.3. 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.

7.4. 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.

7.5. 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.

9. Package Drawing

TBD