

INNOLUX DISPLAY CORPORATION

LCD MODULE

SPECIFICATION

Customer: _____

Model Name: PT035TN01 V.4

SPEC NO.: P035-01-TT-41

Date: 2005/09/06

Version: 1

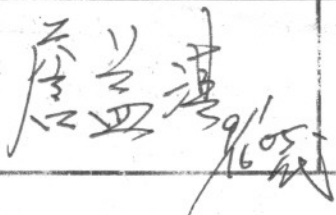
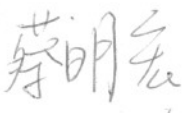

KTTIC

Preliminary Specification

Final Specification

For Customer's Acceptance

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

| Approved by | Reviewed by | Prepared by |
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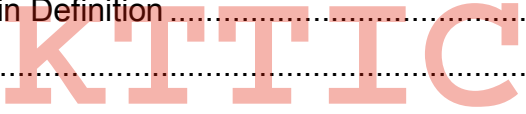
Record of Revision

| Version | Revise Date | Page | Content |
|---------|-------------|------|-----------------|
| 1 | 2005/09/06 | | Initial release |

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1. General Specifications

| No. | Item | Specification | Remark |
|-----|-----------------------------|----------------------------------------------------|--------|
| 1 | LCD size | 3.5" inch | |
| 2 | Driver element | a-Si TFT active matrix | |
| 3 | Resolution | 320X3(RGB)X240 | |
| 4 | Display mode | Normally White, Transmissive with Micro Reflective | |
| 5 | Dot pitch | 0.073(W)X0.219(H) mm | |
| 6 | Active area | 70.08(W)X52.56(H) mm | |
| 7 | Module size | 78.2(W)X65.0(H)X4.6(D) mm | Note 1 |
| 8 | Surface treatment | Hard coating | |
| 9 | Color arrangement | RGB-stripe | |
| 10 | Interface | Digital | |
| 11 | Backlight power consumption | 0.44W(Typ.) | |
| 12 | Panel power consumption | TBD | |
| 13 | Weight | TBD | |

Note 1: Refer to Mechanical Drawing.

2. Pin Assignment

| Pin No. | Symbol | I/O | Function | Remark |
|---------|--------|-----|--------------------------------------------------------|--------|
| 1 | GLED | P | GND for LED | |
| 2 | GLED | P | GND for LED | |
| 3 | VLED | P | Power for LED | |
| 4 | VLED | P | Power for LED | |
| 5 | GND | P | Ground | |
| 6 | X1 | I | X_Right | |
| 7 | Y1 | I | Y_Bottom | |
| 8 | X2 | I | X_Left | |
| 9 | Y2 | I | Y_Up | |
| 10 | GND | P | Ground | |
| 11 | NC | - | No connect | |
| 12 | NC | - | No connect | |
| 13 | POL | I | Polarity select for the line inversion control signal. | |
| 14 | RESET | I | Reset | |
| 15 | SPENA | I | Serial port data enable signal. Normally pull high. | |
| 16 | SPCK | I | Serial port clock .Normally pull high. | |
| 17 | SPDA | I/O | Serial port data input/output. | |
| 18 | D00 | I | Blue data(LSB) | |
| 19 | D01 | I | Blue data | |
| 20 | D02 | I | Blue data | |
| 21 | D03 | I | Blue data | |
| 22 | D04 | I | Blue data | |
| 23 | D05 | I | Blue data | |

| | | | | |
|----|------------------|---|--------------------------------|--|
| 24 | D06 | I | Blue data | |
| 25 | D07 | I | Blue data(MSB) | |
| 26 | D08 | I | Green data(LSB) | |
| 27 | D09 | I | Green data | |
| 28 | D10 | I | Green data | |
| 29 | D11 | I | Green data | |
| 30 | D12 | I | Green data | |
| 31 | D13 | I | Green data | |
| 32 | D14 | I | Green data | |
| 33 | D15 | I | Green data(MSB) | |
| 34 | D16 | I | Red data(LSB) | |
| 35 | D17 | I | Red data | |
| 36 | D18 | I | Red data | |
| 37 | D19 | I | Red data | |
| 38 | D20 | I | Red data | |
| 39 | D21 | I | Red data | |
| 40 | D22 | I | Red data | |
| 41 | D23 | I | Red data(MSB) | |
| 42 | IHS | I | Horizontal synchronous signal | |
| 43 | IVS | I | Vertical synchronous signal | |
| 44 | CLK | I | Data clock | |
| 45 | AV _{DD} | P | Analog power supply(+5V) | |
| 46 | AV _{DD} | P | Analog power supply(+5V) | |
| 47 | V _{CC} | P | Digital power supply(+3.3V) | |
| 48 | V _{CC} | P | Digital power supply(+3.3V) | |
| 49 | NC | - | No connect | |
| 50 | V _{GL} | I | Negative power for scan driver | |

| | | | | |
|----|------------------|---|--------------------------------|--|
| 51 | V _{GL} | I | Negative power for scan driver | |
| 52 | NC | - | No connect | |
| 53 | V _{GH} | I | Positive power for scan driver | |
| 54 | NC | - | No connect | |
| 55 | NC | - | No connect | |
| 56 | V _{COM} | I | V _{COM} input | |
| 57 | V _{COM} | I | V _{COM} input | |
| 58 | DEN | I | Data enabling signal | |
| 59 | GND | P | Ground | |
| 60 | GND | P | Ground | |

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3. Operation Specifications

3.1. Absolute Maximum Rating

(GND =0V, Note 1)

| Item | Symbol | Values | | Unit | Remark |
|-----------------------|-----------------|--------|------|------|--------|
| | | Min. | Max. | | |
| Power voltage | V_{CC} | -0.3 | 7 | V | |
| | AV_{DD} | -0.3 | 7 | V | |
| | V_{GH} | -0.3 | 18 | V | |
| | V_{GL} | -15 | 0.3 | V | |
| | $V_{GH}-V_{GL}$ | - | 33 | V | |
| Operation Temperature | T_{OP} | -20 | 60 | °C | |
| Storage Temperature | T_{ST} | -30 | 70 | °C | |

Note 1: Device is subject to be damaged permanently if stresses beyond those absolute maximum ratings listed above.

3.2. Electrical Characteristics

3.2.1. Typical Operation Conditions

(GND =0V, Note 3)

| Item | Symbol | Values | | | Unit | Remark |
|--------------------------|-----------|-------------|------|-------------|------|------------------------|
| | | Min. | Typ. | Max. | | |
| Power voltage | V_{CC} | 3.0 | 3.3 | 3.6 | V | |
| | AV_{DD} | - | 5.0 | - | V | |
| | V_{GH} | - | TBD | - | V | |
| | V_{GL} | - | TBD | - | V | |
| V_{COM} | V_{CAC} | - | TBD | - | V | Note 1 |
| | V_{CDC} | - | TBD | - | V | Note 2 DC component |
| Input logic high voltage | V_{IH} | $0.7V_{CC}$ | - | V_{CC} | V | |
| Input logic low voltage | V_{IL} | 0 | - | $0.3V_{CC}$ | V | |

Note 1: The brightness of LCD panel could be changed by adjusting the AC component of V_{COM} .

Note 2: The voltage of V_{CDC} must be adjustable from 0V to 3V.

Note 3: Be sure to apply GND, V_{CC} , and V_{GL} , to the LCD first, and then apply V_{GH} .

3.2.2. Current Consumption

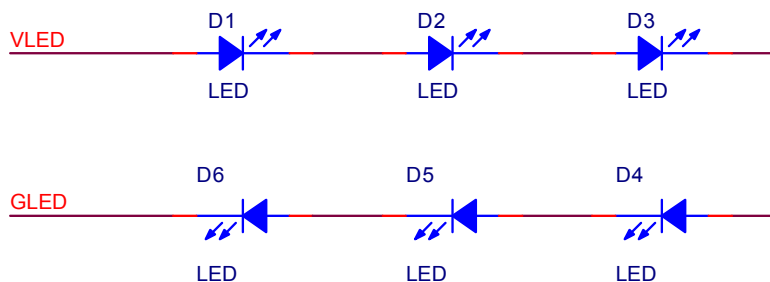
(GND =0V)

| Item | Symbol | Values | | | Unit | Remark |
|--------------------|----------|--------|------|------|------|-----------------|
| | | Min. | Typ. | Max. | | |
| Current for Driver | I_{GH} | - | TBD | - | mA | $V_{GH} = TBD$ |
| | I_{GL} | - | TBD | - | mA | $V_{GL} = TBD$ |
| | I_{CC} | - | TBD | - | mA | $V_{CC} = 3.3V$ |
| | I_{DD} | - | TBD | - | mA | $AV_{DD} = 5V$ |

3.2.3. Backlight Driving Condition

| Item | Symbol | Values | | | Unit | Remark |
|---------------|--------|--------|--------|------|------|--------|
| | | Min. | Typ. | Max. | | |
| LED voltage | V_L | - | (21.6) | - | V | Note 1 |
| LED current | I_L | - | (20) | - | mA | Note 1 |
| LED life time | - | 10,000 | - | - | 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°C and $I_L = 20mA$.

3.3. Timing Characteristics

3.3.1. Timing Conditions

Digital Parallel RGB Interface

| Item | Symbol | Values | | | Unit. | Remark |
|-----------------|------------------|------------------|------|------|------------------|--------|
| | | Min. | Typ. | Max. | | |
| CLK period | T _{OSC} | - | 156 | - | ns | |
| Data setup time | T _{SU} | 12 | - | - | ns | |
| Data hold time | T _{HD} | 12 | - | - | ns | |
| IHS period | T _H | - | 408 | - | T _{OSC} | |
| IHS pulse width | T _{HS} | 5 | 30 | - | T _{OSC} | |
| IVS pulse width | T _{VS} | 1 | 3 | 5 | T _H | |
| IVS-DEN time | NTSC | T _{VSE} | 18 | - | T _H | |
| | PAL | | 26 | | | |
| IHS-DEN time | T _{HE} | 36 | 68 | 88 | T _{OSC} | |
| DEN pulse width | T _{EP} | - | 320 | - | T _{OSC} | |

Hardware reset timing

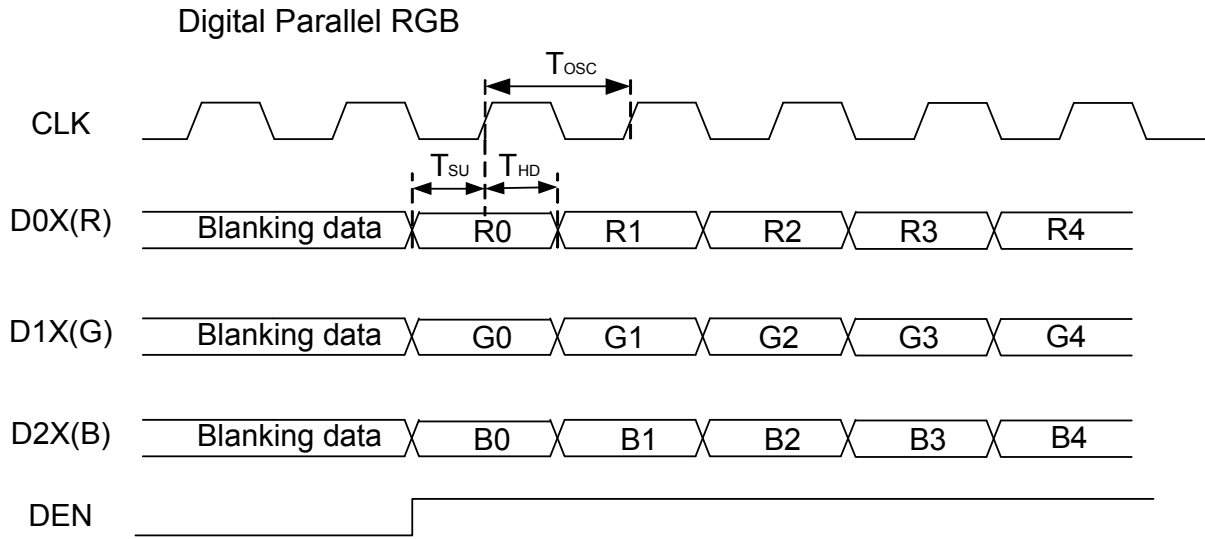
| Item | Symbol | Values | | | Unit. | Remark |
|-----------------------|------------------|--------|------|------|-------|--------|
| | | Min. | Typ. | Max. | | |
| RESET low pulse width | T _{RSB} | 10 | - | - | μs | |

SPI timing characteristics

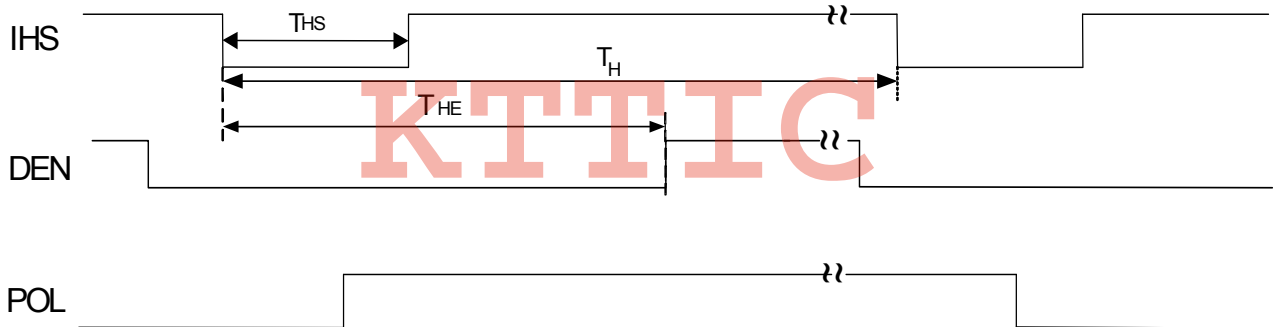
| Item | Symbol | Values | | | Unit | Remark |
|--------------------------|-----------|--------|------|------|----------|--------|
| | | Min. | Typ. | Max. | | |
| SPCK period | T_{CK} | 60 | - | - | ns | |
| SPCK high width | T_{CKH} | 30 | - | - | ns | |
| SPCK low width | T_{CKL} | 30 | - | - | ns | |
| Data setup time | T_{SU1} | 12 | - | - | ns | |
| Data hold time | T_{HD1} | 12 | - | - | ns | |
| SPENA to SPCK setup time | T_{CS} | 20 | - | - | ns | |
| SPENA to SPDA hold time | T_{CE} | 20 | - | - | ns | |
| SPENA high pulse width | T_{CD} | 50 | - | - | ns | |
| SPDA output latency | T_{CR} | - | 1/2 | - | T_{CK} | |

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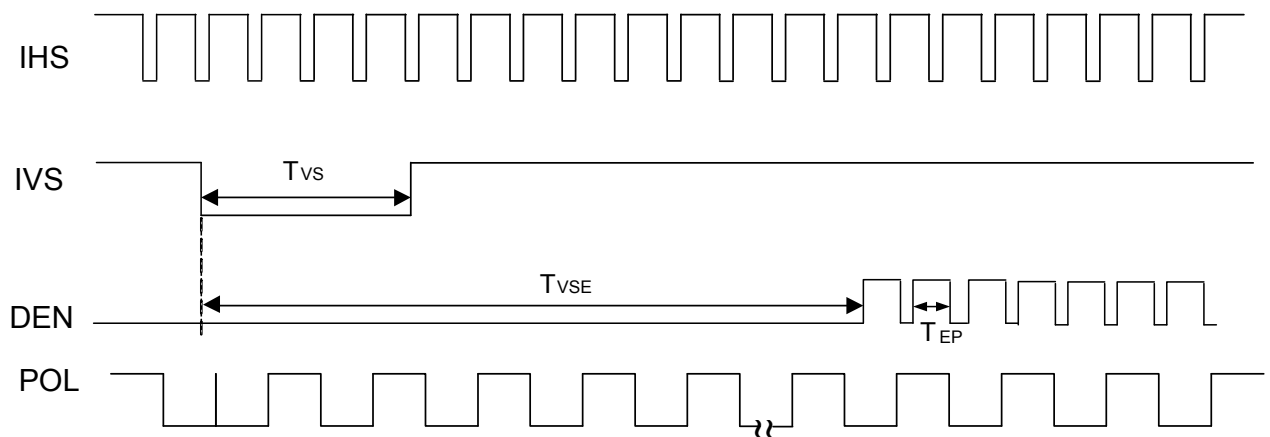
3.3.2. Timing Diagram



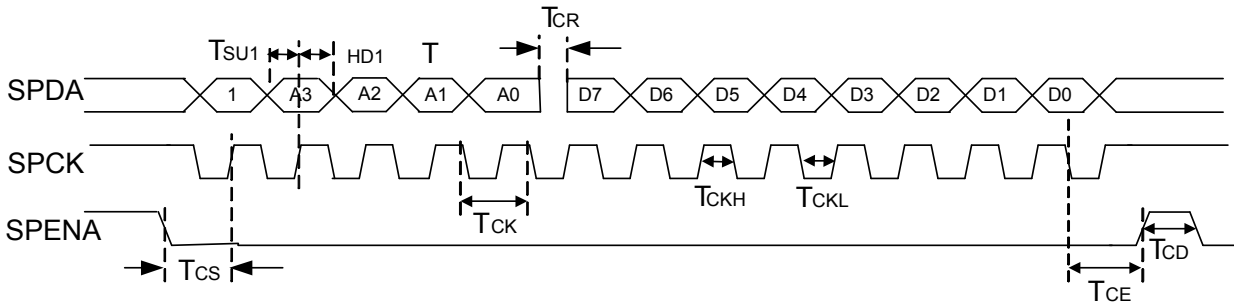
IHS and horizontal control timing waveform



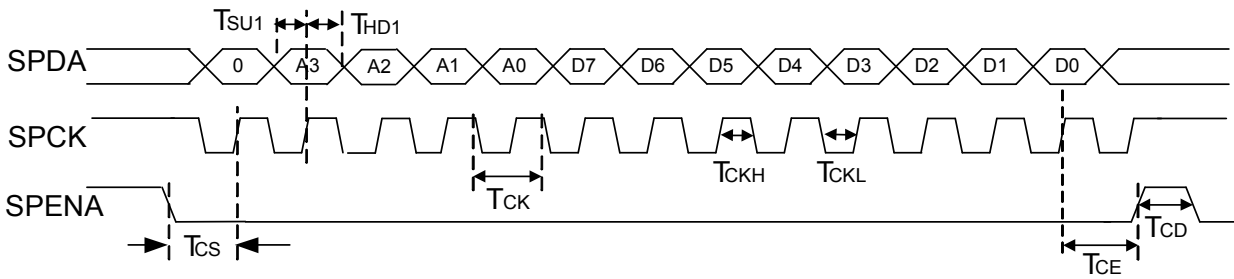
IHS and vertical control timing waveform



SPI "read" timing



SPI "write" timing



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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 | 200 | - | - | Ω | X(Film side) |
| | 160 | - | - | Ω | Y(Glass side) |
| Insulation resistance | 25 | - | - | MΩ | DC 25V |
| Voltage | - | - | 7 | V | DC |
| Chattering | - | - | 10 | ms | 100kΩ pull-up |
| Transparency | 82 | - | - | % | Non-glare |

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, ASTM D3363 |

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

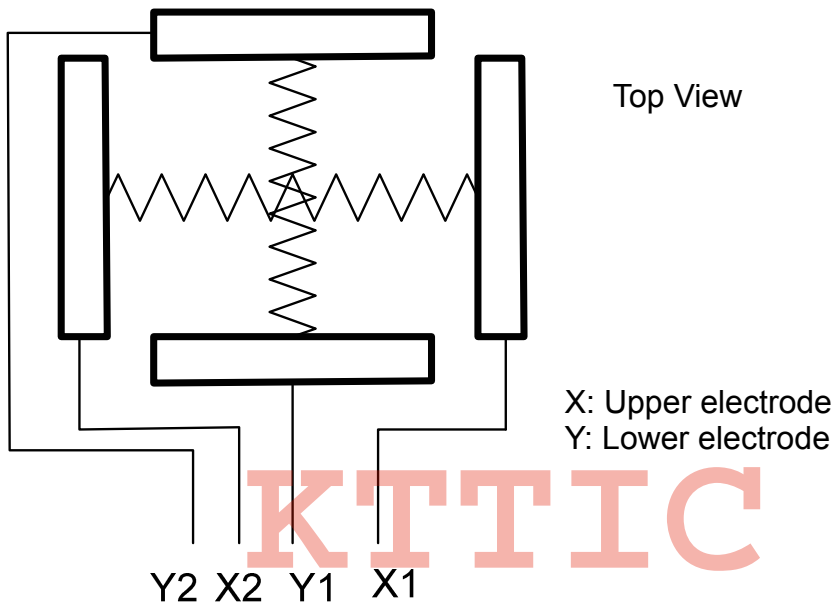
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- times.
- Force: 250gf.
- Speed: 60mm/sec.
- Stylus: R0.8 polyacetal tip.

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 | X1 | Right | Right electrode – differential analog | |
| 2 | Y1 | Bottom | Bottom electrode – differential analog | |
| 3 | X2 | Left | Left electrode – differential analog | |
| 4 | Y2 | Top | Top electrode – differential analog | |

5. Optical Specifications

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit | Remark |
|--------------------------|------------|---------------------------------|------|------|------|-------------------|------------------|
| Viewing angle (CR≥10) | θ_L | $\Phi=180^\circ$ (9 o'clock) | 55 | 60 | - | degree | Note 1 |
| | θ_R | $\Phi=0^\circ$ (3 o'clock) | 55 | 60 | - | | |
| | θ_T | $\Phi=90^\circ$ (12 o'clock) | 35 | 40 | - | | |
| | θ_B | $\Phi=270^\circ$ (6 o'clock) | 55 | 60 | - | | |
| Response Time | T_{ON} | Normal $\theta=\Phi=0^\circ$ | - | 15 | 30 | msec | Note 3 |
| | T_{OFF} | | - | 20 | 50 | msec | Note 3 |
| Contrast ratio | CR | | 200 | 300 | - | - | Note 4 |
| Color chromaticity | W_X | | - | TBD | - | - | Note 5 Note 6 |
| | W_Y | | - | TBD | - | - | |
| Luminance | L | | 150 | 200 | - | cd/m ² | Note 6 |
| Luminance uniformity | Y_U | | 70 | 75 | - | % | Note 7 |

Test Conditions:

1. $V_{CC}=3.3V$, $AV_{DD}=5.0V$, $I_L=20mA$ (Backlight current), the ambient temperature is 25°C.
2. The test systems refer to Note 2.

Note 1: Definition of viewing angle

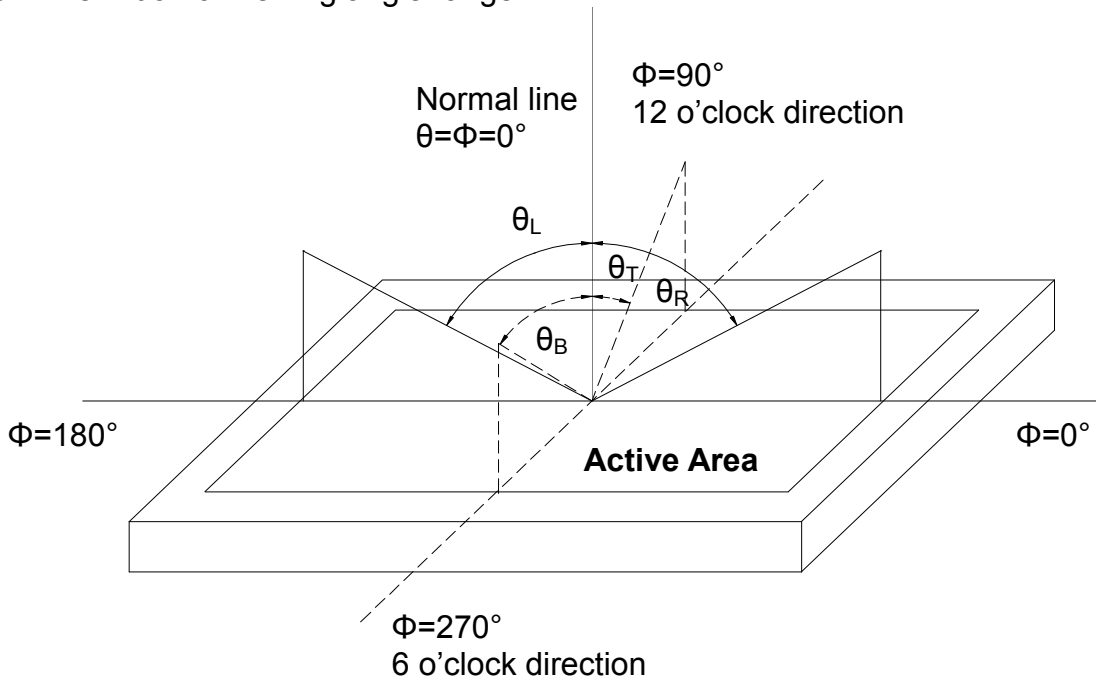


Fig. 5-1 Definition of viewing angle

Note 2: Definition of optical measurement system.

The optical characteristics should be measured in dark room. 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.)

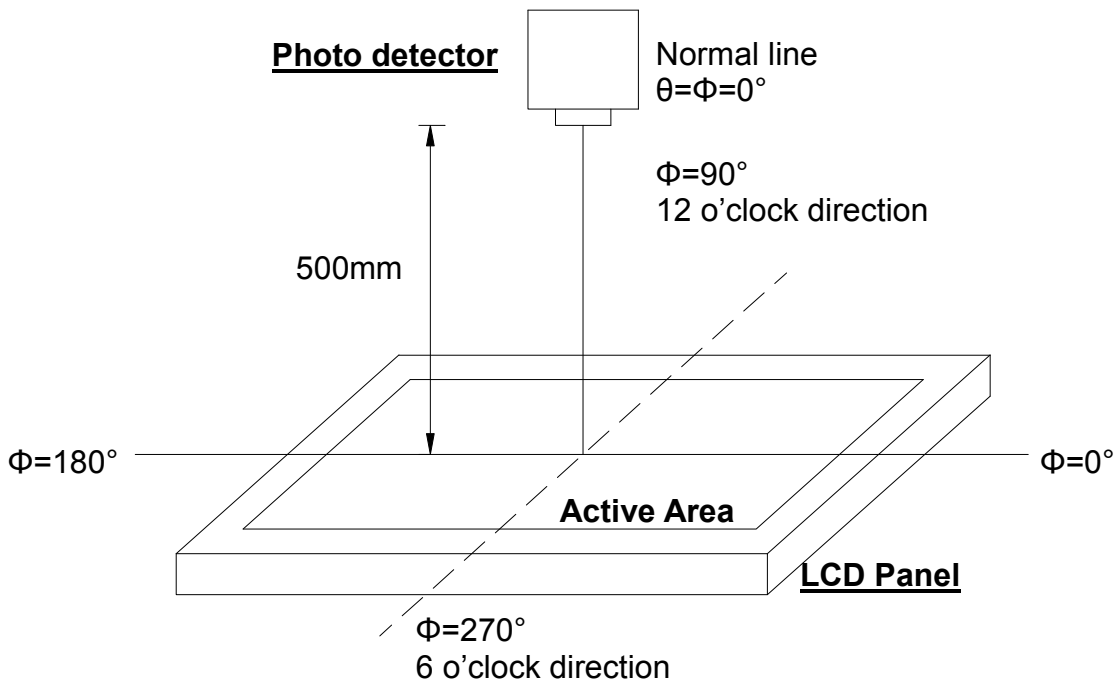


Fig. 5-2 Optical measurement system setup

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%.

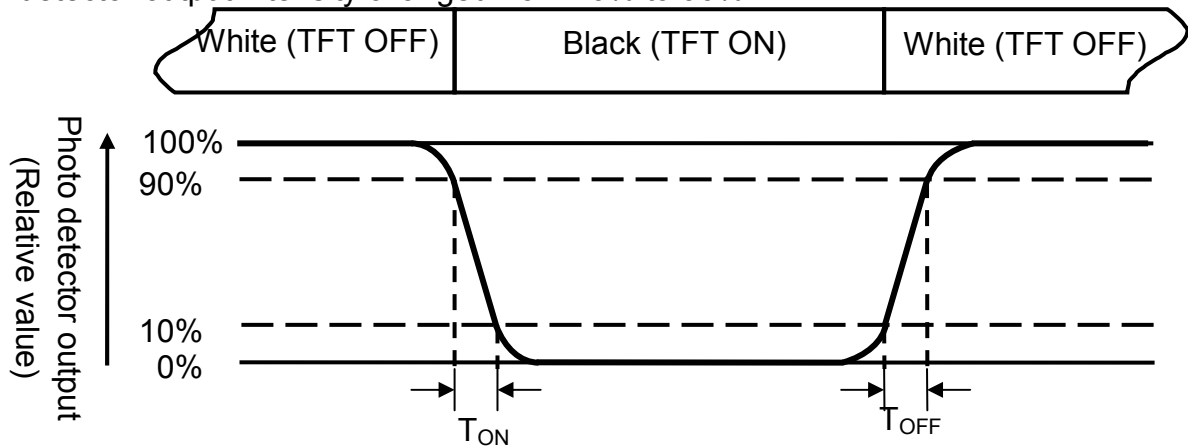


Fig. 5-3 Definition of response time

Note 4: Definition of contrast ratio

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

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 when measuring the center area of the panel.

Note 7: Definition of Luminance Uniformity

To test for uniformity, the tested area, which is inside the active area, is divided into 3 rows and 3 columns. The measurement spot is placed at the center of each box.

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

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

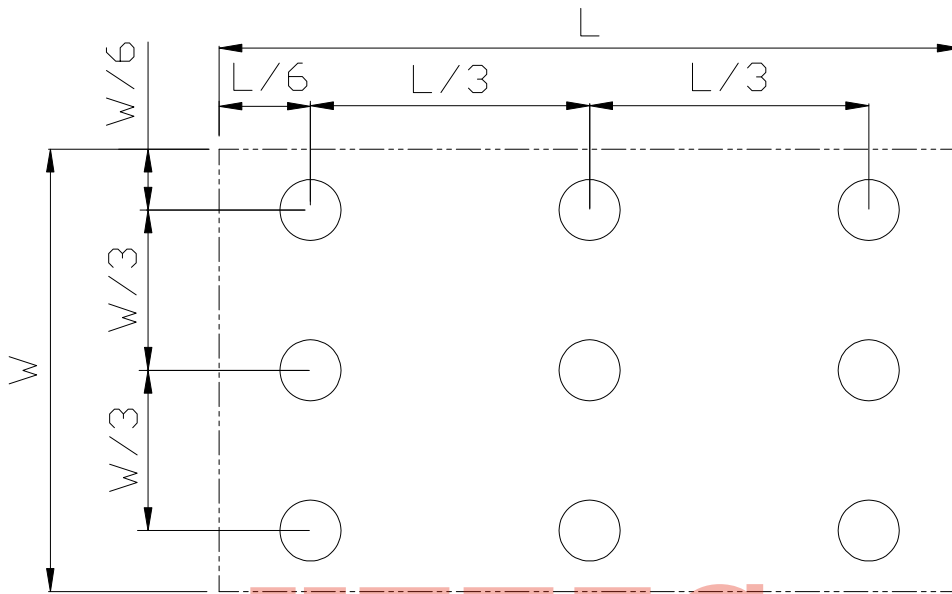


Fig. 5-4 Definition of uniformity

B_{max}: The measured maximum luminance of all measurement position.

B_{min}: The measured minimum luminance of all measurement position.

6. Reliability Test Items

| Item | Test Conditions | Remark |
|------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| High Temperature Storage | Ta = 70°C 240 hrs | Note 1 |
| Low Temperature Storage | Ta = -30°C 240hrs | Note 1 |
| High Temperature Operation | Ts = 60°C 240hrs | Note 2 |
| Low Temperature Operation | Ta = -20°C 240hrs | Note 1 |
| Operate at High Temperature and Humidity | +40°C, 90%RH max. 240 hrs | |
| Thermal Shock | -30°C/30 min ~ +80°C/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) | JIS C0040 A-10 Condition A |
| Mechanical Shock | 100G 6ms,±X, ±Y, ±Z 3 times for each direction | JIS C0041 A-7 Condition C |
| 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) | IEC 68-34 |
| Package Drop Test | Height:60 cm 1 corner, 3 edges, 6 surfaces | JIS Z0202 |
| Electro Static Discharge | ± 2KV, Human Body Mode, 100pF/1500Ω | EIA/JESD22-A114 |

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.

7. Handling 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.

7. Mechanical Drawing

The drawing shows a touch panel assembly with the following dimensions:

- Resolution: 320@60@240
- Active Area Center
- Touch Panel V/A: 73.66±0.30
- Touch Panel I/D: 77.88±0.30
- Outline Size: 78.20±0.30
- Active Area: 70.08
- Active Area Center: 29.95±0.30
- Active Area: 52.56
- Touch Panel V/A: 56.16±0.50
- Touch Panel I/D: 64.50±0.30
- Outline Size: 65.00±0.30
- Panel Thickness: 2.26±0.05
- Panel Thickness: 4.05
- Panel Thickness: 3.67
- Panel Thickness: 1.77±0.05
- Panel Thickness: 55.60±0.50
- Panel Thickness: 39.0±0.15
- Panel Thickness: 3.50±0.50
- Panel Thickness: 3.5±0.05
- Panel Thickness: 3.18±0.05
- Panel Thickness: 0.30±0.05
- Panel Thickness: 4.66±0.20
- Panel Thickness: 1.30±0.20

Labels: LABEL, Conductive Side, SEE DETAIL A

Notes:

- 1.General tolerance 0.3mm;
- 2.The bending radius of FPC should be large than 0.6mm;

DETAIL A SCALE 4:1

| LEVEL | GENERAL TOLERANCE | MATERIAL | DATE | SCALE | 3rd ANGLE | DRAWING |
|-------|-------------------|----------|------------|-------|-----------|---------------|
| 1 | F | APPROVED | 2005/09/13 | 1:1 | 3rd ANGLE | PI035T001 V.4 |
| 2 | M | CHECKED | 2005/09/13 | | | |
| 3 | S | DESIGNED | 2005/09/13 | | | |
| 4 | D | | | | | |
| 5 | C | | | | | |
| 6 | B | | | | | |
| 7 | A | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | | | | | | |

Company Information: INNOLUX, LCM PI035T001 V.4, ZhiFengFu, 2005/09/13, 2005/09/13, A3, 1of1, 0

9. Package Drawing

TBD

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