

INNOLUX DISPLAY CORPORATION

LCD MODULE

SPECIFICATION

Customer: _____

Model Name: AT056TN02

SPEC NO: A05602TT01

Date: July. 2004

Version: 1.0

Preliminary Specification

Final Specification

For Customer's Acceptance

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

| Approved by | Reviewed by | Prepare by |
|-------------|-------------|------------|
| | | |

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Innolux Display Corporation,

2F, No.16, Ke-Tung Road 3, Science-Based Industrial Park, Chu-Nan 350, Mao-Li County, Taiwan

Tel: 886-37-586000

Fax: 886-37-586060

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1. General specification

| NO. | Item | Specification | Remark |
|-----|---------------------------|--------------------------------|--------|
| 1 | LCD size | 5.6 inch | |
| 2 | Driver element | α -Si TFT active matrix | |
| 3 | Resolution | 320 X RGB X 234 | |
| 4 | Display mode | Normally white, Transmissive | |
| 5 | Display number of colors | Full color | |
| 6 | Optimal viewing direction | 6 o'clock | |
| 7 | Dot pitch | 0.118 X 0.362 mm | |
| 8 | Active Area | 113.28 X84.708 mm | |
| 9 | Module size | 126.5 X 100 X 5.7 mm | |
| 10 | Color arrangement | RGB-stripe | |
| 11 | Weight | 142g | |
| 12 | Driver IC | Himax HX8204+HX8604 | |

2. Electrical specifications

2.1 Absolute maximum ratings

| Parameter | Symbol | Values | | Unit | Remark |
|-----------------------|-----------------|--------|--------------|------|---------------------|
| | | Min. | Max. | | |
| Power voltage | V_{CC} | -0.3 | 7 | V | |
| | V_{DD} | -0.3 | 7 | V | |
| | V_{GH} | -0.3 | 18 | V | |
| | V_{GL} | -15 | 0.3 | V | |
| | $V_{GH}-V_{GL}$ | - | 31 | V | |
| Input signal voltage | V_i | -0.3 | $V_{DD}+0.3$ | | Note 1 |
| | V_I | -0.3 | $V_{CC}+0.3$ | | Note 2 |
| | V_{COM} | -2.9 | 5.2 | | |
| Operating temperature | T_{op} | -10 | 70 | °C | Ambient temperature |
| Storage temperature | T_{ST} | -30 | 80 | °C | Ambient temperature |

Note:

1. VR, VG, VB
2. STHL, STHR, Q1H.OEH, L/R, CPH1~CPH3, STVR, STVL, OEV, CKV, U/D.
3. The absolute maximum ratings are the values that must not be exceeded at any time for this product. It is not allowed for any of these ratings to be exceeded. 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.

2.2. Pin assignment

2.2.1 TFT-LCD panel driving section

| Pin no | Symbol | IO | Function | Remark |
|--------|------------------|-----|--|-----------|
| 1 | GND | - | Ground | |
| 2 | V _{CC} | I | Supply voltage for logic control circuit scan driver | |
| 3 | V _{GL} | I | Negative power for scan driver | |
| 4 | V _{GH} | I | Positive power for scan driver | |
| 5 | STVR | I/O | Vertical start pulse | Note 1 |
| 6 | STVL | I/O | Vertical start pulse | Note 1 |
| 7 | CKV | I | Shift clock input for scan driver | |
| 8 | U/D | I | UP/DOWN scan control input | Note 1, 2 |
| 9 | OEV | I | Output enable control for scan driver | |
| 10 | VCOM | I | Common electrode driving signal | |
| 11 | VCOM | I | Common electrode driving signal | |
| 12 | L/R | I | LEFT/RIGHT scan control input | Note 1, 2 |
| 13 | Q1H | I | Analog signal rotate input | |
| 14 | OEH | I | Output enable control for data driver | |
| 15 | STHL | I/O | Start pulse for horizontal scan line | Note 1 |
| 16 | STHR | I/O | Start pulse for horizontal scan line | Note 1 |
| 17 | CPH3 | I | Sampling and shifting clock pulse for data driver | |
| 18 | CPH2 | I | Sampling and shifting clock pulse for data driver | |
| 19 | CPH1 | I | Sampling and shifting clock pulse for data driver | |
| 20 | V _{CC} | I | Supply voltage for logic control circuit scan driver | |
| 21 | GND | - | Ground | Note 1, 2 |
| 22 | VR | I | Alternated video signal (Red) | Note 1 |
| 23 | VG | I | Alternated video signal (Green) | |
| 24 | VB | I | Alternated video signal (Blue) | |
| 25 | AV _{DD} | I | Supply voltage for analog circuit | |
| 26 | AV _{SS} | I | Ground for analog circuit | |

Note:

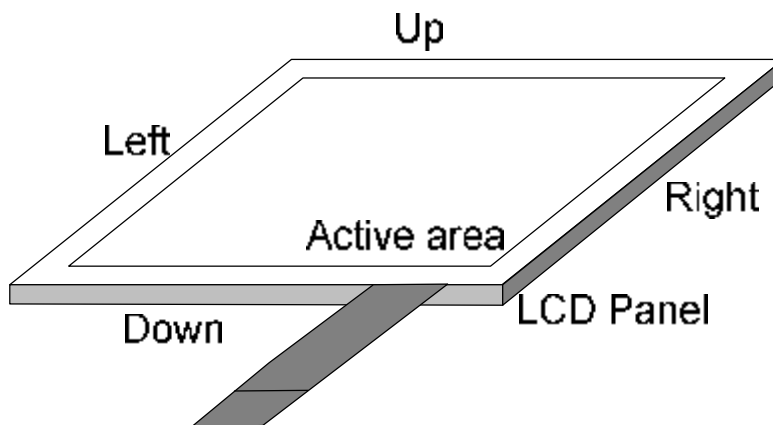
1. Selection of scanning mode (please refer to the following table)

| Setting of scan control input | | IN/OUT state for start pulse | | | | Scanning direction |
|-------------------------------|------------------|------------------------------|------|------|------|---------------------------|
| U/D | L/R | STVR | STVL | STHR | STHL | |
| GND | DV _{DD} | O | I | O | I | Up to Down, Left to Right |
| DV _{DD} | GND | I | O | I | O | Down to Up, Right to Left |
| GND | GND | O | I | I | O | Up to Down, Right to Left |
| DV _{DD} | DV _{DD} | I | O | O | I | Down to Up, Left to Right |

I: input, O: output

2. Definition of Scanning Direction.

Refer to figure as below:



2.2.2 Backlight driving section

JST BHR-03VS-1

| NO. | Symbol | I/O | Description | Remark |
|-----|--------|-----|--|--------|
| 1 | HI | I | Power supply for backlight unit (High voltage) | |
| 2 | NC | - | | |
| 3 | GND | - | Ground for backlight unit | |

2.3 Electrical characteristics

2.3.1 Typical operating conditions (GND=AV_{SS}=V, Note 4)

| Item | Symbol | Min. | Typ. | Max. | Unit | Remark |
|---------------------------------------|-------------------|-----------------------|---------------------|-----------------------|--------------------|-------------------------------|
| Power supply | V _{CC} | 4.8 | 5 | 5.2 | V | |
| | AV _{DD} | 4.8 | 5 | 5.2 | V | |
| | V _{GH} | 14.3 | 15 | 15.7 | V | |
| | V _{GLAC} | - | 5 | - | V _{p-p} | Note 1 |
| | V _{GL-H} | -10.5 | -10 | -9.5 | V | High level of V _{GL} |
| Video signal Amplitude(VR, VG, VB) | V _{iA} | AV _{SS} +0.4 | - | AV _{DD} -0.4 | V | |
| | V _{iAC} | - | 3 | - | V | AC component |
| | V _{iDC} | - | AV _{DD} /2 | - | V | DC component |
| VCOM | V _{CAC} | - | 5 | - | V _{p-p} | Note2 |
| | V _{CDC} | 1.56 | 1.76 | 1.96 | V | DC component |
| Input Signal voltage | H Level | V _{IH} | 0.8V _{CC} | - | V _{CC} | Note 3 |
| | L Level | V _{IL} | 0 | - | 0.2V _{CC} | |

Note:

- 1: The same phase and amplitude with common electrode driving signal (VCOM).
- 2: The brightness of LCD panel could be adjusted by the adjustment of the AC component of VCOM.
- 3: STHL, STHR, Q1H, OEH, L/R, CPH1~CPH3, STVR, STVL, OEV, CKV, U/D.
- 4: Be sure to apply GND, V_{CC} and V_{GL} to the LCD first, and then apply V_{GH}.

2.3.2 Current consumption (GND=AV_{SS}=V)

| Parameter | Symbol | Condition | Min. | Typ. | Max. | Unit | Remark |
|--------------------|-------------------|-----------------------|------|------|------|------|--------|
| Current for driver | I _{GH} | V _{GH} =15V | - | 0.2 | 0.8 | mA | |
| | I _{GL} | V _{GL} =-10V | - | -0.5 | -1 | mA | |
| | I _{CC} | V _{CC} =5V | - | 4 | 8 | mA | |
| | I _{DD} | V _{DD} =5V | - | 12 | 20 | mA | |
| | I _{VCOM} | V _{GH} =15V | - | 10 | 18 | mA | |
| | I _{LI1} | - | -10 | - | 10 | uA | Note 1 |

Note 1: Input Leakage Current

2.3.3 Backlight driving condition

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Remark |
|-----------------------|----------------|--------|------|------|-------|------------|
| Lamp voltage | V _L | - | 470 | 528 | Vrms | Note 3 |
| Lamp current | I _L | 5.9 | 6 | 6.1 | mArms | |
| Frequency | F _L | - | 60 | 80 | kHz | Note 3,4 |
| Lamp starting voltage | V _S | - | - | 650 | Vrms | Note 1,3,5 |
| | | - | - | 910 | Vrms | Note 2,3,5 |
| Lamp Lifetime | - | 20,000 | - | - | hr | Note 6 |

Note:

- 1: Ta = 25°C.
- 2: Ta = 0°C.
- 3: Reference value, correct value is subject to final backlight specification which will be decided in the future.
- 4: The lamp frequency should be selected as different as possible from display horizontal synchronous signal to avoid interference
- 5: For starting the backlight unit, the output voltage of DC/AC's transformer should be larger than the maximum lamp starting voltage.
- 6: The "Lamp life time " is defined as the module brightness decrease to 50% original brightness at Ta= 25°C, I_L=6mA.

2.4 AC Timing

2.4.1 Timing conditions

| Item | Symbol | Values | | | Unit | Remark |
|---------------------------------|-------------------------------------|--------|-------------|-------------|-------------|------------|
| | | Min. | Typ. | Max. | | |
| Rising time | t_r | - | - | 60 | ns | Note 1 |
| Falling time | t_f | - | - | 60 | ns | Note 1 |
| High and low level pulse width | t_{CPH} | 150 | 154 | 158 | ns | CPH1~CPH3 |
| CPH pulse duty | t_{CWH} | 40 | 50 | 60 | % | CPH1~CPH3 |
| CPH pulse delay | t_{C12} t_{C23} t_{C31} | 30 | $t_{CPH}/3$ | $t_{CPH}/2$ | ns | CPH1~CPH3 |
| STH setup time | t_{SUH} | 20 | - | - | ns | STHR, STHL |
| STH hold time | t_{HDH} | 20 | - | - | ns | STHR, STHL |
| STH pulse width | t_{STH} | - | 1 | - | t_{CPH} | STHR, STHL |
| STH period | t_H | 61.5 | 63.5 | 65.5 | μs | STHR, STHL |
| OEH pulse width | t_{OEH} | - | 7 | - | t_{CPH} | |
| Sample and hold disable time | t_{DIS1} | - | 55 | -- | μs | |
| OEV pulse width | t_{OEV} | - | 27 | | t_{CPH} | |
| CKV pulse width | t_{CKV} | 16 | 41 | 40 | t_{CPH} | |
| Clean enable time | t_{DIS2} | - | 16 | -- | t_{CPH} | |
| Horizontal display start | t_{SH} | - | 0 | - | $t_{CPH}/3$ | |
| Horizontal display timing range | t_{DH} | - | 960 | - | $t_{CPH}/3$ | |
| STV setup time | t_{SUV} | 400 | - | - | ns | STVL, STVR |
| STV hold time | t_{HDV} | 400 | - | - | ns | STVL, STVR |
| STV pulse width | t_{STV} | - | - | 1 | t_H | STVL, STVR |
| Horizontal lines per field | t_V | 256 | 262 | 268 | t_H | Note 2 |
| Vertical display start | t_{SV} | | 3 | - | t_H | |
| Vertical display timing range | t_{DV} | | 234 | - | t_H | Note 3 |
| VCOM rising time | t_{rCOM} | | - | 5 | μs | |
| VCOM falling time | t_{fCOM} | | - | 5 | μs | |
| VCOM delay time | t_{DCOM} | | - | 3 | μs | |
| RGB delay time | t_{DRGB} | | - | 1 | μs | |

Note:

1. For all of the logic signals
2. Please don't use odd horizontal lines to drive LCD panel for both odd and even field simultaneously.
3. Vertical total display lines.

2.4.2 Timing diagram

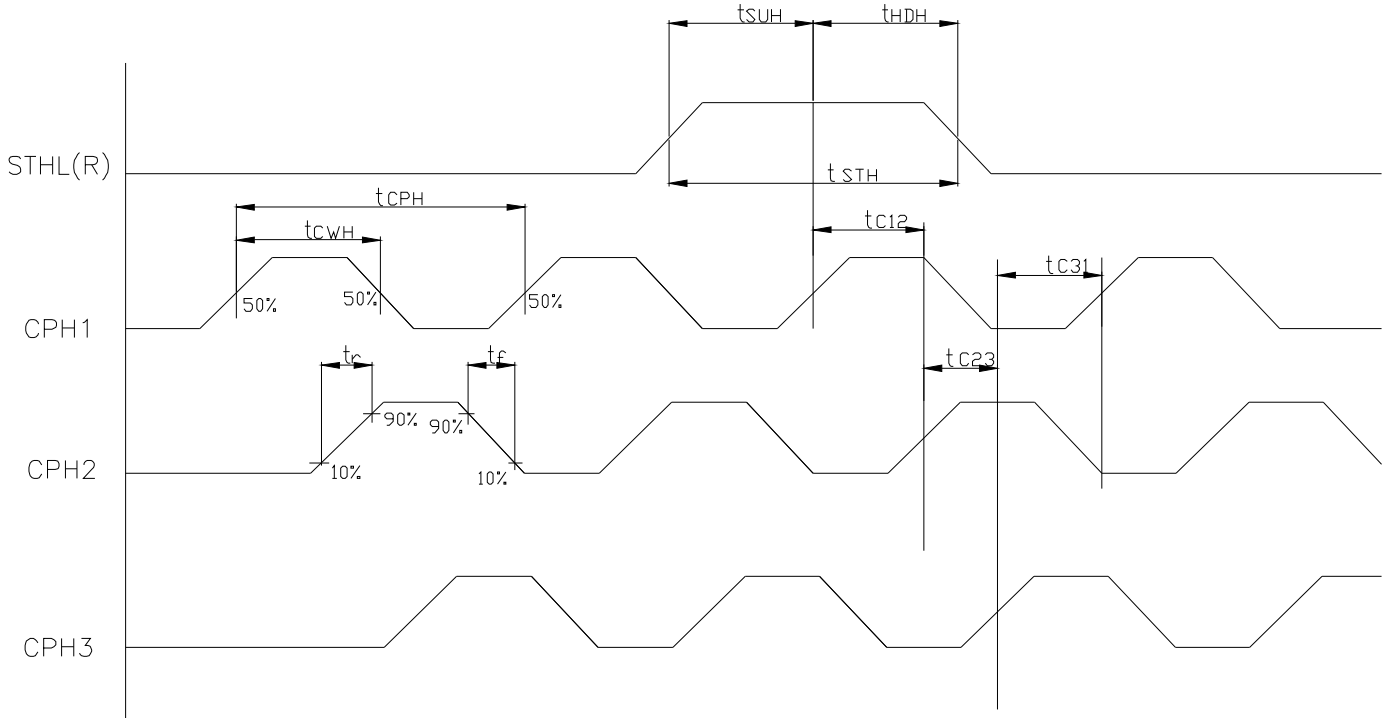


Fig.1 Sampling clock timing

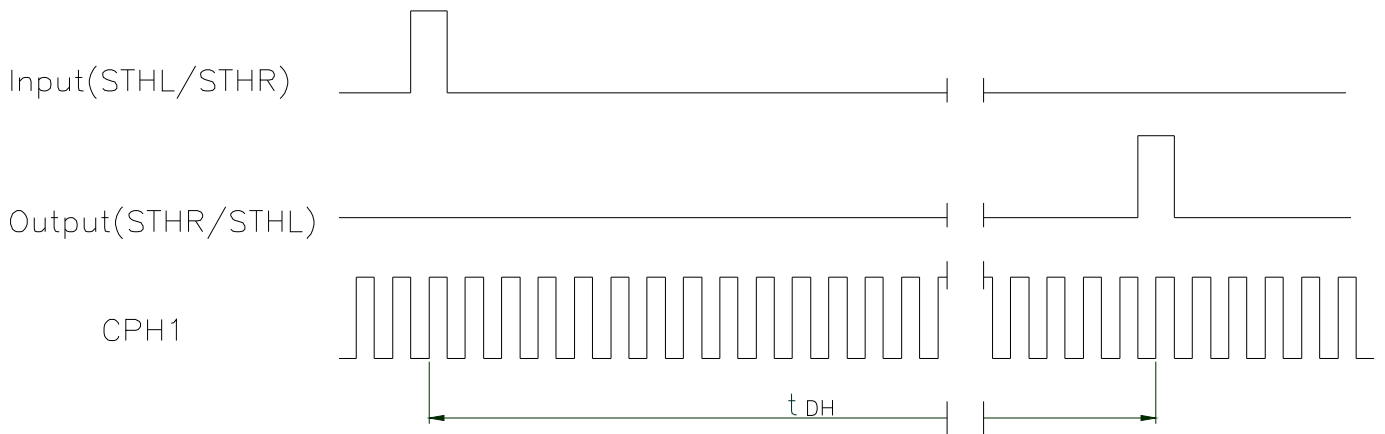


Fig.2 Horizontal display timing range

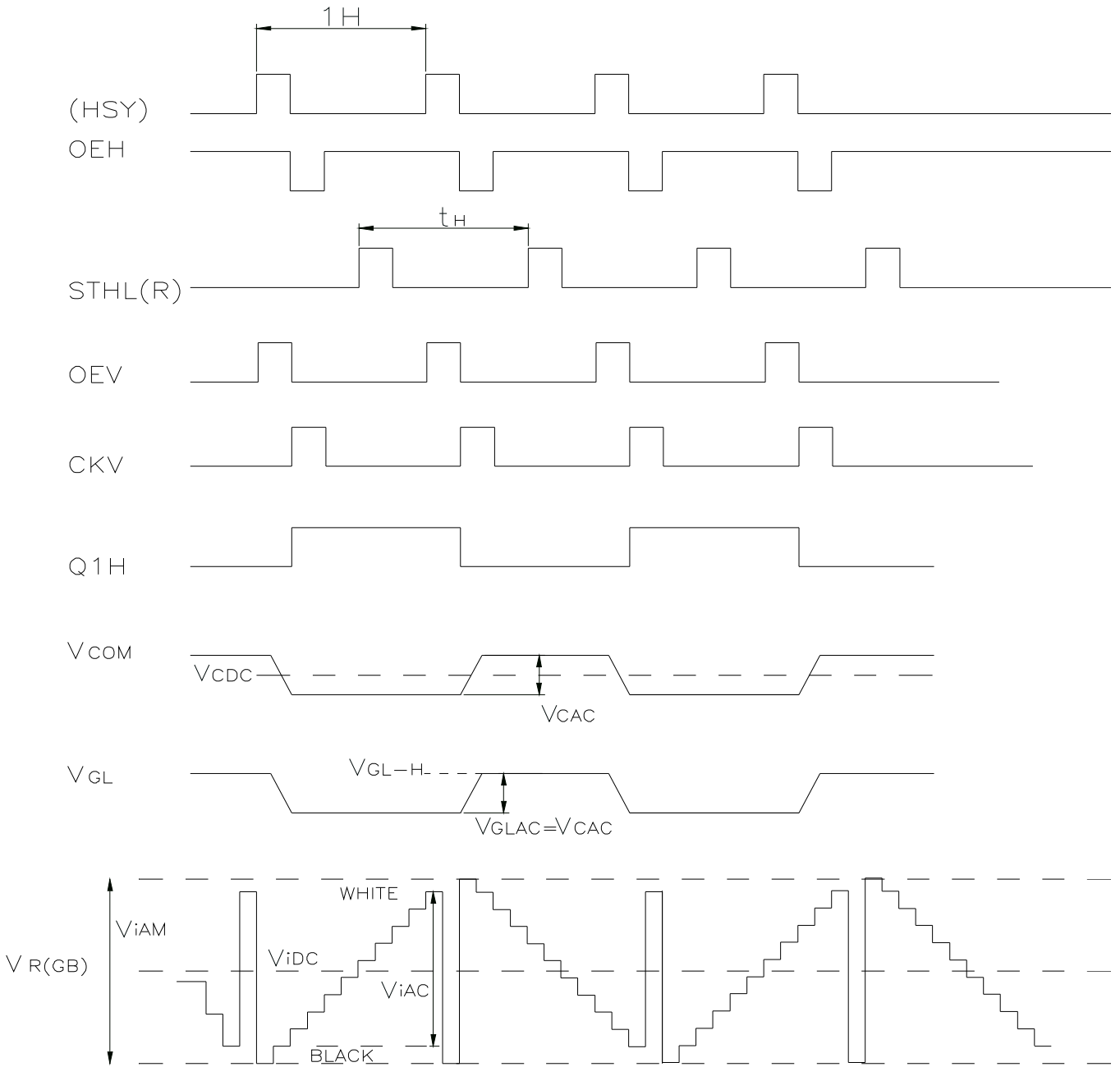
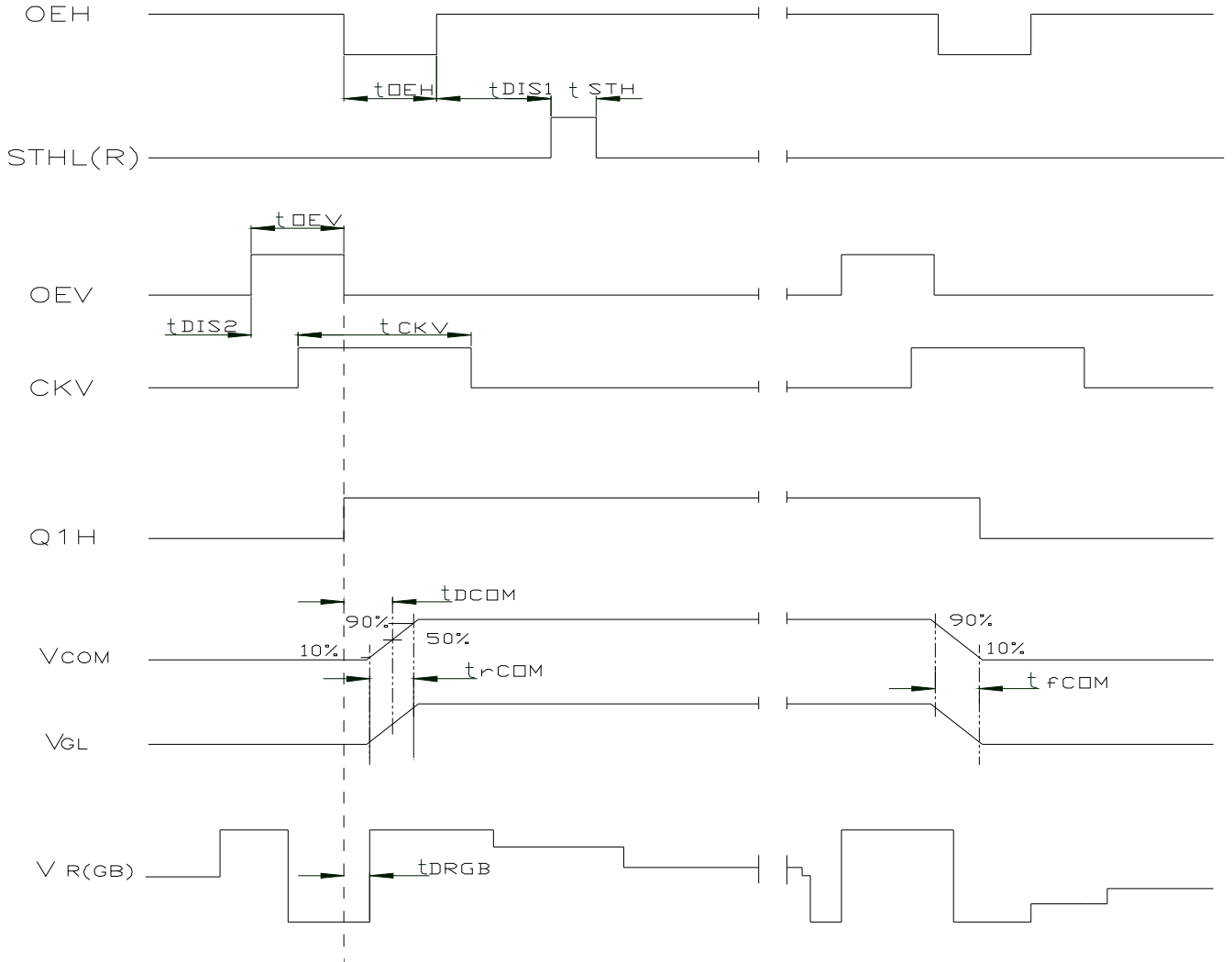


Fig.3-(a) Horizontal timing



Note: The falling edge of OEV should be synchronized with the falling edge of OEH

Fig.3-(b) Detail horizontal timing

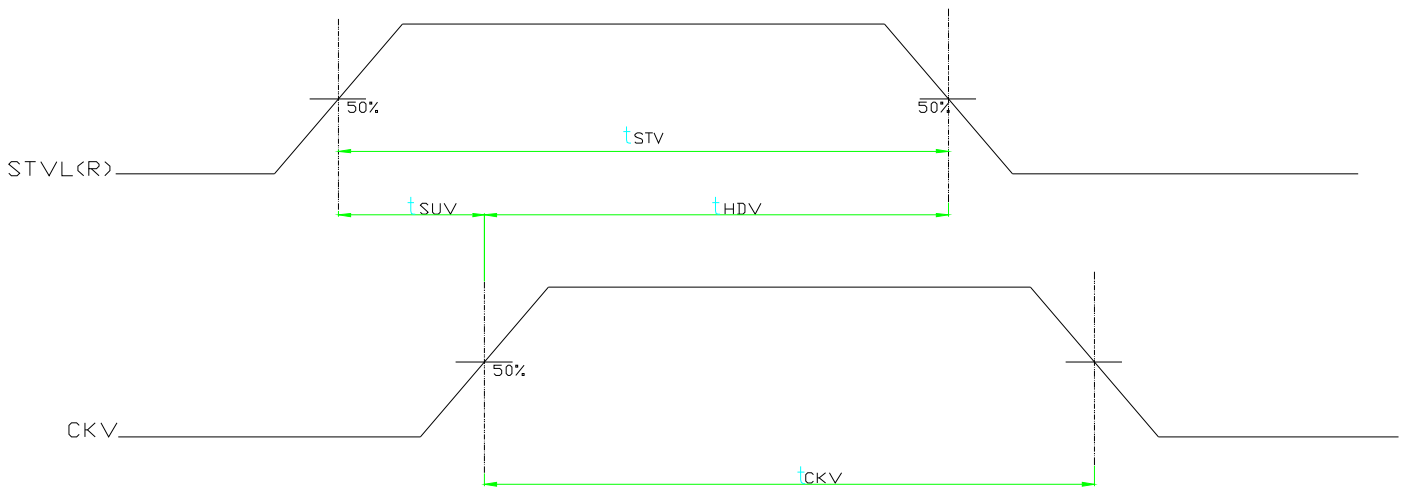


Fig.4 Vertical shift clock timing

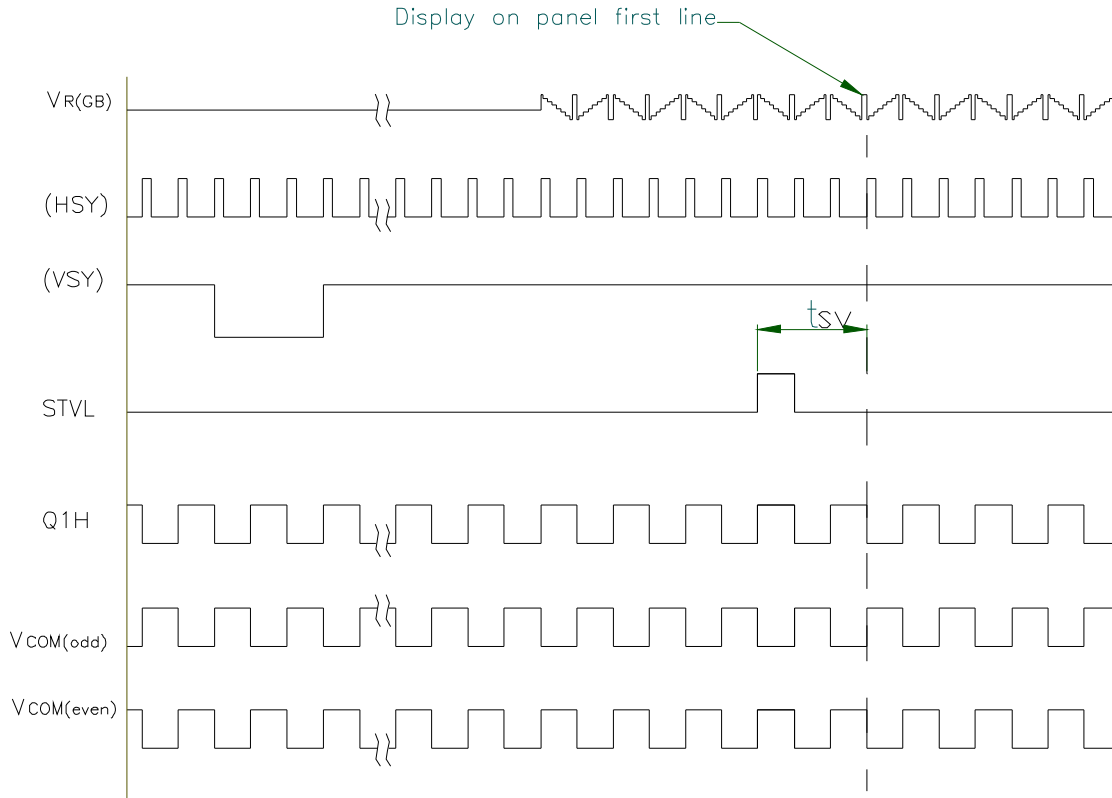


Fig.5 (a) Vertical timing (from up to down)

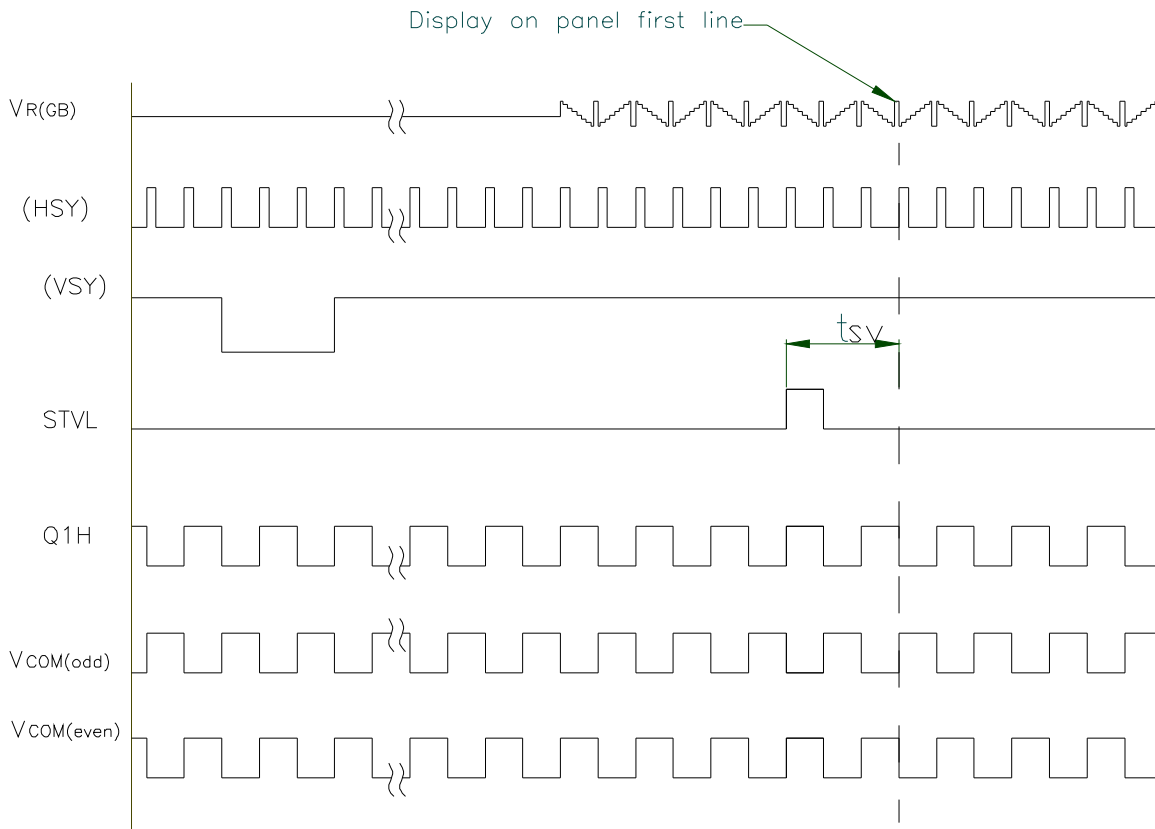


Fig.5 (b) Vertical timing (from up to down)

3. Optical specifications

The following items are measured under stable conditions. The optical characteristics should be measured in dark room or equivalent state with the methods shown in Note 1.

$T_a=25\pm 2^\circ\text{C}, I_L=6\text{mA}$

| Item | Symbol | Condition | Min | Typ | Max | Unit | Remark | |
|--------------------|---------------|---|-------|------|------|-----------------|--------|--|
| Contrast ratio | CR | Note 1 $\Theta=\Phi=0$ Normal Viewing Angle B/L ON | 100 | 150 | - | | Note2 | |
| Luminance of white | Y_L | | 270 | 330 | - | Cd/m^2 | Note3 | |
| Response Time | $(T_r)+(T_f)$ | | - | 35 | 70 | msec | Note4 | |
| Color Chromaticity | White | | W_x | 0.25 | 0.30 | 0.35 | | |
| | | | W_y | 0.30 | 0.35 | 0.40 | | |
| | Red | | R_x | 0.50 | 0.55 | 0.60 | | |
| | | | R_y | 0.28 | 0.33 | 0.38 | | |
| | Green | | G_x | 0.26 | 0.31 | 0.36 | | |
| | | | G_y | 0.55 | 0.60 | 0.65 | | |
| | Blue | | B_x | 0.10 | 0.15 | 0.20 | | |
| | | B_y | 0.08 | 0.13 | 0.18 | | | |
| Viewing Angle | Hor. | θ_L | 40 | 45 | - | Degree | Note5 | |
| | | θ_R | 40 | 45 | - | | | |
| | Ver. | Φ_L | 25 | 30 | - | | | |
| | | Φ_H | 10 | 10 | - | | | |

Note:

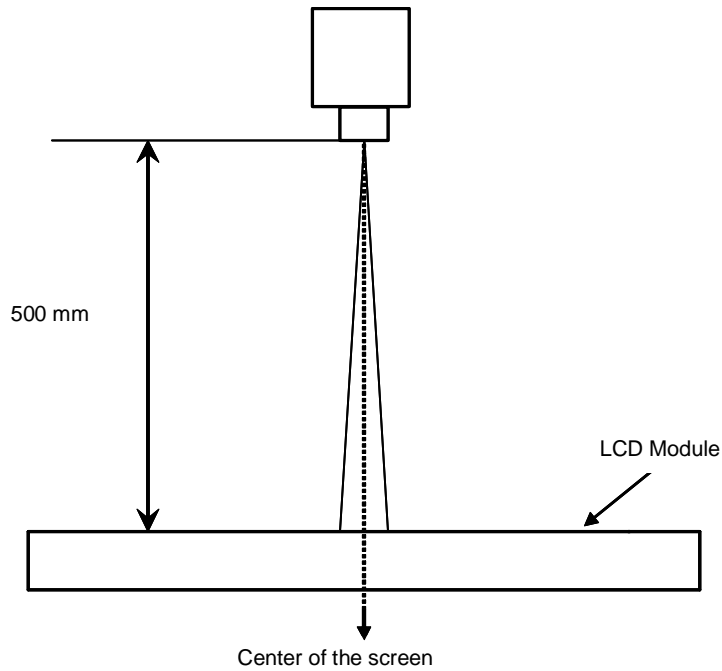
1. Test Equipment Setup

After stabilizing and leaving the panel alone at a given temperature for 20 minutes, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. 20 minutes after lighting the back-light. This should be measured in the center of screen.

-Back-Light ON Condition

Measuring Instrument : TOPCON BM-5A

Field : 1°



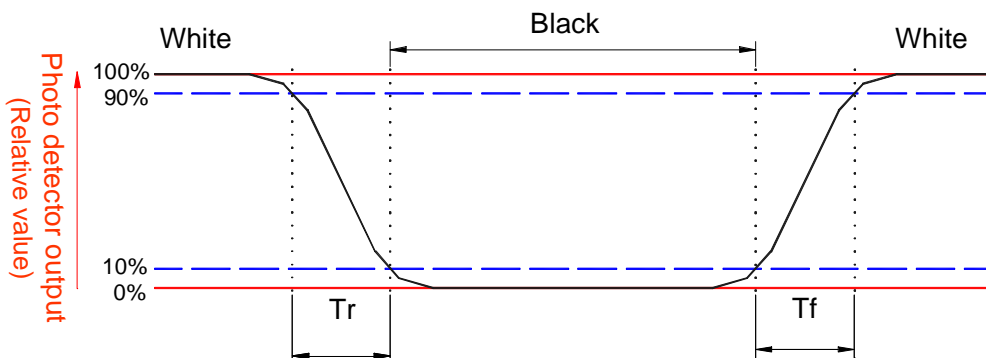
2. Definition of Contrast Ratio (CR): Ratio of gray max (Gmax) & gray min (Gmin) at the center Point

$$CR = \frac{G_{max}}{G_{min}}$$

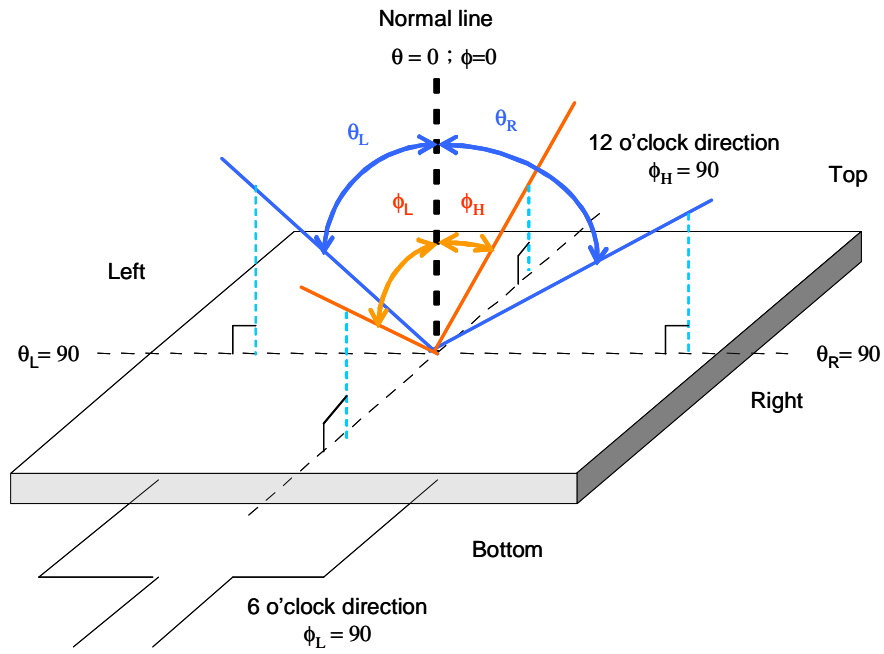
Gmax: Luminance with all pixels white

Gmin: Luminance with all pixels black

3. Definition of Luminance of white: Luminance of white at the center point
4. Definition of Response time: sum of Tr, Tf



5. Definition of Viewing Angle: Viewing angle range ($CR \geq 10$)



4. Reliability test items

Reliability levels in Mass production

| 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 | -10°C± 3°C for 240 hours | |
| High temperature and humidity Operation | +60°C± 3°C, 90%± 3%RH max. for 240 hours | Operation |
| Thermal shock | -30°C /1h ~ +80°C/1h for a total 50 cycles, Start with cold temp and end with high temp | Non-operation |
| Vibration | Frequency range :10~55Hz Stoke :1.5mm Sweep:10~55Hz~10Hz 2 hours for each direction of X,Y,Z (6 hours for total) | JIS C7021, A-10 condition A |
| Mechanical shock | 100G,6ms, ±X, ±Y, ±Z 3 times for each direction | JIS C7021, A-7 condition C |
| Package drop Test (with carton) | 60 cm high /3 times/ each 6 plane /total 18 drops | |
| Package vibration test (with carton) | Random Vibration 0.015G*G/HZ from 5-200HZ,-6dB/octave from 200-500HZ | IEC 68-34 |
| Electro-static discharge | ±2kV Human Body Mode, 100pF/1500Ω | Non-operation |
| | ±200V Machine Model 200pF/no series resistance | |

Note:

- 1 High temp storage & High temp/High humidity Op the polarizer is out of subject.
- 2 The test samples have recovery time 2 hours at room temp before function check.
- 3 No changes (affecting reliability or performance) shall be allowed on production material, process, or manufacturing locations, regardless of whether such changes affect characteristics specified.

5. Handling Precautions

5.1 Safety

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.

5.2 Handling

- 5.2.1 The LCD panel is plate glass. **DO NOT** subject the panel to mechanical shock or to excessive force on its surface.
- 5.2.2 The polarizer attached to the display is very easy to damage, handle it with careful attention.
- 5.2.3 To avoid contamination on the display surface, **DO NOT** touch the display surface with bare hands.
- 5.2.4 Provide a space so that the LCD panel does not come into contact with other components.
- 5.2.5 To protect the LCD panel from external pressure, put covering glass (acrylic board or similar board) keeping appropriate gap between them.
- 5.2.6 Transparent electrodes may be disconnected if you use the LCD panel under environmental conditions where dew condensation occurs.
- 5.2.7 Property of semiconductor devices may be affected when they are exposed to light, possibly resulting in malfunctioning of the ICs.
- 5.2.8 To prevent such malfunctioning of the ICs, your design and mounting layout done are so that the IC is not exposed to light in actual use.

5.3 Static electricity

- 5.3.1 Ground soldering iron tips, tools and testers when you operate.
- 5.3.2 Ground your body when handling the products.
- 5.3.3 **DO NOT** apply voltage to the input terminal without applying power supply.
- 5.3.4 **DO NOT** apply voltage which exceeds the absolute maximum rating.
- 5.3.5 Store the products in an anti-electrostatic container.

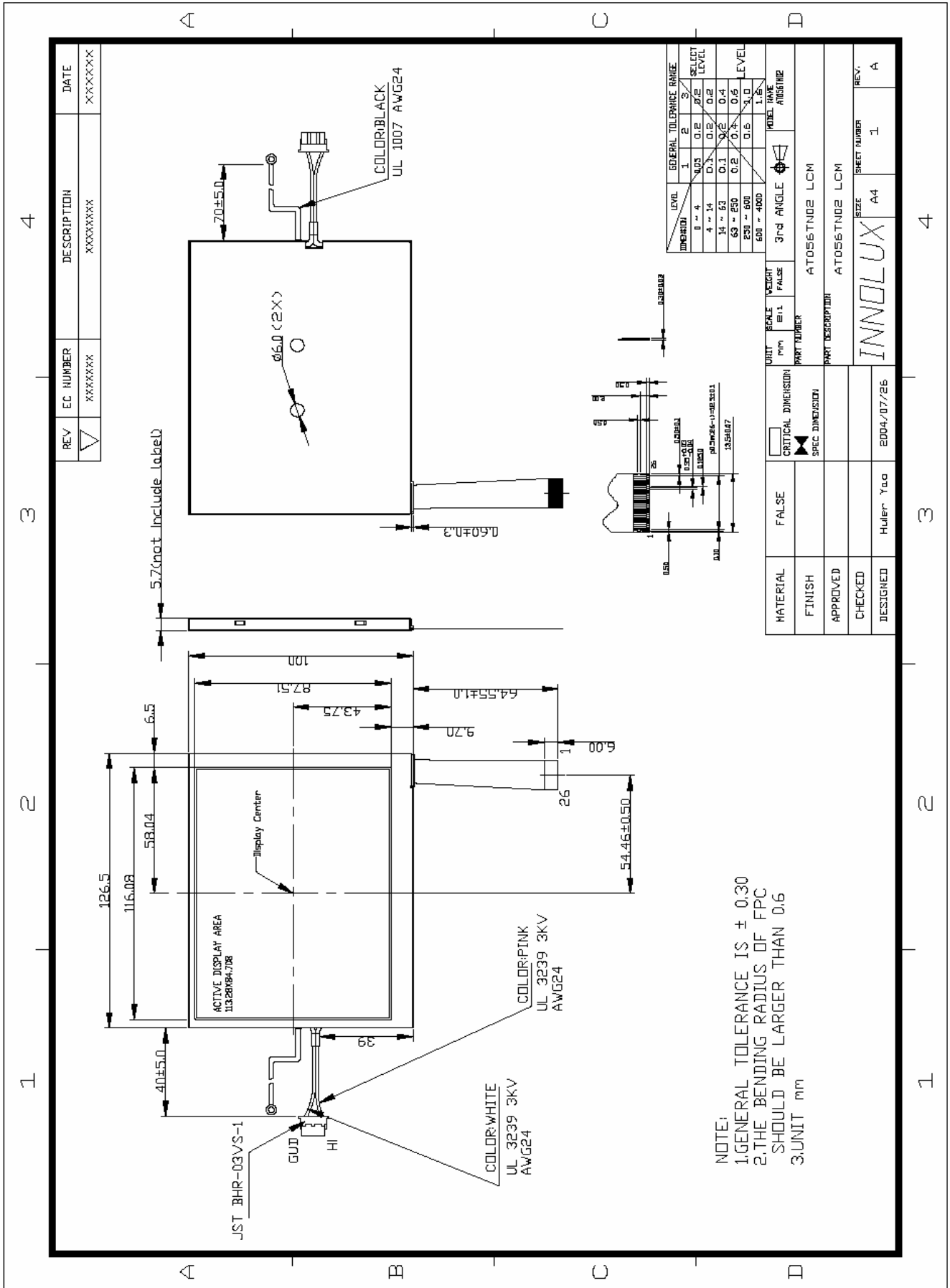
5.4 Storage

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

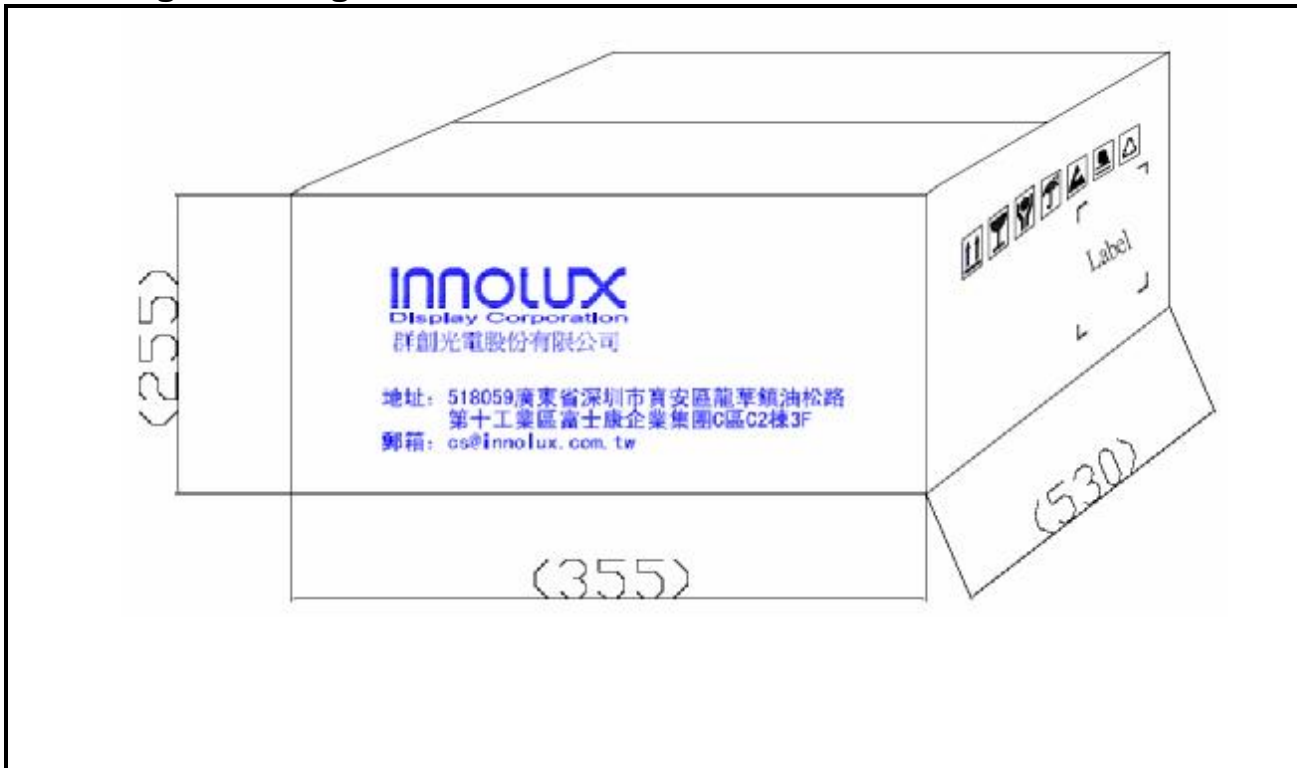
5.5 Cleaning

- 5.5.1 **DO NOT** wipe the polarizer with dry cloth, as it might cause scratch.
- 5.5.2 Wipe the polarizer with a soft cloth soaked with petroleum IPA, other chemical might damage.

6. Mechanical dimensions



7. Package drawing



Label

| | |
|------------------------|--|
| INNOLUX DISPLAY | |
| Customer Name : | |
| Customer P/N : | |
| Box ID: | |
| Model No: | |
| Quantity: | |
| MFG Date: | |
| QC: | |
| | |

