

Date : 2021/08/02

Customer:
Model Name: AT056TN53 V.1
Date: 2021/08/02
Version: 01

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

For Customer's Acceptance

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

| Approved by | Reviewed by | Prepared by |
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1. General Specifications

| No. | Item | Specification | Remark |
|-----|-----------------------------|-------------------------------|--------|
| 1 | LCD size | 5.6 inch(Diagonal) | |
| 2 | Driver element | a-Si TFT active matrix | |
| 3 | Resolution | 640 × (RGB) × 480 | |
| 4 | Display mode | Normally White, Transmissive | |
| 5 | Dot pitch | 0.0588(W) × 0.1764(H) mm | |
| 6 | Active area | 112.896 (W) × 84.672(H) mm | |
| 7 | Module size | 126.5(W) × 100(H) × 5.7(D) mm | Note 1 |
| 8 | Surface treatment | Anti-Glare | |
| 9 | Color arrangement | RGB-stripe | |
| 10 | Interface | Digital | |
| 11 | Backlight Power consumption | 1.90W(Typ.) | Note 2 |
| 12 | Panel Power consumption | 0.66 W(Typ.) | Note 3 |
| 13 | Weight | 83.1g(Typ.) | |

Note 1: Refer to Mechanical Drawing.

Note 2: Including LED Driver power consumption.

Note 3: Including T-con Board power consumption @ black pattern.

2.Pin Assignment

TFT LCD Panel Driving Section

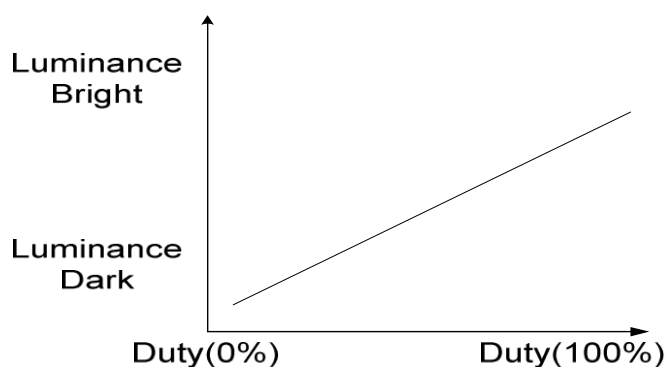
FPC connector is used for the module electronics interface. The recommended model is FH19-40S -0.5SH manufactured by HiRose.

| Pin No. | Symbol | I/O | Function | Remark |
|---------|------------------|-----|--|---------|
| 1 | V _{LED} | P | Power Voltage for LED circuit | |
| 2 | V _{LED} | P | Power Voltage for LED circuit | |
| 3 | ADJ | I | Adjust the LED brightness with PWM Pulse | Note1,2 |
| 4 | G _{LED} | P | Ground for LED circuit | |
| 5 | G _{LED} | P | Ground for LED circuit | |
| 6 | V _{CC} | P | Power Voltage for digital circuit | |
| 7 | V _{CC} | P | Power Voltage for digital circuit | |
| 8 | MODE | I | DE or HV mode control | Note 3 |
| 9 | DE | I | Data enable | |
| 10 | VS | I | Vsync signal input | |
| 11 | HS | I | Hsync signal input | |
| 12 | GND | P | Power ground | |
| 13 | B5 | I | Blue data input (MSB) | |
| 14 | B4 | I | Blue data input | |
| 15 | B3 | I | Blue data input | |
| 16 | GND | P | Power ground | |
| 17 | B2 | I | Blue data input | |
| 18 | B1 | I | Blue data input | |
| 19 | B0 | I | Blue data input(LSB) | |
| 20 | GND | P | Power ground | |
| 21 | G5 | I | Green data input(MSB) | |
| 22 | G4 | I | Green data input | |
| 23 | G3 | I | Green data input | |
| 24 | GND | P | Power ground | |

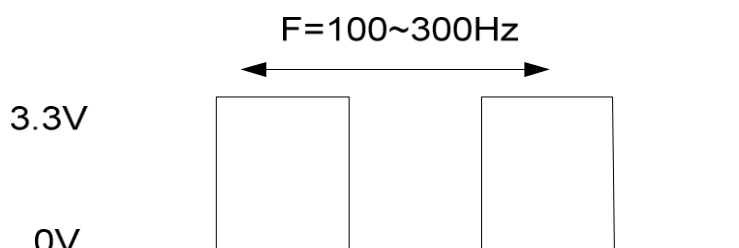
| | | | | |
|----|------|---|---|---------|
| 25 | G2 | I | Green data input | |
| 26 | G1 | I | Green data input | |
| 27 | G0 | I | Green data input(LSB) | |
| 28 | GND | P | Power ground | |
| 29 | R5 | I | Red data input(MSB) | |
| 30 | R4 | I | Red data input | |
| 31 | R3 | I | Red data input | |
| 32 | GND | P | Power ground | |
| 33 | R2 | I | Red data input | |
| 34 | R1 | I | Red data input | |
| 35 | R0 | I | Red data input(LSB) | |
| 36 | GND | P | Power ground | |
| 37 | DCLK | I | Dot clock | |
| 38 | GND | P | Power ground | |
| 39 | L/R | I | Select left to right scanning direction | Note4,5 |
| 40 | U/D | I | Select up or down scanning direction | Note4,5 |

Note: I: input, O: output, P: Power

Note1: Pin.3 is used to adjust brightness.



Note 2: ADJ signal=0~3.3V, operation frequency: 100~300Hz



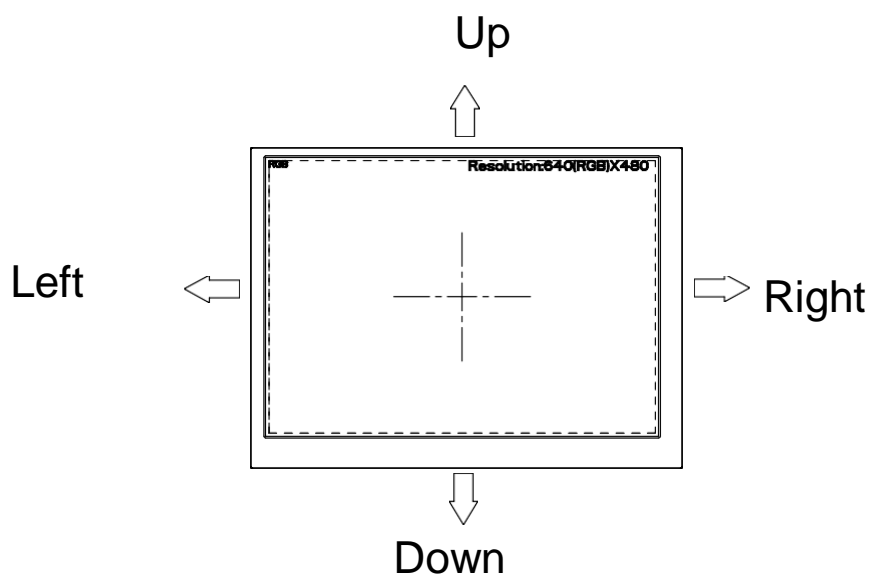
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Note 3: DE Mode, Mode="H", HS floating and VS floating
HV Mode, Mode="L" and DE floating

Note 4: Selection of scanning mode

| Setting of scan control input | | Scanning direction |
|-------------------------------|-----------------|---------------------------|
| U/D | L/R | |
| GND | V _{CC} | Up to down, left to right |
| V _{CC} | GND | Down to up, right to left |
| GND | GND | Up to down, right to left |
| V _{CC} | V _{CC} | Down to up, left to right |

Note 5: Definition of scanning direction.
Refer to the figure as below:



3. Operation Specifications

3.1. Absolute Maximum Ratings

(Note 1)

| Item | Symbol | Values | | Unit | Remark |
|-----------------------|-----------|--------|------|------|--------|
| | | Min. | Max. | | |
| Power voltage | V_{CC} | -0.3 | 4 | V | |
| | V_{LED} | -0.3 | 6.5 | V | |
| Operation temperature | T_{OP} | -20 | 70 | °C | |
| Storage temperature | T_{ST} | -30 | 80 | °C | |

Note 1: 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.

3.2. Typical Operation Conditions

| Item | Symbol | Values | | | Unit | Remark |
|--------------------------|------------|-------------|------|-------------|------|-----------------|
| | | Min. | Typ. | Max. | | |
| Power voltage | V_{CC} | 3.1 | 3.3 | 3.5 | V | Note 1 |
| | V_{LED} | 4.8 | 5.0 | 5.2 | V | Note 2 |
| Current Consumption | I_{VCC} | - | 200 | 250 | mA | @ black pattern |
| | I_{VLED} | - | 380 | 450 | mA | Note 3 |
| Input logic high voltage | V_{IH} | $0.7V_{CC}$ | - | $1V_{CC}$ | V | Note 4 |
| Input logic low voltage | V_{IL} | 0 | - | $0.3V_{CC}$ | V | |
| LED life time | - | 20,000 | - | - | Hr | Note 5 |

Note 1: V_{CC} setting should match the signals output voltage (refer to Note 4) of customer's system board.

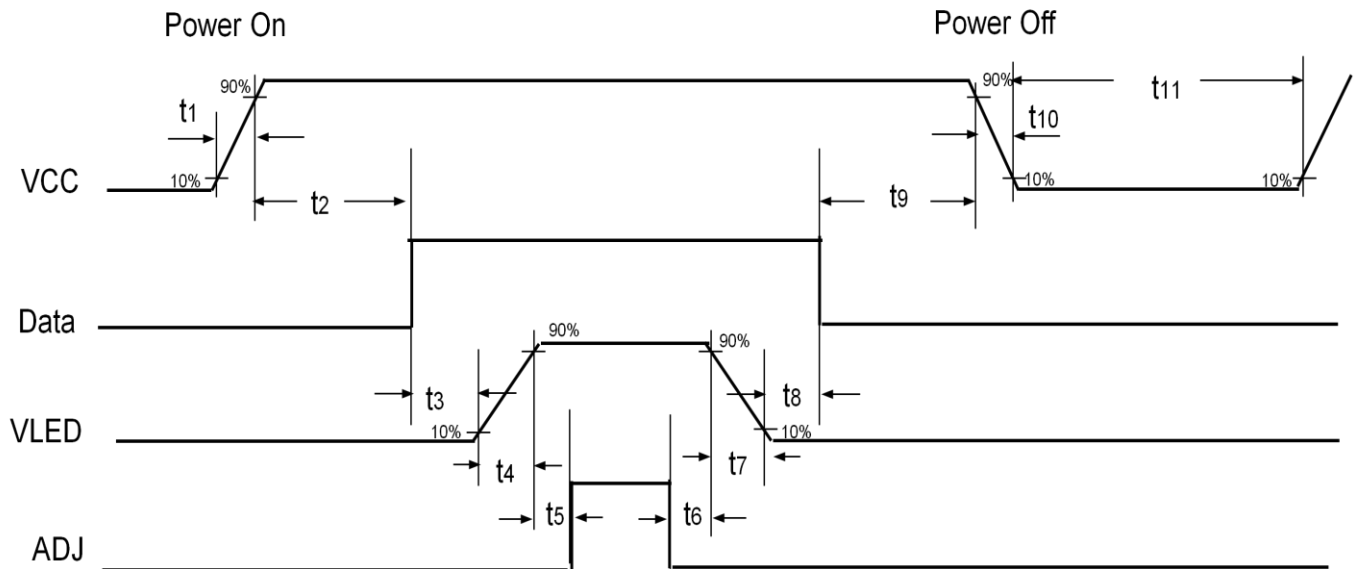
Note 2: LED driving voltage.

Note 3: LED driving current.

Note 4: DCLK, DE, HS, VS, R0~ R5, G0~ G5, B0~ B5.

Note 5: The "LED life time" is defined as the module brightness decrease to 50% original brightness at $T_a=25^{\circ}\text{C}$ and $V_{LED}=5.0\text{V}$. The LED lifetime could be decreased if operating V_{LED} is larger than 5.0V.

3.3.Power Sequence



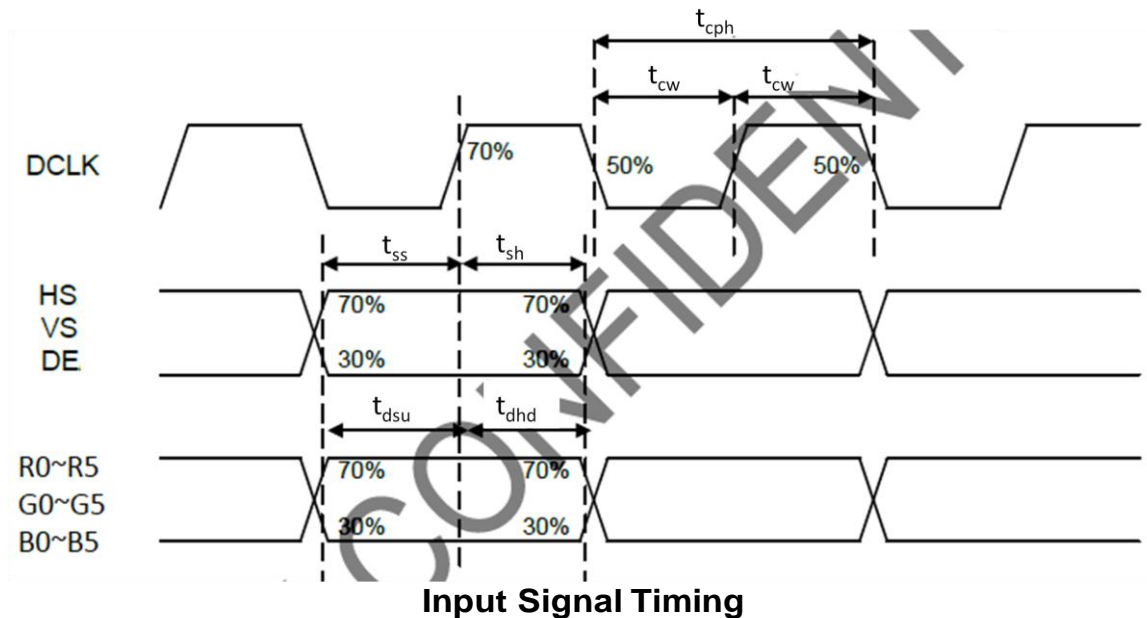
Note: Data includes DE, VS, HS, R0~ R5, G0~ G5, B0~ B5, DCLK.

Timing spec as below table

| Item | Min | Typ | Max | Unit |
|----------|-----|-----|-----|------|
| t_1 | 1 | - | 10 | ms |
| t_2 | 50 | - | - | ms |
| t_3 | 200 | - | - | ms |
| t_4 | 1 | - | 10 | ms |
| t_5 | 0 | - | - | ms |
| t_6 | 0 | - | - | ms |
| t_7 | 0 | - | 10 | ms |
| t_8 | 200 | - | - | ms |
| t_9 | 200 | - | - | ms |
| t_{10} | 0 | - | 10 | ms |
| t_{11} | 500 | - | - | ms |

3.4. Timing Characteristics

3.4.1. TTL mode AC electrical characteristics

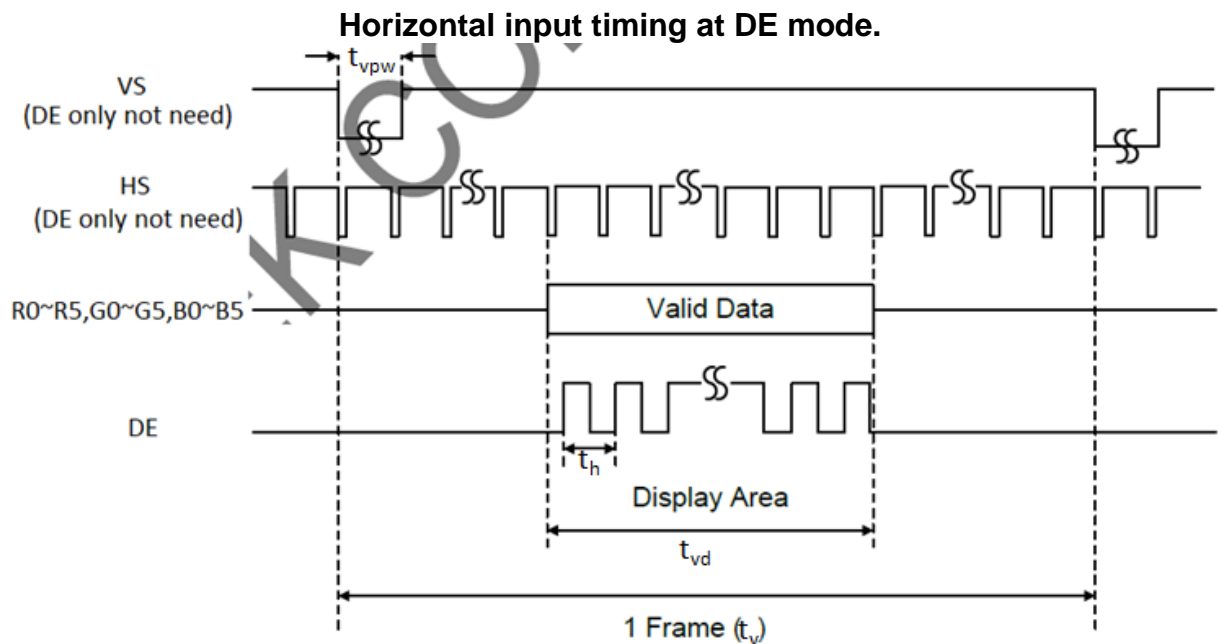
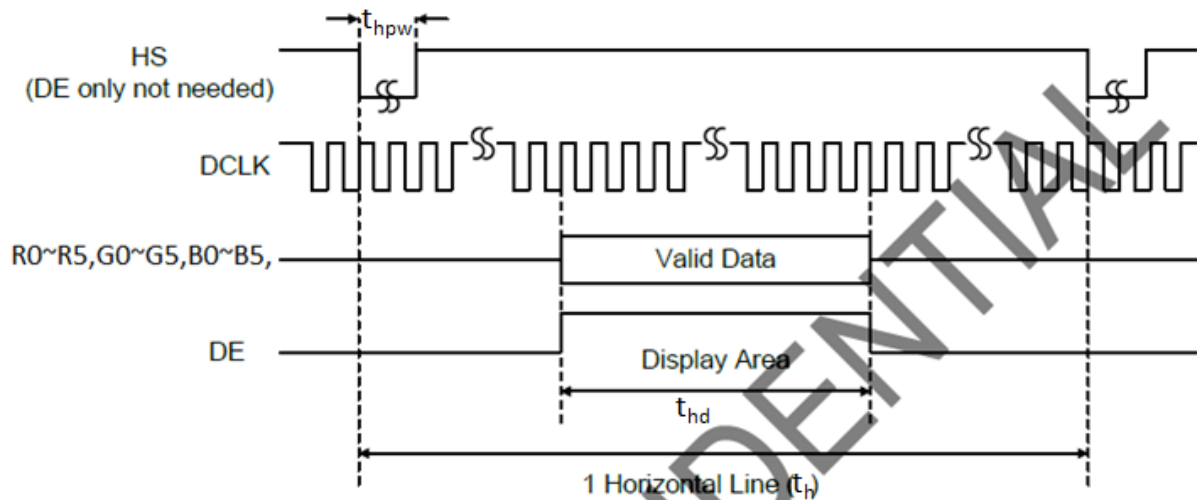


Input data/Sync. Parameters

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|-------------------|-----------|------|------|------|------|
| DCLK period | T_{cph} | 16.7 | - | - | ns |
| DCLK duty ratio | T_{cw} | 40 | 50 | 60 | % |
| Data setup time | T_{dsu} | 5 | - | - | ns |
| Data hold time | T_{dhd} | 5 | - | - | ns |
| VS/POL setup time | T_{ss} | 5 | - | - | ns |
| VS/POL hold time | T_{sh} | 5 | - | - | ns |
| HS/DIO setup time | T_{ss} | 5 | - | - | ns |
| HS/DIO hold time | T_{sh} | 5 | - | - | ns |
| DE/LD setup time | T_{ss} | 5 | - | - | ns |
| DE/LD hold time | T_{sh} | 5 | - | - | ns |

3.4.2. TTL mode DC electrical characteristics

3.4.2.1 Parallel RGB at DE only mode

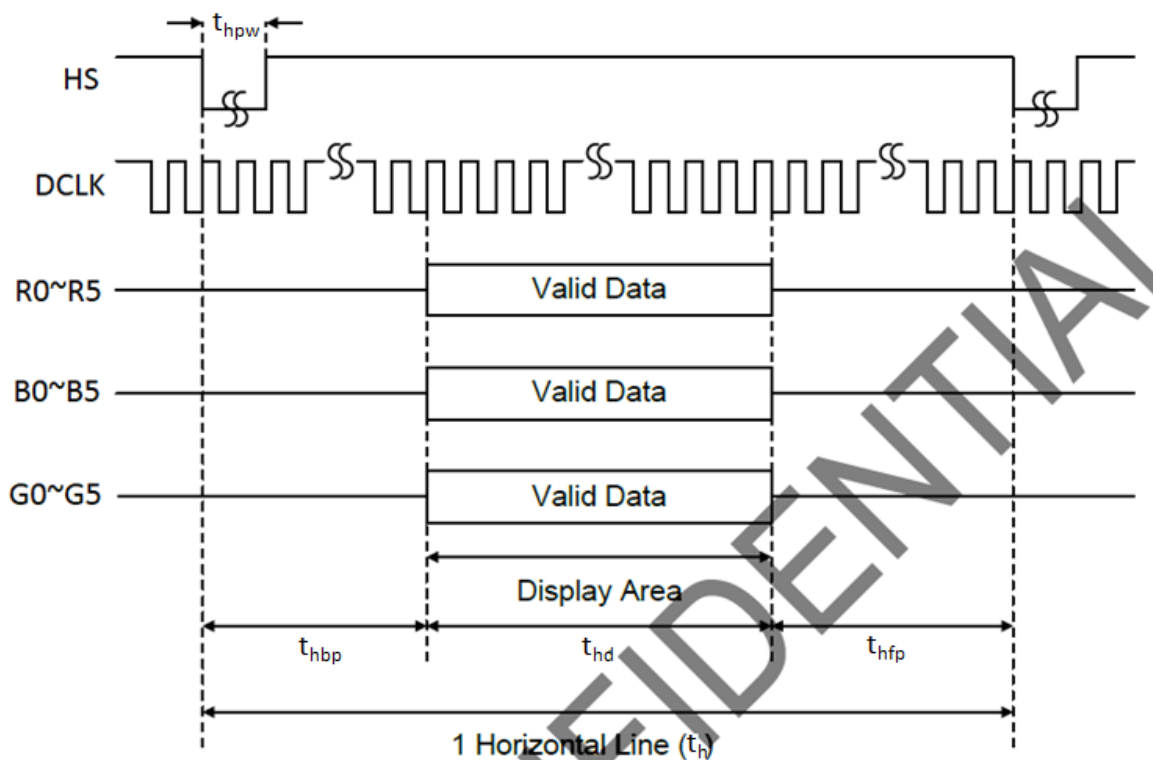


DE mode timing

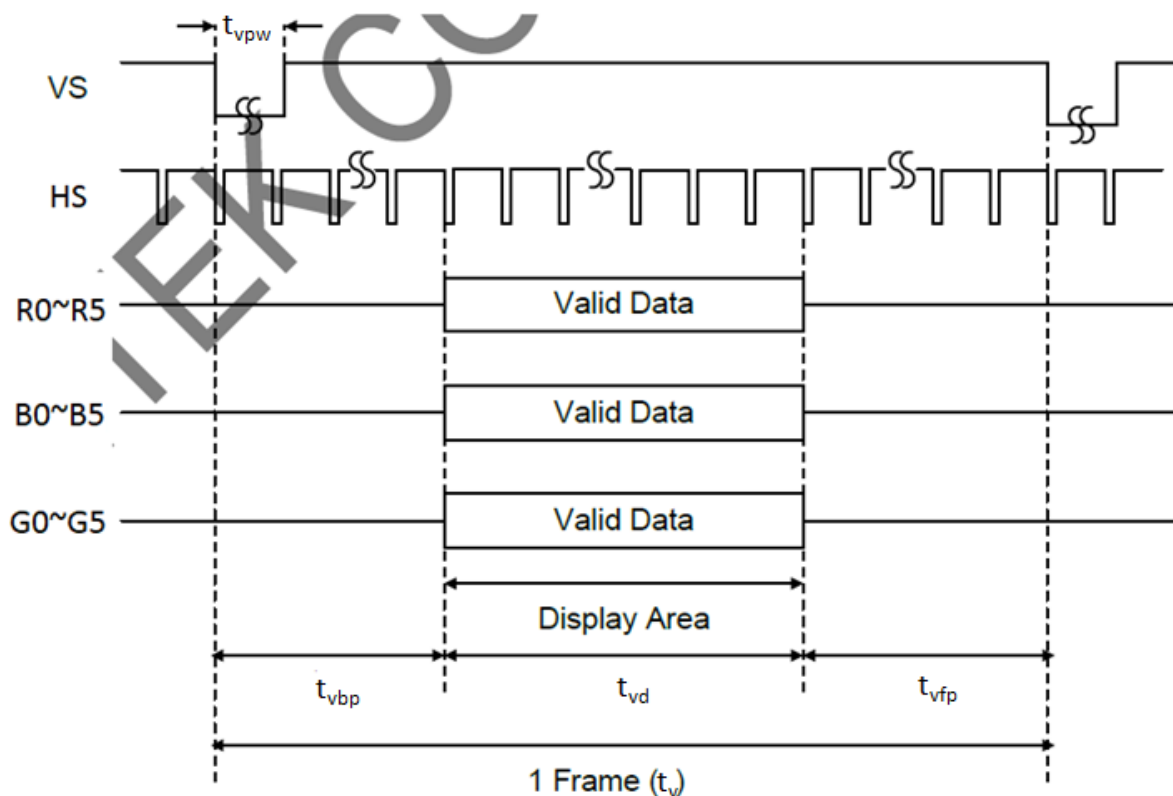
DE only mode 640xRGBx480

| Parameter | Symbol | Panel Resolution | | | Unit |
|-------------------------|-------------------|--------------------|------|------|------|
| | | 1 port 640xRGBx480 | | | |
| | | Min. | Typ. | Max. | |
| DCLK frequency | F _{DCLK} | 20.0 | 23.0 | 31.2 | MHz |
| Horizontal display area | t _{hd} | 640 | 640 | 640 | DCLK |
| 1 horizontal line | t _h | 669 | 776 | 832 | DCLK |
| Vertical display area | t _{vd} | 480 | 480 | 480 | H |
| 1 vertical field | t _v | 487 | 493 | 624 | H |
| Frame rate | FR | - | 60 | - | Hz |

3.4.2.2 Parallel RGB at Sync mode (HV mode)



Horizontal input timing at sync mode.



Vertical input timing at sync mode.

HV mode timing

Sync mode 640xRGBx480

| Parameter | Symbol | Panel Resolution | | | Unit |
|-------------------------|-----------------------------|--------------------|------|------|------|
| | | 1 port 640xRGBx480 | | | |
| | | Min. | Typ. | Max. | |
| DCLK frequency | F _{DCLK} | 20.0 | 23.0 | 31.2 | MHz |
| Horizontal display area | t _{hd} | 640 | 640 | 640 | DCLK |
| Hsync pulse Width | t _{h_{pw}} | 10 | 12 | 255 | DCLK |
| Hsync back porch | t _{h_{bp}} | 5 | 16 | 255 | DCLK |
| Hsync front porch | t _{h_{fp}} | 24 | 120 | 260 | DCLK |
| 1 horizontal line | t _h | 669 | 776 | 832 | DCLK |
| Vertical display area | t _{vd} | 480 | 480 | 480 | H |
| Vsync pulse width | t _{vpw} | 1 | 3 | 20 | H |
| Vsync back porch | t _{vbp} | 2 | 5 | 255 | H |
| Vsync front porch | t _{vfp} | 5 | 8 | 260 | H |
| 1 vertical field | t _v | 487 | 493 | 624 | H |
| Frame rate | FR | - | 60 | - | Hz |

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 | | 0.26 | 0.31 | 0.36 | - | Note 2 |
| | W_Y | | 0.28 | 0.33 | 0.38 | - | Note 5 Note 6 |
| Luminance | L_1 | | 280 | 350 | - | cd/m ² | Note 6 |
| Luminance uniformity | Y_U | | 70 | 75 | - | % | Note 6,7 |

Test Conditions:

1. $V_{CC}=3.3V$, $V_{LED}=5.0V$, the ambient temperature is $25^\circ C$.
2. The test systems refer to Note 2.

Note 1: Definition of viewing angle range

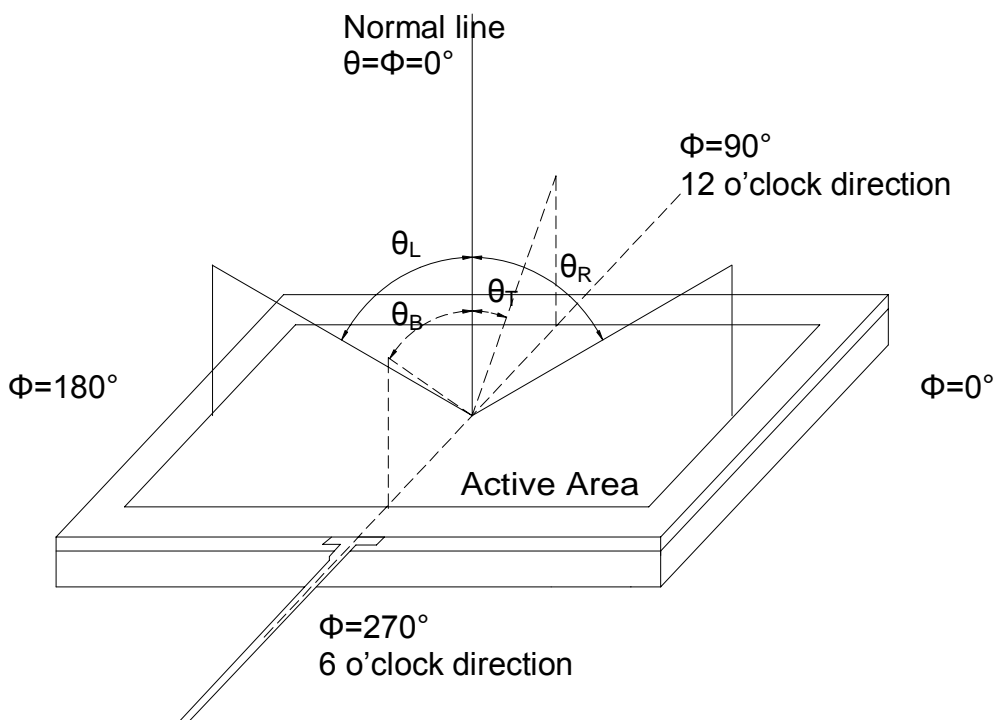


Fig. 4-1 Definition of viewing angle

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.)

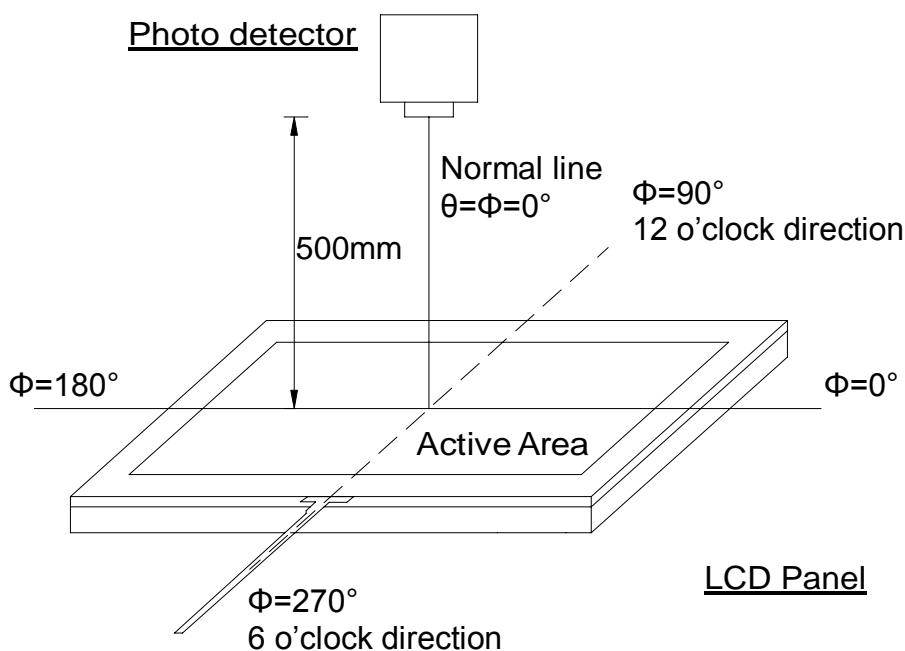


Fig. 4-2 Optical measurement system setup

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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%.

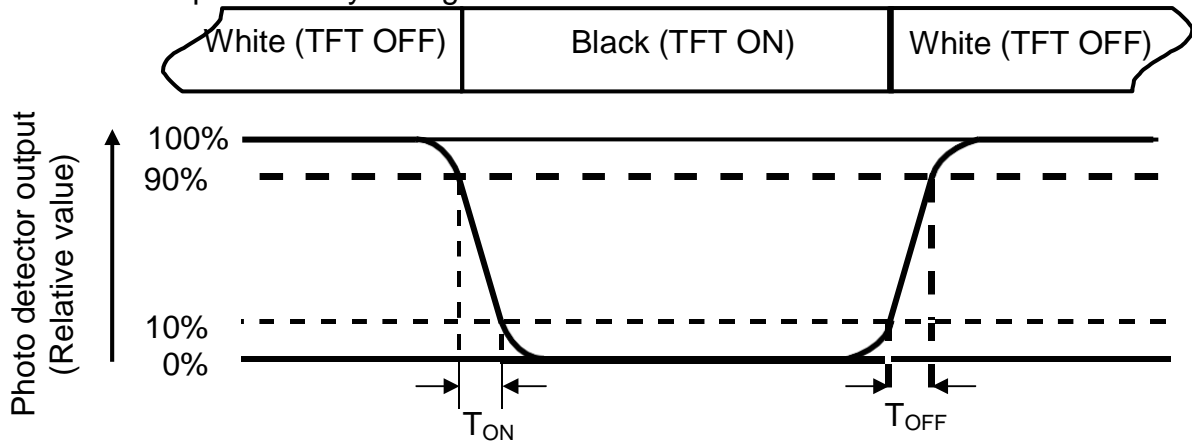


Fig. 4-3 Definition of response time

Note 4: Definition of contrast ratio

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

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. The LED driving condition is $V_{LED}=5.0V$

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

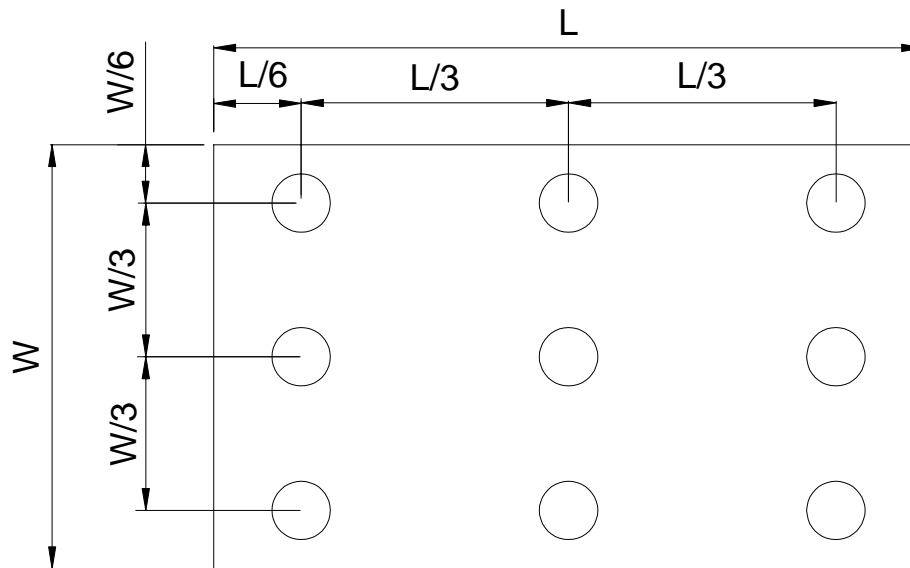


Fig. 4-4 Definition of measuring points

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

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

5. Reliability Test

| Item | Test Conditions | | Remark |
|--|---|---------|-----------|
| High Temperature Storage | 80°C | 240 hrs | Note 1, 2 |
| Low Temperature Storage | -30°C | 240hrs | Note 1, 2 |
| High Temperature Operation | 70°C | 240hrs | Note 1, 2 |
| Low Temperature Operation | -20°C | 240hrs | Note 1, 2 |
| Operate at High Temperature and Humidity | +40°C, 90%RH | 240 hrs | Note 1, 2 |
| 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 1, 2 |
| Vibration Test | Frequency: 1.5G / 10-500Hz, 30min/cycle, 1cycle for each X, Y, Z | | Note 2 |
| Mechanical Shock | 100G 6ms, ±X, ±Y, ±Z 1 times for each direction | | Note 2 |
| Package Vibration Test | 1.14Grms Random frequency 1~200Hz 30min/Bottom, 15min/Right-Left, 15min/Front-Back | | Note 2 |
| Package Drop Test | Height:60 cm 1 corner, 3 edges, 6 surfaces | | Note 2 |
| Electro Static Discharge | ± 2KV, Human Body Mode, 100pF/1500Ω | | Note 2 |

Note 1: The test samples have recovery time need more than 2 hours at room temperature before the function check. In the standard conditions, there is no abnormal display function occurred.

Note 2: After the reliability test, the product only guarantees operational function, but don't guarantee all of the cosmetic specification.

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

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

6.3. Static Electricity

- 6.3.1.** Be sure to ground module before turning on power or operating module.
- 6.3.2.** Do not apply voltage which exceeds the absolute maximum rating value.

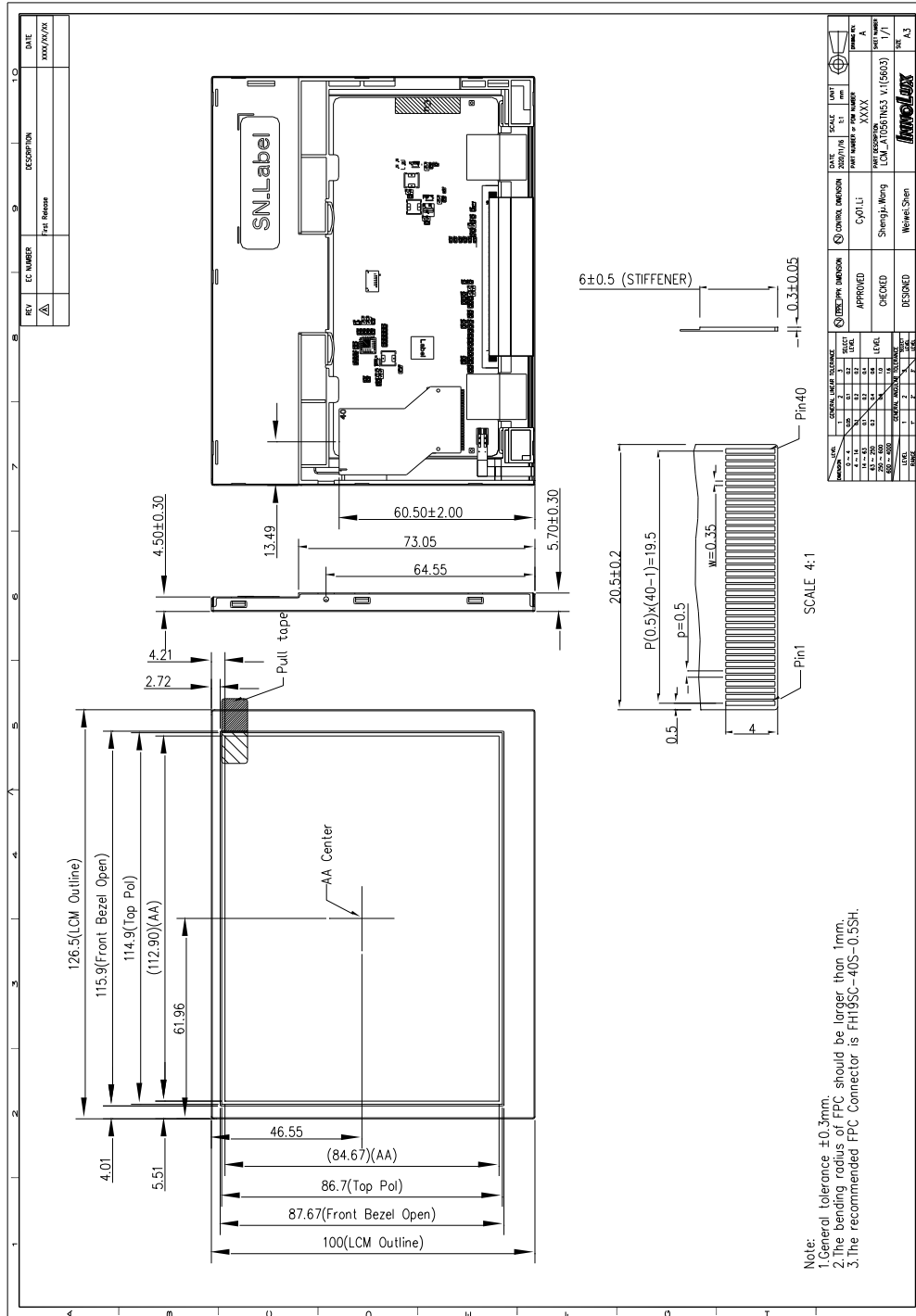
6.4. Storage

- 6.4.1.** Store the module in a dark room where must keep at $+25\pm 10^{\circ}\text{C}$ and 65%RH or less.
- 6.4.2.** Do not store the module in surroundings containing organic solvent or corrosive gas.
- 6.4.3.** Store the module in an anti-electrostatic container or bag.

6.5. Cleaning

- 6.5.1.** Do not wipe the polarizer with dry cloth. It might cause scratch.
- 6.5.2.** 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

