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Specifications

TFT-LCD module

Model No: AML240H45100-A

| For Customer's Acceptance | |
|----------------------------------|----------------|
| Approved by | Comment |
| | |

| | Signature | Date |
|--------------------|------------------|-------------|
| Prepared by | | |
| Checked by | | |
| Approved by | | |

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1. Document revision history :

| DOCUMENT REVISION | DATE | DESCRIPTION | PREPARED BY | APPROVED BY |
|-------------------|------------|----------------|-------------|-------------|
| A | 2017-11-04 | First Release. | | |

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2.General Description

AML240H45100-A is a transmissive type a-Si TFT-LCD (amorphous silicon thin film transistor liquid crystal display) module, which is composed of a TFT-LCD panel, a driver circuit a backlight unit, The panel size is 2.4 inch and the resolution is 240×320. High image quality a-Si TFT LCD module. Partial-screen display function is available. Sleep and Stand-by modes are available for power saving.

2.1 Features

| No | Item | Specification | Remark |
|----|-------------------|--------------------|--------|
| 1 | Display Mode | Normally Black | |
| 2 | Screen Size | 2.4inch (diagonal) | |
| 3 | Resolution | 240×RGB×320 | |
| 4 | Color Number | 262K | |
| 5 | Color Arrangement | TFT Active matrix | |
| 6 | Driver IC | ST7789V | |
| 7 | Back Light | White LED*4 | |
| 8 | Viewing Direction | ALL | |
| 9 | Interface | MCU | |
| 10 | Surface Treatment | -- | |
| 11 | touch panel | -- | |

2.2 Application

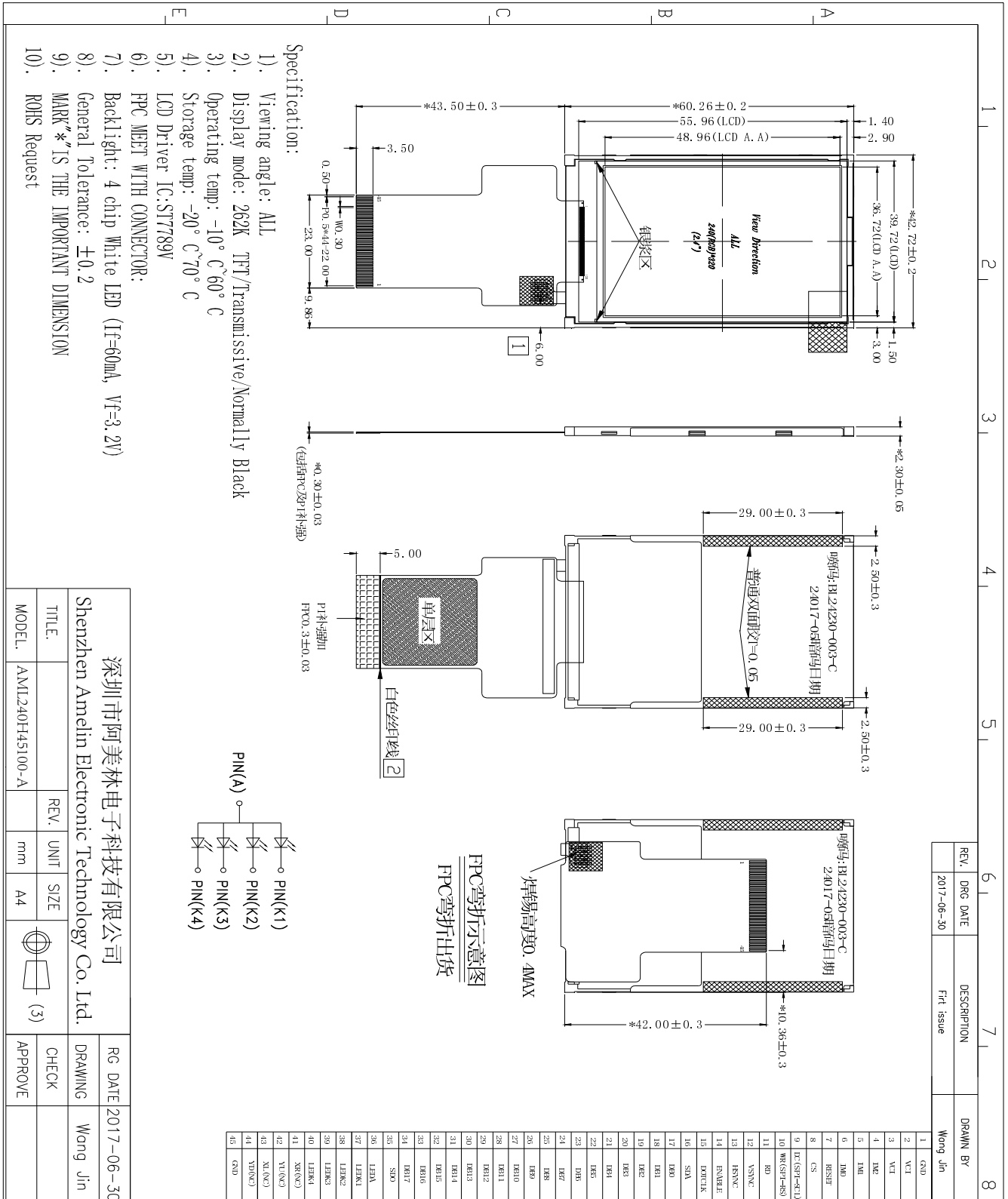
- ◆ Mobile phone.
- ◆ Portable multimedia device.

3.Outline Dimension

The mechanical detail is shown in Fig. 1 and summarized in Table 1 below.

| Parameter | Specifications | Unit |
|--------------------|--|------|
| Outline dimensions | 42.72(W) × 60.26(H) × 2.30(D) (LCM, not include FPC) | mm |
| Active area | 36.72(W) × 48.96(H) | mm |
| Resolution | 240(H)RGB × 320(V) dots | - |
| Dot size | 0.153(H) x 0.153(V) | mm |

Figure 1: Module specification of the module



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4.TFT-LCM Interface Specification

| Pin No | Symbol | Description | Note |
|--------|-------------|---|------|
| 1 | GND | System Ground | |
| 2-3 | VCI | Power supply input for LCM: 2.8 | |
| 4-6 | IM2-IM0 | Select interface | |
| 7 | /RESET | Reset signal input Pin | |
| 8 | CS | Chip select input pin. | |
| 9 | DC(SPI-SCL) | Display data/command selection pin in parallel interface. clock signal for serial interface. | |
| 10 | WR(SPI-RS) | Write enable in MCU parallel interface. Display data/command selection pin in 4-line serial interface. | |
| 11 | RD | Read signal | |
| 12 | VSYNC | Vertical (Frame) synchronizing input signal for RGB interface operation. | |
| 13 | HSYNC | Horizontal (Line) synchronizing input signal for RGB interface operation. | |
| 14 | ENABLE | Data enable signal for RGB interface operation. | |
| 15 | DOTCLK | Dot clock signal for RGB interface operation. | |
| 16 | SDA | SPI interface input pin | |
| 17-34 | DB0-DB17 | Data bus | |
| 35 | SDO | SPI interface output pin. | |
| 36 | LEDA | Power supply Anode input for backlight | |
| 37 | LEDK1 | Power supply Cathode input for backlight | |
| 38 | LEDK2 | Power supply Cathode input for backlight | |
| 39 | LEDK3 | Power supply Cathode input for backlight | |
| 40 | LEDK4 | Power supply Cathode input for backlight | |
| 41 | XR | NC | |
| 42 | YU | NC | |
| 43 | XL | NC | |
| 44 | YD | NC | |
| 45 | GND | System Ground | |

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5. Absolute Maximum Ratings

5.1 Electrical Maximum Ratings – for IC Only

Table 3: Electrical Maximum Ratings – for IC

| Parameter | Symbol | Min. | Max. | Unit | Note |
|------------------------------|--------|------|------|------|------|
| Power supply voltage (VCI) | VCI | -0.3 | +4.0 | V | 1 |
| Power supply voltage (IOVCC) | IOVCC | -0.3 | +3.6 | V | 1 |

Note:

1. IOVCC, VCI, GND must be maintained.
2. The modules may be destroyed if they are used beyond the absolute maximum ratings.

5.2 Environmental Condition

Table 4

| Item | Operating temperature (Topr) | | Storage temperature (Tstg) (Note 1) | | Remark |
|---------------------|--|-------|-------------------------------------|-------|-----------------|
| | Min. | Max. | Min. | Max. | |
| Ambient temperature | -10°C | +60°C | -20°C | +70°C | Dry |
| Humidity (Note 1) | 80% max. RH for Ta 40°C < 50% RH for 40°C < Ta Maximum operating temperature | | | | No condensation |

Note 1: Product cannot sustain at extreme storage conditions for long time.

6. Electrical Specifications

Typical Electrical Characteristics

At Ta = 25 °C, VCI = 2.6V to 3.3V, IOVCC = 1.65V to 3.3V GND = 0V.

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|---------------------------------------|------------------------|-------------------------|------|------|------|-------------------|
| Supply voltage (analog) | VCI-GND | | 2.6 | 2.8 | 3.3 | V |
| Supply voltage (logic) | IOVDD-GND | | 1.65 | 1.8 | 3.3 | V |
| Supply current (Logic & LCD) | ICC | VCI=2.8V | - | - | 10 | mA |
| Supply voltage of white LED backlight | VLED = V(BL+) - V(BL-) | Forward current = 60 mA | -- | 3.2 | -- | V |
| Luminance (on the module surface) | | Number of LED dies = 4 | -- | TBD | -- | cd/m ² |

7. Timing Characteristics

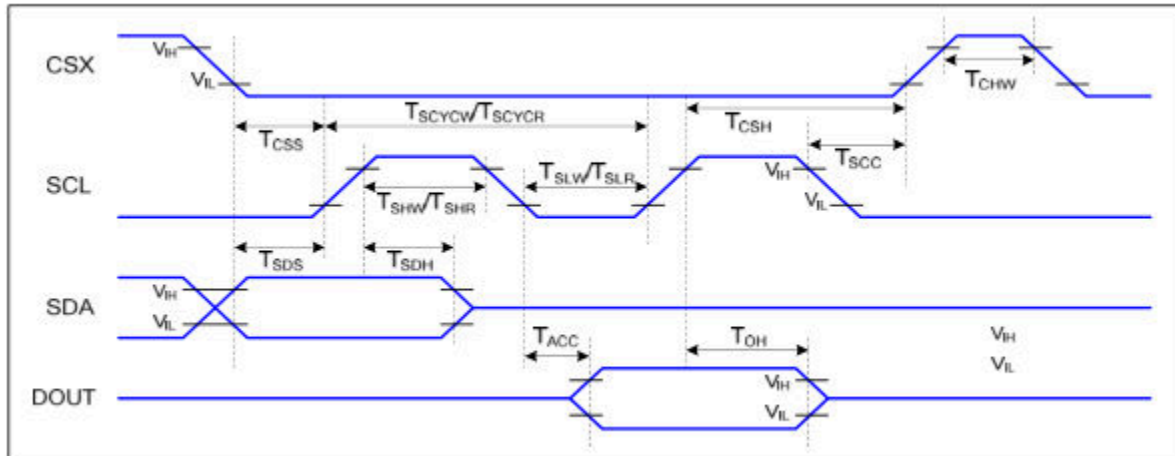


Figure 4 3-line serial Interface Timing Characteristics

VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=-30 to 70 °C

| Signal | Symbol | Parameter | Min | Max | Unit | Description |
|--------------|--------------------|--------------------------------|-----|-----|------|---------------------|
| CSX | T _{CSS} | Chip select setup time (write) | 15 | | ns | |
| | T _{CSH} | Chip select hold time (write) | 15 | | ns | |
| | T _{CSS} | Chip select setup time (read) | 60 | | ns | |
| | T _{SCC} | Chip select hold time (read) | 65 | | ns | |
| | T _{CHW} | Chip select "H" pulse width | 40 | | ns | |
| SCL | T _{SCYCW} | Serial clock cycle (Write) | 66 | | ns | |
| | T _{SHW} | SCL "H" pulse width (Write) | 15 | | ns | |
| | T _{SLW} | SCL "L" pulse width (Write) | 15 | | ns | |
| | T _{SCYCR} | Serial clock cycle (Read) | 150 | | ns | |
| | T _{SHR} | SCL "H" pulse width (Read) | 60 | | ns | |
| | T _{SLR} | SCL "L" pulse width (Read) | 60 | | ns | |
| SDA (DIN) | T _{SDS} | Data setup time | 10 | | ns | |
| | T _{SDH} | Data hold time | 10 | | ns | |
| DOUT | T _{ACC} | Access time | 10 | 50 | ns | For maximum CL=30pF |
| | T _{OH} | Output disable time | 15 | 50 | ns | For minimum CL=8pF |

Table 5 3-line serial Interface Characteristics

Note : The rising time and falling time (Tr, Tf) of input signal are specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

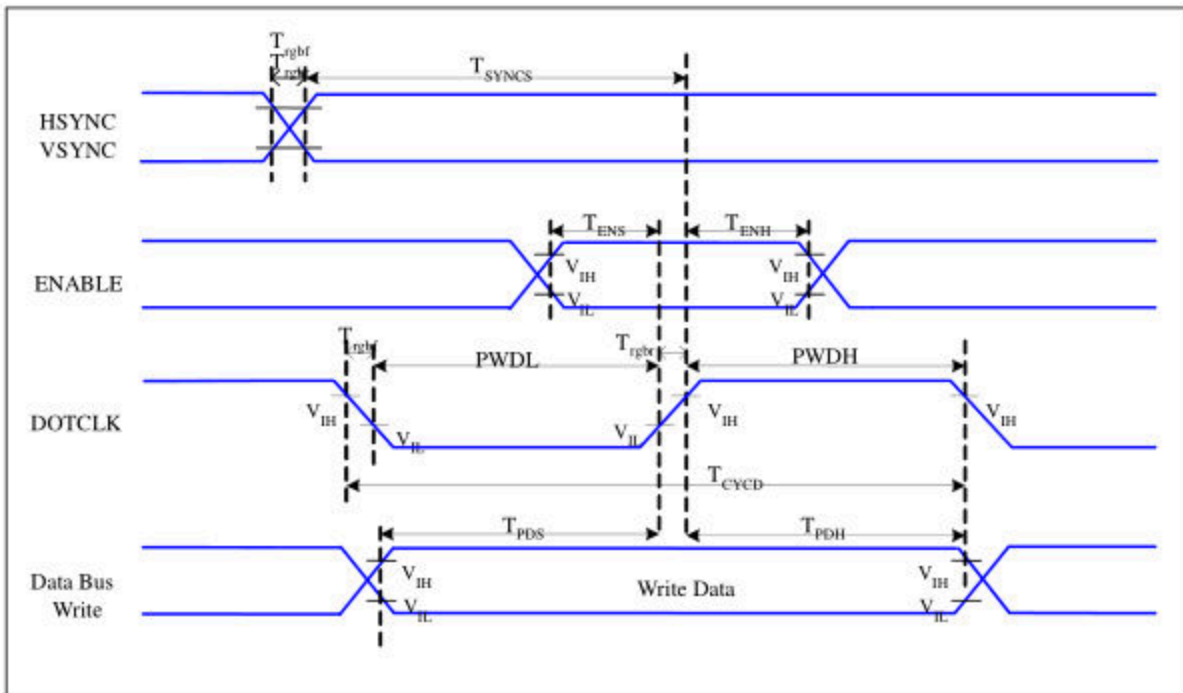


Figure 6 RGB Interface Timing Characteristics

$V_{DD1}=1.65$ to $3.3V$, $V_{DD}=2.4$ to $3.3V$, $AGND=DGND=0V$, $T_a=-30 \sim 70 \text{ }^\circ\text{C}$

| Signal | Symbol | Parameter | MIN | MAX | Unit | Description |
|--------------|------------------------------------|-------------------------------|-----|-----|------|-------------|
| HSYNC, VSYNC | T_{SYNC} | VSYNC, HSYNC Setup Time | 30 | - | ns | |
| ENABLE | T_{ENS} | Enable Setup Time | 25 | - | ns | |
| | T_{ENH} | Enable Hold Time | 25 | - | ns | |
| DOTCLK | PWDH | DOTCLK High-level Pulse Width | 60 | - | ns | |
| | PWDL | DOTCLK Low-level Pulse Width | 60 | - | ns | |
| | T_{CYCD} | DOTCLK Cycle Time | 120 | - | ns | |
| | $T_{\text{rghr}}, T_{\text{rgbf}}$ | DOTCLK Rise/Fall time | - | 20 | ns | |
| DB | T_{PDS} | PD Data Setup Time | 50 | - | ns | |
| | T_{PDH} | PD Data Hold Time | 50 | - | ns | |

Table 7 18/16 Bits RGB Interface Timing Characteristics

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8. Power Supply Configuration

19.4.1. Power Structure

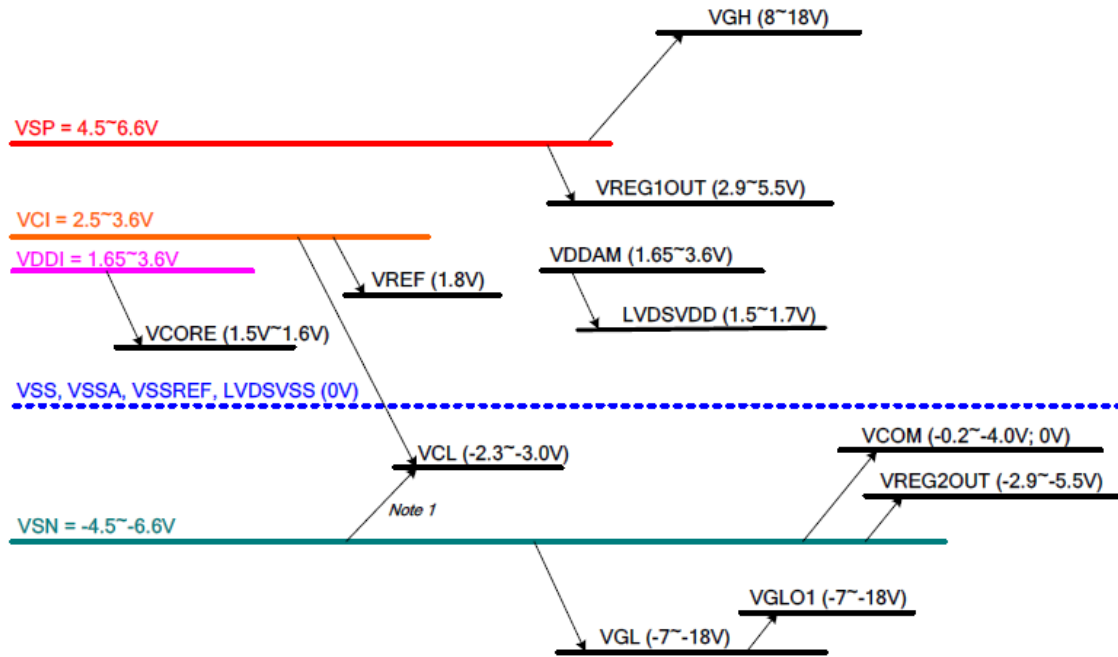


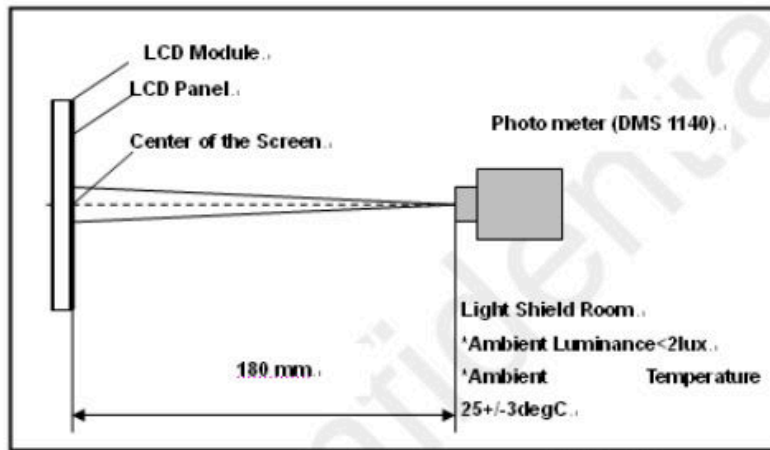
Figure 130: Power Structure of Power Mode 4

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9.Optical Specification

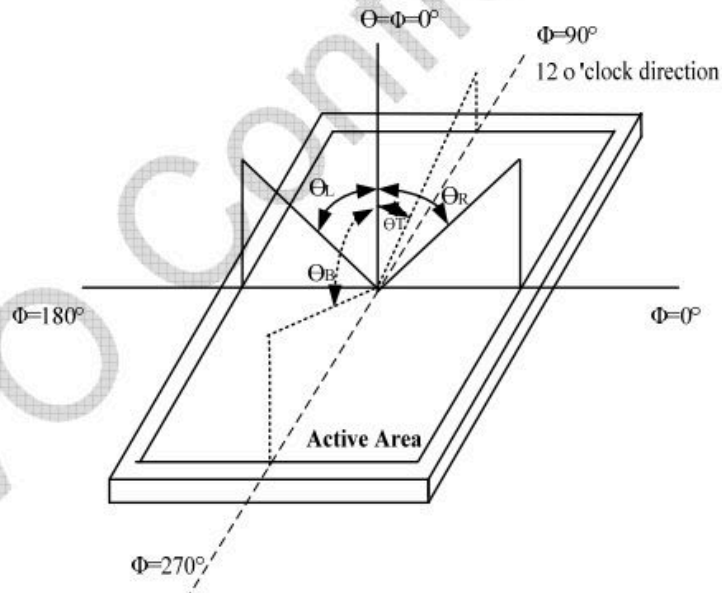
| Item | | Symbol | Condition | Min. | Typ. | Max. | Unit | Note |
|--------------------------------------|---------|----------------|-----------------------------------|-------|-------|-------|------|---|
| Transmittance (with Polarizer) | | T (%) | Θ=0 Normal viewing angle | — | 4.65 | — | % | Measuring with Polarizer , Reference Only |
| Transmittance (without Polarizer) | | T (%) | | — | 14.6 | — | % | |
| Contrast | | CR | | 640 | 800 | — | — | (1)(2) |
| Response time | Rising | T _R | | — | 16 | 21 | msec | (1)(3) |
| | Falling | T _F | | — | 19 | 24 | | |
| Color gamut | | (%) | | — | 70 | — | % | C-light |
| Color chromaticity (CIE1931) | White | W _x | | 0.290 | 0.310 | 0.330 | — | (1)(4) CF glass |
| | | W _y | 0.316 | 0.336 | 0.356 | | | |
| | Red | R _x | 0.627 | 0.647 | 0.667 | — | | |
| | | R _y | 0.297 | 0.317 | 0.337 | | | |
| | Green | G _x | 0.255 | 0.275 | 0.295 | — | | |
| | | G _y | 0.562 | 0.582 | 0.602 | | | |
| | Blue | B _x | 0.120 | 0.140 | 0.160 | — | | |
| | | B _y | 0.068 | 0.088 | 0.108 | | | |
| Viewing angle | Hor. | Θ _L | CR>10 | — | 80 | — | — | (1)(4) Measuring with Polarizer , Reference Only |
| | | Θ _R | | — | 80 | — | | |
| | Ver. | Θ _U | | — | 80 | — | | |
| | | Θ _D | | — | 80 | — | | |
| Optima View Direction | | Free | | | | | (5) | |

Figure 2 Measurement Setup



Note (2) Definition of Viewing Angle

Figure 3 Definition of Viewing Angle



Note (3) Definition Of Contrast Ratio (CR)

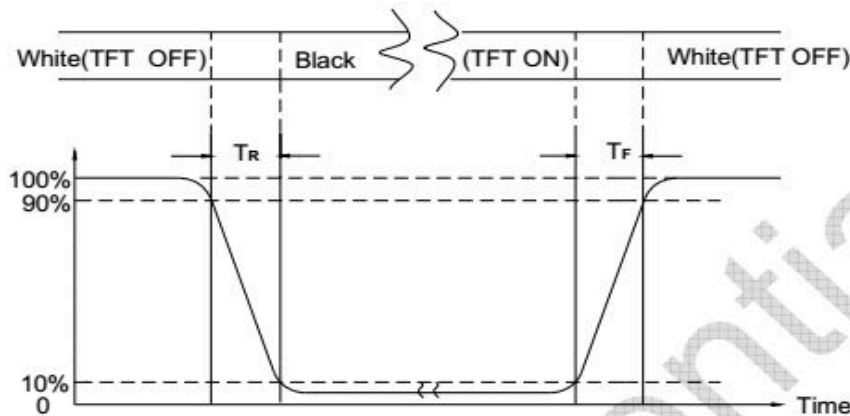
The contrast ratio can be calculated by the following expression

$$\text{Contrast Ratio (CR)} = L63 / L0$$

L63: Luminance of gray level 63, L0: Luminance of gray level 0

Note (4) Definition Of Response Time (TR, TF)

Figure 4 Definition of Response Time

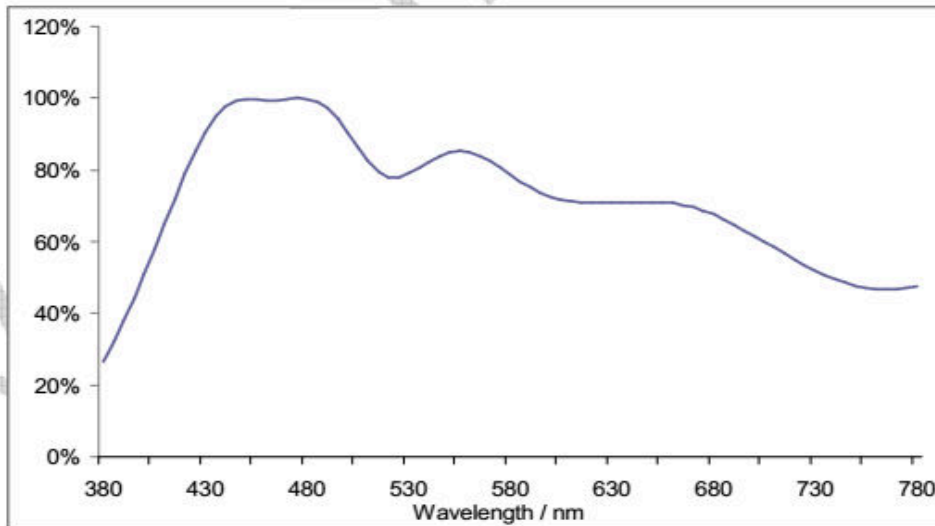


Note (5) Definition of Transmittance (Module is without signal input and IVO reference backlight).

$$\text{Transmittance} = \frac{\text{Luminance of LCD Module}}{\text{Luminance of Back light}} \times 100\%$$

Note (6) Reference C-light Spectrum

Figure 5 C-light Spectrum



Note (7) The polarizer type: Samsung/CF, Samsung /Array.

Note (8) All optical data based on IVO given polarizer & C-light& testing machine in this document.

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10. Reliability Test Items

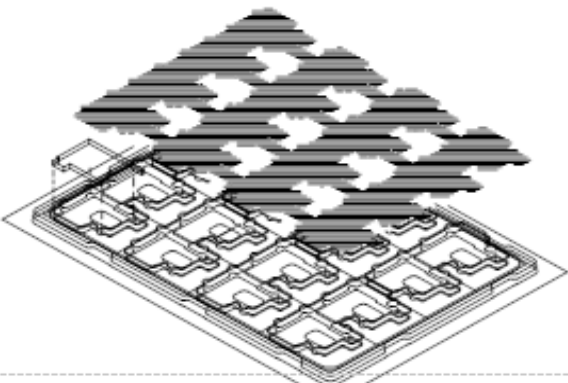
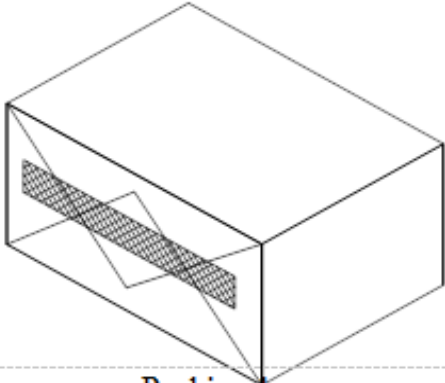
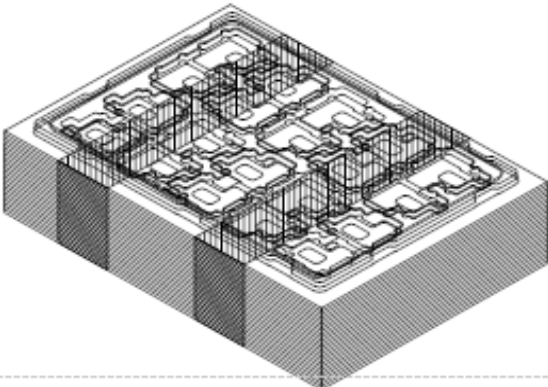
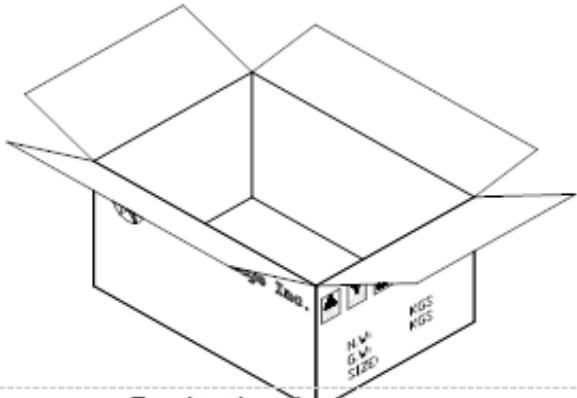
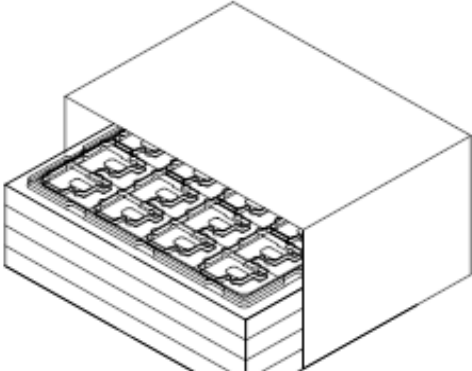
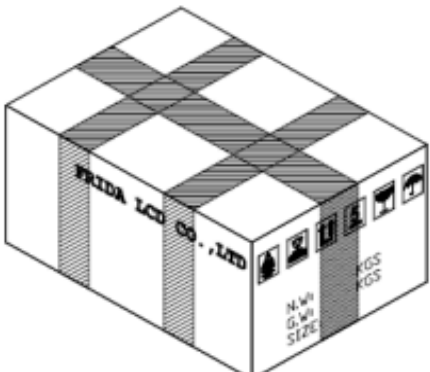
| Item | Test Condition | | Criterion |
|---|---|------------------------------|--|
| High Temperature Storage | 70 °C, 120 hrs | | There should be no change which might affect the practical display function when the display quality test is conducted under normal operating condition. |
| Low Temperature Storage | -20 °C, 120 hrs | | |
| High Temp. & High Humidity Storage | 60 °C, 90% RH, 120 hrs | | |
| Vibration Test (Non-operating) | Freq.:10~55~10 Hz, Amp.:1.5mm 1 hr for each direction of X, Y, Z | | |
| Electrostatic Discharge Test (Non-operating) | Terminals | 150 pF, 0 Ω, ±300 V, Contact | |
| | Panel | 150 pF, 330 Ω, ±8 KV, Air | |
| Thermal Shock (Static) | -20 °C, 30 min /70 °C, 30 min, 20 cycles | | |
| High Temperature Operation | 60 °C, 120 hrs | | |
| Low temperature Operation | -10 °C, 120 hrs | | |
| High Temperature & High Humidity (Operating) | 50 °C, 90% RH, 120 hrs | | |
| FPC Peeling Strength Test | Pull speed: 50 mm/min, +90°, | | |

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11. Package

| | |
|---|---|
| <p>1</p>  <p>16 pcs per tray + 1 cover (EPE)</p> | <p>4</p>  <p>Packing bag</p> |
| <p>2</p>  <p>25 trays + 1 dummy tray = 400 ps</p> | <p>5</p>  <p>Putting bag into carton Protected by 6 pieces of cushion EPE sheet</p> |
| <p>3</p>  <p>Putting trays into anti-electrostatic bag</p> | <p>6</p>  <p>FRIDA LCD CO., LTD N.W G.W SIZE FCS KGS</p> |

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12.Precautions

Please pay attentions to the followings as using the LCD module.

Handling

- (a) Do not apply strong mechanical stress like drop, shock or any force to LCD module. It may cause improper operation, even damage.
- (b) Because the polarizer is very fragile and easy to be damaged, do not hit, press or rub the display surface with hard materials.
- (c) Do not put heavy or hard material on the display surface, and do not stack LCD modules.
- (d) If the display surface is dirty, please wipe the surface softly with cotton swab or clean cloth.
- (e) Avoid using Ketone type materials (e.g. Acetone), Toluene, Ethyl acid or Methyl chloride to clean the display surface. It might damage the touch panel surface permanently. The recommended solvents are water and Isopropyl alcohol.
- (f) Wipe off water droplets or oil immediately.
- (g) Protect the LCD module from ESD. It will damage the LSI and the electronic circuit.
- (h) Do not touch the output pins directly with bare hands.
- (i) Do not disassemble the LCD module.
- (j) Do not lift the FPC of Touch Panel.

Storage

- (a) Do not leave the LCD modules in high temperature, especially in high humidity for a long time.
- (b) Do not expose the LCD modules to sunlight directly.
- (c) The liquid crystal is deteriorated by ultraviolet. Do not leave it in strong ultraviolet ray for a long time.
- (d) Avoid condensation of water. It may cause improper operation.
- (e) Please stack only up to the number stated on carton box for storage and transportation. Excessive weight will cause deformation and damage of carton box.

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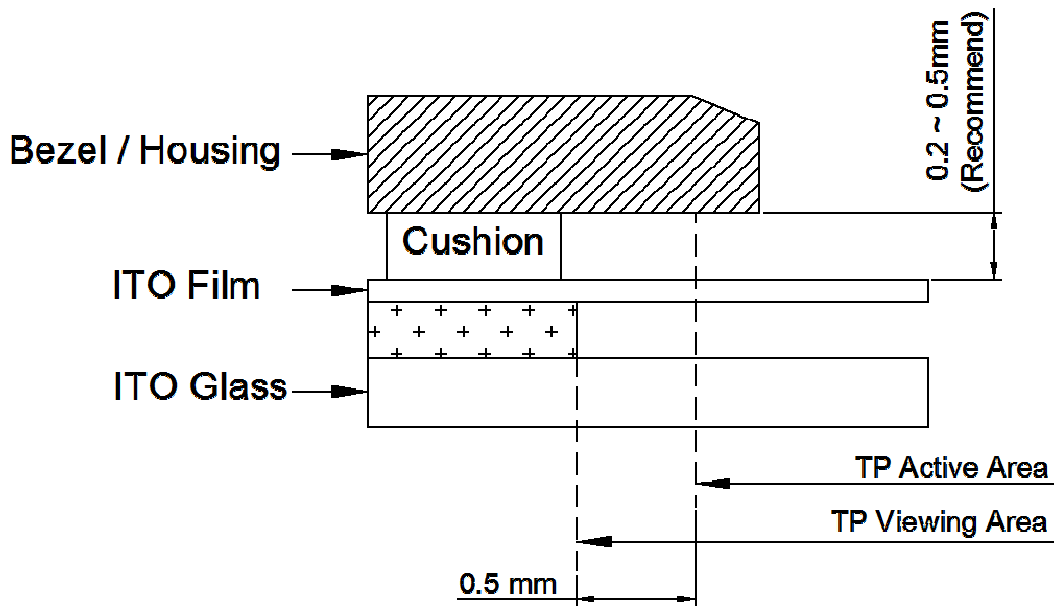
Operation

- (a) When mounting or dismounting the LCD modules, turn the power off.
- (b) Protect the LCD modules from electric shock.
- (c) The Driver IC control algorithms stated above should always obeyed to avoid damaging the LSI and electronic circuit.
- (d) Be careful to avoid mixing up the polarity of power supply for backlight.
- (e) Absolute maximum rating specified above has to be always kept in any case. Exceeding it may cause non-recoverable damage of electronic components or, nevertheless, burning.
- (f) When a static image is displayed for a long time, remnant image is likely to occur.
- (g) Be sure to avoid bending the FPC to an acute shape, it might break FPC.
- (h) Most of the touch screens have air vent to equalize the inside air pressure to the outside one. The air vent must be open and liquid contact must be avoided as the liquid may be absorbed if the liquid is accumulated near the air vent.
- (i) For the fragility of ITO film, it should avoid to use too tapering pen as the input material.

Touch Panel Mounting Notes

- (a) If a cushion is used between bezel/housing and film must be choose as free as enough to absorb the expansion and contraction to avoid the distortion of film.
- (b) The cushion must be placed out of the Viewing Area.
- (c) Bezel/Housing edge must be posited between Key Area and Viewing Area. The edge enters the Key Area may cause unexpected input if the gap is too narrow or foreign particles like dusts exist between Bezel/Housing and ITO film.
- (d) Mounting example:

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The corner part has conductivity. Do not touch any metal part after mounting.

Others

- a) If the liquid crystal leaks from the panel, it should be kept away from the eyes or mouth.
- b) For the fragility of polarizer, it is recommended to attach a transparent protective plate over the display surface.
- c) It is recommended to peel off the protection film on the polarizer slowly so that the electrostatic charge can be minimized.

13. Inspection standard

TBD