

LCD Module Specification

Model No.: LT070B-01ACT

7", 1024 (RGB) x 600 PIXELS TFT LCD MODULE

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RECORD OF REVISION

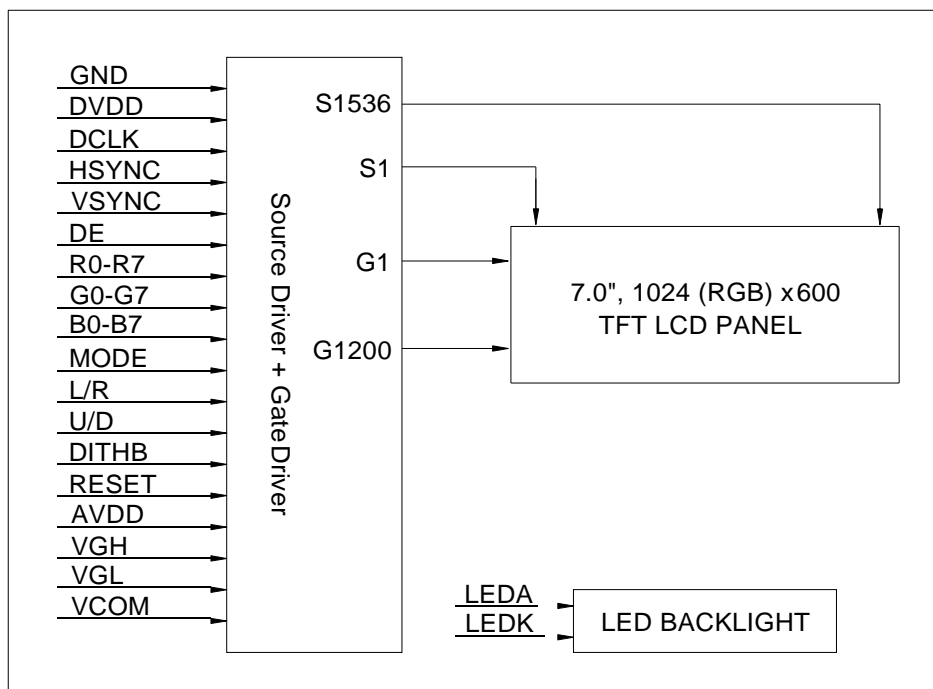
| Rev. | Date | Page | Item | Description |
|------|------------|------|------|-------------|
| 0.1 | 2018/12/20 | - | - | New release |
| | | | | |

1. BASIC SPECIFICATIONS

1.1 Features

| Item | Specifications | Unit |
|---------------------------|---|------|
| Screen Size | 7.0 (Diagonal) | inch |
| Resolution | 1024 (RGB) x 600 | dot |
| Display Mode | Normally white, transmissive TFT | - |
| Color Configuration | RGB-stripe | - |
| Color Depth | 24-bit (RGB=888), 16.7M colors | - |
| Viewing Direction | 6:00 o'clock (Gray scale inversion direction) | - |
| Outline Dimension (WxHxT) | 164.9 x 100.0 x 5.5 (FPC length=78.7) | mm |
| Viewing Area (WxH) | 157.0 x 89.6 | mm |
| Active Area (WxH) | 154.21 x 85.92 | mm |
| Dot Pitch (WxH) | 0.0502 x 0.1432 | mm |
| Touch Panel | None | - |
| Weight | 130 | g |
| LCD Controller | NT51008Q + NT51003B or equivalent | - |
| Interface Mode | Digital 24-bit parallel RGB | - |
| Power Supply (DVDD) | 3.3 | V |

1.2 Block Diagram



1.3 Terminals Functions

| Pin No. | Symbol | I/O | Function |
|---------|--------|-----|--|
| 1 | LEDA | P | LED backlight anode |
| 2 | LEDA | P | LED backlight anode |
| 3 | LEDK | P | LED backlight cathode |
| 4 | LEDK | P | LED backlight cathode |
| 5 | GND | P | Power ground |
| 6 | VCOM | I | Common voltage |
| 7 | DVDD | P | Power supply for digital circuit |
| 8 | MODE | I | DE/SYNC mode selection. Normally pull high. MODE=1: DE mode. VSYNC and HSYNC must be "H". MODE=0: SYNC mode. DE must be "L". |
| 9 | DE | I | Data enable signal. Active "H". |
| 10 | VSYNC | I | Vertical sync signal. Negative polarity. |
| 11 | HSYNC | I | Horizontal sync signal. Negative polarity. |
| 12 | B7 | I | Blue data (MSB) |
| 13 | B6 | I | Blue data |
| 14 | B5 | I | Blue data |
| 15 | B4 | I | Blue data |
| 16 | B3 | I | Blue data |
| 17 | B2 | I | Blue data |
| 18 | B1 | I | Blue data |
| 19 | B0 | I | Blue data (LSB) |
| 20 | G7 | I | Green data (MSB) |
| 21 | G6 | I | Green data |
| 22 | G5 | I | Green data |
| 23 | G4 | I | Green data |
| 24 | G3 | I | Green data |
| 25 | G2 | I | Green data |
| 26 | G1 | I | Green data |
| 27 | G0 | I | Green data (LSB) |
| 28 | R7 | I | Red data (MSB) |
| 29 | R6 | I | Red data |
| 30 | R5 | I | Red data |
| 31 | R4 | I | Red data |
| 32 | R3 | I | Red data |
| 33 | R2 | I | Red data |
| 34 | R1 | I | Red data |

| Pin No. | Symbol | I/O | Function |
|---------|--------|-----|---|
| 35 | R0 | I | Red data (LSB) |
| 36 | GND | P | Power ground |
| 37 | DCLK | I | Data clock. Latch data at falling edge. |
| 38 | GND | P | Power ground |
| 39 | L/R | I | Left/Right scanning direction selection L/R=1: Scanning from left to right L/R=0: Scanning from right to left |
| 40 | U/D | I | Up/Down scanning direction selection U/D=1: Scanning from down to up U/D=0: Scanning from up to down |
| 41 | VGH | P | Gate on voltage |
| 42 | VGL | P | Gate off voltage |
| 43 | AVDD | P | Power supply for analog circuit |
| 44 | RESET | I | Global reset pin. Normally pull high. Active “L” to enter reset state. Suggest connecting with an RC reset circuit for stability. |
| 45 | NC | - | No connection |
| 46 | VCOM | I | Common voltage |
| 47 | DITHB | I | Dithering function. Normally pull low. DITHB=1: Enable internal dithering function DITHB=0: Disable internal dithering function |
| 48 | GND | P | Power ground |
| 49 | NC | - | No Connection |
| 50 | NC | - | No Connection |

I=Input; O=Output; P=Power

2. ABSOLUTE MAXIMUM RATINGS

| Item | Symbol | Min. | Max. | Unit |
|-----------------------------------|-----------|-------|------------|------|
| Supply Voltage (Digital) | DVDD | -0.3 | 5.0 | V |
| Supply Voltage (Analog) | AVDD | 6.5 | 15.0 | V |
| Supply Voltage (Gate on voltage) | VGH | -0.3 | 40.0 | V |
| Supply Voltage (Gate off voltage) | VGL | -20.0 | 0.3 | V |
| Supply Voltage (VGH to VGL) | VGH - VGL | - | 40.0 | V |
| Input Voltage | VI | -0.3 | DVDD + 0.3 | V |
| LED Forward Current (Each LED) | IF | - | 25 | mA |
| Operating Temperature | Topr | -20 | +70 | °C |
| Storage Temperature | Tstg | -30 | +80 | °C |

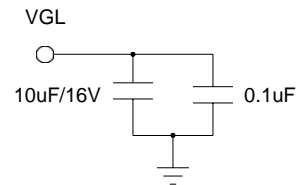
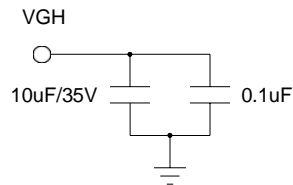
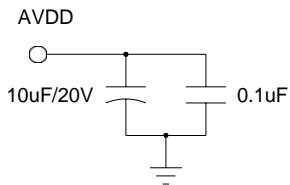
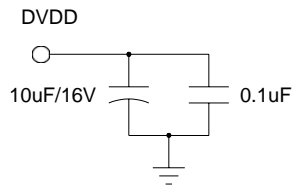
Cautions: Stresses above those listed as ‘absolute maximum ratings’ may cause permanent damage to the device. This is a stress rating only and functional operation of the device under these conditions is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

3. ELECTRICAL CHARACTERISTICS

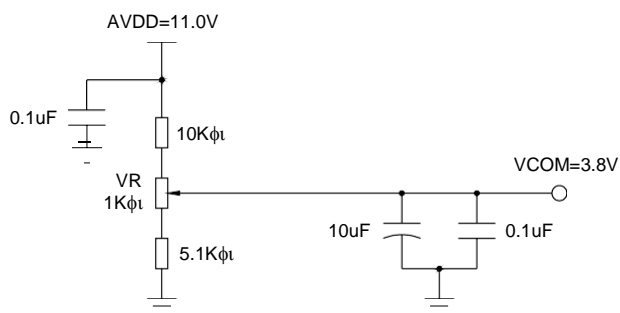
3.1 DC Characteristics for LCD (Ta=25°C)

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|----------------------|--------|--------------|---------|------|---------|------|
| Supply Voltage | DVDD | Note 1 | 3.0 | 3.3 | 3.6 | V |
| | AVDD | Note 1 | 10.8 | 11.0 | 11.2 | V |
| | VGH | Note 1 | 19.7 | 20.0 | 20.3 | V |
| | VGL | Note 1 | -7.1 | -6.8 | -6.5 | V |
| Input Signal Voltage | VCOM | Note 2 | 3.5 | 3.8 | 4.1 | V |
| Input High Voltage | VIH | | 0.7DVDD | - | DVDD | V |
| Input Low Voltage | VIL | | 0 | - | 0.3DVDD | V |
| Supply Current | IDD | DVDD = 3.3V | - | 15.0 | 30.0 | mA |
| | IDDA | AVDD = 11.0V | - | 20.0 | 30.0 | mA |
| | IGH | VGH = 20.0V | - | 0.25 | 1.0 | mA |
| | IGL | VGL = -6.8V | - | 0.25 | 1.0 | mA |

Note 1: It is suggested that users follow the circuits below to design DVDD, AVDD, VGH and VGL.



Note 2: Reference circuit for VCOM



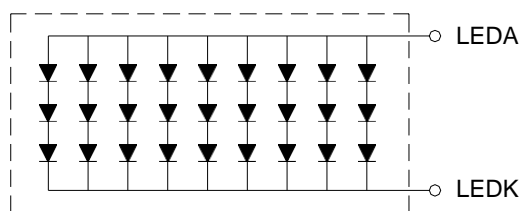
The typical VCOM is only a reference value. It must be optimized according to each TFT. Please use a VR and refer to the application circuit at left.

3.2 LED Backlight Characteristics (Ta=25°C)

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---------------------|--------|-----------|--------|------|------|------|
| LED Forward Voltage | VLED | Note 1 | 8.4 | 8.7 | 9.0 | V |
| LED Forward Current | ILED | | 135 | 180 | 198 | mA |
| LED Life Time | - | Note 2 | 20,000 | - | - | Hr |

Note 1: The LED forward voltage is defined by the number of LED at Ta=25°C and ILED=180mA.

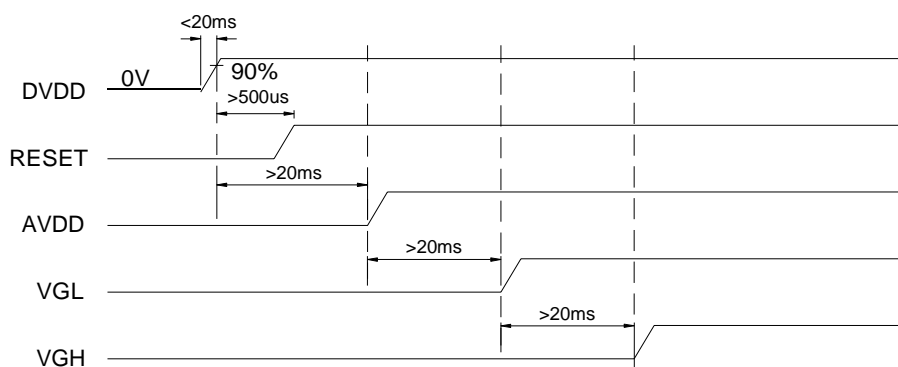
Note 2: The LED life time is defined as the module brightness decreases to 50% initial brightness at Ta=25°C and ILED=180mA. The LED life time could be decreased if operating ILED is larger than 180mA.



LED Backlight: 3 x 9 = 27 LEDS

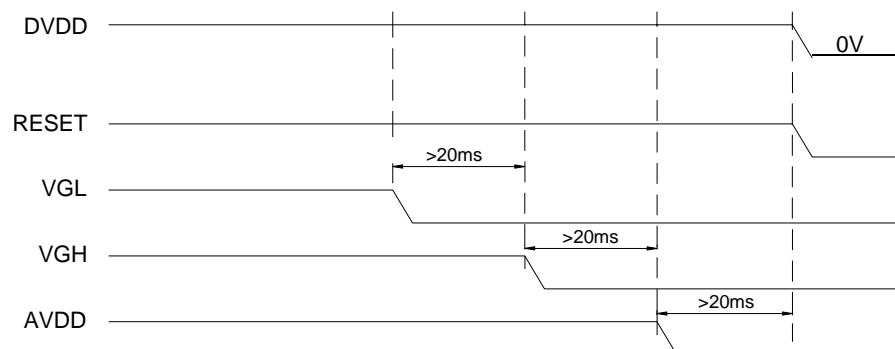
3.3 Power Sequence

3.3.1 Power on Sequence



Power on sequence: DVDD→AVDD→VGL→VGH

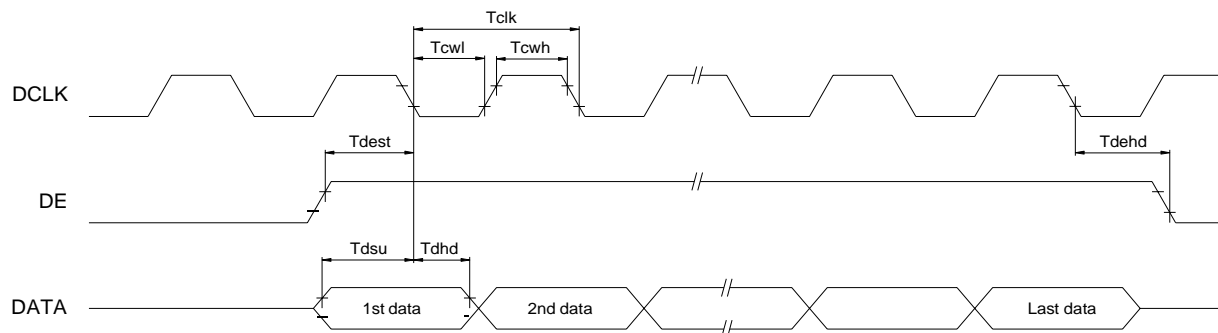
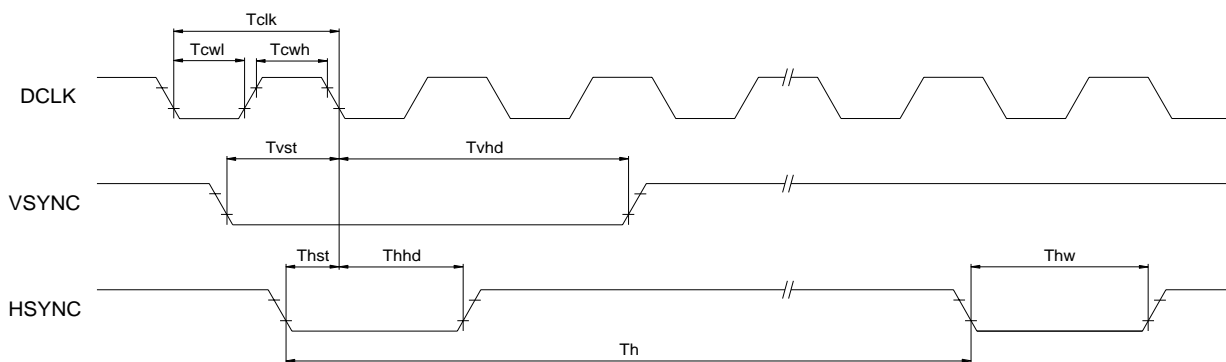
3.3.2 Power off Sequence



Power off sequence: VGL→VGH→AVDD→DVDD

3.4 AC Characteristics (DVDD=3.3V, Ta=25°C)

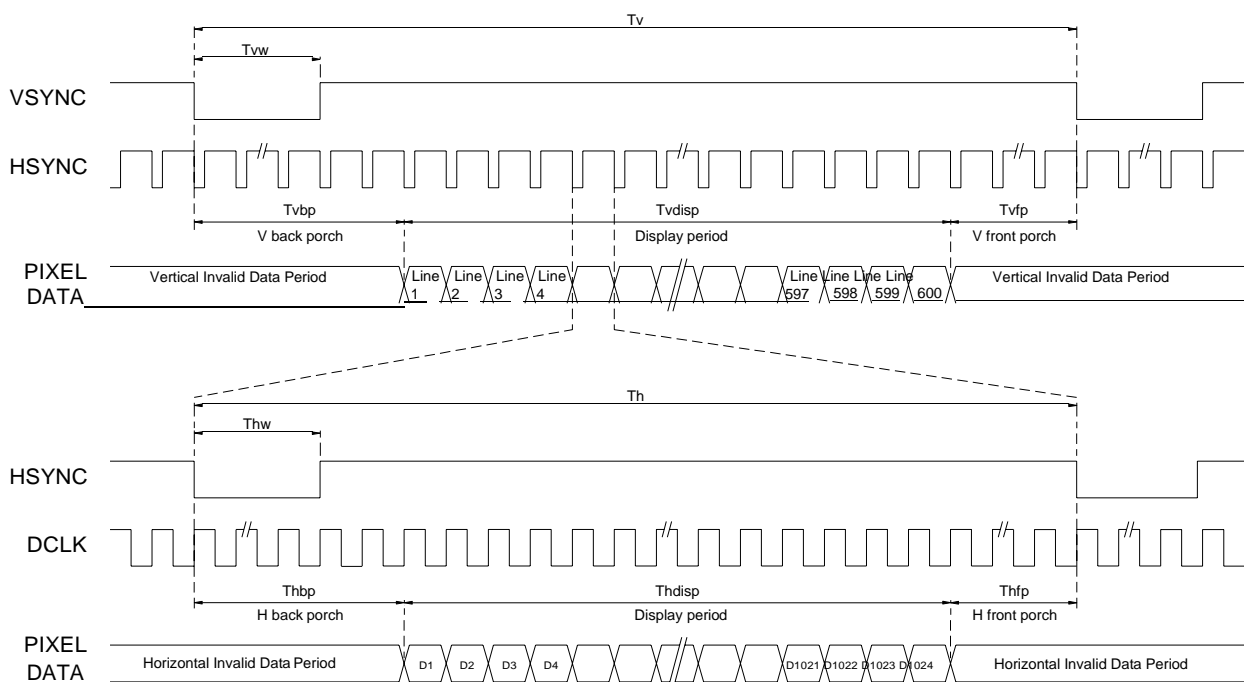
| Item | Symbol | Min. | Typ. | Max. | Unit |
|------------------|--------|------|------|------|------|
| DCLK Pulse Duty | Tcwh | 40 | 50 | 60 | % |
| DCLK Period | Tclk | 14 | - | - | ns |
| VSYNC Setup Time | Tvst | 5 | - | - | ns |
| VSYNC Hold Time | Tvhd | 5 | - | - | ns |
| HSYNC Setup Time | Thst | 5 | - | - | ns |
| HSYNC Hold Time | Thhd | 5 | - | - | ns |
| Data Setup Time | Tdsu | 5 | - | - | ns |
| Data Hold Time | Tdhd | 5 | - | - | ns |
| DE Setup Time | Tdest | 5 | - | - | ns |
| DE Hold Time | Tdehd | 5 | - | - | ns |



3.5 Input Signals Timing Characteristics (SYNC Mode)

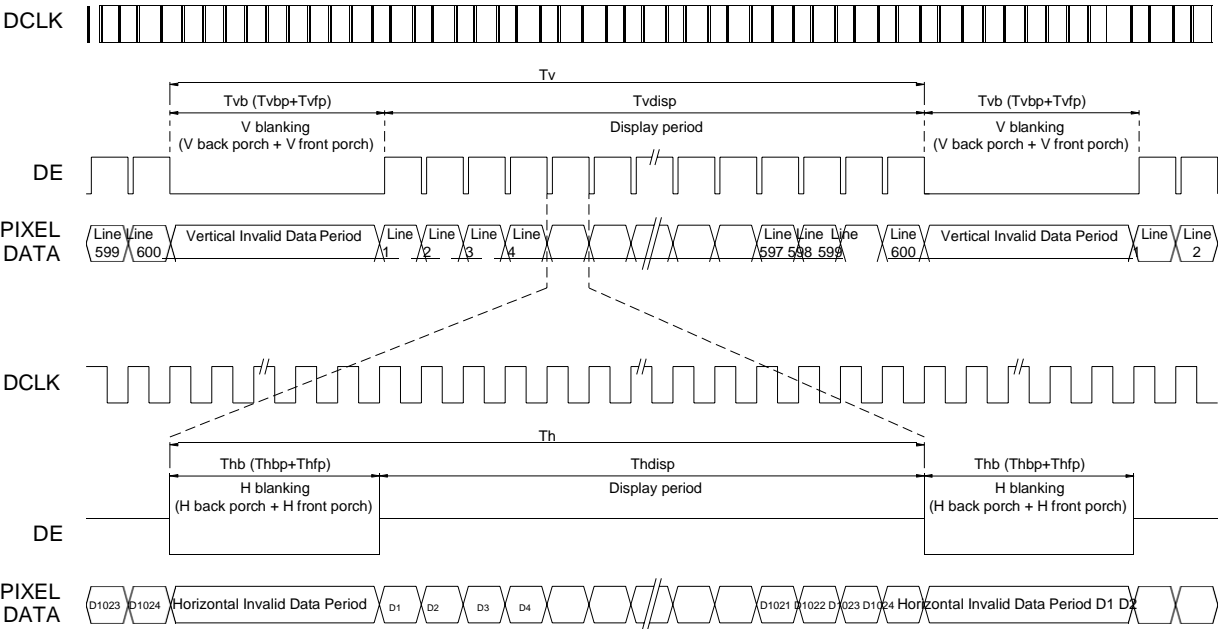
| Item | Symbol | Min. | Typ. | Max. | Unit |
|----------------------|--------|------|------|------|------|
| DCLK Frequency | Fclk | 44.9 | 51.2 | 63 | MHz |
| HSYNC Period | Th | 1200 | 1344 | 1400 | DCLK |
| HSYNC Display Period | Thdisp | - | 1024 | - | DCLK |
| HSYNC Back Porch | Thbp | 160 | 160 | 160 | DCLK |
| HSYNC Front Porch | Thfp | 16 | 160 | 216 | DCLK |
| HSYNC Pulse Width | Thw | 1 | - | 140 | DCLK |
| VSYNC Period | Tv | 624 | 635 | 750 | Th |
| VSYNC Display Period | Tvdisp | - | 600 | - | Th |
| VSYNC Back Porch | Tvbp | 23 | 23 | 23 | Th |
| VSYNC Front Porch | Tvfp | 1 | 12 | 127 | Th |
| VSYNC Pulse Width | Tvw | 1 | - | 20 | Th |

Note: It is necessary to keep $Tvbp=23$ and $Thbp=160$ in SYNC mode. It's unnecessary to keep it in DE mode.



3.6 Input Signals Timing Characteristics (DE Mode)

| Item | Symbol | Min. | Typ. | Max. | Unit |
|----------------------|---------------|------|------|------|------|
| DCLK Frequency | Fclk | 40.8 | 51.2 | 67.2 | MHz |
| HSYNC Period | Th | 1114 | 1344 | 1400 | DCLK |
| HSYNC Display Period | Thdisp | - | 1024 | - | DCLK |
| DEH Blanking | Thb=Thbp+Thfp | 90 | 320 | 376 | DCLK |
| VSYNC Period | Tv | 610 | 635 | 800 | Th |
| VSYNC Display Period | Tvdisp | - | 600 | - | Th |
| DEV Blanking | Tvb=Tvbp+Tvfp | 10 | 35 | 200 | Th |

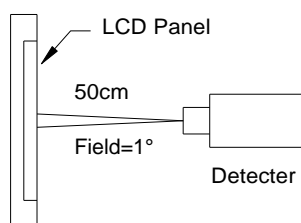


4. ELECTRO-OPTICAL CHARACTERISTICS (Ta=25°C)

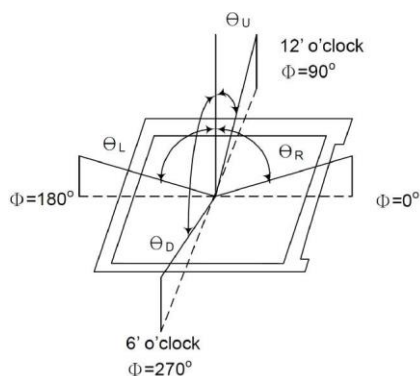
| Item | Symbol | | Condition | Min. | Typ. | Max. | Unit | Note | |
|---------------------|-------------|----------------|--|------|--|------|-------------------|------|------|
| Brightness of White | Bp | | $\Theta=0^{\circ}$ $\Phi=0^{\circ}$ | - | 200 | - | cd/m ² | 1 | |
| Uniformity | Δ Bp | | ILED=180mA | 70% | - | - | - | 2 | |
| Viewing Angle | Hor | Θ R | Cr \geq 10 | - | 75 | - | deg. | 3 | |
| | | Θ L | | - | 75 | - | | | |
| | Ver | Θ U | | - | 70 | - | | | |
| | | Θ D | | - | 75 | - | | | |
| | | Contrast Ratio | | Cr | $\Theta=0^{\circ}$ $\Phi=0^{\circ}$ | 500 | | | 800 |
| Response Time | Tr | - | 10 | 20 | | ms | 5 | | |
| | Tf | - | 15 | 30 | | | | | |
| Color Chromaticity | Wx | | | 0.26 | | 0.31 | 0.36 | - | 1, 6 |
| | Wy | | | 0.28 | | 0.33 | 0.38 | - | |

Note 1: The optical characteristics should be measured by BM-7 in dark room after 15 minutes. The optical properties are measured at the center point of the LCD.

Note 2: Δ Bp = $B_p(\text{Min.}) / B_p(\text{Max.}) \times 100 (\%)$
 $B_p(\text{Max.})$ = Maximum brightness in 9 operation.
 $B_p(\text{Min.})$ = Minimum brightness in 9



Note 3: Definition of Viewing Angle

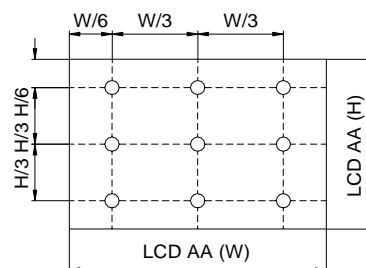


Note 4: Definition of Contrast Ratio

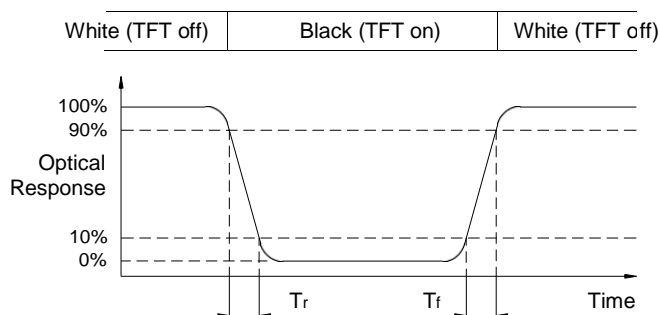
$$\text{Contrast Ratio (Cr)} = \frac{\text{Brightness measured when LCD on "White" State}}{\text{Brightness measured when LCD on "Black" state}}$$

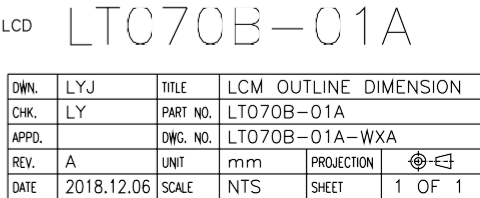
Note 6: Definition of color chromaticity (CIE1931)

Color coordinates is measured at the center point of the LCD with I_{LED}=180mA and the LCD displays white.

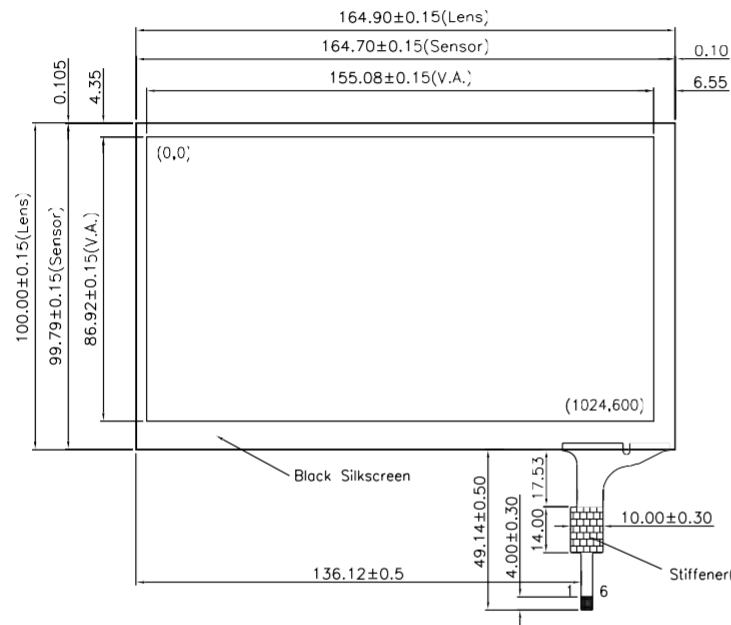


Note 5: Definition of Response Time

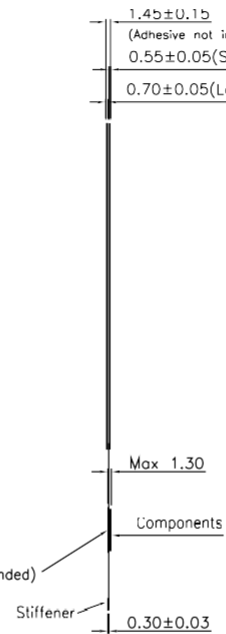




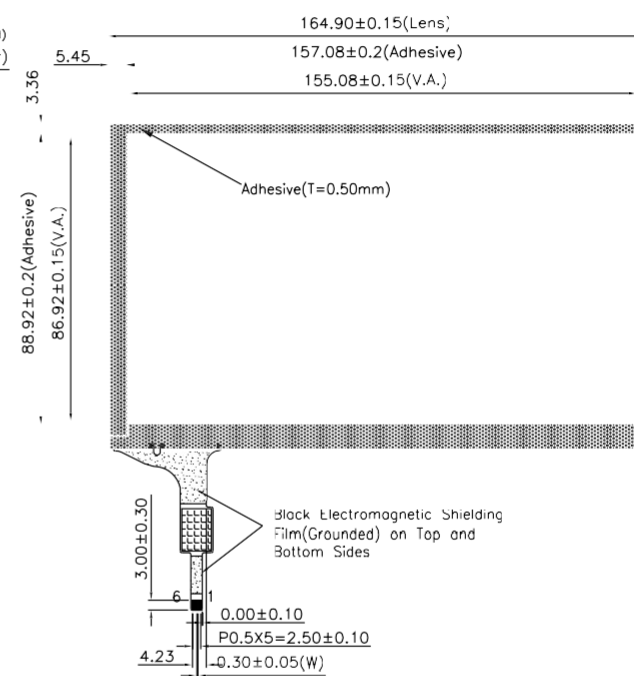
Front View



Side View



Rear View



Specification:

1. Lens + ITO Glass + FPC + Adhesive
2. IC: FT5436 , 5 Points Touch, G+G Structure
3. VDD: 2.8V to 3.3V
4. Light Transmittance: 82%
5. Surface Hardness: 6H
6. Operating temperature: -20° to +70°(≤90%RH)
7. Storage temperature: -30° to +80°(≤90%RH)
8. General Tolerance: ±0.2mm



6. PRECAUTIONS FOR USE OF LCD MODULE

6.1 Handling Precautions

- 1) The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.
- 2) If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth. If the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.
- 3) Do not apply excessive force on the surface of display or the adjoining areas of LCD module since this may cause the color tone to vary.
- 4) The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.
- 5) If the display surface of LCD module becomes contaminated, blow on the surface and gently wipe it with a soft dry cloth. If it is heavily contaminated, moisten cloth with one of the following solvents.
 - Isopropyl alcohol
 - Ethyl alcoholSolvents other than those mentioned above may damage the polarizer. Especially, do not use the following:
 - Water
 - Ketone
 - Aromatic Solvents
- 6) When mounting the LCD module make sure that it is free of twisting, warping, and distortion. Distortion has great influence upon display quality. Also keep the stiffness enough regarding the outer case.
- 7) Be sure to avoid any solvent such as flux for soldering never stick to Heat-Seal. Such solvent on Heat-Seal may cause connection problem of heat-Seal and TAB.
- 8) Do not forcibly pull or bend the TAB I/O terminals.
- 9) Do not attempt to disassemble or process the LCD module.
- 10) NC terminal should be open. Do not connect anything.
- 11) If the logic circuit power is off, do not apply the input signals.
- 12) To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.
 - Be sure to ground the body when handling the LCD module.
 - Tools required for assembly, such as soldering irons, must be properly grounded.
 - To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.
 - The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.

6.2 Storage Precautions

- 1) When storing the LCD module, avoid exposure to direct sunlight or to the light of fluorescent lamps and high temperature/high humidity. Whenever possible, the LCD module should be stored in the same conditions in which they were shipped from our company.
- 2) Exercise care to minimize corrosion of the electrodes. Corrosion of the electrodes is accelerated by water droplets or a current flow in a high humidity environment.

6.3 Design Precautions

- 1) The absolute maximum ratings represent the rated value beyond which LCD module can not exceed. When the LCD modules are used in excess of this rated value, their operating characteristics may be adversely affected.

- 2) To prevent the occurrence of erroneous operation caused by noise, attention must be paid to satisfy VIL, VIH specification values, including taking the precaution of using signal cables that are short.
- 3) The liquid crystal display exhibits temperature dependency characteristics. Since recognition of the display becomes difficult when the LCD is used outside its designated operating temperature range, be sure to use the LCD within this range. Also, keep in mind that the LCD driving voltage levels necessary for clear displays will vary according to temperature.
- 4) Sufficiently notice the mutual noise interference occurred by peripheral devices.
- 5) To cope with EMI, take measures basically on outputting side.
- 6) If DC is impressed on the liquid crystal display panel, display definition is rapidly deteriorated by the electrochemical reaction that occurs inside the liquid crystal display panel. To eliminate the opportunity of DC impressing, be sure to maintain the AC characteristics of the input signals sent to the LCD Module.

6.4 Others

- 1) Liquid crystals solidify under low temperatures (below the storage temperature range) leading to defective orientation or the generation of air bubbles (black or white). Air bubbles may also be generated if the LCD module is subjected to a strong shock at a low temperature.
- 2) If the LCD modules have been operating for a long time showing the same display patterns, the display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. A normal operating status can be regained by suspending use for some time. It should be noted that this phenomenon does not adversely affect performance reliability.
- 3) To minimize the performance degradation of the LCD modules resulting from destruction caused by static electricity, etc., exercise care to avoid touching the following sections when handling the module:
 - Terminal electrode sections.
 - Part of pattern wiring on TAB, etc.