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TFT | CHARACTER | UWVD | FSC | SEGMENT | CUSTOM | REPLACEMENT

TFT Display Module

Part Number

E50RG68048LW2M350-C

Overview:

- 5.0-inch TFT (132.72x87.8mm)
- 16/18/24-bit RGB Interface
- 800x480 pixels
- 3.3V
- White LED back-light
- Transmissive/ Normally Black
- Capacitive Touch Screen
- 350 NITS
- Controller: ILI5960/ILI6122
- RoHS Compliant

Description

This is a color active matrix TFT (Thin Film Transistor) LCD (Liquid Crystal Display) that uses amorphous silicon TFT as a switching device. This model is composed of a transmissive type TFT-LCD Panel, driver circuit and backlight unit. The resolution of a 5.0" TFT-LCD contains 800x480 pixels and can display up to 65K/262K/16.7M colors.

Features

Low Input Voltage: 3.3V (TYP)

Display Colors of TFT LCD: 65K/262K/16.7M colors

TFT Interface: 16/18/24-bit RGB

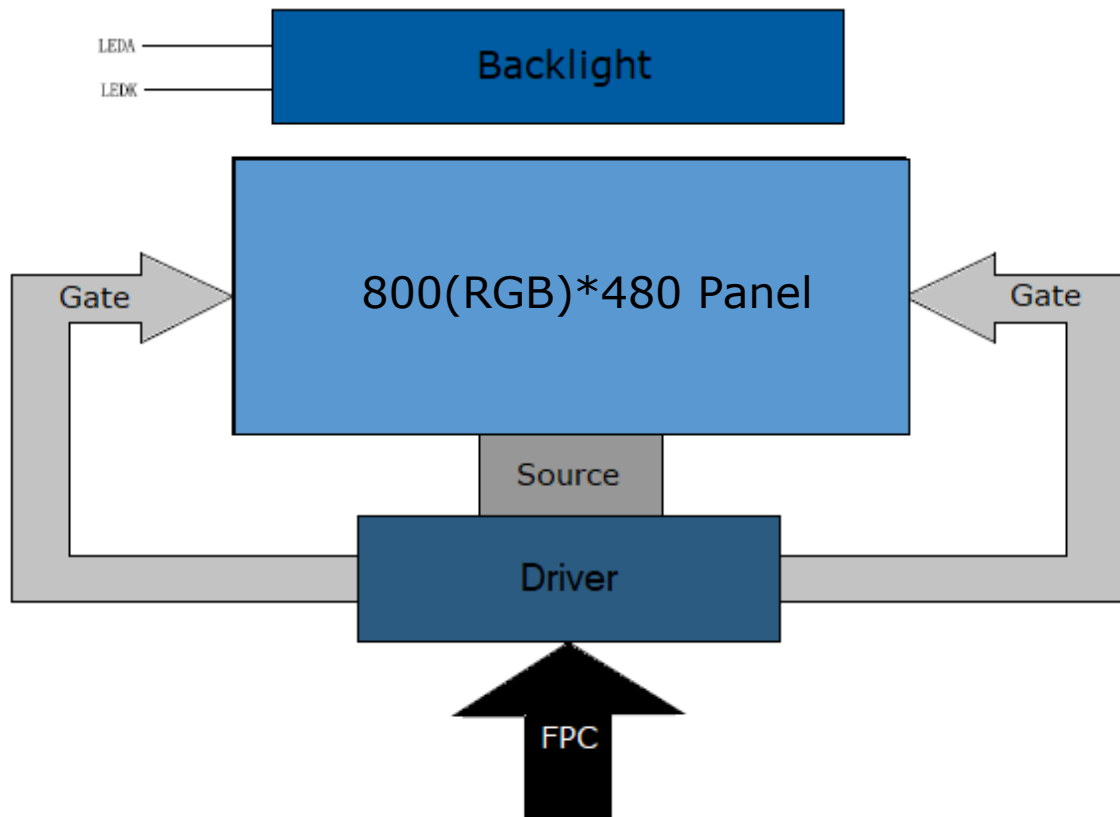
CTP Interface: I2C

| General Information Items | Specification | Unit | Note |
|---------------------------|---------------------------------|---------|------|
| | Main Panel | | |
| TFT Display area (AA) | 108.00(H) * 64.80(V) (5.0 inch) | mm | - |
| CTP View Area | 109.00(H)*65.80(V) | mm | - |
| Driver element | TFT active matrix | - | - |
| Display colors | 65K/262K/16.7M | colors | - |
| Number of pixels | 800(RGB)*480 | dots | - |
| TFT Pixel arrangement | RGB vertical stripe | - | - |
| Pixel pitch | 0.198 (H) x 0.198 (V) | mm | - |
| Viewing angle | 12:00 | o'clock | - |
| TFT Controller IC | ILI5960/ILI6122 | - | - |
| CTP Driver IC | GT911 | - | - |
| Simultaneous Touch Points | 5 | - | - |
| Display mode | Transmissive/ Normally White | - | - |
| Operating temperature | -20~+70 | °C | - |
| Storage temperature | -30~+80 | °C | - |

Mechanical Information

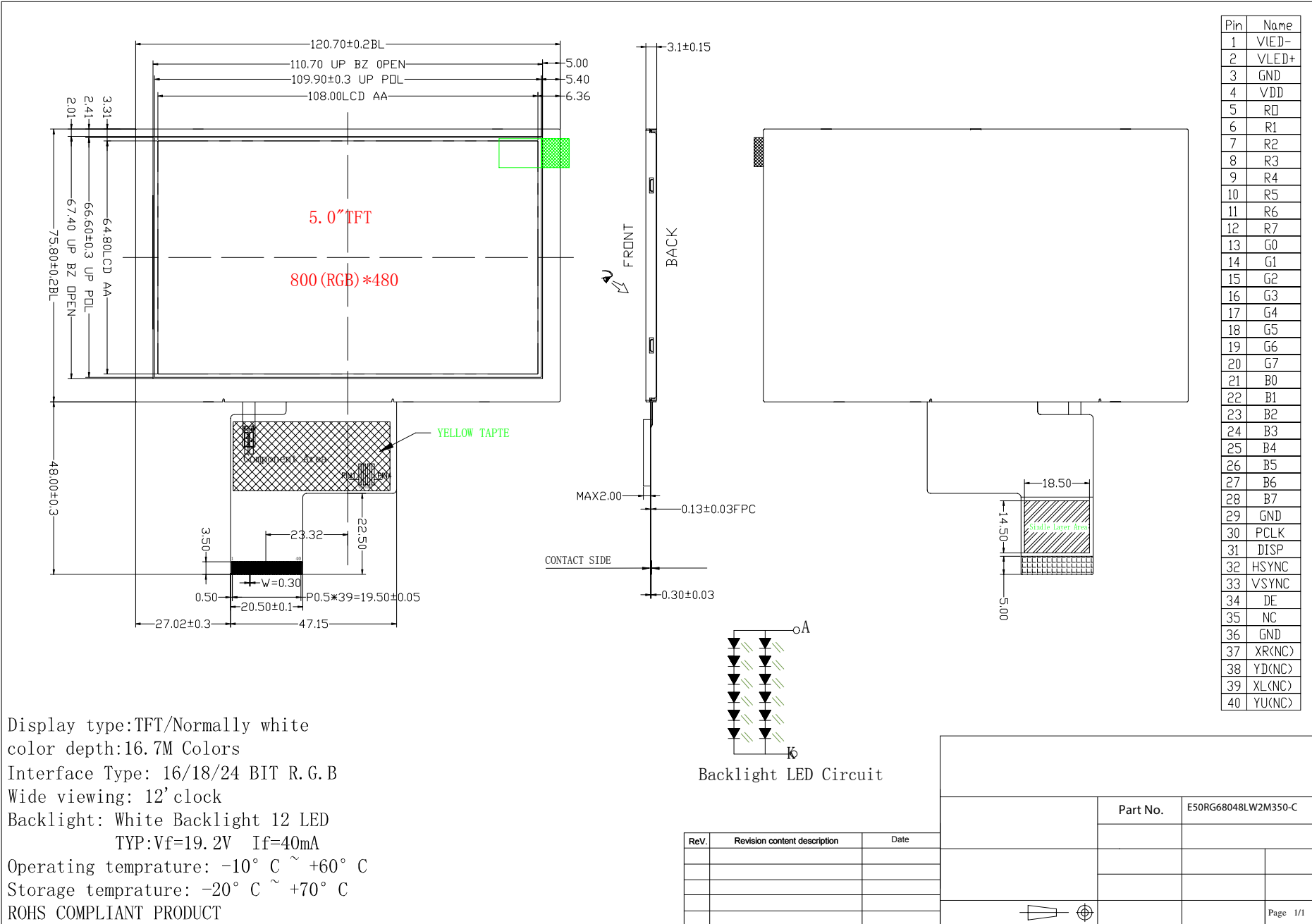
| Item | | Min | Typ. | Max | Unit | Note |
|-------------|---------------|-----|--------|-----|------|------|
| Module size | Horizontal(H) | | 132.72 | | mm | - |
| | Vertical(V) | | 87.80 | | mm | - |
| | Depth(D) | | 4.13 | | mm | - |
| Weight | | | TBD | | g | - |

1. Block Diagram



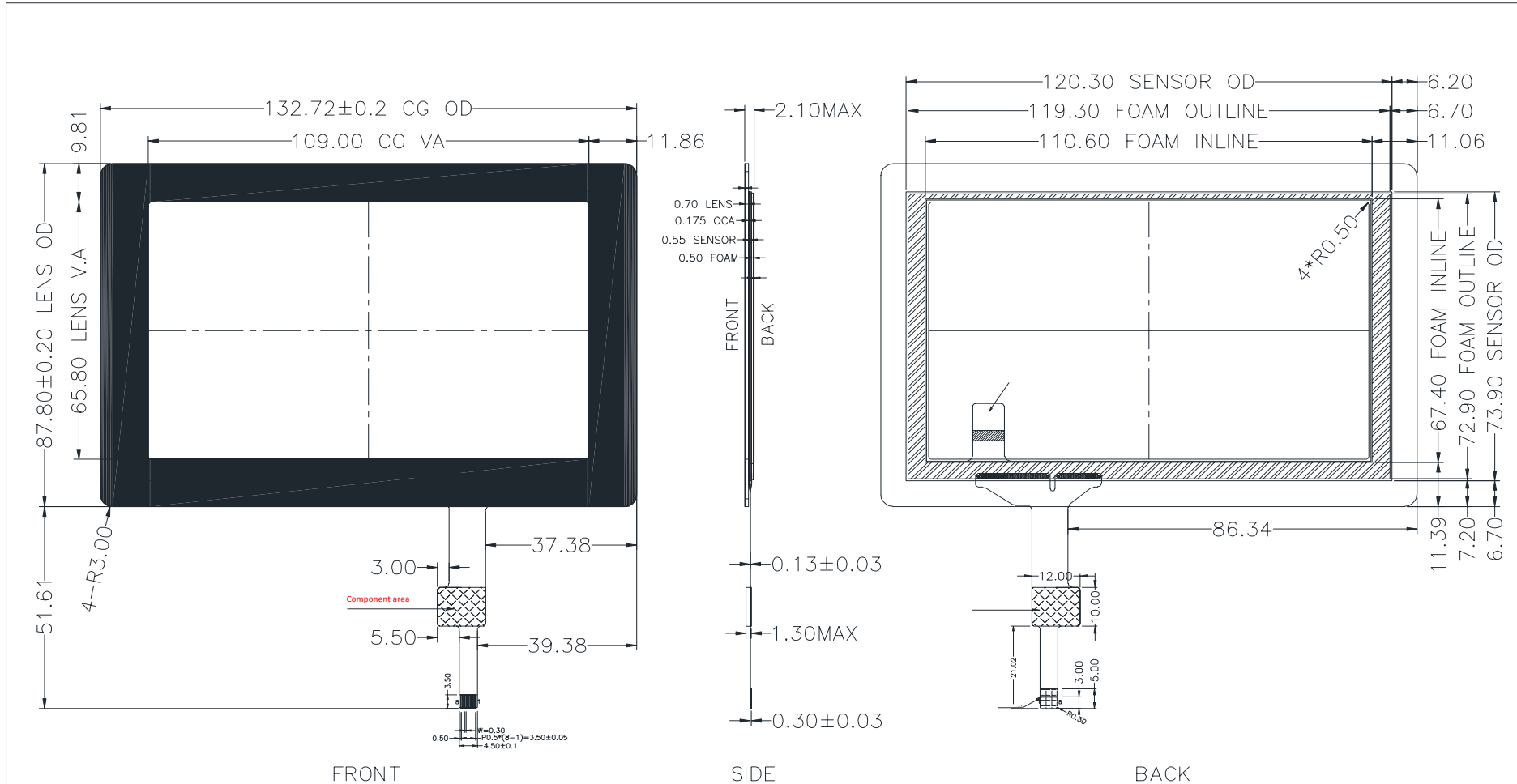
2. Outline dimensions

2.1 LCM



Display type:TFT/Normally white
 color depth:16.7M Colors
 Interface Type: 16/18/24 BIT R.G.B
 Wide viewing: 12'clock
 Backlight: White Backlight 12 LED
 TYP:Vf=19.2V If=40mA
 Operating temprature: -10° C ~ +60° C
 Storage temprature: -20° C ~ +70° C
 ROHS COMPLIANT PRODUCT

2.2 CTP



NOTES:

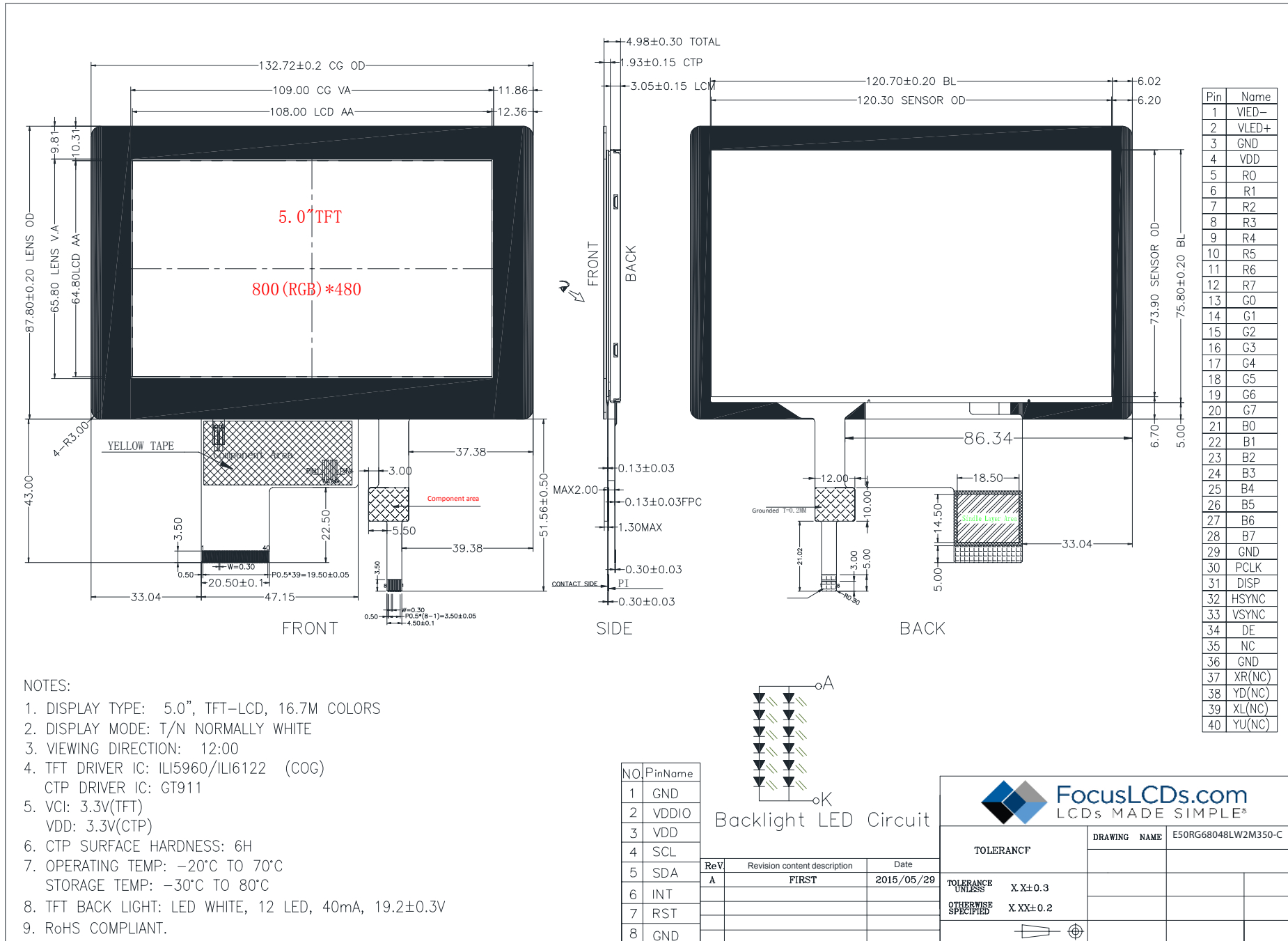
- 1.DRIVER IC: GT911
- 2.WORKING VOLTAGE: 3.3V
- 3.LIGHT TRANSMISSION: ≥ 86
- 4.SURFACE HARDNESS: 6H
- 5.OPERATING TEMP: $-20^{\circ}\text{C} \sim +70^{\circ}\text{C}$, $\leq 90\%RH$
- 6.STORAGE TEMP: $-30^{\circ}\text{C} \sim +80^{\circ}\text{C}$, $\leq 90\%RH$
- 7.UNMARKED TOLERANCE $\pm 0.2\text{mm}$
- 8.PRECISE DIMENSION IN<>

| NO. | PinName |
|-----|---------|
| 1 | GND |
| 2 | VDDIO |
| 3 | VDD |
| 4 | SCL |
| 5 | SDA |
| 6 | INT |
| 7 | RST |
| 8 | GND |

| ReV | Revision content description | Date |
|-----|------------------------------|------------|
| A | FIRST | 2015/05/29 |
| | | |
| | | |

| TOLERANCE | | DRAWING NAME | E50RG68048LW2M350-C |
|--------------------------------------|----------------|--------------|---------------------|
| TOLERANCE UNLESS OTHERWISE SPECIFIED | X X ± 0.3 | | |
| | X XX ± 0.2 | | |
| | | | Page 1/1 |

2.3 LCM+CTP



3. Input Terminal Pin Assignment

Recommended TFT Connector: FH33-40S-0.5SH(99)

Recommended CTP Connector: FH12-8S-0.5SH(55)

| NO. | Symbol | Description | I/O |
|-----|--------|--|-----|
| 1 | LEDK | Cathode pin of backlight | P |
| 2 | LEDA | Anode pin of backlight | P |
| 3 | GND | Ground | P |
| 4 | VDD | Supply voltage (3.3V) | P |
| 5 | R0 | Red data input | I |
| 6 | R1 | Red data input | I |
| 7 | R2 | Red data input | I |
| 8 | R3 | Red data input | I |
| 9 | R4 | Red data input | I |
| 10 | R5 | Red data input | I |
| 11 | R6 | Red data input | I |
| 12 | R7 | Red data input | I |
| 13 | G0 | Green data input | I |
| 14 | G1 | Green data input | I |
| 15 | G2 | Green data input | I |
| 16 | G3 | Green data input | I |
| 17 | G4 | Green data input | I |
| 18 | G5 | Green data input | I |
| 19 | G6 | Green data input | I |
| 20 | G7 | Green data input | I |
| 21 | B0 | Blue data input | I |
| 22 | B1 | Blue data input | I |
| 23 | B2 | Blue data input | I |
| 24 | B3 | Blue data input | I |
| 25 | B4 | Blue data input | I |
| 26 | B5 | Blue data input | I |
| 27 | B6 | Blue data input | I |
| 28 | B7 | Blue data input | I |
| 29 | GND | Ground | P |
| 30 | PCLK | Clock signal for RGB interface operation. Latching data at the rising edge. | I |
| 31 | DISP | Standby setting for testing. Should be connected to VDDIO in normal operation mode. If connected to GND the IC is in standby mode. | I |
| 32 | HSYNC | Horizontal sync input. Negative polarity. | I |
| 33 | VSYNC | Vertical sync input. Negative polarity. | I |
| 34 | DE | Data input enable. Active high to enable the data input bus under "DE mode" | I |
| 35 | NC | NC | |
| 36 | GND | Ground | P |
| 37 | XR(NC) | Touch panel right glass terminal | |
| 38 | YD(NC) | Touch panel bottom film terminal | |
| 39 | XL(NC) | Touch panel left glass terminal | |
| 40 | YU(NC) | Touch panel top film terminal | |

4. LCD Optical Characteristics

4.1 Optical Specifications

| Item | | Symbol | Condition | Min | Typ. | Max | Unit | Note |
|-----------------------------------|---------|------------|---|-------|-------|-------|--------|------|
| Contrast Ratio | | CR | $\theta = \phi = 0$ Normal viewing angle | 560 | 700 | -- | | (2) |
| Response time | Rising | TR | | -- | 4 | 8 | msec | (4) |
| | Falling | TF | | -- | 12 | 24 | | |
| Transmittance (with polarizer) | | T(%) | | -- | 4.29 | -- | % | (3) |
| Transmittance (without polarizer) | | T(%) | | -- | 12.16 | -- | % | (3) |
| Color Gamut | | S(%) | | -- | 62 | -- | % | (5) |
| Color Filter Chromaticity | White | W_x | | 0.283 | 0.303 | 0.323 | (5)(6) | |
| | | W_y | | 0.305 | 0.325 | 0.345 | | |
| | Red | R_x | | 0.606 | 0.626 | 0.646 | | |
| | | R_y | | 0.314 | 0.334 | 0.354 | | |
| | Green | G_x | 0.257 | 0.277 | 0.297 | | | |
| | | G_y | 0.529 | 0.549 | 0.569 | | | |
| | Blue | B_x | 0.122 | 0.142 | 0.162 | | | |
| | | B_y | 0.102 | 0.122 | 0.142 | | | |
| Viewing angle | Hor. | θ_L | CR>10 | 60 | 70 | -- | (1)(6) | |
| | | θ_R | | 60 | 70 | -- | | |
| | Ver. | θ_U | | 60 | 70 | -- | | |
| | | θ_D | | 40 | 60 | -- | | |
| Option View Direction | | 12 o'clock | | | | | (1) | |

4.2 Measuring Condition

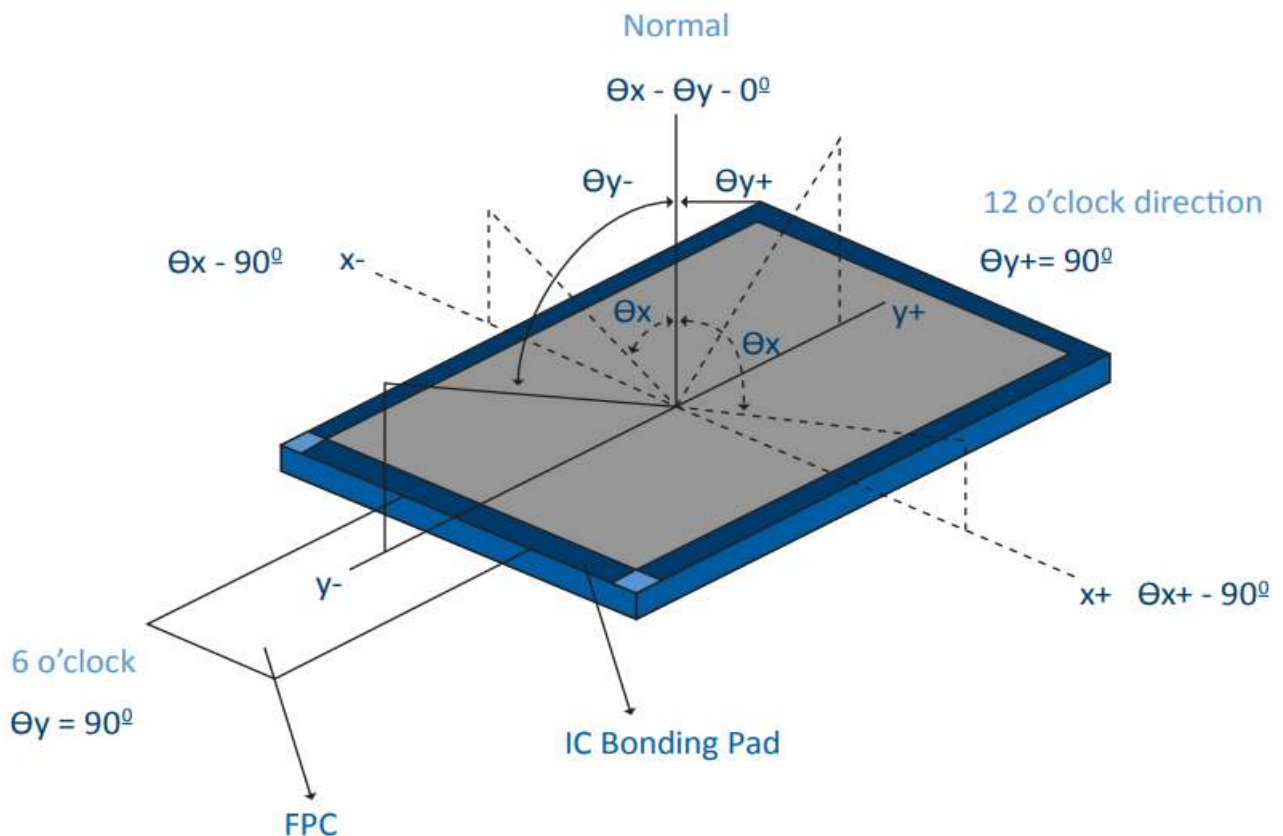
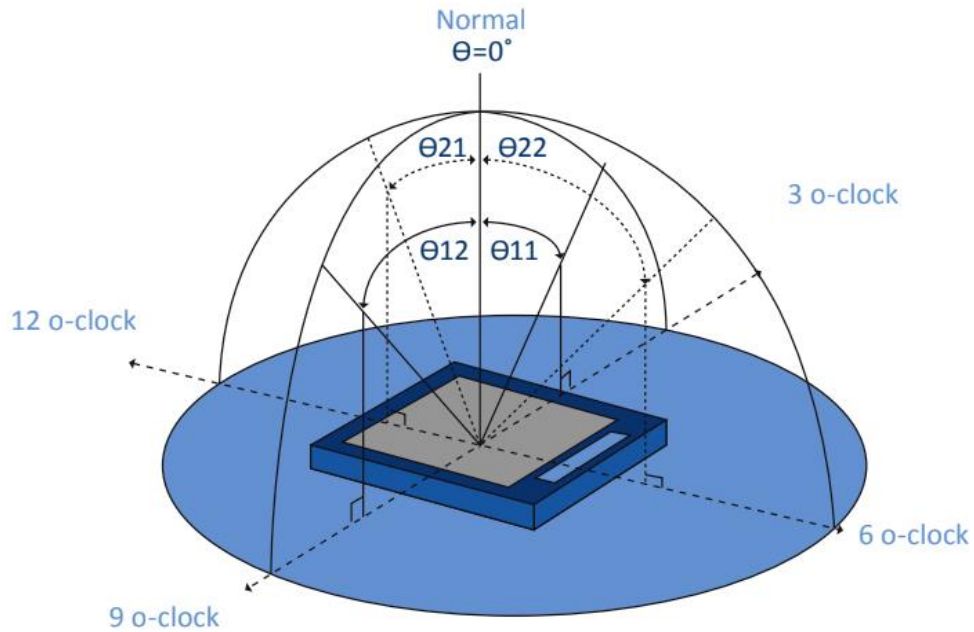
VDD = 3.3V, IL = 20mA (Backlight current)

Ambient temperature: 25 ± 2°C

15min. warm-up time

Optical Specification Reference Notes:

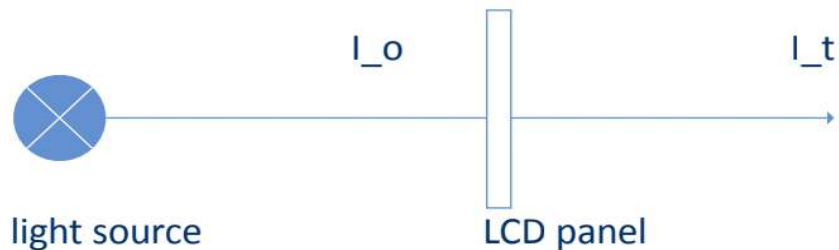
(1) Definition of Viewing Angle: The viewing angle is the angle at which the contrast ratio is greater than 10. The viewing angles are determined for the horizontal or 3,9 o'clock direction and the vertical or 6,12 o'clock direction with respect to the optical axis which is normal to the LCD surface.



(2) Definition of Contrast Ratio (Cr): measured at the center point of panel. The contrast ratio (Cr) measured on a module, is the ratio between the luminance (Lw) in a full white area (R=G=B=1) and the luminance (Ld) in a dark area (R=G=B=0).

$$Cr = \frac{L_w}{L_d}$$

(3) Definition of transmittance (T%): The transmittance of the panel including the polarizers is measured with electrical driving.



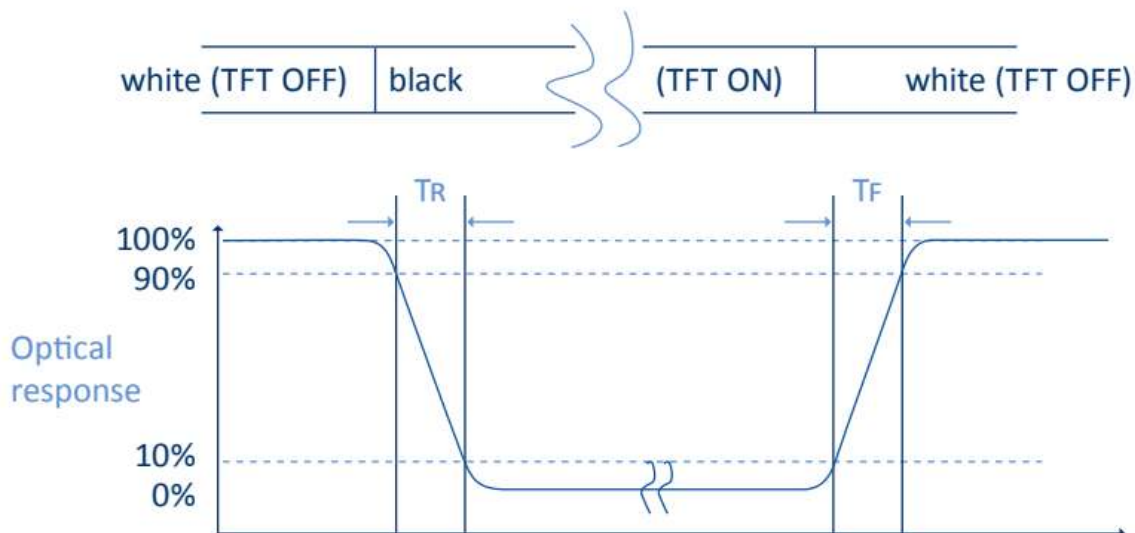
The transmittance is defined as:

$$Tr = \frac{I_t}{I_o} \times 100\%$$

I_o = the brightness of the light source.

I_t = the brightness after panel transmission

(4) Definition of Response Time (Tr, Tf): The rise time 'Tr' is defined as the time for luminance to change from 90% to 10% as a result of a change of the electrical condition. The fall time 'Tf' is defined as the time for luminance to change from 10% to 90% as a result of a change of the electrical condition.



(5) Definition of Color Gamut: Measuring machine CFT-01. NTSC's Primaries: R(x,y,Y),G(x,y,Y), B(x,y,Y). FPM520 of Westar Display Technologies, INC., which utilized SR-3 for Chromaticity and BM-5A for other optical characteristics. The color chromaticity shall be calculated from the spectral data measured with all pixels first in red, green, blue and white. Measurements shall be made at the center of the panel.

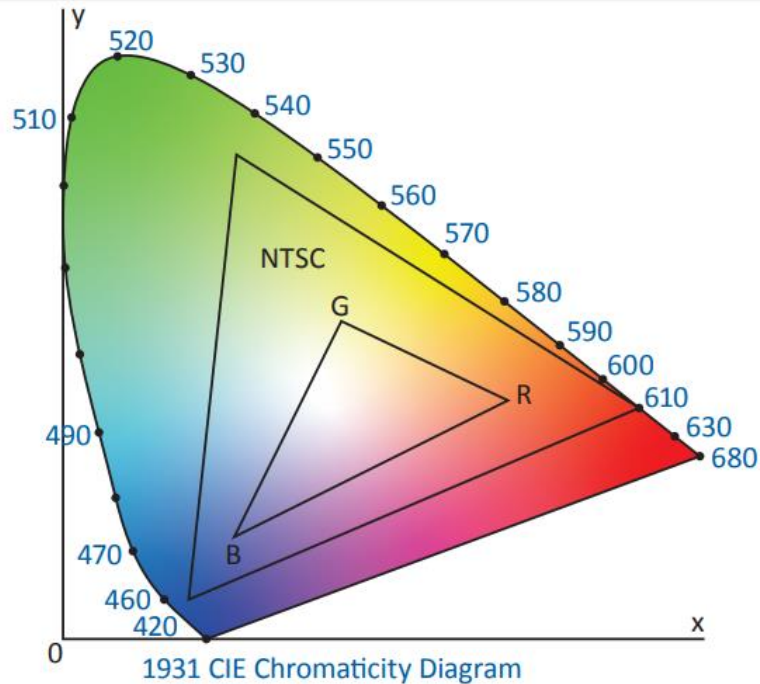
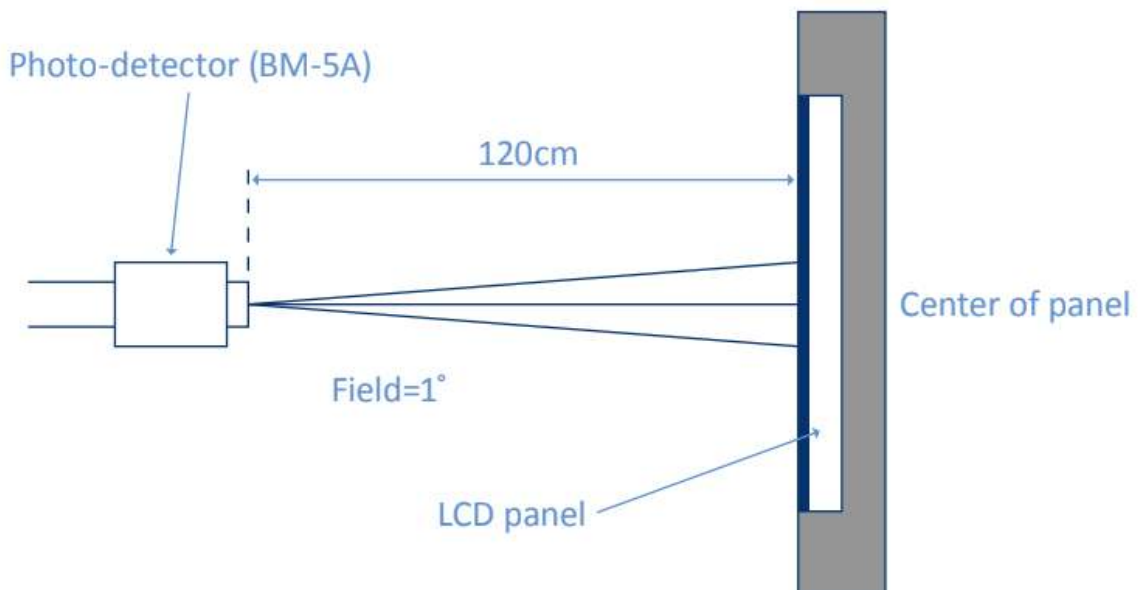


Fig. 1931 CIE chromacity diagram

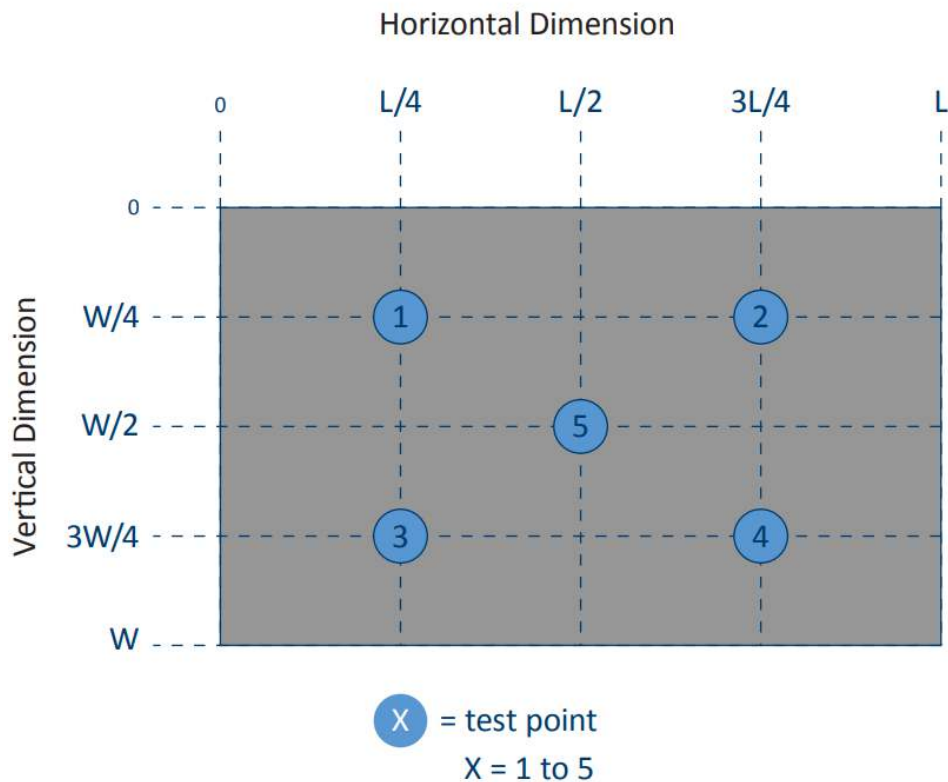
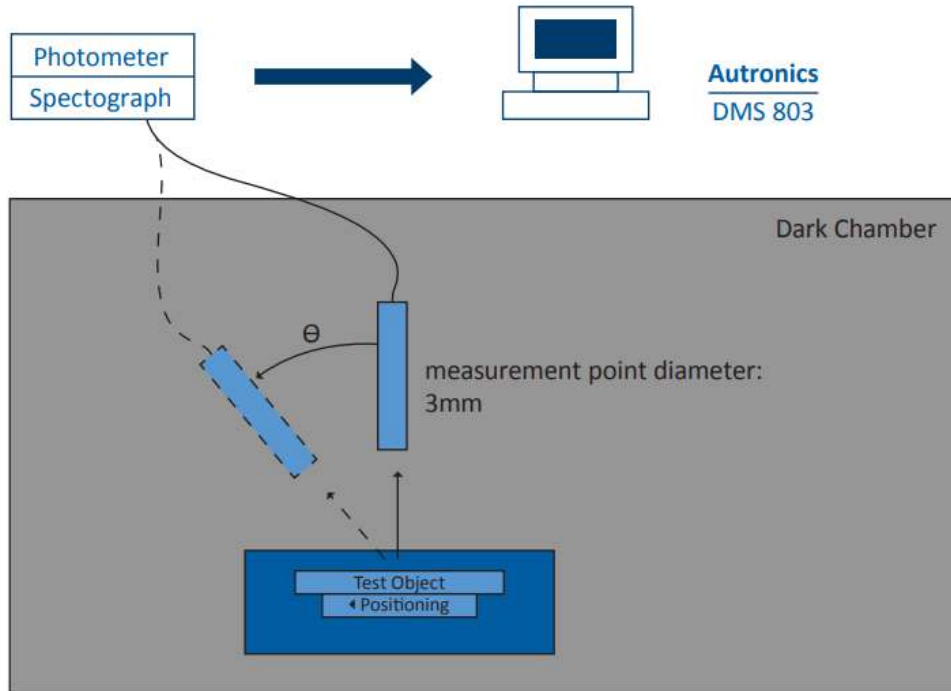
$$\text{Color gamut: } S = \frac{\text{Area of RGB triangle}}{\text{Area of NTSC triangle}} \times 100\%$$

(6) Definition of Optical Measurement Setup:



(6) Optical Measurement Setup Continued:

The LCD module should be stabilized at a given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting backlight for 20 minutes.



5. Electrical Characteristics

5.1 Absolute Maximum Rating (Ta=25 VSS=0V)

| Characteristics | Symbol | Min | Max | Unit |
|----------------------------------|-----------------|------|-----|------|
| Digital Supply Voltage | VDD | -0.3 | 4.6 | V |
| Digital Interface Supply Voltage | VDDIO | 1.8 | VDD | V |
| Operating temperature | T _{OP} | -20 | +70 | °C |
| Storage temperature | T _{ST} | -30 | +80 | °C |

NOTE: If the absolute maximum rating of even is one of the above parameters is exceeded even momentarily, the quality of the product may be degraded. Absolute maximum ratings, therefore, specify the values exceeding which the product may be physically damaged. Be sure to use the product within the range of the absolute maximum ratings.

5.2 DC Electrical Characteristics

| Characteristics | Symbol | Min | Typ. | Max | Unit | Note |
|----------------------------------|-----------------|----------|------|----------|------|------|
| Digital Supply Voltage | VDD | 3.0 | 3.3 | 4.2 | V | |
| Digital Interface Supply Voltage | VDDIO | 1.8 | 3.3 | 4.2 | V | |
| Normal Mode Current Consumption | IDD | -- | 200 | -- | mA | |
| Level input voltage | V _{IH} | 0.7VDDIO | -- | VDDIO | V | |
| | V _{IL} | GND | -- | 0.3VDDIO | V | |
| Level output voltage | V _{OH} | VDDIO-04 | -- | -- | V | |
| | V _{OL} | GND | -- | GND+0.4 | V | |

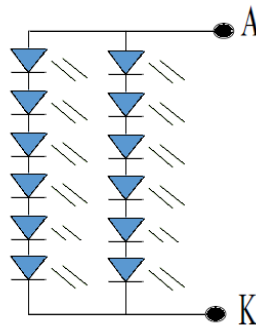
5.3 LED Backlight Characteristics

| Item | Symbol | Min | Typ. | Max | Unit | Note |
|-----------------|--------|-------|------|-----|-------------------|-----------|
| Forward Current | IF | 30 | 40 | -- | mA | |
| Forward Voltage | VF | -- | 19.2 | -- | V | |
| LCM Luminance | LV | 350 | -- | -- | cd/m ² | Note 3 |
| LED lifetime | Hr | 50000 | -- | -- | hour | Note1 & 2 |
| Uniformity | AVg | 80 | -- | -- | % | Note 3 |

The back-light system is edge-lighting type with 12 chips White LED

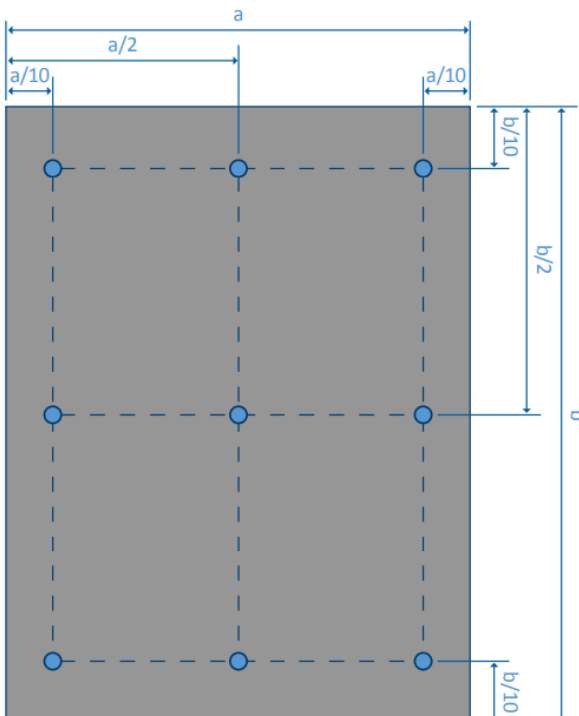
Note 1: LED lifetime (Hr) can be defined as the time in which it continues to operate under the condition: Ta=25 ±3 °C, typical IF value indicated in the above table until the brightness becomes less than 50%.

Note 2: The “LED lifetime” is defined as the module brightness decrease to 50% original brightness at Ta=25°C and IF = 40mA. The LED lifetime could be decreased if operating IL is larger than 40mA. The constant current driving method is suggested.



Backlight LED Circuit

Note 3: Luminance Uniformity of these 9 points is defined as below:



$$\text{Luminance} = \frac{\text{Total Luminance of 9 points}}{9}$$

$$\text{Uniformity} = \frac{\text{minimum luminance in 9 points(1-9)}}{\text{maximum luminance in 9 points(1-9)}}$$

6. AC Characteristic

For further details and configurations, please see the spec for IC [ILI6122](#) and [ILI5960](#).

6.1 Input Signal Characteristics

| Parameters | Symbol | Min | Typ. | Max | Unit | Condition |
|--------------------------------------|--------|------|------|-----|------|-----------------------------|
| VDD power source slew time | TPOR | -- | -- | 20 | ms | From 0V to 99%VDD |
| GRB pulse width | tRSTW | 10 | 50 | -- | us | R=10kΩ, C=1uF |
| DCLK clock time | Tclk | 33.3 | -- | -- | ns | DCLK=30MHz |
| DCLK clock low period | Tcwl | 40 | -- | 60 | % | |
| DCLK clock high period | Tcwh | 40 | -- | 60 | % | |
| Clock rising time | Trck | 9 | -- | -- | ns | |
| Clock falling time | Tfck | 9 | -- | -- | ns | |
| HSD width | Thwh | 1 | -- | -- | DCLK | |
| HSD period time | Th | 55 | 60 | 65 | us | |
| HSD setup time | Thsu | 12 | -- | -- | ns | |
| HSD hold time | Thhd | 12 | -- | -- | ns | |
| VSD width | Tvwh | 1 | -- | -- | Th | |
| VSD setup time | Tvsu | 12 | -- | -- | ns | |
| VSD hold time | Tvhd | 12 | -- | -- | ns | |
| Data setup time | Tdasu | 12 | -- | -- | ns | |
| Data hold time | Tdahd | 12 | -- | -- | ns | |
| DE setup time | Tdesu | 12 | -- | -- | ns | |
| DE hold time | Tdehd | 12 | -- | -- | ns | |
| Source output setting time | Tssf | -- | -- | TBD | us | 10% to 90% CL=60pF, RL=2kΩ |
| Gate output setting time | Tgst | -- | -- | TBD | ns | 10% to 90% CL=60pF |
| VCOM output setting time | Tcst | -- | -- | TBD | us | 10% to 90% CL=40nF, RL=50Ω |
| Time from VSD to 1st line data input | Tvs | 3 | 8 | 31 | Th | HV mode By HDL[4:0] setting |

Table 6.1: AC Input Signal Timing Characteristics

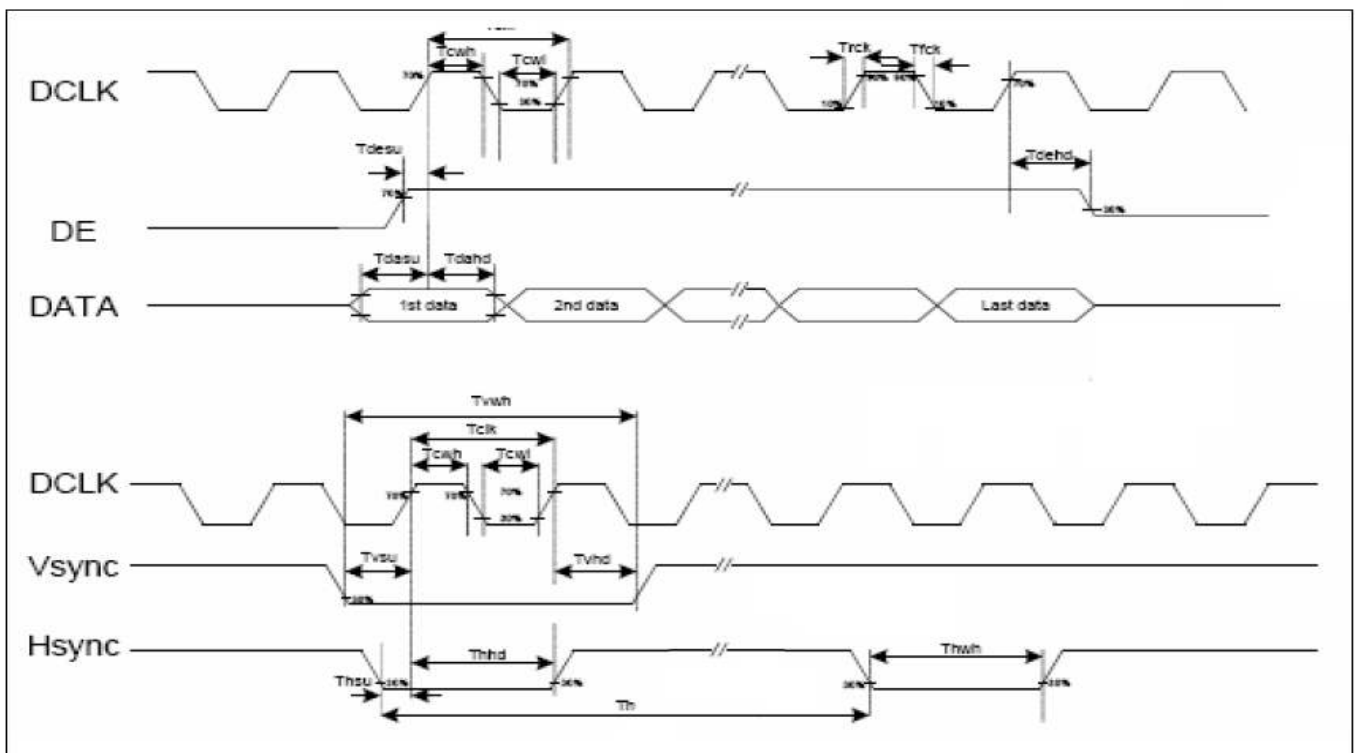


Figure 6.1: Clock and Data Input Waveforms

6.2 Data Input Format

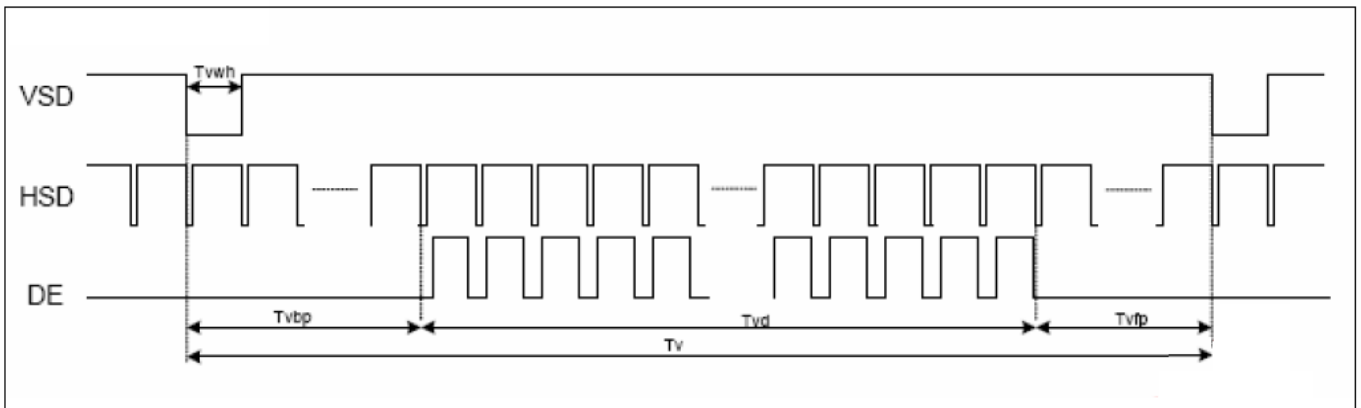


Figure 6.2: Vertical Input Timing Diagram

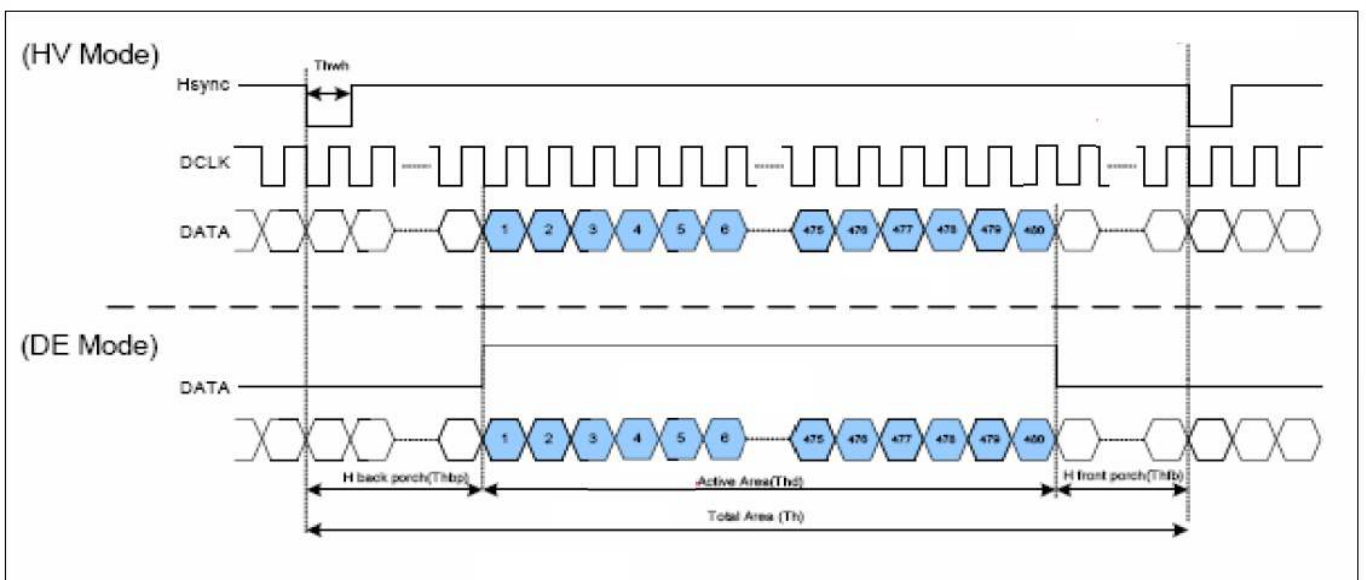


Figure 6.3: Serial 8-bit RGB Mode Timing Diagram

| Parameters | Symbol | Min | Typ. | Max | Unit | Condition |
|----------------------------------|------------------|-----|------|-----|------|-----------|
| DCLK frequency | F _{clk} | 24 | 27 | 30 | MHz | |
| DCLK cycle time | T _{clk} | 83 | 110 | 200 | ns | |
| DCLK pulse duty | T _{cwh} | 40 | 50 | 60 | % | |
| Time from HSD to source output | T _{hso} | -- | 13 | -- | DCLK | |
| Time from HSD to gate output | T _{hgo} | -- | 27 | -- | DCLK | |
| Time from HSD to gate output off | T _{hgz} | -- | 3 | -- | DCLK | |
| Time from HSD to VCOM | T _{hvc} | -- | 12 | -- | DCLK | |

Table 6.2: Horizontal and Vertical Input Timing Characteristics

6.3 Parallel RGB Mode Data Format

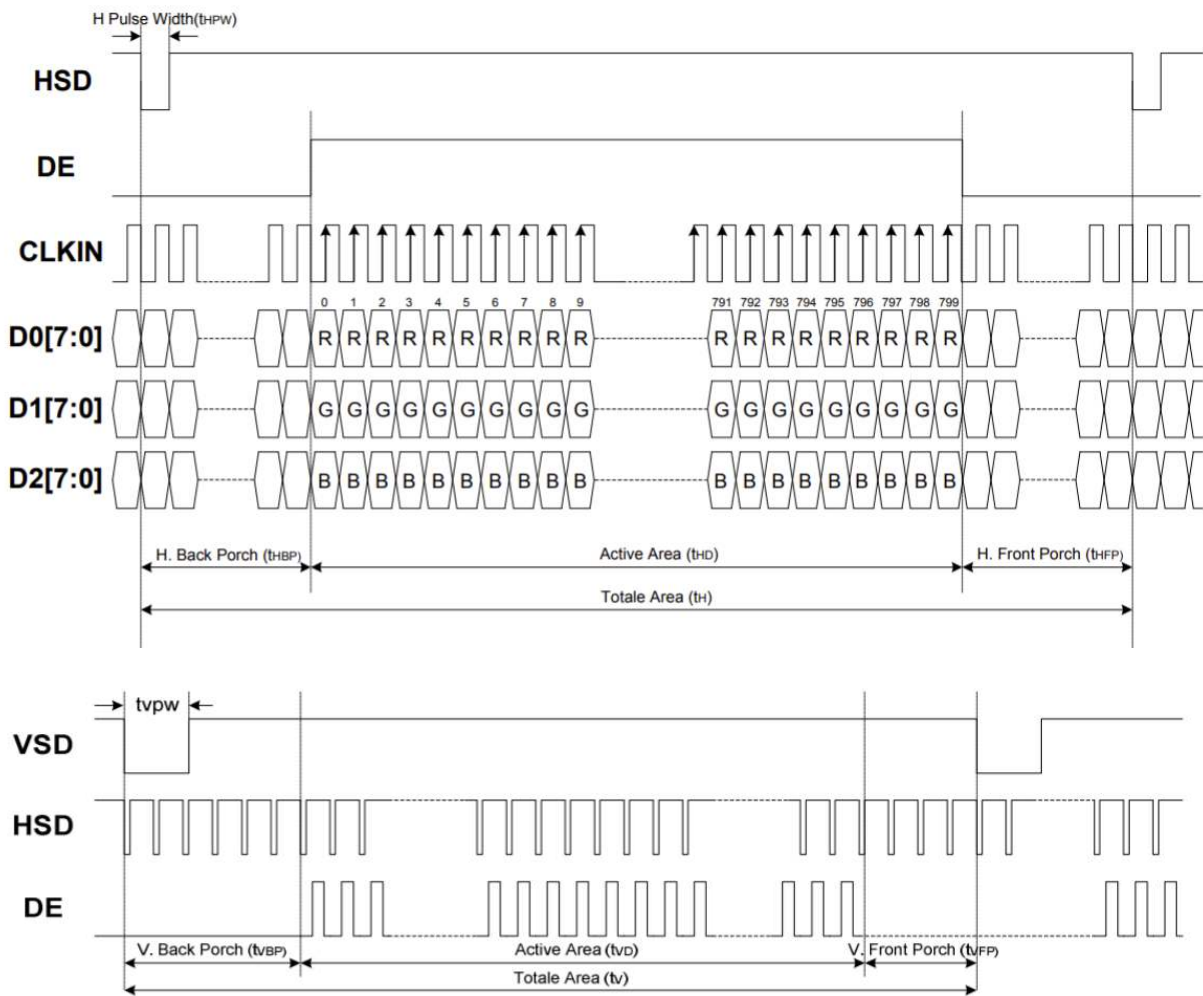


Figure 6.4: Parallel RGB Input Timing Diagram

| Parameters | Symbol | Min | Typ. | Max | Unit | Condition |
|------------------|--------|-----|------|------|-------|-----------|
| CLKIN frequency | Fclk | -- | 33.3 | 50 | MHz | |
| VSD period time | Tv | 510 | 525 | 650 | HSD | |
| VSD display area | Tvd | -- | 480 | -- | HSD | |
| VSD back porch | Tvbp | 23 | 23 | 23 | HSD | |
| VSD front porch | Tvfp | 7 | 22 | 147 | HSD | |
| HSD period time | Th | 862 | 1056 | 1200 | CLKIN | |
| HSD display area | Thd | -- | 800 | -- | CLKIN | |
| HSD back porch | Thbp | 46 | 46 | 46 | CLKIN | |
| HSD front porch | Thfp | 16 | 210 | 354 | CLKIN | |

Table 6.3: Parallel RGB Input Timing Characteristics

7. CTP Specification

7.1 Electrical Characteristics

7.1.1 Absolute Maximum Rating

| Item | Symbol | Min | Max | Unit | Note |
|-----------------------|-----------------|------|------|------|------|
| Power Supply Voltage | VDD | -0.3 | 3.47 | V | 1 |
| I/O Digital Voltage | VDDIO | -0.3 | 3.47 | V | 1 |
| Operating Temperature | T | -20 | +70 | °C | - |
| Storage Temperature | T _{ST} | -30 | +80 | °C | - |

Table 7.1: CTP Absolute Maximum Rating Characteristics

Note: If used beyond the absolute maximum ratings, GT911 may permanently damage. It is strongly recommended that the device be used within the electrical characteristics in normal operations. If exposed to the condition not within the electrical characteristics, it may affect the reliability of the device.

7.1.2 DC Electrical Characteristics (Ta=25°C)

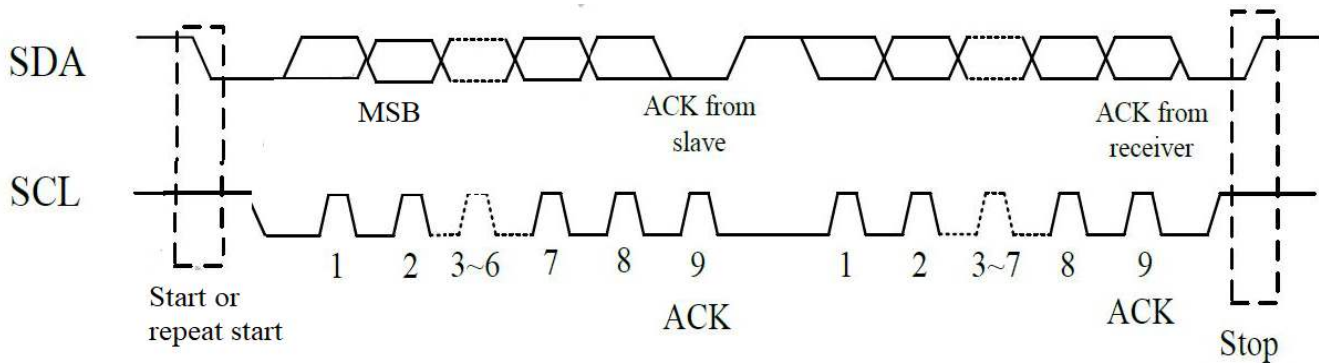
| Item | Symbol | Condition | Min | Typ. | Max | Unit | Note |
|---|------------------|--------------------------------------|-----------|------|-----------|------|------|
| Digital supply voltage | VDD | | 2.8 | | 3.3 | V | |
| I/O Digital supply voltage | VDDIO | | 1.8 | | 3.3 | V | |
| Normal operation mode current consumption | I _{OPr} | VDD=2.8V Ta=25°C MCLK=17.5 MHz | | 8 | 14.5 | mA | |
| Monitor mode current consumption | I _{mon} | | | 3.3 | | mA | |
| Sleep mode current consumption | I _{sip} | | 70 | | 120 | uA | |
| Level input voltage | V _{IH} | | 0.75VDDIO | | VDDIO+0.3 | V | |
| | V _{IL} | | -0.3 | | 0.25VDDIO | V | |
| Level output voltage | V _{OH} | I _{OH} =-0.1mA | 0.85VDDIO | | | V | |
| | V _{OL} | I _{OL} =0.1mA | | | 0.15VDDIO | V | |

Table 7.2: CTP DC Electrical Characteristics

7.2 AC Characteristics

7.2.1 I2C Interface Characteristics

GT911 provides a standard I2C interface for SCL and SDA to communicate with the host. GT911 always serves as slave device in the system with all communication being initialized by the host. It is recommended that transmission rate be kept at or below 400kbps. The figure shown below is the I2C timing:



| Parameter | Symbols | Condition | Min | Max | Units |
|------------------------------------|------------------|-----------|-----|-----|-------|
| SCL low period | t _{lo} | | 1.3 | | us |
| SCL high period | t _{hi} | | 0.6 | | us |
| SCL setup time for start condition | t _{st1} | | 0.6 | | us |
| SCL setup time for stop condition | t _{st3} | | 0.6 | | us |
| SCL hold time for start condition | t _{hd1} | | 0.6 | | us |
| SDA setup time | t _{st2} | | 0.1 | | us |
| SDA hold time | t _{hd2} | | 0 | | us |

Table 7.3: I2C AC Characteristics, 1.8V interface voltage, 400kbps transmission rate, 2k pull-up resistor

| Parameter | Symbols | Condition | Min | Max | Units |
|------------------------------------|------------------|-----------|-----|-----|-------|
| SCL low period | t _{lo} | | 1.3 | | us |
| SCL high period | t _{hi} | | 0.6 | | us |
| SCL setup time for start condition | t _{st1} | | 0.6 | | us |
| SCL setup time for stop condition | t _{st3} | | 0.6 | | us |
| SCL hold time for start condition | t _{hd1} | | 0.6 | | us |
| SDA setup time | t _{st2} | | 0.1 | | us |
| SDA hold time | t _{hd2} | | 0 | | us |

Table 7.4: I2C AC Characteristics, 3.3V interface voltage, 400kbps transmission rate, 2k pull-up resistor

GT911 supports two I2C slave addresses: 0xBA/0xBB and 0x28/0x29. The host can select the address by changing the status of Reset and INT pins during the power-on initialization phase. The configuration methods and timings are shown below:

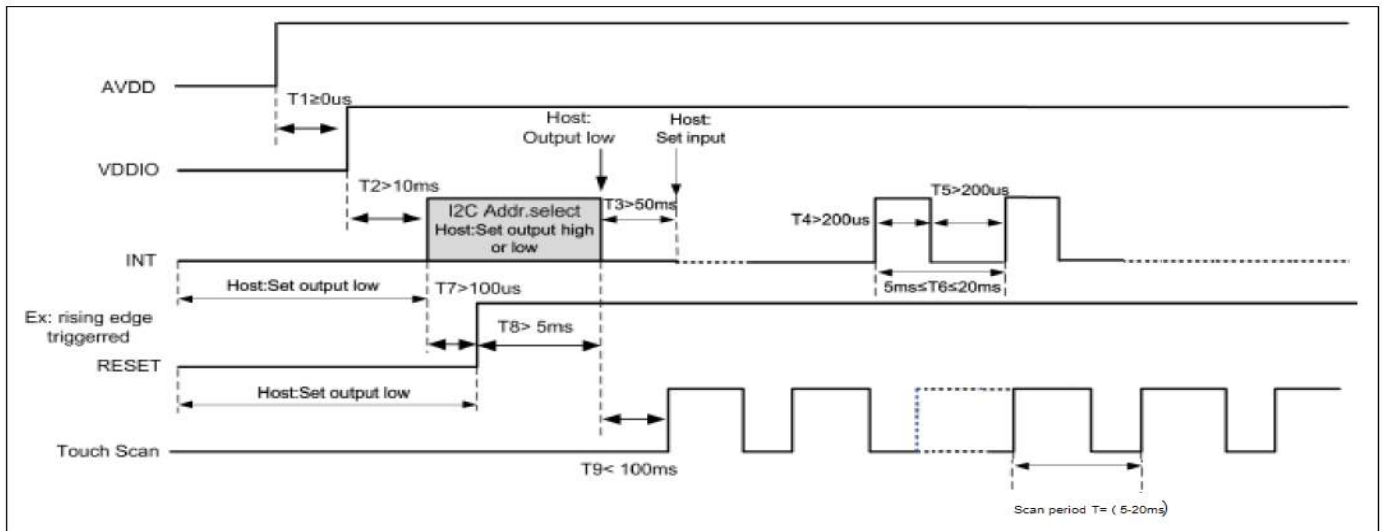


Figure 7.1: I2C Power on Timing

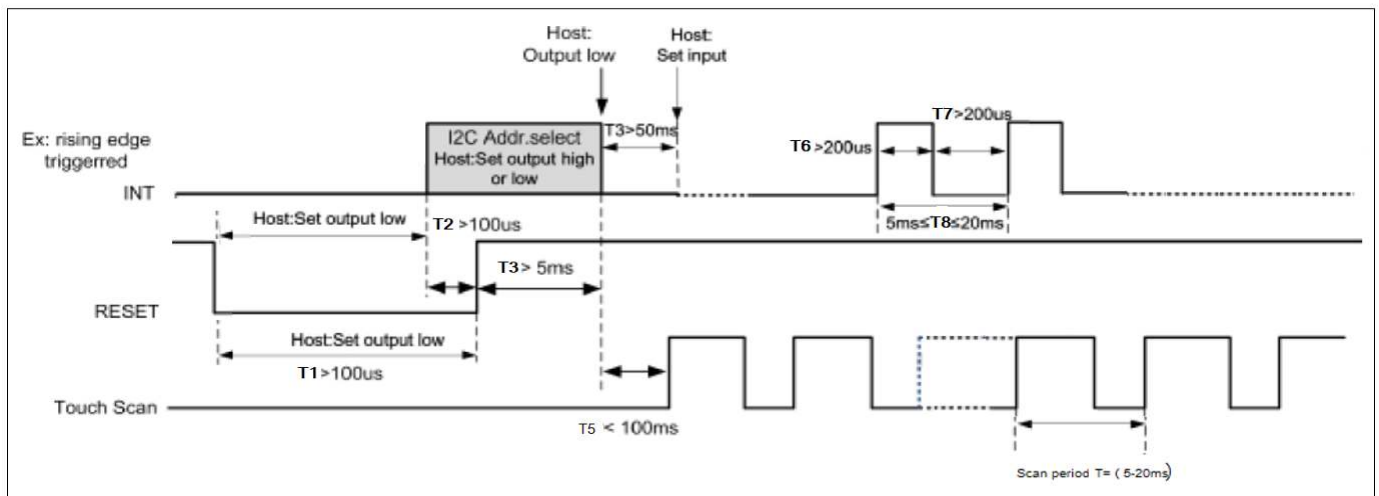


Figure 7.2: I2C Host Resetting Timing

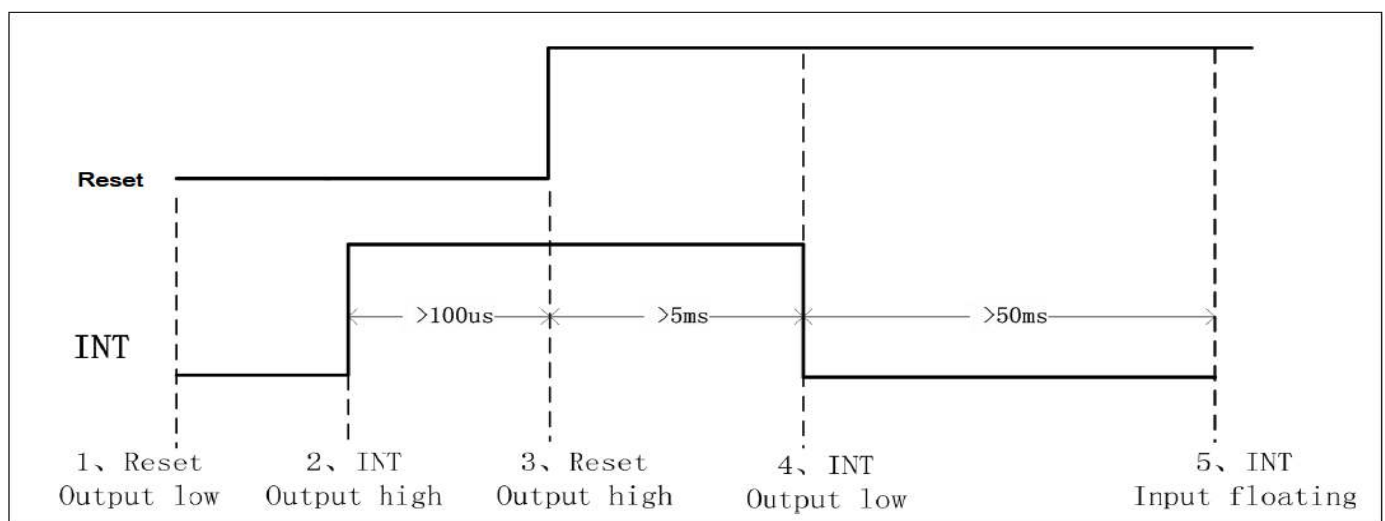


Figure 7.3: Setting Slave Address to 0x28/0x29 Timing

6.0 TFT AC Characteristics

6.1 Input Signal Characteristics

For the interface timing diagram, see diagram on page 61 of the data sheet for controller IC ST7282. The data sheet can be found here: <https://focuslcds.com/content/ST7282.pdf>

6.2 Data Input Format

For the vertical input timing diagram, see diagram

6.3 Parallel RGB Mode Data Format

For the parallel RGB Input timing diagrams and tables, see diagrams and tables on pages 45-46 of the datasheet for IC ILI5960. The datasheet can be found here: <https://focuslcds.com/content/ILI5960.pdf>

7.0 Quality Inspection Standards

For TFT quality inspection standards, please see the following link: <https://focuslcds.com/tft-quality-inspection-standards/>

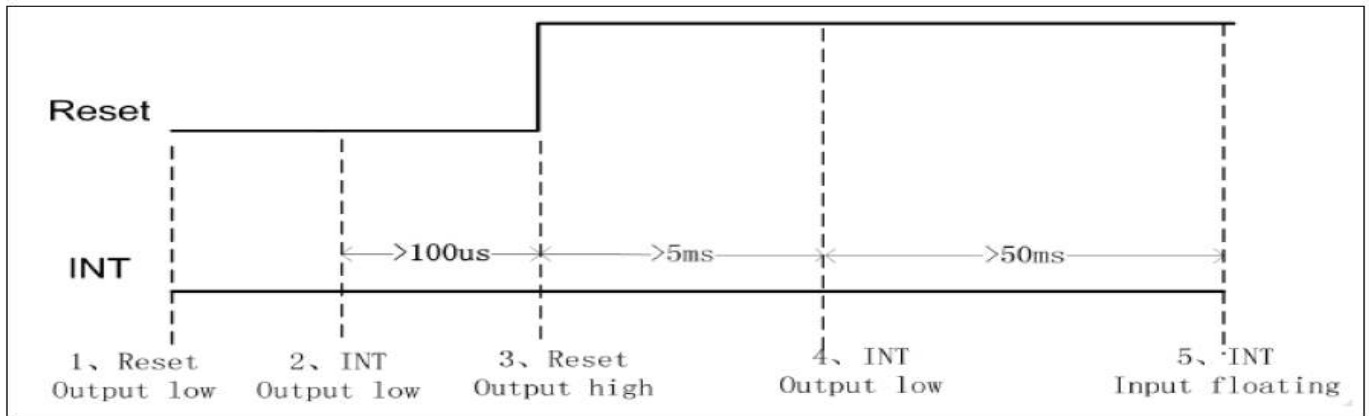


Figure 7.4: Setting Slave Address to 0xBA/0xBB Timing

Data Transmission (ex. 0xBA/0xBB)

Communication is always initiated by the host. Valid start condition is signaled by pulling SDA line from high to low when SCL is high. Data flow or address is transmitted after the start condition.

All slave devices connected to I2C bus should detect the 8-bit address issued after start condition and send the correct ACK. After receiving matching address, GT911 acknowledges by configuring SDA line as output port and pulling SDA line low during the ninth SCL cycle. When receiving unmatched address, namely not 0xBA or 0xBB, GT911 will stay in an idle state.

For data bytes on SDA, each of the 9 serial bits will be sent on nine SCL cycles. Each data byte consists of 8 valid data bits and one ACK or NACK bit sent by the recipient. The data transmission is valid when SCL line is high. When communication is completed the host will issue the stop condition. Stop condition implies the transition of SDA line from low to high when SCL is high.

Writing Data to GT911

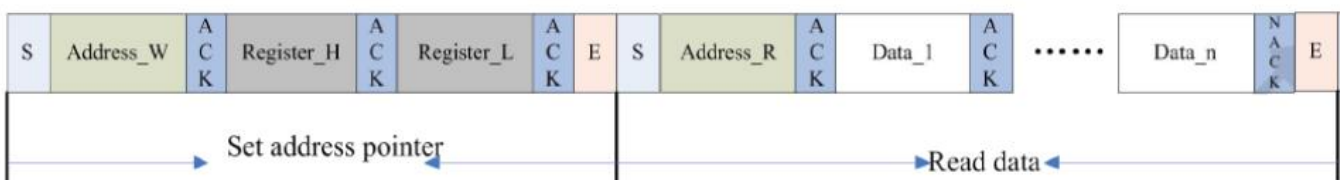
The diagram displays the timing sequence of the host writing data onto GT911. First the host issues a start condition. The host sends 0xBA (address bits and R/W bit; R/W bit as 0 indicates write operation) to the slave device. After receiving ACK, the host sends the 16-bit register address (where writing starts) and the 8-bit data bytes (to be written onto the register)



The location of the register address pointer will automatically add 1 every write operation. When the host needs to perform write operations on a group of registers of continuous addresses it can write continuously. The write operation is terminated when the host issues the stop condition.

Reading Data from GT911

The diagram below is the timing sequence of the host reading data from GT911. The host issues the start condition and sends 0xBA (Address bits and R/W bit, R/W bit as 0 indicates write operation) to the slave device. After receiving ACK, the host sends the 16-bit register address (where reading starts) to the slave device. Then the host sets register addresses which need to be read.



The host issues the start condition once again and sends 0xBB (read operation). After receiving ACK, the host starts to read the data. GT911 also supports continuous read operation. When receiving a byte of data, the host sends an ACK signal indicating successful reception. After receiving the last byte of data, the host sends a NACK signal followed by a STOP condition which terminates communication.

8. Cautions and Handling Precautions

8.1 Handling and Operating the Module

1. When the module is assembled, it should be attached to the system firmly. Do not warp or twist the module during assembly work.
2. Protect the module from physical shock or any force. In addition to damage, this may cause improper operation or damage to the module and back-light unit.
3. Note that polarizer is very fragile and could be easily damaged. Do not press or scratch the surface.
4. Do not allow drops of water or chemicals to remain on the display surface. If you have the droplets for a long time, staining and discoloration may occur.
5. If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.
6. The desirable cleaners are water, IPA (Isopropyl Alcohol) or Hexane. Do not use ketene type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.
7. If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, legs, or clothes, it must be washed away thoroughly with soap.
8. Protect the module from static; it may cause damage to the CMOS ICs.
9. Use fingerstalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
10. Do not disassemble the module.
11. Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.
12. Pins of I/F connector shall not be touched directly with bare hands.
13. Do not connect, disconnect the module in the "Power ON" condition.
14. Power supply should always be turned on/off by the item Power On Sequence & Power Off Sequence

8.2 Storage and Transportation.

1. Do not leave the panel in high temperature, and high humidity for a long time. It is highly recommended to store the module with temperature from 0 to 35 °C and relative humidity of less than 70%
2. Do not store the TFT-LCD module in direct sunlight.
3. The module shall be stored in a dark place. When storing the modules for a long time, be sure to adopt effective measures for protecting the modules from strong ultraviolet radiation, sunlight, or fluorescent light.
4. It is recommended that the modules should be stored under a condition where no condensation is allowed. Formation of dewdrops may cause an abnormal operation or a failure of the module. In particular, the greatest possible care should be taken to prevent any module from being operated where condensation has occurred inside.
5. This panel has its circuitry FPC on the bottom side and should be handled carefully in order not to be stressed.