



RAYSTAR

RAYSTAR Optronics, Inc.
曜凌光電股份有限公司



曜凌光電股份有限公司 Raystar Optonics, Inc.

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RFA180F-ALW-DNN

SPECIFICATION

CUSTOMER:

| | |
|-------------|--|
| APPROVED BY | |
| PCB VERSION | |
| DATE | |

FOR CUSTOMER USE ONLY

| SALES BY | APPROVED BY | CHECKED BY | PREPARED BY |
|----------|-------------|------------|-------------|
| | | | |

Release DATE:

TFT Display Inspection Specification: <https://www.raystar-optronics.com/download/products.htm>

Precaution in use of TFT module: <https://www.raystar-optronics.com/download/declaration.htm>

Revision History

| VERSION | DATE | REVISED PAGE NO. | Note |
|---------|--------------------------|------------------|--|
| 0 A | 2017/11/17 2019/12/05 | | First issue Modify Summary Add Uniformity. |

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1.Module Classification Information

| | | | | | | | | | | | | |
|----------|----------|----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|
| R | F | A | 18 | 0F | - | A | L | W | - | D | N | N |
| 1 | 2 | 3 | 4 | 5 | - | 6 | 7 | 8 | - | 9 | 10 | 11 |

| Item | Description | | | | |
|------|---|--|--|---|--|
| 1 | R : Raystar Optonics Inc. | | | | |
| 2 | Display Type : F→TFT Type, J→ Custom TFT | | | | |
| 3 | Solution: A: 128x160 B:320x234 C:320x240 D:480x234 E:480x272 F:800x480 G:640x480 H:1024x600 I:320x480 J:240x320 K:1280x800 L:240x400 M:1024x768 N:128x128 O:480x800 P:640x320 Q:800x600 S:480x128 T:800x320 | | | | |
| 4 | Display Size : 1.8” TFT | | | | |
| 5 | Version Code. | | | | |
| 6 | Model Type: A : TFT LCD E : TFT+FR+CONTROL BOARD J : TFT+FR+A/D BOARD N : TFT+FR+A/D BOARD+CONTROL BOARD S : TFT+FR+POWER BOARD (DC TO DC) 1 : TFT+CONTROL BOARD | | | 6 : TFT+FR H : TFT+D/V BOARD I : TFT+FR+D/V BOARD B : TFT+POWER BD | |
| 7 | Polarizer Type, Temperature range, View direction | I→Transmissive, W. T, 6:00 ; C→Transmissive, N. T, 6:00 L→Transmissive, W.T,12:00 ; F→Transmissive, N.T,12:00 Y→Transmissive,W.T, IPS TFT ; A→Transmissive, N.T, IPS TFT Z→Transmissive, W.T, O-TFT R→Transmissive, Super W.T, O-TFT N→Transmissive, Super W.T, 6:00; Q→Transmissive, Super W.T, 12:00 V→Transmissive, Super W.T, VA TFT | | | |
| 8 | Backlight | W : LED, White | | H : LED, High Light White | |
| | | F : CCFL, White | | | |
| 9 | Driver Method | D: Digital A: Analog L : LVDS M:MIPI | | | |
| 10 | Interface | N : without control board A : 8Bit B : 16Bit S:SPI Interface R: RS232 U:USB I: I2C | | | |
| 11 | TS | N : Without TS S : resistive touch panel C : capacitive touch panel capacitive touch panel (G-F-F) G : capacitive touch panel(G-G) | | | |

2.Summary

RF18F is a color active matrix thin film transistor (TFT) liquid crystal display with polarizer. This model is composed of amorphous silicon TFT as a switching device. It is a transmissive type display operating in the normally white mode.

This TFT LCD has a 1.77-inch diagonally measured active display area with 384 x 160 dot (128 vertical by 160 horizontal pixel) resolution. Each pixel is divided into Red, Green, Blue dots which are arranged in vertical stripes.

RAYSTAR OPTRONICS

3.General Specifications

- Size: 1.77 inch
- Dot Matrix: 128 x RGB x 160(TFT) dots
- Module dimension: 34.0(W) x 45.83(H) x 2.65(D) mm
- Active area: 28.03 x 35.04 mm
- Dot pitch: 0.073 x 0.219 mm
- LCD type: TFT, Normally White, Transmissive
- View Direction: 6 o'clock
- Gray Scale Inversion Direction: 12 o'clock
- Aspect Ratio: Portrait
- IC: ST7735S
- Backlight Type: LED, Normally White
- With /Without TP: Without TP
- Surface: Anti-Glare

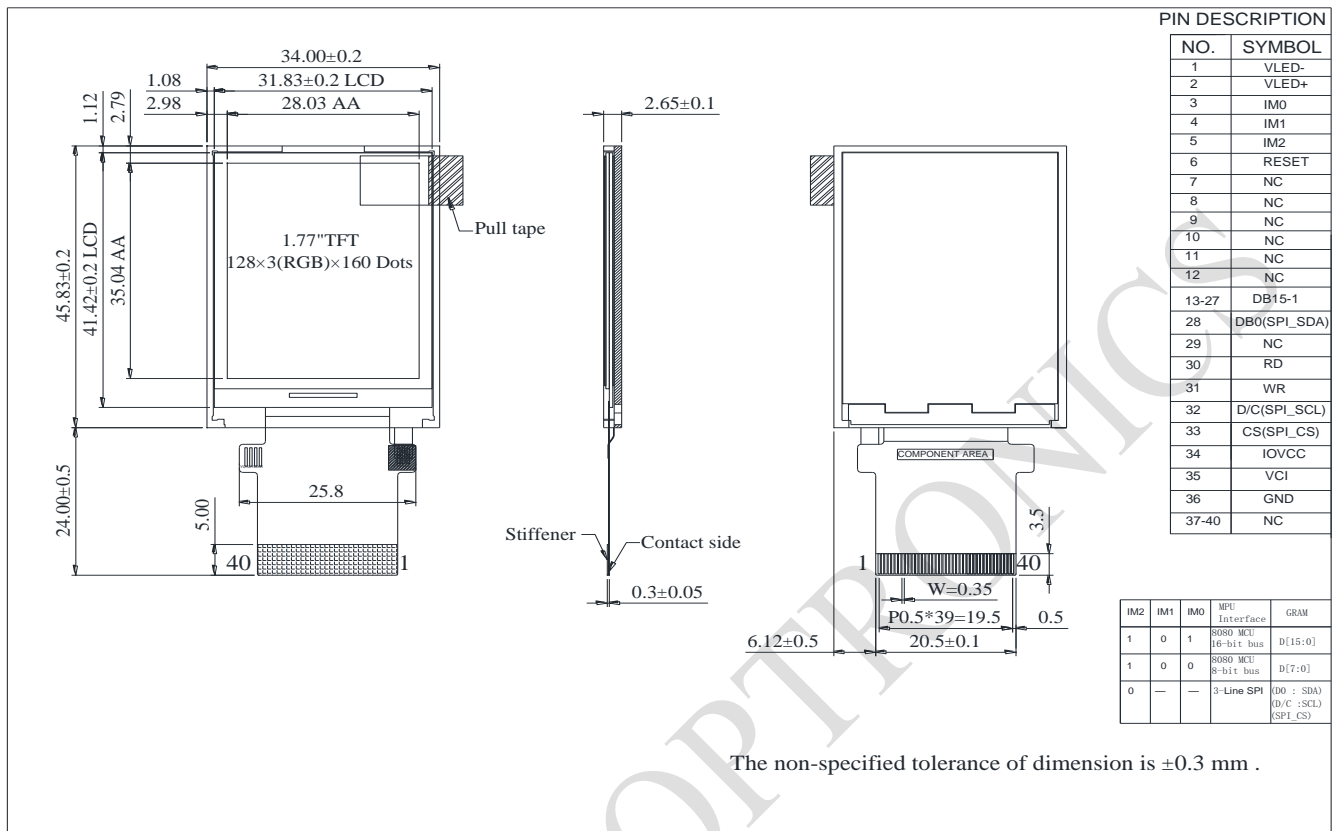
*Color tone slight changed by temperature and driving voltage.

4.Interface

4.1. LCM PIN Definition

| Pin | Symbol | I/O | Function | Remark | | | | | | | | | | | | | | | |
|-------|-------------------|---------------------|--|--------|-----|--------------------|---|---|--------------------|---|---|---------------------|---|---|--------------------|---|---|---------------------|--|
| 1 | VLED- | P | Back light cathode | | | | | | | | | | | | | | | | |
| 2 | VLED+ | P | Back light anode | | | | | | | | | | | | | | | | |
| 3 | IM0 | I | - MCU Parallel Interface Type Selection -If Not Used, Please Fix this Pin at VDDI or DGND Level. <table border="1"><thead><tr><th>IM1</th><th>IM0</th><th>Parallel Interface</th></tr></thead><tbody><tr><td>0</td><td>0</td><td>MCU 8-bit Parallel</td></tr><tr><td>0</td><td>1</td><td>MCU 16-bit Parallel</td></tr><tr><td>1</td><td>0</td><td>MCU 9-bit Parallel</td></tr><tr><td>1</td><td>1</td><td>MCU 18-bit Parallel</td></tr></tbody></table> | IM1 | IM0 | Parallel Interface | 0 | 0 | MCU 8-bit Parallel | 0 | 1 | MCU 16-bit Parallel | 1 | 0 | MCU 9-bit Parallel | 1 | 1 | MCU 18-bit Parallel | |
| IM1 | IM0 | | Parallel Interface | | | | | | | | | | | | | | | | |
| 0 | 0 | MCU 8-bit Parallel | | | | | | | | | | | | | | | | | |
| 0 | 1 | MCU 16-bit Parallel | | | | | | | | | | | | | | | | | |
| 1 | 0 | MCU 9-bit Parallel | | | | | | | | | | | | | | | | | |
| 1 | 1 | MCU 18-bit Parallel | | | | | | | | | | | | | | | | | |
| 4 | IM1 | | | | | | | | | | | | | | | | | | |
| 5 | IM2 | I | MCU Parallel Interface Bus and Serial Interface select IM2='1', Parallel Interface IM2='0', Serial Interface | | | | | | | | | | | | | | | | |
| 6 | RESET | P | Reset signal | | | | | | | | | | | | | | | | |
| 7-12 | NC | - | No Connect | | | | | | | | | | | | | | | | |
| 13-28 | DB15-DB0(SPI_SDA) | I/O | DB15:0] are used as MCU parallel interface data bus. -DBis the serial input/output signal in serial interface mode. -In serial interface, DB15:1] are not used and should be fixed at VDDI or DGND level. | | | | | | | | | | | | | | | | |
| 29 | NC | - | No Connect | | | | | | | | | | | | | | | | |
| 30 | RD | I | Read Enable in 8080 MCU Parallel Interface. -If not used, please fix this pin at VDDI or DGND level. | | | | | | | | | | | | | | | | |
| 31 | WR | I | Serial clock -Write Enable in MCU Parallel Interface. -If not used, please fix this pin at VDDI or DGND level. | | | | | | | | | | | | | | | | |
| 32 | D/C(SPI_SCL) | I | -Display data/command Selection Pin in MCU Interface. -D/CX='1': Display Data or Parameter. -D/CX='0': Command Data. -In Serial Interface, this is used as SCL. -If not used, please fix this pin at VDDI or DGND level. | | | | | | | | | | | | | | | | |
| 33 | CS(SPI_CS) | I | Chip enable | | | | | | | | | | | | | | | | |
| 34 | IOVCC | P | Interface Operation Voltage | | | | | | | | | | | | | | | | |
| 35 | VCI | P | Analog Supply Voltage | | | | | | | | | | | | | | | | |
| 36 | GND | P | Ground | | | | | | | | | | | | | | | | |
| 37-40 | NC | - | No Connect | | | | | | | | | | | | | | | | |

5. Contour Drawing



6. Absolute Maximum Ratings

| Item | Symbol | Min | Typ | Max | Unit |
|-----------------------|--------|-----|-----|-----|------|
| Operating Temperature | TOP | -20 | — | +70 | °C |
| Storage Temperature | TST | -30 | — | +80 | °C |

Note: Device is subject to be damaged permanently if stresses beyond those absolute maximum ratings listed above

- Temp. $\leq 60^{\circ}\text{C}$, 90% RH MAX. Temp. $> 60^{\circ}\text{C}$, Absolute humidity shall be less than 90% RH at 60°C

7. Electrical Characteristics

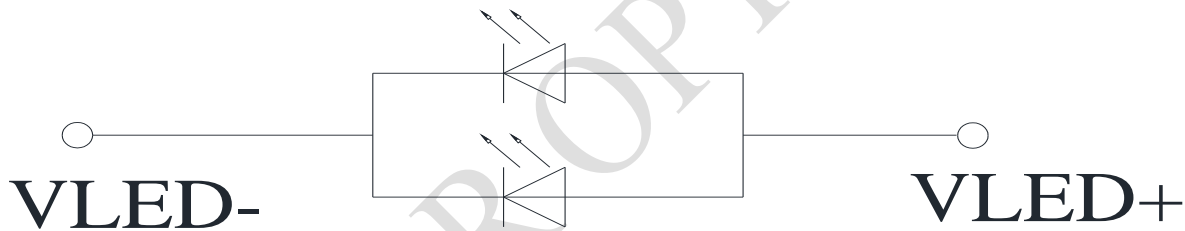
7.1. Operating conditions:

| Item | Symbol | Condition | Min | Typ | Max | Unit |
|-----------------------------|---------|-----------|------|------|-----|------|
| Supply Voltage For Analog | VCI | — | 2.5 | 2.75 | 4.8 | V |
| Interface Operation Voltage | IOVCC | — | 1.65 | 1.8 | 3.7 | V |
| Supply LCM current | ICI(mA) | — | - | 0.9 | 2 | mA |

7.2. LED driving conditions

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Remark |
|-------------------|--------|------|--------|------|------|------------|
| LED current | | - | 40 | - | mA | |
| Power Consumption | | | 128 | - | mW | |
| LED voltage | VBL+ | 2.9 | 3.2 | 3.4 | V | Note 1 |
| LED Life Time | | - | 50,000 | - | Hr | Note 2,3,4 |

Note 1 : There are 1 Groups LED



Note 2 : $T_a = 25\text{ }^{\circ}\text{C}$

Note 3 : Brightness to be decreased to 50% of the initial value

Note 4 : The single LED lamp case

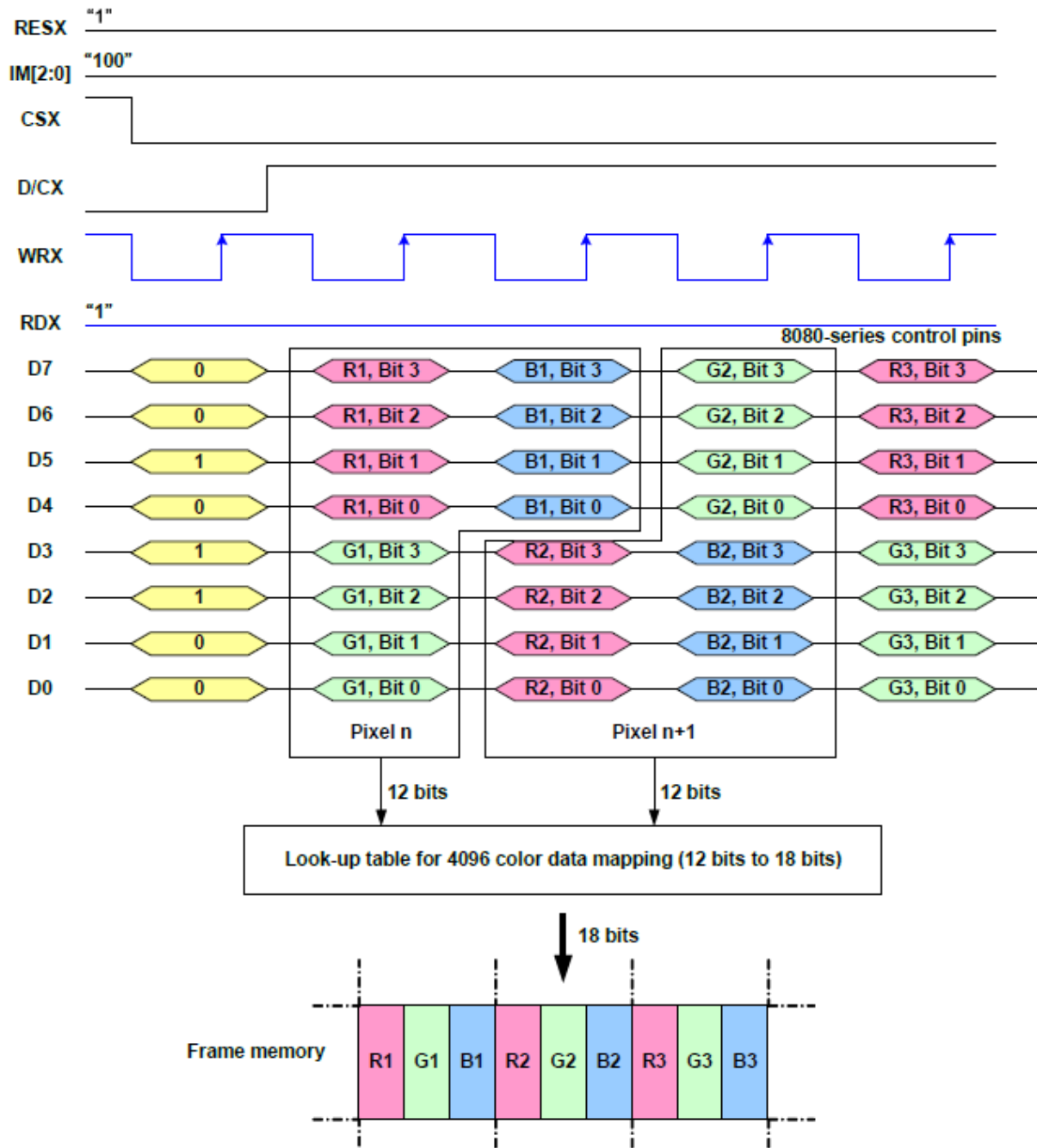
8.Data Color Coding

8.1. 8-bit Parallel Interface (IM2, IM1, IM0= "100")

Different display data formats are available for three Colors depth supported by listed below.

- 4k Colors, RGB 4,4,4-bit Input.
- 65k Colors, RGB 5,6,5-bit Input.
- 262k Colors, RGB 6,6,6-bit Input.

8-bit Data Bus for 12-bit/Pixel (RGB 4-4-4-bit Input), 4K-Colors, 3AH= "03h"



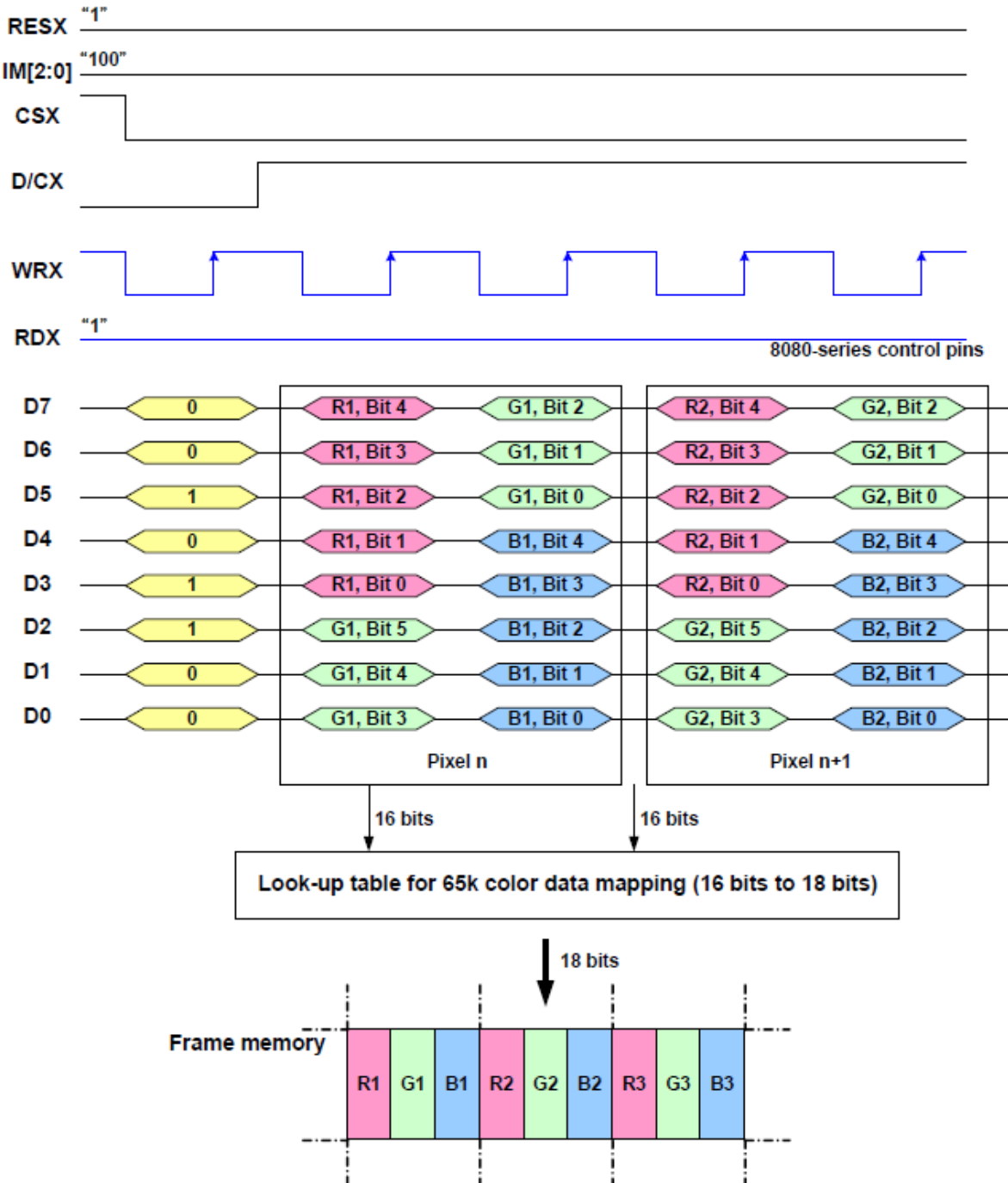
Note1: The data order is as follows, MSB=D7, LSB=D0 and picture data is MSB=Bit 3, LSB=Bit 0 for Red, Green and Blue data.

Note 2: 3-timetransfer is used to transmit 1 pixel data with the 12-bit color depth information.

Note 3: '-' = Don't care -Can be set to '0' or '1'

8-bit Data Bus for 16-bit/Pixel (RGB 5-6-5-bit Input), 65K-Colors, 3AH= "05h"

There is 1 pixel (3 sub-pixels) per 2-byte



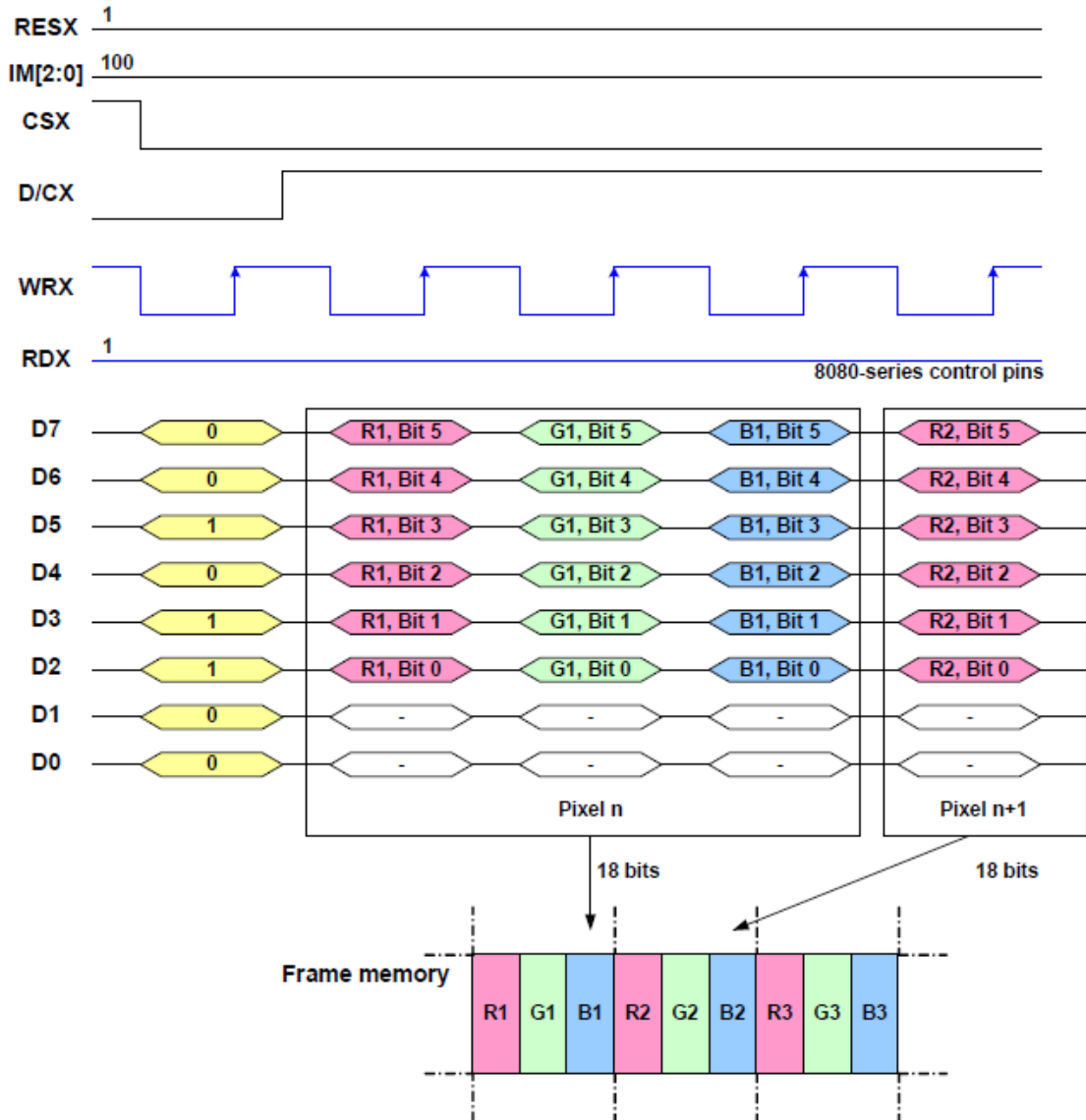
Note1: The data order is as follows, MSB=D7, LSB=D0 and picture data is MSB=Bit 5, LSB=Bit 0 for Green and MSB=Bit 4, LSB=Bit 0 for Red and Blue data.

Note 2: 2-times transfer is used to transmit 1 pixel data with the 16-bit color depth information.

Note 3: '-' = Don't care -Can be set to '0' or '1'

8-bit Data Bus for 18-bit/Pixel (RGB 6-6-6-bit Input), 262K-Colors, 3AH= "06h"

There is 1 pixel (3 sub-pixels) per 3-bytes.



Note1: The data order is as follows, MSB=D7, LSB=D0 and picture data is MSB=Bit 5, LSB=Bit 0 for Red, Green and Blue data.

Note 2: 3-times transfer is used to transmit 1 pixel data with the 18-bit color depth information.

Note 3: '-' = Don't care -Can be set to '0' or '1'

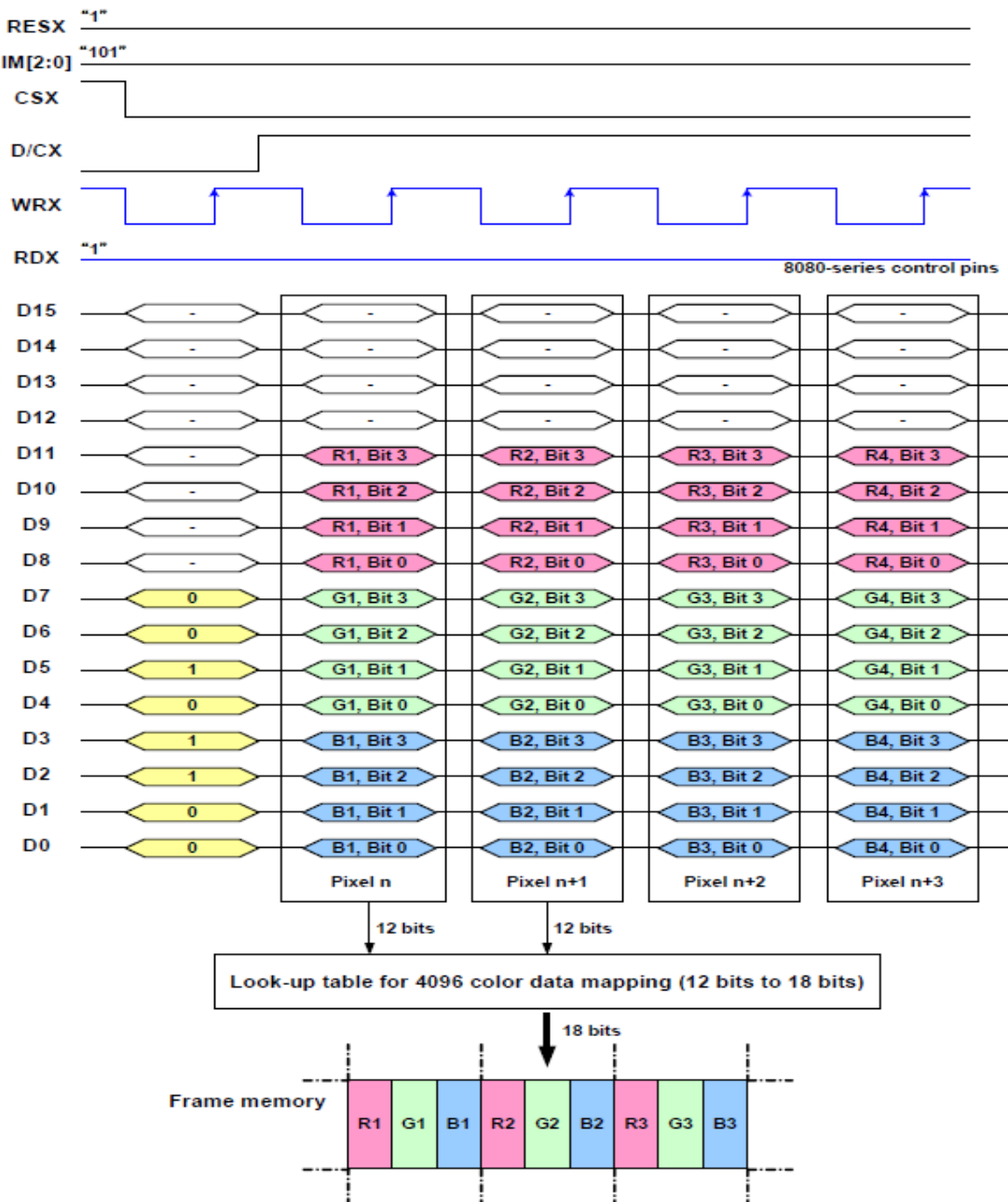
8.2. 16-Bit Parallel Interface (IM2,IM1, IM0= "101")

Different display data formats are available for three colors depth supported by listed below.

- 4k Colors, RGB 4,4,4-bit Input
- 65k Colors, RGB 5,6,5-bit Input
- 262k Colors, RGB 6,6,6-bit Input

16-bit Data Bus for 12-bit/Pixel (RGB 4-4-4-bit Input), 4K-Colors, 3AH= "03h"

There is 1 pixel (3 sub-pixels) per 1 byte

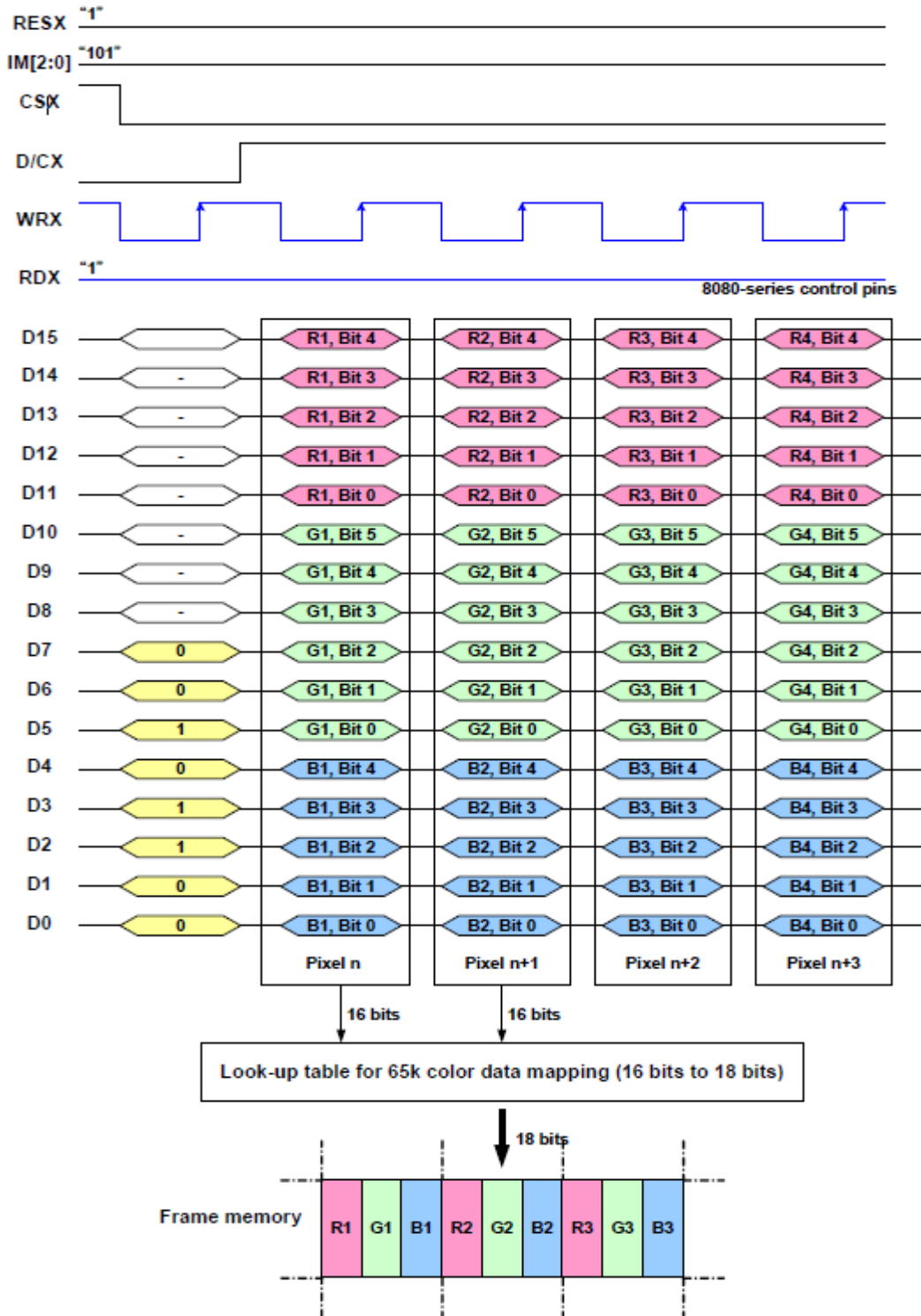


Note1: The data order is as follows, MSB=D11, LSB=D0 and picture data is MSB=Bit 3, LSB=Bit 0 for Red, Green and Blue data.

Note 2: 1-times transfer (D11 to D0) is used to transmit 1 pixel data with the 12-bit color depth information.

16-bit Data Bus for 16-bit/Pixel (RGB 5-6-5-bit Input), 65K-Colors, 3AH= "05h"

There is 1 pixel (3 sub-pixels) per 1 byte



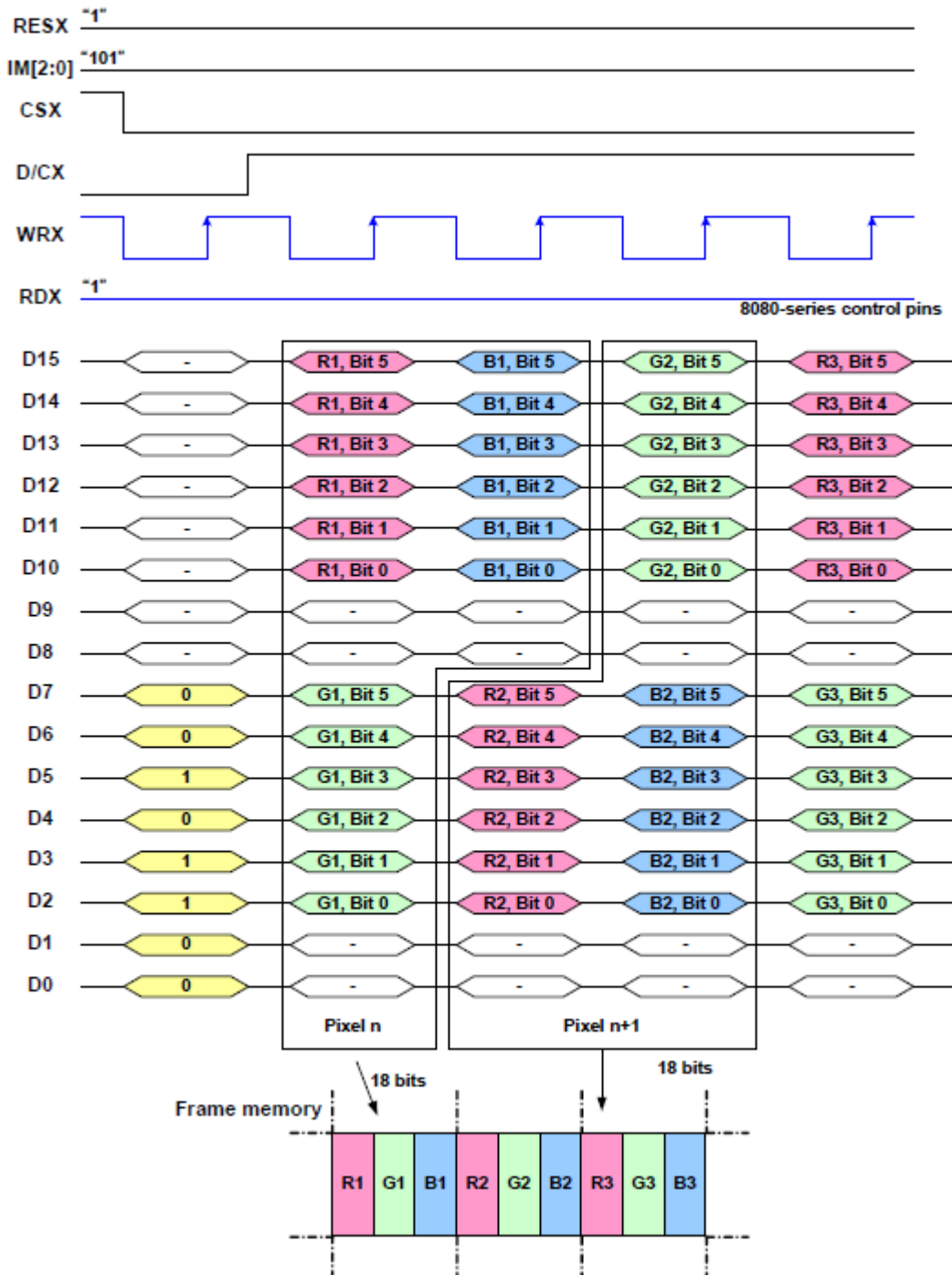
Note1: The data order is as follows, MSB=D15, LSB=D0 and picture data is MSB=Bit 5, LSB=Bit 0 for Green, and MSB=Bit 4, LSB=Bit 0 for Red and Blue data.

Note 2: 1-times transfer (D15 to D0) is used to transmit 1 pixel data with the 16-bit color depth information.

Note 3: '-' = Don't care -Can be set to '0' or '1'

16-bit Data Bus for 18-bit/Pixel (RGB 6-6-6-bit Input), 262K-Colors, 3AH= "06h"

There are 2 pixels (6 sub-pixels) per 3 bytes



Note1: The data order is as follows, MSB=D15, LSB=D0 and picture data is MSB=Bits 5, LSB=Bit 0 for Red, Green and Blue data.

Note 2: 3-times transfer is used to transmit 1 pixel data with the 18-bit color depth information.

Note 3: '-' = Don't care -Can be set to '0' or '1'

8.3. 3-line Serial Interface

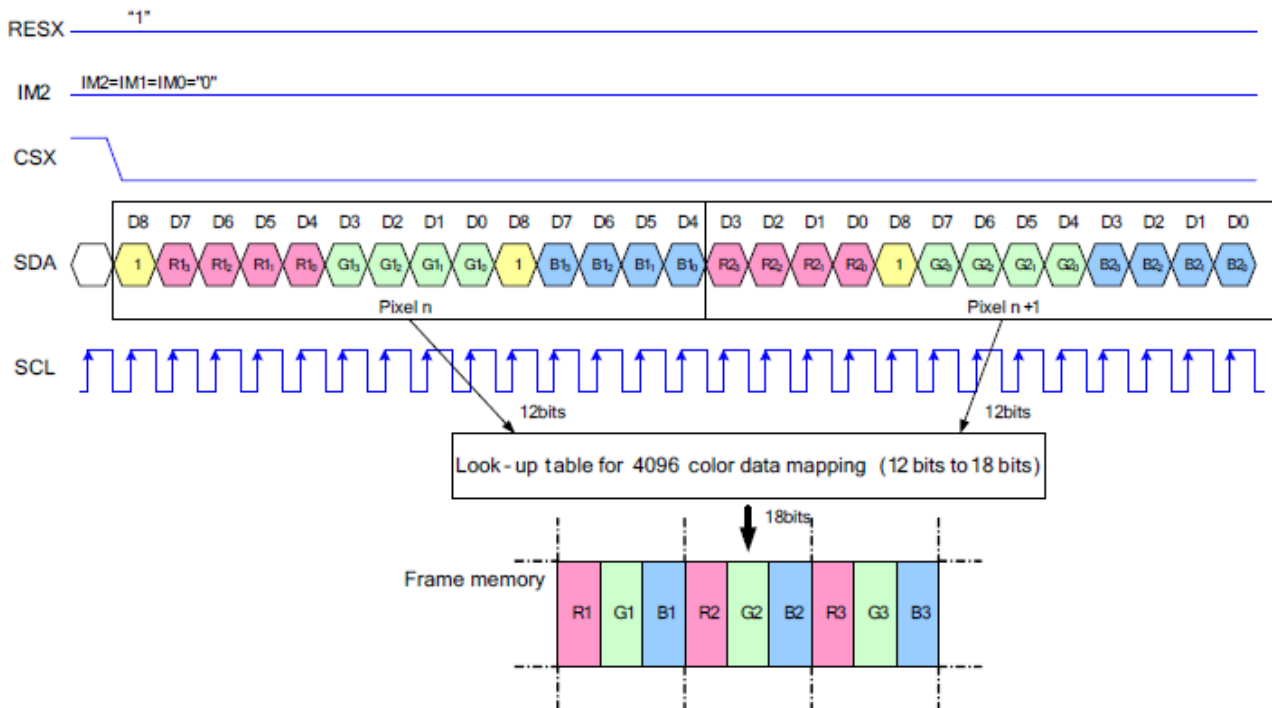
Different display data formats are available for three colors depth supported by the LCM listed below.

4k Colors, RGB 4-4-4-bit Input

65k Colors, RGB 5-6-5-bit Input

262k Colors, RGB 6-6-6-bit Input

Write Data for 12-bit/Pixel (RGB 4-4-4-bit Input), 4K-Colors, 3AH="03h"

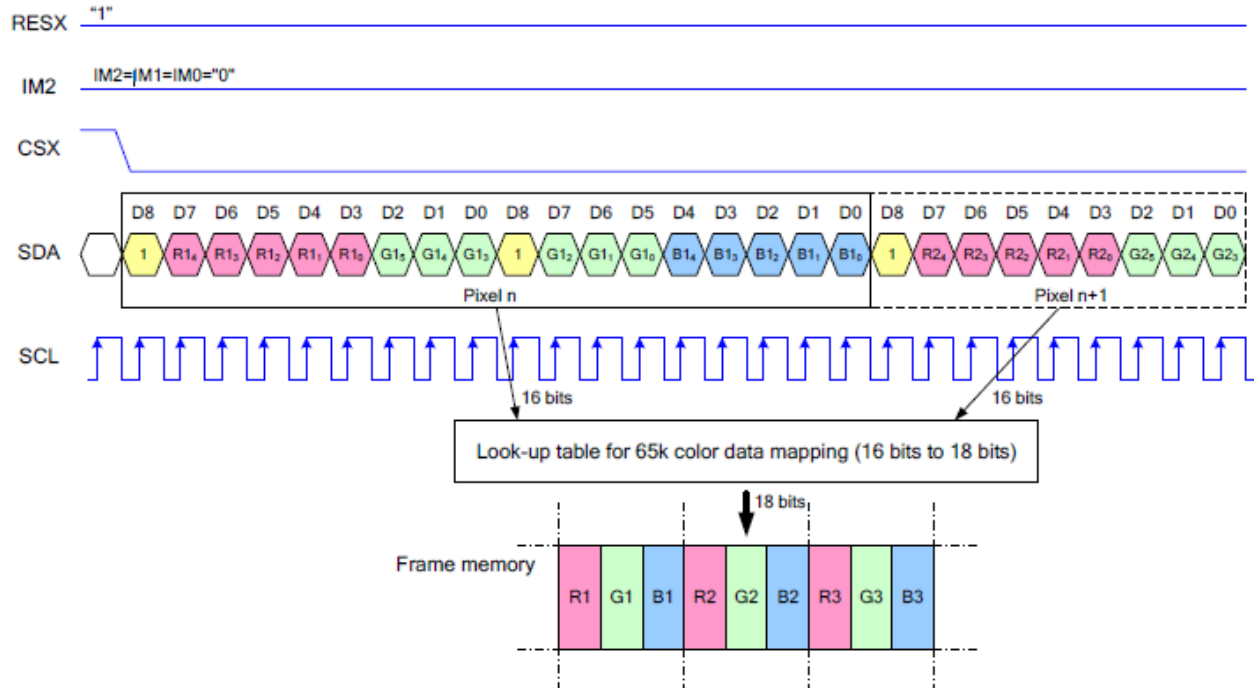


Note 1: Pixel data with the 12-bit color depth information

Note 2: The most significant bits are: Rx3, Gx3 and Bx3

Note 3: The least significant bits are: Rx0, Gx0 and Bx0

Write Data for 16-bit/Pixel (RGB 5-6-5-bit Input), 65K-Colors, 3AH="05h"

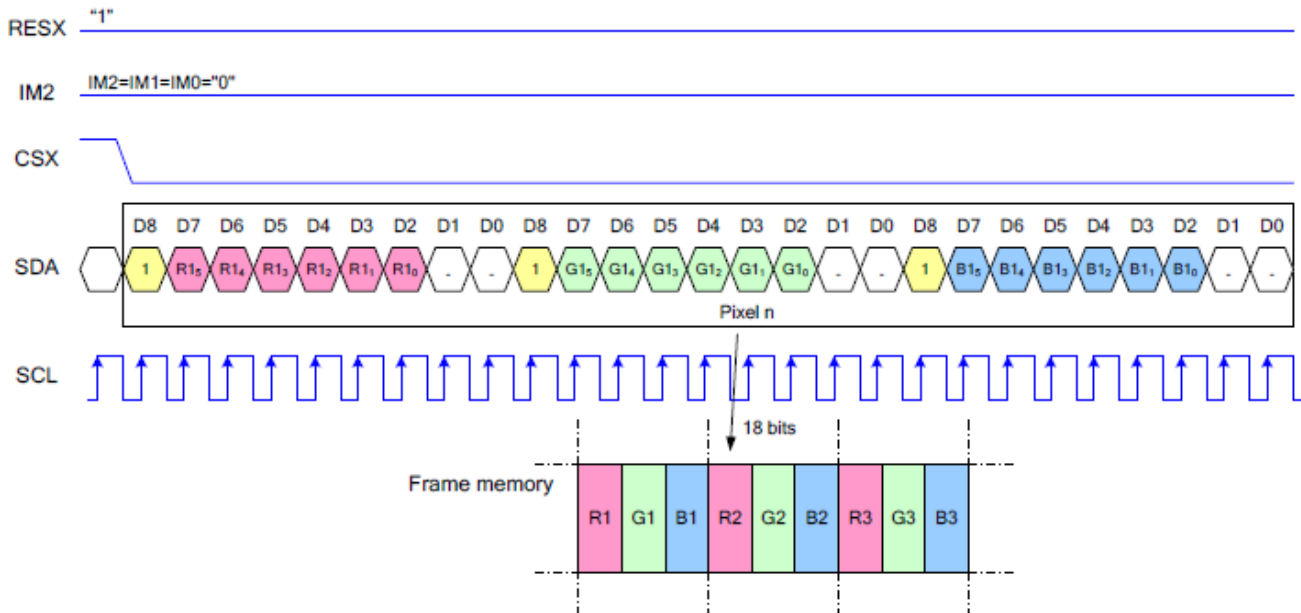


Note 1: Pixel data with the 16-bit color depth information

Note 2: The most significant bits are: Rx4, Gx5 and Bx4

Note 3: The least significant bits are: Rx0, Gx0 and Bx0

Write Data for 18-bit/Pixel (RGB 6-6-6-bit Input), 262K-Colors, 3AH="06h"



Note 1: Pixel data with the 18-bit color depth information

Note 2: The most significant bits are: Rx5, Gx5 and Bx5

Note 3: The least significant bits are: Rx0, Gx0 and Bx0

9. Optical Characteristics

| Item | Symbol | Condition. | Min | Typ. | Max. | Unit | Remark |
|---|--------|-----------------------------------|-----------------------------------|------|------|-------------------|-------------------|
| Response time | Tr | $\theta=0^\circ$ 、 $\phi=0^\circ$ | - | 2 | 4 | .ms | Note 3, |
| | Tf | | | 6 | 12 | .ms | |
| Contrast ratio | CR | At optimized viewing angle | 400 | 500 | - | - | Note 4, |
| Color Chromaticity | White | Wx | $\theta=0^\circ$ 、 $\phi=0^\circ$ | 0.26 | 0.31 | 0.36 | Note 2,6,7 |
| | | Wy | | 0.28 | 0.33 | 0.38 | |
| Viewing angle (Gray Scale Inversion Direction) | Hor. | Θ_R | $CR \geq 10$ | 35 | 45 | Deg. | Note 1 |
| | | Θ_L | | 35 | 45 | | |
| | Ver. | Φ_T | | 35 | 45 | | |
| | | Φ_B | | 10 | 20 | | |
| Brightness | - | - | 450 | 500 | - | Cd/m ² | Center of display |
| Uniformity | (U) | - | 75 | - | - | % | Note 5 |

Ta=25±2℃

Note 1: Definition of viewing angle range

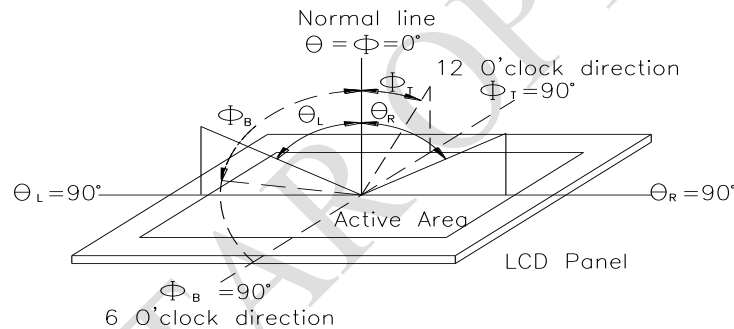


Fig.9.1. Definition of viewing angle

Note 2: Test equipment setup:

After stabilizing and leaving the panel alone at a driven temperature for 10 minutes, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. Optical specifications are measured by Topcon BM-7orBM-5 luminance meter 1.0° field of view at a distance of 50cm and normal direction.

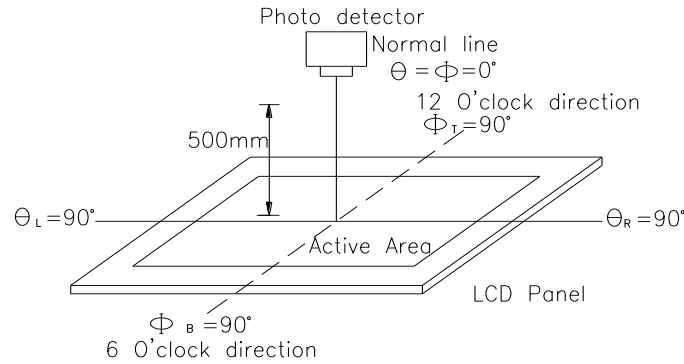
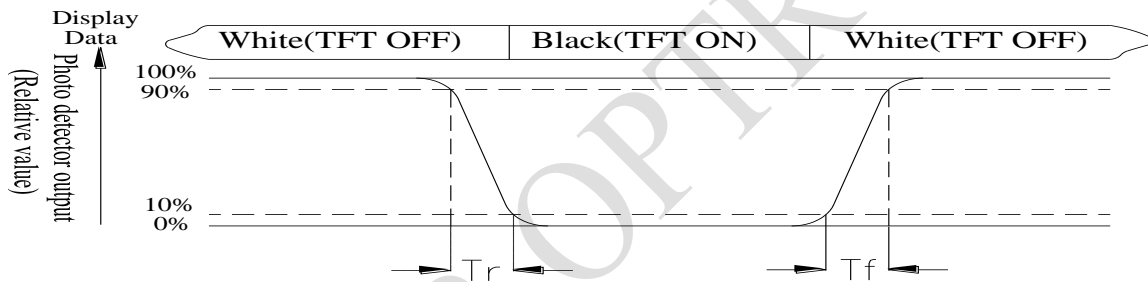


Fig. 9.2. Optical measurement system setup

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_r , is the time between photo detector output intensity changed from 90% to 10%. And fall time, T_f , is the time between photo detector output intensity changed from 10% to 90%



Note 4: Definition of contrast ratio:

The contrast ratio is defined as the following expression.

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

Note 5: Definition of Luminance Uniformity

Active area is divided into 9 measuring areas (reference the picture in below). Every measuring point is placed at the center of each measuring area.

Luminance Uniformity (U) = $L_{min}/L_{max} \times 100\%$

L = Active area length

W = Active area width

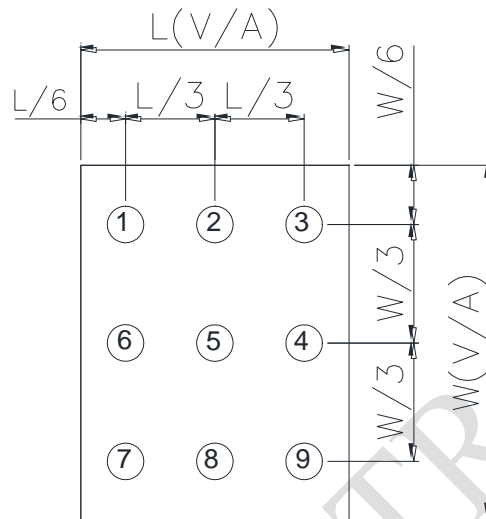


Fig9.3. Definition of uniformity

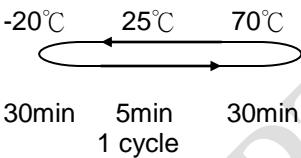
Note 6: Definition of color chromaticity (CIE 1931)

Color coordinates measured at the center point of LCD

Note 7: Measured at the center area of the panel when all the input terminals of LCD panel are electrically opened.

10. Reliability

Content of Reliability Test (Wide temperature, -20°C~70°C)

| Environmental Test | | | |
|--------------------------------------|--|--|------|
| Test Item | Content of Test | Test Condition | Note |
| High Temperature storage | Endurance test applying the high storage temperature for a long time. | 80°C 200hrs | 2 |
| Low Temperature storage | Endurance test applying the low storage temperature for a long time. | -30°C 200hrs | 1,2 |
| High Temperature Operation | Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time. | 70°C 200hrs | — |
| Low Temperature Operation | Endurance test applying the electric stress under low temperature for a long time. | -20°C 200hrs | 1 |
| High Temperature/ Humidity Operation | The module should be allowed to stand at 60°C,90%RH max | 60°C,90%RH 96hrs | 1,2 |
| Thermal shock resistance | <p>The sample should be allowed stand the following 10 cycles of operation</p>  | -20°C/70°C 10 cycles | — |
| Vibration test | Endurance test applying the vibration during transportation and using. | Total fixed amplitude : 3 1.5mm Vibration Frequency : 10~55Hz One cycle 60 seconds to 3 directions of X,Y,Z for Each 15 minutes | 3 |
| Static electricity test | Endurance test applying the electric stress to the terminal. | VS=±600V(contact) ,±800v(air), RS=330Ω CS=150pF 10 times | — |

Note1: No dew condensation to be observed.

Note2: The function test shall be conducted after 4 hours storage at the normal Temperature and humidity after remove from the test chamber.

Note3: The packing have to including into the vibration testing.

LCM Sample Estimate Feedback Sheet

Module Number : _____

1 、 Panel Specification :

| | | |
|----------------------------|-------------------------------|-------------------------------------|
| 1. Panel Type : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 2. View Direction : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 3. Numbers of Dots : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 4. View Area : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 5. Active Area : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 6. Operating Temperature : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 7. Storage Temperature : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 8. Others : _____ | | |

2 、 Mechanical Specification :

| | | |
|-----------------------------|-------------------------------|-------------------------------------|
| 1. PCB Size : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 2. Frame Size : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 3. Material of Frame : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 4. Connector Position : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 5. Fix Hole Position : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 6. Backlight Position : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 7. Thickness of PCB : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 8. Height of Frame to PCB : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 9. Height of Module : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 10. Others : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |

3 、 Relative Hole Size :

| | | |
|-----------------------------|-------------------------------|-------------------------------------|
| 1. Pitch of Connector : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 2. Hole size of Connector : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 3. Mounting Hole size : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 4. Mounting Hole Type : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 5. Others : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |

4 、 Backlight Specification :

| | | |
|---|-------------------------------|-------------------------------------|
| 1. B/L Type : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 2. B/L Color : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 3. B/L Driving Voltage (Reference for LED Type) : <input type="checkbox"/> Pass <input type="checkbox"/> NG , _____ | | |
| 4. B/L Driving Current : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 5. Brightness of B/L : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 6. B/L Solder Method : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 7. Others : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |

>> **Go to page 2** <<

Module Number : _____

5 、 Electronic Characteristics of Module :

| | | |
|-----------------------------|-------------------------------|-------------------------------------|
| 1.Input Voltage : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 2.Supply Current : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 3.Driving Voltage for LCD : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 4.Contrast for LCD : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 5.B/L Driving Method : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 6.Negative Voltage Output : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 7.Interface Function : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 8.LCD Uniformity : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 9.ESD test : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 10.Others : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |

6 、 Summary :
Sales signature : _____

Customer Signature : _____

Date : / /