

Display Elektronik GmbH

# DATA SHEET

*TFT MODULE*

## DEM 128160D TMH-PW-N

### 1,8“ TFT

Product Specification

Ver.: 4

17.01.2025

## Revision History

VERSION	DATE	REVISED PAGE NO.	Note
0	17.11.2017		First issue
1	05.12.2019		Modify Summary Add Uniformity.
2	22.02.2021		Modify Backlight Information
3	31.10.2024		Modify Static electricity test
4	17.01.2025		Modify Reliability

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3. Interface
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## **1. Summary**

DEM 128160D TMH-PW-N 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.

## **2. General Specifications**

- n Size: 1.77 Inch
- n Dot Matrix: 128 x RGB x 160 dots
- n Module Dimension: 34.00 x 45.83 x 2.65 mm
- n Active Area: 28.03 x 35.04 mm
- n Dot Pitch: 0.073 x 0.219 mm
- n LCD Type: TFT, TN - Normally White, Transmissive
- n View Direction: 6 o'clock
- n Gray Scale Inversion Direction: 12 o'clock
- n Aspect Ratio: Portrait
- n IC: ST7735S (Sitronix)
- n Backlight Type: LED, Normally White
- n Brightness: typ. 500cd/m<sup>2</sup>
- n With / Without TP: Without TP
- n Surface: Anti-Glare

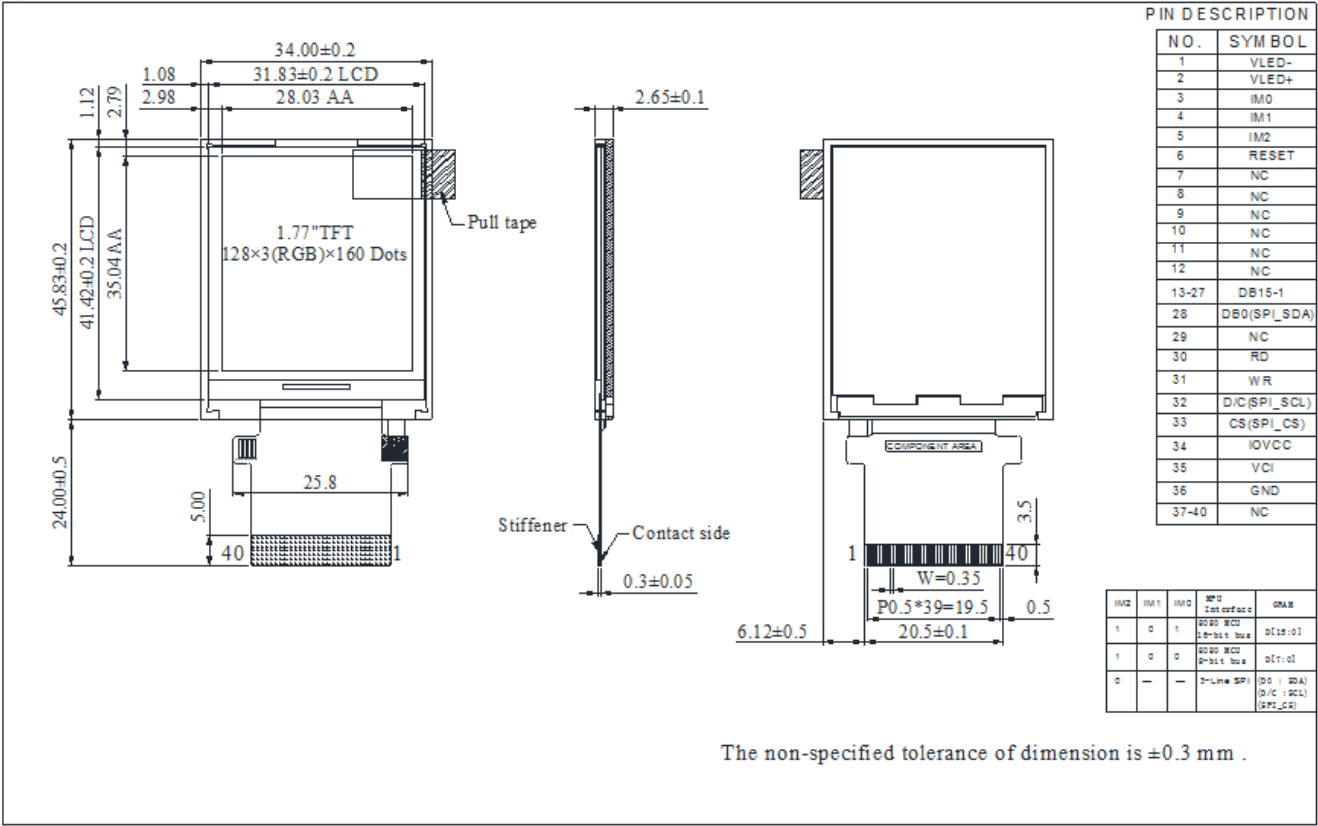
\*Color tone slight changed by temperature and driving voltage.

### 3. Interface

#### 3.1. LCM PIN Definition

Pin	Symbol	I/O	Function	Remark															
1	VLED-	P	Backlight Cathode																
2	VLED+	P	Backlight Anode																
3	IM0	I	- MCU Parallel Interface Type Selection - If Not Used, Please Fix this Pin at VDDI or DGND Level.																
4	IM1		<table><tr><th>IM1</th><th>IM0</th><th>Parallel Interface</th></tr><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></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																	
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. - DB is 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																

4. Contour Drawing



**5. Absolute Maximum Ratings**

Item	Symbol	Min	Typ	Max	Unit
Operating Temperature	T <sub>OP</sub>	-20	-	+70	°C
Storage Temperature	T <sub>ST</sub>	-30	-	+80	°C

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

1. Temp. ≤60°C, 90% RH MAX. Temp. > 60°C,  
Absolute Humidity shall be less than 90% RH at 60°C

## 6. Electrical Characteristics

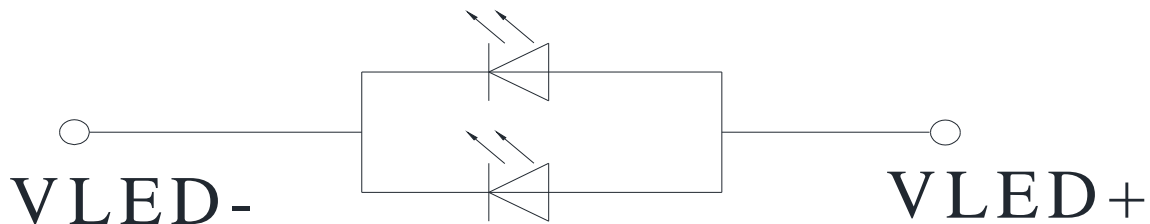
### 6.1. Operating conditions:

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

### 6.2. LED driving conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
LED Current		-	40	-	mA	
Power Consumption			124	-	mW	
LED Voltage	VBL+	2.9	3.1	3.4	V	Note 1
LED Lifetime		-	50,000	-	Hr	Note 2,3,4

Note 1 : There are 1 Groups LED



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

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

Note 4 : The single LED lamp case



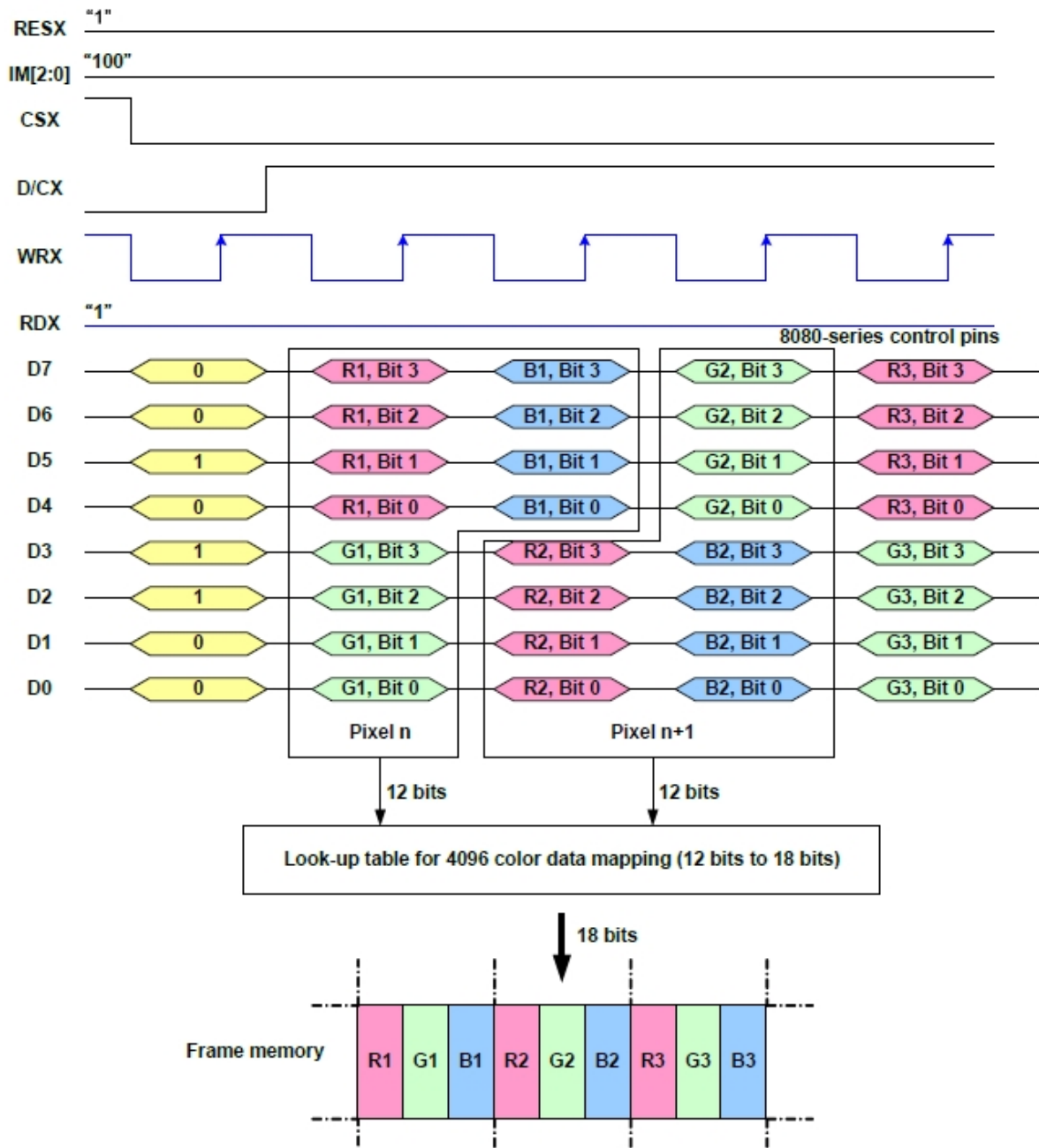
## 7. Data Color Coding

### 7.1. 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"



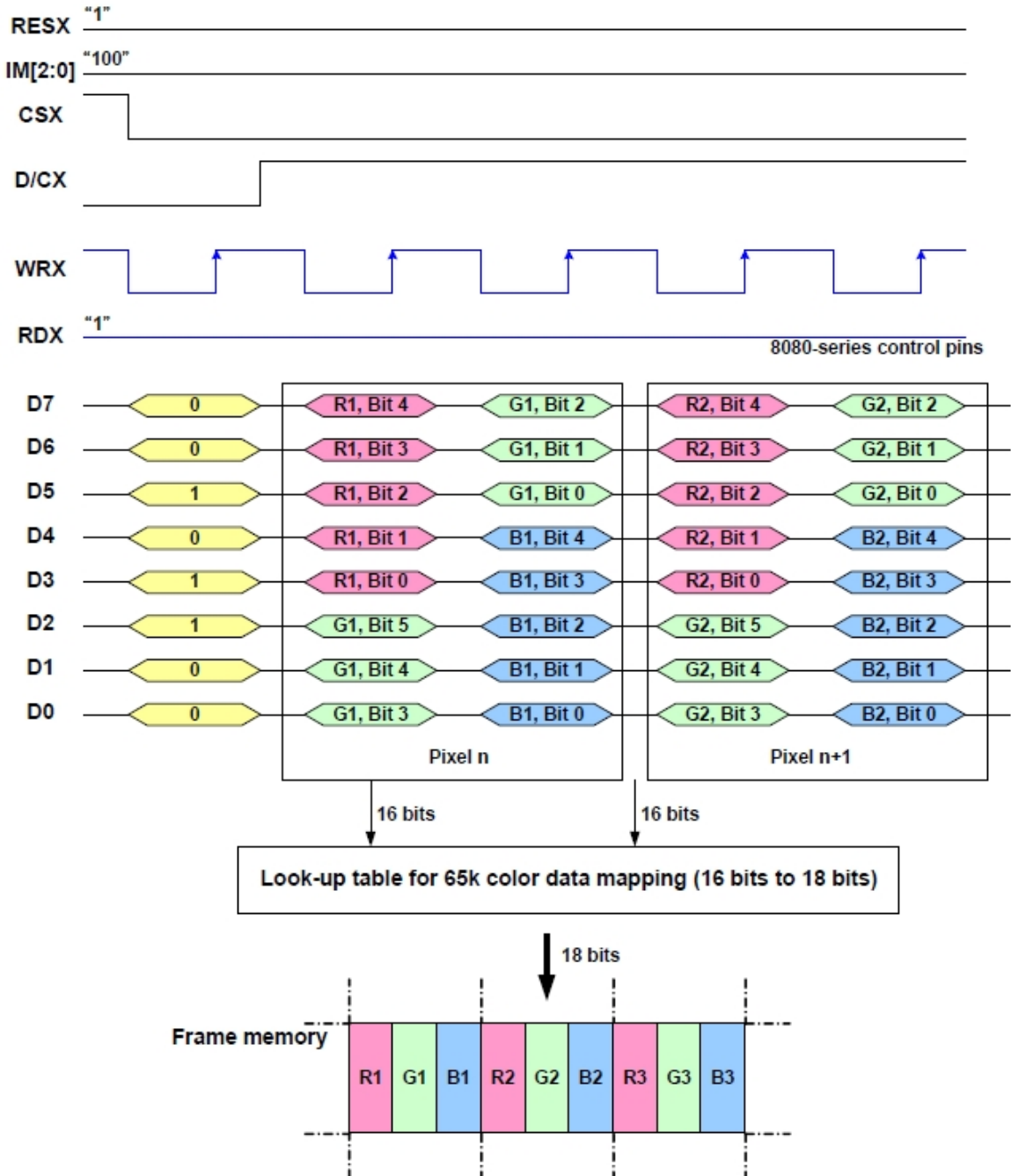
Note1: The data order is as follows, MSB=D7, LSB=D0 and picture data is MSB=Bit 3, LSB=Bit 0 for Red, Green and Blue data.

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,

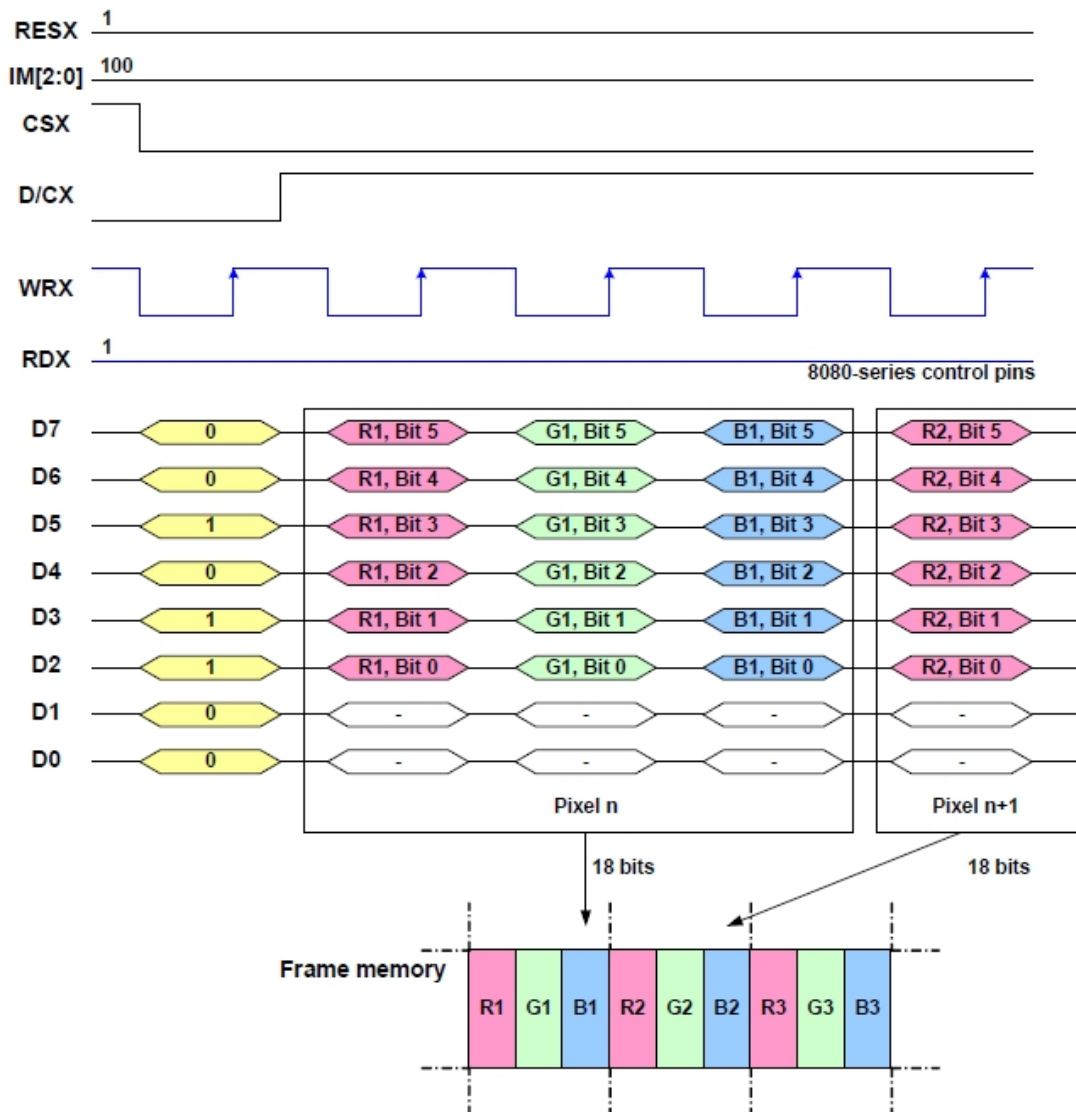
LSB=Bit 0 for Green and MSB=Bit 4, LSB=Bit 0 for Red and Blue data.

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'

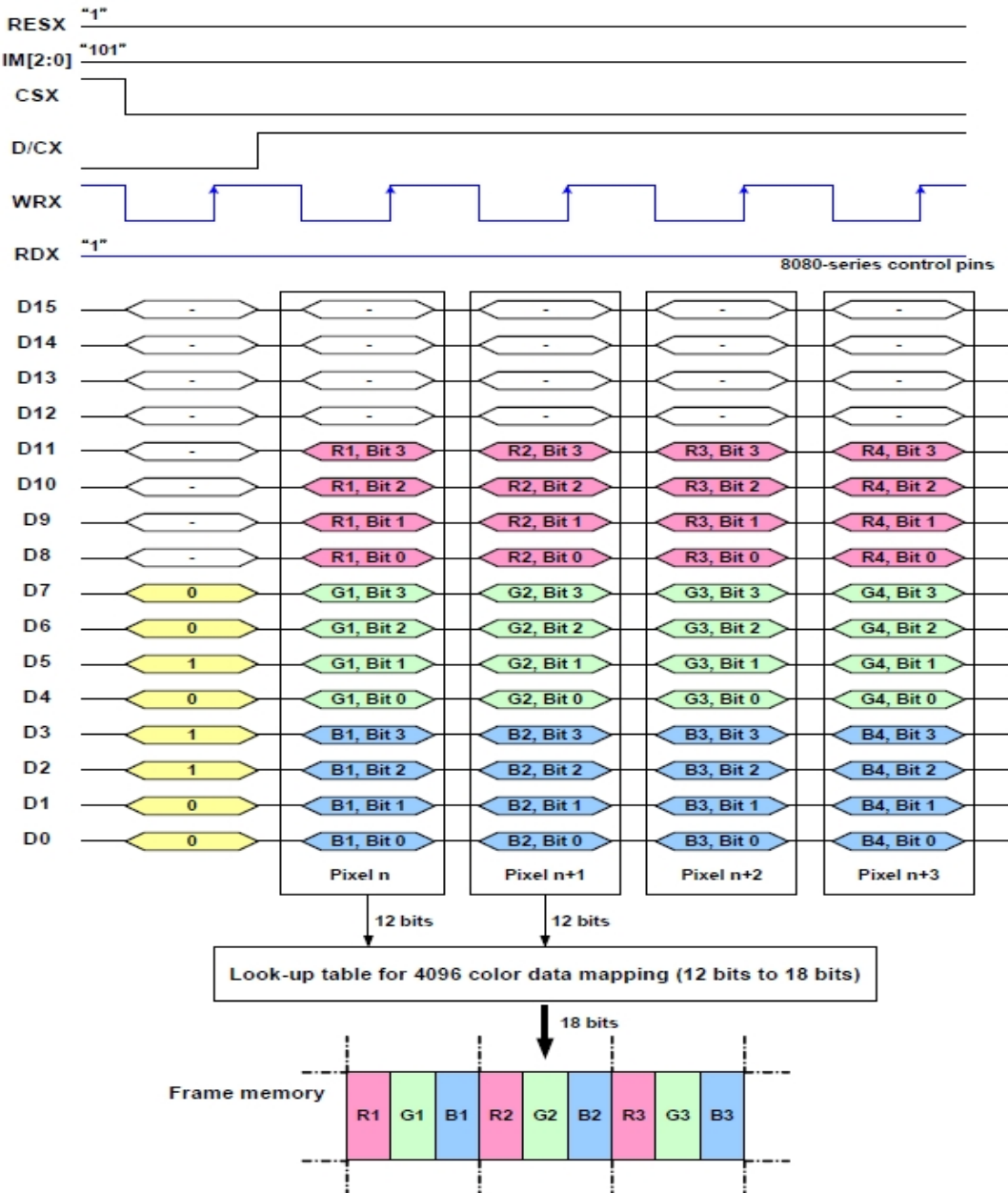
**8.2. 16-Bit Parallel Interface (IM2,IM1, IM0= "101")**

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

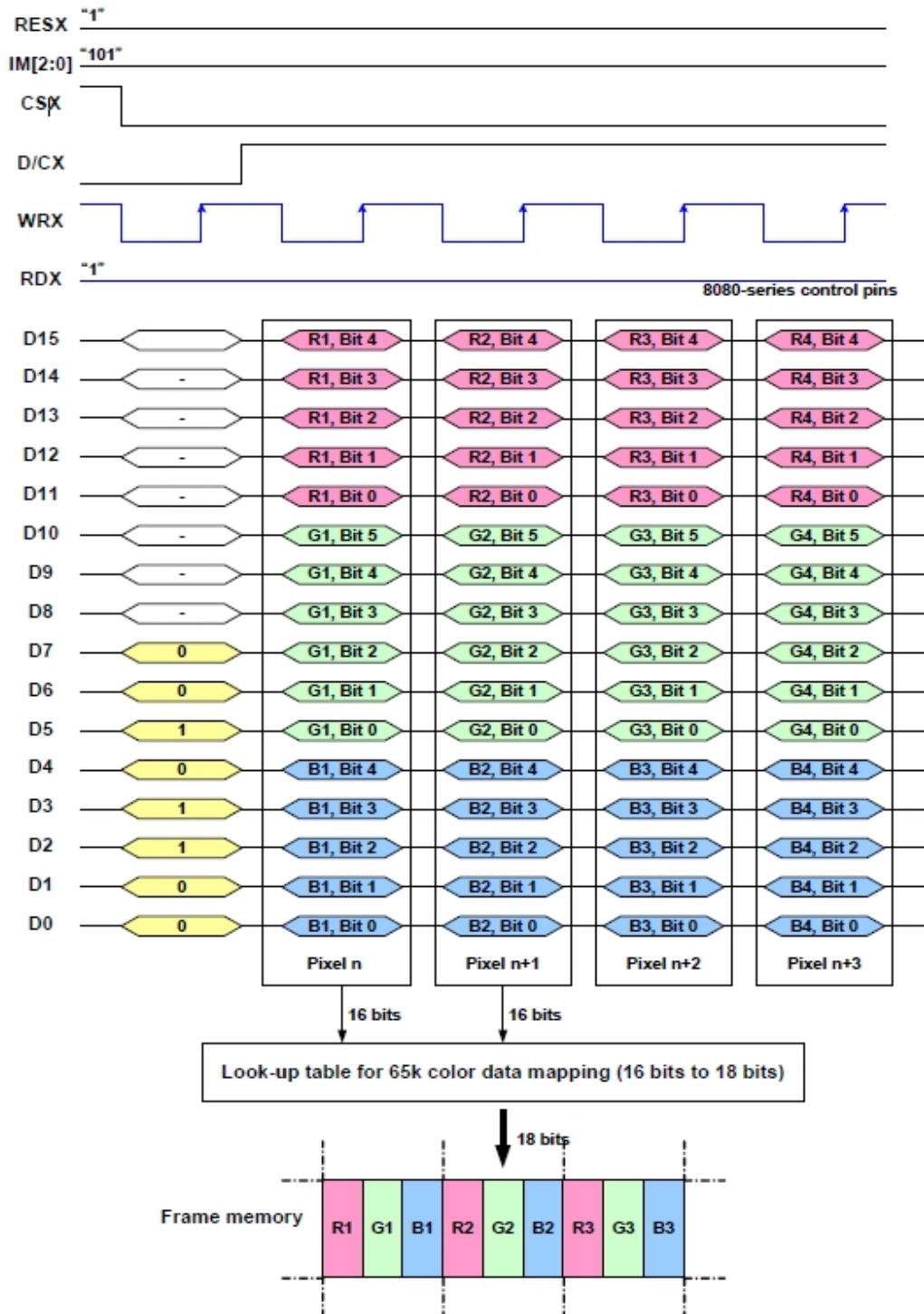


Note1: The data order is as follows, MSB=D11, LSB=D0 and picture data is MSB=Bit 3, LSB=Bit 0 for Red, Green and Blue data.

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



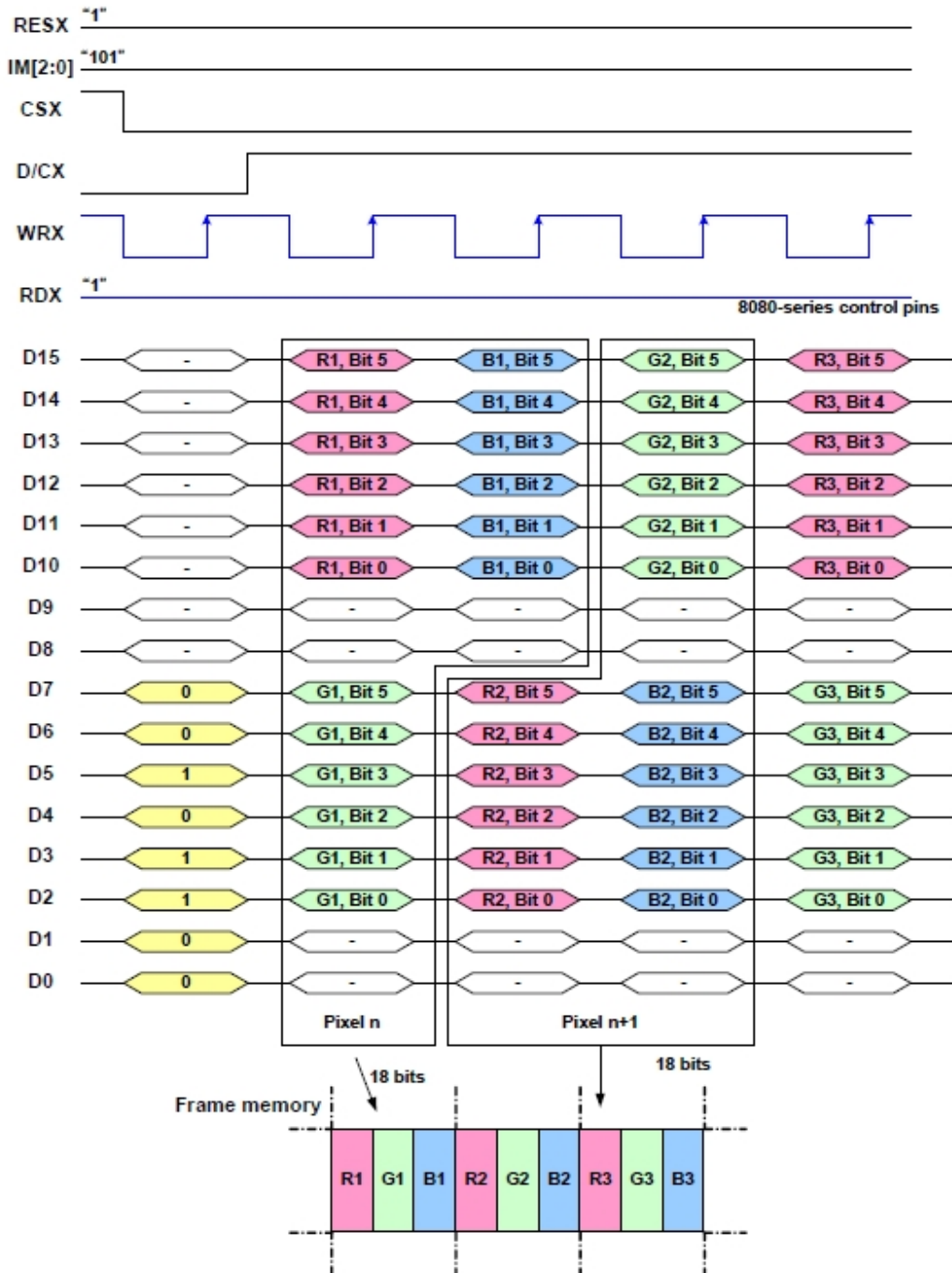
Note1: The data order is as follows, MSB=D15, LSB=D0 and picture data is MSB=Bit 5, LSB=Bit 0 for Green, and MSB=Bit 4, LSB=Bit 0 for Red and Blue data.

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

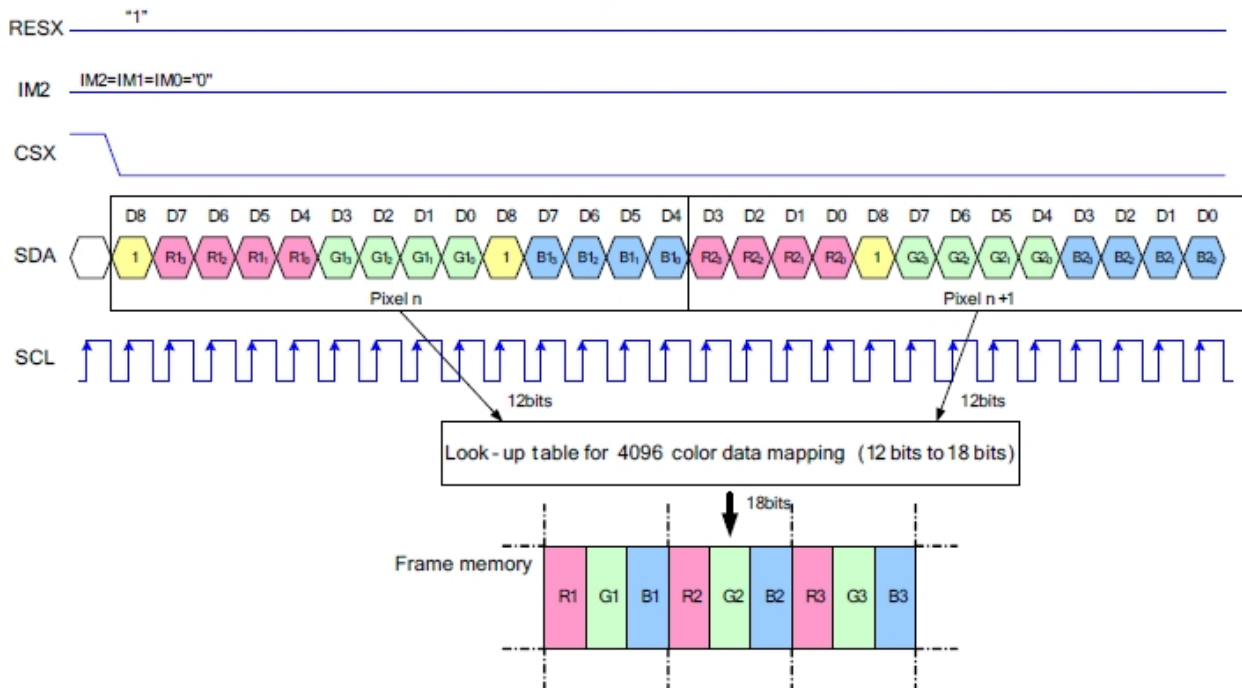
Different display data formats are available for three colors depth supported by the LCM listed below.

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"



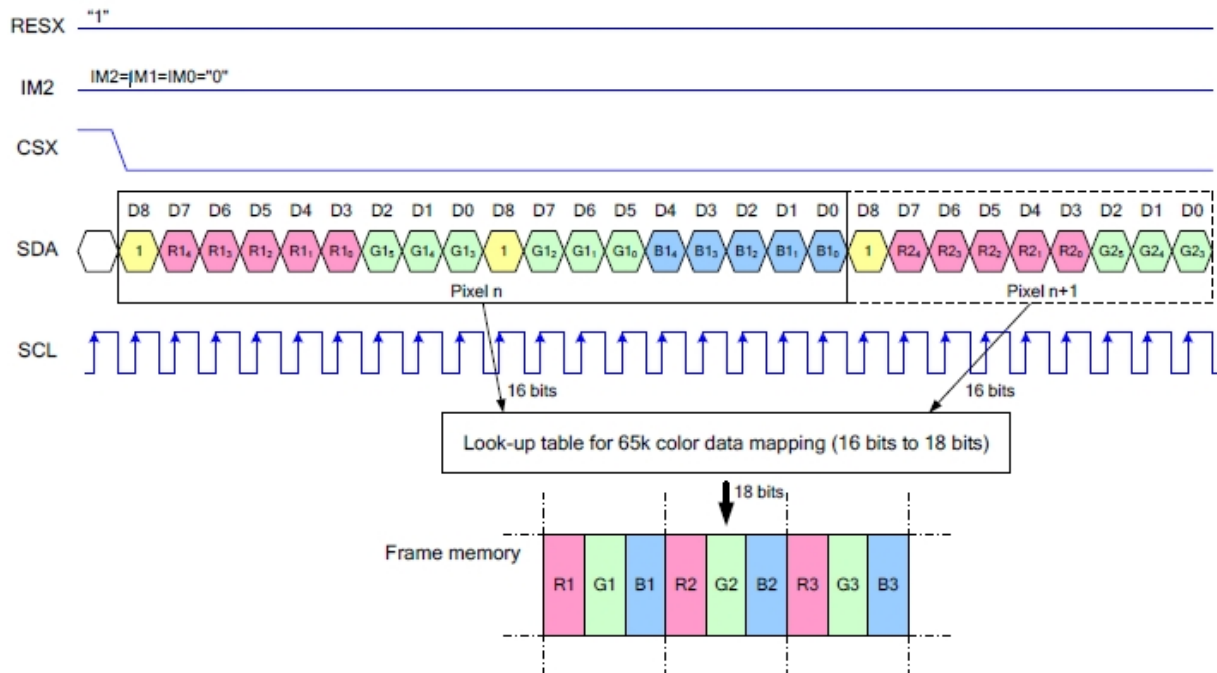
Note 1: Pixel data with the 12-bit color depth information

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"

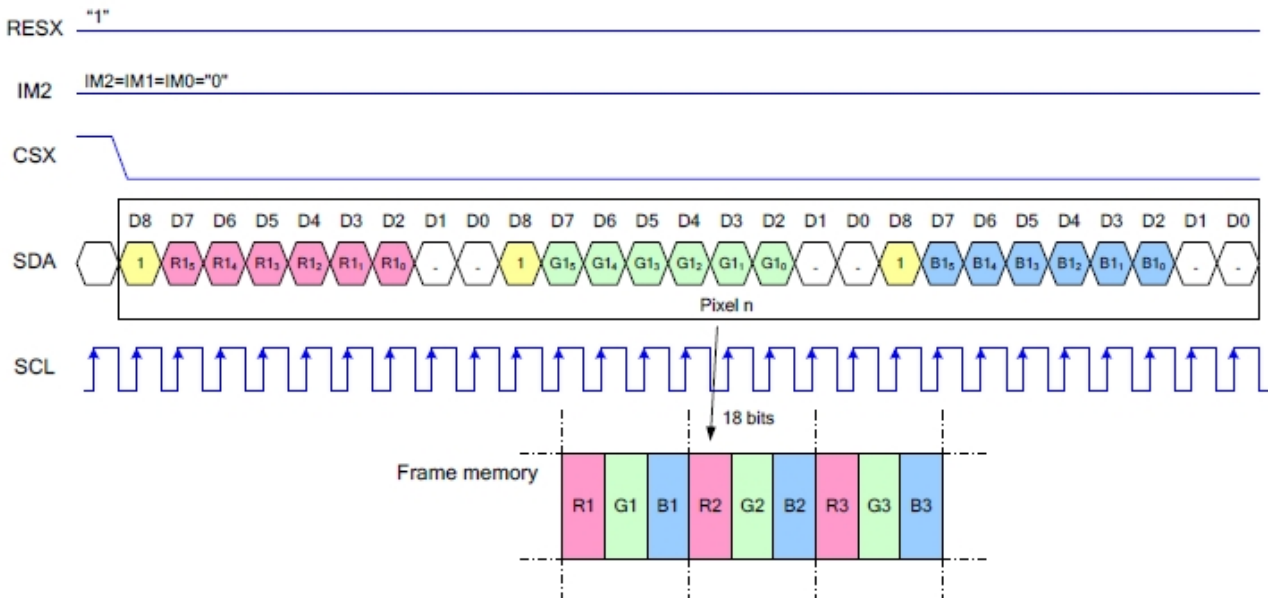


Note 1: Pixel data with the 16-bit color depth information

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



## 8. Optical Characteristics

Item	Symbol	Condition.	Min	Typ.	Max.	Unit	Remark
Response Time	Tr	$\theta=0^\circ$ 、 $\Phi=0^\circ$	-	2	4	.ms	Note 3,5
	Tf			6	12	.ms	
Contrast Ratio	CR	At optimized viewing angle	400	500	-	-	Note 4,5
Color Chromaticity	White	$\theta=0^\circ$ 、 $\Phi=0^\circ$	0.26	0.31	0.36		Note 2,6,7
			0.28	0.33	0.38		
Viewing Angle (Gray Scale Inversion Direction)	Hor.	$\Theta_R$	35	45		Deg.	Note 1
		$\Theta_L$	35	45			
	Ver.	$\Phi_T$	35	45			
		$\Phi_B$	10	20			
Brightness	-	-	450	500	-	Cd/m <sup>2</sup>	Center of display
Uniformity	(U)	-	75	-	-	%	Note 5

Ta=25°C±2°C

Note 1: Definition of viewing angle range

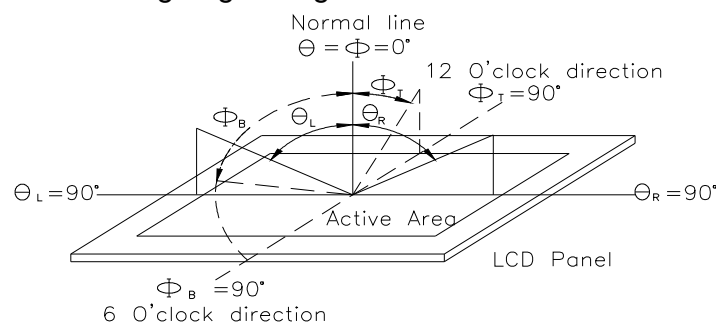


Fig.9.1. Definition of viewing angle

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.

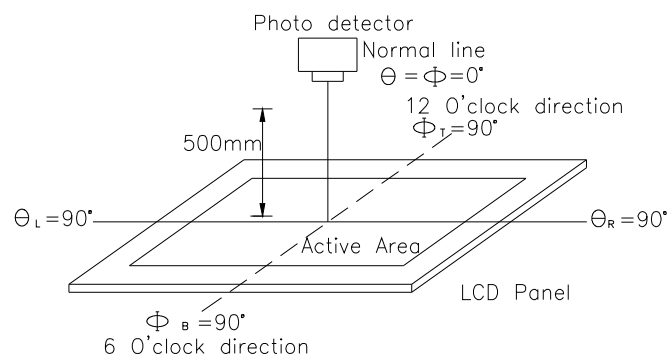
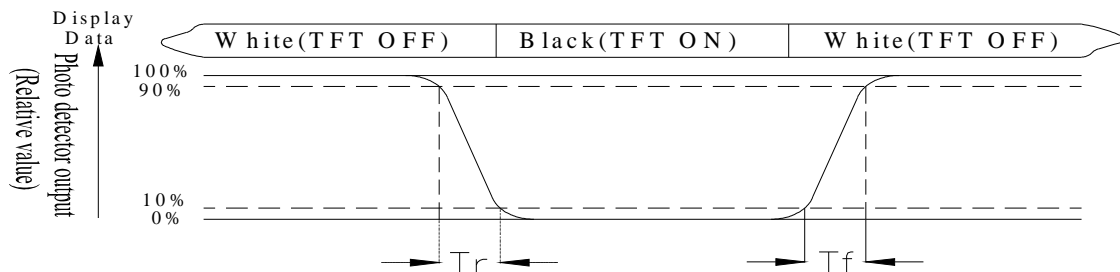


Fig. 9.2. Optical measurement system setup

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

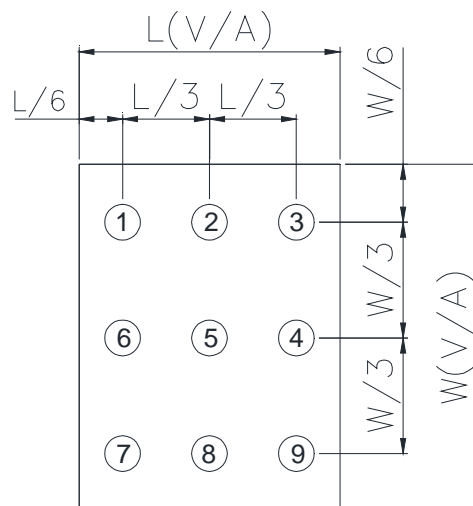


Fig9.3. Definition of uniformity

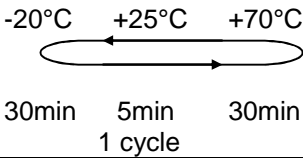
Note 6: Definition of color chromaticity (CIE 1931)

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.

## 9. 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□,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>  <p style="text-align: center;">-20°C    +25°C    +70°C</p> <p style="text-align: center;">30min    5min    30min</p> <p style="text-align: center;">1 cycle</p>	-20°C / +70°C 10 cycles	—
Vibration Test	Endurance test applying the vibration during transportation and using.	Total fixed amplitude : 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.

Note4: Endurance test applying the electric stress to the finished product housing