Winstar Display Co., LTD
華凌光電股份有限公司
WEB: http://www.winstar.com.tw *E-mail: winstar@winstar.com.tw*

SPECIFICATION

CUSTOMER : _____

MODULE NO.: WF24FTLAJDNN0#

APPROVED BY: **(FOR CUSTOMER USE ONLY)**	**PCB VERSION:** **DATA:**

SALES BY	APPROVED BY	CHECKED BY	PREPARED BY
			葉虹蘭
ISSUED DATE: 2016/01/21			

TFT Display Inspection Specification: http://www.winstar.com.tw/service.php

MODLE NO：

RECORDS OF REVISION	**DOC. FIRST ISSUE**

VERSION	DATE	REVISED PAGE NO.	**SUMMARY**
0	2015/05/05		First issue
A	2016/01/21		Modify Static electricity test

Contents

1.Module Classification Information

W	F	24	F	T	L	A	J	D	N	N	0	#
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬

①	Brand：WINSTAR DISPLAY CORPORATION		
②	Display Type：F→TFT Type, J→Custom TFT		
③	Display Size：2.4” TFT		
④	Model serials no.		
⑤	Backlight Type：	F→CCFL, White S→LED, High Light White	T→LED, White
⑥	LCD Polarize Type/ Temperature range/ Gray Scale Inversion Direction	C→Transmissive, N. T, 6:00 ; I→Transmissive, W. T, 6:00 F→Transmissive, N.T,12:00 ; L→Transmissive, W.T,12:00 N→Transmissive, Super W.T, 6:00 Q→Transmissive, Super W.T, 12:00 X→Transmissive, W.T, VA TFT V→Transmissive, Super W.T, VA TFT R→Transmissive, Super W.T, O-TFT Z→Transmissive, W.T, O-TFT A→Transmissive, N.T, IPS TFT Y→Transmissive, W.T, IPS TFT	
⑦	A：TFT LCD B：TFT+FR+CONTROL BOARD C：TFT+FR+A/D BOARD D：TFT+FR+A/D BOARD+CONTROL BOARD E：TFT+FR+POWER BOARD F：TFT+CONTROL BOARD	G：TFT+FR H：TFT+D/V BOARD I：TFT+FR+D/V BOARD J：TFT+POWER BD	
⑧	Resolution:		
	A: 128160	B:320234	C:320240	D:480234	E:480272	F: 640480	G: 800480
	H:1024600	I:320480	J:240320	K:800600	L:240400	M :1024768	P :1280800
	S:480128	T:800320					
⑨	D: Digital L：LVDS						
⑩	Interface： N：without control board A：8Bit B：16Bit						
⑪	TS：N：Without TS T：resistive touch panel C：capacitive touch panel (G-F-F) G：capacitive touch panel(G-G)						
⑫	Version						
⑬	Special Code	#:Fit in with ROHS directive regulations					

2.Summary

This technical specification applies to 2.4’ color TFT-LCD panel. The 2.4’ color TFT-LCD panel is designed for camcorder, digital camera application and other electronic products which require high quality flat panel displays. This module follows RoHS.

3.General Specifications

Item	Dimension	Unit
Size	2.4”	
Dot Matrix	240 x RGB x 320(TFT)	dots
Module dimension	42.72(W) x 60.26(H) x 2.2(D)	mm
Active area	36.72 x 48.96	mm
Dot pitch	0.051 x 0.153	mm
LCD type	TFT, Normally White, Transmissive	
View Direction	6 o’clock	
Gray Scale Inversion Direction	12 o’clock	
Backlight Type	LED,Normally White	
With /Without TP	Without TP	
Surface	Glare	

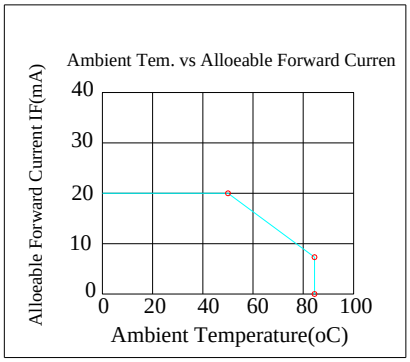
*Color tone slight changed by temperature and driving voltage.

4.Absolute Maximum Ratings

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

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

1. Temp. ≦60℃, 90% RH MAX. Temp.＞60℃, Absolute humidity shall be less than 90% RH at 60℃



5.Electrical Characteristics

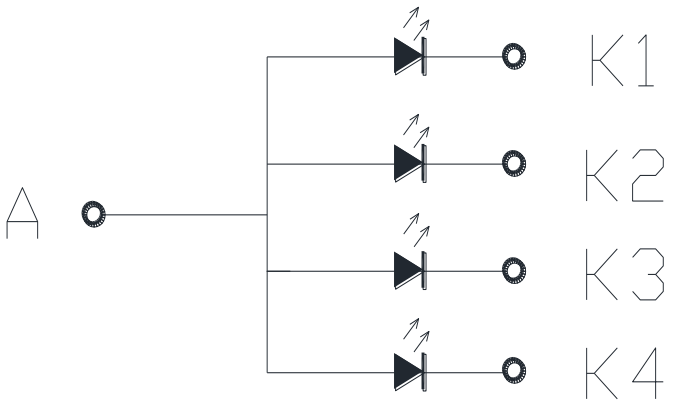
5.1. Operating conditions:

Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage For Analog	VCC	—	2.5		3.3	V
Supply Voltage For Logic	VCCIO		1.65		3.3	V

5.2. LED driving conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
LED current		-	80	-	mA	
Power Consumption			180		mW	
LED voltage	VBL+		3.2		V	Note 1
LED Life Time		-	20,000	-	Hr	Note 2,3,4

Note 1 : There are 1 Groups LED



Note 2 : Ta = 25 ℃

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

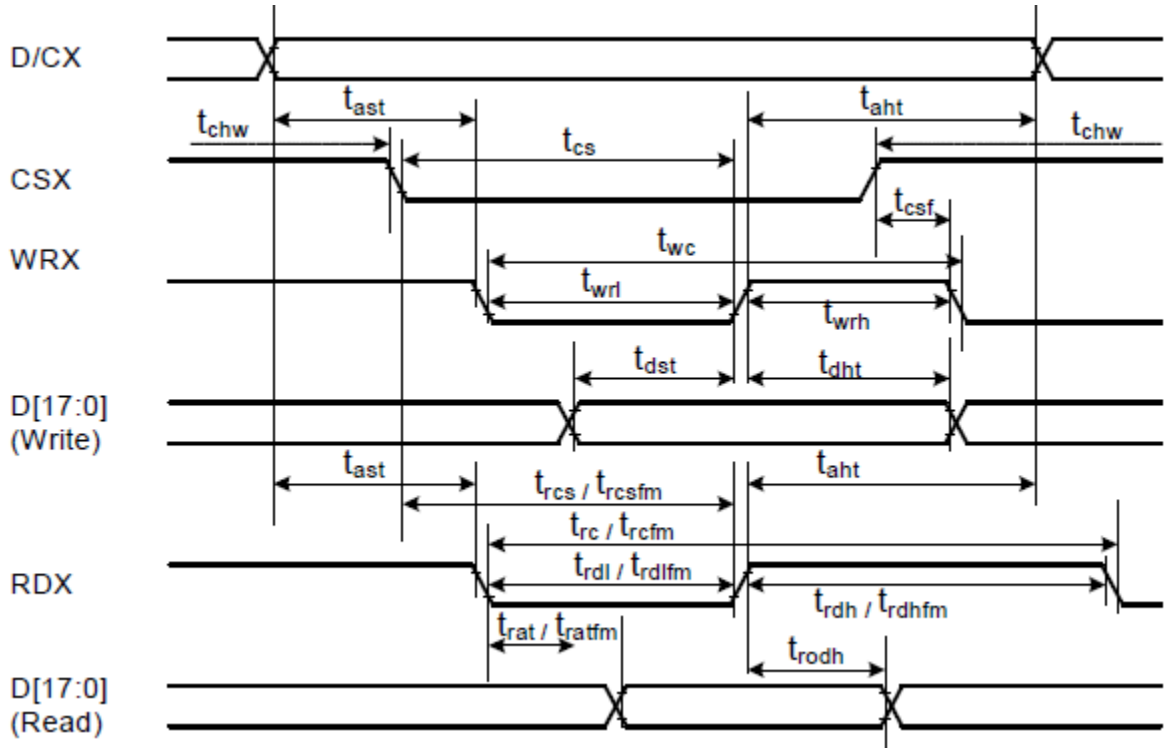
Note 4 : The single LED lamp case

6.DC CHARATERISTICS

Parameter	Symbol	Rating			Unit	Condition
		Min	Typ	Max		
Low level input voltage	V_{IL}	0	-	0.3VCC	V	
High level input voltage	V_{IH}	0.7VCC	-	VCC	V	

7.AC Characteristics

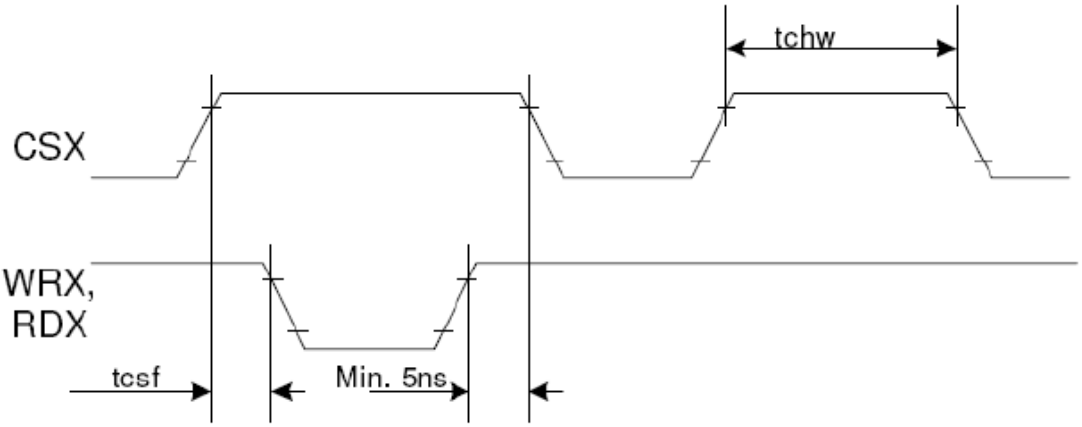
7.1. 8080 Series MCU Parallel Interface Characteristics: 18/16/9/8-bit Bus



Signal	Symbol	Parameter	min	max	Unit	Description
DCX	tast	Address setup time	0	-	ns	
	taht	Address hold time (Write/Read)	0	-	ns	
CSX	tchw	CSX "H" pulse width	0	-	ns	
	tcs	Chip Select setup time (Write)	15	-	ns	
	trcs	Chip Select setup time (Read ID)	45	-	ns	
	trcsfm	Chip Select setup time (Read FM)	355	-	ns	
	tcsf	Chip Select Wait time (Write/Read)	10	-	ns	
WRX	twc	Write cycle	66	-	ns	
	twrh	Write Control pulse H duration	15	-	ns	
	twrl	Write Control pulse L duration	15	-	ns	
RDX (FM)	trcfm	Read Cycle (FM)	450	-	ns	
	trdhfm	Read Control H duration (FM)	90	-	ns	
	trdlfm	Read Control L duration (FM)	355	-	ns	
RDX (ID)	trc	Read cycle (ID)	160	-	ns	
	trdh	Read Control pulse H duration	90	-	ns	
	trdl	Read Control pulse L duration	45	-	ns	
D[17:0], D[15:0], D[8:0], D[7:0]	tdst	Write data setup time	10	-	ns	For maximum CL=30pF For minimum CL=8pF
	tdht	Write data hold time	10	-	ns	
	trat	Read access time	-	40	ns	
	tratfm	Read access time	-	340	ns	
	trod	Read output disable time	20	80	ns	

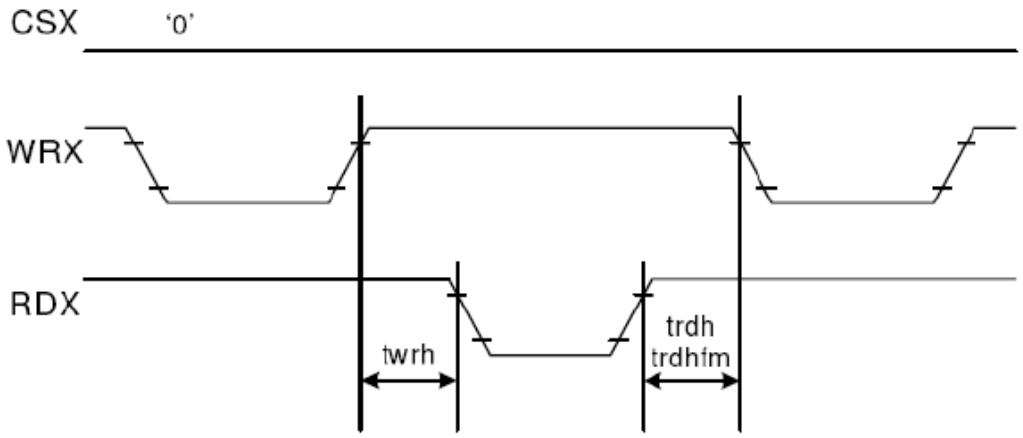
Note: Ta = -30 to 70 °C, VDDI=1.65V to 3.3V, VCI=2.5V to 3.3V, VSS=0V

CSX timings :



Note: Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

Write to read or read to write timings:

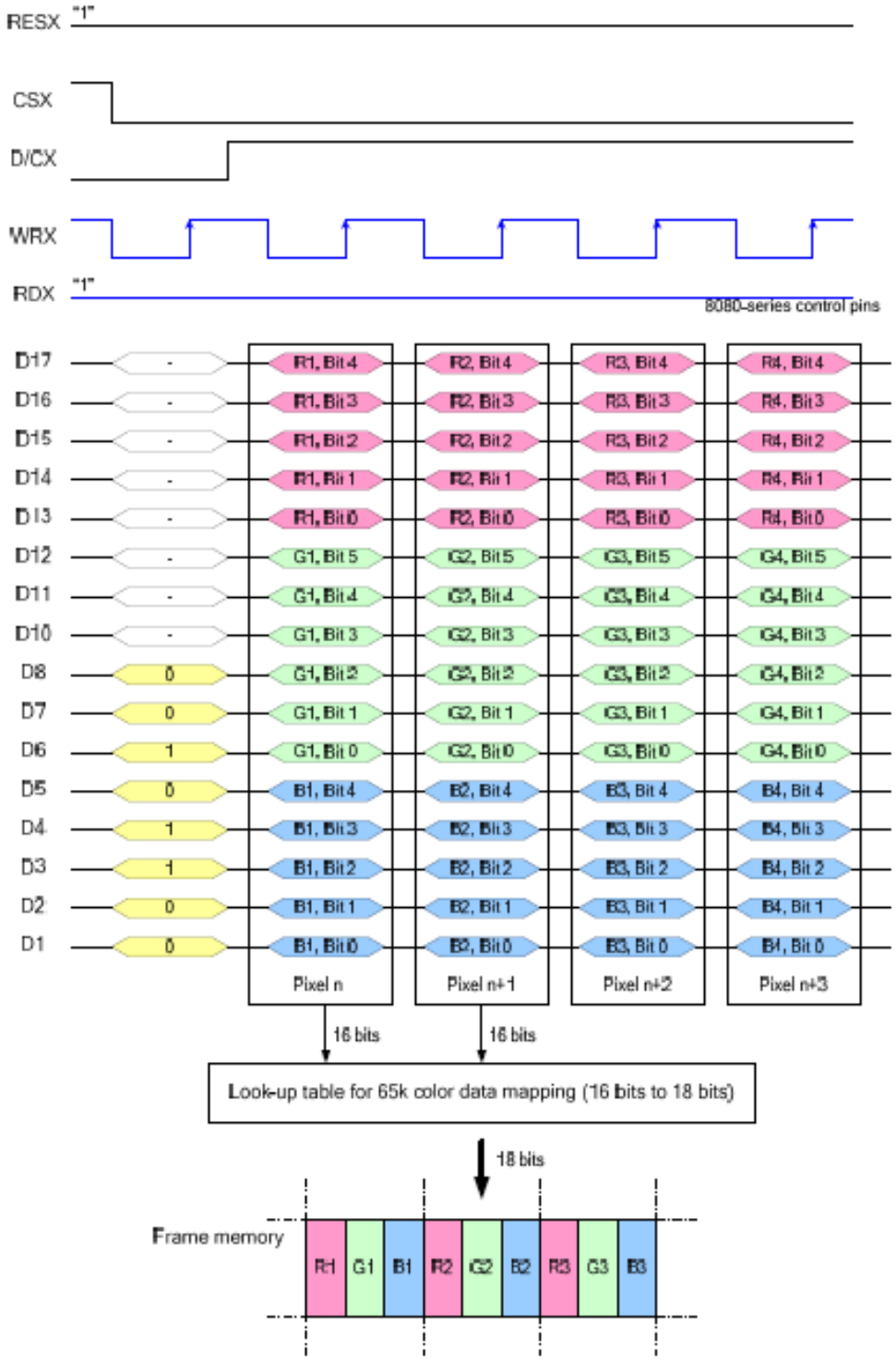


Note: Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

7.2. Interface Pixel Format

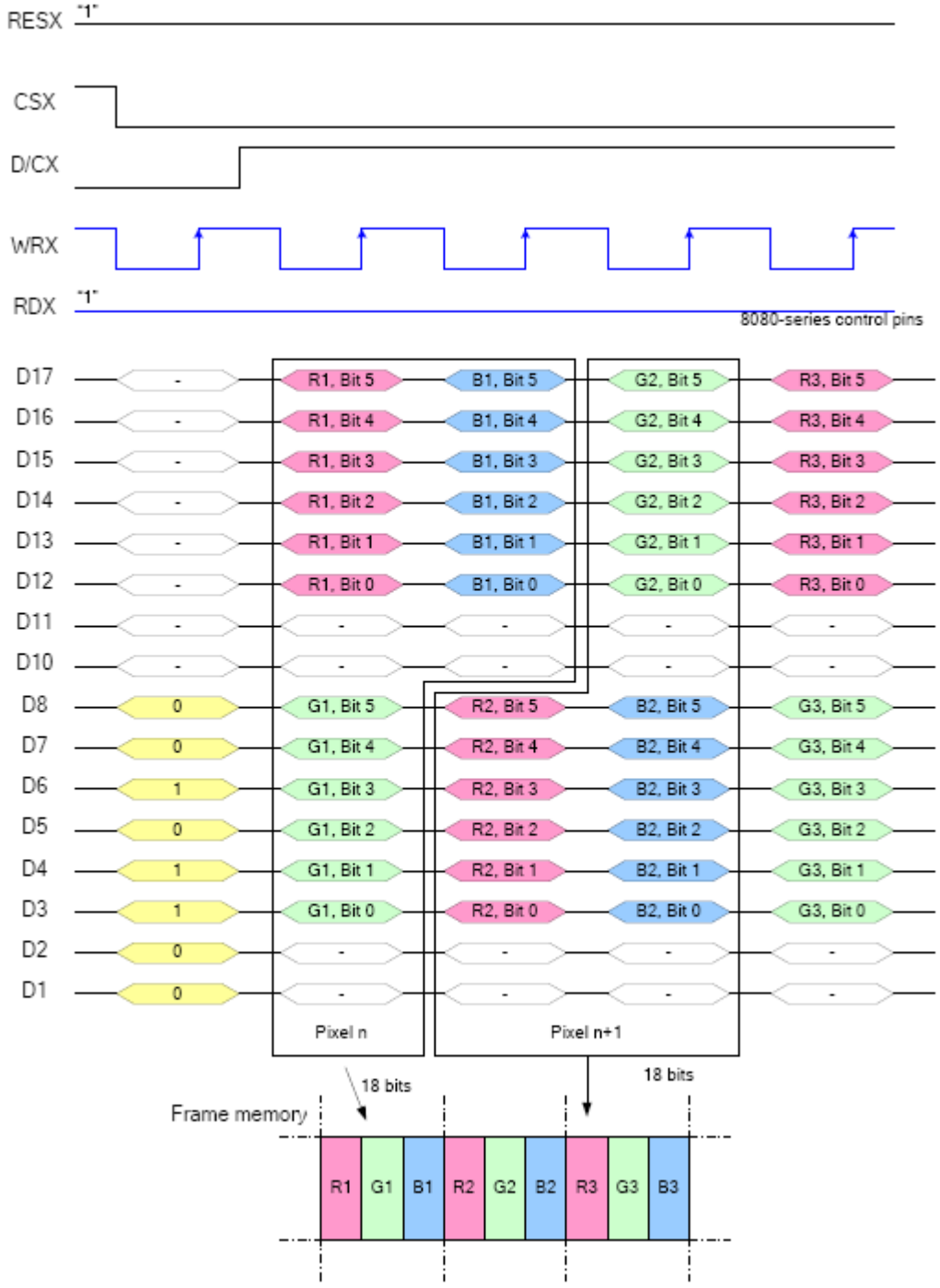
<table>
<tr><th>3Ah</th><th colspan="13">PIXSET (Pixel Format Set)</th></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D17-8</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>0</td><td>1</td><td>↑</td><td>XX</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td><td>3Ah</td></tr>
<tr><td>Parameter</td><td>1</td><td>1</td><td>↑</td><td>XX</td><td>0</td><td colspan="3">DPI [2:0]</td><td>0</td><td colspan="3">DBI [2:0]</td><td>66</td></tr>
<tr><td>Description</td><td colspan="13">This command sets the pixel format for the RGB image data used by the interface. DPI [2:0] is the pixel format select of RGB interface and DBI [2:0] is the pixel format of MCU interface. If a particular interface, either RGB interface or MCU interface, is not used then the corresponding bits in the parameter are ignored. The pixel format is shown in the table below.
<table>
<tr><th colspan="3">DPI [2:0]</th><th>RGB Interface Format</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>Reserved</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Reserved</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Reserved</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Reserved</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Reserved</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>16 bits / pixel</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>18 bits / pixel</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Reserved</td></tr>
</table>
<table>
<tr><th colspan="3">DBI [2:0]</th><th>MCU Interface Format</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>Reserved</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Reserved</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Reserved</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Reserved</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Reserved</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>16 bits / pixel</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>18 bits / pixel</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Reserved</td></tr>
</table>
If using RGB Interface must selection serial interface.
X = Don't care</td></tr>
</table>

7.3. 8080 series Parallel Interface Data Color Format
16-bit data bus for 16-bit/pixel (RGB 5-6-5-bit input) 65K-Color, 3Ah=”05h”



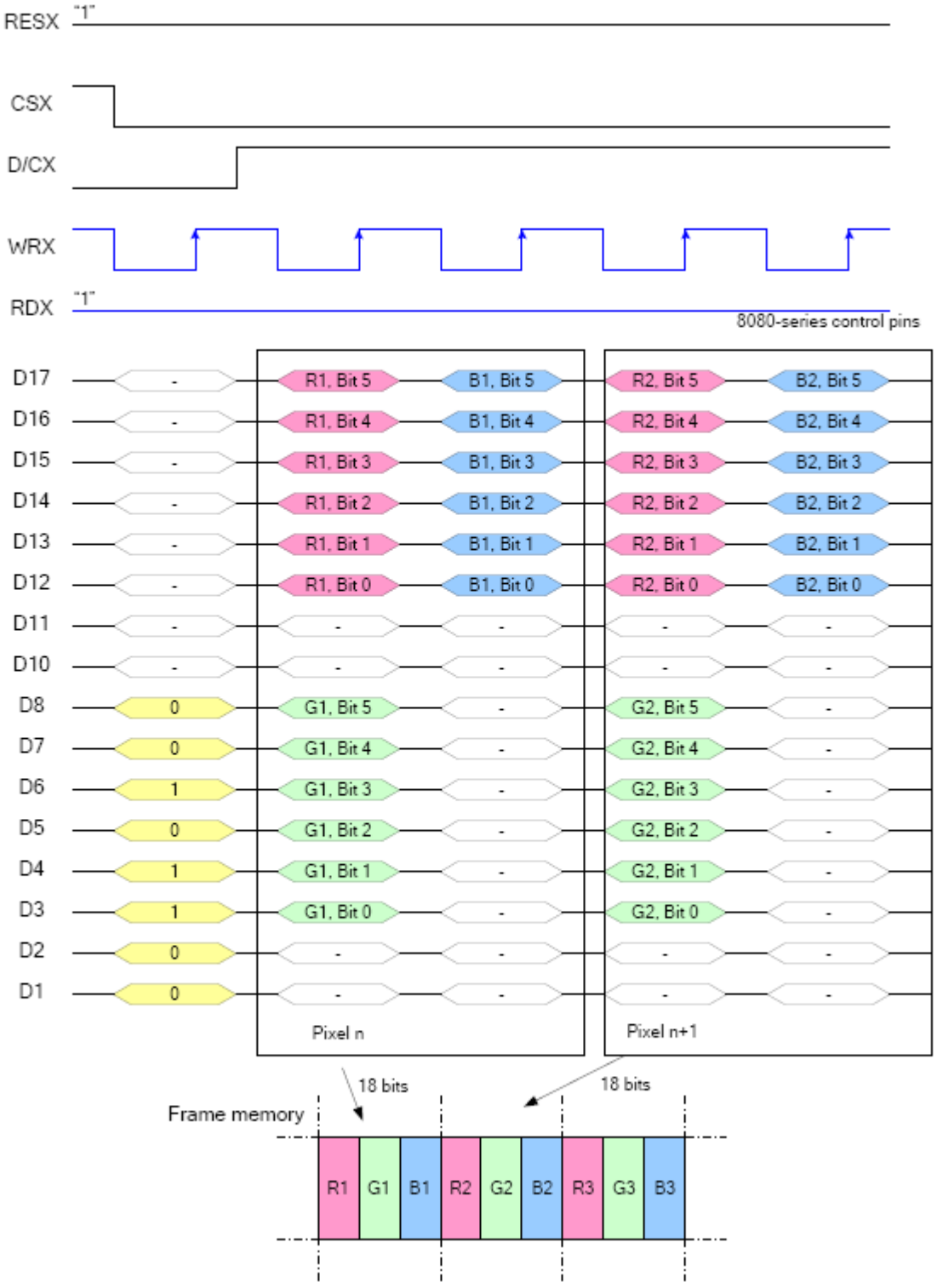
Note 1: The data order is as follows, MSB=D17, LSB=D1 and picture data is MSB=Bit 5, LSB=Bit 0 for Green, and MSB=Bit 4, LSB=Bit 0 for Red and Blue data.
Note 2: 1-times transfer (D17~D10, D8~D1) is used to transmit 1 pixel data with the 16-bit color depth information.
Note 3: ‘-‘ = Don’t care – Can be set to ‘0’ or ‘1’

16-bit data bus for 18-bit/pixel (RGB-6-6-6-bit input), 262K-Colors, 3Ah=”06h” ,MDT[1:0]=”00b”



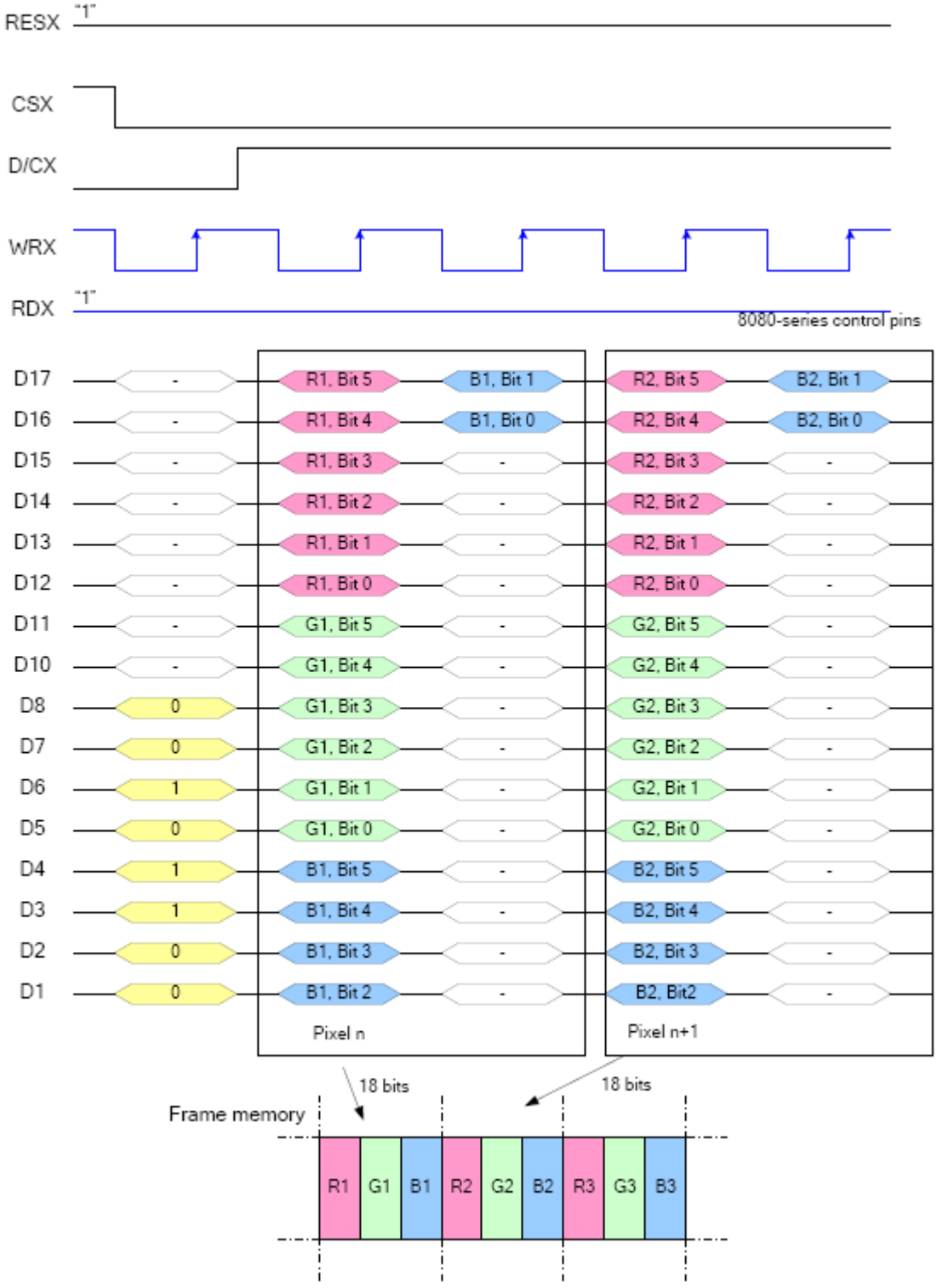
Note 1: The data order is as follows, MSB=D17, LSB=D1 and picture data is MSB=Bits 5, LSB=Bit 0 for Red, Green and Blue data.
Note 2: 2-times transfer is used to transmit 1 pixel data with the 18-bit color depth information.
Note 3: ‘-‘ = Don't care - Can be set to '0' or '1'

16-bit data bus for 18-bit/pixel (RGB-6-6-6-bit input), 262K-Colors, 3Ah=”06h”,MDT[1:0]=”01b”



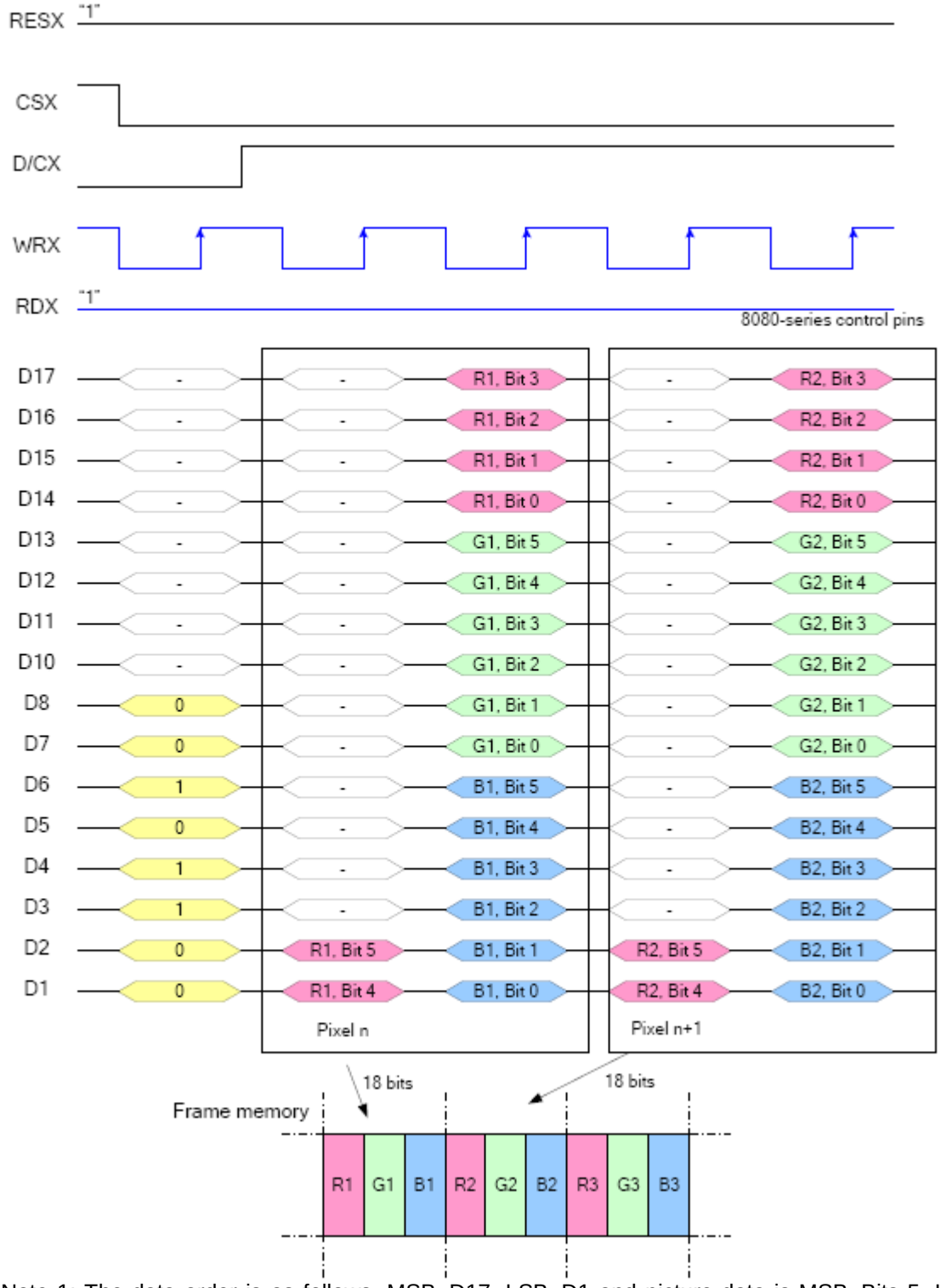
Note 1: The data order is as follows, MSB=D17, LSB=D1 and picture data is MSB=Bits 5, LSB=Bit 0 for Red, Green and Blue data.
Note 2: 2-times transfer is used to transmit 1 pixel data with the 18-bit color depth information.
Note 3: ‘-‘ = Don't care - Can be set to '0' or '1'

16-bit data bus for 18-bit/pixel (RGB-6-6-6-bit input), 262K-Colors, 3Ah=”06h”, MDT[1:0]=”10b”



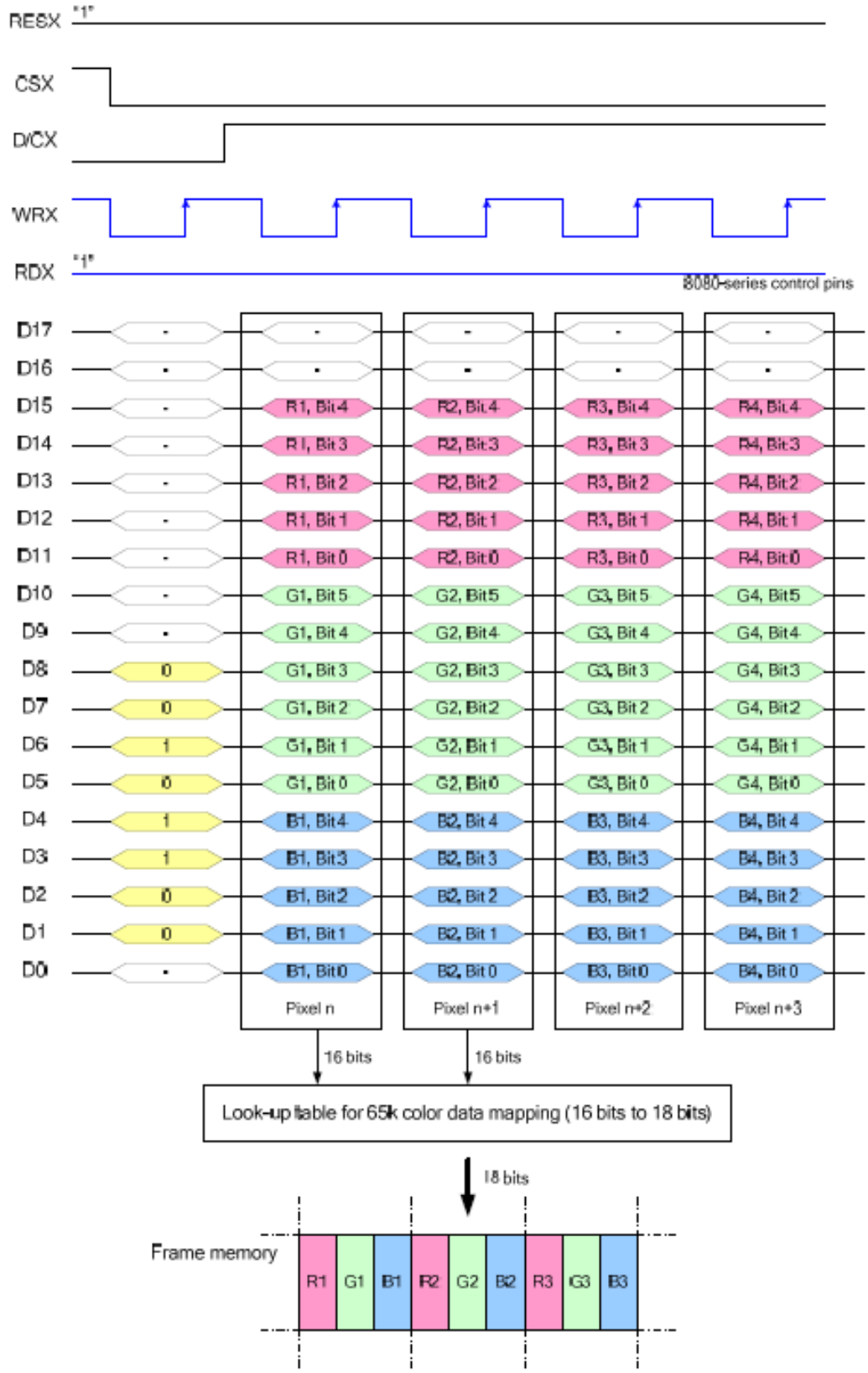
Note 1: The data order is as follows, MSB=D17, LSB=D0 and picture data is MSB=Bits 5, LSB=Bit 0 for Red, Green and Blue data.
Note 2: 2-times transfer is used to transmit 1 pixel data with the 18-bit color depth information.
Note 3: ‘-‘ = Don't care - Can be set to '0' or '1'

16-bit data bus for 18-bit/pixel (RGB-6-6-6-bit input), 262K-Colors, 3Ah=”06h”,MDT[1:0]=”11b”



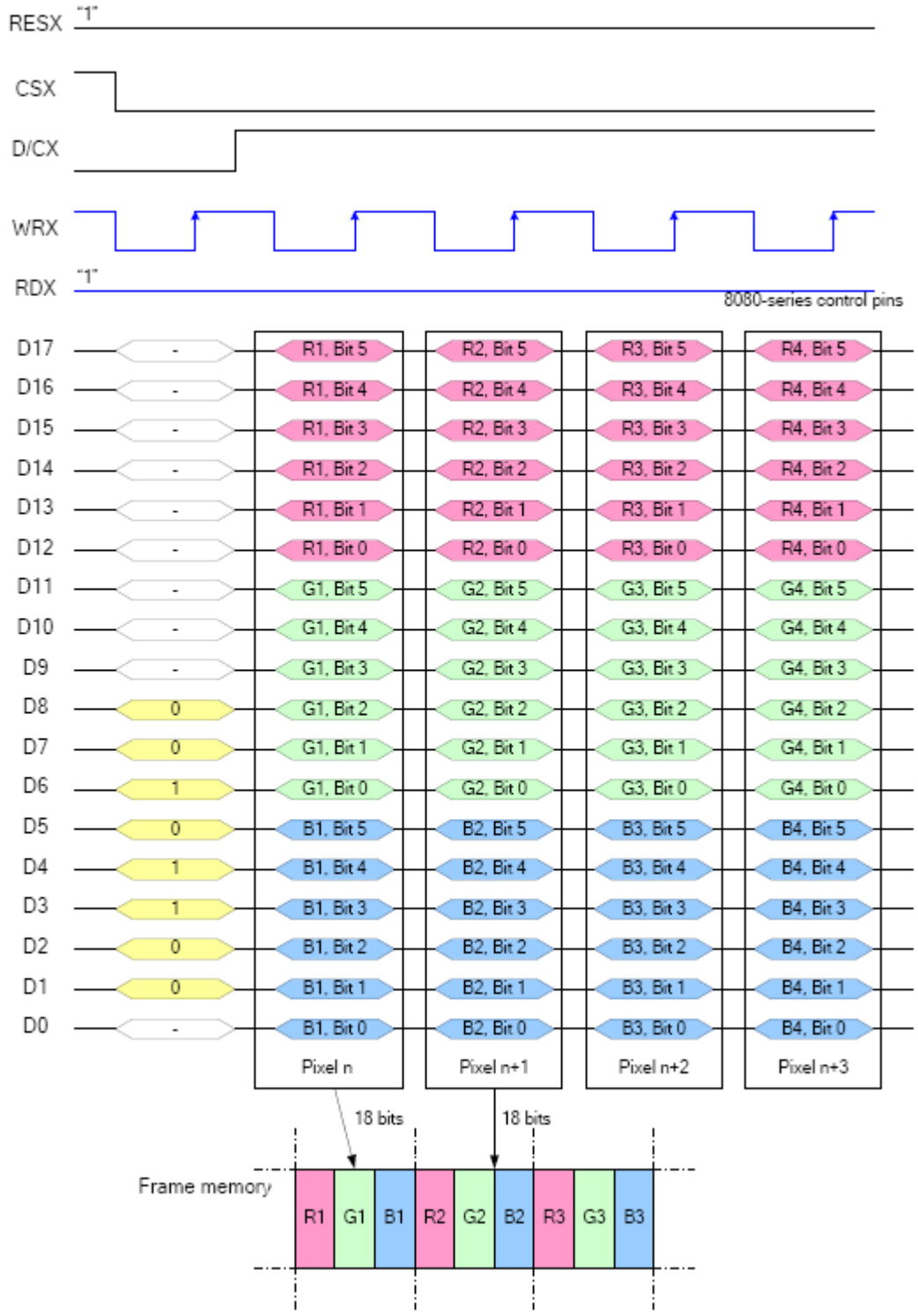
Note 1: The data order is as follows, MSB=D17, LSB=D1 and picture data is MSB=Bits 5, LSB=Bit 0 for Red, Green and Blue data.
Note 2: 2-times transfer is used to transmit 1 pixel data with the 18-bit color depth information.
Note 3: ‘-‘ = Don't care - Can be set to '0' or '1'

18-bit data bus for 16-bit/pixel (RGB-5-6-5-bit input), 65K-colors, 3Ah=”05h”



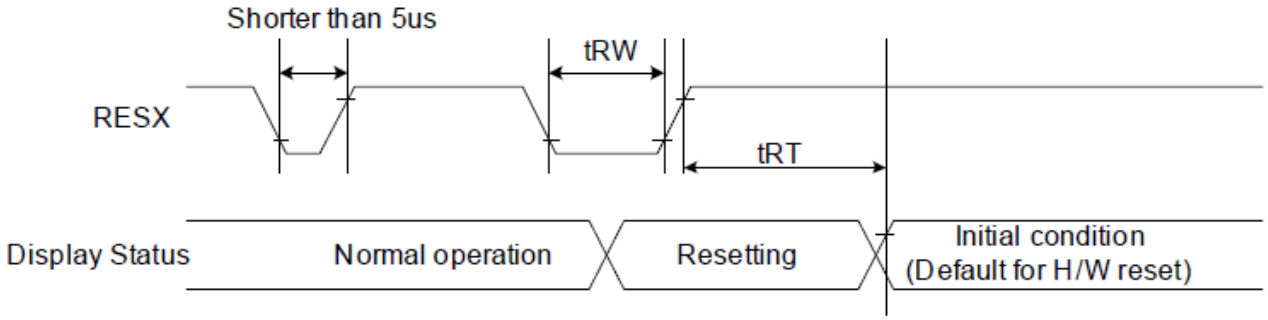
Note 1: The data order is as follows, MSB=D15, LSB=D0 and picture data is MSB=Bit 5, LSB=Bit 0 for Green, and MSB=Bit 4, LSB=Bit 0 for Red and Blue data.
Note 2: 1-time transfer is used to transmit 1 pixel data with the 16-bit color depth information.

18-bit data bus for 18-bit/pixel (RGB-6-6-6-bit input), 262K-colors, 3Ah=”06h”



Note 1: The data order is as follows, MSB=D17, LSB=D0 and picture data is MSB=Bit 5, LSB=Bit 0 for Read, Green and Blue data.
Note 2: 1-times transfer (D17o D0) is used to transmit 1 pixel data with the 18-bit color depth information.

7.4. Reset Timing



Signal	Symbol	Parameter	Min	Max	Unit
RESX	tRW	Reset pulse duration	10		us
	tRT	Reset cancel		5 (Note 1, 5)	ms
				120 (Note 1, 6, 7)	

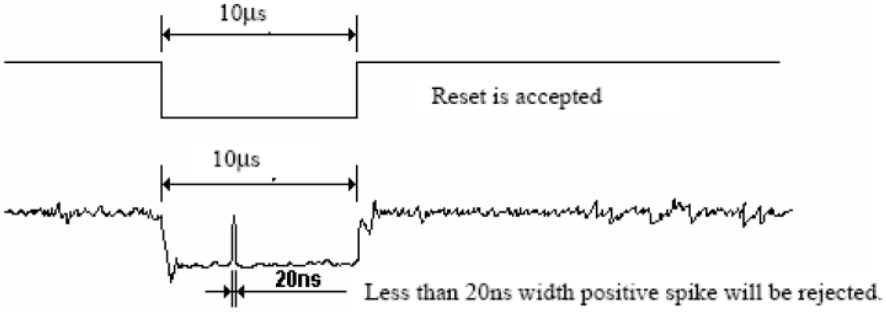
VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=-30 ~ 70 ℃

Notes:

1. The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NVM (or similar device) to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5 ms after a rising edge of RESX.
2. Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the table below:

RESX Pulse	Action
Shorter than 5us	Reset Rejected
Longer than 10us	Reset
Between 5us and 10us	Reset starts

3. During the Resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120 ms, when Reset Starts in Sleep Out –mode. The display remains the blank state in Sleep In –mode.) and then return to Default condition for Hardware Reset.
4. Spike Rejection also applies during a valid reset pulse as shown below:



5. When Reset applied during Sleep In Mode.
6. When Reset applied during Sleep Out Mode.
7. It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec.

8.Optical Characteristics

Item		Symbol	Condition.	Min	Typ.	Max.	Unit	Remark
Response time		Tr	θ=0°、Φ=0°	-	4	8	ms	Note 3,5
		Tf		-	12	24	ms	
Contrast ratio		CR	At optimized viewing angle	-	500	-	-	Note 4,5
Color Chromaticity	White	Wx	θ=0°、Φ=0	0.258	0.308	0.358		Note 2,6,7
		Wy		0.265	0.325	0.385		
Viewing angle (Gray Scale Inversion Direction)	Hor.	ΘR	CR≧10		45	-	Deg.	Note 1
		ΘL			45	-		
	Ver.	ΦT			45	-		
		ΦB			20	-		
Brightness		-	-	170	200	-	cd/m^2	Center of display

Ta=25±2℃

Note 1: Definition of viewing angle range

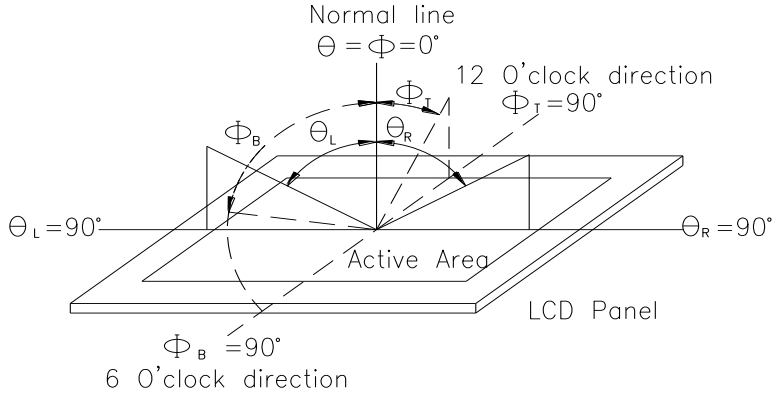


Fig. 8.1. Definition of viewing angle

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-7 or BM-5 luminance meter 1.0° field of view at a distance of 50cm and normal direction.

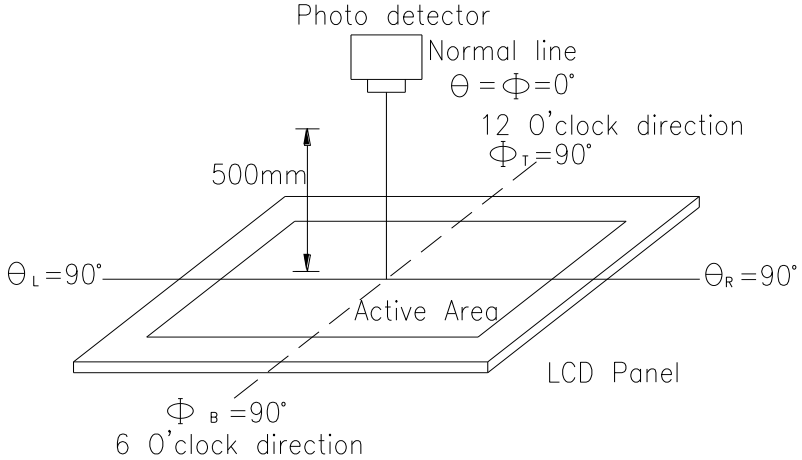
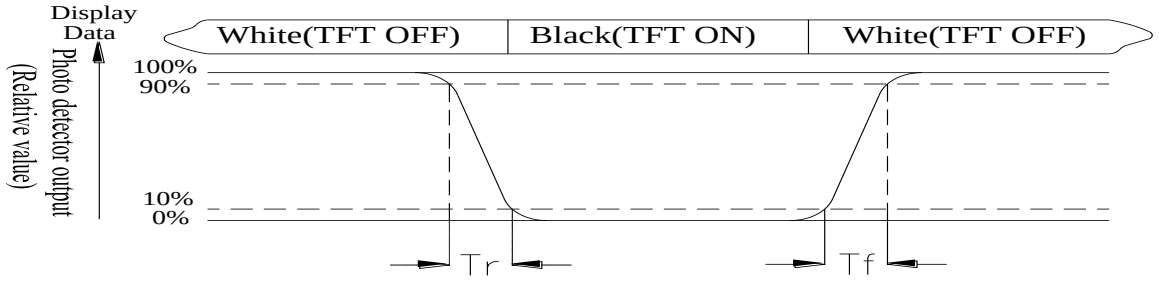


Fig. 8.2. Optical measurement system setup

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, Tr, is the time between photo detector output intensity changed from 90%to 10%. And fall time, Tf, 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: White Vi = V_{i50} ± 1.5V
Black Vi = V_{i50} ± 2.0V
“±” means that the analog input signal swings in phase with VCOM signal.
“±” means that the analog input signal swings out of phase with VCOM signal.
The 100% transmission is defined as the transmission of LCD panel when all the input terminals of module are electrically opened.

Note 6: Definition of color chromaticity (CIE 1931)
Color coordinates measured at the center point of LCD

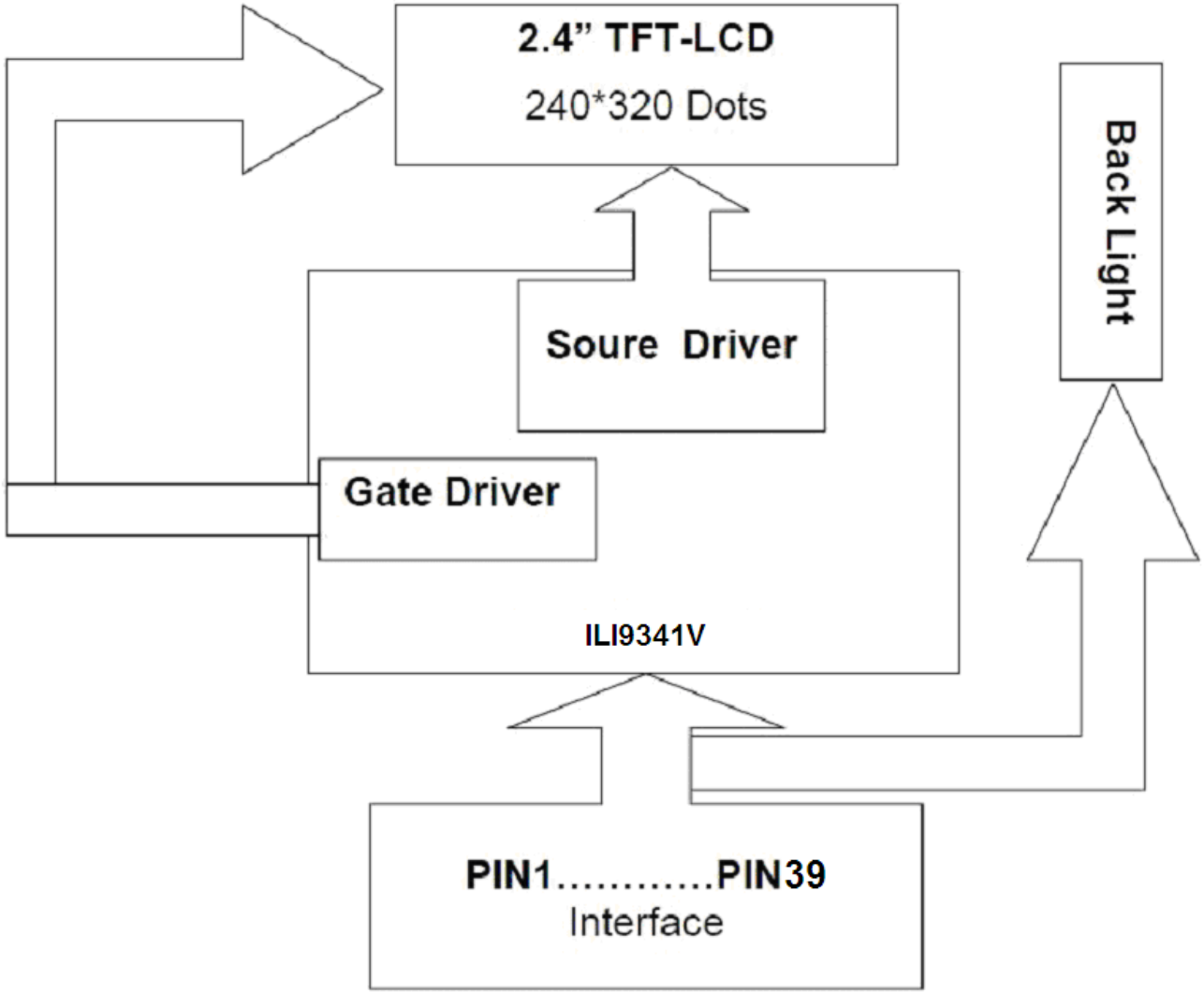
Note 7: Measured at the center area of the panel when all the input terminals of LCD panel are electrically opened.

9.Interface

9.1. LCM PIN Definition

NO	Symbol	Function	I/O
1	GND	Ground	P
2-5	NC	No connect	-
6	LCD_ID	No connect	-
7	VCC	power supply(TYP:2.8V).	P
8	IOVCC	power supply(TYP:1.8V/2.8V).	P
9	FMARK	Synchronies MCU to frame rate	I
10	CS	Chip select signal.	I
11	RS	register select	I
12	WR	Write data when WRX is Low.	I
13	RD	Read strobe signal. Read out data when RDX is Low.	I
14-29	DB0- DB15	Data bus	I/O
30	RESET	System reset pin.	I
31	IM0	Data interface select IM0=GND 16Bit DB0-DB15 IM0=IOVCC 8Bit DB8-DB15	I
32	NC	No connect	-
33	GND	Ground	P
34-37	LEDK1-K4	Cathode of LED backlight.	P
38	LEDA	Anode of LED backlight.	P
39	GND	Ground	P

10.Block Diagram



11.Reliability

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

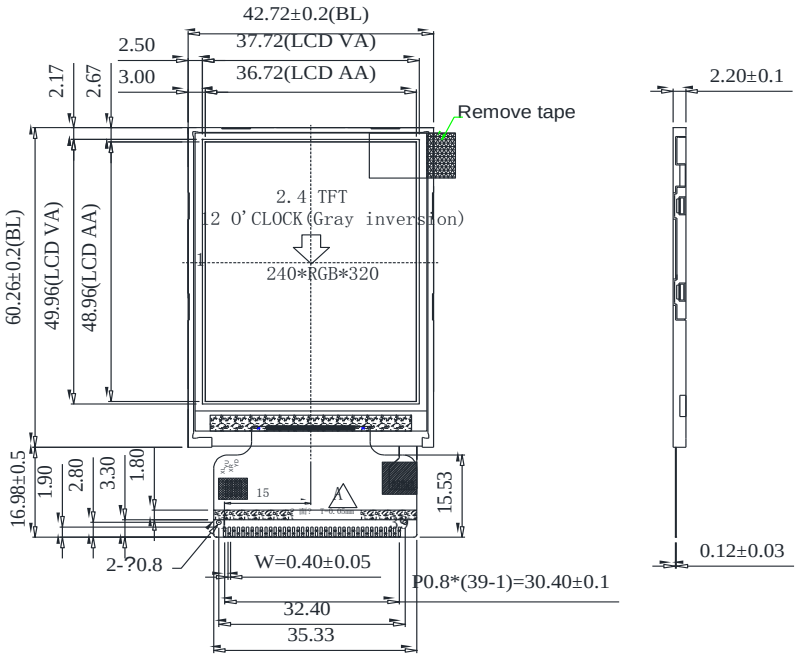
Environmental Test			
Test Item	**Content of Test**	**Test Condition**	**Note**
High Temperature storage	Endurance test applying the high storage temperature for a long time.	80℃ 96hrs	2
Low Temperature storage	Endurance test applying the low storage temperature for a long time.	-30℃ 96hrs	1,2
High Temperature Operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	70℃ 96hrs	——
Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time.	-20℃ 96hrs	1
High Temperature/ Humidity Operation	The module should be allowed to stand at 60℃,85%RH max	60℃,85%RH 96hrs	1,2
Thermal shock resistance	The sample should be allowed stand the following 10 cycles of operation -20℃ 25℃ 60℃ 30min 5min 30min 1 cycle	-20℃/60℃ 10 cycles	——
Vibration test	Endurance test applying the vibration during transportation and using.	Total fixed amplitude : 15mm 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	——

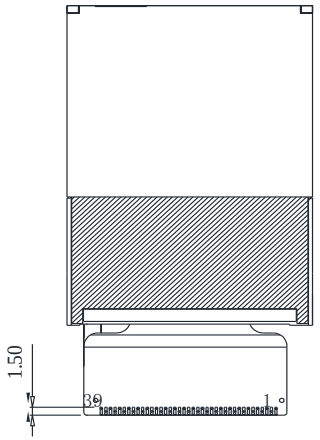
Note1: No dew condensation to be observed.

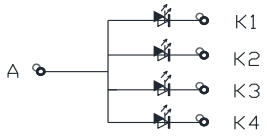
Note2: The function test shall be conducted after 4 hours storage at the normal Temperature and humidity after remove from the test chamber.

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

12.Contour Drawing







Back Light Circuit

PIN NO.	SYMBOL
1	GND
2	NC
3	NC
4	NC
5	NC
6	LCD_ID
7	VCC
8	IOVCC
9	FMARK
10	CS
11	RS
12	WR
13	RD
14-29	DB0-DB15
30	RESET
31	IM0
32	NC
33	GND
34	LEDK1
35	LEDK2
36	LEDK3
37	LEDK4
38	LEDA
39	GND

The non-specified tolerance of dimension is ±0.3mm.

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LCM Sample Estimate Feedback Sheet

Module Number： _____ **Page: 1**

1、Panel Specification：

1. Panel Type： □ Pass □ NG ,_____
2. View Direction： □ Pass □ NG ,_____
3. Numbers of Dots： □ Pass □ NG ,_____
4. View Area： □ Pass □ NG ,_____
5. Active Area： □ Pass □ NG ,_____
6. Operating Temperature： □ Pass □ NG ,_____
7. Storage Temperature： □ Pass □ NG ,_____
8. Others：_____

2、Mechanical Specification：

1. PCB Size： □ Pass □ NG ,_____
2. Frame Size： □ Pass □ NG ,_____
3. Material of Frame： □ Pass □ NG ,_____
4. Connector Position： □ Pass □ NG ,_____
5. Fix Hole Position： □ Pass □ NG ,_____
6. Backlight Position： □ Pass □ NG ,_____
7. Thickness of PCB： □ Pass □ NG ,_____
8. Height of Frame to PCB： □ Pass □ NG ,_____
9. Height of Module： □ Pass □ NG ,_____
10. Others： □ Pass □ NG ,_____

3、Relative Hole Size：

1. Pitch of Connector： □ Pass □ NG ,_____
2. Hole size of Connector： □ Pass □ NG ,_____
3. Mounting Hole size： □ Pass □ NG ,_____
4. Mounting Hole Type： □ Pass □ NG ,_____
5. Others： □ Pass □ NG ,_____

4、Backlight Specification：

1. B/L Type： □ Pass □ NG ,_____
2. B/L Color： □ Pass □ NG ,_____
3. B/L Driving Voltage (Reference for LED Type)： □ Pass □ NG ,_____
4. B/L Driving Current： □ Pass □ NG ,_____
5. Brightness of B/L： □ Pass □ NG ,_____
6. B/L Solder Method： □ Pass □ NG ,_____
7. Others： □ Pass □ NG ,_____

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

5、Electronic Characteristics of Module：

1.	Input Voltage：	□ Pass	□ NG ,_____
2.	Supply Current：	□ Pass	□ NG ,_____
3.	Driving Voltage for LCD：	□ Pass	□ NG ,_____
4.	Contrast for LCD：	□ Pass	□ NG ,_____
5.	B/L Driving Method：	□ Pass	□ NG ,_____
6.	Negative Voltage Output：	□ Pass	□ NG ,_____
7.	Interface Function：	□ Pass	□ NG ,_____
8.	LCD Uniformity：	□ Pass	□ NG ,_____
9.	ESD test：	□ Pass	□ NG ,_____
10.	Others：	□ Pass	□ NG ,_____

6、Summary：

Sales signature：_____

Customer Signature：_____ **Date：** / /