



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 Optronics, Inc.

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## RFA515600B-AYH-ENN

### SPECIFICATION

CUSTOMER:

<b>APPROVED BY</b>	
<b>PCB VERSION</b>	
<b>DATE</b>	

FOR CUSTOMER USE ONLY

<b>SALES BY</b>	<b>APPROVED BY</b>	<b>CHECKED BY</b>	<b>PREPARED BY</b>

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	2023/08/29		First issue

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# 1.Module Classification Information

<b>R</b>	<b>F</b>	<b>A5</b>	<b>1560</b>	<b>0B</b>	<b>-</b>	<b>A</b>	<b>Y</b>	<b>H</b>	<b>-</b>	<b>E</b>	<b>N</b>	<b>N</b>
1	2	3	4	5	-	6	7	8	-	9	10	11

Item	Description	
1	R : Raystar Optronics 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    A5: 1920 x 1080	
4	Display Size : 15.6" 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)	6 : TFT+FR H : TFT+D/V BOARD I : TFT+FR+D/V BOARD B : TFT+POWER BD 1 : TFT+CONTROL BOARD
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    E:eDP
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)

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## 2.Summary

The TFT15.6" is a color active matrix LCD module incorporation Oxide TFT. It is composed of a TFT LCD panel, a backlight, a timing controller, voltage reference, common voltage, column driver, and row driver circuit. This TFT LCD has a 15.6-inch diagonally measured active display area with resolution 1,920 horizontal by 1,080 vertical pixel array.

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### 3. General Specifications

- Size: 15.6 inch
- Dot Matrix: 1920 x RGB x 1080 dots
- Module dimension: 360.0(W) x 212.3(H)x 9.0(D) mm
- Active area: 344.16 x 193.59 mm
- Pixel pitch: 0.17925 (H) x 0.17925 (V) mm
- LCD type: TFT, Normally Black, Transmissive
- Viewing Angle: 80/80/80/80
- Backlight Type: LED, Normally White
- TFT Driver IC: TC2055G or equivalent
- TFT Interface: eDP
- 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 No.	Signal Name	Description	Remarks
1	NC	Not Connect	
2	H_GND	Ground	
3	Lane1_N	Complement Signal Link Lane 1	
4	Lane1_P	True Signal Line 1	
5	H_GND	Ground	
6	Lane0_N	Complement Signal Link Lane 0	
7	Lane0_P	True Signal Line 0	
8	H_GND	Ground	
9	AUX_CH_P	True Signal Auxiliary Ch.	
10	AUX_CH_N	Complement Signal Auxiliary Ch.	
11	H_GND	Ground	
12-13	LCD_VDD	LCD Logic and Driver Power	+3.3V
14	NC	Not Connect	
15-16	LCD_GND	Ground	
17	HPD	HPD Signal Pin	
18-21	LCD_GND	Ground	
22-30	NC	Not Connect	

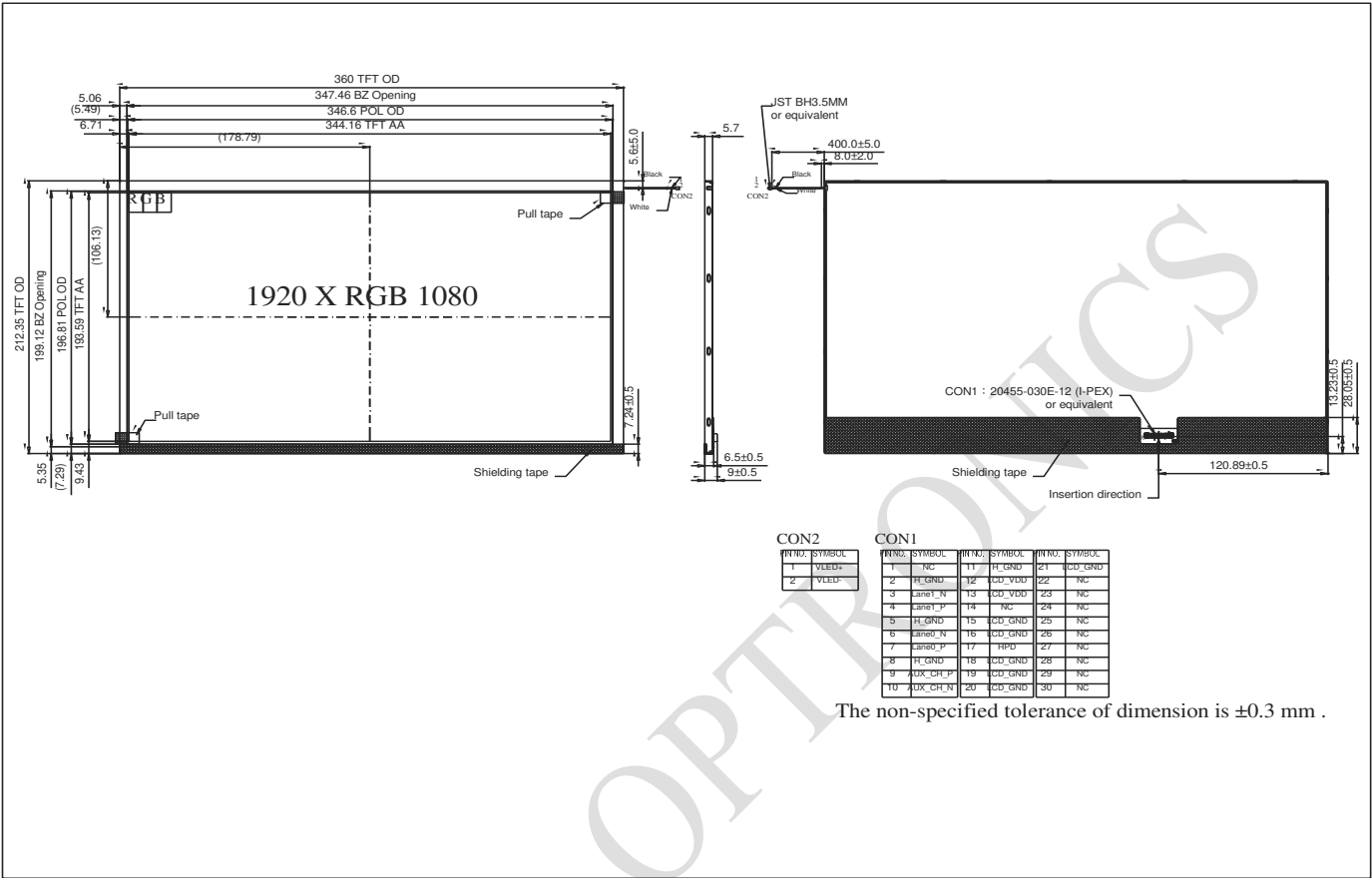
Note: All input signals shall be low or Hi-Z state when LCD\_VDD is off

### 4.2. Backlight PIN Definition

Pin No.	Symbol	Description
1	VLED+	Black, LED_ Anode
2	VLED-	White, LED_ Cathode

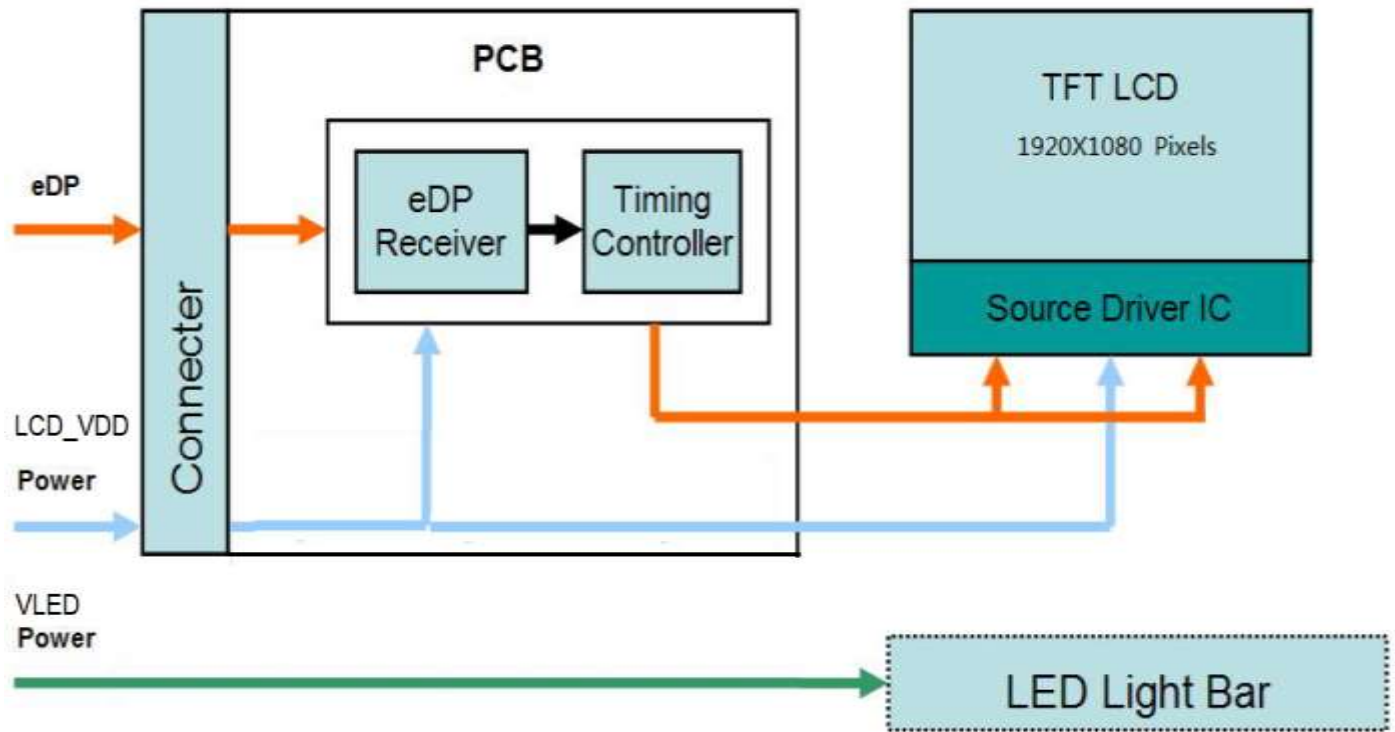


# 5. Contour Drawing



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

## 6. Block Diagram



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## 7. 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

1. Temp.  $\leq 50^{\circ}\text{C}$ , 80% RH MAX. Temp.  $> 50^{\circ}\text{C}$ , Absolute humidity shall be less than 80% RH at  $50^{\circ}\text{C}$

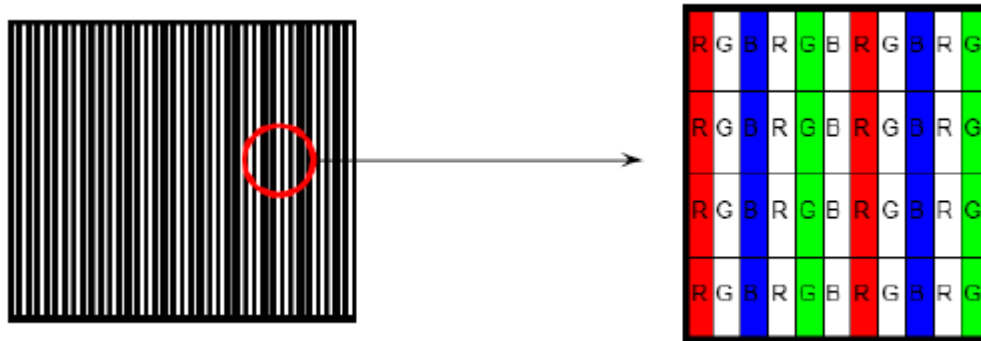
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# 8. Electrical Characteristics

## 8.1. TFT LCD Module

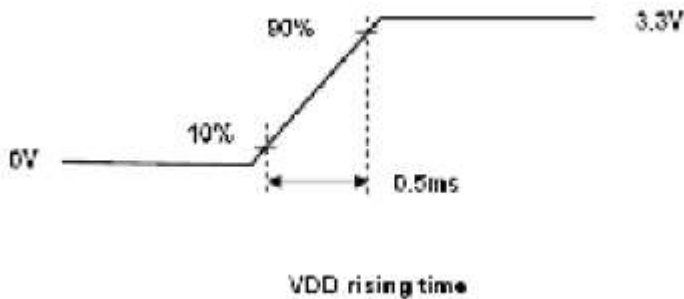
Parameter	Symbol	Min.	Typ.	Max.	Units	Condition
Logic/LCD Drive Voltage	LCD_VDD	3.0	3.3	3.6	V	
LCD_VDD Current	IDD	-	200	300	mA	Note A,
LCD_VDD Current	IDDMAX	-	-	400	mA	Note B, C
LCD_VDD Power	PDD	-	0.66	1.32	W	Note A, B, C
Inrush Current	IRush	-	-	2	A	Note D, E
Allowable Logic/LCD Drive Ripple Voltage	LCD_VDDrp	-	-	100	mV	Vp-p

Note A : IDDBlack measurement condition, Normal pattern.  
 Note B : IDDMAX measurement condition, V-Stripe pattern.  
 Note C : Description of the V-Stripe pattern.



Note D : Measure Condition Figure 1.

**Figure 1 LCD\_VDD Rising Time**



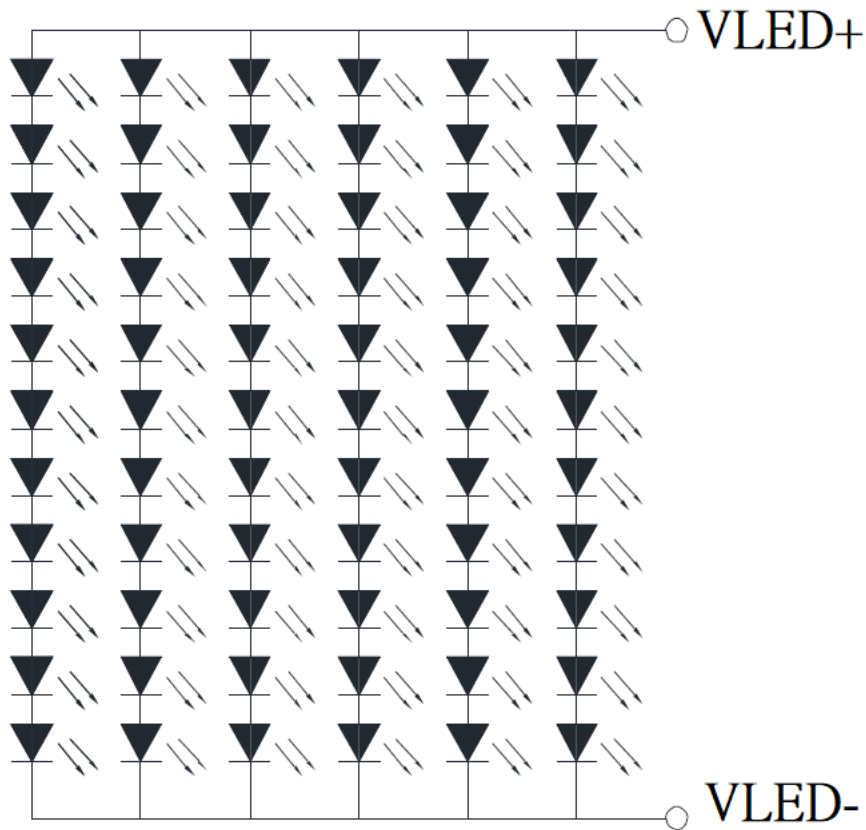
Note E : When the IRush Measure Condition at LCD\_VDD rising time=1.5ms, the value of IRush(Typ.)= 1A.

### 8.2. Backlight Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units	Condition
LED input	VLED	29.7	33	37.4	V	Ta=25 °C
LED Forward Current	ILED	-	360	-	mA	
LED Life Time	-	-	30000	-	Hours	Ta=25 °C

Note A: Calculator value for LED chip specification.

Note B: The LED life time define as the estimated time to 50% degradation of initial luminous.



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### 8.3. Signal Electrical Characteristics

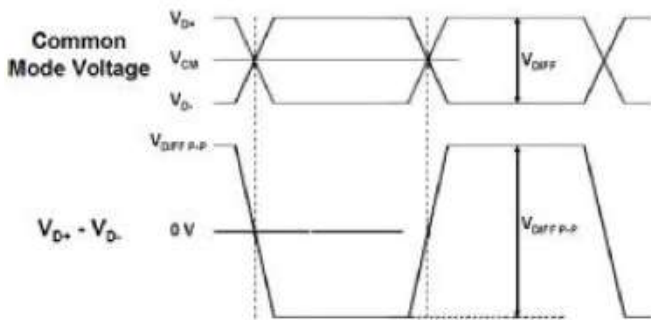
Input signals shall be low or High-impedance state when LCD\_VDD is off.  
 It is recommended to refer the specifications of VESA Display Port Standard V1.2 in detail.

**Table 1 Display Port Main Link**

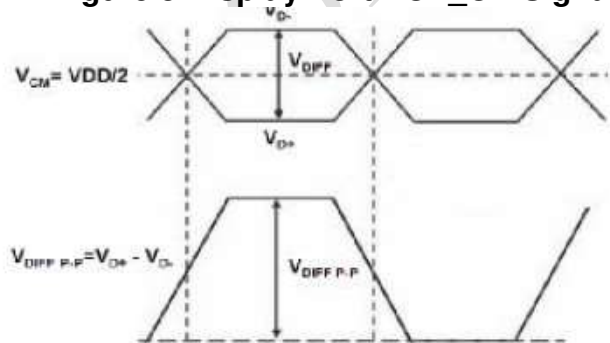
Parameter	Description	Min.	Typ.	Max.	Unit
$V_{CM}$	Differentia Common Mode Voltage	0	-	2.0	V
$V_{DIFF P-P}$ Level 1	Differential Peak to Peak Voltage Level 1	0.34	0.40	0.46	V
$V_{DIFF P-P}$ Level 2	Differential Peak to Peak Voltage Level 2	0.51	0.60	0.68	V
$V_{DIFF P-P}$ Level 3	Differential Peak to Peak Voltage Level 3	0.69	0.80	0.92	V
$V_{DIFF P-P}$ Level 4	Differential Peak to Peak Voltage Level 4	1.02	1.20	1.38	V

Note: Follow as VESA display port standard V1.2 at both 1.62 and 2.7Gbps link rates.

**Figure 2 Display Port Main Link Signal**



**Figure 3 Display Port AUX\_CH Signal**



**Table 2 Display Port AUX\_CH**

Parameter	Description	Min.	Typ.	Max.	Unit
$V_{CM}$	Differentia Common Mode Voltage	0	VDD/2	2	V
$V_{DIFF P-P}$	Differential Peak to Peak Voltage	0.39	-	1.38	V

Note: Follow as VESA display port standard V1.2.

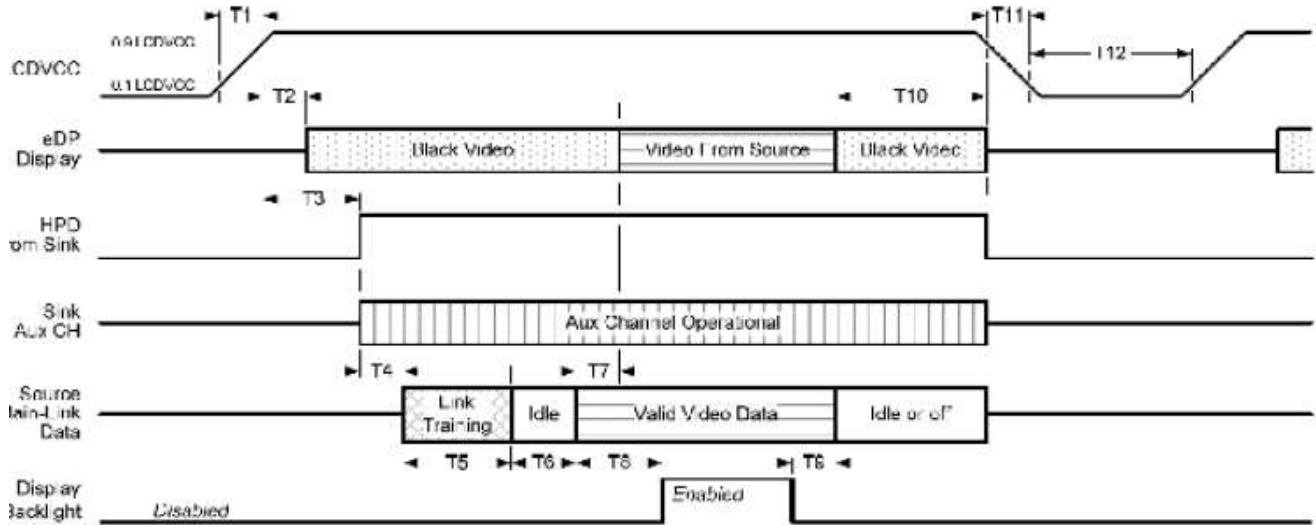
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**Table 3 Display Port VHPD**

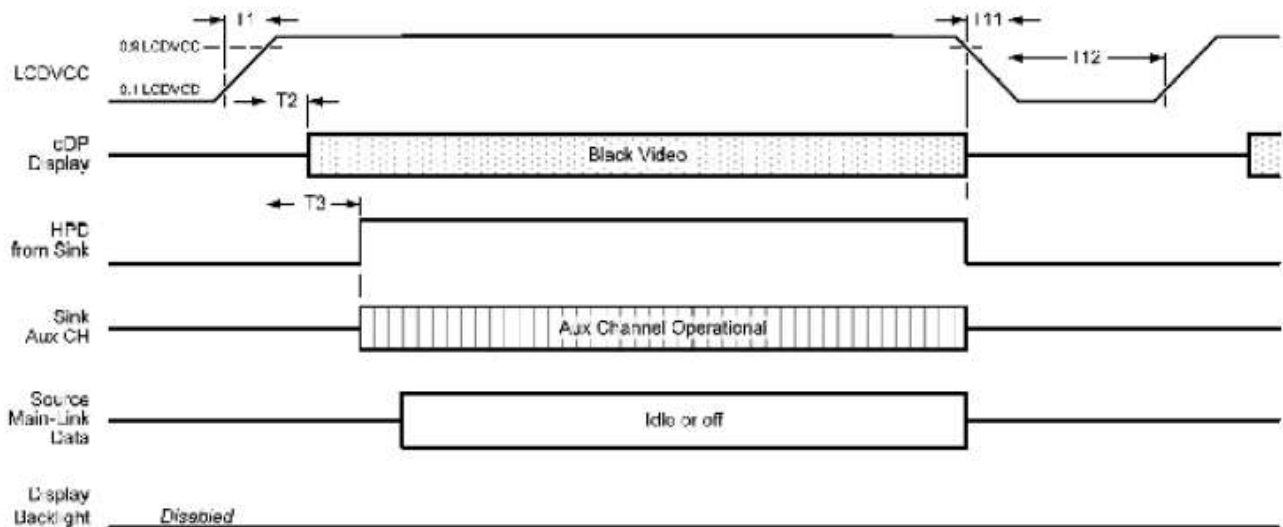
Parameter	Description	Min.	Typ.	Max.	Unit
V <sub>HPD</sub>	HPD Voltage	2.25		3.60	V

Note: Follow as VESA display port standard V1.2

**Figure 4 Display Port Interface Power Up/Down Sequence, Normal System Operation**



**Figure 5 Display Port Interface Power Up/Down Sequence, Aux Channel Transaction Only**



**Table 4 eDP Panel Power Sequence Timing Parameters**

Timing Parameter	Description	Reqd. By	Limits		Notes
			Min.	Max.	
T1	Power rail rise time, 10% to 90%	Source	0.5ms	10ms	-
T2	Delay from LCD VCC to black video generation	Sink	0ms	200ms	Prevents display noise until valid video data is received from the Source.(see note 1 below)
T3	Delay from LCD VCC to HPD high	Sink	0ms	200ms	Sink Aux Channel must be operational upon HPD high.
T4	Delay from HPD high to link training initialization	Source	-	-	Allows for Source to read Link capability and initialize.
T5	Link training duration	Source	-	-	Dependant on Source link training protocol.
T6	Link idle	Source	-	-	Min accounts for required BS-Idle pattern. Max allows for Source frame synchronization.
T7	Delay from valid video data from Source to video on display	Sink	0ms	50ms	Max allows Sink validate video data and timing.
T8	Delay from valid video from Source to backlight enable	Source	-	-	Source must assure display video is stable.
T9	Delay from backlight disable to end of valid video data	Source	-	-	Source must assure backlight is no longer illuminated.(see note 1 below)
T10	Delay from end of valid video data from Source to power off	Source	0ms	500ms	-
T11	Power rail fall time, 90% to 10%	Source	-	10ms	-
T12	Power off time	Source	500ms	-	-



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Note 1: The Sink must include the ability to generate black video autonomously. The Sink must automatically enable black video under the following conditions:

- Upon LCDVCC power-on (within T2 max)
- When the “NoVideoStream\_Flag” (VB-ID Bit 3) is received from the Source (at the end of T9)
- When no Main Link data, or invalid video data, is received from the Source. Black video must be displayed within 50ms (max) from the start of either condition. Video data can be deemed invalid based on MSA and timing information, for example.

Note 2: The Sink may implement the ability to disable the black video function, as described in Notes 1, above, for system development and debugging purposes.

Note 3: The Sink must support Aux Channel polling by the Source immediately following LCDVCC power-on without causing damage to the Sink device (the Source can re-try if the Sink is not ready).

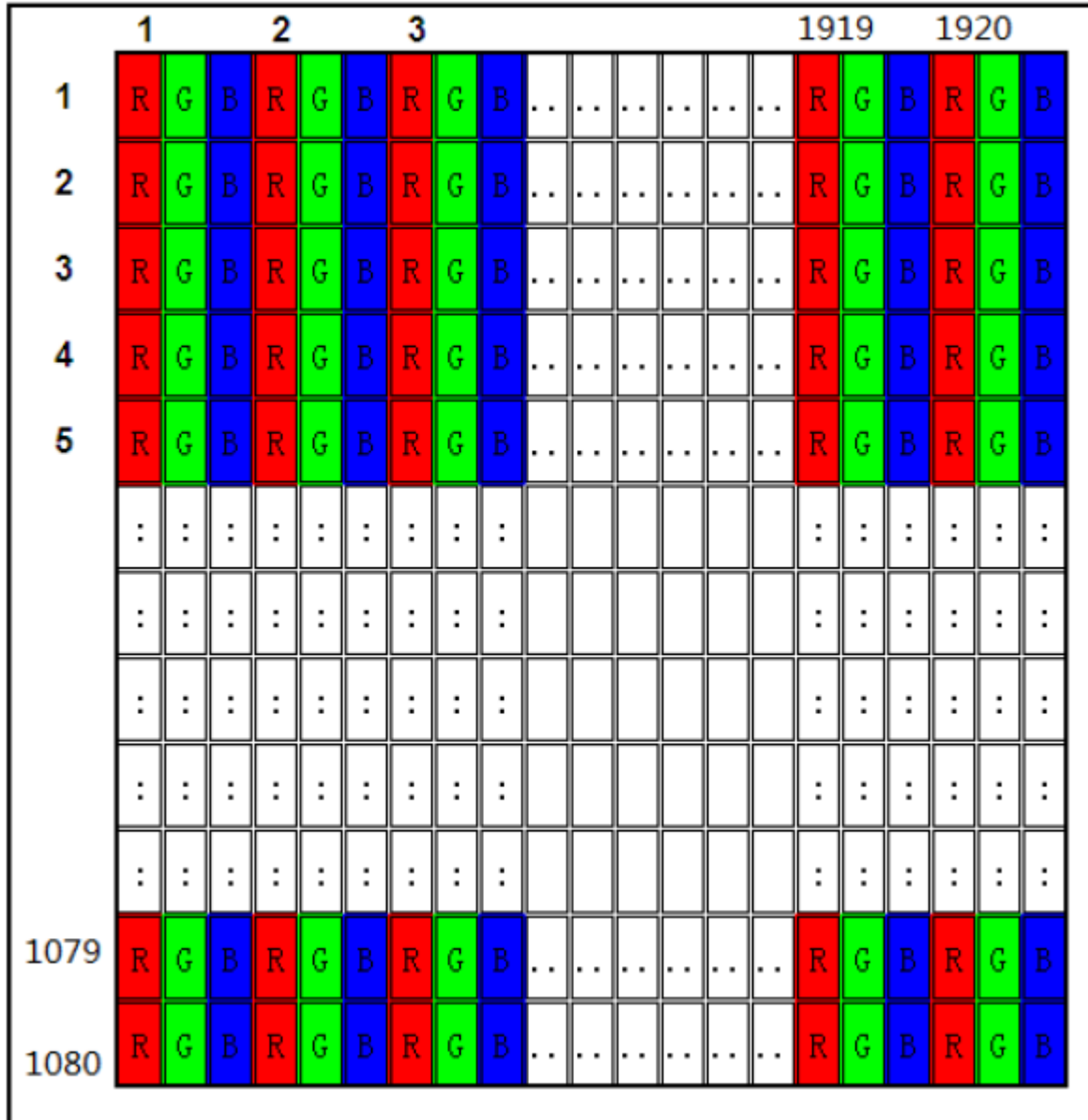
The Sink must be able to respond to an Aux Channel transaction with the time specified within T3max.

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## 9.Pixel Format Image

Figure 6 shows the relationship of the input signals and LCD pixels format image.

**Figure 6 Pixel Format**



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# 10. Interface Timings

## Timing Characteristics

Basically, interface timings should match the 1920 x 1080 /60Hz manufacturing guide line timing.

**Table 5 Interface Timings**

Parameter	Symbol	Unit	Min.	Typ.	Max.
Signal Clock Frequency	$f_{dck}$	MHz	140	152.5	165
H Total Time	$T_{hp}$	clocks	-	2192	-
H Active Time	HA	clocks	1920		
H Blanking	$T_{hfp}$	clocks	-	272	-
V Total Time	$T_{vp}$	lines	-	1160	-
V Active Time	VA	lines	1080		
V Blanking	$T_{vfp}$	lines	-	80	-
V Frequency	$f_v$	Hz	55	60	65

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# 11. Power ON/OFF Sequence

LCD\_VDD power on/off sequence is as follows. Interface signals are also shown in the chart. Signals from any system shall be Hi-Z state or low level when LCD\_VDD is off.

Figure 7 Power Sequence

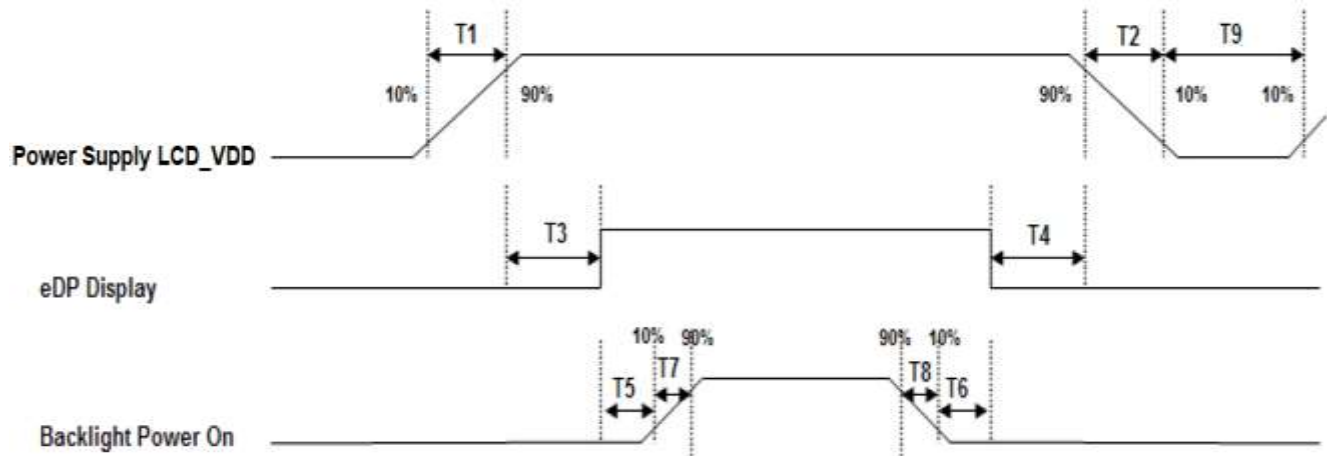


Table 6 Power Sequencing Requirements

Parameter	Unit	Min.	Max.
T1	ms	0.5	10
T2	ms	0	10
T3	ms	0	200
T4	ms	0	50
T5	ms	300	-
T6	ms	200	-
T7	ms	0.5	10
T8	ms	0	10
T9	ms	500	-

## 12. Optical Characteristics

Item	Symbol	Condition.	Min	Typ.	Max.	Unit	Remark	
Response time	Tr+ Tf	$\theta=0^\circ$ 、 $\phi=0^\circ$	-	25	-	.ms	Note 3	
Contrast ratio	CR	At optimized viewing angle	-	1500	-	-	Note 4,	
Color Chromaticity	White	Wx	$\theta=0^\circ$ 、 $\phi=0$	0.26	0.306	0.36	Note 2,6,7	
		Wy		0.27	0.328	0.37		
Viewing angle	Hor.	$\Theta_R$	CR $\geq$ 10	-	80	-	Deg.	Note 1
		$\Theta_L$		-	80	-		
	Ver.	$\Phi_T$		-	80	-		
		$\Phi_B$		-	80	-		
Brightness	-	-	850	1000	-	cd/m <sup>2</sup>	Center of display	
Uniformity	(U)	-	75	-	-	%	Note 5	

Ta=25±2°C

Note 1: Definition of viewing angle range

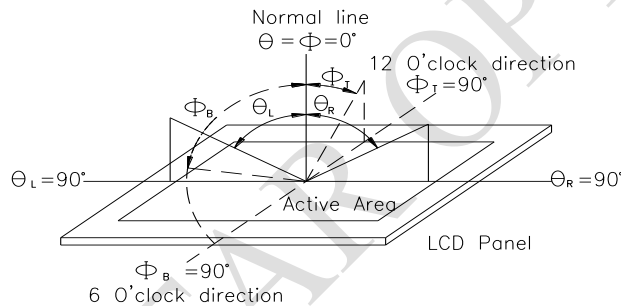


Fig 12.1. Definition of viewing angle

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.

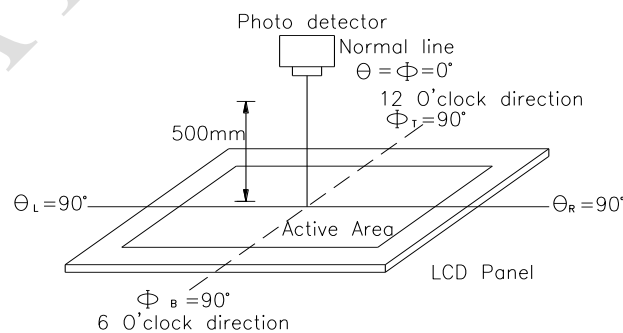
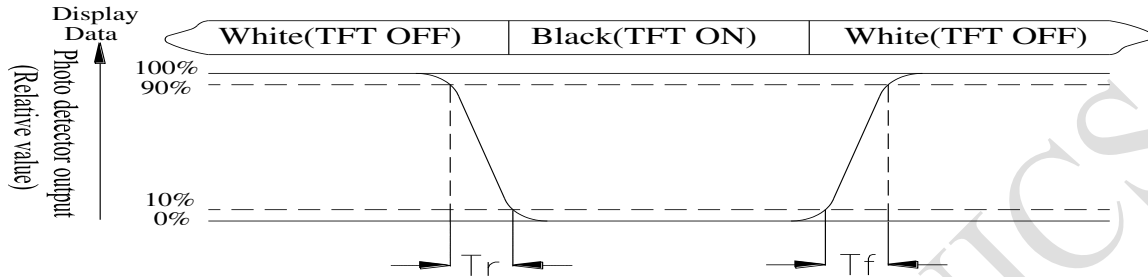


Fig 12.2. Optical measurement system setup

**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.

$$\text{Luminance Uniformity (U)} = \text{Lmin/Lmax} \times 100\%$$

L = Active area length

W = Active area width



Fig 12.3. Definition of uniformity

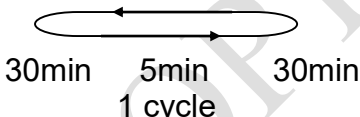
**Note 6: Definition of color chromaticity (CIE 1931)**

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.

# 13. 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 50°C,80%RH max	50°C,80%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=±8KV(contact), ±15KV(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 :**    /    /