



SPECIFICATION

[☒] Preliminary Specification
[] Final Specification

Description**15.6" 1920xRGBx1080 TFT-LCD Module****Part Number****P1560FHF3MB04**

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REVISION HISTORY

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1. Summary

1.1 General Description

This is a 15.6 inch a-Si TFT-LCD module with Normal-Black technology. It is composed of a TFT-LCD panel, a driver circuit, PCB, and a LED backlight unit.

1.2 Features

- Ultra-wide viewing angle
- High resolution
- Interface: eDP
- LED driver integrated
- Surface treatment: Anti-Glare
- This product will comply with the European RoHS Directive (2011/65/EU) and Delegated Directive (2015/863/EU, Amending Annex II of 2011/65/EU)

2. General Specifications

Feature		Spec	Unit
Display Spec	Size	15.6 inches	-
	Resolution	1920(RGB)x1080	-
	Pixel Pitch	0.17925x0.17925	mm
	TFT Active Area	344.16*193.59	mm
	Technology Type	a-Si	-
	Pixel Configuration	R.G.B Vertical Stripe	-
	Display Mode	SFT, Normally Black	-
	Surface Treatment	AG	-
	Viewing Direction	All	-
	Gray Scale Inversion Direction	No Gray Scale Inversion	-
Mechanical Characteristics	LCM (W x H x D)	363.8x 215.9 x 9.6(max)	mm
	Weight	TBD	g
Optical Characteristics	Luminance	500	cd/m ²
	Contrast Ratio	1500:1	-
	NTSC	72 TYP	%
	Viewing Angle	89/89/89/89(SFT)	degree
Electrical Characteristics	Interface	eDP1.2	-
	Color Depth	16.7 Million	color
	Power Consumption	TBD	mW

Table 2.1 General TFT Specifications

3. Input / Output Terminals

3.1 CN1 Pin assignment (LCD Interface)

Connector Information	
LCD Module connector	IPEX 20455-040E-76
Matching connector	IPEX 20453-040T-03

Table 3.1.1 Connector information

No	Symbol	I/O	Description	Comment
1	NC	N	No connection	
2	NC	N	No connection	
3	NC	N	No connection	
4	NC	N	No connection	
5	NC	N	No connection	
6	NC	N	No connection	
7	NC	N	No connection	
8	NC	N	No connection	
9	NC	N	No connection	
10	NC	N	No connection	
11	NC	N	No connection	
12	LED_VCCS	P	BL_POWER	
13	LED_VCCS	P	BL_POWER	
14	LED_VCCS	P	BL_POWER	
15	LED_VCCS	P	BL_POWER	
16	NC	N	No connection	
17	NC	N	No connection	
18	LED_PWM	I	BL_PWM signal input	
19	LED_En	I	BL ENABLE	
20	BL_GND	P	BL Ground	
21	BL_GND	P	BL Ground	
22	BL_GND	P	BL Ground	
23	BL_GND	P	BL Ground	
24	HPD	O	HPD signal pin	
25	GND	P	Ground	
26	GND	P	Ground	
27	NC	N	No connection	
28	VCCS	P	Power Supply +3.3 V (typical)	
29	VCCS	P	Power Supply +3.3 V (typical)	
30	GND	P	Ground	
31	AUX-	I	Complement Signal-Auxiliary Channel	

32	AUX+	I	True Signal-Auxiliary Channel	
33	GND	P	Ground	
34	ML0+	I	True Signal-Main Lane 0	
35	ML0-	I	Complement Signal-Lane 0	
36	GND	P	Ground	
37	ML1+	I	True Signal-Main Lane 1	
38	ML1-	I	Complement Signal-Lane 1	
39	GND	P	Ground	
40	NC	N	No connection	

Table 3.1.2 Pin Assignment for LCD Interface

Note1: I/O definition: I---Input, O---Output, P---Power/Ground, N---No connection

Note2: All of the GND pins should be connected to the system ground.

3.2 Positions of socket

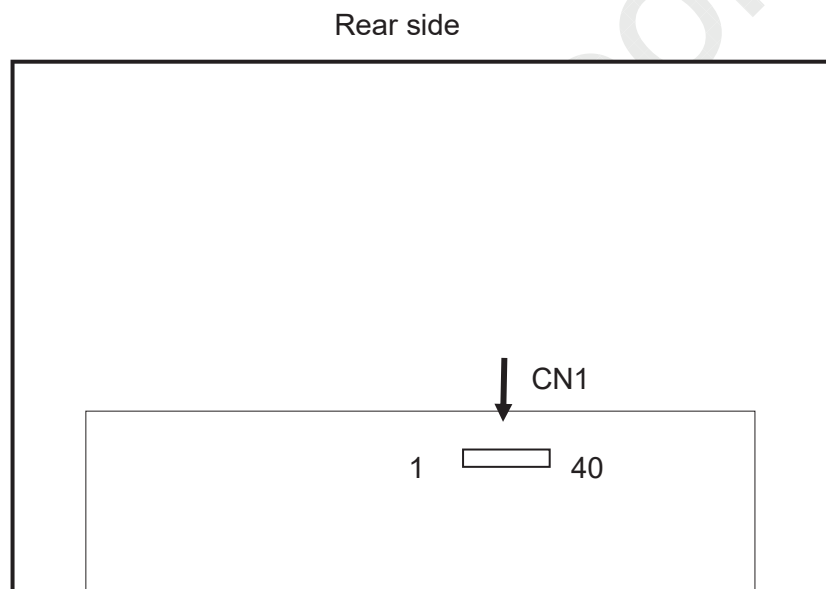
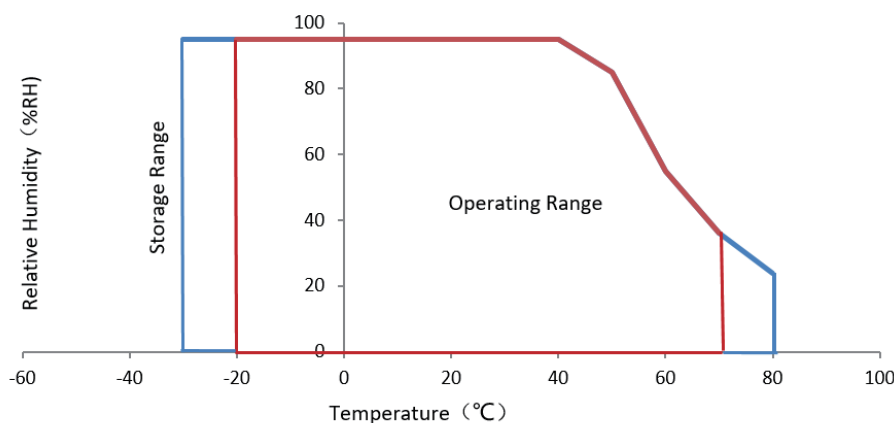


Table 3.2 Positions of Socket

4. Absolute Maximum Ratings

Item		Symbol	Rating	Unit	Remark
Power supply voltage	LCD panel	VCCS	(-0.3 to +4.0)	V	Ta= 25°C
	Backlight	LED_VCCS	(-0.3 to +27.0)	V	
Input voltage for signals	Display signals Note1	VD	T.B.D.	V	
	Function signal for Backlight	LED_EN	(-0.3 to +27.0)	V	
		LED_PWM	(-0.3 to +27.0)		
Storage temperature		Tst	-30 to +80	°C	-
Operating temperature	Front surface	TopF	-20 to +70	°C	Note2
	Rear surface	TopF	-20 to +70	°C	Note3
Relative humidity Note4		RH	≤ 95	%	Ta ≤ 40°C
			≤ 85	%	40°C < Ta ≤ 50°C
			≤ 55	%	50°C < Ta ≤ 60°C
			≤ 36	%	60°C < Ta ≤ 70°C
			≤ 24	%	70°C < Ta ≤ 80°C
Absolute humidity Note4		AH	≤ 70 Note5	g/m3	Ta= 70°C

Table 4.1 Absolute Maximum Ratings



Note1: HPD, AUX-, AUX+, ML0+, ML0-, ML1+, ML1-

Note2: Measured at LCD panel surface (including self-heat)

Note3: Measured at LCD module's rear shield surface (including self-heat)

Note4: No condensation

Note5: Water amount at Ta= 70°C and RH= 36%

Note6: The absolute maximum rating values of this product are not allowed to be exceeded at any times. A module should be used with any of the absolute maximum ratings exceeded, the characteristics of the module may not be recovered, or in an extreme condition, the module may be permanently destroyed

5. Electrical Characteristics

5.1 DC Characteristics for Panel Driving

(Ta= 25°C)

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Supply Voltage	VCCS	3.0	3.3	3.6	V	Note1
Supply current	I _{VCCS}	-	221	TBD	mA	At VCC= 3.3V Note2
Power Consumption	W _{VCCS}	-	730	TBD	mW	
Inrush Current	Inrush_VCCS	-	-	1.5	A	-
Permissible ripple voltage	VRPC	-	-	100	mVp-p	for VCC Note3
Output Signal Voltage	High Level	V _{OH}	0.8*VCC	-	V	HPD
	Low Level	V _{OL}	-	0.2*VCC	V	

Table 5.1.1 Operating Voltages

Note1: VCCS should be voltage on the LCD module connector, Including ripple.

Note2: Test at White pattern.

Note3: The permissible ripple voltage includes spike noise.

5.2 DC Characteristics for Backlight Driving

(Ta= 25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Power supply voltage	LED_VCCS	11.2	12.0	12.8	V	Note1, Note2 at LED_VCCS = 12.0V Note4
Power supply current	I _{LED_VCCS}	-	820	-	mA	
Power Consumption	W _{LED_VCCS}	-	9.84	-	W	
Inrush Current	Inrush_LED_VCCS	-	-	TBD	A	-
Permissible ripple voltage	VRPD	-	-	200	mVp-p	for LED_VCCS Note2, Note5
Input voltage for BL_PWM, BL_ENABLE signal	VIH	1.6	-	5	V	
	VIL	0	-	0.8	V	
BL_PWM frequency	f _{PWM}	200	-	20k	Hz	Note6
BL_PWM duty ratio	DR _{PWM}	10	-	100	%	Note7, Note8
LED life time	Hr	-	50000	-	Hour	Note 9

Table 5.2.1 LED Backlight Characteristics

Note1: When designing of the power supply, take the measures for the prevention of surge voltage.

Note2: The power supply lines (LED_VCCS and BL_GND) may have ripple voltage during luminance control of LED. There is the possibility that the ripple voltage produces acoustic noise and signal wave noise in audio circuit and so on.

Note3: This value excludes peak current such as overshoot current.

Note4: At the maximum luminance control.

Note5: The permissible ripple voltage includes spike noise.

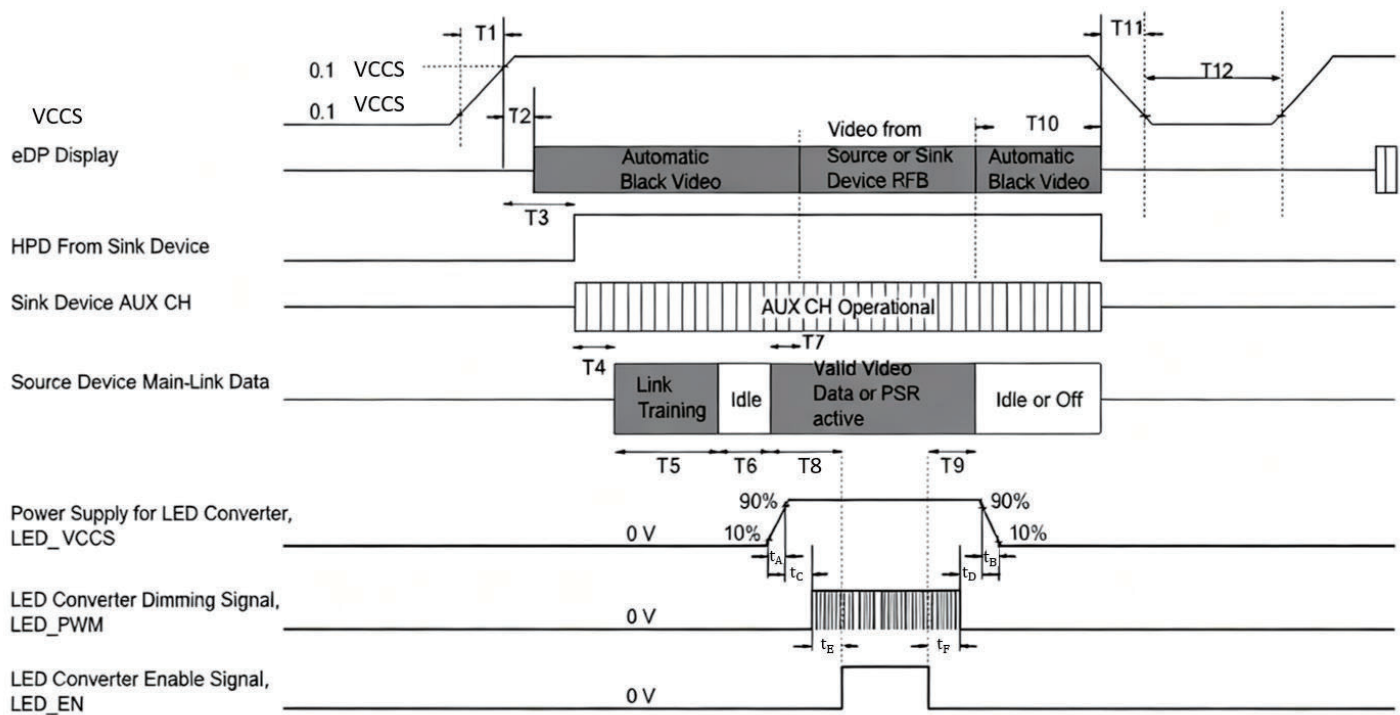
Note6: Depending on the frequency used, some noise may appear on the screen, please conduct a thorough evaluation.

Note7: While the LED_EN signal is high, do not set the tPWH (PWM pulse width) is less than minimum value. It may cause abnormal working of the backlight. In this case, turn the backlight off and then on again by LED_EN signal.

Note8: Regardless of the PWM frequency, both PWM duty ratio and PWM pulse width must be always more than the minimum values.

Note9: Optical performance should be evaluated at Ta=25°C. Only If LED is driven by high current, high ambient temperature & humidity condition. The life time of LED will be reduced. Operating life means brightness goes down to 50% of initial brightness. Typical operating life time is an estimated data.

5.3 Recommended Power ON/OFF Sequence



Timing Parameter	Timing Parameter	Required By	Value		Units	Notes
			Min.	Max.		
T1	Power rail rise time, 10% to 90%	Source	0.5	10	ms	N/A
T2	Delay from VCCS to automatic Black Video generation	Sink	0	200	ms	Automatic Black Video generation prevents display noise until valid video data is received from the Source (see Notes: 1 and 2 below)
T3	Delay from VCCS to HPD high	Sink	0	200	ms	Sink AUX Channel must be operational upon HPD high (see Note: 3 below)
T4	Delay from HPD high to link training initialization	Source	-	-	ms	Allows for Source to read Link capability and initialize
T5	Link training duration	Source	-	-	ms	Dependant on Source link training protocol
T6	Link idle	Source	-	-	ms	Min accounts for required BS-Idle pattern. Max allows for Source frame synchronization.

ProfessionalDisplay Module

T7	Delay from valid video data from Source to video on display	Sink	0	50	ms	Max value allows for Sink to validate video data and timing. At the end of T7, Sink will indicate the detection of valid video data by setting the SINK_STATUS bit to logic 1 (DPCD 00205h, bit 0), and Sink will no longer generate automatic Black Video.
T8	Delay from valid video data from Source to backlight enable	Source	-	-	ms	Source must assure display video is stable
T9	Delay from backlight disable to end of valid video data	Source	-	-	ms	Source must assure backlight is no longer illuminated. At the end of T9, Sink will indicate the detection of no valid video data by setting the SINK_STATUS bit to logic 0 (DPCD 00205h, bit 0), and Sink will automatically display Black Video. (See Notes: 1 and 2 below)
T10	Delay from end of valid video data from Source to power off	Source	0	500	ms	N/A
T11	Power rail fall time, 90% to 10%	Source	-	200	ms	N/A
T12	Power off time	Source	500	-	ms	N/A
t _A	Delay from LED_VCCS rise time, 10% to 90%		0.5	50	ms	
t _B	Delay from LED_VCCS fall time, 90% to 10%		0.5	200	ms	
t _C	Delay from LED_VCCS 90% to LED_PWM on		1		ms	
t _D	Delay from LED_PWM off to LED_VCCS 90%		1	-	ms	
t _E	Delay from LED_PWM on to LED_EN on		10		ms	

t_F	Delay from LED_EN off to LED_PWM off	10	-	ms
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Note1: The sink must include the ability to generate black video autonomously. The sink must automatically enable black video under the following conditions:

- (1) upon VCCS power on (with in T2 max)
- (2) when the "Novideostream_Flag" (VB-ID Bit 3) is received from the source (at the end of T9)
- (3) when no main link data, or invalid video data, is received from the source. Black video must be displayed within 64ms (typ) from the start of either condition. Video data can be deemed invalid based on MSA and timing information, for example.

Note2: The sink may implement the ability to disable the black video function, as described in Note 1, above, for system development and debugging purpose.

Note3: The sink must support AUX_CH polling by the source immediately following VCCS 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_CH transaction with the time specified within T3 max.

5.4 LCD Module Block Diagram

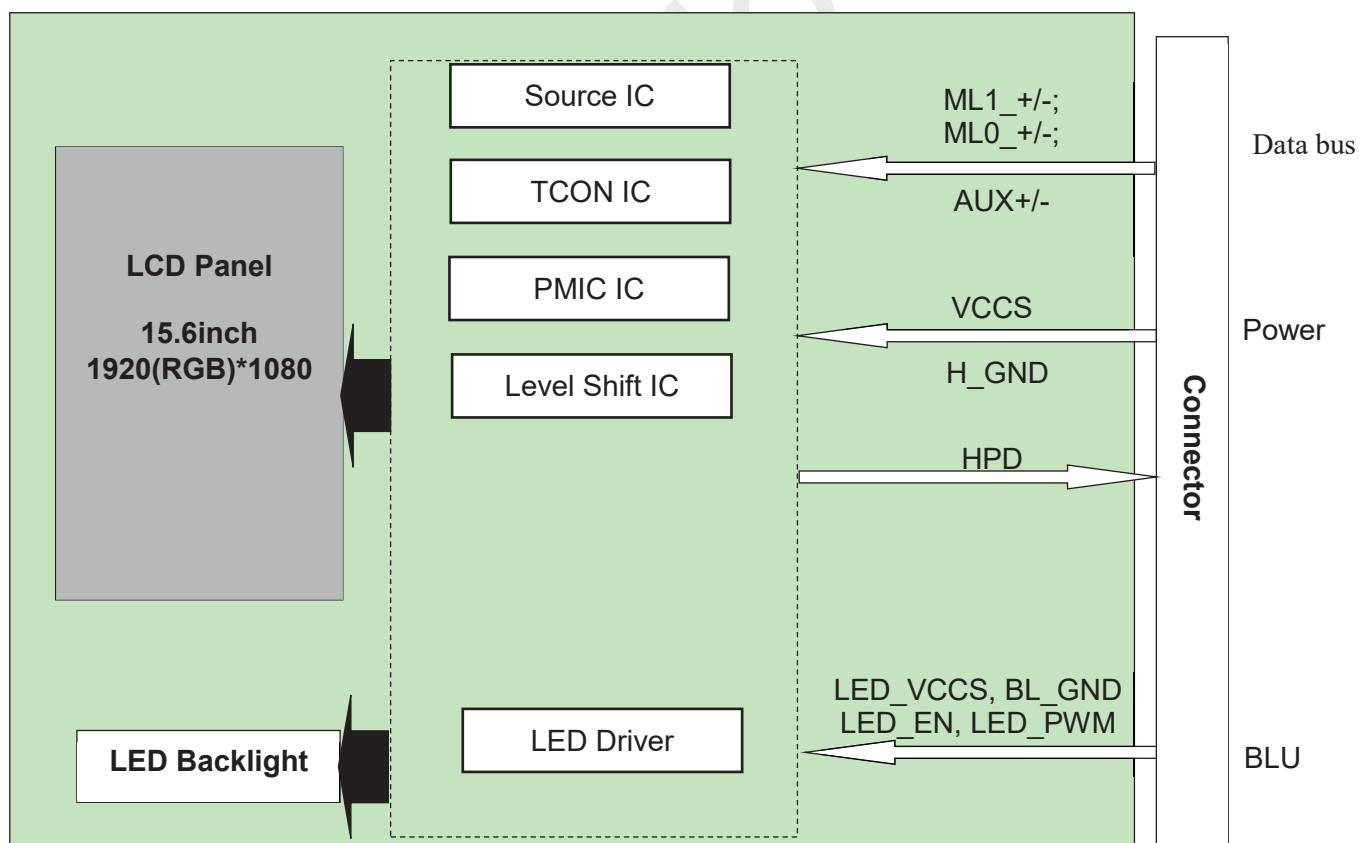


Figure 5.4.1 LCD Module Block Diagram

Note1: H_GND and BL_GND must be connected to customer equipment's ground, and it is recommended that these grounds to be connected together in customer equipment ground.

5.5 Display Positions

The following table is the coordinates per pixel (See following figures)

$C(0, 0)$

R	G	B
---	---	---

$C(0, 0)$	$C(1, 0)$	...	$C(X, 0)$	...	$C(1918, 0)$	$C(1919, 0)$
$C(0, 1)$	$C(1, 1)$	...	$C(X, 1)$	...	$C(1918, 1)$	$C(1919, 1)$
⋮	⋮	⋮	⋮	⋮	⋮	⋮
$C(0, Y)$	$C(1, Y)$	...	$C(X, Y)$	...	$C(1918, Y)$	$C(1919, Y)$
⋮	⋮	⋮	⋮	⋮	⋮	⋮
$C(0, 1078)$	$C(1, 1078)$	...	$C(X, 1078)$	...	$C(1918, 1078)$	$C(1919, 1078)$
$C(0, 1079)$	$C(1, 1079)$	...	$C(X, 1079)$	...	$C(1918, 1079)$	$C(1919, 1079)$

Table 5.5.1 Display Positions

5.6 Input Signal Timings

(Note1)

Parameter		Symbol	min.	typ.	max.	Unit	Remarks
CLK	Frequency	1/tc	142.9	148.5	158.7	MHz	
	Frame	TV-Total	V total line number	1108	1125	1150	Line
		TV-Active	Data duration	-	1080	-	Line
		TV-Blank	V-Blank	28	45	70	Line
	Line	TH-Total	H total pixel number	2150	2200	2300	CLK
		TH-Active	Data duration	-	1920	-	CLK
		TH-Blank	H-Blank	230	280	380	CLK
FR	Frame Rate	FR	60			Hz	

Note1: Definition of parameters is as follows.

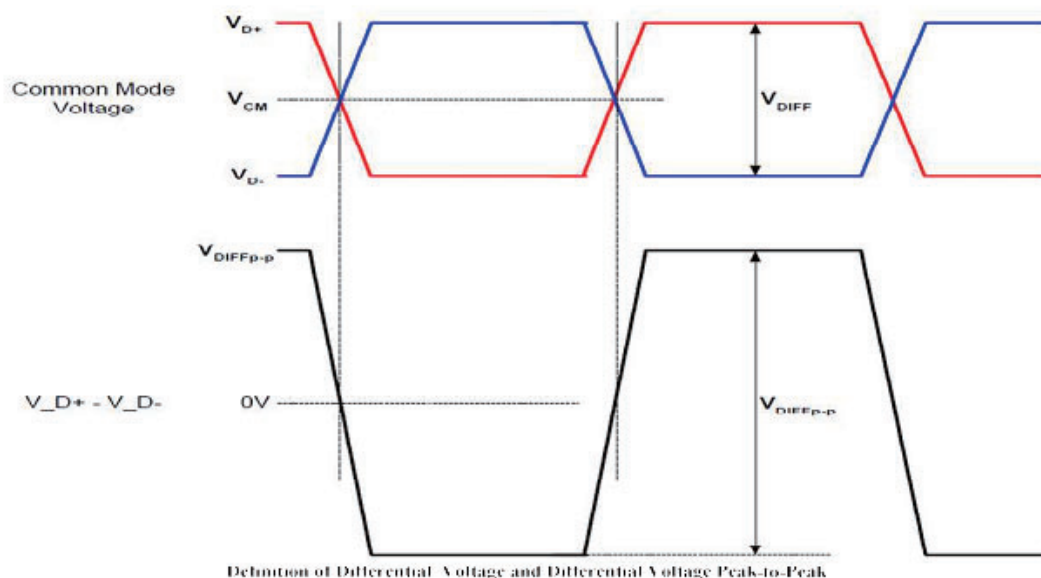
tc= 1CLK, th= 1H

6. eDP Signal Timing Specification

6.1 Display Port Main Link Signal

Main-Link

DC Specification	Min	Typ	Max	Unit
DC common mode voltage	0		2	V
AC Specification	Min	Typ	Max	Unit
Frequency for high bit rate	2.68569	2.7	2.70081	Gbps
Frequency for reduced bit rate	1.611414	1.62	1.620486	Gbps
Spread spectrum clock (down spreading)	0		0.5	%
SSC modulation frequency	30		33	KHz
Differential peak-to-peak input voltage at package pins	100			mV
Differential termination resistance	80		120	ohm
Rx short circuit current limit			50	mA
Rx intra-pair skew tolerance at HBR			60	ps



6.2 Display Port AUX Signal

AUX

AC Specification	Min.	Typ.	Max.	Unit
Unit interval	0.4	-	0.6	Us
AUX differential peak to peak voltage at TX	0.18	-	0.8	V
AUX differential peak to peak voltage at RX	0.14	-	1.36	V
Rx sensitivity	0.1	-	-	V

7. Optical Characteristics

Item		Symbol	Condition	Min	Typ	Max	Unit	Remark
View Angles		θT	CR≧10	80	89		degree	Note2,3
		θB		80	89			
		θL		80	89			
		θR		80	89			
Contrast Ratio		CR	θ=0°	1000	1500			Note 3
Response Time		T _{ON}	25℃		30	40	ms	Note 4
		T _{OFF}						
Chromaticity	White	x	Backlight is on	0.255	0.305	0.355		Note 1,5
		y		0.275	0.325	0.375		
	Red	x		0.605	0.655	0.705		Note 1,5
		y		0.282	0.332	0.382		
	Green	x		0.102	0.152	0.202		Note 1,5
		y		-0.003	0.047	0.097		
	Blue	x		0.261	0.311	0.361		Note 1,5
		y		0.579	0.629	0.679		
Uniformity		U		75	80		%	Note 6
NTSC		-			72		%	Note 5
Luminance		L		400	500		cd/m ²	Note 7

Table 7.1 Optical Parameters

Test Conditions:

1. The ambient temperature is 25℃.
2. The test systems refer to Note1 and Note2.

Note1: Definition of optical measurement system.

The optical characteristics should be measured in dark room. The optical characteristics are measured at the center point of the LCD screen.

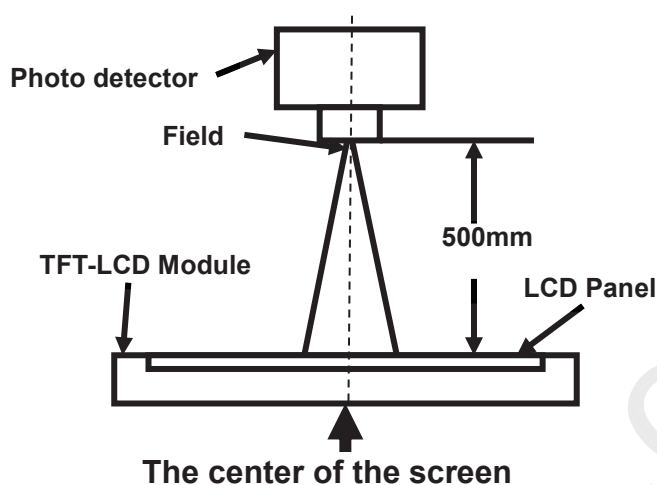


Fig1. Measurement Set Up

Note2: Definition of viewing angle range and measurement system. Viewing angle is measured at the center point of the LCD.

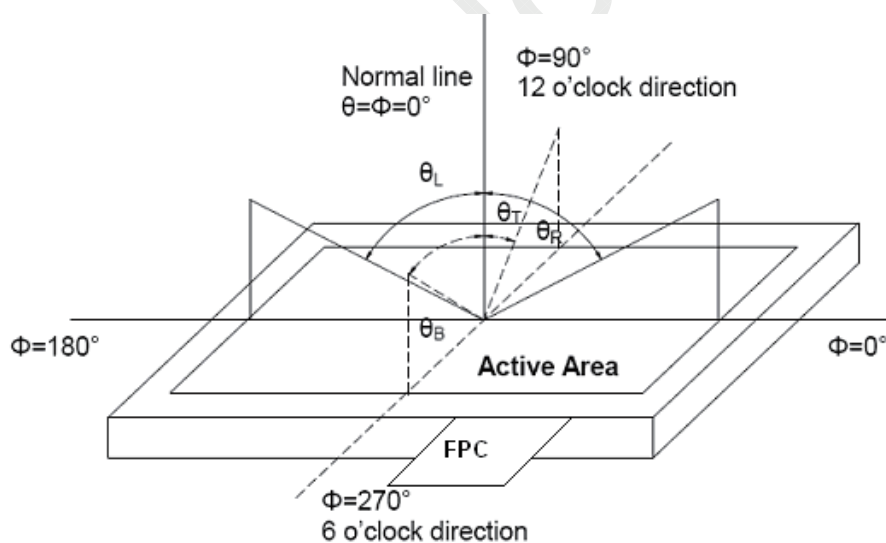


Fig2. Measurement viewing angle

Note3: Definition of contrast ratio

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

Note4: Definition of Response time

For SFT LCM, 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 10% to 90%. And fall time (T_f) is the time between photo detector output intensity changed from 90% to 10%.

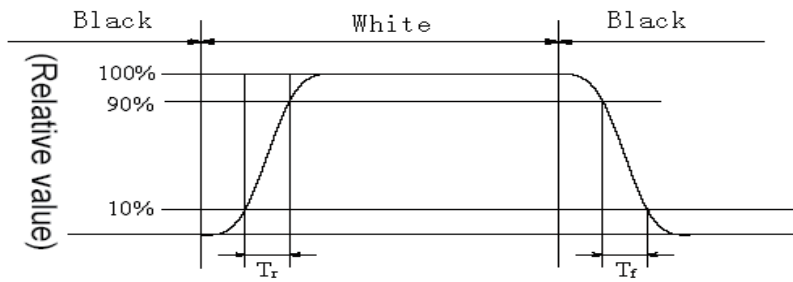


Fig4. Response Time Testing(SFT)

Note5: Definition of color chromaticity (CIE1931)

Color coordinates measured at center point of LCD.

Note6: Definition of Luminance Uniformity

Active area is divided into 9 measuring areas (Refer Fig.5). Every measuring point is placed at the center of each measuring area.

Luminance Uniformity (U) = L_{min} / L_{max}

L_{max} : The measured Maximum luminance of all measurement position.

L_{min} : The measured Minimum luminance of all measurement position.

L-----Active area length; W----- Active area width

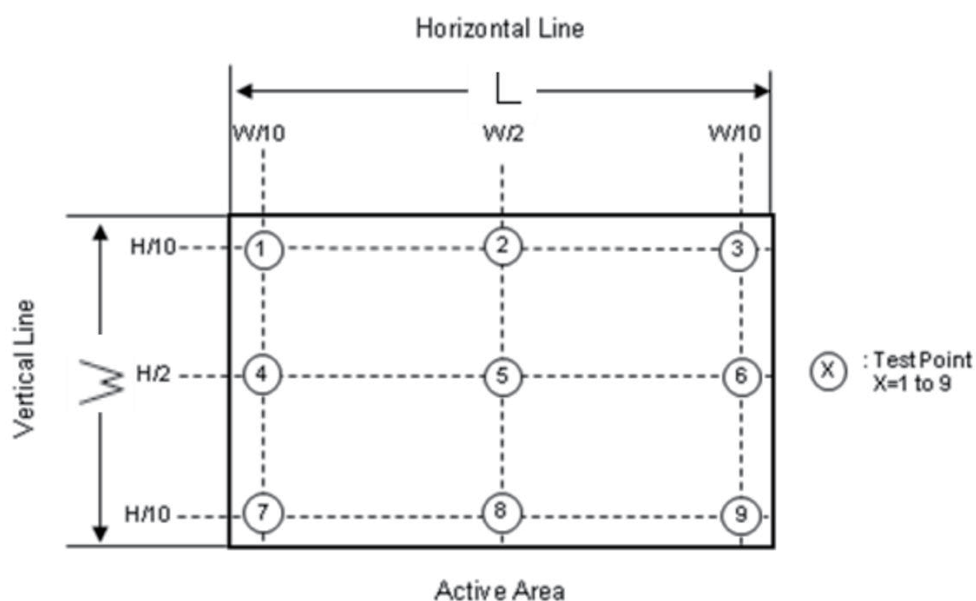


Fig5. Luminance Uniformity Measurement Locations(9 points)

Note7: Definition of Luminance:

Measure the luminance of white state at center point.



8. Reliability Test

No	Test Item	Condition	Remarks
1	High Temperature Operation	+70℃ , 240H	IEC60068-2-1:2007 GB2423.2-2008
2	Low Temperature Operation	-20℃ , 240H	IEC60068-2-1:2007 GB2423.1-2008
3	High Temperature Storage	+80℃ , 240H	IEC60068-2-1:2007 GB2423.2-2008
4	Low Temperature Storage	-30℃ , 240H	IEC60068-2-1:2007 GB2423.1-2008
5	Storage at High Temperature and Humidity(non-operation)	60℃, RH 90%, 240 hours	IEC60068-2-78 :2001 GB/T2423.3—2006
6	Thermal Shock (non-operation)	-30℃~80℃ 30min , 50cycles	Start with cold temperature, End with high temperature, IEC60068-2-14:1984,GB2423.22-2002
7	ESD	C=150pF , R=330Ω , 9point/panel Air : ±15kv , 10times ; Contact : ±8kv , 10times ; (Environment : 15℃~35℃ , 30%~60% , 86Kpa~106Kpa)	IEC61000-4-2:2001 GB/T17626.2-2006
8	Vibration (Non-operation)	1.5G, 10 ~ 300 Hz, 10min/cycle, 3 cycles each X, Y, Z	GB/T 2423.10-2019
9	Shock (Non-operation)	50G, 11ms, half sine wave, 1 time for ± X, ± Y, ± Z.	GB/T 2423.5-2019
10	Package Vibration	5-20-200HZ , PSD : 0.01-0.01-0.001 Total:0.781g ² /HZ,x/y/z 30min)	GB/T 4857.23-2021
11	Package Drop Test	Height: 60cm,1 corner, 3edges, 6 surfaces	IEC60068-2-32:1990 GB/T2423.8—1995

Table 8.1 RA test condition

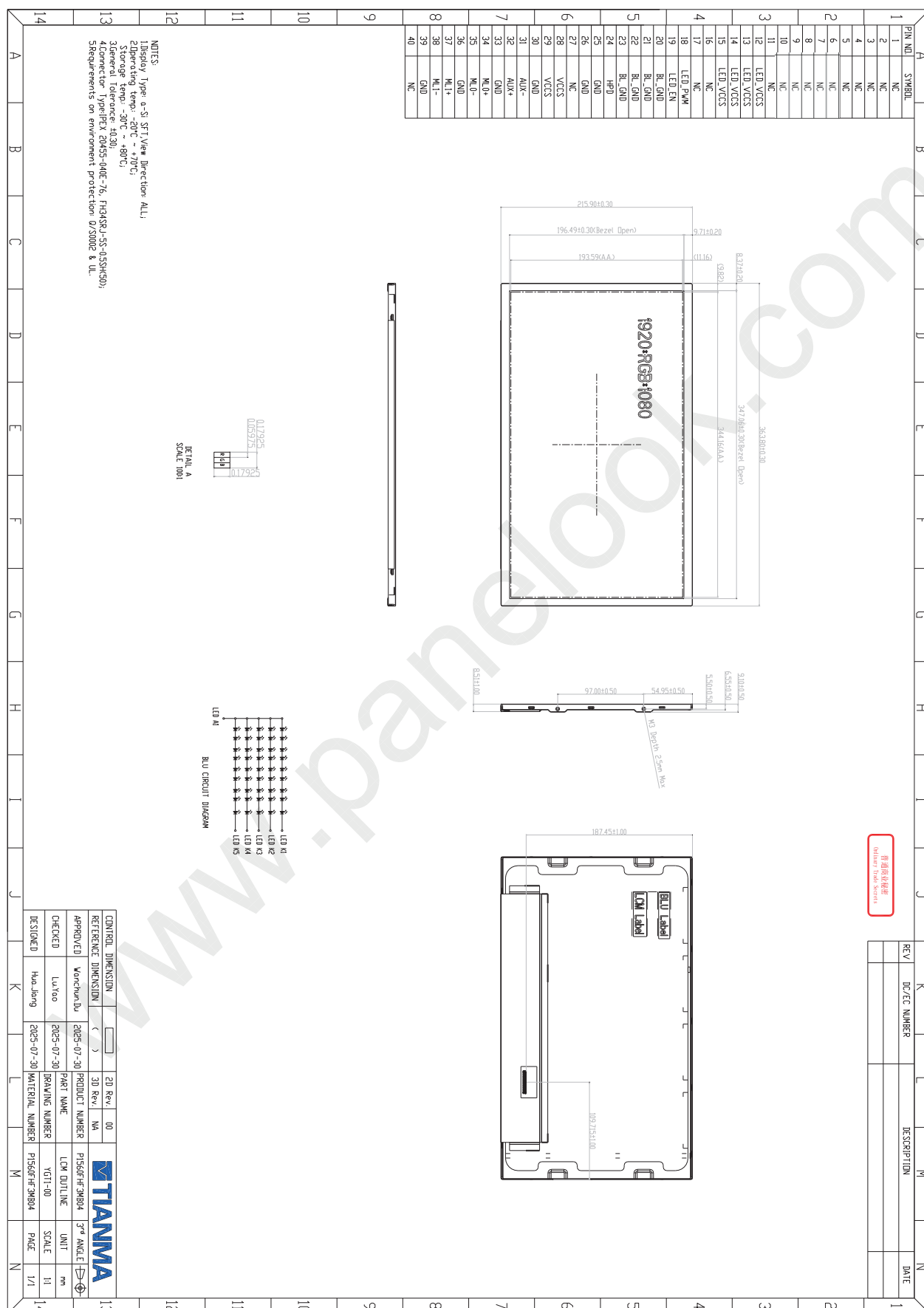
Note1: Temperature is the ambient temperature of sample

Note2: Before cosmetic and function test, the product must have enough recovery time, at least 2 hours at room temperature.

Note3: In the standard condition, there shall be no practical problem that may affect the display function. After the reliability test, the product's function only be guaranteed, but not for all of the cosmetic specification.

9. Mechanical Drawing

9.1 Mechanical Drawing Of LCM



9.2 Markings

The marking is attached to this product.

9.2.1 Nameplate label

Nameplate label



10. Packing Instruction

No	Item	Model (Material)	Dimensions(mm)	Unit Weight(Kg)	Quantity	Material Number
1	LCM module	P1560FHF3MB04	363.8x 215.9 x 9.1	TBD	14	P1560FHF3MB04
2	Label	Paper	100×52	0.001	1	-
3	Total weight	TBD Kg				

14 products are packed as the maximum in an packing box. The type name and quantity are shown on outside of the packing box, either labeling or printing. In case the packing box with products is dropped from a height of 40cm or more, there is a risk of damage to products.

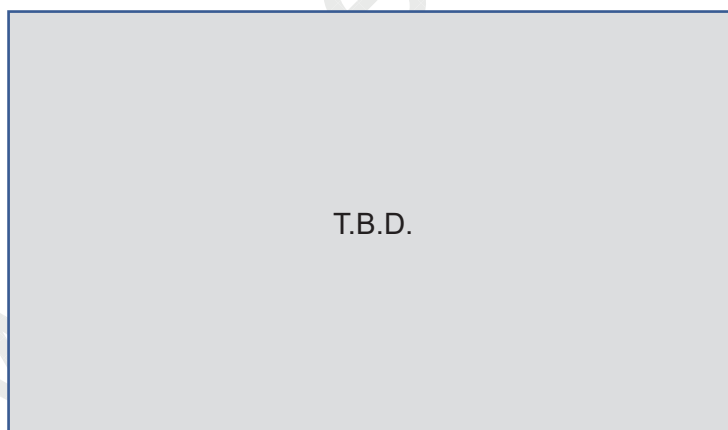


Figure 10.1 Outline Figure for Packing

11. Precautions for Use of LCD Modules

11.1 Handling Precautions

- (1) The display panel is made of glass. Do not subject it to mechanical shock by dropping it, etc.
- (2) If the display panel is damaged and the liquid crystal fluid inside it leaks out be sure not to get any in your mouth. If the fluid comes into contact with your skin or clothes promptly wash it off using soap and water.
- (3) Do not apply excessive force to the display surface or the bezel since this may cause the color tone to vary.
- (4) The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle the polarizer carefully.
- (5) If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is still not completely clear use a moist cloth with one of the following solvents:

- Isopropyl alcohol
- Ethyl alcohol

Solvents other than those mentioned above may damage the polarizer. Specifically, do not use the following:

- Water
- Ketone
- Aromatic solvents

- (6) Do not disassemble the LCD Module.
- (7) If powered off, do not apply the input signals.
- (8) To prevent destruction of the module by static electricity, be careful to maintain an optimum work environment.
- (9) Be sure to ground your body when handling the LCD Modules.
- (10) Tools used for assembly, must be properly grounded.
- (11) To reduce the amount of static electricity generated, do not conduct assembly or other work under very low humidity conditions.
- (12) The LCD Module is covered with a film to protect the display surface, remove film slowly under the ionizer.

11.2 Storage precautions

- (1) When storing the LCD modules avoid exposure to direct sunlight or to the light of fluorescent lamps.
- (2) The LCD modules should be stored within the rated storage temperature range. The recommend condition is: Temperature: 0 ~ 35 °C at normal humidity.
- (3) The LCD modules should be stored in a room without acid, alkali or other harmful gas.

11.3 Transportation Precautions

The LCD modules should not be dropped or subject to violent mechanical shock during transportation. Also they should avoid excessive pressure, water, high humidity and direct sunlight.

11.4 Screen saver Precautions

Not display the fixed pattern for a long time. Use a screen saver, if the fixed pattern is displayed on the screen

11.5 Safety Precautions

- (1) When you waste damaged or unnecessary LCDs, it is recommended to crush LCDs into pieces and wash them off with solvents such as acetone and ethanol, which should later be burned
- (2) Be sure to turn off the power supply when inserting or disconnecting the LED backlight cable.



- (3) LED driver should be designed to limit or stop its function when over current is detected on the LED.

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