SPECIFICATION FOR
TFT LCD MODULE

MODEL NO: DMH156CS01-1A

Accepted by: （接受部门）	
Signature（签字）	Date（日期）
Proposed by: Technical Service Division（技术服务部）	
Signature（签字）	Date（日期）

DATE	NO.	REVISED No.	PAGE	SUMMARY	NOTE
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Contents

1.GENERAL DESCRIPTION

1.1 General Description

The specification is applied to 15.6” model (DMH156CS01-1A) TFT Liquid Crystal Display. The Product Type is Open Cell and the LED driver for back-light driving is built in this model. The matrix uses a-Si Thin Film Trans istor as a switching device. This TFT LCD has a 15.6 inch diagonally measured active display area with FHD reso lution (1,920 horizontal by 1080 vertical pixels array). Each pixel is divided into RED, GREEN, BLUE dots which are arranged in vertical stripe and this Open Cell can display 16.7M(6bit+Hi FRC) colors and color gamut 45%. Th e TFT-LCD panel used for this Open Cell is a low reflection and higher color type. Therefore, this Open Cell is suitable for POS.

All input signals are eDP1.2 interface compatible.

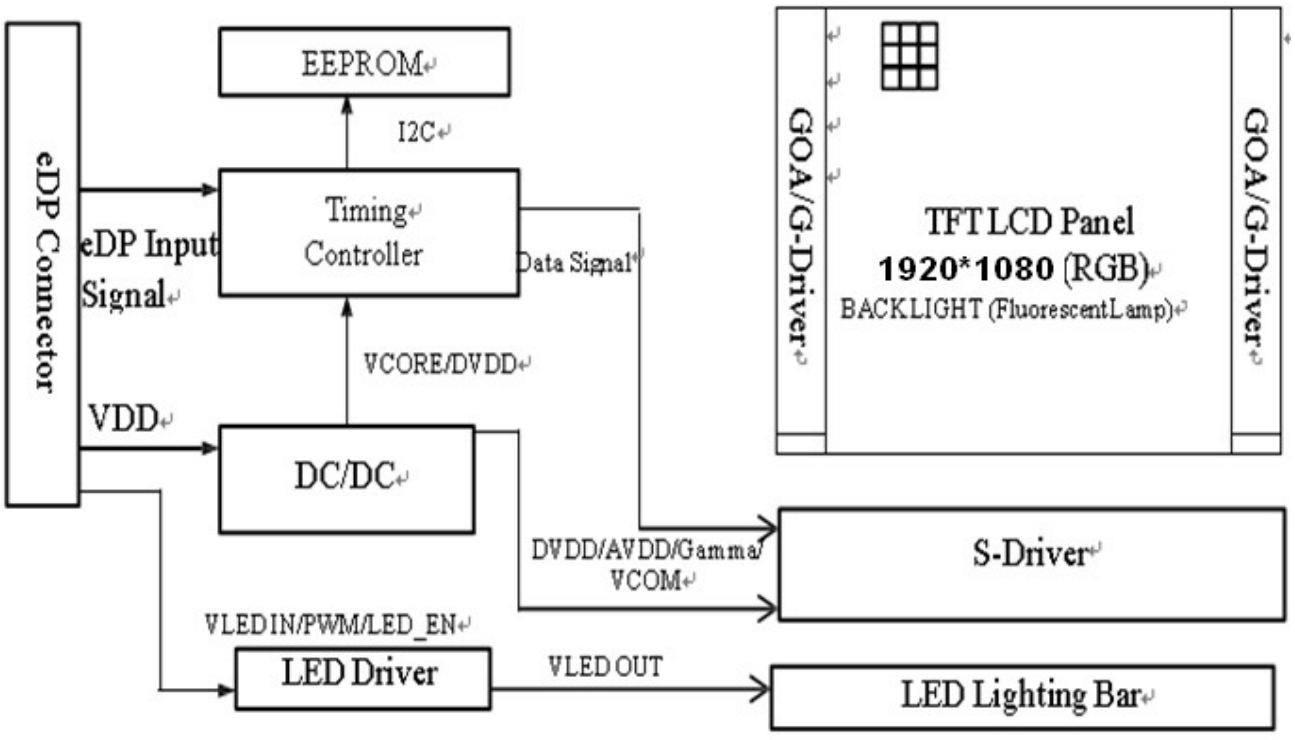


Figure 1. Drive Architecture

1.2 Features

（1）2 lane eDP interface with 2.7 Gbps link rates

（2）16.7M(6bit+Hi FRC) color depth, color gamut 45%

（3）Green product (RoHS & Halogen free product

（4）On board LED driving circuit

（5）Low driving voltage and low power consumption

（6） Adjust backlight brightness with PWM mode

1.3 General Specifications

The followings are general specifications at the model DMH156CS01-1A. (listed in Table 1)

<Table 1. General Specifications>

Item	Specification	Unit	Note
Active area	344.16(H) × 193.59(V)	mm	-
Number of pixels	1920(H) × 1080(V)	pixels	-
Pixel pitch	0.17925(H) × 0.17925(V)	mm	-
Pixel arrangement	RGB Vertical stripe	-	-
Display colors	16.7M	-	-
Color gamut	45%@CIE1931	-	-
Display mode	Normally black	-	-
Dimensional outline	350.72*214.13*(V)*2.8	mm	-
Weight	TBD	g	-
Surface treatment	Anti-Glare	-	-
Surface hardness	3H	-	-
Power consumption	3.75(Max.)	W	@Mosaic
	-	W	-
	-	W	@Mosaic

2. ABSOLUTE MAXIMUM RATINGS

2.1 Absolute Maximum Ratings

The followings are maximum values which, if exceed, may cause faulty operation or damage to the unit.

The operational and non-operational maximum voltage and current values are listed in Table 2.

<Table 2. Absolute Maximum Ratings>

Ta=25+/-2°C

Parameter	Symbol	Min.	Max.	Unit	Remarks
Power Supply Voltage	Vcc	-0.3	4	V	Note 1
Logic Supply Voltage	Vsignal	-0.3	Vcc	V	
Operating Temperature	TOP	0	50	℃	Note 2
Storage Temperature	TST	-20	60	℃	

Notes :

（1）Permanent damage to the device may occur if maximum values are exceeded functional operation should be restricted to the condition described under normal operating conditions.

（2）Temperature and relative humidity range are shown in the figure below.

90% RH Max. (Ta ≤ 40ºC), Maximum wet-bulb temperature at 39ºC or less. (Ta > 40ºC) No condensation.

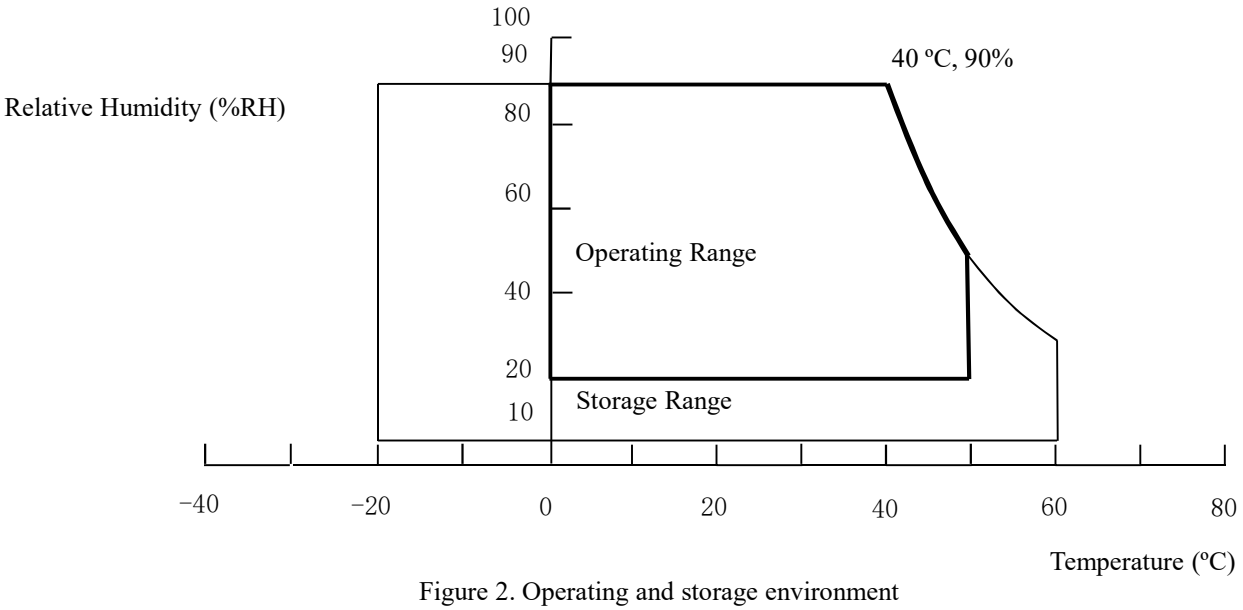


Figure 2. Operating and storage environment

3. ELECTRICAL SPECIFICATION

3.1 Electrical Characteristics

<Table 3. Electrical Specifications>

Ta=25+/-2℃

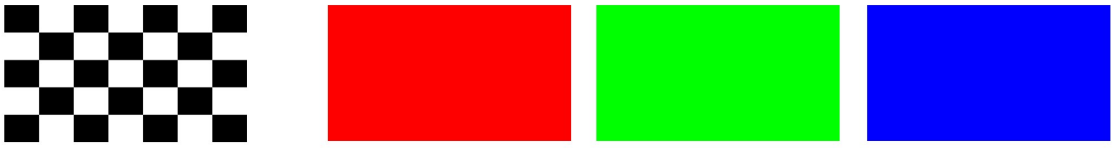
Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Power Supply Voltage	VDD	3.0	3.3	3.6	V	Note 4
Permissible Input Ripple Voltage	VRF	-	-	200	mV	-
BIST Control Level	High Level	3.0	-	3.6	V	-
BIST Control Level	Low Level	-	-	0.4	V	-
Power Supply Current	IDD			250	mA	Note 1
Power Supply Inrush Current	Inrush			1.5	A	Note 3
Power Consumption	PD			0.75	W	Note 1
Power Consumption	PBL			-	W	Note 2
Power Consumption	Ptotal			-	W	Note 1

Notes :

（1）The supply voltage is measured and specified at the interface connector of LCM. The current draw and power consumption specified is for 3.3V at 25 ° C.

a) Mosaic pattern

b) R/G/B patterns



(a) (b)

Figure 3. Power Measure Patterns

（2）Calculated value for reference (VLED × ILED)

（3）Measure condition (Figure 4)

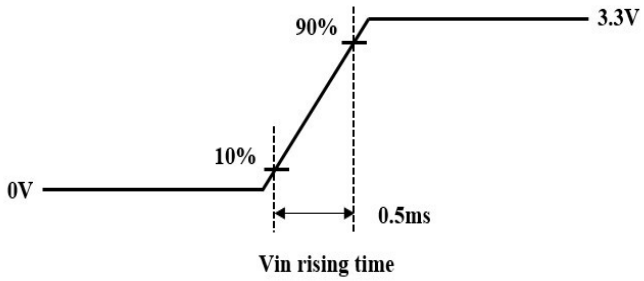


Figure 4. Inrush Measure Condition

（4）Input voltage range:3.0~3.6V. Test condition: Oscilloscope bandwidth 20MHz, AC coupling

3.2 Backlight Unit

<Table 4. LED Driving Guideline Specifications>

Ta=25+/-2°C

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
LED Forward Voltage	VF	2.8	-	3.3	V	
LED Forward Current	IF	-	19.87	-	mA	
LED Power Input Voltage	VLED	12	-	21	V	
LED Power Input Current	ILED		-		mA	Note 1
LED Power Consumption	PLED		-		W	
Power Supply Voltage for LED Driver Inrush	Iled inrush		-		A	Note 3
LED Life-Time	N/A		-		hour	Note 2
EN Control Level(B/L On)	VBL_EN	3.0		3.6	V	
EN Control Level(B/L Off)	VBL_EN			0.4	V	
PWM Control Level(High Level)	VBL_PWM	3.0		3.6	V	
PWM Control Level(Low Level)	VBL_PWM			0.4	V	
PWM Control Frequency	FPWM	200		2K	Hz	
Duty Ratio		5		100	%	

Notes :

（1）Power supply voltage12V for LED driver.

（2）The LED life-time define as the estimated time to 50% degradation of initial luminous.

（3）Measure condition (Figure 5)

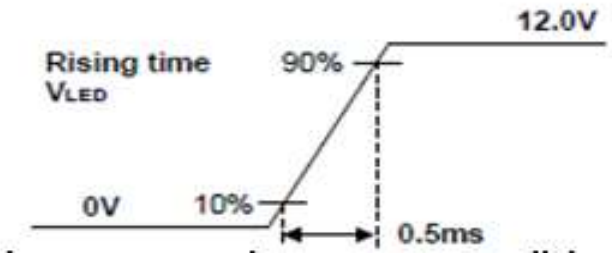


Figure 5. Inrush Measure Condition

3.3 LED Structure

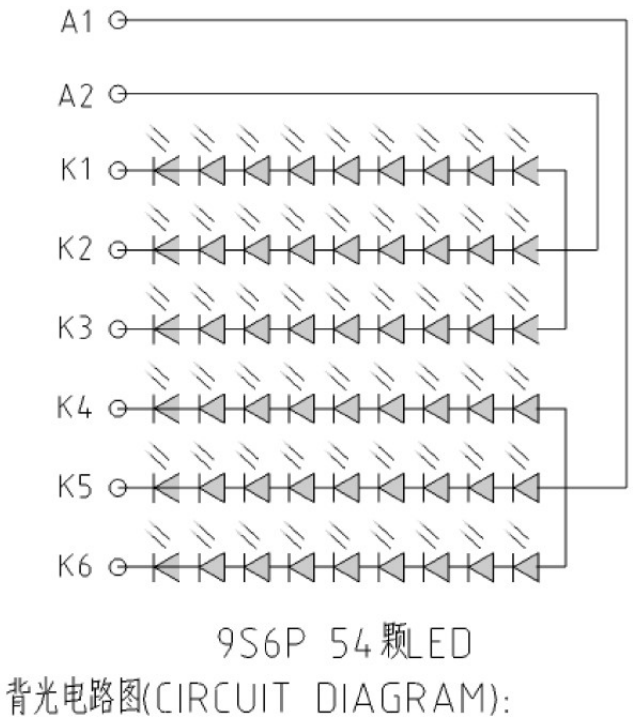


Figure 6. LED Structure

4. OPTICAL SPECIFICATION

4.1 Measurement Conditions

The table below is the test condition of optical measurement.

<Table 5. Optical Measurement >

Item	Symbol	Value	Unit
Ambient Temperature	T_A	23±5	ºC
Ambient Humidity	H_A	50±20	% RH
Supply Voltage	V_{CC}	3.3	V
Driving Signal	Refer to the typical value in Chapter 3: Electrical Specification		
Vertical Refresh Rate	F_v	60	Hz
Warm up time	Twarm	>15 min	min
Dark room	ED	£ 1 lux	lux

4.2 Optical Specifications

<Table 6. Optical Specifications>

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Color Chromaticity (CIE1931) Under C-light	Red	Rx	θ_x=0°,θ_y=0°	Typ. -0.03	（0.613）	Typ. + 0.03	-	(1)
		Ry			（0.345）			
	Green	Gx			（0.299）			
		Gy			（0.558）			
	Blue	Bx			（0.143）			
		By			（0.204）			
	White	Wx			（0.310）			
		Wy			（0.371）			
Color Gamut（under C-light）		CG		-	45	-	%	
Brightness				-	250	-	cd/m2	
Contrast Ratio		CR	θ_x=0°,θ_y=0°	600:1	800:1(AG)	-	-	(4)
Response Time		T_g		-	20	25	ms	(5)
Viewing Angle	Horizontal	θ_x+	CR≧10 θ_x=0°,θ_y=0°	-	85	-	Deg.	(6)
		θ_x-		-	85	-		
	Vertical	θ_y+		-	85	-		
		θ_y-		-	85	-		

Notes :

(1) The chromaticity coordinates specified in Table the center of the panel. 5 should be calculated from the measurement s pectrum of all pixels in red, green, blue, and white, which need to be converted to C-light standard light source, and should be measured in

(2) Center Luminance of white is defined as luminance values of 5 point average across the LCD surface. Luminance shall be measured with all pixels in the view field set first to white. This measurement shall be taken at the locations shown in Figur e 10 for a total of the measurements per display.

(3) The White luminance uniformity on LCD surface is then expressed as : ΔY =Minimum Luminance of 13 points / Maxi mum Luminance of 13 points.(see Figure 11).

(4) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression,

Contrast Ratio (CR): $\boldsymbol{CR = \frac{CR_W}{CR_D}}$

CR_W : Luminance of LCD module with full screen white pattern (255,255, 255) at center point.

CR_D : Luminance of LCD module with full screen Dark pattern (0, 0, 0) at center point.

Where the measure point of to the Contrast Ratio is the center of the panel.

(5) Definition of Response time (Tg):

Average switching time of luminance ratios among 10% and 90% to each other and is optimized on frame rate =60Hz.

Measured Response time		**To**	
		10%	90%
From	10%		$T_{10\%to90\%}$
	90%	$T_{90\% \text{ to } 10\%}$	

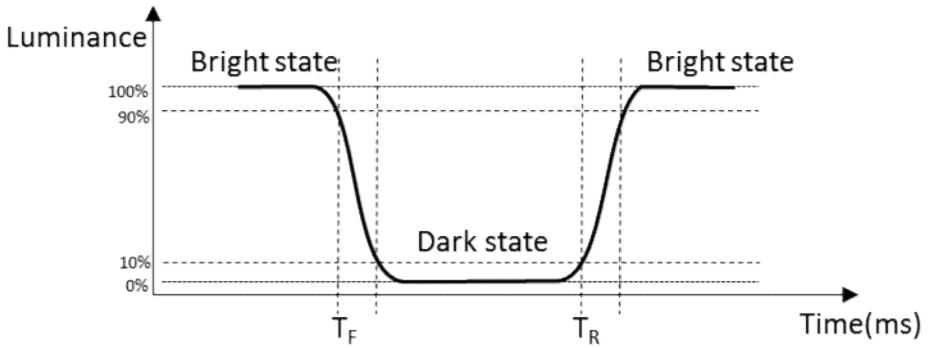


Figure 7. The definition of TR and TF

Measured response time is determined by 10% to 90% brightness difference of rising (T_R) or falling (T_F) time.

(6) Definition of Viewing angle:

As Note (4) the static contrast ratio definition, the viewing angles are defined at the angle that the contrast ratio is larger than 10 at four directions relative to the perpendicular direction of the HKC's module (two vertical angles: up θ_y+ and down θ_y-; and two horizontal angles: right θ_x+ and left θ_x-). The standard setup of measurement is shown in Figure 8 & 9.

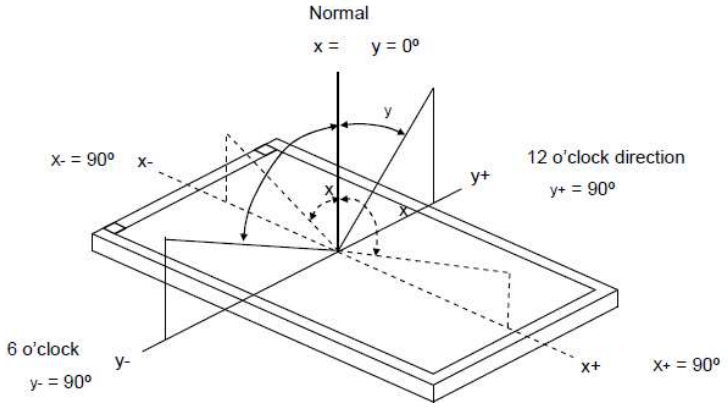


Figure 8. Definition of Viewing angle

4.3 Optical Measurements

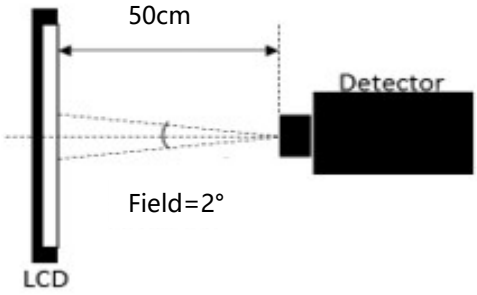


Figure 9. Measurement equipment

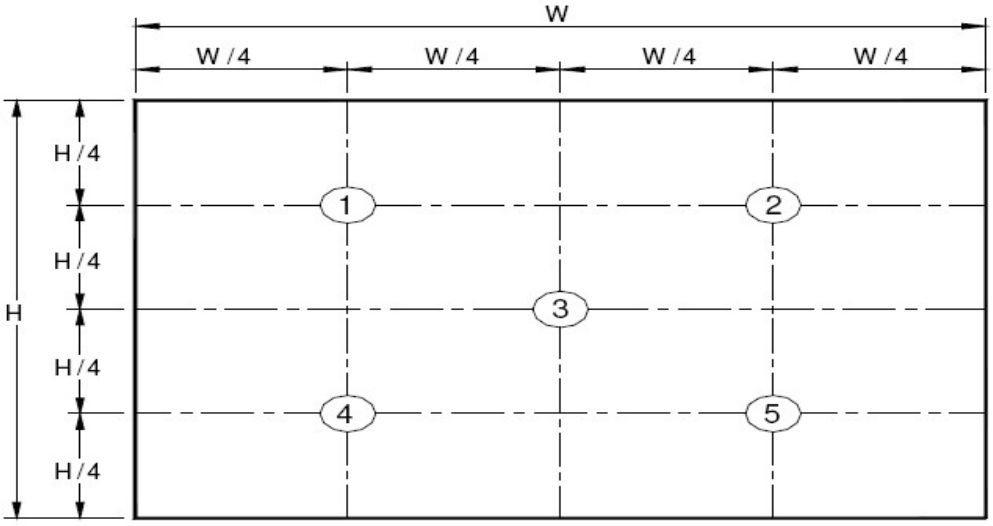


Figure 10. White Luminance Measurement Locations (5 points)

Center Luminance of white is defined as luminance values of 5 point average across the LCD surface. Luminance shall be measured with all pixels in the view field set first to white. This measurement shall be taken at the locations shown in Figure 10 for a total of the measurements per display.

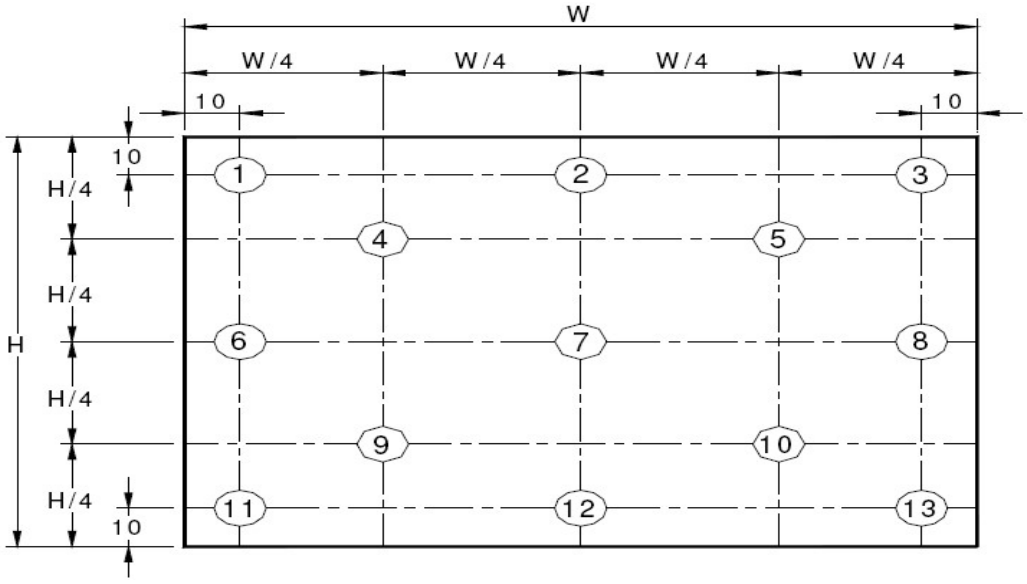


Figure 11. Uniformity Measurement Locations (13 points)

The White luminance uniformity on LCD surface is then expressed as : ΔY13 = Minimum Luminance of 13 points /Maximum Luminance of 13 points (see Figure 11).

5. INTERFACE CONNECTION

5.1 Electrical Interface Connection

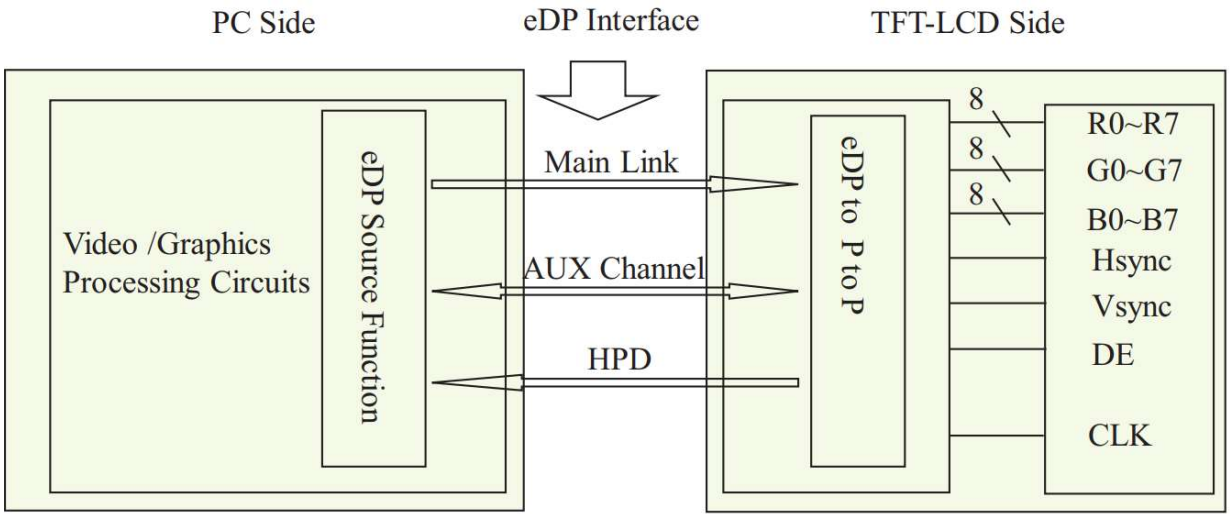
The electronics interface connector is IPEX 20455-030E-66 or Compatible.

The connector interface pin assignments are listed in Table 6.

<Table 8. Pin Assignments for the Interface Connector>

Terminal	Symbol	Functions
Pin No.	Symbol	Description
1	NC	No Connection
2	H_GND	Ground
3	LANE1_N	eDP RX Channel 1 Negative
4	LANE1_P	eDP RX Channel 1 Positive
5	H_GND	Ground
6	LANE0_N	eDP RX Channel 0 Negative
7	LANE0_P	eDP RX Channel 0 Positive
8	H_GND	Ground
9	AUX_CH_P	eDP AUX CH Positive
10	AUX_CH_N	eDP AUX CH Negative
11	H_GND	Ground
12	LCD_VCC	Power Supply, 3.3V (typ.)
13	LCD_VCC	Power Supply, 3.3V (typ.)
14	BIST	Panel Self Test Enable
15	H_GND	Ground
16	H_GND	Ground
17	HPD	Hot Plug Detect Output
18	BL_GND	LED Ground
19	BL_GND	LED Ground
20	BL_GND	LED Ground
21	BL_GND	LED Ground
22	BL_ENABLE	LED Enable Pin
23	BL_PWM	System PWM Signal Input
24	NC	No Connection
25	NC	No Connection
26	BL_POWER	LED Power Supply 12V-21V
27	BL_POWER	LED Power Supply 12V-21V
28	BL_POWER	LED Power Supply12V-21V
29	BL_POWER	LED Power Supply12V-21V
30	NC	No Connection

5.2 eDP Interface



Note:
Transmitter : Parade DP501 or equivalent.
Transmitter is not contained in module.

Figure 12. eDP Interface Architecture

5.3 Data Input Format

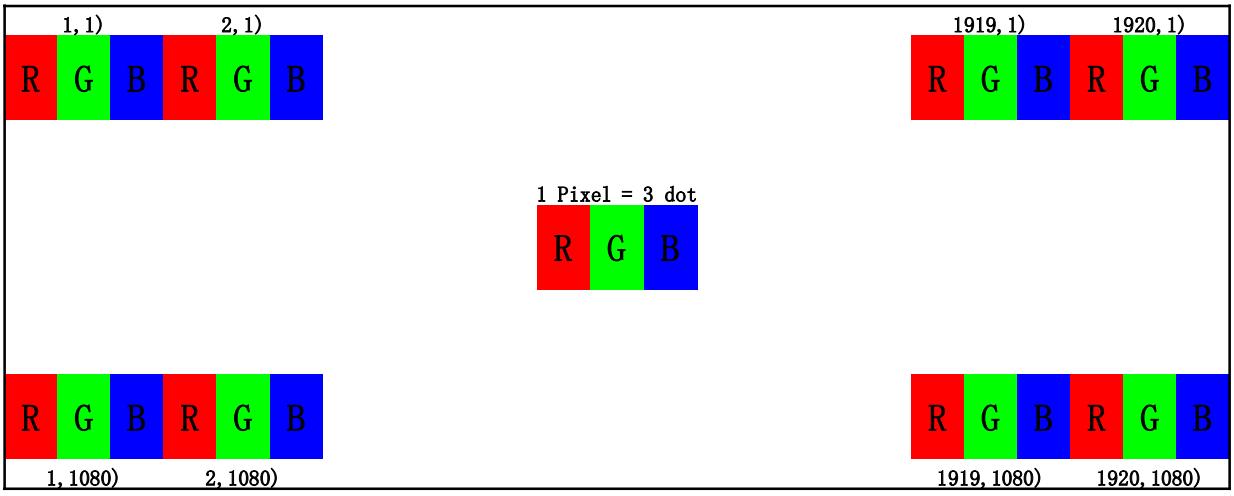


Figure 13. Display Position of Input Data(V-H)

5.4 Back-light & LCM Interface Connection

BLU Interface Connector STM MSAK24037P9S or Compatible.

<Table 9. Pin Assignments for the BLU Connector>

Pin No.	Symbol	Description	Pin No.	Symbol	Description
1	LED	LED cathode connection	6	LED	LED cathode connection
2	LED	LED cathode connection	7	NC	No Connection
3	LED	LED cathode connection	8	Vout	LED anode connection
4	LED	LED cathode connection	9	Vout	LED anode connection
5	LED	LED cathode connection			

6. SIGNAL TIMING SPECIFICATION

6.1 Signal Timing Specification

<Table 10. Signal Timing Specification>

Item		Symbols	Min	Typ	Max	Unit
Clock	Frequency	1/Tc	139.85	152.57	165.27	MHz
Frame Period		Tv	-	1160	-	lines
			55	60	65	Hz
			-	16.67	-	ms
Vertical Display Period		Tvd	-	1080	-	lines
One line Scanning Period		Th	-	2192	-	clocks
Horizontal Display Period		Thd	-	1920	-	clocks

6.2 eDP Rx Interface Timing Parameter

The specification of the eDP Rx interface timing parameter is shown in Table 11.

<Table 11. eDP Main-Link RX TP4 Package Pin Parameters>

Item	Symbol	Min	Typ.	Max	Unit	Remark
Spread spectrum clock (Link clock down-spreading)	ssc	0	-	0.5	%	
Differential peak-to-peak input voltage at package pins	VRX-DIFFp-p	100	-	1320	mv	
Rx input DC common mode voltage	VRX_DC_CM	0	-	2	V	
Differential termination resistance	RRX-DIFF	80	-	120	Ω	
Single-ended termination resistance	RRX-SE	40	-	60	Ω	
Rx short circuit current limit	IRX_SHORT	-	-	50	mA	
Intra-pair skew at Rx package pins (HBR) RX intra-pair skew tolerance at HBR	LRX_SKEW_ INTRA_PAIR	-	-	60	ps	

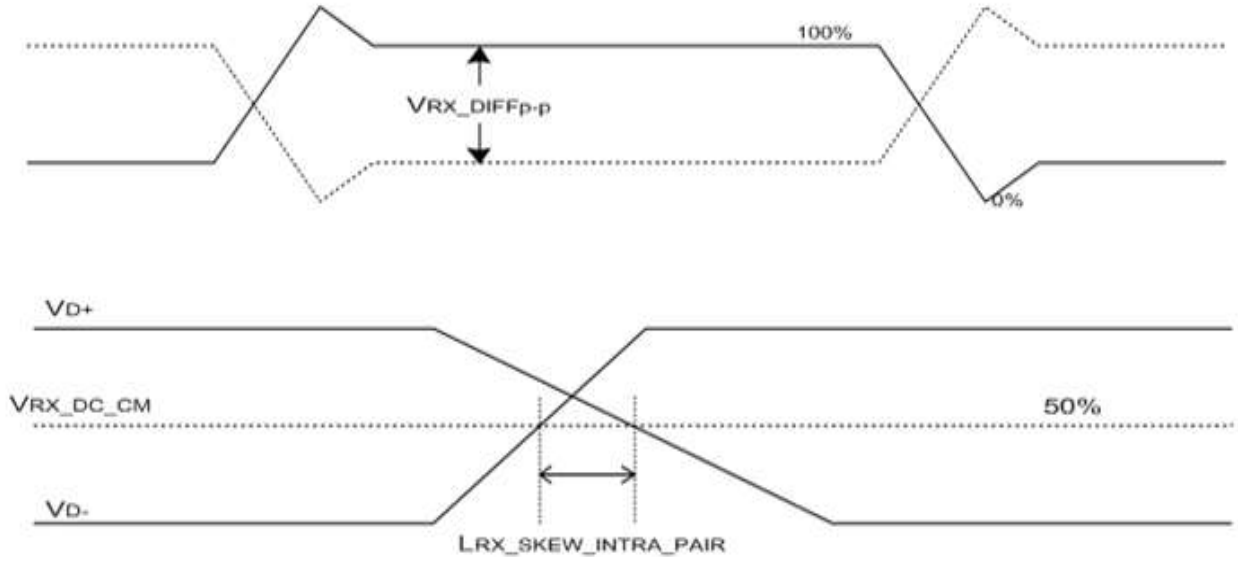


Figure 14. VRX-DIFFP-P & LRX_SKEW_INTRA_PAIR

7. POWER SEQUENCE

To prevent a latch-up or DC operation of the LCD module, the power on/off sequence shall be as shown in below.

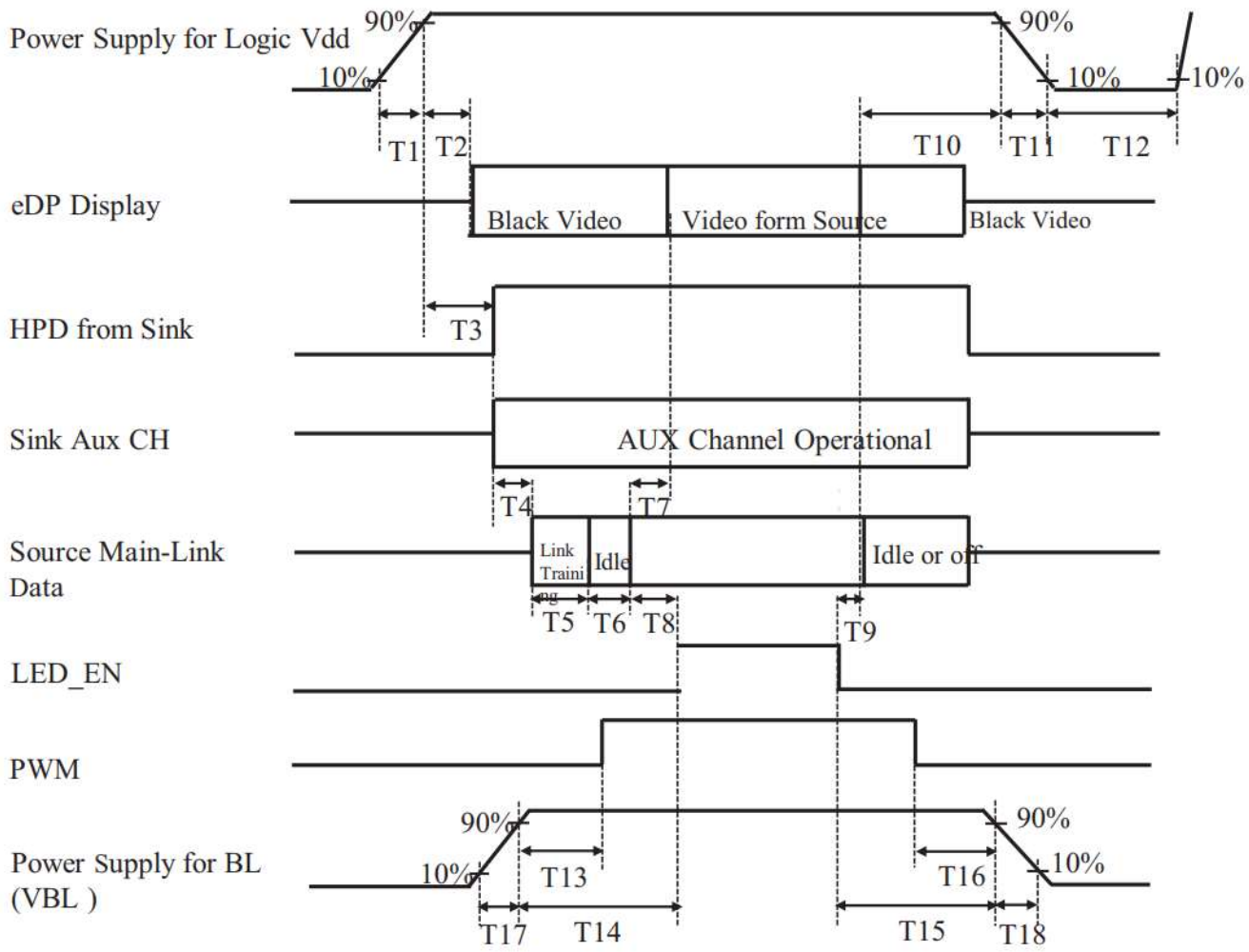


Figure 15. Power Sequence

- 0.5ms ≤ T1 ≤ 10 ms
- 0ms < T2 ≤ 200 ms
- 0ms < T3 ≤ 200 ms
- T3+T4+T5+T6+T8>200ms
- 0ms < T7 ≤ 50ms
- 80ms < T8
- 0ms < T9
- 0ms < T10 < 500 ms
- 0.5ms ≤ T11 ≤ 10 ms
- 500ms ≤ T12
- 0ms < T13
- 0ms < T14
- 0ms < T15
- 0ms < T16
- 0.5ms < T17
- 0.5ms < T18

Notes :

(1) When the power supply VDD is 0V, keep the level of input signals on the low or keep high impedance.

(2) Do not keep the interface signal high impedance when power is on. Back Light must be turn on after power for logic and in terface signal are valid.

8. CONNECTOR DESCRIPTION

Physical interface is described as for the connector on LCM.

These connectors are capable of accommodating the following signals and will be following components

8.1 TFT LCD Module

<Table 12. Signal Connector>

Connector Name /Description	For Signal Connector
Manufacturer	IPEX
Type/ Part Number	20455-030E-66

9. MECHANICAL CHARACTERISTICS

9.1 Dimensional Requirements

<Table 13. Dimensional Parameters>

Parameter	Specification	Unit
Active Area	344.16(H) × 193.59 (V)	mm
Number of pixels	1920(H) x 1080(V)	pixels
Pixel pitch	0.17925(H) x 0.17925(V)	mm
Pixel arrangement	RGB Vertical stripe	-
Display colors	16.7M	-
Display mode	Normally black	-
Dimensional outline		mm
Weight		g

10. RELIABILITY TEST

The reliability test items and its conditions are shown in below.

<Table 14. Reliability Test>

No	Test Items	Conditions
1	High temperature storage test	60℃, 240hrs
2	Low temperature storage test	-20℃, 240hrs
3	High temperature & high humidity operation test	50℃, 80%RH, 240hr
4	High temperature operation test	50℃, 240hrs
5	Low temperature operation test	0℃ , 240hrs
6	Thermal shock	-20~60℃, per 30min, 100 cycle, Storage
7	High temperature & high humidity storage test	THS(8585): 85℃/85%RH, 240hrs
8	Packing Vibration	1.05Grms, 5~200Hz, Random +Z, 2hrs
9	Drop Test	Free fall or one-sided stationary fall

13.HANDLING & STORAGE

13.1 HANDLING

(1) When the module is assembled, It should be attached to the system firmly using every mounting holes. Be careful not to twist or bend the modules.

(2) Refrain from strong mechanical shock or any force to the module. Otherwise, it may cause improper operation or damage to the module.

(3) Note that polarizers are very fragile and could be easily damaged. Do not press or scratch the surface harder than 1 HB pencil lead.

(4) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, Staining and disc oloration may occur.

(5) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.

(6) The desirable cleaners are water, IPA (Isopropyl Alcohol) or Hexane. Do not use Ketone type material s(ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanently damage to the polarizer due to chemical reaction.

(7) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth .In c ase of contact with hands, legs or clothes, it must be washed away thoroughly with soap.

(8) Protect the module from static , it may cause damage to the module.

(9) Use fingerstalls with soft gloves to keep display clean during the incoming inspection and assembly p rocess.

(10) Do not disassemble the module.

(11) Do not pull or fold the LED FPC.

(12) Do not touch any component which is located on the back side.

(13) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electr ostatic charge can be minimized.

(14) Pins of connector shall not be touched directly with bare hands.

13.2 STORAGE

(1) Do not leave the module in high temperature, and high humidity for a long time. It is highly recommended to store the module with temperature from 0 to 35℃ and relative humidity of less than 70%.

(2) Do not store the TFT-LCD module in direct sunlight.

(3) The module shall be stored in a dark place. It is prohibited to apply sunlight or fluorescent light during the store.

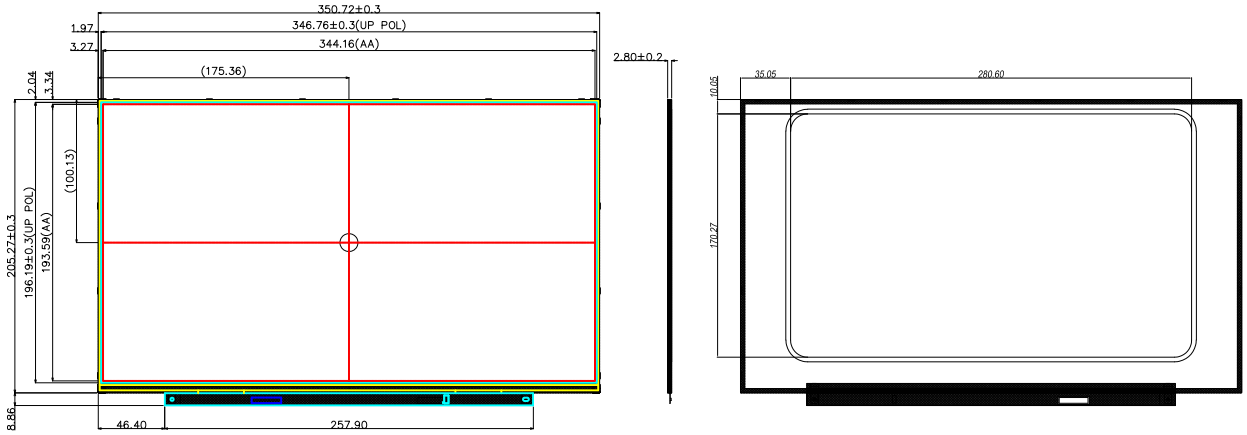
TOLERANCE GRADE (±)	DIMENSION RANGE 尺寸范围					
	0 ≤ 5	5 ≤ 15	15 ≤ 60	60 ≤ 150	150 ≤ 300	300 ≤ 630
☐ A	0.05	0.10	0.15	0.20	0.25	0.30
☑ B	0.10	0.15	0.20	0.25	0.30	0.35
UNLESS OTHERWISE SPECIFIED 公差以上表所示，除非另有指定						

Edition 版本	DATE 日期	Modified description 修订内容描述
04		
03		
02		

(*为重点管控尺寸，（）为参考尺寸)

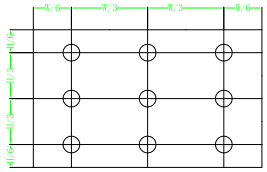
Drawing Of B/L :

模组图:

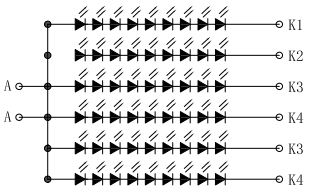


NO.	Parts name	Q'ty	Material
1.	Housing 塑胶框	1	
2.	Light Guide Plate 导光板	1	
3.	Down_Cover 下铁框	1	
4.	Reflector 反射膜	1	
5.	Diffuser 扩散膜	1	
6.	Bef 增光膜	2	
7.	SMD-LED 发光二极管	54	
8.	PCB 印制电路板	1	
9.	LINE 导线	1	
10.			
11.			
12.			
13.			
14.			
15.			
16.			
17.			
18.			
19.			

测试点示意图



Backlight LED Circuit



(9串6并 54颗LED)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	REMARK
Center luminance	Lv	250	280		cd/m²	中心点
Color ranks	X	0.270	0.0290	0.330		IF=20mA/SMD
	Y	0.270	0.0300	0.340		IF=20mA/SMD
Forward Voltage	VF	27		34.5	V	IF=120mA, 9※6=54
Luminance uniformity	/	80	85		%	(Min/MAX)*100%

Measuring Instument:BM-7(测试镜头与产品距离500±10mm);测量视场度为1°;温度25±3°;环境照度不大於1LUX;测试点为9点.

UNIT 单位	mm	EDITION 版本	A1	PART NO. 产品型号	APPROVED BY 核准	CHECKED BY 审核	DRAWN BY 编制
THIRD ANGLE PROJECTION 第三角法		SCALE 比例	1:1	SHL'S P/N(exclude wrapper): LPDLM-15.6H39-055-A1			
		DATE 日期	2023.02.23	SHL'S P/N: (include wrapper) LPDL-15.6H39-055-A1			
		PAGE 页码	1/3				