HL 海罗光电有限公司 Hello Lighting co.,LTD	Specification document
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SPECIFICATION
OF
LCD MODULE

MODULE NO.: HL238T06

Customer Approval:

☐ **Accept** ☐ **Reject**

	SIGNATURE	DATE
PREPARED BY		
CHECKED BY		
APPROVED BY		

DOCUMENT REVISION HISTORY

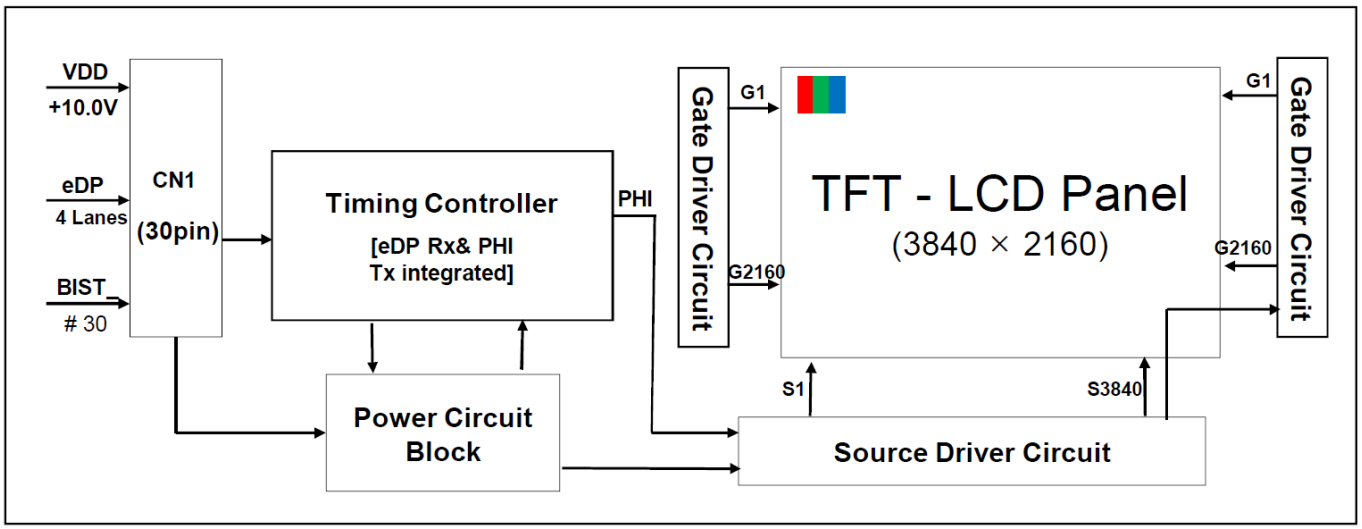
Sample Version	Doc. Version	DATE	DESCRIPTION	CHECKED BY
	A0	2019-10-18	First Release.	
A1	A1	2019-11-18	Modify screw hole, modify BL interface	
A2	A2	2023-11-17	Modify backside cover	

1. MECHANICAL SPECIFICATIONS:

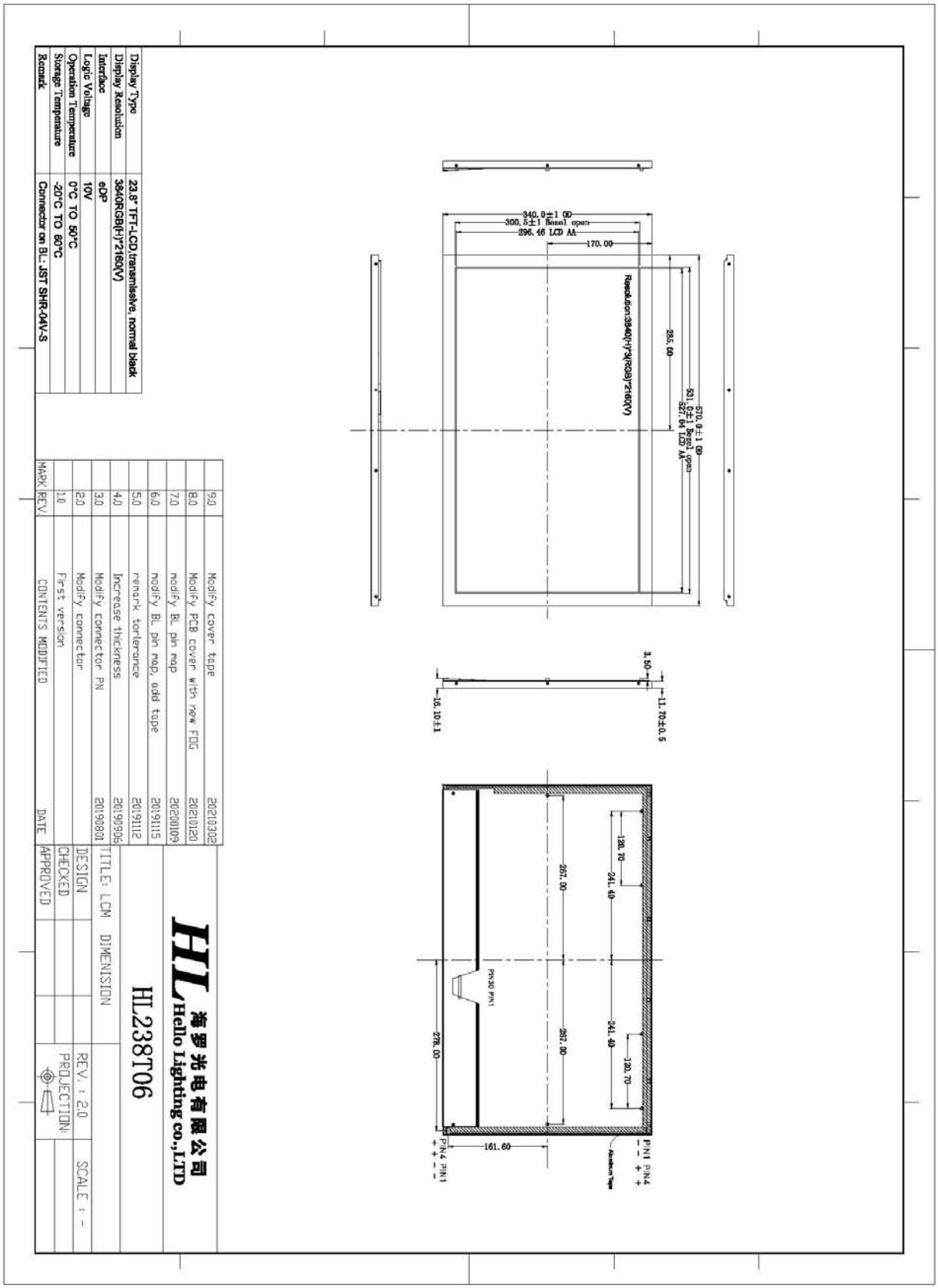
ITEM	SPECIFICATION	UNIT
OUTLINE DIMEMSIONS	570.0(W) X340.0(H) X11.7(D)	mm
DISPLAY SIZE	23.8	inch
PIXEL PITCH	0.13725mmX0.13725mm	mm
NUMBER OF DOTS	3840*（RGB）*2160	-
DISPLAY COLORS	1.07Billion 10bit(8bit+A-FRC)	-
PIXEL ARRANGEMENT	Pixels RGB stripes arrangement	-
DISPLAY MODE	Transmissive mode, normally black	-
SURFACE TREATMENT	Advanced Anti-glare treatment of the front polarizer (3H)	-

***See attached drawing for details.**

2.BLOCK DIAGRAM:



3.DIMENSIONAL



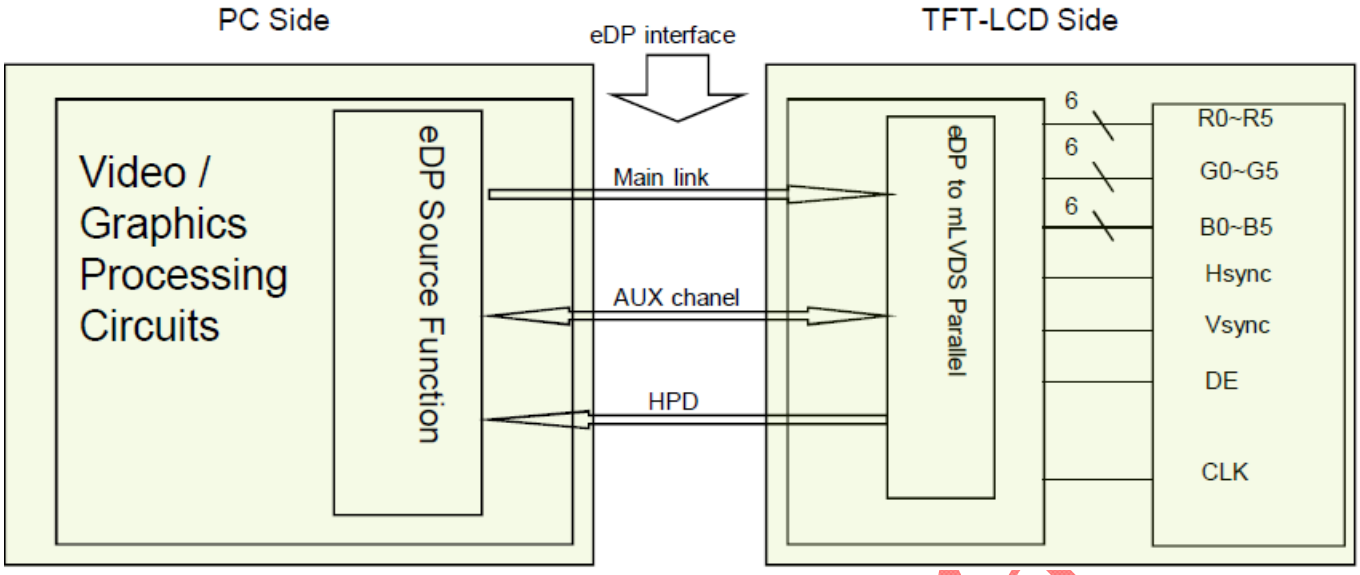
4. INTERFACE:

4.1 PIN MAP

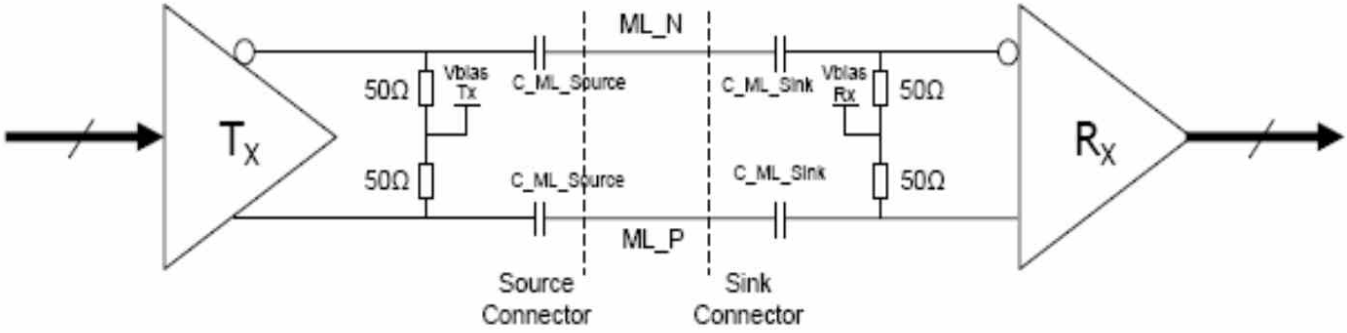
LCD Connector : STM MSAK24025P30 or Equivalent

NO.	PIN NAME	Description
1	VDD	Ground
2	VDD	No connection
3	VDD	N No connection
4	VDD	Serial data
5	VDD	Serial clock
6	GND	No connection
7	GND	L : Normal mode, H : Dual mode
8	NC	No connection(ITLC)
9	NC	No connection(PWM OUT)
10	GND	No connection
11	HDP	Ground
12	GND	FIRST eDP Receiver Signal (A-)
13	DAUXN	FIRST eDP Receiver Signal (A+)
14	DAUXP	FIRST eDP Receiver Signal (B-)
15	GND	FIRST eDP Receiver Signal (B+)
16	DRX0P	FIRST eDP Receiver Signal (C-)
17	DRX0N	FIRST eDP Receiver Signal (C+)
18	GND	Ground
19	DRX1P	FIRST eDP Receiver Clock Signal(-)
20	DRX1N	FIRST eDP Receiver Clock Signal(+)
21	GND	Positive sampling clock(EVEN data)
22	DRX2P	FIRST eDP Receiver Signal (D-)
23	DRX2N	FIRST eDP Receiver Signal (D+)
24	GND	FIRST eDP Receiver Signal (E-)
25	DRX3P	FIRST eDP Receiver Signal (E+)
26	DRX3N	No connection or GND
27	GND	No connection
28	GND	SECOND eDP Receiver Signal (A-)
29	NC	SECOND eDP Receiver Signal (A+)
30	BIST	SECOND eDP Receiver Signal (B-)

4.2 eDP INTERFACE



Note. Transmitter : Parade DP501or equivalent.
Transmitter is not contained in Module



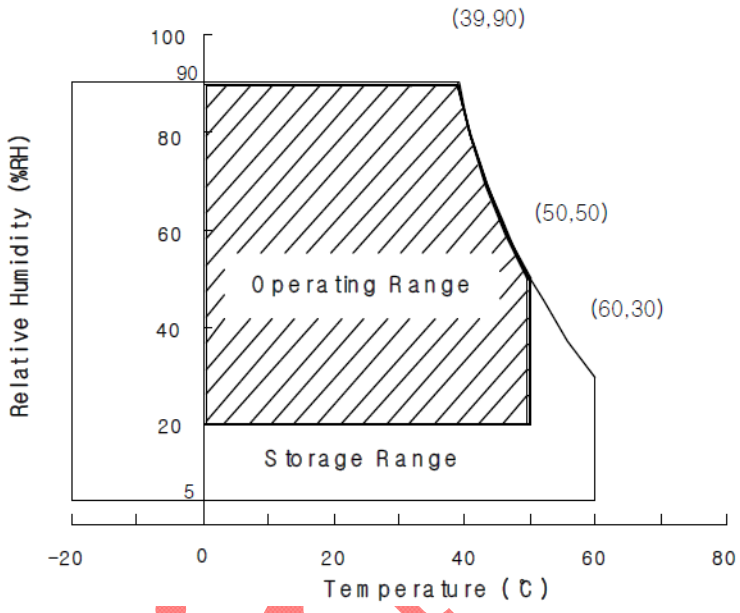
eDP Main Link differential pair

5. MAXIMUM ABSOLTE LIMIT:

Item	Symbol	Value	Unit
Power supply voltage	V_{DD}	GND-0.3 ~ 12	V
Operating temperature	Topr	0 to 50	°C
Storage temperature	Tstg	-20 to 60	°C(3)

Note : 1) Temperature and relative humidity range are shown in the figure below.

Wet bulb temperature should be 39 OC max. and no condensation of water.



6.ELECTRICAL CHARACTERISTICS

6.1 DC Characteristics (Ta=25°C)

Item	Symbol	Min	Type	Max	Unit	Note
Voltage of power supply	V_{LCD}	9.0	10.0	11.0	V	(1)
Permissive Power Input Ripple	Vdrf			400	mVp-p	
Rush Current	I_{RUSH}	-	2	3	A	(4)
Power Consumption	Pc TYP		3	6.8	watt	(2)
Power Supply Input Current	Ilcd		410	560	mA	(2)
High Level Differential Input Threshold Voltage	Vih			+100	mV	
Low Level Differential Input Threshold Voltage	Vil	-100			mV	
Differential input voltage	|Vid|	100		600	mV	
Differential input common mode voltage	Vcm	0		2		

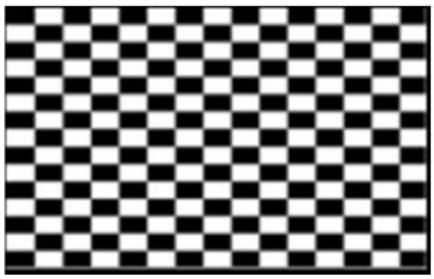
Notes: 1. The supply voltage is measured and specified at the interface connector of LCM.

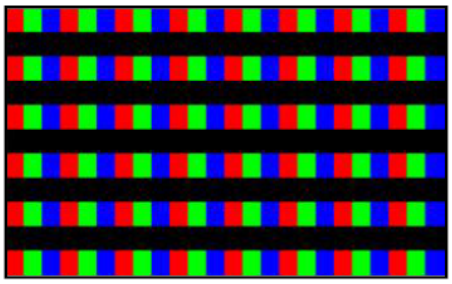
The current draw and power consumption specified is for VDD=10.0V, Frame rate=60Hz

Test Pattern of power supply current

a) Typ : Mosaic Pattern

b) Max : 1 line Inversion





2. Duration of rush current is about 2 ms and rising time of VDD is 1ms(min).

3. Ripple Voltage should be covered by Input voltage Spec.

4. Calculated value for reference (Input pins*VPIN ×IPIN) excluding inverter loss.

6.2 Backlight Electrical-optical Characteristics

Item	Symbol	MIN	TYP	MAX	UNIT	Test Condition	Note
Supply Voltage	Vf	63.8	-	70.4	V		-
Supply Current	If	-	1.4	1.8	A	-	2string total
Reverse Voltage	Vr	-	-	5	V	10uA	
Power dissipation	Pd	-	92.4	-	W	-	
Uniformity for LCM	-	80	-	-	%		3
Life Time	-	30000	-	-	Hr		-
Backlight Color	White						

NOTE:

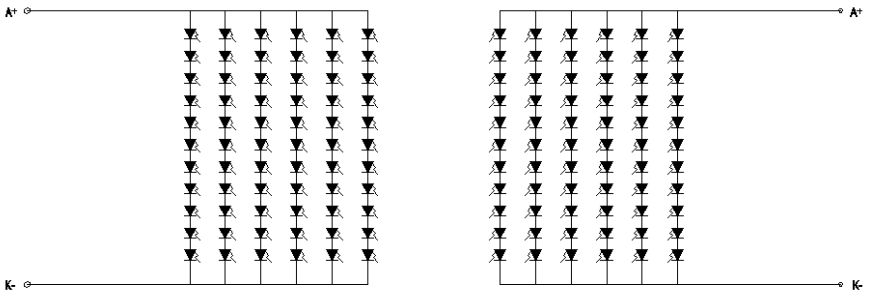
1. Average Luminous Intensity of P1-P9
2. Uniformity = Min/Max * 100%
3. LED life time defined as follows: The final brightness is at 70% of original brightness

Measured Method: (X*Y: Light Area)(Left Draft as follow)

Internal Circuit Diagram(Right Draft as follow)

(Effective spatial Distribution)

Hole Diameter ø 3mm ; 1 to 9 per Position Measured Luminous:



7 TIMING

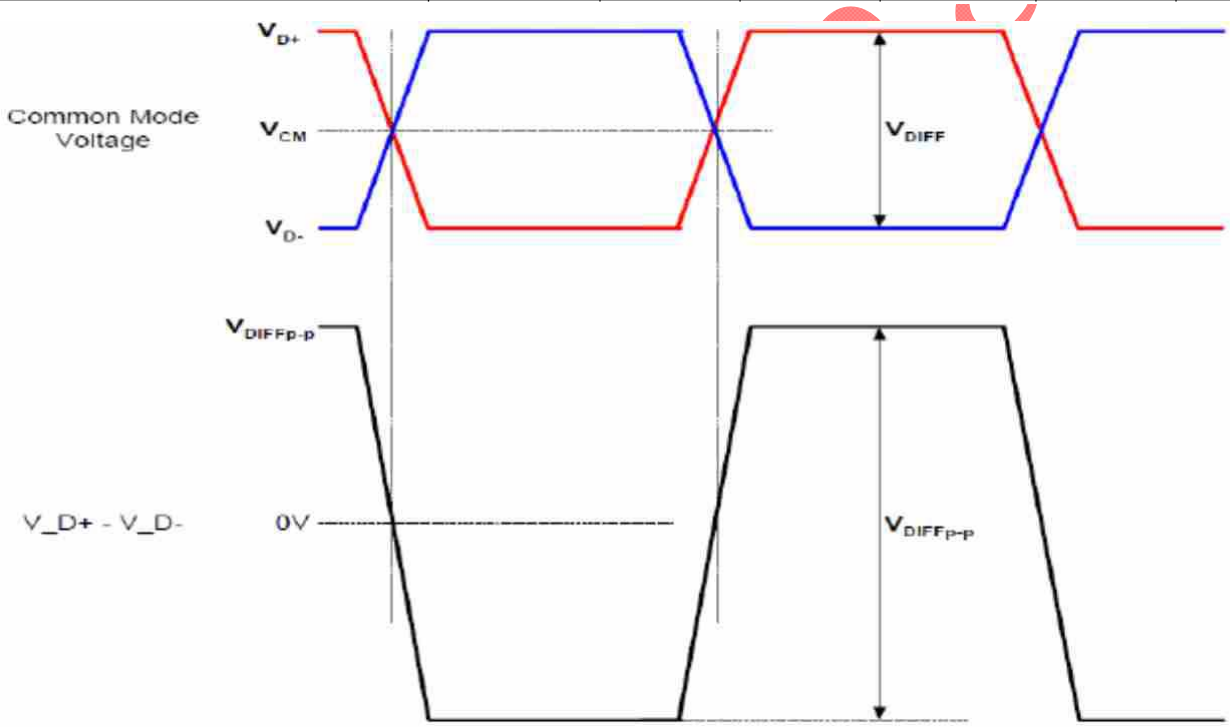
7.1 Timing characteristics

The HL238T05 is operated by the DE only

Item		Symbols	Min	Typ	Max	Unit
Clock	Frequency	1/Tc	-	140	-	MHz
	High Time	Tch	-	4/7Tc	-	
	Low Time	Tcl	-	4/7Tc	-	
Frame Period		Tv	-	2222	-	lines
			50	60	62	Hz
			20	16.7	16.13	ms
Vertical Display Period		Tvd	-	2160	-	lines
One line Scanning Period		Th	-	4200	-	clocks
Horizontal Display Period		Thd	-	3840	-	clocks

7.2 eDP Rx Interface Timing Parameter

Item	Symbol	Min	Typ	Max	Unit	Remark
Spread spectrum clock	ssc	-2	-	+2	%	
Differential peak-to-peak input voltage at package pins	$V_{RX-DIFFp-p}$	120	-	-	mV	
Rx input DC common mode voltage	$V_{RX\_DC\_CM}$	0	-	2	V	
Differential termination resistance	$R_{RX-DIFF}$	-	100	-	Ω	
Single-ended termination resistance	R_{RX-SE}	-	50	-	Ω	
Rx short circuit current limit	I_{RX_SHORT}	-	-	50	mA	
Intra-pair skew at Rx package pins (HBR) RX intra-pair skew tolerance at HBR	$L_{RX\_SKEW\_INTRA\_PAIR}$	-	-	150	ps	

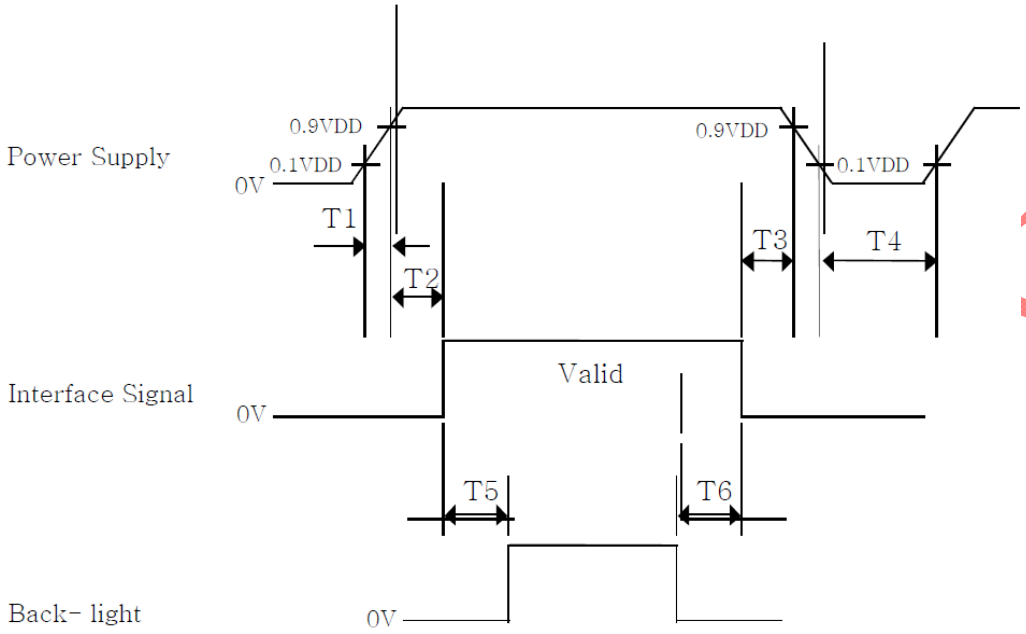


7.3 INPUT SIGNALS, BASIC DISPLAY COLORS & GRAY SCALE OF COLORS

Color & Gray Scale		RED DATA								GREEN DATA								BLUE DATA							
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Gray Scale of RED	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	△	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Darker	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	△	↑								↑								↑							
	▽	↓								↓								↓							
	Brighter	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	▽	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gray Scale of GREEN	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	△	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Darker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	△	↑								↑								↑							
	▽	↓								↓								↓							
	Brighter	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
	▽	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Gray Scale of BLUE	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	△	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Darker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	△	↑								↑								↑							
	▽	↓								↓								↓							
	Brighter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1
	▽	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
Gray Scale of WHITE	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	△	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
	Darker	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0
	△	↑								↑								↑							
	▽	↓								↓								↓							
	Brighter	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1
	▽	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

7.1 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



- 0.5 ms ≤ T1 10 ms
- 0 T2 50 ms
- 0 ≤ T3 50 ms
- 1 sec T4
- 200 ms T5
- 200 ms T6

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.
3. Back Light must be turn on after power for logic and interface signal are valid.

8. OPTICAL CHARACTERISTICS:

Driving the backlight

No.	ITEM		Symbol	Conditions	Specification			Unit	Note
					Min	Typ	Max		
1	Response Time		Tg	25℃	-	10	20	ms	(1)(2)
2	Contrast Rate		Cr	θ=0, Normal viewing angle	700	1000	-	-	(1)(3)
3	Viewing Angle	Hor.	θL + θR	CR>10	170	178	-	Deg	-
		Ver.	Θ+ + Θ-		170	178	-		
4	Chromaticiry	White	x	Brightness is ON	Typ – 0.03	TBD	Typ+0.03		
			y			TBD			
		Red	x			TBD			
			y			TBD			
		Green	x			TBD			
			y			TBD			
		Blue	x			TBD			
			y						
5	luminance		L		-	1000	1300	cd/m2	
6	Color Gamut				-	100	108	%	DCI P3
7	White Variation		δ W		80			%	

Measure Conditions:

1. Measure surrounding : dark room;
2. Ambient temperature: 25±2℃;
3. 30min.warm-up time.

Note

1. Viewing angle is the angle at which the contrast ratio is greater than 10. The viewing are determined for the horizontal or 3, 9 o' clock direction and the vertical or 6, 12 o' clock direction with respect to the optical axis which is normal to the LCD surface.

2. Contrast measurements shall be made at viewing angle of = 0° and at the center of the LCD surface. Luminance shall be measured with all pixels in the view field set first to white, then to the dark (black) state. Luminance Contrast Ratio (CR) is defined mathematically.

$$CR = \frac{\text{Luminance when displaying a white raster}}{\text{Luminance when displaying a black raster}}$$

3. Center Luminance of white is defined as 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 2 for a total of the measurements per display.

4. The White luminance uniformity on LCD surface is then expressed as :

$\triangle Y$ = (Minimum Luminance of 9points / Maximum Luminance of 9points) * 100

5. The color chromaticity coordinates specified shall be calculated from the spectral data measured with all pixels first in red, green, blue and white. Measurements shall be made at the center of the panel.

6. Response time Tg is the average time required for display transition by switching the input signal as below table and is based on Frame rate fV =60Hz to optimize.

7. Cross-Talk of one area of the LCD surface by another shall be measured by comparing the luminance (YA) of a 25mm diameter area, with all display pixels set to a gray level, to the luminance (YB) of that same area when any adjacent area is driven dark.

9. GENERAL PRECAUTIONS

9.1 Handling

(a) When the module is assembled, it should be attached to the system firmlyusing all mounting holes. Be careful not to twist and bend the module.

(b) Because the inverter uses high voltages, it should be disconnected from powersource before it is assembled or disassembled.

(c) Refrain from strong mechanical shock and / or any force to the module.In addition to damage, it may cause improper operation or damage to the moduleand CCFT back light.

(d) Note that polarizer films are very fragile and could be damaged easily.Do not press or scratch the surface harder than a HB pencil lead.

(e) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, staining or discoloration may occur.

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

(g) Desirable cleaners are water, IPA (Isopropyl Alcohol) or Hexane. Do not use Ketone type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might cause permanent damage to the polarizer due to chemical reaction.

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

(i) Protect the Module from static, or the CMOS Gate Array IC would be damaged.

(j) Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.

(k) Do not disassemble the Module.

(l) Do not pull or fold the lamp wire.

(m) Do not adjust the variable resistor located on the Module.

(n) Protection film for polarizer on the Module should be slowly peeled off just before use so that the electrostatic charge can be minimized.

(o) Pins of I/F connector should not be touched directly with bare hands.

9.2 Storage

(a) 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%.

(b) Do not store the TFT-LCD Module in direct sunlight.

(c) The Module should be stored in a dark place. It is prohibited to apply sunlight or fluorescent light in storing.

9.3 Operation

(a) Do not connect or disconnect the Module in the "Power On" condition.

(b) Power supply should always be turned on/off by the item "Power on/off sequence"

(c) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference should be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.

(d) The cable between the back light connector and its inverter power supply should be connected directly with a minimized length. A longer cable between the back light and the inverter may cause lower luminance of lamp(CCFT) and may require higher startup voltage(Vs).

9.4 Operation Condition Guide

(a) The LCD product should be operated under normal conditions.

Normal condition is defined as below;

- Temperature : 20±15℃

- Humidity : 65±20%

- Display pattern : continually changing pattern (Not stationary)

(b) If the product will be used in extreme conditions such as high temperature, humidity, display patterns or operation time etc.., It is strongly recommended to contact SEC for Application engineering advice. Otherwise, its reliability and function may not be guaranteed. Extreme conditions are commonly found at Airports, Transit Stations, Banks, Stock market, and Controlling systems.

9.5 Others

(a) Ultra-violet ray filter is necessary for outdoor operation.

(b) Avoid condensation of water. It may result in improper operation or disconnection of electrode.

(c) Do not exceed the absolute maximum rating value. (supply voltage variation, input voltage variation, variation in part contents and environmental temperature, and so on) Otherwise the Module may be damaged.

(d) If the Module keeps displaying the same pattern for a long period of time, the image may be "sticked" to the screen. To avoid image sticking, it is recommended to use a screen saver.

(e) This Module has its circuitry PCB's on the rear side and should be handled carefully in order not to be stressed.

(f) Please contact SEC in advance when you display the same pattern for a long time.

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- END -