



# PHOENIX DISPLAY INTERNATIONAL, INC.

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### SPECIFICATION FOR LCD MODULE

<b>CUSTOMER</b>	
<b>PART NUMBER</b>	PDI154HVBS-01
<b>DESCRIPTION</b>	1.54" 320x (RGB) × 320
<b>VERSION</b>	V1.0
<b>ISSUE DATE</b>	29-Jun-17

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## 1 General Characteristics

ITEM	Specification	Unit
LCD Type	a-Si TFT, Transmissive, Normally black, ADS	-
LCD Size	1.54	inch
Resolution (W x H)	320x (RGB) × 320	pixel
LCM (W × H × D)	31.82(W) x 33.87(H) x 1.8(D)	mm
Active Area (W × H)	27.744(H) × 27.744(V)	mm
Dot Pitch (W × H)	0.0867(H) × 0.0867(V)	mm
Viewing Direction	All o'clock	-
Viewing Angle	80/80/80/80	deg.
Color Depth	262K/16.7M	-
Pixel Arrangement	RGB Vertical stripe	-
Backlight Type	3 LEDs, 60mA, 3.2V	-
Surface Luminance	280 ± 30	cd/m <sup>2</sup>
Surface Treatment	Anti-Glare	-
Driver IC	ST7796S	-
Interface Type	MIPI 1 Lane	-
Input Voltage	2.8 (Typ)	V
TP/Lens	without	-
Weight	TBD.	g

**Note 1: RoHS compliant**

**Note 2: LCM weight tolerance: ± 5%.**

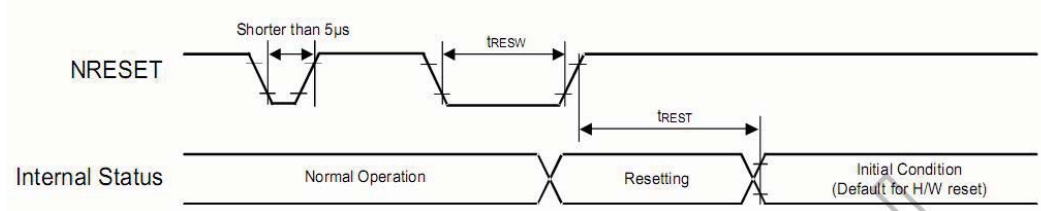


### 3 Interface description

PIN NO.	Symbol	description
1	VBAT(+)	Backlight A Aothod input pin.
2	ISINK0(-)	Backlight K Cathode input pin.
3	ISINK1(-)	Backlight K Cathode input pin.
4	ISINK2(-)	Backlight K Cathode input pin.
5	GND	System Ground. (0V)
6	LPTE(TE)	- Tearing effect output. - If not used, leave this pin open
7	VIO18(1.8V)	Power supply +1.8V
8	VIO28(2.8V)	Power supply +2.8V
9	LSRSTB(RST)	- This signal will reset the device and it must be applied to properly initialize the chip. - Signal is active low.
10	GND	System Ground. (0V)
11	TDP0	- Positive polarity of low voltage differential data signal - Leave the pin to open when not in use.
12	TDN0	- Negative polarity of low voltage differential data signal - Leave the pin to open when not in use.
13	GND	System Ground. (0V)
14	TCP	- Positive polarity of low voltage differential clock signal - Leave the pin to open when not in use.
15	TCN	- Negative polarity of low voltage differential clock signal - Leave the pin to open when not in use.
16	GND	System Ground. (0V)
17~23	NC	
24	GND	System Ground. (0V)

## 4 LCM Interface Timing

### 4.1 Reset Timing



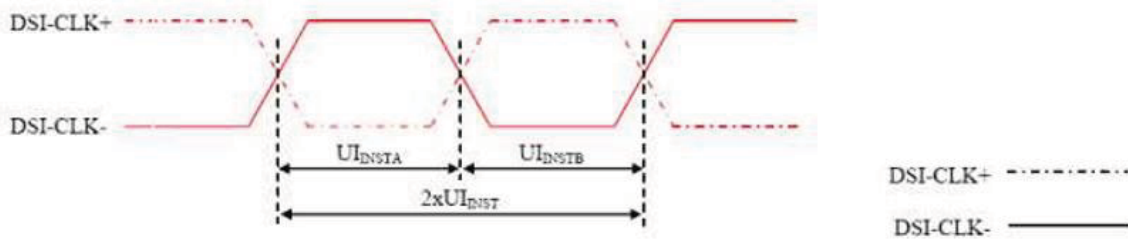
Signal	Symbol	Parameter	Min	Max	Unit
NRESET	tRESW	Reset low pulse width	10	-	us
	tREST	Reset complete time	5 (note 1)	-	ms
			120(note 2)	-	ms

Note: (1) When reset applied during SLPIN mode;

(2) When reset applied during SLPOUT mode.

### 4.2 MIPI DSI Timing

#### High Speed Mode – Clock Channel Timing



Signal	Symbol	Parameter	MIN	MAX	Unit	Description
DSI-DATA_P/N	2xUI INST	Double UI instantaneous	TBD	TBD	ns	
DSI-DATA_P/N	UI INSTA ,UI INSTB	UI instantaneous Half	TBD	TBD	ns	

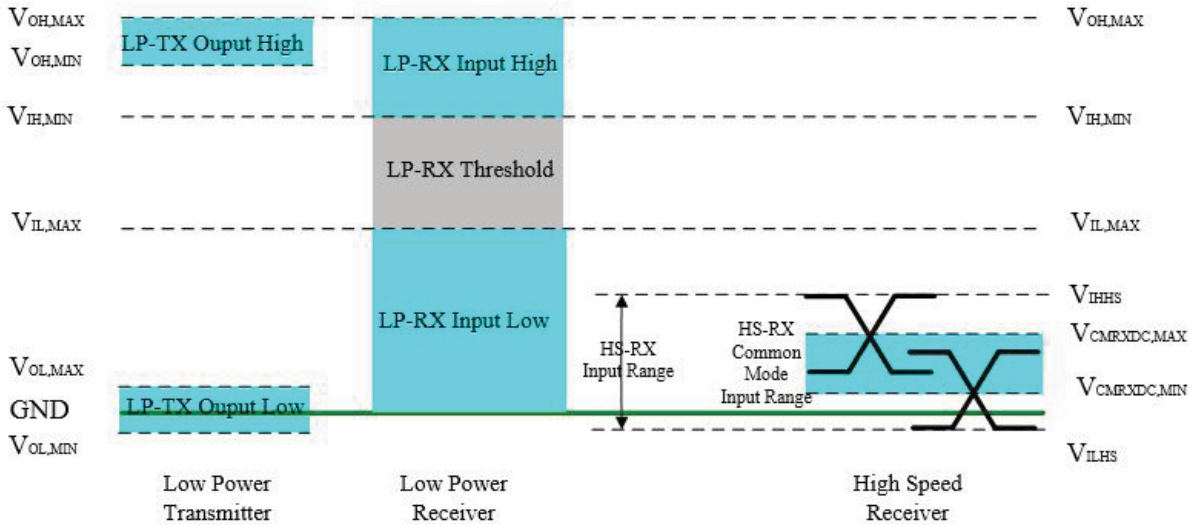
\*See ST7796S SPEC page87-112.

## 5 Absolute Maximum Ratings

PARAMETER	SYMBOL	MIN	MAX	UNIT
Supply Voltage (Analog)	VCC~GND	-0.3	4.6	V
Logic signal voltage(I/O)	IOVCC~GND	-0.3	4.6	V
Operating Temperature	TOP	-20	70	° C
Storage Temperature	TST	-30	80	° C
Humidity	RH	-	90%(Max 60° C)	RH

## 6 DC characteristics for MIPI DSI

- MIPI Signaling Voltage Levels



- MIPI DC characteristics

Parameter	Symbol	Specification			Unit
		MIN	TYP	MAX	
Operation Voltage for MIPI Receiver					
Low power mode operating voltage	$V_{LPH}$	1.1	1.2	1.3	V
MIPI Characteristics for High Speed Receiver					
Single-ended input low voltage	$V_{ILHS}$	-40	-	-	mV
Single-ended input high voltage	$V_{IHHS}$	-	-	460	mV
Common-mode voltage	$V_{CMRXDC}$	70	-	330	mV
Differential input impedance	$Z_{ID}$	80	100	125	ohm
MIPI Characteristics for Low Power Mode					
Pad signal voltage range	$V_i$	-50	-	1350	mV
Differential Input Low Level Threshold Voltage for Clock	$V_{THLCLK-}$	-70	-	-	mV
Logic 0 input threshold	$V_{IL}$	0	-	550	mV
Logic 1 input threshold	$V_{IH}$	880	-	1350	mV
Output low level	$V_{OL}$	-50	-	50	mV
Output high level	$V_{OH}$	1.1	1.2	1.3	V

## 7 Backlight Characteristics

ITEM	SYMBOL	MIN	TYP	MAX	UNIT
Voltage for LED backlight	$V_f$	-	3.1	3.2	V
Current for LED backlight	$I_f$	-	45	60	mA
Power consumption	Wbl	-	139.5	192	mW
Uniformity	Avg	80	-	-	%
LED Life Time	-	30000	40000	-	Hrs

Note:

1. The LED life time is defined as the module brightness decrease to 50% original brightness at  $T_a=25^\circ\text{C}$ , 60%RH  $\pm 5\%$ .
2. The life time of LED will be reduced if LED is driven by high current, high ambient temperature and humidity conditions.
3. Typical operating life time is an estimated data.
4. Permanent damage to the device may occur if maximum values are exceeded or reverse voltage is loaded. Functional operation should be restricted to the conditions described under normal operating conditions.

## 8 LCD Optical specifications

Item	Symbol	Condition	Specification			Unit	Remark
			Min.	Typ.	Max.		
Response time (By Quick)	Tr+Tf	$\theta = 0^\circ$	-	35	50	ms	Note 5
Contrast ratio	CR	$\theta = 0^\circ$	-	900	-		Note 2
Viewing angle	Top	$CR \geq 10$	-	80	-	Deg.	Note 1
	Bottom	$CR \geq 10$	-	80	-		
	Left	$CR \geq 10$	-	80	-		
	Right	$CR \geq 10$	-	80	-		
Color chromaticity (CF only with ITO, light source is C light, CIE 1931)	Wx	$\theta = 0^\circ$	0.28	0.29 $\bar{5}$	0.31		Note 4
	Wy		0.31	0.32 $\bar{5}$	0.34		
	Rx		0.11	0.12 $\bar{5}$	0.14		
	Ry		0.29 $\bar{5}$	0.31	0.32 $\bar{5}$		
	Gx		0.281	0.29 $\bar{5}$	0.311		
	Gy		0.103	0.118	0.133		
	Bx		0.129	0.144	0.159		
By	0.124	0.139	0.154				
NTSC				50%			
Transmittance (with Polarizer)	T(%)	$\theta = 0^\circ$	-	5.5	-	%	Note3

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 (See FIG.2).
2. Contrast measurements shall be made at viewing angle of  $\theta = 0^\circ$  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



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

3. Transmittance is the value with APF Pol.

4. The color chromaticity coordinates specified in Table1 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 C/F.

Measurement condition is C - light source & Halogen Lamp

5. The electro-optical response time measurements shall be made as FIG.3 by switching the “data” input signal ON and OFF.

The times needed for the luminance to change from 10% to 90% is Tr, and 90% to 10% is Tf.

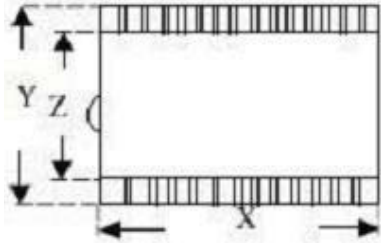
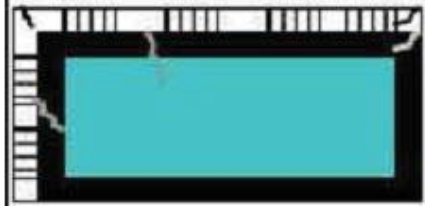
## 9 RELIABILITY TEST

NO.	TEST ITEM	TEST CONDITION	INSPECTION AFTER TEST
1	High Temperature Storage	80±2°C/72 hours	Inspection after 2~4 hours storage at room temperature and humidity. The condensation is not accepted. The sample shall be free from defects:  1. Air bubble in the LCD 2. Seal leak 3. Non-display 4. Missing segments 5. Glass crack
2	Low Temperature Storage	-30±2°C/72 hours	
3	High Temperature Operating	70±2°C/72 hours	
4	Low Temperature Operating	-20±2°C/72 hours	
5	Temperature Cycle	-30±2°C ~ 25~ 80± 2°C × 10 cycles (30 min.) (5min.) (30min.)	
6	Damp Proof Test	60°C ±5°C × 90%RH/96 hours	
7	Vibration Test	Frequency 10Hz~55Hz Stroke: 1.5mm Sweep: 10Hz~150 Hz~10Hz 2 hours For each direction of X, Y, Z	
8	Shock Test	Half-sine, wave, 300m/s	
9	Packing Drop Test	Height: 80 cm 1 corner, concrete floor	
10	Electrostatic Discharge Test	C=150pF, R=330 Ω Air: ±8KV 150pF/330Ω 30 times Contact: ±4KV,20 times	

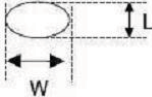
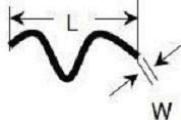
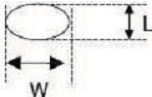
## 10 Inspection standards

### 10.1 Visual inspection criterion in cosmetic

#### 10.1.1 Glass defect

NO.	Defect	Criteria	Remark
1	Dimension(Minor)	By engineering diagram	
2	Cracks(Major)	Extensive crack [Reject]	

#### 10.1.2 LCM appearance defect

NO.	Defect	Criteria		Remark
		Spec	Permissible Qty	
1	Round type(Minor)	$\phi \leq 0.1\text{mm}$	Disregard	1. $\phi = (W+L)/2$ , L:Length, W=Width 2. Disregard if out of A.A 
		$0.1\text{mm} < \phi \leq 0.2\text{mm}$	2	
		$\phi > 0.2\text{mm}$	0	
2	Line type(Minor)	$W \leq 0.03\text{mm}$	Disregard	1. L:Length, W=Width 2. Disregard if out of A.A 
		$L \leq 3.0\text{mm}$ and $0.03\text{mm} < W \leq 0.05\text{mm}$	2	
		$L \leq 3.0\text{mm}$ and $0.05\text{mm} < W \leq 0.1\text{mm}$	1	
		$W > 0.10\text{mm}$ or $L > 3.0\text{mm}$	0	
3	Polarizer dent(Minor)	$\phi \leq 0.2\text{mm}$	Disregard	1. $\phi = (W+L)/2$ , L:Length, W=Width 2. Disregard if out of A.A 
		$0.2\text{mm} < \phi \leq 0.3\text{mm}$	2	
		$0.3\text{mm} < \phi \leq 0.5\text{mm}$	1	
		$\phi > 0.5\text{mm}$	0	

### 10.1.3 FPC

NO.	Defect	Criteria	Remark
1	Copper peeling(Minor)	Copper peeling [Reject]	
2	Damaged	Damaged[Reject]	

### 10.1.4 Black tape

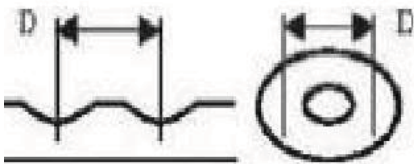


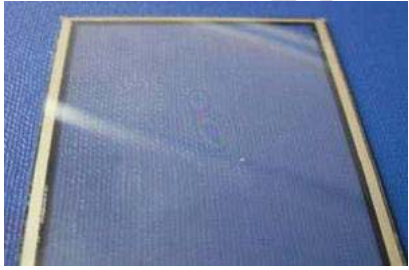
NO.	Defect	Criteria	Remark
1	Shift(Minor)	IC exposed [Reject]	
2	No black tape(Minor)	No black tape [Reject]	

### 10.1.5 Silicon

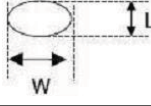
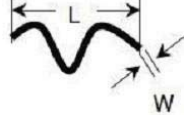
NO.	Defect	Criteria	Remark
1	Amount of silicon (Minor)	ITO exposed [Reject]	

### 10.1.6 Touch Panel

Defect	Criteria	Remark
TP shift	Click on the TP, the distance between the show position and click position>1.5mm [Reject]	

TP Circle, Dent Dot, Bubble MI	Size(mm)	Accessible QTY	
	$D \leq 0.20$	Access	
	$0.2 < D \leq 0.3$	2	
	$0.3 < D \leq 0.5$	1	
	$D > 0.5$	0	
TP Ripple MI	1.(Figure A): Ripple $D > 5\text{mm}$ [Reject] 2.(Figure B): Ripple area $< 1/7$ TP area and not impact fonts display effect [Access]		 <p style="text-align: center;">A</p>  <p style="text-align: center;">B</p>
			
Remark: Tear up the protective film to inspect. The distance of two dirt must $> 10\text{mm}$ ; The white dot found in manufacture is conformity to $0.1\text{mm}$ , if $> 0.1\text{mm}$ [Reject]			

## 10.2 Visual inspection criterion in electrical display

NO.	Defect	Criteria		Remark
		Spec.	Permissible Qty	
1	No display (Major)	Not allowed		
2	Missing line (Major)	Not allowed		
3	Darker or lighter Line (Major)	Not allowed		
4	Weak line(Major)	By limited sample		
5	Bright / Dark point (Minor)	Bright point	1	1:1sub-pixel: 1R or 1G or 1B 2:Point defect area 1/2 sub pixel.
		Dark point	2	
6	Round type (Minor)	$\phi \leq 0.1\text{mm}$	Disregard	1. $\phi = (W+L)/2$ , L:Length, W=Width 2.Disregard if out of A.A 
		$0.1 < \phi \leq 0.2$	3	
		$\phi > 0.2\text{mm}$	0	
	Line type (Minor)	$W \leq 0.03\text{mm}$	Disregard	1. L:Length, W=Width 2.Disregard if out of A.A 
		$L \leq 3.0\text{mm}$ and $0.03\text{mm} < W \leq 0.05\text{mm}$	2	
		$L \leq 3.0\text{mm}$ and $0.05\text{mm} < W \leq 0.1\text{mm}$	1	
		$W > 0.10\text{mm}$ or $L > 3.0\text{mm}$	0	
	Mura (Minor)	By 5% ND filter invisible		

## 10.3 Others

1. Issues that are not defined in this document shall be discussed and agreed with both parties. (Customer and supplier)
2. Unless otherwise agreed upon in writing, the criteria shall be applied to both parties. (Customer and supplier)

## 11 Suggestions for using LCD modules

### 11.1 Handling of LCM

1. The LCD screen is made of glass. Don't give excessive external shock, or drop from a high place.
2. If the LCD screen is damaged and the liquid crystal leaks out, do not lick and swallow. When the liquid is attach to your hand, skin, cloth etc, wash it off by using soap and water thoroughly and immediately.
3. Don't apply excessive force on the surface of the LCM.
4. If the surface is contaminated, clean it with soft cloth. If the LCM is severely contaminated, use Isopropyl alcohol/Ethyl alcohol to clean. Other solvents may damage the polarizer. The following solvents is especially prohibited: water , ketone Aromatic solvents etc.
5. Exercise care to minimize corrosion of the electrode. Corrosion of the electrodes is accelerated by water droplets, moisture condensation or a current flow in a high-humidity environment.

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6. Install the LCD Module by using the mounting holes. When mounting the LCD module make sure it is free of twisting, warping and distortion. In particular, do not forcibly pull or bend the I/O cable or the backlight cable.
  7. Don't disassemble the LCM.
  8. To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.
    - Be sure to ground the body when handling the LCD modules.
    - Tools required for assembling, such as soldering irons, must be properly grounded.
    - To reduce the amount of static electricity generated, do not conduct assembling and other work under dry conditions.
    - The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.
  9. Do not alter, modify or change the the shape of the tab on the metal frame.
  10. Do not make extra holes on the printed circuit board, modify its shape or change the positions of components to be attached.
  11. Do not damage or modify the pattern writing on the printed circuit board.
  12. Absolutely do not modify the zebra rubber strip (conductive rubber) or heat seal connector
  13. Except for soldering the interface, do not make any alterations or modifications with a soldering iron.
  14. Do not drop, bend or twist LCM.

## **11.2 Storage**

1. Store in an ambient temperature of 5 to 45 C, and in a relative humidity of 40% to 60%. Don't expose to sunlight or fluorescent light.
2. Storage in a clean environment, free from dust, active gas, and solvent.
3. Store in antistatic container.