PHOENIX DISPLAY INTERNATIONAL, INC.

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SPECIFICATION FOR LCD MODULE

CUSTOMER	
PART NUMBER	PDI101WUBN-33
DESCRIPTION	10.1" 1200 (xRGB) x 1920
VERSION	
ISSUE DATE	15-Dec-15

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1 GENERAL DESCRIPTION

This module is a TFT (Thin Film Transistor) active matrix LCD (Liquid Crystal Display) module. Each module comprises:

- a 10.1" amorphous silicon colour TFT panel
- panel driver electronics
- a 4-Line MIPI interface board
- WITHOUT LED drive

The 10.1" diagonal display active area contains 1200 (xRGB) x 1920 pixels WUXGA and can display 16,777,216 colours. The module can withstand intense environments.

2 FEATURES

- RGB Stripe Alignment Method
- MIPI-DSI (Display Serial Interface) interface
  - Support DSI Version 1.1
  - Support D-PHY version 1.00
- Display resolution 1200 (x RGB) x 1920 lines
- High contrast TFT LCD drive system
- High speed response
- High brightness
- Backlight for Long lifetime LED
- Extended temperature range

3 APPLICATIONS

- DVD/MID Digital Multi-Media applications
- GPS for auto, Video games and other mobile handheld applications.
- Netbook, UMPC, small computer applications.

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4 QUICK REFERENCE DATA

PARAMETER	VALUE	UNIT
Overall dimensions Width Height Depth	 143.00 +/-0.2 228.60+/-0.2 2.45	 mm mm mm
Screen size (diagonal)	10.1	inch
Active area dimensions Width Height	 135.36 216.58	 mm mm
Display resolution	1200 x 3 x 1920 WUXGA	Pixels
Aspect ratio	10:16	
Pixel dimensions Horizontal Vertical Pixel per Inch	 0.1128 0.1128 224	 mm mm PPI
Pixel arrangement	RGB Vertical stripe	
Display colors	16.7M	colors
Display mode	Normally Black	
Driver IC	NT51021	
Driver RAM size	RAMLESS	
Light Source	LED Backlight	
Interface	MIPI, 4-line	
Supply voltage module	+ 3.3	V
Interface Supply voltage	N.A.	V
Power consumption module (normal value with backlight)	2.35	W
Advised viewing direction	Free	
Maximum contrast ratio (peak viewing angle)	1000:1	
Typical luminance	250	Cd/m^2
Backlight lifetime (Continuous operation at 25C; I_{LED} = +15mArms)	Min. 15000	hours
Operating temperature range* - Bare module - Module installed in customer application cluster	 0 to +50 -20 to +60	 °C
Storage temperature	t.b.d.	°C
Response speed (typical)	25	ms
Module mass (without external flexible foil cable)	t.b.d.	g

* This is the ambient temperature set for the chamber.

5 Pinning

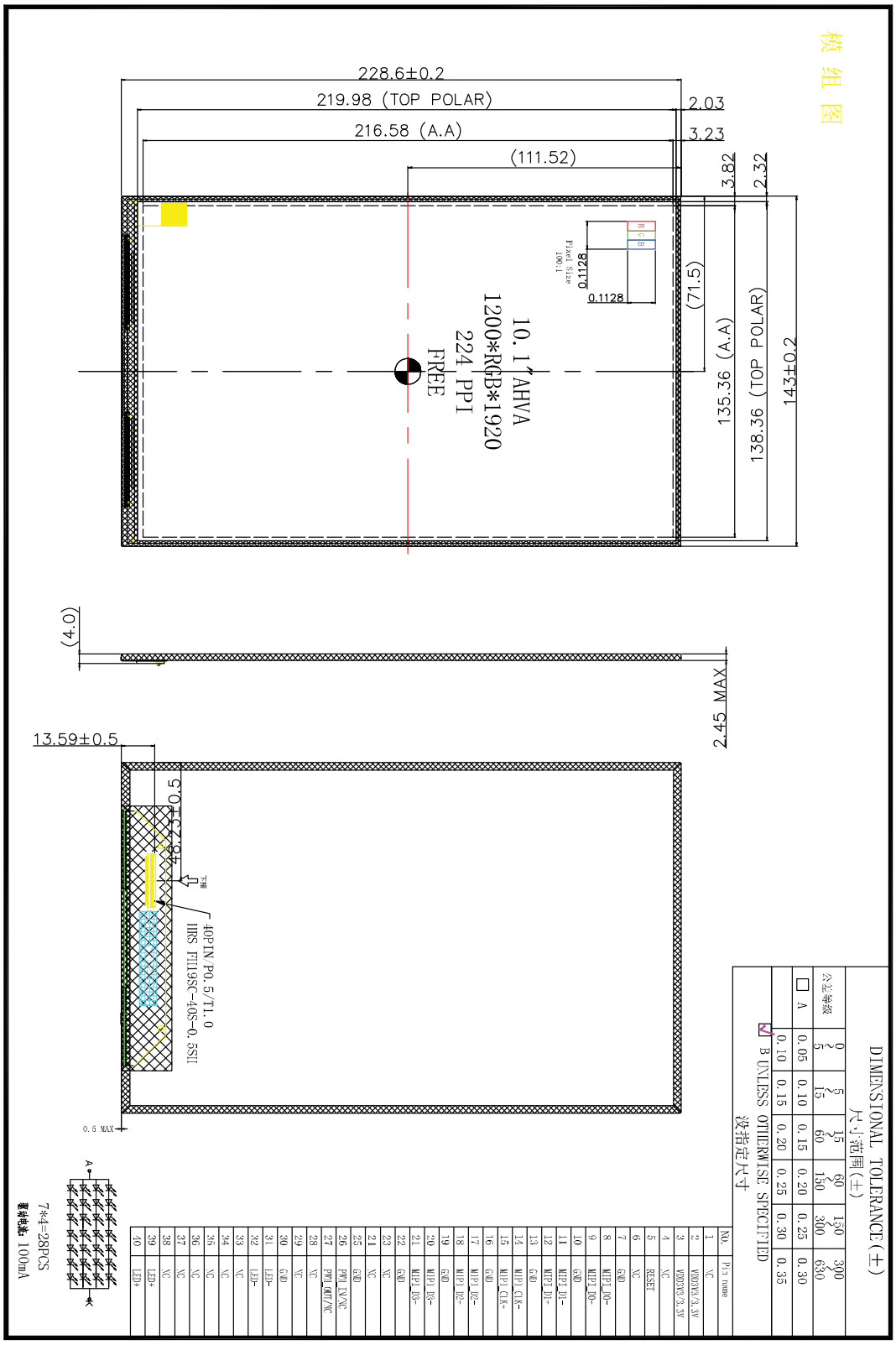
SYMBOL	PIN	I/O	DISCRIPTION
NC	1	-	No Connection
VDD3V3	2	P	Logic Power & I/O circuit supply (+3.3V)
VDD3V3	3	P	Logic Power & I/O circuit supply (+3.3V)
NC	4	-	No Connection
Reset	5	-	LCD-IC Reset signal, normal pull High
NC	6	-	No Connection
GND	7	P	Ground
MIPI_D0-	8	I/O	Negative MIPI differential Data Input 0
MIPI_D0+	9	I/O	Positive MIPI differential Data Input 0
GND	10	P	Ground
MIPI_D1-	11	I	Negative MIPI differential Data Input 1
MIPI_D1+	12	I	Positive MIPI differential Data Input 1
GND	13	P	Ground
MIPI_CLK-	14	I	Negative MIPI differential Clock Input
MIPI_CLK+	15	I	Positive MIPI differential Clock Input
GND	16	P	Ground
MIPI_D2-	17	I	Negative MIPI differential Data Input 2
MIPI_D2+	18	I	Positive MIPI differential Data Input 2
GND	19	P	Ground
MIPI_D3-	20	I	Negative MIPI differential Data Input 3
MIPI_D3+	21	I	Positive MIPI differential Data Input 3
GND	22	P	Ground
NC	23	-	No Connection
NC	24	-	No Connection
GND	25	P	Ground
PWM_IN	26	P	PWM singal input
PWM_OUT	27	O	This pin is connected to the external LED driver. PWM control signal for brightness of the LED backlight. If not use, please float this pin.
NC	28	-	No Connection
NC	29	-	No Connection
GND	30	P	Ground
LED-	31	P	LED Cathode
LED-	32	P	LED Cathode
NC	33	-	No Connection
NC	34	-	No Connection
NC	35	-	No Connection
NC	36	-	No Connection
NC	37	-	No Connection
NC	38	-	No Connection
LED+	39	P	LED Anode
LED+	40	P	LED Anode

Note:

1 This module support 4 lines MIPI mode.

2 FPC Signal interface : 40PIN/P=0.5mm/H=1.0 (HRS FH19SC-40S-0.5SH)

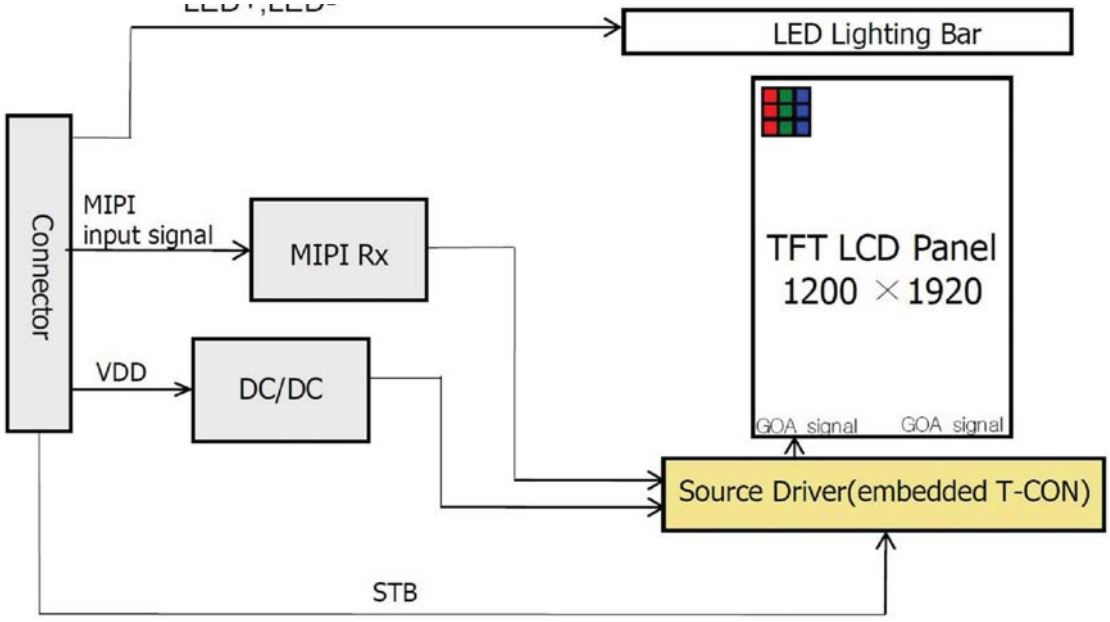
6 MECHANICAL DATA



NO.	Pin name
1	VC
2	VDDSW3.3V
3	VDDSW3.3V
4	VC
5	RESET
6	VC
7	GND
8	MIPI_D0-
9	MIPI_D0+
10	GND
11	MIPI_D1-
12	MIPI_D1+
13	GND
14	MIPI_CLK-
15	MIPI_CLK+
16	GND
17	MIPI_D2-
18	MIPI_D2+
19	GND
20	MIPI_D3-
21	MIPI_D3+
22	GND
23	VC
24	VC
25	GND
26	PWM_EN/NC
27	PWM_OUT/NC
28	VC
29	VC
30	GND
31	LED-
32	LED-
33	VC
34	VC
35	VC
36	VC
37	VC
38	VC
39	LED+
40	LED+

7 ELECTRICAL CHARACTERISTICS

7.1 Block Diagram



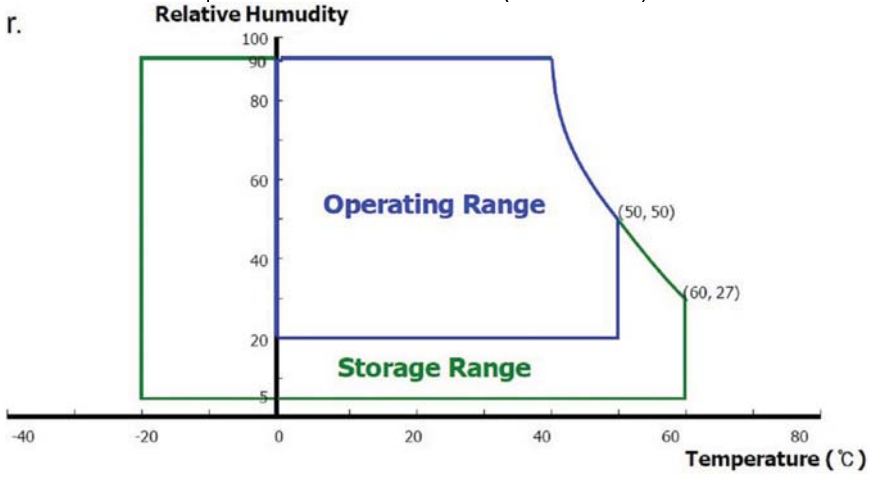
7.2 ABSOLUTE MAXIMUM RATINGS

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 below

Parameter	Symbol	Min.	Max.	Unit	Remarks
Power Supply Voltage (LCD Module)	V_{DD}	-0.3	3.6	V	
LED string Reverse Voltage	V_R	-	2	V	
Operating Temperature	T_{OP}	0	+50	℃	1)
Storage Temperature	T_{ST}	-20	+60	℃	

Notes : 1. Temperature and relative humidity range are shown in the figure below.
wet - bulb temperature at 39 OC or less. (Ta > 40 OC) No condensation of water.

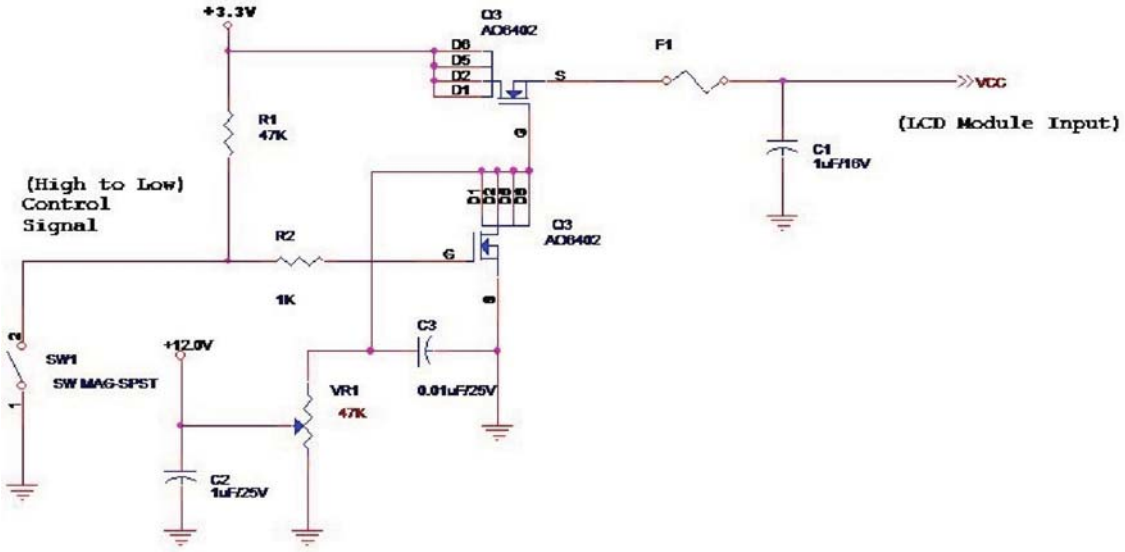
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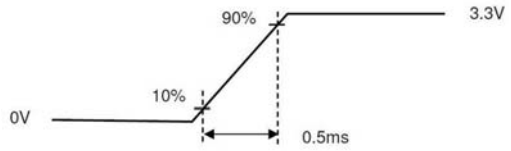


7.3 DC characteristics

Symble	Parameter	Min	Typ	Max	Units	Note
VDD	Logic/LCD Drive Voltage	3.0	3.3	3.6	[Volt]	
PVDD	VDD Power	-	-	0.45	[Watt]	Note 1
IVDD	IDD Current	-	-	150	[mA]	Note 1
Irush	Inrush Current	-	-	2000	[mA]	Note 2

Note 1 : Maximum Measurement Condition:
White Pattern at 3.3V driving voltage. (Pmax=V3.3 x Iwhite)
VDD also provide power to power IC(power IC generate VCC, XON_IN, AVDD, VGH, VGL & VCOM).
Note 2:
Measure Condition



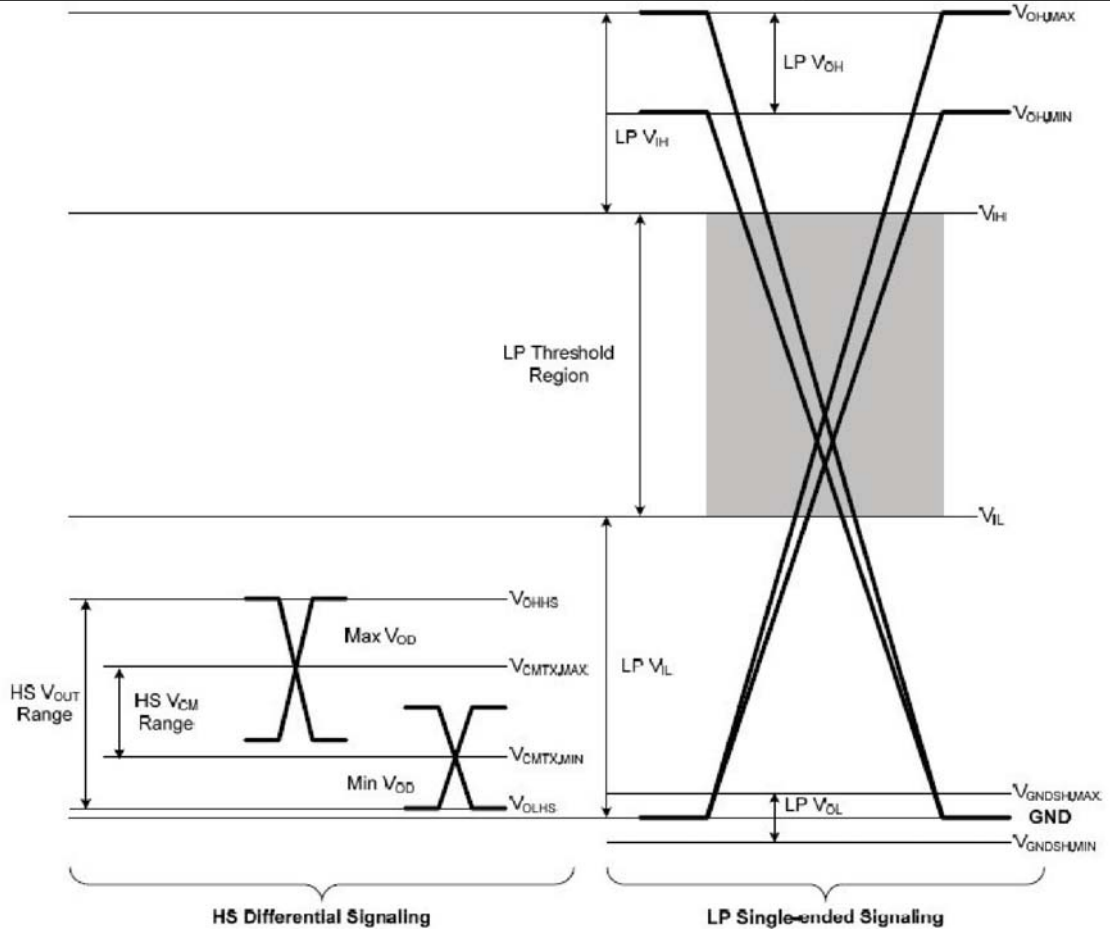


Vin rising time

7.4 Electrical Specification

7.4.1 MIPI INPUT SIGNAL SPEC

MIPI Receiver Differential Input (DC Characteristics)					
Symbol	Parameter	Min	Typ	Max	Unit
BR_{MIPI}	Input data bit rate	200	-	1000	Mbps
V_{CMRX}	Common-mode voltage(HS Rx mode)	155	-	330	mV
V_{IDTH}	Differential input high threshold (HS Rx mode)	-	-	70	mV
V_{IDTL}	Differential input low threshold (HS Rx mode)	-70	-	-	mV
$\lvert V_{IDM} \rvert$	Differential input voltage range (HS Rx mode)	70	-	500	mV
V_{IHHS}	Single-end input high voltage (HS Rx mode)	-	-	460	mV
V_{ILHS}	Single-end input low voltage (HS Rx mode)	-40	-	-	mV
Z_{ID}	Differential input impedance	80	100	125	Ω
V_{IHLP}	Logic 1 input voltage (LP Rx mode)	880			mV
V_{ILLP}	Logic 0 input voltage (LP Rx mode)			550	mV



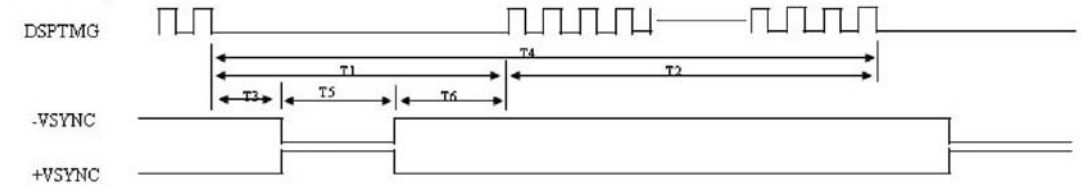
7.4.2 SIGNAL TIMING SPEC

Parameter	Symbol	Min.	Typ.	Max.	Unit
MIPI data frequency	F_{DATA}	955(Note)	999(Note)	1000(Note)	Mbps
Horizontal display area	T_{HD}		1200		pixel
Hsync period time	T_H	1275	1341	1342	pixel
Hsync pulse width	T_{HPW}	1	1	1	pixel
Hsync back porch	T_{HBP}	32	60	60	pixel
Hsync front porch	T_{HFP}	42	80	81	pixel
Vertical display area	T_{VD}		1920		H
Vsync period time	T_V	1981	1981	1982	H
Vsync pulse width	T_{VPW}	1	1	1	H
Vsync back porch	T_{VBP}		25		H
Vsync front porch	T_{VFP}	35	35	36	H

Driving

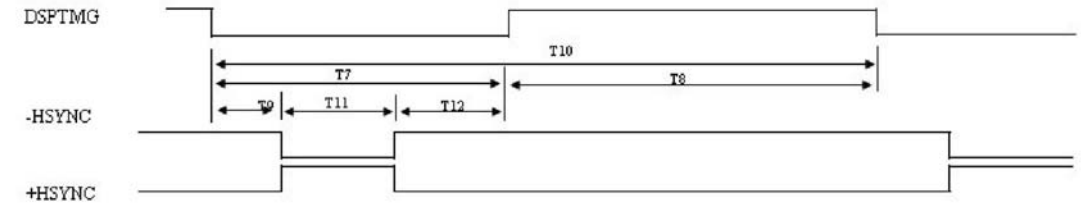
(LVDS Receiver Output)

Vertical Timing



Item	T1 Vertical Blanking	T2 Active Field	T3 VSYNC Front Porch	T4 Frame Time	T5 VSYNC Width	T6 VSYNC Back Porch
Value	20	1920	13	1940	5	2

Horizontal Timing

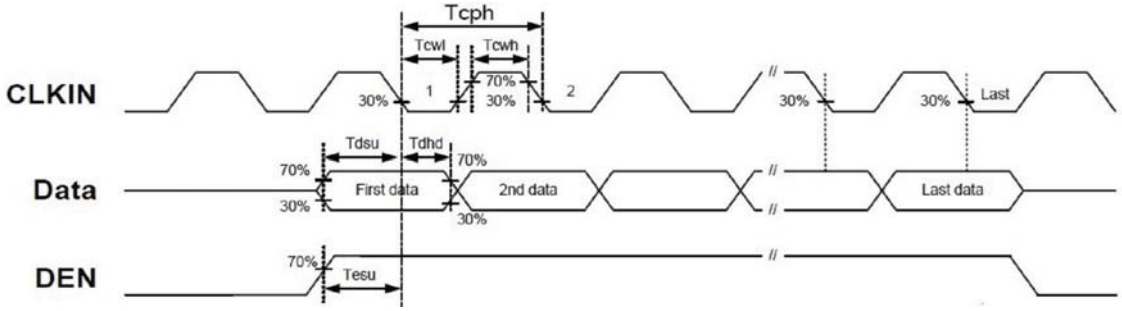


Item	T7 Horizontal Blanking	T8 Active Field	T9 HSYNC Front Porch	T10 H line Time	T11 HSYNC Width	T12 HSYNC Back Porch
Value	140	1200	116	1340	16	8

Dot Timing

Item		Dot Clock Frequency			Data Clock Frequency		
Value		155.976MHz			Dot Clock Frequency		

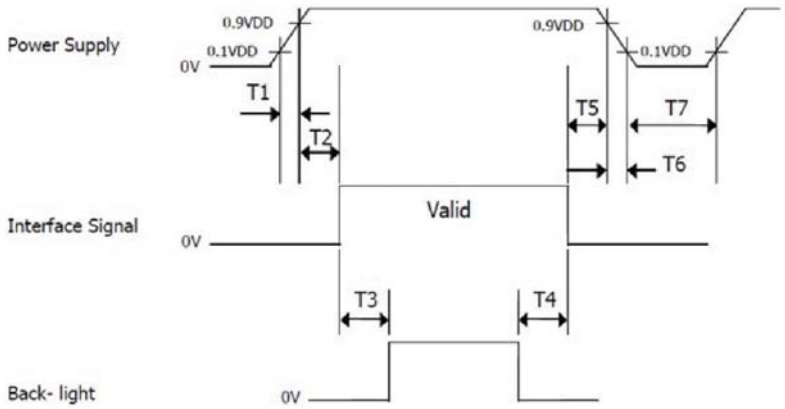
7.4.3 MIPI INPUT DC CHARACTERISTICS



MIPI Receiver Differential Input (DC Characteristics)						
Symbol	Description	Min.	Typ.	Max.	Unit	Condition
BR_{MIPI}	Input data bit rate(4 lane)	980	980	998	Mbps	
V_{CMRX}	Common-mode voltage(HS Rx mode)	155	–	330	mV	
V_{IDTH}	Differential input high threshold (HS Rx mode)	–	–	70	mV	
V_{IDTL}	Differential input low threshold (HS Rx mode)	-70	–	–	mV	
V_{IHHS}	Single-end input high voltage (HS Rx mode)	–	–	460	mV	
V_{ILHS}	Single-end input low voltage (HS Rx mode)	-40	–	–	mV	
Z_{ID}	Differential input impedance	60	75	95	ohm	
V_{IHLP}	Logic 1 input voltage (LP Rx mode)	1100	1200	1300	mV	
V_{ILLP}	Logic 0 input voltage (LP Rx mode)	-150	–	150	mV	

MIPI Receiver Differential Input (DC Characteristics)						
Symbol	Description	Min.	Typ.	Max.	Unit	Condition
T_{MIN-RX}	Minimum pulse width response (LP Rx mode)	50	-	-	ns	
$T_{LP-PULSE-TX}$	Pulse width of the LP exclusive-OR clock	50	-	-	ns	1st clock pulse after STOP state or last clock pulse before STOP state/all other pulse
$T_{RLP / TFLP}$	15%~85% rise time and fall time (LP Tx mode)	-	-	25	ns	
$T_{LP-PER-TX}$	Period of the LP exclusive-OR clock	100	-	-	ns	
UI_{INST}	UI instantaneous	1.0	-	12.5	ns	
T_{SETUP}	Data to clock setup time	0.25	-	-	UI	
T_{HOLD}	Data to clock hold time	0.25	-	-	UI	

7.5 Power Sequence



Parameter	Values			Units
	Min	Typ	Max	
T1	0	-	10	ms
T2	0	-	50	ms
T3	200	-	-	ms
T4	200	-	-	ms
T5	0.5	-	50	ms
T6	0	-	10	ms
T7	500	-	-	ms

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 interface signal are valid.

7.6 Initial Code

MIPI @LP mode	Register(Hex)	Value(Hex)
Step 1 : I2C mode --> MIPI mode	8F	0xA5
Step 2 : Soft Reset	01	0x00
Step 3 : I2C mode --> MIPI mode	8F	0xA5
Step 4 : change Page 1	83	0xAA
	84	0x11
Step 5: Setting	A9	0x4B
Step 6 : return Page 0	83	0x00
	84	0x00

7.7 Backlight Electrical Characteristics

Parameter	Symbol	Min	Typ	Max	Unit	Remark
Forward Voltage	V_F	21.0	22.4	24.5	V	Ta=25℃
Forward Current	I_F	-	80	-	mA	Ta=25℃
LED chips	-	-	28	-	PCS	7(s)*4(p)

8 OPTICAL DATA

8.1 Optical characteristics

The optical characteristics are measured under stable conditions at 25℃(Room Temperature) :

Item		Symbol	Conditions	Min.	Typ.	Max.	Unit	Note
Viewing Angle		θ_R θ_L	Horizontal (Right) CR = 10 (Left)	- -	85 85	- -	degree	1, 6
		ψ_H ψ_L	Vertical (Upper) CR = 10 (Lower)	- -	85 85	- -		
Contrast Ratio		CR		800	1000			1, 3
Cross talk		%		---	---	4		1, 4
Response Time		T_{RT}	Rising + Falling	-	25	35	msec	5
Color / Chromaticity Coodinates	Red	Rx	CIE 1931		TBD			Base on C-Light
		Ry			TBD			
	Green	Gx			TBD			
		Gy			TBD			
	Blue	Bx			TBD			
		By			TBD			
	White	Wx			TBD			
		Wy			TBD			
NTSC		%	-	-	67	-		
Transmittance		%		3.67	4.17	NA		Base on C-Light

Notes:

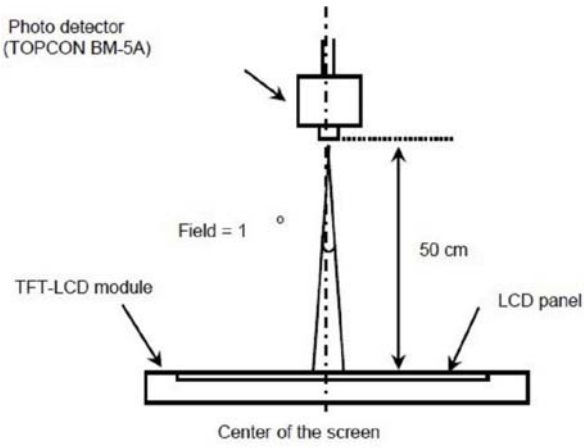
1. Viewing angle is the angle at which the contrast ratio is greater than 10. The viewing angles are determined for the horizontal or 3, 9 o'clock direction and the vertical or 6, 12 o'clock direction with respect to the optical axis which is normal to the LCD surface (see FIGURE 1).
2. Contrast measurements shall be made at viewing angle of Θ= 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 . (see FIGURE
   1) 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 luminance values of 5point 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 2 for a total of the measurements per display, the LED current is set at 20mA.
4. The White luminance uniformity on LCD surface is then expressed as : ΔY = Minimum Luminance of 5 (13)points / Maximum Luminance of 5(13) (points (see FIGURE 2).
5. The color chromaticity coordinates specified in Table 5 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. The electro-optical response time measurements shall be made as FIGURE 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 Td.
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. (See FIGURE 4).

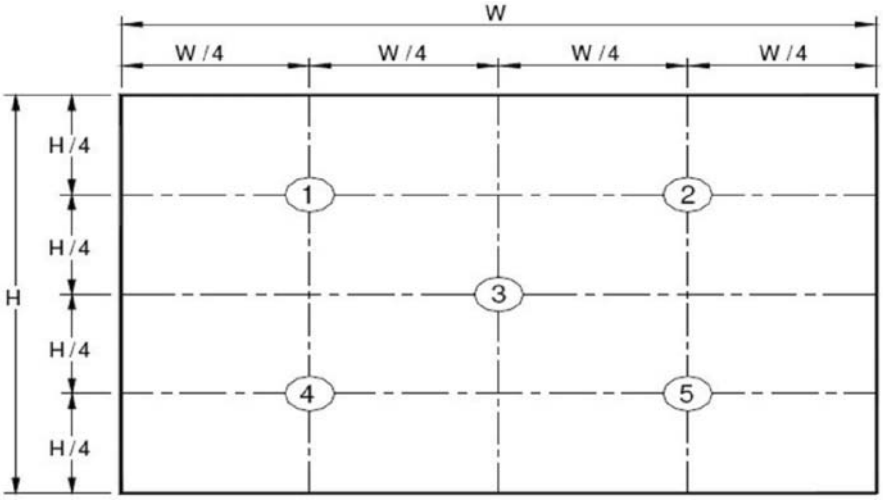
8.2 Optical measurements

8.2.1 FIGURE 1. MEASUREMENT SET UP

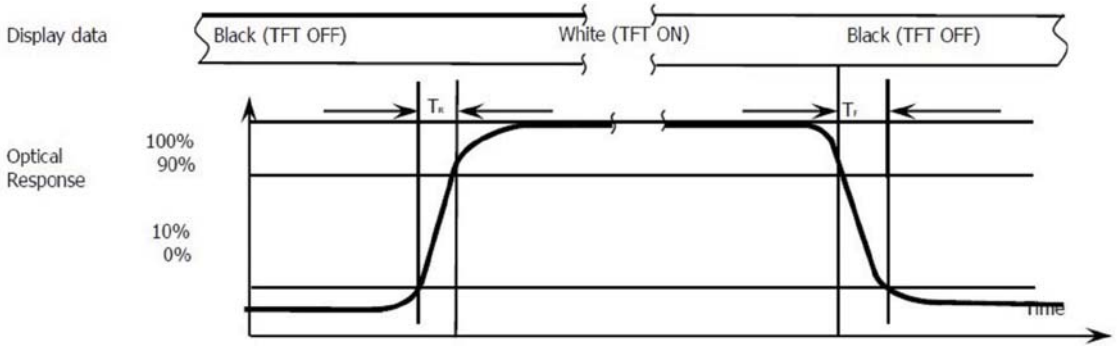


View angel range measurement setup

8.2.2 FIGURE 2. WHITE LUMINANCE AND UNIFORMITY MEASUREMENT LOCATIONS (5 POINTS)

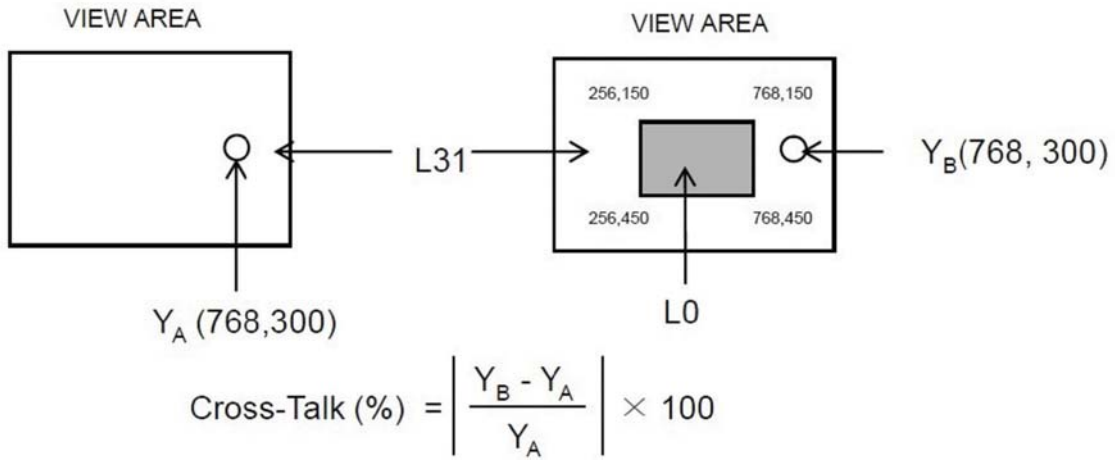


8.2.3 FIGURE 4. RESPONSE TIME TESTING



The electro-optical response time measurements shall be made as shown in FIGURE 4 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 Td.

8.2.4 FIGURE 5. CROSS MODULATION TEST DESCRIPTION



$$\text{Cross-Talk (\%)} = \left| \frac{Y_B - Y_A}{Y_A} \right| \times 100$$

Where:

Y_A = Initial luminance of measured area (cd/m^2)

Y_B = Subsequent luminance of measured area (cd/m^2)

The location measured will be exactly the same in both patterns.

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 (Refer to FIGURE 5).

9 ENVIRONMENTAL DATA

9.1 Environmental tests

Measurements are performed after two hours at room temperature environment unless otherwise specified.

Test item	Test condition	No. of failures / No. of examinations
Low temperature storage test	Ta= -20°C, 240h	0/5
High temperature storage test	Ta= 70°C, 240h	0/5
Low temperature operation test	Ta= -10°C, 240h	0/5
High temperature operation test	Ta= 60°C, 240h	0/5
High temperature & High humidity operation test	Ta= 50°C, 90%RH, 240h	0/5
Thermal Shock	[(-20℃ 30min) → (70℃ 30min)]/cycle, 100cycles	0/5

9.2 Mechanical tests

TEST	CONDITIONS	METHOD	REMARK
Shock test	3 directions: X, Y, Z axes; 6 repeats; peak acceleration = 100 G; pulse duration = 6 ms; ½ sine wave	IEC 60 068-2-27Ea	not operated; not packed

Vibration test	3 directions: X, Y and Z axes; 6 repeats;
	sweep time = 11 minutes;
	peak acceleration = 10 G;
	frequency = 10 to 150 Hz;
		IEC 60 068-2-6Fc	not operated;
			not packed

	amplitude = 1.5 mm; peak-to-peak sine wave		

9.3 Electrostatic discharge (ESD)

TEST	CONDITIONS	METHOD	REMARK
Human Body model	10 kV (330 Ω, 150 pF), excluding input pin	IEC 61000-4-2	Not operating
Machine model	250V (0 Ω, 200 pF)	Mil 883C method 3015	Not operating

9.4 Electromagnetic compatability (EMC)

The target EMC level is CISPR25, level 5. An evaluation is to be performed on the different sample module deliveries. In case of discrepancy, principal and PMDS are to find a mutually acceptable solution.

*Note : The target EMC level is on module level without flexible flat cable.

10 QUALITY REQUIREMENTS

Refer to IIS

11 MALFUNCTIONING

Not allowed are:
- Malfunctioning display: no picture, distinct block or line failure.
- Malfunctioning backlight.
- Excessive start up time (> 3 sec.)

11.1 Appearance

Not allowed are:
- Type and/or serial number wrong, missing or not legible.
- Offensive surface damage.
- Connectors damaged.
- Stains within active area, such as finger prints or adhesive residues.
- Dirty appearance (can not be removed with a dry cloth).

11.2 Packing

Not allowed are:
- Box damaged, wet, badly taped or stapled causing the product not to arrive in good condition at the customer.
- Type or model number wrong, missing or not legible.

12 PACKING

Refer toTSDstandard packing method.

13 HANDLING AND SAFETY REQUIREMENTS

WARNING

The display glass may break when it is dropped or bumped on a hard surface. Handle with care. Should the display break, do not touch the liquid crystalline material. In case of contamination with liquid crystal material, wash immediately with water and soap.
The display module contains parts that operate at high voltage. Under no circumstances should the front or back cover be removed during operation.

CAUTION
At temperatures lower than the rated storage temperature, the liquid crystal solidifies causing permanent damage to the display.
At temperatures higher than the rated storage temperature, the liquid crystal turns into an isotropic liquid and may not recover.
The display module should not be exposed to harmful gases, such as acid and alkali gases, which corrode electronics components.
Disassembling the display module can cause permanent damage and invalidates the warranty agreements.
Observe general precautions that are common to handling delicate electronic components. The glass can break and polarizers can easily be damaged. Moreover the display is sensitive to static electricity (see also Section 11) and other rough environmental conditions.

14 MOUNTING

CAUTION
Allow enough space at the back of the module for sufficient airflow to disperse heat generated by the backlighting system.

15 DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains goal specifications for product development.
Development Specification	This data sheet contains target data; supplementary data may be published later. The target data will be evaluated after production.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

16 LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury.TSD customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnifyTSDfor any damages resulting from such improper use or sale.

17 NOTES

Reading *list*

This document was read and the content is in accordance with the project requirements.

Name	Comment	Date	Signature

Changes

Version	Modifications	Where	Date	Name
0.0	First Issue	-	2015.11.30	Linqin Huang
0.1	Updated pin define, add reset pin	P4	2015.12.17	