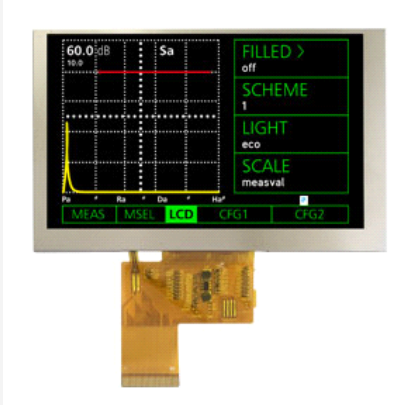


# TFT DISPLAY MODULE

## *Product Specification*

Customer	Standard		
Product Number	DMT050WVHTNT0-1A		
Customer Part Number			
Customer Approval		Date:	

### Internal Approvals

Product Mgr	Doc. Control	Electr. Eng
Luo Luo	Luo Luo	Eric Wan
Date: 14/11/17	Date: 14/11/17	Date: 20/10/17

# Revision Record

Rev.	Date	Page	Chapt.	Comment	ECR no.
1.0	20-Oct-17	All	All	Initial Release	

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## 1.0 Main Features

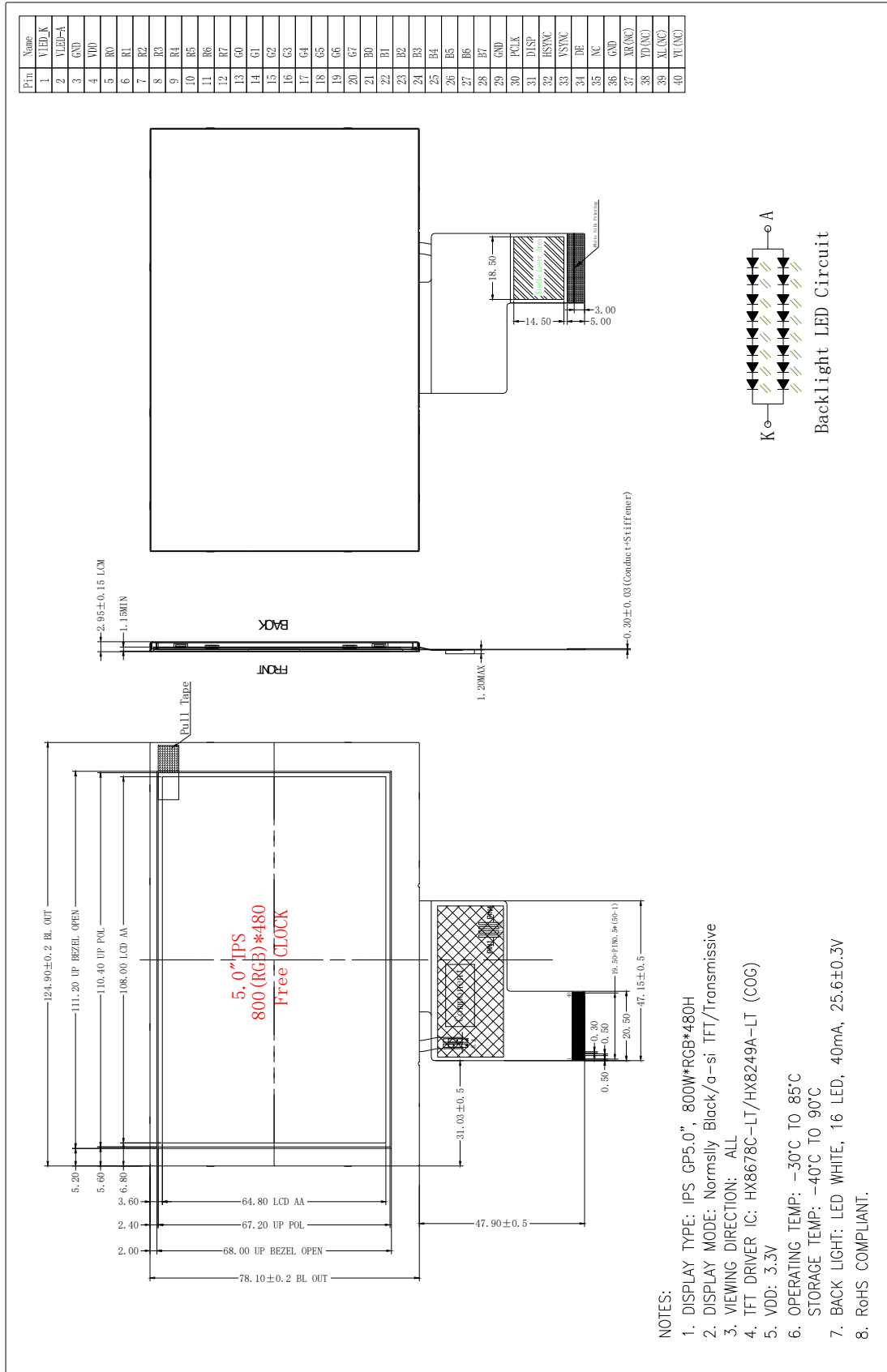
Item	Contents
Screen Size	5.0" Diagonal
Display Format	800 x RGB x 480 Dots
N° of Colour	65K/262K/16.7M
Active Area	108 mm (H) x 64.8 mm (V)
LCD Type	TFT
Mode	Transmissive / Normally Black
Viewing Direction	ALL
TFT Interface	16/18/24-Bit RGB Interface
TFT Driver IC	HX8678C and HX8249A
Backlight Type	LED
Operating Temperature	-30°C ~ +85°C
Storage Temperature	-40°C ~ +90°C
RoHS compliant	Yes

## 2.0 Mechanical Specification

### 2.1 Mechanical Characteristics

Item	Characteristic	Unit
Overall Dimensions	124.9 mm (H) x 78.1 mm (V) x 2.95 mm (D)	mm
pixel Pitch	135 (H) x 135 (V)	μm
Weight	59	g

## 2.2 Mechanical Drawing



## 3.0 Electrical Specification

### 3.1 Absolute Maximum Ratings

Item	Symbol	Condition	Min	Max	Unit	Note
Power Supply Voltage LCM	VDD		-0.3	4.0	V	
Operating Temperature	TOP		-30	85	°C	1
Storage Temperature	TST		-40	90	°C	1,2,3

**Note 1.** 90 % RH Max for  $T_a < 50$  °C, and 60% RH for  $T_a \geq 50$ °C.

**Note 2.** In case of below 0°C, the response time of liquid crystal (LC) becomes slower and the colour of panel becomes darker than normal one. Level of retardation depends on temperature, because of LC's characteristic.

**Note 3.** Only operation is guaranteed at operating temperature. Contrast, response time, another display quality are evaluated at +25°C.

### 3.2 Electrical Characteristics

Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Supply Voltage	VDD	$T_a = 25$ °C	3.0	3.3	3.6	V	
Input Voltage for Logic	V <sub>IH</sub>		0.7VDD	-	VDD	V	
	GND		GND	-	0.3 VDD	V	
Output Voltage for Logic	V <sub>OH</sub>		0.8VDD	-	VDD	V	
	V <sub>OL</sub>		GND	-	0.2VDD	V	
Current Consumption	I <sub>DD</sub>		-	65	-	mA	1

**Note 1:** The specified power consumption is under the conditions of VDD=3.3V.



## 3.3 Interface Pin Assignment

### 3.3.1 TFT Pin Assignment

No.	Symbol	Function
1	LEDK	Cathode pin of backlight
2	LEDA	Anode pin of backlight
3	GND	Ground.
4	VDD	Supply voltage(3.3V).
5	R0	Red data input.
6	R1	Red data input.
7	R2	Red data input.
8	R3	Red data input.
9	R4	Red data input.
10	R5	Red data input.
11	R6	Red data input.
12	R7	Red data input.
13	G0	Green data input.
14	G1	Green data input.
15	G2	Green data input.
16	G3	Green data input.
17	G4	Green data input.
18	G5	Green data input.
19	G6	Green data input.
20	G7	Green data input.
21	B0	Blue data input.
22	B1	Blue data input.
23	B2	Blue data input.
24	B3	Blue data input.
25	B4	Blue data input.

No.	Symbol	Function
26	B5	Blue data input.
27	B6	Blue data input.
28	B7	Blue data input.
29	GND	Ground.
30	PCLK	Clock signal. Latching data at the rising edge
31	DISP	Standby setting for testing, it should be connected to VDDIO in normal operation mode. If connected to GND, the IC is in standby mode.
32	HSYNC	Horizontal Sync input. Negative polarity.
33	VSYNC	Vertical Sync input. Negative polarity.
34	DE	Data input Enable. Active High to enable the data input Bus under "DE Mode".
35	NC	Not Connected
36	GND	Ground.
37	XR(NC)	Resistive touch panel Right Glass Terminal(Not Connected)
38	YD(NC)	Resistive touch panel Bottom Film Terminal(Not Connected)
39	XL(NC)	Resistive touch panel Left Glass Terminal(Not Connected)
40	YU(NC)	Resistive touch panel Top Film Terminal(Not Connected)

## 3.4 Timing Characteristics

### 3.4.1 Input Signal Timing

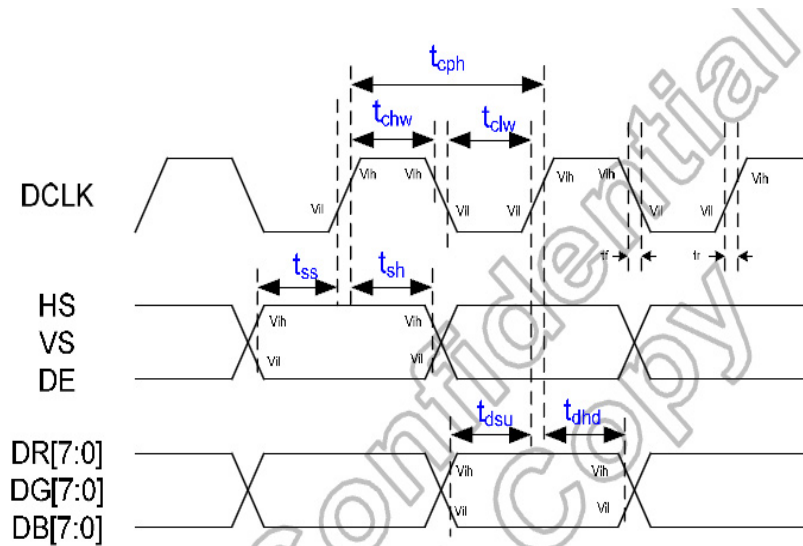


Figure 7.1: TTL input timing

Parameter	Symbol	Spec.			Unit
		Min.	Typ.	Max.	
DCLK period	$T_{cph}$	16.8	-	-	ns
DCLK clock high width	$T_{chw}$	6	-	-	ns
DCLK clock low width	$T_{clw}$	6	-	-	ns
VS setup time	$T_{ss}$	5	-	-	ns
VS hold time	$T_{sh}$	5	-	-	ns
HS setup time	$T_{ss}$	5	-	-	ns
HS hold time	$T_{sh}$	5	-	-	ns
DE setup time	$T_{ss}$	5	-	-	ns
DE hold time	$T_{sh}$	5	-	-	ns
Data setup time	$T_{dsu}$	5	-	-	ns
Data hold time	$T_{dhd}$	5	-	-	ns
Input signal rising time	$T_r$	-	-	10	ns
Input signal falling time	$T_f$	-	-	10	ns

### 3.4.2 Parallel RGB at Sync mode(when R9=0Ω)

- Horizontal

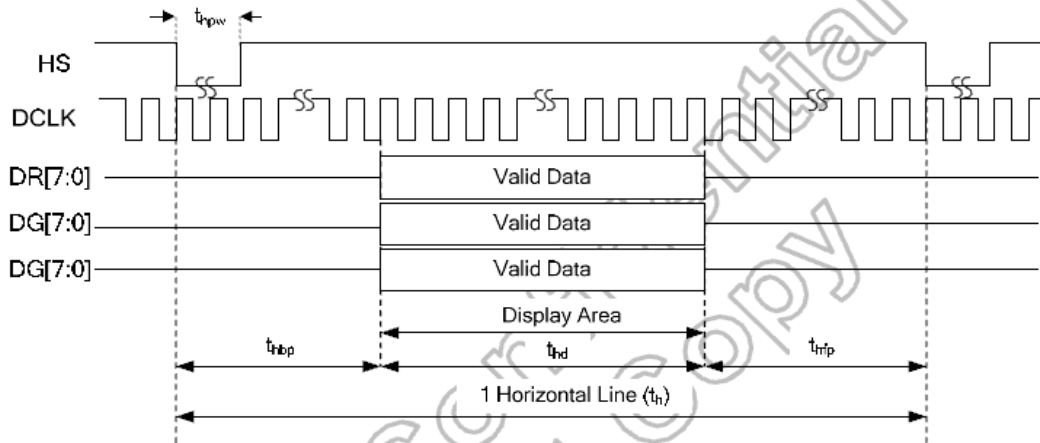
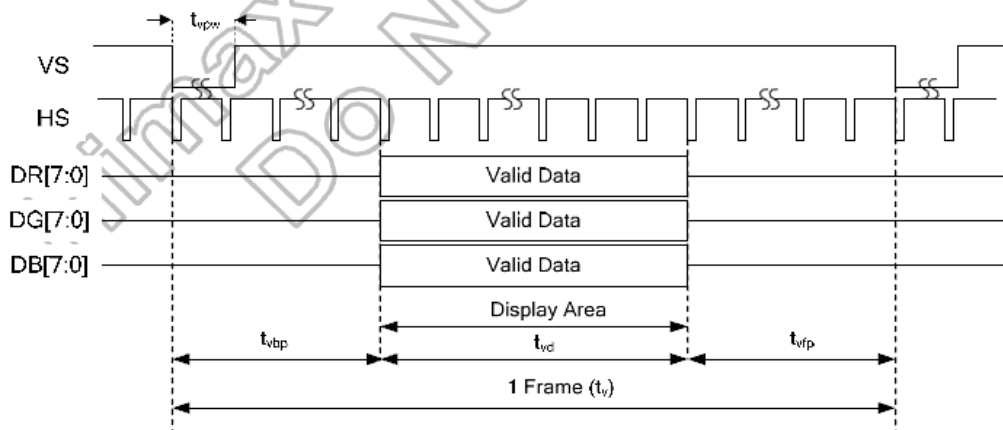


Figure 7.7: Horizontal input timing at Sync mode

- Vertical



Parameter	Symbol	Panel resolution									Unit
		800xRGBx480 (RS[3:0]=6h)			800xRGBx1280 (RS[3:0]=7h)			960xRGBx160 (RS[3:0]=8h)			
		Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
DCLK frequency	$F_{DCLK}$	25.2	27.2	30.5	66.3	69.4	77.7	10.4	11.8	14.8	MHz
Horizontal valid data	$t_{hd}$	800			800			960			DCLK
Hsync pulse width	$t_{hpw}$	1	2	100	1	2	100	1	2	124	DCLK
Hsync back porch	$t_{hbp}$	5	16	101	5	16	101	5	16	125	DCLK
Hsync front porch	$t_{hfp}$	19	44	115	19	44	115	19	44	139	DCLK
1 horizontal line	$t_h$	856	860	920	856	860	920	1016	1020	1104	DCLK
Vertical valid data	$t_{vd}$	480			1280			160			H
Vsync pulse width	$t_{vpw}$	1	2	66	1	2	122	1	2	58	H
Vsync back porch	$t_{vbp}$	5	5	67	5	5	123	5	5	59	H
Vsync front porch	$t_{vfp}$	5	43	67	5	59	123	5	27	59	H
1 vertical field	$t_v$	490	528	552	1290	1344	1408	170	192	224	H

### 3.4.3 Parallel RGB at DE mode (when R10=0Ω default)

#### • Horizontal

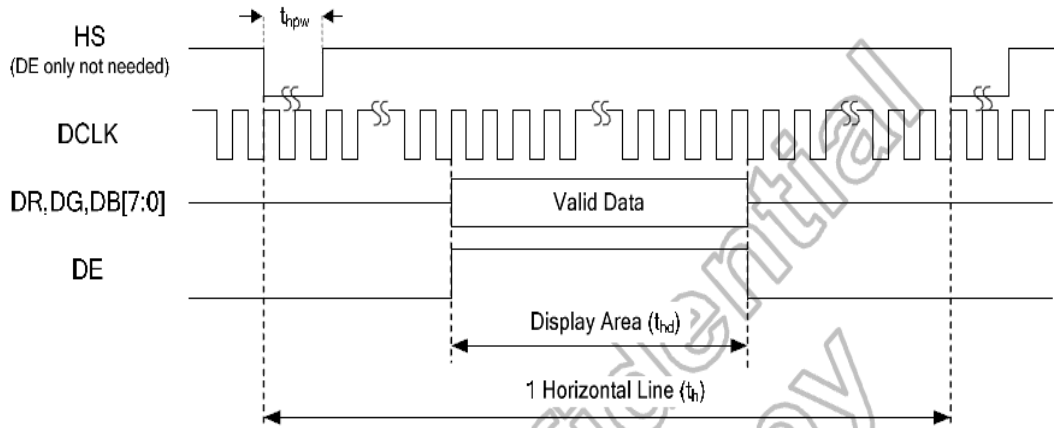
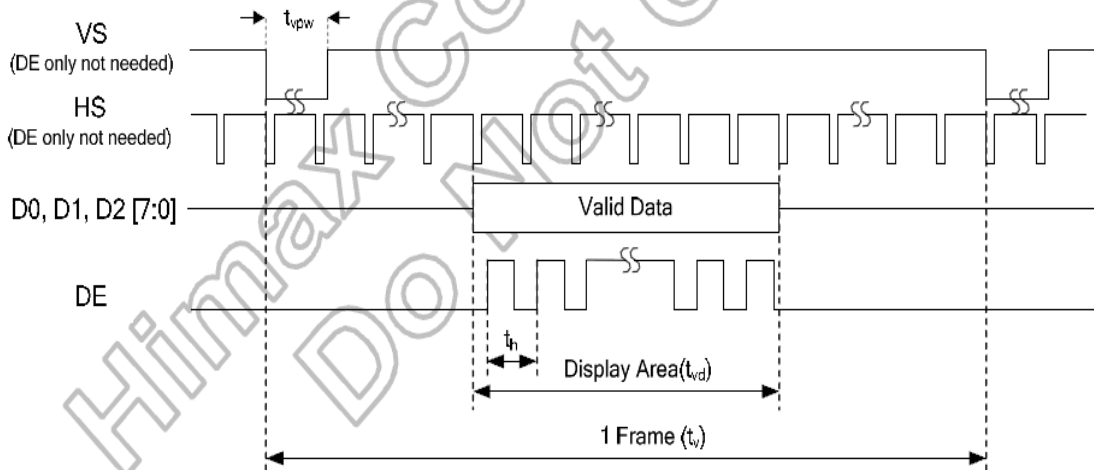


Figure 7.9: Horizontal input timing at DE only mode

#### • Vertical



Parameter	Symbol	Panel Resolution									Unit
		800xRGBx480 (RS[3:0]=6h)			800xRGBx1280 (RS[3:0]=7h)			960xRGBx160 (RS[3:0]=8h)			
		Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
DCLK frequency	$F_{DCLK}$	25.2	27.2	30.5	66.3	69.4	77.7	10.4	11.8	14.8	MHz
Horizontal valid data	$t_{hd}$	800			800			960			
1 horizontal line	$t_h$	856	860	920	856	860	920	1016	1020	1104	DCLK
Vertical valid data	$t_{vd}$	480			1280			160			
1 vertical field	$t_v$	490	528	552	1290	1344	1536	170	192	224	H

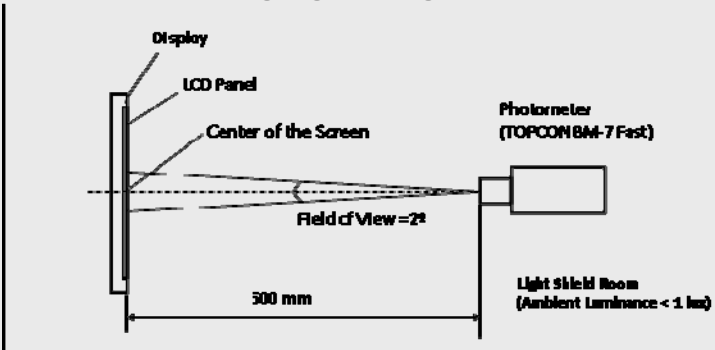
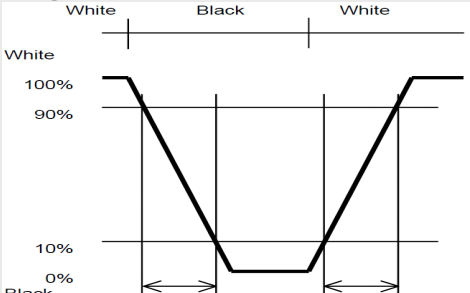
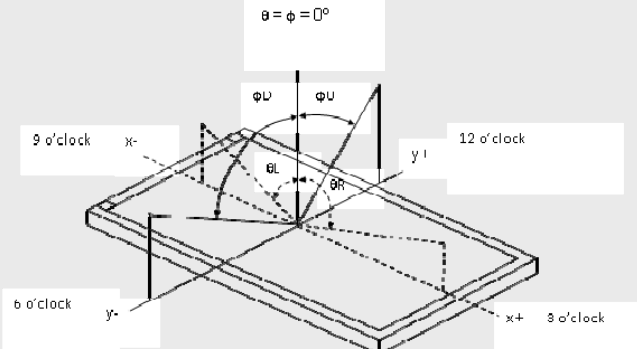
# 4.0 Optical Specification

## 4.1 Optical Characteristics

Measuring instruments : LCD-5100, Eldim, Topcon BM-7  
 Driving condition: VDD = 3.3V, VSS = 0V  
 Backlight: IF=40mA  
 Measured temperature: Ta = 25 °C

Item	Symbol	Condition	Min	Typ	Max	Unit	Note	
Response Time	TR+TF	$\theta=\phi=0^\circ$ Normal Viewing Angle	-	35	40	ms	2	
Contrast Ratio	CR		-	1000	-		3	
Viewing Angle	Left	$\theta_L$	CR $\geq$ 10	-	85	-	deg	4
	Right	$\theta_R$		-	85	-	deg	
	Up	$\phi_U$		-	85	-	deg	
	Down	$\phi_D$		-	85	-	deg	
Colour Chromaticity	Red	Rx	CR $\geq$ 10	0.579	0.619	0.659	-	5
		Ry		0.306	0.346	0.386	-	
	Green	Gx		0.286	0.326	0.366	-	
		Gy		0.585	0.625	0.665	-	
	Blue	Bx		0.105	0.145	0.185	-	
		By		0.045	0.085	0.125	-	
	White	Wx		0.275	0.325	0.365	-	
		Wy		0.326	0.366	0.406	-	
Centre Brightness			650	700	-	cd/m <sup>2</sup>	6	
Brightness Distribution			80	-	-	%	7	

## 4.1.1 Test Method

Note	Item	Test Method
1	Setup	<p>The display should be stabilised at a given temperature for 30 minutes to avoid abrupt temperature change during measuring. In order to stabilise the luminance, measurements should be executed after lighting the backlight for 30 minutes in a windless room.</p>  <p>The diagram illustrates the test setup. A display with an LCD panel is shown. A phometer (TOPCON BM-7 Fast) is positioned 500 mm away from the center of the screen. The field of view is 2°. The measurement is conducted in a light shield room with ambient luminance &lt; 1 lux.</p>
2	Response time	<p>Measure output signal waveform by the luminance meter when raster of window pattern is changed from white to black and from black to white.</p>  <p>The diagram shows a timing diagram for response time measurement. It depicts a signal waveform that transitions from 100% white to 0% black and back to 100% white. The time taken for the signal to rise from 10% to 90% is labeled as TON, and the time taken to fall from 90% to 10% is labeled as TOFF.</p>
3	Contrast ratio	<p>Measure maximum brightness and minimum brightness at the centre of the screen by displaying raster or window pattern. Then calculate the ratio between these two values.</p> $\text{Contrast Ratio (CR)} = \frac{\text{Brightness of unselected position (white)}}{\text{Brightness of selected position (black)}}$
4	Viewing angle Horizontal $\theta$ Vertical $\phi$	<p>Move the luminance meter from right to left and up and down and determine the angles where contrast ratio is 10</p>  <p>The diagram shows a 3D perspective of a rectangular display. The center is the origin of a coordinate system with x and y axes. Viewing angles are defined as <math>\theta</math> (horizontal) and <math>\phi</math> (vertical). Clock positions (9, 12, 3, 6 o'clock) are marked to indicate directions. The condition <math>\theta = \phi = 0^\circ</math> is noted at the top.</p>
5	Colour chromaticity	Measure chromaticity coordinates x and y of CIE1931 colorimetric system
6	Centre brightness	Measure the brightness at the centre of the screen
7	Brightness distribution	<p>(Brightness distribution) = <math>100 \times B/A \%</math>  A: max. brightness of the 9 points  B: min. brightness of the 9 points</p>

# 5.0 Backlight Specification

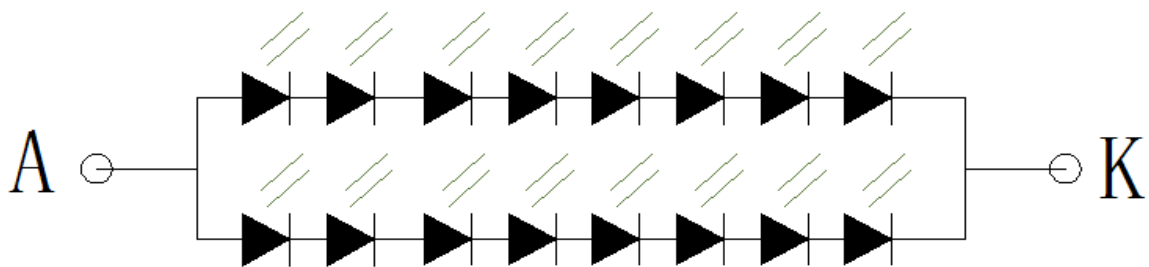
## 5.1 LED Driving Conditions

Item	Symbol	Condition	Min	Typ	Max	Unit
Forward Current	IF	Ta=25 °C	30	40	-	mA
Forward Voltage	VF	Ta= 25°C		25.6		V
LED life time	Hr				50k	hour

Note:

- The lifetime of the LED is defined as a period till the brightness of the LED decreases to the half of its initial value.
- This figure is given as a reference purpose only, and not a guarantee.
- This figure is estimated for an LED operating alone.  
The performance of an LED may differ when assembled as a monitor together with a TFT panel due to different environmental temperature.
- Estimated lifetime could vary on a different temperature and usually higher temperature could reduce the life significantly.

## 5.2 LED Circuit



# Backlight LED Circuit

LED Circuit Drawing



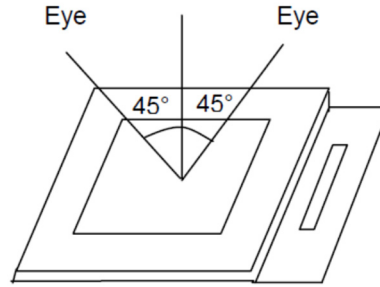
# 6.0 Quality Assurance Specification

## 6.1 Delivery Inspection Standards

### 6.1.1 Inspection Conditions

Inspection distance: 30 cm ± 2 cm

Viewing angle: ±45°



### 6.1.2 Environmental Conditions

Ambient temperature: 25°C ±5°C

Ambient humidity: 65±10% RH

Ambient illumination: 300~700 lux

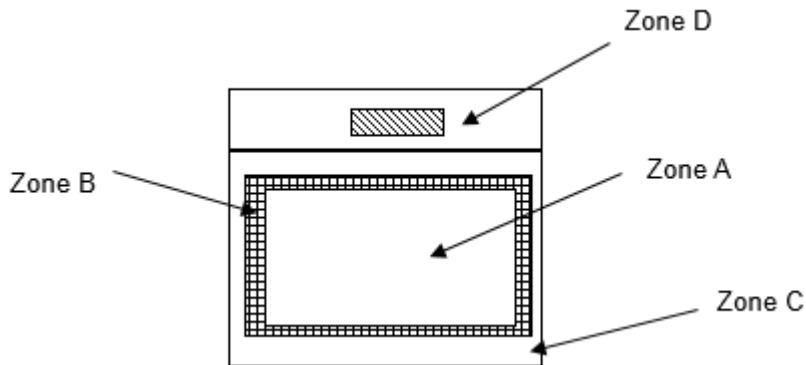
### 6.1.3 Sampling Conditions

1. Lot size: quantity of shipment lot per model
2. Sampling method:

Sampling Plan		GB/T 2828-2003
		Normal inspection, Class II
AQL	Major Defect	0.65%
	Minor Defect	1.5%

No	Items to be inspected	Criteria	Classification of defects
1	Functional defects	1) No display, Open or miss line 2) Display abnormally, Short 3) Backlight no lighting, abnormal lighting. 4) TP no function	Major
2	Missing	Missing component	
3	Outline dimension	Overall outline dimension beyond the drawing is not allowed	
4	Color tone	Color unevenness, refer to limited sample	Minor
5	Spot Line defect	Light dot , Dim spot,Polarizer Bubble ; Polarizer accidented spot.	
6	Soldering appearance	Good soldering , Peeling off is not allowed.	

#### 6.1.4 Definition of Area



Zone A : Effective Viewing Area(Character or Digit can be seen)

Zone B : Viewing Area except Zone A

Zone C : Outside (Zone A+Zone B) which can not be seen after assembly by customer .)

Zone D : IC Bonding Area

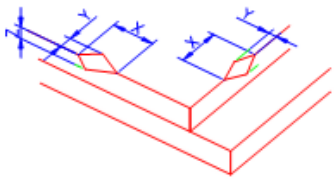
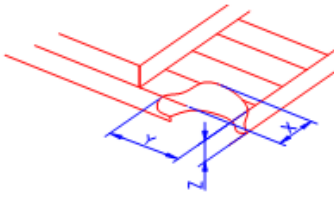
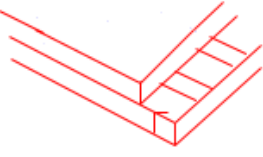
Note:

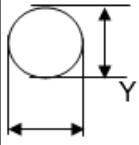
As a general rule ,visual defects in Zone C can be ignored when it doesn't effect product function or appearance after assembly by customer

#### 6.1.5 Basic Principle

A set of sample to indicate the limit of acceptable quality level shall be discussed should a dispute occur.

### 6.1.6 Inspection Criteria

Number	Items	Criteria(mm)						
1.0 LCD Crack/Broken NOTE: X: Length Y: Width Z: Height L: Length of ITO, T: Height of LCD	(1) The edge of LCD broken	 <table border="1" data-bbox="770 562 1374 689"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤3.0mm</td> <td>&lt;Inner border line of the seal</td> <td>≤T</td> </tr> </tbody> </table>	X	Y	Z	≤3.0mm	<Inner border line of the seal	≤T
	X	Y	Z					
	≤3.0mm	<Inner border line of the seal	≤T					
(2)LCD corner broken	 <table border="1" data-bbox="837 987 1307 1068"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤3.0mm</td> <td>≤L</td> <td>≤T</td> </tr> </tbody> </table>	X	Y	Z	≤3.0mm	≤L	≤T	
X	Y	Z						
≤3.0mm	≤L	≤T						
(3) LCD crack	 <p data-bbox="997 1339 1141 1400">Crack Not allowed</p>							

2.0	<p>Spot defect</p>  <p><math>\Phi=(X+Y)/2</math></p>	① light dot (LCD/TP/Polarizer black/white spot , light dot, pinhole, dent, stain )																							
		<table border="1"> <thead> <tr> <th rowspan="2">Zone Size (mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td><math>\Phi \leq 0.10</math></td> <td colspan="3">Ignore</td> </tr> <tr> <td><math>0.10 &lt; \Phi \leq 0.25</math></td> <td colspan="3">3( distance <math>\geq 10\text{mm}</math>)</td> </tr> <tr> <td><math>0.25 &lt; \Phi \leq 0.3</math></td> <td colspan="3">2</td> </tr> <tr> <td><math>\Phi &gt; 0.35</math></td> <td colspan="3">0</td> </tr> </tbody> </table>	Zone Size (mm)	Acceptable Qty			A	B	C	$\Phi \leq 0.10$	Ignore			$0.10 < \Phi \leq 0.25$	3( distance $\geq 10\text{mm}$ )			$0.25 < \Phi \leq 0.3$	2			$\Phi > 0.35$	0		
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$0.25 < \Phi \leq 0.3$	2																								
$\Phi > 0.35$	0																								
② Dim spot (LCD/TP/Polarizer dim dot, light leakage, dark spot)																									
<table border="1"> <thead> <tr> <th rowspan="2">Zone Size (mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td><math>\Phi \leq 0.1</math></td> <td colspan="3">Ignore</td> </tr> <tr> <td><math>0.10 &lt; \Phi \leq 0.25</math></td> <td colspan="3">3( distance <math>\geq 10\text{mm}</math>)</td> </tr> <tr> <td><math>0.25 &lt; \Phi \leq 0.3</math></td> <td colspan="3">2</td> </tr> <tr> <td><math>\Phi &gt; 0.35</math></td> <td colspan="3">0</td> </tr> </tbody> </table>	Zone Size (mm)	Acceptable Qty			A	B	C	$\Phi \leq 0.1$	Ignore			$0.10 < \Phi \leq 0.25$	3( distance $\geq 10\text{mm}$ )			$0.25 < \Phi \leq 0.3$	2			$\Phi > 0.35$	0				
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④ Pixel bad points (light dot, Dim dot, color dot)																									
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3.0	Line defect (LCD/TP /Polarizer backlight black/white line, scratch, stain)	Width(mm)	Length(m m)	Acceptable Qty		
				A	B	C
		$\Phi \leq 0.05$	Ignore	Ignore		
		$0.05 < W \leq 0.06$	$L \leq 3.0$	$N \leq 2$		
		$0.07 < W \leq 0.08$	$L \leq 2.0$	$N \leq 1$		
	$0.08 < W$	Define as spot defect				
4.0	Electronic Comp onents SMT	Not allow missing parts , solderless connection , cold solder joint , mis match , The positive and negative polarity opposite				
5.0	Display color& B rightness	1. Color : Measuring the color coordinates, The measurement standar d according to the datasheet or samples. 2. Brightness : Measuring the brightness of White screen, The measu rement standard according to the datasheet or Samples.				

Criteria ( functional items)

Number	Items	Criteria (mm)
1	No display	Not allowed
2	Missing segment	Not allowed
3	Short	Not allowed
4	Backlight no lighting	Not allowed
5	TP no function	Not allowed

### 6.1.7 Classification of Defects

Visual defects (except no or wrong label) are treated as minor defects, while electrical defects are treated as major defects.

Two minor defects are equal to one major defect in lot sampling inspection.

### 6.1.8 Identification / marking criteria

Any unit with illegible / wrong / double or no marking / label shall be rejected.

## 6.2 Dealing with Customer Complaints

### 6.2.1 Non-conforming analysis

Purchaser should supply Densitron with detailed data of non-conforming sample. After accepting it, Densitron should complete the analysis in two weeks from receiving the sample.

If the analysis cannot be completed on time, Densitron must inform the purchaser.

### 6.2.2 Handling of non-conforming displays

If any non-conforming displays are found during customer acceptance inspection which Densitron is clearly responsible for, return them to Densitron.

Both Densitron and customer should analyse the reason and discuss the handling of non-conforming displays when the reason is not clear.

Equally, both sides should discuss and come to agreement for issues pertaining to modification of Densitron quality assurance standard.

# 7.0 Reliability Specification

## 7.1 Reliability Tests

Test Item		Test Condition		Sample Size
Durability Test	High Temperature Operation	Ta= 85°C	96h	3pcs
	Low Temperature Operation	Ta=-30°C	96h	3pcs
	High Temperature Storage	Tp= 90°C	96h	3pcs
	Low Temperature Storage	Tp= -40°C	96h	3pcs
	ESD Test	150pF, 330Ω, ±6KV (Contact)/±8KV (Air), 5 Points/panel, 10 times/point		3pcs
	Thermal Shock Resistance	The sample should be allowed to stand the following 5 cycles of operation: LTS for 30 minutes -> normal temperature for 5 minutes -> HTS for 30 minutes -> normal temperature for 5 minutes, as one cycle, then taking it out and drying it at normal temperature, and allowing it stand for 24 hours		3pcs
	Box Drop Test	1 Corner 3 Edges 6 faces, 80 cm (Medium Box)		1 box

Note: Ta=ambient temperature Tp= Panel temperature

Notes:

1. No dew condensation to be observed.
2. The function test shall be conducted after 4 hours storage at the normal temperature and humidity after removed from the test chamber.
3. No cosmetic or functional defects should be allowed.
4. Total current consumption should be less than twice the initial value.

# 8.0 Handling Precautions

## **Safety**

If the LCD panel breaks, be careful not to get the liquid crystal fluid in your mouth or in your eyes.

If the liquid crystal touches your skin or clothes, wash it off immediately using soap and plenty of water.

## **Mounting and Design**

Place a transparent plate (e.g. acrylic, polycarbonate or glass) on the display surface to protect the display from external pressure. Leave a small gap between the transparent plate and the display surface.

When assembling with a zebra connector, clean the surface of the pads with alcohol and keep the surrounding air very clean.

Design the system so that no input signal is given unless the power supply voltage is applied.

## **Caution during LCD cleaning**

Lightly wipe the display surface with a soft cloth soaked with Isopropyl alcohol, Ethyl alcohol or Trichlorotrifluoroethane.

Do not wipe the display surface with dry or hard materials that will damage the polariser surface.

Do not use aromatic solvents (toluene and xylene), or ketonic solvents (ketone and acetone).

## **Caution against static charge**

As the display uses C-MOS LSI drivers, connect any unused input terminal to VDD or VSS. Do not input any signals before power is turned on. Also, ground your body, work/assembly table and assembly equipment to protect against static electricity.

## **Packaging**

Displays use LCD elements, and must be treated as such. Avoid strong shock and drop from a height. To prevent displays from degradation, do not operate or store them exposed directly to sunshine or high temperature/humidity.

## **Caution during operation**

It is indispensable to drive the display within the specified voltage limit since excessive voltage shortens its life. Direct current causes an electrochemical reaction with remarkable deterioration of the display quality. Give careful consideration to prevent direct current during ON/OFF timing and during operation. Response time is extremely delayed at temperatures lower than the operating temperature range while, at high temperatures, displays become dark. However, this phenomenon is reversible and does not mean a malfunction or a display that has been permanently damaged. If the display area is pushed on hard during operation, some graphics will be abnormally displayed but returns to a normal condition after turning off the display once. Even a small amount of condensation on the contact pads (terminals) can cause an electro-chemical reaction which causes missing rows and columns. Give careful attention to avoid condensation.

## **Storage**

Store the display in a dark place where the temperature is  $25^{\circ}\text{C} \pm 10^{\circ}\text{C}$  and the humidity below 50%RH. Store the display in a clean environment, free from dust, organic solvents and corrosive gases. Do not crash, shake or jolt the display (including accessories).