LIQUID CRYSTAL DISPLAY MODULE

Product Specification

CUSTOMER	**Standard**
CUSTOMER PART NUMBER	
PRODUCT NUMBER	**DET121XGNLNT0M-1A**

Product Mgr	Design Eng
Bruno Recaldini	**Sunny**
Date: 24-Dec-13	Date: 24-Dec-13

TABLE OF CONTENTS

REVISION RECORD

Rev.	Date	Page	Chapt.	Comment	ECN no.
1.0	24-Dec-13			Initial Release	

1 MAIN FEATURES

ITEM	CONTENTS
Screen Size	12.1” Diagonal
Display Format	1024 x RGB x 768 Dots
N° of Colour	16.7M
Overall Dimensions	279 mm (H) x 209 mm (V) x 9 mm (D)
Active Area	245.76 mm (H) x 184.32 mm (V)
LCD Type	TFT
Mode	Transmissive / Normally White
Viewing Direction	Full view
Electrical Interface	LVDS
Backlight Type	LED
Operating Temperature	-20°C ~ +70°C
Storage Temperature	-30°C ~ +80°C
RoHS compliant	Yes

2 MECHANICAL SPECIFICATION

2.1 MECHANICAL CHARACTERISTICS

ITEM	CHARACTERISTIC	UNIT
Display Format	1024 x RGB x 768 Dots	Dots
Overall Dimensions	279 (H) x 209 (V) x 9 (D)	mm
Active Area	245.76 (H) x 184.32 (V)	mm
pixel Pitch	0.24 (H) x 0.24 (V)	mm
Weight	545 (MAX)	g

2.2 MECHANICAL DRAWING

Fig1: Reference outline drawing: Front side

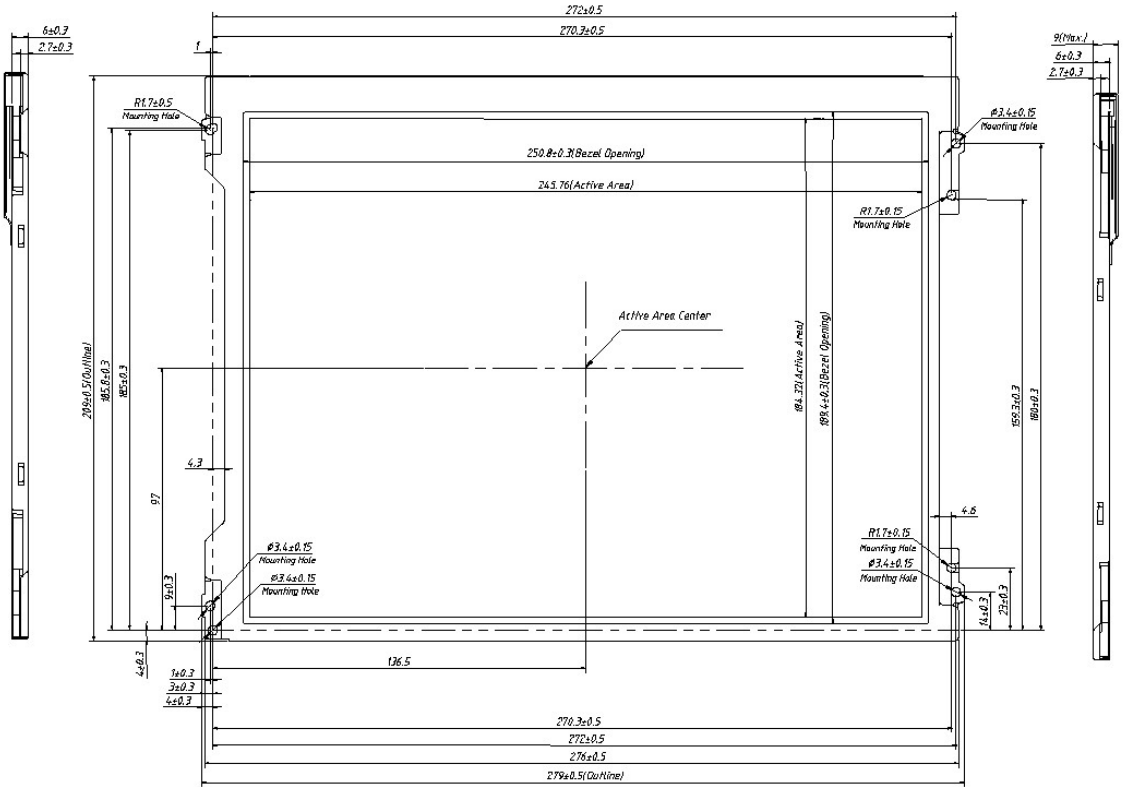
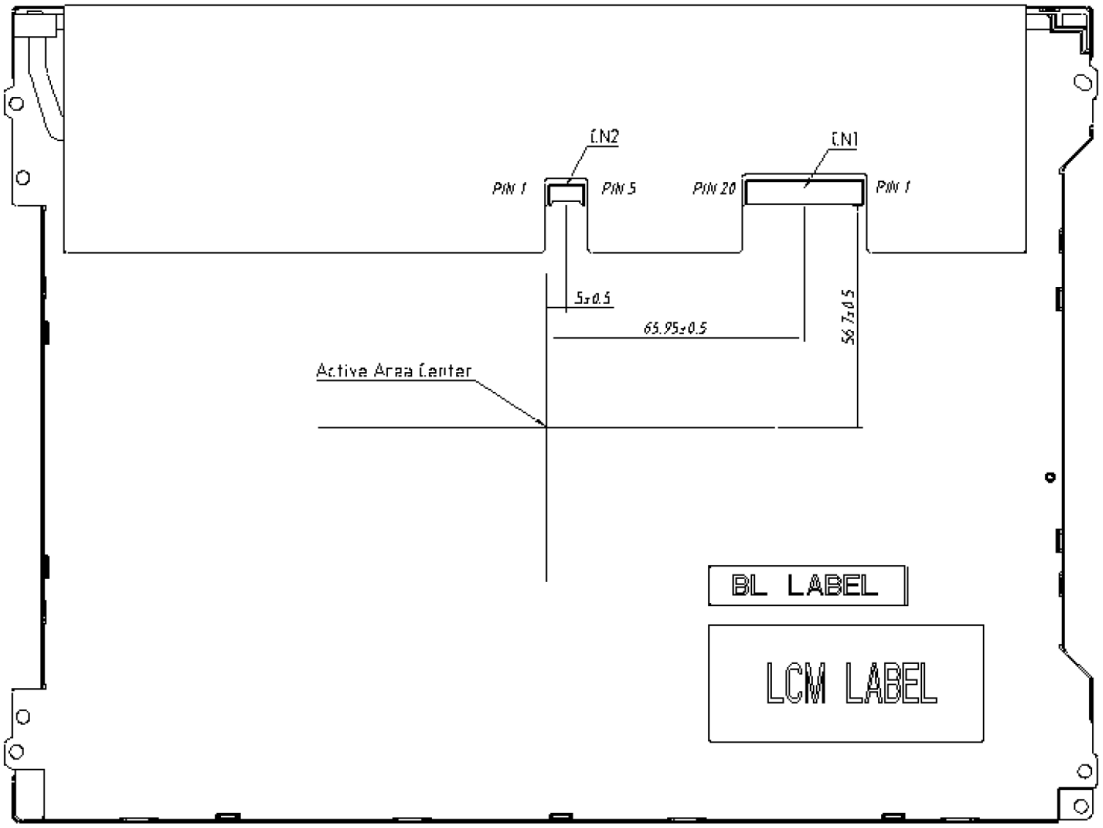


Fig2: Reference outline drawing: Back side



3 ELECTRICAL SPECIFICATION

3.1 ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Condition	Min	Max	Unit	Note
Operating Temperature	TOP		-20	70	°C	1
Storage Temperature	TST		-30	80	°C	1,2,3
Operating Humidity	HOP		10	85	%RH	4
Storage Humidity	HST		10	90	%RH	4
Supply Voltage	VDD		-0.5	5	V	5

Note 1. 90 % RH Max for Ta<50 °C, and 60% RH for Ta≥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.

Note 4. Storage Range & Operating Range Picture:

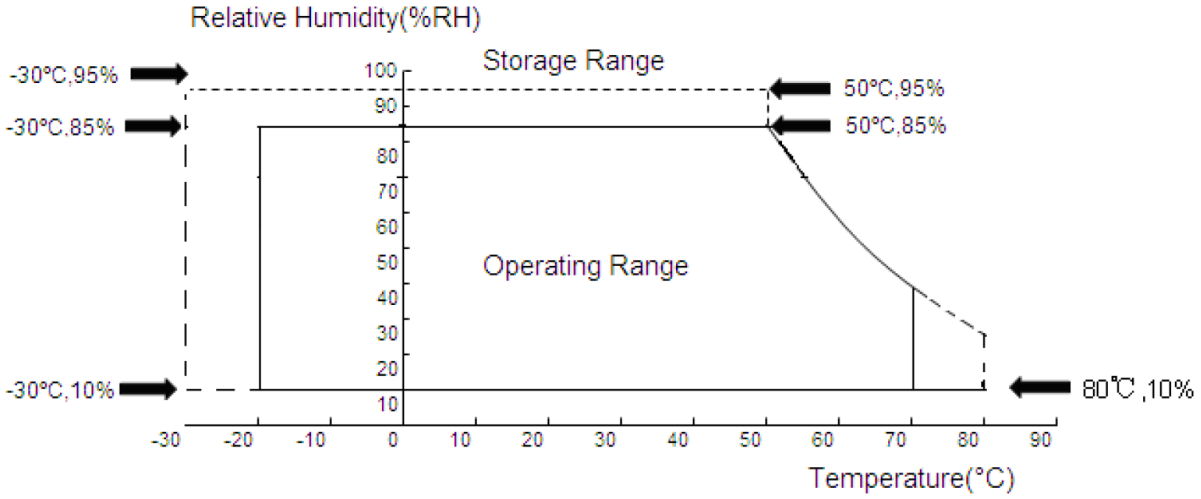


Fig 3: Storage Range & Operating Range Picture

Note 5. Humidity: 85%RH MAX (T<40°C) Note static electricity. Maximum wet bulb temperature at 39°C or less. (T>40°C) No condensation.

3.2 ELECTRICAL CHARACTERISTICS

3.2.1 ELECTRICAL CHARACTERISTICS

Item	Symbol	Min	Typ	Max	Unit	Note
Differential Input High Threshold	Vth	-	-	+100	mV	Vcm=+1.2V
Differential Input Low Threshold	Vtl	-100	-	-	mV	Vcm=+1.2V
Magnitude Differential Input Voltage	|VID|	100	-	600	mV	-
Common Mode Voltage	Vcm	|VID|/2+0.6	1.2	1.8-|VID|/2	V	-
Common Mode Voltage Offset	ΔVcm	-	-	50	mV	Vcm=+1.2V

Note: (1) Input signals shall be low or Hi-resistance state when VDD is off.
(2) All electrical characteristics for LVDS signal are defined and shall be measured at the interface connector of LCD.

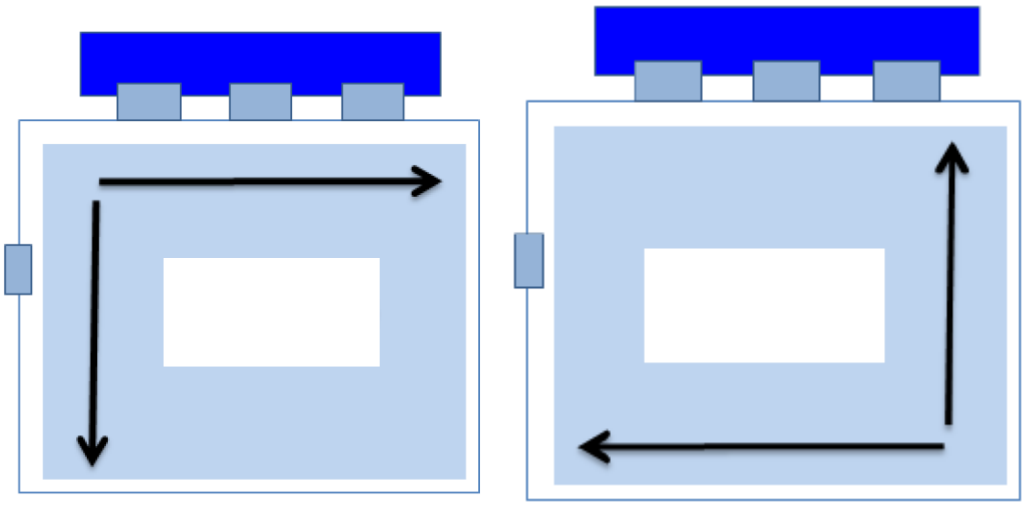
3.3 INTERFACE PIN ASSIGNMENT

3.3.1 SIGNAL PIN ASSIGNMENT

Item: FDP Down Connector (20 pin pitch=1.25mm)
Connector recommended model: MSB 240420HE; Manufactured by STM

Pin #	Signal Name	Description	Remarks
1	VDD	LCD power supply (Typ. +3.3V)	
2	VDD	LCD power supply (Typ. +3.3V)	
3	VSS	Ground	
4	REV	Revers Scan Selection {High:2.5(min), 3.3(Typ), 3.6(Max); Low 0.5(Max)}	
5	Rin1-	-LVDS differential data input (R0-R5,G0)	
6	Rin1+	+LVDS differential data input (R0-R5, G0)	
7	VSS	Ground	
8	Rin2-	-LVDS differential data input (G1-G5,B0-B1)	
9	Rin2+	+LVDS differential data input (G1-G5,B0-B1)	
10	VSS	Ground	
11	Rin3-	-LVDS differential data input (B2-B5,HS,VS,DE)	
12	Rin3+	+LVDS differential data input (B2-B5,HS,VS,DE)	
13	VSS	GND	
14	ClkIN-	-LVDS differential clock input	
15	ClkIN+	+LVDS differential clock input	
16	GND	GND	
17	Rin4-	-LVDS differential data input (R6-R7,G6-G7,B6-B7)	
18	Rin4+	+LVDS differential data input (R6-R7,G6-G7,B6-B7)	
19	SEL68	6/8 bits LVDS data input selection (H:8bit L/NC: 6bit)	
20	Bist	Internal use	

Note1: All input signals shall be low or Hi-resistance state when VDD is off.
Note2: REV=LOW/NC REV= High



3.4 BLOCK DIAGRAM

It shows the functional block diagram of the LED module.

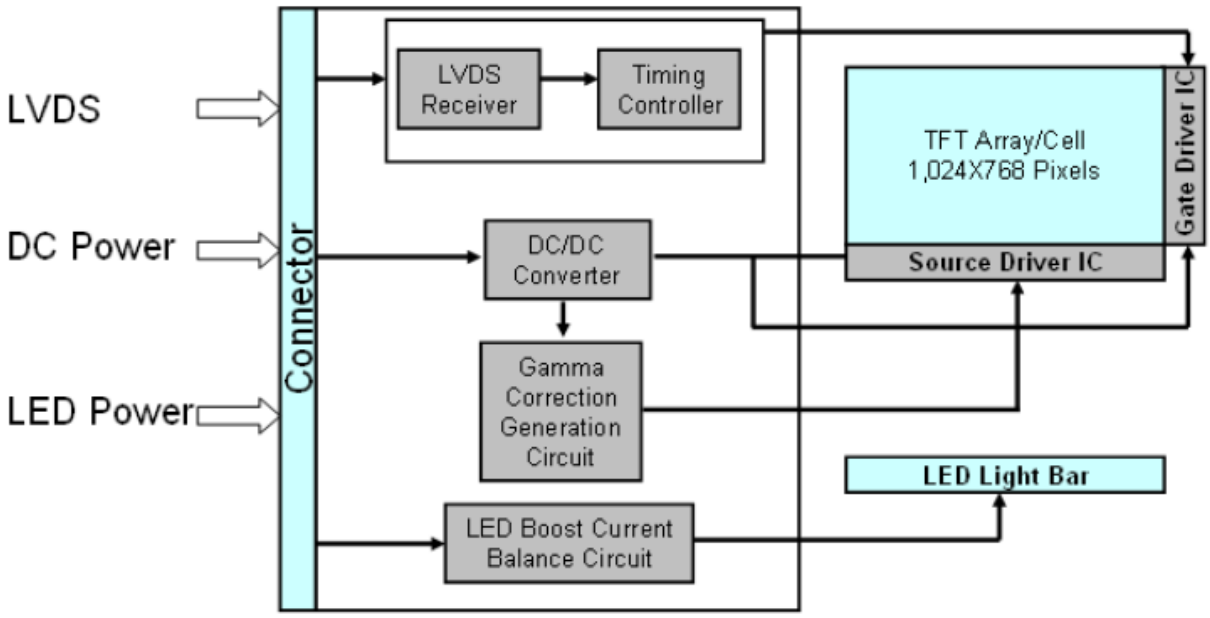


Fig 4: functional block diagram

3.5 TIMING CHARACTERISTICS

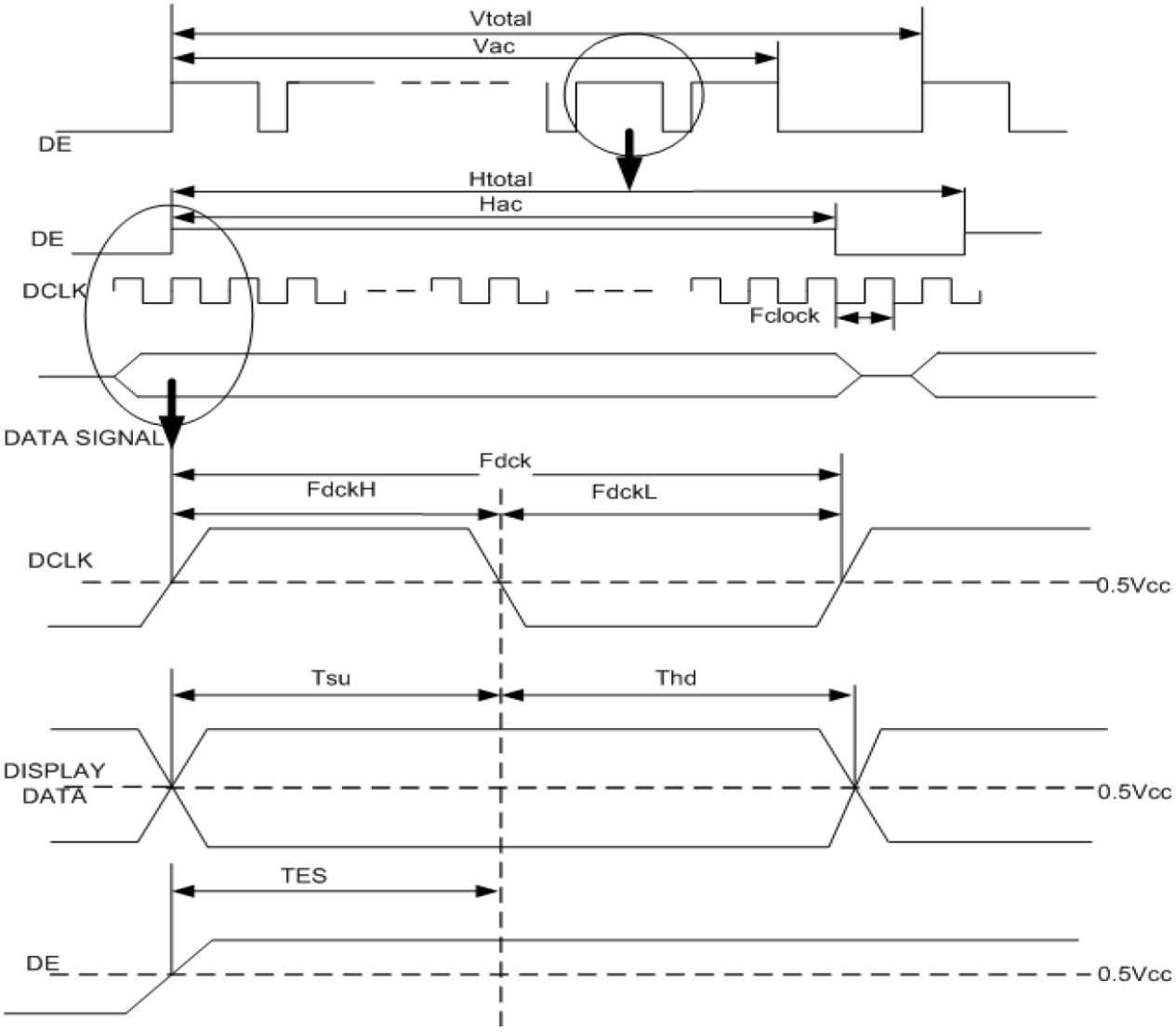
3.5.1 INTERFACE TIMING

Interface timings table

Parameter	Symbol	Unit	Min.	Typ.	Max.
LVDS Clock Frequency	Fclk	MHz	50	65	80
H Total Time	HT	Clocks	1100	1344	2047
H Active Time	HA	Clocks	1024	1024	1024
H Blanking Time	HBL	Clocks	76	320	1023
V Total Time	VT	Lines	776	806	1023
V Active Time	VA	Lines	768	768	768
V Blanking Time	VBL	Lines	8	38	255
Frame Rate	Vsync	Hz	-	60	-

Note: H Blanking Time and V Blanking Time can not be changed at every frame

Fig 5: Timing Characteristics



3.5.2 LVDS Signal definition and circuits

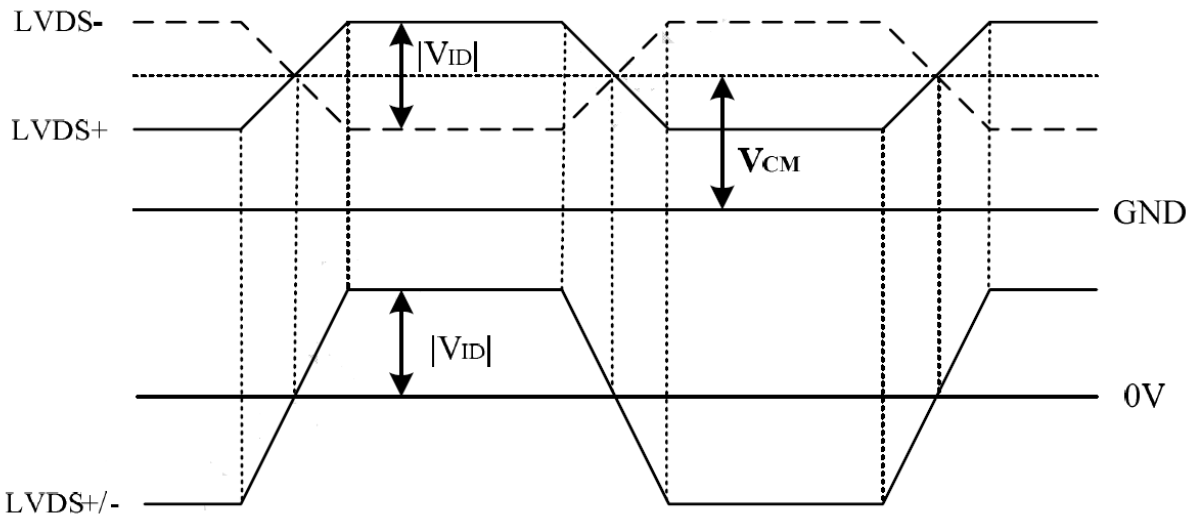


Fig6: Voltage Definitions

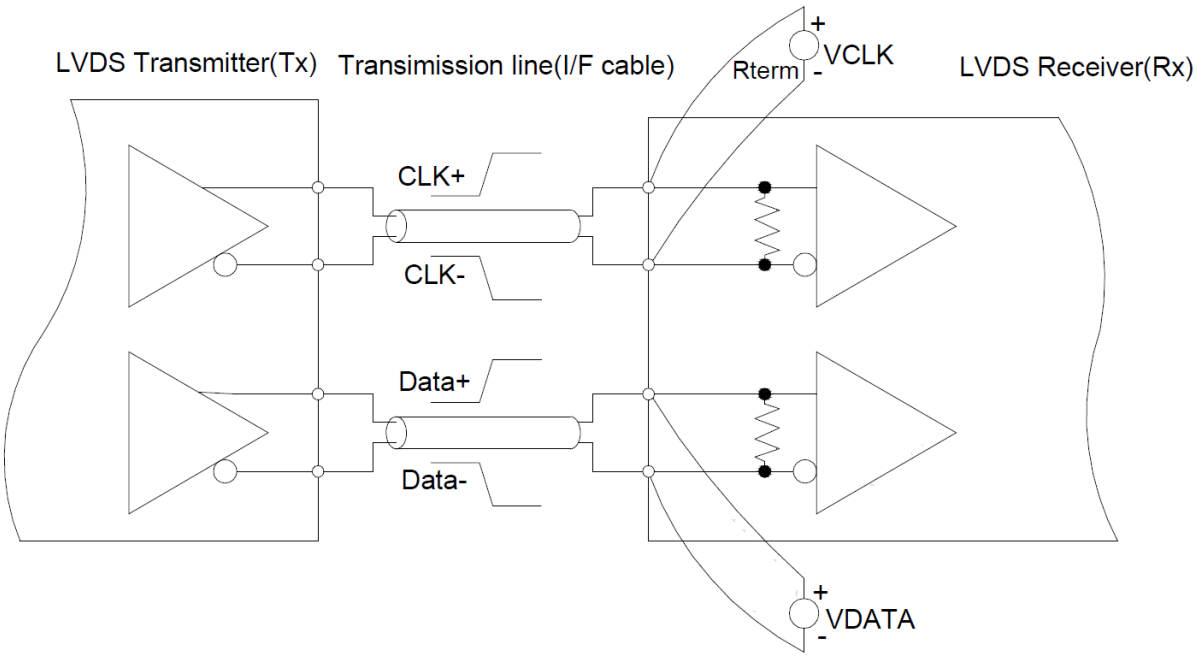


Fig7: Measurement System

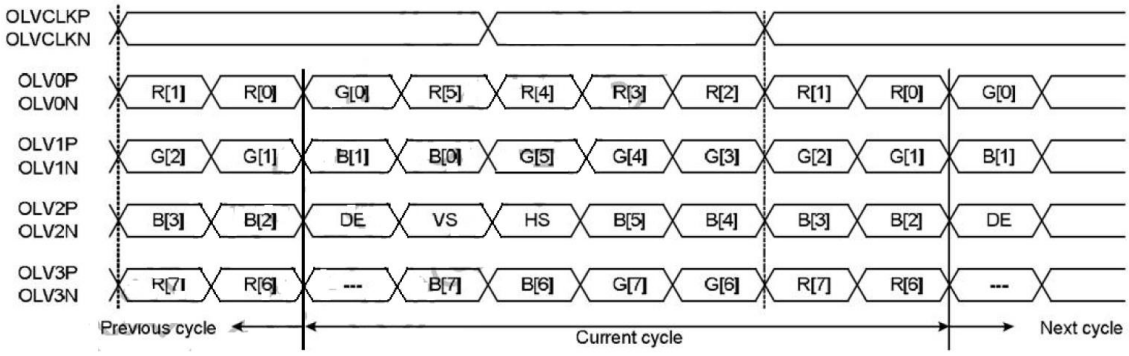


Fig8: Data Mapping

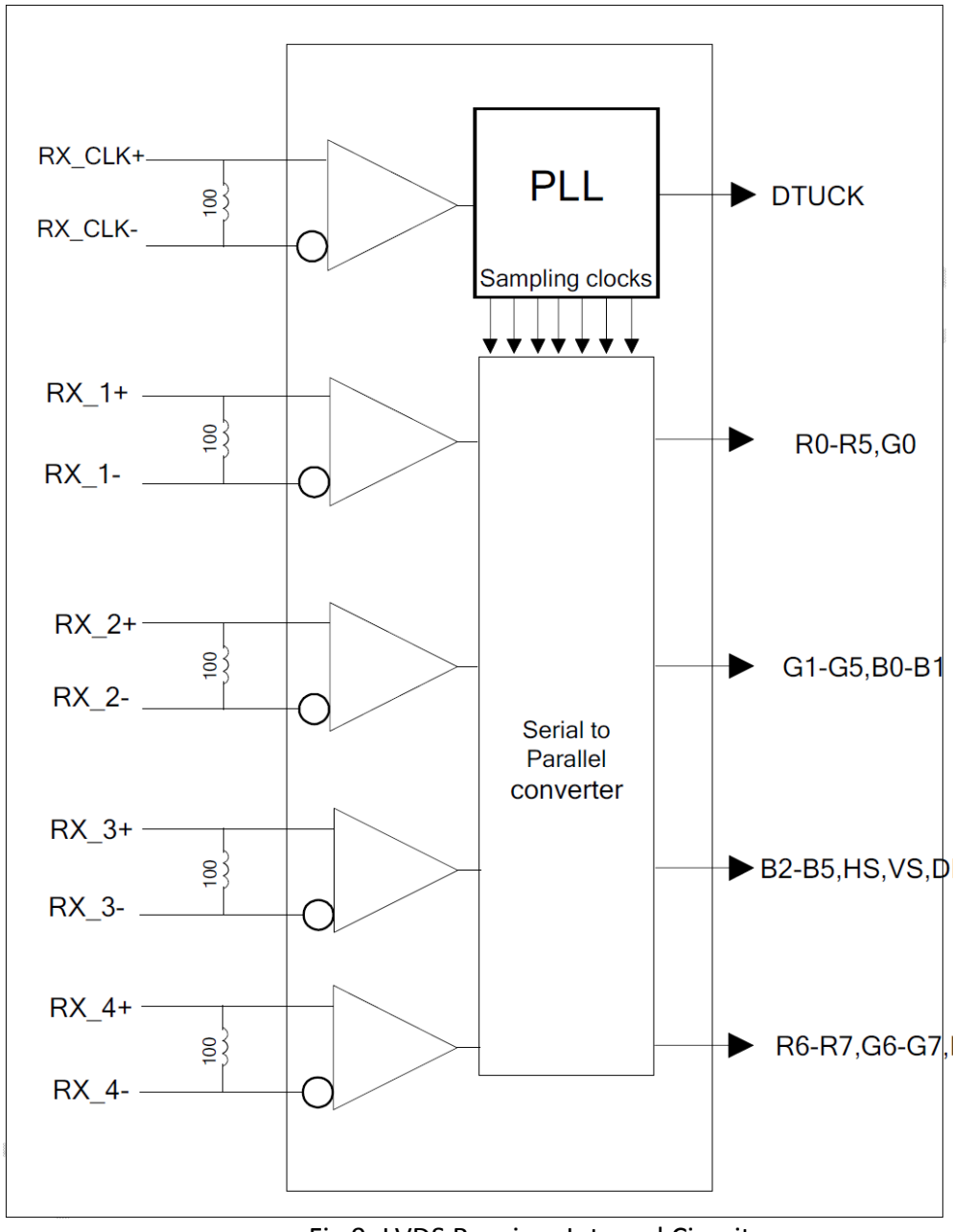


Fig 9: LVDS Receiver Internal Circuit

3.6 PIXEL DATA FORMAT

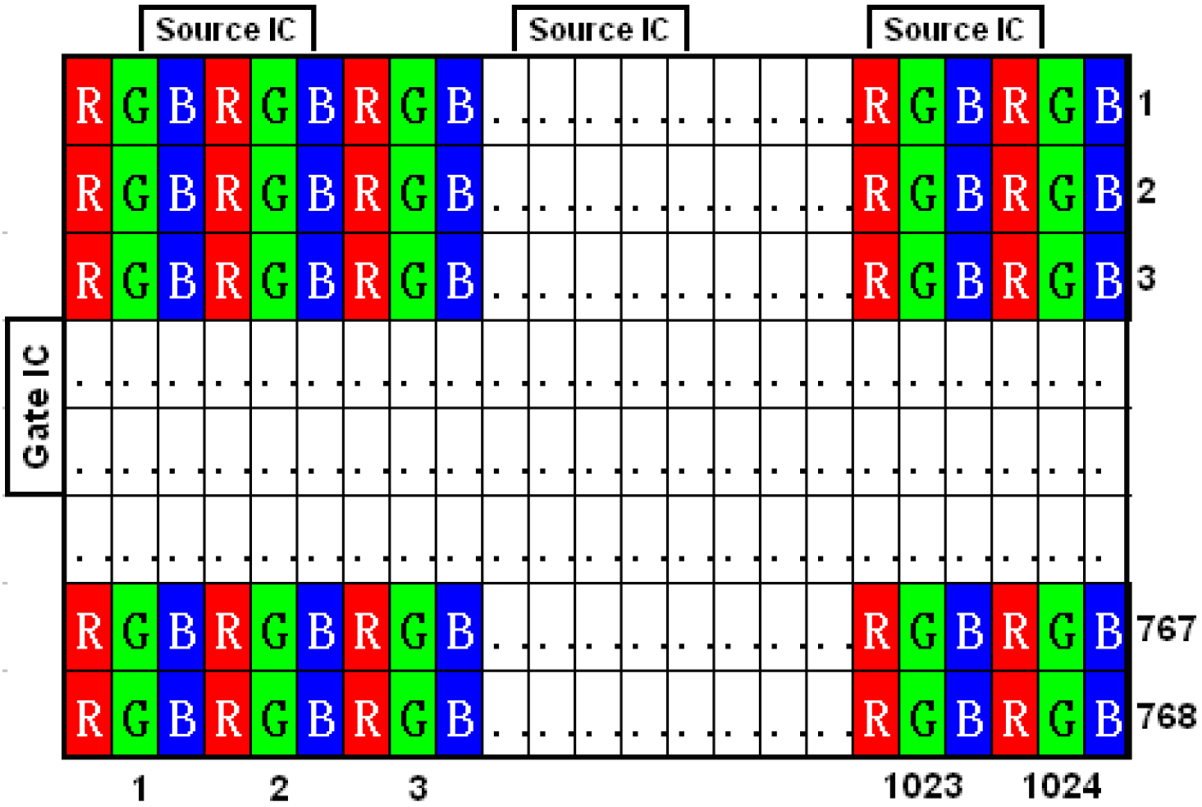


Fig 10: Pixel Format

3.7 POWER CONSUMPTION

Item		Symbol	Min.	Typ.	Max.	Units	Note
LCD Drive Voltage (Logic)		VDD	3.0	3.3	3.6	V	(2), (4)
VDD Power Consumption	Black Pattern	PDD	-	-	0.825	W	
	VDD Current, Black Pattern	IDD	-	-	250	mA	
Rush Current		Irush	-	-	3	A	(1),(4)
Allowable Logic/LCD Drive Ripple Voltage		VRP	-	-	200	mV	(2),(4)

Item		Symbol	Min.	Typ.	Max.	Units	Note
LCD Drive Voltage (Logic)		VDD	3.0	3.3	3.6	V	(2), (4)
VDD Power Consumption	Black Pattern	PDD	-	-	0.825	W	
	VDD Current, Black Pattern	IDD	-	-	250	mA	
Rush Current		Irush	-	-	3	A	(1),(4)
Allowable Logic/LCD Drive Ripple Voltage		VRP	-	-	200	mV	(2),(4)

Note1: Measure condition

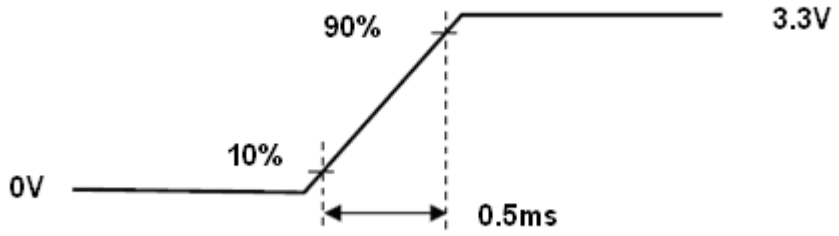


Fig11: VDD Rising Time

Note 2: VDD Power Dip condition
If VTH<VDD ≤ Vmin, then td≤ 10ms; When the voltage returns to normal our panel must revive automatically.

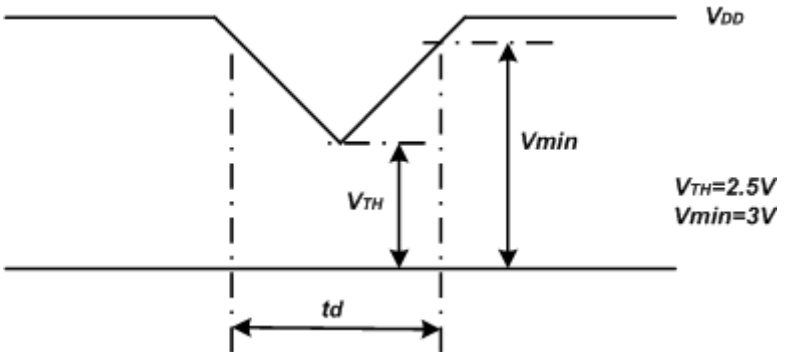


Fig12: VDD Power Dip

Note 3: Frame Rate= 60Hz, VDD=3.3 V, DC current
Note 4: Operating temperature 25°C, Humidity 55% RH

3.8 POWER SEQUENCE

Power ON/OFF Sequence

VDD power on/off sequence is as follows. Signals from any system shall be Hi-resistance state or low level when VDD is off. Interface signals are also shown in the chart.

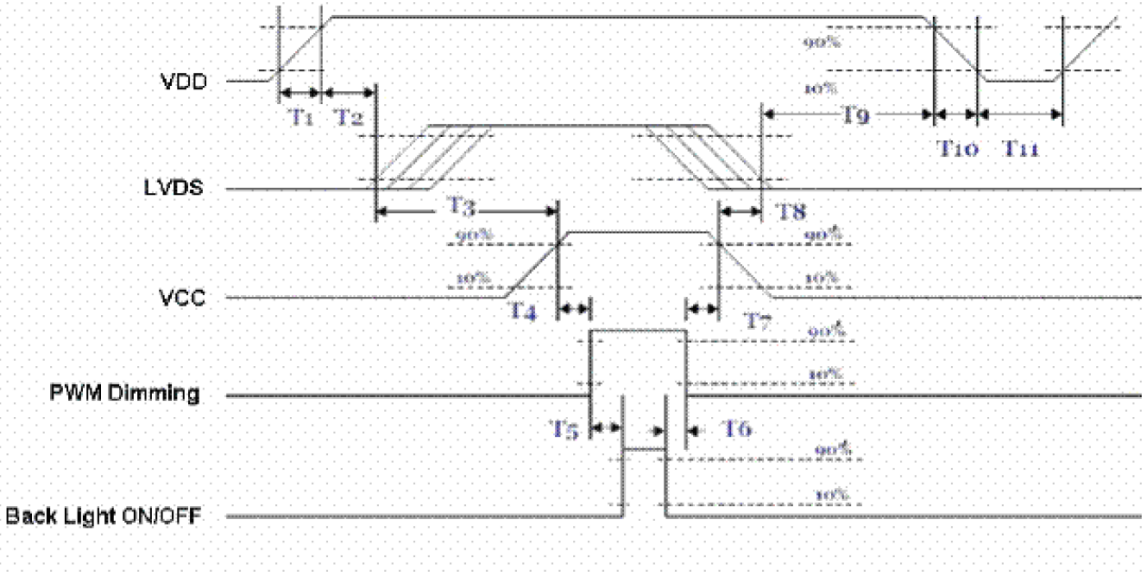


Fig13: Power Sequencing

Parameter	Value			Units
	Min.	Typ.	Max.	
T1	0.5	-	10	[ms]
T2	30	40	50	[ms]
T3	200	-	-	[ms]
T4	10	-	-	[ms]
T5	10	-	-	[ms]
T6	0	-	-	[ms]
T7	10	-	-	[ms]
T8	100	-	-	[ms]
T9	0	16	50	[ms]
T10	-	-	10	[ms]
T11	1000	-	-	[ms]

Fig14: Power ON/OFF sequence timing

Note1: Power On sequence: VCC→AVDD→VGL→VGH→Data→B/L
Note2: Power Off Sequence: B/L→ Data→VGH→VGL→AVDD→VCC

4 OPTICAL SPECIFICATION

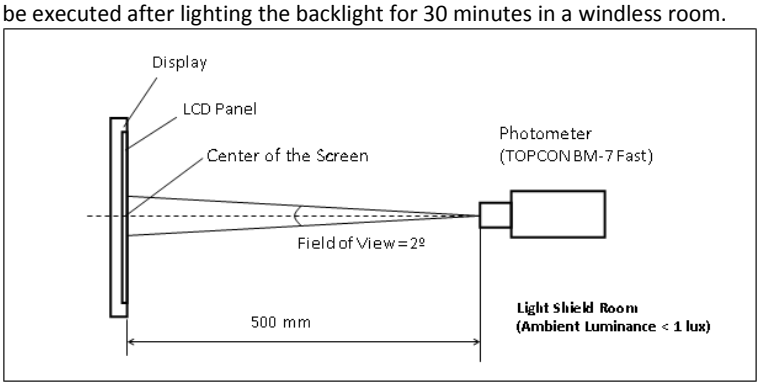
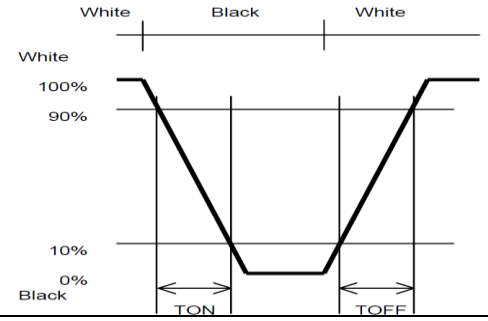
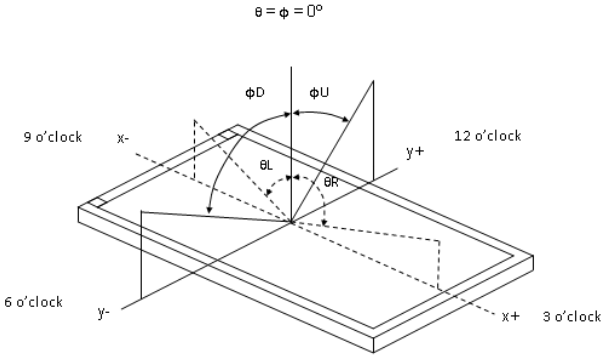
4.1 OPTICAL CHARACTERISTICS

Driving condition: IOVCC = VCI = 2.8V, VSS = 0V
Backlight: I_LED=240 mA, V_LED=12V, PWM_LED: Duty 100%
Measured temperature: Ta ＝ 25° C

Item		Symbol	Condition	MIN	TYP	MAX	Unit	Note
Response Time		TR+TF	θ=Φ=0° Normal Viewing Angle	-	16	TBD	ms	2
Contrast Ratio		CR		720	800	-		3
Viewing Angle	Left	θL	CR ≥ 10	70	80	-	deg	4
	Right	θR		70	80	-	deg	
	Up	ϕU		70	80	-	deg	
	Down	ϕD		70	80	-	deg	
Colour Chromaticity	Red	Rx	CR ≥ 10	Typ.-0.03	TBD	Typ.+0.03	-	5
		Ry			TBD		-	
	Green	Gx			TBD		-	
		Gy			TBD		-	
	Blue	Bx			TBD		-	
		By			TBD		-	
	White	Wx		0.255	0.305	0.355	-	
		Wy		0.275	0.325	0.375	-	
Centre Brightness			5 points Average	315	350	-	cd/m²	6
Brightness Distribution			9 Points	75	80	-	%	7

.

Test Method

Note	Item	Test method
1	Setup	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. 
2	Response time	Measure output signal waveform by the luminance meter when raster of window pattern is changed from white to black and from black to white. 
3	Contrast ratio	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. Contrast Ratio (CR) = $\frac{\text{Brightness of unselected position (white)}}{\text{Brightness of selected position (black)}}$
4	Viewing angle Horizontal θ Vertical Ø	Move the luminance meter from right to left and up and down and determinate the angles where contrast ratio is 10 
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	(Brightness distribution)= 100 x B/A % A: max. brightness of the 9 points B: min. brightness of the 9 points

5 BACKLIGHT SPECIFICATION

5.1 LED INTERFACE PIN ASSIGNMENT

Connector mode: MSB24038P5A
Manufactured by STM

Pin #	Function
1	VCC(12V input)
2	GND
3	On/Off(5V-ON,0V-OFF)
4	Dimming(PWM)
5	NC

5.2 LED CIRCUIT DIAGRAM

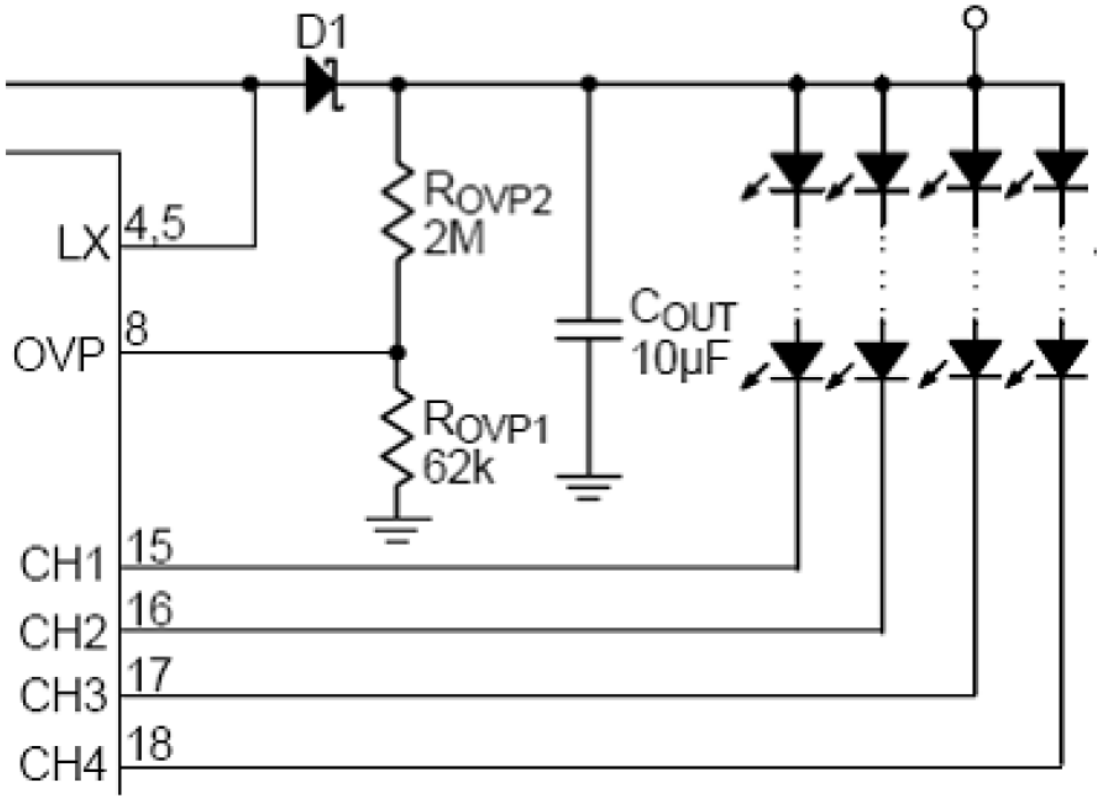


Fig 15: LED CIRCUIT DIAGRAM

5.3 PARAMETER GUIDELINE OF LED BACKLIGHT

Item	Symbol	Min.	Typ.	Max.	Units	Condition
LED Voltage	VL	10.8	12	12.6	V	Ta=25°C
LED Current	IL	-	240	-	mA	
LED Forward Voltage	VF	2.8	3.3	3.6	V	
LED Forward Current	IF	-	60	-	mA	
BL Power Consumption	PL	-	-	6.1	W	
LED Life Time	-	(30,000)	-	-	Hours	Ta=25°C/IL=240mA

Note1: The LED life time define as the estimated time to 50% degradation of initial luminous.
Note2: Operating temperature 25°C, humidity 55% RH
Note3: A higher LED power supply voltage will result in better power efficiency. Keep the V_LED between 12V and 12.6V is strongly recommended.

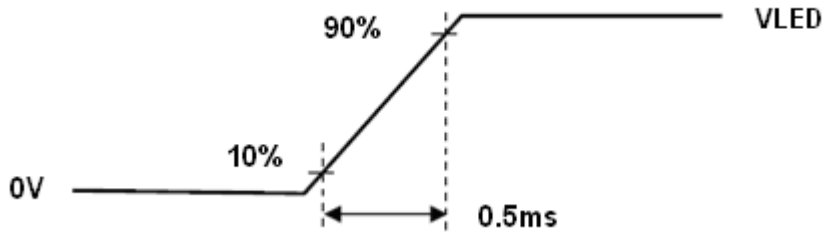


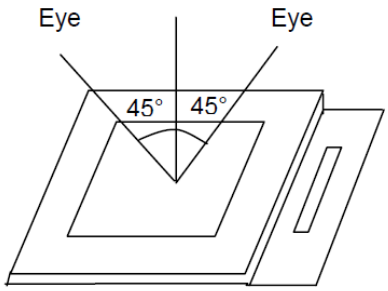
Fig16: LED Rush Current Measure Condition

6 QUALITY ASSURANCE SPECIFICATION

6.1 DELIVERY INSPECTION STANDARDS

Inspection Conditions

Inspection distance: 30 cm ± 2 cm
Viewing angle: ±45°



Environmental Conditions

Ambient temperature: 23°C ±5°C
Ambient humidity: 55±10% RH
Ambient illumination: 1000~1500 lux

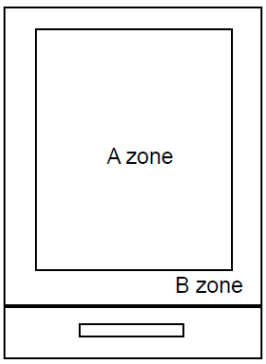
Sampling Conditions

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

Sampling Plan		ANSI / ASQC Z1.4-1993
		Normal inspection, Single Sampling
AQL	Major Defect	0.65%
	Minor Defect	1.5%

Definition of Area

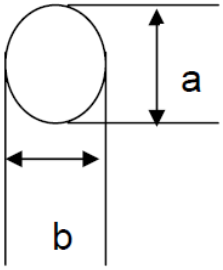
A zone: active area
B zone: viewing area

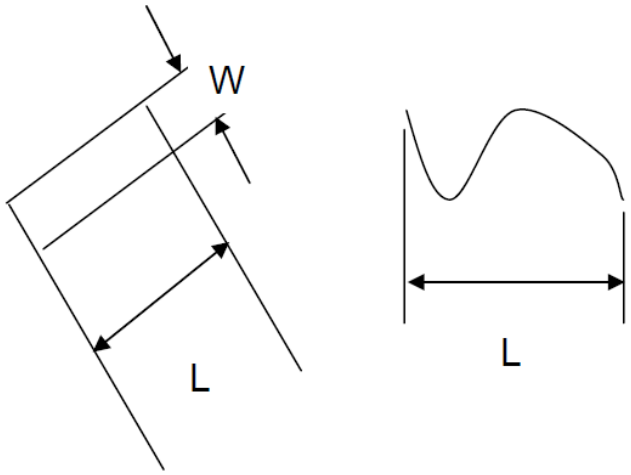


Basic Principle

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

Inspection Criteria

<table>
<tr><th>No.</th><th>Item</th><th>Criteria (Unit: mm)</th></tr>
<tr><td>01</td><td>Black / White spot
Foreign material
(Round type)
Pinholes
Stain
Particles inside cell.
(Minor defect)</td><td>


φ= (a + b) /2
<table>
<tr><th>Area / Size</th><th>Acc. Qty</th></tr>
<tr><td>φ≤0.10</td><td>Ignore</td></tr>
<tr><td>0.10<φ≤0.15</td><td>2</td></tr>
<tr><td>0.15<φ≤0.25</td><td>1</td></tr>
<tr><td>0.25<φ</td><td>0</td></tr>
<tr><td>Total</td><td>2 no include
φ≤ 0.10</td></tr>
</table>
Distance between 2 defects should more than 3mm apart.
</td></tr>
<tr><td>02</td><td>Black and White line
Scratch
Foreign material
(Line type)
(Minor defect)</td><td>


</td></tr>
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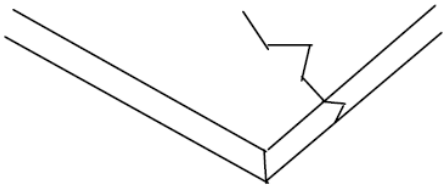
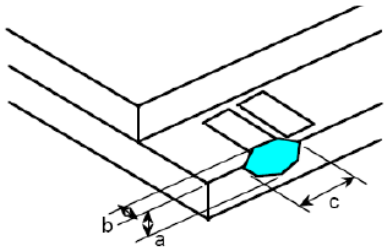
		<table><tr><th>Length</th><th>Width</th><th>Acc. Qty</th></tr><tr><td>/</td><td>W ≦ 0.03</td><td>Ignore</td></tr><tr><td>L ≦ 2.5</td><td>0.03 < W ≦ 0.05</td><td>3</td></tr><tr><td>L ≦ 2.5</td><td>0.05 < W ≦ 0.10</td><td>2</td></tr><tr><td>/</td><td>0.1 < W</td><td>0</td></tr><tr><td colspan="2">Total</td><td>3</td></tr></table> Distance between 2 defects should more than 3mm apart. Scratches not viewable through the back of the display are acceptable.
03	Glass Crack (Minor defect)	 Crack is potential to enlarge, any type is not allowed.

04	Glass Chipping Pad Area: (Minor defect) 	<table><tr><th>Length and Width</th><th>Acc. Qty</th></tr><tr><td>c > 3.0, b< 1.0</td><td>1</td></tr><tr><td>c< 3.0, b< 1.0</td><td>3</td></tr><tr><td colspan="2">a<Glass Thickness</td></tr></table>

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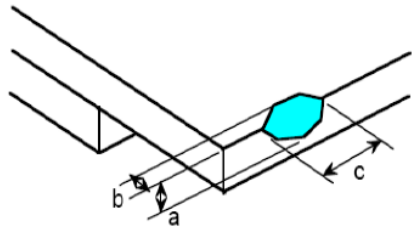
(Minor defect)
 
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<td><table>
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<tr><td>c< 3.0, b< 1.0</td><td>2</td></tr>
<tr><td>c< 3.0, b< 0.5</td><td>4</td></tr>
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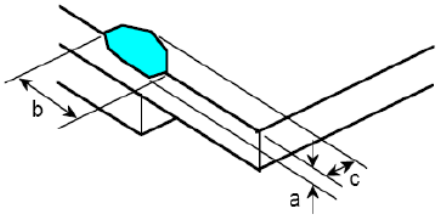
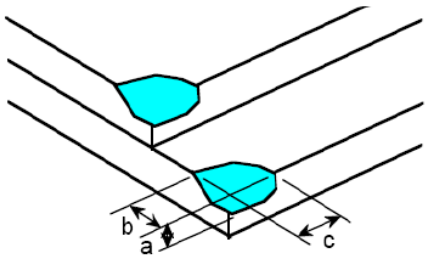
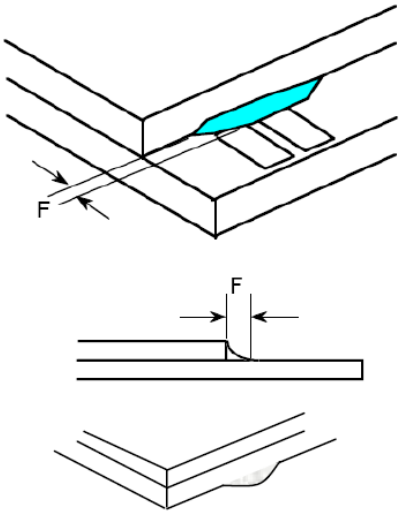
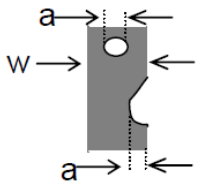
</table></td>
</tr>
<tr>
<td>06</td>
<td>Glass Chipping Except Pad Area:
(Minor defect)
 
</td>
<td><table>
<tr><th>Length and Width</th><th>Acc. Qty</th></tr>
<tr><td>c > 3.0, b< 1.0</td><td>1</td></tr>
<tr><td>c< 3.0, b< 1.0</td><td>2</td></tr>
<tr><td>c< 3.0, b< 0.5</td><td>4</td></tr>
<tr><td colspan="2">a<Glass Thickness</td></tr>
</table></td>
</tr>
<tr>
<td>07</td>
<td>Glass Corner Chipping:
(Minor defect)
 
</td>
<td><table>
<tr><th>Length and Width</th><th>Acc. Qty</th></tr>
<tr><td>c < 3.0, b< 3.0</td><td>Ignore</td></tr>
<tr><td colspan="2">a<Glass Thickness</td></tr>
</table></td>
</tr>
</table>

<table>
<tr>
<td>08</td>
<td>Glass Burr:
(Minor defect)
  </td>
<td><table><tr><th>Length</th><th>Acc. Qty</th></tr><tr><td>F < 1.0</td><td>Ignore</td></tr></table>
Glass burr don’t affect assemble and module dimension.</td>
</tr>
<tr>
<td>09</td>
<td>FPC Defect:
(Minor defect)
  </td>
<td>9.1 Dent, pinhole width a<w/3.
(w: circuitry width.)
9.2 Open circuit is unacceptable.
9.3 No oxidation, contamination and distortion.</td>
</tr>
<tr>
<td>10</td>
<td>Bubble on Polarizer
(Minor defect)</td>
<td colspan="2"><table><tr><th>Diameter</th><th>Acc. Qty</th></tr><tr><td>φ≤0.20</td><td>Ignore</td></tr><tr><td>0.20 <φ≤0.30</td><td>4</td></tr><tr><td>0.30 < φ</td><td>None</td></tr></table></td>
</tr>
<tr>
<td>11</td>
<td>Dent on Polarizer
(Minor defect)</td>
<td colspan="2"><table><tr><th>Diameter</th><th>Acc. Qty</th></tr><tr><td>φ≤0.20</td><td>Ignore</td></tr><tr><td>0.20 <φ≤0.30</td><td>4</td></tr><tr><td>0.30 < φ</td><td>None</td></tr></table></td>
</tr>
<tr>
<td>12</td>
<td>Bezel</td>
<td colspan="2">12.1 No rust, distortion on the Bezel.
12.2 No visible fingerprints, stains or other contamination.</td>
</tr>
</table>

13	Touch Panel	D: Diameter W: width L: length 13.1 Spot: D<0.25 is acceptable 0.25≤D≤0.4 2dots are acceptable and the distance between defects should more than 10 mm. D>0.4 is unacceptable 13.2 Dent: D>0.40 is unacceptable 13.3 Scratch: W≤0.03, L≤10 is acceptable, 0.03<W≤0.10, L≤10 is acceptable Distance between 2 defects should more than 10 mm. W>0.10 is unacceptable.
14	PCB	14.1 No distortion or contamination on PCB terminals. 14.2 All components on PCB must same as documented on the BOM/component layout. 14.3 Follow IPC-A-600F.
15	Soldering	Follow IPC-A-610C standard
16	Electrical Defect (Major defect)	The below defects must be rejected. 16.1 Missing vertical / horizontal segment, 16.2 Abnormal Display. 16.3 No function or no display. 16.4 Current exceeds product specifications. 16.5 LCD viewing angle defect. 16.6 No Backlight. 16.7 Dark Backlight. 16.8 Touch Panel no function. 16.9 Dark Dot –one Allowed. 16.10 Bright Dot – one Allowed. Remark: 1. A pixel defect is acceptable if one color is none functional and causes a bright dot. The display may have one case where one color is out and cause a dark dot. 2. Bright dot caused by scratch and foreign object accords to item 1.

Remark: LCD Panel Broken shall be rejected. Defect out of LCD viewing area is acceptable.

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.

Identification / marking criteria

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

6.2 DEALING WITH CUSTOMER COMPLAINTS

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.

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 RELIABILITY SPECIFICATION

7.1 RELIABILITY TESTS

Test Item		Test Condition
Durability Test	High Temperature Storage	Ta= 80˚C 96h
	Low Temperature Storage	Ta=-30˚C 96h
	Temperature Cycle Storage	-20°C for 30 min, then 70°C for 30 min, 20 cycles
	High Temperature Operation	Tp= 70°C 96h
	Low Temperature Operation	Tp= -20°C 96h
	High Temperature & Humidity Operation	Tp= 40°C RH= 90% 96h Non condensing
	Thermal Shock Resistance	The sample should be allowed to stand the following 5 cycles of operation: TSTL for 30 minutes -> normal temperature for 5 minutes -> TSTH 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

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 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 Trichlorotriflorothane.
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°C ± 10°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).