

TFT LCD DISPLAY MODULE

Product Specification

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

Internal Approvals		
Product Mgr	Doc. Control	Electr. Eng.
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1.0 General Description

1.1 Introduction

This is a colour active matrix TFT (Thin Film Transistor) LCD (liquid crystal display) that uses amorphous silicon TFT as a switching device. This module is composed of a Transmissive type TFT-LCD Panel, driver circuit, back-light unit. The resolution of a 5.0" TFT-LCD contains 800x480 pixels and can display up to 65K/262K/16.7M colours.

1.2 Main Features

Item	Contents
Screen Size	5.0" Diagonal
Display Format	800 x RGB x 480 Dots
N° of Colour	65K/262K/16.7M colours
Overall Dimensions	120.70 mm(H) x 75.90 mm(V) x 2.95 mm (D)
Active Area	108.00 mm (H) x 64.80 mm (V)
Display Mode	Transmissive / Normally Black
Viewing Direction	All round
TFT Interface	16/18/24 Bit RGB
TFT Driver IC	ST7262
Backlight Type	LED, White, 16 chips
Operating Temperature	-30C ~ +85°C
Storage Temperature	-30°C ~ +85°C
ROHS	Compliant to 2015/863/EU

2.0 Mechanical Specification

2.1 Mechanical Characteristics

Item	Characteristic	Unit
Display Format	800 x RGB x 480	Dots
Overall Dimensions	120.70 (H) x 75.90 (V) x 2.95 (D)	mm
Active Area	108.00 (H) x 64.80 (V)	mm
Pixel Pitch	0.135 (H) x 0.135 (V)	mm
Weight	50	g

3.0 Electrical Specification

3.1 Absolute Maximum Ratings

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	VDD	-0.3	4.0	V	-
Operating Temperature	T _{OP}	-30	+85	°C	1
Storage Temperature	T _{ST}	-30	+85	°C	1,2,3

Note 1: If the absolute maximum rating of even is one of the above parameters is exceeded even momentarily, the quality of the product may be degraded. Absolute maximum ratings, therefore, specify the values exceeding which the product may be physically damaged. Be sure to use the product within the range of the absolute maximum ratings.

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 qualities are evaluated at +25°C.

3.2 Electrical Characteristics

Item	Symbol	Min.	Typ.	Max.	Unit
Digital Supply Voltage	VDD	3.3	-	3.6	V
Normal mode Current	IDD	-	30	-	mA
High Level Input	V _{IH}	0.7xVDD	-	VDD	V
Low Level Input	V _{IL}	GND	-	0.3xVDD	V
High Level Output	V _{OH}	VDD-0.4	-	-	V
Low Level Output	V _{OL}	GND	-	VDD+0.4	V

3.3 Interface Pin Assignment

No.	Symbol	Function
1	LED-	Cathode pin of backlight
2	LED+	Anode pin of backlight
3	GND	Ground.
4	VDD	Supply voltage(3.3V).
5-12	R0-R7	Red data input.
13-20	G0-G7	Green data input.
21-28	B0-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	VSNC	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)	Not Connected.
38	YD(NC)	Not Connected.
39	XL(NC)	Not Connected.
40	YU(NC)	Not Connected.

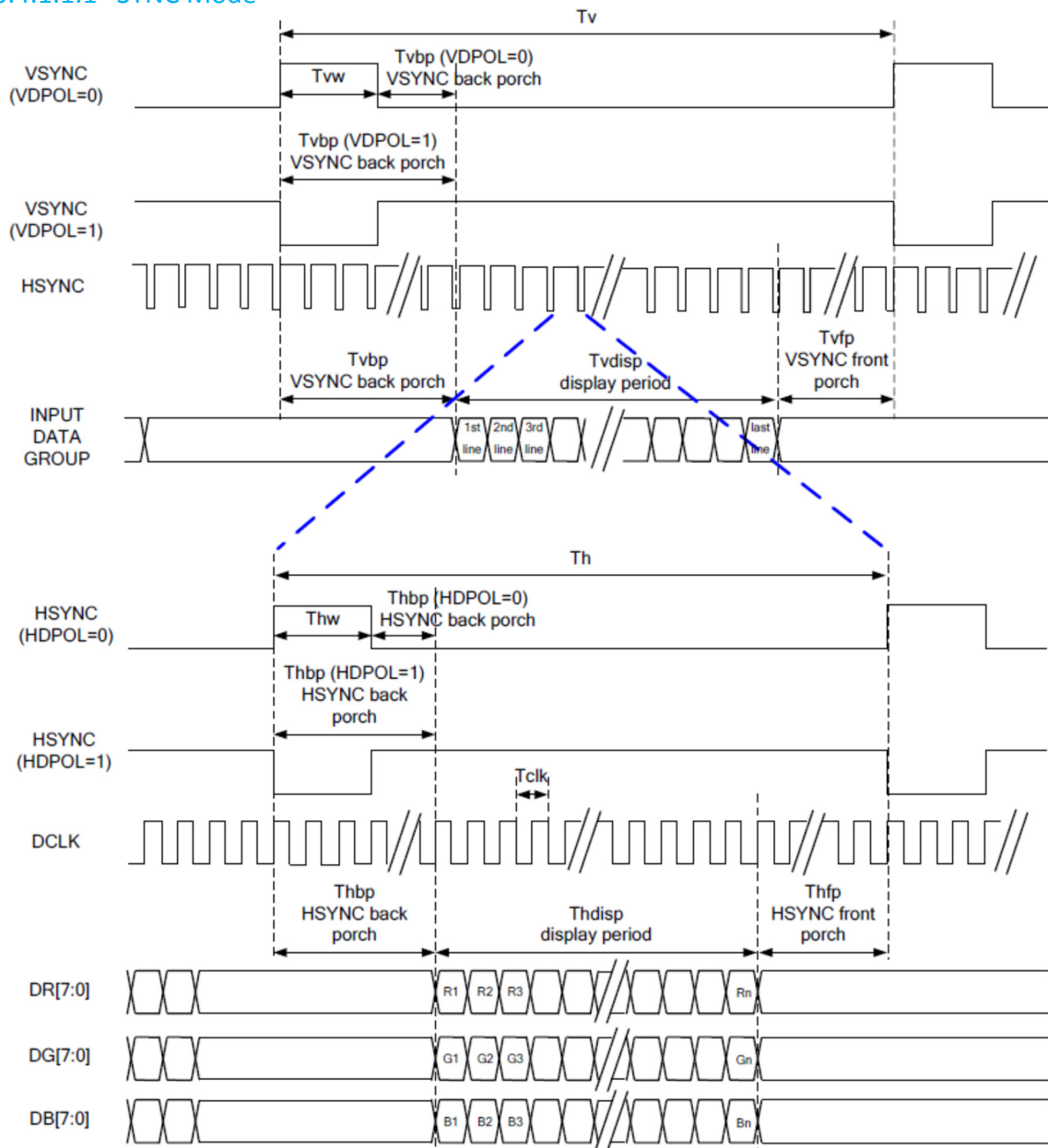
3.4 Timing Characteristics

For more information refer to the Sitronix ST7262 Datasheet

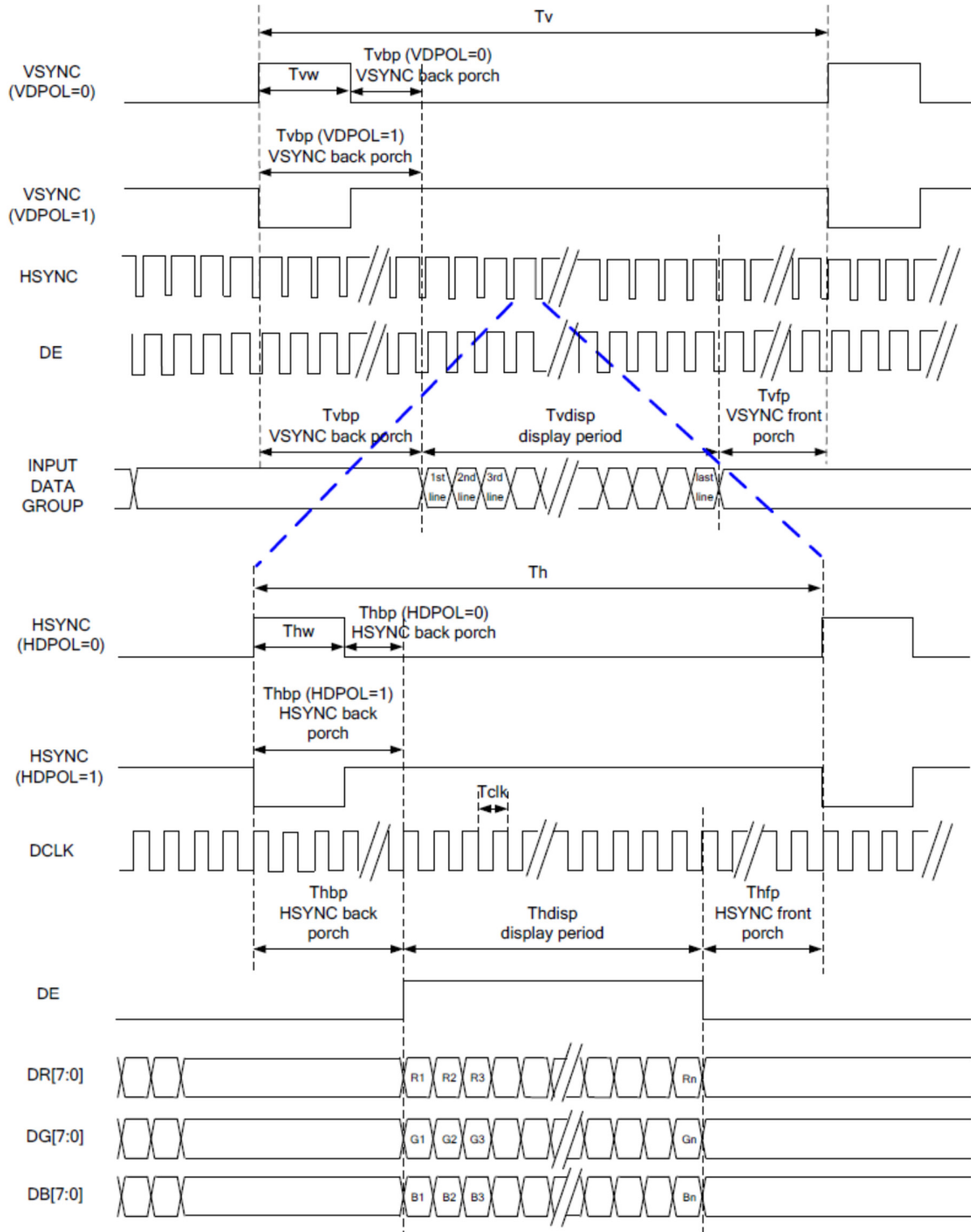
3.4.1 RGB Interface Characteristics

RGB Mode Selection Table	DCLK	HSYNC	VSYNC	DE
SYNC – DE Mode	Input	Input	Input	Input
SYNC Mode	Input	Input	Input	GND
DE Mode	Input	GND	GND	Input

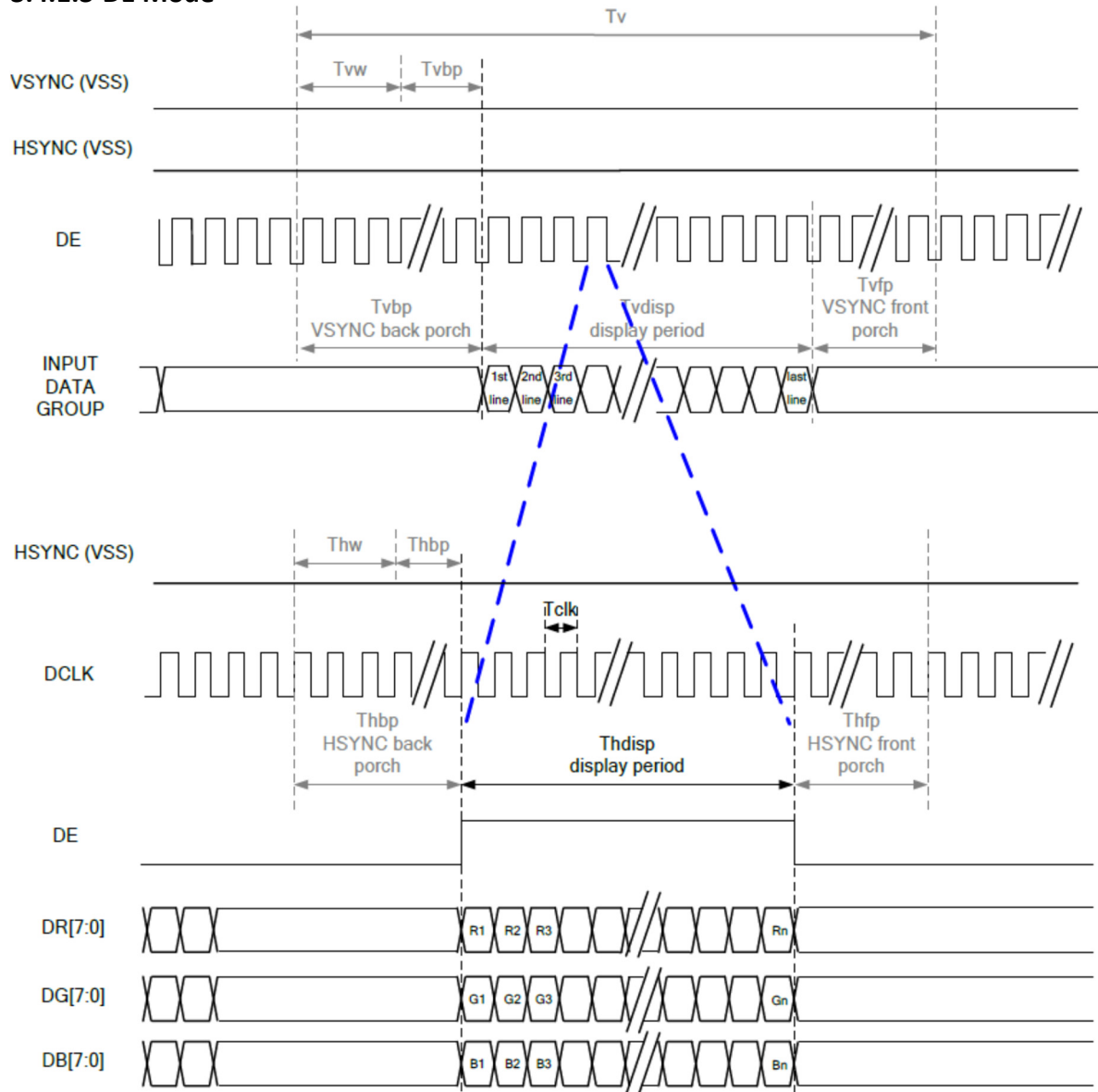
3.4.1.1.1 SYNC Mode



3.4.1.2 SYNC-DE Mode



3.4.1.3 DE Mode

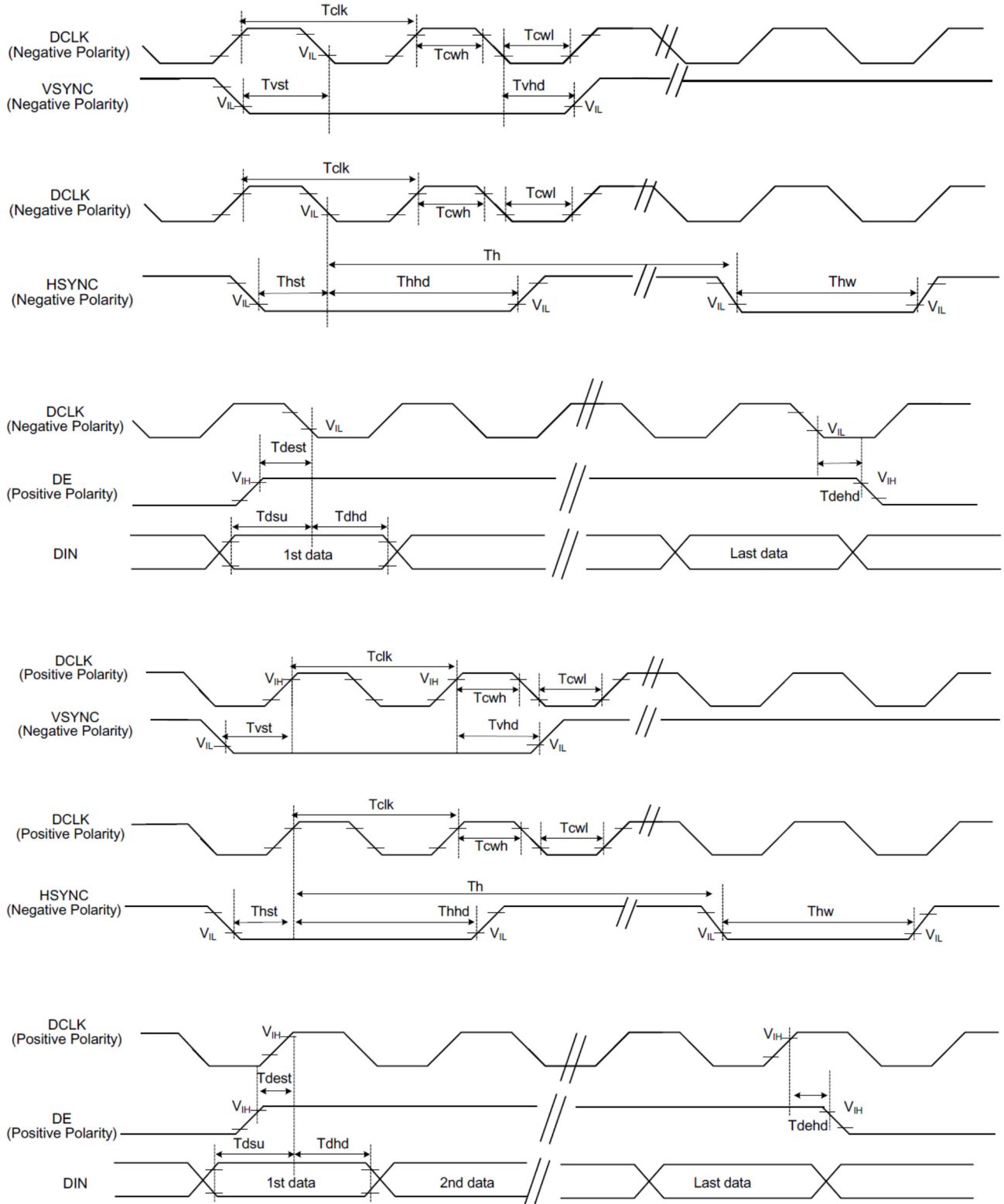


3.4.1.4 Parallel 24-bit RGB Input Timing Table

Parallel 24-bit RGB Input Timing (PVDD=PVDD1=VDD=VDDI=3.3V, AGND=0V, TA=25°C)

Item		Symbol	Min.	Typ.	Max.	Unit
DCLK Frequency		Fclk	23	25	27	MHz
HSYNC	Period Time	Th	808	816	896	DCLK
	Display Period	Thdisp	800			DCLK
	Back Porch	Thbp	4	8	48	DCLK
	Front Porch	Thfp	4	8	48	DCLK
	Pulse Width	Thw	2	4	8	DCLK
VSYNC	Period Time	Tv	488	496	504	HSYNC
	Display Period	Tvdisp	480			HSYNC
	Back Porch	Tvbp	4	8	12	HSYNC
	Front Porch	Tvfp	4	8	12	HSYNC
	Pulse Width	Tvw	2	4	8	HSYNC

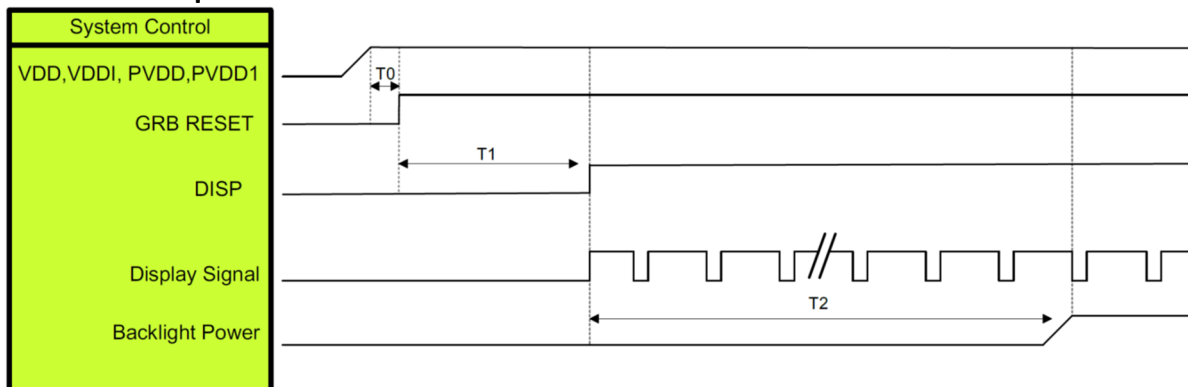
3.4.2 System Bus Timing for RGB Interface



Item	Symbol	Min.	Typ.	Max.	Unit
CLK Pulse Duty	Tcw	40	50	60	%
HSYNC Width	Thw	2	-	-	DCLK
HSYNC Period	Th	55	60	65	μs
VSYNC Setup Time	Tvst	12	-	-	ns
VSYNC Hold Time	Tvhd	12	-	-	ns
HSYNC Setup Time	Thst	12	-	-	ns
HSYNC Hold Time	Thhd	12	-	-	ns
Data Setup Time	Tdsu	12	-	-	ns
Data Hold Time	Tdhd	12	-	-	ns
DE Setup Time	Tdest	12	-	-	ns
DE Hold Time	Tdehd	12	-	-	ns

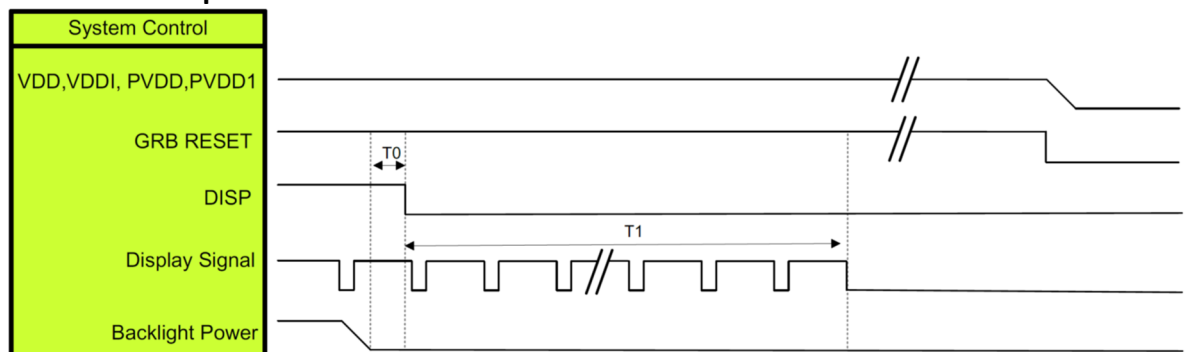
3.4.4 Power ON/OFF Sequence

3.4.4.1 ON Sequence



Symbol	Description	Min. Time	Unit
T0	System power stability to GRB RESET Signal	0	ms
T1	GRB RESET='High' to DISP='High'	10	ms
T2	Display Signal output to Backlight Power on	250	ms

3.4.4.2 OFF Sequence



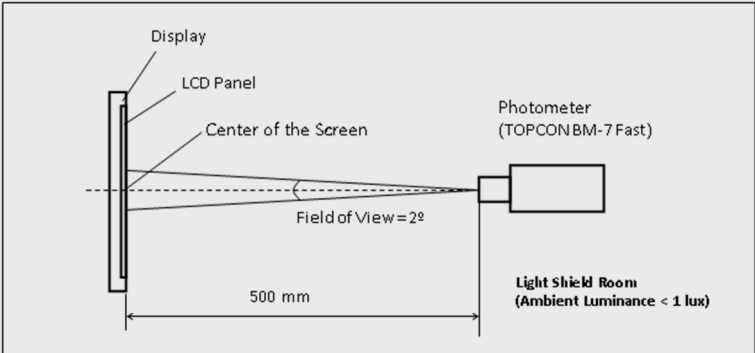
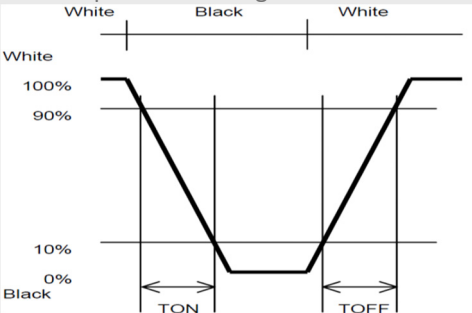
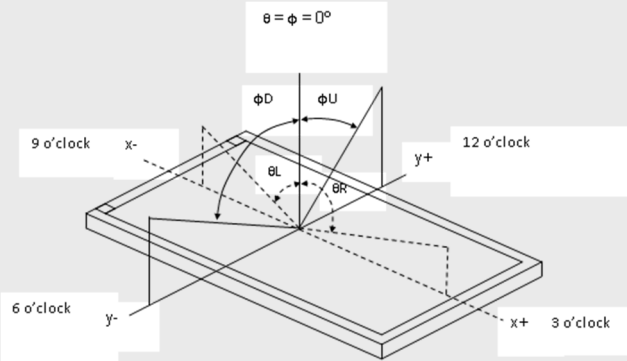
Symbol	Description	Min. Time	Unit
T0	Backlight Power off to DISP='Low'	5	ms
T1	DISP='Low' to IC internal voltage discharge complete	100	ms

4.0 Optical Specification

4.1 Optical Characteristics

Measuring instruments: LCD-5100, Eldim, Topcon BM-7
 Driving condition: $V_{DD} = 3.3V$, $V_{SS} = 0V$
 Measured temperature: $T_a = 25^{\circ}C$

Characteristics		Symbol	Conditions	Min	Typ	Max	Unit	Note
Response time		TR+TF	$\theta = \phi = 0^{\circ}$ Normal Viewing Angle	-	30	40	ms	2
Contrast Ratio		CR		800	1000	-	-	3
Viewing Angle	Left	θ_L	$CR \geq 10$	75	80	-	deg	4
	Right	θ_R		75	80	-		
	Up	θ_U		75	80	-		
	Down	θ_D		75	80	-		
Colour Chromaticity	Red	Rx	$CR \geq 10$	0.5478	0.5878	0.6278	-	5
		Ry		0.3154	0.3554	0.3954		
	Green	Gx		0.3162	0.3562	0.3954		
		Gy		0.5194	0.5594	0.5994		
	Blue	Bx		0.1121	0.1521	0.1921		
		By		0.0705	0.1105	0.1505		
	White	Wx		0.2731	0.3131	0.3531		
		Wy		0.3059	0.3459	0.3859		

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. To stabilise the luminance, measurements should be executed after lighting the backlight for 30 minutes in a windless room.</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> 
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 θ Vertical ϕ	<p>Move the luminance meter from right to left and up and down and determinate the angles where contrast ratio is 10</p> 
5	Colour chromaticity	Measure chromaticity coordinates x and y of CIE1931 colorimetric system

5.0 LED Backlight Specification

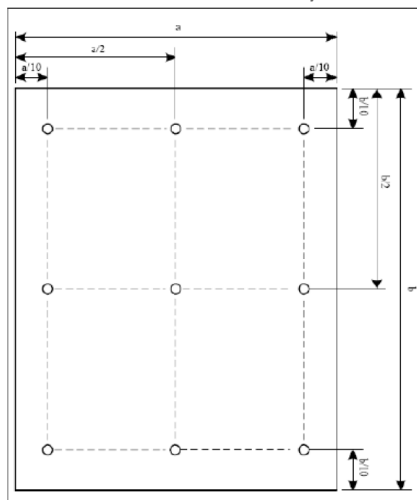
5.1 LED Backlight Characteristics

The back-light system is edge-lighting type with 16 chips LED

Characteristics	Symbol	Min	Typ.	Max	Unit	Note
Forward Current	I_F	30	40	-	mA	-
Forward Voltage	V_F	-	25.6	-	V	-
LCM Luminance at 40mA	LV	850	900	-	Cd/m ²	2
LED life time	Hr	-	50000	-	Hour	1
Luminance Uniformity	Avg	80	-	-	%	2

Note 1: LED life time (Hr) can be defined as the time in which it continues to operate under the condition: $T_a = 25 \pm 3$ °C, typical IL value indicated in the above table until the brightness becomes less than 50%.

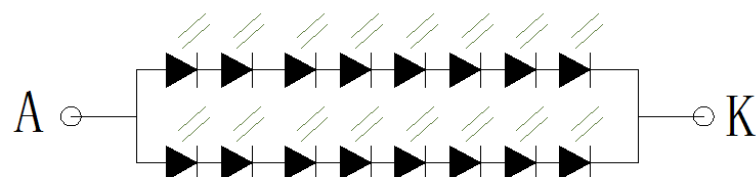
Note 2: Luminance Uniformity of these 9 points is defined as below:



$$\text{Uniformity} = \frac{\text{minimum luminance in 9 points (1-9)}}{\text{maximum luminance in 9 points (1-9)}}$$

$$\text{Luminance} = \frac{\text{Total Luminance of 9 points}}{9}$$

5.2 Internal Circuit Diagram



6.0 Quality Assurance Specification

6.1 Delivery Inspection Standards

6.1.1 Inspection Conditions

Inspection distance: 30 cm - 50cm
Viewing angle: $\pm 45^\circ$

6.1.2 Environmental Conditions

Ambient temperature: $25^\circ\text{C} \pm 5^\circ\text{C}$
Ambient humidity: $65 \pm 10\% \text{ RH}$
Ambient illumination: 300~700 lux

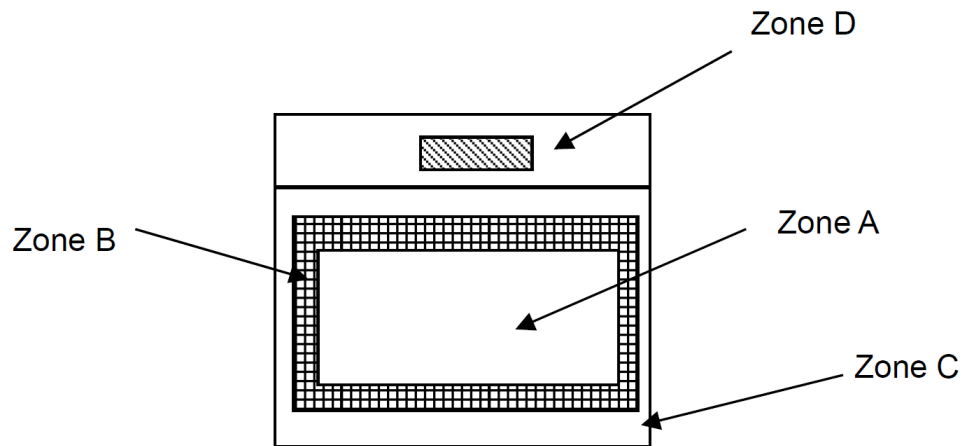
6.1.3 Sampling Conditions

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	Colour tone	Colour 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.	
7	LCD/Polarizer/TP	Black/White spot/line, scratch, crack, etc.	

6.1.4 Zone Definition



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

Zone B: Viewing Area except Zone A

Zone C: Outside (ZoneA+ZoneB) which can't be seen after assembly by customer.

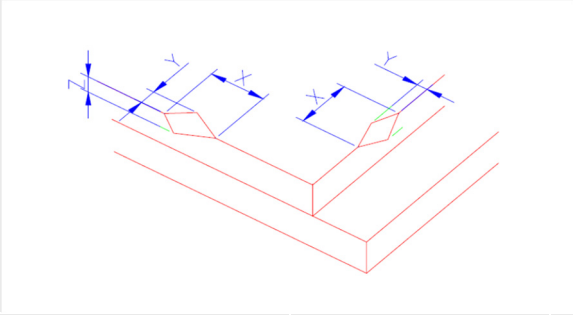
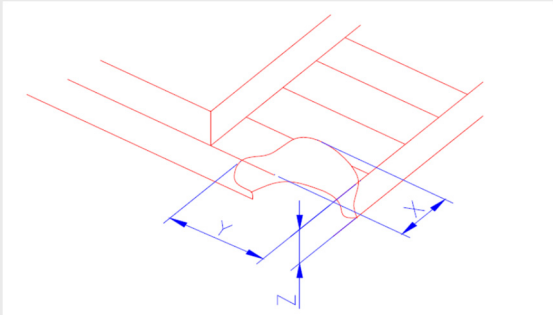
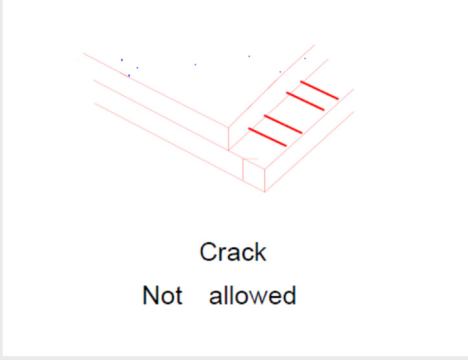
Zone D: IC Bonding Area

Note: Generally, visual defects in Zone C can be ignored when it doesn't affect 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	(1) The edge of LCD broken			
		X	Y	Z
		≤3.0mm	<Inner border line of the seal	≤T
	(2) LCD corner broken			
		X	Y	Z
		≤3.0mm	≤L	≤T
	(3) LCD crack	 Crack Not allowed		

Number	Items	Criteria (mm)				
2.0	<div>Spot defects</div> <div></div> <div>Φ=(X+Y)/2</div>	① Light dot (LCD/TP/Polarizer black/white spot, light dot, pinhole, dent, stain)				
		Size (mm)	Zone	Acceptable Qty		
				A	B	C
		Φ≤0.10		Ignore		Ignore
		0.10<Φ≤0.25		4(distance≥10mm)		
		0.25<Φ≤0.35		3		
		Φ>0.4		0		
		②Dim spot (LCD/TP/Polarizer dim dot, light leakage, dark spot)				
		Size (mm)	Zone	Acceptable Qty		
				A	B	C
		Φ≤0.1		Ignore		Ignore
		0.10<Φ≤0.25		4(distance≥10mm)		
		0.25<Φ≤0.35		3		
		Φ>0.40		0		
		③ Polarizer accidented spot				
		Size (mm)	Zone	Acceptable Qty		
				A	B	C
		Φ≤0.2		Ignore		Ignore
		0.3<Φ≤0.5		3(distance≥10mm)		
		Φ>0.5		1		
		④ Pixel bad points (light dot, Dim dot, colour dot)				
		Size (mm)	Zone	Acceptable Qty		
				A	B	C
Φ≤0.15		Ignore	Ignore			
0.2<Φ≤0.3		2(distance≥10mm)				
Φ>0.4		1				
⑤ Polarizer Bubble						
Size (mm)	Zone	Acceptable Qty				
		A	B	C		
Φ≤0.2		Ignore		Ignore		
0.3<Φ≤0.4		4(distance≥10mm)				
0.4<Φ≤0.5		3				
Φ>0.5		1				

3.0	Line defect (LCD/TP/ Polarizer black/ white line, scratch, stain)	Width (mm)	Length (mm)	Acceptable Qty		
				A	B	C
		$\Phi \leq 0.05$	Ignore	Ignore		Ignore
		$0.05 < W \leq 0.06$	$L \leq 5.0$	$N \leq 2$		
		$0.07 < W \leq 0.08$	$L \leq 4.0$	$N \leq 2$		
$0.08 < W$	Define as spot defect					
4.0	SMT	Do not allow: missing parts, solderless connection, cold solder joint, miss match, the positive and negative polarity oppose				
5.0	Display colour & Brightness	1. Colour: Measuring the colour coordinates, The measurement standard according to the datasheet or samples 2. Brightness: Measuring the brightness of White screen, The measurement standard according to the datasheet or Samples				
6.0	LCD Mura	By 5% ND filter invisible				

- Criteria (functional items)

Number	Items	Criteria
1	No display	Not allowed
2	Missing segment	Not allowed
3	Short	Not allowed
4	Backlight no lighting	Not allowed

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
High Temperature Operation	Ta = 85°C	96 h	3pcs
Low Temperature Operation	Ta = -30°C	96 h	3pcs
High Temperature Storage	Tp = 85°C	96 h	3pcs
Low Temperature Storage	Tp = -30°C	96 h	3pcs
High Temperature & High Humidity Operation	60°C, 90% RH	96 h	3pcs
Thermal Shock (Non-operation)	-30°C, 30 min ↔ 85°C, 30 min, Change time: 5min 20 Cycles.		3pcs
ESD test	C=150pF, R=330, 5 points/panel Air: ±8KV, 5 times; Contact: ±6KV, 5 times; (Environment: 15°C~35°C, 30%~60%).		3pcs
Vibration (Non-operation)	Frequency range: 10~55Hz, Stroke: 1.5mm Sweep: 10Hz~55Hz~10Hz 2 hours for each direction of X.Y.Z. (6 hours for total) (Package condition).		3pcs
Box Drop Test	1 Corner 3 Edge 6 faces, 80 cm (Medium Box)		1 box

Note: Ta = ambient temperature, Tp = panel temperature

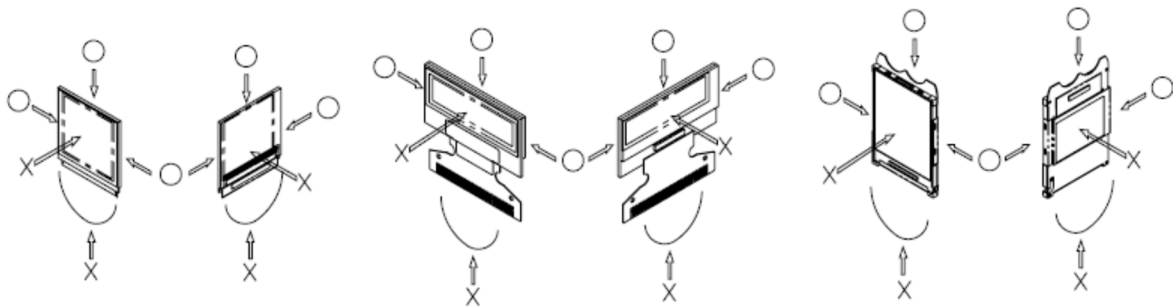
Notes:

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

8.1 Handling Precautions

- 1) Since the display panel is being made of glass, do not apply mechanical impacts such as dropping from a high position.
- 2) If the display panel is broken by some accident and the internal organic substance leaks out, be careful not to inhale nor lick the organic substance.
- 3) If the liquid crystal touches your skin or clothes, wash it off immediately using soap and plenty of water
- 4) If pressure is applied to the display surface or its neighbourhood of the display module, the cell structure may be damaged and be careful not to apply pressure to these sections.
- 5) The polarizer covering the surface of the display module is soft and easily scratched. Please be careful when handling the display module.
- 6) When the surface of the polarizer of the display module has soil, clean the surface. It takes advantage of by using following adhesion tape.
 - a. Scotch Mending Tape No. 810 or an equivalent
2. Never try to breathe upon the soiled surface nor wipe the surface using cloth containing solvent such as ethyl alcohol, since the surface of the polarizer will become cloudy.
3. Also, pay attention that the following liquid and solvent may spoil the polarizer:
 - Water
 - Ketone
 - Aromatic Solvents
- 7) Hold the display module very carefully when placing it into the system housing. Do not apply excessive stress or pressure to display module. And, do not over bend the film with electrode pattern layouts. These stresses will influence the display performance. Also, secure sufficient rigidity for the outer cases.



- 8) Do not apply stress to the LSI chips and the surrounding molded sections.
- 9) Do not disassemble nor modify the display module.
- 10) Do not apply input signals while the logic power is off.
- 11) Pay sufficient attention to the working environments when handing display modules to prevent occurrence of element breakage accidents by static electricity.
 - Be sure to make human body grounding when handling display modules.
 - Be sure to ground tools to use or assembly such as soldering irons.
 - To suppress generation of static electricity, avoid carrying out assembly work under dry environments.

- Protective film is being applied to the surface of the display panel of the display module. Be careful since static electricity may be generated when exfoliating the protective film.
- 12) Protection film is being applied to the surface of the display panel and removes the protection film before assembling it. If the display module has been stored for a long period of time, residue adhesive material of the protection film may remain on the surface of the display panel after removed of the film. In such case, remove the residue material by the method introduced in the above Section 5).
 - 13) If electric current is applied when the display module is being dewed or when it is placed under high humidity environments, the electrodes may be corroded and be careful to avoid the above.

8.2 Storage Precautions

- 1) When storing display modules, put them in static electricity preventive bags avoiding exposure to direct sun light nor to lights of fluorescent lamps, etc. and, also, avoiding high temperature and high humidity environments or low temperature (less than 0°C) environments. (We recommend you to store these modules in the packaged state when they were shipped from Densitron) At that time, be careful not to let water drops adhere to the packages or bags nor let dewing occur with them.
- 2) If electric current is applied when water drops are adhering to the surface of the display module, when the display module is being dewed or when it is placed under high humidity environments, the electrodes may be corroded and be careful about the above.

8.3 Designing Precautions

- 1) The absolute maximum ratings are the ratings which cannot be exceeded for display module, and if these values are exceeded, panel damage may be happen.
- 2) To prevent occurrence of malfunctioning by noise, pay attention to satisfy the VIL and VIH specifications and, at the same time, to make the signal line cable as short as possible.
- 3) We recommend you to install excess current preventive unit (fuses, etc.) to the power circuit (VDD). (Recommend value: 0.5A)
- 4) Pay sufficient attention to avoid occurrence of mutual noise interference with the neighbouring devices.
- 5) As for EMI, take necessary measures on the equipment side basically.
- 6) When fastening the display module, fasten the external plastic housing section.
- 7) If power supply to the display module is forcibly shut down by such errors as taking out the main battery while the display panel is in operation, we cannot guarantee the quality of this display module.

8.4 Operation Precautions

- 1) It is indispensable to drive the display within the specified voltage limit since excessive voltage shortens its life.
- 2) Direct current causes an electrochemical reaction with remarkable deterioration of the display quality. Consider prevent direct current during ON/OFF timing and during operation.
- 3) 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.
- 4) To protect display modules from performance drops by static electricity rapture, etc., do not touch the following sections whenever possible while handling the display modules.
 - Pins and electrodes
 - Pattern layouts such as the FPC
- 5) When the driver is being exposed (COG), semiconductor elements change their characteristics when light is radiated according to the principle of the solar battery. Consequently, if the driver is exposed to light, malfunctioning may occur.
 - Design the product and installation method so that the driver may be shielded from light in actual usage.
 - Design the product and installation method so that the driver may be shielded from light during the inspection processes.
- 6) Although the display module stores the operation state data by the commands and the indication data, when excessive external noise, etc. enters the module, the internal status may be changed. It therefore is necessary to take appropriate measures to suppress noise generation or to protect from influences of noise on the system design.
- 7) We recommend you construct its software to make periodical refreshment of the operation statuses (re-setting of the commands and re-transference of the display data) to cope with catastrophic noise.

8.5 Other Precautions

Request the qualified companies to handle industrial wastes when disposing of the display modules. Or, when burning them, be sure to observe the environmental and hygienic laws and regulations.