

DMT068WVHTCLO-1A

PRODUCT SPECIFICATION

Version 0.1
Nov 07, 2023

TBD

<i>Customer's Approval</i>	
<u>Signature</u>	<u>Date</u>

Prepared by Yvette Hsieh
Approved by Eric Wan

Revision History

VERSION	DATE	DESCRIPTION	AUTHOR
0.1	Nov 07, 2023	Preliminary	Yvette Hsieh

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1. General Description

1.1 Introduction

This is a 6.8" size colour active matrix TFT LCD module that uses amorphous silicon TFT as a switching device. The display is normally black mode, transmissive, and featuring high contrast and excellent colour saturation. The resolution of the TFT-LCD is 800 x 480 and can display up to 16.7M colours. The display module supports 24-bit RGB interface and adopts optical bonding method to laminate cover lens to the LCD.

1.2 Main Features

Item	Contents
Display Type	TFT LCD
Screen Size	6.8" Diagonal
Display Format	800 x RGB x 480 Dots
No. of Colour	16.7M
Overall Dimensions	156.96 (W) x 100.77 (H) x 8.46 (D) mm
Active Area	148.10 (W) x 88.86 (H) mm
Mode	Normally Black / Transmissive
Surface Treatment	Glare (6H)
Viewing Direction	All round
Interface	24-bit RGB
Cover lens	Glass, 3mm
Bonding type (CL with LCD)	Optical bonded
Backlight	LDE, White, 24 chips
Operating Temperature	-30°C ~ 85°C
Storage Temperature	-30°C ~ 85°C
ROHS	Compliant to RoHS 2.0

2. Mechanical Specification

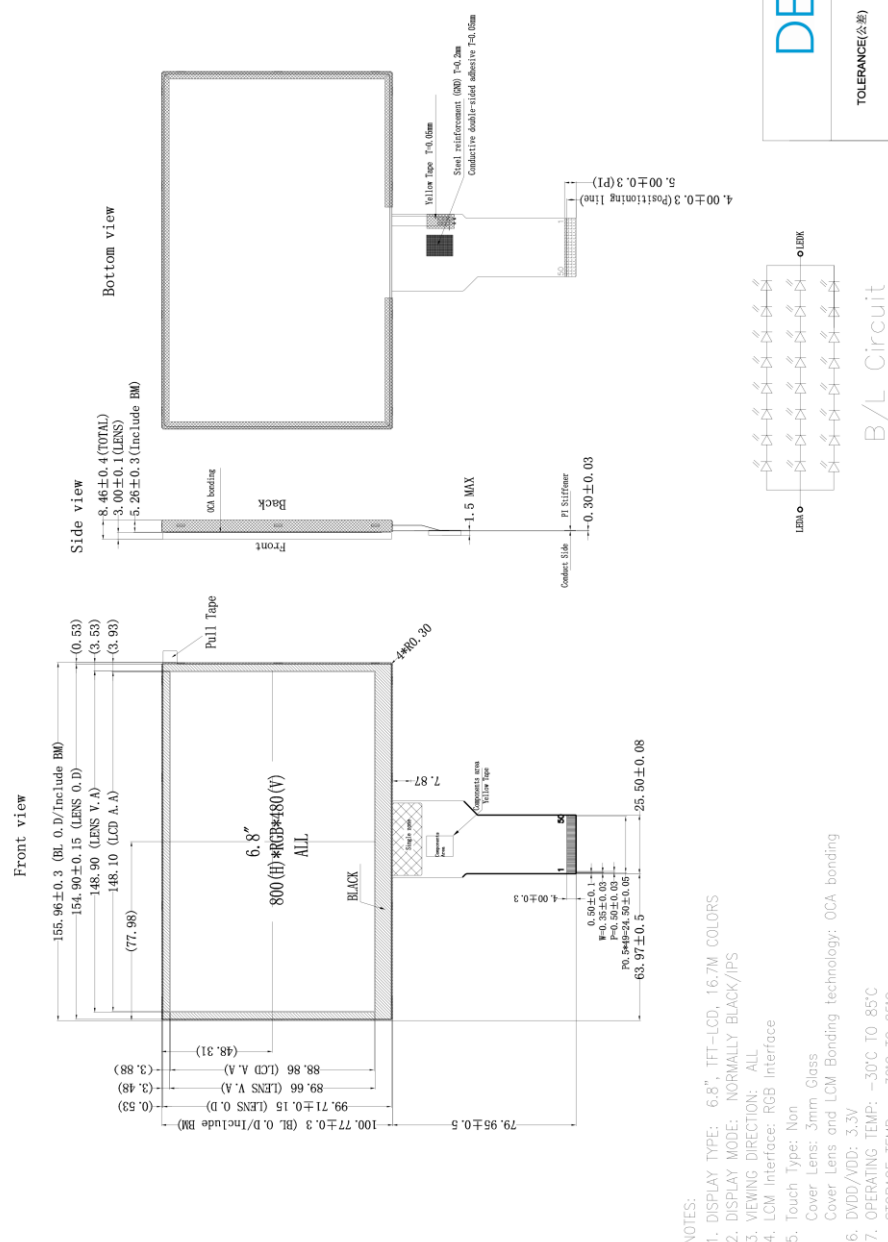
2.1 Mechanical Characteristics

Item	Characteristic	Unit
Display Format	800 x RGB x 480	Dots
Overall Dimensions	156.96 (W) x 100.77 (H) x 8.46 (D)	mm
Active Area	148.10 (W) x 88.86 (H)	mm
Dot Pitch	0.18513 (W) x 0.18513 (H)	mm
Weight	TBD	g

DENSITRON

Pin	Name	Pin	Name
1	VLED+	27	G1
2	VLED+	28	G0
3	VLED-	29	R7
4	VLED-	30	R6
5	GND	31	R5
6	GND	32	R4
7	DVDD	33	R3
8	MODE	34	R2
9	DE	35	R1
10	V5	36	R0
11	H5	37	GND
12	H7	38	DCLX
13	B6	39	GND
14	B5	40	L/R
15	B4	41	U/D
16	B3	42	NC
17	B2	43	NC
18	B1	44	NC
19	B0	45	RESET
20	G7	46	NC
21	G6	47	NC
22	G5	48	GND
23	G4	49	NC
24	G3	50	NC
25	G2		

TOLERANCE(公差) TOLERANCE UNITS OTHERS SPECIFIED	DRAWING NAME	DW1088VHTCUD-1A
	PARTS NO.	
	Drawn Checked Approved	Unit 
Scale 1:1 	Page 1/1	



3. Electrical Specification

3.1 Absolute Maximum Ratings

3.1.1 Absolute Ratings of Environment

Item	Symbol	Min	Max	Unit
Digital Supply Voltage	V_{DD}	-0.3	4.0	V
Operating Temperature	T_{OP}	-30	+85	°C
Storage Temperature	T_{ST}	-35	+85	°C

Note 1: The absolute maximum rating values of this product are not allowed to be exceeded at any times. Should a module be used with any of the absolute maximum ratings exceeded, the characteristics of the module may not be recovered, or in an extreme case, the module may be permanently destroyed.

Note 2: Please refer to RELIABILITY.

3.2 DC Electrical Characteristics

3.2.1 Recommended Operating Condition

Item	Symbol	Min	Typ.	Max	Unit
Digital Supply Voltage	DV_{DD}	3.1	3.3	3.6	V
Normal Mode Current	I_{DD}	-	40	80	mA
Level Input Voltage	V_{IH}	0.7 DV_{DD}	-	DV_{DD}	V
	V_{IL}	GND	-	0.3 DV_{DD}	V
Level Output Voltage	V_{OH}	$DV_{DD} - 0.4$	-	VDD	V
	V_{OL}	GND	-	GND + 0.4	V

3.3 Interface Pin Assignment

No.	Symbol	Function	I/O
1-2	VLED+	Power for LED backlight (Anode)	P
3-4	VLED-	Power for LED backlight (Cathode)	P
5	GND	Power ground	P
6	NC	No connection	-
7	DVDD	Power for digital circuit	P
8	MODE	DE/SYNC mode select	I
9	DE	Data input enable	I
10	VS	Vertical sync input	I
11	HS	Horizontal sync input	I
12-19	B7-B0	Blue data	I/O
20-27	G7-G0	Green data	I/O
28-35	R7-R0	Red data	I/O
36	GND	Power ground	P
37	DCLK	Sample clock	I
38	GND	Power ground	P
39	L/R	Left/right selection	I
40	U/D	Up/down selection	I
41-43	NC	No connection	-
44	RESET	Global reset pin	I
45-47	NC	No connection	-
48	GND	Power ground	P
49-50	NC	No connection	-

I: Input, O: Output, P: Power

Note 1: DE/SYNC mode select. Normal pull high.

When select DE mode, Mode = "1", VS and HS must pull high.

When select SYNC mode, Mode = "0", DE must be grounded.

Note 2: When input 18 bits RGB data, the two low bits of R, G and B data must be grounded.

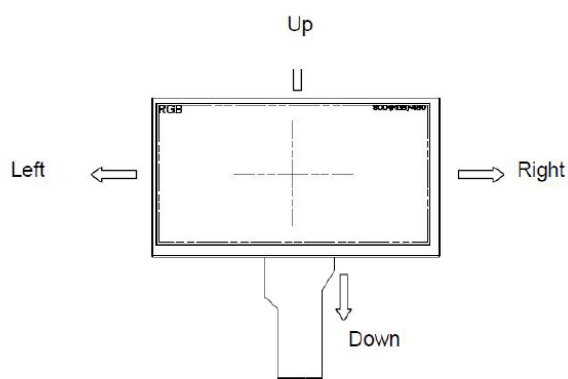
Note 3: Data shall be latched at the falling edge of DCLK.

Note 4: Selection of scanning mode.

Setting of scan control input		Scanning direction
U/D	L/R	
GND	DV _{DD}	Up to down, left to right
DV _{DD}	GND	Down to up, right to left

Setting of scan control input		Scanning direction
U/D	L/R	
GND	GND	Up to down, right to left
DV _{DD}	DV _{DD}	Down to up, left to right

Note 5: Definition of scanning direction refer to the figure as below.



Note 6: Global reset pin. Active low to enter reset state. Suggest connecting with an RC reset circuit for stability. Normally pull high.

3.4 Timing Characteristics

3.4.1 AC Characteristics

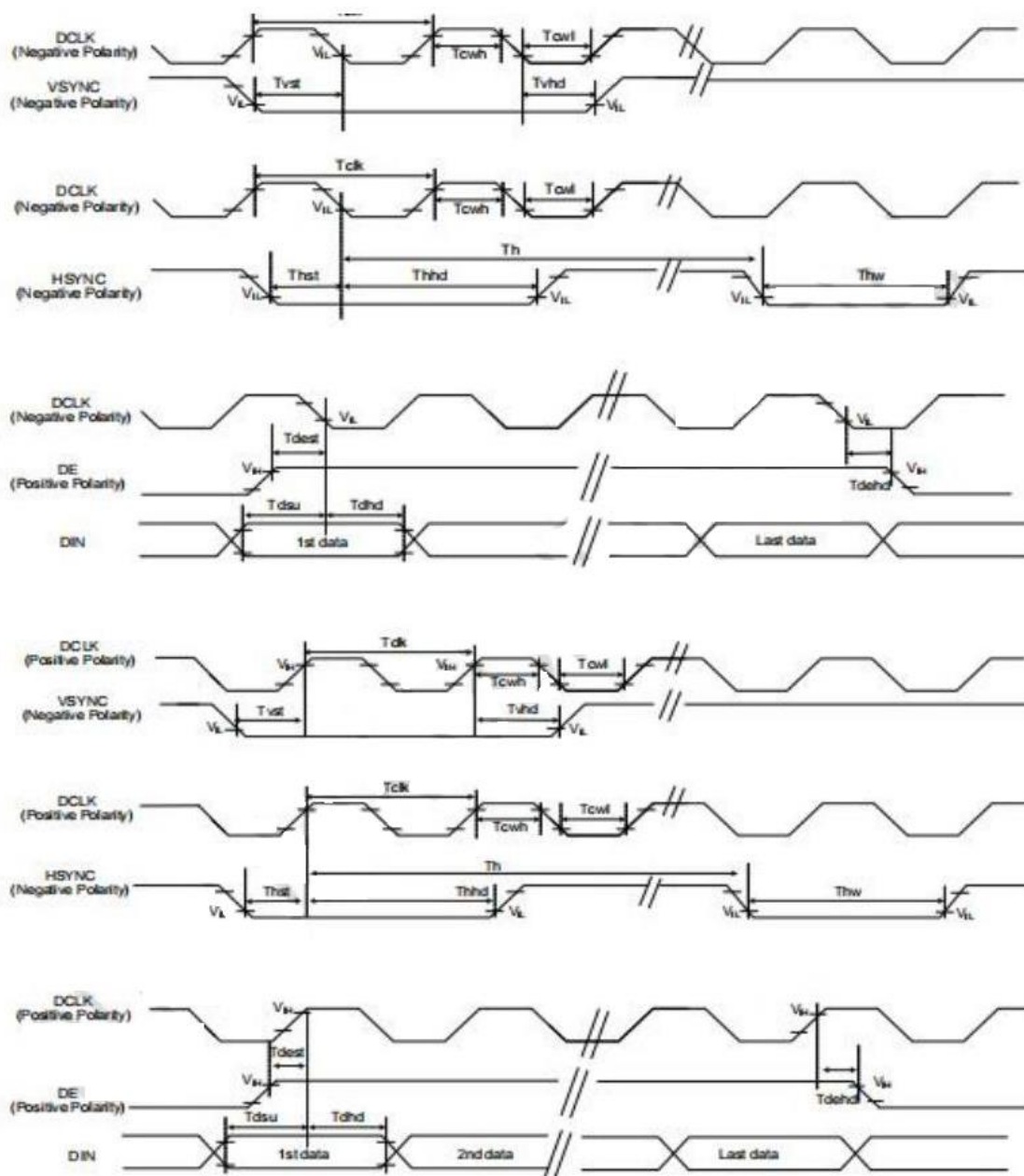
DC Electrical Characteristics (PVDD=VDD=VDDI=3.3V, AGND=0V, Ta=25°C, bare chip)

Parameter	Symbol	Min	Typ	Max	Unit	Note
VDD Power Source Slew Time	TPOR	-	-	20	ms	From 0V to 9% VDD
GRB Pulse Width	tRSTW	10	50	-	us	R = 10Kohm, C = 1uF
SD Output Stable Time	Tst	-	-	12	us	Output settled within +20mV. Loading = 6.8K + 28.2pF
GD Output Rise and Fall Time	Tgst	-	-	6	us	Output settled (5% ~ 95%) Loading = 6.8K + 28.2pF

3.4.2 System Bus Timing for RGB Interface

DC Electrical Characteristics (PVDD=VDD=VDDI=3.3V, AGND=0V, Ta=25°C, bare chip)

Parameter	Symbol	Min	Typ	Max	Unit
CLK Pulse Duty	Tcw	40	50	60	%
VSYNC Setup Time	Tvst	40	-	-	ns
VSYNC Hold Time	Tvhd	10	-	-	ns
HSYNC Setup Time	Thst	10	-	-	ns
HSYNC Hold Time	Thhd	10	-	-	ns
Data Setup Time	Tdsu	10	-	-	ns
Data Hold Time	Tdhd	10	--	-	ns
DE Setup Time	Tdest	10	-	-	ns
DE Hold Time	Tdehd	10	-	-	ns



3.4.3 Input Timing Table

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

Parameter		Symbol	Min	Typ	Max	Unit
DCLK Frequency		FCLK	23	25	27	MHz
HSYNC	Period Time	Th	808	816	848	DCLK
	Display Period	Thdisp	800			DCLK
	Back Porch	Thbp	4	8	24	DCLK
	Front Porch	Thfp	4	8	24	DCLK
	Pulse Width	Thw	2	4	8	DCLK
VSYNC	Period Time	Tv	496	512	528	HSYNC
	Display Period	Tvdisp	480			HSYNC
	Back Porch	Tvbp	8	16	24	HSYNC
	Front Porch	Tvfp	8	16	24	HSYNC
	Pulse Width	tvw	2	4	8	HSYNC

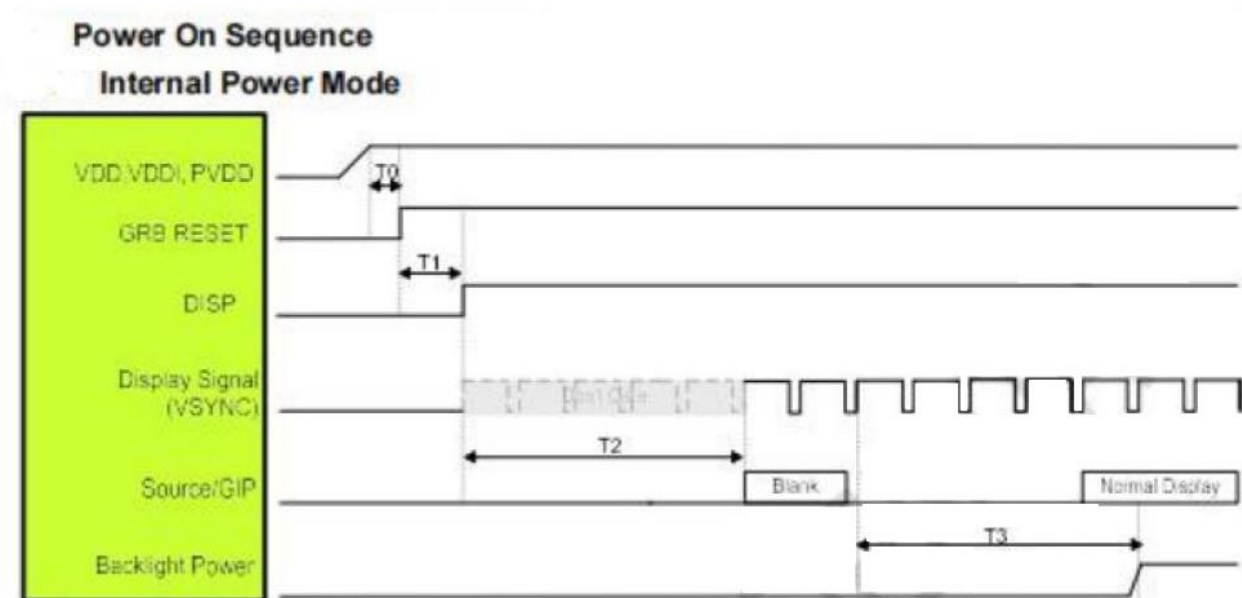
Note 1: The minimum blanking time depends on the GIP timing of the panel specification.

Note 2: To ensure the compatibility of different panels, it is recommended to use the typically setting.

Note 3: It is necessary to keep Tvbp = 8 and Thbp = 8 in sync mode. DE mode is unnecessary to keep it.

Note 4: The maximum DCLK Frequency is 27MHz.

3.4.4 Power On/Off Sequence



Symbol	Description	Time	Unit
T0	System power stability to RGB RESET signal	≥ 1	ms
T1	RGB RESET = "High" to DISP = "High"	≥ 10	ms
T2	DISP = "High" to Source/GIP scan blank	85	ms
T3	Display signal input to Backlight power on (base on Display Signal Frame Rate 60Hz)	≥ 100	ms

Note 1: When DISP pull "H" or "L", IC will execute the internal power on or power off procedures. Please be careful about the timing of DISO and do not interrupt it during power on or power off procedures, otherwise, unexpected errors will occur.

Note 2: RGB interface Display signal: DCLK, VSYNC, HSYNC, DE, DR [7:0], DG [7:0], DB [7:0]

Note 3: LVDS interface Display signal: DLCK P/N, RX [3:0] P/N

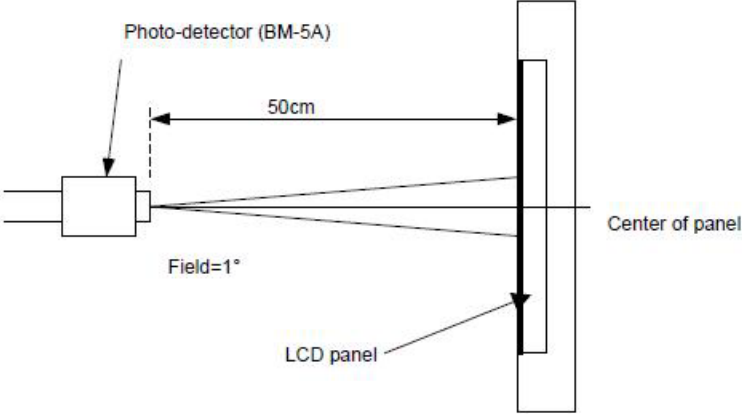
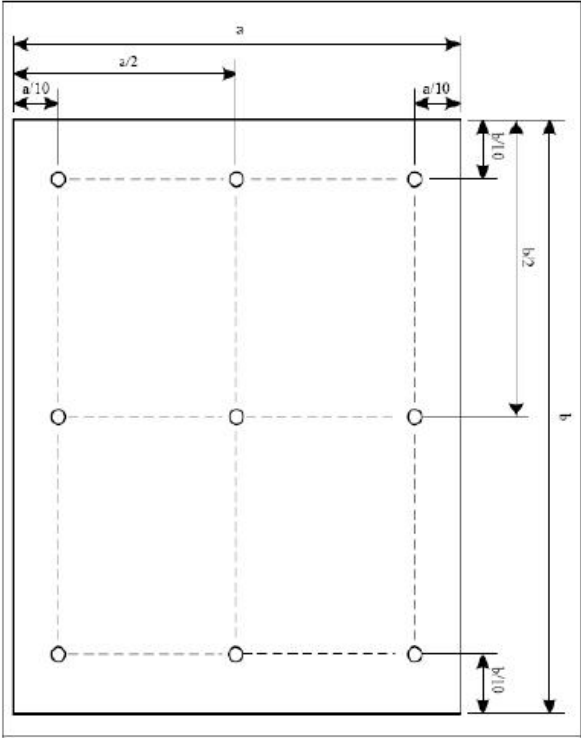
4. Optical Specification

4.1 Optical Characteristics

Characteristics		Symbol	Conditions	Min	Typ.	Max	Unit	Note
Contrast Ratio		CR	$\theta=0$	-	1000	-	-	1, 2
Response time		TR + TF	Normal Viewing Angle	-	30	-	ms	1, 3
Viewing Angle	Left	θ_{x-}	CR ≥ 10	-	85	-		1, 4
	Right	θ_{x+}		-	85	-		
	Up	θ_{y+}		-	85	-		
	Down	θ_{y-}		-	85	-		
Colour Chromaticity	Red	Rx	-	0.576	0.616	0.656	-	1, 4, CA-310
		Ry		0.329	0.369	0.409		
	Green	Gx		0.288	0.328	0.368		
		Gy		0.523	0.563	0.603		
	Blue	Bx		0.108	0.148	0.188		
		By		0.018	0.058	0.098		
	White	Wx		0.257	0.297	0.337		
		Wy		0.266	0.306	0.346		
Uniformity		Avg	-	80	-	-	%	5
Luminance		LV	-	TBD	720	-	cd/m ²	-
Color Gamut		S (%)	-	52	57	-	%	-

Measuring Condition: in dark room, at ambient temperature 25±2°C, for 15 min warm-up time.

Note	Item	Test method
1	Definition of Viewing Angle	
2	Definition of Contrast Ratio	<p>measured at the center point of panel</p> $CR = \frac{\text{Luminance with all pixels white}}{\text{Luminance with all pixels black}}$
3	Definition of Response Time	<p>Display data: { Black (TFT OFF) } { White (TFT ON) } { Black (TFT OFF) }</p>

Note	Item	Test method
4	Definition of Optical Measurement Setup	
5	Definition of Luminance and Uniformity	<div><div><div>Uniformity = $\frac{\text{minimum luminance in 9 points (1-9)}}{\text{maximum luminance in 9 points (1-9)}}$</div><div>Luminance= $\frac{\text{Total Luminance of 9 points}}{9}$</div></div></div>

5. LED Backlight Specification

5.1 LED Driver Electrical Characteristics

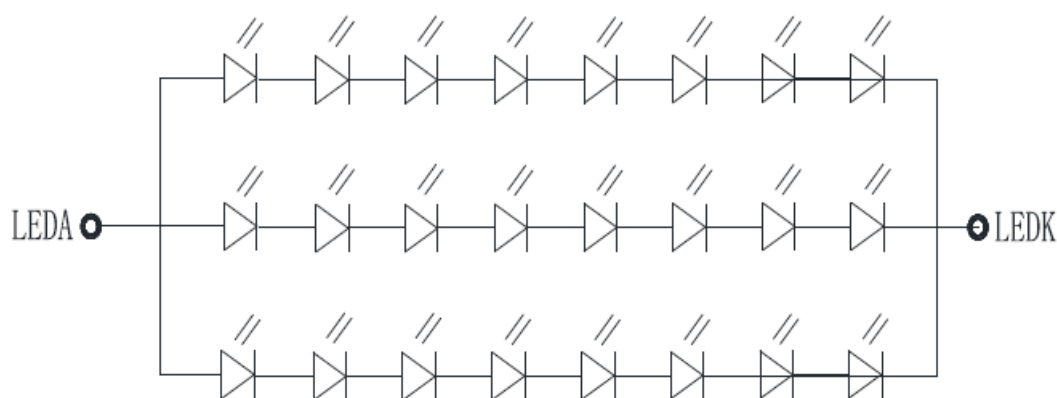
The back-light system is edge-lighting type with 24 chips LED.

Item	Symbol	Min	Typ.	Max	Unit
Forward Current	I_F	-	150	-	mA
Forward Voltage	V_F	22.4	24	26.4	V
LED Lifetime	Hr	-	20000	-	Hrs

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

Note 2: The "LED lifetime" is defined as the module brightness decrease to 50% original brightness at $T_a = 25^\circ\text{C}$ and $I_L = 150\text{ mA}$. The LED lifetime could be decreased if operating I_L is larger than 150mA. The constant current driving method is suggested.

5.2 Internal Circuit Diagram



B/L Circuit

6. Packaging

TBD

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7. Quality Assurance Specification

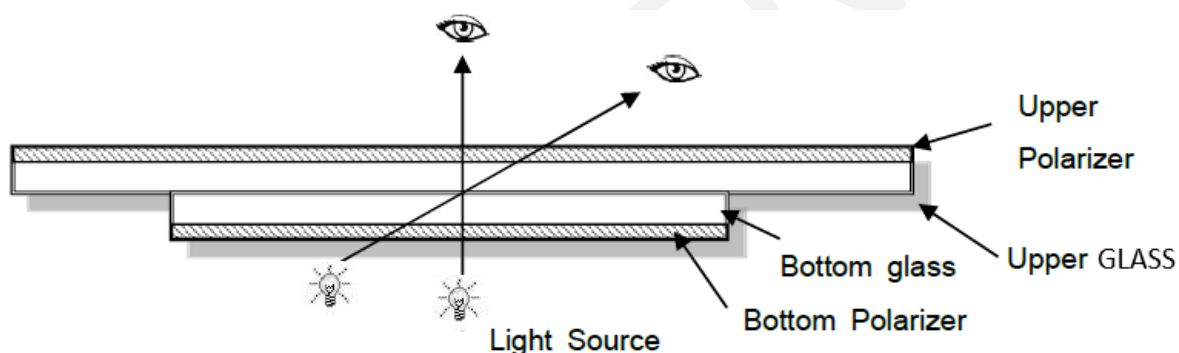
7.1 Conformity

The performance, function and reliability of the shipped products conform to the Product Specification.

7.2 Environment Required

Customer's test & measurement are required to be conducted under the following conditions:

Temperature:	$25 \pm 5^{\circ} \text{C}$
Humidity:	$65\% \pm 10\% \text{ RH}$
Viewing Angle:	Normal viewing Angle
Illumination:	300 ~ 700 Lux (single fluorescent lamp)
Viewing distance:	30 ~ 50cm
Finger glove (or finger cover) must be worn by the inspector.	
Inspection table or jig must be anti-electrostatic.	

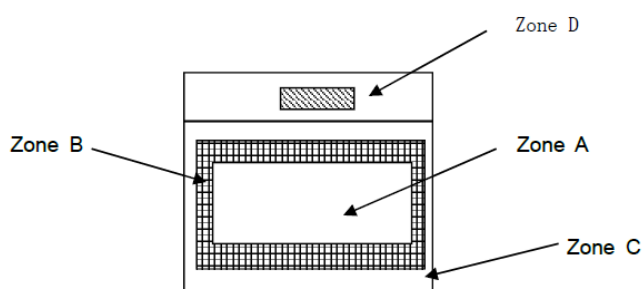


7.3 Delivery Assurance

7.3.1 Delivery Inspection Standards

Class II, Normal Inspection, MIL-STD-105E

7.3.2 Zone Definition



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 cannot 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 affect product function or appearance after assembly by customer

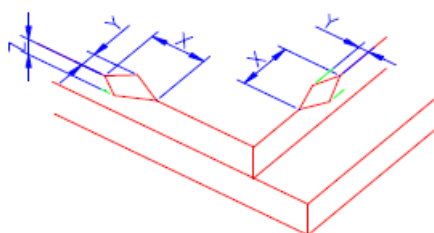
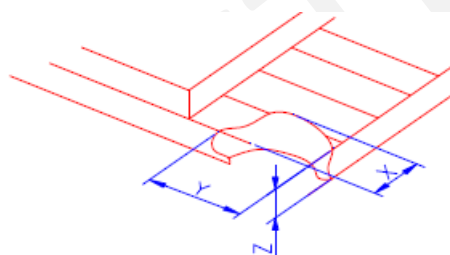
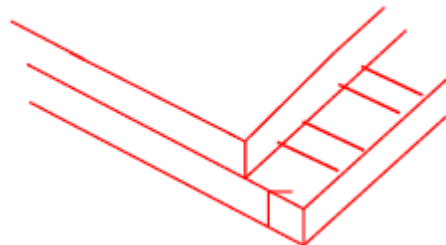
7.3.3 Criteria & Acceptable Quality Level

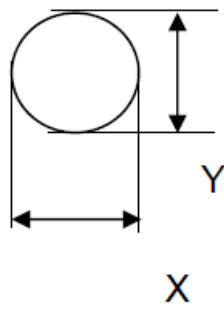
Item	Criteria	Classification	Partition
Functional defects	1) No display, Open or miss line 2) Display abnormally, Short 3) Backlight no lighting, abnormal lighting etc.	Major	0.65
Missing	Missing components and etc.		
Outline dimension	Overall outline dimension beyond the drawing is not allowed, deformation and etc.		
Color tone	Color unevenness, refer to limited sample	Minor	1.5
Spot/Line defect	Light dot, dim spot, polarizer air bubble, polarizer accidented spot and etc.		
Soldering appearance	Good soldering, peeling off is not allowed and etc.		
LCD/Polarizer	Black/White spot/line, scratch, crack, etc.		

Note:

- a) Light dot : Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.
- b) Dim dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue picture.

7.3.4 Criteria & Classification

Item	Criteria (mm)																			
LCD Crack/Broken	X: Length, Y: Width, Z: Height, L: Length of ITO, T: Height of LCD																			
	1. The edge of LCD broken																			
																				
	$X \leq 3\text{mm}$, $Y < \text{inner border line of the seal}$, $Z \leq T$																			
	2. LCD corner broken																			
																				
	$X \leq 3\text{mm}$, $Y < L$, $Z \leq T$																			
	3. LCD crack																			
																				
	Not allow																			
Spot defect	$\Phi = (X + Y)/2$																			
	1. light dot (black/white spot, pinhole, stain, etc.)																			
	<table><tr><th rowspan="2">Size</th><th colspan="3">Acceptable number</th></tr><tr><th>A</th><th>B</th><th>C</th></tr><tr><td>$\Phi \leq 0.15$</td><td colspan="3">Ignore</td></tr><tr><td>$0.15 < \Phi \leq 0.25$</td><td colspan="3">3 (distance $\geq 10\text{mm}$)</td></tr><tr><td>$0.25 < \Phi \leq 0.4$</td><td colspan="3">2 (distance $\geq 10\text{mm}$)</td></tr></table>	Size	Acceptable number			A	B	C	$\Phi \leq 0.15$	Ignore			$0.15 < \Phi \leq 0.25$	3 (distance $\geq 10\text{mm}$)			$0.25 < \Phi \leq 0.4$	2 (distance $\geq 10\text{mm}$)		
	Size		Acceptable number																	
		A	B	C																
$\Phi \leq 0.15$	Ignore																			
$0.15 < \Phi \leq 0.25$	3 (distance $\geq 10\text{mm}$)																			
$0.25 < \Phi \leq 0.4$	2 (distance $\geq 10\text{mm}$)																			
			Ignore																	

Item	Criteria (mm)			
	$\Phi > 0.4$	0		
	2. Dim spot (light leakage, dent, dark spot etc)			
	Size	Acceptable number		
		A	B	C
	$\Phi \leq 0.15$	Ignore		Ignore
	$0.15 < \Phi \leq 0.25$	3 (distance $\geq 10\text{mm}$)		
	$0.25 < \Phi \leq 0.4$	2 (distance $\geq 10\text{mm}$)		
	$\Phi > 0.4$	0		
	3. Polarizer accidented spot			
	Size	Acceptable number		
		A	B	C
	$\Phi \leq 0.2$	Ignore		Ignore
	$0.2 < \Phi \leq 0.5$	2 (distance $\geq 10\text{mm}$)		
	$\Phi > 0.5$	0		
	4. Polarizer Bubble			
Size	Acceptable number			
	A	B	C	
$\Phi \leq 0.2$	Ignore		Ignore	
$0.2 < \Phi \leq 0.4$	2 (distance $\geq 10\text{mm}$)			
$0.4 < \Phi \leq 0.5$	1			
$\Phi > 0.5$	0			
LCD Pixel defect	Pixel bad points			
	Item	Zone A	Acceptable number	
	Bright dot	Random	$N \leq 2$	
		2 dots adjacent	$N \leq 0$	
		3 dots adjacent	$N \leq 0$	
	Dark dot	Random	$N \leq 3$	
		2 dots adjacent	$N \leq 0$	
		3 dots adjacent	$N \leq 0$	
	Distance	1. Minimum distance between bright dots.		5mm
		2. Minimum distance between dark dots		
3. Minimum distance between dark and bright dot.				

Item	Criteria (mm)				
	Total bright and dark dot		N ≤ 4		
	Note:				
	A) Bright dot: Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.				
	B) Dark dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue picture.				
	C) 2 dot adjacent = 1 pair = 2 dots				
	Picture:				
	2 dot adjacent		2 dot adjacent		
	2 dot adjacent (vertical)		2 dot adjacent (slant)		
Line defect (LCD/Polarizer backlight black/white line, scratch, stain)	N : Count				
	Width (mm)	Length (mm)	Acceptable number		
			A	B	C
	W ≤ 0.05	Ignore	Ignore		
	0.05 < W ≤ 0.06	L ≤ 5.0	N ≤ 3		
0.06 < W ≤ 0.08	L ≤ 4.0	N ≤ 2			
W > 0.08	Define as spot defect				
Electronic Components SMT.	Not allow missing parts, solderless connection, cold solder joint, mismatch. The positive and negative polarity opposite				
Display color & Brightness.	1. Color: Measuring the color 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.				
LCD Mura/Waving/Hot spot	Not visible through 5% ND filter in 50% gray or judge by limit sample if necessary.				

Criteria (functional items)

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

7.4 Dealing with Customer Complaints

7.4.1 Non-conforming Analysis

Purchaser should supply Densitron with detailed data of non-conforming sample.

After accepting it, Densitron should complete the analysis in reasonable time and update the status to the purchaser.

7.4.2 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.

8. Reliability Specification

8.1 Reliability Tests

Test Item	Test Condition	Inspection after Test
High Temperature Operation	85°C, 96 hours	Inspection after 2~4hours storage at room temperature, the sample shall be free from defects: 1. Air bubble in the LCD. 2. Non-display. 3. Missing segments. 4. Glass crack. 5. Current Idd is twice higher than initial value.
Low Temperature Operation	-30°C, 96 hours	
High Temperature Storage	85°C, 96 hours	
Low Temperature Storage	-30°C, 96 hours	
Damp Proof Test	60°C, 90%RH, 96 hours	
Temperature Cycle	-10°C ~ 60°C, 20cycles, 30 min Change time: 5min	
ESD Test	C = 150pF, R = 330,5points/panel Air: ±8KV, 5times; Contact: ±6KV, 5 times. (Environment: 15°C ~ 35°C, 30% ~ 60%).	
Vibration Test (non-operation)	Frequency : 10Hz ~ 55Hz Stroke: 1.5mm Sweep: 10Hz ~ 55Hz ~ 10Hz, 2 hours for each direction of X.Y.Z. (6 hours for total) (Package condition).	
Box Drop Test	1 Corner 3 Edges 6 faces,80cm (MEDIUM BOX)	

Note 1: The test samples should be applied to only one test item.

Note 2: Sample size for each test item is 5~10pcs.

Note 3: For Damp Proof Test, Pure water(Resistance > 10MΩ) should be used.

Note 4: In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judge as a good part.

Note 5: Failure Judgment Criterion: Basic Specification, Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.

Note 6: The color fading mura of polarizing filter should not care.

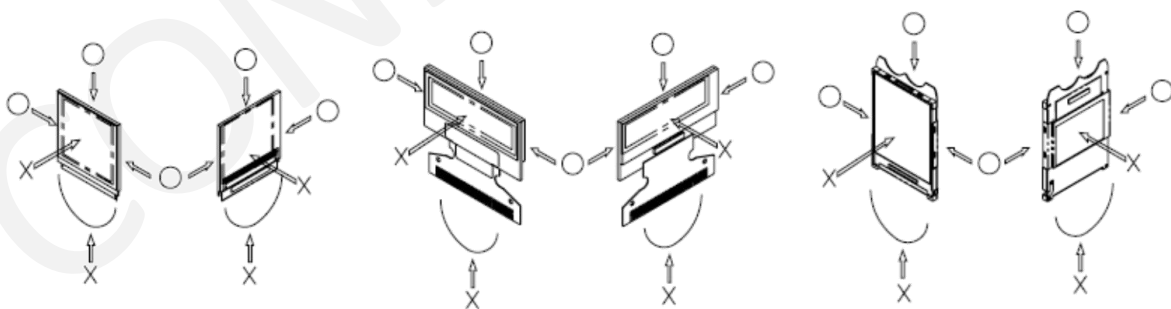
8.1.1 Inspection Check Standard

After the completion of the described reliability test, the samples are to be left at room temperature for 4 hrs prior to conducting the inspection check at 25±5 °C, 65±5% RH.

9. Handling Precautions

9.1 Handling Precautions

- 1) Since the display panel is made of glass, do not apply mechanical impacts such as dropping from a high position.
- 2) If the display panel is broken by 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
 - b. 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.
 - c. 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 handling display modules to prevent occurrence of element breakage accidents by static electricity.
 - a. Be sure to make human body grounding when handling display modules.

- b. Be sure to ground tools to use or assembly such as soldering irons.
 - c. To suppress generation of static electricity, avoid carrying out assembly work under dry environments.
 - d. 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) A 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.

9.2 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 store these modules in the packaged state when they are 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.

9.3 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 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 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.

9.4 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. Give careful consideration to 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.
 - a. Pins and electrodes
 - b. 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.
 - a. Design the product and installation method so that the driver may be shielded from light in actual usage.
 - b. 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 into the module, the internal status may be changed. It therefore is necessary to take appropriate measures to suppress noise generation or to protect from the influences of noise on the system design.
- 7) We recommend you construct its software to make periodical refreshments of the operation statuses (re-setting of the commands and re-transference of the display data) to cope with catastrophic noise.

9.5 Cleaning Precautions

- 1) **Keep TFT Scratch free:** Avoid using abrasive materials like paper towels and newspaper in cleaning TFT LCD screens as they may scratch the surface. Instead, opt for a lint-free cloth. Don't spray the liquid directly on the monitor and remember to put gentle pressure when wiping the screen.
- 2) **Avoid Vibration:** During cleaning process, try to keep the TFT on shock proof platform to avoid strong shock and vibration. Do not apply pressure to the LCD screen of the LCD or bump or squeeze the LCD display back cover.
- 3) When the surface of the polarizer of the display module has soil, clean the surface. It takes advantage of using the following adhesion tape:
 - a) Scotch Mending Tape No. 810 or an equivalent.
 - b) Never try to breathe upon the soiled surface.
 - c) List of Safe and Unsafe solvents to clean TFT display:

Safe Solvents	Unsafe Solvents
Distilled Water	Ammonia
Isopropyl Alcohol	Acetone
Diluted White Vinegar = Water (Mix 1 part vinegar + 5 parts of Water)	Ethyl Alcohol
	Methyl Chloride
	Ethyl Acid

9.6 Other Precautions

- 1) 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.