DMT035VGNTNT0-2D

PRODUCT SPECIFICATION

Version 0.1
Nov 08, 2023

TBD

Customer's Approval	
Signature	*Date*

Prepared by *Yvette Hsieh*
Approved by *Eric Wan*

Revision History

VERSION	DATE	DESCRIPTION	AUTHOR
0.1	Nov 08, 2023	Preliminary	Yvette Hsieh

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Table of Contents

1. General Description

1.1 Introduction

This is a 3.5" 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 480 x 640 and can display up to 262Kcolours. The display module supports 18-bit RGB interface.

1.2 Main Features

Item	Contents
Display Type	TFT LCD
Screen Size	3.5" Diagonal
Display Format	480 x RGB x 640 Dots
No. of Colour	262K
Overall Dimensions	64.0 (W) x 85.0 (H) x 3.1 (D) mm
Active Area	53.28 (W) x 71.04 (H) mm
Mode	Normally black / Transmissive
Surface Treatment	Glare, polarizer with 1/4λ film
Viewing Direction	All round
Interface	18-bit RGB
Backlight Type	LED, White, 6 chips
Operating Temperature	-20°C ~ +70°C
Storage Temperature	-30°C ~ +80°C
ROHS	Compliant to RoHS 2.0

2. Mechanical Specification

2.1 Mechanical Characteristics

Item	Characteristic	Unit
Display Format	480 x RGB x 640	Dots
Overall Dimensions	64.0 (W) x 85.0 (H) x 3.1 (D)	mm
Active Area	53.28 (W) x 71.04 (H)	mm
Dot Pitch	0.111 (W) x 0.111 (H)	mm
Weight	33	g

2.2   Mechanical Drawing
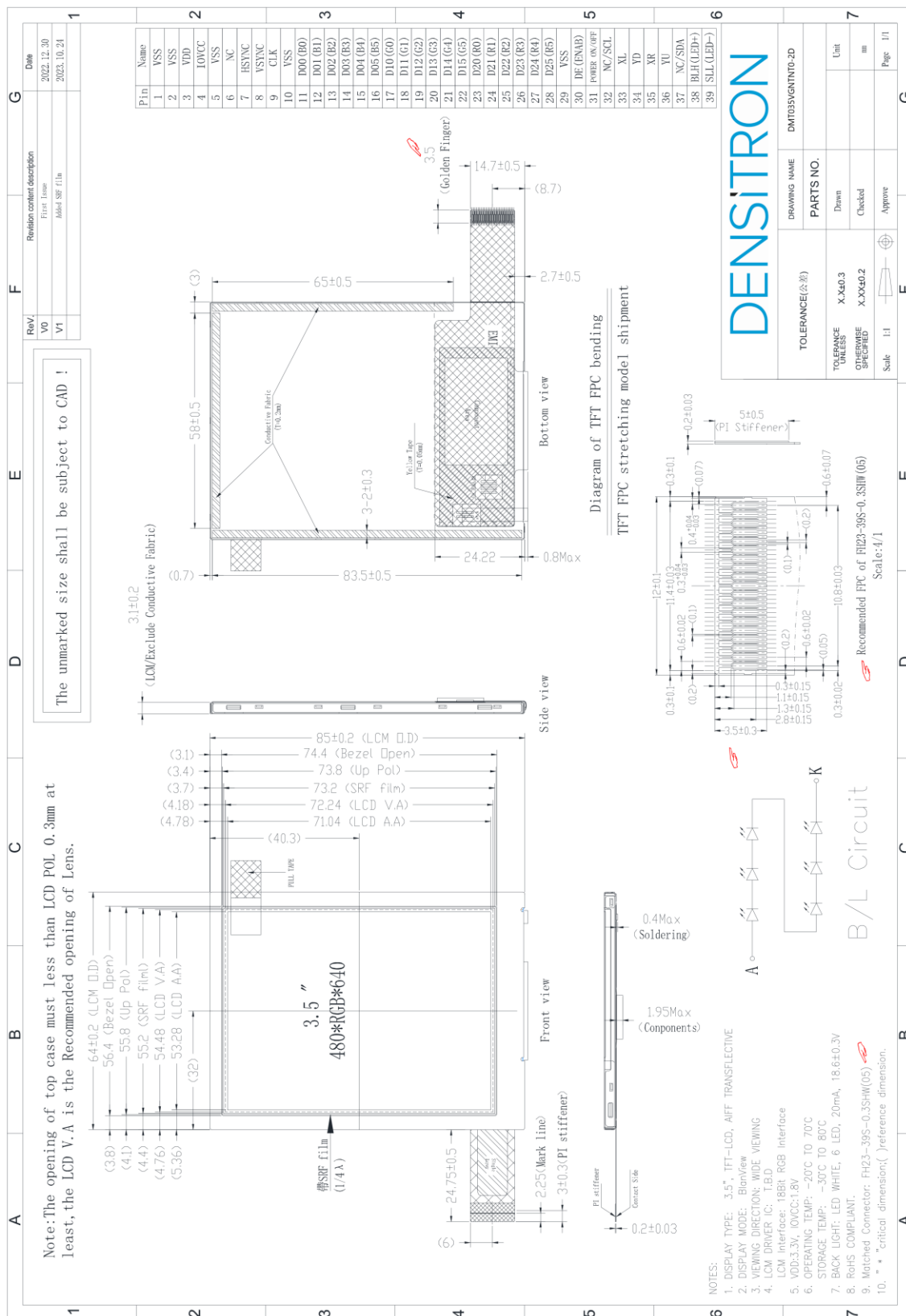
3. Electrical Specification

3.1 Absolute Maximum Ratings

Item	Symbol	Min	Max	Unit	Note
Digital Supply Voltage	VDD	-0.3	4.6	V	1
Digital Interface Supply Voltage	IOVCC	-0.3	4.6	V	1
Operating Temperature	T_{OP}	-20	+70	°C	-
Storage Temperature	T_{ST}	-30	+80	°C	-

Note 1: When this module is used beyond the above absolute maximum ratings, permanent breakage of the module may occur. For normal operations, it is desirable to use this module under the conditions according to Section 3.2 "Electrical Characteristics", to avoid malfunctioning.

Note 2: Background colour changes slightly depending on ambient temperature. This phenomenon is reversible.

Note 3: Please refer to item of RELIABILITY.

3.2 Electrical Characteristics

3.2.1 DC Electrical Characteristics

Item	Symbol	Min	Typ.	Max	Unit	Note
Digital Supply Voltage	VDD	2.5	3.3	3.6	V	-
Digital Interface Supply Voltage	IOVCC	1.65	1.8	3.6	V	-
Normal Mode Current Consumption	IDD	-	20	40	mA	-
Level Input Voltage	V_{IH}	0.7 IOVCC	-	IOVCC	V	-
	V_{IL}	GND	-	0.3 IOVCC	V	-
Level Output Voltage	V_{OH}	0.8 IOVCC	-	IOVCC	V	-
	V_{OL}	GND	-	0.2 IOVCC	V	-

3.3 Interface Pin Assignment

No.	Symbol	I/O	Function
1-2	VSS	P	Ground
2	VSS	P	Ground
3	VDD	P	Supply Voltage (3.3V)
4	IOVCC	P	I/O power supply voltage (1.65-3.3V)
5	VSS	P	Ground
6	NC	-	-
7	HSYNC	I	Line synchronizing signal for DPI (RGB) interface operation.
8	VSYNC	I	Frame synchronizing signal for DPI (RGB) interface operation.
9	CLK	I	Dot clock signal for DPI (RGB) interface operation.
10	VSS	P	Ground
11	D00 (B0)	I/O	Blue data input
12	D01 (B1)	I/O	Blue data input
13	D02 (B2)	I/O	Blue data input
14	D03 (B3)	I/O	Blue data input
15	D04 (B4)	I/O	Blue data input
16	D05 (B5)	I/O	Blue data input
17	D10 (G0)	I/O	Green data input
18	D11 (G1)	I/O	Green data input
19	D12 (G2)	I/O	Green data input
20	D13 (G3)	I/O	Green data input
21	D14 (G4)	I/O	Green data input
22	D15 (G5)	I/O	Green data input
23	D20 (R0)	I/O	Red data input

No.	Symbol	I/O	Function
24	D21 (R1)	I/O	Red data input
25	D22 (R2)	I/O	Red data input
26	D23 (R3)	I/O	Red data input
27	D24 (R4)	I/O	Red data input
28	D25 (R5)	I/O	Red data input
29	VSS	P	Ground
30	DE (ENAB)	I	Data enable signal for DPI (RGB) interface operation. Low: access enabled. High: access inhibited.
31	Power On/Off	I	Standby signal. (Lo: Standby operation, Hi: Normal operation)
32	NC/SCL	-	-
33	XL (NC)	-	-
34	YD (NC)	-	-
35	XR (NC)	-	-
36	YU (NC)	-	-
37	NC/SDA	-	-
38	BLH (LED+)	P	Anode pin of backlight.
39	SLL (LED-)	P	Cathode pin of backlight.

3.4 Block Diagram
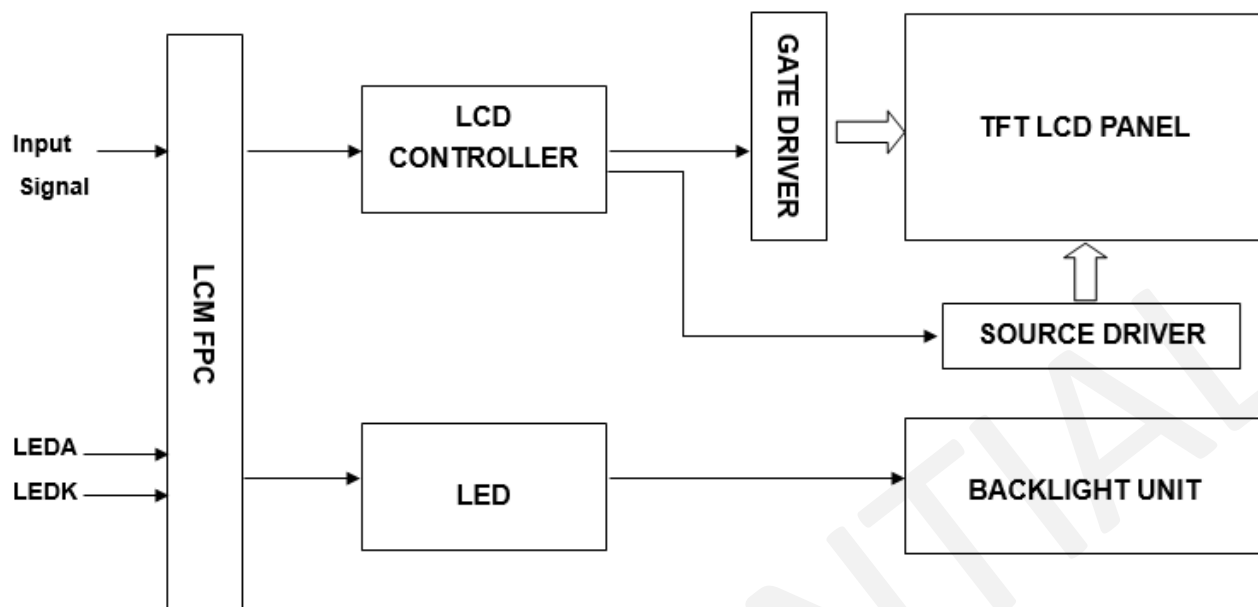
3.5 Timing Characteristics

3.5.1 Parallel RGB Interface Timing
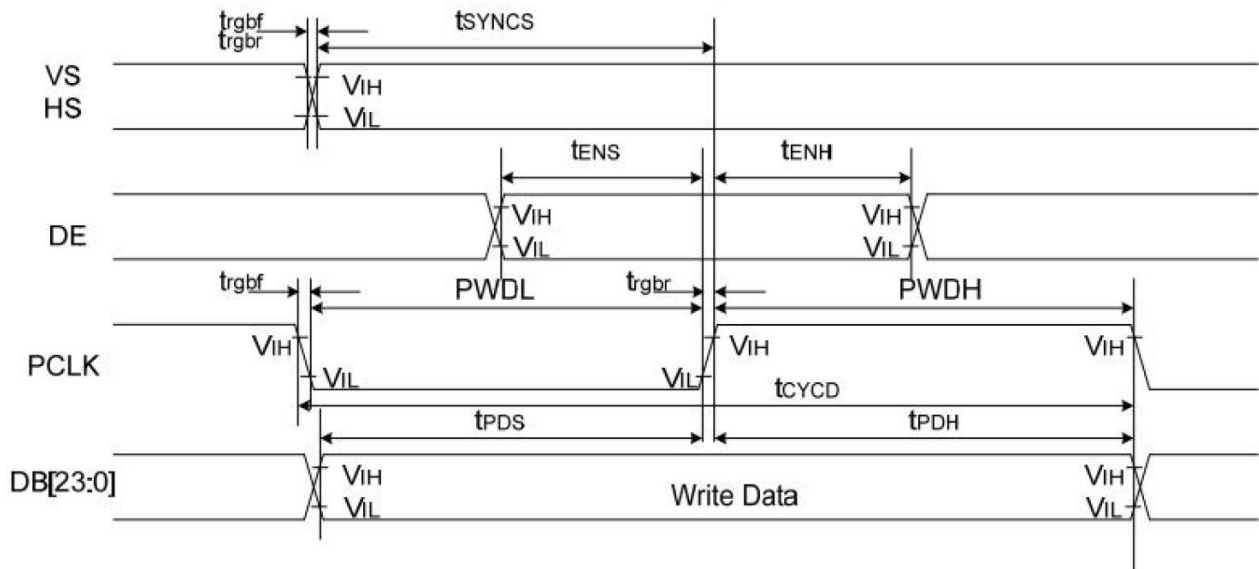
Signal	Symbol	Parameter	Min	Max	Unit	Condition
VS/HS	t_{SYNCS}	VS/HS Setup Time	5	-	ns	
	t_{SYNCH}	VS/HS Hold Time	5	-	ns	
DE	t_{ENS}	DE Setup Time	5	-	ns	
	t_{ENH}	DE Hold Time	5	-	ns	
DB [23:0]	t_{POS}	Data Setup Time	5	-	ns	24/18/16-bit bus RGB interface mode
	t_{PDH}	Data Hold Time	5	-	ns	
PCLK	PWDH	PCLK High-level Period	13	-	us	
	PWDL	PCLK Low-level Period	13	-	ns	
	t_{CYCD}	PCLK Cycle Time	28	-	ns	
	t_{rgbr}, t_{rgbf}	PCLK, HS, VS Rise/Fall Time	-	15	ns	

Note: Ta = -30 to 70°C, VCCIO = 1.65V to 3.6V, VDD = 2.5V to 3.6V, VSS = 0V, DB0-DB5=D00-D05, DB8-DB13=D10-D15, DB16-DB21=D20-D25

3.5.2 DPI Interface Timing

The display operation via the RGB interface is synchronized with the VSYNC, HSYNC, and DOTCLK signals. The data can be written only within the specified area with low power consumption by using window address function. The back porch and front porch are used to set the RGB interface timing.
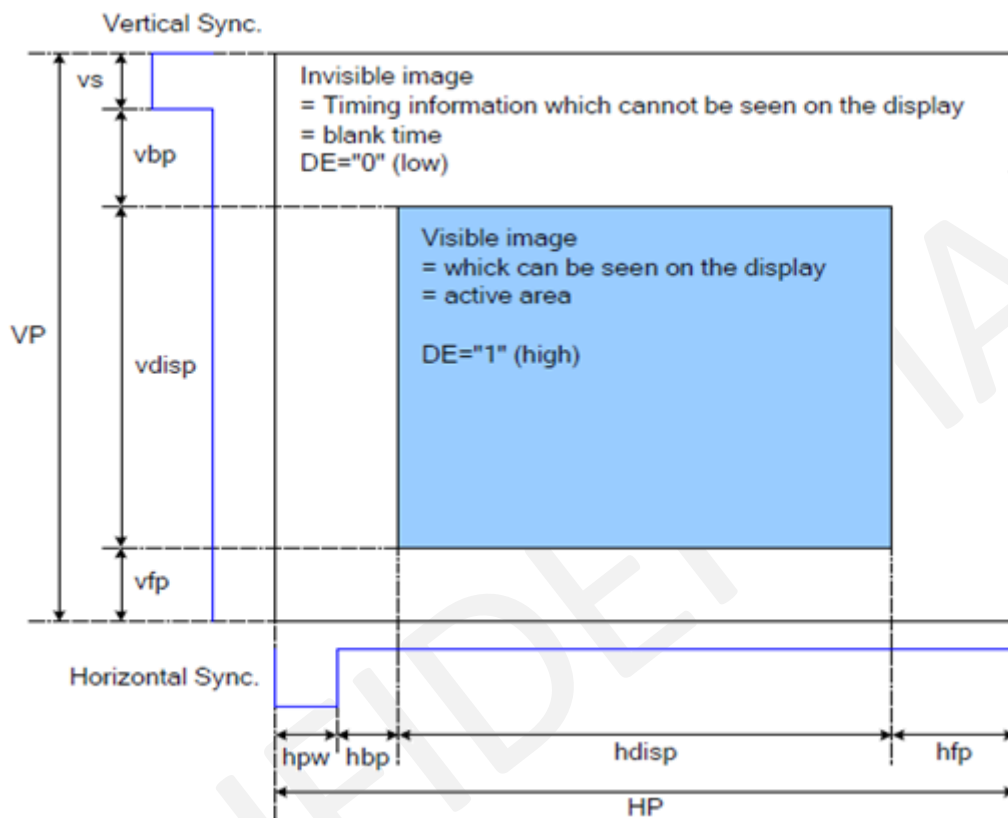
Item	Symbol	Min.	Typ.	Max.	Unit	Note
DCLK Frequency	FCLK	-	22	-	MHz	-
Horizontal Active Pixels	thd	-	480	-	Clock	
Horizontal Sync. Width	hpw	2	4	255	Clock	
Horizontal Sync. Back Porch	hbp	5	20	255	Clock	
Horizontal Sync. Front Porch	hfp	24	40	-	Clock	
Vertical Active pixels	tvd	-	640	-	Line	
Vertical Sync. Width	vs	1	4	254	Line	
Vertical Sync. Back Porch	vbp	2	10	254	Line	
Vertical Sync. Front Porch	vfp	5	20	-	Line	
Frame-Rate	-	-	60	-	Hz	

3.5.3   Reset Timing

Reset Timing
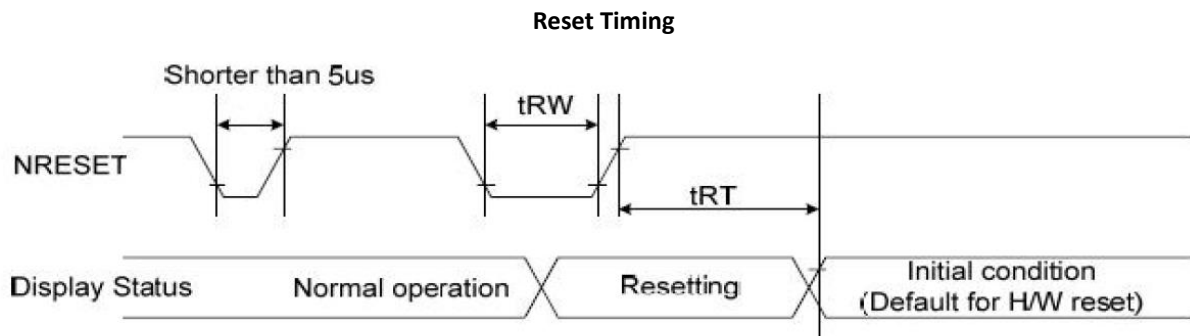
| Signal	Symbol	Item	Min	Max	Unit
RESX	tRW	Reset pulse duration	10	-	us
	tRT	Reset cancel	-	5 (Note 1, 5)	ms
			-	120 (Note 1, 6, 7)	ms

Note 1: The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from OTP to registers. This loading is done every time when there is H/W reset cancel time (tRT) within 5ms after a rising edge of RESX.

Note 2: Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the table below.

RESX Pulse	Action
Shorter than 5us	Reset Rejected
Longer than 9us	Reset
Between 5us and 9us	Reset starts

Note 3: During the Resetting period, the display will be blanked (The display enters the blanking sequence, which maximum time is 120ms, when Reset Starts in the Sleep Out mode. The display remains the blank state in the Sleep In mode.) and then return to Default condition for Hardware Reset.

Note 4: Spike Rejection can also be applied during a valid reset pulse, as shown below:
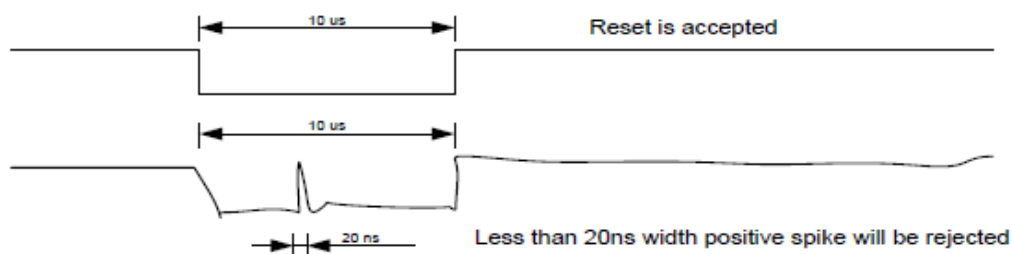
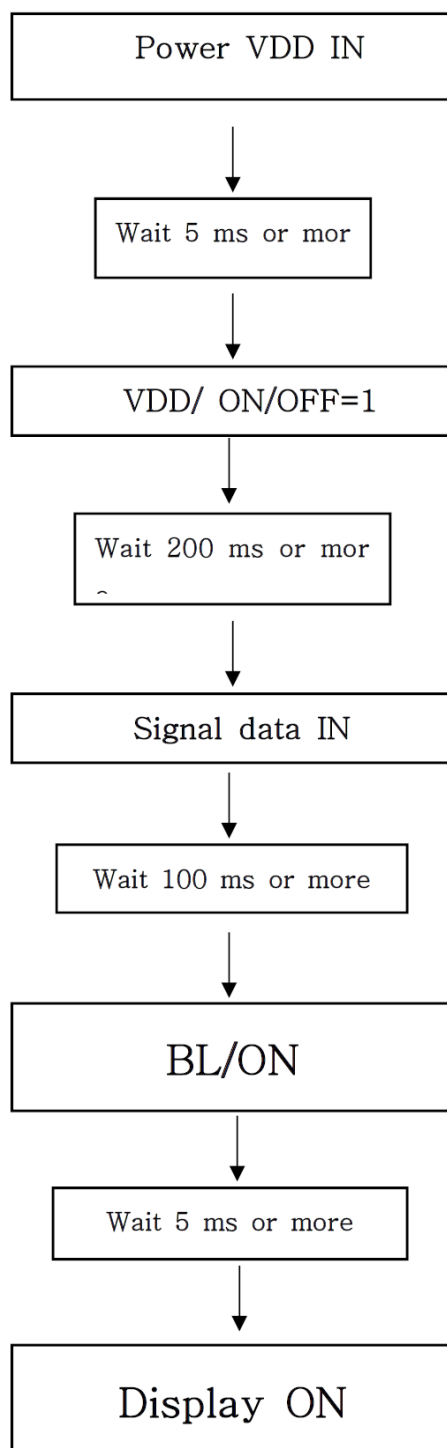**Note 5:** When Reset is applied during Sleep In Mode.

Note 6: When Reset is applied during Sleep Out Mode.

Note 7: It is necessary to wait 5msec after releasing RESC before sending commands. Also Sleep Out command cannot be sent for 120msec.
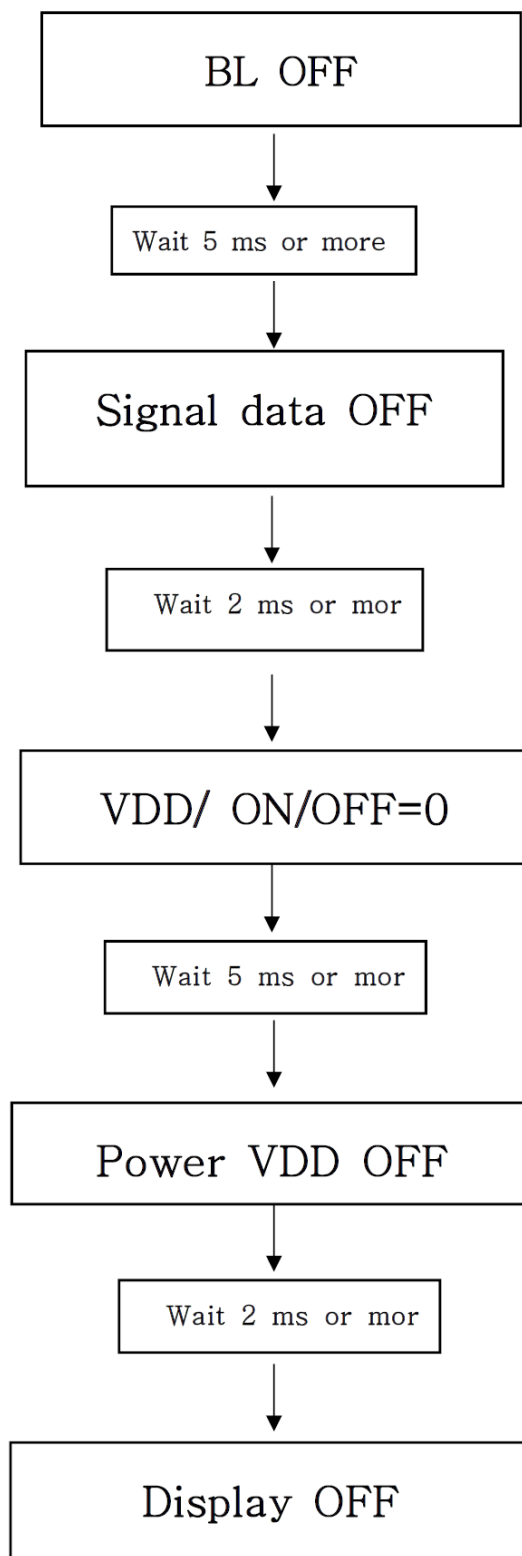
3.5.4 Display Sequence

3.5.4.1 Display ON Sequence

```
┌────────────────────────┐
│      Power  VDD  IN     │
└────────────────────────┘
             │
             ▼
     ┌──────────────────┐
     │ Wait 5 ms or mor │
     └──────────────────┘
             │
             ▼
     ┌──────────────────┐
     │   VDD/ ON/OFF=1   │
     └──────────────────┘
             │
             ▼
     ┌──────────────────┐
     │ Wait 200 ms or mor│
     │                   │
     └──────────────────┘
             │
             ▼
     ┌──────────────────┐
     │   Signal data IN  │
     └──────────────────┘
             │
             ▼
     ┌──────────────────┐
     │ Wait 100 ms or more│
     └──────────────────┘
             │
             ▼
     ┌──────────────────┐
     │       BL/ON       │
     └──────────────────┘
             │
             ▼
     ┌──────────────────┐
     │ Wait 5 ms or more │
     └──────────────────┘
             │
             ▼
     ┌──────────────────┐
     │    Display  ON    │
     └──────────────────┘
```

3.5.4.2 Display OFF Sequence

```
┌─────────────────────────┐
│         BL OFF          │
└─────────────────────────┘
             │
             ▼
   ┌─────────────────────┐
   │  Wait 5 ms or more  │
   └─────────────────────┘
             │
             ▼
┌─────────────────────────┐
│     Signal data OFF     │
└─────────────────────────┘
             │
             ▼
   ┌─────────────────────┐
   │   Wait 2 ms or mor  │
   └─────────────────────┘
             │
             ▼
┌─────────────────────────┐
│     VDD/ ON/OFF=0       │
└─────────────────────────┘
             │
             ▼
   ┌─────────────────────┐
   │   Wait 5 ms or mor  │
   └─────────────────────┘
             │
             ▼
┌─────────────────────────┐
│     Power VDD OFF       │
└─────────────────────────┘
             │
             ▼
   ┌─────────────────────┐
   │   Wait 2 ms or mor  │
   └─────────────────────┘
             │
             ▼
┌─────────────────────────┐
│       Display OFF       │
└─────────────────────────┘
```
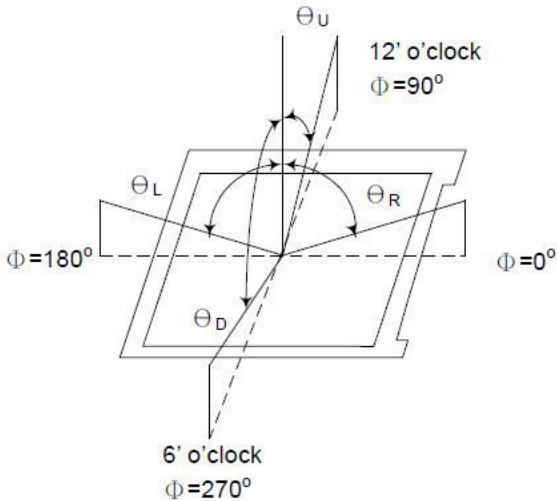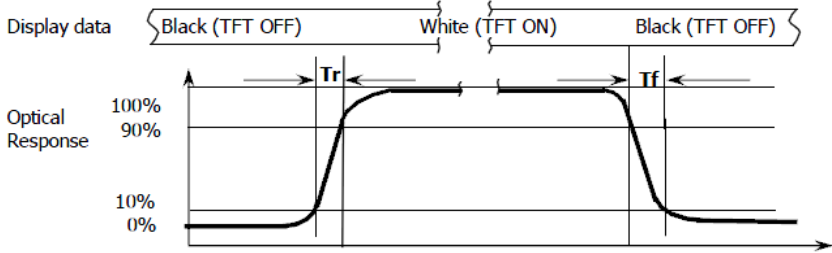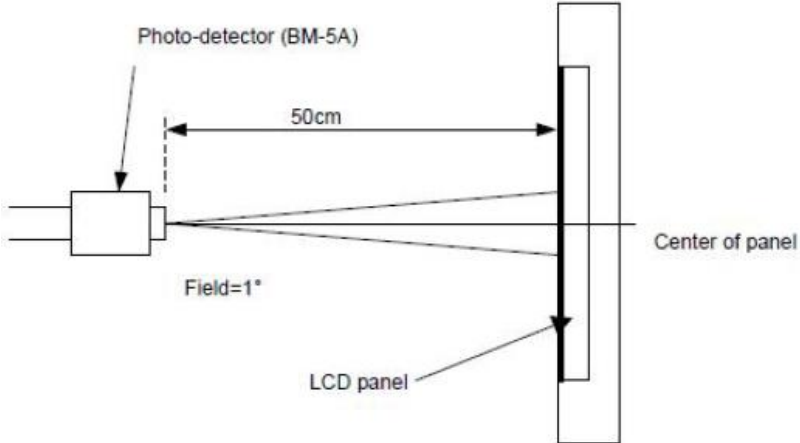
4. Optical Specification
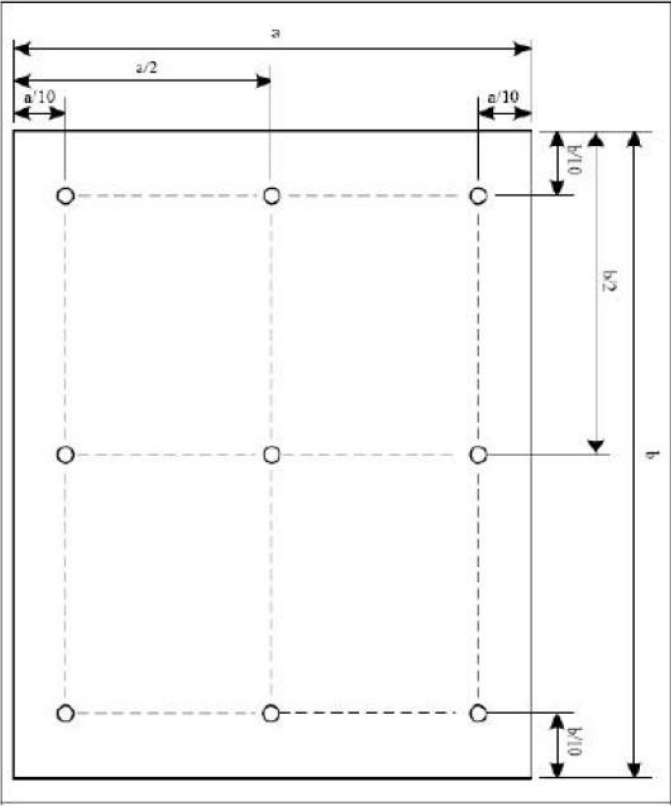
4.1 Optical Characteristics

Characteristics		Symbol	Conditions	Min	Typ.	Max	Unit	Note
Contrast Ratio		CR	$\theta = 0°$	500	700	-	-	1, 2
Response time		$T_R + T_F$	Normal viewing angle	-	25	-	msec	1, 3
Color Gamut		S	-	40	46.8	-	%	-
Viewing Angle	Left	θ_x-	CR > 10	-	80	-	-	1, 4
	Right	θ_x+		-	80	-		
	Up	θ_Y+		-	80	-		
	Down	θ_Y-		-	80	-		
Colour Chromaticity	Red	Rx	$\theta = 0°$ Normal viewing angle	0.537	0.577	0.617	-	1, 4 CA-310
		Ry		0.309	0.349	0.389		
	Green	Gx		0.302	0.342	0.382		
		Gy		0.533	0.573	0.613		
	Blue	Bx		0.112	0.152	0.192		
		By		0.083	0.123	0.163		
	White	Wx		0.262	0.302	0.342		
		Wy		0.297	0.337	0.377		
Luminance		Lv	-	750	800	-	cd/m^2	5
Uniformity		Avg	-	80	-	-	%	5

Note:

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

b) Measuring Equipment: FPM520 of Westar Display technologies, INC., which utilized SR-3 for Chromaticity and BM-5A for other optical characteristics.

Note	Item	Test method
1	Definition of Viewing Angle (θx, θy)	
2	Definition of Contrast Ratio (CR)	Measured at the center point of panel $$CR = \frac{\text{Luminance with all pixels white}}{\text{Luminance with all pixels black}}$$
3	Definition of Response Time (T_R, T_F)	
4	Definition of Optical Measurement Setup	

Note	Item	Test method
5	Definition of Luminance & Uniformity	$$\text{Uniformity} = \frac{\text{minimum luminance in 9 points (1-9)}}{\text{maximum luminance in 9 points (1-9)}}$$ $$\text{Luminance} = \frac{\text{Total Luminance of 9 points}}{9}$$

5. LED Backlight Specification

5.1 LED Backlight Characteristics

The back-light system is edge-lighting type with 6 LED chips.

Item	Symbol	Min	Typ.	Max	Unit	Note
Forward Current	I_F	15	20	-	mA	-
Forward Voltage	V_F	-	18.6	-	V	-
LED Lifetime	Hr	50000	-	-	Hour	1, 2

Note 1: LED lifetime (Hr) can be defined as the time in which it continues to operate under the condition:

Ta=25±3℃, typical IL (I_F) value indicated in the above table until the brightness becomes less than 50%.

Note 2: The "LED lifetime" is defined as the module brightness decreases to 50% original brightness at Ta=25℃ and

IL=20mA. The LED lifetime could be decreased if operating IL is larger than 20mA. The constant current driving

method is suggested.

5.2 INTERNAL CIRCUIT DIAGRAM
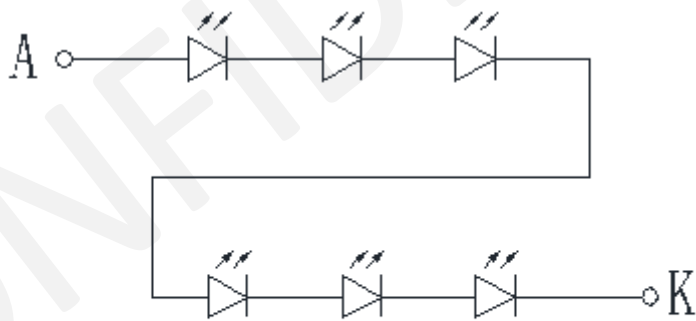
B/L Circuit

# 6. Packaging
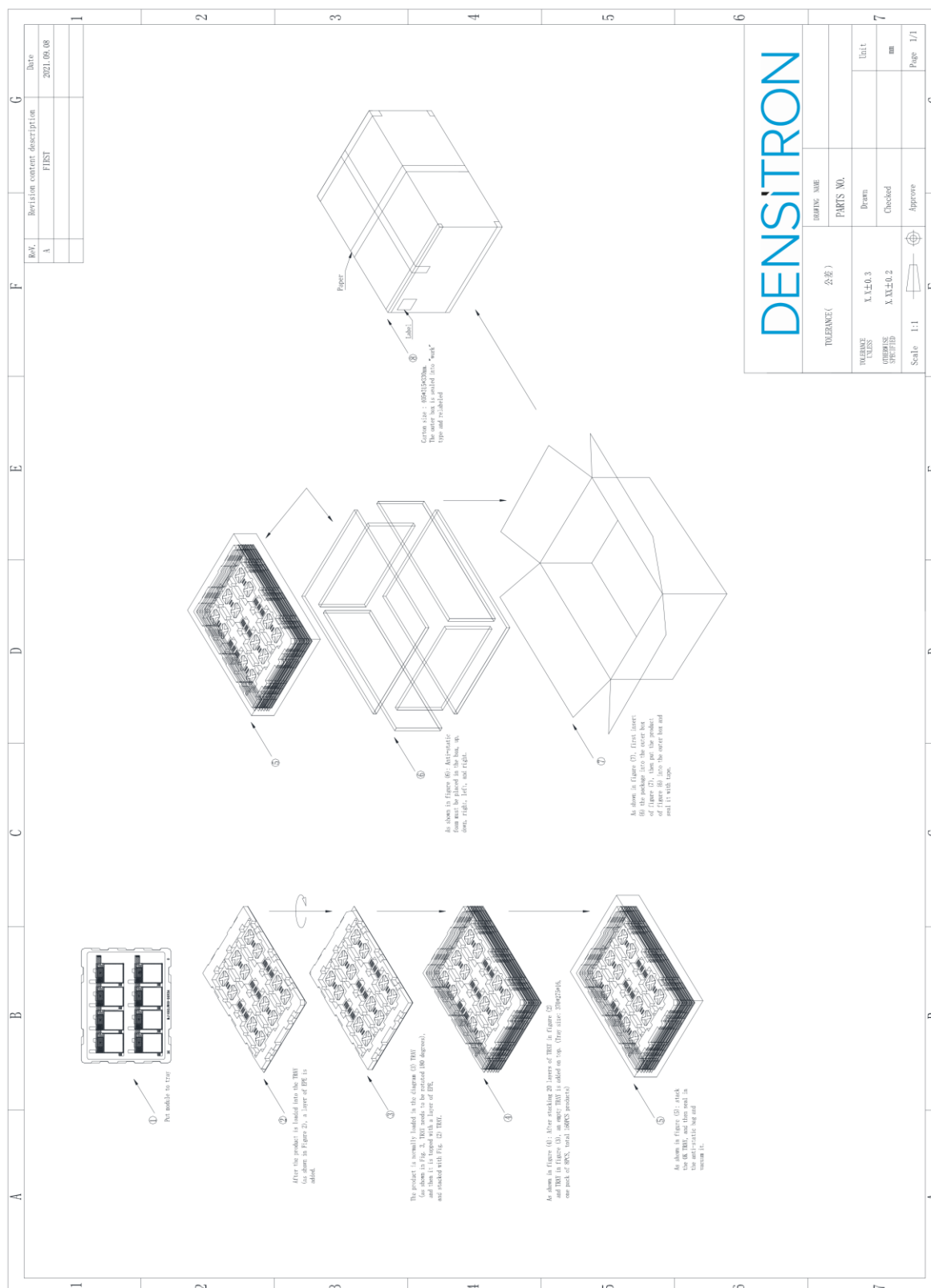
7. Quality Assurance Specification

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 ± 5°C

Humidity: 65% ± 10% RH

Viewing Angle: Normal Viewing Angle

Illumination: Single fluorescent lamp (300 to 700 Lux)

Viewing distance: 30 - 50cm

Finger glove (or finger cover) must be worn by the inspector.

Inspection table or jig must be anti-electrostatic.
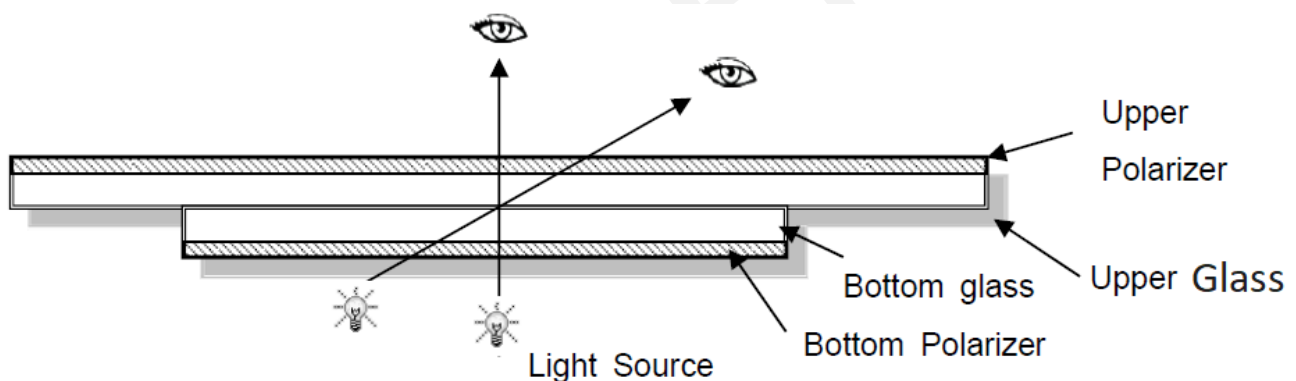
7.3 Delivery Assurance

7.3.1 Delivery Inspection Standards

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

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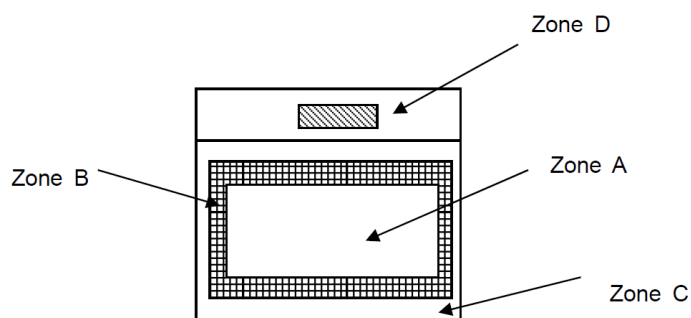
Zone A: Effective Viewing Area (Character or Digit can be seen)

Zone B: Viewing Area except Zone A

Zone C: Outside (Zone A + Zone B) Area which cannot 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

7.3.3 Criteria & Acceptable Quality Level

Partition	AQL	Definition
Major	0.65	Defects in Pattern Check (Display On)
Minor	1.5	Defects in Cosmetic Check (Display Off)
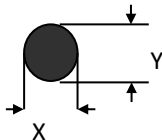
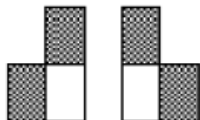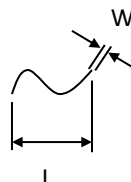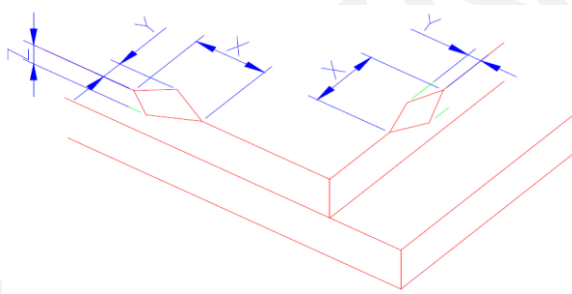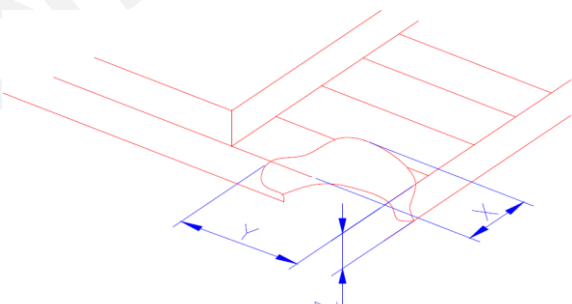| No.	Items	Criteria	Classification of defects
1	Functional defects	1) No display, open or missing line 2) Display abnormally, short circuit. 3) Backlight no lighting, abnormal lighting.	Major
2	Missing	Missing component, etc.	
3	Outline dimension	Overall outline dimension beyond the drawing or deformation is not allowed.	
4	Color tone	To judge color unevenness, please refer to limited sample.	Minor
5	Spot Line defect	Light dot, dim spot, polarizer bubble, polarizer accidented spot, etc.	
6	Soldering Appearance	Good soldering. Peeling-off is not allowed.	
7	LCD/Polarizer	Black/White spot/line, scratch, crack, etc.	

Note:

a) Light dot: dots appearing bright and unchanged in size in which LCD panel is displaying under black pattern.

b) Dim dot: dots appearing dark and unchanged in size in which LCD panel is displaying under pure red, green, or blue picture.
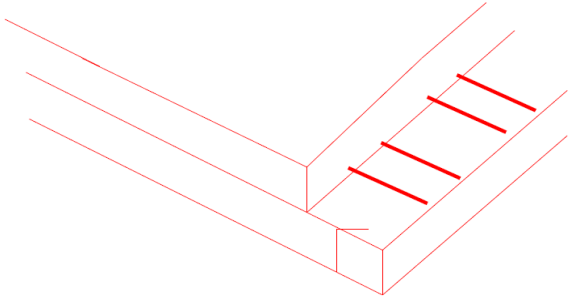
7.3.4 Criteria & Classification

Units: mm

Class	Item	Criteria		
Minor	Spot Defect	Round type: as per following drawing, $\varnothing = (X+Y)/2$		

1) Light Dot (black/white spot, pinhole, stain.)

Size\Zone	Acceptable Quantity		
	A	B	C
$\varnothing \leq 0.15$	Ignore	Ignore	
$0.15 < \varnothing \leq 0.25$	3 (distance $\geq$ 10mm)		
$0.25 < \varnothing \leq 0.40$	2 (distance $\geq$ 10mm)		
$0.4 < \varnothing$	0		

2) Dim Spot (Light leakage, dent, dark spot.)

Size\Zone	Acceptable Quantity		
	A	B	C
$\varnothing \leq 0.15$	Ignore	Ignore	
$0.15 < \varnothing \leq 0.25$	3 (distance $\geq$ 10mm)		
$0.25 < \varnothing \leq 0.4$	2 (distance $\geq$ 10mm)		
$0.4 < \varnothing$	0		

3) Polarizer Accidented Spot

Size\Zone	Acceptable Quantity		
	A	B	C
$\varnothing \leq 0.2$	Ignore	Ignore	
$0.2 < \varnothing \leq 0.5$	2 (distance $\geq$ 10mm)		
$0.5 < \varnothing$	0		

4) Pixel Bad Points

Item		Zone A	Acceptable Quantity
Bright Dot		Random	N≤2
		2 Dots Adjacent	N≤0
		3 Dots Adjacent	N≤0
Dark Dot		Random	N≤2
		2 Dots Adjacent	N≤0

Class	Item	Criteria		
		3 Dots Adjacent		N≤0
		Distance	1. Minimum distance between bright dots. 2. Minimum distance between dark dots 3. Minimum distance between dark and bright dots.	5mm
		Total quantity of bright and dark dots		N≤4

Note:

A) Bright dot: Dots appearing bright and unchanged in size in which LCD panel is displaying under black pattern.

B) Dark dot: Dots appearing dark and unchanged in size in which LCD panel is displaying under pure red, green, or 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)

5)   Polarizer Bubble

Size\Zone	Acceptable Quantity		
	A	B	C
∅≤0.2	Ignore		
0.2<∅≤0.4	3 (distance ≧ 10mm)		Ignore
0.4<∅	0		

Class	Item	Criteria
Minor	Line Defect (LCD/ Polarizer backlight black/white line, scratch, stain)	Line type: as per following drawing

Width	Length	Acceptable quantity		
		A	B	C
W≤0.05	Ignore	Ignore		Ignore
0.05<W≤0.06	L ≤ 4.0	N ≤ 3		
0.06<W≤0.08	L ≤ 3.0	N ≤ 2		
0.08<W	Define as spot defect			

Class	Item	Criteria
Minor	LCD Crack/Broken	Symbols: X: Length, Y: Width, Z: Height, L: Length of ITO, T: Height of LCD 1) The edge of LCD broken: X≦3.0mm; Y<Inner border line of the seal; Z≦T 2) LCD corner broken: X≦3.0mm; Y≦L; Z≦T

Class	Item	Criteria
Major	LCD Crack	The LCD with extensive crack is not acceptable.
Major	Electronic Components SMT	Not allow missing parts, solderless connection, cold solder joint, mismatch. The positive and negative polarity opposite
Minor	Display color& Brightness	1. Color: Measuring the color coordinates according to the datasheet or samples. 2. Brightness: Measuring the brightness of white screen according to the datasheet or samples.
Minor	LCD Mura/Waving/ Hot Spot	Not visible through 5% ND filter in 50% gray or judged by limit sample if necessary.

Criteria (functional items)

No.	Item	Criteria
1	No display	
2	Missing segment	Not allowed
3	Short circuit	
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	Evaluation and assessment
High Temperature Operation	70°C, 96 hrs	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/line; 4) Glass crack; 5) Current IDD is twice higher than initial value.
Low Temperature Operation	-20°C, 96 hrs	
High Temperature Storage	80°C, 96 hrs	
Low Temperature Storage	-30°C, 96 hrs	
High Temperature & High Humidity Operation	+60°C, 90% RH, 96 hours	
Thermal Shock (Non-operation)	-10℃, 30 min ↔ 60℃, 30 min, Change time: 5min 20CYC.	
ESD test	C=150pF, R=330, 5points/panel Air: ±8KV, 5times; Contact: ±6KV, 5 times (Environment: 15℃~35℃, 30%~60%).	
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).	
Box Drop Test	1 Corner 3 Edges 6 faces, 80 cm (MEDIUM BOX)	

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

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

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 judged 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 be ignored.

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 ℃, 65±10% RH.

9. Handling Precautions

9.1 Handling Precautions

1) Since the display panel is made of glass, do not apply mechanical impacts such us 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
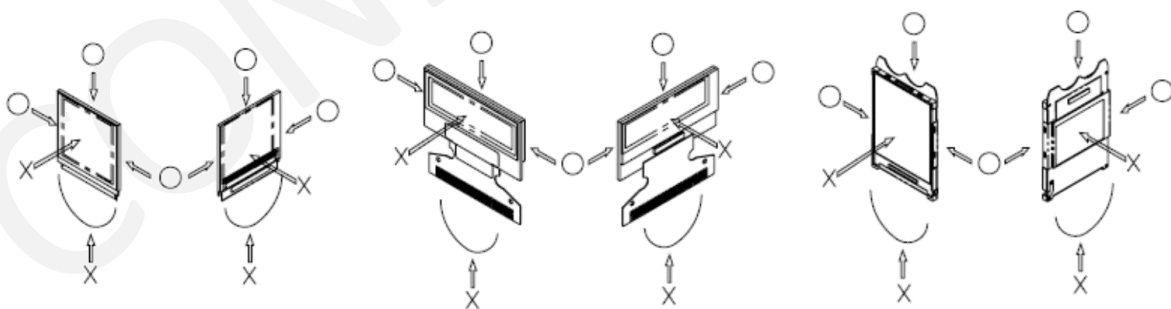
influence the display performance. Also, secure sufficient rigidity for the outer cases.

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 handing 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.