DMT027QVNTNT0-1B

PRODUCT SPECIFICATION

Version 0.2

Jan 14, 2022

TBD

Customer's Approval	
Signature	*Date*

Prepared by *Erica Cheng*

Approved by *Eric Wan*

Revision History

VERSION	DATE	DESCRIPTION	AUTHOR
0.1	Dec 15, 2020	Preliminary	Joyce Huang
0.2	Jan 14, 2022	Add "Sunlight readable" description in Introduction and Main Features sections (p.5).	Erica Cheng

Legal Notice

Table of Contents

1. General Description

1.1 Introduction

This is a 2.7" size colour active matrix TFT LCD module that uses amorphous silicon TFT as a switching device. The display is readable under sunlight, VA type, normally black mode and featuring high contrast and excellent colour saturation. All round viewing direction. The resolution of the TFT-LCD is 240 x 320 and can display up to 262 and 144 colours. The display module supports 6-bit RGB interface.

1.2 Main Features

Item	Contents
Display Type	TFT LCD
Screen Size	2.7" Diagonal
Display Format	240 x RGB x 320 Dots
No. of Colour	262, 144
Overall Dimensions	47 (W) x 66 (H) x 2.89 (D) mm (Exclude FPC cable and parts on FPC)
Active Area	41.04 (W) x 54.72 (H) mm
Mode	Normally black / VA type/ Sunlight readable
Surface Treatment	Glare (3H)
Viewing Direction	All round
Interface	6-bit RGB
Backlight Type	Long life & High bright LED, White, 3 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	240 x RGB x 320	Dots
Overall Dimensions	47 (W) x 66 (H) x 2.89 (D) (Exclude FPC cable and parts on FPC)	mm
Active Area	41.04 (W) x 54.72 (H)	mm
Dot Pitch	0.057 (W) x 0.171 (H)	mm
Weight	19 (Include FPC cable)	g

2.2 Mechanical Drawing
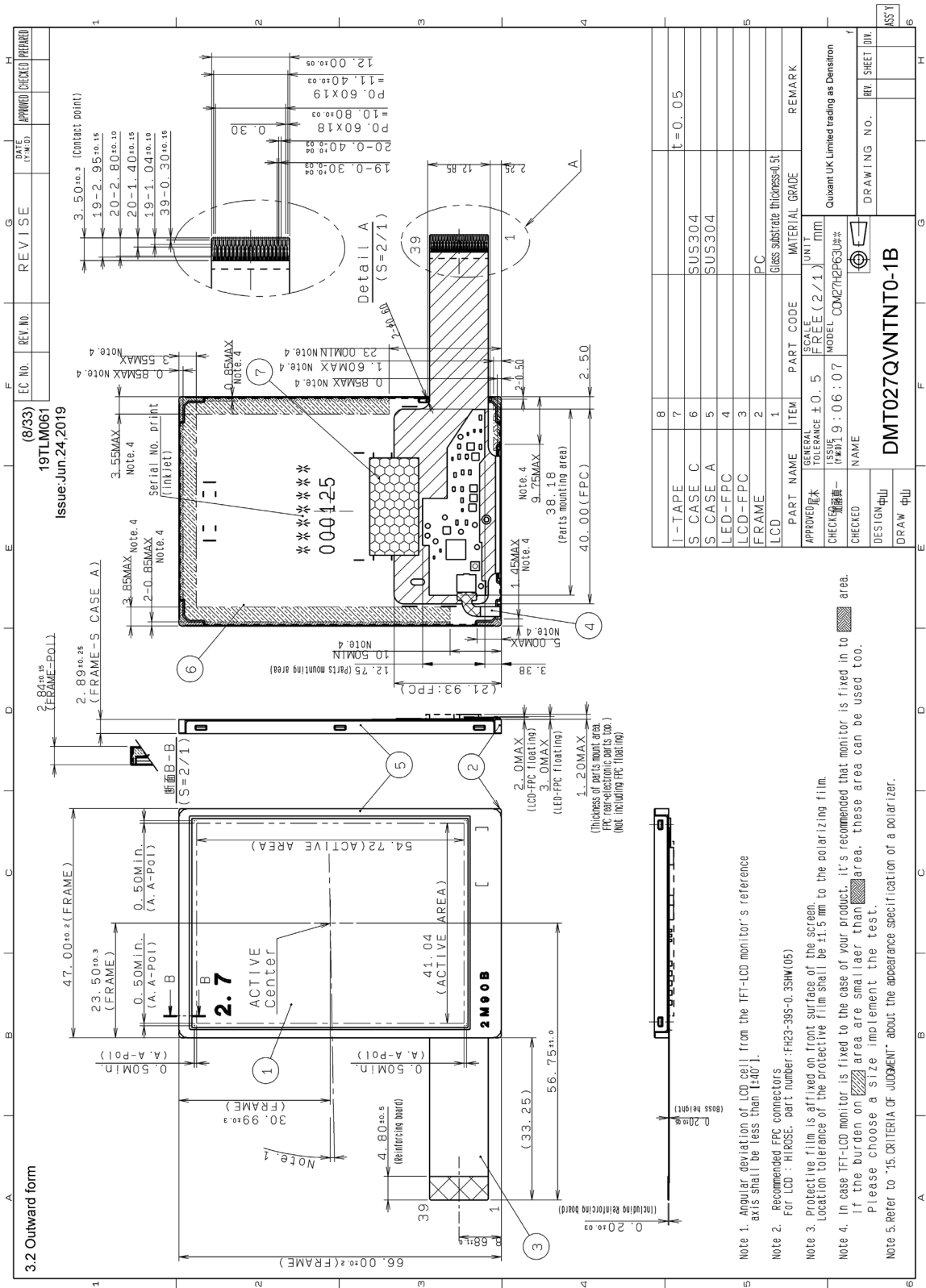
3. Electrical Specification

3.1 Absolute Maximum Ratings

VSS=0V

Item	Symbol	Condition	Min	Max	Unit	Applicable Terminal	Note
Supply Voltage	VDD		-0.3	4.6	V	VDD	-
Input Voltage for Logic	VI	Ta=25°C	-0.3	VDD+0.3	V	CLK, VSYNC, HSYNC, DE D[05:00], D[15:10], D[25:20] STBYB,RESETB TEST1, TEST2	-
LED Forward Current	IL	Ta=25°C	-	35	mA	BLH - BLL	-
		Ta=70°C	-	15			
Storage Temperature Range	Tstg	-	-30	80	°C	-	2,3
Storage Humidity Range	Hstg	Noncondensing in an environmental moisture at or less than 40°C, 90%RH.			%	-	3

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

VSS=0V

Item	Symbol	Condition	Min	Typ.	Max	Unit	Applicable Terminal	Note
Supply Voltage	VDD		2.7	3.0	3.6	V	VDD	-
Input Voltage for Logic	VI	Ta=25°C	0	-	VDD	V	CLK, VSYNC, HSYNC DE, D [05:00] D [15:10], D [25:20] STBYB, RESETB TEST1, TEST2	-
Operating Temperature Range	Top	-	-20	+25	+70	°C	LCD Panel surface temperature	1, 2
Operating Humidity Range	Hop	Ta≦40°C	20	-	85	%	-	-
		Ta>40°C	40°C85%RH or less of moisture content with no condensation				-	-

Note 1: This monitor is operatable in this temperature range. With regard to optical characteristics,

refer to Item " 4. Optical Specification"

Note 2:   Acceptable Forward Current to LED is up to 15mA, when Ta=+70°C.

Do not exceed Allowable Forward Current shown on the chart below.

Allowable Forward Current
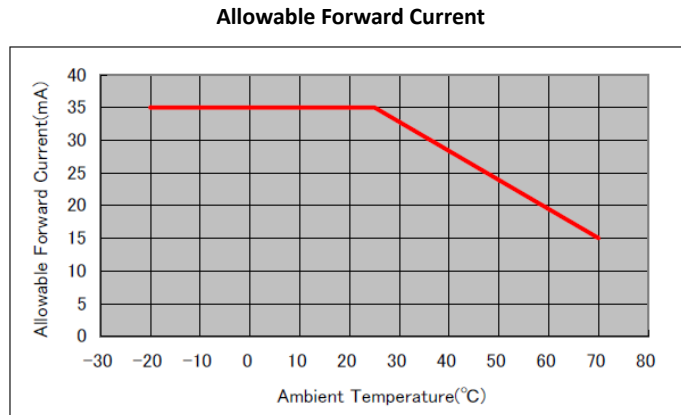
3.2.1   DC Characteristics

(Unless otherwise noted, Ta=25°C, VDD=3.3V, VSS=0V)

Item	Symbol	Condition	Min	Typ.	Max	Unit	Applicable Terminal
Input Signal Voltage	VIH	-	0.7×VDD	–	VDD	V	CLK,VSYNC,HSYNC DE,STBYB,RESETB D[05:00],D[15:10], D[25:20] TEST1,TEST2
	VIL	-	0	–	0.3×VDD	V	
Operating Current	IDD	fCLK=6.25MHz Color bar display	–	9.2	18.4	mA	VDD

3.2.2   AC Characteristics

(Unless otherwise noted, Ta=25°C, VDD=3.3V, VSS=0V)

Item	Symbol	Condition	Min	Typ.	Max	Unit	Applicable Terminal
Clock Frequency	fCLK	-	4.4	5.6	7.0	MHz	CLK
Clock Low Period	tw1L	0.3×VDD or less of the period	15	-	-	ns	CLK
Clock High Period	tw1H	0.7×VDD or less of the period	15	-	-	ns	CLK
INPUT Setup Time	tsp	-	15	-	-	ns	HSYNC, VSYNC, CLK, DE
INPUT Hold Time	thd	-	15	-	-	ns	D[05:00], D[15:10],D[25:20]

Switching Waveform Characteristics
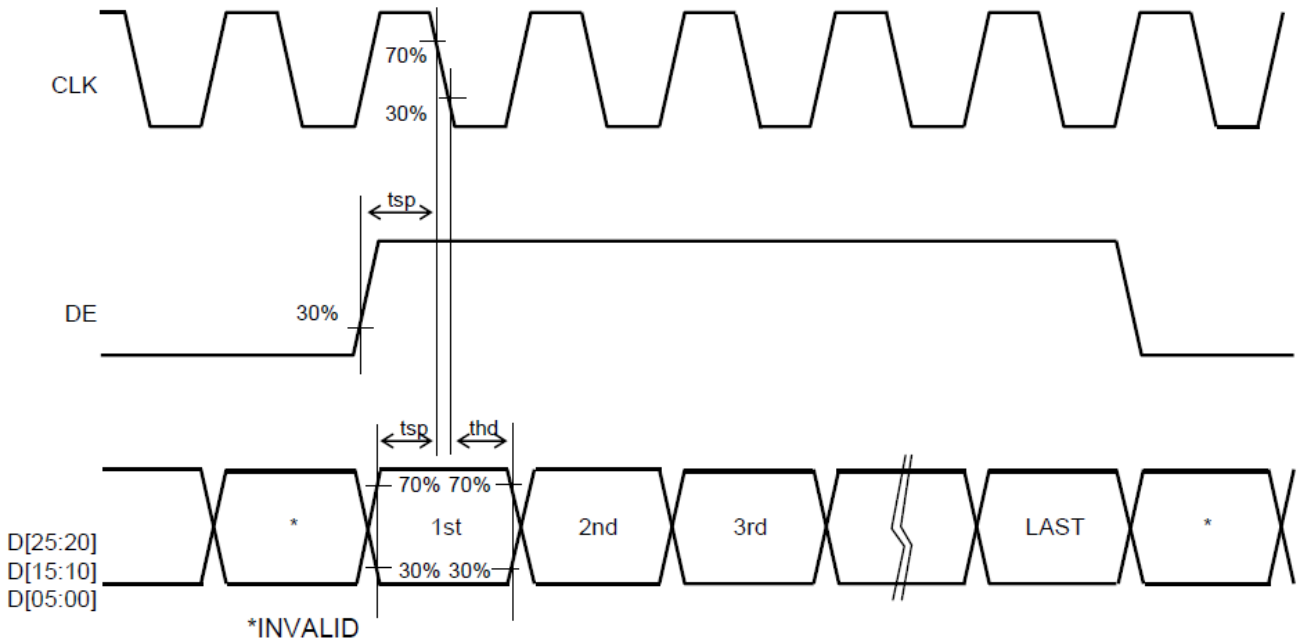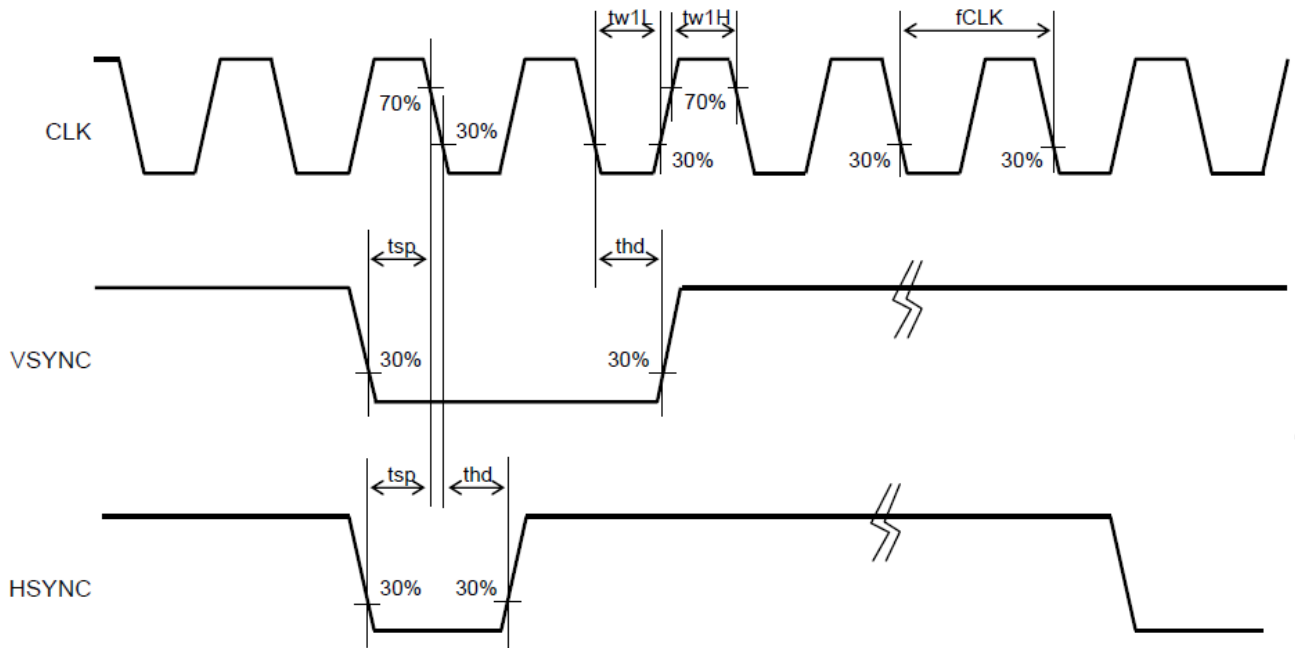
3.3   Interface Pin Assignment

No.	Symbol	I/O	Functions
1	VSS	P	Ground
2	VSS	P	Ground
3	VDD	P	Power supply
4	VDD	P	Power supply
5	VSS	P	Ground
6	RESETB	I	Reset signal (Lo-active)
7	HSYNC	I	Horizontal synchronization signal　（Negative polarity）
8	VSYNC	I	Vertical synchronizing signal　（Negative polarity）
9	CLK	I	Display clock (Falling read)
10	VSS	P	Ground
11	D00	I	Display data (B) input It becomes black display in 00h. D00：LSB D05：MSB gamma conversion internally driver.
12	D01	I	
13	D02	I	
14	D03	I	
15	D04	I	
16	D05	I	
17	D10	I	Display data (G) input It becomes black display in 00h. D10：LSB D15：MSB gamma conversion internally driver.
18	D11	I	
19	D12	I	
20	D13	I	
21	D14	I	
22	D15	I	
23	D20	I	Display data (R) input It becomes black display in 00h. D20：LSB D25：MSB gamma conversion internally driver.
24	D21	I	
25	D22	I	
26	D23	I	

No.	Symbol	I/O	Functions
27	D24	I	
28	D25	I	
29	VSS	P	Ground
30	DE	I	Input data valid signal (Hi-active)
31	STBYB	I	Standby control signal （Lo：Standby, Hi： Normal-operation）
32	TEST1	I	MODE1 (GND connection)
33	NC	-	OPEN
34	NC	-	OPEN
35	NC	-	OPEN
36	NC	-	OPEN
37	TEST2	I	MODE2 (GND connection)
38	BLH	P	LED drive power source. (Anode side)
39	BLL	P	LED drive power source. (Cathode side)

Note 1: Recommended connector: Hirose FH23 series "FH23-39S-0.3SHW (05) "

Note 2: Terminal arrangement, please refer to "outline specification drawings".

Note 3: FPC of the terminal has been decorated with gold-plated.

Note 4: Connector contact terminals is recommended the use of gold-plated products.

3.4   Timing Characteristics

3.4.1   Input Timing Characteristics

Item	Symbol	Min	Typ.	Max	Unit	Applicable Terminal	Note
CLK Frequency	fCLK	4.4	5.6	7.0	MHz	CLK	-
VSYNC Frequency	fVSYNC	54	60	66	Hz	VSYNC	1
VSYNC Signal Cycle Time	tv	324	325	348	H	VSYNC,HSYNC	-
VSYNC Pulse Width	tw2H	1	–	–	H	VSYNC,HSYNC	-
Vartical Back Porch	tvb	2	–	14	H	VSYNC,HSYNC,DE D[05:00],D[15:10],D[25:20]	-
Vartical Display Period	tvdp	–	320	–	H	VSYNC,HSYNC,DE D[05:00],D[15:10],D[25:20]	-
HSYNC Frequency	fHSYNC	–	19.5	–	kHz	HSYNC	-
HSYNC Signal Cycle Time	th	–	287	402	CLK	HSYNC,CLK	-
HSYNC Pulse Width	tw3H	1	–	–	CLK	HSYNC,CLK	-
Horizontal Back Porch	thb	2	–	14	CLK	CLK,HSYNC,DE D[05:00],D[15:10],D[25:20]	-
DE Pulse Width	tw4H	–	240	–	CLK	DE,CLK	-
Horizontal Display Period	thdp	–	240	–	CLK	CLK D[05:00],D[15:10],D[25:20]	-

Note 1: The characteristic of this item is recommended standard.
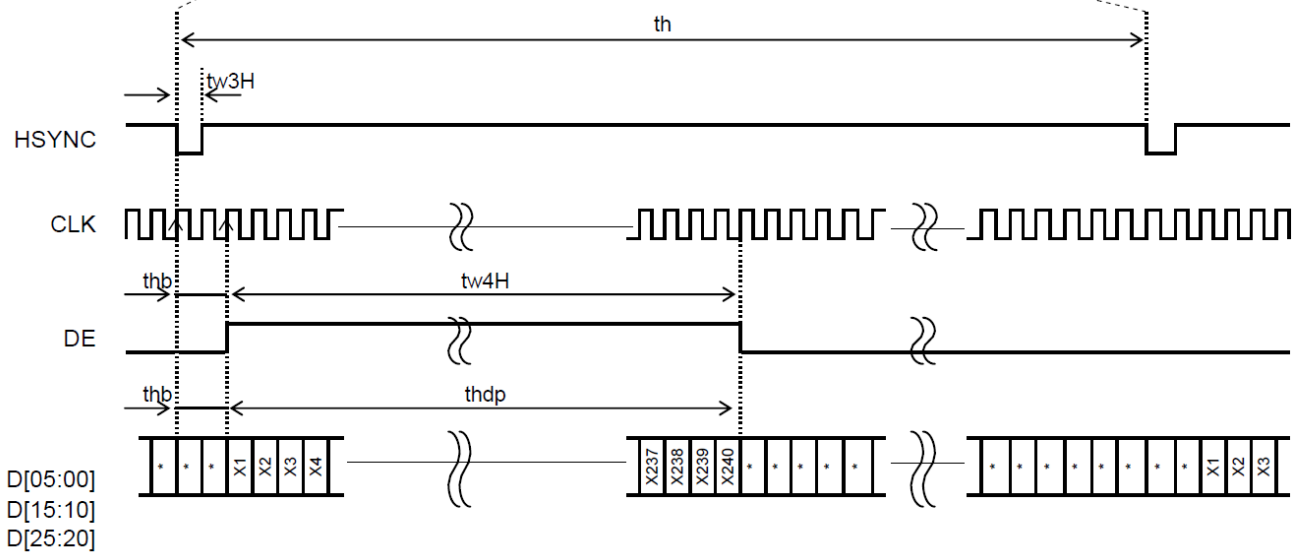When used in outside this property, please use after confirming a sufficient display quality, etc.

3.4.2 Input Timing Chart

Ⅰ. Vertical Timing
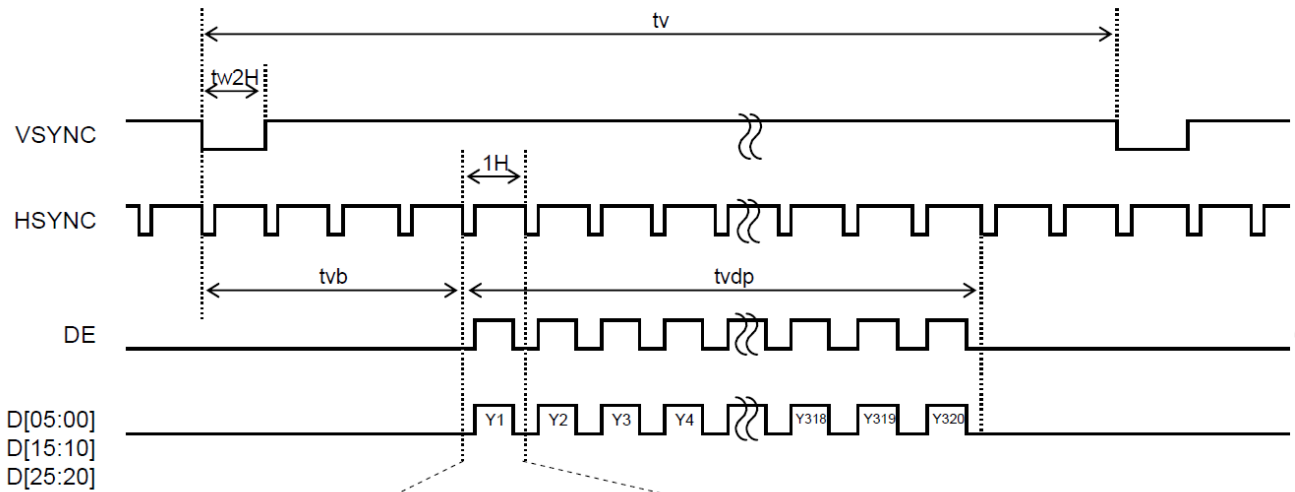
Ⅱ. Horizontal Timing

3.4.3 Input Timing Example (fCLK=5.0MHz,5.6MHz,6.25MHz)

Ⅰ. Vertical Timing
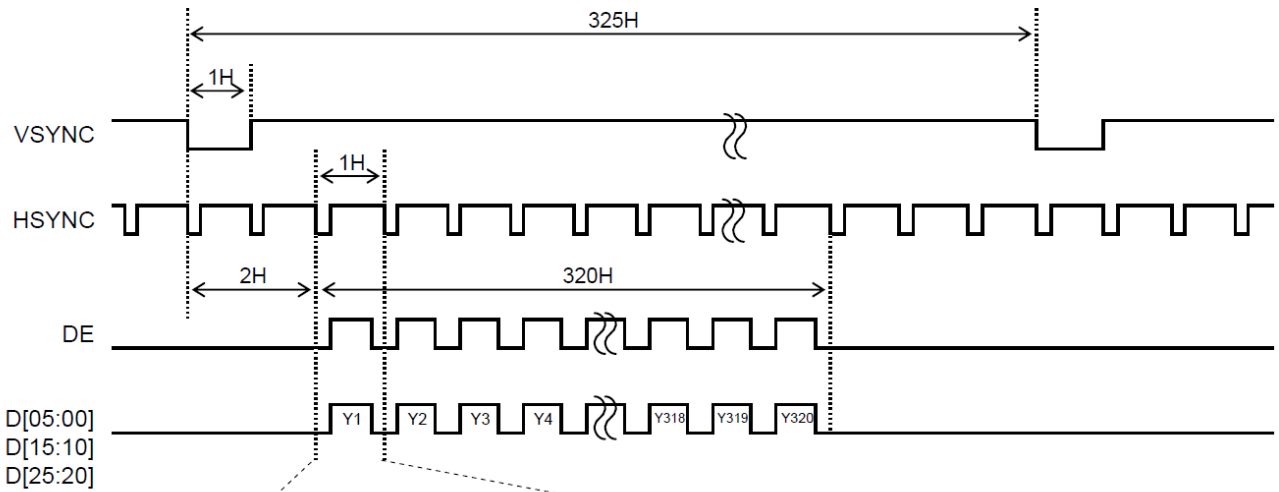
Ⅱ. Horizontal Timing
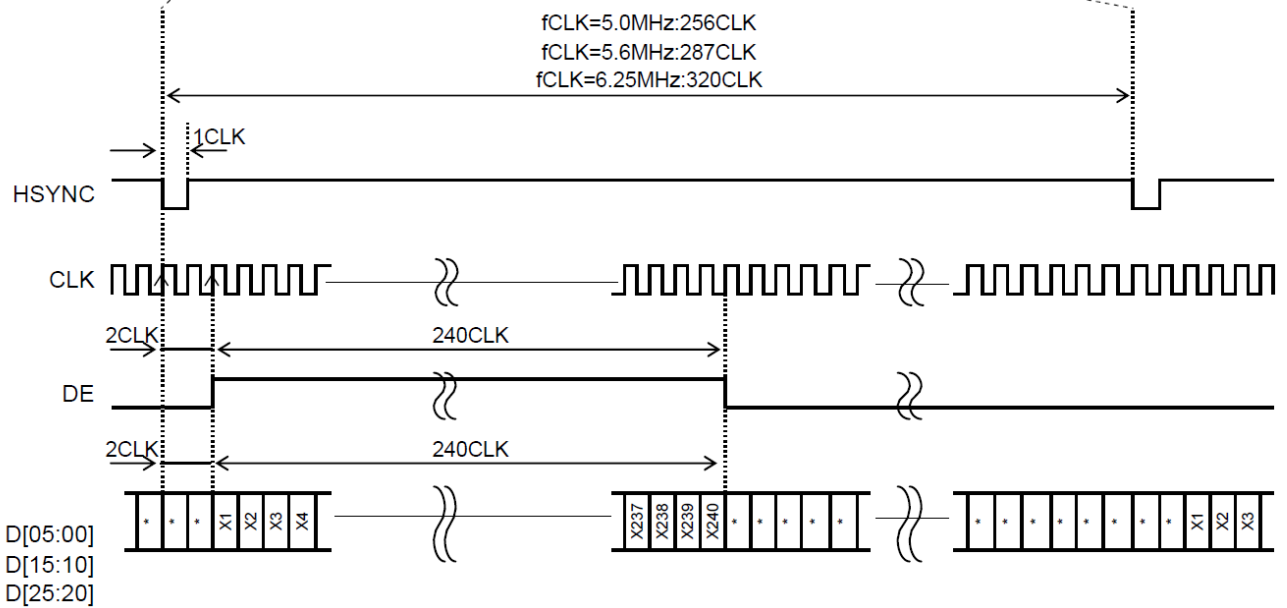
3.4.4 Power ON/OFF sequence
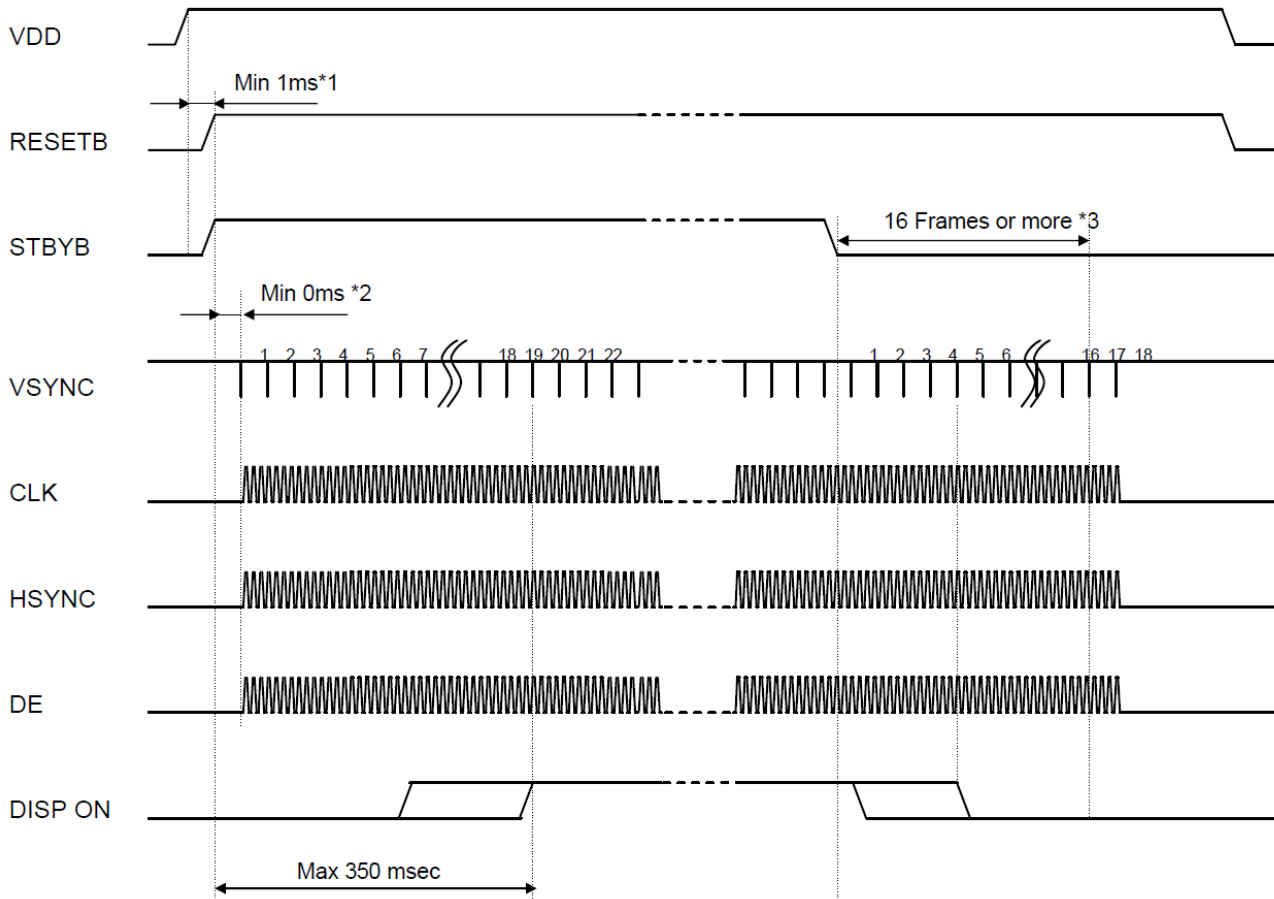
Note 1: After the power supply, please execute RESETB. (refer to 3.5.6 Reset sequence)

Note 2: There is no regulations at time until each signal is supplied from RESETB"H" But meanwhile, It is necessary to fix each signal to "H" or "L".

Note 3: It is necessary to supply VSYNC and CLK (DOTCLK) for 16 frames or more from STBYB "L" to turning off the power supply without leaving the afterimage.

3.4.5 Display On/Off Sequence

It explains the display sequence when display ON/OFF by the STBYB signal.

The following time will be needed by the time the display is begun from the standby release.
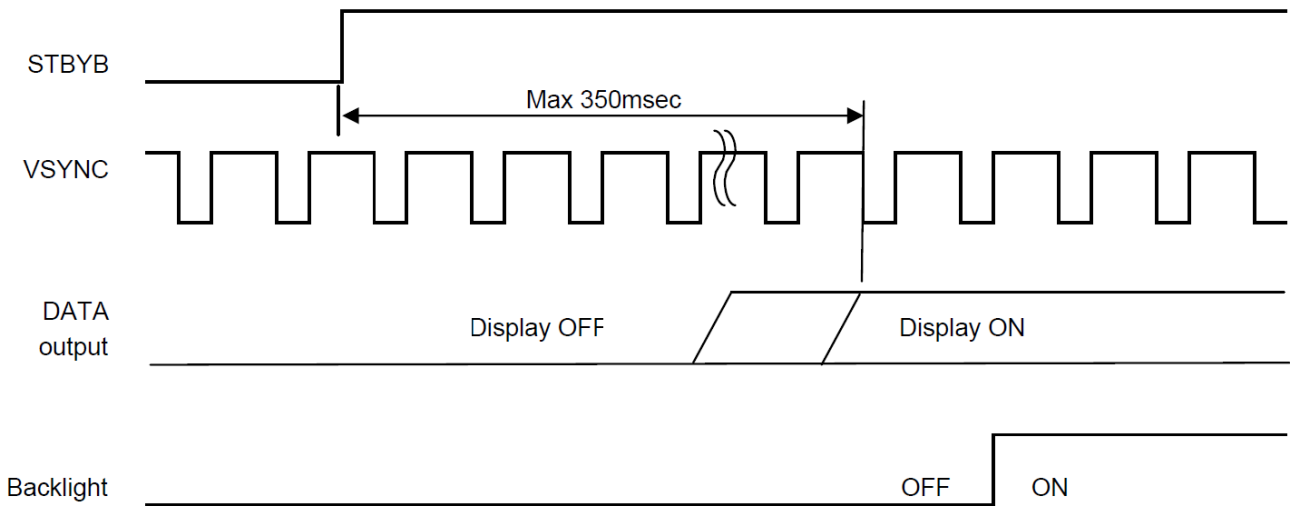
The following time will be needed by the time the standby sequence is ended from the standby setting. Meanwhile, DOTCLK and the VSYNC signal should keep being supplied.

When DOTCLK and the VSYNC signal are stopped or the power supply is turned off to a regulated frame or less, the afterimage might remain.
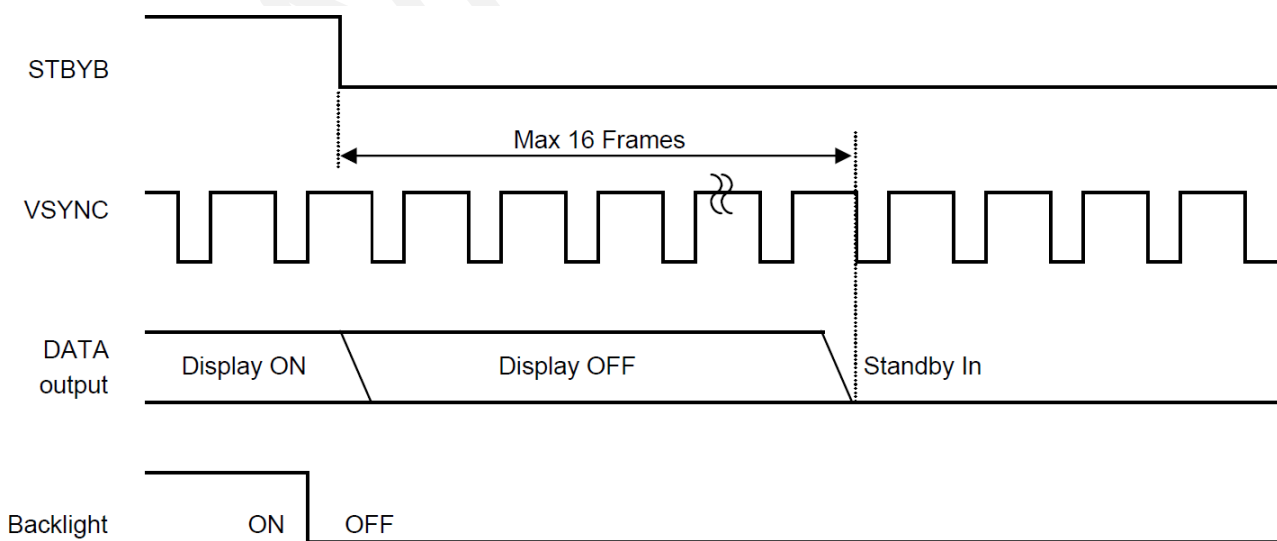
3.4.6 Reset sequence

There is a limitation between the power supply turning on and the RESETB input.

Please defend the following conditions.

T > 1ms

4. Optical Specification

4.1 Optical Characteristics

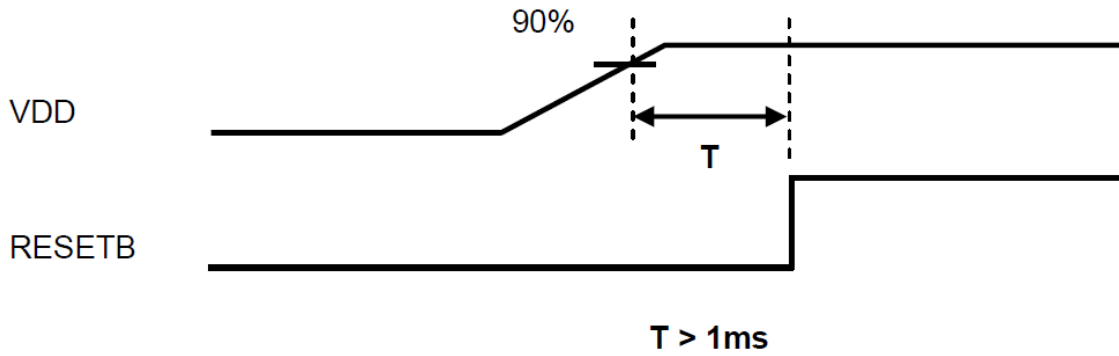| Characteristics		Symbol	Conditions	Min	Typ.	Max	Unit	Note
Response Time*	Rise Time	TON	[Data]= 00h→3Fh	-	-	60	ms	1
	Fall Time	TOFF	[Data]= 3Fh→00h	-	-	40		
Contrast Ratio	Backlight ON	CR	[Data]= 3Fh/00h	400	800	-	-	2
	Backlight OFF			-	2	-		
Viewing Angle*	Left	θx-	[Data]= 3Fh/00h CR≧10	80	-	-	deg	3
	Right	θx+		80	-	-		
	Up	θY+		80	-	-		
	Down	θY-		80	-	-		
White Chromaticity	x		[Data] = 3Fh	Refer to White chromaticity range			-	4
	y							
Burn-in		-	-	No noticeable burn-in image shall be observed after 2 hours of window pattern display.				5
Centre Brightness		-	[Data] = 3Fh	240	350	-	cd/m^2	6
Brightness Distribution		-	[Data] = 3Fh	70	-	-	%	7

Measuring Condition:

Measuring instruments: CS2000 (KONICA MINOLTA), LCD7200 (OTSUKA ELECTRONICS), EZcontrast160D (ELDIM)

Driving condition: VDD = 3.0V, VSS = 0V Optimized VCOMDC

Backlight: IL=7.0mA

Measured temperature: Ta=25˚C
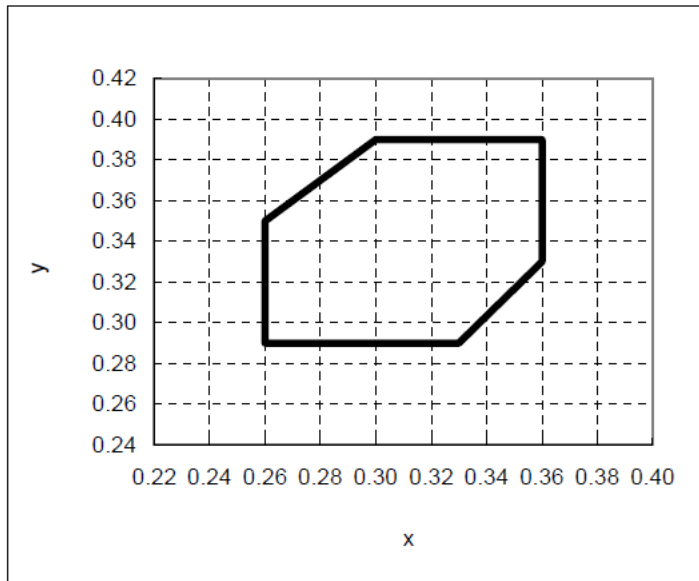
【White Chromaticity Range】

x	y
0.30	0.39
0.26	0.35
0.26	0.29
0.33	0.29
0.36	0.33
0.36	0.39

White Chromaticity Range

Note	Item	Test method	Measuring Instrument	Note
1	Definition of Response Time	Measure output signal waves with a brightness meter when the raster or window pattern is changed over from Black to White and from White to Black.	LCD7200	Black display [Data]=00h White display [Data]=3Fh TON Rise Time TOFF Fall Time
2	Definition of Contrast Ratio	Measure maximum luminance Y1([Data]=3Fh) and minimum luminance Y2([Data]=00h) at the center of the screen by displaying raster or window pattern. Then calculate the ratio between these two values.	CS2000 LCD7200	Backlight ON Backlight OFF

Note	Item	Test method	Measuring Instrument	Note
		Contrast ratio = Y1/Y2 Diameter of measuring point: 7.8mmφ(CS2000) Diameter of measuring point: 3mmφ(LCD7200)		
3	Viewing Angle Horizontal and Vertical	Move the luminance meter from right to left and up and down and determine the angles where contrast ratio is 10.	EZcontrast160D	-
4	White Chromaticity	Measure chromaticity coordinates x and y of CIE1931 colorimetric system at [Data] = 3Fh Color matching function: 2°view Measurement angle: 1°	CS2000	-
5	Burn-in	Visually check burn-in image on the screen after 2 hours of "window display" ([Data]=00h/3Fh).	At optimized VCOMDC	-
6	Center Brightness	Measure the brightness at the center of the screen.	CS2000	
7	Brightness Distribution	(Brightness distribution) = 100 x B/A % A: max. brightness of the 9 points B: min. brightness of the 9 points	CS2000	-

5. LED Backlight Specification

5.1 LED Backlight Characteristics

Item	Symbol	Condition	Min	Typ.	Max	Unit	Applicable Terminal	Note
Forward Current	IL25	Ta=25°C	-	7.0	35.0	mA	BLH - BLL	-
	IL70	Ta=70°C	-	-	15.0	mA		-
Forward Voltage	VL	Ta=25°C IL=7.0mA	-	8.0	8.5	V		-
Estimated Life of LED	LL	Ta=25°C IL=7.0mA	-	50,000	-	Hr	-	1

Note 1: The lifetime of the LED is defined as a period till the brightness of the LED decreases to the half of its initial value.

This figure is given as a reference purpose only, and not as a guarantee.

This figure is estimated for an LED operating alone.

As the performance of an LED may differ when assembled as a monitor together with a TFT panel due to different environmental temperature.

Estimated lifetime could vary on a different temperature and usually higher temperature could reduce the life significantly.

5.2 Internal Circuit Diagram
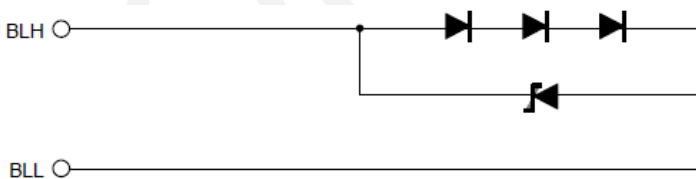
6. Packaging

Step 1. Each product is to be placed in one of the cut-outs of the tray
   with the display surface facing upward.
   Foam sheet A/B are to be placed on the products in the tray.
   Each product is to be placed in one of the cut-outs of the tray
   with the display surface facing downward.(24products per tray)

Step 2. Each tray is to be piled up in same orientation and the trays be
   in a stack of 6.
   One empty tray is to be put on the top of stack of 6 trays.

Step 3. 2 packs of moisture absorbers are to be placed on the top tray as
   shown in the drawing.
   Put piled trays into a sealing bag.

Step 4. Vacuum and seal the sealing bag with the vacuum sealing machine.

Step 5. The stack of trays in the plastic back is to be wrapped with B SHEET A.

Step 6. The wrapped trays are placed in the carton.

Step 7. B SHEET B are to be inserted into a outer carton with same orientation.
   The outer carton is to be sealed in H-shape with packing tape
   as shown in the drawing.

Step 8. The model number, quantity of products, and shipping date are
   to be printed on the outer carton.
   If necessary, shipping labels or impression markings are to be
   put on the outer carton.

Remark: The return of packing materials is not required.

Packing item name	Specs., Material
① Tray	A-PET
② B SHEET A	Anti-static air babble sheet
③ B SHEET B	Anti-static air babble sheet
④ Sealing bag	
⑤ Drier	Moisture absorber
⑥ Packing tape	
⑦ Outer carton	Corrugated cardboard
⑧ FOAM SHEET A	Anti-static polyethylene
⑨ FOAM SHEET B	Anti-static polyethylene

Dimension of outer carton	
D : Approx.	(337mm)
W : Approx.	(618mm)
H : Approx.	(179mm)
Quantity of products packed in one carton:	144
Gross weight : Approx.	5.2 Kg

Quixant UK Limited trading as Densitron

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: 60% ± 10% RH

Viewing Angle: Normal viewing Angle

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 Zone Definition

<Landscape model>
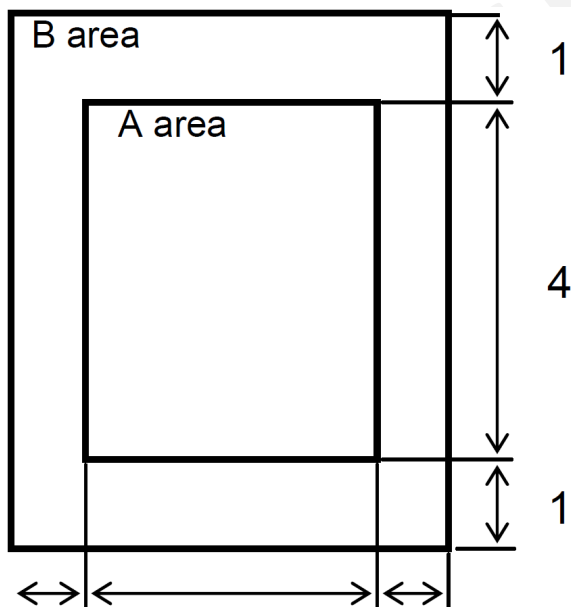
Division of A and B areas

B area: Active area

Dimensional ratio between A and B areas: 1: 4: 1 (Refer to the above figure)

7.3.2   Criteria & Classification

7.3.2.1 Defective Display and Screen Quality

Test Condition: Observed TFT-LCD monitor from front during operation with the following conditions

Driving Signal: Raster Patter (RGB, white, black)

Signal condition: [Data]: 00h, 28h, 3Fh (3steps)

Observation distance: 30 cm
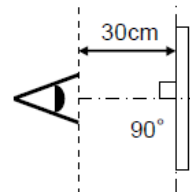
Illuminance: 200 to 350 lx

Backlight: IL=7.0mA

Defect item		Defect content	Criteria
Display Quality	Line defect	Black, white or color line, 3 or more neighboring defective dots	Not exists
	Dot defect	Uneven brightness on dot-by-dot base due to defective TFT or CF, or dust is counted as dot defect (brighter dot, darker dot) High bright dot: Visible through 2% ND filter at [Data]=00h Low bright dot: Visible through 5% ND filter at [Data]=00h Dark dot: Appear dark through white display at [Data]=28h	Refer to table 1
		Invisible through 5% ND filter at [Data]=00h	Acceptable
Screen Quality	Dirt	Uneven brightness (white stain, black stain etc)	Invisible through 5% ND filter at Black screen. Invisible through 1% ND filter at other screen.
	Foreign particle	Point-like 0.25mm< φ	N=0
		Point-like 0.20mm< φ ≦0.25mm	N≦2
		Point-like φ ≦0.20mm	Acceptable
		Liner 3.0mm<length and 0.08mm<width	N=0
		Liner length≦3.0mm or width≦0.08mm	Acceptable
	Others	-	Use boundary sample for judgment when necessary

Note: φ(mm): Average diameter = (major axis + minor axis)/2; Permissible number: N

Table 1

Area	High Bright Dot	Low Bright Dot	Dark Dot	Total	Criteria
A	0	2	2	3	Permissible distance between same color bright dots (includes neighboring dots): 3 mm or more
B	2	4	4	5	Permissible distance between same color high bright dots (includes neighboring dots): 5 mm or more
Total	2	4	4	5	

7.3.2.2 Screen and Other Appearance

Test Condition:

Observation distance: 30cm

Illumination: 1200 to 2000 lx

Item		Criteria	Note
Polarizer	Flaw Stain Bubble Dust Dent	Ignore invisible defect when the backlight is on.	Applicable area: Active area only (refer to the section "2.2 Mechanical Drawing")
S-case		No functional defect occurs	-
Connector		No functional defect occurs	-

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 two weeks from receiving the sample.

If the analysis cannot be completed on time, Densitron must inform 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	(Number of Failures / Number of Examinations)
High Temperature Operation	Tp = 70°C, 240 hrs	0/3
Low Temperature Operation	Tp = -20°C, 240 hrs	0/3
High Temperature Storage	Ta = 80°C, 240 hrs	0/3
Low Temperature Storage	Ta = -30°C, 240 hrs	0/3
High Temperature & High Humidity Operation*	Tp = 60°C, 90% RH non-condensing, 240 hrs	0/3
High Temperature & High Humidity Storage*	Ta = 60°C, 90% RH non-condensing, 240 hrs	0/3
Thermal Shock Storage	-30⟵⟶80°C(30min/30min) 100 cycles	0/3
Electrostatic discharge test (Non operation)	Confirms to EIAJ ED-4701/300 C=200pF,R=0Ω,V=±200V Each 3 times of discharge on and power supply and other terminals.	0/3
Surface discharge test (Non operation)	C=250pF, R=100Ω, V=±12kV Each 5 times of discharge in both polarities on the center of screen with the case grounded.	0/3
Vibration test	Total amplitude 1.5mm, f=10 ~ 55Hz, X,Y,Z directions for each 2 hours	0/3
Impact test	Use original jig and make an impact with peak acceleration of 1000m/s2 for 6 msec with half sine-curve at 3 times to each X, Y, Z directions in conformance with JIS 60068-2-27-2011.	0/3
Packing vibration-proof test	Acceleration of 19.6m/s^2 with frequency of 10→55→10Hz, X,Y, Zdirection for each 30 minutes	0/1 Packing
Packing drop test	Drop from 75cm high. 1 time to each 6 surfaces, 3 edges, 1 corner	0/1 Packing

Note: Ta=ambient temperature, Tp=Panel temperature

*The profile of high temperature/humidity storage and high temperature/humidity operation

(Pure water of over 10MΩcm shall be used).
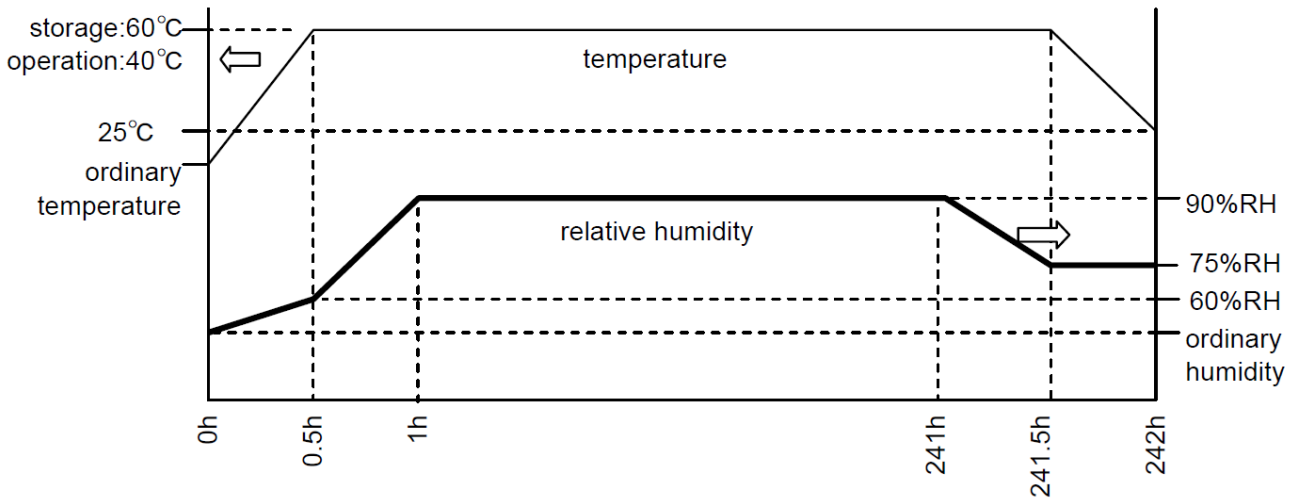
Reliability Criteria

Measure the parameters after leaving the monitor at the ordinary temperature for 24 hours or more after the test completion.

| Item	Standard	Remarks
Display quality	No visible abnormality shall be seen.	-
Contrast ratio	200 or more	Backlight ON

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 23±5 °C, 55±15% RH.

9. Handling Precautions

9.1 Handling Precautions

1) Since the display panel is being made of glass, do not apply mechanical impacts such us 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

   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
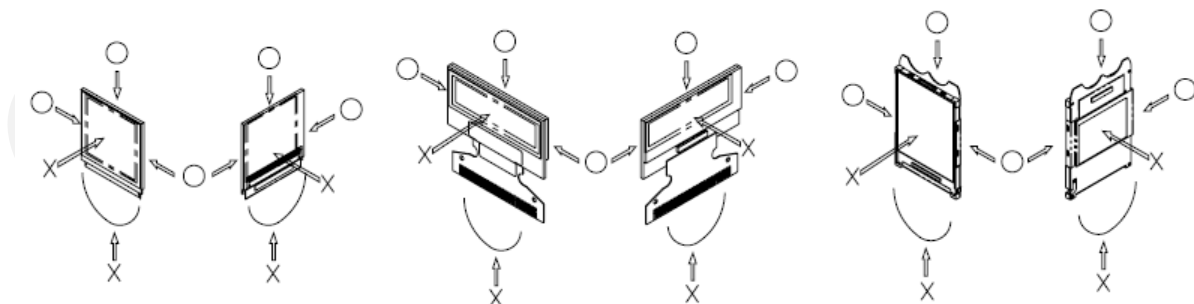
influence the display performance. Also, secure sufficient rigidity for the outer cases.

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) 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 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.

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 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.

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 influences of noise on the system design.

7)   We recommend you to 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.

9.5   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.