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1. Summary

1.1 General Description

This is a 10.4 inch a-Si TFT-LCD module with normal-black technology. It is composed of a TFT-LCD panel, a driver circuit, PCB, and a LED backlight unit. It is designed for medical diagnosis applications.

1.2 Features

- High contrast ratio
- Ultra-wide viewing angle
- Wide temperature range
- Long LED life time
- Interface: 6-bit digital signals
- This product will comply with UL62368-1/CSA C22.2 No.62368-1-03(File number: TBD)
- This product will comply with the European RoHS Directive (2011/65/EU) and Delegated Directive (2015/863/EU, Amending Annex II of 2011/65/EU)

2. General Specifications

	Feature	Spec	Unit
Display Spec	Size	10.4 inches	-
	Resolution	640(RGB)x480	-
	Pixel Pitch	0.33 x 0.33	mm
	TFT Active Area	211.2 x 158.4	mm
	Technology Type	a-Si	-
	Pixel Configuration	R.G.B Vertical Stripe	-
	Display Mode	SFT, Normally Black	-
	Surface Treatment	Anti-Glare	-
	Viewing Direction	All	-
Mechanical Characteristics	LCM (W x H x D)	243.0 x 185.1 x 11.0	mm
	Weight	(475)	g
Optical Characteristics	Luminance	900	cd/m ²
	Contrast Ratio	1000:1	-
	NTSC	50	%
	Viewing Angle	88/88/88/88	degree
Electrical Characteristics	Interface	6-bit digital signals for data of RGB colors	-
	Color Depth	262,144	color
	Power Consumption	LCD: TBD Backlight: 2700	mW

Table 2.1 General TFT Specifications

3. Input / Output Terminals

3.1 CN1 Pin assignment (LCD Interface)

Connector Information	
LCD Module connector	MSAK24025P40 (STM)
Matching connector	20453-240T-03 (I-PEX) or equivalent

Table 3.1.1 Connector information

No	Symbol	I/O	Description	Comment
1	GND	P	Ground	-
2	CLK	I	Dot clock	-
3	Hsync	I	Horizontal synchronous signal	-
4	Vsync	I	Vertical synchronous signal	
5	GND	P	Ground	
6	R0	I	Red data	
7	R1	I	Red data	
8	R2	I	Red data	
9	R3	I	Red data	
10	R4	I	Red data	
11	R5	I	Red data	
12	GND	P	Ground	
13	G0	I	Green data	
14	G1	I	Green data	
15	G2	I	Green data	
16	G3	I	Green data	
17	G4	I	Green data	
18	G5	I	Green data	
19	GND	P	Ground	
20	B0	I	Blue data	
21	B1	I	Blue data	
22	B2	I	Blue data	
23	B3	I	Blue data	
24	B4	I	Blue data	
25	B5	I	Blue data	
26	GND	P	Ground	
27	DE	I	Data enable	
28	VCC	P	Power supply	
29	VCC	P	Power supply	
30	MODE	-	Select DE or SYNC mode	High: SYNC Mode Low or Open: DE Mode

No	Symbol	I/O	Description	Comment
31	DPS	I	Selection of scan direction	Low or Open: Normal scan High: Reverse scan
32	NC	-	-	Keep this pin Open.
33	NC	-	-	Keep this pin Open.
34	NC	-	-	Keep this pin Open.
35	NC	-	-	Keep this pin Open.
36	NC	-	-	Keep this pin Open.
37	NC	-	-	Keep this pin Open.
38	NC	-	-	Keep this pin Open.
39	NC	-	-	Keep this pin Open.
40	NC	-	-	Keep this pin Open.

Table 3.1.2 Pin Assignment for LCD Interface

Note1: I/O definition: I---Input, P---Power/Ground

Note2: All of the GND pins should be connected to the system ground.

3.2 CN2 Pin assignment (Backlight Interface)

Connector Information	
LCD Module connector	MS24011P8RA (STM)
Matching connector	P24011P8 (STM) or equivalent

Table 3.2.1 Connector information

No	Symbol	I/O	Description	Comment
1	A1	P	Anode1	-
2	K1	P	Cathode1	-
3	A2	P	Anode2	-
4	K2	P	Cathode2	-
5	A3	P	Anode3	-
6	K3	P	Cathode3	-
7	A4	P	Anode4	-
8	K4	P	Cathode4	-

Table 3.2.2 Pin Assignment for Back Light Interface

Note1: I/O definition: P---Power/Ground

Note2: All of the GND pins should be connected to the system ground

3.3 Positions of socket

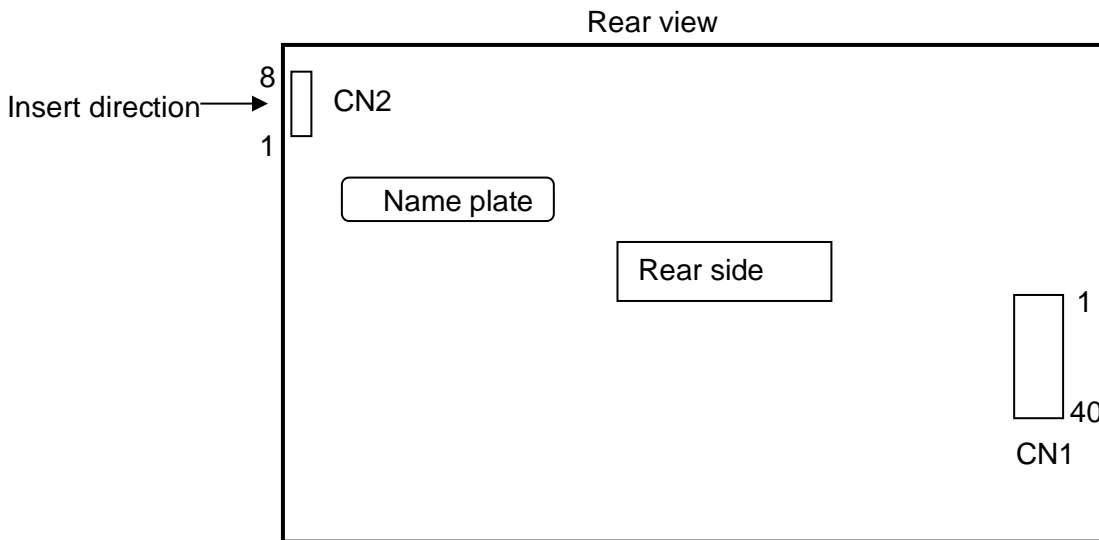


Figure 3.3 Connector pin location

4. Absolute Maximum Ratings

Item		Symbol	Rating	Unit	Remark
Power supply voltage	LCD panel signal processing board	VCC	(-0.5 to +6.0)	V	
Input voltage for signals	Display signals Note1	VD	(-0.3 to VCC+0.3)	V	
	Function signal Note2	VF		V	
Backlight	Forward current	IL	55	mA	per one circuit
Storage temperature		Tst	-35 to +85	°C	-
Operating temperature		Top	-30 to +80	°C	
Relative humidity Note5		RH	≤ 95	%	Ta ≤ 40°C
			≤ 85	%	40°C < Ta ≤ 50°C
			≤ 55	%	50°C < Ta ≤ 60°C
			≤ 36	%	60°C < Ta ≤ 70°C
			≤ 24	%	70°C < Ta ≤ 80°C
Absolute humidity Note5		AH	≤ 70 Note6	g/m3	Ta>80°C

Table 4.1 Absolute Maximum Ratings

- Note1: CLK, Hsync, Vsync, DE, DATA (R0 to R5, G0 to G5, B0 to B5)
- Note2: DPS, MODE
- Note3: Measured at LCD panel surface (including self-heat)
- Note4: Measured at LCD module's rear shield surface (including self-heat)
- Note5: No condensation
- Note6: Water amount at Ta= 80°C and RH= 24%

5. Electrical Characteristics

5.1 DC Characteristics for Panel Driving

(Ta= 25°C, Note1)

Item	Symbol	MIN	TYP	MAX	Unit	Remark
Power supply voltage	VCC	(TBD)	3.3	(TBD)	V	at VCC = 3.3V
Power supply current	ICC	-	TBD Note2	TBD Note3	mA	at VCC = 3.3V
Logic input voltage for display signals	High	VDH	0.8VCC	-	VCC	CMOS level
	Low	VDL	GND	-	0.2VCC	
Input voltage for DPS signal	High	VFH	0.8VCC	-	VCC	
	Low	VFL	0	-	0.2VCC	
Input voltage for MODE signal	High	VFH	0.8VCC	-	VCC	
	Low	VFL	0	-	0.2VCC	

Table 5.1.1 Panel driving Voltages

Note1: When designing of the power supply, take the measures for the prevention of surge voltage.

Note2: Checkered flag pattern [by IEC 61747-6]

Note3: Pattern for maximum current

5.2 DC Characteristics for Backlight Driving

Item	Symbol	MIN	TYP	MAX	Unit	Remark
Forward current	IL	-	50.0	55.0	mA	-
Forward Voltage	VL	24.3	27.0	29.7	V	Ta= +25°C at IL= 50mA /One circuit
LED life time	Hr	-	70000	-	hours	Ta= +25°C Note 4

Table 5.2.1 LED Backlight Characteristics

Note1: Please drive with constant current.

Note2: The above specifications are for one LED circuit of the backlight.

Note3: The Luminance uniformity may be changed depending on the current variation between 3 circuits. It is recommended that the current value difference among the circuits be less than 5%.

Note4: Operating life means brightness goes down to 50% of initial brightness.

5.3 Power supply voltage ripple

Power supply voltage		MIN	Remark
VCC	3.3 V	≤ 100	mVp-p

Note1: The permissible ripple voltage includes spike noise.

5.4 Fuse

Parameter	Fuse		Rating	Fusing current	Remarks
	Type	Supplier			
VCC	(FCC16202AB)	TBD	2.0A	4.0A	Note1
			36V		

Note1: The power supply's rated current must be more than the fusing current. If it is less than the fusing current, the fuse may not blow in a short time, and then nasty smell, smoke and so on may occur.

5.5 Recommended Power ON/OFF Sequence

5.5.1 LCD power on/off

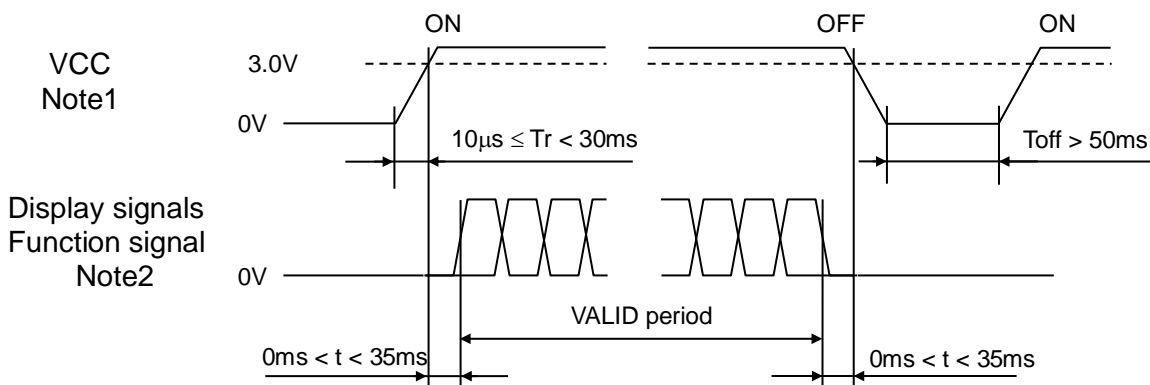


Figure 5.5.1 Backlight on/off

Note1: If there is a voltage variation (voltage drop) at the rising edge of VCC below 3.0V in "VCC = 3.3V", there is a possibility that a product does not work due to a protection circuit.

Note2: Display signals (CLK, Hsync, Vsync, DE, DATA (R0 to R5, G0 to G5, B0 to B5)) and function signal (DPS , MODE) must be set to Low or High-impedance, except the VALID period (See above sequence diagram), in order to avoid the circuitry damage.

If some of display and function signals of this product are cut while this product is working, even if the signal input to it once again, it might not work normally. If a customer stops the display and function signals, VCC also must be shut down.

5.5.2 Backlight on/off

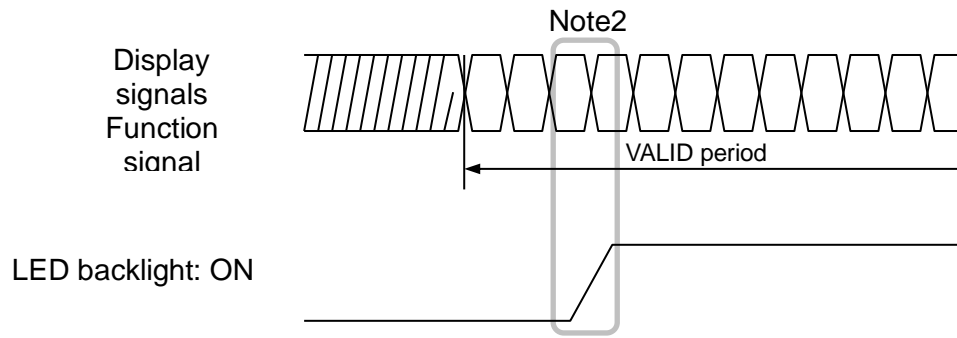


Figure 5.5.2 Backlight on/off

Note1: These are the display and function signals for LCD panel signal processing board.

Note2: The backlight should be turned on within the VALID period of display and function signals, in order to avoid unstable data display.

5.6 LCD Module Block Diagram

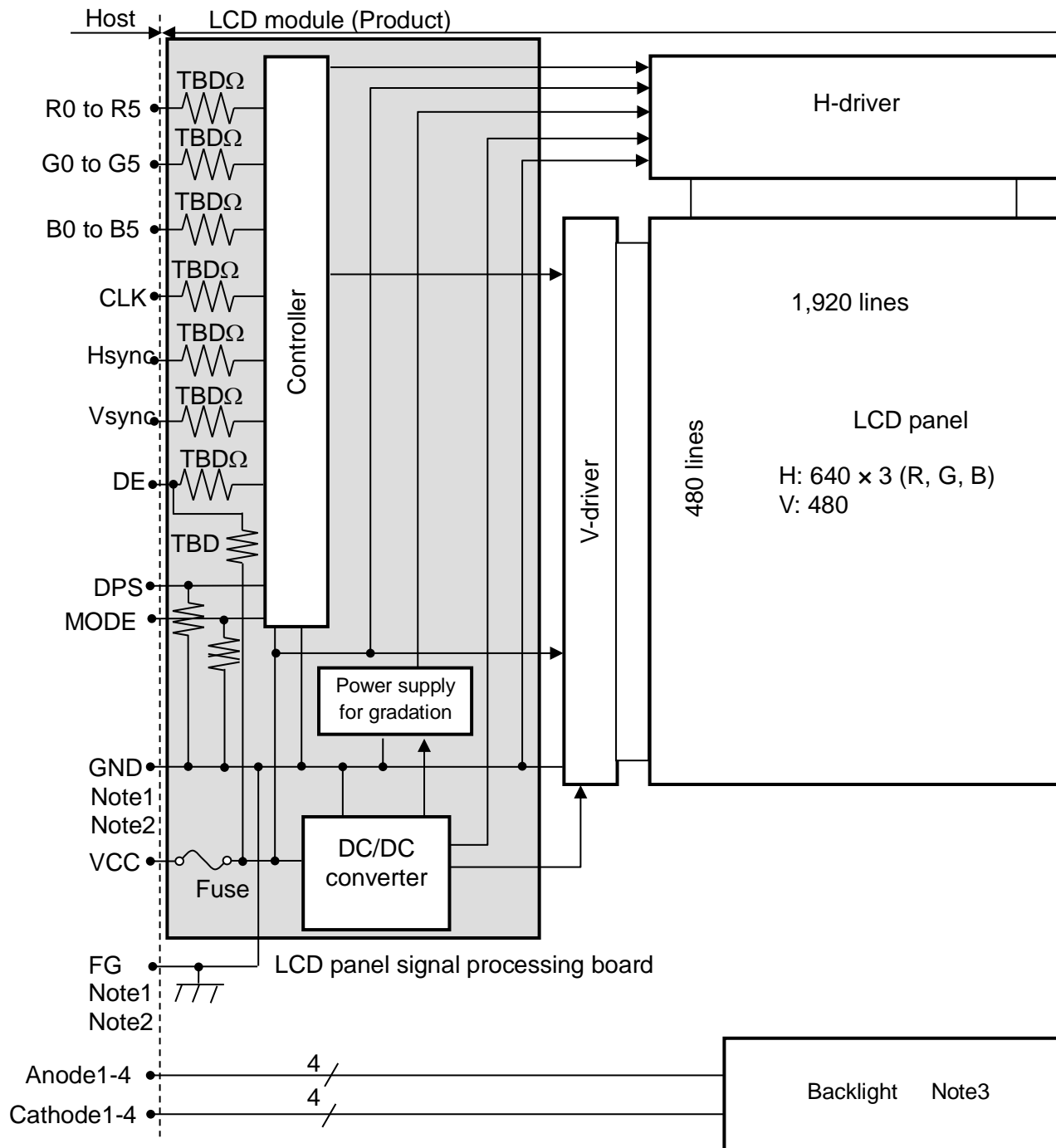


Figure 5.6.1 LCD Module Block Diagram

Note1: Relation between GND (Signal ground) and FG (Frame ground) in the LCD module is as follows.

GND - FG	Connected
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Note2: GND and FG must be connected to customer equipment's ground, and it is recommended that these grounds to be connected together in customer equipment.

Note3: Backlight in detail

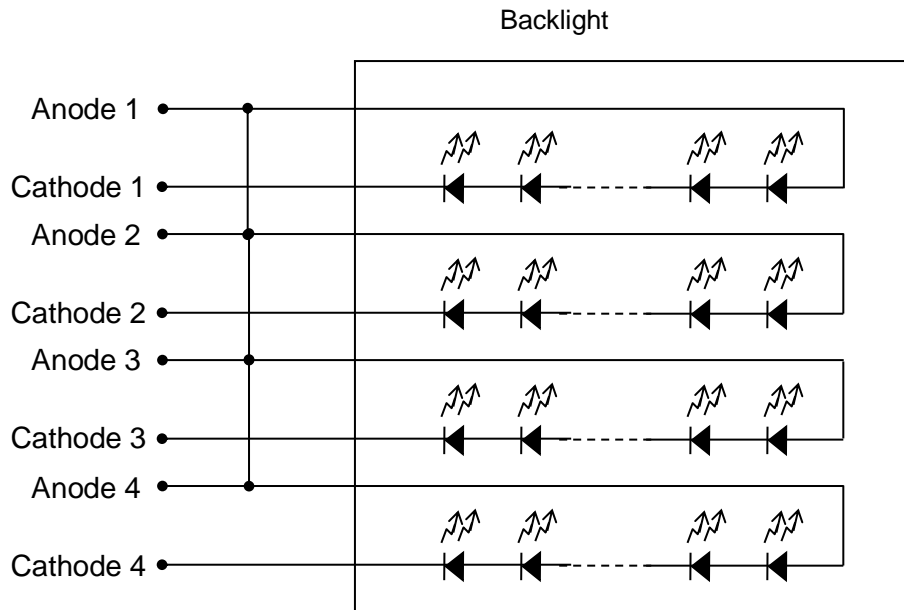


Figure 5.6.2 Backlight Block Diagram

5.7 Display Colors and Input Data Signals

This product can display 262,144 colors with 64 gray scales. Also the relation between display colors and input data signals is as follows.

Display colors		Data signal (0: Low level, 1: High level)																	
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
Basic colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Red gray scale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	dark	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	↑				:					:						:			
	↓				:					:						:			
	bright	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Red	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	
Green gray scale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	dark	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	↑				:					:						:			
	↓				:					:						:			
	bright	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0
Green	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	
Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	
Blue gray scale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	↑				:					:						:			
	↓				:					:						:			
	bright	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	
Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	

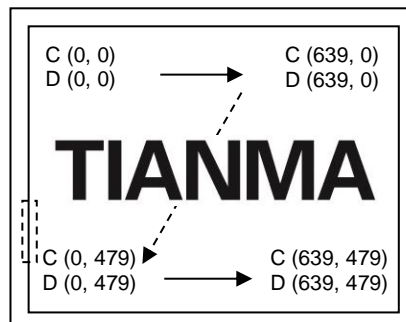
5.8 Display Positions

The following table is the coordinates per pixel.

C (0, 0)													
<table border="1" style="margin: auto;"> <tr> <td style="padding: 2px;">R</td> <td style="padding: 2px;">G</td> <td style="padding: 2px;">B</td> <td colspan="4"></td> </tr> </table>							R	G	B				
R	G	B											
$C(0, 0)$	$C(1, 0)$...	$C(X, 0)$...	$C(638, 0)$	$C(639, 0)$							
$C(0, 1)$	$C(1, 1)$...	$C(X, 1)$...	$C(638, 1)$	$C(639, 1)$							
⋮	⋮	⋮	⋮	⋮	⋮	⋮							
$C(0, Y)$	$C(1, Y)$...	$C(X, Y)$...	$C(638, Y)$	$C(639, Y)$							
⋮	⋮	⋮	⋮	⋮	⋮	⋮							
$C(0, 478)$	$C(1, 478)$...	$C(X, 478)$...	$C(638, 478)$	$C(639, 478)$							
$C(0, 479)$	$C(1, 479)$...	$C(X, 479)$...	$C(638, 479)$	$C(639, 479)$							

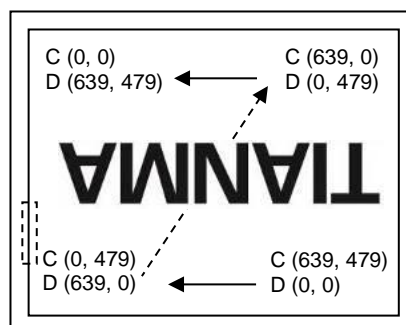
5.9 Scan Directions

The following figures are seen from a front view. Also the arrow shows the direction of scan.



Note1

Figure1. Normal scan (DPS: Low or Open)



Note1

Figure2. Reverse scan (DPS: High)

Note1: Meaning of C (X, Y) and D (X, Y)

C (X, Y): The coordinates of the display position

D (X, Y): The data number of input signal for LCD panel signal processing board

6. Timing Characteristics

6.1 Outline of input signal timings

6.1.1 SYNC Mode Timing Diagram

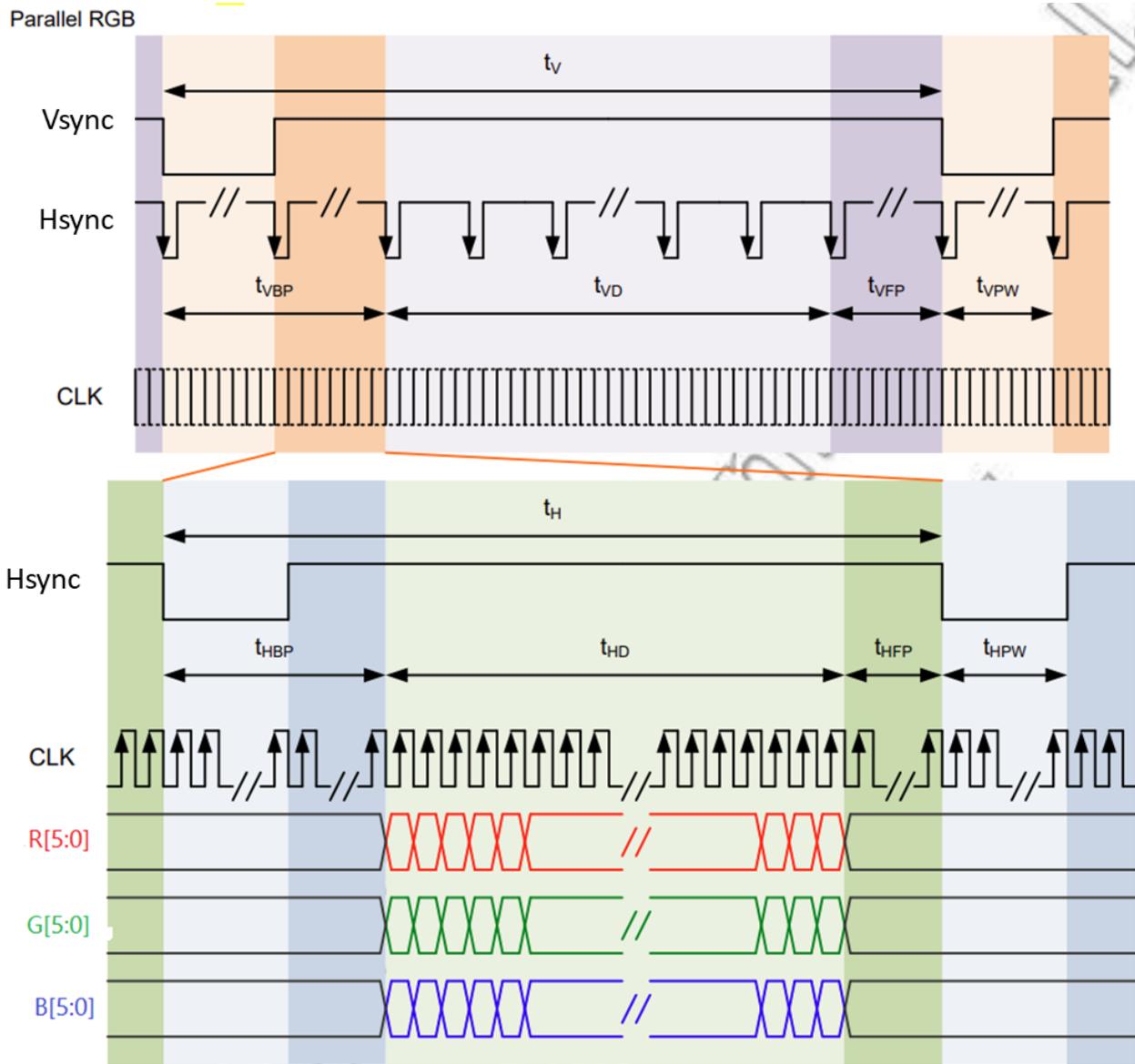


Figure 6.1.1 Data Input Timing Diagram Under SYNC Mode

6.1.2 DE Mode Timing Diagram

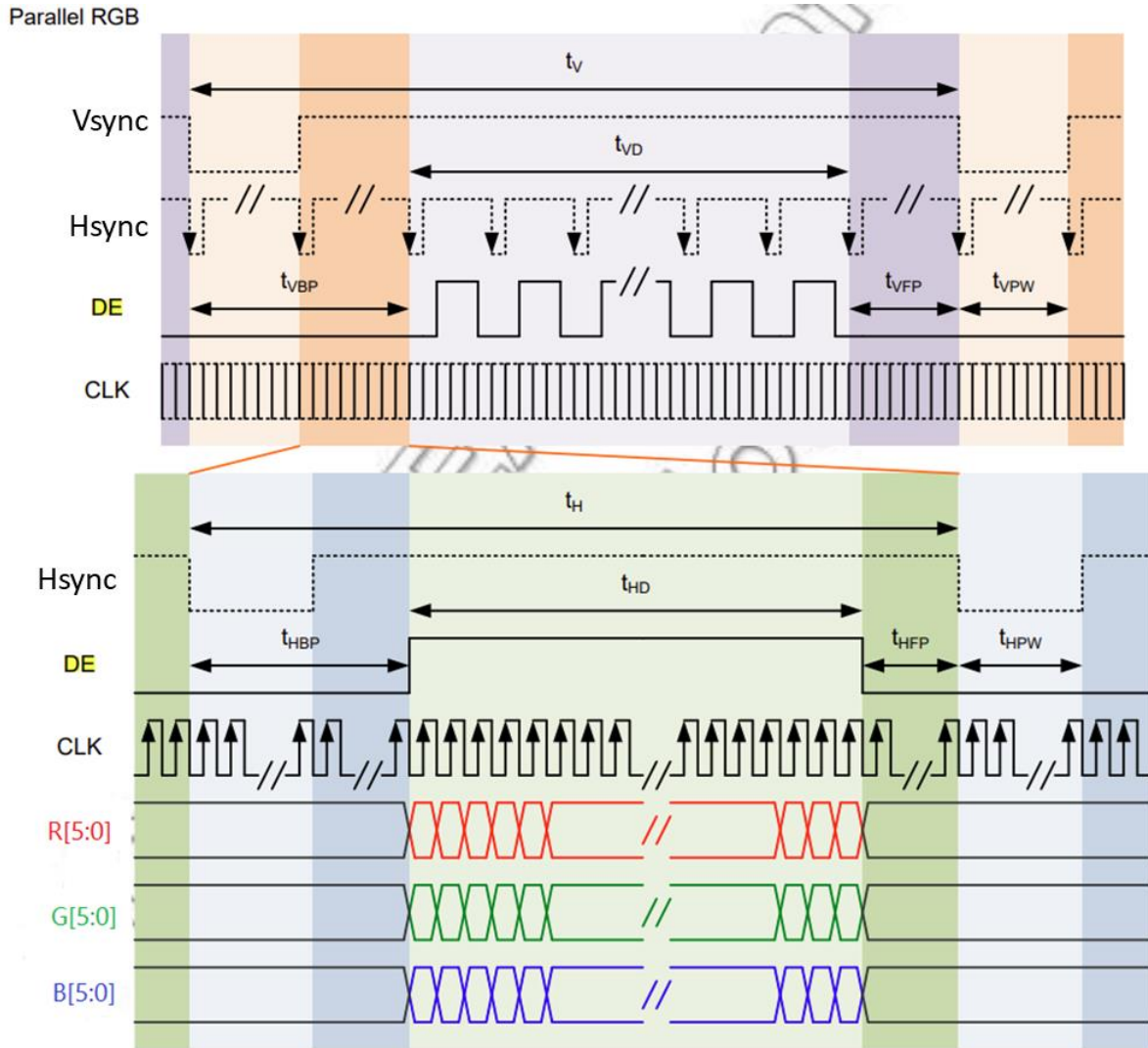


Figure 6.1.2 Data Input Timing Diagram Under DE Mode

6.2 Input Timing Parameters

(a) Sync mode

Parameter		Symbol	min.	typ.	max.	Unit	Remarks
CLK	Frequency	1/tc	23.1	25.2	27.1	MHz	Note1
Hsync	Cycle	t _H	744	800	840	CLK	
	Display period	t _{HD}	640				
	Front-porch	t _{HFP}	80	136	176	CLK	
	Pulse width	t _{HPW}	2	2	5	CLK	
	Back-porch	t _{HBP}	24	24	24	CLK	Note2 Register HBP
Vsync	Cycle	t _V	517	525	537	H	
	Display period	t _{VD}	480				
	Front-porch	t _{VFP}	17	25	37	H	
	Pulse width	t _{VPW}	2	2	5	H	
	Back-porch	t _{VBP}	20	20	20	H	Note2 Register VBP
FR	Frame Rate	FR	60			Hz	

Figure 6.1.1 Input Timing Parameters on Fixed Mode

Note1: Definition of parameters is as follows.

tc= 1CLK, th= 1H

Note2: Need to be consistent with the register settings.

(b) DE mode

Parameter		Symbol	min.	typ.	max.	Unit	Remarks	
CLK	Frequency	1/tc	23.1	25.2	27.1	MHz	Note1	
DE	Horizontal	Cycle	t _H	800	840	736		CLK
		Display period	t _{HD}	640			CLK	Note2
	Vertical (One frame)	Cycle	t _V	517	525	537	H	Note3
		Display period	t _{VD}	480			H	-
FR	Frame Rate	FR	60			Hz	-	

Figure 6.1.1 Input Timing Parameters on DE Mode

Note1: Definition of parameters is as follows.

tc= 1CLK, th= 1H

Note2: Hsync signal (Pin No.3 of CN1) and Vsync signal (Pin No.4 of CN1) are not used inside the product at DE mode.

Do not keep pin open to avoid noise problem.

Note3: Vertical cycle (tv) should be specified in integral multiple of Horizontal cycle (th).

6.3 AC Characteristics

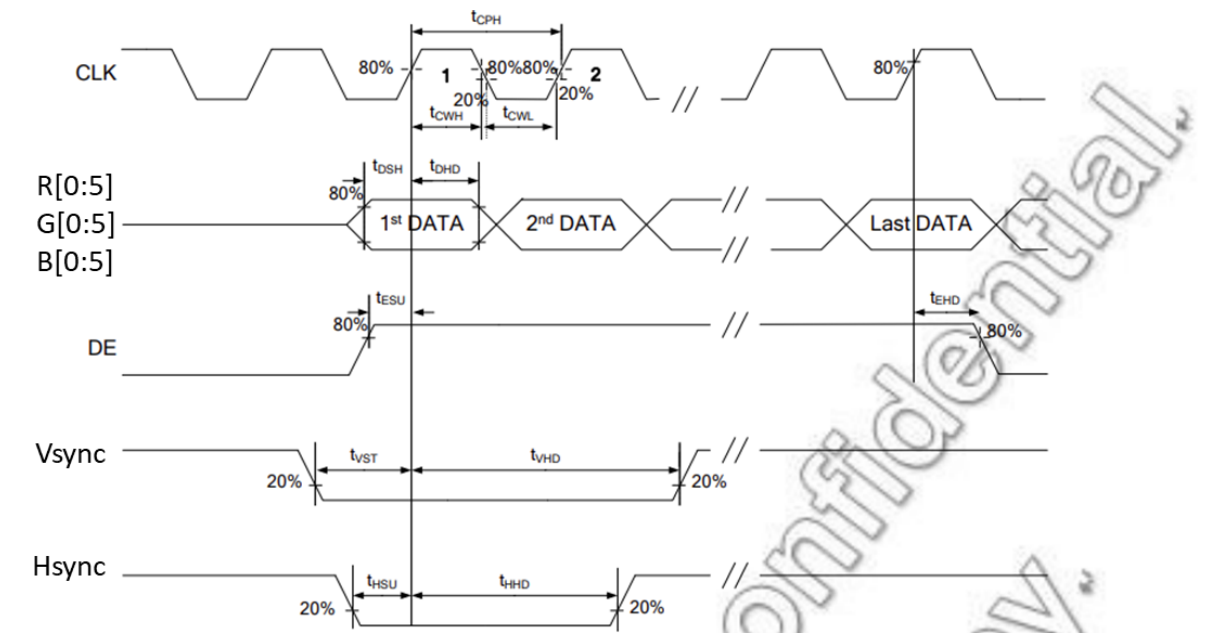


Figure 6.3.1 Input Timing Chart

Item	Signal	Symbol	Condition	Rating		Unit
				Min.	Max.	
CLK cycle time	CLK	t_{CPH}	-	42.3	46.3	ns
CLK pulse high duty		t_{CWH}	-	40	60	%
CLK pulse low duty		t_{CWL}	-	40	60	
Vsync setup time	Vsync	t_{VST}	-	4	-	ns
Vsync hold time		t_{VHD}	-	2	-	
Hsync setup time	Hsync	t_{HST}	-	4	-	
Hsync hold time		t_{HHD}	-	2	-	
Data setup time	R[0:5] G[0:5] B[0:5]	t_{DSH}	-	4	-	
Data hold time		t_{DHD}	-	2	-	
DE setup time	DE	t_{ESU}	-	4	-	
DE hold time		t_{EHD}	-	2	-	

Table 6.3.1 Input Timing Chart

7. Optical Characteristics

Item	Symbol	Condition	Min	Typ	Max	Unit	Remark	
View Angles	θT	CR ≥ 10	70	88	-	Degree	Note 2	
	θB		70	88	-			
	θL		70	88	-			
	θR		70	88	-			
Contrast Ratio	CR	θ=0°	800	1000	-	-	Note1 Note3	
Response Time	Ton+Toff	25°C	-	25	35	ms	Note1 Note4	
Chromaticity	White	Backlight is on	x	0.263	0.313	0.363	-	Note5 Note1
			y	0.279	0.329	0.379		
	Red		x	-	TBD	-		
			y	-	TBD	-		
	Green		x	-	TBD	-		
			y	-	TBD	-		
	Blue		x	-	TBD	-		
			y	-	TBD	-		
Uniformity	LU	White (255/255gray)	72	80	-	%	Note1 Note6	
NTSC	-	-	45	50	-	%	Note 5	
Luminance	L	White (255/255gray)	560	900	-	cd/m2	Note1 Note7	

Table 7.1 Optical Parameters

Test Conditions:

1. The ambient temperature is 25±2°C.humidity is 65±7%.

Measurement conditions are as follows.

Ta= 25°C, VCC= 3.3V, IL= 50mA/One circuit, Display mode: VGA, DPS= Low or Open: Normal scan

2. The test systems refer to Note 1 and Note 2.
3. Contrast Ratio, Chromaticity, Uniformity, and Luminance is measured by SR-UL, SR-3AR or equivalent.
4. Response Time is measured by TRD-100, LCD-5200 or equivalent.

Note1: Definition of optical measurement system.

The optical characteristics should be measured in dark room. After 20 Minutes operation, the optical characteristics are measured at the center point of the LCD screen.

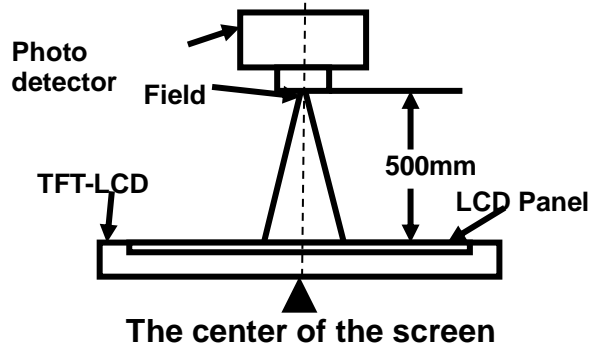


Figure 7.1 Measurement Set Up

Note2: Definition of viewing angle range and measurement system. Viewing angle is measured at the center point of the LCD .

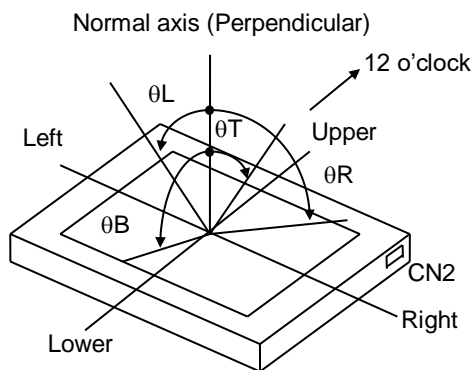


Figure 7.2 Measurement viewing angle

Note3: Definition of contrast ratio

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance of white screen}}{\text{Luminance of black screen}}$$

Note4: Definition of Response time

For SFT LCM, the response time is defined as the LCD optical switching time interval between “White” state and “Black” state. Rise time (T_r) is the time between photo detector output intensity changed from 10% to 90%. And fall time (T_f) is the time between photo detector output intensity changed from 90% to 10%.

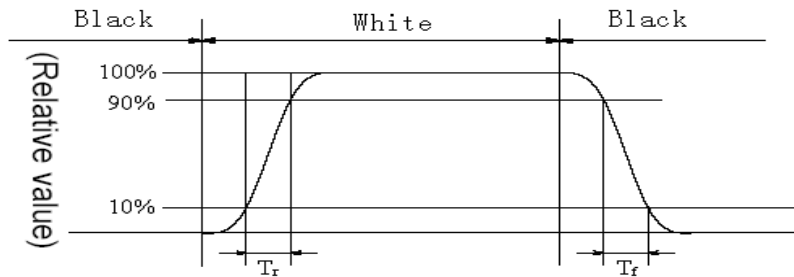


Figure 7.3 Response Time Testing($T_a=25^{\circ}C$)

Note5: Definition of color chromaticity (CIE1931)

Color coordinates measured at center point of LCD.

Note6: Definition of Luminance Uniformity

Active area is divided into 5 measuring area.

$$\text{Luminance Uniformity}(U) = L_{\min} / L_{\max}$$

L-----Active area length W----- Active area width

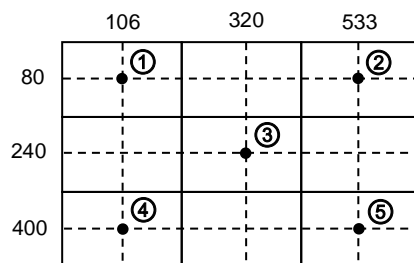


Figure 7.4 Definition of uniformity

Note7: Definition of Luminance:

Measure the luminance of white state at center point.

8. Reliability Test

No	Test Item	Condition	Judgment
1	High Temperature Operation	+80°C , 240H	No display malfunctions
2	High Temperature and Humidity (Operation)	+60°C , 90%RH , 240H	
3	Heat cycle (Operation)	-30°C, 1hrs ~ 80°C, 1hrs, 50cycle, 4hours/cycle	
4	Thermal Shock (non-operation)	-30°C,30min ~ 80°C,30min, change time : 5min, 100cycle	
5	ESD Note4	C=150pF , R=150Ω , 9point/panel Contact : ±10kv, 10times each place at 1 sec interval; (Environment : 15°C~35°C , 30%~60% , 86Kpa~106Kpa)	
6	Vibration (Non-operation)	5 to 100Hz, 19.6m/s ² 1 minute/cycle X, Y, Z directions 120 times each direction	No display malfunctions No physical damages
7	Shock (Non-operation)	539m/s ² , 11ms ±X, ±Y, ±Z directions 5 times each direction	

Table 8.1 RA test condition

Note1: Temperature is the ambient temperature of sample

Note2: Before cosmetic and function test, the product must have enough recovery time, at least 2hours at room temperature.

Note3: In the standard condition, there shall be no practical problem that may affect the display function. After the reliability test, the product's function only be guaranteed, but not for all of the cosmetic specification.

Note4: See the following figure for discharge points.

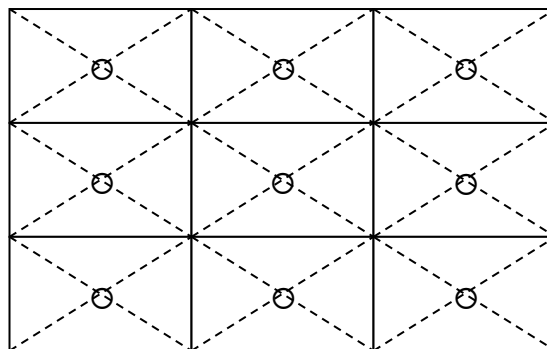
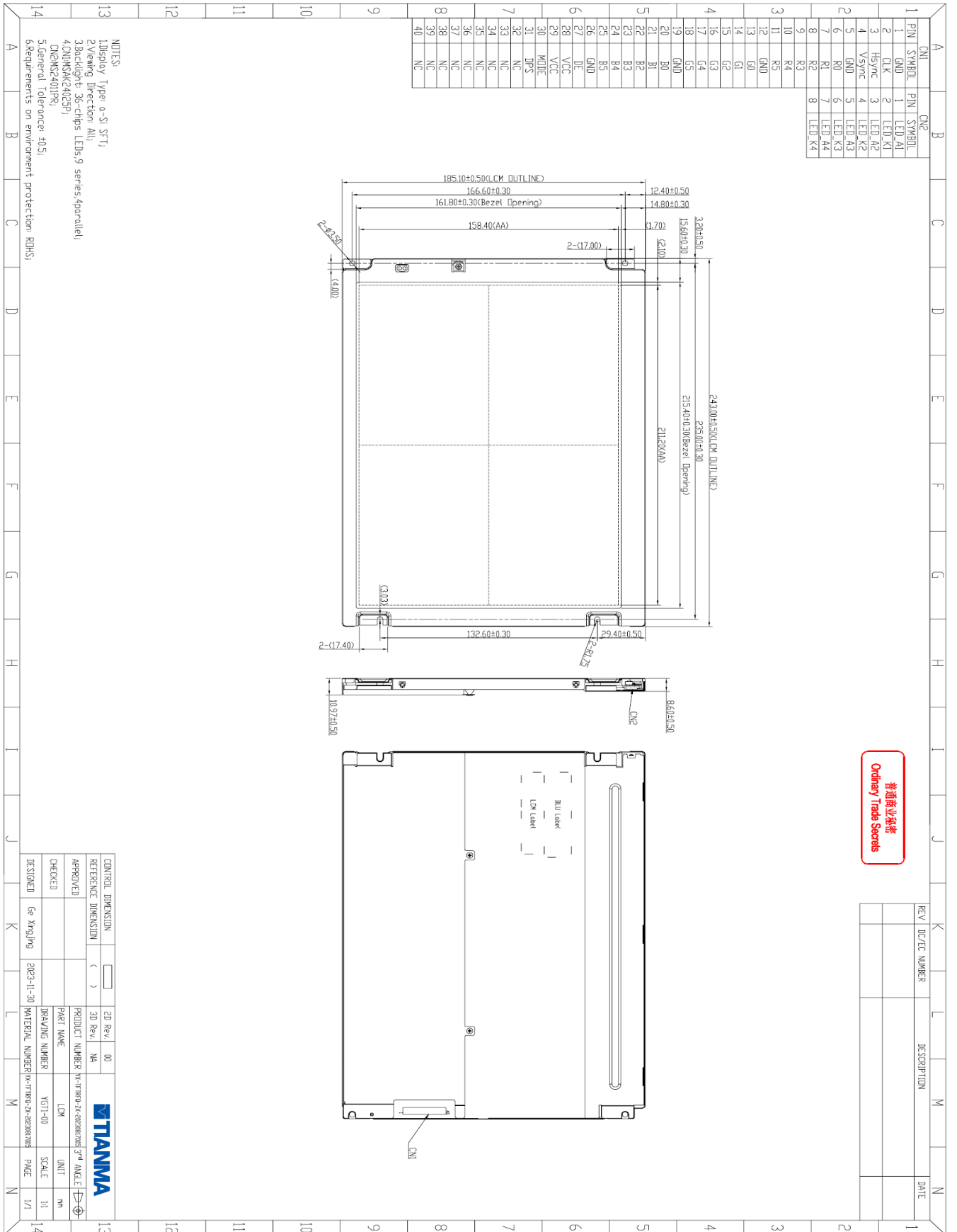


Figure 8.1 ESD position

9. Mechanical Drawing

9.1 Mechanical Drawing Of LCM



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9.2 Markings

The marking is attached to this product.

9.2.1 Nameplate label



10. Packing Instruction

Tianma will pack products to deliver to customer in accordance with Tianma 's packing specifications, and will deliver products to customer in such a condition that products will not suffer from a damage during transportation. The delivery conditions are as follows.

Parameter	Packing box type	Unit
Size	TBD(W) x TBD (H) x TBD (D) (typ.)	mm
Weight	TBD(typ.)	kg
Total weight	TBD(typ.) (with 10 products)	kg

10.1 Packing Box

10 products are packed as the maximum in an packing box. The type name and quantity are shown on outside of the packing box, either labeling or printing. In case the packing box with products is dropped from a height of 40cm or more, there is a risk of damage to products.

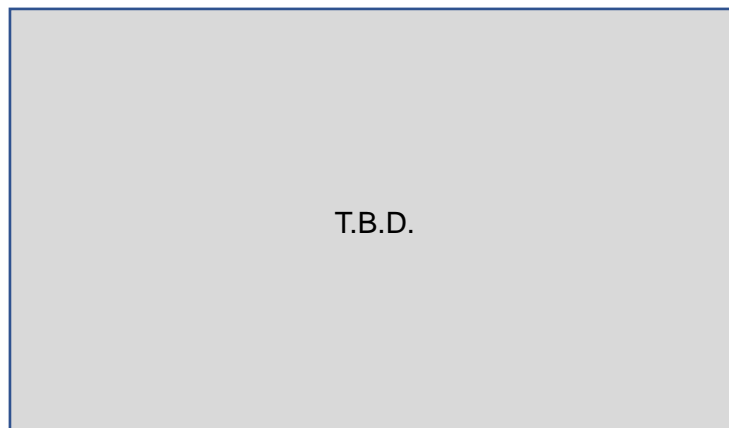


Figure 10.1 Outline Figure for Packing

11. Precautions for Use of LCD Modules

11.1 Handling Precautions

- (1) The display panel is made of glass. Do not subject it to mechanical shock by dropping it, etc.
- (2) If the display panel is damaged and the liquid crystal fluid inside it leaks out be sure not to get any in your mouth. If the fluid comes into contact with your skin or clothes promptly wash it off using soap and water.
- (3) Do not apply excessive force to the display surface or the bezel since this may cause the color tone to vary.
- (4) The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle the polarizer carefully.
- (5) If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is still not completely clear use a moist cloth with one of the following solvents:
 - Isopropyl alcohol
 - Ethyl alcoholSolvents other than those mentioned above may damage the polarizer. Specifically, do not use the following:
 - Water
 - Ketone
 - Aromatic solvents
- (6) Do not disassemble the LCD Module.
- (7) If powered off, do not apply the input signals.
- (8) To prevent destruction of the module by static electricity, be careful to maintain an optimum work environment.
- (9) Be sure to ground your body when handling the LCD Modules.
- (10) Tools used for assembly, must be properly grounded.
- (11) To reduce the amount of static electricity generated, do not conduct assembly or other work under very low humidity conditions.
- (12) The LCD Module is covered with a film to protect the display surface, remove film slowly under the ionizer.

11.2 Storage precautions

- (1) When storing the LCD modules avoid exposure to direct sunlight or to the light of fluorescent lamps.
- (2) The LCD modules should be stored within the rated storage temperature range. The recommend condition is: Temperature: 0 ~ 35 °C at normal humidity.
- (3) The LCD modules should be stored in a room without acid, alkali or other harmful gas.

11.3 Transportation Precautions

The LCD modules should not be dropped or subject to violent mechanical shock during transportation. Also they should avoid excessive pressure, water, high humidity and direct sunlight.

11.4 Screen saver Precautions

Not display the fixed pattern for a long time. Use a screen saver, if the fixed pattern is displayed on the screen

11.5 Safety Precautions

- (1) When you waste damaged or unnecessary LCDs, it is recommended to crush LCDs into pieces and wash them off with solvents such as acetone and ethanol, which should later be burned
- (2) Be sure to turn off the power supply when inserting or disconnecting the LED backlight cable.
- (3) LED driver should be designed to limit or stop its function when over current is detected on the LED.