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■ **Preliminary Specification**

□ **Final Product Specification**

Customer :

Approved by	Notes

TIANMA Confirmed :

Prepared by	Checked by	Approved by
Han Yongqiang		

This technical specification is subjected to change without notice

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Record of Revision

Rev	Issued Date	Description	Editor
1.0	2019-11-04	Preliminary Specification Released.	Han Yongqiang

1 General Specifications

Feature		Spec
Display Spec.	Size (inch)	15.6
	Resolution	1920(RGB) x 1080
	Technology Type	SFT
	Pixel Configuration	R.G.B. Vertical Stripe
	Pixel Pitch (mm)	0.17925 x 0.17925
	Display Mode	Transmissive, Normally Black
	Polarizer pencil-hardness	3H (min.) [by JIS K5600]
	Surface Treatment (Up Polarizer)	Antiglare
	Viewing Direction	-
	Gray Scale Inversion Direction	-
Optical Characteristics	Luminance (cd/m2)	400 Typ.
	Contrast ratio	1000:1 Typ.
	Color gamut (%)	72 Typ.
	Response time Ton+Toff (ms)	25 Typ.
	Viewing angle R/L/U/D (Degree)	88/88/88/88 Typ.
Mechanical Characteristics	LCM (W x H x D) (mm)	363.8 x 215.9 x 6.3 Typ.
	Active Area (mm)	344.16 x 193.59
	With /Without TSP	Without TSP
	Weight (g)	(610) Typ.
	Backlight LED replacement	Not Available
Electrical Characteristics	Interface	LVDS (2 port), 8bit
	Power supply voltage (V)	LCD panel: 3.3 Typ.
		Backlight: 12.0 Typ.
	Color Depth	16.7M
	Backlight LED driver	Build in.
	Power consumption (W)	(13.9) Typ.

Note 1: Requirements on Environmental Protection: Q/S0002

Note 2 : LCM weight max. tolerance : +10%

Note 3: Color gamut is against NTSC color space.

Note 4: Power consumption is defined at the maximum luminance control, with checkered flag pattern.

2 Input/Output Terminals

2.1 TFT LCD Panel

CN1 socket (LCD module side): MDF76KBW-30S-1H(55) (HIROSE ELECTRIC Co.,td.)
Adaptable plug: MDF76-30P-1C (HIROSE ELECTRIC Co., Ltd.)

Pin No.	Symbol	Signal	Remarks
1	DA0-	Odd pixel data 0	Note1
2	DA0+		
3	DA1-	Odd pixel data 1	Note1
4	DA1+		
5	DA2-	Odd pixel data 2	Note1
6	DA2+		
7	GND	Ground	Note2
8	CLKA-	Odd pixel clock	Note1
9	CLKA+		
10	DA3-	Odd pixel data 3	Note1
11	DA3+		
12	DB0-	Even pixel data 0	Note1
13	DB0+		
14	GND	Ground	Note2
15	DB1-	Even pixel data 1	Note1
16	DB1+		
17	GND	Ground	Note2
18	DB2-	Even pixel data 2	Note1
19	DB2+		
20	CLKB-	Even pixel clock	Note1
21	CLKB+		
22	DB3-	Even pixel data 3	Note1
23	DB3+		
24	GND	Ground	Note2
25	GND	Ground	Note2
26	GND	Ground	Note2
27	GND	Ground	Note2
28	VCC	Power supply	Note2
29			
30			

Note1: Twist pair wires with 100 (Characteristic impedance) should be used between LCD panel signal processing board and LVDS transmitter.
Note2: All GND and VCC terminals should be used without any non-connected lines.

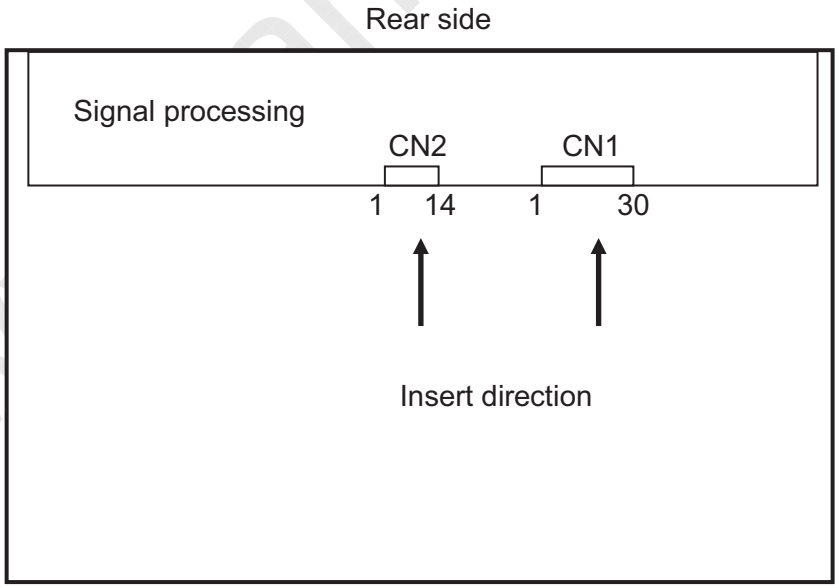
2.2 LED driver board

CN201 socket (LCD module side): DF19L-14P-1H(54) (HIROSE ELECTRIC Co., Ltd.)
Adaptable plug: DF19-14S-1C (HIROSE ELECTRIC Co., Ltd.)

Pin No.	Symbol	Function	Description
1	VDD	Power supply	Note1
2	VDD		
3	VDD		
4	VDD		
5	VDD		
6	GND	LED driver board ground	Note1
7	GND		
8	GND		
9	GND		
10	GND		
11	Reserve	Keep open	–
12	BRTC	Backlight ON/OFF control	High or Open: Backlight ON Low: Backlight OFF
13	PWM	Luminance control	PWM Dimming
14	GND	LED driver board ground	Note1

Note1:All VDDB and GNDB terminals should be used without any non-connected lines.

2.3 Positions of Socket



3 Absolute Maximum Ratings

GND=0V

Parameter			Symbol	Rating	Unit	Remarks
Power supply voltage	LCD panel signal processing board		VCC	-0.3to +4.0	V	Ta= 25°C
	LED driver		VDD	-0.3to +15.0		
Input voltage for signals	Display signals Note1		VD	-0.3to VCC+0.3	V	
	Function signal for LED driver		PWM	-0.3to +5.5	V	
			BRTC	-0.3to +5.5	V	
Storage temperature			Tst	-20 to +70	°C	-
Operating temperature		Front surface	TopF	-20 to +70	°C	Note2
		Rear surface	TopR	-20 to +70	°C	Note3
Relative humidity Note4			RH	≤ 95	%	Ta ≤ 40°C
				≤ 85	%	40°C < Ta ≤ 50°C
				≤ 55	%	50°C < Ta ≤ 60°C
				≤ 36	%	60°C < Ta ≤ 70°C
Absolute humidity Note4			AH	≤ 70 Note5	g/m^3	Ta = 70°C

Note1: DA0+/-, DA1+/-, DA2+/-, DA3+/- ,CLKA+/-, DB0+/-, DB1+/-, DB2+/-, DB3+/-, CLKB+/-
Note2: Measured at LCD panel surface (including self-heat)
Note3: Measured at LCD module's rear shield surface (including self-heat)
Note4: No condensation
Note5: Water amount at Ta= 70°C and RH= 36%

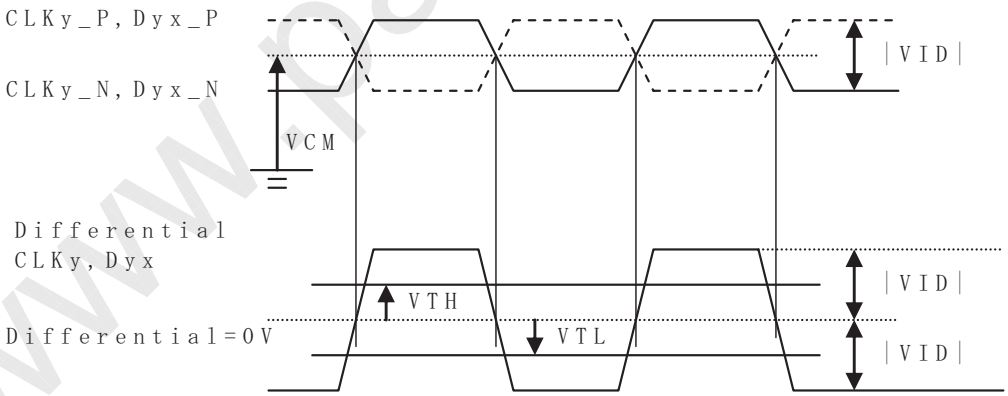
4 Electrical Characteristics

4.1 Driving TFT LCD Panel

(Ta= 25°C)

Parameter		Symbol	min.	typ.	max.	Unit	Remarks
Power supply voltage		VCC	3.0	3.3	3.6	V	-
Power supply current		ICC	-	580 Note1	1000 Note2	mA	at VCC= 3.3V
Permissible ripple voltage		VRPC	-	-	100	mVp-p	for VCC Note3, Note4, Note5
Differential input threshold voltage	High	VTH	-	-	+100	mV	at VCM= 1.2V Note6, Note7
	Low	VTL	-100	-	-	mV	
Input Differential Voltage		|VID|	100	400	600	mV	-
Differential Input Common Mode Voltage		VCM	0.7	1.2	1.6	V	-
Terminating resistance		RT	-	100	-	Ω	-

Note1: Checkered flag pattern [by IEC 61747-6]
Note2: Pattern for maximum current
Note3: This product works even if the ripple voltage levels are over the permissible values, but there might be noise on the display image.
Note4: The permissible ripple voltage includes spike noise.
Note5: The load variation influence does not include.
Note6: Common mode voltage for LVDS receiver
Note7: DC characteristics (LVDS receiver part)



CLKy_P, CLKy_N: y = A,B
Dyx_P, Dyx_N: y = A,B x = 0,1,2,3
|VID| = |**_P-**_N|
VCM = (**_P+**_N)/2
P: +, N: -
**: CLKy or Dxy

4.2 Driving Backlight

(Ta= 25°C)

Parameter		Symbol	min.	typ.	max.	Unit	Remarks
Power supply voltage		VDD	10.8	12.0	13.2	V	Note1
Power supply current		IDD	-	(1,000)	(1250) Note2	mA	At the maximum luminance control
Permissible ripple voltage		VRPD	-	-	200	mVp-p	for VDD Note3, Note4, Note5
Input voltage for PWM signal	High	VDFH1	2.0	-	5.0	V	-
	Low	VDFL1	0	-	0.4		
Input voltage for BRTC signal	High	VDFH2	2.0	-	5.0		
	Low	VDFL2	0	-	0.8		
Input current for PWM signal	High	IBCH1	-	-	+200	μA	-
	Low	IBCL1	-200	-	-		
Input current for BRTC signal	High	IBCH2	-	-	+200		
	Low	IBCL2	-200	-	-		
PWM frequency		f_{PWM}	200	-	1k	Hz	Note6, Note8
PWM duty ratio		DR_{PWM}	1	-	100	%	Note7, Note9, Note10
PWM pulse width		tPWH	20	-	-	μs	Note9, Note10
LED life time		Hr	-	50000	-	Hour	Note 11

Note1: When designing of the power supply, take the measures for prevention of surge voltage.
Note2: This value excludes peak current such as overshoot current.
Note3: This product works even if the ripple voltage levels are over the permissible values, but there might be noise on the display image.
Note4: The permissible ripple voltage includes spike noise.
Note5: The power supply lines (VDD and GND) may have ripple voltage during luminance control of LED. There is the possibility that the ripple voltage produces acoustic noise and signal wave noise in audio circuit and so on.
Note6: A recommended f_{PWM} value is as follows.

$$f_{PWM} = \frac{2n-1}{4} \times fv$$

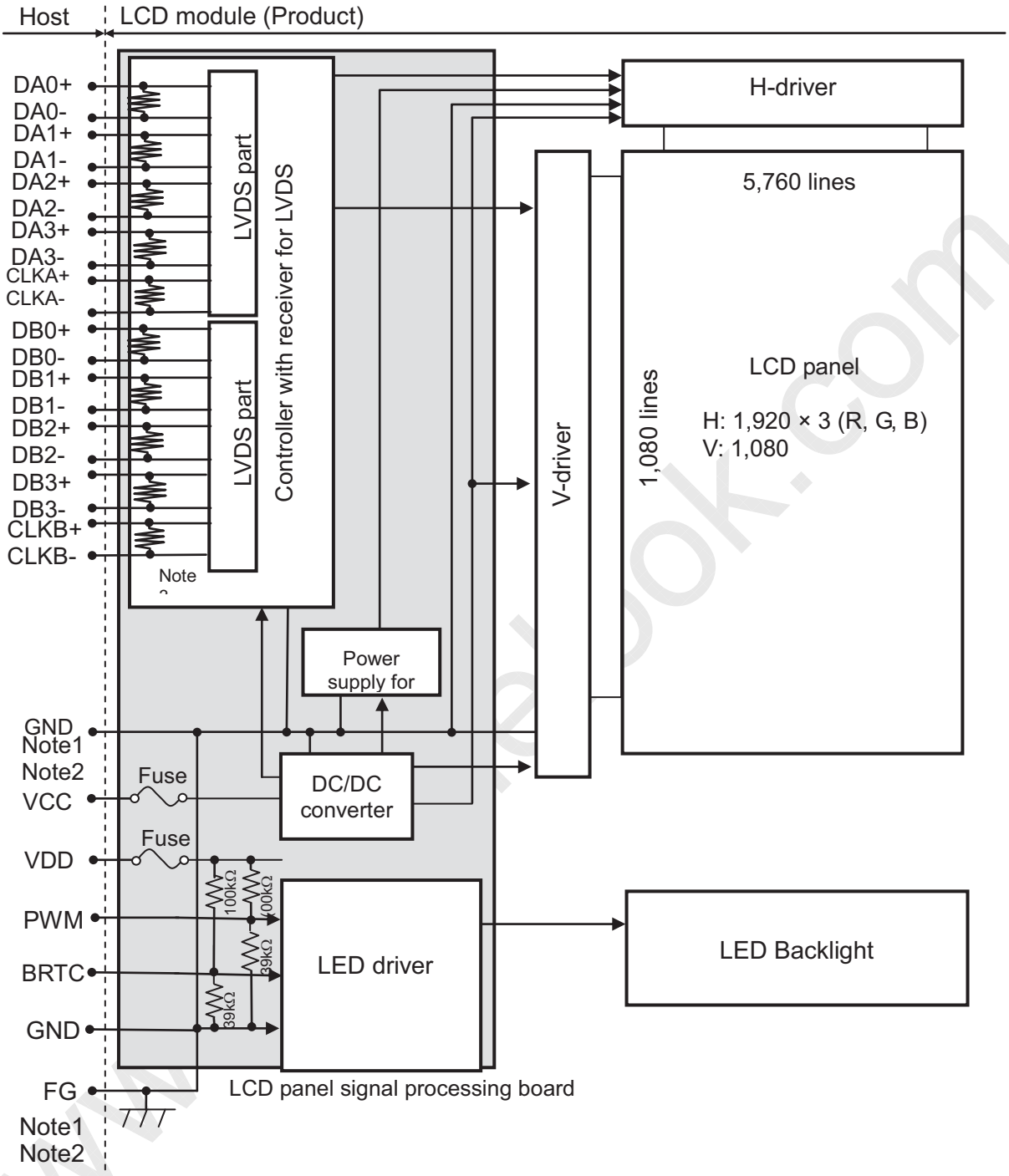
(n = integer, fv = frame frequency of LCD module)

Note7: $$DR_{PWM} = \frac{tPWH}{tPW}$$

tPWH: PWM pulse width, tPW: PWM dimming cycle (= $1/f_{PWM}$)

Note8: Depending on the frequency used, some noise may appear on the screen, please conduct a thorough evaluation.
Note9: While the BRTC signal is high, do not set the tPWH (PWM pulse width) is less than minimum value. It may cause abnormal working of the backlight. In this case, turn the backlight off and then on again by BRTC signal.
Note10: Regardless of the PWM frequency, both PWM duty ratio and PWM pulse width must be always more than the minimum values.
Note11: Optical performance should be evaluated at Ta=25℃.Only If LED is driven by high current, high ambient temperature & humidity condition. The life time of LED will be reduced. Operating life means brightness goes down to 50% of initial brightness. Typical operating life time is an estimated data.

4.3 Block Diagram



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

GND- FG	Connected

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: Each pair of the LVDS signal has a 100Ω terminating resistance.

5 Timing Chart

5.1 Timing Characteristics

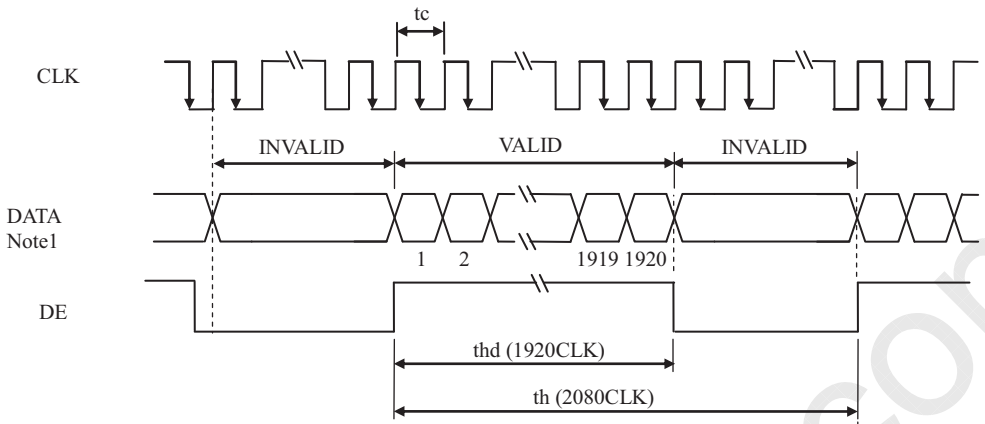
(Note1, Note2, Note3)

Parameter			Symbol	min.	typ.	max.	Unit	Remarks
CLK	Frequency		1/tc	65.0	74.175	81.5	MHz	13.48ns (typ.)
	Duty ratio		-	-			-	-
	Rise time, Fall time		-				ns	
DATA	CLK-DATA	Setup time	-	-			ns	-
		Hold time	-				ns	
	Rise time, Fall time		-				ns	
DE	Horizontal	Cycle	th	13.19	14.83	16.53	μs	67.43kHz (typ.)
				1,075	1,100	-	CLK	
		Display period	thd	960			CLK	-
	Vertical (One frame)	Cycle	tv	15.39	16.68	18.18	ms	59.94Hz (typ.)
				1,100	1,125	-	H	
		Display period	tvd	1,080			H	-
	CLK-DE	Setup time	-	-			ns	-
		Hold time	-				ns	
	Rise time, Fall time		-				ns	

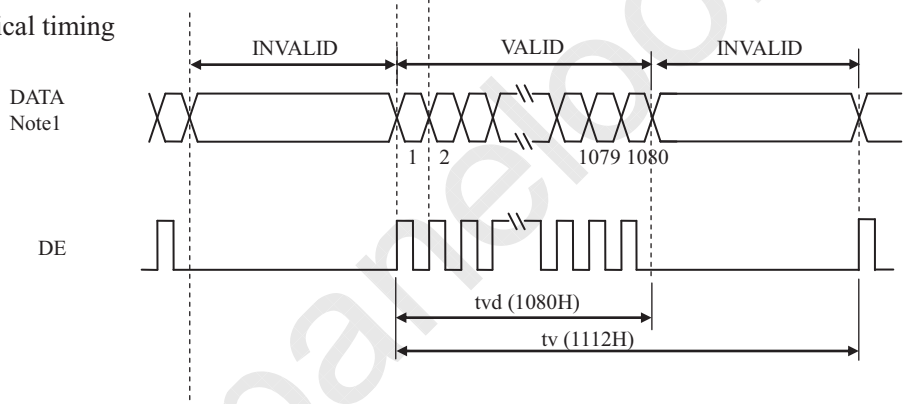
Note1: Definition of parameters is as follows.
tc= 1CLK, th= 1H
Note2: See the data sheet of LVDS transmitter.
Note3: Vertical cycle (tv) should be specified in integral multiple of Horizontal cycle (th).

5.2 Input Signal Timing Chart

Horizontal timing



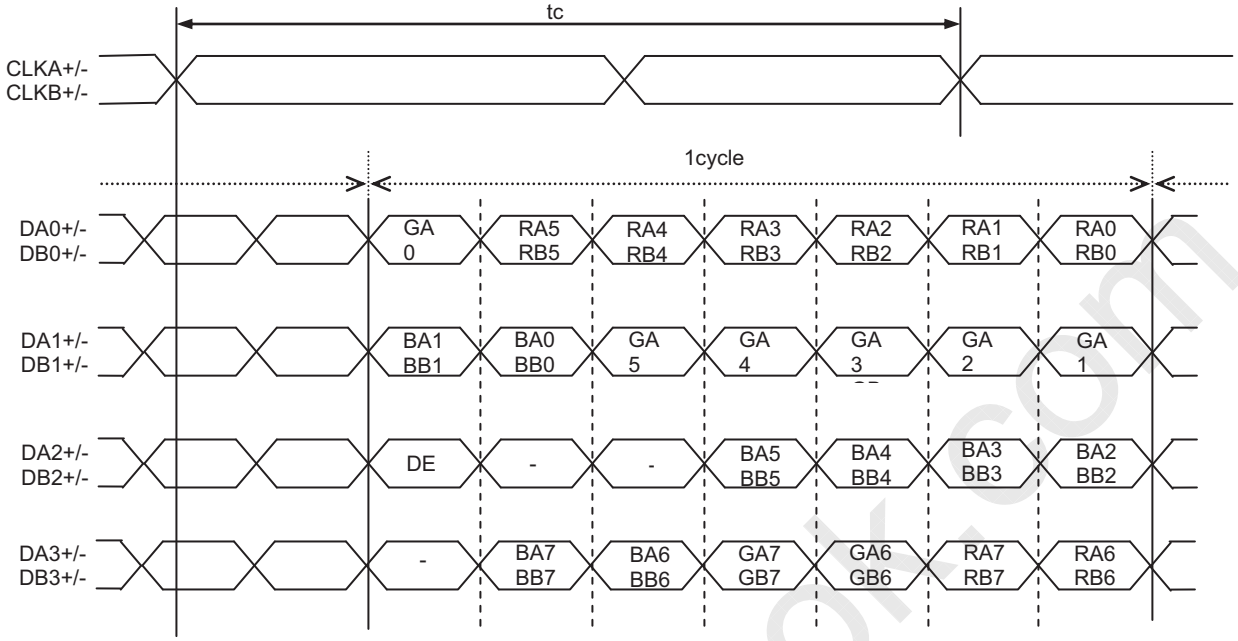
Vertical timing



Note1: DATA = R0-R7, G0-G7, B0-B7

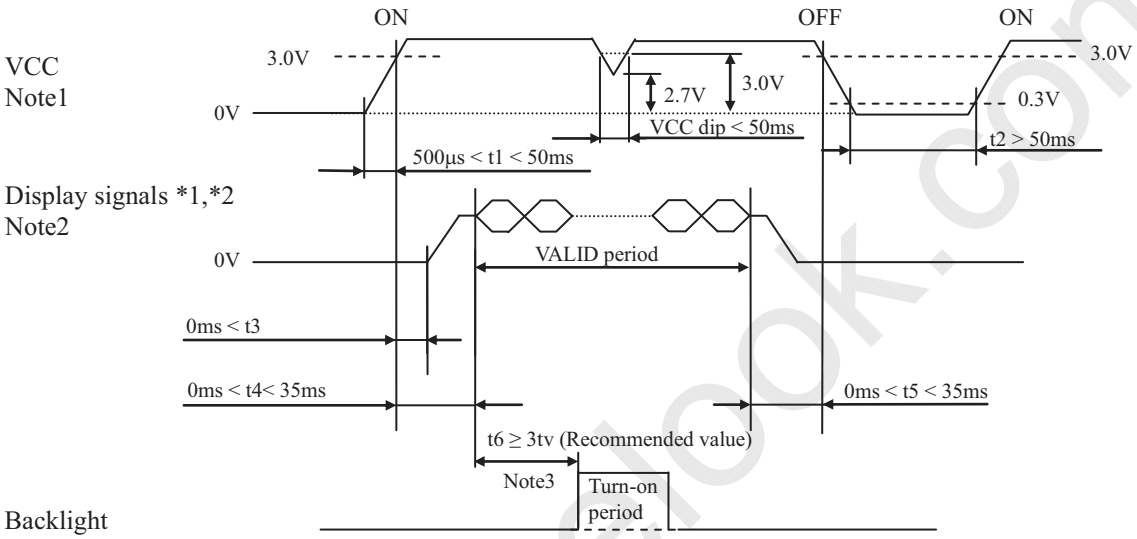
5.3 Input Data Mapping

(1) Input data signal:



5.4 Power On/Off Sequence

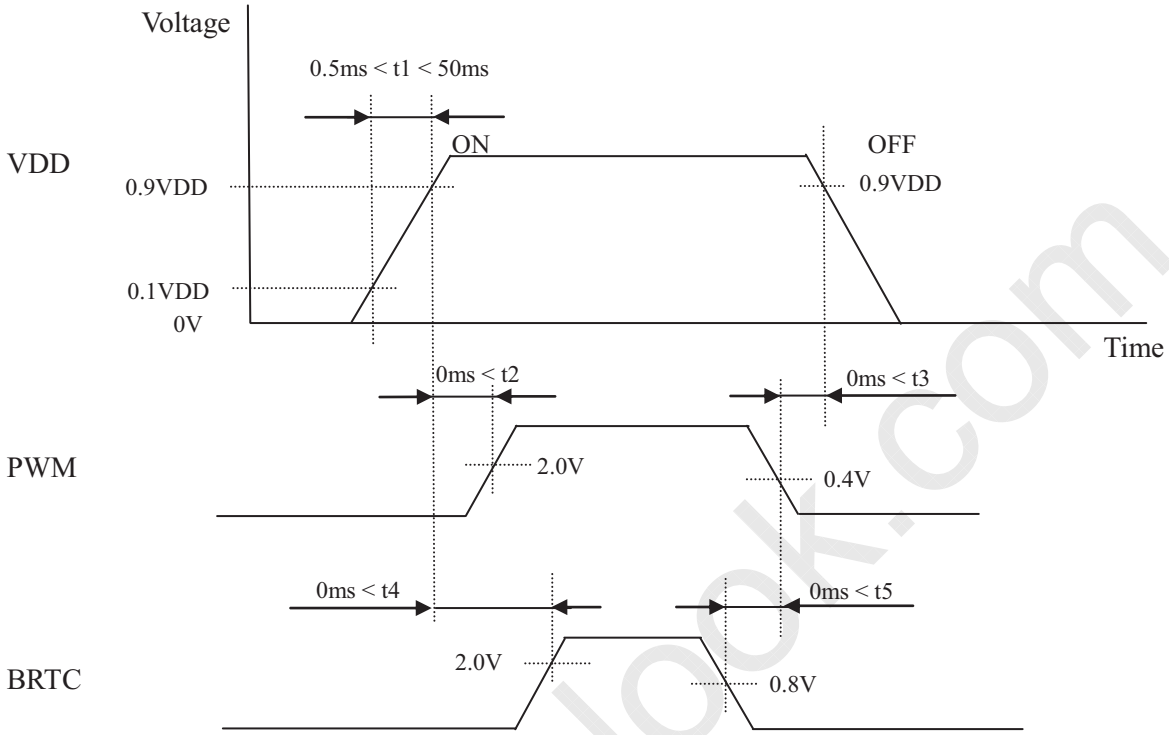
Item	Symbol	Min	Typ	Max	Unit	Remark
VCC on to VCC stable	t1	0.5	-	50	ms	
VCC off to next VCC on	t2	50	-	-	ms	
VCC stable to Signal on	t3	0	-	-	ms	
VCC stable to Signal stable	t4	0	-	34	ms	
Signal off to VCC off	t5	0	-	35	ms	
Signal stable to BL on	t6	55	-	-	ms	



*1 DA0+/-, DA1+/-, DA2+/-, DA3+/-, CLKA+/-, DB0+/-, DB1+/-, DB2+/-, DB3+/-, CLKB+/-
*2 These signals should be measured at the terminal of 100Ω resistance.

Note1: If there is a voltage variation (voltage drop) at the rising edge of VCC below 3.0V, there is a possibility that a product does not work due to a protection circuit.
Note2: Display signals (DA0+/-, DA1+/-, DA2+/-, DA3+/-,CLKA+/-, DB0+/-, DB1+/-, DB2+/-, DB3+/-, CLKB+/-) 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 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 signals, VCC also must be shut down.
Note3: In order to avoid unstable data display, the backlight is recommended to turn on within the VALID period of display and function signals.
Recommended value: t6 ≥ 3tv
(tv is vertical cycle (Please refer to 5.1 Timing characteristics))

5.5 LED driver



6 Optical Characteristics

Ta=25℃

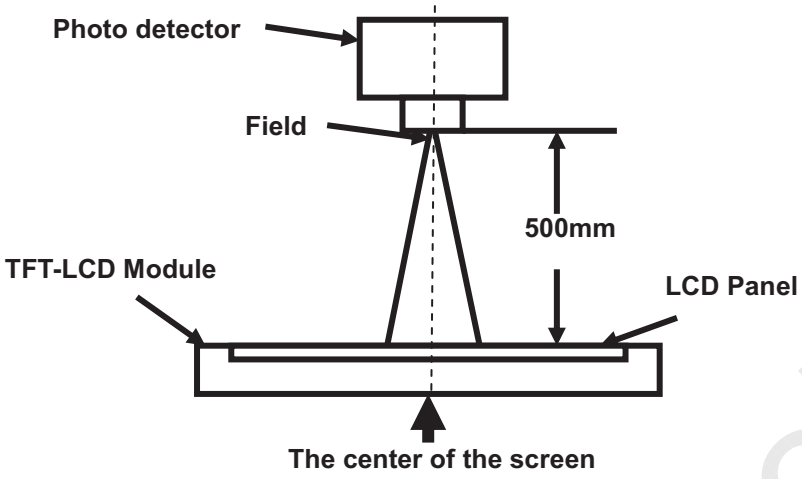
Item		Symbol	Condition	Min	Typ	Max	Unit	Remark
View Angles		θT	CR≧10	70	88	-	Degree	Note 2
		θB		70	88	-		
		θL		70	88	-		
		θR		70	88	-		
Contrast Ratio		CR	θ=0°	600	1000	-	-	Note1 Note3
Response Time		$T_{ON}+T_{OFF}$	25℃	-	25	40	ms	Note1 Note4
Chromaticity	White	x	Backlight is on	0.263	0.313	0.363	-	Note5 Note1
		y		0.279	0.329	0.379		
	Red	x		-	(0.630)	-		
		y		-	(0.335)	-		
	Green	x		-	(0.290)	-		
		y		-	(0.620)	-		
	Blue	x		-	(0.155)	-		
		y		-	(0.065)	-		
Uniformity		U	-	72	80	-	%	Note1 Note6
NTSC		-	-	65	72	-	%	Note 5
Luminance		L		280	400	-	cd/m^2	Note1 Note7

Test Conditions:

1. The ambient temperature is 25±2℃.humidity is 65±7%. PWM duty ratio is 100%.
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.

Note 1: Definition of optical measurement system.

The optical characteristics should be measured in dark room. After 20 minutes operation, the optical properties are measured at the center point of the LCD screen. All input terminals LCD panel must be ground when measuring the center area of the panel.



Note 2: Definition of viewing angle range and measurement system.

Viewing angle is measured at the center point of the LCD by LCD5200。

The 12 o'clock direction is upper side of outline in "**8 Mechanical Drawing**".

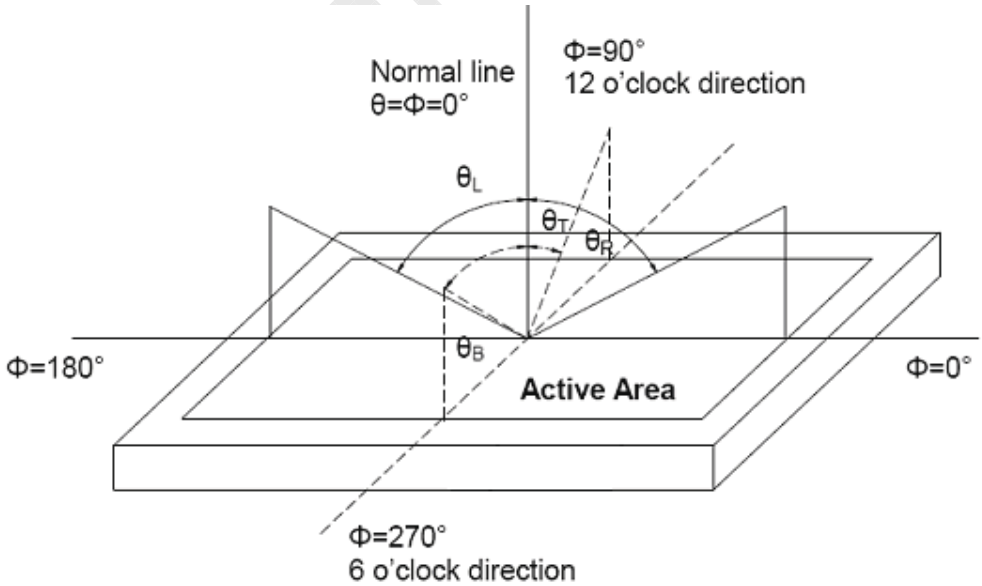


Fig. 1 Definition of viewing angle

Note 3: Definition of contrast ratio

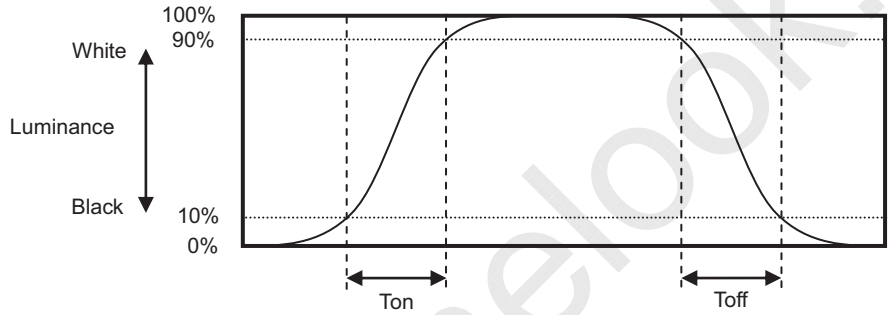
The contrast ratio is calculated by using the following formula.

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

Note 4: Definition of Response time

The response time is defined as the LCD optical switching time interval between “Black” state and “White” state. Fall time (Ton) is the time between photo detector output intensity changed from 10% to 90%. And rise time (Toff) is the time between photo detector output intensity changed from 90% to 10%.

Product surface temperature: TopF= 29℃.



Note 5: Definition of color chromaticity (CIE1931)

Color coordinates measured at center point of LCD.

Note 6: Definition of Luminance Uniformity

The luminance uniformity is calculated by using following formula.

$$\text{Luminance uniformity (LU)} = \frac{\text{Minimum luminance from ① to ⑤}}{\text{Maximum luminance from ① to ⑤}}$$

The luminance is measured at near the 5 points shown below.

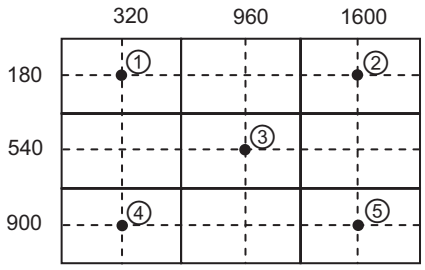


Fig. 2 Definition of uniformity

Note 7: Definition of Luminance :

Measure the luminance of white state at center point.

7 Environmental / Reliability Test

No	Test Item	Condition	Remarks
1	High Temperature Operation	①Ts = +70±3℃, 240 hours (Note1) ②Display data is white.	No display malfunctions
2	Low Temperature Operation	Ts = -20±3℃, 240 hours (Note1)	
3	High Temperature & High Humidity Operation	①Ta = +60℃, 60% RH max, 240hours ②Display data is white.	
4	Thermal Shock (non-operation)	① -20 ± 3°C…30minutes +60 ± 3°C…30minutes ② 100cycles, 1hour/cycle ③ Temperature transition time is within 5 minutes.	
5	ESD(Operation)	① 150pF, R=150Ω,10kV ② 9 places on a panel surface Note2 ③ 10 times each point at 1 sec interval	
6	Vibration (Non-operation)	① 5 to 100Hz, 11.76m/s2 ② 1 minute/cycle ③ X, Y, Z directions ④ 50 times each direction	No display malfunctions No physical damages
7	Shock (Non-operation)	① 294m/ s2, 11ms ② ±X, ±Y, ±Z directions ③ 3 times each direction	

Note1: Ts is the temperature of panel's surface.

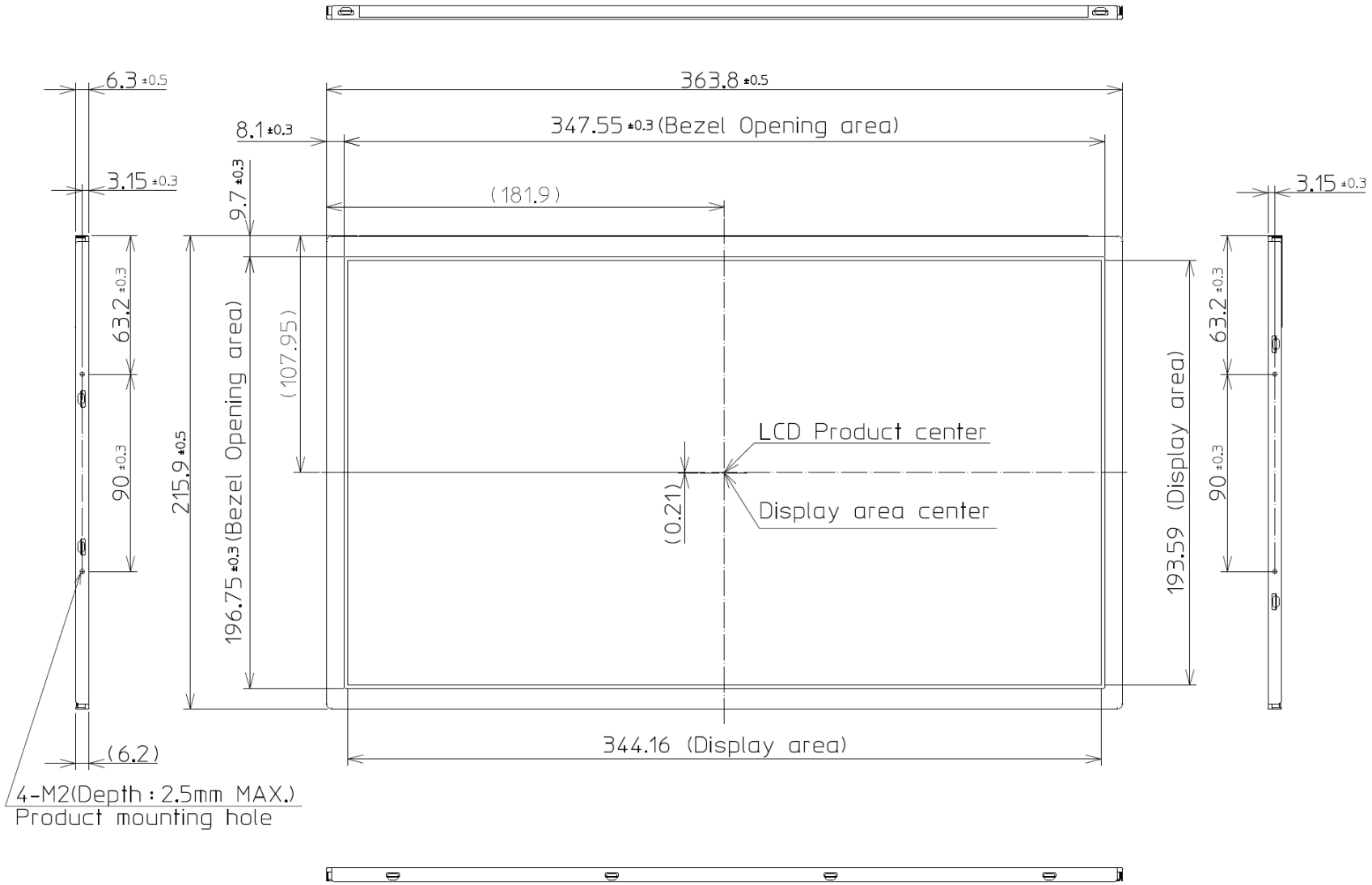
Note2: Ta is the ambient temperature of sample.

Note3: Before cosmetic and function test, the product must have enough recovery time, at least 2 hours at room temperature.

Note 4: In the standard condition, there shall be no practical problem that may affect the display function. After the reliability test, the product only guarantees operation, but don't guarantee all of the cosmetic specification.

8 Mechanical Drawing

8.1 Mechanical Drawing Of LCM



9 Packing Drawing

Parameter	Inner packing box	Unit
Size	394 (W) × 520 (H) × 524 (D) (typ.)	mm
Weight	(1.8) (typ.)	kg
Total weight	(7.9) (typ.) (with 10 products)	kg

10 Precautions For Use of LCD Modules

10.1 Handling Precautions

10.1.1 The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.

10.1.2 If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.

10.1.3 Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

10.1.4 The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

10.1.5 If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:

- Isopropyl alcohol
- Ethyl alcohol

Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:

- Water
- Ketone
- Aromatic solvents

10.1.6 Do not attempt to disassemble the LCD Module.

10.1.7 If the logic circuit power is off, do not apply the input signals.

10.1.8 To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

10.1.8.1 Be sure to ground the body when handling the LCD Modules.

10.1.8.2 Tools required for assembly, such as soldering irons, must be properly ground.

10.1.8.3 To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.

10.1.8.4 The LCD Module is coated with a film to protect the display surface. Be care when peeling off this protective film since static electricity may be generated.

10.2 Storage Precautions

10.2.1 When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.

10.2.2 The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:

Temperature : 0℃ ～ 40℃ Relatively humidity: ≤80%

10.2.3 The LCD modules should be stored in the room without acid, alkali and harmful gas.

10.3 Transportation Precautions

The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.