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SPECIFICATION

[☒] Preliminary Specification
[] Final Specification

Description **21.3" 2560xRGBx2048 TFT-LCD Module**
Part Number **P2130QSF2MA01**

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REVISION HISTORY

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1. Summary

1.1 General Description

This is a 21.3 inch a-Si TFT-LCD module with Normal- Black technology. It is composed of a TFT-LCD panel, a driver circuit, POL, PCB and a LED backlight unit.

1.2 Application

- Color monitor system

1.3 Features

- Ultra-wide viewing angle : Super Fine TFT(SFT)
- High resolution
- High luminance
- Interface: LVDS(4 ports)
- Compliant 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	21.3 inch	
	Resolution	2560(RGB)x2048	
	Pixel Pitch	0.165x0.165	mm
	TFT Active Area	422.40x337.92	mm
	Technology Type	a-Si	
	Pixel Configuration	R.G.B Vertical Stripe	
	Display Mode	SFT, Normally Black	
	Surface Treatment	AG	
	Viewing Direction	ALL	
Mechanical Characteristics	LCM (W x H x D)	442.3x354.9x20.9	mm
	Weight	TBD	g
Optical Characteristics	Luminance	Typ:TBD	cd/m ²
	Contrast Ratio	Typ:2200	
	NTSC	Typ:72	%
	Viewing Angle	Typ:88/88/88/88	degree
Electrical Characteristics	Interface	LVDS(4 port)	
	Color Depth	1073.74M(Real 10bit)	color
	Power Consumption	LCD:TBD Backlight:TBD	mW

Table 2.1 General TFT Specifications

Note 1: Viewing direction for best image quality is different from TFT definition. There is a 180 degree shift.

Note 2: Requirements on Environmental Protection: Q/S0002.

Note 3: LCM weight tolerance: $\pm 5\%$

3. LCD Module Block Diagram

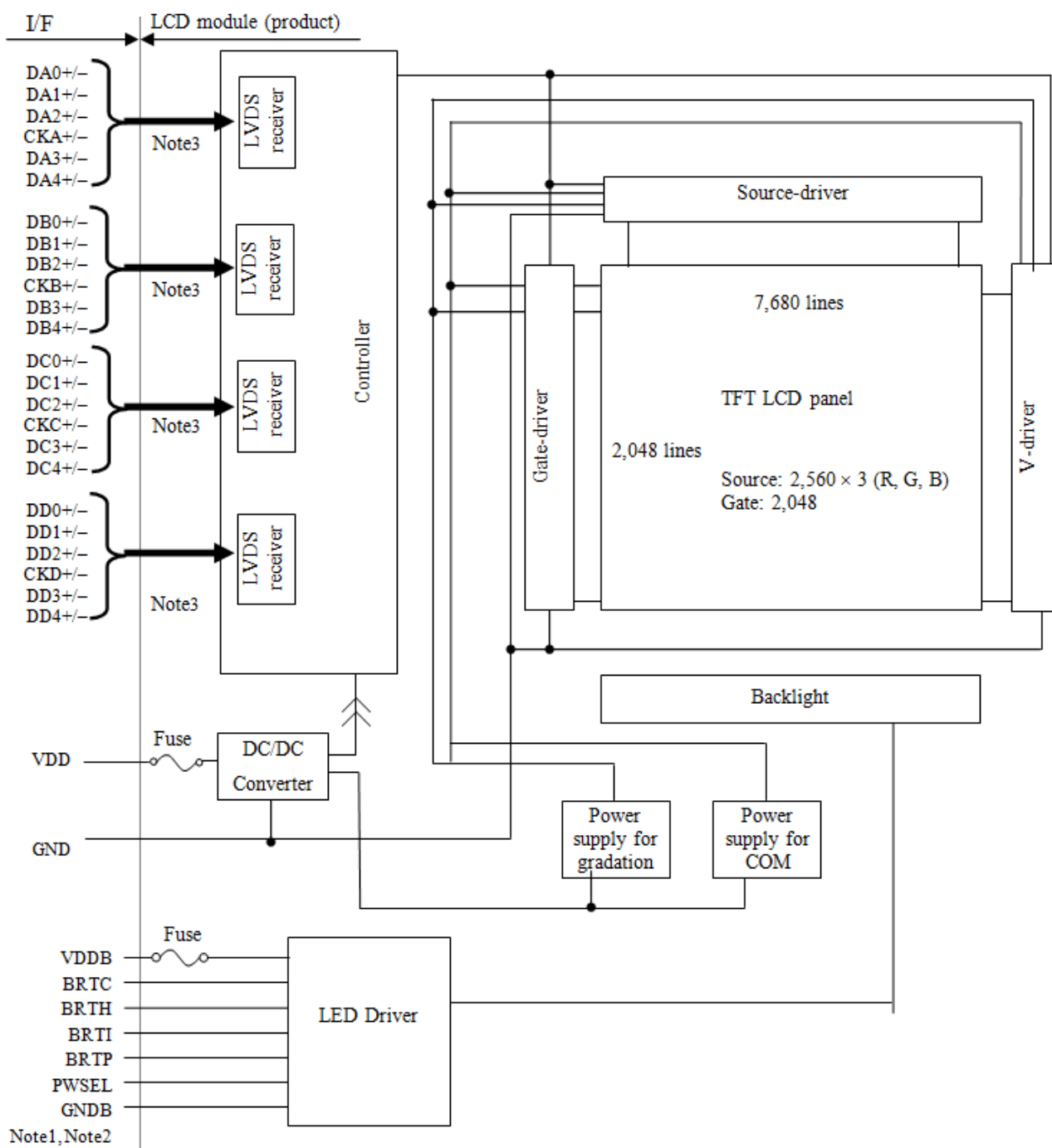


Figure 3.1 LCD Module Block Diagram

Note1: Relations between GND (Signal ground), FG (Frame ground) and GNDB (LED driver ground) in the LCD module are as follows.

GND - FG	Connected
GND - GNDB	Not connected
FG - GNDB	Not connected

Note2: GND, FG and GNDB 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 lines has 100Ω terminating resistance.

4. Input / Output Terminals

4.1 CN1/CN2/CN3 Pin assignment (LCD Interface)

4.1.1 CN1 Pin assignment

CN1 Connector Information	
LCD Module connector	MSAKS24020P41
Matching connector	FI-RE41HL

Table 4.1.1.1 CN1 Connector information

PIN #	Symbol	P/I/O	Description	Remark
1	GND	P	GND	Note4
2	GND	P	GND	--
3	GND	P	GND	--
4	DC0-	I	LVDS differential data input -	Note3
5	DC0+	I	LVDS differential data input +	Note3
6	GND	P	GND	--
7	DC1-	I	LVDS differential data input -	Note3
8	DC1+	I	LVDS differential data input +	Note3
9	GND	P	GND	--
10	DC2-	I	LVDS differential data input -	Note3
11	DC2+	I	LVDS differential data input +	Note3
12	GND	P	GND	--
13	CKC-	I	LVDS differential CLK input -	Note3
14	CKC+	I	LVDS differential CLK input +	Note3
15	GND	P	GND	--
16	DC3-	I	LVDS differential data input -	Note3
17	DC3+	I	LVDS differential data input +	Note3
18	GND	P	GND	--
19	DC4-	I	LVDS differential data input -	Note3
20	DC4+	I	LVDS differential data input +	Note3
21	GND	P	GND	--
22	DD0-	I	LVDS differential data input -	Note3
23	DD0+	I	LVDS differential data input +	Note3
24	GND	P	GND	--
25	DD1-	I	LVDS differential data input -	Note3
26	DD1+	I	LVDS differential data input +	Note3
27	GND	P	GND	--
28	DD2-	I	LVDS differential data input -	Note3
29	DD2+	I	LVDS differential data input +	Note3
30	GND	P	GND	--
31	CKD-	I	LVDS differential CLK input -	Note3
32	CKD+	I	LVDS differential CLK input +	Note3
33	GND	P	GND	--
34	DD3-	I	LVDS differential data input -	Note3

PIN #	Symbol	P/I/O	Description	Remark
35	DD3+	I	LVDS differential data input +	Note3
36	GND	P	GND	--
37	DD4-	I	LVDS differential data input -	Note3
38	DD4+	I	LVDS differential data input +	Note3
39	GND	P	GND	--
40	GND	P	GND	Note3
41	GND	P	GND	Note3

Table 4.1.1.2 CN1 Pin Assignment for LCD Interface

Note1: I/O definition: I---Input, O---Output, P---Power/Ground, N---No connection.

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

Note3: Twist pair wires with 100Ω (Characteristic impedance) should be used between LCD panel signal processing board and LVDS transmitter.

Note4: All GND and VCC terminals should be used without any non-connected lines.

4.1.2 CN2 Pin assignment

CN2 Connector Information	
LCD Module connector	MSAKS24020P51
Matching connector	FI-RE51HL

Table 4.1.2.1 CN2 Connector information

PIN #	Symbol	P/I/O	Description	Remark
1	GND	P	GND	Note4
2	GND	P	GND	--
3	GND	P	GND	--
4	DA0-	I	LVDS differential data input -	Note3
5	DA0+	I	LVDS differential data input +	Note3
6	GND	P	GND	--
7	DA1-	I	LVDS differential data input -	Note3
8	DA1+	I	LVDS differential data input +	Note3
9	GND	P	GND	--
10	DA2-	I	LVDS differential data input -	Note3
11	DA2+	I	LVDS differential data input +	Note3
12	GND	P	GND	--
13	CKA-	I	LVDS differential CLK input -	Note3
14	CKA+	I	LVDS differential CLK input +	Note3
15	GND	P	GND	--
16	DA3-	I	LVDS differential data input -	Note3
17	DA3+	I	LVDS differential data input +	Note3
18	GND	P	GND	-
19	DA4-	I	LVDS differential data input -	Note3
20	DA4+	I	LVDS differential data input +	Note3
21	GND	P	GND	--
22	DB0-	I	LVDS differential data input -	Note3

PIN #	Symbol	P/I/O	Description	Remark
23	DB0+	I	LVDS differential data input +	Note3
24	GND	P	GND	--
25	DB1-	I	LVDS differential data input -	Note3
26	DB1+	I	LVDS differential data input +	Note3
27	GND	P	GND	--
28	DB2-	I	LVDS differential data input -	Note3
29	DB2+	I	LVDS differential data input +	Note3
30	GND	P	GND	--
31	CKB-	I	LVDS differential CLK input -	Note3
32	CKB+	I	LVDS differential CLK input +	Note3
33	GND	P	GND	-
34	DB3-	I	LVDS differential data input -	Note3
35	DB3+	I	LVDS differential data input +	Note3
36	GND	P	GND	--
37	DB4-	I	LVDS differential data input -	Note3
38	DB4+	I	LVDS differential data input +	Note3
39	GND	I	GND	--
40	GND	P	GND	--
41	RSVD	/	For internal use, Keep this pin Open.	
42	RSVD	/	For internal use, Keep this pin Open.	
43	RSVD	/	For internal use, Keep this pin Open.	
44	RSVD	/	For internal use, Keep this pin Open.	
45	GND	P	GND	
46	GND	P	GND	
47	GND	P	GND	
48	RSVD	/	For internal use, Keep this pin Open.	
59	RSVD	/	For internal use, Keep this pin Open.	
50	RSVD	/	For internal use, Keep this pin Open.	
51	GND	P	GND	

Table 4.1.2.2 CN2 Pin Assignment for LCD Interface

Note1: I/O definition: I---Input, O---Output, P---Power/Ground, N---No connection.

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

Note3: Twist pair wires with 100Ω (Characteristic impedance) should be used between LCD panel signal processing board and LVDS transmitter.

Note4: All GND and VCC terminals should be used without any non-connected lines.

4.1.3 CN3 Pin assignment

CN3 Connector Information	
LCD Module connector	53261-1271
Matching connector	51021-1200

Table 4.1.3.1 CN3 Connector information

PIN #	Symbol	P/I/O	Description	Remark
1	GND	P	Signal ground	--
2	GND	P		--
3	GND	P		--
4	GND	P		--
5	GND	P		--
6	GND	P		--
7	VDD	P	Power supply	--
8	VDD	P		--
9	VDD	P		--
10	VDD	P		--
11	VDD	P		--
12	VDD	P		--

Table 4.1.3.2 CN3 Pin Assignment for LCD Interface

Note1: All VDD and GND terminals should be used without any non-connected lines.

4.2 CN201/CN202 Pin assignment (LED Driver Interface)

4.2.1 CN201 Pin assignment

CN201 Connector Information	
LCD Module connector	DF3EA-10P-2H
Matching connector	DF3-10S-2C

Table 4.2.1.1 CN201 Connector information

PIN #	Symbol	P/I/O	Description	Remark
1	GNDB	P	LED driver ground	--
2	GNDB	P		--
3	GNDB	P		--
4	GNDB	P		--
5	GNDB	P		--
6	VDDDB	P	Power supply	--
7	VDDDB	P		--
8	VDDDB	P		--
9	VDDDB	P		--
10	VDDDB	P		--

Table 4.2.1.2 CN201 Pin Assignment for LCD Interface

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

4.2.2 CN202 Pin assignment

CN202 Connector Information	
LCD Module connector	53261-0971
Matching connector	51021-0900

Table 4.2.2.1 CN202 Connector information

PIN #	Symbol	P/I/O	Description	Remark
1	PWSEL	I	Selection of luminance control signal method	--
2	GNDB	P	LED driver ground	--
3	BRTP	I	BRTP signal	--
4	BRTI	I	Luminance control terminal	--
5	BRTH	I		--
6	BRTC	I	Backlight ON/OFF control signal	--
7	N. C.	/	-	--
8	GNDB	P	LED driver ground	--
9	GNDB	P		--

Table 4.2.2.2 CN202 Pin Assignment for LCD Interface

Note1: I/O definition: I---Input, O---Output, P---Power/Ground, N---No connection.

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

Note3: When VDDB is 0V or BRTC is Low, PWSEL must be set to Low or Open.

Note4: All GNDB terminals should be used without any non-connected lines.

4.3 Positions of socket

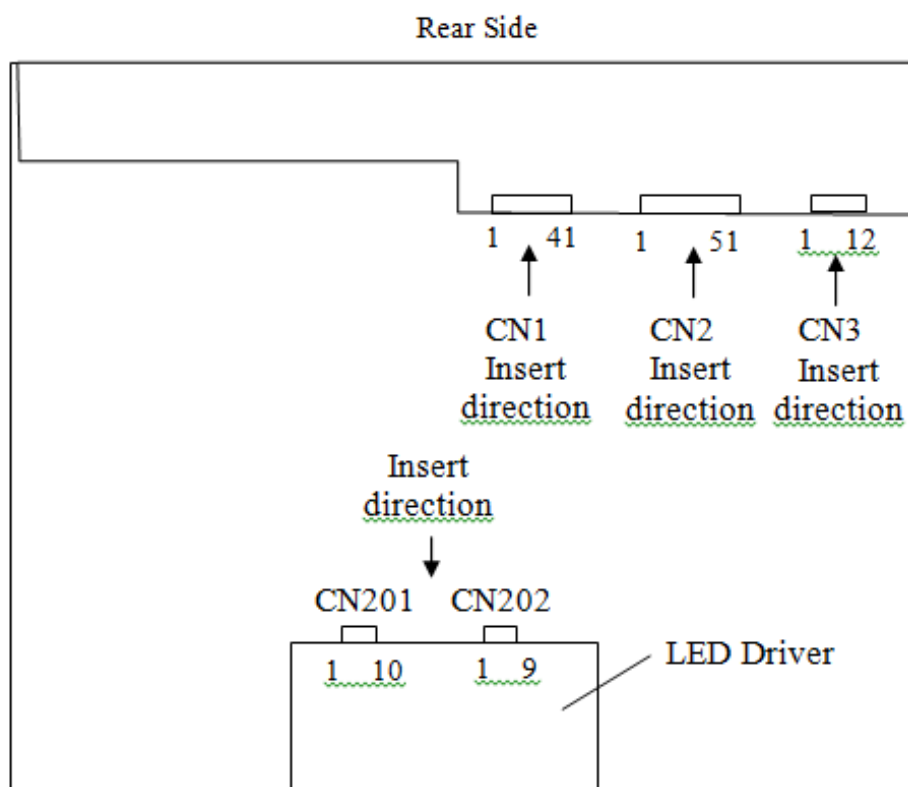


Figure 4.3.1 Position of socket

Note1: The definition of 1st pin for CN201 and CN202 are different from datasheet of connector.

5. Absolute Maximum Ratings

GND=0V

Parameter			Symbol	Rating	Unit	Remarks
Power supply voltage	LCD panel signal processing board		VDD	-0.3 to +15.0	V	Ta= 25℃
	LED driver		VDDDB	-0.3 to +28.0	V	
Input voltage for signals	LCD panel signal processing board Note1		Vi	-0.3 to +2.8	V	VDD= 12.0V Ta= 25℃
	LED driver	BRTI signal	VBI	-0.3 to +1.5	V	VDDDB= 24.0V Ta= 25℃
		BRTP signal	VBP	-0.3 to +5.5	V	
		BRTC signal	VBC	-0.3 to +5.5	V	
		PWSEL signal	VBS	-0.3 to +5.5	V	
Storage temperature			Tst	-20 to +60	℃	-
Operating temperature		Center of front surface	TopF	0 to +60	℃	Note2
		Edge of front surface	TopF	0 to +65	℃	Note2
		Edge of rear surface	TopR	0 to +70	℃	Note3
Relative humidity Note4, Note6			RH	≤ 95	%	Ta ≤ 40℃
				≤ 85	%	40℃ < Ta ≤ 50℃
				≤ 55	%	50℃ < Ta ≤ 60℃
Absolute humidity Note4, Note6			AH	≤ 70 Note5	g/m ³	Ta > 60℃
Operating altitude			-	≤ 5,100	m	0℃ ≤ Ta ≤ 60℃
Storage altitude			-	≤ 13,600	m	-20℃ ≤ Ta ≤ 60℃

Table 5.1 Absolute Maximum Ratings

Note1: DA0+/-, DA1+/-, DA2+/-, DA3+/-, DA4+/-, CKA+/-, DB0+/-, DB1+/-, DB2+/-, DB3+/-, DB4+/-, CKB+/-, DC0+/-, DC1+/-, DC2+/-, DC3+/-, DC4+/-, CKC+/-, DD0+/-, DD1+/-, DD2+/-, DD3+/-, DD4+/-, CKD+/-.

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= 60°C and RH= 55%.

Note6: Rapid change of humidity and temperature may cause degradation of the image quality.

6. Electrical Characteristics

6.1 DC Characteristics for Panel Driving

(Ta=25°C)

Parameter		Symbol	min.	typ.	max.	Unit	Remarks
Power supply voltage		VDD	10.8	12.0	13.2	V	-
Power supply current		IDD	-	TBD Note1	TBD Note2	mA	at VDD= 12.0V
Permissible ripple voltage		VRP	-	-	200	mVp-p	for VDD Note3,4,5
Differential input threshold voltage	High	VTH	-	-	+100	mV	at VCM= 1.2V Note6,7
	Low	VTL	-100	-	-	mV	
Input voltage swing		VI	0	-	2.4	V	Note7
Terminating resistance		RT	-	100	-	Ω	-

Table 6.1.1 Operating Voltages

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 driver.

Note7: DA0+/-, DA1+/-, DA2+/-, DA3+/-, DA4+/-, CKA+/-, DB0+/-, DB1+/-, DB2+/-, DB3+/-, DB4+/-, CKB+/-, DC0+/-, DC1+/-, DC2+/-, DC3+/-, DC4+/-, CKC+/-, DD0+/-, DD1+/-, DD2+/-, DD3+/-, DD4+/-, CKD+/-.

6.2 DC Characteristics for Backlight Driving

(Ta=25°C)

Parameter			Symbol	min.	typ.	max.	Unit	Remarks
Power supply voltage			VDDB	22.8	24.0	25.2	V	Note1
Power supply current			IDDB	-	TBD	TBD Note2	mA	VDDB= 24.0V, At the maximum luminance control
Permissible ripple voltage			VRPB	-	-	200	mVp-p	for VDDB Note3, 4, 5
Input voltage for signals	BRTI signal		VBI	0	-	1.0	V	-
	BRTP signal	High	VBPH	2.0	-	5.25	V	
		Low	VBPL	0	-	0.8	V	
	BRTC signal	High	VBCH	2.0	-	5.25	V	
		Low	VBCL	0	-	0.8	V	
	PWSEL signal	High	VBSH	2.0	-	5.25	V	
		Low	VBSL	0	-	0.8	V	
Input current for signals	BRTI signal		IBI	-200	-	-50	μA	
	BRTP signal	High	IBPH	-	-	1,000	μA	
		Low	IBPL	-600	-	-	μA	
	BRTC signal	High	IBCH	-	-	300	μA	
		Low	IBCL	-300	-	-	μA	
	PWSEL signal	High	IPSH	-	-	1,000	μA	
		Low	IPSL	-600	-	-	μA	
LED life time			-	-	50000	-	Hrs	Note6

Table 6.2.1 LED Backlight Characteristics

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 (VDDB and GNDB) 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: Optical performance should be evaluated at Ta=25°C. 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.

6.3 Luminance Control

6.3.1 Luminance control methods

(Ta= 25°C)

Method	Adjustment and luminance ratio	PWSEL terminal	B RTP terminal						
Variable resistor control Note1	• Adjustment The variable resistor (R) for luminance control should be 10kΩ ±5%, 1/10W. Minimum point of the resistance is the minimum luminance and maximum point of the resistance is the maximum luminance. The resistor (R) must be connected between B RTH-B RTI terminals.  • Luminance ratio Note3 <table><tr><th>Resistance</th><th>Luminance ratio</th></tr><tr><td>720Ω</td><td>10% (typ.)</td></tr><tr><td>10kΩ</td><td>100%</td></tr></table>	Resistance	Luminance ratio	720Ω	10% (typ.)	10kΩ	100%	High or Open	Open
Resistance	Luminance ratio								
720Ω	10% (typ.)								
10kΩ	100%								
Voltage control Note1	• Adjustment Voltage control method works, when B RTH terminal is 0V and VBI voltage is input between B RTI-B RTH terminals. This control method can carry out continuation adjustment of luminance. Luminance is the maximum when B RTI terminal is Open. • Luminance ratio Note3 <table><tr><th>B RTI Voltage (VBI)</th><th>Luminance ratio</th></tr><tr><td>0.085V</td><td>10% (typ.)</td></tr><tr><td>1.0V</td><td>100%</td></tr></table>	B RTI Voltage (VBI)	Luminance ratio	0.085V	10% (typ.)	1.0V	100%		
B RTI Voltage (VBI)	Luminance ratio								
0.085V	10% (typ.)								
1.0V	100%								
Pulse width modulation (PWM) Note1 Note2 Note4	• Adjustment Pulse width modulation (PWM) method works, when PWSEL terminal is Low and PWM signal (B RTP signal) is input into B RTP terminal. The luminance is controlled by duty ratio of B RTP signal. Keep B RTI and B RTH terminals Open when using PWM method. • Luminance ratio Note3 <table><tr><th>Duty ratio</th><th>Luminance ratio</th></tr><tr><td>5%</td><td>5% (typ.)</td></tr><tr><td>100%</td><td>100%</td></tr></table>	Duty ratio	Luminance ratio	5%	5% (typ.)	100%	100%	Low	B RTP signal
Duty ratio	Luminance ratio								
5%	5% (typ.)								
100%	100%								

Table 6.3.1.1 Luminance control methods

Note1: In case of the variable resistor control method and the voltage control method, noises may appear on the display image depending on the input signals timing for LCD panel signal processing board.

Use Pulse width modulation (PWM) method, if interference noises appear on the display image!

Note2: The LED driver will stop working, if the Low period of B RTP signal is more than 50ms while B RTC signal is High or Open. Then the backlight will not turn on anymore, even if B RTP signal is input again. This is not out of order. The LED driver will start to work when power is supplied again.

Note3: These data are the target values.

Note4: See "6.3.2 Detail of B RTP timing".

6.3.2 Detail of B RTP timing

(1) Timing diagrams

- Outline chart

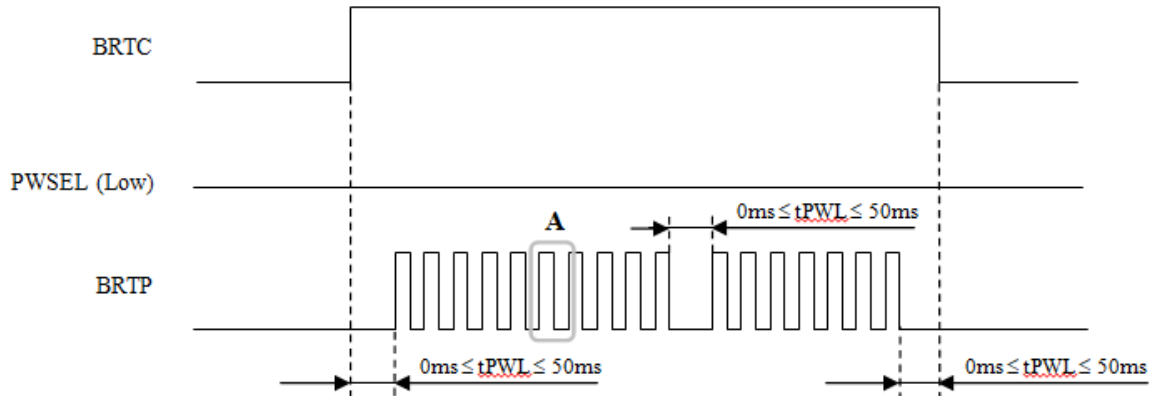


Figure 6.3.2.1 Outline chart

- Detail of A part

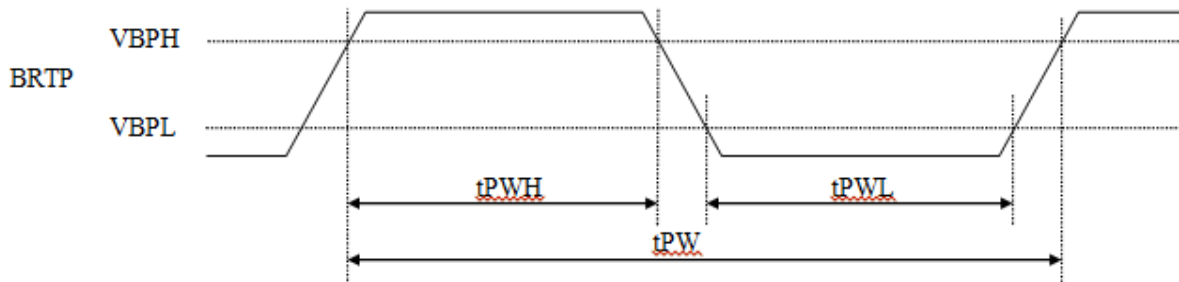


Figure 6.3.2.2 Detail of A part

(2) Each parameter

Parameter	Symbol	min.	typ.	max.	Unit	Remarks
PWM frequency	f_{PWM}	185	-	20k	Hz	Note1,2,3
PWM duty ratio	DR_{PWM}	(5)	-	100	%	Note4,5
PWM pulse width	t_{PWH}	10	-	-	μs	Note1,4,5

Table 6.3.2.1 Each parameter

Note1: Definition of parameters is as follows.

$$f_{PWM} = \frac{1}{t_{PW}}, \quad DR_{PWM} = \frac{t_{PWH}}{t_{PW}}$$

Note2: A recommended f_{PWM} value is as follows.

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

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

Note3: Depending on the frequency used, a noise may appear on the screen, please conduct a thorough evaluation.

Note4: While the BRTC signal is high, do not set the tPWH (PWM pulse width) is less than the minimum values. It may cause abnormal working of the backlight. In this case, turn the backlight off and then on again by BRTC signal.

Note5: Regardless of the PWM frequency, both PWM duty ratio and PWM pulse width must be always more than the minimum values.

7. Interface Timing Characteristics

7.1 Method of Connection for LVDS Transmitter

	Bit mapping	Transmitter Pin Assignment		Output Connector		CN1	
		THine THC63LVD1023B				Pin No.	Signal name
Pixel data A	LA4	R14		ATA- ATA+	Note1 → →		
	LA5	R15					
	LA6	R16				4	DA0-
	LA7	R17				5	DA0+
	LA8	R18					
	LA9	R19					
	CA4	G14		ATB- ATB+	→ →		
	CA5	G15					
	CA6	G16					
	CA7	G17				7	DA1-
	CA8	G18				8	DA1+
	CA9	G19					
	RA4	B14		ATC- ATC+	→ →		
	RA5	B15					
	RA6	B16					
	RA7	B17					
	RA8	B18				10	DA2-
	RA9	B19				11	DA2+
	Hsync	HSYNC		ATD- ATD+	→ →		
	Vsync	VSYNC					
	DE	DE					
	LA2	R12					
	LA3	R13				16	DA3-
	CA2	G12				17	DA3+
	CA3	G13		ATE- ATE+	→ →		
	RA2	B12					
	RA3	B13					
	N.C.	-					
	LA0	R10					
	LA1	R11					
	CA0	G10		ATCLK- ATCLK+	→ →	19	DA4-
	CA1	G11				20	DA4+
	RA0	B10					
	RA1	B11					
N.C.	-						
CLK	CLK						13
Pixel data B	LB4	R24		BTA- BTA+	→ →	14	CKA+
	LB5	R25					
	LB6	R26					
	LB7	R27				22	DB0-
	LB8	R28				23	DB0+
	LB9	R29					
	CB4	G24		BTB- BTB+	→ →		
	CB5	G25					
	CB6	G26					
	CB7	G27				25	DB1-
	CB8	G28				26	DB1+
	CB9	G29					
	RB4	B24		BTC- BTC+	→ →		
	RB5	B25					
	RB6	B26					
	RB7	B27					
	RB8	B28				28	DB2-
	RB9	B29				29	DB2+
	Hsync	HSYNC		BTD- BTD+	→ →		
	Vsync	VSYNC					
	DE	DE					
	LB2	R22					
	LB3	R23				34	DB3-
	CB2	G22				35	DB3+
	CB3	G23		BTE- BTE+	→ →		
	RB2	B22					
	RB3	B23					
	N.C.	-					
	LB0	R20					
	LB1	R21					
	CB0	G20		BTCLK- BTCLK+	→ →	37	DB4-
	CB1	G21				38	DB4+
	RB0	B20					
	RB1	B21					
N.C.	-						
CLK	CLK						31
					32	CKB+	

Note1: Twist pair wires with 100Ω (Characteristic impedance) should be used between LCD panel signal processing board and LVDS transmitter.

Industrial Display Module

	Bit mapping	Transmitter Pin Assignment		Output Connector		CN2	
		THine THC63LVD1023B				Pin No.	Signal name
Pixel data C	LC4	R14	CTA- CTA+	Note1 → →			
	LC5	R15					
	LC6	R16			4	DC0-	
	LC7	R17			5	DC0+	
	LC8	R18					
	LC9	R19					
	CC4	G14	CTB- CTB+	→ →			
	CC5	G15					
	CC6	G16					
	CC7	G17			7	DC1-	
	CC8	G18			8	DC1+	
	CC9	G19					
	RC4	B14	CTC- CTC+	→ →			
	RC5	B15					
	RC6	B16					
	RC7	B17					
	RC8	B18			10	DC2-	
	RC9	B19			11	DC2+	
	Hsync	HSYNC					
	Vsync	VSYNC					
	DE	DE					
	LC2	R12	CTD- CTD+	→ →			
	LC3	R13					
	CC2	G12			16	DC3-	
	CC3	G13			17	DC3+	
	RC2	B12					
	RC3	B13					
	N.C.	-	CTE- CTE+	→ →			
	LC0	R10					
	LC1	R11					
	CC0	G10			19	DC4-	
	CC1	G11			20	DC4+	
RC0	B10						
RC1	B11	CTCLK- CTCLK+	→ →				
N.C.	-						
CLK	CLK			13	CKC-		
				14	CKC+		
Pixel data D	LD4	R24	DTA- DTA+	→ →			
	LD5	R25					
	LD6	R26			22	DD0-	
	LD7	R27			23	DD0+	
	LD8	R28					
	LD9	R29					
	CD4	G24	DTB- DTB+	→ →			
	CD5	G25					
	CD6	G26					
	CD7	G27			25	DD1-	
	CD8	G28			26	DD1+	
	CD9	G29					
	RD2	B24	DTC- DTC+	→ →			
	RD3	B25					
	RD6	B26					
	RD7	B27					
	RD8	B28			28	DD2-	
	RD9	B29			29	DD2+	
	Hsync	HSYNC					
	Vsync	VSYNC					
	DE	DE					
	LD2	R22	DTD- DTD+	→ →			
	LD3	R23					
	CD2	G22			34	DD3-	
	CD3	G23			35	DD3+	
	RD2	B22					
	RD3	B23					
	N.C.	-	DTE- DTE+	→ →			
	LD0	R20					
	LD1	R21					
	CD0	G20			37	DD4-	
	CD1	G21			38	DD4+	
RD0	B20						
RD1	B21	DTCLK- DTCLK+	→ →				
N.C.	-						
CLK	CLK			31	CKD-		
				32	CKD+		

Note1: Twist pair wires with 100Ω (Characteristic impedance) should be used between LCD panel signal processing board and LVDS transmitter.

7.2 Timing Characteristics

Parameter			Symbol	min.	typ.	max.	Unit	Remarks
CLK	Frequency		1/ tc	68.27	72.94	74.69	MHz	13.71ns (typ.)
	Duty ratio		-	See the data sheet of LVDS transmitter.			-	-
	Rise time, Fall time		-				ns	-
DATA	CLK-DAT A	Setup time	-				ns	-
		Hold time	-	ns	-			
	Rise time, Fall time		-	ns	-			
DE	Horizontal	Cycle	th	-	9.570	-	μs	104.5kHz (typ.)
				684	698	1009	CLK	
		Display period	thd	640			CLK	-
		Vertical (One frame)	Cycle	tv	-	20	-	ms
				2086	2,090	2317	H	
		Display period	tvd	2,064			H	-
		CLK-DE	Setup time	-	See the data sheet of LVDS transmitter.			ns
			Hold time	-				ns
Rise time, Fall time		-	ns	-				

Table 7.2.1 Timing characteristics

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).

Note4: Definition for landscape.

7.3 Input Signal Timing Chart

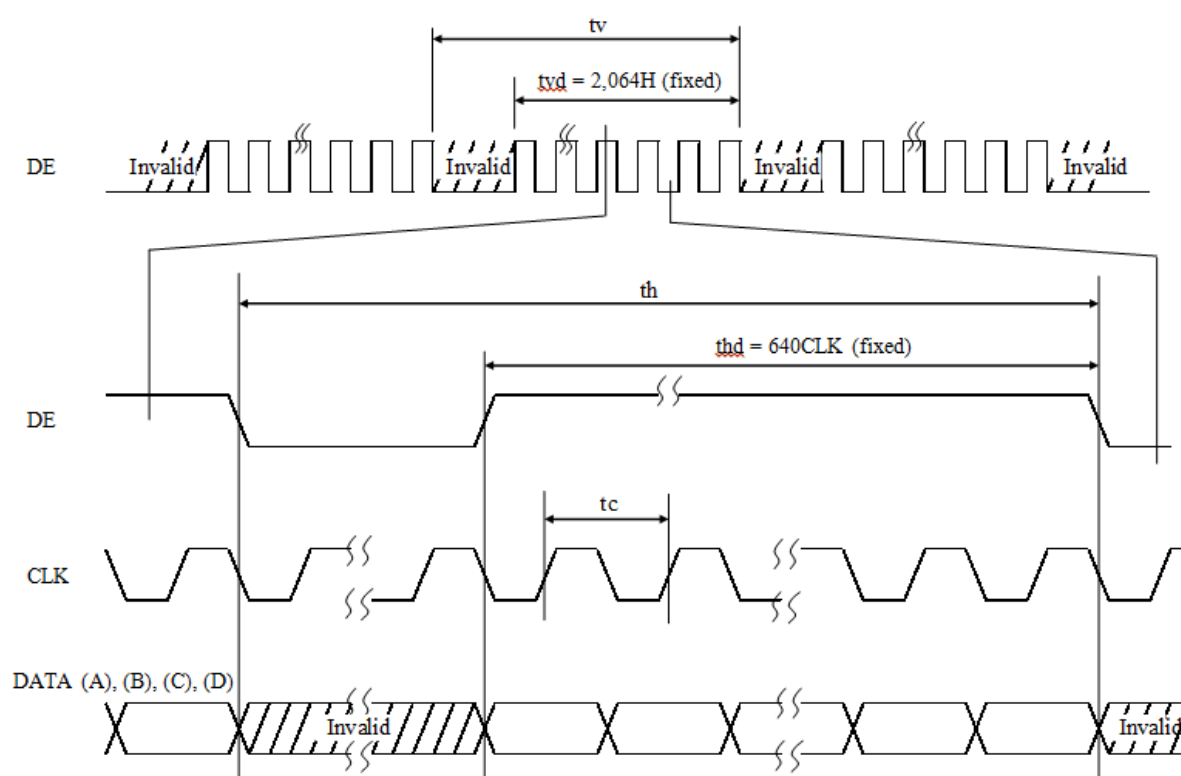


Figure 7.3.1 Input signal timing chart

7.4 Input Data Mapping

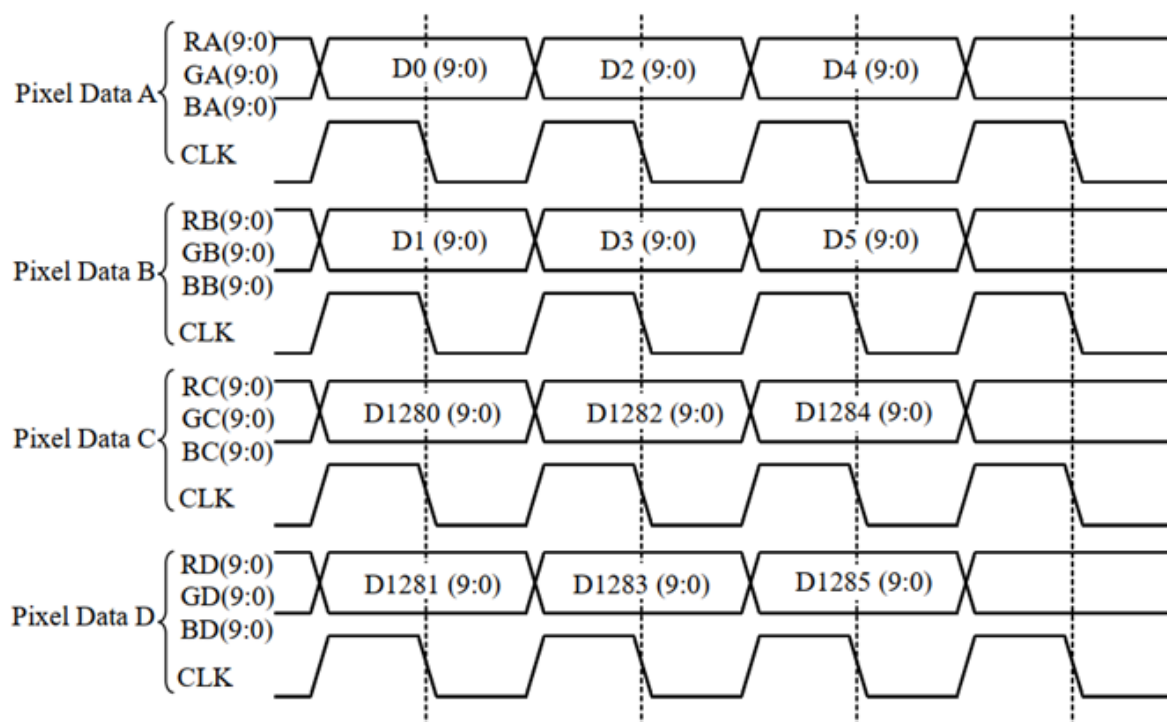
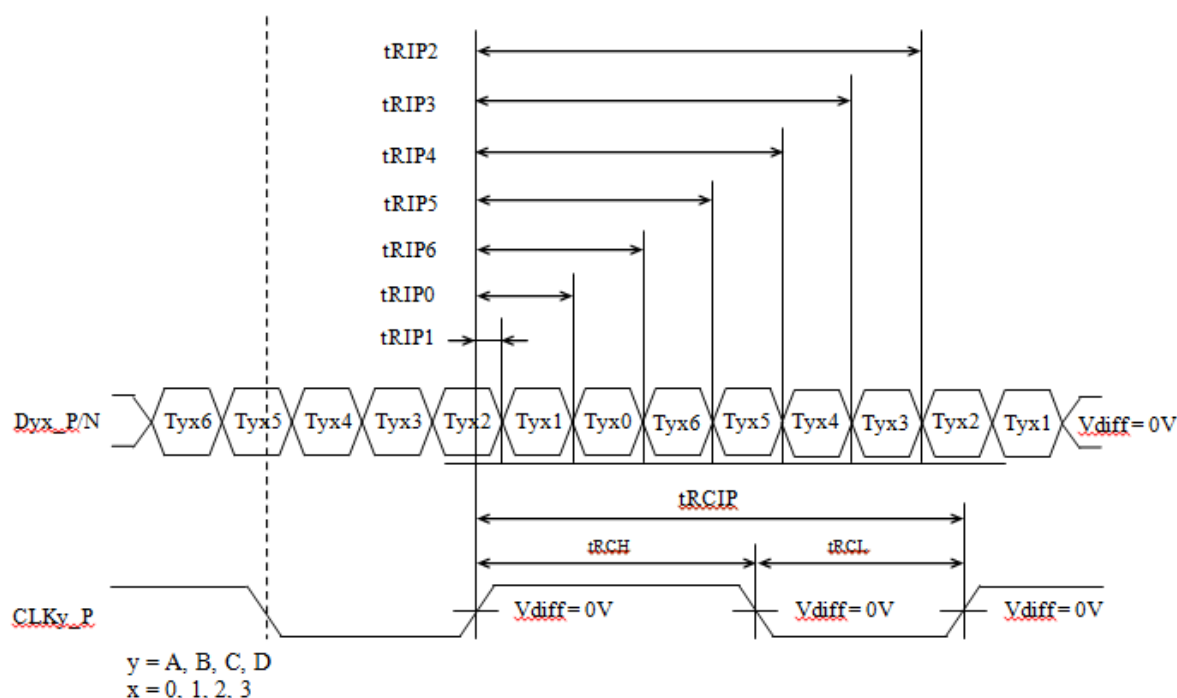


Figure 7.4.1 LVDS data transmission method

Note1: Definition for landscape.

7.5 LVDS Rx AC SPEC

Symbol	Parameter	min.	typ.	max.	Unit
t_{RCIP}	CKy_+ Period	13.39	-	14.64	ns
t_{RCIH}	CKy_+ High pulse width	-	$\frac{4}{7}t_{RCIP}$	-	ns
t_{RCIL}	CKy_+ Low pulse width	-	$\frac{3}{7}t_{RCIP}$	-	ns
t_{RMG}	Receiver Data Input Margin CLK=72.94MHz	(-0.5)	-	(0.5)	ns
t_{RIP1}	Input Data Position 0	$- t_{RMG} $	0.0	$+ t_{RMG} $	ns
t_{RIP0}	Input Data Position 1	$\frac{t_{RCIP}}{7} - t_{RMG} $	$\frac{t_{RCIP}}{7}$	$\frac{t_{RCIP}}{7} + t_{RMG} $	ns
t_{RIP6}	Input Data Position 2	$2\frac{t_{RCIP}}{7} - t_{RMG} $	$2\frac{t_{RCIP}}{7}$	$2\frac{t_{RCIP}}{7} + t_{RMG} $	ns
t_{RIP5}	Input Data Position 3	$3\frac{t_{RCIP}}{7} - t_{RMG} $	$3\frac{t_{RCIP}}{7}$	$3\frac{t_{RCIP}}{7} + t_{RMG} $	ns
t_{RIP4}	Input Data Position 4	$4\frac{t_{RCIP}}{7} - t_{RMG} $	$4\frac{t_{RCIP}}{7}$	$4\frac{t_{RCIP}}{7} + t_{RMG} $	ns
t_{RIP3}	Input Data Position 5	$5\frac{t_{RCIP}}{7} - t_{RMG} $	$5\frac{t_{RCIP}}{7}$	$5\frac{t_{RCIP}}{7} + t_{RMG} $	ns
t_{RIP2}	Input Data Position 6	$6\frac{t_{RCIP}}{7} - t_{RMG} $	$6\frac{t_{RCIP}}{7}$	$6\frac{t_{RCIP}}{7} + t_{RMG} $	ns



7.6 Power On/Off Sequence

7.6.1 LCD panel signal processing board

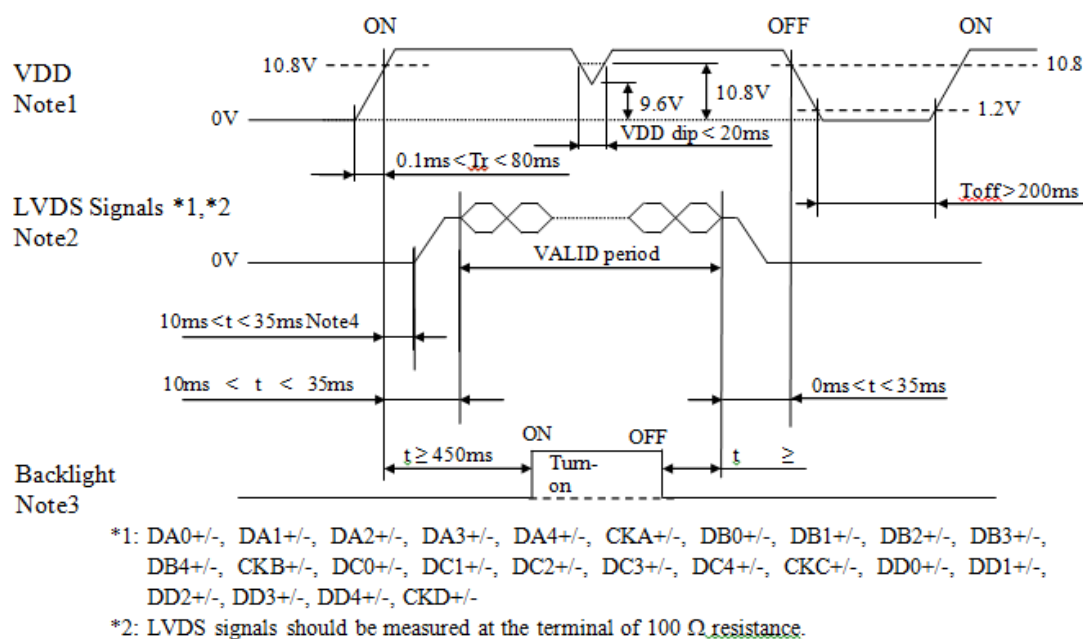


Figure 7.6.1.1 LCD panel signal processing board

Note1: If there is a voltage variation (voltage drop) at the rising edge of VDD below 10.8V, there is a possibility that a product does not work due to a protection circuit.

Note2: LVDS signals 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 signals 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, VDD also must be shut down.

Note3: The backlight should be turned on within the turn-on period, in order to avoid unstable data display.

Note4: After turning VDD on, terminal voltages on LVDS input terminals (*1) will rise. This is caused by initial operation of the product.

7.6.2 LED Driver

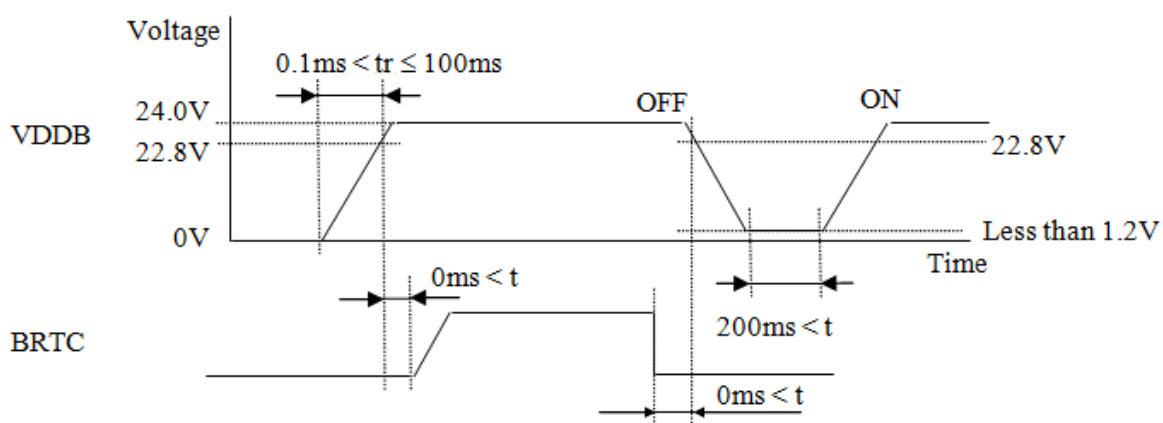


Figure 6.4.2.1 LED driver

Note1: If tr is more than 100ms, the backlight will be turned off by a protection circuit for LED driver.

Note2: When VDDB is 0V or BRTC is Low, PWSEL must be set to Low or Open.

8. Optical Characteristics

Item		Symbol	Condition	Min	Typ	Max	Unit	Remark
View Angles		θT	CR ≥ 10	70	88	--	degree	Note2,3
		θB		70	88	--		
		θL		70	88	--		
		θR		70	88	--		
Contrast Ratio		CR	θ=0°	1400	2200	--		Note 3
Response Time		T _{ON}	25℃	--	25	40	ms	Note 4
		T _{OFF}						
Chromaticity	White	x	CIE1931-XY Z	0.264	0.294	0.324		Note 1,5
		y		0.279	0.309	0.339		
	Red	x		0.620	0.650	0.680		Note 1,5
		y		0.304	0.334	0.364		
	Green	x		0.281	0.311	0.341		Note 1,5
		y		0.588	0.618	0.648		
	Blue	x		0.122	0.152	0.183		Note 1,5
		y		0.035	0.065	0.095		
Uniformity		U		80	--	--	%	Note 6
NTSC		-		65	72	--	%	Note 5
Luminance		L		(1000)	1250	--	cd/m ²	Note 7

Table 8.1 Optical Parameters

Test Conditions:

- These are initial characteristics.
- Measurement conditions are as follows.
Ta= 25°C, VDD= 12.0V, VDDB= 24.0V, PWM duty ratio: 100%,
Display mode: QSXGA, Horizontal cycle= 1/104.5kHz, Vertical cycle= 1/50.0Hz

Note1: Definition of optical measurement system.

The optical characteristics should be measured in dark room. After 5 Minutes operation, the optical characteristics are measured at the center point of the LCD screen.

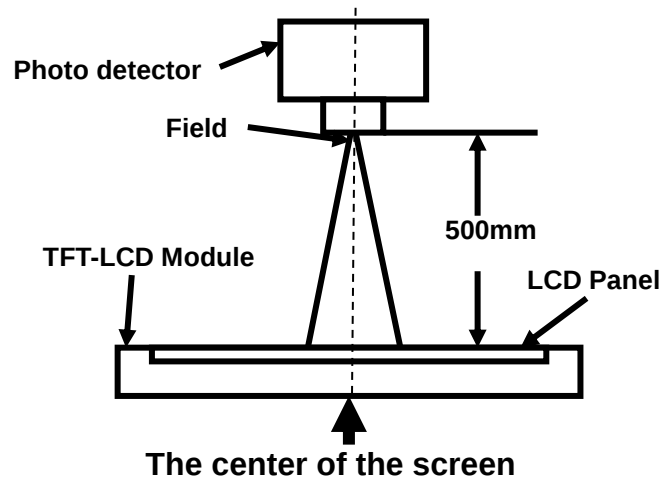


Fig1.Measurement Set Up

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

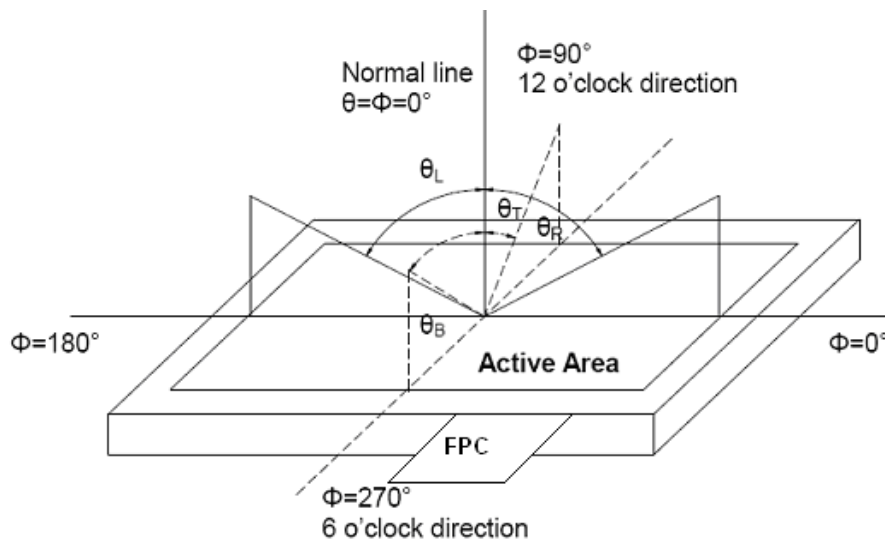


Fig2. Measurement viewing angle

Note3: Definition of contrast ratio

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD is on the "White" state}}{\text{Luminance measured when LCD is on the "Black" state}}$$

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%.

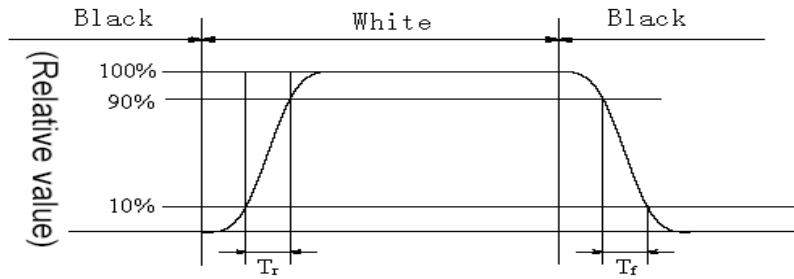


Fig3. Response Time Testing(SFT)

Note5: Definition of color chromaticity (CIE1931)

Color coordinates measured at center point of LCD.

Note6: Definition of Luminance Uniformity

Active area is divided into 9 measuring areas (Refer Fig.5). Every measuring point is placed at the center of each measuring area.

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

L_{max} : The measured Maximum luminance of all measurement position.

L_{min} : The measured Minimum luminance of all measurement position.

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

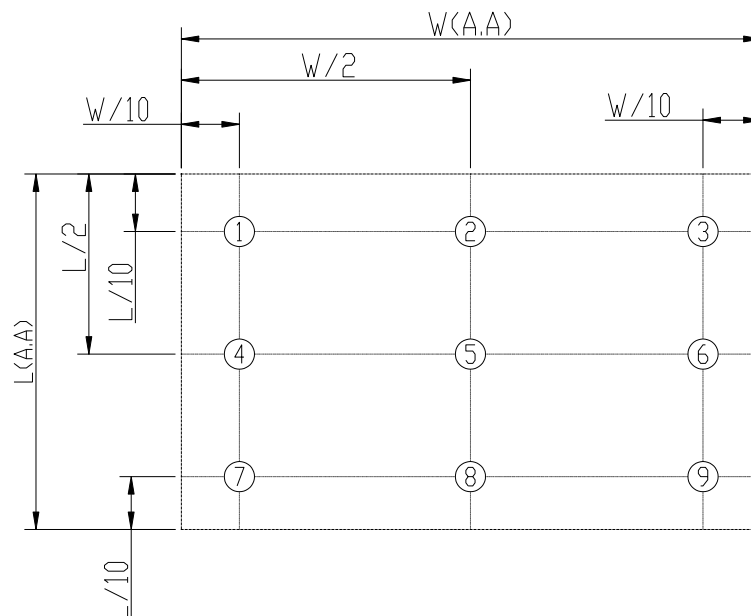


Fig4. Luminance Uniformity Measurement Locations(9 points)

Note7: Definition of Luminance:

Measure the luminance of white state at center point.

9. Reliability Test

No	Test Item	Test condition	Criterion
1	High Temperature Operation	Ta = +60℃, 240 hours	IEC60068-2-2,GB2423.2
2	Low Temperature Operation	Ta = -10℃, 240 hours	IEC60068-2-1,GB2423.1
3	High Temperature and Humidity(operational)	Ta = +60℃, 60% RH max,240hours	IEC60068-2-2,GB2423.2
4	Thermal Shock (non-operational)	-0℃ 30 min~+60℃ 30 min, Change time:5min, 100 Cycle	IEC60068-2-1,GB2423.1
5	Heat cycle (Operation)	-0℃1hour~60℃1hour 50cycles, 4 hours/cycle	IEC60068-2-78,GB/T2423.3
6	ESD (operational)	C=150pF, R=330Ω , 9points/panel Air:±15KV, 25times; Contact:±8KV, 25 times; (Environment: 15℃ ~ 35℃, 30% ~ 60%, 86Kpa ~ 106Kpa)	IEC61000-4-2
7	Vibration(non-operational)	5~100HZ , 11.76m/s2 1min/cycle 10times Per X\Y\Z	
8	Mechanical Shock (non-operational)	294m/s2, 11ms 3times ±X、±Y、±Z	
9	Package Vibration	Frequency range: 5~20-200Hz, PSD:0.01-0.01-0.001 Total:0.781g2/Hz, Time: X/Y/Z 30min for each direction	GB/T 4857.23-2012
10	Package Drop Test	整箱重≤10Kg, Height:80cm; 整箱重 > 10Kg,, Height:60cm; 1corner,3edges,6surfaces	GB/T 4857.5-1992

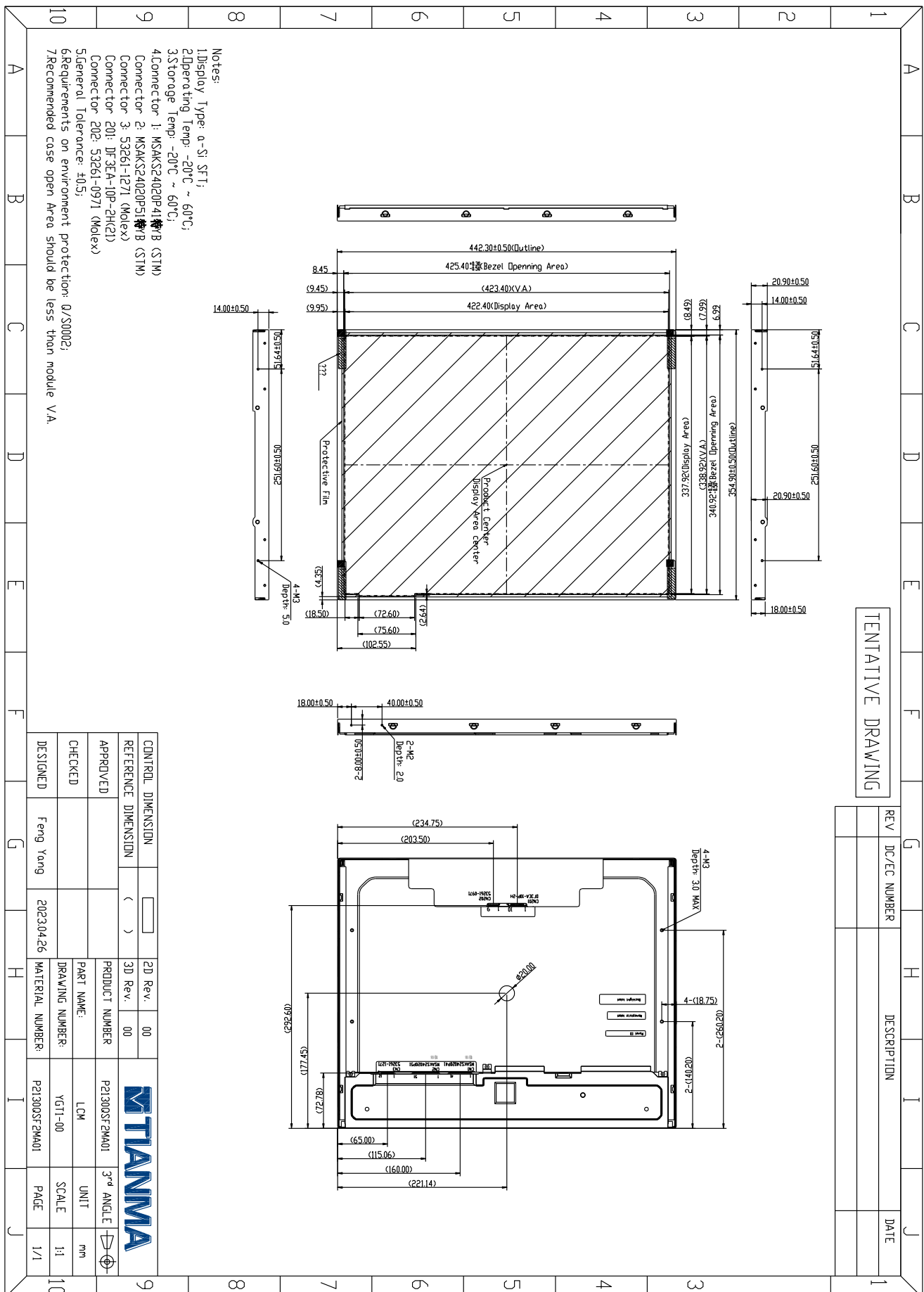
Table 9.1 RA test condition

Note1: Temperature is the ambient temperature of sample

Note2: Before cosmetic and function test, the product must have enough recovery time, at least 24 hours 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.

10. Mechanical Drawing



11. 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.

No	Item	Model (Material)	Dimensions(mm)	Unit Weight(Kg)	Quantity	Remark
1	LCM module	P2130QSF2MA01	442.3x354.9x20.9	TBD	5	
2	Partition board	Corrugated paper	460x378	0.075	2	
3	Anti-static Bag	LD-PE	500x460	0.022	5	
4	EPP-Bottom	EPP	597×410×190	0.34	1	
5	EPP-Top	EPP	410x185x110	0.064	2	
6	Carton-inside	Corrugated paper	612x425x520	1.65	1	
7	Barcode Label	Paper	100x52	0.001	2	
8	Vacuum bag	PE	1200x1000x0.12	0.5	1	
9	Drier	硅胶	110x70	0.03	2	
10	Total weight	TBD ±10% kg				

11.1 Inner Packing Box

5 products are packed as the maximum in an packing box (See "11.1 Outline Figure for Packing").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 11.1 Outline Figure for Packing

12. Precautions for Use of LCD Modules

12.1 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.

12.2 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.

12.3 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.

12.4 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

12.5 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 carefully to limit or stop its function when over current is detected on the LED.