MODEL NO : P2130QXF1MA00

SPEC VERSION : V1.2

ISSUED DATE: 2024-5-30

■**Preliminary Specification**

□**Final Product Specification**

Customer :

Approved by	Notes

TIANMA Confirmed :

Prepared by	Checked by	Approved by
Zhou Jie	Zhu Guanchen	Zhu Guanchen

This technical specification is subjected to change without notice

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Record of Revision

Rev	Issued Date	Description	Editor
1.0	2023-11-14	Preliminary Specification Released.	Zhou Jie
1.1	2024-3-13	P4: Response time Ton+Toff 35Typ. => 25 Typ. P27: View Angles Min. 70° => Min. 85° Response Time Typ. 35ms, Max. 45ms => Typ. 25ms, Max. 40ms Chromaticity tolerance ±0.5 => ±0.3 Luminance Min. 720 => 800	Zhou Jie
1.2	2024-5-30	P27: Update chromaticity red, green and blue.	Zhou Jie

1 General Specifications

Feature		Spec
Display Spec.	Size (inch)	21.3
	Resolution	1536(RGB)*2048
	Technology Type	SFT
	Pixel Configuration	RGB vertical stripe
	Pixel Pitch (mm)	0.2115 x 0.2115
	Display Mode	Transmissive, Normally Black
	Polarizer pencil-hardness	3H (min.) [by JIS K5600]
	Surface Treatment (Up Polarizer)	Antiglare
Optical Characteristics	Luminance (cd/m2)	900 Typ.
	Contrast ratio	2000:1 Typ.
	Response time Ton+Toff (ms)	25 Typ.
	Viewing angle R/L/U/D (Degree)	89/89/89/89 Typ. At the contrast ratio ≥ 10:1
Mechanical Characteristics	LCM (W x H x D) (mm)	336.1 x 453.0 x 10.5 Typ.
	Active Area (mm)	324.864 x 433.152
	With /Without TSP	Without TSP
	Weight (g)	1930g Typ.
	Backlight LED replacement	Not Available
Electrical Characteristics	Interface	4port LVDS, 10bit
	Power supply voltage (V)	LCD panel: 12.0 Typ.
		Backlight: 24.0 Typ.
	Color Depth	1,024 gray scales per 1 sub-pixel (10-bit), (3,072 gray scales per 1 pixel)
	Backlight LED driver	Build in
	Power consumption (W)	48.6 W (typ.) At checkered flag pattern, the maximum luminance control

Note 1 : Requirements on Environmental Protection: Q/S0002

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

2 Input/Output Terminals

2.1 TFT LCD Panel

CN1 socket (LCD module side): FI-RE51S-HF (Japan Aviation Electronics Industry Limited (JAE))
Adaptable plug: FI-RE51HL (Japan Aviation Electronics Industry Limited (JAE))

Pin No.	Symbol	Signal	Remarks
1	GND	Ground	Note1
2	GND	Ground	
3	GND	Ground	
4	DA0-	Pixel data A0	LVDS differential data input Note2
5	DA0+		
6	GND	Ground	Note1
7	DA1-	Pixel data A1	LVDS differential data input Note2
8	DA1+		
9	GND	Ground	Note1
10	DA2-	Pixel data A2	LVDS differential data input Note2
11	DA2+		
12	GND	Ground	Note1
13	CKA-	Pixel clock A	LVDS differential data input Note2
14	CKA+		
15	GND	Ground	Note1
16	DA3-	Pixel data A3	LVDS differential data input Note2
17	DA3+		
18	GND	Ground	Note1
19	DA4-	Pixel data A4	LVDS differential data input Note2
20	DA4+		
21	GND	Ground	Note1
22	DB0-	Pixel data B0	LVDS differential data input Note2
23	DB0+		
24	GND	Ground	Note1
25	DB1-	Pixel data B1	LVDS differential data input Note2
26	DB1+		
27	GND	Ground	Note1
28	DB2-	Pixel data B2	LVDS differential data input Note2
29	DB2+		
30	GND	Ground	Note1
31	CKB-	Pixel clock B	LVDS differential data input Note2
32	CKB+		
33	GND	Ground	Note1
34	DB3-	Pixel data B3	LVDS differential data input Note2
35	DB3+		
36	GND	Ground	Note1
37	DB4-	Pixel data B4	LVDS differential data input Note2
38	DB4+		
39	GND	Ground	Note1

Pin No.	Symbol	Signal	Remarks
40	GND	Ground	Note1
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	Ground	Note1
46	GND	Ground	Note1
47	GND	Ground	Note1
48	RSVD	-	For internal use, Keep this pin Open.
49	RSVD	-	For internal use, Keep this pin Open.
50	RSVD	-	For internal use, Keep this pin Open.
51	GND	Ground	Note1

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

Note2: Twist pair wires with 100Ω (Characteristic impedance) should be used between LCD panel signal processing board and LVDS transmitter.

CN2 socket (LCD module side): FI-RE41S-HF (Japan Aviation Electronics Industry Limited (JAE))
Adaptable plug: FI-RE41HL (Japan Aviation Electronics Industry Limited (JAE))

Pin No.	Symbol	Signal	Remarks
1	GND	Ground	Note1
2	GND	Ground	
3	GND	Ground	
4	DC0-	Pixel data C0	LVDS differential data input Note2
5	DC0+		
6	GND	Ground	Note1
7	DC1-	Pixel data C1	LVDS differential data input Note2
8	DC1+		
9	GND	Ground	Note1
10	DC2-	Pixel data C2	LVDS differential data input Note2
11	DC2+		
12	GND	Ground	Note1
13	CKC-	Pixel clock C	LVDS differential data input Note2
14	CKC+		
15	GND	Ground	Note1
16	DC3-	Pixel data C3	LVDS differential data input Note2
17	DC3+		
18	GND	Ground	Note1
19	DC4-	Pixel data C4	LVDS differential data input Note2
20	DC4+		
21	GND	Ground	Note1
22	DD0-	Pixel data D0	LVDS differential data input Note2
23	DD0+		
24	GND	Ground	Note1
25	DD1-	Pixel data D1	LVDS differential data input Note2
26	DD1+		
27	GND	Ground	Note1
28	DD2-	Pixel data D2	LVDS differential data input Note2
29	DD2+		
30	GND	Ground	Note1
31	CKD-	Pixel clock D	LVDS differential data input Note2
32	CKD+		
33	GND	Ground	Note1
34	DD3-	Pixel data D3	LVDS differential data input Note2
35	DD3+		
36	GND	Ground	Note1
37	DD4-	Pixel data D4	LVDS differential data input Note2
38	DD4+		
39	GND	Ground	Note1
40	GND	Ground	Note1
41	GND	Ground	Note1

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

CN3 socket (LCD module side): 53261-1271 (MOLEX Inc.)
Adaptable plug: 51021-1200 (MOLEX Inc.)

Pin No.	Symbol	Function	Description
1	GND	Signal ground	Note1
2			
3			
4			
5			
6			
7	VDD	Power supply	Note1
8			
9			
10			
11			
12			

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

2.2 Backlight

CN201 socket (LCD module side): DF3EA-10P-2H(21) (HIROSE ELECTRIC Co., Ltd.)
Adaptable plug: DF3-10S-2C (HIROSE ELECTRIC Co., Ltd.)

Pin No	Symbol	Function	Description
1	GNDB	LED driver ground	Note1
2	GNDB		
3	GNDB		
4	GNDB		
5	GNDB		
6	VDDB	Power supply	Note1
7	VDDB		
8	VDDB		
9	VDDB		
10	VDDB		

Note1:All VDDB and GNDB terminals should be used without any non-connected lines.
Note2: Pin Numbering on module is opposite from pin numbering in the manufacturers datasheet"

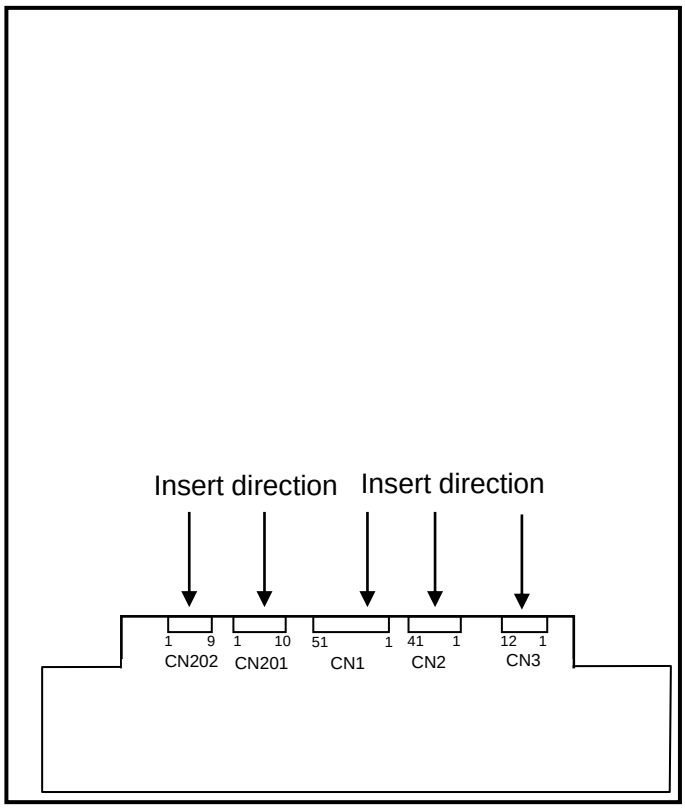
CN202 socket (LCD module side): 53261-0971 (MOLEX Inc.)
Adaptable plug: 51021-0900 (MOLEX Inc.)

Pin No	Symbol	Function	Description
1	PWSEL	Selection of luminance control signal method	Note1, Note2
2	GNDB	LED driver ground	Note3
3	BRTP	BRTP signal	Note1
4	BRTI	Luminance control terminal	
5	BRTH		
6	BRTC	Backlight ON/OFF control signal	High or Open: Backlight ON Low: Backlight OFF
7	N. C.	-	Keep this pin Open.
8	GNDB	LED driver ground	Note3
9	GNDB		

Note1: See "**5.3 LUMINANCE CONTROL** ".
Note2: When VDDB is 0V or BRTC is Low, PWSEL must be set to Low or Open.
Note3: All GNDB terminals should be used without any non-connected lines.
Note4: Pin Numbering on module is opposite from connector pin numbering in the connector manufacturers datasheet".

2.3 Positions of Socket

Rear side



3 Absolute Maximum Ratings

Parameter			Symbol	Rating	Unit	Remarks
Power supply voltage	LCD panel signal processing board		VDD	-0.3 to +15.0	V	Ta= 25°C
	LED driver		VDDB	-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°C
	LED driver	BRTI signal	VBI	-0.3 to +1.5	V	VDDB= 24.0V Ta= 25°C
		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	°C	-
Operating temperature		Center of front surface	TopF	0 to +60	°C	Note2
		Edge of front surface	TopF	0 to +65	°C	Note2
		Edge of rear surface	TopR	0 to +70	°C	Note3
Relative humidity Note4, Note6			RH	≤ 95	%	Ta ≤ 40°C
				≤ 85	%	40°C < Ta ≤50°C
				≤ 55	%	50°C < Ta ≤60°C
Absolute humidity Note4, Note6			AH	≤ 70 Note5	g/m^3	Ta > 60°C

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.

4 Mechanical Characteristics

Parameter	Specification	Unit
Module size	336.1 ±0.5 (W) × 453.0 ±0.5 (H) ×10.5 ±0.5 (D) Note1	mm
Weight	1930 (typ.), 2130 (max.)	g

Note1: See " **9 Mechanical Drawing** ".

5 Electrical Characteristics

5.1 Driving TFT LCD Panel

(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	-	650 Note1	800 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	100	-	600	mV	Note7
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 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+/-

5.2 Driving Backlight

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	-	1700	1800 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	uA	
	BRTP signal	High	IBPH	-	-	1,000	uA	
		Low	IBPL	-600	-	-	uA	
	BRTC signal	High	IBCH	-	-	300	uA	
		Low	IBCL	-300	-	-	uA	
	PWSEL signal	High	IPSH	-	-	1,000	uA	
		Low	IPSL	-600	-	-	uA	
LED life time			Hr		50000		hour	Note 6

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℃.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.

5.3Luminance Control

5.3.1 Luminance control methods

(Ta= 25°C)

<table>
<tr><th>Method</th><th>Adjustment and luminance ratio</th><th>PWSEL terminal</th><th>BRTP terminal</th></tr>
<tr><td>Variable resistor control

Note1</td><td>• 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 BRTH-BRTI terminals.
 
• Luminance ratio Note3
<table><tr><th>Resistance</th><th>Luminance ratio</th></tr><tr><td>0Ω</td><td>10% (typ.)</td></tr><tr><td>10kΩ</td><td>100%</td></tr></table></td><td rowspan="2">High or Open</td><td rowspan="2">Open</td></tr>
<tr><td>Voltage control

Note1</td><td>• Adjustment
Voltage control method works, when BRTH terminal is 0V and VBI voltage is input between BRTI-BRTH terminals. This control method can carry out continuation adjustment of luminance.
Luminance is the maximum when BRTI terminal is Open.
• Luminance ratio Note3
<table><tr><th>BRTI Voltage (VBI)</th><th>Luminance ratio</th></tr><tr><td>0V</td><td>10% (typ.)</td></tr><tr><td>1.0V</td><td>100%</td></tr></table></td></tr>
<tr><td>Pulse width modulation (PWM)

Note1
Note2
Note4</td><td>• Adjustment
Pulse width modulation (PWM) method works, when PWSEL terminal is Low and PWM signal (BRTP signal) is input into BRTP terminal. The luminance is controlled by duty ratio of BRTP signal.
Keep BRTI and BRTH terminals Open when using PWM method.
• Luminance ratio Note3
<table><tr><th>Duty ratio</th><th>Luminance ratio</th></tr><tr><td>0.21</td><td>21% (typ.)</td></tr><tr><td>1.0</td><td>100%</td></tr></table></td><td>Low</td><td>BRTP signal</td></tr>
</table>

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 BRTP signal is more than 50ms while BRTC signal is High or Open. Then the backlight will not turn on anymore, even if BRTP signal is input again. This is not out of order. The LED driver will start to work when power is supplied again.

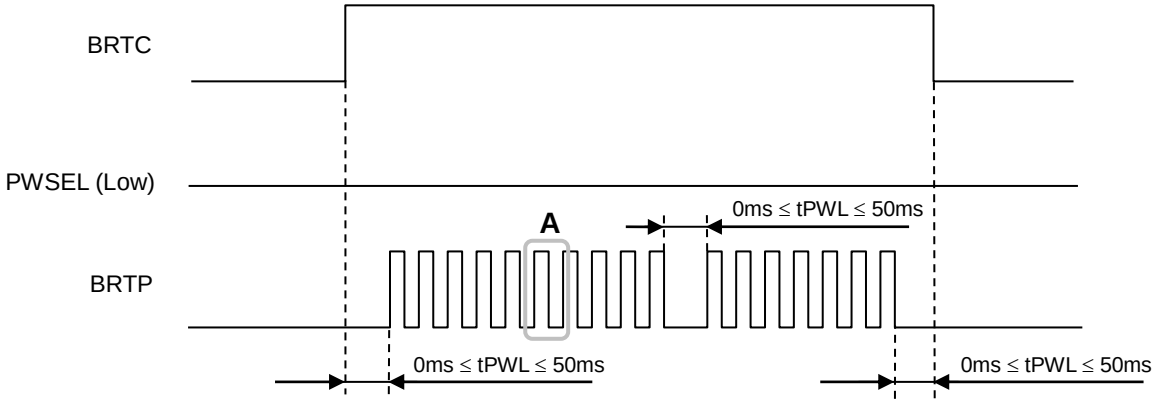
Note3: These data are the target values.

Note4:See "5**.3.2 Detail of BRTP timing**".

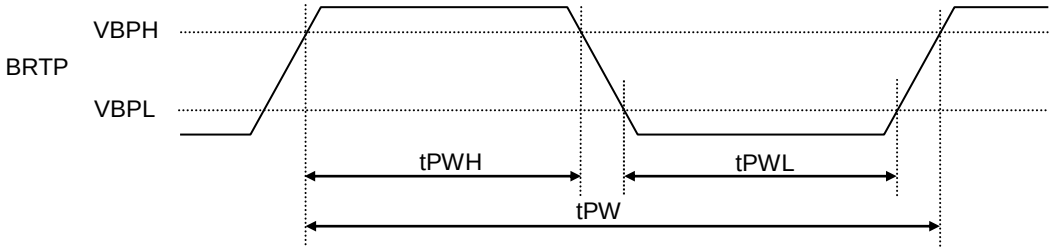
5.3.2 Detail of BRTP timing

(1) Timing diagrams

- Outline chart



- 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}	1	-	100	%	185≤ f_{PWM} < 950 (Hz) Note4,5
		21	-	100	%	950≤ f_{PWM} < 20K (Hz) Note4,5
PWM pulse width	tPWH	10	-	-	μs	Note1,4,5

Note1: Definition of parameters is as follows.

$$f_{PWM} = \frac{1}{tPW} \quad , DR_{PWM} = \frac{tPWH}{tPW}$$

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.

5.4Method of connection for LVDS transmitter

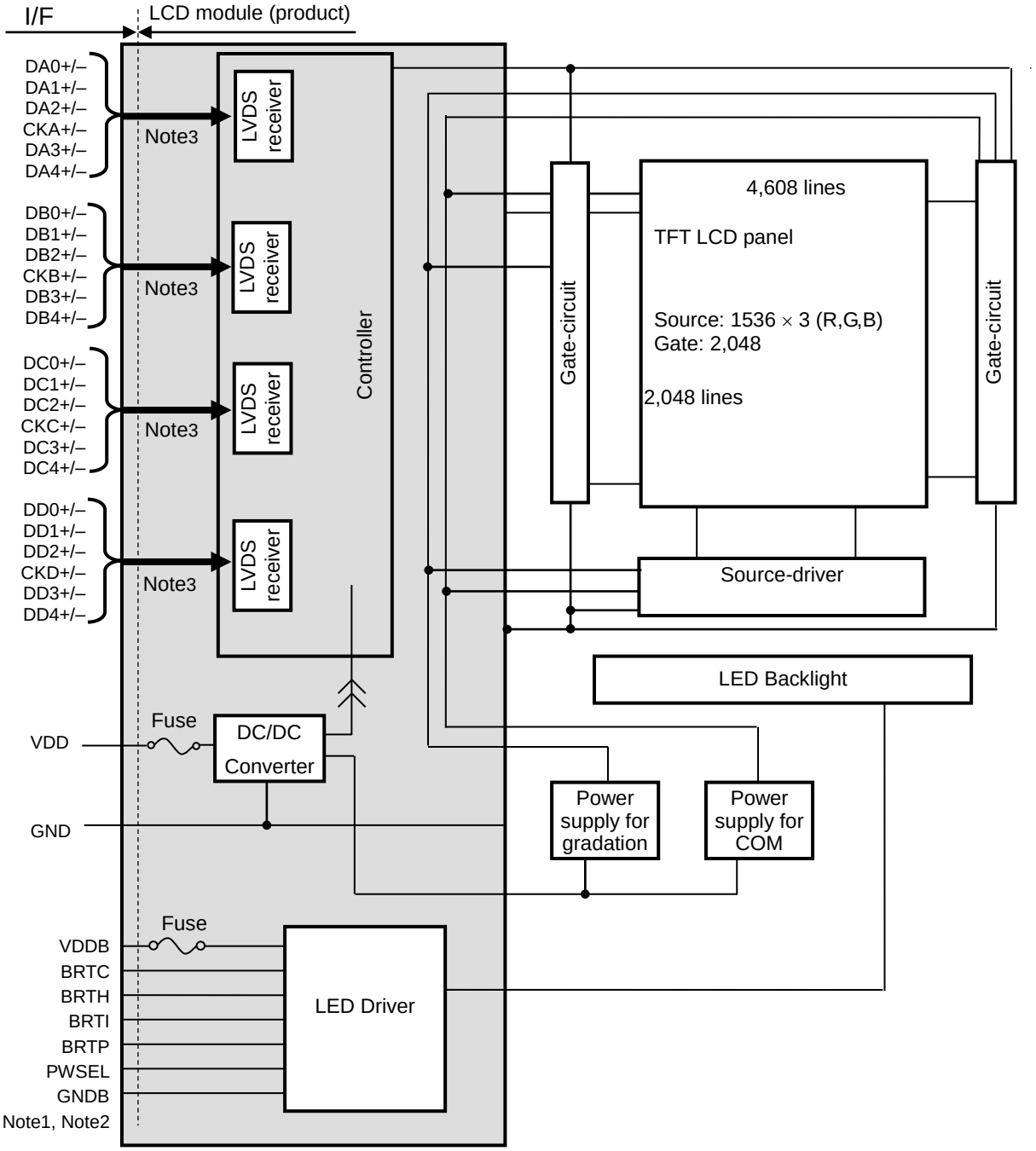
	Bit mapping	Transmitter Pin Assignment THine THC63LVD1023B	Output Connector		CN1 Pin No.	CN1 Signal name
Pixel data A	RA4	R14	ATA- / ATA+	Note1 →		
	RA5	R15				
	RA6	R16		→	4	DA0-
	RA7	R17		→	5	DA0+
	RA8	R18				
	RA9	R19				
	GA4	G14				
	GA5	G15	ATB- / ATB+			
	GA6	G16				
	GA7	G17		→	7	DA1-
	GA8	G18		→	8	DA1+
	GA9	G19				
	BA4	B14				
	BA5	B15				
	BA6	B16	ATC- / ATC+			
	BA7	B17				
	BA8	B18		→	10	DA2-
	BA9	B19		→	11	DA2+
	Hsync	HSYNC				
	Vsync	VSYNC				
	DE	DE				
	RA2	R12	ATD- / ATD+			
	RA3	R13				
	GA2	G12		→	16	DA3-
	GA3	G13		→	17	DA3+
	BA2	B12				
	BA3	B13				
	N.C.	-				
	RA0	R10	ATE- / ATE+			
	RA1	R11				
	GA0	G10		→	19	DA4-
	GA1	G11		→	20	DA4+
	BA0	B10				
	BA1	B11				
	N.C.	-				
	CLK	CLK	ATCLK- / ATCLK+	→	13	CKA-
				→	14	CKA+
Pixel data B	RB4	R24	BTA- / BTA+			
	RB5	R25				
	RB6	R26		→	22	DB0-
	RB7	R27		→	23	DB0+
	RB8	R28				
	RB9	R29				
	GB4	G24				
	GB5	G25	BTB- / BTB+			
	GB6	G26				
	GB7	G27		→	25	DB1-
	GB8	G28		→	26	DB1+
	GB9	G29				
	BB4	B24				
	BB5	B25				
	BB6	B26	BTC- / BTC+			
	BB7	B27				
	BB8	B28		→	28	DB2-
	BB9	B29		→	29	DB2+
	Hsync	HSYNC				
	Vsync	VSYNC				
	DE	DE				
	RB2	R22	BTD- / BTD+			
	RB3	R23				
	GB2	G22		→	34	DB3-
	GB3	G23		→	35	DB3+
	BB2	B22				
	BB3	B23				
	N.C.	-				
	RB0	R20	BTE- / BTE+			
	RB1	R21				
	GB0	G20		→	37	DB4-
	GB1	G21		→	38	DB4+
	BB0	B20				
	BB1	B21				
	N.C.	-				
	CLK	CLK	BTCLK- / BTCLK+	→	31	CKB-
				→	32	CKB+

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

	Bit mapping	Transmitter Pin Assignment THine THC63LVD1023B	Output Connector		CN2 Pin No.	CN2 Signal name
Pixel data C	RC4	R14				
	RC5	R15		Note1		
	RC6	R16	CTA-	→	4	DC0-
	RC7	R17	CTA+	→	5	DC0+
	RC8	R18				
	RC9	R19				
	GC4	G14				
	GC5	G15				
	GC6	G16				
	GC7	G17	CTB-	→	7	DC1-
	GC8	G18	CTB+	→	8	DC1+
	GC9	G19				
	BC4	B14				
	BC5	B15				
	BC6	B16				
	BC7	B17				
	BC8	B18	CTC-	→	10	DC2-
	BC9	B19	CTC+	→	11	DC2+
	Hsync	HSYNC				
	Vsync	VSYNC				
	DE	DE				
	RC2	R12				
	RC3	R13				
	GC2	G12	CTD-	→	16	DC3-
	GC3	G13	CTD+	→	17	DC3+
	BC2	B12				
	BC3	B13				
	N.C.	-				
	RC0	R10				
	RC1	R11				
	GC0	G10	CTE-	→	19	DC4-
	GC1	G11	CTE+	→	20	DC4+
	BC0	B10				
	BC1	B11				
	N.C.	-				
	CLK	CLK	CTCLK-	→	13	CKC-
			CTCLK+	→	14	CKC+
Pixel data D	RD4	R24				
	RD5	R25				
	RD6	R26	DTA-	→	22	DD0-
	RD7	R27	DTA+	→	23	DD0+
	RD8	R28				
	RD9	R29				
	GD4	G24				
	GD5	G25				
	GD6	G26				
	GD7	G27	DTB-	→	25	DD1-
	GD8	G28	DTB+	→	26	DD1+
	GD9	G29				
	BD2	B24				
	BD3	B25				
	BD6	B26				
	BD7	B27				
	BD8	B28	DTC-	→	28	DD2-
	BD9	B29	DTC+	→	29	DD2+
	Hsync	HSYNC				
	Vsync	VSYNC				
	DE	DE				
	RD2	R22				
	RD3	R23				
	GD2	G22	DTD-	→	34	DD3-
	GD3	G23	DTD+	→	35	DD3+
	BD2	B22				
	BD3	B23				
	N.C.	-				
	RD0	R20				
	RD1	R21				
	GD0	G20	DTE-	→	37	DD4-
	GD1	G21	DTE+	→	38	DD4+
	BD0	B20				
	BD1	B21				
	N.C.	-				
	CLK	CLK	DTCLK-	→	31	CKD-
			DTCLK+	→	32	CKD+

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

5.5Block 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.

Note3: Each pair of the LVDS signal has a 100Ω terminating resistance.

5.6 Fuse

Parameter	Fuse		Rating	Fusing current	Remarks
	Type	Supplier			
VDD	FCC16202ABTP	KAMAYA	2.A 36V	4A@5S	Note1
VDDB	CRUCQ12LV3A63V	CONQUER	3A 63V	6A@5S	

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.

6 Timing Chart

6.1 Timing Characteristics

(Note1, Note2, Note3，Note4)

Parameter			Symbol	Min.	Typ.	Max.	Unit	Remarks
CLK	Frequency		1/ tc	54	55.7	58	MHz	17.9ns (typ.)
	Duty ratio		-	See the data sheet of LVDS transmitter.			-	-
	Rise time, Fall time		-				ns	-
DATA	CLK-DATA	Setup time	-				ns	-
		Hold time	-				ns	-
	Rise time, Fall time		-				ns	-
DE	Horizontal	Cycle	th	-	8.03	-	μs	124.4kHz (typ.)
				442	448	518	CLK	
		Display period	thd	384			CLK	-
	Vertical (One frame)	Cycle	tv	-	16.7	-	ms	60.0Hz (typ.)
				2067	2,074	2081	H	
		Display period	tvd	2,048			H	-
	CLK-DE	Setup time	-	See the data sheet of LVDS transmitter.			ns	-
		Hold time	-				ns	-
	Rise time, Fall time		-				ns	-

Note1: Definition of parameters is as follows.

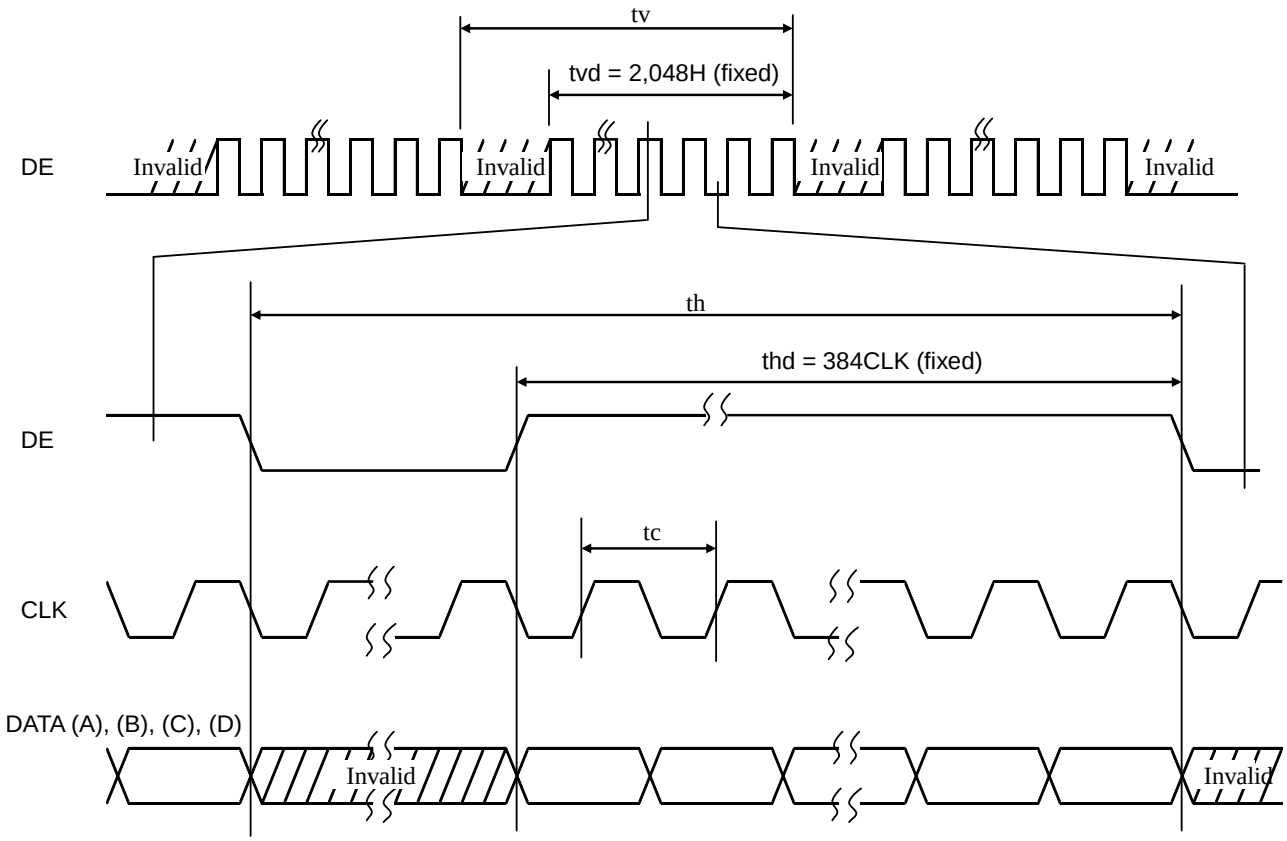
tc= 1CLK, th= 1H

Note2: See the data sheet of LVDS transmitter.

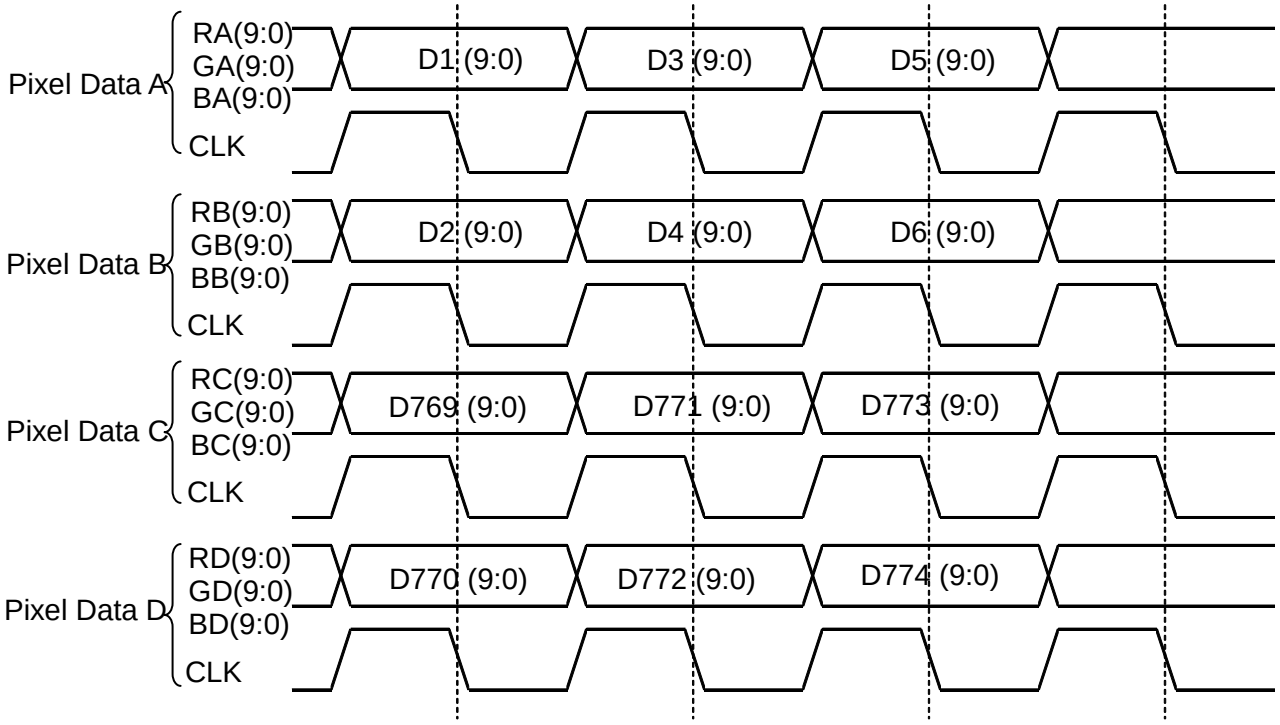
Note3: Vertical cycle (tv) should be specified in integral multiple of Horizontal cycle (th).

Note4：Definition for landscape

6.2 Input Signal Timing Chart



6.3 Input Data Mapping

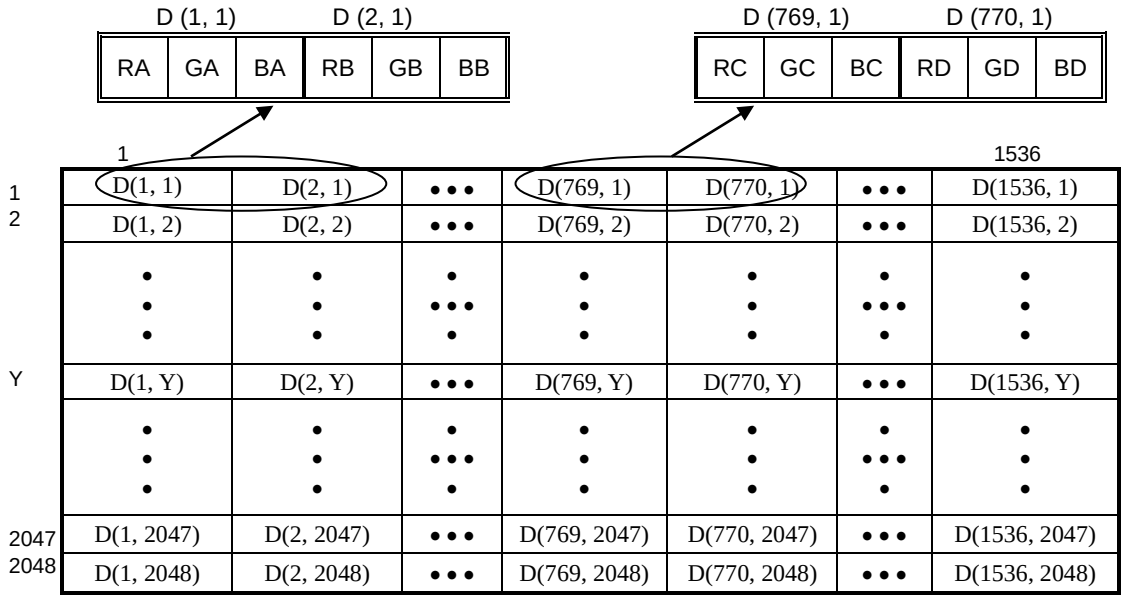


6.4 Display Colors and Input Data Signals

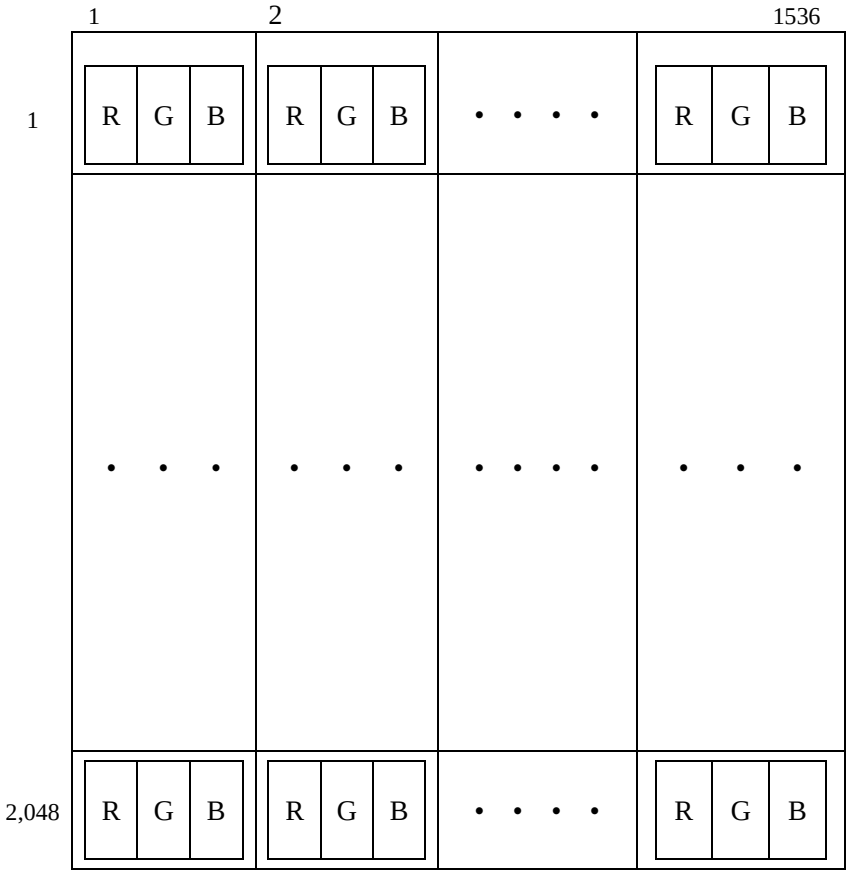
This product can display 1,024 gray scales in each RGB sub-pixel and 3,072 gray scales per 1 pixel. Also the relation between display gray scale and input data signals is as follows.

Display gray scale		Data signal (0: Low level, 1: High level)																															
		RA9	RA8	RA7	RA6	RA5	RA4	RA3	RA2	RA1	RA0	GA9	GA8	GA7	GA6	GA5	GA4	GA3	GA2	GA1	GA0	BA9	BA8	BA7	BA6	BA5	BA4	BA3	BA2	BA1	BA0
		RB9	RB8	RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0	GB9	GB8	GB7	GB6	GB5	GB4	GB3	GB2	GB1	GB0	BB9	BB8	BB7	BB6	BB5	BB4	BB3	BB2	BB1	BB0
		RC9	RC8	RC7	RC6	RC5	RC4	RC3	RC2	RC1	RC0	GC9	GC8	GC7	GC6	GC5	GC4	GC3	GC2	GC1	GC0	BD9	BC8	BC7	BC6	BC5	BC4	BC3	BC2	BC1	BC0
		RD9	RD8	RD7	RD6	RD5	RD4	RD3	RD2	RD1	RD0	GD9	GD8	GD7	GD6	GD5	GD4	GD3	GD2	GD1	GD0	BD9	BD8	BD7	BD6	BD5	BD4	BD3	BD2	BD1	BD0
Left sub-pixel 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	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	dark	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	↑						:										:										:				
	↓						:										:										:				
	bright	1	1	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Center sub-pixel 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	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
	dark	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
	↑						:										:										:				
	↓						:										:										:				
	bright	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
	White	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
Right sub-pixel 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	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	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	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	1
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0
	White	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1

6.5 Display Positions



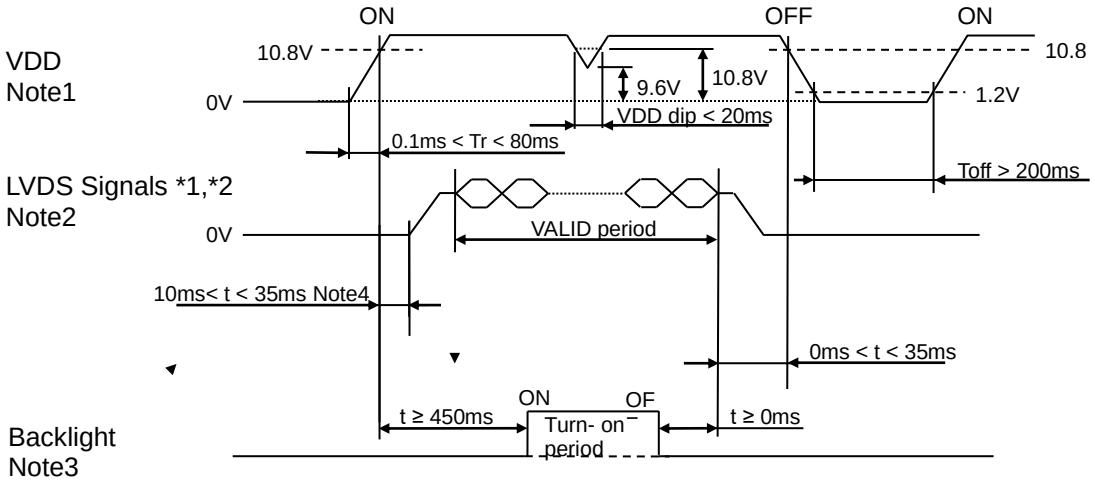
6.6 Scanning Direction



Note1：Definition for portrait

6.7 Power On/Off Sequence

6.7.1 LCD panel signal processing board



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

*2: LVDS signals should be measured at the terminal of 100 Ω resistance.

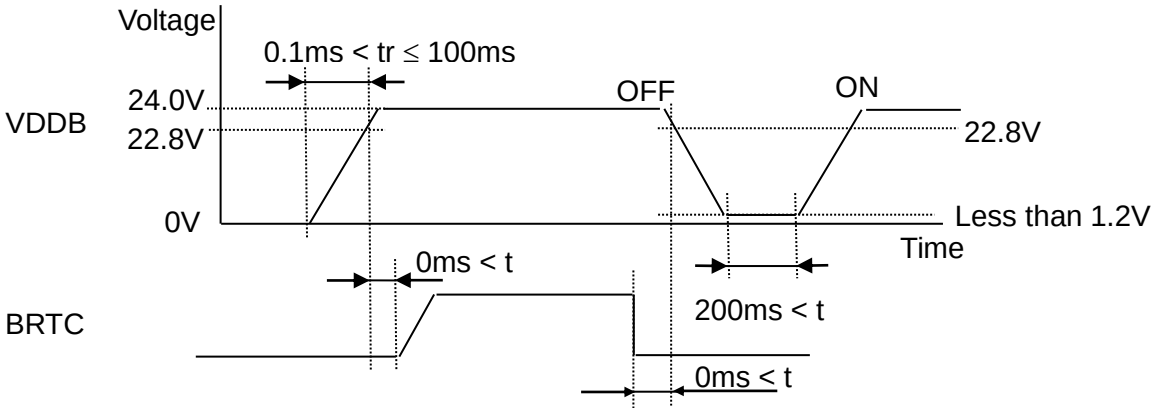
Note1: If there is a voltage variation (voltage drop) at the rising edge of VDD below 10.8V, there is a possibility that a product does not work due to a protection circuit.

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.

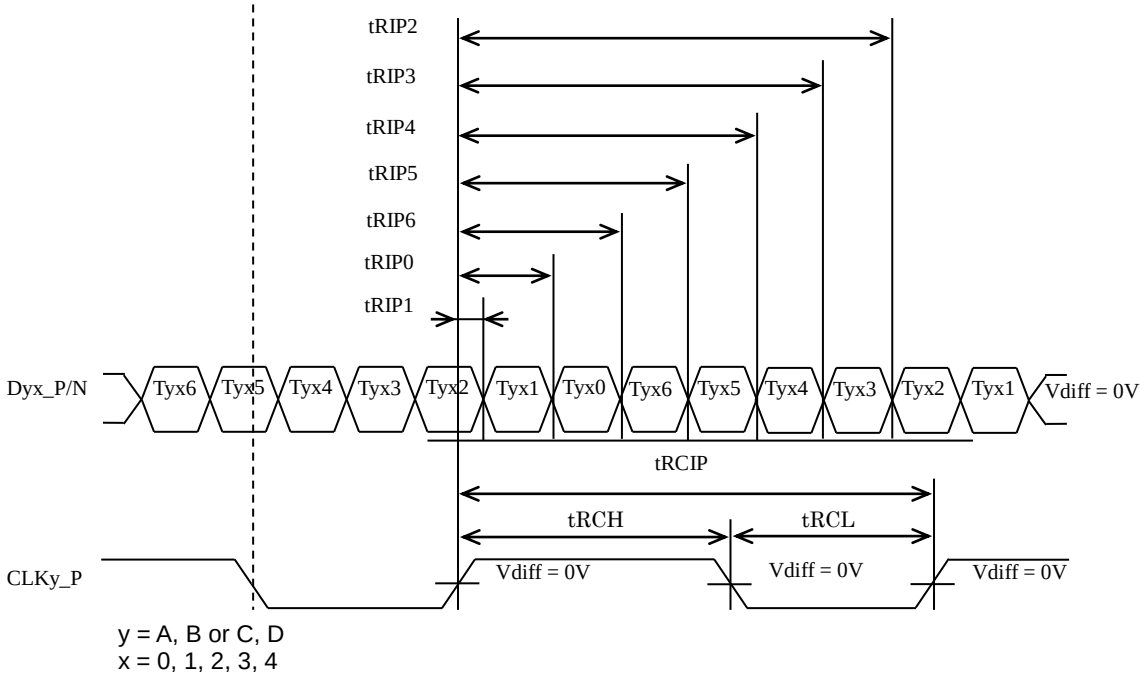
6.7.2 LED Driver



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.

6.8 LVDS Rx AC SPEC

Symbol	Parameter	min.	typ.	max.	Unit
t_{RCIP}	CKy_+ Period	17.24	-	18.52	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 = 56MHz	-0.676	-	0.676	ns
t_{RIP1}	Input Data Position 0	$-\lvert t_{RMG}\rvert$	0.0	$+\lvert t_{RMG}\rvert$	ns
t_{RIP0}	Input Data Position 1	$\frac{t_{RCIP}}{7}-\lvert t_{RMG}\rvert$	$\frac{t_{RCIP}}{7}$	$\frac{t_{RCIP}}{7}+\lvert t_{RMG}\rvert$	ns
t_{RIP6}	Input Data Position 2	$2\frac{t_{RCIP}}{7}-\lvert t_{RMG}\rvert$	$2\frac{t_{RCIP}}{7}$	$2\frac{t_{RCIP}}{7}+\lvert t_{RMG}\rvert$	ns
t_{RIP5}	Input Data Position 3	$3\frac{t_{RCIP}}{7}-\lvert t_{RMG}\rvert$	$3\frac{t_{RCIP}}{7}$	$3\frac{t_{RCIP}}{7}+\lvert t_{RMG}\rvert$	ns
t_{RIP4}	Input Data Position 4	$4\frac{t_{RCIP}}{7}-\lvert t_{RMG}\rvert$	$4\frac{t_{RCIP}}{7}$	$4\frac{t_{RCIP}}{7}+\lvert t_{RMG}\rvert$	ns
t_{RIP3}	Input Data Position 5	$5\frac{t_{RCIP}}{7}-\lvert t_{RMG}\rvert$	$5\frac{t_{RCIP}}{7}$	$5\frac{t_{RCIP}}{7}+\lvert t_{RMG}\rvert$	ns
t_{RIP2}	Input Data Position 6	$6\frac{t_{RCIP}}{7}-\lvert t_{RMG}\rvert$	$6\frac{t_{RCIP}}{7}$	$6\frac{t_{RCIP}}{7}+\lvert t_{RMG}\rvert$	ns



y = A, B or C, D
x = 0, 1, 2, 3, 4

7 Optical Characteristics

Ta=25℃

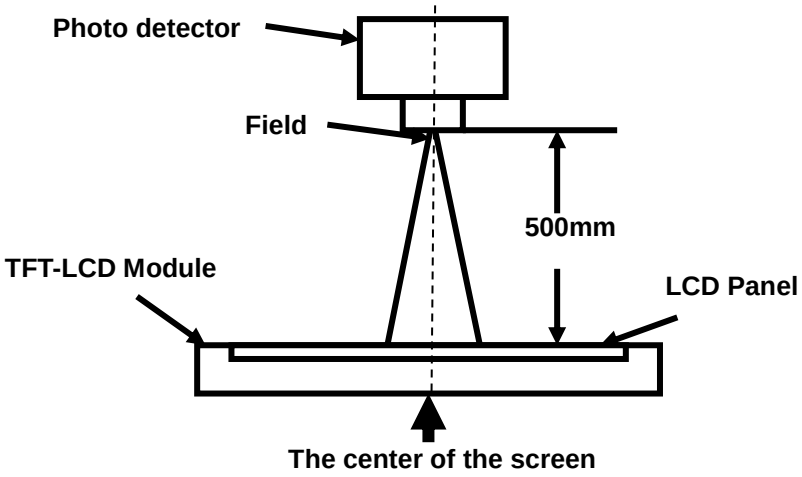
Item		Symbol	Condition	Min	Typ	Max	Unit	Remark
View Angles		θT	CR≧10	85	89	-	Degree	Note 2
		θB		85	89	-		
		θL		85	89	-		
		θR		85	89	-		
Contrast Ratio		CR	θ=0°	1400	2000	-	-	Note1 Note3
Response Time		$T_{ON}+T_{OFF}$	25℃	-	25	40	ms	Note1 Note4
Chromaticity	White	x	Backlight is on	Typ-0.03	0.314	Typ+0.03	-	Note5 Note1
		y			0.326			
	Red	x			0.657			
		y			0.333			
	Green	x			0.328			
		y			0.621			
	Blue	x			0.148			
		y			0.061			
Uniformity		LU1	White (1023/1023gray)	80	-	-	%	Note1 Note6
		LU2	Gray (102/1023gray)	-	-	20		
		LU3	Gray (816/1023gray)	-	-	20		
NTSC		-	-	67	72	-	%	Note 5
Luminance		L	White (1023/1023gray)	800	900	-	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 "**9 Mechanical Drawing**".

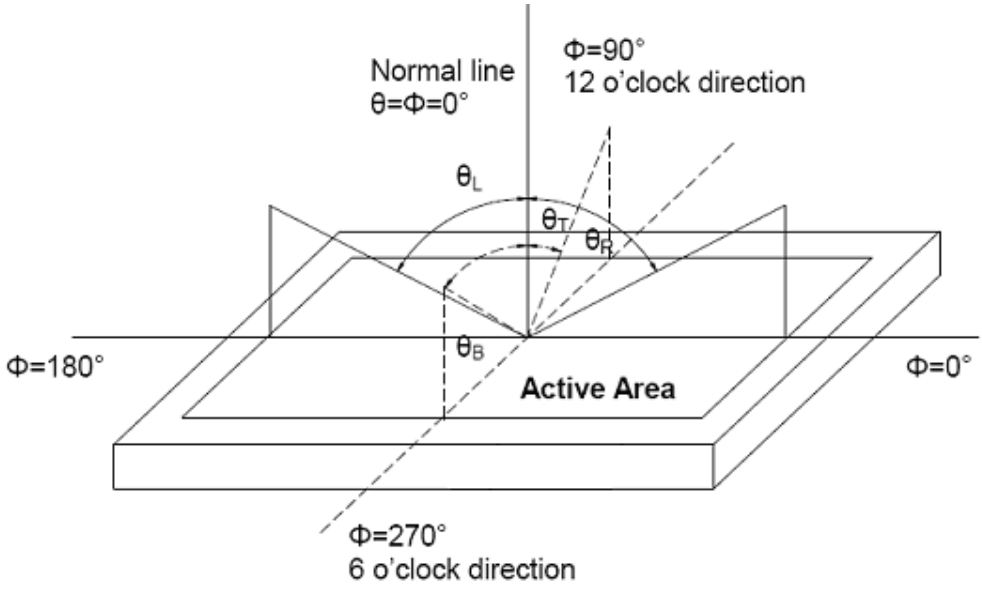


Fig. 1 Definition of viewing angle

Note 3: Definition of contrast ratio

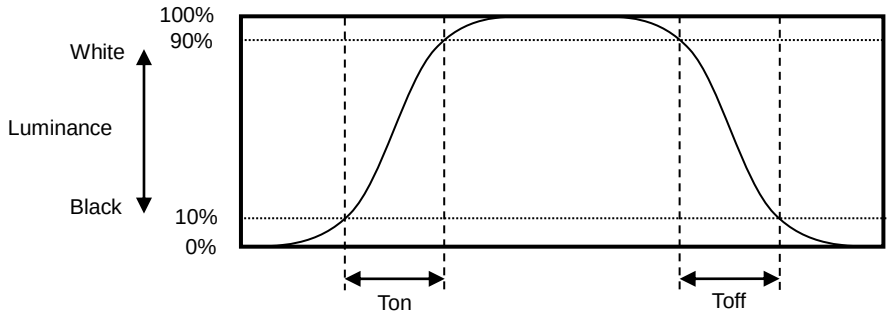
The contrast ratio is calculated by using the following formula.

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

Note 4: Definition of Response time

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

LU1：

Active area is divided into 9 measuring areas (Refer Fig. 2).

Luminance Uniformity(LU) = Lmin/ Lmax

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

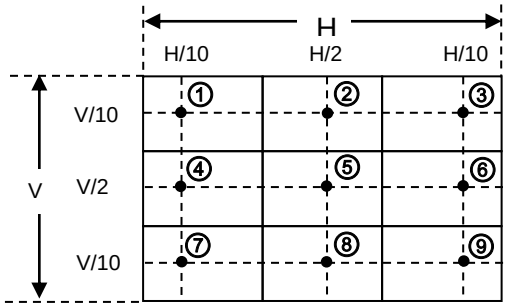


Fig. 2 Definition of uniformity

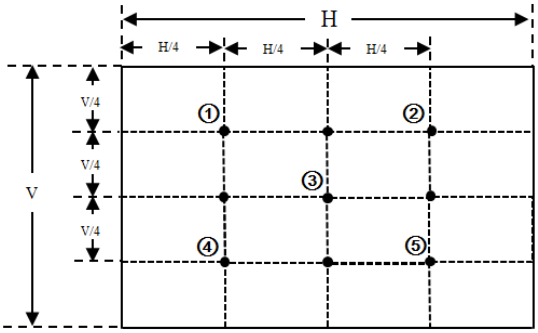
Lmax: The measured maximum luminance of all measurement position.

Lmin: The measured minimum luminance of all measurement position.

The Gray luminance uniformity is calculated by using following formula.

$$\text{LU2/ LU3} = 200^{*} \frac{\text{Maximum luminance from ① to ⑤} - \text{Minimum luminance from ① to ⑤}}{\text{Maximum luminance from ① to ⑤} + \text{Minimum luminance from ① to ⑤}}$$

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



Note 7: Definition of Luminance :

Measure the luminance of white state at center point.

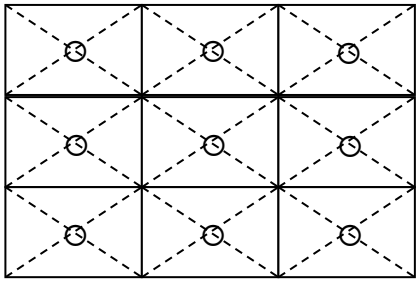
8 Environmental / Reliability Test

Test item	Condition	Judgment Note1
High temperature and humidity (Operation)	①60 ± 2°C, RH= 60%, 240hours ②Display data is white.	No display malfunctions Note2
Heat cycle (Operation)	① 0 ± 3°C1hour 60 ± 3°C 1hour ② 50cycles, 4hours/cycle ③ Display data is white.	
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.	
Vibration (Non operation)	① 5 to 100Hz, 11.76m/s^2 ② 1 minute/cycle ③ X, Y, Z directions ④ 10 times each direction	No display malfunctions No physical damages
Mechanical shock (Non operation)	① 294m/s^2, 11ms ② ±X, ±Y, ±Z directions ③ 3 times each direction	
ESD (Operation)	Contact Discharge ① 150pF, 330 , ±8kV ② 9 places on a panel surface Note3 ③ 25 times each place at 1 sec interval Air Discharge ① 150pF, 330 , ±15kV ② 9 places on a panel surface ③ 25times each place at 1 sec interval	No display malfunctions Note3

Note1: Display and appearance are checked under environmental conditions equivalent to the inspection conditions of defect criteria.

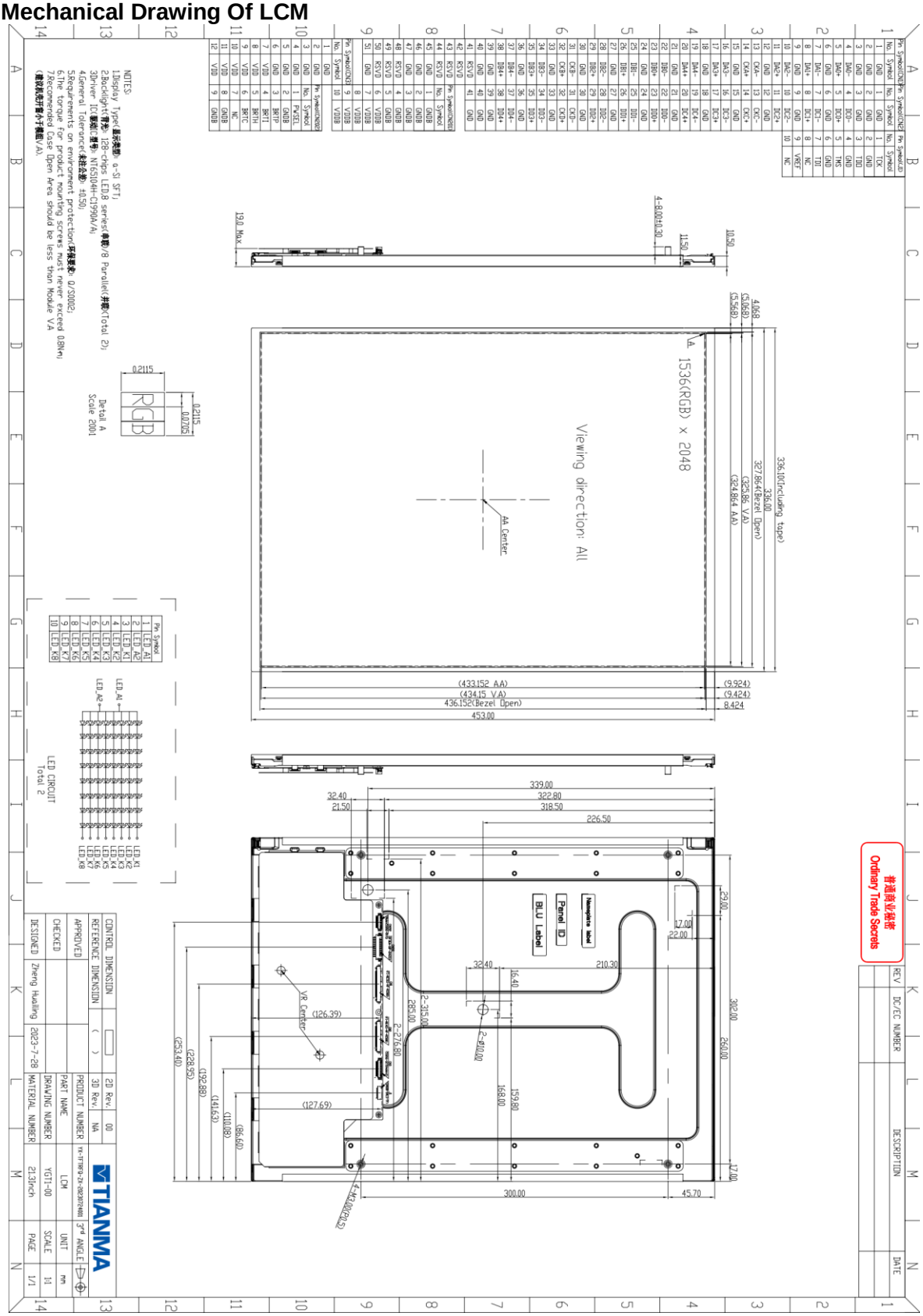
Note2: Luminance: 600cd/m^2 at luminance control.

Note3: See the following figure for discharge points



9 Mechanical Drawing

9.1 Mechanical Drawing Of LCM



9.2 Markings

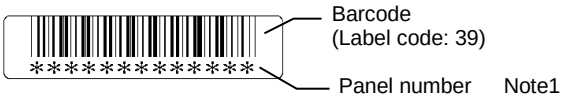
The marking is attached to this product.

9.2.1 Nameplate label

Nameplate label

9.2.2 Barcode label

Barcode label

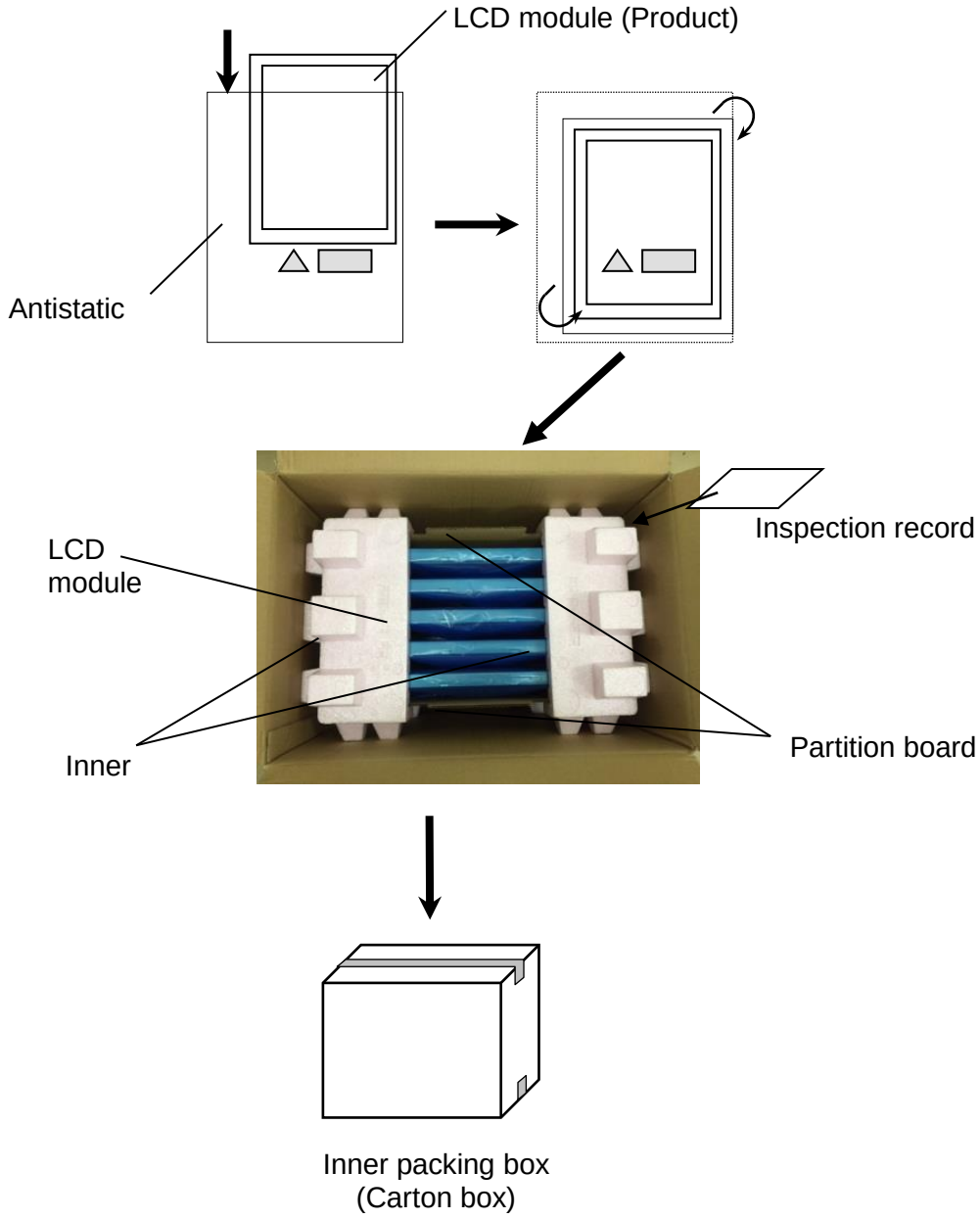


Note1: **Do not attach anything like another label on the nameplate label!**

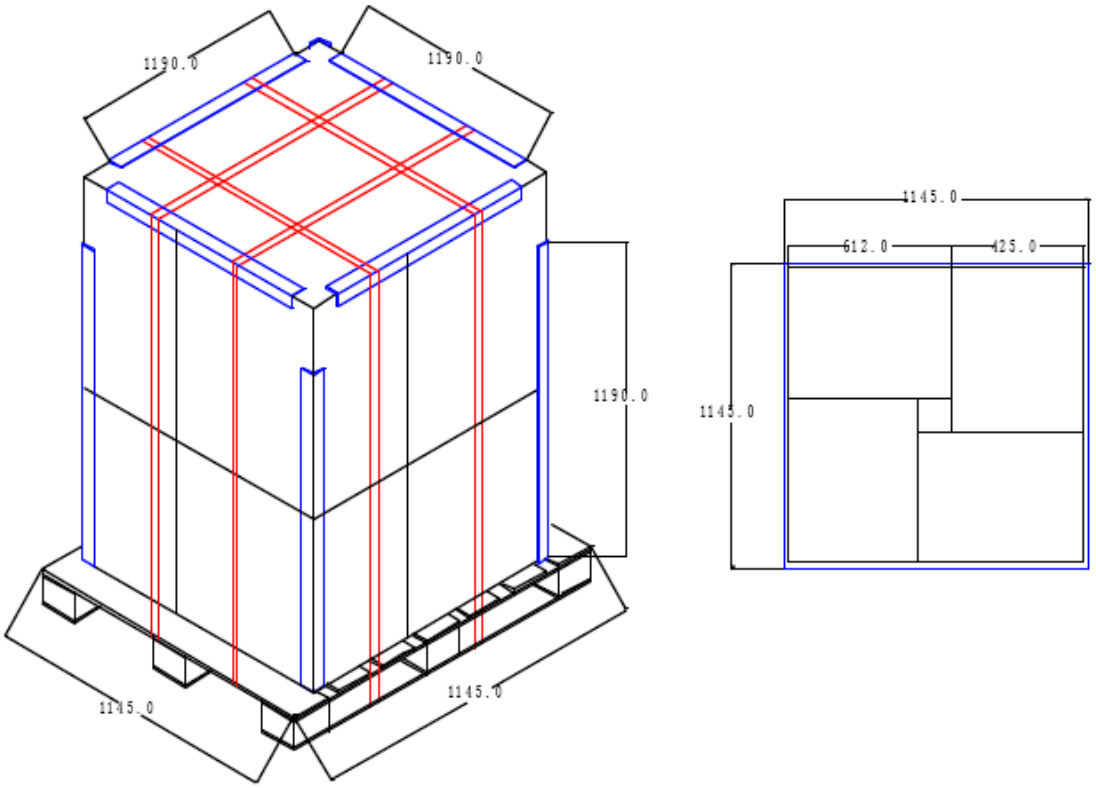
10 Packing Drawing

No	Item	Model (Material)	Dimensions(mm)	Unit Weight(Kg)	Quantity	Remark
1	LCM module	TM213XDGP05-00	336.1x453.0x10.5	1.93	5	
2	Partition board	Corrugated paper	460x378	0.075	2	
3	Anti-static Bag	LD-PE	600x420	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	76x104	0.001	2	
8	Total weight	**12.03 ±10% kg**				

10.1 LCD Module Packing Method



10.2 Stacking method (2 x 2 x 2)



11 Precautions For Use of LCD Modules

11.1 Handling Precautions

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

11.1.2 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.

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

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

11.1.5 Do not get the polarizer contacted with Petroleum solvents, such as Hydrocarbon solvents, N-heptane .

11.1.6 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

11.1.7 Do not attempt to disassemble the LCD Module.

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

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

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

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

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

11.1.8.4 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

11.1.9 The torque for product mounting screws must never exceed (0.8) N·m. Higher torque might result in distortion of the bezel. And the length of product mounting screws must be ≤ (7) mm.

11.2 Storage Precautions

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

11.2.2 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%

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

11.3 Transportation Precautions

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