NEC LCD Technologies, Ltd.

TFT COLOR LCD MODULE

NL128102BC29-10C

48.0cm (19.0 Type)
SXGA
LVDS Interface (2 port)

DATA SHEET

DOD-PP-0703 (1st edition)

This PRELIMINARY DATA SHEET is updated document from DOD-PP-0597(2).

All information is subject to change without notice. Please confirm the sales representative before starting to design your system.

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INTRODUCTION

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Examples: Control systems for transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, medical equipment not specifically designed for life support, safety equipment, etc.

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Examples: Military systems, aircraft control equipment, aerospace equipment, nuclear reactor control systems, medical equipment/devices/systems for life support, etc.

The quality grade of this product is the **"Standard"** unless otherwise specified in this document.

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1. OUTLINE

1.1 STRUCTURE AND PRINCIPLE

Color LCD module NL128102BC29-10C is composed of the amorphous silicon thin film transistor liquid crystal display (a-Si TFT LCD) panel structure with driver LSIs for driving the TFT (Thin Film Transistor) array and a backlight.

The a-Si TFT LCD panel structure is injected liquid crystal material into a narrow gap between the TFT array glass substrate and a monochrome-filter glass substrate.

Grayscale data signals from a host system (e.g. signal generator, etc.) are modulated into best form for active matrix system by a signal processing board, and sent to the driver LSIs which drive the individual TFT arrays.

The TFT array as an electro-optical switch regulates the amount of transmitted light from the backlight assembly, when it is controlled by data signals. Monochrome images are created by regulating the amount of transmitted light through the TFT array.

1.2 APPLICATION

- Monitor system

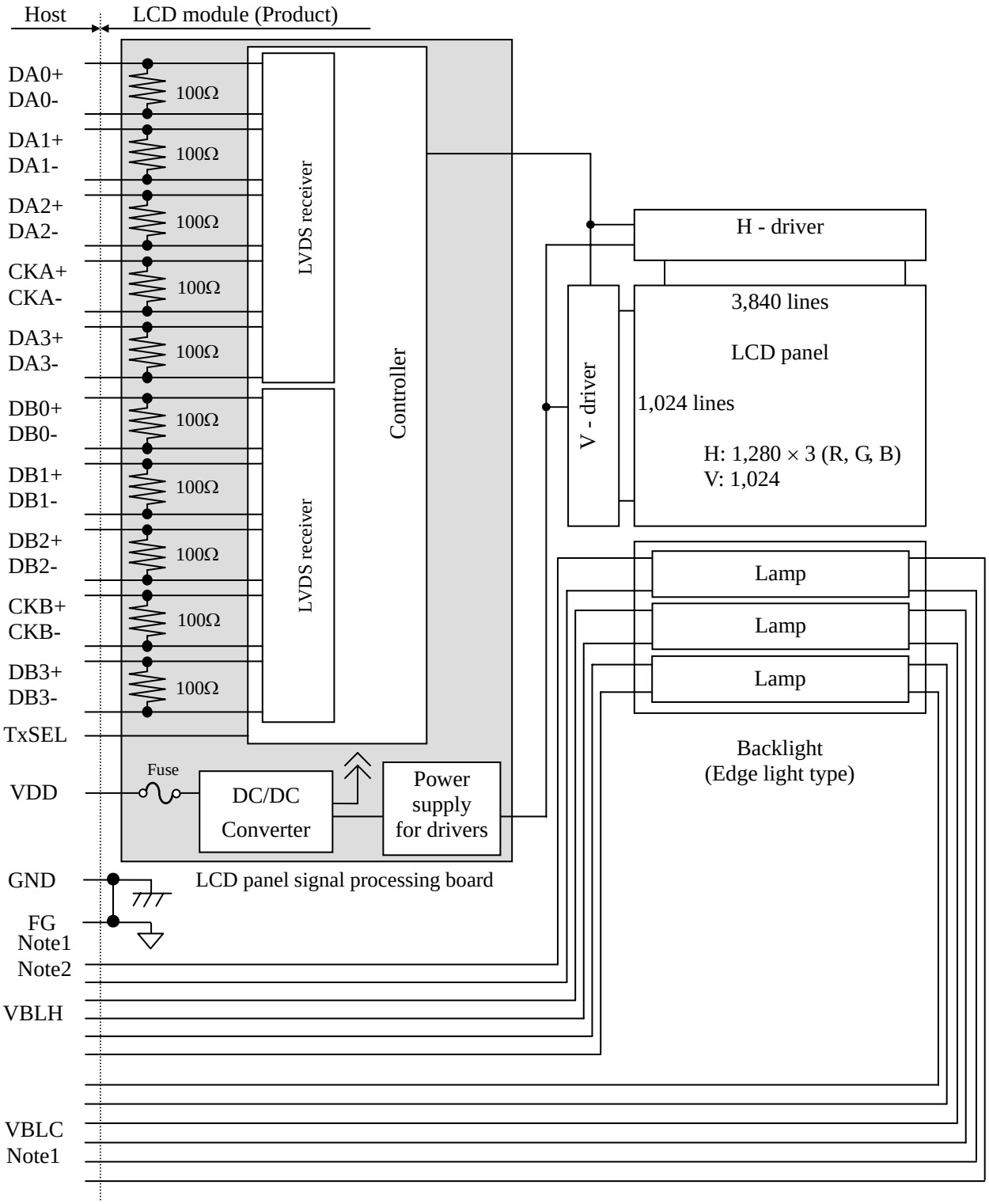
1.3 FEATURES

- Ultra-wide viewing angle (Adoption of Ultra-Advanced Super Fine TFT (UA-SFT))
- Wide color gamut
- High contrast
- LVDS interface
- Selectable LVDS data input map
- Edge light type (without inverter)
- Acquisition product for UL60950-1 /CSA C22.2 No.60950-1-03 (File number: E170632) ☆
- Compliance with the European RoHS directive (2002/95/EC) ☆

2. GENERAL SPECIFICATIONS

Display area	376.32 (H) × 301.056 (V) mm	
Diagonal size of display	48cm (19.0 inches)	
Drive system	a-Si TFT active matrix	
Display color	16,777,216 colors	
Pixel	1,280 (H) × 1,024 (V) pixels	
Pixel arrangement	RGB (Red dot, Green dot, Blue dot) vertical stripe	
Dot pitch	0.098 (H) × 0.294 (V) mm	
Pixel pitch	0.294 (H) × 0.294 (V) mm	
Module size	404.2 (W) × 330.0 (H) × 22.0 (D) mm (typ.)	
Weight	2,600 g (typ.)	☆
Contrast ratio	800:1 (typ.)	☆
Viewing angle	*At the contrast ratio ≥ 10:1* • Horizontal: Right side 88° (typ.), Left side 88° (typ.) • Vertical: Up side 88° (typ.), Down side 88° (typ.)	
Designed viewing direction	Viewing angle with optimum grayscale ($\gamma \fallingdotseq 2.5$): normal axis (Perpendicular)	
Polarizer surface	Antiglare	
Polarizer pencil-hardness	2H (min.) [by JIS K5400]	
Color gamut	*At LCD panel center* 72 % (typ.) [against NTSC color space]	
Response time	*Ton+Toff (10%←→90%)* 20 ms (typ.)	☆
Luminance	*At IBL=6.0mArms / lamp* 290 cd/m^2 (typ.)	☆
Signal system	LVDS 2 port (Receiver: THC63LVDF84B, THine Electronics Inc. or equivalent) [8bit digital signals for data of RGB colors, Dot clock (CLK), Data enable (DE)]	
Power supply voltage	LCD panel signal processing board: 5.0V	
Backlight	Edge light type: 6 cold cathode fluorescent lamps (without inverter)	
Power consumption	*At IBL= 6.0mArms/lamp, Checkered flag pattern* 25.9 W (typ., Power dissipation of the inverter is not included.)	☆

3. BLOCK DIAGRAM



Note1: Relations between GND (Signal ground), FG (Frame ground) and VBLC (Lamp low voltage terminal) in the LCD module are as follows.

GND - FG	Connected
GND - VBLC	Not connected
FG - VBLC	Not connected

Note2: GND and FG must be connected to customer equipment's ground, and it is recommended that GND, FG and customer inverter ground are connected together in customer equipment.

4. DETAILED SPECIFICATIONS

4.1 MECHANICAL SPECIFICATIONS

Parameter	Specification		Unit
Module size	404.2 ± 0.5 (W) × 330.0 ± 0.5 (H) × 22.0 ± 0.3 (D) Note1	Note2	mm
Display area	376.32 (H) × 301.056 (V)	Note2	mm
Weight	2,600 (typ.), 2,750 (max.)		g

☆

Note1: Excluding lamp cable, cable clamp and projections.
Note2: See "**7. OUTLINE DRAWINGS**".

4.2 ABSOLUTE MAXIMUM RATINGS

Parameter		Symbol	Rating	Unit	Remarks
Power supply voltage	LCD panel signal processing board	VDD	-0.3 to +6.0	V	Ta = 25°C
	Lamp voltage	VBLH	2,000	Vrms	
Input voltage for signals	Display signals Note1	VD	-0.3 to +2.8	V	
	Function signal Note2	VF		V	
Storage temperature		Tst	-20 to +60	°C	-
Operating temperature	Front surface	TopF	0 to +55	°C	Note3
	Rear surface	TopR	0 to +60	°C	Note4
Relative humidity Note5		RH	≤ 95	%	Ta ≤ 40°C
			≤ 85	%	40 < Ta ≤ 50°C
			≤ 70	%	50 < Ta ≤ 55°C
Absolute humidity Note5		AH	≤ 73 Note6	g/m^3	Ta > 55°C
Operating altitude		-	≤ 4,850	m	0°C≤ Ta ≤ 55°C
Storage altitude		-	≤ 13,600	m	-20°C≤ Ta ≤ 60°C

Note1: Display signals are DA0+/-, DA1+/-, DA2+/-, DA3+/-, CKA+/-, DB0+/-, DB1+/-, DB2+/-, DB3+/-, CKB+/-
Note2: Function signal is TxSEL.
Note3: Measured at center of LCD panel surface (including self-heat)
Note4: Measured at center of LCD module's rear shield surface (including self-heat)
Note5: No condensation
Note6: Water amount at Ta = 55°C and RH = 70%

4.3 ELECTRICAL CHARACTERISTICS

4.3.1 LCD panel signal processing board

(Ta = 25°C)

Parameter		Symbol	min.	typ.	max.	Unit	Remarks
Power supply voltage		VDD	4.5	5.0	5.5	V	-
Power supply current		IDD	-	500 Note1	800 Note2	mA	at VDD = 5.0V ☆
Permissible ripple voltage		VRP	-	-	100	mVp-p	for VDD
Differential input threshold voltage	High	VTH	-	-	+100	mV	at VCM = 1.2V Note3
	Low	VTL	-100	-	-	mV	
Terminating resistance		RT	-	100	-	Ω	-
Input voltage for TxSEL signal	High	VFH	Keep this pin open.			-	TxSEL Note4
	Low	VFL	-	-	0.5	V	
Input current for TxSEL signal		IFL	-80	-	-35	μA	

Note1: Checkered flag pattern [by EIAJ ED-2522]
Note2: Pattern for maximum current
Note3: Common mode voltage for LVDS receiver
Note4: TxSEL is pulled-up in the product. (Pull-up resistance: 50kΩ)

4.3.2 Backlight lamp

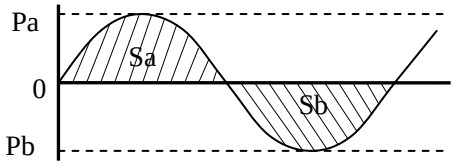
(Ta=25°C, Note1)

Parameter	Symbol	min.	typ.	max.	Unit	Remarks
Lamp current	IBL	3.5	6.0	7.0	mArms	at IBL=6.0mArms: 290 cd/m^2 Note3 ☆
Lamp voltage	VBLH	-	650	-	Vrms	Note2, Note3
Lamp starting voltage	VS	1,350	-	-	Vrms	Ta = 25°C Note2, Note3, Note6
		1,550	-	-	Vrms	Ta = 0°C Note2, Note3, Note6
Lamp oscillation frequency	FO	40	48	55	kHz	Note4

Note1: This product consists of 6 backlight lamps, and these specifications are for each lamp.

Note2: The lamp voltage cycle between lamps should be kept on a same phase. "VS" and "VBLH" are the voltage value between low voltage side (Cold) and high voltage side (Hot).

Note3: The asymmetric ratio of working waveform for lamps (Power supply voltage peak ratio, power supply current peak ratio and waveform space ratio) should be less than 5 % (See the following figure.). If the waveform is asymmetric, DC (Direct current) element apply into the lamp. In this case, a lamp lifetime may be shortened, because a distribution of a lamp enclosure substance inclines toward one side between low voltage terminal (Cold terminal) and high voltage terminal (Hot terminal). When designing the inverter, evaluate asymmetric of lamp working waveform sufficiently.



$$\frac{|Pa - Pb|}{Pb} \times 100 \leq 5\ \%$$

$$\frac{|Sa - Sb|}{Sb} \times 100 \leq 5\ \%$$

Pa: Supply voltage/current peak for positive, Pb: Supply voltage/current peak for negative
Sa: Waveform space for positive part, Sb: Waveform space for negative part

Note4: In case "FO" is not the recommended value, beat noise may display on the screen, because of interference between "FO" and "1/th". Recommended value of "FO" is as following.

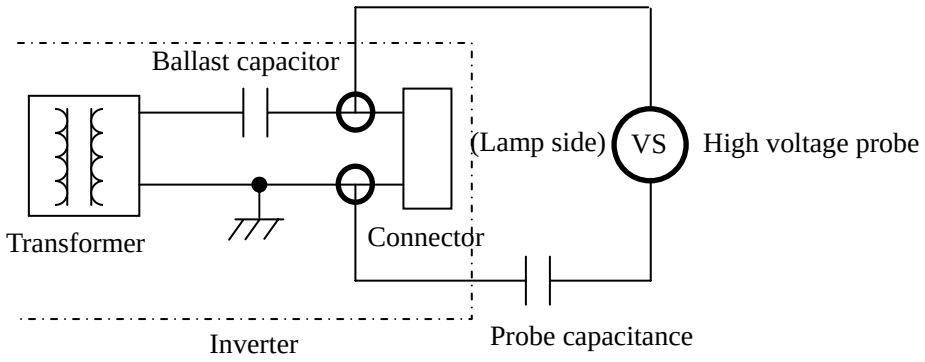
$$FO = \frac{1}{4} \times \frac{1}{th} \times (2n-1)$$

th: Horizontal cycle (See "**4.9.1 Timing characteristics**".)
n: Natural number (1, 2, 3 ·····)

Note5: Method of lamp cable installation may invite fluctuation of lamp current and voltage or asymmetric of lamp working waveform. When designing method of lamp cable installation, evaluate the fluctuation of lamp current, voltage and working waveform sufficiently.

Note6: In case of Inverter with Ballast capacitor, "VS" is the voltage level between Ballast capacitorer and Connector (Refer to the below “Example of measurement”). "VS" should be designed to be more than minimum "VS". Otherwise the lamp may not be turned on because the lamp starting voltage is less than minimum "VS".

Example of measurement
Probe capacitance: 3pF (Tektronix, Inc.: P6015A)



4.3.3 Power supply voltage ripple

This product works, even if the ripple voltage levels are beyond the permissible values as following the table, but there might be noise on the display image.

Power supply voltage		Ripple voltage Note1 (Measure at input terminal of power supply)	Unit
VCC	5.0V	≤ 100	mVp-p

Note1: The permissible ripple voltage includes spike noise.

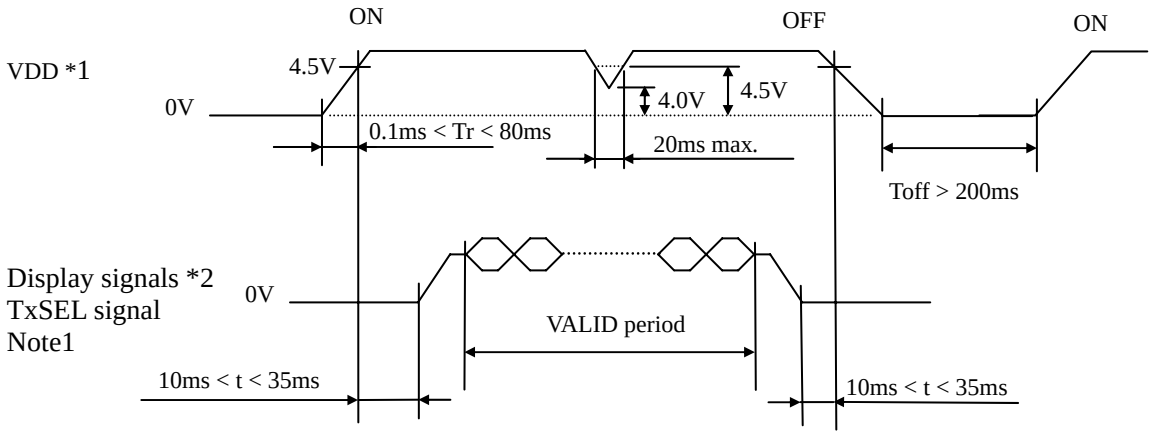
4.3.4 Fuse

Parameter	Fuse		Rating	Fusing current	Remarks
	Type	Supplier			
VCC	FCC16252AD	KAMAYA ELECTRIC CO., LTD.	2.5 A 32 V	6.25 A 5min. max.	Note1

☆

Note1: The power supply capacity should 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.

4.4 POWER SUPPLY VOLTAGE SEQUENCE



*1 In terms of voltage variation (voltage drop) while VDD rising edge is below 4.5V, a protection circuit may work, and then this product may not work.

*2 These signals should be measured at the terminal of 100 Ω resistances.

Note1: Display signals (DA0+/-, DA1+/-, DA2+/-, DA3+/-, CKA+/-, DB0+/-, DB1+/-, DB2+/-, DB3+/-, CKB+/-) and TxSEL signal must be "0" voltage, exclude the VALID period (See above sequence diagram). If these signals are higher than 0.3V, the internal circuit is damaged. If some of display and function signals of this product are cut while this product is working, even if the signal input to it once again, it might not work normally. VDD should be cut when the display and function signals are stopped.

Note2: VDD should be 4.5V or more while VDD ON period.

Note3: The backlight should be turned on within the valid period of display and function signals, in order to avoid unstable data display.

Note4: As for the LDVS, it is a pull-up in 2.5V in an internal power supply because of malfunction prevention. Check a sequence also in the state where a module is not connected. ☆

4.5 CONNECTIONS AND FUNCTIONS FOR INTERFACE PINS

4.5.1 LCD panel signal processing board

CN1 socket (LCD module side): FI-X30SSL-HF (Japan Aviation Electronics Industry Limited (JAE)) ☆
Adaptable plug: FI-X30C series/ FI-X30H series/ FI-X30M series
(Japan Aviation Electronics Industry Limited (JAE))

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	CKA-	Odd pixel clock	Note1
9	CKA+		
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	CKB-	Even pixel clock	Note1
21	CKB+		
22	DB3-	Even pixel data 3	Note1
23	DB3+		
24	GND	Ground	Note2
25	TxSEL	Selection of LVDS data input map	Open: Mode A Low: Mode B Note3, Note4
26	RSVD	-	Keep this pin Open.
27	N.C.	-	Keep this pin Open.
28	VDD	Power supply	Note2
29			
30			

Note1: Twist pair wires with 100Ω (Characteristic impedance) should be used between LCD panel signal processing board and LVDS transmitter.
Note2: All GND and VDD terminals should be used without any non-connected lines.
Note3: TxSEL is pulled-up in the product. (Pull-up resistance: 50kΩ)
Note4: See "**4.6 SELECTION OF LVDS DATA INPUT MAP**".

4.5.2 Backlight lamp

Attention: VBLH and VBLC must be connected correctly. Wrong connections will cause electric shock and also break down of the product.

CN201 plug (LCD module side): BHSR-02VS-1 (J.S.T Mfg. Co., Ltd.)
Adaptable socket: SM02B-BHSS-1-TB (J.S.T Mfg. Co., Ltd.)

Pin No.	Symbol	Signal	Remarks
1	VBLH	High voltage (Hot)	Cable color: (Pink)
2	VBLC	Low voltage (Cold)	Cable color: (White)

CN202 plug (LCD module side): BHSR-02VS-1 (J.S.T Mfg. Co., Ltd.)
Adaptable socket: SM02B-BHSS-1-TB (J.S.T Mfg. Co., Ltd.)

Pin No.	Symbol	Signal	Remarks
1	VBLH	High voltage (Hot)	Cable color: (White)
2	VBLC	Low voltage (Cold)	Cable color: (White)

CN203 plug (LCD module side): BHSR-02VS-1 (J.S.T Mfg. Co., Ltd.)
Adaptable socket: SM02B-BHSS-1-TB (J.S.T Mfg. Co., Ltd.)

Pin No.	Symbol	Signal	Remarks
1	VBLH	High voltage (Hot)	Cable color: (Red)
2	VBLC	Low voltage (Cold)	Cable color: (White)

CN204 plug (LCD module side): BHSR-02VS-1 (J.S.T Mfg. Co., Ltd.)
Adaptable socket: SM02B-BHSS-1-TB (J.S.T Mfg. Co., Ltd.)

Pin No.	Symbol	Signal	Remarks
1	VBLH	High voltage (Hot)	Cable color: (Pink)
2	VBLC	Low voltage (Cold)	Cable color: (White)

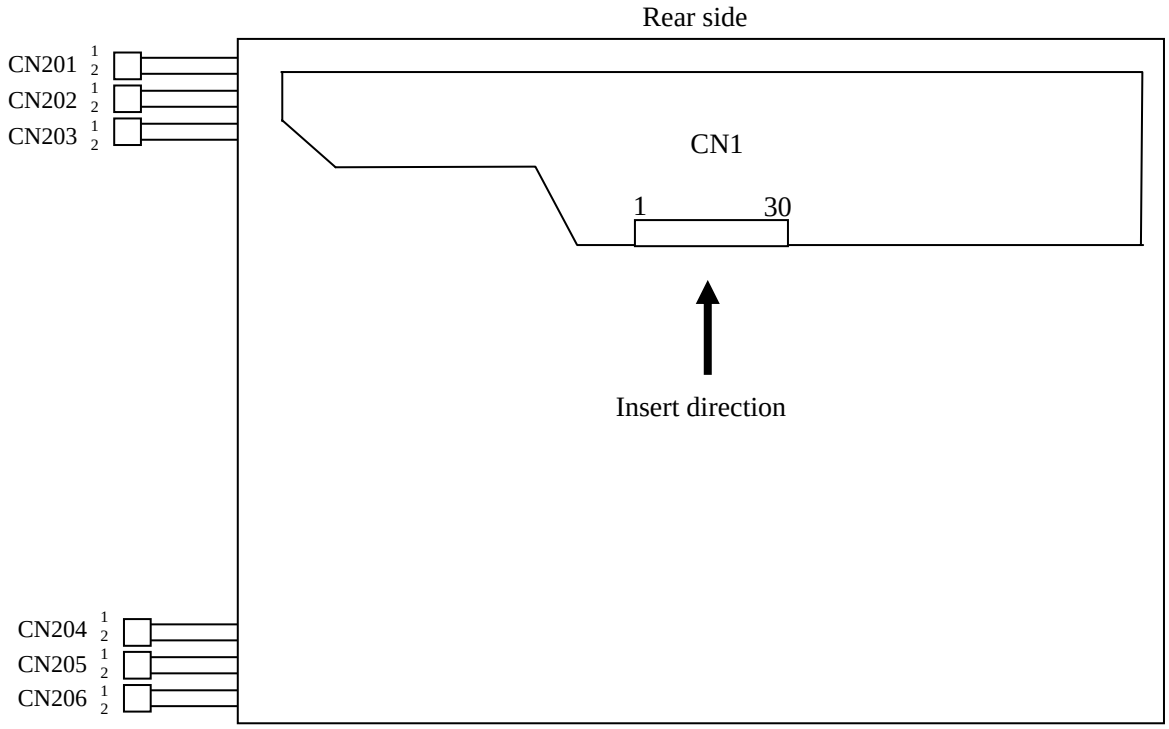
CN205 plug (LCD module side): BHSR-02VS-1 (J.S.T Mfg. Co., Ltd.)
Adaptable socket: SM02B-BHSS-1-TB (J.S.T Mfg. Co., Ltd.)

Pin No.	Symbol	Signal	Remarks
1	VBLH	High voltage (Hot)	Cable color: (White)
2	VBLC	Low voltage (Cold)	Cable color: (White)

CN206 plug (LCD module side): BHSR-02VS-1 (J.S.T Mfg. Co., Ltd.)
Adaptable socket: SM02B-BHSS-1-TB (J.S.T Mfg. Co., Ltd.)

Pin No.	Symbol	Signal	Remarks
1	VBLH	High voltage (Hot)	Cable color: (Red)
2	VBLC	Low voltage (Cold)	Cable color: (White)

4.5.3 Positions of plug and socket



4.6 SELECTION OF LVDS DATA INPUT MAP

4.6.1 Mode A

Input data		Note1		Transmitter Pin	Transmitter DS90CF383, C385 or equivalent			Note2	CN1 Pin	CN1 Symbol
Odd pixel data and control signal		RA0	→	51	TXIN0					
		RA1	→	52	TXIN1		TA1-	→	1	DA0-
		RA2	→	54	TXIN2		TA1+	→	2	DA0+
		RA3	→	55	TXIN3					
		RA4	→	56	TXIN4		TB1-	→	3	DA1-
		RA5	→	3	TXIN6		TB1+	→	4	DA1+
		GA0	→	4	TXIN7					
		GA1	→	6	TXIN8		TC1-	→	5	DA2-
		GA2	→	7	TXIN9		TC1+	→	6	DA2+
		GA3	→	11	TXIN12				7	GND
		GA4	→	12	TXIN13		TCLK1-	→	8	CKA-
		GA5	→	14	TXIN14		TCLK1+	→	9	CKA+
		BA0	→	15	TXIN15					
		BA1	→	19	TXIN18		TD1-	→	10	DA3-
		BA2	→	20	TXIN19	1st	TD1+	→	11	DA3+
		BA3	→	22	TXIN20					
		BA4	→	23	TXIN21					
		BA5	→	24	TXIN22					
	Note3	RSVD	→	27	TXIN24					
	Note3	RSVD	→	28	TXIN25					
		DE	→	30	TXIN26					
		RA6	→	50	TXIN27					
		RA7	→	2	TXIN5					
		GA6	→	8	TXIN10					
		GA7	→	10	TXIN11					
		BA6	→	16	TXIN16					
		BA7	→	18	TXIN17					
	Note3	RSVD	→	25	TXIN23					
		CLK	→	31	CLKIN					
Even pixel data		RB0	→	51	TXIN0					
		RB1	→	52	TXIN1		TA2-	→	12	DB0-
		RB2	→	54	TXIN2		TA2+	→	13	DB0+
		RB3	→	55	TXIN3				14	GND
		RB4	→	56	TXIN4		TB2-	→	15	DB1-
		RB5	→	3	TXIN6		TB2+	→	16	DB1+
		GB0	→	4	TXIN7				17	GND
		GB1	→	6	TXIN8		TC2-	→	18	DB2-
		GB2	→	7	TXIN9		TC2+	→	19	DB2+
		GB3	→	11	TXIN12					
		GB4	→	12	TXIN13		TCLK2-	→	20	CKB-
		GB5	→	14	TXIN14		TCLK2+	→	21	CKB+
		BB0	→	15	TXIN15					
		BB1	→	19	TXIN18		TD2-	→	22	DB3-
		BB2	→	20	TXIN19	2nd	TD2+	→	23	DB3+
		BB3	→	22	TXIN20				24	GND
		BB4	→	23	TXIN21				25	TxSEL
		BB5	→	24	TXIN22				26	RSVD
	Note3	RSVD	→	27	TXIN24				27	N.C.
	Note3	RSVD	→	28	TXIN25				28	VDD
	Note3	RSVD	→	30	TXIN26				29	VDD
		RB6	→	50	TXIN27				30	VDD
		RB7	→	2	TXIN5					
		GB6	→	8	TXIN10					
		GB7	→	10	TXIN11					
		BB6	→	16	TXIN16					
		BB7	→	18	TXIN17					
	Note3	RSVD	→	25	TXIN23					
		CLK	→	31	CLKIN					

4.6.2 Mode B

Input data		Note1		Transmitter Pin	THC63LVDF83A/R or equivalent		Transmitter Pin	THC63LVD823 or equivalent		Note2	CN1 Pin	CN1 Symbol
Odd pixel data and control signal		RA2	→	51	TA0		53	R12				
		RA3	→	52	TA1		54	R13	TA1-	→	1	DA0-
		RA4	→	54	TA2		57	R14	TA1+	→	2	DA0+
		RA5	→	55	TA3		58	R15				
		RA6	→	56	TA4		59	R16	TB1-	→	3	DA1-
		RA7	→	3	TA5		60	R17	TB1+	→	4	DA1+
		GA2	→	4	TA6		63	G12				
		GA3	→	6	TB0		64	G13	TC1-	→	5	DA2-
		GA4	→	7	TB1		65	G14	TC1+	→	6	DA2+
		GA5	→	11	TB2		66	G15			7	GND
		GA6	→	12	TB3		67	G16	TCLK1-	→	8	CKA-
		GA7	→	14	TB4		68	G17	TCLK1+	→	9	CKA+
		BA2	→	15	TB5		73	B12				
		BA3	→	19	TB6		74	B13	TD1-	→	10	DA3-
		BA4	→	20	TC0	1st	75	B14	TD1+	→	11	DA3+
		BA5	→	22	TC1		76	B15				
		BA6	→	23	TC2		77	B16				
		BA7	→	24	TC3		78	B17				
	Note3	RSVD	→	27	TC4		7	RSVD				
	Note3	RSVD	→	28	TC5		8	RSVD				
		DE	→	30	TC6		9	DE				
		RA0	→	50	TD0		51	R10				
		RA1	→	2	TD1		52	R11				
		GA0	→	8	TD2		61	G10				
		GA1	→	10	TD3		62	G11				
		BA0	→	16	TD4		69	B10				
		BA1	→	18	TD5		70	B11				
	Note3	RSVD	→	25	TD6		-					
		CLK	→	31	CLKIN		10	CLK				
Even pixel data		RB2	→	51	TA0		81	R22				
		RB3	→	52	TA1		82	R23	TA2-	→	12	DB0-
		RB4	→	54	TA2		83	R24	TA2+	→	13	DB0+
		RB5	→	55	TA3		84	R25			14	GND
		RB6	→	56	TA4		85	R26	TB2-	→	15	DB1-
		RB7	→	3	TA5		86	R27	TB2+	→	16	DB1+
		GB2	→	4	TA6		91	G22			17	GND
		GB3	→	6	TB0		92	G23	TC2-	→	18	DB2-
		GB4	→	7	TB1		93	G24	TC2+	→	19	DB2+
		GB5	→	11	TB2		94	G25				
		GB6	→	12	TB3		95	G26	TCLK2-	→	20	CKB-
		GB7	→	14	TB4		96	G27	TCLK2+	→	21	CKB+
		BB2	→	15	TB5		99	B22				
		BB3	→	19	TB6		100	B23	TD2-	→	22	DB3-
		BB4	→	20	TC0	2nd	1	B24	TD2+	→	23	DB3+
		BB5	→	22	TC1		2	B25			24	GND
		BB6	→	23	TC2		5	B26			25	TxSEL
		BB7	→	24	TC3		6	B27			26	RSVD
	Note3	RSVD	→	27	TC4		-				27	N.C.
	Note3	RSVD	→	28	TC5		-				28	VDD
	Note3	RSVD	→	30	TC6		-				29	VDD
		RB0	→	50	TD0		79	R20			30	VDD
		RB1	→	2	TD1		80	R21				
		GB0	→	8	TD2		89	G20				
		GB1	→	10	TD3		90	G21				
		BB0	→	16	TD4		97	B20				
		BB1	→	18	TD5		98	B21				
	Note3	RSVD	→	25	TD6		-					
		CLK	→	31	CLKIN		-					

Note1: LSB (Least Significant Bit) – RA0, GA0, BA0, RB0, GB0, BB0
MSB (Most Significant Bit) – RA7, GA7, BA7, RB7, GB7, BB7

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

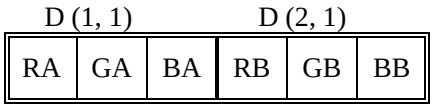
Note3: Input signal RSVD is not used inside the product, but do not keep pin open to avoid noise problem.

4.7 DISPLAY COLORS AND INPUT DATA SIGNALS

This product can display in equivalent to 16,777,216 colors in 256 gray scales. Also the relation between display colors and input data signals is as the following table.

Display colors		Data signal (0: Low level, 1: High level)																									
		RA7	RA6	RA5	RA4	RA3	RA2	RA1	RA0	GA7	GA6	GA5	GA4	GA3	GA2	GA1	GA0	BA7	BA6	BA5	BA4	BA3	BA2	BA1	BA0
		RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0	GB7	GB6	GB5	GB4	GB3	GB2	GB1	GB0	BB7	BB6	BB5	BB4	BB3	BB2	BB1	BB0
Basic Colors	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
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Red gray scale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
	dark	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	↑					:								:								:			
	↓					:								:								:			
	bright	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Green gray scale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	↑					:								:								:			
	↓					:								:								:			
	bright	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Blue gray scale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	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	1	0
	↑					:								:								:			
	↓					:								:								:			
	bright	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

4.8 DISPLAY POSITION



D(1, 1)	D(2, 1)	•••	D(1280, 1)
D(1, 2)	D(2, 2)	•••	D(1280, 2)
•	•	•	•
•	•	•	•
•	•	•	•
•	•	•	•
•	•	•	•
•	•	•	•
D(1,1024)	D(2, 1024)	•••	D(1280, 1024)

4.9 INPUT SIGNAL TIMINGS

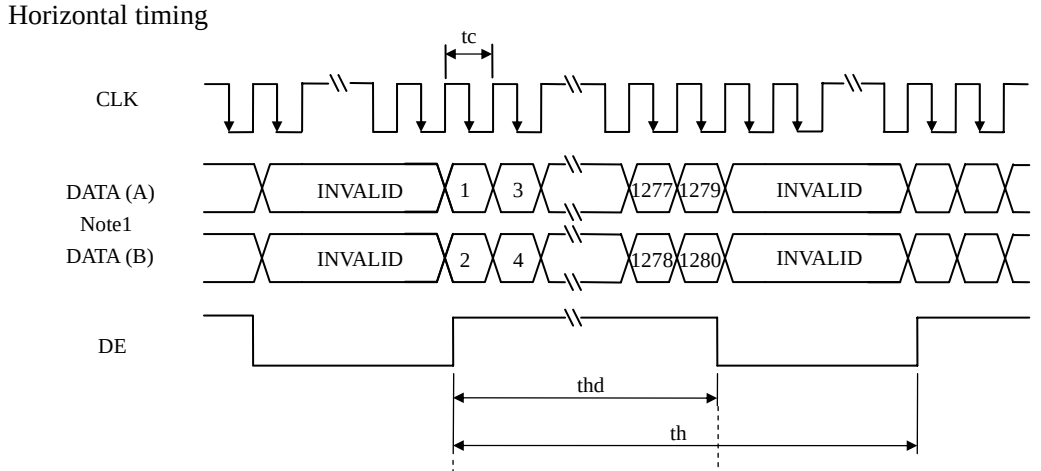
4.9.1 Timing characteristics

Parameter			Symbol	min.	typ.	max.	Unit	Remarks
CLK	Frequency		1/tc	49	54	59	MHz	18.52 ns (typ.)
	Duty		-		-		-	Note2
	Rise time, Fall time		-				ns	
DATA	CLK-DATA	Setup time	-		-		ns	Note2
		Hold time	-				ns	
	Rise time, Fall time		-				ns	
DE	Horizontal	Cycl	th	12.3	15.63	20.59	µs	64.0 kHz (typ.) Note1, Note2
				660	844	1,024	CLK	
		Display period	thd		640		CLK	
	Vertical (One frame)	Cycle	tv	13.1	16.6	17.5	ms	60.0 Hz (typ.) Note1
				1,030	1,066	1,422	H	
		Display period	tvd		1,024		H	
	CLK-DE	Setup time	-		-		ns	Note2
		Hold time	-				ns	
	Rise time, Fall time		-				ns	

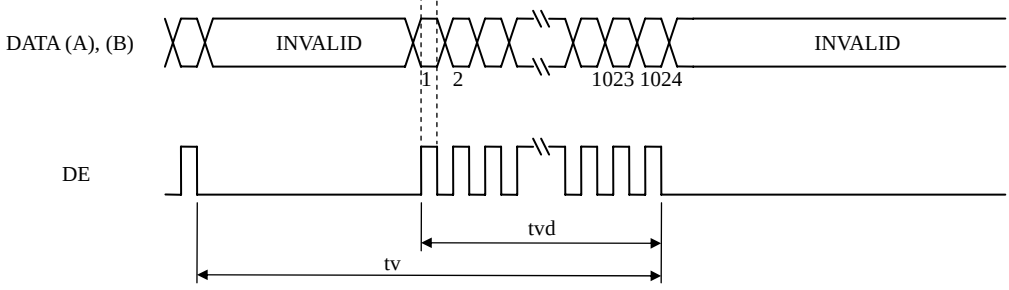
Note1: Definition of parameters is as follows.
tc = 1CLK, th = 1H
Note2: See the data sheet of LVDS transmitter.

4.9.2 Input signal timing chart

Horizontal timing



Vertical timing



Note1: DATA (A) = RA0-RA7, GA0-GA7, BA0-BA7
DATA (B) = RB0-RB7, GB0-GB7, BB0-BB7

4.10 OPTICS

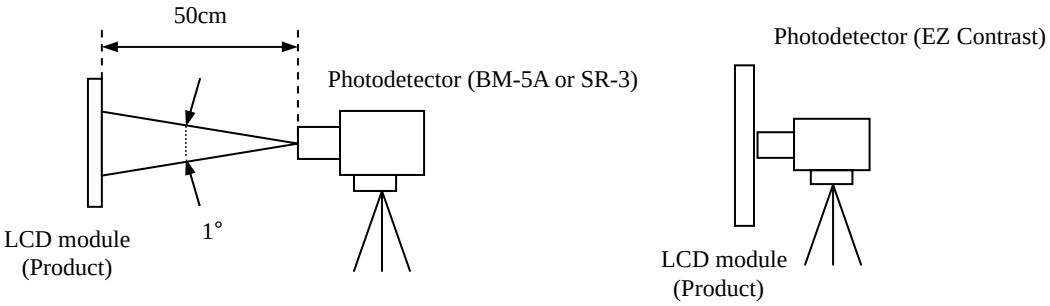
4.10.1 Optical characteristics

(Note1, Note2)

Parameter		Condition	Symbol	min.	typ.	max.	Unit	Measuring instrument	Remarks	
Luminance		White at center θR = 0°, θL = 0°, θU = 0°, θD = 0°	L	230	290	-	cd/m^2	BM5A or SR-3	-	☆
Contrast ratio		White/Black at center θR = 0°, θL = 0°, θU = 0°, θD = 0°	CR	600	800	-	-	BM5A or SR-3	Note3	☆
Luminance uniformity		White θR = 0°, θL = 0°, θU = 0°, θD = 0°	LU	-	1.1	1.25	-	BM-5A	Note4	
Chromaticity	White	x coordinate	Wx	0.270	0.300	0.330	-	SR-3	Note5	
		y coordinate	Wy	0.285	0.315	0.345	-			
	Red	**x** coordinate	Rx	0.62	0.65	0.68	-			
		y coordinate	Ry	0.30	0.33	0.36	-			
	Green	**x** coordinate	Gx	0.26	0.29	0.32	-			
		y coordinate	Gy	0.59	0.62	0.65	-			
	Blue	**x** coordinate	Bx	0.11	0.14	0.17	-			
		y coordinate	By	0.05	0.08	0.11	-			
Color gamut		θR = 0°, θL = 0°, θU = 0°, θD = 0° at center, against NTSC color space	C	65	72	-	%			
Response time		Black to white	Ton	-	10	20	ms	BM-5A	Note6 Note7	
		White to black	Toff	-	10	20	ms			☆
		Ton + Toff		-	20	40	ms			
Viewing angle	Right	θU = 0°, θD = 0°, CR ≥ 10	θR	70	88	-	°	BM-5A, EZ Contrast	Note8	
	Left	θU = 0°, θD = 0°, CR ≥ 10	θL	70	88	-	°			
	Up	θR = 0°, θL = 0°, CR ≥ 10	θU	70	88	-	°			
	Down	θR = 0°, θL = 0°, CR ≥ 10	θD	70	88	-	°			
Viewing angle γ characteristic	Horizontal	at center, 170° over θU = 0°, θD = 0°	-	-	-	0.3	-	BM-5A, EZ Contrast	Note8 Note9	☆
	Vertical	at center, 170° over θR = 0°, θL = 0°	-	-	-	0.3				

Note1: These are initial characteristics.
Note2: Measurement conditions are as follows.
Ta = 25°C, VDD = 5.0V, IBL = 6.0mArms/lamp, Display mode: SXGA,
Horizontal cycle = 1/64.0kHz, Vertical cycle = 1/60.0Hz

Optical characteristics are measured after 20minutes from working the product, in the dark room. Also measurement methods are as follows.



Note3: See "**4.10.2 Definition of contrast ratio**".
Note4: See "**4.10.3 Definition of luminance uniformity**".
Note5: These coordinates are found on CIE 1931 chromaticity diagram.
Note6: Product surface temperature: TopF = 35°C
Note7: See "**4.10.4 Definition of response times**".
Note8: See "**4.10.5 Definition of viewing angles**".
Note9: The method of calculating γ depends on the VESA definition. (SLOPE function is used.) ☆

4.10.2 Definition of contrast ratio

The contrast ratio is calculated by using the following formula.

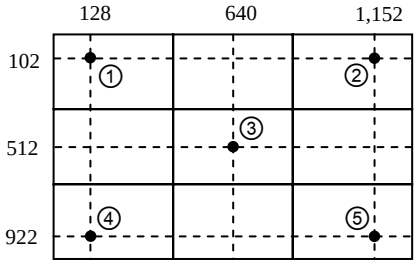
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance of white screen}}{\text{Luminance of black screen}}$$

4.10.3 Definition of luminance uniformity

The luminance uniformity is calculated by using following formula.

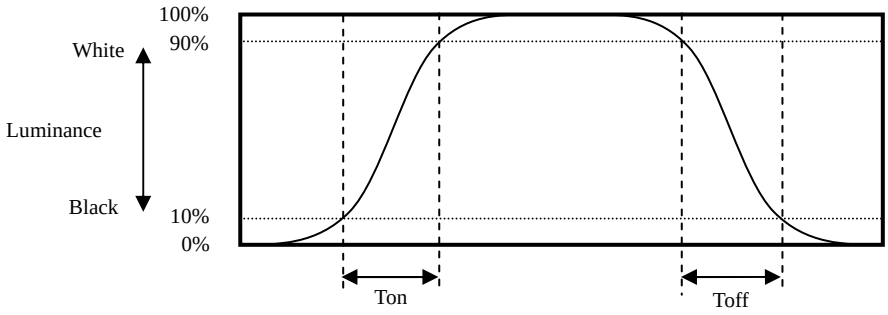
$$\text{Luminance uniformity (LU)} = \frac{\text{Maximum luminance from ① to ⑤}}{\text{Minimum luminance from ① to ⑤}}$$

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

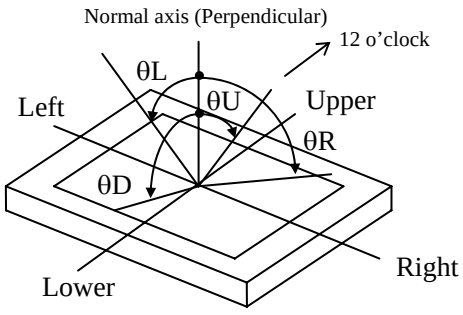


4.10.4 Definition of response times

Response time is measured, the luminance changes from "black" to "white", or "white" to "black" on the same screen point, by photo-detector. Ton is the time it takes the luminance change from 10% up to 90%. Also Toff is the time it takes the luminance change from 90% down to 10% (See the following diagram.).



4.10.5 Definition of viewing angles



5. ESTIMATED LUMINANCE LIFETIME ☆

The luminance lifetime is the time from initial luminance to half-luminance.

This lifetime is the estimated value, and is not guarantee value.

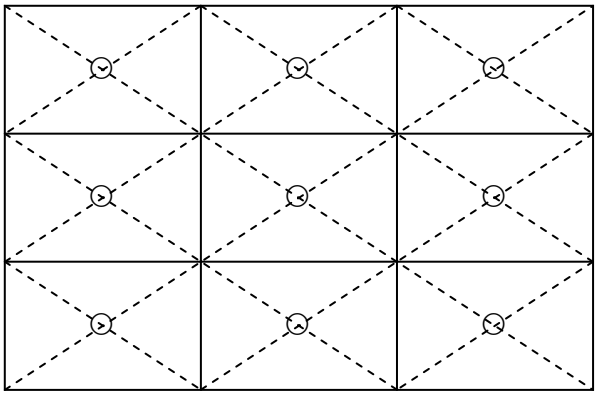
Condition		Luminance lifetime (MTTF) Note1, Note2	Unit
Module	25°C (Ambient temperature of the product) Continuous operation, IBL=6.0mArms	22,000	h
	50°C (Surface temperature at screen center) Continuous operation, IBL=6.0mArms	19,000	h
Cold cathode fluorescent lamp	25°C (Ambient temperature of the lamp) Continuous operation, IBL=6.0mArms	50,000 min,	h

Note1: MTTF is mean time to half-luminance.
Note2: In case the product works under low temperature environment, the lifetime becomes short.

6. RELIABILITY TESTS

Test item		Condition	Judgment Note1
High temperature and humidity (Operation)		① 60 ± 2°C, RH = 60%, 240hours ② Display data is white.	No display malfunctions
Heat cycle (Operation)		① 0 ± 3°C…1hour 55 ± 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 directions	No display malfunctions No physical damages
Mechanical shock (Non operation)		① 294m/ s^2, 11ms ② X, Y, Z directions ③ 3 times each directions	
ESD (Operation)		① 150pF, 150Ω, ±10kV ② 9 places on a panel surface Note2 ③ 10 times each places at 1 sec interval	No display malfunctions
Dust (Operation)		① Sample dust: No.15 (by JIS-Z8901) ② 15 seconds stir ③ 8 times repeat at 1 hour interval	
Low pressure	Operation	① 53.3 kPa ② 0°C±3°C…24 hours ③ 55°C±3°C…24 hours	
	Non-operation	① 15 kPa ② -20°C±3°C…24 hours ③ 60°C±3°C…24 hours	

Note1: Display functions are checked under the same conditions as product inspection.
Note2: See the following figure for discharge points

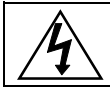


7. PRECAUTIONS

7.1 MEANING OF CAUTION SIGNS

The following caution signs have very important meaning. **Be sure to read "7.2 CAUTIONS" and "7.3 ATTENTIONS", after understanding these contents!**

This sign has the meaning that customer will be injured by personal or the product will sustain a damage, if customer has wrong operations.



This sign has the meaning that customer will get an electrical shock, if customer has wrong operations.

This sign has the meaning that customer will be injured by personal, if customer has wrong operations.

7.2 CAUTIONS

- **Do not touch the working backlight. There is a danger of an electric shock.**

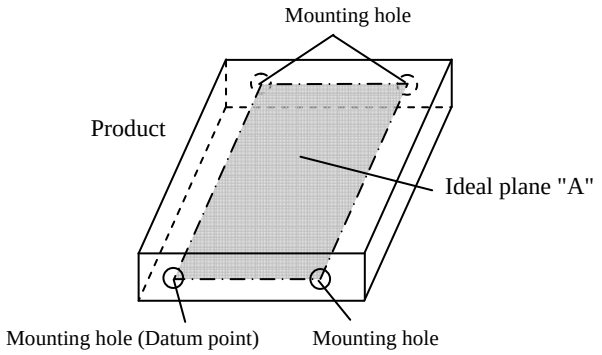
- **Do not touch the working backlight. There is a danger of burn injury.**
- **Do not shock and press the LCD panel and the backlight! There is a danger of breaking, because they are made of glass. (Shock: To be not greater 294m/s^2 and to be not greater 11ms, Pressure: To be not greater 19.6N (ϕ16mm jig))**

7.3 ATTENTIONS 

7.3.1 Handling of the product

① Take hold of both ends without touching the circuit board when the product (LCD module) is picked up from inner packing box to avoid broken down or misadjustment, because of stress to mounting parts on the circuit board.
② Do not hook nor pull cables such as lamp cable, and so on, in order to avoid any damage.
③ When the product is put on the table temporarily, display surface must be placed downward.
④ When handling the product, take the measures of electrostatic discharge with such as earth band, ionic shower and so on, because the product may be damaged by electrostatic.
⑤ The torque for product mounting screws must never exceed 0.67N·m. Higher torque might result in distortion of the bezel. And the length of product mounting screws from surface of plate(product side) must be 4.0mm to 7.0mm.

⑥ The product must be installed using mounting holes without undue stress such as bends or twist (See outline drawings). And do not add undue stress to any portion (such as bezel flat area). Bends or twist described above and undue stress to any portion may cause display mura.
Recommended installing method: Ideal plane "A" is defined by one mounting hole (datum point) and other mounting holes. The ideal plane "A" should be the same plane within ±0.3 mm.



⑦ Do not press or rub on the sensitive product surface. When cleaning the product surface, use of the cloth with ethanolic liquid such as screen cleaner for LCD is recommended.
⑧ Do not push nor pull the interface connectors while the product is working.
⑨ Do not locate the lamp cable on the signal processing board. A noise may occur on the display image.
⑩ Properly connect the plug (backlight side) to adaptable socket (inverter side) without incomplete connection. After connecting, be careful not to hook the lamp cables because incomplete connection may occur by hooking the lamp cables. This incomplete connection may cause abnormal operation of high voltage circuit.
⑪ If the lamp cable is attached on the metal part of the product directly, high frequency leak current to the metal part may occur, then the brightness may decrease or the lamp may not be turned on.
⑫ When handling the product, use of an original protection sheet on the product surface (polarizer) is recommended for protection of product surface. Adhesive type protection sheet may change color or characteristics of the polarizer.
⑬ Usually liquid crystals don't leak through the breakage of glasses because of the surface tension of thin layer and the construction of LCD panel. But, if you contact with liquid crystal for the worst, please wash it out with soap

7.3.2 Environment

① Do not operate or store in high temperature, high humidity, dewdrop atmosphere or corrosive gases. Keep the product in packing box with antistatic pouch in room temperature to avoid dusts and sunlight, when storing the product.
② In order to prevent dew condensation occurring by temperature difference, the product packing box should be opened after enough time being left under the environment of an unpacking room. Evaluate the leaving time sufficiently because a situation of dew condensation occurring is changed by the environmental temperature and humidity. (Recommended leaving time: 6 hours or more with packing state)
③ Do not operate in high magnetic field. Circuit boards may be broken down by it.
④ This product is not designed as radiation hardened.

7.3.3 Characteristics

☆

The following items are neither defects nor failures.

① Response time, luminance and color may be changed by ambient temperature.
② Display mura, flicker, vertical seam or small spot may be observed depending on display patterns.
③ Optical characteristics (e.g. luminance, display uniformity, etc.) gradually is going to change depending on operating time, and especially low temperature, because the LCD has cold cathode fluorescent lamps.
④ Do not display the fixed pattern for a long time because it may cause image sticking. Use a screen saver, if the fixed pattern is displayed on the screen.
⑤ The display color may be changed depending on viewing angle because of the use of condenser sheet in the backlight.
⑥ Optical characteristics may be changed depending on input signal timings.
⑦ The interference noise between input signal frequency for this product's signal processing board and luminance control frequency of the inverter may appear on a display. Set up luminance control frequency of the inverter so that the interference noise does not appear.
⑧ After the product is stored under condition of low temperature or dark place for a long time, the cold cathode fluorescent lamp may not be turned on under the same condition because of the general characteristic of cold cathode fluorescent lamp. In addition, when Luminance control ratio is low in pulse width modulation method inverter, the lamp may not be turned on. In this case, power should be supplied again.

7.3.4 Other

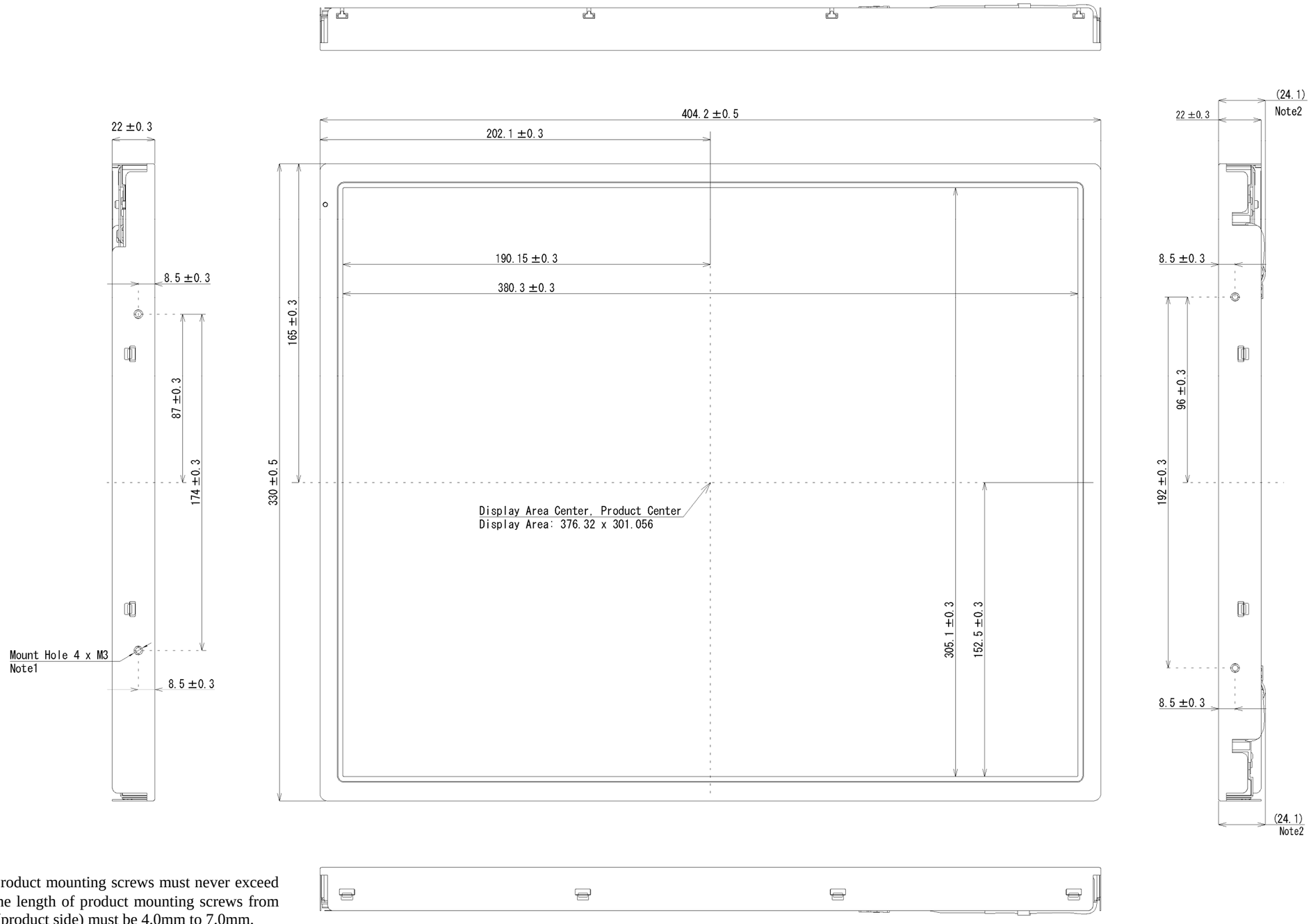
① All GND and VDD terminals should be used without any non-connected lines.
② Do not disassemble a product or adjust variable resistors.
③ Pack the product with original shipping package, in order to avoid any damages during transportation, when returning the product to NEC for repair and so on.
④ The LCD module by itself or integrated into end product should be packed and transported with display in the vertical position. Otherwise the display characteristics may be degraded.
⑤ The information of China RoHS directive six hazardous substances or elements in this product is as follows.
⑨ The information of China RoHS directive six hazardous substances or elements in this product is as follows.

China RoHS directive six hazardous substances or elements					
Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr VI)	Polybrominated Biphenys (PBB)	Polybrominated Biphenyl Ethers (PBDE)
×	×	○	○	○	○

Note1: ○: This indicates that the poisonous or harmful material in all the homogeneous materials for this part is equal or below the limitation level of SJ/T11363-2006 standard regulation.
×: This indicates that the poisonous or harmful material in all the homogeneous materials for this part is above the limitation level of SJ/T11363-2006 standard regulation.

8. OUTLINE DRAWINGS

8.1 FRONT VIEW



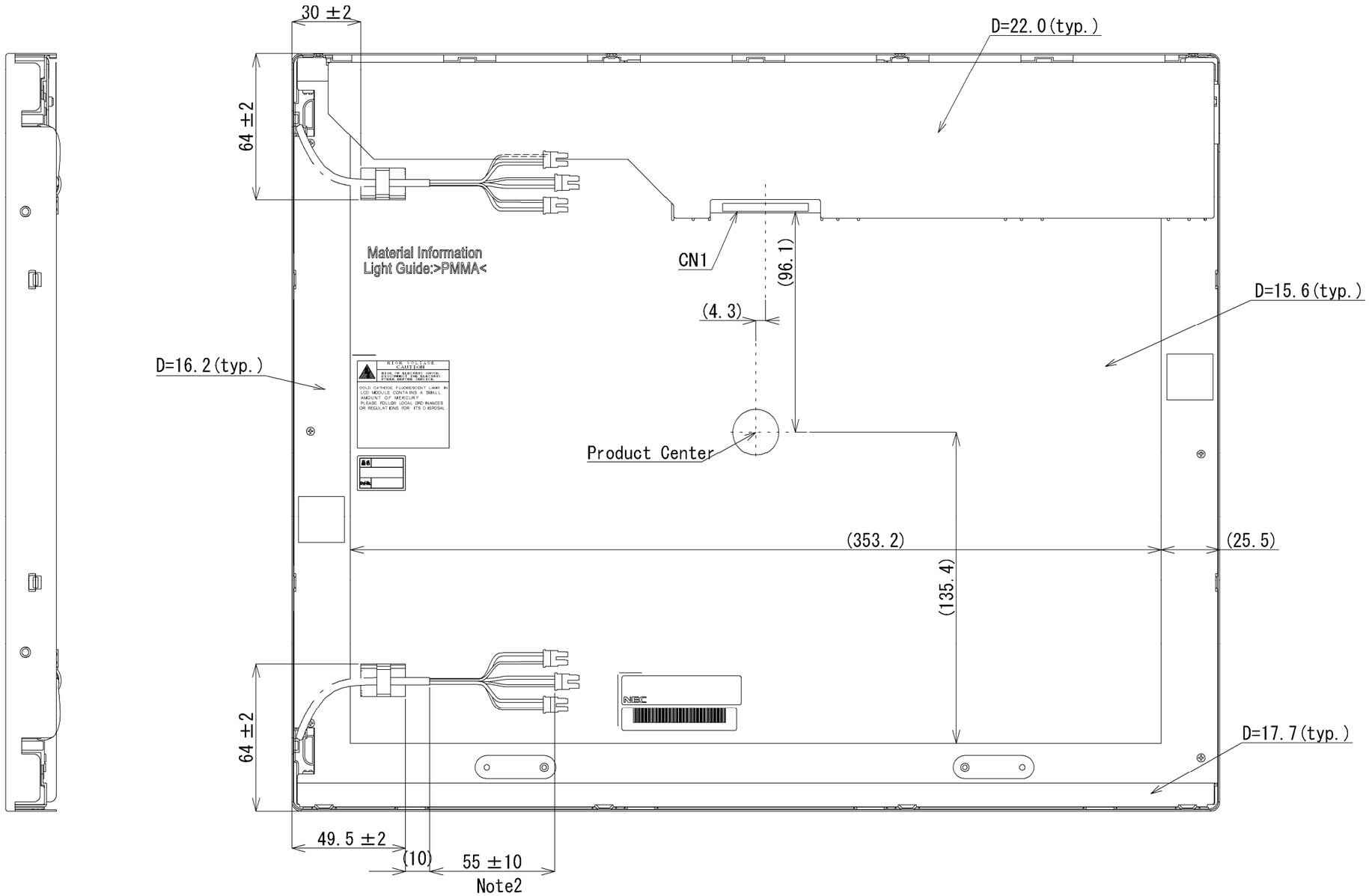
Note1: The torque for product mounting screws must never exceed 0.67N·m. And the length of product mounting screws from surface of plate (product side) must be 4.0mm to 7.0mm.

Note2: Excluding lamp cable, cable clamp and projections.

Note3: The values in parentheses are for reference.

Unit: mm

8.2 REAR VIEW



Note1: The values in parentheses are for reference.
Note2: The cable of up side and down side is the same length.

Unit: mm