PRELIMINARY

NEC LCD Technologies, Ltd.

TFT COLOR LCD MODULE

NL128102BC29-01

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

PRELIMINARY DATA SHEET

DOD-PD-0410 (2nd edition)

This PRELIMINARY DATA SHEET is updated document from DOD-PD-0104(1).

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

INTRODUCTION

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

Specific: Military systems, aircraft, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems (medical equipment, etc.) and any other equipment

The quality grade of this product is ***"Standard"*** unless otherwise specified in this document. If customers intend to use this product for applications other than those specified for ***"Standard"*** quality grade, they should contact NEC sales representative in advance.

CONTENTS

1. OUTLINE

1.1 STRUCTURE AND PRINCIPLE

Color LCD module NL128102BC29-01 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 color-filter glass substrate.

Color (Red, Green, Blue) data signals from a host system (e.g. PC, 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. Color images are created by regulating the amount of transmitted light through the TFT array of red, green and blue dots.

1.2 APPLICATIONS

- Monitor for PC

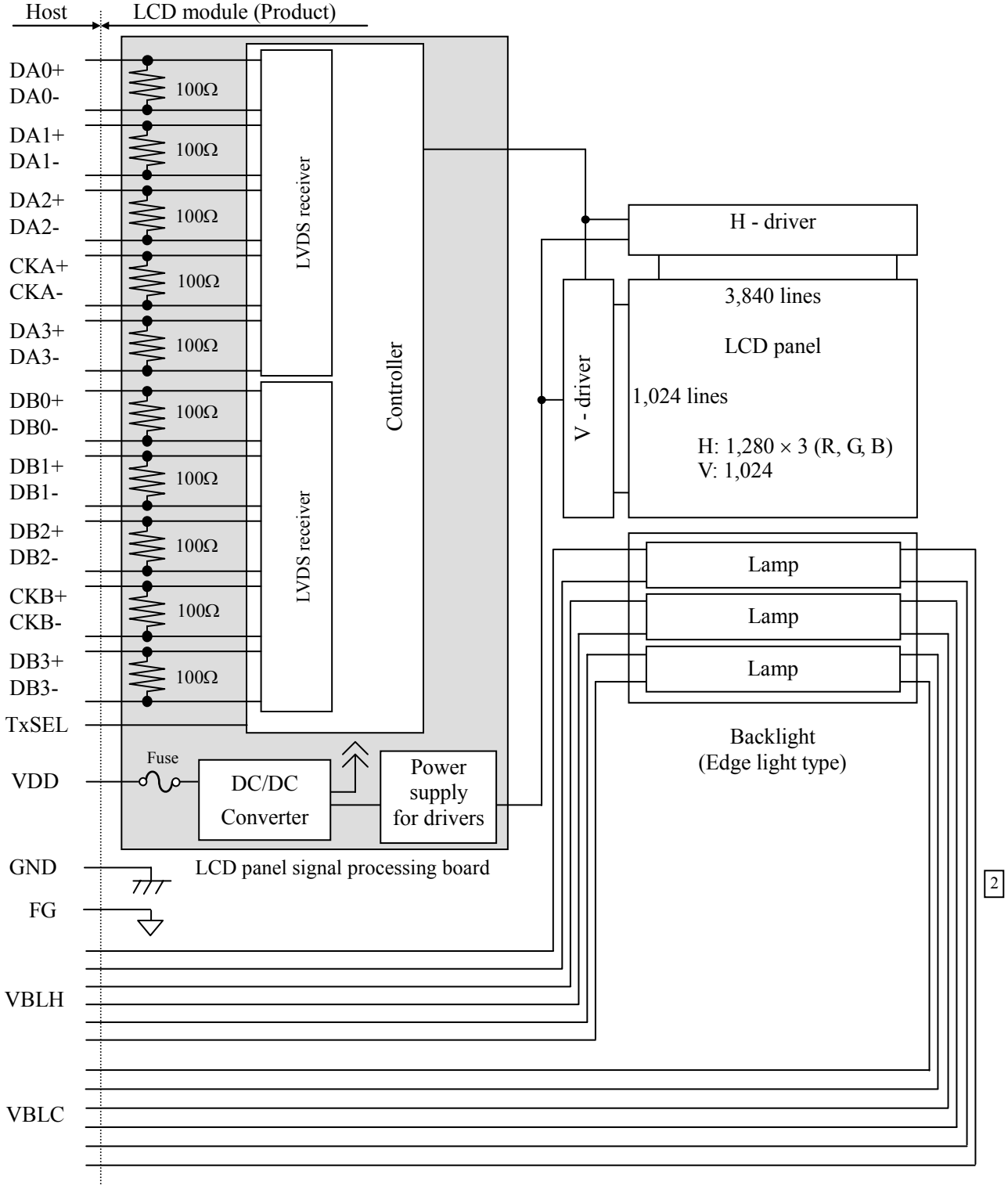
1.3 FEATURES

- Ultra-wide viewing angle
- Wide color gamut
- High contrast
- High resolution
- LVDS interface
- Selectable LVDS input map
- Edge light type (without inverter)

2. GENERAL SPECIFICATIONS

Display area	376.32 (H) × 301.056 (V) mm (typ.)	
Diagonal size of display	48.0 cm (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	2,900 g (typ.)	2
Contrast ratio	450:1 (typ.)	2
Viewing angle	*At the contrast ratio ≥10:1* • Horizontal: Right side 85° (typ.), Left side 85° (typ.) • Vertical: Up side 85° (typ.), Down side 85° (typ.)	
Designed viewing direction	Viewing angle with optimum grayscale (γ=2.2): normal axis	
Polarizer surface	Antiglare	2
Polarizer pencil-hardness	2H (min.) [by JIS K5400]	2
Color gamut	*At LCD panel center* 72 % (typ.) [against NTSC color space]	
Response time	*Ton+Toff (10%←→ 90%)* (25) ms (typ.)	
Luminance	*At IBL=6.0mArms / lamp* (300) cd/m^2 (typ.)	
Signal system	LVDS 2 port 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 and checkered flag pattern* 26.8 W (typ., Power dissipation of the inverter does not include.)	2

3. BLOCK DIAGRAM



Note1: Connections between GND (Signal ground), FG (Frame ground) and VBLC (Lamp low voltage terminal) in the product

GND - FG	Not 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	2,900 (typ.), 3,100 (max.)		g

2

Note1: Excluding lamp cable and cable clamp. 2
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	2
Input voltage for signals	Display signals Note1	VD	-0.3 to +2.8	V	Ta = 25°C VDD= 5.0V
	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 2
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: Ta = 55°C, RH = 70%

4.3 ELECTRICAL CHARACTERISTICS

4.3.1 LCD panel signal processing board

2

(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	-	(680) Note1	(1,400) Note2	mA	at VDD = 5.0V
Permissible ripple voltage		VRP	-	-	100	mVp-p	for VDD
Differential input threshold voltage for LVDS receiver	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	High must be Open.			-	TxSEL Note4
	Low	VFL	-	-	0.5	V	
Input current for TxSEL signal		IFL	-80	-	+10	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 2

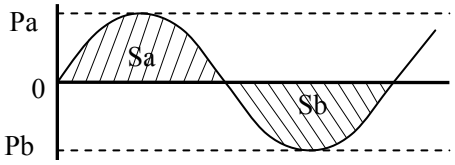
(Ta=25°C, Note1)

Parameter	Symbol	min.	typ.	max.	Unit	Remarks
Lamp current	IBL	3.5	6.0	7.0	mArms	at IBL=6.0mArms: (300)cd/m^2 Note3
Lamp voltage	VBLH	-	(650)	-	Vrms	Note2, Note3
Lamp starting voltage	VS	(1,350)	-	-	Vrms	Ta = 25°C Note2, Note3
		(1,550)	-	-	Vrms	Ta = 0°C Note2, Note3
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).



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

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

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.

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
VDD	5.0V	≤ 100	mVp-p

Note1: The permissible ripple voltage includes spike noise.

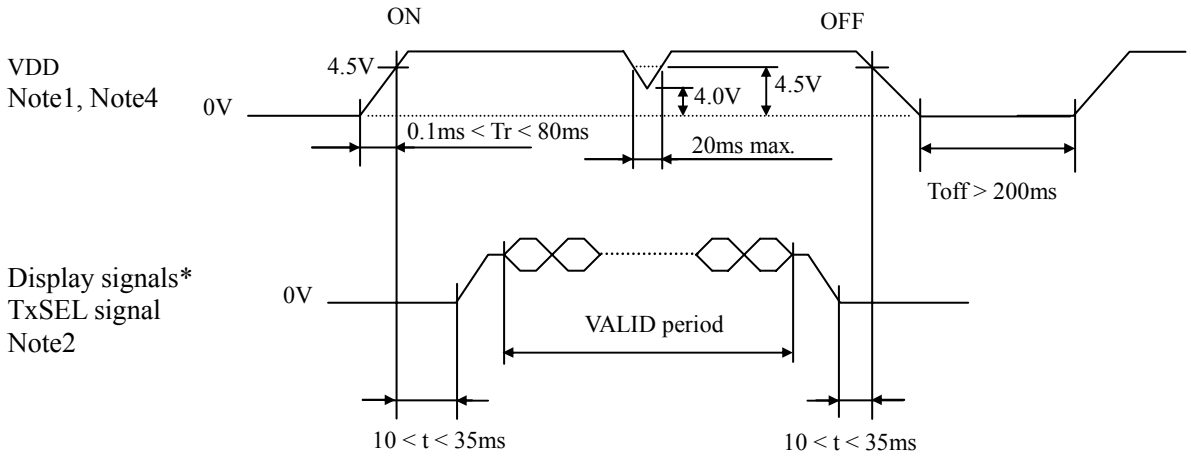
4.3.4 Fuse

Parameter	Fuse		Rating	Fusing current	Remarks
	Type	Supplier			
VDD	(FSC16402AB)	KAMAYA ELECTRIC Co., Ltd.	(4.0 A) (32 V)	(8 A), (5s max.)	Note1

2

Note1: The power supply capacity should be more than the fusing current. If the power supply capacity is less than the fusing current, the fuse may not blow for a short time, and then nasty smell, smoking and so on may occur.

4.4 POWER SUPPLY VOLTAGE SEQUENCE 2



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

Note1: In terms of voltage variation (voltage drop) while VDD rising edge is below (4.5)V, a protection circuit may work, and then this product may not work.

Note2: 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. If customer stops the display and function signals, they should be cut VDD.

Note3: VDD should be 4.5V or more while VDD ON period.

Note4: The backlight power supply voltage should be inputted within the valid period of display and function signals, in order to avoid unstable data display.

4.5 CONNECTIONS AND FUNCTIONS FOR INTERFACE PINS

4.5.1 LCD panel signal processing board

CN1 socket (LCD module side): FI-X30SL-HF (Japan Aviation Electronics Industry Limited (JAE))
Adaptable plug: FI-X30C/ FI-30H/ FI-X30M (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	-
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	-
15	DB1-	Even pixel data 1	Note1
16	DB1+		
17	GND	Ground	-
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	-
25	TxSEL	Selection of LVDS input map	High or Open: Mode A Low: Mode B Note2, Note3
26	RSVD	-	Keep this pin Open.
27	N.C.	-	Keep this pin Open.
28	VDD	Power supply	-
29			
30			

Note1: Twist pair wires with 100Ω (Characteristic impedance) should be connected between LCD panel signal processing board and LVDS transmitter.
Note2: TxSEL is pulled-up in the product. (Pull-up resistor: 50kΩ)
Note3: See "**4.6 SELECTION OF LVDS INPUT MAP**".

4.5.2 Backlight lamp

Attention: VBLH and VBLC must be connected correctly. If customer connects wrongly, customer will be hurt and the module will be broken.

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: Gray

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: Gray

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: Gray

2

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: Gray

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.)

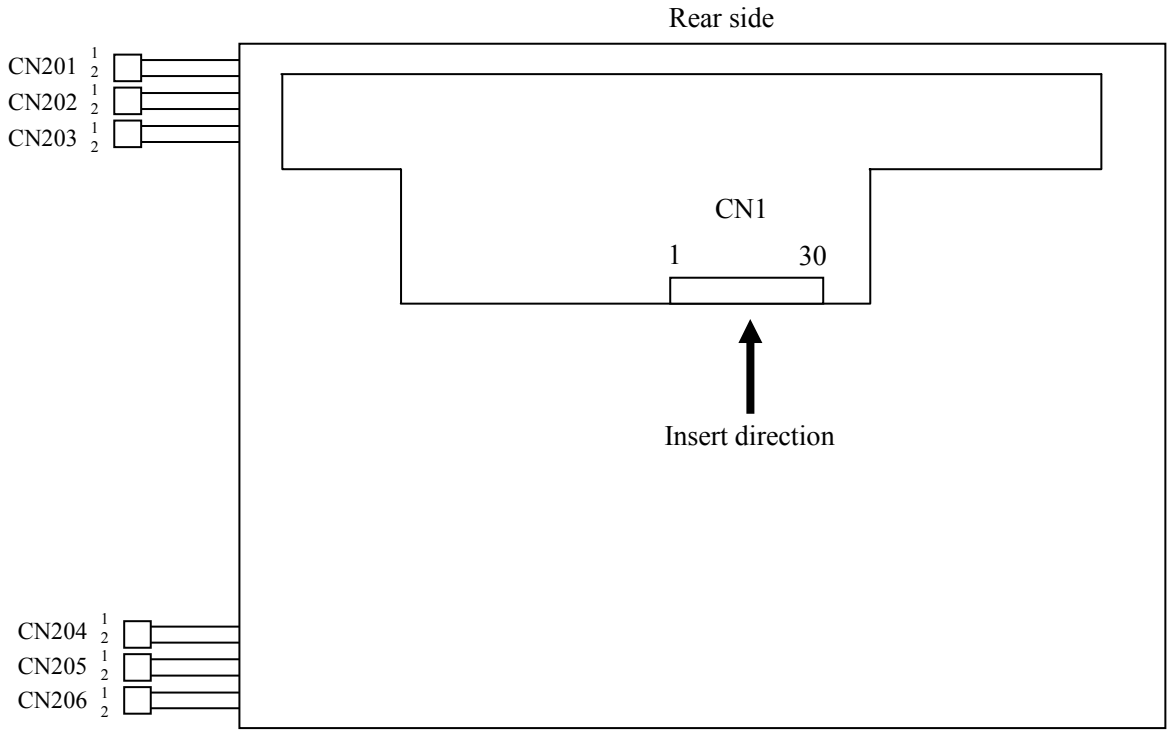
Pin No.	Symbol	Signal	Remarks
1	VBLH	High voltage (Hot)	Cable color: White
2	VBLC	Low voltage (Cold)	Cable color: Gray

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: Gray

2

4.5.3 Positions of plugs and a socket



4.6 SELECTION OF LVDS 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	TXIN18					
	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 connected between LCD panel signal processing board and LVDS transmitter.

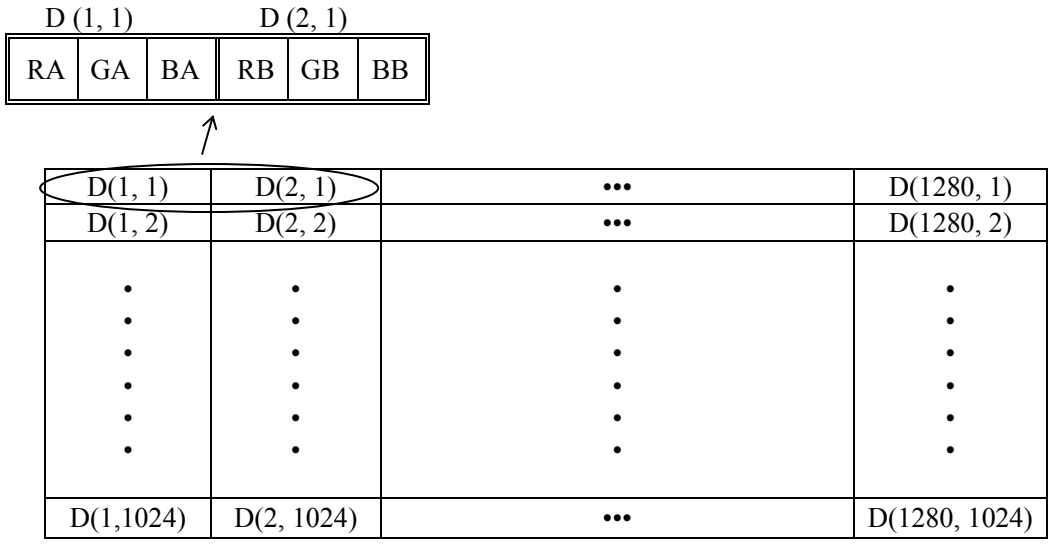
Note3: Input signal RSVD is not used inside the product. It is recommended that these signals are set to Low.

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



4.9 INPUT SIGNAL TIMINGS

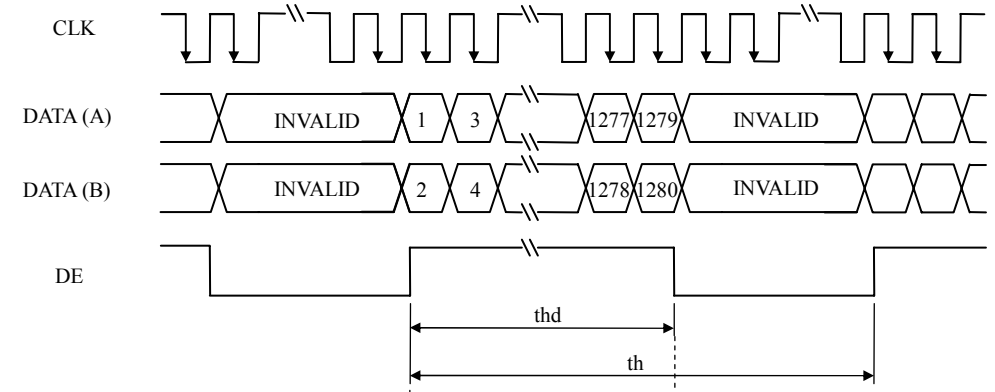
4.9.1 Timing characteristics 2

Parameter			Symbol	min.	typ.	max.	Unit	Remarks
CLK	Frequency		-	(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	Cycle	th	(12.3)	15.63	20.59	µs	64.0 kHz (typ.) Note1, Note2, Note3
				(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	-	H	
		Display period	tvd	1,024			H	
	CLK-DE	Setup time	-	-			ns	Note2
		Hold time	-				ns	
	Rise time, Fall time		-				ns	

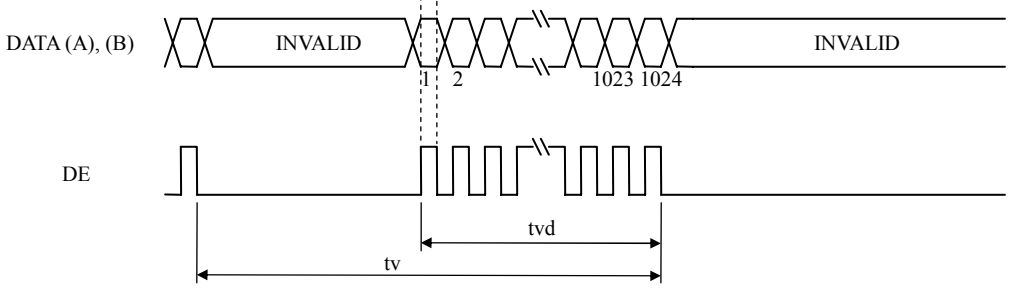
Note1: Definition of parameters is as follows.
tc = 1CLK, th = 1H
Note2: See the data sheet of LVDS transmitter.
Note3: "th" must keep the fluctuation within ±1 CLK, because of avoidance of image sticking.

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

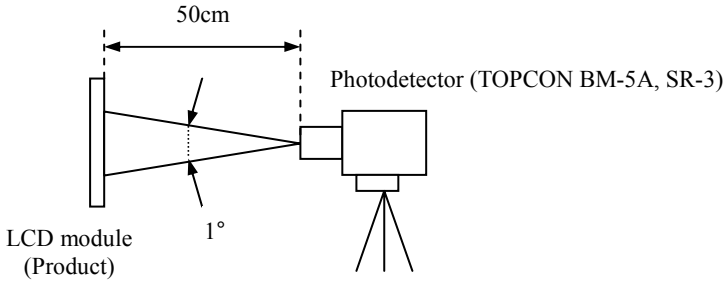
2

(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	(220)	(300)	-	cd/m^2	SR-3	-
Contrast ratio		White/Black at center θR = 0°, θL = 0°, θU = 0°, θD = 0°	CR	(300)	450	-	-	SR-3	Note3
Luminance uniformity		-	LU	-	1.2	1.3	-	BM-5A	Note4
Chromaticity	White	**x** coordinate	Wx	-	0.313	-	-	SR-3	Note5
		y coordinate	Wy	-	0.329	-	-		
	Red	**x** coordinate	Rx	-	(0.65)	-	-		
		y coordinate	Ry	-	(0.33)	-	-		
	Green	**x** coordinate	Gx	-	(0.29)	-	-		
		y coordinate	Gy	-	(0.62)	-	-		
	Blue	**x** coordinate	Bx	-	(0.14)	-	-		
		y coordinate	By	-	(0.09)	-	-		
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	-	(12)	(25)	ms	BM-5A	Note6 Note7
		White to black	Toff	-	(13)	(25)	ms		
Viewing angle	Right	θU = 0°, θD = 0°, CR ≥ 10	θR	70	85	-	°	BM-5A	Note8
	Left	θU = 0°, θD = 0°, CR ≥ 10	θL	70	85	-	°		
	Up	θR = 0°, θL = 0°, CR ≥ 10	θU	70	85	-	°		
	Down	θR = 0°, θL = 0°, CR ≥ 10	θD	70	85	-	°		

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 = 64.0kHz, Vertical cycle = 60.0Hz

Optical characteristics are measured at luminance saturation after 20minutes from working the product, in the dark room. Also measurement method for luminance is 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 = (30)°C
Note7: See "**4.10.4 Definition of response times**".
Note8: See "**4.10.5 Definition of viewing angles**".

4.10.2 Definition of contrast ratio

The contrast ratio is calculated by using the following formula.

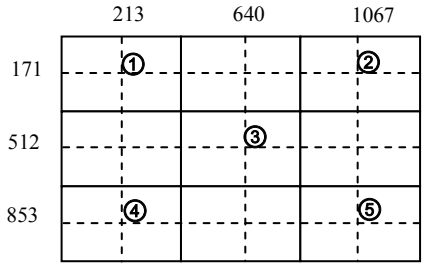
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance of white screen}}{\text{Luminance of black screen}}$$

4.10.3 Definition of luminance uniformity

The luminance uniformity is calculated by using following formula.

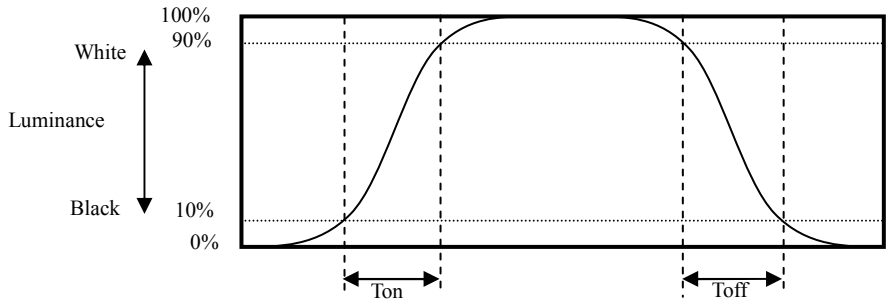
$$\text{Luminance uniformity (LU)} = \frac{\text{Maximum luminance from ① to ⑤}}{\text{Minimum luminance from ① to ⑤}}$$

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

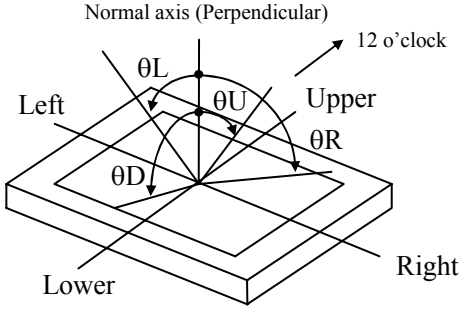


4.10.4 Definition of response times

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.).



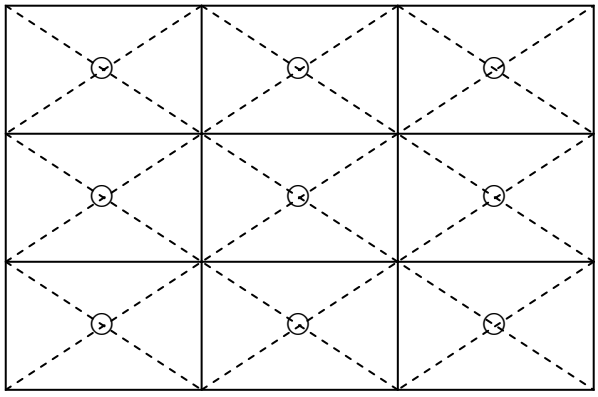
4.10.5 Definition of viewing angles



5. 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 direction ④ 10 times each directions	No display malfunctions No physical damages
Mechanical shock (Non operation)		① 490m/ s^2, 11ms ② X, Y, Z direction 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	

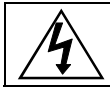
Note1: Display functions are checked under the same conditions as product inspection.
Note2: See the following figure for discharge points



6. PRECAUTIONS

6.1 MEANING OF CAUTION SIGNS

The following caution signs have very important meaning. **Be sure to read "6.2 CAUTIONS" and "6.3 ATTENTIONS", after understanding this contents!**

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

6.2 CAUTIONS

∗ Do not touch the working backlight. Customer will be in danger of an electric shock.

∗ Do not touch the working backlight. Customer will be in 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 490m/s^2 and to be not greater 11ms, Pressure: To be not greater 19.6 N)

6.3 ATTENTIONS 

6.3.1 Handling of the product

① Take hold of both ends without touch the circuit board cover when customer pulls out products (LCD modules) from inner packing box. If customer touches it, products may be broken down or out of adjustment, because of stress to mounting parts.
② Do not hook cables nor pull connection cables such as lamp cable and so on, for fear of damage.
③ If customer puts down the product temporarily, the product puts on flat subsoil as a display side turns down.
④ Take the measures of electrostatic discharge such as earth band, ionic shower and so on, when customer deals with the product, because products may be damaged by electrostatic.
⑤ The torque for mounting screws must never exceed 0.67N·m. Higher torque values might result in distortion of the bezel. And the screw length 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) except mounting hole portion.
Bends or twist described above and undue stress to any portion except mounting hole portion may cause display un-uniformity.

⑦ Do not press or rub on the sensitive display surface. If customer clean on the panel surface, NEC recommends using the cloth with ethanolic liquid such as screen cleaner for LCD.
⑧ Do not push-pull the interface connectors while the product is working, because wrong power sequence may break down the product.
⑨ Do not bend or unbend the lamp cable at the near part of the lamp holding rubber, to avoid the damage for high voltage side of the lamp. This damage may cause a lamp breaking and abnormal operation of high voltage circuit.
⑩ When installing the lamp cable, do not attach the lamp cable on the metal part of the LCD module directly. This may cause leakage high frequency current to the metal part, then the brightness may decrease or the lamp may not light.
⑪ Do not locate the lamp cable on the signal processing board. A noise may occur on the display image. 2

6.3.2 Environment

① Do not operate or store in high temperature, high humidity, dewdrop atmosphere or corrosive gases. Keep the product in antistatic pouch in room temperature, because of avoidance for dusts and sunlight, if customer stores the product.
② In order to prevent dew condensation occurring by temperature difference, the product packing box must be opened after leave under the environment of an unpacking room temperature enough. Because a situation of dew condensation occurring is changed by the environmental temperature and humidity, evaluate the leaving time sufficiently. (Recommendation leaving time: 6 hour 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.
⑤ Use an original protection sheet on the product surface (polarizer). Adhesive type protection sheet should be avoided, because it may change color or properties of the polarizer.

6.3.3 Characteristics

The following items are neither defects nor failures.

① Response time, luminance and color may be changed by ambient temperature.
② The LCD may be seemed luminance non-uniformity, flicker, vertical seam or small spot by 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 by viewing angle because of the use of condenser sheet in the backlight.
⑥ Optical characteristics may be changed by input signal timings.
⑦ The interference noise of input signal frequency for this product's signal processing board and luminance control frequency of customer's backlight inverter may appear on a display. Set up luminance control frequency of backlight inverter so that the interference noise does not appear.

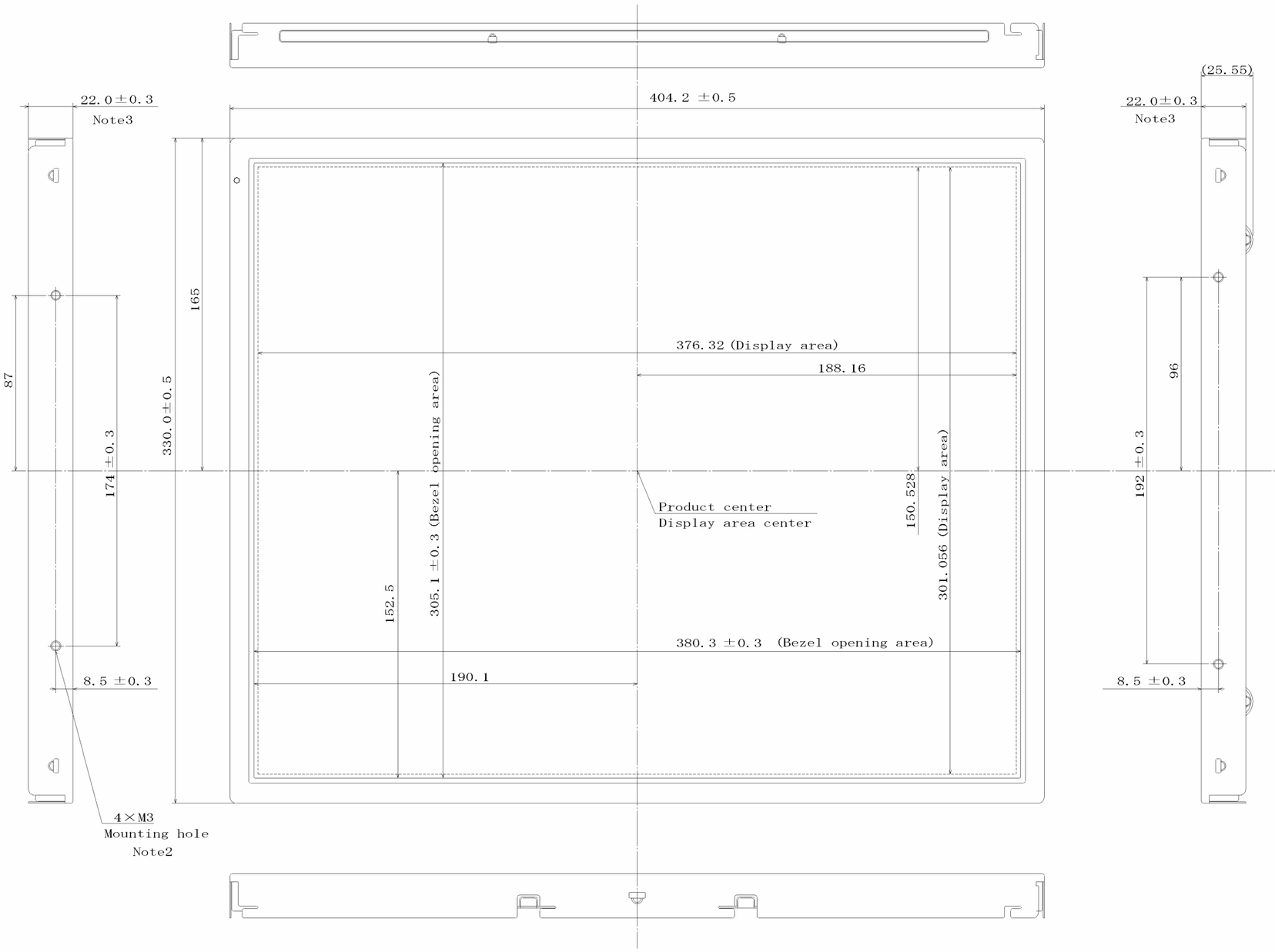
6.3.4 Other

① All GND, backlight inverter ground (GNDB), VCC and backlight inverter power supply voltage (VDDB) terminals should be used without a non-connected line.
② Do not disassemble a product or adjust variable resistors without permission of NEC.
③ Pay attention not to insert waste materials inside of products, if customer uses screwnails.
④ Pack the product with original shipping package, because of avoidance of some damages during transportation, when customer returns it to NEC for repair and so on.

7. OUTLINE DRAWINGS

7.1 FRONT VIEW

2

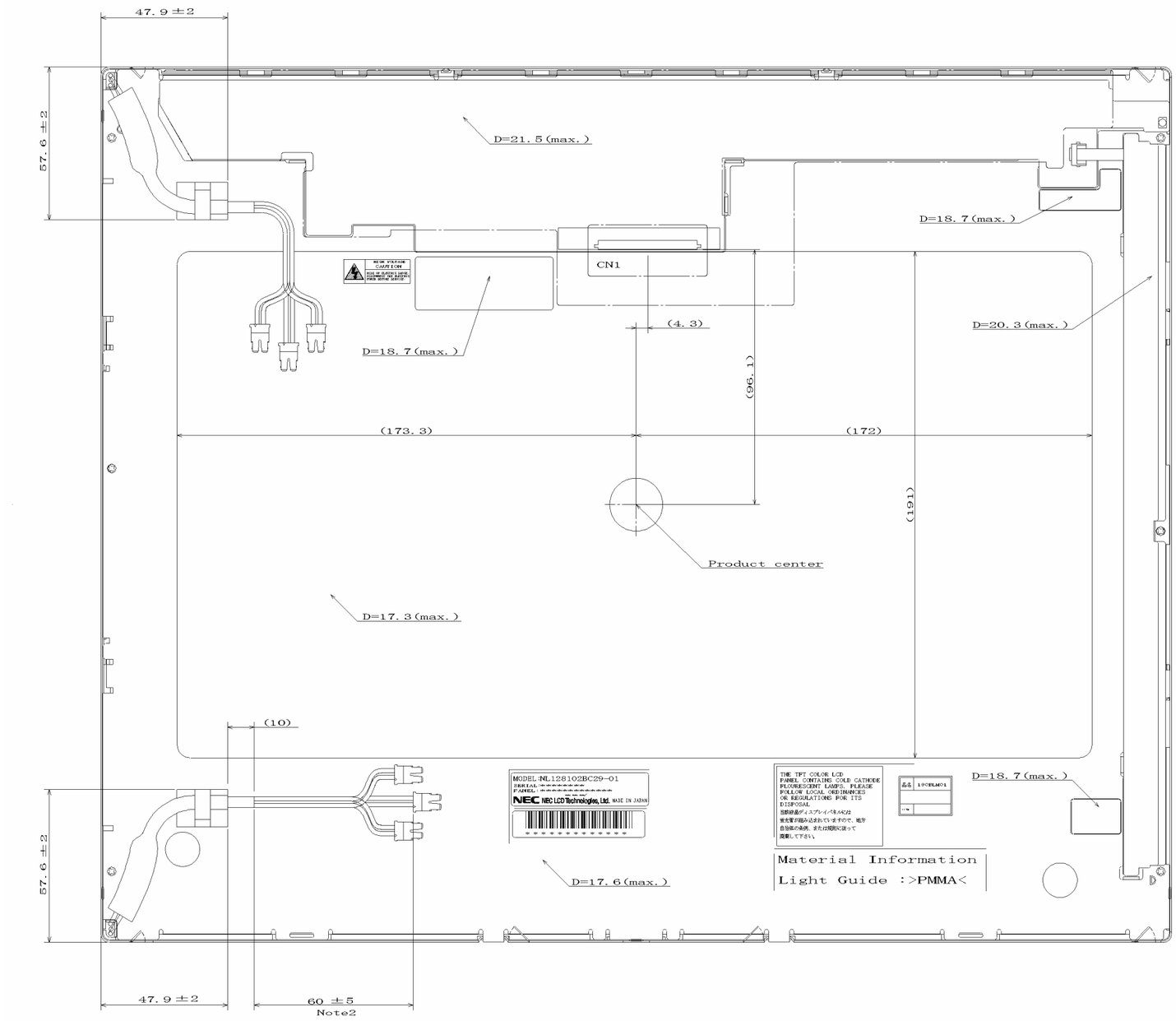


Note1: Not shown tolerances of the dimensions are TBD.
Note2: The torque for mounting screws must never exceed 0.67N·m. And the screw length must be 4.0mm to 7.0mm.
Note3: Excluding lamp cable and cable clamp.
Note4: The values in parentheses are for reference.

Unit: mm

7.2 REAR VIEW

2



Note1: Not shown tolerances of the dimensions are TBD.

Note2: The structure of up side and down side lamp cable is the same.

Unit: mm

REVISION HISTORY

The inside of latest specifications is revised to the clerical error and the major improvement of previous edition. Only a changed part such as functions, characteristic value and so on that may affect a design of customers, are described especially below.

Edition	Prepared date	Revision contents and signature
1st edition	July 2, 2003	**Revision contents** New issue **Signature of writer** *Approved by* T. ITO *Checked by* _____ *Prepared by* R. KAWASHIMA
2nd edition	Feb. 26, 2004	**Revision contents** Data correction and implementation depend on the specification review. P5 General specifications P6 Block diagram P7 Mechanical specifications Absolute maximum ratings P8, P9 Electrical characteristics P10 Fuse P11 power supply voltage sequence P13 Connections and functions for interface pins-Backlight lamp P18 Timing characteristics P20 Optical characteristics P24 Precautions-Handling of the product P25, P26 Outline drawings **Signature of writer** *Approved by* Toshihide Ito T. ITO *Checked by* _____ *Prepared by* R. Kawashima R. KAWASHIMA