NEC LCD Technologies, Ltd.

TFT COLOR LCD MODULE

NL10276BC30-18C

38cm (15.0 Type)
XGA
LVDS Interface (1port)

DATA SHEET

DOD-PP-0327 (2nd edition)

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

INTRODUCTION

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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.

CONTENTS

1. OUTLINE

1.1 STRUCTURE AND PRINCIPLE

Color LCD module NL10276BC30-18C 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. 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

- For industrial use

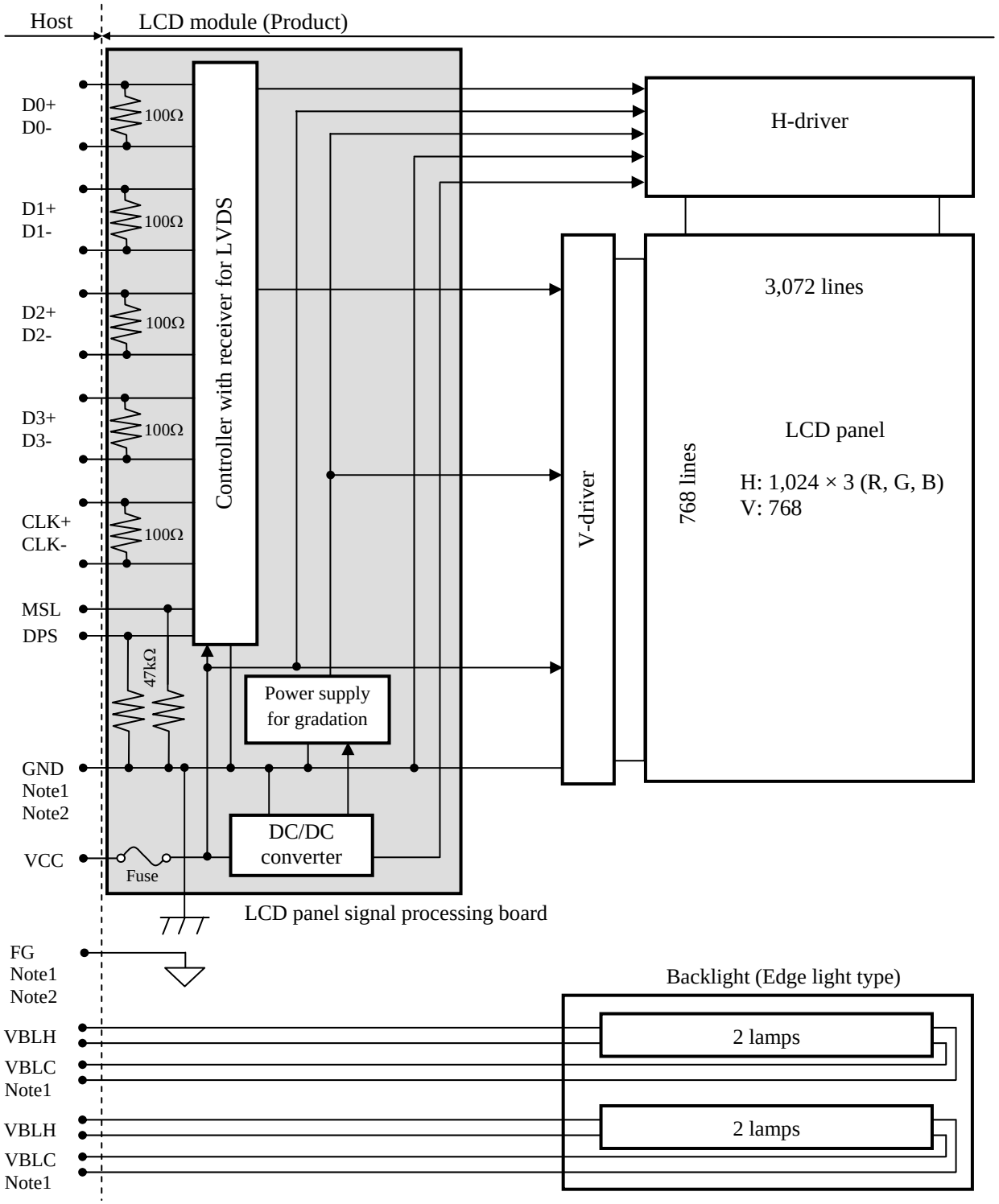
1.3 FEATURES

- Adoption of ST-NLT (Super-Transmissive Natural Light TFT)
- Wide viewing angle
- High luminance
- Fast response time
- Low reflection
- LVDS interface (8-bit)
- Selectable LVDS input map
- Reversible-scan direction
- Small foot print
- Edge light type backlight (without inverter)
- Replaceable lamp for backlight
- 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	304.128 (H) × 228.096 (V) mm
Diagonal size of display	38cm (15.0 inches)
Drive system	a-Si TFT active matrix
Display color	16,777,216 colors (6bit+FRC)
Pixel	1,024 (H) × 768 (V) pixels
Pixel arrangement	RGB (Red dot, Green dot, Blue dot) vertical stripe
Dot pitch	0.099 (H) × 0.297 (V) mm
Pixel pitch	0.297 (H) × 0.297 (V) mm
Module size	326.5 (typ., W) × 253.5 (typ., H) × 17.0 (max., D) mm
Weight	1,300g (typ.)
Contrast ratio	600:1 (typ.)
Viewing angle	*At the contrast ratio ≥ 10:1* • Horizontal: Right side 80° (typ.), Left side 80° (typ.) • Vertical: Up side 80° (typ.), Down side 60° (typ.)
Designed viewing direction	*At DPS terminal= Low or Open: Normal scan* • Viewing direction without image reversal: up side (12 o'clock) • Viewing direction with contrast peak: down side (6 o'clock) • Viewing angle with optimum grayscale (γ=2.2): normal axis (perpendicular)
Polarizer surface	Clear + Antireflection (AR)
Polarizer pencil-hardness	2H (min.) [by JIS K5400]
Color gamut	*At LCD panel center* 40% (typ.) [against NTSC color space]
Response time	*Ton+Toff (10%←→ 90%)* 18ms (typ.)
Luminance	*At IBL=6.0mArms / lamp* 600cd/m^2 (typ.)
Signal system	LVDS 1port (Receiver: Equivalent of THC63LVDF84B, THine Electronics Inc.) [8-bit digital signals for data of RGB colors, Dot clock (CLK), Data enable (DE)]
Power supply voltage	LCD panel signal processing board: 3.3V
Backlight	Edge light type: 4 cold cathode fluorescent lamps (without inverter) (Replaceable part • Lamp holder set: Type No. 150LHS29) (Recommended inverter (Option) • Inverter: Type No. 150PW231)
Power consumption	*At IBL= 6.0mArms / lamp, Checkered flag pattern* 15.7W (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	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	326.5 ± 0.5 (W) × 253.5 ± 0.5 (H) × 17.0 max. (D)	Note1, Note2	mm
Display area	304.128 (H) × 228.096 (V)	Note1	mm
Weight	1,300 (typ.), 1,430 (max.)		g

Note1: Excluding lamp cables.
Note2: See "**7. OUTLINE DRAWINGS**".

4.2 ABSOLUTE MAXIMUM RATINGS

Parameter			Symbol	Rating	Unit	Remarks
Power supply voltage	LCD panel signal processing board		VCC	-0.3 to +3.6	V	-
	Lamp voltage		VBLH	2,000	Vrms	
Input voltage for signals	Display signals Note1		VD	-0.3 to +3.6 and <VCC +0.3	V	
	Function signals Note2		VF			
Incident light intensity			II	150,000	lx	Note3
Storage temperature			Tst	-20 to +80	°C	-
Operating temperature		Front surface	TopF	-10 to +70	°C	Note4
		Rear surface	TopR	-10 to +70	°C	Note5
Relative humidity Note6			RH	≤ 95	%	Ta ≤ 40°C
				≤ 85	%	40 < Ta ≤ 50°C
				≤ 55	%	50 < Ta ≤ 60°C
				≤ 36	%	60 < Ta ≤ 70°C
Absolute humidity Note6			AH	≤ 70 Note7	g/m^3	Ta > 70°C

Note1: D0+/-, D1+/-, D2+/-, D3+/-, CLK+/-
Note2: MSL, DPS
Note3: If the product surface (polarizer) is exposed to an ultraviolet ray, the polarizer may discolor (Surface treatment may be damaged.). Use a filter to protect the polarizer from the ultraviolet ray.
Note4: Measured at center of LCD panel surface (including self-heat)
Note5: Measured at center of LCD module's rear shield surface (including self-heat)
Note6: No condensation
Note7: Water amount at Ta= 70°C and RH= 36%

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		VCC	3.0	3.3	3.6	V	-
Power supply current		ICC	-	530 Note1	900 Note2	mA	at VCC= 3.3V
Permissible ripple voltage		VRP	-	-	100	mVp-p	for VCC
Differential input threshold voltage for LVDS receiver	High	VTH	-	-	+100	mV	at VCM= 1.2V Note3
	Low	VTL	-100	-	-	mV	
Input voltage swing for LVDS receiver		Vi	0	-	2.4	V	-
Terminating resistance		RT	-	100	-	Ω	-
Input voltage for MSL and DPS signal	High	VFH	0.6VCC	-	VCC	V	-
	Low	VFL	0	-	0.3VCC	V	
Input current for MSL and DPS signal	High	IFH	-	-	300	μA	-
	Low	IFL	-300	-	-	μA	

Note1: Checkered flag pattern [by EIAJ ED-2522]
Note2: Pattern for maximum current
Note3: Common mode voltage for LVDS receiver

4.3.2 Backlight lamp

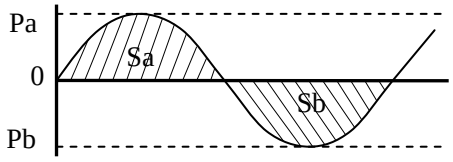
(Ta= 25°C, Note1)

Parameter	Symbol	min.	typ.	max.	Unit	Remarks
Lamp current	IBL	3.0	6.0	6.5	mArms	at IBL=6.0mArms: L= 500cd/m^2(typ.) Note3 ☆
Lamp voltage	VBLH	-	580	-	Vrms	Note2, Note3
Lamp starting voltage	VS	1,550	-	-	Vrms	Ta= 25°C Note2, Note3, Note4, Note7
		1,690	-	-	Vrms	Ta= -10°C Note2, Note3, Note4, Note7
Lamp oscillation frequency	FO	38	43	48	kHz	Note5

Note1: This product consists of 4 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 (Lamp voltage peak ratio, Lamp 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: The inverter should be designed so that the lamp starting voltage can be maintained for more than 1 second. Otherwise the lamp may not be turned on.

Note5: 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.

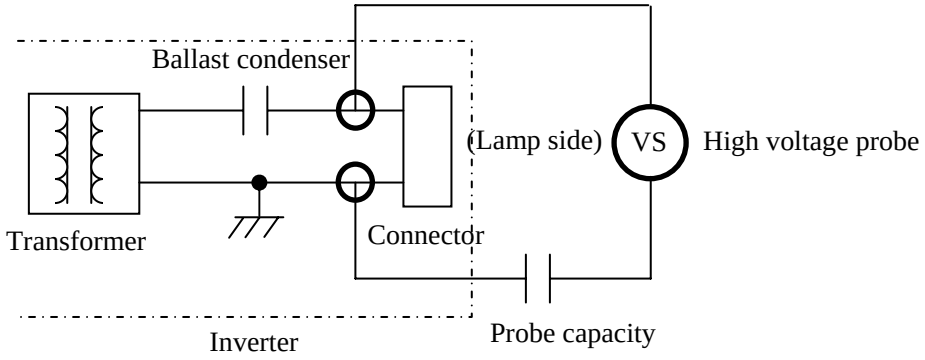
$$FO = \frac{1}{4} \times \frac{1}{th} \times (2n\text{-}1)$$

th: Horizontal signal period (See "**4.9.2 Timing characteristics**".)
n: Natural number (1, 2, 3 ·····)

Note6: 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.

Note7: In case of Inverter with Ballast condenser, "VS" is the voltage level between Ballast condenser 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 capacity: 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	3.3V	≤ 100	mVp-p

Note1: The permissible ripple voltage includes spike noise.

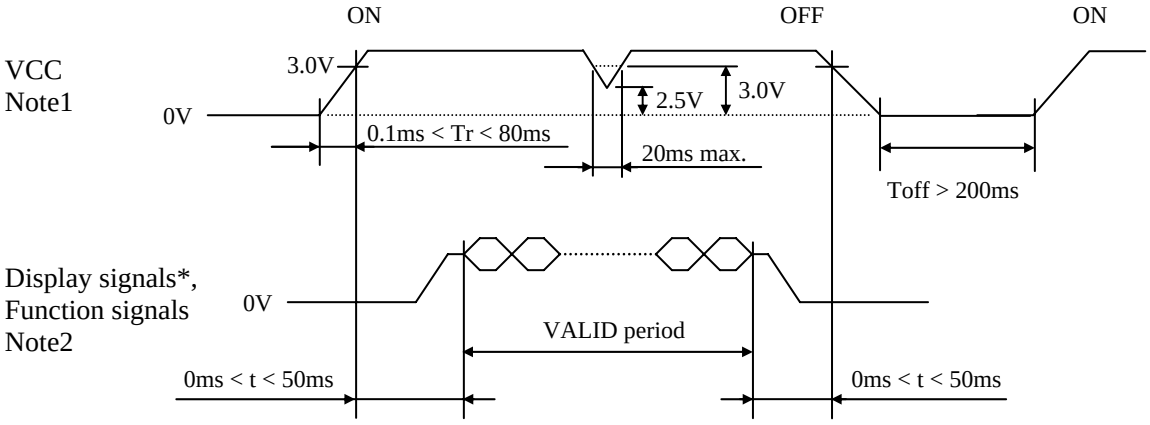
4.3.4 Fuse

Parameter	Fuse		Rating	Fusing current	Remarks
	Type	Supplier			
VCC	TF16SN3.15T	KOA Corporation	3.15A 32V	6.3A	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

4.4.1 LCD panel signal processing board



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

Note1: In terms of voltage variation (voltage drop) while VCC rising edge is below 3.0V, a protection circuit may work, and then this product may not work.

Note2: Display signals (D0+/-, D1+/-, D2+/-, D3+/- and CLK+/-) and function signals (MSL and DPS) must be Low or High impedance, exclude the VALID period (See above sequence diagram), in order to avoid that 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. VCC should be cut when the display and function signals are stopped.

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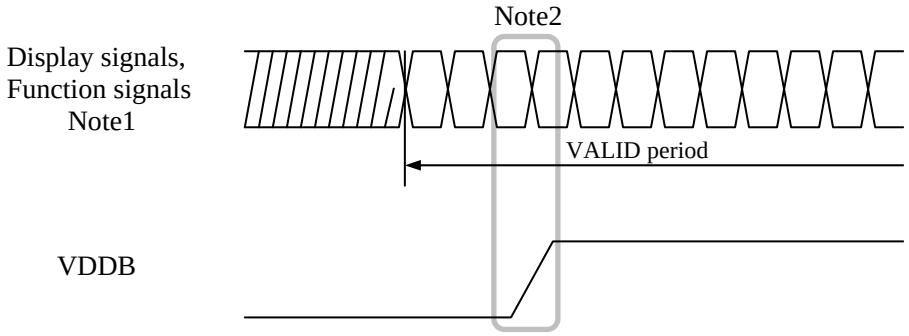
4.4.2 Inverter (Option)



Note1: These are the display and function signals for LCD panel signal processing board.

Note2: The backlight should be turned on 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): DF14H-20P-1.25H (Hirose Electric Co., Ltd. (HRS))
Adaptable plug: DF14-20S-1.25C (Hirose Electric Co., Ltd. (HRS))

Pin No.	Symbol	Signal	Remarks
1	VCC	Power supply	Note1
2	VCC		
3	GND	Ground	Note1
4	GND		
5	D0-	Pixel data	Note2
6	D0+		
7	GND	Ground	Note1
8	D1-	Pixel data	Note2
9	D1+		
10	GND	Ground	Note1
11	D2-	Pixel data	Note2
12	D2+		
13	GND	Ground	Note1
14	CLK-	Pixel clock	Note2
15	CLK+		
16	GND	Ground	Note1
17	D3-	Pixel data	Note2
18	D3+		
19	DPS	Selection of scan direction	High: Reverse scan Low or Open: Normal scan Note3
20	MSL	Selection of LVDS input map	High: Input map A Low or Open: Input map B Note4

Note1: All GND and VCC 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.
Note3: See "**4.8 SCANNING DIRECTIONS**".
Note4: See "**4.5.4 Connection between receiver and transmitter for LVDS**".

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): BHR-03VS-1 (J.S.T Mfg. Co., Ltd.)
Adaptable socket: SM02(8.0)B-BHS-1-TB(LF)(SN), SM02(8.0)B-BHS-1-TB (J.S.T Mfg. Co., Ltd.)

Pin No.	Symbol	Signal	Remarks
1	VBLH	High voltage terminal (Hot)	Cable color: Pink
2	N.C.	-	Keep this pin Open.
3	VBLC	Low voltage terminal (Cold)	Cable color: Gray

CN202 plug (LCD module side): BHR-03VS-1 (J.S.T Mfg. Co., Ltd.)
Adaptable socket: SM02(8.0)B-BHS-1-TB(LF)(SN), SM02(8.0)B-BHS-1-TB (J.S.T Mfg. Co., Ltd.)

Pin No.	Symbol	Signal	Remarks
1	VBLH	High voltage terminal (Hot)	Cable color: Blue
2	N.C.	-	Keep this pin Open.
3	VBLC	Low voltage terminal (Cold)	Cable color: Gray

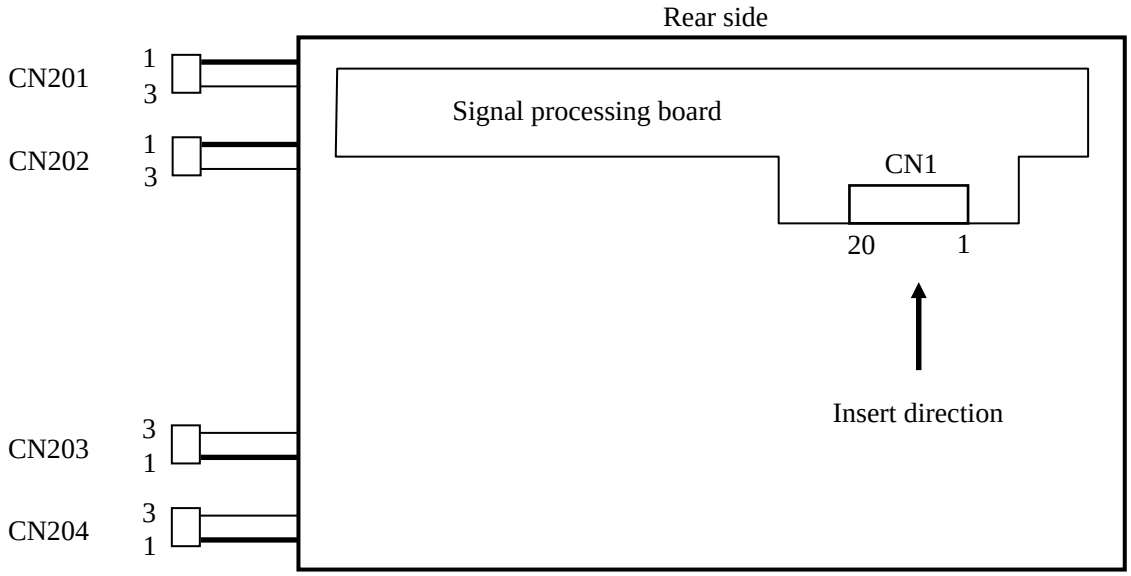
CN203 plug (LCD module side): BHR-03VS-1 (J.S.T Mfg. Co., Ltd.)
Adaptable socket: SM02(8.0)B-BHS-1-TB(LF)(SN), SM02(8.0)B-BHS-1-TB (J.S.T Mfg. Co., Ltd.)

Pin No.	Symbol	Signal	Remarks
1	VBLH	High voltage terminal (Hot)	Cable color: Pink
2	N.C.	-	Keep this pin Open.
3	VBLC	Low voltage terminal (Cold)	Cable color: Gray

CN204 plug (LCD module side): BHR-03VS-1 (J.S.T Mfg. Co., Ltd.)
Adaptable socket: SM02(8.0)B-BHS-1-TB(LF)(SN), SM02(8.0)B-BHS-1-TB (J.S.T Mfg. Co., Ltd.)

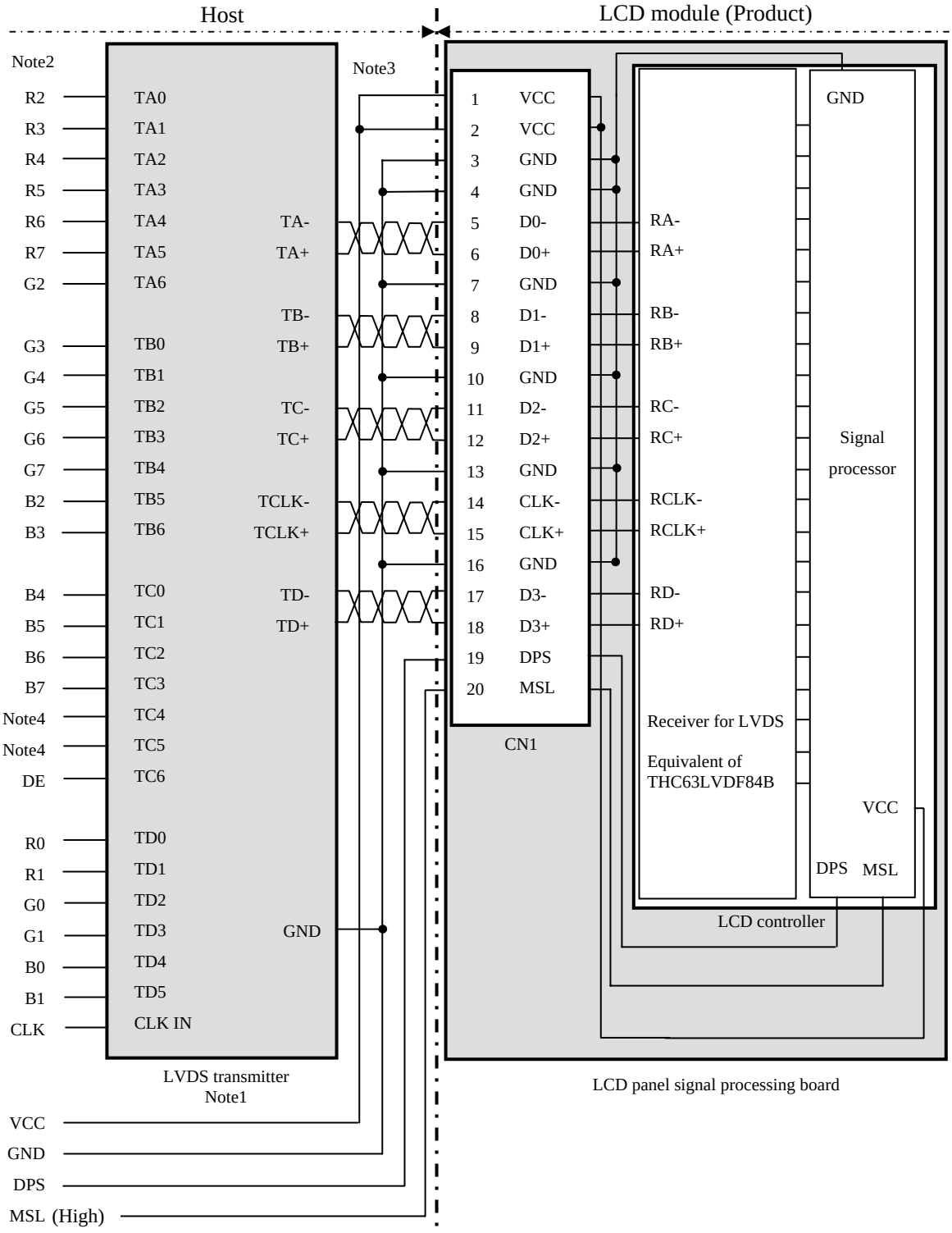
Pin No.	Symbol	Signal	Remarks
1	VBLH	High voltage terminal (Hot)	Cable color: Blue
2	N.C.	-	Keep this pin Open.
3	VBLC	Low voltage terminal (Cold)	Cable color: Gray

4.5.3 Position of plug and socket



4.5.4 Connection between receiver and transmitter for LVDS

(1) Input LVDS map A (MSL: "High")



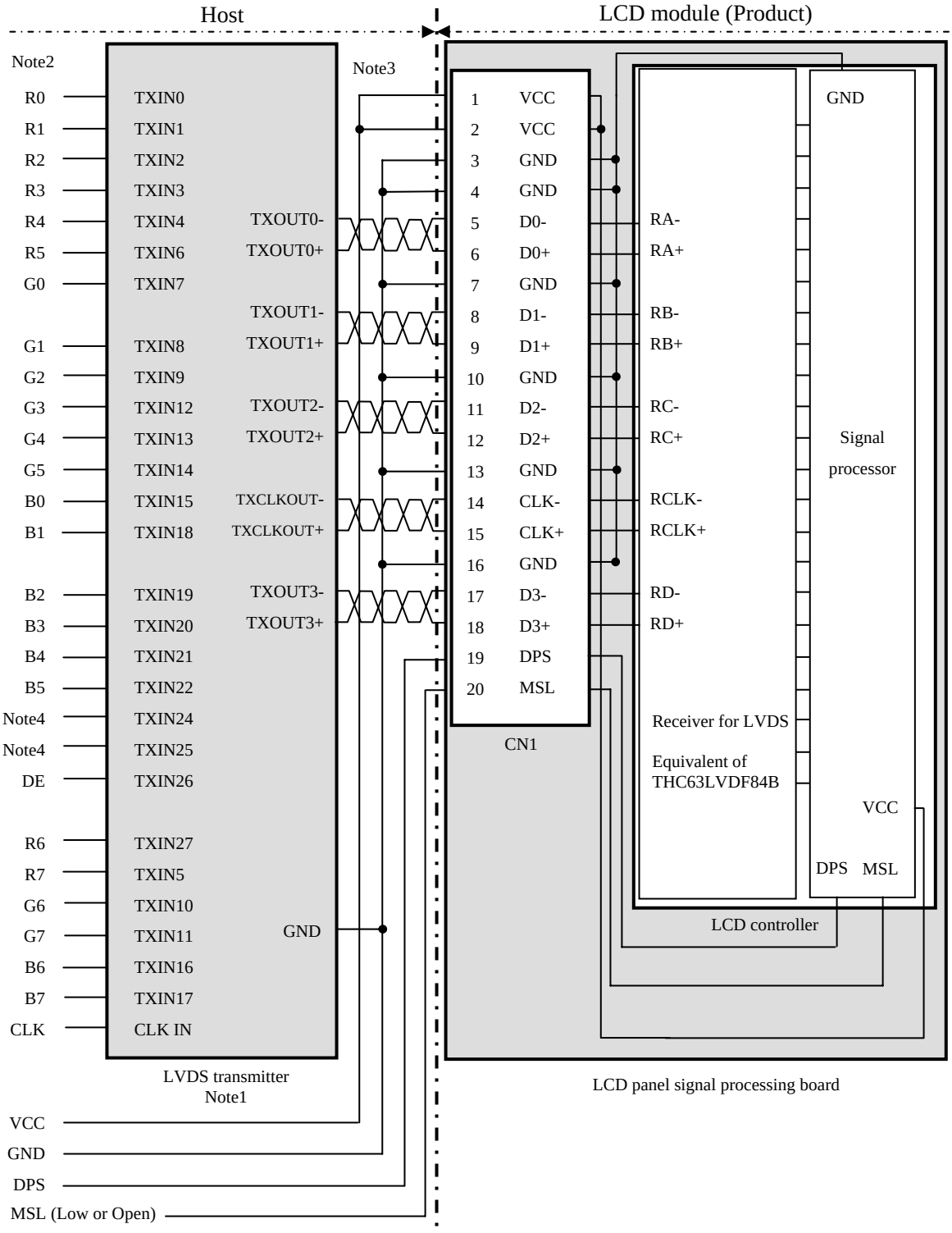
Note1: Recommended transmitter: THC63LVDM83R (THine Electronics Inc.) or equivalent

Note2: LSB (Least Significant Bit) – R0, G0, B0 MSB (Most Significant Bit) – R7, G7, B7

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

Note4: Input signals to TC4 and TC5 are not used inside the product, but do not keep TC4 and TC5 open to avoid noise problem.

(2) Input LVDS map B (MSL: "Low" or "Open")



Note1: Recommended transmitter: DS90C383 (National Semiconductor) or equivalent
Note2: LSB (Least Significant Bit) – R0, G0, B0 MSB (Most Significant Bit) – R7, G7, B7
Note3: Twist pair wires with 100Ω (Characteristic impedance) should be used between LCD panel signal processing board and LVDS transmitter.
Note4: Input signals to TXIN24 and TXIN25 are not used inside the product, but do not keep TXIN24 and TXIN25 open to avoid noise problem.

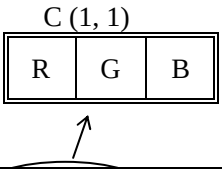
4.6 DISPLAY COLORS AND INPUT DATA SIGNALS

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)																									
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
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

4.7 DISPLAY POSITIONS

The following table is the coordinates per pixel (See "**4.8 SCANNING DIRECTIONS**".).



C(1, 1)	C(2, 1)	• • •	C(X, 1)	• • •	C(1023, 1)	C(1024, 1)
C(1, 2)	C(2, 2)	• • •	C(X, 2)	• • •	C(1023, 2)	C(1024, 2)
• • •	• • •	• • •	• • •	• • •	• • •	• • •
C(1, Y)	C(2, Y)	• • •	C(X, Y)	• • •	C(1023, Y)	C(1024, Y)
• • •	• • •	• • •	• • •	• • •	• • •	• • •
C(1, 767)	C(2, 767)	• • •	C(X, 767)	• • •	C(1023, 767)	C(1024, 767)
C(1, 768)	C(2, 768)	• • •	C(X, 768)	• • •	C(1023, 768)	C(1024, 768)

4.8 SCANNING DIRECTIONS

The following figures are seen from a front view. Also the arrow shows the direction of scan.

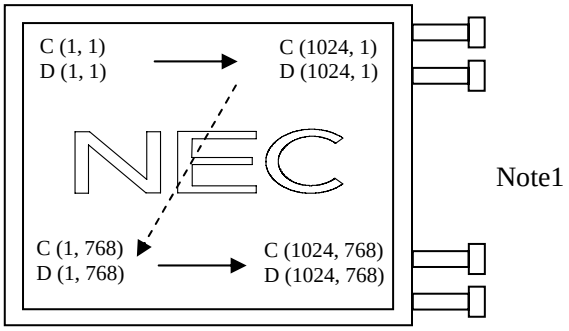


Figure1. Normal scan (DPS: Low or Open)

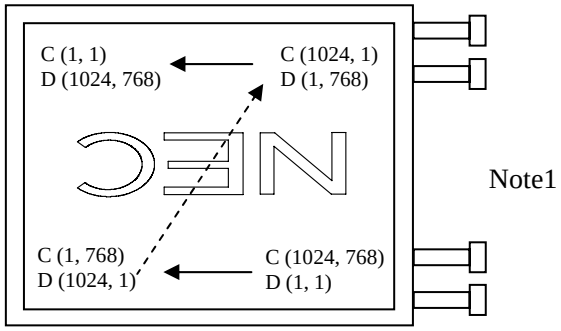


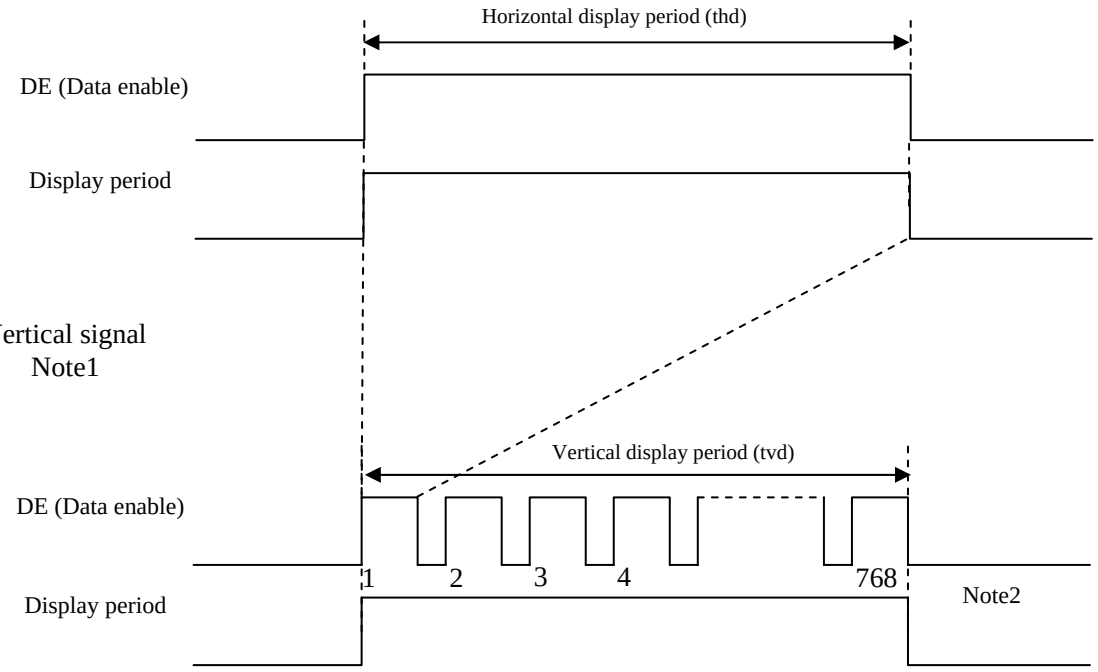
Figure2. Reverse scan (DPS: High)

Note1: Meaning of C (X, Y) and D (X, Y)
C (X, Y): The coordinates of the display position (See "**4.7 DISPLAY POSITIONS**".)
D (X, Y): The data number of input signal for LCD panel signal processing board

4.9 INPUT SIGNAL TIMINGS

4.9.1 Outline of input signal timings

• Horizontal signal
Note1



• Vertical signal
Note1

Note1: This diagram indicates virtual signal for set up to timing.
Note2: See "**4.9.3 Input signal timing chart**" for numeration of pulse.

4.9.2 Timing characteristics

(Note1)

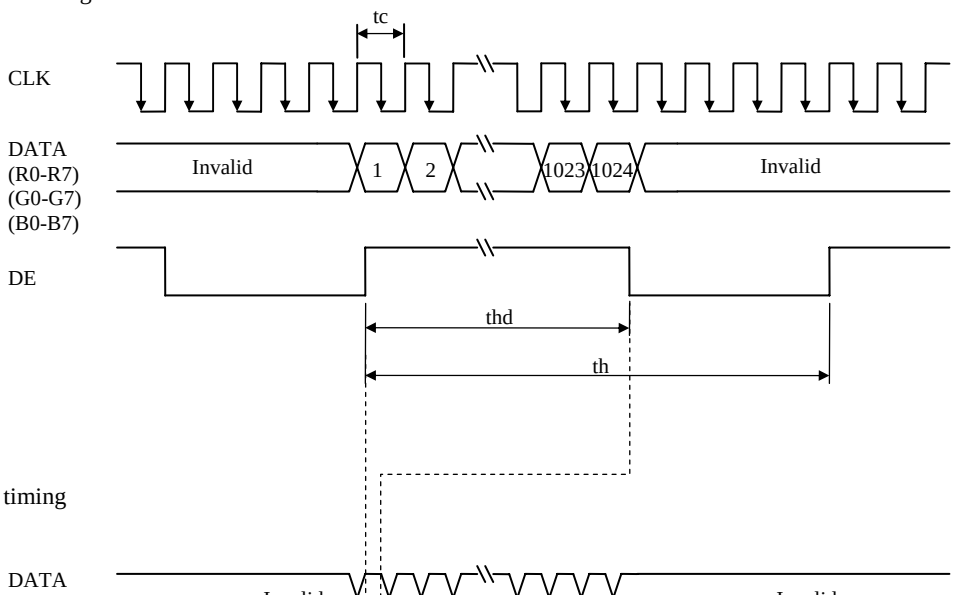
Parameter				Symbol	min.	typ.	max.	Unit	Remarks
CLK	Frequency		Vf= 75Hz	1/tc	60.0	-	70.0	MHz	-
			Vf= 60Hz		60.0	65.0	70.0		15.384ns (typ.)
	Duty			-	-			-	Note2
	Rise time, Fall time			-				ns	
DATA	CLK-DATA	Setup time		-	-			ns	Note2
		Hold time		-				ns	
	Rise time, Fall time			-				ns	
DE	Horizontal	Cycle	Vf= 75Hz	th	16.000	-	-	µs	-
					1,100	-	1,800	CLK	
			Vf= 60Hz		16.000	20.676	-	µs	48.363kHz (typ.)
					1,100	1,344	1,800	CLK	
		Display period		thd	1,024			CLK	-
	Vertical (One frame)	Cycle	Vf= 75Hz	tv	-	13.328	20.0	ms	75.029Hz (typ.)
					771	-	-	H	
			Vf= 60Hz		-	16.666	20.0	ms	60.000Hz (typ.)
					771	806	-	H	
		Display period		tvd	768			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, Vf= 1/tv

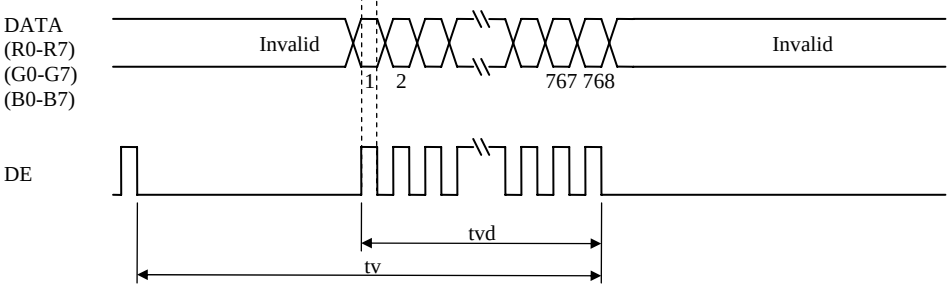
Note2: See the data sheet of LVDS transmitter.

4.9.3 Input signal timing chart

Horizontal timing



Vertical timing



4.10 OPTICS

4.10.1 Optical characteristics

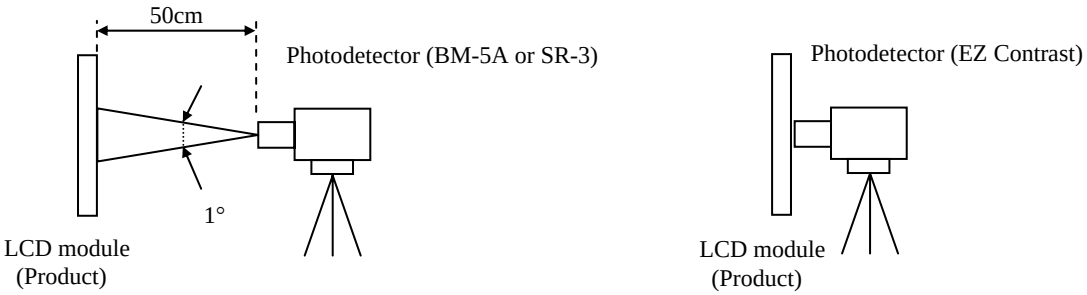
(Note1, Note2)

Parameter		Condition	Symbol	min.	typ.	max.	Unit	Measuring instrument	Remarks
Luminance		White at center θR= 0°, θL= 0°, θU= 0°, θD= 0°	L	430	600	-	cd/m^2	BM-5A	-
Contrast ratio		White/Black at center θR= 0°, θL= 0°, θU= 0°, θD= 0°	CR	420	600	-	-	BM-5A	Note3
Luminance uniformity		White θR= 0°, θL= 0°, θU= 0°, θD= 0°	LU	-	1.1	1.3	-	BM-5A	Note4
Chromaticity	White	**x** coordinate	Wx	0.283	0.313	0.343	-	SR-3	Note5
		y coordinate	Wy	0.299	0.329	0.359	-		
	Red	**x** coordinate	Rx	-	0.59	-	-		
		y coordinate	Ry	-	0.34	-	-		
	Green	**x** coordinate	Gx	-	0.33	-	-		
		y coordinate	Gy	-	0.52	-	-		
	Blue	**x** coordinate	Bx	-	0.16	-	-		
		y coordinate	By	-	0.15	-	-		
Color gamut		θR= 0°, θL= 0°, θU= 0°, θD= 0° at center, against NTSC color space	C	33	40	-	%		
Response time		White to Black	Ton	-	4	8	ms	BM-5A	Note6 Note7
		Black to White	Toff	-	14	21	ms		
Viewing angle	Right	θU= 0°, θD= 0°, CR≥ 10	θR	70	80	-	°	EZ Contrast	Note8
	Left	θU= 0°, θD= 0°, CR≥ 10	θL	70	80	-	°		
	Up	θR= 0°, θL= 0°, CR≥ 10	θU	70	80	-	°		
	Down	θR= 0°, θL= 0°, CR≥ 10	θD	50	60	-	°		

Note1: These are initial characteristics.

Note2: Measurement conditions are as follows.
Ta= 25°C, VCC= 3.3V, IBL= 6.0mArms/lamp, Display mode: XGA,
Horizontal cycle= 1/48.363kHz, Vertical cycle= 1/60.0Hz, DPS= Low or Open: Normal scan

Optical characteristics are measured at luminance saturation 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= 32°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.

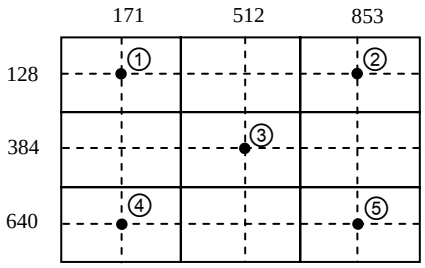
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance of white screen}}{\text{Luminance of black screen}}$$

4.10.3 Definition of luminance uniformity

The luminance uniformity is calculated by using following formula.

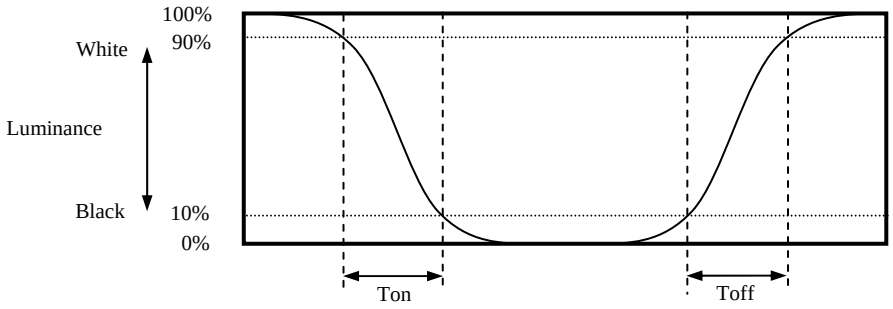
$$\text{Luminance uniformity (LU)} = \frac{\text{Maximum luminance from ① to ⑤}}{\text{Minimum luminance from ① to ⑤}}$$

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

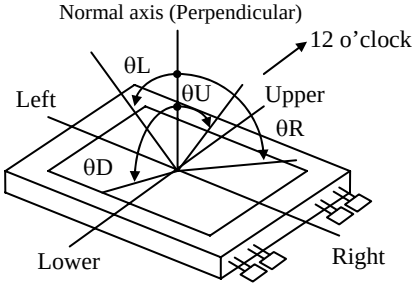


4.10.4 Definition of response times

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



4.10.5 Definition of viewing angles



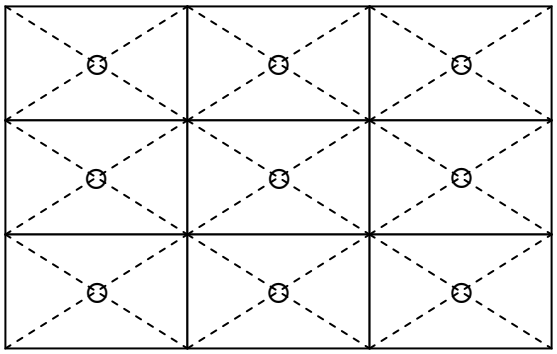
5. RELIABILITY TESTS

(Note1)

Test item	Condition	Judgment
High temperature and humidity (Operation)	① 60 ± 2°C, RH= 90%, 240hours ② Display data is black.	No display malfunctions
High temperature (Operation)	① 70 ± 3°C, 240hours ② Display data is black.	
Heat cycle (Operation)	① -10 ± 3°C…1hour 70 ± 3°C…1hour ② 50cycles, 4 hours/cycle ③ Display data is black.	
Thermal shock (Non operation)	① -20 ± 3°C…30minutes 80 ± 3°C…30minutes ② 100cycles, 1hour/cycle ③ Temperature transition time is within 5 minutes.	
ESD (Operation)	① 150pF, 150Ω, ±10kV ② 9 places on a panel surface Note2 ③ 10 times each places at 1 sec interval	
Dust (Operation)	① Sample dust: No. 15 (by JIS-Z8901) ② 15 seconds stir ③ 8 times repeat at 1 hour interval	
Vibration (Non operation)	① 5 to 100Hz, 11.76m/s^2 ② 1 minute/cycle ③ X, Y, Z direction ④ 50 times each directions	No display malfunctions No physical damages
Mechanical shock (Non operation)	① 294m/ s^2, 11ms ② ±X, ±Y, ±Z direction ③ 3 times each directions	

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

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 these 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 lamp cables while turn on. There is a danger of an electric shock.

∗ Do not touch the working backlight and IC. There is a danger of burn injury.

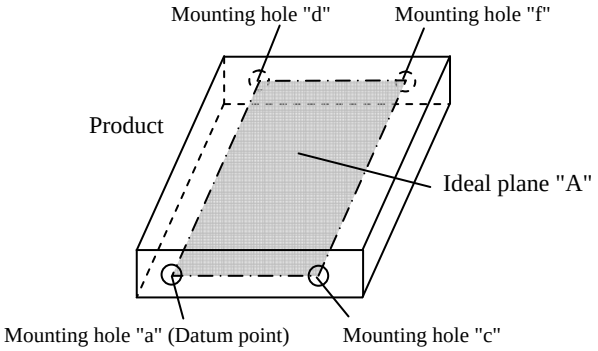
∗ Do not shock and press the LCD panel and the backlight! There is a danger of breaking, because they are made of glass. (Shock: To be not greater 294m/s^2 and to be not greater 11ms, Pressure: To be not greater 19.6 N (ϕ16mm jig))

6.3 ATTENTIONS 

6.3.1 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 0.343 N·m. Higher torque might result in distortion of the bezel. And the length of product mounting screws must be ≤ 2.8mm.

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 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.
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 not connecting FG of the LCD module to the customer's equipment ground, inverter noise may create video noise on the LCD screen.
⑬ 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.
⑭ 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.

6.3.2 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.

6.3.3 Characteristics

The following items are neither defects nor failures.

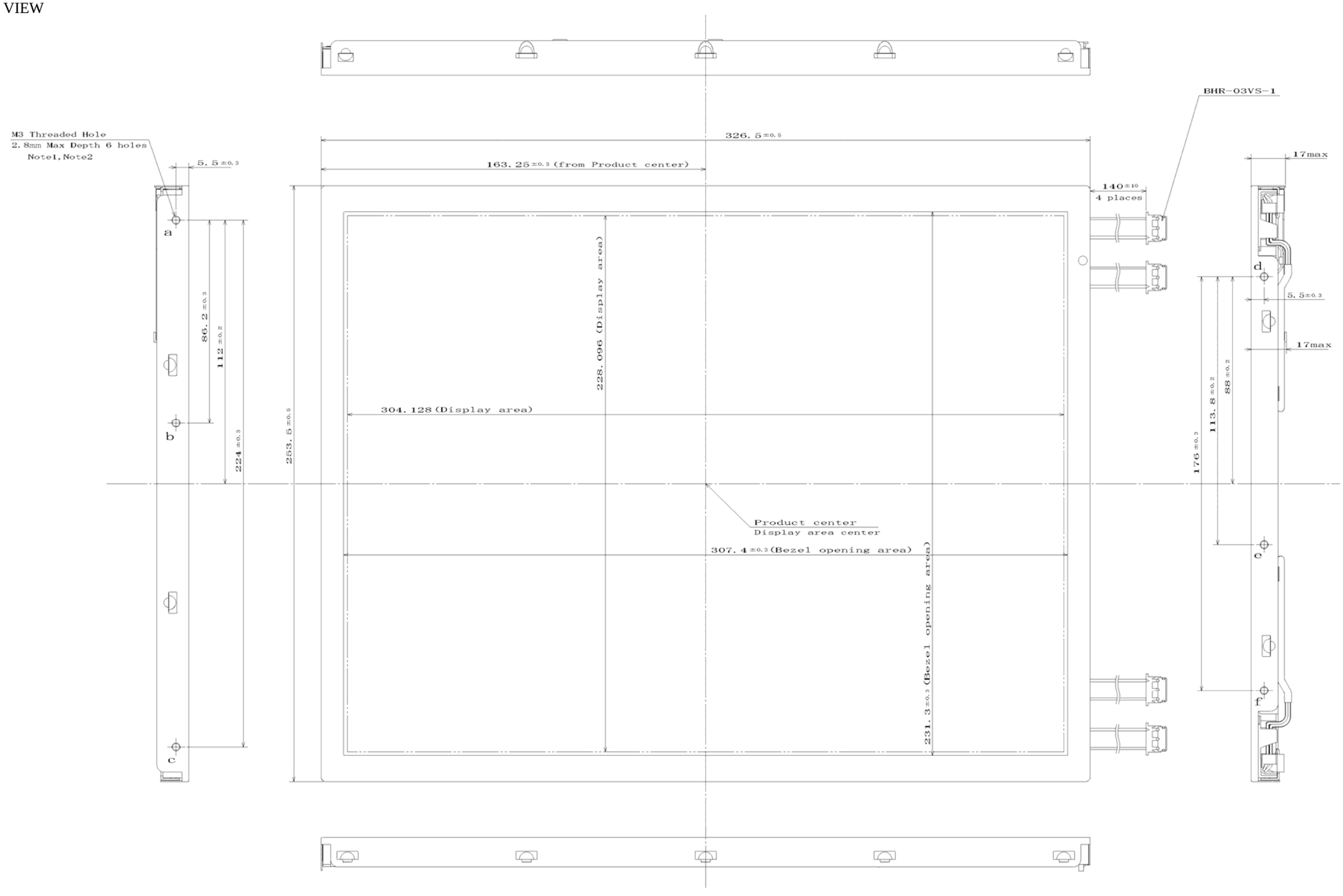
① Response time, luminance and color may be changed by ambient temperature.
② Display mura, flicker, vertical seam or small spot may be observed depending on display patterns.
③ Optical characteristics (e.g. luminance, display uniformity, etc.) gradually is going to change depending on operating time, 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 The color of the polarizer surface may differ between products because of antireflection treatment.
⑨ 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.

6.3.4 Other

① All GND and VCC terminals should be used without any non-connected lines.
② Do not disassemble a product or adjust variable resistors.
③ See "REPLACEMENT MANUAL FOR LAMP HOLDER SET", when replacing backlight lamps.
④ 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.
⑤ 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.

7. OUTLINE DRAWINGS

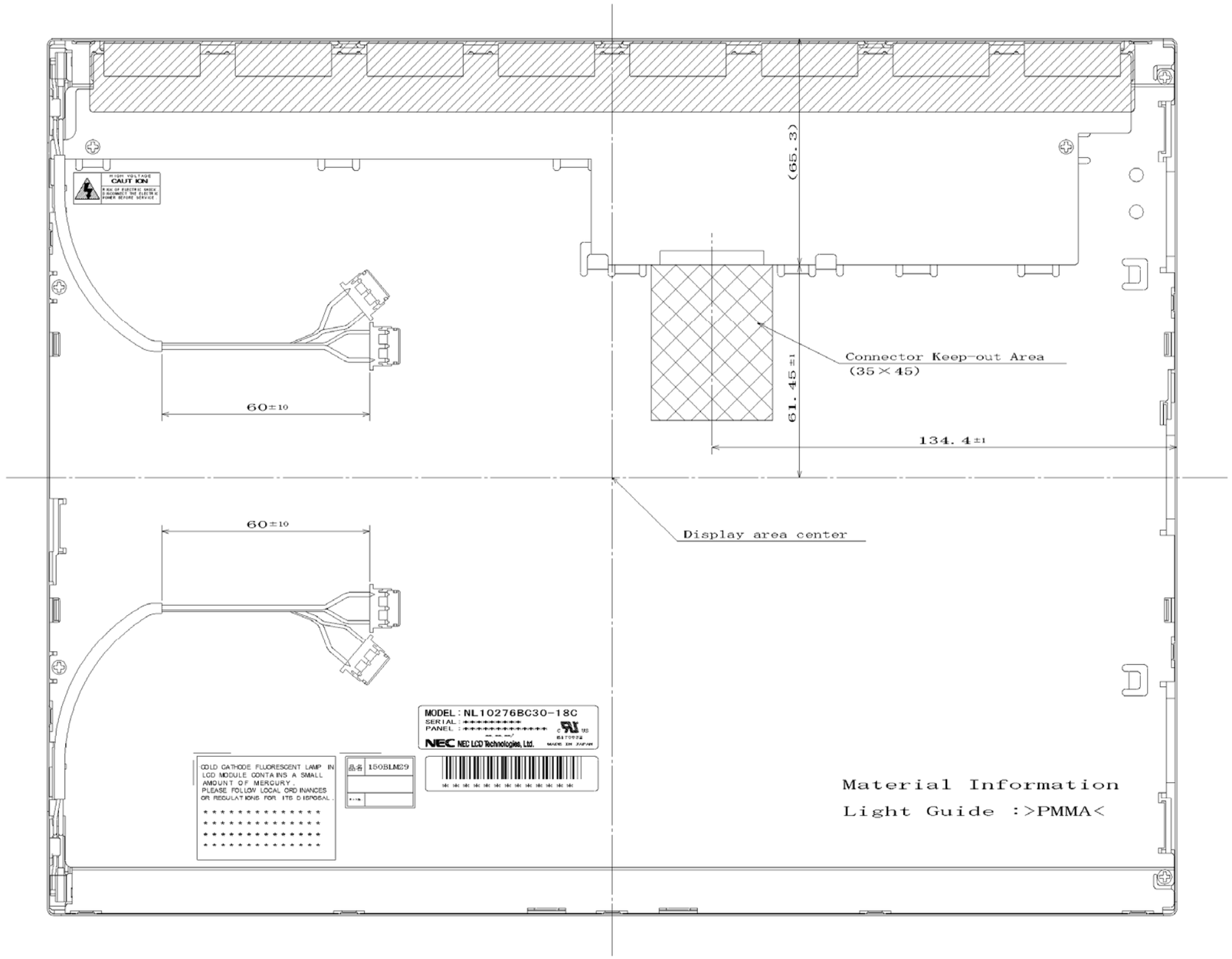
7.1 FRONT VIEW



Unit: mm

Note1: The torque for product mounting screws must never exceed 0.343N·m. And the length of product mounting screws must be ≤ 2.8mm.
Note2: NEC's reliability tests are carried out using mounting holes "a", "c", "d" and "f".

7.2 REAR VIEW



Note1: The values in parentheses are for reference.
Note2: The torque for product mounting screws must never exceed 0.343N·m. And the length of product mounting screws must be ≤ 2.8mm.

Unit: mm