

# **TFT COLOR LCD MODULE**

**NL12876BC26-28**

**39cm (15.3 Type)**

**WXGA**

**LVDS interface (1port)**

## **DATA SHEET**

**DOD-PP-0853 (3rd edition)**

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## 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.

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## 1. OUTLINE

### 1.1 STRUCTURE AND PRINCIPLE

Color LCD module NL12876BC26-28 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 circuit, 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 APPLICATION

- For industrial use

### 1.3 FEATURES

- Ultra-wide viewing angle (Adoption of Ultra-Advanced Super Fine TFT (UA-SFT))
- High luminance
- High contrast
- Wide color gamut
- Wide temperature range
- LVDS interface
- 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)



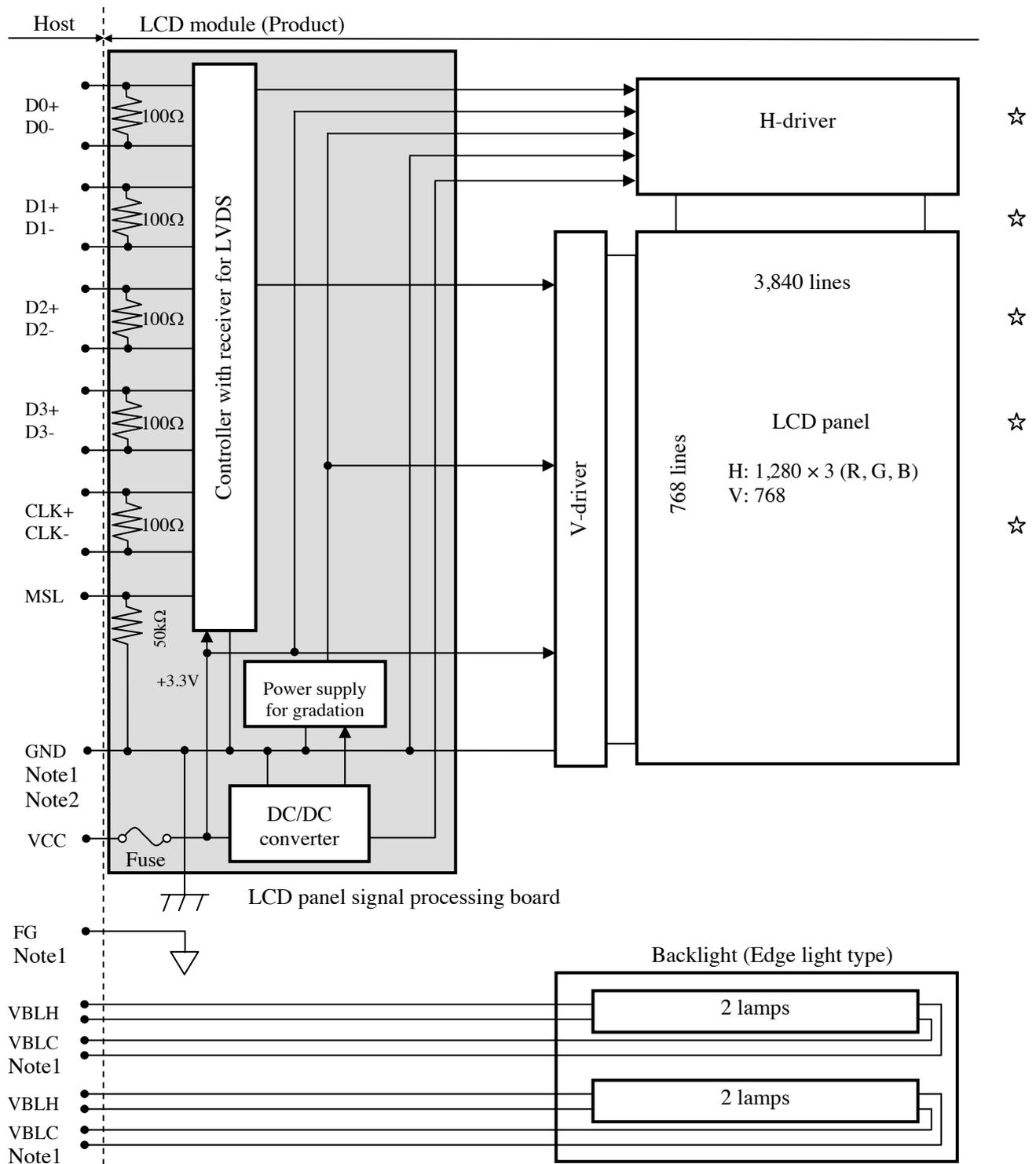
**2. GENERAL SPECIFICATIONS**

<i>Display area</i>	334.08 (H) × 200.45 (V) mm	
<i>Diagonal size of display</i>	39cm (15.3 inches)	
<i>Drive system</i>	a-Si TFT active matrix	
<i>Display color</i>	16,777,216 colors (At 6 bit + FRC)	
<i>Pixel</i>	1,280 (H) × 768 (V) pixels	
<i>Pixel arrangement</i>	RGB (Red dot, Green dot, Blue dot) vertical stripe	
<i>Dot pitch</i>	0.087 (H) × 0.261 (V) mm	
<i>Pixel pitch</i>	0.261 (H) × 0.261 (V) mm	
<i>Module size</i>	358.0 (W) × 226.0 (H) × 15.8 (D)mm (typ.)	Note 1
<i>Weight</i>	1,270g (typ.)	
<i>Contrast ratio</i>	1000:1 (typ.)	
<i>Viewing angle</i>	At the contrast ratio $\geq 10:1$ <ul style="list-style-type: none"> <li>• Horizontal: Right side 88° (typ.), Left side 88° (typ.)</li> <li>• Vertical: Up side 88° (typ.), Down side 88° (typ.)</li> </ul>	
<i>Designed viewing direction</i>	<ul style="list-style-type: none"> <li>• Viewing angle with optimum grayscale (<math>\gamma = 2.2</math>): Normal axis (perpendicular)</li> </ul>	
<i>Polarizer surface</i>	Antiglare	
<i>Polarizer pencil-hardness</i>	3H (min.) [by JIS K5400]	
<i>Color gamut</i>	At LCD panel center 72% (typ.) [against NTSC color space]	
<i>Response time</i>	$T_{on} + T_{off}$ (10% ← → 90%) 25ms (typ.)	
<i>Luminance</i>	At $IBL = 6.0 \text{ mArms / lamp}$ 330cd/m <sup>2</sup> (typ.)	
<i>Signal system</i>	LVDS 1port (Receiver: THC63LVDF84B, THine Electronics Inc. or equivalent) [8bit digital signals for data of RGB colors, Dot clock (CLK), Data enable (DE)]	
<i>Power supply voltage</i>	LCD panel signal processing board: 3.3V	
<i>Backlight</i>	Edge light type: 4 cold cathode fluorescent lamps (without inverter)  <div style="border-left: 1px solid black; border-right: 1px solid black; padding: 0 10px;">                     Replaceable parts                     <ul style="list-style-type: none"> <li>• Lamp holder set: Type No. 153LHS05</li> </ul> </div>	
<i>Power consumption</i>	At $IBL = 6.0 \text{ mArms / lamp}$ , Checkered flag pattern 18W (typ., Power dissipation of the inverter is not included.)	

Note1: Excluding projection



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, FG and GNDB must be connected to customer equipment's ground, and it is recommended that these grounds are connected together in customer equipment.

**4. DETAILED SPECIFICATIONS**

**4.1 MECHANICAL SPECIFICATIONS**

Parameter	Specification	Unit
Module size	358.0 ± 0.5 (W) × 226.0 ± 0.5 (H) × 16.8 max. (D) Note1,Note2	mm
Display area	334.08 (H) × 200.45 (V) Note1	mm
Weight	1,270 (typ.), 1,400 (max.)	g

Note1: See "7. OUTLINE DRAWINGS".

Note2: Excluding projection

**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 signal Note2	VF			
Storage temperature		Tst	-20 to +80	°C	-
Operating temperature	Front surface	TopF	-10 to +70	°C	Note3
	Rear surface	TopR	-10 to +70	°C	Note4
Relative humidity Note5		RH	≤ 95	%	Ta ≤ 40°C
			≤ 85	%	40°C < Ta ≤ 50°C
			≤ 55	%	50°C < Ta ≤ 60°C
			≤ 36	%	60°C < Ta ≤ 70°C
Absolute humidity Note5		AH	≤ 70 Note6	g/m <sup>3</sup>	Ta > 70°C
Operating altitude		-	≤ 4,850	m	-10°C ≤ Ta ≤ 70°C
Storage altitude		-	≤ 13,600	m	-20°C ≤ Ta ≤ 80°C

Note1: D0+/-, D1+/-, D2+/-, D3+/-, CLK+/-

Note2: MSL

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= 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	-	550 Note1	800 Note2	mA	at VCC= 3.3V	
Permissible ripple voltage	VRP	-	-	100	mVp-p	for VCC	
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 MSL signal	High	VFH	0.7VCC	-	VCC	V	CMOS level
	Low	VFL	0	-	0.3VCC	V	
Input current for MSL signal	High	IFH	-	-	160	μA	-
	Low	IFL	-160	-	-	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

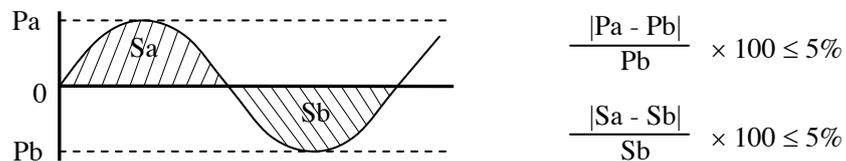
(Ta= 25°C, Note1)

Parameter	Symbol	min.	typ.	max.	Unit	Remarks
Lamp current Note3	IBL	3.0	6.0	6.5	mArms	at IBL= 6.0 mArms: L= 330cd/m <sup>2</sup>
Lamp voltage Note2, Note3	VBLH	-	670	-	Vrms	-
Lamp starting voltage Note2, Note3, Note4, Note7	VS	1,350	-	-	Vrms	Ta= 25°C
		1,550	-	-	Vrms	Ta= -10°C
Lamp oscillation frequency Note5	FO	38	43	48	kHz	-

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 (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.



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.

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

th: Horizontal cycle (See "4.8.2 Timing characteristics" .)

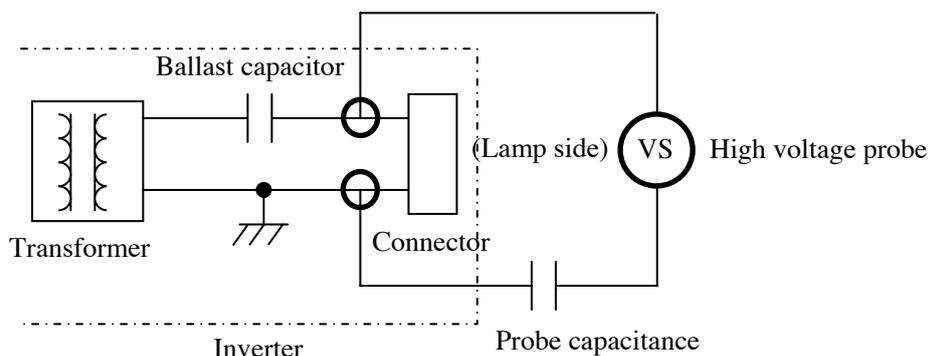
n : Natural number (1, 2, 3 .....)

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 capacitor, "VS" is the voltage level between Ballast capacitor 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 (Measure at input terminal of power supply)	Note1	Unit
VCC	3.3V	≤ 100		mVp-p

Note1: The permissible ripple voltage includes spike noise.

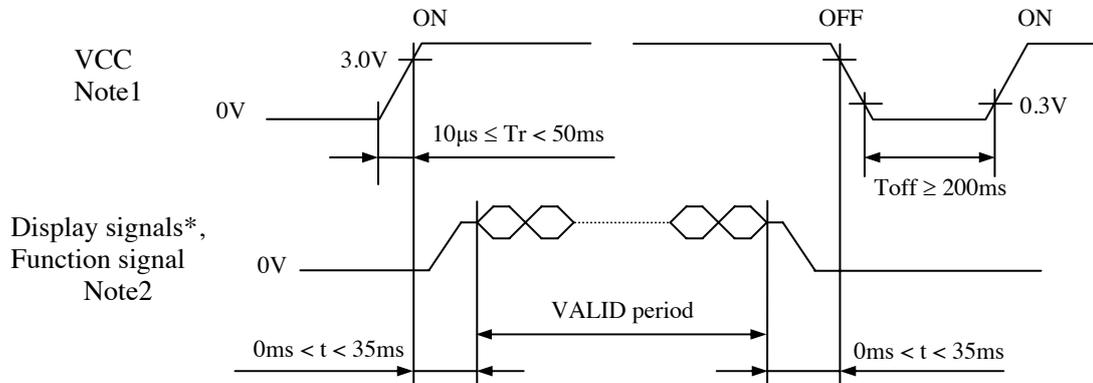
#### 4.3.4 Fuse

Parameter	Fuse		Rating	Fusing current	Remarks
	Type	Supplier			
VCC	TF16SN3.15	KOA	3.15A	6.3A	Note1
			32V		

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+/-, CLK+/-) and function signal (MSL) must be Low or High-impedance, exclude the VALID period (See above sequence diagram), in order to avoid that internal circuits 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.

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	Note3
2	VCC		
3	GND	Ground	Note3
4	GND		
5	D0-	Pixel data	Note2
6	D0+		
7	GND	Ground	Note3
8	D1-	Pixel data	Note2
9	D1+		
10	GND	Ground	Note3
11	D2-	Pixel data	Note2
12	D2+		
13	GND	Ground	Note3
14	CLK-	Pixel clock	Note2
15	CLK+		
16	GND	Ground	Note3
17	D3-	Pixel data	Note2
18	D3+		
19	GND	Ground	Note3
20	MSL	Selection of LVDS Input data map	High: LVDS input map A Low or Open: LVDS input map B Note1, Note4

Note1: See "4.6 DISPLAY COLORS AND INPUT DATA SIGNALS".

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

Note3: All GND and VCC terminals should be used without any non-connected lines.

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: White

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: White

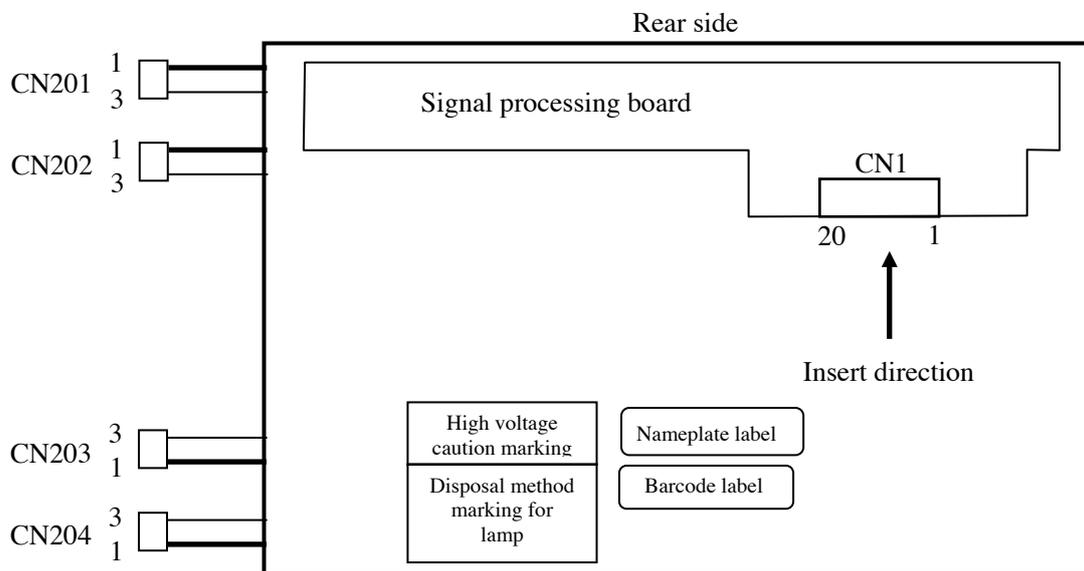
CN203 plug (LCD module side): BHR-03VS-1 (J.S.T Mfg. Co., Ltd.)  
 Adaptable socket: SM02(8.0)B-BHS-1-TB(LF)(SN),  
 SM02(8.0)B-BHS-1-TB (J.S.T Mfg. Co., Ltd.)

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: White

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.)

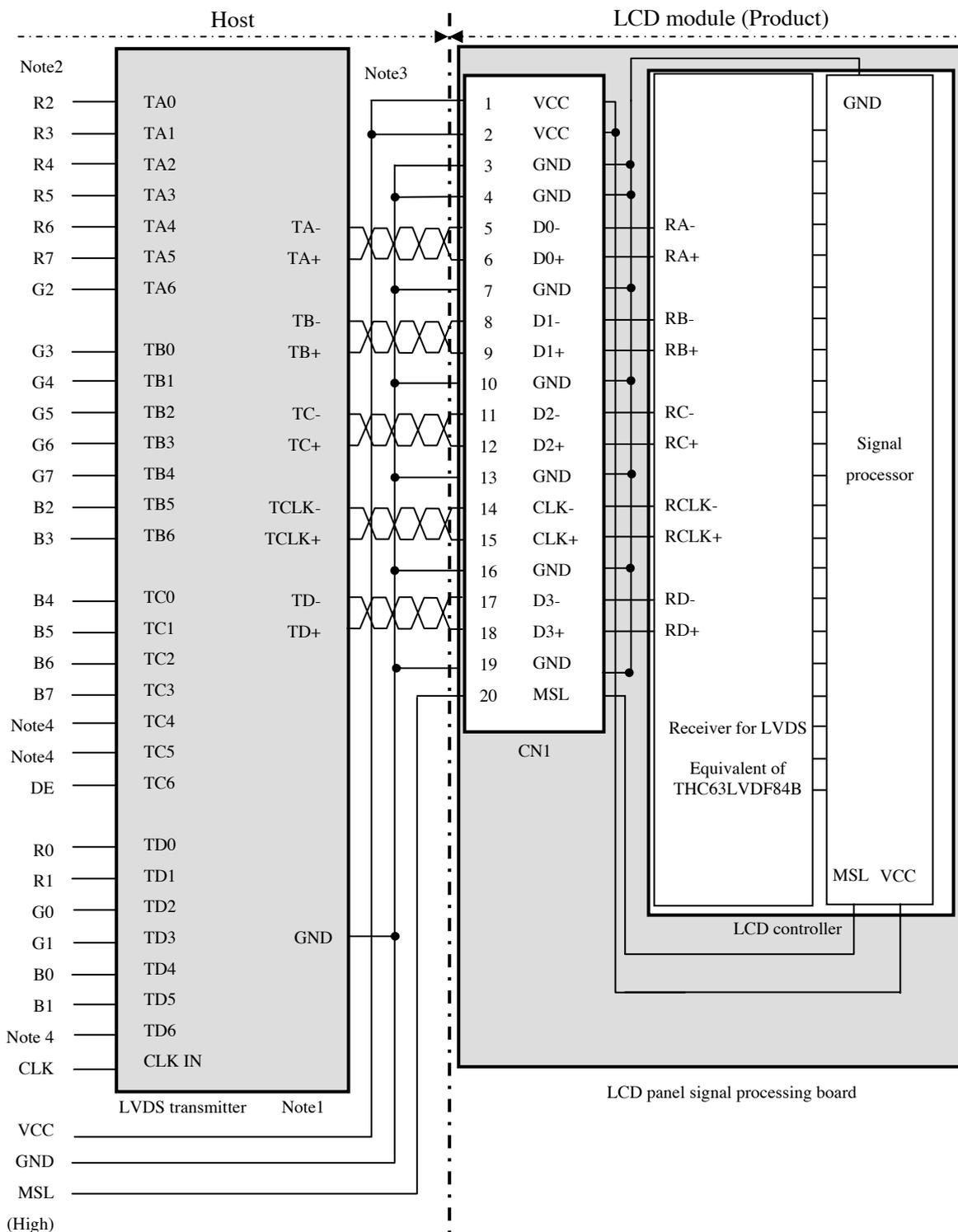
Pin No.	Symbol	Signal	Remarks
1	VBLH	High voltage terminal (Hot)	Cable color: Blue
2	N.C.	-	Keep this pin Open.
3	VBLC	Low voltage terminal (Cold)	Cable color: White

4.5.3 Positions of plugs and a socket



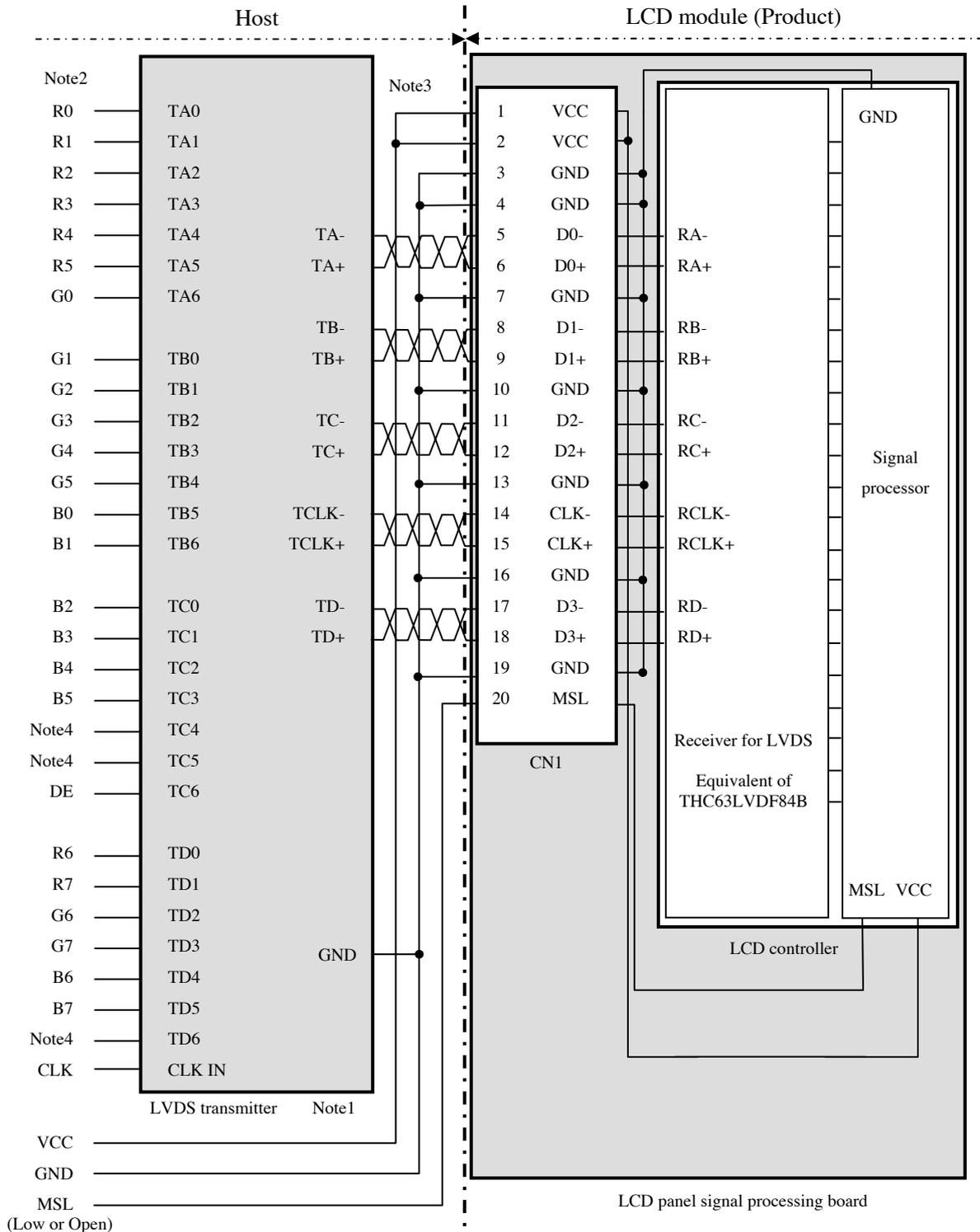
4.5.4 Connection between receiver and transmitter for LVDS

(1) LVDS Input data 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, TC5 and TD6 are not used inside the product, but do not keep TC4, TC5 and TD6 open to avoid noise problem.

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



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, TC5 and TD6 are not used inside the product, but do not keep TC4, TC5 and TD6 open to avoid noise problem.

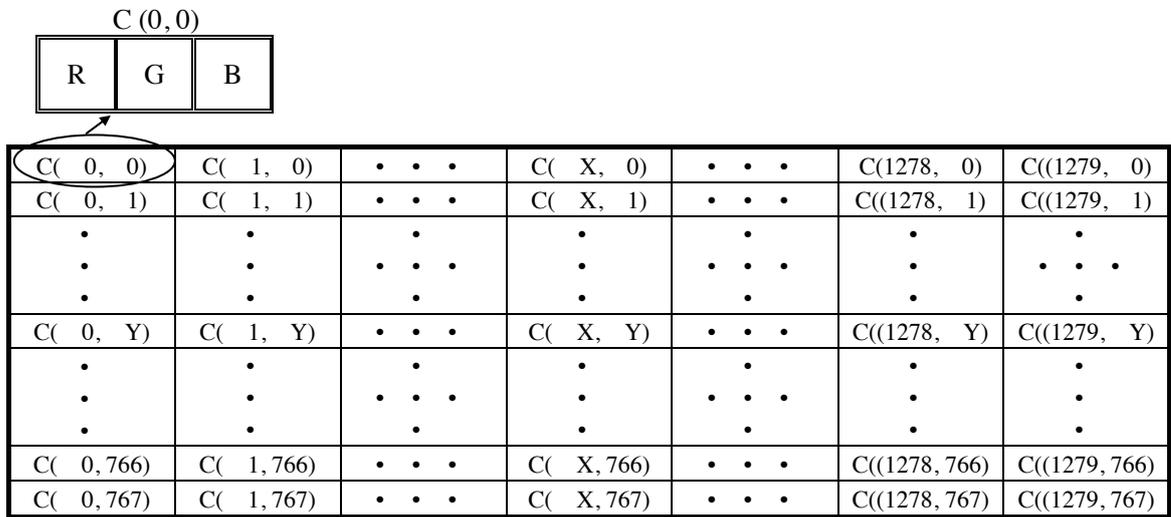
4.6 DISPLAY COLORS AND INPUT DATA SIGNALS

This product can display equivalent of 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
Red	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	1	1	1	1	1	1	1	1	0	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
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	
	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
Blue	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	1	1	1	1	1	1	1	1	

4.7 DISPLAY POSITIONS

The following table is the coordinates per pixel.

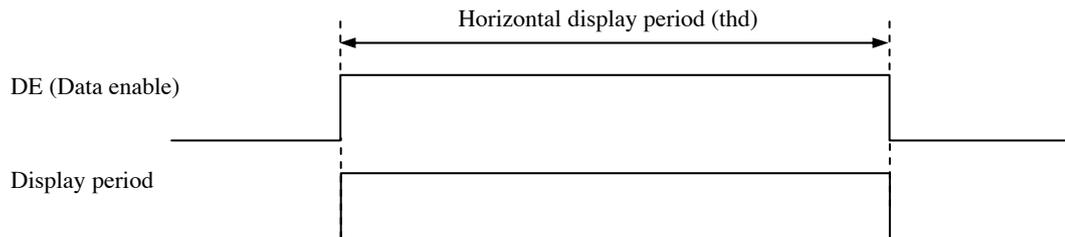


4.8 INPUT SIGNAL TIMINGS

4.8.1 Outline of input signal timings

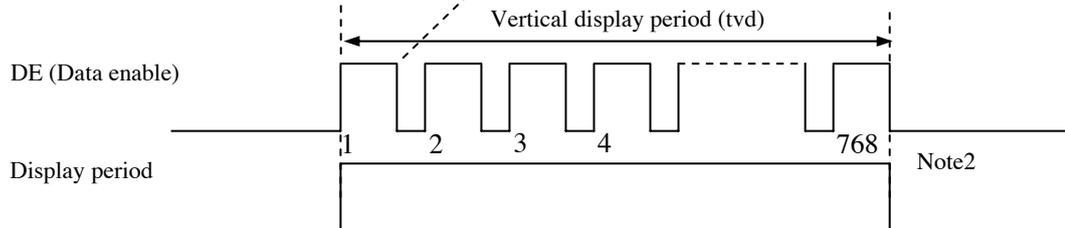
• Horizontal signal

Note1



• Vertical signal

Note1



Note1: This diagram indicates virtual signal for set up to timing.

Note2: See "4.8.3 Input signal timing chart" for numeration of pulse.

4.8.2 Timing characteristics

(Note1, Note2, Note3)

Parameter		Symbol	min.	typ.	max.	Unit	Remarks	
CLK	Frequency	1/tc	70	79.5	82	MHz	12.579ns (typ.)	
	Duty	-	-			-	-	
	Rise time, Fall time	-				ns		
DATA	CLK-DATA	Setup time	-			ns	-	
		Hold time				ns		
	Rise time, Fall time	-				ns		
DE	Horizontal	Cycle	th	20.10	20.93	24.33	μs	47.776kHz (typ.)
			-	-	1664	-	CLK	
	Vertical (One frame)	Cycle	tv	13.33	16.70	20.00	ms	60.0Hz (typ.)
			-	-	798	-	H	
	CLK-DE	Setup time	-	-			ns	-
			Hold time				-	
	Rise time, Fall time	-	ns					
	Display period	thd	1280			CLK	-	
	Display period	tvd	768			H	-	

Note1: Definition of parameters is as follows.

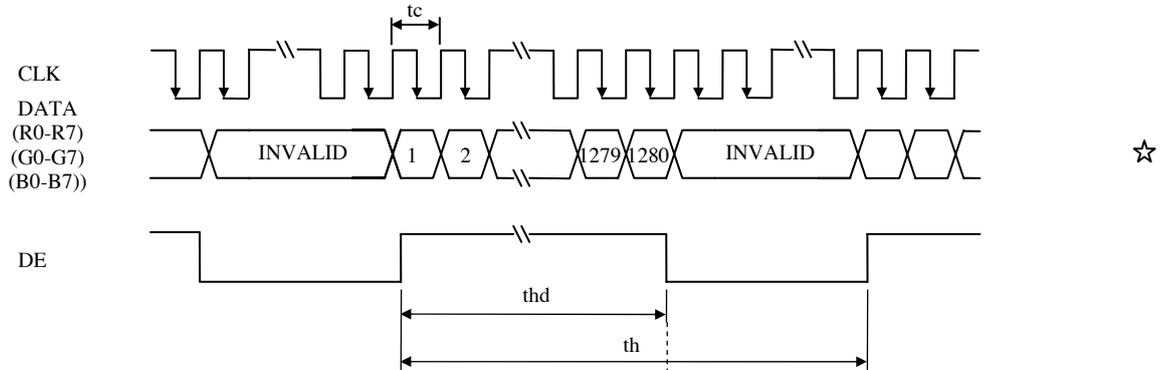
$$tc = 1CLK, th = 1H$$

Note2: See the data sheet of LVDS transmitter.

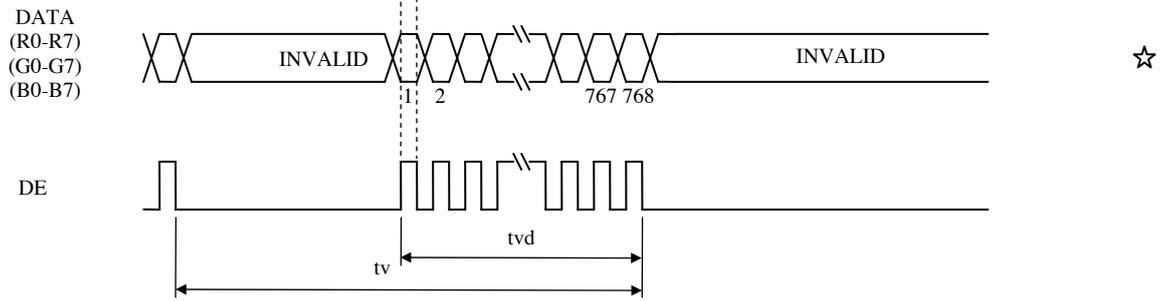
Note3: Vertical cycle (tv) should be specified in integral multiple of Horizontal cycle (th).

4.8.3 Input signal timing chart

Horizontal timing



Vertical timing



4.9 OPTICS

4.9.1 Optical characteristics

(Note1, Note2)

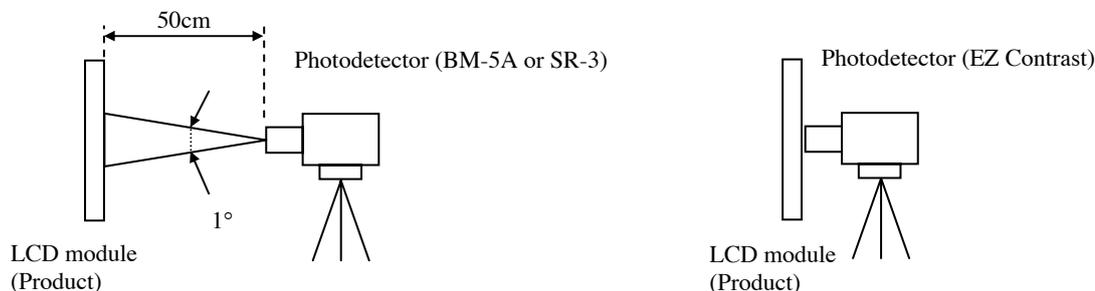
Parameter	Condition	Symbol	min.	typ.	max.	Unit	Measuring instrument	Remarks	
Luminance	White at center $\theta R=0^\circ, \theta L=0^\circ, \theta U=0^\circ, \theta D=0^\circ$	L	230	330	-	cd/m <sup>2</sup>	BM-5A	-	
Contrast ratio	White/Black at center $\theta R=0^\circ, \theta L=0^\circ, \theta U=0^\circ, \theta D=0^\circ$	CR	700	1000	-	-	BM-5A	Note3	
Luminance uniformity	White $\theta R=0^\circ, \theta L=0^\circ, \theta U=0^\circ, \theta D=0^\circ$	LU	-	1.1	1.3	-	BM-5A	Note4	
Chromaticity	White	x coordinate	W <sub>x</sub>	0.283	0.313	0.343	-	SR-3	Note5
		y coordinate	W <sub>y</sub>	0.299	0.329	0.359	-		
	Red	x coordinate	R <sub>x</sub>	-	0.650	-	-		
		y coordinate	R <sub>y</sub>	-	0.330	-	-		
	Green	x coordinate	G <sub>x</sub>	-	0.290	-	-		
		y coordinate	G <sub>y</sub>	-	0.610	-	-		
Blue	x coordinate	B <sub>x</sub>	-	0.150	-	-			
	y coordinate	B <sub>y</sub>	-	0.072	-	-			
Color gamut	$\theta R=0^\circ, \theta L=0^\circ, \theta U=0^\circ, \theta D=0^\circ$ at center, against NTSC color space	C	65	72	-	%			
Response time	Black to White	T <sub>on</sub>	-	14	20	ms	BM-5A	Note6	
	White to Black	T <sub>off</sub>	-	11	15	ms		Note7	
Viewing angle	Right	$\theta U=0^\circ, \theta D=0^\circ, CR \geq 10$	$\theta R$	70	88	-	EZ Contrast	Note8	
	Left	$\theta U=0^\circ, \theta D=0^\circ, CR \geq 10$	$\theta L$	70	88	-			
	Up	$\theta R=0^\circ, \theta L=0^\circ, CR \geq 10$	$\theta U$	70	88	-			
	Down	$\theta R=0^\circ, \theta L=0^\circ, CR \geq 10$	$\theta D$	70	88	-			
Viewing angle $\gamma$ characteristic	Horizontal	at center, 170° more than $\theta U=0^\circ, \theta D=0^\circ$	-	-	-	0.3	BM-5A or EZ- Contrast	Note8	
	Vertical	at center, 170° more than $\theta R=0^\circ, \theta L=0^\circ$	-	-	-	0.3			

Note1: These are initial characteristics.

Note2: Measurement conditions are as follows.

T<sub>a</sub>= 25°C, VCC= 3.3V, IBL= 6.0 mArms / lamp, Display mode: WXGA,  
Horizontal cycle= 1/47.776kHz, Vertical cycle= 1/60.0Hz

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 "4.9.2 Definition of contrast ratio".

Note4: See "4.9.3 Definition of luminance uniformity".

Note5: These coordinates are found on CIE 1931 chromaticity diagram.

Note6: Product surface temperature: TopF= 30°C

Note7: See "4.9.4 Definition of response times".

Note8: See "4.9.5 Definition of viewing angles".

4.9.2 Definition of contrast ratio

The contrast ratio is calculated by using the following formula.

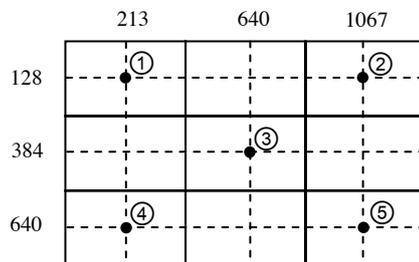
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance of white screen}}{\text{Luminance of black screen}}$$

4.9.3 Definition of luminance uniformity

The luminance uniformity is calculated by using following formula.

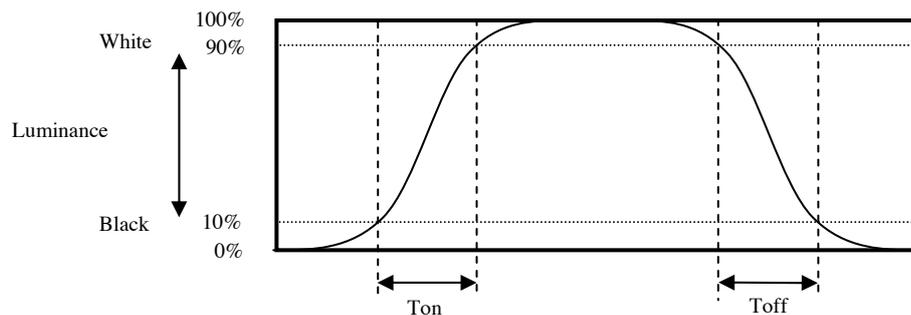
$$\text{Luminance uniformity (LU)} = \frac{\text{Maximum luminance from ① to ⑤}}{\text{Minimum luminance from ① to ⑤}}$$

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

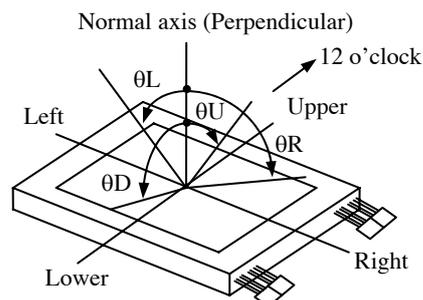


4.9.4 Definition of response times

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.).



4.9.5 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= 6.0 mArms / lamp	43,000	h
	70°C (Surface temperature at screen center) Continuous operation, IBL= 6.0 mArms / lamp	33,000	h
Cold cathode fluorescent lamp	25°C (Ambient temperature of the lamp) Continuous operation, IBL= 6.0 mArms / lamp	50,000	h

Note1: MTTF is mean time to half-luminance.

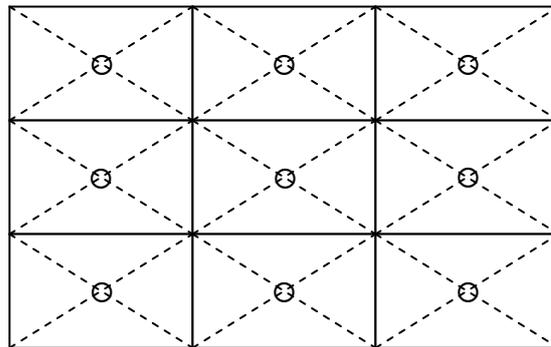
Note2: In case the product works under low temperature environment, the lifetime becomes short.

6. RELIABILITY TESTS

Test item	Condition	Judgment	Note1
High temperature and humidity (Operation)	① 60 ± 2°C, RH= 90%, 240hours ② Display data is white.	No display malfunctions	
High temperature (Operation)	① 70 ± 3°C, 240hours ② Display data is white.		
Heat cycle (Operation)	① -10 ± 3°C...1hour 70 ± 3°C...1hour ② 50cycles, 4 hours/cycle ③ Display data is white.		
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 <sup>2</sup> ② 1 minute/cycle ③ X, Y, Z directions ④ 50 times each directions	No display malfunctions No physical damages	
Mechanical shock (Non operation)	① 294m/ s <sup>2</sup> , 11ms ② ±X, ±Y, ±Z directions 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.



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 personnel 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 personnel, 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<sup>2</sup> and to be not greater 11ms, Pressure: To be not greater 19.6 N (φ16mm jig))**

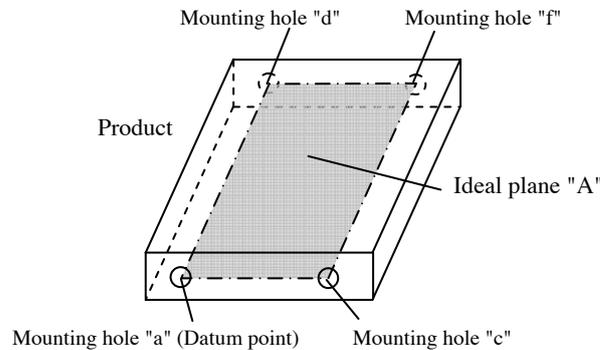
7.3 ATTENTIONS



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 0.343N·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  $\pm 0.3$  mm.



- ⑦ Do not press or rub on the sensitive product surface. When cleaning the product surface, wipe it with a soft dry cloth.
- 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.

### 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 VCC terminals should be used without any non-connected lines.
- ② Do not disassemble a product.
- 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 information of China RoHS directive six hazardous substances or elements in this product is as follows.

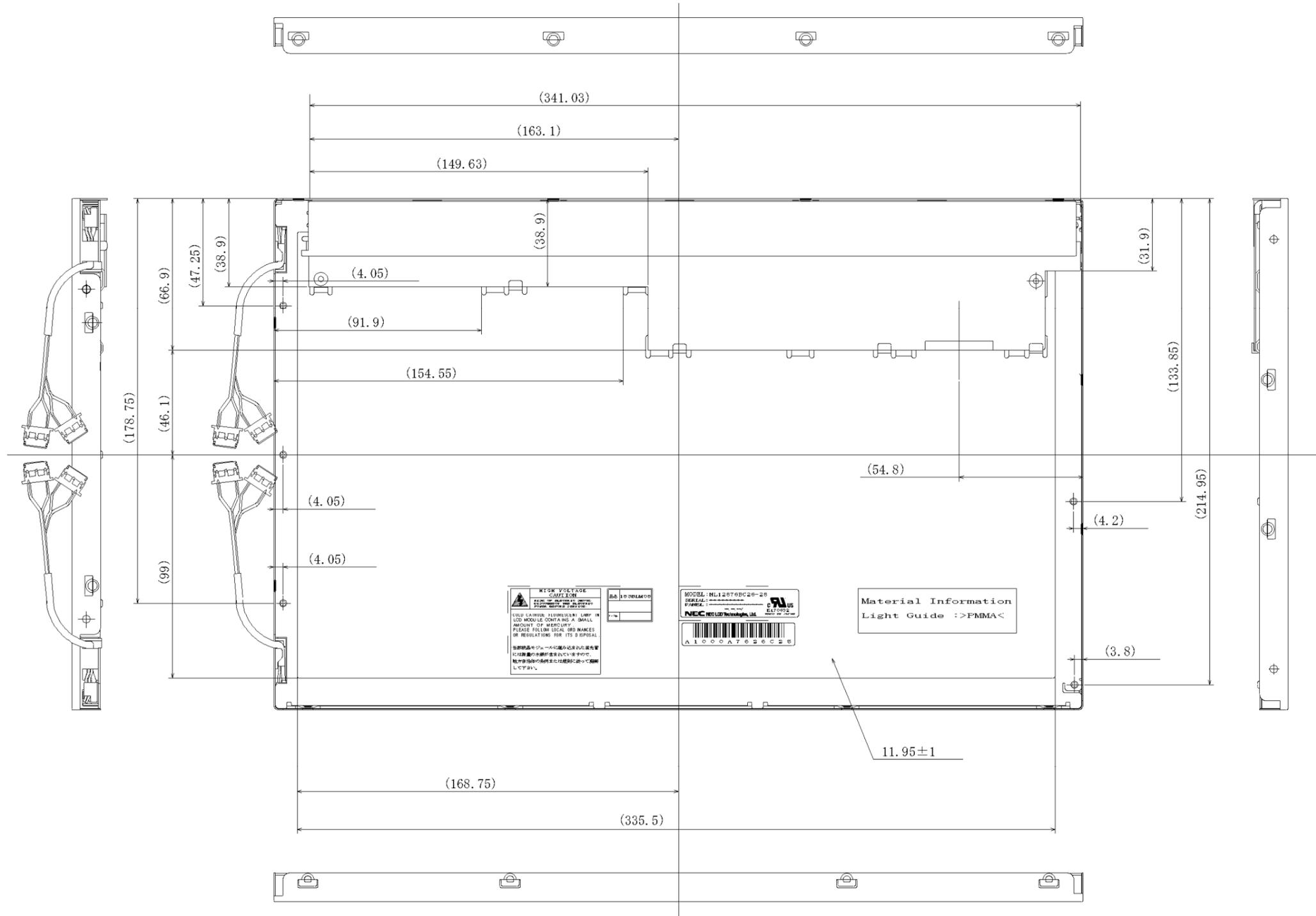
China RoHS directive six hazardous substances or elements					
Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr VI)	Polybrominated Biphenyls (PBB)	Polybrominated Biphenyl Ethers (PBDE)
×	×	○	○	○	○

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.



8.2 REAR VIEW



Note1: The values in parentheses are for reference.

Note2: The torque for product mounting screws must never exceed 0.343 N·m.

Note3: The length of product mounting screws from surface of plate must be ≤ 2.8mm.

Unit: mm