

# **TFT COLOR LCD MODULE**

**NL10276BC20-47**

**26cm (10.4 Type)**

**XGA**

**LVDS interface (1 port)**

## **DATA SHEET**

**DOD-PP-2274 (1st edition)**

**This DATA SHEET is updated document from  
PRELIMINARY DATA SHEET DOD-PP-2057(1).**

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## INTRODUCTION

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Examples: Office equipment, audio and visual equipment, communication equipment, test and measurement equipment, personal electronic equipment, home electronic appliances, car navigation system (with no vehicle control functions), seat entertainment monitor for vehicles and airplanes, fish finder (except marine radar integrated type), PDA, etc.

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Examples: Aerospace system (except seat entertainment monitor), nuclear control system, life support system, 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 NL10276BC20-47 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 APPLICATION

- For industrial use

### 1.3 FEATURES

- Ultra-wide viewing angle (Super Fine TFT (SFT))
- High resolution
- High contrast
- LVDS interface
- Reversible-scan direction
- Edge light LED backlight
- Replaceable lamp for backlight
- Compliant with the European RoHS directive (2011/65/EU)



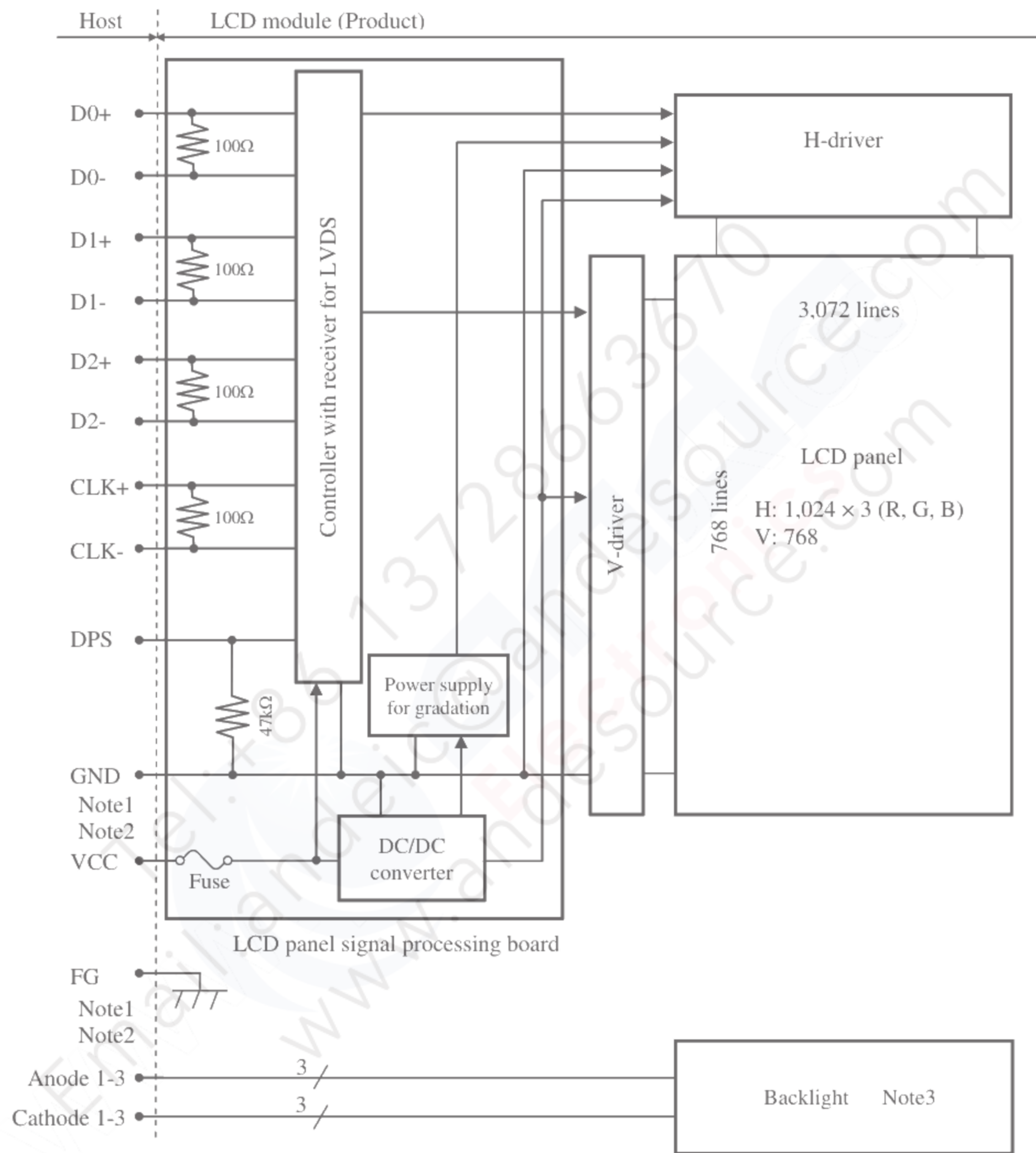


## 2. GENERAL SPECIFICATIONS

<i>Display area</i>	210.432 (H) × 157.824 (V) mm	
<i>Diagonal size of display</i>	26cm (10.4 inches)	
<i>Drive system</i>	a-Si TFT active matrix	
<i>Display color</i>	262,144 colors (At 6-bit input)	
<i>Pixel</i>	1,024 (H) × 768 (V) pixels	
<i>Pixel arrangement</i>	RGB (Red dot, Green dot, Blue dot) vertical stripe	
<i>Dot pitch</i>	0.0685 (H) × 0.2055 (V) mm	
<i>Pixel pitch</i>	0.2055 (H) × 0.2055 (V) mm	
<i>Module size</i>	227.0 (W) × 175.4 (H) × 8.7 (D) mm (typ.)	
<i>Weight</i>	360g (typ.)	☆
<i>Contrast ratio</i>	700:1 (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>	• Viewing angle with optimum grayscale ( $\gamma \approx 2.2$ ): Normal axis (perpendicular)	
<i>Polarizer surface</i>	Clear	
<i>Polarizer pencil-hardness</i>	3H (min.) [by JIS K5600]	
<i>Color gamut</i>	At LCD panel center 40% (typ.) [against NTSC color space]	
<i>Response time</i>	$T_{on} + T_{off}$ (10% $\longleftrightarrow$ 90%) 25ms (typ.)	
<i>Luminance</i>	At $I_L = 45\text{mA/One circuit}$ 300cd/m <sup>2</sup> (typ.)	☆
<i>Signal system</i>	LVDS 1port (Receiver: THC63LVDF84B, Thine Electronics Inc. or equivalent) [6-bit 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>	LED backlight <div style="border-left: 1px solid black; border-right: 1px solid black; padding: 0 10px; margin: 5px 0;"> Replaceable part  • Lamp holder set: 104LHS71 </div>	☆
<i>Power consumption</i>	At $I_L = 45\text{mA/One circuit}$ , Checkered flag pattern 3.8W (typ.)	☆ ☆



3. BLOCK DIAGRAM



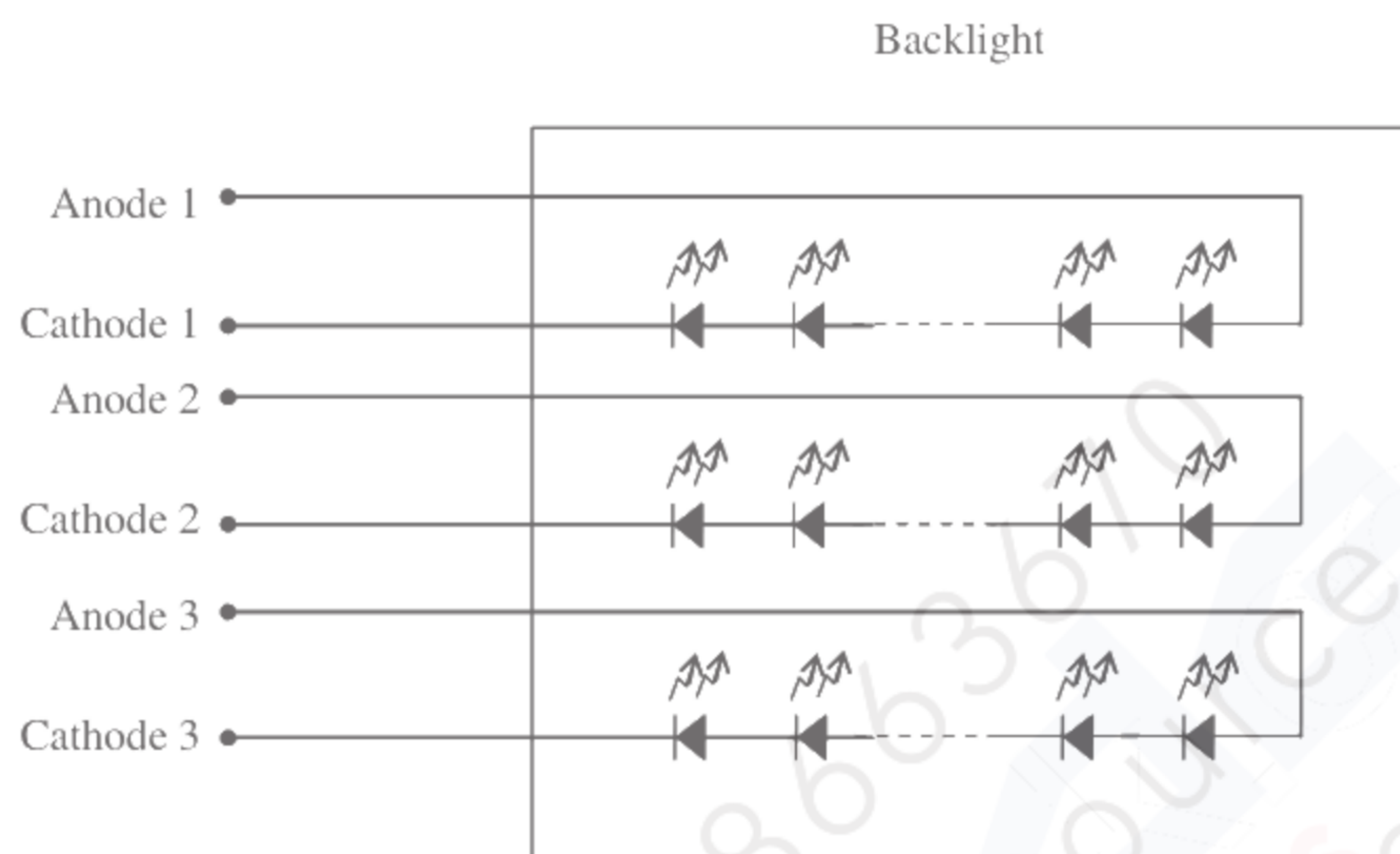
Note1: Relation between GND (Signal ground) and FG (Frame ground) in the LCD module is as follow.

GND- FG	Not connected
---------	---------------

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



Note3: Backlight in detail





## 4. DETAILED SPECIFICATIONS

## 4.1 MECHANICAL SPECIFICATIONS

Parameter	Specification	Unit
Module size	227.0 ± 0.5 (W) × 175.4 ± 0.5 (H) × 8.7 ± 0.5 (D) Note1	mm
Display area	210.432 (H) × 157.824 (V) Note1	mm
Weight	360 (typ.), 400 (max.)	g

Note1: See "8. OUTLINE DRAWINGS".

## 4.2 ABSOLUTE MAXIMUM RATINGS

Parameter		Symbol	Rating	Unit	Remarks	
Power supply voltage	LCD panel signal processing board	VCC	-0.3 to +4.0	V	Ta= 25℃	
Input voltage for signals	Display signals Note1	VD	-0.3 to VCC+0.3	V		
	Function signal Note2	VF				
Backlight	Forward current	IL	65	mA	per one circuit	
Storage temperature		Tst	-20 to +60	℃	-	
Operating temperature		Front surface	TopF	0 to +55	℃	Note3
		Rear surface	TopR	0 to +65	℃	Note4
Relative humidity Note5		RH	≤ 95	%	Ta ≤ 40℃	
			≤ 85	%	40℃ < Ta ≤ 50℃	
			≤ 70	%	50℃ < Ta ≤ 55℃	
Absolute humidity Note5		AH	≤ 73 Note6	g/m <sup>3</sup>	Ta > 55℃	

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

Note2: DPS

Note3: Measured at LCD panel surface (including self-heat)

Note4: Measured at LCD module's rear shield surface (including self-heat)

Note5: No condensation

Note6: Water amount at Ta= 55°C and RH= 70%



### 4.3 ELECTRICAL CHARACTERISTICS

#### 4.3.1 LCD panel signal processing board

(Ta= 25°C)

Parameter		Symbol	min.	typ.	max.	Unit	Remarks
Power supply voltage		VCC	3.0	3.3	3.6	V	-
Power supply current		ICC	-	420 Note1	750 Note2	mA	at VCC= 3.3V
Permissible ripple voltage		VRP	-	-	100	mVp-p	for VCC Note3, Note4, Note5
Differential input threshold voltage	High	VTH	-	-	+100	mV	at VCM= 1.2V Note6
	Low	VTL	-100	-	-	mV	
Terminating resistance		RT	-	100	-	Ω	-
Input voltage for DPS signal	High	VFH	0.7VCC	-	VCC	V	CMOS level
	Low	VFL	0	-	0.3VCC	V	
Input current for DPS signal	High	IFH	-	-	300	μA	-
	Low	IFL	-300	-	-	μA	

Note1: Checkered flag pattern [by EIAJ ED-2522]

Note2: Pattern for maximum current

Note3: This product works if the ripple voltage levels are over the permissible values, but there might be noise on the display image.

Note4: The permissible ripple voltage includes spike noise.

Note5: The load variation influence does not include.

Note6: Common mode voltage for LVDS receiver

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## 4.3.2 Backlight

(Ta= 25°C, Note1, Note2, Note3)

Parameter	Symbol	min.	typ.	max.	Unit	Remarks
Forward current	IL	-	45.0	50.0	mA	-
Forward voltage	VL	16.3	17.9	19.5	V	Ta= +25°C, at IL= 45mA, /One circuit
		15.7	-	-		Ta= +55°C at IL= 45mA, /One circuit
		-	-	20.0		Ta= 0°C at IL= 45mA, /One circuit
		-	-	20.4		Ta= 0°C at IL= 50mA, /One circuit

Note1: Please drive the backlight with constant current.

Note2: The above specifications are for one LED circuit of the backlight.

Note3: The Luminance uniformity may be changed depending on the current variation between 3 circuits. It is recommended that the current value difference among the circuits be less than 5%.

## 4.3.3 Fuse

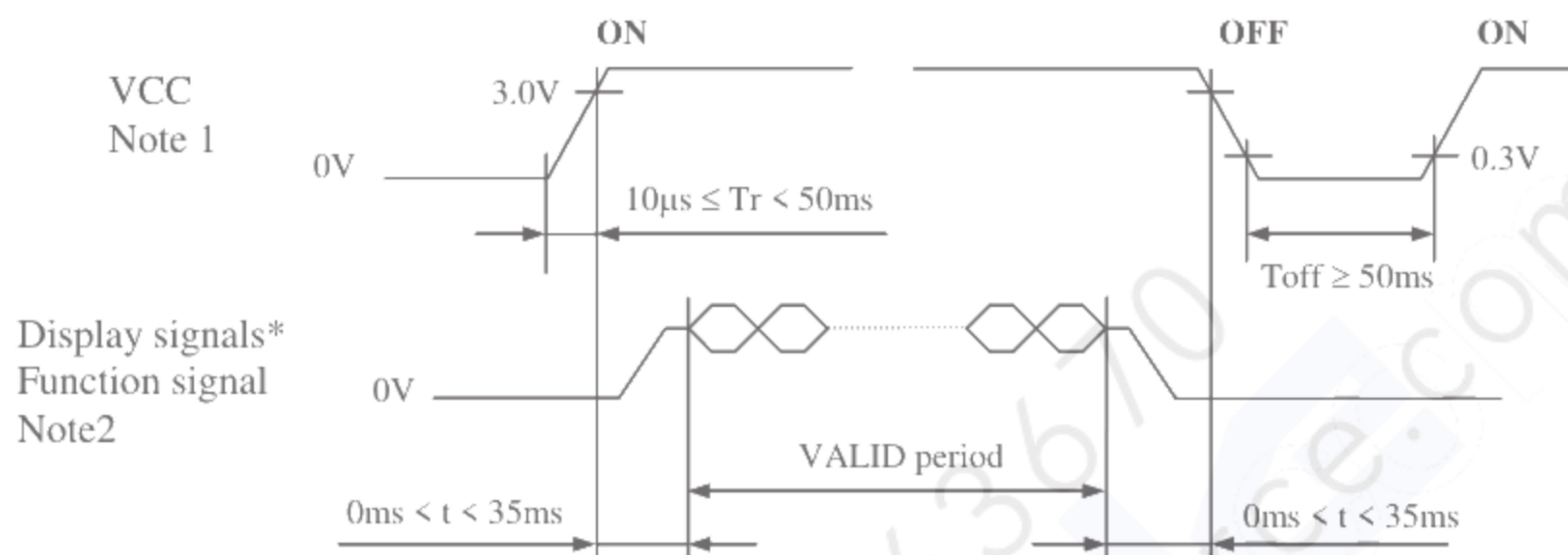
Parameter	Fuse		Rating	Fusing current	Remarks
	Type	Supplier			
VCC	FCC16202AB	KAMAYA ELECTRIC Co., Ltd.	2.0A 36V	4.0A, 5 seconds maximum	Note1

Note1: The power supply's rated current must be more than the fusing current. If it is less than the fusing current, the fuse may not blow in a short time, and then nasty smell, smoke and so on may occur.



#### 4.4 POWER SUPPLY VOLTAGE SEQUENCE

##### 4.4.1 LCD panel signal processing board



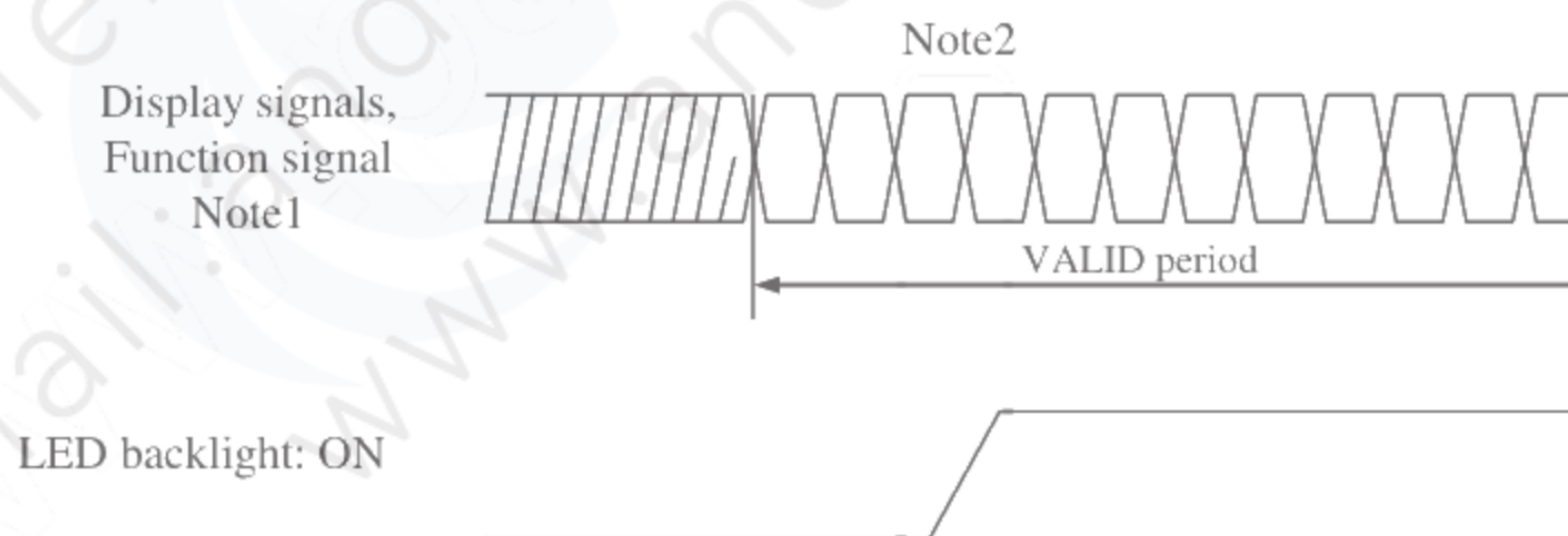
\* These signals should be measured at the terminal of 100Ω resistance.

Note1: If there is a voltage variation (voltage drop) at the rising edge of VCC below 3.0V, there is a possibility that a product does not work due to a protection circuit.

Note2: Display signals (D0+/-, D1+/-, D2+/- and CLK+/-) and function signal (DPS) must be set to Low or High-impedance, except the VALID period (See above sequence diagram), in order to avoid the circuitry damage.

If some of 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 a customer stops the display and function signals, VCC also must be shut down.

##### 4.4.2 LED driver



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): FI-SE20P-HFE (Japan Aviation Electronics Industry Limited (JAE))  
 Adaptable plug: FI-S20S (Japan Aviation Electronics Industry Limited (JAE))

Pin No.	Symbol	Signal	Remarks
1	N. C.	Not connected	Keep this pin open.
2	N. C.	Not connected	
3	DPS	Selection of scan direction	High: Reverse scan Low or Open: Normal scan Note1
4	N. C.	Not connected	Keep this pin open.
5	GND	Ground	Note2
6	CLK+	Pixel clock	Note3
7	CLK-		
8	GND	Ground	Note2
9	D2+	Pixel data	Note3
10	D2-		
11	GND	Ground	Note2
12	D1+	Pixel data	Note3
13	D1-		
14	GND	Ground	Note2
15	D0+	Pixel data	Note3
16	D0-		
17	GND	Ground	Note2
18	GND		
19	VCC	Power supply	Note2
20	VCC		

Note1: See "4.8 SCANNING DIRECTIONS".

Note2: All GND and VCC terminals should be used without any non-connected lines.

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

Note4: See "4.5.4 Connection between receiver and transmitter for LVDS".





### 4.5.2 Backlight

CN2 (LCD module side):

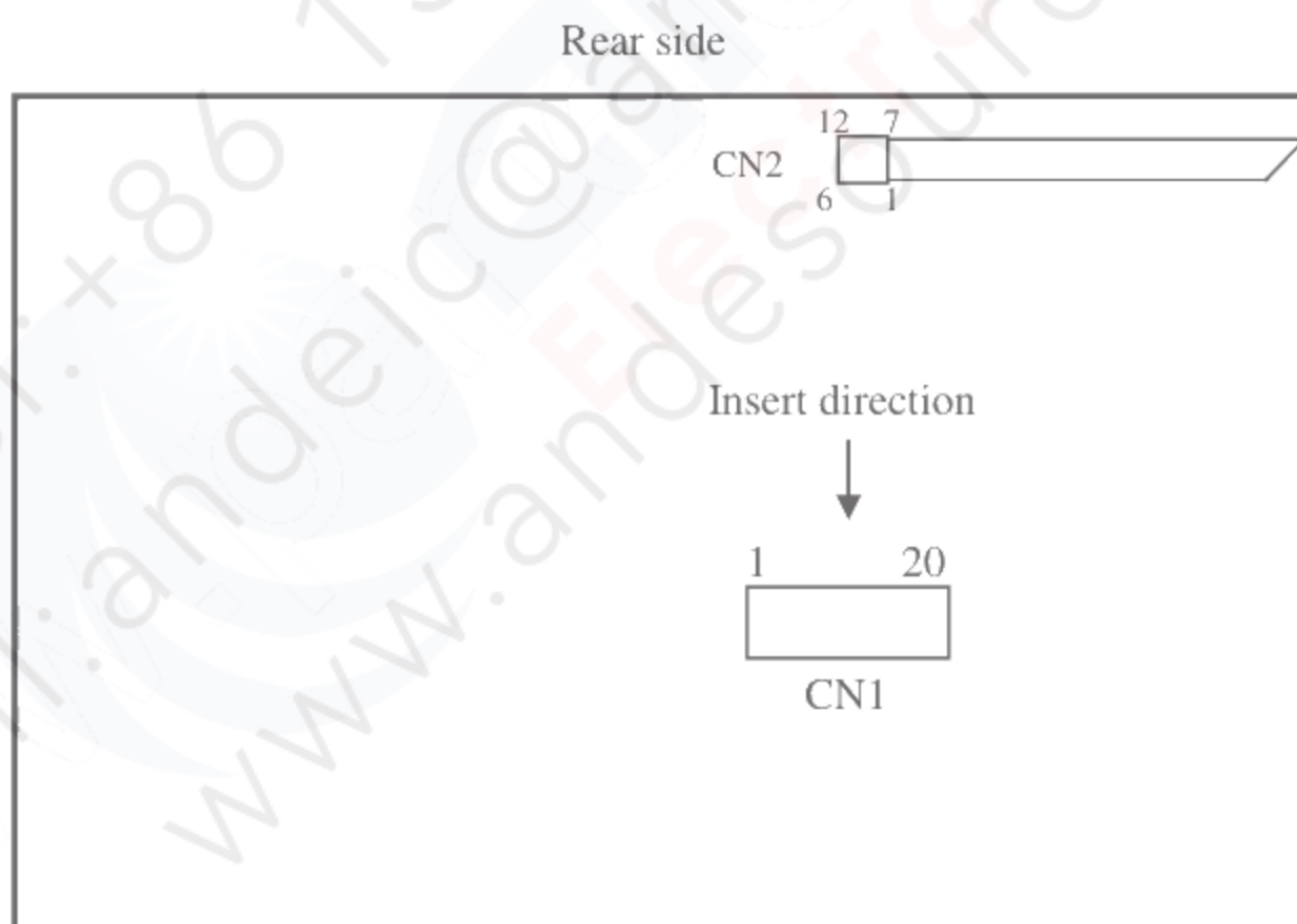
AXT612124 (Panasonic Corporation)

Adaptable connector:

AXT512124 (Panasonic Corporation)

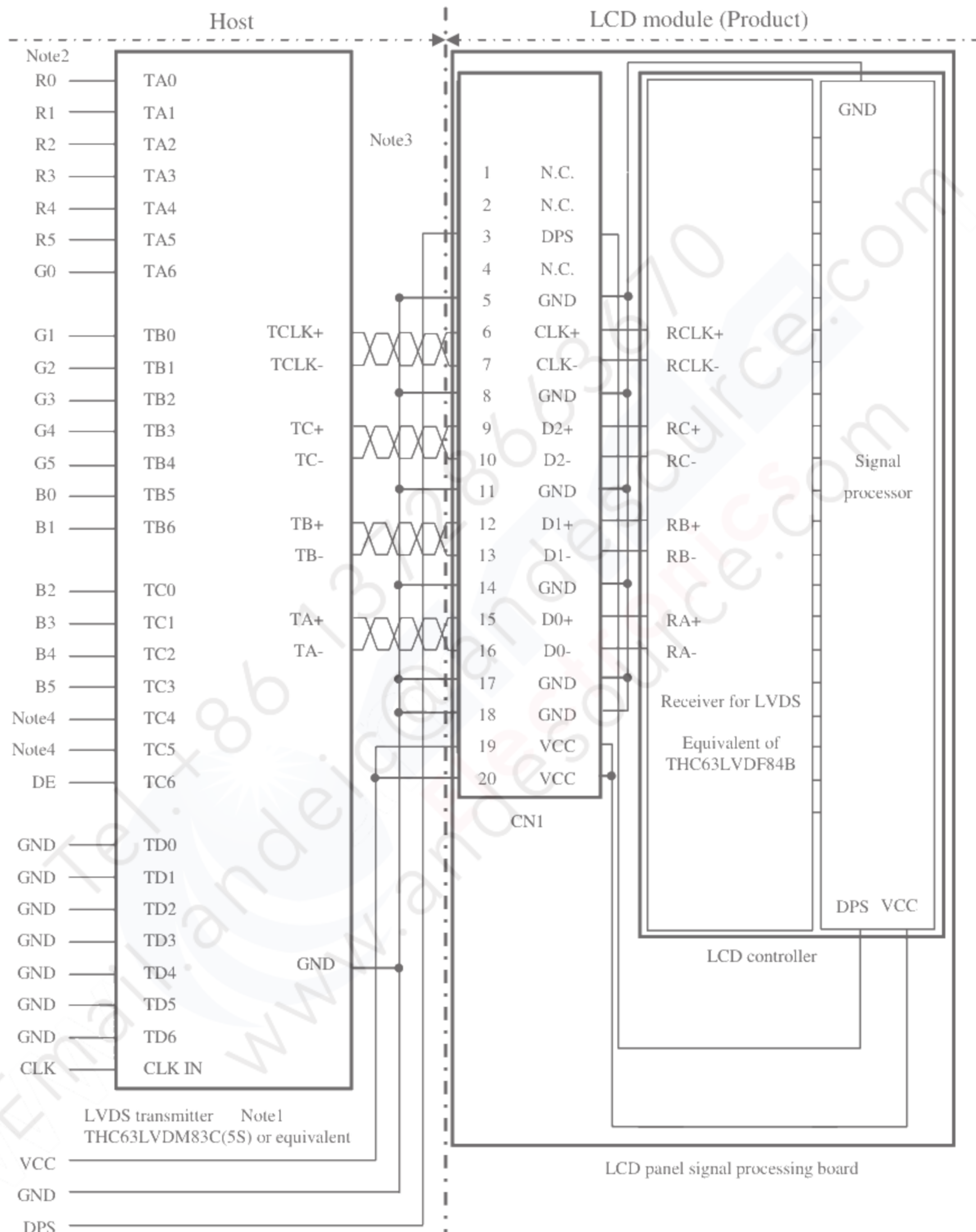
Pin No.	Symbol	Signal	Remarks
1	A1	Anode1	-
2	A1		
3	A2	Anode2	-
4	A2		
5	A3	Anode3	-
6	A3		
7	K1	Cathode1	-
8	K1		
9	K2	Cathode2	-
10	K2		
11	K3	Cathode3	-
12	K3		

### 4.5.3 Positions of sockets





#### 4.5.4 Connection between receiver and transmitter for LVDS



Note1: Recommended transmitter: THC63LVDM83C(5S) (THine Electronics Inc.) or equivalent

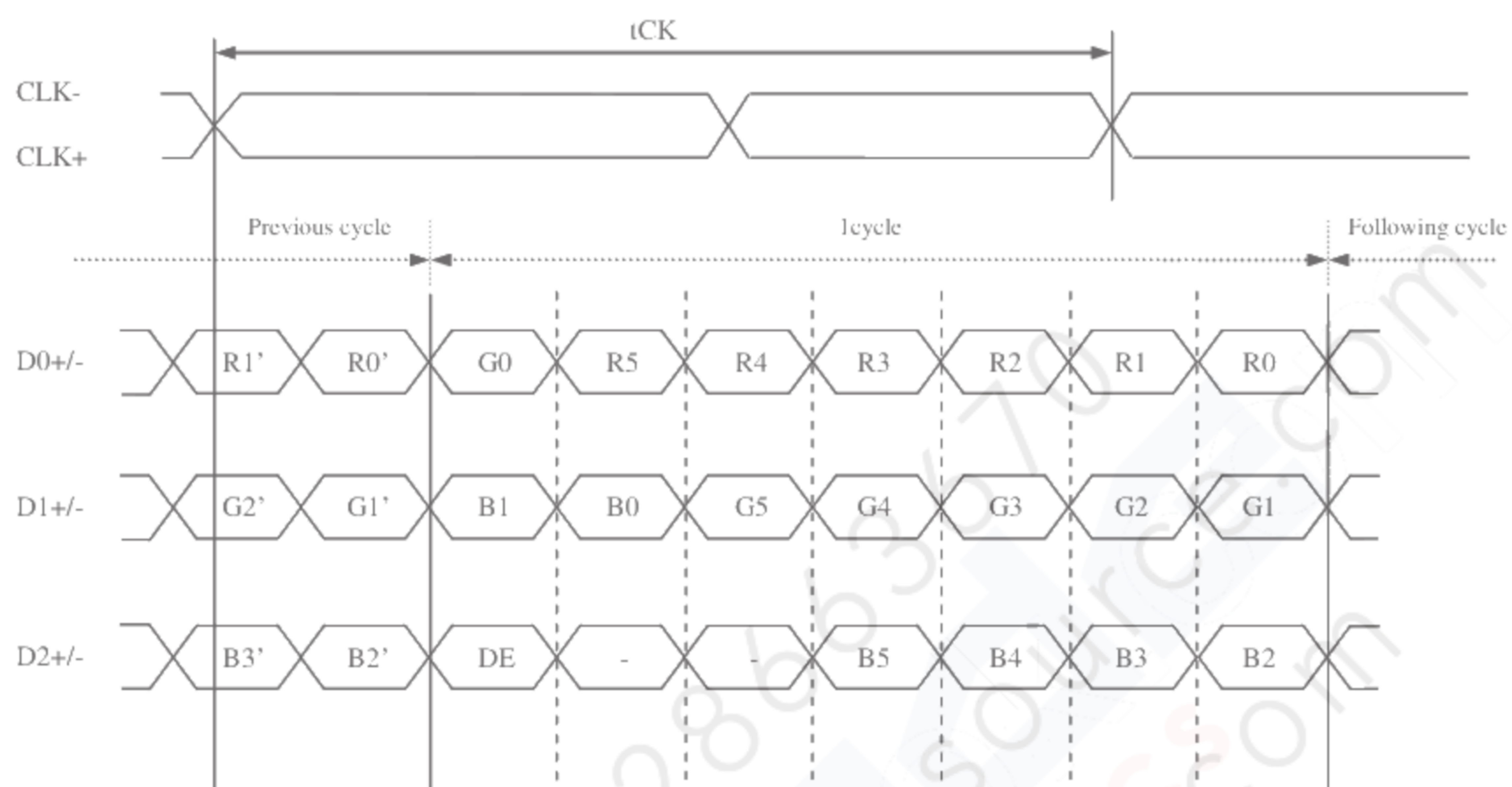
Note2: LSB (Least Significant Bit) - R0, G0, B0 MSB (Most Significant Bit) – R5, G5, B5

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 them open to avoid noise problem.



#### 4.5.5 Input data mapping





## 4.6 DISPLAY COLORS AND INPUT DATA SIGNALS

This product can display 262,144 colors with 64 gray scales. Also the relation between display colors and input data signals is as follows.

Display colors		Data signal (0: Low level, 1: High level)																	
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	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
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Cyan	0	0	0	0	0	0	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	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
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	1	0	0	0	0	0	0	0	0	0	0	0	0
	dark	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	↑				:					:						:			
	↓				:					:						:			
	bright	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Green gray scale		1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	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	1	0	0	0	0	0	0
	dark	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	↑				:					:						:			
Blue gray scale	↓				:					:						:			
	bright	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0
		0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	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	1
Blue gray scale	dark	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	1	1	1	1	0	1
		0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1



#### 4.7 DISPLAY POSITIONS



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

<div style="display: flex; align-items: center; justify-content: center;"> <div style="border: 1px solid black; padding: 2px; margin-right: 5px;">D (1, 1)</div> <div style="display: flex; border: 1px solid black;"> <div style="border: 1px solid black; padding: 2px; margin: 0 2px;">R</div> <div style="border: 1px solid black; padding: 2px; margin: 0 2px;">G</div> <div style="border: 1px solid black; padding: 2px; margin: 0 2px;">B</div> </div> </div>						
D( 1, 1)	D( 2, 1)	• • •	D( X, 1)	• • •	D(1023, 1)	D(1024, 1)
D( 1, 2)	D( 2, 2)	• • •	D( X, 2)	• • •	D(1023, 2)	D(1024, 2)
•	•	•	•	•	•	•
•	•	•	•	•	•	•
•	•	•	•	•	•	•
D( 1, Y)	D( 2, Y)	• • •	D( X, Y)	• • •	D(1023, Y)	D(1024, Y)
•	•	•	•	•	•	•
•	•	•	•	•	•	•
•	•	•	•	•	•	•
D( 1, 767)	D( 2, 767)	• • •	D( X, 767)	• • •	D(1023, 767)	D(1024, 767)
D( 1, 768)	D( 2, 768)	• • •	D( X, 768)	• • •	D(1023, 768)	D(1024, 768)

#### 4.8 SCANNING DIRECTIONS



The following figures are seen from a front view.

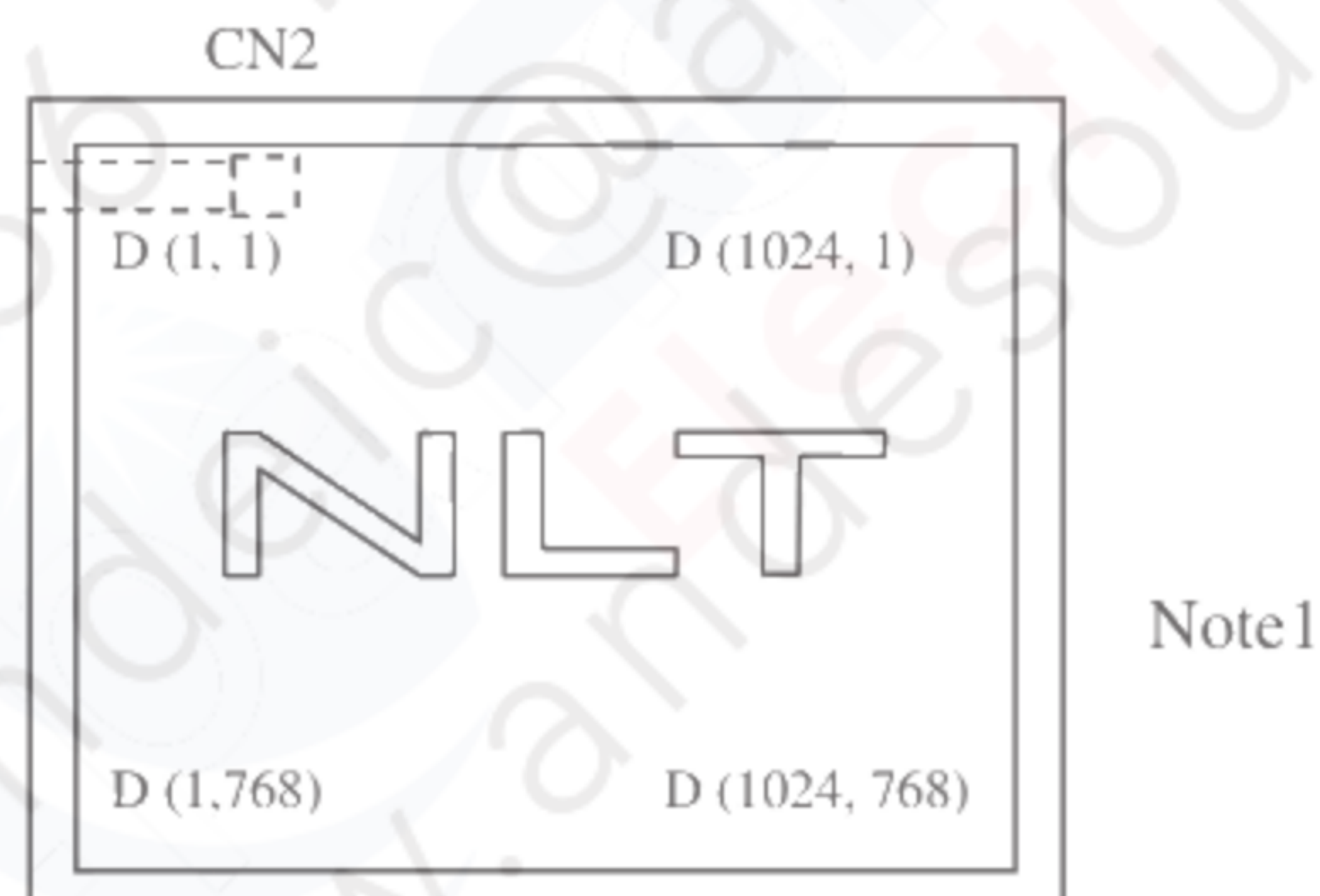


Figure1. Normal scan (DPS: Low or Open)

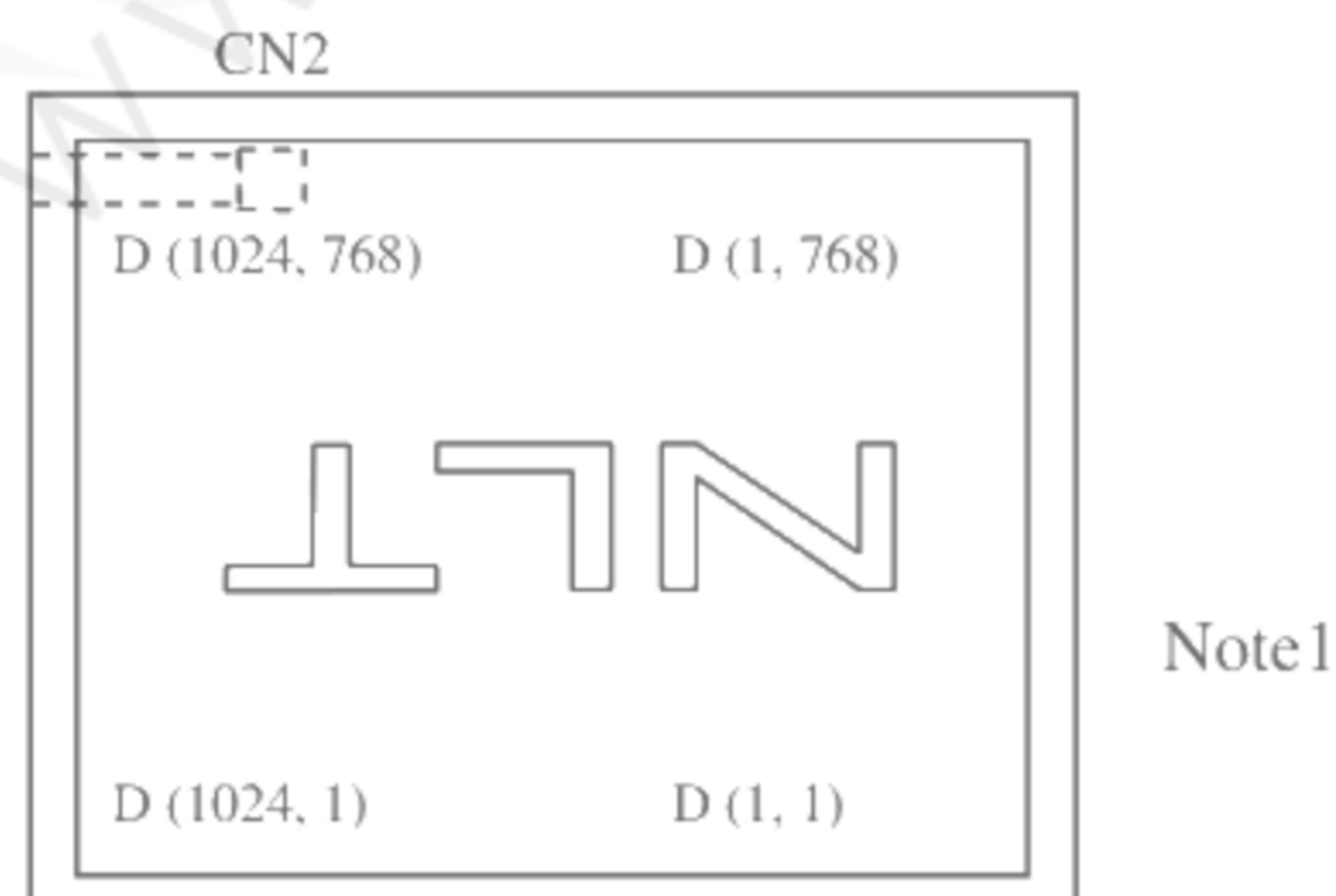


Figure2. Reverse scan (DPS: High)

Note1: Meaning of D (X, Y)

D (X, Y): Input data signals for LCD panel signal processing board

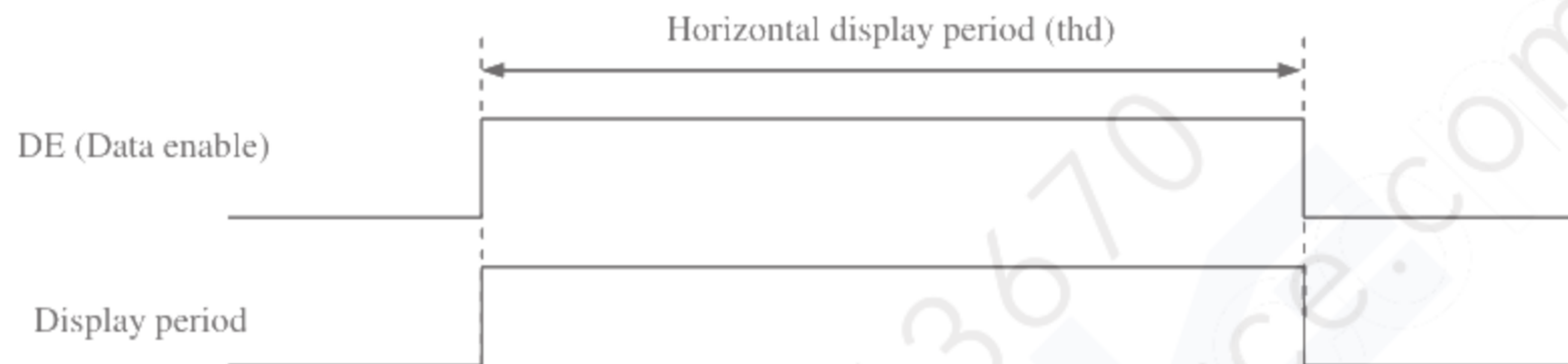


## 4.9 INPUT SIGNAL TIMINGS

### 4.9.1 Outline of input signal timings

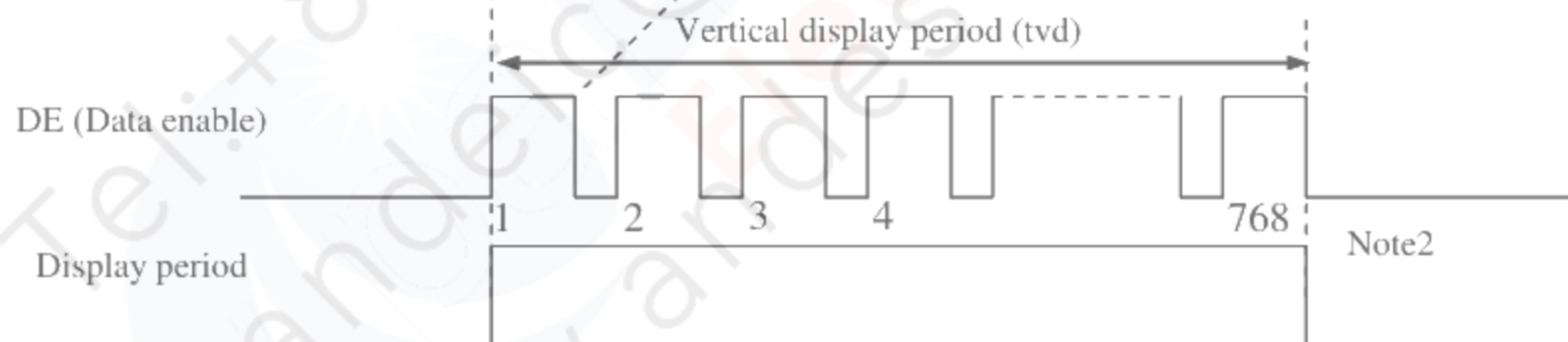
- Horizontal signal

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 the pulse number.



## 4.9.2 Timing characteristics

(Note1, Note2)

Parameter			Symbol	min.	typ.	max.	Unit	Remarks
CLK	Frequency		1/tc	60.0	65.0	68.0	MHz	15.385ns(typ.)
	Duty ratio		-	-			-	-
	Rise time, Fall time		-				ns	
DATA	CLK-DATA	Setup time	-	-			ns	-
		Hold time	-				ns	
	Rise time, Fall time		-				ns	
DE	Horizontal	Cycle	th	19.67	20.676	22.4	μs	48.363kHz(typ.)
				-	1,344	-	CLK	
		Display period		thd	1,024			CLK
	Vertical (One frame)	Cycle	tv	13.3	16.666	18.5	ms	60.0Hz(typ.)
				780	806	-	H	
		Display period		tvd	768			H
	CLK-DE	Setup time	-	-			ns	-
		Hold time	-				ns	
	Rise time, Fall time		-				ns	

Note1: Definition of parameters is as follows.

tc= 1CLK, th= 1H

Note2: See the data sheet of LVDS transmitter.

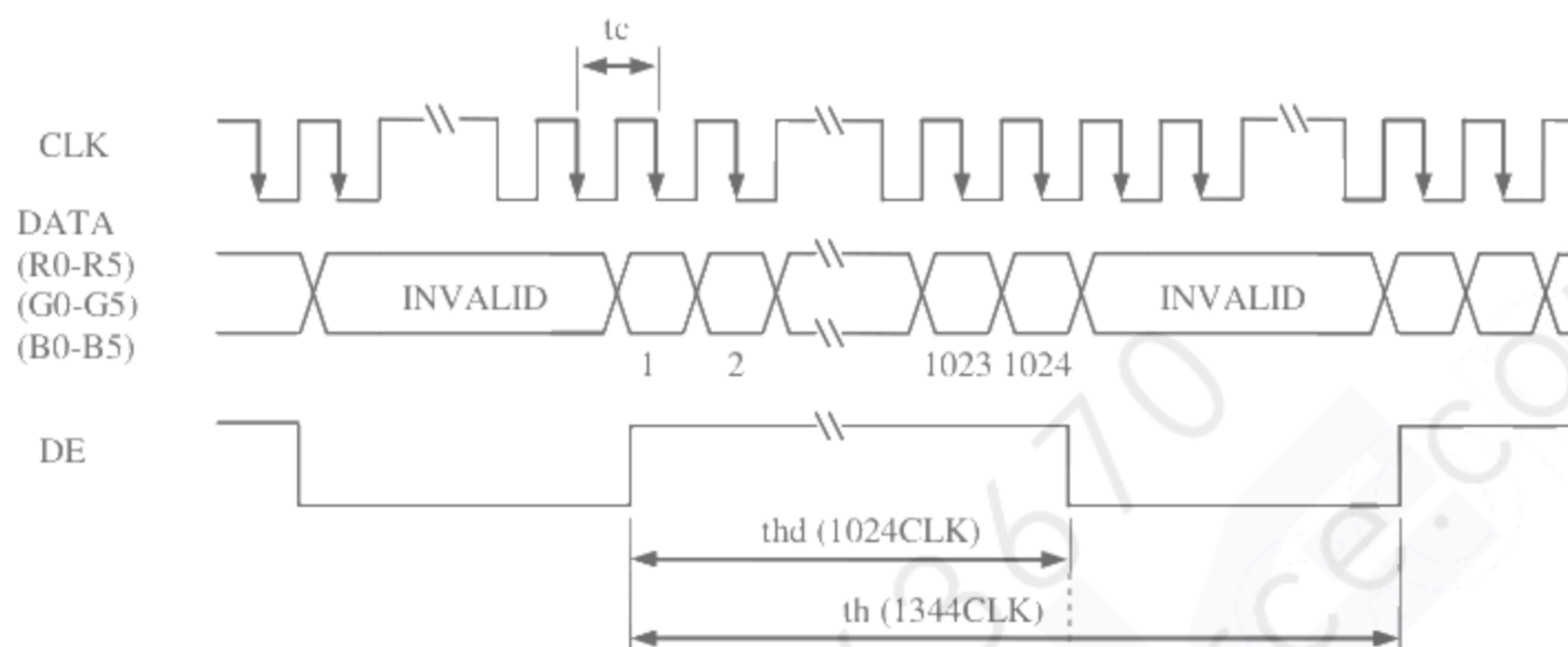
Note3: Vertical cycle (tv) should be specified in integral multiple of Horizontal cycle (th).



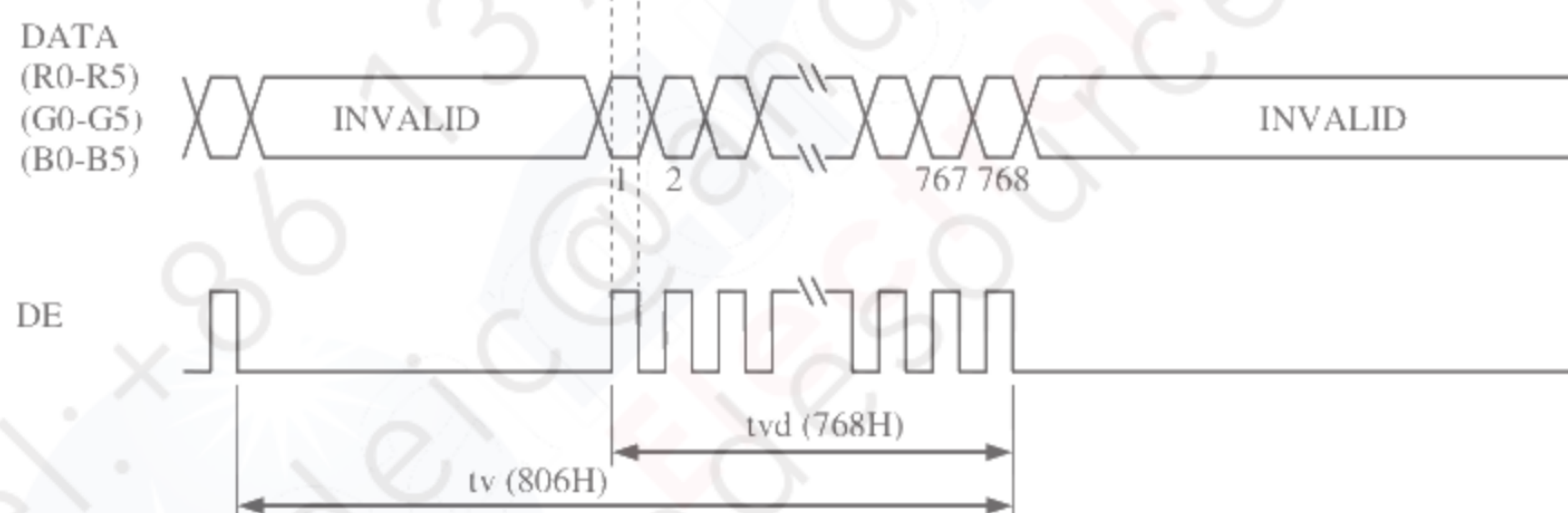


### 4.9.3 Input signal timing chart

#### Horizontal timing



#### Vertical timing





## 4.10 OPTICS

## 4.10.1 Optical characteristics

(Note1, Note2)

(Note1, Note2)

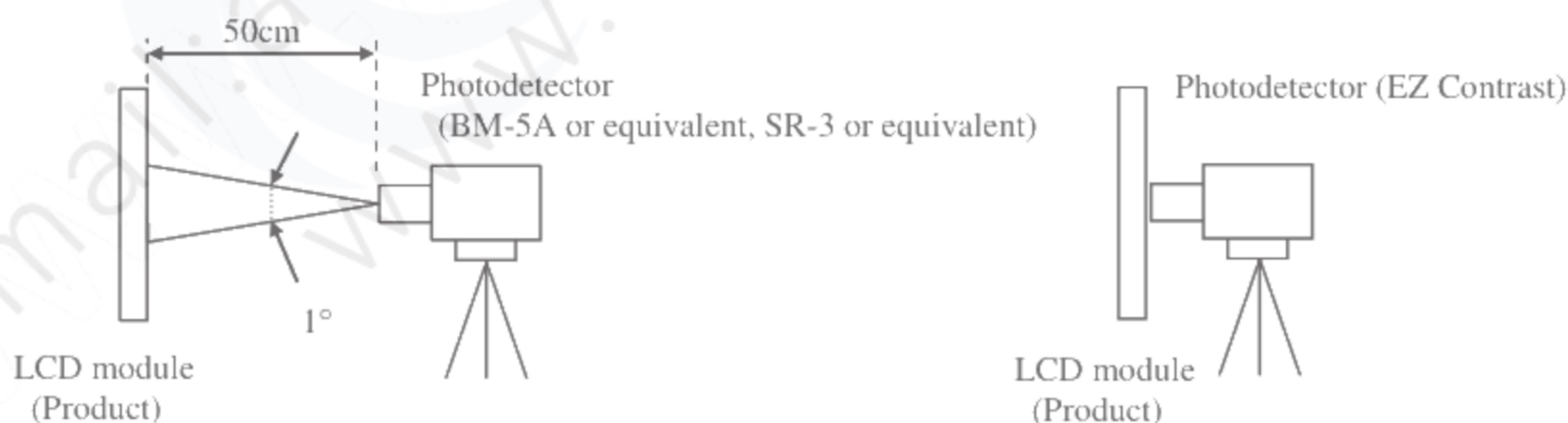
Parameter	Condition	Symbol	min.	typ.	max.	Unit	Measuring instrument	Remarks		
Luminance	White at center $\theta R=0^{\circ}, \theta L=0^{\circ}, \theta U=0^{\circ}, \theta D=0^{\circ}$	L	250	300	-	cd/m <sup>2</sup>	BM-5A or equivalent	-	☆	
Contrast ratio	White/Black at center $\theta R=0^{\circ}, \theta L=0^{\circ}, \theta U=0^{\circ}, \theta D=0^{\circ}$	CR	400	700	-	-	BM-5A or equivalent	Note3	☆	
Luminance uniformity	White $\theta R=0^{\circ}, \theta L=0^{\circ}, \theta U=0^{\circ}, \theta D=0^{\circ}$	LU	-	1.25	1.4	-	BM-5A or equivalent	Note4	☆	
Chromaticity	White	x coordinate	Wx	0.263	0.313	0.363	-	SR-3 or equivalent	Note5	☆
		y coordinate	Wy	0.279	0.329	0.379	-			
	Red	x coordinate	Rx	-	0.565	-	-			
		y coordinate	Ry	-	0.345	-	-			
	Green	x coordinate	Gx	-	0.340	-	-			
		y coordinate	Gy	-	0.530	-	-			
	Blue	x coordinate	Bx	-	0.150	-	-			
		y coordinate	By	-	0.105	-	-			
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	35	40	-	%				
Response time	Black to White	Ton	-	13	17	ms	BM-5A or equivalent	Note6	☆	
	White to Black	Toff	-	12	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	-				

Note1: These are initial characteristics.

Note2: Measurement conditions are as follows.

Ta= 25°C, VCC= 3.3V, IL= 45mA/One Circuit, 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 20minutes after the product works 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= 31°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.

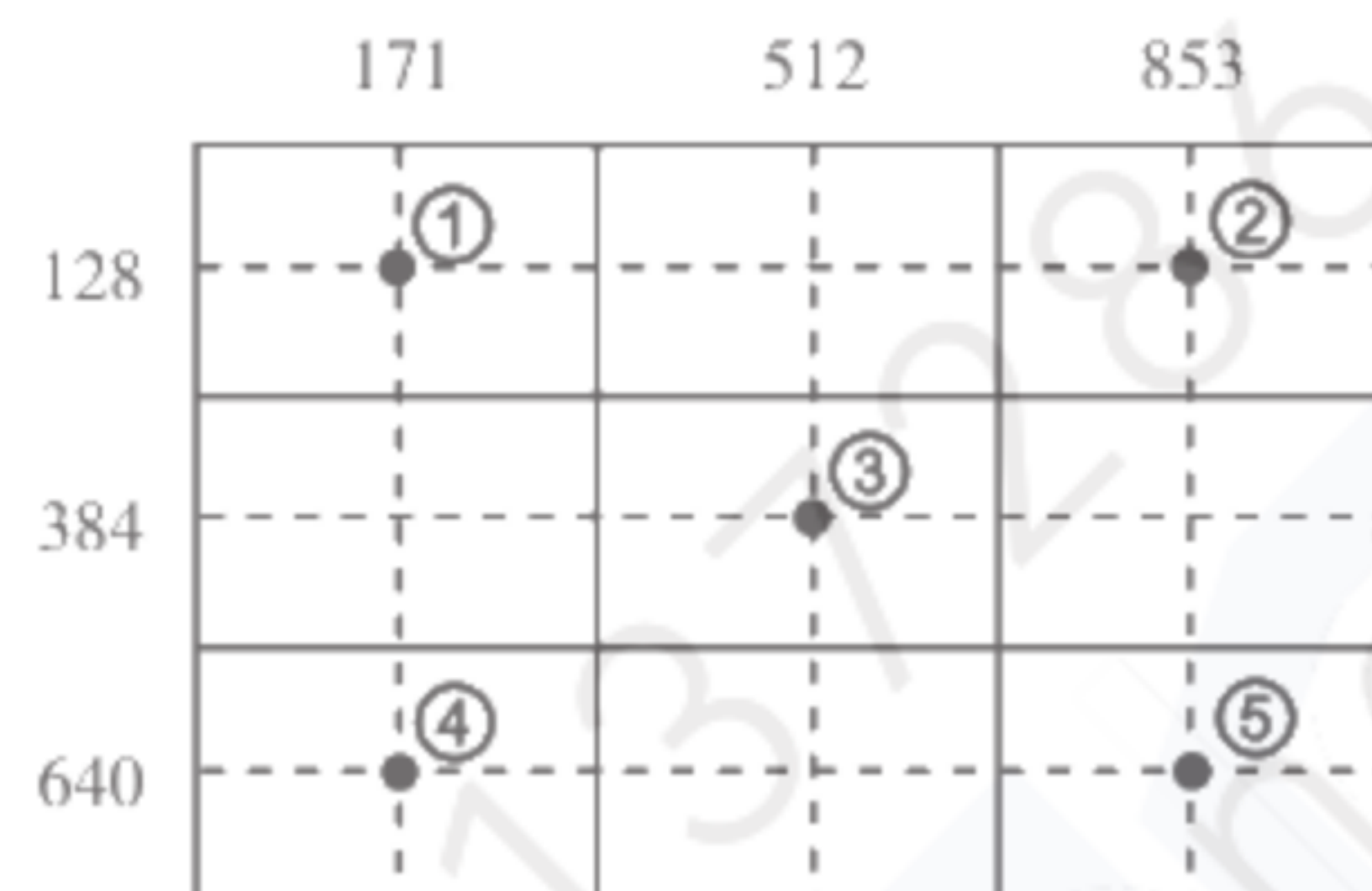
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance of white screen}}{\text{Luminance of black screen}}$$

#### 4.10.3 Definition of luminance uniformity

The luminance uniformity is calculated by using following formula.

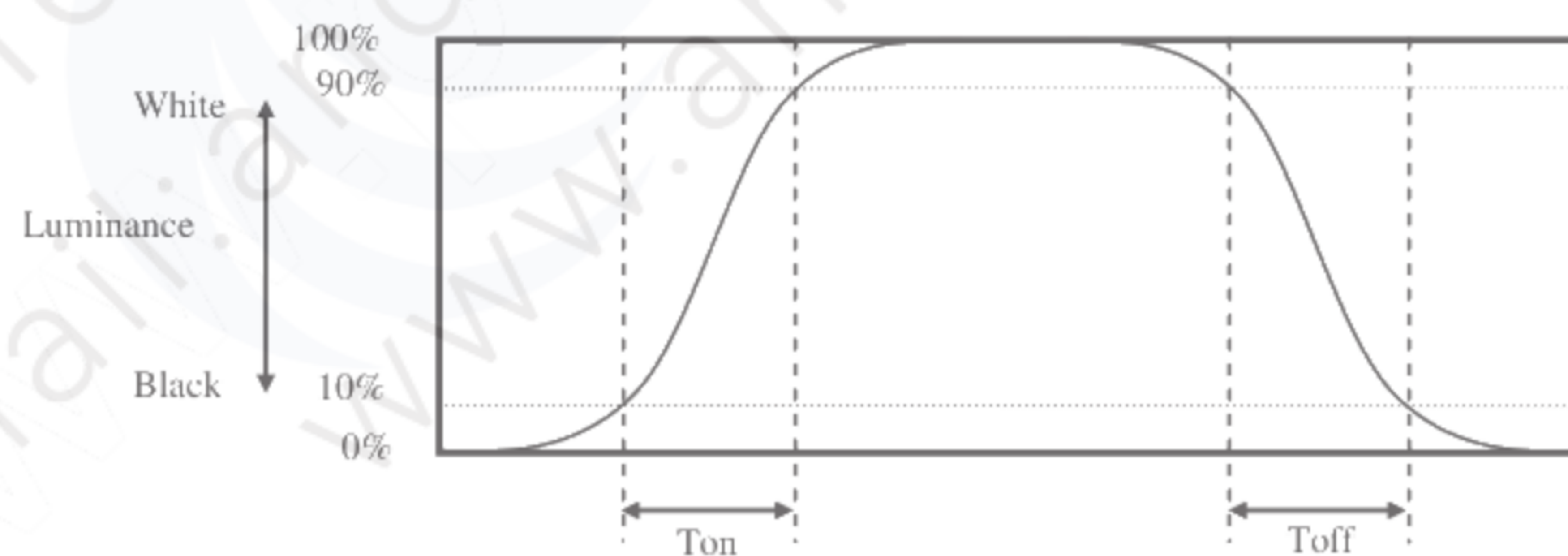
$$\text{Luminance uniformity (LU)} = \frac{\text{Maximum luminance from ① to ⑤}}{\text{Minimum luminance from ① to ⑤}}$$

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

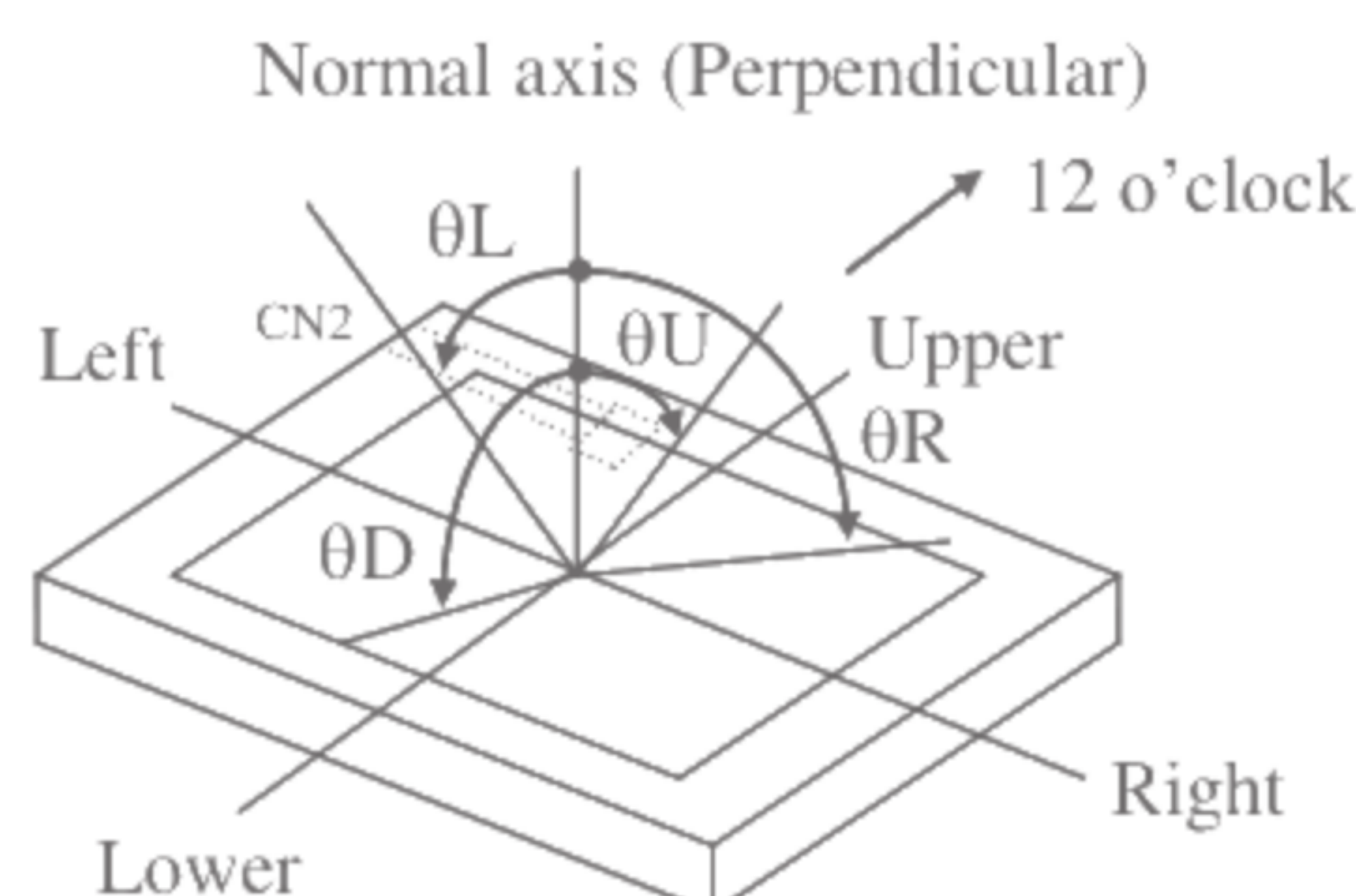


#### 4.10.4 Definition of response times

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



#### 4.10.5 Definition of viewing angles





## 5. ESTIMATED LUMINANCE LIFETIME

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

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

Condition		Estimated luminance lifetime (Life time expectancy) Note1, Note2, Note3	Unit
LED elementary substance	25°C (Ambient temperature of the product) Continuous operation, IL= 45mA/One circuit	70,000	h
	55°C (Temperature of LCD panel surface and rear shield surface) Continuous operation, IL= 45mA/One circuit	60,000	h

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Note1: Life time expectancy is mean time to half-luminance.

Note2: Estimated luminance lifetime is not the value for LCD module but the value for LED elementary substance.

Note3: By ambient temperature, the lifetime changes particularly. Especially, in case the product works under high temperature environment, the lifetime becomes short.

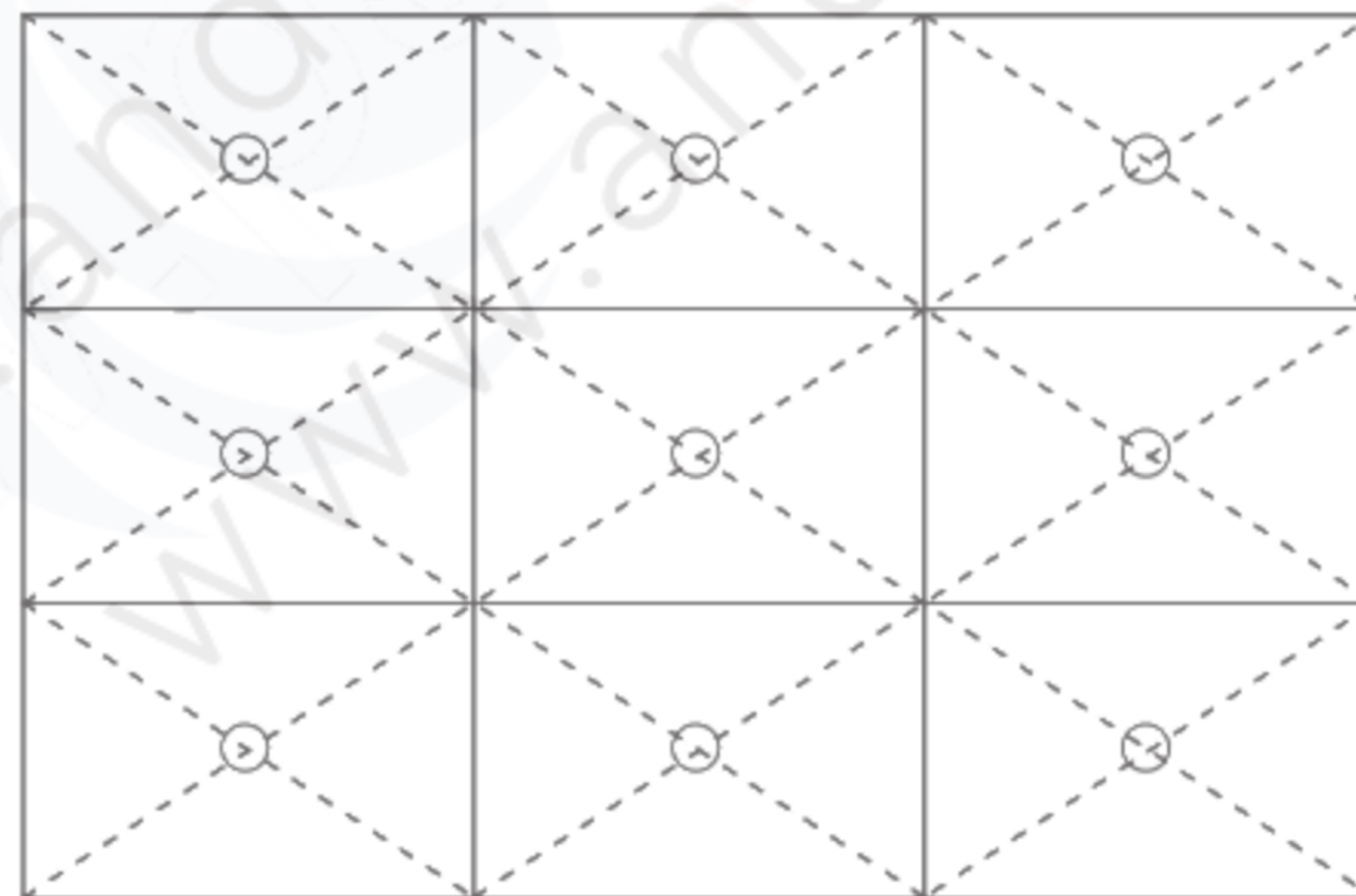


## 6. RELIABILITY TESTS

Test item	Condition	Judgment	Note1
High temperature and humidity (Operation)	① $60 \pm 2^{\circ}\text{C}$ , RH= 60%, 240 hours ② Display data is white.	No display malfunctions	
Heat cycle (Operation)	① $0 \pm 3^{\circ}\text{C}$ ...1 hour $55 \pm 3^{\circ}\text{C}$ ...1 hour ② 50 cycles, 4hours/cycle ③ Display data is white.		
Thermal shock (Non operation)	① $-20 \pm 3^{\circ}\text{C}$ ...30 minutes $60 \pm 3^{\circ}\text{C}$ ...30 minutes ② 100 cycles, 1hour/cycle ③ Temperature transition time is within 5 minutes.		
ESD (Operation)	① 150pF, 150Ω, $\pm 10\text{kV}$ ② 9 places on a panel surface Note2 ③ 10 times each place 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, $19.6\text{m/s}^2$ ② 1 minute/cycle ③ X, Y, Z directions ④ 120 times each direction	No display malfunctions No physical damages	
Mechanical shock (Non operation)	① $539\text{m/s}^2$ , 11ms ② $\pm X$ , $\pm Y$ , $\pm Z$ directions Note3 ③ 5 times each direction		

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.



Note3: Mechanical shock in the Z direction is tested under the condition that the distance between the LCD module and the evaluation equipment is 4mm long.





## 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"!**



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



This sign has the meaning that a customer will be injured if the customer practices wrong operations.

### 7.2 CAUTIONS



**\* Do not shock and press the LCD panel and the backlight! There is a danger of breaking, because they are made of glass. (Shock: Equal to or no greater than  $539\text{m/s}^2$  and equal to or no greater than 11ms, Pressure: Equal to or no greater than 19.6 N ( $\phi 16\text{mm}$  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 When the product is put on the table temporarily, display surface must be placed downward.
- ③ 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.
- ④ The product must be installed 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.
- ⑤ Do not press or rub on the sensitive product surface. When cleaning the product surface, wipe it a soft dry cloth.
- ⑥ Do not push or pull the interface connectors while the product is working.
- ⑦ 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.
- ⑧ 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 by any chance, please wash it away with soap and water.



## 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 occurred by temperature difference, the product packing box must be opened after enough time being left under the environment of an unpacking room. Evaluate the storage time sufficiently because dew condensation is affected by the environmental temperature and humidity. (Recommended leaving time: 6 hours or more with the original packing state after a customer receives the package)
- ③ Do not operate in high magnetic field. If not, circuit boards may be broken.
- ④ This product is not designed as radiation hardened.

## 7.3.3 Characteristics

**The following items are neither defects nor failures.**

- ① Characteristics of the LCD (such as response time, luminance, color uniformity and so on) may be changed depending on ambient temperature. If the product is stored under condition of low temperature for a long time, it may cause display mura. In this case, the product should be operated after enough time being left under condition of operating temperature.
- ② Display mura, flickering, vertical streams or tiny spots may be observed depending on display patterns.
- ③ 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.
- ④ The display color may be changed depending on viewing angle because of the use of condenser sheet in the backlight.

## 7.3.4 Others

- 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 lamp holder set.
- ④ Pack the product with the original shipping package, in order to avoid any damages during transportation, when returning the product to NLT for repairing and so on.
- ⑤ 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)
×	○	○	○	○	○

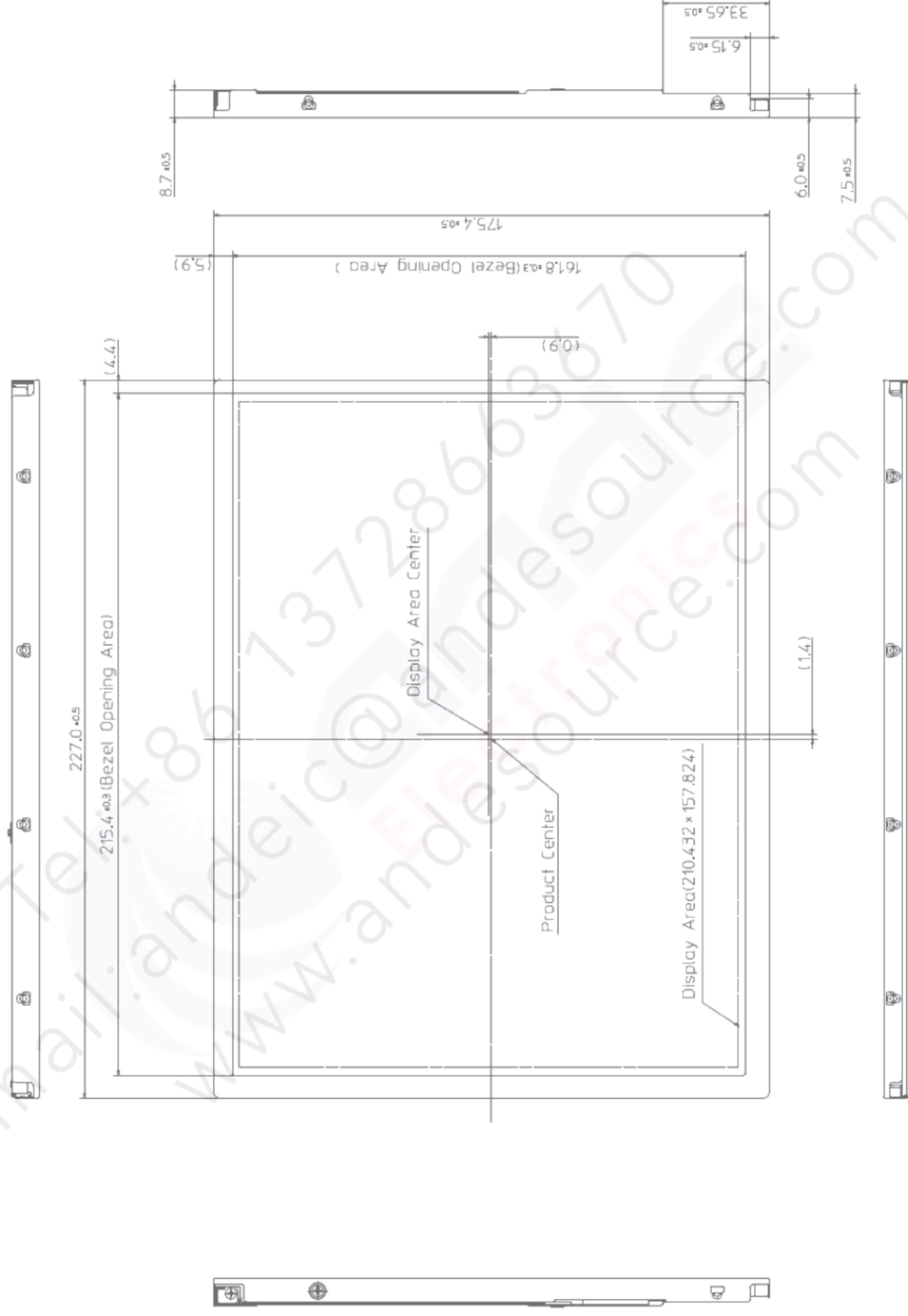
Note1: ○: This indicates that the poisonous or harmful material in all the homogeneous materials for this part is equal or below the limitation level of SJ/T11363-2006 standard regulation.

×: 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. OUTLINE DRAWINGS

### 8.1 FRONT VIEW



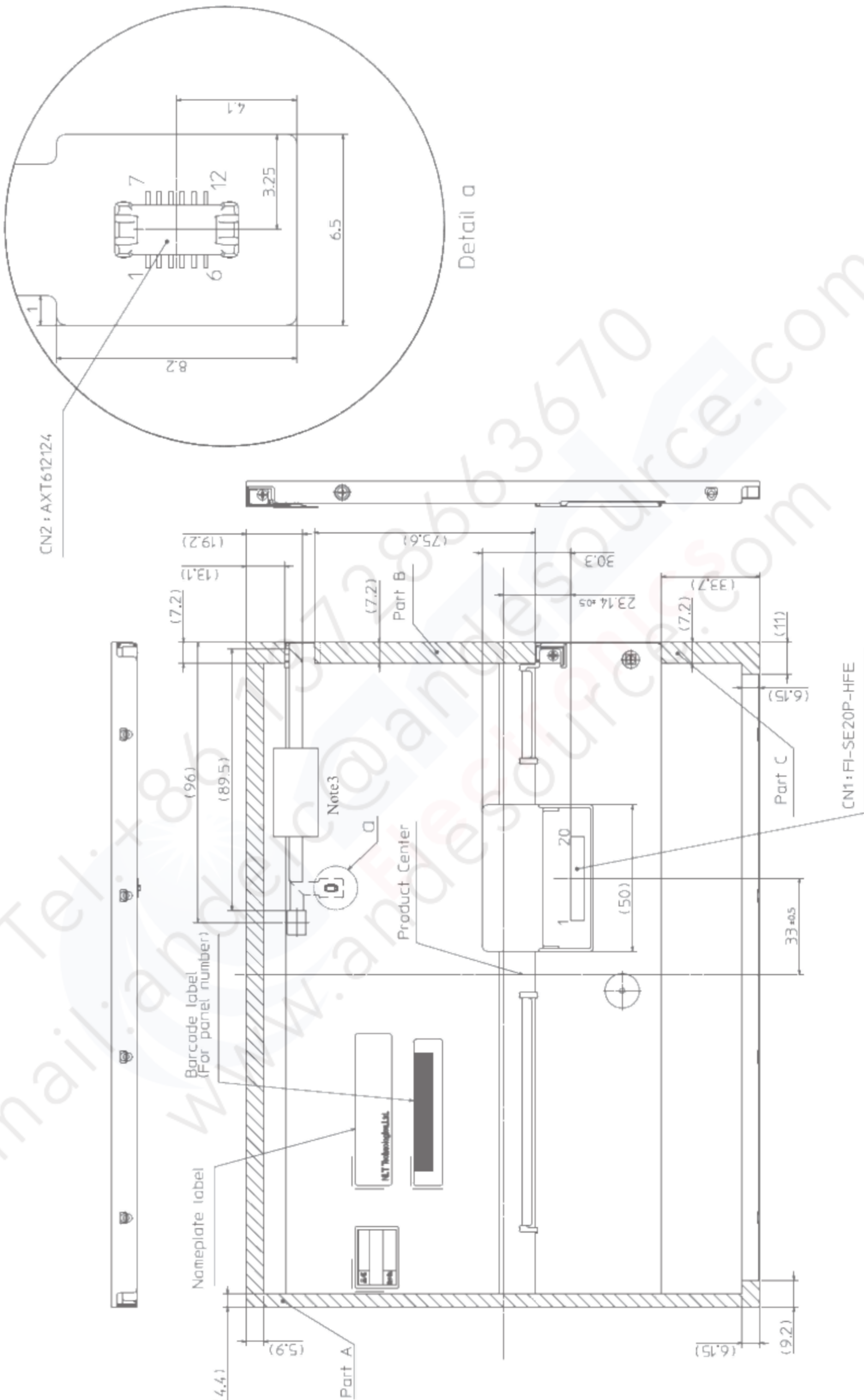
Note 1: The values in parentheses are for reference.

Unit: mm



8.2 REAR VIEW

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Note1: The values in parentheses are for reference.  
Note2: When mounting the product, the area A, B and C including edges of the front shield should be pressed by flat faces.  
Note3: Backlight FPC is temporarily fixed by the tape on the product rear chassis.  
Please remove the tape and fix the FPC by a customer when the product is installed in the customer's equipment.

Unit: mm

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