

PRELIMINARY

NEC NEC LCD Technologies, Ltd.

TFT COLOR LCD MODULE

NL10276BC13-01C

17cm (6.5 Type)

XGA

LVDS interface (1port)

PRELIMINARY DATA SHEET 

DOD-PP-0051 (2nd edition)

**This PRELIMINARY DATA SHEET is updated
document from DOD-MD-0019(1).**

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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

INTRODUCTION	2
1. OUTLINE	4
1.1 STRUCTURE AND PRINCIPLE	4
1.2 APPLICATION	4
1.3 FEATURES	4
2. GENERAL SPECIFICATIONS	5
3. BLOCK DIAGRAM	6
4. DETAILED SPECIFICATIONS	8
4.1 MECHANICAL SPECIFICATIONS	8
4.2 ABSOLUTE MAXIMUM RATINGS	8
4.3 ELECTRICAL CHARACTERISTICS	9
4.3.1 LCD panel signal processing board	9
4.3.2 Bccklight	10
4.3.3 Power supply voltage ripple	10
4.3.4 Fuse	10
4.4 POWER SUPPLY VOLTAGE SEQUENCE	11
4.4.1 LCD panel signal processing board	11
4.4.2 LED lighting circuit	11
4.5 CONNECTIONS AND FUNCTIONS FOR INTERFACE PINS	12
4.5.1 LCD panel signal processing board	12
4.5.2 Backlight lamp	13
4.5.3 Positions of plug and socket	13
4.5.4 Connection between receiver and transmitter for LVDS	14
4.6 DISPLAY COLORS AND INPUT DATA SIGNALS	16
4.6.1 Combinations between input data signals and FRC signal	16
4.6.2 16,777,216 colors	17
4.6.3 262,144 colors	18
4.7 DISPLAY POSITIONS	19
4.8 SCANNING DIRECTIONS	19
4.9 INPUT SIGNAL TIMINGS	20
4.9.1 Outline of input signal timings	20
4.9.2 Timing characteristics	21
4.9.3 Input signal timing chart	22
4.10 OPTICS	23
4.10.1 Optical characteristics	23
4.10.2 Definition of contrast ratio	24
4.10.3 Definition of luminance uniformity	24
4.10.4 Definition of response times	24
4.10.5 Definition of viewing angles	24
5. RELIABILITY TESTS	25
6. PRECAUTIONS	26
6.1 MEANING OF CAUTION SIGNS	26
6.2 CAUTIONS	26
6.3 ATTENTIONS	26
6.3.1 Handling of the product	26
6.3.2 Environment	27
6.3.3 Characteristics	27
6.3.4 Other	27
7. OUTLINE DRAWINGS	28
REVISION HISTORY	29

1. OUTLINE

1.1 STRUCTURE AND PRINCIPLE

Color LCD module NL10276BC13-01C 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

- Adoption of ST-NLT (Super-Transmissive Natural Light TFT)
- High resolution
- High luminance
- High contrast
- Wide viewing angle
- LVDS interface
- Reversible-scan direction
- Selectable 8bit or 6bit digital signals for data of RGB
- LED backlight type
- Replaceable LED holder for backlight

2. GENERAL SPECIFICATIONS

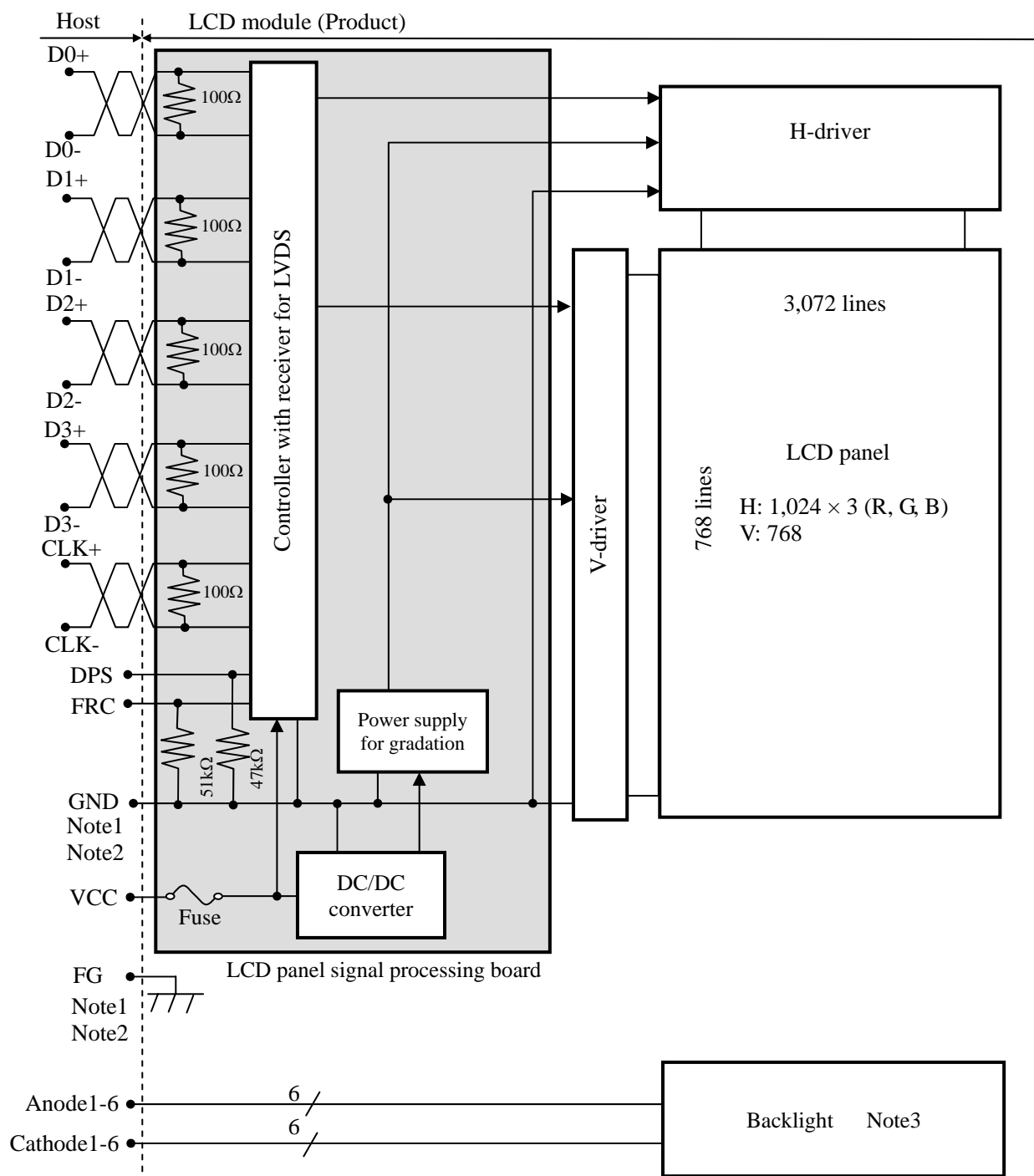
Display area	132.096 (H) × 99.072 (V) mm
Diagonal size of display	17cm (6.5 inches)
Drive system	a-Si TFT active matrix
Display color	16,777,216 colors (At 8-bit input, FRC terminal= High) 262,144 colors (At 6-bit input, FRC terminal= Low or Open)
Pixel	1,024 (H) × 768 (V) pixels
Pixel arrangement	RGB (Red dot, Green dot, Blue dot) vertical stripe
Dot pitch	0.043 (H) × 0.129 (V) mm
Pixel pitch	0.129 (H) × 0.129 (V) mm
Module size	153.0 (W) × 118.0 (H) × 9.0 (D) mm (typ.)
Weight	(180) g (typ.)
Contrast ratio	600:1 (typ.)
Viewing angle	At the contrast ratio $\geq 10:1$ <ul style="list-style-type: none"> • Horizontal: Right side 80° (typ.), Left side 80° (typ.) • Vertical: Up side 80° (typ.), Down side 60° (typ.)
Designed viewing direction	At DPS= Low or open: normal scan <ul style="list-style-type: none"> • Viewing angle with optimum grayscale ($\gamma=2.2$): normal axis
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	$T_{on}+T_{off}$ (10% \longleftrightarrow 90%) 25 ms (typ.)
Luminance	At $IL=(16)mA$ 600 cd/m ² (typ.)
Signal system	LVDS 1port (Receiver: THC63LVDF84B, Thine Electronics Inc. or equivalent) 8bit/6bit digital signals for data of RGB colors, Dot clock (CLK), Data enable (DE)
Power supply voltage	LCD panel signal processing board: 3.3V
Backlight	LED backlight type: <div style="border-left: 1px solid black; border-right: 1px solid black; padding: 0 10px; margin: 10px 0;"> Replaceable part <ul style="list-style-type: none"> • LED holder set: Type No. TBD • LED lightning circuit: Type No. TBD </div>
Power consumption	At $IL=(16)mA$, Checkered flag pattern TBD W (typ.)

2

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3. BLOCK DIAGRAM



Note1: Relations between GND (Signal ground), FG (Frame ground) in the LCD module are as follows.

GND - FG	Connected
----------	-----------

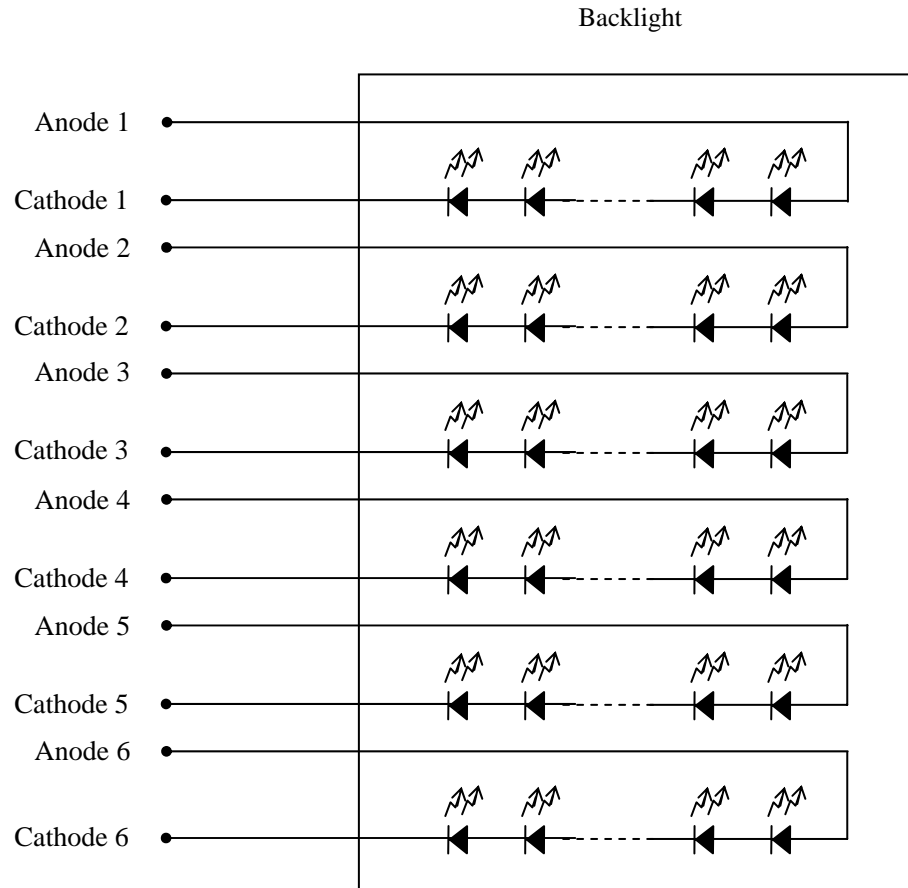
Note2: GND and FG must be connected to customer equipment's ground, and it is recommended that these grounds are connected together in customer equipment.

PRELIMINARY

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NL10276BC13-01C

Note3: Backlight in detail



4. DETAILED SPECIFICATIONS

4.1 MECHANICAL SPECIFICATIONS

Parameter	Specification	Unit
Module size	153.0 ± 0.5 (W) × 118.0 ± 0.5 (H) × 9 (typ) Note1	mm
Display area	132.096 (H) × 99.072 (V) Note1	mm
Weight	(180) (typ.)	g

Note1: 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 +4.0	V	-	
Input voltage for signals	Display signals Note1	VD	-0.3 to VCC+0.3	V		
	Function signal Note2	VF				
Incident light intensity		II	150,000	lx	Note3	
Backlight	Power dissipation	PD	1.1	W	per one circuit	
	Forward current	IL	Note4	mA	per one circuit	
	Pulse forward current	IFP	Note5	mA		
Storage temperature		Tst	-30 to +80	°C	-	
Operating temperature		Front surface	TopF	-20 to +70	°C	Note6
		Rear surface	TopR	-20 to +70	°C	Note7
Relative humidity Note8		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 Note8		AH	≤ 70 Note9	g/m ³	Ta> 70°C	

Note1: Display signals are D0+/-, D1+/-, D2+/-, D3+/- and CLK+/-.

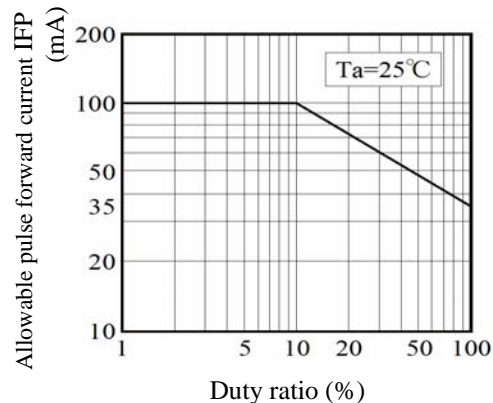
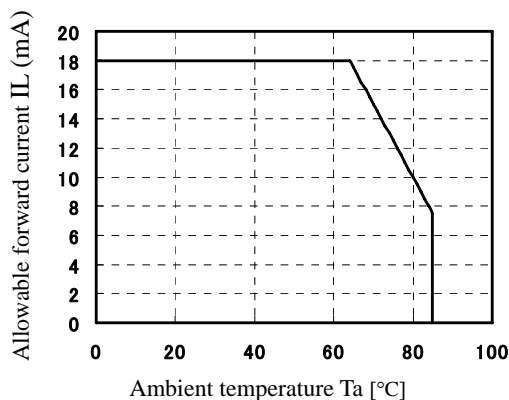
Note2: Function signal 1 is DPS, FRC.

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: Forward current

Note5: Pulse forward current

2



Note6: Measured at center of LCD panel surface (including self-heat)

Note7: Measured at center of LCD module's rear shield surface (including self-heat)

Note8: No condensation

Note9: Water amount at Ta = 70°C and RH = 36%

2

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	-	TBD Note1	TBD 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	
Terminating resistance		RT	-	100	-	Ω	-
Input voltage for DPS and FRC signals	High	VFH	0.7VCC	-	VCC	V	CMOS level
	Low	VFL	0	-	0.3VCC	V	
Input current for FRC 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

2

(Ta= 25°C)

Parameter	Symbol	min.	typ.	max.	Unit	Remarks
Forward current	IL	-	(16)	(18)	mA	Note3
Forward Voltage	VL	-	28.8	31.5	V	at IL= (16)mA

2

2

Note1: Please drive with constant current .

Note2: The Luminance uniformity may be changed depending on the current variation between 6 circuits.

It is recommended that the current value difference between each circuit is less than 5%.

Note3: See "**4.2 ABSOLUTE MAXIMUM RATINGS Note4**".

2

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)	Unit
VCC	3.3V	≤ 100	mVp-p

Note1: The permissible ripple voltage includes spike noise.

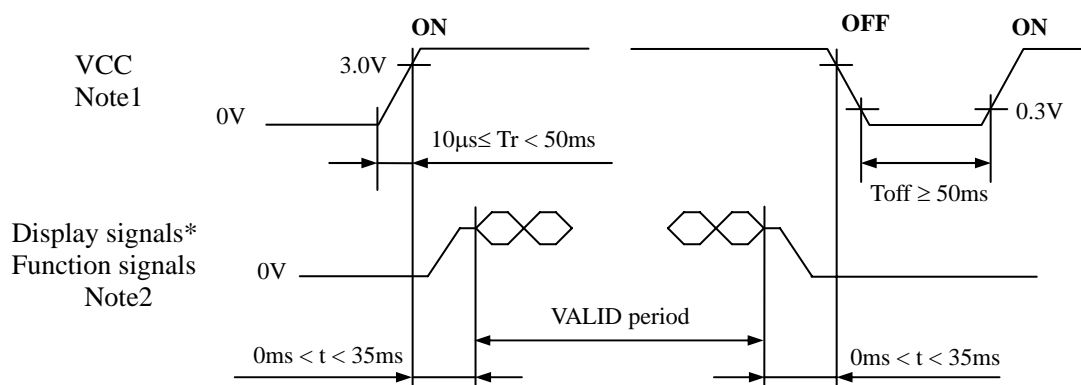
4.3.4 Fuse

Parameter	Fuse		Rating	Fusing current	Remarks
	Type	Supplier			
VCC	TBD	TBD	TBD	TBD	Note1
			TBD		

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



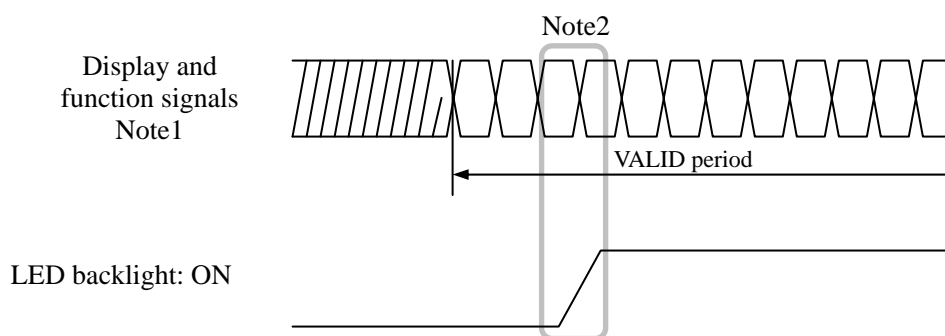
* These signals should be measured at the terminal of 100Ω resistance.

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 (DPS and FRC) 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. If customer stops the display and function signals, they should be cut VCC.

4.4.2 LED lighting circuit



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	A	D3+	Pixel data
	B	GND	Ground
2	A	D3-	Pixel data
	B	GND	Ground
3	DPS	Selection of scan direction	High: Reverse scan Low or Open: Normal scan
4	FRC	Selection signal of frame rate control	High: Frame rate control ON Low or Open: Frame rate control OFF
5	GND	Ground	Note4
6	CLK+	Pixel clock	Note3
7	CLK-		
8	GND	Ground	Note4
9	D2+	Pixel data	Note3
10	D2-		
11	GND	Ground	Note4
12	D1+	Pixel data	Note3
13	D1-		
14	GND	Ground	Note4
15	D0+	Pixel data	Note3
16	D0-		
17	GND	Ground	Note4
18	GND		
19	VCC	Power supply	Note4
20	VCC		

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

Note2: See "4.8 SCANNING DIRECTIONS".

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

Note4: All GND and VCC terminals should be used without any non-connected lines.

Note5: See "4.5.4 Connection between receiver and transmitter for LVDS".

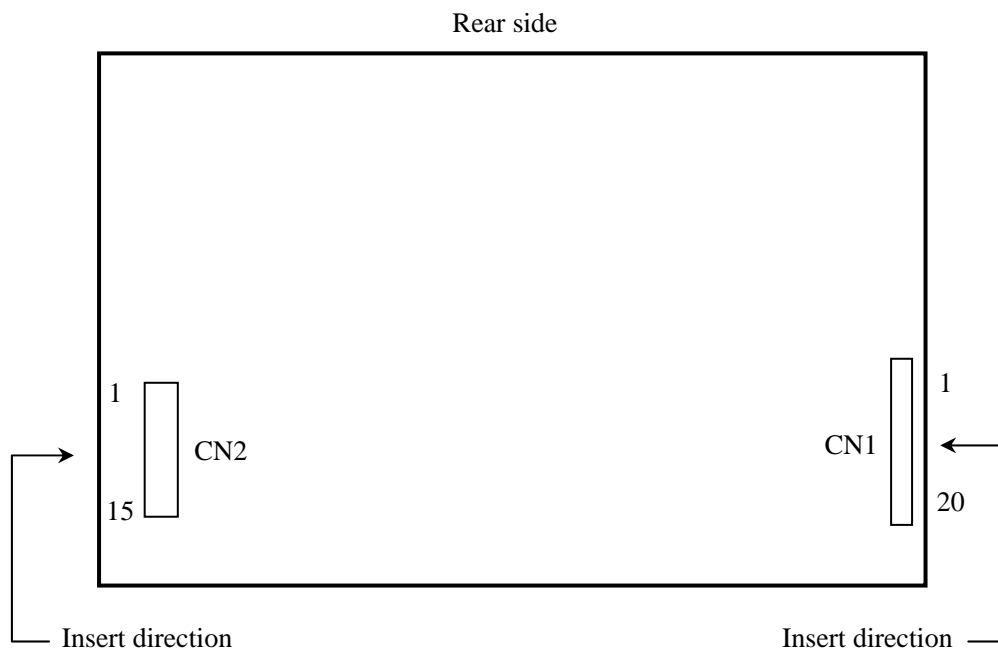
4.5.2 Backlight lamp

CN2 plug (LCD module side): DF14A-15P-1.25H (Hirose Electric Co., Ltd.(HRS))

Adaptable socket: DF14-15S-1.25C (Hirose Electric Co., Ltd.(HRS))

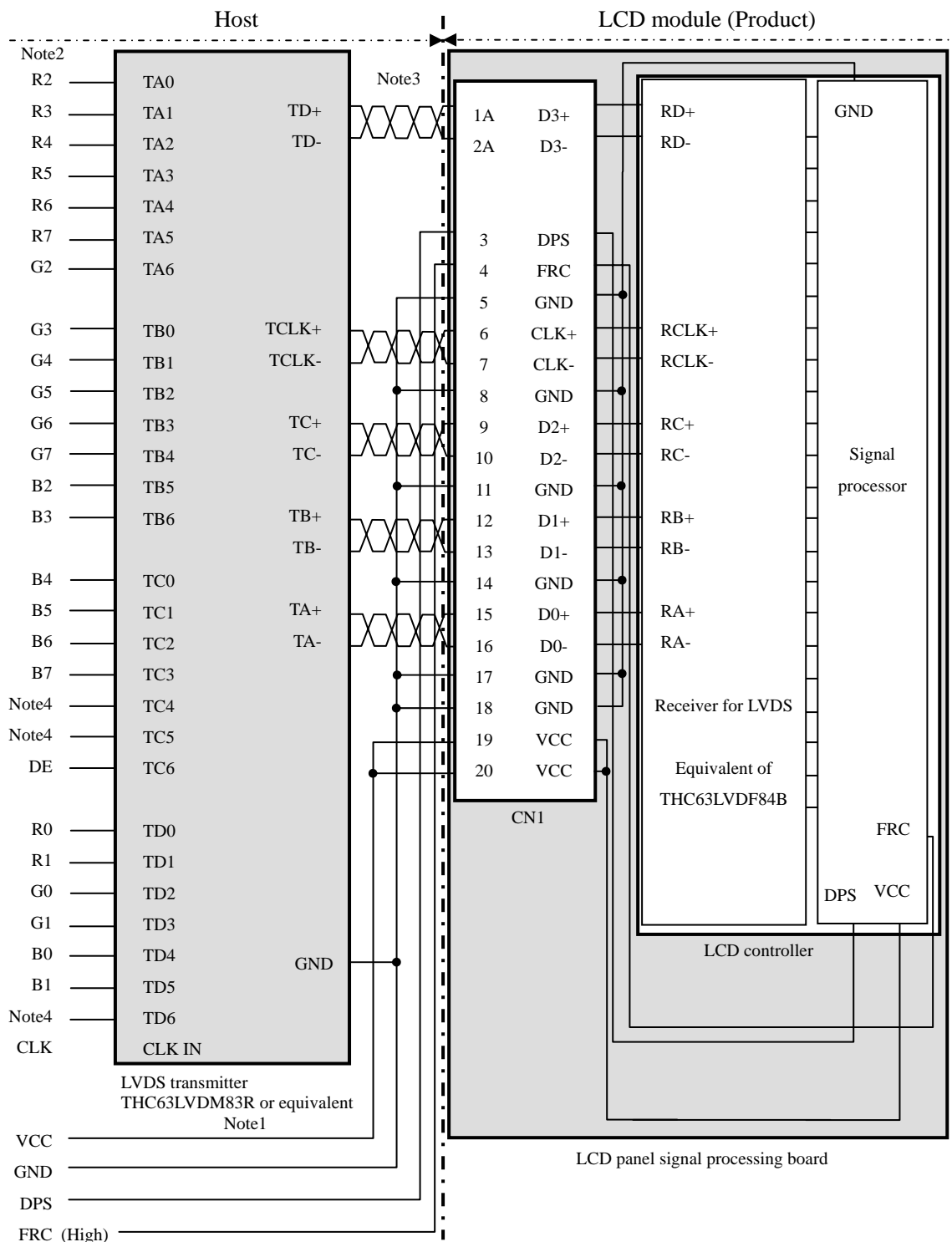
Pin No.	Symbol	Signal	Remarks
1	A1	Anode1	-
2	K1	Cathode1	-
3	A2	Anode2	-
4	K2	Cathode2	-
5	A3	Anode3	-
6	K3	Cathode3	-
7	A4	Anode4	-
8	K4	Cathode4	-
9	A5	Anode5	-
10	K5	Cathode5	-
11	A6	Anode6	-
12	K6	Cathode6	-
13	N. C.	-	Keep this pin Open.
14	N. C.	-	Keep this pin Open.
15	N. C.	-	Keep this pin Open.

4.5.3 Positions of plug and socket

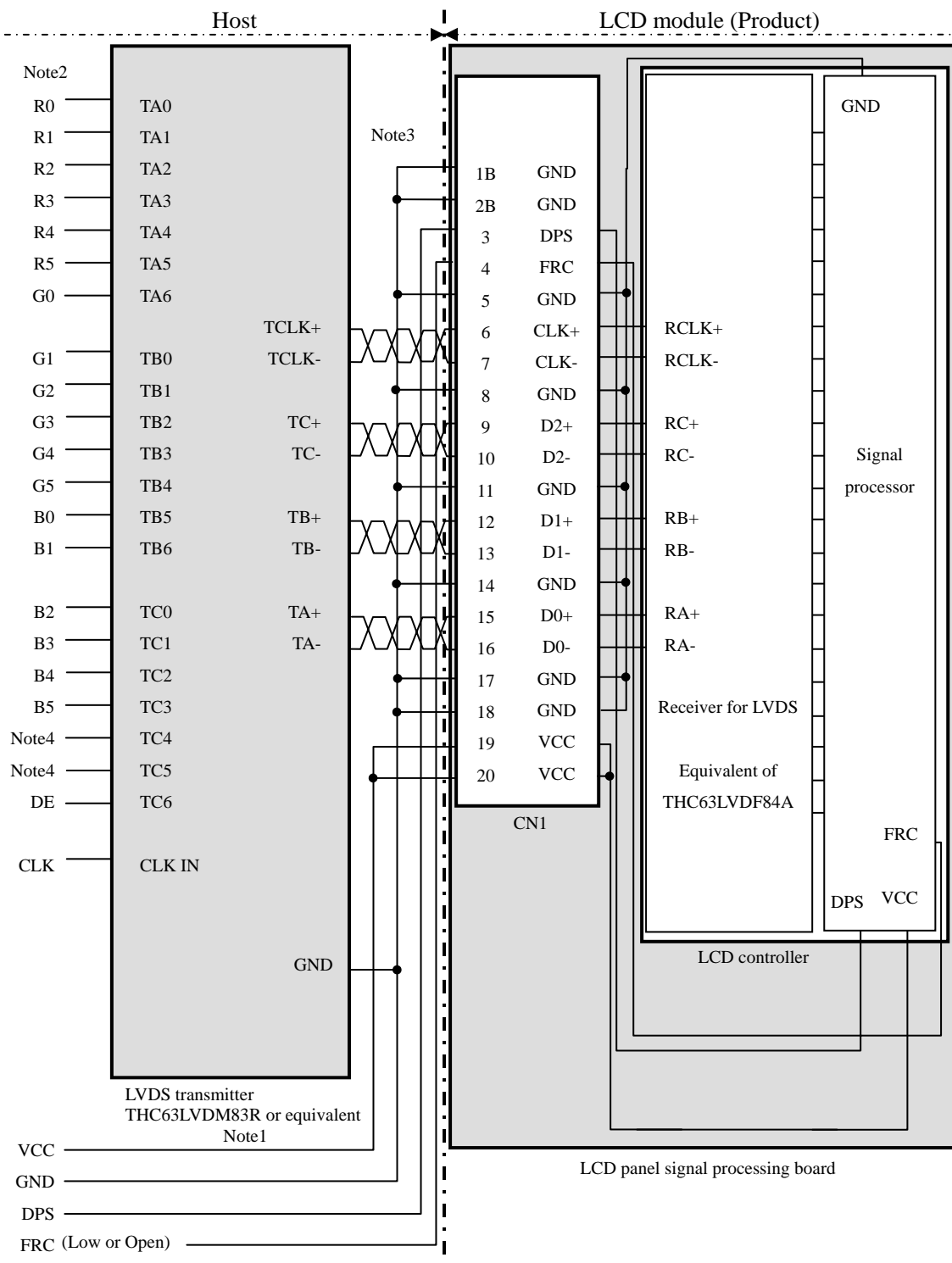


4.5.4 Connection between receiver and transmitter for LVDS

(1) Input data signal: 8bit



(2) Input data signal: 6bit



Note1: Recommended transmitter THC63LVDM83R (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 TC4 and TC5 open to avoid noise problem.

4.6 DISPLAY COLORS AND INPUT DATA SIGNALS

4.6.1 Combinations between input data signals and FRC signal

This product can display in equivalent to 16,777,216 colors in 256 gray scales and 262,144 colors in 64 gray scales by combination between input data signals and FRC signal. See following table.

Combination	Input data signals	CN1-Pin No.1 and 2	FRC signal	Display colors	Remarks
①	8bit	D3+/-	High	16,777,216	Note1
②	6bit	GND	Low or Open	262,144	Note2

Note1: See "**4.6.2 16,777,216 colors**".

Note2: See "**4.6.3 262,144 colors**".

4.6.2 16,777,216 colors

This product can display equivalent of 16,777,216 colors in 256 gray scales by combination ①.

(See "4.6.1 Combinations between input data signals and FRC signal".)

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
	dark	0	0	0	0	0	0	0	1	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	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
	dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	↑					:								:							:				
	↓					:								:							:				
	bright	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	0	0	0	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
	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	0	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

4.6.3 262,144 colors

This product can display equivalent of 262,144 colors in 64 gray scales by combination ②.

(See "4.6.1 Combinations between input data signals and FRC signal".)

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)																	
		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
	dark ↑ ↓ bright	0	0	0	0	0	1	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	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	
Green gray scale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	dark ↑ ↓ bright	0	0	0	0	0	0	0	0	0	0	1	0	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	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	
Blue gray scale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	dark ↑ ↓ bright	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	1	0
						:					:					:			
					:					:					:				
		0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	

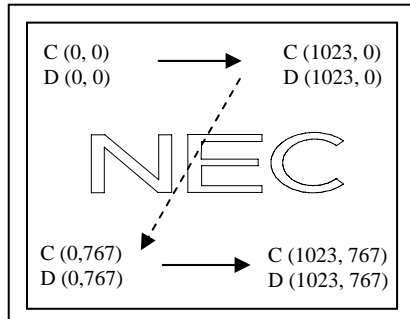
4.7 DISPLAY POSITIONS

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

C (0, 0)						
R	G	B				
C(0, 0)	C(1, 0)	...	C(X, 0)	...	C(1022, 0)	C(1023, 0)
C(0, 1)	C(1, 1)	...	C(X, 1)	...	C(1022, 1)	C(1023, 1)
⋮	⋮	⋮	⋮	⋮	⋮	⋮
C(0, Y)	C(1, Y)	...	C(X, Y)	...	C(1022, Y)	C(1023, Y)
⋮	⋮	⋮	⋮	⋮	⋮	⋮
C(0, 766)	C(1, 766)	...	C(X, 766)	...	C(1022, 766)	C(1023, 766)
C(0, 767)	C(1, 767)	...	C(X, 767)	...	C(1022, 767)	C(1023, 767)

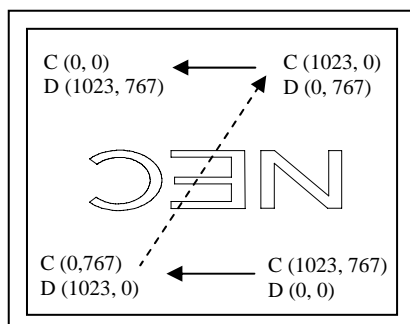
4.8 SCANNING DIRECTIONS

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



Note1

Figure 1. Normal scan (DPS: Low or Open)



Note1

Figure 2. 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").

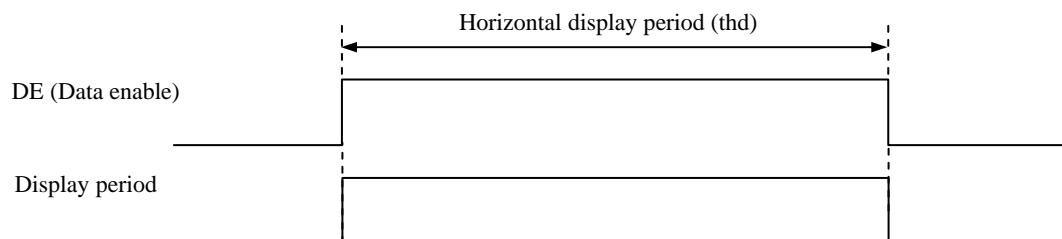
D (X, Y): The data number of input signal for LCD panel signal processing board

4.9 INPUT SIGNAL TIMINGS

4.9.1 Outline of input signal timings

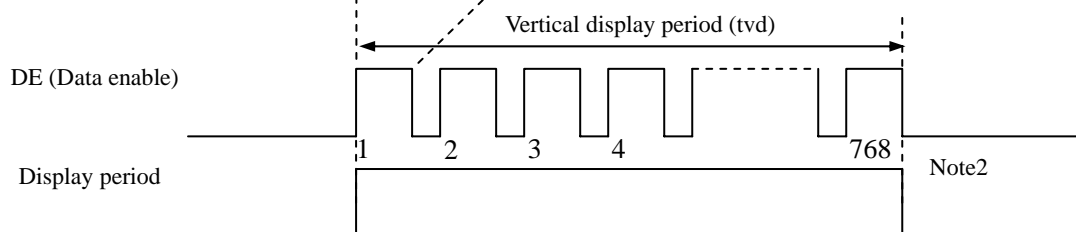
- Horizontal signal

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

Parameter			Symbol	min.	typ.	max.	Unit	Remarks
CLK	Frequency		1/tc	60.0	65.0	68.0	MHz	15.385 ns (typ.)
	Duty		-	-			-	Note2
	Rise time, Fall time		-				ns	
DATA	CLK-DATA	Setup time	-	-			ns	Note2
		Hold time	-				ns	
	Rise time, Fall time		-				ns	
DE	Horizontal	Cycle	th	19.67	20.676	22.4	μs	48.363 kHz (typ.) Note1, Note2
			-	1,344	-	CLK		
		Display period	thd	1,024			CLK	
	Vertical (One frame)	Cycle	tv	13.3	16.666	18.5	ms	60.0 Hz (typ.) Note1
			780	806	-	H		
		Display period	tvd	768			H	
	CLK-DE	Setup time	-	-			ns	Note2
		Hold time	-				ns	
	Rise time, Fall time		-				ns	

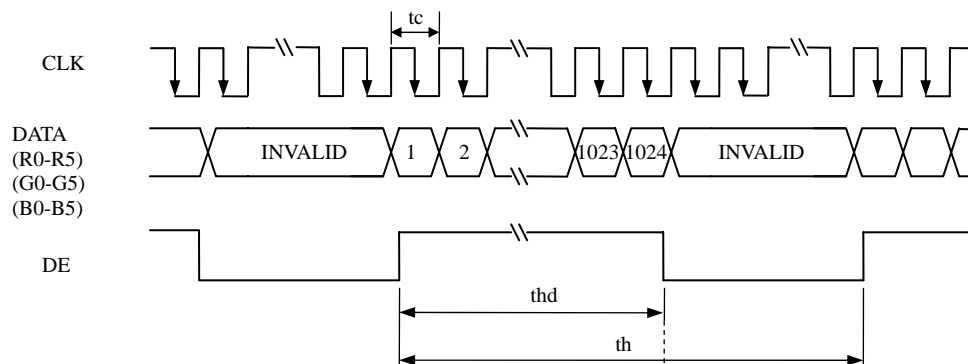
Note1: Definition of parameters is as follows.

tc = 1CLK, th = 1H

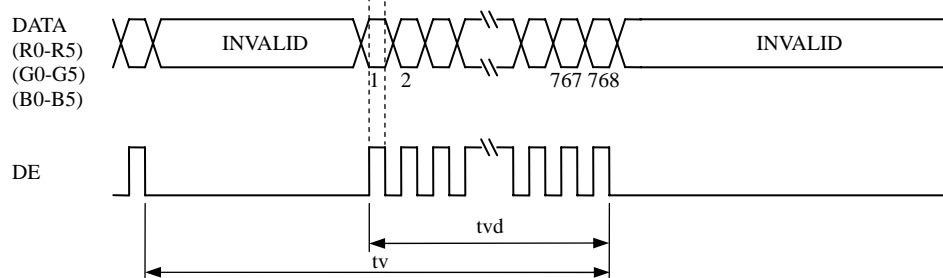
Note2: See the data sheet of LVDS transmitter.

4.9.3 Input signal timing chart

Horizontal timing



Vertical timing



4.10 OPTICS

4.10.1 Optical characteristics

(Note1, Note2)

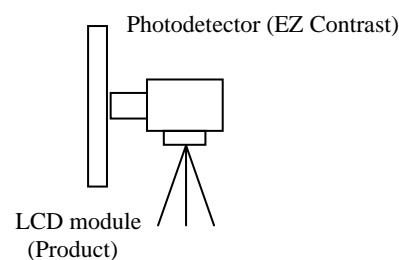
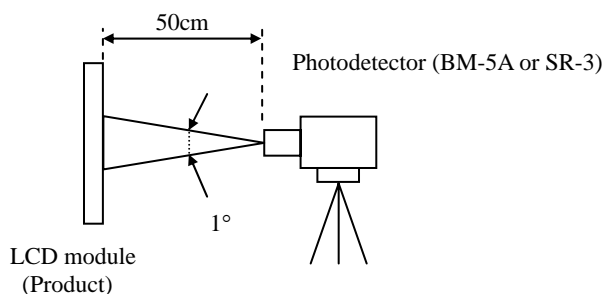
Parameter		Condition	Symbol	min.	typ.	max.	Unit	Measuring instrument	Remarks
Luminance		White at center θR= 0°, θL= 0°, θU= 0°, θD= 0°	L	TBD	600	-	cd/m ²	BM-5A	-
Contrast ratio		White/Black at center θR= 0°, θL= 0°, θU= 0°, θD= 0°	CR	TBD	600	-	-	BM-5A	Note3
Luminance uniformity		White θR= 0°, θL= 0°, θU= 0°, θD= 0°	LU	-	1.25	1.4	-	BM-5A	Note4
Chromaticity	White	x coordinate	W _x	TBD	TBD	TBD	-	SR-3	Note5
		y coordinate	W _y	TBD	TBD	TBD	-		
	Red	x coordinate	R _x	-	TBD	-	-		
		y coordinate	R _y	-	TBD	-	-		
	Green	x coordinate	G _x	-	TBD	-	-		
		y coordinate	G _y	-	TBD	-	-		
	Blue	x coordinate	B _x	-	TBD	-	-		
		y coordinate	B _y	-	TBD	-	-		
Color gamut		θR= 0°, θL= 0°, θU= 0°, θD= 0° at center, against NTSC color space	C	35	(38)	-	%		
Response time		White to Black	T _{on}	-	6	15	ms	BM-5A	Note6
		Black to White	T _{off}	-	19	47	ms		Note7
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.

T_a = 25°C, VCC = 3.3V, I_L = (16)mA, Display mode: XGA, Horizontal cycle = 1/48.363kHz, Vertical cycle = 1/60.0Hz, DPS= Low or Open, FRC= Low or Open

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 = TBD°C

Note7: See "4.10.4 Definition of response times".

Note8: See "4.10.5 Definition of viewing angles".

4.10.2 Definition of contrast ratio

The contrast ratio is calculated by using the following formula.

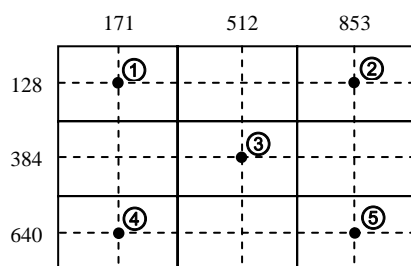
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance of white screen}}{\text{Luminance of black screen}}$$

4.10.3 Definition of luminance uniformity

The luminance uniformity is calculated by using following formula.

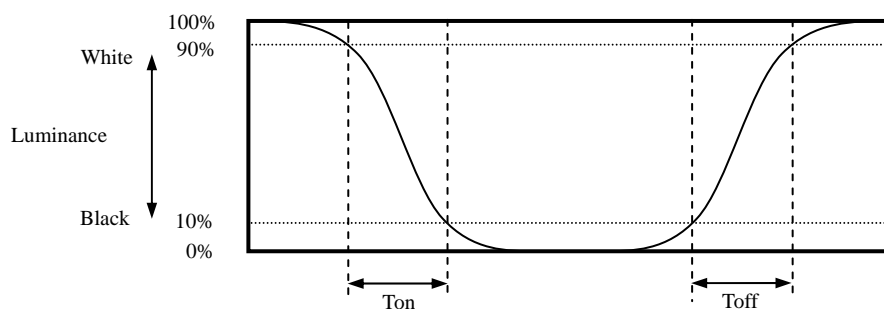
$$\text{Luminance uniformity (LU)} = \frac{\text{Maximum luminance from ① to ⑤}}{\text{Minimum luminance from ① to ⑤}}$$

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

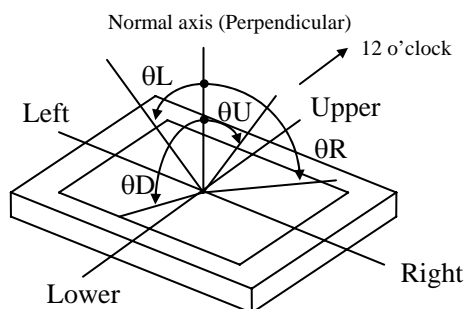


4.10.4 Definition of response times

Response time is measured, the luminance changes from "black" to "white", or "white" to "black" on the same screen point, by photo-detector. Ton is the time it takes the luminance change from 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



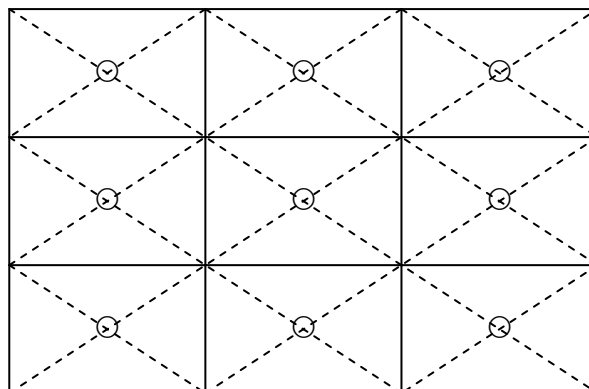
5. RELIABILITY TESTS

(Note1)

Test item	Condition	Judgment
High temperature and humidity (Operation)	① $60 \pm 2^{\circ}\text{C}$, RH= 90%, 240hours ② Display data is black.	No display malfunctions
Heat cycle (Operation)	① $-20 \pm 3^{\circ}\text{C}$...1hour $70 \pm 3^{\circ}\text{C}$...1hour ② 50cycles, 4 hours/cycle ③ Display data is black.	
Thermal shock (Non operation)	① $-30 \pm 3^{\circ}\text{C}$...30minutes $80 \pm 3^{\circ}\text{C}$...30minutes ② 100cycles, 1hour/cycle ③ Temperature transition time is within 5 minutes.	
ESD (Operation)	① 150pF, 150 Ω , $\pm 10\text{kV}$ 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, 19.6m/s^2 ② 1 minute/cycle ③ X, Y, Z direction ④ 120 times each directions	No display malfunctions No physical damages
Mechanical shock (Non operation)	① 539m/s^2 , 11ms ② $\pm\text{X}$, $\pm\text{Y}$, $\pm\text{Z}$ direction ③ 5 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 be injured by himself, if customer has wrong operations.

6.2 CAUTIONS



- * **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 539m/s^2 and to be not greater 11ms, Pressure: To be not greater 19.6 N ($\phi 16\text{mm}$ 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 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 torque for product mounting screws must never exceed $0.147\text{N}\cdot\text{m}$. Higher torque might result in distortion of the bezel.
- ⑤ 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.
- ⑥ 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.

- ⑦ Do not push nor pull the interface connectors while the product is working.
- ⑧ 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.

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

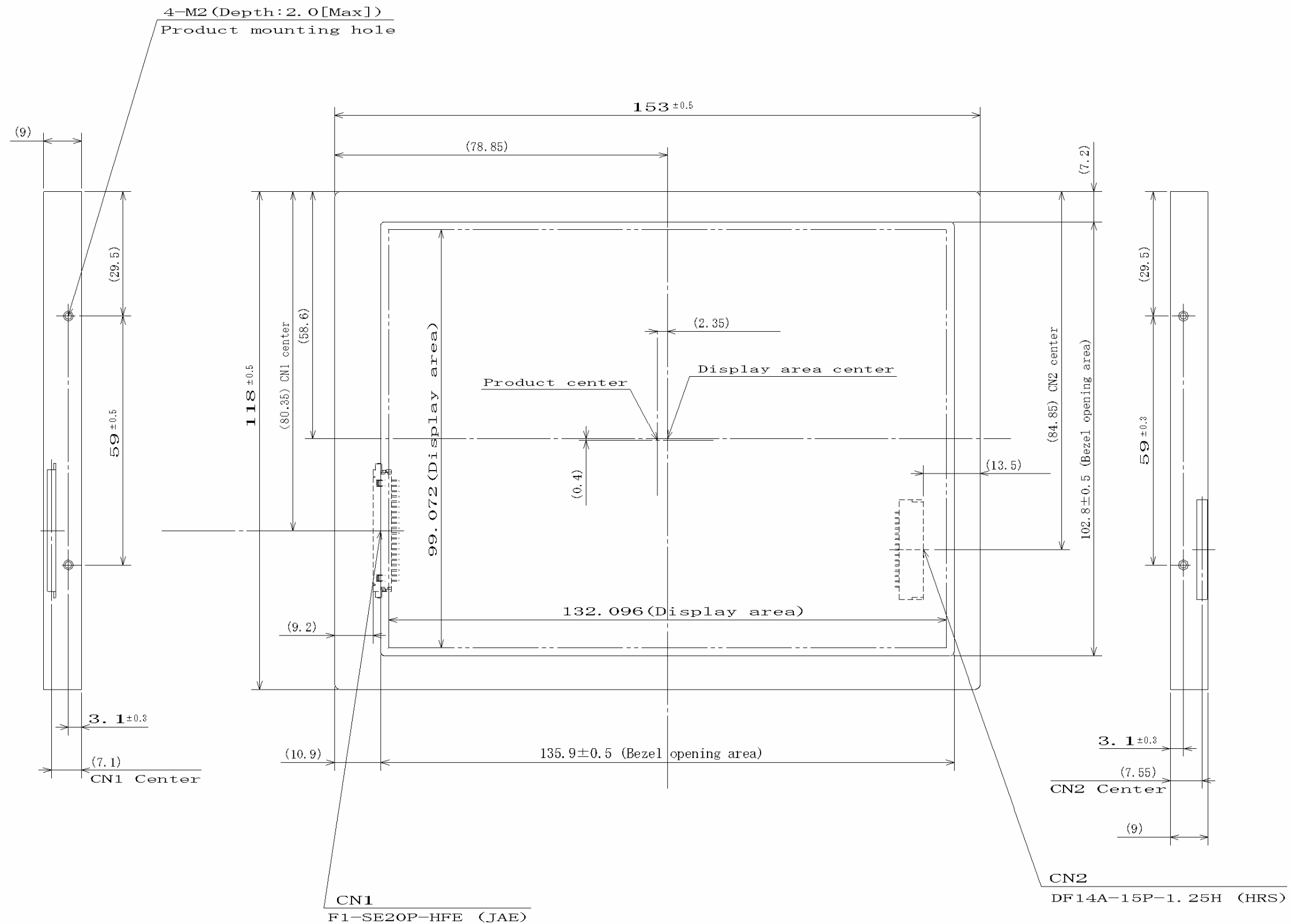
The following items are neither defects nor failures.

- ① 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, flicker, vertical seam or small spot 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.
- ⑤ Optical characteristics may be changed depending on input signal timings.
- ⑥ The color of the polarizer surface may differ between products because of antireflection treatment.

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 LED HOLDER SET", when replacing backlight.
- ④ Pay attention not to insert foreign materials inside of the product, when using tapping screws.
- ⑤ 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.

7. OUTLINE DRAWINGS



Note1: The values in parentheses are for reference.

Note2: The torque for product mounting screws must never exceed 0.147N·m.

Unit: mm

