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Datasheet

Tianma

NL10276BC24-21F

12.1" TFT Display

NL-01-003

TFT COLOR LCD MODULE

NL10276BC24-21F

31cm (12.1 Type)
XGA
LVDS interface (1port)

DATA SHEET
DOD-PP-3079 (4th edition)

This DATA SHEET is updated document from DOD-PP-1680(3).

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

INTRODUCTION

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Examples: 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.

CONTENTS

1. OUTLINE

1.1 STRUCTURE AND PRINCIPLE

   Color LCD module NL10276BC24-21F 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

- High luminance
- High contrast
- Wide viewing angle
- Wide temperature range
- LVDS interface
- Reversible-scan direction
- Selectable 8-bit or 6-bit digital signals for data of RGB
- Long life LED backlight
- Replaceable lamp for backlight
- Acquisition product for UL60950-1/CSA C22.2 No.60950-1-03 (File number: E170632)
- Compliant with the European RoHS directive (2011/65/EU)

2. GENERAL SPECIFICATIONS

Display area	245.76 (H) × 184.32 (V) mm
Diagonal size of display	31cm (12.1 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	0.08 (H) × 0.24 (V) mm
Pixel pitch	0.24 (H) × 0.24 (V) mm
Module size	260.5 (W) × 203.0 (H) × 8.7 (D) mm (typ.)
Weight	490 g (typ.)
Contrast ratio	900:1 (typ.)
Viewing angle	*At the contrast ratio* $\geq$*10:1* • Horizontal: Right side 80° (typ.), Left side 80° (typ.) • Vertical: Up side 80° (typ.), Down side 80° (typ.)
Designed viewing direction	*At DPS= Low or Open: Normal scan* • Viewing direction without image reversal: Up side (12 o'clock) • Viewing direction with contrast peak: Down side (6 o'clock) • Viewing angle with optimum grayscale ($\gamma\fallingdotseq$ 2.2): Normal axis (perpendicular)
Polarizer surface	Clear
Polarizer pencil-hardness	3H (min.) [by JIS K5600]
Color gamut	*At, LCD panel center* 40 % (typ.) [against NTSC color space]
Response time	*Ton+Toff (10%$\leftarrow\rightarrow$90%)* 18 ms (typ.)
Luminance	Luminance 1 · 800cd/m^2 (typ.), *At IL= 50mA/One circuit* Luminance 2 · 1,000cd/m^2 (typ.), *At IL= 70mA/One circuit*
Signal system	LVDS interface (1 port) (Receiver: THC63LVDF84B, THine Electronics Inc. or equivalent) [8-bit/6-bit digital signals for data of RGB colors, Dot clock (CLK), Data enable (DE)]
Power supply voltage	LCD panel signal processing board: 3.3V

Backlight	LED backlight:
	
	 Replaceable part
	 • Lamp holder set: 121LHS32
	
	 Recommended LED driver board (Option)
	 • LED driver board:
	  Luminance 1 · 104PW03F
	  Luminance 2 · user
	 • Corresponding wiring harness:
	  Luminance 1 · 121CBL03
	  Luminance 2 · user

Power consumption	Luminance 1 · *At IL= 50mA/One circuit, Checkered flag pattern* 7.5 W (typ.) Luminance 2 · *At IL= 70mA/One circuit, Checkered flag pattern* 10.3 W (typ.)

3. BLOCK DIAGRAM
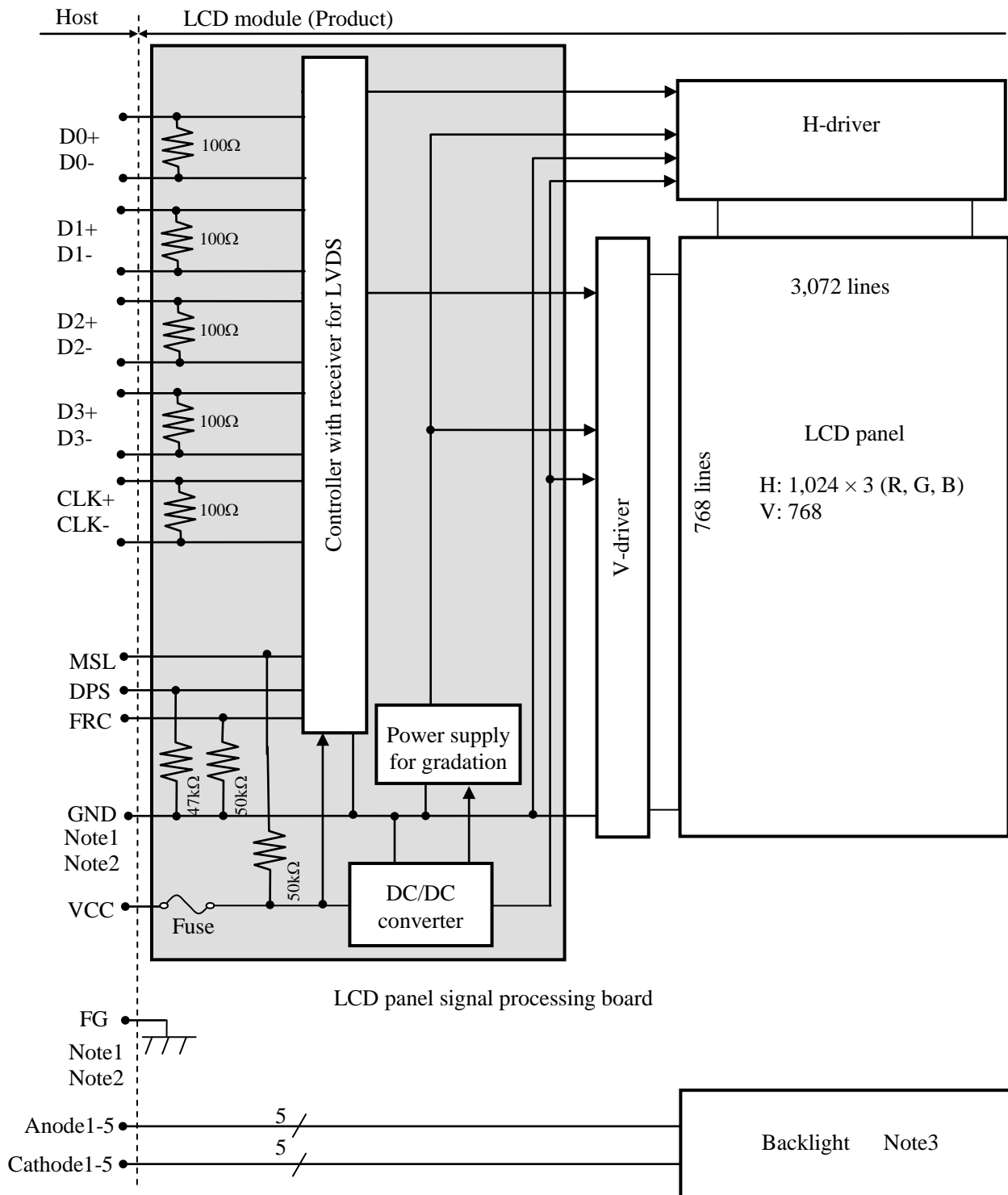
Note1: Relation between GND (Signal ground) and FG (Frame ground) in the LCD module is as follows.

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 detail

Backlight

Anode 1

Cathode 1

Anode 2

Cathode 2

Anode 3

Cathode 3

Anode 4

Cathode 4

Anode 5

Cathode 5
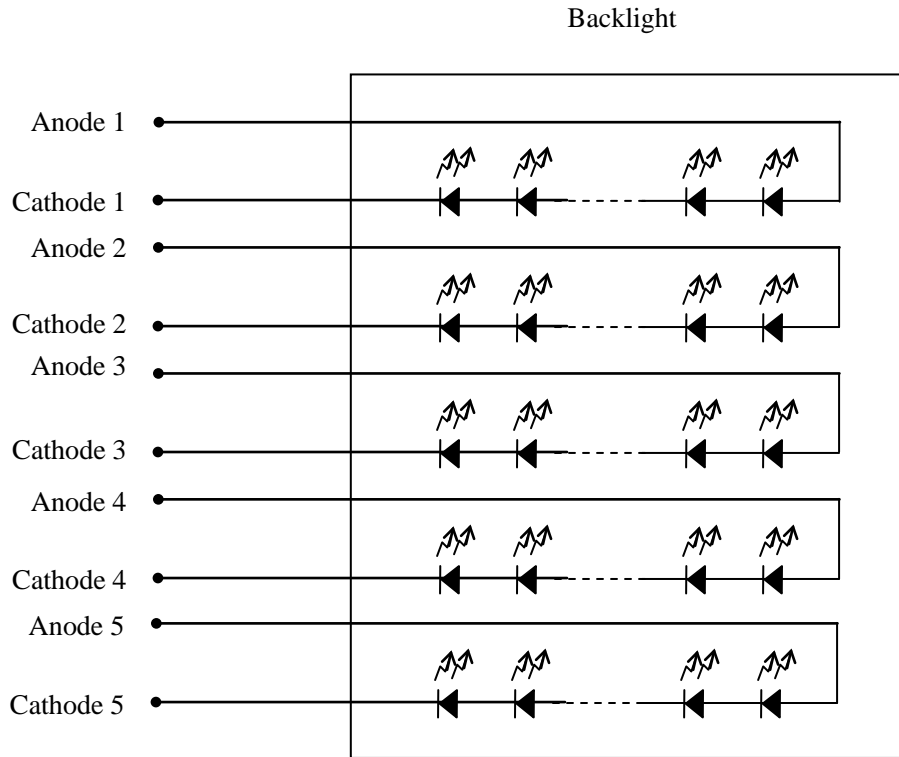
4. DETAILED SPECIFICATIONS

4.1 MECHANICAL SPECIFICATIONS

Parameter	Specification		Unit
Module size	260.5 ± 0.5 (W) ×203.0 ± 0.5 (H) × 8.7 ± 0.5 (D)	Note1	mm
Display area	245.76 (H) × 184.32 (V)	Note1	mm
Weight	490(typ.), 540(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	
Input voltage for signals	Display signals Note1		VD	-0.3 to VCC +0.3	V	-
	Function signals Note2		VF		V	
Backlight	Forward current	Luminance 1	IL	60	mA	per one circuit
		Luminance 2		80		
Storage temperature			Tst	-30 to +80	°C	-
Operating temperature	Luminance 1	Front surface	TopF	-30 to +80	°C	Note3
		Rear surface	TopR	-30 to +80	°C	Note4
	Luminance 2	Front surface	TopF	-30 to +60	°C	Note5
		Rear surface	TopR	-30 to +60	°C	Note6
Relative humidity Note7			RH	≤ 95	%	Ta ≤ 40°C
				≤ 85	%	40°C < Ta ≤ 50°C
				≤ 55	%	50°C < Ta ≤ 60°C
				≤ 36	%	60°C < Ta ≤ 70°C
				≤ 24	%	70°C < Ta ≤ 80°C
Absolute humidity Note7			AH	≤ 70 Note8	g/m$_3$	Ta= 80°C

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Note1: D0+/-, D1+/-, D2+/-, D3+/-, CLK+/-
Note2: DPS, FRC, MSL
Note3: Measured at LCD panel surface (including self-heat)
Note4: Measured at LCD module's rear shield surface (including self-heat)
Note5: Measured at center of LCD panel surface (including self-heat)
Note6: Measured at center of LCD module's rear shield surface (including self-heat)
Note7: No condensation
Note8: Water amount at Ta= 80°C and RH= 24%

4.3 ELECTRICAL CHARACTERISTICS

4.3.1 LCD panel signal processing board

(Ta= 25°C, Note1)

Parameter		Symbol	min.	typ.	max.	Unit	Remarks
Power supply voltage		VCC	3.0	3.3	3.6	V	-
Power supply current		ICC	-	460 Note2	720 Note3	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 Note4
	Low	VTL	-100	-	-	mV	
Terminating resistance		RT	-	100	-	Ω	-
Input voltage for DPS, FRC and MSL signals	High	VFH	0.7VCC	-	VCC	V	CMOS level
	Low	VFL	0	-	0.3VCC	V	
Input current for DPS, FRC and MSL signals	High	IFH	-	-	300	μA	-
	Low	IFL	-300	-	-	μA	

Note1: When designing of the power supply, take the measures for the prevention of surge voltage. ☆
Note2: Checkered flag pattern [by IEC 61747-6] ☆
Note3: Pattern for maximum current
Note4: Common mode voltage for LVDS receiver

4.3.2 Backlight

(1) Luminance 1: 800cd/m^2 (typ.)

(Ta= 25°C, Note1, Note2, Note3, Note4)

Parameter	Symbol	min.	typ.	max.	Unit	Remarks
Forward current	IL	-	50.0	55.0	mA	-
Forward Voltage	VL	21.2	24.0	27.2	V	Ta= +25°C at IL= 50 mA /One circuit
		19.0	-	-	V	Ta= +80°C at IL= 50 mA /One circuit
		-	-	29.8	V	Ta= -30°C at IL= 50 mA /One circuit
		-	-	30.1	V	Ta= -30°C at IL= 55 mA /One circuit

(2) Luminance 2: 1000cd/m^2 (typ.)

(Ta= 25°C, Note1, Note2, Note3, Note4)

Parameter	Symbol	min.	typ.	max.	Unit	Remarks
Forward current	IL	-	70.0	77.0	mA	-
Forward Voltage	VL	22.0	25.1	28.3	V	Ta= +25°C at IL= 70 mA /One circuit
		20.3	-		V	Ta= +60°C at IL= 70 mA /One circuit
		-	-	31.1	V	Ta= -30°C at IL= 70 mA /One circuit
		-	-	31.4	V	Ta= -30°C at IL= 77 mA /One circuit

Note1: Please drive 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 5 circuits. It is recommended that the current value difference amongst the circuits be less than 5%.

Note4: Forward Current vs Luminance / Operating temperature
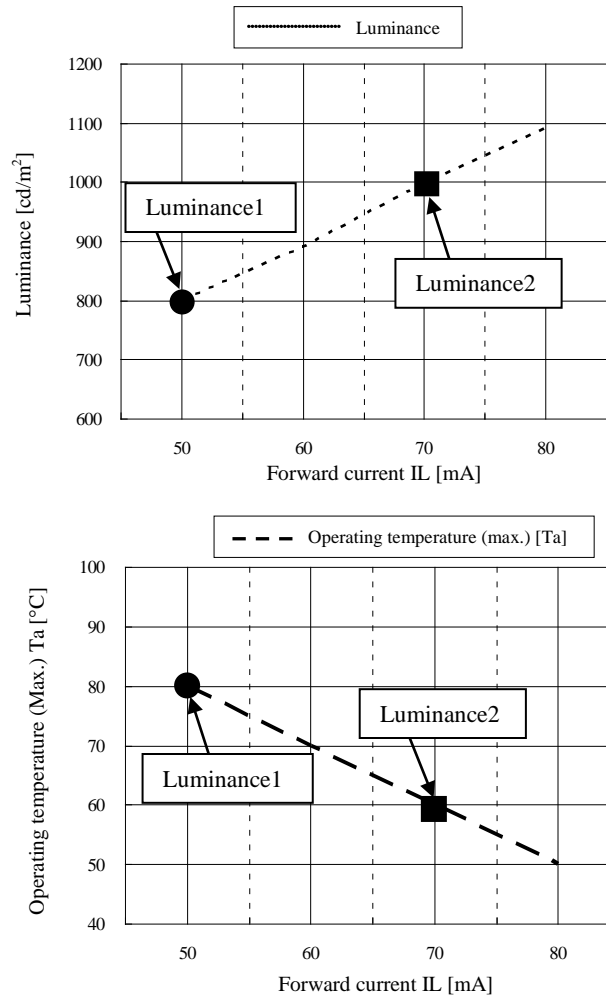
4.3.3 Power supply voltage ripple

This product works even if the ripple voltage levels are over the permissible values as the following table, but there might be noise on the display image.

Power supply voltage		Ripple voltage Note1 (Measure at input terminal of power supply)	Unit
VCC	3.3V	≤ 100	mVp-p

Note1: The permissible ripple voltage includes spike noise.

4.3.4 Fuse

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

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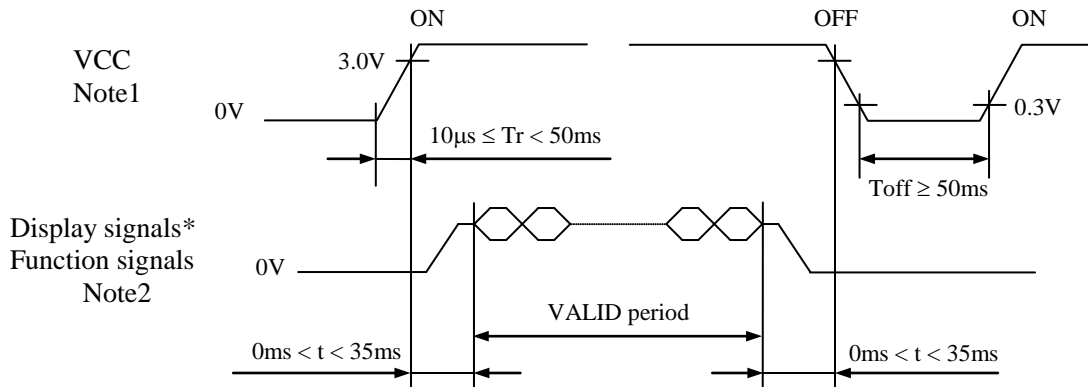
* These signals should be measured at the terminal of 100Ω resistance.

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+/-, D3+/- and CLK+/-) and function signals (DPS, FRC and MSL) 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
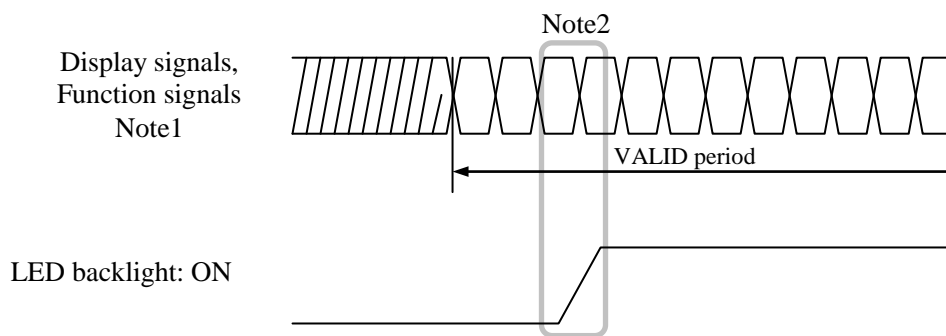
Note1: These are the display and function signals for LCD panel signal processing board.

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	Input data signal: 8-bit		Input data signal: 6-bit	Remarks
				MAP A	MAP B		
1	A	D3+	Pixel data	R0-R1,G0-G1,B0-B1	R6-R7,G6-G7,B6-B7	-	Note1, Note2
	B	GND	Ground	-		Ground	Note3
2	A	D3-	Pixel data	R0-R1,G0-G1,B0-B1	R6-R7,G6-G7,B6-B7	-	Note1, Note2
	B	GND	Ground	-		Ground	Note3
3		DPS	Selection of scan direction	High : Reverse scan Low or Open : Normal scan			Note4
4		FRC	Selection of the number of colors	High		Low or Open	Note1 Note5
5		GND	Ground	Ground			Note3
6		CLK+	Pixel clock	Pixel clock			Note2
7		CLK-					
8		GND	Ground	Ground			Note3
9		D2+	Pixel data	B4-B7,DE	B2-B5,DE		Note2
10		D2-					
11		GND	Ground	Ground			Note3
12		D1+	Pixel data	G3-G7,B2-B3	G1-G5,B0-B1		Note2
13		D1-					
14		GND	Ground	Ground			Note3
15		D0+	Pixel data	R2-R7,G2	R0-R5,G0		Note2
16		D0-					
17		GND	Ground	Ground			Note3
18		MSL	Selection of LVDS input map	Low	High or Open	Low	Note5
19		VCC	Power supply	Power supply			Note3
20		VCC					

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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 "**4.8 SCANNING DIRECTIONS**".
Note5: See "**4.5.4 Connection between receiver and transmitter for LVDS**".

4.5.2 Backlight

CN2 socket (LCD module side): SM10B-SRSS-TB   (J.S.T. Mfg. Co., Ltd.)
Adaptable plug: SHR-10V-S (J.S.T. Mfg. Co., Ltd.)

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	-

4.5.3 Positions of socket
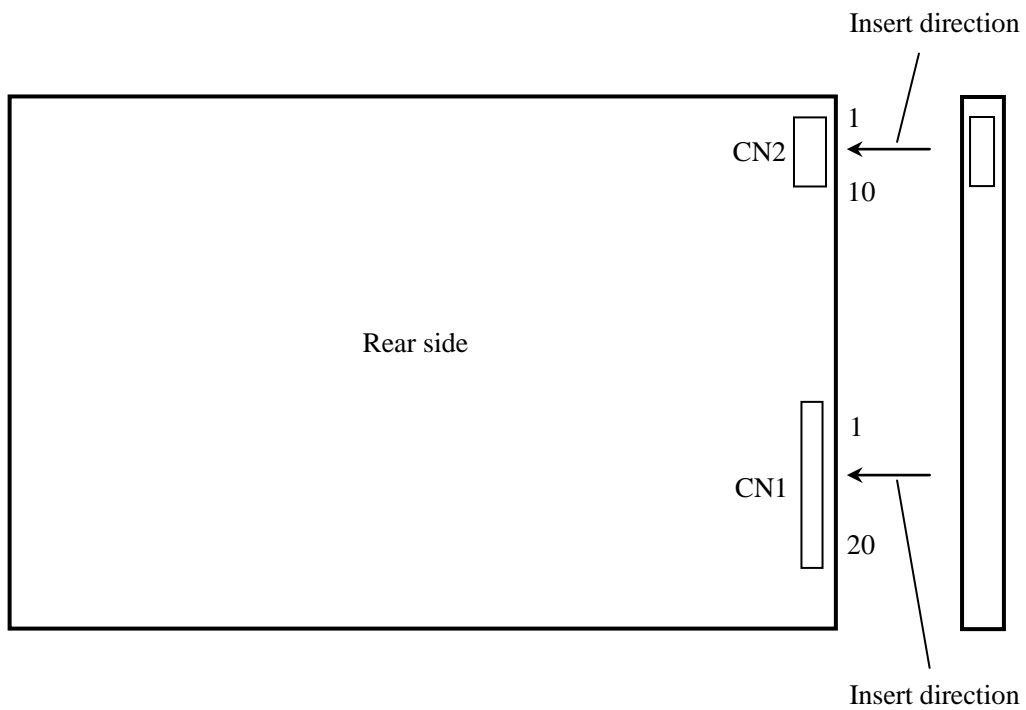
4.5.4 Connection between receiver and transmitter for LVDS

(1) Input data signal: 8-bit, MAP A (FRC: High, MSL: Low)
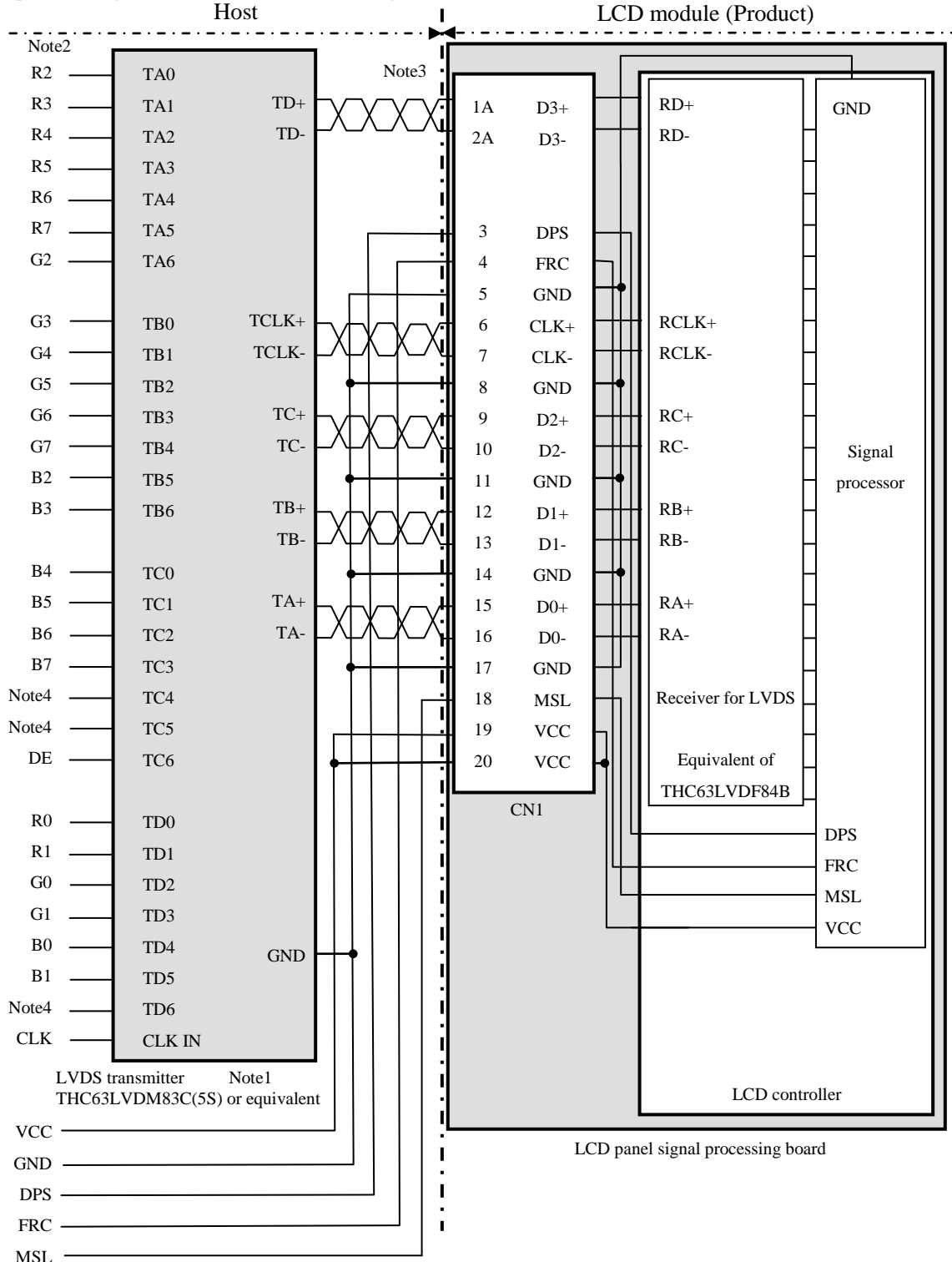
Note1: Recommended transmitter: THC63LVDM83C (5S) (THine Electronics Inc.) or equivalent

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 them open to avoid noise problem.

(2) Input data signal: 8-bit, MAP B (FRC: High, MSL: High or Open)

Host | LCD module (Product)

Note2

Host (LVDS transmitter)	CN1	Receiver for LVDS
R0 — TA0		
R1 — TA1 TD+	1A D3+	RD+ GND
R2 — TA2 TD-	2A D3-	RD-
R3 — TA3		
R4 — TA4		
R5 — TA5	3 DPS	
G0 — TA6	4 FRC	
	5 GND	
G1 — TB0 TCLK+	6 CLK+	RCLK+
G2 — TB1 TCLK-	7 CLK-	RCLK-
G3 — TB2	8 GND	
G4 — TB3 TC+	9 D2+	RC+
G5 — TB4 TC-	10 D2-	RC-
B0 — TB5	11 GND	Signal processor
B1 — TB6 TB+	12 D1+	RB+
TB-	13 D1-	RB-
B2 — TC0	14 GND	
B3 — TC1 TA+	15 D0+	RA+
B4 — TC2 TA-	16 D0-	RA-
B5 — TC3	17 GND	
Note4 — TC4	18 MSL	Receiver for LVDS
Note4 — TC5	19 VCC	
DE — TC6	20 VCC	Equivalent of
		THC63LVDF84B
R6 — TD0	CN1	
R7 — TD1		
G6 — TD2		DPS
G7 — TD3		FRC
B6 — TD4 GND		MSL
B7 — TD5		VCC
Note4 — TD6		
CLK — CLK IN		

LVDS transmitter   Note1
THC63LVDM83C(5S) or equivalent

LCD controller

VCC
GND
DPS
FRC
MSL

LCD panel signal processing board

Note1: Recommended transmitter: THC63LVDM8C (5S) (THine Electronics Inc.) or equivalent   ☆
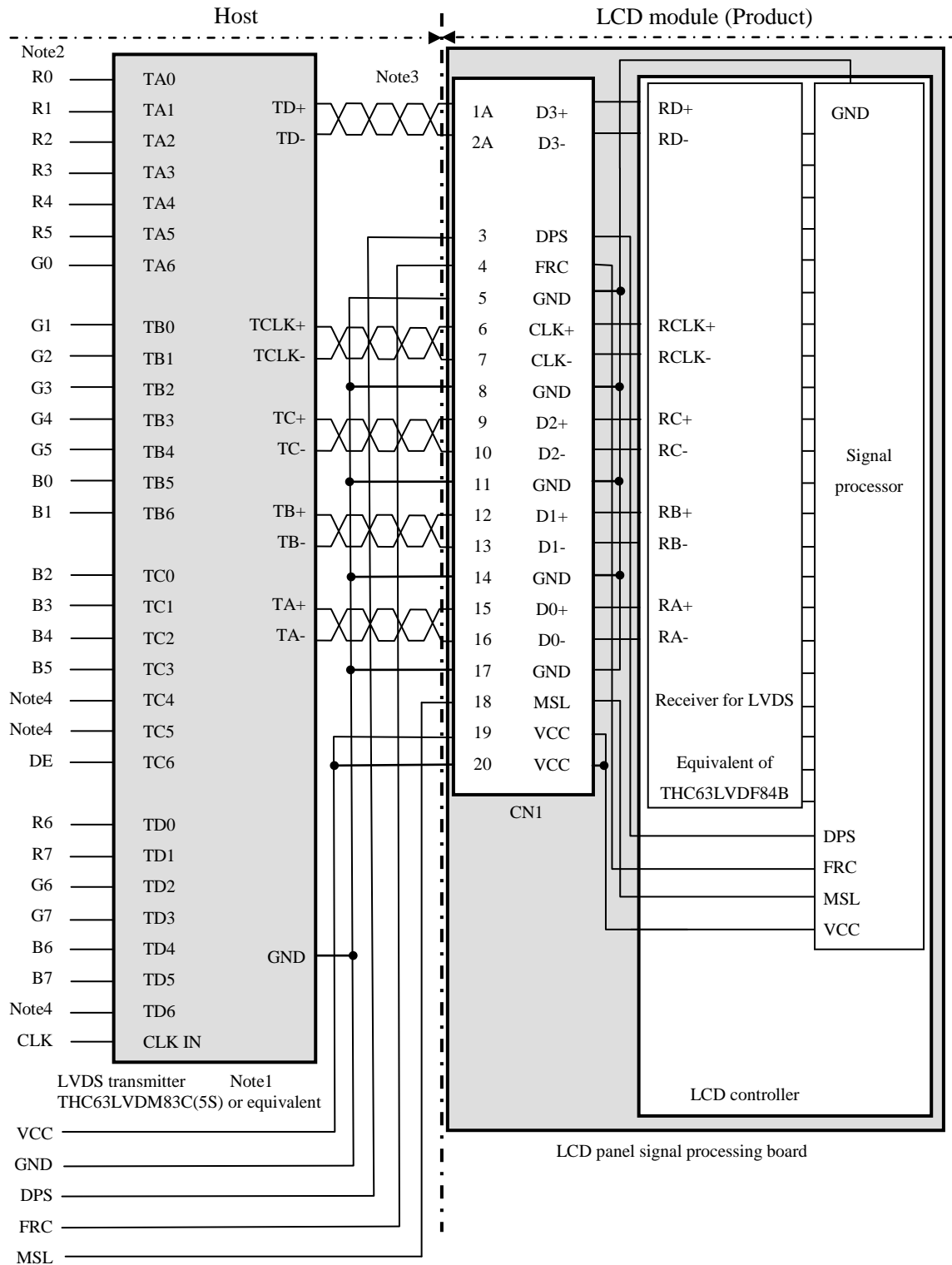Note2: LSB (Least Significant Bit) – R0, G0, B0   MSB (Most Significant Bit) – R7, G7, B7
Note3: Twist pair wires with 100Ω (Characteristic impedance) should be used between LCD panel signal processing board and LVDS transmitter.
Note4: Input signals to TC4, TC5 and TD6 are not used inside the product, but do not keep them open to avoid noise problem.

(3) Input data signal: 6-bit (FRC: Low or Open, MSL: Low)

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
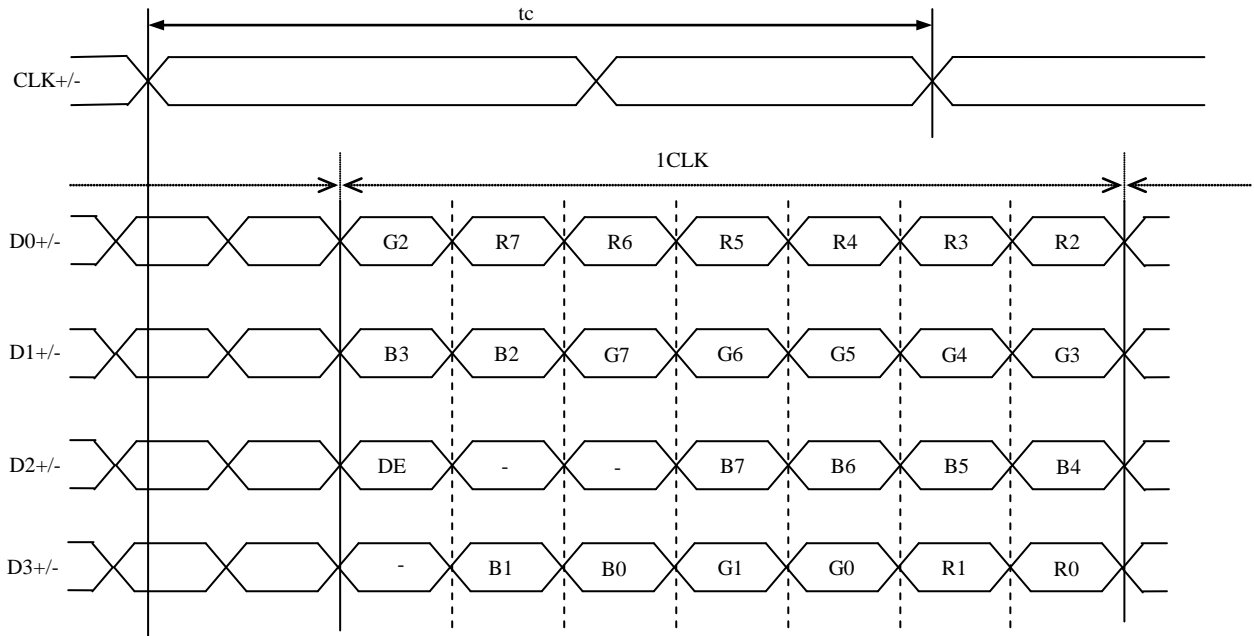Note3: Twist pair wires with 100Ω (Characteristic impedance) should be used between LCD panel signal processing board and LVDS transmitter.
Note4: Input signals to TC4, TC5 and TD0-6 are not used inside the product, but do not keep them open to avoid noise problem.

4.5.5 Input data mapping

(1) Input data signal: 8-bit, MAP A

D0+/-	G2	R7	R6	R5	R4	R3	R2
D1+/-	B3	B2	G7	G6	G5	G4	G3
D2+/-	DE	-	-	B7	B6	B5	B4
D3+/-	-	B1	B0	G1	G0	R1	R0

(2) Input data signal: 8-bit, MAP B

D0+/-	G0	R5	R4	R3	R2	R1	R0
D1+/-	B1	B0	G5	G4	G3	G2	G1
D2+/-	DE	-	-	B5	B4	B3	B2
D3+/-	-	B7	B6	G7	G6	R7	R6
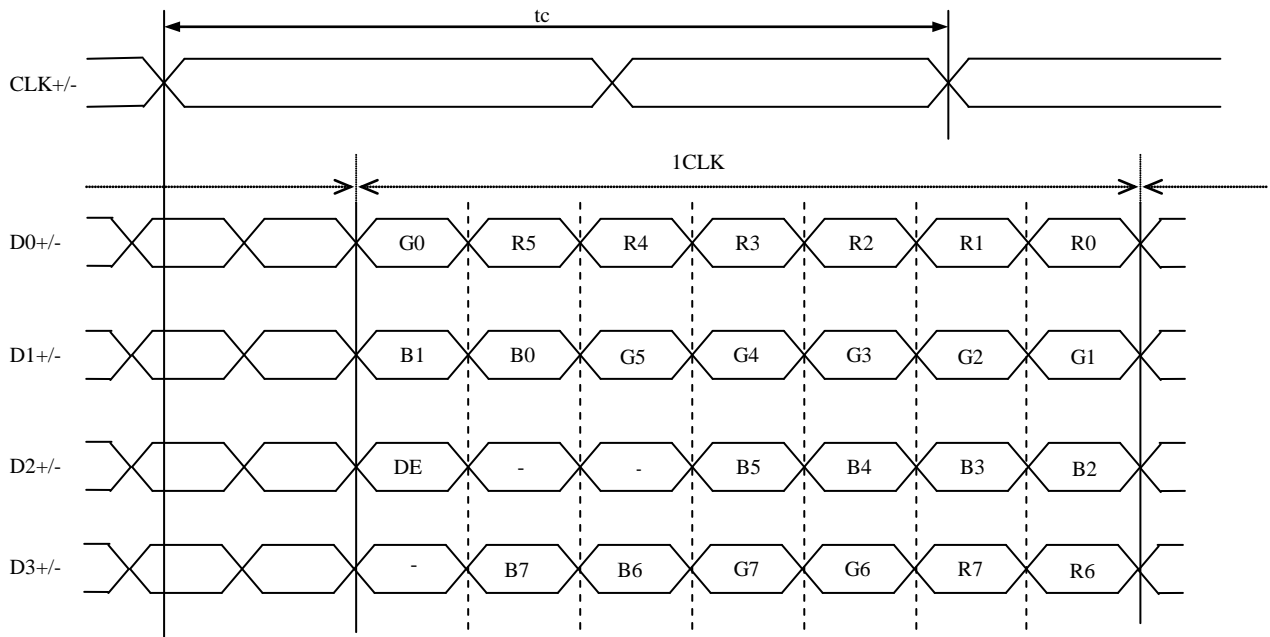
(3) Input data signal: 6-bit
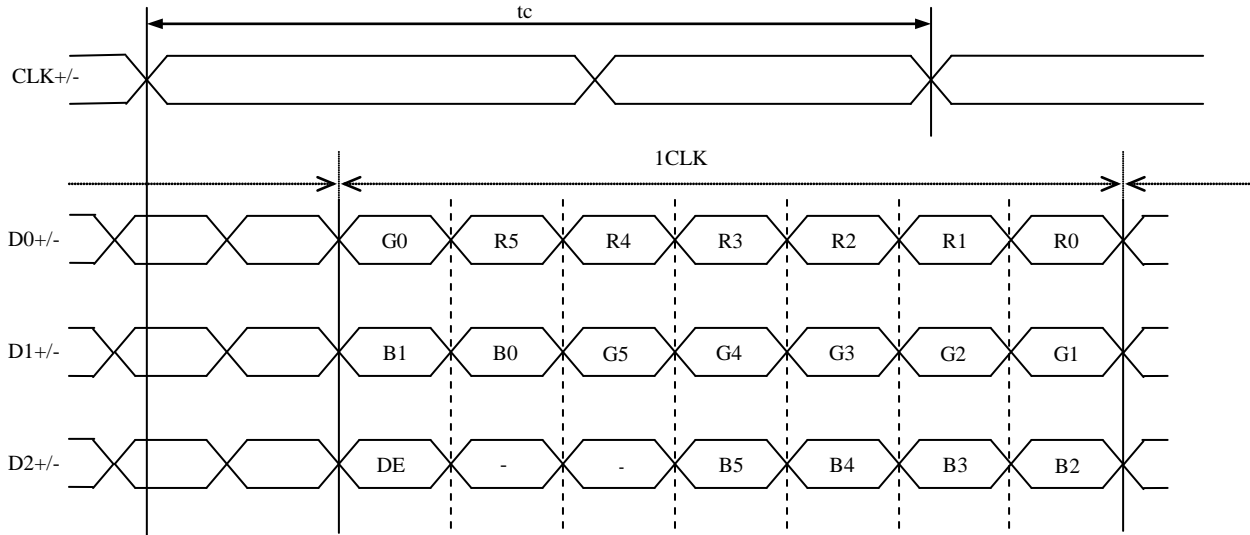
4.6 DISPLAY COLORS AND INPUT DATA SIGNALS

4.6.1 Combinations of input data signals, FRC and MSL signals

This product can display equivalent of 16,777,216 colors and 262,144 colors by combination of input data signals, FRC and MSL signals. See the following table.

Combination	Input data signals	Input Data mapping	CN1-Pin No.1 and 2	FRC terminal	MSL terminal	Display colors	Remarks
①	8-bit	MAP A	D3+/-	High	Low	16,777,216	Note1
②	8-bit	MAP B	D3+/-	High	High or Open	16,777,216	Note1
③	6-bit	-	GND	Low or Open	Low	262,144	Note2

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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 with 256 gray scales by combination ① or ②.
(See "**4.6.1 Combinations of input data signals, FRC and MSL signals**".)
 Also the relation between display colors and input data signals is as follows.

Display colors		Data signal (0: Low level, 1: High level)		
		R7 R6 R5 R4 R3 R2 R1 R0	G7 G6 G5 G4 G3 G2 G1 G0	B7 B6 B5 B4 B3 B2 B1 B0
Basic Colors	Black	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
	Blue	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1
	Red	1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
	Magenta	1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1
	Green	0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0
	Cyan	0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1
	Yellow	1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0
	White	1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1
Red gray scale	Black	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
		0 0 0 0 0 0 0 1	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
	dark	0 0 0 0 0 0 1 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
	↑	:	:	:
	↓	:	:	:
	bright	1 1 1 1 1 1 0 1	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
		1 1 1 1 1 1 1 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
	Red	1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
Green gray scale	Black	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
		0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 1	0 0 0 0 0 0 0 0
	dark	0 0 0 0 0 0 0 0	0 0 0 0 0 0 1 0	0 0 0 0 0 0 0 0
	↑	:	:	:
	↓	:	:	:
	bright	0 0 0 0 0 0 0 0	1 1 1 1 1 1 0 1	0 0 0 0 0 0 0 0
		0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 0	0 0 0 0 0 0 0 0
	Green	0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0
Blue gray scale	Black	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
		0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 1
	dark	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 1 0
	↑	:	:	:
	↓	:	:	:
	bright	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	1 1 1 1 1 1 0 1
		0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 0
	Blue	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1

4.6.3 262,144 colors

This product can display 262,144 colors with 64 gray scales by combination ③.
(See "**4.6.1 Combinations of input data signals, FRC and MSL signals** ".)
 Also the relation between display colors and input data signals is as follows.

Display colors		Data signal (0: Low level, 1: High level)																	
		R 5	R 4	R 3	R 2	R 1	R 0	G 5	G 4	G 3	G 2	G 1	G 0	B 5	B 4	B 3	B 2	B 1	B 0
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
		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
		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
	↑			:						:						:			
	↓			:						:						:			
	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
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	1
	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"**.).

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.

CN2

C (0, 0)   C (1023, 0)
D (0, 0)   D (1023, 0)

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Note1

CN1

C (0, 767)   C (1023, 767)
D (0, 767)   D (1023, 767)
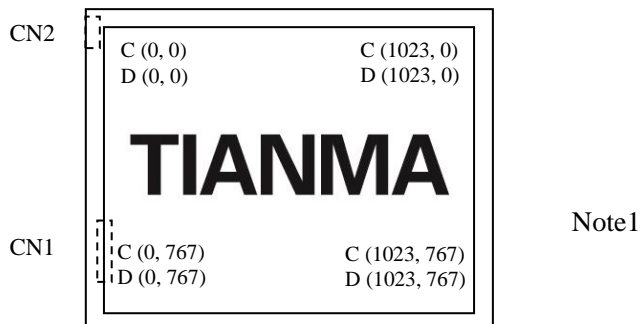
Figure1. Normal scan (DPS: Low or Open)

CN2

C (0, 0)   C (1023, 0)
D (1023, 767)   D (0, 767)

AMNAIT

Note1

CN1

C (0, 767)   C (1023, 767)
D (1023, 0)   D (0, 0)
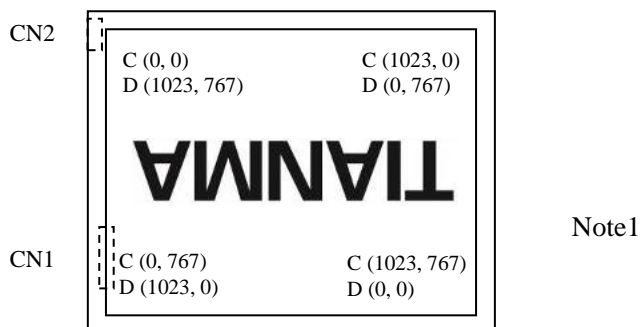
Figure2. Reverse scan (DPS: High)

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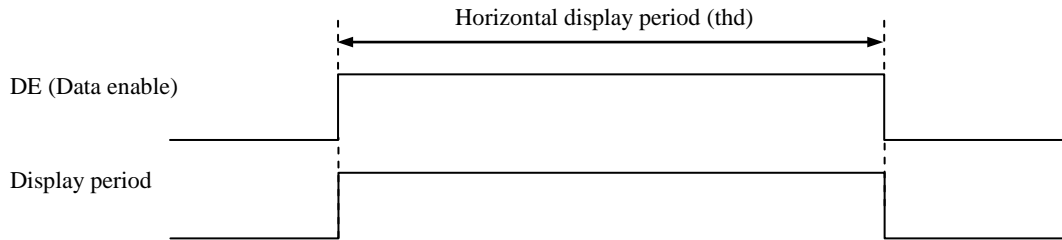C (X, Y): The coordinates of the display position (See "**4.7 DISPLAY POSITIONS**".)
D (X, Y): The data number of input signal for LCD panel signal processing board

4.9 INPUT SIGNAL TIMINGS
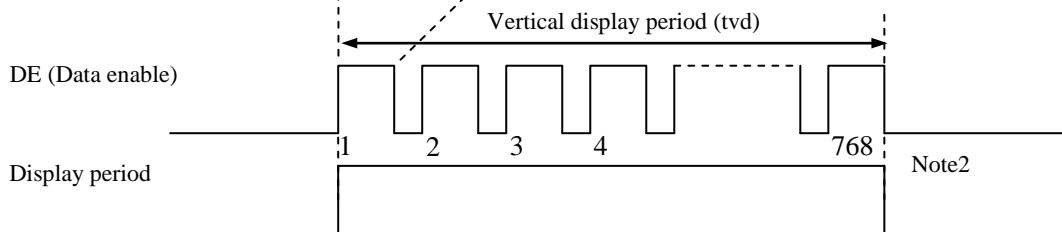
4.9.1 Outline of input signal timings

• Horizontal signal

Note1

• Vertical signal

Note1

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

4.9.2 Timing characteristics

(Note1, Note2, Note3)

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
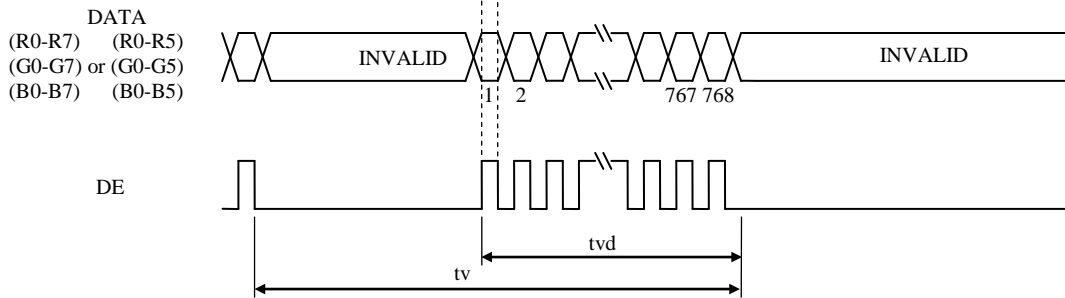Note2: See the data sheet of LVDS transmitter.
Note3: Vertical cycle (tv) should be specified in integral multiple of Horizontal cycle (th).

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4.9.3 Input signal timing chart

Horizontal timing
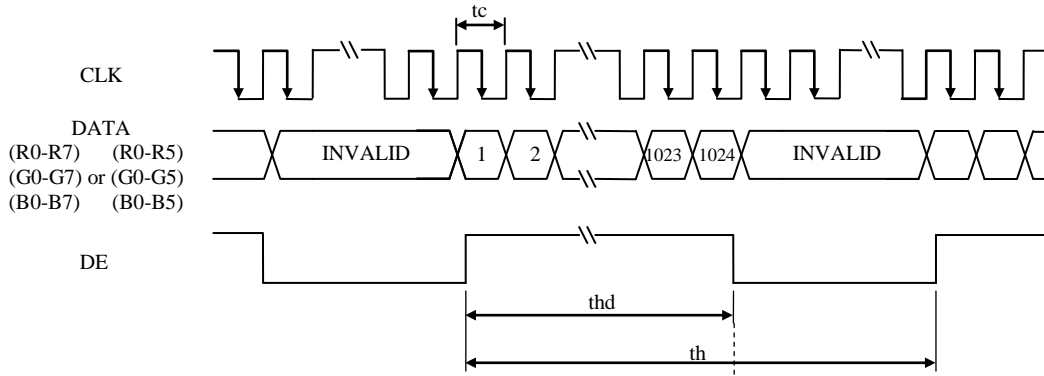
Vertical timing

4.10 OPTICS

4.10.1 Optical characteristics

(Note1, Note2)

Parameter		Condition	Symbol	min.	typ.	max.	Unit	Measuring instrument	Remarks
Luminance 1		White at center $\theta R= 0°, \theta L= 0°, \theta U= 0°, \theta D= 0°$	L	460	800	-	cd/m^2	BM-5A or equivalent	Note3
Luminance 2		White at center $\theta R= 0°, \theta L= 0°, \theta U= 0°, \theta D= 0°$	L	575	1,000	-	cd/m^2	BM-5A or equivalent	Note4
Contrast ratio		White/Black at center $\theta R= 0°, \theta L= 0°, \theta U= 0°, \theta D= 0°$	CR	540	900	-	-	BM-5A or equivalent	Note5
Luminance uniformity		White $\theta R= 0°, \theta L= 0°, \theta U= 0°, \theta D= 0°$	LU	-	1.25	1.4	-	BM-5A or equivalent	Note6
Chromaticity	White	**x** coordinate	Wx	0.263	0.313	0.363	-	SR-3 or equivalent	Note7
		y coordinate	Wy	0.279	0.329	0.379	-		
	Red	**x** coordinate	Rx	-	0.564	-	-		
		y coordinate	Ry	-	0.346	-	-		
	Green	**x** coordinate	Gx	-	0.348	-	-		
		y coordinate	Gy	-	0.541	-	-		
	Blue	**x** coordinate	Bx	-	0.151	-	-		
		y coordinate	By	-	0.134	-	-		
Color gamut		$\theta R= 0°, \theta L= 0°, \theta U= 0°, \theta D= 0°$ at center, against NTSC color space	C	35	40	-	%		
Response time		White to Black	Ton	-	3	5	ms	BM-5A or equivalent	Note8 Note9
		Black to White	Toff	-	15	21	ms		
Viewing angle	Right	$\theta U= 0°, \theta D= 0°, CR≥ 10$	θR	70	80	-	°	EZ Contrast	Note10
	Left	$\theta U= 0°, \theta D= 0°, CR≥ 10$	θL	70	80	-	°		
	Up	$\theta R= 0°, \theta L= 0°, CR≥ 10$	θU	70	80	-	°		
	Down	$\theta R= 0°, \theta L= 0°, CR≥ 10$	θD	70	80	-	°		

Note1:　These are initial characteristics.
Note2:　Measurement conditions are as follows.
　　　　Ta= 25°C, VCC= 3.3V, IL= 50mA and 70mA / 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.
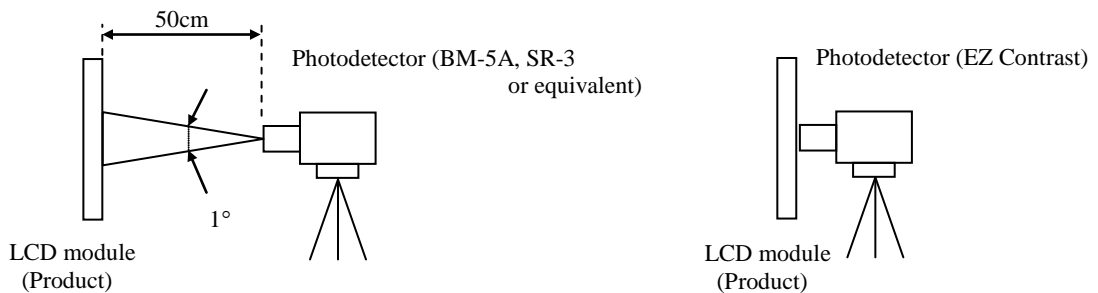
Note3:　At IL= 50mA/One circuit
Note4:　At IL= 70mA/One circuit
Note5:　See "**4.10.2 Definition of contrast ratio**".
Note6:　See "**4.10.3 Definition of luminance uniformity**".
Note7:　These coordinates are found on CIE 1931 chromaticity diagram.
Note8:　Product surface temperature: TopF= 30 °C
Note9:　See "**4.10.4 Definition of response times**".
Note10:　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.
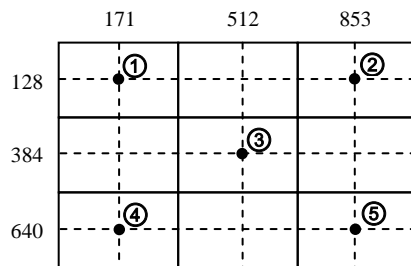
4.10.4 Definition of response times

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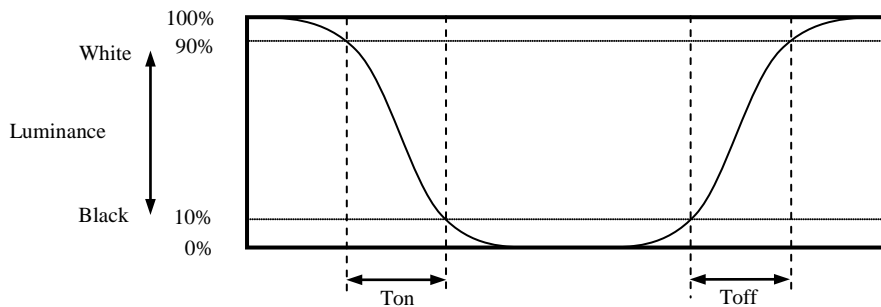
4.10.5 Definition of viewing angles
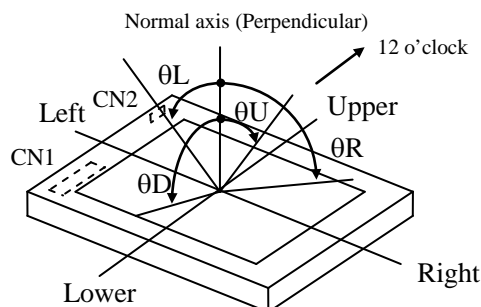
5. ESTIMATED LUMINANCE LIFETIME

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

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

(1) Luminance 1: 800cd/m^2 (typ.)

Condition		Estimated luminance lifetime (Life time expectancy) Note1, Note2, Note3	Unit
LED elementary substance	25°C (Ambient temperature of the product) Continuous operation, IL= 50mA/One circuit	70,000	h
	80°C (Surface temperature at screen) Continuous operation, IL= 50mA/One circuit	60,000	

(2) Luminance 2: 1000cd/m^2 (typ.)

Condition		Estimated luminance lifetime (Life time expectancy) Note1, Note2, Note3	Unit
LED elementary substance	25°C (Ambient temperature of the product) Continuous operation, IL= 70mA/One circuit	60,000	h
	60°C (Surface temperature at screen) Continuous operation, IL= 70mA/One circuit	-	

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 ± 2°C, RH= 90%, 240hours ② Display data is black.	No display malfunctions
High temperature (Operation)	① 80 ± 3°C, 240hours ② Display data is black.	
Heat cycle (Operation)	① -30 ± 3°C…1hour 80 ± 3°C…1hour ② 50cycles, 4 hours/cycle ③ Display data is black.	
Thermal shock (Non operation)	① -30 ± 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 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, $19.6 m/s^2$ 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 $539 m/s^2$, 11ms ② ±X, ±Y, ±Z directions 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.
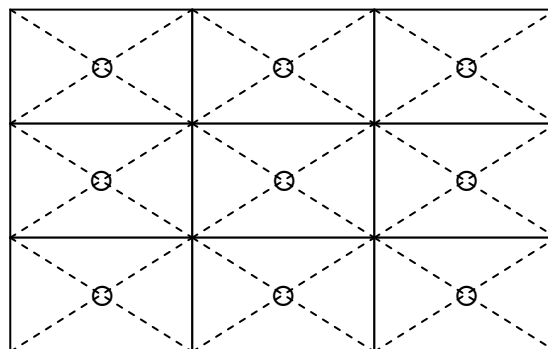
7. PRECAUTIONS

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 539m/s^2 and equal to or no greater than 11ms, Pressure: Equal to or no greater than 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 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 0.23N·m. Higher torque might result in distortion of the bezel. And the length of product mounting screws must be ≤ 2.0mm.

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, wipe it with a soft dry cloth.

⑦ Do not push or 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.

⑨ 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.
⑤ Optical characteristics may be changed depending on input signal timings.

7.3.4 Others

① All VCC and GND 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 TMJ for repairing and so on.
⑤ The information of China RoHS (Ⅱ) six hazardous substances or elements in this product is as follows. ☆

China RoHS (Ⅱ) six hazardous substances or elements					
Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr VI)	Polybrominated Biphenys (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 GB/T26572-2011 standard regulation.

× : This indicates that the poisonous or harmful material in all the homogeneous materials for this part is above the limitation level of GB/T26572-2011 standard regulation.

⊻ TIANMA

8. OUTLINE DRAWINGS

8.1 FRONT VIEW
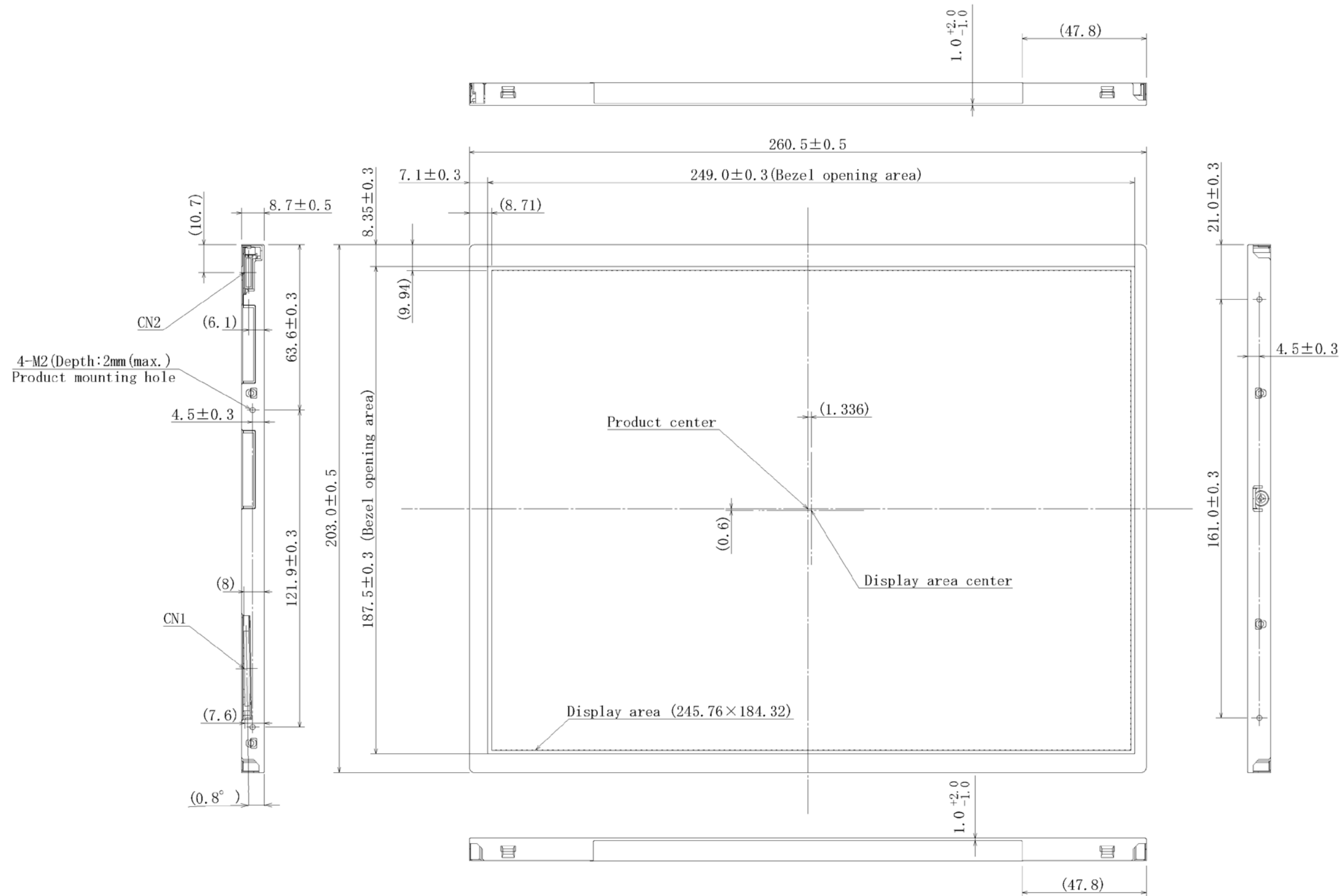
Note1: The values in parentheses are for reference.
Note2: The torque for product mounting screws must never exceed 0.23N·m. And the length of product mounting screws must be ≤ 2.0mm.
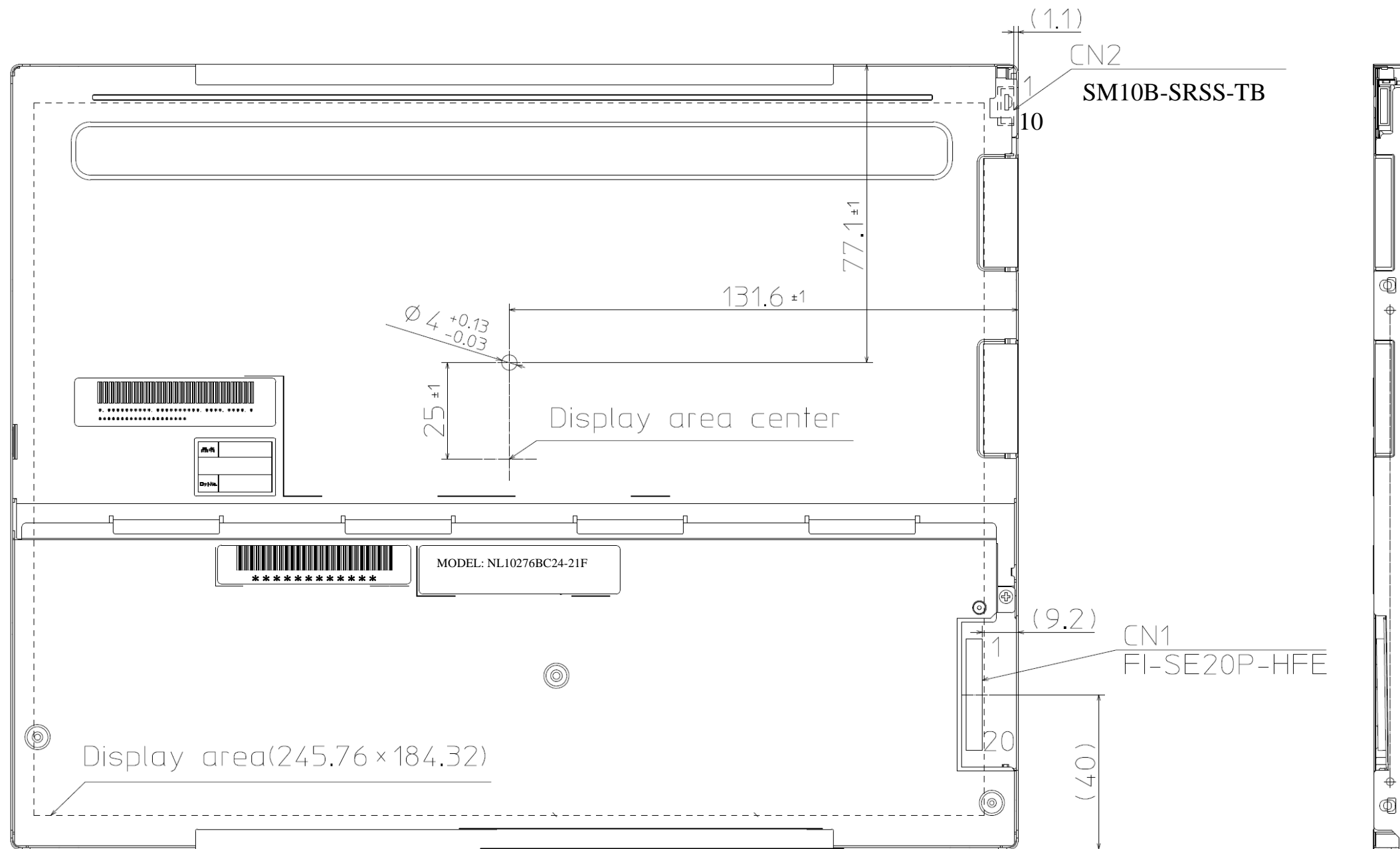
Unit: mm

8.2 REAR VIEW

Note1: The values in parentheses are for reference.
Note2: The torque for product mounting screws must never exceed 0.23N·m. And the length of product mounting screws must be ≤ 2.0mm.

Unit: mm

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