NLT Technologies, Ltd.

TFT COLOR LCD MODULE

NL10276BC30-34BD

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

PRELIMINARY DATA SHEET

DOD-PP-1566 (1st edition)

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: Vehicle/train/ship control system, traffic signals system, traffic information control system, air traffic control system, surgery/operation equipment monitor, disaster/crime prevention system, 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.

CONTENTS

1. OUTLINE

1.1 STRUCTURE AND PRINCIPLE

Color LCD module NL10276BC30-34BD 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, touch panel (T/P) 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

- Projected capacitive touch panel (P-CAP T/P) attached
- Touch panel having cover glass
- Long life LED backlight type
- High luminance
- High contrast
- Wide viewing angle
- Fast response time
- LVDS interface
- Reversible-scan direction
- Selectable LVDS input map
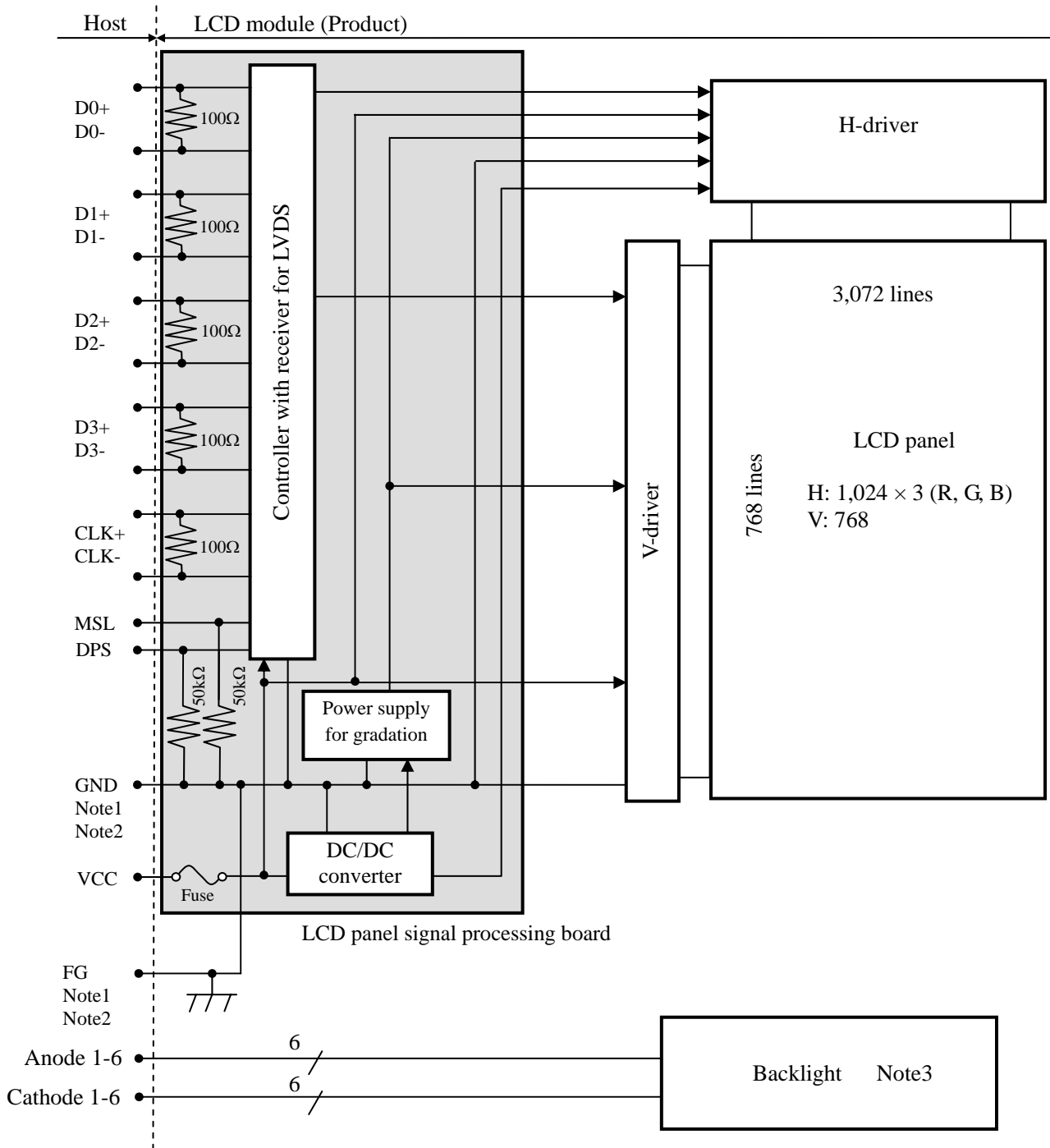- Small foot print
- Replaceable lamp for backlight

2. GENERAL SPECIFICATIONS

Display area	304.128 (H) × 228.096 (V) mm
Diagonal size of display	38cm (15.0 inches)
Drive system	a-Si TFT active matrix
Display color	16,777,216 colors (6bit+FRC)
Pixel	1,024 (H) × 768 (V) pixels
Pixel arrangement	RGB (Red dot, Green dot, Blue dot) vertical stripe
Dot pitch	0.099 (H) × 0.297 (V) mm
Pixel pitch	0.297 (H) × 0.297 (V) mm
Module size	326.5 (W) ×253.5 (H) × (13.8) (D) mm (typ.)
Weight	TBD g (typ.)
Contrast ratio	TBD (typ.)
Viewing angle	*At the contrast ratio ≥ 10:1* • Horizontal: Right side (80)° (typ.), Left side (80)° (typ.) • Vertical: Up side (80)° (typ.), Down side (80)° (typ.)
Designed viewing direction	*At DPS terminal= Low or Open: Normal scan* • Viewing direction without image reversal: Up side (12 o'clock) • Viewing direction with contrast peak: Down side (6 o'clock) • Viewing angle with optimum grayscale (γ≒2.2): Normal axis (perpendicular)
Touch panel type	Projected capacitive ⎡ Recommended Touch panel controller board (Option) ⎣ • Touch panel controller board: Type No. PTPW01 ⎤⎦
Touch panel surface	Antiglare
Touch panel pencil-hardness	(2H) (min.) [by JIS K5600]
Touch panel cover glass	0.7mm normal glass
Touch panel bonding method	Perimeter-bonding (with air gap)
Color gamut	*At LCD panel center* 50% (typ.) [against NTSC color space]
Response time	*Ton+Toff (10%←→90%)* 18ms (typ.)
Luminance	*At IL= 50mA / One circuit* (350)cd/m^2 (typ.)
Signal system	LVDS 1port (Receiver: Equivalent of THC63LVDF84B, THine Electronics Inc.) [8-bit digital signals for data of RGB colors, Dot clock (CLK), Data enable (DE)]
Power supply voltage	LCD panel signal processing board: 3.3V
Backlight	LED Backlight type: ⎡ Replaceable part ⎣ • Lamp holder set: Type No.:150LHS36 ⎤⎦ ⎡ Recommended LED driver board (Option) • LED driver board: Type No.:150PW02F ⎣ • Corresponding wiring harness: Type No. 150CBL02 ⎤⎦
Power consumption	*At IL= 50mA / One circuit, Checkered flag pattern* 9.8W (typ.) (except for T/P)

3. BLOCK DIAGRAM

Host | LCD module (Product)

D0+
D0-
100Ω

D1+
D1-
100Ω

D2+
D2-
100Ω

D3+
D3-
100Ω

CLK+
CLK-
100Ω

MSL

DPS

50kΩ 50kΩ

Controller with receiver for LVDS

Power supply for gradation

GND
Note1
Note2

VCC

Fuse

DC/DC converter

LCD panel signal processing board

H-driver

V-driver

768 lines

LCD panel

3,072 lines

H: 1,024 × 3 (R, G, B)
V: 768

FG
Note1
Note2

Anode 1-6   6

Cathode 1-6   6

Backlight   Note3

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

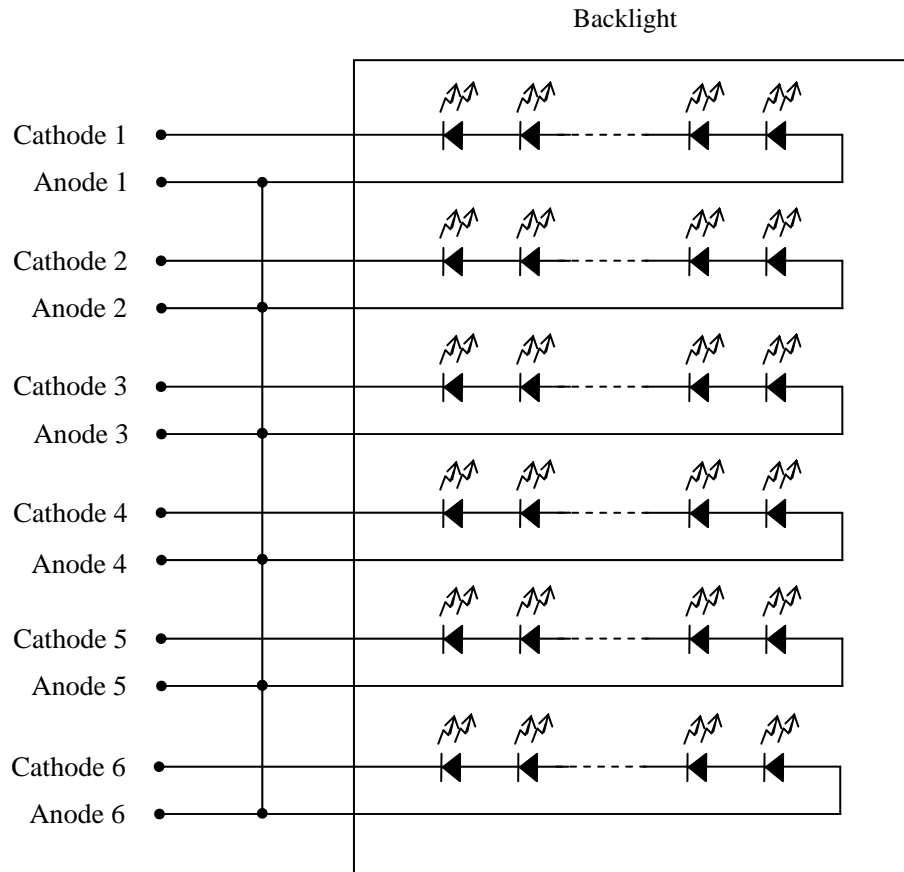| GND- FG	Connected

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

Note3: Detail of backlight

Backlight

Cathode 1
Anode 1

Cathode 2
Anode 2

Cathode 3
Anode 3

Cathode 4
Anode 4

Cathode 5
Anode 5

Cathode 6
Anode 6

4. DETAILED SPECIFICATIONS

4.1 MECHANICAL SPECIFICATIONS

Parameter	Specification		Unit
Module size	326.5 ± 0.5 (W) × 253.5 ± 0.5 (H) × (13.8) max. (D)	Note1	mm
Display area	304.128 (H) × 228.096 (V)	Note1	mm
Weight	TBD (typ.), TBD (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			
Backlight	Forward current	IL	60	mA	per one circuit
Touch panel input voltage		Vtp	6.0	V	-
Storage temperature		Tst	-20 to +80	°C	-
Operating temperature	Front surface	TopF	-20 to +70	°C	Note3
	Rear surface	TopR	-20 to +70	°C	Note4
Relative humidity Note5		RH	≤ 95	%	Ta ≤ 40°C
			≤ 85	%	40 < Ta ≤ 50°C
			≤ 55	%	50 < Ta ≤ 60°C
			≤ 36	%	60 < Ta ≤ 70°C
Absolute humidity Note5		AH	≤ 70 Note6	g/m³	Ta > 70°C
Operating altitude		-	≤ 5,100	m	-20°C ≤ Ta ≤ 70°C
Storage altitude		-	≤ 13,600	m	-20°C ≤ Ta ≤ 80°C

Note1: D0+/-, D1+/-, D2+/-, D3+/-, CLK+/-
Note2: MSL, DPS
Note3: Measured at center of LCD panel surface (including self-heat)
Note4: Measured at center of LCD module's rear shield surface (including self-heat)
Note5: No condensation
Note6: Water amount at Ta= 70°C and RH= 36%

4.3 ELECTRICAL CHARACTERISTICS

4.3.1 LCD panel signal processing board

(Ta= 25°C)

Parameter		Symbol	min.	typ.	max.	Unit	Remarks
Power supply voltage		VCC	3.0	3.3	3.6	V	-
Power supply current		ICC	-	500 Note1	700 Note2	mA	at VCC= 3.3V
Permissible ripple voltage		VRP	-	-	100	mVp-p	for VCC
Differential input threshold voltage for LVDS receiver	High	VTH	-	-	+100	mV	at VCM= 1.2V Note3
	Low	VTL	-100	-	-	mV	
Input voltage swing for LVDS receiver		Vi	0	-	2.4	V	-
Terminating resistance		RT	-	100	-	Ω	-
Input voltage for MSL and DPS signals	High	VFH	2.0	-	VCC	V	-
	Low	VFL	0	-	0.8	V	
Input current for MSL and DPS signals	High	IFH	-	-	300	μA	-
	Low	IFL	-300	-	-	μA	

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

4.3.2 Backlight lamp

(Ta= 25°C, Note1, Note2, Note3)

Parameter	Symbol	min.	typ.	max.	Unit	Remarks
Forward Current	IL	-	50	55	mA	-
Forward Voltage	VL	23.9	27.0	30.6	V	Ta= +25°C at IL= 50 mA/ One circuit
		21.42	-	-	V	Ta= +70°C at IL= 50 mA/ One circuit
		-	-	32.94	V	Ta= -20°C at IL= 50 mA/ One circuit
		-	-	33.21	V	Ta= -20°C at IL= 55 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 6 circuits. It is recommended that the current value difference among the circuits be less than 5%.

4.3.3 Power supply voltage ripple

This product works 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
			32V		

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 Touch panel specification

(Ta= 25°C)

| Parameter		Symbol	min.	typ.	max.	Unit	Remarks
X drive voltage		XVDD	2.5	3.3	10.5	V	-
Accuracy	Center	Acrc	-	-	(1.5)	mm	Note1
	Boarder	Acrb	-	-	(2.5)	mm	Note1
Number of touch		NUM	1	-	16	Point	Note2
Resolution	X		-	-	4,096	-	Note2
	Y		-	-	4,096	-	Note2

Note1: Input method is φ8mm conductive stylus
Note2: Using the Touch panel controller board, which is a option parts.
Note3: See "**8. OUTLINE DRAWINGS**".

4.5 POWER SUPPLY VOLTAGE SEQUENCE

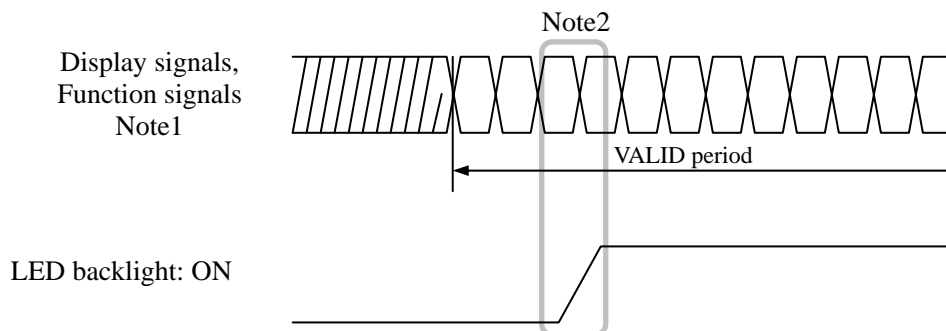### 4.5.1 LCD panel signal processing board
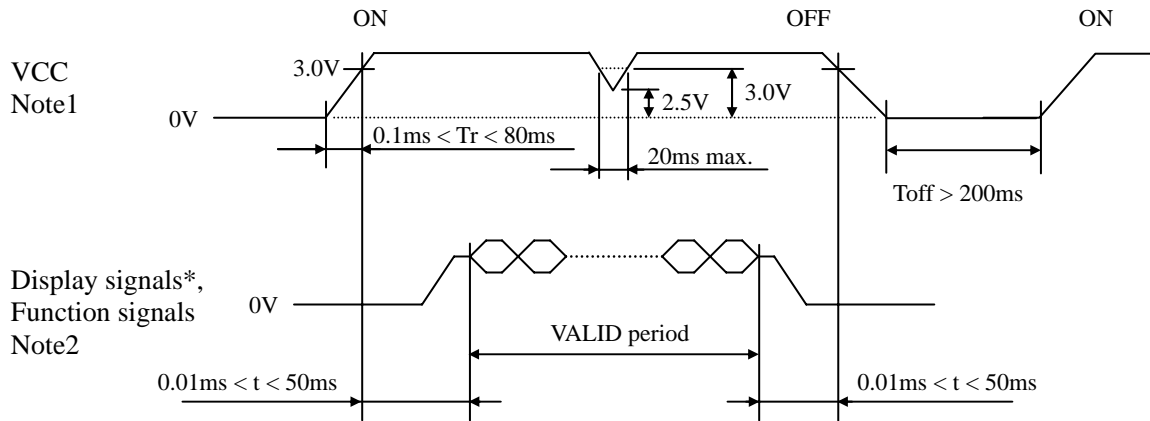
* These signals should be measured at the terminal of 100Ω resistance.

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+/-, CLK+/-) and function signals (MSL, 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.

4.5.2 LED driver board

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.

4.6 CONNECTIONS AND FUNCTIONS FOR INTERFACE PINS

4.6.1 LCD panel signal processing board

CN1 socket (LCD module side): DF14H-20P-1.25H (Hirose Electric Co., Ltd. (HRS))
MSB240420HE (SIN SHENG TERMINAL & MACHINE INC. (STM))
Adaptable plug: DF14-20S-1.25C (Hirose Electric Co., Ltd. (HRS))

Pin No.	Symbol	Signal	Remarks		
1	VCC	Power supply	Note1		
2	VCC				
3	GND	Ground	Note1		
4	GND				
5	D0-	Pixel data	Note2		
6	D0+				
7	GND	Ground	Note1		
8	D1-	Pixel data	Note2		
9	D1+				
10	GND	Ground	Note1		
11	D2-	Pixel data	Note2		
12	D2+				
13	GND	Ground	Note1		
14	CLK-	Pixel clock	Note2		
15	CLK+				
16	GND	Ground	Note1		
17	D3-	Pixel data	Note2		
18	D3+				
19	DPS	Selection of scan direction	High: Reverse scan Low or Open: Normal scan		Note3, Note5
20	MSL	Selection of LVDS input map	High: Input map A Low or Open: Input map B		Note4, Note5

Note1: All GND and VCC terminals should be used without any non-connected lines.
Note2: Twist pair wires with 100Ω (Characteristic impedance) should be used between LCD panel signal processing board and LVDS transmitter.
Note3: See "**4.9 SCANNING DIRECTIONS**".
Note4: See "**4.6.5 Connection between receiver and transmitter for LVDS**".
Note5: This terminal is pulled-down in the product. (Pull-down resistance: 50kΩ)

4.6.2 Backlight lamp

CN2 plug (LCD module side):   SM12B-SRSS-TB   (J.S.T. Mfg. Co., Ltd.)
Adaptable socket: SHR-12V-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	-
11	A6	Anode6	-
12	K6	Cathode6	-

4.6.3 Touch panel

CN3 (FPC)
Adaptable socket: FH28-40S-0.5SH(05) (Hirose Electric Co., Ltd.(HRS))

Pin No.	Symbol	Signal	Pin No.	Symbol	Signal
1	GND	Ground Note1	21	X13	X line terminal
2	GND	Ground Note1	22	X12	X line terminal
3	X31	X line terminal	23	X11	X line terminal
4	X30	X line terminal	24	X10	X line terminal
5	X29	X line terminal	25	X9	X line terminal
6	X28	X line terminal	26	X8	X line terminal
7	X27	X line terminal	27	X7	X line terminal
8	X26	X line terminal	28	X6	X line terminal
9	X25	X line terminal	29	X5	X line terminal
10	X24	X line terminal	30	X4	X line terminal
11	X23	X line terminal	31	X3	X line terminal
12	X22	X line terminal	32	X2	X line terminal
13	X21	X line terminal	33	X1	X line terminal
14	X20	X line terminal	34	X0	X line terminal
15	X19	X line terminal	35	GND	Ground Note1
16	X18	X line terminal	36	GND	Ground Note1
17	X17	X line terminal	37	N. C.	(Keep this pin open)
18	X16	X line terminal	38	N. C.	(Keep this pin open)
19	X15	X line terminal	39	N. C.	(Keep this pin open)
20	X14	X line terminal	40	N. C.	(Keep this pin open)

Note1: All GND terminals should be used without any non-connected lines.
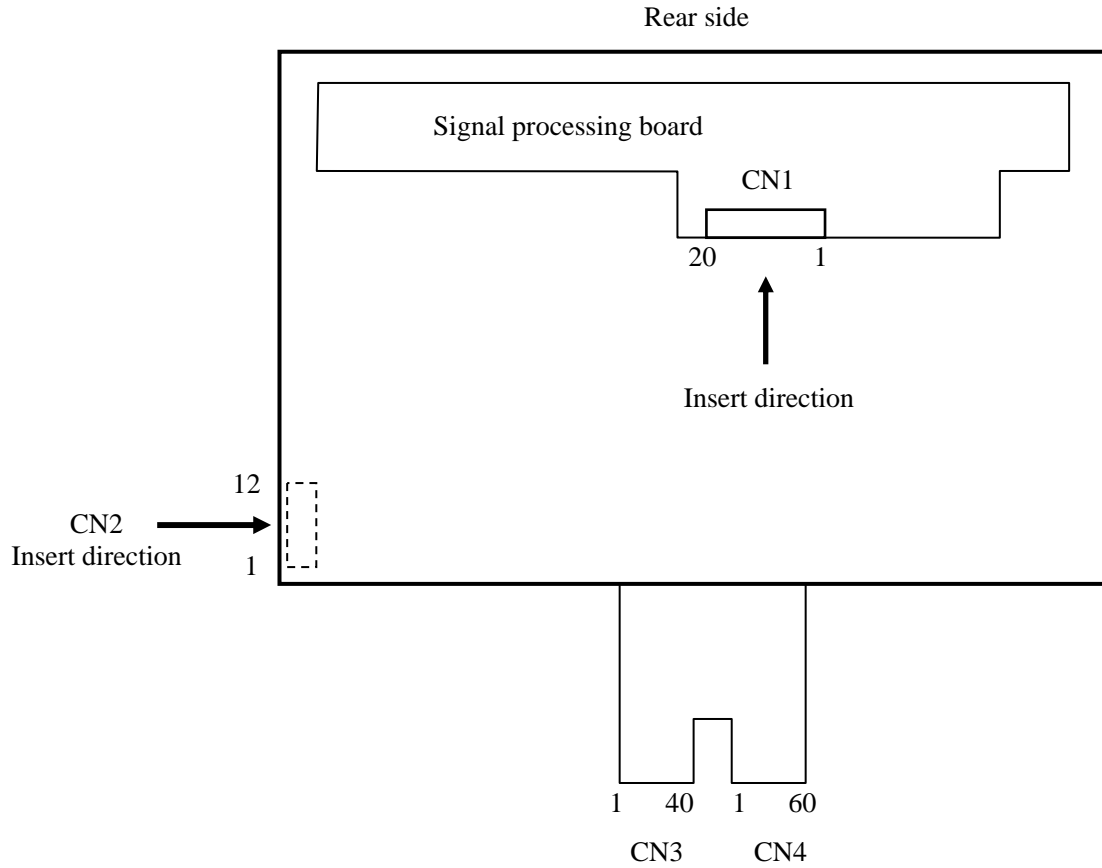
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CN4 (FPC)
Adaptable socket: FH28-60S-0.5SH(05) (Hirose Electric Co., Ltd.(HRS))

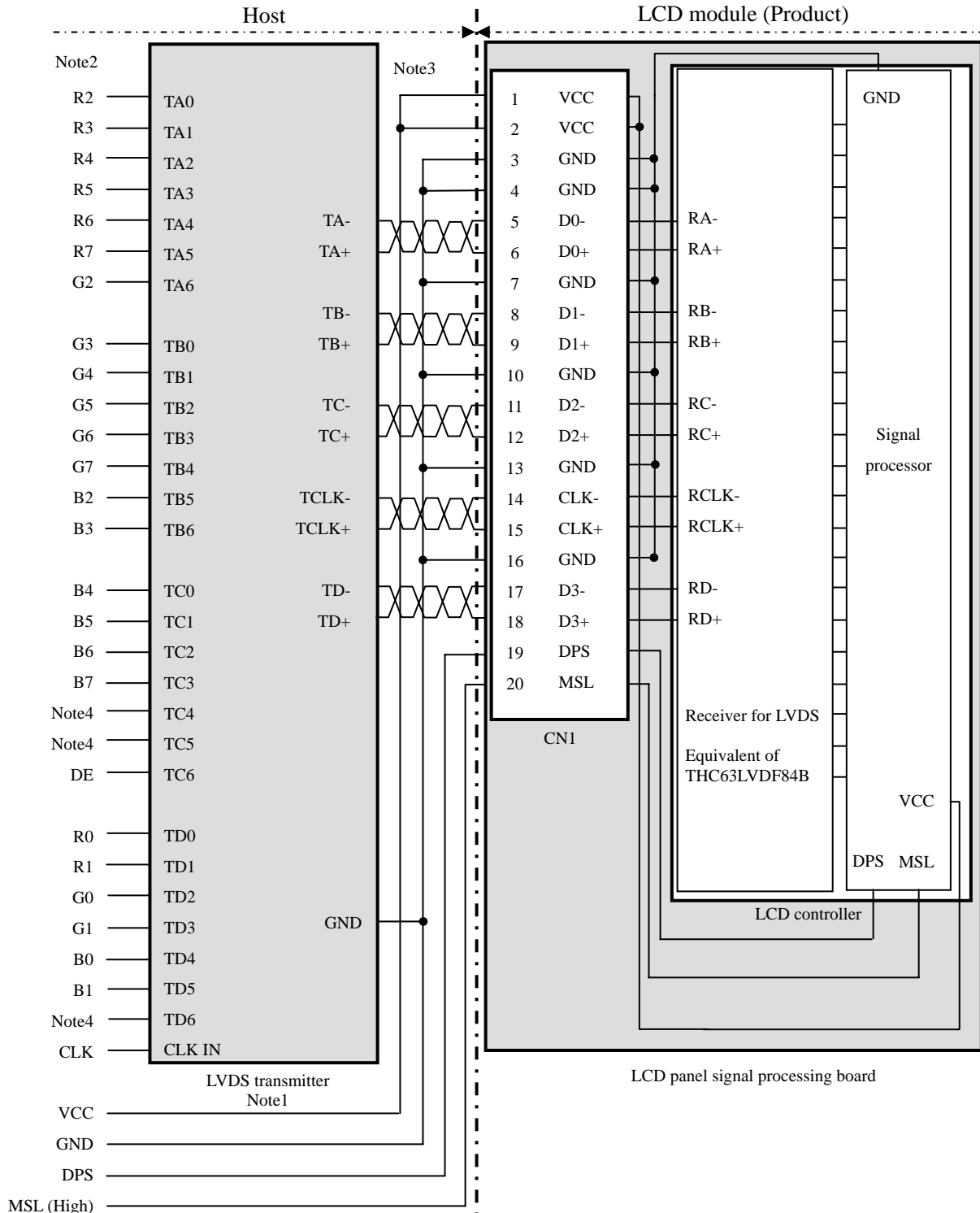| Pin No.	Symbol	Signal	Pin No.	Symbol	Signal
1	GND	Ground Note1	31	Y28	Y line terminal
2	GND	Ground Note1	32	Y29	Y line terminal
3	Y0	Y line terminal	33	Y30	Y line terminal
4	Y1	Y line terminal	34	Y31	Y line terminal
5	Y2	Y line terminal	35	Y32	Y line terminal
6	Y3	Y line terminal	36	Y33	Y line terminal
7	Y4	Y line terminal	37	Y34	Y line terminal
8	Y5	Y line terminal	38	Y35	Y line terminal
9	Y6	Y line terminal	39	Y36	Y line terminal
10	Y7	Y line terminal	40	Y37	Y line terminal
11	Y8	Y line terminal	41	Y38	Y line terminal
12	Y9	Y line terminal	42	Y39	Y line terminal
13	Y10	Y line terminal	43	Y40	Y line terminal
14	Y11	Y line terminal	44	Y41	Y line terminal
15	Y12	Y line terminal	45	Y42	Y line terminal
16	Y13	Y line terminal	46	Y43	Y line terminal
17	Y14	Y line terminal	47	Y44	Y line terminal
18	Y15	Y line terminal	48	Y45	Y line terminal
19	Y16	Y line terminal	49	Y46	Y line terminal
20	Y17	Y line terminal	50	Y47	Y line terminal
21	Y18	Y line terminal	51	Y48	Y line terminal
22	Y19	Y line terminal	52	Y49	Y line terminal
23	Y20	Y line terminal	53	Y50	Y line terminal
24	Y21	Y line terminal	54	Y51	Y line terminal
25	Y22	Y line terminal	55	GND	Ground Note1
26	Y23	Y line terminal	56	GND	Ground Note1
27	Y24	Y line terminal	57	N. C.	(Keep this pin open)
28	Y25	Y line terminal	58	N. C.	(Keep this pin open)
29	Y26	Y line terminal	59	N. C.	(Keep this pin open)
30	Y27	Y line terminal	60	N. C.	(Keep this pin open)

Note1: All GND terminals should be used without any non-connected lines.

4.6.4 Positions of plug and socket

Rear side

Signal processing board

CN1

20   1

Insert direction

12

CN2
Insert direction

1

1   40   1   60

CN3   CN4

4.6.5 Connection between receiver and transmitter for LVDS
(1) Input LVDS map A (MSL: "High")

Host

LCD module (Product)

Note2

Note3		
R2	TA0	
R3	TA1	
R4	TA2	
R5	TA3	
R6	TA4	TA-
R7	TA5	TA+
G2	TA6	

CN1

1	VCC
2	VCC
3	GND
4	GND
5	D0-
6	D0+
7	GND
8	D1-
9	D1+
10	GND
11	D2-
12	D2+
13	GND
14	CLK-
15	CLK+
16	GND
17	D3-
18	D3+
19	DPS
20	MSL

GND

RA-
RA+

RB-
RB+

RC-
RC+

RCLK-
RCLK+

RD-
RD+

Signal processor

Receiver for LVDS

Equivalent of THC63LVDF84B

VCC

DPS   MSL

LCD controller

LCD panel signal processing board

G3   TB0
G4   TB1
G5   TB2   TC-
G6   TB3   TC+
G7   TB4
B2   TB5   TCLK-
B3   TB6   TCLK+

B4   TC0   TD-
B5   TC1   TD+
B6   TC2
B7   TC3
Note4   TC4
Note4   TC5
DE   TC6

R0   TD0
R1   TD1
G0   TD2
G1   TD3   GND
B0   TD4
B1   TD5
Note4   TD6
CLK   CLK IN

LVDS transmitter
Note1

VCC
GND
DPS
MSL (High)

Note1: Recommended transmitter: THC63LVDM83D (THine Electronics Inc.) or equivalent
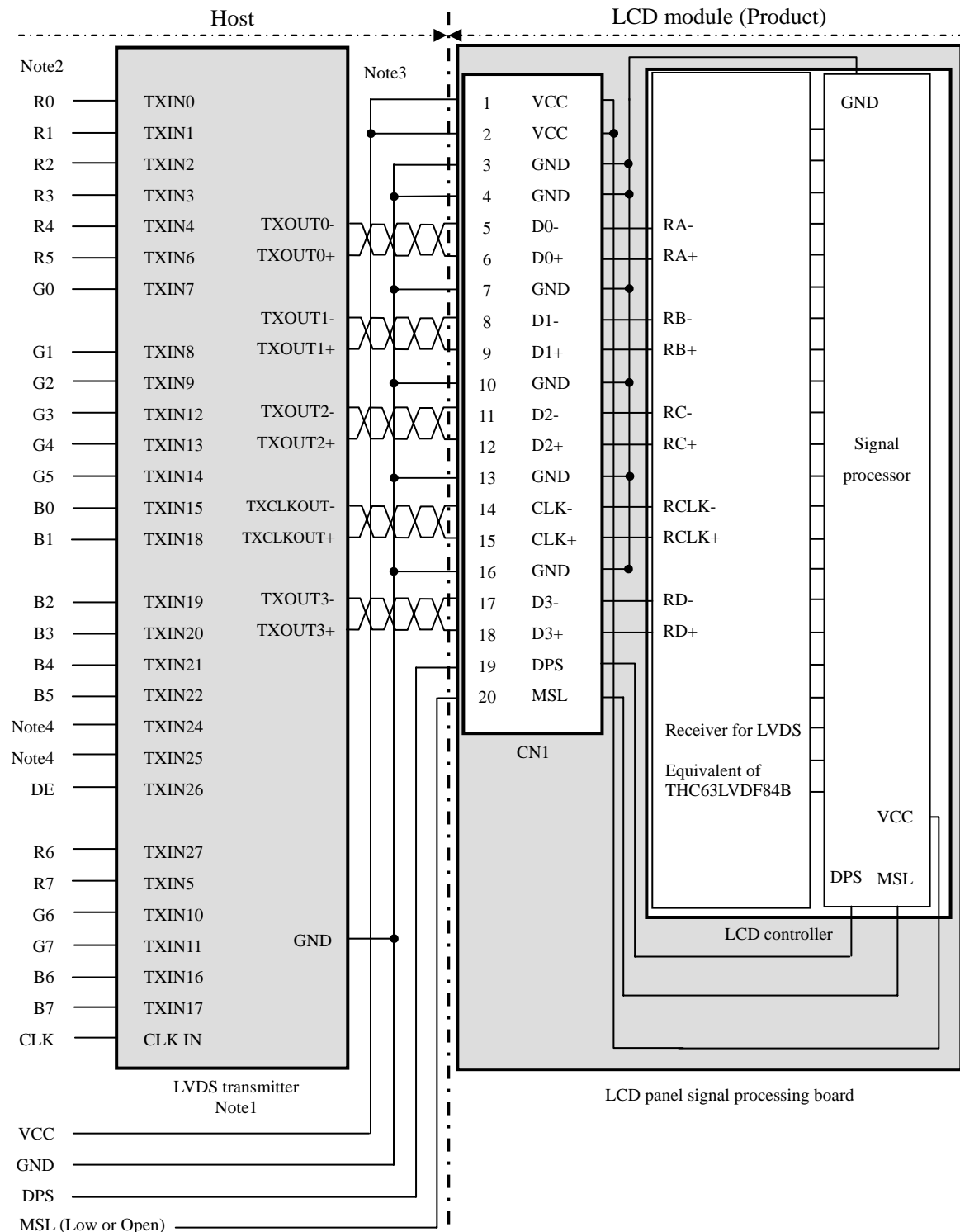Note2: LSB (Least Significant Bit) – R0, G0, B0   MSB (Most Significant Bit) – R7, G7, B7
Note3: Twist pair wires with 100Ω (Characteristic impedance) should be used between LCD panel signal processing board and LVDS transmitter.
Note4: Input signals to TC4, TC5 and TD6 are not used inside the product, but do not keep TC4, TC5 and TD6 open to avoid noise problem.

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

Note1: Recommended transmitter: DS90C383 (National Semiconductor) or equivalent

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

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

Note4: Input signals to TXIN24 and TXIN25 are not used inside the product, but do not keep TXIN24 and TXIN25 open to avoid noise problem.

4.7 DISPLAY COLORS AND INPUT DATA SIGNALS

This product can display 16,777,216 colors with 256 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)																							
		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

4.8 DISPLAY POSITIONS

The following table is the coordinates per pixel (See "**4.9 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)

4.9 SCANNING DIRECTIONS

The following figures are seen from a front view.

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

NLT

Note1

C (0, 767)   C (1023, 767)
D (0, 767)   D (1023, 767)   CN2

CN4   CN3
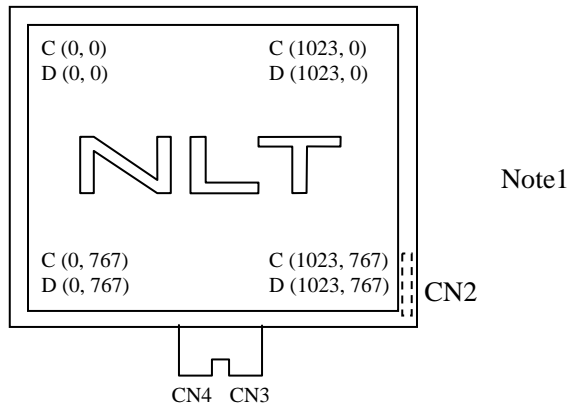
Figure1. Normal scan (DPS: Low or Open)

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

Note1

C (0, 767)   C (1023, 767)
D (1023, 0)   D (0, 0)   CN2

CN4   CN3
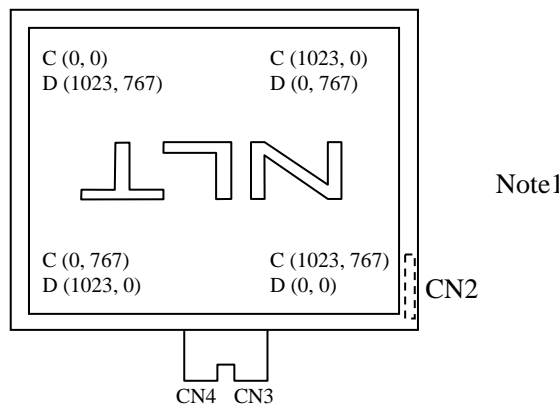
Figure2. Reverse scan (DPS: High)

Note1: Meaning of C (X, Y) and D (X, Y)
  C (X, Y): The coordinates of the display position (See "**4.8 DISPLAY POSITIONS**".)
  D (X, Y): The data number of input signal for LCD panel signal processing board

PRELIMINARY

4.10 INPUT SIGNAL TIMINGS

4.10.1 Outline of input signal timings

• Horizontal signal
  Note1

Horizontal display period (thd)

DE (Data enable)

Display period

• Vertical signal
  Note1

Vertical display period (tvd)

DE (Data enable)

1   2   3   4   768

Display period   Note2
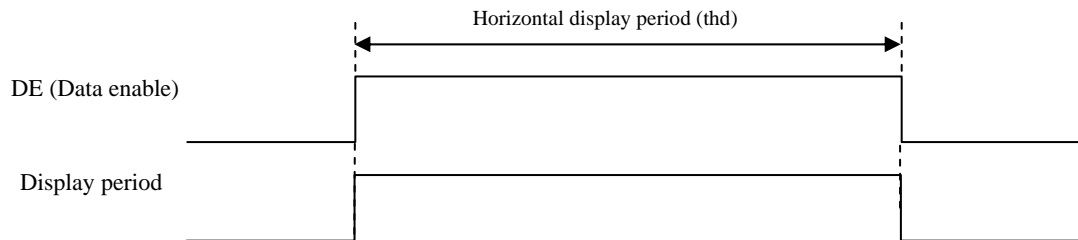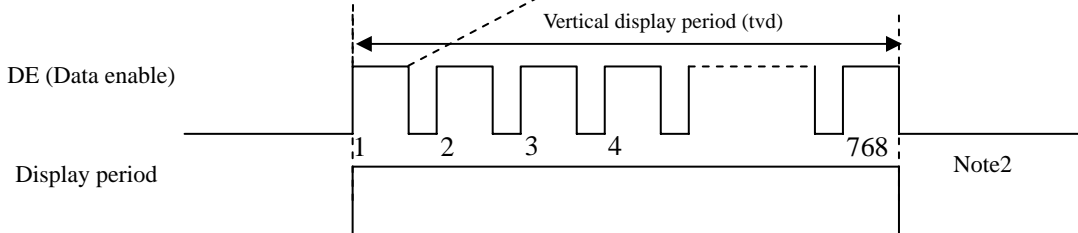
Note1: This diagram indicates virtual signal for set up to timing.
Note2: See "**4.10.3 Input signal timing chart**" for the pulse number.

4.10.2 Timing characteristics

(Note1, Note2, Note3)

Parameter			Symbol	min.	typ.	max.	Unit	Remarks
CLK	Frequency		1/tc	50.0	65.0	80.0	MHz	15.384 ns (typ.)
	Duty		-		-		-	-
	Rise time, Fall time		-				ns	
DATA	CLK-DATA	Setup time	-				ns	-
		Hold time	-		-		ns	
	Rise time, Fall time		-				ns	
DE	Horizontal	Cycle	th	15.0	20.676	-	μs	48.363 kHz (typ.)
				1,050	1,344	1,800	CLK	
		Display period	thd		1,024		CLK	-
	Vertical (One frame)	Cycle	tv	13.1	16.666	20.0	ms	60.0 Hz (typ.)
				770	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, Vf= 1/tv
Note2: See the data sheet of LVDS transmitter.
Note3: Vertical cycle (tv) should be specified in integral multiple of Horizontal cycle (th).

4.10.3 Input signal timing chart

Horizontal timing
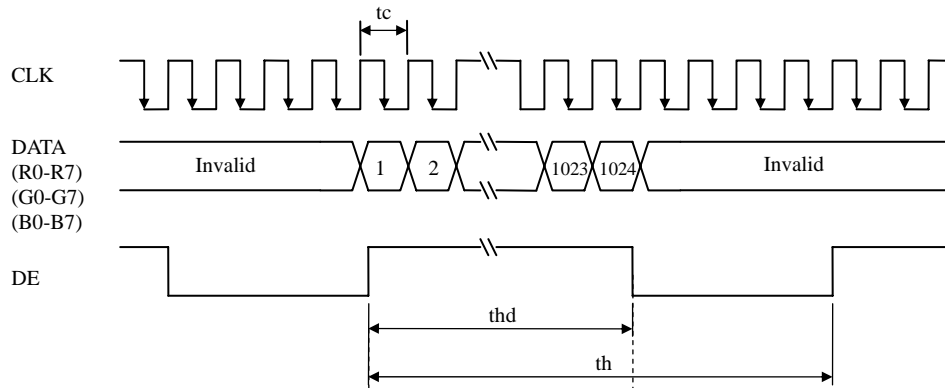
Vertical timing
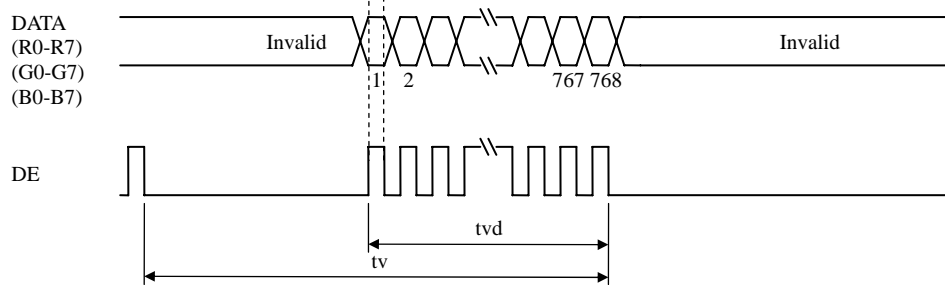
4.11 OPTICS

4.11.1 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	(350)	-	cd/m²	SR-3 or BM-5A	-
Contrast ratio		White/Black at center θR= 0°, θL= 0°, θU= 0°, θD= 0°	CR	TBD	TBD	-	-	SR-3 or BM-5A	Note3
Luminance uniformity		White θR= 0°, θL= 0°, θU= 0°, θD= 0°	LU	-	1.2	1.35	-	BM-5A	Note4
Chromaticity	White	x coordinate	Wx	(0.263)	(0.313)	(0.363)	-	SR-3	Note5
		y coordinate	Wy	(0.279)	(0.329)	(0.379)	-		
	Red	x coordinate	Rx	-	(0.599)	-	-		
		y coordinate	Ry	-	(0.354)	-	-		
	Green	x coordinate	Gx	-	(0.348)	-	-		
		y coordinate	Gy	-	(0.579)	-	-		
	Blue	x coordinate	Bx	-	(0.152)	-	-		
		y coordinate	By	-	(0.107)	-	-		
Color gamut		θR= 0°, θL= 0°, θU= 0°, θD= 0° at center, against NTSC color space	C	40	50	-	%		
Response time		White to Black	Ton	-	3	5	ms	BM-5A-10000	Note6 Note7
		Black to White	Toff	-	15	21	ms		
Viewing angle	Right	θU= 0°, θD= 0°, CR≥ 10	θR	(70)	(80)	-	°	EZ Contrast	Note8
	Left	θU= 0°, θD= 0°, CR≥ 10	θL	(70)	(80)	-	°		
	Up	θR= 0°, θL= 0°, CR≥ 10	θU	(70)	(80)	-	°		
	Down	θR= 0°, θL= 0°, CR≥ 10	θD	(70)	(80)	-	°		

Note1: These are initial characteristics.
Note2: Measurement conditions are as follows.
Ta= 25°C, VCC= 3.3V, IL= 50mA / 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 after 20minutes after the product works in the dark room. Also measurement methods are as follows.
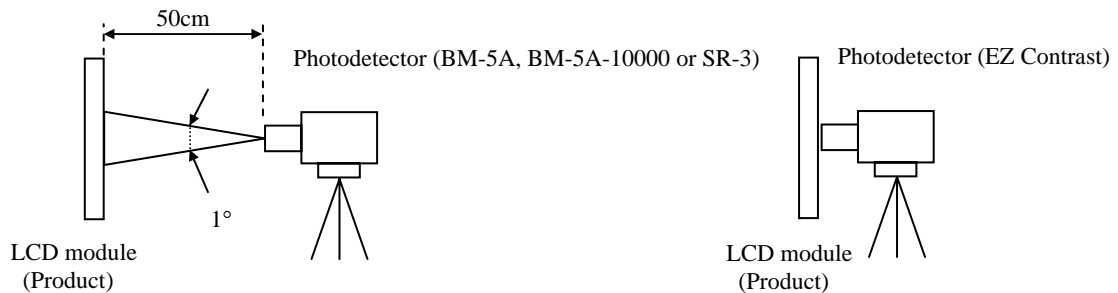
Note3: See "**4.11.2 Definition of contrast ratio**".
Note4: See "**4.11.3 Definition of luminance uniformity**".
Note5: These coordinates are found on CIE 1931 chromaticity diagram.
Note6: Product surface temperature: TopF= 32 °C
Note7: See "**4.11.4 Definition of response times**".
Note8: See "**4.11.5 Definition of viewing angles**".

4.11.2 Definition of contrast ratio

The contrast ratio is calculated by using the following formula.

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

4.11.3 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.
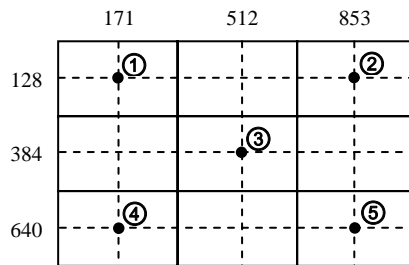
4.11.4 Definition of response times

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.).
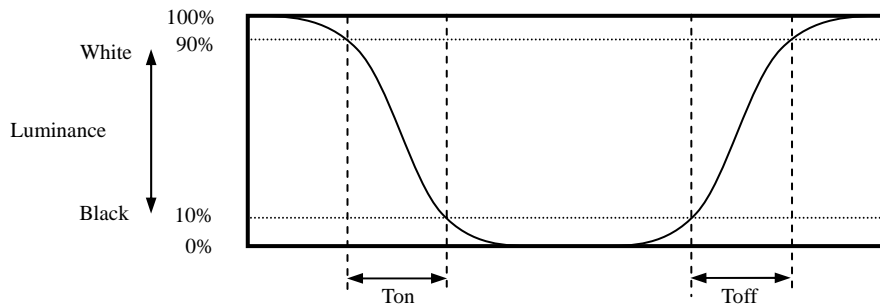
4.11.5 Definition of viewing angles
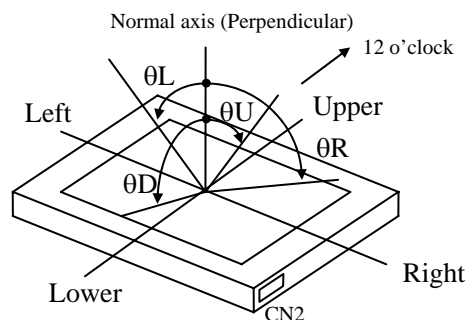
5. ESTIMATED LUMINANCE LIFETIME

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= 50mA/One circuit	70,000	h
	70°C (Surface temperature at screen center) Continuous operation, IL= 50mA/One circuit	60,000	h

Note1: Life time expectancy is mean time to half-luminance.
Note2: Estimated luminance lifetime is not the value for an 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 70 ± 3°C, 240hours ② Display data is black.	
Heat cycle (Operation)		① -20 ± 3°C…1hour 70 ± 3°C…1hour ② 50cycles, 4hours/cycle ③ Display data is black.	
Thermal shock (Non operation)		① -20 ± 3°C…30minutes 80 ± 3°C…30minutes ② 100cycles, 1hour/cycle ③ Temperature transition time is within 5 minutes.	
ESD (Operation)		① 150pF, 150Ω, ±10kV ② 9 places on a panel surface Note2 ③ 10 times each places at 1 sec interval	
Dust (Operation)		① Sample dust: No. 15 (by JIS-Z8901) ② 15 seconds stir ③ 8 times repeat at 1 hour interval	
Vibration (Non operation)		① 5 to 100Hz, 11.76m/s^2 ② 1 minute/cycle ③ X, Y, Z directions ④ 50 times each directions	No display malfunctions No physical damages
Mechanical shock (Non operation)		① 294m/s^2, 11ms ② ±X, ±Y, ±Z directions ③ 3 times each directions	
Low pressure	Operation	① 53.3kPa (Equivalent to altitude 5,100m) ② -20°C±3°C…24 hours ③ 70°C±3°C…24 hours	No display malfunctions
	Non-operation	① 15kPa (Equivalent to altitude 13,600m) ② -20°C±3°C…24 hours ③ 80°C±3°C…24 hours	

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.
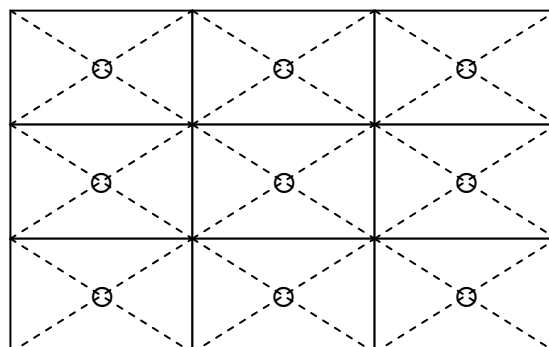
7. PRECAUTIONS

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

⚠

* **Be taken care when handling the touch panel. There is a danger of injury, because the touch panel has the glass edge and corner which are sharp.**
* **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 294m/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 Use gloves or fingerstalls and do not touch glass edge of touch panel when handling it, because it has sharp glass edge.

Touch panel
Product
Glass edge
Corner
Glass edge
Detail A
(4 points)
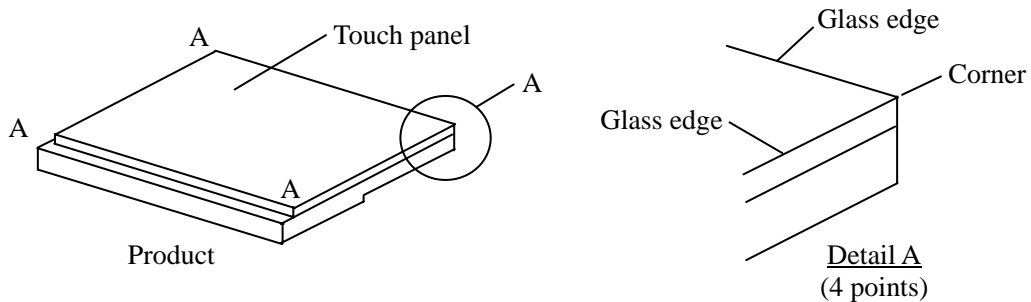
② Take hold of both ends without touching the circuit board when the product (LCD module) is picked up from inner packing box to avoid broken down or misadjustment, because of stress to mounting parts on the circuit board.
③ When the product is put on the table temporarily, display surface must be placed downward.
④ When handling the product, take the measures of electrostatic discharge with such as earth band, ionic shower and so on, because the product may be damaged by electrostatic.
⑤ The torque for product mounting screws must never exceed 0.343N·m. Higher torque might result in distortion of the bezel. And the length of product mounting screws must be ≤ 2.8mm.
⑥ The product must be installed using mounting holes without undue stress such as bends or twist (See outline drawings). And do not add undue stress to any portion (such as bezel flat area). Bends or twist described above and undue stress to any portion may cause display mura.
⑦ Do not hit or rub the surface of touch panel with hard materials, because it is easily scratched. (Touch panel pencil-hardness: (2H))

⑧　When cleaning the T/P surface, wipe it with a soft dry cloth.
⑨　Do not push or pull the interface connectors while the product is working.
⑩　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.
⑪　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.
⑫　If the product is subjected to direct sunlight for a long time, touch panel transmission may be degraded.

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 affected is changed 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 a 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　Touch panel film has polarizing characteristic. And the polarizer characteristics differ among products. Therefore, when seeing the displays through the other polarizing material (for example polarizing sunglasses), some displays can not be seen and some displays look different color darker because of polarizer characteristic mismatching between touch panel film and the other polarizing material.

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.

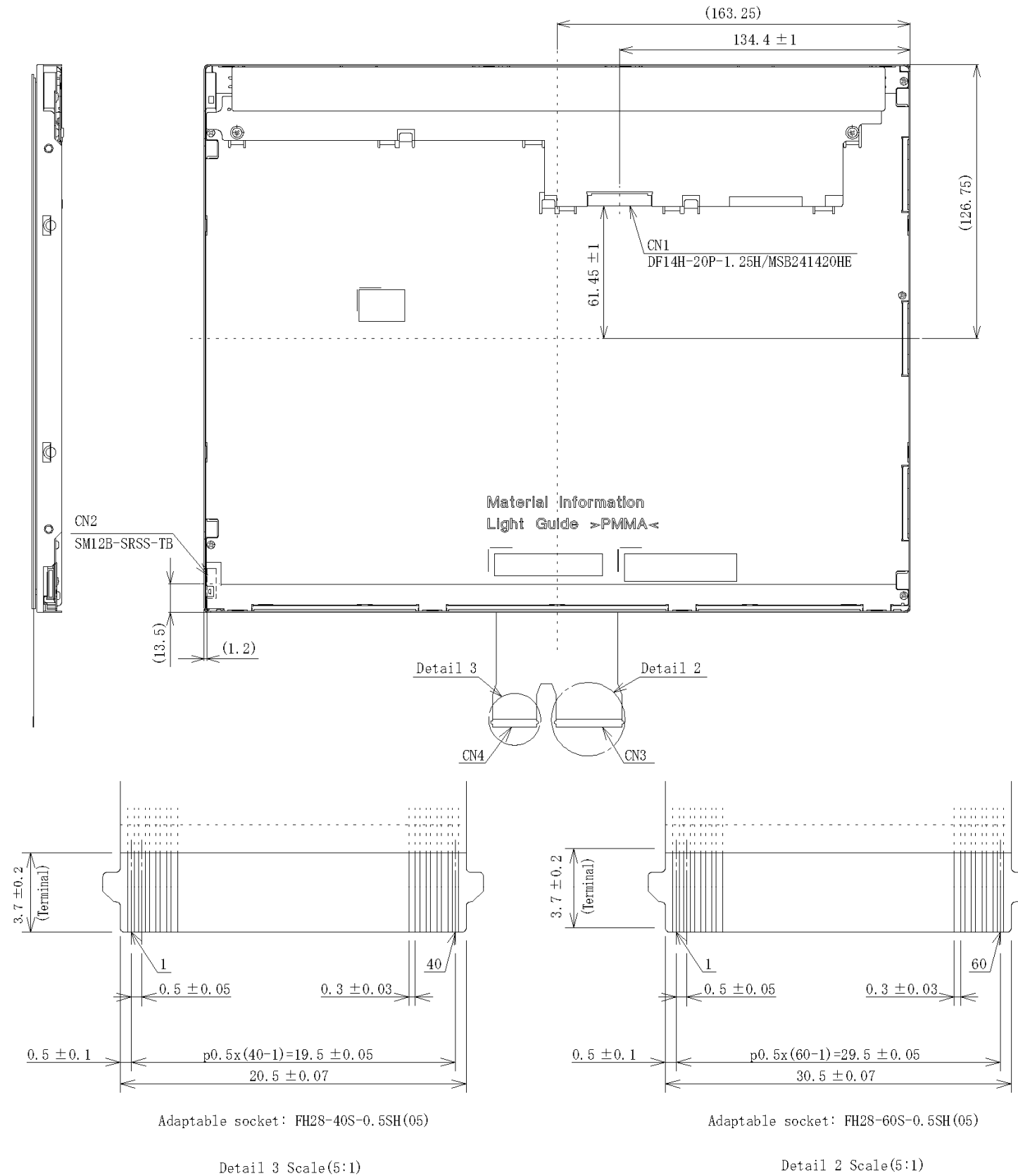PRELIMINARY

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 0.343N·m. And the length of product mounting screws must be ≤ 2.8mm.

Unit: mm

PRELIMINARY

8.2 REAR VIEW

(163.25)

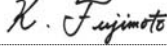134.4 ±1

(126.75)

61.45 ±1

CN1
DF14H-20P-1.25H/MSB241420HE

CN2
SM12B-SRSS-TB

Material Information
Light Guide >PMMA<

(13.5)

(1.2)

Detail 3

Detail 2

CN4

CN3

3.7 ±0.2 (Terminal)

1

40

0.5 ±0.05

0.3 ±0.03

0.5 ±0.1

p0.5x(40-1)=19.5 ±0.05

20.5 ±0.07

Adaptable socket: FH28-40S-0.5SH(05)

Detail 3 Scale(5:1)

3.7 ±0.2 (Terminal)

1

60

0.5 ±0.05

0.3 ±0.03

0.5 ±0.1

p0.5x(60-1)=29.5 ±0.05

30.5 ±0.07

Adaptable socket: FH28-60S-0.5SH(05)

Detail 2 Scale(5:1)

INSTALL GUIDANCE

1. Bezel mounting

   IF add front bezel on the touch panel, please take care following issue.
   - Use front bezel make from insulative material, like plastic, or resin. If not, touch panel sensitivity will be blocked or unstable by this bezel.
   - Settle the bezel out of touch panel active area. If not, touch panel sensitivity will be blocked or unstable by this bezel.
   - Keep the distance between front bezel to touch panel over 1mm.

Customer bezel opening

Customer front bezel

T/P active area

Spacer

T/P
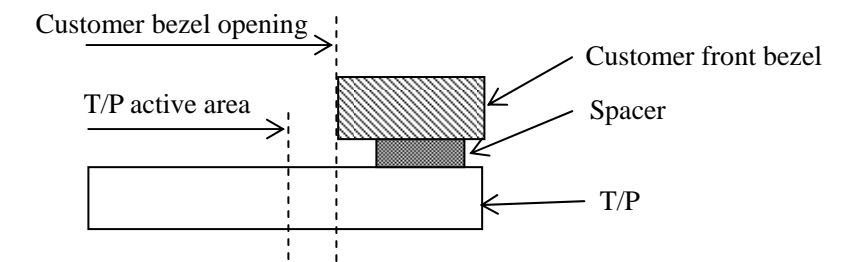
2. T/P FPC handles with care point

   When bend the fpc, don't stress to the root area of fpc, nor bending so tight.

T/P

T/P FPC

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

Unit: mm

REVISION HISTORY

The inside of latest specifications is revised to the clerical error and the major improvement of previous edition. Only a changed part such as functions, characteristic value and so on that may affect a design of customers, are described especially below.

Edition	Document number	Prepared date	Revision contents and signature
1st edition	DOD-PP-1566	Jan. 31, 2013	**Revision contents** New issue **Signature of writer** *Approved by* *Checked by* *Prepared by* K. FUJIMOTO A. KUMANO