PRELIMINARY

NEC NEC LCD Technologies, Ltd.

TFT COLOR LCD MODULE

NL12876BC15-01

22.6cm (8.9 Type)
WXGA
LVDS interface (1port)

PRELIMINARY DATA SHEET

DOD-PP-0414 (1st edition)

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Compliant
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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

1. OUTLINE

1.1 STRUCTURE AND PRINCIPLE

Color LCD module NL12876BC15-01 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 Notebook PC

1.3 FEATURES

- LVDS interface
- LED backlight type
- Touch Panel (T/P) attached

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2. GENERAL SPECIFICATIONS

Display area	193.92 (H) × 116.35 (V)mm
Diagonal size of display	22.6cm (8.9 inches)
Drive system	a-Si TFT active matrix
Display color	262,144 colors
Pixel	1,280(H) × 768 (V) pixels
Pixel arrangement	RGB (Red dot, Green dot, Blue dot) vertical stripe
Dot pitch	0.0505 (H) × 0.1515 (V) mm
Pixel pitch	0.1515(H) × 0.1515 (V) mm
Module size	209.2 mm (W) (typ.) × 130.3 mm (H) (typ.) × 7.2 (D) mm (typ.)
Weight	(265) g (typ.)
Contrast ratio	500:1 (typ.)
Viewing angle	*At the contrast ratio ≥10:1* • Horizontal: Right side 45° (typ.), Left side 45° (typ.) • Vertical: Up side 20° (typ.), Down side 40° (typ.)
Designed viewing direction	• Viewing angle without image reversal: Up side (12 o'clock) • Viewing angle with contrast peak: Down side (6 o'clock) • Viewing angle with optimum grayscale (γ=2.2): normal axis (perpendicular)
Touch Panel surface	Clear
Touch panel pencil-hardness	3H (min.) [by JIS K5400]
Color gamut	*At LCD panel center* 50% (typ.) [against NTSC color space]
Response time	*Ton+Toff (10%←→90%)* 8ms (typ.)
Luminance	*At IL=20 mArms* 280cd/m^2 (typ.)
Signal system	LVDS 1port (Receiver: THC63LVDF64B, THine Electronics Inc. or equivalent) [6bit digital signals for data of RGB colors, Dot clock (CLK), Data enable (DE), Selection of LVDS input map (MSL)]
Power supply voltage	LCD panel signal processing board: 3.3V
Backlight	LED backlight type
Power consumption	*At IL=20mA, Checkered flag pattern* (3.8) W (typ.)

3. BLOCK DIAGRAM
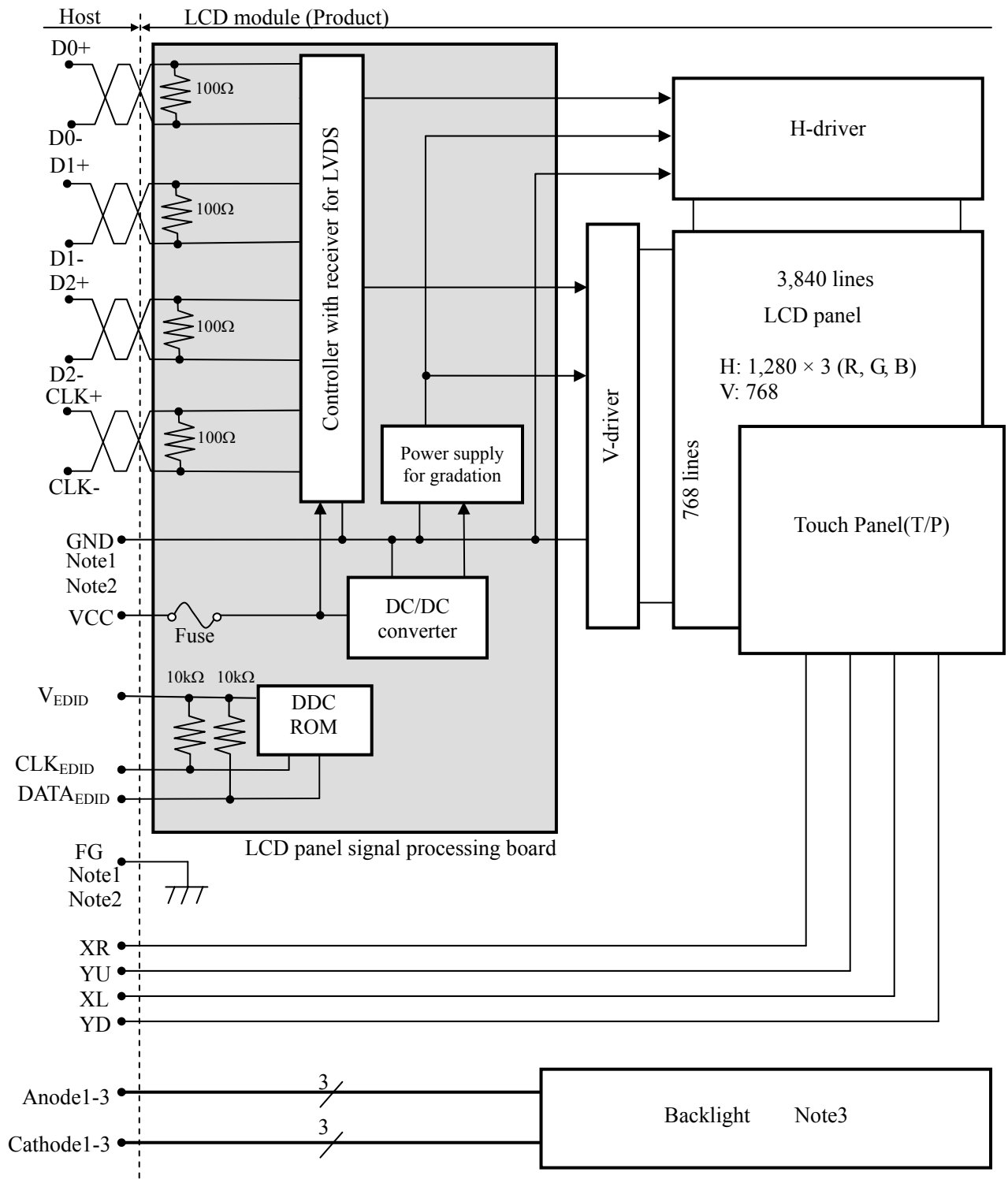
Note1: Relations between GND (Signal ground), FG (Frame ground) and VBLC (Lamp low voltage terminal) in the LCD module are as follows.

GND - FG	Not connected

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.

Note3: Backlight in detail

Backlight

Anode 1

Cathode 1

Anode 2

Cathode 2

Anode 3

Cathode 3
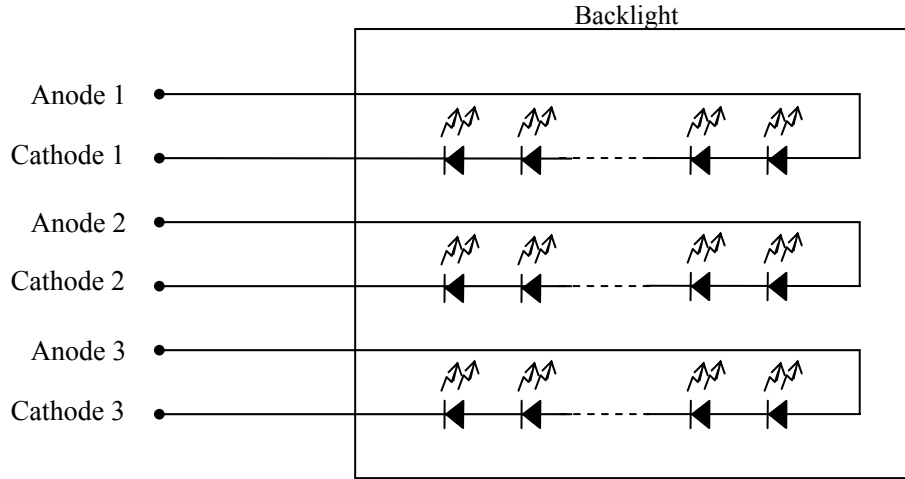
※ Number of LED : 33 pcs (11 pcs × 3 in parallel)

4. DETAILED SPECIFICATIONS

4.1 MECHANICAL SPECIFICATIONS

Parameter	Specification		Unit
Module size	209.2 ± 0.3 (W) × 130.3 ± 0.3 (H) × 7.2±0.5 (D)	Note1	mm
Display area	193.92 (H) × 116.35 (V)	Note1	mm
Weight	(265) (typ.), TBD (max.)		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	-
	DDC(EDID) ROM	V_{EDID}	-0.3 to +4.0	V	
Input voltage for signals	Display signals Note1	VD	-0.3 to +3.6 and < VCC+0.3	V	
	Function signal Note2	VF	-0.3 to +3.6 and < V_{EDID}+0.3	V	-
Input voltage for Backlight	Power dissipation	PD	1.358	W	per one circuit
	Forward current	IL	Note3	mA	
Touch Panel input voltage		Vtp	7	V	-
Storage temperature		Tst	(-30 to +70)	°C	-
Operating temperature	Front surface	TopF	(-20 to +60)	°C	Note4
	Rear surface	TopR	(-20 to +60)	°C	Note5
Relative humidity Note6		RH	≤ 95	%	Ta ≤ 40°C
			≤ 85	%	40 < Ta ≤ 50°C
			≤ 55	%	50°C < Ta ≤ 60°C
Absolute humidity Note6		AH	≤ 72 Note7	g/m³	Ta > 60°C

Note1: Display signals are D0+/-, D1+/-, D2+/- and CLK+/-.
Note2: Function signals are CLK_{EDID} and $DATA_{EDID}$,

Note3: Forward current
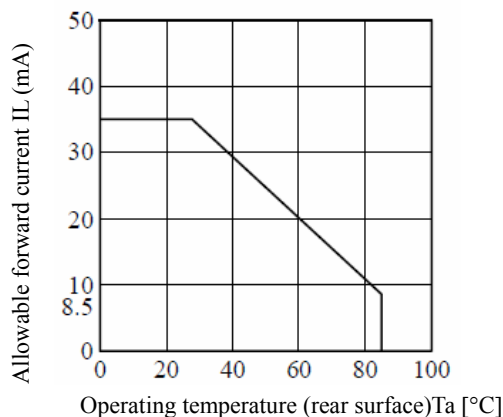
Note4: Measured at center of LCD panel surface (including self-heat)
Note5: Measured at center of LCD module's rear shield surface (including self-heat)
Note6: No condensation
Note7: Water amount at Ta = 60°C and RH = 55%

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	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	-
Power supply voltage for DDC		V_{EDID}	3.0	-	3.6	V	-
Input voltage for DDC signal	High	VFIL	0.7VCC	-	-	V	-
	Low	VFIL	-	-	0.3VCC	V	

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

4.3.2 Backlight

Parameter	Symbol	min.	typ.	max.	Unit	Remarks
Forward current	IL	-	20	22	mArms	note3
Forward voltage	VL	-	35.2	38.5	Vrms	at IL=20mArms

Note1: Please drive with constant current .
Note2: The Luminance uniformity may be changed depending on the current variation between 3 circuits.
It is recommended that the current value difference between each circuit is less than 5%.

4.3.3 Touch panel

(Ta= 25°C)

Parameter	Symbol	min.	typ.	max.	Unit	Remarks
Touch panel input voltage	Vtp	-	-	5.5	V	-
Resistor between pins(XR-XL)	Rx	300	-	1,300	Ω	-
Resistor between pins(YU-YD)	Ry	100	-	500	Ω	-
Line linearity (X direction)	Xlin	-	-	1.5	%	Note1
Line linearity (Y direction)	Ylin	-	-	1.5	%	Note1
Insulation resistance	Rins	20	-	-	MΩ	at DC 25V
Static capacitance	Ctp	-	-	100	nF	-
Chattering	Chat	-	-	10	ms	Note1
Operation starting force	Ost	-	-	0.784	N	Note1, Note2
				80	gf	
Surface hardness	Hs	3	-	-	H	Pencil hardness
Line writing life	Lwl	50,000	-	-	times	Polyacetal stylus pen: R0.8mm Load: 2.45N(250gf), 35mm
Point hitting life	Lhp	1,000,000	-	-	times	Polyacetal stylus pen: R0.8mm Load: 2.45N(250gf)
	Lhr	1,000,000	-	-	times	Silicon rubber: R8mm, Hardness 60° Load: 2.94N(300gf)

Note1: Input method are a Finger or R0.8mm Polyacetal Stylus Pen
Note2: Test condition
　　　Resistance between X and Y axis must be 2kΩ or less, and the test voltage is 5V DC.

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

Note1: The permissible ripple voltage includes spike noise.

4.3.5 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 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
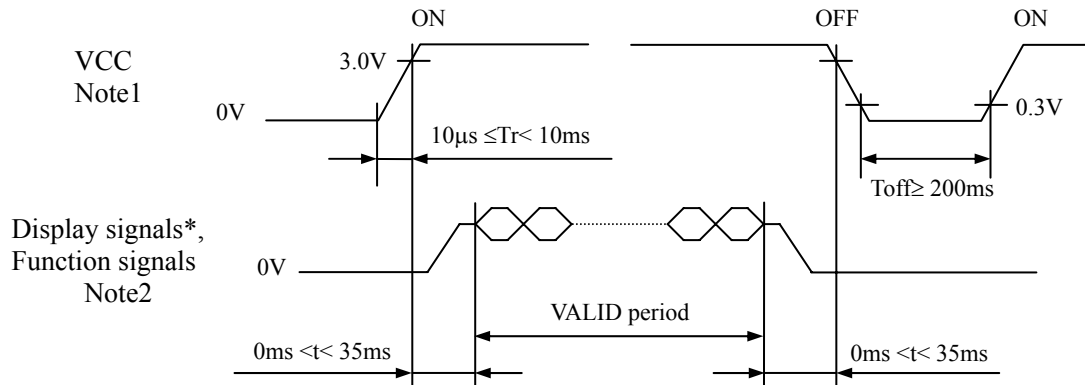
* These signals should be measured at the terminal of 100Ω resistance.

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+/- and CLK+/-) must be Low or High-impedance, exclude the VALID period (See above sequence diagram), in order to avoid that internal circuits is damaged.
If some of display and function signals of this product are cut while this product is working, even if the signal input to it once again, it might not work normally. VCC should be cut when the display and function signals are stopped.

4.4.2 LED lighting circuit
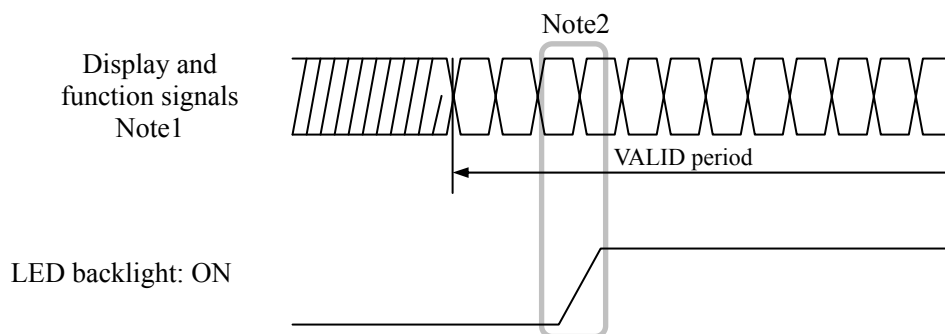
Note1: These are the display and function signals for LCD panel signal processing board.

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): DF19L-30P-1H (Hirose Electric Co., Ltd. (HRS))
Adaptable plug: DF19G-30S-1C, DF19G-30S-1F (Hirose Electric Co., Ltd. (HRS))

Pin No.	Symbol	Signal	Remarks
1	YU	Vertical terminal (Up side)	Note6
2	XL	Horizontal terminal (Left side)	
3	YD	Vertical terminal (Down side)	
4	XR	Horizontal terminal (Right side)	
5	GND	Ground	Note1
6	A1	Anode1	-
7	K1	Cathode1	-
8	A2	Anode2	-
9	K2	Cathode2	-
10	A3	Anode3	-
11	K3	Cathode3	-
12	GND	Ground	Note1
13	VCC	Power supply	Note1
14	VCC		
15	V EDID	DDC 3.3V	-
16	CLK EDID	DDC CLK	-
17	DATA EDID	DDC Data	-
18	GND	Ground	Note1
19	D0-	Pixel data (R0-R5,G0)	Note2
20	D0+		
21	GND	Ground	Note1
22	D1-	Pixel data (G1-G5,B0-B1)	Note2
23	D1+		
24	GND	Ground	Note1
25	D2-	Pixel data (B2-B5,DE)	Note2
26	D2+		
27	GND	Ground	Note1
28	CLK-	Pixel clock	Note2
29	CLK+		
30	GND	Ground	Note1

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 "**4.6 DISPLAY COLORS AND INPUT DATA SIGNALS**".
Note4: See "**4.8 SCANNING DIRECTIONS**".
Note5: See "**4.5.4 Connection between receiver and transmitter for LVDS**".

Note6: Connection description of Touch Panel

4.5.2 Positions of plug and socket

Rear side

PRELIMINARY
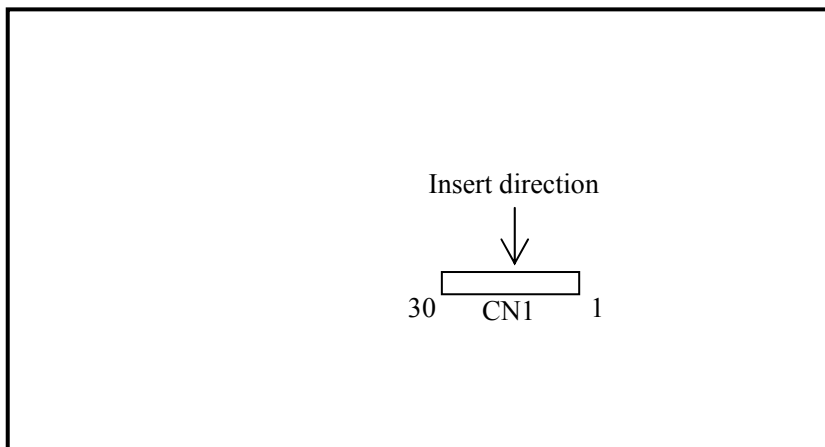
4.5.3 Connection between receiver and transmitter for LVDS
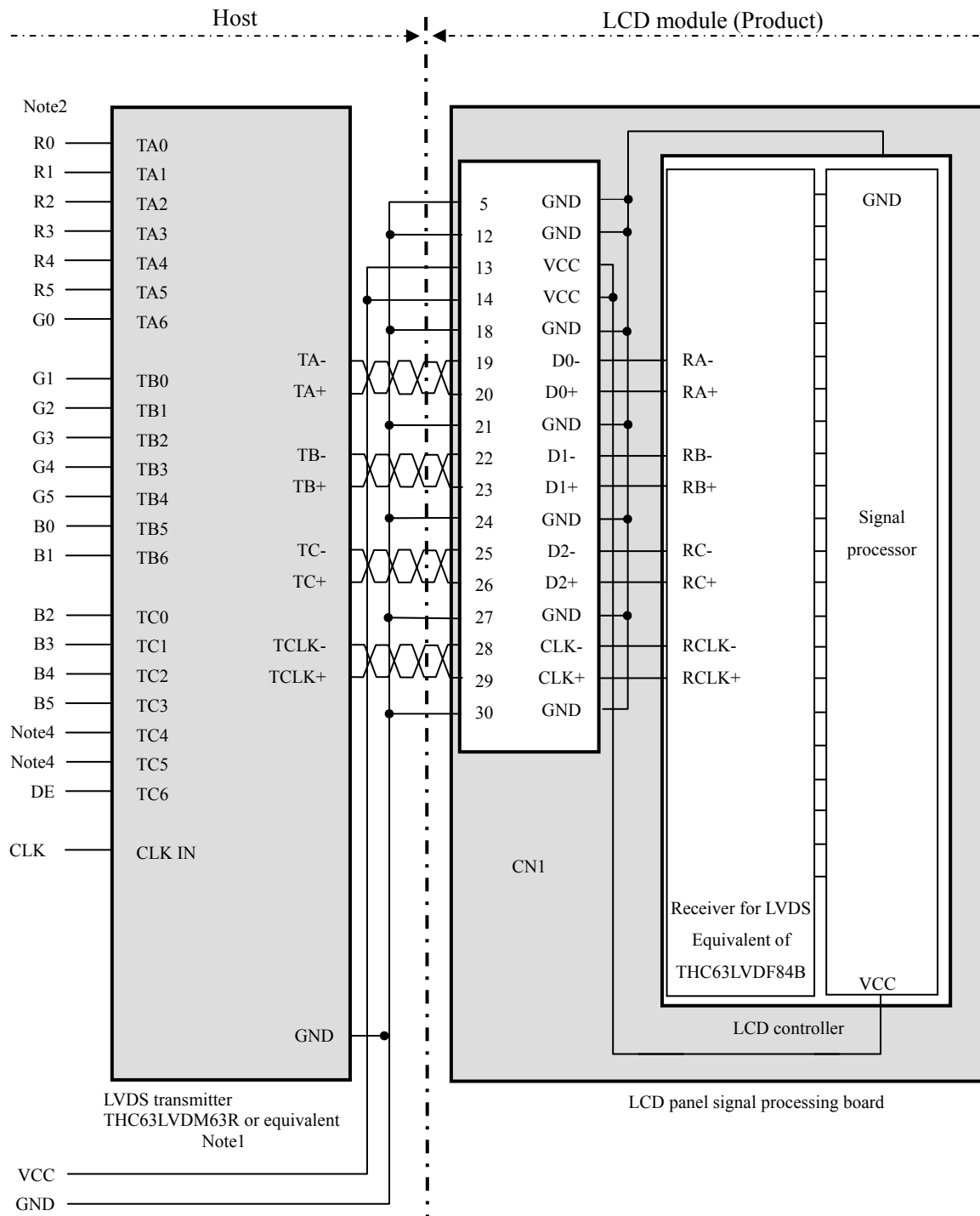
Note1: Recommended transmitter THC63LVDM63R (THine Electronics Inc.) or equivalent
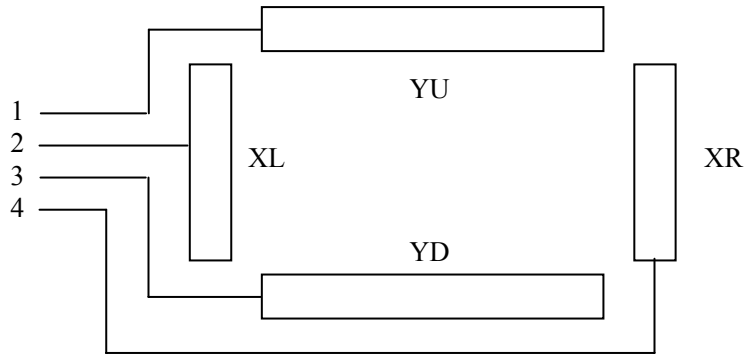Note2: LSB (Least Significant Bit) – R0, G0, B0   MSB (Most Significant Bit) – R5, G5, B5
Note3: Twist pair wires with 100Ω (Characteristic impedance) should be used between LCD panel signal processing board and LVDS transmitter.
Note4: Input signals to TC4 and TC5 are not used inside the product, but do not keep TC4 and TC5 open to avoid noise problem.

4.5.4 Input data mapping

CLK+/-		tc		

(timing diagram)

CLK+/-

1CLK

D0+/-	G0	R5	R4	R3	R2	R1	R0
D1+/-	B1	B0	G5	G4	G3	G2	G1
D2+/-	DE	-	-	B5	B4	B3	B2
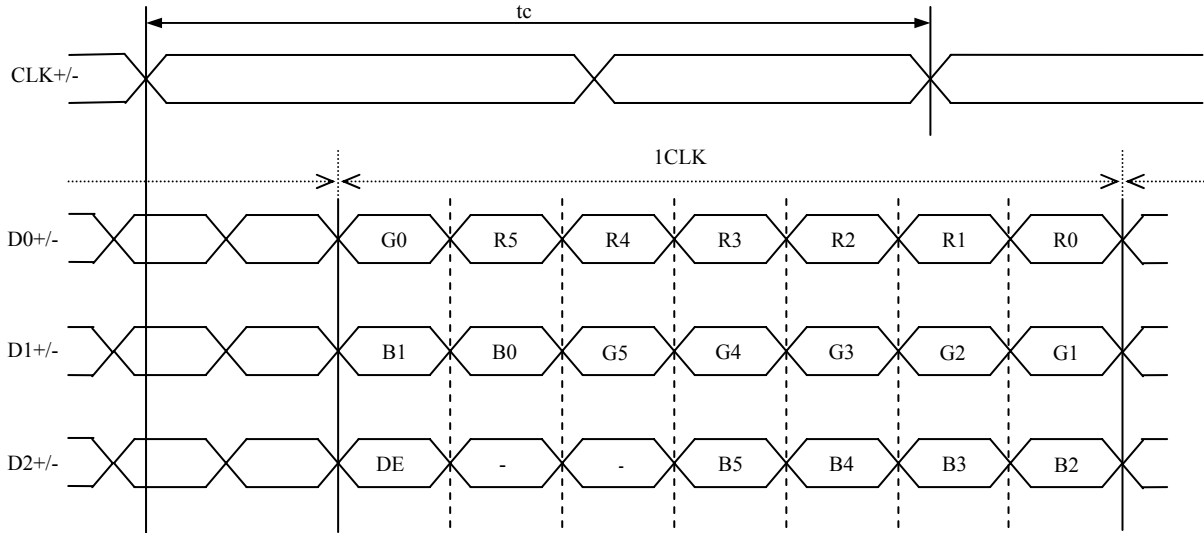
4.6 DISPLAY COLORS AND INPUT DATA SIGNALS

This product can display equivalent of 262,144 colors in 64 gray scales by combination.
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
		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**".).
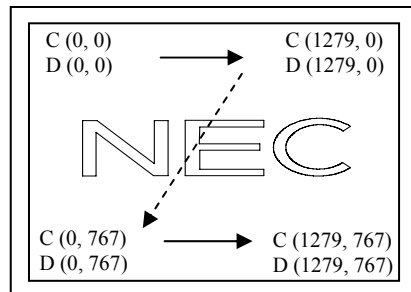
C (0, 0)

R	G	B

C(0, 0)	C(1, 0)	• • •	C(X, 0)	• • •	C(1278, 0)	C((1279, 0)
C(0, 1)	C(1, 1)	• • •	C(X, 1)	• • •	C((1278, 1)	C((1279, 1)
•	•	•	•	•	•	•
•	•	• • •	•	• • •	•	• • •
•	•	•	•	•	•	•
C(0, Y)	C(1, Y)	• • •	C(X, Y)	• • •	C((1278, Y)	C((1279, Y)
•	•	•	•	•	•	•
•	•	• • •	•	• • •	•	•
•	•	•	•	•	•	•
C(0, 766)	C(1, 766)	• • •	C(X, 766)	• • •	C((1278, 766)	C((1279, 766)
C(0, 767)	C(1, 767)	• • •	C(X, 767)	• • •	C((1278, 767)	C((1279, 767)

4.8 SCANNING DIRECTIONS

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

Note1

Figure1. Scanning direction

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 DDC FUNCTION

This product has equivalent of BR24L02-W (ROHM CO., LED..) or Compatible as a memory to write the EDID for the DDC.
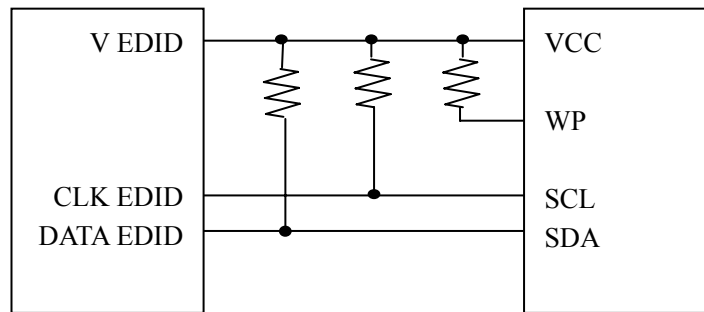The internal equivalent circuit is following figure.
Control method and usage are according to SPWG (corresponding to Version 3.5) and IC specifications.
See "**NL12876BC15-01 EDID Table**" of the following page for detail.

DDC: Display Data Channel
EDID: Extended Display Identification Data
SPWG: STANDARD PANELS WORKING GROUP

<Internal equivalent circuit>

CN1

Equivalent of
BR24L02-W (ROHM CO., LTD.) or Compatible

<NL12876BC15-01 EDID Table (1/3)>

Address (DEC)	Address (HEX)	Field Name & Comments	Value (HEX)	BIN	DEC
0	00	Header	00	00000000	0
1	01	Header	FF	11111111	255
2	02	Header	FF	11111111	255
3	03	Header	FF	11111111	255
4	04	Header	FF	11111111	255
5	05	Header	FF	11111111	255
6	06	Header	FF	11111111	255
7	07	Header	00	00000000	0
8	08	EISA manufacture code = " "	FF	11111111	255
9	09	EISA manufacture code (Compressed ASCII)	FF	11111111	255
10	0A	Panel Supplier Reserved – Product Code	00	00000000	0
11	0B	Panel Supplier Reserved – Product Code	00	00000000	0
12	0C	LCD module Serial No	00	00000000	0
13	0D	LCD module Serial No	00	00000000	0
14	0E	LCD module Serial No	00	00000000	0
15	0F	LCD module Serial No	00	00000000	0
16	10	Week of manufacture	00	00000000	0
17	11	Year of manufacture	11	00010001	17
18	12	EDID structure version # = 1	01	00000001	1
19	13	EDID revision # = 3	03	00000011	3
20	14	Video I/P definition	80	10000000	128
21	15	Max H image size = 19.4cm	13	00010011	19
22	16	Max V image size = 11.6cm	0C	00001100	12
23	17	Display gamma = 2.2	78	01111000	120
24	18	Feature support (no DPMS, Active off, RGB, timing BLK 1)	0A	00001010	10
25	19	Red/Green Low bit (RxRy/GxGy)	00	00000000	0
26	1A	Blue/White Low bit (BxBy/WxWy)	00	00000000	0
27	1B	Red X Rx = 0.xxx	00	00000000	0
28	1C	Red Y Ry = 0.xxx	00	00000000	0
29	1D	Green X Gx = 0.xxx	00	00000000	0
30	1E	Green Y Gy = 0.xxx	00	00000000	0
31	1F	Blue X Bx = 0.xxx	00	00000000	0
32	20	Blue Y By = 0.xxx	00	00000000	0
33	21	White X Wx = 0.xxx	00	00000000	0
34	22	White Y Wy = 0.xxx	00	00000000	0
35	23	Established timings 1	00	00000000	0
36	24	Established timings 2	00	00000000	0
37	25	Manufacturer's timings	00	00000000	0
38	26	Standard timing ID1	01	00000001	1
39	27	Standard timing ID1	01	00000001	1
40	28	Standard timing ID2	01	00000001	1
41	29	Standard timing ID2	01	00000001	1
42	2A	Standard timing ID3	01	00000001	1
43	2B	Standard timing ID3	01	00000001	1
44	2C	Standard timing ID4	01	00000001	1
45	2D	Standard timing ID4	01	00000001	1

<NL12876BC15-01 EDID Table (2/3)>

Address (DEC)	Address (HEX)	Field Name & Comments	Value (HEX)	BIN	DEC
46	2E	Standard timing ID5	01	00000001	1
47	2F	Standard timing ID5	01	00000001	1
48	30	Standard timing ID6	01	00000001	1
49	31	Standard timing ID6	01	00000001	1
50	32	Standard timing ID7	01	00000001	1
51	33	Standard timing ID7	01	00000001	1
52	34	Standard timing ID8	01	00000001	1
53	35	Standard timing ID8	01	00000001	1
54	36	**Timing Descriptor** #1: Pixel Clock/10000 (LSB)	A9	10101001	169
55	37	Pixel Clock/10000 (MSB)	1A	00011010	26
56	38	Horizontal Active = 1280 pixels (lower 8 bits)	00	00000000	0
57	39	Horizontal Blanking (Thbp) = 80 pixels (lower 8 bits)	50	01010000	80
58	3A	Horizontal Active/Horizontal Blanking (upper4: 4bits)	50	01010000	80
59	3B	Vertical Active = 768 lines	00	00000000	0
60	3C	DE Blanking = 22 lines	16	00010110	22
61	3D	Vertical Active: DE Blanking (upper4: 4bits)	30	00110000	48
62	3E	Horizontal Sync, Offset(Thfp) = 48 pixels	30	00110000	48
63	3F	Horizontal Sync, Pulse Width = 32 pixels	20	00100000	32
64	40	Vertical Sync, Offset (Tvfp) = 3 lines Sync Width = 7 lines	37	00110111	55
65	41	Horizontal Vertical Sync Offset/Width upper 2 bits	00	00000000	0
66	42	Horizontal image Size = 194mm	C2	11000010	194
67	43	Vertical image Size = 116mm	74	01110100	116
68	44	Horizontal image Size / Vertical image Size	00	00000000	0
69	45	Horizontal Border = 0	00	00000000	0
70	46	Vertical Border = 0	00	00000000	0
71	47	Non-interlaced, Normal, no stereo, Separate sync, H/V pol Negatives, DE only note: LSB is set to "1" if panel is DE-timing only. H/V can be ignored.	19	00011001	25
72	48	**Timing Descriptor#2:** -	00	00000000	0
73	49	-	00	00000000	0
74	4A	-	00	00000000	0
75	4B	-	00	00000000	0
76	4C	-	00	00000000	0
77	4D	-	00	00000000	0
78	4E	-	00	00000000	0
79	4F	-	00	00000000	0
80	50	-	00	00000000	0
81	51	-	00	00000000	0
82	52	-	00	00000000	0
83	53	-	00	00000000	0
84	54	-	00	00000000	0
85	55	-	00	00000000	0

<NL12876BC15-01 EDID Table (3/3)>

Address (DEC)	Address (HEX)	Field Name & Comments	Value (HEX)	BIN	DEC
86	56	-	00	00000000	0
87	57	Horizontal Border = 0	00	00000000	0
88	58	Vertical Border = 0	00	00000000	0
89	59	-	00	00000000	0
90	5A	Flag	00	00000000	0
91	5B	Flag	00	00000000	0
92	5C	Flag	00	00000000	0
93	5D	Dummy Descriptor	FE	11111110	254
94	5E	Flag	00	00000000	0
95	5F	PC Maker P/N 1st Character	00	00000000	0
96	60	PC Maker P/N 2nd Character	00	00000000	0
97	61	PC Maker P/N 3rd Character	00	00000000	0
98	62	PC Maker P/N 4th Character	00	00000000	0
99	63	PC Maker P/N 5th Character	00	00000000	0
100	64	LCD Supplier EDID Revision #	00	00000000	0
101	65	Manufacturer P/N	00	00000000	0
102	66	Manufacturer P/N	00	00000000	0
103	67	Manufacturer P/N	00	00000000	0
104	68	Manufacturer P/N	00	00000000	0
105	69	Manufacturer P/N	00	00000000	0
106	6A	Manufacturer P/N	00	00000000	0
107	6B	Manufacturer P/N (if <13 char, terminate with ASCII code 0Ah, set remaining char = 20h)	0A	00001010	10
108	6C	Flag	00	00000000	0
109	6D	Flag	00	00000000	0
110	6E	Flag	00	00000000	0
111	6F	Data Type Tag:	FE	11111110	254
112	70	Flag	00	00000000	0
113	71	SMBUS Value = XX nits	00	00000000	0
114	72	SMBUS Value = XX nits	00	00000000	0
115	73	SMBUS Value = XX nits	00	00000000	0
116	74	SMBUS Value = XX nits	00	00000000	0
117	75	SMBUS Value = XX nits	00	00000000	0
118	76	SMBUS Value = XX nits	00	00000000	0
119	77	SMBUS Value = XX nits	00	00000000	0
120	78	SMBUS Value = max nits (Typically = 00h, XXXnits)	00	00000000	0
121	79	Number of LVDS channels = 1 or 2	01	00000001	1
122	7A	Panel Self Test(00-Not Present, 01-Present)	00	00000000	0
123	7B	(If < 13 char, then terminate with ASCII code 0Ah, set remaining char = 20h)	0A	00001010	10
124	7C		20	00100000	32
125	7D		20	00100000	32
126	7E	Extension Flag	00	00000000	0
127	7F	Checksum	F2	11110010	242

4.10 INPUT SIGNAL TIMINGS

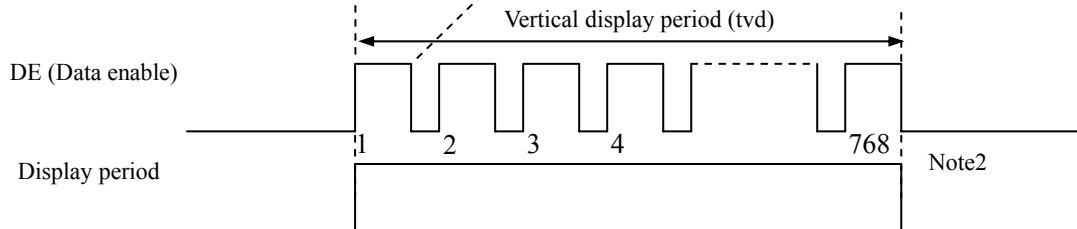4.10.1 Outline of input signal timings

- Horizontal signal

    Note1
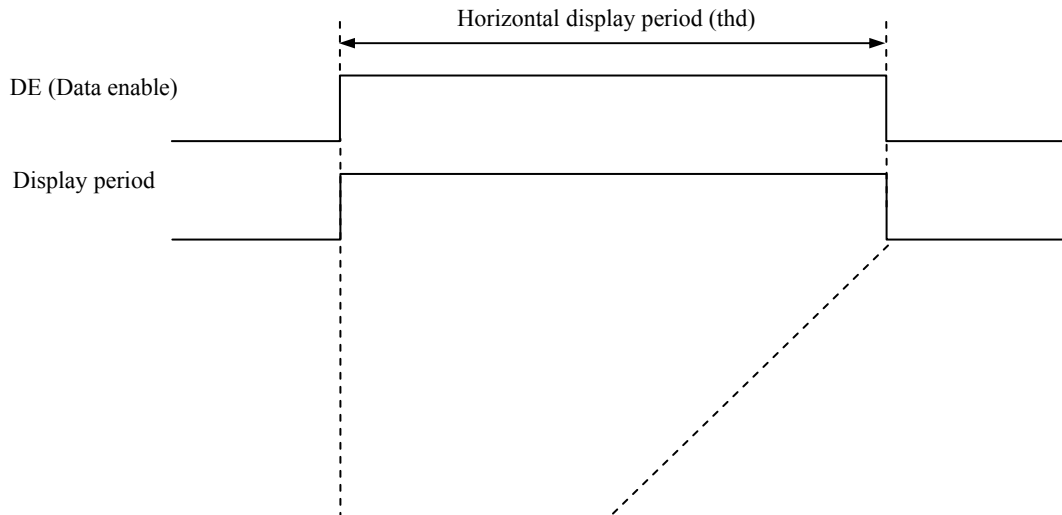
- Vertical signal

    Note1

Note1: This diagram indicates virtual signal for set up to timing.
Note2: See "**4.10.3 Input signal timing chart**" for numeration of pulse.

4.10.2 Timing characteristics

(Note1, Note2, Note3)

Parameter			Symbol	min.	typ.	max.	Unit	Remarks
CLK	Frequency		1/tc	TBD	68.25	TBD	MHz	14.652ns
	Duty		-		-		-	-
	Rise time, Fall time		-				ns	
DATA	CLK-DATA	Setup time	-				ns	
		Hold time	-		-		ns	-
	Rise time, Fall time		-				ns	
DE	Horizontal	Cycle	th	TBD	21.099	TBD	μs	47.396kHz (typ.
				-	1440	-	CLK	
		Display period	thd		1,280		CLK	-
	Vertical (One frame)	Cycle	tv	TBD	16.668	TBD	ms	59.995Hz (typ.)
				-	790	-	H	
		Display period	tvd		768		H	
	CLK-DE	Setup time	-				ns	
		Hold time	-		-		ns	-
	Rise time, Fall time		-				ns	

Note1: Definition of parameters is as follows.
       tc = 1CLK, th = 1H
Note2: See the data sheet of LVDS transmitter.
Note3: Vertical cycle (tv) should be specified in integral multiple of Horizontal cycle (th).

4.10.3 Input signal timing chart

Horizontal timing
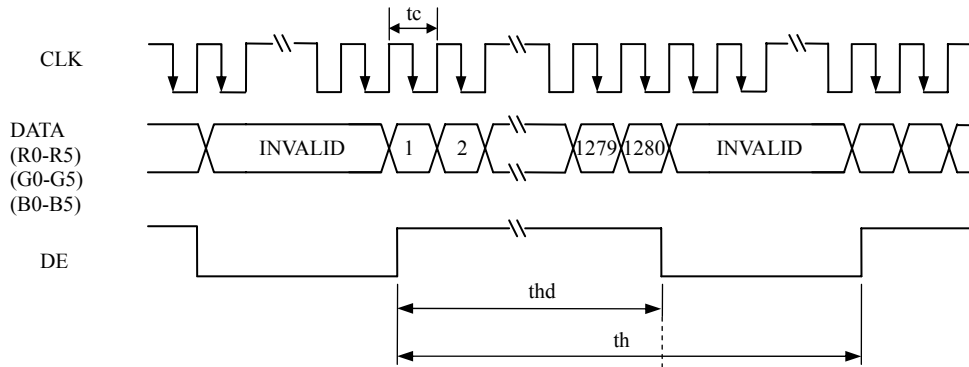
Vertical timing
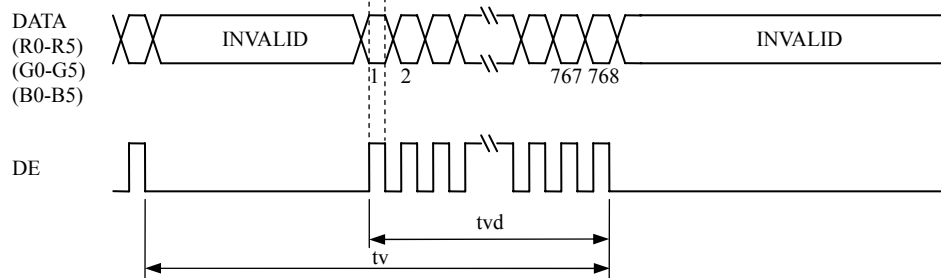
4.11 OPTICS

4.11.1 Optical characteristics

(Note1, Note2)

Parameter		Condition	Symbol	min.	typ.	max.	Unit	Measuring instrument	Remarks
Luminance		White at center $\theta R= 0°, \theta L= 0°, \theta U= 0°, \theta D= 0°$	L	TBD	280	-	cd/m^2	BM-5A	-
Contrast ratio		White/Black at center $\theta R= 0°, \theta L= 0°, \theta U= 0°, \theta D= 0°$	CR	TBD	500	-	-	BM-5A	Note3
Luminance uniformity		White $\theta R= 0°, \theta L= 0°, \theta U= 0°, \theta D= 0°$	LU	-	1.25	1.4	-	BM-5A	Note4
Chromaticity	White	x coordinate	Wx	0.272	0.322	0.372	-	SR-3	Note5
		y coordinate	Wy	0.290	0.340	0.390	-		
	Red	x coordinate	Rx	-	TBD	-	-		
		y coordinate	Ry	-	TBD	-	-		
	Green	x coordinate	Gx	-	TBD	-	-		
		y coordinate	Gy	-	TBD	-	-		
	Blue	x coordinate	Bx	-	TBD	-	-		
		y coordinate	By	-	TBD	-	-		
Color gamut		$\theta R= 0°, \theta L= 0°, \theta U= 0°, \theta D= 0°$ at center, against NTSC color space	C	TBD	50	-	%		
Response time		White to Black	Ton	-	6	-	ms	BM-5A	Note6 Note7
		Black to White	Toff	-	2	-	ms		
Viewing angle	Right	$\theta U= 0°, \theta D= 0°, CR\geq 10$	θR	-	45	-	°	EZ Contrast	Note8
	Left	$\theta U= 0°, \theta D= 0°, CR\geq 10$	θL	-	45	-	°		
	Up	$\theta R= 0°, \theta L= 0°, CR\geq 10$	θU	-	20	-	°		
	Down	$\theta R= 0°, \theta L= 0°, CR\geq 10$	θD	-	40	-	°		

Note1: These are initial characteristics.
Note2: Measurement conditions are as follows.
Ta= 25°C, VCC= 3.3V, IL= 20mA
Horizontal cycle= 1/47.396kHz, Vertical cycle= 1/59.995Hz

Optical characteristics are measured at luminance saturation after 20minutes from working the product, in the dark room. Also measurement methods are as follows.
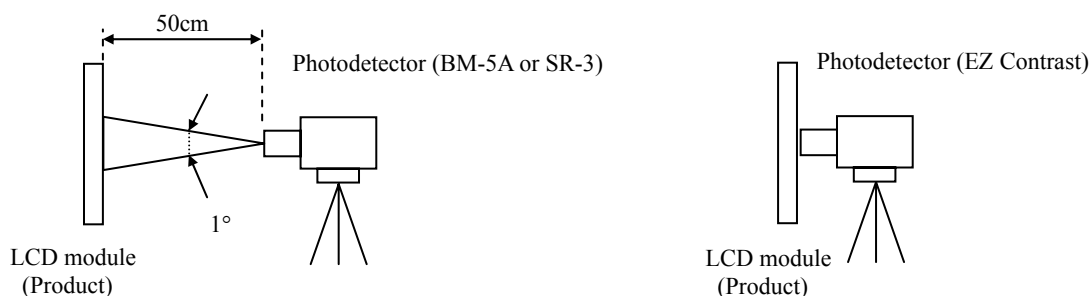
Note3: See "**4.11.2 Definition of contrast ratio**".
Note4: See "**4.11.3 Definition of luminance uniformity**".
Note5: These coordinates are found on CIE 1931 chromaticity diagram.
Note6: Product surface temperature: TopF = TBD°C
Note7: See "**4.11.4 Definition of response times**".
Note8: See "**4.11.5 Definition of viewing angles**".

4.11.2 Definition of contrast ratio

The contrast ratio is calculated by using the following formula.
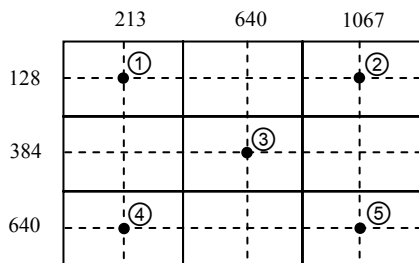
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance of white screen}}{\text{Luminance of black screen}}$$

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, the luminance changes from " black " to " white ", or " white " to " black " on the same screen point, by photo-detector. Ton is the time it takes the luminance change from 10% up to 90%. Also Toff is the time it takes the luminance change from 90% down to 10% (See the following diagram.).
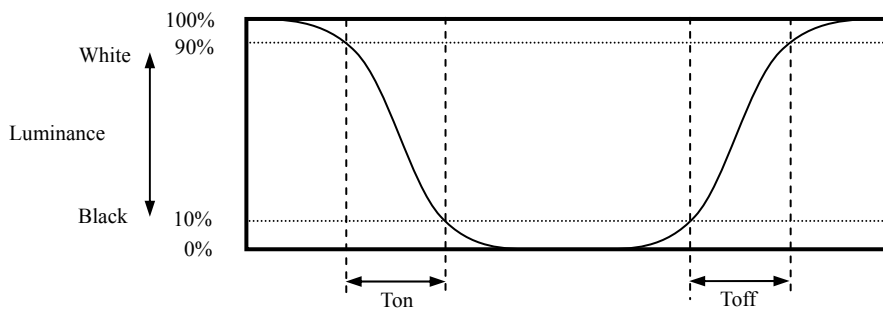
4.11.5 Definition of viewing angles
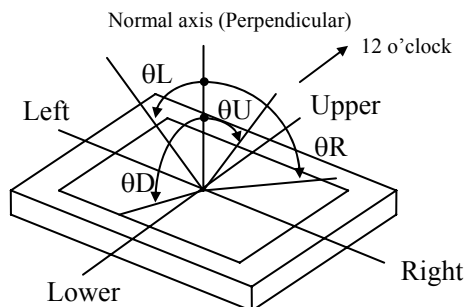
PRELIMINARY

5. RELIABILITY TESTS

(Note1)

Test item	Condition	Judgment
High temperature and humidity (Operation)	① 60 ± 2°C, RH= 60%, 240hours ② Display data is Black.	No display malfunctions
Heat cycle (Operation)	① -20 ± 3°C…1hour 　60 ± 3°C…1hour ② 50cycles, 4 hours/cycle ③ Display data is Black.	
Thermal shock (Non operation)	① -30 ± 3°C…30minutes 　70 ± 3°C…30minutes ② 100cycles, 1hour/cycle ③ Temperature transition time is within 5 minutes.	
ESD (Operation)	① 150pF, 330Ω, ±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, 19.6m/s^2 ② 1 minute/cycle ③ X, Y, Z directions ④ 120 times each directions	No display malfunctions No physical damages
Mechanical shock (Non operation)	① 539m/ s^2, 11ms ② ±X, ±Y, ±Z directions 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.
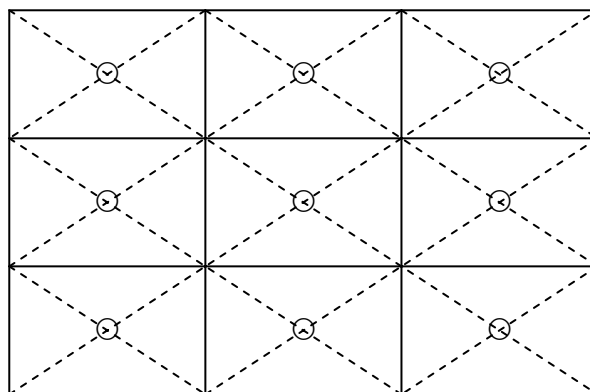
6. PRECAUTIONS

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 $539 m/s^2$ and to be not greater 11ms, Pressure: To be not greater 19.6 N (ϕ16mm 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 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.

⑤ Do not hit or rub the surface of touch panel with hard materials, because it is easily scratched. (Touch panel pencil-hardness: 3H)

⑥ Do not push nor pull the interface connectors while the product is working.

⑦ When handling the product, use of an original protection sheet on the product surface (polarizer) is recommended for protection of product surface. Adhesive type protection sheet may change color or characteristics of the polarizer.

⑧ When cleaning the T/P surface, wipe it with a soft dry cloth.

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 for the worst, please wash it out with soap.

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 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.

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 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.
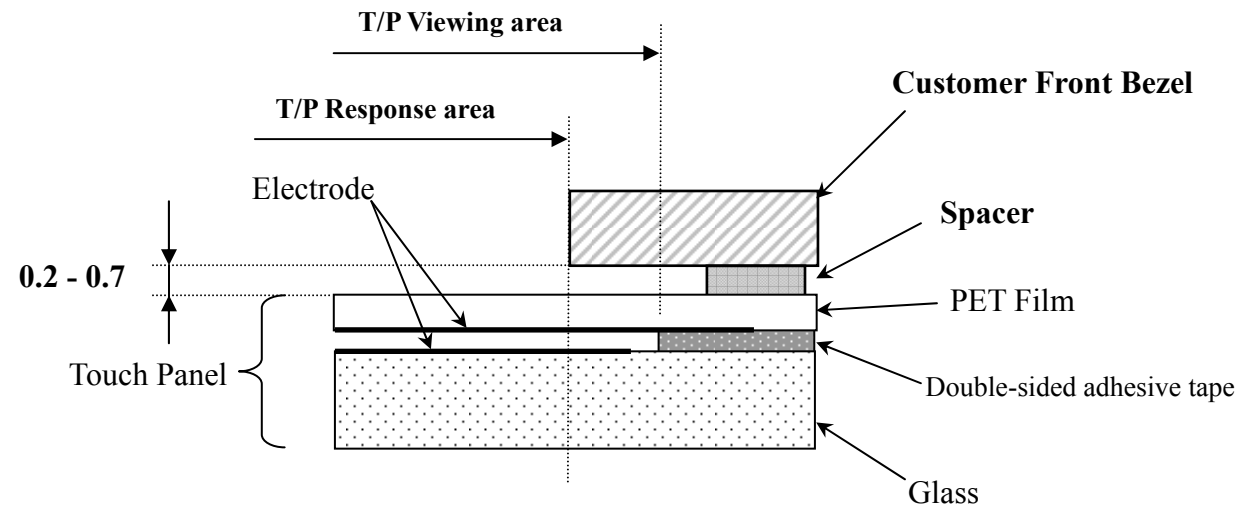
7. OUTLINE DRAWINGS

Note1: The values in parentheses are for reference.

Unit: mm
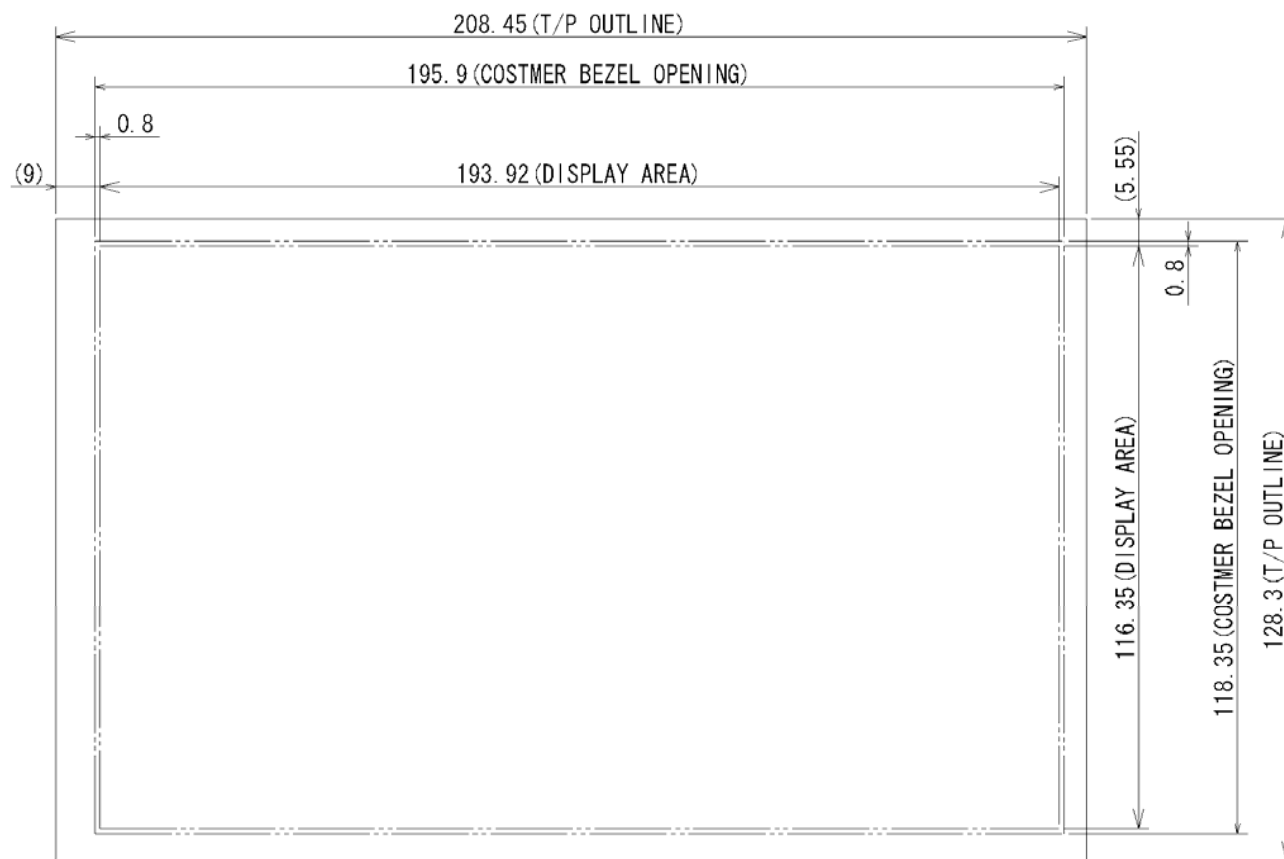
8. RECOMMENDATION DESIGN OF CUSTOMER FRONT BEZEL

T/P Viewing area

T/P Response area

Customer Front Bezel

Electrode

Spacer

0.2 - 0.7
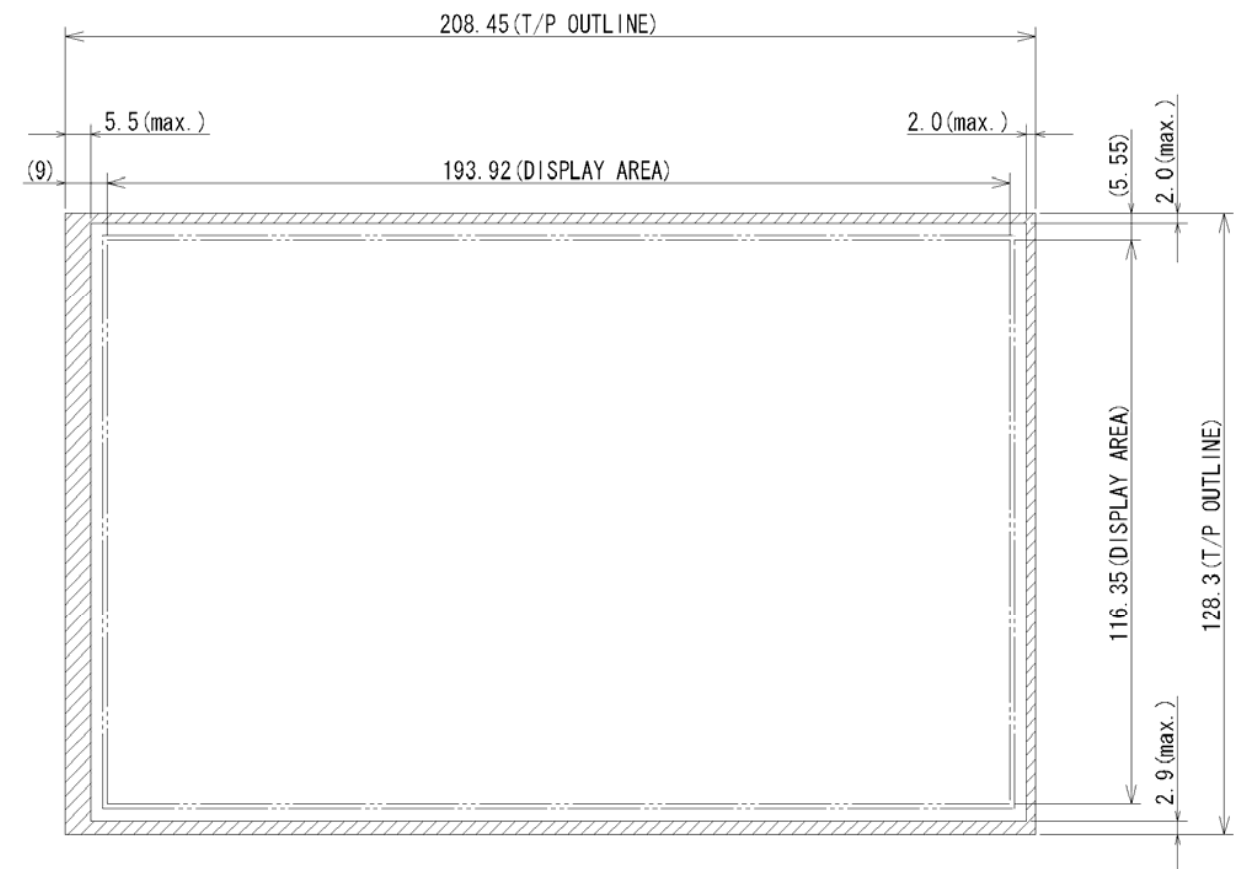
PET Film

Touch Panel

Double-sided adhesive tape

Glass

Design guidance for Customer Front Bezel and a Spacer

1. Customer Front Bezel Opening Design
   a. Please place Customer Front Bezel Opening to maintain the operation by a finger inside the T/P response area.
   b. Any pressures in the area between T/P response area and T/P viewing area are prohibited.
      Please use an appropriate material as Customer Front Bezel.

2. Spacer design
   a. Please put a spacer, a cushion, on the Customer Front Bezel. Do not use a double-sided adhesive tape because it adheres on the touch panel surface.
   b. Please position the spacer over the Spacer area to avoid a "short".

208.45 (T/P OUTLINE)

195.9 (COSTMER BEZEL OPENING)

0.8

(9)

193.92 (DISPLAY AREA)

(5.55)

0.8

116.35 (DISPLAY AREA)

118.35 (COSTMER BEZEL OPENING)

128.3 (T/P OUTLINE)

Customer Front Bezel Opening Design

208.45 (T/P OUTLINE)

5.5 (max.)

2.0 (max.)

(9)

193.92 (DISPLAY AREA)

(5.55)

2.0 (max.)

116.35 (DISPLAY AREA)

128.3 (T/P OUTLINE)

2.9 (max.)

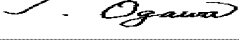**Spacer Design**

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-0414	Nov. 22, 2007	**Revision contents** New issue **Signature of writer** *Approved by* *Checked by* *Prepared by* _T. OGAWA_ _____ _E. KATAYAMA_