NEC NEC LCD Technologies, Ltd.

TFT COLOR LCD MODULE

NL4827HC19-01B

11cm (4.3 Type)
WQVGA

DATA SHEET

DOD-PP-0204 (3rd edition)

This DATA SHEET is updated document from DOD-PP-0098(2).

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INTRODUCTION

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> Examples: Military systems, aircraft control equipment, aerospace equipment, nuclear reactor control systems, medical equipment/devices/systems for life support, etc.

The quality grade of this product is the **"Standard"** unless otherwise specified in this document.

CONTENTS

1. OUTLINE

1.1 STRUCTURE AND PRINCIPLE

   Color LCD module NL4827HC19-01B 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 controller, 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

- Portable GPS

1.3 FEATURES

- Transmissive type
- Backlight and touch panel attached
- Recommended LCD controller: Part No. S1L50282B37N000 (NEC corp.)
- High luminance
- High contrast
- 6-bit digital RGB signals
- Compliance with the European RoHS directive (2002/95/EC)
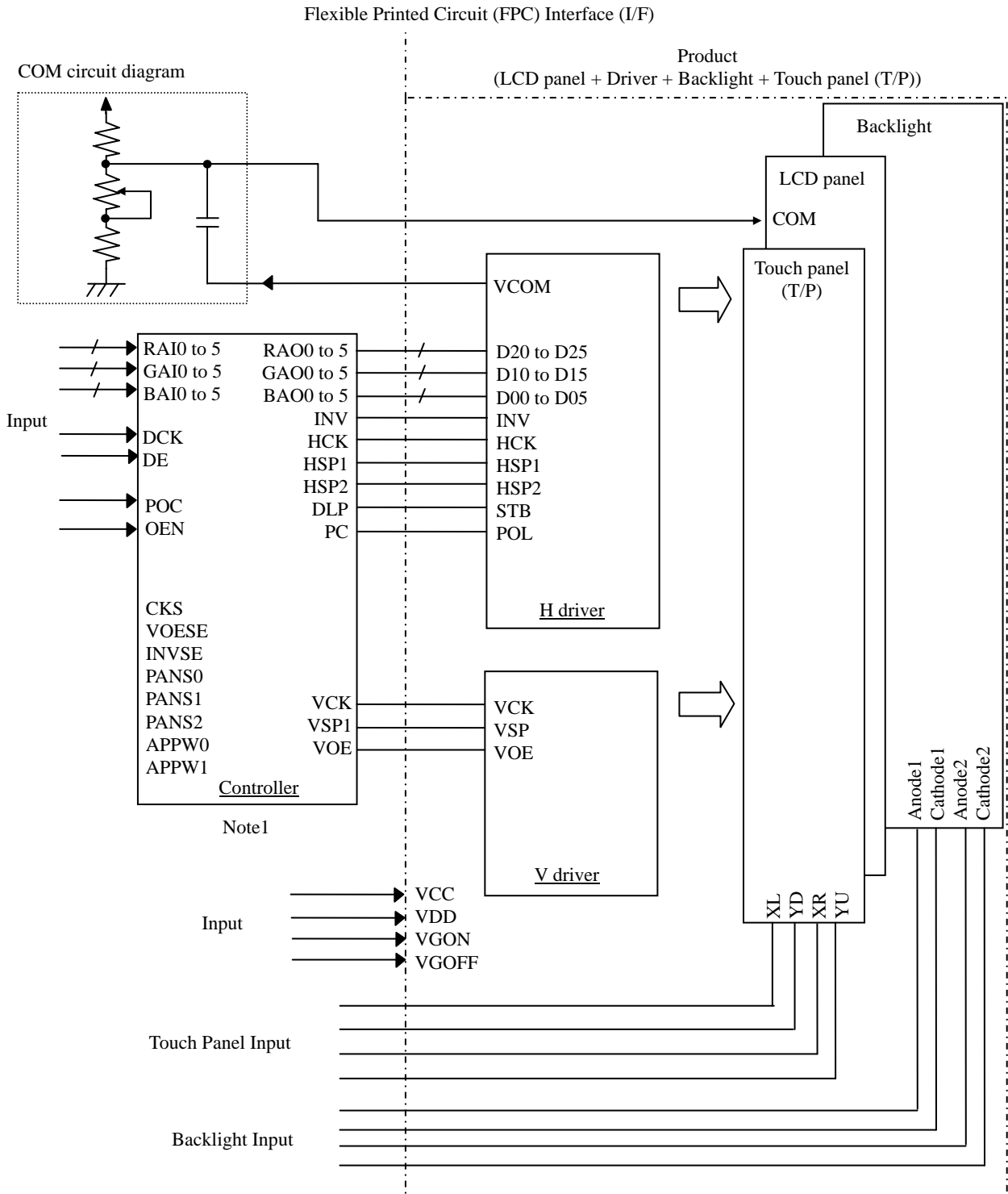
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2. GENERAL SPECIFICATIONS

Display area	95.04 (H) × 53.856 (V) mm
Diagonal size of display	11cm (4.3 inches)
Drive system	a-Si TFT active matrix
Display color	262,144 colors
Pixel	480 (H) × 272 (V) pixels
Pixel arrangement	RGB (Red dot, Green dot, Blue dot) vertical stripe
Dot pitch	0.066 (H) × 0.198 (V) mm
Pixel pitch	0.198 (H) × 0.198 (V) mm
Module size	105.5 (H) × 67.2 (V) × 4.45 (D) mm (typ.)
Weight	65g (typ.)
Touch panel surface	Antiglare
Touch panel pencil-hardness	3H (min.) [by JIS K5400]
Designed viewing direction	Viewing direction without image reversal: down side (6 o'clock)
Luminance	*At IL= 20mA, with Touch panel* 450cd/m^2 (typ.)
Contrast ratio	*At IL= 20mA, with Touch panel* 500:1 (typ.)
Color gamut	*At LCD panel center* 60% (typ.) [against NTSC color space]
Response time	*Ton+Toff (10%←→90%)* 25ms (typ.)
Signal system	Controller input signals (6-bit RGB data, DCK, DE, POC, OEN) Note1
Supply voltage	VCC: 3.0V (typ., for Logic) VDD: 5.0V (typ., for LCD Horizontal driver) VGON: +15.0V (typ., for LCD Vertical driver) VGOFF: -15.0V (typ., for LCD Vertical driver)
Power consumption	LCD panel + Driver: 40mW (typ.) Backlight: 640mW (typ., at IL= 20mA)

Note1: Refer to the controller specifications.

3. BLOCK DIAGRAM

Flexible Printed Circuit (FPC) Interface (I/F)

Product
(LCD panel + Driver + Backlight + Touch panel (T/P))

COM circuit diagram

Backlight

LCD panel

COM

Touch panel
(T/P)

VCOM

Controller	H driver
RAI0 to 5 → RAO0 to 5	D20 to D25
GAI0 to 5 → GAO0 to 5	D10 to D15
BAI0 to 5 → BAO0 to 5	D00 to D05
INV	INV
DCK → HCK	HCK
DE → HSP1	HSP1
HSP2	HSP2
POC → DLP	STB
OEN → PC	POL

Input

CKS
VOESE
INVSE
PANS0
PANS1
PANS2
APPW0
APPW1

Controller

Note1

V driver
VCK → VCK
VSP1 → VSP
VOE → VOE

VCC
VDD
VGON
VGOFF

Input

Touch Panel Input

Backlight Input

XL YD XR YU

Anode1 Cathode1 Anode2 Cathode2

Note1: Refer to the controller specifications for input timings.

FPC I/F

Pin No.	Symbol
29 to 34	D00 to D05
22 to 27	D10 to D15
15 to 20	D20 to D25
10	HCK
12	HSP1
13	HSP2
11	STB
36	POL
37	INV
39	VCOM
4	VCK
8	VSP
6	VOE
5	VGON
7	VGOFF
2, 3	VCC
9	VDD
41	COM
1,14,21,28,35, 38,40,42,47	GND
43, 44	XL, YD
45, 46	XR, YU
48	CATHODE1
49	ANODE1
50	CATHODE2
51	ANODE2

H driver

1,440 lines

LCD panel
272 lines

H: 480 × 3 (R, G, B)
V: 272

V driver

+15V
-15V

+3.0V
+5.0V

Touch panel

Backlight

Reference design of COM circuit

VDD

100kΩ

100kΩ

10kΩ

COM

4.7μF/10V

VCOM

4. DETAILED SPECIFICATIONS

4.1 MECHANICAL SPECIFICATIONS

Parameter	Specification		Unit
Module size	105.5 ± 0.3 (W) × 67.2 ± 0.3 (H) × 4.45 ± 0.3 (D) Note1	Note2	mm
Display area	95.04 (H) × 53.856 (V)	Note2	mm
Weight	65 (typ.), 67 (max.)		g

Note1: Excluding FPC
Note2: See "**7. OUTLINE DRAWINGS**".

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4.2 ABSOLUTE MAXIMUM RATINGS

Parameter		Symbol	Rating	Unit	Remarks
Supply voltage		VCC	-0.3 to +4.0	V	Ta= 25°C
		VDD	-0.3 to +6.0		
		VGON	-0.3 to +44.0		
		VGOFF	VGON -44.0 to +0.3		
Logic input voltage		VI	-0.3 to VCC+0.3	V	Logic signals
Backlight	Reverse voltage	VR	≤ 25	V	Ta= 25°C, These values are applied for both Anode1 and 2.
	Power dissipation	PD	≤ 615	mW	
	Forward current	IL	Note1	mA	-
	Pulse forward current	IFP	100	mA	Pulse width ≤ 10ms, Duty ≤ 1/10
Storage temperature		Tst	-30 to +80	°C	-
Operating temperature		Top	-10 to +60		Product surface Note2
Relative humidity Note3		RH	≤ 95	%	Ta≤ 40°C
			≤ 85		40°C <Ta≤ 50°C
			≤ 55		50°C <Ta≤ 60°C
Absolute humidity Note3		AH	≤ 70 Note4	g/m³	Ta> 60°C
Storage altitude			≤ 13,600	m	-30°C ≤ Ta ≤ 80°C
Operating altitude			≤ 4,850	m	-10°C ≤ Ta ≤ 60°C

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Note1: Allowable forward current

35mA (27.5°C)

8.5mA (85°C)
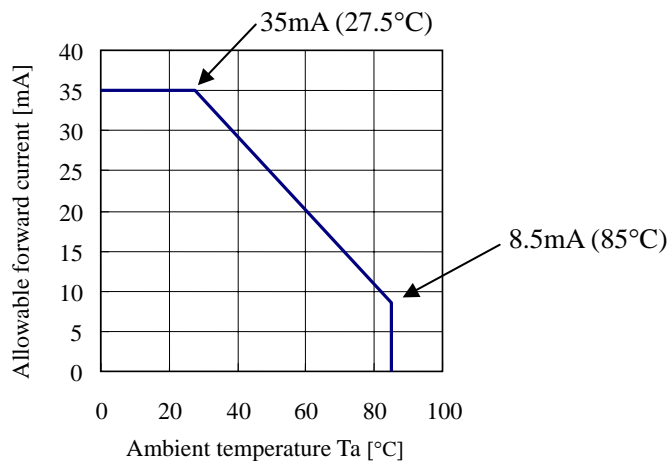
Note2: Measured at display area
Note3: No condensation
Note4: Water amount at Ta= 60°C and RH= 55%

4.3 ELECTRICAL CHARACTERISTICS

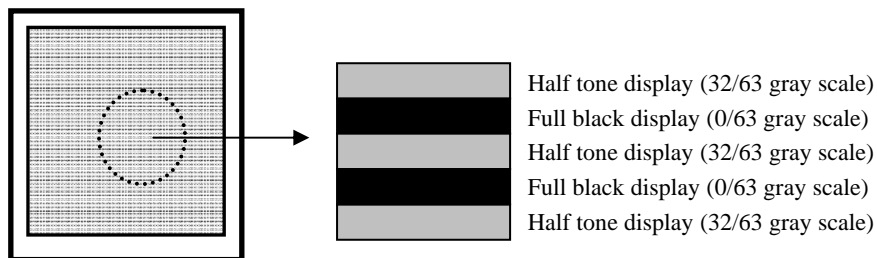(1) Logic/ LCD driving

(Ta= 25°C)

Parameter	Symbol	min.	typ.	max.	Unit	Remarks
Logic supply voltage	VCC	2.6	3.0	3.6	V	-
H driver supply voltage	VDD	4.5	5.0	5.25	V	-
V driver(+) supply voltage	VGON	14.0	15.0	16.0	V	-
V driver(-) supply voltage	VGOFF	-16.0	-15.0	-14.0	V	-
Logic input high voltage	VIH	0.8VCC	-	VCC	V	Logic signal
Logic input low voltage	VIL	0	-	0.2VCC	V	
COM voltage input level	COM	VDD-0.3	VDD	-	Vp-p	-
COM center voltage	COM/C	-	1.8	-	V	at VDD=5.0V Note1
VCC supply current	ICC	-	0.8	2.0	mA	at VCC= 3.0V, Note2 Excluding the controller
VDD supply current	IDD	-	7.0	11.0	mA	at VDD= 5.0V Note2
VGON supply current	IGON	-	0.04	0.1	mA	at VGON= 15.0V Note2
VGOFF supply current	IGOFF	-0.2	-0.15	-	mA	at VGOFF= -15.0V Note2

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Note1: The optimum value for COM/C is in the range of 1.2 V to 2.2 V.

Recommended adjustment display for COM/C

Half tone display (32/63 gray scale)
Full black display (0/63 gray scale)
Half tone display (32/63 gray scale)
Full black display (0/63 gray scale)
Half tone display (32/63 gray scale)

Note2: PPHCK= 8.69MHz, PPSTB= 16.56kHz, PPVCK= 16.56kHz, PPVSP= 60Hz,
Checkered flag pattern (by EIAJ ED-2522)

(2) Backlight

(Ta= 25°C)

Parameter	Symbol	min.	typ.	max.	Unit	Remarks
Forward Current	IL1, 2	-	20	25	mA	-
Forward Voltage	VL1, 2	-	16.0	17.5	V	at IL= 20mA

(3) Touch panel

(Ta= 25°C)

Parameter	Symbol	min.	typ.	max.	Unit	Remarks
Touch panel input voltage	Vtp	-	-	5.5	V	-
Resistor between terminals(XL-XR)	Rx	370	-	990	Ω	-
Resistor between terminals(YU-YD)	Ry	160	-	520	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	-	-	1.177	N	Note1, Note2
				120	gf	
Surface hardness	Hs	3	-	-	H	Pencil hardness [by JIS K5400]
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)
Line writing life	Lwl	50,000	-	-	times	Polyacetal stylus pen: R0.8mm Load: 2.45N(250gf), 35mm 0.5mm inside of Response area.

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

4.4 POWER SUPPLY VOLTAGE SEQUENCE
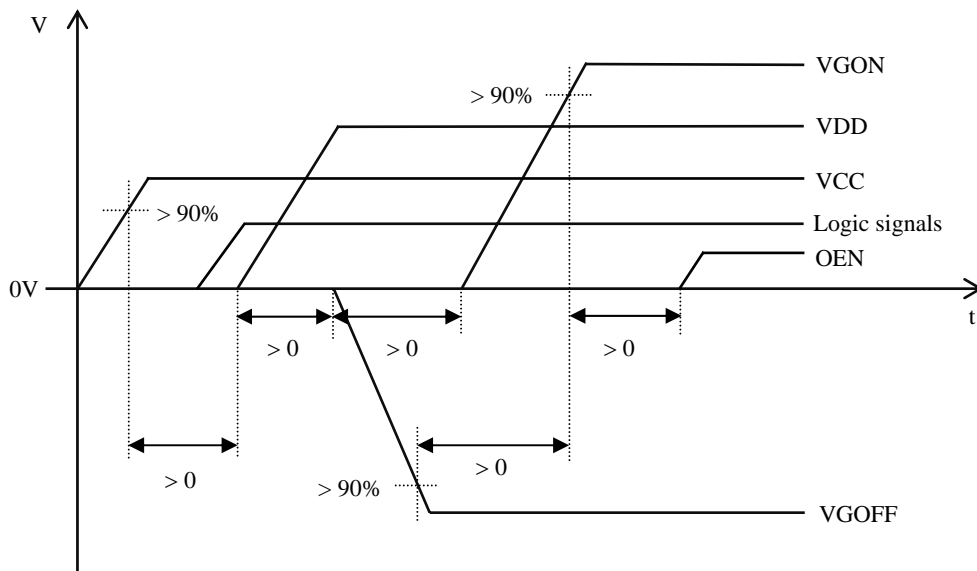
Note1: Supply voltage sequence must be followed above sequence diagram. To shut down, follow above sequence inversely.
Note2: The "OEN" signal of the controller must be "H" after VGON.
Note3: All signals should not be interrupted during the operation. Even if the signals recover, the LCD module may not be operated correctly. In this case, reset the sequence again.

4.5 INTERFACE PIN CONNECTIONS

CN1 (FPC)
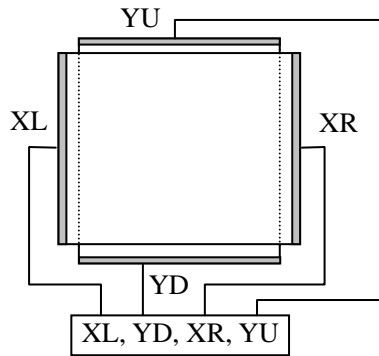Adaptable socket: FH23-51S-0.3SH (05) (Lower contact type) (Hirose Electric Co., Ltd. (HRS))

Pin No.	Symbol	Function	Pin No.	Symbol	Function
1	GND	Ground　　　　Note1	26	D11	Green data
2	VCC	Logic supply voltage	27	D10	Green data (LSB)
3	VCC	Logic supply voltage	28	GND	Ground　　　　Note1
4	VCK	V driver shift clock	29	D05	Red data (MSB)
5	VGON	V driver ON voltage	30	D04	Red data
6	VOE	V driver output enable ("L" output)	31	D03	Red data
7	VGOFF	V driver OFF voltage	32	D02	Red data
8	VSP	V driver start pulse	33	D01	Red data
9	VDD	H driver supply voltage	34	D00	Red data(LSB)
10	HCK	H driver shift clock	35	GND	Ground　　　　Note1
11	STB	H driver latch signal	36	POL	Polarity reversal signal
12	HSP1	H1 driver start pulse	37	INV	Data inversion signal
13	HSP2	H2 driver start pulse	38	GND	Ground　　　　Note1
14	GND	Ground　　　　Note1	39	VCOM	Driver output signal
15	D25	Blue data (MSB)	40	GND	Ground　　　　Note1
16	D24	Blue data	41	COM	Signal for common electrode
17	D23	Blue data	42	GND	Ground　　　　Note1
18	D22	Blue data	43	XL	T/P Horizontal terminal (Left side)
19	D21	Blue data	44	YD	T/P Vertical terminal (Down side)
20	D20	Blue data (LSB)	45	XR	T/P Horizontal terminal (Right side)
21	GND	Ground　　　　Note1	46	YU	T/P Vertical terminal (Up side)
22	D15	Green data(MSB)	47	GND	Ground　　　　Note1
23	D14	Green data	48	CATHODE1	LED1 voltage (Cathode)
24	D13	Green data	49	ANODE1	LED1 voltage (Anode)
25	D12	Green data	50	CATHODE2	LED2 voltage (Cathode)
			51	ANODE2	LED2 voltage (Anode)

Note1: All GND terminals should be used without any non-connected lines.
Note2: Do not fold the FPC. When the FPC is folded, pattern disconnection may be caused. In case of bending FPC, the minimum curvature (R) must be more than 1.0 mm.

Description of terminals

Terminal	Description
COM	This is the Common voltage. The voltage needs to be adjusted. See "**3 BLOCK DIAGRAM - Reference design of COM circuit**".
VCOM	This pin inverts the input signal from the POL pin and outputs it following conversion to the VDD potential at the rising edge of STB.
INV	This pin inverts the input data signal. Input data in synchronization with the shift clock. INV= L: Normal, INV= H: Data inversion
POL	This pin inverts the output polarity. The polarity inversion signal data is captured at the rising edge of STB. The gamma-resistor is switched in accordance with the positive/negative polarity. POL= H: Positive polarity POL= L: Negative polarity
STB	A timing signal that latches the contents of the data register. When a H level is read at the rising edge of HCK, the contents of the data register are latched and transferred to the D/A converter, and analog voltage corresponding to the display data is output. Also, because the internal operation via HCK continues even after the STB latch, do not stop HCK. The contents of the shift register are cleared at the rising edge of STB.
HCK	This pin is the shift clock input of the column shift register. Display data is captured into the data register at the rising edge.
HSP1, 2	Fetching of display data starts when H is read at the rising edge of HCK.
VCK	This pin is the shift clock input of the gate shift register. The start pulse is captured at the rising edge of clock and output the pulse at the falling edge.
VOE	This pin controls the output of the gate drivers. Output can be controlled regardless of VSP and VCK.
VSP	This pin synchronizes with the frame and the gate driver.
YU, XR, YD, XL	Refer to the below "**Circuits of touch panel**".
ANODE1, 2 CATHODE1, 2	Refer to the below "**Circuits of back light**".

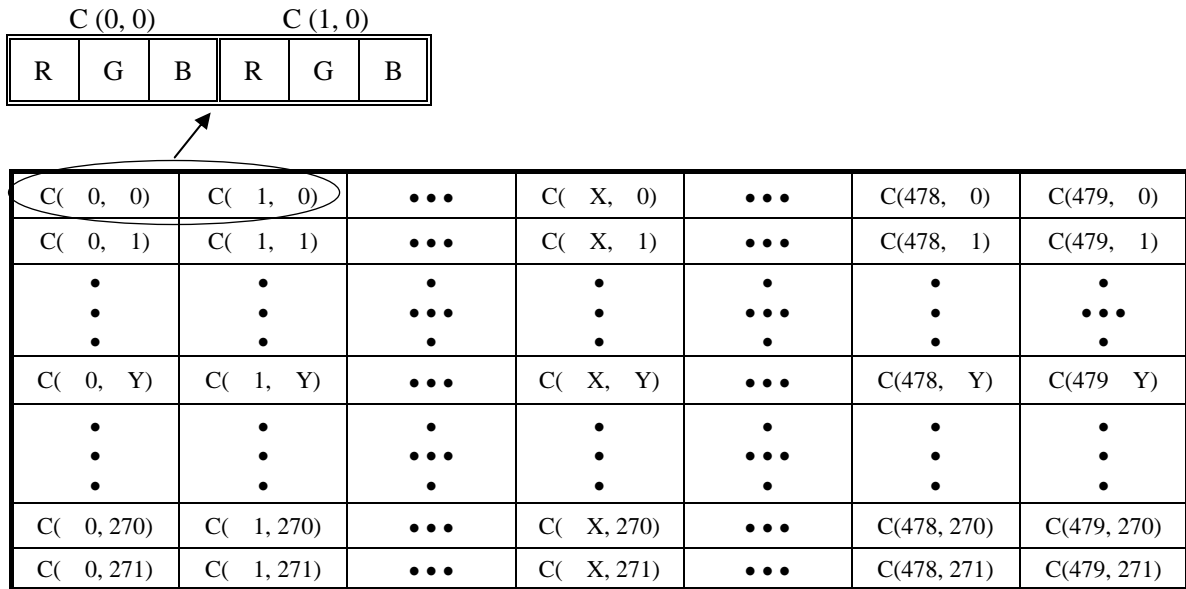Circuits of touch panel
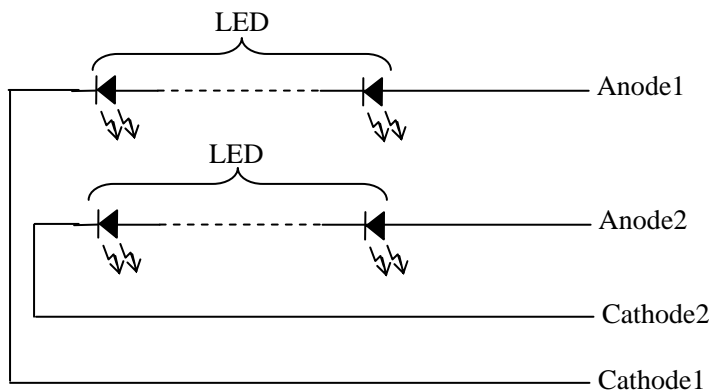
Circuits of backlight

4.6 DISPLAY COLORS AND INPUT DATA SIGNALS

This product can display in equivalent to 262,144 colors in 64 gray scales. 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 figure of "**4.8 SCANNING DIRECTIONS**".).

C (0, 0)   C (1, 0)

| R | G | B | R | G | B |

C(0, 0)	C(1, 0)	• • •	C(X, 0)	• • •	C(478, 0)	C(479, 0)
C(0, 1)	C(1, 1)	• • •	C(X, 1)	• • •	C(478, 1)	C(479, 1)
• • •	• • •	• • •	• • •	• • •	• • •	• • •
C(0, Y)	C(1, Y)	• • •	C(X, Y)	• • •	C(478, Y)	C(479 Y)
• • •	• • •	• • •	• • •	• • •	• • •	• • •
C(0, 270)	C(1, 270)	• • •	C(X, 270)	• • •	C(478, 270)	C(479, 270)
C(0, 271)	C(1, 271)	• • •	C(X, 271)	• • •	C(478, 271)	C(479, 271)

4.8 SCANNING DIRECTIONS

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

C (0, 0)   C (479, 0)
D (0, 0)   D (479, 0)

FPC

C (0, 271)   C (479, 271)
D (0, 271)   D (479, 271)
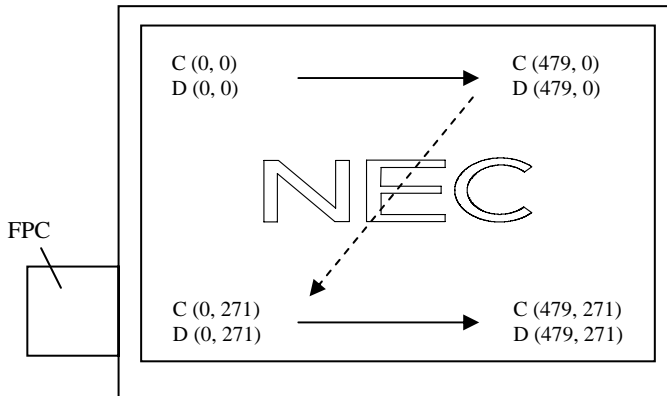
Note1: Meaning of C (X, Y) and D (X, Y)
       C (X, Y): The coordinates of the display position (See "**4.7 DISPLAY POSITIONS**".)
       D (X, Y): The data number of input signal for LCD panel

4.9 INPUT SIGNAL TIMINGS

Input signal specifications for the LCD controller (Ta= 25°C, VCC= 3.0V, VDD= 5.0V)

(1) Timing characteristics

Parameter	Symbol	min.	typ.	max.	Unit
HCK frequency	PPHCK	7.3	8.69	9.4	MHz
HCK High period	PWHCK(H)	35	-	-	ns
HCK Low period	PWHCK(L)	35	-	-	ns
Last data timing	tLDT	2	-	-	CLK
HCK-STB time	tHCK- STB	35	-	-	ns
STB frequency	PPSTB	13.9	16.56	17.9	kHz
STB pulse width	PWSTB	550	-	-	ns
STB-HSP1 time	tSTB-HSP1	4	-	-	CLK
HSP1-HSP2 time	tHSP1-HSP2	239			CLK
HSP1 pulse width	PWHSP1	1	-	-	CLK
HSP2 pulse width	PWHSP2	1	-	-	CLK
STB-POL time	tSTB-POL	40	-	-	ns
VCK-STB time	tVCK-STB	1	3	-	μs
STB-VOE time	tSTB-VOE	2	-	-	CLK
VSP frequency	PPVSP	50	60	65	Hz
VCK frequency	PPVCK	13.9	16.56	17.9	kHz
STB setup time	tSU1	35	-	-	ns
STB hold time	tH1	35	-	-	ns
DATA setup time	tSU2	35	-	-	ns
DATA hold time	tH2	35	-	-	ns
HSP1, 2 setup time	tSU3	35	-	-	ns
HSP1, 2 hold time	tH3	35	-	-	ns
VSP setup time	tSU4	150	-	-	ns
VSP hold time	tH4	300	-	-	ns

Note1: All parameters should be kept within the specified range.

NEC NEC LCD Technologies, Ltd.

HCK   0.8VCC
       0.2VCC

STB   0.8VCC
       0.2VCC

tSU1   tH1

tSU2   tH2

DATA   0.8VCC
       0.2VCC

tSU3   tH3

HSP1, 2 0.8VCC
         0.2VCC

VCK   0.8VCC
       0.2VCC

tSU4   tH4

VSP   0.8VCC
       0.2VCC
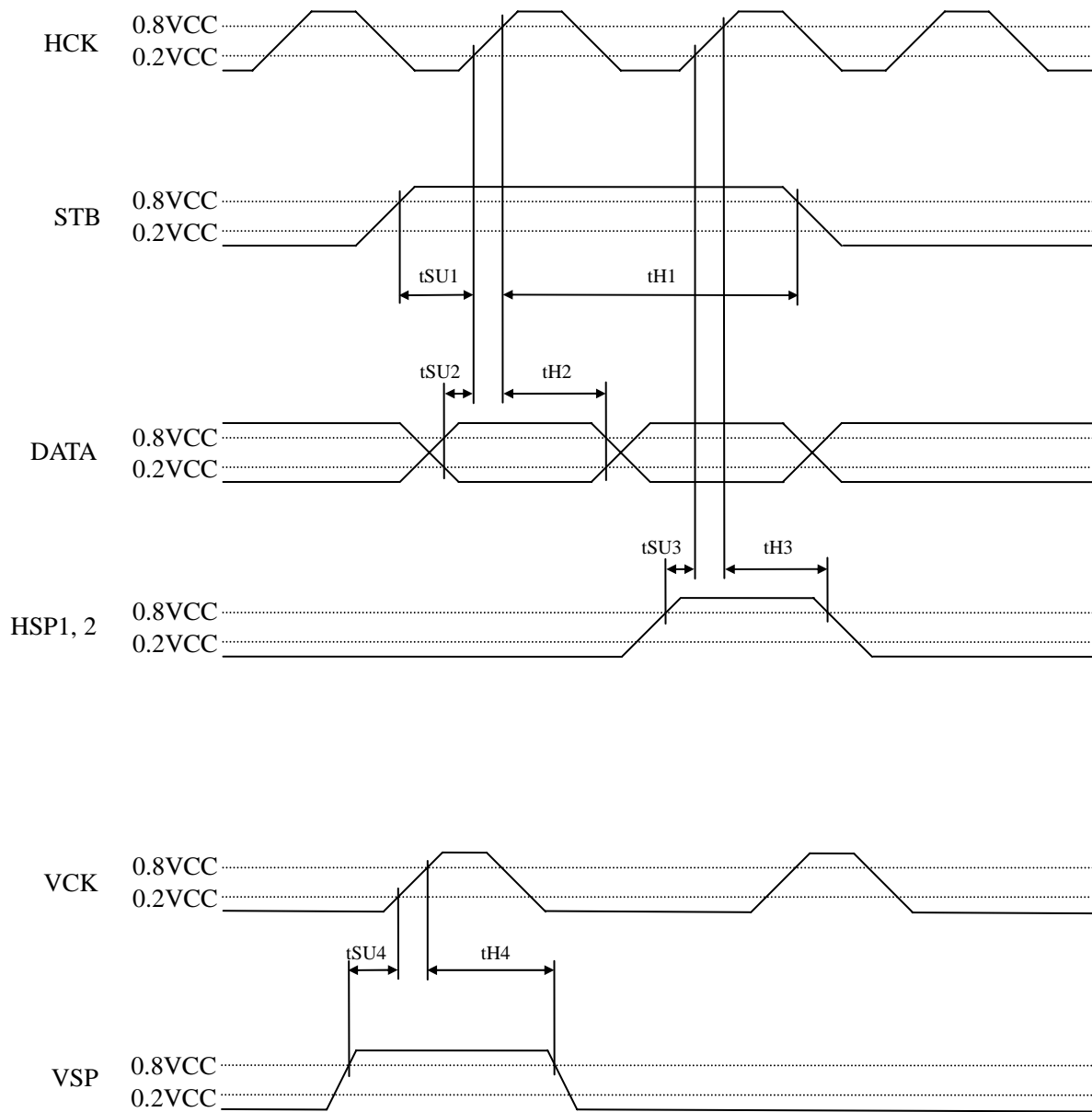
(2) Horizontal timing chart
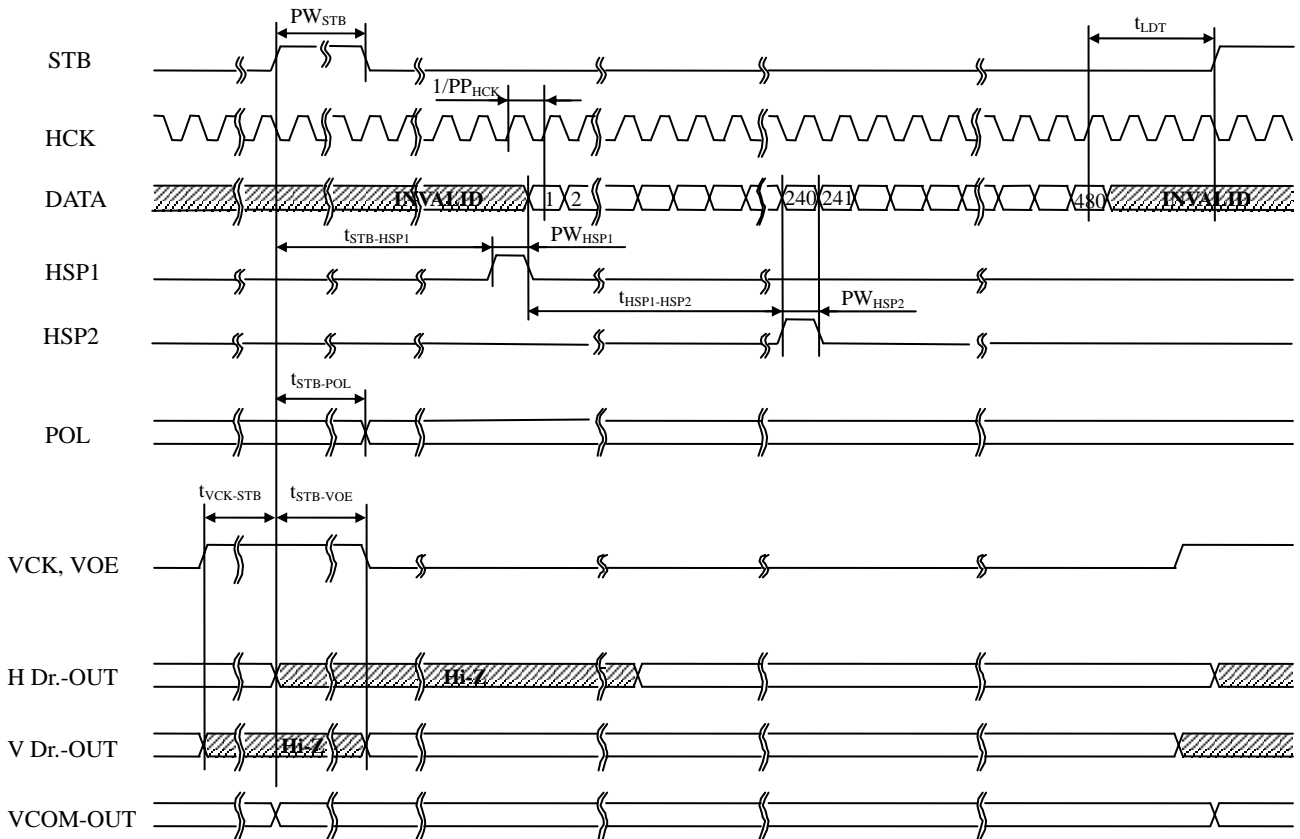
(3) Vertical timing chart
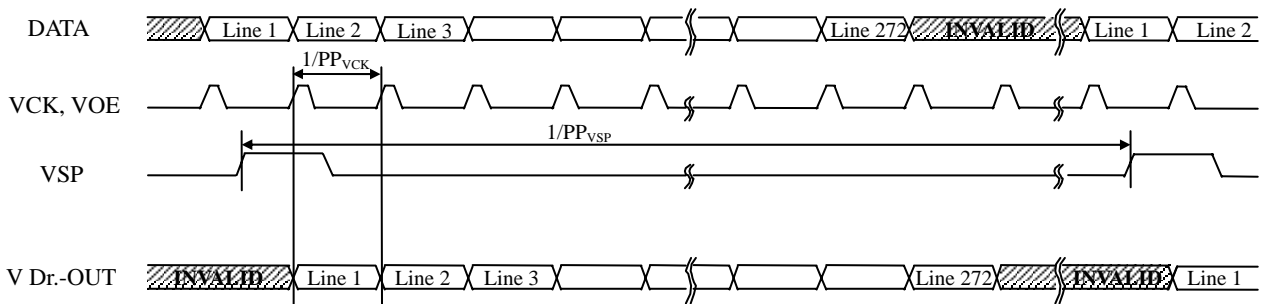
(4) Polarity of signal "POL"

Frame N

Frame N+1
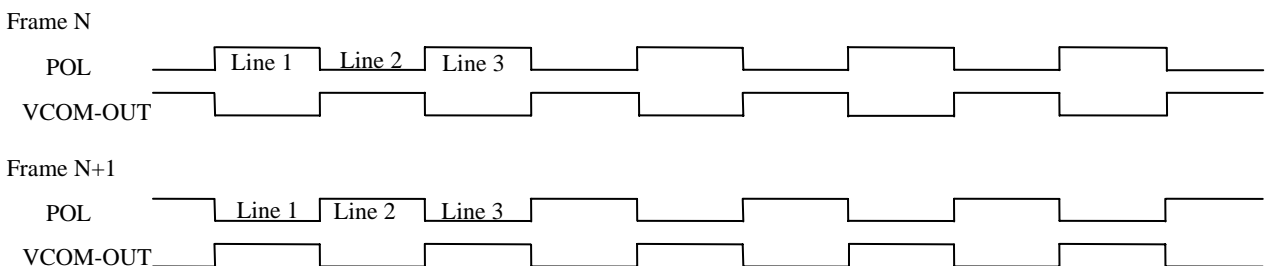
Note1: Unless otherwise specified, the input level is defined to be VIH= 0.8VCC, VIL= 0.2VCC

4.10 OPTICAL CHARACTERISTICS

(Note1, Note2)

Parameter	Condition	Symbol	min.	typ.	max.	Unit	Remarks
Luminance	White at center θR= 0°, θL= 0°, θU= 0°, θD= 0°	L	280	450	-	cd/m^2	-
Contrast ratio	White/Black at center θR= 0°, θL= 0°, θU= 0°, θD= 0°	CR	300	500	-	-	Note3
Luminance uniformity	White θR= 0°, θL= 0°, θU= 0°, θD= 0° Maximum luminance: 100%	LU	60	80	-	%	Note4

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Reference data

(Note1, Note2)

Parameter		Condition		Symbol	min.	typ.	max.	Unit	Remarks
Chromaticity coordinates		White		Wx	0.25	0.30	0.35	-	Note5
				Wy	0.29	0.34	0.39	-	
		Red		Rx	0.58	0.63	0.68	-	
				Ry	0.28	0.33	0.38	-	
		Green		Gx	0.28	0.33	0.38	-	
				Gy	0.55	0.60	0.65	-	
		Blue		Bx	0.10	0.15	0.20	-	
				By	0.06	0.11	0.16	-	
Color gamut		θR= 0°, θL= 0°, θU= 0°, θD= 0° at center, against NTSC color space		C	50	60	-	%	
Response time		White to black	90%→ 10%	Ton	-	8	16	ms	Note6 Note7
		Black to white	10%→ 90%	Toff	-	17	34		
Viewing angle	Right	θU= 0°, θD= 0°, CR≥ 10		θR	-	50	-	°	-
	Left	θU= 0°, θD= 0°, CR≥ 10		θL	-	50	-	°	
	Up	θR= 0°, θL= 0°, CR≥ 10		θU	-	70	-	°	
	Down	θR= 0°, θL= 0°, CR≥ 10		θD	-	40	-	°	

Note1: Measurement conditions are as follows.

Ta= 25°C, VCC= 3.0V, VDD= 5.0V, IL= 20mA, with touch panel
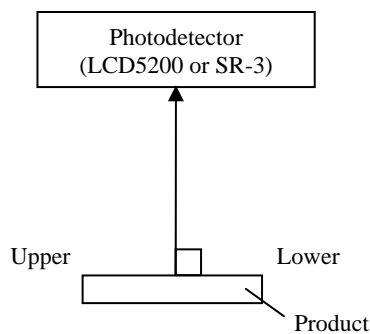
Note2: Definition of viewing angles
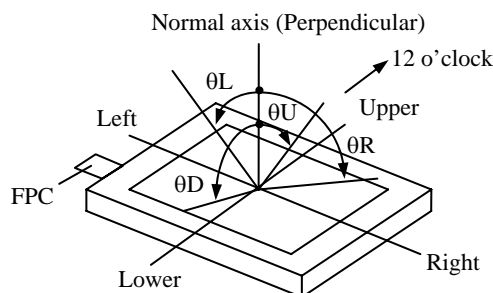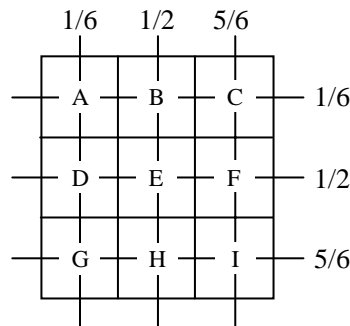
Note3: Definition of contrast ratio

The contrast ratio is calculated by using the following formula.

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

Note4: Definition of luminance uniformity

Luminance uniformity is calculated by using the following formula.

$$\text{Luminance uniformity (LU)} = \frac{\text{Minimum luminance from A to I}}{\text{Maximum luminance from A to I}} \times 100$$

```
      1/6    1/2   5/6
       |      |     |
   ----A------B-----C----   1/6
       |      |     |
   ----D------E-----F----   1/2
       |      |     |
   ----G------H-----I----   5/6
       |      |     |
```

Note5: The White chromaticity coordinates are deviated by the LED deviation in addition to color filter deviation.

Note6: Definition of response times

Response time is measured, the luminance changes from "white" to "black", or "black" to "white" on the same screen point, by photo-detector. Ton is the time it takes the luminance change from 90% down to 10%. Also Toff is the time it takes the luminance change from 10% up to 90% (See the following diagram.).
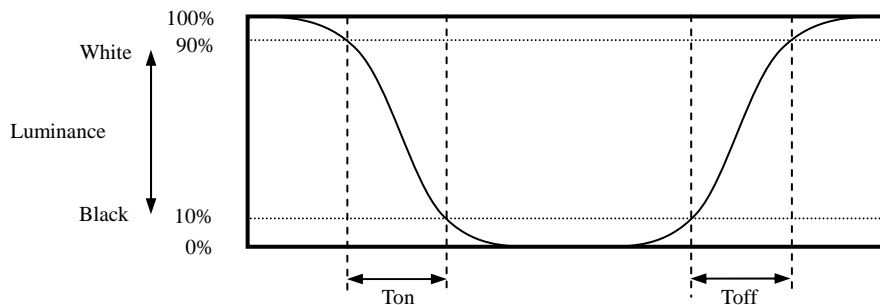
Note7: Product surface temperature: Top= 25°C

5. RELIABILITY TESTS

(Note1)

Test item	Condition	Judgment
High temperature and humidity (Operation)	① 60 ± 2°C, RH= 90%, 240 hours ② Display data is black.	No display malfunctions
Heat cycle (Operation)	① -10 ± 3°C…1 hour 60 ± 3°C…1 hour ② 50 cycles, 4 hours/cycle ③ Display data is black.	
Thermal shock (Non operation)	① -30 ± 3°C…30 minutes 80 ± 3°C…30 minutes ② 100 cycles, 1 hour/cycle ③ Temperature transition time is within 5 minutes.	
Low pressure (Non operation)	① 15kPa ② -30 ± 3°C…24 hours ③ 80 ± 3°C…24 hours	
Low pressure (Operation)	① 53.3kPa ② -10 ± 3°C…24 hours ③ 60 ± 3°C…24 hours	
ESD (Operation)	① 150pF, 150Ω, ±10kV ② 3 places on a panel surface 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 (Operation)	① 30 to 100Hz, $19.6m/s^2$ (2G) ② 30 minutes/cycle ③ X, Y, Z direction ④ 1 times each directions	No display malfunctions No physical damages
Mechanical shock (Non operation)	① $3,920m/s^2$, 2.5ms ② ±X, ±Y, ±Z direction ③ 1 times each directions	

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Note1:Display and appearance are checked under environmental conditions equivalent to the inspection conditions of defect specifications.

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 get an electrical shock, 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 an electric shock.**

⚠

    ∗ **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 $3,920m/s^2$ and to be not greater 2.5ms)**

6.3 ATTENTIONS ⚠ **!**

6.3.1 Handling of the product

    ① Take hold of both ends without touching the FPC when the product (LCD module) is picked up from the tray.
    ② Do not hook nor pull the FPC in order to avoid any damage.
    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 product must be installed and/or handled without undue stress such as bends or twist. Bends, twist or undue stress to any portion may cause display failures. And also do not put heavy or hard materials on the product.
    ⑥ Do not hit or rub the surface of touch panel with hard materials, because it is easily scratched. (Touch panel pencil-hardness: 3H)
    ⑦ When cleaning the T/P surface, wipe it with a soft dry cloth.
    ⑧ Do not push nor pull the FPC while the product is working.
    ⑨ Do not fold the FPC. When the FPC is folded, pattern disconnection may be caused. In case of bending FPC, the minimum curvature (R) must be more than 1.0 mm.
    ⑩ When installing the product, do not contact a conductor such as a metal to the FPC excluding the terminal area. There is a risk of short circuit which is caused by breakage of insulation layer of the FPC.

⑪ When installing the product, apply the waterproof design to avoid going of water into the product.
⑫ If the product is subjected to direct sunlight for a long time, touch panel transmission may be degraded. ☆

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 for 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. Circuits 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 Response time, luminance and color may be changed by ambient 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.
④ Optical characteristics may be changed depending on input signal timings.
⑤ 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 terminals should be used without any non-connected lines.
② Do not disassemble the product.
③ Pack the product with original shipping package, in order to avoid any damages during transportation, when returning the product to NEC.

7. OUTLINE DRAWINGS

FRONT VIEW   **REAR VIEW**
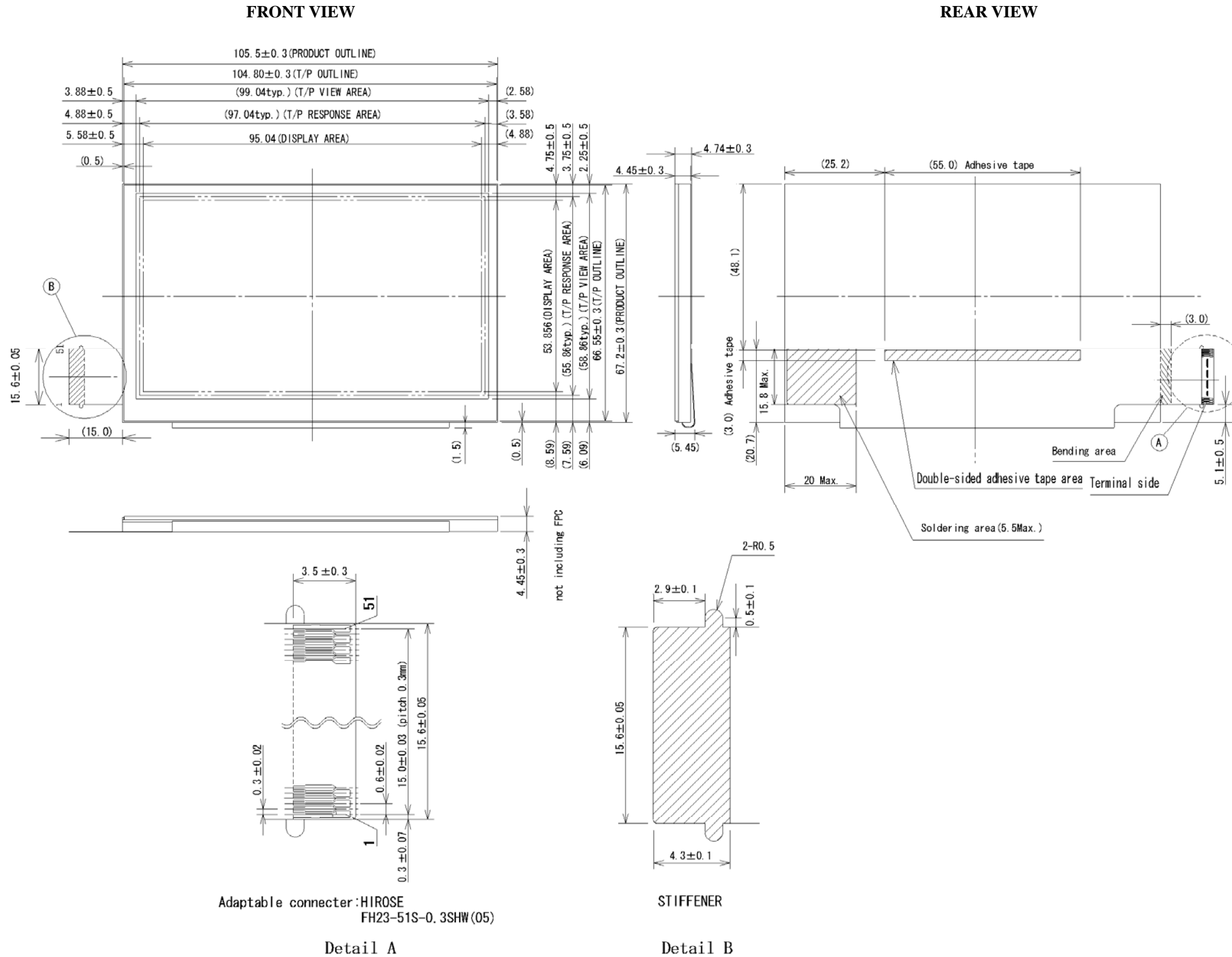
Pin No.	Symbol	Pin No.	Symbol
1	GND	26	D11
2	VCC	27	D10
3	VCC	28	GND
4	VCK	29	D05
5	VGON	30	D04
6	VOE	31	D03
7	VGOFF	32	D02
8	VSP	33	D01
9	VDD	34	D00
10	HCK	35	GND
11	STB	36	POL
12	HSP1	37	INV
13	HSP2	38	GND
14	GND	39	VCOM
15	D25	40	GND
16	D24	41	COM
17	D23	42	GND
18	D22	43	XL
19	D21	44	YD
20	D20	45	XR
21	GND	46	YU
22	D15	47	GND
23	D14	48	CATHODE1
24	D13	49	ANODE1
25	D12	50	CATHODE2
		51	ANODE2

Adaptable connecter：HIROSE
FH23-51S-0.3SHW(05)

Detail A   Detail B

STIFFENER

Note1: The values in parentheses are for reference.
Note2: When installing the product to the customer equipment, do not apply undue stress to rear side of the product and the FPC.
If not, it may cause display mura or break down of the product.

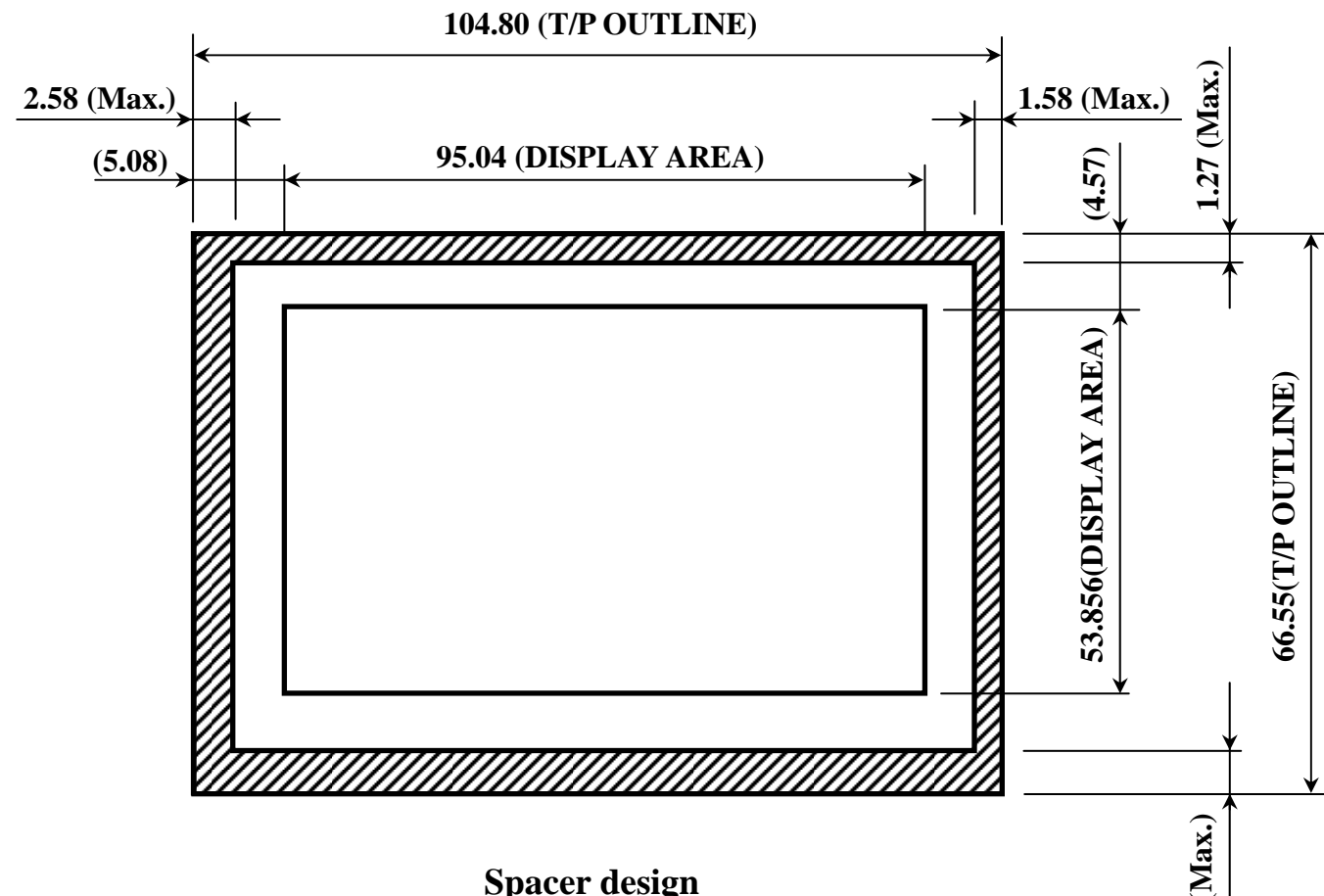Unit: mm

8. RECOMMENDATION DESIGN OF FRONT BEZEL
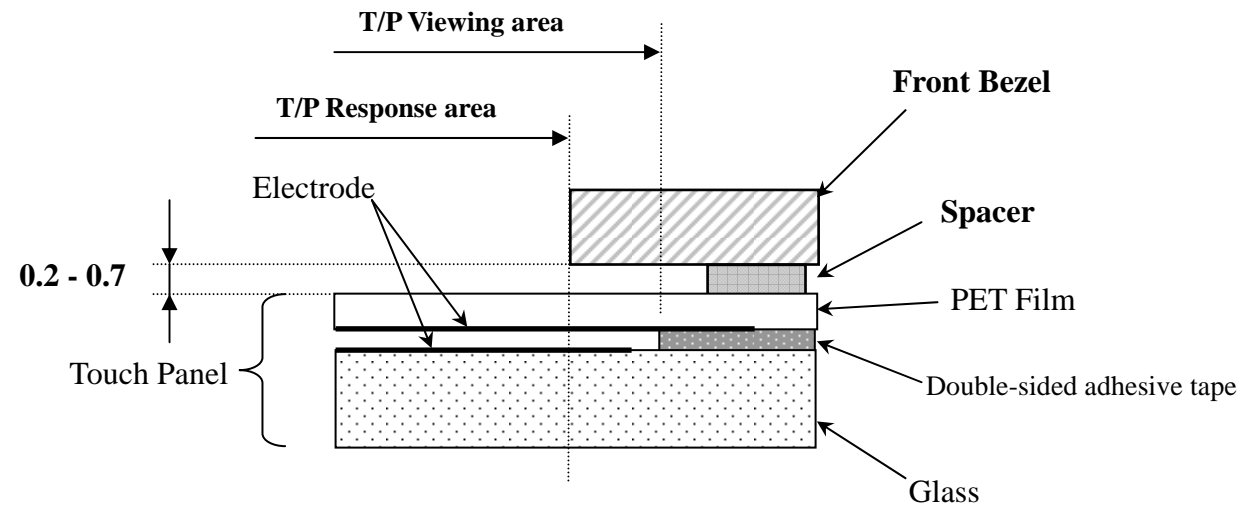
Design guidance for a front bezel and a spacer

1. Front Bezel opening design
   a. Please place a front bezel opening to maintain the operation by a stylus pen 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 the front bezel.

2. Spacer design
   a. Please put a spacer, a cushion, on the 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".
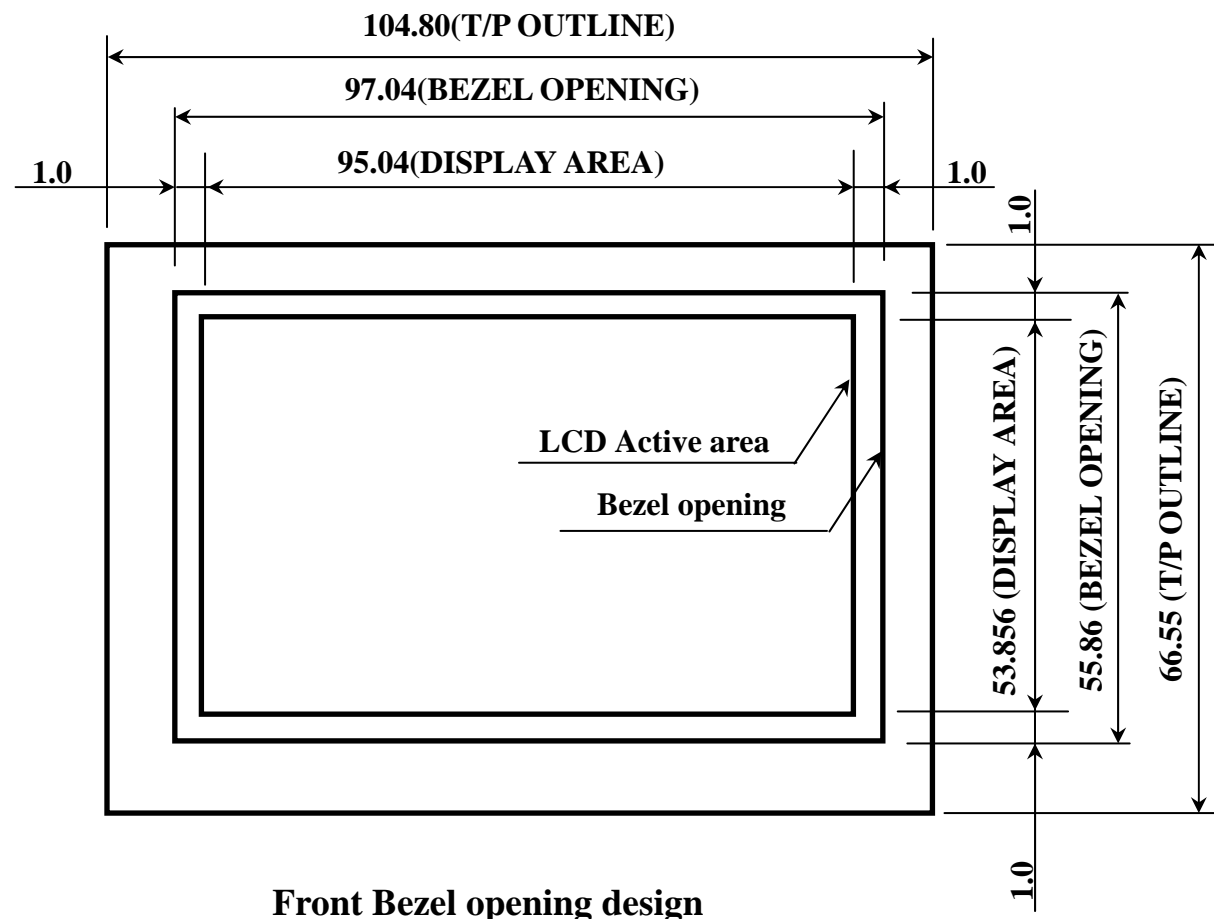
Front Bezel opening design

Spacer design

Unit: mm