

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).**

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

INTRODUCTION

The Copyright to this document belongs to NEC LCD Technologies, Ltd. (hereinafter called "NEC"). No part of this document will be used, reproduced or copied without prior written consent of NEC.

NEC does and will not assume any liability for infringement of patents, copyrights or other intellectual property rights of any third party arising out of or in connection with application of the products described herein except for that directly attributable to mechanisms and workmanship thereof. No license, express or implied, is granted under any patent, copyright or other intellectual property right of NEC.

Some electronic parts/components would fail or malfunction at a certain rate. In spite of every effort to enhance reliability of products by NEC, the possibility of failures and malfunction might not be avoided entirely. To prevent the risks of damage to death, human bodily injury or other property arising out thereof or in connection therewith, each customer is required to take sufficient measures in its safety designs and plans including, but not limited to, redundant system, fire-containment and anti-failure.

The products are classified into three quality grades: "**Standard**", "**Special**", and "**Specific**" of the highest grade of a quality assurance program at the choice of a customer. Each quality grade is designed for applications described below. Any customer who intends to use a product for application other than that of Standard quality grade is required to contact an NEC sales representative in advance.

The **Standard** quality grade applies to the products developed, designed and manufactured in accordance with the NEC standard quality assurance program, which are designed for such application as any failure or malfunction of the products (sets) or parts/components incorporated therein a customer uses are, directly or indirectly, free of any damage to death, human bodily injury or other property, like general electronic devices.

Examples: Computers, office automation equipment, communications equipment, test and measurement equipment, audio and visual equipment, home electronic appliances, machine tools, personal electronic equipment, industrial robots, etc.

The **Special** quality grade applies to the products developed, designed and manufactured in accordance with an NEC quality assurance program stricter than the standard one, which are designed for such application as any failure or malfunction of the products (sets) or parts/components incorporated therein a customer uses might directly cause any damage to death, human bodily injury or other property, or such application under more severe condition than that defined in the Standard quality grade without such direct damage.

Examples: Control systems for transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, medical equipment not specifically designed for life support, safety equipment, etc.

The **Specific** quality grade applies to the products developed, designed and manufactured in accordance with the standards or quality assurance program designated by a customer who requires an extremely higher level of reliability and quality for such products.

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

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

CONTENTS

INTRODUCTION 2

1. OUTLINE 4

 1.1 STRUCTURE AND PRINCIPLE 4

 1.2 APPLICATION 4

 1.3 FEATURES 4

2. GENERAL SPECIFICATIONS..... 5

3. BLOCK DIAGRAM 6

4. DETAILED SPECIFICATIONS..... 8

 4.1 MECHANICAL SPECIFICATIONS 8

 4.2 ABSOLUTE MAXIMUM RATINGS 8

 4.3 ELECTRICAL CHARACTERISTICS 9

 4.4 POWER SUPPLY VOLTAGE SEQUENCE..... 10

 4.5 INTERFACE PIN CONNECTIONS..... 11

 4.6 DISPLAY COLORS AND INPUT DATA SIGNALS 13

 4.7 DISPLAY POSITIONS 14

 4.8 SCANNING DIRECTIONS..... 14

 4.9 INPUT SIGNAL TIMINGS 15

 4.10 OPTICAL CHARACTERISTICS 18

5. RELIABILITY TESTS 20

6. PRECAUTIONS..... 21

 6.1 MEANING OF CAUTION SIGNS 21

 6.2 CAUTIONS..... 21

 6.3 ATTENTIONS..... 21

 6.3.1 Handling of the product 21

 6.3.2 Environment..... 22

 6.3.3 Characteristics 22

 6.3.4 Other..... 22

7. OUTLINE DRAWINGS 23

8. RECOMMENDATION DESIGN OF FRONT BEZEL 24

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)



2. GENERAL SPECIFICATIONS

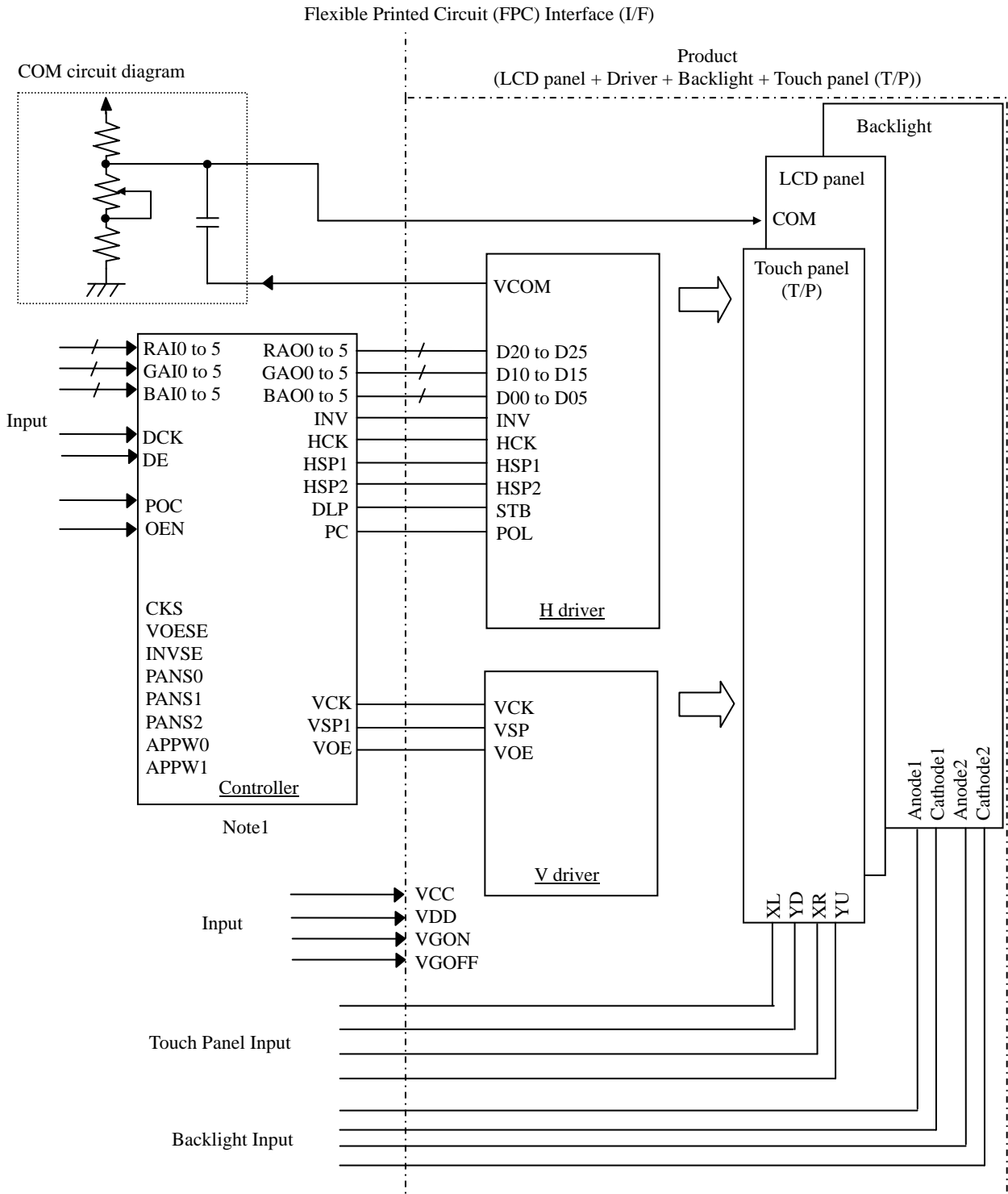
<i>Display area</i>	95.04 (H) × 53.856 (V) mm
<i>Diagonal size of display</i>	11cm (4.3 inches)
<i>Drive system</i>	a-Si TFT active matrix
<i>Display color</i>	262,144 colors
<i>Pixel</i>	480 (H) × 272 (V) pixels
<i>Pixel arrangement</i>	RGB (Red dot, Green dot, Blue dot) vertical stripe
<i>Dot pitch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

Note1: Refer to the controller specifications.

☆

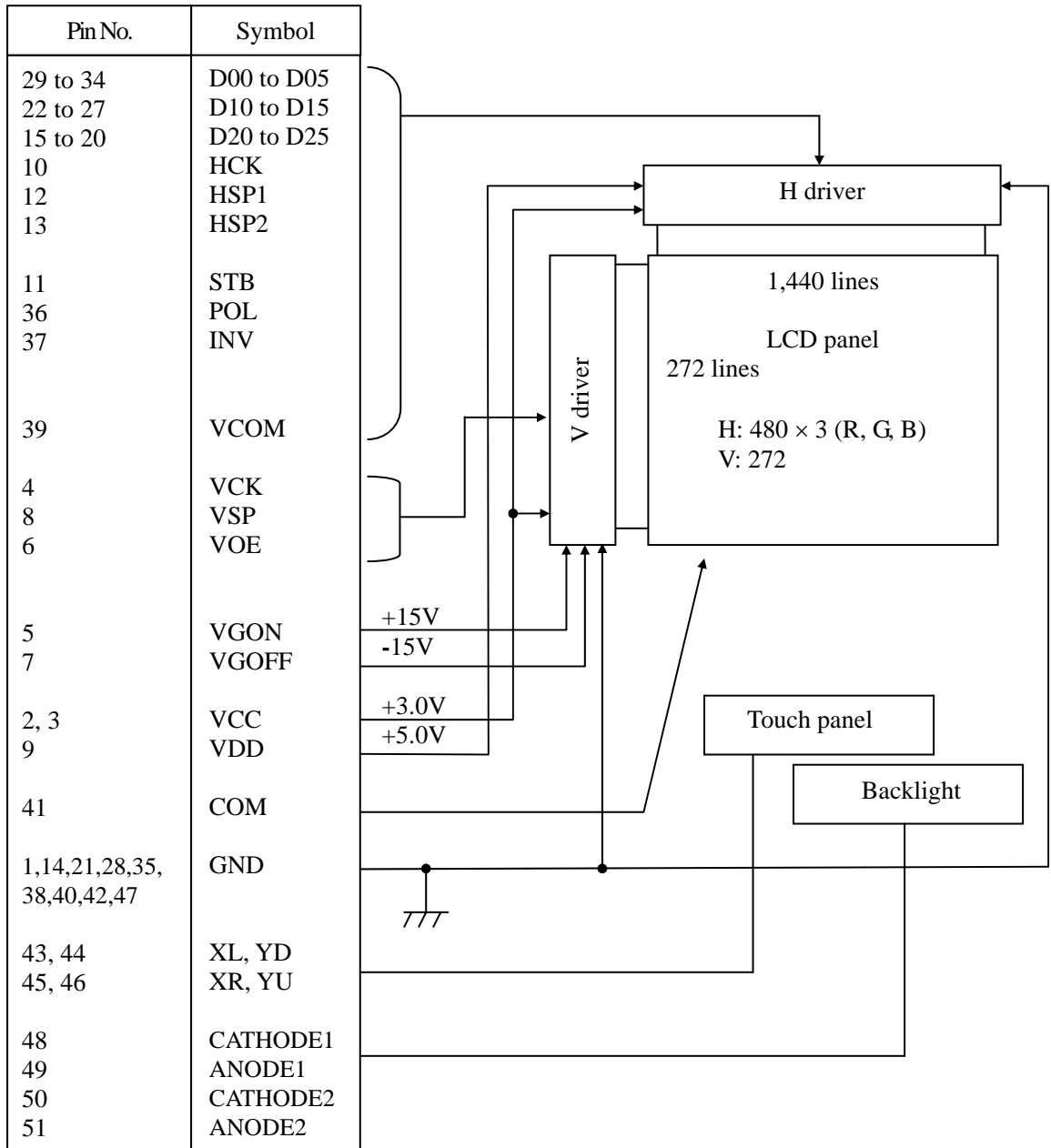
☆

3. BLOCK DIAGRAM

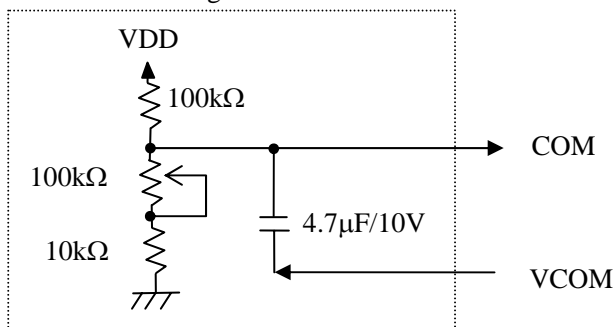


Note1: Refer to the controller specifications for input timings.

FPC I/F



Reference design of COM circuit



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".

☆

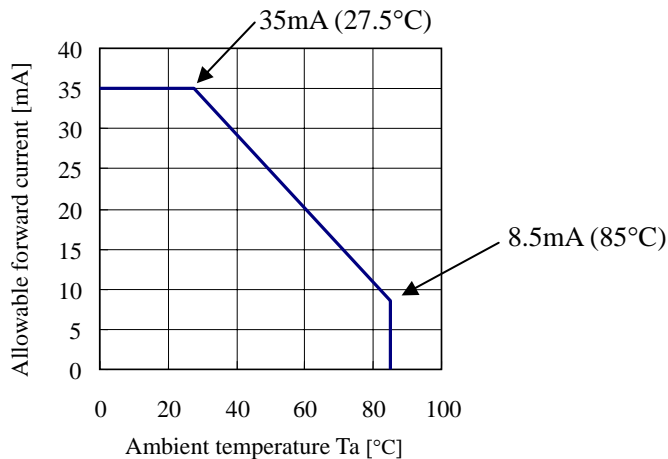
4.2 ABSOLUTE MAXIMUM RATINGS

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			
	Forward current	IL	Note1			mW
	Pulse forward current	IFP	100			mA
Storage temperature	Tst	-30 to +80	°C	-		
Operating temperature	Top	-10 to +60		Product surface Note2		
Relative humidity	RH	≤ 95	%	Ta ≤ 40°C		
		≤ 85		40°C < Ta ≤ 50°C		
		≤ 55		50°C < Ta ≤ 60°C		
Absolute humidity	AH	≤ 70 Note4	g/m ³	Ta > 60°C		
Storage altitude		≤ 13,600	m	-30°C ≤ Ta ≤ 80°C		
Operating altitude		≤ 4,850	m	-10°C ≤ Ta ≤ 60°C		

☆

☆

Note1: Allowable forward current



Note2: Measured at display area

Note3: No condensation

Note4: Water amount at Ta= 60°C and RH= 55%

4.3 ELECTRICAL CHARACTERISTICS

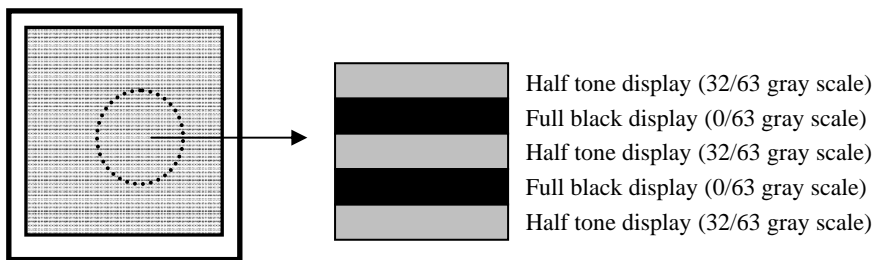
(1) Logic/ LCD driving

(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

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



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)

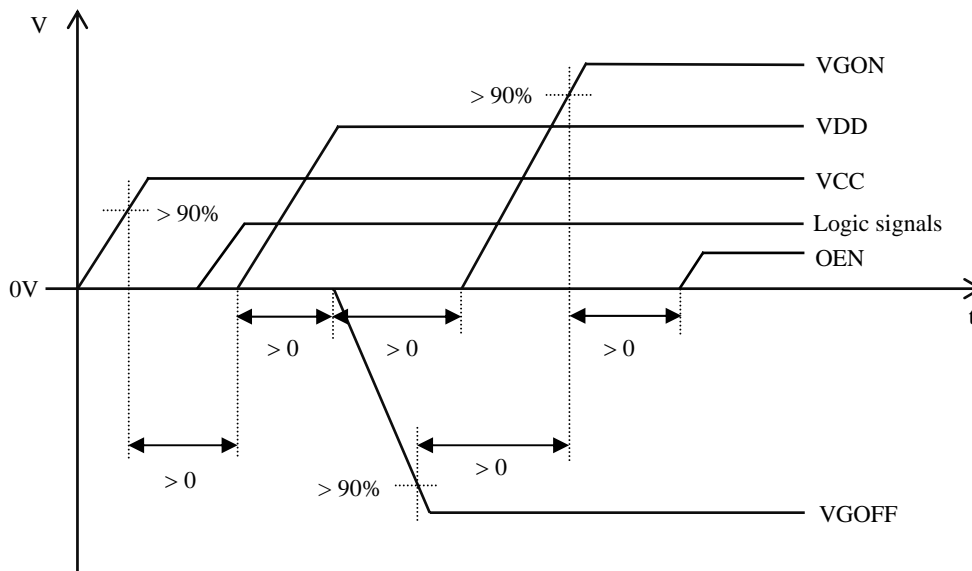
Parameter	Symbol	min.	typ.	max.	Unit	Remarks
Touch panel input voltage	Vtp	-	-	5.5	V	-
Resistor between terminals(XL-XR)	Rx	370	-	990	Ω	-
Resistor between terminals(YU-YD)	Ry	160	-	520	Ω	-
Line linearity (X direction)	Xlin	-	-	1.5	%	Note1
Line linearity (Y direction)	Ylin	-	-	1.5	%	Note1
Insulation resistance	Rins	20	-	-	MΩ	at DC 25V
Static capacitance	Ctp	-	-	100	nF	-
Chattering	Chat	-	-	10	ms	Note1
Operation starting force	Ost	-	-	1.177 120	N gf	Note1, Note2
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))

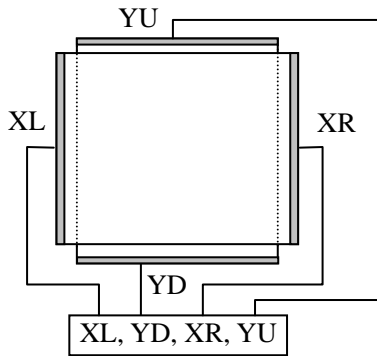
Pin No.	Symbol	Function	Pin No.	Symbol	Function
1	GND	Ground Note1	26	D11	Green data
2	VCC	Logic supply voltage	27	D10	Green data (LSB)
3	VCC	Logic supply voltage	28	GND	Ground Note1
4	VCK	V driver shift clock	29	D05	Red data (MSB)
5	VGON	V driver ON voltage	30	D04	Red data
6	VOE	V driver output enable ("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.

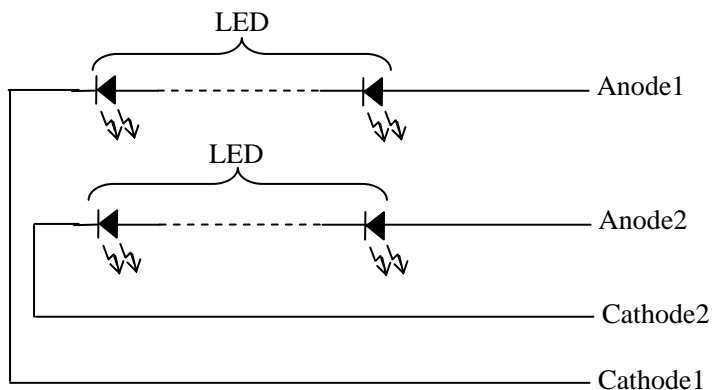
Note2: Do not fold the FPC. When the FPC is folded, pattern disconnection may be caused. In case of bending FPC, the minimum curvature (R) must be more than 1.0 mm.

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

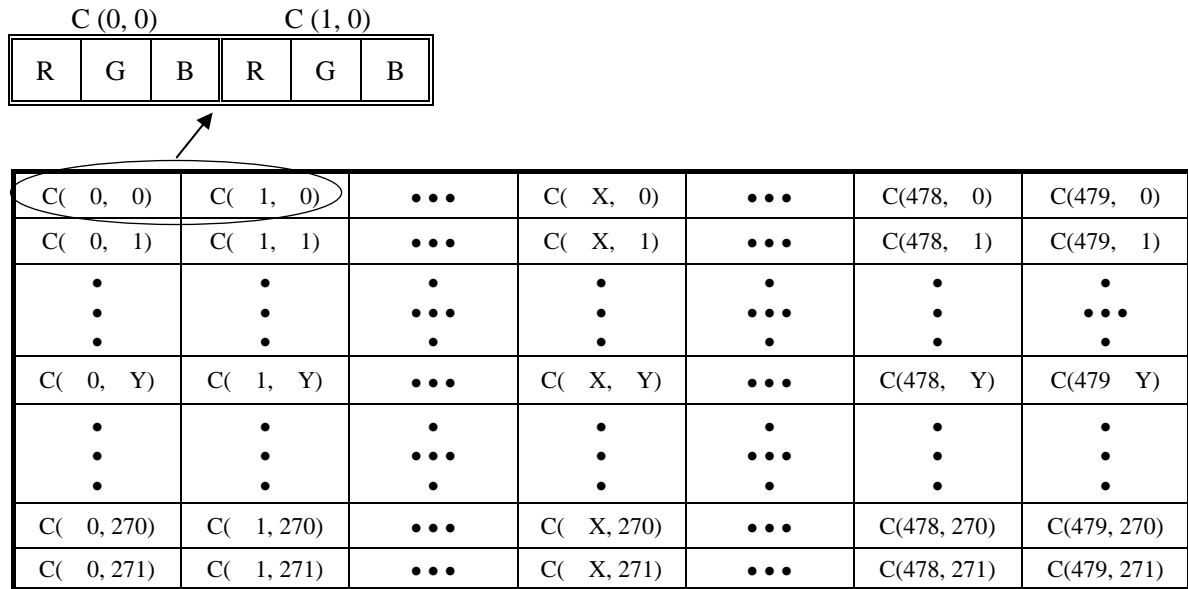
4.6 DISPLAY COLORS AND INPUT DATA SIGNALS

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
	dark	0	0	0	0	0	1	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
Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	
Green gray scale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	dark	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
Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	
Blue gray scale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	dark	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
Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	

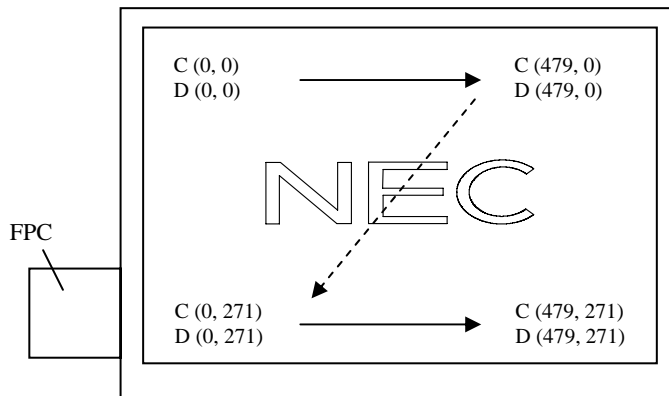
4.7 DISPLAY POSITIONS

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



4.8 SCANNING DIRECTIONS

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



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

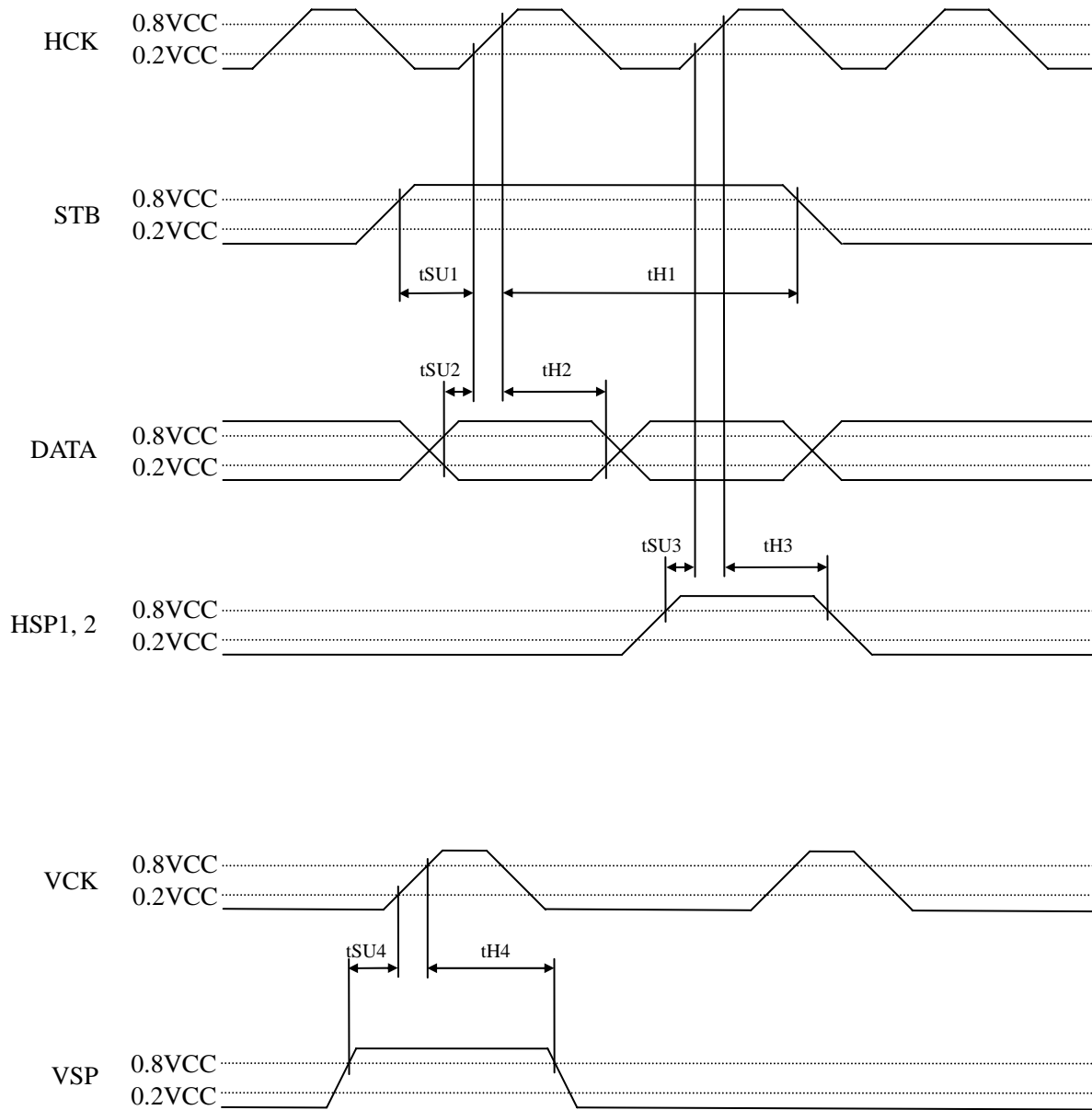
4.9 INPUT SIGNAL TIMINGS

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

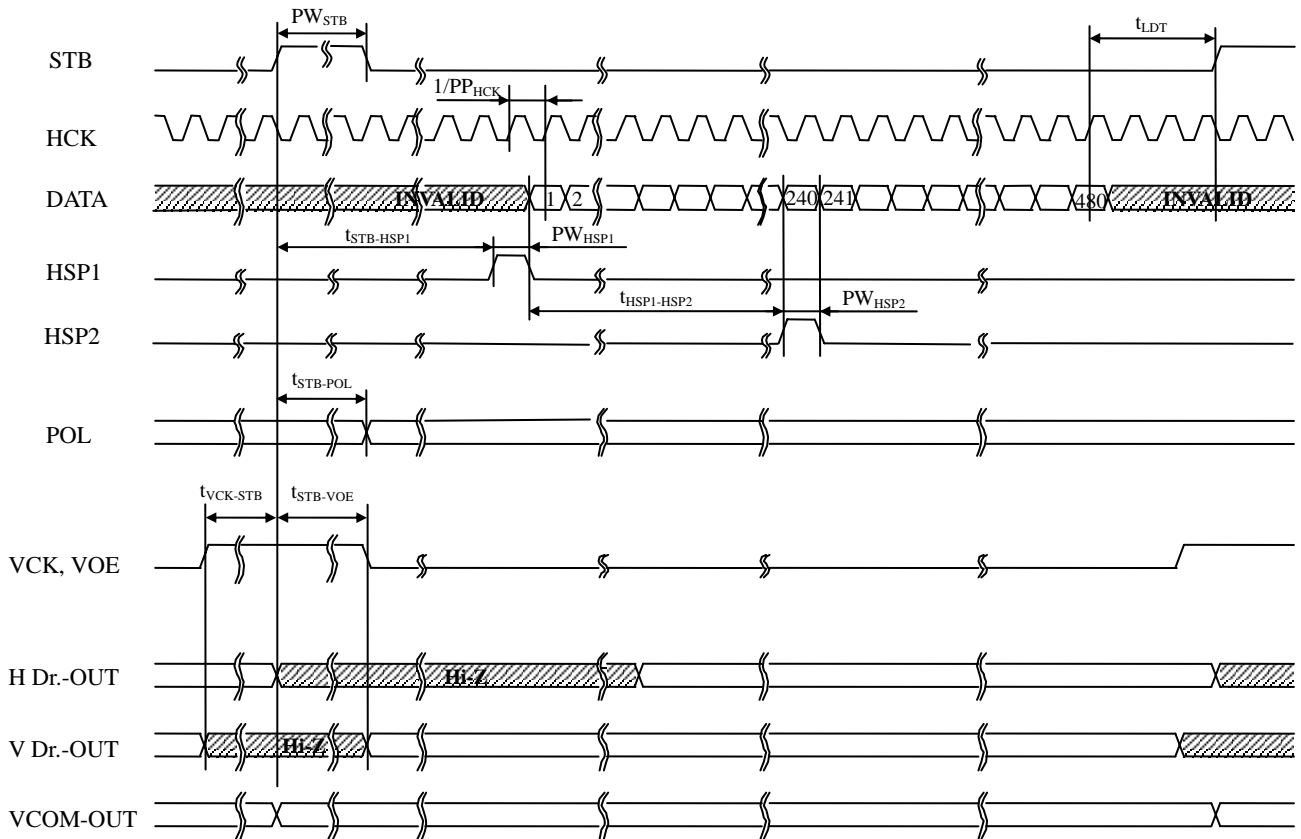
(1) Timing characteristics

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

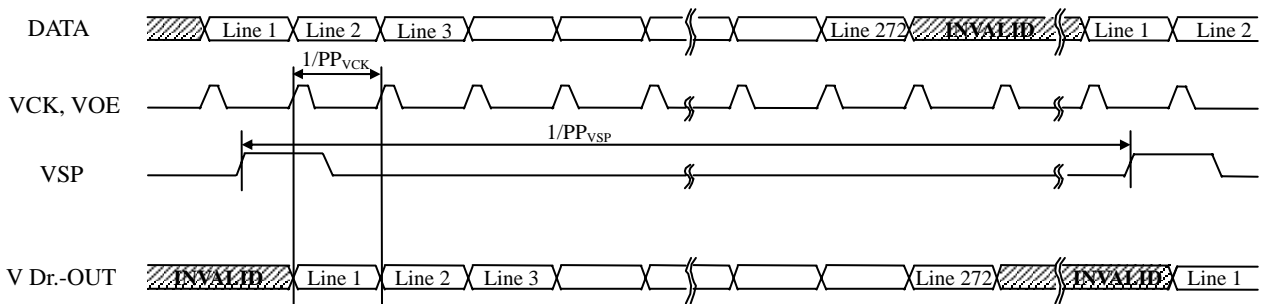
Note1: All parameters should be kept within the specified range.



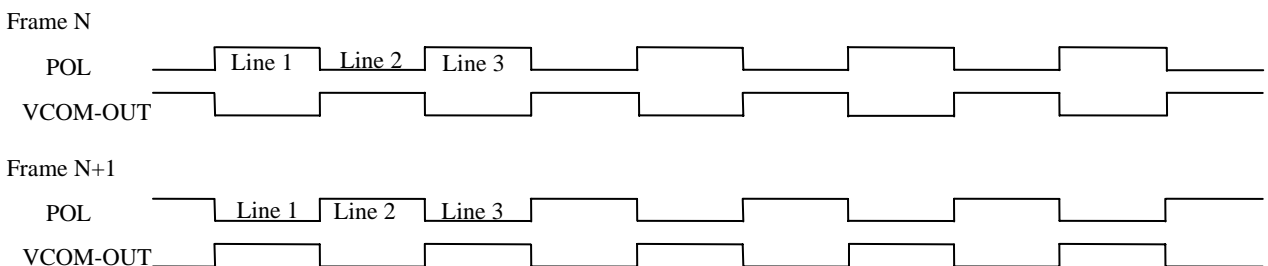
(2) Horizontal timing chart



(3) Vertical timing chart



(4) Polarity of signal "POL"



Note1: Unless otherwise specified, the input level is defined to be $V_{IH} = 0.8V_{CC}$, $V_{IL} = 0.2V_{CC}$

4.10 OPTICAL CHARACTERISTICS

(Note1, Note2)

Parameter	Condition	Symbol	min.	typ.	max.	Unit	Remarks
Luminance	White at center $\theta R=0^\circ, \theta L=0^\circ, \theta U=0^\circ, \theta D=0^\circ$	L	280	450	-	cd/m ²	-
Contrast ratio	White/Black at center $\theta R=0^\circ, \theta L=0^\circ, \theta U=0^\circ, \theta D=0^\circ$	CR	300	500	-	-	Note3
Luminance uniformity	White $\theta R=0^\circ, \theta L=0^\circ, \theta U=0^\circ, \theta D=0^\circ$ Maximum luminance: 100%	LU	60	80	-	%	Note4

☆
☆
☆

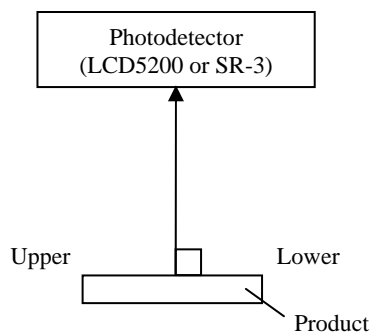
Reference data

(Note1, Note2)

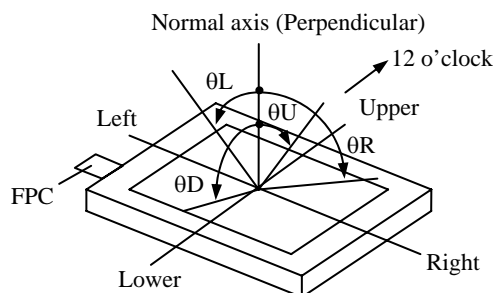
Parameter	Condition	Symbol	min.	typ.	max.	Unit	Remarks	
Chromaticity coordinates	White	Wx	0.25	0.30	0.35	-	Note5	
		Wy	0.29	0.34	0.39	-		
	Red	Rx	0.58	0.63	0.68	-		
		Ry	0.28	0.33	0.38	-		
	Green	Gx	0.28	0.33	0.38	-		
		Gy	0.55	0.60	0.65	-		
	Blue	Bx	0.10	0.15	0.20	-		
By		0.06	0.11	0.16	-			
Color gamut	$\theta R=0^\circ, \theta L=0^\circ, \theta U=0^\circ, \theta D=0^\circ$ 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	$\theta U=0^\circ, \theta D=0^\circ, CR \geq 10$	θR	-	50	-	°	-
	Left	$\theta U=0^\circ, \theta D=0^\circ, CR \geq 10$	θL	-	50	-		
	Up	$\theta R=0^\circ, \theta L=0^\circ, CR \geq 10$	θU	-	70	-		
	Down	$\theta R=0^\circ, \theta L=0^\circ, CR \geq 10$	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

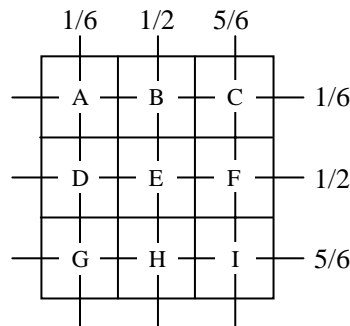
The contrast ratio is calculated by using the following formula.

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

Note4: Definition of luminance uniformity

Luminance uniformity is calculated by using the following formula.

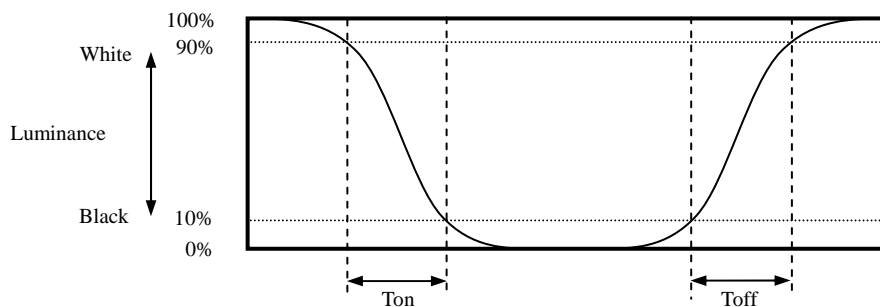
$$\text{Luminance uniformity (LU)} = \frac{\text{Minimum luminance from A to I}}{\text{Maximum luminance from A to I}} \times 100$$



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		

☆


☆


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.
---	--

	<p>* Do not touch the working backlight. There is a danger of burn injury.</p> <p>* 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/s² and to be not greater 2.5ms)</p>
---	--

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.

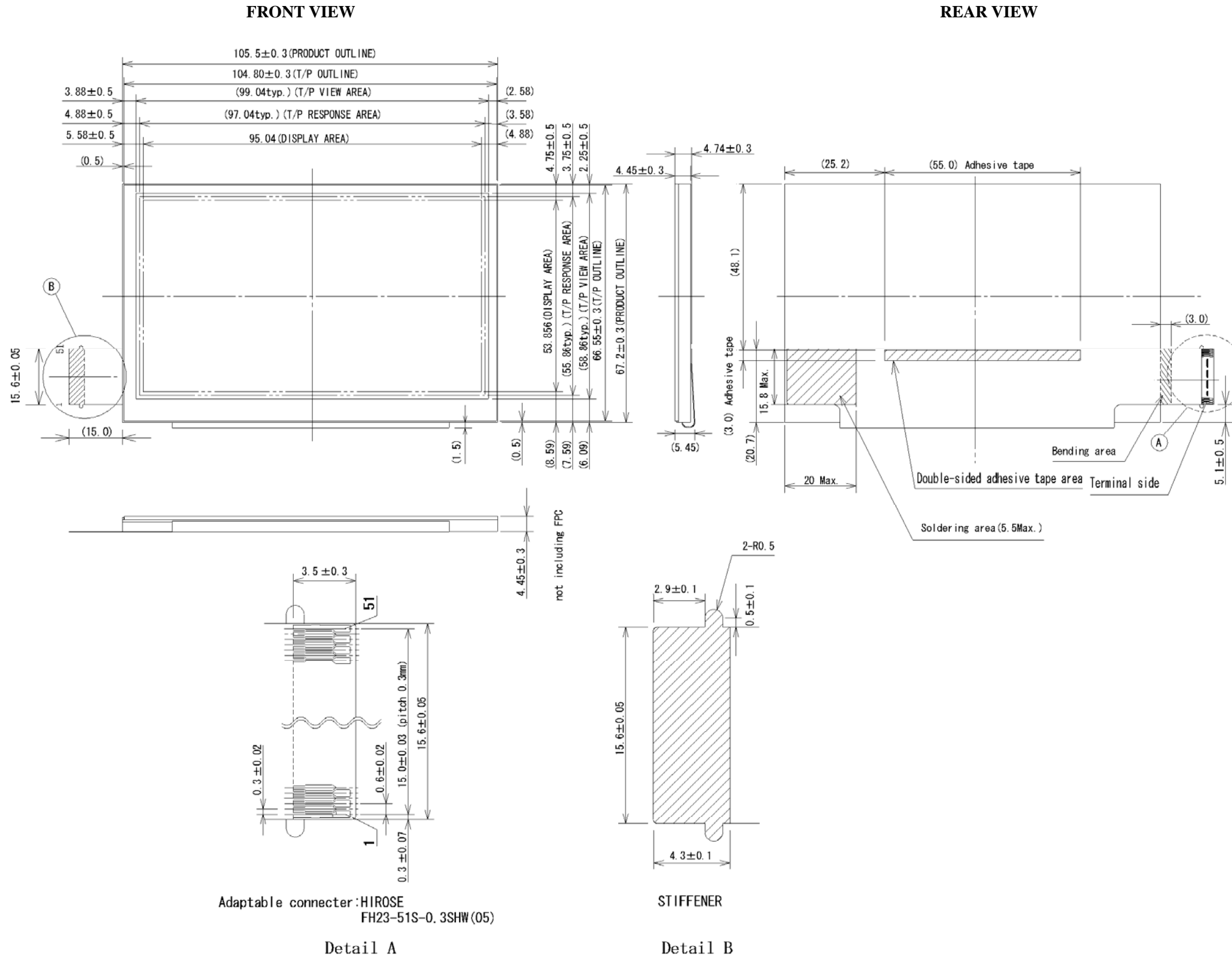
- ① Response time, luminance and color may be changed by ambient temperature.
- ② Display mura, flicker, vertical seam or small spot may be observed depending on display patterns.
- ③ Do not display the fixed pattern for a long time because it may cause image sticking.
- ④ Optical characteristics may 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



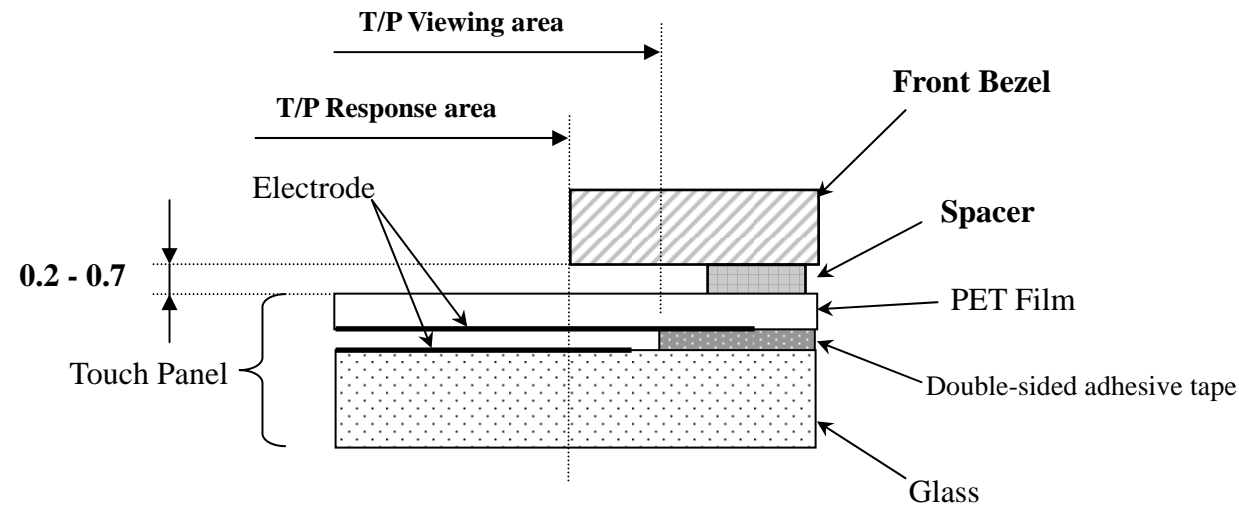
Pin No.	Symbol	Pin No.	Symbol
1	GND	26	D11
2	VCC	27	D10
3	VCC	28	GND
4	VCK	29	D05
5	VGON	30	D04
6	VOE	31	D03
7	VGOFF	32	D02
8	VSP	33	D01
9	VDD	34	D00
10	HCK	35	GND
11	STB	36	POL
12	HSP1	37	INV
13	HSP2	38	GND
14	GND	39	VCOM
15	D25	40	GND
16	D24	41	COM
17	D23	42	GND
18	D22	43	XL
19	D21	44	YD
20	D20	45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

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.

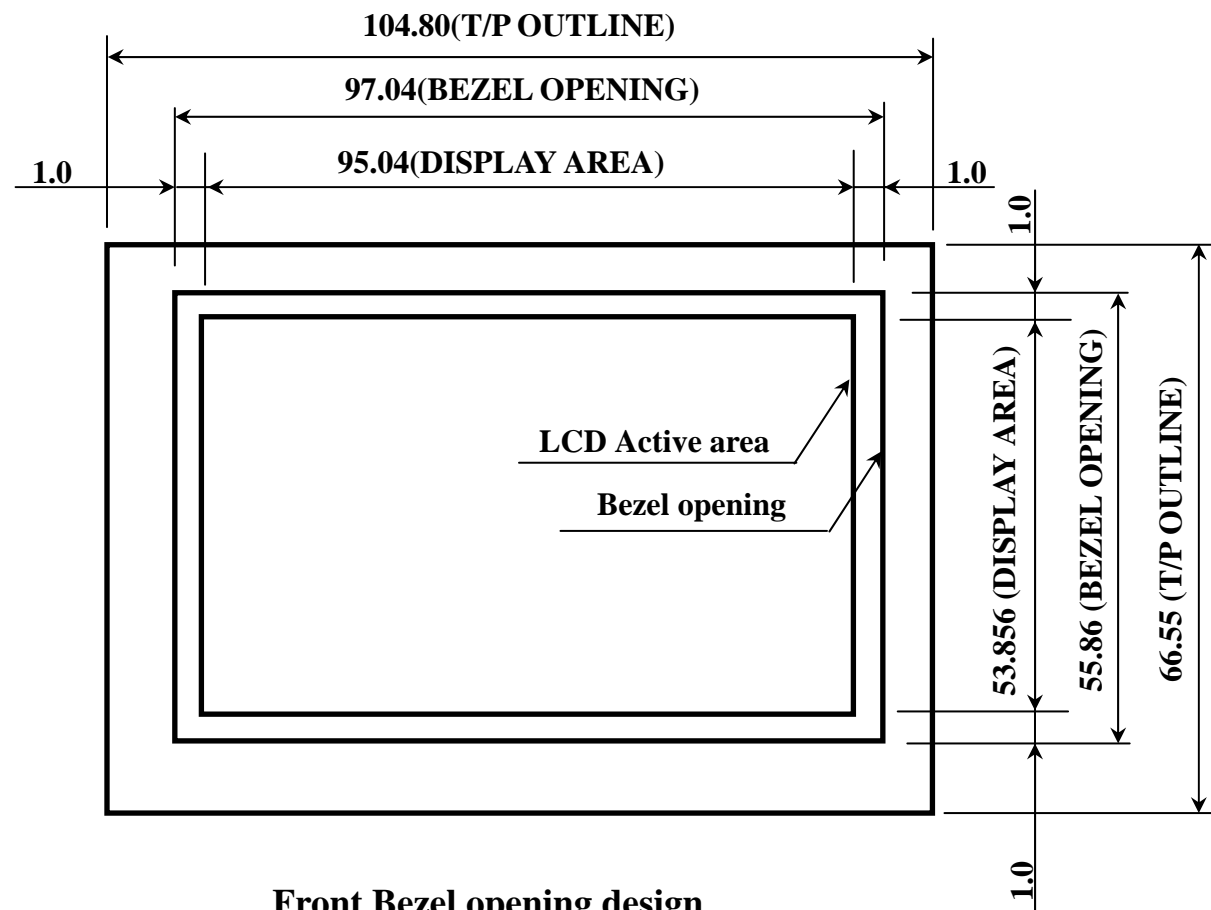
Unit: mm

8. RECOMMENDATION DESIGN OF FRONT BEZEL

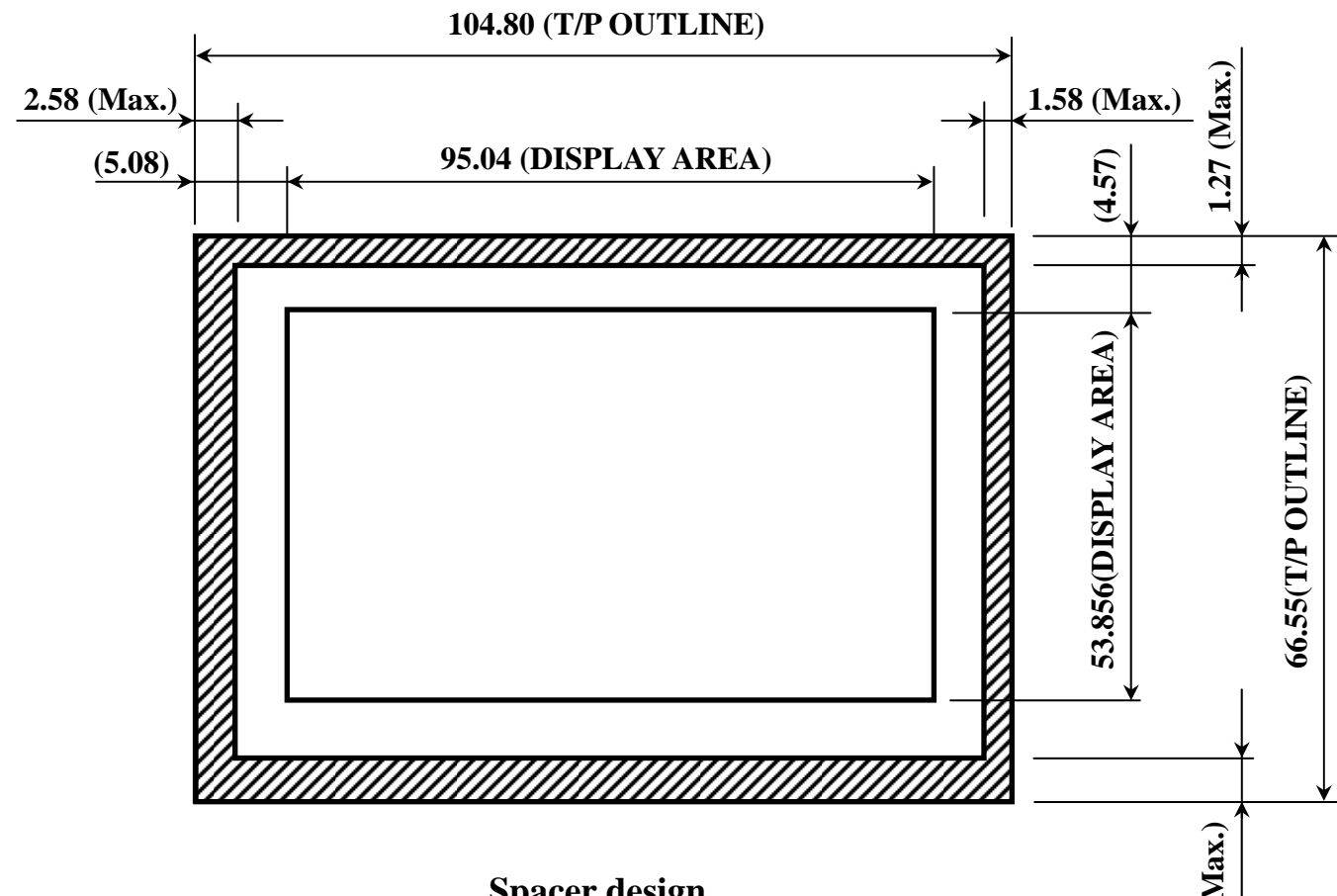


Design guidance for a front bezel and a spacer

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

4.82 (Max.)
Unit: mm