

PRELIMINARY


NEC NEC LCD Technologies, Ltd.

TFT COLOR LCD MODULE

NL4827HC19-05B

**11cm (4.3 Type)
WQVGA**

PRELIMINARY DATA SHEET

DOD-PP-0569 (6th edition) 

**This PRELIMINARY DATA SHEET is updated
document from DOD-PP-0519(5).**

**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.

PRELIMINARY

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	19
5. RELIABILITY TESTS	21
6. PRECAUTIONS	22
6.1 MEANING OF CAUTION SIGNS	22
6.2 CAUTIONS	22
6.3 ATTENTIONS	22
6.3.1 Handling of the product.....	22
6.3.2 Environment	23
6.3.3 Characteristics	23
6.3.4 Other	23
7. OUTLINE DRAWINGS	24
8. RECOMMENDATION DESIGN OF FRONT BEZEL	25
REVISION HISTORY	26

1. OUTLINE

1.1 STRUCTURE AND PRINCIPLE

Color LCD module NL4827HC19-05B 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

- Personal navigation device

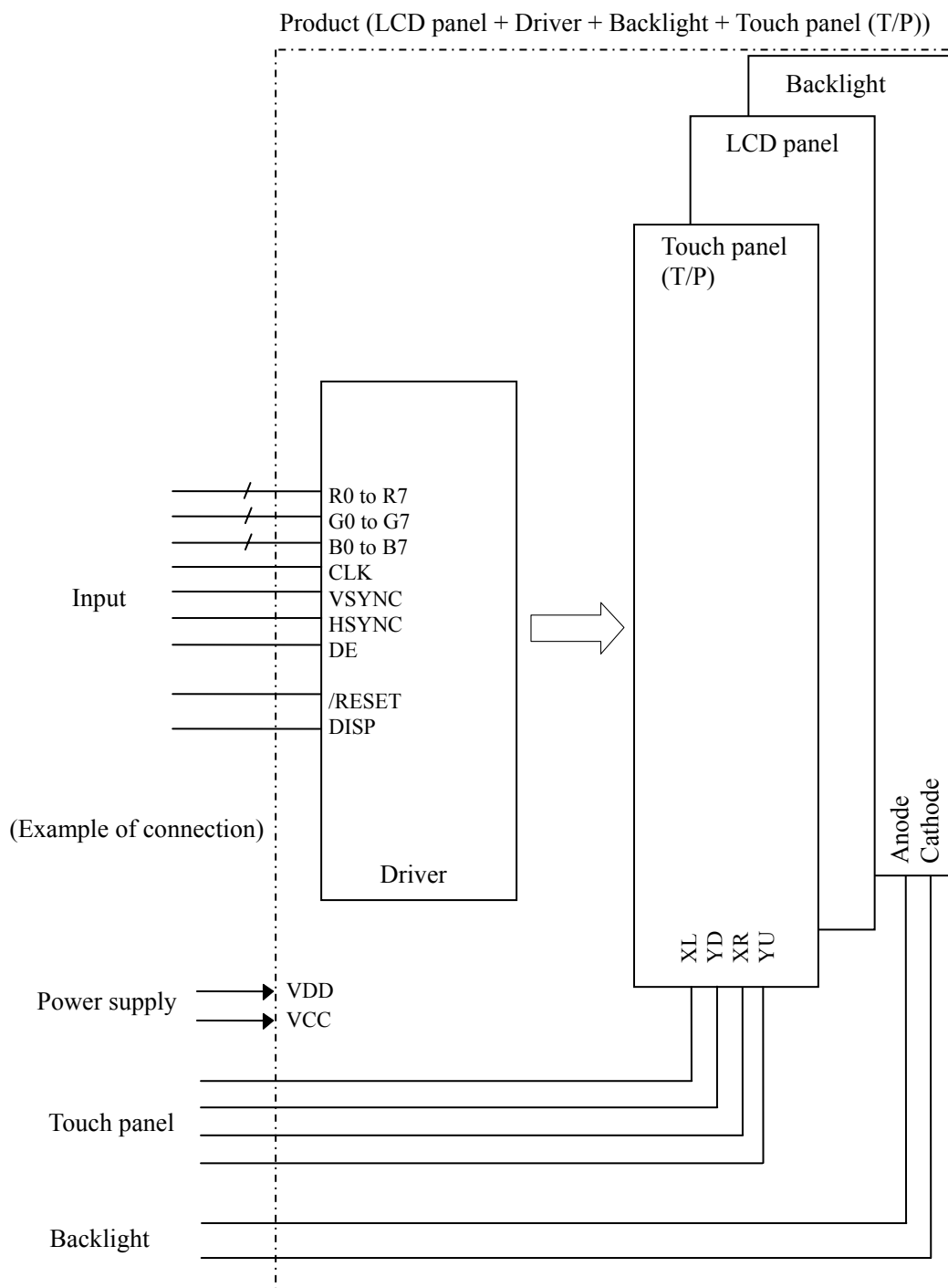
1.3 FEATURES

- Transmissive type
- Backlight and touch panel attached
- High luminance
- High contrast
- Including LCD controller and power supply
- 8-bit digital RGB signals

2. GENERAL SPECIFICATIONS

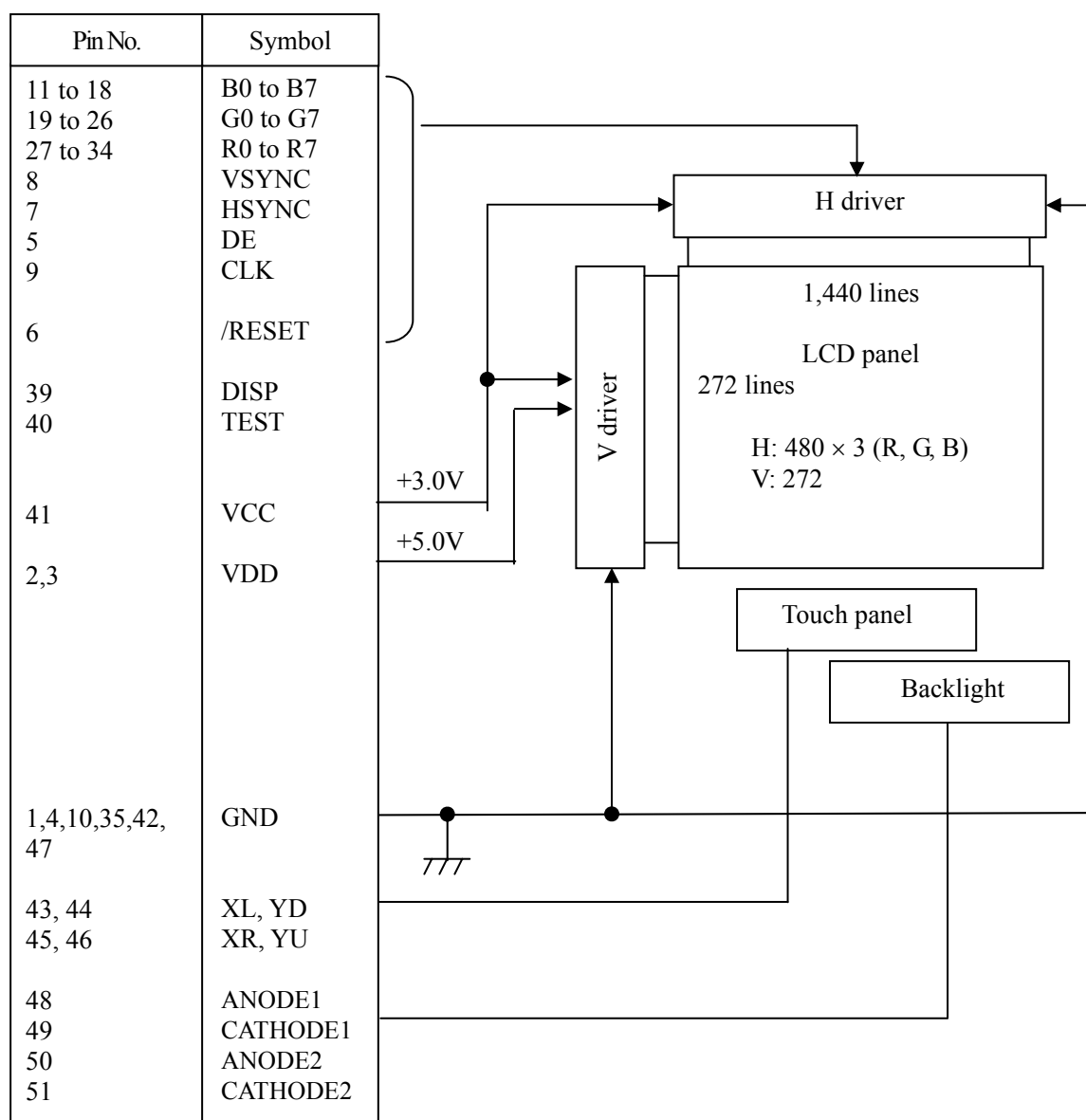
Display area	95.04 (H) × 53.856 (V) mm
Diagonal size of display	11 cm (4.3 inches)
Drive system	a-Si TFT active matrix
Display color	16,777,216 colors
Pixel	480 (H) × 272 (V) pixels
Pixel arrangement	RGB (Red dot, Green dot, Blue dot) vertical stripe
Dot pitch	0.066 (H) × 0.198 (V) mm
Pixel pitch	0.198 (H) × 0.198 (V) mm
Module size	105.5 (H) × 67.2 (V) × 4.8 (D) mm (typ.)
Weight	(72) (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 500cd/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%) 33ms (typ.)
Signal system	8-bit digital signals for data of RGB colors, Dot clock (CLK), DE, Horizontal synchronous signal (HSYNC), Vertical synchronous signal (VSYNC), Reset signal (/RESET)
Supply voltage	VCC: 3.0V (typ., for Logic) VDD: 5.0V (typ., for LCD driver)
Power consumption	LCD panel + Driver: 87 mW (typ.) Backlight: 512 mW (typ., at IL = 20mA)

3. BLOCK DIAGRAM



NEC NEC LCD Technologies, Ltd.

FPC I/F



4. DETAILED SPECIFICATIONS

4.1 MECHANICAL SPECIFICATIONS

Parameter	Specification	Unit
Module size	105.5 ± 0.3 (W) × 67.2 ± 0.3 (H) × 4.8 ± 0.3 (D) Note1	mm
Display area	95.04 (H) × 53.856 (V) Note2	mm
Weight	(72) (typ.), (74) (max.)	g

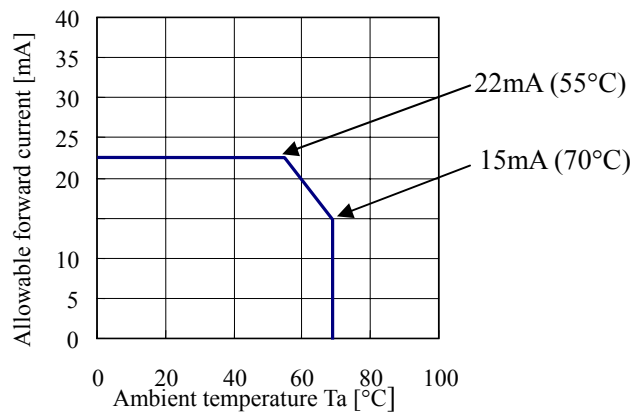
Note1: Excluding FPC

Note2: See "7. OUTLINE DRAWINGS".

4.2 ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating	Unit	Remarks
Supply voltage	VCC	-0.3 to +6.0	V	Ta= 25°C
	VDD	-0.3 to +6.0		
Logic input voltage	VI	-0.3 to VCC+0.3	V	Logic signals
Backlight	Reverse voltage	VR	≤ 20	Ta= 25°C, These values are applied for both Anode1 and 2.
	Power dissipation	PD	≤ 492	
	Forward current	IL	Note1	-
	Pulse forward current	IFP	100	Pulse width ≤ 10ms, Duty ≤ 1/10
Storage temperature	Tst	(-30 to +80)	°C	-
Operating temperature	Top	-20 to +70		Product surface Note2
Relative humidity Note3	RH	≤ 95	%	Ta ≤ 40°C
		≤ 85		40°C < Ta ≤ 50°C
		≤ 55		50°C < Ta ≤ 60°C
		≤ 36		60°C < Ta ≤ 70°C
Absolute humidity Note3	AH	≤ 70 Note4	g/m ³	Ta > 70°C
Storage altitude		≤ 13,600	m	(-30°C ≤ Ta ≤ 80°C)
Operating altitude		≤ 4,850	m	-20°C ≤ Ta ≤ 70°C

Note1: Allowable forward current



Note2: Measured at display area

Note3: No condensation

Note4: Water amount at Ta= 70°C and RH= 36%

4.3 ELECTRICAL CHARACTERISTICS

(1) Logic/ LCD driving

(Ta= 25°C)

Parameter	Symbol	min.	typ.	max.	Unit	Remarks
Logic supply voltage	VCC	2.3	3.0	3.6	V	-
LCD driver supply voltage	VDD	4.8	5.0	5.2	V	-
Logic input high voltage	VIH	0.7VCC	-	VCC	V	Logic signal
Logic input low voltage	VIL	0	-	0.3VCC	V	
VCC supply current	ICC	-	4	8	mA	at VCC= 3.0V, VDD=5.0V Note1
VDD supply current	IDD	-	15	24	mA	at VCC= 3.0V, VDD=5.0V Note1

Note1: PPHCK= (10.87)MHz, HSYNC= (20.7)kHz, VSYNC= (75)Hz,
Checkered flag pattern (by EIAJ ED-2522)

(2) Backlight

(Ta= 25°C)

Parameter	Symbol	min.	typ.	max.	Unit	Remarks
Forward Current	IL1, 2	-	(20)	22	mA	-
Forward Voltage	VL1, 2	-	(12.8)	14	V	at IL= 20mA

(3) Touch panel

(Ta= 25°C)

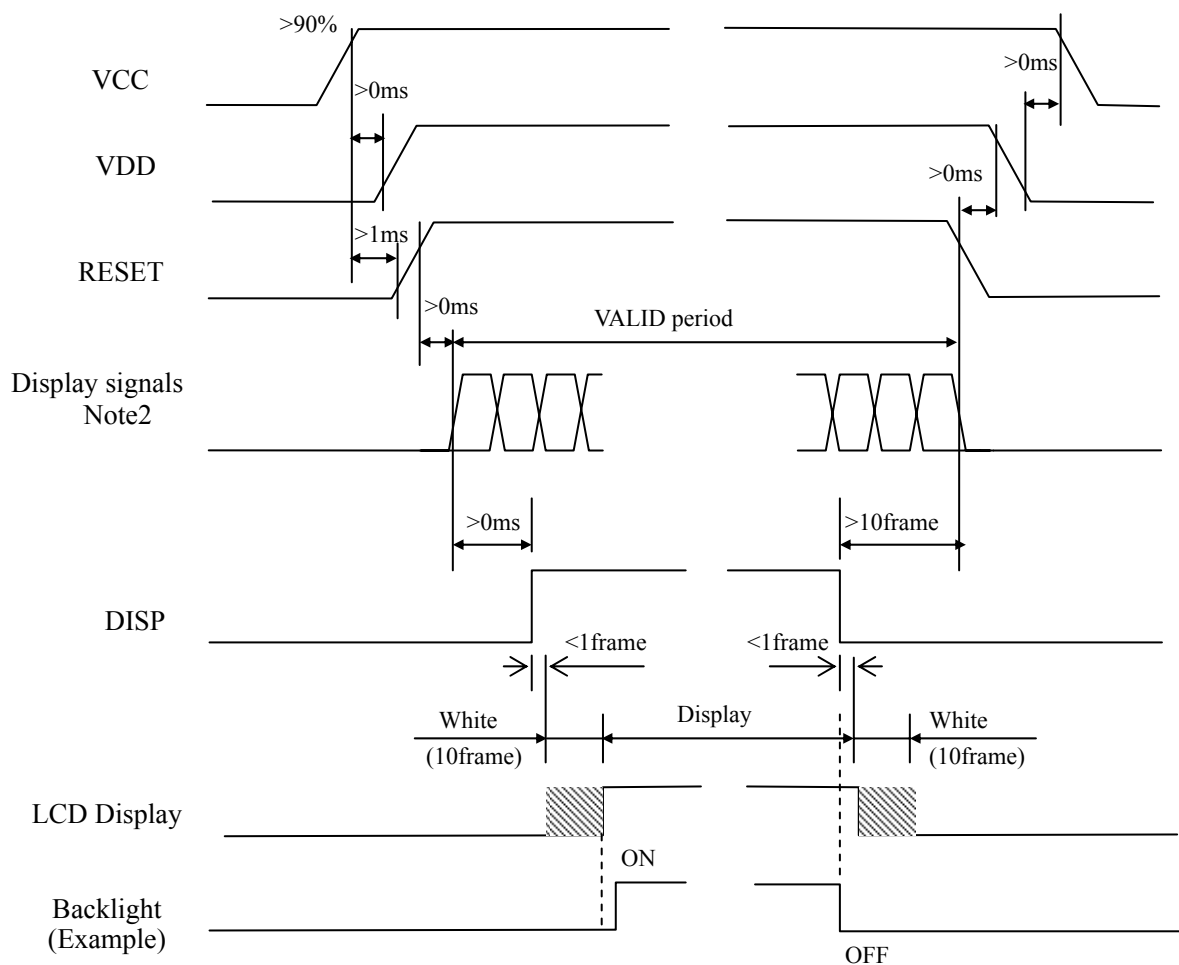
Parameter	Symbol	min.	typ.	max.	Unit	Remarks
Touch panel input voltage	Vtp	-	-	5.5	V	-
Resistor between terminals(XL-XR)	Rx	(370)	-	(990)	Ω	-
Resistor between terminals(YU-YD)	Ry	(160)	-	(520)	Ω	-
Line linearity (X direction)	Xlin	-	-	1.5	%	Note1
Line linearity (Y direction)	Ylin	-	-	1.5	%	Note1
Insulation 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), 300mm/s, 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.

Note2: Display signals (CLK, HSYNC, VSYNC, DE, R0 to R7, G0 to G7, B0 to B7) must be Low or High-impedance, exclude the VALID period (See above sequence diagram), in order to avoid that internal circuits is damaged.

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-0.3SHW(06)) (Hirose Electric Co., Ltd.(HRS))

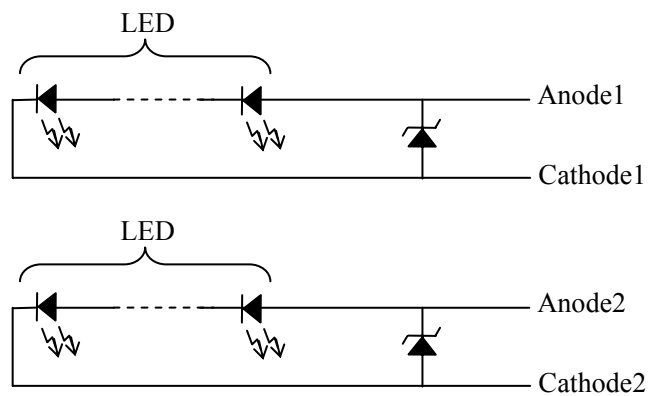
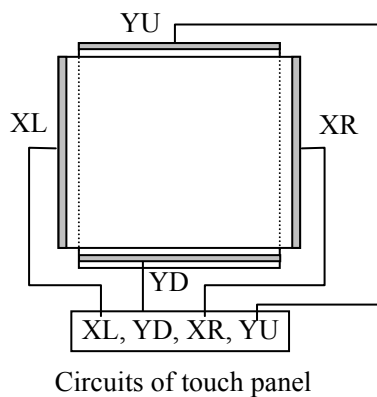
Pin No.	Symbols	Functions	Pin No.	Symbols	Functions
1	GND	Ground Note1	27	R0	Red data (LSB)
2	VDD	Power supply	28	R1	Red data
3	VDD		29	R2	Red data
4	GND	Ground Note1	30	R3	Red data
5	DE	Data enable signal	31	R4	Red data
6	/RESET	Reset	32	R5	Red data
7	HSYNC	Horizontal synchronous signal	33	R6	Red data
8	VSYNC	Vertical synchronous signal	34	R7	Red data (MSB)
9	CLK	Dot clock	35	GND	Ground Note1
10	GND	Ground Note1	36	RSVD	Keep this pin Open.
11	B0	Blue data (LSB)	37	RSVD	Keep this pin Open.
12	B1	Blue data	38	RSVD	Keep this pin Open.
13	B2	Blue data	39	DISP	Display ON/OFF
14	B3	Blue data	40	TEST	Keep this pin H.
15	B4	Blue data	41	VCC	Power supply (Logic)
16	B5	Blue data	42	GND	Ground Note1
17	B6	Blue data	43	XL	Horizontal terminal (Left side)
18	B7	Blue data (MSB)	44	YD	Vertical terminal (Down side)
19	G0	Green data (LSB)	45	XR	Horizontal terminal (Right side)
20	G1	Green data	46	YU	Vertical terminal (Up side)
21	G2	Green data	47	GND	Ground Note1
22	G3	Green data	48	ANODE1	LED1 voltage (Anode)
23	G4	Green data	49	CATHODE1	LED1 voltage (Cathode)
24	G5	Green data	50	ANODE2	LED2 voltage (Anode)
25	G6	Green data	51	CATHODE2	LED2 voltage (Cathode)
26	G7	Green data (MSB)			

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

Terminals	Description
/RESET	When /RESET is L, an internal reset is performed. The reset operation is executed at the /RESET signal level. Be sure to perform reset via this pin at power application.
DISP	Display ON/ OFF mode control. Internally pulled high. When DISP is L, input data is invalid and display OFF (white).
YU,XR,YD,XL	Refer to the below “ Circuits of touch panel ”.
ANODE, CATHODE	Refer to the below “ Circuits of backlight ”.



4.6 DISPLAY COLORS AND INPUT DATA SIGNALS

This product can display equivalent of 16,777,216 colors in 256 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)																							
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Red gray scale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	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	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	↑					:								:							:				
	↓					:								:							:				
	bright	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Green gray scale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	↑					:								:							:				
	↓					:								:							:				
	bright	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
Blue gray scale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	↑					:								:							:				
	↓					:								:							:				
	bright	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	1	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

4.7 DISPLAY POSITIONS

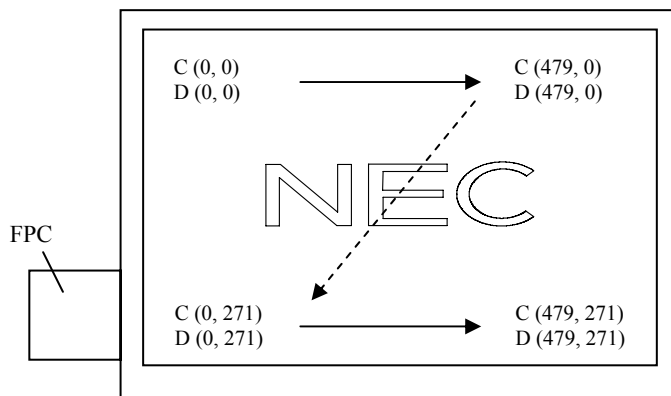
The following table is the coordinates per pixel (See figure of "4.8 SCANNING DIRECTIONS".).

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.



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

RGB interface (Ta= 25°C, VCC= 3.0V, VDD=5.0V)

(1) Timing characteristics

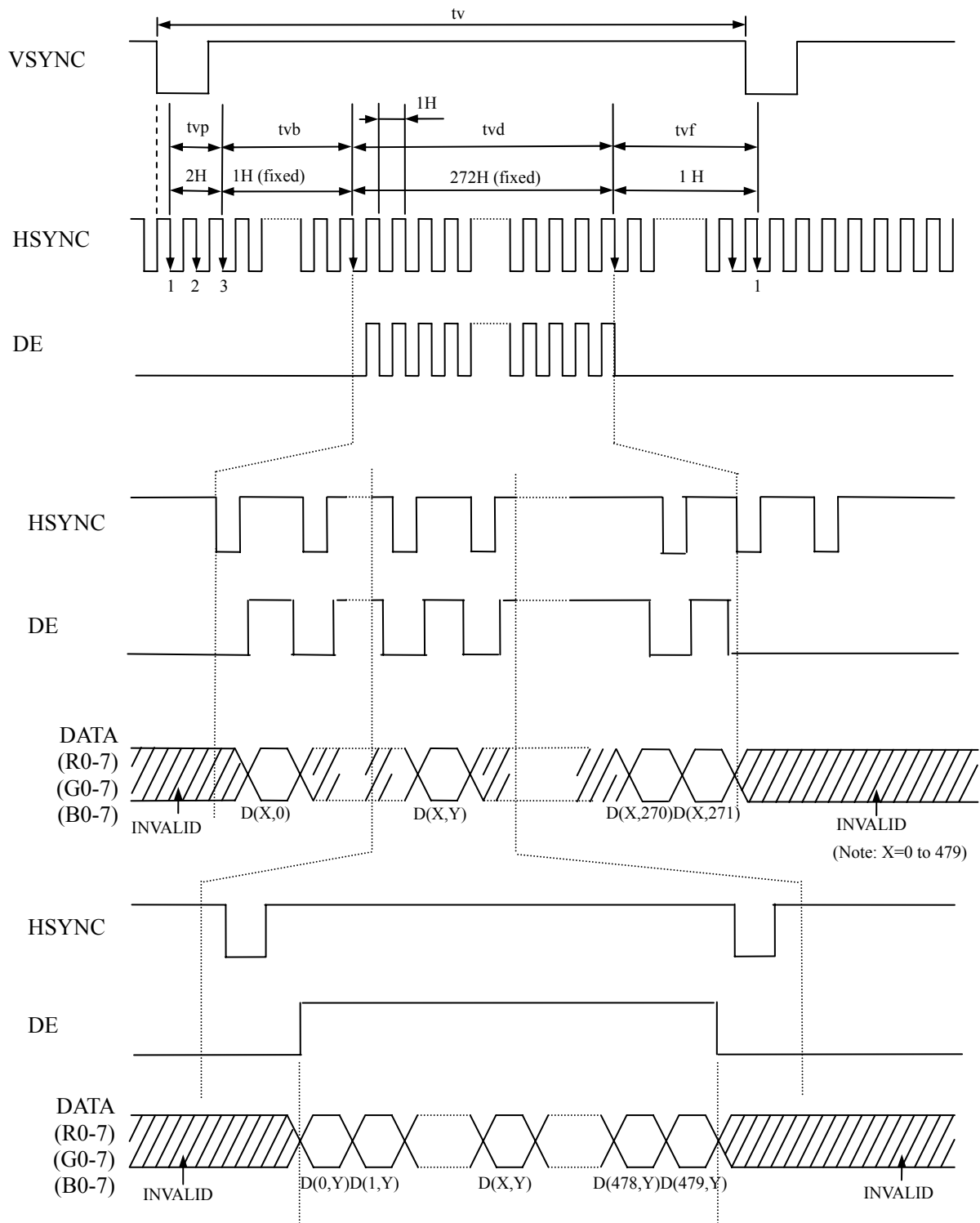
Parameter			Symbol	min.	typ.	max.	Unit	Remarks
CLK	Frequency		1/tc	8.69	10.87	11.59	MHz	-
	Duty		tcd	0.4	0.5	0.6	-	-
	Rise time, Fall time		terf	-	-	2	ns	-
DATA (D00-05) (D10-15) (D20-25)	CLK-DATA	Setup time	tds	15	-	-	ns	-
		Hold time	tdh	15	-	-	ns	
	Rise time, Fall time		tdrf	-	-	2	ns	
DE	CLK-DE	Setup time	tdes	15	-	-	ns	-
		Hold time	tdeh	15	-	-	ns	
	Rise time, Fall time		tderf	-	-	2	ns	
HSYNC	Cycle		th	45.3	48.3	60.4	μs	(20.7)kHz (typ.)
				496	525	-	CLK	-
	Display period		thd	480			CLK	
	Front-porch		thf	2	2	-	CLK	
	Pulse width		thp	2	41	-	CLK	
	Back-porch		thb	2			CLK	
	CLK- HSYNC	Setup time	ths	15	-	-	ns	
		Hold time	thh	15	-	-	ns	
	Rise time, Fall time		thrf	-	-	2	ns	
VSYNC	Cycle		tv	12.5	13.33	16.67	ms	(75)Hz (typ.)
				275	276	-	H	-
	Display period		tvd	272			H	
	Front-porch		tvf	1	1	-	H	
	Pulse width		tvp	1	2	-	H	
	Back-porch		tvb	1			H	
	VSYNC- HSYNC	Setup time	tvhs	15	-	-	ns	
		Hold time	tvhh	15	-	-	ns	
	Rise time, Fall time		tvrif	-	-	2	ns	
DISP	DISP- VSYNC	Setup time	tdiss	15	-	-	ns	-
		Hold time	tdish	15	-	-	ns	
	Rise time, Fall time		tdisrf	-	-	2	ns	

Note1: Definition of parameters is as follows.

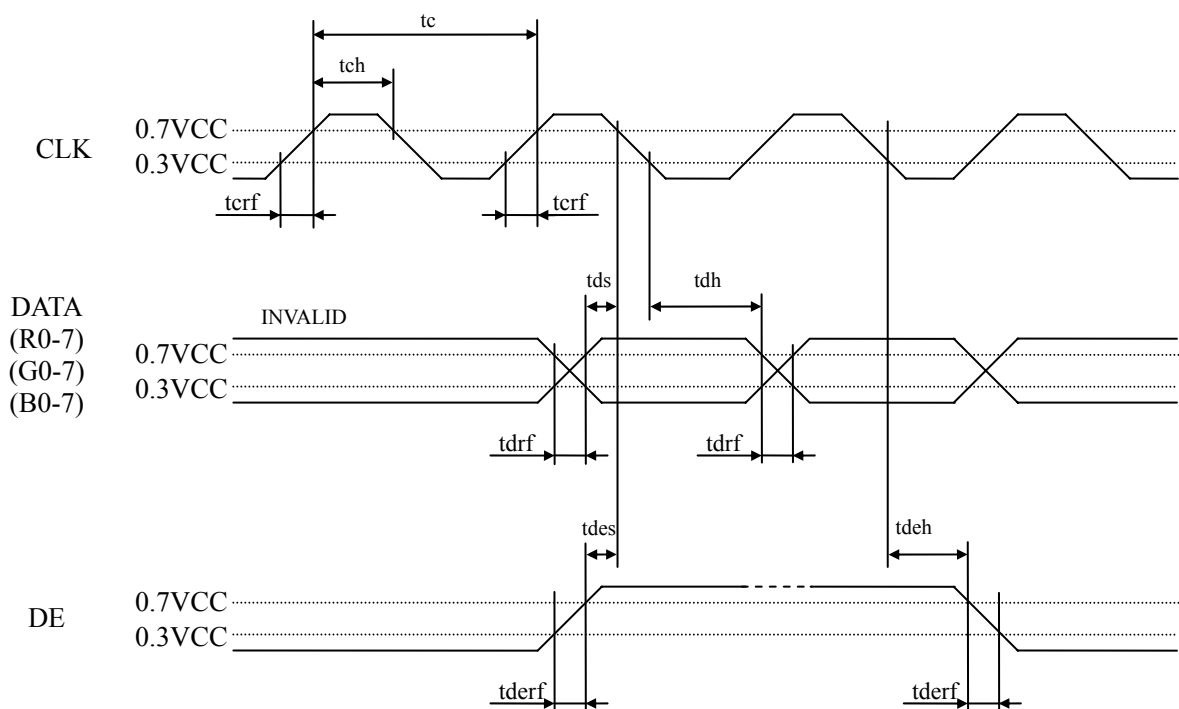
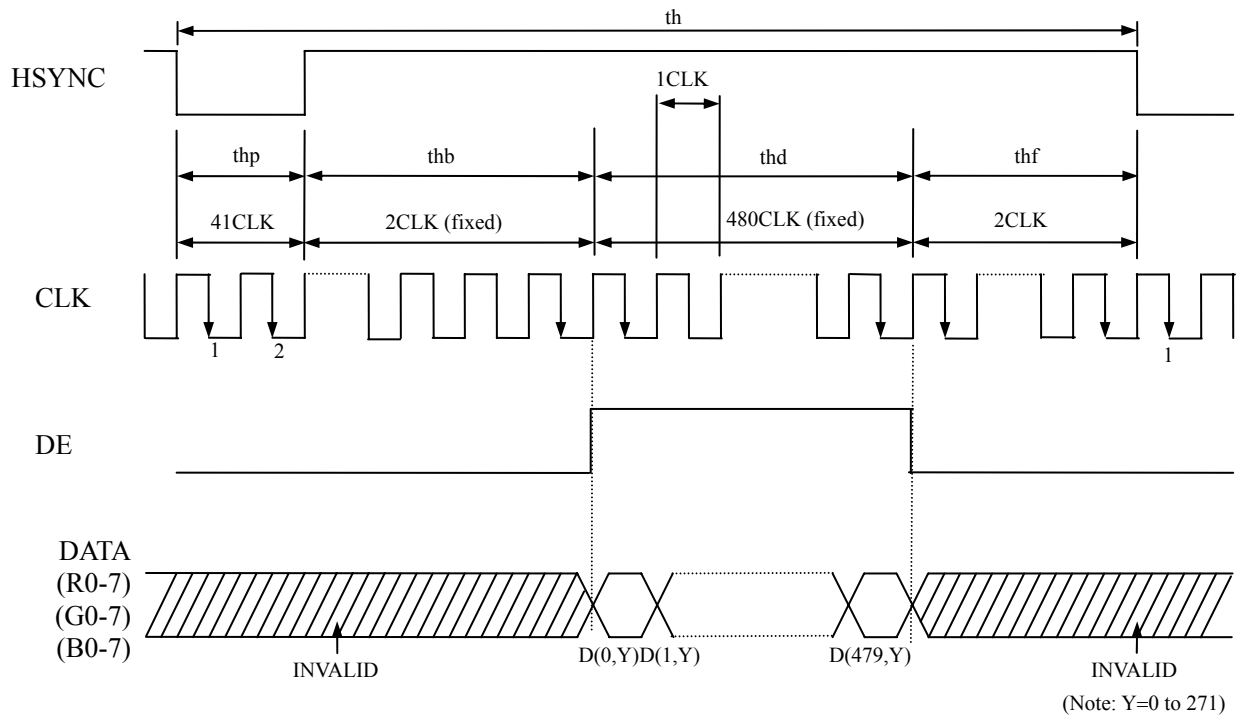
tc= 1CLK, tcd= tch/tc, th= 1H

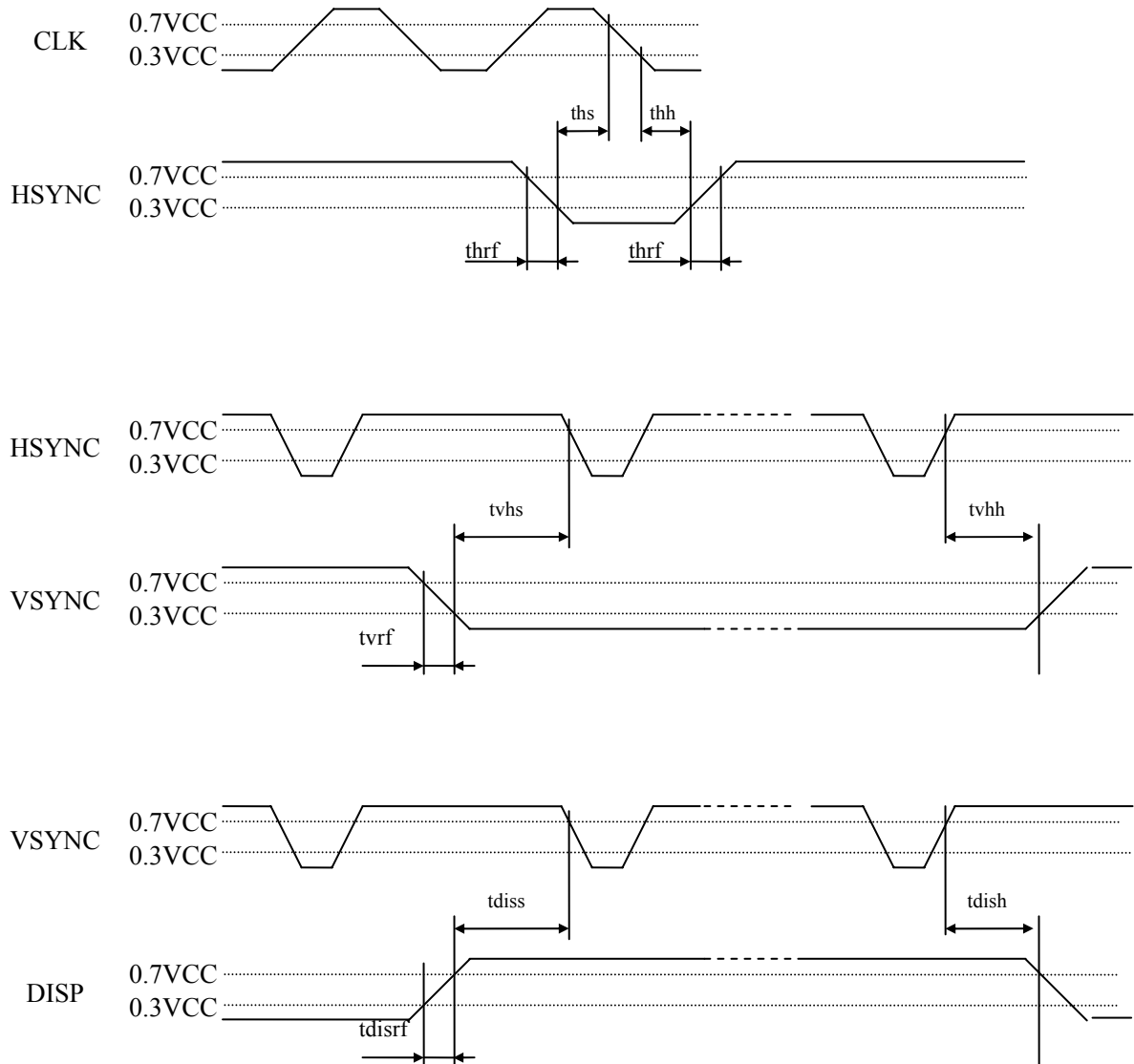
Note2: All parameters should be kept within the specified range.

(2) Input signal timing chart



Note1: Unless otherwise specified, the input level is defined to be $V_{IH} = 0.7V_{CC}$, $V_{IL} = 0.3V_{CC}$.





Note1: Unless otherwise specified, the input level is defined to be $V_{IH} = 0.7V_{CC}$, $V_{IL} = 0.3V_{CC}$.

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	300	500	-	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	70	80	-	%	Note4

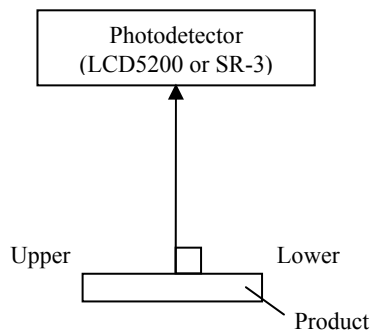
Reference data

(Note1, Note2)

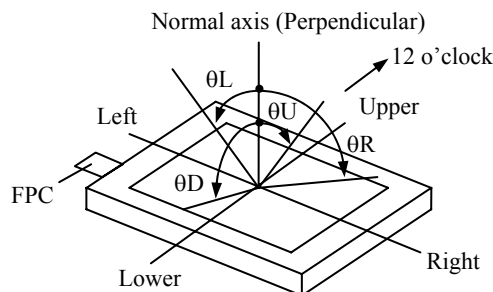
Parameter	Condition	Symbol	min.	typ.	max.	Unit	Remarks
Chromaticity coordinates	White	Wx	-	TBD	-	-	Note5
		Wy	-	TBD	-	-	
Color gamut	$\theta R = 0^\circ, \theta L = 0^\circ, \theta U = 0^\circ, \theta D = 0^\circ$ at center, against NTSC color space	C	50	60	-	%	
Response time	White to black 90%→10%	Ton	-	8	-	ms	Note6 Note7
	Black to white 10%→90%	Toff	-	25	-		
Viewing angle	Right $\theta U = 0^\circ, \theta D = 0^\circ, CR \geq 10$	θR	-	80	-	°	-
	Left $\theta U = 0^\circ, \theta D = 0^\circ, CR \geq 10$	θL	-	80	-	°	
	Up $\theta R = 0^\circ, \theta L = 0^\circ, CR \geq 10$	θU	-	60	-	°	
	Down $\theta R = 0^\circ, \theta L = 0^\circ, CR \geq 10$	θD	-	80	-	°	

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

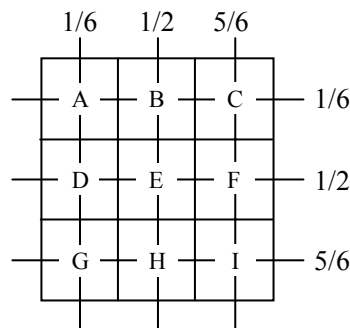
The contrast ratio is calculated by using the following formula.

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

Note4: Definition of luminance uniformity

Luminance uniformity is calculated by using the following formula.

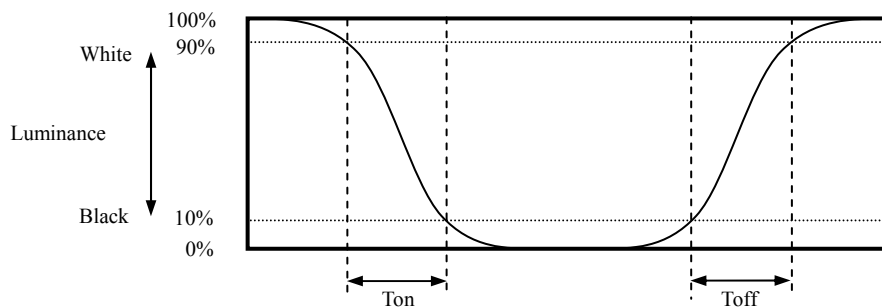
$$\text{Luminance uniformity (LU)} = \frac{\text{Minimum luminance from A to I}}{\text{Maximum luminance from A to I}} \times 100$$



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 $60 \pm 2^{\circ}\text{C}$, RH= 90%, 240 hours ② Display data is black.	No display malfunctions
Heat cycle (Operation)	① $-20 \pm 3^{\circ}\text{C}$...1 hour $70 \pm 3^{\circ}\text{C}$...1 hour ② 50 cycles, 4 hours/cycle ③ Display data is black.	
Thermal shock (Non operation)	① $(-30) \pm 3^{\circ}\text{C}$...30 minutes $(80) \pm 3^{\circ}\text{C}$...30 minutes ② 100 cycles, 1 hour/cycle ③ Temperature transition time is within 5 minutes.	
Low pressure (Non operation)	① 15kPa ② $(-30) \pm 3^{\circ}\text{C}$...24 hours ③ $(80) \pm 3^{\circ}\text{C}$...24 hours	
Low pressure (Operation)	① 53.3kPa ② $-20 \pm 3^{\circ}\text{C}$...24 hours ③ $70 \pm 3^{\circ}\text{C}$...24 hours	
ESD (Operation)	① 150pF, 150Ω, $\pm 10\text{kV}$ 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	No display malfunctions No physical damages
Vibration (Operation)	① 30 to 100Hz, 19.6m/s^2 (2G) ② 30 minutes/cycle ③ X, Y, Z directions ④ 1 times each directions	
Mechanical shock (Non operation)	① $3,920\text{m/s}^2$, 2.5ms ② $\pm X, \pm Y, \pm Z$ directions 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.**



*** 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/s² 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 any stress such as bends or twist. Bends, twist or any 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

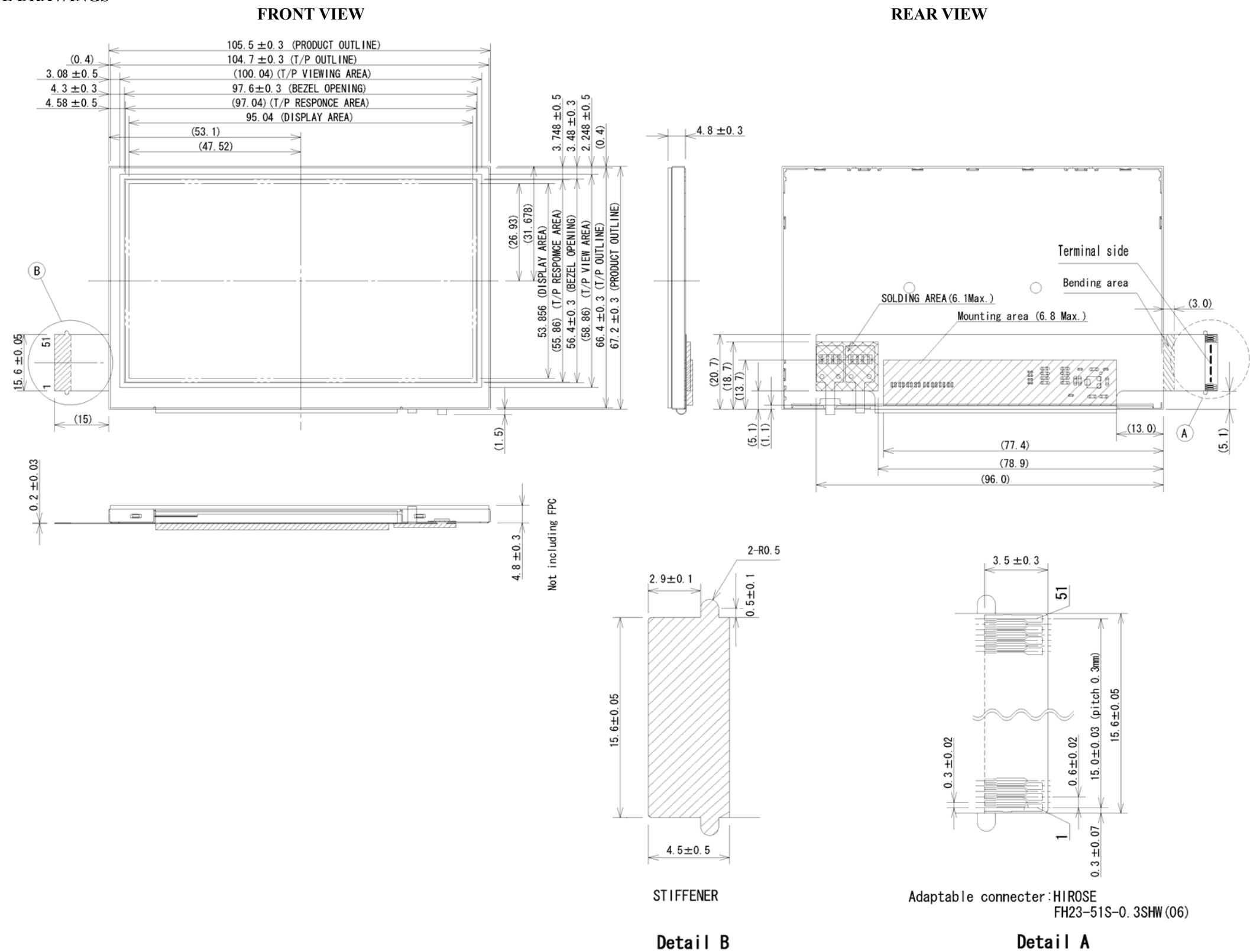
The following items are neither defects nor failures.

- 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

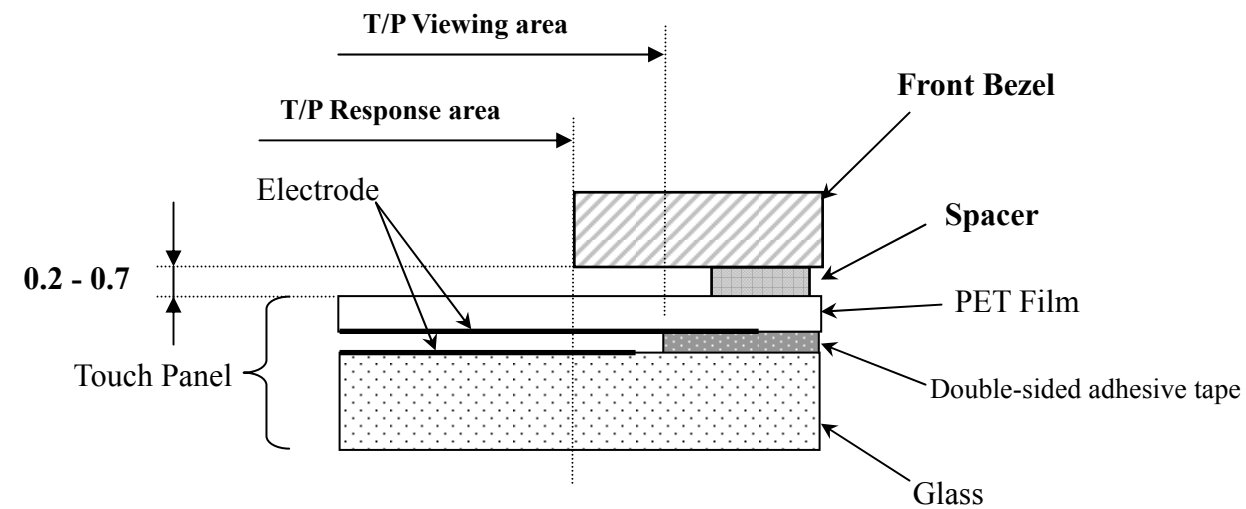


Pin No.	Symbol	Pin No.	Symbol
1	GND	26	G7
2	VDD	27	R0
3	VDD	28	R1
4	GND	29	R2
5	DE	30	R3
6	/RESET	31	R4
7	HSYNC	32	R5
8	VSYNC	33	R6
9	CLK	34	R7
10	GND	35	GND
11	B0	36	RSVD
12	B1	37	RSVD
13	B2	38	RSVD
14	B3	39	DISP
15	B4	40	TEST
16	B5	41	VCC
17	B6	42	GND
18	B7	43	XL
19	G0	44	YD
20	G1	45	XR
21	G2	46	YU
22	G3	47	GND
23	G4	48	ANODE1
24	G5	49	CATHODE1
25	G6	50	ANODE2
		51	CATHODE2

Note1: The values in parentheses are for reference.
 Note2: When installing the product to the customer equipment, do not apply any stress to rear side of the product, FPC, Soldering Area and Mounting Area.
 If not, it may cause display mura or break down of the product.
 Note3: While the product is working, do not contact a conductor such as a metal to the Soldering Area and Mounting Area of the FPC.

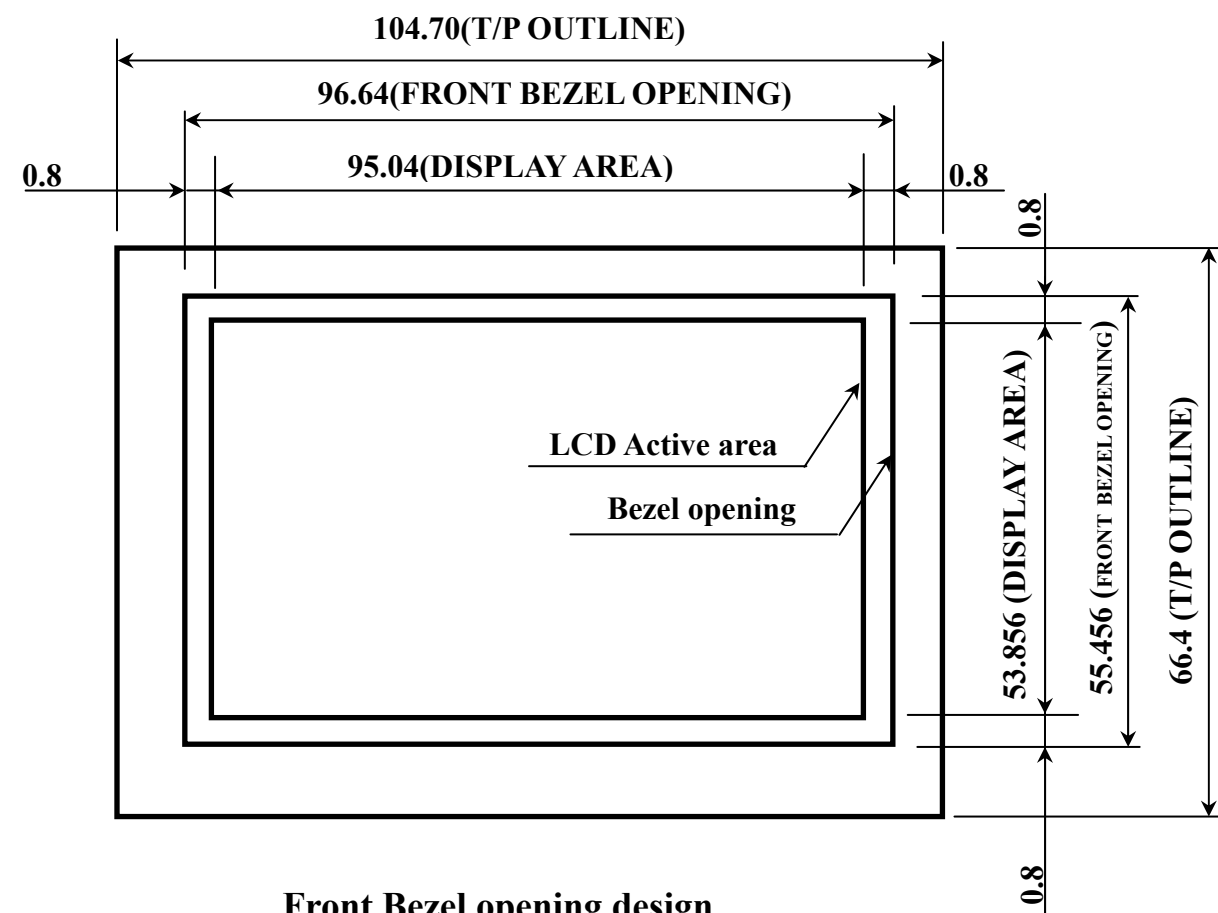
Unit: mm

8. RECOMMENDATION DESIGN OF FRONT BEZEL

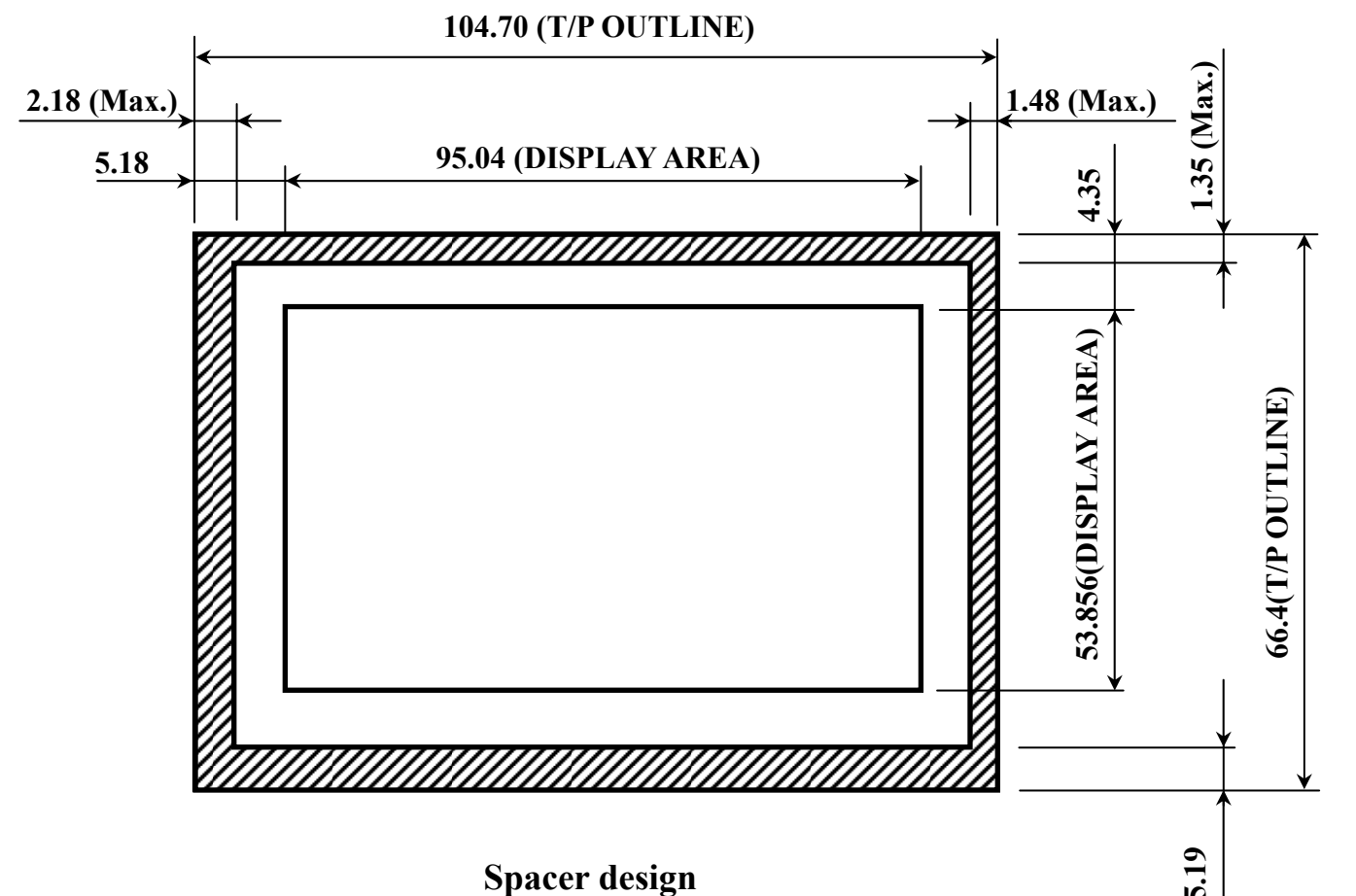


Design guidance for a front bezel and a spacer

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

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-0361	Sep. 3, 2007	Revision contents New issue Writer <i>Approved by</i> T. OGAWA <i>Checked by</i> <i>Prepared by</i> E. KATAYAMA
2nd edition	DOD-PP-0406	Oct. 15, 2007	Revision contents P5 General specifications <ul style="list-style-type: none"> Module size: 105.5 (H) × 67.2 (V) × TBD (D)mm (typ.) → 105.5 (H) × 67.2 (V) × 4.8 (D)mm (typ.) Weight: TBD → 65 g (typ.) Response time: 25ms (typ.) → 33ms (typ.) Supply voltage-VCC: 2.5V → 3.0V (typ.) Power consumption <ul style="list-style-type: none"> LCD panel + Driver: TBD (typ.) → (125)mW (typ.) Backlight: TBD (typ.) → (512)mW (typ.) P6-7 Block diagram <ul style="list-style-type: none"> DISP (addition) Pin No.39,40 (addition) VCC: +2.5V → +3.0V P8 Mechanical specifications <ul style="list-style-type: none"> Module size: 105.5 ± 0.3 (W) × 67.2 ± 0.3 (H) × TBD ± 0.3 (D)mm (typ.) → 105.5 ± 0.3 (W) × 67.2 ± 0.3 (H) × 4.8 ± 0.3 (D)mm (typ.) Weight: TBD → 65g (typ.), 67g (max.) P8 Absolute maximum ratings <ul style="list-style-type: none"> Backlight: VR: ≤25 → ≤20 (V), PD: ≤615 → ≤492 (mW) Relative humidity: ≤36 (%) (addition) Absolute humidity Remarks: Ta > 60°C → Ta > 70°C Note4: Ta= 60°C and RH= 55% → Ta= 70°C and RH= 36% P9 Logic/ LCD driving <ul style="list-style-type: none"> VCC: TBD (min.), 2.5 (typ.), TBD (max.) → 2.3 (min.) 3.0 (typ.), 3.6 (max.) (V) VDD: TBD (min.), TBD (max.) → 4.8 (min.), 5.2 (max.) (V) VIH: 0.8VCC → 0.7VCC (V), VIL: 0.2VCC → 0.3VCC (V) ICC: TBD (typ.) → (4.0) (typ.) (mA), Remarks: VCC: 2.5V → 3.0V IDD: TBD (typ.) → (22.5) (typ.) (mA), Remarks: VCC: 2.5V → 3.0V Note1: T PPHCK= 8.69MHz, HSYNC= 16.56kHz, VSYNC= 60Hz → PPHCK= (10.87)MHz, HSYNC= (20.7)kHz, VSYNC= (75)Hz P9 Backlight <ul style="list-style-type: none"> Forward voltage: (16.0) (typ.), TBD (max.) → 12.8 (typ.), 14 (max.) (V) P10 Power supply voltage sequence <ul style="list-style-type: none"> Diagram (revision) Note1 (change), Note2 (addition) P11 Interface pin connections <ul style="list-style-type: none"> Pin No.39: RSVD → DISP, Pin No.40: N.C. → TEST P12 Description of terminals <ul style="list-style-type: none"> DISP (addition) Circuits of backlight (revision) P15 Input signal timing <ul style="list-style-type: none"> VCC= 2.5V → VCC= 3.0V

REVISION HISTORY


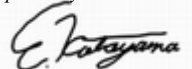
Edition	Document number	Prepared date	Revision contents and signature
2nd edition	DOD-PP-0406	Oct. 15, 2007	<p>Revision contents</p> <p>P15 Timing characteristics</p> <ul style="list-style-type: none"> • CLK-frequency: TBD (min.), 8.69 (typ.) → (8.69) (min.), (10.87) (typ.) (MHz) Rise time, Fall time: TBD (max.) → (2) (max.) (ns) • DATA-Rise time, Fall time: TBD (max.) → (2) (max.) (ns) • DE-Rise time, Fall time: TBD (max.) → (2) (max.) (ns) • HSYNK-cycle: 60.4 (typ.), TBD (max.) → (48.3) (typ.), (60.4) (max.) (μs) Remarks: 16.56 kHz → (20.7) kHz Rise time, Fall time: TBD (max.) → (2) (max.) (ns) • VSYNK-cycle: 16.59 (typ.), TBD (max.) → (13.33) (typ.), (16.67) (max.) (ms) Remarks: 60 Hz → (75) Hz Rise time, Fall time: TBD (max.) → (2) (max.) (ns) • VSYNC-HSYNC timing → VSYNC-HSYNC: Setup time, Hold time (revision) • DISP (addition) <p>P16-18 Input signal timing chart</p> <ul style="list-style-type: none"> • VIH: 0.8VCC → 0.7VCC (V), VIL: 0.2VCC → 0.3VCC (V) • HSYNC-VSYNC (revision) • VSYNC-DISP (addition) <p>P19 Optical characteristics</p> <ul style="list-style-type: none"> • Luminance uniformity: 60 (min.) → 70 (min.) (%) • Response time: Ton: TBD (typ.) → 8 (typ.) (ms), Toff: TBD (typ.) → 25 (typ.) (ms) • Viewing angle: θR, θL: 50 (typ.) → 60 (typ.) (°), θU: 70 (typ.) → 60 (typ.) (°) • Note1: VCC= 2.5V → VCC= 3.0V <p>P24 Outline drawings is revised.</p> <p>P25 Front bezel opening design and spacer design are revised.</p> <p style="text-align: center;">Writer</p> <p style="text-align: center;">Approved by <u>T. OGAWA</u> Checked by _____ Prepared by <u>T. OGAWA</u></p>
3rd edition	DOD-PP-0447	Jan. 18, 2008	<p>Revision contents</p> <p>P5 General specifications</p> <ul style="list-style-type: none"> • Power consumption <ul style="list-style-type: none"> • LCD panel + Driver: (125) (typ.) → 87mW (typ.) • Backlight: (512) (typ.) → 512mW (typ.) <p>P6-7 Block diagram</p> <p>P11 Interface pin connections - CN1</p> <p>P16-17 Input signal timing chart</p> <p>P24 Outline drawings</p> <ul style="list-style-type: none"> • D20 to D27, D10 to D17, D00 to D07 → R0 to R7, G0 to G7, B0 to B7 <p>P8 Absolute maximum ratings- Note1: Graph chart (specified)</p> <p>P9 Logic/ LCD driving</p> <ul style="list-style-type: none"> • ICC: (4.0) (typ.), TBD (max.) → 4 (typ.), 8 (max.) mA • IDD: (22.5) (typ.), TBD (max.) → 15 (typ.), 24 (max.) mA <p>P9 Backlight</p> <ul style="list-style-type: none"> • Forward current: TBD (max.) → , 22 (max.) (mA) <p>P10 Power supply voltage sequence</p> <ul style="list-style-type: none"> • Diagram (revision) <p>P15 Timing characteristics</p> <ul style="list-style-type: none"> • CLK-frequency: (8.69) (min.), (10.87) (typ.) TBD (max.) → 8.69 (min.), 10.87 (typ.) 11.59 (max.) MHz • CLK-Rise time, Fall time: (2) (max.) → 2 (max.) ns • DATA: D00 to D05, D10 to D15, D20 to D25 → R0 to R7, G0 to G7, B0 to B7

REVISION HISTORY

Edition	Document number	Prepared date	Revision contents and signature
3rd edition	DOD-PP-0447	Jan. 18, 2008	<p>Revision contents</p> <p>P15 Timing characteristics</p> <ul style="list-style-type: none"> • DATA-Rise time, Fall time: (2) (max.) → 2 (max.)ns • DE-Rise time, Fall time: (2) (max.) → 2 (max.)ns • HSYNK-cycle: TBD (min.), (48.3) (typ.), (60.4) (max.) → 45.3 (min.), 48.3 (typ.), 60.4 (max.)μs, (525) (typ.) → 525 (typ.)CLK, Remarks: (20.7) (typ.) → 20.7kHz (typ.) • HSYNK-Front-porch: (2) (typ.) → 2 (typ.)CLK • HSYNK-Pulse-width: (2) (min.), (41) (typ.) → 2 (min.), 41 (typ.)CLK • HSYNK-Back-porch: (2) (typ.) → 2 (typ.)CLK • HSYNK-Rise time, Fall time: (2) (max.) → 2 (max.)ns • VSYNK-cycle: TBD (min.), (13.33) (typ.), (16.67) (max.) → 12.5 (min.), 13.33 (typ.), 16.67 (max.)ms, (276) (typ.) → 276 (typ.)H, Remarks: (75) (typ.) → 75Hz (typ.) • VSYNK-Front-porch: (1) (typ.) → 1 (typ.)H • VSYNK-Pulse-width: (1) (min.), (2) (typ.) → 1 (min.), 2 (typ.)H • VSYNK-Back-porch: (1) (typ.) → 1 (typ.)H • VSYNK-Rise time, Fall time: (2) (max.) → 2 (max.)ns • DISP-Rise time, Fall time: (2) (max.) → 2 (max.)ns <p>P19 Optical characteristics</p> <ul style="list-style-type: none"> • Luminance: TBDcd/m² (min.) → 350cd/m² (min.) <p>P24 Outline drawings</p> <ul style="list-style-type: none"> • Front view, Rear view (revision) <p>P25 Recommendation design of front bezel</p> <ul style="list-style-type: none"> • Spacer design (revision) <p>Writer <i>Approved by</i> _____ <i>Checked by</i> _____ <i>Prepared by</i> _____ T. OGAWA _____ T. OGAWA _____</p>
4th edition	DOD-PP-0487	Mar. 3, 2008	<p>Revision contents</p> <p>P5 General specifications</p> <ul style="list-style-type: none"> • Weight: 65 → (72) g (typ.) <p>P8 Mechanical specifications</p> <ul style="list-style-type: none"> • Weight: 65g (typ.), 67g (max.) → (72)g (typ.), (74)g (max.) <p>P15 Timing characteristics</p> <ul style="list-style-type: none"> • HSYNK <ul style="list-style-type: none"> • Cycle: 525 → 496(min.), 525 (typ.), - (max.)CLK • Front-porch: 2 → 2(min.), 2 (typ.), - (max.)CLK • VSYNK <ul style="list-style-type: none"> • Cycle: 276 → 275(min.), 276 (typ.), - (max.)H • Front-porch: 1 → 1(min.), 1 (typ.), - (max.)H <p>P16 Input signal timing chart</p> <ul style="list-style-type: none"> • VSYNK <ul style="list-style-type: none"> • tvp + tvb: 3H(fixed) → tvp: 2H, tvb: 1H(fixed) • tvf: (1)H(fixed) → 1H <p>P17 Input signal timing chart</p> <ul style="list-style-type: none"> • HSYNK <ul style="list-style-type: none"> • thp + thb: 43CLK(fixed) → thp: 41CLK, thb: 2CLK(fixed) • thf: 2CLK(fixed) → 2CLK <p>P24 Outline drawings-Front view (revision)</p> <ul style="list-style-type: none"> • (47.52), 4.3 ± 0.3, 97.6 ± 0.3 (BEZEL OPENING) (addition) • (26.93), 56.4 ± 0.3 (BEZEL OPENING), 3.48 ± 0.3 (addition) • (2.38), (3.88), (4.88), (8.594), (7.592), (6.092) (elimination)

PRELIMINARY

REVISION HISTORY

Edition	Document number	Prepared date	Revision contents and signature
4th edition	DOD-PP-0487	Mar. 3, 2008	Revision contents P25 Recommendation design of front bezel-Front bezel opening design • BEZEL OPENING → FRONT BEAEL OPENING Writer <div> <div>Approved by</div> <div>Checked by</div> <div>Prepared by</div> </div> <div> <div>T. OGAWA</div> <div></div> <div>T. OGAWA</div> </div>
5th edition	DOD-PP-0519	Apr. 15, 2008	Revision contents P10 Powe supply voltage sequence (revision) Writer <div> <div>Approved by</div> <div>Checked by</div> <div>Prepared by</div> </div> <div> <div>T. OGAWA</div> <div></div> <div>T. OGAWA</div> </div>
6th edition	DOD-PP-0569	Jun. 16, 2008	Revision contents P19 Optical characteristics • Viewing angle - θ_R , θ_L : $60^\circ \rightarrow 80^\circ$ - θ_D : $40^\circ \rightarrow 80^\circ$ Signature of writer <div> <div>Annroved hv</div> <div>Checked by</div> <div>Prepared by</div> </div> <div> <div></div> <div></div> <div></div> </div> <div> <div>T. OGAWA</div> <div></div> <div>E. KATAYAMA</div> </div>