NEC NEC LCD Technologies, Ltd.

TFT COLOR LCD MODULE

NL8048HL11-01B

10.4cm (4.1 Type)
WVGA

PRELIMINARY SPECIFICATIONS

(7h edition)

RoHS Compliant
2002/95/EC

INTRODUCTION

• WARRANTY

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2) Operation or usage outside of specifications and instructions or warnings given by NEC
3) Any other causes attributable to customers

In case where NEC replaces a product after the one (1) year warranty period, NEC shall be entitled to charge for such replacement.

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For the purpose of product improvement, this product design may be changed in the areas of appearance, parts, circuits and etc. In case, a design change affects on the product specifications, NEC shall inform the customers in advance.

• HANDLING OF DOUBTFUL POINTS

Any question arising out of, or in connection with, this SPECIFICATION or any matter not stipulated herein will be settled each time upon consultation between both parties.

CONTENTS

1. OUTLINE

1.1 STRUCTURE AND PRINCIPLE

Color LCD module NL8048HL11-01B is composed of the low temperature poly silicon thin film transistor liquid crystal display (LTPS TFT LCD) panel structure with driver LSIs for driving the TFT (Thin Film Transistor) array, touch panel (T/P) and a backlight.

The LTPS 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

- PDAs

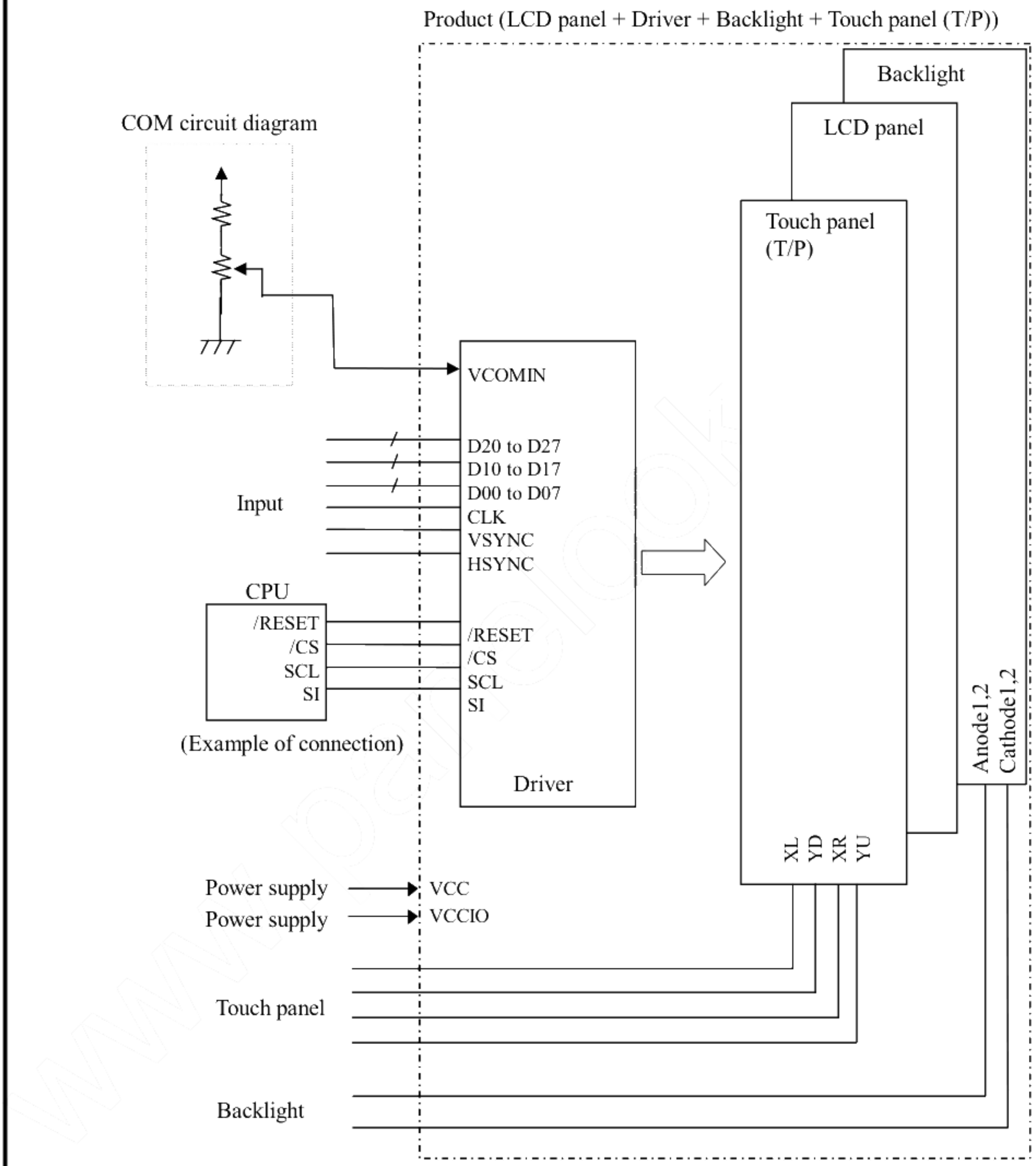
1.3 FEATURES

- Transmissive type
- Backlight and touch panel attached
- Including LCD controller and power supply
- 8-bit digital RGB signals
- Compliance with the European RoHS directive(2002/95/EC)

2. GENERAL SPECIFICATIONS

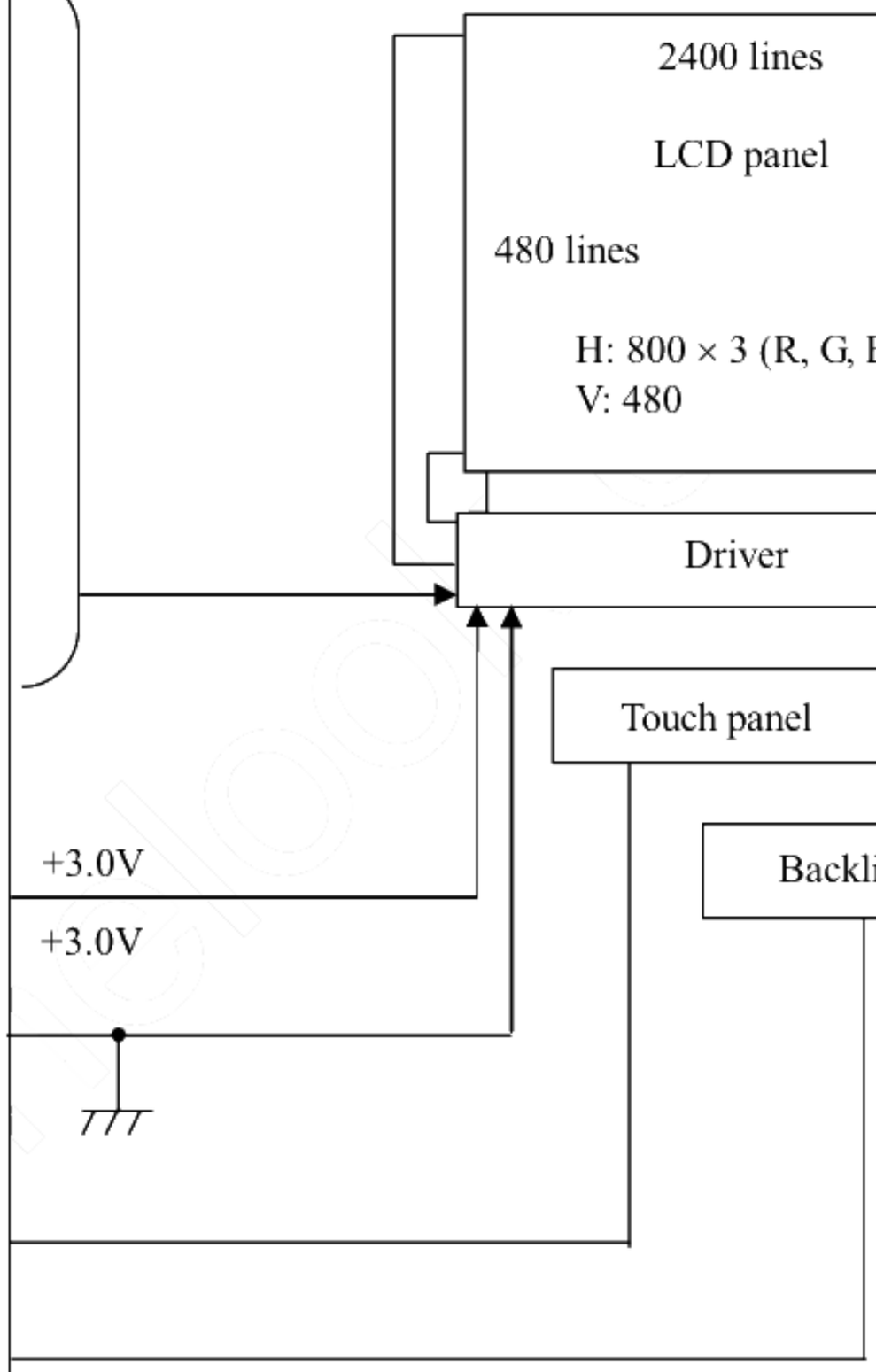
Display area	88.80 (H) × 53.28 (V) mm
Diagonal size of display	10.4cm (4.1 inches)
Drive system	LTPS TFT active matrix
Display color	16,777,216 colors
Pixel	800 (H) × 480 (V) pixels
Pixel arrangement	RGB (Red dot, Green dot, Blue dot) vertical stripe
Dot pitch	0.037 (H) × 0.111 (V) mm
Pixel pitch	0.111 (H) × 0.111 (V) mm
Module size	99.6 (H) × 69.5 (V) × 5.0 (D) mm (typ.)
Weight	70g (typ.)
Touch panel surface	Clear
Touch panel pencil-hardness	3 H (min.) [by JIS K5400]
Designed viewing direction	• Viewing direction without image reversal: lower side (6 o'clock) • Viewing direction with contrast peak: up side (12 o'clock)
Luminance	At IL= 14mA, With Touch panel 350cd/m^2 (typ.)
Contrast ratio	At IL= 14mA, with Touch panel 400:1 (typ.)
Response time	Ton+ Toff (10% ←→ 90%) 25 ms (typ.)
Signal system	8-bit digital signals for data of RGB colors, Dot clock (CLK), Horizontal synchronous signal (HSYNC), Vertical synchronous signal (VSYNC) Serial interface (SPI correspondence) (/CS, SCL, SI)
Supply voltage	VCCIO: 3.0V (typ.) VCC: 3.0V (typ.)
Power consumption	LCD panel + Driver: 165mW (typ.) Backlight: 604mW (typ., at IL= 14mA)

3. BLOCK DIAGRAM

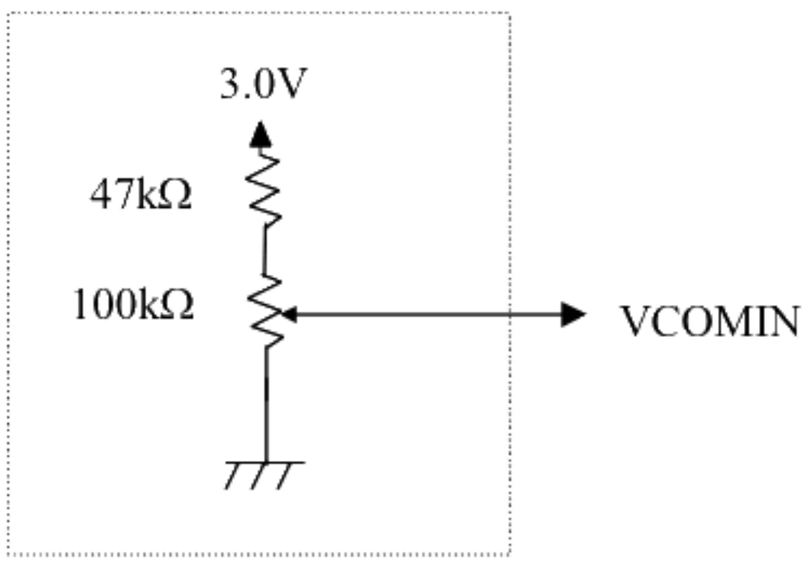


FPC I/F

Pin No.	Symbol
11 to 18	D00 to D07
19 to 26	D10 to D17
27 to 34	D20 to D27
8	VSYNC
7	HSYNC
9	CLK
6	/RESET
39	/CS
36	SCL
37	SI
40	VCOMIN
41	VCCIO
2,3,4	VCC
1,5,10,35 42,47	GND
43,44, 45,46	XL, YD XR, YU
48	ANODE1
49	CATHODE1
50	ANODE2
51	CATHODE2



Reference design of COM circuit



4. DETAILED SPECIFICATIONS

4.1 MECHANICAL SPECIFICATIONS

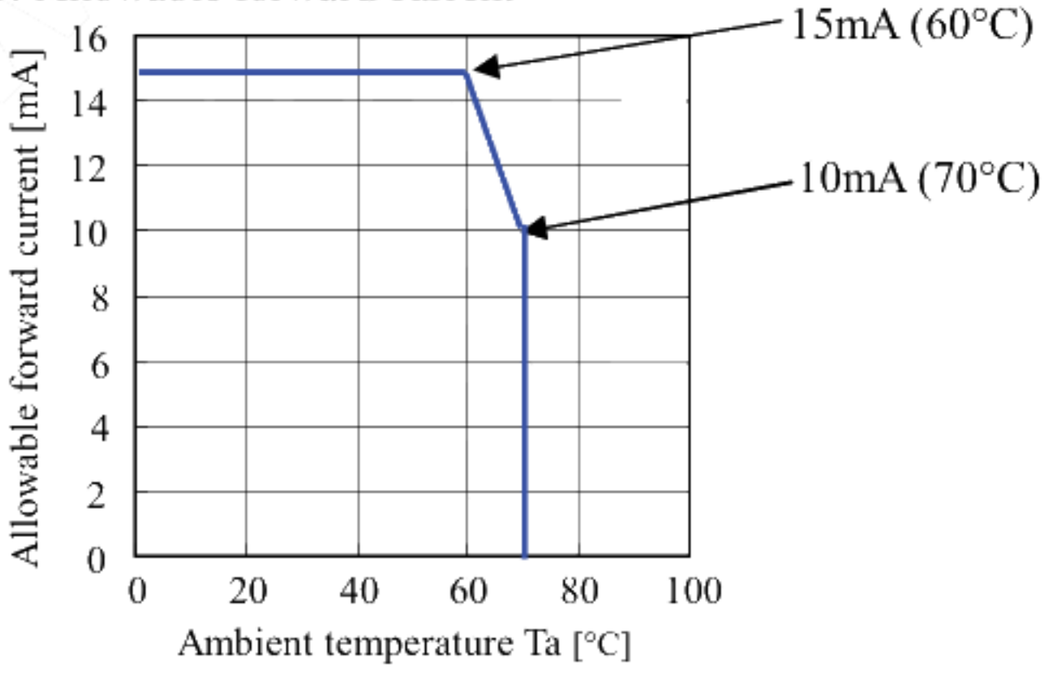
Parameter	Specification		Unit
Module size	99.6 ± 0.3 (W) × 69.5 ± 0.3 (H) × 5.0 ± 0.2 (D) Note1	Note2	mm
Display area	88.80 (H) × 53.28 (V)	Note2	mm
Weight	70 (typ.), 73 (max.)		g

Note1: Excluding FPC
Note2: See "12. OUTLINE DRAWINGS".

4.2 ABSOLUTE MAXIMUM RATINGS

Parameter		Symbol	Rating	Unit	Remarks
Supply voltage (DC/DC)		VCC	-0.3 to + 3.7	V	Ta= 25°C
Supply voltage (Logic)		VCCIO	-0.3 to + 6.0	V	Ta= 25°C
Logic input voltage		VI	-0.3 to VCCIO + 0.3	V	Logic signals
Backlight	Reverse voltage	VR	≤ 35	V	Ta= 25°C
	Power dissipation	PD	714	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	-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

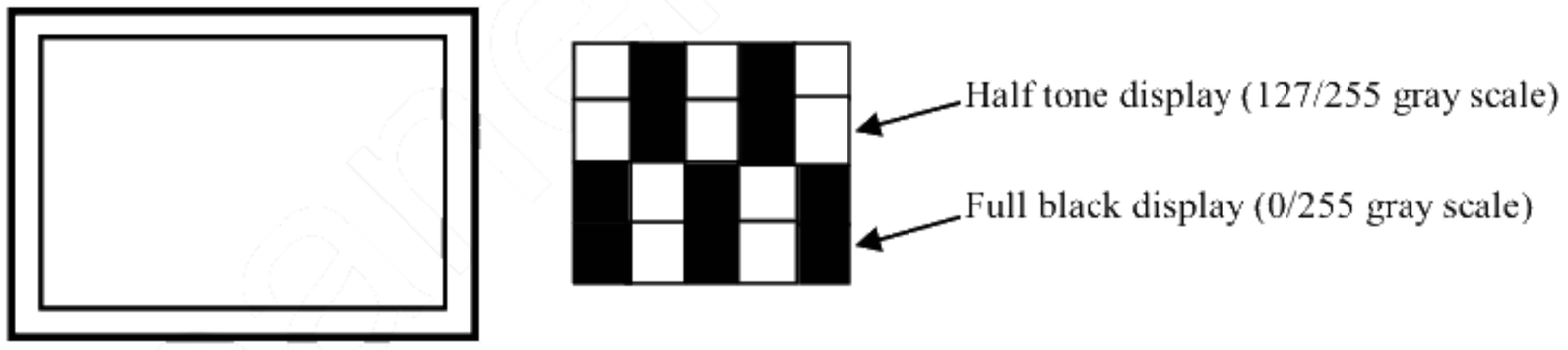
(1) Logic/ LCD driving

(Ta= 25°C)

Parameter	Symbol	min.	typ.	max.	Unit	Remarks
Supply voltage (DC/DC)	VCC	2.85	3.0	3.15	V	-
Supply voltage (Logic)	VCCIO	1. 7	3.0	3.3	V	-
Logic input high voltage	VIH	0.8VCCIO	-	VCCIO	V	Logic signal
Logic input low voltage	VIL	0	-	0.2VCCIO	V	
VCOM input voltage	VCOMIN	-	0.3	-	V	at VCC= 3.0V Note1
VCC supply current	ICC	-	55	70	mA	at VCC= 3.0V Note2
VCCIO supply current	ICCIO	-	0.06	0.5	mA	at VCCIO= 3.0V Note2
VCC standby current	ICCs	-	1.0	2.0	mA	Standby mode at VCC=3.0 Note3
VCCIO standby current	ISBIO	-	0.06	0.1	mA	Standby mode at VCCIO=3.0 Norte3

Note1: The optimum value for VCOMIN is in the range of 0.1 V to 1.0 V.
Note2: CLK= 23.8MHz, HSYNC= 29.3kHz, VSYNC= 60Hz,
Checkered flag pattern (by EIAJ ED-2522)

Recommended adjustment display for VCOMIN



Note3:CLK,control signals : inactive

(2) Backlight

(Ta= 25°C)

Parameter	Symbol	min.	typ.	max.	Unit	Remarks
Forward Current	IL1,2	-	14	15	mA	-
Forward Voltage	VL1,2	-	21.6	23.8	V	at IL= 14mA

(3) Touch panel

(Ta= 25°C)

Parameter	Symbol	min.	Typ.	max.	Unit	Remarks
Touch panel input voltage	Vtp	-	-	5.5	V	-
Resistor between pins(XL-XR)	Rx	380	-	1160	Ω	-
Resistor between pins(YU-YD)	Ry	70	-	260	Ω	-
Line linearity (X direction)	Xlin	-	-	1.5	%	Note1
Line linearity (Y direction)	Ylin	-	-	1.5	%	Note1
Insulation resistance	Rins	20	-	-	MΩ	at DC 25V
Static Capacitance	Ctp	-	-	100	nF	-
Chattering	Chat	-	-	10	ms	Note1
Operation starting force	Ost	-	-	0.78	N	Note1
				80	gf	
Surface hardness	Hs	3	-	-	H	Pencil hardness
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

Note1:Input methods are aFinger or R0.8mm Polyacetal Stylus Pen

Note2:Test condition

Resistance between X and Y axis must be 2KΩ or less, and the test voltage is 5V DC.

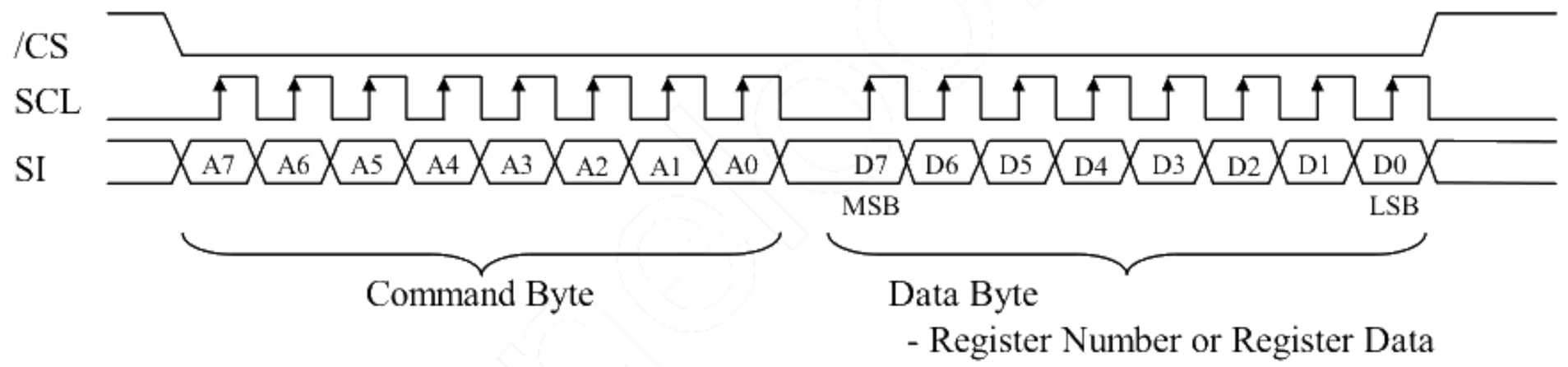
4.4 SETTING OF THE INTERNAL RESISTER

Initial setting of the internal Resister is undefined data. So the Resister Data must be written in the Resister, after initialization by the /RESET pin. The Resister Data can be written from serial interface pins (/CS, SCL and SI). This serial interface supports SPI. The setting method is as follows.

(1) Command Byte Function

Bits	Functions	Discription
A7	-	-
A6	-	-
A5	Read / Write	0:Write 1:Read
A4	-	-
A3	-	-
A2	-	-
A1	-	-
A0	Register Number / Data	0:Register Number 1:Register Data

(2) Timing chart



Ex) When data 55h is written to Register R26 (R1Ah)

Note1: During 32-bit transfer of the Resister Data, /CS pin (Pin No.39) must be maintained active.
Note2: "X" is set in accordance with the usage conditions.

Command sequence

①Power On(At VCC=(3.0±0.15V))

Sequence	Register Number	Data	Comment	Sequence	Register Number	Data	Comment
1	Power On			46	R83	42h	-
2	1ms min. wait.			47	R84	42h	-
3	Reset by the /RESET pin(PIN No.6)			48	R85	41h	
4	1ms min. wait after /RESET ↑			49	R86	14h	
5	R3	01h	-	50	R89	88h	-
6	R0	00h	-	51	R90	01h	-
7	R1	01h	-	52	R91	00h	-
8	R4	00h	-	53	R92	02h	-
9	R5	14h	-	54	R93	0Ch	-
10	R6	24h	-	55	R94	1Ch	-
11	R16	D7h	-	56	R95	27h	-
12	R17	00h	-	57	R98	49h	-
13	R18	00h	-	58	R99	27h	-
14	R19	55h	-	59	R102	76h	-
15	R20	01h	-	60	R103	27h	-
16	R21	70h	-	61	R112	01h	-
17	R22	1Eh	-	62	R113	0Eh	-
18	R23	25h	-	63	R114	02h	-
19	R24	25h	-	64	R115	0Ch	-
20	R25	02h	-	65	R118	0Ch	-
21	R26	02h	-	66	R121	20h	-
22	R27	A0h	-	67	R130	00h	-
23	R32	2Fh	-	68	R131	00h	-
24	R33	0Fh	-	69	R132	FCh	-
25	R34	0Fh	-	70	R134	00h	-
26	R35	0Fh	-	71	R136	00h	-
27	R36	0Fh	-	72	R138	00h	-
28	R37	0Fh	-	73	R139	00h	-
29	R38	0Fh	-	74	R140	00h	-
30	R39	00h	-	75	R141	FCh	-
31	R40	02h	-	76	R143	00h	-
32	R41	02h	-	77	R145	00h	-
33	R42	02h	-	78	R147	00h	-
34	R43	0Fh	-	79	R148	00h	-
35	R44	0Fh	-	80	R149	00h	-
36	R45	0Fh	-	81	R150	FCh	-
37	R46	0Fh	-	82	R152	00h	-
38	R47	0Fh	-	83	R154	00h	-
39	R48	0Fh	-	84	R156	00h	-
40	R49	0Fh	-	85	R157	00h	-
41	R50	00h	-	86	20us min. wait		
42	R51	02h	-	87	Data input start		
43	R52	02h	-	88	R2	00h	
44	R53	02h					
45	R80	0Ch	-				

②Power Off

Sequence	Register Number	Data	Comment
1	R16	05h	-
2	20 us min. wait.		
3	R16	01h	-
4	20 us min. wait.		
5	R16	00h	
6	20 us min. wait.		
7	R3	01h	-
8	Data Off		
9	Power Off		

③Stand-by

Sequence	Register Number	Data	Comment
1	R2	01h	-
2	40ms min.wait		

④Wakeup

Sequence	Register Number	Data	Comment
1	R2	00h	-

⑤Reverse Mode

	Register Number	Data	Comment
Horizontal	R1	01h	-
		03h	Reverse
Vertical	R121	30h	-
		10h	Reverse

Note1: Be sure to perform reset by the /RESET pin (Pin No. 6) every power-on
Note2: Write the Resister Data every power-on, because the data are not stored in the product.
Note3: Due to influence such as static electricity from the outside, data in the register may transform. Data is recommended to be written in the register regularly.

4.5 INTERFACE PIN CONNECTIONS

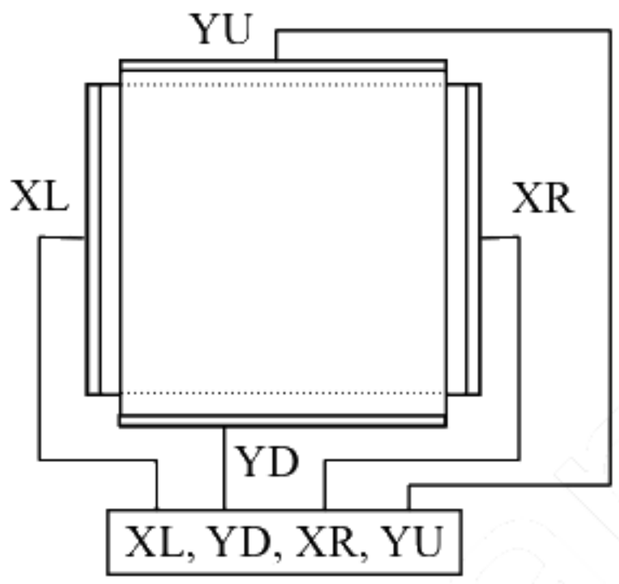
CN1 (FPC)
Adaptable socket: FH23-51S-0.3SHW(06) (Hirose Electric Co., Ltd.(HRS))

Pin No.	Symbols	Functions	Pin No.	Symbols	Functions
1	GND	Ground Note1	27	D20	Red data (LSB)
2	VCC	Power supply	28	D21	Red data
3	VCC		29	D22	Red data
4	VCC		30	D23	Red data
5	GND	Ground Note1	31	D24	Red data
6	/RESET	Reset	32	D25	Red data
7	HSYNC	Horizontal synchronous signal	33	D26	Red data
8	VSYNC	Vertical synchronous signal	34	D27	Red data (MSB)
9	CLK	Dot clock	35	GND	Ground Note1
10	GND	Ground Note1	36	SCL	Serial clock
11	D00	Blue data (LSB)	37	SI	Serial input
12	D01	Blue data	38	RSVD	Keep this pin Open.
13	D02	Blue data	39	/CS	Chip selection
14	D03	Blue data	40	VCOMIN	COM high voltage input
15	D04	Blue data	41	VCCIO	Power supply (Logic)
16	D05	Blue data	42	GND	Ground Note1
17	D06	Blue data	43	XL	Horizontal terminal (Left side)
18	D07	Blue data (MSB)	44	YD	Vertical terminal (Down side)
19	D10	Green data (LSB)	45	XR	Horizontal terminal (Right side)
20	D11	Green data	46	YU	Vertical terminal (Up side)
21	D12	Green data	47	GND	Ground Note1
22	D13	Green data	48	ANODE1	LED1 voltage (Anode)
23	D14	Green data	49	CATHODE1	LED1 voltage (Cathode)
24	D15	Green data	50	ANODE2	LED2 voltage (Anode)
25	D16	Green data	51	CATHODE2	LED2 voltage (Cathode)
26	D17	Green data (MSB)			

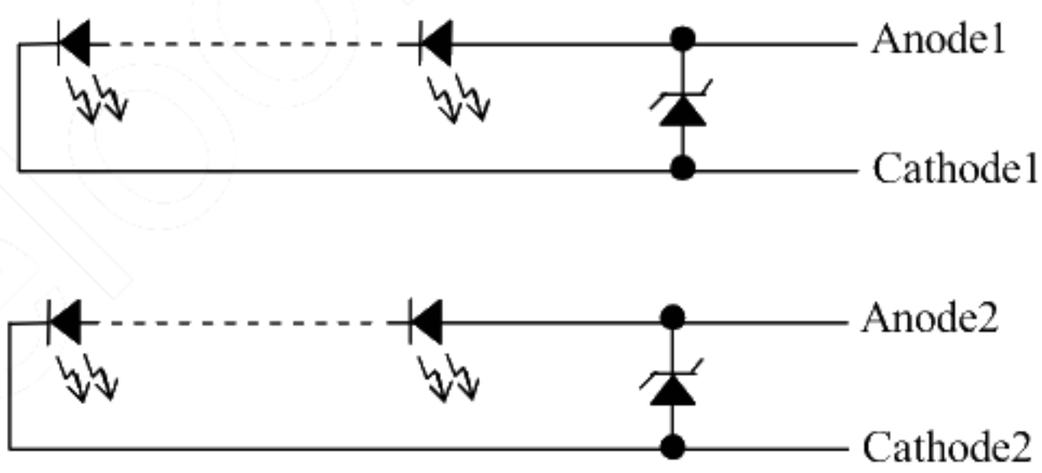
Note1: All GND terminals should be used without any non-connected lines.
Note2: Do not fold the FPC. When folding the FPC, pattern disconnection may occur. In case of bending FPC, the minimum curvature (R) must be more than 1.0 mm.

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.
/CS	This pin is used for chip select signals. When /CS= L, the chip is active and can perform data I/O operations including command and data I/O.
SCL	This pin is clock input of serial interface.
SI	This pin is data input of serial interface.
VCOMIN	This pin is the Common input voltage. The voltage needs to be adjusted. The details are explained the above. See "**3 BLOCK DIAGRAM – Reference design of COM circuit**".
YU,XR,YD,XL	Refer to the below "**Circuits of touch panel**".
ANODE1,2 CATHODE1,2	Refer to the below "**Circuits of backlight**".



Circuits of touch panel



Circuits of backlight

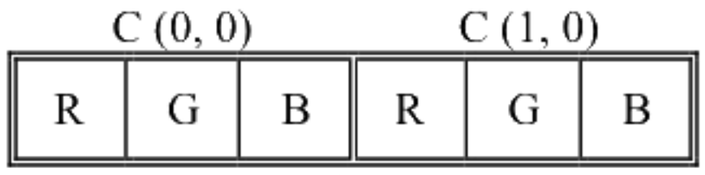
4.6 DISPLAY COLORS AND INPUT DATA SIGNALS

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

4.7 DISPLAY POSITIONS

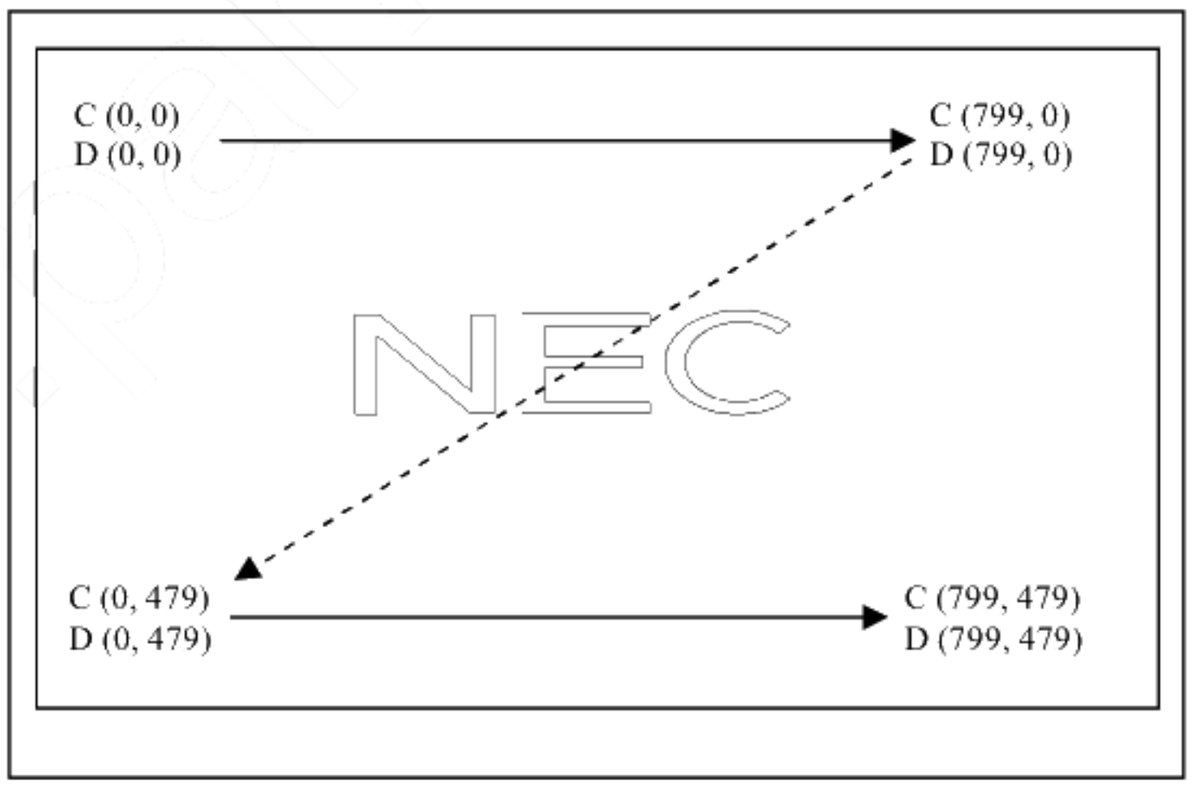
The following table is the coordinates per pixel (See figure of "**4.8 SCANNING DIRECTIONS**".).



C(0, 0)	C(1, 0)	• • •	C(X, 0)	• • •	C(798, 0)	C(799, 0)
C(0, 1)	C(1, 1)	• • •	C(X, 1)	• • •	C(798, 1)	C(799, 1)
• • •	• • •	• • •	• • •	• • •	• • •	• • •
C(0, Y)	C(1, Y)	• • •	C(X, Y)	• • •	C(798, Y)	C(799, Y)
• • •	• • •	• • •	• • •	• • •	• • •	• • •
C(0, 478)	C(1, 478)	• • •	C(X, 478)	• • •	C(798, 478)	C(799, 478)
C(0, 479)	C(1, 479)	• • •	C(X, 479)	• • •	C(798, 479)	C(799, 479)

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

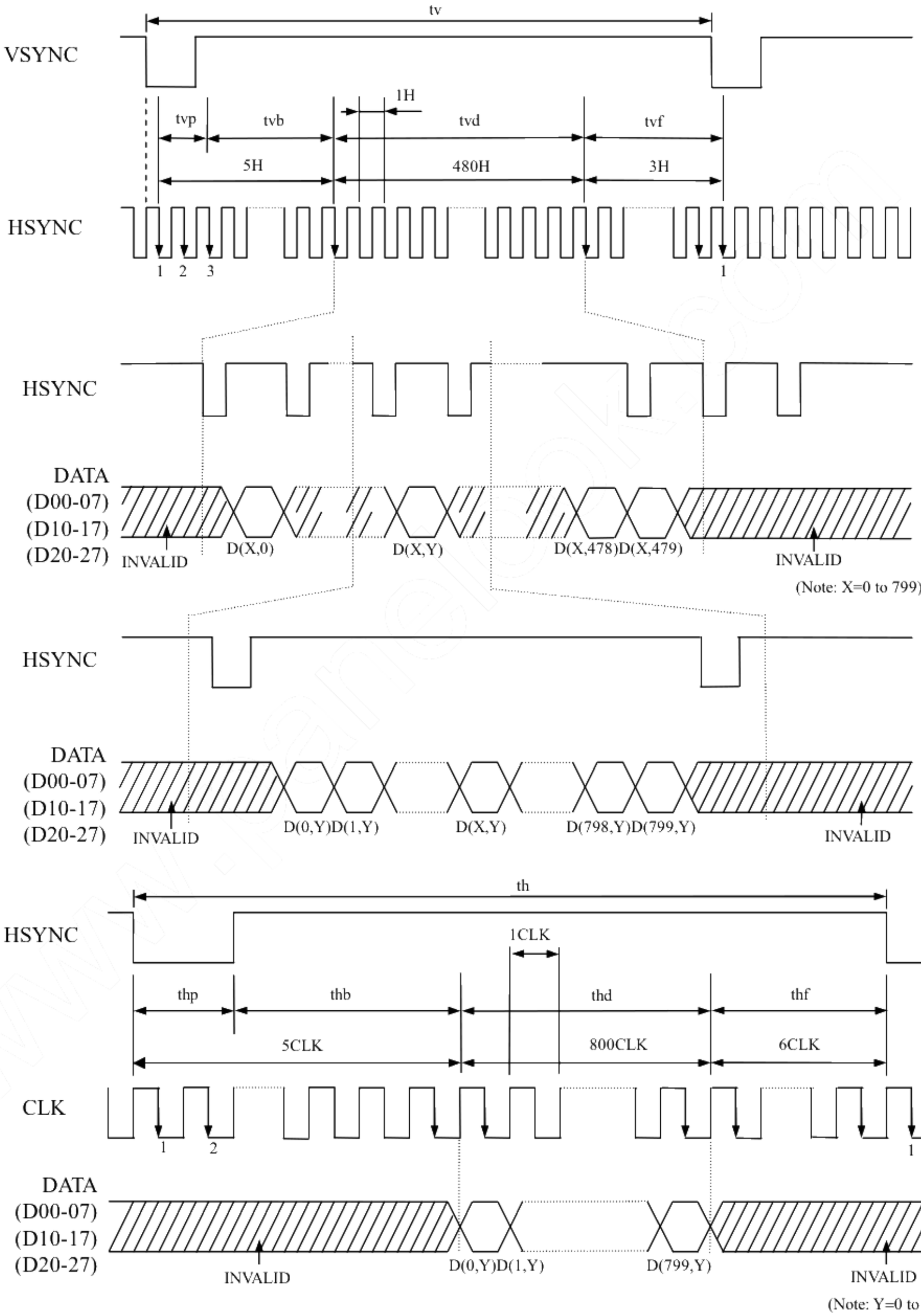
4.9.1 RGB interface (Ta= 25°C, VCCIO= 3.0V)

(1) Timing characteristics

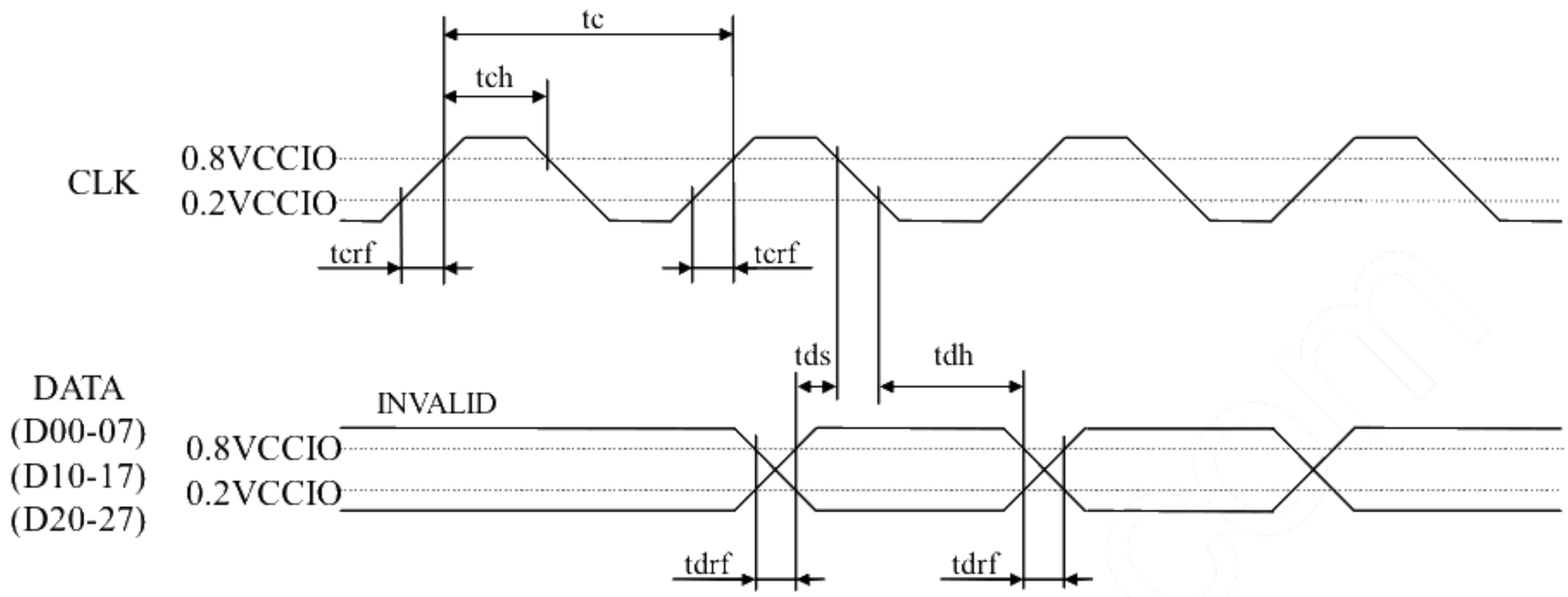
Parameter			Symbol	min.	typ.	max.	Unit	Remarks
CLK	Frequency		1/tc	21.8	23.8	25.7	MHz	42ns (typ.)
	Duty		tcd	0.4	0.5	0.6	-	-
	Rise time, Fall time		tcrf	-	-	2	ns	
DATA (D00-05) (D10-15) (D20-25)	CLK-DATA	Setup time	tds	13	-	-	ns	-
		Hold time	tdh	13	-	-	ns	
	Rise time, Fall time		tdrf	-	-	2	ns	
HSYNC	Cycle		th	31.6	34.1	37.2	µs	29.3kHz (typ.)
				811			CLK	-
	Display period		thd	800			CLK	
	Front-porch		thf	6			CLK	
	Pulse width		thp	1			CLK	
	Back-porch		thb	4			CLK	
	CLK-HSYNC	Setup time	ths	13	-	-	ns	
		Hold time	thh	13	-	-	ns	
	Rise time, Fall time		thrf	-	-	2	ns	
VSYNC	Cycle		tv	15.4	16.63	18.2	ms	60Hz (typ.)
				488			H	-
	Display period		tvd	480			H	
	Front-porch		tvf	3			H	
	Pulse width		tvp	1			H	
	Back-porch		tvb	4			H	
	Rise time, Fall time		tvrf	-	-	2	ns	

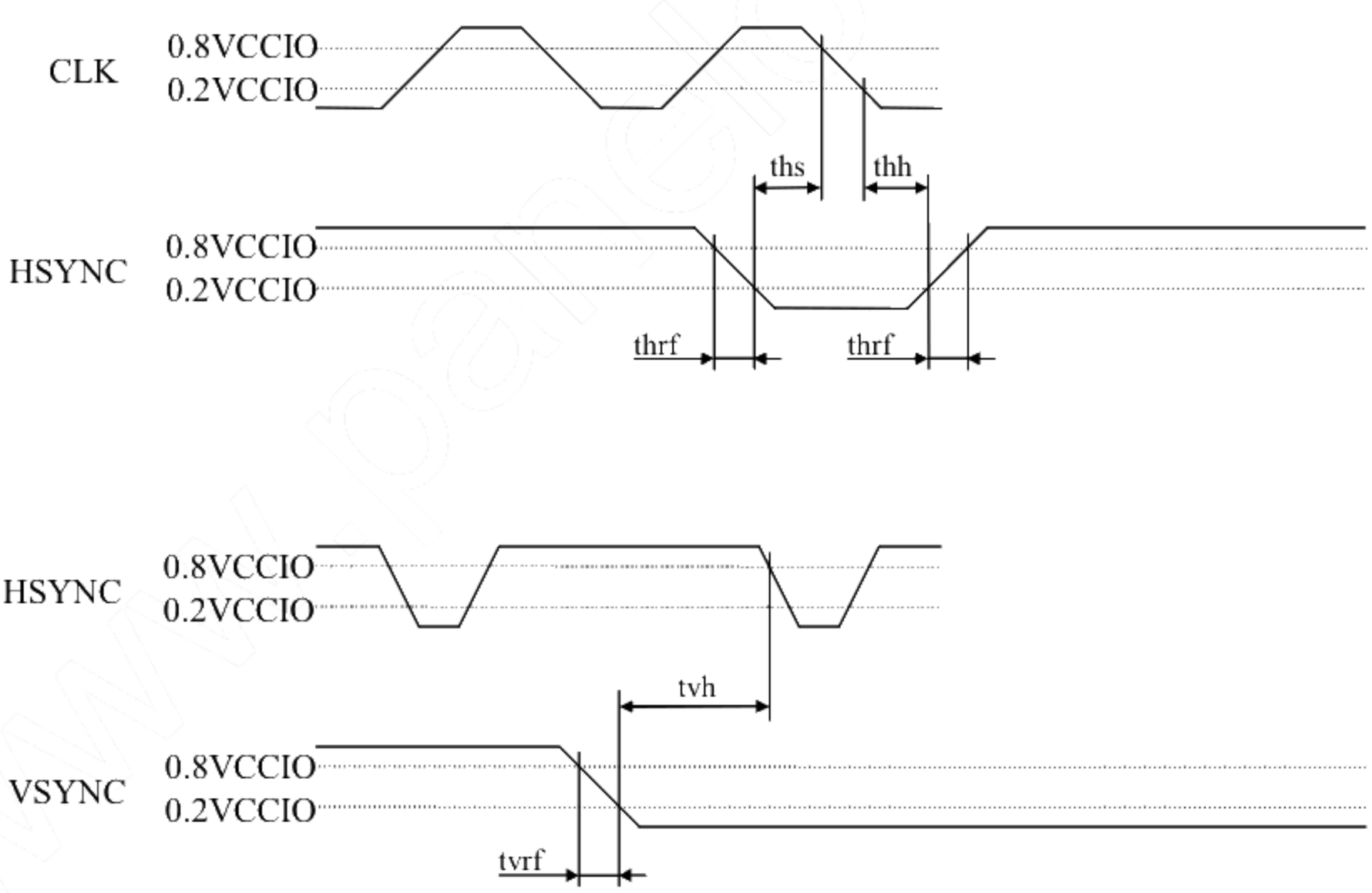
Note1: Definition of parameters is as follows.
tc= 1CLK, tcd= tch/tc, th= 1H
Note2: All parameters should be kept within the specified range.

(2) Input signal timing chart



Note1: Unless otherwise specified, the input level is defined to be VIH= 0.8VCCIO, VIL= 0.2VCCIO.





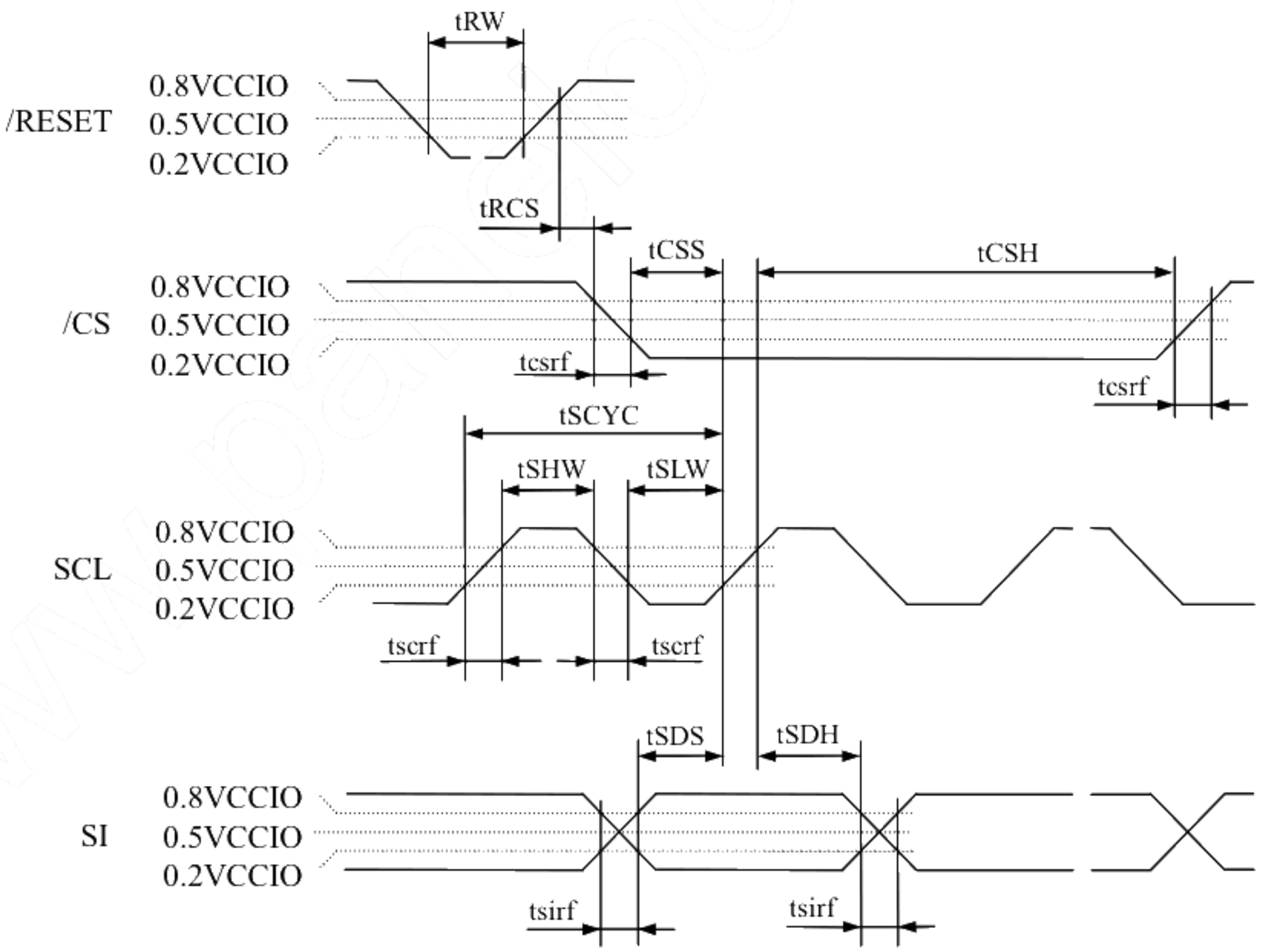
Note1: Unless otherwise specified, the input level is defined to be VIH= 0.8VCCIO, VIL= 0.2VCCIO.

4.9.2 Serial interface (Ta= 25°C, VCCIO= 3.0V)

(1) Timing characteristics

Parameter	Symbol	Condition	min.	typ.	max.	Unit	Remarks
Serial clock cycle	tSCYC	SCL	100	-	-	ns	-
SCL high level pulse width	tSHW	SCL	50	-	-	ns	-
SCL low level pulse width	tSLW	SCL	50	-	-	ns	-
/CS rise time, fall time	tcsrf	/CS	-	-	2	ns	-
SCL rise time, fall time	tscrf	SCL	-	-	2	ns	-
SI rise time, fall time	tsirf	SI	-	-	2	ns	-
/CS setup time	tCSS	/CS	50	-	-	ns	-
/CS hold time	tCSH	/CS	50	-	-	ns	-
Data setup time	tSDS	SI	50	-	-	ns	-
Data hold time	tSDH	SI	50	-	-	ns	-
Reset pulse width	tRW	/RESET	10	-	-	µs	-
/RESET↑ to /CS time	tRCS	/RESET↑ to /CS	10	-	-	µs	-

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



Note2: Unless otherwise specified, the input level is defined to be VIH= 0.8VCCIO, VIL= 0.2VCCIO.

4.10 OPTICAL CHARACTERISTICS

(Note1, Note2)

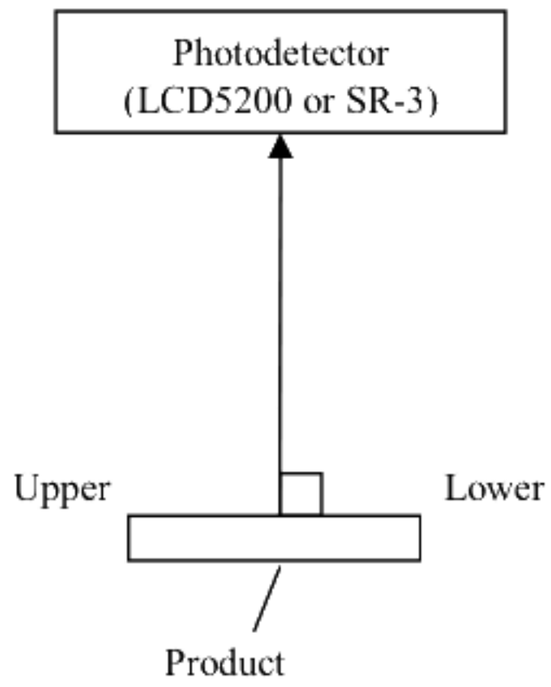
Parameter	Condition	Symbol	min.	typ.	max.	Unit	Remarks
Luminance	White at center θR= 0°, θL= 0°, θU= 0°, θD= 0°	L	220	350	-	cd/m^2	-
Contrast ratio	White/Black at center θR= 0°, θL= 0°, θU= 0°, θD= 0°	CR	300	400	-	-	Note3
Luminance uniformity	White θR= 0°, θL= 0°, θU= 0°, θD= 0° Maximum luminance: 100%	LU	70	85	-	%	Note4

Reference data

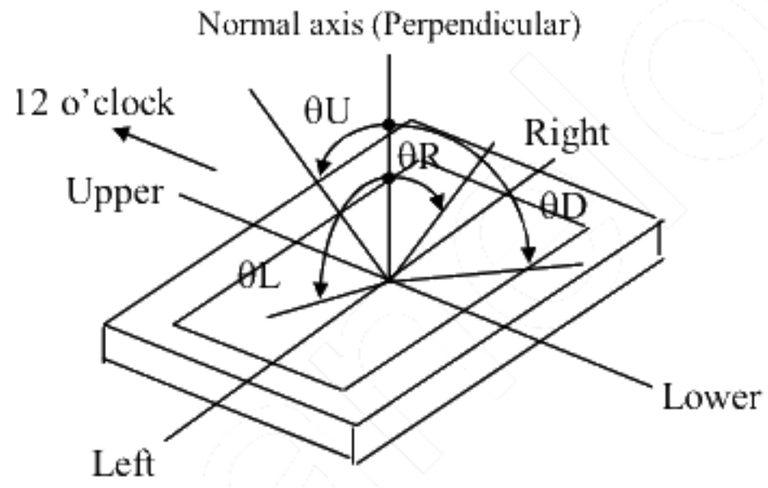
(Note1, Note2)

Parameter		Condition		Symbol	Min.	typ.	max.	Unit	Remarks
Chromaticity coordinates		White		Wx	0.29	0.34	0.39	-	Note5
				Wy	0.29	0.34	0.39	-	
Color gamut		θR= 0°, θL= 0°, θU= 0°, θD= 0° at center, against NTSC color space		C	60	70	-	%	
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	-	80	-	°	-
	Left	θU= 0°, θD= 0°, CR≥ 10		θL	-	80	-	°	
	Up	θR= 0°, θL= 0°, CR≥ 10		θU	-	60	-	°	
	Down	θR= 0°, θL= 0°, CR≥ 10		θD	-	80	-	°	

Note1: Measurement conditions are as follows.
Ta= 25°C, VCC= 3.0V, VCCIO= 3.0V, IL= 14mA,with touch panel



Note2: Definition of viewing angles



Note3: Definition of contrast ratio

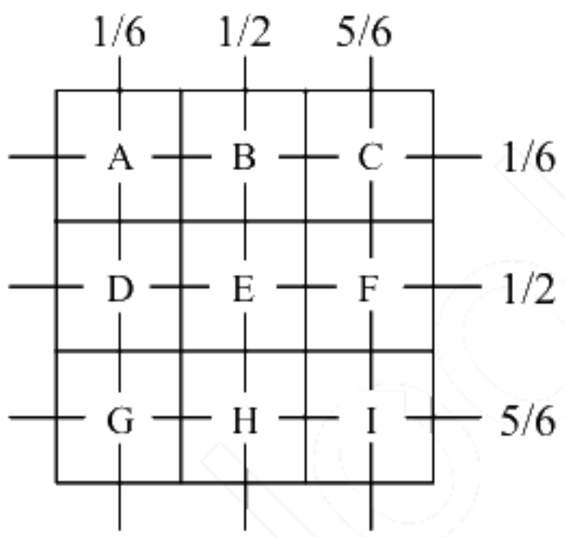
The contrast ratio is calculated by using the following formula.

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

Note4: Definition of luminance uniformity

Luminance uniformity is calculated by using the following formula.

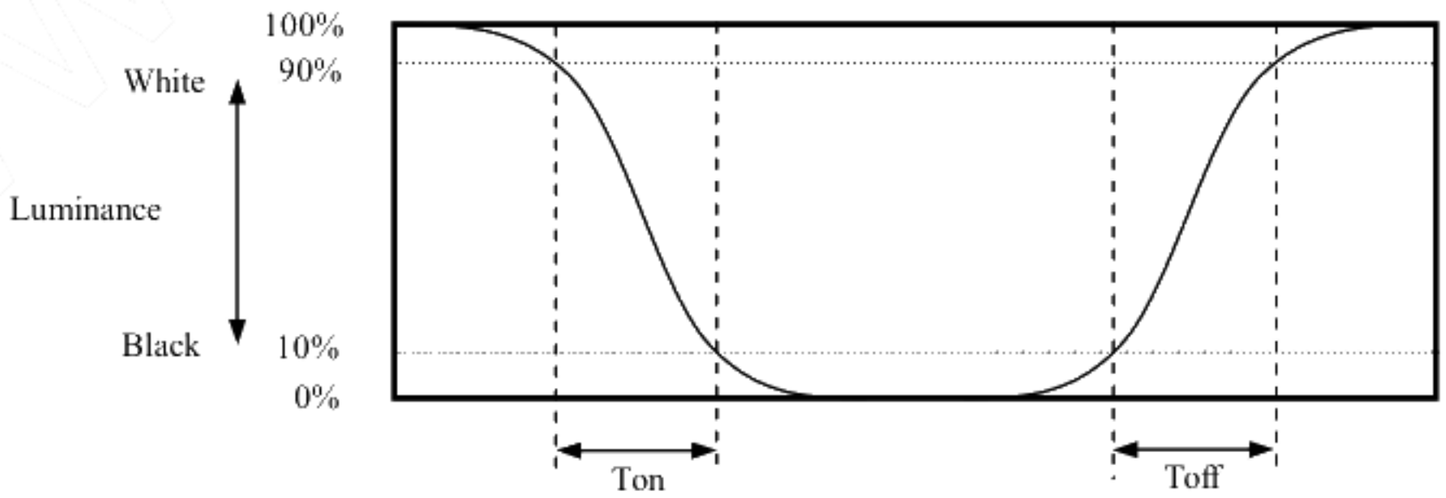
$$\text{Luminance uniformity (LU)} = \frac{\text{Minimum luminance from A to I}}{\text{Maximum luminance from A to I}} \times 100$$



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. DEFECT SPECIFICATIONS

a) Inspection conditions are as follows.

Distance: The distance between the inspector's eye and the LCD panel is 20 to 35 cm.

Temperature: 25 ± 5°C

Viewing angle and illumination:

Display specifications:	0° ≤ θR ≤ 20°, 0° ≤ θL ≤ 20°, 0° ≤ θU ≤ 20°, 0° ≤ θD ≤ 20° 60lx at a LCD surface Backlight On (IL= 8mA)
Appearance specifications:	0° ≤ θR ≤ 45°, 0° ≤ θL ≤ 45°, 0° ≤ θU ≤ 45°, 0° ≤ θD ≤ 45° 800lx at an operation table

b) Display specifications

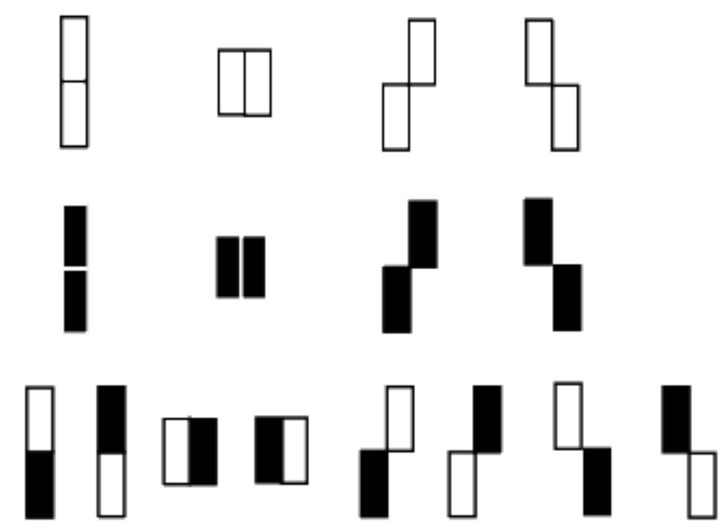
Defect pattern	Condition		Criteria
Line defect	Not allowed		
Bright dots Note1, Note2	Red + Green + Blue		≤ 5 dots
	Green		≤ 2 dots
	Linked 2 dots	Note4	≤ 1 set
	Linked 3 or more dots		0 set
	Within a circle of ϕ10mm		≤ 1 dot
Dark dots Note1, Note3	Red + Green + Blue		≤ 6 dots
	Linked 2 dots	Note4	≤1 set
	Linked 3 or more dots		0set
Between Bright dots and Dark dots	Linked 2 dots	Note4	≤1 set
Total	Bright dots + Dark dots		≤ 9 dots

Note1: Regardless of bright or intermittent bright, 1/3 or more defects of a dot area is counted as the defect dot.

Note2: Bright dots are measured while the display is black.

Note3: Dark dots are measured while the display is illuminated with red, green and blue.

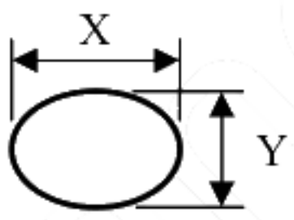
Note4: The pattern of linked 2 dots is as follows.

□ : Bright dot ■ : Dark dot	Criteria
	≤1 set

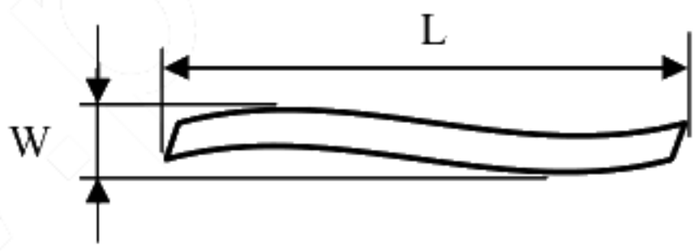
c) Appearance specifications

Defect pattern	Condition			Criteria
Other objects 1 (Stains, Dusts, Dent, Bubble, Foreign materials, Dark spot, White spot & Fungus) Note1, Note4	d < 0.2mm			All allowed
	0.2mm ≤ d < 0.4mm			≤ 4 points
	0.4 mm≤ d			0 point
Other objects 2 (Stains & Dusts) Note2, Note4	W ≤ 0.1mm	L < 0.5mm		All allowed
		0.5mm ≤ L < 2.5mm		≤ 4 points
	W > 0.1mm			0 point
	L ≥ 2.5mm			0 point
Touch panel scratch Note2, Note4	W ≤ 0.05mm	L ≤ 2.0mm		All allowed
	W > 0.05mm	L ≤ 2.0mm		0 point
	L > 2.0mm			0 point
Touch panel glass crack Note3	A ≤ 2.0mm	B ≤ 2.0mm	Z ≤ T	All allowed
	A > 2.0mm	B > 0.5mm		0 point
		B ≤ 0.5mm		All allowed
	B > 2.0mm	A > 0.5mm	Z ≤ T	0 point
		A ≤ 0.5mm		All allowed
	C ≤ 5.0mm	D ≤ 1.0mm	Z ≤ T	All allowed
		D > 1.0mm		
	C > 5.0mm	D ≤ 1.0mm	Z ≤ T	All allowed
		D > 1.0mm		0 point

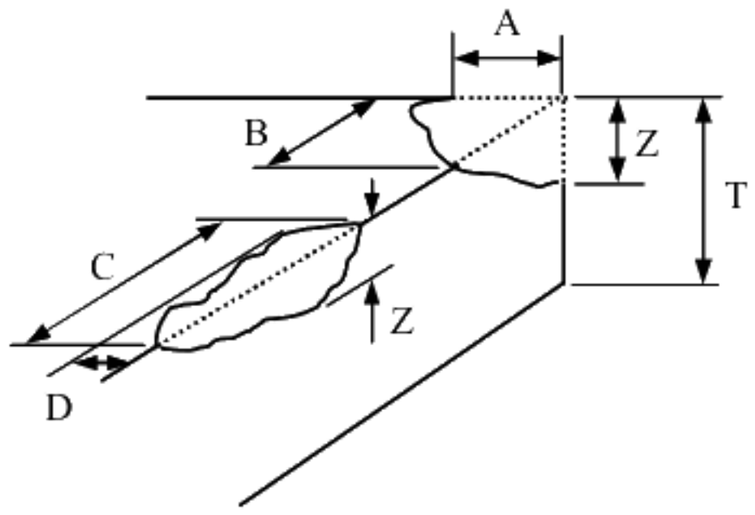
Note1: The shape is like a point.
The definition of "d" is as follows.
Average diameter (d) mm: d = (X+Y)/2



Note2: The shape is like a point.
The definitions of "W" and "L" are as follows.



Note3: The definitions of "A", "B", "C", "D", "Z" and "T" are as follows.



Note4: Inspection area
88.8mm (H)×53.28mm (V) (Active area)

Note5: Clear, unclear Mura and any other bands should be inspected based on NEC's limit samples.
Any question arising out from the shipping products will be discussed between both parties

6. LUMINANCE LIFETIME (Reference)

The luminance lifetime is the time from initial luminance to half-luminance.

This lifetime is reference data, and is not guarantee data.

Condition		Luminance lifetime Note1	Unit
LED elementary substance	25°C (Ambient temperature of LED) Continuous operation and IL= 14mA	10,000	h

Note1: In case the product works under high temperature environment, the lifetime becomes short.

7. PRODUCT INSPECTIONS

The following inspections are carried out on products before shipment

(1) 100% inspection

- Display
- Appearance

(2) Sampling inspection

- White luminance
- Contrast ratio
- Luminance uniformity

8. RELIABILITY TESTS

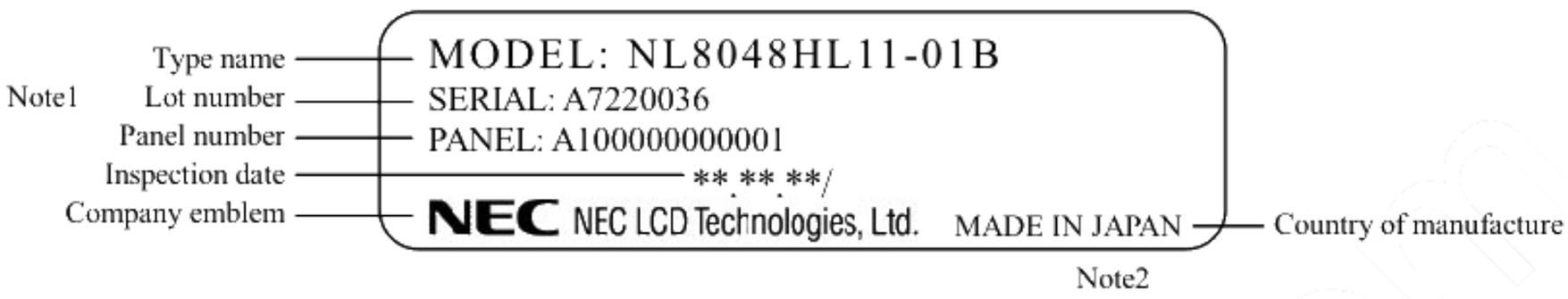
Test item	Condition	Judgement Note1
High temperature and humidity (Operation)	① 55 ± 2°C, RH = 85%, 240 hours ② Display data is black.	No display malfunctions
Heat cycle (Operation)	① -20 ± 3°C…1 hour 70 ± 3°C…1 hour ② 50 cycles, 4 hours/cycle ③ Display data is black.	
Thermal shock (Non operation)	① -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 53.3 kPa ② -20 ± 3°C…24 hours ③ 70 ± 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 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.

9. MARKING

Name plate label is attached to this product.

Nameplate label



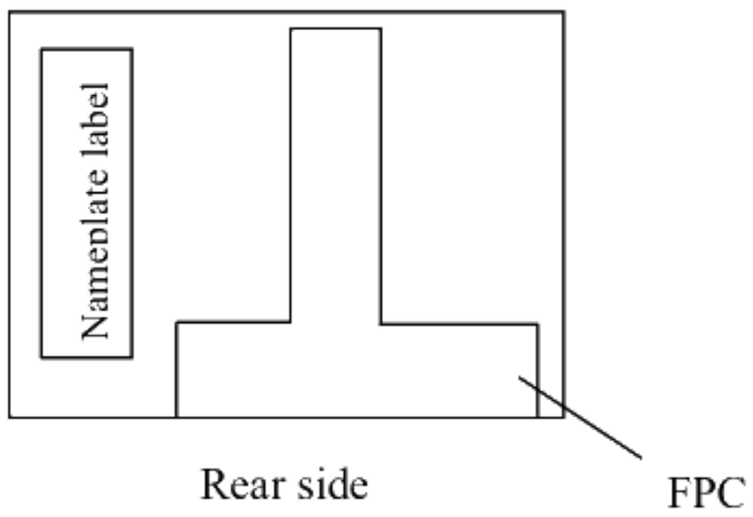
Note1: The meaning of lot number

- Example: A7220036

A	7	2	20036
Revision 1 letter (Alphabet)	**Manufacturing year** 1 letter of the A.D. end numbers (e.g.: A.D. 2007 is 7.)	**Manufacturing month** 1 letter Jan. to Sep.: Number of month October: A November: B December: C	**Production number** Multi-letter

Note2: **Do not attach anything such as label and so on, on the nameplate!** As replacing the product, NEC needs the contents of nameplate such as the lot number, inspection date and so on, to identify the warranty period with individual product. If NEC cannot decipher the contents of nameplate, such replacement shall be entitled to charge.

Note3: Label location



10. PACKING, TRANSPORTATION AND DELIVERY

NEC will pack products to deliver to customer in accordance with NEC's packing specifications, and will deliver products to customer in such a condition that products will not suffer from a damage during transportation. The delivery conditions are as follows.

10.1 PACKING

(1) Inner packing box

60 products are packed as the maximum in an inner packing box (See "**10.5 OUTLINE FIGURE FOR PACKING**"). The type name and quantity are shown on outside of the inner packing box, either labeling or printing.

(2) Outer packing box

2 inner packing boxes with products are packed in an outer packing box (See "**10.5 OUTLINE FIGURE FOR PACKING**). The type name and quantity are shown on outside of the outer packing box, either labeling or printing. In case the outer packing box with products is dropped from a height of 40cm or more, there is a risk of damage to products.

(3) Pallet packing (See "**10.5 OUTLINE FIGURE FOR PACKING**")

① Transport by aircraft
Outer packing boxes are tiered on a cardboard pallet. (8 Outer packing boxes × 4 tiers maximum)

② Transport by ship
Outer packing boxes are tiered on a cardboard pallet. (8 Outer packing boxes × 5 tiers maximum)

③ Cardboard sleeve and top cap are attached to packing boxes, and then they are fixed by bands.

The product is shipped by the outer packing box or the pallet packing according to shipment quantity.

10.2 INSPECTION RECORD SHEET

Inspection record sheets are included in an inner packing box with products. It is summarized to a number of products for pass/fail assessment.

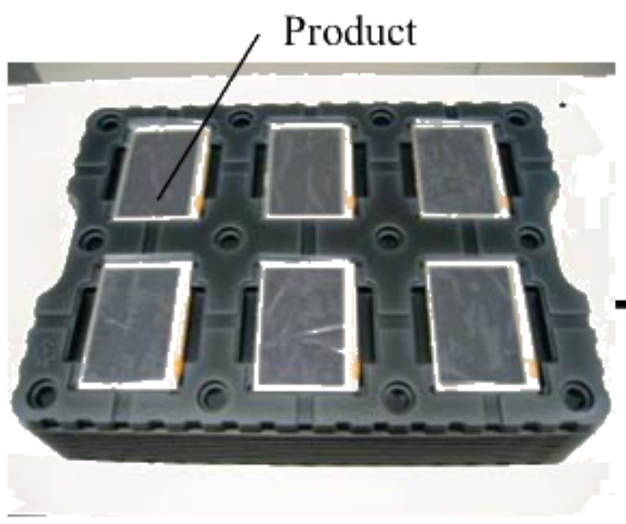
10.3 TRANSPORTATION

The product is transported by vehicle, aircraft or ship.

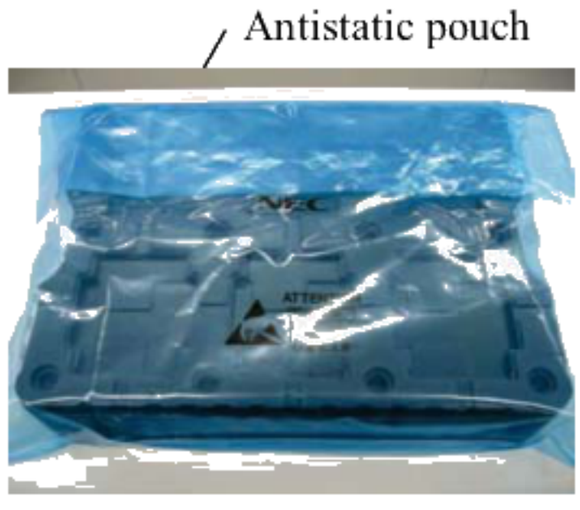
10.4 SIZE AND WEIGHT FOR PACKING BOXES

Parameter	Inner packing box	Outer packing box	Unit
Size	415 (L) × 312 (W) × 155 (H) (typ.)	439 (L) × 334 (W) × 292 (H) (typ.)	mm
Total weight	5.9(typ.) (with 60 products)	13.0 (typ.) (with 2 inner boxes and 120 products)	kg

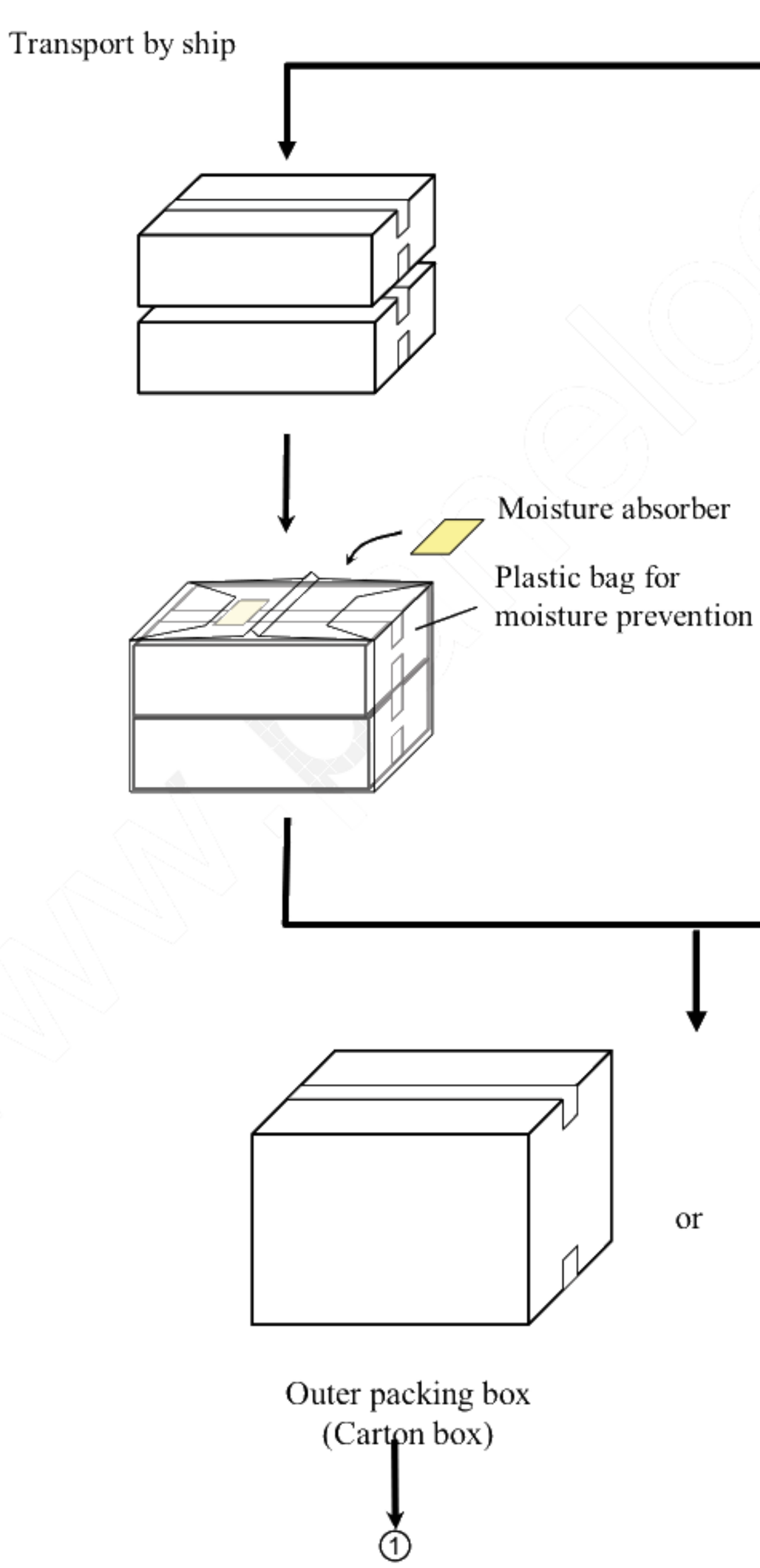
10.5 OUTLINE FIGURE FOR PACKING

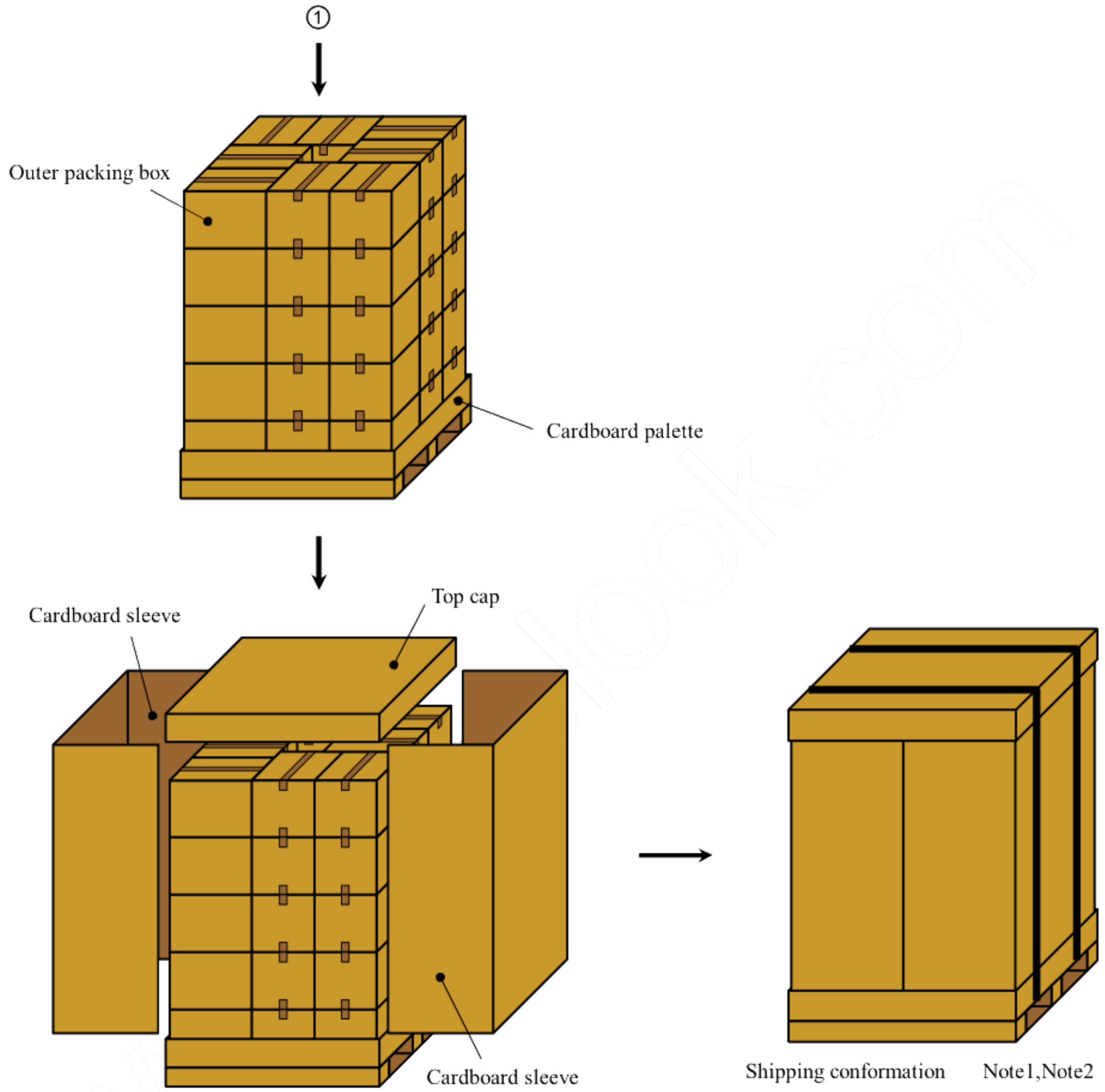


8 products are located on each tray.



Maximum 60 units are packed in the inner packing box.





Note1: Transport by aircraft

8 boxes × 4 tiers maximum
Size: 1,196 (L) × 1,176 (W) × 1,536 (H) mm
Weight: 429kg (with 32 outer packing boxes and 3,840 products)

Note2: Transport by ship

8 boxes × 5 tiers maximum
Size: 1,196 (L) × 1,176 (W) × 1,890 (H) mm
Weight: 536kg (with 40 outer packing boxes and 4,800 products)

11. PRECAUTIONS

11.1 MEANING OF CAUTION SIGNS

The following caution signs have very important meaning. **Be sure to read "11.2 CAUTIONS" and "11.3 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.

11.2 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)**

11.3 ATTENTIONS

11.3.1 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 without undue stress such as bends or twist. Bends, twist or undue stress to any portion may cause display mura.
⑥ When cleaning the T/P surface, wipe it with a soft dry cloth.
⑦ Do not push nor pull the FPC while the product is working.
⑧ Do not fold the FPC. When folding the FPC, pattern disconnection may occur. In case of bending FPC, the minimum curvature (R) must be more than 1.0 mm.
⑨ 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.
⑩ When installing the product, apply the waterproof design to avoid going of water into the product.

11.3.2 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.

11.3.3 Characteristics

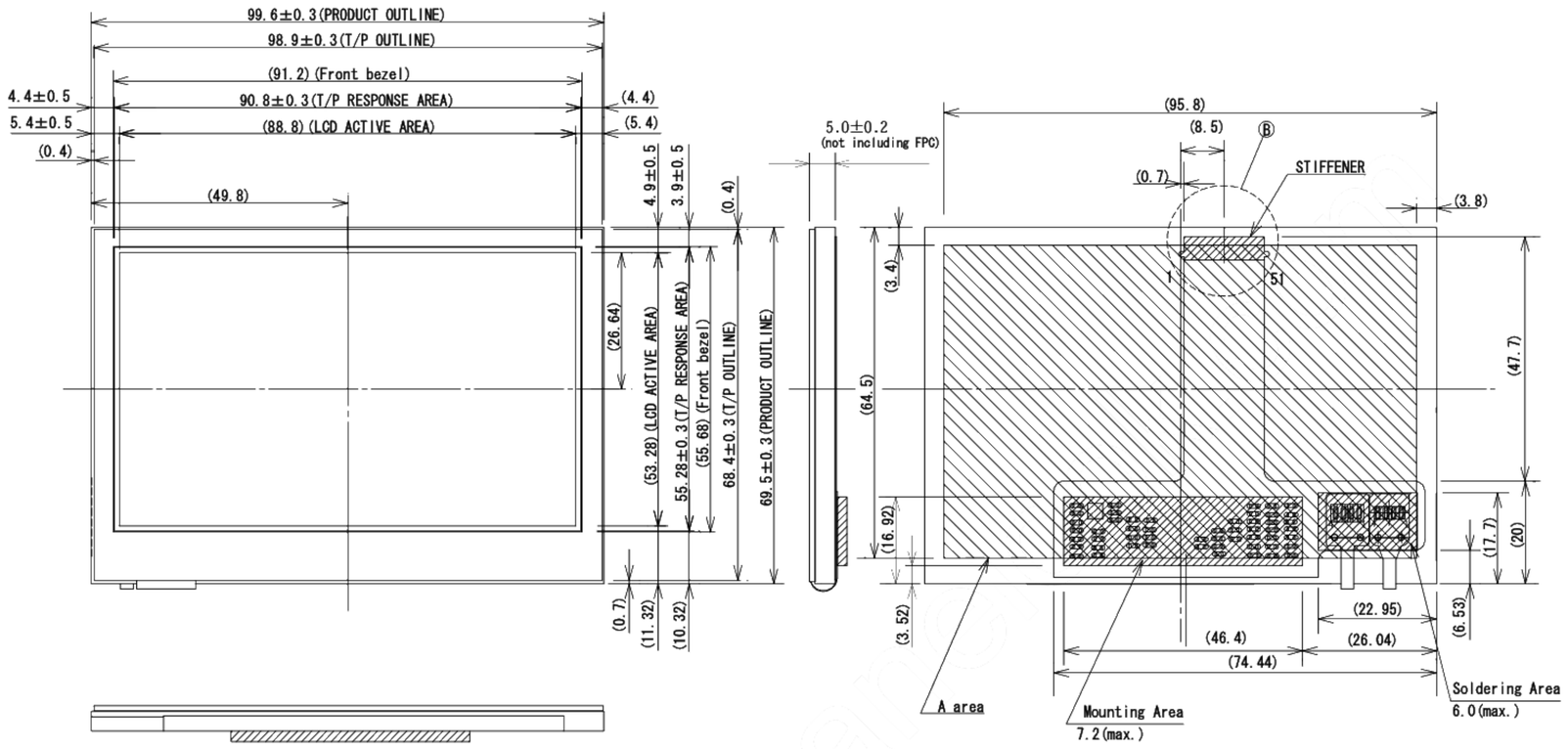
The following items are neither defects nor failures.

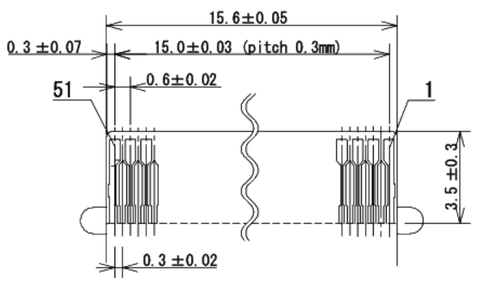
① Response time, luminance and color may be changed by ambient temperature.
② Display mura, flicker, vertical seam or small spot may be observed depending on display patterns.
③ Do not display the fixed pattern for a long time because it may cause image sticking.
④ Optical characteristics may be changed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

11.3.4 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.

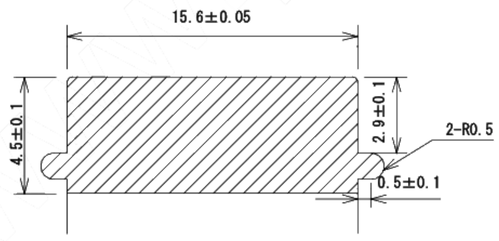
12. OUTLINE DRAWINGS





Adaptable connecter:HIROSE
FH23-51S-0.3SHW(06)

Detail B(Terminal face)



STIFFENER

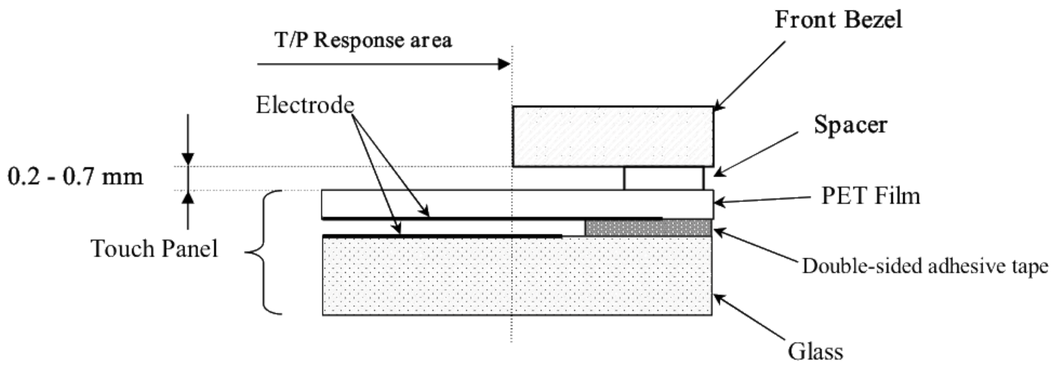
Detail B

Pin No.	Symbols	Pin No.	Symbols
1	GND	27	D20
2	VCC	28	D21
3	VCC	29	D22
4	VCC	30	D23
5	GND	31	D24
6	/RESET	32	D25
7	HSYNC	33	D26
8	VSYNC	34	D27
9	CLK	35	GND
10	GND	36	SCL
11	D00	37	SI
12	D01	38	RSVD
13	D02	39	/CS
14	D03	40	VCOMIN
15	D04	41	VCCIO
16	D05	42	GND
17	D06	43	XL
18	D07	44	YD
19	D10	45	XR
20	D11	46	YU
21	D12	47	GND
22	D13	48	ANODE1
23	D14	49	CATHODE1
24	D15	50	ANODE2
25	D16	51	CATHODE2
26	D17		

Note1: The values in parentheses are for reference.
Note2: When installing the product to customer equipment, do not apply undue stress to the rear side of the product, FPC, A area, Soldering Area and Mounting Area.
If not, it may cause display un-uniformity 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

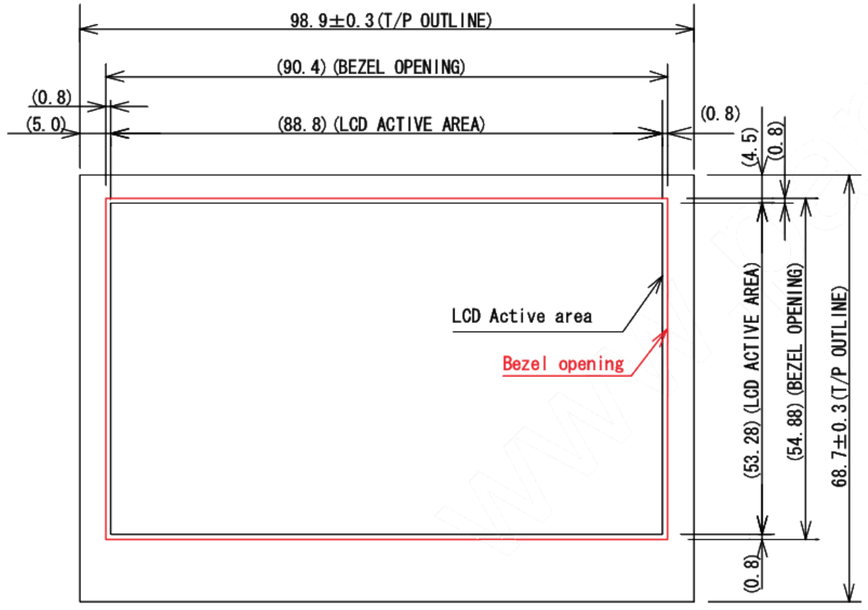
13. RECOMMENDATION DESIGN OF FRONT BEZEL



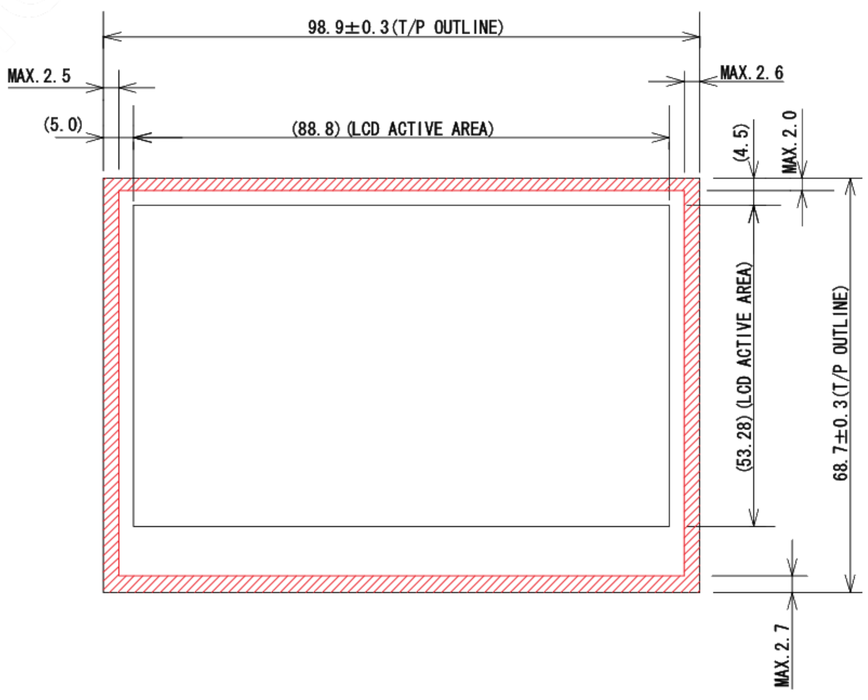
Design guidance for the front bezel and the spacer

1. Front Bezel opening design
   a. Please place the front bezel opening to maintain the operation by a stylus pen inside the T/P response area.
   b. The any pressures in the area between T/P response area and T/P viewing area is prohibited.
      Please use the appropriate material as the front bezel.

2. Spacer design
   a. Please put the 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	Prepared date	Revision contents and signature	Issued date
7th edition	Nov. 22, 2007	**Revision contents** 25p: Dark dots Linked 2 dots 0set→≤1 set,Linked 3 or more dots ≤1 set→0set(changed) Between Bright dots and Dark dots(addition),Criteria(addition) 30p: 「10. PACKING,TRANSPORTATION AND DELIVERY」(addition) **Signature of writer** Approved by: H.YAMAGUCHI　Checked by:　Prepared by: S.MORISHITA	Nov.22, 2007