NEC LCD Technologies, Ltd.

TFT COLOR LCD MODULE

NL8048HL11-01A

10.4cm (4.1 Type)
WVGA

DATA SHEET

DOD-PP-0788 (1st edition)

This DATA SHEET is updated document form PRELIMINARY DATA SHEET DOD-PP-0615(1).

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

INTRODUCTION

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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

1. OUTLINE

1.1 STRUCTURE AND PRINCIPLE

Color LCD module NL8048HL11-01A 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, 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

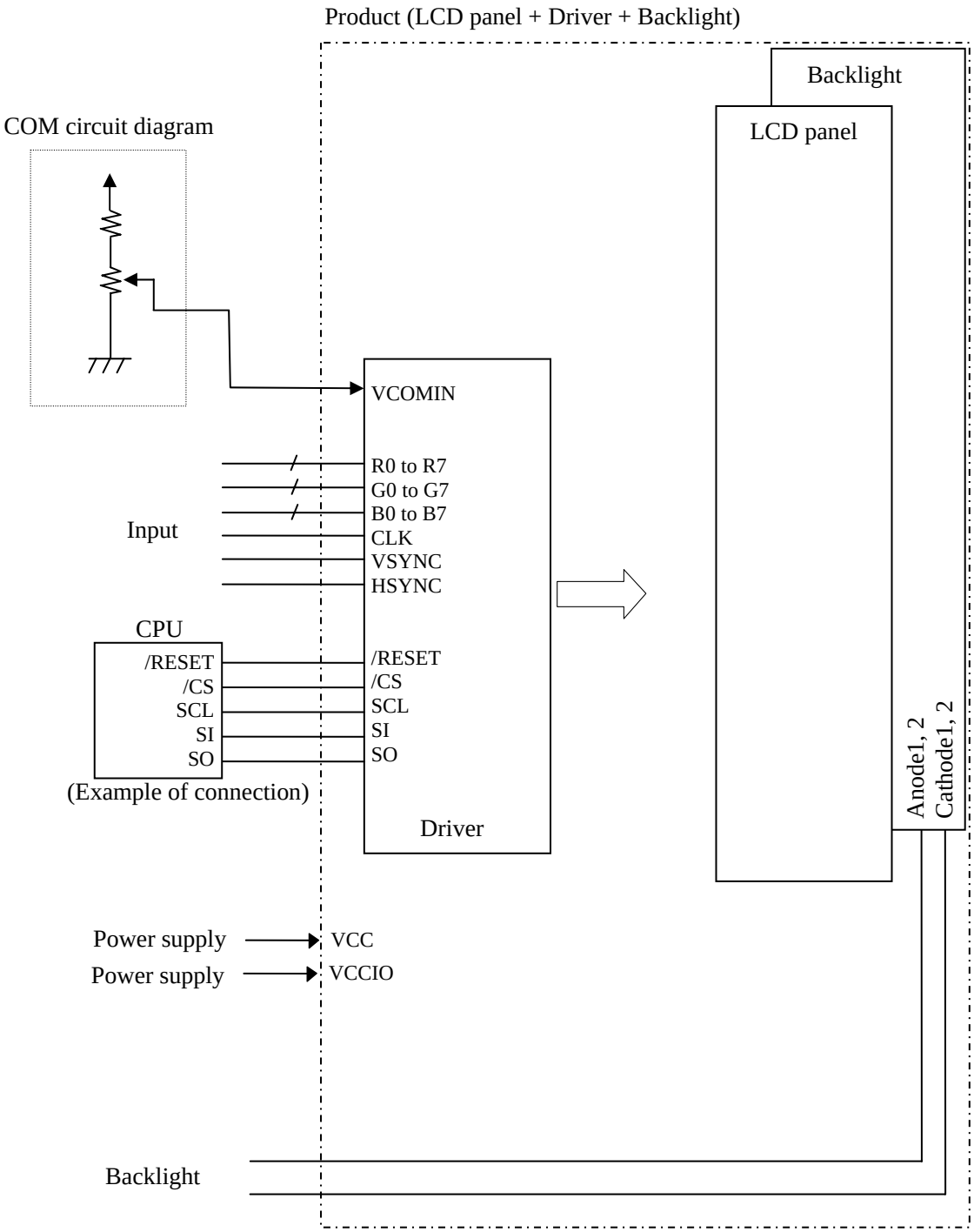
1.3 FEATURES

- Adoption of VIT (Value integrated TFT) (Transmissive type)
- High resolution
- High luminance
- High contrast
- Backlight attached
- Including LCD controller and power supply
- 8-bit digital RGB signals

2. GENERAL SPECIFICATIONS

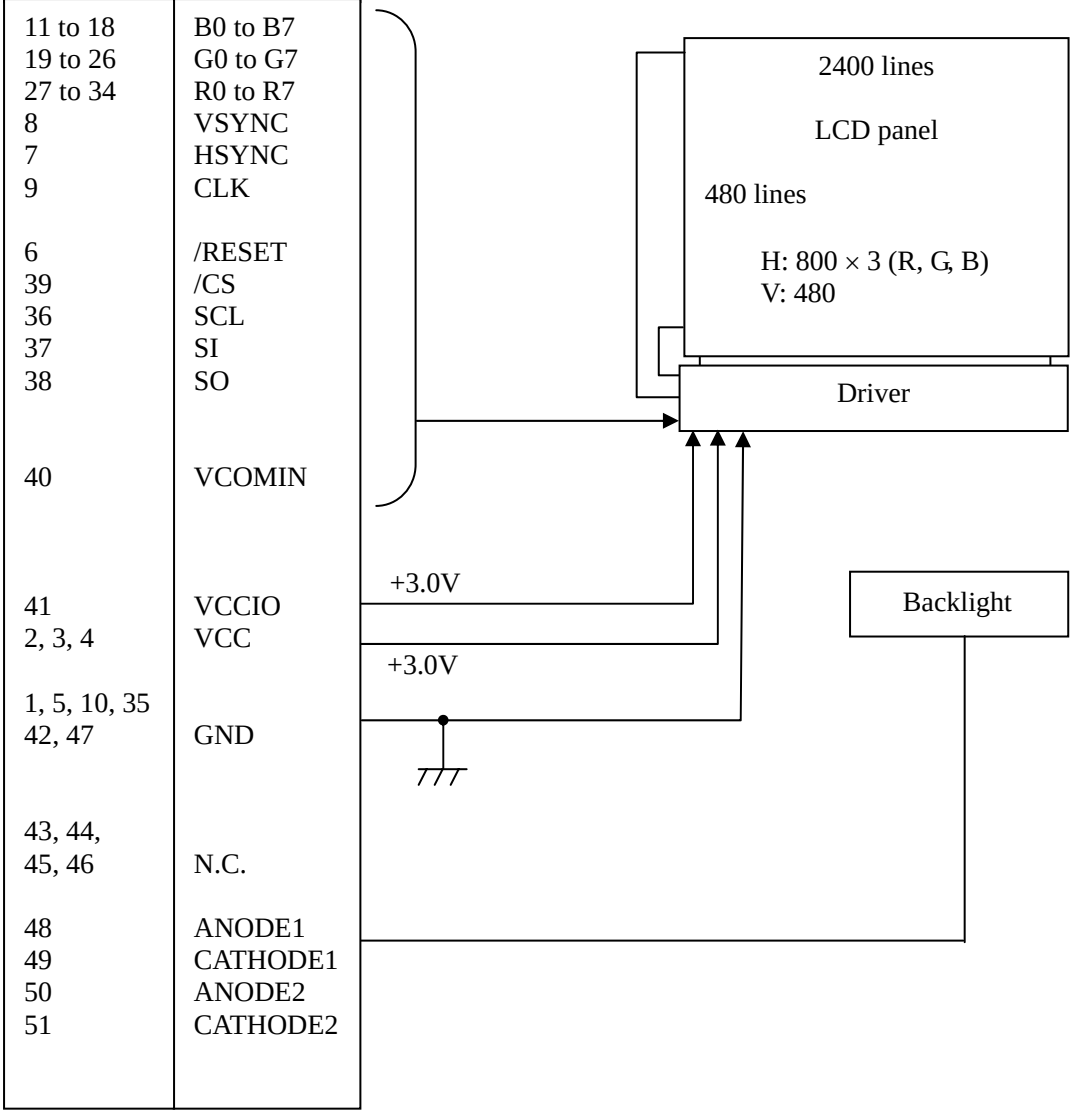
Display area	88.80 (H) × 53.28 (V) mm	
Diagonal size of display	10.4cm (4.1 inches)	
Drive system	LTPS TFT active matrix	
Display color	16,777,216 colors	
Pixel	800 (H) × 480 (V) pixels	
Pixel arrangement	RGB (Red dot, Green dot, Blue dot) vertical stripe	
Dot pitch	0.037 (H) × 0.111 (V) mm	
Pixel pitch	0.111 (H) × 0.111 (V) mm	
Module size	99.6 (H) × 69.5 (V) × 4.0 (D) mm (typ.) [Excluding FPC]	☆
Weight	55g (typ.)	☆
Polarizer panel surface	Clear	
Polarizer 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/LED* 400cd/m^2 (typ.)	☆
Contrast ratio	*At IL= 14mA/LED* 450:1 (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, SO)	
Supply voltage	VCCIO: 3.0V (typ.) VCC: 3.0V (typ.)	
Power consumption	LCD panel + Driver: 165mW (typ.) Backlight: 604mW (typ., at IL= 14mA/LED)	

3. BLOCK DIAGRAM

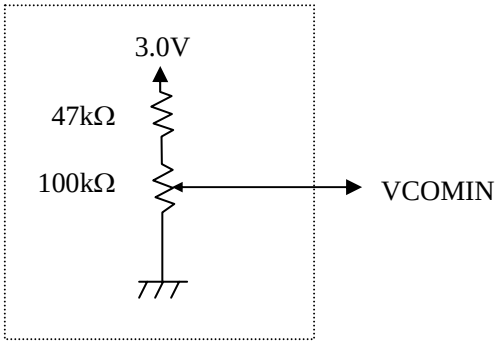


FPC I/F

Pin No.	Symbol
11 to 18	B0 to B7
19 to 26	G0 to G7
27 to 34	R0 to R7
8	VSYNC
7	HSYNC
9	CLK
6	/RESET
39	/CS
36	SCL
37	SI
38	SO
40	VCOMIN
41	VCCIO
2, 3, 4	VCC
1, 5, 10, 35 42, 47	GND
43, 44, 45, 46	N.C.
48	ANODE1
49	CATHODE1
50	ANODE2
51	CATHODE2



Reference design of COM circuit



4. DETAILED SPECIFICATIONS

4.1 MECHANICAL SPECIFICATIONS

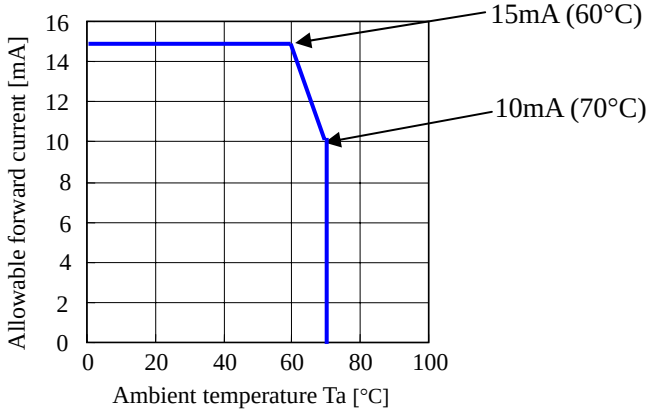
Parameter	Specification	Unit
Module size	99.6 ± 0.3 (W) × 69.5 ± 0.3 (H) × 4.0 ± 0.2 (D) Note1 Note2	mm
Display area	88.80 (H) × 53.28 (V) Note2	mm
Weight	55 (typ.), 58 (max.)	g

Note1: Excluding FPC
Note2: See "**8. 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)

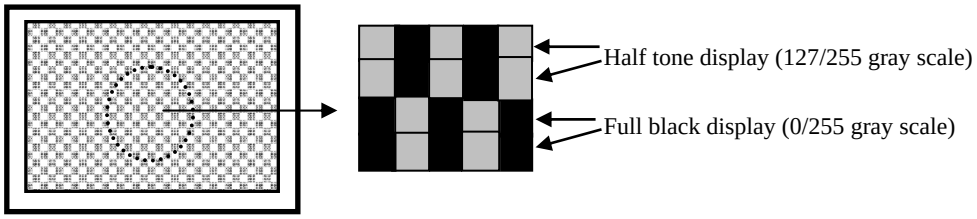
Parameter	Symbol	min.	typ.	max.	Unit	Remarks
Supply voltage (DC/DC)	VCC	2.85	3.0	3.15	V	-
Supply voltage (Logic)	VCCIO	1.7	3.0	3.3	V	-
Logic input high voltage	VIH	0.8VCCIO	-	VCCIO	V	Logic signal
Logic input low voltage	VIL	0	-	0.2VCCIO	V	
VCOM input voltage	VCOMIN	-	0.3	-	V	at VCC= 3.0V Note1
VCC supply 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. The optimum VCOMIN is different each product. ☆

Note2: CLK= 23.8MHz, HSYNC= 29.3 kHz, VSYNC= 60 Hz,
Checkered flag pattern (by EIAJ ED-2522) ☆

Recommended adjustment display for VCOMIN

The figure is every one line.



Note3: CLK, control signals: inactive

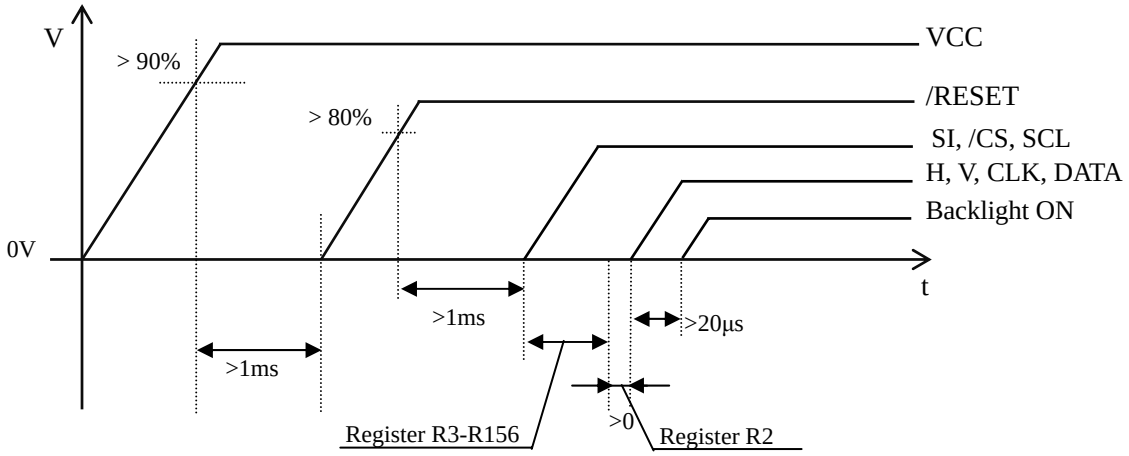
(2) Backlight

(Ta= 25°C)

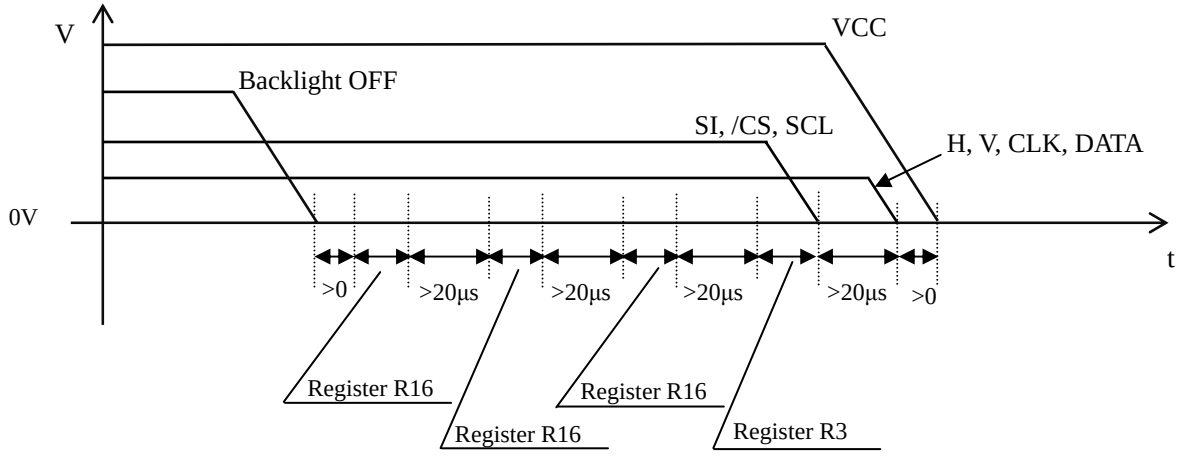
Parameter	Symbol	min.	typ.	max.	Unit	Remarks
Forward Current	IL1,2	-	14	15	mA	-
Forward Voltage	VL1,2	-	21.6	23.8	V	at IL= 14mA

4.4 POWER SUPPLY VOLTAGE SEQUENCE ☆

(1) Power ON



(2) Power OFF



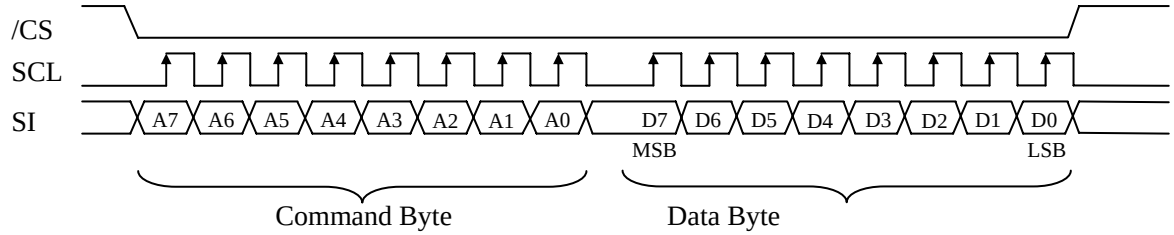
4.5 SETTING OF THE INTERNAL REGISTER

Initially, the internal register of driver is undefined. Therefore, the following procedure is required. After initialization is done by the /REST pin, the register must be written using /CS, SCL and SI pins. To check or confirm the written register data, you can read it using SO pin. The setting method is as follows. ☆

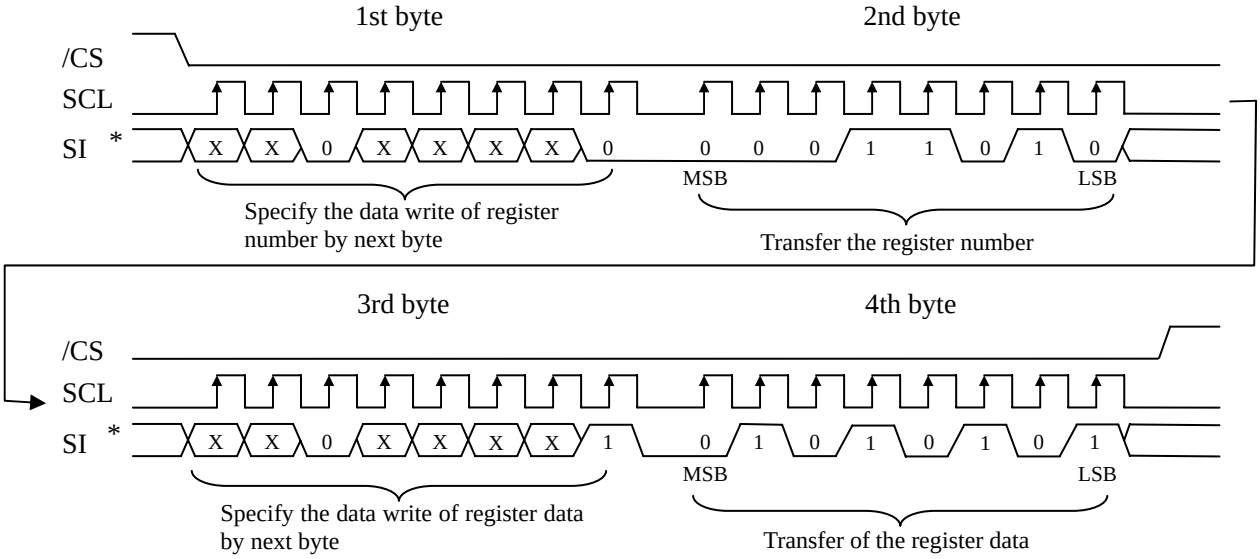
(1) Command Byte Function

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

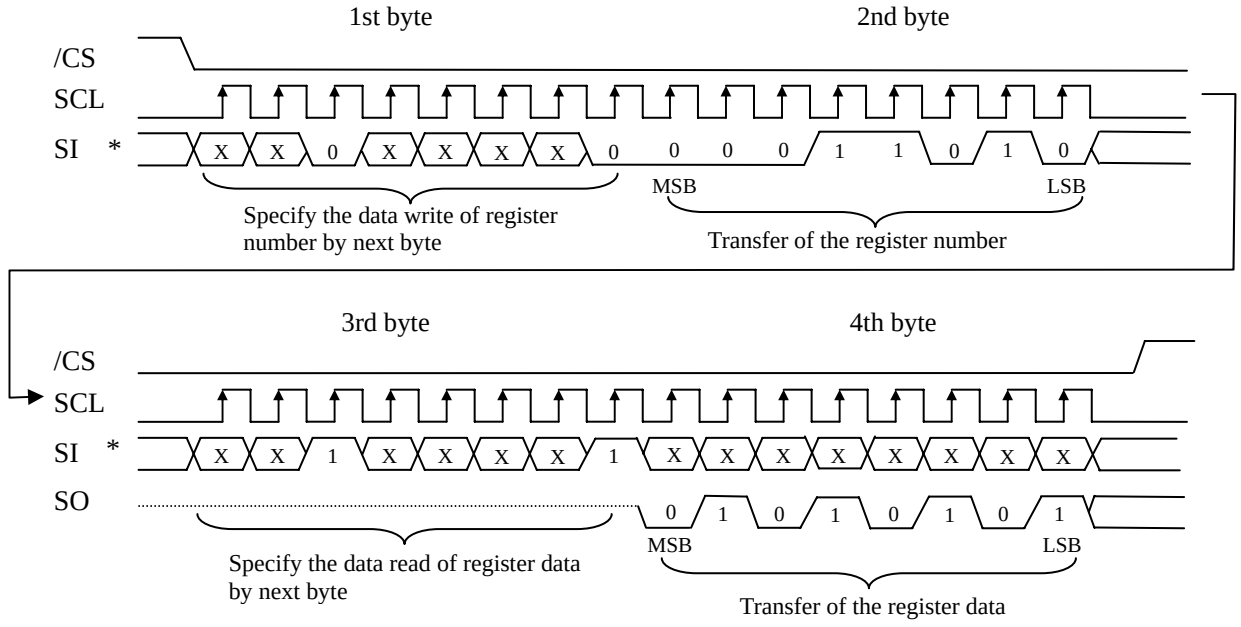


Ex) When data 55h is written to Register R26 (R1Ah)



* "X" value can be set any data. ☆

Ex) When data 55h is read from Register R26 (R1Ah)



* "X" value can be set any data. ☆

Note1: During 32 bits data transfer of the Register, /CS pin (Pin No.39) must be maintained active.
Note2: Please transfer the data every 32 bits. ☆

(3) Command sequence

①Power On

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	30h	-
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	20μs 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 μs min. wait.		
3	R16	01h	-
4	20 μs min. wait.		
5	R16	00h	
6	20 μs 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.

4.6 INTERFACE PIN CONNECTIONS

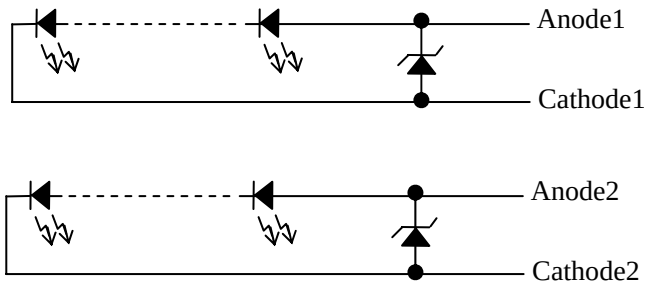
CN1 (FPC)
Adaptable socket: FH23-51S-0.3SHW (06) (Hirose Electric Co., Ltd. (HRS))

Pin No.	Symbols	Functions	Pin No.	Symbols	Functions
1	GND	Ground Note1	27	R0	Red data (LSB)
2	VCC	Power supply	28	R1	Red data
3	VCC		29	R2	Red data
4	VCC		30	R3	Red data
5	GND	Ground Note1	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	SCL	Serial clock
11	B0	Blue data (LSB)	37	SI	Serial input
12	B1	Blue data	38	SO	Serial output
13	B2	Blue data	39	/CS	Chip selection
14	B3	Blue data	40	VCOMIN	COM high voltage input
15	B4	Blue data	41	VCCIO	Power supply (Logic)
16	B5	Blue data	42	GND	Ground Note1
17	B6	Blue data	43	N.C.	Keep this pin open.
18	B7	Blue data (MSB)	44	N.C.	
19	G0	Green data (LSB)	45	N.C.	
20	G1	Green data	46	N.C.	
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 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.
SO	This pin is data output 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**".
ANODE1,2 CATHODE1,2	Refer to the below "**Circuits of backlight**".



Circuits of backlight

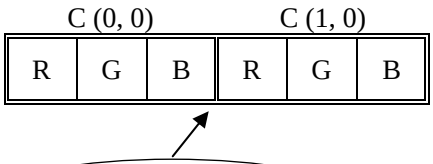
4.7 DISPLAY COLORS AND INPUT DATA SIGNALS

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

4.8 DISPLAY POSITIONS

The following table is the coordinates per pixel (See figure of "**4.9 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)

4.9 SCANNING DIRECTIONS

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

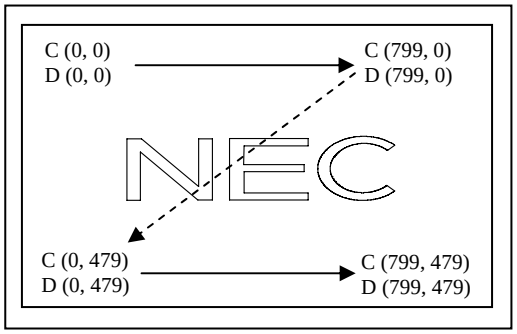


Figure1. Normal scan
(R1:01h, R121:30h)

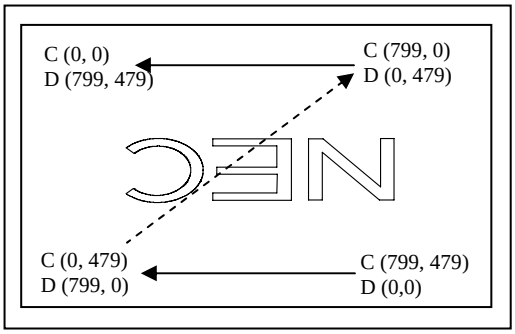


Figure2. Reverse scan
(R1:03h, R121:10h)

Note1: Meaning of C (X, Y) and D (X, Y)
C (X, Y): The coordinates of the display position (See "**4.8 DISPLAY POSITIONS**".)
D (X, Y): The data number of input signal for LCD panel

4.10 INPUT SIGNAL TIMINGS

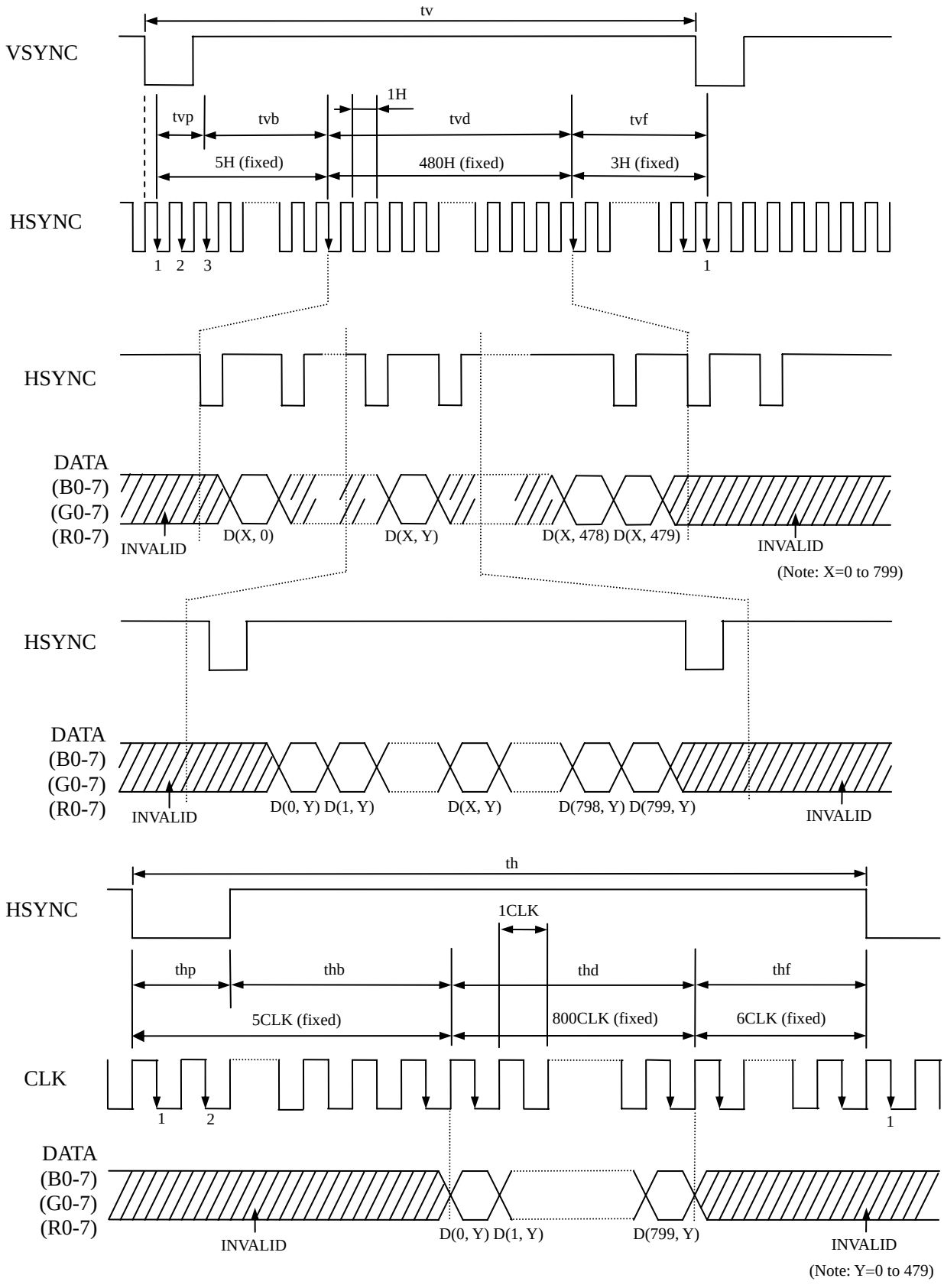
4.10.1 RGB interface (Ta= 25°C, VCCIO= 3.0V)

(1) Timing characteristics

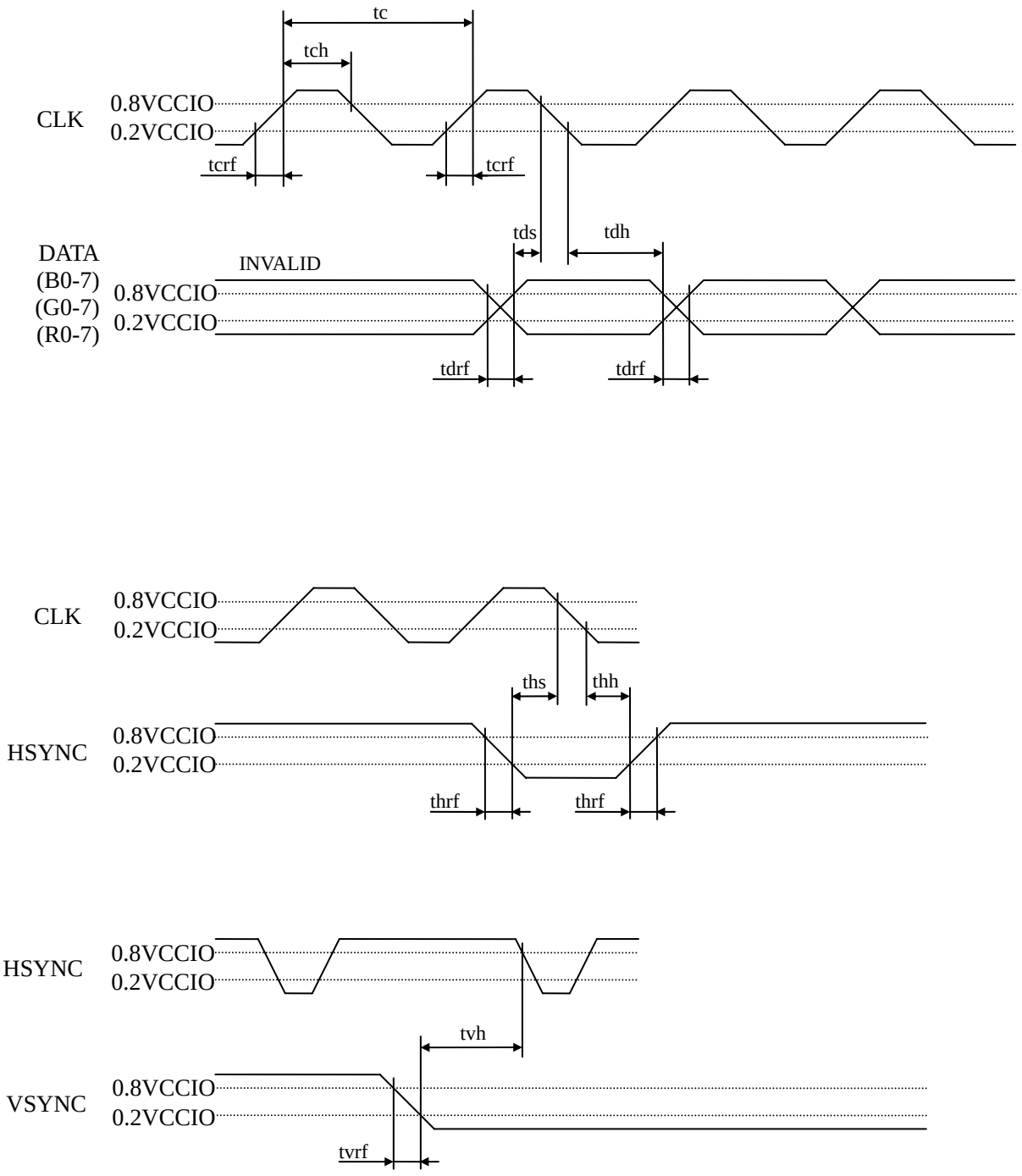
Parameter			Symbol	min.	typ.	max.	Unit	Remarks
CLK	Frequency		1/tc	21.8	23.8	25.7	MHz	42ns (typ.)
	Duty		tcd	0.4	0.5	0.6	-	-
	Rise time, Fall time		tcrf	-	-	2	ns	
DATA (B0-7) (G0-7) (R0-7)	CLK-DATA	Setup time	tds	13	-	-	ns	-
		Hold time	tdh	13	-	-	ns	
	Rise time, Fall time		tdrf	-	-	2	ns	
HSYNC	Cycle		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.



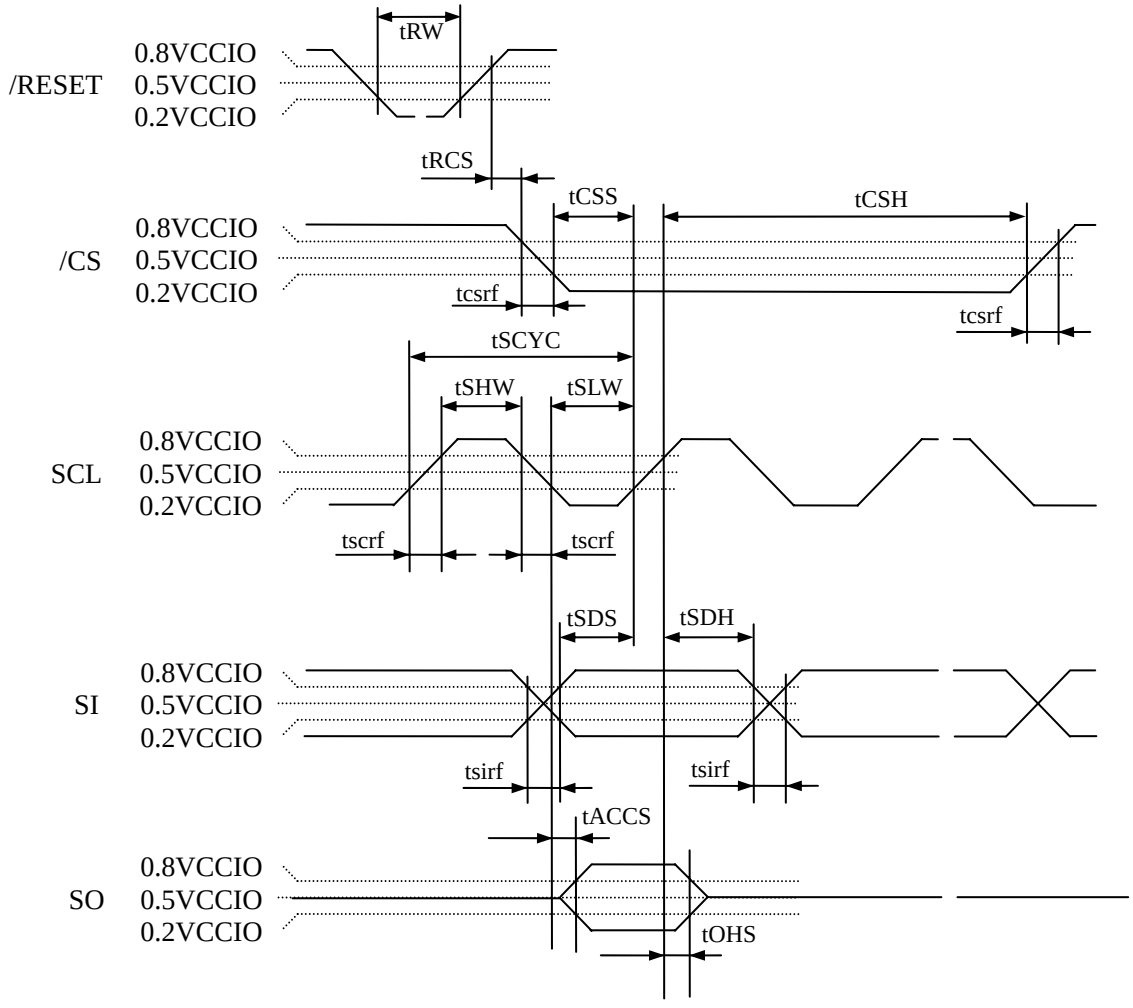
Note1: Unless otherwise specified, the input level is defined to be VIH= 0.8VCCIO, VIL= 0.2VCCIO.

4.10.2 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	-
Access time	tACCS	SO	-	-	150	ns	
Output disable time	tOHS	SO	-	-	20	ns	-

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.

4.11 OPTICAL CHARACTERISTICS

(Note1, Note2)

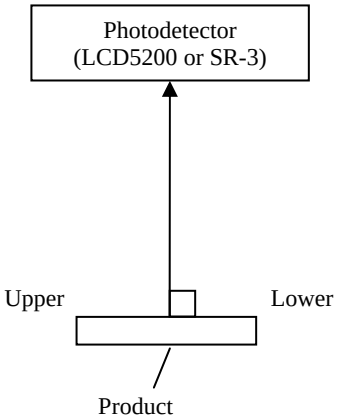
Parameter	Condition	Symbol	min.	typ.	max.	Unit	Remarks
Luminance	White at center θR= 0°, θL= 0°,θU= 0°, θD= 0°	L	250	400	-	cd/m^2	-
Contrast ratio	White/Black at center θR= 0°, θL= 0°,θU= 0°, θD= 0°	CR	300	450	-	-	Note3
Luminance uniformity	White θR= 0°, θL= 0°, θU= 0°, θD= 0° Maximum luminance: 100%	LU	70	85	-	%	Note4

Reference data

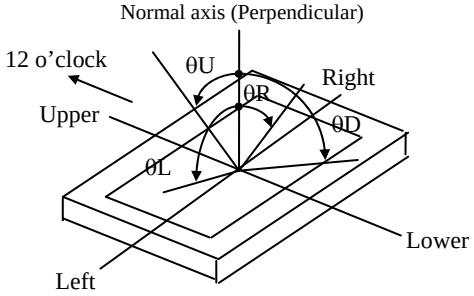
(Note1, Note2)

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



Note2: Definition of viewing angles



Note3: Definition of contrast ratio

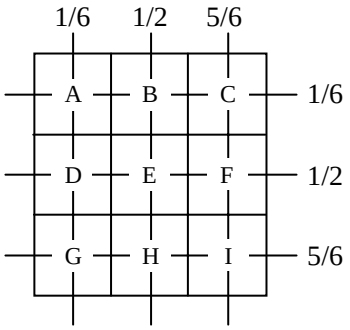
The contrast ratio is calculated by using the following formula.

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

Note4: Definition of luminance uniformity

Luminance uniformity is calculated by using the following formula.

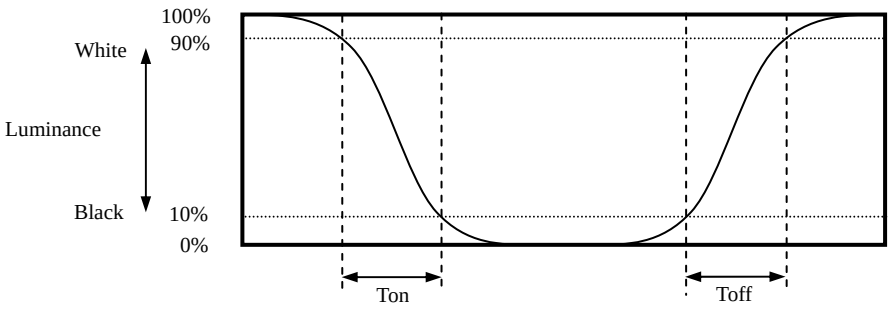
$$\text{Luminance uniformity (LU)} = \frac{\text{Minimum luminance from A to I}}{\text{Maximum luminance from A to I}} \times 100$$



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

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5. ESTIMATED LUMINANCE LIFETIME

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

This lifetime is the estimated value, and is not guarantee value.

Condition		Estimated luminance lifetime (Life time expectancy) Note1, Note2, Note3	Unit
LED elementary substance	25°C (Ambient temperature of LED) Continuous operation, IL=14mA	22,000	h

Note1: Life time expectancy is mean time to half-luminance.
Note2: Estimated luminance lifetime is not the value for LCD module but the value for LED elementary substance.
Note3: By ambient temperature, the lifetime changes particularly. Especially, in case the product works under high temperature environment, the lifetime becomes short.

6. RELIABILITY TESTS

Test item	Condition	Judgment 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 directions 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 directions ③ 1 times each directions	

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

7. PRECAUTIONS

7.1 MEANING OF CAUTION SIGNS

The following caution signs have very important meaning. **Be sure to read "7.2 CAUTIONS" and "7.3 ATTENTIONS", after understanding these contents!**

This sign has the meaning that customer will be injured by personnel or the product will sustain a damage, if customer has wrong operations.

This sign has the meaning that customer will be injured by personnel, if customer has wrong operations.

7.2 CAUTIONS

∗ **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)**

☆

7.3 ATTENTIONS

7.3.1 Handling of the product

① Pull out the product from side without FPC and take hold of side with out FPC, when the product (LCD module) is picked up from the tray. Do not touch the FPC.
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 any stress such as bends or twist. Bends, twist or any stress to any portion may cause display mura.
⑥ Do not hit or rub the surface of panel with hard materials, because it is easily scratched. (Polarizer pencil-hardness: 3H)
⑦ When cleaning the panel 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 folding the FPC, pattern disconnection may occur. 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 Usually liquid crystals don't leak through the breakage of glasses because of the surface tension of thin layer and the construction of LCD panel. But, if you contact with liquid crystal for the worst, please wash it out with soap.

7.3.2 Environment

① Do not operate or store in high temperature, high humidity, dewdrop atmosphere or corrosive gases. Keep the product in packing box with antistatic pouch in room temperature to avoid dusts and sunlight, when storing the product.
② In order to prevent dew condensation occurring by temperature difference, the product packing box should be opened after enough time being left under the environment of an unpacking room. Evaluate the leaving time sufficiently because a situation of dew condensation occurring is changed by the environmental temperature and humidity. (Recommended leaving time: 6 hours or more with packing state)
③ Do not operate in high magnetic field. Circuits may be broken down by it.
④ This product is not designed as radiation hardened.

7.3.3 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.

7.3.4 Other

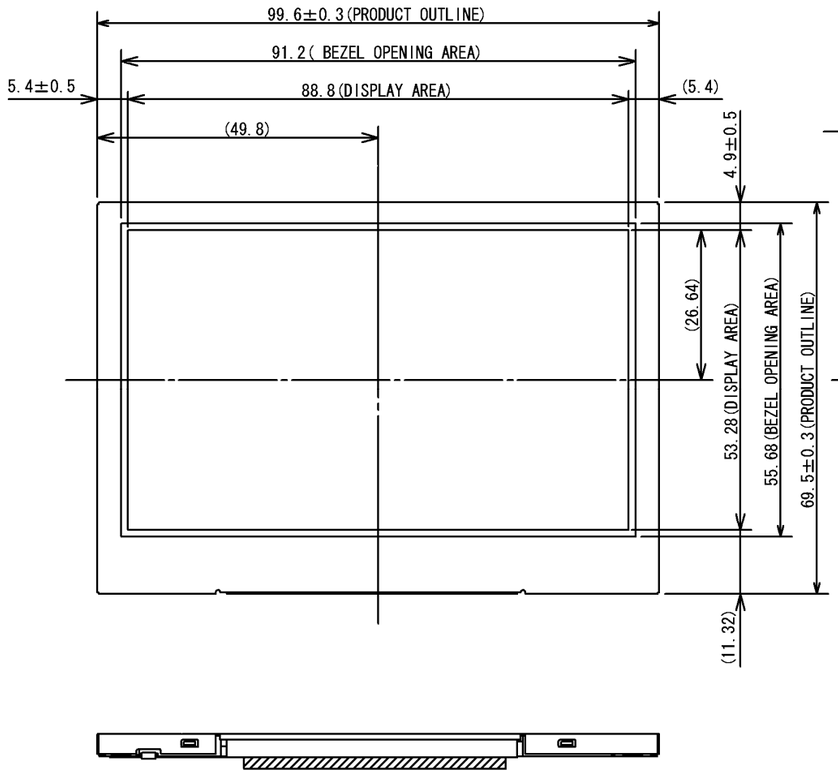
① All GND terminals should be used without any non-connected lines.
② Do not disassemble the product.
③ Pack the product with original shipping package, in order to avoid any damages during transportation, when returning the product to NEC.
④ When installing the product to the customer equipment, do not apply any stress to the rear side of fhe product, FPC, A area, Soldering Area and Mounting Area. If not, it may cause display un-uniformity or LCD panel separation or break down of the product.
⑤ The information of China RoHS directive six hazardous substances or elements in this product is as follows. ☆

China RoHS directive six hazardous substances or elements					
Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr VI)	Polybrominated Biphenys (PBB)	Polybrominated Biphenyl Ethers (PBDE)
×	○	○	○	○	○

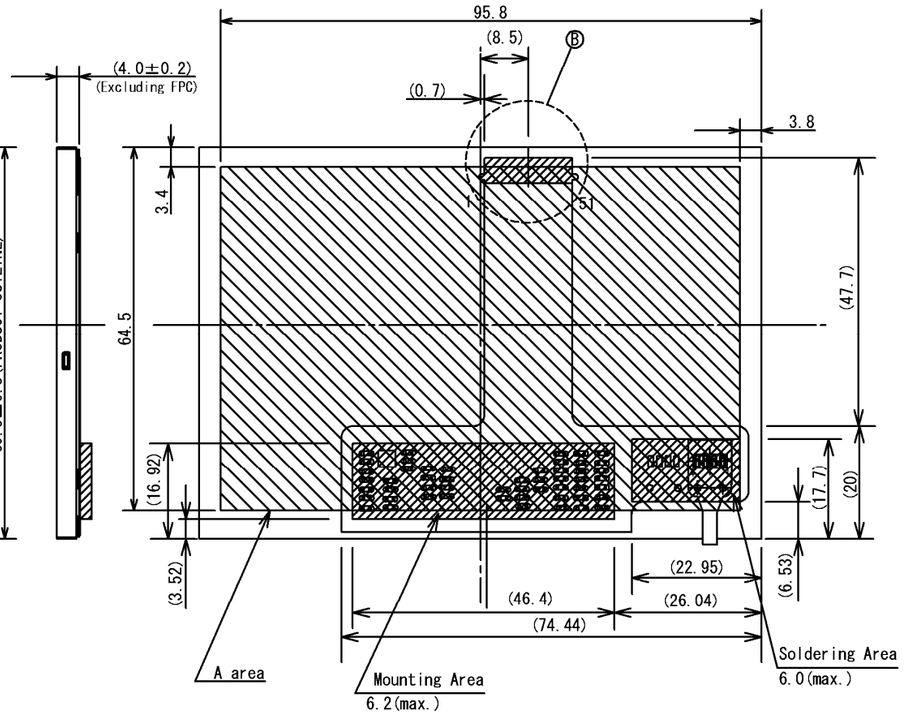
Note1: ○: This indicates that the poisonous or harmful material in all the homogeneous materials for this part is equal or below the limitation level of SJ/T11363-2006 standard regulation.
×: This indicates that the poisonous or harmful material in all the homogeneous materials for this part is above the limitation level of SJ/T11363-2006 standard regulation.

8. OUTLINE DRAWINGS

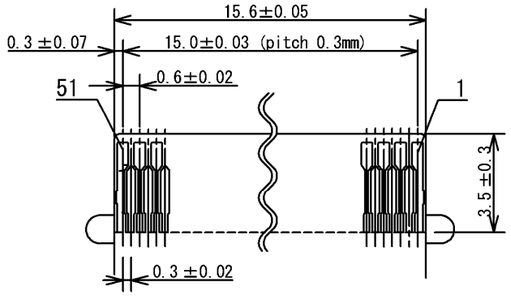
Front view



Rear view

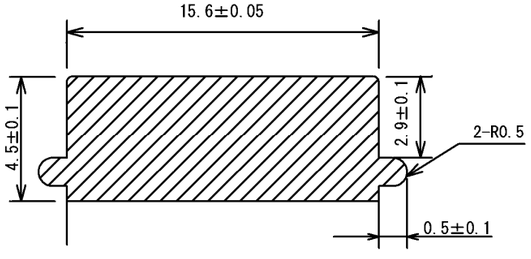


Pin No.	Symbols	Pin No.	Symbols
1	GND	27	R0
2	VCC	28	R1
3	VCC	29	R2
4	VCC	30	R3
5	GND	31	R4
6	/RESET	32	R5
7	HSYNC	33	R6
8	VSYNC	34	R7
9	CLK	35	GND
10	GND	36	SCL
11	B0	37	SI
12	B1	38	SO
13	B2	39	/CS
14	B3	40	VCOMIN
15	B4	41	VCCIO
16	B5	42	GND
17	B6	43	N.C.
18	B7	44	N.C.
19	G0	45	N.C.
20	G1	46	N.C.
21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



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

Detail B(Terminal face)



STIFFENER

Detail B

Note1: The values in parentheses are for reference.
Note2: When installing the product to customer equipment, do not apply any 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 LCD panel separation 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