NEC LCD Technologies, Ltd.

TFT COLOR LCD MODULE

NL6448BC18-06F

15cm (5.7 Type)
VGA

DATA SHEET

DOD-PP-1099 (1st edition)

This DATA SHEET is updated document from PRELIMINARY DATA SHEET DOD-PP-0995(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: 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.

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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 NL6448BC18-06F 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 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 signal processing board, 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

- For industrial use

1.3 FEATURES

- High luminance
- High contrast
- Wide viewing angle
- Wide temperature range
- 6-bit digital RGB signals
- Reversible-scan direction
- LED Backlight type
- Replaceable lamp for backlight
- Suitable for setting in the portrait position (See "**4.7.2 Setting the LCD module in the portrait position (vertical)**"). ☆
- Acquisition product for UL60950-1/CSA C22.2 No.60950-1-03 (File number: E170632)
- Compliant with the European RoHS directive (2002/95/EC)

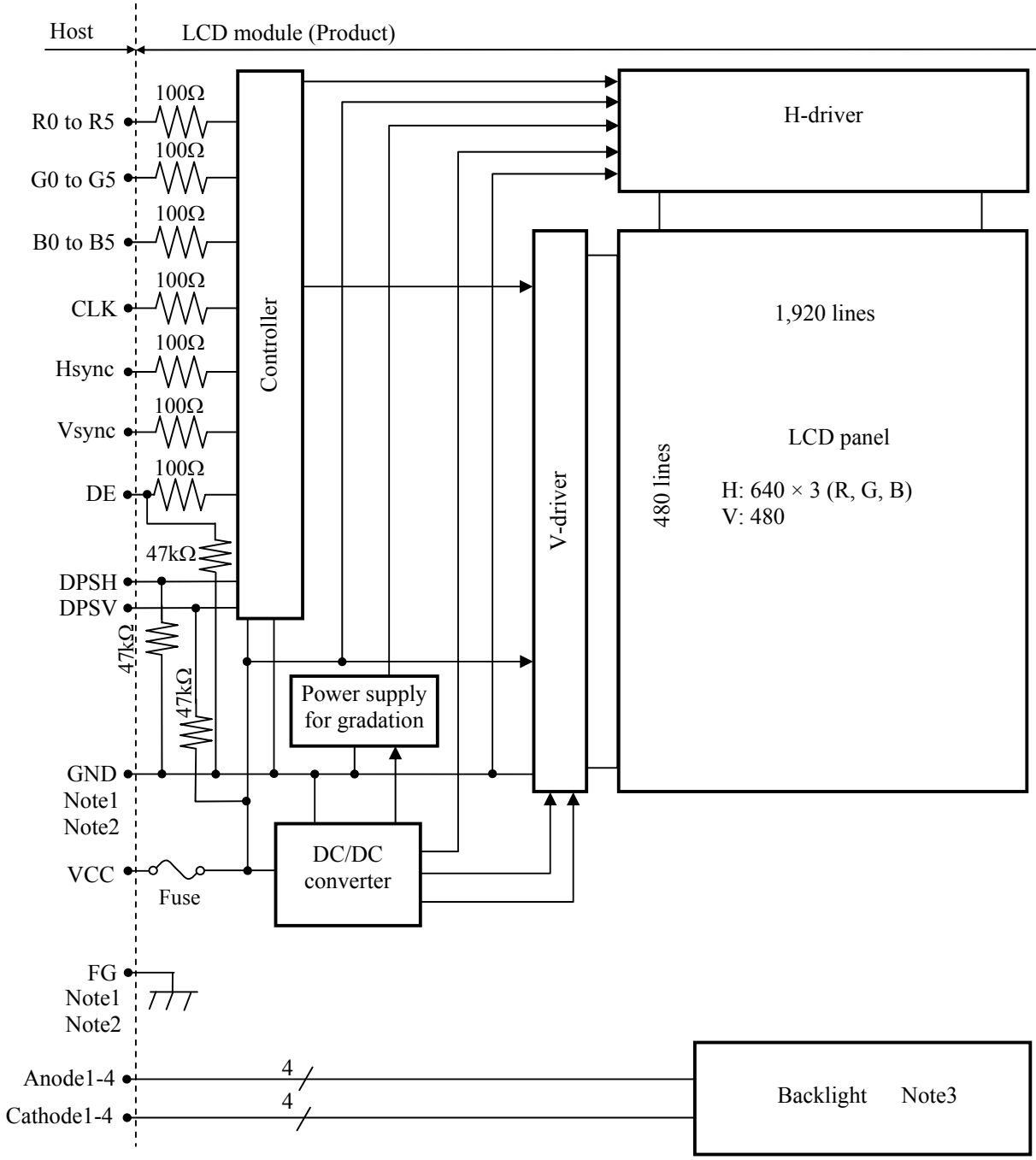
Display setting difference between NL6448BC18-06F and NL6448BC18-03F ☆

Item	NL6448BC18-06F	NL6448BC18-03F
LCD panel signal processing board: CN1 socket	502790-4091 (Molex Japan Co., Ltd.) Pin No. 1 to 40	08 6260 033 340 829+ (Kyocera Elco Corp.) Pin No. 1 to 33

2. GENERAL SPECIFICATIONS

Display area	116.16 (H) × 87.12 (V) mm	
Diagonal size of display	15cm (5.7inches)	
Drive system	a-Si TFT active matrix	
Display color	262,144 colors	
Pixel	640 (H) × 480 (V) pixels	
Pixel arrangement	RGB (Red dot, Green dot, Blue dot) vertical stripe	
Dot pitch	0.0605 (H) × 0.1815 (V) mm	
Pixel pitch	0.1815 (H) × 0.1815 (V) mm	
Module size	135.0 (W) × 104.6 (H) × 10.5 (D) mm (typ.)	☆
Weight	165g (typ.)	
Contrast ratio	850:1 (typ.)	
Viewing angle	*At the contrast ratio ≥10:1* • Horizontal: Right side 80° (typ.), Left side 80° (typ.) • Vertical: Up side 80° (typ.), Down side 80° (typ.)	
Designed viewing direction	*At DPSH= Low or Open, DPSV= Hight or Open: Normal scan* • Viewing direction without image reversal: Right side (3 o'clock) • Viewing direction with contrast peak: Left side (9 o'clock) • Viewing angle with optimum grayscale (γ≒2.2): Normal axis (perpendicular)	
Polarizer surface	Clear	
Polarizer pencil-hardness	3H (min.) [by JIS K5600]	☆
Color gamut	*At LCD panel center* 60% (typ.) [against NTSC color space]	
Response time	*Ton+Toff (10% ←→ 90%)* 18ms (typ.)	
Luminance	*At IL= 25mA / One circuit* 800cd/m^2 (typ.)	
Signal system	6-bit digital signals for data of RGB colors, Dot clock (CLK), Data enable (DE), Horizontal synchronous signal (Hsync), Vertical synchronous signal (Vsync)	
Power supply voltage	LCD panel signal processing board: 3.3V	
Backlight	LED backlight type (Replaceable part • Lamp holder set: Type No. 57LHS02)	
Power consumption	*At IL= 25mA / One circuit, Checkered flag pattern* 3.3W (typ.)	

3. BLOCK DIAGRAM

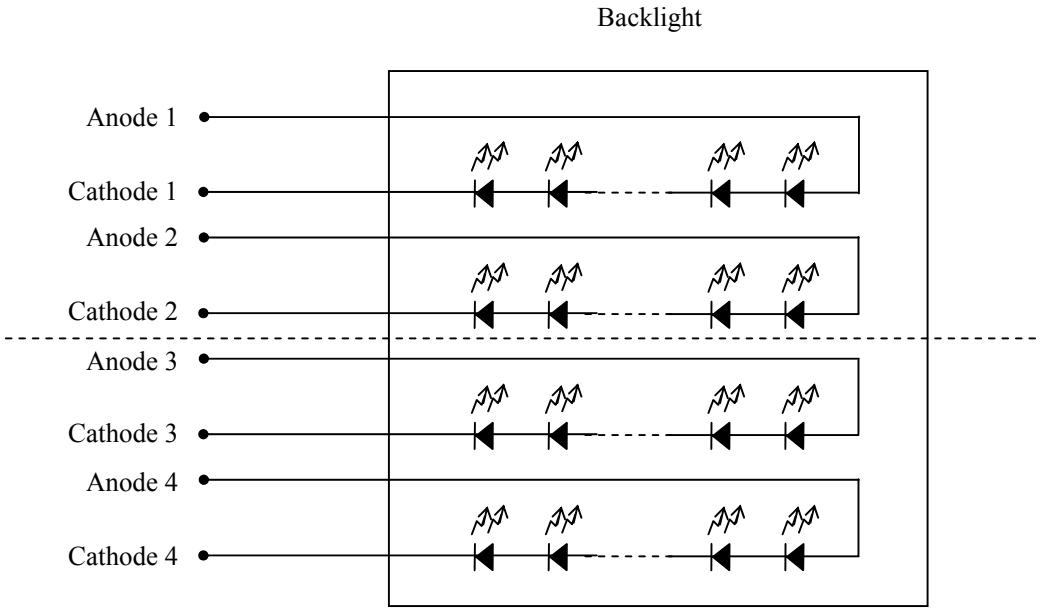


Note1: Relations between GND (Signal ground) and FG (Frame ground) in the LCD module are as follows.

GND - FG	Not Connected

Note2: GND and FG must be connected to customer equipment's ground, and it is recommended that these grounds be connected together in customer equipment.

Note3: Backlight in detail



4. DETAILED SPECIFICATIONS

4.1 MECHANICAL SPECIFICATIONS

Parameter	Specification		Unit
Module size	135 ± 0.5 (W) × 104.6 ± 0.5 (H) × 10.5 ± 0.5 (D)	Note1	mm
Display area	116.16 (H) × 87.12 (V)	Note1	mm
Weight	165 (typ.), 175 (max.)		g

☆

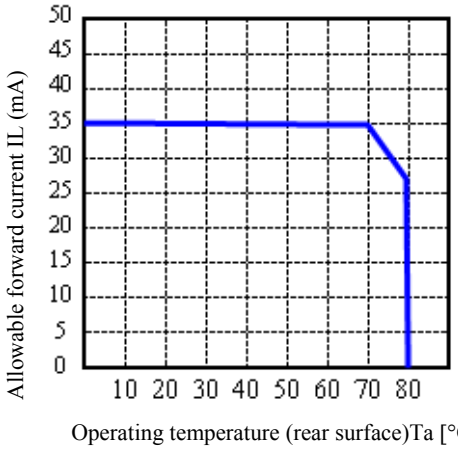
Note1: See "**8. OUTLINE DRAWINGS**".

4.2 ABSOLUTE MAXIMUM RATINGS

Parameter			Symbol	Rating	Unit	Remarks
Power supply voltage	LCD panel signal processing board		VCC	-0.3 to +6.5	V	-
Input voltage for signals	Display signals Note1		VD	-0.3 to VCC +0.3	V	-
	Function signals Note2		VF			
Backlight	Forward current		IL	Note3	mA	per one circuit
Storage temperature			Tst	-30 to +80	°C	-
Operating temperature		Front surface	TopF	-30 to +80	°C	Note4
		Rear surface	TopR	-30 to +80	°C	Note5
Relative humidity Note6			RH	≤ 95	%	Ta ≤ 40°C
				≤ 85	%	40 < Ta ≤ 50°C
				≤ 55	%	50°C < Ta ≤ 60°C
				≤ 36	%	60°C < Ta ≤ 70°C
				≤ 24	%	70°C < Ta ≤ 80°C
Absolute humidity Note6			AH	≤ 70 Note7	g/m^3	Ta > 80°C

Note1: CLK, Hsync, Vsync, DE, DATA (R0 to R5, G0 to G5, B0 to B5)
Note2: DPSH, DPSV

Note3: Forward current



Note4: Measured at center of LCD panel surface (including self-heat) ☆
Note5: Measured at center of LCD module's rear shield surface (including self-heat) ☆
Note6: No condensation
Note7: Water amount at Ta= 80°C and RH= 24%

4.3 ELECTRICAL CHARACTERISTICS

4.3.1 LCD panel signal processing board

(Ta= 25°C)

Parameter		Symbol	min.	typ.	max.	Unit	Remarks
Power supply voltage		VCC	3.0	3.3	3.6	V	-
Power supply current		ICC	-	100 Note1	175 Note2	mA	at VCC= 3.3V
Logic input voltage for display signals	High	VDH	0.7VCC	-	VCC	V	CMOS level
	Low	VDL	0	-	0.3VCC	V	
Input voltage for DPSH and DPSV signal	High	VFH	0.7VCC	-	VCC	V	
	Low	VFL	0	-	0.3VCC	V	

Note1: Checkered flag pattern [by EIAJ ED-2522]
Note2: Pattern for maximum current

4.3.2 Backlight

(Ta=25°C, Note1, Note2)

Parameter	Symbol	min.	typ.	max.	Unit	Remarks
Forward current	IL	-	25	27.5	mA	Note3
Forward Voltage	VL	-	29.7	34.2	V	at IL= 25mA / One circuit

Note1: Please drive with constant current.
Note2: The Luminance uniformity may be changed depending on the current variation between 4 circuits. It is recommended that the current value difference among the circuits be less than 5%.
Note3: See "**4.2 ABSOLUTE MAXIMUM RATINGS Note3**".

4.3.3 Power supply voltage ripple

This product works if the ripple voltage levels are over the permissible values as the following table, but there might be noise on the display image.

Power supply voltage		Ripple voltage Note1 (Measure at input terminal of power supply)	Unit
VCC	3.3V	≤ 100	mVp-p

Note1: The permissible ripple voltage includes spike noise.

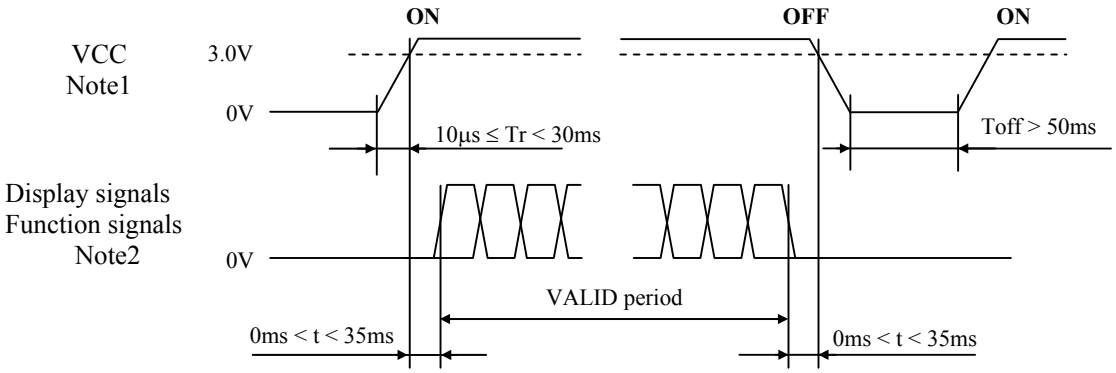
4.3.4 Fuse

Parameter	Fuse		Rating	Fusing current	Remarks
	Type	Supplier			
VCC	3216FF-1A	COOPER Bussmann	1A 63V (DC)	2.5A	Note1

Note1: The power supply's rated current must be more than the fusing current. If it is less than the fusing current, the fuse may not blow in a short time, and then nasty smell, smoke and so on may occur.

4.4 POWER SUPPLY VOLTAGE SEQUENCE

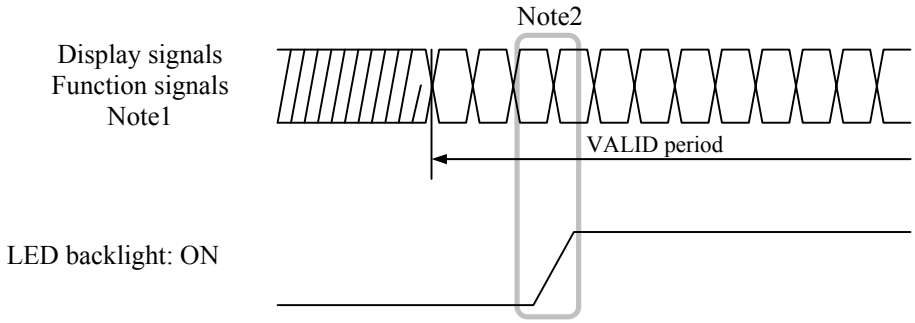
4.4.1 LCD panel signal processing board



Note1: If there is a voltage variation (voltage drop) at the rising edge of VCC below 3.0V, there is a possibility that a product does not work due to a protection circuit.

Note2: Display signals (CLK, Hsync, Vsync, DE, DATA (R0 to R5, G0 to G5, B0 to B5)) and function signals (DPSH, DPSV) must be set to Low or High-impedance, except the VALID period (See above sequence diagram), in order to avoid the circuitry damage.
If some of display and function signals of this product are cut while this product is working, even if the signal input to it once again, it might not work normally. If a customer stops the display and function signals, VCC also must be shut down.

4.4.2 LED driver board ☆



Note1: These are the display and function signals for LCD panel signal processing board.

Note2: The backlight should be turned on within the valid period of display and function signals, in order to avoid unstable data display.

4.5 CONNECTIONS AND FUNCTIONS FOR INTERFACE PINS

4.5.1 LCD panel signal processing board

CN1 socket (LCD module side): 502790-4091 (Molex Japan Co., Ltd.)
Adaptable plug: [0.5mm pitch, Bottom Contact Type]

Pin No.	Symbol	Signal	Remarks
1	GND	Ground	Note1
2	CLK	Dot clock	-
3	Hsync	Horizontal synchronous signal	
4	Vsync	Vertical synchronous signal	
5	GND	Ground	Note1
6	R0	Red data (LSB)	Least significant bit
7	R1	Red data	-
8	R2	Red data	
9	R3	Red data	
10	R4	Red data	
11	R5	Red data (MSB)	Most significant bit
12	GND	Ground	Note1
13	G0	Green data (LSB)	Least significant bit
14	G1	Green data	-
15	G2	Green data	
16	G3	Green data	
17	G4	Green data	
18	G5	Green data (MSB)	Most significant bit
19	GND	Ground	Note1
20	B0	Blue data (LSB)	Least significant bit
21	B1	Blue data	-
22	B2	Blue data	
23	B3	Blue data	
24	B4	Blue data	
25	B5	Blue data (MSB)	Most significant bit
26	GND	Ground	Note1
27	DE	Selection of DE / Fixed mode	Low or Open: Fixed mode Data enable signal: DE mode
28	VCC	Power supply	Note1
29	VCC	Power supply	
30	DPSH	Selection of Horizontal scan direction	High: Reverse scan Low or Open: Normal scan Note2
31	DPSV	Selection of Vertical scan direction	High or Open: Normal scan Low: Reverse scan Note2
32	N. C.	-	Keep this pin Open.
33	GND	Ground	Note1
34 - 40	N. C.	-	Keep these pins Open.

Note1: All GND and VCC terminals should be used without any non-connected lines.
Note2: See "**4.7 DISPLAY POSITIONS AND SCANNING DIRECTIONS**"

4.5.2 Backlight

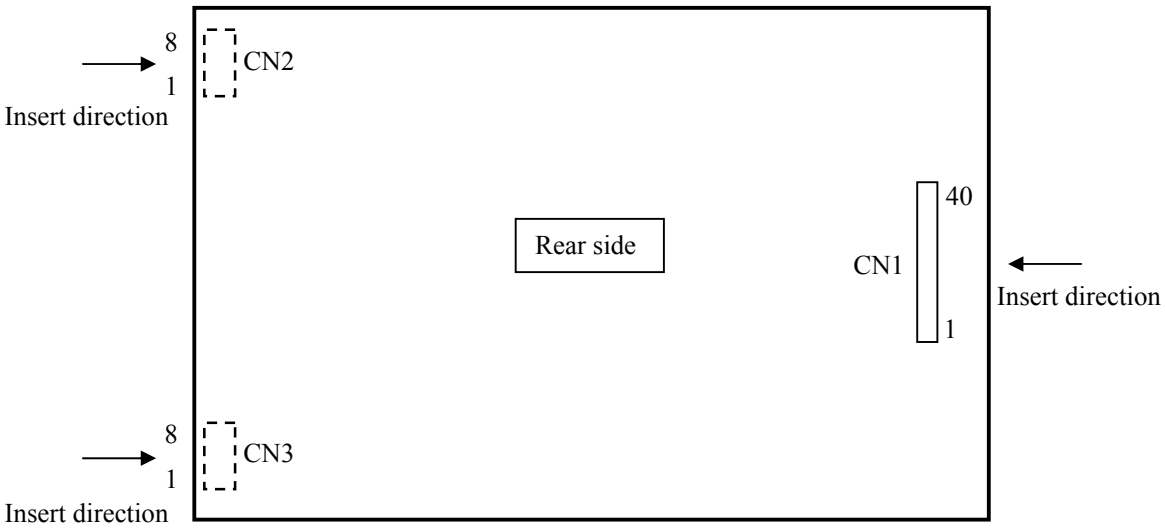
CN2 plug (LCD module side): SM08B-SRSS-TB (J.S.T. Mfg. Co., Ltd.)
Adaptable socket: SHR-08V-S, SHR-08V-S-B (J.S.T. Mfg. Co., Ltd.) ☆

Pin No.	Symbol	Signal	Remarks
1	A1	Anode1	-
2	K1	Cathode1	-
3	A2	Anode2	-
4	K2	Cathode2	-
5	N.C.	-	Keep this pin Open.
6	N.C.	-	Keep this pin Open.
7	N.C.	-	Keep this pin Open.
8	N.C.	-	Keep this pin Open.

CN3 plug (LCD module side): SM08B-SRSS-TB (J.S.T. Mfg. Co., Ltd.)
Adaptable socket: SHR-08V-S, SHR-08V-S-B (J.S.T. Mfg. Co., Ltd.) ☆

Pin No.	Symbol	Signal	Remarks
1	A3	Anode3	-
2	K3	Cathode3	-
3	A4	Anode4	-
4	K4	Cathode4	-
5	N. C.	-	Keep this pin Open.
6	N. C.	-	Keep this pin Open.
7	N. C.	-	Keep this pin Open.
8	N. C.	-	Keep this pin Open.

4.5.3 Positions of plug and socket



4.6 DISPLAY COLORS AND INPUT DATA SIGNALS

This product can display 262,144 colors with 64 gray scales. Also the relation between display colors and input data signals is as follows.

Display colors		Data signal (0: Low level, 1: High level)																	
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
Basic colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Red gray scale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	dark	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	↑				:						:						:		
	↓				:						:						:		
	bright	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
		1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Green gray scale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	dark	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	↑				:						:						:		
	↓				:						:						:		
	bright	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0
		0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Blue gray scale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	↑				:						:						:		
	↓				:						:						:		
	bright	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
		0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

4.7 DISPLAY POSITIONS AND SCANNING DIRECTIONS

4.7.1 Setting the LCD module in the landscape position (horizontal)

(1) Display positions

The following table is the coordinates per pixel (See **"4.7.1 (2) Scanning directions"**.).

C(0, 0)	C(1, 0)	• • •	C(X, 0)	• • •	C(638, 0)	C(639, 0)
C(0, 1)	C(1, 1)	• • •	C(X, 1)	• • •	C(638, 1)	C(639, 1)
•	•	•	•	•	•	•
•	•	• • •	•	• • •	•	• • •
•	•	•	•	•	•	•
C(0, Y)	C(1, Y)	• • •	C(X, Y)	• • •	C(638, Y)	C(639, Y)
•	•	•	•	•	•	•
•	•	• • •	•	• • •	•	•
•	•	•	•	•	•	•
C(0, 478)	C(1, 478)	• • •	C(X, 478)	• • •	C(638, 478)	C(639, 478)
C(0, 479)	C(1, 479)	• • •	C(X, 479)	• • •	C(638, 479)	C(639, 479)

(2) Scanning directions

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

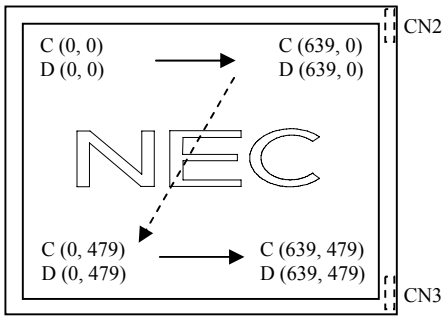


Figure1. DPSH= Low or Open (Normal scan)
DPSV= High or Open (Normal scan)

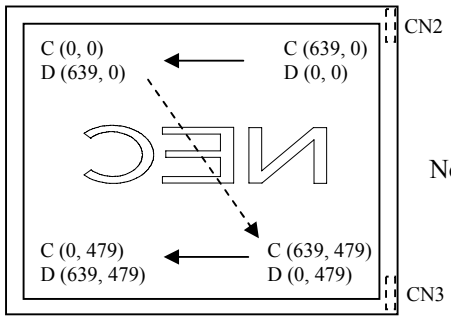


Figure2. DPSH= High (Reverse scan)
DPSV= High or Open (Normal scan)

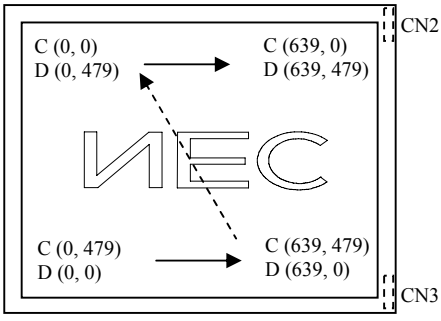


Figure3. DPSH= Low or Open (Normal scan)
DPSV= Low (Reverse scan)

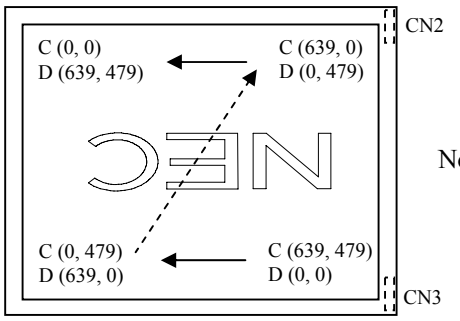


Figure4. DPSH= High (Reverse scan)
DPSV= Low (Reverse scan)

Note1: Meaning of C (X, Y) and D (X, Y)
C (X, Y): The coordinates of the display position (See "**4.7 1 (1) Display positions**".)
D (X, Y): The data number of input signal for LCD panel signal processing board

4.7.2 Setting the LCD module in the portrait position (vertical)

(1) Display positions

The following table is the coordinates per pixel (See figure of "**4.7.2 (2) Scanning directions**".).

C(639, 0)	C(639, 1)	• • •	C(639, Y)	• • •	C(639,478)	C(639,479)
C(638, 0)	C(638, 1)	• • •	C(638, Y)	• • •	C(638,478)	C(638,479)
• • •	• • •	• • • •	• • •	• • • •	• • •	• • • •
C(X, 0)	C(X, 1)	• • •	C(X, Y)	• • •	C(X,478)	C(X,479)
• • •	• • •	• • • •	• • •	• • • •	• • •	• • •
C(1, 0)	C(1, 1)	• • •	C(1, Y)	• • •	C(1,478)	C(1,479)
C(0, 0)	C(0, 1)	• • •	C(0, Y)	• • •	C(0, 478)	C(0,479)

(2) Scanning directions

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

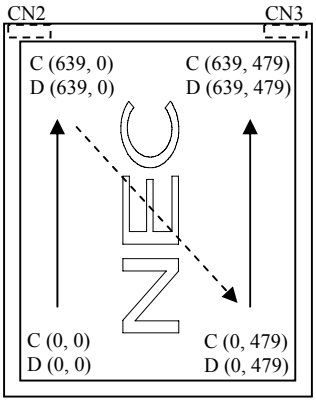


Figure1. DPSH= Low or Open (Normal scan)
DPSV= High or Open (Normal scan)

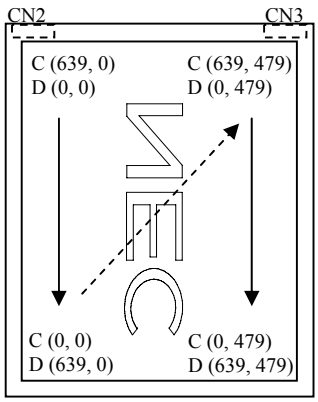


Figure2. DPSH= High (Reverse scan)
DPSV= High or Open (Normal scan)

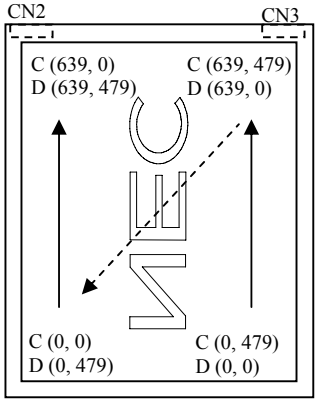


Figure3. DPSH= Low or Open (Normal scan)
DPSV= Low (Reverse scan)

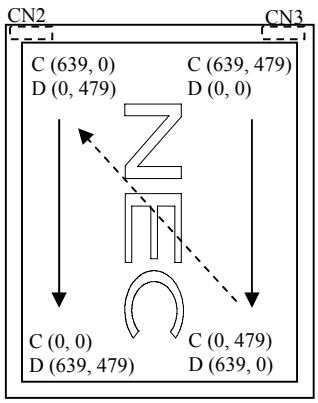


Figure4. DPSH= High (Reverse scan)
DPSV= Low (Reverse scan)

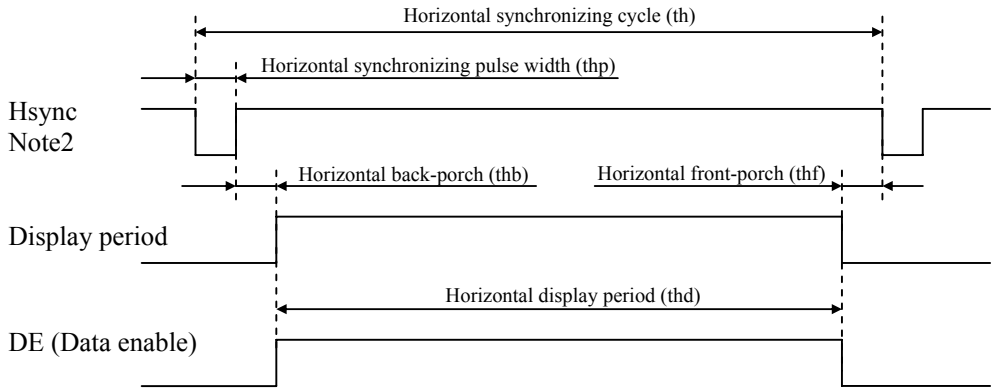
Note1: Meaning of C (X, Y) and D (X, Y)
C (X, Y): The coordinates of the display position (See "**4.7.2 (1) Display positions**".)
D (X, Y): The data number of input signal for LCD panel signal processing board

4.8 INPUT SIGNAL TIMINGS

4.8.1 Outline of input signal timings

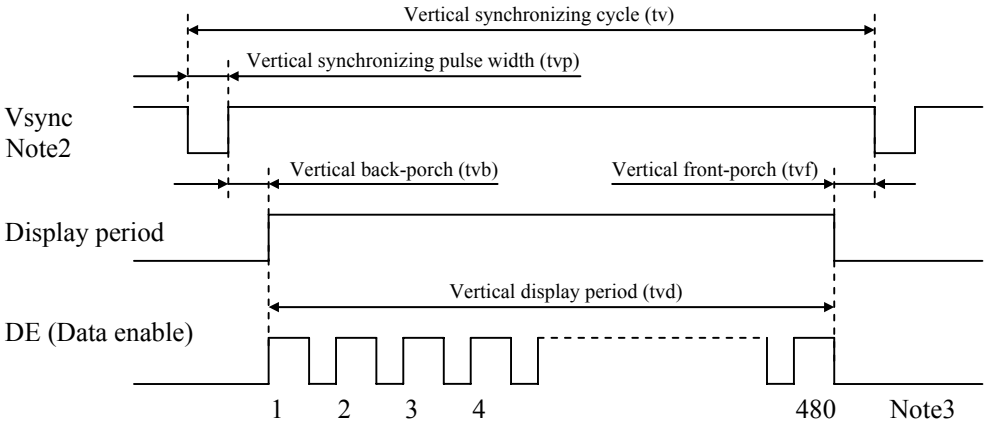
• Horizontal signal

Note1



• Vertical signal

Note1



Note1: This diagram indicates virtual signal for set up to timing.
Note2: Fixed mode cannot be used while working of DE mode.
Note3: See "**4.8.3 Input signal timing chart**" for the pulse number.

4.8.2 Timing characteristics

(a) Fixed mode

(Note1, Note3)

Parameter			Symbol	min.	typ.	max.	Unit	Remarks
CLK	Frequency		1/tc	22.66	25.175	27.69	MHz	39.72ns (typ.)
	Duty		tcd	0.4	0.5	0.6	-	-
	Rise time, Fall time		tcrf	-	-	10	ns	
DATA (R0-R5) (G0-G5) (B0-B5)	CLK-DATA	Setup time	tds	10	-	-	ns	-
		Hold time	tdh	10	-	-	ns	
	Rise time, Fall time		tdrf	-	-	10	ns	
Hsync	Cycle		th	30.0	31.778	33.6	µs	31.468kHz (typ.)
				800			CLK	-
	Display period		thd	640			CLK	
	Front-porch		thf	16			CLK	
	Pulse width		thp	10	96	-	CLK	
	Back-porch		thb	-	48	134	CLK	
	Total of pulse width and back-porch		thp + thb	144			CLK	Note2
	CLK- Hsync	Setup time	ths	10	-	-	ns	-
		Hold time	thh	10	-	-	ns	
	Rise time, Fall time		thrf	-	-	10	ns	
Vsync	Cycle		tv	16.1	16.683	17.2	ms	59.94Hz (typ.)
				525			H	-
	Display period		tvd	480			H	
	Front-porch		tvf	12			H	
	Pulse width		tvp	1	3	-	H	
	Back-porch		tvb	-	32	34	H	
	Total of pulse width and back-porch		tvp + tvb	35			H	Note2
	Hsync-Vsync	Setup time	tvhs	10	-	-	ns	-
		Hold time	tvhh	10	-	-	ns	
	Rise time, Fall time		tvrf	-	-	10	ns	

Note1: Definition of parameters is as follows.
tc= 1CLK, tcd= tch/tc, th= 1H

Note2: Keep tvp + tvb and thp + thb within the table. If it is out of specification, display position will be shifted to right/left side or up/down.

Note3: Vertical cycle (tv) should be specified in integral multiple of Horizontal cycle (th).

(b) DE mode

(Note1, Note2, Note3)

Parameter			Symbol	min.	typ.	max.	Unit	Remarks
CLK	Frequency		1/tc	22.66	25.175	27.69	MHz	39.72ns (typ.)
	Duty		tcd	0.4	0.5	0.6	-	-
	Rise time, Fall time		tcrf	-	-	10	ns	
DATA (R0-R5) (G0-G5) (B0-B5)	CLK-DATA	Setup time	tds	10	-	-	ns	-
		Hold time	tdh	10	-	-	ns	
	Rise time, Fall time		tdrf	-	-	10	ns	
DE	Horizontal	Cycle	th	30.0	31.778	33.6	µs	31.468kHz (typ.)
				-	800	-	CLK	-
		Display period	thd	640			CLK	
	Vertical (One frame)	Cycle	tv	16.1	16.683	17.2	ms	59.94Hz (typ.)
				-	525	-	H	-
		Display period	tvd	480			H	
	CLK-DE	Setup time	tdes	10	-	-	ns	
		Hold time	Tdeh	10	-	-	ns	
	Rise time, Fall time		tderf	-	-	10	ns	

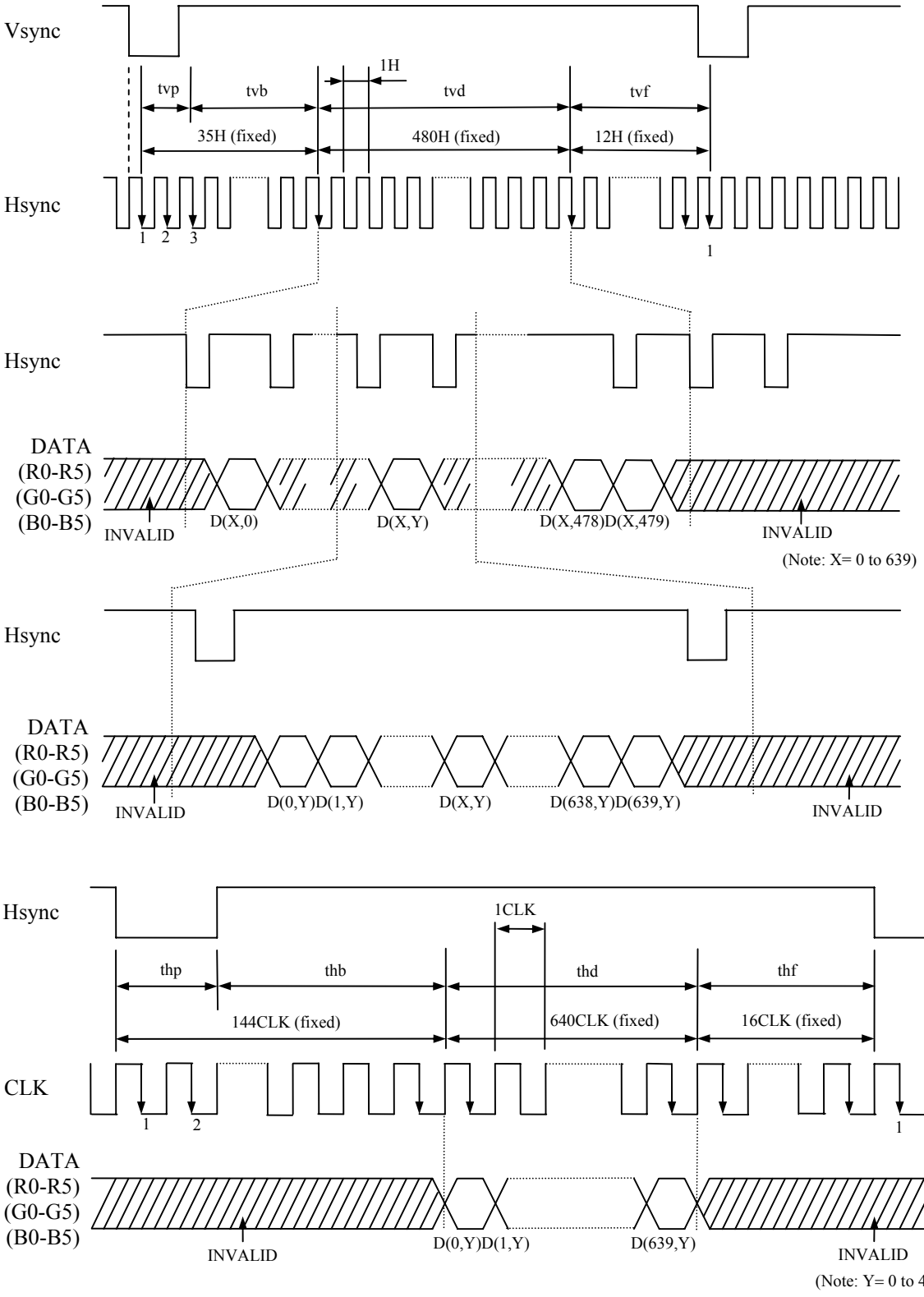
Note1: Definition of parameters is as follows.
tc= 1CLK, tcd= tch/tc, th= 1H

Note2: Hsync signal (CN1-Pin No.3) and Vsync signal (CN1-Pin No.4) are not used inside the product at DE mode, but these terminals are connected with “GND” to avoid the noise problem when unused.

Note3: Vertical cycle (tv) should be specified in integral multiple of Horizontal cycle (th).

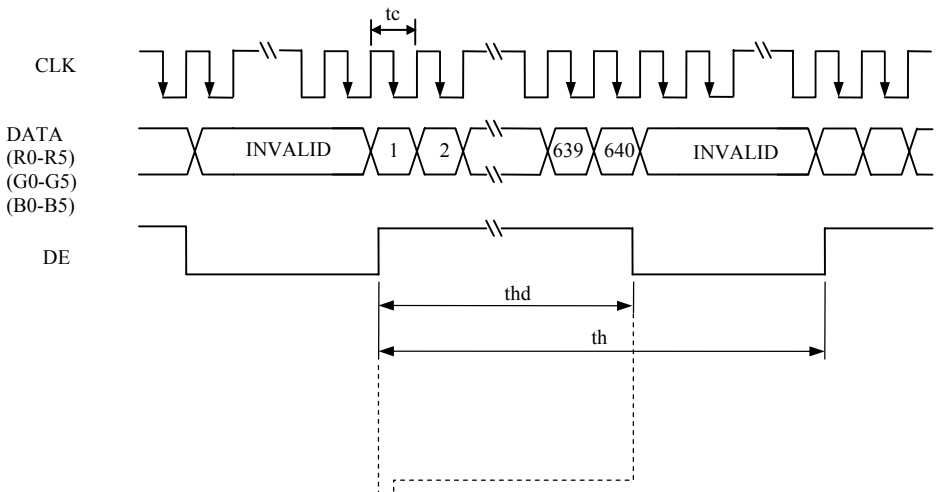
4.8.3 Input signal timing chart

(a) Fixed mode

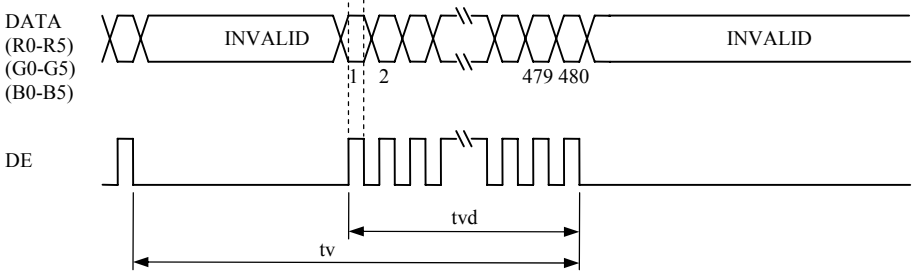


(b) DE mode

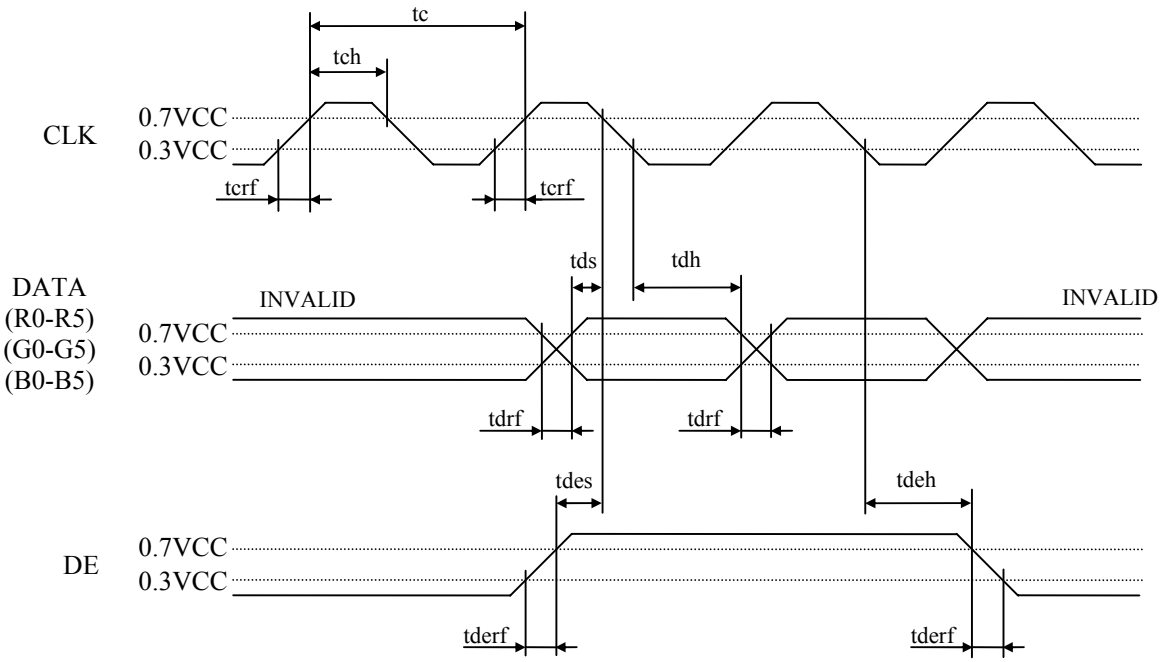
Horizontal timing

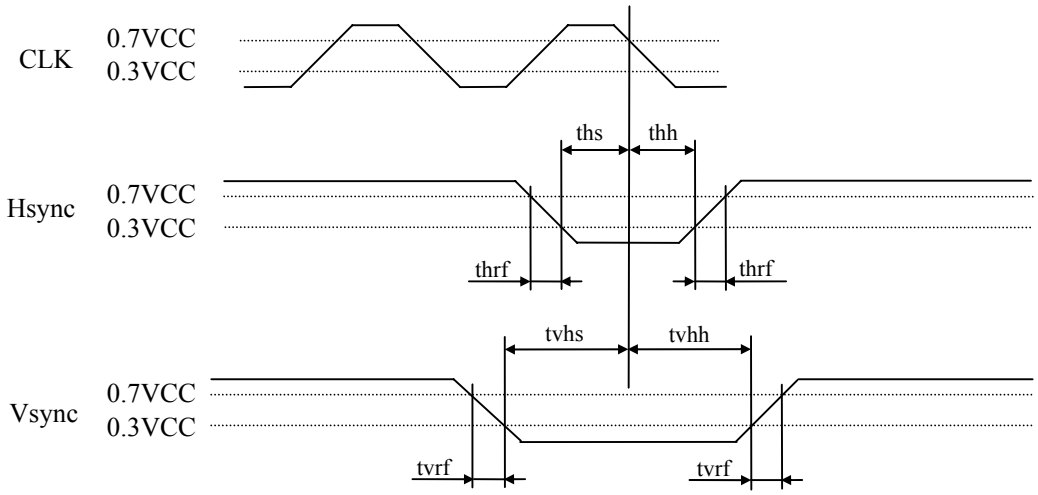


Vertical timing



(c) Common item of Fixed mode and DE mode





4.9 OPTICS

4.9.1 Optical characteristics

(Note1, Note2)

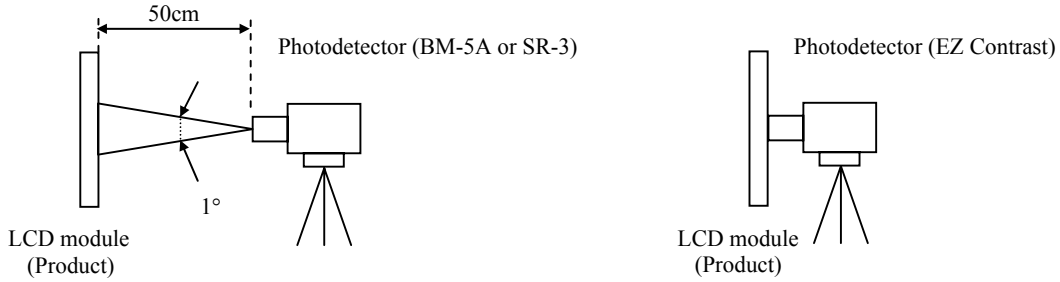
Parameter		Condition	Symbol	min.	typ.	max.	Unit	Measuring instrument	Remarks
Luminance		White at center θR= 0°, θL= 0°, θU= 0°, θD= 0°	L	500	800	-	cd/m^2	BM-5A	-
Contrast ratio		White/Black at center θR= 0°, θL= 0°, θU= 0°, θD= 0°	CR	550	850	-	-	BM-5A	Note3
Luminance uniformity		White θR= 0°, θL= 0°, θU= 0°, θD= 0°	LU	-	1.25	1.4	-	BM-5A	Note4
Chromaticity	White	**x** coordinate	Wx	0.250	0.300	0.350	-	SR-3	Note5
		y coordinate	Wy	0.300	0.350	0.400	-		
	Red	**x** coordinate	Rx	-	0.640	-	-		
		y coordinate	Ry	-	0.335	-	-		
	Green	**x** coordinate	Gx	-	0.310	-	-		
		y coordinate	Gy	-	0.580	-	-		
	Blue	**x** coordinate	Bx	-	0.135	-	-		
		y coordinate	By	-	0.135	-	-		
Color gamut		θR= 0°, θL= 0°, θU= 0°, θD= 0° at center, against NTSC color space	C	55	60	-	%		
Response time		White to Black	Ton	-	3	5	ms	BM-5A	Note6 Note7
		Black to White	Toff	-	15	21	ms		
Viewing angle	Right	θU= 0°, θD= 0°, CR≥ 10	θR	70	80	-	°	EZ Contrast	Note8
	Left	θU= 0°, θD= 0°, CR≥ 10	θL	70	80	-	°		
	Up	θR= 0°, θL= 0°, CR≥ 10	θU	70	80	-	°		
	Down	θR= 0°, θL= 0°, CR≥ 10	θD	70	80	-	°		

Note1: These are initial characteristics.

Note2: Measurement conditions are as follows.

Ta= 25°C, VCC= 3.3V, IL= 25mA/One circuit, Display mode: VGA, Horizontal cycle= 1/31.468kHz, Vertical cycle= 1/59.94Hz, DPSH/DPSV= Low or Open /Hight or Open: Normal scan

Optical characteristics are measured at luminance saturation 20minutes after the product works in the dark room. Also measurement methods are as follows.



Note3: See "**4.9.2 Definition of contrast ratio**".

Note4: See "**4.9.3 Definition of luminance uniformity**".

Note5: These coordinates are found on CIE 1931 chromaticity diagram.

Note6: Product surface temperature: TopF= 29°C

Note7: See "**4.9.4 Definition of response times**".

Note8: See "**4.9.5 Definition of viewing angles**".

4.9.2 Definition of contrast ratio

The contrast ratio is calculated by using the following formula.

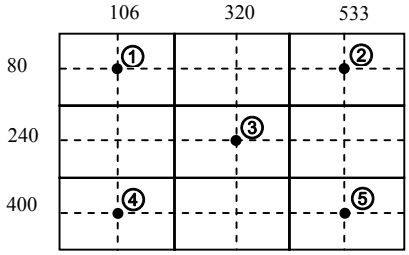
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance of white screen}}{\text{Luminance of black screen}}$$

4.9.3 Definition of luminance uniformity

The luminance uniformity is calculated by using following formula.

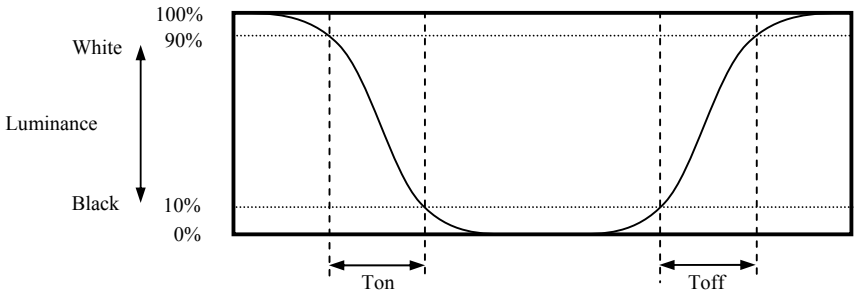
$$\text{Luminance uniformity (LU)} = \frac{\text{Maximum luminance from ① to ⑤}}{\text{Minimum luminance from ① to ⑤}}$$

The luminance is measured at near the 5 points shown below.

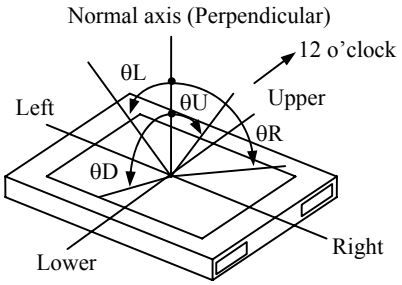


4.9.4 Definition of response times

Response time is measured at the time when the luminance changes from "white" to "black", or "black" to "white" on the same screen point, by photo-detector. Ton is the time when the luminance changes from 90% down to 10%. Also Toff is the time when the luminance changes from 10% up to 90% (See the following diagram.).



4.9.5 Definition of viewing angles



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= 25mA / One circuit	50,000	h

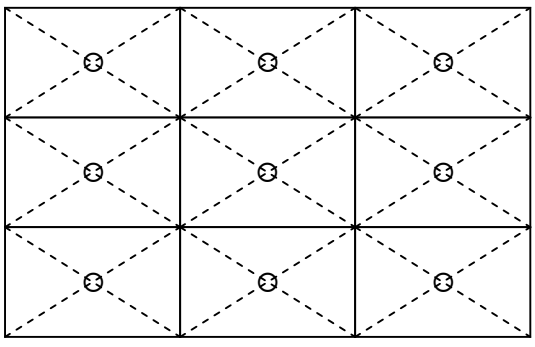
Note1: Life time expectancy is mean time to half-luminance.
Note2: Estimated luminance lifetime is not the value for an LCD module but the value for LED elementary substance.
Note3: By ambient temperature, the lifetime changes particularly. Especially, in case the product works under high temperature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

6. RELIABILITY TESTS

Test item	Condition	Judgment Note1
High temperature and humidity (Operation)	① 60 ± 2°C, RH= 90%, 240hours ② Display data is black.	No display malfunctions
High temperature (Operation)	① 80 ± 3°C, 240hours ② Display data is black.	
Heat cycle (Operation)	① -30 ± 3°C…1hour 80 ± 3°C…1hour ② 50cycles, 4 hours/cycle ③ Display data is black.	
Thermal shock (Non operation)	① -30 ± 3°C…30minutes 80 ± 3°C…30minutes ② 100cycles, 1hour/cycle ③ Temperature transition time is within 5 minutes.	
ESD (Operation)	① 150pF, 150Ω, ±10kV ② 9 places on a panel surface Note2 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 (Non operation)	① 5 to 100Hz, 19.6m/s^2 ② 1 minute/cycle ③ X, Y, Z directions ④ 120 times each directions	No display malfunctions No physical damages
Mechanical shock (Non operation)	① 539m/ s^2, 11ms ② ±X, ±Y, ±Z directions ③ 5 times each directions	

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

Note2: See the following figure for discharge points.



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"!**

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

This sign has the meaning that a customer will be injured if the customer practices 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: Equal to or no greater than 539m/s^2 and equal to or no greater than 11ms, Pressure: Equal to or no greater than 19.6N (ϕ16mm jig))**

7.3 ATTENTIONS

7.3.1 Handling of the product

① Take hold of both ends without touching the circuit board when the product (LCD module) is picked up from inner packing box to avoid broken down or misadjustment, because of stress to mounting parts on the circuit board.
② When the product is put on the table temporarily, display surface must be placed downward.
③ 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.
④ The torque for product mounting screws must never exceed 0.147N·m. Higher torque might result in distortion of the bezel.
⑤ The product must be installed using mounting holes without undue stress such as bends or twist (See outline drawings). And do not add undue stress to any portion (such as bezel flat area). Bends or twist described above and undue stress to any portion may cause display mura.
⑥ Do not press or rub on the sensitive product surface. When cleaning the product surface, wipe it with a soft dry cloth.
⑦ Do not push or pull the interface connectors while the product is working.
⑧ When handling the product, use of an original protection sheet on the product surface (polarizer) is recommended for protection of product surface. Adhesive type protection sheet may change color or characteristics of the polarizer.
⑨ 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 by any chance, please wash it away with soap and water.

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 occurred by temperature difference, the product packing box must be opened after enough time being left under the environment of an unpacking room. Evaluate the storage time sufficiently because dew condensation is affected by the environmental temperature and humidity. (Recommended leaving time: 6 hours or more with the original packing state after a customer receives the package)
③ Do not operate in high magnetic field. If not, circuit boards may be broken.
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, flickering, vertical streams or tiny spots may be observed depending on display patterns.
③ Do not display the fixed pattern for a long time because it may cause image sticking. Use a screen saver, if the fixed pattern is displayed on the screen.
④ The display color may be changed depending on viewing angle because of the use of condenser sheet in the backlight.
⑤ Optical characteristics may be changed depending on input signal timings.

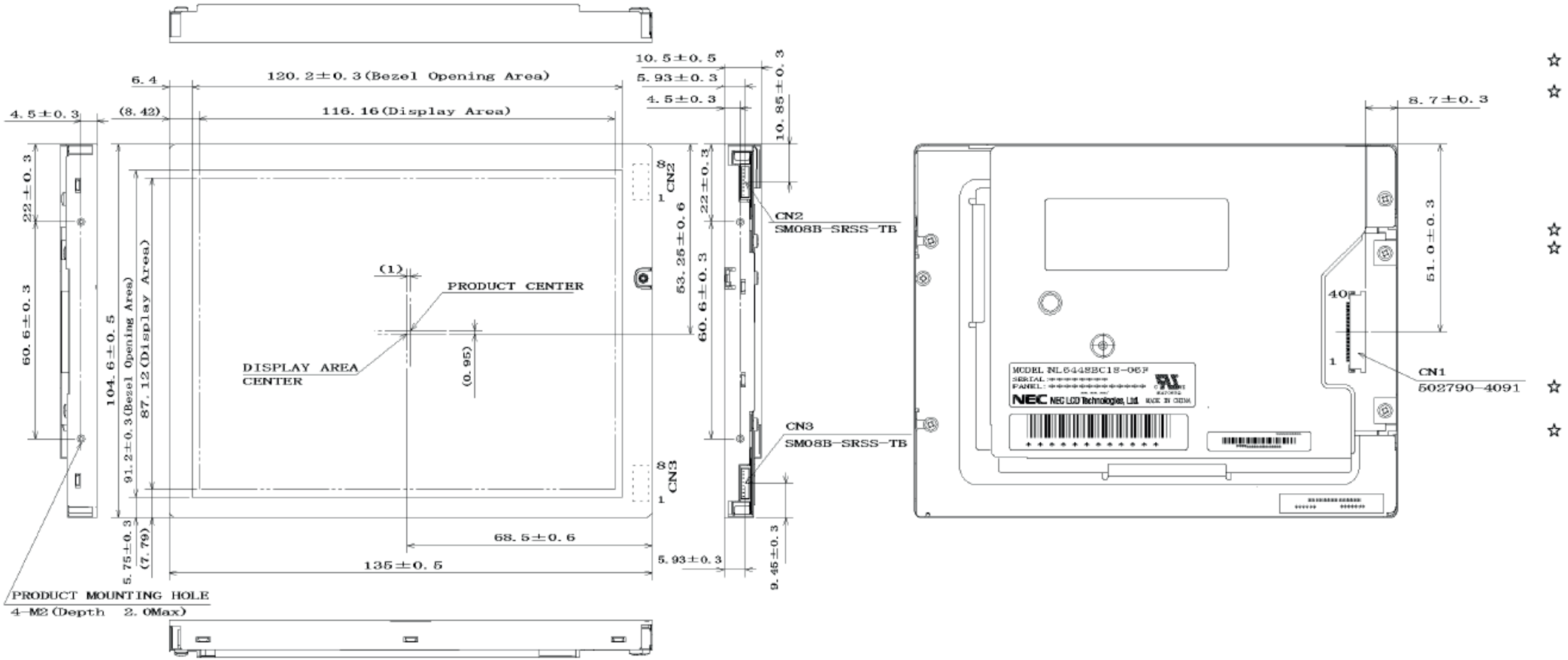
7.3.4 Others

① All GND and VCC terminals should be used without any non-connected lines.
② Do not disassemble a product or adjust variable resistors.
③ See "REPLACEMENT MANUAL FOR LAMP HOLDER SET", when replacing LED backlight lamps.
④ Pack the product with the original shipping package, in order to avoid any damages during transportation, when returning the product to NEC for repairing and so on.
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 homogeneousmaterials for this part is above the limitation level of SJ/T11363-2006 standard regulation.

8. OUTLINE DRAWINGS



Note1: The values in parentheses are for reference.
Note2: The torque for product mounting screws must never exceed 0.147N·m.

Unit: mm