

PRELIMINARY

NEC NEC LCD Technologies, Ltd.

TFT COLOR LCD MODULE

NL6448BC26-26

21cm (8.4 Type)

VGA

PRELIMINARY DATA SHEET

DOD-PP-0705 (1st edition)



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starting to design your system.**

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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

INTRODUCTION	2
1. OUTLINE.....	4
1.1 STRUCTURE AND PRINCIPLE	4
1.2 APPLICATION	4
1.3 FEATURES	4
2. GENERAL SPECIFICATIONS	5
3. BLOCK DIAGRAM.....	6
4. DETAILED SPECIFICATIONS	8
4.1 MECHANICAL SPECIFICATIONS	8
4.2 ABSOLUTE MAXIMUM RATINGS	8
4.3 ELECTRICAL CHARACTERISTICS	9
4.3.1 LCD panel signal processing board	9
4.3.2 Backlight lamp	10
4.3.3 Power supply voltage ripple.....	10
4.3.4 Fuse	10
4.4 POWER SUPPLY VOLTAGE SEQUENCE.....	11
4.4.1 LCD panel signal processing board	11
4.4.2 Backlight lighting circuit	11
4.5 CONNECTIONS AND FUNCTIONS FOR INTERFACE PINS	12
4.5.1 LCD panel signal processing board	12
4.5.2 Backlight lamp	13
4.5.3 Positions of plug and socket.....	13
4.6 DISPLAY COLORS AND INPUT DATA SIGNALS	14
4.7 DISPLAY POSITIONS	15
4.8 SCANNING DIRECTIONS.....	15
4.9 INPUT SIGNAL TIMINGS	16
4.9.1 Outline of input signal timings.....	16
4.9.2 Timing characteristics	17
4.9.3 Input signal timing chart	19
4.10 OPTICS	21
4.10.1 Optical characteristics	21
4.10.2 Definition of contrast ratio	22
4.10.3 Definition of luminance uniformity	22
4.10.4 Definition of response times	22
4.10.5 Definition of viewing angles.....	22
5. ESTIMATED LUMINANCE LIFETIME.....	23
6. RELIABILITY TESTS	24
7. PRECAUTIONS	25
7.1 MEANING OF CAUTION SIGNS.....	25
7.2 CAUTIONS.....	25
7.3 ATTENTIONS.....	25
7.3.1 Handling of the product	25
7.3.2 Environment.....	26
7.3.3 Characteristics.....	26
7.3.4 Other	26
8. OUTLINE DRAWINGS	27
8.1 FRONT VIEW.....	27
8.2 REAR VIEW	28
REVISION HISTORY	29

1. OUTLINE

1.1 STRUCTURE AND PRINCIPLE

Color LCD module NL6448BC26-26 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 circuit, 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

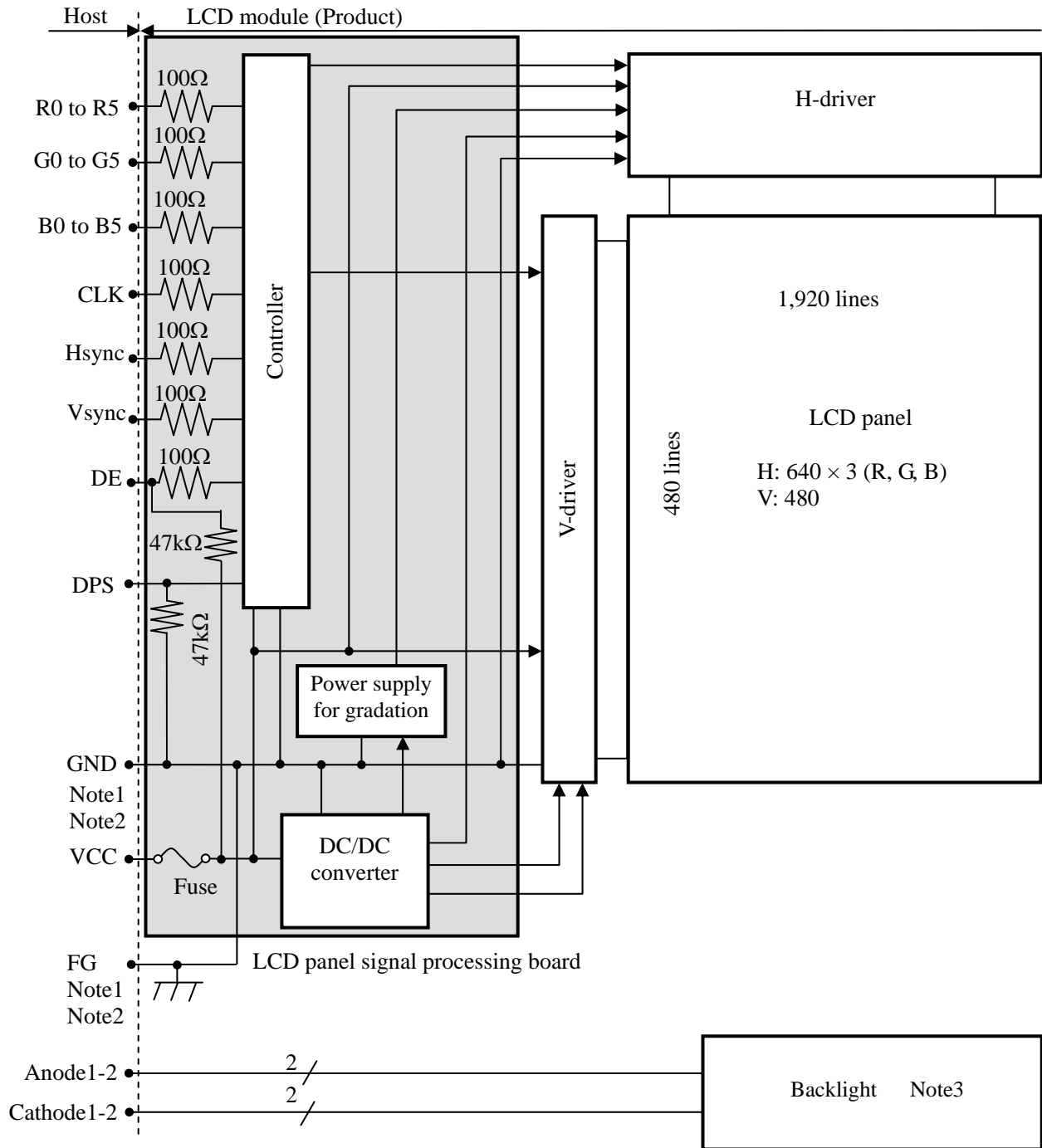
1.3 FEATURES

- High luminance
- High contrast
- Wide viewing angle
- 6-bit digital RGB signals
- Reversible-scan direction
- LED backlight type
- Replaceable lamp holder for backlight

2. GENERAL SPECIFICATIONS

Display area	170.88 (H) × 128.16 (V) mm
Diagonal size of display	21cm (8.4inches)
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	0.089 (H) × 0.267 (V) mm
Pixel pitch	0.267 (H) × 0.267 (V) mm
Module size	200.0 (W) × 152.0 (H) × 10.5 (D) mm (typ.)
Weight	(330) g (typ.)
Contrast ratio	(600):1 (typ.)
Viewing angle	At the contrast ratio $\geq 10:1$ <ul style="list-style-type: none"> • Horizontal: Right side 80° (typ.), Left side 80° (typ.) • Vertical: Up side 80° (typ.), Down side 60° (typ.)
Designed viewing direction	At DPS= Low or open: Normal scan <ul style="list-style-type: none"> • Viewing direction without image reversal: up side (12 o'clock) • Viewing direction with contrast peak: down side (6 o'clock) • Viewing angle with optimum grayscale ($\gamma=2.2$): normal axis (perpendicular)
Polarizer surface	Clear
Polarizer pencil-hardness	3H (min.) [by JIS K5400]
Color gamut	At LCD panel center 40 % (typ.) [against NTSC color space]
Response time	Ton+Toff (10%←→90%) 25 ms (typ.)
Luminance	At IL=50mA (450) cd/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 or 5.0V
Backlight	LED backlight type: (Replaceable part • Lamp holder set: Type No. TBD)
Power consumption	At IL=50mA, Checkered flag pattern (4.0) W (typ.)

3. BLOCK DIAGRAM



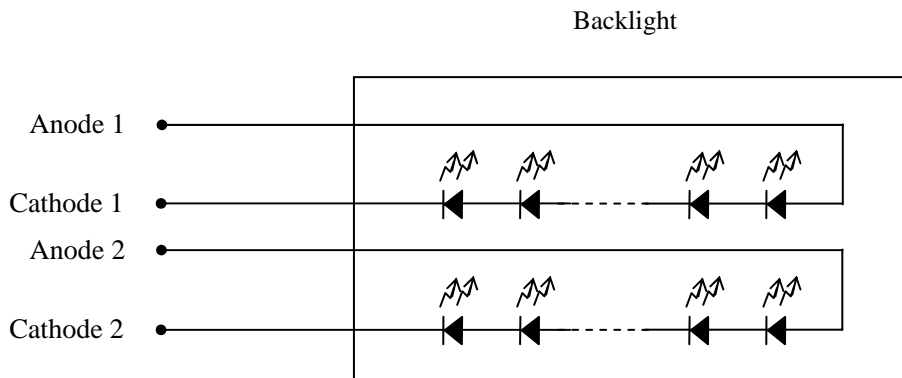
Note1: Relations between GND (Signal ground) and FG (Frame ground) in the LCD module are as follows.

GND - FG	Connected
----------	-----------

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

PRELIMINARY

Note3: Backlight in detail



4. DETAILED SPECIFICATIONS

4.1 MECHANICAL SPECIFICATIONS

Parameter	Specification	Unit
Module size	200.0 ± 0.5 (W) × 152.0 ± 0.5 (H) × 10.5 ± 0.5 (D) Note1	mm
Display area	170.88 (H) × 128.16 (V) Note1	mm
Weight	(330) (typ.), TBD (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 signal Note2	VF			
Backlight	Power dissipation	PD	TBD	W	per one circuit
	Forward current	IL	TBD	mA	per one circuit
Storage temperature		Tst	-30 to +80	°C	-
Operating temperature	Front surface	TopF	-20 to +70	°C	Note3
	Rear surface	TopR	-20 to +70	°C	Note4
Relative humidity Note5		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 Note5		AH	≤ 70 Note6	g/m ³	Ta > 70°C

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

Note2: DPS

Note3: Measured at center of LCD panel surface (including self-heat)

Note4: Measured at center of LCD module's rear shield surface (including self-heat)

Note5: No condensation

Note6: Water amount at Ta= 70°C and RH= 36%

PRELIMINARY

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	at VCC= 3.3V
		4.75	5.0	5.25	V	at VCC= 5.0V
Power supply current	ICC	-	280 Note1	380 Note2	mA	at VCC= 3.3V
		-	180 Note1	250 Note2	mA	at VCC= 5.0V
Logic input voltage for display signals	High	VDH	0.7VCC	-	VCC	CMOS level
	Low	VDL	0	-	0.3VCC	
Input voltage for DPS signal	High	VFH	0.7VCC	-	VCC	
	Low	VFL	0	-	0.3VCC	

Note1: Checkered flag pattern [by EIAJ ED-2522]

Note2: Pattern for maximum current

4.3.2 Backlight lamp

(Ta=25°C, Note1, Note2)

Parameter	Symbol	min.	typ.	max.	Unit	Remarks
Forward current	IL	-	50.0	55.0	mA	-
Forward Voltage	VL	-	23.1	26.6	V	at IL=50 mA

Note1: Please drive with constant current.

Note2: The Luminance uniformity may be changed depending on the current variation between 2 circuits.
It is recommended that the current value difference between each circuit is less than 5%.

4.3.3 Power supply voltage ripple

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

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

Note1: The permissible ripple voltage includes spike noise.

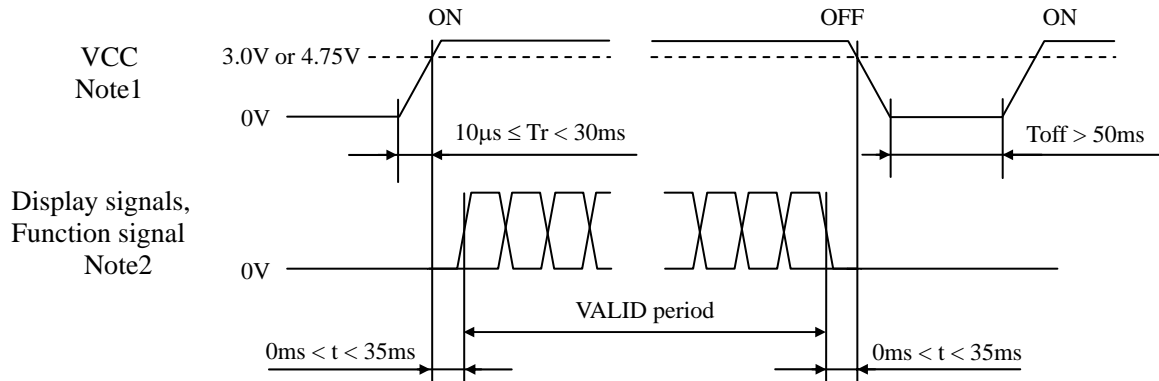
4.3.4 Fuse

Parameter	Fuse		Rating	Fusing current	Remarks
	Type	Supplier			
VCC	FCC16202AB	KAMAYA ELECTRIC Co., Ltd	2.0A	4.0A	Note1
			32V		

Note1: The power supply capacity should 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

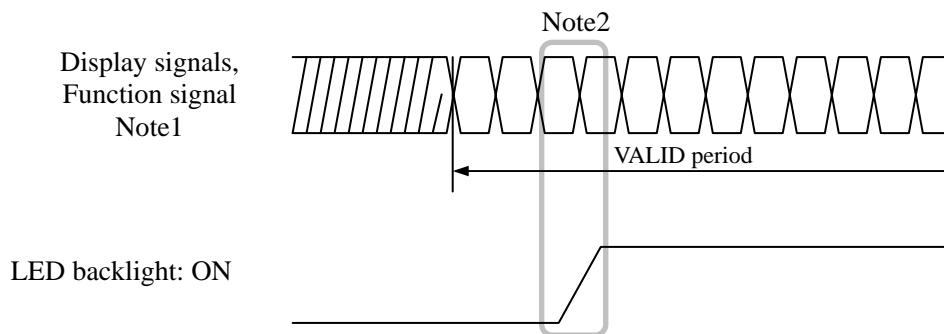


Note1: In terms of voltage variation (voltage drop) while VCC rising edge is below 3.0V in "VCC = 3.3V" or 4.75V in "VCC = 5.0V", a protection circuit may work, and then this product may not work.

Note2: Display signals (CLK, Hsync, Vsync, DE, DATA (R0 to R5, G0 to G5 and B0 to B5)) and function signal (DPS) must be Low or High-impedance, exclude the VALID period (See above sequence diagram), in order to avoid that internal circuits is damaged.

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. VCC should be cut when the display and function signals are stopped.

4.4.2 Backlight lighting circuit



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): DF9C-31P-1V (2*) (Hirose Electric Co., Ltd. (HRS))

Adaptable plug: DF9-31S-1V (2*), DF9-31S-1V (3*) (Hirose Electric Co., Ltd. (HRS))

Pin No.	Symbol	Signal	Remarks
1	GND	Ground	Note 1
2	CLK	Dot clock	-
3	Hsync	Horizontal synchronous signal	
4	Vsync	Vertical synchronous signal	
5	GND	Ground		Note 1
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	Note 1
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	Note 1
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	Note 1
27	DE	Selection of DE / Fixed mode	High or Open: Fixed mode Data enable signal: DE mode
28	VCC	Power supply	Note 1
29	VCC	Power supply	
30	N.C.	-	Keep this pin Open.
31	DPS	Selection of scan direction	High: Reverse scan Low or Open: Normal scan Note 2

Note1: All GND and VCC terminals should be used without any non-connected lines.

Note2: See "4.8 SCANNING DIRECTIONS".

PRELIMINARY

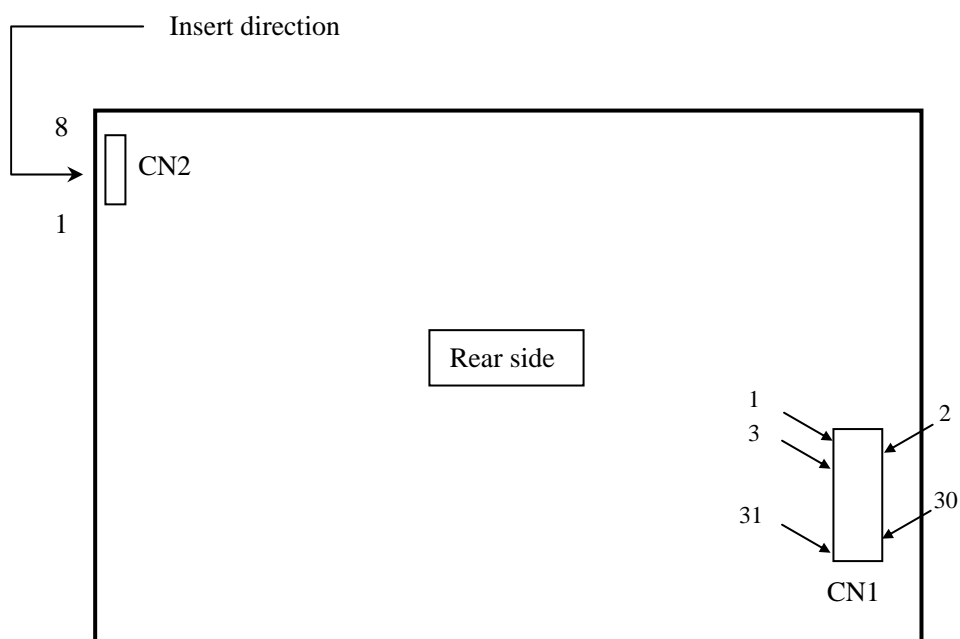
4.5.2 Backlight lamp

CN2 plug (LCD module side): SM08B-SRSS-TB (J.S.T. Mfg. Co., Ltd.)

Adaptable socket: SHR-8V-S, SHR-8V-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.

4.5.3 Positions of plug and socket



PRELIMINARY

4.6 DISPLAY COLORS AND INPUT DATA SIGNALS

This product can display in equivalent to 262,144 colors in 64 gray scales. Also the relation between display colors and input data signals is as the following table.

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

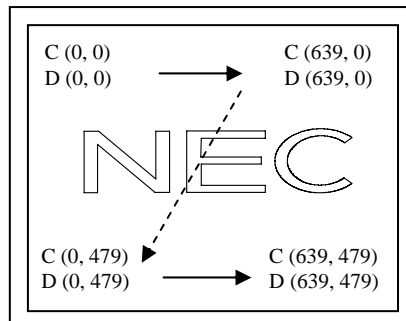
4.7 DISPLAY POSITIONS

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

$C(0, 0)$						
R	G	B				
$C(0, 0)$	$C(1, 0)$	...	$C(X, 0)$	...	$C(638, 0)$	$C(639, 0)$
$C(0, 1)$	$C(1, 1)$	...	$C(X, 1)$	...	$C(638, 1)$	$C(639, 1)$
.
.
.
$C(0, Y)$	$C(1, Y)$	...	$C(X, Y)$	...	$C(638, Y)$	$C(639, Y)$
.
.
.
$C(0, 478)$	$C(1, 478)$	...	$C(X, 478)$	...	$C(638, 478)$	$C(639, 478)$
$C(0, 479)$	$C(1, 479)$	...	$C(X, 479)$	...	$C(638, 479)$	$C(639, 479)$

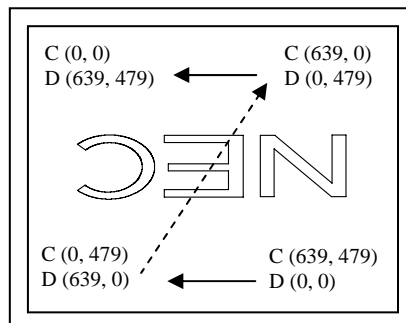
4.8 SCANNING DIRECTIONS

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



Note1

Figure1. Normal scan (DPS: Low or Open)



Note1

Figure2. Reverse scan (DPS: High)

Note1: Meaning of C (X, Y) and D (X, Y)

C (X, Y): The coordinates of the display position (See "4.7 DISPLAY POSITIONS".)

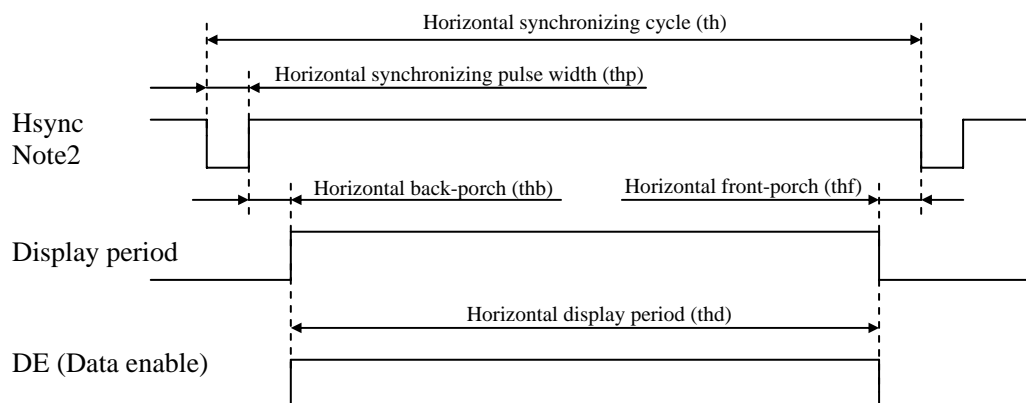
D (X, Y): The data number of input signal for LCD panel signal processing board

4.9 INPUT SIGNAL TIMINGS

4.9.1 Outline of input signal timings

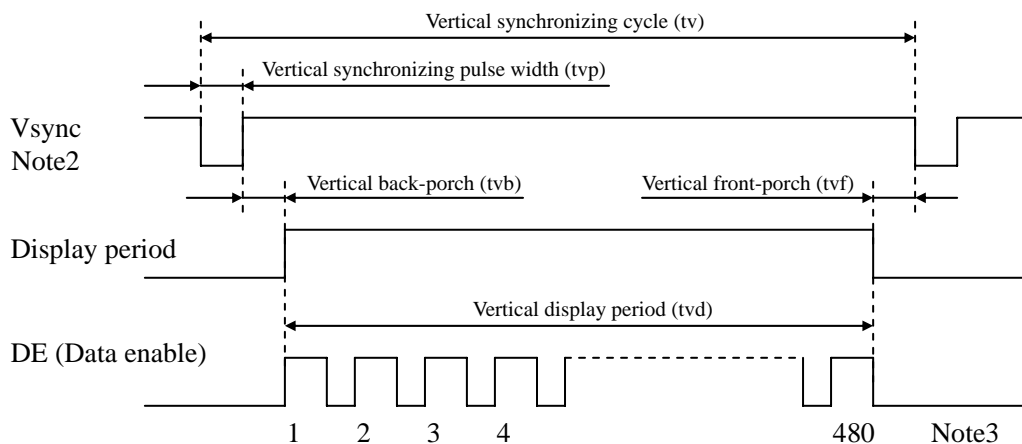
- Horizontal signal

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 "4.9.3 Input signal timing chart" for numeration of pulse.

PRELIMINARY

4.9.2 Timing characteristics

(a) Fixed mode

(Note1)

Parameter		Symbol	min.	typ.	max.	Unit	Remarks	
CLK	Frequency	1/tc	21.0	25.175	29.0	MHz	39.72 ns (typ.)	
	Duty	tcd	0.4	0.5	0.6	-	-	
	Rise time, Fall time	trcf	-	-	10	ns		
DATA (R0-R5) (G0-G5) (B0-B5)	CLK-DATA	Setup time	tds	3	-	-	ns	-
		Hold time	tdh	5	-	-	ns	
	Rise time, Fall time	tdrf	-	-	10	ns		
Hsync	Cycle	th	30.0	31.778	33.6	μs	31.468 kHz (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	3	-	-	ns	-
Hold time		thh	5	-	-	ns		
Rise time, Fall time	thrf	-	-	10	ns			
sync	Cycle	tv	16.1	16.683	17.2	ms	59.94 Hz (typ.)	
			525			H	-	
	Display period	tvd	480			H		
	Front-porch	tvf	12			H		
	Pulse width	tvp	1	2	-	H		
	Back-porch	tvb	-	31	32	H		
	Total of pulse width and back-porch	tvp + tvb	33			H		Note2
	Hsync-Vsync	Setup time	thv	3	-	-	ns	-
Hold time		tvh	5	-	-	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.

PRELIMINARY

(b) DE mode

(Note1, Note2, Note3)

Parameter		Symbol	min.	typ.	max.	Unit	Remarks	
CLK	Frequency	1/tc	21.0	25.175	29.0	MHz	39.72 ns (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	3	-	-	ns	-
		Hold time	tdh	5	-	-	ns	
	Rise time, Fall time	tdrf	-	-	10	ns		
DE	Horizontal	Cycle	th	30.0	31.778	33.6	μs	31.468 kHz (typ.)
				-	800	-	CLK	-
	Vertical (One frame)	Cycle	tv	640		CLK	-	
				16.1	16.683	17.2	ms	59.94 Hz (typ.)
	CLK-DE	Setup time	tdes	3	-	-	ns	-
				5	-	-	ns	
	Rise time, Fall time	tderf	-	-	10	ns	-	
			480	H	-			

Note1: Definition of parameters is as follows.

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

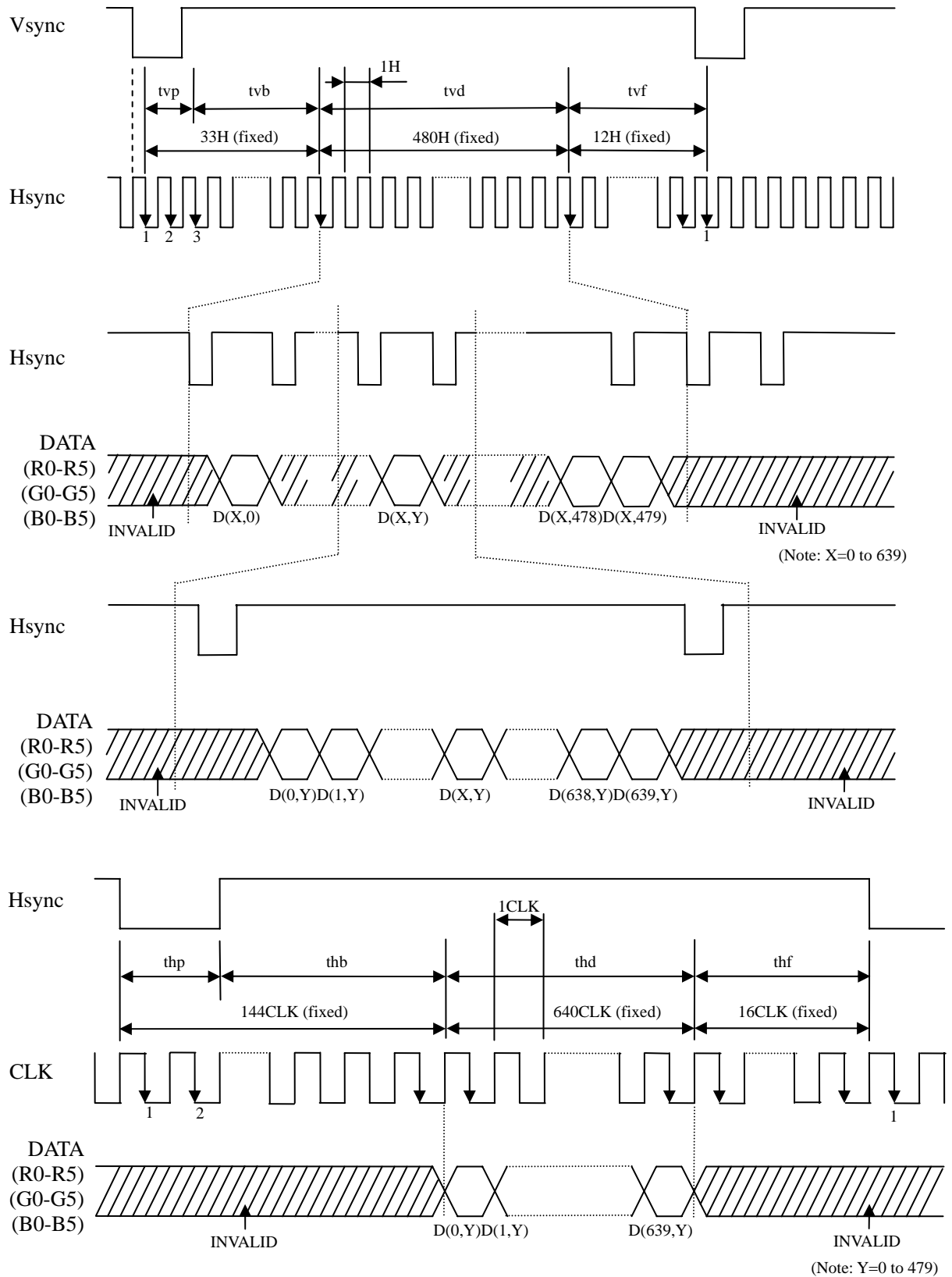
Note2: Hsync signal (Pin No.3 of CN1) and Vsync signal (Pin No.4 of CN1) are not used inside the product at DE mode.

Do not keep pin open to avoid noise problem.

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

4.9.3 Input signal timing chart

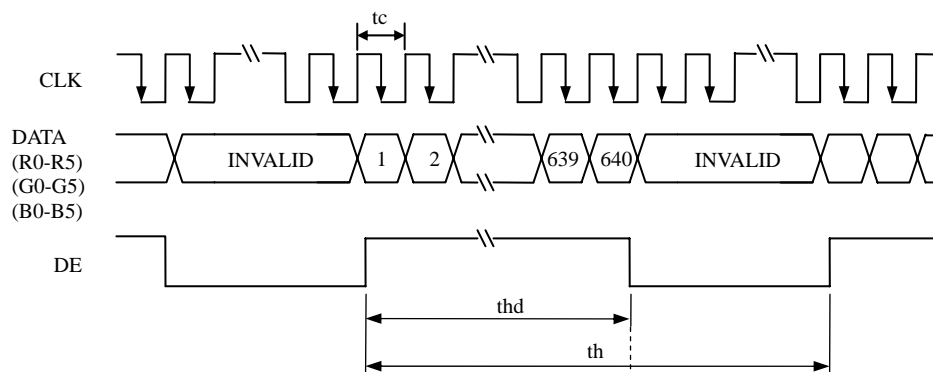
(a) Fixed mode



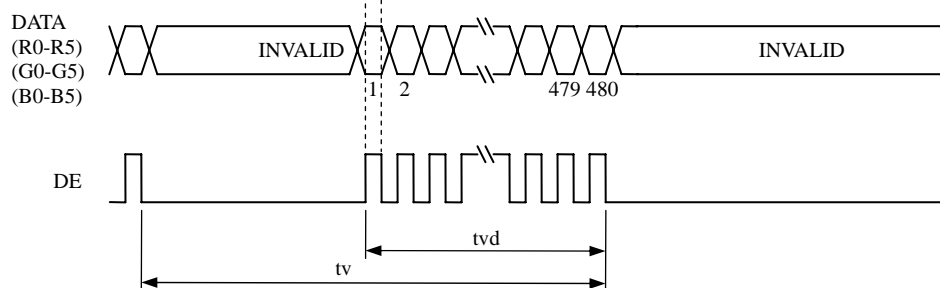
PRELIMINARY

(b) DE mode

Horizontal timing



Vertical timing



4.10 OPTICS

4.10.1 Optical characteristics

(Note1, Note2)

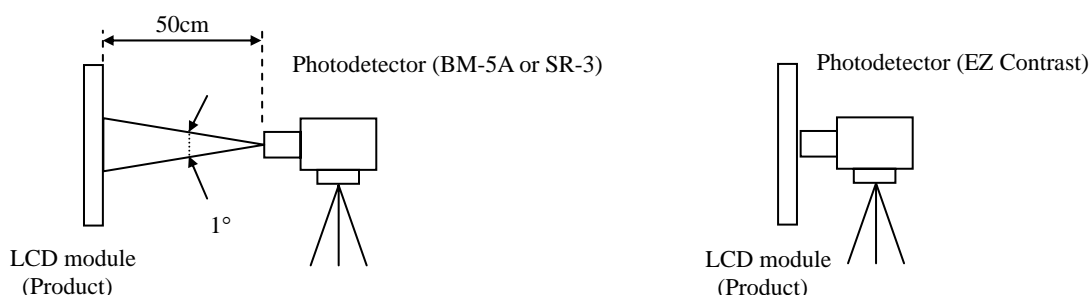
Parameter	Condition	Symbol	min.	typ.	max.	Unit	Measuring instrument	Remarks	
Luminance	White at center $\theta R=0^\circ, \theta L=0^\circ, \theta U=0^\circ, \theta D=0^\circ$	L	TBD	(450)	-	cd/m ²	BM-5A	-	
Contrast ratio	White/Black at center $\theta R=0^\circ, \theta L=0^\circ, \theta U=0^\circ, \theta D=0^\circ$	CR	TBD	(600)	-	-	BM-5A	Note3	
Luminance uniformity	White $\theta R=0^\circ, \theta L=0^\circ, \theta U=0^\circ, \theta D=0^\circ$	LU	-	1.25	1.4	-	BM-5A	Note4	
Chromaticity	White	x coordinate	Wx	TBD	TBD	TBD	-	SR-3	Note5
		y coordinate	Wy	TBD	TBD	TBD	-		
	Red	x coordinate	Rx	-	TBD	-	-		
		y coordinate	Ry	-	TBD	-	-		
	Green	x coordinate	Gx	-	TBD	-	-		
		y coordinate	Gy	-	TBD	-	-		
Blue	x coordinate	Bx	-	TBD	-	-			
	y coordinate	By	-	TBD	-	-			
Color gamut	$\theta R=0^\circ, \theta L=0^\circ, \theta U=0^\circ, \theta D=0^\circ$ at center, against NTSC color space	C	TBD	40	-	%			
Response time	White to Black	Ton	-	6	15	ms	BM-5A	Note6	
	Black to White	Toff	-	19	47	ms		Note7	
Viewing angle	Right	$\theta U=0^\circ, \theta D=0^\circ, CR \geq 10$	θR	70	80	-	EZ Contrast	Note8	
	Left	$\theta U=0^\circ, \theta D=0^\circ, CR \geq 10$	θL	70	80	-			
	Up	$\theta R=0^\circ, \theta L=0^\circ, CR \geq 10$	θU	70	80	-			
	Down	$\theta R=0^\circ, \theta L=0^\circ, CR \geq 10$	θD	50	60	-			

Note1: These are initial characteristics.

Note2: Measurement conditions are as follows.

Ta= 25°C, VCC= 3.3V, IL= 50mA, Display mode: VGA, Horizontal cycle= 1/31.468kHz,
Vertical cycle= 1/59.94Hz, DPS= Low or Open: Normal scan

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



Note3: See "4.10.2 Definition of contrast ratio".

Note4: See "4.10.3 Definition of luminance uniformity".

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

Note6: Product surface temperature: TopF= TBD °C

Note7: See "4.10.4 Definition of response times".

Note8: See "4.10.5 Definition of viewing angles".

4.10.2 Definition of contrast ratio

The contrast ratio is calculated by using the following formula.

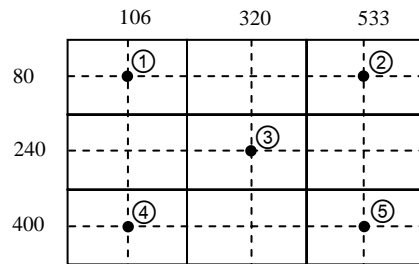
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance of white screen}}{\text{Luminance of black screen}}$$

4.10.3 Definition of luminance uniformity

The luminance uniformity is calculated by using following formula.

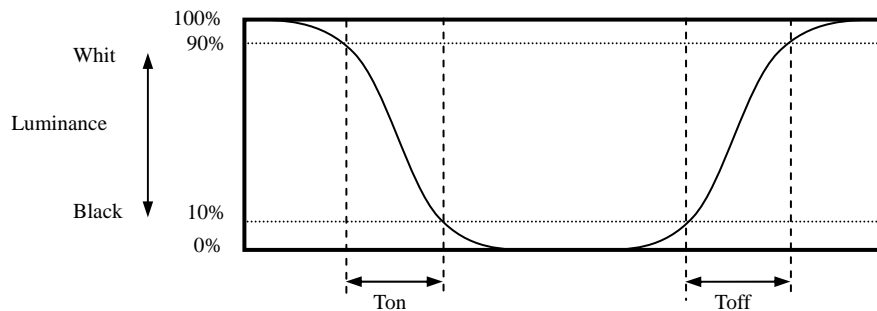
$$\text{Luminance uniformity (LU)} = \frac{\text{Maximum luminance from ① to ⑤}}{\text{Minimum luminance from ① to ⑤}}$$

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

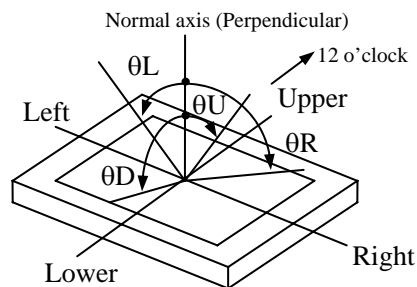


4.10.4 Definition of response times

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.).



4.10.5 Definition of viewing angles



PRELIMINARY

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		Expected luminance lifetime Note1, Note2	Unit
LED elementary substance	25°C (Ambient temperature of LED) Continuous operation, IL=50mA	70,000	h
	70°C (Ambient temperature of LED) Continuous operation, IL=50mA	60,000	h

Note1: Expected luminance lifetime is not the value for LCD module but the value for LED elementary substance.

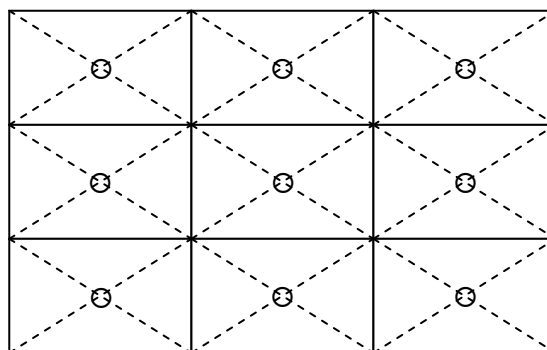
Note2: By ambient temperature, the lifetime changes particularly. Especially, in case the product works under high temperature environment, the lifetime becomes short.

6. RELIABILITY TESTS

Test item	Condition	Judgment	Note1
High temperature and humidity (Operation)	① $60 \pm 2^{\circ}\text{C}$, RH= 90%, 240hours ② Display data is black.	No display malfunctions	
High temperature (Operation)	① $70 \pm 3^{\circ}\text{C}$, 240hours ② Display data is black.		
Heat cycle (Operation)	① $-20 \pm 3^{\circ}\text{C}$...1hour $70 \pm 3^{\circ}\text{C}$...1hour ② 50cycles, 4 hours/cycle ③ Display data is black.		
Thermal shock (Non operation)	① $-30 \pm 3^{\circ}\text{C}$...30minutes $80 \pm 3^{\circ}\text{C}$...30minutes ② 100cycles, 1hour/cycle ③ Temperature transition time is within 5 minutes.		
ESD (Operation)	① 150pF, 150 Ω , $\pm 10\text{kV}$ 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 $\pm X$, $\pm Y$, $\pm Z$ 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", 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 539m/s^2 and to be not greater 11ms, Pressure: To be not greater 19.6 N ($\phi 16\text{mm}$ 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 0.294N·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 nor 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 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. Circuit boards may be broken down by it.
- ④ This product is not designed as radiation hardened.

7.3.3 Characteristics

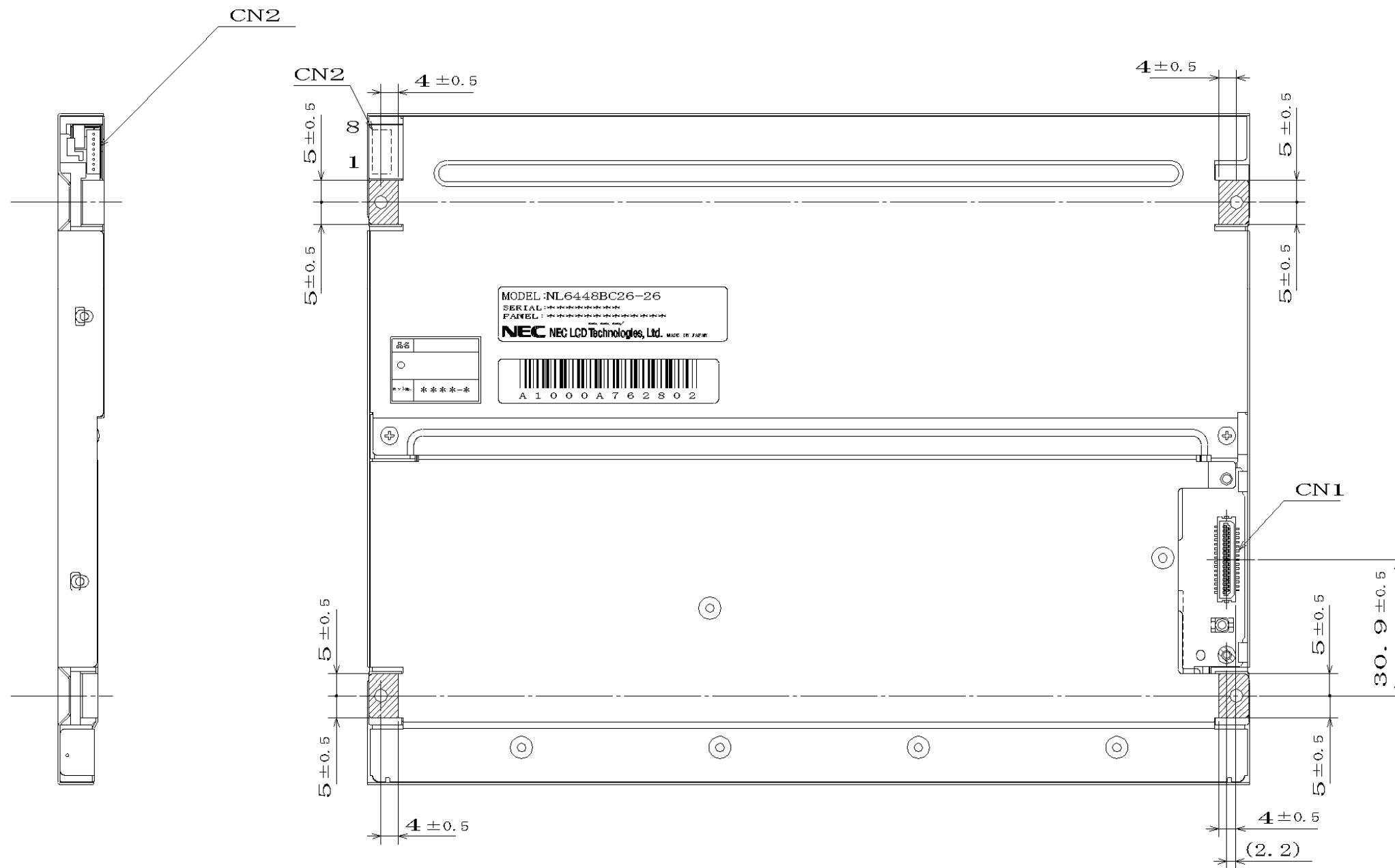
The following items are neither defects nor failures.

- ① Characteristics of the LCD (such as response time, luminance, color uniformity and so on) may be changed depending on ambient temperature. If the product is stored under condition of low temperature for a long time, it may cause display mura. In this case, the product should be operated after enough time being left under condition of operating 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. 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 Other


- ① All VCC and GND 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 holder.
- ④ Pay attention not to insert foreign materials inside of the product, when using tapping screws.
- ⑤ Pack the product with original shipping package, in order to avoid any damages during transportation, when returning the product to NEC for repair and so on.

8.2 REAR VIEW



Note1: The values in parentheses are for reference.

Note2: The torque for product mounting screws must never exceed 0.294N·m.



Note3:  Mounting hole portions (4 pieces)

Unit: mm

PRELIMINARY

REVISION HISTORY

The inside of latest specifications is revised to the clerical error and the major improvement of previous edition. Only a changed part such as functions, characteristic value and so on that may affect a design of customers, are described especially below.

Edition	Document number	Prepared date	Revision contents and signature
1st edition	DOD-PP-0705	Jan. 8, 2009	<p>Revision contents</p> <p>New issue</p> <p>Signature of writer</p> <p>Approved by  _____ H.FUKUYOSHI</p> <p>Checked by _____</p> <p>Prepared by  _____ A.KUMANO</p>