

PRELIMINARY

NEC NEC LCD Technologies, Ltd.

TFT COLOR LCD MODULE

NL6448BC20-18D

16.6cm (6.5 Type)

VGA

PRELIMINARY DATA SHEET 

DOD-PD-0644 (1st edition)

www.millotech.com

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INTRODUCTION

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1. OUTLINE

1.1 STRUCTURE AND PRINCIPLE

Color LCD module NL6448BC20-18D 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. PC, 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

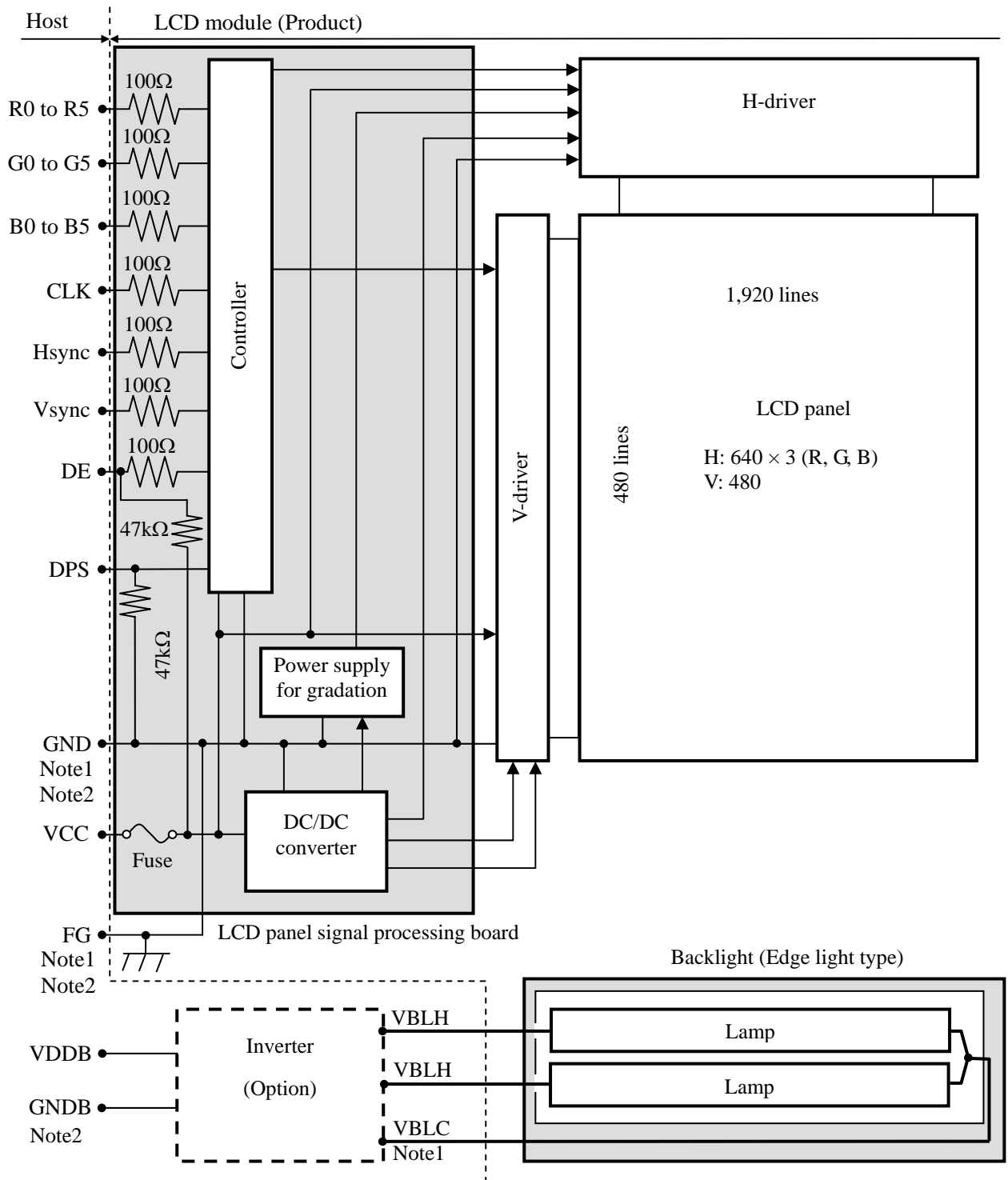
- High luminance
- High contrast
- Ultra wide viewing angle
- Wide temperature range
- 6-bit digital RGB signals
- Reversible-scan direction
- Edge light type (without inverter)
- Replaceable lamp for backlight

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2. GENERAL SPECIFICATIONS

Display area	132.48 (H) × 99.36 (V) mm
Diagonal size of display	16.6 cm (6.5 inches)
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	0.0690 (H) × 0.2070 (V) mm
Pixel pitch	0.2070 (H) × 0.2070 (V) mm
Module size	153.0 (W) × 118.0 (H) × 10.5 (D) mm (typ.)
Weight	200 g (typ.)
Contrast ratio	400:1 (typ.)
Viewing angle	At the contrast ratio ≥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
Polarizer surface	Antiglare
Polarizer pencil-hardness	2H (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 IBL= 5.0mArms / lamp 400 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	Edge light type: 2 cold cathode fluorescent lamps (Replaceable part) • Lamp holder set: Type No. 65LHS10 (Recommended inverter (Option)) • Inverter: Type No. 65PW061
Power consumption	At IBL=5.0mArms / lamp and checkered flag pattern TBD W (typ., Power dissipation of the inverter is not included.)

3. BLOCK DIAGRAM



Note1: Connections between GND (Signal ground), FG (Frame ground) and VBLC (Lamp low voltage terminal) in the LCD module

GND - FG	Connected
GND - VBLC	Not connected
FG - VBLC	Not connected

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

4. DETAILED SPECIFICATIONS

4.1 MECHANICAL SPECIFICATIONS

Parameter	Specification	Unit
Module size	153.0 ± 0.5 (W) × 118.0 ± 0.5 (H) × 10.5 ± 0.5 (D) Note1	mm
Display area	132.48 (H) × 99.36 (V) Note1	mm
Weight	200 (typ.), TBD (max.)	g

Note1: See "7. 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	Ta = 25°C
	Lamp voltage	VBLH	TBD	Vrms	
Input voltage for signals	Display signals Note1	VD	-0.3 to VCC+0.3	V	
	Function signal Note2	VF			
Storage temperature		Tst	-20 to +80	°C	-
Operating temperature	Front surface	TopF	-10 to +70	°C	Note3
	Rear surface	TopR	-10 to +70	°C	Note4
Relative humidity Note5		RH	≤ 95	%	Ta ≤ 40°C
			≤ 85	%	40 < Ta ≤ 50°C
Absolute humidity Note5		AH	≤ 70 Note6	g/m ³	Ta > 50°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 = 50°C and RH = 85%

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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	-	TBD Note1	TBD Note2	mA	at VCC = 3.3V
		-	TBD Note1	TBD 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

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4.3.2 Backlight lamp

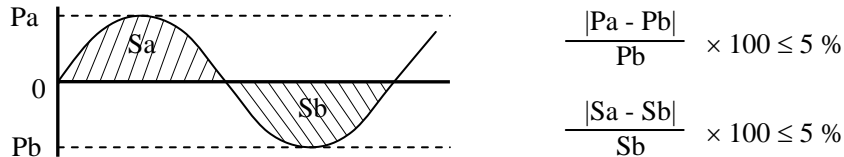
(Ta=25°C, Note1)

Parameter	Symbol	min.	typ.	max.	Unit	Remarks
Lamp current	IBL	TBD	5.0	TBD	mArms	at IBL=5.0mArms: 400cd/m ² Note3, Note4
Lamp voltage	VBLH	-	TBD	-	Vrms	Note2, Note3
Lamp starting voltage	VS	TBD	-	-	Vrms	Ta = 25°C Note2, Note3
		TBD	-	-	Vrms	Ta = -10°C Note2, Note3
Lamp oscillation frequency	FO	TBD	54	TBD	kHz	Note5

Note1: This product consists of 2 backlight lamps, and these specifications are for each lamp.

Note2: The lamp voltage cycle between lamps should be kept on a same phase. "VS" and "VBLH" are the voltage value between low voltage side (Cold) and high voltage side (Hot).

Note3: The asymmetric ratio of working waveform for lamps (Power supply voltage peak ratio, power supply current peak ratio and waveform space ratio) should be less than 5 % (See the following figure.). If the waveform is asymmetric, DC (Direct current) element apply into the lamp. In this case, a lamp lifetime may be shortened, because a distribution of a lamp enclosure substance inclines toward one side between low voltage terminal (Cold terminal) and high voltage terminal (Hot terminal). When designing the inverter, evaluate asymmetric of lamp working waveform sufficiently.



Pa: Supply voltage/current peak for positive, Pb: Supply voltage/current peak for negative
 Sa: Waveform space for positive part, Sb: Waveform space for negative part.

Note4: This product consists of 2 lamps. 2 lamps are contained in the 1 lamp holder, and both lamps are connected to 1 low voltage cable. Recommended lamp current is 5.0mArms typical for each lamp, and sum of 2 lamps is 10mArms typical. The lamp current should be measured by high-frequency current meter at the low voltage terminal.

Note5: In case "FO" is not the recommended value, beat noise may display on the screen, because of interference between "FO" and "1/th". Recommended value of "FO" is as following

$$FO = \frac{1}{4} \times \frac{1}{th} \times (2n-1)$$

th: Horizontal cycle (See "4.9.2 Timing characteristics".)
 n: Natural number (1, 2, 3)

Note6: Method of lamp cable installation may invite fluctuation of lamp current and voltage or asymmetric of lamp working waveform. When designing method of lamp cable installation, evaluate the fluctuation of lamp current, voltage and working waveform sufficiently.

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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
	5.0V	≤ 100		mVp-p

Note1: The permissible ripple voltage includes spike noise.

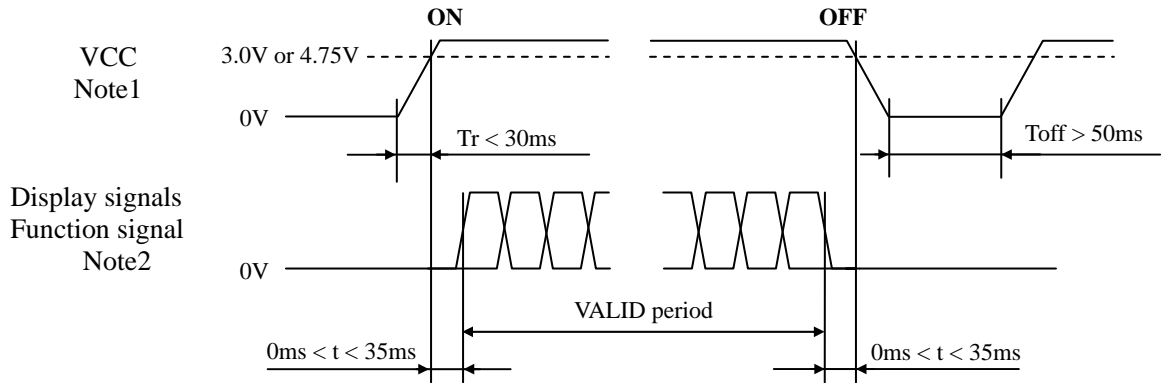
4.3.4 Fuse

Parameter	Fuse		Rating	Fusing current	Remarks
	Type	Supplier			
VCC	TBD	TBD	TBD	TBD	Note1
			TBD		

Note1: The power supply capacity should be more than the fusing current. If the power supply capacity is less than the fusing current, the fuse may not blow for a short time, and then nasty smell, smoking and so on may occur.

4.4 POWER SUPPLY VOLTAGE SEQUENCE

4.4.1 LCD panel signal processing board

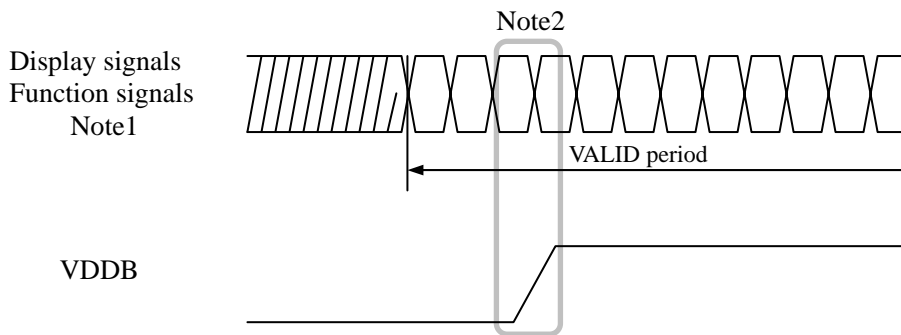


Note1: In terms of voltage variation (voltage drop) while VCC rising edge is below 3.0V in "VCC = 3.3V" or 4.75V in "VCC = 5.0V", a protection circuit may work, and then this product may not work.

Note2: Display signals (CLK, Hsync, Vsync, DE, R0 to R5, G0 to G5, 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. If customer stops the display and function signals, they should be cut VCC.

4.4.2 Inverter (Option)



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

Note2: The inverter power supply voltage (VDDDB) should be inputted within the valid period of display and function signals, in order to avoid unstable data display.

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4.5 CONNECTIONS AND FUNCTIONS FOR INTERFACE PINS

4.5.1 LCD panel signal processing board

CN1 socket (LCD module side): DF9B-31P-1V (**) (Hirose Electric Co., Ltd. (HRS))

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

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	
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)	
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)	
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)	
26	GND	Ground	Note1
27	DE	Selection of DE / Fixed mode	Data enable signal: DE mode High or Open: Fixed mode
28	VCC	Power supply	Note1
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 Note2

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

Note2: See "4.8 SCANNING DIRECTIONS".

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4.5.2 Backlight lamp

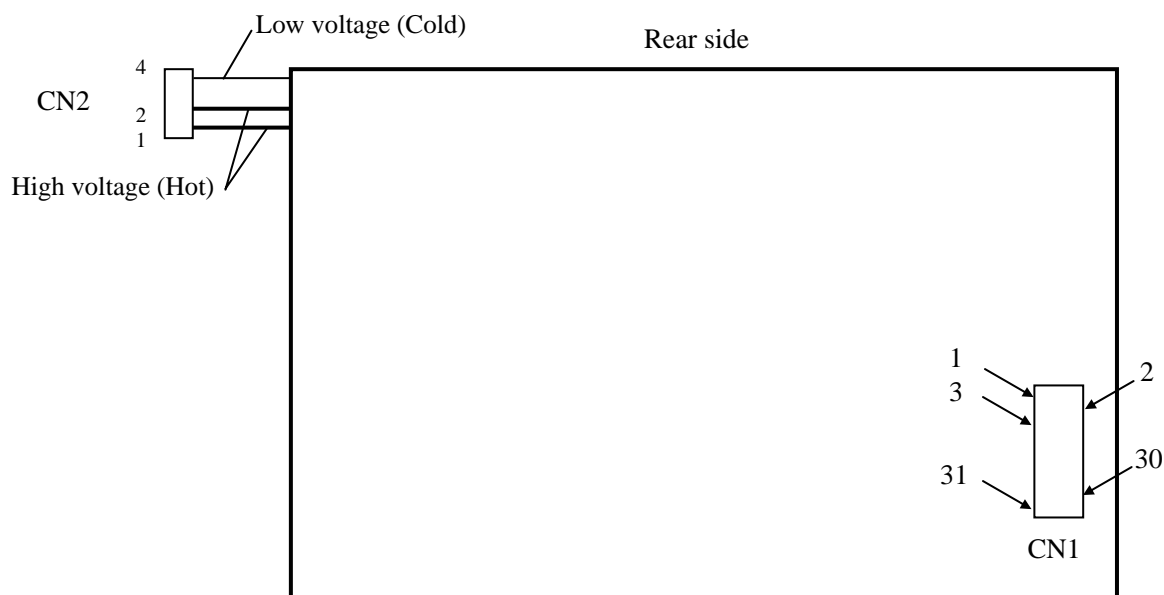
Attention: VBLH and VBLC must be connected correctly. If customer connects wrongly, customer will be hurt and the module will be broken.

CN2 plug (LCD module side): BHR-04VS-1 (J.S.T Mfg. Co., Ltd.)

Adaptable socket: SM03 (7-D1) B-BHS-1 (J.S.T Mfg. Co., Ltd.)

Pin No.	Symbol	Signal	Remarks
1	VBLH	High voltage (Hot)	Cable color: TBD
2	VBLH	High voltage (Hot)	Cable color: TBD
3	N. C.	-	Keep this pin Open.
4	VBLC	Low voltage (Cold)	Cable color: TBD

4.5.3 Positions of plug and socket



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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	0	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

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.

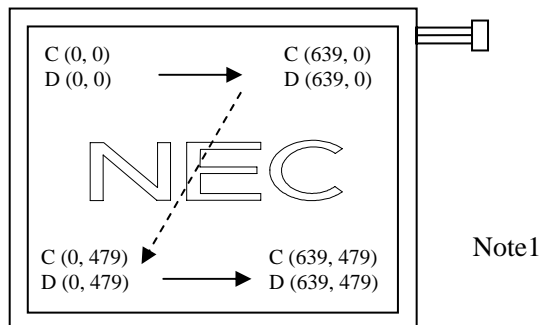


Figure 1. Normal scan (DPS: Low or Open)

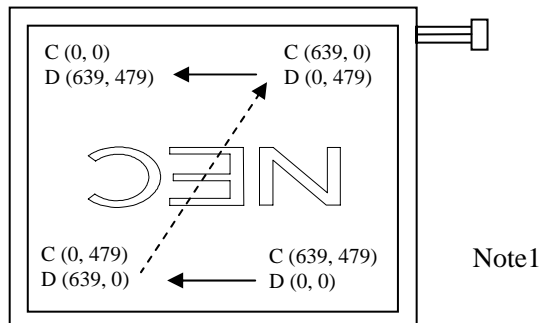


Figure 2. Reverse scan (DPS: High)

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

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

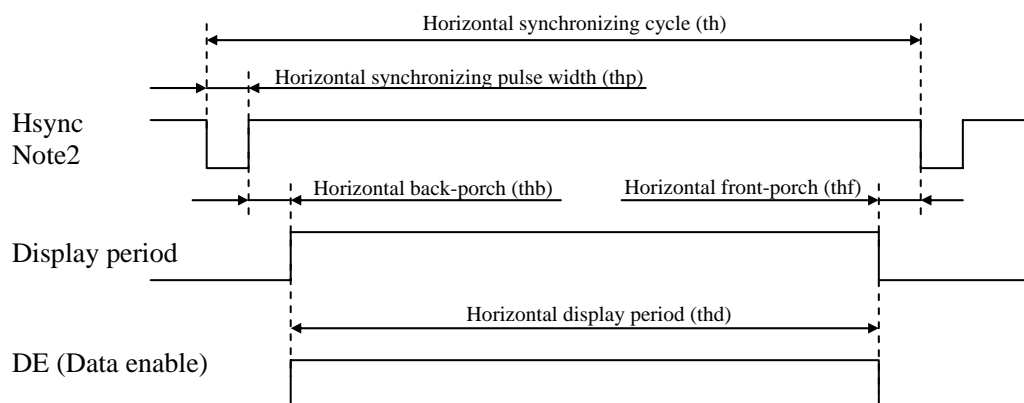
D (X, Y): The data number of input signal for LCD panel signal processing board

4.9 INPUT SIGNAL TIMINGS

4.9.1 Outline of input signal timings

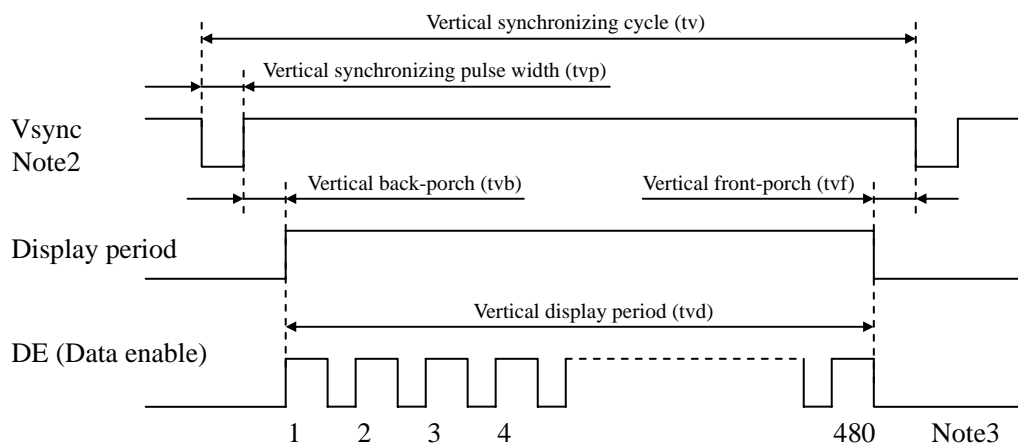
- Horizontal signal

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.

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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	trf	-	-	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				
Vsync	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	2	-	-	H			
	Back-porch	tvb	-	-	31	H			
	Total of pulse width and back-porch	tvp + tvb	33			H		Note2	
	Hsync-Vsync timing	thv	1	-	-	CLK		-	
	Vsync-Hsync timing	tvh	30	-	-	ns			
Rise time, Fall time	tvrf	-	-	10	ns				

Note1: Definition of parameters is as follows.

$$tc = 1\text{CLK}, tcd = tch/tc, th = 1H$$

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.

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(b) DE mode

(Note1, Note2)

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	trf	-	-	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.)
		Display period	thd	-	800	-	CLK	-
	Vertical (One frame)	Cycle	tv	16.1	16.683	17.2	ms	59.94 Hz (typ.)
		Display period	tvd	-	525	-	H	-
	CLK-DE	Setup time	tdes	3	-	-	ns	
		Hold time	tdeh	5	-	-	ns	
		Rise time, Fall time	tderf	-	-	10	ns	

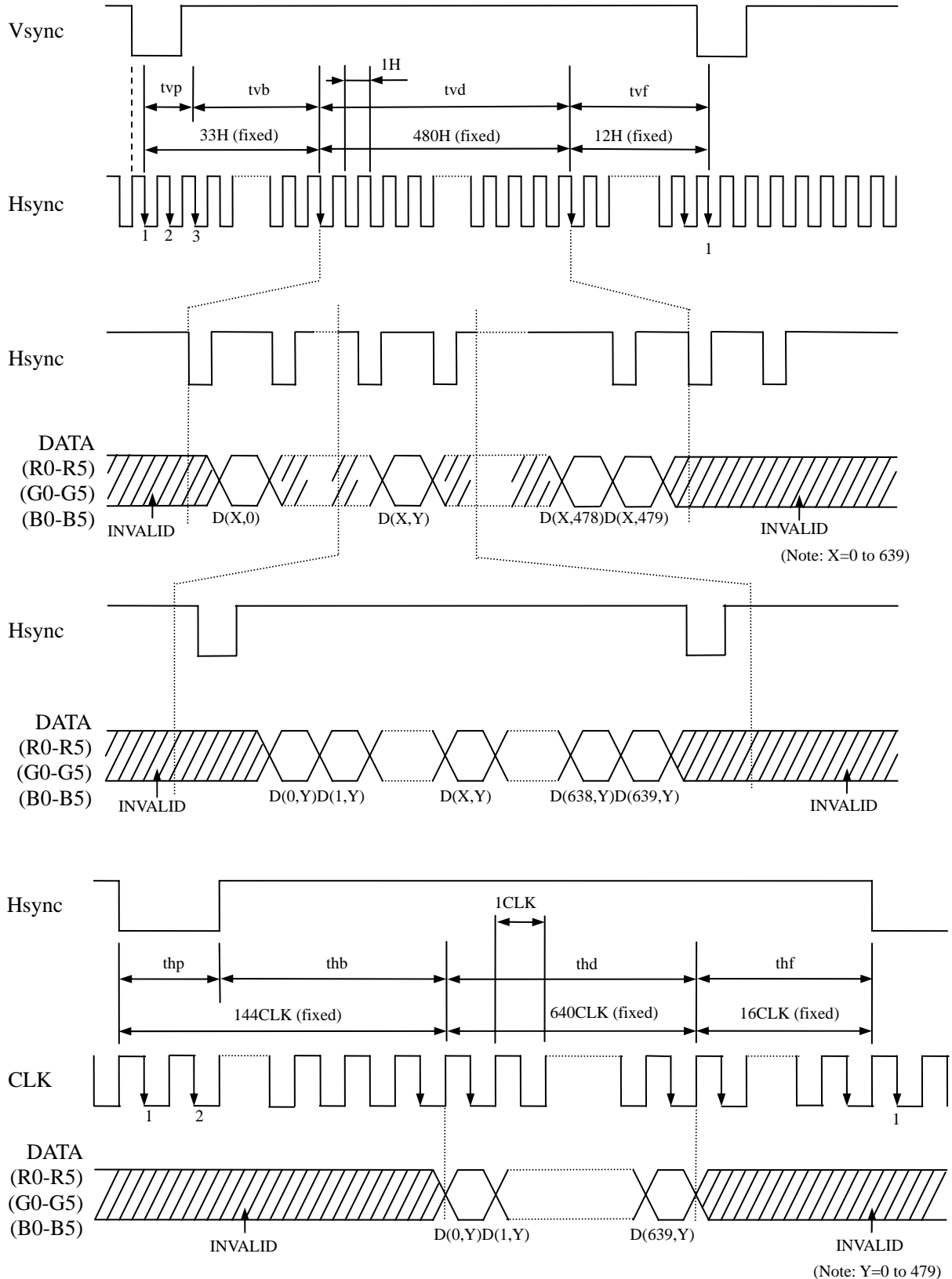
Note1: Definition of parameters is as follows.

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

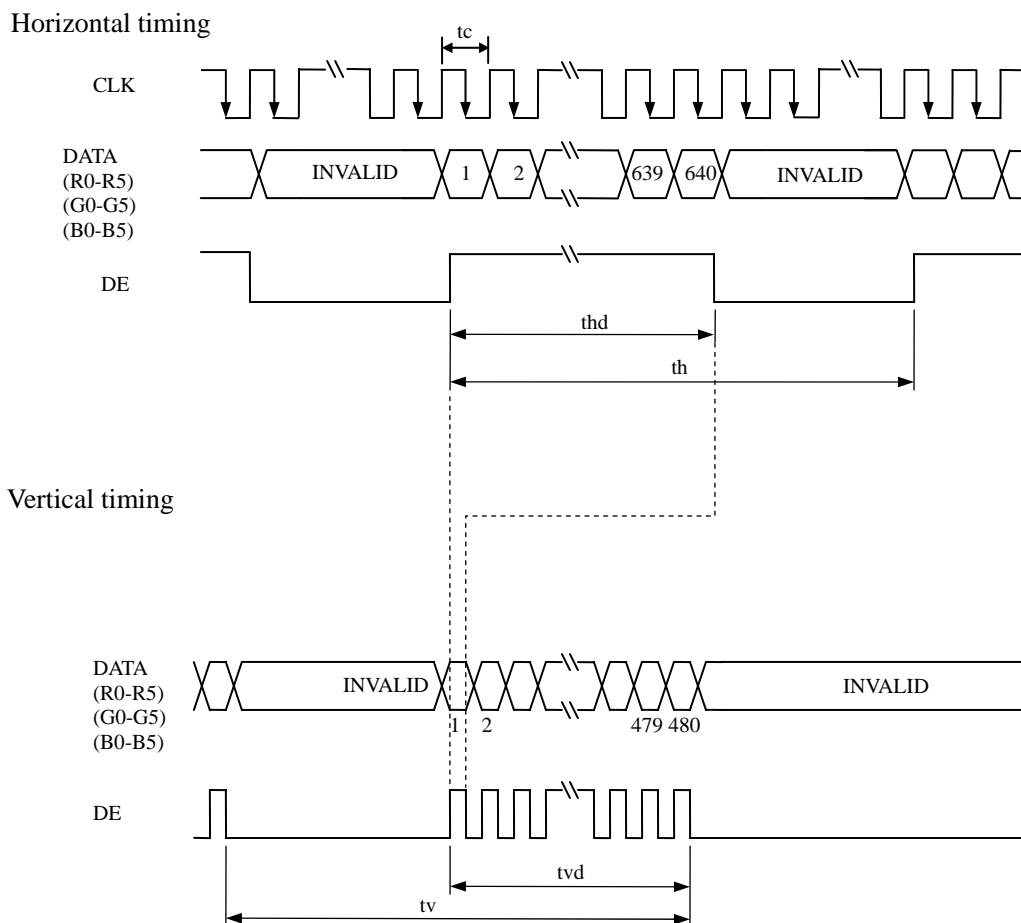
Note2: Hsync signal (CN1-Pin No.3) and Vsync signal (CN1-Pin No.4) are not used inside the product at DE mode, but do not keep pin open to avoid noise problem.

4.9.3 Input signal timing chart

(a) Fixed mode

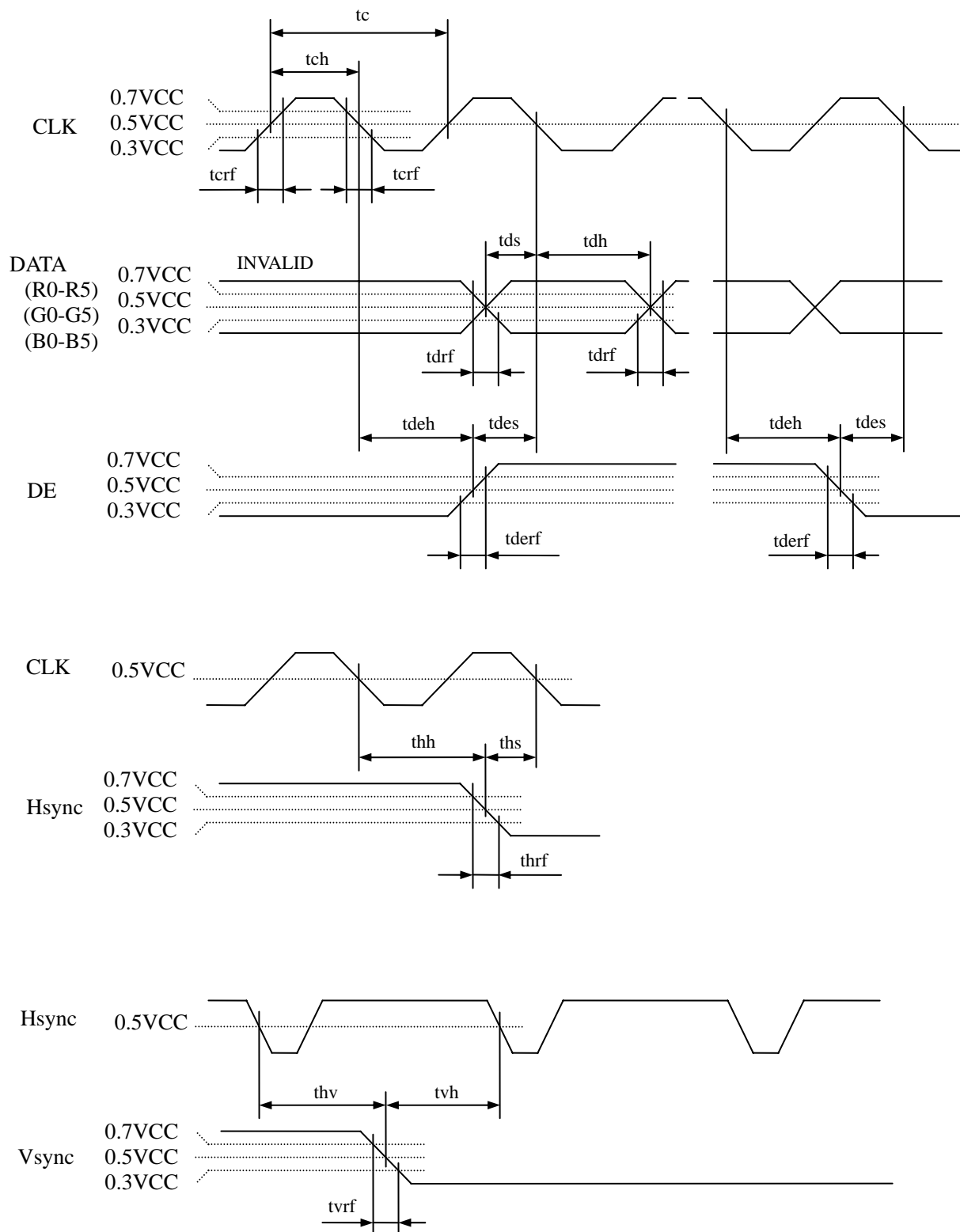


(b) DE mode



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(c) Common item of Fixed mode and DE mode



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

4.10 OPTICS

4.10.1 Optical characteristics

(Note1, Note2)

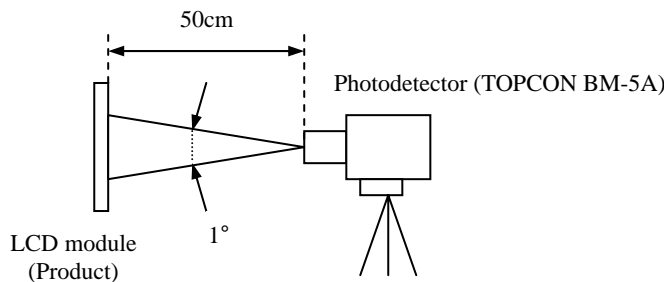
Parameter	Condition	Symbol	min.	typ.	max.	Unit	Remarks	
Luminance	White at center $\theta R = 0^\circ, \theta L = 0^\circ, \theta U = 0^\circ, \theta D = 0^\circ$	L	TBD	400	-	cd/m ²	-	
Contrast ratio	White/Black at center $\theta R = 0^\circ, \theta L = 0^\circ, \theta U = 0^\circ, \theta D = 0^\circ$	CR	TBD	400	-	-	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	-	Note4	
Chromaticity	White	x coordinate	Wx	TBD	0.313	TBD	-	Note5
		y coordinate	Wy	TBD	0.329	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	-	(8)	TBD	ms	Note6	
	Black to White	Toff	-	(17)	TBD	ms	Note7	
Viewing angle	Right	$\theta U = 0^\circ, \theta D = 0^\circ, CR \geq 10$	θR	TBD	80	-	°	Note8
	Left	$\theta U = 0^\circ, \theta D = 0^\circ, CR \geq 10$	θL	TBD	80	-	°	
	Up	$\theta R = 0^\circ, \theta L = 0^\circ, CR \geq 10$	θU	TBD	80	-	°	
	Down	$\theta R = 0^\circ, \theta L = 0^\circ, CR \geq 10$	θD	TBD	60	-	°	

Note1: These are initial characteristics.

Note2: Measurement conditions are as follows.

Ta=25°C, VCC=3.3V, IBL= 5.0mAmps/lamp, Display mode: VGA, Horizontal cycle = 31.468kHz, Vertical cycle = 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 method for luminance is 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.

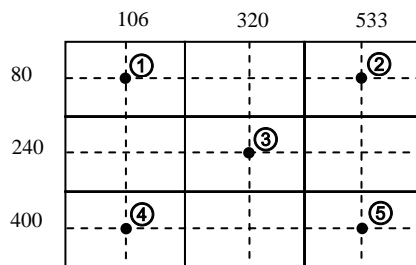
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance of white screen}}{\text{Luminance of black screen}}$$

4.10.3 Definition of luminance uniformity

The luminance uniformity is calculated by using following formula.

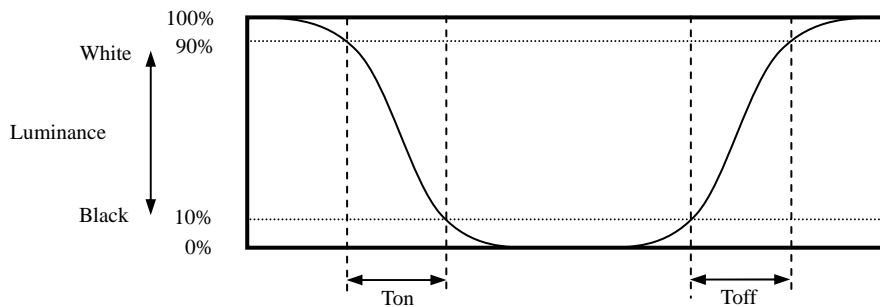
$$\text{Luminance uniformity (LU)} = \frac{\text{Maximum luminance from ① to ⑤}}{\text{Minimum luminance from ① to ⑤}}$$

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

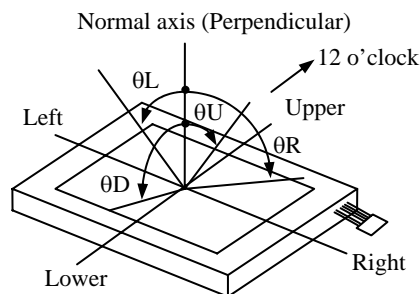


4.10.4 Definition of response times

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



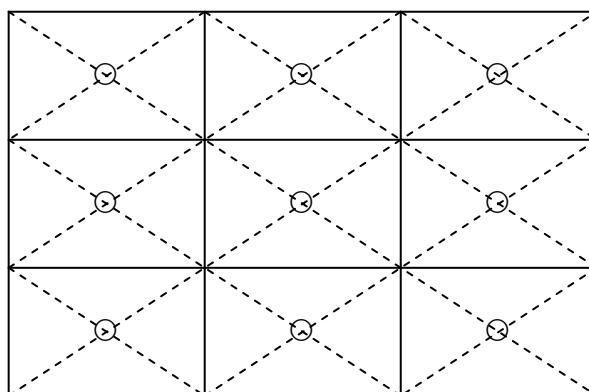
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5. RELIABILITY TESTS

Test item	Condition	Judgement
High temperature and humidity (Operation)	① $60 \pm 2^{\circ}\text{C}$, RH = 90%, 240hours ② Display data is black.	No display malfunctions Note1
High temperature (Operation)	① $70 \pm 2^{\circ}\text{C}$, 240hours ② Display data is black.	
Heat cycle (Operation)	① $-10 \pm 3^{\circ}\text{C}$...1hour $70 \pm 3^{\circ}\text{C}$...1hour ② 50cycles, 4hours/cycle ③ Display data is black.	
Thermal shock (Non operation)	① $-20 \pm 3^{\circ}\text{C}$...30minutes $80 \pm 3^{\circ}\text{C}$...30minutes ② 100cycles, 1hour/cycle ③ Temperature transition time is within 5 minutes.	
ESD (Operation)	① 150pF, 150Ω, $\pm 10\text{kV}$ 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 direction ④ 120 times each directions	No display malfunctions No physical damages Note1
Mechanical shock (Non operation)	① 539m/s^2 , 11ms ② $\pm X$, $\pm Y$, $\pm Z$ direction 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.



6. PRECAUTIONS


6.1 MEANING OF CAUTION SIGNS

The following caution signs have very important meaning. **Be sure to read "6.2 CAUTIONS" and "6.3 ATTENTIONS", after understanding these contents!**

	This sign has the meaning that customer will be injured by himself or the product will sustain a damage, if customer has wrong operations.
	This sign has the meaning that customer will get an electrical shock, if customer has wrong operations.
	This sign has the meaning that customer will be injured by himself, if customer has wrong operations.

6.2 CAUTIONS

 *** Do not touch the working backlight. Customer will be in danger of an electric shock.**

 *** Do not touch the working backlight. Customer will be in danger of burn injury.**
*** Do not shock and press the LCD panel and the backlight! There is a danger of breaking, because they are made of glass. (Shock: To be not greater 539m/s² and to be not greater 11ms, Pressure: To be not greater 19.6 N)**

6.3 ATTENTIONS

6.3.1 Handling of the product

- ① Take hold of both ends without touch the circuit board cover when customer pulls out products (LCD modules) from inner packing box. If customer touches it, products may be broken down or out of adjustment, because of stress to mounting parts.
- ② Do not hook cables nor pull connection cables such as lamp cable and so on, for fear of damage.
- ③ If customer puts down the product temporarily, the product puts on flat subsoil as a display side turns down.
- ④ Take the measures of electrostatic discharge such as earth band, ionic shower and so on, when customer handles the product, because products may be damaged by electrostatic.
- ⑤ The torque for mounting screws must never exceed TBD N·m. Higher torque values might result in distortion of the bezel.
- ⑥ 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) except mounting hole portion.
Bends or twist described above and undue stress to any portion except mounting hole portion may cause display un-uniformity.
- ⑦ Do not press or rub on the sensitive display surface. If customer clean on the panel surface, NEC recommends using the cloth with ethanolic liquid such as screen cleaner for LCD.

- ⑧ Do not push-pull the interface connectors while the product is working, because wrong power sequence may break down the product.
- ⑨ Do not bend or unbend the lamp cable at the near part of the lamp holding rubber, to avoid the damage for high voltage side of the lamp. This damage may cause a lamp breaking and abnormal operation of high voltage circuit.
- ⑩ If the lamp cable is attached on the metal part of the LCD module directly, a leak high frequency current to the metal part may occur, then the brightness may decrease or the lamp may not light.
- ⑪ When not connecting FG of the LCD module to the customer's equipment ground, inverter noise may create a beat frequency that will cause video noise on the LCD screen.
- ⑫ When customer handles 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 properties of the polarizer.

6.3.2 Environment

- ① Do not operate or store in high temperature, high humidity, dewdrop atmosphere or corrosive gases. Keep the product in antistatic pouch in room temperature, because of avoidance for dusts and sunlight, if customer stores the product.
- ② In order to prevent dew condensation occurring by temperature difference, the product packing box must be opened after leave under the environment of an unpacking room temperature enough. Because a situation of dew condensation occurring is changed by the environmental temperature and humidity, evaluate the leaving time sufficiently. (Recommendation leaving time: 6 hour 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.

6.3.3 Characteristics

The following items are neither defects nor failures.

- ① Response time, luminance and color may be changed by ambient temperature.
- ② The LCD may be seemed luminance non-uniformity, flicker, vertical seam or small spot by display patterns.
- ③ Optical characteristics (e.g. luminance, display uniformity, etc.) gradually is going to change depending on operating time, and especially low temperature, because the LCD has cold cathode fluorescent lamps.
- ④ 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.
- ⑤ The display color may be changed by viewing angle because of the use of condenser sheet in the backlight.
- ⑥ Optical characteristics may be changed by input signal timings.
- ⑦ The interference noise of input signal frequency for this product's signal processing board and luminance control frequency of customer's inverter may appear on a display. Set up luminance control frequency of inverter so that the interference noise does not appear.

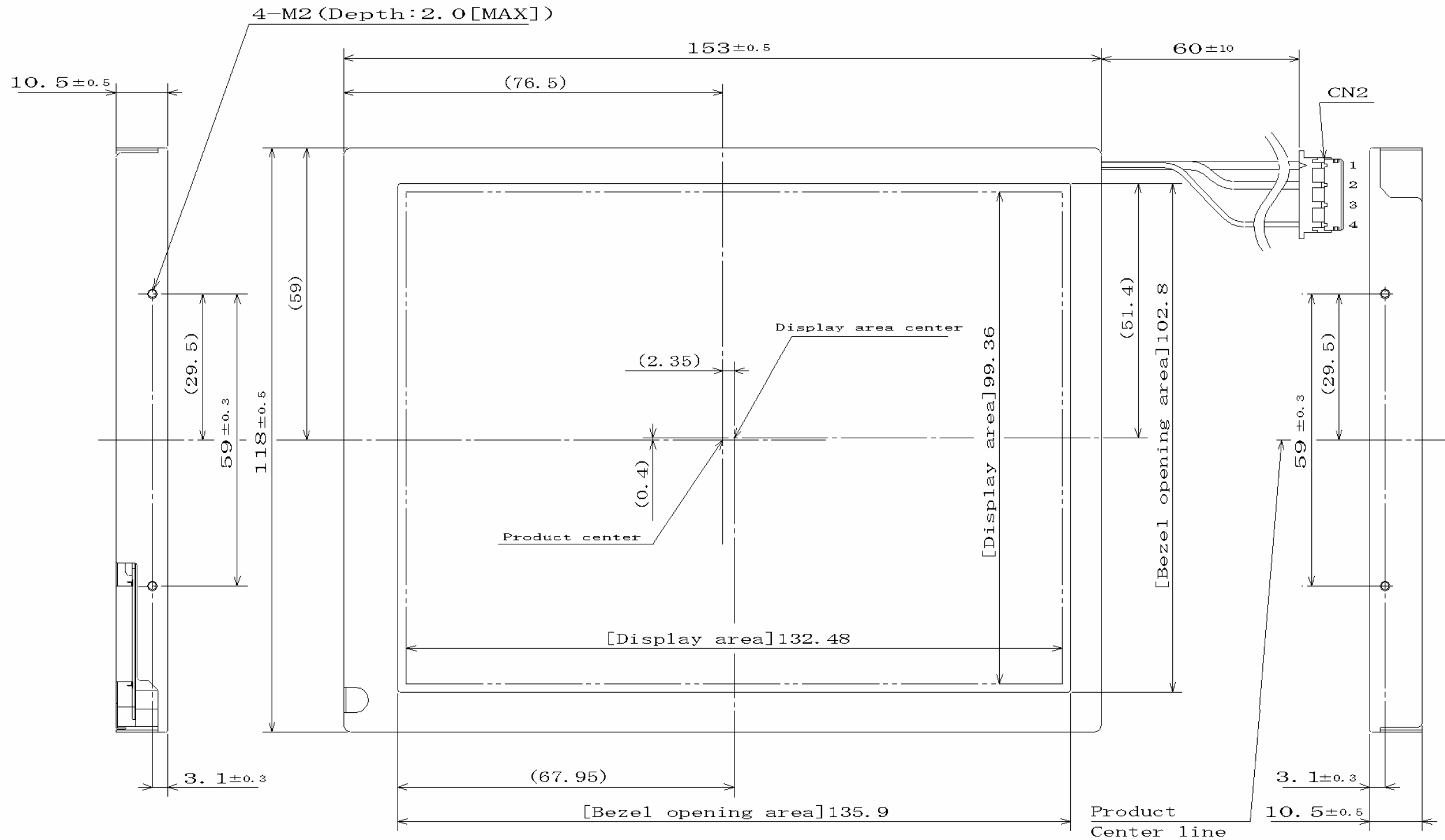
6.3.4 Other

- ① All GND and VCC terminals should be used without any non-connected lines.
- ② Do not disassemble a product or adjust variable resistors without permission of NEC.
- ③ See "REPLACEMENT MANUAL FOR LAMP HOLDER SET", if customer would like to replace backlight lamps.
- ④ Pay attention not to insert waste materials inside of products, if customer uses screwdrivers.
- ⑤ Pack the product with original shipping package, because of avoidance of some damages during transportation, when customer returns it to NEC for repair and so on.

PRELIMINARY

7. OUTLINE DRAWINGS

7.1 FRONT VIEW



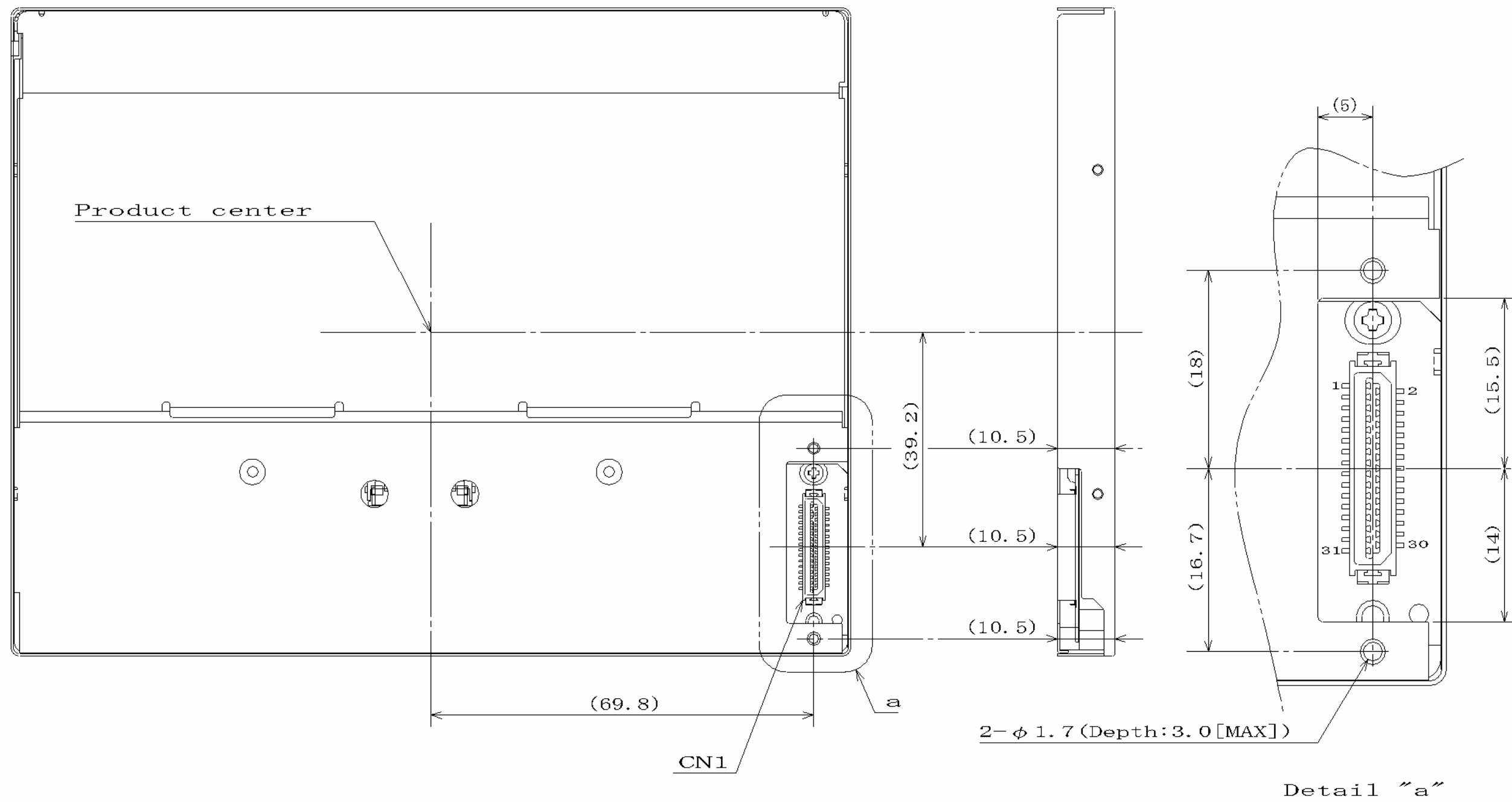
Unit: mm

Note1: The values in parentheses are for reference.

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

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7.2 REAR VIEW






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

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-PD-0644	Sep. 10, 2004	<p>Revision contents</p> <p>New issue.</p> <p>Signature of writer</p> <table data-bbox="558 694 1404 851"><tr><td data-bbox="558 694 837 728"><i>Approved by</i></td><td data-bbox="837 694 1101 728"><i>Checked by</i></td><td data-bbox="1101 694 1404 728"><i>Prepared by</i></td></tr><tr><td data-bbox="558 739 837 795"></td><td data-bbox="837 739 1101 795">_____</td><td data-bbox="1101 739 1404 795"><i>R. Kawashima</i></td></tr><tr><td data-bbox="558 795 837 840">T. ITO</td><td data-bbox="837 795 1101 840">_____</td><td data-bbox="1101 795 1404 840">R. KAWASHIMA</td></tr></table>	<i>Approved by</i>	<i>Checked by</i>	<i>Prepared by</i>		_____	<i>R. Kawashima</i>	T. ITO	_____	R. KAWASHIMA
<i>Approved by</i>	<i>Checked by</i>	<i>Prepared by</i>										
	_____	<i>R. Kawashima</i>										
T. ITO	_____	R. KAWASHIMA										