

TFT COLOR LCD MODULE

NL8060BC31-20

**30.8cm (12.1 Type)
SVGA**

DATA SHEET 
DOD-PD-0519 (5th edition)

**This DATA SHEET is updated document from
EN0551EJ4V0DS00 (4th edition)**

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Please confirm the sales representative before
starting to design your system.**

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1. OUTLINE

1.1 STRUCTURE AND PRINCIPLE

Color LCD module NL8060BC31-20 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 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 APPLICATIONS

- For industrial use



1.3 FEATURES

- High luminance
- Wide viewing angle
- High contrast
- 6-bit digital RGB signals
- Reversible-scan direction
- Edge light type (without inverter)
- Replaceable lamp for backlight
- Acquisition product for UL60950-1 1st edition/CSA-C22.2 No.60950-1-03 (File number: E170632)

2. GENERAL SPECIFICATIONS

Display area	246.0 (H) × 184.5 (V) mm
Diagonal size of display	30.8 cm (12.1 inches)
Drive system	a-Si TFT active matrix
Display color	262,144 colors
Pixel	800 (H) × 600 (V) pixels
Pixel arrangement	RGB (Red dot, Green dot, Blue dot) vertical stripe
Dot pitch	0.1025 (H) × 0.3075 (V) mm
Pixel pitch	0.3075 (H) × 0.3075 (V) mm
Module size	280.0 (W) × 210.0 (H) × 13.0 (D) mm (typ.)
Weight	760 g (typ.)
Contrast ratio	400:1 (typ.)
Viewing angle	<i>At the contrast ratio ≥ 10:1</i> <ul style="list-style-type: none"> • Horizontal: Left side 80° (typ.), Right side 80° (typ.) • Vertical: Up side 80° (typ.), Down side 80° (typ.)
Designed viewing direction	<ul style="list-style-type: none"> • Viewing angle with optimum grayscale ($\gamma=2.2$): normal axis
Polarizer surface	Clear
Polarizer pencil-hardness	3H (min.) [by JIS K5400]
Color gamut	<i>At LCD panel center</i> 38 % (typ.) [against NTSC color space]
Response time	<i>Ton + Toff (10% ←→ 90%)</i> 80 ms (typ.)
Luminance	<i>At IBL = 5.0mAmps / lamp</i> 250 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 parts) • Lamp holder set: Type No. 121LHS16 (Recommended inverter (Option)) • Inverter: Type No. 121PW111
Power consumption	<i>At IBL = 5.0mAmps / lamp and checkered flag pattern</i> 7.0 W (typ.) (Power dissipation of the inverter does not include.)

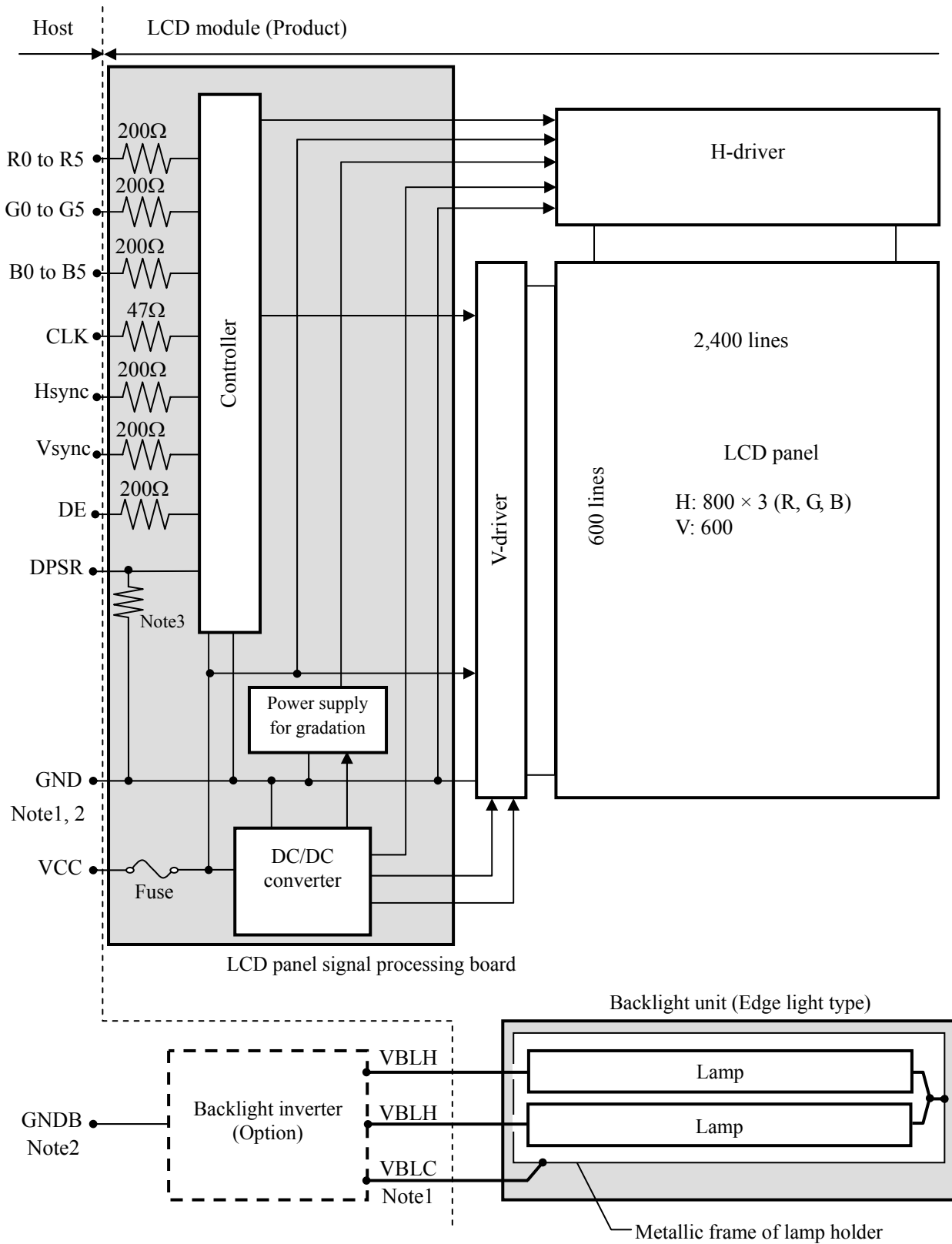
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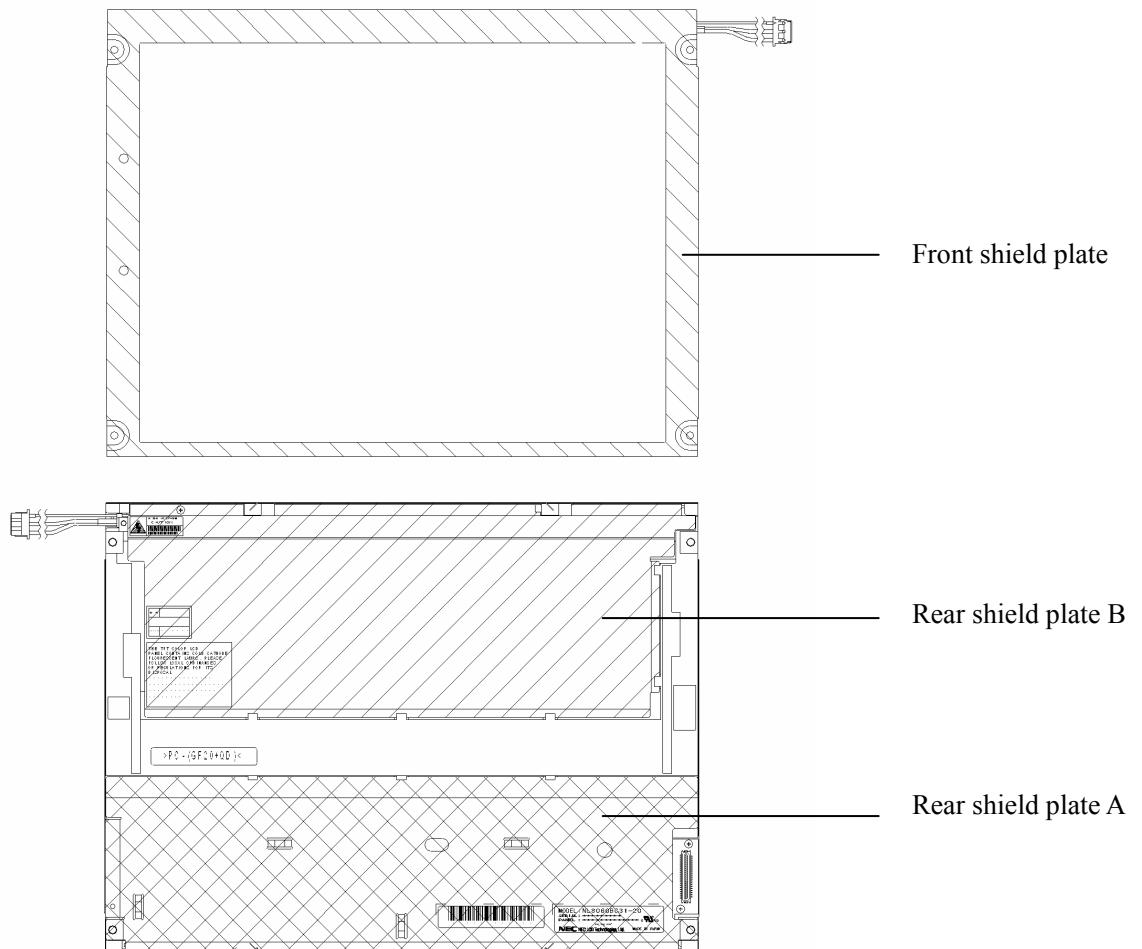
3. BLOCK DIAGRAM



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Note1: Connections between GND, shield plate and VBLC in the LCD module

Front shield plate - Rear shield plate A	Connected
Front shield plate - Rear shield plate B	Not connected
GND - Front shield plate and Rear shield plate A	Not connected
GND - Rear shield plate B	Not connected
VBLC - Front shield plate and Rear shield plate A	Not connected
VBLC - Rear shield plate B	Connected
GND - VBLC	Not connected



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

Note3: Pull-down resistance of DPSR pin ☆

Power supply voltage VCC	Pull-down resistance of DPSR pin (kΩ)		
	min.	typ.	max.
at 3.3V	7.5	15	30
at 5.0V	5.0	10	20

4. DETAILED SPECIFICATIONS

4.1 MECHANICAL SPECIFICATIONS

Parameter	Specification	Unit
Module size	280.0 ± 0.5 (W) × 210.0 ± 0.5 (H) × 13.0 ± 0.7 (D)	Note1 mm
Display area	246.0 (H) × 184.5 (V)	Note1 mm
Weight	760 (typ.), 800 (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 Note1	VBLH	2,000	Vrms	
Input voltage for signals	Display signals Note2	VD	-0.3 to VCC+0.3	V	
	Function signals Note3	VF	-0.3 to VCC+0.3	V	
Storage temperature		Tst	-20 to +60	°C	
Operating temperature	Front surface	TopF	0 to +55	°C	-
	Rear surface	TopR	0 to +55	°C	
Relative humidity Note4		RH	≤ 95	%	Ta ≤ 40°C
			≤ 85	%	40 < Ta ≤ 50°C
			≤ 70	%	50 < Ta ≤ 55°C
Absolute humidity Note4		AH	≤ 73 Note5	g/m ³	Ta > 55°C

Note1: "VBLH" is the voltage value between low voltage terminal (Cold) and high voltage terminal (Hot).

Note2: Display signals are CLK, Hsync, Vsync, DE and DATA (R0 to R5, G0 to G5, B0 to B5).

Note3: Function signal is DPSR.

Note4: No condensation

Note5: Ta = 55°C, RH = 70%

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
		4.7	5.0	5.3	V	at VCC = 5.0V
Power supply current	ICC	-	400 Note1	600	mA	at VCC = 3.3V
		-	300 Note1	500	mA	at VCC = 5.0V
Logic input voltage for display signals	High	VDLH	0.7Vcc	-	Vcc	CMOS level
	Low	VDLL	0	-	0.3Vcc	
Input voltage for DPSR signal	High	VFDH	0.7Vcc	-	Vcc	
	Low	VFDL	0	-	0.3Vcc	

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

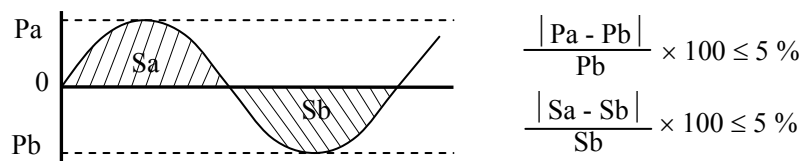
4.3.2 Backlight lamp

Parameter	Symbol	Ta	min.	typ.	max.	Unit	Remarks
Lamp starting voltage	VS	0°C	1,200	-	-	Vrms	Note1
		25°C	960	-	-	Vrms	
Lamp voltage	VBLH	25°C	-	600	-	Vrms	Note1,Note2
Lamp current	IBL	25°C	3.0	5.0	5.5	mArms	Note2, Note3
Lamp oscillation frequency	FO	25°C	58	65	69	kHz	Note4

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Note1: The power supply 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).

Note2: 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)



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

Note3: The lamp holder of this product contains two backlight lamps. The low voltage terminal of both lamps is connected to one contact point. Also above power supply current specification is one lamp duty. Therefore, this lamp holder becomes twice as many power supply current as above value. The measurement for the power supply current value of one lamp should measure to use between low voltage terminal (Cold terminal) and high voltage terminal (Hot terminal) to each lamp.

Note4: 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 synchronous cycle (See "4.9.4 Timing characteristics".)

n: Natural number (1, 2, 3)

Note5: 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	3.3 V	≤ 100		mVp-p
	5.0 V	≤ 100		mVp-p

Note1: The permissible ripple voltage includes spike noise.

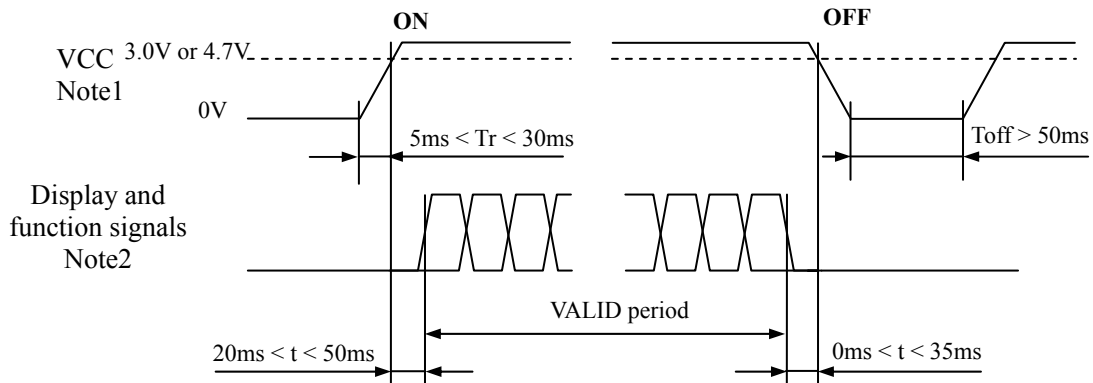
4.3.4 Fuse

Fusing line	Fuse		Rating	Fusing current Note1
	Type	Supplier		
VCC	KAB2402162NA31	Matsuo Electric Co., Ltd.	1.6 A	3.2 A
			24 V	

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

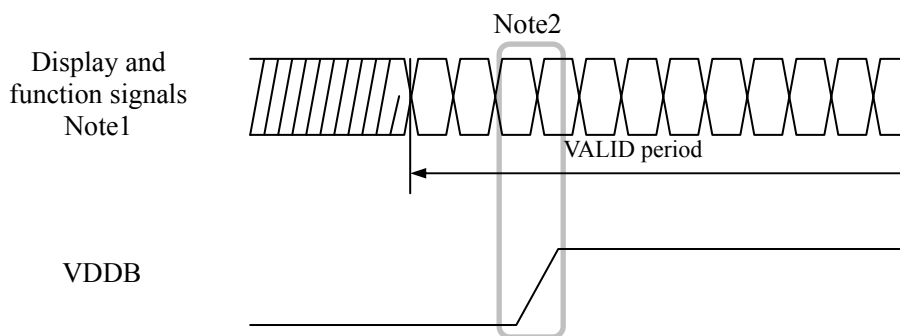


Note1: In terms of voltage variation (voltage drop) while VCC rising edge is below 3.0V in "VCC = 3.3V" or 4.7V in "VCC = 5.0V", a protection circuit may work, and then this product may not work.

Note2: Display signal (CLK, Hsync, Vsync, DE, R0 to R5, G0 to G5, B0 to B5) and function signal (DPSR) 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 Backlight inverter (Option)



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

Note2: The backlight inverter voltage (VDDB) should be inputted 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): DF9-41P-1V (2*) (Hirose Electric Co., Ltd. (HRS)) ☆

Adaptable plug: DF9-41S-1V (2*) (Hirose Electric Co., Ltd. (HRS))

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

Note1: See "4.8 SCANNING DIRECTIONS".

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4.5.2 Backlight lamp

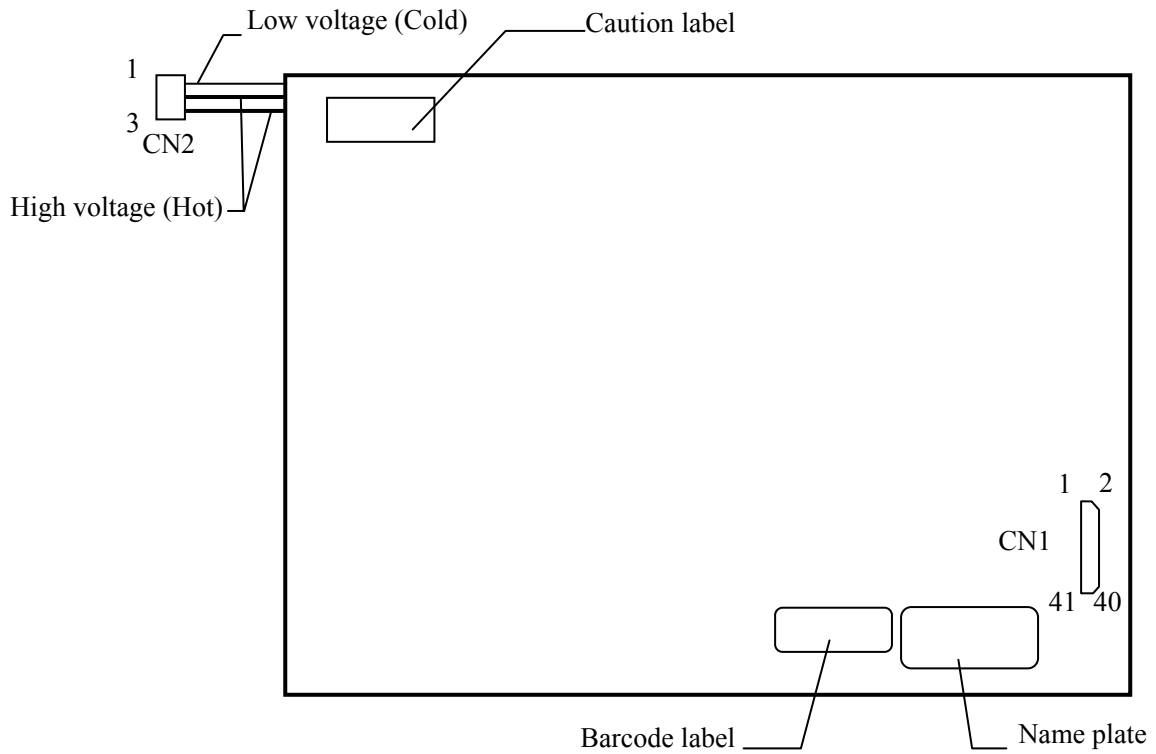


Attention: VBLH and VBLC must be connected correctly. If customer connects wrongly, customer will be hurt and the module will be broken.

CN2 plug: BHR-03VS-1 (J.S.T Mfg. Co., Ltd.)
 Adaptable socket: SM03 (4.0) B-BHS-TB (J.S.T Mfg. Co., Ltd.)

Pin No.	Symbol	Signal	Remarks
1	VBLC	Low voltage (Cold)	Cable color: White
2	VBLH	High voltage (Hot)	Cable color: Pink
3	VBLH	High voltage (Hot)	Cable color: Pink

4.5.3 Positions of a plug and a socket



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	1	0	0	0	0	0	0	0	0
	dark	0	0	0	0	0	0	0	0	0	1	0	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)	C(1, 0)	...	C(X, 0)	...	C(798, 0)	C(799, 0)
C(0, 1)	C(1, 1)	...	C(X, 1)	...	C(798, 1)	C(799, 1)
•	•	•	•	•	•	•
•	•	•••	•	•••	•	•••
•	•	•	•	•	•	•
C(0, Y)	C(1, Y)	...	C(X, Y)	...	C(798, Y)	C(799, Y)
•	•	•	•	•	•	•
•	•	•••	•	•••	•	•
•	•	•	•	•	•	•
C(0,598)	C(1,598)	...	C(X,598)	...	C(798,598)	C(799,598)
C(0,599)	C(1,599)	...	C(X,599)	...	C(798,599)	C(799,599)

4.8 SCANNING DIRECTIONS

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

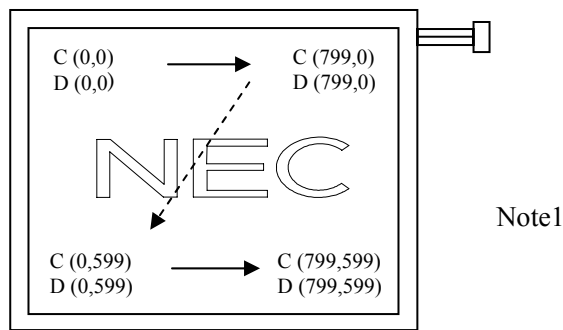


Figure1. Normal scan (DPSR: Low or Open)

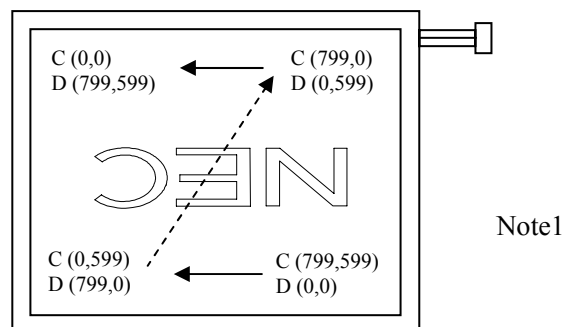


Figure2. Reverse scan (DPSR: High)

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

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

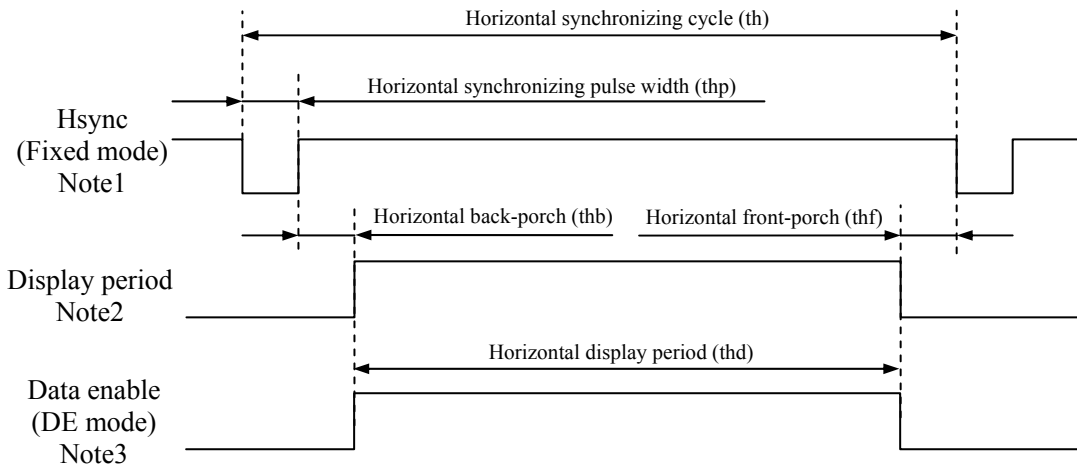
D (X, Y): The data number of input signal for LCD panel signal processing board

4.9 INPUT SIGNAL TIMINGS

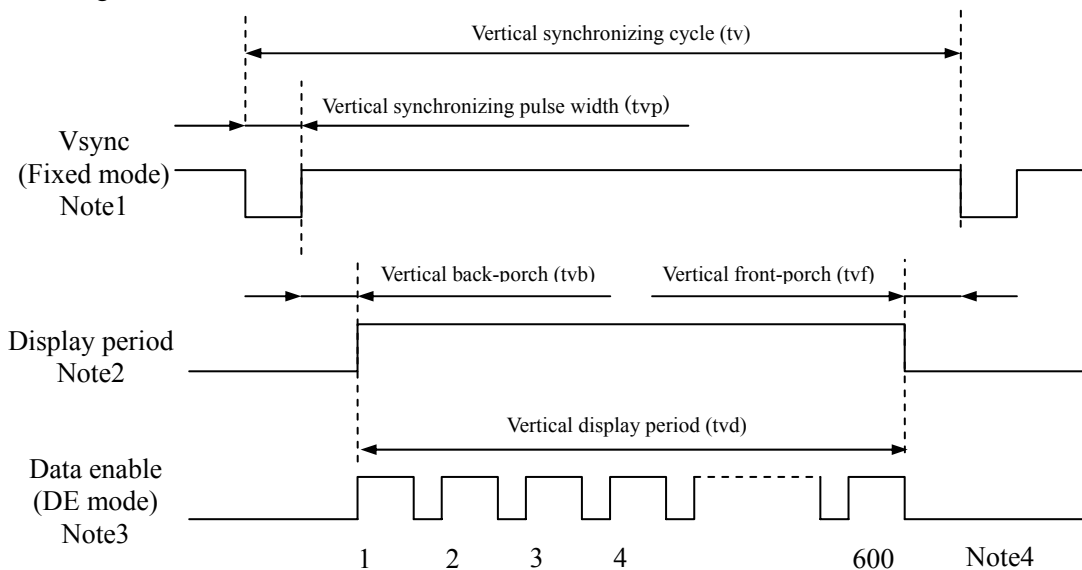


4.9.1 Outline of input signal timings

- Horizontal signal



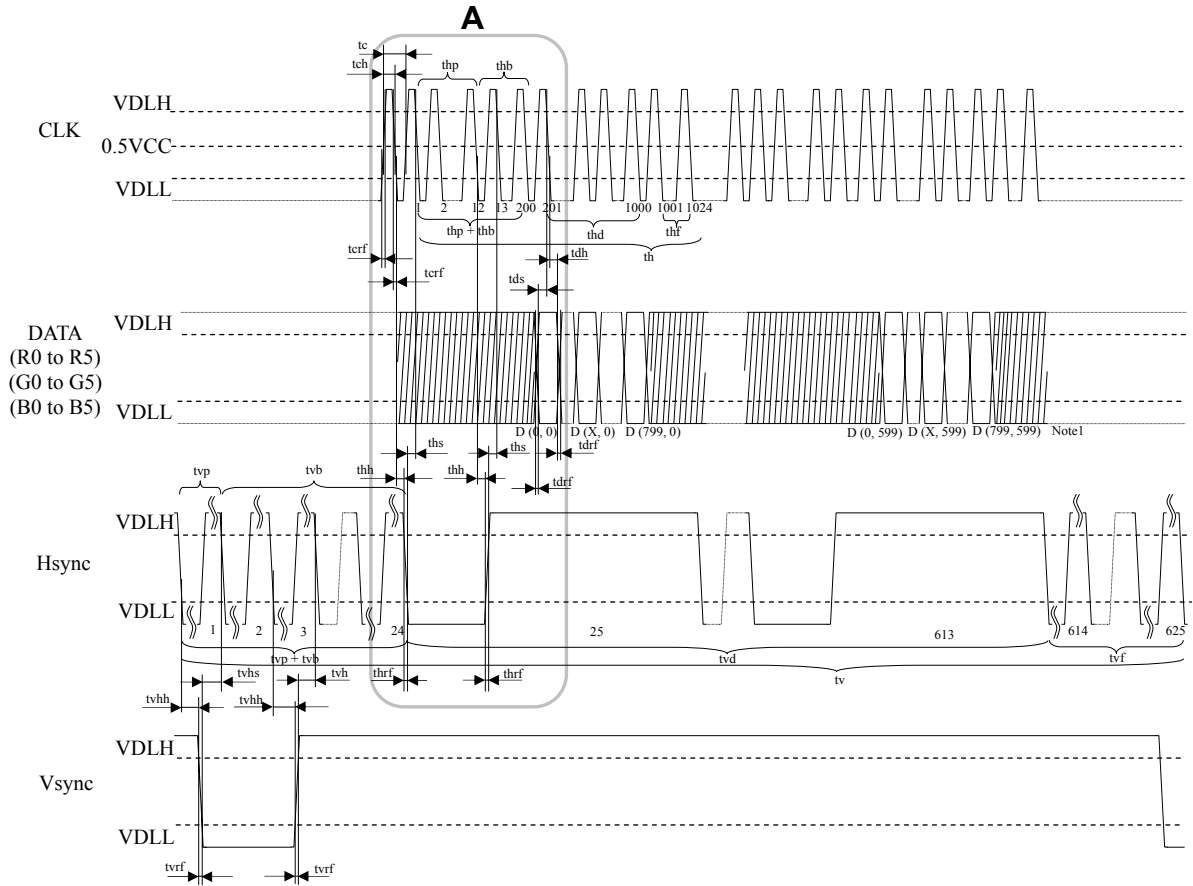
- Vertical signal



- Note1: Fixed mode cannot be used while working of DE mode.
- Note2: This diagram indicates virtual signal for set up to timing.
- Note3: Customer should be inputted synchronized signals (Hsync, Vsync) in addition to DE signal to this product, when it is worked in DE mode. Synchronized signals are used for DE/Fixed mode detection.
- Note4: See "4.9.2 Detailed input signal timing chart for fixed mode" and "4.9.3 Detailed input signal timing chart for DE mode" for numeration of pulse.

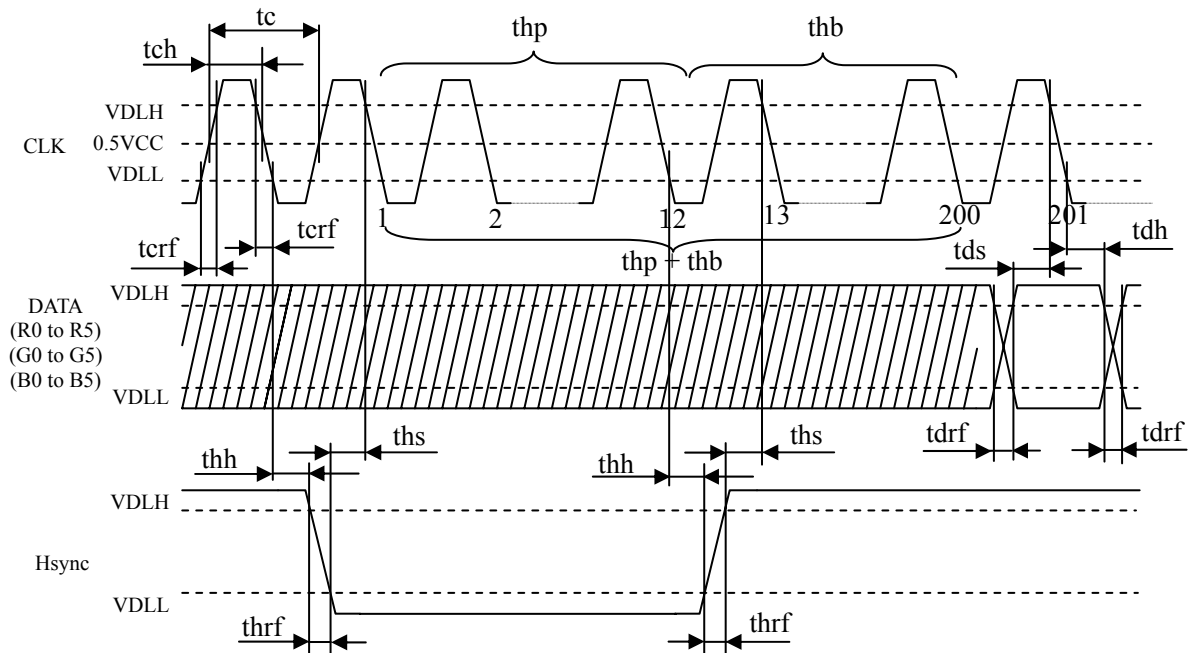
4.9.2 Detailed input signal timing chart for fixed mode

- Outline chart



Note1: X is data number from 1 to 798. See "4.8 SCANNING DIRECTIONS".

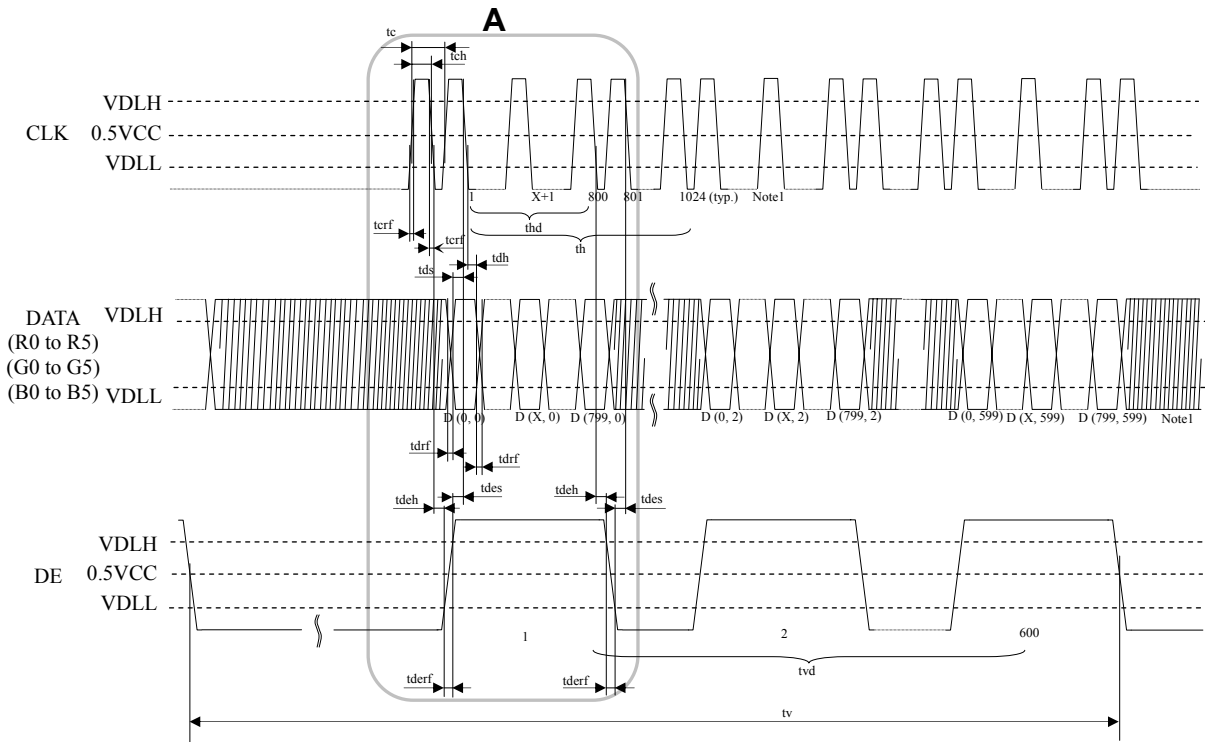
- Detail of A part



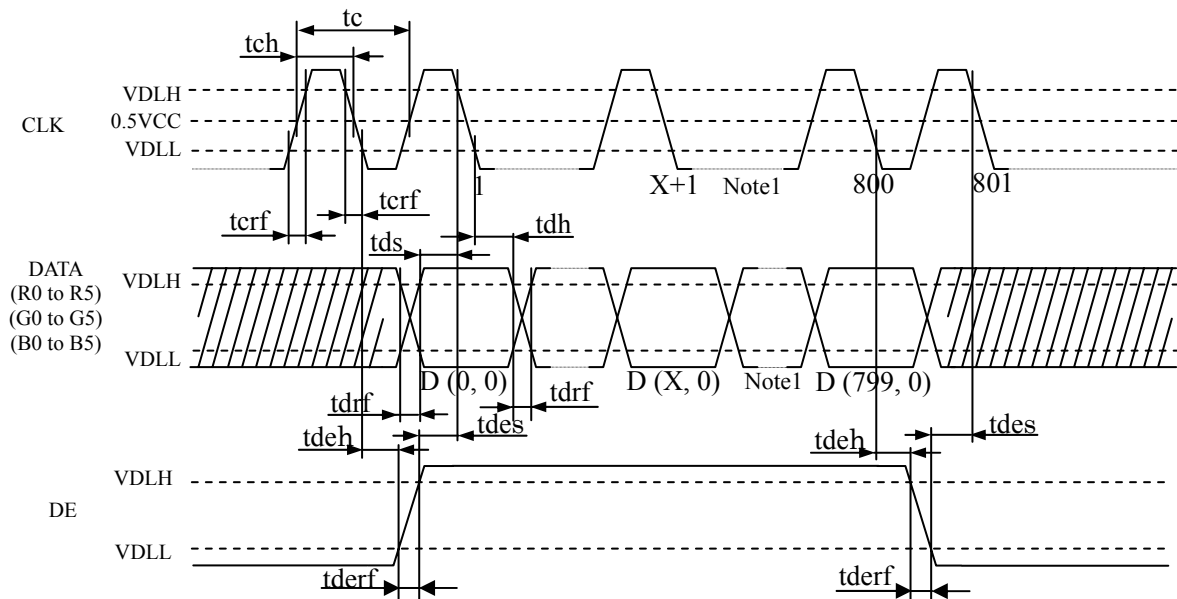
4.9.3 Detailed input signal timing chart for DE mode

Customer should be inputted synchronized signals (See "4.9.2 Detailed input signal timing chart for fixed mode".) in addition to DE signal to this product, when it is worked in DE mode. Synchronized signals are used for DE/Fixed mode detection.

- Outline chart



- Detail of A part



Note1: X is data number from 1 to 798. See "4.8 SCANNING DIRECTIONS".

4.9.4 Timing characteristics

- Common to fixed mode and DE mode

Parameter		Symbol	min.	typ.	max.	Unit	Remarks
CLK	Frequency	tcf	34.0	38.4	40.0	MHz	26.1 ns (typ.) Note1
	Duty	tcd	0.4	-	0.6	-	
	Rise time, Fall time		trf	-	-	10	ns
DATA	CLK-DATA	Setup time	tds	8	-	-	-
		Hold time	tdh	10	-	-	
	Rise time, Fall time		tdrf	-	-	10	

Note1: Definition of parameters is as follows.

$$tcf = 1/tc, tcd = tch/tc = tch \times tcd$$

- Fixed mode

Parameter		Symbol	min.	typ.	max.	Unit	Remarks	
Hsync	Cycle	th	24.0	26.7	30.1	μs	37.5 kHz (typ.)	
			1024			CLK		
	Display period	thd	800			CLK	Note1	
	Front-porch	thf	24			CLK		
	Pulse width	thp	12	72	-	CLK		
	Back-porch	thb	-	128	198	CLK		
	Total of pulse width and back-porch		thp + thb	200			CLK	Note1, Note2
	CLK- Hsync	Setup time	ths	8	-	-	ns	-
Hold time		thh	10	-	-	ns		
Rise time, Fall time		thrf	-	-	10	ns		
Vsync	Cycle	tv	16.0	16.7	18.8	ms	59.9 Hz (typ.)	
			625			H		
	Display period	tvd	600			H	Note1	
	Front-porch	tvf	1			H		
	Pulse width	tvp	1	-	2	H		
	Back-porch	tvb	22	-	23	H		
	Total of pulse width and back-porch		tvp + tvb	24			H	Note1, Note2
	Vsync-Hsync	Setup time	tvhs	15	-	-	ns	Note1
Hold time		tvhh	1	-	-	CLK	-	
Rise time, Fall time		tvrf	-	-	10	ns		

Note1: Definition of parameters is as follows.

$$tc = 1CLK, th = 1H$$

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.

- DE mode

Parameter		Symbol	min.	typ.	max.	Unit	Remarks	
DE Note1	Horizontal	Cycle	th	829	1024	-	CLK	Note2
		Display period	thd	800			CLK	
	Vertical (One frame)	Cycle	tv	603	625	-	H	
		Display period	tvd	600			H	
	CLK-DE	Setup time	tdes	4	-	-	ns	-
		Hold time	tdeh	5	-	-	ns	
Rise time, Fall time		tderf	-	-	10	ns		

Note1: Customer should be inputted synchronized signals (See fixed mode in "4.9.4 Timing characteristics".) in addition to DE signal to this product, when it is worked in DE mode. Synchronized signals are used for DE/Fixed mode detection.

Note2: Definition of parameters is as follows.

$$tc = 1CLK, th = 1H$$

4.10 OPTICS

4.10.1 Optical characteristics

(Note1, Note2)

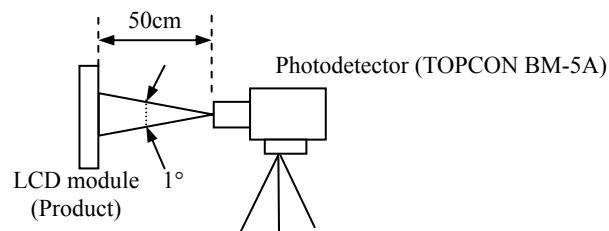
Parameter	Condition	Symbol	min.	typ.	max.	Unit	Remarks	
Contrast ratio	White/Black at center $\theta R = 0^\circ, \theta L = 0^\circ, \theta U = 0^\circ, \theta D = 0^\circ$	CR	300	400	-	-	Note3	
Luminance	White at center $\theta R = 0^\circ, \theta L = 0^\circ, \theta U = 0^\circ, \theta D = 0^\circ$	L	200	250	-	cd/m ²	-	
Luminance uniformity	White $\theta R = 0^\circ, \theta L = 0^\circ, \theta U = 0^\circ, \theta D = 0^\circ$	LU	-	1.25	1.40	-	Note4	
Chromaticity	White	x coordinate	Wx	-	0.308	-	-	Note5
		y coordinate	Wy	-	0.351	-	-	
	Red	x coordinate	Rx	-	0.576	-	-	
		y coordinate	Ry	-	0.349	-	-	
	Green	x coordinate	Gx	-	0.329	-	-	
		y coordinate	Gy	-	0.539	-	-	
Blue	x coordinate	Bx	-	0.162	-	-		
	y coordinate	By	-	0.172	-	-		
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	-	38	-	%		
Response time	Black to white	Ton	-	40	50	ms	Note6	
	White to black	Toff	-	40	50	ms	Note7	
Viewing angle	Right	$\theta U = 0^\circ, \theta D = 0^\circ, CR \geq 10$	θR	-	80	-	°	Note8
	Left	$\theta U = 0^\circ, \theta D = 0^\circ, CR \geq 10$	θL	-	80	-	°	
	Up	$\theta R = 0^\circ, \theta L = 0^\circ, CR \geq 10$	θU	-	80	-	°	
	Down	$\theta R = 0^\circ, \theta L = 0^\circ, CR \geq 10$	θD	-	80	-	°	

Note1: These are initial characteristics.

Note2: Measurement conditions are as follows.

Ta = 25°C, VCC = 3.3V, IBL = 5.0mArms/lamp

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 = 25°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.

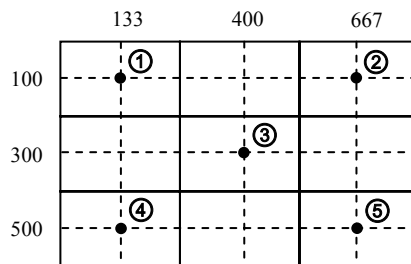
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance of white screen}}{\text{Luminance of black screen}}$$

4.10.3 Definition of luminance uniformity

The luminance uniformity is calculated by using following formula.

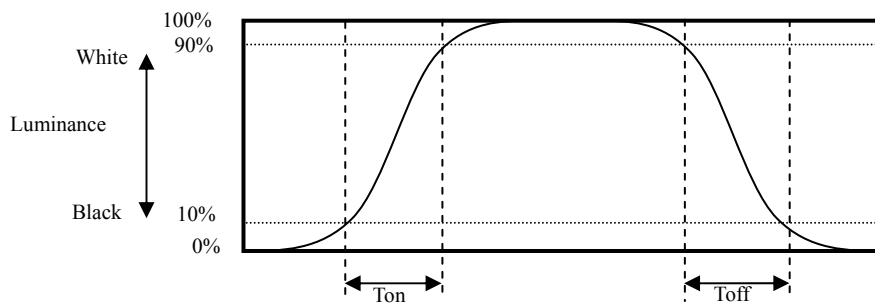
$$\text{Luminance uniformity (LU)} = \frac{\text{Maximum luminance from ① to ⑤}}{\text{Minimum luminance from ① to ⑤}}$$

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

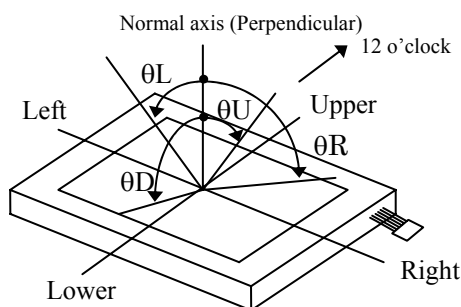


4.10.4 Definition of response times

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



4.10.5 Definition of viewing angles

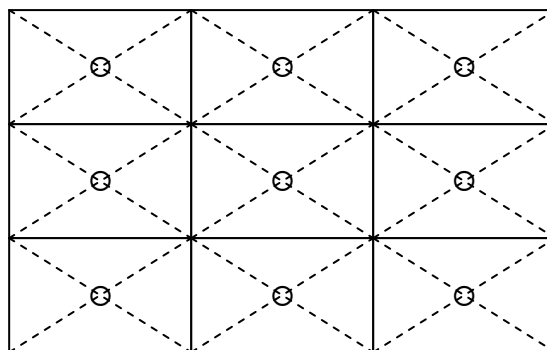


5. RELIABILITY TESTS

Test item	Condition	Judgement
High temperature and humidity (Operation)	① 60 ± 2°C, RH = 60%, 240hours ② Display data is white.	No display malfunctions Note1
Heat cycle (Operation)	① 0 ± 3°C...1hour 55 ± 3°C...1hour ② 50cycles, 4hours/cycle ③ Display data is white.	
Thermal shock (Non operation)	① -20 ± 3°C...30minutes 60 ± 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 direction ④ 120 times each directions	No display malfunctions Note1 No physical damages
Mechanical shock (Non operation)	① 539m/ s ² , 11ms ② ±X, ±Y, ±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 this 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.	☆
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	This sign has the meaning that customer will get an electrical shock, if customer has wrong operations.	☆
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	This sign has the meaning that customer will be injured by himself, if customer has wrong operations.	
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6.2 CAUTIONS

	* Do not touch the working backlight. Customer will be in danger of an electric shock.	☆
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	<p>* Do not touch the working backlight. Customer will be in danger of burn injury.</p> <p>* 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)</p>	☆
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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 flexible 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 deals with the product, because products may be damaged by electrostatic.
- ⑤ The torque for mounting screws must never exceed 0.294N-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, leak high frequency current to the metal part may occur, then the brightness may decrease or the lamp may not light. ☆

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. ☆
- ⑤ Use an original protection sheet on the product surface (polarizer). Adhesive type protection sheet should be avoided, because it may change color or properties of the polarizer.

6.3.3 Characteristics

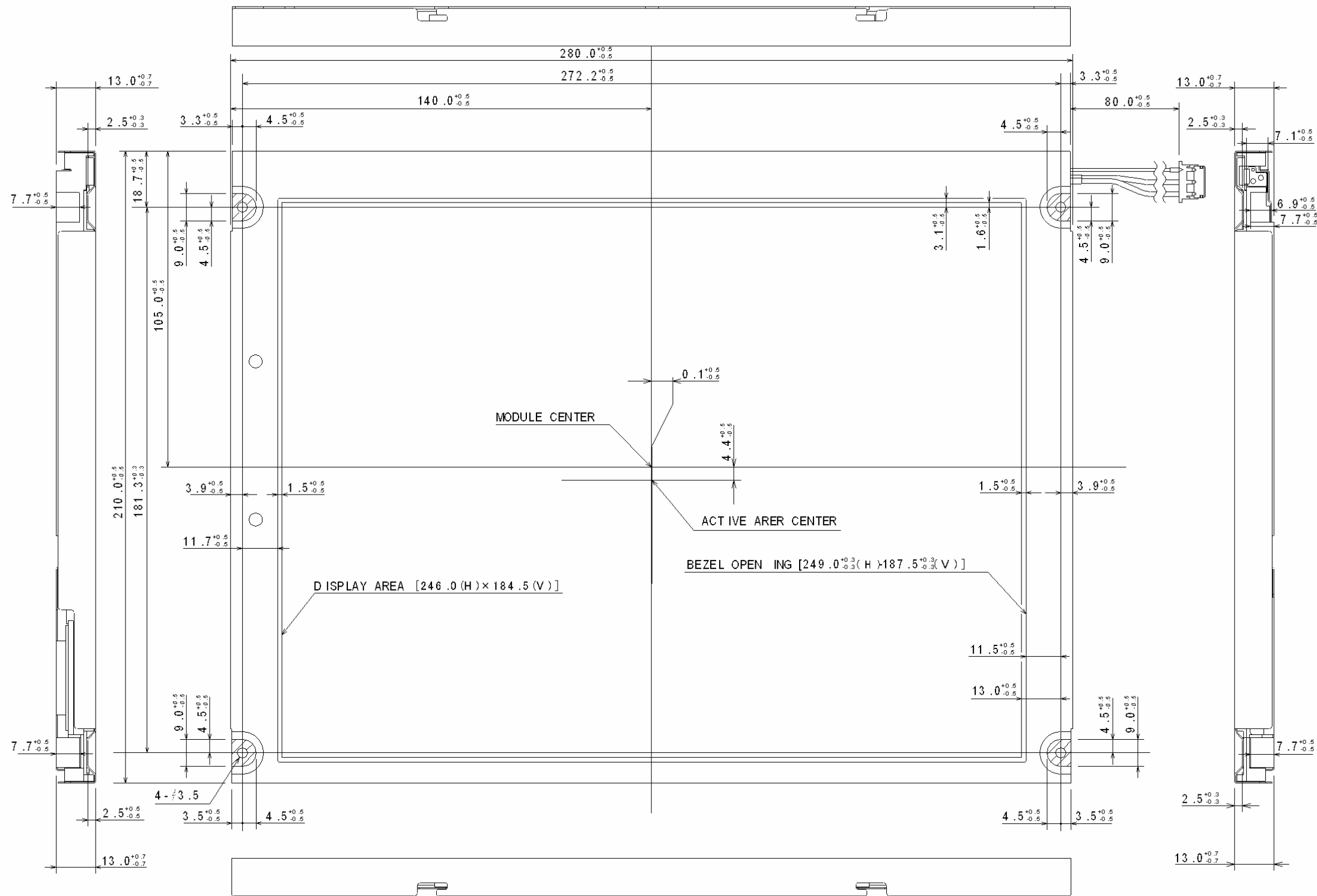
The following items are neither defects nor failures.

- 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 unit.
- 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 backlight inverter may appear on a display. Set up luminance control frequency of backlight inverter so that the interference noise does not appear.

6.3.4 Other

- ① All GND, backlight inverter ground (GNDB), VCC and backlight inverter power supply voltage (VDDB) terminals should be used without a non-connected line.
- ② Do not disassemble a product or adjust variable resistors without permission of NEC.
- ③ See "REPLACEMENT MANUAL FOR LAMPHOLDER", if customer would like to replace backlight lamps.
- ④ Pay attention not to insert waste materials inside of products, if customer uses screwnails.
- 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. ☆

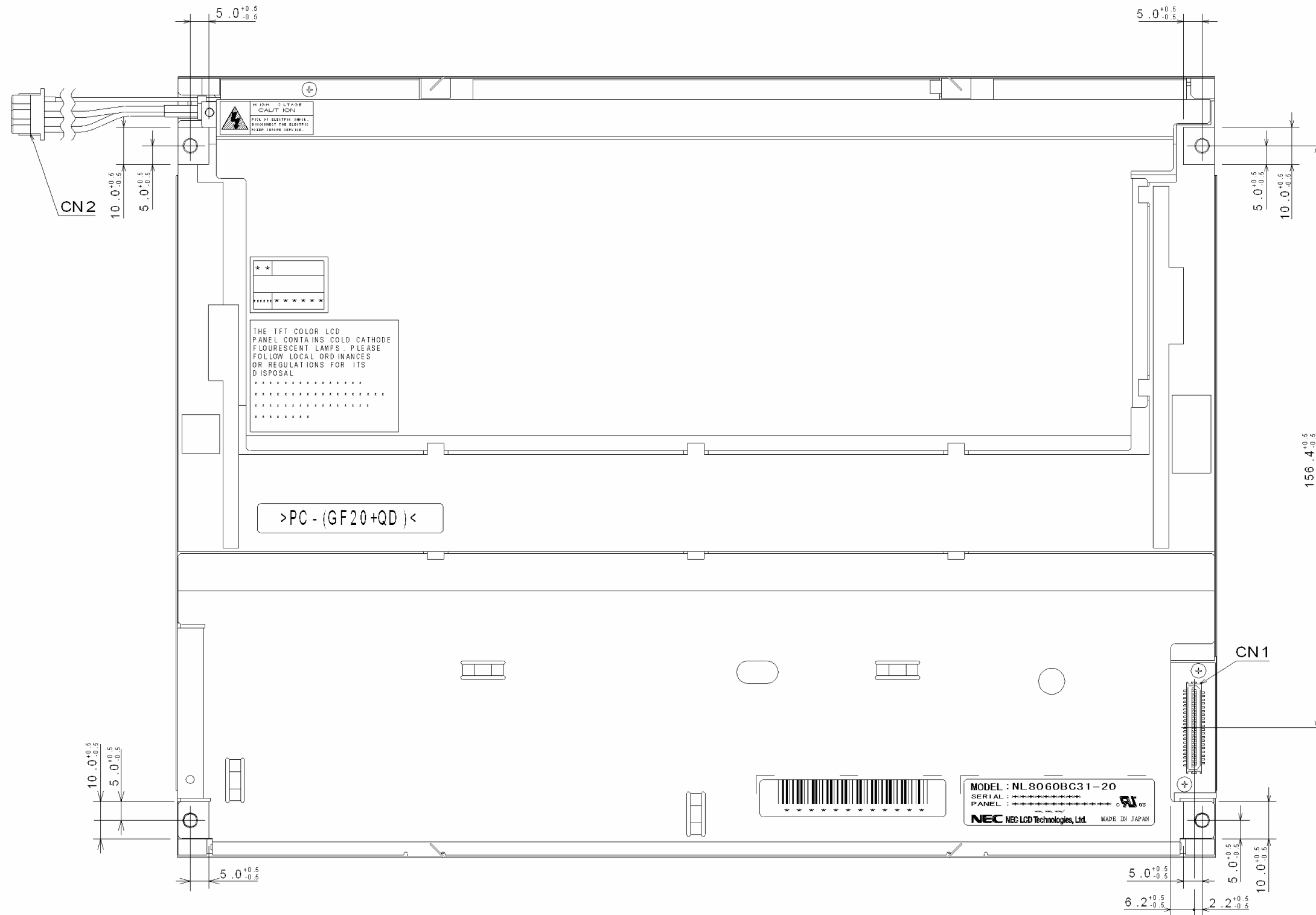
7. OUTLINE DRAWINGS
7.1 FRONT VIEW



Note1: The torque for mounting screws must never exceed 0.294N·m.
Note2: Mounting hole portions (4 pieces)

Unit: mm

7.2 REAR VIEW



Unit: mm

Note1: The torque for mounting screws must never exceed 0.294N-m.