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www.smarterglass.com
978 997 4104
sales@smarterglass.com



TFT COLOR LCD MODULE

NL8060BC31-20

30.8cm (12.1 Type)

SVGA

DATA SHEET 

(4th edition)

All information is subject to change without notice.

INTRODUCTION

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Anti-radioactive design is not implemented in this product.

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1. OUTLINE

1.1 STRUCTURE AND PRINCIPLE

NL8060BC31-20 module 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 unit.

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

- Display terminal for control system

1.3 FEATURES

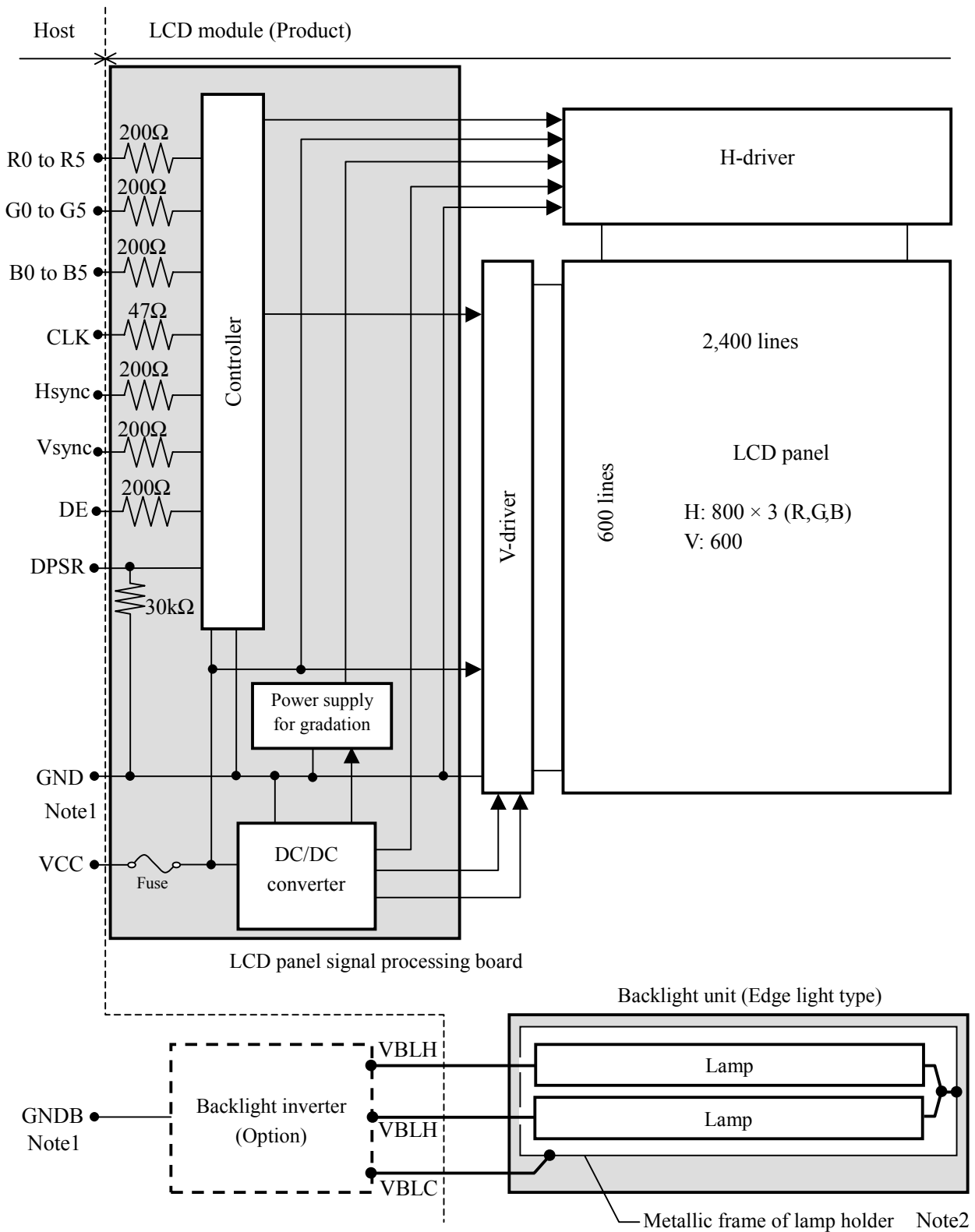
- High luminance
- Wide viewing angle
- High contrast
- 6-bit digital RGB signals
- Reversible-scan direction
- Edge light type
- Replaceable lamp for backlight unit (Inverter less)
- Acquisition product for UL/c-UL (File number: E170632)

2. GENERAL SPECIFICATIONS

<i>Display area</i>	246.0 (W) × 184.5 (H) mm (typ.)
<i>Diagonal size of display</i>	30.8 cm (12.1 inches)
<i>Drive system</i>	a-Si TFT active matrix
<i>Display color</i>	262,144 colors
<i>Pixel</i>	800 (H) × 600 (V) pixels
<i>Pixel arrangement</i>	RGB (Red dot, Green dot, Blue dot) vertical stripe
<i>Dot pitch</i>	0.1025 (W) × 0.3075 (H) mm
<i>Pixel pitch</i>	0.3075 (W) × 0.3075 (H) mm
<i>Module size</i>	280.0 (W) × 210.0 (H) × 13.0 (D) mm (typ.)
<i>Weight</i>	760 g (typ.)
<i>Contrast ratio</i>	400:1 (typ.)
<i>Viewing angle</i>	At the contrast ratio 10:1 <ul style="list-style-type: none"> • Horizontal: Left side 80° (typ.), Right side 80° (typ.) • Vertical: Up side 80° (typ.), Down side 80° (typ.)
<i>Designed viewing direction</i>	<ul style="list-style-type: none"> • Viewing angle with optimum grayscale (γ=2.2): normal axis
<i>Polarizer surface</i>	Non matt treatment
<i>Polarizer pencil-hardness</i>	3H (min.) [by JIS K5400]
<i>Color gamut</i>	At LCD panel center 38 % (typ.) [against NTSC color space]
<i>Response time</i>	40 ms (typ.)
<i>Luminance</i>	At 5.0mArms / lamp 250 cd/m ² (typ.)
<i>Signal system</i>	6-bit digital signals for data of RGB colors, Dot clock (CLK), Data enable (DE), Horizontal synchronous signal (Hsync), Vertical synchronous signal (Vsync)
<i>Power supply voltage</i>	LCD panel signal processing board: 3.3V or 5.0V
<i>Backlight</i>	Edge light type: 2 cold cathode fluorescent lamps (Replaceable parts • Lamps for backlight unit: Type No. 121LHS16) (Recommended inverter (Option) • Inverter: Type No. 121PW111)
<i>Power consumption</i>	At maximum luminance and checkered flag pattern 7.0 W (typ.)

3. BLOCK DIAGRAM

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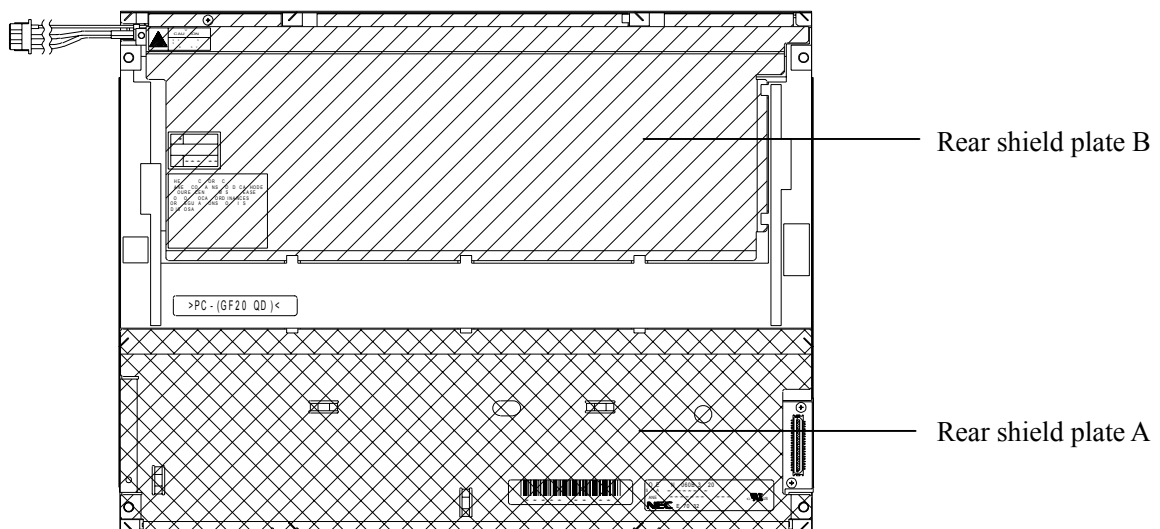
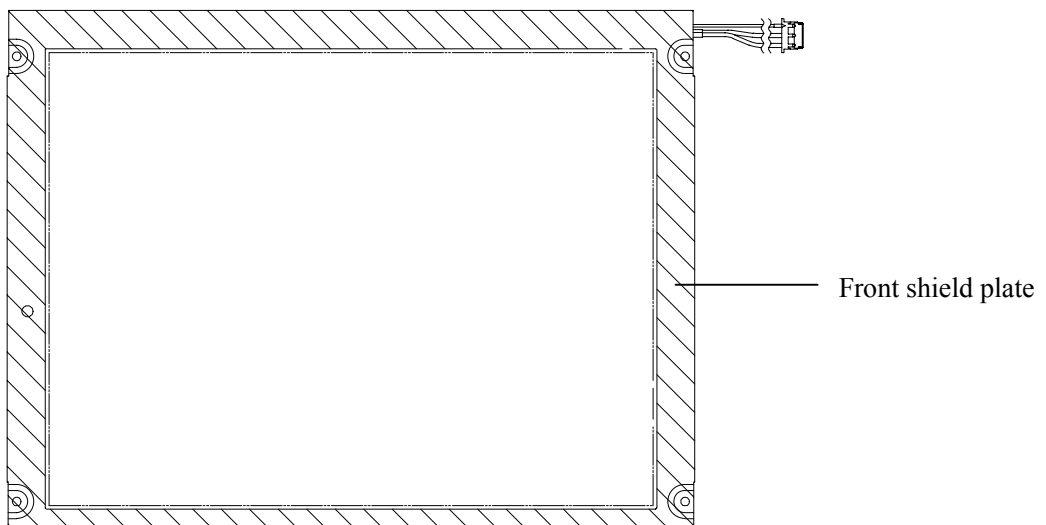


Note1: GND and GNDB (Backlight inverter ground) should be connected together in customer equipment.
 Note2: The metallic frame of lamp holder is connected to VBLC (Lamp low voltage terminal).

Note3: Connections between GND, shield plate and VBLC in the LCD module

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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



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 ± 0.5 (W) × 184.5 ± 0.5 (H) 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 board		VCC	-0.3 to +6.5	V	Ta = 25°C
	Lamp	High voltage side (Hot) Note1	VBLH	2,000	Vrms	
		Low voltage side (Cold) Note2	VBLC	42.4	Vrms	
Input voltage for signals	Display signals Note3		VD	-0.3 to VCC+0.3	V	
	Function signals Note4		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 Note5			RH	≤ 95	%	Ta ≤ 40°C
				≤ 85	%	40 < Ta ≤ 50°C
				≤ 70	%	50 < Ta ≤ 55°C
Absolute humidity Note5			AH	≤ 78 Note6	g/m ³	Ta > 55°C

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

Note2: "VBLC" is the voltage value between backlight inverter ground (GNDB) and low voltage terminal (Cold).

Note3: Display signals are CLK, Hsync, Vsync, DE and DATA (R0 to R5, G0 to G5, B0 to B5).

Note4: Function signal is DPSR.

Note5: No condensation

Note6: Ta = 55°C, RH = 70%

4.3 ELECTRICAL CHARACTERISTICS

4.3.1 Driving for 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	for 3V system
		4.7	5.0	5.3	V	for 5V system
Power supply current	ICC	-	400 Note1	600	mA	VCC = 3.3V
		-	300 Note1	500	mA	VCC = 5.0V
Logic input voltage for display signals	Low	VDLL	0	-	0.3Vcc	CMOS level
	High	VDLH	0.7Vcc	-	Vcc	
Input voltage for DPSR signal	Low	VFDL	0	-	0.3Vcc	
	High	VFDH	0.7Vcc	-	Vcc	

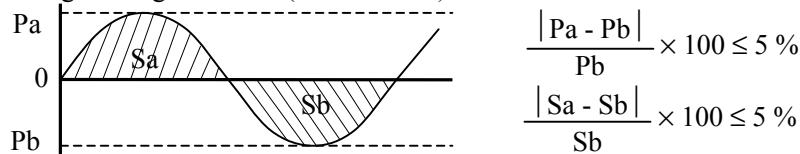
Note1: Checkered flag pattern [by EIAJ ED-2522]

4.3.2 Working for backlight lamp

Parameter	Symbol	Ta	Min.	Typ.	Max.	Unit	Remarks
Starting voltage	VS	0°C	1,200	-	-	Vrms	Note1
		25°C	960	-	-	Vrms	
Power supply voltage	VBLH	25°C	-	600	-	Vrms	Note1, Note2
Power supply current	IBL	25°C	3.0	5.0	6.0	mArms	Note2, Note3
Oscillation frequency	FO	25°C	58	65	69	kHz	Note4

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)

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.

Parameter	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.

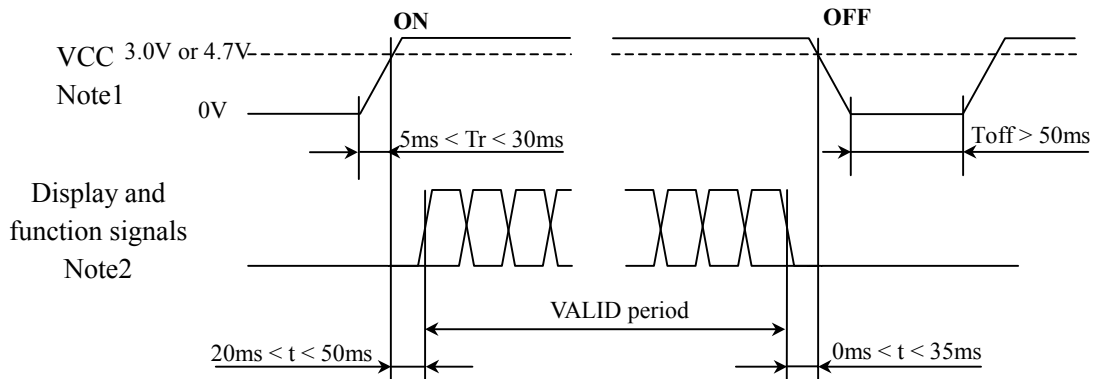
4.3.4 Fuse

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 Sequence for LCD panel signal processing board

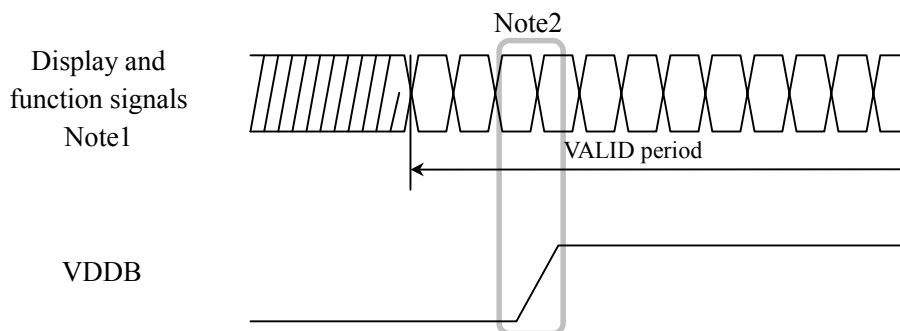


Note1: In terms of voltage variation (voltage drop) while VCC rising edge is below 3.0V in "VCC = 3.3V" or 4.7V in "VCC = 5.0V", a protection circuit may work, and then this product may not work.

Note2: Display (CLK, Hsync, Vsync, DE, R0 to R5, G0 to G5, B0 to B5) and function (DPSR) signals 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 Sequence for backlight inverter (Option)



Note1: These are 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

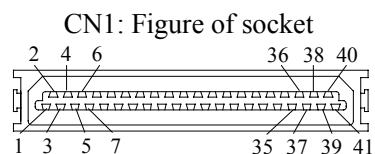
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CN1 socket (LCD module side): DF9-41P-1V (Hirose Electric Co., Ltd.)

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

Pin No.	Symbol	Signal	Remarks
1	GND	Ground	
2	CLK	Dot clock	
3	GND	Ground	
4	Hsync	Horizontal synchronous	
5	Vsync	Vertical synchronous	-
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 data
36	GND	Ground	-
37	DE	Select of DE / Fixed mode	DE mode: Data enable signal, Fixed mode: Open
38	NC	Non connection	
39	VCC	Power supply	-
40	VCC	Power supply	
41	DPSR	Select of scan direction	Normal scan: Low or Open, Reverse scan: High Note1

Note1: See "4.8 SCANNING DIRECTIONS".



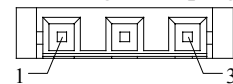
4.5.2 Backlight lamp

CN2 plug: BHR-03VS-1 (J.S.T Mfg. Co., Ltd.)

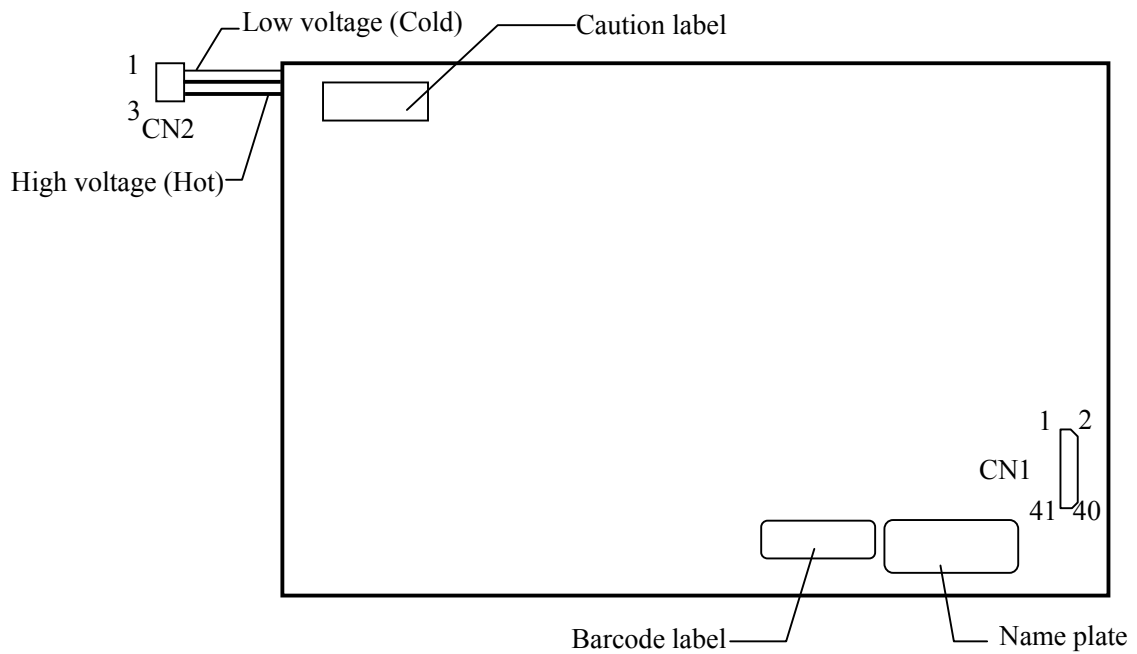
Adaptable socket: SM03 (4.0) B-BHS-TB (J.S.T Mfg. Co., Ltd.)

Pin No.	Symbol	Signal	Remarks
1	VBLC	Low voltage (Cold)	-
2	VBLH	High voltage (Hot)	
3	VBLH	High voltage (Hot)	

CN2: Figure of plug



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 scale. 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)																	
		R 5	R 4	R 3	R 2	R 1	R 0	G 5	G 4	G 3	G 2	G 1	G 0	B 5	B 4	B 3	B 2	B 1	B 0
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	1	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	1	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 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	
	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	
Green 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	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	
	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	
Blue 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	1	1	1	1	0	1	1
	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	
	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	

4.7 DISPLAY POSITIONS

The following table is the coordinates per pixel (See figure of "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.

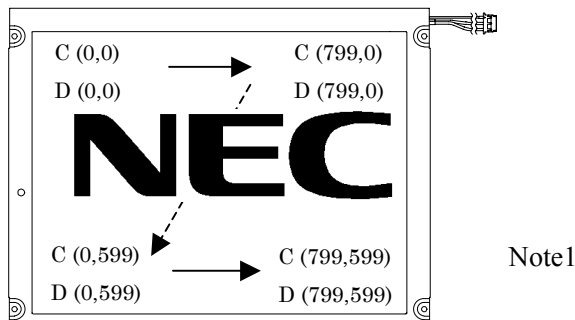


Figure 1. Normal scan (DPSR: Low or Open)

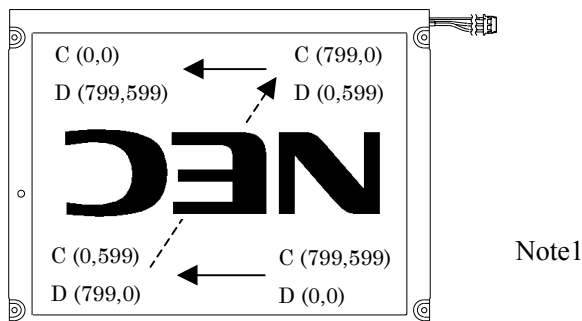


Figure 2. Reverse scan (DPSR: High)

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

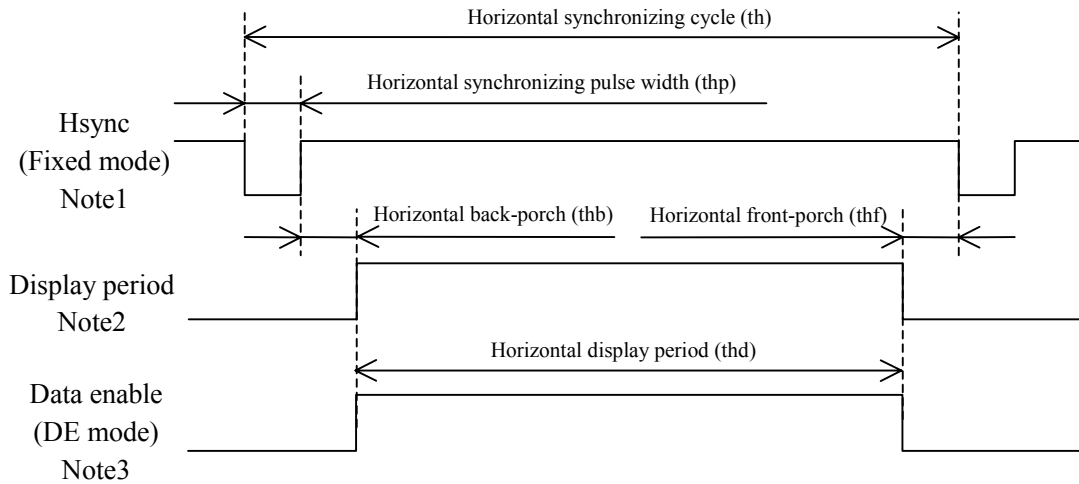
C (X, Y): The coordinates of the display position (See "4.7 DISPLAY POSITIONS".)

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

4.9 INPUT SIGNAL TIMINGS FOR LCD PANEL SIGNAL PROCESSING BOARD

4.9.1 Outline of input signal timings

• Horizontal signal

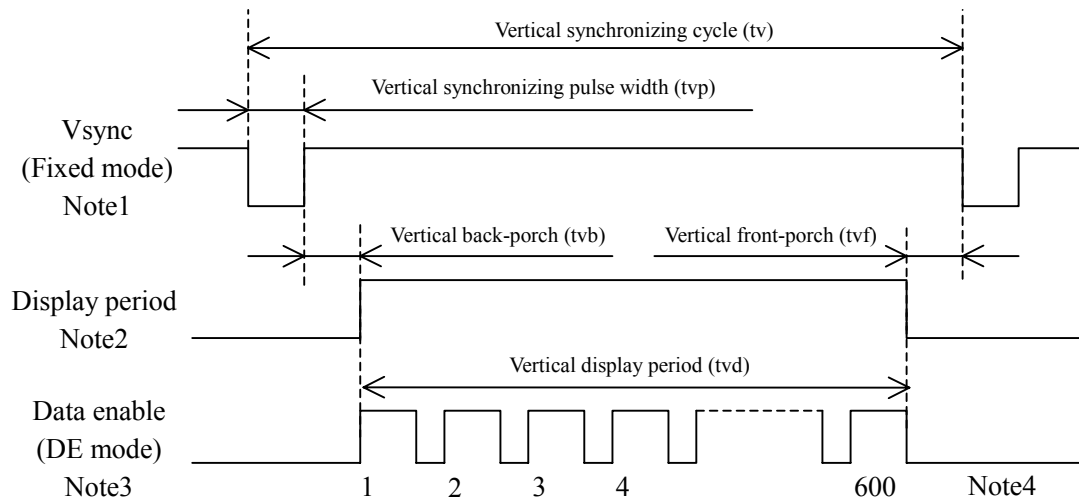


Note1: Fixed mode cannot be used while working of DE mode.

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.

• Vertical signal



Note1: Fixed mode cannot be used while working of DE mode.

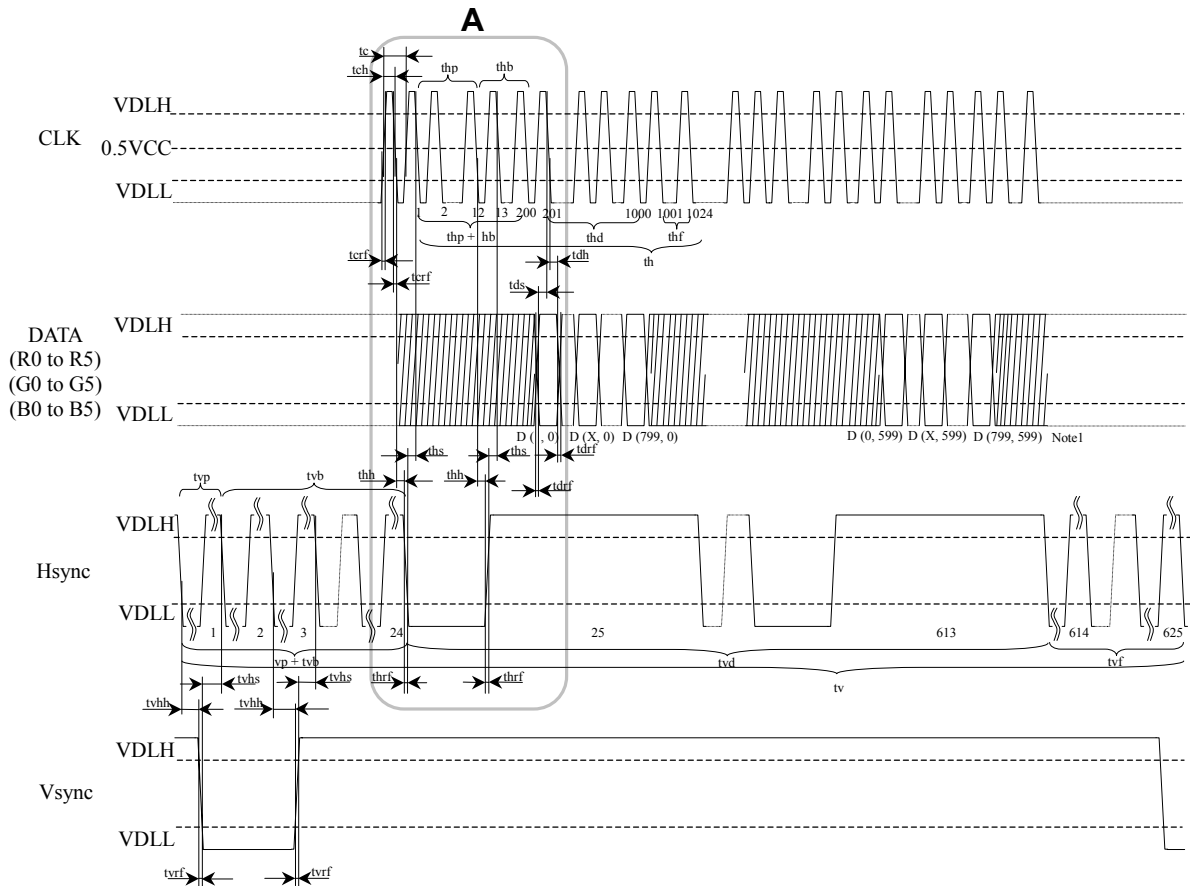
Note2: This diagram indicates virtual signal for set up to timing.

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.

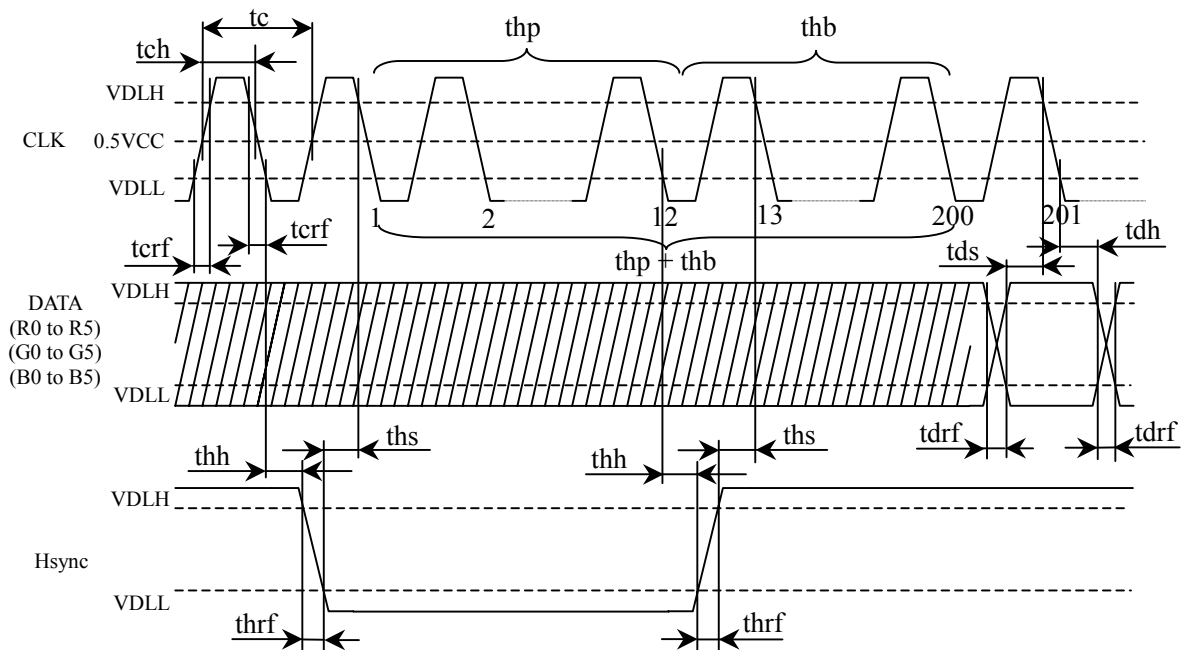
4.9.2 Detailed input signal timing chart for fixed mode

• Outline chart



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

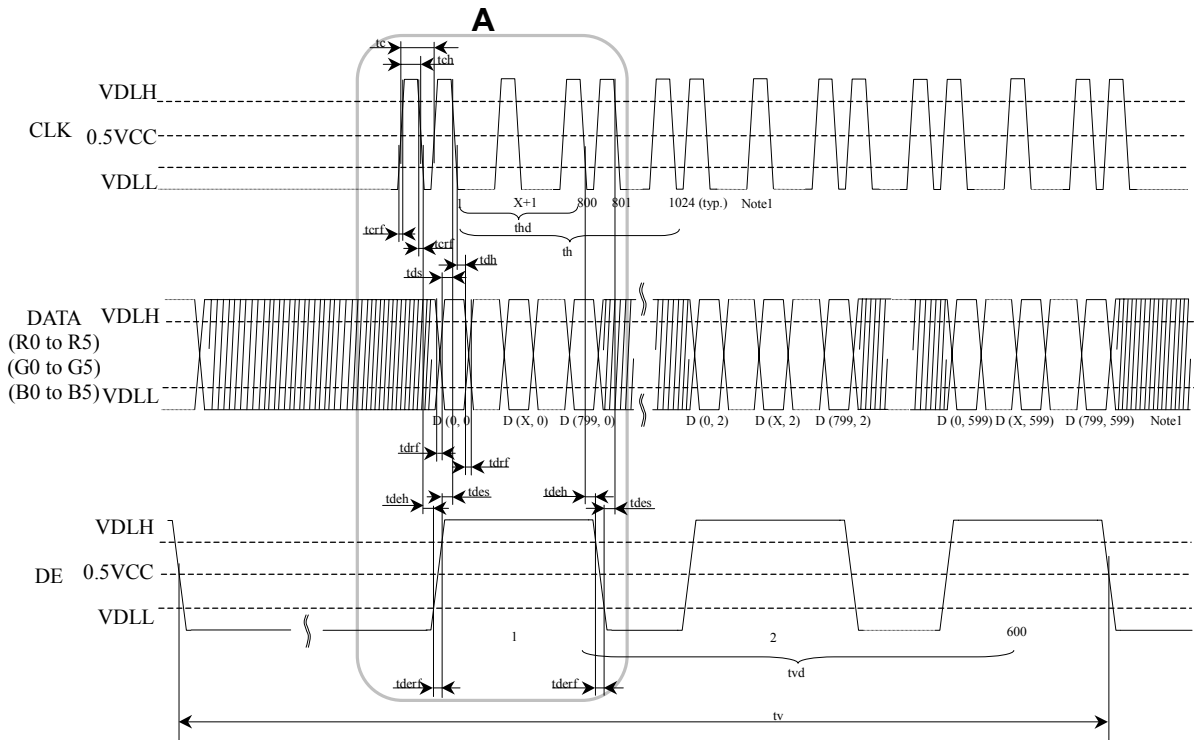
• Detail of A part



4.9.3 Detailed input signal timing chart for DE mode

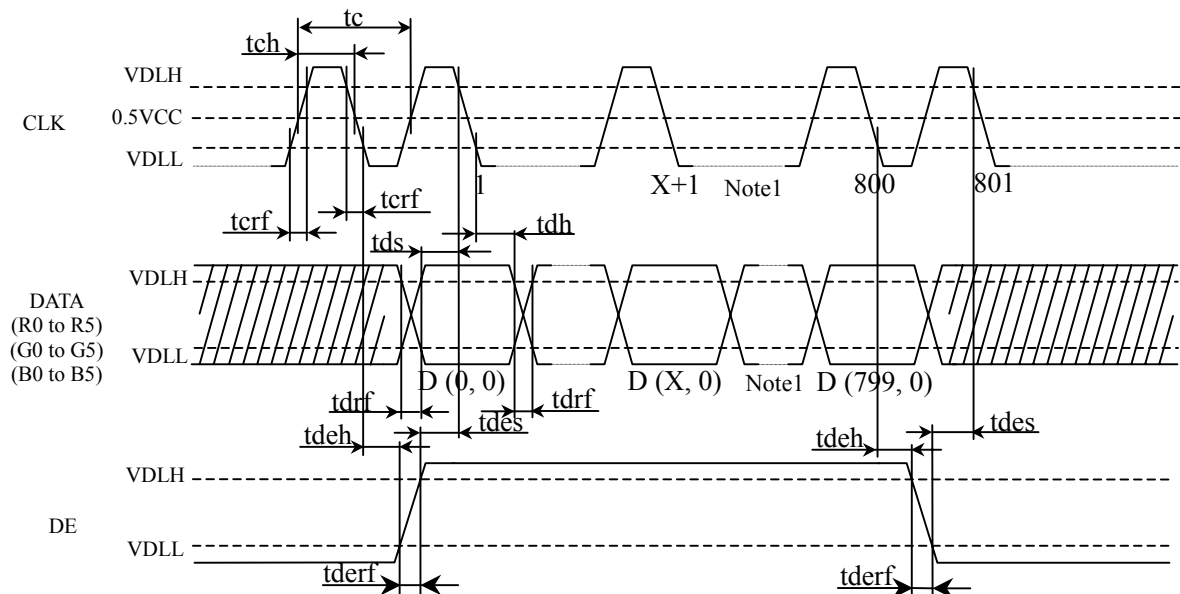
Customer should be inputted synchronized signals (See "4.9.2 Detailed input signal timing chart for fixed mode".) in addition to DE signal to this product, when it is worked in DE mode. Synchronized signals are used for DE/Fixed mode detection.

• Outline chart



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

• 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	-	Note1	
	Rise time, Fall time	terf	-	-	10	ns	-	
DATA	CLK-DATA	Setup time	tds	8	-	-		ns
		Hold time	tdh	10	-	-		ns
Rise time, Fall time		tdrf	-	-	10	ns		

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	20.7	26.7	30.1	μs	37.5 kHz (typ.)		
			1024			CLK	Note1		
	Display period	thd	800			CLK			
	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	Note1		
	Display period	tvd	600			H			
	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

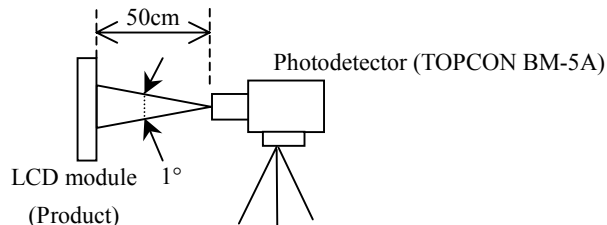
4.10.1 Optical characteristics

Parameter	Note1	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	-	-	Note2
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		-	LU	-	1.25	1.40	-	Note3
Chromaticity	White	x coordinate	Wx	-	0.308	-	-	Note4
		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	Note5 Note6
		White to black	Toff	-	40	50	ms	
Viewing angle	Right	$\theta U = 0^\circ, \theta D = 0^\circ, CR = 10$	θR	-	80	-	°	Note7
	Left	$\theta U = 0^\circ, \theta D = 0^\circ, CR = 10$	θL	-	80	-	°	
	Up	$\theta R = 0^\circ, \theta L = 0^\circ, CR = 10$	θU	-	80	-	°	
	Down	$\theta R = 0^\circ, \theta L = 0^\circ, CR = 10$	θD	-	80	-	°	

Note1: 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.



Note2: See "4.10.2 Definition of contrast ratio".

Note3: See "4.10.3 Definition of luminance uniformity".

Note4: These coordinates are found on CIE 1931 chromaticity diagram.

Note5: Product surface temperature: TopF = 25°C

Note6: See "4.10.4 Definition of response times".

Note7: 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.

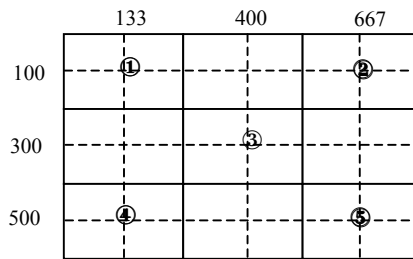
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance of white screen}}{\text{Luminance of black screen}}$$

4.10.3 Definition of luminance uniformity

The luminance uniformity is calculated by using following formula.

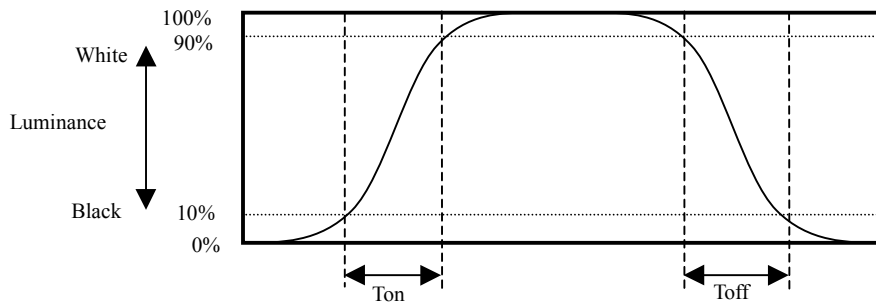
$$\text{Luminance uniformity (LU)} = \frac{\text{Maximum luminance from ① to ⑤}}{\text{Minimum luminance from ① to ⑤}}$$

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

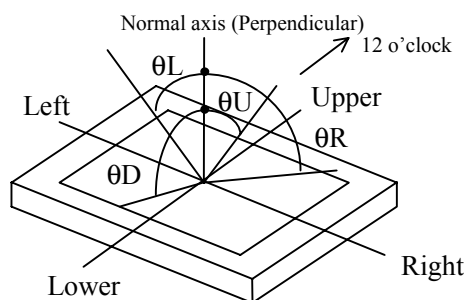


4.10.4 Definition of response times

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

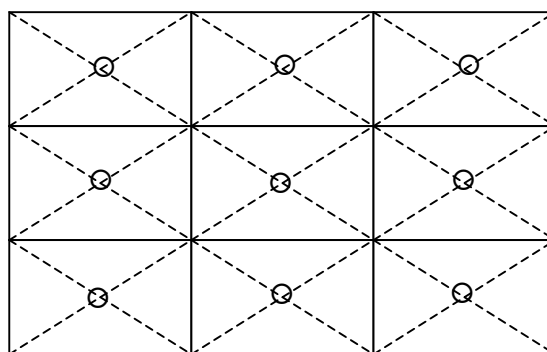


5. RELIABILITY TESTS

Test item	Condition	Judgement
High temperature and humidity (Operation)	① $60 \pm 2^{\circ}\text{C}$, RH = 60%, 240hours ② Display data is white.	No display malfunctions Note1
Heat cycle (Operation)	① $0 \pm 3^{\circ}\text{C}$...1hour $55 \pm 3^{\circ}\text{C}$...1hour ② 50cycles, 4hours/cycle ③ Display data is white.	
Thermal shock (Non operation)	① $-20 \pm 3^{\circ}\text{C}$...30minutes $60 \pm 3^{\circ}\text{C}$...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 10 times each directions	No display malfunctions Note1 No physical damages
Mechanical shock (Non operation)	① 539m/s^2 , 11ms ② $\pm X$, $\pm Y$, $\pm Z$ direction ③ 3 times each directions	

Note1: Display functions are checked under the same conditions as product inspection.

Note2: See the following figure for discharge points.



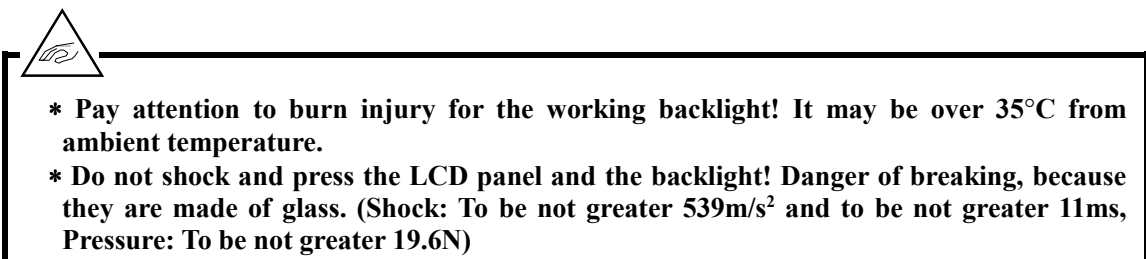
6. PRECAUTIONS

6.1 MEANING OF CAUTION SIGNS

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



6.2 CAUTIONS



6.3 ATTENTIONS

6.3.1 Handling of the product

- ① Take hold of both ends without touch the circuit board 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 0.29N·m. Higher torque values might result in distortion of the bezel.
- ⑥ Do not press or rub on the sensitive display surface. If customer clean on the panel surface, NEC Corporation recommends using the cloth with ethanolic liquid such as screen cleaner for LCD.
- ⑦ Do not push-pull the interface connectors while the product is working, because wrong power sequence may break down the product.

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 Do not operate in high magnetic field. Circuit boards may be broken down by it.
- ③ 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.

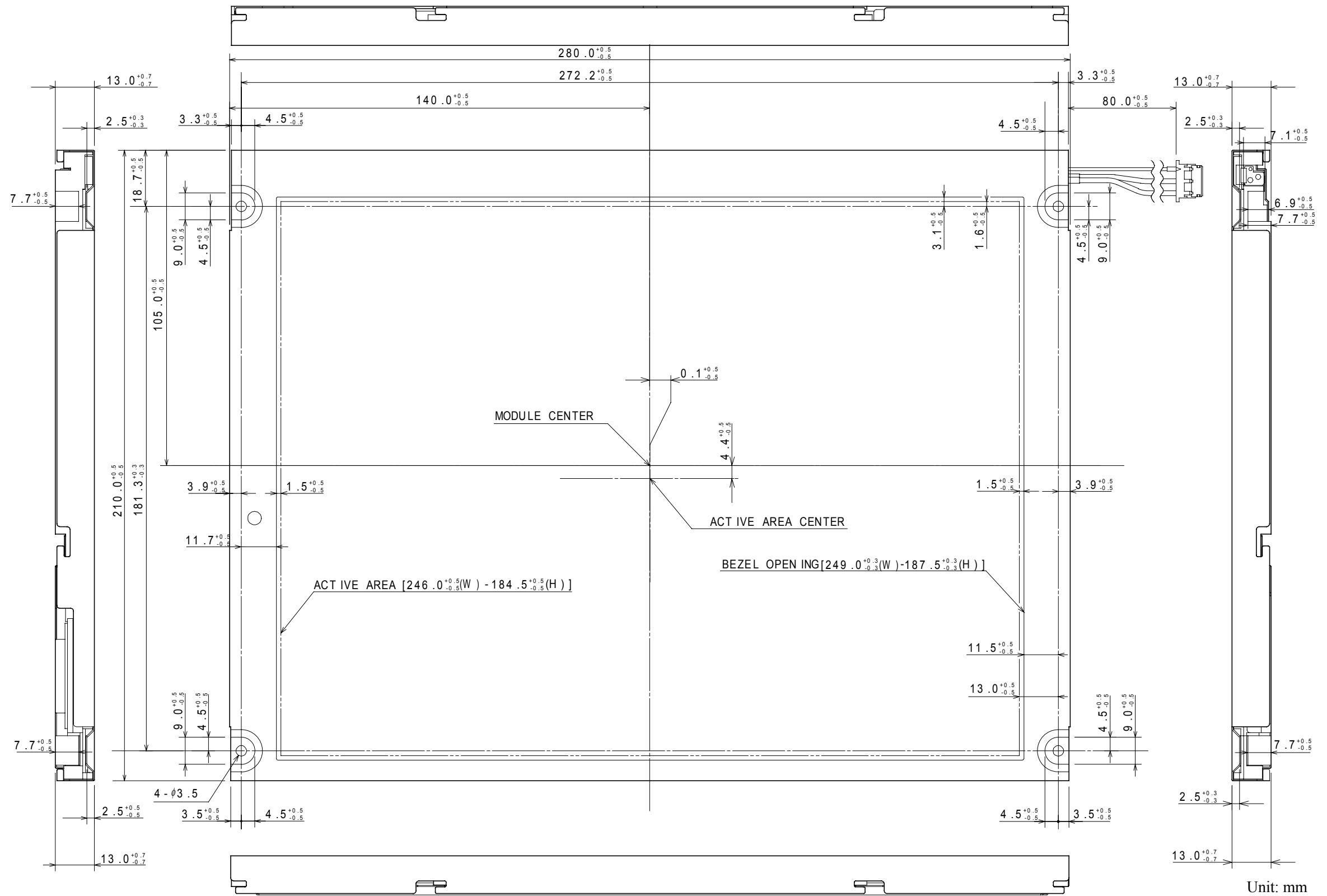
- ① Response time, luminance and color may be changed by ambient temperature.
- ② The LCD may be seemed luminance non-uniformity, flicker, vertical seam or small spot by display patterns.
- ③ Optical characteristics (e.g. luminance, display uniformity, etc.) gradually is going to change depending on 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 (VDDDB) terminals should be used without a non-connected line.
- ② Do not disassemble a product or adjust volume without permission of NEC Corporation.
- 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 screwdrivers.

7. OUTLINE DRAWINGS

7.1 FRONT VIEW



Unit: mm

7.2 REAR VIEW

