NEC

# TFT COLOR LCD MODULE

## NL6448BC33-50

### 26.4cm (10.4 Type)
### VGA

## PRELIMINARY DATA SHEET

(2nd edition)

**All information is subject to change without notice.**

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## INTRODUCTION

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The quality grade of this product is ***"Standard"*** unless otherwise specified in this document. If customers intend to use this product for applications other than those specified for ***"Standard"*** quality grade, they should contact NEC Corporation sales representative in advance.

Anti-radioactive design is not implemented in this product.

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## 1. OUTLINE

### 1.1 STRUCTURE AND PRINCIPLE

NL6448BC33-50 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 or reflective light through the TFT array of red, green and blue dots.

### 1.2 APPLICATIONS

- Industrial PC
- Display terminal for control system

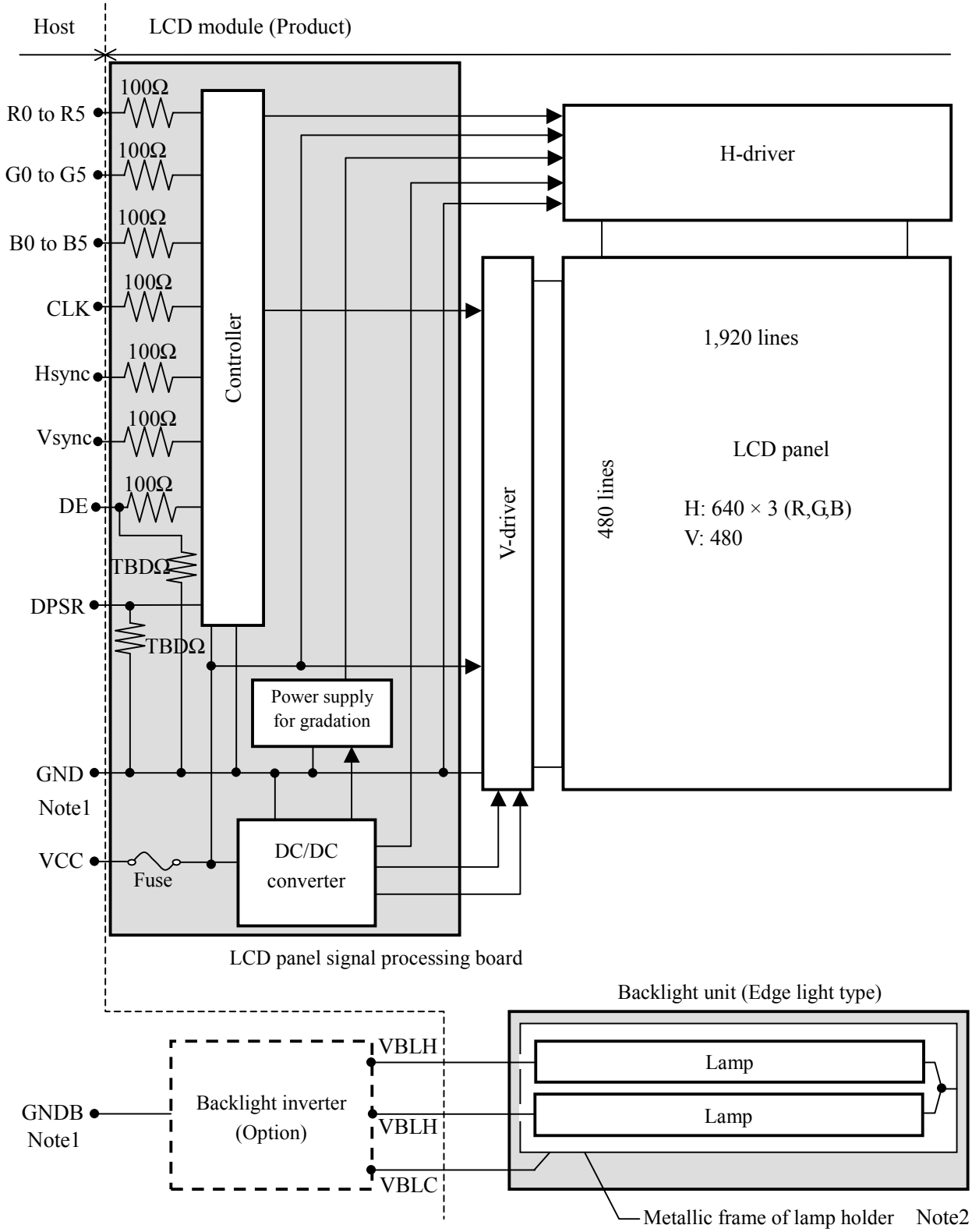
### 1.3 FEATURES

- Transflective type LCD
- 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

| | |
|---|---|
| ***Display area*** | 211.2 (W) × 158.4 (H) mm (typ.) |
| ***Diagonal size of display*** | 26.4 cm (10.4 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*** | 0.1100 (W) × 0.3300 (H) mm |
| ***Pixel pitch*** | 0.3300 (W) × 0.3300 (H) mm |
| ***Module size*** | 243.0 (W) × 185.1 (H) × 11.0 (D) mm (typ.) |
| ***Weight*** | TBD g (typ.) |
| ***Contrast ratio*** | *At transmissive mode*<br>100:1 (typ.)<br>*At reflective mode*<br>15:1 (typ.) |
| ***Viewing angle*** | *At transmissive mode, the contrast ratio 10:1*<br>• Horizontal: Left side 60° (typ.), Right side 60° (typ.)<br>• Vertical: Up side 40° (typ.), Down side 45° (typ.) |
| ***Designed viewing direction*** | *At transmissive mode, DPSR: normal scan*<br>• Viewing direction without image reversal: TBD<br>• Viewing direction with contrast peak: TBD<br>• Viewing angle with optimum grayscale ($\gamma$=2.2): normal axis |
| ***Polarizer surface*** | TBD |
| ***Polarizer pencil-hardness*** | 2H (min.) [by JIS K5400] |
| ***Color gamut*** | *At transmissive mode, LCD panel center*<br>50 % (typ.) [against NTSC color space]<br>*At reflective mode, LCD panel center*<br>35 % (typ.) [against NTSC color space] |
| ***Response time*** | 5 ms (typ.) |
| ***Luminance*** | *At transmissive mode, 5.0mArms / lamp*<br>250 cd/m$^2$ (typ.) |
| ***Reflectance*** | *At reflective mode*<br>3.5 % (typ.) |
| ***Signal system*** | 6-bit digital signals for data of RGB colors,<br>Dot clock (CLK), Data enable (DE),<br>Horizontal synchronous signal (Hsync),<br>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<br>( Replaceable parts<br>• Lamps for backlight unit: Type No. 104LHS38 )<br>( Recommended inverter (Option)<br>• Inverter: Type No. 104PW161 ) |
| ***Power consumption*** | *At maximum luminance and checkered flag pattern*<br>TBD W (typ.) |

### 3. BLOCK DIAGRAM




Note1: GND and GNDB (Backlight inverter ground) should be connected together in customer equipment.
Note2: The metallic frame of lamp holder is used to a transmission line for VBLC.

## 4. DETAILED SPECIFICATIONS

### 4.1 MECHANICAL SPECIFICATIONS

| Parameter | Specification | Unit |
|---|---|---|
| Module size | 243.0 ± 0.5 (W) × 185.1 ± 0.5 (H) × 11.0 ± 0.5 (D) Note1 | mm |
| Display area | 211.2 ± 0.5 (W) × 158.4 ± 0.5 (H) Note1 | mm |
| Weight | TBD (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 board | | VCC | -0.3 to +6.5 | V | Ta = 25°C |
| | Lamp | High voltage side (Hot) Note1 | VBLH | 1,500 | 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 | |
| Absolute light resistance illuminance | | | LRIL | TBD | lx | - |
| Storage temperature | | | Tst | -20 to +80 | °C | |
| Operating temperature | | Front surface | TopF | 0 to +65 | °C | |
| | | Rear surface | TopR | 0 to +70 | °C | |
| Relative humidity Note5 | | | RH | ≤ 95 | % | Ta ≤ 40°C |
| | | | | ≤ 85 | % | 40 < Ta ≤ 50°C |
| | | | | ≤ 70 | % | 50 < Ta ≤ 55°C |
| | | | | ≤ 60 | % | 55 < Ta ≤ 60°C |
| | | | | ≤ 50 | % | 60 < Ta ≤ 65°C |
| Absolute humidity Note5 | | | AH | ≤ 78 Note6 | $g/m^3$ | Ta > 65°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 = 65°C, RH = 50%

## 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 | - | TBD Note1 | TBD | mA | VCC = 3.3V |
| | | | - | TBD Note1 | TBD | mA | VCC = 5.0V |
| Logic input voltage for display signals | Low | VDLL | 0 | - | 0.3Vcc | V | CMOS level |
| | High | VDLH | 0.7Vcc | - | Vcc | V | |
| Input voltage for DPSR signal | Low | VFDL | 0 | - | 0.3Vcc | V | |
| | High | VFDH | 0.7Vcc | - | Vcc | V | |

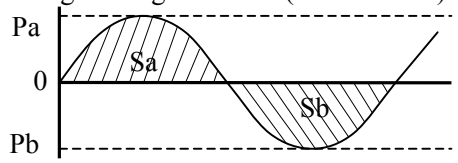
Note1: Checkered flag pattern [by EIAJ ED-2522]

### 4.3.2 Working for backlight lamp

| Parameter | Symbol | Ta | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| Starting voltage | VS | 0°C | 1,100 | - | - | Vrms | Note1 |
| | | 25°C | 850 | - | - | Vrms | |
| Power supply voltage | VBLH | 25°C | - | 520 | - | Vrms | Note1,Note2 |
| Power supply current | IBL | 25°C | 2.0 | 5.0 | 5.5 | mArms | Note2, Note3 |
| Oscillation frequency | FO | 25°C | 50 | 54 | 58 | 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).




$$\frac{|Pa - Pb|}{Pb} \times 100 \leq 5\ \%$$

$$\frac{|Sa - Sb|}{Sb} \times 100 \leq 5\ \%$$

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.

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

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 Note1 (Measure at input terminal of power supply) | Unit |
|---|---|---|---|
| VCC | 3.3 V | ≤ 100 | mVp-p |
| | 5.0 V | ≤ 100 | mVp-p |

Note1: The permissible ripple voltage includes spike noise.

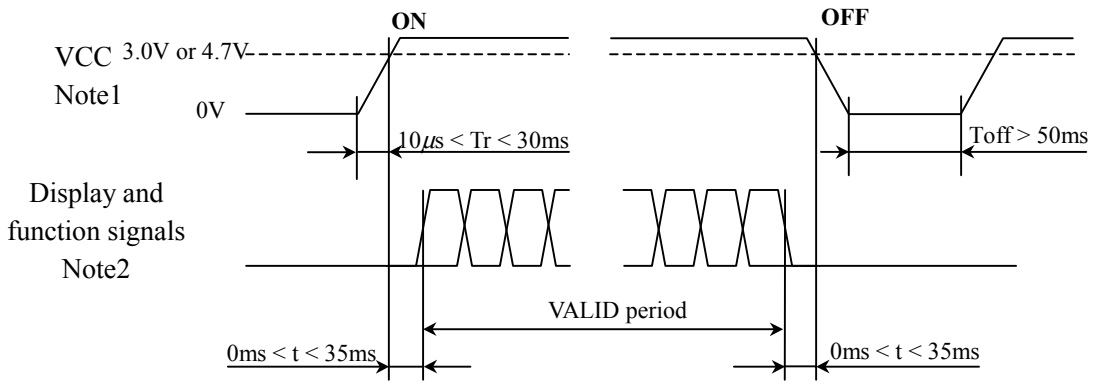
4.3.4 Fuses

| Fusing line | Fuse | | Rating | Fusing current Note1 |
|---|---|---|---|---|
| | Type | Supplier | | |
| VCC | TBD | TBD | TBD | TBD |
| | | | TBD | |

Note1: The power capacity should be more than the fusing current. If the power capacity is less than the fusing current and power supply current (ICC) is over its maximum specification on the fusing line, 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

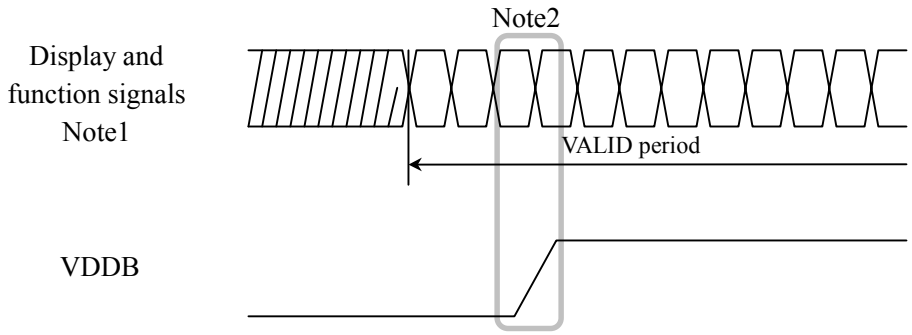



Note1: In terms of voltage variation (voltage drop) while VCC rising edge is below 3.0V in "VCC = 3.3V" or 4.7V in "VCC = 5.0V", a protection circuit may work, and then this product may not work.

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

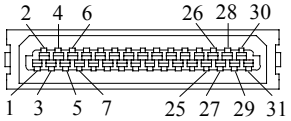
### 4.5.1 LCD panel signal processing board

CN1 socket (LCD module side): DF9-31P-1V (Hirose Electric Co., Ltd.)
Adaptable plug: DF9-31S-1V (Hirose Electric Co., Ltd.)
IL-310-T31S-VF (Japan Aviation Electronics Industry Limited)

| Pin No. | Symbol | Signal | Remarks |
|---|---|---|---|
| 1 | GND | Ground | - |
| 2 | CLK | Dot clock | |
| 3 | Hsync | Horizontal synchronous | |
| 4 | Vsync | Vertical synchronous | |
| 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) | Most significant bit |
| 12 | GND | Ground | - |
| 13 | G0 | Green data (LSB) | Least significant bit |
| 14 | G1 | Green data | - |
| 15 | G2 | Green data | |
| 16 | G3 | Green data | |
| 17 | G4 | Green data | |
| 18 | G5 | Green data (MSB) | Most significant bit |
| 19 | GND | Ground | - |
| 20 | B0 | Blue data (LSB) | Least significant bit |
| 21 | B1 | Blue data | - |
| 22 | B2 | Blue data | |
| 23 | B3 | Blue data | |
| 24 | B4 | Blue data | |
| 25 | B5 | Blue data (MSB) | Most significant bit |
| 26 | GND | Ground | - |
| 27 | DE | Select of DE / Fixed mode | DE mode: Data enable signal, Fixed mode: Open |
| 28 | VCC | Power supply | - |
| 29 | VCC | Power supply | |
| 30 | NC | Non connection | |
| 31 | DPSR | Select of scan direction | Normal scan: Low or Open, Reverse scan: High Note1 |

Note1: See "4.8 SCANNING DIRECTIONS".

CN1: Figure of socket

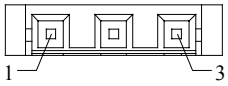


4.5.2 Backlight lamp

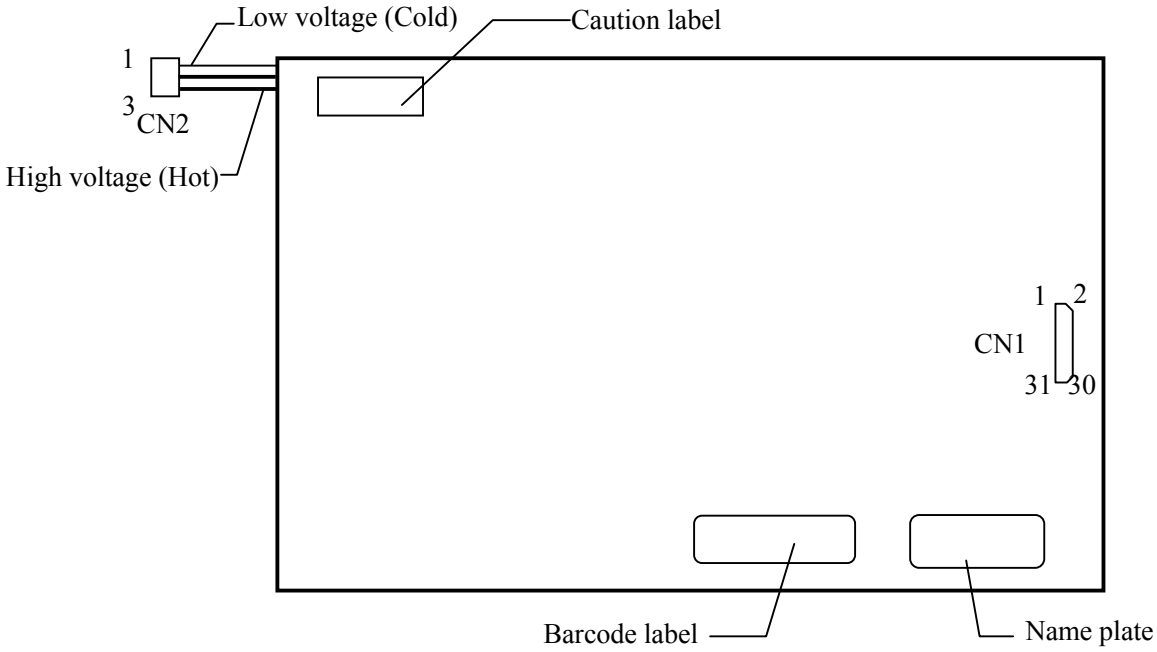
CN2 plug: BHR-03VS-1 (J.S.T Mfg. Co., Ltd.)
Adaptable socket: SM03 (4.0) B-BHS-TB (J.S.T Mfg. Co., Ltd.)

| 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 | 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 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 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 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 figure of "4.8 SCANNING DIRECTIONS".).

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

4.8 SCANNING DIRECTIONS

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

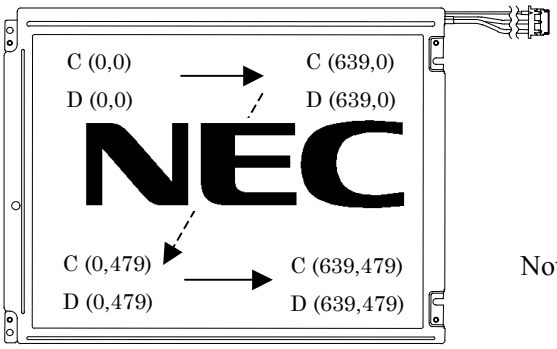



Figure 1. Normal scan (DPSR: Low or Open)

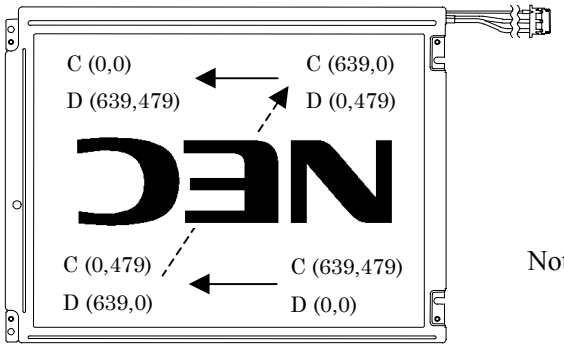


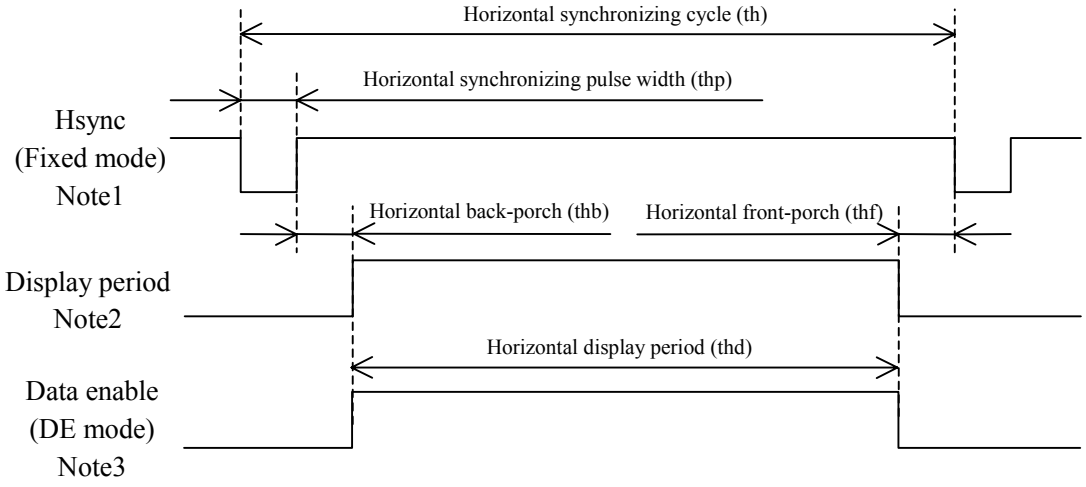

Figure 2. Reverse scan (DPSR: High)

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

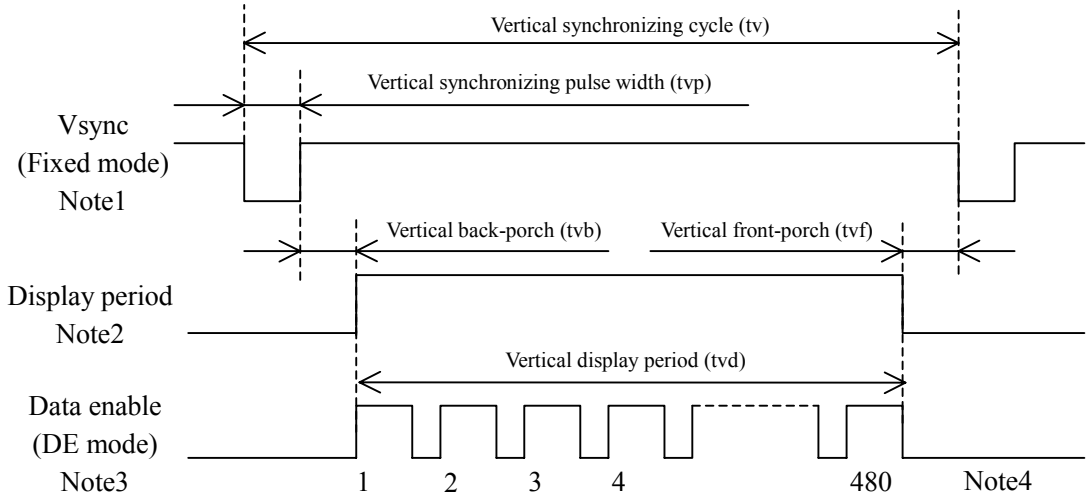
### 4.9.1 Outline of input signal timings

- 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.

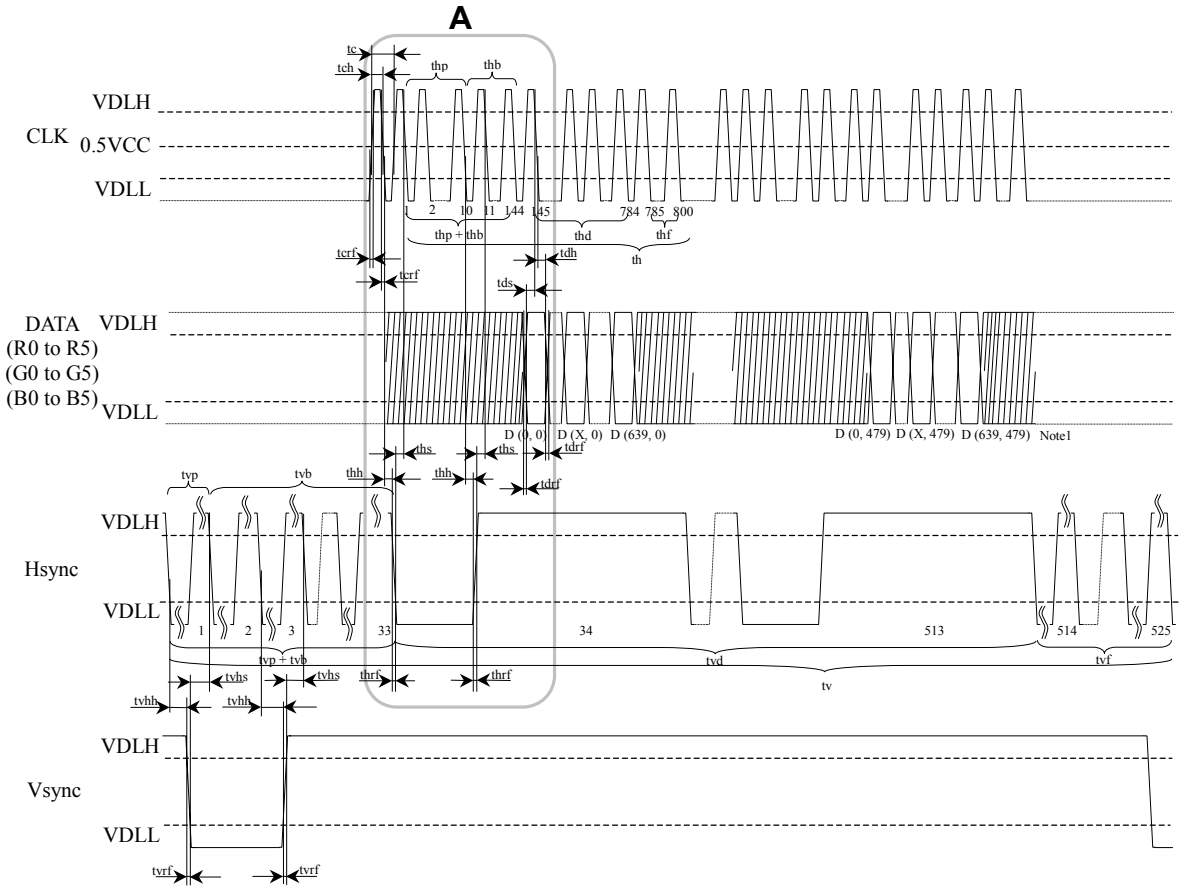
- Vertical signal




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.

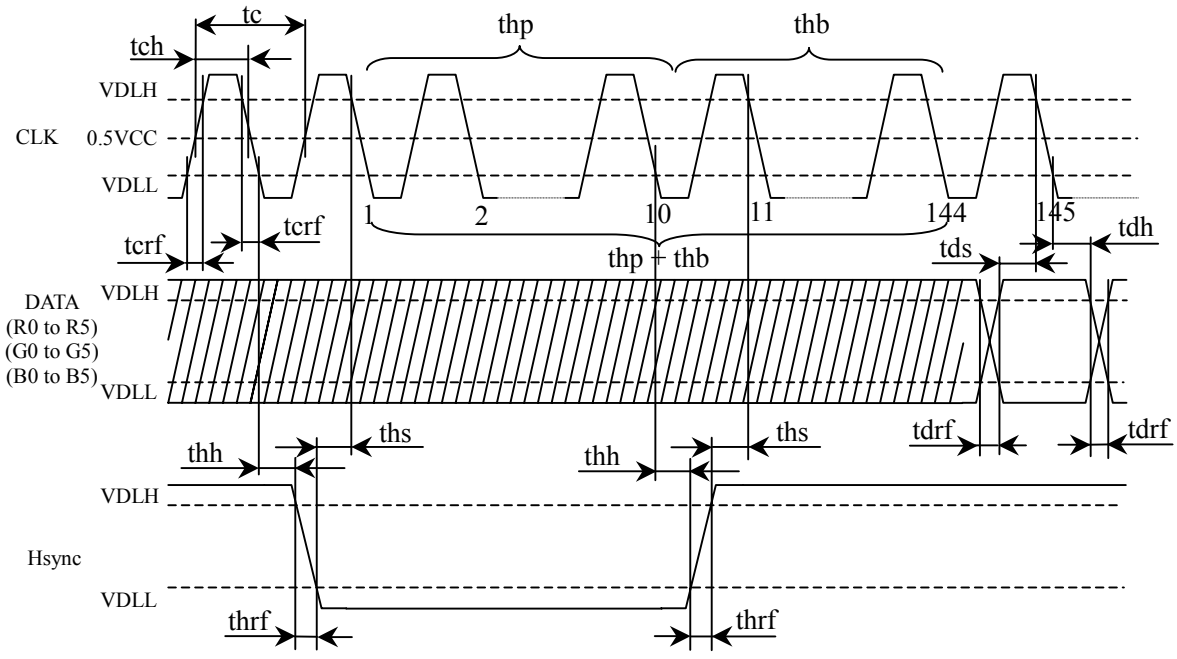
4.9.2 Detailed input signal timing chart for fixed mode

- Outline chart




Note1: X is data number from 1 to 638. See "4.8 SCANNING DIRECTIONS".

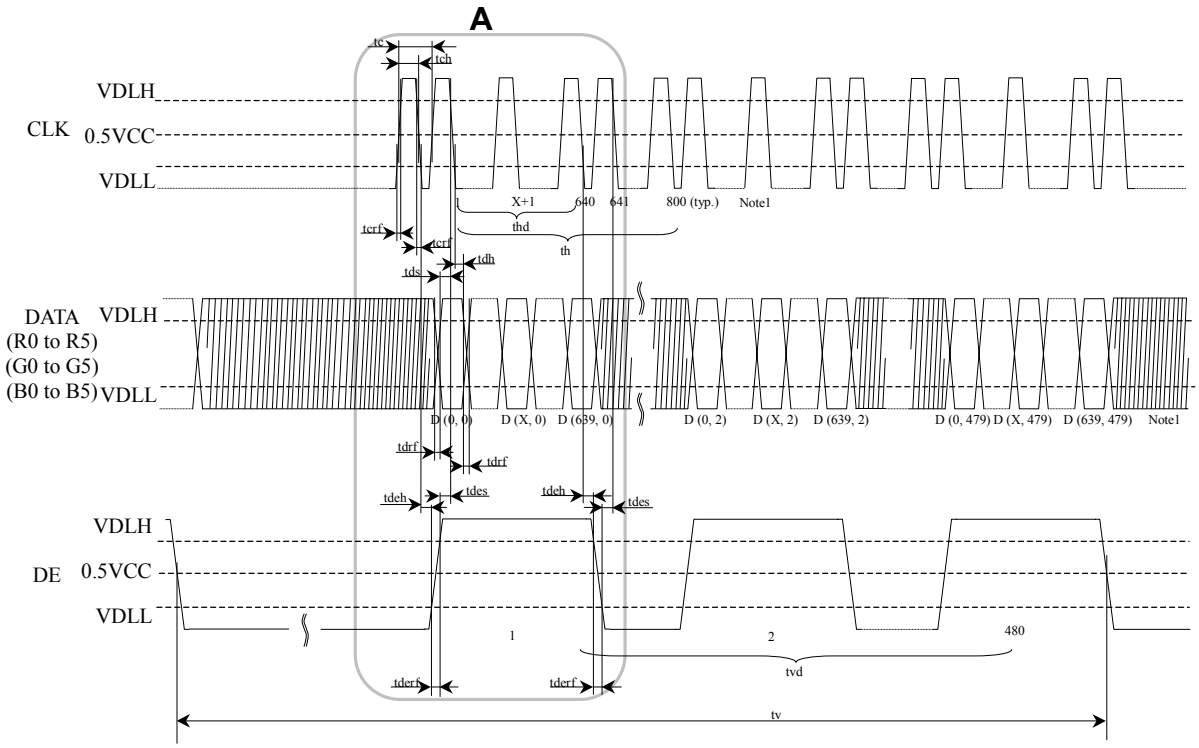
- Detail of **A** part



4.9.3 Detailed input signal timing chart for DE mode

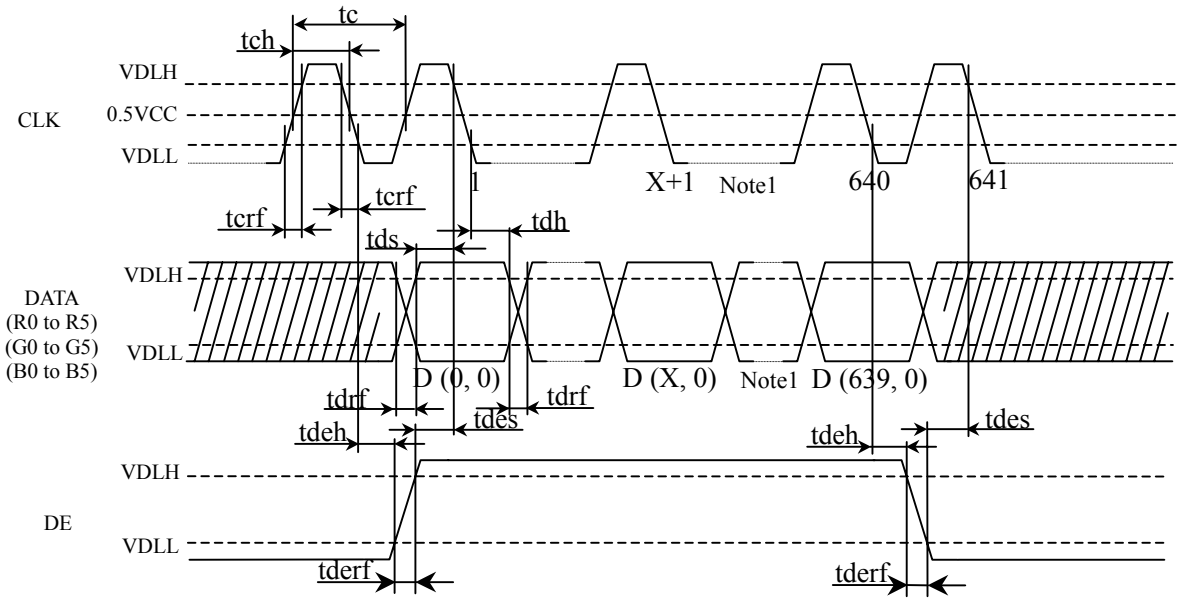
Customer should be inputted synchronized signals (See "4.9.2 Detailed input signal timing chart for fixed mode".) in addition to DE signal to this product, when it is worked in DE mode. Synchronized signals are used for DE/Fixed mode detection.

• Outline chart




Note1: X is data number from 1 to 638. See "4.8 SCANNING DIRECTIONS".

• Detail of **A** part




Note1: X is data number from 1 to 638. 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 | 21.0 | 25.2 | 29.0 | MHz | 39.7 ns (typ.) Note1 |
| | Duty | | tcd | 0.4 | - | 0.6 | - | Note1 |
| | Rise time, Fall time | | tcrf | - | - | 10 | ns | - |
| DATA | CLK-DATA | Setup time | tds | 8 | - | - | ns | |
| | | Hold time | tdh | 12 | - | - | ns | |
| | Rise time, Fall time | | tdrf | - | - | 10 | ns | |

Note1: Definition of parameters is as follows.

tcf = 1/tc, tcd = tch/tc = tch×tcd

• Fixed mode

| Parameter | | | Symbol | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|---|---|---|
| Hsync | Cycle | | th | 30.0 | 31.8 | 33.6 | μs | 31.4 kHz (typ.) |
| | | | | | 800 | | CLK | Note1 |
| | 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 | Note1, Note2 |
| | CLK- Hsync | Setup time | ths | 8 | - | - | ns | - |
| | | Hold time | thh | 12 | - | - | ns | |
| | Rise time, Fall time | | thrf | - | - | 10 | ns | |
| Vsync | Cycle | | tv | 16.1 | 16.7 | 17.2 | ms | 59.9 Hz (typ.) |
| | | | | | 525 | | H | Note1 |
| | Display period | | tvd | | 480 | | H | |
| | Front-porch | | tvf | | 12 | | H | |
| | Pulse width | | tvp | 1 | - | 2 | H | |
| | Back-porch | | tvb | 31 | - | 32 | H | |
| | Total of pulse width and back-porch | | tvp + tvb | | 33 | | H | Note1, Note2 |
| | Vsync-Hsync | Setup time | tvhs | 30 | - | - | 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 | - | 800 | - | CLK | Note2 |
| | | Display period | thd | | 640 | | CLK | |
| | Vertical (One frame) | Cycle | tv | - | 525 | - | H | |
| | | Display period | tvd | | 480 | | H | |
| | CLK-DE | Setup time | tdes | 8 | - | - | ns | - |
| | | Hold time | tdeh | 12 | - | - | 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

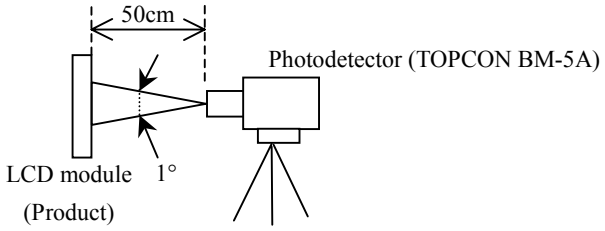
4.10.1 Optical characteristics for transmissive mode

| Parameter Note1 | | Condition | Symbol | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|---|---|---|
| Contrast ratio | | White/Black at center<br>θR = 0°, θL = 0°, θU = 0°, θD = 0° | CR | TBD | 100 | - | - | Note2 |
| Luminance | | White at center<br>θR = 0°, θL = 0°, θU = 0°, θD = 0° | L | TBD | 250 | - | cd/m$^2$ | - |
| Luminance uniformity | | - | LU | - | 1.25 | 1.40 | - | Note3 |
| Chromaticity | White | **x** coordinate | Wx | - | 0.305 | - | - | Note4 |
| | | **y** coordinate | Wy | - | 0.330 | - | - | |
| | 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 | | θR = 0°, θL = 0°, θU = 0°, θD = 0°<br>at center, against NTSC color space | C | TBD | 50 | - | % | |
| Response time | | White to black | Ton | - | 5 | TBD | ms | Note5<br>Note6 |
| | | Black to white | Toff | - | 20 | TBD | ms | |
| Viewing angle | Right | θU = 0°, θD = 0°, CR = 10 | θR | - | 50 | - | ° | Note7 |
| | Left | θU = 0°, θD = 0°, CR = 10 | θL | - | 50 | - | ° | |
| | Up | θR = 0°, θL = 0°, CR = 10 | θU | - | 40 | - | ° | |
| | Down | θR = 0°, θL = 0°, CR = 10 | θD | - | 45 | - | ° | |

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 "4.10.3 Definition of contrast ratio".

Note3: See "4.10.4 Definition of optical uniformity".

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

Note5: Product surface temperature: TopF = 25°C

Note6: See "4.10.5 Definition of response times".

Note7: See "4.10.6 Definition of viewing angles".

4.10.2 Optical characteristics for reflective mode

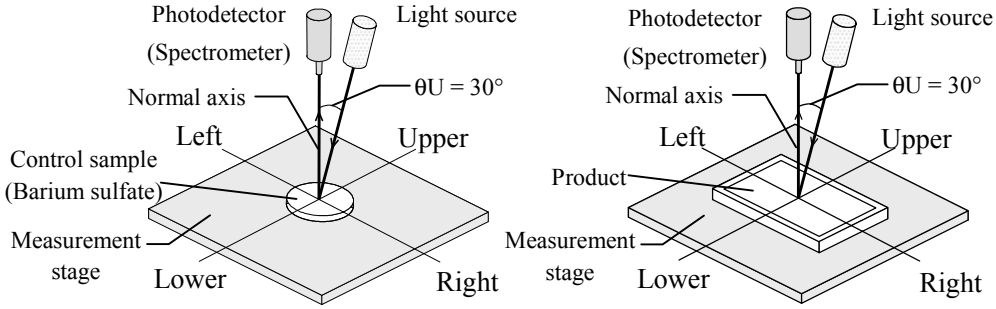
| Parameter Note1 | | Condition | Symbol | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|---|---|---|
| Contrast ratio | | White/Black at center<br>θR = 0°, θL = 0°, θU = 0°, θD = 0° | CR | - | 15 | - | - | Note2 |
| Reflectance | | White at center<br>θR = 0°, θL = 0°, θU = 0°, θD = 0° | R | - | 3.7 | - | % | - |
| Reflectance uniformity | | - | RU | - | TBD | - | - | Note3 |
| Chromaticity | White | **x** coordinate | Wx | - | TBD | - | - | Note4 |
| | | **y** coordinate | Wy | - | TBD | - | - | |
| Color gamut | | θR = 0°, θL = 0°, θU = 0°, θD = 0°<br>at center, against NTSC color space | C | - | 35 | - | % | |

Note1: Measurement conditions are as follows.

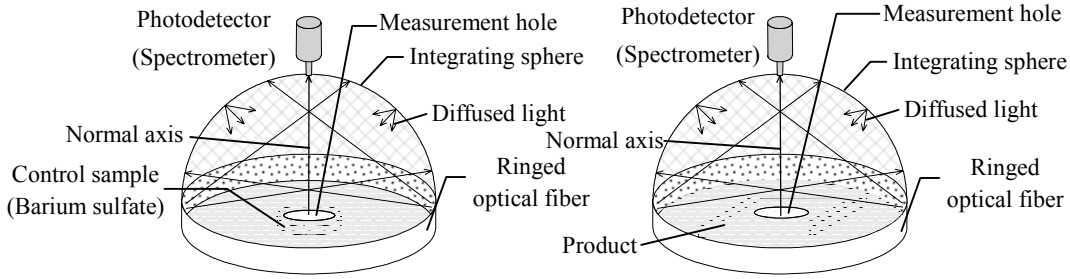
Ta = 25°C, VCC = 3.3V

Optical characteristics are measured at luminance saturation for measurement light source after 1 hour from working the product, in the dark room. Each measured value is computed on the basis of barium sulfate. Also measurement method is as follows.

- Measurements of contrast ratio, reflectance and reflectance uniformity




- Measurements of chromaticity and color gamut




Note2: See "4.10.3 Definition of contrast ratio".

Note3: See "4.10.4 Definition of optical uniformity".

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

4.10.3 Definitions of contrast ratio

The contrast ratio is calculated by using the following formula.

- Transmissive mode

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

- Reflective mode

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

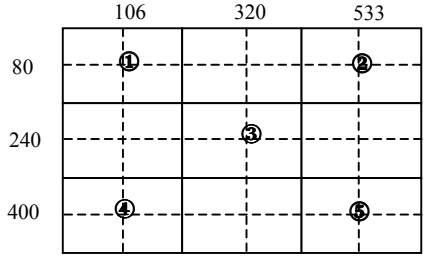
4.10.4 Definitions of optical uniformity

The optical uniformity is calculated by using following formula.

- Luminance uniformity for transmissive mode

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

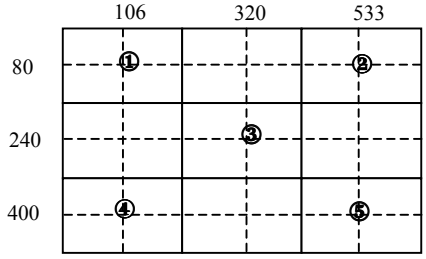
The luminance is measured at near the 5 points shown below.




- Reflectance uniformity for reflective mode

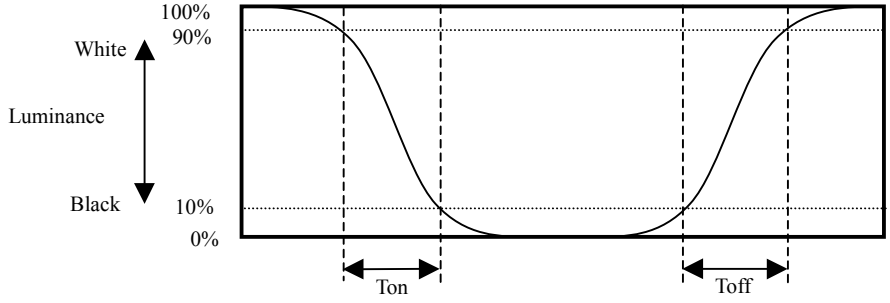
$$\text{Reflectance uniformity (RU)} = \frac{\text{Maximum reflectance from ① to ⑤}}{\text{Minimum reflectance from ① to ⑤}}$$

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

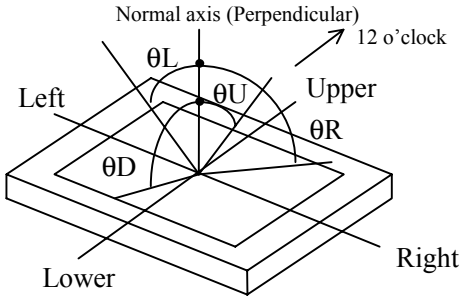


4.10.5 Definition of response times

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.).




4.10.6 Definition of viewing angles

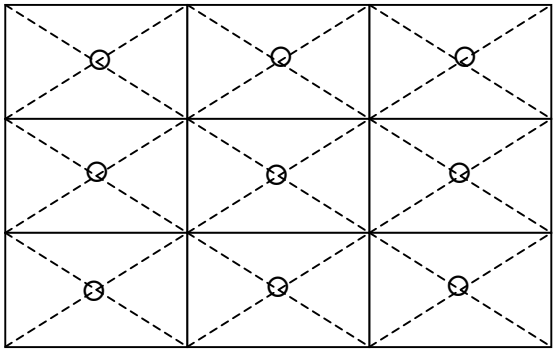


## 5. RELIABILITY TESTS

| Test item | Condition | Judgement |
|---|---|---|
| High temperature and humidity (Operation) | ① 55 ± 2°C, RH = 85%, 240hours<br>② Display data is black. | No display malfunctions Note1 |
| High temperature (Operation) | ① 65 ± 2°C, 240hours<br>② Display data is black. | |
| Heat cycle (Operation) | ① 0 ± 3°C…1hour<br>55 ± 3°C…1hour<br>② 50cycles, 4hours/cycle<br>③ Display data is black. | |
| Thermal shock (Non operation) | ① -20 ± 3°C…30minutes<br>80 ± 3°C…30minutes<br>② 100cycles, 1hour/cycle<br>③ Temperature transition time is within 5 minutes. | |
| ESD (Operation) | ① 150pF, 150Ω, ±10kV<br>② 9 places on a panel surface Note2<br>③ 10 times each places at 1 sec interval | |
| Dust (Operation) | ① Sample dust: No. 15 (by JIS-Z8901)<br>② 15 seconds stir<br>③ 8 times repeat at 1 hour interval | |
| Vibration (Non operation) | ① 5 to 100Hz, 19.6m/$s^2$<br>② 1 minute/cycle<br>③ X, Y, Z direction<br>④ 120 times each directions | No display malfunctions Note1<br>No physical damages |
| Mechanical shock (Non operation) | ① 539m/ $s^2$, 11ms<br>② ±X, ±Y, ±Z direction<br>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!**

This sign has the meaning that customer will be injured by himself, if customer has wrong operations.

### 6.2 CAUTIONS

**∗ Pay attention to burn injury for the working backlight! It may be over 35°C from ambient temperature.**

**∗ Do not shock and press the LCD panel and the backlight! Danger of breaking, because they are made of glass. (Shock: To be not greater 539m/s$^2$ and to be not greater 11ms, Pressure: To be not greater 19.6N)**

### 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.**

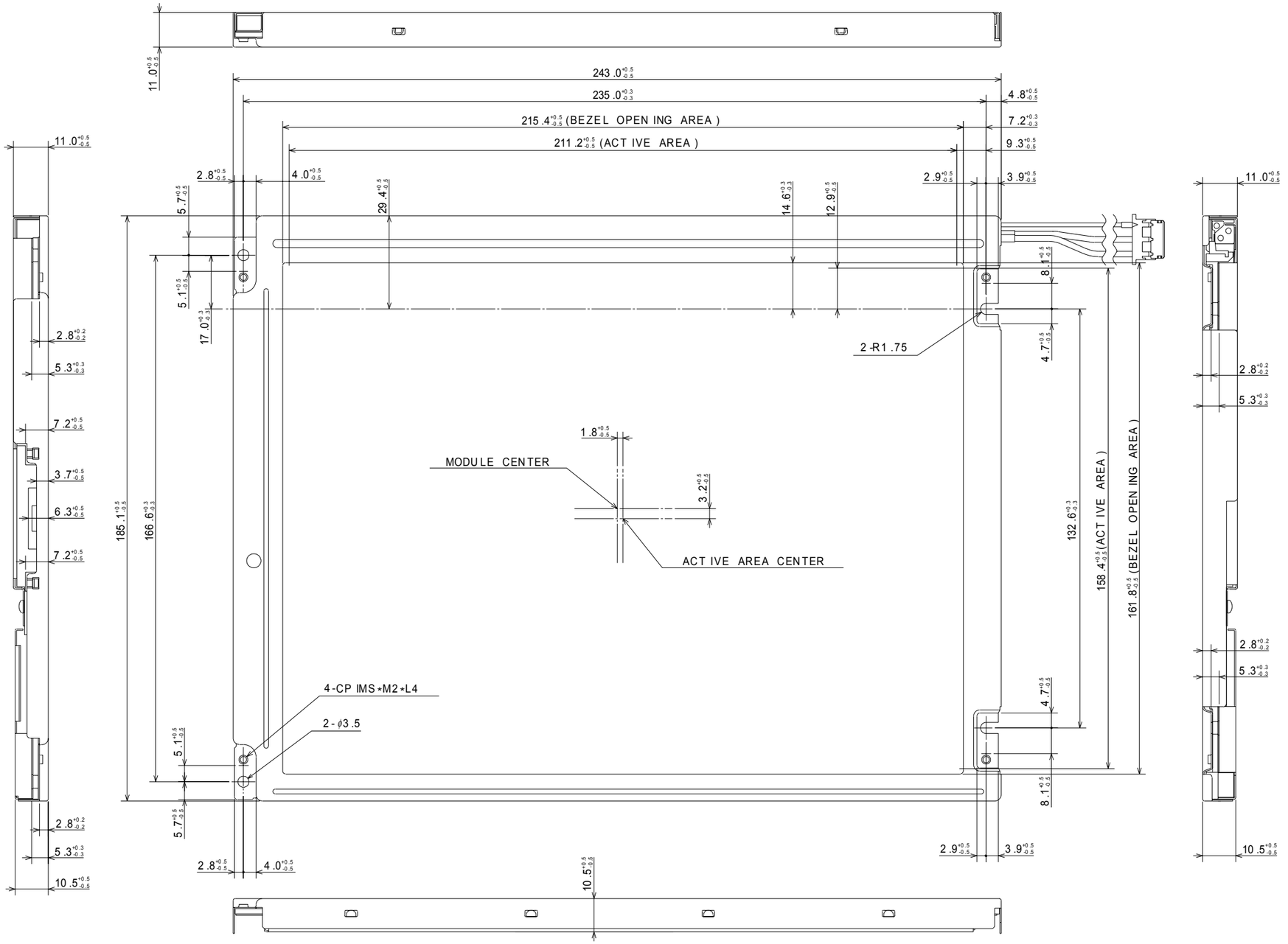
① Response time, luminance and color may be changed by ambient temperature.
② The LCD may be seemed luminance non-uniformity, flicker, vertical seam or small spot by display patterns.
③ Optical characteristics (e.g. luminance, display uniformity, etc.) gradually is going to change depending on operating 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 (VDDB) 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 screwnails.

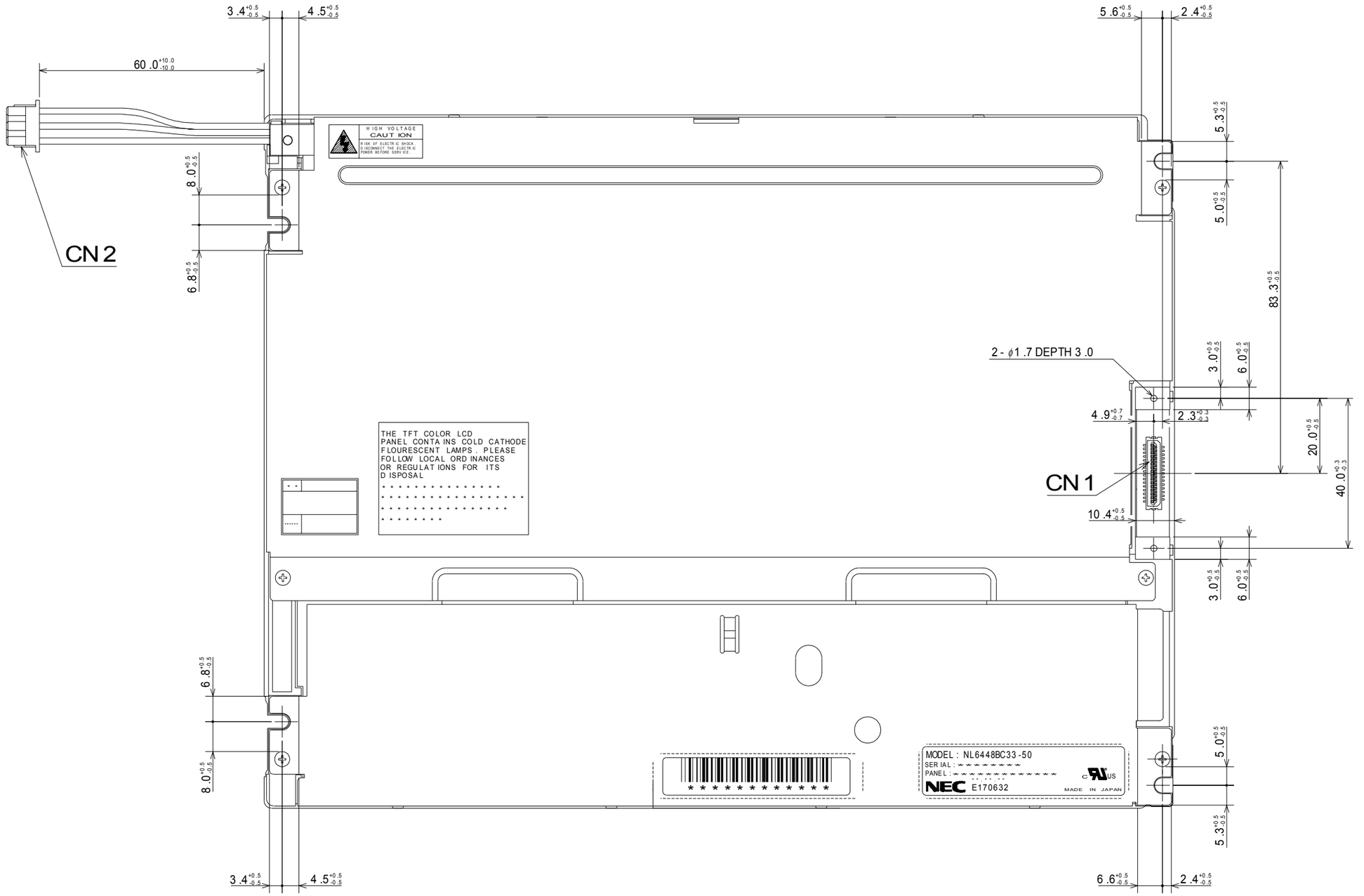
## 7. OUTLINE DRAWINGS

### 7.1 FRONT VIEW




Unit: mm

7.2 REAR VIEW




Unit: mm