PRELIMINARY

NEC NEC LCD Technologies, Ltd.

# TFT COLOR LCD MODULE

## NL10276BC30-18

**38cm (15.0 Type)**
**XGA**
**LVDS Interface (1port)**

# PRELIMINARY DATA SHEET

**DOD-PD-1276 (3rd edition)**



**This PRELIMINARY DATA SHEET is updated document from DOD-PD-1182(2).**

**All information is subject to change without notice. Please confirm the sales representative before starting to design your system.**

## INTRODUCTION



NEC does and will not assume any liability for infringement of patents, copyrights or other intellectual property rights of any third party arising out of or in connection with application of the products described herein except for that directly attributable to mechanisms and workmanship thereof. No license, express or implied, is granted under any patent, copyright or other intellectual property right of NEC.

Some electronic parts/components would fail or malfunction at a certain rate. In spite of every effort to enhance reliability of products by NEC, the possibility of failures and malfunction might not be avoided entirely. To prevent the risks of damage to death, human bodily injury or other property arising out thereof or in connection therewith, each customer is required to take sufficient measures in its safety designs and plans including, but not limited to, redundant system, fire-containment and anti-failure.

The products are classified into three quality grades: **"Standard"**, **"Special"**, and **"Specific"** of the highest grade of a quality assurance program at the choice of a customer. Each quality grade is designed for applications described below. Any customer who intends to use a product for application other than that of Standard quality grade is required to contact an NEC sales representative in advance.

The **Standard** quality grade applies to the products developed, designed and manufactured in accordance with the NEC standard quality assurance program, which are designed for such application as any failure or malfunction of the products (sets) or parts/components incorporated therein a customer uses are, directly or indirectly, free of any damage to death, human bodily injury or other property, like general electronic devices.

Examples: Computers, office automation equipment, communications equipment, test and measurement equipment, audio and visual equipment, home electronic appliances, machine tools, personal electronic equipment, industrial robots, etc.

The **Special** quality grade applies to the products developed, designed and manufactured in accordance with an NEC quality assurance program stricter than the standard one, which are designed for such application as any failure or malfunction of the products (sets) or parts/components incorporated therein a customer uses might directly cause any damage to death, human bodily injury or other property, or such application under more severe condition than that defined in the Standard quality grade without such direct damage.

Examples: Control systems for transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, medical equipment not specifically designed for life support, safety equipment, etc.

The **Specific** quality grade applies to the products developed, designed and manufactured in accordance with the standards or quality assurance program designated by a customer who requires an extremely higher level of reliability and quality for such products.

Examples: Military systems, aircraft control equipment, aerospace equipment, nuclear reactor control systems, medical equipment/devices/systems for life support, etc.

The quality grade of this product is the **"Standard"** unless otherwise specified in this document.

## CONTENTS

# 1. OUTLINE

## 1.1 STRUCTURE AND PRINCIPLE

Color LCD module NL10276BC30-18 is composed of the amorphous silicon thin film transistor liquid crystal display (a-Si TFT LCD) panel structure with driver LSIs for driving the TFT (Thin Film Transistor) array and a backlight.

The a-Si TFT LCD panel structure is injected liquid crystal material into a narrow gap between the TFT array glass substrate and a color-filter glass substrate.

Color (Red, Green, Blue) data signals from a host system (e.g. signal generator, etc.) are modulated into best form for active matrix system by a signal processing 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

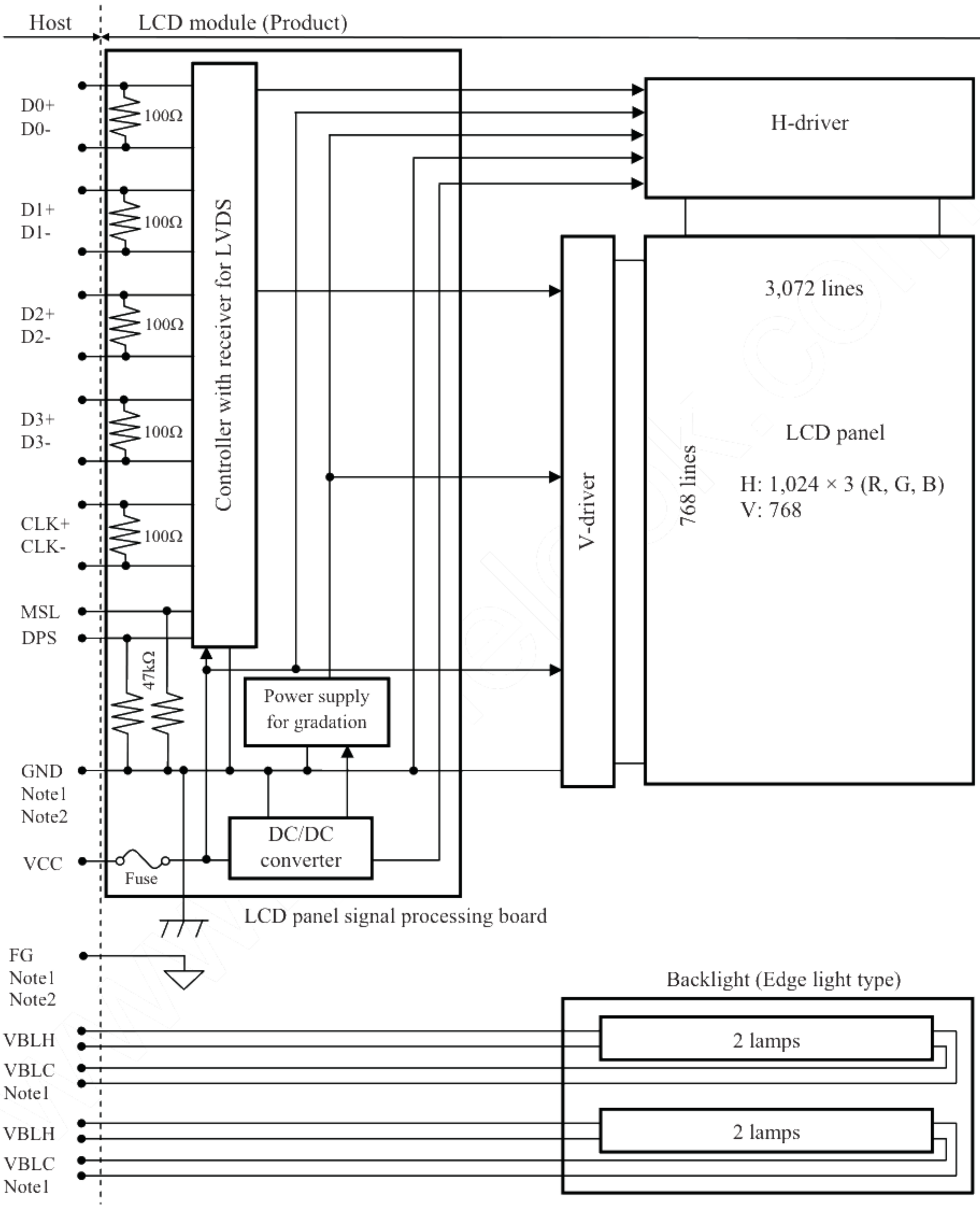
- Wide viewing angle
- High luminance
- Fast response time
- LVDS interface (8-bit)
- Selectable LVDS input map
- Reversible-scan direction
- Small foot print
- Edge light type backlight (without inverter)
- Replaceable lamp for backlight

## 2. GENERAL SPECIFICATIONS

3

| | |
|---|---|
| ***Display area*** | 304.128 (H) × 228.096 (V) mm |
| ***Diagonal size of display*** | 38cm (15.0 inches) |
| ***Drive system*** | a-Si TFT active matrix |
| ***Display color*** | 16,777,216 colors (6bit+FRC) |
| ***Pixel*** | 1,024 (H) × 768 (V) pixels |
| ***Pixel arrangement*** | RGB (Red dot, Green dot, Blue dot) vertical stripe |
| ***Dot pitch*** | 0.099 (H) × 0.297 (V) mm |
| ***Pixel pitch*** | 0.297 (H) × 0.297 (V) mm |
| ***Module size*** | 326.5 (typ., W) × 253.5 (typ., H) × 17.0 (max., D) mm |
| ***Weight*** | 1,300g (typ.) |
| ***Contrast ratio*** | 500:1 (typ.) |
| ***Viewing angle*** | *At the contrast ratio ≥ 10:1*<br>• Horizontal: Right side 80° (typ.), Left side 80° (typ.)<br>• Vertical: Up side 80° (typ.), Down side 60° (typ.) |
| ***Designed viewing direction*** | *At DPS terminal= Low or Open: Normal scan*<br>• Viewing direction without image reversal: up side (12 o'clock)<br>• Viewing direction with contrast peak: down side (6 o'clock)<br>• Viewing angle with optimum grayscale (γ=2.2): normal axis (perpendicular) |
| ***Polarizer surface*** | Antiglare |
| ***Polarizer pencil-hardness*** | 3H (min.) [by JIS K5400] |
| ***Color gamut*** | *At LCD panel center*<br>40% (typ.) [against NTSC color space] |
| ***Response time*** | *Ton+Toff (10%←→ 90%)*<br>18ms (typ.) |
| ***Luminance*** | *At IBL=6.0mArms / lamp*<br>500cd/m$^2$ (typ.) |
| ***Signal system*** | LVDS 1port (Receiver: Equivalent of THC63LVDF84B, THine Electronics Inc.)<br>[8-bit digital signals for data of RGB colors, Dot clock (CLK),<br>Data enable (DE)] |
| ***Power supply voltage*** | LCD panel signal processing board: 3.3V |
| ***Backlight*** | Edge light type: 4 cold cathode fluorescent lamps (without inverter)<br>( Replaceable part<br>• Lamp holder set: Type No. 150LHS29 )<br>( Recommended inverter (Option)<br>• Inverter: Type No. 150PW231 ) |
| ***Power consumption*** | *At IBL= 6.0mArms / lamp, Checkered flag pattern*<br>15.7W (typ., Power dissipation of the inverter is not included.) |

## 3. BLOCK DIAGRAM




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

| | |
|---|---|
| GND-FG | Not connected |
| GND-VBLC | Not connected |
| FG-VBLC | Not connected |

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

## 4. DETAILED SPECIFICATIONS

### 4.1 MECHANICAL SPECIFICATIONS

| Parameter | Specification | | Unit |
|---|---|---|---|
| Module size | 326.5 ± 0.5 (W) × 253.5 ± 0.5 (H) × 17.0 max. (D) | Note1, Note2 | mm |
| Display area | 304.128 (H) × 228.096 (V) | Note1 | mm |
| Weight | 1,300 (typ.), 1,430 (max.) | | g |

Note1: Excluding lamp cables.
Note2: 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 +3.6 | V | - |
| | Lamp voltage | VBLH | 2,000 | Vrms | |
| Input voltage for signals | Display signals Note1 | VD | -0.3 to +3.6 and <VCC +0.3 | V | |
| | Function signals Note2 | VF | | | |
| Storage temperature | | Tst | -20 to +80 | °C | - |
| Operating temperature | Front surface | TopF | -10 to +70 | °C | Note3 |
| | Rear surface | TopR | -10 to +70 | °C | Note4 |
| Relative humidity Note5 | | RH | ≤ 95 | % | Ta ≤ 40°C |
| | | | ≤ 85 | % | 40 < Ta ≤ 50°C |
| | | | ≤ 55 | % | 50 < Ta ≤ 60°C |
| | | | ≤ 36 | % | 60 < Ta ≤ 70°C |
| Absolute humidity Note5 | | AH | ≤ 70 Note6 | $g/m^3$ | Ta > 70°C |

3

Note1: D0+/-, D1+/-, D2+/-, D3+/-, CK+/-
Note2: MSL, DPS
Note3: Measured at center of LCD panel surface (including self-heat)
Note4: Measured at center of LCD module's rear shield surface (including self-heat)
Note5: No condensation
Note6: Water amount at Ta= 70°C and RH= 36%

## 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 | - |
| Power supply current | | ICC | - | 530 Note1 | 900 Note2 | mA | at VCC= 3.3V |
| Permissible ripple voltage | | VRP | - | - | 100 | mVp-p | for VCC |
| Differential input threshold voltage for LVDS receiver | High | VTH | - | - | +100 | mV | at VCM= 1.2V Note3 |
| | Low | VTL | -100 | - | - | mV | |
| Input voltage swing for LVDS receiver | | Vi | 0 | - | 2.4 | V | - |
| Terminating resistance | | RT | - | 100 | - | Ω | - |
| Input voltage for MSL and DPS signal | High | VFH | 0.6VCC | - | VCC | V | - |
| | Low | VFL | 0 | - | 0.3VCC | V | |
| Input current for MSL and DPS signal | High | IFH | - | - | 300 | μA | - |
| | Low | IFL | -300 | - | - | μA | |

Note1: Checkered flag pattern [by EIAJ ED-2522]
Note2: Pattern for maximum current
Note3: Common mode voltage for LVDS receiver

4.3.2 Backlight lamp

(Ta= 25°C, Note1)

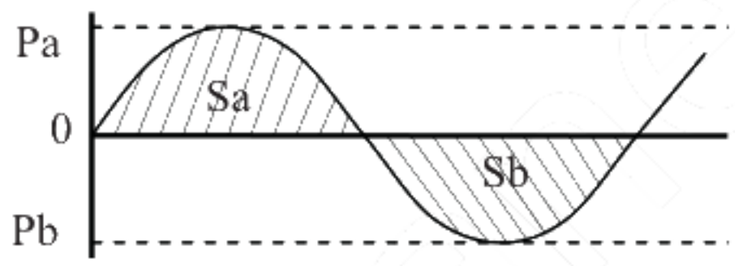
| Parameter | Symbol | min. | typ. | max. | Unit | Remarks |
|---|---|---|---|---|---|---|
| Lamp current | IBL | 5.5 | 6.0 | 6.5 | mArms | at IBL=6.0mArms: L= 500cd/m$^2$(typ.) Note3 |
| Lamp voltage | VBLH | - | 580 | - | Vrms | Note2, Note3 |
| Lamp starting voltage | VS | 1,550 | - | - | Vrms | Ta= 25°C Note2, Note3, Note4 |
| | | 1,690 | - | - | Vrms | Ta= -10°C Note2, Note3, Note4 |
| Lamp oscillation frequency | FO | 38 | 43 | 48 | kHz | Note5 |

3

Note1: This product consists of 4 backlight lamps, and these specifications are for each lamp.

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

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




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

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

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

Note4: The inverter should be designed so that the lamp starting voltage can be maintained for more than 1 second. Otherwise the lamp may not be turned on.

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

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

th: Horizontal signal period (See "**4.9.2 Timing characteristics**".)
n: Natural number (1, 2, 3 ·····)

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

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

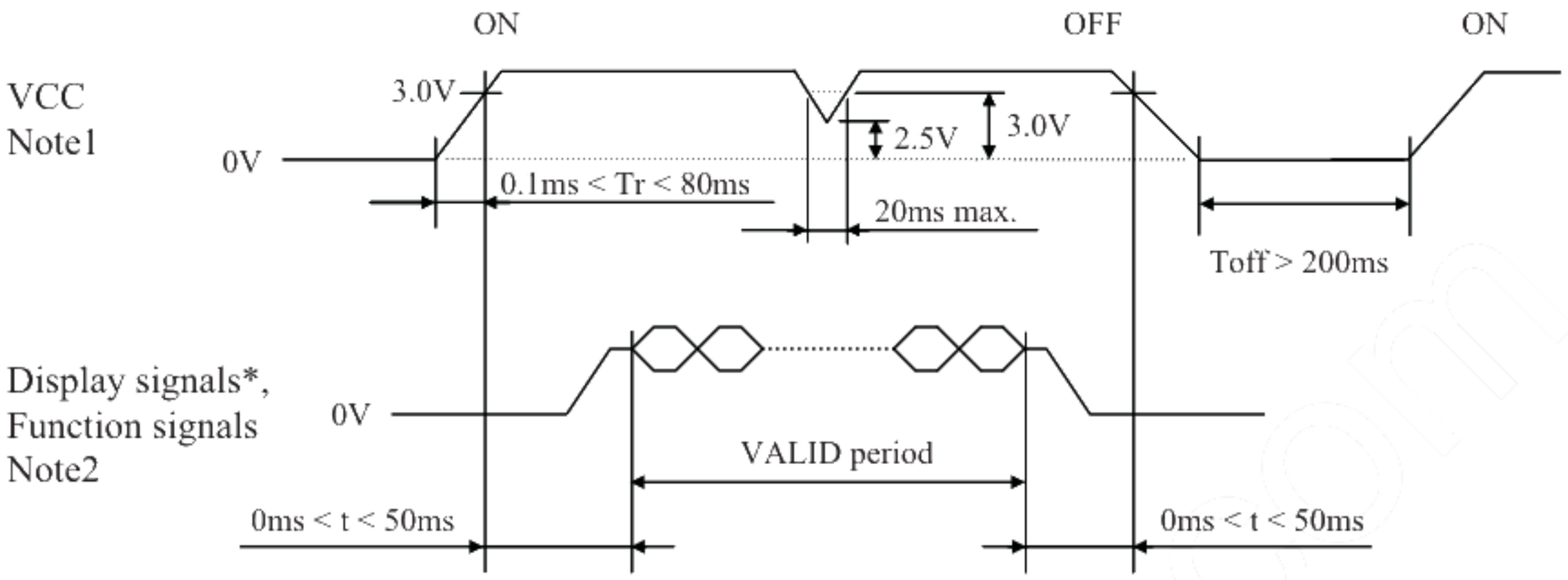
Note1: The permissible ripple voltage includes spike noise.

4.3.4 Fuse

| Parameter | Fuse | | Rating | Fusing current | Remarks |
|---|---|---|---|---|---|
| | Type | Supplier | | | |
| VCC | TF16SN3.15T | KOA Corporation | 3.15A<br>32V | 6.3A | Note1 |

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

4.4 POWER SUPPLY VOLTAGE SEQUENCE




* These signals should be measured at the terminal of 100Ω resistance.

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

Note2: Display signals (D0+/-, D1+/-, D2+/-, D3+/- and CK+/-) and function signals (MSL and DPS) must be Low or High impedance, exclude the VALID period (See above sequence diagram), in order to avoid that internal circuit is damaged.
If some of display and function signals of this product are cut while this product is working, even if the signal input to it once again, it might not work normally. VCC should be cut when the display and function signals are stopped.

Note3: The backlight should be turned on within the valid period of display and function signals, in order to avoid unstable data display.

## 4.5 CONNECTIONS AND FUNCTIONS FOR INTERFACE PINS

### 4.5.1 LCD panel signal processing board

CN1 socket (LCD module side): DF14H-20P-1.25H (Hirose Electric Co., Ltd. (HRS))
Adaptable plug: DF14-20S-1.25C (Hirose Electric Co., Ltd. (HRS))

| Pin No. | Symbol | Signal | Remarks |
|---|---|---|---|
| 1 | VCC | Power supply | Note1 |
| 2 | VCC | | |
| 3 | GND | Ground | Note1 |
| 4 | GND | | |
| 5 | D0- | Pixel data | Note2 |
| 6 | D0+ | | |
| 7 | GND | Ground | Note1 |
| 8 | D1- | Pixel data | Note2 |
| 9 | D1+ | | |
| 10 | GND | Ground | Note1 |
| 11 | D2- | Pixel data | Note2 |
| 12 | D2+ | | |
| 13 | GND | Ground | Note1 |
| 14 | CLK- | Pixel clock | Note2 |
| 15 | CLK+ | | |
| 16 | GND | Ground | Note1 |
| 17 | D3- | Pixel data | Note2 |
| 18 | D3+ | | |
| 19 | DPS | Selection of scan direction | High: Reverse scan<br>Low or Open: Normal scan<br>Note3 |
| 20 | MSL | Selection of LVDS input map | High: Input map A<br>Low or Open: Input map B<br>Note4 |

Note1: All GND and VCC terminals should be used without any non-connected lines.
Note2: Twist pair wires with 100Ω (Characteristic impedance) should be used between LCD panel signal processing board and LVDS transmitter.
Note3: See "**4.8 SCANNING DIRECTIONS**".
Note4: See "**4.5.4 Connection between receiver and transmitter for LVDS**".

4.5.2 Backlight lamp

**Attention: VBLH and VBLC must be connected correctly. Wrong connections will cause electric shock and also break down of the product.**

CN201 plug (LCD module side): BHR-03VS-1 (J.S.T Mfg. Co., Ltd.)
Adaptable socket: SM02(8.0)B-BHS-1-TB(LF)(SN), SM02(8.0)B-BHS-1-TB
(J.S.T Mfg. Co., Ltd.)

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

CN202 plug (LCD module side): BHR-03VS-1 (J.S.T Mfg. Co., Ltd.)
Adaptable socket: SM02(8.0)B-BHS-1-TB(LF)(SN), SM02(8.0)B-BHS-1-TB
(J.S.T Mfg. Co., Ltd.)

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

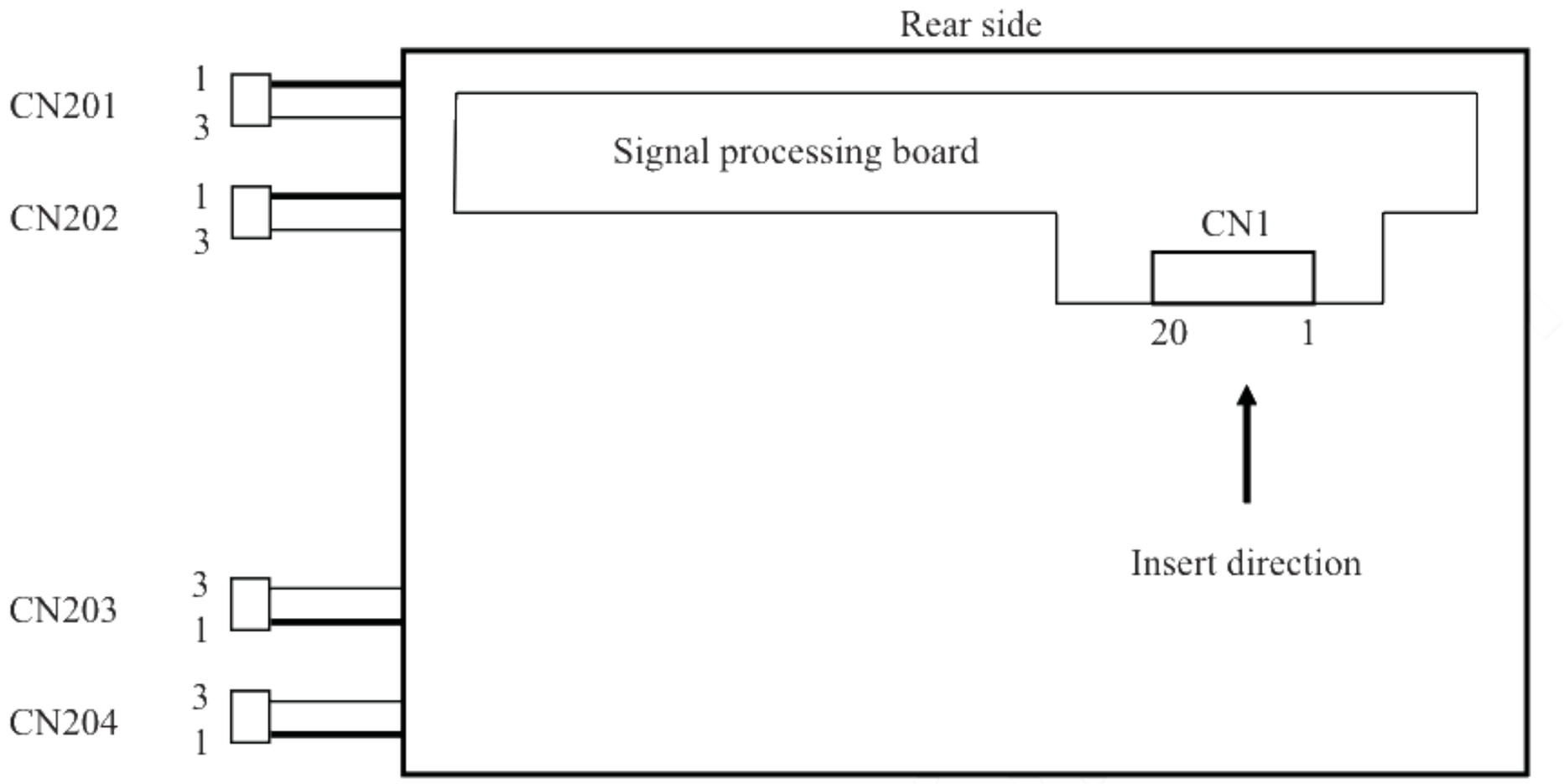
CN203 plug (LCD module side): BHR-03VS-1 (J.S.T Mfg. Co., Ltd.)
Adaptable socket: SM02(8.0)B-BHS-1-TB(LF)(SN), SM02(8.0)B-BHS-1-TB
(J.S.T Mfg. Co., Ltd.)

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

CN204 plug (LCD module side): BHR-03VS-1 (J.S.T Mfg. Co., Ltd.)
Adaptable socket: SM02(8.0)B-BHS-1-TB(LF)(SN), SM02(8.0)B-BHS-1-TB
(J.S.T Mfg. Co., Ltd.)

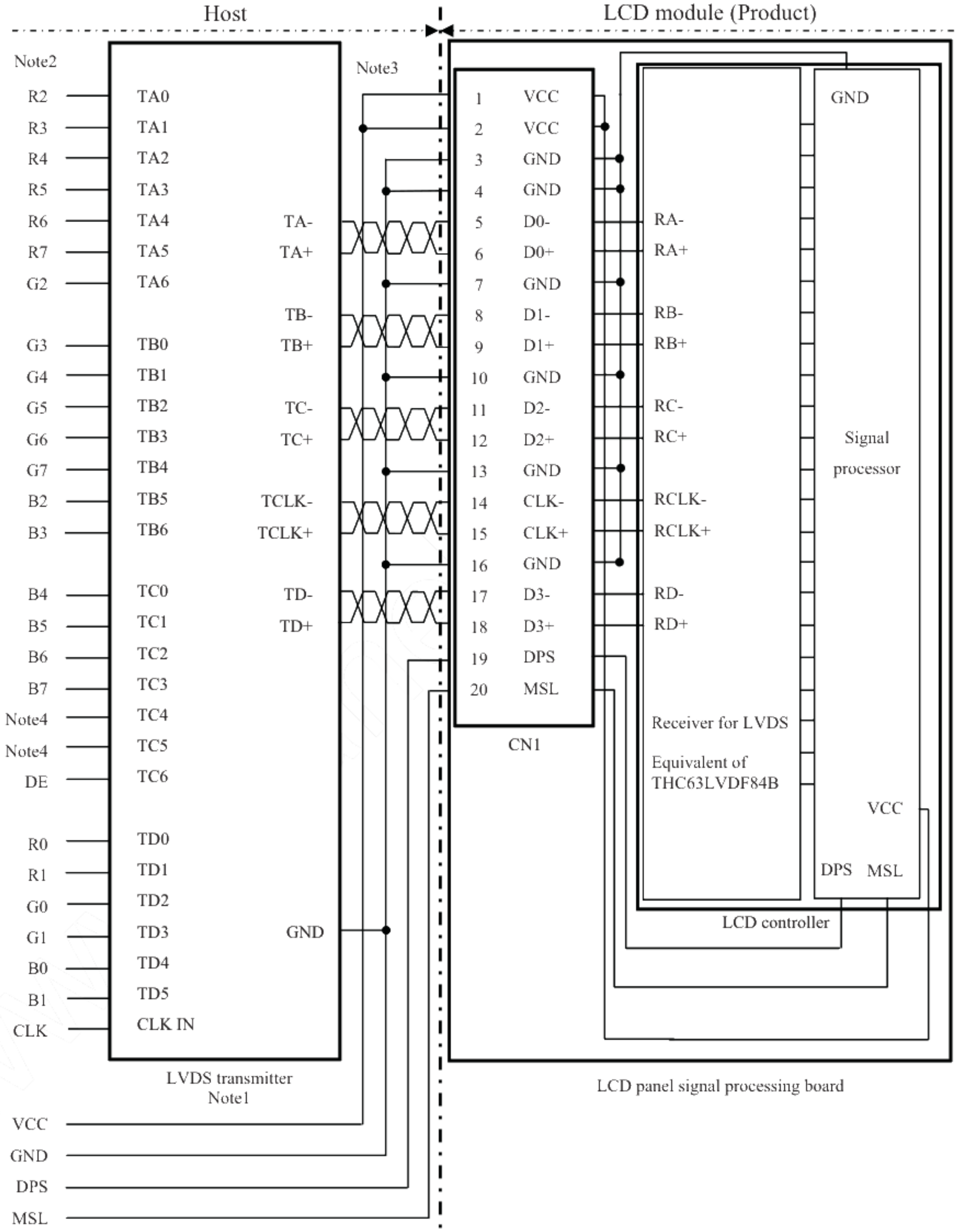
| Pin No. | Symbol | Signal | Remarks |
|---|---|---|---|
| 1 | VBLH | High voltage terminal (Hot) | Cable color: Blue |
| 2 | N.C. | - | Keep this pin Open. |
| 3 | VBLC | Low voltage terminal (Cold) | Cable color: Gray |

4.5.3 Position of plug and socket



4.5.4 Connection between receiver and transmitter for LVDS

(1) Input LVDS map A (MSL: "High")



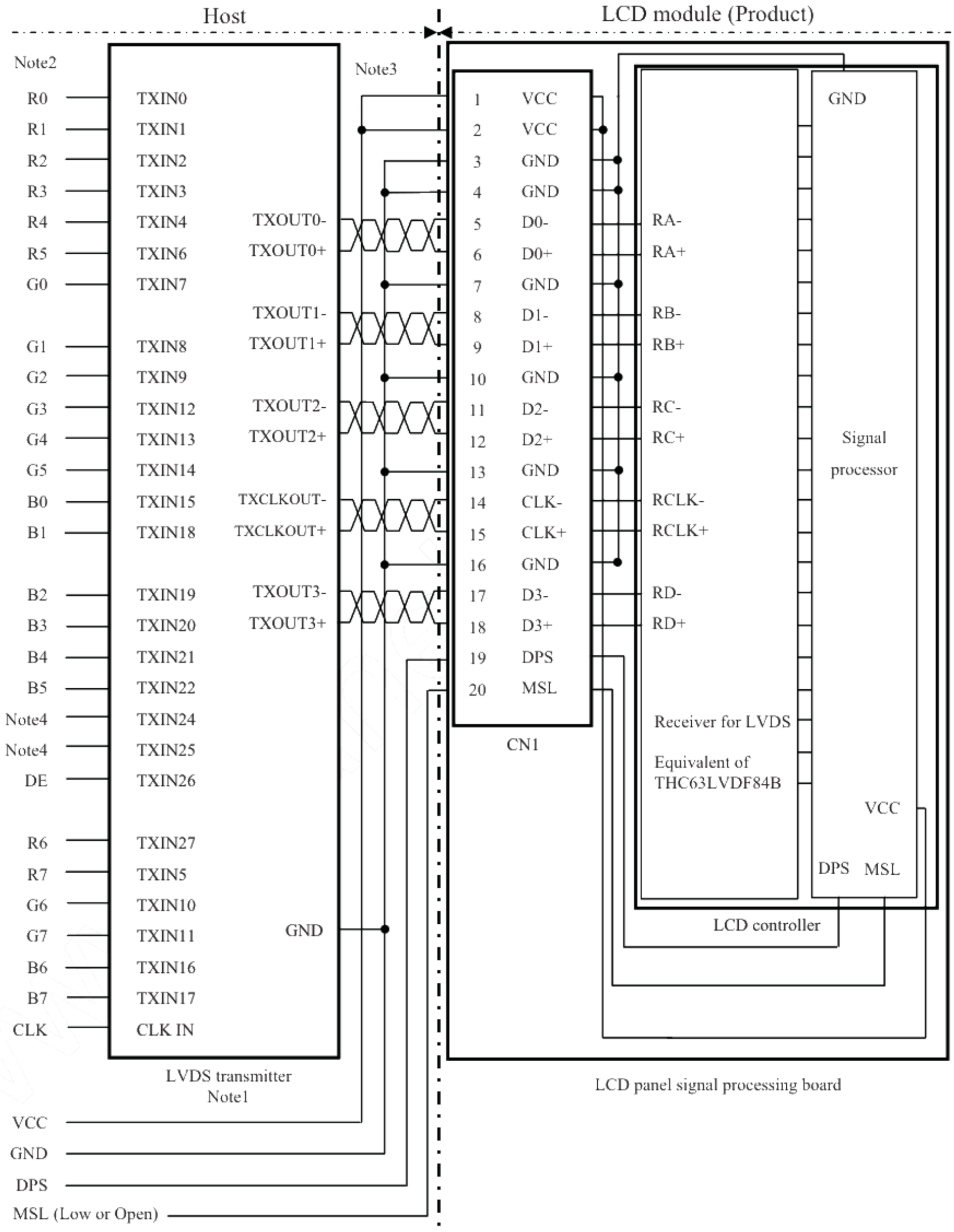

Note1: Recommended transmitter: THC63LVDM83R (THine Electronics Inc.) or equivalent

Note2: LSB (Least Significant Bit) – R0, G0, B0 MSB (Most Significant Bit) – R7, G7, B7

Note3: Twist pair wires with 100Ω (Characteristic impedance) should be used between LCD panel signal processing board and LVDS transmitter.

Note4: Input signals to TC4 and TC5 are not used inside the product, but do not keep TC4 and TC5 open to avoid noise problem.

(2) Input LVDS map B (MSL: "Low" or "Open")




Note1: Recommended transmitter: DS90C383 (National Semiconductor) or equivalent
Note2: LSB (Least Significant Bit) – R0, G0, B0 MSB (Most Significant Bit) – R7, G7, B7
Note3: Twist pair wires with 100Ω (Characteristic impedance) should be used between LCD panel signal processing board and LVDS transmitter.
Note4: Input signals to TC4 and TC5 are not used inside the product, but do not keep TC4 and TC5 open to avoid noise problem.

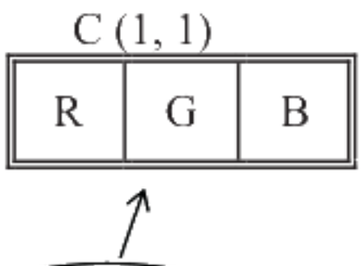
## 4.6 DISPLAY COLORS AND INPUT DATA SIGNALS

This product can display in equivalent to 16,777,216 colors in 256 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) | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | R7 | R6 | R5 | R4 | R3 | R2 | R1 | R0 | G7 | G6 | G5 | G4 | G3 | G2 | G1 | G0 | B7 | B6 | 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 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Red | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Magenta | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Green | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Cyan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 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 | 1 | 1 | 1 | 1 | 0 | 0 | 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 | 1 | 1 | 1 | 1 | 1 | 1 |
| Red gray scale | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | dark | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ↑ | | | | | : | | | | | | | | : | | | | | | | | : | | | |
| | ↓ | | | | | : | | | | | | | | : | | | | | | | | : | | | |
| | bright | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Green gray scale | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | 0 | 0 | 0 | 0 | 0 | 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 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ↑ | | | | | : | | | | | | | | : | | | | | | | | : | | | |
| | ↓ | | | | | : | | | | | | | | : | | | | | | | | : | | | |
| | bright | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 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 | 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 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | ↑ | | | | | : | | | | | | | | : | | | | | | | | : | | | |
| | ↓ | | | | | : | | | | | | | | : | | | | | | | | : | | | |
| | bright | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| | Blue | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

## 4.7 DISPLAY POSITIONS

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




| | | | | | | |
|---|---|---|---|---|---|---|
| C( 1, 1) | C( 2, 1) | ••• | C( X, 1) | ••• | C(1023, 1) | C(1024, 1) |
| C( 1, 2) | C( 2, 2) | ••• | C( X, 2) | ••• | C(1023, 2) | C(1024, 2) |
| • • • | • • • | • ••• • | • • • | • ••• • | • • • | • ••• • |
| C( 1, Y) | C( 2, Y) | ••• | C( X, Y) | ••• | C(1023, Y) | C(1024, Y) |
| • • • | • • • | • ••• • | • • • | • ••• • | • • • | • • • |
| C( 1, 767) | C( 2, 767) | ••• | C( X, 767) | ••• | C(1023, 767) | C(1024, 767) |
| C( 1, 768) | C( 2, 768) | ••• | C( X, 768) | ••• | C(1023, 768) | C(1024, 768) |

## 4.8 SCANNING DIRECTIONS

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

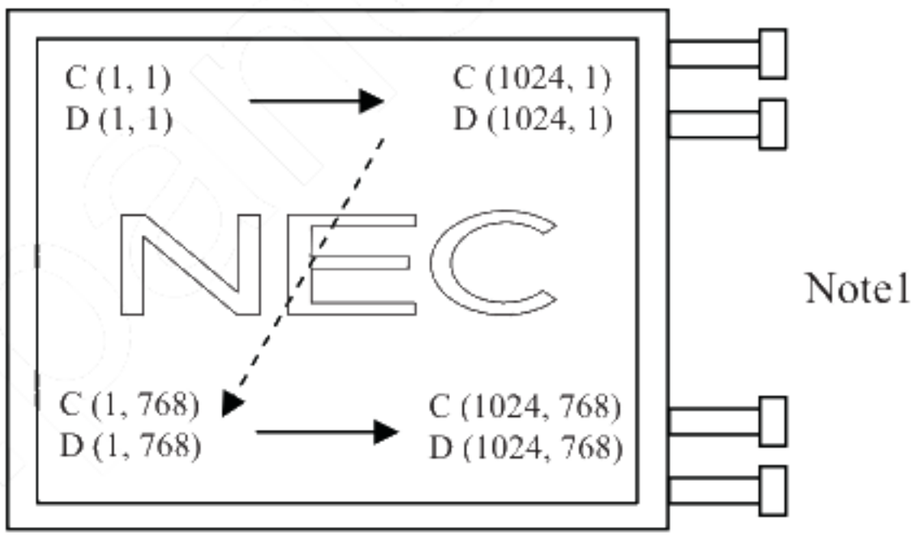



Figure1. Normal scan (DPS: Low or Open)

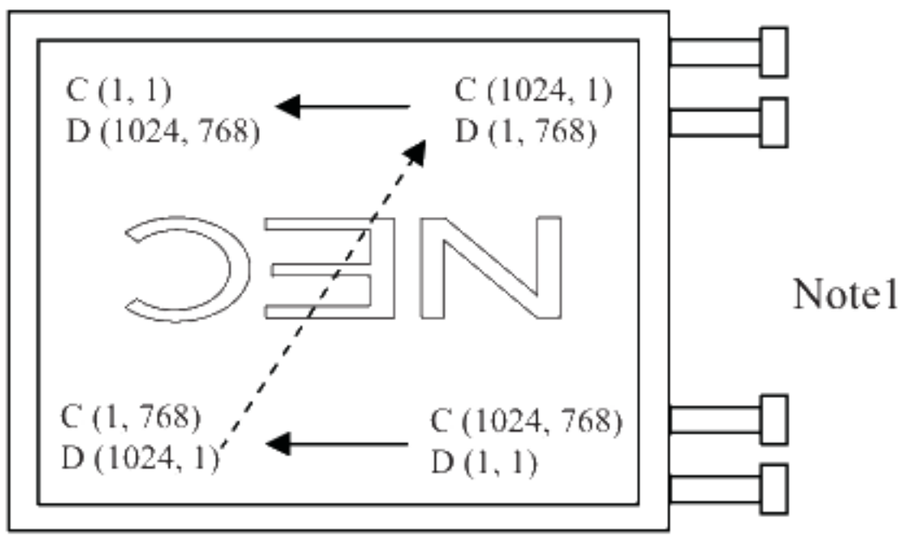



Figure2. Reverse scan (DPS: High)

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

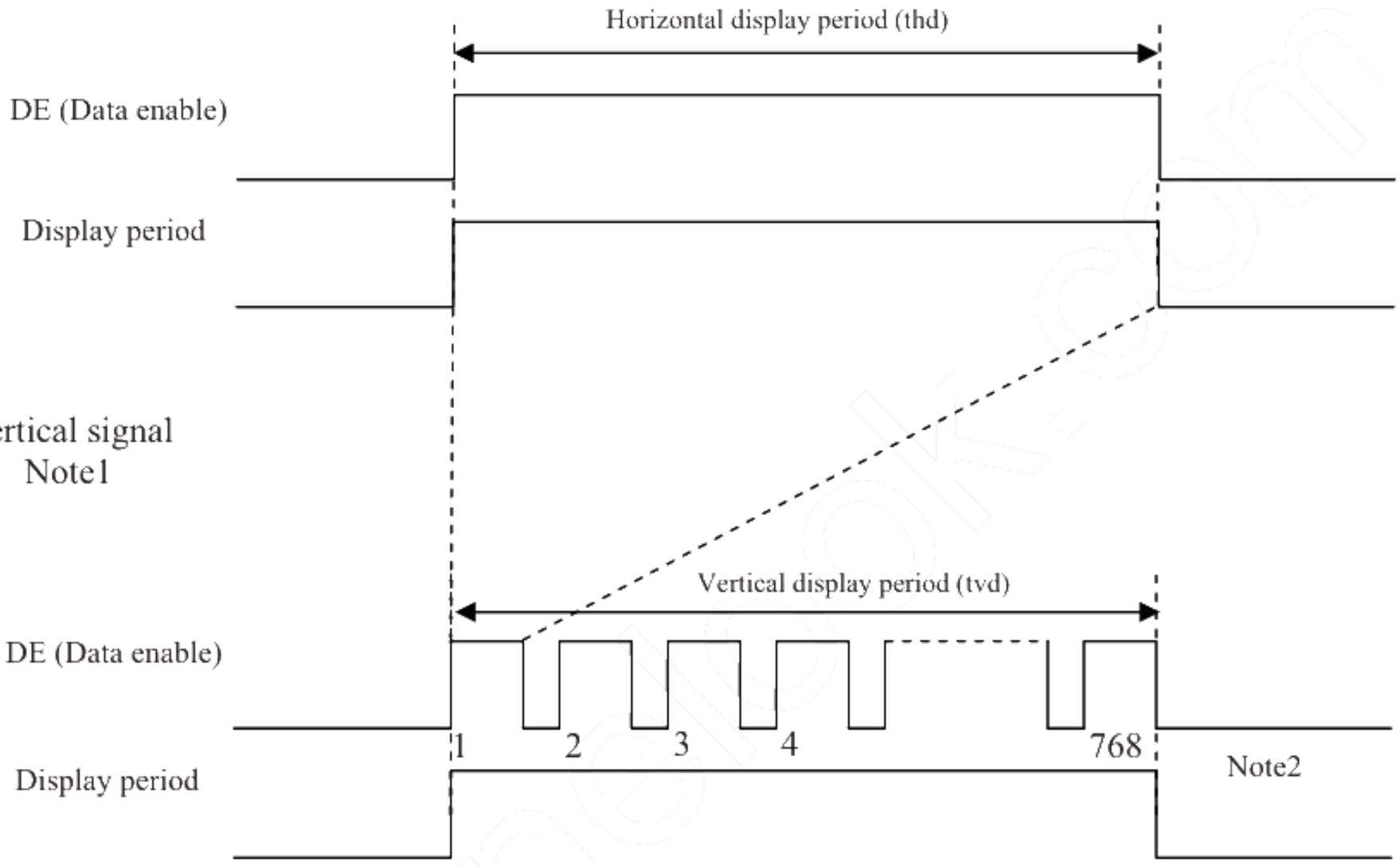
C (X, Y): The coordinates of the display position (See "**4.7 DISPLAY POSITIONS**".)

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

## 4.9 INPUT SIGNAL TIMINGS

### 4.9.1 Outline of input signal timings

- Horizontal signal
  Note1




- Vertical signal
  Note1




Note1: This diagram indicates virtual signal for set up to timing.
Note2: See "**4.9.3 Input signal timing chart**" for numeration of pulse.

4.9.2 Timing characteristics

(Note1)

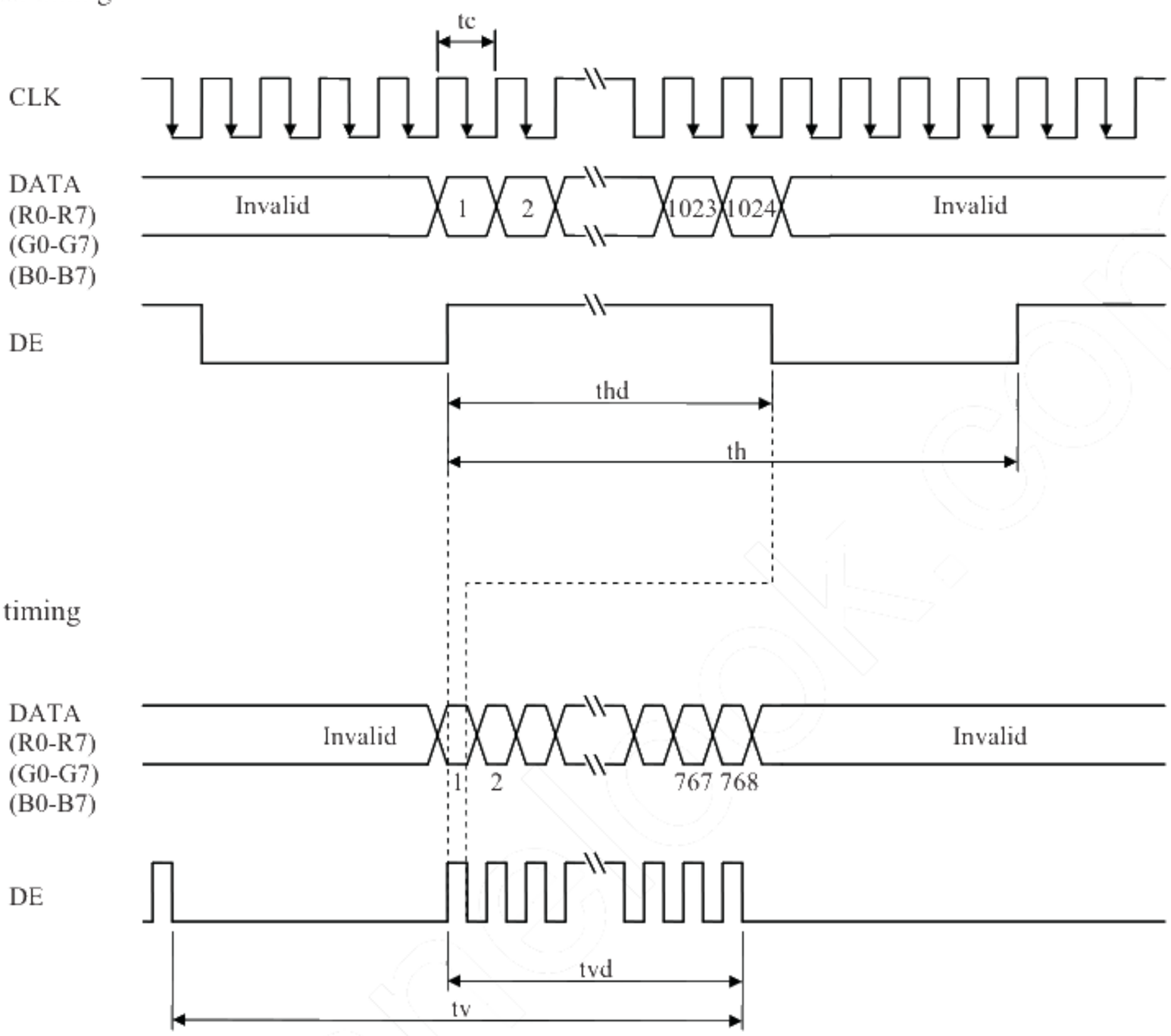
| Parameter | | | | Symbol | min. | typ. | max. | Unit | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| CLK | Frequency | | Vf= 75Hz | 1/tc | 60.0 | - | 70.0 | MHz | - |
| | | | Vf= 60Hz | | 60.0 | 65.0 | 70.0 | | 15.384ns (typ.) |
| | Duty | | | - | - | | | - | Note2 |
| | Rise time, Fall time | | | - | | | | ns | |
| DATA | CLK-DATA | Setup time | | - | - | | | ns | Note2 |
| | | Hold time | | - | | | | ns | |
| | Rise time, Fall time | | | - | | | | ns | |
| DE | Horizontal | Cycle | Vf= 75Hz | th | 16.000 | - | - | µs | - |
| | | | | | 1,100 | - | 1,800 | CLK | |
| | | | Vf= 60Hz | | 16.000 | 20.676 | - | µs | 48.363kHz (typ.) |
| | | | | | 1,100 | 1,344 | 1,800 | CLK | |
| | | Display period | | thd | 1,024 | | | CLK | - |
| | Vertical (One frame) | Cycle | Vf= 75Hz | tv | - | 13.328 | 20.0 | ms | 75.029Hz (typ.) |
| | | | | | 771 | - | - | H | |
| | | | Vf= 60Hz | | - | 16.666 | 20.0 | ms | 60.000Hz (typ.) |
| | | | | | 771 | 806 | - | H | |
| | | Display period | | tvd | 768 | | | H | - |
| | CLK-DE | Setup time | | - | - | | | ns | Note2 |
| | | Hold time | | - | | | | ns | |
| | Rise time, Fall time | | | - | | | | ns | |

Note1: Definition of parameters is as follows.
tc= 1CLK, th= 1H, Vf= 1/tv

Note2: See the data sheet of LVDS transmitter.

4.9.3 Input signal timing chart

Horizontal timing




Vertical timing

## 4.10 OPTICS

### 4.10.1 Optical characteristics

3

(Note1, Note2)

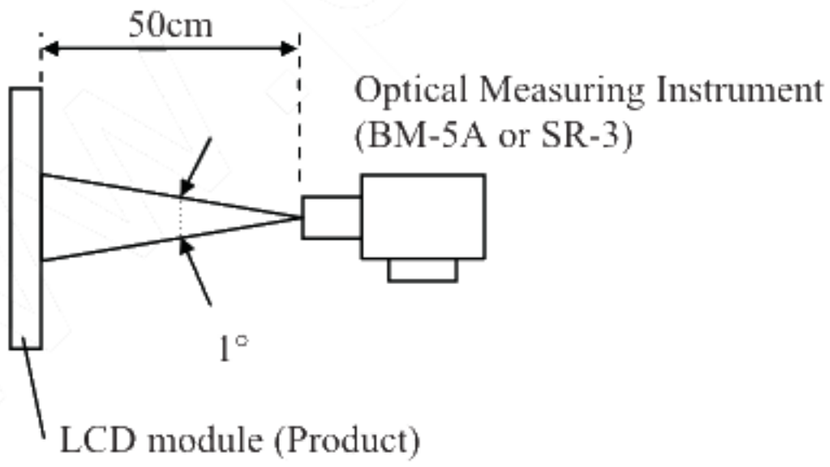
| Parameter | | Condition | Symbol | min. | typ. | max. | Unit | Measuring instrument | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| Luminance | | White at center<br>θR= 0°, θL= 0°, θU= 0°, θD= 0° | L | 400 | 500 | - | cd/m$^2$ | BM-5A | - |
| Contrast ratio | | White/Black at center<br>θR= 0°, θL= 0°, θU= 0°, θD= 0° | CR | 400 | 500 | - | - | BM-5A | Note3 |
| Luminance uniformity | | White<br>θR= 0°, θL= 0°, θU= 0°, θD= 0° | LU | - | 1.1 | 1.3 | - | BM-5A | Note4 |
| Chromaticity | White | **x** coordinate | Wx | 0.283 | 0.313 | 0.343 | - | SR-3 | Note5 |
| | | **y** coordinate | Wy | 0.299 | 0.329 | 0.359 | - | | |
| | Red | **x** coordinate | Rx | - | 0.59 | - | - | | |
| | | **y** coordinate | Ry | - | 0.34 | - | - | | |
| | Green | **x** coordinate | Gx | - | 0.33 | - | - | | |
| | | **y** coordinate | Gy | - | 0.52 | - | - | | |
| | Blue | **x** coordinate | Bx | - | 0.16 | - | - | | |
| | | **y** coordinate | By | - | 0.15 | - | - | | |
| Color gamut | | θR= 0°, θL= 0°, θU= 0°, θD= 0°<br>at center, against NTSC color space | C | 33 | 40 | - | % | | |
| Response time | | White to Black | Ton | - | 4 | 8 | ms | BM-5A | Note6<br>Note7 |
| | | Black to White | Toff | - | 14 | 21 | ms | | |
| Viewing angle | Right | θU= 0°, θD= 0°, CR≥ 10 | θR | 70 | 80 | - | ° | EZ Contrast | Note8 |
| | Left | θU= 0°, θD= 0°, CR≥ 10 | θL | 70 | 80 | - | ° | | |
| | Up | θR= 0°, θL= 0°, CR≥ 10 | θU | 70 | 80 | - | ° | | |
| | Down | θR= 0°, θL= 0°, CR≥ 10 | θD | 50 | 60 | - | ° | | |

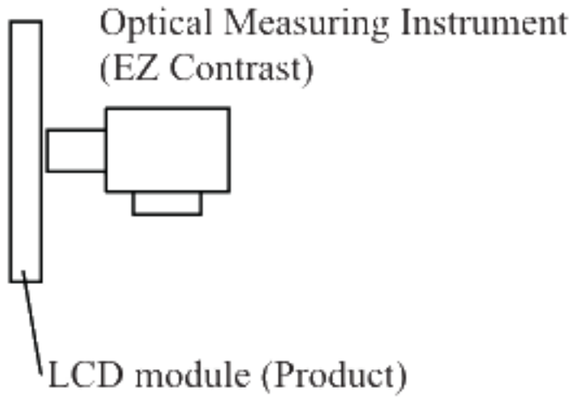
Note1: These are initial characteristics.

Note2: Measurement conditions are as follows.

Ta= 25°C, VCC= 3.3V, IBL= 6.0mArms/lamp, Display mode: XGA,
Horizontal cycle= 1/48.363kHz, Vertical cycle= 1/60.0Hz, DPS= Low or Open: Normal scan

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




Note3: See "**4.10.2 Definition of contrast ratio**".

Note4: See "**4.10.3 Definition of luminance uniformity**".

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

Note6: Product surface temperature: TopF= 32°C

Note7: See "**4.10.4 Definition of response times**".

Note8: See "**4.10.5 Definition of viewing angles**".

4.10.2 Definition of contrast ratio

The contrast ratio is calculated by using the following formula.

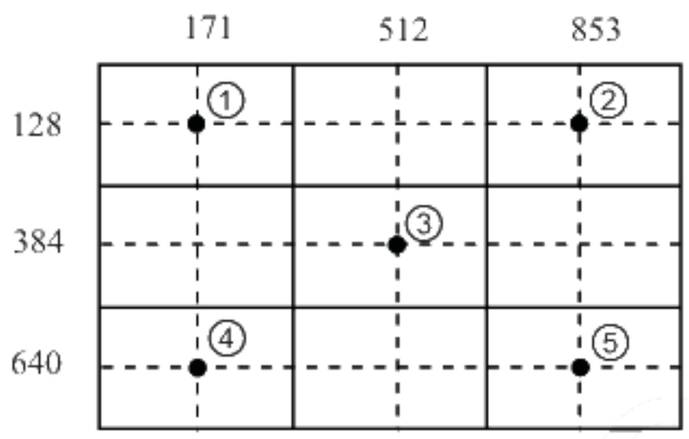
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance of white screen}}{\text{Luminance of black screen}}$$

4.10.3 Definition of luminance uniformity

The luminance uniformity is calculated by using following formula.

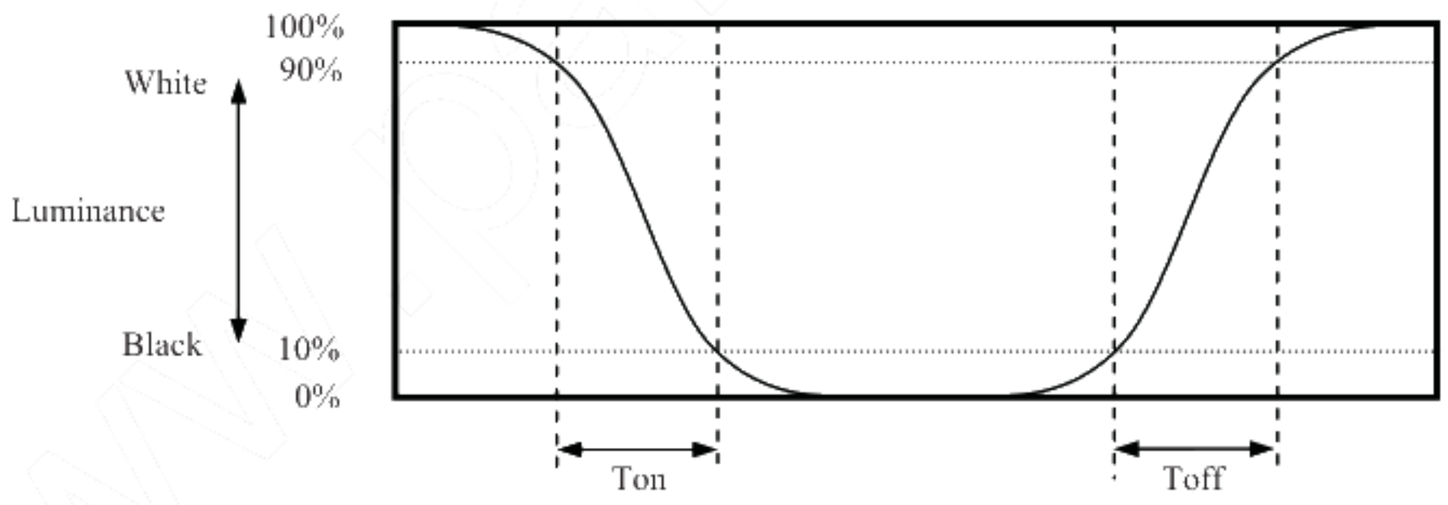
$$\text{Luminance uniformity (LU)} = \frac{\text{Maximum luminance from ① to ⑤}}{\text{Minimum luminance from ① to ⑤}}$$

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

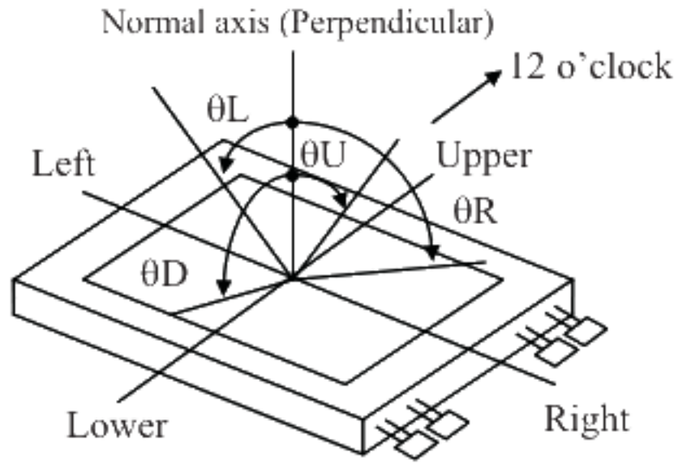



4.10.4 Definition of response times

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




4.10.5 Definition of viewing angles

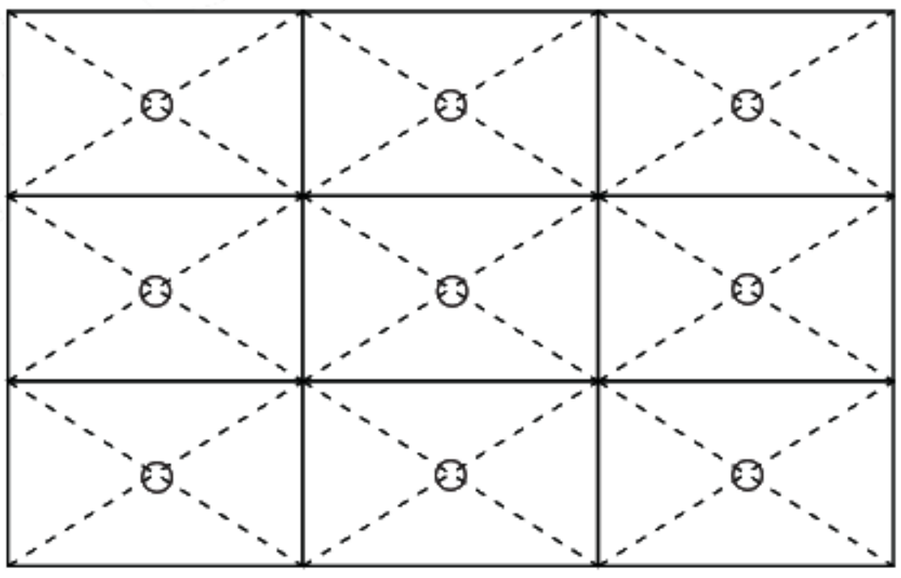


## 5. RELIABILITY TESTS

| Test item | Condition | Judgement |
|---|---|---|
| High temperature and humidity (Operation) | ① 60 ± 2°C, RH= 90%, 240hours<br>② Display data is black. | No display malfunctions<br>Note1 |
| High temperature (Operation) | ① 70 ± 3°C, 240hours<br>② Display data is black. | |
| Heat cycle (Operation) | ① -10 ± 3°C…1hour<br>70 ± 3°C…1hour<br>② 50cycles, 4 hours/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, 11.76m/s$^2$<br>② 1 minute/cycle<br>③ X, Y, Z direction<br>④ 50 times each directions | No display malfunctions<br>No physical damages<br>Note1 |
| Mechanical shock (Non operation) | ① 294m/ s$^2$, 11ms<br>② ±X, ±Y, ±Z direction<br>③ 3 times each directions | |

Note1: Display and appearance are checked under environmental conditions equivalent to the inspection conditions of defect criteria.

Note2: See the following figure for discharge points.



## 6. PRECAUTIONS

### 6.1 MEANING OF CAUTION SIGNS

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

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

### 6.2 CAUTIONS

*** Do not touch lamp cables while turn on. There is a danger of an electric shock.**

*** Do not touch the working backlight and IC. There is a danger of burn injury.**
*** Do not shock and press the LCD panel and the backlight! There is a danger of breaking, because they are made of glass. (Shock: To be not greater 294m/s$^2$ and to be not greater 11ms, Pressure: To be not greater 19.6 N (ϕ16mm jig))**

### 6.3 ATTENTIONS 

#### 6.3.1 Handling of the product

① Take hold of both ends without touching the circuit board when the product (LCD module) is picked up from inner packing box to avoid broken down or misadjustment, because of stress to mounting parts on the circuit board.
② Do not hook nor pull cables such as lamp cable, and so on, in order to avoid any damage.
③ When the product is put on the table temporarily, display surface must be placed downward.
④ When handling the product, take the measures of electrostatic discharge with such as earth band, ionic shower and so on, because the product may be damaged by electrostatic.
⑤ The torque for product mounting screws must never exceed 0.343N·m. Higher torque might result in distortion of the bezel. And the length of product mounting screws must be ≤ 2.8mm.
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). Bends or twist described above and undue stress to any portion may cause display mura.
⑦ Do not press or rub on the sensitive product surface. When cleaning the product surface, use of the cloth with ethanolic liquid such as screen cleaner for LCD is recommended.
⑧ Do not push nor pull the interface connectors while the product is working.
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.

⑩ If the lamp cable is attached on the metal part of the product directly, high frequency leak current to the metal part may occur, then the brightness may decrease or the lamp may not be turned on.
⑪ When not connecting FG of the LCD module to the customer's equipment ground, inverter noise may create video noise on the LCD screen.
⑫ When handling the product, use of an original protection sheet on the product surface (polarizer) is recommended for protection of product surface. Adhesive type protection sheet may change color or characteristics of the polarizer.

6.3.2 Environment

① Do not operate or store in high temperature, high humidity, dewdrop atmosphere or corrosive gases. Keep the product in packing box with antistatic pouch in room temperature to avoid dusts and sunlight, when storing the product.
② In order to prevent dew condensation occurring by temperature difference, the product packing box should be opened after enough time being left under the environment of an unpacking room. Evaluate the leaving time sufficiently because a situation of dew condensation occurring is changed by the environmental temperature and humidity. (Recommended leaving time: 6 hours or more with packing state)
③ Do not operate in high magnetic field. Circuit boards may be broken down by it.
④ This product is not designed as radiation hardened.

6.3.3 Characteristics

**The following items are neither defects nor failures.**

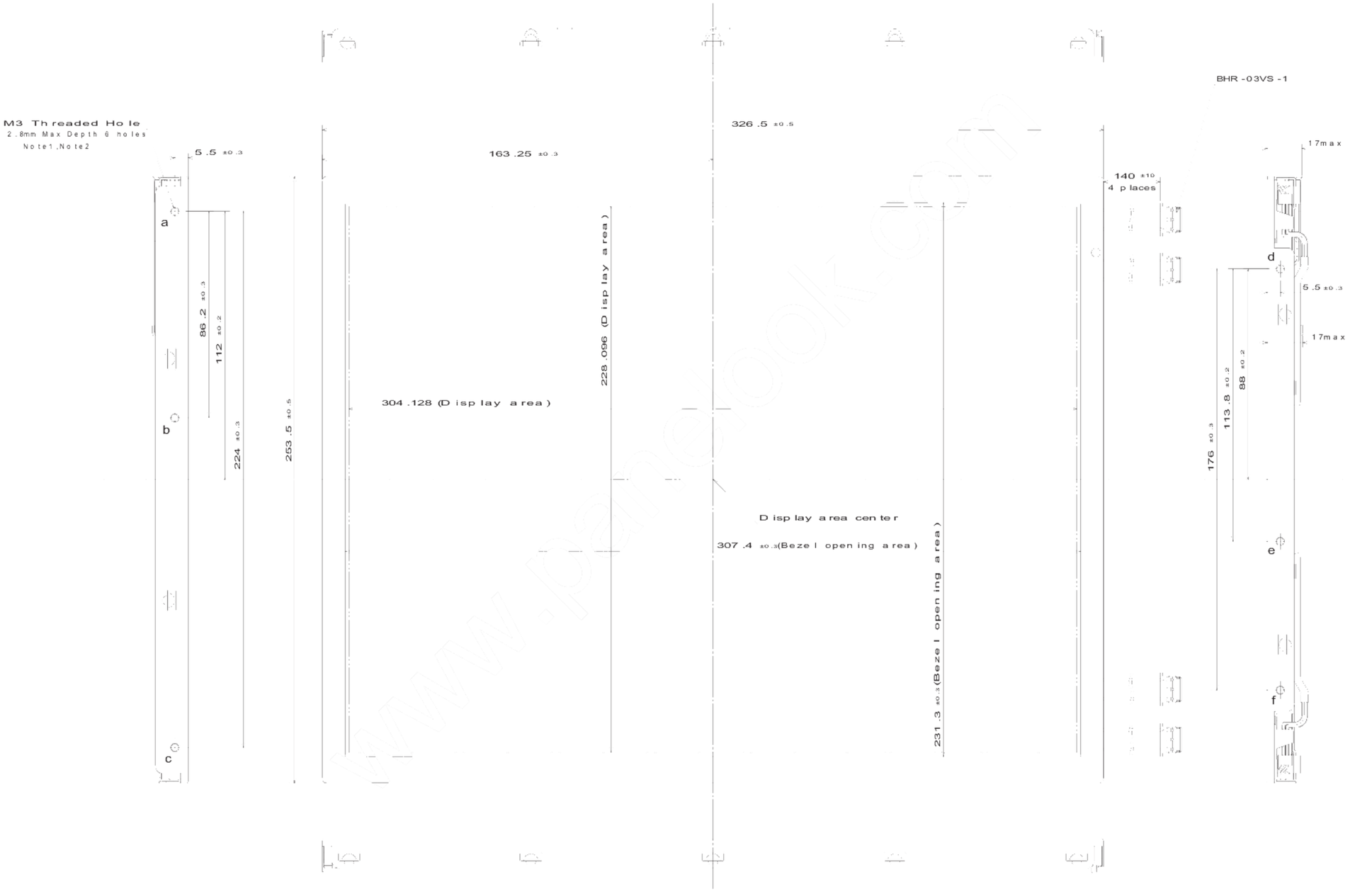
① Response time, luminance and color may be changed by ambient temperature.
② Display mura, flicker, vertical seam or small spot may be observed depending on display patterns.
③ Optical characteristics (e.g. luminance, display uniformity, etc.) gradually is going to change depending on operating time,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

6.3.4 Other

① All GND and VCC terminals should be used without any non-connected lines.
② Do not disassemble a product or adjust variable resistors.
③ See "REPLACEMENT MANUAL FOR LAMP HOLDER SET", when replacing backlight lamps.
④ Pack the product with original shipping package, in order to avoid any damages during transportation, when returning the product to NEC for repair and so on.
⑤ The LCD module by itself or integrated into end product should be packed and transported with display in the vertical position. Otherwise the display characteristics may be degraded.

**7. OUTLINE DRAWINGS**

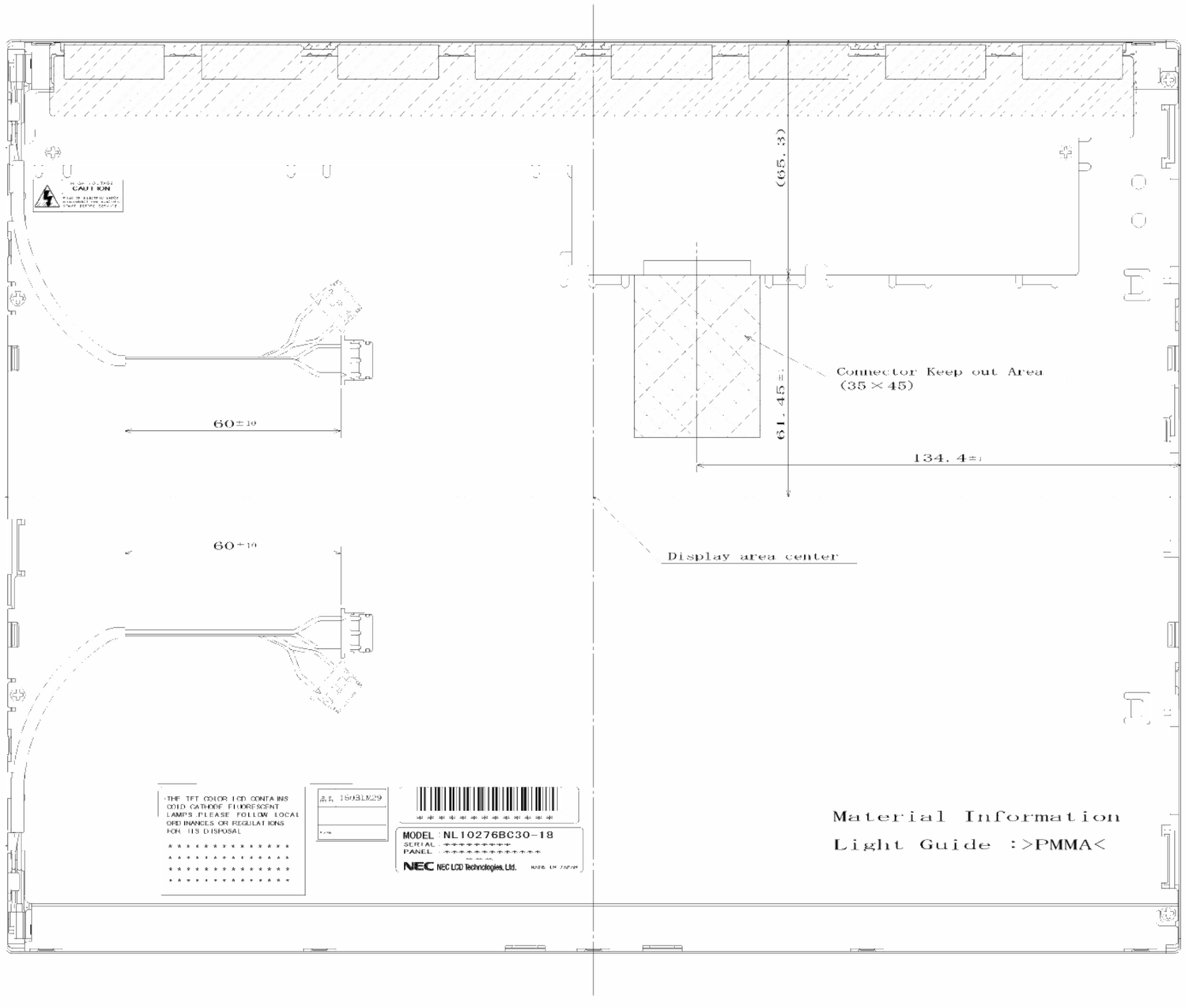
7.1 FRONT VIEW




Unit: mm

Note1: The torque for product mounting screws must never exceed 0.343N·m. And the length of product mounting screws must be ≤ 2.8mm.
Note2: NEC's reliability tests are carried out using mounting holes "a", "c", "d" and "f".

7.2 REAR VIEW




Note1: The values in parentheses are for reference.
Note2: The torque for product mounting screws must never exceed 0.343N·m.

Unit: mm

## REVISION HISTORY

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

| Edition | Prepared date | Revision contents and signature |
|---|---|---|
| 1st edition | June 8, 2005 | **Revision contents**<br><br>New issue<br><br>**Writer**<br><br>*Approved by*: T. ITO ; *Checked by*: ——— ; *Prepared by*: R. KAWASHIMA |
| 2nd edition | Oct 17, 2005 | **Revision contents**<br><br>P5 General specifications, P22 Optical characteristics<br>• Contrast ratio: 400 (typ.) → 450 (typ.)<br>• Response time (Ton+Toff): → 25ms (typ.)<br>P6 Block diagram<br>• Pull-down resistance of MSL terminal: 47kΩ (addition)<br>• Connection between GND and FG: Connected → Not connected<br>P8 Electrical characteristics- LCD panel signal processing board<br>• Input voltage for MSL and DPS signal (correction)<br>• Input current for MSL and DPS signal (addition)<br>P10 Fuse: → TF16SN3.15T<br>P11 Power supply voltage sequence: The timing from VCC to Display and Function signals (correction)<br>P13 Backlight lamp: Cable color (decision)<br>P16 Connection between receiver and transmitter for LVDS: Input LVDS map B (correction)<br>P20 Input signal timings- Timing characteristics: Note3 (elimination)<br><br>**Writer**<br><br>*Approved by*: T. ITO ; *Checked by*: ——— ; *Prepared by*: R. KAWASHIMA |
| 3rd edition | Dec. 27, 2005 | **Revision contents**<br><br>P5 General specifications<br>• Lamp holder set: → 150LHS29<br>• Power consumption: → 15.7W (typ.)<br>P7 Absolute maximum ratings- Operating temperature- Rear surface: → -10 to +70°C<br>P8, P9 Electrical characteristics<br>• LCD panel signal processing board<br>• Power supply current: → 530mA (typ.), 900mA (max.)<br>• Backlight lamp- Lamp starting voltage<br>• Ta= -10°C: → 1,690Vrms (min.)<br>P5 General specifications, P22 Optical characteristics<br>• Parameters are decided.<br>• Measuring Instrument<br>• Chromaticity BM-5A → SR-3<br>• Viewing angle BM-5A → EZ Contrast<br><br>**Signature of writer**<br><br>*Approved by*: T. ITO ; *Checked by*: ——— ; *Prepared by*: R. KAWASHIMA |