PRELIMINARY

NEC LCD Technologies, Ltd.

# TFT COLOR LCD MODULE

## NL10276BC30-34D

### 38cm (15.0 Type)
### XGA
### LVDS interface (1port)

## PRELIMINARY DATA SHEET

**DOD-PP-0753 (1st edition)**

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## INTRODUCTION



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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 NL10276BC30-34D 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 APPLICATION

- For industrial use

### 1.3 FEATURES

- Wide viewing angle
- Fast response time
- LVDS interface (8-bit)
- Selectable LVDS input map
- Reversible-scan direction
- Small foot print
- Long life LED backlight type
- Replaceable lamp holder for backlight

## 2. GENERAL SPECIFICATIONS

| | |
|---|---|
| ***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) × (12.0) (max. D) mm Note1 |
| ***Weight*** | 970g (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 80° (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>50% (typ.) [against NTSC color space] |
| ***Response time*** | *Ton+Toff (10%←→ 90%)*<br>18ms (typ.) |
| ***Luminance*** | *At IL=50mA / One circuit*<br>400cd/$m^2$ (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*** | LED Backlight type:<br>( Replaceable part<br>• Lamp holder set: Type No. TBD ) |
| ***Power consumption*** | *At IL= 50mA / One circuit, Checkered flag pattern*<br>10.6W (typ.) |

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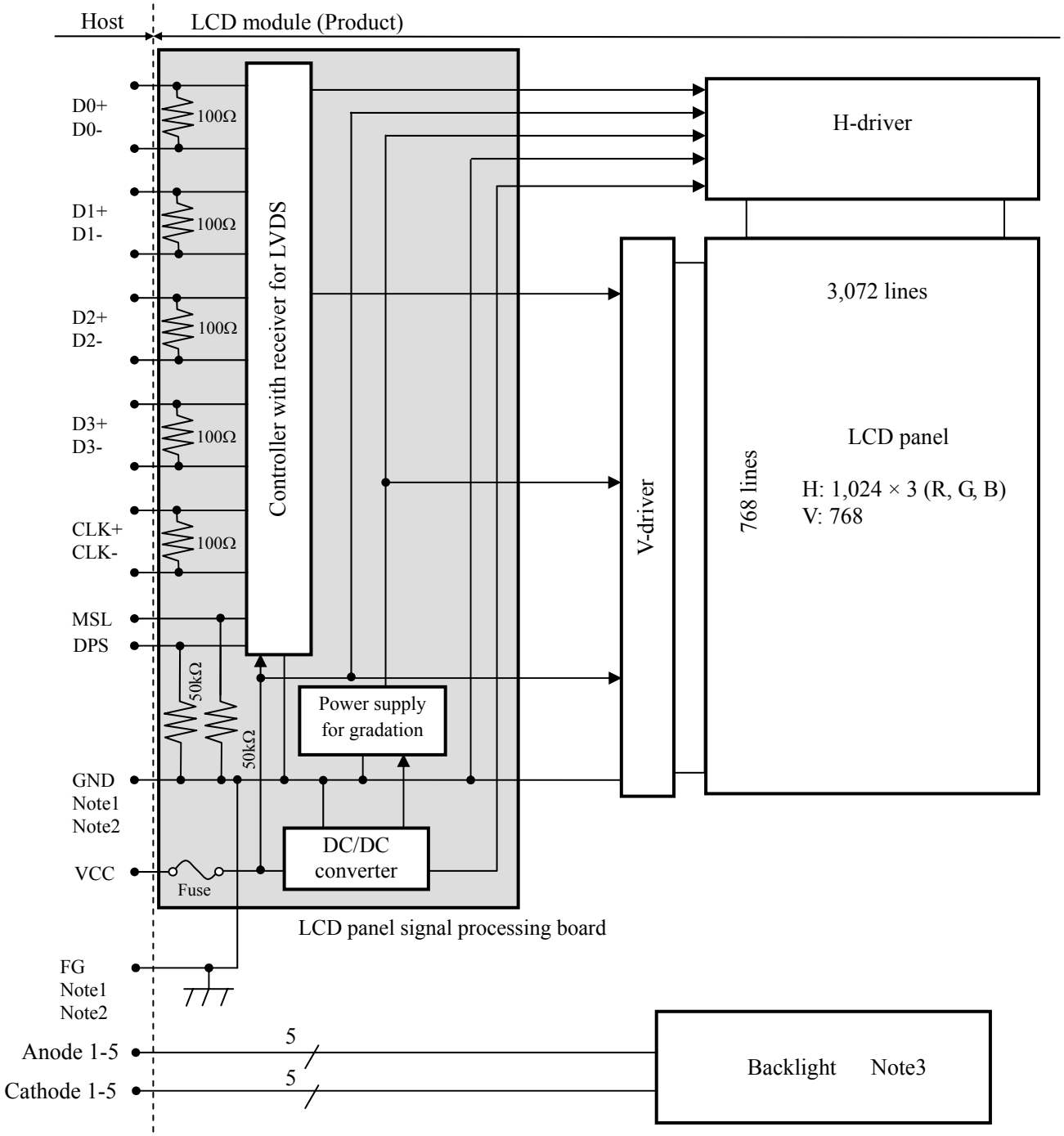
**3. BLOCK DIAGRAM**

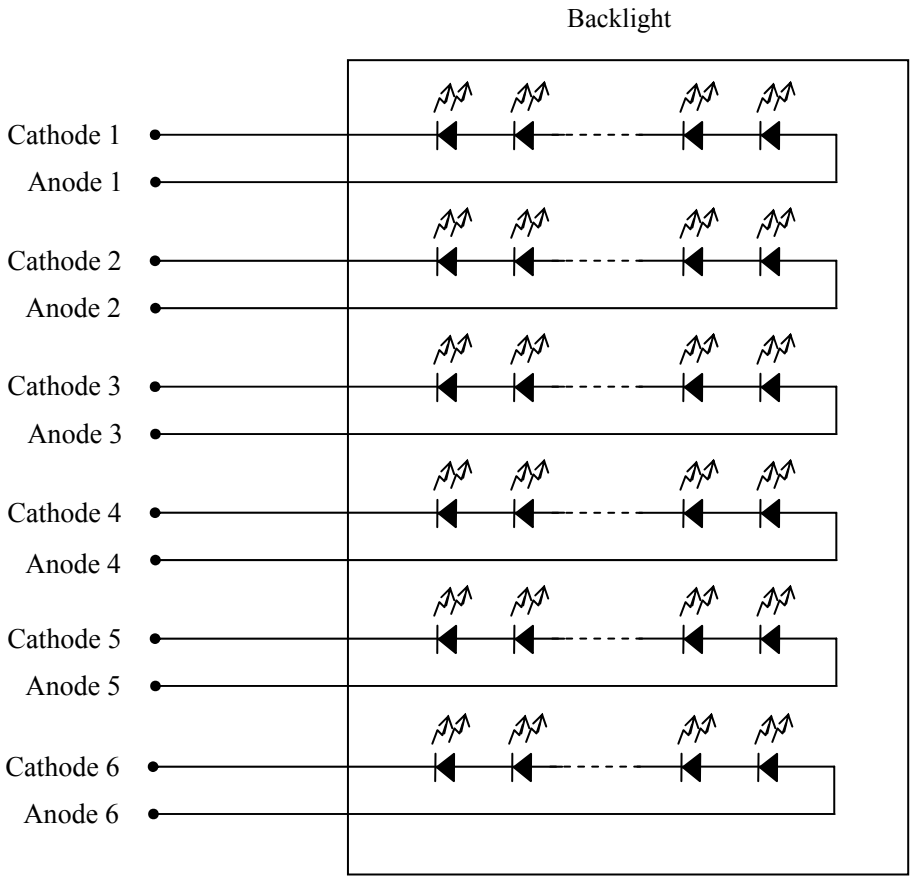



Note1: Relations between GND (Signal ground) and FG (Frame ground) in the LCD module is as follows.

| | |
|---|---|
| GND-FG | Connected |

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

Note3: Detail of backlight



## 4. DETAILED SPECIFICATIONS

### 4.1 MECHANICAL SPECIFICATIONS

| Parameter | Specification | | Unit |
|---|---|---|---|
| Module size | 326.5 ± 0.5 (W) × 253.5 ± 0.5 (H) × (12.0) max. (D) | Note1, | mm |
| Display area | 304.128 (H) × 228.096 (V) | Note1 | mm |
| Weight | 970(typ.), 1,050 (max.) | | g |

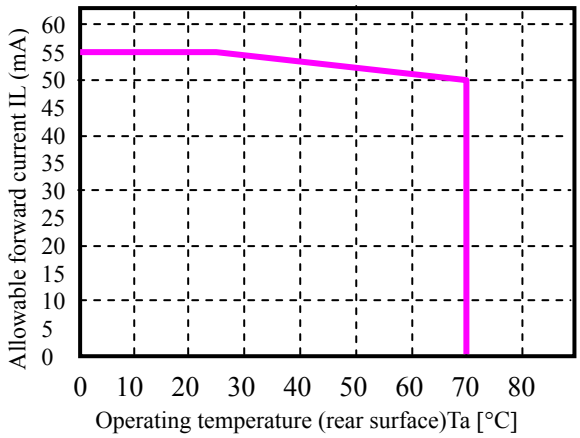
Note1: See "**8. OUTLINE DRAWINGS**".

### 4.2 ABSOLUTE MAXIMUM RATINGS

| Parameter | | Symbol | Rating | Unit | Remarks |
|---|---|---|---|---|---|
| Power supply voltage | LCD panel signal processing board | VCC | -0.3 to +4.0 | V | - |
| Input voltage for signals | Display signals Note1 | VD | -0.3 to VCC+0.3 | V | |
| | Function signal Note2 | VF | | | |
| Backlight | Power dissipation | PD | (600) | mW | per one circuit |
| | Forward current | IL | Note3 | mA | |
| Storage temperature | | Tst | -20 to +70 | °C | Note4 |
| Operating temperature | | Top | -20 to +70 | °C | Note5 |
| Relative humidity Note6 | | RH | ≤ 95 | % | Ta ≤ 40°C |
| | | | ≤ 85 | % | 40 < Ta ≤ 50°C |
| | | | ≤ 55 | % | 50 < Ta ≤ 60°C |
| | | | ≤ 36 | % | 60 < Ta ≤ 70°C |
| Absolute humidity Note6 | | AH | ≤ 70 Note7 | $g/m^3$ | Ta > 60°C |

Note1: D0+/-, D1+/-, D2+/-, D3+/-, CLK+/-
Note2: MSL, DPS

Note3 Forward current




Note4: Measured at LCD panel surface (including self-heat)
Note5: Measured at LCD module's rear shield surface (including self-heat)
Note6: No condensation
Note7: 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 | - | 500 Note1 | 700 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 | 2.0 | - | VCC | V | - |
| | Low | VFL | 0 | - | 0.8 | 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, Note2 Note3)

| Parameter | Symbol | min. | typ. | max. | Unit | Remarks |
|---|---|---|---|---|---|---|
| Forward Current | IL | - | 50 | 55 | mA | - |
| Forward Voltage | VL | - | 29.7 | 34.2 | V | at IL= 50 mA / One circuit |

Note1: Please drive with constant current.

Note2: The Luminance uniformity may be changed depending on the current variation between 6 circuits. It is recommended that the current value difference between each circuit is less than 5%.

Note3: See **"4.2 ABSOLUTE MAXIMUM RATING "**

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 |

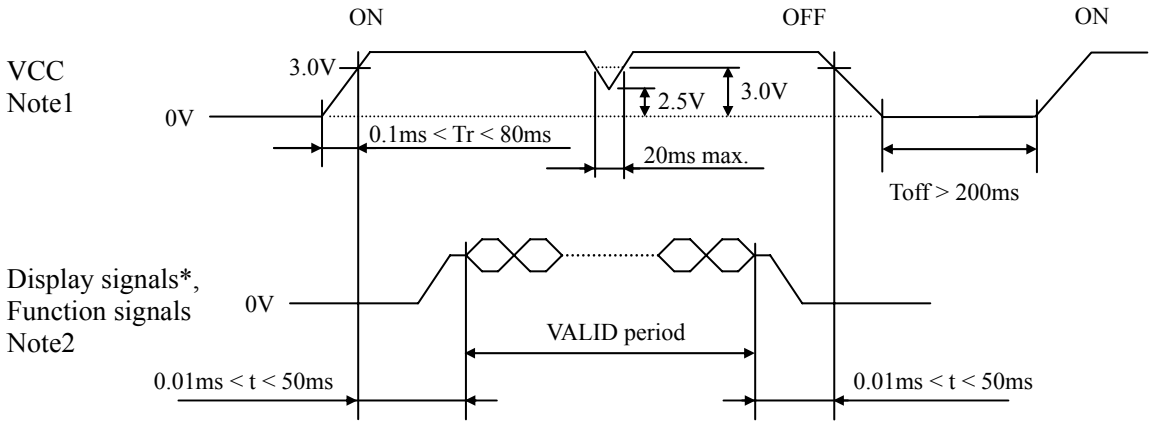
Note1: The permissible ripple voltage includes spike noise.

4.3.4 Fuse

| Parameter | Fuse | | Rating | Fusing current | Remarks |
|---|---|---|---|---|---|
| | Type | Supplier | | | |
| VCC | FCC16202AB | KAMAYA ELECTRIC Co., Ltd | 2.0A<br>32V | 4.0A | 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.

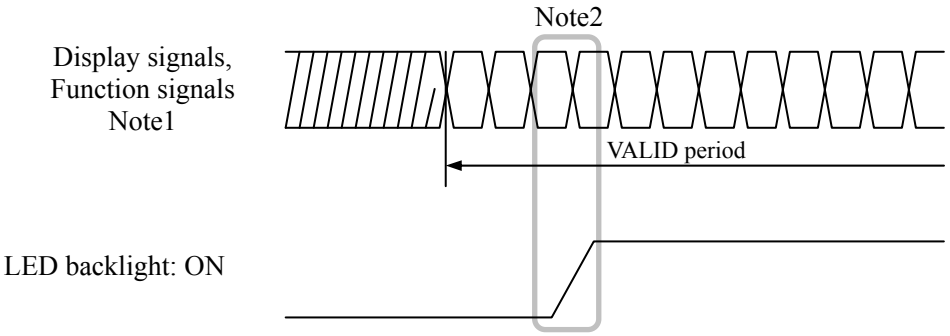
4.4 POWER SUPPLY VOLTAGE SEQUENCE




* 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+/-, CLK+/-) and function signals (MSL, 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.

4.4.2 Backlight lighting circuit




Note1: These are the display and function signals for LCD panel signal processing board.
Note2: 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, Note5 |
| 20 | MSL | Selection of LVDS input map | High: Input map A<br>Low or Open: Input map B<br>Note4, Note5 |

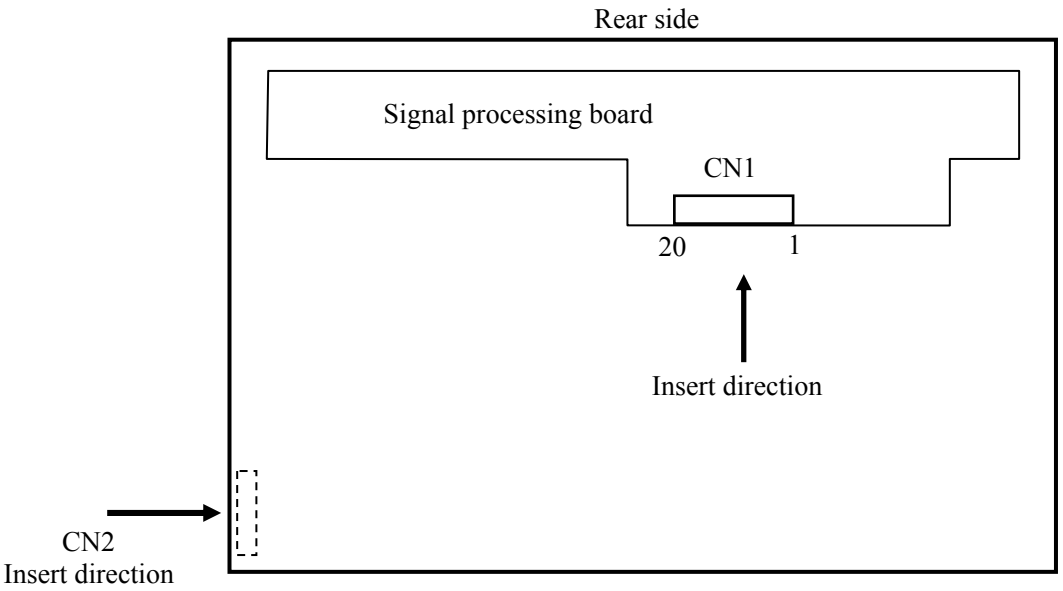
Note1: All GND and VCC terminals should be used without any non-connected lines.
Note2: Twist pair wires with 100Ω (Characteristic impedance) should be used between LCD panel signal processing board and LVDS transmitter.
Note3: See "**4.8 SCANNING DIRECTIONS**".
Note4: See "**4.5.4 Connection between receiver and transmitter for LVDS**".
Note5: This terminal is pulled-down in the product. (Pull-down resistance: 50kΩ)

4.5.2 Backlight

CN2 plug (LCD module side): SM12B-SRSS-TB (J.S.T. Mgf. Co., Ltd.)
Adaptable socket: SHR-12V-S, SHR-12V-S-B (J.S.T. Mgf. Co., Ltd.)

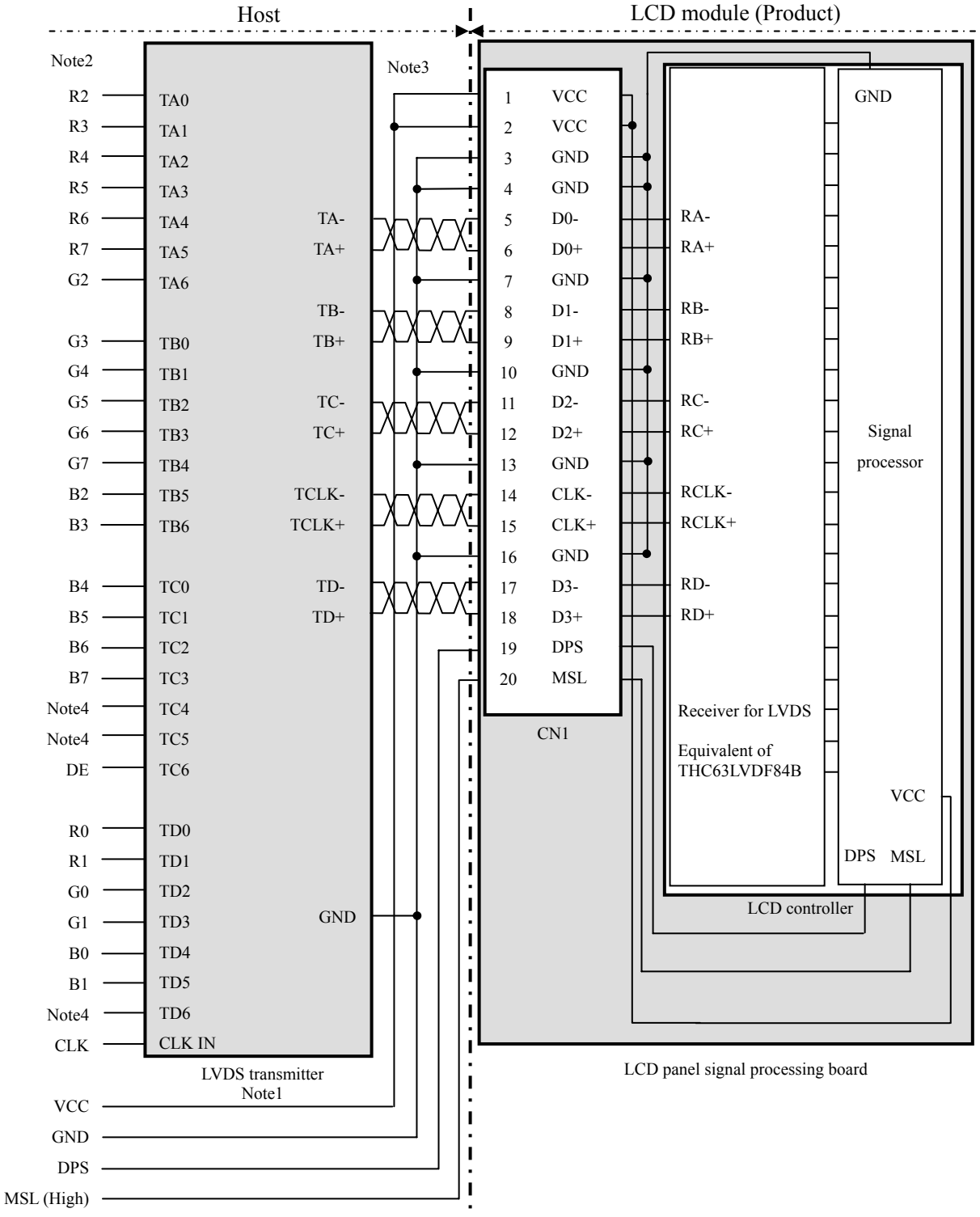
| Pin No. | Symbol | Signal | Remarks |
|---|---|---|---|
| 1 | A1 | Anode1 | - |
| 2 | K1 | Cathode1 | - |
| 3 | A2 | Anode2 | - |
| 4 | K2 | Cathode2 | - |
| 5 | A3 | Anode3 | - |
| 6 | K3 | Cathode3 | - |
| 7 | A4 | Anode4 | - |
| 8 | K4 | Cathode4 | - |
| 9 | A5 | Anode5 | - |
| 10 | K5 | Cathode5 | - |
| 11 | A6 | Anode6 | |
| 12 | K6 | Cathode6 | |

4.5.3 Positions of plug and socket



4.5.4 Connection between receiver and transmitter for LVDS

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



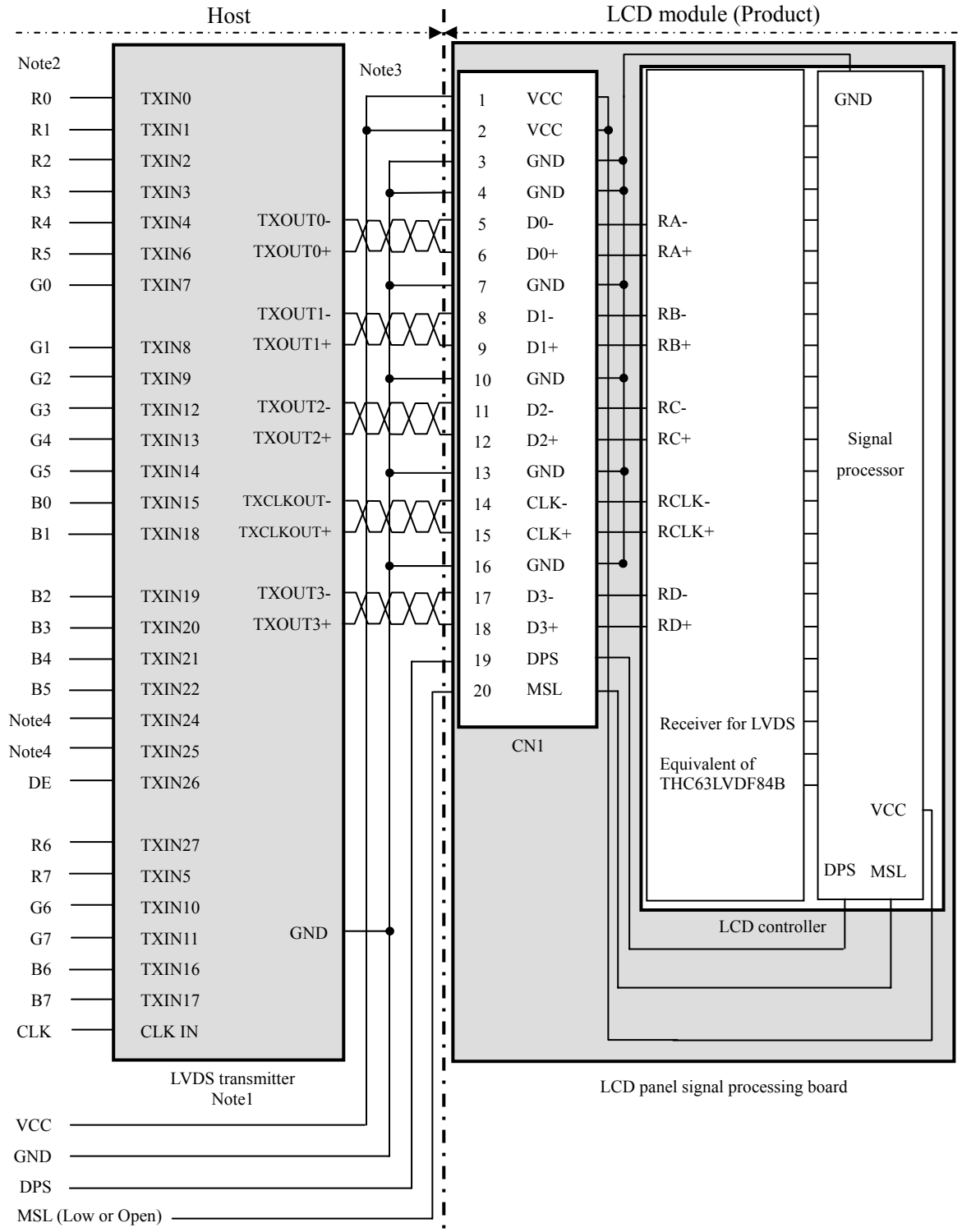

Note1: Recommended transmitter: THC63LVDM83R (THine Electronics Inc.) or equivalent

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, TC5 and TD6 are not used inside the product, but do not keep TC4, TC5 and TD6 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 TXIN24 and TXIN25 are not used inside the product, but do not keep TXIN24 and TXIN25 open to avoid noise problem.

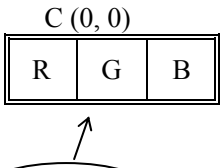
4.6 DISPLAY COLORS AND INPUT DATA SIGNALS

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

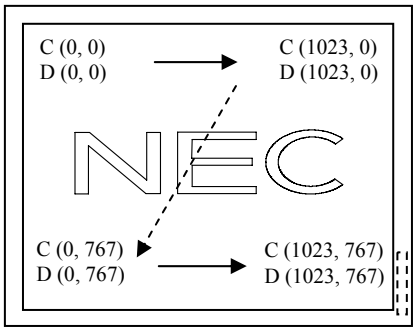
The following table is the coordinates per pixel (See "**4.8 SCANNING DIRECTIONS**".).




| | | | | | | |
|---|---|---|---|---|---|---|
| C( 0, 0) | C( 1, 0) | • • • | C( X, 0) | • • • | C(1022, 0) | C(1023, 0) |
| C( 0, 1) | C( 1, 1) | • • • | C( X, 1) | • • • | C(1022, 1) | C(1023, 1) |
| • • • | • • • | • • • | • • • | • • • | • • • | • • • |
| C( 0, Y) | C( 1, Y) | • • • | C( X, Y) | • • • | C(1022, Y) | C(1023, Y) |
| • • • | • • • | • • • | • • • | • • • | • • • | • • • |
| C( 0, 766) | C( 1, 766) | • • • | C( X, 766) | • • • | C(1022, 766) | C(1023, 766) |
| C( 0, 767) | C( 1, 767) | • • • | C( X, 767) | • • • | C(1022, 767) | C(1023, 767) |

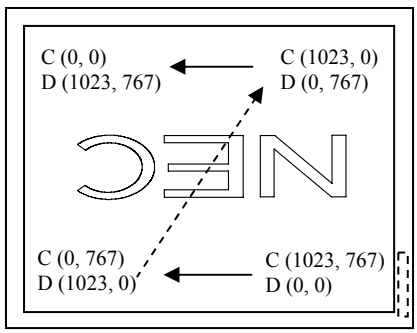
4.8 SCANNING DIRECTIONS

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




Note1

Figure1. Normal scan (DPS: Low or Open)




Note1

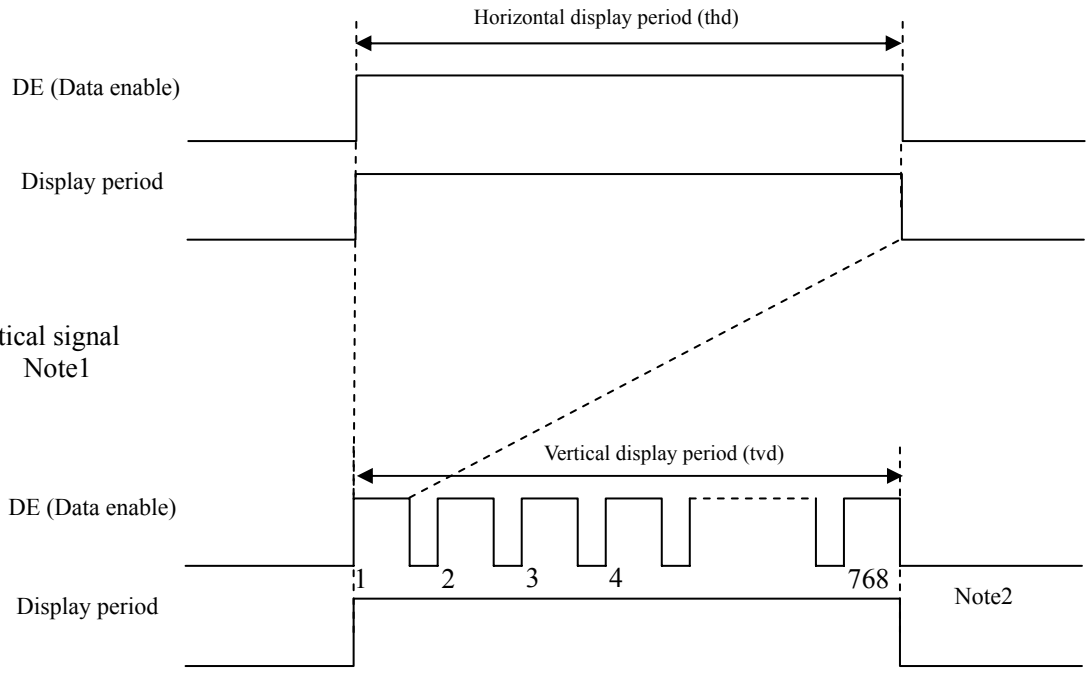
Figure2. Reverse scan (DPS: High)

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, Note2,Note3)

| Parameter | | | Symbol | min. | typ. | max. | Unit | Remarks |
|---|---|---|---|---|---|---|---|---|
| CLK | Frequency | | 1/tc | 50.0 | 65.0 | 80.0 | MHz | 15.384ns (typ.) |
| | Duty | | - | | - | | - | - |
| | Rise time, Fall time | | - | | | | ns | |
| DATA | CLK-DATA | Setup time | - | | - | | ns | - |
| | | Hold time | - | | | | ns | |
| | Rise time, Fall time | | - | | | | ns | |
| DE | Horizontal | Cycle | th | 15.0 | 20.676 | - | µs | 48.363kHz (typ.) |
| | | | | 1,050 | 1,344 | 1,800 | CLK | |
| | | Display period | thd | | 1,024 | | CLK | - |
| | Vertical (One frame) | Cycle | tv | 13.1 | 16.666 | 20.0 | ms | 60.0Hz (typ.) |
| | | | | 770 | 806 | - | H | |
| | | Display period | tvd | | 768 | | H | - |
| | CLK-DE | Setup time | - | | - | | ns | - |
| | | Hold time | - | | | | ns | |
| | Rise time, Fall time | | - | | | | ns | |

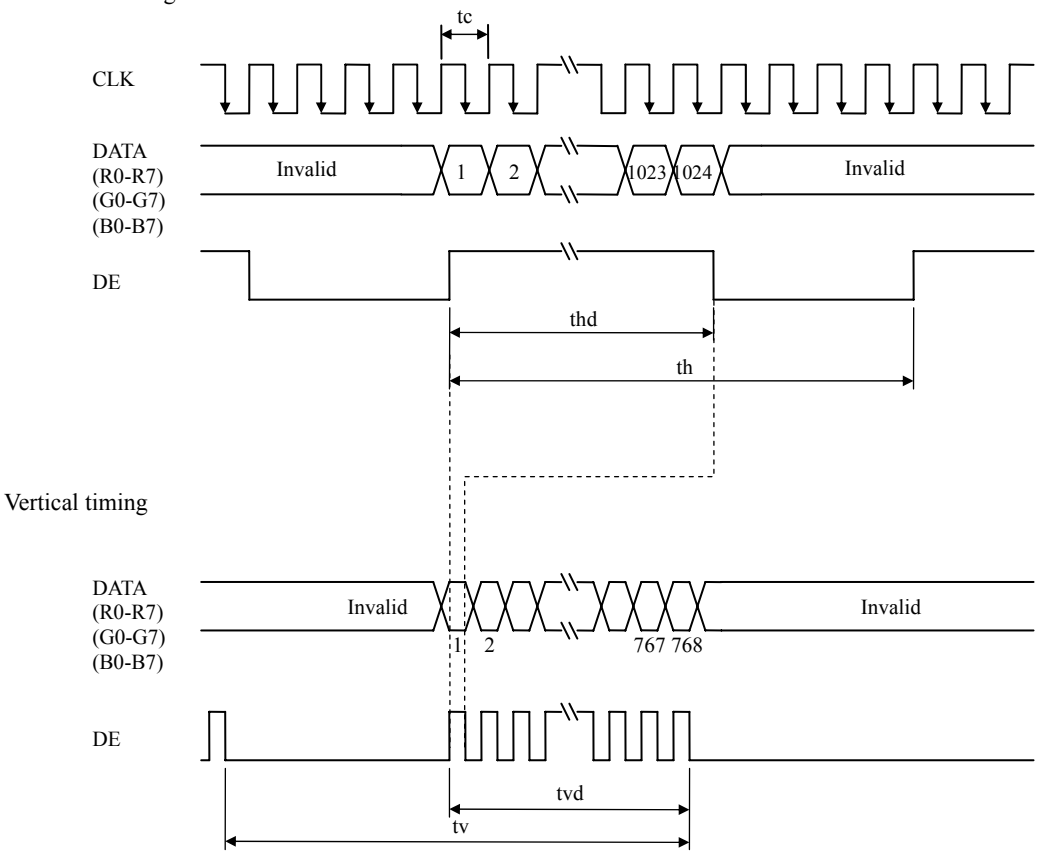
Note1: Definition of parameters is as follows.
tc= 1CLK, th= 1H, Vf= 1/tv

Note2: See the data sheet of LVDS transmitter.

Note3: Vertical cycle (tv) should be specified in integral multiple of Horizontal cycle (th)

4.9.3 Input signal timing chart

Horizontal timing




Vertical timing

4.10 OPTICS

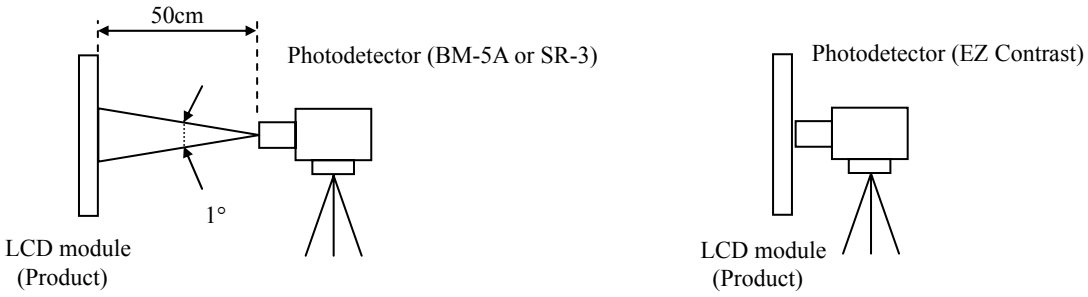
4.10.1 Optical characteristics

(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 | 320 | 400 | - | cd/m$^2$ | SR-3 or BM-5A | - |
| Contrast ratio | | White/Black at center<br>θR= 0°, θL= 0°, θU= 0°, θD= 0° | CR | 350 | 500 | - | - | SR-3 or BM-5A | Note3 |
| Luminance uniformity | | White<br>θR= 0°, θL= 0°, θU= 0°, θD= 0° | LU | - | 1.2 | 1.35 | - | BM-5A | Note4 |
| Chromaticity | White | **x** coordinate | Wx | TBD | TBD | TBD | - | SR-3 | Note5 |
| | | **y** coordinate | Wy | TBD | TBD | TBD | - | | |
| | Red | **x** coordinate | Rx | - | TBD | - | - | | |
| | | **y** coordinate | Ry | - | TBD | - | - | | |
| | Green | **x** coordinate | Gx | - | TBD | - | - | | |
| | | **y** coordinate | Gy | - | TBD | - | - | | |
| | Blue | **x** coordinate | Bx | - | TBD | - | - | | |
| | | **y** coordinate | By | - | TBD | - | - | | |
| Color gamut | | θR= 0°, θL= 0°, θU= 0°, θD= 0°<br>at center, against NTSC color space | C | TBD | 50 | - | % | | |
| Response time | | White to Black | Ton | - | 3 | 5 | ms | BM-5A | Note6<br>Note7 |
| | | Black to White | Toff | - | 15 | 21 | ms | | |
| Viewing angle | Right | θU= 0°, θD= 0°, CR≥ 10 | θR | 70 | 80 | - | ° | BM-5A or 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 | 70 | 80 | - | ° | | |

Note1: These are initial characteristics.
Note2: Measurement conditions are as follows.
Ta= 25°C, VCC= 3.3V, IL= 50mA / One circuit, 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.

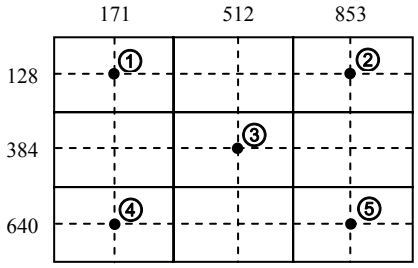
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance of white screen}}{\text{Luminance of black screen}}$$

4.10.3 Definition of luminance uniformity

The luminance uniformity is calculated by using following formula.

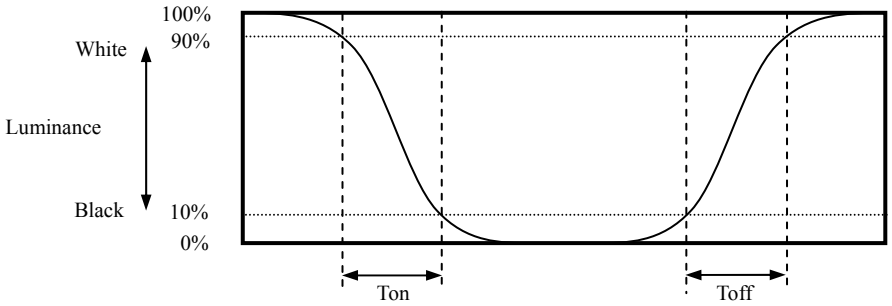
$$\text{Luminance uniformity (LU)} = \frac{\text{Maximum luminance from ① to ⑤}}{\text{Minimum luminance from ① to ⑤}}$$

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

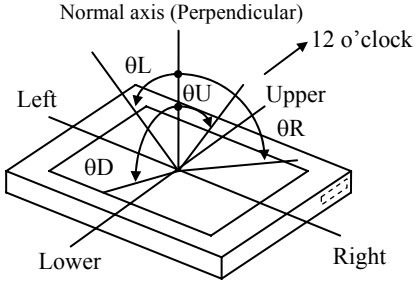



4.10.4 Definition of response times

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. ESTIMATED LUMINANCE LIFETIME

The luminance lifetime is the time from initial luminance to half-luminance.

**This lifetime is the estimated value, and is not guarantee value.**

| Condition | | Estimated luminance lifetime (MTTF) Note1, Note2, Note3 | Unit |
|---|---|---|---|
| LED elementary substance | 25°C (Ambient temperature of LED) Continuous operation, IL=50mA / One circuit | 70,000 | h |

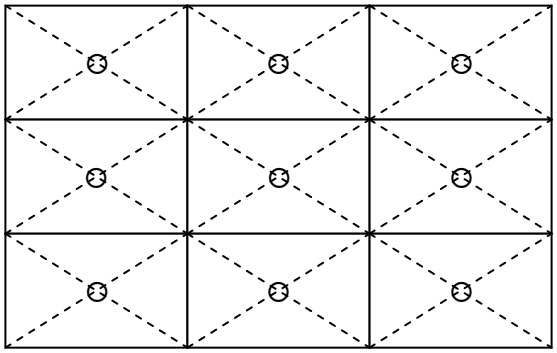
Note1: MTTF is mean time to harf-luminance.
Note2: Estimated luminance lifetime is not the value for LCD module but the value for LED elementary substance.
Note3: By ambient temperature, the lifetime changes particularly. Especially, in case the product works under high temperature environment, the lifetime becomes short.

## 6. RELIABILITY TESTS

| Test item | | Condition | Judgment Note1 |
|---|---|---|---|
| High temperature and humidity (Operation) | | ① 60 ± 2°C, RH= 90%, 240hours<br>② Display data is black. | No display malfunctions |
| High temperature (Operation) | | ① 70 ± 3°C, 240hours<br>② Display data is black. | |
| Heat cycle (Operation) | | ① -20 ± 3°C…1hour<br>70 ± 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, 11.76m/s$^2$<br>② 1 minute/cycle<br>③ X, Y, Z directions<br>④ 50 times each directions | No display malfunctions<br>No physical damages |
| Mechanical shock (Non operation) | | ① 294m/s$^2$, 11ms<br>② X, Y, Z directions<br>③ 3 times each directions | |
| Low pressure | Operation | ① 53.3kPa (Equivalent to altitude 4,850m)<br>② -20°C±3°C…24 hours<br>③ 70°C±3°C…24 hours | No display malfunctions |
| | Non-operation | ① 15kPa (Equivalent to altitude 13,600m)<br>② -20°C±3°C…24 hours<br>③ 80°C±3°C…24 hours | |

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.



## 7. PRECAUTIONS

### 7.1 MEANING OF CAUTION SIGNS

The following caution signs have very important meaning. **Be sure to read "7.2 CAUTIONS" and "7.3 ATTENTIONS", after understanding these contents!**

This sign has the meaning that customer will be injured by personnel or the product will sustain a damage, if customer has wrong operations.

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

### 7.2 CAUTIONS

* **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))**

### 7.3 ATTENTIONS

#### 7.3.1 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 When the product is put on the table temporarily, display surface must be placed downward.
③ 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.
④ 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.
⑤ 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.
⑥ Do not press or rub on the sensitive product surface. When cleaning the panel surface,wipe it with a soft dry cloth.
⑦ Do not push nor pull the interface connectors while the product is working.
⑧ 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.
⑨ Usually liquid crystals don't leak through the breakage of glasses because of the surface tension of thin layer and the construction of LCD panel. But, if you contact with liquid crystal for the worst, please wash it out with soap.

7.3.2 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.

7.3.3 Characteristics

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

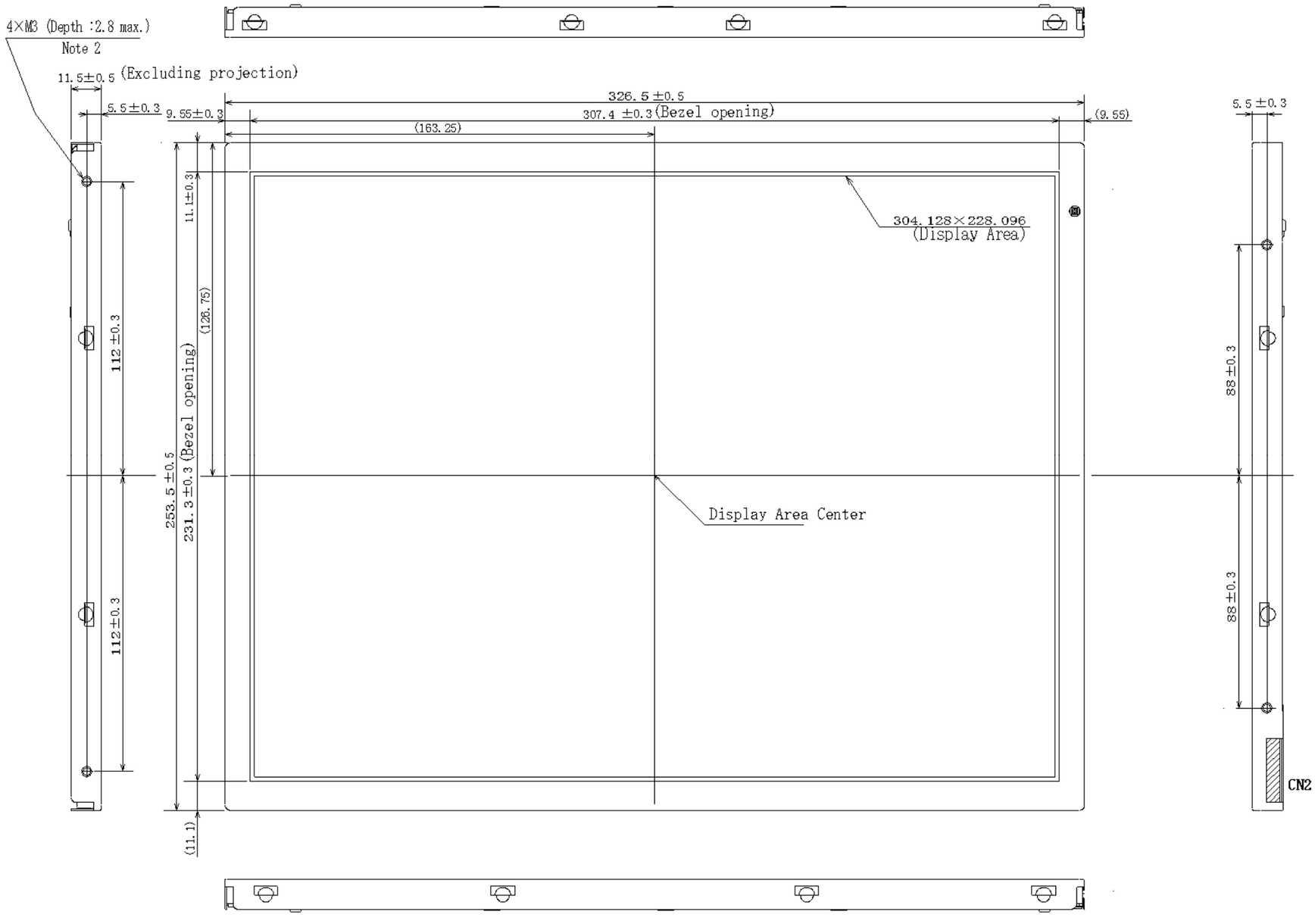
① Characteristics of the LCD (such as response time, luminance, color uniformity and so on) may be changed depending on ambient temperature. If the product is stored under condition of low temperature for a long time, it may cause display mura. In this case, the product should be operated after enough time being left under condition of operating temperature.
② Display mura, flicker, vertical seam or small spot may be observed depending on display patterns.
③ 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.
④ The display color may be changed depending on viewing angle because of the use of condenser sheet in the backlight.
⑤ Optical characteristics may be changed depending on input signal timings.

7.3.4 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 LED holder.
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.

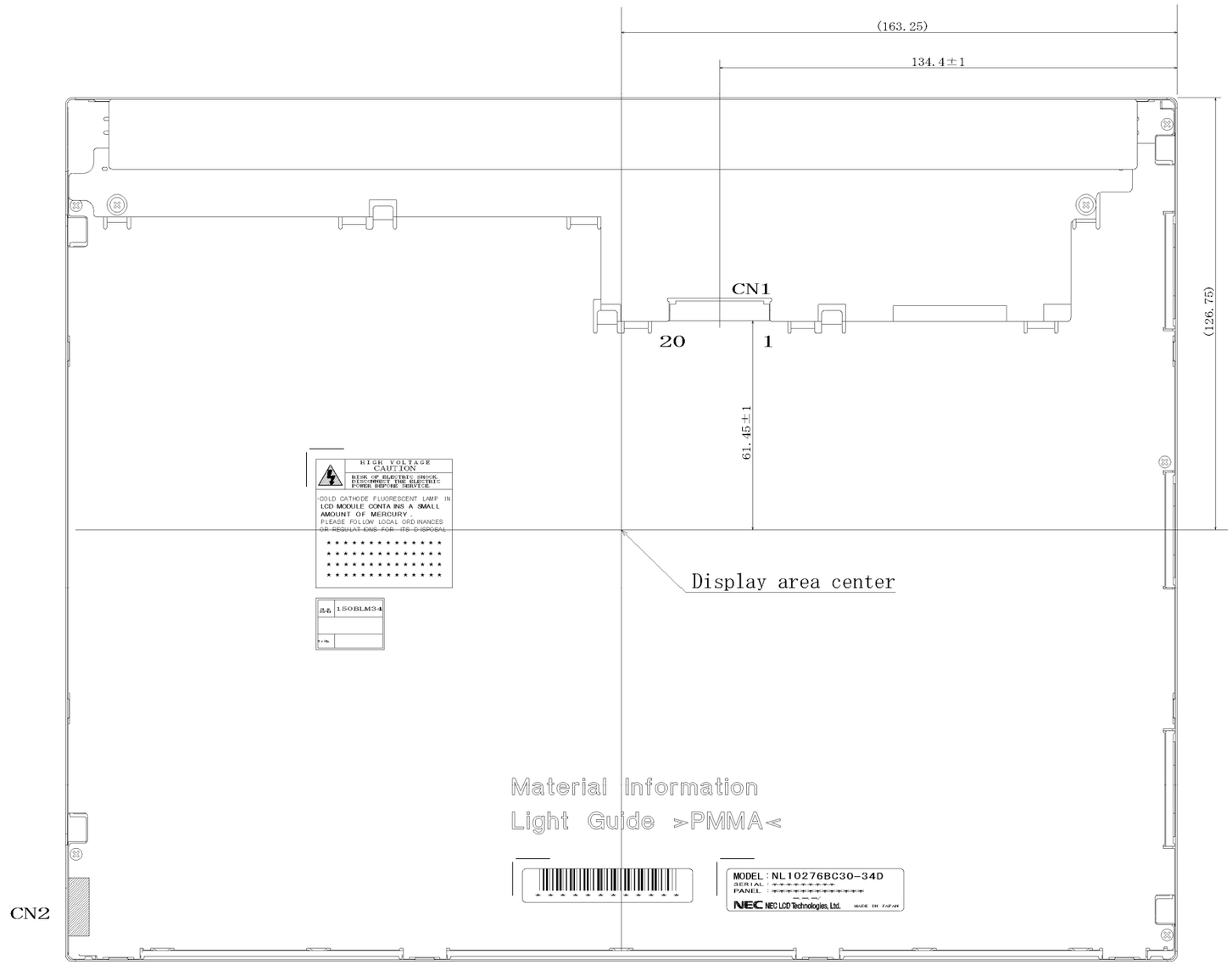
**8. OUTLINE DRAWINGS**

8.1 FRONT VIEW




Unit: mm

8.2 REAR VIEW




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 | Document number | Prepared date | Revision contents and signature |
|---|---|---|---|
| 1st edition | DOD-PP-0753 | Mar.. 18, 2009 | **Revision contents**<br>New issue<br>**Signature of writer**<br>*Approved by* H. FUKUYOSHI<br>*Checked by*<br>*Prepared by* H. FUKUYOSHI |
| | | | |