TIANMA ☆

# TFT COLOR LCD MODULE

## NLB150XG02L-01BD

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

## DATA SHEET

**DOD-PP-3133 (2nd edition)**

**This DATA SHEET is updated document from DOD-PP-2497(1)**

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

## INTRODUCTION



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Examples: Aerospace system (except seat entertainment monitor), nuclear control system, life support system, etc.

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

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## 1. OUTLINE

### 1.1 STRUCTURE AND PRINCIPLE

Color LCD module NLB150XG02L-01BD 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, touch panel (T/P) 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

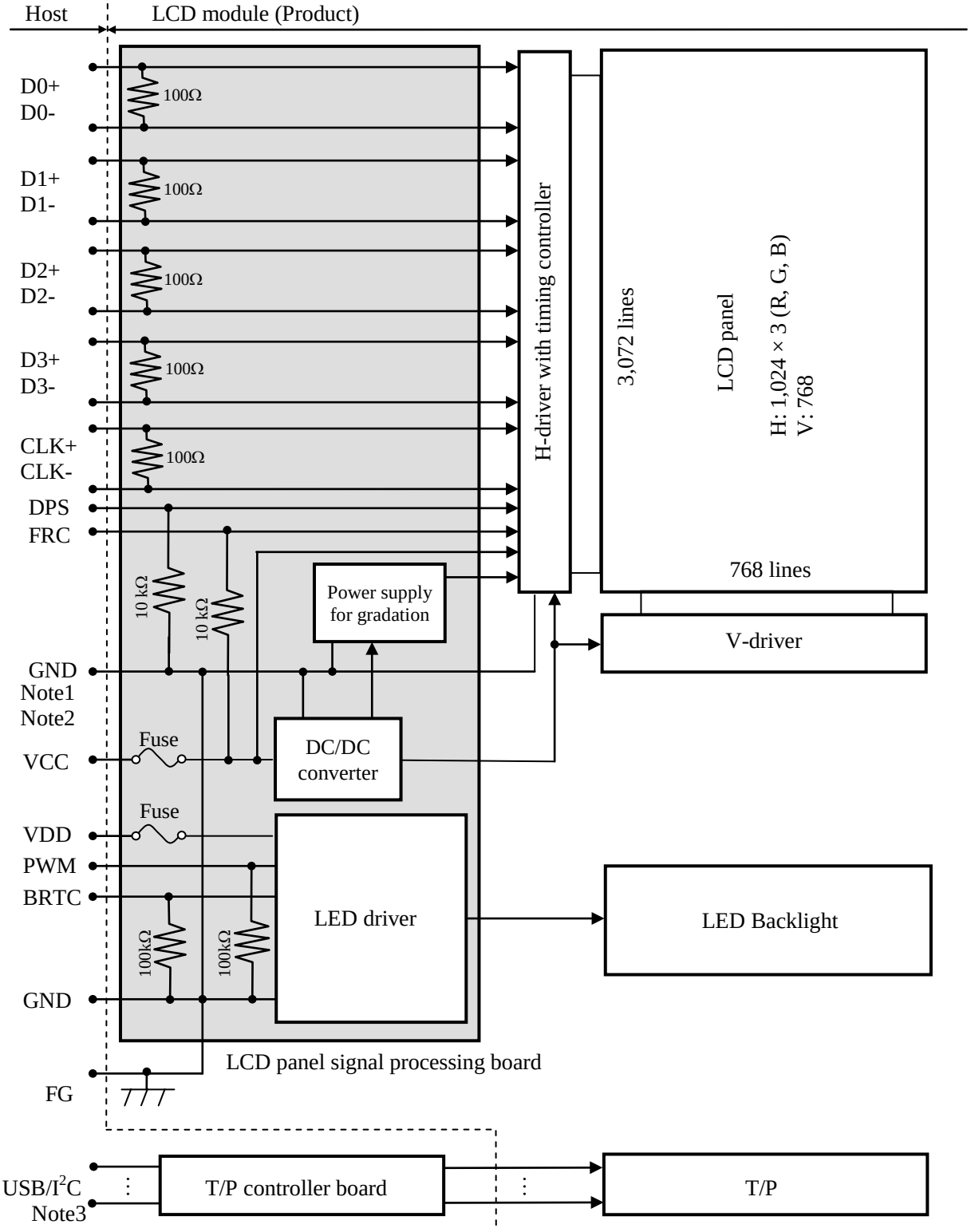
### 1.3 FEATURES

- Projected capacitive touch panel (PCAP T/P) attached
- T/P having cover glass ☆
- Wide viewing angle ☆
- LVDS interface ☆
- Reversible-scan direction
- Selectable 8-bit or 6-bit digital signals for data of RGB
- Narrow border
- LED backlight built in LED driver
- Replaceable lamp holder for backlight
- Acquisition product for UL60950-1/CSA C22.2 No.60950-1-03 (File number: E170632)
- Compliance with the European RoHS directive (2011/65/EU) and Delegated Directive (2015/863/EU, Amending Annex II of 2011/65/EU) ☆

## 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*** | 16,194,277 colors (At 8-bit input, FRC terminal= Low)<br>262,144 colors (At 6-bit input, FRC terminal= High or Open) |
| ***Pixel*** | 1,024 (H) × 768 (V) pixels |
| ***Pixel arrangement*** | BGR (Blue dot, Green dot, Red dot) vertical stripe |
| ***Dot pitch*** | 0.099 (H) × 0.297 (V) mm |
| ***Pixel pitch*** | 0.297 (H) × 0.297 (V) mm |
| ***Module size (Including T/P)*** | 326.5 (W) × 253.5 (H) × 13.6 (D) mm (typ.) |
| ***Weight*** | 1,220 g (typ.) |
| ***Contrast ratio*** | 600:1 (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= 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) |
| ***T/P type*** | Projected capacitive<br>(Recommended T/P controller board (Option)<br>• T/P controller board: PTPW04/05) |
| ***T/P surface*** | Antiglare + AFP(Anti-finger print) |
| ***T/P pencil-hardness*** | 2H (min.) [by JIS K5600] |
| ***T/P cover glass*** | Thickness: 0.7mm glass |
| ***T/P bonding method*** | Perimeter-bonding (with air gap) |
| ***Color gamut*** | *At LCD panel center*<br>60% (typ.) [against NTSC color space] |
| ***Response time*** | *Ton+Toff (10%←→ 90%)*<br>8ms (typ.) |
| ***Luminance*** | *At the maximum luminance control*<br>350cd/m$^2$ (typ.) |
| ***Signal system*** | LVDS interface (1port) |
| ***Power supply voltage*** | LCD panel signal processing board: 3.3V<br>LED driver: 12.0V |
| ***Backlight*** | LED backlight built in LED driver<br>(Replaceable part<br>• Lamp holder set: 150LHS204) |
| ***Power consumption*** | *At the maximum luminance control, Checkered flag pattern*<br>*Driving with the recommended T/P controller board, The number of touch= 10*<br>7.6W (typ.) |

**3. BLOCK DIAGRAM**




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

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

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

Note3: Refer to the specifications of T/P controller board.

## 4. DETAILED SPECIFICATIONS

### 4.1 MECHANICAL SPECIFICATIONS

| Parameter | Specification | | Unit |
|---|---|---|---|
| Module size (Including T/P) | 326.5 ± 0.5 (W) × 253.5 ± 0.5 (H) × 13.6 ± 0.6 (D) | Note1 | mm |
| Display area | 304.128 (H) × 228.096 (V) | Note1 | mm |
| Weight | 1,220 (typ.), 1,350 (max.) | | g |

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

### 4.2 ABSOLUTE MAXIMUM RATINGS

(Note1)

| Parameter | | | Symbol | Rating | Unit | Remarks |
|---|---|---|---|---|---|---|
| Power supply voltage | LCD panel signal processing board | | VCC | -0.3 to +3.96 | V | Ta= 25°C |
| | LED driver | | VDD | -0.3 to +15.0 | | |
| Input voltage for signals | Display signals Note2 | | VD | -0.5 to +3.96 | V | |
| | Function signals Note3 | | VF | -0.5 to +3.96 | | |
| | Function signal for LED driver | | PWM | -0.3 to +5.5 | V | |
| | | | BRTC | -0.3 to +5.5 | V | |
| Storage temperature | | | Tst | -30 to +80 | °C | - |
| Operating temperature | | Front surface | TopF | -20 to +70 | °C | Note4 |
| | | Rear surface | TopR | -20 to +70 | °C | Note5 |
| Relative humidity Note6 | | | RH | ≤ 90 | % | Ta ≤ 40°C |
| | | | | ≤ 80 | % | 40°C < Ta ≤ 50°C |
| Absolute humidity Note6 | | | AH | ≤ 66 Note7 | $g/m^3$ | Ta > 50°C |

Note1: Regarding the driving of T/P, refer to the specifications of T/P controller board.
Note2: D0+/-, D1+/-, D2+/-, D3+/-, CLK+/-
Note3: DPS, FRC
Note4: Measured at T/P surface (including self-heat)
Note5: Measured at LCD module's rear shield surface (including self-heat)
Note6: No condensation
Note7: Water amount at Ta= 50°C and RH= 80%

4.3 ELECTRICAL CHARACTERISTICS

4.3.1 LCD panel signal processing board

(Ta= 25°C, Note1)

| Parameter | | Symbol | min. | typ. | max. | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| Power supply voltage | | VCC | 3.0 | 3.3 | 3.6 | V | - |
| Power supply current | | ICC | - | 400 Note2 | 780 Note3 | mA | at VCC= 3.3V |
| Permissible ripple voltage | | VRP | - | - | 300 | mVp-p | for VCC Note4, Note5, Note6 |
| Differential input threshold voltage | High | VTH | - | - | +100 | mV | at VCM= 1.25V Note7 |
| | Low | VTL | -100 | - | - | mV | |
| Terminating resistance | | RT | - | 100 | - | Ω | - |
| Input voltage for DPS signal | High | VFH1 | 0.7VCC | - | VCC | V | - |
| | Low | VFL1 | 0 | - | 0.3VCC | V | |
| Input voltage for FRC signal | High | VFH2 | 0.7VCC | - | VCC | V | |
| | Low | VFL2 | 0 | - | 0.3VCC | V | |
| Input current for DPS signal | High | IFH1 | - | - | 500 | μA | - |
| | Low | IFL1 | -500 | - | - | μA | |
| Input current for FRC signal | High | IFH2 | - | - | 500 | μA | |
| | Low | IFL2 | -500 | - | - | μA | |

Note1: When designing of the power supply, take the measures for the prevention of surge voltage. ☆
Note2: Checkered flag pattern [by IEC 61747-6]
Note3: Pattern for maximum current
Note4: This product works even if the ripple voltage levels are over the permissible values, but there might be noise on the display image.
Note5: The permissible ripple voltage includes spike noise.
Note6: The load variation influence does not include.
Note7: Common mode voltage for LVDS receiver

4.3.2 LED driver

(Ta= 25°C, Note1) ☆

| Parameter | | Symbol | min. | typ. | max. | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| Power supply voltage | | VDD | 10.8 | 12.0 | 13.2 | V | - |
| Power supply current | | IDD | - | 480 | 650 Note2 | mA | at VDD = 12.0V Note3 |
| Permissible ripple voltage | | VRPD | - | - | 200 | mVp-p | for VDD Note4, Note5, Note6 |
| Input voltage for PWM signal | High | VDFH1 | 1.3 | - | 5.5 | V | - |
| | Low | VDFL1 | - | - | 0.5 | V | |
| Input voltage for BRTC signal | High | VDFH2 | 1.3 | - | 5.5 | V | - |
| | Low | VDFL2 | 0 | - | 0.5 | V | |
| PWM frequency | | $f_{PWM}$ | 200 | - | 20k | Hz | Note7, Note8 |
| PWM duty ratio | | $DR_{PWM}$ | 1 | - | 100 | % | Note9, Note10 |
| PWM pulse width | | tPWH | 5 | - | - | μs | |

Note1: When designing of the power supply, take the measures for the prevention of surge voltage.
Note2: This value excludes peak current such as overshoot current.
Note3: At the maximum luminance control
Note4: This product works even if the ripple voltage levels are over the permissible values, but there might be noise on the display image.
Note5: The permissible ripple voltage includes spike noise.
Note6: The power supply lines (VDD and GND) may have ripple voltage during luminance control of LED. There is the possibility that the ripple voltage produces acoustic noise and signal wave noise in audio circuit and so on.
Note7: A recommended $f_{PWM}$ value is as follows.

$$f_{PWM} = \frac{2n-1}{4} \times fv$$

$$(n = \text{integer}, fv = \text{frame frequency of LCD module})$$

Note8: Depending on the frequency used, some noise may appear on the screen, please conduct a thorough evaluation.
Note9: While the BRTC signal is high, do not set the tPWH (PWM pulse width) is less than minimum value. It may cause abnormal working of the backlight. In this case, turn the backlight off and then on again by BRTC signal.
Note10: Regardless of the PWM frequency, both PWM duty ratio and PWM pulse width must be always more than the minimum values.

4.3.3 Fuse

| Parameter | Fuse | | Rating | Fusing current | Remarks |
|---|---|---|---|---|---|
| | Type | Supplier | | | |
| VCC | FCC16152AB | KAMAYA ELECTRIC Co., Ltd. | 1.5A<br>36V | 3.0A | Note1 |
| VDD | FCC16202AB | KAMAYA ELECTRIC Co., Ltd. | 2.0A<br>36V | 4.0A | |

Note1: The power supply's rated current must 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 TOUCH PANEL SPECIFICATIONS

(Ta= 25°C, Note1)

| Parameter | | Symbol | min. | typ. | max. | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| Accuracy | Center | Acrc | - | - | 1.5 | mm | Note2 |
| | Border | Acrb | - | - | 2.5 | | |
| Number of touch | | NUM | 1 | - | 16 | Point | - |
| Minimum distance for dual touch | Horizontal | Tdist H | 13.5 | | | mm | Note3 |
| | Vertical | Tdist V | 15.5 | | | | |
| Scan speed | Active | Sspd A | - | 100 | - | Hz | - |
| | Idle | Sspd I | - | 30 | - | | |
| Resolution | Horizontal | - | - | - | 4,096 | - | Note4 |
| | Vertical | - | - | - | 4,096 | - | |
| Response area | Horizontal | - | - | 306.124 | - | mm | Note5 |
| | Vertical | - | - | 230.092 | - | | |

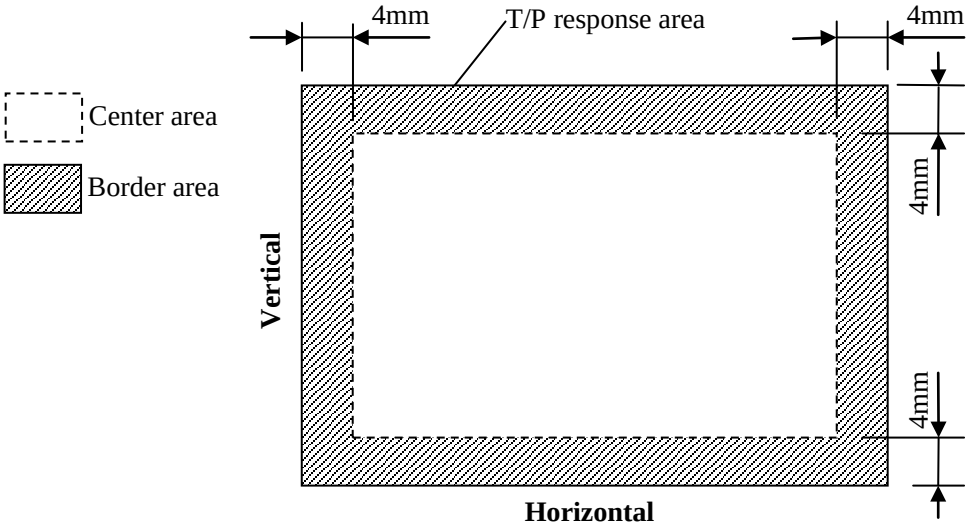
Note1: If a customer uses a recommended T/P controller board, specifications of the T/P controller board are given priority over the specifications in this table.

Note2: Definition of accuracy

Accuracy shows a difference between an ideal position and an actual position.

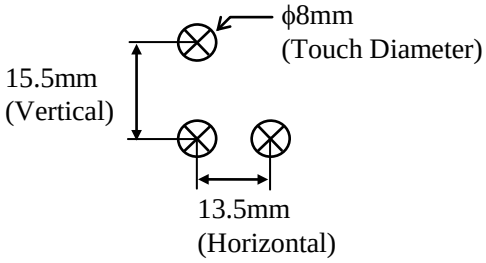
Acrc: Accuracy at center area

Acrb: Accuracy at border area




Input method is ϕ8mm conductive stylus.

Note3: Minimum distance for dual touch

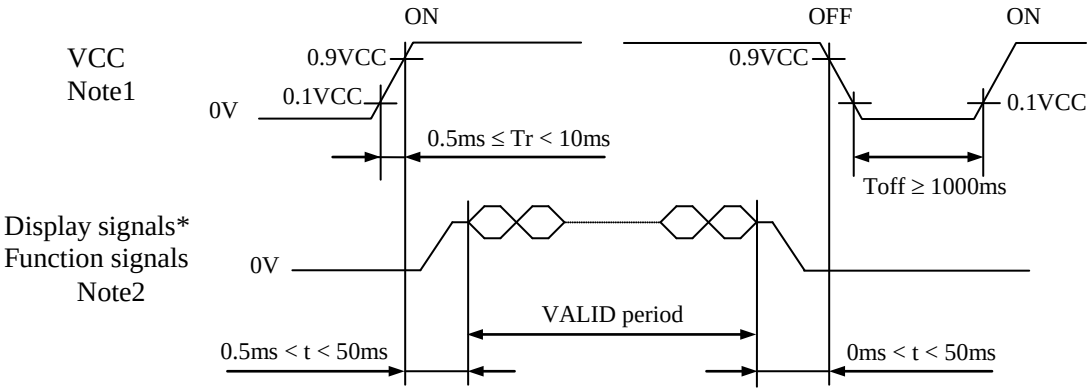



Note4: When using the recommended T/P controller board

Note5: The center point of the T/P response area and the center point of the display area are arranged at the same position.

4.5 POWER SUPPLY VOLTAGE SEQUENCE

4.5.1 LCD panel signal processing board

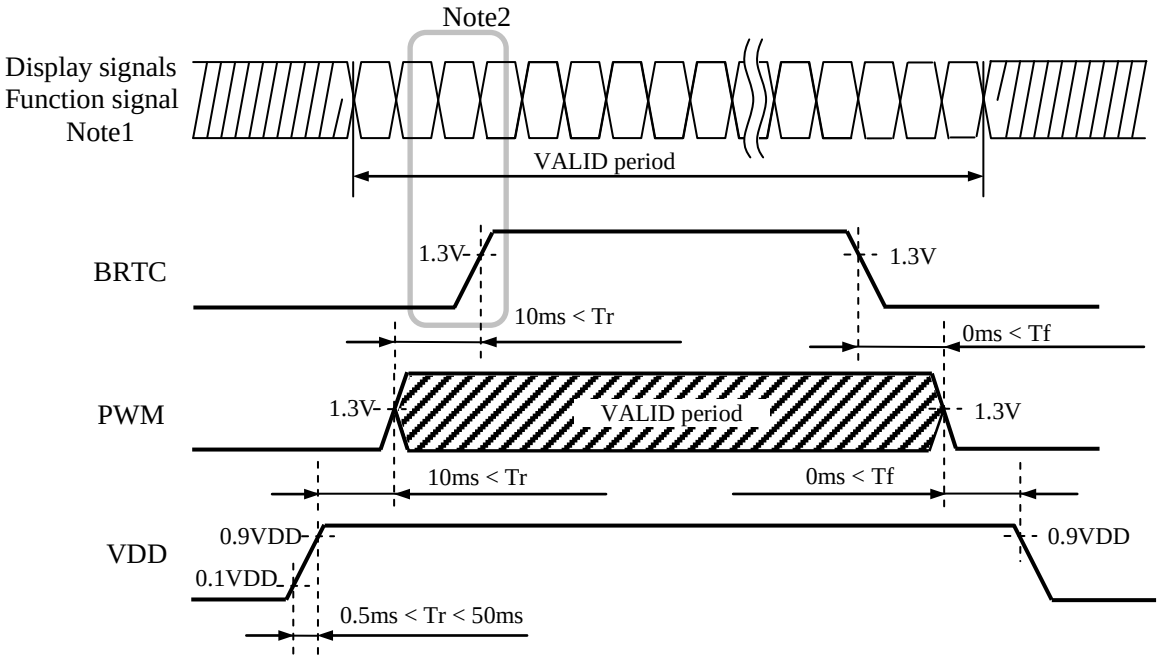



* These signals should be measured at the terminal of 100Ω resistance.

Note1: If there is a voltage variation (voltage drop) at the rising edge of VCC below 3.0V, there is a possibility that a product does not work due to a protection circuit.

Note2: Display signals (D0+/-, D1+/-, D2+/-, D3+/- and CLK+/-) and function signals (DPS and FRC) must be set to Low or High-impedance, except the VALID period (See above sequence diagram), in order to avoid the circuitry damage.
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 a customer stops the display and function signals, VCC also must be shut down.

4.5.2 LED driver




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.

4.6 CONNECTIONS AND FUNCTIONS FOR INTERFACE PINS

4.6.1 LCD panel signal processing board

CN1 socket (LCD module side): 185083-20121 (P-TWO ELECTRIC TECHNOLOGY CO., LTD.)
Adaptable plug: DF14-20S-1.25C (Hirose Electric Co., Ltd. (HRS))

| Pin No. | Symbol | Signal | Input data signal: 8-bit | Input data signal: 6-bit | Remarks |
|---|---|---|---|---|---|
| 1 | VCC | Power supply | Power supply | | Note1 |
| 2 | VCC | | | | |
| 3 | GND | Ground | Ground | | Note1 |
| 4 | DPS | Selection of scan direction | High: Reverse scan<br>Low or Open: Normal scan | | Note2 |
| 5 | D0- | Pixel data | R0-R5, G0 | | Note3 |
| 6 | D0+ | | | | |
| 7 | GND | Ground | Ground | | Note1 |
| 8 | D1- | Pixel data | G1-G5, B0-B1 | | Note3 |
| 9 | D1+ | | | | |
| 10 | GND | Ground | Ground | | Note1 |
| 11 | D2- | Pixel data | B2-B5, DE | | Note3 |
| 12 | D2+ | | | | |
| 13 | GND | Ground | Ground | | Note1 |
| 14 | CLK- | Pixel clock | Pixel clock | | Note3 |
| 15 | CLK+ | | | | |
| 16 | GND | Ground | Ground | | Note1 |
| 17 | D3- / GND | Pixel data / Ground | R6-R7<br>G6-G7<br>B6-B7 | Ground | Note3 |
| 18 | D3+ / GND | | | | |
| 19 | N. C. | Non connection | Keep this pin Open | | - |
| 20 | FRC | Selection of the number of colors | Low | High or Open | - |

Note1: All GND and VCC terminals should be used without any non-connected lines.
Note2: See "**4.9 SCANNING DIRECTIONS**".
Note3: Twist pair wires with 100Ω (Characteristic impedance) should be used between LCD panel signal processing board and LVDS transmitter.

4.6.2 LED driver

CN2 socket (LCD module side): MSB24038P5 (STM)
Adaptable plug: P24038P5 (STM) ☆

| Pin No. | Symbol | Signal | Remarks |
|---|---|---|---|
| 1 | N. C. | Non connection | Keep this pin Open. |
| 2 | PWM | Luminance control | PWM Dimming |
| 3 | BRTC | Backlight ON/OFF control | High: ON / Low or Open: OFF |
| 4 | GND | Ground | - |
| 5 | VDD | Power supply | - |

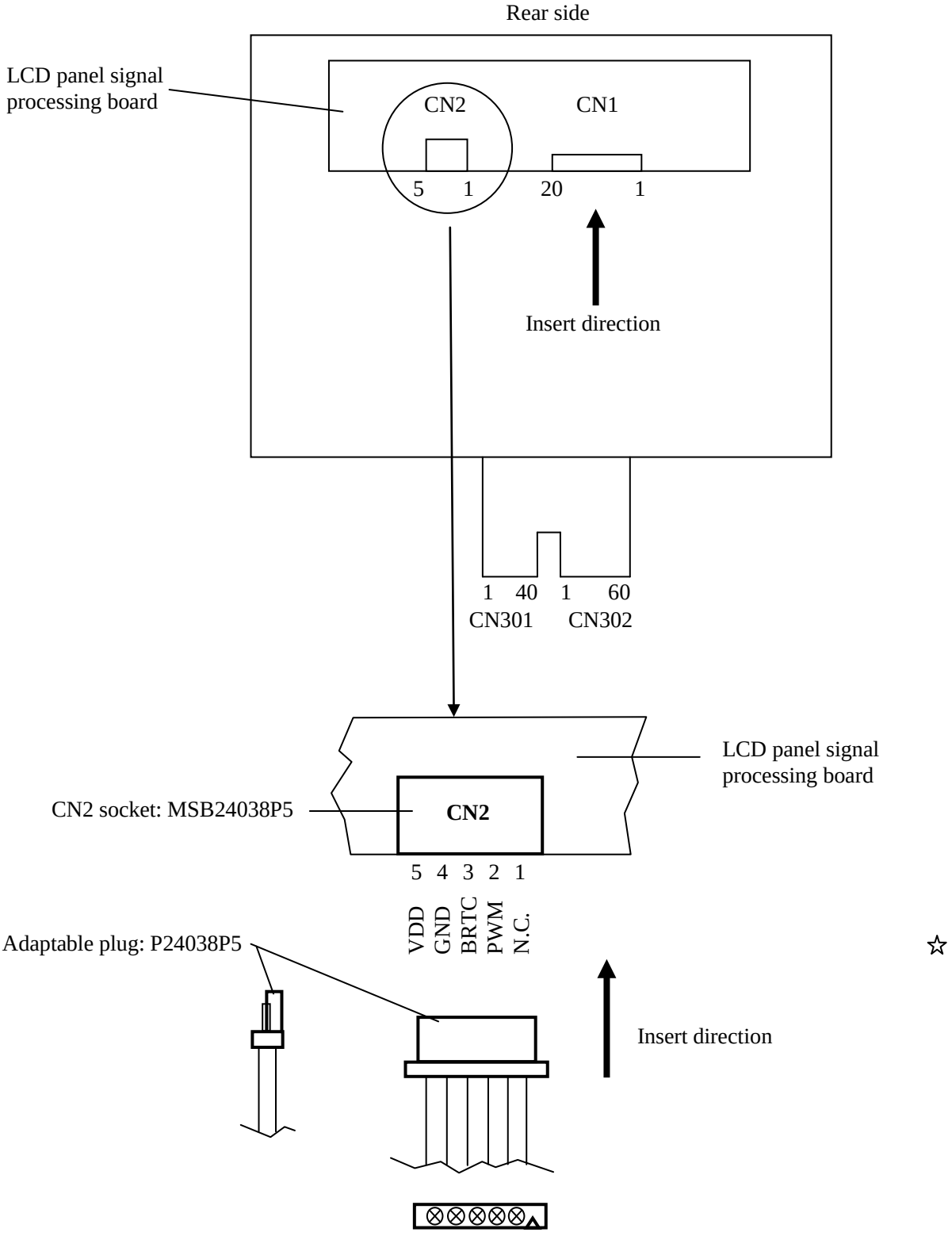
4.6.3 Touch panel

Connect CN301 and CN302 to the sockets of the T/P controller board.

CN301: FPC (40 pins)
Adaptable socket: FH28-40S-0.5SH(05) (Hirose Electric Co., Ltd.(HRS))

CN302: FPC (60 pins)
Adaptable socket: FH28-60S-0.5SH(05) (Hirose Electric Co., Ltd.(HRS))

4.6.4 Positions of plug and socket

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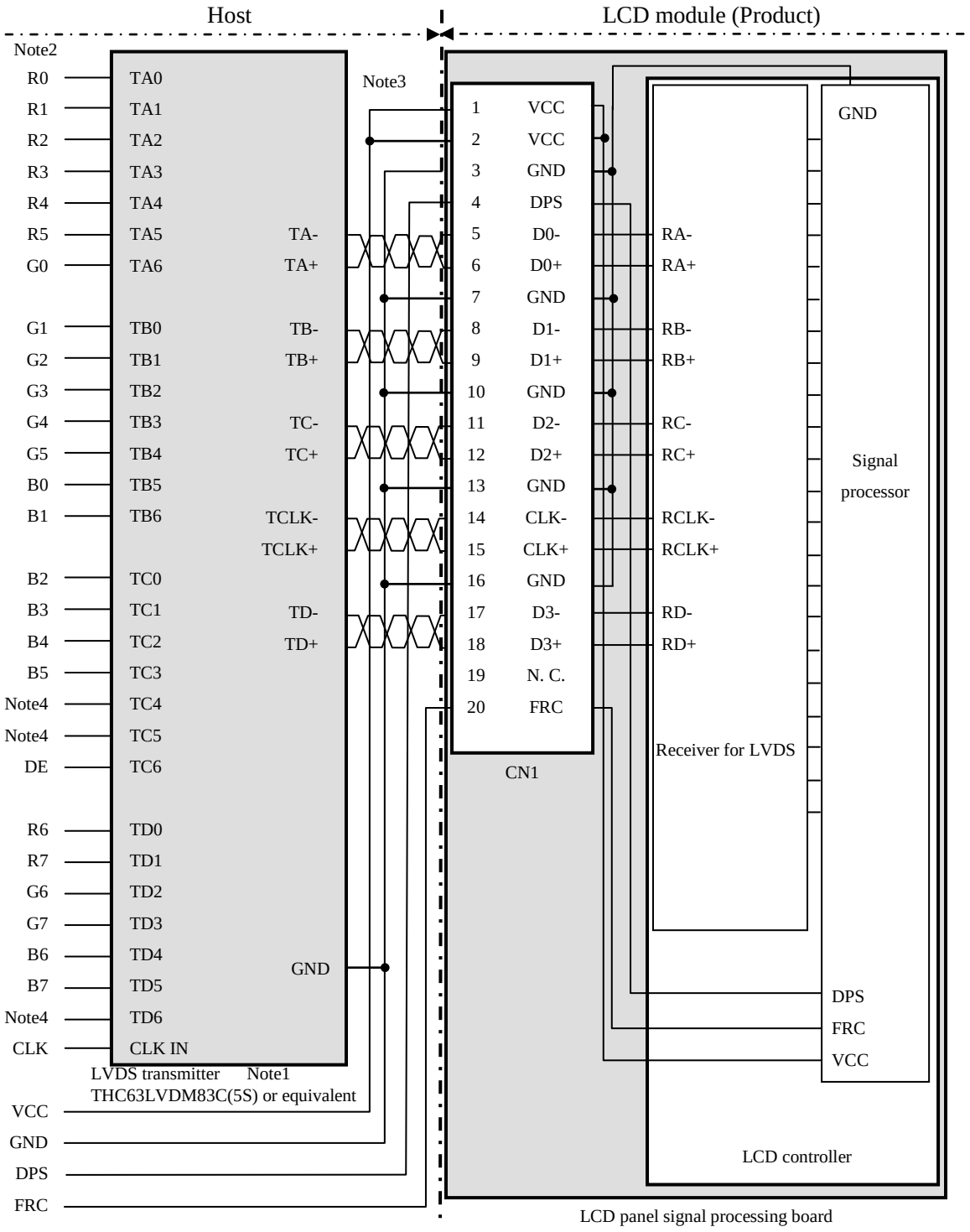
4.6.5 Connection between receiver and transmitter for LVDS

(1) Input data signal: 8-bit (FRC: Low)



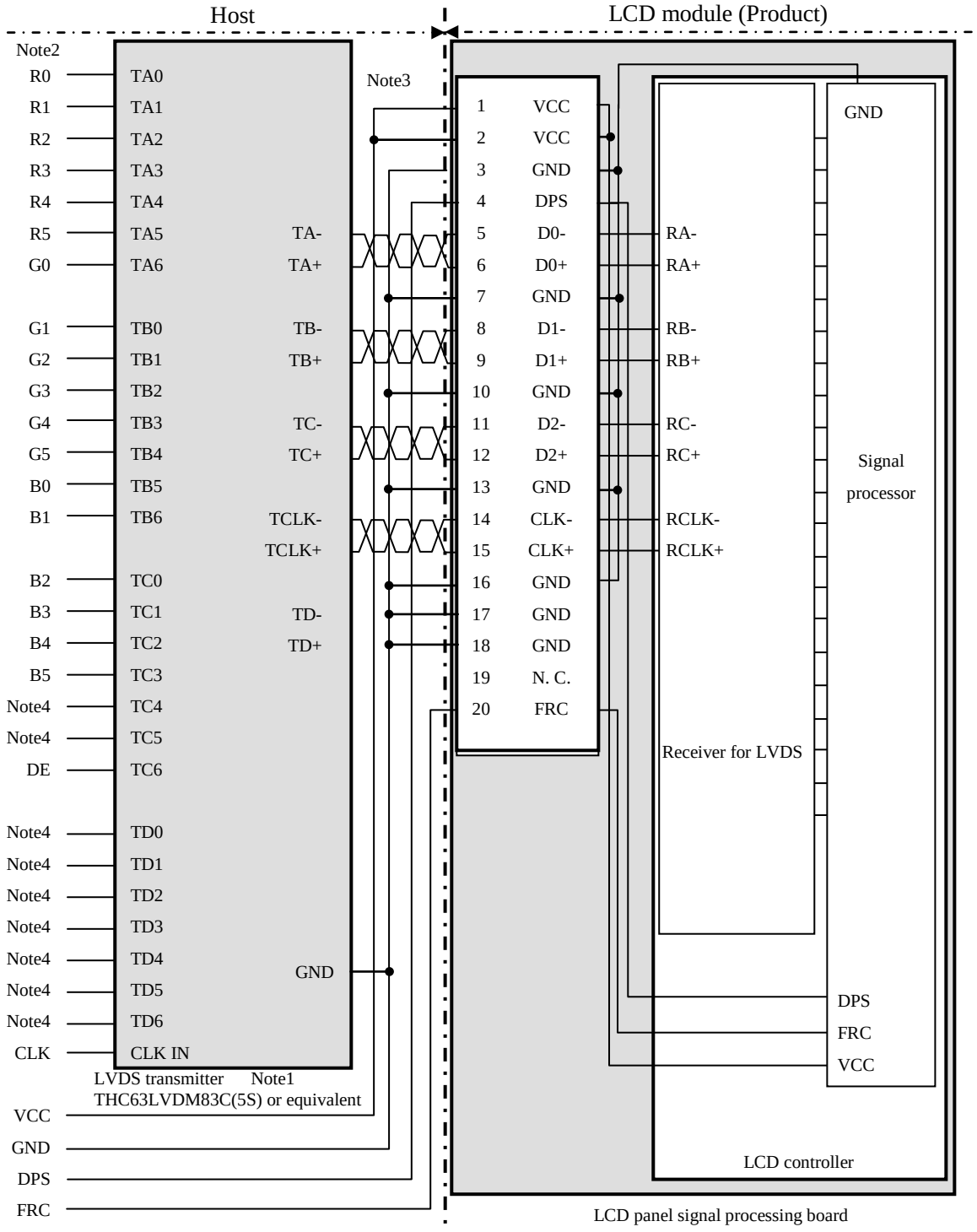

Note1: Recommended transmitter: THC63LVDM83C(5S) (THine Electronics Inc.) or equivalent.

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 them open to avoid noise problem.

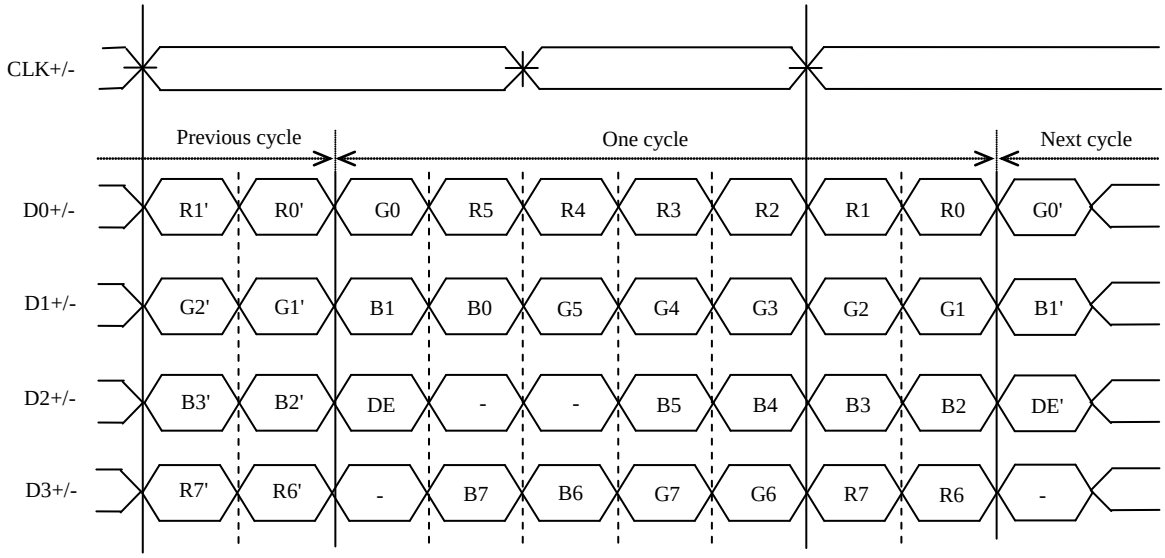
(2) Input data signal: 6-bit (FRC: High or Open)




Note1: Recommended transmitter: THC63LVDM83C(5S) (THine Electronics Inc.) or equivalent.
Note2: LSB (Least Significant Bit) - R0, G0, B0 MSB (Most Significant Bit) - R5, G5, B5
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 TD0-6 are not used inside the product, but do not keep them open to avoid noise problem.

4.6.6 Input data mapping

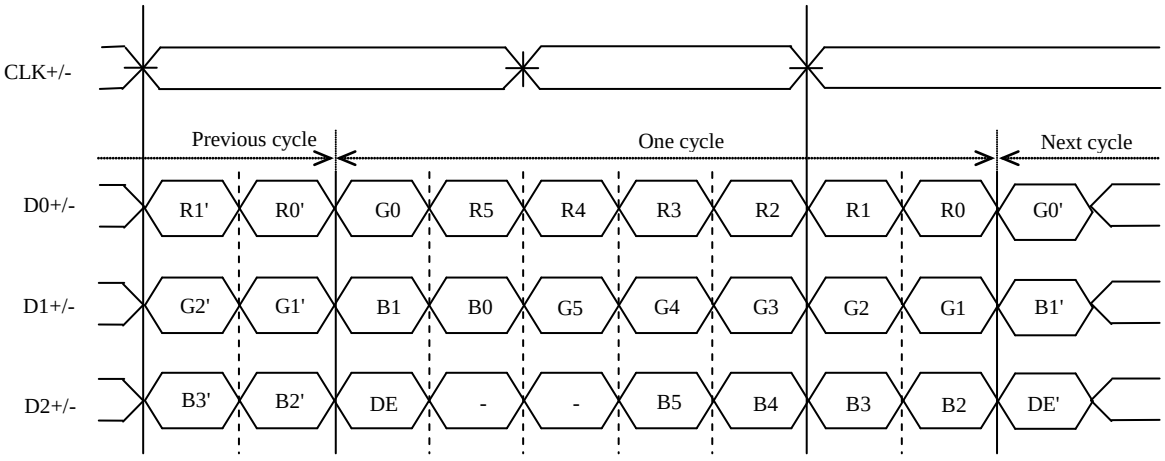
(1) Input data signal: 8-bit




Note1: LSB (Least Significant Bit) – R0, G0, B0 MSB (Most Significant Bit) – R7, G7, B7

Note2: Twist pair wires with 100Ω(Characteristic impedance) should be used between LCD panel signal processing board and LVDS transmitter.

(2) Input data signal: 6-bit




Note1: LSB (Least Significant Bit) – R0, G0, B0 MSB (Most Significant Bit) – R5, G5, B5

Note2: Twist pair wires with 100Ω(Characteristic impedance) should be used between LCD panel signal processing board and LVDS transmitter.

## 4.7 DISPLAY COLORS AND INPUT DATA SIGNALS

### 4.7.1 Combinations of input data signals and FRC signal

This product can display equivalent of 16,194,277 colors and 262,144 colors by combination of input data signals and FRC signal. See the following table.

| Combination | Input data signals | CN1- Pin No.17 and 18 | FRC terminal | Display colors | Remarks |
|---|---|---|---|---|---|
| ① | 8-bit | D3+/- | Low | 16,194,277 | Note1 |
| ② | 6-bit | GND | High or Open | 262,144 | Note2 |

Note1: See "**4.7.2 16,194,277 colors**".
Note2: See "**4.7.3 262,144 colors**".

4.7.2 16,194,277 colors

This product can display equivalent of 16,194,277 colors with 253 gray scales by combination ①.
(See "**4.7.1 Combinations of input data signals and FRC signal**".)
Also the relation between display colors and input data signals is as follows.

(Note1)

| 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 | x | x |
| | Red | 1 | 1 | 1 | 1 | 1 | 1 | x | x | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Magenta | 1 | 1 | 1 | 1 | 1 | 1 | x | x | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | x | x |
| | Green | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | x | x | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Cyan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | x | x | 1 | 1 | 1 | 1 | 1 | 1 | x | x |
| | Yellow | 1 | 1 | 1 | 1 | 1 | 1 | x | x | 1 | 1 | 1 | 1 | 1 | 1 | x | x | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | White | 1 | 1 | 1 | 1 | 1 | 1 | x | x | 1 | 1 | 1 | 1 | 1 | 1 | x | x | 1 | 1 | 1 | 1 | 1 | 1 | x | x |
| 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 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red | 1 | 1 | 1 | 1 | 1 | 1 | x | x | 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 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | x | x | 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 | 0 | 1 | 0 |
| | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 |
| | Blue | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | x | x |

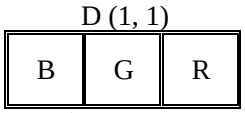
Note1: X means 0 or 1.

4.7.3 262,144 colors

This product can display 262,144 colors with 64 gray scales by combination ②.
(See "**4.7.1 Combinations of input data signals and FRC signal**".)
Also the relation between display colors and input data signals is as follows.

| Display colors | | Data signal (0: Low level, 1: High level) | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | R5 | R4 | R3 | R2 | R1 | R0 | G5 | G4 | G3 | G2 | G1 | G0 | B5 | B4 | B3 | B2 | B1 | B0 |
| Basic colors | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Red | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Magenta | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Green | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Cyan | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Yellow | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | White | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Red gray scale | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | dark | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ↑ | | | | : | | | | | | : | | | | | | : | | |
| | ↓ | | | | : | | | | | | : | | | | | | : | | |
| | bright | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Green gray scale | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 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 gray scale | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | ↑ | | | | : | | | | | | : | | | | | | : | | |
| | ↓ | | | | : | | | | | | : | | | | | | : | | |
| | bright | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 |
| | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 |
| | Blue | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |

4.8 DISPLAY POSITIONS

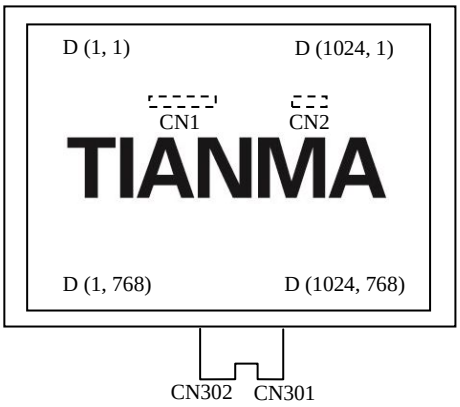



| | | | | | | |
|---|---|---|---|---|---|---|
| D( 1, 1) | D( 2, 1) | • • • | D( X, 1) | • • • | D(1023, 1) | D(1024, 1) |
| D( 1, 2) | D( 2, 2) | • • • | D( X, 2) | • • • | D(1023, 2) | D(1024, 2) |
| • • • | • • • | • • • | • • • | • • • | • • • | • • • |
| D( 1, Y) | D( 2, Y) | • • • | D( X, Y) |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

Note1: See "**4.9 SCANNING DIRECTIONS**".

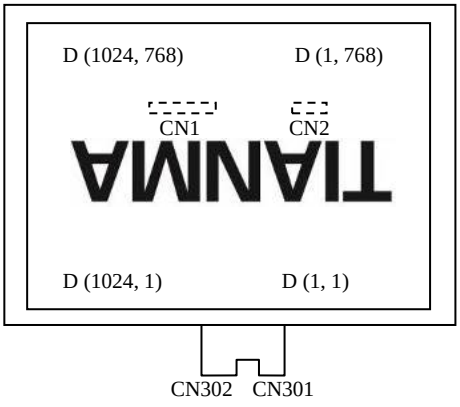
4.9 SCANNING DIRECTIONS

The following figures are seen from a front view.




Note1

Figure1. Normal scan (DPS: Low or Open)



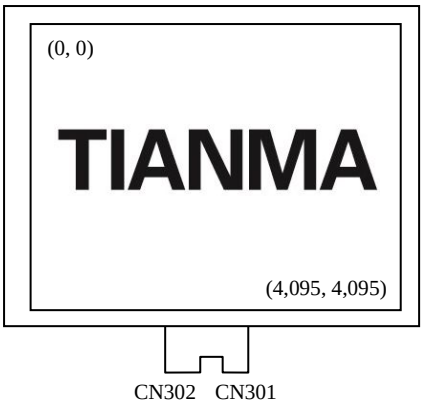

Note1

Figure2. Reverse scan (DPS: High)

Note1: Meaning of D (X, Y)
D (X, Y): Input data signals for LCD panel signal processing board

4.10 TOUCH PANEL POSITIONS

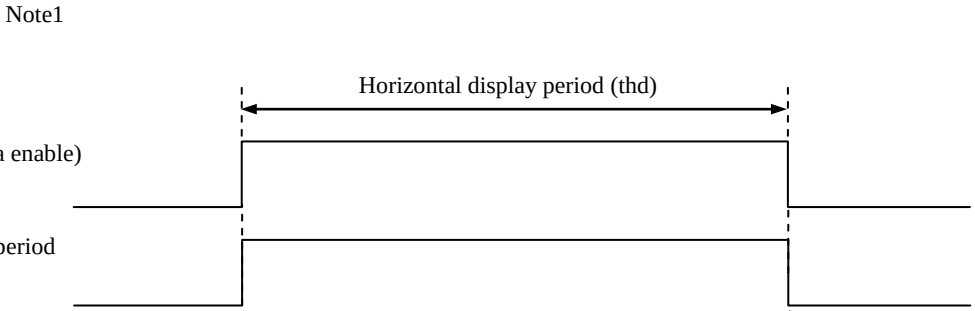
The following figure is the coordinates of the T/P from the front view.



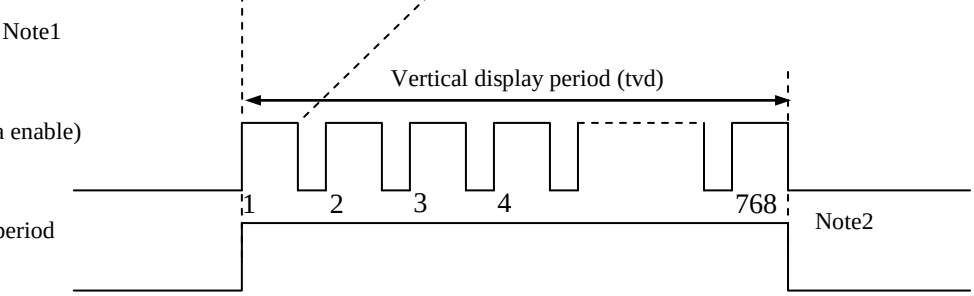
4.11 INPUT SIGNAL TIMINGS

4.11.1 Outline of input signal timings

- Horizontal signal




- Vertical signal




Note1: This diagram indicates virtual signal for set up to timing.
Note2: See "**4.11.3 Input signal timing chart**" for the pulse number.

4.11.2 Timing characteristics

(Note1, Note2, Note3)

| Parameter | | | Symbol | min. | typ. | max. | Unit | Remarks |
|---|---|---|---|---|---|---|---|---|
| CLK | Frequency | | 1/tc | 52.0 | 65.0 | 71.0 | MHz | 15.385ns (typ.) |
| | Duty ratio | | - | - | | | - | - |
| | Rise time, Fall time | | - | | | | ns | |
| DATA | CLK-DATA | Setup time | - | - | | | ns | - |
| | | Hold time | - | | | | ns | |
| | Rise time, Fall time | | - | | | | ns | |
| DE | Horizontal | Cycle | th | 16.542 | 20.676 | 26.88 | μs | 48.363kHz (typ.) |
| | | | | 1,114 | 1,344 | 1,400 | CLK | |
| | | Display period | thd | 1024 | | | CLK | - |
| | Vertical (One frame) | Cycle | tv | 13.34 | 16.666 | 20.0 | ms | 60.0Hz (typ.) |
| | | | | 780 | 806 | 845 | H | |
| | | Display period | tvd | 768 | | | H | - |
| | CLK-DE | Setup time | - | - | | | ns | - |
| | | Hold time | - | | | | ns | |
| | Rise time, Fall time | | - | | | | ns | |

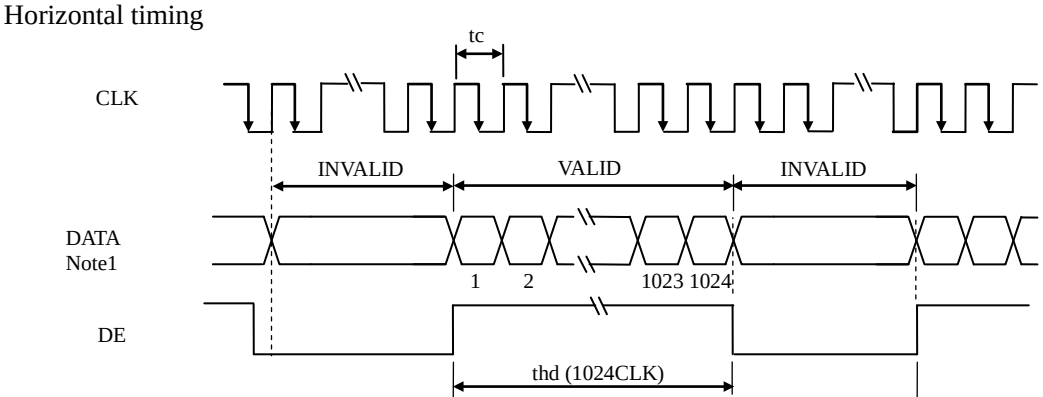
Note1: Definition of parameters is as follows.
tc= 1CLK, th= 1H

Note2: See the data sheet of LVDS transmitter.

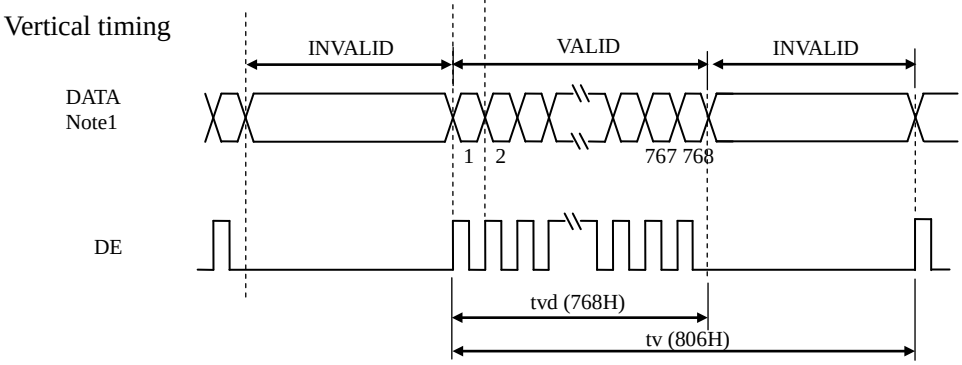
Note3: Vertical cycle (tv) should be specified in integral multiple of Horizontal cycle (th).

4.11.3 Input signal timing chart

Horizontal timing




Vertical timing




Note1: DATA = R0-R7, G0-G7, B0-B7 or R0-R5, G0-G5, B0-B5

## 4.12 OPTICS

### 4.12.1 Optical characteristics

(Note1, Note2)

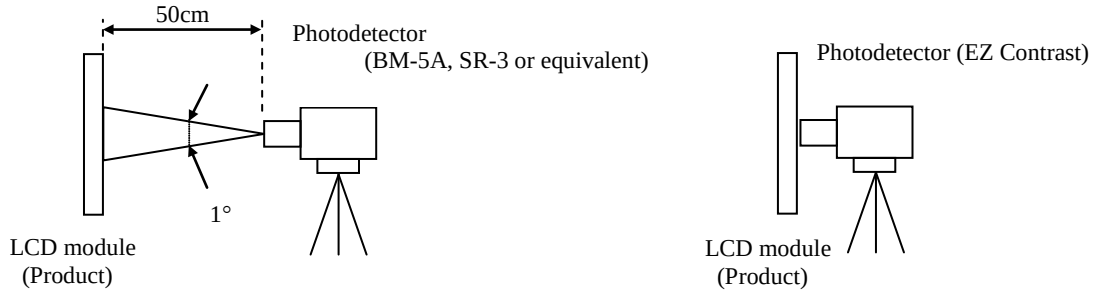
| Parameter | | Condition | Symbol | min. | typ. | max. | Unit | Measuring instrument | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| Luminance | | White at center<br>θR= 0°, θL= 0°, θU= 0°, θD= 0° | L | 230 | 350 | - | cd/m$^2$ | BM-5A or equivalent | - |
| Contrast ratio | | White/Black at center<br>θR= 0°, θL= 0°, θU= 0°, θD= 0° | CR | 400 | 600 | - | - | BM-5A or equivalent | Note3 |
| Luminance uniformity | | White<br>θR= 0°, θL= 0°, θU= 0°, θD= 0° | LU | - | 1.25 | 1.33 | - | BM-5A or equivalent | Note4 |
| Chromaticity | White | **x** coordinate | Wx | 0.263 | 0.313 | 0.363 | - | SR-3 or equivalent | Note5 |
| | | **y** coordinate | Wy | 0.279 | 0.329 | 0.379 | - | | |
| | Red | **x** coordinate | Rx | - | 0.615 | - | - | | |
| | | **y** coordinate | Ry | - | 0.337 | - | - | | |
| | Green | **x** coordinate | Gx | - | 0.334 | - | - | | |
| | | **y** coordinate | Gy | - | 0.608 | - | - | | |
| | Blue | **x** coordinate | Bx | - | 0.157 | - | - | | |
| | | **y** coordinate | By | - | 0.080 | - | - | | |
| Color gamut | | θR= 0°, θL= 0°, θU= 0°, θD= 0°<br>at center, against NTSC color space | C | 55 | 60 | - | % | | |
| Response time | | White to Black | Ton | - | 3 | 5 | ms | BM-5A or equivalent | Note6<br>Note7 |
| | | Black to White | Toff | - | 5 | 8 | 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 | 70 | 80 | - | ° | | |

Note1: These are initial characteristics.

Note2: Measurement conditions are as follows.

Ta= 25°C, VCC= 3.3V, VDD= 12.0V, PWM duty ratio: 100%,
Display mode: XGA, Horizontal cycle= 1/48.363kHz, Vertical cycle= 1/60.0Hz,
DPS= Low or Open: Normal scan, FRC=Low (8-bit mode)

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




Note3: See "**4.12.2 Definition of contrast ratio**".

Note4: See "**4.12.3 Definition of luminance uniformity**".

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

Note6: Product surface temperature: TopF= 29 °C

Note7: See "**4.12.4 Definition of response times**".

Note8: See "**4.12.5 Definition of viewing angles**".

4.12.2 Definition of contrast ratio

The contrast ratio is calculated by using the following formula.

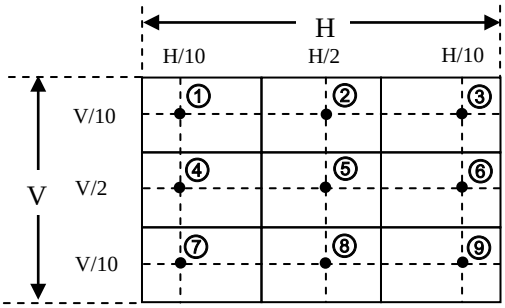
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance of white screen}}{\text{Luminance of black screen}}$$

4.12.3 Definition of luminance uniformity

The luminance uniformity is calculated by using following formula.

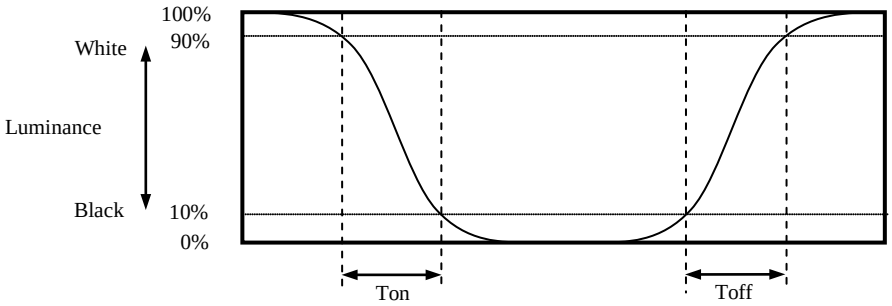
$$\text{Luminance uniformity (LU)} = \frac{\text{Maximum luminance from ① to ⑨}}{\text{Minimum luminance from ① to ⑨}}$$

The luminance is measured at near the 9 points shown below.

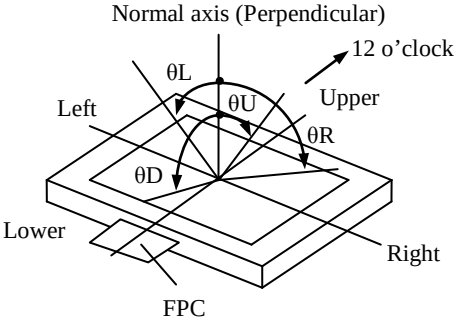



4.12.4 Definition of response times

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




4.12.5 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 (Life time expectancy) Note1, Note2, Note3 | Unit |
|---|---|---|---|
| LED elementary substance | 25°C (Ambient temperature of the product) Continuous operation, PWM duty ratio: 100% | 50,000 | h |

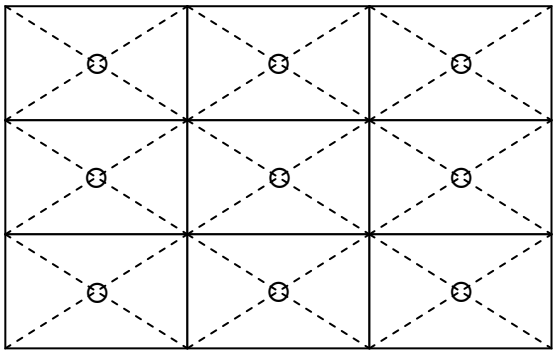
Note1: Life time expectancy is mean time to half-luminance.
Note2: Estimated luminance lifetime is not the value for LCD module but the value for LED elementary substance.
Note3: By ambient temperature, the lifetime changes particularly. Especially, in case the product works under high temperature environment,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

## 6. RELIABILITY TESTS

| Test item | Condition | Judgment Note1 |
|---|---|---|
| High temperature and humidity (Operation) | ① 50 ± 2°C, RH= 80%, 300hours<br>② Display data is black. | No display malfunctions |
| High temperature (Operation) | ① 70 ± 3°C, 300hours<br>② Display data is black. | |
| Thermal shock (Non operation) | ① -20 ± 3°C…30minutes<br>60 ± 3°C…30minutes<br>② 100cycles, 1hour/cycle<br>③ Temperature transition time is within 5 minutes. | |
| ESD (Operation) | Contact Discharge<br>① 150pF, 330Ω, ±8kV<br>② 9 places on a panel surface Note2<br>③ 25 times each place at 1 sec interval<br><br>Air Discharge<br>① 150pF, 330Ω, ±15kV<br>② 9 places on a panel surface Note2<br>③ 25 times each place at 1 sec 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 direction | 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 direction | |

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"!**

| | |
|---|---|
|  | This sign has the meaning that a customer will be injured or the product will sustain damage if the customer practices wrong operations. |
|  | This sign has the meaning that a customer will be injured if the customer practices wrong operations. |

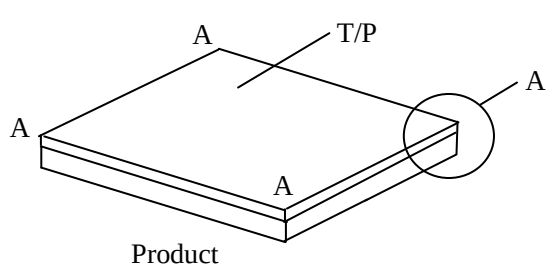
### 7.2 CAUTIONS

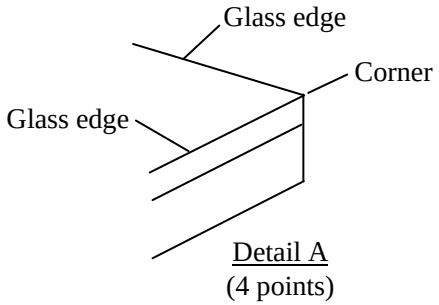
- **Be taken care when handling the T/P. There is a danger of injury, because the T/P has the glass edge and corner which are sharp.**
- **Do not shock and press the LCD panel, T/P and the backlight! There is a danger of breaking, because they are made of glass. (Shock: Equal to or no greater than 294m/s$^2$ and equal to or no greater than 11ms, Pressure: Equal to or no greater than 19.6 N (ϕ16mm jig))**

### 7.3 ATTENTIONS 

#### 7.3.1 Handling of the product

① Use gloves or fingerstalls and do not touch glass edge of T/P when handling it, because it has sharp glass edge.




② 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.
③ Do not hook or pull FPC in order to avoid any damage.
④ When the product is put on the table temporarily, display surface must be placed downward.
⑤ 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.
⑥ The torque for product mounting screws must never exceed 0.392 N·m. Higher torque might result in distortion of the bezel. And the length of product mounting screws must be ≤ 4.5 mm.
⑦ 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 and peeling off the T/P. ☆

⑧ Do not hit or rub the surface of T/P with hard materials, because it is easily scratched.
⑨ When cleaning the T/P surface, wipe it with a soft dry cloth.
⑩ Do not push or pull the interface connectors while the product is working. ☆
⑪ 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 by any chance, please wash it away with soap and water.
⑫ When turning on the power of the T/P do not touch T/P surface with any conductive materials such as finger and so on. It may cause malfunction of the T/P.

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 occurred by temperature difference, the product packing box must be opened after enough time being left under the environment of an unpacking room. Evaluate the storage time sufficiently because dew condensation is affected by the environmental temperature and humidity. (Recommended leaving time: 6 hours or more with the original packing state after a customer receives the package)
③ Do not operate in high magnetic field. If not, circuit boards may be broken.
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, flickering, vertical streams or tiny spots 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.
⑥ T/P has polarizing characteristic. And the polarizing characteristics differ among products. Therefore, when seeing the displays through the other polarizing material (for example polarizing sunglasses), some displays can not be seen and some displays look different color darker because of polarizing characteristic mismatching between T/P and the other polarizing material.
⑦ If the product is subjected to direct sunlight for a long time, T/P transmission may be degraded.

7.3.4 Others

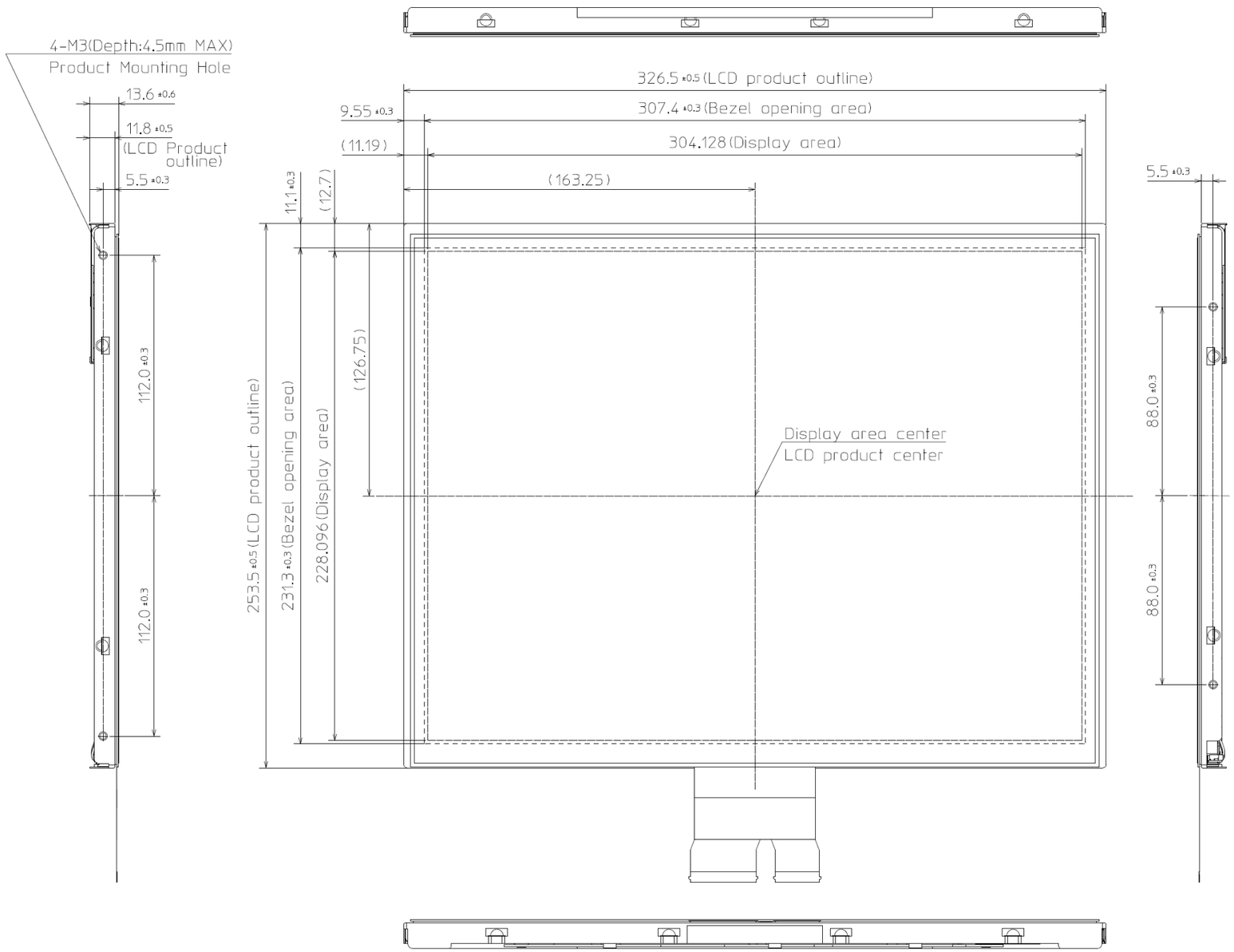
① All GND, VCC and VDD terminals should be used without any non-connected lines.
② Do not disassemble a product or adjust variable resistors.
③ See "REPLACEMENT MANUAL FOR LAMP HOLDER SET", when replacing lamp holder set.
④ Pack the product with the original shipping package, in order to avoid any damages during transportation, when returning the product to TMJ for repairing and so on.
⑤ The information of China RoHS (II) six hazardous substances or elements in this product is as follows.

| China RoHS (II) six hazardous substances or elements | | | | | |
|---|---|---|---|---|---|
| Lead (Pb) | Mercury (Hg) | Cadmium (Cd) | Hexavalent Chromium (Cr VI) | Polybrominated Biphenys (PBB) | Polybrominated Biphenyl Ethers (PBDE) |
| × | ○ | ○ | ○ | ○ | ○ |

Note1: ○: This indicates that the poisonous or harmful material in all the homogeneous materials for this part is equal or below the limitation level of GB/T26572-2011 standard regulation.
×: This indicates that the poisonous or harmful material in all the homogeneous materials for this part is above the limitation level of GB/T26572-2011 standard regulation.

**8. OUTLINE DRAWINGS**

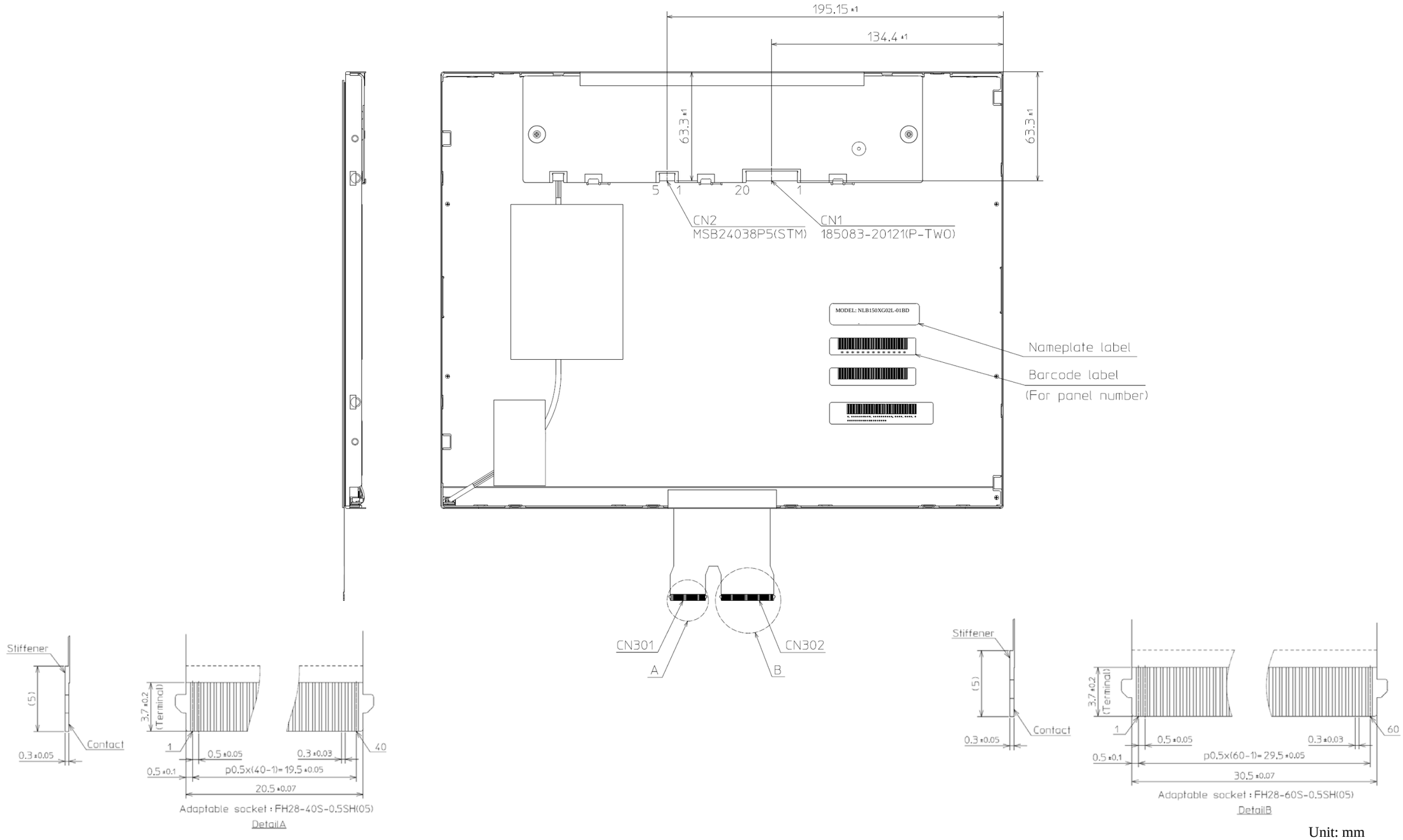
8.1 FRONT VIEW




Unit: mm

Note1: The values in parentheses are for reference.
Note2: The torque for product mounting screws must never exceed 0.392N·m. And the length of product mounting screws must be ≤ 4.5 mm.

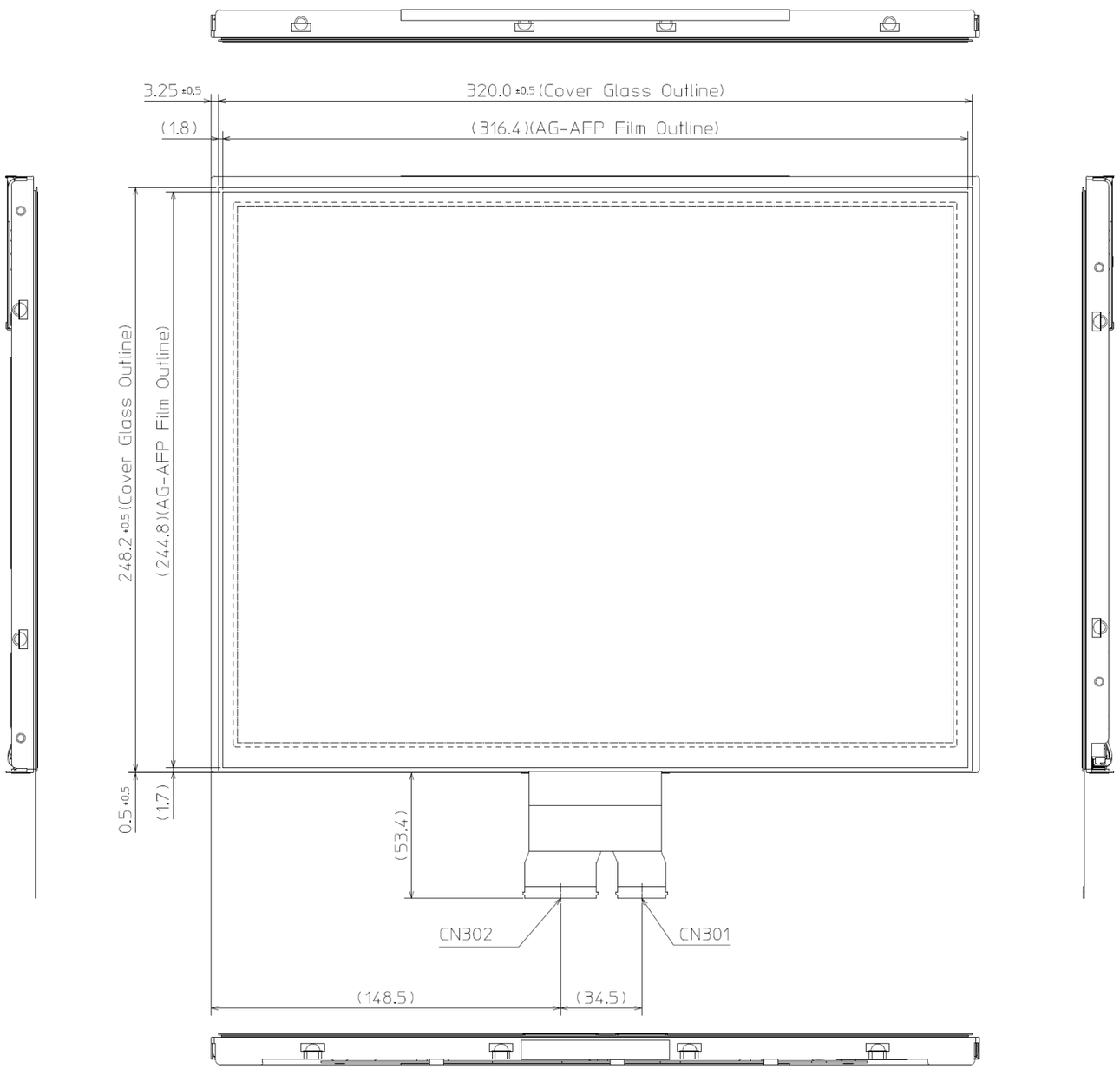
8.2 REAR VIEW




Unit: mm

Note1: The values in parentheses are for reference.

8.3 TOUCH PANEL



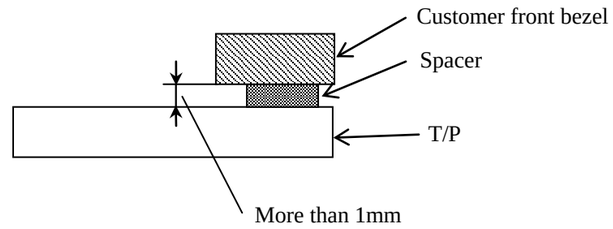

Note1: The values in parentheses are for reference.

**INSTALL GUIDANCE**

1. Bezel mounting

If a customer put a front bezel on the T/P, please take care the following items.

- Use a front bezel made from an insulative material such as plastic and so on.
- If a customer use a front bezel made from a conductive material, please always keep a distance more than 1mm between the front bezel and the T/P. Otherwise, the bezel will lower T/P sensitivity or cause unstable touch action.




2. FPC handling

- Do not fold the FPC. If the FPC is folded, disconnection of a wiring pattern may be caused. In case of bending FPC, the minimum radius of curvature must be 1.0mm or more.
- Do not bend the FPC at the reinforced area (A).

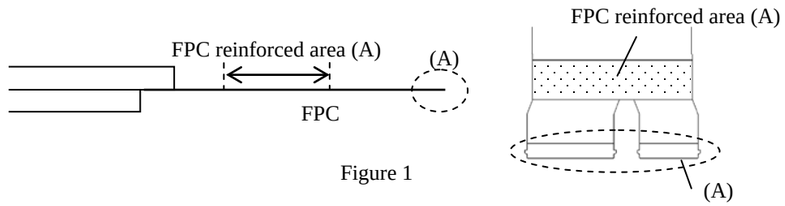



Figure 1

・Bending direction

To avoid any mechanical damage to the base part of the FPC, please always bend the FPC at the outer side of the LCD module in the direction of the arrow in Figure 2.

・Allowable number of bending

30 times

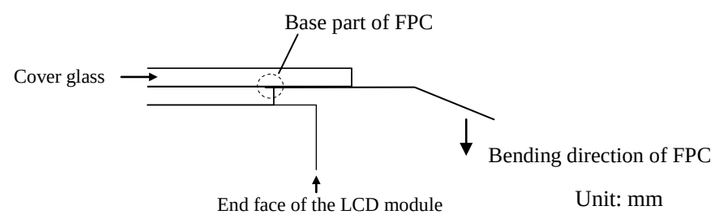



Figure 2