

# **TFT COLOR LCD MODULE**

**NL4827HC19-05A**

**11cm (4.3 Type)  
WQVGA**

**DATA SHEET**   
**DOD-PP-650 (1st edition)**

**This DATA SHEET is updated document from  
PPRELIMINARY DATA SHEET DOD-PP-0568(6).**

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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.

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## 1. OUTLINE

### 1.1 STRUCTURE AND PRINCIPLE

Color LCD module NL4827HC19-05A 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 controller, 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

- Personal navigation device
- Handy terminals



### 1.3 FEATURES

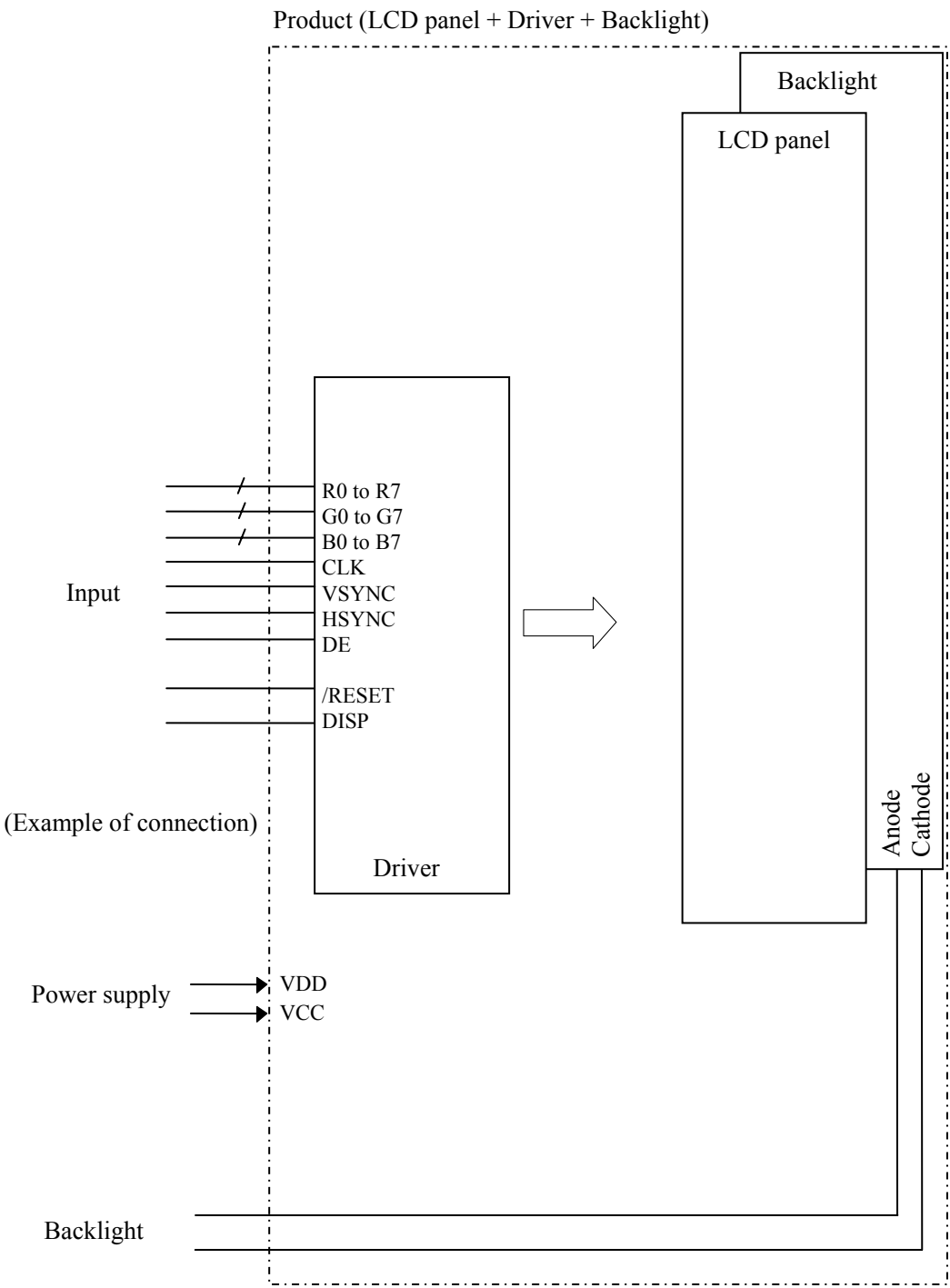
- Transmissive type
- Backlight attached
- High luminance
- High contrast
- Including LCD controller and power supply
- 8-bit digital RGB signals
- Compliance with the European RoHS directive (2002/95/EC)



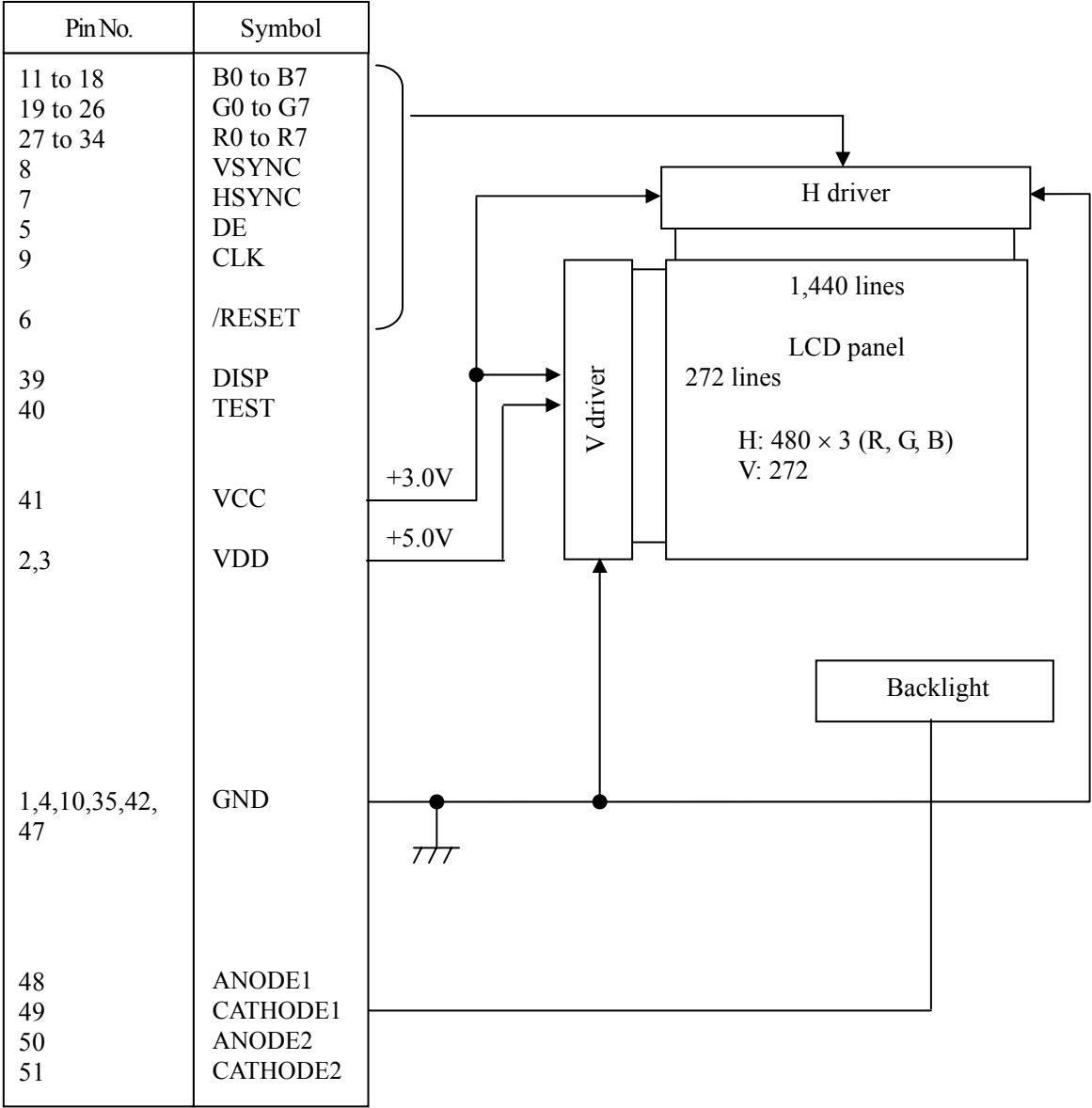
**2. GENERAL SPECIFICATIONS**

|                                   |                                                                                                                                                                      |
|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Display area</b>               | 95.04 (H) × 53.856 (V) mm                                                                                                                                            |
| <b>Diagonal size of display</b>   | 11 cm (4.3 inches)                                                                                                                                                   |
| <b>Drive system</b>               | a-Si TFT active matrix                                                                                                                                               |
| <b>Display color</b>              | 16,777,216 colors                                                                                                                                                    |
| <b>Pixel</b>                      | 480 (H) × 272 (V) pixels                                                                                                                                             |
| <b>Pixel arrangement</b>          | RGB (Red dot, Green dot, Blue dot) vertical stripe                                                                                                                   |
| <b>Dot pitch</b>                  | 0.066 (H) × 0.198 (V) mm                                                                                                                                             |
| <b>Pixel pitch</b>                | 0.198 (H) × 0.198 (V) mm                                                                                                                                             |
| <b>Module size</b>                | 105.5 (H) × 67.2 (V) × 3.8 (D) mm (typ.)                                                                                                                             |
| <b>Weight</b>                     | 58 g (typ.)                                                                                                                                                          |
| <b>Polarizer surface</b>          | Clear                                                                                                                                                                |
| <b>Polarizer pencil-hardness</b>  | 3H (min.) [by JIS K5400]                                                                                                                                             |
| <b>Designed viewing direction</b> | Viewing direction without image reversal: down side (6 o'clock)                                                                                                      |
| <b>Luminance</b>                  | At IL = 20mA<br>600cd/m <sup>2</sup> (typ.)                                                                                                                          |
| <b>Contrast ratio</b>             | At IL = 20mA<br>500:1 (typ.)                                                                                                                                         |
| <b>Color gamut</b>                | At LCD panel center<br>60% (typ.) [against NTSC color space]                                                                                                         |
| <b>Response time</b>              | Ton + Toff (10% ← → 90%)<br>33ms (typ.)                                                                                                                              |
| <b>Signal system</b>              | 8-bit digital signals for data of RGB colors, Dot clock (CLK), DE, Horizontal synchronous signal (HSYNC), Vertical synchronous signal (VSYNC), Reset signal (/RESET) |
| <b>Supply voltage</b>             | VCC: 3.0V (typ., for Logic)<br>VDD: 5.0V (typ., for LCD driver)                                                                                                      |
| <b>Power consumption</b>          | LCD panel + Driver: 87 mW (typ.)<br>Backlight: 512 mW (typ., at IL = 20mA)                                                                                           |

3. BLOCK DIAGRAM



FPC I/F



## 4. DETAILED SPECIFICATIONS

### 4.1 MECHANICAL SPECIFICATIONS

| Parameter    | Specification                                                                       | Unit |
|--------------|-------------------------------------------------------------------------------------|------|
| Module size  | $105.5 \pm 0.3$ (W) $\times$ $67.2 \pm 0.3$ (H) $\times$ $3.8 \pm 0.3$ (D)<br>Note1 | mm   |
| Display area | $95.04$ (H) $\times$ $53.856$ (V)<br>Note2                                          | mm   |
| Weight       | 58 (typ.), 60 (max.)                                                                | g    |

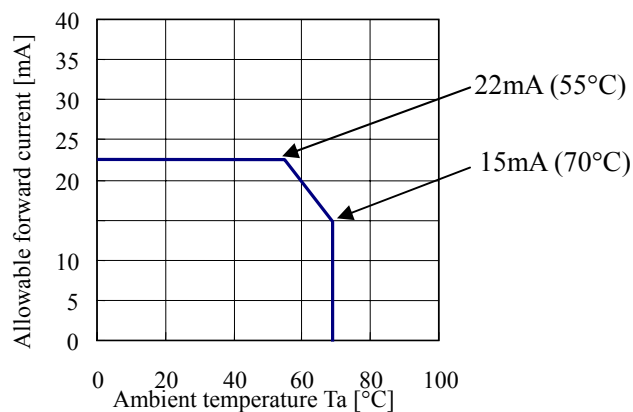
Note1: Excluding FPC

Note2: See "8. OUTLINE DRAWINGS".

### 4.2 ABSOLUTE MAXIMUM RATINGS

| Parameter                  | Symbol                | Rating          | Unit             | Remarks                                                         |
|----------------------------|-----------------------|-----------------|------------------|-----------------------------------------------------------------|
| Supply voltage             | VCC                   | -0.3 to +6.0    | V                | Ta= 25°C                                                        |
|                            | VDD                   | -0.3 to +6.0    |                  |                                                                 |
| Logic input voltage        | VI                    | -0.3 to VCC+0.3 | V                | Logic signals                                                   |
| Backlight                  | Reverse voltage       | VR              | ≤ 20             | Ta= 25°C,<br>These values are applied<br>for both Anode1 and 2. |
|                            | Power dissipation     | PD              | ≤ 492            |                                                                 |
|                            | Forward current       | IL              | Note1            |                                                                 |
|                            | Pulse forward current | IFP             | 100              |                                                                 |
| Storage temperature        | Tst                   | -30 to +80      | °C               | -                                                               |
| Operating temperature      | Top                   | -20 to +70      |                  | Product surface Note2                                           |
| Relative humidity<br>Note3 | RH                    | ≤ 95            | %                | Ta ≤ 40°C                                                       |
|                            |                       | ≤ 85            |                  | 40°C < Ta ≤ 50°C                                                |
|                            |                       | ≤ 55            |                  | 50°C < Ta ≤ 60°C                                                |
|                            |                       | ≤ 36            |                  | 60°C < Ta ≤ 70°C                                                |
| Absolute humidity<br>Note3 | AH                    | ≤ 70<br>Note4   | g/m <sup>3</sup> | Ta > 70°C                                                       |
| Storage altitude           |                       | ≤ 13,600        | m                | -30°C ≤ Ta ≤ 80°C                                               |
| Operating altitude         |                       | ≤ 4,850         | m                | -20°C ≤ Ta ≤ 70°C                                               |

Note1: Allowable forward current



Note2: Measured at display area

Note3: No condensation

Note4: Water amount at Ta= 70°C and RH= 36%

#### 4.3 ELECTRICAL CHARACTERISTICS

##### (1) Logic/ LCD driving

(Ta= 25°C)

| Parameter                 | Symbol | min.   | typ. | max.   | Unit | Remarks                         |
|---------------------------|--------|--------|------|--------|------|---------------------------------|
| Logic supply voltage      | VCC    | 2.3    | 3.0  | 3.6    | V    | -                               |
| LCD driver supply voltage | VDD    | 4.8    | 5.0  | 5.2    | V    | -                               |
| Logic input high voltage  | VIH    | 0.7VCC | -    | VCC    | V    | Logic signal                    |
| Logic input low voltage   | VIL    | 0      | -    | 0.3VCC | V    |                                 |
| VCC supply current        | ICC    | -      | 4    | 8      | mA   | at VCC= 3.0V, VDD=5.0V<br>Note1 |
| VDD supply current        | IDD    | -      | 15   | 24     | mA   | at VCC= 3.0V, VDD=5.0V<br>Note1 |

Note1: CLK=, 10.87MHz, HSYNC= 20.7kHz, VSYNC= 75Hz  
Checkered flag pattern (by EIAJ ED-2522)

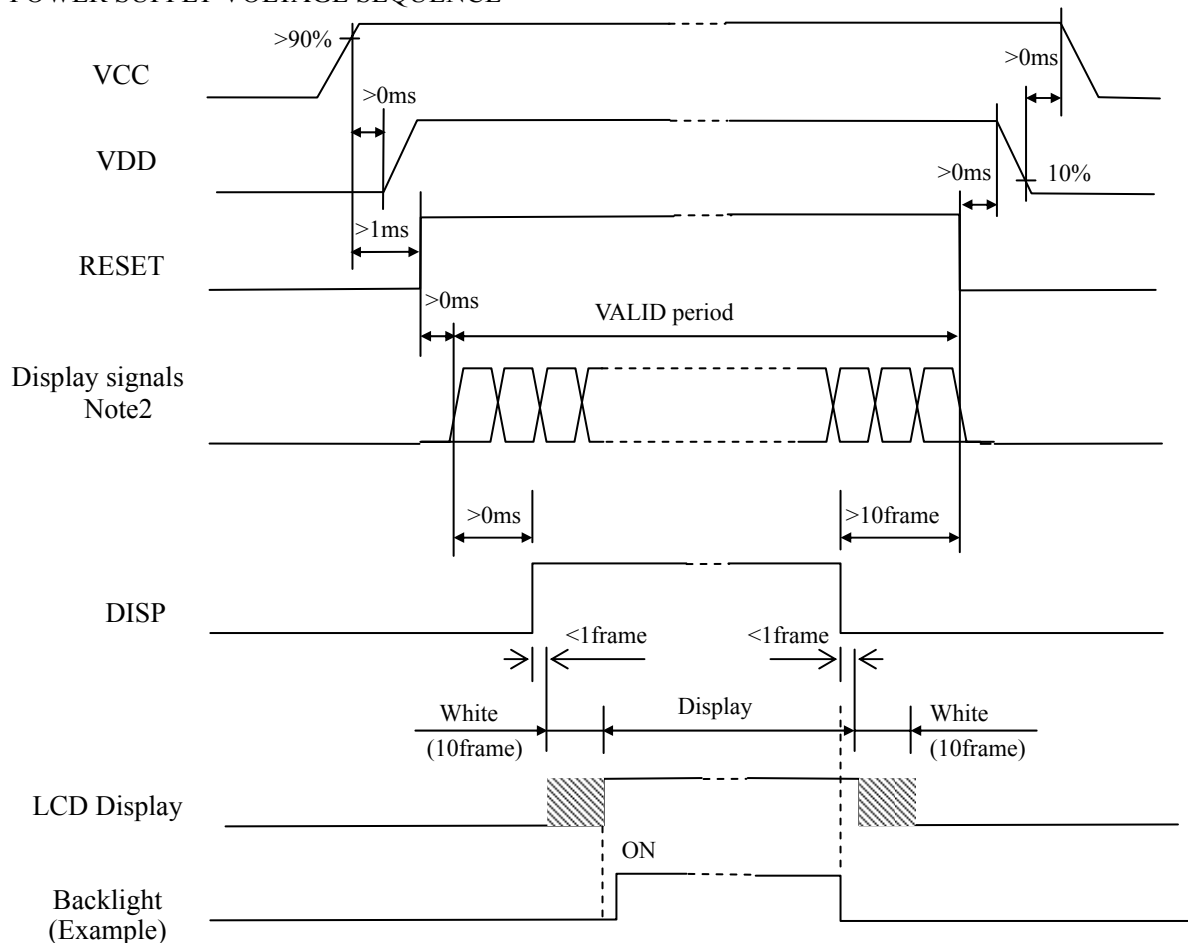


##### (2) Backlight

(Ta= 25°C)

| Parameter       | Symbol | min. | typ. | max. | Unit | Remarks     |
|-----------------|--------|------|------|------|------|-------------|
| Forward Current | IL1, 2 | -    | 20   | 22   | mA   | -           |
| Forward Voltage | VL1, 2 | -    | 12.8 | 14   | V    | at IL= 20mA |

#### 4.4 POWER SUPPLY VOLTAGE SEQUENCE



Note1: Supply voltage sequence must be followed above sequence diagram.

Note2: Display signals (CLK, HSYNC, VSYNC, DE, R0 to R7, G0 to G7, B0 to B7) must be Low or High-impedance, exclude the VALID period (See above sequence diagram), in order to avoid that internal circuits is damaged.

Note3: All signals should not be interrupted during the operation. Even if the signals recover, the LCD module may not be operated correctly. In this case, reset the sequence again.

#### 4.5 INTERFACE PIN CONNECTIONS

CN1 (FPC)

Adaptable socket: (FH23-51S-0.3SHW(06)) (Hirose Electric Co., Ltd.(HRS))

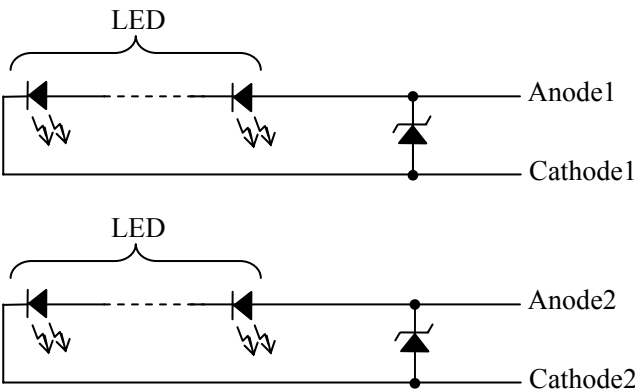
| Pin No. | Symbols | Functions                     | Pin No. | Symbols  | Functions              |
|---------|---------|-------------------------------|---------|----------|------------------------|
| 1       | GND     | Ground Note1                  | 27      | R0       | Red data (LSB)         |
| 2       | VDD     | Power supply                  | 28      | R1       | Red data               |
| 3       | VDD     |                               | 29      | R2       | Red data               |
| 4       | GND     | Ground Note1                  | 30      | R3       | Red data               |
| 5       | DE      | Data enable signal            | 31      | R4       | Red data               |
| 6       | /RESET  | Reset                         | 32      | R5       | Red data               |
| 7       | HSYNC   | Horizontal synchronous signal | 33      | R6       | Red data               |
| 8       | VSYNC   | Vertical synchronous signal   | 34      | R7       | Red data (MSB)         |
| 9       | CLK     | Dot clock                     | 35      | GND      | Ground Note1           |
| 10      | GND     | Ground Note1                  | 36      | RSVD     | Keep this pin Open.    |
| 11      | B0      | Blue data (LSB)               | 37      | RSVD     | Keep this pin Open.    |
| 12      | B1      | Blue data                     | 38      | RSVD     | Keep this pin Open.    |
| 13      | B2      | Blue data                     | 39      | DISP     | Display ON/OFF         |
| 14      | B3      | Blue data                     | 40      | TEST     | Keep this pin H.       |
| 15      | B4      | Blue data                     | 41      | VCC      | Power supply (Logic)   |
| 16      | B5      | Blue data                     | 42      | GND      | Ground Note1           |
| 17      | B6      | Blue data                     | 43      | N. C.    | Keep this pin Open.    |
| 18      | B7      | Blue data (MSB)               | 44      | N. C.    | Keep this pin Open.    |
| 19      | G0      | Green data (LSB)              | 45      | N. C.    | Keep this pin Open.    |
| 20      | G1      | Green data                    | 46      | N. C.    | Keep this pin Open.    |
| 21      | G2      | Green data                    | 47      | GND      | Ground Note1           |
| 22      | G3      | Green data                    | 48      | ANODE1   | LED1 voltage (Anode)   |
| 23      | G4      | Green data                    | 49      | CATHODE1 | LED1 voltage (Cathode) |
| 24      | G5      | Green data                    | 50      | ANODE2   | LED2 voltage (Anode)   |
| 25      | G6      | Green data                    | 51      | CATHODE2 | LED2 voltage (Cathode) |
| 26      | G7      | Green data (MSB)              |         |          |                        |

Note1: All GND terminals should be used without any non-connected lines.

Note2: Do not fold the FPC. When the FPC is folded, pattern disconnection may be caused. In case of bending FPC, the minimum curvature (R) must be more than 1.0 mm.

Description of terminals

| Terminals         | Description                                                                                                                                                                     |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| /RESET            | When /RESET is L, an internal reset is performed.<br>The reset operation is executed at the /RESET signal level.<br>Be sure to perform reset via this pin at power application. |
| DISP              | Display ON/ OFF mode control.<br>Internally pulled high.<br>When DISP is L, input data is invalid and display OFF (white).                                                      |
| ANODE,<br>CATHODE | Refer to the below “Circuits of backlight”.                                                                                                                                     |



Circuits of backlight

#### 4.6 DISPLAY COLORS AND INPUT DATA SIGNALS

This product can display equivalent of 16,777,216 colors in 256 gray scales by combination.

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  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                  | dark    | 0                                         | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 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  |
| 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  | 0  | 1  | 1  | 1  | 1  | 1  | 0  | 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  | 1  | 0  |
|                  | dark    | 0                                         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 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  | 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 figure of "4.8 SCANNING DIRECTIONS".).

C (0, 0)

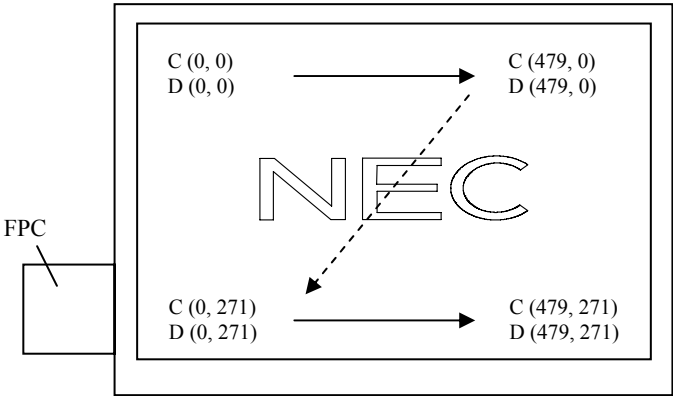
C (1, 0)

|   |   |   |   |   |   |
|---|---|---|---|---|---|
| R | G | B | R | G | B |
|---|---|---|---|---|---|

|            |            |     |            |     |             |             |
|------------|------------|-----|------------|-----|-------------|-------------|
| C( 0, 0)   | C( 1, 0)   | ... | C( X, 0)   | ... | C(478, 0)   | C(479, 0)   |
| C( 0, 1)   | C( 1, 1)   | ... | C( X, 1)   | ... | C(478, 1)   | C(479, 1)   |
| ⋮          | ⋮          | ⋮   | ⋮          | ⋮   | ⋮           | ⋮           |
| C( 0, Y)   | C( 1, Y)   | ... | C( X, Y)   | ... | C(478, Y)   | C(479, Y)   |
| ⋮          | ⋮          | ⋮   | ⋮          | ⋮   | ⋮           | ⋮           |
| C( 0, 270) | C( 1, 270) | ... | C( X, 270) | ... | C(478, 270) | C(479, 270) |
| C( 0, 271) | C( 1, 271) | ... | C( X, 271) | ... | C(478, 271) | C(479, 271) |

4.8 SCANNING DIRECTIONS

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



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

#### 4.9 INPUT SIGNAL TIMINGS

RGB interface (Ta= 25°C, VCC= 3.0V, VDD=5.0V)

##### (1) Timing characteristics

| Parameter                          |                      |            | Symbol | min. | typ.  | max.  | Unit | Remarks        |
|------------------------------------|----------------------|------------|--------|------|-------|-------|------|----------------|
| CLK                                | Frequency            |            | 1/tc   | 8.69 | 10.87 | 11.59 | MHz  | -              |
|                                    | Duty                 |            | tcd    | 0.4  | 0.5   | 0.6   | -    | -              |
|                                    | Rise time, Fall time |            | terf   | -    | -     | 2     | ns   | -              |
| DATA<br>(R0-7)<br>(G0-7)<br>(B0-7) | CLK-DATA             | Setup time | tds    | 15   | -     | -     | ns   | -              |
|                                    |                      | Hold time  | tdh    | 15   | -     | -     | ns   |                |
|                                    | Rise time, Fall time |            | tdrf   | -    | -     | 2     | ns   |                |
| DE                                 | CLK-DE               | Setup time | tdes   | 15   | -     | -     | ns   | -              |
|                                    |                      | Hold time  | tdeh   | 15   | -     | -     | ns   |                |
|                                    | Rise time, Fall time |            | tderf  | -    | -     | 2     | ns   |                |
| HSYNC                              | Cycle                |            | th     | 45.3 | 48.3  | 60.4  | μs   | 20.7kHz (typ.) |
|                                    |                      |            |        | 496  | 525   | 605   | CLK  | -              |
|                                    | Display period       |            | thd    | 480  |       |       | CLK  | -              |
|                                    | Front-porch          |            | thf    | 2    | 2     | 82    | CLK  | -              |
|                                    | Pulse width          |            | thp    | 2    | 41    | 41    | CLK  | -              |
|                                    | Back-porch           |            | thb    | 2    |       |       | CLK  | -              |
|                                    | CLK-HSYNC            | Setup time | ths    | 15   | -     | -     | ns   | -              |
|                                    |                      | Hold time  | thh    | 15   | -     | -     | ns   |                |
|                                    | Rise time, Fall time |            | thrf   | -    | -     | 2     | ns   |                |
| VSYNC                              | Cycle                |            | tv     | 12.5 | 13.33 | 16.67 | ms   | 75Hz (typ.)    |
|                                    |                      |            |        | 275  | 276   | -     | H    | -              |
|                                    | Display period       |            | tvd    | 272  |       |       | H    |                |
|                                    | Front-porch          |            | tvf    | 1    | 1     | -     | H    |                |
|                                    | Pulse width          |            | tvp    | 1    | 2     | -     | H    | -              |
|                                    | Back-porch           |            | tvb    | 1    |       |       | H    | -              |
|                                    | VSYNC-HSYNC          | Setup time | tvhs   | 15   | -     | -     | ns   | -              |
|                                    |                      | Hold time  | tvhh   | 15   | -     | -     | ns   |                |
|                                    | Rise time, Fall time |            | tvrif  | -    | -     | 2     | ns   |                |
| DISP                               | DISP-VSYNC           | Setup time | tdiss  | 15   | -     | -     | ns   | -              |
|                                    |                      | Hold time  | tdish  | 15   | -     | -     | ns   |                |
|                                    | Rise time, Fall time |            | tdisrf | -    | -     | 2     | ns   |                |

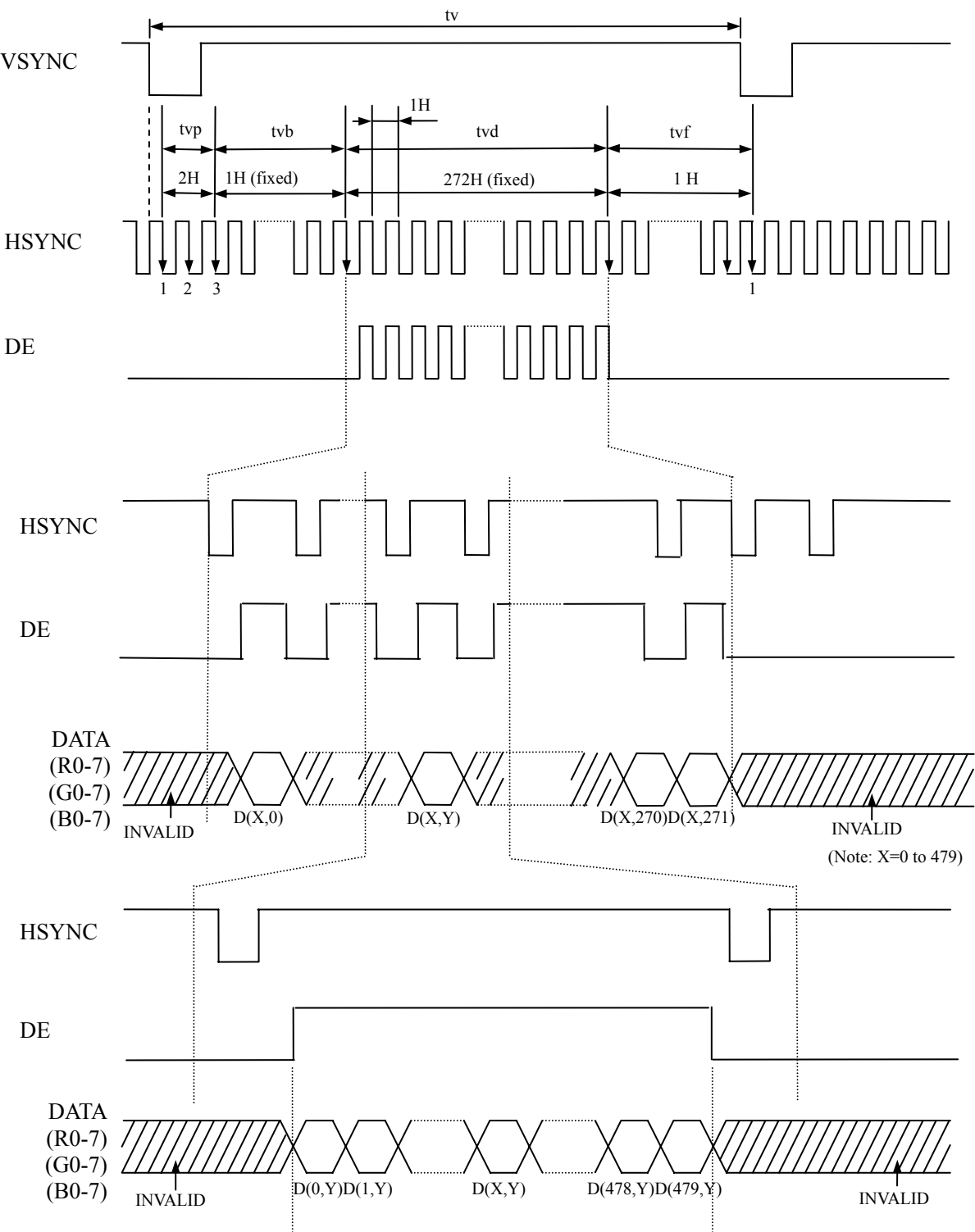
Note1: Definition of parameters is as follows.

tc= 1CLK, tcd= tch/tc, th= 1H

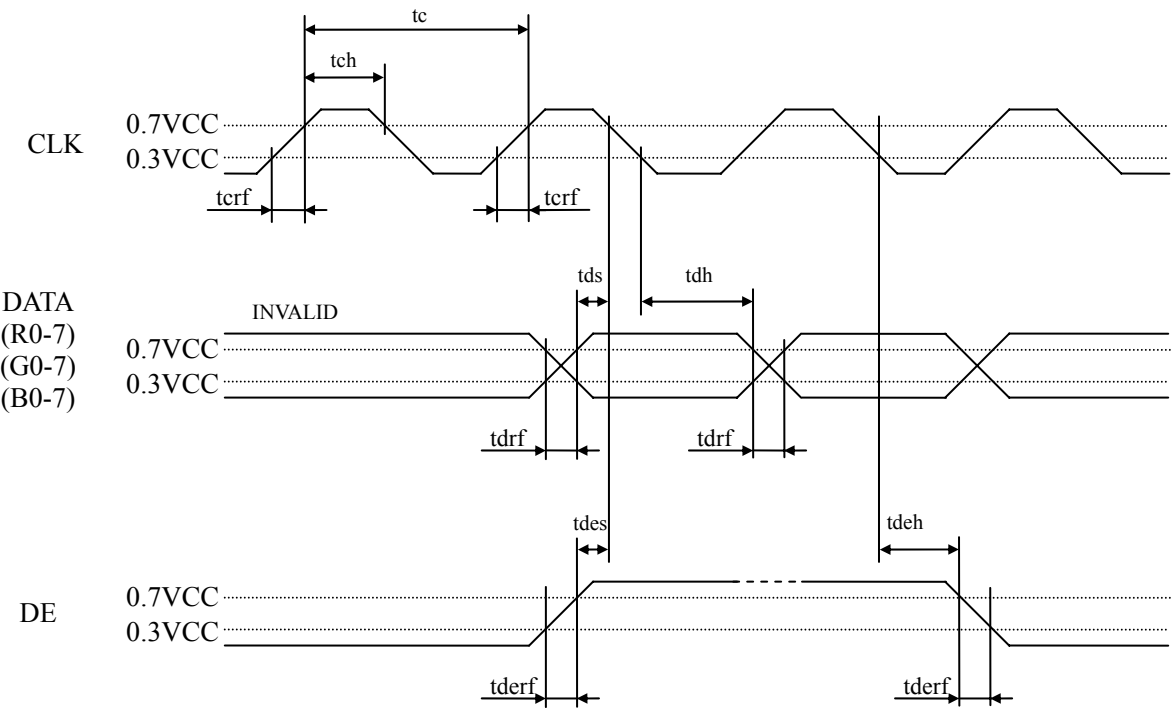
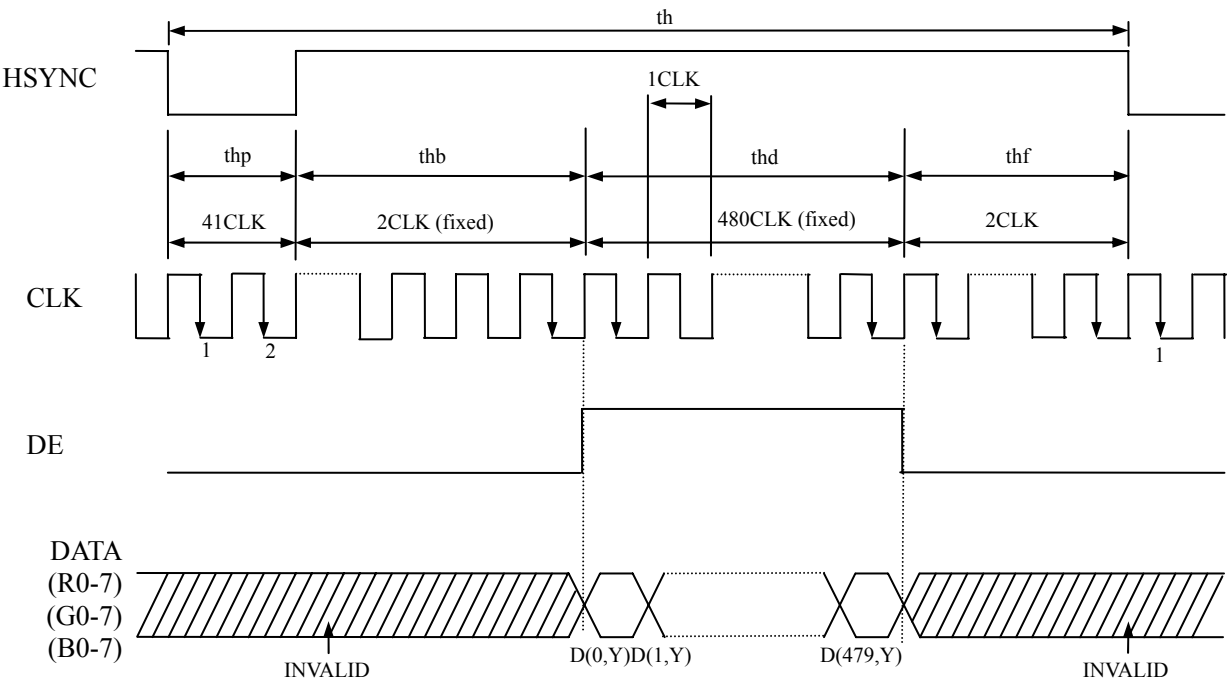
Note2: All parameters should be kept within the specified range.

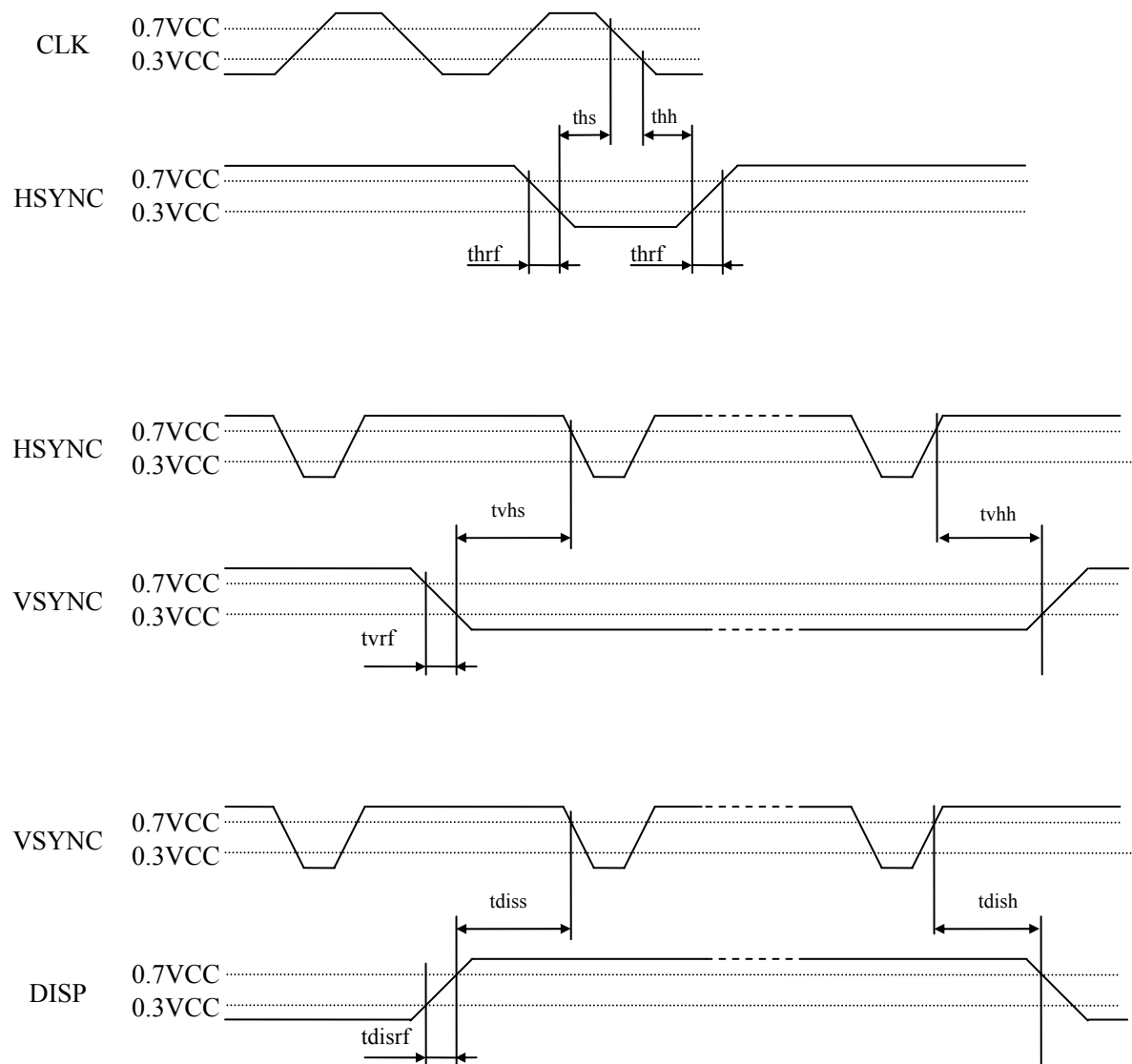


(2) Input signal timing chart



Note1: Unless otherwise specified, the input level is defined to be  $V_{IH} = 0.7V_{CC}$ ,  $V_{IL} = 0.3V_{CC}$ .





Note1: Unless otherwise specified, the input level is defined to be  $V_{IH}=0.7VCC$ ,  $V_{IL}=0.3VCC$ .

#### 4.10 OPTICAL CHARACTERISTICS

(Note1, Note2)

| Parameter            | Condition                                                                                                            | Symbol | min. | typ. | max. | Unit              | Remarks |
|----------------------|----------------------------------------------------------------------------------------------------------------------|--------|------|------|------|-------------------|---------|
| Luminance            | White at center<br>$\theta R = 0^\circ, \theta L = 0^\circ, \theta U = 0^\circ, \theta D = 0^\circ$                  | L      | 350  | 600  | -    | cd/m <sup>2</sup> | -       |
| Contrast ratio       | White/Black at center<br>$\theta R = 0^\circ, \theta L = 0^\circ, \theta U = 0^\circ, \theta D = 0^\circ$            | CR     | 300  | 500  | -    | -                 | Note3   |
| Luminance uniformity | White<br>$\theta R = 0^\circ, \theta L = 0^\circ, \theta U = 0^\circ, \theta D = 0^\circ$<br>Maximum luminance: 100% | LU     | 70   | 80   | -    | %                 | Note4   |

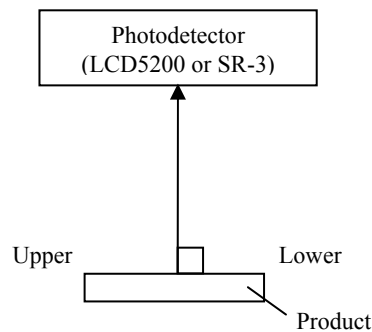
#### Reference data

(Note1, Note2)

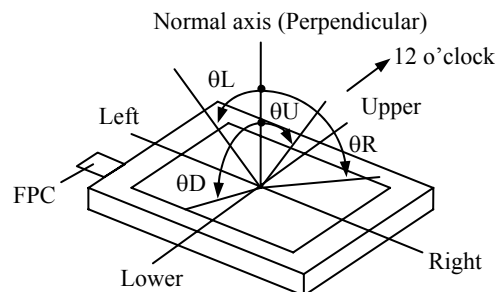
| Parameter                | Condition                                                                                                               | Symbol     | min. | typ. | max. | Unit | Remarks        |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------|------------|------|------|------|------|----------------|
| Chromaticity coordinates | White                                                                                                                   | Wx         | 0.23 | 0.28 | 0.33 | -    | Note5          |
|                          |                                                                                                                         | Wy         | 0.26 | 0.31 | 0.36 | -    |                |
| Color gamut              | $\theta R = 0^\circ, \theta L = 0^\circ, \theta U = 0^\circ, \theta D = 0^\circ$<br>at center, against NTSC color space | C          | 50   | 60   | -    | %    |                |
| Response time            | White to black<br>90%→10%                                                                                               | Ton        | -    | 8    | -    | ms   | Note6<br>Note7 |
|                          | Black to white<br>10%→90%                                                                                               | Toff       | -    | 25   | -    |      |                |
| Viewing angle            | Right<br>$\theta U = 0^\circ, \theta D = 0^\circ, CR \geq 10$                                                           | $\theta R$ | -    | 80   | -    | °    | -              |
|                          | Left<br>$\theta U = 0^\circ, \theta D = 0^\circ, CR \geq 10$                                                            | $\theta L$ | -    | 80   | -    | °    |                |
|                          | Up<br>$\theta R = 0^\circ, \theta L = 0^\circ, CR \geq 10$                                                              | $\theta U$ | -    | 60   | -    | °    |                |
|                          | Down<br>$\theta R = 0^\circ, \theta L = 0^\circ, CR \geq 10$                                                            | $\theta D$ | -    | 80   | -    | °    |                |

Note1: Measurement conditions are as follows.

Ta= 25°C, VCC= 3.0V, VDD= 5.0V, IL= 20mA



Note2: Definition of viewing angles



Note3: Definition of contrast ratio

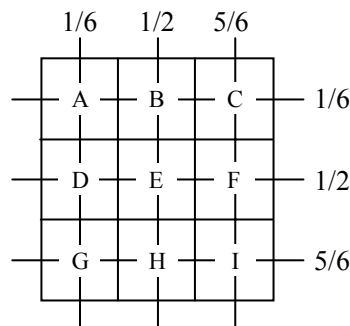
The contrast ratio is calculated by using the following formula.

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

Note4: Definition of luminance uniformity

Luminance uniformity is calculated by using the following formula.

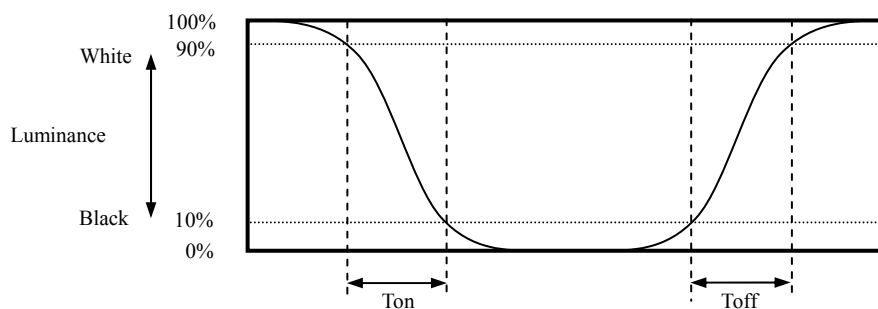
$$\text{Luminance uniformity (LU)} = \frac{\text{Minimum luminance from A to I}}{\text{Maximum luminance from A to I}} \times 100$$



Note5: The White chromaticity coordinates are deviated by the LED deviation in addition to color filter deviation.

Note6: 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.).



Note7: Product surface temperature: Top= 25°C



## 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<br>(Life time expectancy)<br>Note1, Note2, Note3 | Unit |
|--------------------------|--------------------------------------------------------------------|-------------------------------------------------------------------------------|------|
| LED elementary substance | 25°C (Ambient temperature of LED)<br>Continuous operation, IL=20mA | 21,000                                                                        | 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

(Note1)

| Test item                                    | Condition                                                                                                                             | Judgment                                       |
|----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|
| High temperature and humidity<br>(Operation) | ① 60 ± 2°C, RH= 90%, 240 hours<br>② Display data is black.                                                                            | No display malfunctions                        |
| Heat cycle<br>(Operation)                    | ① -20 ± 3°C...1 hour<br>70 ± 3°C...1 hour<br>② 50 cycles, 4 hours/cycle<br>③ Display data is black.                                   |                                                |
| Thermal shock<br>(Non operation)             | ① -30 ± 3°C...30 minutes<br>80 ± 3°C...30 minutes<br>② 100 cycles, 1 hour/cycle<br>③ Temperature transition time is within 5 minutes. |                                                |
| Low pressure<br>(Non operation)              | ① 15kPa<br>② -30 ± 3°C...24 hours<br>③ 80 ± 3°C...24 hours                                                                            |                                                |
| Low pressure<br>(Operation)                  | ① 53.3kPa<br>② -20 ± 3°C...24 hours<br>③ 70 ± 3°C...24 hours                                                                          |                                                |
| ESD<br>(Operation)                           | ① 150pF, 150Ω, ±10kV<br>② 3 places on a panel surface<br>③ 10 times each places at 1 sec interval                                     |                                                |
| Dust<br>(Operation)                          | ① Sample dust: No. 15 (by JIS-Z8901)<br>② 15 seconds stir<br>③ 8 times repeat at 1 hour interval                                      | No display malfunctions<br>No physical damages |
| Vibration<br>(Operation)                     | ① 30 to 100Hz, 19.6m/s <sup>2</sup> (2G)<br>② 30 minutes/cycle<br>③ X, Y, Z directions<br>④ 1 times each directions                   |                                                |
| Mechanical shock<br>(Non operation)          | ① 3,920m/s <sup>2</sup> , 2.5ms<br>② ±X, ±Y, ±Z directions<br>③ 1 times each directions                                               |                                                |

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

## 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 himself or the product will sustain a damage, if customer has wrong operations.



This sign has the meaning that customer will be injured by himself, 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  $3,920\text{m/s}^2$  and to be not greater 2.5ms)**

### 7.3 ATTENTIONS



#### 7.3.1 Handling of the product

- ① Take hold of both ends without touching the FPC when the product (LCD module) is picked up from the tray.
- ② Do not hook nor pull the FPC 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 product must be installed and/or handled without any stress such as bends or twist. Bends, twist or any stress to any portion may cause display failures. And also do not put heavy or hard materials on the product.
- ⑥ Do not hit or rub the surface of panel with hard materials, because it is easily scratched. (Polarizer pencil-hardness: 3H)
- ⑦ When cleaning the product surface, wipe it with a soft dry cloth.
- ⑧ Do not push nor pull the FPC while the product is working.
- ⑨ Do not fold the FPC. When the FPC is folded, pattern disconnection may be caused. In case of bending FPC, the minimum curvature (R) must be more than 1.0 mm.
- ⑩ When installing the product, do not contact a conductor such as a metal to the FPC excluding the terminal area. There is a risk of short circuit which is caused by breakage of insulation layer of the FPC.
- ⑪ Do not adjust the variable resistor which is mounted on the FPC.
- ⑫ When installing the product, apply the waterproof design to avoid going of water into the product.
- ⑬ 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 for 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. Circuits 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 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 Do not display the fixed pattern for a long time because it may cause image sticking.
- ④ Optical characteristics may be changed depending on input signal timings.

7.3.4 Other

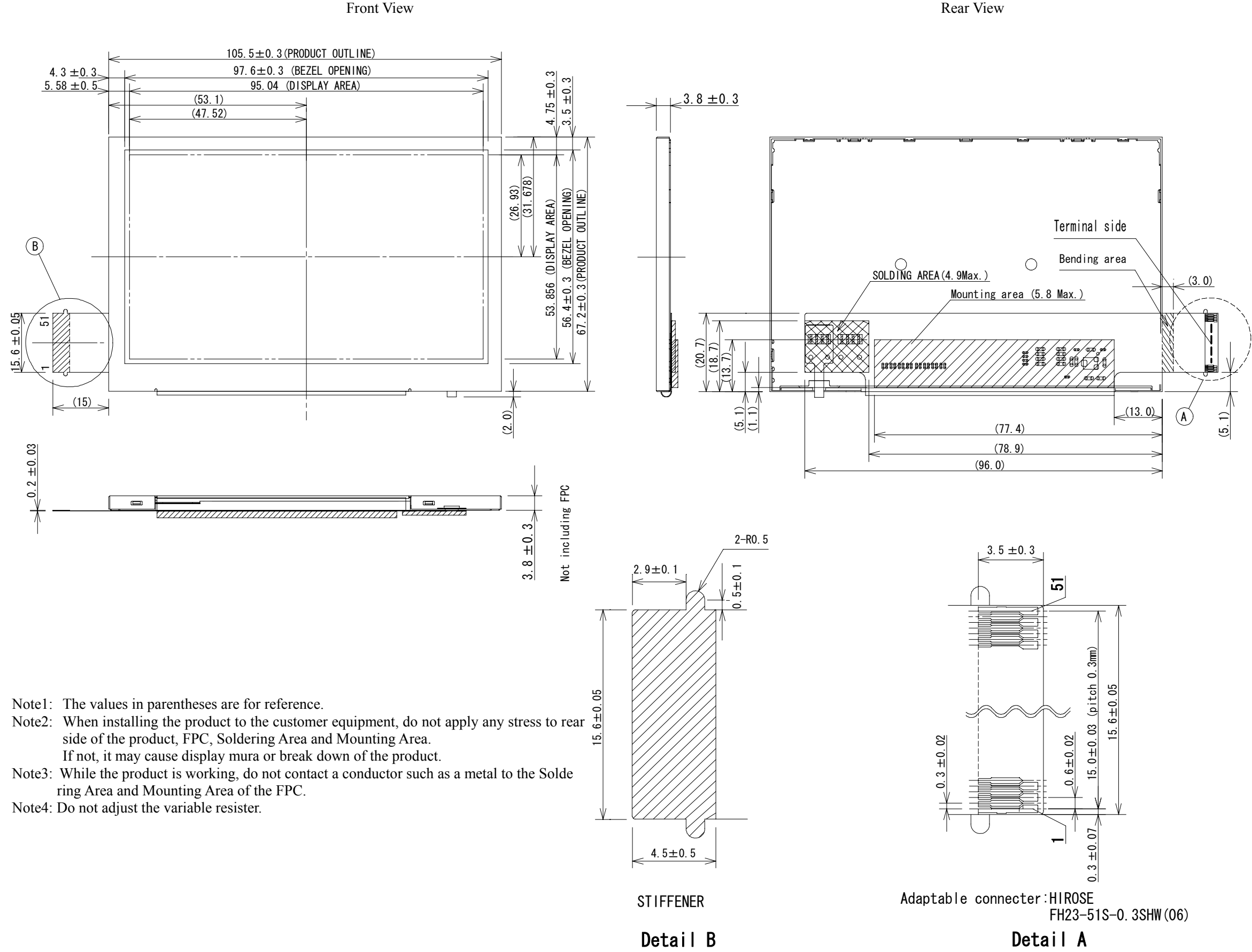
- ① All GND terminals should be used without any non-connected lines.
- ② Do not disassemble the product.
- ③ Pack the product with original shipping package, in order to avoid any damages during transportation, when returning the product to NEC.
- ④ The information of China RoHS directive six hazardous substances or elements in this product is as follows.

| China RoHS directive six hazardous substances or elements |              |              |                             |                                |                                       |
|-----------------------------------------------------------|--------------|--------------|-----------------------------|--------------------------------|---------------------------------------|
| Lead (Pb)                                                 | Mercury (Hg) | Cadmium (Cd) | Hexavalent Chromium (Cr VI) | Polybrominated Biphenyls (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 SJ/T11363-2006 standard regulation.  
× : This indicates that the poisonous or harmful material in all the homogeneous materials for this part is above the limitation level of SJ/T11363-2006 standard regulation.



8. OUTLINE DRAWINGS



| Pin No. | Symbol | Pin No. | Symbol   |
|---------|--------|---------|----------|
| 1       | GND    | 26      | G7       |
| 2       | VDD    | 27      | R0       |
| 3       | VDD    | 28      | R1       |
| 4       | GND    | 29      | R2       |
| 5       | DE     | 30      | R3       |
| 6       | /RESET | 31      | R4       |
| 7       | HSYNC  | 32      | R5       |
| 8       | VSYNC  | 33      | R6       |
| 9       | CLK    | 34      | R7       |
| 10      | GND    | 35      | GND      |
| 11      | B0     | 36      | RSVD     |
| 12      | B1     | 37      | RSVD     |
| 13      | B2     | 38      | RSVD     |
| 14      | B3     | 39      | DISP     |
| 15      | B4     | 40      | TEST     |
| 16      | B5     | 41      | VCC      |
| 17      | B6     | 42      | GND      |
| 18      | B7     | 43      | N. C.    |
| 19      | G0     | 44      | N. C.    |
| 20      | G1     | 45      | N. C.    |
| 21      | G2     | 46      | N. C.    |
| 22      | G3     | 47      | GND      |
| 23      | G4     | 48      | ANODE1   |
| 24      | G5     | 49      | CATHODE1 |
| 25      | G6     | 50      | ANODE2   |
|         |        | 51      | CATHODE2 |

Note1: The values in parentheses are for reference.

Note2: When installing the product to the customer equipment, do not apply any stress to rear side of the product, FPC, Soldering Area and Mounting Area.  
If not, it may cause display mura or break down of the product.

Note3: While the product is working, do not contact a conductor such as a metal to the Solde ring Area and Mounting Area of the FPC.

Note4: Do not adjust the variable resistor.