

PRELIMINARY

NEC NEC LCD Technologies, Ltd.

TFT COLOR LCD MODULE

NL6448BC18-01F

**15 cm (5.7 Type)
VGA**

PRELIMINARY DATA SHEET

DOD-PP-689 (3rd edition)



**This PRELIMINARY DATA SHEET is updated
document from DOD-PP-0601(2).**

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starting to design your system.**

INTRODUCTION

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

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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 NL6448BC18-01F is composed of the amorphous silicon thin film transistor liquid crystal display (a-Si TFT LCD) panel structure with driver LSIs for driving the TFT (Thin Film Transistor) array and a backlight.

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

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

- High luminance
- High contrast
- Wide viewing angle
- Wide temperature range
- 6-bit digital RGB signals
- Reversible-scan direction
- LED backlight type
- Replaceable LED holder for backlight

Difference between NL6448BC18-01F and NL6448BC18-03F

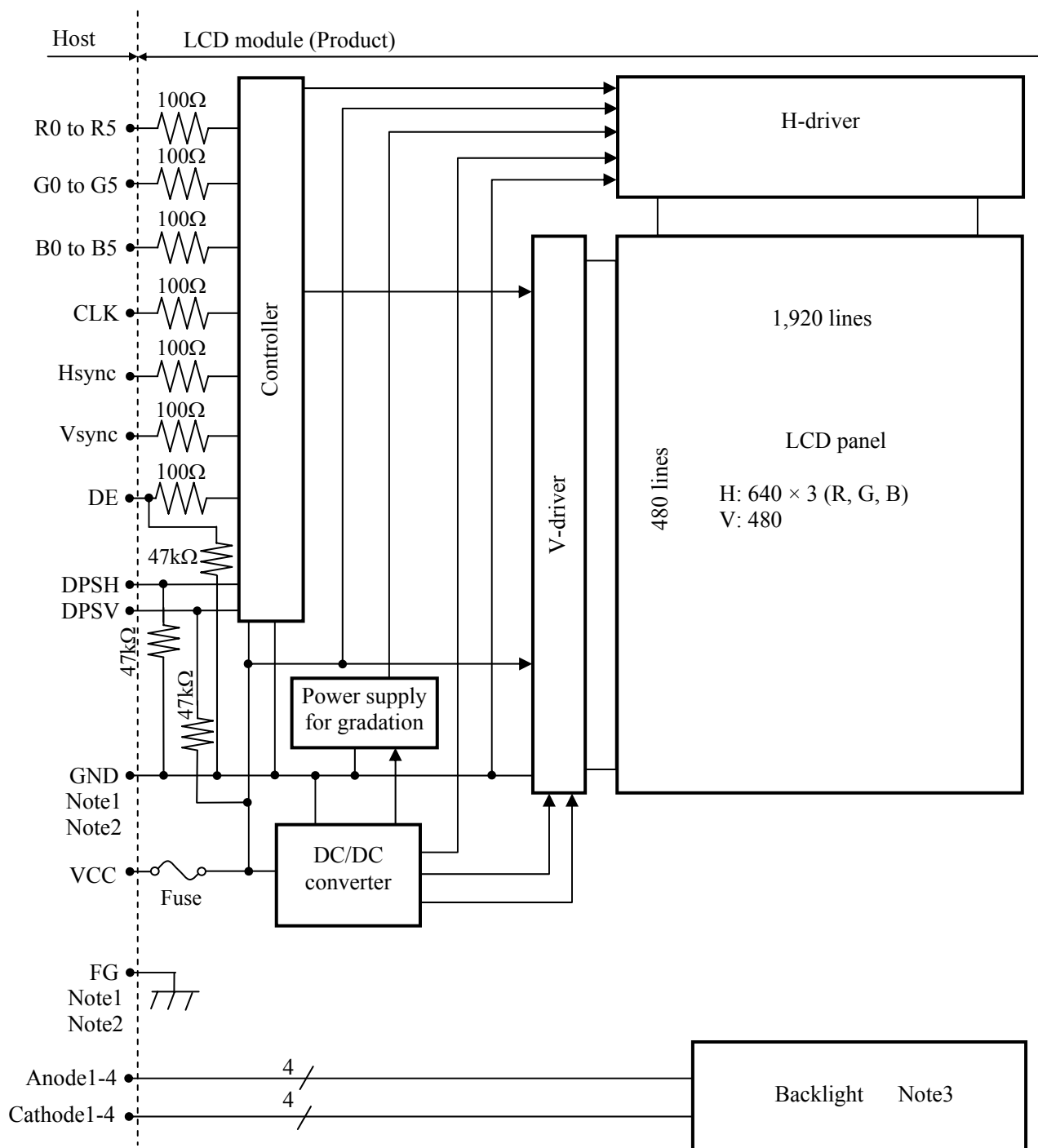
| Item | NL6448BC18-01F | NL6448BC18-03F |
|----------------------------|--|---|
| Designed viewing direction | At DPSH= low or open, At DPSV = high or open : Normal scan <ul style="list-style-type: none"> • Viewing direction without image reversal : up side (12 o'clock) • Viewing direction with contrast peak : down side (6 o'clock) • Viewing angle with optimum grayscale ($\gamma \approx 2.2$) : normal axis(perpendicular) | At DPSH= low or open, At DPSV = high or open : Normal scan <ul style="list-style-type: none"> • Viewing direction without image reversal : up side (3 o'clock) • Viewing direction with contrast peak : down side (9 o'clock) • Viewing angle with optimum grayscale ($\gamma \approx 2.2$) : normal axis(perpendicular) |

2. GENERAL SPECIFICATIONS

| | |
|-----------------------------------|--|
| Display area | 116.16 (H) × 87.12 (V) mm |
| Diagonal size of display | 15cm (5.7inches) |
| Drive system | a-Si TFT active matrix |
| Display color | 262,144 colors |
| Pixel | 640 (H) × 480 (V) pixels |
| Pixel arrangement | RGB (Red dot, Green dot, Blue dot) vertical stripe |
| Dot pitch | 0.0605 (H) × 0.1815 (V) mm |
| Pixel pitch | 0.1815 (H) × 0.1815(V) mm |
| Module size | 135 (W) × 104.6 (H) × 10.5 (D) mm (typ.) |
| Weight | 165 g (typ.) |
| Contrast ratio | 850:1 (typ.) |
| Viewing angle | At the contrast ratio $\geq 10:1$ <ul style="list-style-type: none"> • Horizontal: Right side 80° (typ.), Left side 80° (typ.) • Vertical: Up side 80° (typ.), Down side 80° (typ.) |
| Designed viewing direction | At DPSH= Low or open, At DPSV= High or open: Normal scan <ul style="list-style-type: none"> • Viewing direction without image reversal: up side (12 o'clock) • Viewing direction with contrast peak: down side (6 o'clock) • Viewing angle with optimum grayscale ($\gamma \approx 2.2$): normal axis (perpendicular) |
| Polarizer surface | Clear |
| Polarizer pencil-hardness | 3H (min.) [by JIS K5400] |
| Color gamut | At LCD panel center 60% (typ.) [against NTSC color space] |
| Response time | Ton+Toff (10% \longleftrightarrow 90%) 18 ms (typ.) |
| Luminance | At IL= 25 mA 800 cd/m ² (typ.) |
| Signal system | 6-bit digital signals for data of RGB colors, Dot clock (CLK), Data enable (DE), Horizontal synchronous signal (Hsync), Vertical synchronous signal (Vsync) |
| Power supply voltage | LCD panel signal processing board: 3.3V |
| Backlight | LED backlight type: <div style="border-left: 1px solid black; border-right: 1px solid black; padding: 0 10px; margin: 0;"> Replaceable part <ul style="list-style-type: none"> • Lamp holder set: Type No. TBD </div> |
| Power consumption | At IL= 25 mA, Checkered flag pattern 3.3 W (typ.) |



3. BLOCK DIAGRAM



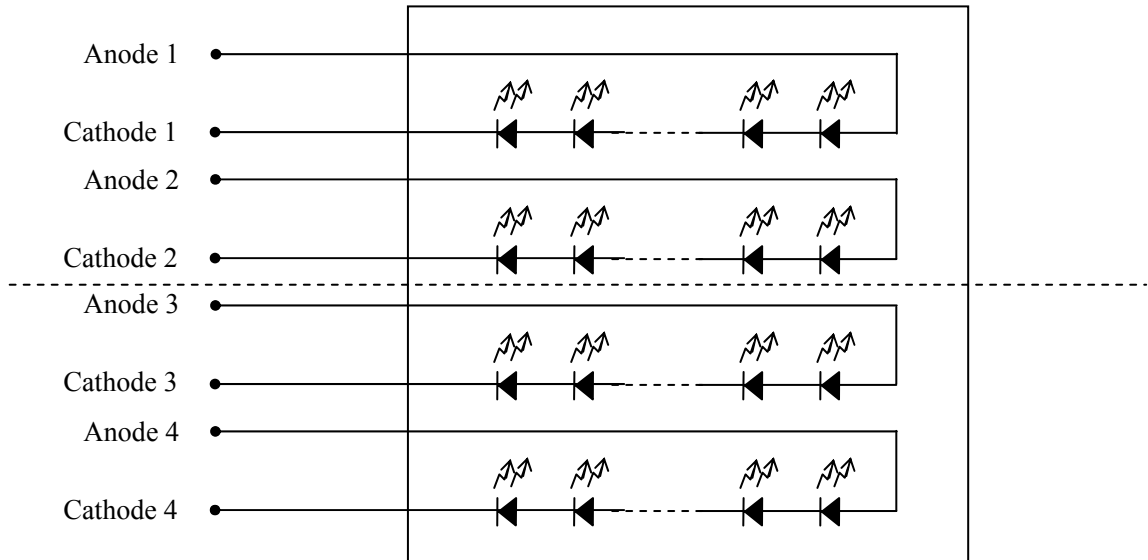
Note1: Relations between GND (Signal ground) and FG (Frame ground) in the LCD module are as follows.

| | |
|----------|---------------|
| GND - FG | Not Connected |
|----------|---------------|

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

Note3: Backlight in detail

Backlight



4. DETAILED SPECIFICATIONS

4.1 MECHANICAL SPECIFICATIONS

| Parameter | Specification | Unit |
|--------------|--|------|
| Module size | 135 ± 0.5 (W) \times 104.6 ± 0.5 (H) \times 10.5 ± 0.5 (D) Note1 | mm |
| Display area | 116.16 (H) \times 87.12 (V) Note1 | mm |
| Weight | 165 (typ.), 180 (max.) | g |

Note1: See "8. OUTLINE DRAWINGS".

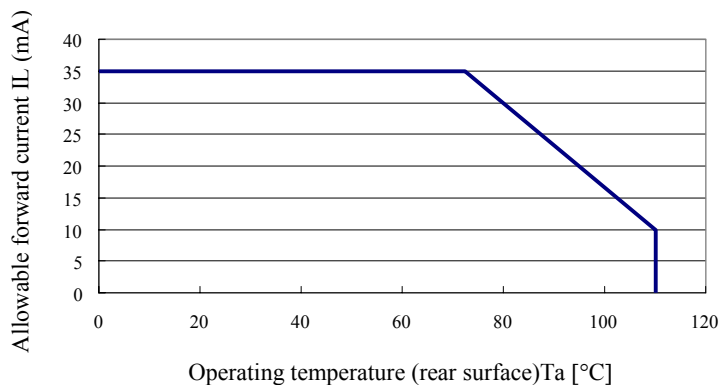
4.2 ABSOLUTE MAXIMUM RATINGS

| Parameter | | Symbol | Rating | Unit | Remarks |
|---------------------------|-----------------------------------|--------|-----------------|------------------|--|
| Power supply voltage | LCD panel signal processing board | VCC | -0.3 to +6.5 | V | - |
| Input voltage for signals | Display signals Note1 | VD | -0.3 to VCC+0.3 | V | - |
| | Function signals Note2 | VF | | | |
| Backlight | Power dissipation | PD | 1.1 | W | per one circuit |
| | Forward current | IL | Note3 | mA | per one circuit |
| Storage temperature | | Tst | -30 to +80 | °C | - |
| Operating temperature | Front surface | TopF | -30 to +80 | °C | Note4 |
| | Rear surface | TopR | -30 to +80 | °C | Note5 |
| Relative humidity Note6 | | RH | ≤ 95 | % | $T_a \leq 40^\circ\text{C}$ |
| | | | ≤ 85 | % | $40 < T_a \leq 50^\circ\text{C}$ |
| | | | ≤ 55 | % | $50^\circ\text{C} < T_a \leq 60^\circ\text{C}$ |
| | | | ≤ 36 | % | $60^\circ\text{C} < T_a \leq 70^\circ\text{C}$ |
| | | | ≤ 24 | % | $70^\circ\text{C} < T_a \leq 80^\circ\text{C}$ |
| Absolute humidity Note6 | | AH | ≤ 70 Note7 | g/m ³ | $T_a = 80^\circ\text{C}$ |

Note1: CLK, Hsync, Vsync, DE, DATA (R0 to R5, G0 to G5, B0 to B5)

Note2: DPSH, DPSV

Note3: Forward current



Note4: Measured at center of LCD panel surface (including self-heat)

Note5: Measured at center of LCD module's rear shield surface (including self-heat)

Note6: No condensation

Note7: Water amount at Ta= 70°C and RH= 36%

4.3 ELECTRICAL CHARACTERISTICS

4.3.1 LCD panel signal processing board

(Ta= 25°C)

| Parameter | | Symbol | min. | typ. | max. | Unit | Remarks |
|---|------|--------|--------|--------------|--------------|------|--------------|
| Power supply voltage | | VCC | 3.0 | 3.3 | 3.6 | V | at VCC= 3.3V |
| Power supply current | | ICC | - | 100 Note1 | 175 Note2 | mA | at VCC= 3.3V |
| Logic input voltage for display signals | High | VDH | 0.7VCC | - | VCC | V | CMOS level |
| | Low | VDL | 0 | - | 0.3VCC | V | |
| Input voltage for DPSH and DPSV signal | High | VFH | 0.7VCC | - | VCC | V | |
| | Low | VFL | 0 | - | 0.3VCC | V | |

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

Note2: Pattern for maximum current

4.3.2 Backlight

(Ta=25°C, Note1, Note2)

| Parameter | Symbol | min. | typ. | max. | Unit | Remarks |
|-----------------|--------|------|------|------|------|--------------|
| Forward current | IL | - | 25 | 27.5 | mA | Note3 |
| Forward Voltage | VL | - | 29.7 | 34.2 | V | at IL= 25 mA |

Note1: Please drive with constant current.

Note2: The Luminance uniformity may be changed depending on the current variation between 4 circuits.

It is recommended that the current value difference between each circuit is less than 5%.

Note3: See "**4.2 ABSOLUTE MAXIMUM RATINGS Note3**".

4.3.3 Power supply voltage ripple

This product works, even if the ripple voltage levels are beyond the permissible values as following the table, but there might be noise on the display image.

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

Note1: The permissible ripple voltage includes spike noise.

4.3.4 Fuse

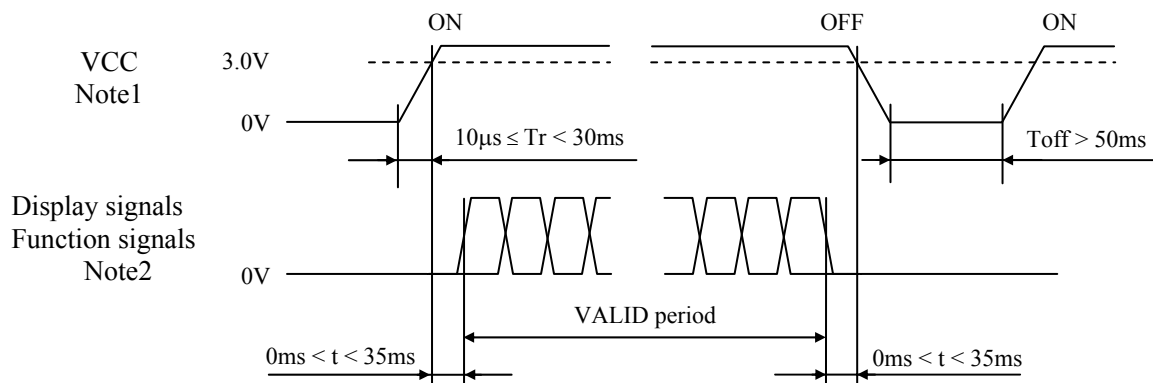
| Parameter | Fuse | | Rating | Fusing current | Remarks |
|-----------|-----------|-----------------|--------------------|----------------|---------|
| | Type | Supplier | | | |
| VCC | 3216FF-1A | COOPER Bussmann | 1A | 2.5A | Note1 |
| | | | 32V(AC) 63V(DC) | | |

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



4.4 POWER SUPPLY VOLTAGE SEQUENCE

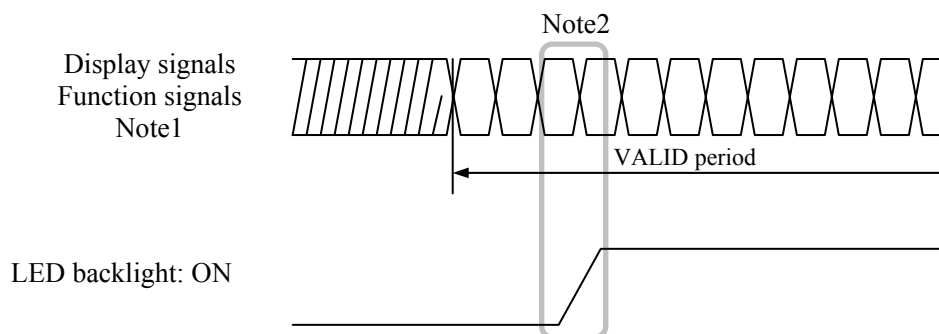
4.4.1 LCD panel signal processing board



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

Note2: Display signals (CLK, Hsync, Vsync, DE, DATA (R0 to R5, G0 to G5, B0 to B5)) and function signals (DPSH, DPSV) must be Low or High-impedance, exclude the VALID period (See above sequence diagram), in order to avoid that internal circuits is damaged. If some of display and function signals of this product are cut while this product is working, even if the signal input to it once again, it might not work normally. VCC should be cut when the display and function signals are stopped.

4.4.2 Backlight lighting circuit



Note1: These are the display and function signals for LCD panel signal processing board.

Note2: The backlight should be turned on within the valid period of display and function signals, in order to avoid unstable data display.

4.5 CONNECTIONS AND FUNCTIONS FOR INTERFACE PINS

4.5.1 LCD panel signal processing board

CN1 socket (LCD module side): 08 6260 033 340 829+ (Kyocera Elco Corp.)

Adaptable plug: [0.5mm pitch, Bottom Contact Type]

| Pin No. | Symbol | Signal | Remarks |
|---------|--------|--|---|
| 1 | GND | Ground | Note1 |
| 2 | CLK | Dot clock | - |
| 3 | Hsync | Horizontal synchronous signal | |
| 4 | Vsync | Vertical synchronous signal | |
| 5 | GND | Ground | Note1 |
| 6 | R0 | Red data (LSB) | Least significant bit |
| 7 | R1 | Red data | - |
| 8 | R2 | Red data | |
| 9 | R3 | Red data | |
| 10 | R4 | Red data | |
| 11 | R5 | Red data (MSB) | Most significant bit |
| 12 | GND | Ground | Note1 |
| 13 | G0 | Green data (LSB) | Least significant bit |
| 14 | G1 | Green data | - |
| 15 | G2 | Green data | |
| 16 | G3 | Green data | |
| 17 | G4 | Green data | |
| 18 | G5 | Green data (MSB) | Most significant bit |
| 19 | GND | Ground | Note1 |
| 20 | B0 | Blue data (LSB) | Least significant bit |
| 21 | B1 | Blue data | - |
| 22 | B2 | Blue data | |
| 23 | B3 | Blue data | |
| 24 | B4 | Blue data | |
| 25 | B5 | Blue data (MSB) | Most significant bit |
| 26 | GND | Ground | Note1 |
| 27 | DE | Selection of DE / Fixed mode | Low or Open: Fixed mode Data enable signal: DE mode |
| 28 | VCC | Power supply | Note1 |
| 29 | VCC | Power supply | |
| 30 | DPSH | Selection of Horizontal scan direction | High: Reverse scan Low or Open: Normal scan Note2 |
| 31 | DPSV | Selection of Vertical scan direction | High or Open: Normal scan Low: Reverse scan Note2 |
| 32 | N.C. | - | Keep this pin Open. |
| 33 | GND | Ground | Note1 |

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

Note2: See "4.8 SCANNING DIRECTIONS "

4.5.2 Backlight

CN2 plug (LCD module side): SM08B-SRSS-TB (J.S.T. Mfg. Co., Ltd.)

Adaptable socket: SHR-08V-S (J.S.T. Mfg. Co., Ltd.)

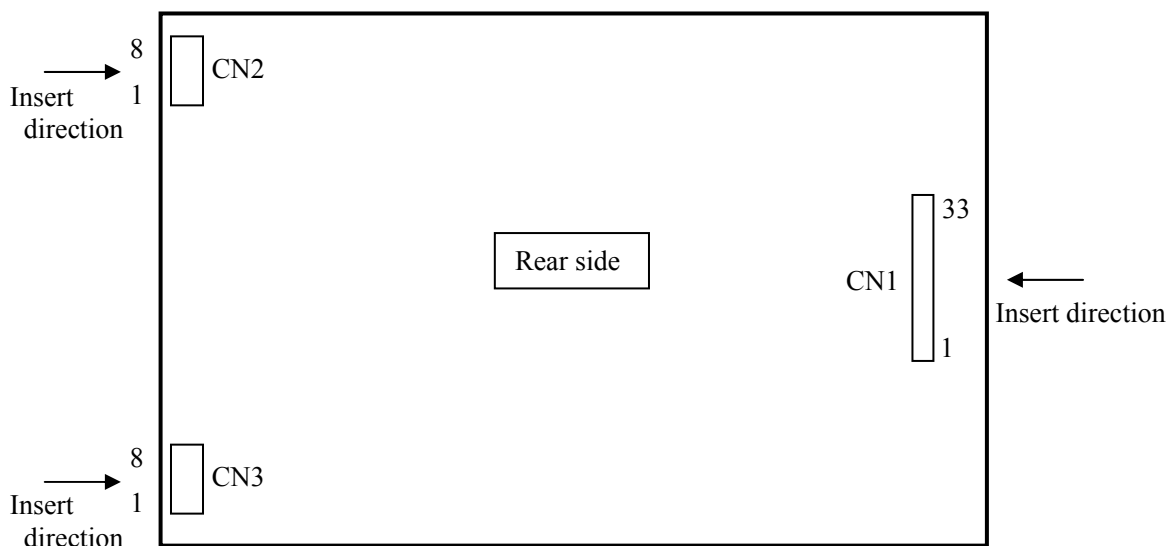
| Pin No. | Symbol | Signal | Remarks |
|---------|--------|---------------------|---------|
| 1 | A1 | Anode1 | - |
| 2 | K1 | Cathode1 | - |
| 3 | A2 | Anode2 | - |
| 4 | K2 | Cathode2 | - |
| 5 | N.C. | Keep this pin Open. | - |
| 6 | N.C. | Keep this pin Open. | - |
| 7 | N.C. | Keep this pin Open. | - |
| 8 | N.C. | Keep this pin Open. | - |

CN3 plug (LCD module side): SM08B-SRSS-TB (J.S.T. Mfg. Co., Ltd.)

Adaptable socket: SHR-08V-S (J.S.T. Mfg. Co., Ltd.)

| Pin No. | Symbol | Signal | Remarks |
|---------|--------|---------------------|---------|
| 1 | A3 | Anode3 | - |
| 2 | K3 | Cathode3 | - |
| 3 | A4 | Anode4 | - |
| 4 | K4 | Cathode4 | - |
| 5 | N.C. | Keep this pin Open. | - |
| 6 | N.C. | Keep this pin Open. | - |
| 7 | N.C. | Keep this pin Open. | - |
| 8 | N.C. | Keep this pin Open. | - |

4.5.3 Positions of plug and socket



4.6 DISPLAY COLORS AND INPUT DATA SIGNALS

This product can display in equivalent to 262,144 colors in 64 gray scales. Also the relation between display colors and input data signals is as the following table.

| Display colors | | Data signal (0: Low level, 1: High level) | | | | | | | | | | | | | | | | | |
|------------------|---------|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| | | 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 |
| 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 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 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 |
| 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 | 1 | 0 |
| | dark | 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 | 1 | 1 | 1 | 1 | 0 | 1 |
| Blue | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| | Blue | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

4.7 DISPLAY POSITIONS

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

| | | | | | | |
|------------|------------|-----|------------|-----|-------------|-------------|
| C (0, 0) | | | | | | |
| R | G | B | | | | |
| C(0, 0) | C(1, 0) | ... | C(X, 0) | ... | C(638, 0) | C(639, 0) |
| C(0, 1) | C(1, 1) | ... | C(X, 1) | ... | C(638, 1) | C(639, 1) |
| ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ |
| C(0, Y) | C(1, Y) | ... | C(X, Y) | ... | C(638, Y) | C(639, Y) |
| ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ |
| C(0, 478) | C(1, 478) | ... | C(X, 478) | ... | C(638, 478) | C(639, 478) |
| C(0, 479) | C(1, 479) | ... | C(X, 479) | ... | C(638, 479) | C(639, 479) |

4.8 SCANNING DIRECTIONS

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

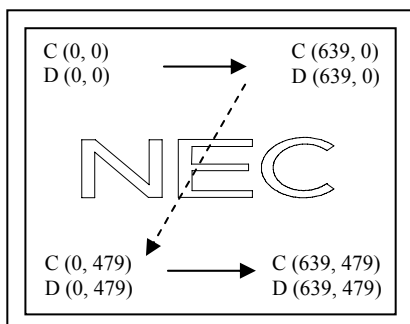


Figure1. DPSH= Low or Open (Normal scan)
DPSV= High or Open (Normal scan)

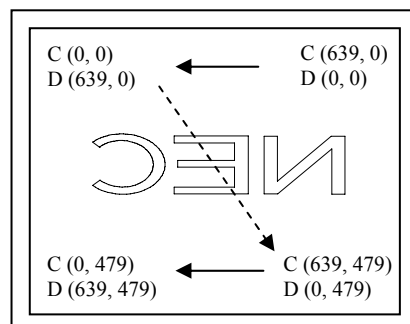


Figure2. DPSH= High (Reverse scan)
DPSV= High or Open (Normal scan)

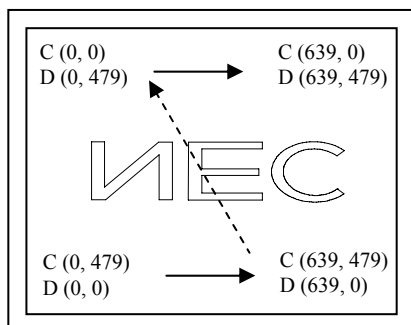


Figure3. DPSH= Low or Open (Normal scan)
DPSV= Low (Reverse scan)

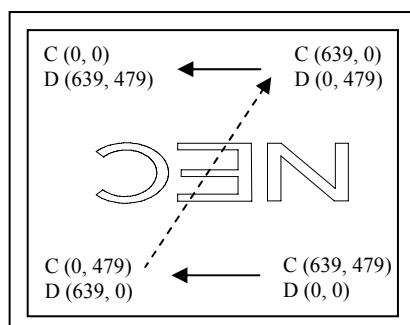


Figure4. DPSH= High (Reverse scan)
DPSV= Low (Reverse scan)

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

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

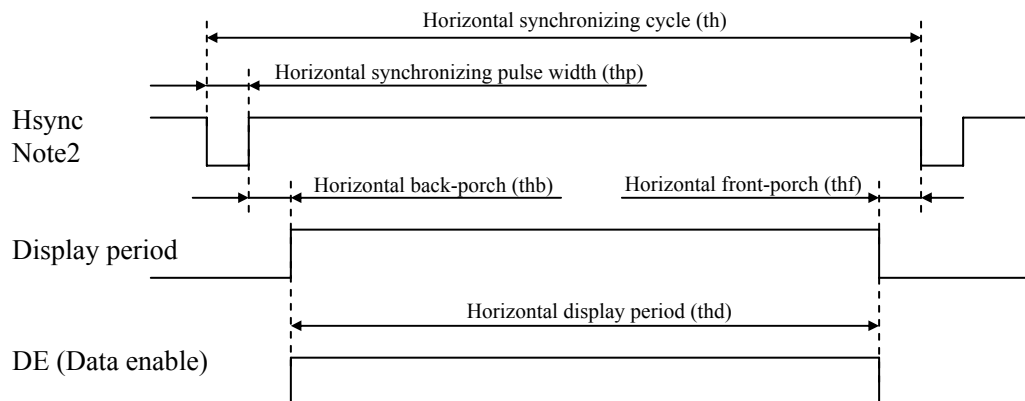
D (X, Y): The data number of input signal for LCD panel signal processing board

4.9 INPUT SIGNAL TIMINGS

4.9.1 Outline of input signal timings

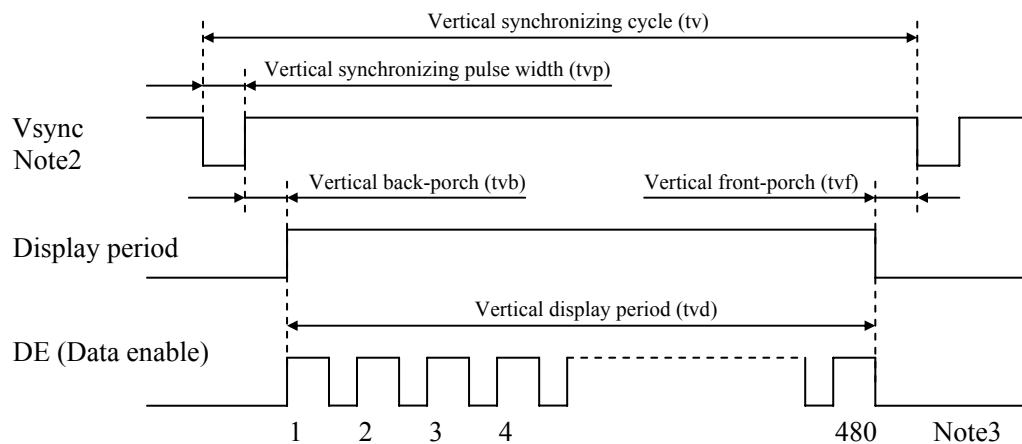
- Horizontal signal

Note1



- Vertical signal

Note1



Note1: This diagram indicates virtual signal for set up to timing.

Note2: Fixed mode cannot be used while working of DE mode.

Note3: See "4.9.3 Input signal timing chart" for numeration of pulse.

4.9.2 Timing characteristics

(a) Fixed mode

(Note1)



| Parameter | | | Symbol | min. | typ. | max. | Unit | Remarks |
|---------------------------------------|-------------------------------------|------------|-----------|-------|--------|-------|------|------------------|
| CLK | Frequency | | 1/tc | 22.66 | 25.175 | 27.69 | MHz | 39.72ns (typ.) |
| | Duty | | tcd | 0.4 | 0.5 | 0.6 | - | - |
| | Rise time, Fall time | | terf | - | - | 10 | ns | |
| DATA (R0-R5) (G0-G5) (B0-B5) | CLK-DATA | Setup time | tds | 10 | - | - | ns | - |
| | | Hold time | tdh | 10 | - | - | ns | |
| | Rise time, Fall time | | tdrf | - | - | 10 | ns | |
| Hsync | Cycle | | th | 30.0 | 31.778 | 33.6 | μs | 31.468kHz (typ.) |
| | | | | 800 | | | CLK | - |
| | Display period | | thd | 640 | | | CLK | |
| | Front-porch | | thf | 16 | | | CLK | |
| | Pulse width | | thp | 10 | 96 | - | CLK | |
| | Back-porch | | thb | - | 48 | 134 | CLK | |
| | Total of pulse width and back-porch | | thp + thb | 144 | | | CLK | Note2 |
| | CLK- Hsync | Setup time | ths | 10 | - | - | ns | - |
| | | Hold time | thh | 10 | - | - | ns | |
| | Rise time, Fall time | | thrf | - | - | 10 | ns | |
| Vsync | Cycle | | tv | 16.1 | 16.683 | 17.2 | ms | 59.94Hz (typ.) |
| | | | | 525 | | | H | - |
| | Display period | | tvd | 480 | | | H | |
| | Front-porch | | tvf | 12 | | | H | |
| | Pulse width | | tvp | 1 | 3 | - | H | |
| | Back-porch | | tvb | - | 32 | 34 | H | |
| | Total of pulse width and back-porch | | tvp + tvb | 35 | | | H | Note2 |
| | Hsync-Vsync | Setup time | tvhs | 10 | - | - | ns | - |
| | | Hold time | tvhh | 10 | - | - | ns | |
| | Rise time, Fall time | | tvrf | - | - | 10 | ns | |

Note1: Definition of parameters is as follows.

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

Note2: Keep tvp + tvb and thp + thb within the table. If it is out of specification, display position will be shifted to right/left side or up/down.

(b) DE mode

(Note1, Note2, Note3)



| Parameter | | | Symbol | min. | typ. | max. | Unit | Remarks |
|---------------------------------------|-------------------------|----------------|--------|-------|--------|-------|------|------------------|
| CLK | Frequency | | 1/tc | 22.66 | 25.175 | 27.69 | MHz | 39.72ns (typ.) |
| | Duty | | tcd | 0.4 | 0.5 | 0.6 | - | - |
| | Rise time, Fall time | | terf | - | - | 10 | ns | |
| DATA (R0-R5) (G0-G5) (B0-B5) | CLK-DATA | Setup time | tds | 10 | - | - | ns | - |
| | | Hold time | tdh | 10 | - | - | ns | |
| | Rise time, Fall time | | tdrf | - | - | 10 | ns | |
| DE | Horizontal | Cycle | th | 30.0 | 31.778 | 33.6 | μs | 31.468kHz (typ.) |
| | | | | - | 800 | - | CLK | - |
| | | Display period | thd | 640 | | | CLK | |
| | Vertical (One frame) | Cycle | tv | 16.1 | 16.683 | 17.2 | ms | 59.94Hz (typ.) |
| | | | | - | 525 | - | H | - |
| | | Display period | tvd | 480 | | | H | |
| | CLK-DE | Setup time | tdes | 10 | - | - | ns | |
| | Rise time, Fall time | | tderf | - | - | 10 | ns | |

Note1: Definition of parameters is as follows.

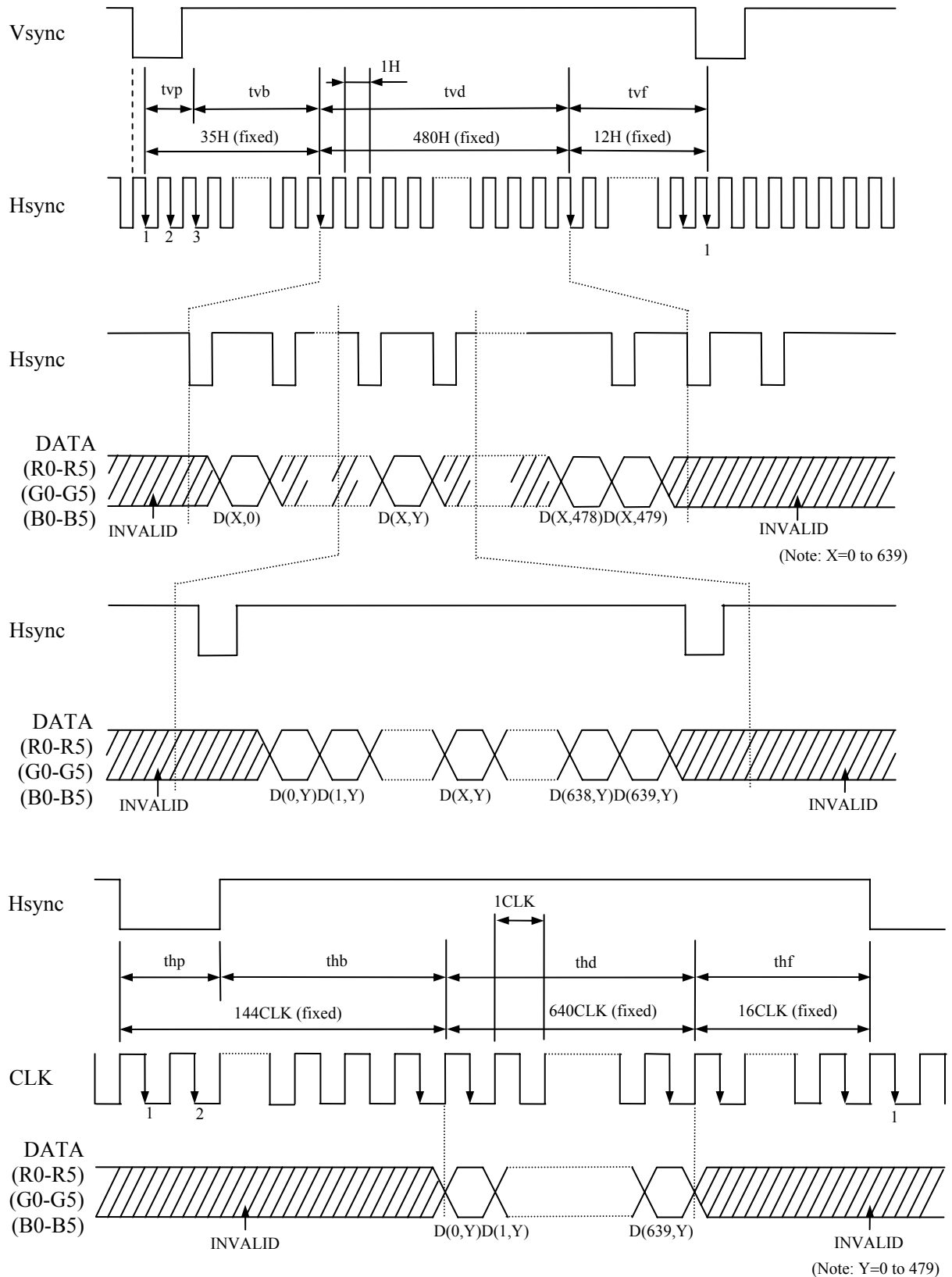
tc= 1CLK, tcd= tch/tc, th= 1H

Note2: Hsync signal (CN1-Pin No.3) and Vsync signal (CN1-Pin No.4) are not used inside the product at DE mode, but do not keep these pins open to avoid noise problem.

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

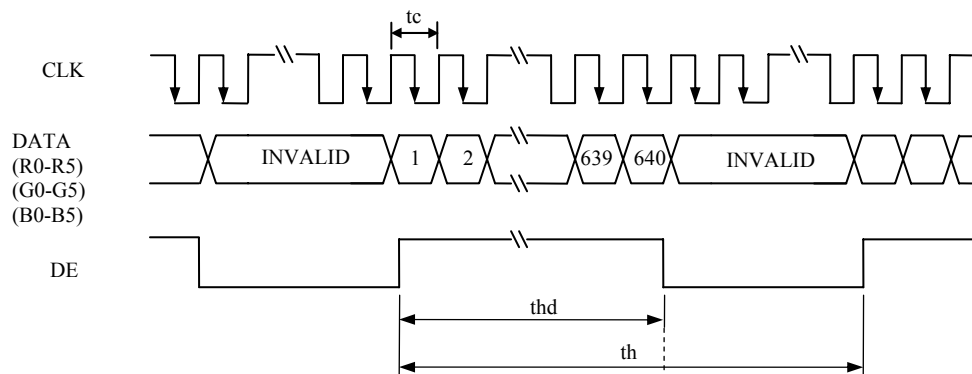
4.9.3 Input signal timing chart

(a) Fixed mode

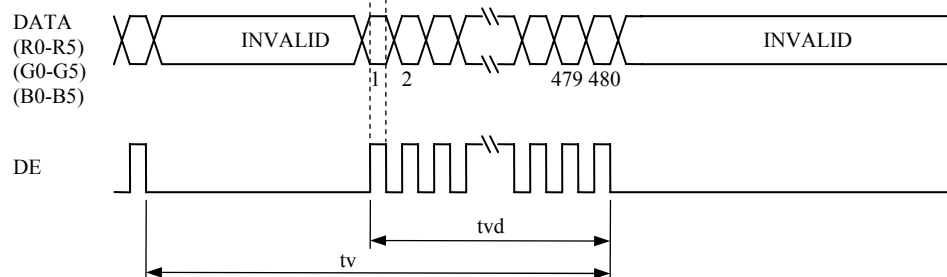


(b) DE mode

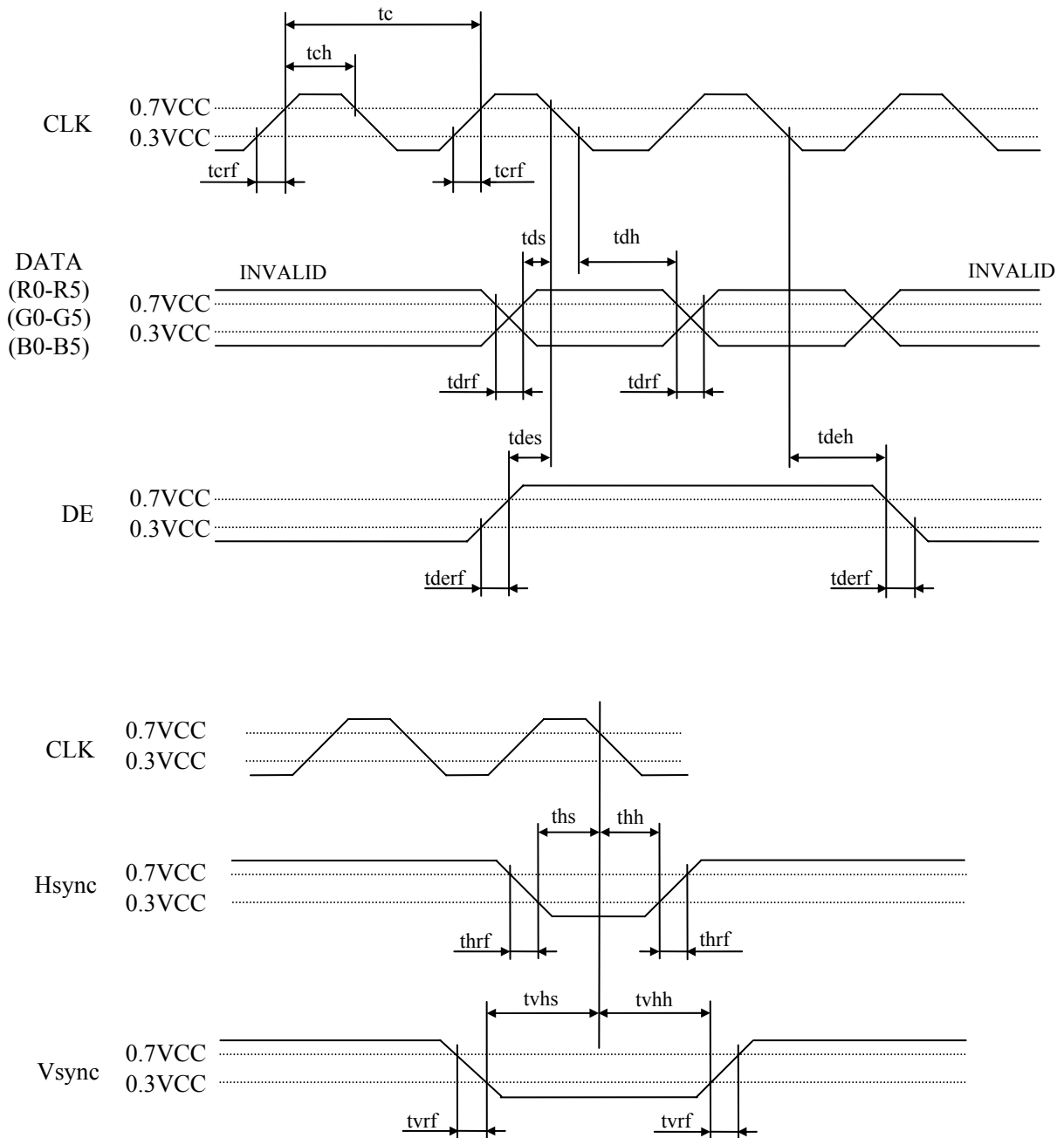
Horizontal timing



Vertical timing



(c) Common item of Fixed mode and DE mode



4.10 OPTICS

4.10.1 Optical characteristics

(Note1, Note2)

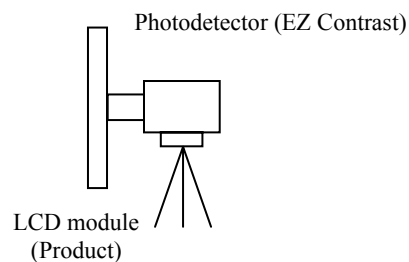
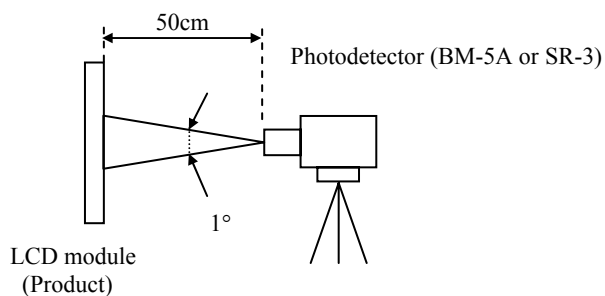
| Parameter | | Condition | Symbol | min. | typ. | max. | Unit | Measuring instrument | Remarks |
|----------------------|-------|---|--------|-------|-------|-------|-------|----------------------|---------|
| Luminance | | White at center θR= 0°, θL= 0°, θU= 0°, θD= 0° | L | 600 | 800 | - | cd/m² | BM-5A | - |
| Contrast ratio | | White/Black at center θR= 0°, θL= 0°, θU= 0°, θD= 0° | CR | 550 | 850 | - | - | BM-5A | Note3 |
| Luminance uniformity | | White θR= 0°, θL= 0°, θU= 0°, θD= 0° | LU | - | 1.25 | 1.4 | - | BM-5A | Note4 |
| Chromaticity | White | x coordinate | Wx | 0.250 | 0.300 | 0.350 | - | SR-3 | Note5 |
| | | y coordinate | Wy | 0.300 | 0.350 | 0.400 | - | | |
| | Red | x coordinate | Rx | - | 0.640 | - | - | | |
| | | y coordinate | Ry | - | 0.335 | - | - | | |
| | Green | x coordinate | Gx | - | 0.310 | - | - | | |
| | | y coordinate | Gy | - | 0.580 | - | - | | |
| | Blue | x coordinate | Bx | - | 0.135 | - | - | | |
| | | y coordinate | By | - | 0.135 | - | - | | |
| Color gamut | | θR= 0°, θL= 0°, θU= 0°, θD= 0° at center, against NTSC color space | C | 55 | 60 | - | % | | |
| Response time | | White to Black | Ton | - | 3 | 5 | ms | BM-5A | Note6 |
| | | Black to White | Toff | - | 15 | 21 | ms | | Note7 |
| 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, IL= 25 mA, Display mode: VGA, Horizontal cycle= 1/31.468kHz,
Vertical cycle= 1/59.94Hz, DPSH/DPSV= Low or Open / High or Open: Normal scan

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



Note3: See "4.10.2 Definition of contrast ratio".

Note4: See "4.10.3 Definition of luminance uniformity".

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

Note6: Product surface temperature: TopF= 29°C

Note7: See "4.10.4 Definition of response times".

Note8: See "4.10.5 Definition of viewing angles".

4.10.2 Definition of contrast ratio

The contrast ratio is calculated by using the following formula.

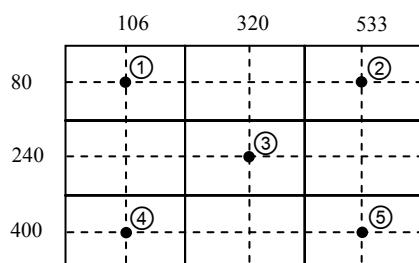
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance of white screen}}{\text{Luminance of black screen}}$$

4.10.3 Definition of luminance uniformity

The luminance uniformity is calculated by using following formula.

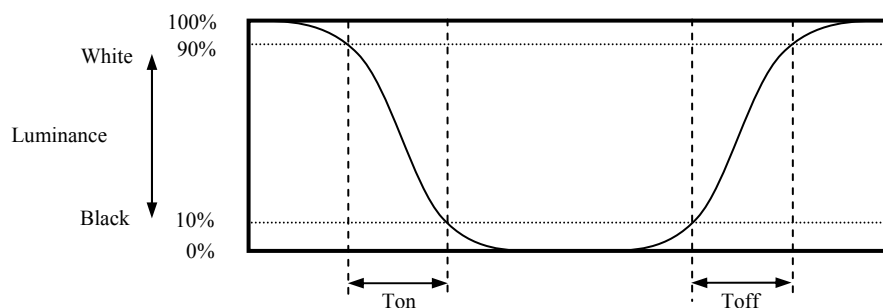
$$\text{Luminance uniformity (LU)} = \frac{\text{Maximum luminance from ① to ⑤}}{\text{Minimum luminance from ① to ⑤}}$$

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

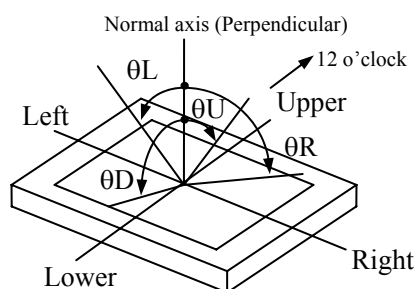


4.10.4 Definition of response times

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



4.10.5 Definition of viewing angles



5. ESTIMATED LUMINANCE LIFETIME

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

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

| Condition | | Estimated luminance lifetime (Life time expectancy) Note1, Note2, Note3 | Unit |
|--------------------------|--|---|------|
| LED elementary substance | 25°C (Ambient temperature of LED) Continuous operation, IL=25mA | 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.

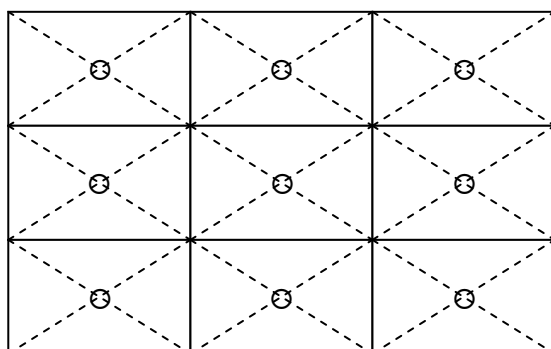
Note3: By ambient temperature, the lifetime changes particularly. Especially, in case the product works under high temperature environment, the lifetime becomes short.

6. RELIABILITY TESTS

| Test item | Condition | Judgment | Note1 |
|--|---|--|-------|
| High temperature and humidity (Operation) | ① $60 \pm 2^{\circ}\text{C}$, RH= 90%, 240hours ② Display data is black. | No display malfunctions | |
| High temperature (Operation) | ① $80 \pm 3^{\circ}\text{C}$, 240hours ② Display data is black. | | |
| Heat cycle (Operation) | ① $-30 \pm 3^{\circ}\text{C} \dots 1\text{hour}$ $80 \pm 3^{\circ}\text{C} \dots 1\text{hour}$ ② 50cycles, 4 hours/cycle ③ Display data is black. | | |
| Thermal shock (Non operation) | ① $-30 \pm 3^{\circ}\text{C} \dots 30\text{minutes}$ $80 \pm 3^{\circ}\text{C} \dots 30\text{minutes}$ ② 100cycles, 1hour/cycle ③ Temperature transition time is within 5 minutes. | | |
| ESD (Operation) | ① 150pF, 150Ω, $\pm 10\text{kV}$ ② 9 places on a panel surface Note2 ③ 10 times each places at 1 sec interval | No display malfunctions Do not shout down | |
| Dust (Operation) | ① Sample dust: No. 15 (by JIS-Z8901)) ② 15 seconds stir ③ 8 times repeat at 1 hour interval | Do not see in the display area | |
| Vibration (Non operation) | ① 5 to 100Hz, 19.6m/s^2 ② 1 minute/cycle ③ X, Y, Z directions ④ 120 times each directions | No display malfunctions No physical damages | |
| Mechanical shock (Non operation) | ① 539m/s^2 , 11ms ② $\pm X$, $\pm Y$, $\pm Z$ directions ③ 5 times each directions | | |

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

Note2: See the following figure for discharge points.



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 539m/s² and to be not greater 11ms, Pressure: To be not greater 19.6N (φ16mm jig))**

7.3 ATTENTIONS



7.3.1 Handling of the product



- ① Take hold of both ends without touching the circuit board when the product (LCD module) is picked up from inner packing box to avoid broken down or misadjustment, because of stress to mounting parts on the circuit board.
- ② When the product is put on the table temporarily, display surface must be placed downward.
- ③ When handling the product, take the measures of electrostatic discharge with such as earth band, ionic shower and so on, because the product may be damaged by electrostatic.
- ④ The torque for product mounting screws must never exceed 0.147N·m. Higher torque might result in distortion of the bezel.
- ⑤ The product must be installed using mounting holes without undue stress such as bends or twist (See outline drawings). And do not add undue stress to any portion (such as bezel flat area). Bends or twist described above and undue stress to any portion may cause display mura.
- ⑥ Do not press or rub on the sensitive product surface. When cleaning the product surface, wipe it with a soft dry cloth.
- ⑦ Do not push nor pull the interface connectors while the product is working.
- ⑧ When handling the product, use of an original protection sheet on the product surface (polarizer) is recommended for protection of product surface. Adhesive type protection sheet may change color or characteristics of the polarizer.
- ⑨ Usually liquid crystals don't leak through the breakage of glasses because of the surface tension of thin layer and the construction of LCD panel. But, if you contact with liquid crystal for the worst, please wash it out with soap.

7.3.2 Environment

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

7.3.3 Characteristics

The following items are neither defects nor failures.

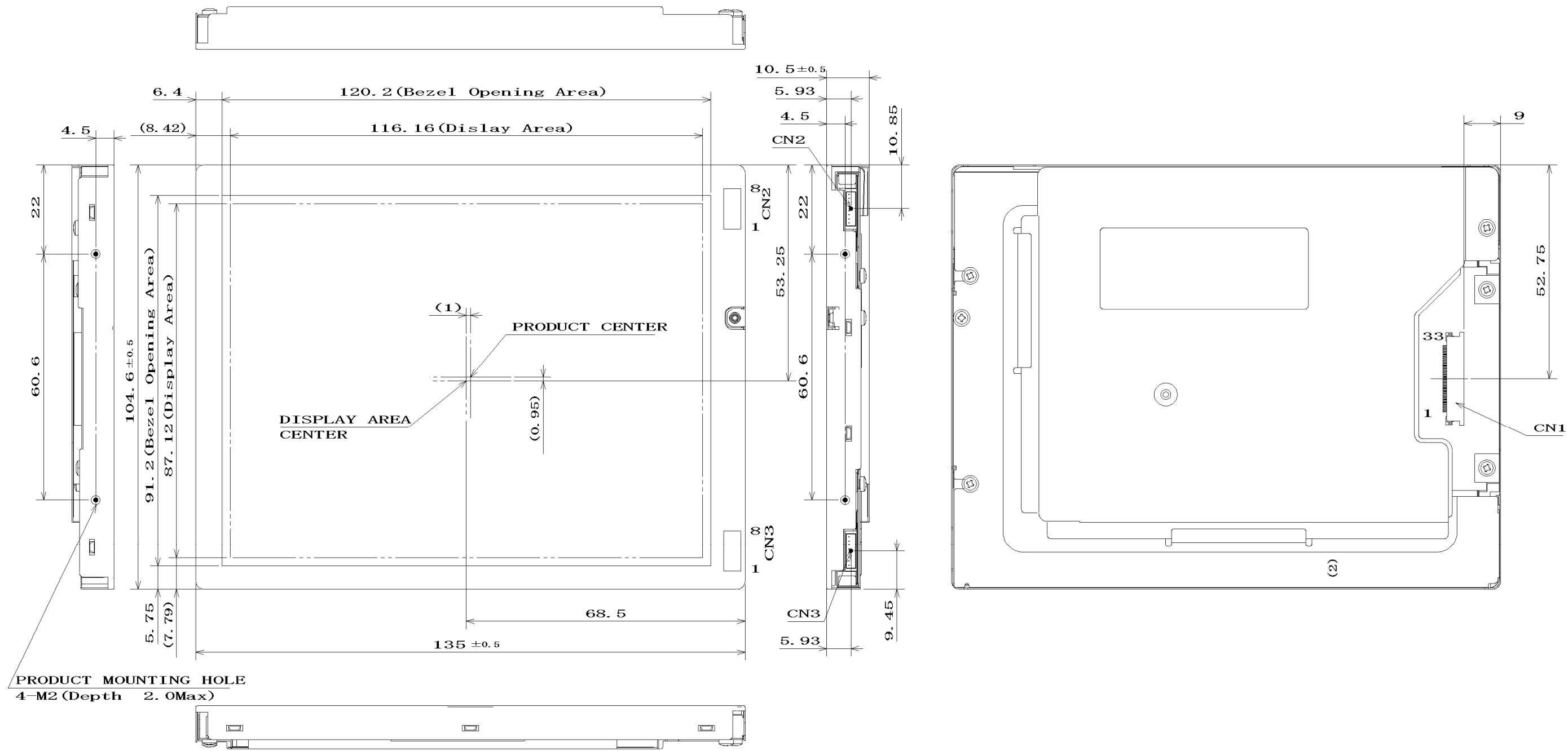


- ① Characteristics of the LCD (such as response time, luminance, color uniformity and so on) may be changed depending on ambient temperature. If the product is stored under condition of low temperature for a long time, it may cause display mura. In this case, the product should be operated after enough time being left under condition of operating temperature.
- ② Display mura, flicker, vertical seam or small spot may be observed depending on display patterns.
- ③ Do not display the fixed pattern for a long time because it may cause image sticking. Use a screen saver, if the fixed pattern is displayed on the screen.
- ④ The display color may be changed depending on viewing angle because of the use of condenser sheet in the backlight.
- ⑤ Optical characteristics may be changed depending on input signal timings.

7.3.4 Other

- ① All GND and VCC terminals should be used without any non-connected lines.
- ② Do not disassemble a product or adjust variable resistors.
- ③ See "REPLACEMENT MANUAL FOR LAMP HOLDER SET", when replacing LED backlight.
- ④ Pay attention not to insert foreign materials inside of the product, when using tapping screws.
- ⑤ Pack the product with original shipping package, in order to avoid any damages during transportation, when returning the product to NEC for repair and so on.

8. OUTLINE DRAWINGS



Note1: The values in parentheses are for reference.
Note2: The torque for product mounting screws must never exceed 0.147N·m.

Unit: mm