DATA SHEET

NEC

# TFT COLOR LCD MODULE

# NL6448AC33-29

## 26 cm (10.4 inches), 640 × 480 pixels, 262,144 colors, Incorporated two-lamp/Edge-light type backlight Ultra Wide viewing angle

### DESCRIPTION

NL6448AC33-29 is a TFT (thin film transistor) active matrix color liquid crystal display (LCD) comprising amorphous silicon TFT attached to each signal electrode, a driving circuit and a backlight. NL6448AC33-29 has a built-in backlight. Backlight includes long-life-lamps and the lamps are replaceable.

The 26 cm (10.4 inches) diagonal display area contains 640 × 480 pixels and can display 262,144 colors simultaneously.

NL6448AC33-29 is suitable for industrial application use, because the viewing angle is ultra wide and the luminance is high. Also the viewing direction is selectable either upper or lower side changing scan direction.

### FEATURES

- Ultra wide viewing angle with lateral electric field
- High luminance (250 cd/$m^2$, typ.)
- Low reflection
- 6-bit digital RGB interface
- Data enable (DE) function
- Incorporated edge type backlight with lamps (Two lamps, with inverter)
- Lamp holder replaceable (Type No.: 104LHS31)
- Reversible scan direction
- Variable luminance control
- Easy to assemble a touch panel
- No antiglare treatment

### APPLICATIONS

- Display terminals for control system
- Monitors for process controller
- Industrial PC

**The information in this document is subject to change without notice.**

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## STRUCTURE AND FUNCTIONS

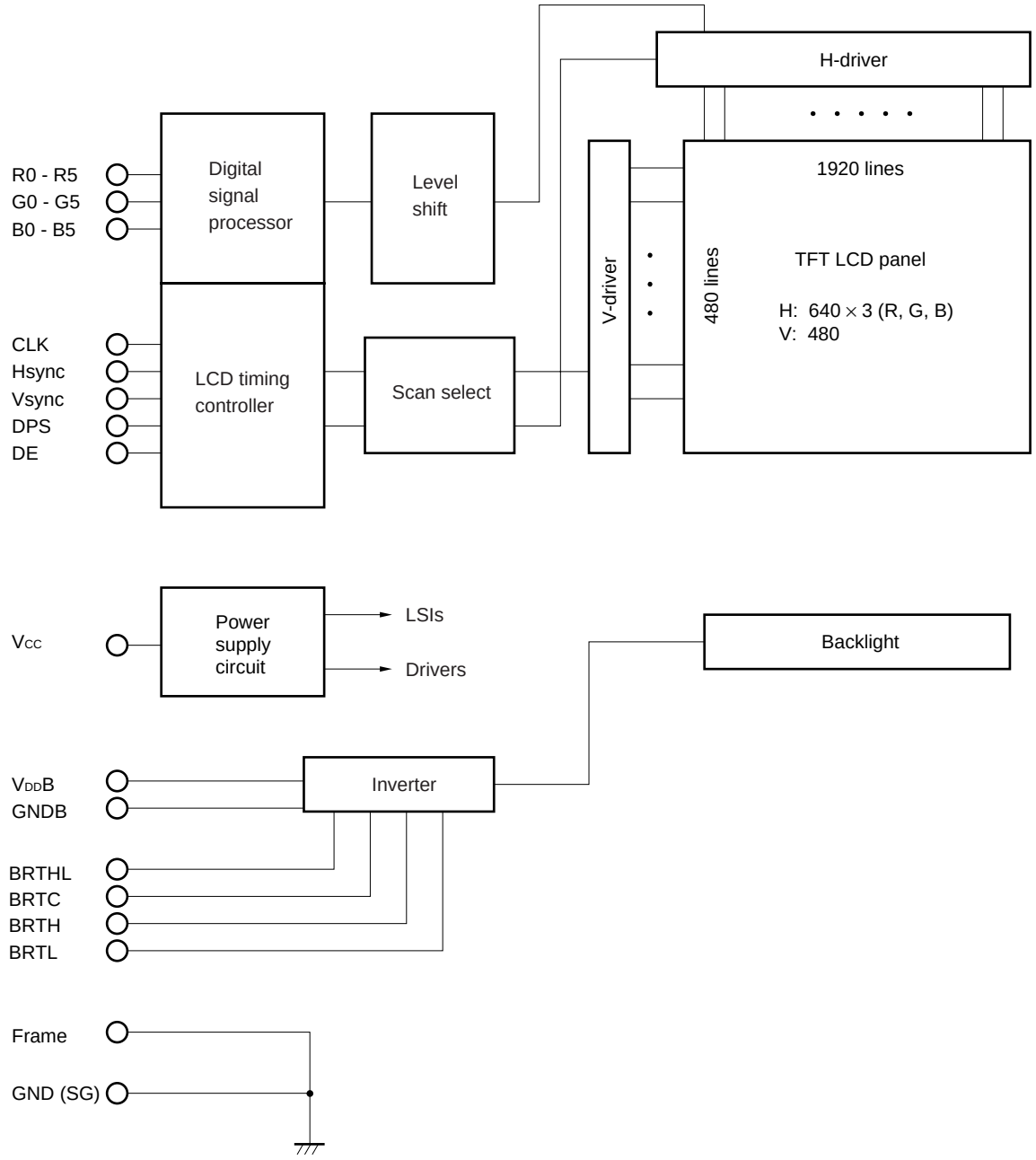
A color TFT (thin film transistor) LCD module is comprised of a TFT liquid crystal panel structure, LSIs for driving the TFT array, and a backlight assembly. The TFT panel structure is created by sandwiching liquid crystal material in the narrow gap between a TFT array glass substrate and a color filter glass substrate. After the driver LSIs are connected to the panel, the backlight assembly is attached to the backside of the panel.

RGB (red, green, blue) data signals from a source system is modulated into a form suitable for active matrix addressing by the onboard signal processor and sent to the driver LSIs which in turn addresses the individual TFT cells.

Acting as an electro-optical switch, each TFT cell regulates light transmission from the backlight assembly when activated by the data source. By regulating the amount of light passing through the array of red, green, and blue dots, color images are created with clarity.

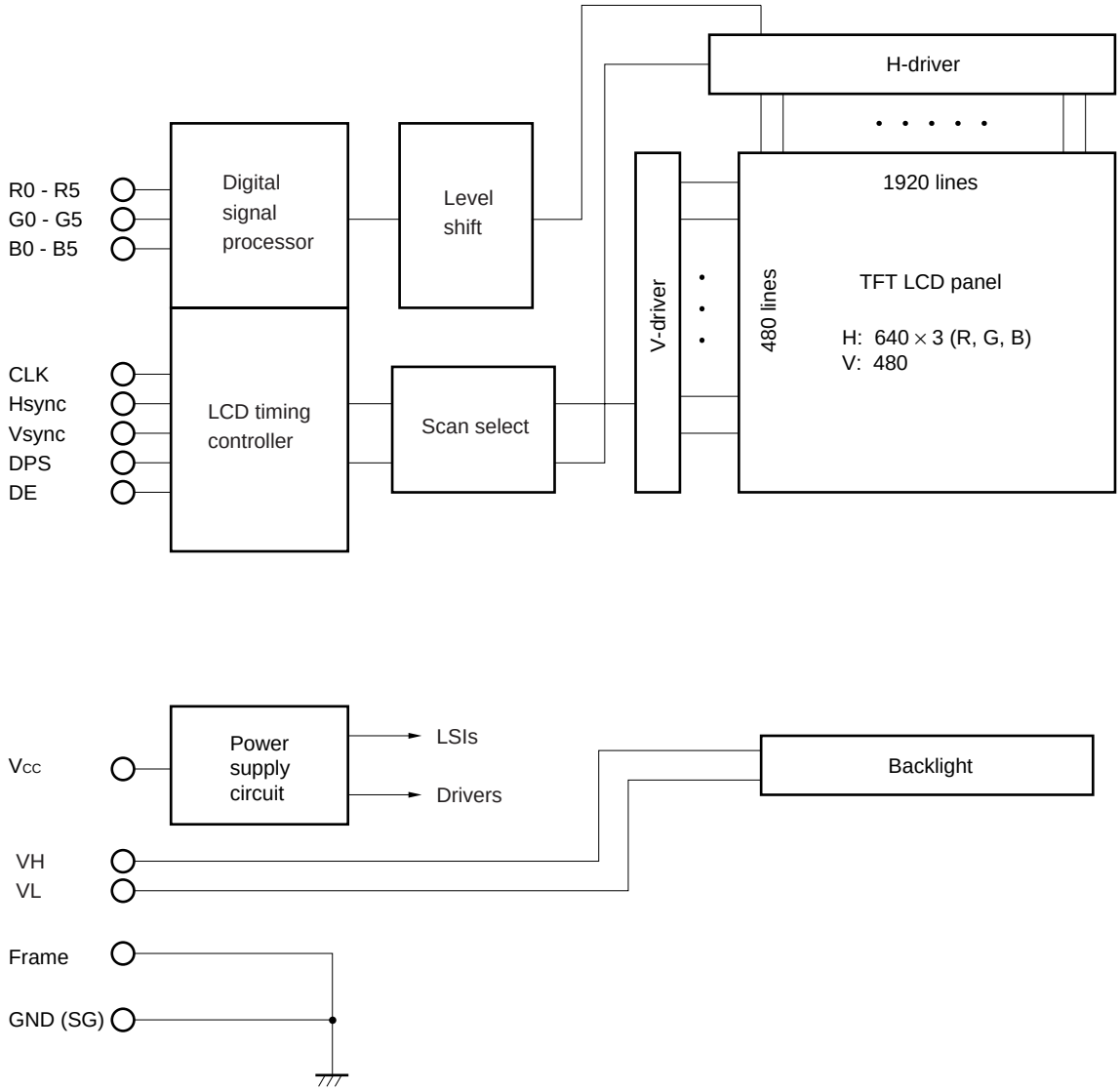
## BLOCK DIAGRAM

<1> In case of use the inverter of NEC




**Note** Both frame and GNDB (Backlight ground) are not contacted to the lamp holder.

<2> In case of use the inverter of customers




**Note** Both frame and GNDB (Backlight ground) are not contacted to the lamp holder.

## OUTLINE OF CHARACTERISTICS (at room temperature)

| | |
|---|---|
| Display area | 211.2 (H) × 158.4 (V) mm |
| Drive system | a-Si TFT active matrix |
| Display colors | 262,144 colors |
| Number of pixels | 640 × 480 pixels |
| Pixel arrangement | RGB vertical stripe |
| Pixel pitch | 0.33 (H) × 0.33 (V) mm |
| Module size | 243.0 (H) × 185.1 (V) × 10.5 typ. (D) mm |
| Inverter size | 25.0 (H) × 105.0 (V) × 10.2 max. (D) mm |
| Weight | 510 g (typ.) + 15 g (typ., inverter) |
| Contrast ratio | 150 : 1 (typ.) |
| Viewing angle (more than the contrast ratio of 10 : 1) | |
| | Horizontal : 80° (typ., left side, right side) |
| | Vertical : 80° (typ., up side, down side) |
| Designed viewing direction | Optimum grayscale ($\gamma$ = 2.2): perpendicular |
| Color gamut | 45% (typ., At center, to NTSC) |
| Response time | 50 ms (typ.), black to white |
| Luminance | 250 cd/m$^2$ (typ.) |
| Signal system | 6-bit digital signals for each of RGB primary colors, synchronous signals (Hsync, Vsync), dot clock (CLK) |
| Supply voltages | 3.3 V [5.0 V] (Logic, LCD driving), 12.0 V (Backlight) |
| Backlight | Edge light type, two cold cathode fluorescent lamp |
| Power consumption | 7.1 W (typ., 3.3 V, 12.0 V) |

## GENERAL SPECIFICATIONS

| Item | Specification | Unit |
|---|---|---|
| Module size | 243.0 ± 0.5 (H) × 185.1 ± 0.5 (V) × 11.2 max. (D) | mm |
| Inverter size | 25.0 ± 0.5 (H) × $105.0^{+0.7}_{-0.3}$ (V) × 10.2 max. (D) | mm |
| Display area | 211.2 (H) × 158.4 (V) | mm |
| Number of dots | 640 × 3 (H) × 480 (V) | dot |
| Number of pixels | 640 (H) × 480 (V) | pixel |
| Dot pitch | 0.11 (H) × 0.33 (V) | mm |
| Pixel pitch | 0.33 (H) × 0.33 (V) | mm |
| Pixel arrangement | RGB (Red, Green, Blue) vertical stripe | – |
| Display colors | 262,144 | color |
| Weight | Module: 530 (max.) + Inverter: 20 (max.) | g |

## ABSOLUTE MAXIMUM RATINGS

| Parameter | Symbol | Rating | Unit | Remarks |
|---|---|---|---|---|
| Supply voltage | $V_{CC}$ | –0.3 to 6.5 | V | $T_a$ = 25°C<br>$V_I - V_{CC} < 0.3$ |
| Input voltage | $V_I$ | –0.3 to 6.5 | V | |
| Supply voltage | $V_{DD}B$ | –0.3 to 15.0 | V | |
| Input voltage | BRTC | –0.3 to 7.0 | V | |
| Lamp voltage | VL | 2000 | Vrms | |
| Storage temp. | $T_{ST}$ | –20 to 60 | °C | – |
| Operating temp. | $T_{OP}$ | 0 to 50 | °C | Module surface[Note] |
| Humidity (No condensation) | RH | ≤ 95% relative humidity | – | $T_a \leq 40$°C |
| | | ≤ 85% relative humidity | – | 40 < $T_a \leq$ 50°C |
| | | Absolute humidity shall not exceed $T_a$ = 50°C, 85% relative humidity level. | – | $T_a$ > 50°C |

**Note** Measured at the display area

## ELECTRICAL CHARACTERISTICS

(1) Logic, LCD driving

$T_a$ = 25°C

| Parameter | Symbol | MIN. | TYP. | MAX. | Unit | Remarks |
|---|---|---|---|---|---|---|
| Supply voltage | $V_{CC}$ | 3.0<br>(4.75) | 3.3<br>(5.0) | 3.6<br>(5.25) | V | $V_{CC}$ = 3.3 V<br>($V_{CC}$ = 5.0 V) |
| Logic input Low voltage | $V_{IL}$ | 0 | – | $V_{CC} \times 0.3$ | V | |
| Logic input High voltage | $V_{IH}$ | $V_{CC} \times 0.7$ | – | 5.25 | V | |
| Supply current | $I_{CC}$ | –<br>– | 400[Note]<br>(300) | 600<br>(400) | mA | $V_{CC}$ = 3.3 V<br>($V_{CC}$ = 5.0 V) |

**Note** Checkered flag pattern (in EIAJ ED-2522)

(2) Backlight

<1> Inventer

$T_a$ = 25°C

| Parameter | Symbol | MIN. | TYP. | MAX. | Unit | Remarks |
|---|---|---|---|---|---|---|
| Supply voltage | $V_{DD}B$ | 11.4 | 12.0 | 12.6 | V | – |
| Logic input “L” voltage | $V_{IL}$ | 0 | – | 0.8 | V | BRTC |
| Logic input “H” voltage | $V_{IH}$ | 2.0 | – | 5.0 | V | |
| Luminance control voltage | – | – | 2.5 | – | V | Minimum luminance |
| | – | – | 1.2 | – | V | Maximum luminance |
| Supply current | $I_{DD}B$ | – | 480 | – | mA | 250 cd/m$^2$ |

<2> Lamp

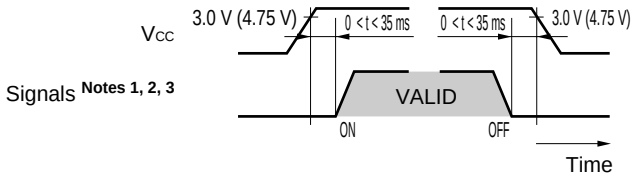
| Parameter | Symbol | MIN. | TYP. | MAX. | Unit | Remarks |
|---|---|---|---|---|---|---|
| Lamp current | IL | $2.0 \times 2$ | $5.0 \times 2$ | – | mArms | With two lamps |
| Lamp voltage | VL | – | 510 | – | Vrms | IL = 5 mArms |
| Power supply | PL | – | 2.55 | – | W | – |
| Lamp turn on voltage | Vs | 840 | – | – | mA | $T_a$ = 25°C |
| | | 1265 | – | – | mA | $T_a$ = 0°C |
| Oscillator frequency | Ft | 50 | 54 | 58 | kHz | **Note** |

**Note** Recommended value of “Ft”

- Ft is within the specification.
- Ft = 1/4 th $\times$ (2n – 1) th: Hsync period
  n : a natural number (1, 2, 3, ⋯)

If Ft is out of the recommended value, interference between Ft frequency and Hsync frequency may cause beat on the display.

## SUPPLY VOLTAGE SEQUENCE




**Notes 1.** The supply voltage for input signals should be the same as $V_{CC}$.

**2.** Apply $V_{DD}B$ within the LCD operation period. When the backlight turns on before LCD operation or the LCD operation turns off before the backlight turns off, the display may momentarily become white.

**3.** While the power is off, please keep whole signals (Hsync, Vsync, CLK, DE, and DATA) at low level or high impedance.

## INTERFACE AND PIN CONNECTION

(1) Interface signals, power supply

Module side connector — Mating connector

CN1 ··· DF9C-31P-1V (No.1 to 31) — DF9-31S-1V, DF9M-31S-1R ····· (1)

IL-310-T31S-VF ····· (2)

Supplier: (1) HIROSE ELECTRIC CO., LTD., (2) Japan Aviation Electronics Industry Limited (JAE)

| Pin No. | Symbol | Function |
|---|---|---|
| 1 | GND | Ground (SG)[Note 4] |
| 2 | CLK | Dot clock |
| 3 | Hsync | Horizontal sync. |
| 4 | Vsync | Vertical sync. |
| 5 | GND | Ground[Note 4] |
| 6 | R0 | Red data (LSB) |
| 7 | R1 | Red data |
| 8 | R2 | Red data |
| 9 | R3 | Red data |
| 10 | R4 | Red data |
| 11 | R5 | Red data (MSB) |
| 12 | GND | Ground[Note 4] |
| 13 | G0 | Green data (LSB) |
| 14 | G1 | Green data |
| 15 | G2 | Green data |
| 16 | G3 | Green data |
| 17 | G4 | Green data |
| 18 | G5 | Green data (MSB) |

| Pin No. | Symbol | Function |
|---|---|---|
| 19 | GND | Ground[Note 4] |
| 20 | B0 | Blue data (LSB) |
| 21 | B1 | Blue data |
| 22 | B2 | Blue data |
| 23 | B3 | Blue data |
| 24 | B4 | Blue data |
| 25 | B5 | Blue data (MSB) |
| 26 | GND | Ground[Note 4] |
| 27 | DE | Data enable[Note 2] |
| 28 | $V_{CC}$ | Power supply[Note 1] |
| 29 | $V_{CC}$ | Power supply[Note 1] |
| 30 | N. C. | Non-connection |
| 31 | DPS | Scan direction select[Note 3] |

LSB : Least Significant Bit

MSB : Most Significant Bit

**Notes 1.** $V_{CC}$: All $V_{CC}$ terminals should be connected to 3.3 V or 5.0 V.

**2.** DE: DE/Fixed mode select is as follows.

{Data enabled signal = DE mode
{$V_{CC}$ or Open = Fixed mode

**3.** DPS: DPS changes display scan direction.

{GND or Open = Scan direction will be decided by the setting of SW1.
{$V_{CC}$ = Reverse scan

INPUT SIGNAL TIMING See (4) DISPLAY POSITION about another way for reversible scan. (DPS is Open)

When DPS is $V_{CC}$, reverse scan is selected even if SW1 is set at normal scan.

When DPS is GND, normal scan is selected even if SW1 is set at reverse scan.

**4.** GND is connected to the frame of the LCD module.

(2) Inverter

- Inverter side connector 1 Mating connector 1
  CN1 ··· LZ-5P-SL-SMT LZ-5S-SC3
  Supplier: Japan Aviation Electronics Industry Limited (JAE)

| Pin No. | Symbol | Function | Pin No. | Symbol | Function |
|---|---|---|---|---|---|
| 1 | $V_{DD}$B | Power supply | 4 | GNDB | Backlight ground |
| 2 | $V_{DD}$B | Power supply | 5 | BRTHL | Luminance select[Note] |
| 3 | GNDB | Backlight ground | | | |

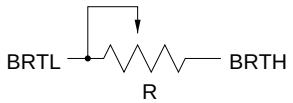
**Note** High luminance (100%): BRTHL = High or open
Low luminance (60%): BRTHL = Low (GNDB level)

- Inverter side connector 2 Mating connector 2
  CN3 ··· IL-Z-3PL-SMTY IL-Z-3S-S125C3
  Supplier: Japan Aviation Electronics Industry Limited (JAE)

| Pin No. | Symbol | Function |
|---|---|---|
| 1 | BRTC | Backlight ON/OFF signal[Note 1] |
| 2 | BRTH | Luminance control input[Note 2] |
| 3 | BRTL | Luminance control input[Note 2] |

**Notes 1.** C-MOS level
Backlight ON : BRTC = High or open
Backlight OFF : BRTC = Low

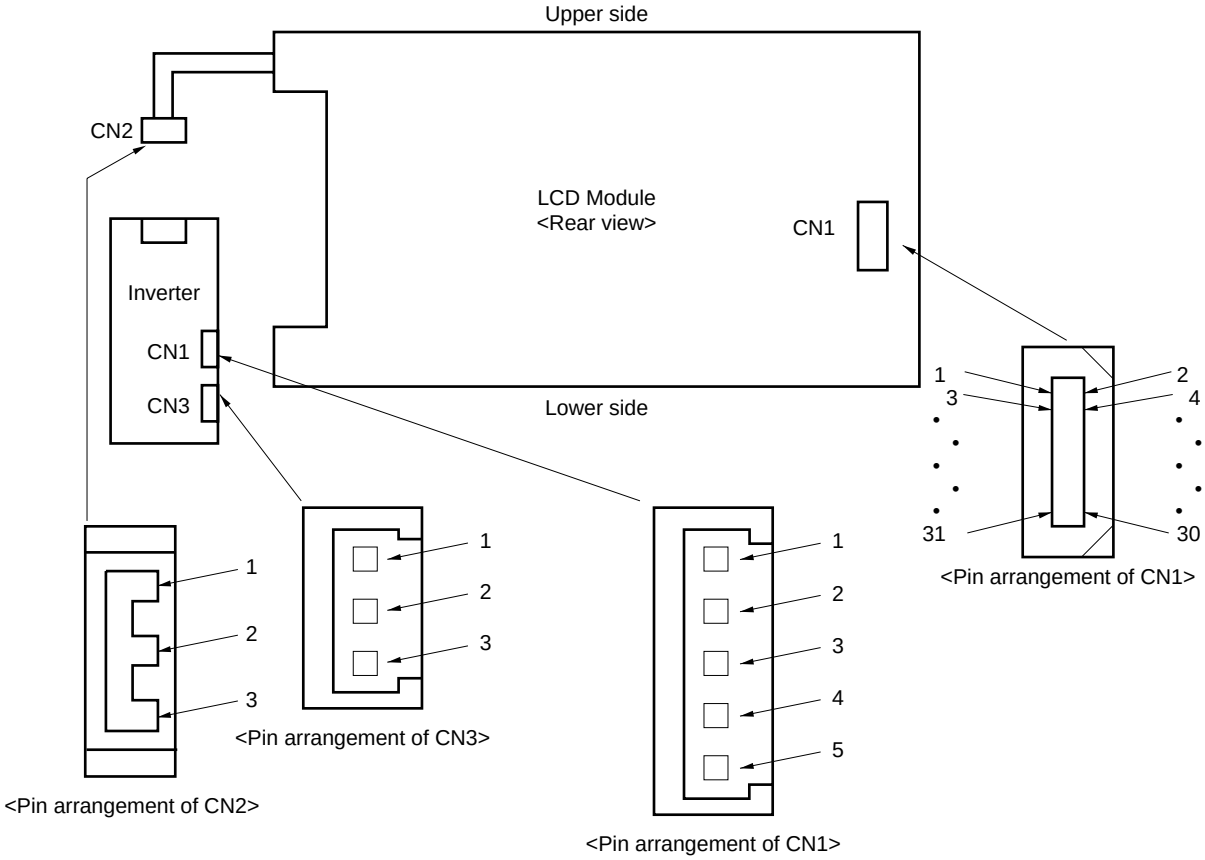
**2.** <1> A way of luminance control by a variable resistor
This way works when BRTHL (No.5 pin) of CN1 is opened.




Mating variable resistor : 10 kΩ ±5%
Minimum luminance (50%) : R = 0 Ω
Maximum luminance (100%) : R = 10 kΩ

<2> A way of luminance control by a voltage
This way works when BRTHL and BRTL are opened. The range of input voltage between BRTH and GNDB is as follows.
Minimum luminance (50%) : 2.5 V
Maximum luminance (100%) : ≤ 1.2 V

<3> Connector location

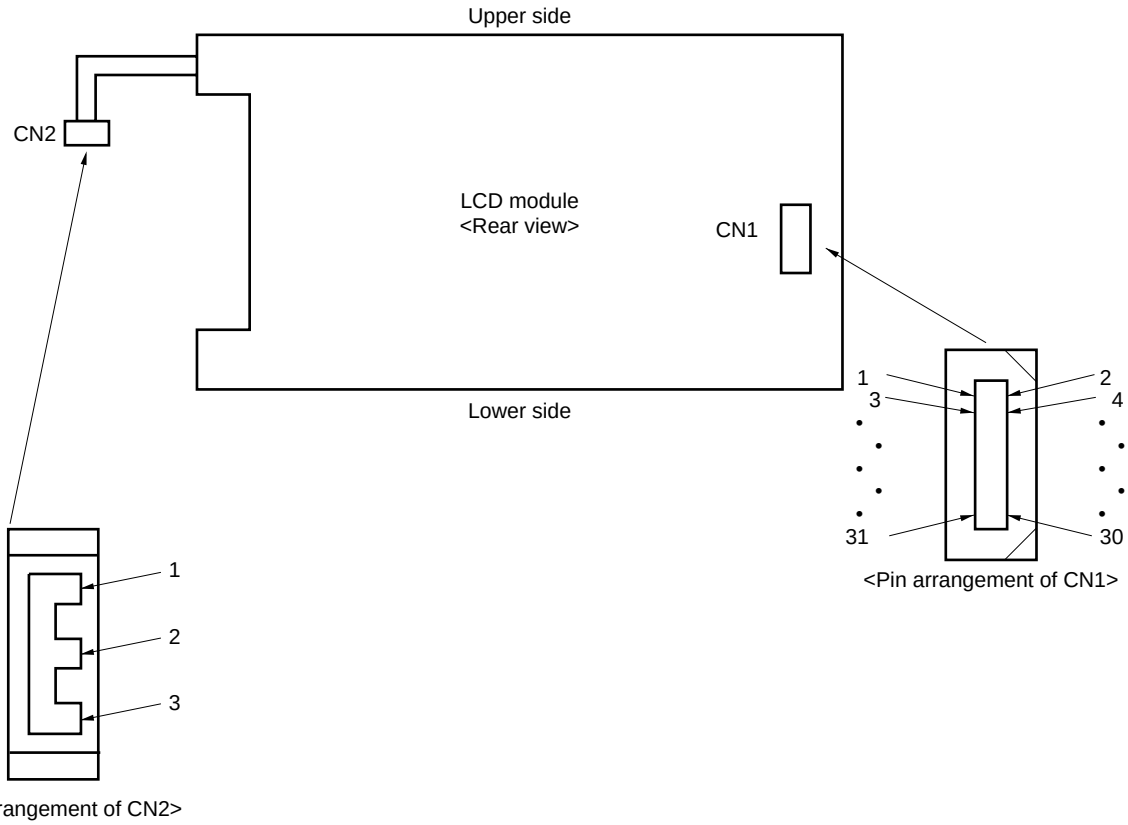


**[In case of use the inverter of customers]**

Lamp side connector Mating connector
CN2 ··· BHR-03VS-1 SM03 (4.0) B-BHS-TB
Supplier: J. S. T TRADING COMPANY, LTD.

| Pin No. | Symbol | Function |
|---|---|---|
| 1 | VL | Low voltage terminal |
| 2 | VH | High voltage terminal |
| 3 | VH | High voltage terminal |

<1> Connector location



**DISPLAY COLORS vs. INPUT DATA SIGNALS**

| 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 grayscale | 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 grayscale | 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 grayscale | 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 |

**Note** Colors are developed in combination with 6-bit signals (64 steps in grayscale) of each primary red, green, and blue color.

This process can result in up to 262,144 ($64 \times 64 \times 64$) colors.

## INPUT SIGNAL TIMING

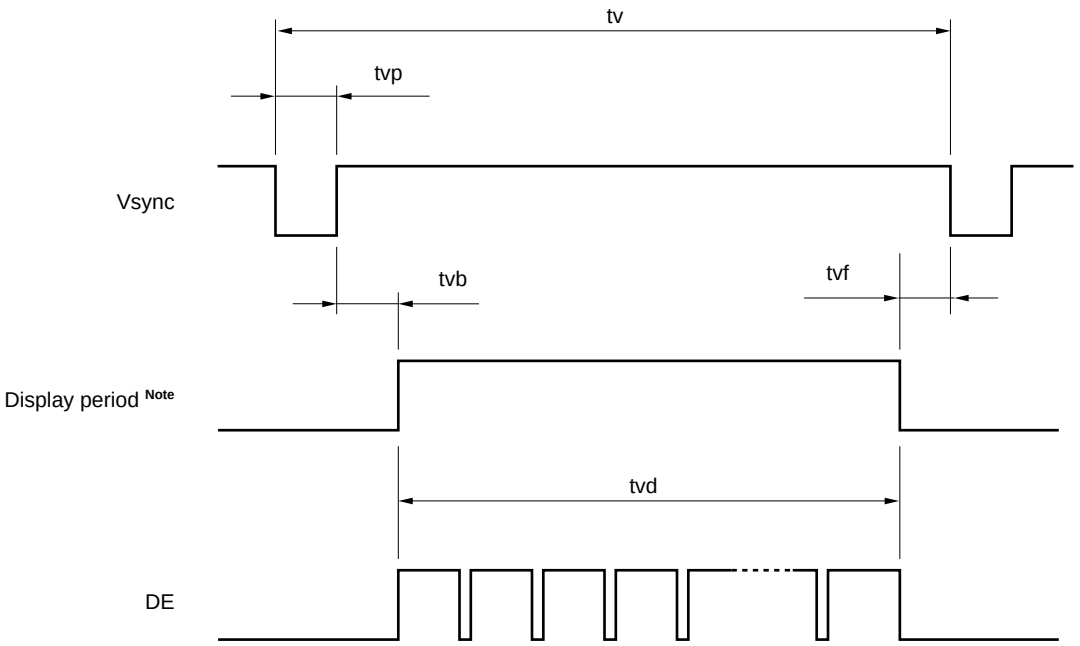
(1) Input signal specifications (DE mode)

| Parameter | | Symbol | MIN. | TYP. | MAX. | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| CLK | Frequency | 1/tc | 21.0 | 25.175 | 29.0 | MHz | 39.72 ns (typ.) |
| | Duty | tch/tc | 0.4 | 0.5 | 0.6 | – | – |
| | Rise, fall | tcrf | – | – | 10 | ns | – |
| Hsync | Period | th | 30.0 | 31.778 | 33.6 | μs | 31.468 kHz (typ.) |
| | | | – | 800 | – | CLK | |
| | Display period | thd | | 640 | | CLK | – |
| | Front-porch | thf | | 16 | | CLK | Fixed mode |
| | | | 2 | 16 | – | CLK | – |
| | Pulse width | thp | – | 96 | – | CLK | Fixed mode |
| | | | 10 | 96 | – | CLK | – |
| | Back-porch | thb | – | 48 | 134 | CLK | Fixed mode |
| | | | 4 | 48 | – | CLK | Adjustable range by DE signal |
| | thp + thb | | | 144 | | CLK | Fixed mode |
| | | | 14 | 144 | – | CLK | Adjustable range by DE signal |
| | CLK-Hsync timing | thch | 12 | – | – | ns | – |
| | Hsync-CLK timing | thcs | 8 | – | – | ns | – |
| | Hsync-Vsync timing | tvh | 1 | – | – | CLK | – |
| | Vsync-Hsync timing | tvs | 30 | – | – | ns | – |
| | Rise, fall | thrf | – | – | 10 | ns | – |
| Vsync | Period | tv | 16.1 | 16.683 | 17.2 | ms | 59.94 Hz (typ.) |
| | | | – | 525 | – | H | |
| | Display period | tvd | | 480 | | H | – |
| | Front-porch | tvf | – | 12 | – | H | Fixed mode |
| | | | 0 | 12 | – | H | – |
| | Pulse width | tvp | 1 | 2 | – | H | Fixed mode |
| | | | 1 | 2 | – | H | – |
| | Back-porch | tvb | – | 31 | – | H | Fixed mode |
| | | | 4 | 31 | – | H | Adjustable range by DE signal |
| | tvp + tvb | | – | 33 | – | H | Fixed mode |
| | | | 5 | 33 | – | H | Adjustable range by DE signal |
| | Rise, fall | tvrf | – | – | 10 | ns | – |
| DATA (R0-R5, G0-G5, B0-B5) | CLK-DATA timing | tds | 8 | – | – | ns | – |
| | DATA-CLK timing | tdh | 12 | – | – | ns | – |
| | Rise, fall | tdrf | – | – | 10 | ns | – |
| DE | DE-CLK timing | tes | 8 | – | – | ns | – |
| | CLK-DE timing | teh | 12 | – | – | ns | |
| | Rise, fall | terf | – | – | 10 | ns | |

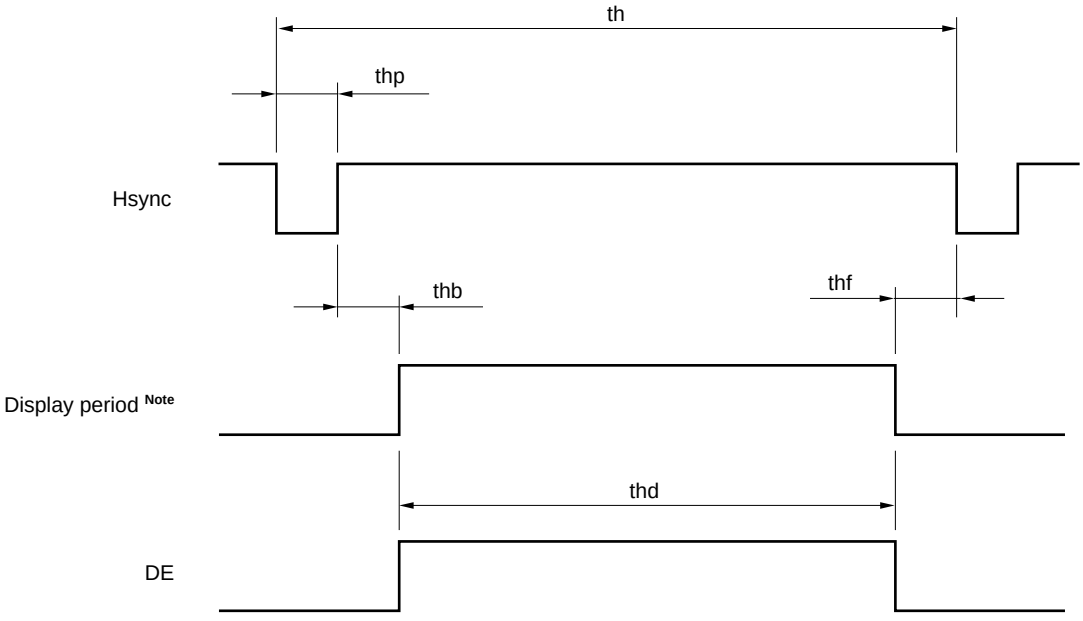
**Caution All of parameters should be kept in the specified range.**

(2) Definition of input signal timing

<Vertical>

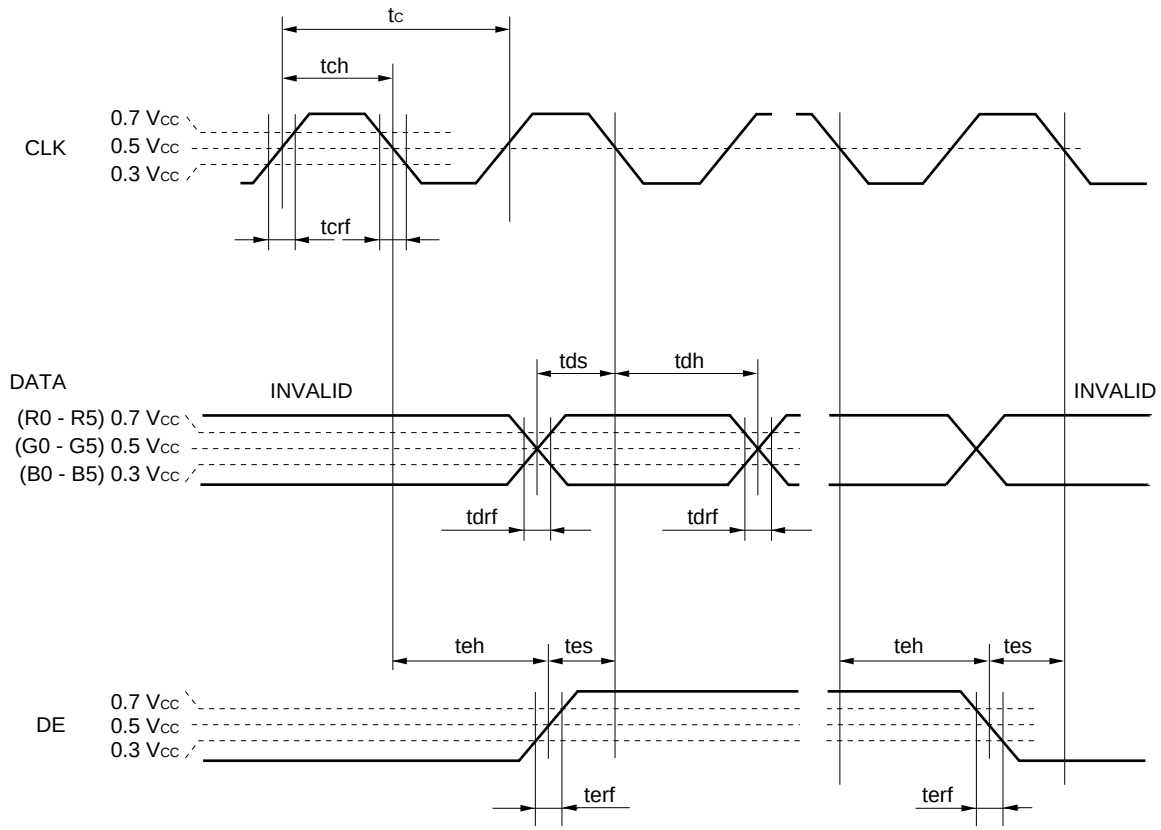


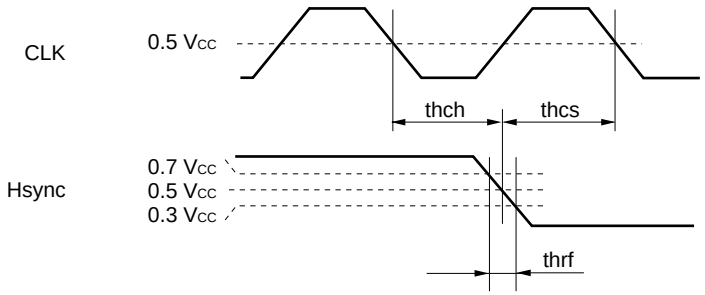

<Horizontal>

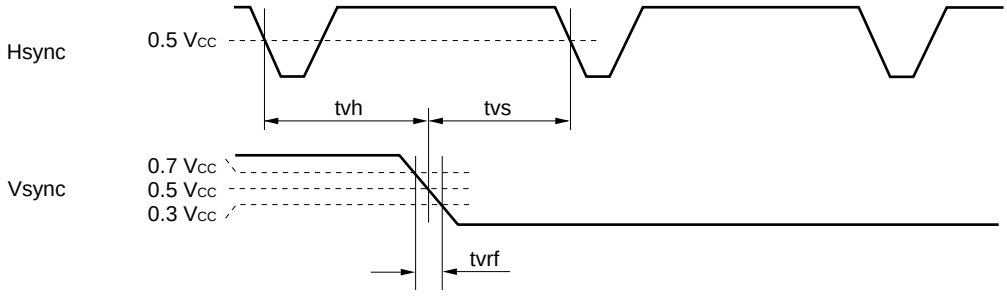



**Notes 1.** These do not exist as signals.

**2.** Keep thp + thb and tvp + tvb within the value shown in the table of input signal timing, otherwise display position is shifted to right or left side, or to up or down side.

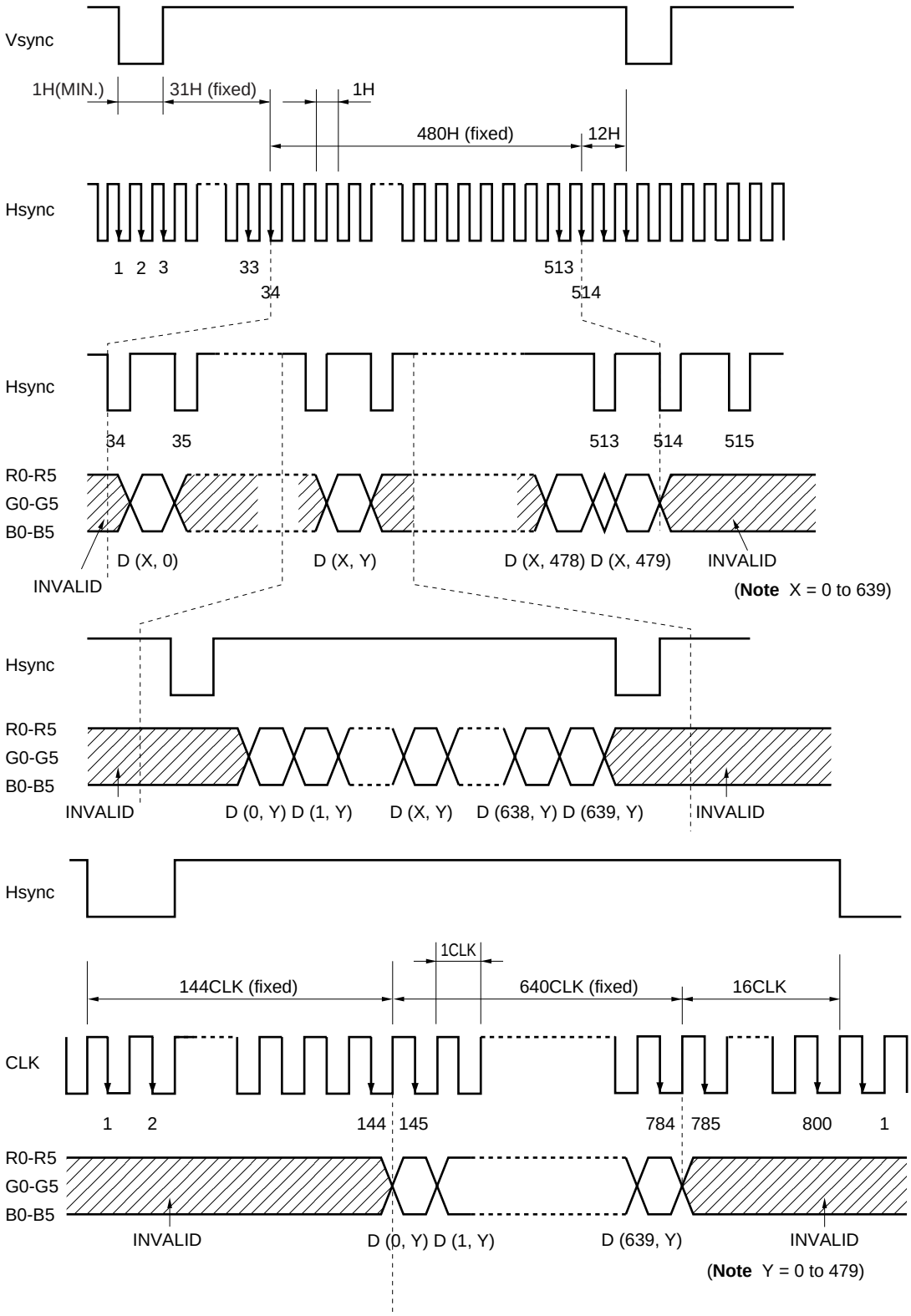

tc
tch
CLK
0.7 Vcc
0.5 Vcc
0.3 Vcc
tcrf
tds
tdh
DATA
INVALID
INVALID
(R0 - R5) 0.7 Vcc
(G0 - G5) 0.5 Vcc
(B0 - B5) 0.3 Vcc
tdrf
tdrf
teh
tes
teh
tes
DE
0.7 Vcc
0.5 Vcc
0.3 Vcc
terf
terf


CLK
0.5 Vcc
thch
thcs
Hsync
0.7 Vcc
0.5 Vcc
0.3 Vcc
thrf

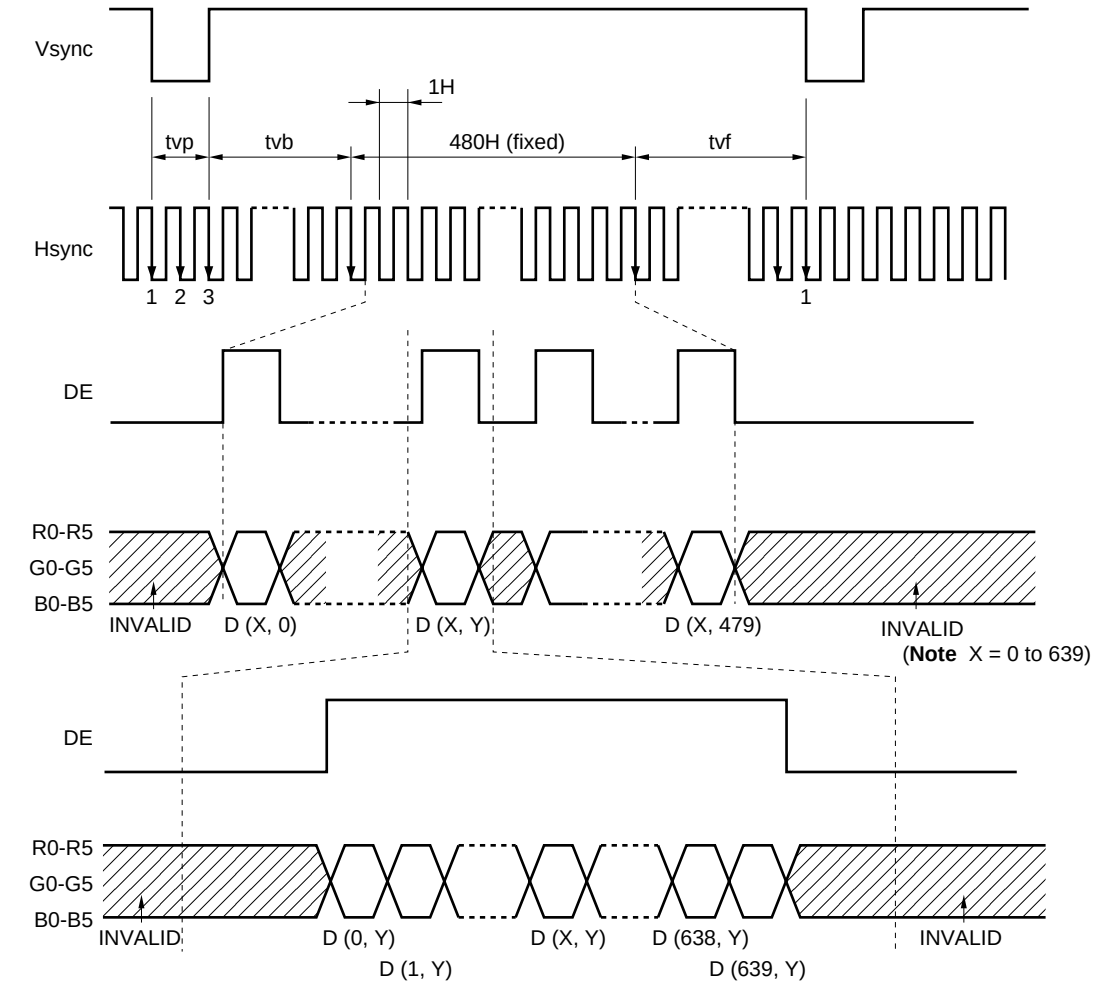

Hsync
0.5 Vcc
tvh
tvs
Vsync
0.7 Vcc
0.5 Vcc
0.3 Vcc
tvrf

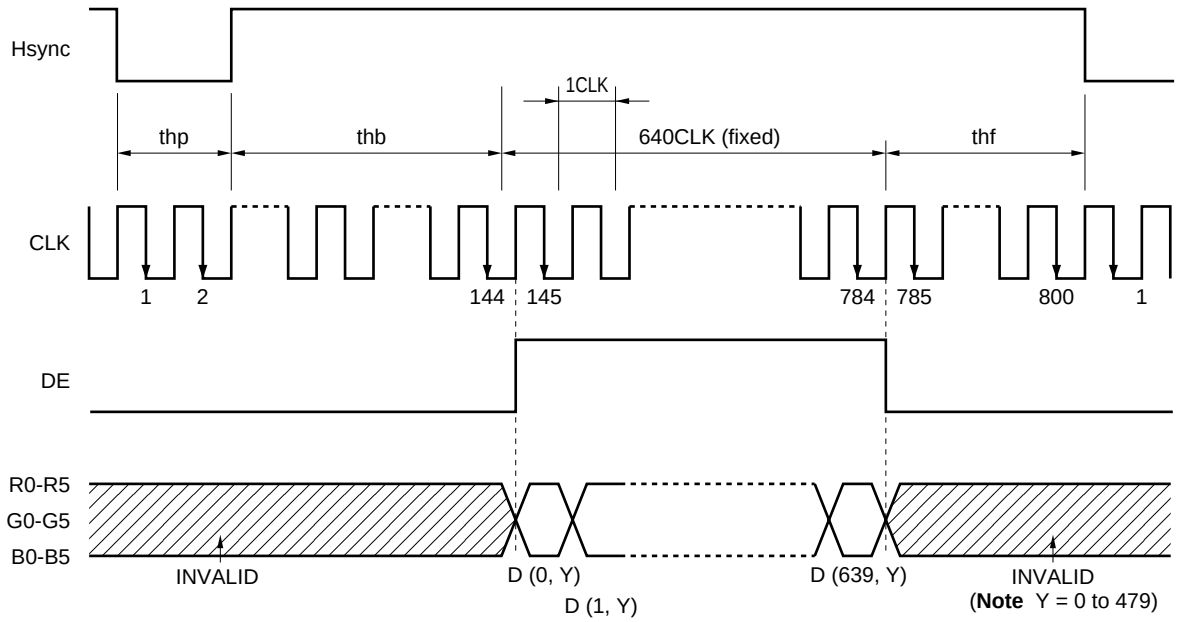
(3) Input signal timing chart

(a) Fixed mode



(b) DE mode


Vsync
1H
tvp
tvb
480H (fixed)
tvf
Hsync
1 2 3
1
DE
R0-R5
G0-G5
B0-B5
INVALID
D (X, 0)
D (X, Y)
D (X, 479)
INVALID
(Note X = 0 to 639)
DE
R0-R5
G0-G5
B0-B5
INVALID
D (0, Y)
D (1, Y)
D (X, Y)
D (638, Y)
D (639, Y)
INVALID


Hsync
1CLK
thp
thb
640CLK (fixed)
thf
CLK
1
2
144
145
784
785
800
1
DE
R0-R5
G0-G5
B0-B5
INVALID
D (0, Y)
D (1, Y)
D (639, Y)
INVALID
(Note Y = 0 to 479)

(4) Display position of input data

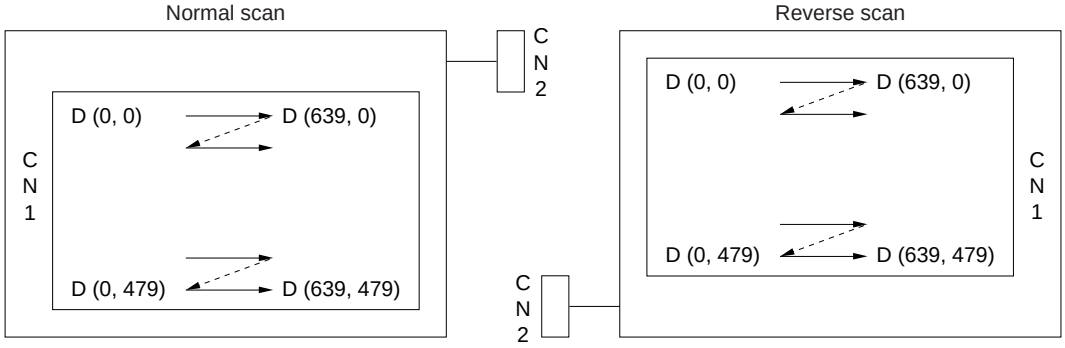
Normal scan (DPS = “GND” or “Open”)

| | | | | | | |
|---|---|---|---|---|---|---|
| D (0, 0) | D (1, 0) | − − − | D (X, 0) | − − − | D (638, 0) | D (639, 0) |
| D (0, 1) | D (1, 1) | − − − | D (X, 1) | − − − | D (638, 1) | D (639, 1) |
| ¦ | ¦ | −¦− | ¦ | −¦− | ¦ | ¦ |
| D (0, Y) | D (1, Y) | − − − | D (X, Y) | − − − | D (638, Y) | D (639, Y) |
| ¦ | ¦ | −¦− | ¦ | −¦− | ¦ | ¦ |
| D (0, 478) | D (1, 478) | − − − | D (X, 478) | − − − | D (638, 478) | D (639, 478) |
| D (0, 479) | D (1, 479) | − − − | D (X, 479) | − − − | D (638, 479) | D (639, 479) |

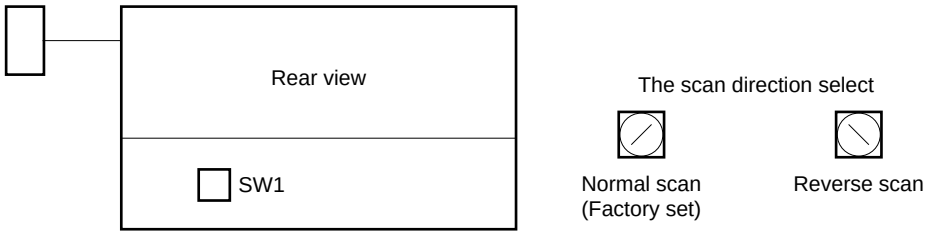
Reverse scan (DPS = “$V_{CC}$”)

| | | | | | | |
|---|---|---|---|---|---|---|
| D (639, 479) | D (638, 479) | − − − | D (X, 479) | − − − | D (1, 479) | D (0, 479) |
| D (639, 478) | D (638, 478) | − − − | D (X, 478) | − − − | D (1, 478) | D (0, 478) |
| ¦ | ¦ | −¦− | ¦ | −¦− | ¦ | ¦ |
| D (639, Y) | D (638, Y) | − − − | D (X, Y) | − − − | D (1, Y) | D (0, Y) |
| ¦ | ¦ | −¦− | ¦ | −¦− | ¦ | ¦ |
| D (639, 1) | D (638, 1) | − − − | D (X, 1) | − − − | D (1, 1) | D (0, 1) |
| D (639, 0) | D (638, 0) | − − − | D (X, 0) | − − − | D (1, 0) | D (0, 0) |

**Notes 1.** Below drawings shows relation between the scan direction and viewing direction.




**2.** When DPS is open, or Low, the scan direction is set up by the switch (SW1) on the rear side.




See (1) Interface signals, power supply about another way for reversible scan.

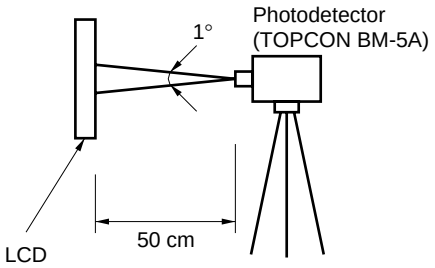
When DPS is $V_{CC}$, reverse scan is selected even if SW1 is set at normal scan.

## OPTICAL CHARACTERISTICS

$V_{CC}$ = 3.3 V, $V_{DD}B$ = 12 V, MAV = "$V_{CC}$" or "Open" at normal scan

| Parameter | | Symbol | Condition | min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|---|
| Luminance | | LVMAX | $\theta X = \pm 0°$, $\theta Y = \pm 0°$, at center **Note 1** | 200 | 250 | – | cd/m$^2$ |
| Contrast ratio | | CR | $\theta X = \pm 0°$, $\theta Y = \pm 0°$, at center **Note 2** | 80 | 150 | – | – |
| Viewing angle range **Note 3** | Horizontal | $\theta X+$ | CR > 10, $\theta Y = \pm 0°$, | 70 | 80 | – | deg. |
| | | $\theta X-$ | CR > 10, $\theta Y = \pm 0°$, | 70 | 80 | – | deg. |
| | Vertical | $\theta Y+$ | CR > 10, $\theta X = \pm 0°$ | 70 | 80 | – | deg. |
| | | $\theta Y-$ | CR > 10, $\theta X = \pm 0°$ | 70 | 80 | – | deg. |
| Color gamut | | C | at center, to NTSC | 40 | 45 | – | % |
| Response time **Note 4** | | ton | Black to white | – | 50 | 70 | ms |
| | | toff | White to black | – | 50 | 80 | ms |
| Luminance uniformity **Note 5** | | – | Maximum luminance / Minimum luminance | – | 1.25 | 1.4 | – |

**Notes 1.** The luminance is measured after 20 minutes from the module works, with all pixels in white. Typical value is measured after luminance saturation.

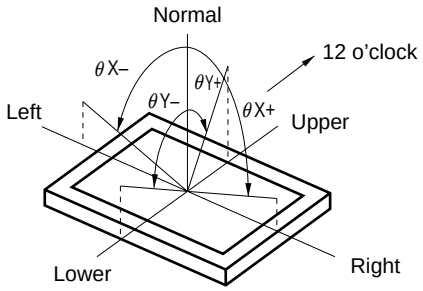



**2.** The contrast ratio is calculated by using the following formula.

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance with all pixels in white}}{\text{Luminance with all pixels in black}}$$

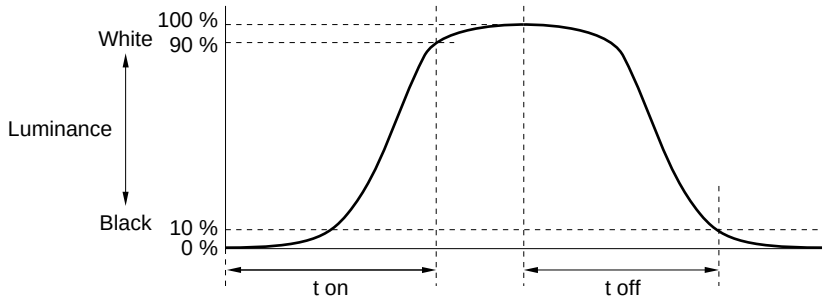
The Luminance is measured in darkroom.

**3.** Definitions of viewing angle are as follows.



**4.** Definition of response time is as follows.

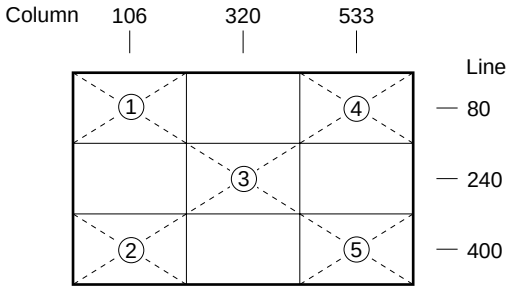
Photodetector output signal is measured when the luminance changes “black” to “white” or “white” to “black”.




**5.** The luminance uniformity is calculated using following formula.

$$\text{Luminance uniformity} = \frac{\text{Maximum luminance}}{\text{Minimum luminance}}$$

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



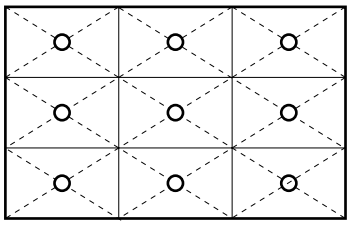
## RELIABILITY TEST

| Test item | Test condition |
|---|---|
| High temperature/humidity operation[Note 1] | 50 ± 2°C, 85% relative humidity<br>240 hours<br>Display data is black. |
| Heat cycle[Note 1] (operation) | <1> 0°C ± 3°C ⋯ 1 hour<br>55°C ± 3°C ⋯ 1 hour<br><2> 50 cycles, 4 hours/cycle<br><3> Display data is black. |
| Thermal shock[Note 1] (non-operation) | <1> –20°C ± 3°C ⋯ 30 minutes<br>60°C ± 3°C ⋯ 30 minutes<br><2> 100 cycles<br><3> Temperature transition time within 5 minutes |
| Vibration[Notes 1, 2] (non-operation) | <1> 5 - 100 Hz, 2G<br>1 minute/cycle<br>X, Y, Z direction<br><2> 120 times each direction |
| Mechanical shock[Notes 1, 2] (non-operation) | <1> 55 G, 11 ms<br>X, Y, Z direction<br><2> 5 times each direction |
| ESD[Notes 1, 3] (operation) | 150 pF, 150 Ω, ±10 kV<br>9 places on a panel<br>10 times each place at one-second intervals |
| Dust[Note 1] (operation) | 15 kinds of dust (JIS Z 8901)<br>Hourly 15 seconds stir, 8 times repeat |

**Notes 1.** Display function is checked by the same condition as LCD module out-going inspection.

**2.** Physical damage.

**3.** Discharge points "○" are shown in the figure.



## GENERAL CAUTIONS

Next figures and sentence are very important. Please understand these contents as follows.

| | |
|---|---|
|  CAUTION | This figure is a mark that you will get hurt and/or the module will have damages when you make a mistake to operate. |

| | |
|---|---|
|  | This figure is a mark that you will get an electric shock when you make a mistake to operate. |
|  | This figure is a mark that you will get hurt when you make a mistake to operate |

 CAUTION

| | |
|---|---|
|  | Do not touch an inverter, on which is stuck a caution label, while the LCD module is under the operation, because of dangerous high voltage. |

(1) Caution when taking out the module

a) Pick the pouch only, in taking out module from a carrier box.

(2) Cautions for handling the module

a) As the electrostatic discharges may break the LCD module, handle the LCD module with care against electrostatic discharges.

b)  As the LCD panel and backlight element are made from fragile glass material, impulse and pressure to the LCD module should be avoided.

c) As the surface of polarizer is very soft and easily scratched, use a soft dry cloth without chemicals for cleaning.

d) Do not pull the interface connectors in or out while the LCD module is operating.

e) Put the module display side down on a horizontal plane.

f) Handle connectors and cables with care.

g) When the module is operating, do not lose CLK, Hsync or Vsync signal. If any one of these signals is lost, the LCD panel would be damaged.

h) The torque to mounting screw should never exceed 0.294 N·m (3 kgf·cm).

i) Don't push or rub the surface of LCD module.
If you do, the scratches or rubbing marks may be left there.

(3) Cautions for the atmosphere

a) Dew drop atmosphere should be avoided.

b) Do not store and/or operate the LCD module in a high temperature and/or high humidity atmosphere. Storage in an electro-conductive polymer packing pouch and under relatively low temperature atmosphere is recommended.

c) This module uses cold cathod fluorescent lamp. Therefore, the life time of the lamp becomes short if the module is operated in the low temperature environment.

d) Do not operate the LCD module in a high magnetic field.

(4) Caution for the module characteristics

a) Do not apply fixed pattern data signal for a long time to the LCD module. It may cause image sticking. Please use screen savers if the display pattern is fixed more than one hour.

(5) Other cautions

a) Do not disassemble and/or reassemble LCD module.

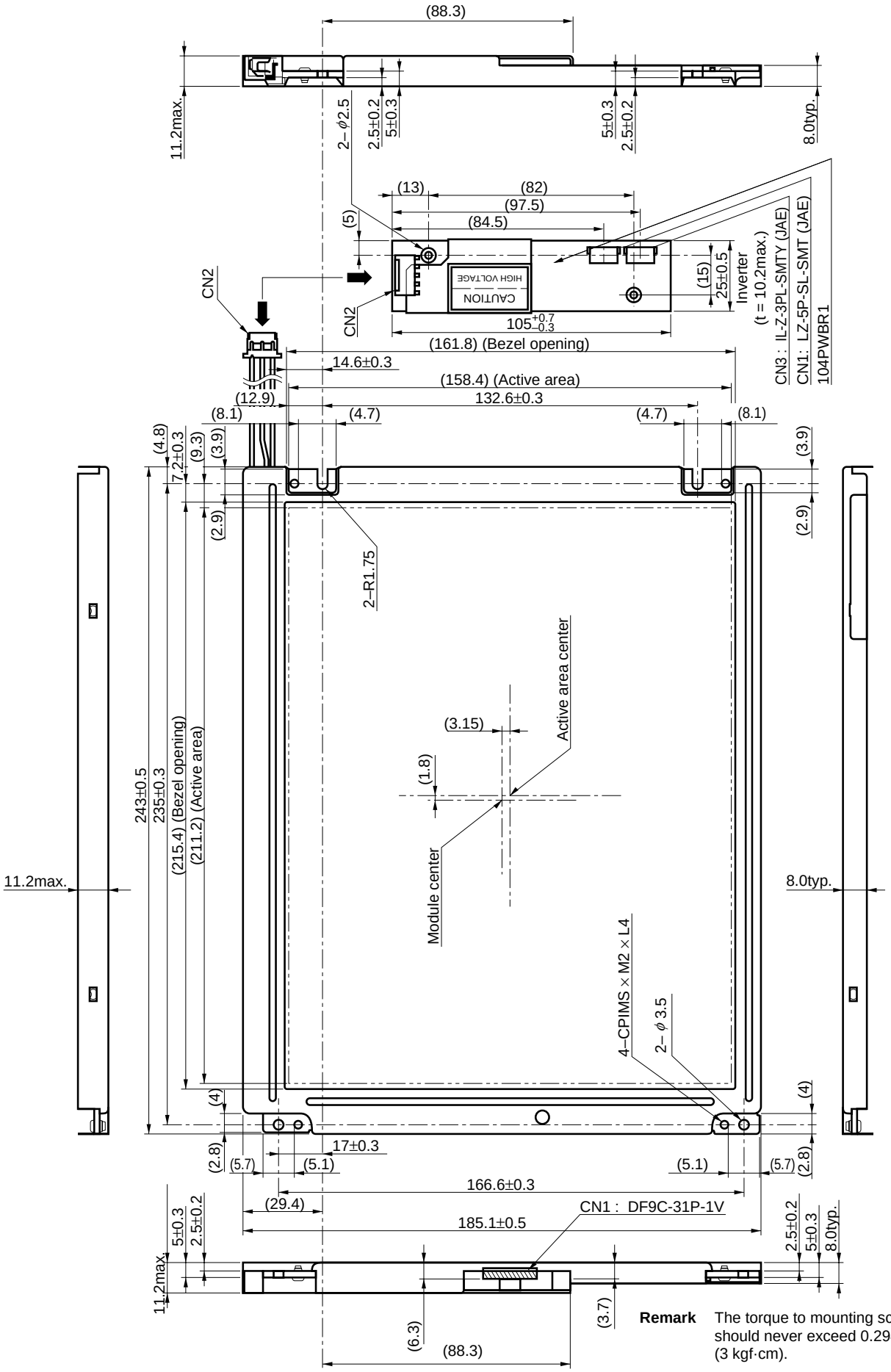
b) Do not readjust variable resistors etc.

c) When returning the module for repair or etc, please pack the module not to be broken. We recommend to the original shipping packages.

Liquid Crystal Display has the following specific characteristics. There are not defects or malfunctions.

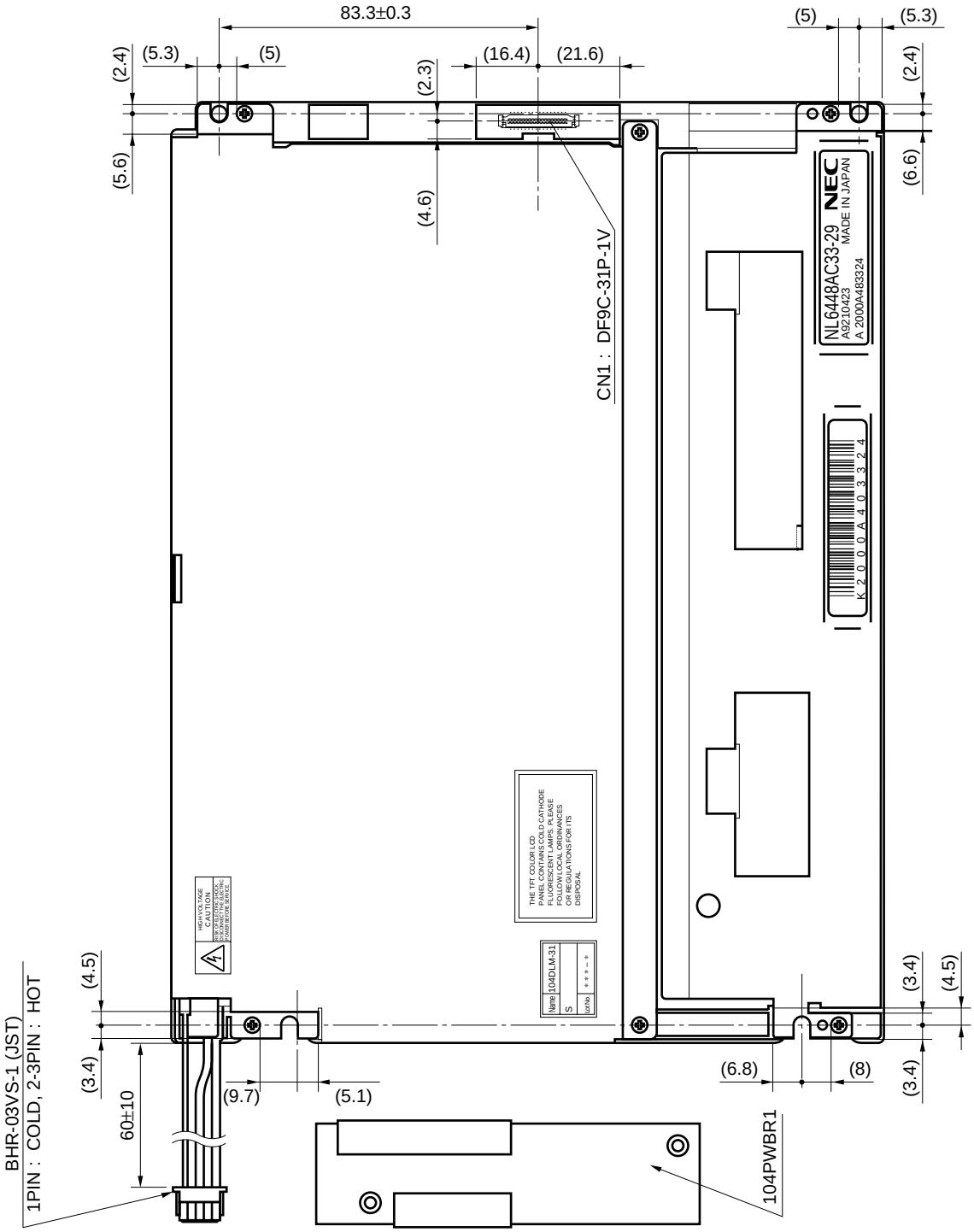
- The display condition of LCD module may be affected by the ambient temperature.
- The LCD module uses cold cathode tube for backlighting. Optical characteristics, like luminance or uniformity, will change during time.
- Uneven brightness and/or small spots may be noticed depending on different display patterns.

**OUTLINE DRAWING: Front View (Unit: mm)**




**Remark** The torque to mounting screw should never exceed 0.294 N·m (3 kgf·cm).

**OUTLINE DRAWING: Rear View (Unit: mm)**



**[MEMO]**

**[MEMO]**

**[MEMO]**