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Datasheet

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1). * " TFT Display

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NLT Technologies

TFT COLOR LCD MODULE

NL192108BC18-06F

40cm (15.6 Type)

FHD

eDP interface

DATA SHEET 

DOD-PP-2577 (1st edition)

**This DATA SHEET is updated document from
PRELIMINARY DATA SHEET DOD-PP-2375(1)**

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

INTRODUCTION

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The **Standard**: Applications as any failure, malfunction or error of the products are free from any damage to death, human bodily injury or other property (Products Safety Issue) and not related the safety of the public (Social Issues), like general electric devices.

Examples: Office equipment, audio and visual equipment, communication equipment, test and measurement equipment, personal electronic equipment, home electronic appliances, car navigation system (with no vehicle control functions), seat entertainment monitor for vehicles and airplanes, fish finder (except marine radar integrated type), PDA, etc.

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Examples: Vehicle/train/ship control system, traffic signals system, traffic information control system, air traffic control system, surgery/operation equipment monitor, disaster/crime prevention system, etc.

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

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

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1. OUTLINE

1.1 STRUCTURE AND PRINCIPLE

Color LCD module NL192108BC18-06F is composed of the amorphous silicon thin film transistor liquid crystal display (a-Si TFT LCD) panel structure with driver LSIs for driving the TFT (Thin Film Transistor) array and a backlight.

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

Color (Red, Green, Blue) data signals from a host system (e.g. signal generator, etc.) are modulated into best form for active matrix system by a signal processing board, and sent to the driver LSIs which drive the individual TFT arrays.

The TFT array as an electro-optical switch regulates the amount of transmitted light from the backlight assembly, when it is controlled by data signals. Color images are created by regulating the amount of transmitted light through the TFT array of red, green and blue dots.

1.2 APPLICATION

- For industrial use

1.3 FEATURES

- Ultra wide viewing angle (Super Fine TFT (SFT))
- Ultra high luminance
- High contrast
- Wide temperature range
- eDP interface
- Narrow frame
- LED backlight
- Acquisition product for UL60950-1/CSA C22.2 No.60950-1-03 (File number: E170632)
- Compliance with the European RoHS directive (2011/65/EU)

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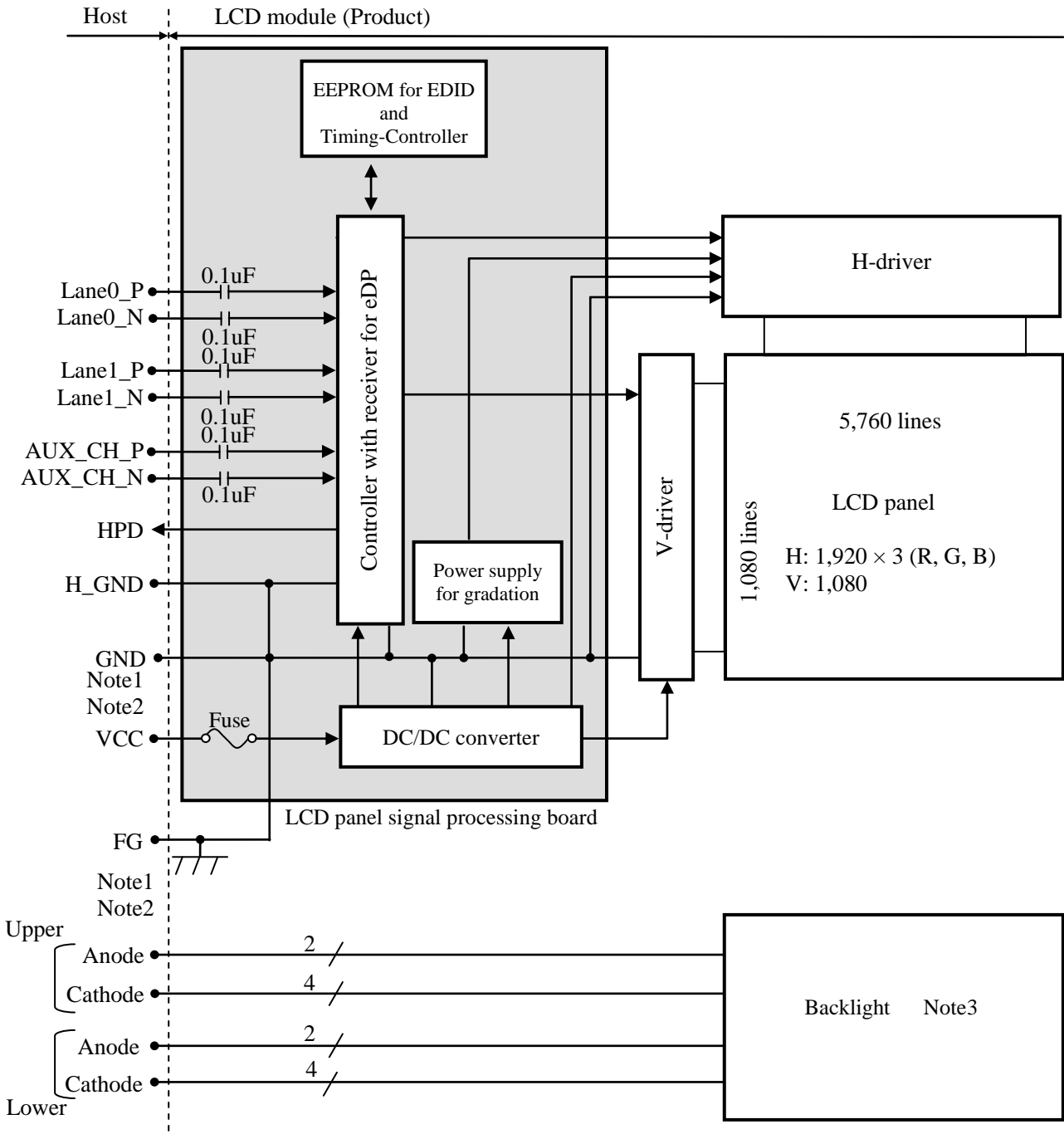
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2. GENERAL SPECIFICATIONS

| | | |
|-----------------------------------|---|---|
| <i>Display area</i> | 344.16 (H) × 193.59 (V) mm | |
| <i>Diagonal size of display</i> | 40cm (15.6 inches) | |
| <i>Drive system</i> | a-Si TFT active matrix | |
| <i>Display color</i> | 16,777,216 colors | |
| <i>Pixel</i> | 1,920 (H) × 1,080 (V) pixels | |
| <i>Pixel arrangement</i> | RGB (Red dot, Green dot, Blue dot) vertical stripe | |
| <i>Dot pitch</i> | 0.05975 (H) × 0.17925 (V) mm | |
| <i>Pixel pitch</i> | 0.17925 (H) × 0.17925 (V) mm | |
| <i>Module size</i> | 363.8 (W) × 215.9 (H) × 15.7 D mm (typ.) | |
| <i>Weight</i> | 1,050g (typ.) | ☆ |
| <i>Contrast ratio</i> | 750:1 (typ.) | |
| <i>Viewing angle</i> | At the contrast ratio ≥ 10:1 <ul style="list-style-type: none"> • Horizontal: Right side 88° (typ.), Left side 88° (typ.) • Vertical: Up side 88° (typ.), Down side 88° (typ.) | |
| <i>Designed viewing direction</i> | • Viewing angle with optimum grayscale ($\gamma = 2.2$): Normal axis (perpendicular) | |
| <i>Polarizer surface</i> | Antiglare | |
| <i>Polarizer pencil-hardness</i> | 3H (min.) [by JIS K5600] | |
| <i>Color gamut</i> | At LCD panel center 40% (typ.) [against NTSC color space] | |
| <i>Response time</i> | $T_{on} + T_{off}$ (10% ← → 90%) 30ms (typ.) | |
| <i>Luminance</i> | At $I_L = 65mA/One\ circuit$ 1,500cd/m ² (typ.) | ☆ |
| <i>Signal system</i> | eDP 2lanes, 2.7Gbps [8-bit digital signals for data of RGB colors, Dot clock (CLK), Data enable (DE)] | |
| <i>Power supply voltage</i> | LCD panel signal processing board: 3.3V | |
| <i>Backlight</i> | LED backlight | |
| <i>Power consumption</i> | At $I_L = 65mA/One\ circuit$, Checkered flag pattern 23.3W (typ.) | ☆ |

3. BLOCK DIAGRAM

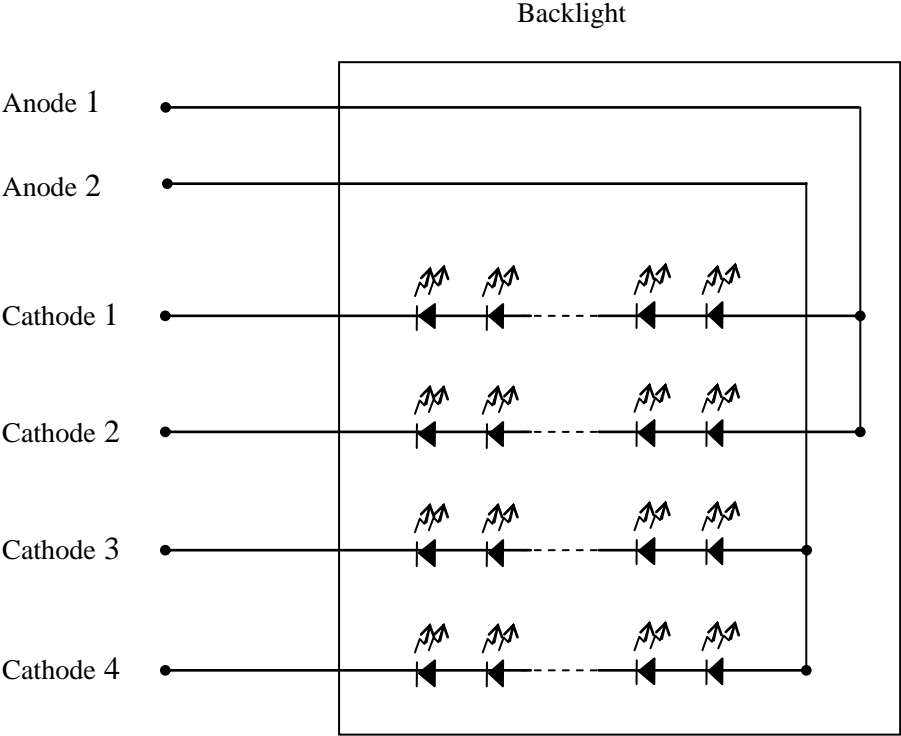


Note1: Relations between H_GND (High Speed Ground), GND (Signal ground) and FG (Frame ground) in the LCD module are as follows.

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

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

Note3: Backlight in detail



This figure is a common view of both upper and lower.

4. DETAILED SPECIFICATIONS

4.1 MECHANICAL SPECIFICATIONS

| Parameter | Specification | Unit |
|--------------|--|------|
| Module size | 363.8 ± 0.5 (W) × 215.9 ± 0.5 (H) × 15.7 ± 0.5 (D) Note1 | mm |
| Display area | 344.16 (H) × 193.59 (V) Note1 | mm |
| Weight | 1,050 (typ.), 1,150 (max.) | g |

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Note1: See "8. OUTLINE DRAWINGS".

4.2 ABSOLUTE MAXIMUM RATINGS

| Parameter | | Symbol | Rating | Unit | Remarks |
|----------------------------|-----------------------------------|--------|---------------|------------------|------------------------------|
| Power supply voltage | LCD panel signal processing board | VCC | -0.3 to +4.0 | V | Ta= 25°C |
| Input voltage for signals | Display signals | VD | -0.3 to +4.0 | V | |
| Backlight | Forward current | IL | 75 | mA | per one circuit Ta = 25°C |
| Storage temperature | | Tst | -40 to +85 | °C | - |
| Operating temperature | Front surface | TopF | -30 to +85 | °C | Note1 |
| | Rear surface | TopR | -30 to +85 | °C | Note2 |
| Relative humidity Note3 | | RH | ≤ 95 | % | Ta ≤ 40°C |
| | | | ≤ 85 | % | 40°C < Ta ≤ 50°C |
| | | | ≤ 55 | % | 50°C < Ta ≤ 60°C |
| | | | ≤ 36 | % | 60°C < Ta ≤ 70°C |
| | | | ≤ 24 | % | 70°C < Ta ≤ 80°C |
| | | | ≤ 20 | % | 80°C < Ta ≤ 85°C |
| Absolute humidity Note3 | | AH | ≤ 70 Note4 | g/m ³ | Ta= 85°C |

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Note1: Measured at LCD panel surface (including self-heat)

Note2: Measured at LCD module's rear shield surface (including self-heat)

Note3: No condensation

Note4: Water amount at Ta= 85°C and RH= 20%

4.3 ELECTRICAL CHARACTERISTICS

4.3.1 LCD panel signal processing board

(Ta= 25°C)

| Parameter | Symbol | min. | typ. | max. | Unit | Remarks |
|----------------------------|--------|------|--------------|----------------|-------|-----------------------------------|
| Power supply voltage | VCC | 3.0 | 3.3 | 3.6 | V | - |
| Power supply current | ICC | - | 580 Note1 | 1,000 Note2 | mA | at VCC= 3.3V |
| Permissible ripple voltage | VRPC | - | - | 100 | mVp-p | for VCC Note3, Note4, Note5 |

Note1: Checkered flag pattern [by IEC 61747-6]

Note2: Pattern for maximum current

Note3: This product works even if the ripple voltage levels are over the permissible values, but there might be noise on the display image.

Note4: The permissible ripple voltage includes spike noise.

Note5: The load variation influence does not include.

4.3.2 Backlight

(Ta= 25°C, Note1, Note2, Note3)

| Parameter | Symbol | min. | typ. | max. | Unit | Remarks |
|-----------------|--------|-------|-------|-------|------|--|
| Forward current | IL | - | 65 | 70 | mA | - |
| Forward Voltage | VL | 37.38 | 41.16 | 46.32 | V | Ta= +25°C at IL= 65mA /One circuit |
| | | 35.72 | - | - | | Ta= +85°C at IL= 65mA /One circuit |
| | | - | - | 48.90 | | Ta= -30°C at IL= 65mA /One circuit |
| | | - | - | 49.40 | | Ta= -30°C at IL= 70mA /One circuit |

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Note1: Please drive the backlight with constant current.

Note2: The above specifications are for one LED circuit of the backlight.

Note3: The luminance uniformity may be changed depending on the current variation between 4 circuits. It is recommended that the current value difference among the circuits be less than 5%.

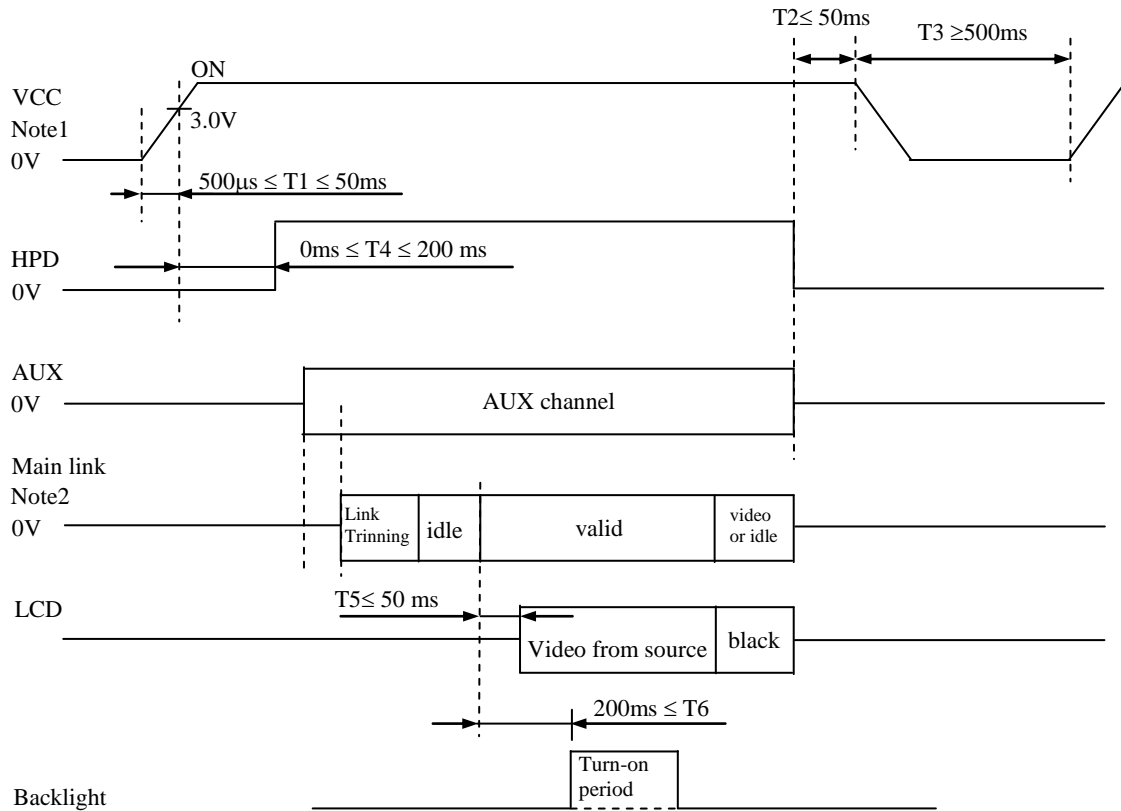
4.3.3 Fuse

| Parameter | Fuse | | Rating | Fusing current | Remarks |
|-----------|------------|-----------------------------|--------|------------------|---------|
| | Type | Supplier | | | |
| VCC | FCC16152AB | KAMAYA ELECTRIC CO., LTD | 1.5A | 3.0A 5seconds | Note1 |
| | | | 36V | | |

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

4.4 POWER SUPPLY VOLTAGE SEQUENCE



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

Note2: Display signals (Lane0_P/N, Lane1_P/N) must be set to Low or High-impedance, except the VCC ON period (See above sequence diagram), in order to avoid the circuitry damage.

4.5 CONNECTIONS AND FUNCTIONS FOR INTERFACE PINS

4.5.1 LCD panel signal processing board

CN1 socket (LCD module side): 20455-040E (IPEX)
 Adaptable plug: 20453-240T-11 (IPEX, Plug Set)
 20454-240T (IPEX, HOUSING) or equivalent

| Pin | Signal Name | Description | Remarks |
|-----|-------------|--|---------|
| 1 | N.C. | Keep this pin Open. | - |
| 2 | N.C. | | |
| 3 | N.C. | | |
| 4 | N.C. | | |
| 5 | N.C. | | |
| 6 | N.C. | | |
| 7 | N.C. | | |
| 8 | H_GND | High Speed Ground | Note1 |
| 9 | Lane1_N | Complement Signal Link Lane 1 | - |
| 10 | Lane1_P | True Signal Link Lane 1 | - |
| 11 | H_GND | High Speed Ground | Note1 |
| 12 | Lane0_N | Complement Signal Link Lane 0 | - |
| 13 | Lane0_P | True Signal Link Lane 0 | - |
| 14 | H_GND | High Speed Ground | Note1 |
| 15 | AUX_CH_P | True Signal Auxiliary Channel | - |
| 16 | AUX_CH_N | Complement Signal Auxiliary Channel | - |
| 17 | H_GND | High Speed Ground | Note1 |
| 18 | VCC | Power supply for LCD panel signal processing board | Note1 |
| 19 | VCC | | |
| 20 | VCC | | |
| 21 | VCC | | |
| 22 | RSVD | Keep this pin Open. | - |
| 23 | GND | Ground | Note1 |
| 24 | GND | | |
| 25 | GND | | |
| 26 | GND | | |
| 27 | HPD | HPD Signal Pin | - |
| 28 | N.C. | Keep this pin Open. | - |
| 29 | N.C. | | |
| 30 | N.C. | | |
| 31 | N.C. | | |
| 32 | N.C. | | |
| 33 | N.C. | | |
| 34 | N.C. | | |
| 35 | N.C. | | |
| 36 | N.C. | | |
| 37 | N.C. | | |
| 38 | N.C. | | |
| 39 | N.C. | | |
| 40 | N.C. | | |

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

4.5.2 Backlight

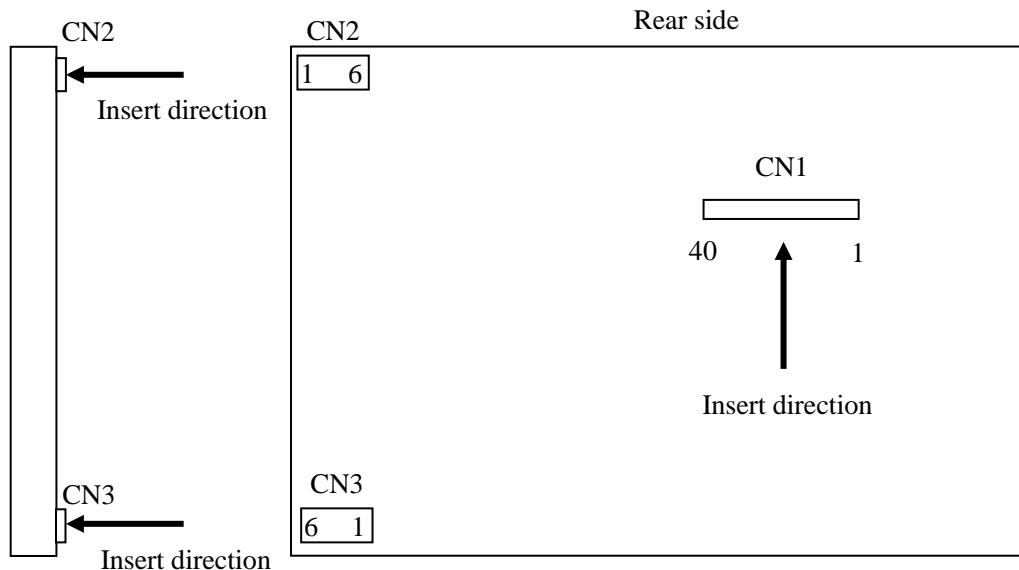
CN2 socket (LCD module side): BM06B-SHJS-TB (HF) (J.S.T. Mfg. Co., Ltd.)
 Adaptable plug: SHJP-06V-S (HF) (J.S.T. Mfg. Co., Ltd.)

| Pin No. | Symbol | Signal | Remarks |
|---------|--------|-----------|---------|
| 1 | A1 | Anode 1 | - |
| 2 | A2 | Anode 2 | - |
| 3 | K1 | Cathode 1 | - |
| 4 | K2 | Cathode 2 | - |
| 5 | K3 | Cathode 3 | - |
| 6 | K4 | Cathode 4 | - |

CN3 socket (LCD module side): BM06B-SHJS-TB (HF) (J.S.T. Mfg. Co., Ltd.)
 Adaptable plug: SHJP-06V-S (HF) (J.S.T. Mfg. Co., Ltd.)

| Pin No. | Symbol | Signal | Remarks |
|---------|--------|-----------|---------|
| 1 | K4 | Cathode 4 | - |
| 2 | K3 | Cathode 3 | - |
| 3 | K2 | Cathode 2 | - |
| 4 | K1 | Cathode 1 | - |
| 5 | A2 | Anode 2 | - |
| 6 | A1 | Anode 1 | - |

4.5.3 Positions of socket

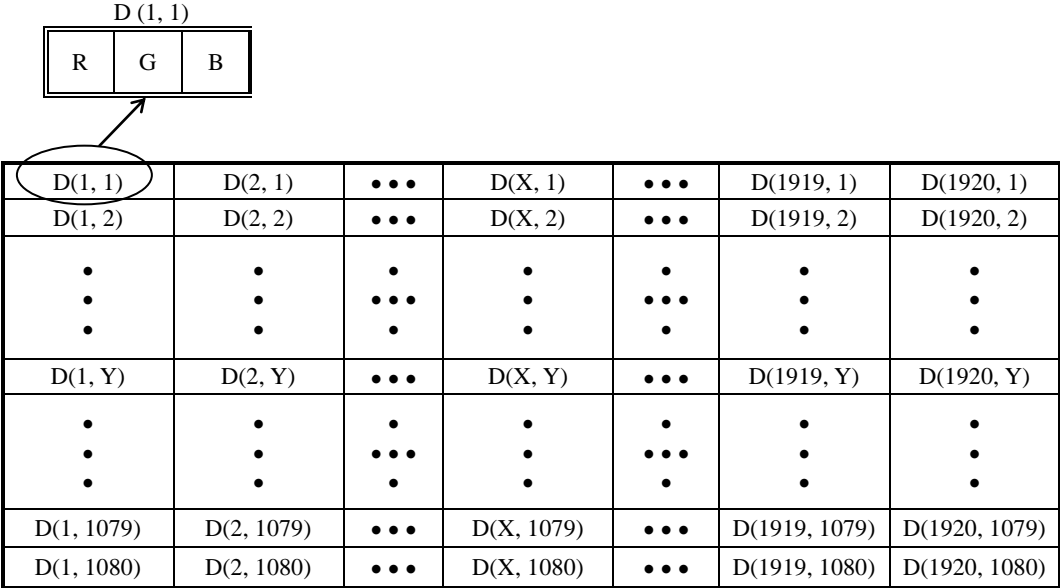


4.6 DISPLAY COLORS AND INPUT DATA SIGNALS

This product can display equivalent of 16,777,216 colors with 256 gray scales.
 Also the relation between display colors and input data signals is as follows.

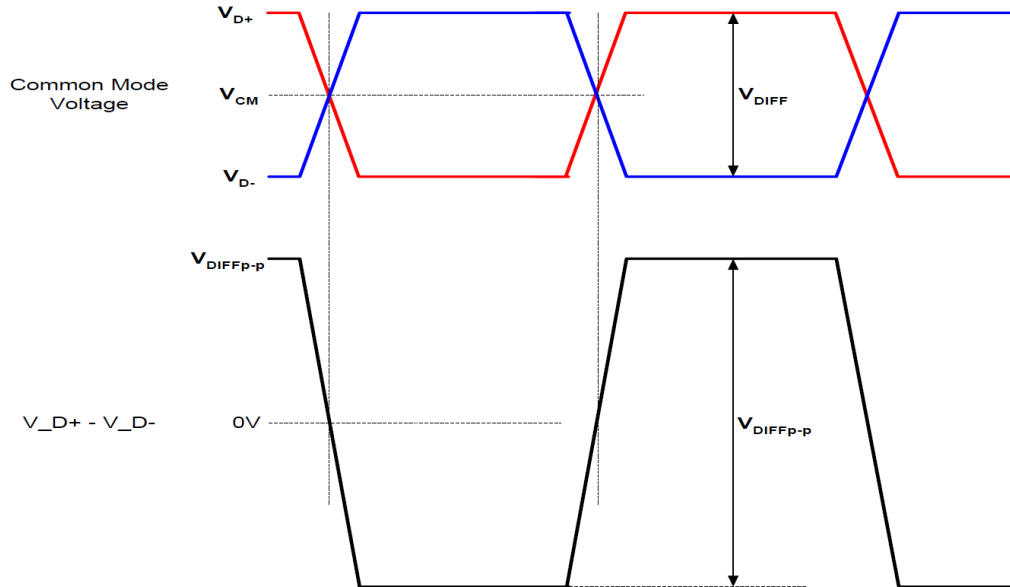
| Display colors | | Input color data | | | | | | | | | | | | | | | | | | | | | | | |
|------------------|---------|------------------|----|----|----|----|----|----|----|-------|----|----|----|----|----|----|----|------|----|----|----|----|----|----|----|
| | | Red | | | | | | | | Green | | | | | | | | Blue | | | | | | | |
| | | R7 | R6 | R5 | R4 | R3 | R2 | R1 | R0 | G7 | G6 | G5 | G4 | G3 | G2 | G1 | G0 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
| Basic Colors | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Red | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Magenta | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Green | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Cyan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Yellow | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | White | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Red gray scale | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | dark | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ↑ | | | | : | : | | | | | | : | : | | | | | | : | : | | | | | |
| | ↓ | | | | : | : | | | | | | : | : | | | | | | : | : | | | | | |
| | bright | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Red | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Green gray scale | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ↑ | | | | : | : | | | | | | : | : | | | | | | : | : | | | | | |
| | ↓ | | | | : | : | | | | | | : | : | | | | | | : | : | | | | | |
| | bright | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Green | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Blue gray scale | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | ↑ | | | | : | : | | | | | | : | : | | | | | | : | : | | | | | |
| | ↓ | | | | : | : | | | | | | : | : | | | | | | : | : | | | | | |
| | bright | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| 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 INPUT DATA SIGNALS AND DISPLAY POSITIONS



4.8 eDP SIGNAL TIMING SPECIFICATIONS

4.8.1 Display Port main link signal



| Parameter | Symbol | min. | typ. | max. | Unit | Remarks |
|---|----------|------|------|-------|------|---------|
| Differential peak-to-peak Input voltage | VDIFFp-p | 100 | - | 1,320 | mV | - |
| Rx input DC common Mode Voltage | VCM | - | 0 | - | V | - |
| Jitter tracking bandwidth | - | 10 | - | - | MHz | - |
| Link clock down spreading | - | - | 0.5 | - | % | - |

4.8.2 Display Port HPD signal

| Description | Symbol | min. | typ. | max. | Unit | Remarks |
|-----------------|--------|------|------|------|------|------------------|
| Hot Plug detect | HPD | 2.0 | - | 2.5 | V | I/O type: LVTTTL |

4.8.3 Display port AUX signal

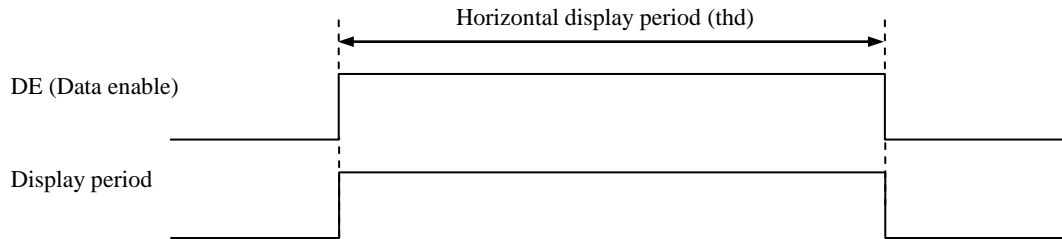
| Description | Symbol | min. | typ. | max. | Unit | Remarks |
|--|--------|------|------|------|----------|---------|
| AUX differential peak-to-peak voltage When driving | - | 0.4 | - | 1 | V | - |
| AUX differential peak-to-peak voltage When receiving | - | 0.25 | - | 1.36 | V | - |
| AUX common-mode voltage When transmitting | - | - | 0.15 | - | V | - |
| AUX common-mode voltage When receiving | - | - | GND | - | V | - |
| AUX differential termination resistance | - | 80 | 100 | 120 | Ω | - |
| Unit interval | - | 0.4 | 0.5 | 0.6 | μ s | - |
| Cycle-to-cycle jitter time | - | - | - | 0.04 | UI | - |

4.9 INPUT SIGNAL TIMINGS

4.9.1 Outline of input signal timings

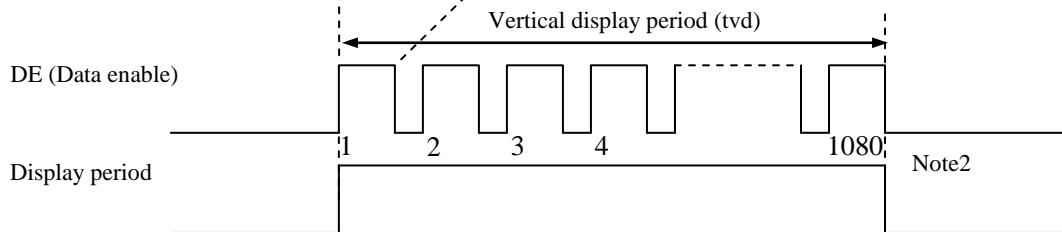
- Horizontal signal

Note1



- Vertical signal

Note1



Note2

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

Note2: See "4.9.3 Input signal timing chart" for the pulse number.

4.9.2 Timing characteristics

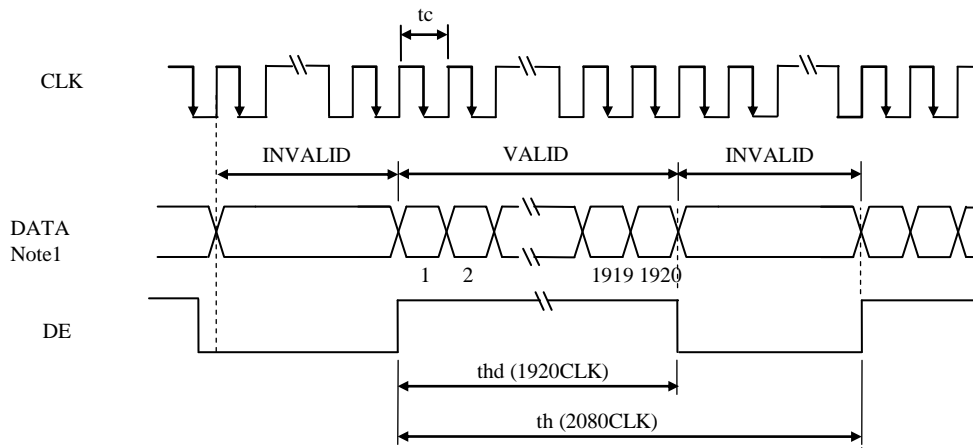
(Note1)

| Parameter | | Symbol | min. | typ. | max. | Unit | Remarks | |
|-----------|----------------------|----------------|-------|-------|-------|------|---------------|------------------|
| CLK | Frequency | 1/tc | 111.0 | 138.5 | 166.5 | MHz | 7.22ns (typ.) | |
| | Duty ratio | - | - | | | - | - | |
| | Rise time, Fall time | - | - | | | ns | - | |
| DE | Horizontal | Cycle | th | - | 15.02 | - | μ s | 66.59 kHz (typ.) |
| | | Display period | thd | 1,920 | | | CLK | |
| | Vertical (One frame) | Cycle | tv | - | 16.70 | - | ms | 59.88Hz (typ.) |
| | | Display period | tvd | 1,080 | | | H | |

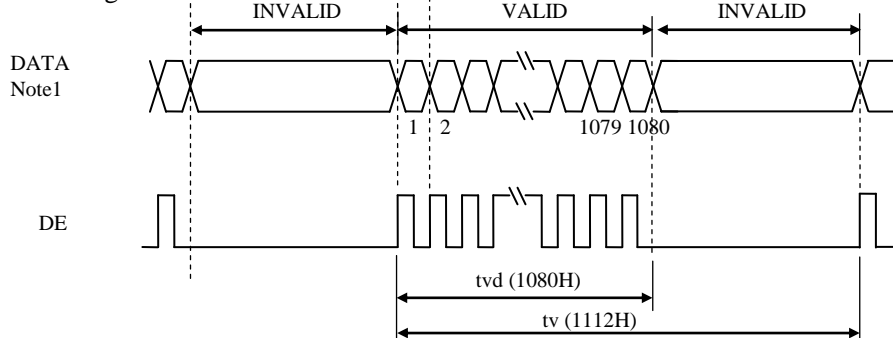
Note1: Definition of parameters is as follows.
 $t_c = 1CLK$, $t_h = 1H$

4.9.3 Input signal timing chart

Horizontal timing



Vertical timing



Note1: DATA=R0-R7, G0-G7, B0-B7

4.10 OPTICS

4.10.1 Optical characteristics

(Note1, Note2)

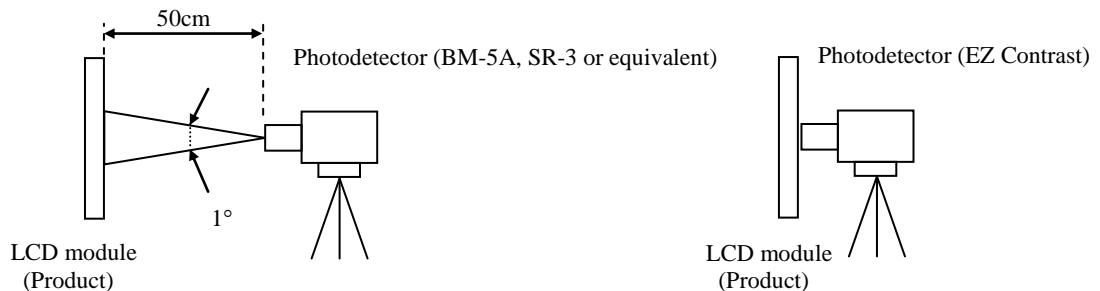
| Parameter | Condition | Symbol | min. | typ. | max. | Unit | Measuring instrument | Remarks | |
|----------------------|---|--|----------------|-------|-------|-------------------|----------------------|--------------------|-------|
| Luminance | White at center $\theta R=0^\circ, \theta L=0^\circ, \theta U=0^\circ, \theta D=0^\circ$ | L | 1,200 | 1,500 | - | cd/m ² | BM-5A or equivalent | - | |
| Contrast ratio | White/Black at center $\theta R=0^\circ, \theta L=0^\circ, \theta U=0^\circ, \theta D=0^\circ$ | CR | 500 | 750 | - | - | BM-5A or equivalent | Note3 ☆ | |
| Luminance uniformity | White $\theta R=0^\circ, \theta L=0^\circ, \theta U=0^\circ, \theta D=0^\circ$ | LU | - | 1.25 | 1.4 | - | BM-5A or equivalent | Note4 | |
| Chromaticity | White | x coordinate | W _x | 0.263 | 0.313 | 0.363 | - | SR-3 or equivalent | Note5 |
| | | y coordinate | W _y | 0.279 | 0.329 | 0.379 | - | | |
| | Red | x coordinate | R _x | - | 0.565 | - | - | | |
| | | y coordinate | R _y | - | 0.345 | - | - | | |
| | Green | x coordinate | G _x | - | 0.340 | - | - | | |
| | | y coordinate | G _y | - | 0.530 | - | - | | |
| Blue | x coordinate | B _x | - | 0.150 | - | - | | | |
| | y coordinate | B _y | - | 0.105 | - | - | | | |
| Color gamut | $\theta R=0^\circ, \theta L=0^\circ, \theta U=0^\circ, \theta D=0^\circ$ at center, against NTSC color space | C | 35 | 40 | - | % | | ☆ | |
| Response time | Black to White | T _{on} | - | 15 | 20 | ms | BM-5A or equivalent | Note6 ☆ | |
| | White to Black | T _{off} | - | 15 | 20 | ms | | Note7 ☆ | |
| Viewing angle | Right | $\theta U=0^\circ, \theta D=0^\circ, CR \geq 10$ | θR | 70 | 88 | - | EZ Contrast | Note8 | |
| | Left | $\theta U=0^\circ, \theta D=0^\circ, CR \geq 10$ | θL | 70 | 88 | - | | | |
| | Up | $\theta R=0^\circ, \theta L=0^\circ, CR \geq 10$ | θU | 70 | 88 | - | | | |
| | Down | $\theta R=0^\circ, \theta L=0^\circ, CR \geq 10$ | θD | 70 | 88 | - | | | |

Note1: These are initial characteristics.

Note2: Measurement conditions are as follows.

T_a= 25°C, VCC= 3.3V, I_L= 65mA/One Circuit, Display mode: FHD,
Horizontal cycle= 1/66.59kHz, Vertical cycle= 1/59.88Hz

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



Note3: See "4.10.2 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= 40°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.

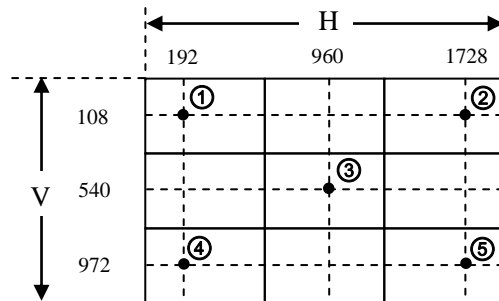
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance of white screen}}{\text{Luminance of black screen}}$$

4.10.3 Definition of luminance uniformity

The luminance uniformity is calculated by using following formula.

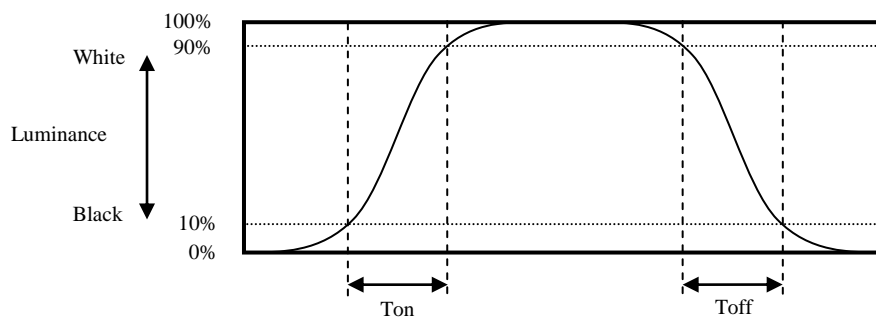
$$\text{Luminance uniformity (LU)} = \frac{\text{Maximum luminance from ① to ⑤}}{\text{Minimum luminance from ① to ⑤}}$$

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

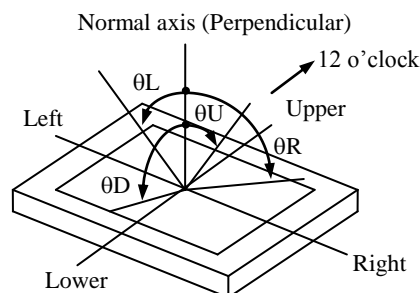


4.10.4 Definition of response times

Response time is measured at the time when the luminance changes from "black" to "white ", or "white" to "black " on the same screen point, by photo-detector. Ton is the time when the luminance changes from 10% up to 90%. Also Toff is the time when the luminance changes from 90% down to 10% (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 the product) Continuous operation, IL= 65mA/One circuit | 50,000 | h |
| | 85°C (Temperature of LCD panel surface and rear shield surface) Continuous operation, IL= 65mA/One circuit | 30,000 | |

☆

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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.

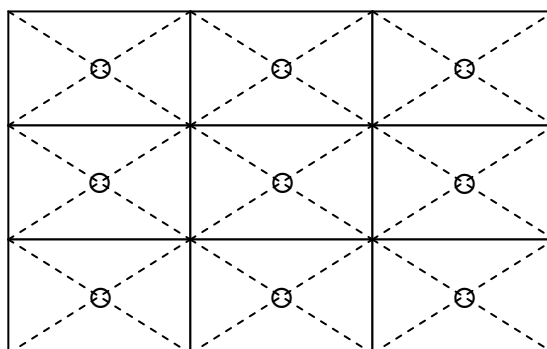
Note3: By ambient temperature, the lifetime changes particularly. Especially, in case the product works under high temperature environment, the lifetime becomes short.

6. RELIABILITY TESTS

| Test item | Condition | Judgment | Note1 |
|--|--|-------------------------|-------|
| High temperature and humidity (Operation) | ① +60 ± 2°C, RH= 90%, 240hours ② Display data is white. | No display malfunctions | |
| High temperature (Operation) | ① +85 ± 3°C, 240hours ② Display data is white. | | |
| Heat cycle (Operation) | ① -30 ± 3°C...1hour +85 ± 3°C...1hour ② 50cycles, 4 hours/cycle ③ Display data is white. | | |
| Thermal shock (Non operation) | ① -40 ± 3°C...30minutes +85 ± 3°C...30minutes ② 100cycles, 1hour/cycle ③ Temperature transition time is within 5 minutes. | | |
| ESD (Operation) | ① 150pF, 150Ω, ±10kV ② 9 places on a panel surface Note2 ③ 10 times each place at 1 sec interval | | |
| Dust (Operation) | ① Sample dust: No. 15 (by JIS-Z8901) ② 15 seconds stir ③ 8 times repeat at 1 hour interval | | |
| Vibration (Non operation) | ① 5 to 100Hz, 11.76m/s ² ② 1 minute/cycle ③ X, Y, Z directions ④ 50 times each direction | | |
| Mechanical shock (Non operation) | ① 294m/s ² , 11ms ② ±X, ±Y, ±Z directions ③ 3 times each direction | | |

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


Note2: See the following figure for discharge points.




7. PRECAUTIONS


7.1 MEANING OF CAUTION SIGNS

The following caution signs have very important meaning. **Be sure to read "10.2 CAUTIONS" and "10.3 ATTENTIONS"!**

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

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

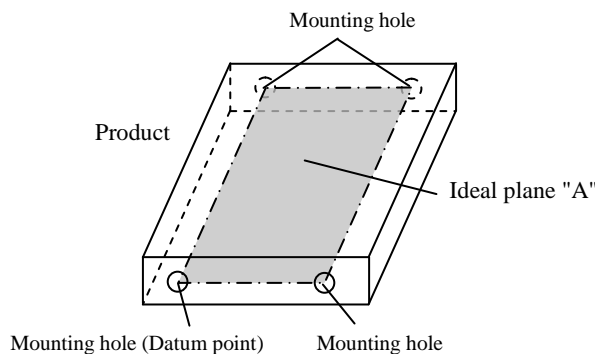
7.2 CAUTIONS

| | |
|---|---|
|  | <p>* Do not shock and press the LCD panel and the backlight! There is a danger of breaking, because they are made of glass. (Shock: Equal to or no greater than 294m/s² and equal to or no greater than 11ms, Pressure: Equal to or no greater than 19.6 N (φ16mm jig))</p> |
|---|---|

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 0.34N·m. Higher torque might result in distortion of the bezel. And the length of product mounting screws must be ≤ 2.8mm.
- ⑤ The product must be installed using mounting holes without undue stress such as bends or twist (See outline drawings). And do not add undue stress to any portion (such as bezel flat area). Bends or twist described above and undue stress to any portion may cause display mura.
Recommended installing method: Ideal plane "A" is defined by one mounting hole (datum point) and other mounting holes. The ideal plane "A" should be the same plane within ±0.3 mm.



- ⑥ Do not press or rub on the sensitive product surface. When cleaning the panel surface, wipe it with a soft dry cloth.
- ⑦ Do not push or pull the interface connectors while the product is working. 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.
- ⑧ Usually liquid crystals don't leak through the breakage of glasses because of the surface tension of thin layer and the construction of LCD panel. But, if you contact with liquid crystal by any chance, please wash it away with soap and water.

7.3.2 Environment

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

7.3.3 Characteristics

The following items are neither defects nor failures.

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

7.3.4 Others

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

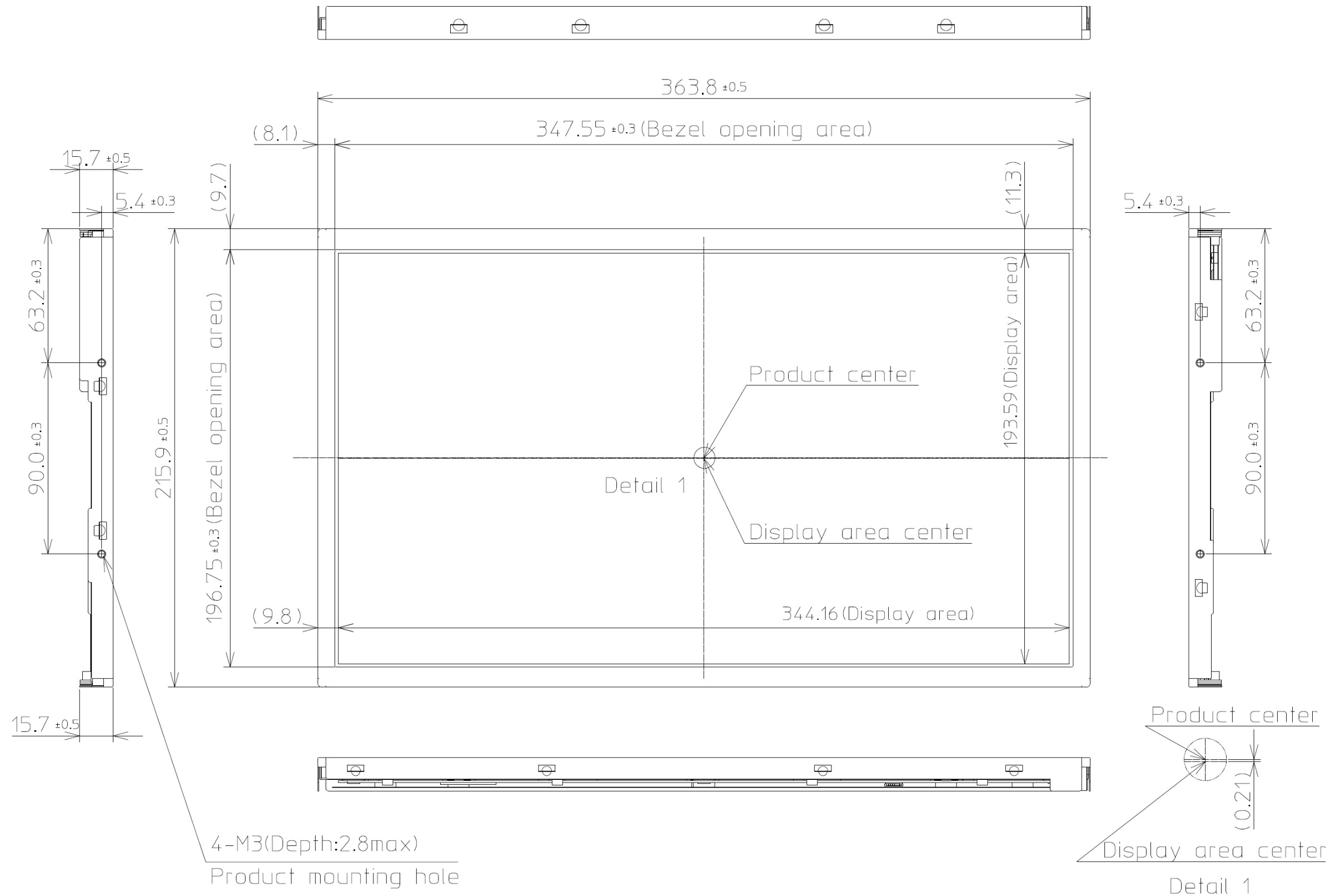
| China RoHS (II) directive six hazardous substances or elements | | | | | |
|---|--------------|--------------|-----------------------------|--------------------------------|---------------------------------------|
| Lead (Pb) | Mercury (Hg) | Cadmium (Cd) | Hexavalent Chromium (Cr VI) | Polybrominated 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 GB/T26572-2011 standard regulation.

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

8. OUTLINE DRAWINGS

8.1 FRONT VIEW

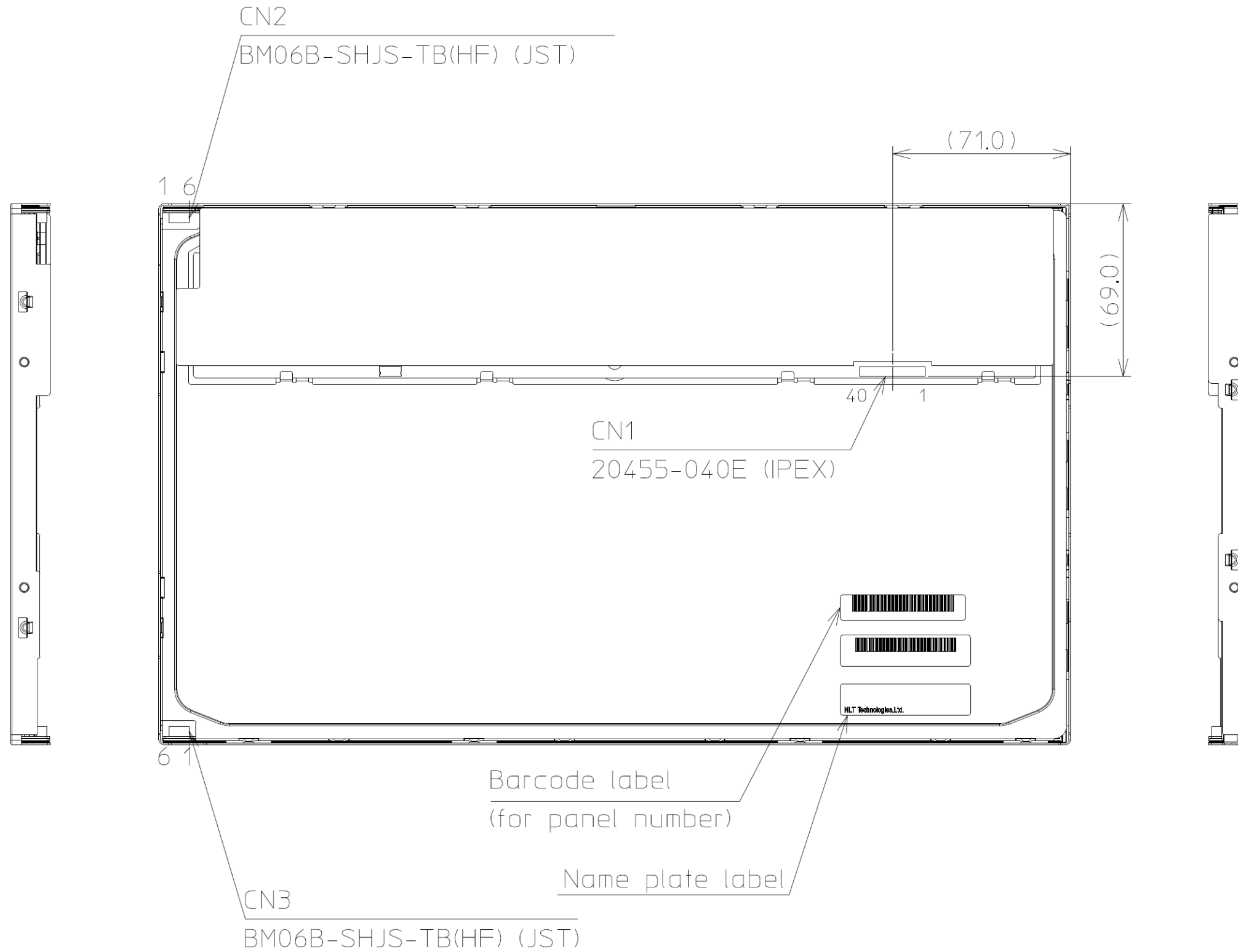


Note1: The values in parentheses are for reference.

Note2: The torque for product mounting screws must never exceed 0.34N·m. And the length of product mounting screws must be ≤ 2.8 mm.

Unit: mm

8.2 REAR VIEW



Note1: The values in parentheses are for reference.

Unit: mm

Our company network supports you worldwide with offices in Germany, Austria, Switzerland, the UK and the USA. For more information please contact:

Headquarters

Germany



FORTEC Elektronik AG
Lechwiesenstr. 9
86899 Landsberg am Lech

Phone: +49 8191 91172-0
E-Mail: sales@forteca.de
Internet: www.forteca.de

Fortec Group Members

Austria



FORTEC Elektronik AG
Office Vienna

Nuschinggasse 12
1230 Wien

Phone: +43 1 8673492-0
E-Mail: office@fortec.at
Internet: www.fortec.at

Germany



Distec GmbH

Augsburger Str. 2b
82110 Germering

Phone: +49 89 894363-0
E-Mail: info@distec.de
Internet: www.distec.de

Switzerland



ALTRAC AG

Bahnhofstraße 3
5436 Würenlos

Phone: +41 44 7446111
E-Mail: info@altrac.ch
Internet: www.altrac.ch

United Kingdom



Display Technology Ltd.

Osprey House, 1 Osprey Court
Hichingbrooke Business Park
Huntingdon, Cambridgeshire, PE29 6FN

Phone: +44 1480 411600
E-Mail: info@displaytechnology.co.uk
Internet: www.displaytechnology.co.uk

USA



Apollo Display Technologies, Corp.

87 Raynor Avenue,
Unit 1 Ronkonkoma,
NY 11779

Phone: +1 631 5804360
E-Mail: info@apolloDisplays.com
Internet: www.apolloDisplays.com