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PRELIMINARY DATA SHEET

NEC

# TFT COLOR LCD MODULE

# NL128102AC31-02

## 51 cm (20.1 inches), 1280 1024 pixels, 8bit/color, Incorporated backlight and Inverter Ultra wide viewing angle

### DESCRIPTION

NL128102AC31-02 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.
NL128102AC31-02 has a built-in backlight with the inverter.

The 51cm (20.1 Inches) diagonal display area contains 1280 x 1024 pixel and can display 16,777,216 colors simultaneously.

### FEATURES

- Ultra-wide viewing angle
- High luminance (200 cd/m2 typ.)
- Low reflection and wide color gamut
- LVDS interface (THC63LVDF84A x 2 chips, THine Electronics, Inc.)
  8bit per color
- Incorporated direct type backlight (12 CCFLs with inverter)

### APPLICATIONS

- Engineering work station, desk-top type of PC
- Display terminals for control system
- Monitors for process controller



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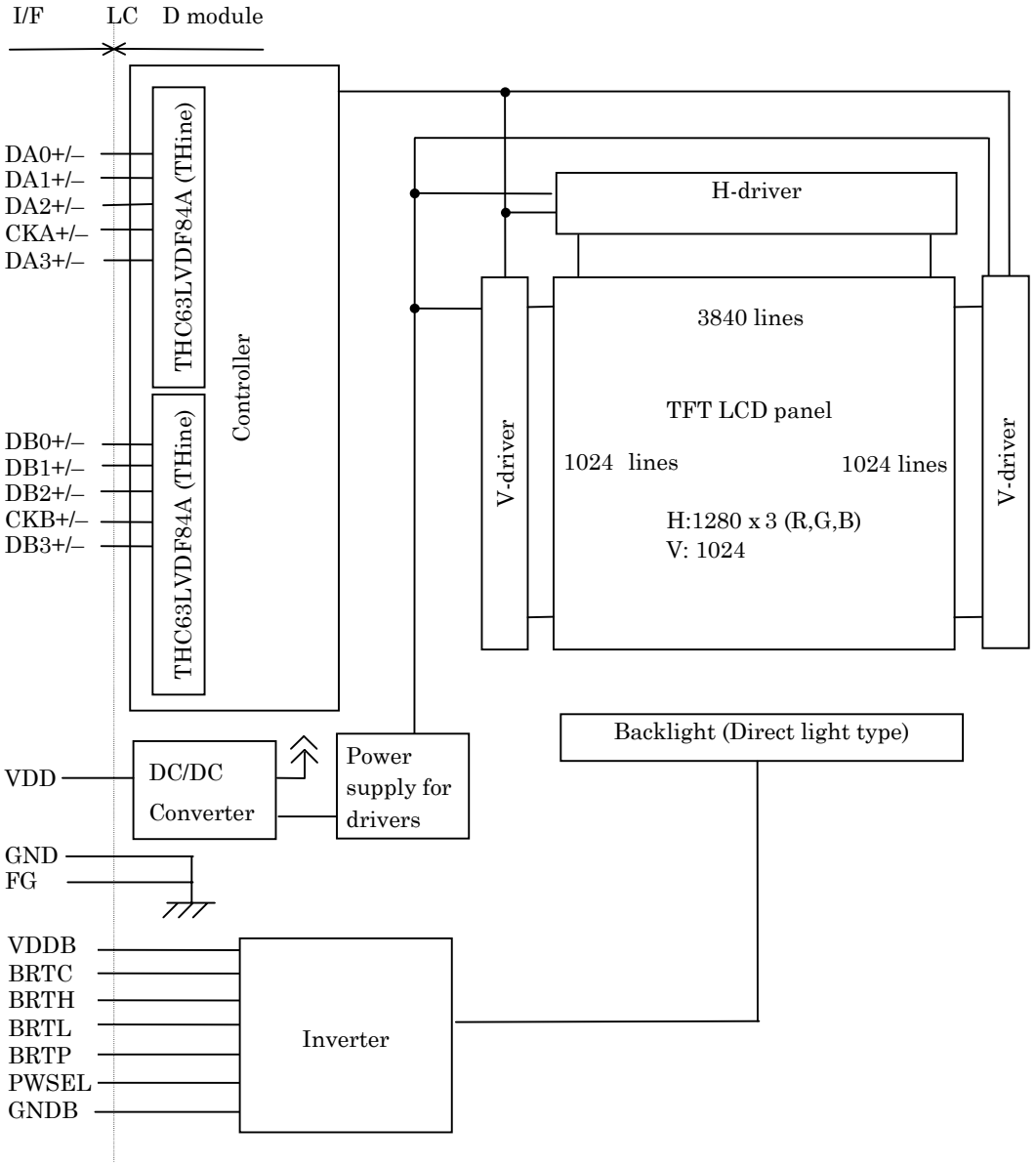
## STRUCTURE AND FUNCTIONS

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




**Remark** GND (Signal Ground) is connected to FG (Frame Ground) in the LCD module. Neither GND nor FG is connected to GNDB (Backlight Ground). GND, FG and GNDB should be connected in the system ground.

**OUTLINE OF CHARACTERISTICS (at room temperature)**

| | |
|---|---|
| Display area | 399.36 (H) x 319.49 (V) |
| Drive system | a-Si TFT active matrix |
| Display colors | 16,777,216 colors |
| Number of pixels | 1280 x 1024 pixels |
| Pixel arrangement | RGB vertical stripe |
| Pixel pitch | 0.312 (H) 0.312 (V) mm |
| Module size | 470.0 (H) x 382.0 (V) x 42.5 (D) mm |
| Weight | 2320 g (typ.) |
| Contrast ratio | 250 : 1 (typ.) |
| Viewing angle (more than the contrast ratio of 10 : 1) | |
| | • Horizontal : 85° (typ., left side, right side) |
| | • Vertical : 85° (typ., up side, down side) |
| Designed viewing direction | • Optimum grayscale (r = 2.2): perpendicular |
| Polarizer pencil-hardness | 3H (min., at JIS K5400) |
| Color gamut | 60 % (typ., at center, to NTSC) |
| Response time | 45 ms (typ.), "black" to "white" |
| Luminance | 200 cd/$m^2$ (typ.) |
| Signal system | RGB 8-bit signals, Synchronous signals (Hsync, Vsync), Dot clock (CLK), DE<br>LVDS interface (THC63LVDF84A, THine Electronics, Inc.) |
| Supply voltage | 12 V (Logic, LCD driving), 12 V (Backlight) |
| Backlight | Direct light type: 12 CCFLs with inverter<br>[Replaceable parts]<br>• Lamp holder type No.: 201LHS02<br>• Inverter type No.: 201PW021 |
| Power consumption | 46.6 W (typ.) |

## GENERAL SPECIFICATIONS

| Item | Specification | Unit |
|---|---|---|
| Module size | 470.0 ± 1.0 (H) 382 ± 1.0 (V) 42.5 max. (D) | mm |
| Display area | 399.36 (H) x 319.49 (V), Diagonal 51cm (20.1 inchies) | mm |
| Number of pixels | 1280 (H) 1024 (V) | pixel |
| Dot pitch | 0.104 (H) 0.312 (V) | mm |
| Pixel pitch | 0.312 (H) 0.312 (V) | mm |
| Pixel arrangement | RGB (Red, Green, Blue) vertical stripe | – |
| Display colors | 16,777,216 (8bit per color) | color |
| Weight | 2430 (max.) | g |

## ABSOLUTE MAXIMUM RATINGS

| Parameter | Symbol | Rating | Unit | Remarks |
|---|---|---|---|---|
| Supply voltage | $V_{DD}$ | –0.3 to +14.0 | V | $T_a$ = 25°C |
| | $V_{DD}B$ | –0.3 to +14.0 | V | |
| Logic input voltage (LCD) | Vi | - 0.3 to + 3.6 | V | $V_{DD}$=12V, $T_a$ = 25°C |
| Logic input voltage (backlight-BRTC signal) | ViBL1 | –0.3 to +5.5 | V | $V_{DD}B$=12V, $T_a$ = 25°C |
| Logic input voltage (backlight-BRTL signal) | ViBL2 | –0.3 to +1.5 | V | |
| Storage temp. | $T_{ST}$ | –20 to +60 | °C | - |
| Operating temp. | $T_{OP}$ | 0 to +55 | °C | Module surface |
| Humidity (No condensation) | – | 95% relative humidity | – | $T_a$ 40°C |
| | – | 85% relative humidity | – | 40 < $T_a$ 50°C |
| | – | 70% rel | – | 50 < T 55°C |
| | – | Absolute humidity shall not exceed $T_a$ = 55°C, 70% relative humidity level. | – | $T_a$ > 55°C |

Note: The temperature is measured at the surface of display.

## ELECTRICAL CHARACTERISTICS

### (1) Logic, LCD driving

$T_a$ = 25°C

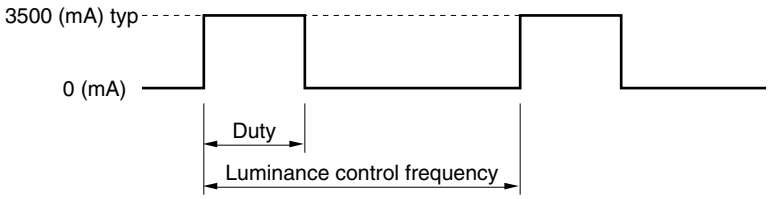
| Parameter | Symbol | MIN. | TYP. | MAX. | Unit | Remarks |
|---|---|---|---|---|---|---|
| Supply voltage | $V_{DD}$ | 11.4 | 12.0 | 12.6 | V | – |
| Ripple voltage | $V_{rp}$ | – | – | 100 | mV | for $V_{DD}$ |
| LVDS signal input "L" voltage | $V_{IL}$ | –100 | – | – | mV | VCM = 1.2 V<br>VCM: Common mode voltage in LVDS driver |
| LVDS signal input "H" voltage | $V_{IH}$ | – | – | +100 | mV | |
| Input voltage | $V_i$ | 0 | – | 2.4 | V | – |
| Terminating resistor | $R_t$ | – | 100 | – | | – |
| Supply current | $I_{DD}$ | – | 380 **Note** | 1000 | mA | $V_{DD}$ = 12.0V |

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

### (2) Backlight

$T_a$ = 25°C

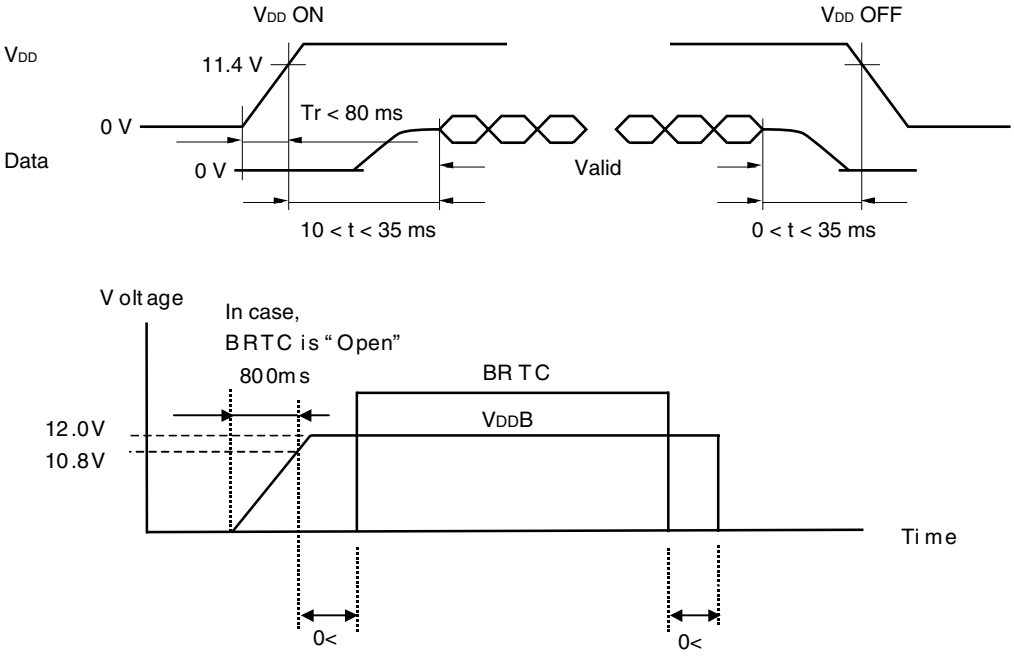
| Parameter | Symbol | MIN. | TYP. | MAX. | Unit | Remarks |
|---|---|---|---|---|---|---|
| Supply voltage | $V_{DD}B$ | 10.8 | 12.0 | 13.2 | V | – |
| Logic input "L" current | IiBL1 | -1.6 | – | – | mA | for BRTC |
| Logic input "H" current | IiBL1 | – | – | 3.5 | mA | |
| Logic input "L" current | IiBL2 | -610 | – | – | A | for BRTC, PWSEL |
| Logic input "H" current | IiBL2 | – | – | 440 | A | |
| Supply current | $I_{DD}B$ | – | 3500 | 4200 | mA | $V_{DD}B$ = 12 V (at max. luminance) |




Maximum luminance control: 100 %
Minimum luminance control: 20 %
Luminance control frequency: 243 to 297 Hz, 270 Hz (typ.)

Note: The power supply line ($V_{DD}B$ and GNDB) has a large ripple noise while dimming. Certain consideration should be taken to reduce the noise.

**SUPPLY VOLTAGE SEQUENCE**




**Notes 1.** Data: pixel data and Pixel clock.

**2.** The supply voltage for input signals should be the same as $V_{DD}$.

**3.** 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. However, 12 V for backlight should be started up within 800ms, otherwise, the protection circuit makes the backlight turns off.

**4.** The backlight on/off signal (BRTC) should be controlled while logic signals are supplied.

**5.** Do not input "H" for PWSE, when $V_{DD}B$ is 0V or BRTC is "L".

**6.** When the power is off, please keep whole signals low level or high impedance.

## INTERFACE PIN CONNECTION

(1) Interface connector for signal and power

Part No. : 53780-2010
Adaptable socket: 51146-2000
Supplier : Molex Incorporated

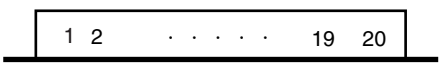
CN1

| Pin No. | Symbol | Signal type | Function |
|---|---|---|---|
| 1 | NC | Non-connection | Keep the termainal open |
| 2 | NC | | |
| 3 | GND | Ground | Connect to system ground |
| 4 | GND | | |
| 5 | DA0- | Odd pixlel data input 0 | Odd pixel data input 0 (LVDS level) |
| 6 | DA0+ | | |
| 7 | GND | Ground | Connect to system ground |
| 8 | DA1- | Odd pixlel data input 1 | Odd pixel data input 1 (LVDS level) |
| 9 | DA1+ | | |
| 10 | GND | Ground | Connect to system ground |
| 11 | DA2- | Odd pixlel data input 2 | Odd pixel data input 2 (LVDS level) |
| 12 | DA2+ | | |
| 13 | GND | Ground | Connect to system ground |
| 14 | CKA- | Odd pixlel clock input | Odd pixel clock input (LVDS level) |
| 15 | CKA+ | | |
| 16 | GND | Ground | Connect to system ground |
| 17 | DA3- | Odd pixlel data input 3 | Odd pixel data input 3 (LVDS level) |
| 18 | DA3+ | | |
| 19 | GND | Ground | Connect to system ground |
| 20 | NC | Non-connection | Keep the termainal open |

**Notes 1.** Signal ground for logic and LCD driving. GND should be connected to system ground. Neither GND nor GNDB is connected to frame.

**2.** Connect all pins and GND terminal. Cable use 100 twist pair.
Connect all pins (except 1, 2, 20) to avoid noise issue.
Use 100 twist pair wires for the cable.

CN1: Figure from socket view



Part No. : 53780-3010
Adaptable socket : 51146-3000
Supplier : Molex Incorporated.

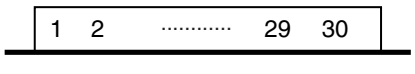
CN2

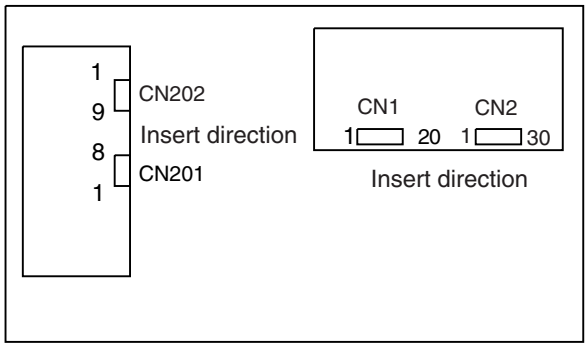
| Pin No. | Symbols | Signal type | Function |
|---|---|---|---|
| 1 | N.C. | Non-connection | Keep the terminal open |
| 2 | N.C. | | |
| 3 | GND | Ground | Connect to system ground |
| 4 | GND | | |
| 5 | DB0- | Even Pixel Data0 | Even pixel data input 0 (LVDS level) |
| 6 | DB0+ | | |
| 7 | GND | Ground | Connect to system ground |
| 8 | DB1- | Even Pixel Data1 | Even pixel data input 1 (LVDS level) |
| 9 | DB1+ | | |
| 10 | GND | Ground | Connect to system ground |
| 11 | DB2- | Even Pixel Data2 | Even pixel data input 2 (LVDS level) |
| 12 | DB2+ | | |
| 13 | GND | Ground | Connect to system ground |
| 14 | CKB- | Even Pixel Clock | Even pixel clock input (LVDS level) |
| 15 | CKB+ | | |
| 16 | GND | Ground | Connect to system ground |
| 17 | DB3- | Even Pixel Data3 | Even pixel data input 3 (LVDS level) |
| 18 | DB3+ | | |
| 19 | GND | Ground | Connect to system ground |
| 20 | Res. | Reserved | Keep the terminal open |
| 21 | Res. | | |
| 22 | Res. | | |
| 23 | Res. | | |
| 24 | GND | Ground | Connect to system ground |
| 25 | GND | | |
| 26 | GND | | |
| 27 | N.C. | Non-connection | Keep the terminal open |
| 28 | $V_{DD}$ | +12V Power Supply | 12V±5% |
| 29 | $V_{DD}$ | | |
| 30 | $V_{DD}$ | | |

Note 1: GND is signal ground for logic and LCD driving. GND is connected to FG (Frame Ground) in the LCD module. Neither GND nor FG is connected to GNDB (Backlight Ground).
GND, FG and GNDB should be connected to the system ground.

Remark: Connect all pins except 1, 2 and 27 to avoid noise issues. Use 100 ohm twist pair wires for the cable.

CN2: Figure from stock view

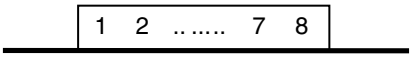


(2) Connector for backlight unit

Part No. : DF3-8P-2H
Adaptable socket: DF3-8S-2C
Supplier : HIROSE Electric Co., Ltd.

CN201: Figure from socket view




CN201

| Pin No. | Symbols | Signal type | Function |
|---|---|---|---|
| 1 | GNDB | Ground for backlight | Note 1 |
| 2 | GNDB | | |
| 3 | GNDB | | |
| 4 | GNDB | | |
| 5 | $V_{DD}$B | 12V power supply | +12V+/-10% |
| 6 | $V_{DD}$B | | |
| 7 | $V_{DD}$B | | |
| 8 | $V_{DD}$B | | |

**Note 1.** GNDB is not connected to GND or the frame.

Part No. ;IL-Z-9PL1-SMTY
Adaptable socket : IL-Z-9S-S125C3
Supplier : Japan Aviation Electronics Industry Limited (JAE)

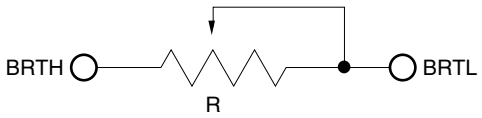
CN202: Figure from socket view


CN202

| Pin No. | Symbols | Signal type | Function |
|---|---|---|---|
| 1 | GNDB | Ground for backlight | Note 1 |
| 2 | GNDB | | |
| 3 | N.C. | Non-connection | Keep the terminal open |
| 4 | BRTC | Backlight ON/OFF control signal | "H" or "Open" Backlight on<br>"L" Backlight off |
| 5 | BRTH | Luminance control signal | Note 2 |
| 6 | BRTL | Luminance control signal | |
| 7 | BRTP | Luminance control signal | Note 2 |
| 8 | GNDB | Ground for backlight | Note 1 |
| 9 | PWSEL | Luminance control select signal | Note 2 |

**Note 1.** GNDB is not connected to GND or the frame.
**2**. There are three ways of controlling luminance.

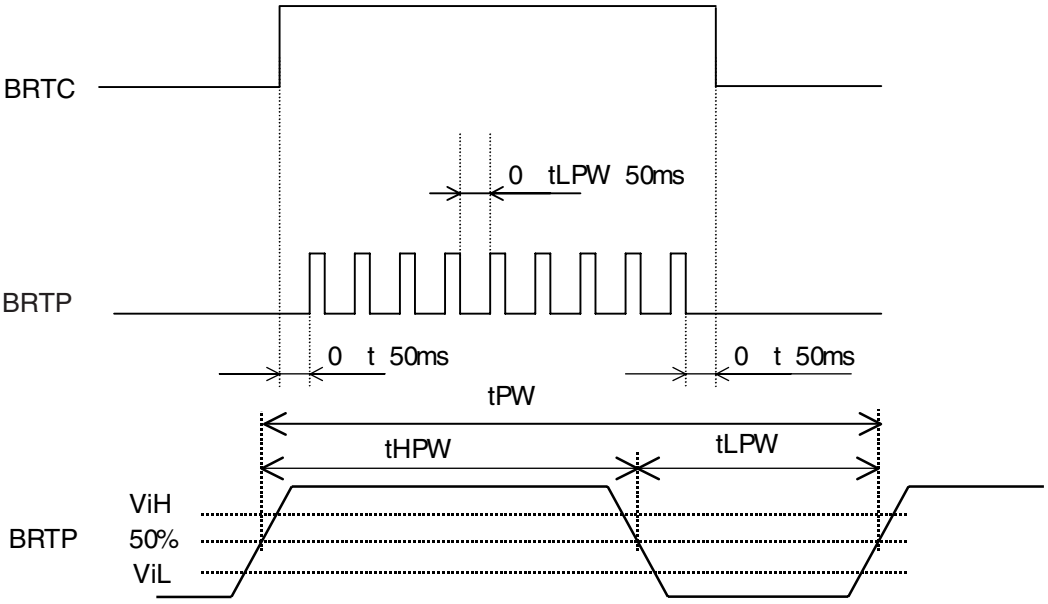
1) A way of luminance control by a variable resistor (PWSEL="H" or "Open", BRTP="Open")
The variable resistor for luminance control should be 10 k type, and zero point of the resistor corresponds to the minimum of luminance.




Mating variable resistor : 10 K ±5 %, B curve
Maximum luminance (100 %): R = 10 K
Minimum luminance (30 %) : R = 0

2) A way of luminance control by voltage (PWSEL="H" or "Open", BRTP="Open")
BRTH should be fixed to 0 V to control luminance by voltage. The range of input voltage between BRTL and GNDB is as follows.
Maximum luminance (100%): 1 V (typ.)
Minimum luminance (30%) : 0 V

3) A way of luminance control by PWM
Outside control is valid, when PWSEL="L" and input signal for BRTP. Luminance can be controlled by the duty value of input signal for BRTP.
Duty=100%: luminance is maximum.
Duty=20%: luminance is minimum.




| Parameters | Symbols | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|---|
| Frequency | 1/tPW | 185 | - | 325 | Hz | - |
| "L" period | tLPW | - | - | 50 | ms | - |
| Pulse-width | tHPW/tPW | 20 | - | 100 | % | at Max. luminance (100%) |
| Input voltage | ViL | 0 | - | 0.8 | V | - |
| | ViH | 2.0 | - | 5.25 | V | - |

Regarding set up for frequency, refer to the below method.
Set up frequency = Vsync frequency x (n+0.25) or (n+0.75)
Adopt the frequency evaluating the display quality, because the display will be disturbed depend on frequency.

(3) Display position of input data

| | | | | | | |
|---|---|---|---|---|---|---|
| D (0, 0) | D (1, 0) | --- | D (X, 0) | --- | D (1022, 0) | D (1023, 0) |
| D (0, 1) | D (1, 1) | --- | D (X, 1) | --- | D (1022, 1) | D (1023, 1) |
| ¦ | ¦ | -¦- | ¦ | -¦- | ¦ | ¦ |
| D (0, Y) | D (1, Y) | --- | D (X, Y) | --- | D (1022, Y) | D (1023, Y) |
| ¦ | ¦ | -¦- | ¦ | -¦- | ¦ | ¦ |
| D (0, 766) | D (1, 766) | --- | D (X, 766) | --- | D (1022, 766) | D (1023, 766) |
| D (0, 767) | D (1, 767) | --- | D (X, 767) | --- | D (1022, 767) | D (1023, 767) |

## METHOD OF CONNECTION FOR THC63LVDF63A

System side ◄——► LCD module side

| | | | TRANSMITTER | | | | I/F CN | | RECIVER | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | pin | THC63LVDF83A | | pin | pin | CN1 | pin | THC63LVDM84A | pin | | INPUT to LCD |
| Odd pixel data and control data | RA | -> | 51 | TA0 | | | 1 | N.C. | | RA0 | 27 | -> | RA2 |
| | RA | -> | 52 | TA1 | | | 2 | N.C. | | RA1 | 29 | -> | RA3 |
| | RA | -> | 54 | TA2 | | | 3 | GND | | RA2 | 30 | -> | RA4 |
| | RA | -> | 55 | TA3 | | | 4 | GND | | RA3 | 32 | -> | RA5 |
| | RA | -> | 56 | TA4 | TA- | 48 | 5 | DA0- | 9 | RA- | 33 | -> | RA6 |
| | RA | -> | 3 | TA5 | TA+ | 47 | 6 | DA0+ | 10 | RA+ | 35 | -> | RA7 |
| | GA2 | -> | 4 | TA6 | | | 7 | GND | | RA4 | 37 | -> | GA2 |
| | GA3 | -> | 6 | TB0 | TB- | 46 | 8 | DA1- | 11 | RB- | 38 | -> | GA3 |
| | GA4 | -> | 7 | TB1 | TB+ | 45 | 9 | DA1+ | 12 | RB+ | 39 | -> | GA4 |
| | GA5 | -> | 11 | TB2 | | | 10 | GND | | RB0 | 43 | -> | GA5 |
| | GA6 | -> | 12 | TB3 | TC- | 42 | 11 | DA2- | 15 | RC- | 45 | -> | GA6 |
| | GA7 | -> | 14 | TB4 | TC+ | 41 | 12 | DA2+ | 16 | RC+ | 46 | -> | GA7 |
| | BA2 | -> | 15 | TB5 | | | 13 | GND | | RB1 | 47 | -> | BA2 |
| | BA3 | -> | 19 | TB6 | TCLK- | 40 | 14 | CKA- | 17 | RCLK- | 51 | -> | BA3 |
| | BA4 | -> | 20 | TC0 | TCLK+ | 39 | 15 | CKA+ | 18 | RCLK+ | 53 | -> | BA4 |
| | BA5 | -> | 22 | TC1 | | | 16 | GND | | RB2 | 54 | -> | BA5 |
| | BA6 | -> | 23 | TC2 | TD- | 38 | 17 | DA3- | 19 | RD- | 55 | -> | BA6 |
| | BA7 | -> | 24 | TC3 | TD+ | 37 | 18 | DA3+ | 20 | RD+ | 1 | -> | BA7 |
| | Hsync | -> | 27 | TC4 | | | 19 | GND | | RB3 | 3 | -> | Hsync |
| | Vsync | -> | 28 | TC5 | | | 20 | Reserved | | RB4 | 5 | -> | Vsync |
| | DE | -> | 30 | TC6 | | | | | | RB5 | 6 | -> | DE |
| | RA0 | -> | 50 | TD0 | | | | | | RB6 | 7 | -> | RA0 |
| | RA1 | -> | 2 | TD1 | | | | | | RC0 | 34 | -> | RA1 |
| | GA0 | -> | 8 | TD2 | | | | | | RC1 | 41 | -> | GA0 |
| | GA1 | -> | 10 | TD3 | | | | | | RC2 | 42 | -> | GA1 |
| | BA0 | -> | 16 | TD4 | | | | | | RC3 | 49 | -> | BA0 |
| | BA1 | -> | 18 | TD5 | | | | | | RC4 | 50 | -> | BA1 |
| | RSVD | -> | 25 | TD6 | | | | | | RC5 | 2 | -> | RSVD |
| | CLK | -> | 31 | CLKIN | | | | | | RC6 | 26 | -> | CLKA |
| | | | | | | | pin | CN2 | | CLKOUT | | | |
| Even pixel data | RB2 | -> | 51 | TA0 | | | 1 | N.C. | | RA0 | 27 | -> | RB2 |
| | RB3 | -> | 52 | TA1 | | | 2 | N.C. | | RA1 | 29 | -> | RB3 |
| | RB4 | -> | 54 | TA2 | | | 3 | GND | | RA2 | 30 | -> | RB4 |
| | RB5 | -> | 55 | TA3 | | | 4 | GND | | RA3 | 32 | -> | RB5 |
| | RB6 | -> | 56 | TA4 | TA- | 48 | 5 | DB0- | 9 | RA- | 33 | -> | RB6 |
| | RB7 | -> | 3 | TA5 | TA+ | 47 | 6 | DB0+ | 10 | RA+ | 35 | -> | RB7 |
| | GB2 | -> | 4 | TA6 | | | 7 | GND | | RA4 | 37 | -> | GB2 |
| | GB3 | -> | 6 | TB0 | TB- | 46 | 8 | DB1- | 11 | RB- | 38 | -> | GB3 |
| | GB4 | -> | 7 | TB1 | TB+ | 45 | 9 | DB1+ | 12 | RB+ | 39 | -> | GB4 |
| | GB5 | -> | 11 | TB2 | | | 10 | GND | | RB0 | 43 | -> | GB5 |
| | GB6 | -> | 12 | TB3 | TC- | 42 | 11 | DB2- | 15 | RC- | 45 | -> | GB6 |
| | GB7 | -> | 14 | TB4 | TC+ | 41 | 12 | DB2+ | 16 | RC+ | 46 | -> | GB7 |
| | BB2 | -> | 15 | TB5 | | | 13 | GND | | RB1 | 47 | -> | BB2 |
| | BB3 | -> | 19 | TB6 | TCLK- | 40 | 14 | CKB- | 17 | RCLK- | 51 | -> | BB3 |
| | BB4 | -> | 20 | TC0 | TCLK+ | 39 | 15 | CKB+ | 18 | RCLK+ | 53 | -> | BB4 |
| | BB5 | -> | 22 | TC1 | | | 16 | GND | | RB2 | 54 | -> | BB5 |
| | BB6 | -> | 23 | TC2 | TD- | 38 | 17 | DB3- | 19 | RD- | 55 | -> | BB6 |
| | BB7 | -> | 24 | TC3 | TD+ | 37 | 18 | DB3+ | 20 | RD+ | 1 | -> | BB7 |
| | RSVD | -> | 27 | TC4 | | | 19 | GND | | RB3 | 3 | -> | RSVD |
| | RSVD | -> | 28 | TC5 | | | 20 | Reserved | | RB4 | 5 | -> | RSVD |
| | RSVD | -> | 30 | TC6 | | | 21 | Reserved | | RB5 | 6 | -> | RSVD |
| | RB0 | -> | 50 | TD0 | | | 22 | Reserved | | RB6 | 7 | -> | RB0 |
| | RB1 | -> | 2 | TD1 | | | 23 | Reserved | | RC0 | 34 | -> | RB1 |
| | GB0 | -> | 8 | TD2 | | | 24 | GND | | RC1 | 41 | -> | GB |
| | GB1 | -> | 10 | TD3 | | | 25 | GND | | RC2 | 42 | -> | GB |
| | BB0 | -> | 16 | TD4 | | | 26 | GND | | RC3 | 49 | -> | BB0 |
| | BB1 | -> | 18 | TD5 | | | 27 | N.C. | | RC4 | 50 | -> | BB1 |
| | RSVD | -> | 25 | TD6 | | | 28 | VDD:12V | | RC5 | 2 | -> | RSVD |
| | CLK | -> | 31 | CLKIN | | | 29 | VDD:12V | | RC6 | 26 | -> | CLKB |
| | | | | | | | 30 | VDD:12V | | CLKOUT | | | |

**Notes 1.** 100 twist pair.

## DISPLAY COLORS vs. INPUT DATA SIGNALS

| Display colors | | Data signal (0: Low level, 1: High level) | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | RA7 | RA6 | RA5 | RA4 | RA3 | RA2 | RA1 | RA0 | GA7 | GA6 | GA5 | GA4 | GA3 | GA2 | GA1 | GA0 | BA7 | BA6 | BA5 | BA4 | BA3 | BA2 | BA1 | BA0 |
| | | RB7 | RB6 | RB5 | RB4 | RB3 | RB2 | RB1 | RB0 | GB7 | GB6 | GB5 | GB4 | GB3 | GB2 | GB1 | GB0 | BB7 | BB6 | BB5 | BB4 | BB3 | BB2 | BB1 | BB0 |
| 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 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 | 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 |
| | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 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 |
| 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 | 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 |
| | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 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 |
| 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 | 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 |
| | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| | Blue | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

**Note** Colors are developed in combination with 8-bit signals (256 steps in grayscale) of each primary red, green, and blue color.
This process can result in up to 16,777,216 (256 x 256 x 256) colors.

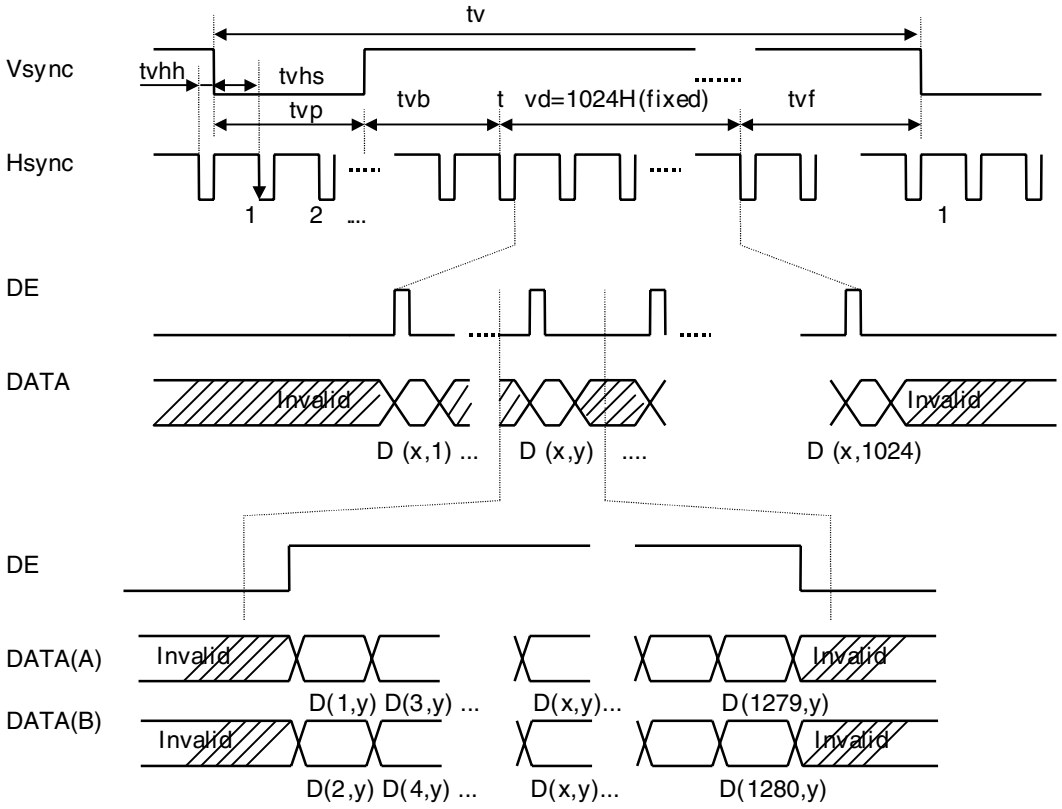
## INPUT SIGNAL TIMING

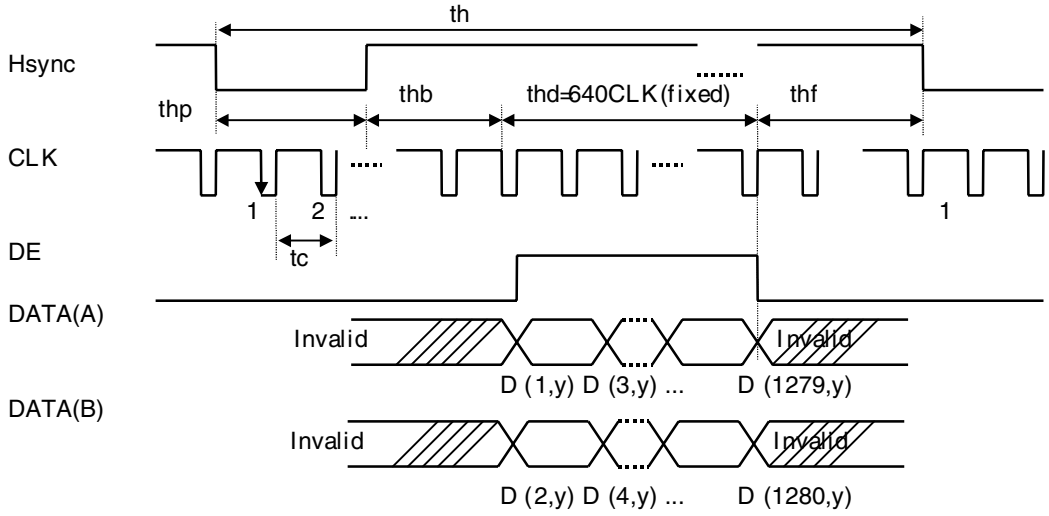
(1) Input signal specifications for LCD controller

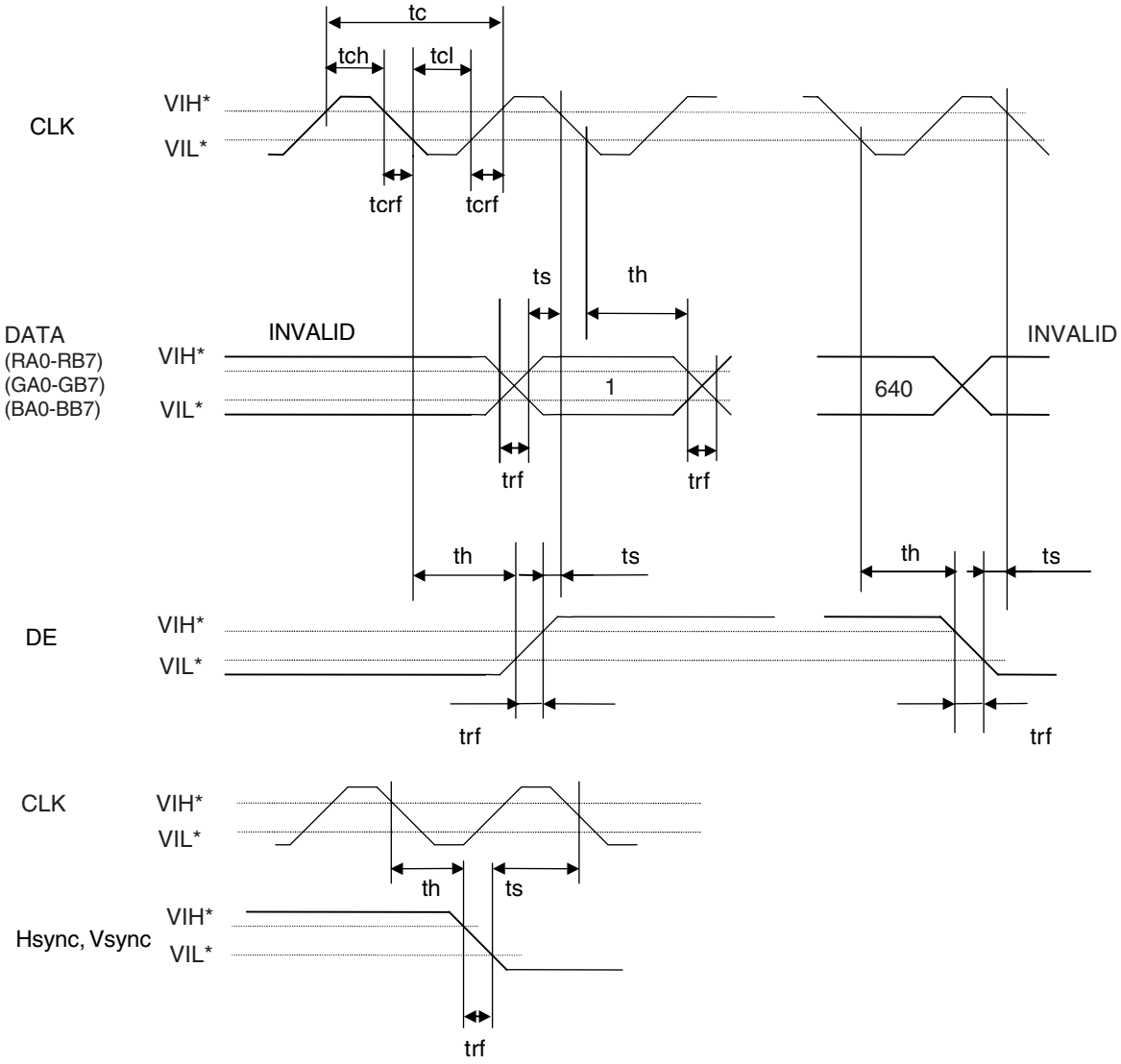
| | Parameters | | Symbols | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|---|---|---|
| CLK | Frequency | Vf=75Hz | 1/tc | 65.0<br>- | 67.5<br>14.815 | 70.0<br>- | MHz<br>ns | - |
| | | Vf=60Hz | | 51.5<br>- | 54.0<br>18.52 | 56.5<br>- | MHz<br>ns | |
| | Duty | | tc/tcl | Note 1 | | | - | - |
| | Rise, fall | | tcrf | | | | ns | - |
| Hsync | Period | Vf=75Hz | th | (12.3)<br>(750) | 12.504<br>844 | -<br>- | s<br>CLK | Typ=80.0kHz |
| | | Vf=60Hz | | (12.3)<br>(750) | 15.630<br>844 | -<br>- | s<br>CLK | Typ=64.0kHz |
| | Display period | | thd | - | 640 | - | CLK | - |
| | Front-porch | | thf | - | - | - | CLK | - |
| | Pulse width | Vf=75Hz | thp * | - | 72 | - | CLK | - |
| | | Vf=60Hz | | - | 56 | - | CLK | - |
| | Back-porch | | thb * | - | 124 | - | CLK | - |
| | * thp + thb | | | (110) | - | - | CLK | - |
| Vsync | Period | Vf=75Hz | tv | -<br>(1027) | 13.329<br>1066 | -<br>- | ms<br>H | Typ=75.0Hz |
| | | Vf=60Hz | | -<br>(1027) | 16.661<br>1066 | -<br>- | ms<br>H | Typ=60.0Hz |
| | Display period | | tvd | - | 1024 | - | H | - |
| | Front-porch | | tvf * | - | 1 | - | H | - |
| | Pulse width | | tvp * | - | 3 | - | H | - |
| | Back-porch | | tvb * | | 38 | - | H | - |
| | * tvp + tvb +tvf | | | (1980) | - | - | CLK | - |
| | Vsync-Hsync timing | | tvhs | 1 | - | - | CLK | - |
| | Hsync-Vsync timing | | tvhh | 1 | - | - | CLK | - |
| DATA | DATA-CLK (Set up) | | ts | Note 1 | | | ns | - |
| | CLK-DATA (Hold) | | th | | | | ns | - |
| | Rise, fall | | trf | | | | ns | - |

**Note** These values are in the timing regulation of THC63LVDM83A (THine).
The product equivalent to THC63LVDM83A (THine) is recommended to the input of LVDS transmitter.
The Timing regulation prescribes in the input of the LVDS transmitter.

(2) Definition of input signal timing



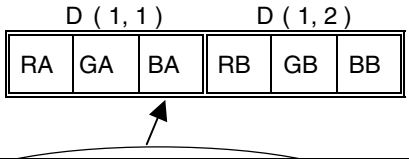






*1: Refer to the specification of LVDS manufacture for the detail timing design.

(3) Display positions of input data

Odd Pixel: RA = R DATA  Even Pixel : RB =R DATA
Odd Pixel: GA= G DA TA  Even Pixel : GB =G DAT A
Odd Pixel: BA = B DATA  Even Pixel : BB =B D ATA




| | | | |
|---|---|---|---|
| D( 1, 1) | D( 1, 2) | | D(1, 1280) |
| D( 2, 1) | D( 2, 2) | | D(2, 1280) |
| | | | |
| D( 1024,1) | D( 1024,2) | | D(1024,1280) |

Memo

# Intentionally blank

## OPTICAL CHARACTERISTICS

($T_a$ = 25°C, $V_{DD}$ = 12 V, $V_{DD}B$ = 12 V)

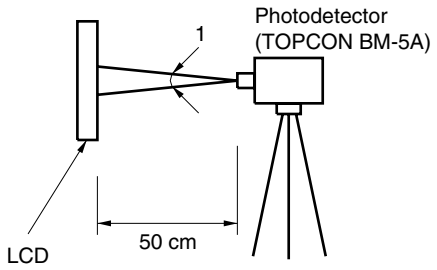
| Parameter | Symbol | Condition | MIN. | TYP. | MAX. | Unit | Remark |
|---|---|---|---|---|---|---|---|
| Luminance | Lumax | "White" | 150 | 200 | – | cd/m$^2$ | **Note 1** |
| Contrast ratio | CR | X = ±0°, Y = ±0°, at center | 150 | 250 | – | – | **Note 2** |
| Luminance uniformity | – | Maximum luminance | – | 1.1 | 1.30 | – | **Note 3** |

Reference data

($T_a$ = 25°C, $V_{DD}$ = 12 V, $V_{DD}B$ = 12 V)

| Parameter | | Symbol | Condition | MIN. | TYP. | MAX. | Unit | Remark |
|---|---|---|---|---|---|---|---|---|
| Chromaticity Coordinate | | | Y = ±0° X = ±0° | – | | – | – | |
| Viewing angle range | Horizontal | X+ | CR > 10, Y = ±0° | 70 | 85 | – | deg. | **Note 4** |
| | | X– | CR > 10, Y = ±0° | 70 | 85 | – | deg. | |
| | Vertical | Y+ | CR > 10, X = ±0° | 70 | 85 | – | deg. | |
| | | Y– | CR > 10, X = ±0° | 70 | 85 | – | deg. | |
| Color gamut | | C | To NTSC | 50 | 60 | – | % | – |
| Response time | | ton | White to black | – | 45 | TBD | ms | **Note 5** |
| | | toff | Black to white | – | 35 | TBD | | |

**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.

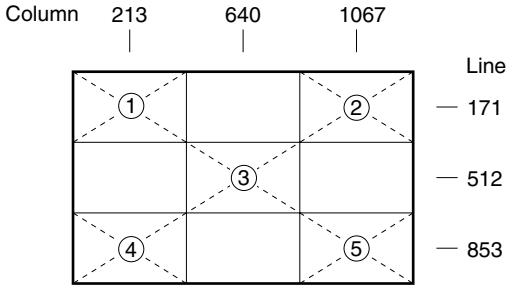



**2.** The contrast ratio is calculated by using the following formula.

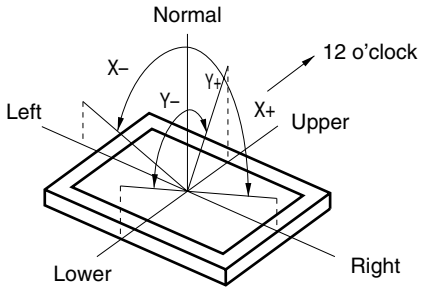
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance with all pixels in white}}{\text{Luminance with all pixels in black}}$$

The Luminance is measured in darkroom.

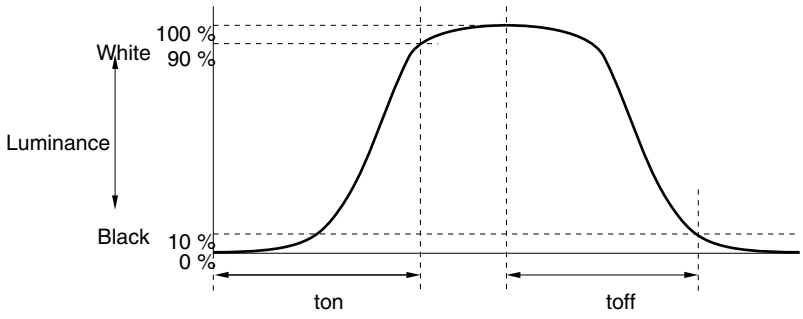
**3.** The luminance is measured at near the five points shown below.




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




**5.** Definition of response time is as follows.
Photo-detector output signal is measured when the luminance changes “white” to “black” or “black” to “white”.



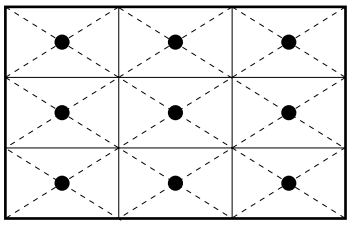
**RELIABILITY TEST**

| Test item | Test condition |
|---|---|
| High temperature/humidity operation **Note 1** | 60 ± 2°C, 60% relative humidity<br>240 hours<br>Display data is black. |
| Heat cycle (operation) **Note 1** | <1> 0℃ ± 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 (non-operation) **Note 1** | <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 (non-operation) **Notes 1, 2** | <1> 5 - 100 Hz, 1.2G<br>1 minute/cycle<br>X, Y, Z direction<br><2> 50 times each direction |
| Mechanical shock (non-operation) **Notes 1, 2** | <1> 30 G, 11 ms<br>X, Y, Z direction<br><2> 3 times each direction |
| ESD (operation) **Notes 1, 3** | 150 pF, 150 , ±10 kV<br>9 places on a panel<br>10 times each place at one-second intervals |
| Dust (operation) **Note 1** | 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 “z “ 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 flat 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 0.392 N·m (4 kgf·cm).

(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 anti-static pouch and under the room temperature atmosphere is recommended.

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

b) This module has the retardation film which may cause the variation of the color hue in the different viewing angles. The ununiformity may appear on the screen under the high temperature operation.

c) The light vertical stripe may be observed depending on the display pattern. This is not defects or malfunctions.

d) The noise from the inverter circuit may be observed in the luminance control mode. This is not defects or malfunctions.

(5) Other cautions

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

b) Do not readjust variable resistors or switches in the module.

c) When returning the module for repair or etc, please pack the module properly to avoid any damages. We recommend using the original shipping packages.

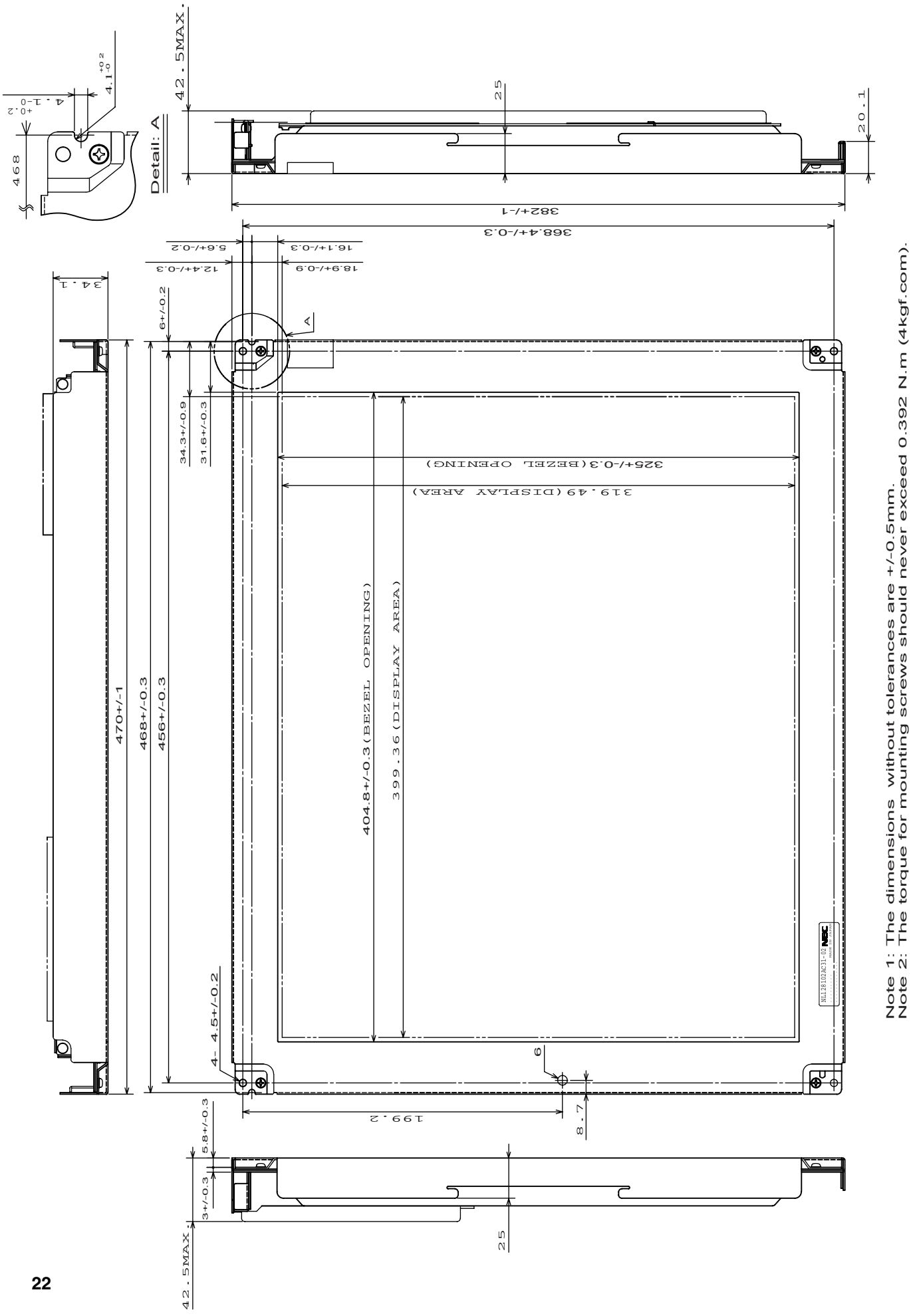
d) In case that the scan converter is used to convert VGA signal to NTSC, it is recommended using the frame-memory type, not the line-memory.

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

The optical characteristics of this module may be affected by the ambient temperature.
This module has cold cathode tube for backlight. Optical characteristics, like luminance or uniformity, will be changed by the progress in time.

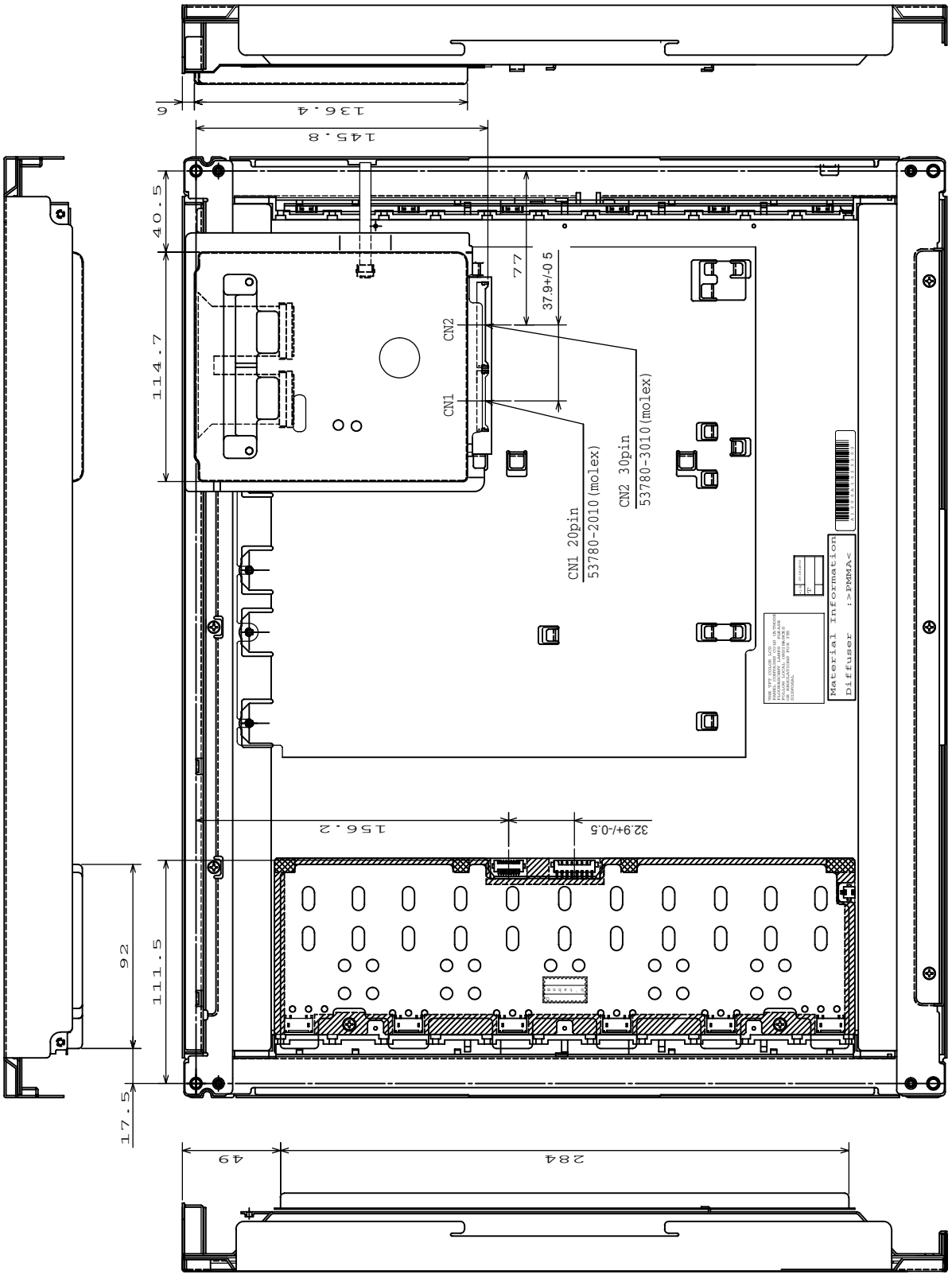
Uneven brightness and/or small spots may be observed depending on different display patterns.

**OUTLINE DRAWING (1/2): Front View (Unit: mm)**




Note 1: The dimensions without tolerances are +/-0.5mm.
Note 2: The torque for mounting screws should never exceed 0.392 N.m (4kgf.com).

**OUTLINE DRAWING (2/2): Rear View (Unit: mm)**




Note 1: The dimensions without tolerances are +/-1.0mm.
Note 2: The torque for mounting screws should never exceed 0.392 N.m (4kgf.com).