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| MDT4600AIH-LVDS | 1920 x 1080 | LVDS Interface | TFT Module |
|---|---|---|---|

**Specification**

| Version: 1 | Date: 17/02/2019 |
|---|---|

**Revision**

| | | |
|---|---|---|
| 1 | 15/02/2019 | First issue |

| Display Features | |
|---|---|
| Display Size | 46.00” |
| Resolution | 1920 x 1080 |
| Orientation | Landscape |
| Appearance | RGB |
| Logic Voltage | 12V |
| Interface | LVDS |
| Brightness | 2500 cd/m$^2$ |
| Touchscreen | --- |
| Module Size | 1083.00 x 627.00 x 35.00mm |
| Operating Temperature | 0°C ~ +50°C |
| Pinout | 51 way FFC |
| Pitch | --- |

RoHS compliant

| Box Quantity | Weight / Display |
|---|---|
| --- | --- |

**Display Accessories**

| Part Number | Description |
|---|---|
| | |
| | |
| | |

**Optional Variants**

| Appearances | Voltage |
|---|---|
| | |

# General Description

## Overview

This specification applies to the 46 inch color TFT-LCD module with enhanced backlight brightness and 2-ch 10 bit LVDS interface.

This module supports the WUXGA -1920(H) x 1080(V) screen format and the LED driver is built in.

## Features

- Sunlight readable display, 2500nits.
- Direct LED backlight
- WUXGA (1920 x 1080 pixels) full HD resolution
- Long operation life
- RoHS Compliance

## Application

Industrial Application.

Display specifications

| Items | Unit | Specification |
|---|---|---|
| Screen Diagonal | inch | 46 |
| Active Area | mm | 1018.08(H) x 572.67(V) |
| Pixels H x V | pixels | 1920(x3) x 1080 |
| Pixels Pitch | um | 530.25(per one triad) x 530.25 |
| Pixel Arrangement | | RGB Vertical stripe |
| Display mode | | MVA mode, normally black |
| White luminance (center) | $Cd/m^2$ | 2,500 (Typ.) |
| Contrast ratio | | 3,000 (Typ.) |
| Optical Response Time | msec | 6.5 ms (Typ. on/off) |
| Normal Input Voltage VDD | Volt | 5 |
| Power Consumption<br>(VDD Line + Backlight) | Watt | 390.8<br>(VDD=10.8W, Backlight= 380W) |
| Weight | Grams | 12500 (typ) |
| Physical size | mm | 1083 (H) x 627 (V) x 35 (D) (Back metal)<br>54 (D) (LED driver) |
| Electrical Interface | | Dual Channel LVDS |
| Support Colors | | 10 bit (8 bit+FRC), 1073.7 M colors |
| Surface Treatment | | Anti-Glare |
| Temperature range<br>Operating<br>Storage (Shipping) | <br>$^0C$<br>$^0C$ | <br>0 ~ 50<br>-20 ~ 60 |
| RoHS Compliance | | RoHS Compliance |

## Absolute Maximum Ratings

The following are maximum values which, if exceeded, may cause faulty operation or damage to the unit.

| Item | Symbol | Min | Max | Unit | Note |
|---|---|---|---|---|---|
| Power supply input voltage | $V_{DD}$ | -0.3 | 14 | Volt | 1 |
| Logic input voltage | $V_{in}$ | -0.3 | 4 | Volt | 1 |
| BLU input voltage | $V_{DDB}$ | -0.3 | 28 | Volt | 1 |
| BLU brightness control voltage | $BL_{ON}$ | -0.3 | 7 | Volt | 1 |
| Ambient operation temperature | $T_{OP}$ | 0 | 50 | $^0$C | 2 |
| Ambient operation humidity | $H_{OP}$ | 10 | 90 | %RH | 2 |
| Storage temperature | $T_{ST}$ | -20 | 60 | $^0$C | 2 |
| Storage humidity | $H_{ST}$ | 10 | 90 | %RH | 2 |
| Shock (non-operation) | | - | 30 | G | 3 |
| Vibration (non-operation) | | - | 1.5 | G | 4 |
| Thermal shock | | -20 | 60 | C | 5 |

(Suggestion: The panel designed by direct backlight, it must be operated under stable air flow from bottom to top side on whole back chassis.)

Note 1 : Duration = 50msec

Note 2 : Maximum Wet-Bulb should be 50℃ and No condensation.

Note 3 : Half sine wave, shock level : 50G(11ms), direction : ±x, ±y, ±z (one time each direction)

Note 4 : Wave form : Random, vibration level : 1.5G RMS, Bandwidth : 10~500Hz Duration : X,Y,Z 30min (one time each direction)

Note 5 : -20C/1hr ~ 60C/1hr, 100 cycles

## Electrical Characteristics

The display panel requires two power inputs. One is employed to power the LCD electronics and to drive the TFT array and liquid crystal. The second input, which powers the LED backlight.

TFT LCD module

DC characteristics

| Parameter | | Symbol | Values | | | Unit | Notes |
|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | | |
| LCD | | | | | | | |
| Power supply input voltage | | $V_{DD}$ | 10.8 | 12 | 13.2 | Vdc | 1 |
| Power supply input current | | $I_{DD}$ | | 0.9 | 1.08 | A | 2 |
| Power consumption | | Pc | | 10.8 | 13.0 | Watt | 2 |
| Inrush current | | $I_{RUSH}$ | | | 5.5 | A | |
| LVDS Interface | Input Differential Voltage | $V_{ID}$ | 200 | 400 | 600 | $mV_{DC}$ | 3 |
| | Differential Input High Threshold Voltage | $V_{TH}$ | +100 | | +300 | $mV_{DC}$ | 4 |
| | Differential Input Low Threshold Voltage | $V_{TL}$ | -300 | | -100 | $mV_{DC}$ | 4 |
| | Input Common Mode Voltage | $V_{ICM}$ | 1.1 | 1.25 | 1.4 | $V_{DC}$ | |
| CMOS Interface | Input High Threshold Voltage | VIH | 2.7 | | 3.3 | $V_{DC}$ | |
| | Input Low Threshold Voltage | VIL | 0 | | 0.6 | $V_{DC}$ | |
| Backlight Power Consumption | | | | 380 | | Watt | |
| Life Time | | | | 100,000 | | Hour | 6 |

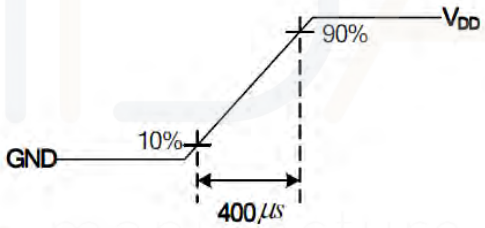
## AC characteristics

AC Characteristics

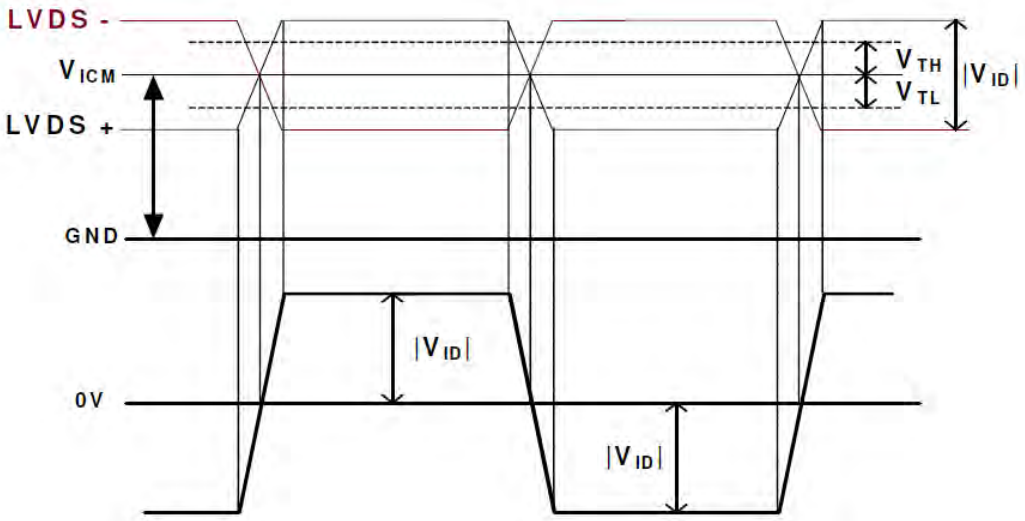
| Parameter | | Symbol | Value | | | Unit | Note |
|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max | | |
| LVDS Interface | Input Channel Pair Skew Margin | $t_{SKEW\ (CP)}$ | -500 | --- | +500 | ps | 5 |
| | Receiver Clock : Spread Spectrum Modulation range | Fclk_ss | Fclk -3% | --- | Fclk +3% | MHz | 6 |
| | Receiver Clock : Spread Spectrum Modulation frequency | Fss | 30 | --- | 200 | kHz | 6 |
| | Receiver Data Input Margin<br>Fclk = 85 MHz<br>Fclk = 65 MHz | tRMG | <br>-0.4<br>-0.5 | <br>---<br> | <br>0.4<br>0.5 | ns | 7 |

**Note 1:** $V_{DD}$ = 12.0V, Fv = 60Hz, Fclk= 82MHz , 25 , Test Pattern : White Pattern

**Note 2:** Measurement condition : Rising time = 400us

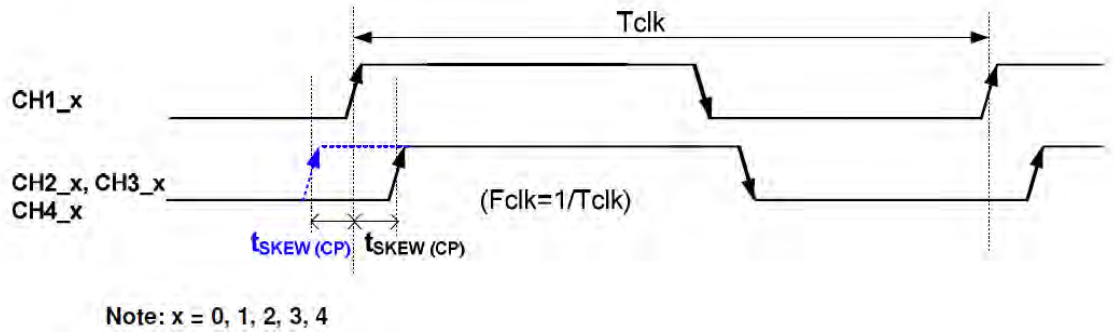



**Note 3:** $V_{ICM}$ = 1.25V



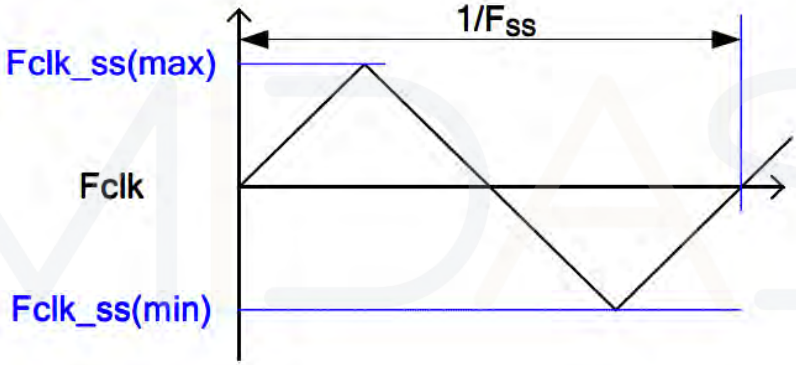
**Note 4:** The measure points of $V_{IH}$ and $V_{IL}$ are in LCM side after connecting the System Board and LCM.

**Note 5:** Input Channel Pair Skew Margin



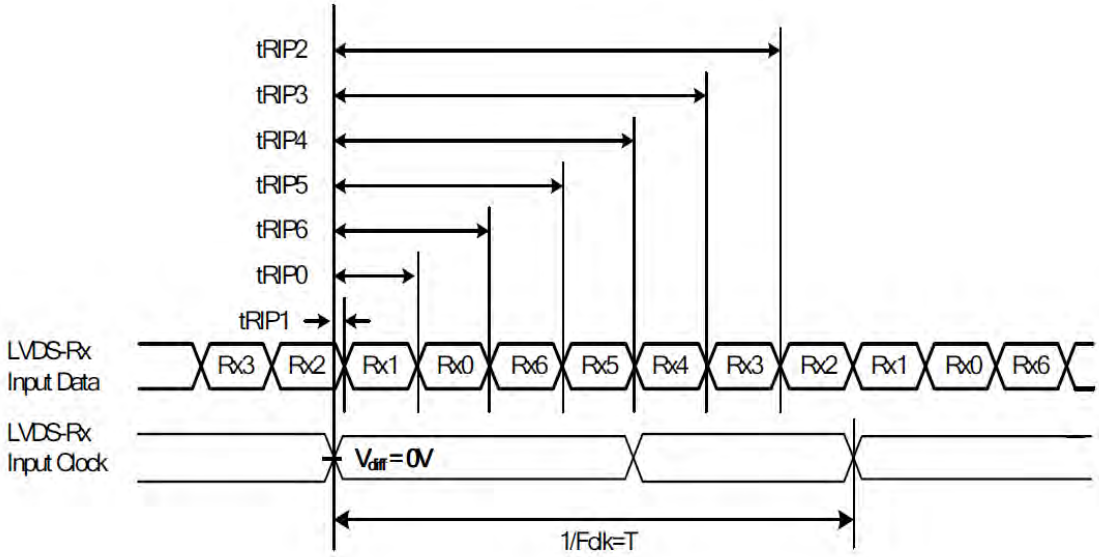

Note: x = 0, 1, 2, 3, 4

**Note 6:** LVDS Receiver Clock SSCG (Spread spectrum clock generator) is defined as below figures




**Note 7:** Receiver Data Input Margin

| Parameter | Symbol | Rating | | | Unit | Note |
|---|---|---|---|---|---|---|
| | | Min | Type | Max | | |
| Input Clock Frequency | Fclk | Fclk (min) | -- | Fclk (max) | MHz | **T=1/Fclk** |
| Input Data Position0 | tRIP1 | -\|tRMG\| | 0 | \|tRMG\| | ns | |
| Input Data Position1 | tRIP0 | T/7-\|tRMG\| | T/7 | T/7+\|tRMG\| | ns | |
| Input Data Position2 | tRIP6 | 2T/7-\|tRMG\| | 2T/7 | 2T/7+\|tRMG\| | ns | |
| Input Data Position3 | tRIP5 | 3T/7-\|tRMG\| | 3T/7 | 3T/7+\|tRMG\| | ns | |
| Input Data Position4 | tRIP4 | 4T/7-\|tRMG\| | 4T/7 | 4T/7+\|tRMG\| | ns | |
| Input Data Position5 | tRIP3 | 5T/7-\|tRMG\| | 5T/7 | 5T/7+\|tRMG\| | ns | |
| Input Data Position6 | tRIP2 | 6T/7-\|tRMG\| | 6T/7 | 6T/7+\|tRMG\| | ns | |




**Note 8:** Do not attach a conducting tape to lamp connecting wire. If the lamp wire attach to conducting tape, TFT-LCD Module have a low luminance and the inverter has abnormal action because leakage current occurs between lamp wire and conducting tape

**Note 9:** The relative humidity must not exceed 80% non-condensing at temperatures of 40 $^{0}$Cor less. At temperatures greater than 40 $^{0}$C, the wet bulb temperature must not exceed 39 $^{0}$C. When operate at low temperatures, the brightness of LED will drop and the life time of LEF will be reduced.

**Note 10:** Specified values are for a single lamp only which is aligned horizontally. The lifetime is defined as the time which luminance of the lamp is 50% compared to its original value. [Operating condition: Continuous operating at Ta = 25±2 $^{0}$C.

Interface connection

LCD connector: 187059-51221 (P-TWO, LVDS connector)

| PIN | Symbol | Description | PIN | Symbol | Description |
|---|---|---|---|---|---|
| 1 | N.C. | AUO Internal Use Only | 26 | N.C. | AUO Internal Use Only |
| 2 | N.C. | AUO Internal Use Only | 27 | N.C. | AUO Internal Use Only |
| 3 | N.C. | AUO Internal Use Only | 28 | CH2_0- | LVDS Channel 2, Signal 0- |
| 4 | N.C. | AUO Internal Use Only | 29 | CH2_0+ | LVDS Channel 2, Signal 0+ |
| 5 | N.C. | AUO Internal Use Only | 30 | CH2_1- | LVDS Channel 2, Signal 1- |
| 6 | N.C. | N.C. | 31 | CH2_1+ | LVDS Channel 2, Signal 1+ |
| 7 | LVDS_SEL | Open/High(3.3V) for NS, Low(GND) for JEIDA | 32 | CH2_2- | LVDS Channel 2, Signal 2- |
| 8 | N.C. | No connection | 33 | CH2_2+ | LVDS Channel 2, Signal 2+ |
| 9 | N.C. | No connection | 34 | GND | Ground |
| 10 | N.C. | No connection | 35 | CH2_CLK- | LVDS Channel 2, Clock - |
| 11 | GND | Ground | 36 | CH2_CLK+ | LVDS Channel 2, Clock + |
| 12 | CH1_0- | LVDS Channel 1, Signal 0- | 37 | GND | Ground |
| 13 | CH1_0+ | LVDS Channel 1, Signal 0+ | 38 | CH2_3- | LVDS Channel 2, Signal 3- |
| 14 | CH1_1- | LVDS Channel 1, Signal 1- | 39 | CH2_3+ | LVDS Channel 2, Signal 3+ |
| 15 | CH1_1+ | LVDS Channel 1, Signal 1+ | 40 | CH2_4- | LVDS Channel 2, Signal 4- |
| 16 | CH1_2- | LVDS Channel 1, Signal 2- | 41 | CH2_4+ | LVDS Channel 2, Signal 4+ |
| 17 | CH1_2+ | LVDS Channel 1, Signal 2+ | 42 | N.C. | AUO Internal Use Only |
| 18 | GND | Ground | 43 | N.C. | No connection |
| 19 | CH1_CLK- | LVDS Channel 1, Clock - | 44 | GND | Ground |
| 20 | CH1_CLK+ | LVDS Channel 1, Clock + | 45 | GND | Ground |
| 21 | GND | Ground | 46 | GND | Ground |
| 22 | CH1_3- | LVDS Channel 1, Signal 3- | 47 | N.C. | No connection |
| 23 | CH1_3+ | LVDS Channel 1, Signal 3+ | 48 | $V_{DD}$ | Power Supply, +12V DC Regulated |
| 24 | CH1_4- | LVDS Channel 1, Signal 4- | 49 | $V_{DD}$ | Power Supply, +12V DC Regulated |
| 25 | CH1_4+ | LVDS Channel 1, Signal 4+ | 50 | $V_{DD}$ | Power Supply, +12V DC Regulated |
| | | | 51 | $V_{DD}$ | Power Supply, +12V DC Regulated |

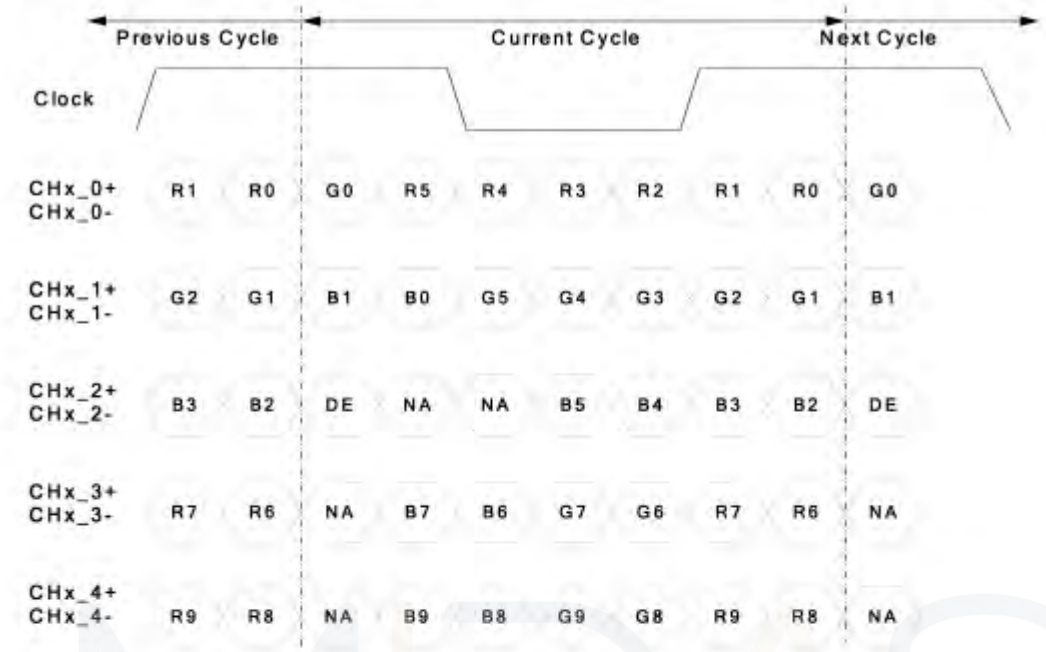
Note1: N.C. : please leave this pin unoccupied. It can not be connected by any signal (Low/GND/High).

Note 2: All GND (ground) pins should be connected together and should also be connected to the LCD's metal frame.

Note 3: All VDD (power input) pins should be connected together.

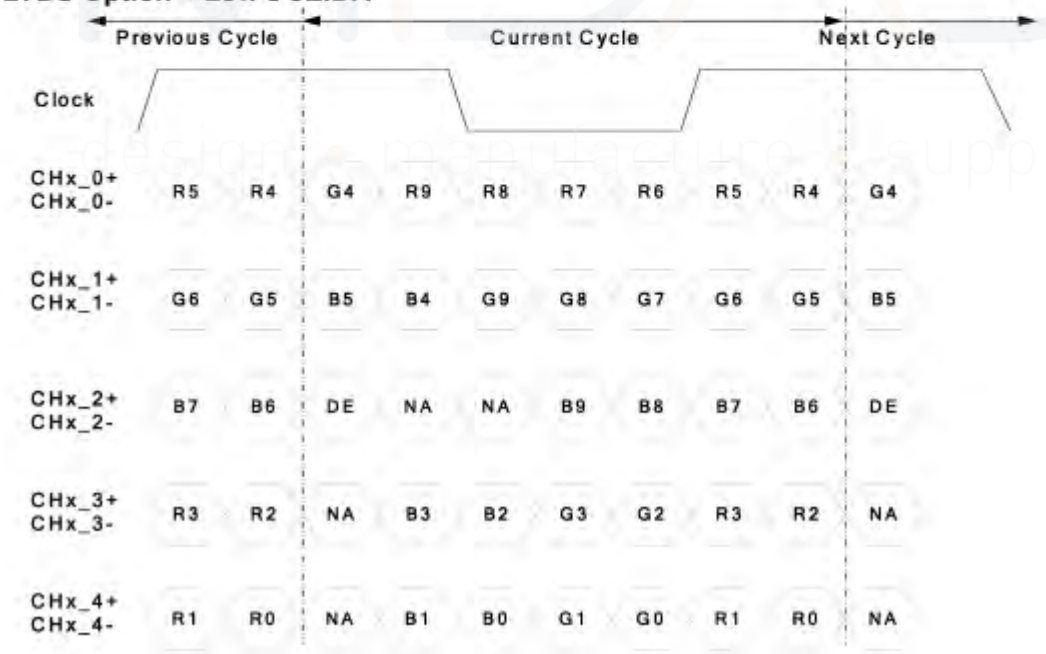
Note 4: All NC (no connection) pins should be open without voltage input.

**LVDS Option = High/Open➔NS**




Note: x = 1, 2, 3, 4…

**LVDS Option = Low➔JEIDA**




Note: x = 1, 2, 3, 4…

## Signal Timing specifications

This is the signal timing required at the input of the User connector. All of the interface signal timing should be satisfied with the following specifications for its proper operation.

| Signal | Item | Symbol | Min. | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Vertical Section | Period | Tv | 1090 | 1125 | 1480 | Th |
| | Active | Tdisp (v) | | 1080 | | Th |
| | Blanking | Tblk (v) | 10 | 45 | 400 | Th |
| Horizontal Section | Period | Th | 1030 | 1100 | 1325 | Tclk |
| | Active | Tdisp (h) | | 960 | | Tclk |
| | Blanking | Tblk (h) | 70 | 140 | 365 | Tclk |
| Clock | Frequency | Fclk=1/Tclk | 50 | 74.25 | 82 | MHz |
| Vertical Frequency | Frequency | Fv | 47 | 60 | 63 | Hz |
| Horizontal Frequency | Frequency | Fh | 60 | 67.5 | 73 | KHz |

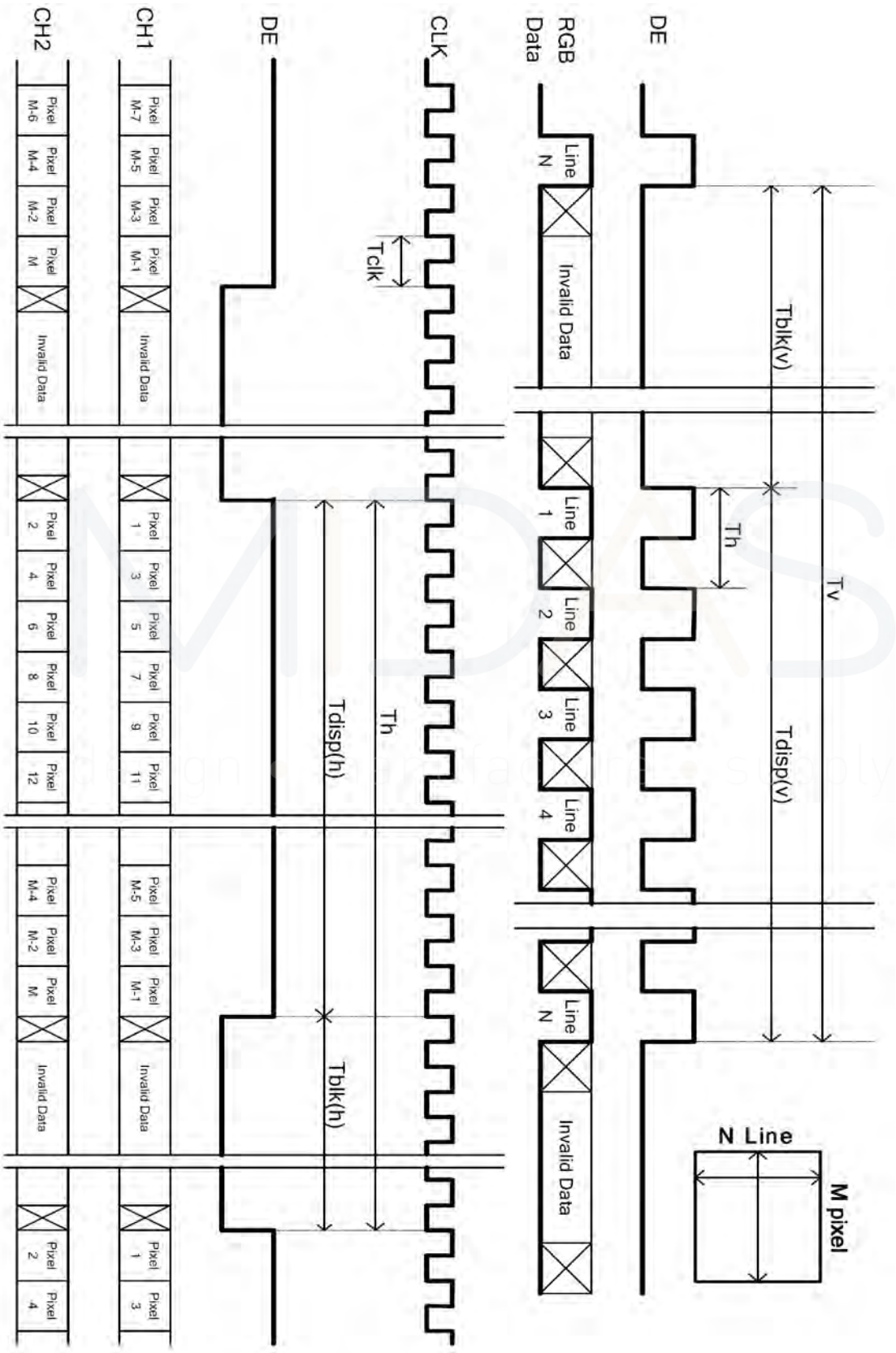
Notes 1: Display position is specific by the rise of DE signal only. Horizontal display position is specified by the rising edge of 1st DCLK after the rise of 1st DE, is displayed on the left edge of the screen.

Notes 2: Vertical display position is specified by the rise of DE after a “Low” level period equivalent to eight times of horizontal period. The 1st data corresponding to one horizontal line after the rise of 1st DE is displayed at the top line of screen.

Notes 3: If a period of DE “High” is less than 1920 DCLK or less than 1080 lines, the rest of the screen displays black.

Notes 4: The display position does not fit to the screen if a period of DE “High” and the effective data period do not synchronize with each other.

Signal timing waveforms



Color input data reference

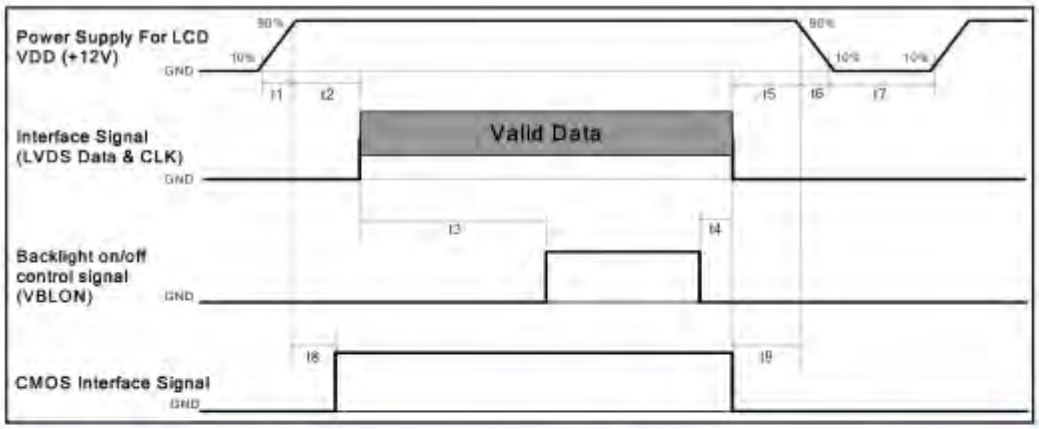
The brightness of each primary color (red, green and blue) is based on the 10 bit gray scale data input for the color; the higher the binary input, the brighter the color. The table below provides a reference for color versus data input.

COLOR DATA REFERENCE

| Color | | Input Color Data | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | RED | | | | | | | | | | GREEN | | | | | | | | | | BLUE | | | | | | | | | |
| | | MSB | | | | | | | | | LSB | MSB | | | | | | | | | LSB | MSB | | | | | | | | | LSB |
| | | R9 | R8 | R7 | R6 | R5 | R4 | R3 | R2 | R1 | R0 | G9 | G8 | G7 | G6 | G5 | G4 | G3 | G2 | G1 | G0 | B9 | B8 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
| Basic Color | 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 |
| | Red(1023) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(1023) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue(1023) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Cyan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Magenta | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 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 | 1 | 1 | 1 | 1 | 0 | 0 | 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 | 1 | 1 | 1 | 1 | 1 | 1 |
| R | RED(000) | 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 |
| | RED(001) | 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 | 0 | 0 | 0 | 0 |
| | ---- | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | RED(1022) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | RED(1023) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| G | GREEN(000) | 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 |
| | GREEN(001) | 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 |
| | ---- | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | GREEN(1022) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | GREEN(1023) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| B | BLUE(000) | 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 |
| | BLUE(001) | 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 |
| | ---- | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | BLUE(1022) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| | BLUE(1023) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

Power sequence

Power sequence of panel




| Parameter | Values | | | Unit |
|---|---|---|---|---|
| | Min. | Type. | Max. | |
| t1 | 0.4 | --- | 30 | ms |
| t2 | 0.1 | --- | 50 | ms |
| t3 | 450 | --- | --- | ms |
| t4 | 0 *1 | --- | --- | ms |
| t5 | 0 | --- | --- | ms |
| t6 | --- | --- | --- *2 | ms |
| t7 | 500 | --- | --- | ms |
| t8 | 10 | --- | 50 | ms |
| t9 | 0 | --- | --- | ms |

Note 1: T4=0 : concern for residual pattern before BLU turn off.

Note 2: T6 : voltage of VDD must decay smoothly after power-off. (customer system decide this value)

Backlight power specification

The backlight unit contains multi LED bars (Direct type)

Electrical specification

| No | Item | Symbol | | Condition | Min | TYP | Max | Unit | Note |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Input voltage | $V_{DDB}$ | | --- | 21.6 | 24 | 26.4 | V | |
| 2 | Input current | $I_{DDB}$ | | $V_{DDB}$ =24V, 100% brightness | | (16) | | A | |
| 3 | Input power | $P_{DDB}$ | | $V_{DDB}$ =24V, 100% brightness | | (380) | | W | |
| 4 | Input inrush current | $I_{INRUSH}$ | | $V_{DDB}$ =24V, 100% brightness | | TBD | | Acc | |
| 5 | Output frequency | $F_{BL}$ | | $V_{DDB}$ =24V | | TBD | | KHz | |
| 6 | ON/OFF control voltage | $V_{BLON}$ | ON | $V_{DDB}$ =24V | | 3.3 | 5 | Vdc | |
| | | | OFF | $V_{DDB}$ =24V | 0 | | 0.8 | | |
| 7 | Dimming control | F-EPWM | | $V_{DDB}$ =24V | 90 | 180 | 240 | Hz | |
| | | D-EPWM | | $V_{DDB}$ =24V | 20 | | 100 | % | |

（Ta=25±5 ℃Turn on for 15minutes）

Input pin assignment (Preliminary)

CN2: Cvilux CI0114M1HRL-NH

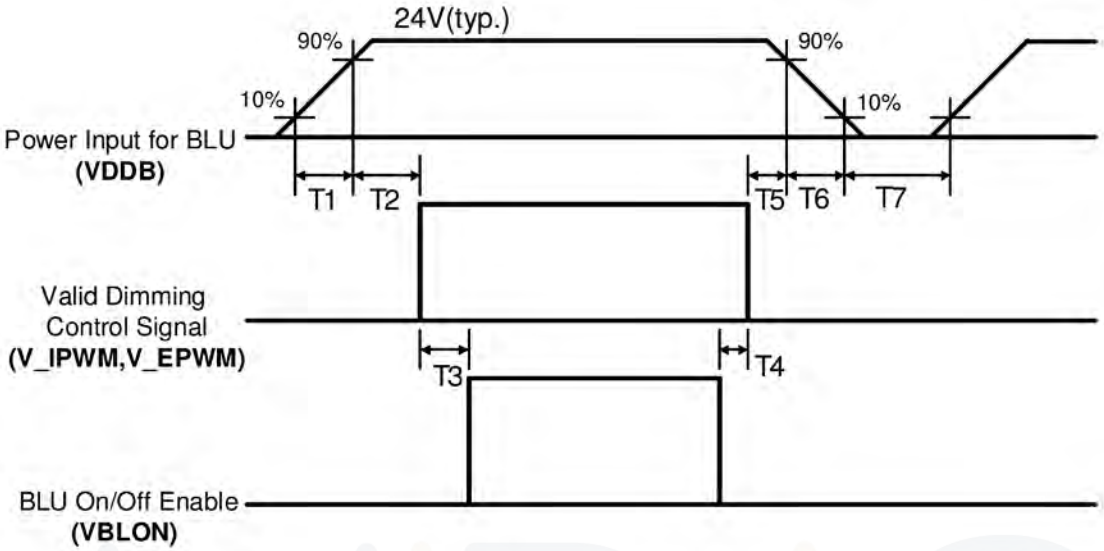
Master:

| Pin NO | Symbol | Description |
|---|---|---|
| 1 | VIN | DC +24V |
| 2 | VIN | DC +24V |
| 3 | VIN | DC +24V |
| 4 | VIN | DC +24V |
| 5 | VIN | DC +24V |
| 6 | GND | Ground |
| 7 | GND | Ground |
| 8 | GND | Ground |
| 9 | GND | Ground |
| 10 | GND | Ground |
| 11 | NC | No connected |
| 12 | ON / OFF | BLU on |
| 13 | DIMM | Dimming control |
| 14 | NC | No connected |

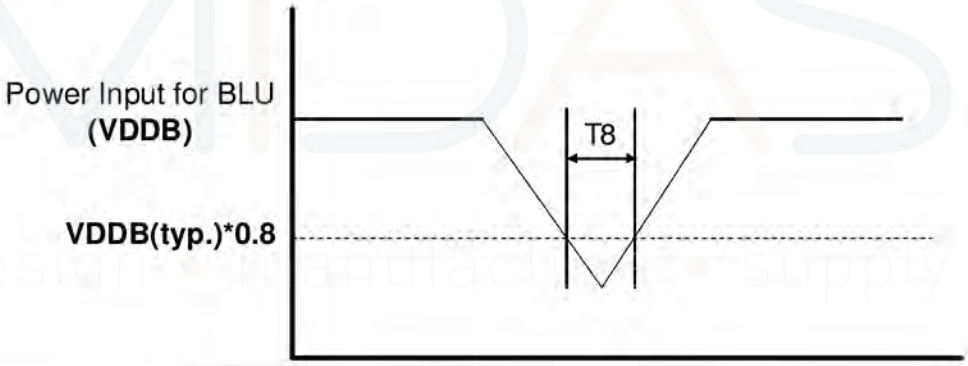
Slave:

| Pin NO | Symbol | Description |
|---|---|---|
| 1 | VIN | DC +24V |
| 2 | VIN | DC +24V |
| 3 | VIN | DC +24V |
| 4 | VIN | DC +24V |
| 5 | VIN | DC +24V |
| 6 | GND | Ground |
| 7 | GND | Ground |
| 8 | GND | Ground |
| 9 | GND | Ground |
| 10 | GND | Ground |
| 11 | NC | No connected |
| 12 | NC | Internal to master pin 12 |
| 13 | NC | Internal to master pin 13 |
| 14 | NC | No connected |

Power sequence for inverter




**Dip condition**




| Parameter | Value | | | Units |
|---|---|---|---|---|
| | Min | Typ | Max | |
| T1 | 20 | - | - | ms *1 |
| T2 | 500 | - | - | ms |
| T3 | 250 | - | - | ms |
| T4 | 0 | - | - | ms |
| T5 | 1 | - | - | ms |
| T6 | | - | - | ms |
| T8 | - | - | 10 | Ms |

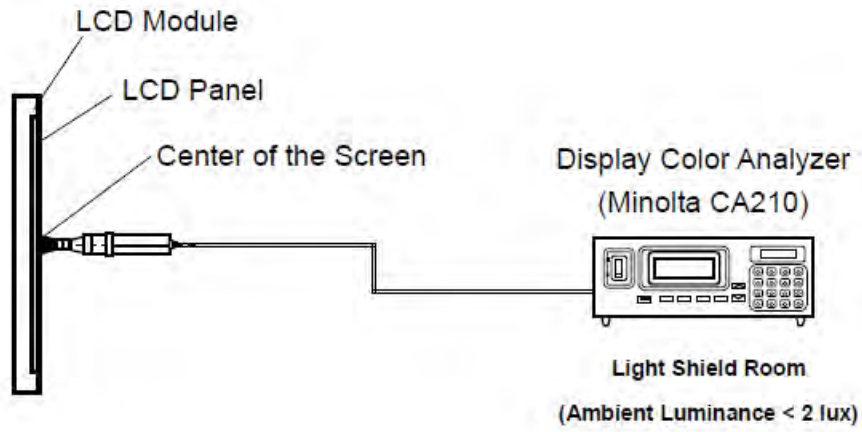
## Optical characteristics

The following optical characteristics are measured under stable condition at 25 $^{0}$C

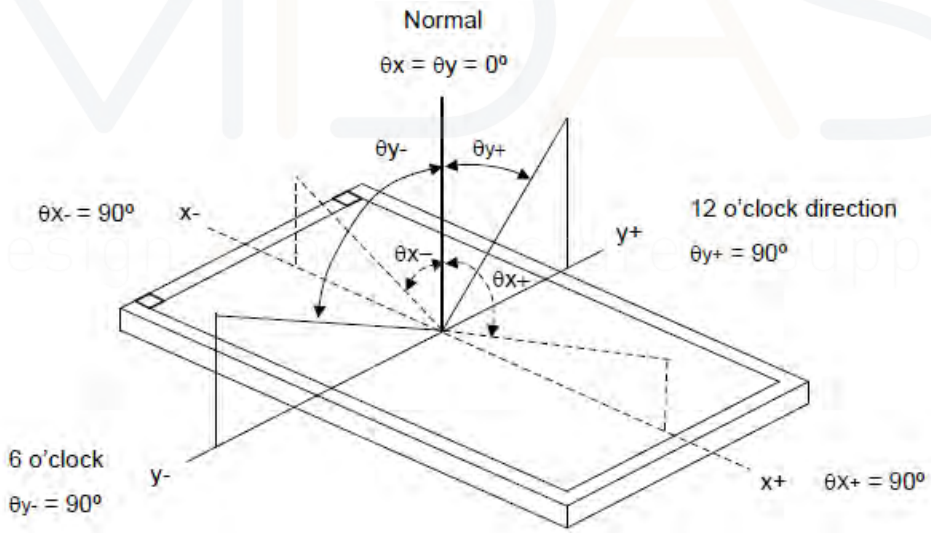
| Items | Unit | Conditions | Min. | Typ. | Max. | Note |
|---|---|---|---|---|---|---|
| Viewing angle | Deg. | Horizontal (Right) CR=10 (Left) | | 178 | | 2 |
| | | Vertical (Up) CR=10 (Down) | | 178 | | |
| Contrast Ratio | | Normal Direction | 3000 | 4000 | | 3 |
| Response Time | msec | Raising time ($T_{rR}$) | | | | 4 |
| | | Falling time ($T_{rF}$) | | | | |
| | | Raising + Falling | | 6.5 | | |
| Color / Chromaticity Coordinates (CIE) | | Red x | -0.04 | 0.64 | 0.04 | 5 |
| | | Red y | | 0.33 | | |
| | | Green x | | 0.32 | | |
| | | Green y | | 0.62 | | |
| | | Blue x | | 0.15 | | |
| | | Blue y | | 0.05 | | |
| Color coordinates (CIE) White | | White x | | 0.29 | | |
| | | White y | | 0.32 | | |
| Center Luminance | Cd/m$^2$ | | 2000 | 2500 | | 6 |
| Luminance Uniformity | % | | 70 | 75 | | 7 |
| Crosstalk (in 60 Hz) | % | | | | 1.5 | |
| Flicker | dB | | | | -20 | |

Note 1: Measurement method

The LCD module should be stabilized at given temperature for 0.5 hour to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 1 hour in a windless room.



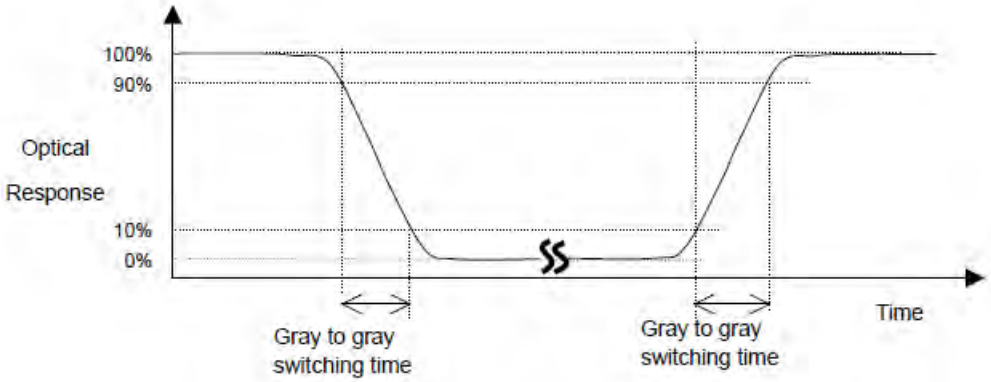

Note 2: Definition of viewing angle




Note 3: Contrast ratio is measured by Minolta CA210

Note 4: Definition of Response time

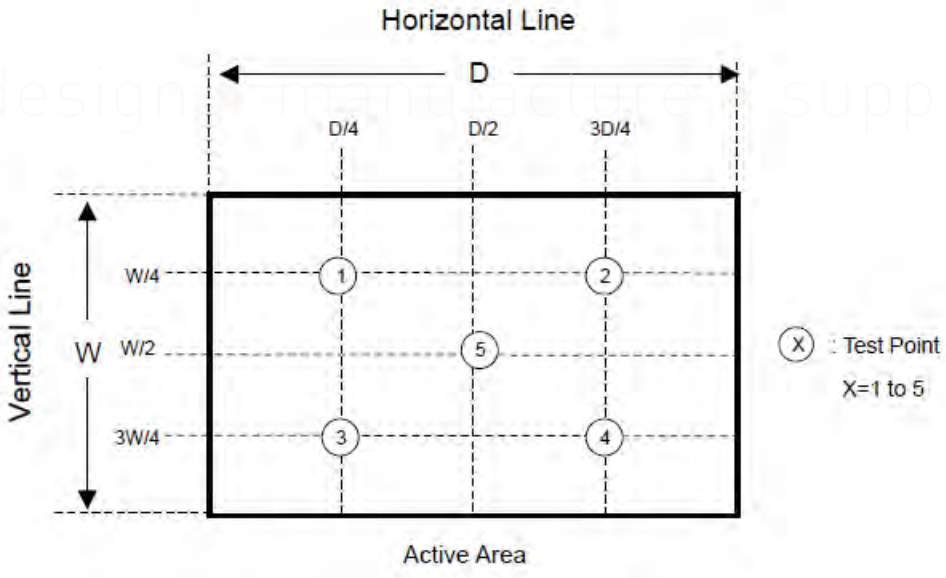
The output signals of photo detector are measured when the input signals are changed from “Full Black” to “Full White” (rising time), and from “Full White” to “Full Black” (falling time), respectively. The response time is interval between the 10% and 90% of amplitudes. Please refer to the figure as below.




Note 5: Color chromaticity and coordinates (CIE) is measured by Minolta CA210

Note 6: Center luminance is measured by Minolta CA210

Note 7: Luminance uniformity of these 5 points is defined as below and measured by Minolta CA210




Uniformity = (Min. Luminance of 5 points) / (Max. Luminance of 5 points)

## Reliability Test

| Items | Required Condition | Note |
|---|---|---|
| Temperature Humidity Bias (THB) | Ta= 50℃, 80%RH, 240hours | |
| High Temperature Operation (HTO) | Ta= 50℃, 240hours | 3 |
| Low Temperature Operation (LTO) | Ta= 0℃, 240hours | |
| High Temperature Storage (HTS) | Ta= 60℃, 240hours | |
| Drop Test | Height: 60 cm, package test | |
| Thermal Shock Test (TST) | -20℃/30min, 60℃/30min, 100 cycles | |
| On/Off Test | On/10sec, Off/10sec, 30,000 cycles | |
| ESD (ElectroStatic Discharge) | Contact Discharge: ± 8KV, 150pF(330Ω ) 1sec, 9 points, 25 times/ point. | |
| | Air Discharge: ± 15KV, 150pF(330Ω ) 1sec 9 points, 25 times/ point. | |

Result Evaluation Criteria:

There should be no change which might affect the practical display function when the display quality test is conducted under normal operating condition

# Precautions

## Mounting precautions

(1) You must mount a module using holes arranged on back side of panel.
(2) Please attach the surface transparent protective plate to the surface in order to protect the polarizer. Transparent protective plate should have sufficient strength in order to the resist external force.
(3) You should adopt radiation structure to satisfy the temperature specification.
(4) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
(5) Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment. Do not touch the surface of polarizer for bare hand or greasy cloth. (Some cosmetics are detrimental to the polarizer.)
(6) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzene. Normal-hexane is recommended for cleaning the adhesives used to attach front/ rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
(7) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
(8) Do not open the case because inside circuits do not have sufficient strength.

## Operating precautions

(1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage: V=± 200mV(Over and under shoot voltage)
(2) Response time depends on the temperature. (In lower temperature, it becomes longer..)
(3) Brightness depends on the temperature. (In lower temperature, it becomes lower.) And in lower temperature, response time (required time that brightness is stable after turned on) becomes longer.
(4) Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
(5) When fixed patterns are displayed for a long time, remnant image is likely to occur.
(6) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimize the interface.

## Electrostatic discharge control

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly.

## Precautions for strong light exposure

Strong light exposure causes degradation of polarizer and color filter.

## Storage

When storing modules as spares for a long time, the following precautions are necessary.

(1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5℃ and 35℃ at normal humidity.

(2) The polarizer surface should not come in contact with any other object. It is recommended that they be stored in the container in which they were shipped.

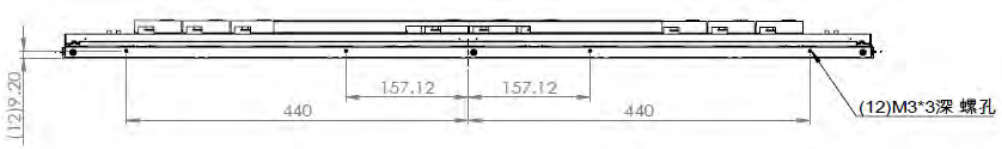
## Handing precautions for protection film

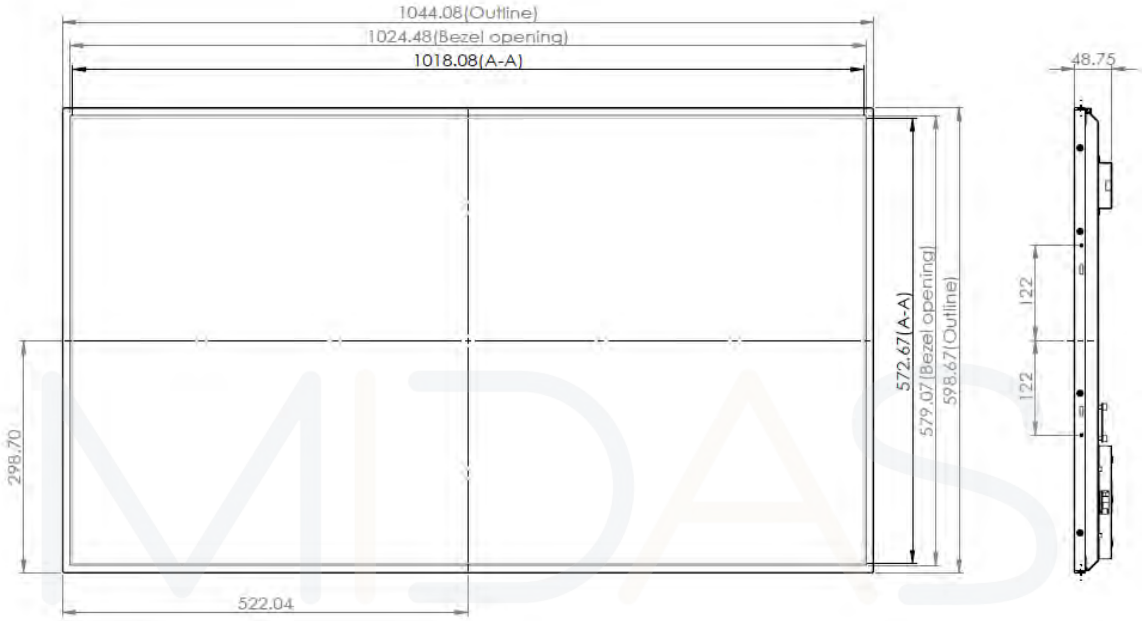
(1) The protection film is attached to the bezel with a small masking tape. When the protection film is peeled off, static electricity is generated between the film and polarizer. This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.

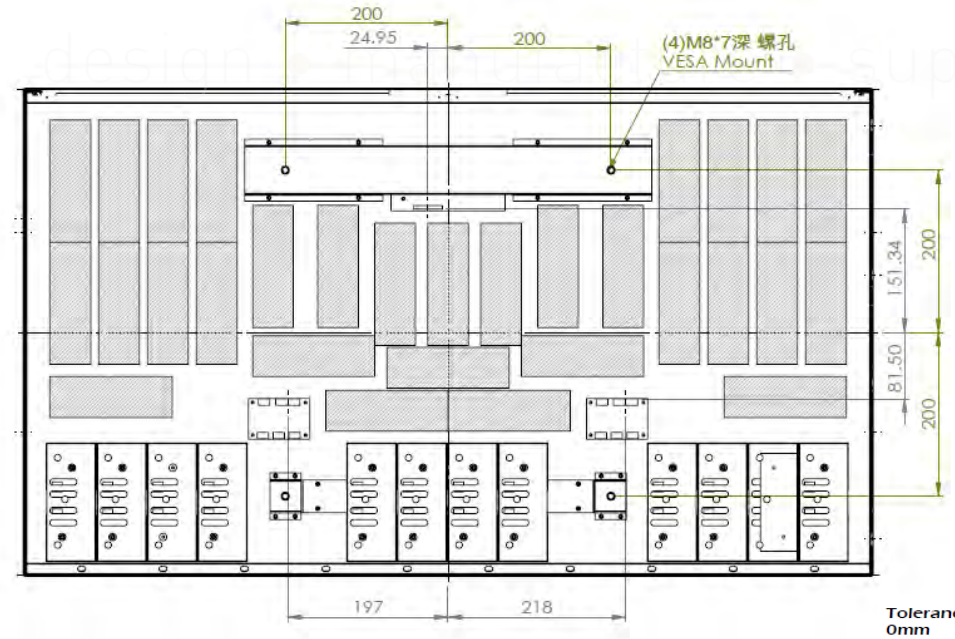
(2) When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of flue still on the Bezel after the protection film is peeled off.

(3) You can remove the glue easily. When the glue remains on the Bezel or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.

## Mechanical Characteristics




Tolerance:

| | | | |
|---|---|---|---|
| 0mm | ~ | 250mm | +/- 0.2mm |
| 250mm | ~ | 400mm | +/- 0.3mm |
| 400mm | ~ | 500mm | +/- 0.4mm |
| 500mm | ~ | 780mm | +/- 0.5mm |
| 780mm | ~ | 870mm | +/- 0.6mm |
| 870mm | ~ | 1100mm | +/- 0.8mm |
| 1100mm | ~ | 1400mm | +/-1.0mm |
| 1400mm | ~ | | +/-1.2mm |