# SPECIFICATION
# FOR
# APPROVAL

( ) **Preliminary Specification**
( ● ) **Final Specification**

| Title | 30.0" WQXGA TFT LCD |
|---|---|

| BUYER | HP |
|---|---|
| MODEL | |

| SUPPLIER | LG Display Co., Ltd. |
|---|---|
| "MODEL | LM300WQ5 |
| SUFFIX | SDA1 |

*When you obtain standard approval,
please use the above model name without suffix

| APPROVED BY | SIGNATURE / DATE |
|---|---|
| / | |
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Please return 1 copy for your confirmation with your signature and comments.

| APPROVED BY | SIGNATURE / DATE |
|---|---|
| J.H PARK / G.Manager | 10. 3. 11 |
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| J.H KIM / Manager [C] | 2010. 3. 11 |
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**MNT Products Engineering Dept.**
**LG Display Co., Ltd**

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# RECORD OF REVISIONS

| Revision No | Data | Page | Description |
|---|---|---|---|
| Ver. 0.0 | APR 24, 2009 | - | Preliminary specification |
| Ver. 0.1 | APR 30. 2009 | 16 | Added the color gamut specification and expression “with ODC” |
| Ver. 0.2 | MAY 06. 2009 | 4 | Block Diagram change. (Not fixed) |
| | | 8 | 30pin connector pin map change. (22~29pin) |
| | | 9 | Added page9 for 20pin power connector |
| Ver. 0.3 | JUN 09. 2009 | 9 | Changed 20 pin CNT pin map |
| | | 15 | Updated power sequence |
| Ver. 0.4 | JUN 17. 2009 | 4, 7 | Updated Inverter Electrical Characteristics (CCFL) |
| | | 17 | Changed DCR spec |
| | | 23, 24 | Updated Mechanical Drawing (CCFL) |
| Ver. 0.5 | AUG 27. 2009 | 8 | Changed 30pin connector pin map (22~25pin) |
| | | 9 | Changed 20pin connector pin map |
| | | 11 | Changed Inverter 14pin connector pin map (11 pin ) |
| | | 13 | Added single mode timing table |
| | | 29 | Added operating precaution 9-2 (10) |
| Ver. 0.6 | OCT 27. 2009 | 4, 6 | Updated electrical characteristics |
| | | 15 | Changed color data reference |
| | | 20 | Changed to gray response time table |
| | | 21 | Changed Average RGB values table |
| Ver. 0.7 | NOV 09. 2009 | 16 | Changed T3 (1400ms) |
| | | 26 | Reliability |
| Ver. 0.8 | JAN 26. 2010 | 18 | Changed GTG Spec.(5ms → 7ms) |
| | | 25 | Changed rear side tape shape and quantity. |
| Ver. 1.0 | MAR. 10. 2010 | - | Final Specification |
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## 1. General Description

The LM300WQ5 LCD is a Color Active Matrix Liquid Crystal Display with an integral Cold Cathode Fluorescent Lamp(CCFL) backlight system . The matrix employs a-Si Thin Film Transistor as the active element. It is a transmissive type display operating in the normally black mode. This TFT-LCD has a 30.0 inch diagonally measured active display area with WQXGA resolution(2560 vertical by 1600 horizontal pixel array). Each pixel is divided into Red, Green and Blue sub-pixels or dots which are arranged in vertical stripes. Gray scale or the luminance of the sub-pixel color is determined with a 10-bit gray scale signal for each dot, thus, presenting a palette of more than 1,073,741,824 colors.
The LM300WQ5 has been designed to apply the DisplayPort™ as the interface method to enables a simple and low-cost implementation in both the host and monitor.

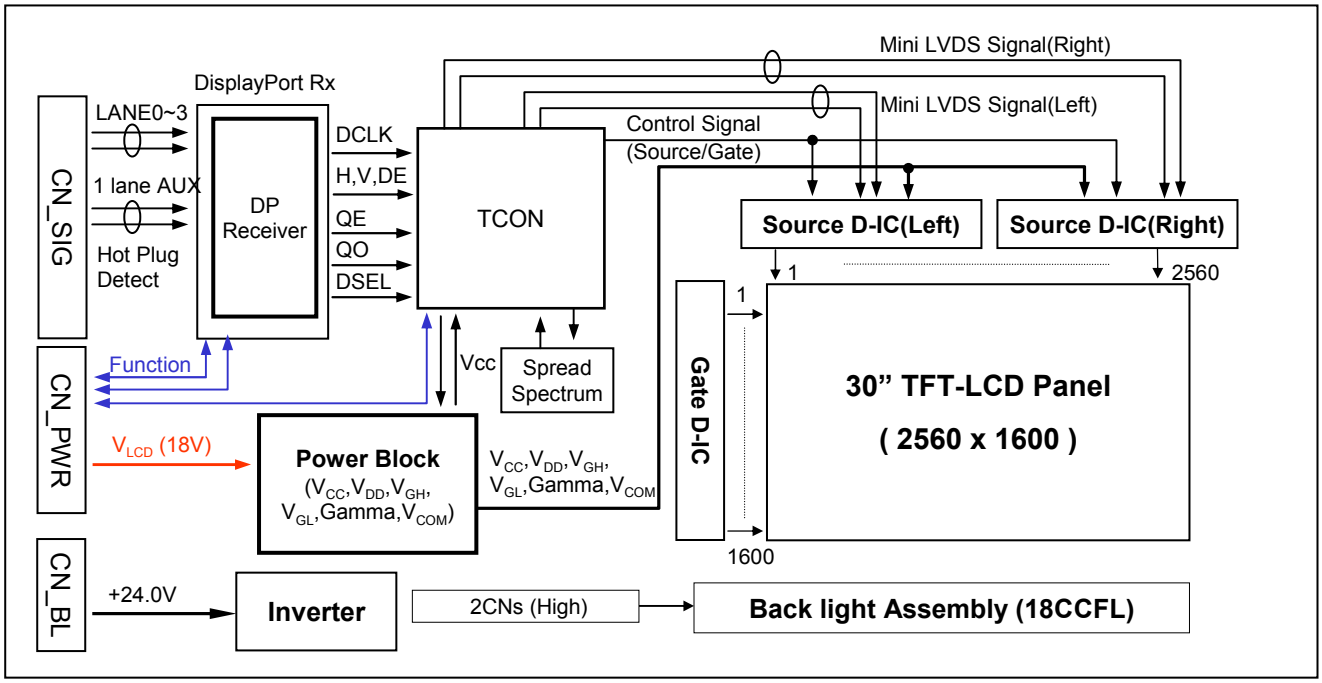



Figure 1. Block diagram

### General Features

| | |
|---|---|
| Active screen size | 30.0 inches (756.228mm) diagonal |
| Outline Dimension | 677.30(H) x 436.80(V) x 42.30(D) mm(Typ.) |
| Pixel Pitch | 0.2505 mm x 0.2505 mm |
| Pixel Format | 2560 horizontal By 1600 vertical Pixels. RGB stripe arrangement |
| Color Depth | 10-bit, 1,073,741,824 color |
| Luminance, White | 370 cd/m$^2$ ( 1 point Avg) |
| Viewing Angle(CR>10) | Viewing Angle Free(R/L 178(Typ.), U/D 178(Typ.)) |
| Power Consumption | Total 123 Watt(Typ.), ( 15 Watt @$V_{LCD}$, 108W @370cd) |
| Weight | 5100 g |
| Display Operating Mode | Transmissive mode, Normally Black |
| Surface Treatments | Hard coating (3H), Anti-glare treatment of the front polarizer |

## 2. Absolute Maximum Ratings

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

**Table 1. Absolute Maximum Ratings**

| Parameter | Symbol | Values | | Units | Notes |
|---|---|---|---|---|---|
| | | Min. | Max. | | |
| Power Supply Input Voltage for Panel | $V_{LCD}$ | -0.3 | 21.0 | $V_{dc}$ | At 25℃ ± 2°C |
| Operating Temperature | $T_{OP}$ | 0 | 50 | ℃ | 1 |
| Storage Temperature | $T_{ST}$ | -20 | 60 | ℃ | |
| Operating Ambient Humidity | $H_{OP}$ | 10 | 90 | %RH | |
| Storage Humidity | $H_{ST}$ | 10 | 90 | %RH | |

Note : 1. Temperature and relative humidity range are shown in the figure below.
Wet bulb temperature should be 39 °C Max, and no condensation of water.

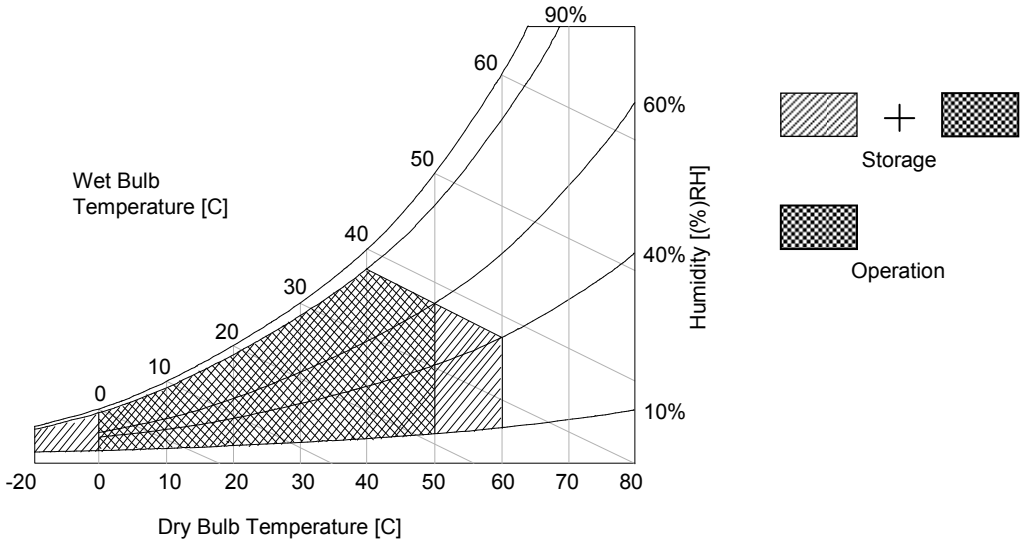



Figure 2. Temperature and relative humidity

# 3. Electrical Specifications

## 3-1. Electrical Characteristics

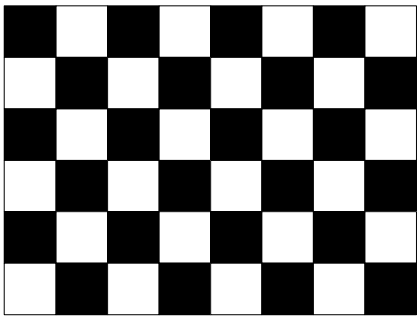
It requires three power inputs. One & two are employed to power the LCD electronics and to drive the TFT array and liquid crystal. The third input power for the CCFL, is typically generated by an inverter. The inverter is an external unit to the LCDs.

**Table 2. Electrical Characteristics**

| Parameter | Symbol | Values | | | Unit | Notes |
|---|---|---|---|---|---|---|
| | | Min | Typ | Max | | |
| MODULE : | | | | | | |
| Power Supply Input Voltage | $V_{LCD}$ | 17 | 18 | 19 | Vdc | |
| Permissive Power Input Ripple | $V_{dRF}$ | | | 400 | $mV_{p-p}$ | |
| Power Supply Input Current | $I_{LCD}$ | 700 | 830 | 960 | mA | 1 |
| | | - | 1080 | 1400 | mA | 2 |
| Power Consumption | $P_{LCD}$ | | 15 | 17.3 | Watt | 1 |
| Rush current | $I_{RUSH}$ | - | - | 4 | A | 3 |

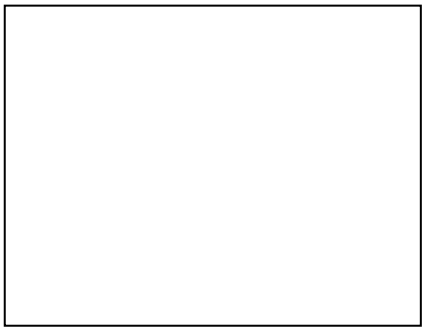
Note :
1. The specified current and power consumption are under the $V_{LCD}$=18.0V, 25 ± 2°C,$f_V$=60Hz condition whereas mosaic pattern(8 x 6) is displayed and $f_V$ is the frame frequency.
2. The current is specified at the maximum current pattern.
3. The duration of rush current is about 2ms and rising time of power Input is 1ms(min.).

White : 255Gray
Black : 0Gray



Mosaic Pattern(8 x 6)

Maximum current pattern



White Pattern

[ Figure 3 ] Mosaic pattern : for power consumption measurement

## Table 3. INVERTER Electrical Characteristics

| Parameter | Symbol | Condition | Values | | | Unit | Notes |
|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | | |
| **Inverter :** | | | | | | | |
| Input Voltage | $V_{BL}$ | | 22 | 24 | 26 | V | 1 |
| Input Current | $I_{BL}$ | $V_{BR}$ = 3.3V | | 4.5 | 5.4 | A | 2 |
| Input Power | PBL | $V_{BR}$ = 3.3V | | 108 | 130 | Watt | 2 |
| B/L on/off control | VON/OFF | Lamp ON = High | 2.0 | - | 5.0 | V | |
| | | Lamp OFF =Low | 0.0 | - | 0.8 | V | |
| Brightness Adj | VBR | | 0 | - | 3.3 | V | |
| **LAMP :** | | | | | | | |
| Life time | | | 40,000 | | | Hrs | 3 |

Notes :

1. The input voltage ripple is limited below 400mVp-p.
2. The specified current and power consumption are under the typical supply Input voltage, 24V.
3. The life is determined as the time at which luminance of the lamp is 50% compared to that of initial value at the typical lamp current on condition of continuous operating at 25 ± 2°C.
4. Electrical characteristics are determined after the unit has been 'ON' and stable for approximately 30min in a dark environment at 25 °C± 2°C.

## 3-2. Interface Connections

This LCD employs three kinds of interface connections. A 30-pin connector is used for DisplayPort signals from the host computer. A 20-pin connector is used for LCD module power and LCM controls signal from external monitor control circuits. And 14-pin connector is used for the inverter for backlight system.

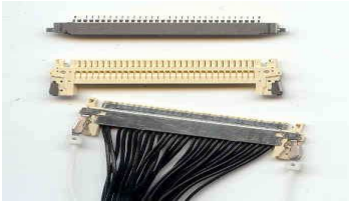
### 3-2-1. Signal Interface

The DisplayPort signal interface connector is KDF71G-30S-1H(500)(manufactured by Hirose) or equivalent. The pin configuration for the 30 pin connector is shown in the table below.

**Table 4. 30Pin Connector pin configuration(For DisplayPort)**

| Pin No. | Symbol | Description | Pin No. | Symbol | Description |
|---|---|---|---|---|---|
| 1 | Reserved | NC | 16 | Lane 3P | True Signal for Main Link 3 |
| 2 | Reserved | NC | 17 | Lane 3N | Component Signal for Main Link 3 |
| 3 | H_GND | High Speed Ground for Auxiliary Channel | 18 | H_GND | High Speed Ground |
| 4 | AUX_CH N | Component Signal for Auxiliary Channel | 19 | Reserved | LCD Vender use/No Connection |
| 5 | AUX_CH P | True Signal for Auxiliary Channel | 20 | Reserved | LCD Vender use/No Connection |
| 6 | H_GND | High Speed Ground for Main Link 0 | 21 | HPD | Hot Plug Detect Signal |
| 7 | Lane 0P | True Signal for Main Link 0 | 22 | H_GND | High Speed Ground |
| 8 | Lane 0N | Component Signal for Main Link 0 | 23 | UART _RX | For DP RX Firmware update |
| 9 | H_GND | High Speed Ground for Main Link 1 | 24 | UART _TX | For DP RX Firmware update |
| 10 | Lane 1P | True Signal for Main Link 1 | 25 | H_GND | High Speed Ground |
| 11 | Lane 1N | Component Signal for Main Link 1 | 26 | Reserve | NC |
| 12 | H_GND | High Speed Ground for Main Link 2 | 27 | Reserve | NC |
| 13 | Lane 2P | True Signal for Main Link 2 | 28 | Reserve | NC |
| 14 | Lane 2N | Component Signal for Main Link 2 | 29 | Reserve | NC |
| 15 | H_GND | High Speed Ground for Main Link 3 | 30 | Reserved | NC |

Notes : 1. Interface Chips
: gm68020 x 1ea (DisplayPort Receiver, GENESIS)
2. Connector
2.1 Connector(Receptacle) : KDF71G-30S-1H(500)(Hirose) or equivalent.
2.2 Mating Connector(Plug) : FI-X30H and FI-X30HL or its equivalent.



### 3-2-2. Power Connector

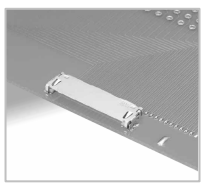
The Power connector is DF19G-20P-1H(56) or equivalent.

The pin configuration for the 20 pin connector is shown in the table below.

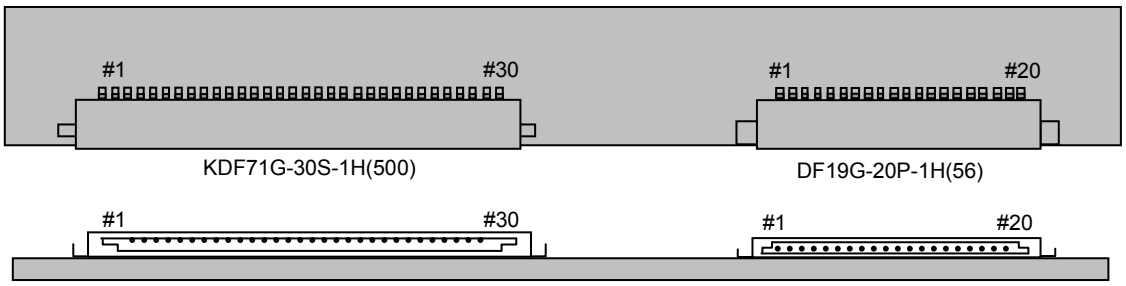
**Table 5. 20Pin Connector pin configuration (Power Connector)**

| Pin No. | Symbol | I/O | Description | Notes |
|---|---|---|---|---|
| 1 | LCM_SDA | I/O | NC | |
| 2 | LCM_SCL | I | NC | |
| 3 | PWR_ON | I | LCM on signal input. (3.3V) | |
| 4 | GND | | Ground | |
| 5 | DDC_SDA | I/O | NC | |
| 6 | DDC_SCL | O | NC | |
| 7 | AGP | I | Auto pattern generation. (High is enable, Low / NC is disable) | |
| 8 | GND | | Ground | |
| 9 | HS_OUT | O | NC | |
| 10 | VS_OUT | O | NC | |
| 11 | PWM | O | PWM Signal output for synchronized Inverter | |
| 12 | GND | | Ground | |
| 13 | DCR_BR | O | Brightness voltage output for DCR function. | |
| 14 | GND | | Ground | |
| 15 | VLCD | I | LCD Power (18V) | |
| 16 | VLCD | I | LCD Power (18V) | |
| 17 | VLCD | I | LCD Power (18V) | |
| 18 | GND | | Ground | |
| 19 | GND | | Ground | |
| 20 | GND | | Ground | |

Notes : 1. Connector
1) Connector(Receptacle) : DF19G-20P-1H(56) or Equivalent.
2) Mating Connector(Plug) : DF19G-20S-1C or Equivalent.



[ Figure 4 ] Connector diagram




**Rear view of LCM**

**Signal Connector(30pins) is left side and**
**Power Connector(20pins) is right side**

Notes:

1. All GND(ground) pins should be connected together and should also be connected to the LCD's metal frame.
2. All power input pins should be connected together.
3. All NC pins should be separated from other signal or power.

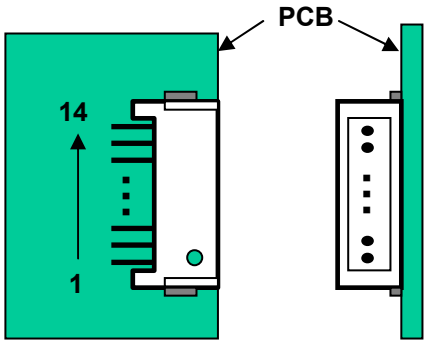
### 3-2-3. Inverter Connector for Backlight

The inverter connector is S14B-PH-SM3-TB (manufactured by YeonHo) or equivalent
The pin configuration for the 14 pin connector is shown in the table below.

**Table 5. 14Pin Connector Pin Configuration (Inverter Connector)**

| Pin | Symbol | Description | Notes |
|---|---|---|---|
| 1 | $V_{BL}$ | Power Supply, +24V | |
| 2 | $V_{BL}$ | Power Supply, +24V | |
| 3 | $V_{BL}$ | Power Supply, +24V | |
| 4 | $V_{BL}$ | Power Supply, +24V | |
| 5 | $V_{BL}$ | Power Supply, +24V | |
| 6 | GND | Power Ground | |
| 7 | GND | Power Ground | |
| 8 | GND | Power Ground | |
| 9 | GND | Power Ground | |
| 10 | GND | Power Ground | |
| 11 | PWM | PWM Signal Input for Synchronized Inverter | |
| 12 | $V_{ON}$ | BL On/Off Control signal | ON : 2.0V~5.0V<br>OFF : 0.0~0.8V |
| 13 | $V_{BR}$ | PWM Dimming Control Signal | Max3.3V/Min0.0V |
| 14 | NC | NC | |

1. Connector
   1) Connector(Receptacle) : S14B-PHA-SM3-TB (YeonHo) or equivalent
   2) Mating Connector(Plug) : PHR14 or its equivalent




**Rear view of LCM**

### 3-3. Signal Timing Specifications

This is the signal timing required at the input of the DisplayPort Transmitter. All of the interface signal timing should be satisfied with the following specifications for it's proper operation.

**Table 6. TIMING TABLE 1 ( Resolution : 2560x1600)**

| ITEM | | SYMBOL | Min | Typ | Max | Unit | Note |
|---|---|---|---|---|---|---|---|
| DCLK | Period | $t_{CLK}$ | 7.45 | 7.45 | 7.45 | ns | Pixel Frequency : Typ 268.5MHz |
| | Frequency | $f_{CLK}$ | (133.25) | 134.25 | (135.25) | MHz | |
| Hsync | Width-Total | $t_{HT}$ | 2720 | 2720 | 2720 | $t_{CLK}$ | |
| | Period | $t_{HP}$ | 10.13 | 10.13 | 10.13 | us | |
| | Frequency | $f_H$ | 98.71 | 98.71 | 98.71 | KHz | |
| | Width | $t_{WH}$ | 32 | 32 | 32 | $t_{CLK}$ | |
| Vsync | Width-Total | $t_{VT}$ | 1646 | 1646 | 1646 | $t_{HP}$ | |
| | Period | $t_{VP}$ | 16.68 | 16.68 | 16.68 | | |
| | Frequency | $f_V$ | 59.97 | 59.97 | 59.97 | Hz | |
| | Width | $t_{WV}$ | 6 | 6 | 6 | $t_{HP}$ | |
| Data Enable | Horizontal Valid | $t_{HV}$ | 2560 | 2560 | 2560 | $t_{CLK}$ | |
| | Horizontal Back Porch | $t_{HBP}$ | 80 | 80 | 80 | | |
| | Horizontal Front Porch | $t_{HFP}$ | 48 | 48 | 48 | | |
| | Horizontal Blank | - | 160 | 160 | 160 | | $t_{WH}$+ $t_{HBP}$+ $t_{HFP}$ |
| | Vertical Valid | $t_{V V}$ | 1600 | 1600 | 1600 | $t_{HP}$ | |
| | Vertical Back Porch | $t_{VBP}$ | 38 | 38 | 38 | | |
| | Vertical Front Porch | $t_{VFP}$ | 2 | 2 | 2 | | |
| | Vertical Blank | - | 46 | 46 | 46 | | $t_{WV}$+ $tV_{BP}$+ $t_{VFP}$ |

Note: Hsync period and Hsync width-active should be even number times of $t_{CLK}$. If the value is odd number times of $t_{CLK}$, display control signal can be asynchronous. In order to operate this LCM a Hsync, Vsyn, and DE(data enable) signals should be used.

1. : The performance of the electro-optical characteristics may be influenced by variance of the vertical refresh rates.
2. Vsync and Hsync should be keep the above specification.
3. Hsync Period, Hsync Width, and Horizontal Back Porch should be any times of of character number(8).
4. The polarity of Hsync, Vsync is not restricted.

**Table 8. TIMING TABLE 2 ( Single mode: 1280x800)**

PS ON : Low

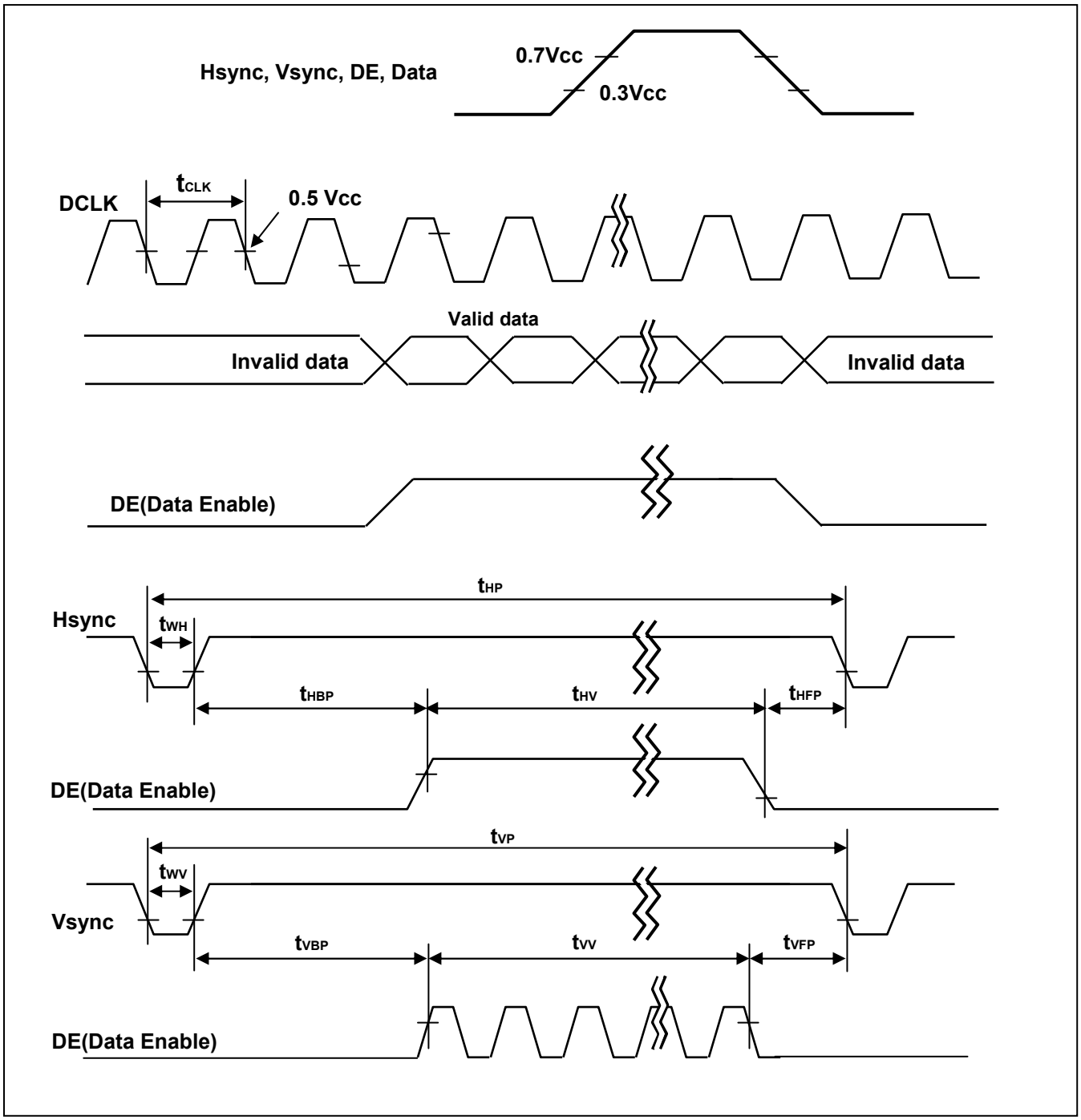
| ITEM | | SYMBOL | Min | Typ | Max | Unit | Note |
|---|---|---|---|---|---|---|---|
| DCLK | Period | $t_{CLK}$ | 14.08 | 14.08 | 14.08 | ns | |
| | Frequency | $f_{CLK}$ | 71.00 | 71.00 | 71.00 | MHz | Single |
| Hsync | Width-Total | $t_{HP}$ | 1440 | 1440 | 1440 | $t_{CLK}$ | |
| | Period | $t_{HP}$ | 20.28 | 20.28 | 20.28 | us | |
| | Frequency | $f_H$ | 49.31 | 49.31 | 49.31 | KHz | |
| | Width | $t_{WH}$ | 32 | 32 | 32 | $t_{CLK}$ | |
| Vsync | Width-Total | $t_{VT}$ | 823 | 823 | 823 | $t_{HP}$ | |
| | Period | $t_{VP}$ | 16.69 | 16.69 | 16.69 | ms | |
| | Frequency | $f_V$ | 59.91 | 59.91 | 59.91 | Hz | |
| | Width | $t_{WV}$ | 6 | 6 | 6 | $t_{HP}$ | |
| Data Enable | Horizontal Valid | $t_{HV}$ | 1280 | 1280 | 1280 | $t_{CLK}$ | |
| | Horizontal Back Porch | $t_{HBP}$ | 80 | 80 | 80 | | |
| | Horizontal Front Porch | $t_{HFP}$ | 48 | 48 | 48 | | |
| | Horizontal Blank | - | 160 | 160 | 160 | | $t_{WH}$+ $t_{HBP}$+ $t_{HFP}$ |
| | Vertical Valid | $t_{V V}$ | 800 | 800 | 800 | $t_{HP}$ | |
| | Vertical Back Porch | $t_{VBP}$ | 15 | 15 | 15 | | |
| | Vertical Front Porch | $t_{VFP}$ | 2 | 2 | 2 | | |
| | Vertical Blank | - | 23 | 23 | 23 | | $t_{WV}$+ $tV_{BP}$+ $t_{VFP}$ |

**Notes** :

Hsync period and Hsync width-active should be even number times of $t_{CLK}$. If the value is odd number times of $t_{CLK}$, display control signal can be asynchronous. In order to operate this LCM a Hsync.,Vsync and DE(data enable) signals should be used.

1. The performance of the electro-optical characteristics are may be influenced by variance of the vertical refresh rates.
2. Vsync, Hsync should be keep the above specification.
3. Hsync Period should be a double number of character (8).
4. The polarity of Hsync, Vsync is not restricted.

### 3-4. Signal Timing Waveforms



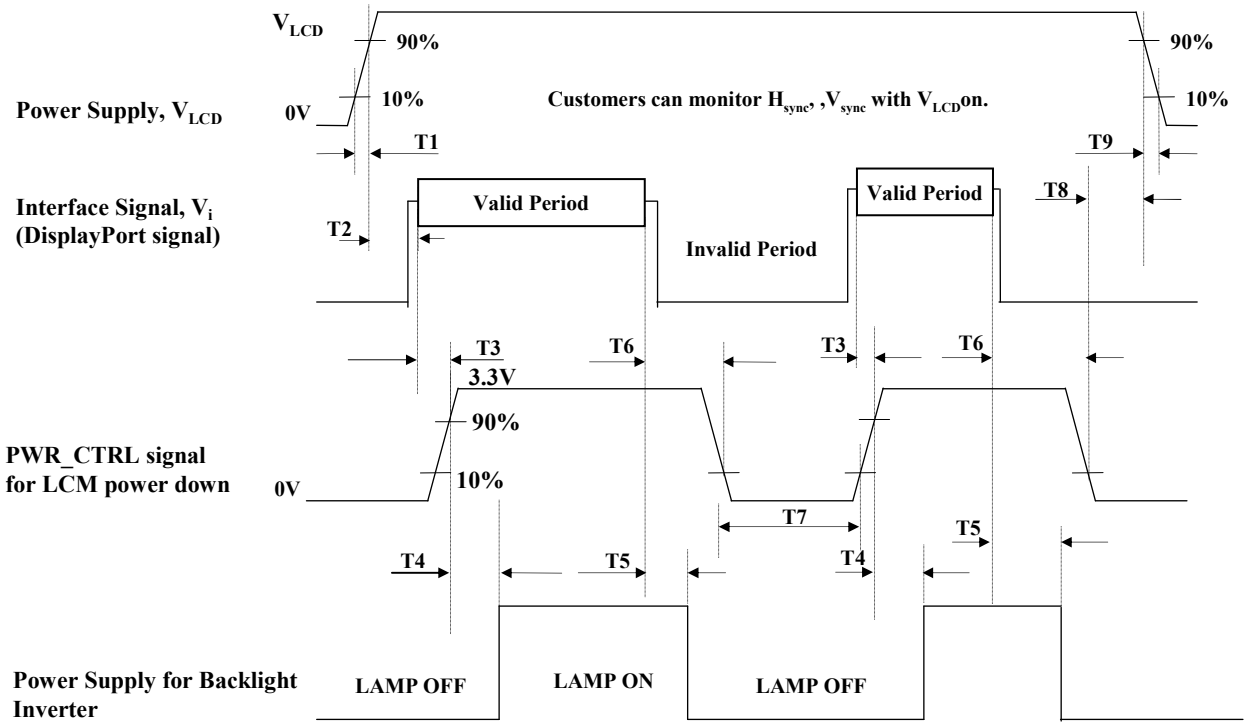
### 3-5. Color Input Data Reference

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.

**Table 7. 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 |
| RED | 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 |
| GREEN | 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 |
| BLUE | 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 |

## 3-6. Power Sequence for Panel




**POWER SEQUENCE**

### Table 8. Power Sequence

| Parameter | Values | | | Units |
|---|---|---|---|---|
| | Min. | Typ. | Max. | |
| T1 | - | | 30 | ms |
| T2 | - | - | - | ms |
| T3 | 1400 | | - | ms |
| T4 | 100 | | - | ms |
| T5 | - | | 80 | ms |
| T6 | - | | 80 | ms |
| T7 | 400 | | - | ms |
| T8 | 50 | | - | ms |
| T9 | - | | 10 | ms |

Notes : 1. Please avoid floating state of interface signal at invalid period.
2. When the interface signal is invalid, be sure to pull down the power supply for LCD $V_{LCD}$to 0V.
3. Lamp power must be turn on after power supply for LCD and interface signal are valid.

### 3-7. Power Sequence for Inverter

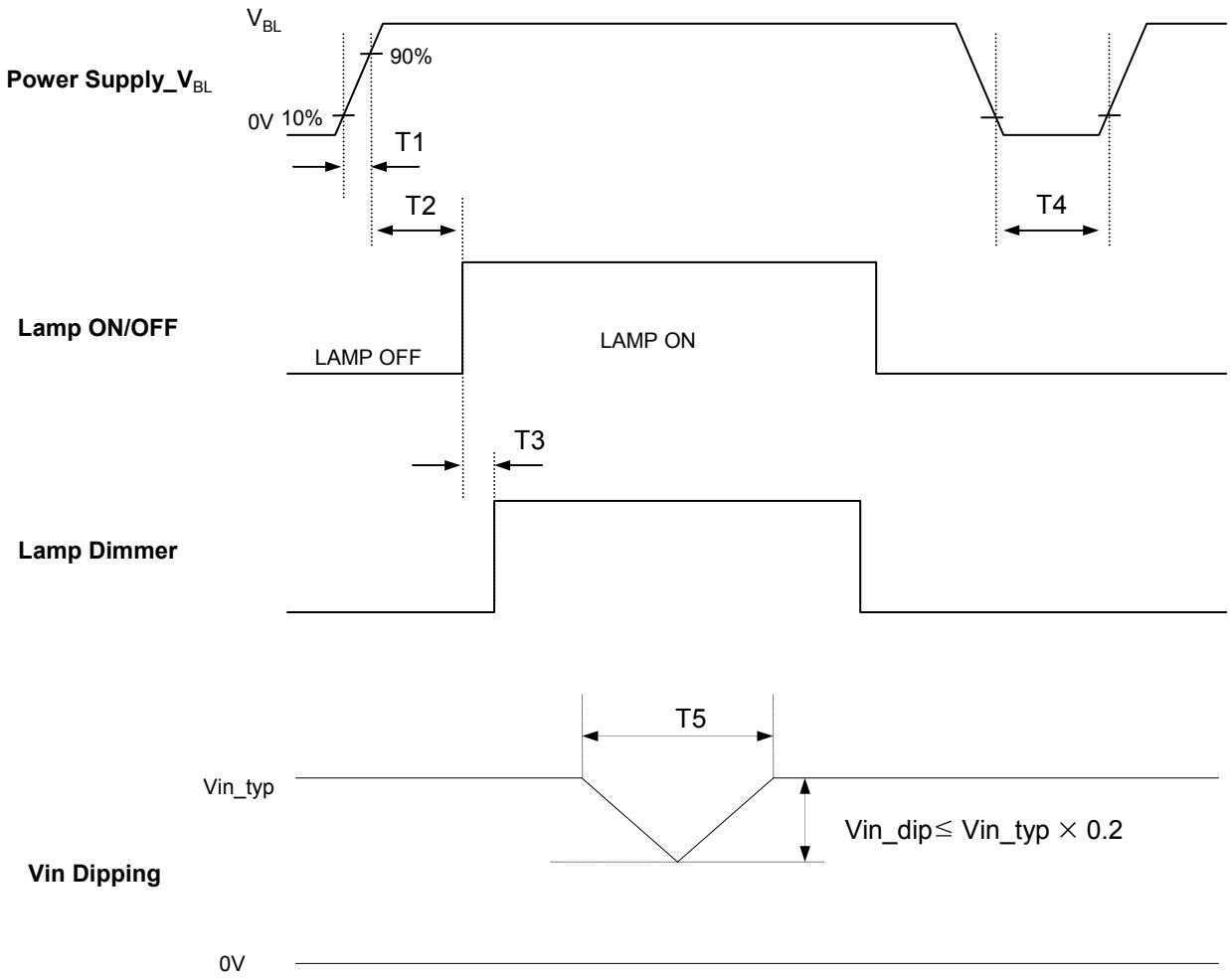
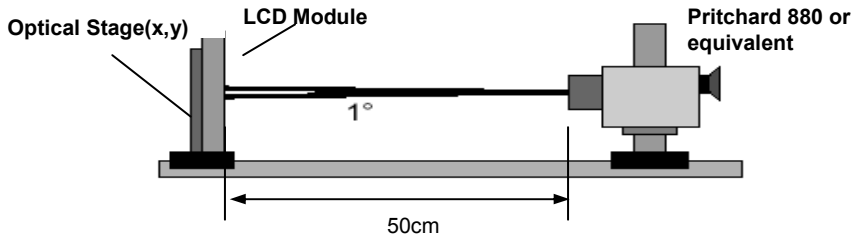



**Table 9. Power Sequence**

| Parameter | Values | | | Units | Notes |
|---|---|---|---|---|---|
| | Min. | Typ. | Max. | | |
| T1 | 10 | - | - | ms | |
| T2 | 200 | - | - | ms | |
| T3 | - | - | 50 | ms | |
| T4 | 500 | - | - | ms | |
| T5 | - | - | 10 | ms | |

## 4. Optical Specification

Optical characteristics are determined after the unit has been 'ON' and stable for approximately 30 minutes in a dark environment at 25 °C. The values specified are measured at an approximate distance 50cm from the LCD surface at a viewing angle of Φ and θ equal to 0 °.
Figure. 5 presents additional information concerning the measurement equipment and method.




[Figure 5] Optical characteristic measurement equipment and method

**Table 10. Optical characteristics** (Ta=25±2°C, $V_{LCD}$=18V, $f_V$=60Hz, CLK=134.25MHz)

| Parameter | | Symbol | Values | | | Units | Notes |
|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | | |
| Contrast Ratio | | CR | 700 | 1000 | | | 1 |
| | | DCR | 2100 | 3000 | | | |
| Surface Luminance, white | | $L_{WH}$ | 300 | 370 | | cd/m$^2$ | 2 |
| Luminance Variation | | $\delta_{WHITE}$ | 75 | - | - | % | 3 |
| Luminance Uniformity (angular dependant) | | | - | - | 1.7 | TCO '99 | |
| Response Time | Rise Time | $Tr_R$ | - | 6 | 12 | ms | 4 |
| | Decay Time | $Tr_D$ | - | 6 | 12 | ms | 4 |
| | Gray To Gray (with ODC) | $T_{GTG\_AVR}$ | - | 7 | - | ms | 5 |
| | | $T_{GTG\_MAX}$ | - | 17 | - | ms | 5 |
| Color Coordinates [CIE1931] | RED | Rx | Typ -0.03 | 0.678 | Typ +0.03 | | |
| | | Ry | | 0.309 | | | |
| | GREEN | Gx | | 0.210 | | | |
| | | Gy | | 0.692 | | | |
| | BLUE | Bx | | 0.146 | | | |
| | | By | | 0.055 | | | |
| | WHITE | Wx | | 0.313 | | | |
| | | Wy | | 0.329 | | | |
| Color shift | Horizontal | $\theta_{CST\_H}$ | - | 176 | - | degree | 6 |
| | Vertical | $\theta_{CST\_V}$ | - | 176 | - | | |
| Viewing Angle (CR>10) | | | | | | | |
| General | Horizontal | $\theta_H$ | 170 | 178 | - | degree | 7 |
| | Vertical | $\theta_V$ | 170 | 178 | - | | |
| Effective | Horizontal | $\theta_{GMA\_H}$ | - | 176 | - | degree | 8 |
| | Vertical | $\theta_{GMA\_V}$ | - | 176 | - | | |
| Gray Scale | | | | 2.2 | | | 9 |
| Color Gamut [CIE1976] | | CG | | 117.5 | | | |

Notes 1. Contrast Ratio(CR) is defined mathematically as :

$$\text{Contrast Ratio} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$

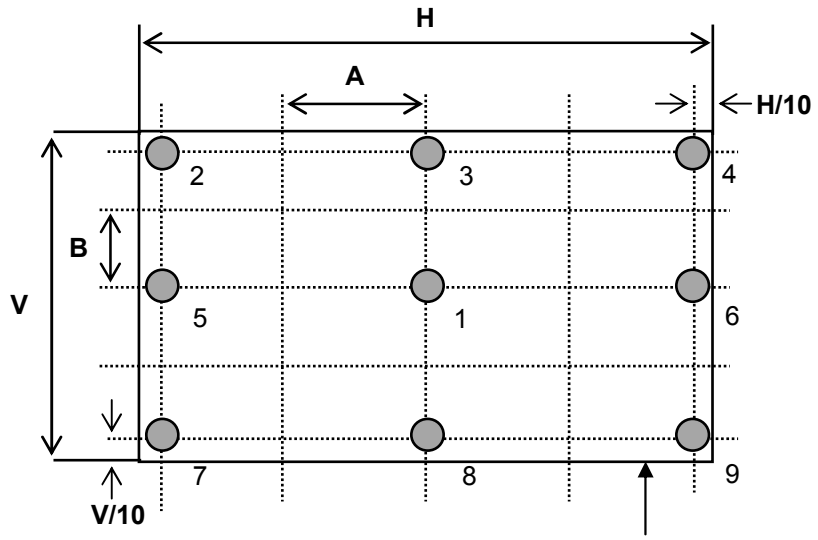
2. Surface luminance is luminance value at 5 points average across the LCD surface 50cm from the surface with all pixels displaying white. For more information see FIG 6.

$L_{WH} = L_{on1}$

3. The variation in surface luminance , $\delta$ WHITE is defined as :

$$\delta_{WHITE} = \frac{\text{Minimum}(L_{on1}, L_{on2}, \ldots L_{on9})}{\text{Maximum}(L_{on1}, L_{on2}, \ldots L_{on9})} \times 100(\%)$$

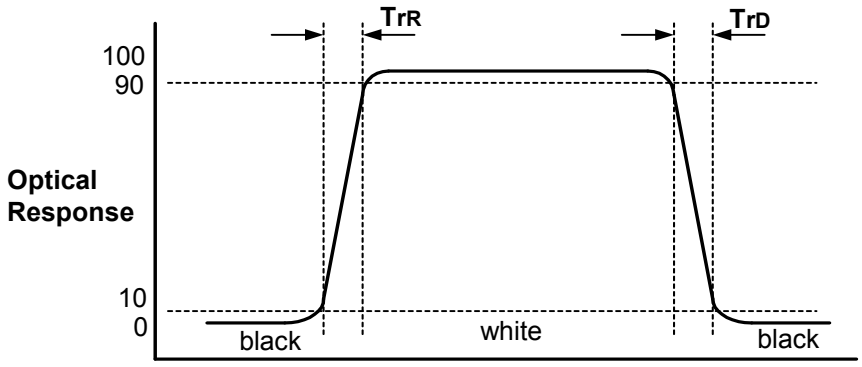
Measuring point for surface luminance & measuring point for luminance variation




A : H/4 mm
B : V/4 mm
@ H,V : Active Area

[Figure 6] **Measure Point for Luminance**

4. **The response time** is defined as the following figure and shall be measured by switching the input signal for “black” and “white”.
   Response time is the time required for the display to transition from black to white (Rise Time, T**rR**) and from white to black (Decay Time, T**rD**).




[Figure 7] **Response Time**

5. **The Gray to Gray response time** is defined as the following figure and shall be measured by switching the input signal for “Gray To Gray “.
   - Gray step : 5 Step
   - $T_{GTG\_AVR}$ is the total average time at rising time and falling time for “Gray To Gray “.
   - $T_{GTG\_MAX}$ is the max time at rising time or falling time for “Gray To Gray “.

| Gray to Gray | | Rising Time | | | | |
|---|---|---|---|---|---|---|
| | | G1023 | G767 | G511 | G255 | G0 |
| Falling Time | G1023 | | | | | |
| | G767 | | | | | |
| | G511 | | | | | |
| | G255 | | | | | |
| | G0 | | | | | |

6. **Color shift** is the angle at which the color difference is lower than 0.04.

- Color difference( Δ u'v')

$$u' = \frac{4x}{-2x + 12y + 3} \qquad v' = \frac{9y}{-2x + 12y + 3}$$

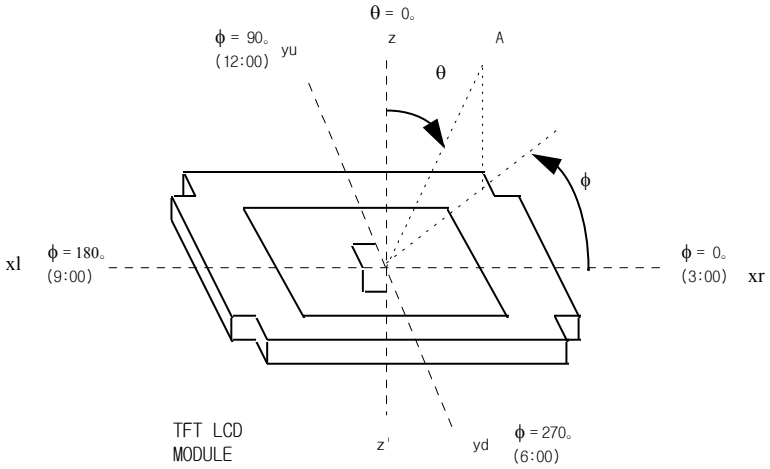
$$\Delta u'v' = \sqrt{(u'_1-u'_2)^2+(v'_1-v'_2)^2}$$

u'1, v'1 : u'v' value at viewing angle direction

u'2, v'2 : u'v' value at front(Θ=0)

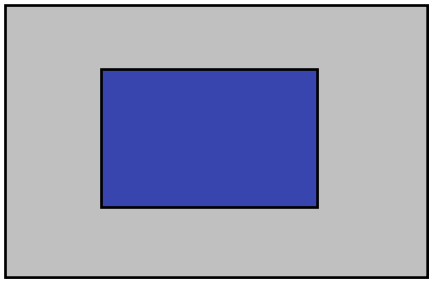
- Pattern size : 25% Box size

- Viewing angle direction of color shift : Horizontal, Vertical




Viewing angle direction

25% Box size



Average RGB values in Bruce RGB for Macbeth Chart

| | Dark skin | Light skin | Blue sky | Foliage | Blue flower | Bluish green |
|---|---|---|---|---|---|---|
| R | 395 | 827 | 343 | 311 | 519 | 459 |
| G | 227 | 571 | 451 | 411 | 475 | 799 |
| B | 183 | 495 | 647 | 187 | 743 | 715 |
| | Orange | Purplish blue | Moderate red | Purple | Yellow green | Orange yellow |
| R | 879 | 227 | 847 | 307 | 643 | 923 |
| G | 419 | 279 | 271 | 159 | 775 | 651 |
| B | 99 | 699 | 351 | 347 | 235 | 119 |
| | Blue | Green | Red | Yellow | Magenta | cyan |
| R | 107 | 291 | 791 | 967 | 831 | 143 |
| G | 131 | 595 | 111 | 851 | 251 | 507 |
| B | 583 | 263 | 151 | 147 | 607 | 691 |
| | White | Neutral 8 | Neutral 6.5 | Neutral 5 | Neutral 3.5 | black |
| R | 963 | 827 | 623 | 443 | 255 | 91 |
| G | 963 | 827 | 623 | 443 | 255 | 91 |
| B | 963 | 827 | 623 | 443 | 255 | 91 |

7. **General viewing angle** is the angle at which the contrast ratio is greater than 10.

8. **Effective viewing angle** is the angle at which the gamma shift of gray scale is lower than 0.3.

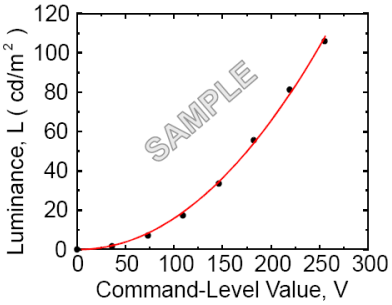



*Fig. 1. Sample Luminance vs. gray scale (using a 256 bit gray scale).*

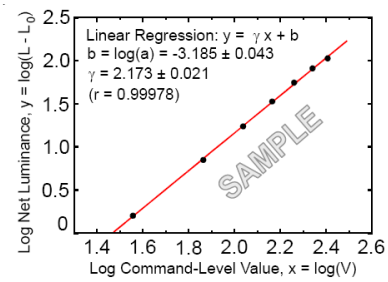



*Fig. 2. Sample Log-log plot of luminance vs. gray scale.*

$$L = aV^{r} + L_b$$

$$\log(L - L_b) = r\log(V) + \log(a)$$

Here the Parameter $\alpha$ and $\gamma$ relate the signal level V to the luminance L.

The GAMMA we calculate from the log-log representation

9. Gray scale specification

Gamma Value is approximately 2.2. For more information see Table 11.

**Table 11. Gray Scale Specification**

| Gray Level | Relative Luminance [%] (Typ.) |
|---|---|
| 0 | 0.3 |
| 127 | 1.2 |
| 255 | 4.68 |
| 383 | 11.7 |
| 511 | 21.2 |
| 639 | 35.2 |
| 767 | 53.0 |
| 895 | 75.4 |
| 1023 | 100 |

## 5. Mechanical Characteristics

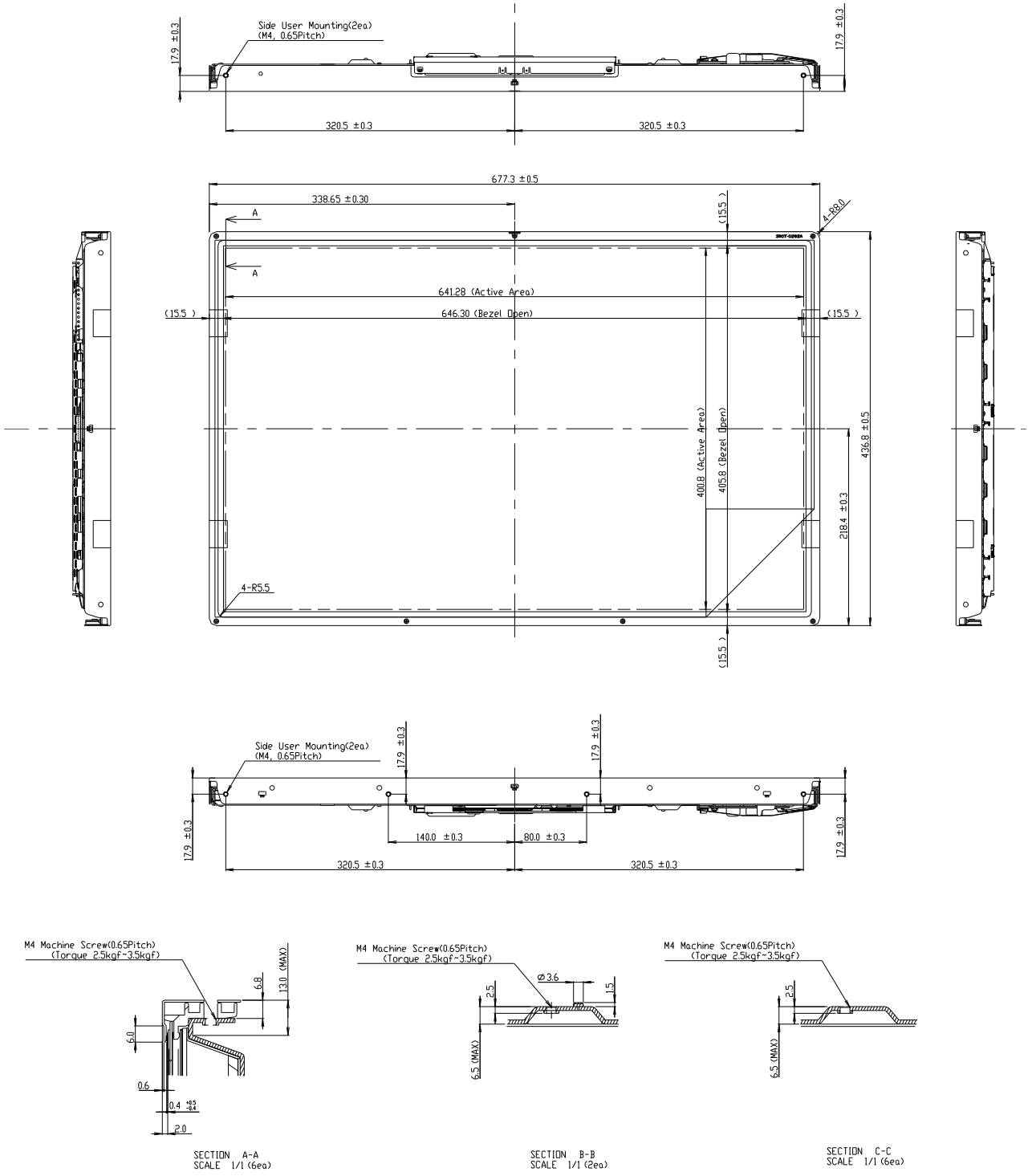
The contents provide general mechanical characteristics. In addition the figures in the next page are detailed mechanical drawing of the LCD.

**Table 12. Mechanical characteristics**

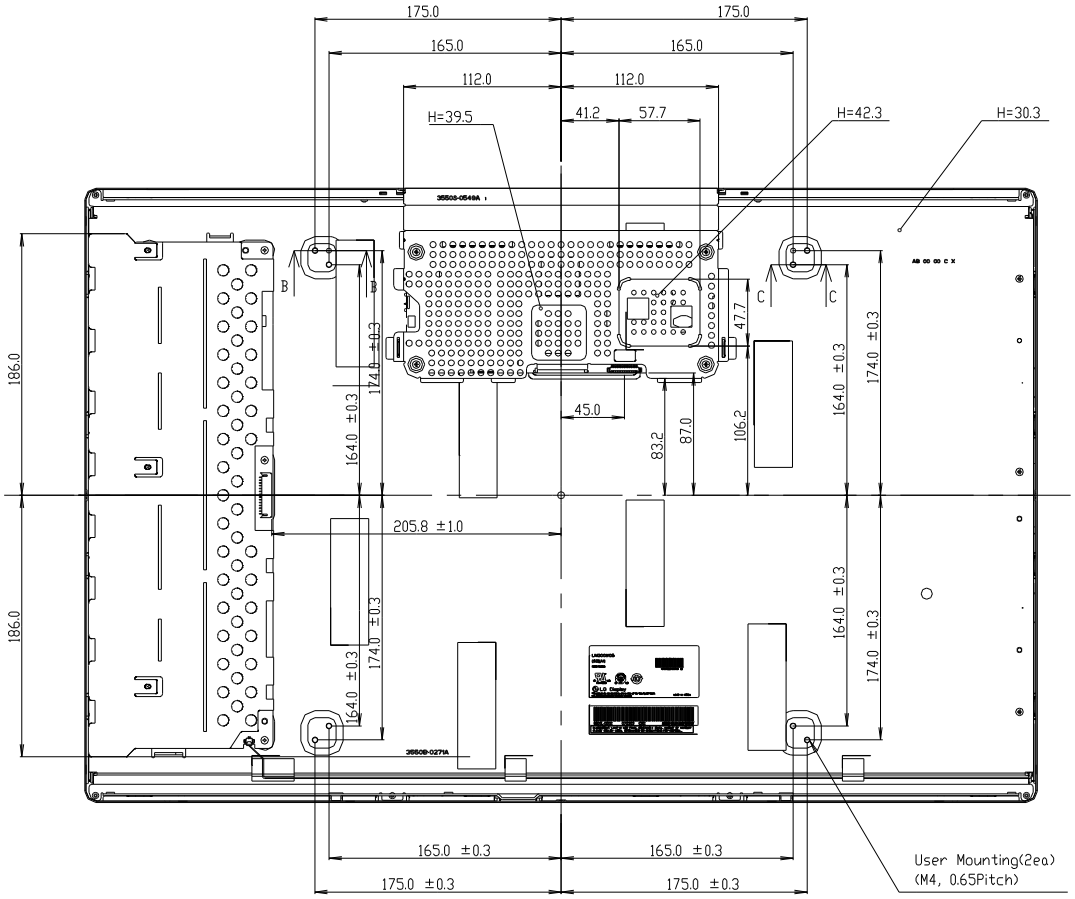
| | | |
|---|---|---|
| Outline Dimension | Horizontal | 677.30 mm |
| | Vertical | 436.80 mm |
| | Depth | 42.30 mm |
| Bezel Area | Horizontal | 646.30 mm |
| | Vertical | 405.80 mm |
| Active Display Area | Horizontal | 641.28 mm |
| | Vertical | 400.8 mm |
| Weight | 5100g (Typ.), 5400g (Max.) | |
| Surface Treatment | Hard coating(3H)<br>Anti-glare(13%) treatment of the front polarizer | |

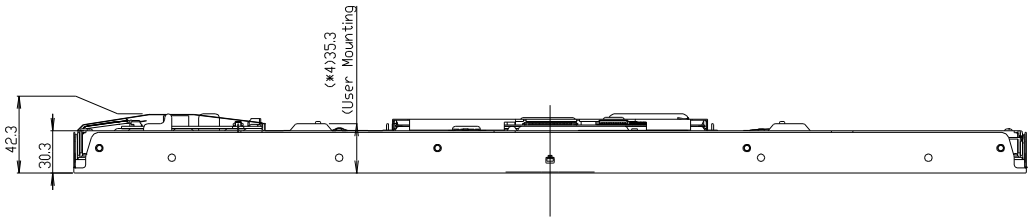
Notes : Please refer to a mechanic drawing in terms of tolerance at the next page.

<FRONT VIEW>

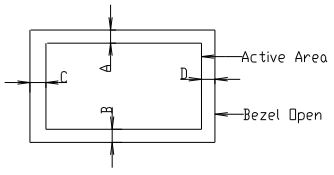

Side User Mounting(2ea)
(M4, 0.65Pitch)
17.9 ±0.3
320.5 ±0.3
677.3 ±0.5
338.65 ±0.30
A
4-R8.0
(15.5 )
641.28 (Active Area)
646.30 (Bezel Open)
400.8 (Active Area)
415.8 (Bezel Open)
436.8 ±0.5
218.4 ±0.3
4-R5.5
140.0 ±0.3
80.0 ±0.3
M4 Machine Screw(0.65Pitch)
(Torque 2.5kgf~3.5kgf)
13.0 (MAX)
6.8
6.0
0.6
0.4
2.0
Ø3.6
2.5
1.5
6.5 (MAX)
SECTION A-A
SCALE 1/1 (6ea)
SECTION B-B
SCALE 1/1 (2ea)
SECTION C-C
SCALE 1/1 (6ea)

<REAR VIEW>




Notes
1. Unspecified tolerances are to be ±0.5mm.
2. Both backlight wires and contraction tubes are excluded from outline dimensions.
3. Tilt and partial disposition tolerance of display area are as following.
   (1) Y-direction : |A-B| ≤ 1.4mm
   (2) X-direction : |A-B| ≤ 1.4mm




4. User Connector Specification : KDF71G-30S-1H
5. Power Connector Specification : DF19G-20P-1H

## 6. Reliability

Environment test condition

| No | Test Item | Condition |
|---|---|---|
| 1 | High temperature storage test | Ta= 60°C 240h |
| 2 | Low temperature storage test | Ta= -20°C 240h |
| 3 | High temperature operation test | Ta= 50°C 50%RH 240h |
| 4 | Low temperature operation test | Ta= 0°C 240h |
| 5 | Vibration test<br>(non-operating) | Wave form : random<br>Vibration level : 1.0G RMS<br>Bandwidth : 10-300Hz<br>Duration : X,Y,Z, 10 min<br>One time each direction |
| 6 | Shock test<br>(non-operating) | Shock level : 100G<br>Waveform : half sine wave, 2ms<br>Direction : ±X, ±Y, ±Z<br>One time each direction |
| 7 | Altitude<br>operating<br>storage / shipment | <br>0 - 16,400 feet(5000m)<br>0 - 40,000 feet(12,192m) |

# 7. International Standards

## 7-1. Safety

a) UL 60950-1:2003, First Edition, Underwriters Laboratories, Inc.,
Standard for Safety of Information Technology Equipment.
b) CAN/CSA C22.2, No. 60950-1-03 1st Ed. April 1, 2003, Canadian Standards Association,
Standard for Safety of Information Technology Equipment.
c) EN 60950-1:2001, First Edition,
European Committee for Electrotechnical Standardization(CENELEC)
European Standard for Safety of Information Technology Equipment.

## 7-2. EMC

a) ANSI C63.4 “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electrical Equipment in the Range of 9kHZ to 40GHz. “American National Standards Institute(ANSI), 1992
b) C.I.S.P.R. “Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment.“ International Special Committee on Radio Interference.
c) EN 55022 “Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment.“ European Committee for Electrotechnical Standardization.(CENELEC), 1998
( Including A1: 2000 )

# 8. Packing

## 8-1. Designation of Lot Mark

a) Lot Mark

| A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

A,B,C : SIZE(INCH)
D : YEAR
E : MONTH
F ~ M : SERIAL NO.

Note

1. YEAR

| Year | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|
| Mark | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 |

2. MONTH

| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mark | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C |

b) Location of Lot Mark

Serial No. is printed on the label. The label is attached to the backside of the LCD module.
This is subject to change without prior notice.

## 8-2. Packing Form

a) Package quantity in one box : 5 pcs

b) Box size : 756mm X 343mm X 515mm

## 9. Precautions

Please pay attention to the following when you use this TFT LCD module.

## 9-1. Mounting Precautions

(1) You must mount a module using holes (refer 23~24 page)
(2) You should consider the mounting structure so that uneven force(ex. twisted stress) is not applied to the module.
And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
(3) Please attach a 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.
(4) You should adopt radiation structure to satisfy the temperature specification.
(5) Acetic acid type and chlorine type materials for the cover case are not describe because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
(6) 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 determined to the polarizer.)
(7) 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.
(8) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
(9) Do not open the case because inside circuits do not have sufficient strength.

## 9-2. 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 minimized the interference.
(7) Please do not give any mechanical and/or acoustical impact to LCM. Otherwise, LCM can not be operated its full characteristics perfectly.
(8) A screw which is fastened up the steels should be a machine screw (if not, it causes metal foreign material and deal LCM a fatal blow)
(9) Please do not set LCD on its edge.
(10) When LCMs are used for public display defects such as Yogure, image sticking can not be guarantee.

## 9-3. 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.

## 9-4. Precautions for Strong Light Exposure

Strong light exposure causes degradation of polarizer and color filter.

## 9-5. 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°C and 35°C 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.

## 9-6. Handling 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 glue 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.