

Product Specification

SPECIFICATION FOR APPROVAL

- (?) Preliminary Specification
() Final Specification

| | |
|-------|---------------------------|
| Title | 18.1" SXGA TFT LCD |
|-------|---------------------------|

| | |
|-------|----------------|
| BUYER | Philips |
| MODEL | |

| | |
|----------|---------------------------------|
| SUPPLIER | LG.Philips LCD CO., Ltd. |
| *MODEL | LM181E06 |
| SUFFIX | A4M1 |

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

| SIGNATURE | DATE |
|-----------|-------|
| / | _____ |
| / | _____ |
| / | _____ |

Please return 1 copy for your confirmation with your signature and comments.

| APPROVED BY | DATE |
|----------------------|-------|
| G T. Kim / G.Manager | _____ |
| REVIEWED BY | |
| K.J. Kwon / Manager | _____ |
| PREPARED BY | |
| K N. Kim / Engineer | _____ |

**Product Engineering Dept.
LG. Philips LCD Co., Ltd**

Product Specification

CONTENTS

| NO. | ITEM | Page |
|-----|---|------|
| - | COVER | 1 |
| - | CONTENTS | 2 |
| - | RECORD OF REVISIONS | 3 |
| 1 | GENERAL DESCRIPTION | 4 |
| 2 | ABSOLUTE MAXIMUM RATINGS | 5 |
| 3 | ELECTRICAL SPECIFICATIONS | 6 |
| 3-1 | ELECTRICAL CHARACTERISTICS | 6 |
| 3-2 | INTERFACE CONNECTIONS | 8 |
| 3-3 | SIGNAL TIMING SPECIFICATIONS | 10 |
| 3-4 | SIGNAL TIMING WAVE FORMS | 11 |
| 3-5 | COLOR INPUT DATA REFERANCE | 12 |
| 3-6 | POWER SEQUENCE | 13 |
| 4 | OPTICAL SPECIFICATIONS | 14 |
| 5 | MECHANICAL CHARACTERISTICS | 18 |
| 6 | RELIABILITY | 21 |
| 7 | INTERNATIONAL STANDARDS | 22 |
| 7-1 | SAFETY | 22 |
| 7-2 | EMC | 22 |
| 8 | PACKING | 23 |
| 8-1 | DESIGNATION OF LOT MARK | 23 |
| 8-2 | PACKING FORM | 23 |
| 9 | PRECAUTIONS | 24 |
| 10 | OTHERS | - |
| | APPENDIX 1. REQUIRED SIGNAL ASSIGNMENT FOR FLATLink Transmitter | 26 |
| | | |

Product Specification

RECORD OF REVISIONS

| Revision No | Date | Page | Description |
|-------------|--------------|------|---|
| Ver 0.0 | Apr.07, 2002 | | First Draft, Preliminary Specifications |

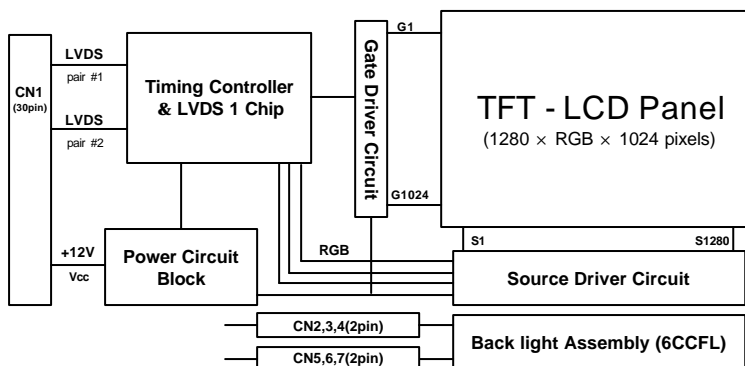
Product Specification

1. General Description

The LM181E06-A4M1 is a Color Active Matrix Liquid Crystal Display with an integral Cold Cathode Fluorescent Lamp (CCFL) backlight system. The matrix employs aSi Thin Film Transistor as the active element. It is a transmissive type display operating in the normally black mode. This TFT-LCD has a 18.1 inch diagonally measured active display area with SXGA resolution (1024 vertical by 1280 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 brightness of the sub-pixel color is determined with a 8-bit gray scale signal for each dot, thus, presenting a palette of more than 16,777,216 colors.

The LM181E06-A4M1 has been designed to apply the interface method that enables low power, high speed, low EMI. FPD Link must be used as a LVDS (Low Voltage Differential Signaling) chip.

The LM181E06-A4M1 is intended to support applications where thin thickness, wide viewing angle, low power are critical factors and graphic displays are important. In combination with the vertical arrangement of the sub-pixels, the LM181E06-A4M1 characteristics provide an excellent flat panel display for office automation products such as monitors.



General Features

| | |
|------------------------|--|
| Active screen size | 18.1 inches (459.74mm) diagonal |
| Outline Dimension | 389.0(H) x 317.2(V) x 27.0(D) mm(Typ) |
| Pixel Pitch | 0.2805 mm x 0.2805 mm |
| Pixel Format | 1280 horizontal By 1024 vertical Pixels RGB stripe arrangement |
| Color depth | 8-bits, 16,777,216 colors |
| Luminance, white | 250 cd/m ² (Typ. Center 1 point) |
| Power Consumption | Total 29.52 Watt(Typ.), (4.32Watt @Vcc, 25.2 Watt @250cd/? [Lamp=7mA]) |
| Weight | 3100g (Typ) |
| Display operating mode | Transmissive mode, normally black |
| Surface treatments | Hard coating (3H), Anti-glare treatment of the front polarizer |

Product Specification

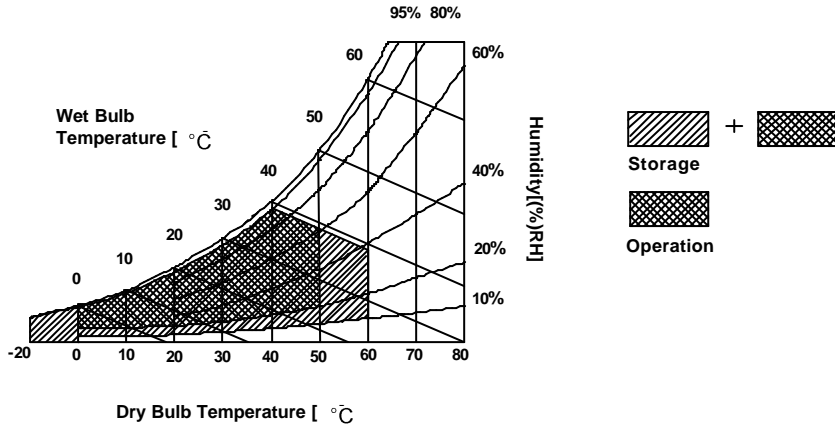
2. Absolute Maximum Ratings

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 Input Voltage | V_{CC} | - 0.3 | + 14 | V_{dc} | at 25? |
| Operating Temperature | T_{OP} | 0 | + 50 | ? | 1 |
| Storage Temperature | T_{ST} | - 20 | + 60 | ? | 1 |
| Operating Ambient Humidity | H_{OP} | 20 | + 95 | %RH | 1 |
| Storage Humidity | H_{ST} | 5 | + 95 | %RH | 1 |

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.



Product Specification

3. Electrical Specifications

3-1. Electrical Characteristics

The LM181E06-A4M1 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 CCFL, is typically generated by an inverter. The inverter is an external unit to the LCD.

Table 2. ELECTRICAL CHARACTERISTICS

| Parameter | Symbol | Values | | | Units | Notes |
|------------------------------|-------------------|----------|----------|----------|-------------------|-------|
| | | Min. | Typ. | Max. | | |
| MODULE : | | | | | | |
| Power Supply Input Voltage | V _{CC} | 11.4 | 12.0 | 12.6 | V(DC) | |
| Power Supply Input Current | I _{CC} | - | 0.36 | 0.45 | A | 1 |
| Differential Impedance | Z _m | 90 | 100 | 110 | Ohm | 2 |
| Power Consumption | P _C | - | 4.32 | 5.4 | Watts | 1 |
| Rush Current | I _{RUSH} | - | -- | 4 | A | 3 |
| LAMP : | | | | | | |
| Operating Voltage | V _{BL} | 550(8.0) | 600(7.0) | 725(3.0) | V _{RMS} | 4 |
| Operating Current | I _{BL} | 3.0 | 7.0 | 8.0 | mA _{RMS} | |
| Established Starting Voltage | V _S | | | | | 5 |
| at 25° | - | - | - | 1,000 | V _{RMS} | |
| at 0° | - | - | - | 1,300 | V _{RMS} | |
| Operating Frequency | F _{BL} | 45 | 55 | 65 | KHz | 6 |
| Discharge Stabilization Time | T _S | - | - | 3 | Minutes | 7 |
| Power Consumption(6CCFL's) | P _{BL} | - | 25.2 | 27.7 | Watts | 8 |
| Life Time | - | 40,000 | - | - | Hrs | 9 |

Note : **The design of the inverter must have specifications for the lamp in LCD Assembly.**

The performance of the Lamp in LCM, for example life time or brightness, is extremely influenced by the characteristics of the DC-AC inverter. So all the parameters of an inverter should be carefully designed so as not to produce too much leakage current from high-voltage output of the inverter.

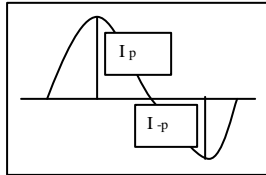
When you design or order the inverter, please make sure unwanted lighting caused by the mismatch of the lamp and the inverter(no lighting, flicker, etc) never occurs. When you confirm it, the LCD Assembly should be operated in the same condition as installed in you instrument.

Requirements for a system inverter design, which is intended to have a better display performance, a better power efficiency and a more reliable lamp.

It shall help increase the lamp lifetime and reduce its leakage current.

- a. The asymmetry rate of the inverter waveform should be 10% below;
- b. The distortion rate of the waveform should be within $v2 \pm 10\%$;
- c. The ideal sine wave form shall be symmetric in positive and negative polarities.

Product Specification



* Asymmetry rate:

$$|I_p - I_{-p}| / I_{rms} * 100\%$$

* Distortion rate

$$I_p \text{ (or } I_{-p}) / I_{rms}$$

- The specified current and power consumption are under the $V_{CC}=12.0V$, $25^{\circ}C$, $f_v=60Hz$ condition, Typical supply current is measured at the condition of 8 X 6 chess pattern(white & black)
- This impedance value is for impedance matching between LVDS T_x and the mating connector of the LCD.
- The duration of rush current is about 1ms.
- The variance of the voltage is $\pm 10\%$.
- The voltage above V_{GS} should be applied to the lamps for more than 1 second for start-up. Otherwise, the lamps may not be turned on.
- The output of the inverter must have symmetrical (negative and positive) voltage waveform and symmetrical current waveform.(Unsymmetrical ratio is less than 10%) Please do not use the inverter which has unsymmetrical voltage and unsymmetrical current and spike wave.
Lamp frequency may produce interface with horizontal synchronous frequency and as a result this may cause beat on the display. Therefore lamp frequency shall be as away possible from the horizontal synchronous frequency and from its harmonics in order to prevent interference.
- Let's define the brightness of the lamp after being lighted for 5 minutes as 100%.
 T_S is the time required for the brightness of the center of the lamp to be not less than 95%.
The used lamp current is the lamp typical current.
- The lamp power consumption shown above does not include loss of external inverter.
The used lamp current is the lamp typical current.
- The life time is determined as the time at which brightness of the lamp is 50% compared to that of initial value at the typical lamp current on condition of continuous operating at $25 \pm 2^{\circ}C$.

Typical life time shall be defined that remained rate maintains over 50% of total amount at the life test.

- ? Do not attach a conductive tape to lamp connecting wire.
If the lamp wire attach to a conducting tape, TFT-LCD Module has a low luminance and the inverter has abnormal action. Because leakage current is occurred between lamp wire and conducting tape.

Product Specification

3-2. Interface Connections

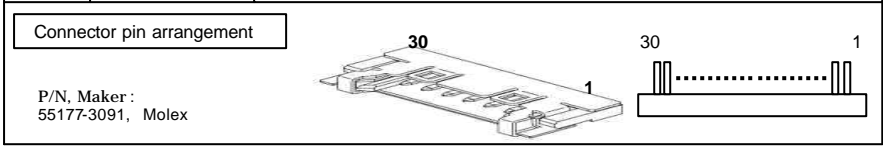
Interface chip must be used LVDS, part No. DS90CF383MTD(Transmitter) made by Nation Semiconductor. Or used the compatible interface chips(TI:SN75LVDS83, Thine).
This LCD employs seven interface connections, a 30-pin connector is used for the module electronics interface. Six 2-pin connectors are used for the integral back-light system.
The electronics interface connector is a model 55177-3091 manufactured by MOLEX. The pin configuration for the connector is shown in the table 3.

Table 3. MODULE CONNECTOR PIN CONFIGURATION(LVDS)

| Pin | Symbol | Description |
|-----|---------|---|
| 1 | Vcc | Supply voltage for LCD module |
| 2 | Vcc | Supply voltage for LCD module |
| 3 | Vcc | Supply voltage for LCD module |
| 4 | Vcc | Supply voltage for LCD module |
| 5 | GND | Ground |
| 6 | GND | Ground |
| 7 | SR0M | Minus signal of even channel 0 (LVDS) |
| 8 | SR0P | Plus signal of even channel 0 (LVDS) |
| 9 | SR1M | Minus signal of even channel 1 (LVDS) |
| 10 | SR1P | Plus signal of even channel 1 (LVDS) |
| 11 | SR2M | Minus signal of even channel 2 (LVDS) |
| 12 | SR2P | Plus signal of even channel 2 (LVDS) |
| 13 | SCLKINM | Minus signal of even clock channel (LVDS) |
| 14 | SCLKINP | Plus signal of even clock channel (LVDS) |
| 15 | SR3M | Minus signal of even channel 3 (LVDS) |
| 16 | SR3P | Plus signal of even channel 3 (LVDS) |
| 17 | GND | Ground |
| 18 | GND | Ground |
| 19 | FR0M | Minus signal of odd channel 0 (LVDS) |
| 20 | FR0P | Plus signal of odd channel 0 (LVDS) |
| 21 | FR1M | Minus signal of odd channel 1 (LVDS) |
| 22 | FR1P | Plus signal of odd channel 1 (LVDS) |
| 23 | FR2M | Minus signal of odd channel 2 (LVDS) |
| 24 | FR2P | Plus signal of odd channel 2 (LVDS) |
| 25 | FCLKINM | Minus signal of odd clock channel (LVDS) |
| 26 | FCLKINP | Plus signal of odd clock channel (LVDS) |
| 27 | FR3M | Minus signal of odd channel 3 (LVDS) |
| 28 | FR3P | Plus signal of odd channel 3 (LVDS) |
| 29 | GND | Ground |
| 30 | GND | Ground |

Second data

First data



Product Specification

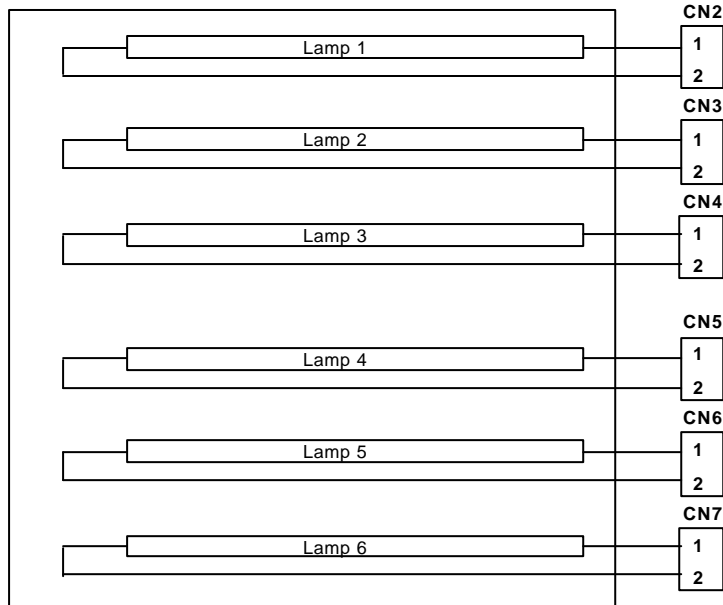
The backlight interface connector is a model BHSR-02VS-1, manufactured by JST. The mating connector part number is SM02B-BHS-1 or equivalent. The pin configuration for the connector is shown in the table 4.

Table 4. BACKLIGHT CONNECTOR PIN CONFIGURATION

| No. | Pin | Symbol | Description | Notes |
|---------------|-----|--------|--|-------|
| CN2,3,4,5,6,7 | 1 | HV | Power supply for lamp (High voltage side) | 1 |
| | 2 | LV | Power supply for lamp (Low voltage side) | 2 |

Note : 1. The high voltage side terminal is colored Pink & Blue & Gray.
 2. The low voltage side terminal is all White

The below is block diagram for pin configuration of lamp connectr.



Product Specification

3-3. Signal Timing Specifications

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

Table 6. TIMING TABLE

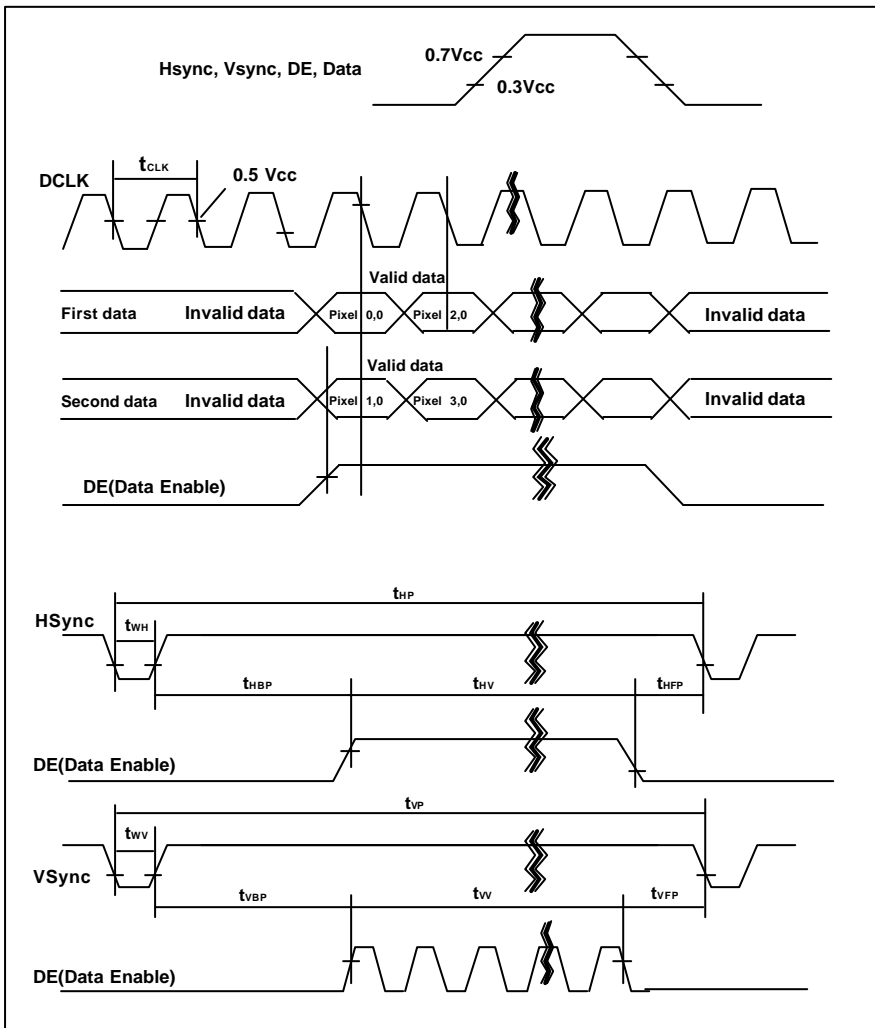
| | ITEM | SYMBOL | MIN | TYP | MAX | UNIT | NOTES |
|---------------------|------------------------|-----------|-------|-------------------|-------------------|-----------|-------|
| Dclk | Period | t_{CLK} | 18.18 | 18.52 | 18.87 | ns | 1 |
| | Frequency | - | 53.0 | 54.0 | 55.0 | MHz | |
| Hsync | Period | t_{HP} | 784 | 844 | 904 | t_{CLK} | 2 |
| | Width | t_{WH} | 8 | 56 | 240 | | |
| | Frequency | f_h | 58.63 | 63.98 | 70.16 | KHz | |
| Vsync | Period | t_{VP} | 1034 | 1066 | 1098 | t_{HP} | |
| | Frequency | f_v | 59 | 60 | 61 | Hz | 3 |
| | Width | t_{VV} | 2 | 3 | 24 | t_{HP} | |
| DE (Data Enable) | Horizontal Valid | t_{HV} | 640 | 640 | 640 | t_{CLK} | 4 |
| | Horizontal Back Porch | t_{HBP} | 12 | 124 | - | | |
| | Horizontal Front Porch | t_{HFP} | 8 | 24 | - | | |
| | Horizontal Blank | - | 144 | - | $t_{HP} - t_{HV}$ | | |
| | Vertical Valid | t_{VV} | 1024 | 1024 | 1024 | t_{HP} | |
| | Vertical Back Porch | t_{VBP} | 1 | 38 | - | | |
| | Vertical Front Porch | t_{VFP} | 1 | 1 | - | | |
| Vertical Blank | - | 10 | - | $t_{VP} - t_{VV}$ | | | |

Notes: " No Variation of Hsync(DE) input is required for normal operation .
"Input data shall be latched at the falling edge of DCLK.

1. Please refer transmitter data sheets for the detail timing condition (required setup, hold time and etc.) between video processor and LVDS transmitter.
2. Horizontal sync shall be active high.
3. Vertical sync shall be active high.
4. Data enable shall be active high.

Product Specification

3-4. Signal Timing Waveforms



Product Specification

3-5. Color Input Data Reference

The brightness of each primary color(red,green and blue) is based on the 8-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 | | | |
| | | R7 | R6 | R5 | R4 | R3 | R2 | R1 | R0 | G7 | G6 | G5 | G4 | G3 | G2 | G1 | G0 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
| Basic 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 |
| | Red (255) | 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 (255) | 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 (255) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | 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 |
| | 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 |
| | 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 | Red(000) Dark | 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 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(002) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ----- | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Red(253) | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(254) | 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(255) Bright | 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 | Green(000) Dark | 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 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(002) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ----- | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Green(253) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(254) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(255) Bright | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blue | Blue(000) Dark | 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 | 1 |
| | Blue(002) | 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(253) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| | Blue(254) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| | Blue(255) Bright | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

Product Specification

3-6. Power Sequence

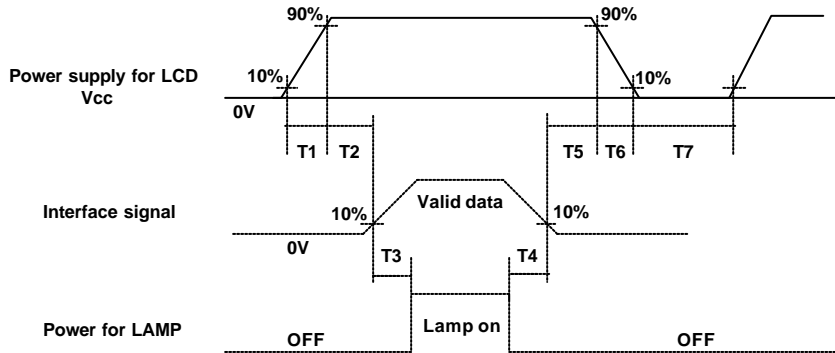


Table 8. POWER SEQUENCE

| Parameter | Values | | | Units |
|-----------|--------|------|------|-------|
| | Min. | Typ. | Max. | |
| T 1 | - | - | 10 | ms |
| T 2 | 0.01 | - | 50 | ms |
| T 3 | 200 | - | - | ms |
| T 4 | 200 | - | - | ms |
| T 5 | 0.01 | - | 50 | ms |
| T 6 | - | - | 10 | ms |
| T 7 | 1 | - | - | s |

- 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_{CC} to 0V. Invalid signal with V_{CC} for a long period of time, causes permanent damage to LCD panel.
 3. Lamp power must be turn on after power supply for LCD and interface signals are valid.

Product Specification

4. Optical Specifications

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 at an approximate distance 50cm from the LCD surface at a viewing angle of Φ and θ equal to 0 °.

FIG. 1 presents additional information concerning the measurement equipment and method.

FIG. 1 Optical Characteristic Measurement Equipment and Method

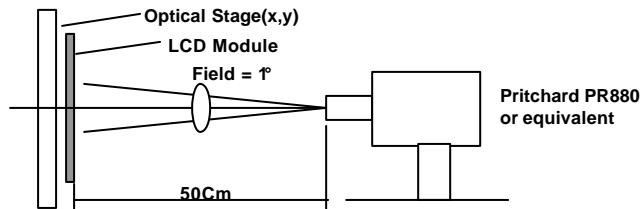


Table 9. OPTICAL CHARACTERISTICS (Ta=25 °C, V_{CC}=12.0V, f_v=60Hz, Dclk=54MHz, I_{BL}=7mArms)

| Parameter | Symbol | Values | | | Units | Notes |
|------------------------------|--------------------|--------|-------|-------|-------------------|-------|
| | | Min. | Typ. | Max. | | |
| Contrast Ratio | CR | 200 | 350 | - | | 1 |
| Surface Luminance, white | L _{WH} | 200 | 250 | - | cd/m ² | 2 |
| Luminance Variation | δ _{WHITE} | - | | 1.45 | | 3 |
| Luminance Uniformity (TC099) | L _R | - | - | 1.7 | | 4 |
| Response Time | T _r | | | | ms | 5 |
| Rise Time | T _{rR} | - | 15 | 25 | | |
| Decay Time | T _{rD} | - | 15 | 25 | | |
| CIE Color Coordinates | | | | | | |
| Red | X _R | 0.603 | 0.633 | 0.663 | | |
| | y _R | 0.310 | 0.340 | 0.370 | | |
| Green | X _G | 0.265 | 0.295 | 0.325 | | |
| | y _G | 0.570 | 0.600 | 0.630 | | |
| Blue | X _B | 0.111 | 0.141 | 0.171 | | |
| | y _B | 0.066 | 0.096 | 0.126 | | |
| White | X _W | 0.283 | 0.313 | 0.343 | | |
| | y _W | 0.299 | 0.329 | 0.359 | | |
| Viewing Angle | | | | | degree | |
| x axis, right(φ=0°) | θ x | + 60 | + 80 | - | | 6 |
| x axis, left (φ=180°) | θ x | - 60 | - 80 | - | | |
| y axis, up (φ=90°) | θ y | + 60 | + 80 | - | | |
| y axis, down (φ=270°) | θ y | - 60 | - 80 | - | | |
| Cross talk | - | - | - | 1.5 | | 7 |
| Gamma Value | - | - | 2.2 | - | | 8 |

Product Specification

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 the center point across the LCD surface 50cm from the surface with all pixels displaying white under the condition of $I_{BL} = 7mArms$. For more information see FIG 2.

3. The variation in surface luminance , δ_{WHITE} is determined by measuring L_{ON} at each test position 1 through 9, and then dividing the maximum L_{ON} of 9 points luminance by minimum L_{ON} of 9 points luminance. For more information see FIG 2.

$$\delta_{WHITE} = \frac{\text{Maximum}(L_{ON1}, L_{ON2}, \dots, L_{ON9})}{\text{Minimum}(L_{ON1}, L_{ON2}, \dots, L_{ON9})}$$

4. TCO'99 Certification Requirements and test methods for environmental labeling of display [flat] Report No.2 (x 1.5.2. Luminance Uniformity)

$$L_R = (L_{MAX,+ 30deg.} / L_{MIN,+ 30deg.}) + (L_{MAX,- 30deg.} / L_{MIN,- 30deg.}) / 2$$

5. Response time is the time required for the display to transition from black to white(Rise Time, Tr_r) and from white to black(Decay Time, Tr_d). For additional information see FIG 3.

6. Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG 4.

7. Cross talk shall be measured at the V and H position.(Window size : 427x341pixels)
For more information see FIG. 5.

$$\text{Cross talk} = \frac{(\text{Luminance at pattern A} - \text{Luminance at pattern B})}{\text{Luminance at pattern A}} \times 100\%$$

8. Gray scale specification

| Gray Level | Luminance (%) | | |
|------------|---------------|------|------|
| | Min. | Typ. | Max. |
| L 0 | - | 0.25 | 0.57 |
| L 31 | - | 0.77 | 1.82 |
| L 63 | 1.61 | 4.5 | 7.40 |
| L 95 | 5.43 | 11.3 | 17.1 |
| L 127 | 10.4 | 20.2 | 30.0 |
| L 159 | 18.1 | 32.4 | 46.6 |
| L 191 | 30.8 | 49.1 | 67.5 |
| L 223 | 50.1 | 69.8 | 89.5 |
| L 255 | - | 100 | - |

Product Specification

FIG. 2 Luminance

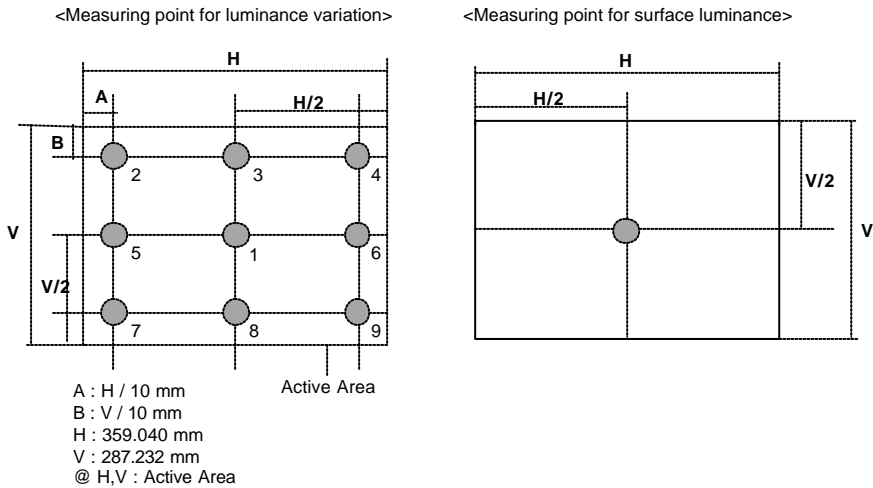
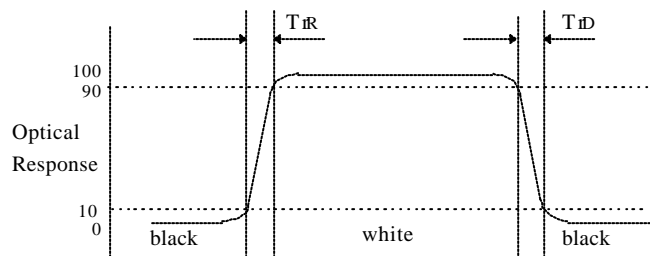


FIG. 3 Response Time

The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white".



Product Specification

FIG. 4 Viewing angle

<Definition of viewing angle range>

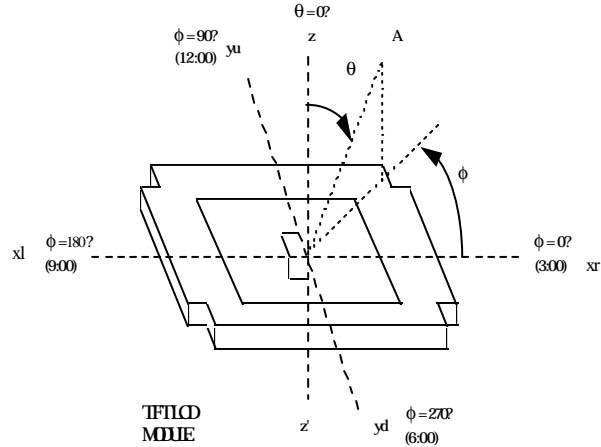
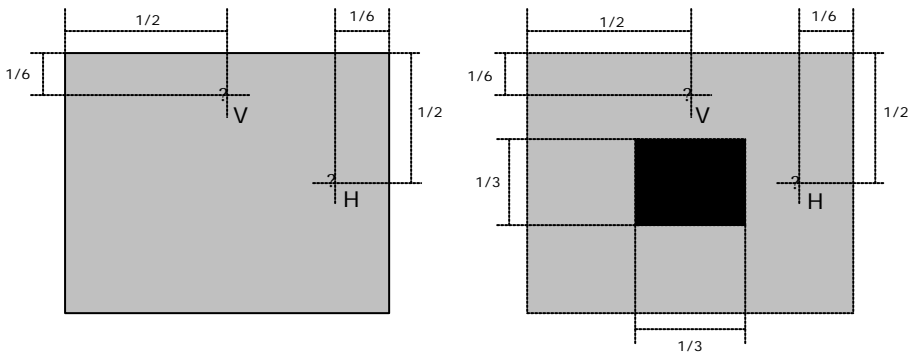


FIG. 5 Cross talk



Pattern : A
(Background : 127-Gray or White)

Pattern : B
(Window : Black)
(Background : 127-Gray or White)

Product Specification

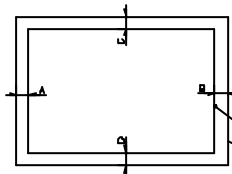
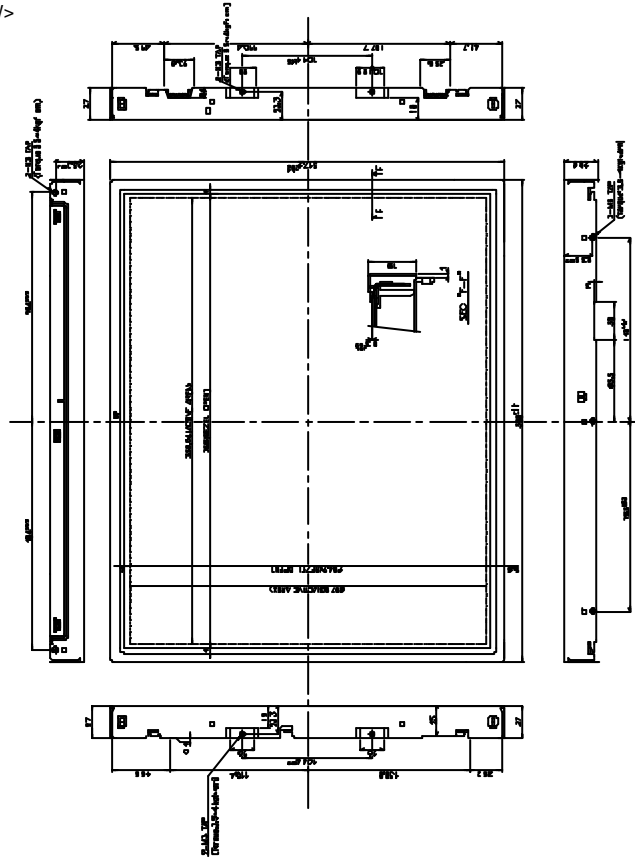
5. Mechanical Characteristics

The contents provide general mechanical characteristics for the model LM181E06-A4M1 . In addition, the figures in the next page are detailed mechanical drawing of the LCD.

| | | |
|----------------------|--|----------------|
| Outside dimensions | Horizontal | 389.0 ± 0.5 mm |
| | Vertical | 317.2 ± 0.5 mm |
| | Depth | 27.0 ± 0.5 mm |
| Bezel area | Horizontal | 366.0 ± 0.5 mm |
| | Vertical | 294.2 ± 0.5 mm |
| Active display area | Horizontal | 359.040 mm |
| | Vertical | 287.232 mm |
| Weight (approximate) | 3,100g (Typ.), 3,255 (Max.) | |
| Surface Treatment | Hard coating (3H) Anti-glare treatment of the front polarizer Haze (25%) | |

Product Specification

<FRONT VIEW>



- NOTE
- 1 UNSPECIFIED TOLERANCE IS $\pm 0.5\text{mm}$
 2. GAP BETWEEN TOP CASE AND GLASS IS $0.2^{+0.03}$
 3. TILT AND A PARTIAL DISPOSITION TOLERANCE OF DISPLAY AREA ARE AS FOLLOWS.
 - 1) X-DIRECTION : $|A-B| \leq 1\text{mm}$
 - 1) Y-DIRECTION : $|C-D| \leq 1\text{mm}$

Product Specification

6. Reliability

Environment test condition

| No | Test Item | Conditions |
|----|-----------------------------------|--|
| 1 | High temperature storage test | Ta= 60°C 240hr |
| 2 | Low temperature storage test | Ta= -20°C 240hr |
| 3 | High temperature operation test | Ta= 50°C 50%RH 240hr |
| 4 | Low temperature operation test | Ta= 0°C 240hr |
| 5 | Humidity condition operation | 20%RH ~ 95%RH |
| 6 | Humidity condition storage | 5%RH ~ 95%RH |
| 7 | Vibration test (non-operating) | 1. Sinusoidal Vibration 1.0G zero to peak. 10 to 500 Hz, 0.5 oct/min sweep rate. 10 to 500, 10Hz, one sweep along each axis. 2. Random Vibration 0.002 G ² /Hz, 10 to 500Hz, normal 1 GRMS. 20 minute for each of the three axis. |
| 8 | Shock test (non-operating) | 1. Half sine wave shock : 120G peak, half sine pulse, 2ms pulse duration. Testing shall consist of one shock in each direction in each axis, for a total of 6 shock inputs.(1 time) 2. Square wave shock : 30G peak acceleration, 180 inches/sec velocity change. There shall be one shock in each direction in each axis, for a total of 6 shock inputs.(1 time) |
| 9 | Altitude storage / shipment | 0 - 40,000 feet |
| 10 | ESD test (Non-operation) | Condition : 150pF, 330? Terminal : 200V Chassis : 10KV |

{ 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.

Product Specification**7. International Standards****7-1. Safety**

- a) UL 1950 Third Edition, Underwriters Laboratories, Inc. Jan. 28, 1995.
Standard for Safety of Information Technology Equipment Including Electrical Business Equipment.
- b) CAN/CSA C22.2 No. 950-95 Third Edition, Canadian Standards Association, Jan. 28, 1995.
Standard for Safety of Information Technology Equipment Including Electrical Business Equipment.
- c) EN 60950 : 1992+A1: 1993+A2: 1993+A3: 1995+A4: 1997+A11: 1997
IEC 950 : 1991+A1: 1992+A2: 1993+A3: 1995+A4: 1996
European Committee for Electrotechnical Standardization(CENELEC)
EUROPEAN STANDARD for Safety of Information Technology Equipment Including Electrical
Business 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 (Standards apply by CISPR22 class B).
- c) EN 55022 "Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment." European Committee for Electrotechnical Standardization (CENELEC), 1988

Product Specification

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
 D : YEAR
 E : MONTH
 F,G : PANEL CODE
 H : ASSEMBLY CODE
 I,J,K,L,M : SERIAL NO.

Note:

1. YEAR

| | | | | | | | | | | | |
|------|------|------|------|------|------|------|------|------|------|------|------|
| YEAR | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
| Mark | 7 | 8 | 9 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

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 |

3. Serial No.

| | | |
|------------|---------------|-----------------------------|
| Serial No. | 1 ~ 99999 | 100000 ~ |
| Mark | 00001 ~ 99999 | A0001 ~ A9999,, Z9999 |

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 : 530mm × 307mm × 453mm

Product Specification**9. PRECAUTIONS**

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

9-1. MOUNTING PRECAUTIONS

- (1) You must mount a module using holes arranged in four corners.
- (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 the surface transparent protective plate to the surface in order to protect the polarizer. Transparent protective plate should have sufficient strength in order to 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 desirable 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 detrimental 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:
 $V = \pm 200\text{mV}$ (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.

Product Specification

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 surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.

Product Specification
APPENDIX 1. REQUIRED SIGNAL ASSIGNMENT FOR FlatLink(TI:SN75LVDS83) Transmitter

| Pin # | Pin Name | Require Signal | Pin # | Pin Name | Require Signal |
|-------|----------|----------------------------|-------|------------------------|--|
| 1 | VCC | Power Supply for TTL Input | 29 | GND | Ground pin for TTL |
| 2 | D5 | TTL Input (R7) | 30 | D26 | TTL Input (DE) |
| 3 | D6 | TTL Input (R5) | 31 | T _x CLKIN | TTL Level clock Input |
| 4 | D7 | TTL Input (G0) | 32 | PWR DWN | Power Down Input |
| 5 | GND | Ground pin for TTL | 33 | PLL GND | Ground pin for PLL |
| 6 | D8 | TTL Input (G1) | 34 | PLL VCC | Power Supply for PLL |
| 7 | D9 | TTL Input (G2) | 35 | PLL GND | Ground pin for PLL |
| 8 | D10 | TTL Input (G6) | 36 | LVDS GND | Ground pin for LVDS |
| 9 | VCC | Power Supply for TTL Input | 37 | T _x OUT3+ | Positive LVDS differential data output 3 |
| 10 | D11 | TTL Input (G7) | 38 | T _x OUT3- | Negative LVDS differential data output 3 |
| 11 | D12 | TTL Input (G3) | 39 | T _x CLKOUT+ | Positive LVDS differential clock output |
| 12 | D13 | TTL Input (G4) | 40 | T _x CLKOUT- | Negative LVDS differential clock output |
| 13 | GND | Ground pin for TTL | 41 | T _x OUT2+ | Positive LVDS differential data output 2 |
| 14 | D14 | TTL Input (G5) | 42 | T _x OUT2- | Negative LVDS differential data output 2 |
| 15 | D15 | TTL Input (B0) | 43 | LVDS GND | Ground pin for LVDS |
| 16 | D16 | TTL Input (B6) | 44 | LVDS VCC | Power Supply for LVDS |
| 17 | VCC | Power Supply for TTL Input | 45 | T _x OUT1+ | Positive LVDS differential data output 1 |
| 18 | D17 | TTL Input (B7) | 46 | T _x OUT1- | Negative LVDS differential data output 1 |
| 19 | D18 | TTL Input (B1) | 47 | T _x OUT0+ | Positive LVDS differential data output 0 |
| 20 | D19 | TTL Input (B2) | 48 | T _x OUT0- | Negative LVDS differential data output 0 |
| 21 | GND | Ground pin for TTL Input | 49 | LVDS GND | Ground pin for LVDS |
| 22 | D20 | TTL Input (B3) | 50 | D27 | TTL Input (R6) |
| 23 | D21 | TTL Input (B4) | 51 | D0 | TTL Input (R0) |
| 24 | D22 | TTL Input (B5) | 52 | D1 | TTL Input (R1) |
| 25 | D23 | TTL Input (RSVD) | 53 | GND | Ground pin for TTL |
| 26 | VCC | Power Supply for TTL Input | 54 | D2 | TTL Input (R2) |
| 27 | D24 | TTL Input (HSYNC) | 55 | D3 | TTL Input (R3) |
| 28 | D25 | TTL Input (VSYNC) | 56 | D4 | TTL Input (R4) |

Notes : Refer to LVDS Transmitter Data Sheet for detail descriptions.