# HM121SV101IV

## 12.1" Color TFT-LCD

**FUNCTIONAL DRAFT SPECIFICATION**

(This document is meant for customers' approval)

**Release Date**
**15th Jun 2020**



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# 1.0 General Descriptions

## 1.1 Introduction

The HM121SV101IV is a Color Active Matrix Liquid Crystal Display with a back light system. The matrix uses a-Si Thin Film Transistor as a switching device. This TFT LCD has a 12.1 inch diagonally measured active display area with SVGA resolution (800 horizontal by 600 vertical pixels array).

## 1.2 Features

- ■ Supported SVGA Resolution
- ■ LVDS Interface
- ■ Compatible with RoHS Standard

## 1.3 Product Summary

| Items | Specifications | Unit |
|---|---|---|
| Screen Diagonal | 12.1 | inch |
| Active Area (H x V) | 246.00x184.50 | mm |
| Number of Pixels (H x V) | 800 x 600 | - |
| Pixel Pitch (H x V) | 0.3075 x 0. 3075 | mm |
| Pixel Arrangement | R.G.B. Vertical Stripe | - |
| Display Mode | Normally White | - |
| White Luminance | (400) (Typ.) | cd /$m^2$ |
| Contrast Ratio | (800) (Typ.) | - |
| Response Time | TBD (Typ.) | ms |
| Input Voltage | (3.3) (Typ.) | V |
| Power Consumption | (6.16) (Max.) @ Black pattern, FV=(60)Hz | W |
| Weight | (665)(Max.) | g |
| Outline Dimension (H x V x D) | (276.00) (Typ.) x (209.00) (Typ.) x (9.10) (Max.) | mm |
| Electrical Interface (Logic) | LVDS | - |
| Support Color | 262 K | - |
| NTSC | (50) (Typ.) | % |
| Optimum Viewing Direction | 6 O'clock | - |
| Surface Treatment | Anti-glare,3H | - |

## 1.4 Functional Block Diagram

Figure 1 shows the functional block diagram of the LCD module.

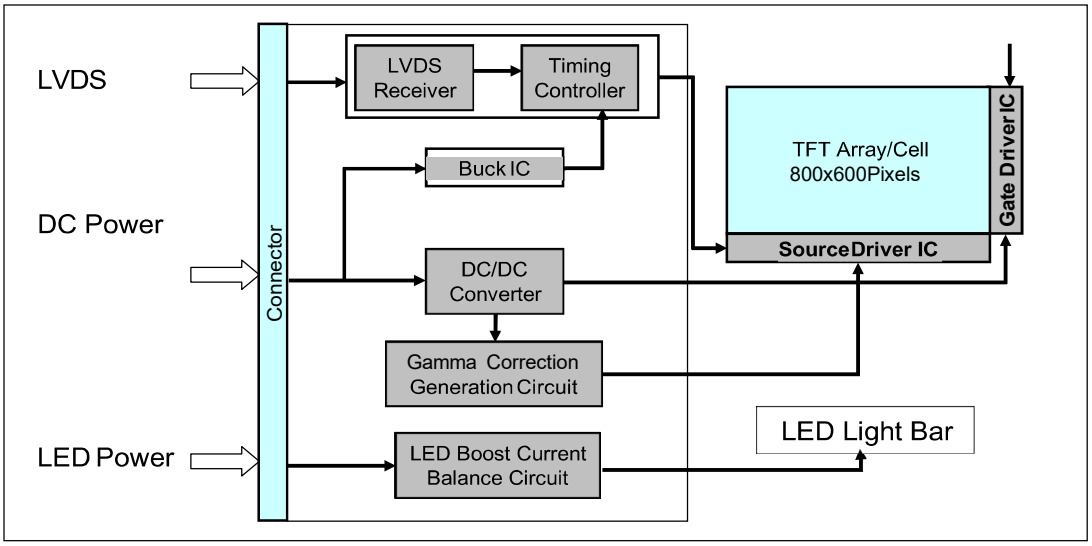



**Figure 1 Block Diagram**

## 1.5 Pixel Mapping

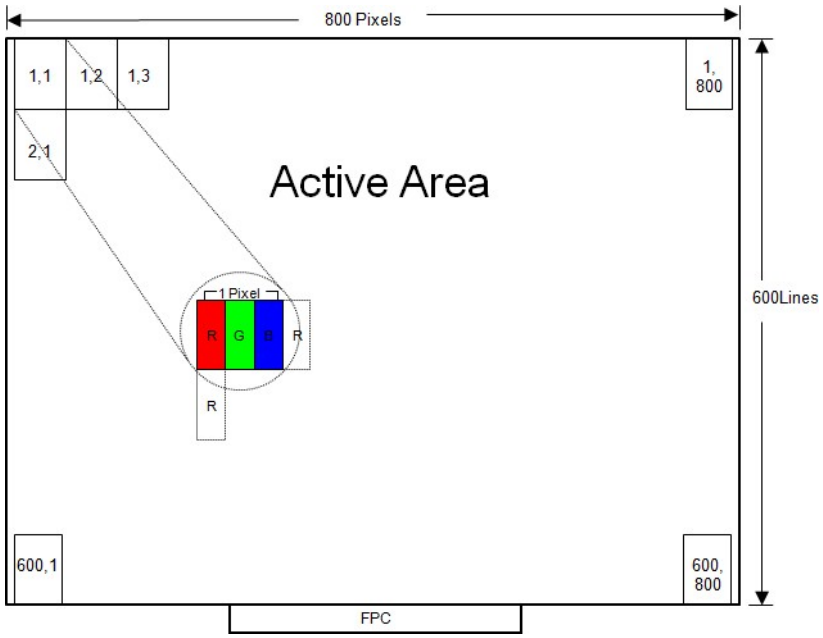



**Figure 2 Pixel Mapping**

## 2.0 Absolute Maximum Ratings

**Table 1 Electrical & Environment Absolute Rating**

| Item | Symbol | Min. | Max. | Unit | Note |
|---|---|---|---|---|---|
| Logic Supply Voltage | $V_{cc}$ | (-0.3) | (4.0) | V | (1),(2),(3),(4) |
| Logic Input Signal Voltage | $V_{Signal}$ | (-0) | (2.4) | V | |
| Operating Temperature | $T_{gs}$ | (-20) | (70) | ℃ | |
| Storage Temperature | $T_a$ | (-30) | (85) | ℃ | |

Note (1) All the parameters specified in the table are absolute maximum rating values that may cause faulty operation or unrecoverable damage, if exceeded. It is recommended to follow the typical value.

Note (2) All the contents of electro-optical specifications and display fineness are guaranteed under Normal Conditions. All the display fineness should be inspected under normal conditions. Normal conditions are defined as follow: Temperature: 25℃, Humidity: 55± 10%RH.

Note (3) Unpredictable results may occur when it was used in extreme conditions. $T_a$= Ambient Temperature, $T_{gs}$= Glass Surface Temperature. All the display fineness should be inspected under normal conditions.

Note (4) Temperature and relative humidity range are shown in the figure below. Wet bulb temperature should be lower than 47℃, and no condensation of water. Besides, protect the module from static electricity.

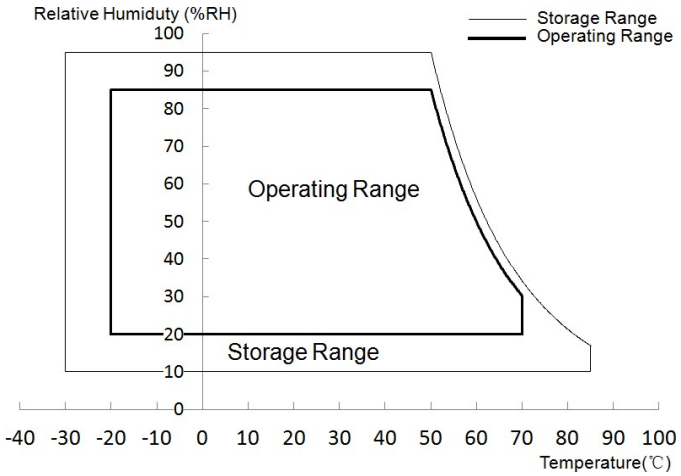



**Figure 3 Absolute Ratings of Environment of the LCD Module**

## 3.0 Optical Characteristics

The optical characteristics are measured under stable conditions as following notes.

**Table 2 Optical Characteristics**

| Item | Conditions | | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|---|
| Viewing Angle (CR≥10) | Horizontal | $\theta_{x+}$ | TBD | (80) | - | degree | (1),(2),(3),(4)(8) |
| | | $\theta_{x-}$ | TBD | (80) | - | | |
| | Vertical | $\theta_{y+}$ | TBD | (60) | - | | |
| | | $\theta_{y-}$ | TBD | (80) | - | | |
| Contrast Ratio | Center | | (650) | (800) | - | - | (1),(2),(4),(8) θx=θy=0° |
| Response Time | Rising + Falling | | - | TBD | (30) | ms | (1),(2),(5),(8) θx=θy=0° |
| Color Chromaticity (CIE1931) | Red x | | Typ. -0.03 | (0.561) | Typ. +0.03 | - | (1),(2),(3),(8) θx=θy=0° |
| | Red y | | | (0.327) | | - | |
| | Green x | | | (0.347) | | - | |
| | Green y | | | (0.590) | | - | |
| | Blue x | | | (0.160) | | - | |
| | Blue y | | | (0.084) | | - | |
| | White x | | (0.263) | (0.313) | (0.363) | - | |
| | White y | | (0.279) | (0.329) | (0.379) | - | |
| NTSC | - | | TBD | (50) | - | % | (1),(2),(3),(8) θx=θy=0° |
| White Luminance | Center Point | | (300) | (400) | - | $cd/m^2$ | (1),(2),(6),(8) θx=θy=0° |
| Luminance Uniformity | 5 Points | | (75) | - | - | % | (1),(2),(7),(8) θx=θy=0° |

Note (1) Measurement Setup:

The LCD module should be stabilized at given ambient temperature (25℃) for 30 minutes to avoid abrupt temperature changing during measuring. In order to stabilize the luminance, the measurement should be executed after lighting backlight for 30 minutes in the windless room.

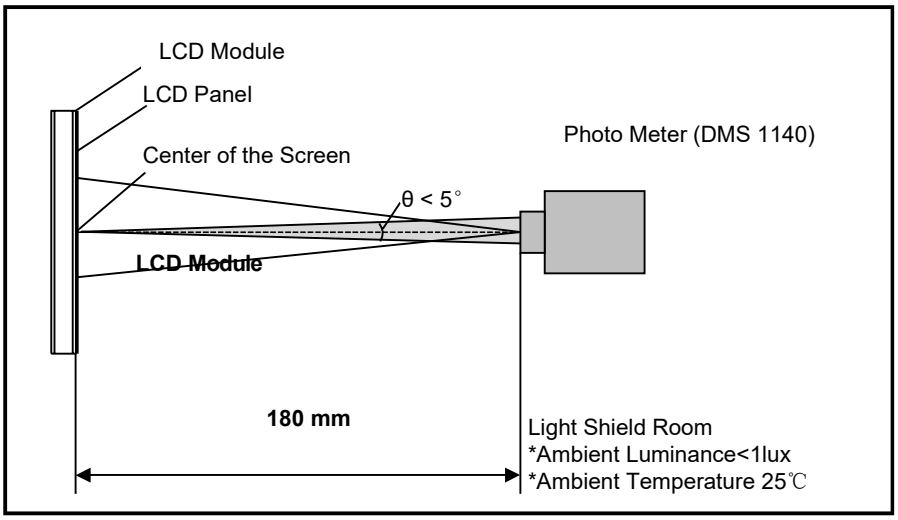


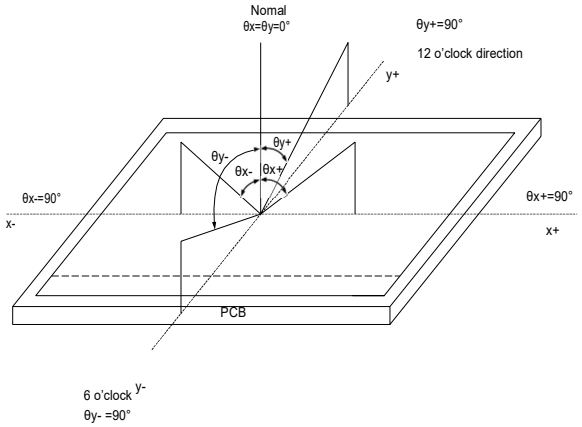

**Figure 4 Measurement Setup**

Note (2) The LED input parameter setting as:

$V_{LED}$: (12)V

PWM_LED: Duty 100 %

Note (3) Definition of Viewing Angle




Note (4) Definition of Contrast Ratio (CR)

The contrast ratio can be calculated by the following expression:

Contrast Ratio (CR) = The luminance of White pattern/ The luminance of Black pattern

Note (5) Definition of Response Time ($T_R$, $T_F$)

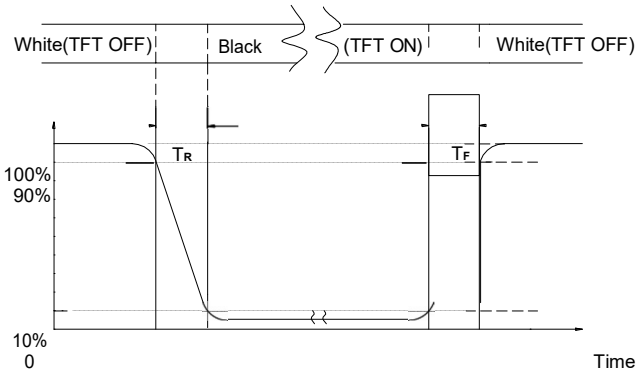



**Figure 5 Definition of Response Time**

Note (6) Definition of Luminance of White

Measure the luminance of White pattern (Ref.: Active Area)

Display Luminance=L1 (center point)

H—Active Area Width, V—Active Area Height, L—Luminance

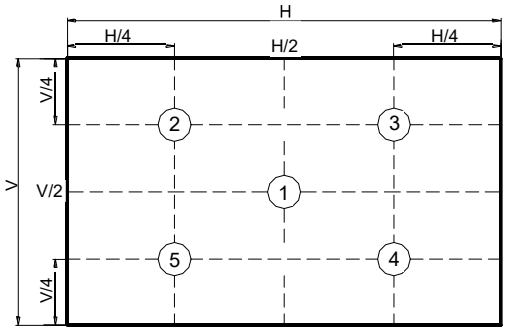



**Figure 6 Measurement Locations of 5 Points**

Note (7) Definition of Luminance Uniformity (Ref.: Active Area)

Measure the luminance of White pattern at 5 points.

Luminance Uniformity= Min.(L1, L2, ... L5) / Max.(L1, L2, ... L5)

H—Active Area Width, V—Active Area Height, L—Luminance

Note (8) All optical data are based on HIGHNESS given system & nominal parameter & testing machine in this document.

## 4.0 Electrical Characteristics

### 4.1 Interface Connector

**Table 3 Signal Connector Type**

| Item | Description |
|---|---|
| Mating Receptacle / Type (Reference) | 076B20-0048RA-G4 |

**Table 4 Signal Connector Pin Assignment**

| Pin No. | Symbol | Description | Remarks |
|---|---|---|---|
| 1 | Vcc | +3.3V Power supply | - |
| 2 | Vcc | +3.3V Power supply | - |
| 3 | GND | GND | - |
| 4 | GND | GND | - |
| 5 | RxIN0- | LVDS receiver signal CH0(-) | - |
| 6 | RxIN0+ | LVDS receiver signal CH0(+) | - |
| 7 | GND | GND | - |
| 8 | RxIN1- | LVDS receiver signal CH1(-) | - |
| 9 | RxIN1+ | LVDS receiver signal CH1(+) | - |
| 10 | GND | GND | - |
| 11 | RxIN2- | LVDS receiver signal CH2(-) | - |
| 12 | RxIN2+ | LVDS receiver signal CH2(+) | - |
| 13 | GND | GND | - |
| 14 | CK IN- | LVDS receiver signal CK(-) | - |
| 15 | CK IN+ | LVDS receiver signal CK(+) | - |
| 16 | GND | GND | - |
| 17 | NC | Non connection | - |
| 18 | RL/UD | Horizontal/Vertical Control Pin | - |
| 19 | GND | GND | - |
| 20 | GND | GND | - |

Note (1) L/NC：(0~0.4)V；H：(3~3.6)V；

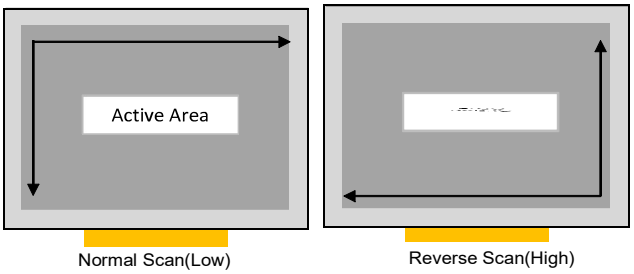



**Table 5 LED Connector Name / Designation**

| Item | Description |
|---|---|
| Mating Receptacle / Type (Reference) | SM06B-SHLK-G-TF (HF) |

**Table 6 LED Connector Pin Assignment**

| Pin No. | Symbol | Description | Remarks |
|---|---|---|---|
| 1 | VCC | Power supply(+12V) | - |
| 2 | VCC | Power supply(+12V) | - |
| 3 | GND | Ground | - |
| 4 | GND | Ground | - |
| 5 | EN_LED | LED ENABLE PIN(+3.3V INPUT) | - |
| 6 | PWM_LED | SYSTEM PWM SIGNAL INPUT | - |

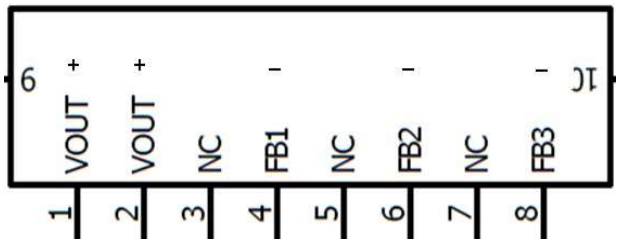



**Figure 7 LED Connector**

### 4.2 Signal Electrical Characteristics

4.2.1 Signal Electrical Characteristics For LVDS Receiver

The built-in LVDS receiver is compatible with (ANSI/TIA/TIA-644 ) standard.

**Table 7 LVDS Receiver Electrical Characteristics**

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Conditions |
|---|---|---|---|---|---|---|
| Differential Input High Threshold | Vth | - | - | +100 | mV | $V_{CM}$=+1.2V |
| Differential Input Low Threshold | Vtl | -100 | - | - | mV | $V_{CM}$=+1.2V |
| Magnitude Differential Input | $\|V_{ID}\|$ | 200 | - | 600 | mV | - |
| Common Mode Voltage | $V_{CM}$ | – | 1.2 | – | V | $V_{th}$ –$V_{tl}$ = 200 mV |
| Common Mode Voltage Offset | $\Delta V_{CM}$ | -50 | - | 50 | mV | $V_{th}$ –$V_{tl}$ = 200 mV |

Note (1) Input signals shall be low or Hi- resistance state when VCC is off.

Note (2) All electrical characteristics for LVDS signal are defined and shall be measured at the interface connector of LCD.

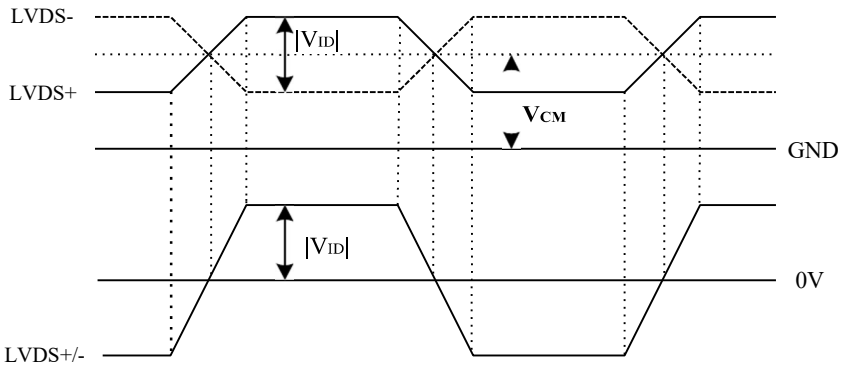



**Figure 8 Voltage Definitions**

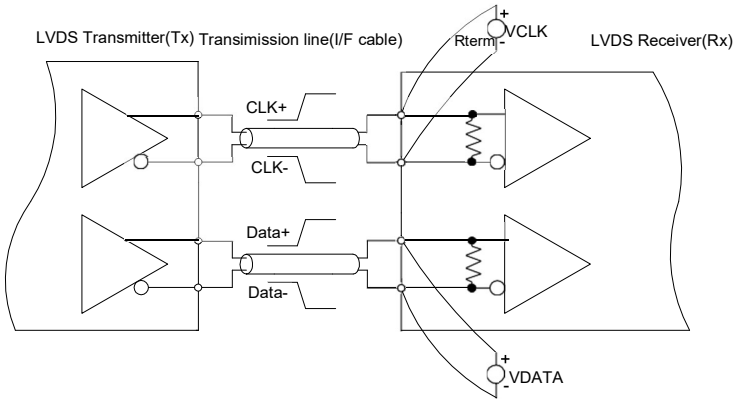



**Figure 9 Measurement System**

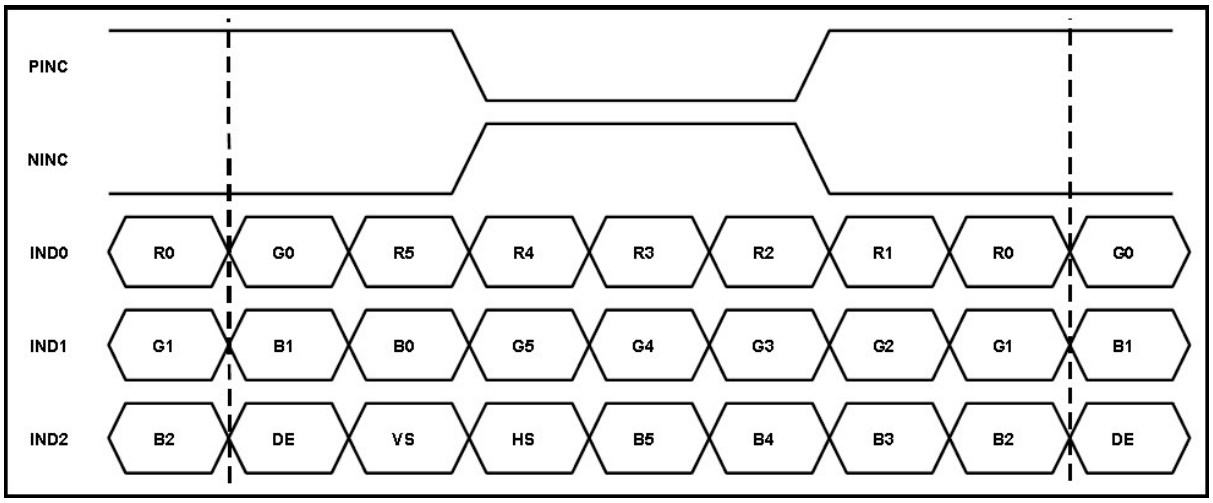



**Figure 10 Data Mapping**

4.2.2 LVDS Receiver Internal Circuit

Figure 12 shows the internal block diagram of the LVDS receiver. This LCD module equips termination resistors for LVDS link.

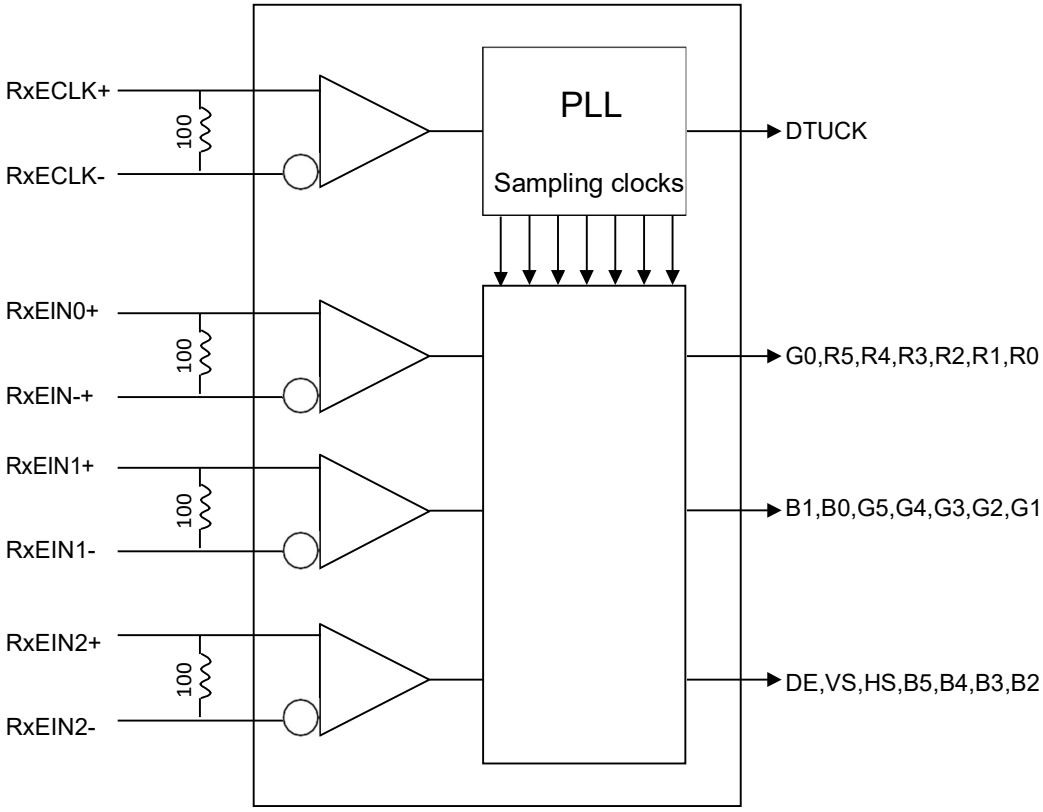



**Figure 11 LVDS Receiver Internal Circuit**

### 4.3 Interface Timings

**Table 8 Table 8 Interface Timings**

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| LVDS Clock Frequency | Fclk | (38.7) | (42.2) | (45.7) | MHz |
| H Total Time | HT | (940) | (1056) | (1395) | Clocks |
| H Active Time | HA | | (800) | | |
| V Total Time | VT | (628) | (666) | (798) | Lines |
| V Active Time | VA | | (600) | | |
| Frame Rate | FV | (55) | (60) | (65) | Hz |

Note1：HT * VT *Frame Frequency≤42.2 MHz

Note2: All reliabilities are specified for timing specification based on refresh rate of 60 Hz. HM121SV101IV is secured only for function under lower refresh rate; 60 Hz at Normal mode, 55 Hz at Power save mode. Don’t care flicker level (power save mode)

### 4.4 Input Power Specifications

Input power specifications are as follows.

**Table 9 Input Power Specifications**

| Parameter | | Symbol | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|---|
| *System Power Supply* | | | | | | | |
| LCD Drive Voltage (Logic) | | $V_{CC}$ | (3.0) | (3.3) | (3.6) | V | (1),(2) |
| VCC Current | Black Pattern | $I_{DD}$ | - | - | (0.35) | A | (1),(4) |
| VCC Power Consumption | | $P_{DD}$ | - | - | (1.16) | W | |
| Logic Input Signal Voltage | | $V_{IH}$ | (3.0) | - | (3.6) | V | (1) |
| | | $V_{IL}$ | (0) | - | (0.4) | V | |
| Rush Current | | $I_{Rush}$ | - | - | (1.5) | A | (1),(4) |
| Allowable Logic/LCD Drive Ripple Voltage | | $V_{VCC-RP}$ | - | - | (200) | mV | (1) |
| *LED Power Supply* | | | | | | | |
| LED Input Voltage | | $V_{LED}$ | (10.2) | (12.0) | (13.8) | V | (1),(2),(9) |
| LED Power Consumption | | $P_{LED}$ | - | - | (5.0) | W | (1),(5),(9) |
| LED Forward Voltage | | $V_F$ | (2.7) | - | (3.2) | V | (1),(2) |
| LED Forward Current | | $I_F$ | - | (49.26) | - | mA | |
| PWM Signal Voltage | High | $V_{PWM}$ | (3.0) | - | (3.6) | V | |
| | Low | | (0) | - | (0.4) | | |
| LED Enable Voltage | High | $V_{LED\_EN}$ | (3.0) | - | (3.6) | V | |
| | Low | | (0) | - | (0.4) | | |
| Input PWM Frequency | | $F_{PWM}$ | (200) | - | (1,000) | Hz | (1),(2),(6) |
| Duty Ratio | | PWM | (10) | - | (100) | % | (1),(7) |
| LED Life Time | | LT | (50,000) | - | - | Hours | (1),(8) |

Note (1) All of the specifications are guaranteed under normal conditions. Normal conditions are defined as follow: Temperature: 25℃, Humidity: 55± 10%RH.

Note (2) All of the absolute maximum ratings specified in the table, if exceeded, may cause faulty operation or unrecoverable damage .It is recommended to follow the typical value.

Note (3) The specified $V_{CC}$ current and power consumption are measured under the $V_{CC}$ = (3.3) V, FV= (60) Hz condition and Black pattern.

Note (4) The figures below is the measuring condition of $V_{CC}$. Rush current can be measured when $T_{RUSH}$ is 0.5 ms.

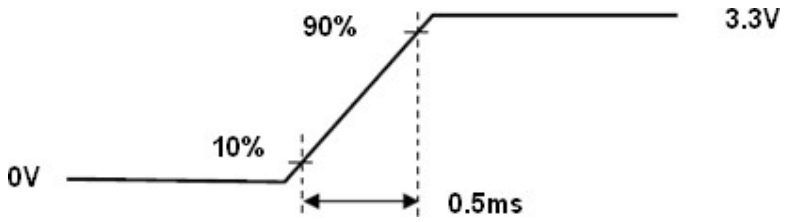



**Figure 12 $V_{CC}$ Rising Time**

Note (5) The power consumption of LED Driver are under the $V_{LED}$ = (12) V, Dimming of Max luminance.

Note (6) Although acceptable range as defined, the dimming ratio is not effective at all conditions. The PWM frequency should be fixed and stable for more consistent luminance control at any specific level desired.

Note (7) The operation of LED Driver below minimum dimming ratio may cause flickering or reliability issue.

Note (8) The life time is determined as the sum of the lighting time till the luminance of LCD at the typical LED current reducing to 50% of the minimum value under normal operating condition.

### 4.5 Power ON/OFF Sequence

1. Interface signals are also shown in the chart. Signals from any system shall be Hi-resistance state or low level when VCC voltage is off.
2. When system first start up, should keep the VCC high time longer than 200ms, otherwise may cause image sticking when VCC drop off.

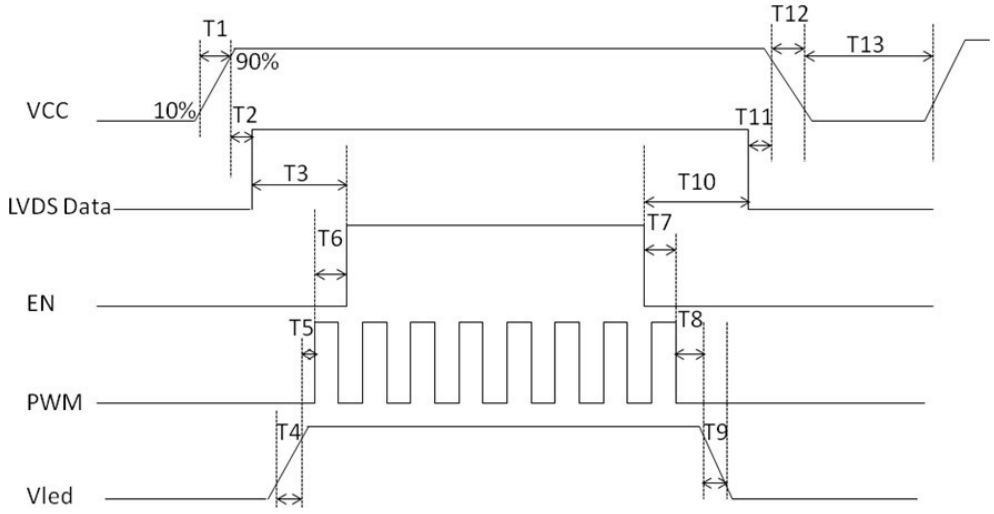



**Figure 13 Power Sequence**

**Table 10 Power Sequencing Requirements**

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| VCC Rise Time | T1 | (0.5) | - | (10) | ms |
| VCC Good to Signal Valid | T2 | (0) | - | (50) | ms |
| Signal Valid to Backlight Enable On | T3 | (200) | - | - | ms |
| Vled Power On Time | T4 | (0.5) | - | (10) | ms |
| Vled Good to System PWM On | T5 | (10) | - | - | ms |
| System PWM ON to Backlight Enable ON | T6 | (10) | - | - | ms |
| Backlight Enable Off to System PWM Off | T7 | (10) | - | - | ms |
| System PWM Off to B/L Power Disable | T8 | (10) | - | - | ms |
| Backlight Power Off Time | T9 | (0.5) | - | (30) | ms |
| Backlight Power Off to Signal Disable | T10 | (200) | - | - | ms |
| Signal Disable to Power Down | T11 | (0) | - | (50) | ms |
| VCC Fall Time | T12 | (0.5) | - | (30) | ms |
| VCC Power Off | T13 | (500) | - | - | ms |

## 5.0 Mechanical Characteristics

### 5.1 Outline Drawing

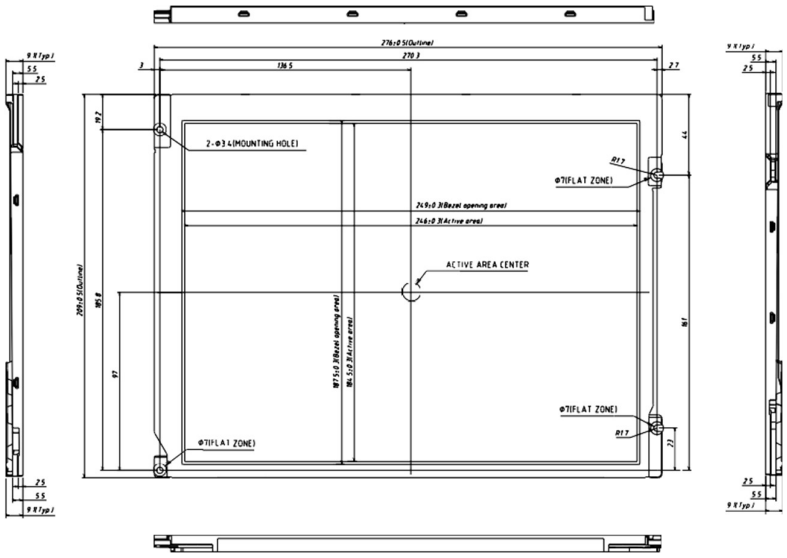



**Figure 14 Reference Outline Drawing (Front Side)**

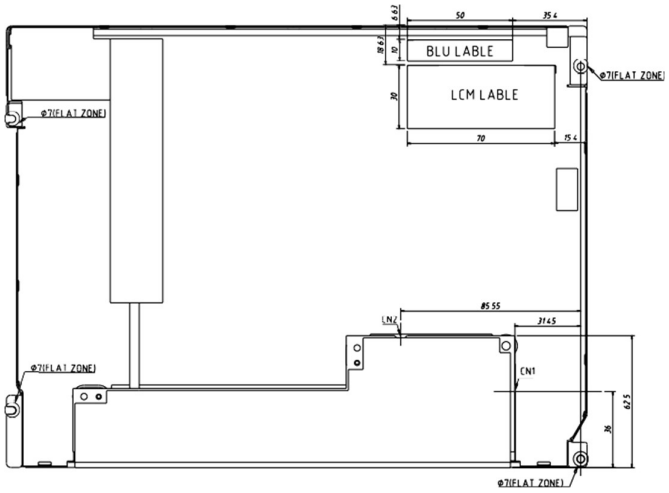



**Figure 15 Reference Outline Drawing (Back Side)**

Unit:mm

Note1: Unnoted tolerance ±0.5mm;

### 5.2 Dimension Specifications

**Table 11 Module Dimension Specifications**

| Item | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Width | | (275.5) | (276) | (276.5) | mm |
| Height | | (208.5) | (209) | (209.5) | mm |
| Thickness | With PCBA | (8.6) | (9.1) | (9.6) | mm |
| Weight | | - | - | (665) | g |

Note Outline dimension measure instrument: Vernier Caliper.

## 6.0 Reliability Conditions

**Table 12 Reliability Condition**

| Item | | Package | Test Conditions | | Note |
|---|---|---|---|---|---|
| High Temperature/High Humidity Operating Test | | Module | $T_{gs}$=50℃, 85%RH, 300 hours | | (1),(2),(3),(4) |
| High Temperature Operating Test | | Module | $T_{gs}$=70℃, 300 hours | | |
| Low Temperature Operating Test | | Module | $T_a$=-20℃, 300 hours | | |
| High Temperature Storage Test | | Module | $T_a$=85℃, 300 hours | | (1),(3),(4) |
| Low Temperature Storage Test | | Module | $T_a$=-30℃, 300 hours | | |
| Shock Non-operating Test | | Module | 100G, 6ms,X Y Z ×<br>2face×3times, Total 18 times | | (1),(3),(5) |
| Vibration Non-operating Test | | Module | half-sine,Frequency: 8Hz ~ 33Hz,Stroke: 1.3mm,Sweep: 2.9G 33.3Hz ~ 400Hz X,Z ,Cycle : 15 minutes,2 hrs for each direction of X,Z ; 4 hours for Y direction | | |
| ESD Test | Operating | Module | Contact | ±8KV, 150pF(330Ohm) | (1),(2),(6) |
| | | | Air | ±15KV, 150pF(330Ohm) | |
| | Non-operating | | Contact | ±10KV, 150pF(330Ohm) | (1),(6) |
| | | | Air | ±20KV, 150pF(330Ohm) | |

Note (1) A sample can only have one test. Outward appearance, image quality and optical datacan only be checked at normal conditions according to the HIGHNESS document before reliable test. Only check the function of the module after reliability test.

Note (2) The setting of electrical parameters should follow the typical value before reliability test.

Note (3) During the test, it is unaccepted to have condensate water remains. Besides, protect the module from static electricity.

Note (4) The sample must be released for 24 hours under normal conditions before judging. Furthermore, all the judgment must be made under normal conditions. Normal conditions are defined as follow: Temperature: 25℃, Humidity: 55± 10%RH. $T_a$= Ambient Temperature, $T_{gs}$= Glass Surface Temperature.

Note (5) The module should be fixed firmly in order to avoid twisting and bending.

Note (6) It could be regarded as pass, when the module recovers from function fault caused by ESD after resetting.

## 7.0 Display Label.