**() Preliminary Specifications**
**(V) Final Specifications**

| | |
|---|---|
| **Module** | 13.3 Inch Color TFT-LCD |
| **Model Name** | G133HAN03.1 |
| **Note** | LED Backlight with driving circuit design |

| | |
|---|---|
| **Company** | **Approved by** Ginger Lin **Date** 2022/12/15 |
| **Checked & Approved by** **Date** | **Prepared by** CH Tsai 2022/12/15 |
| | General Display Business Unit / AUO Display Plus Corporation |

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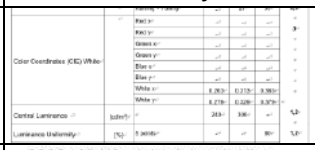
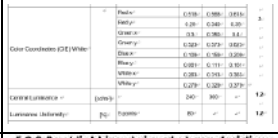
| 1.0 | 6 |  |  |
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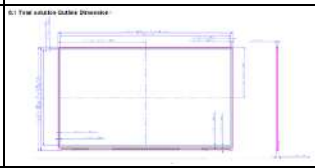
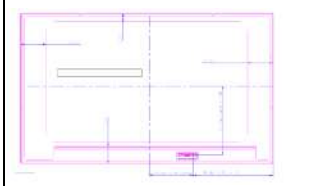
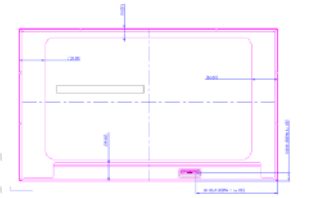
| | 22 |  |  |
| | 23 |  |  |
| 1.1 | 5 | LCD Power Consumption / [Watt] / 4.0W (Include Logic and BLU power) | LCD Power Consumption / [Watt] / 4.8W (Include Logic and BLU power) |
| | 14 | 5.2.1 LED characteristics<br>Parameter / Symbol / Min / Typ / Max / Units / Condition<br>Backlight Power Consumption / PLED / / / 2.4 / [Watt] / (Ta=25°C), Note 1 | 5.2.1 LED characteristics<br>Parameter / Symbol / Min / Typ / Max / Units / Condition<br>Backlight Power Consumption / PLED / / / 3.2 / [Watt] / (Ta=25°C), Note 1 |

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## 1. Operating Precautions

1) Since front polarizer is easily damaged, please be cautious and not to scratch it.
2) Be sure to turn off power supply when inserting or disconnecting from input connector.
3) Wipe off water drop immediately. Long contact with water may cause discoloration or spots.
4) When the panel surface is soiled, wipe it with absorbent cotton or soft cloth.
5) Since the panel is made of glass, it may be broken or cracked if dropped or bumped on hard surface.
6) Since CMOS LSI is used in this module, take care of static electricity and insure human earth when handling.
7) Do not open nor modify the module assembly.
8) Do not press the reflector sheet at the back of the module to any direction.
9) In case if a module has to be put back into the packing container slot after it was taken out from the container, do not press the center of the LED Reflector edge. Instead, press at the far ends of the LED Reflector edge softly. Otherwise the TFT Module may be damaged.
10) At the insertion or removal of the Signal Interface Connector, be sure not to rotate nor tilt the Interface Connector of the TFT Module.
11) TFT-LCD Module is not allowed to be twisted & bent even force is added on module in a very short time. Please design your display product well to avoid external force applying to module by end-user directly.
12) Small amount of materials without flammability grade are used in the TFT-LCD module. The TFT-LCD module should be supplied by power complied with requirements of Limited Power Source (IEC60950-1 or UL60950-1), or be applied exemption.
13) Severe temperature condition may result in different luminance, response time.
14) Continuous operating TFT-LCD Module under high temperature environment may accelerate LED light bar exhaustion and reduce luminance dramatically.
15) The data on this specification sheet is applicable when TFT-LCD module is placed in landscape position.
16) Continuous displaying fixed pattern may induce image sticking or abnormal display .
It's recommended to use screen saver or power off panel periodically.

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## 2. General Description

This specification applies to the 13.3 inch Color a-Si TFT-LCD Module G133HAN03.1. The display supports the FHD_1920(H)x1080(V) screen format and 16.2M colors (RGB 6-bits +FRC). All input signals are eDP interface and this module contains with an LED driver for backlight.

### 2.1 Display Characteristics

The following items are characteristics summary total solution on the table under 25 ℃condition:

| Items | Unit | Specifications |
|---|---|---|
| Screen Diagonal | [inch] | 13.3 |
| Active Area | [mm] | 293.76(H) x 165.24(V) |
| Pixels H x V | | 1920x3(RGB) x 1080 |
| Pixel Pitch | [mm] | 0.153 x 0.153 |
| Pixel Arrangement | | R.G.B. Vertical Stripe |
| Display Mode | | AHVA, Normally Black |
| Normal Input Voltage VDD | [Volt] | 3.3 (Typ.) |
| LCD Power Consumption | [Watt] | 4.8W (Include Logic and BLU power) |
| Weight (Total) | [Grams] | 250 (max) |
| Physical Size (Total) | [mm] | 300.26(W)X177.47(H) Typ. |
| Thickness (Total) | [mm] | 5.0 (Max.) |
| Electrical Interface | | eDP 1.2 |
| Support Color | | 16.2M (6bit+FRC) |
| Temperature Range<br>Operating<br>Storage (Non-Operating) | <br>[°C]<br>[°C] | <br>0 to +50℃<br>-20℃ to +60℃ |
| RoHS Compliance | | RoHS Compliance |
| Light Bar Unit | | LED, Non-replaceable |

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## 2.2 Optical Characteristics

The optical characteristics are measured with total sulotion under stable conditions at 25 °C:

| Item | Unit | Conditions | Min. | Typ. | Max. | Note |
|---|---|---|---|---|---|---|
| Viewing Angle | [degree] | Horizontal (Right)<br>CR = 10 (Left) | 80<br>80 | 89<br>89 | -<br>- | ***3,6*** |
| | | Vertical (Up)<br>CR = 10 (Down) | 80<br>80 | 89<br>89 | -<br>- | |
| Contrast ratio | | Normal Direction | 500 | 600 | - | ***3,4*** |
| Response Time | | Raising + Falling | - | 27 | 35 | **3,5** |
| Color Coordinates (CIE) White | | Red x | 0.518 | 0.568 | 0.618 | ***3*** |
| | | Red y | 0.29 | 0.340 | 0.39 | |
| | | Green x | 0.3 | 0.350 | 0.4 | |
| | | Green y | 0.523 | 0.573 | 0.623 | |
| | | Blue x | 0.109 | 0.159 | 0.209 | |
| | | Blue y | 0.061 | 0.111 | 0.161 | |
| | | White x | 0.263 | 0.313 | 0.363 | |
| | | White y | 0.279 | 0.329 | 0.379 | |
| Central Luminance | [cd/m$^2$] | | 240 | 300 | - | **1,2** |
| Luminance Uniformity | [%] | 5 points | 80 | - | - | **1,2** |
| NTSC | [%] | | - | 45 | - | |

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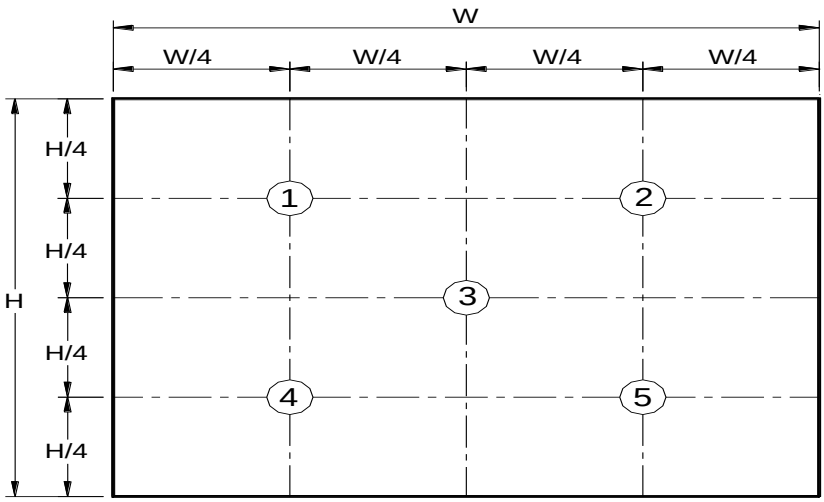
**Note 1**: 5 points' position (Ref: Active area)

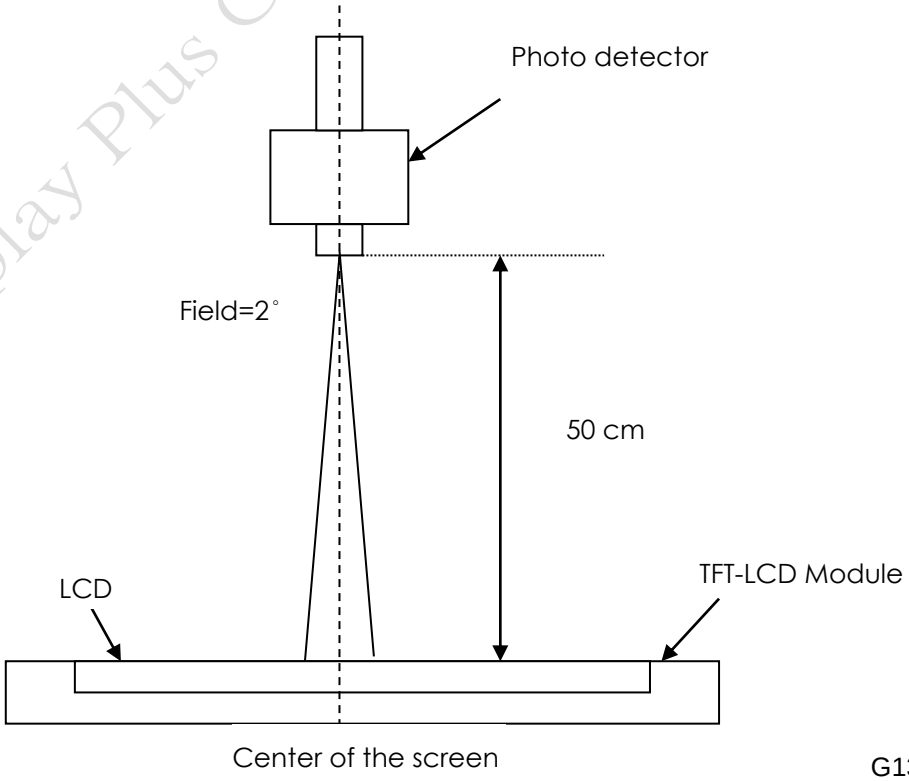



**Note 2**: The luminance uniformity of 5 points is defined by dividing the maximum luminance values by the minimum test point luminance

$$\delta_{W5} = \frac{\text{Maximum Brightness of five points}}{\text{Minimum Brightness of five points}}$$

**Note 3**: Measurement method

The LCD module should be stabilized at given temperature for 30 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 30 minutes in a stable, windless and dark room, and it should be measured in the center of screen.

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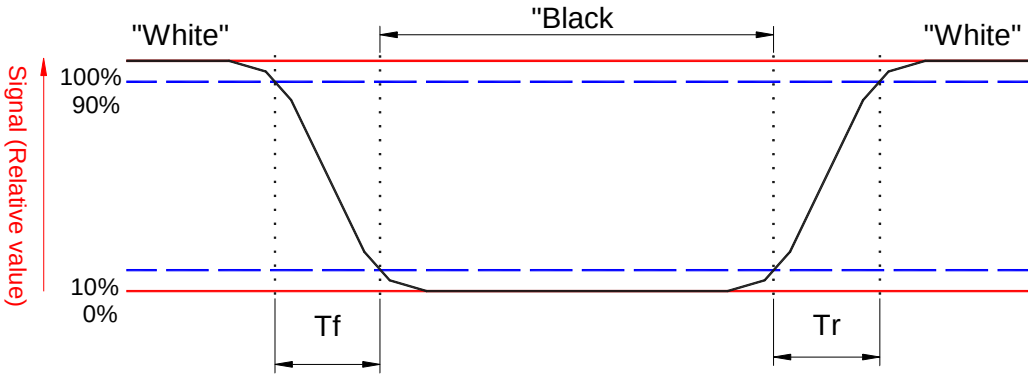
**Note 4:** Definition of contrast ratio:

Contrast ratio is calculated with the following formula.

$$\text{Contrast ratio (CR)} = \frac{\text{Brightness on the "White" state}}{\text{Brightness on the "Black" state}}$$

**Note 5**: Definition of response time:

The output signals of BM-7 or equivalent are measured when the input signals are changed from "Black" to "White" (falling time) and from "White" to "Black" (rising time), respectively. The response time interval is between the 10% and 90% of amplitudes. Refer to figure as below.




N

1

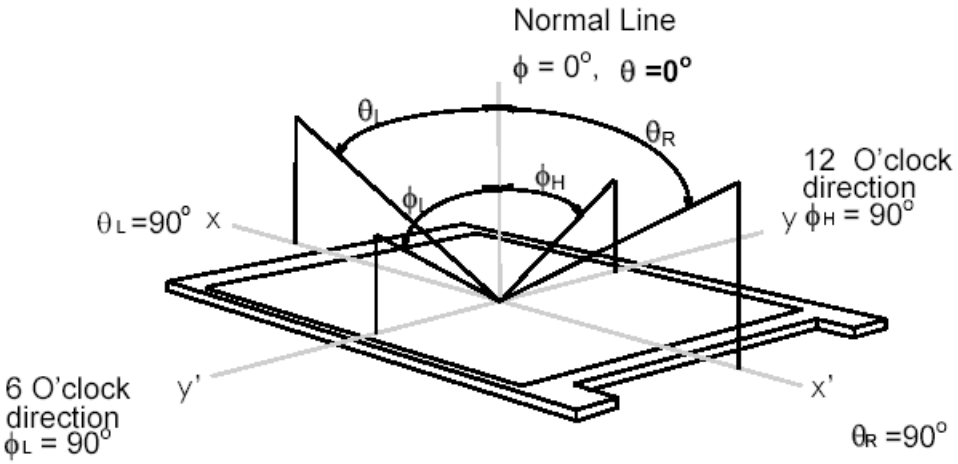
(

30° horizontal and

own as follows; 90°

ent direction is

typically perpendicular to the display surface with the screen rotated about its center to develop the desired measurement viewing angle.





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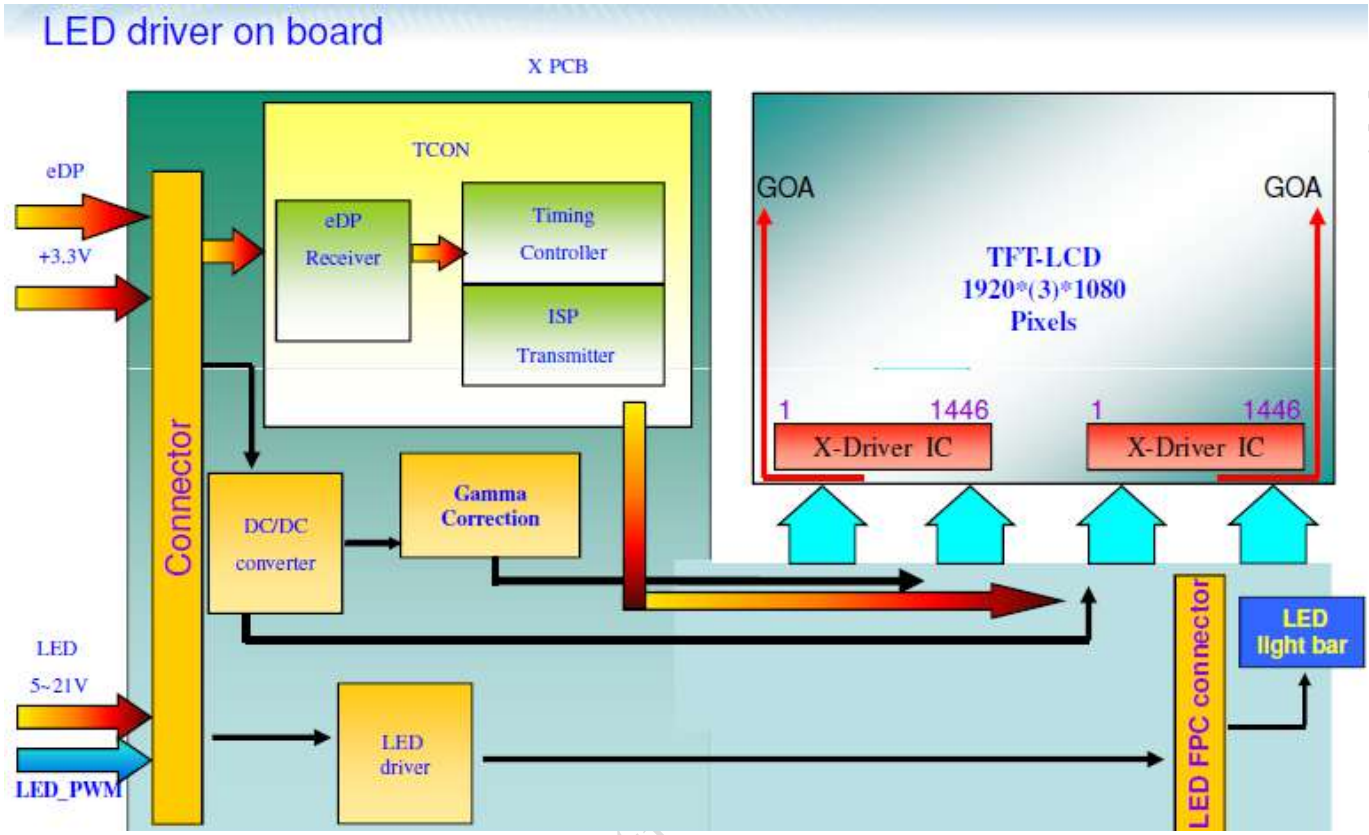
## 3. Functional Block Diagram

The following diagram shows the functional block of the 13.3 inch color TFT/LCD module:

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# 4. Absolute Maximum Ratings

An absolute maximum rating of the module is as following:

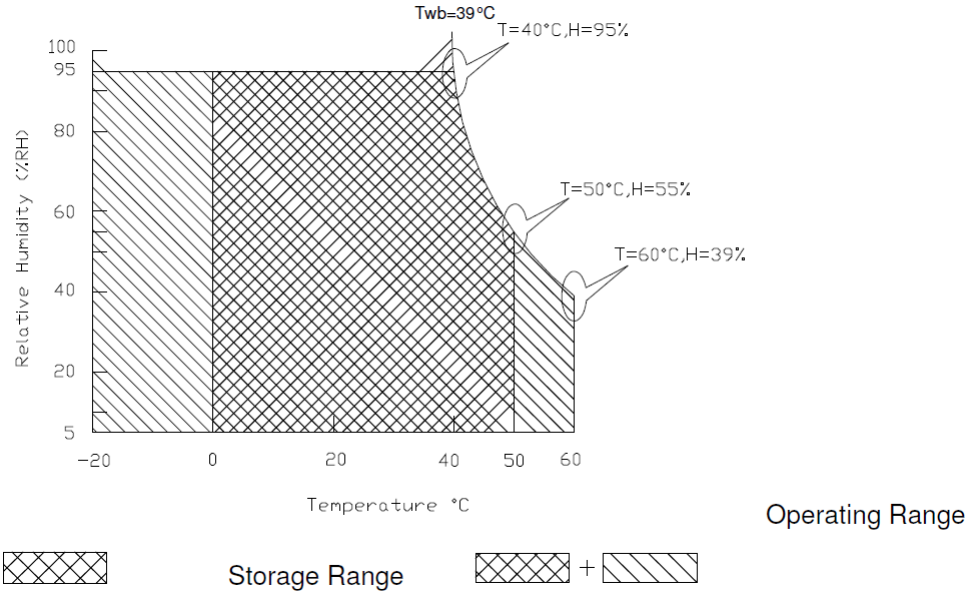
## 4.1 Absolute Ratings of TFT LCD Module

| Item | Symbol | Min | Max | Unit | Conditions |
|---|---|---|---|---|---|
| Logic/LCD Drive Voltage | VDD | -0.3 | +4.0 | [Volt] | Note 1,2 |

## 4.2 Absolute Ratings of Environment

| Item | Symbol | Min | Max | Unit | Conditions |
|---|---|---|---|---|---|
| Operating Temp. | TOP | 0 | +50 | [°C] | Note 4 |
| Operation Humidity | HOP | 5 | 95 | [%RH] | Note 4 |
| Storage Temperature | TST | -20 | +60 | [°C] | Note 4 |
| Storage Humidity | HST | 5 | 95 | [%RH] | Note 4 |

**Note 1:** At Ta (25℃)
**Note 2:** Permanent damage to the device may occur if exceed maximum values
**Note 3:** LED specification refer to section 5.2
**Note 4:** For quality performance, please refer to AUO IIS (Incoming Inspection Standard)

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# 5. Electrical Characteristics

## 5.1 TFT LCD Module

### 5.1.1 Power Specification

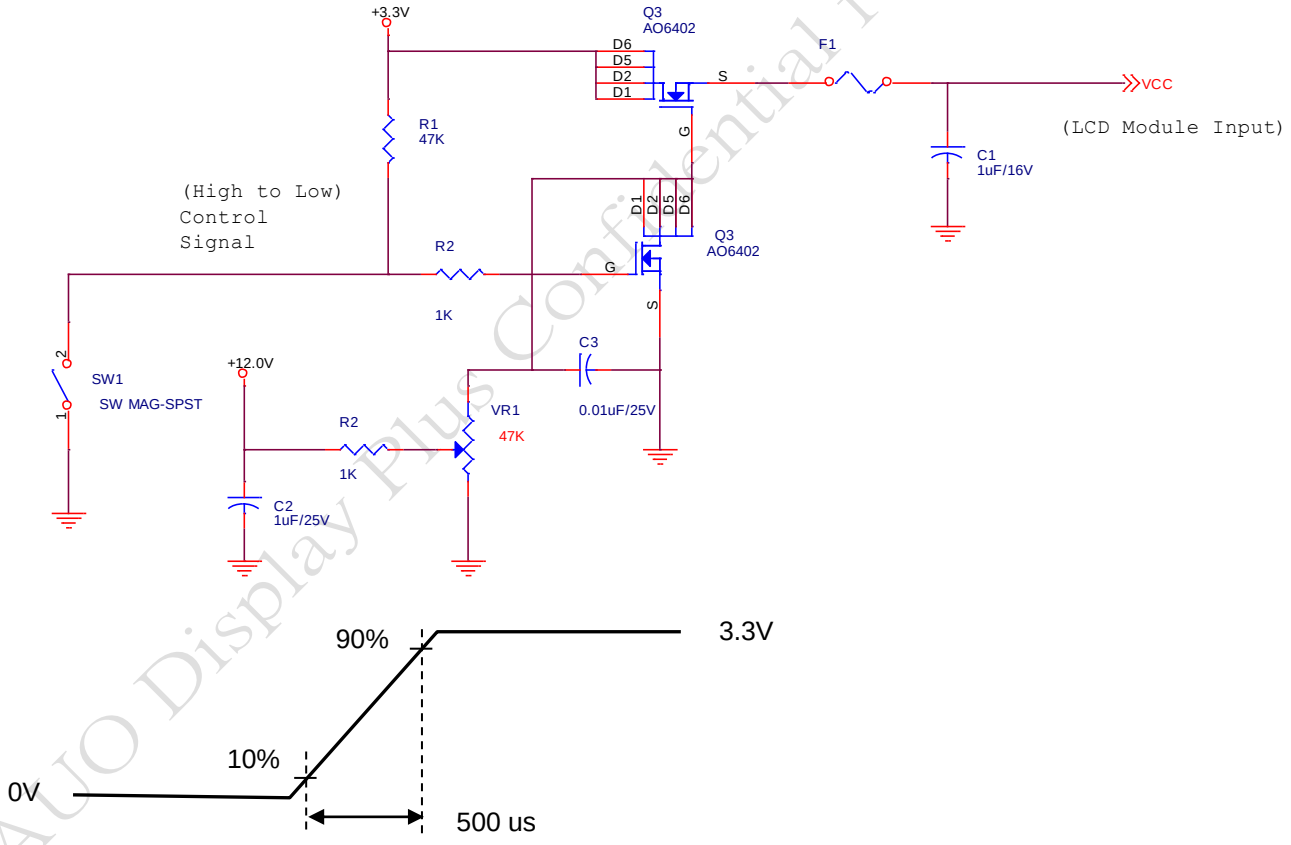
Input power specifications are as follows;

The power specification are measured under 25℃and frame frequency under 60Hz

| Symble | Parameter | Min | Typ | Max | Units | Note |
|---|---|---|---|---|---|---|
| VDD | Logic/LCD Drive Voltage | 3.0 | 3.3 | 3.6 | [Volt] | |
| PDD | VDD Power | _ | 0.8 | 1.2 | [Watt] | Note 1 |
| IDD | IDD Current | - | - | 400 | [mA] | Note 1 |
| IRush | Inrush Current | - | - | 1500 | [mA] | Note 2 |
| VDDrp | Allowable Logic/LCD Drive Ripple Voltage | - | - | 100 | [mV] p-p | |

**Note 1:** PDD(typ)@ mosaic pattern Maximum Power; PDD(Max)@ R/G/B pattern Maximum Power
IDD(Max)=PDD(Max) / VDD(Min)

**Note 2:** Measure Condition







**VDD rising time**

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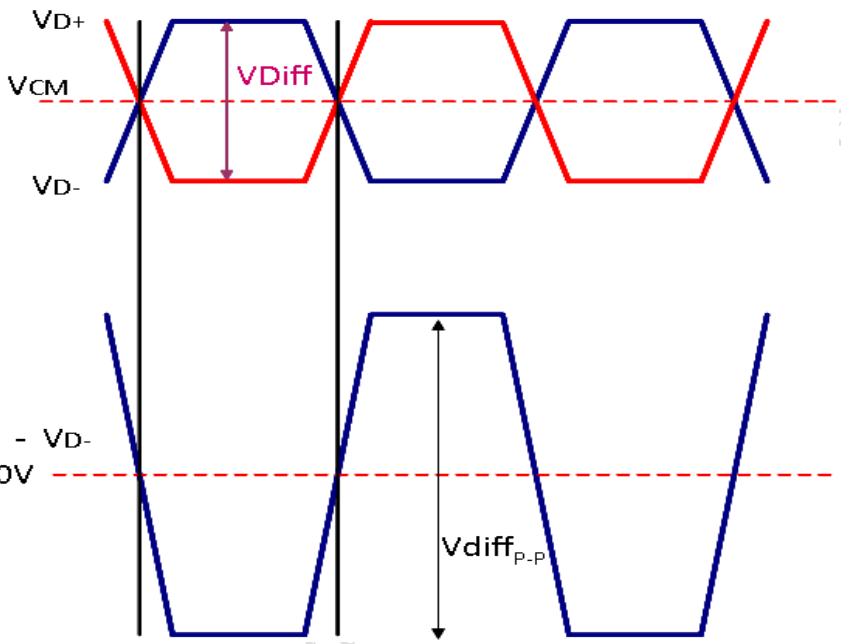
### 5.1.2 Signal Electrical Characteristics

Signal electrical characteristics are as follows;

**Display Port main link signal:**

Differential pair VD+ , VD- Which is one Display port Main link

VCM of Display port Main link




$Vdiff_{P-P} = [(VD+) - (VD-)] \times 2$

| Display port main link | | | | | |
|---|---|---|---|---|---|
| | | Min | Typ | Max | unit |
| VCM | RX input DC Common Mode Voltage | | 0 | | V |
| $VDiff_{P-P}$ | Peak-to-peak Voltage at a receiving Device | 150 | | 1320 | mV |

Follow as VESA display port standard V1.4

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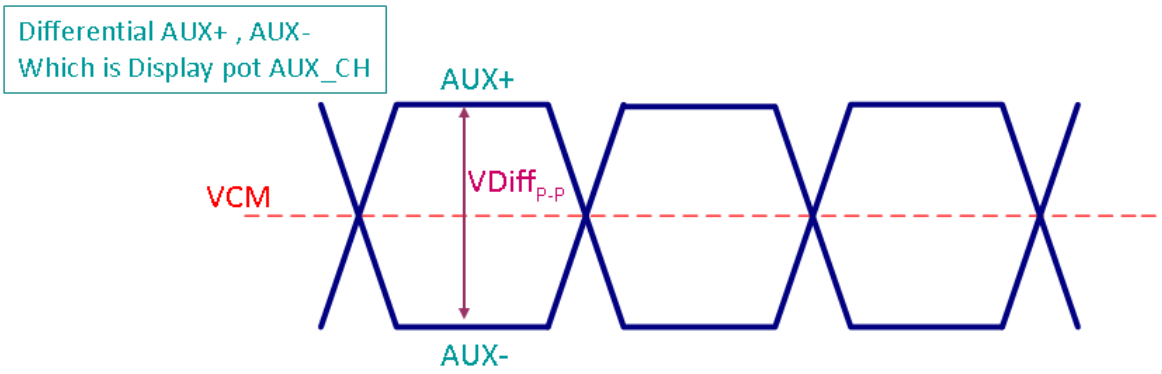
**Display Port AUX_CH signal:**




| Display port AUX_CH | | | | | |
|---|---|---|---|---|---|
| | | Min | Typ | Max | unit |
| VCM | AUX DC Common Mode Voltage | | 0 | | V |
| $VDiff_{P-P}$ | AUX Peak-to-peak Voltage at a receiving Device | 270 | | 800 | mV |

Follow as VESA display port standard V1.3

**Display Port $V_{HPD}$ signal:**

| Display port $V_{HPD}$ | | | | | |
|---|---|---|---|---|---|
| | | Min | Typ | Max | unit |
| $V_{HPD}$ | HPD Voltage (input impedance 1KΩ) | 2.25 | - | 3.6 | V |

Follow as VESA display port standard V1.3

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## 5.2 Backlight Unit

### 5.2.1 LED characteristics

| Parameter | Symbol | Min | Typ | Max | Units | Condition |
|---|---|---|---|---|---|---|
| Backlight Power Consumption | PLED | - | - | 3.2 | [Watt] | (Ta=25℃, Note 1 |
| LED Life-Time | N/A | - | 30,000 | - | Hour | (Ta=25℃, Note 2 |

**Note 1:** Calculator value for reference $P_{LED}$ = $V_F$ (Normal Distribution) * $I_F$ (Normal Distribution) / Efficiency

**Note 2:** The LED life-time define as the estimated time to 50% degradation of initial luminous.

### 5.2.2 Backlight input signal characteristics

| Parameter | Symbol | Min | Typ | Max | Units | Remark |
|---|---|---|---|---|---|---|
| LED Power Supply | VLED (Note 1) | 10.8 | 12.0 | 13.2 | [Volt] | Define as Connector Interface (Ta=25℃) |
| LED Enable Input High Level | VLED_EN (Note 2) | 2.5 | - | 5.5 | [Volt] | |
| LED Enable Input Low Level | | - | - | 0.5 | [Volt] | |
| PWM Logic Input High Level | VLED_PWM (Note 2) | 2.5 | - | 5.5 | [Volt] | |
| PWM Logic Input Low Level | | - | - | 0.5 | [Volt] | |
| PWM Input Frequency | FPWM | 200 | 1K | 10K | Hz | |
| PWM Duty Ratio | Duty | 5 (Note 3) | -- | 100 | % | |

**Note 1 :** Recommend system pull up/down resistor no bigger than 10kohm

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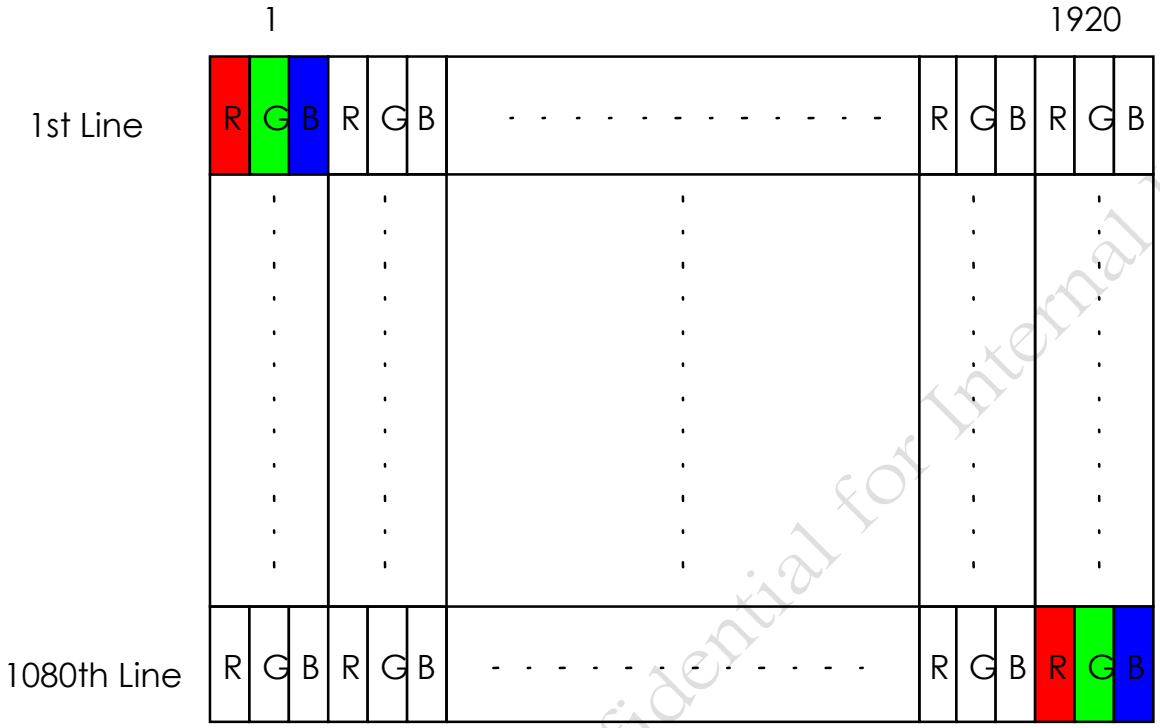
# 6. Signal Interface Characteristic

## 6.1 Pixel Format Image

Following figure shows the relationship of the input signals and LCD pixel format.

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## 6.2 Integration Interface Requirement

### 6.2.1 Connector Description (LCM)

Physical interface is described as for the connector on module.

These connectors are capable of accommodating the following signals and will be following components.

| Connector Name / Designation | For Signal Connector |
|---|---|
| Manufacturer | STM or compatible |
| Type / Part Number | STM MSAK24025P30M or compatible |
| Mating Housing/Part Number | I-PEX 20704-030T-13 or compatible |

### 6.2.2 Pin Assignment

| Pin | Symbol | Description |
|---|---|---|
| 1 | NC | No connect |
| 2 | H_GND | High Speed Ground |
| 3 | Lane1_N | Comp Signal Link Lane 1 |
| 4 | Lane1_P | True Signal Link Lane 1 |
| 5 | H_GND | High Speed Ground |
| 6 | Lane0_N | Comp Signal Link Lane 0 |
| 7 | Lane0_P | True Signal Link Lane 0 |
| 8 | H_GND | High Speed Ground |
| 9 | AUX_CH_P | True Signal Auxiliary Ch. |
| 10 | AUX_CH_N | Comp Signal Auxiliary Ch. |
| 11 | H_GND | High Speed Ground |
| 12 | LCD_VCC | LCD logic and driver power |
| 13 | LCD_VCC | LCD logic and driver power |
| 14 | LCD_Self_Test | LCD Panel Self Test Enable |
| 15 | LCD_GND | LCD logic and driver ground |
| 16 | LCD_GND | LCD logic and driver ground |
| 17 | HPD | HPD signal pin |
| 18 | BL_GND | Backlight ground |
| 19 | BL_GND | Backlight ground |
| 20 | BL_GND | Backlight ground |
| 21 | BL_GND | Backlight ground |
| 22 | BL_Enable | Backlight On / Off |
| 23 | BL_PWM_DIM | System PWM signal Input |
| 24 | NC | No connect |
| 25 | NC | No connect |
| 26 | BL_PWR | Backlight power |
| 27 | BL_PWR | Backlight power |
| 28 | BL_PWR | Backlight power |
| 29 | BL_PWR | Backlight power |
| 30 | NC | Reserve for LCD supplier |

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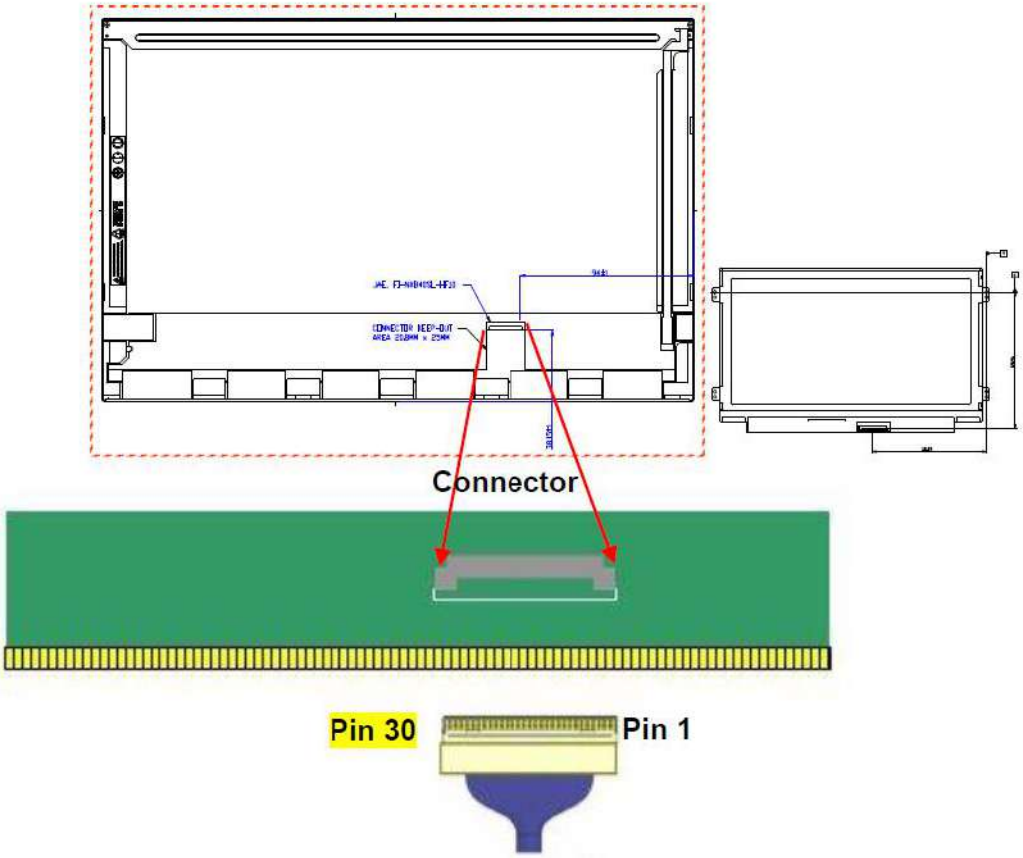
### 6.2.5 Connector Pin 1 Locations

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## 6.3 Interface Timing

6.3.1 Timing Characteristics

Basically, interface timings should match the 1920x1080 /60Hz manufacturing guide line timing.

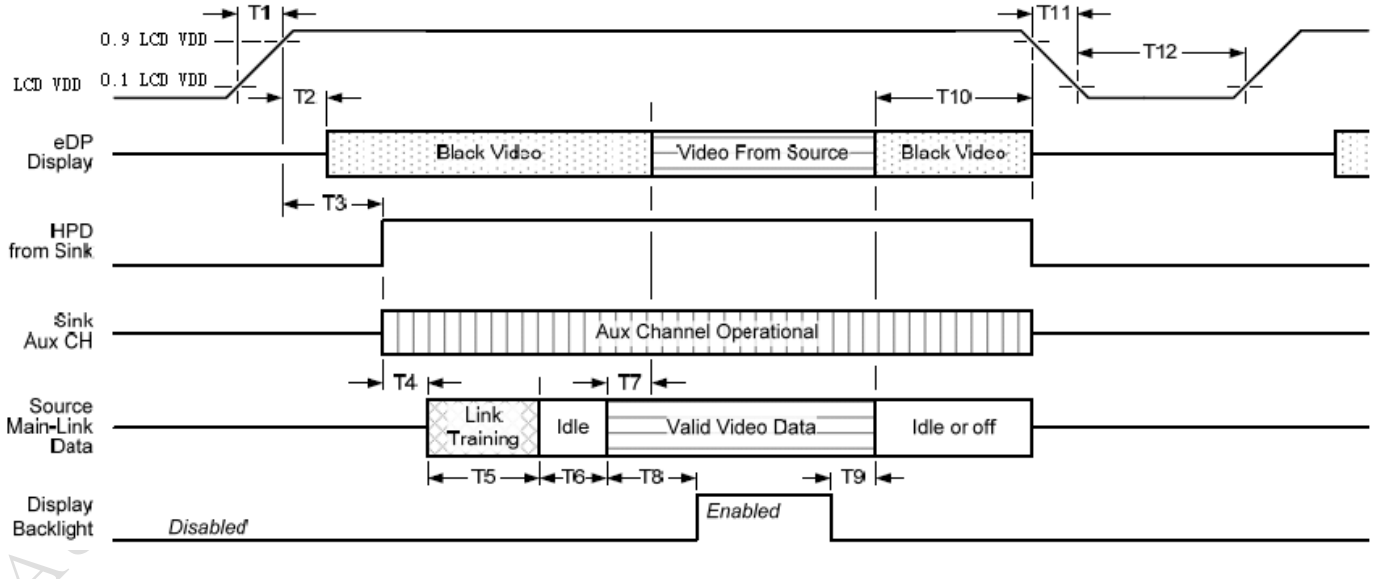
| Parameter | | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Frame Rate | | - | | 60 | | Hz |
| Clock frequency | | 1/ $T_{Clock}$ | | 140 | | MHz |
| Vertical Section | Period | $T_V$ | 1110 | 1112 | 1080+A | $T_{Line}$ |
| | Active | $T_{VD}$ | | 1080 | | |
| | Blanking | $T_{VB}$ | 20 | 32 | A | |
| Horizontal Section | Period | $T_H$ | 2080 | 2098 | 1920+B | $T_{Clock}$ |
| | Active | $T_{HD}$ | | 1920 | | |
| | Blanking | $T_{HB}$ | 160 | 178 | B | |

**Note 1 :** The above is as optimized setting
**Note 2 :** The maximum clock frequency = (1920+B)*(1080+A)*60<160MHz

## 6.4 Power ON/OFF Sequence

Power on/off sequence is as follows. Interface signals and LED on/off sequence are also shown in the chart. Signals from any system shall be Hi-Z state or low level when VDD is off

**Display Port panel power sequence:**




**Display port interface power up/down sequence, normal system operation**

**Display Port AUX_CH transaction only:**

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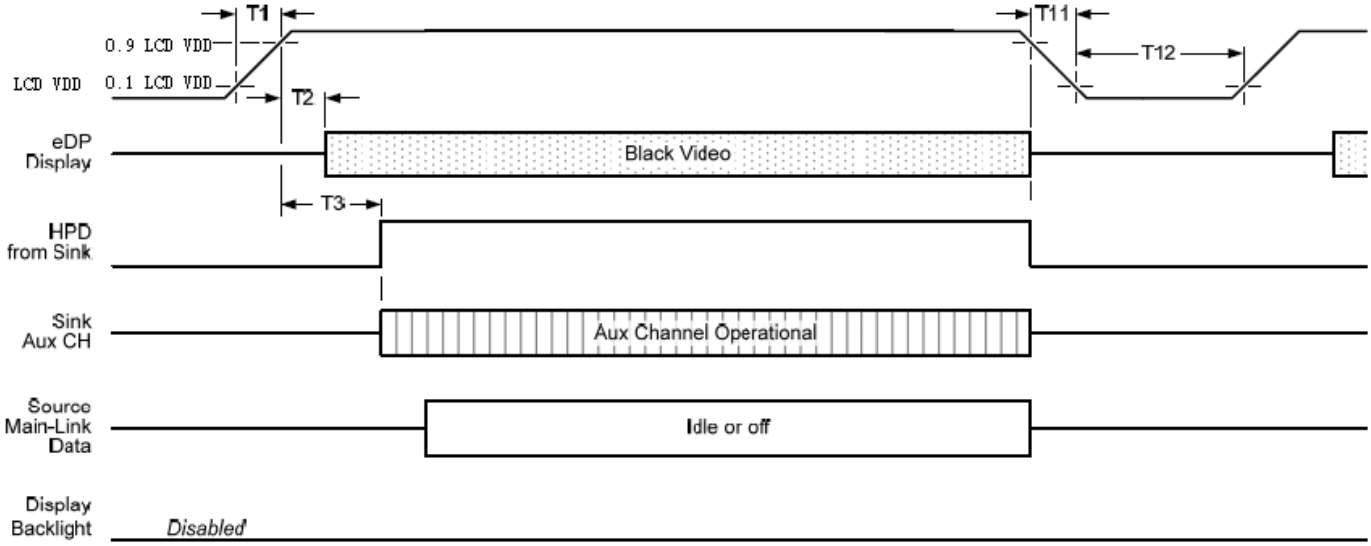


Display port interface power up/down sequence, AUX_CH transaction only

## Display Port panel power sequence timing parameter:

| Timing parameter | Description | Reqd. by | Limits | | | Notes |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| T1 | power rail rise time, 10% to 90% | source | 0.5ms | | 10ms | |
| T2 | delay from LCDVDD to black video generation | sink | 0ms | | 200ms | prevents display noise until valid video data is received from the source |
| T3 | delay from LCDVDD to HPD high | sink | 0ms | | 200ms | sink AUX_CH must be operational upon HPD high. |
| T4 | delay from HPD high to link training initialization | source | | | | allows for source to read link capability and initialize. |
| T5 | link training duration | source | | | | dependant on source link to read training protocol. |
| T6 | link idle | source | | | | Min accounts for required BS-Idle pattern.<br>Max allows for source frame synchronization. |
| T7 | delay from valid video data from source to video on display | sink | 0ms | | 50ms | max allows sink validate video data and timing. |
| T8 | delay from valid video data from source to backlight enable | source | | | | source must assure display video is stable. |
| T9 | delay from backlight disable to end of valid video data | source | | | | source must assure backlight is no longer illuminated. |
| T10 | delay from end of valid video data from source to power off | source | 0ms | | 500ms | |
| T11 | power rail fall time, 905 to 10% | source | | | 10ms | |
| T12 | power off time | source | 500ms | | | |

**Note1:** The sink must include the ability to generate black video autonomously. The sink must automatically enable black video under the following conditions:
-upon LCD VDD power on (with in T2 max)-when the "Novideostream_Flag" (VB-ID Bit 3) is received from the source (at


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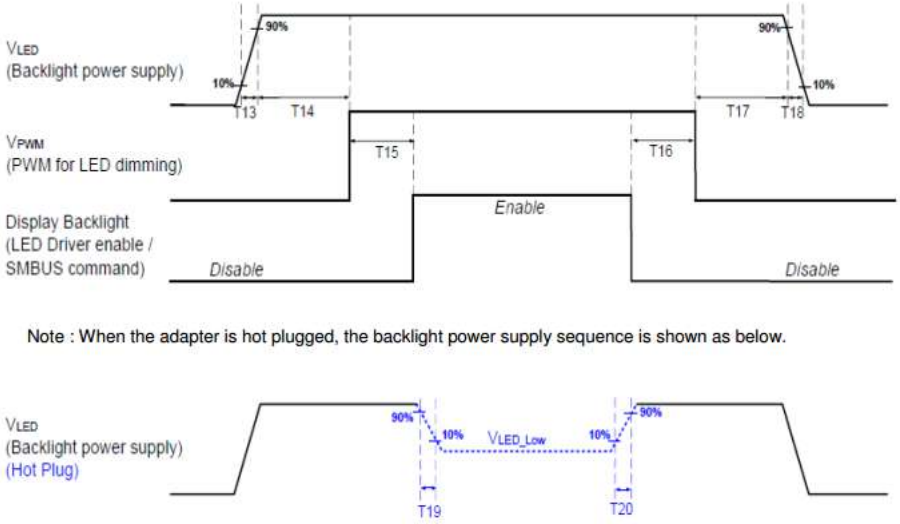
the end of T9).

-when no main link data, or invalid video data, is received from the source. Black video must be displayed within 64ms (typ) from the start of either condition. Video data can be deemed invalid based on MSA and timing information, for example.

**Note 2:** The sink may implement the ability to disable the black video function, as described in Note 1, above, for system development and debugging purpose.

**Note 3:** The sink must support AUX_CH polling by the source immediately following LCD VDD power on without causing damage to the sink device (the source can re-try if the sink is not ready). The sink must be able to respond to an AUX_CH transaction with the time specified within T3 max.

## Display Port Panel B/L power sequence timing parameter:




Note : When the adapter is hot plugged, the backlight power supply sequence is shown as below.




| | Min (ms) | Max (ms) |
|---|---|---|
| T13 | 0.5 | 10 |
| T14 | 10 | - |
| T15 | 0 | - |
| T16 | 0 | - |
| T17 | 10 | - |
| T18 | 0.5 | 10 |
| T19 | 1* | - |
| T20 | 1* | - |

Seamless change: T19/T20 = 5x$T_{PWM}$*

*$T_{PWM}$= 1/PWM Frequency

Note 1 : If T14,T15,T16,T17<10ms，The display garbage may occur. We suggest T14,T15,T16,T17>10ms to avoid the display garbage.

Note 2 : If T13 or T18<0.5ms，the inrush current may cause the damage of fuse. If T13 or T18<0.5ms，the inrush current $I^2t$ is under typical melt of fuse Spec.，there is no mentioned problem.

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# 7. Panel Reliability Test

## 7.1 Vibration Test

**Test Spec:**

- Test method: Non-Operation
- Acceleration: 1.5 G
- Frequency: 10 - 500Hz Random
- Sweep: 30 Minutes each Axis (X, Y, Z)

## 7.2 Shock Test

**Test Spec:**

- Test method: Non-Operation
- Acceleration: 220 G , Half sine wave
- Active time: 2 ms
- Pulse: X,Y,Z .one time for each side

## 7.3 Reliability Test

| Items | Required Condition | Note |
|---|---|---|
| Temperature Humidity Bias | Ta= 40℃, 90%RH, 300h | |
| High Temperature Operation | Ta= 50℃, 300h | |
| Low Temperature Operation | Ta=0℃, 300h | |
| High Temperature Storage | Ta= 60℃, 300h | |
| Low Temperature Storage | Ta= -20℃, 250h | |
| Thermal Shock Test | Ta=-20℃(30min) ~60℃(30min), 100cycles condition. | |
| ESD | Contact: ±8 KV<br>Air : ±15 KV | Note 1 |

**Note1:** According to EN 61000-4-2, ESD class B: Some performance degradation allowed. No data lost . Self-recoverable. No hardware failures.

**Remark:** MTBF (Excluding the LED): 30,000 hours with a confidence level 90%

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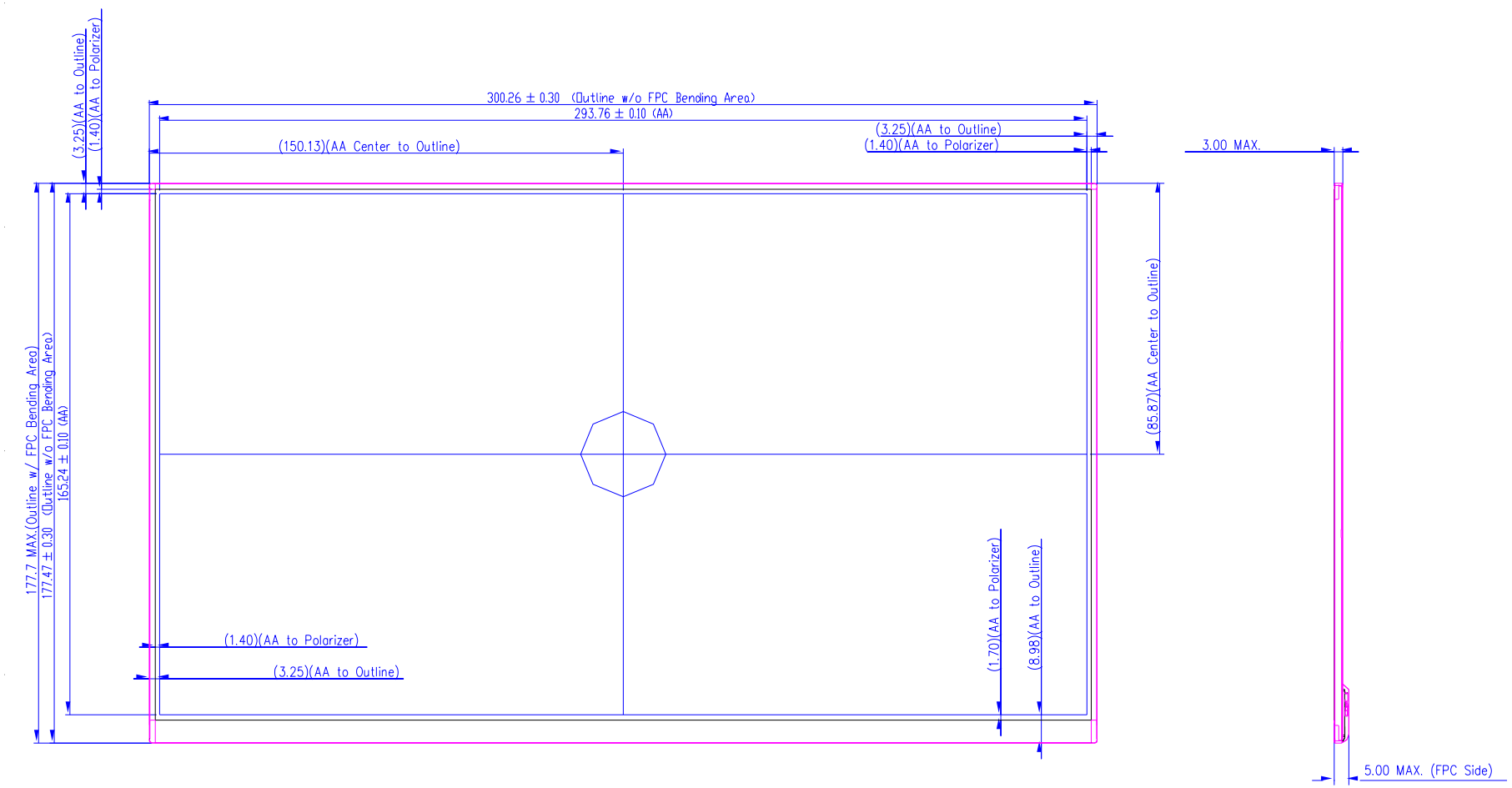
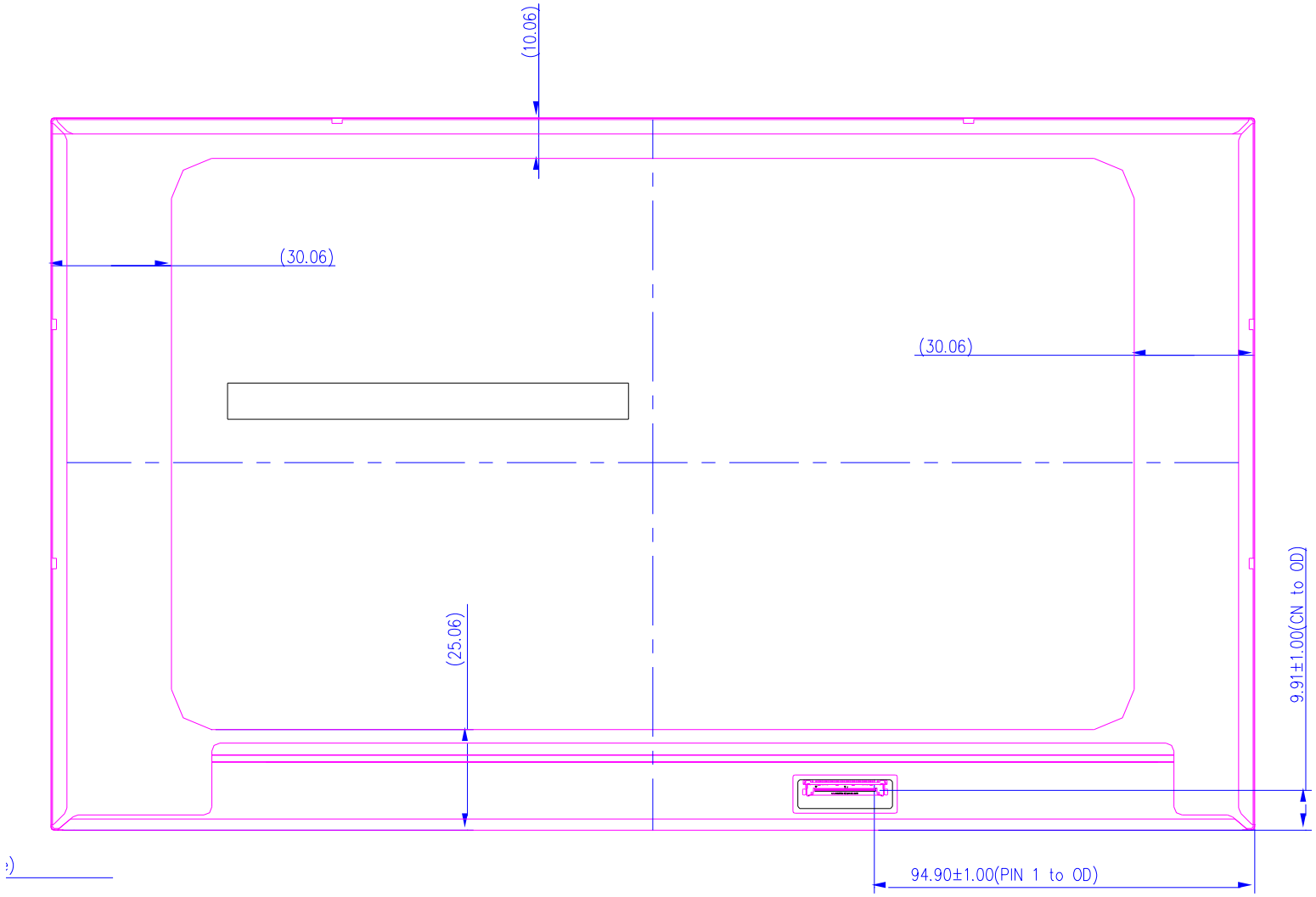
# 8. Mechanical Characteristics

## 8.1 Total solution Outline Dimension

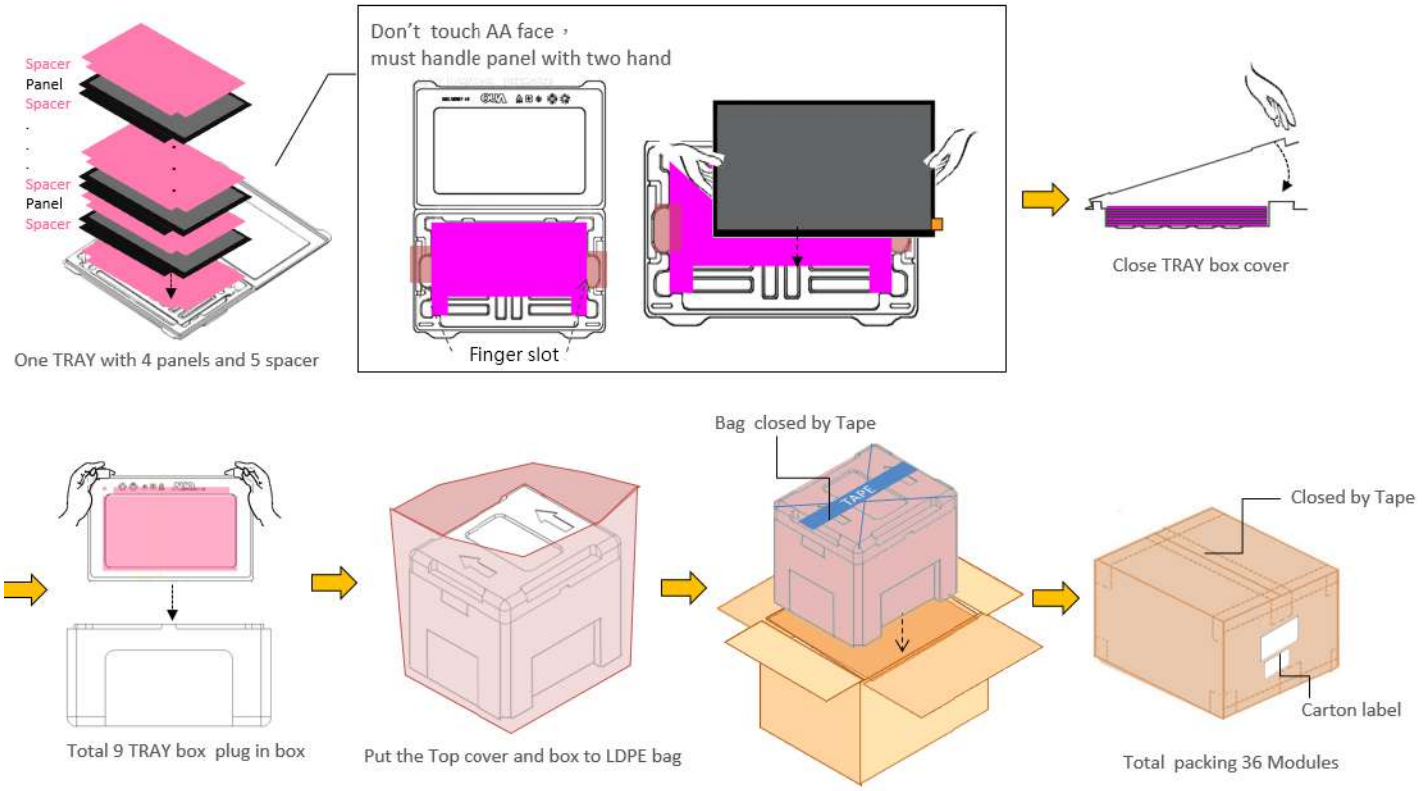


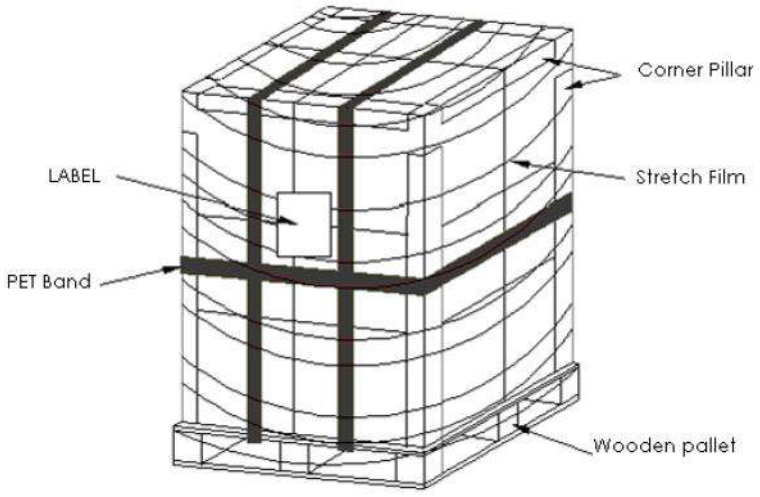

(10.06)
(30.06)
(30.06)
(25.06)
9.91±1.00(CN to OD)
94.90±1.00(PIN 1 to OD)

# 9. Label and Packaging

## 9.1 Shipping Label

## 9.2 Carton Package




| Item | Specification | | | Remark |
|---|---|---|---|---|
| | Q'ty | Dimension | Weight (kg) | |
| Packing Material | 1 | 446(L)mm x373(W)mm x 293(H)mm | 1.5 | TRAY +Box |
| Packing | 36pcs/carton | 446(L)mm x373(W)mm x 293(H)mm | 10.87 | with panel & cushion |
| Pallet | 1 | 1150(L)mm x 910(W)mm x 132(H)mm | 14 | |
| 1 Pallet after Packing | boxes/pallet | 1150(L)mm x 910(W)mm x 1304(H)mm | 277 | (3*2)*4 layer=24 cartons |

# 10 Safety

## 10.1 Keen Edge Requirements

There will be no keen edges or corners on the display assembly that could cause injury.

## 10.2 Materials

### 10.2.1 Toxicity

There will be no carcinogenic materials used anywhere in the TFT-LCD module. If toxic materials are used, they will be reviewed and approved by the responsible AUO toxicologist.

### 10.2.2 Flammability

The printed circuit board will be made from material rated 94-V1 or better. The actual UL flammability rating will be printed on the printed circuit board.

## 10.3 Capacitors

If any polarized capacitors are used in the TFT-LCD module, provisions will be made to keep them from being inserted backwards.

## 10.4 International Safety Standard Compliance

The TFT-LCD Module will satisfy all requirements for compliance to IEC/UL 62368-1.