

TFT-DISPLAY DATASHEET

AUO
Model: G190EAN01.1

BRIEF SPEC.:

| | |
|-----------------------|--|
| Main Feature | Landscape Type White LED backlighth Wide Viewing Angle |
| Active Screen Area | 376.32 x 301.05 (mm) |
| Diagonal Format | 19" 5:4 |
| Resolution | 1280 x 1024 |
| Colors | 16.7 M (8 Bit) |
| Backlight | Black |
| Brightness | 1300 cd/m ² |
| LED Life Time | 50K (h) |
| Interface | LVDS |
| Viewing Angle | 89/89 L/R 89/89 |
| Touchscreen | no |
| Power Supply | 5.0 V (Typ.) |
| Module Outline | 396 x 324 x 17.0 (mm) |
| Operation Temperature | -0 ... +50°C |
| Storage Temperature | -20... +60 °C |
| Surface Treatment | Anti-Glare |



- Preliminary Specification
- Final Specification

| | |
|-------------------|-------------------------------|
| Module | 19.0" SXGA Monochrome TFT-LCD |
| Model Name | G190EAN01.1 |

| Customer | Date |
|--|-------|
| _____ | _____ |
| Approved by | |
| _____ | _____ |
| <p>Note: This Specification is subject to change without notice.</p> | |

| Checked & Approved by | Date |
|---|--------------------|
| <i>Crystal Hsieh</i> | <u>5/ 25, 2016</u> |
| Prepared by | |
| <i>Ginger Lin</i> | <u>5/ 25, 2016</u> |
| <p>Audio-Video Business Unit / AU Optronics corporation</p> | |



Record of Revision

| Version & Date | Page | Old Description | New Description |
|----------------|------|----------------------------|-----------------|
| V0 & 2016/5/25 | All | Frist Edition for Customer | |
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1. Handling Precautions

- 1) Since front polarizer is easily damaged, pay attention 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 other soft cloth.
- 5) Since the panel is made of glass, it may break or crack 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 or modify the Module Assembly.
- 8) Do not press the reflector sheet at the back of the module to any directions.
- 9) In case if a Module has to be put back into the packing container slot after once it was taken out from the container, do not press the center of LED light bar edge. Instead, press at the far ends of LED light bar 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) After installation of the TFT Module into an enclosure, do not twist nor bend the TFT Module even momentary. At designing the enclosure, it should be taken into consideration that no bending/twisting forces are applied to the TFT Module from outside. Otherwise the TFT Module may be damaged.
- 12) Small amount of materials having no flammability grade is used in the LCD module. The LCD module should be supplied by power complied with requirements of Limited Power Source (IEC60950 or UL1950), or be applied exemption.
- 13) Avoid stressing front bezel position when doing mechanical design.

2. General Description

G190EAN01.1 is a Monochrome Active Matrix Liquid Crystal Display composed of a TFT-LCD panel, a driver circuit, and a backlight system. The screen format is intended to support the SXGA (1280(H) x 1024(V)) screen and 256 gray scales per one sub-pixel (8 bit). All input signals are 2-channel LVDS interface compatible.

2.1 Display Characteristics

The following items are characteristics summary on the table under 25 °C condition:

| Items | Unit | Specifications |
|---|----------------------|--|
| Screen Diagonal | [mm] | 482.6 (19.0") |
| Active Area | [mm] | 376.32 (H) x 301.06 (V) |
| Pixels H x V | | 1280(H) x 1024(V) x 3 (1pixel consists of 3 sub-pixels) |
| Pixel Pitch | [mm] | 0.294 (per one triad) x 0.294 |
| Pixel Arrangement | | Sub-pixel Vertical Stripe |
| Display Mode | | Normally Black |
| White Luminance | [cd/m ²] | 1300 (center, Typ) @ 80mA |
| Contrast Ratio | | 1000 : 1 (Typ) |
| Optical ResponseTime | [msec] | 25 (Typ, on/off) |
| Nominal Input Voltage VDD | [Volt] | +5.0 V |
| Power Consumption | [Watt] | 17.9 W (Typical) |
| Weight | [Grams] | 1550 (TYP) |
| Physical Size (H x V x D) | [mm] | 396 (H) x 324 (V) x 17.0 (D) (Typ) |
| Electrical Interface | | Dual channel LVDS |
| Surface Treatment | | Anti-Glare treatment |
| Support Color | | 256 gray scales per one sub-pixel (8 bit) |
| Temperature Range Operating Storage (Non-Operating) | °C °C | 0 to +50 -20 to +60 |
| RoHS Compliance | | RoHS Compliance |

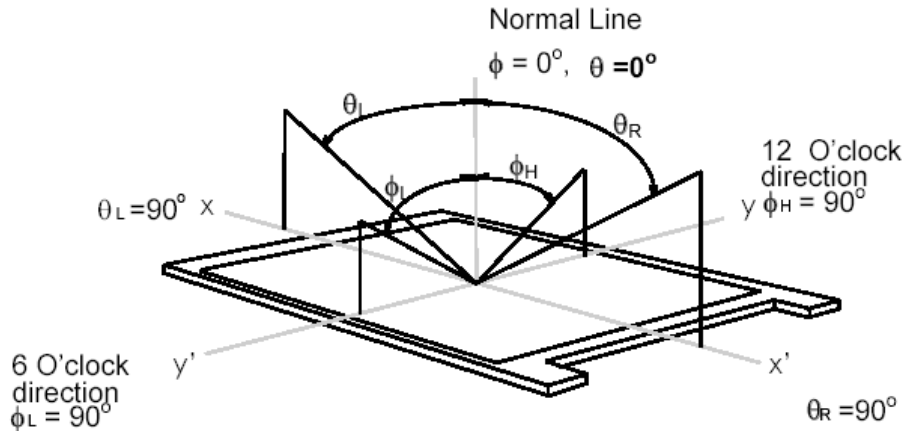
2.2 Optical Characteristics

The optical characteristics are measured under stable conditions at 25°C (Room Temperature):

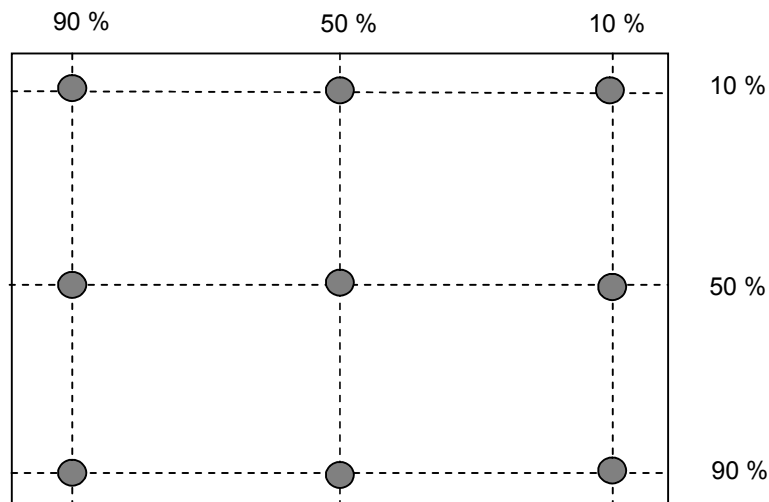
| Item | Unit | Conditions | Min. | Typ. | Max. | Note |
|--|----------------------|--------------------------------------|----------|----------|-------|------|
| Viewing Angle | [degree] | Horizontal (Right) CR = 10 (Left) | 80 80 | 89 89 | - | 1 |
| | | Vertical (Up) CR = 10 (Down) | 80 80 | 89 89 | - | |
| Luminance Uniformity | [%] | 9 Points | 75 | 80 | - | 2, 3 |
| Optical Response Time | [msec] | Rising | - | 13 | 18 | 4, 6 |
| | | Falling | - | 12 | 17 | |
| | | Rising + Falling | -- | 25 | 35 | |
| Color / Chromaticity Coordinates (CIE) | | White x | 0.264 | 0.294 | 0.324 | |
| | | White y | 0.279 | 0.309 | 0.339 | |
| White Luminance (At LED= 80mA) | [cd/m ²] | | 1000 | 1300 | - | 4 |
| Contrast Ratio | - | | 700 | 1000 | - | 4 |
| Cross Talk (At 60Hz) | [%] | | - | - | 1.5 | 5 |

Note 1: Definition of viewing angle, measured by ELDIM (EZContrast 88)

Viewing angle is the measurement of contrast ratio ≥ 10 , at the screen center, over a 180° horizontal and 180° vertical range (off-normal viewing angles). The 180° viewing angle range is broken down as follows; 90° (θ) horizontal left and right and 90° (Φ) vertical, high (up) and low (down). The measurement direction is typically perpendicular to the display surface with the screen rotated about its center to develop the desired measurement viewing angle.



Note 2: 9 points position

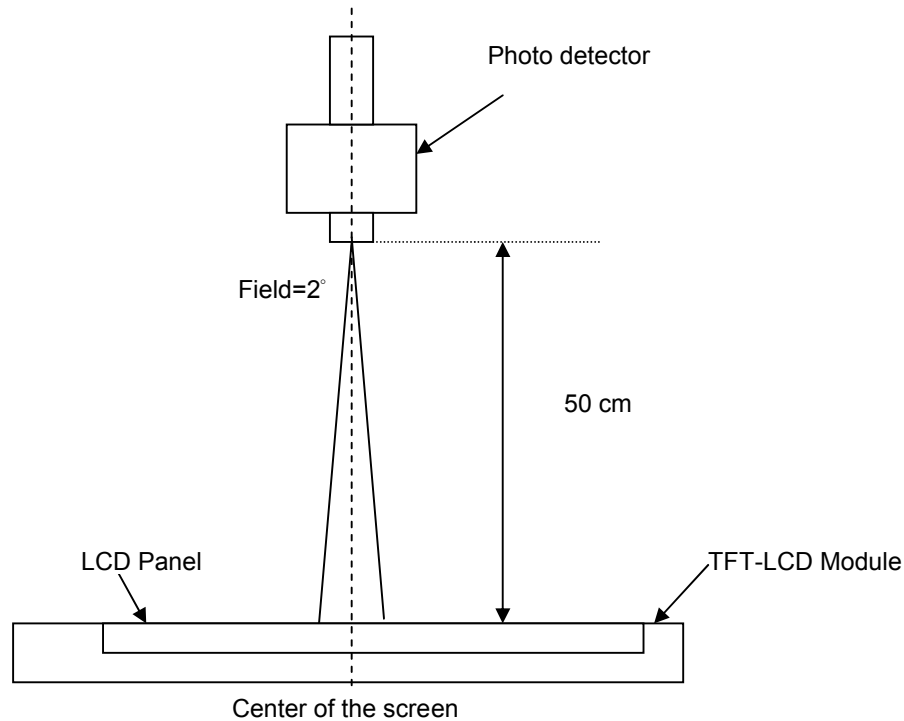


Note 3: The luminance uniformity of 9 points is defined by dividing the maximum luminance values by the minimum test point luminance. And measured by TOPCON SR-3

$$\delta_{w9} = \frac{\text{Minimum Luminance of 9 points}}{\text{Maximum Luminance of 9 points}}$$

Note 4: 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.



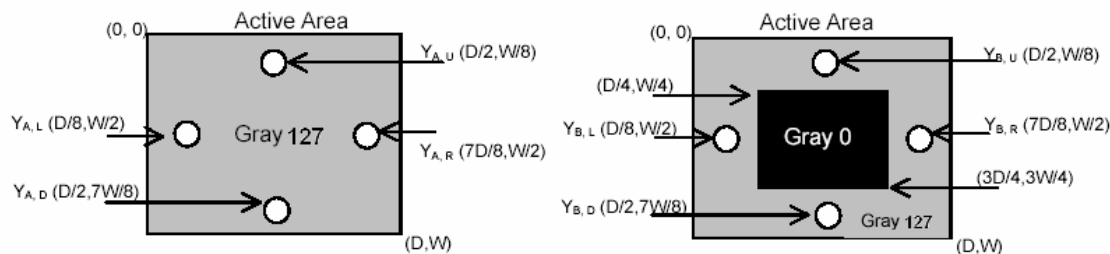
Note 5: Definition of Cross Talk (CT) and measured by TOPCON SR-3

$$CT = |Y_B - Y_A| / Y_A \times 100 (\%)$$

Where

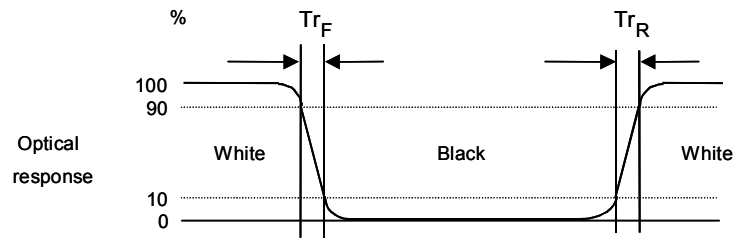
Y_A = Luminance of measured location without gray level 0 pattern (cd/m²)

Y_B = Luminance of measured location with gray level 0 pattern (cd/m²)



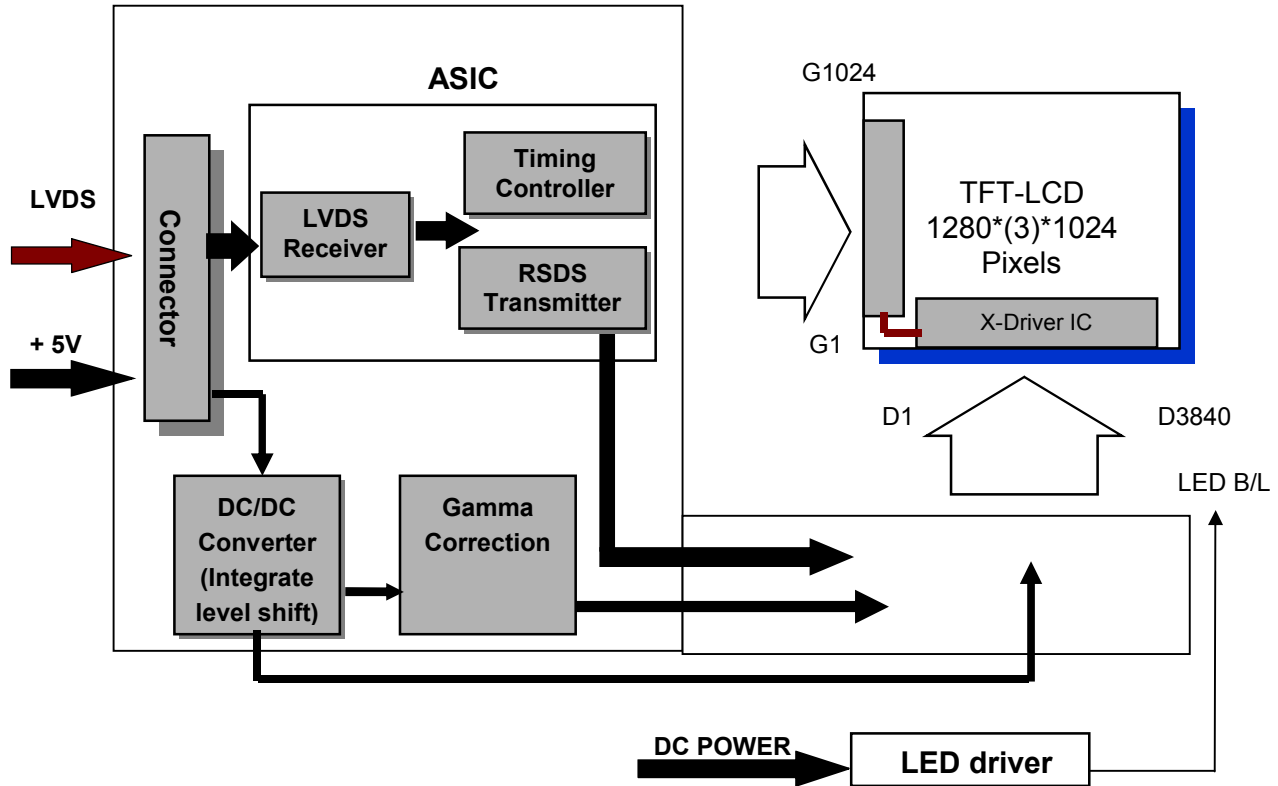
Note 6: Definition of response time, measured by WESTAR TRD-100A

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



3. Functional Block Diagram

The following diagram shows the functional block of the 19.0 inches Monochrome TFT-LCD Module:



I/F PCB Interface:

FI-XB30SSL-HF15 / MSBKT2407P30HB

Mating Type:

FI-X30HL (Locked Type)

FI-X30H (Unlocked Type)

4. Absolute Maximum Ratings

Absolute maximum ratings of the module are as following:

4.1 Absolute Ratings of TFT LCD Module

| Item | Symbol | Min. | Max. | Unit | Conditions |
|-------------------------|--------|------|------|--------|------------|
| Logic/LCD Drive Voltage | VDD | -0.3 | +5.5 | [Volt] | Note 1, 2 |

4.2 Absolute Ratings of Backlight Unit

| Item | Symbol | Min. | Max. | Unit | Conditions |
|-------------------|--------|------|------|---------|------------|
| LED Power Current | Iled | - | 1.7 | [A] rms | Note 1, 2 |

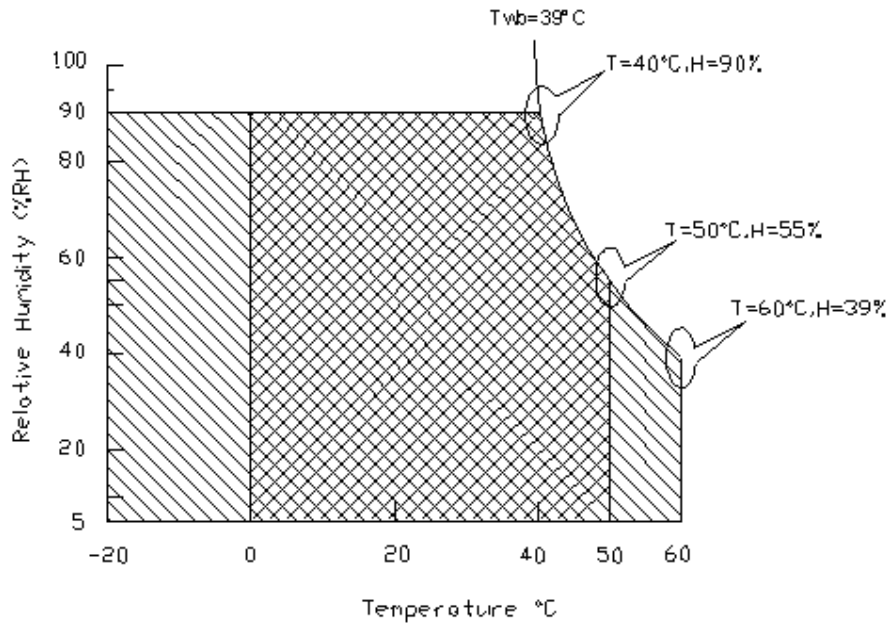
4.3 Absolute Ratings of Environment

| Item | Symbol | Min. | Max. | Unit | Conditions |
|-----------------------|--------|------|------|-------|------------|
| Operating Temperature | TOP | 0 | +50 | [°C] | Note 3 & 4 |
| Operation Humidity | HOP | 5 | 90 | [%RH] | |
| Storage Temperature | TST | -20 | +60 | [°C] | |
| Storage Humidity | HST | 5 | 90 | [%RH] | |

Note 1: With in $T_a = 25^\circ\text{C}$

Note 2: Permanent damage to the device may occur if exceed maximum values

Note 3: For quality performance, please refer to AUO IIS (Incoming Inspection Standard).



Operating Range  Storage Range  + 

Note 4: Operation Temperature + 50°C is defined as panel surface temperature.

5. Electrical characteristics

5.1 TFT LCD Module

5.1.1 Power Specification

Input power specifications are as follows:

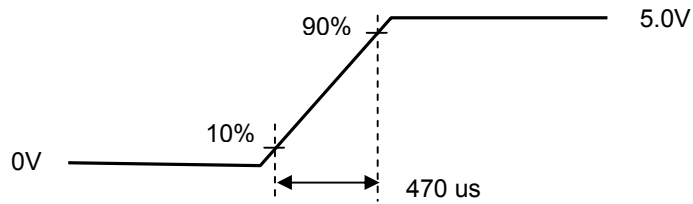
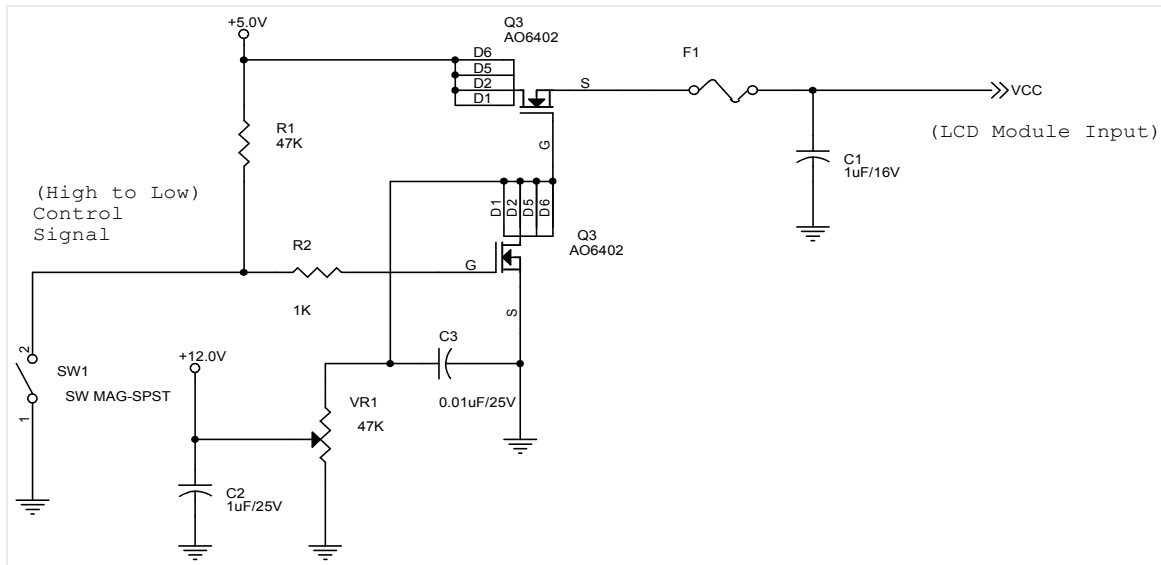
| Symble | Parameter | Min. | Typ. | Max. | Unit | Condition |
|--------|--|------|------|------|-------------|---------------------------------------|
| VCC | Logic/LCD Drive Voltage | 4.5 | 5.0 | 5.5 | [Volt] | ± 10% |
| ICC | Input Current | - | 0.7 | 0.9 | [A] | Vin=5V, 2dot checker Pattern, at 60Hz |
| IRush | Inrush Current | - | 2.7 | 3.4 | [A] | Note 2 |
| PCC | VCC Power | - | 3.5 | 4.5 | [Watt] | Vin=5V, 2dot checker Pattern, at 60Hz |
| VCCrp | Allowable Logic/LCD Drive Ripple Voltage | - | - | 300 | [mV] p-p | With panel loading |

Note 1: The 2dot checker Pattern is defined as below:

| | | | | | | | | | | | |
|-------------|---|---|---|---|-----|------|------|------|------|-------|------------------|
| | 1 | 2 | 3 | 4 | ... | 1277 | 1278 | 1279 | 1280 | L --> | Gray Level = 255 |
| 1 st Line | L | C | R | L | C | R | L | C | R | C --> | Gray Level = 255 |
| . | | | L | C | R | L | C | R | L | R --> | Gray Level = 255 |
| . | L | C | R | L | C | R | L | C | R | | Gray Level = 0 |
| . | | | L | C | R | L | C | R | L | | |
| . | . | . | . | . | . | . | . | . | . | | |
| . | . | . | . | . | . | . | . | . | . | | |
| . | . | . | . | . | . | . | . | . | . | | |
| . | . | . | . | . | . | . | . | . | . | | |
| . | . | . | . | . | . | . | . | . | . | | |
| 1024th Line | | | L | C | R | L | C | R | L | | |

Note2: L=Left Sub-Pixel , C=Center Sub-Pixel , R=Right Sub-Pixel

Note 3: Measurement conditions:



VDD rising time

5.2 Backlight Unit

Following characteristics are measured under a stable condition at 25 °C (Room Temperature):

| Symbol | Parameter | Min. | Typ. | Max. | Unit | Remark |
|-----------------------------|-----------------------|--------|------|------|--------|----------------------------------|
| VCC | Input Voltage | 10.8 | 12.0 | 13.2 | [Volt] | |
| I_{VCC} | Input Current | | 1.2 | | [A] | 100% PWM Duty |
| P_{VCC} | Power Consumption | | 14.4 | 15.8 | [Watt] | 100% PWM Duty |
| I_{rush LED} | Inrush Current | - | 1.7 | 2.1 | [A] | at rising time=470us |
| Analog Control | Input Voltage | 0 | - | 3.3 | V | |
| F_{PWM} | Dimming Frequency | | 0.2 | 20 | [kHz] | |
| | Swing Voltage | 3 | 3.3 | 5 | V | |
| | Dimming Duty Cycle | 10 | - | 100 | % | |
| Enable | On Control Voltage | 3 | - | 5.5 | Volt | |
| | Off Control Voltage | 0 | - | 0.8 | Volt | |
| I_F | LED Forward Current | | 80 | | mA | Ta = 25°C |
| V_F | LED Forward Voltage | - | - | - | Volt | |
| | | - | 3.2 | 3.75 | Volt | I _F =80 mA, Ta = 25°C |
| | | - | - | - | | |
| P_{LED} | LED Power Consumption | - | 13.8 | 16.2 | Watt | I _F =80 mA, Ta = 25°C |
| LED Lifetime | | 50,000 | | | Hrs | I _F =80 mA, Ta= 25°C |

Note 1: Ta means ambient temperature of TFT-LCD module.

Note 2: VCC, I_{VCC}, P_{VCC}, I_{rush LED} are defined for LED B/L.(100% duty of PWM dimming)

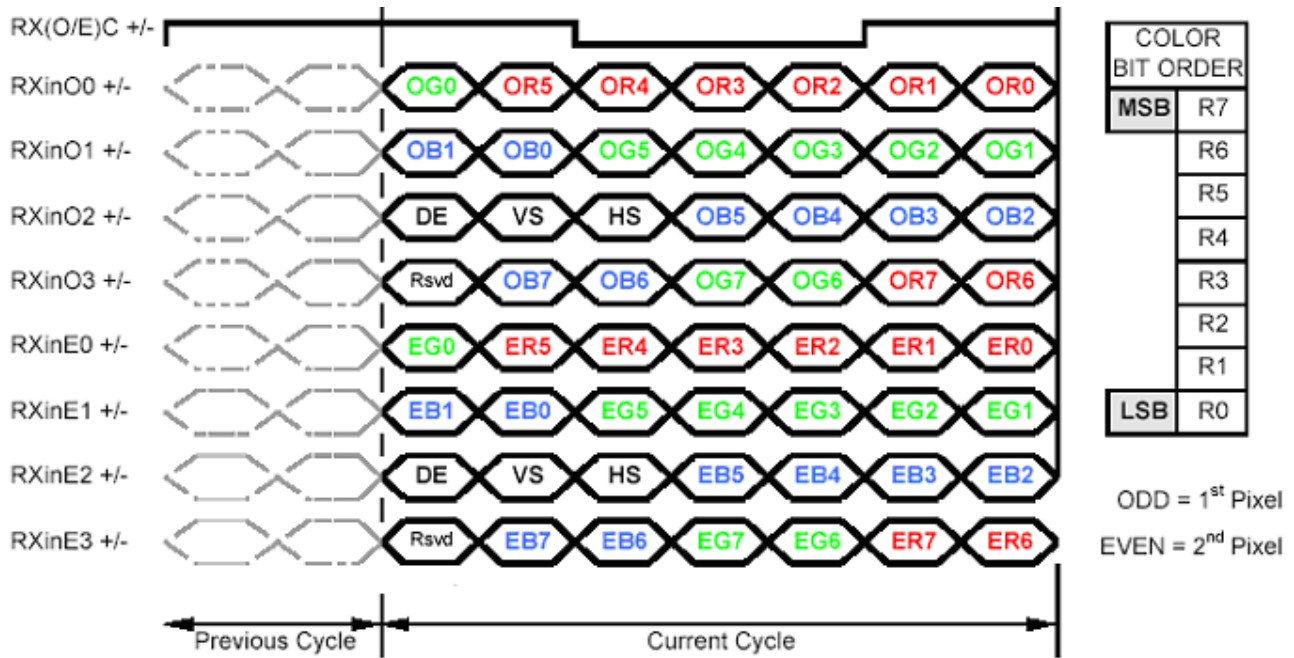
Note 3: I_F, V_F are defined for one channel LED. There are six LED channel in one light bar. P_{LED} is defined for one light bar. There is one light bar in back light unit.

Note 4: If G190EAN01.1 module is driven by high current or at high ambient temperature & humidity condition. The operating life will be reduced.

Note 5: LED life means brightness goes down to 50% initial brightness.

Note 6: Two kind types for adjusting brightness: PWM and Analog.

6.2 The Input Data Format



Note1: Normally DE mode only. VS and HS on EVEN channel are not used.

Note2: Please follow VESA.

Note3: 8-bit in

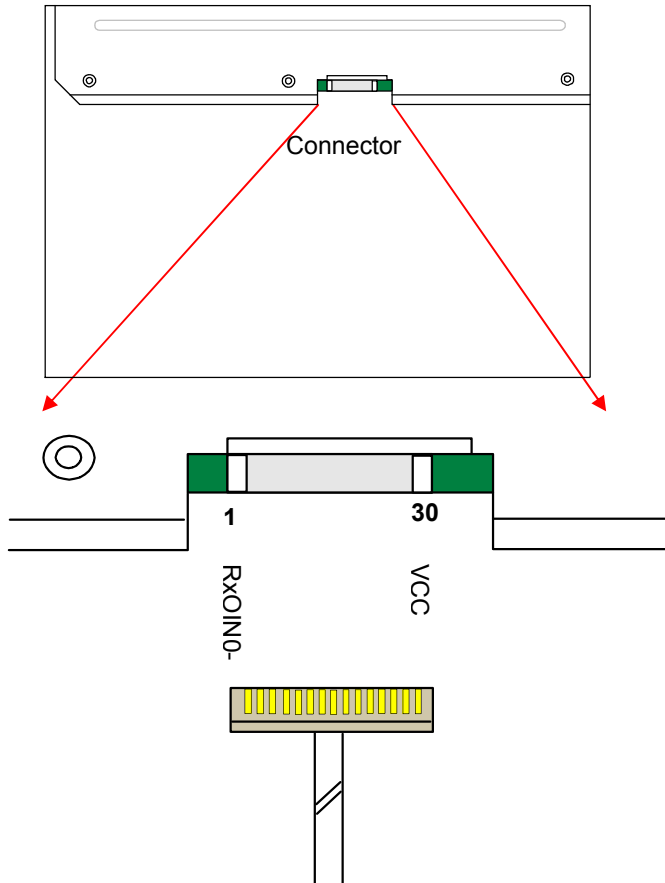
Note4: **R**=Left Sub-Pixel , **G**=Center Sub-Pixel , **B**=Right Sub-Pixel

6.3 Signal Description

The module using a pair of LVDS receiver SN75LVDS82(Texas Instruments) or compatible. LVDS is a differential signal technology for LCD interface and high speed data transfer device. Transmitter shall be SN75LVDS83(negative edge sampling) or compatible. The first LVDS port(RxOxxx) transmits odd pixels while the second LVDS port(RxExxx) transmits even pixels.

| PIN # | SIGNAL NAME | DESCRIPTION |
|-------|-------------|--|
| 1 | RxOIN0- | Negative LVDS differential data input (Odd data) |
| 2 | RxOIN0+ | Positive LVDS differential data input (Odd data) |
| 3 | RxOIN1- | Negative LVDS differential data input (Odd data) |
| 4 | RxOIN1+ | Positive LVDS differential data input (Odd data) |
| 5 | RxOIN2- | Negative LVDS differential data input (Odd data, H-Sync,V-Sync,DSPTMG) |
| 6 | RxOIN2+ | Positive LVDS differential data input (Odd data, H-Sync,V-Sync,DSPTMG) |
| 7 | VSS | Power Ground |
| 8 | RxOCLKIN- | Negative LVDS differential clock input (Odd clock) |
| 9 | RxOCLKIN+ | Positive LVDS differential clock input (Odd clock) |
| 10 | RxOIN3- | Negative LVDS differential data input (Odd data) |
| 11 | RxOIN3+ | Positive LVDS differential data input (Odd data) |
| 12 | RxEIN0- | Negative LVDS differential data input (Even data) |
| 13 | RxEIN0+ | Positive LVDS differential data input (Even data) |
| 14 | VSS | Power Ground |
| 15 | RxEIN1- | Negative LVDS differential data input (Even data) |
| 16 | RxEIN1+ | Positive LVDS differential data input (Even data) |
| 17 | VSS | Power Ground |
| 18 | RxEIN2- | Negative LVDS differential data input (Even data) |
| 19 | RxEIN2+ | Positive LVDS differential data input (Even data) |
| 20 | RxECLKIN- | Negative LVDS differential clock input (Even clock) |
| 21 | RxECLKIN+ | Positive LVDS differential clock input (Even clock) |
| 22 | RxEIN3- | Negative LVDS differential data input (Even data) |
| 23 | RxEIN3+ | Positive LVDS differential data input (Even data) |
| 24 | VSS | Power Ground |
| 25 | VSS | Power Ground |
| 26 | NC | Do not connect (for AUO test) |
| 27 | VSS | Power Ground |
| 28 | VCC | +5.0V Power Supply |
| 29 | VCC | +5.0V Power Supply |
| 30 | VCC | +5.0V Power Supply |

Note1: Start from left side



Note2: Input signals of odd and even clock shall be the same timing.

Note3: Please follow VESA.

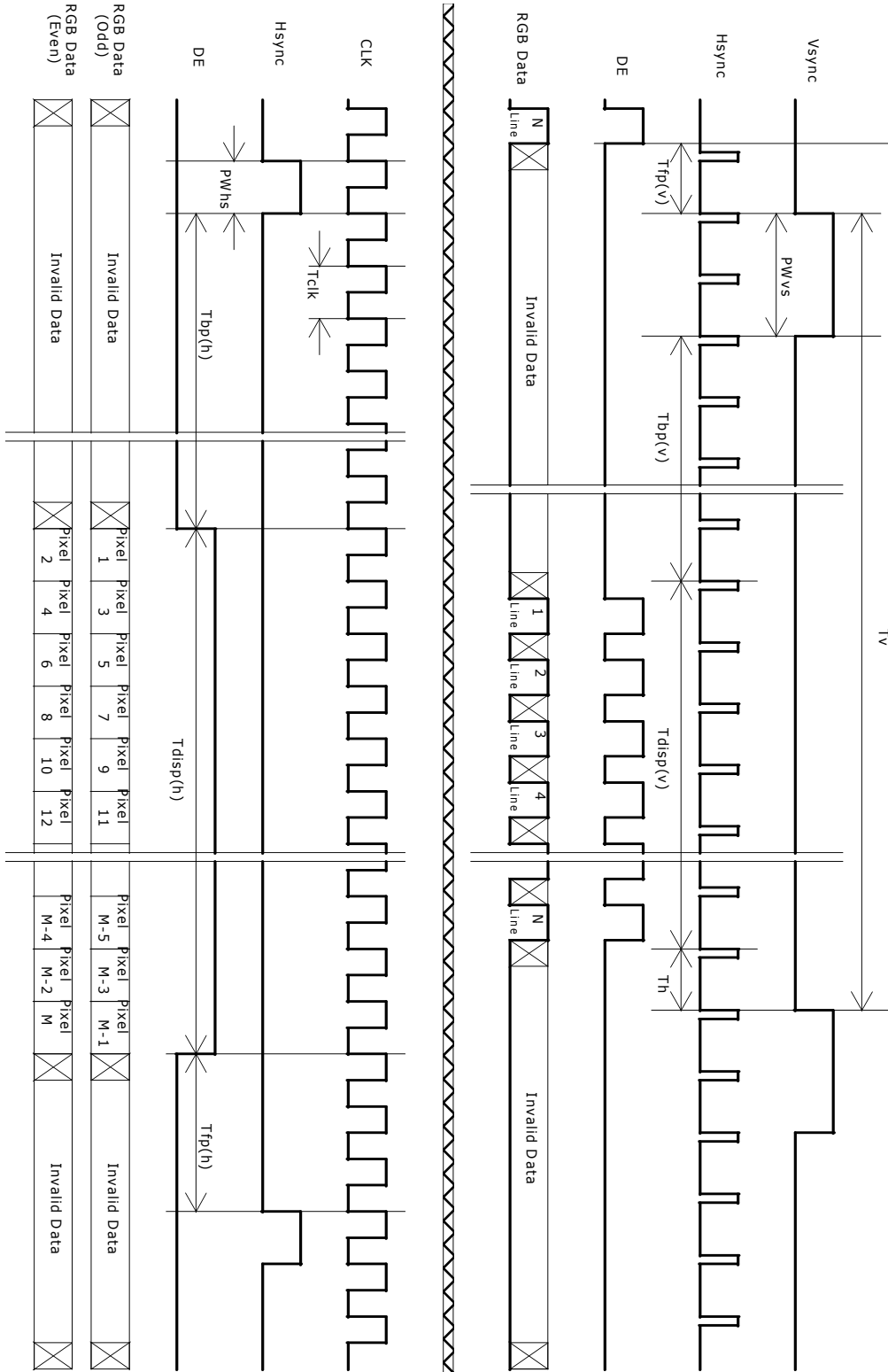
6.4 Interface Timing

6.4.1 Timing Characteristics

| Signal | Item | Symbol | Min | Typ | Max | Unit |
|--------------------|-----------|-------------------------------|------|-------|-------|------|
| Vertical Section | Period | T_v | 1032 | 1066 | 1150 | Th |
| | Active | $T_{disp(v)}$ | 1024 | 1024 | 1024 | Th |
| | Blanking | $T_{bp(v)}+T_{fp(v)}+PW_{vs}$ | 8 | 42 | 126 | Th |
| Horizontal Section | Period | T_h | 780 | 844 | 2047 | Tclk |
| | Active | $T_{disp(h)}$ | 640 | 640 | 640 | Tclk |
| | Blanking | $T_{bp(h)}+T_{fp(h)}+PW_{hs}$ | 140 | 204 | - | Tclk |
| Clock | Period | T_{clk} | 22.2 | 18.52 | 14.81 | ns |
| | Frequency | Freq. | 45 | 54 | 67.5 | MHz |
| Frame Rate | Frequency | $1/T_v$ | 50 | 60 | 75 | Hz |

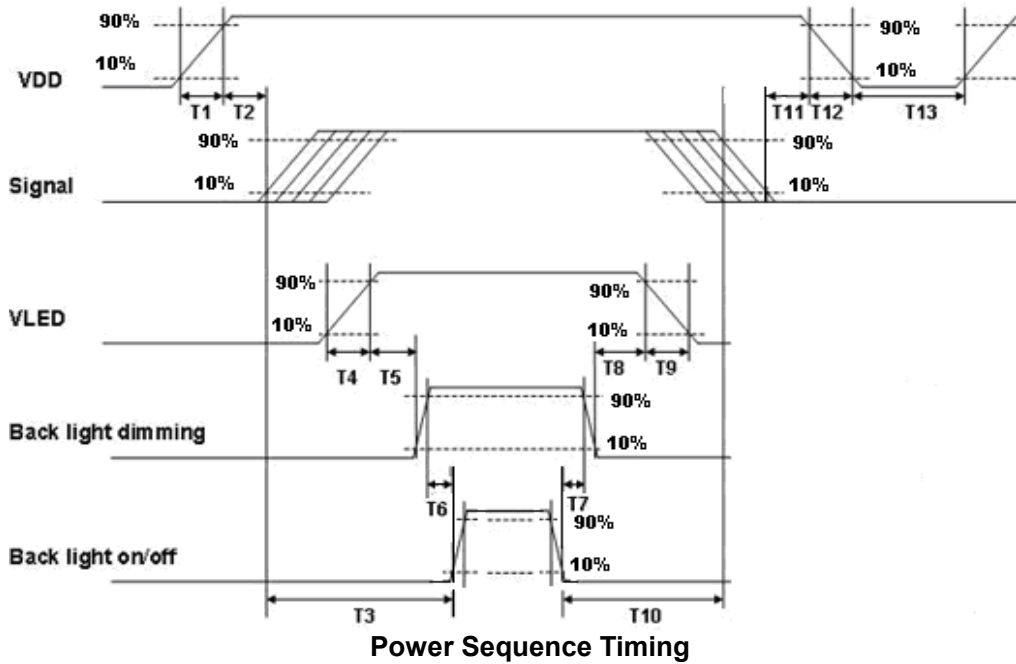
Note : DE mode only

6.4.2 Timing Diagram



6.5 Power ON/OFF Sequence

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



| Power Sequence Timing | | | | |
|-----------------------|-------|------|------|-------|
| Parameter | Value | | | Units |
| | Min. | Typ. | Max. | |
| T1 | 0.5 | - | 10 | ms |
| T2 | 30 | 40 | 50 | |
| T3 | 200 | - | -- | |
| T4 | 0.5 | - | 10 | |
| T5 | 10 | - | - | |
| T6 | 10 | - | - | |
| T7 | 0 | - | - | |
| T8 | 10 | - | - | |
| T9 | - | - | 10 | |
| T10 | 110 | - | - | |
| T11 | 0 | 16 | 50 | |
| T12 | 0 | - | 10 | |
| T13 | 1000 | - | - | |

7. Connector & Pin Assignment

Physical interface is described as for the connector on module. These connectors are capable of accommodating the following signals and will be following components.

7.1 TFT LCD Module

7.1.1 Connector

| | |
|------------------------------|--------------------------------------|
| Connector Name / Designation | Interface Connector / Interface card |
| Manufacturer | JAE / STM |
| Type Part Number | FI-XB30SSLA-HF15 / MSBKT2407P30HB |
| Mating Housing Part Number | FI-X30HL FI-X30H (Unlocked Type) |

7.1.2 Pin Assignment

| Pin# | Signal Name | Pin# | Signal Name |
|------|-------------|------|-------------|
| 1 | RxOIN0- | 2 | RxOIN0+ |
| 3 | RxOIN1- | 4 | RxOIN1+ |
| 5 | RxOIN2- | 6 | RxOIN2+ |
| 7 | VSS | 8 | RxOCLKIN- |
| 9 | RxOCLKIN+ | 10 | RxOIN3- |
| 11 | RxOIN3+ | 12 | RxEIN0- |
| 13 | RxEIN0+ | 14 | VSS |
| 15 | RxEIN1- | 16 | RxEIN1+ |
| 17 | VSS | 18 | RxEIN2- |
| 19 | RxEIN2+ | 20 | RxECLKIN- |
| 21 | RxECLKIN+ | 22 | RxEIN3- |
| 23 | RxEIN3+ | 24 | VSS |
| 25 | VSS | 26 | NC |
| 27 | VSS | 28 | VCC |
| 29 | VCC | 30 | VCC |

7.2 Backlight Unit

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 | LED Connector / Backlight |
| Manufacturer | STM |
| Type Part Number | MS24019RHD |
| Mating Type Part Number | P24019 |

7.2.1 Signal for LED connector

| Pin # | Symbol | Pin Description |
|-------|--|--|
| 1 | +12V | Power +12V |
| 2 | +12V | Power +12V |
| 3 | +12V | Power +12V |
| 4 | NC | NC |
| 5 | GND | GND |
| 6 | GND | GND |
| 7 | GND | GND |
| 8 | EN | Enable(0V:disable, 5V:Enable) |
| 9 | Dimming (or Analog Control Voltage) | PWM; duty 10%~ 100% (Analog Control Voltage 0~3.3V) |

8. Reliability Test

Environment test conditions are listed as following table.

| Items | Required Condition | Note |
|-----------------------------------|---|------|
| Temperature Humidity Bias (THB) | Ta= 50°C, 80%RH, 300hours | |
| High Temperature Operation (HTO) | Ta= 50°C, 300hours | |
| Low Temperature Operation (LTO) | Ta= 0°C, 300hours | |
| High Temperature Storage (HTS) | Ta= 60°C, 300hours | |
| Low Temperature Storage (LTS) | Ta= -20°C, 300hours | |
| Vibration Test (Non-operation) | Acceleration: 1.5 G Wave: Random Frequency: 10 - 200 - 10 Hz Sweep: 30 Minutes each Axis (X, Y, Z) | |
| Shock Test (Non-operation) | Acceleration: 50 G Wave: Half-sine Active Time: 20 ms Direction: ±X, ±Y, ±Z (one time for each Axis) | |
| Drop Test | Height: 60 cm, package test | |
| Thermal Shock Test (TST) | -20 °C /30min, 60/°C 30min, 100 cycles | 1 |
| On/Off Test | On/10sec, Off/10sec, 30,000 cycles | |
| ESD (Electrostatic Discharge) | Contact Discharge: ± 8KV, 150pF(330Ω) 1sec, 9 points, 25 times/ point. | 2 |
| | Air Discharge: ± 15KV, 150pF(330Ω) 1sec 9 points, 25 times/ point. | |
| Altitude Test | Operation:10,000 ft Non-Operation:30,000 ft | |

Note 1: The TFT-LCD module will not sustain damage after being subjected to 100 cycles of rapid temperature change. A cycle of rapid temperature change consists of varying the temperature from -20°C to 60°C, and back again. Power is not applied during the test. After temperature cycling, the unit is placed in normal room ambient for at least 4 hours before power on.

Note 2: According to EN61000-4-2 , ESD class B: Some performance degradation allowed. No data lost. Self-recoverable. No hardware failures.

Note 3:


- Water condensation is not allowed for each test items.
- Each test is done by new TFT-LCD module. Don't use the same TFT-LCD module repeatedly for reliability test.
- The reliability test is performed only to examine the TFT-LCD module capability.
- To inspect TFT-LCD module after reliability test, please store it at room temperature and room humidity for 24 hours at least in advance.
- No function failure occurs.


9. Shipping Label and Packaging

9.1 Shipping Label

The label is on the panel as shown below:



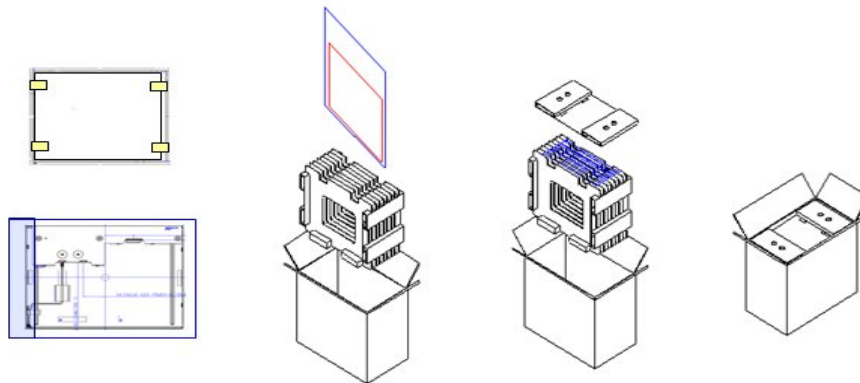
Note 1: For Pb Free products, AUO will add  for identification.

Note 2: For RoHS compatible products, AUO will add  for identification.

Note 3: For China RoHS compatible products, AUO will add  for identification.

Note 4: The Green Mark will be presented only when the green documents have been ready by AUO Internal Green Team.

9.2 Packaging



Max capacity : 7 PCS TFT-LCD module per carton

Max weight: 17.5 kg per carton

Outside dimension of carton: 476mm(L)* 274mm(W)*414mm(H)

Pallet size : 1140 mm * 980 mm * 135mm

Box stacked

Module by air_Max : (2 *4) *3 layers , one pallet put 24 boxes , total 168pcs module

Module by sea_Max : (2 *4) *3 layers + (2 *4) *1 layers , two pallet put 32 boxes , total 224pcs module

Module by sea_HQ_Max : (2 *4) *3 layers+(2 *4) *2 layers, two pallet put 40 boxes, total 280pcs module

10. Mechanical Characteristic

