

TFT-DISPLAY DATASHEET

AUO
Model: G156HTN02.0

BRIEF SPEC.:

Main Feature Landscape Type
White LED Backlight

| | |
|-----------------------|--------------------------|
| Active Screen Area | 344.16 x 193.59 (mm) |
| Diagonal Format | 15.6" 16:9 |
| Resolution | 1920 X 1080 |
| Colors | 262k16.7M (6 Bit) |
| Backlight | LED |
| Brightness | 400 cd/m ² |
| LED Life Time | 50K (h) |
| Interface | LVDS |
| Viewing Angle | 70/70 L/R 60/60 |
| Touchscreen | No |
| Power Supply | 3.3 V (Typ.) |
| Module Outline | 363.8 x 215.9 x 9.3 (mm) |
| Operation Temperature | -10... +70 °C |
| Storage Temperature | -20... +60 °C |
| Surface Treatment | Anti-Glare |



Product Specification

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Preliminary Specifications

Final Specifications

| | |
|------------|---|
| Module | 15.6" FHD Color TFT-LCD |
| Model Name | G156HTN02.0 |
| Note | LED backlight with driving circuit design |

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

| | |
|---|-------------------|
| Approved by | Date |
| <u>Crystal Hsieh</u> | <u>05/15/2015</u> |
| Prepared by | Date |
| <u>Sandy Su</u> | <u>05/15/2015</u> |
| <p>NBBU Marketing Division AU Optronics Corporation</p> | |



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Product Specification

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Record of Revision

| Version and Date | Page | Old Description | New Description | Remark |
|------------------|------|---------------------------------------|-----------------|--------|
| 0.0 2015/05/15 | All | 1 st Edition for Customers | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |



Product Specification

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1. Handling 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) To avoid ESD (Electro Static Discharge) damage, be sure to ground yourself before handling TFT-LCD Module.
- 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 light bar edge. Instead, press at the far ends of the 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) 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 or UL1950), or be applied exemption.
- 13) Severe temperature condition may result in different luminance, response time and lamp ignition voltage.
- 14) Continuous operating TFT-LCD display under low temperature environment may accelerate lamp exhaustion and reduce luminance dramatically.
- 15) The data on this specification sheet is applicable when LCD module is placed in landscape position.
- 16) Continuous displaying fixed pattern may induce image sticking. It's recommended to use screen saver or shuffle content periodically if fixed pattern is displayed on the screen.



Product Specification

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2. General Description

G156HTN02.0 is a Color Active Matrix Liquid Crystal Display composed of a TFT LCD panel, a driver circuit, and LED backlight system. The screen format is intended to support the 16:9 FHD, 1920(H) x1080(V) screen and 16.2M colors (RGB 6-bits+2FRC data driver) with LED backlight driving circuit.

G156HTN02.0 is designed for a display unit of industrial machine.

2.1 General Specification

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

| Items | Unit | Specifications | | | |
|---|----------------------|----------------------------------|-------|-------|-------|
| Screen Diagonal | [inch] | 15.6" | | | |
| Active Area | [mm] | 344.16(H) x 193.59(V) | | | |
| Pixels H x V | | 1920 x 3(RGB) x 1080 | | | |
| Pixel Pitch | [mm] | 0.17925 x 0.17925 | | | |
| Pixel Format | | R.G.B. Vertical Stripe | | | |
| Display Mode | | TN Mode, Normally White | | | |
| White Luminance (Center) (ILED=50mA,Note: ILED is LED current) | [cd/m ²] | 400 Typ. 320 Min. | | | |
| Luminance Uniformity | | TBD (5 points, Max.) | | | |
| Contrast Ratio | | 500:1 (Typ.) | | | |
| Response Time | [ms] | 8 (Typ.)/ 16 (Max.) | | | |
| Nominal Input Voltage VDD | [Volt] | +3.3 (Typ.) | | | |
| LCD Power Consumption | [Watt] | 3.76 W (Max.) | | | |
| LED Power Consumption | [Watt] | 10.6 W (Max.) | | | |
| Weight | [Grams] | TBD (Max.) | | | |
| Physical Size Without bracket. | [mm] | | Min. | Typ. | Max. |
| | | Length | 363.3 | 363.8 | 364.3 |
| | | Width | 215.4 | 215.9 | 216.4 |
| | | Thickness | 8.8 | 9.3 | 9.8 |
| Electrical Interface | | Two channel LVDS | | | |
| Surface Treatment | | Anti-glare (Haze=25%) | | | |
| Support Color | | 16.2M Colors (RGB 6-bits +2FRC) | | | |
| Temperature Range | | | | | |
| Operating | [°C] | -10 to +70 | | | |
| Storage (Non-Operating) | [°C] | -20 to +70 | | | |



Product Specification

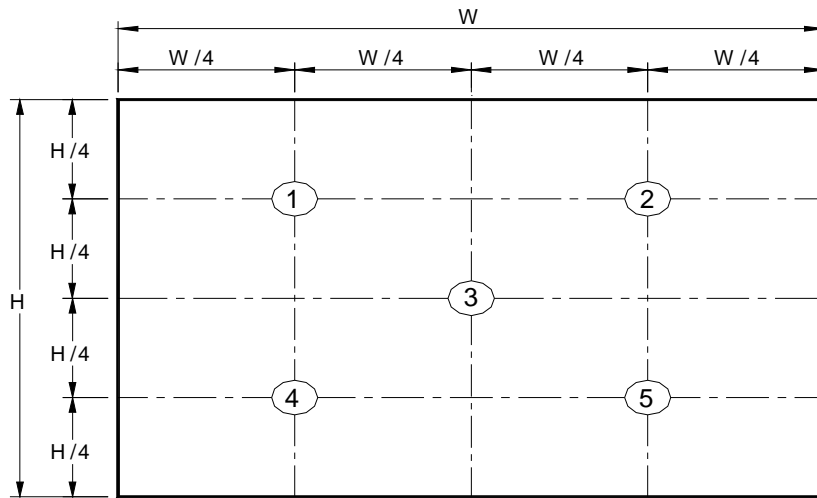
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2.2 Optical Characteristics

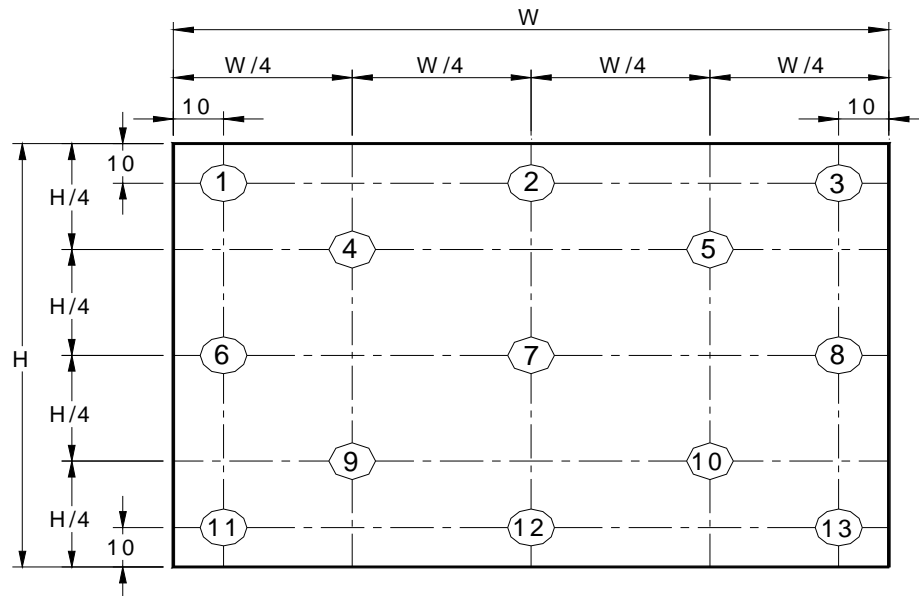
The optical characteristics are measured under stable conditions at 25°C (Room Temperature) :

| Item | Unit | Conditions | Min. | Typ. | Max. | Note | |
|--|--------|--------------------------------------|----------|----------|--------|---------|---|
| Central Luminance ILED=50mA | cd/m2 | | 320 | 400 | --- | 1, 4, 5 | |
| Viewing Angle | degree | Horizontal (Right) CR = 10 (Left) | 60 60 | 70 70 | --- | 4, 9 | |
| | | Vertical (Upper) CR = 10 (Lower) | 45 50 | 60 60 | --- | | |
| Luminance Uniformity | | 5 Points | --- | --- | TBD | 1, 3, 4 | |
| | | 13 Points | --- | --- | TBD | 2, 3, 4 | |
| Contrast Ratio | | | 400 | 500 | - | 4, 6 | |
| Cross talk | | | --- | --- | 4 | 4, 7 | |
| Response Time | msec | Rising + Falling | --- | 8 | 16 | 4, 8 | |
| Color / Chromaticity Coordinates | Red | Rx | CIE 1931 | TBD | TBD | TBD | 4 |
| | | Ry | | TBD | TBD | TBD | |
| | Green | Gx | | TBD | TBD | TBD | |
| | | Gy | | TBD | TBD | TBD | |
| | Blue | Bx | | TBD | TBD | TBD | |
| | | By | | TBD | TBD | TBD | |
| | White | Wx | | TBD | *0.313 | TBD | |
| | | Wy | | TBD | *0.329 | TBD | |
| NTSC | % | | - | 72 | - | | |

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



Note 2: 13 points position (Ref: Active area)



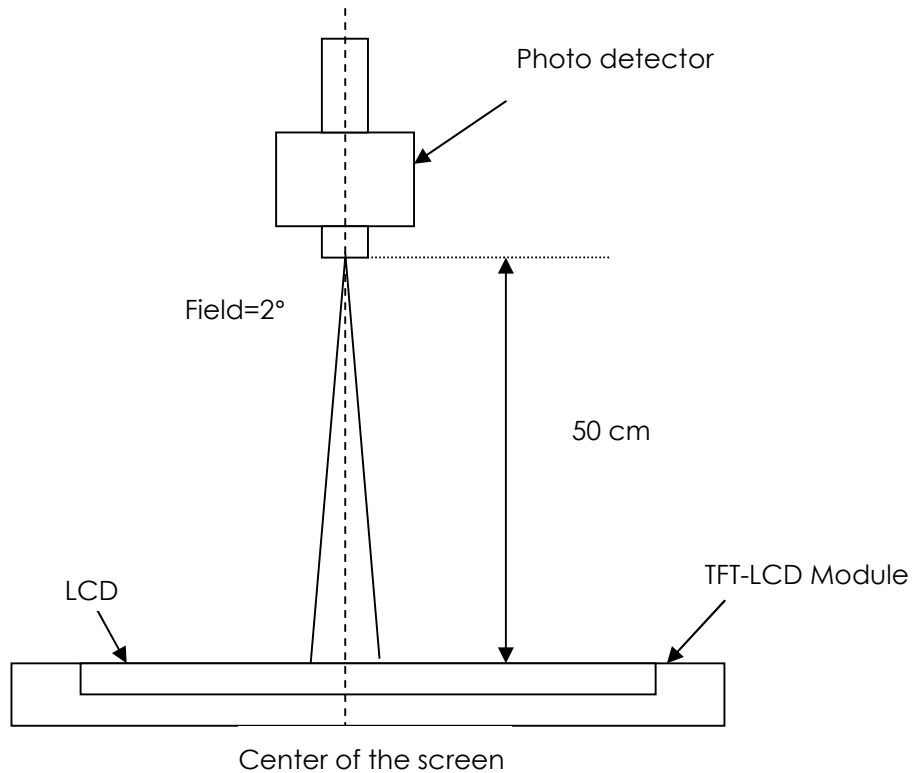
Note 3: The luminance uniformity of 5 or 13 points is defined by dividing the maximum luminance values by the minimum test point luminance

$$w_5 = \frac{\text{Maximum Brightness of five points}}{\text{Minimum Brightness of five points}}$$

$$w_{13} = \frac{\text{Maximum Brightness of thirteen points}}{\text{Minimum Brightness of thirteen points}}$$

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, and it should be measured in the center of screen.



Note 5 : Definition of Average Luminance of White (Y_L):

Measure the luminance of gray level 63 at 5 points , $Y_L = [L (1)+ L (2)+ L (3)+ L (4)+ L (5)] / 5$

$L (x)$ is corresponding to the luminance of the point X at Figure in Note (1).

Note 6 : Definition of contrast ratio:

Contrast ratio is calculated with the following formula.

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

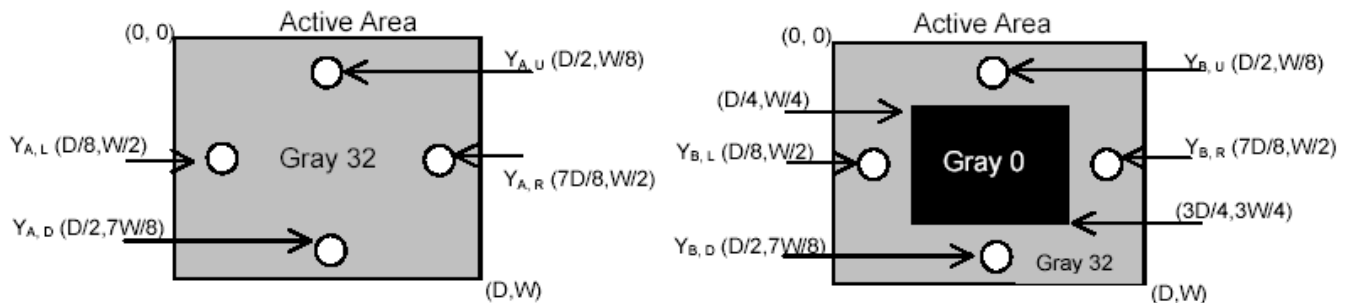
Note 7 : Definition of Cross Talk (CT)

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

Where

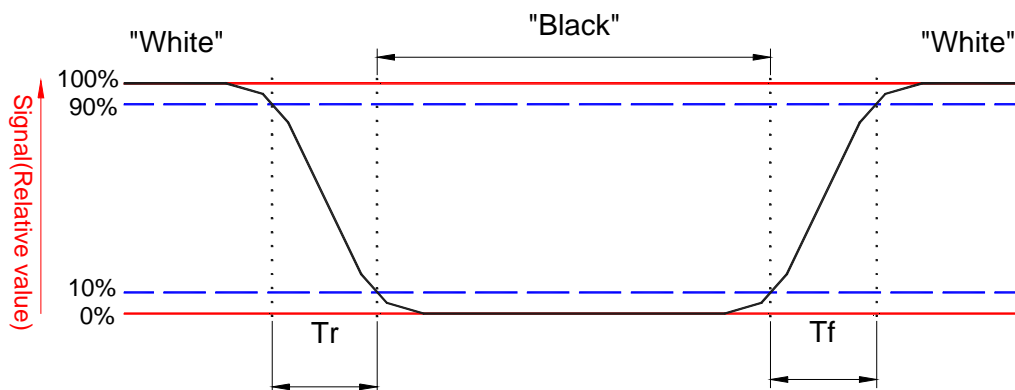
Y_A = Luminance of measured location without gray level 0 pattern (cd/m²)

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



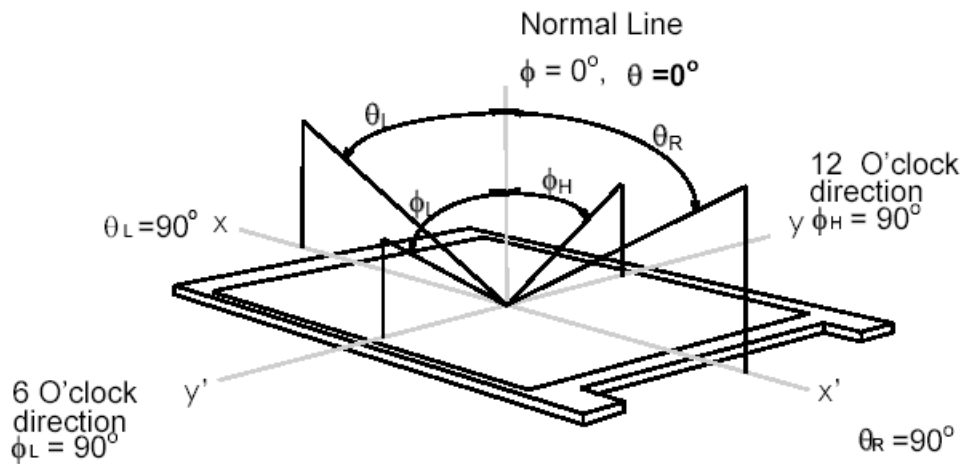
Note 8: Definition of response time:

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 between the 10% and 90% of amplitudes. Refer to figure as below.



Note 9. Definition of viewing angle

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.



Crosstalk above for viewing angle under 3D mode is defined as below:

$$\text{Crosstalk_Left(\%)} = L_{\text{black}}R_{\text{white}} / L_{\text{white}}R_{\text{black}}$$

Where

Crosstalk_Left(%) means left eye crosstalk;

L_{black} means left eye black signal;

R_{white} means right eye white signal;

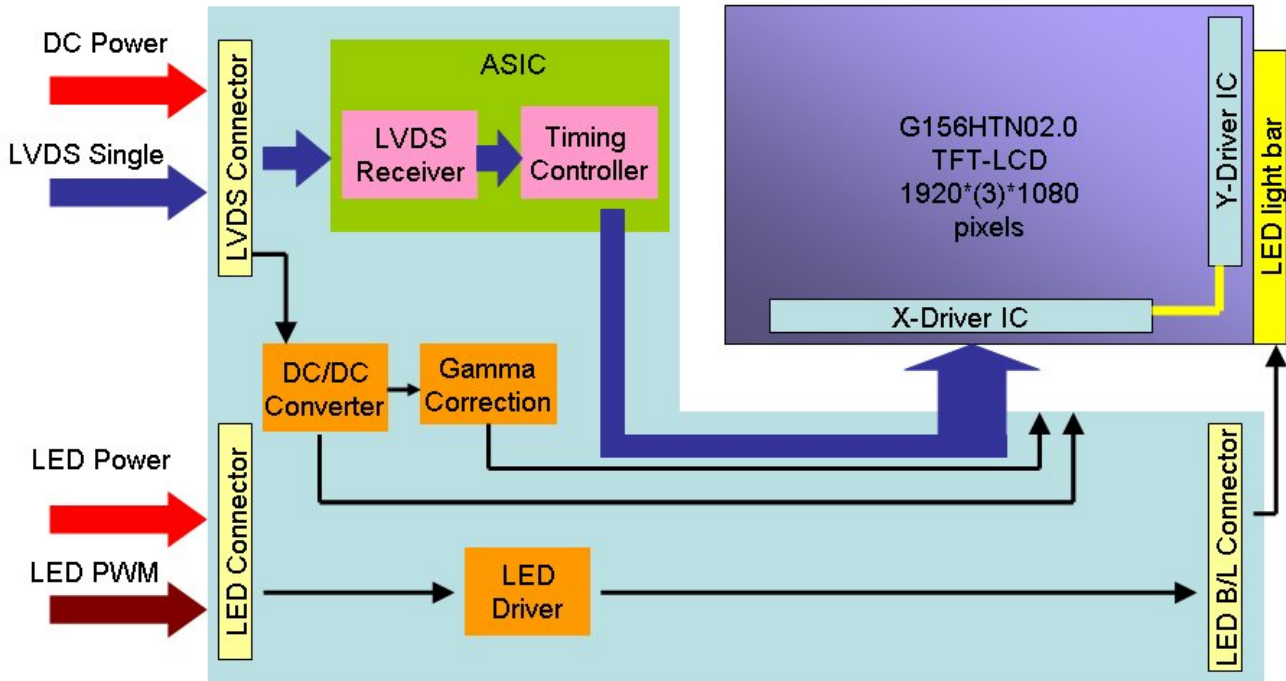
L_{white} means left eye white signal;

R_{black} means right eye black signal;

Right eye crosstalk is defined by analogy.

3. Functional Block Diagram

The following diagram shows the functional block of the 15.6 inch Color TFT-LCD Module:



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 | Vin | -0.3 | +5.0 | [Volt] | Note 1,2 |

4.2 Absolute Ratings of Environment

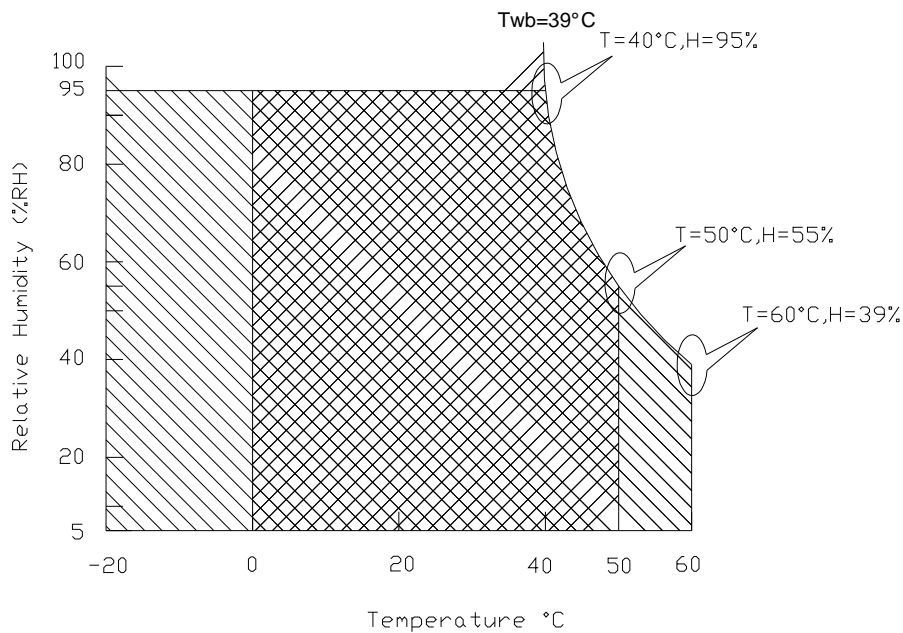
| Item | Symbol | Min | Max | Unit | Conditions |
|---------------------|--------|-----|-----|-------|------------|
| Operating Temp. | TOP | 0 | +50 | [°C] | Note 4 |
| Operation Humidity | HOP | 8 | 95 | [%RH] | Note 4 |
| Storage Temperature | TST | -20 | +60 | [°C] | Note 4 |
| Storage Humidity | HST | 5 | 95 | [%RH] | Note 4 |

Note 1: At Ta (25 °C)

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)



Operating Range Storage Range +

5. Electrical Characteristics

5.1 TFT LCD Module

5.1.1 Power Specification

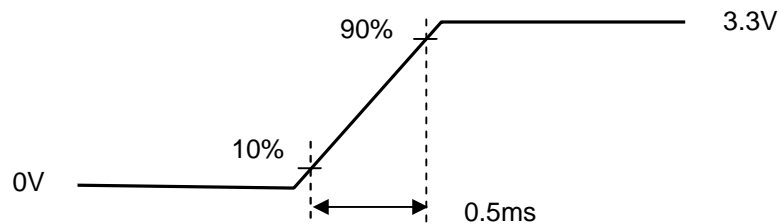
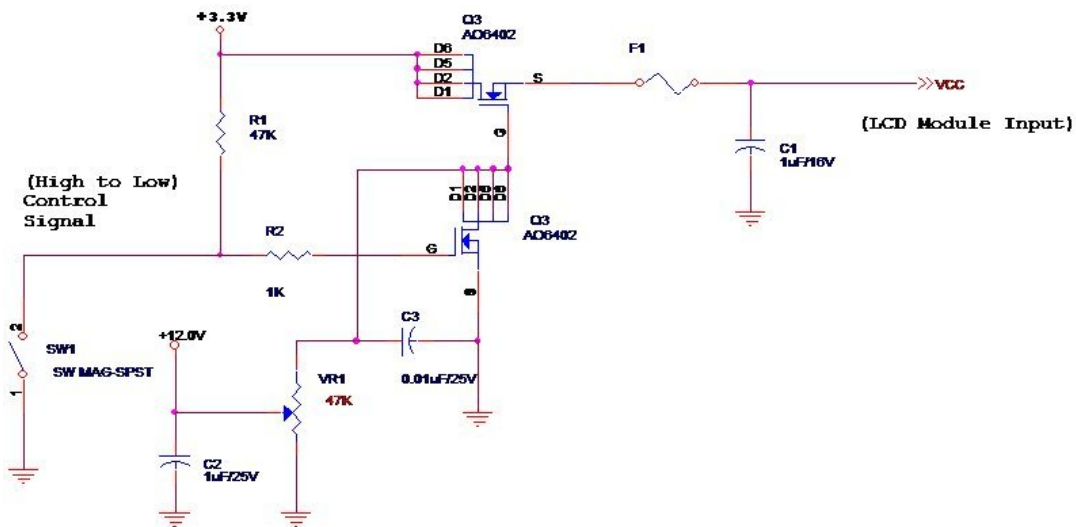
Input power specifications are as follows;

The power specification are measured under 25 °C 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 | - | 3.14 | 3.76 | [Watt] | Note 1 |
| IDD | IDD Current | - | 950 | 1140 | [mA] | Note 1 |
| IRush | Inrush Current | - | - | TBD | [mA] | Note 2 |
| VDDrp | Allowable Logic/LCD Drive Ripple Voltage | - | - | TBD | [mV] p-p | |

Note 1: Maximum Measurement Condition : Red Pattern

Note 2: Measure Condition



Vin rising time

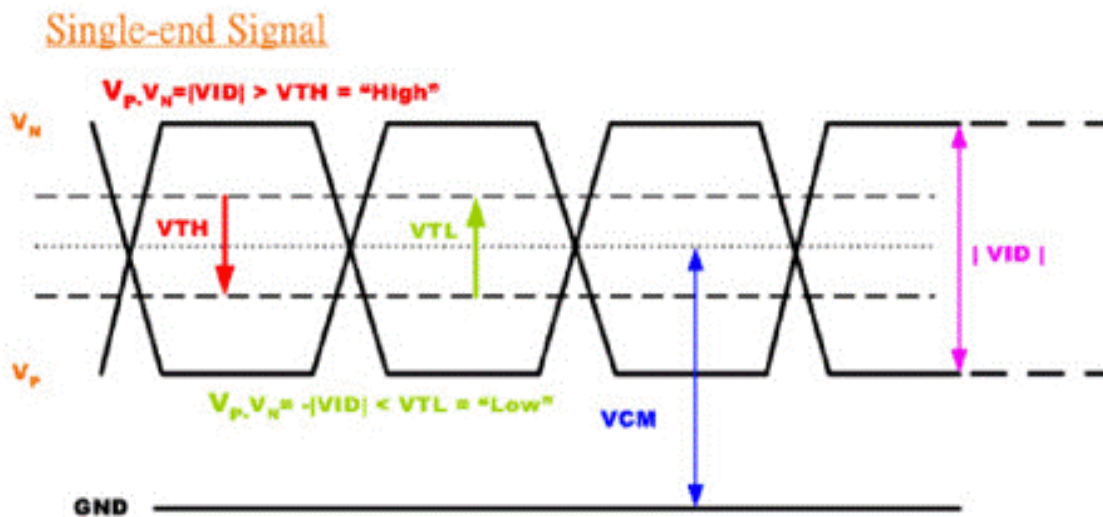
5.1.2 Signal Electrical Characteristics

Input signals shall be low or High-impedance state when VDD is off.

Signal electrical characteristics are as follows;

| Parameter | Condition | Min | Max | Unit |
|------------|---|-------|-------|------|
| V_{TH} | Differential Input High Threshold ($V_{cm}=+1.2V$) | --- | 100 | [mV] |
| V_{TL} | Differential Input Low Threshold ($V_{cm}=+1.2V$) | -100 | --- | [mV] |
| $ V_{ID} $ | Differential Input Voltage | 100 | 600 | [mV] |
| V_{CM} | Differential Input Common Mode Voltage | 1.125 | 1.375 | [V] |

Note 1: LVDS Signal Waveform





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5.2 Backlight Unit

5.2.1 LED characteristics

| Parameter | Symbol | Min | Typ | Max | Units | Condition |
|-----------------------------|--------|-----|--------|-------|--------|---------------------|
| Backlight Power Consumption | PLED | - | - | 10.6W | [Watt] | (Ta=25), Note 1 |
| LED Life-Time | N/A | - | 50,000 | - | 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.

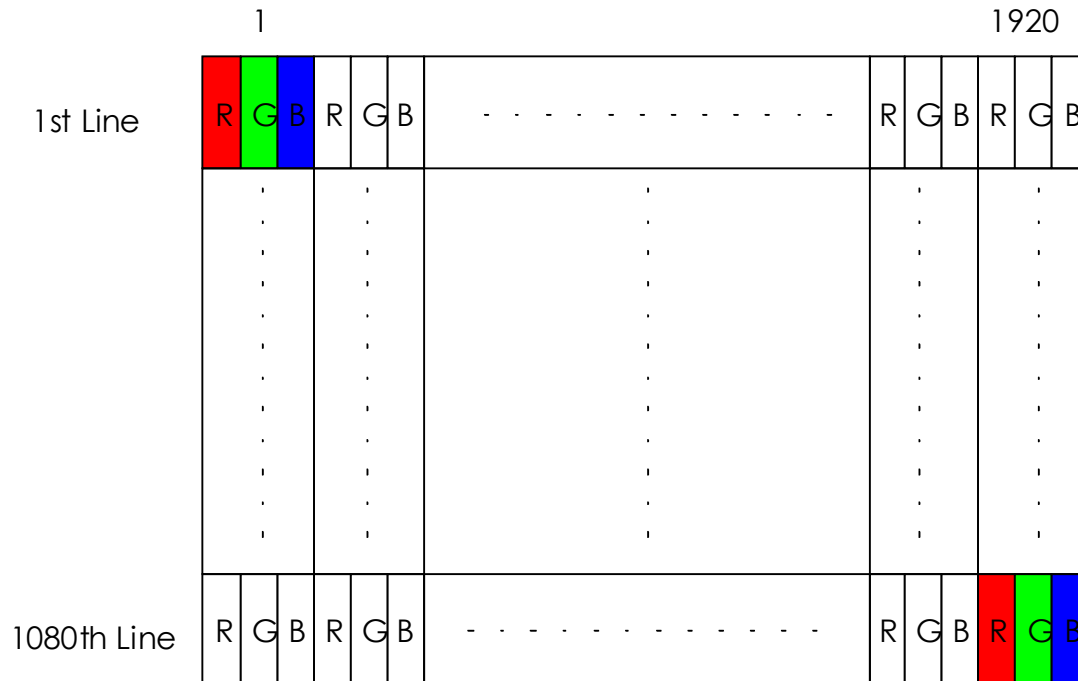
5.2.2 Backlight input signal characteristics

| Parameter | Symbol | Min | Typ | Max | Units | Remark |
|-----------------------------|---------|------|------|------|--------|---|
| LED Power Supply | VLED | 10.8 | 12.0 | 13.2 | [Volt] | Define as Connector Interface (Ta=25) |
| LED Enable Input High Level | VLED_EN | 2.5 | - | 5 | [Volt] | |
| LED Enable Input Low Level | | - | - | 0.8 | [Volt] | |
| PWM Logic Input High Level | VPWM_EN | 2.5 | - | 5 | [Volt] | |
| PWM Logic Input Low Level | | - | - | 0.8 | [Volt] | |
| PWM Input Frequency | FPWM | 200 | - | 15K | Hz | |
| PWM Duty Ratio | Duty | 5 | - | 100 | % | |

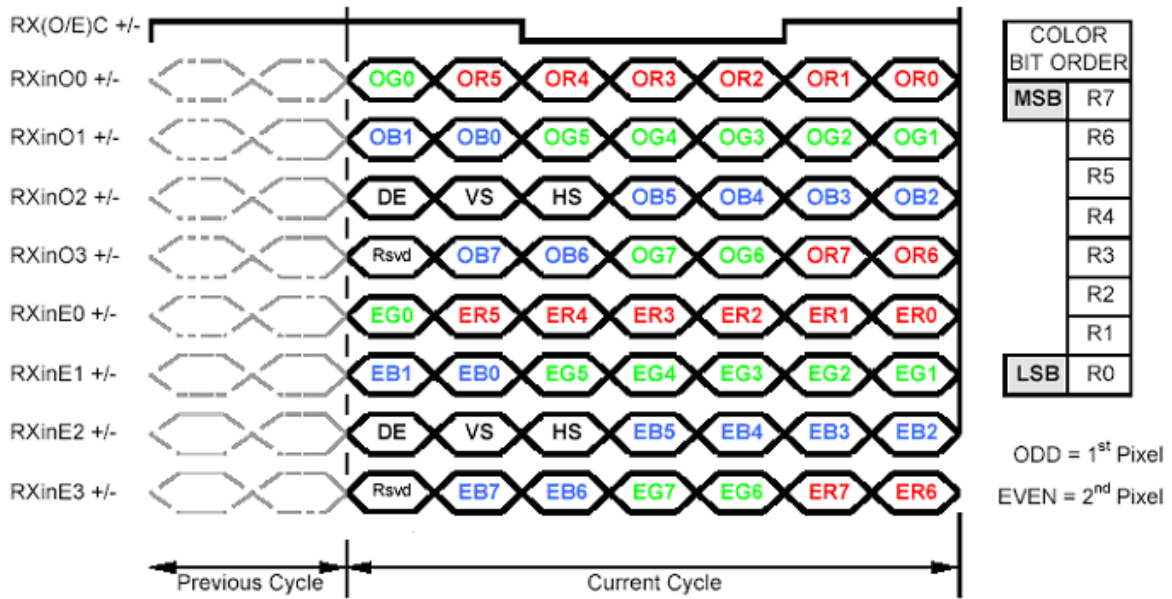
6. Signal Interface Characteristic

6.1 Pixel Format Image

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



6.2 The Input Data Format





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6.3 Signal Description

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

| Pin | Signal | Description |
|-----|----------|---|
| 1 | REIN3+ | + LVDS differential data input (Even CH3) |
| 2 | REIN3- | - LVDS differential data input (Even CH3) |
| 3 | RECLKIN+ | + LVDS differential data input (Even CLK) |
| 4 | RECLKIN- | - LVDS differential data input (Even CLK) |
| 5 | REIN2+ | + LVDS differential data input (Even CH2) |
| 6 | REIN2- | - LVDS differential data input (Even CH2) |
| 7 | GND | Ground |
| 8 | REIN1+ | + LVDS differential data input (Even CH1) |
| 9 | REIN1- | - LVDS differential data input (Even CH1) |
| 10 | GND | Ground |
| 11 | REIN0+ | + LVDS differential data input (Even CH0) |
| 12 | REIN0- | - LVDS differential data input (Even CH0) |
| 13 | ROIN3+ | + LVDS differential data input (Odd CH3) |
| 14 | ROIN3- | - LVDS differential data input (Odd CH3) |
| 15 | ROCLKIN+ | + LVDS differential data input (Odd CLK) |
| 16 | ROCLKIN- | - LVDS differential data input (Odd CLK) |
| 17 | GND | Ground |
| 18 | ROIN2+ | + LVDS differential data input (Odd CH2) |
| 19 | ROIN2- | - LVDS differential data input (Odd CH2) |
| 20 | ROIN1+ | + LVDS differential data input (Odd CH1) |
| 21 | ROIN1- | - LVDS differential data input (Odd CH1) |
| 22 | ROIN0+ | + LVDS differential data input (Odd CH0) |
| 23 | ROIN0- | - LVDS differential data input (Odd CH0) |
| 24 | GND | Ground |
| 25 | GND | Ground |
| 26 | GND | Ground |
| 27 | GND | Ground |
| 28 | VDD | +3.3V |
| 29 | VDD | +3.3V |
| 30 | VDD | +3.3V |

6.4 Interface Timing (LVDS)

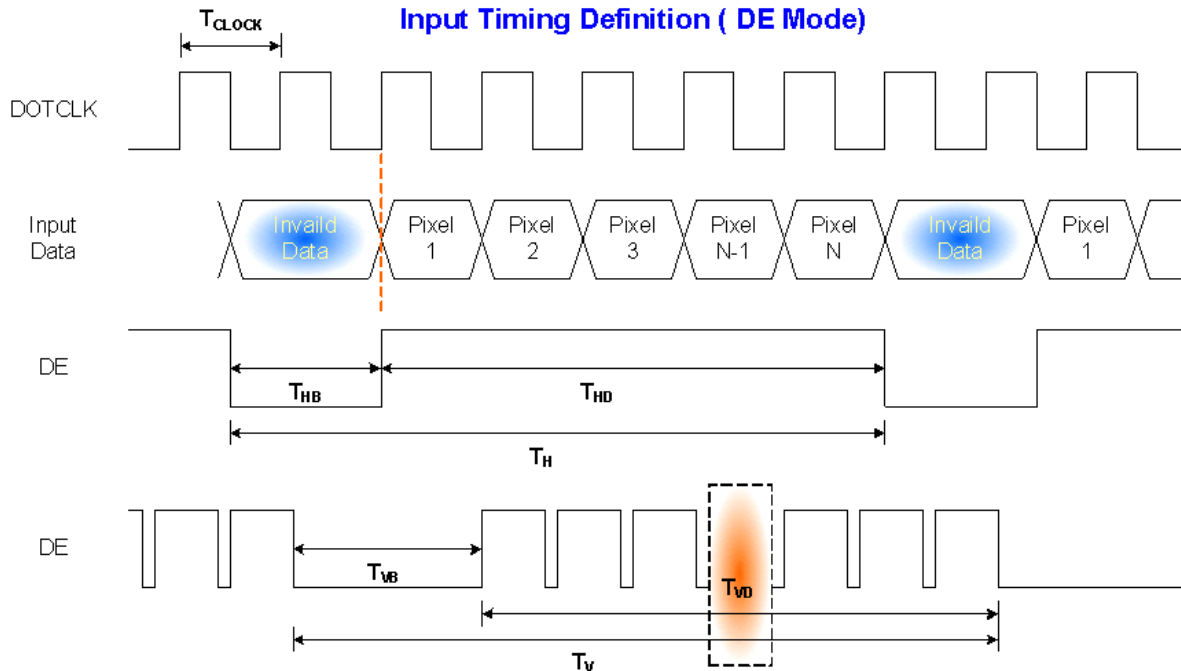
6.4.1 Timing Characteristics

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

| Parameter | Symbol | Min. | Typ. | Max. | Unit | |
|--------------------|----------------------|----------|-------|------|------|--------------------|
| Frame Rate | - | 40 | 60 | 60 | Hz | |
| Clock frequency | $1/T_{\text{Clock}}$ | 50 | 70.93 | 75 | MHz | |
| Horizontal Section | Period | T_H | 1050 | 1065 | 1075 | T_{clock} |
| | Active | T_{HD} | 960 | | | |
| | Blanking | T_{HB} | 90 | 105 | 115 | |
| Vertical Section | Period | T_V | 1090 | 1110 | 1130 | T_{line} |
| | Active | T_{VD} | 1080 | | | |
| | Blanking | T_{VB} | 10 | 30 | 50 | |

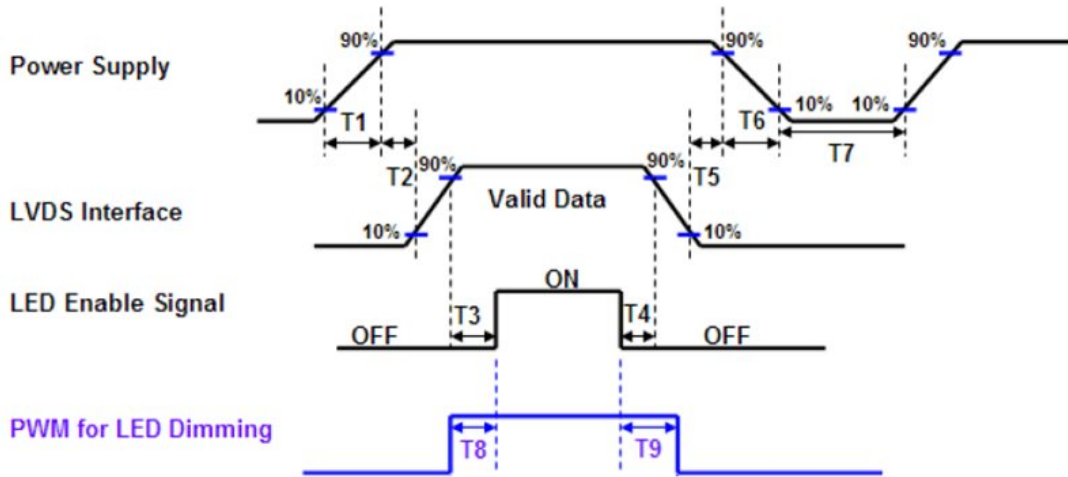
Note 1: DE mode only.

6.4.2 Timing Diagram



6.5 Power ON/OFF Sequence

LED on/off sequence is as follows. Interface signals are also shown in the chart.



| Power Sequence Timing | | | |
|-----------------------|-------|------|-------|
| Parameter | Value | | Units |
| | Min. | Max. | |
| T1 | 0.5 | 10 | ms |
| T2 | 60 | 70 | |
| T3 | 400 | - | |
| T4 | 400 | - | |
| T5 | 0 | 50 | |
| T6 | 0 | 10 | |
| T7 | 500 | - | |
| T8 | 10 | 180 | |
| T9 | 10 | 180 | |

Note 1: If $T4 < 400\text{ms}$, The display garbage may occur. We suggest $T4 > 400\text{ms}$ to avoid the display garbage.

Note 2: If $T1 < 0.5\text{ms}$, the inrush current may cause the damage of fuse. If $T1 < 0.5\text{ms}$, the inrush current I_{2t} is under typical melt of fuse Spec., there is no mentioned problem.



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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

| Connector Name / Designation | Interface Connector / Interface card |
|------------------------------|--------------------------------------|
| Manufacturer | HRS |
| Type Part Number | DF14H-30P-1.25H |
| Mating Housing Part Number | DF14H-30S-1.25C |

7.1.1 Pin Assignment

| Pin# | Signal Name | Pin# | Signal Name |
|------|-------------|------|-------------|
| 1 | REIN3+ | 2 | REIN3- |
| 3 | RECLKIN+ | 4 | RECLKIN- |
| 5 | REIN2+ | 6 | REIN2- |
| 7 | GND | 8 | REIN1+ |
| 9 | REIN1- | 10 | GND |
| 11 | REIN0+ | 12 | REIN0- |
| 13 | ROIN3+ | 14 | ROIN3- |
| 15 | ROCLKIN+ | 16 | ROCLKIN- |
| 17 | GND | 18 | ROIN2+ |
| 19 | ROIN2- | 20 | ROIN1+ |
| 21 | ROIN1- | 22 | ROIN0+ |
| 23 | ROIN0- | 24 | GND |
| 25 | GND | 26 | GND |
| 27 | GND | 28 | VDD |
| 29 | VDD | 30 | VDD |

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.

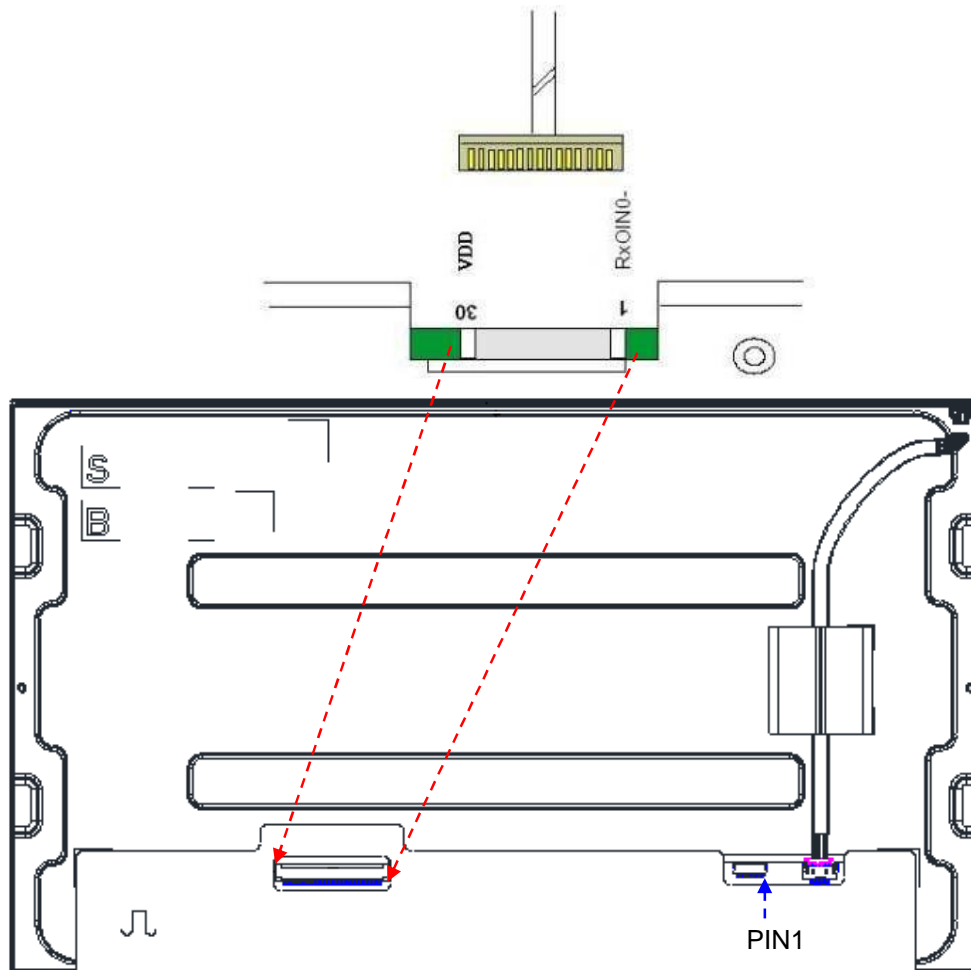
| Connector Name / Designation | LED Connector |
|------------------------------|----------------|
| Manufacturer | E&T |
| Type Part Number | 3710K-Q10N-01R |
| Mating Housing Part Number | H113K-D10N-01B |

7.2.1 LED Driver Connector Pin Assignment

| Pin# | Symbol | Signal Name |
|------|--------|-------------------------|
| 1 | VCC | +12V |
| 2 | VCC | +12V |
| 3 | VCC | +12V |
| 4 | VCC | +12V |
| 5 | GND | Ground |
| 6 | GND | Ground |
| 7 | GND | Ground |
| 8 | GND | Ground |
| 9 | ENABLE | LED enable pin |
| 10 | PWM | System PWM Single Input |

Note1: Start from right side

Note2: Connector Illustration





8. Panel Reliability Test

8.1 Vibration Test

Test Spec:

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

8.2 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

8.3 Reliability Test

| Items | Required Condition | Note |
|----------------------------|--|----------|
| Temperature Humidity Bias | Ta= 40°C, 90%RH, 300h | Note 1,2 |
| High Temperature Operation | Ta= 70°C , Dry, 300h | |
| Low Temperature Operation | Ta= -10°C, 300h | |
| High Temperature Storage | Ta= 70°C, Dry, 300h | |
| Low Temperature Storage | Ta= -20°C, 300h | |
| Thermal Shock Test | Ta=-20°C to 60°C, Duration at 30 min, 100 cycles | |
| ESD | Contact : ±8 KV (TBD) Air : ±15 KV (TBD) | Note 1 |

Note 1: According to EN 61000-4-2 , ESD class B: Some performance degradation allowed.

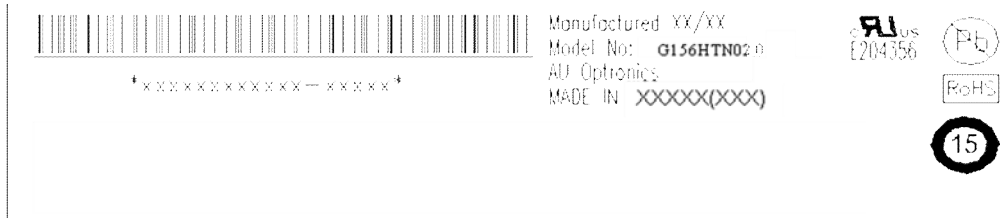
Self-recoverable. No data lost, No hardware failures.

Note 2:

- 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. Mura shall be ignored after high temperature reliability test

9. Shipping and Package

9.1 Shipping Label Format



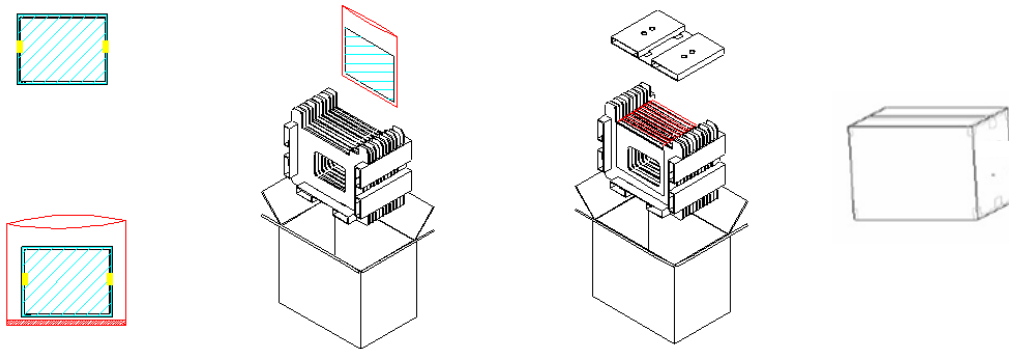
Note 1: For Pb Free products, AUO will add for identification.

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 Carton Package



Max capacity : 16 TFT-LCD module per carton

Max weight: 16.3 kg per carton

Outside dimension of carton: 450mm(L)*375mm(W)*319mm(H)

Pallet size : 1150 mm * 910 mm * 132mm

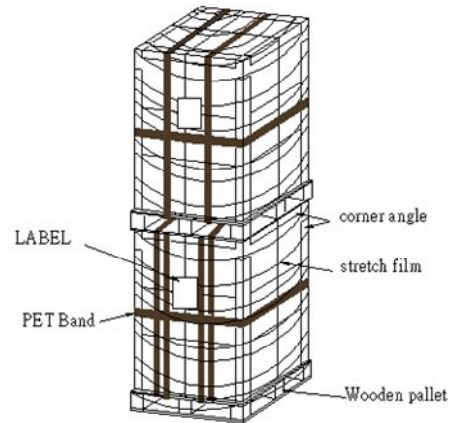
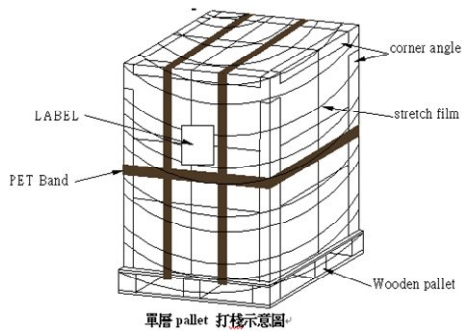
Box stacked

Module by air : (2 *3) *4 layers , one pallet put 24 boxes , total 384pcs module

Module by sea : (2 *3) *4 layers+(2 *3) *1 layers , two pallet put 30 boxes , total 480pcs module

Module by sea_HQ : (2 *3) *4 layers+(2 *3) *2 layers , two pallet put 42 boxes , total 576 pcs module

9.3 Shipping Package of Palletizing Sequence





Product Specification

AU OPTRONICS CORPORATION

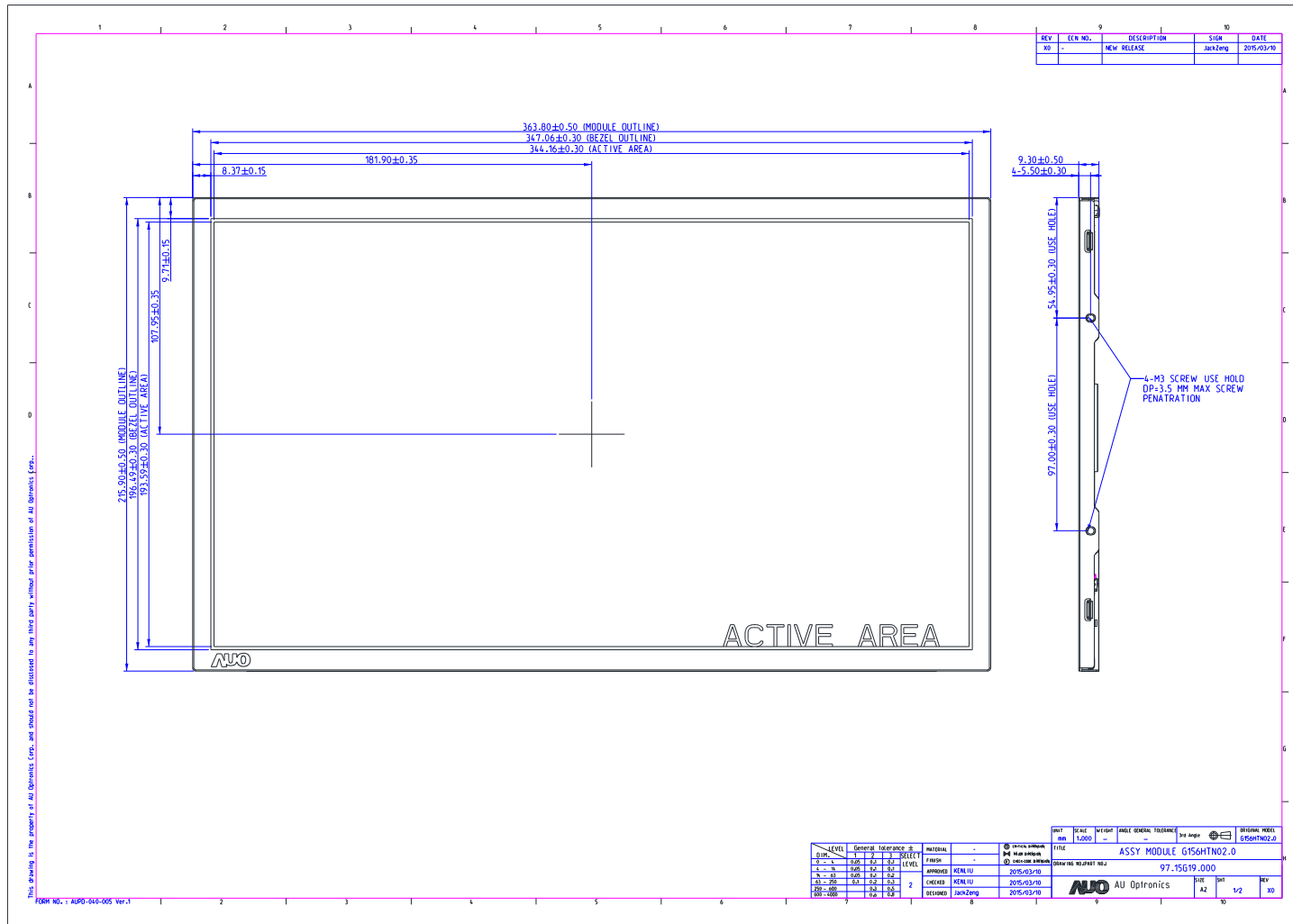


Product Specification

AU OPTRONICS CORPORATION

10 .Mechanical Characteristics

10.1 LCM Outline Dimension (Front View)





Product Specification

AU OPTRONICS CORPORATION

10.2 LCM Outline Dimension (Rear View)

