



Product Specification

AU OPTRONICS CORPORATION

- () Preliminary Specifications
- (✓) Final Specifications

| | |
|------------|-----------------------|
| Module | 32 Inch Color TFT-LCD |
| Model Name | G320ZAN02.1 |

| | |
|---------------------------|-------|
| Customer | Date |
| _____ | _____ |
| Checked & Approved by | Date |
| _____ | _____ |
| Customer's sign back page | |

| | |
|---|-------------------|
| Approved by | Date |
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Product Specification

AU OPTRONICS CORPORATION

Record of Revision

| Version | Date | Page | Old description | New Description |
|---------|------------|------|---------------------------|--------------------------|
| 0.1 | 2021/04/26 | All | First draft specification | |
| 0.2 | 2021/06/02 | | | Correct the Chromaticity |
| 0.3 | 2021/06/12 | | | Modify Chromaticity |
| 1.0 | 2021/07/30 | | | Final specification |
| | | | | |

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I. 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) 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 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 (IEC60950-1 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.

2. General Description

This specification applies to the Color Active Matrix Liquid Crystal Display G320ZAN02.1 composed of a TFT-LCD display, a driver and power supply circuit, and a LED backlight system. The screen format is intended to support the UHD (3840(H)x2160(V)) screen and 1.07B colors. All input signals are V by one interface compatible. LED driving board for backlight unit is included in G320ZAN02.1.

2.1 Display Characteristics

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

| Items | Unit | Specifications |
|---|---------|---|
| Screen Diagonal | [inch] | 32.0" (812.8mm) |
| Active Area | [mm] | 708.48 (H) x 398.52 (V) |
| Resolution | | 3840(x3) x 2160 |
| Pixel Pitch | [mm] | 0.1845 (per one triad) x 0.1845 |
| Pixel Arrangement | | R.G.B. Vertical Stripe |
| Display Mode | | Normally Black, AHVA |
| Nominal Input Voltage VDD | [Volt] | +12.0 V |
| Power Consumption | [Watt] | Max. 96.48W (Logic: max. 28.8W; BL power: max. 67.68W) |
| Weight | [Grams] | 4630 g(Typ) |
| Physical Size | [mm] | 727.3 (H) x 424.5 (V) x 20.48 (D) (Typ) |
| Electrical Interface | | V by one |
| Surface Treatment | | Anti-Glare treatment |
| Support Color | | 10bit (8bit+2FRC) |
| Temperature Range Operating Storage (Non-Operating) | [°C] | 0 to +50 -20 to +60 |
| RoHS Compliance | | Yes |

2.2 Optical Characteristics

The optical characteristics are measured under stable conditions(warm up 30 mins) at 25 °C (Room Temperature), VDD 12V , Frame rate:60Hz:

| Item | Unit | Conditions | | Min. | Typ. | Max. | Note |
|---|-------------------|-------------------------|---------|-------|-------|-------|------|
| White Luminance | cd/m ² | ILED=70mA(center point) | | 680 | 850 | --- | 1 |
| Uniformity | % | 9 points | | --- | --- | 20 | 2,3 |
| Contrast Ratio | -- | | | 1000 | 1500 | | 4 |
| Response Time | msec | Rising | | --- | --- | --- | 5 |
| | | Falling | | --- | --- | --- | |
| | | Rising + Falling | | --- | 20 | --- | |
| Viewing Angle | degree | Horizontal CR >= 10 | (Right) | 75 | 89 | --- | 6 |
| | | | (Left) | 75 | 89 | --- | |
| | | Vertical CR >= 10 | (Upper) | 75 | 89 | --- | |
| | | | (Lower) | 75 | 89 | --- | |
| Color / Chromaticity Coordinates (CIE 1931) | -- | Red x | | 0.660 | 0.690 | 0.720 | |
| | | Red y | | 0.277 | 0.307 | 0.337 | |
| | | Green x | | 0.208 | 0.238 | 0.268 | |
| | | Green y | | 0.663 | 0.693 | 0.723 | |
| | | Blue x | | 0.117 | 0.147 | 0.177 | |
| | | Blue y | | 0.026 | 0.056 | 0.086 | |
| | | White x | | 0.283 | 0.313 | 0.343 | |
| | | White y | | 0.299 | 0.329 | 0.359 | |
| NTSC | % | | | --- | (100) | --- | |

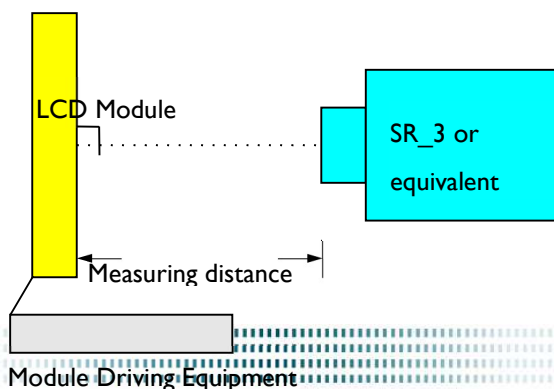
Note 1: Measurement method

Equipment Pattern Generator, Power Supply, Digital Voltmeter, Luminance meter (SR_3 or equivalent)

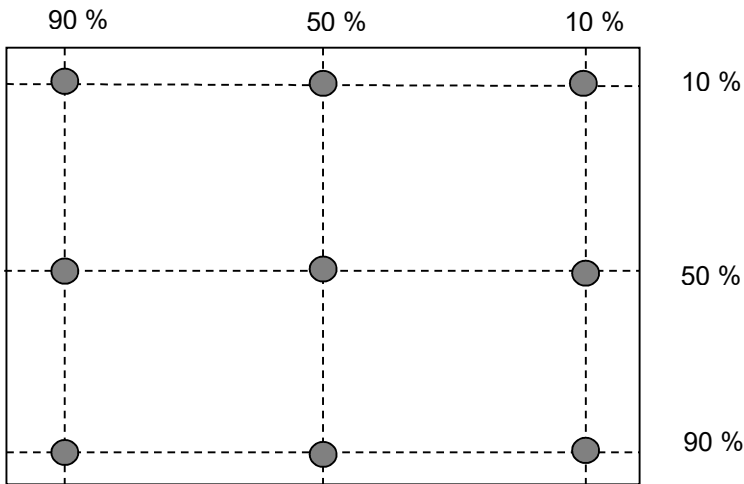
Aperture 1 with 50cm viewing distance

Test Point Center

Environment < 1 lux



Note 2: Definition of 9 points position



Note 3: Definition of luminance uniformity of 9 points.

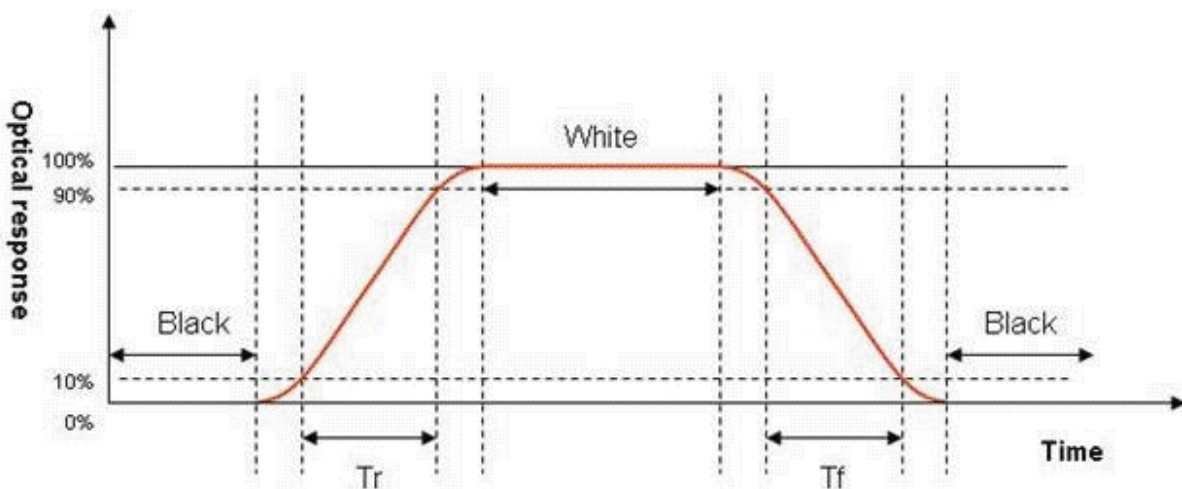
$$\delta_{w9} = \frac{|B_{\max} \text{ or } B_{\min} - B_{\text{avg}}|}{B_{\text{avg}}} \times 100\%$$

Note 4: Definition of contrast ratio (CR):

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

Note 5: Definition of response time:

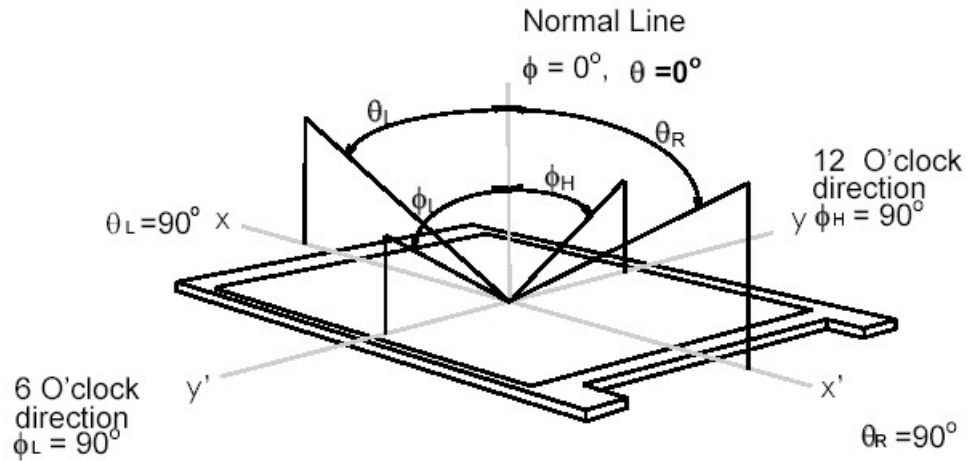
The output signals of photo detector are measured when the input signals are changed from "White" to "Black" (falling time) and from "Black" to "White" (rising time), respectively. The response time interval is between 10% and 90% of amplitudes. Please refer to the figure as below.



Note 6: Definition of viewing angle

Viewing angle is the measurement of contrast ratio ≥ 10 , at the screen center, over a 180° horizontal and 180°

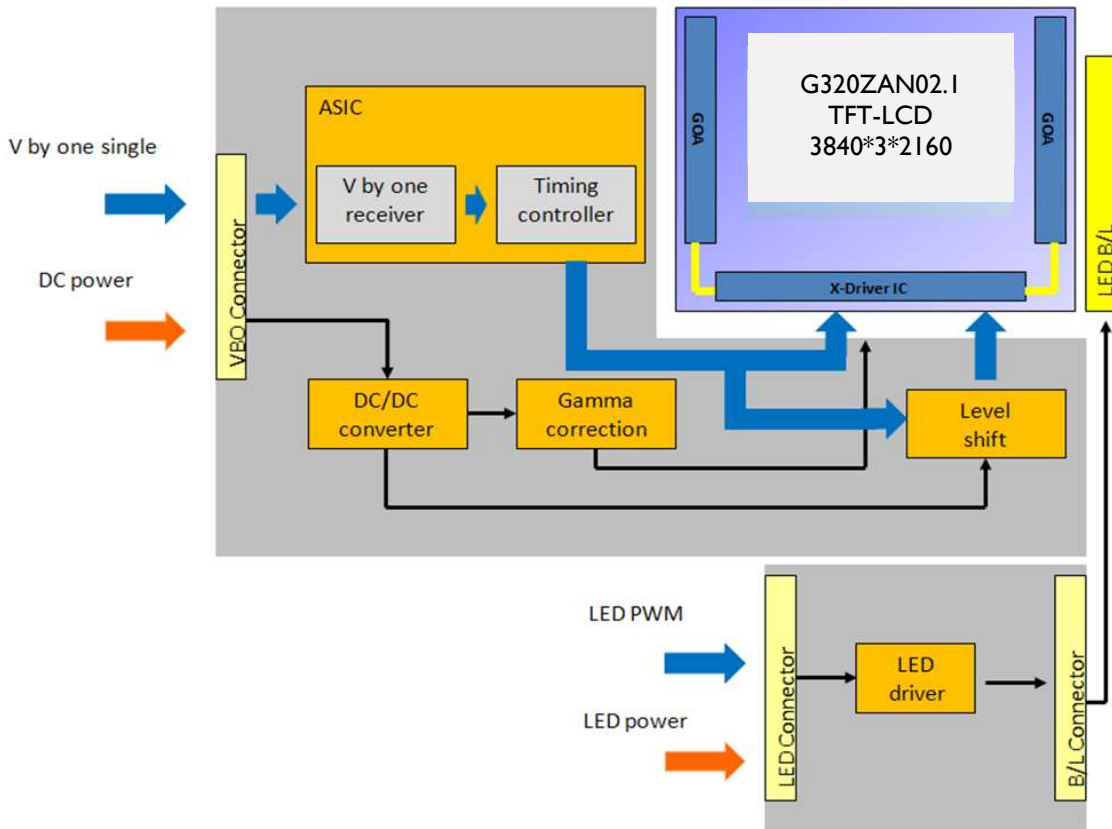
vertical range (off-normal viewing angles). The 180° viewing angle range is broken down as below: 90° (θ) horizontal left and right, and 90° (Φ) vertical high (up) and low (down). The measurement direction is typically perpendicular to the display surface with the screen rotated to its center to develop the desired measurement viewing angle.



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3. Functional Block Diagram

The following diagram shows the functional block of the 32 inch color TFT/LCD module:



| Connector Name / Designation | Signal Connector |
|------------------------------|------------------|
| Manufacturer | JAE |
| Connector Model Number | FI-RE51S-HF |
| Adaptable Plug | FI-RE51HL |

4. Absolute Maximum Ratings

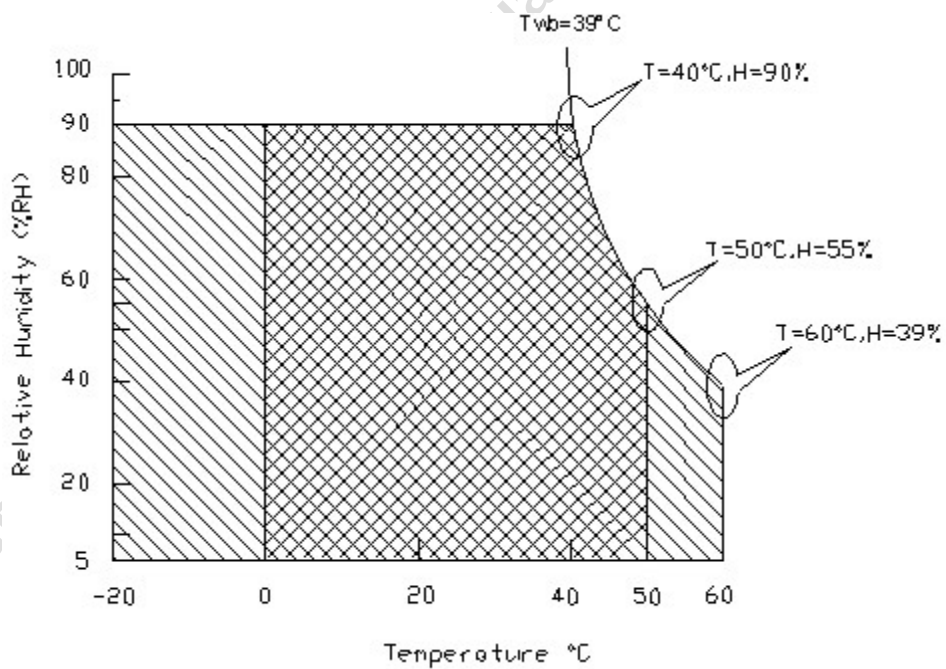
4.1 Absolute Ratings of TFT LCD Module

| Item | Symbol | Min | Max | Unit |
|-------------------------|--------|------|-------|--------|
| Logic/LCD drive Voltage | Vin | -0.3 | +13.5 | [Volt] |

4.2 Absolute Ratings of Environment

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

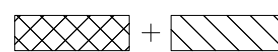
Note: Maximum Wet-Bulb should be 39°C and no condensation.



Operating Range



Storage Range



5. Electrical Characteristics

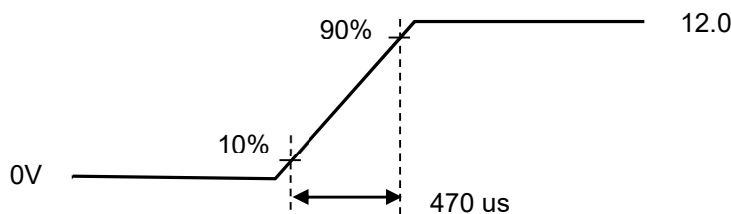
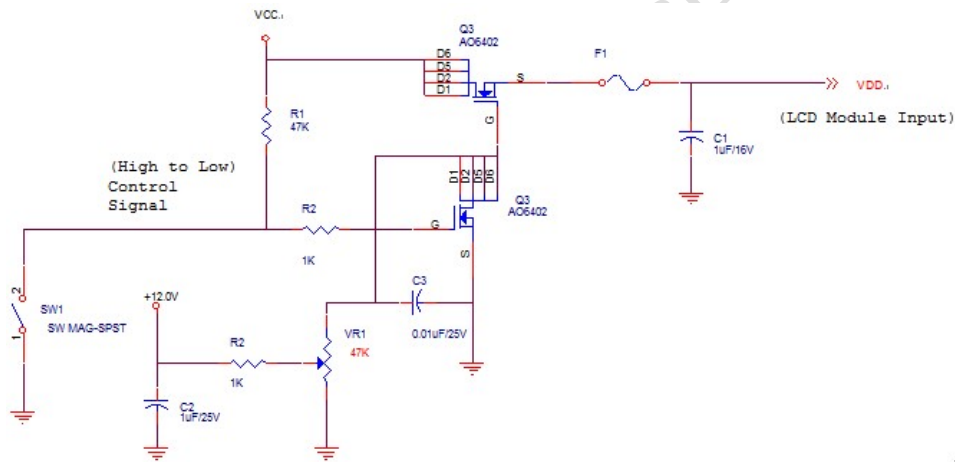
5.1 TFT LCD Module

5.1.1 Power Specification

Input power specifications are shown as follows;

| Symbol | Parameter | Min | Typ | Max | Units | Remark |
|--------|--|------|--------|--------|--------|-------------------------------------|
| VDD | Logic/LCD Drive Voltage | 10.8 | 12.0 | 13.2 | [Volt] | ±10% |
| IDD | VDD Current | - | (2.0) | 2.4 | [A] | White Pattern (VDD=12V, at 60Hz) |
| Irush | LCD Inrush Current | - | - | 4 | [A] | Note 1 (VDD=12V, at 60Hz) |
| PDD | VDD Power | - | (24.0) | (28.8) | [Watt] | White Pattern (VDD=12V, at 60Hz) |
| VDDrp | Allowable Logic/LCD Drive Ripple Voltage | - | - | VDD*5% | [mV] | White Pattern (VDD=12V, at 60Hz) |

Note 1: Measurement condition:



VDD rising time



5.2 Backlight Unit

5.2.1 LED Backlight Unit: Driver Connector

| | |
|------------------------------|----------------------|
| Connector Name / Designation | Lamp Connector |
| Manufacturer | JST |
| Connector Model Number | SI4B-PH-SM6-K-TB(HF) |
| Mating Model Number | PHR-14 |

| Pin # | Symbol | Pin Description |
|-------|----------|------------------------------|
| 1 | VBL | +24V |
| 2 | VBL | +24V |
| 3 | VBL | +24V |
| 4 | VBL | +24V |
| 5 | VBL | +24V |
| 6 | GND | GND |
| 7 | GND | GND |
| 8 | GND | GND |
| 9 | GND | GND |
| 10 | GND | GND |
| 11 | NC | N/A |
| 12 | BL_EN | BL enable (3.3V-On / 0V-Off) |
| 13 | NC | N/A |
| 14 | BL_DIM_P | PWM Dimming |

5.2.2 Parameter guideline for LED

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

LED characteristics

| Symbol | Parameter | Min | Typ | Max | Units | Condition |
|--------|-----------------------------|--------|---------|--------|--------|-----------|
| PLED | Backlight Power Consumption | --- | (53.76) | (60.9) | [Watt] | LED only |
| LTLED | LED Life-Time | 30,000 | --- | --- | Hour | LED only |

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

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

Backlight input signal characteristics

| Symbol | Parameter | Min. | Typ. | Max. | Unit | Remark |
|------------------------------------|---------------------|------|--------|---------|--------|-----------------------|
| VDD | Input Voltage | 21.6 | 24.0 | 26.4 | [Volt] | |
| I _{VDD} | Input Current | --- | (2.35) | (2.82) | [A] | 100% PWM Duty |
| P _{VDD} | Power Consumption | --- | (56.4) | (67.68) | [Watt] | 100% PWM Duty |
| Backlight on/off | On control Voltage | 2 | 3.3 | 5 | [Volt] | |
| | Off control Voltage | --- | --- | 0.8 | [Volt] | |
| Backlight Dimming (PWM Mode) | Dimming Frequency | 0.2 | | 15 | [kHz] | |
| | Swing Voltage | 3 | --- | 3.6 | V | Note3 |
| | Dimming Duty Cycle | 10 | - | 100 | % | |
| I _{F (one channel)} | LED Forward Current | --- | 70 | --- | mA | T _a = 25°C |

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

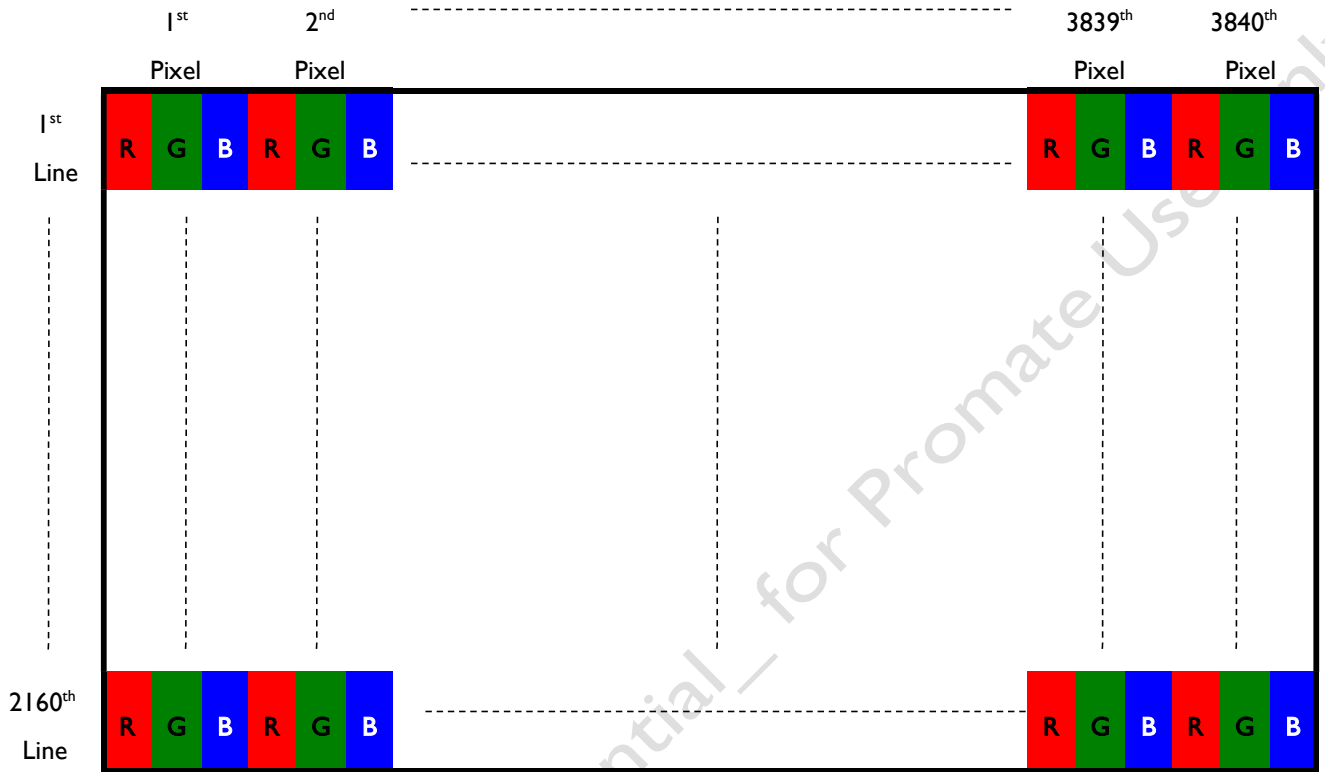
Note 2: VDD, I_{VDD}, P_{VDD}, I_{rush} LED are defined for LED B/L.(100% duty of PWM dimming).

Note 3: Swing voltage 3V is best linear of PWM mode.

6. Signal Characteristic

6.1 Pixel Format Image

Following figure shows the relationship between input signal and LCD pixel format.



6.2 Scanning Direction

The following figures show the image seen from the front view. The arrow indicates the direction of scan.



6.3 Signal Description

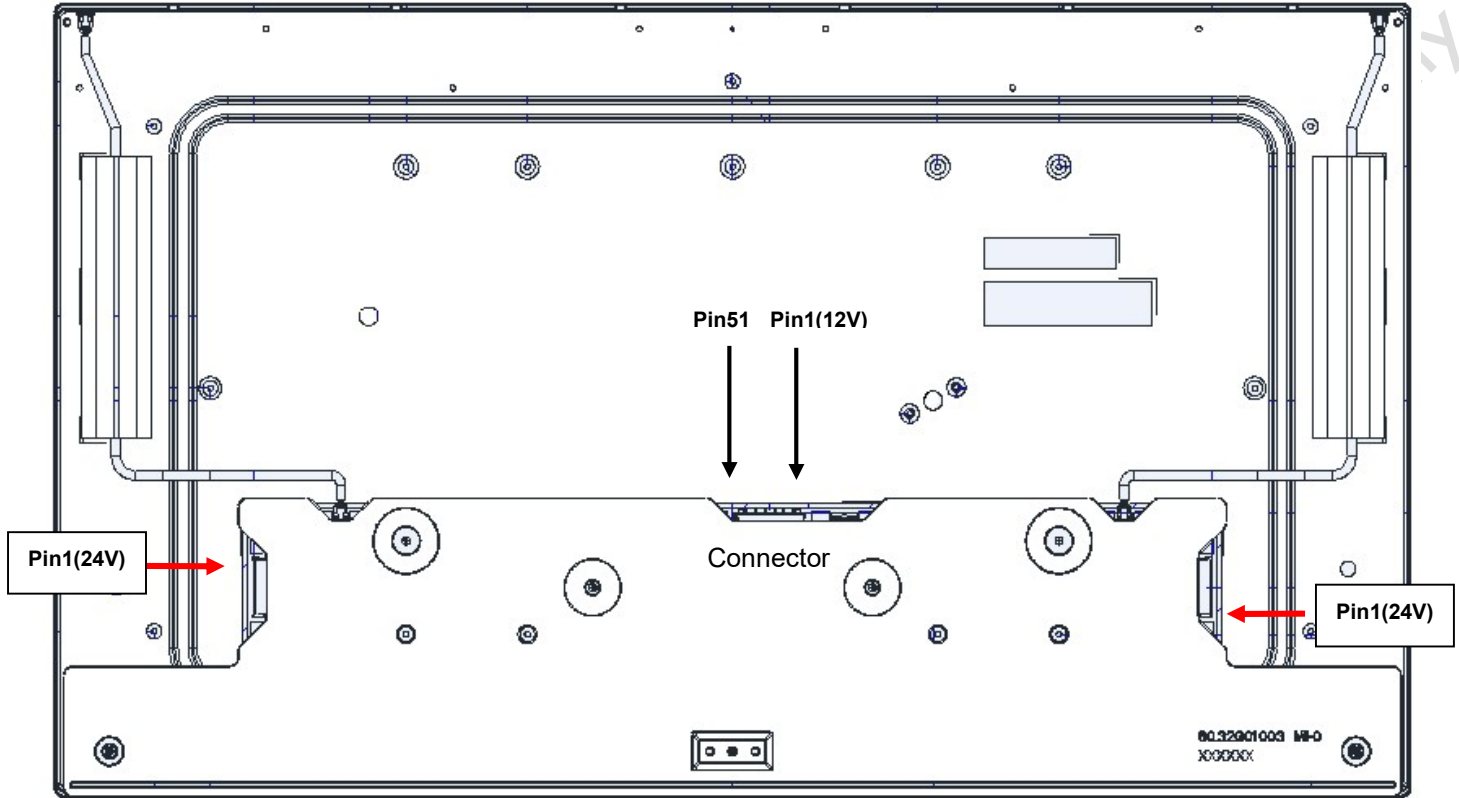
The module uses a V by One receiver embedded in AUO's ASIC. V by One is a differential signal technology for LCD interface and a high-speed data transfer device.

6.3.1 TFT LCD Module: LCD Connector

| Connector Name / Designation | Signal Connector |
|------------------------------|------------------|
| Manufacturer | JAE |
| Connector Model Number | FI-RE51S-HF |
| Adaptable Plug | FI-RE51HL |

| Pin | Symbol | Description | Pin | Symbol | Description |
|-----|--------|---------------------------------|-----|--------|-------------|
| 1 | VDD | Power input (+12V) | 26 | LOCKN | Vx1 LOCKN |
| 2 | VDD | Power input (+12V) | 27 | GND | Ground |
| 3 | VDD | Power input (+12V) | 28 | RX0N | Vx1 lane0 |
| 4 | VDD | Power input (+12V) | 29 | RX0P | Vx1 lane0 |
| 5 | VDD | Power input (+12V) | 30 | GND | Ground |
| 6 | VDD | Power input (+12V) | 31 | RX1N | Vx1 lane1 |
| 7 | VDD | Power input (+12V) | 32 | RX1P | Vx1 lane1 |
| 8 | VDD | Power input (+12V) | 33 | GND | Ground |
| 9 | NC | No Connection | 34 | RX2N | Vx1 lane2 |
| 10 | GND | Ground | 35 | RX2P | Vx1 lane2 |
| 11 | GND | Ground | 36 | GND | Ground |
| 12 | GND | Ground | 37 | RX3N | Vx1 lane3 |
| 13 | GND | Ground | 38 | RX3P | Vx1 lane3 |
| 14 | GND | Ground | 39 | GND | Ground |
| 15 | NC | No Connection | 40 | RX4N | Vx1 lane4 |
| 16 | NC | No Connection | 41 | RX4P | Vx1 lane4 |
| 17 | NC | No Connection | 42 | GND | Ground |
| 18 | NC | For internal use, no connection | 43 | RX5N | Vx1 lane5 |
| 19 | NC | For internal use, no connection | 44 | RX5P | Vx1 lane5 |
| 20 | NC | No Connection | 45 | GND | Ground |
| 21 | NC | No Connection | 46 | RX6N | Vx1 lane6 |
| 22 | NC | No Connection | 47 | RX6P | Vx1 lane6 |
| 23 | NC | No Connection | 48 | GND | Ground |
| 24 | NC | No Connection | 49 | RX7N | Vx1 lane7 |
| 25 | HTPDN | Vx1 HTPDN | 50 | RX7P | Vx1 lane7 |
| | | | 51 | GND | Ground |

Notel: Pin1 start position





6.4 The Input Data Format

6.4.1 Color data input reference

The brightness of each primary color is based on the 10bit gray scale data input for the color; the higher the binary input, the brighter the color. The table below provides a reference for color versus data input.

| Color | Input color data | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-------------|------------------|----|----|----|----|-----|----|----|----|----|-------|----|----|----|----|-----|----|----|----|----|------|----|----|----|----|-----|----|----|----|----|
| | RED | | | | | | | | | | GREEN | | | | | | | | | | BLUE | | | | | | | | | |
| | MSB | | | | | LSB | | | | | MSB | | | | | LSB | | | | | MSB | | | | | LSB | | | | |
| | R9 | R8 | R7 | R6 | R5 | R4 | R3 | R2 | R1 | R0 | G9 | G8 | G7 | G6 | G5 | G4 | G3 | G2 | G1 | G0 | B9 | B8 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
| Basic Color | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(0123) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(1023) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue(1023) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Cyan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Magenta | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Yellow | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | White | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| R | RED(000) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | RED(001) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | RED(1022) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| RED(1023) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| G | Green(000) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Green(001) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Green(1022) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Green(1023) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| B | Blue(000) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Blue(001) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Blue(1022) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | |
| Blue(1023) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | |

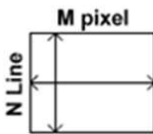
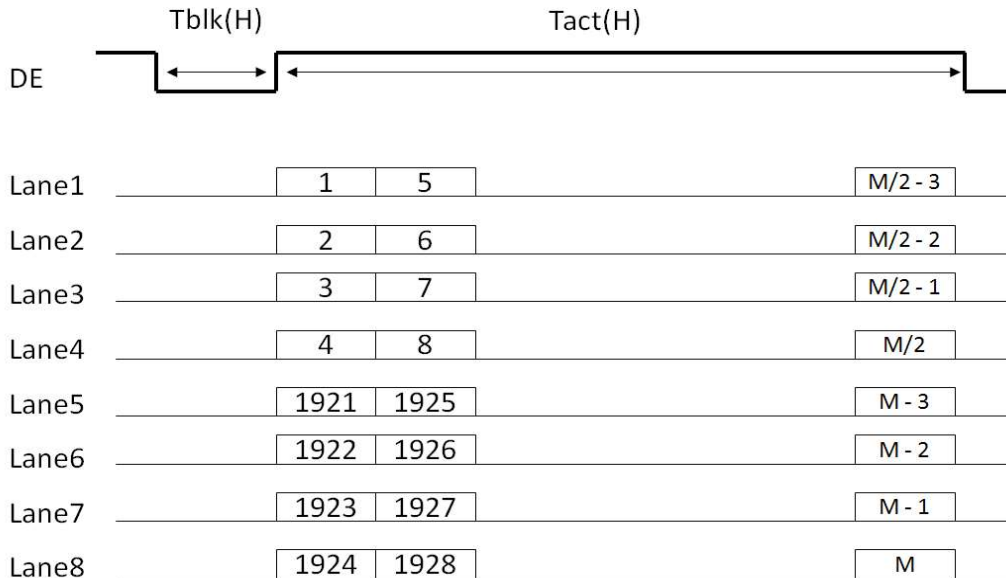
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6.4.2 The Input Data Format(V-by-one)

| Mode | Packer input & Unpacker output | 30bpp RGB /YCbCr444 (10bit) | |
|------------|--------------------------------|-----------------------------|---------|
| 4byte mode | Byte0 | D[0] | R/Cr[2] |
| | | D[1] | R/Cr[3] |
| | | D[2] | R/Cr[4] |
| | | D[3] | R/Cr[5] |
| | | D[4] | R/Cr[6] |
| | | D[5] | R/Cr[7] |
| | | D[6] | R/Cr[8] |
| | | D[7] | R/Cr[9] |
| | Byte1 | D[8] | G/Y[2] |
| | | D[9] | G/Y[3] |
| | | D[10] | G/Y[4] |
| | | D[11] | G/Y[5] |
| | | D[12] | G/Y[6] |
| | | D[13] | G/Y[7] |
| | | D[14] | G/Y[8] |
| | | D[15] | G/Y[9] |
| | Byte2 | D[16] | B/Cb[2] |
| | | D[17] | B/Cb[3] |
| | | D[18] | B/Cb[4] |
| | | D[19] | B/Cb[5] |
| | | D[20] | B/Cb[6] |
| | | D[21] | B/Cb[7] |
| | | D[22] | B/Cb[8] |
| | | D[23] | B/Cb[9] |
| | Byte3 | D[24] | -- |
| | | D[25] | -- |
| | | D[26] | B/Cb[0] |
| | | D[27] | B/Cb[1] |
| | | D[28] | G/Y[0] |
| | | D[29] | G/Y[1] |
| | | D[30] | R/Cr[0] |
| | | D[31] | R/Cr[1] |

6.4.3 Timing Diagram

(Lane1~8 V by One data: 1, 2, 3, 4, 1921, 1922, 1923, 1924)



6.5 V-by-one Specification

6.5.1 Timing Characteristics

| Signal | Item | Symbol | Min | Typ | Max | Unit |
|--------------------|-----------|-------------------------------|-------|-------|-------|------|
| Vertical Section | Period | T_v | 2200 | 2250 | 2260 | Th |
| | Active | $T_{disp(v)}$ | - | 2160 | - | Th |
| | Blanking | $T_{bp(v)}+T_{fp(v)}+PW_{vs}$ | 40 | 90 | 100 | Th |
| Horizontal Section | Period | T_h | 530 | 550 | 580 | Tclk |
| | Active | $T_{disp(h)}$ | - | 480 | - | Tclk |
| | Blanking | $T_{bp(h)}+T_{fp(h)}+PW_{hs}$ | 50 | 70 | 100 | Tclk |
| Clock | Period | T_{clk} | 19.06 | 13.47 | 12.25 | ns |
| | Frequency | Freq. | 55 | 74.25 | 75.49 | MHz |
| Frame Rate | Frequency | $1/T_v$ | 45 | 60 | 61 | Hz |

Note 3-3: The equation is listed as following. Please don't exceed the above recommended value.

$$F_h (\text{Min.}) = F_{clk} (\text{Min.}) / T_h (\text{Min.});$$

$$F_h (\text{Typ.}) = F_{clk} (\text{Typ.}) / T_h (\text{Typ.});$$

$$F_h (\text{Max.}) = F_{clk} (\text{Max.}) / T_h (\text{Min.});$$

Note 3-4: The equation is listed as following. Please don't exceed the above recommended value.

$$F_{clk} (\text{Min.}) = F_v (\text{Min.}) \times T_h (\text{Min.}) \times T_v (\text{Min.});$$

$$F_{clk} (Typ.) = F_v (Typ.) \times T_h (Typ.) \times T_v (Typ.);$$

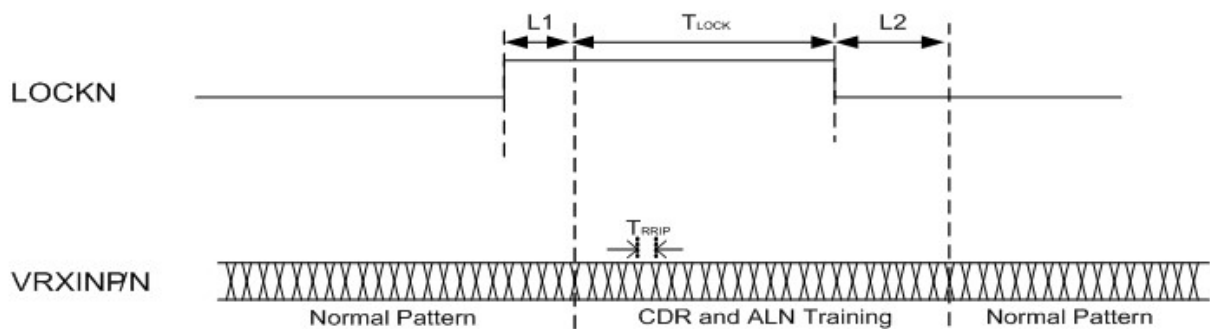
$$F_{clk} (Max.) = F_v (Max.) \times T_h (Typ.) \times T_v (Typ.);$$

6.5.2 V-By-One SPEC

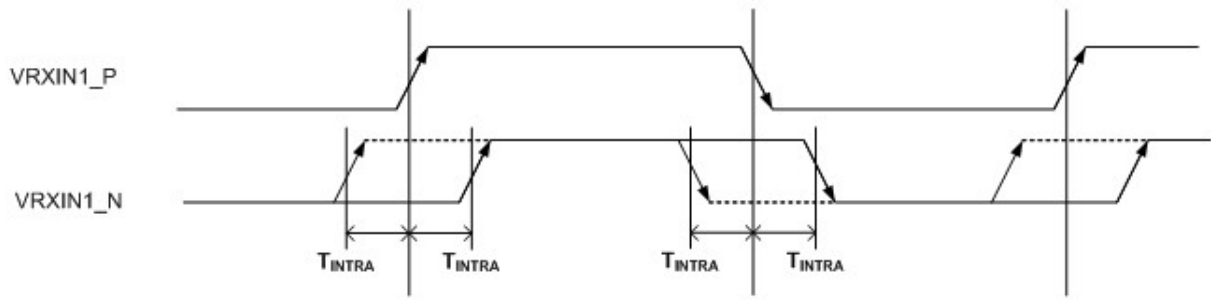
| Item | Symbol | Min. | Typ. | Max | Unit | Note | |
|--------------------|---|--------------------|------|-----|------|------------------|---|
| V-by-one Interface | VRXINP/N input each bit Period | TRRIP | 310 | -- | 379 | ps | 1 |
| | CDR training pattern time | TLOCK | -- | -- | 200 | us | 1 |
| | Latency from LOCKN 'HIGH' to clock training pattern | L1 | 0 | -- | -- | us | 1 |
| | Latency from LOCKN 'LOW' to normal 8b10b data | L2 | -- | -- | 70 | us | 1 |
| | CML Differential Input High Threshold | V _{RTH} | -- | -- | +50 | mV _{DC} | |
| | CML Differential Input Low Threshold | V _{RTL} | -50 | -- | -- | mV _{DC} | |
| | CML Common mode Bias Voltage | V _{RCT} | -0.1 | 0 | +0.1 | mV _{DC} | |
| | Intra-pair skew | T _{INTRA} | -- | -- | 0.3 | UI | 2 |
| | Inter-pair skew | T _{INTER} | -- | -- | 5 | UI | 3 |

Note: The V-By-One receiver spec is compliant to V-By-One HS standard version 1.4.

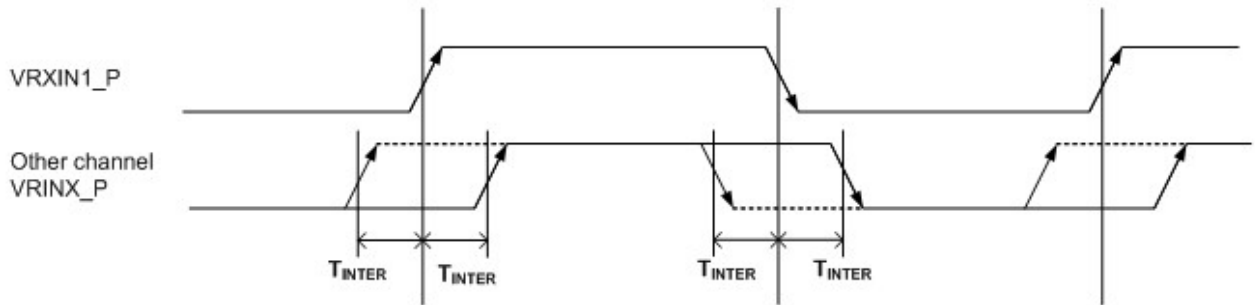
1. V-By-One signal diagram



2. V-By-One intra-pair Skew



3. V-By-One intra-pair Skew



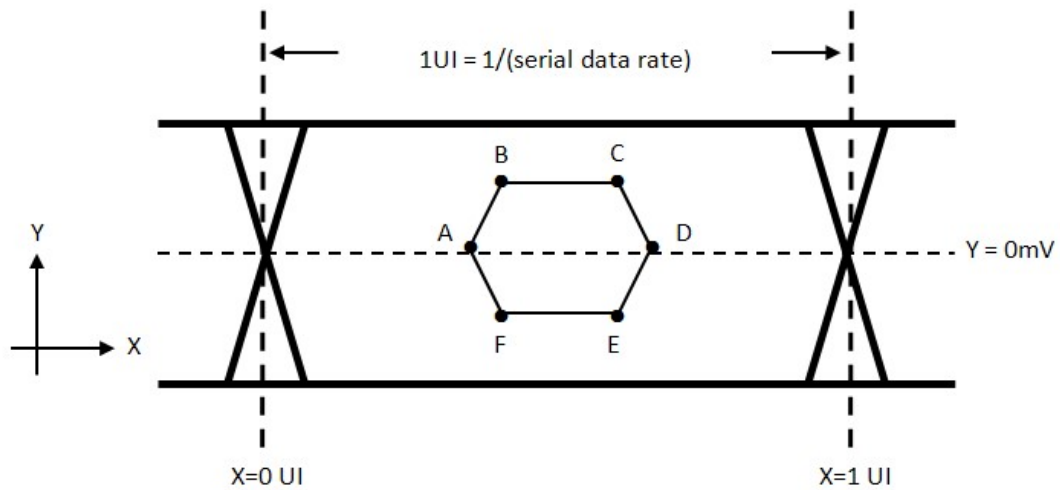
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Use only

6.5.3 V-By-One Eye diagram at receiver

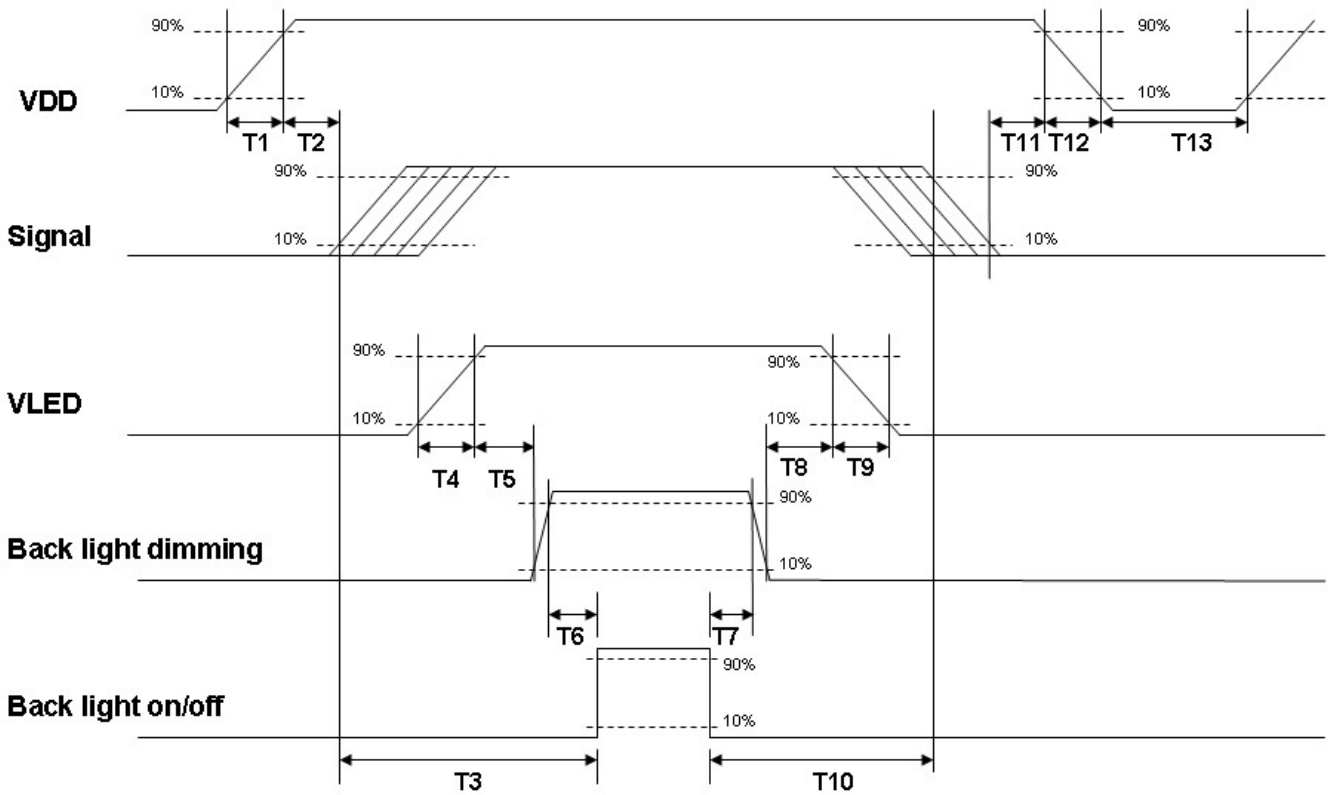
| Item | Symbol | Min. | Typ. | Max | Unit | Note |
|--------------------|--------|------|------|-----|------|------|
| V-by-one Interface | A_X | -- | 0.25 | -- | UI | I. |
| | A_Y | -- | 0 | -- | mV | |
| | B_X | -- | 0.3 | -- | UI | |
| | B_Y | -- | 50 | -- | mV | |
| | C_X | -- | 0.7 | -- | UI | |
| | C_Y | -- | 50 | -- | mV | |
| | D_X | -- | 0.75 | -- | UI | |
| | D_Y | -- | 0 | -- | mV | |
| | E_X | -- | 0.7 | -- | UI | |
| | E_Y | -- | -50 | -- | mV | |
| | F_X | -- | 0.3 | -- | UI | |
| | F_Y | -- | -50 | -- | mV | |

Note I. Eye Mask



6.6 Power ON/OFF Sequence

VDD power and lamp on/off sequence is as below. 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 | 40 | - | ~*1 | [ms] |
| T3 | 200 | - | - | [ms] |
| T4 | 0.5 | - | 10 | [ms] |
| T5 | 10 | - | - | [ms] |
| T6 | 10 | - | ~*2 | [ms] |
| T7 | 0 | - | - | [ms] |
| T8 | 10 | - | - | [ms] |
| T9 | - | - | 10 | [ms] |
| T10 | 110 | - | - | [ms] |
| T11 | 0 | 16 | 50 | [ms] |
| T12 | 0 | - | 10 | [ms] |
| T13 | 1000 | - | - | [ms] |

The above on/off sequence should be applied to avoid abnormal function in the display. Please make sure to turn off the power when you plug the cable into the input connector or pull the cable out of the connector.

7. Reliability Test Criteria

All testing under following setting: VDD 12V, Frame rate: 60Hz

| Items | Required Condition | Note |
|---------------------------------|--|--------|
| Temperature Humidity Bias (Ta) | 50°C/80%,300Hr | |
| High Temperature Operation (Ta) | 50°C, 300Hr | |
| Low Temperature Operation (Ta) | 0 °C, 300Hr | |
| Hot Storage | 60 °C, 300 hours | |
| Cold Storage | -20°C, 300 hours | |
| Thermal Shock Test (Ta) | -20°C /30 min ,60 °C /30 min ,100cycles, 40 °C minimum ramp rate | |
| Shock Test (Non-Operating) | 50G,20ms,Half-sine wave,(+X,+Y,+Z) | |
| Vibration Test (Non-Operating) | 1.0G, 10~300Hz, Random wave 10mins/axis, 3 direction (X, Y, Z) | |
| Altitude Test | Operation : 10,000ft Non-Operation : 30,000ft | |
| ESD | Contact : ± 8KV/ operation, Class B Air : ± 15KV / operation, Class B | Note I |

Note1: According to EN61000-4-2 , ESD class B: Some performance degradation allowed. No data lost

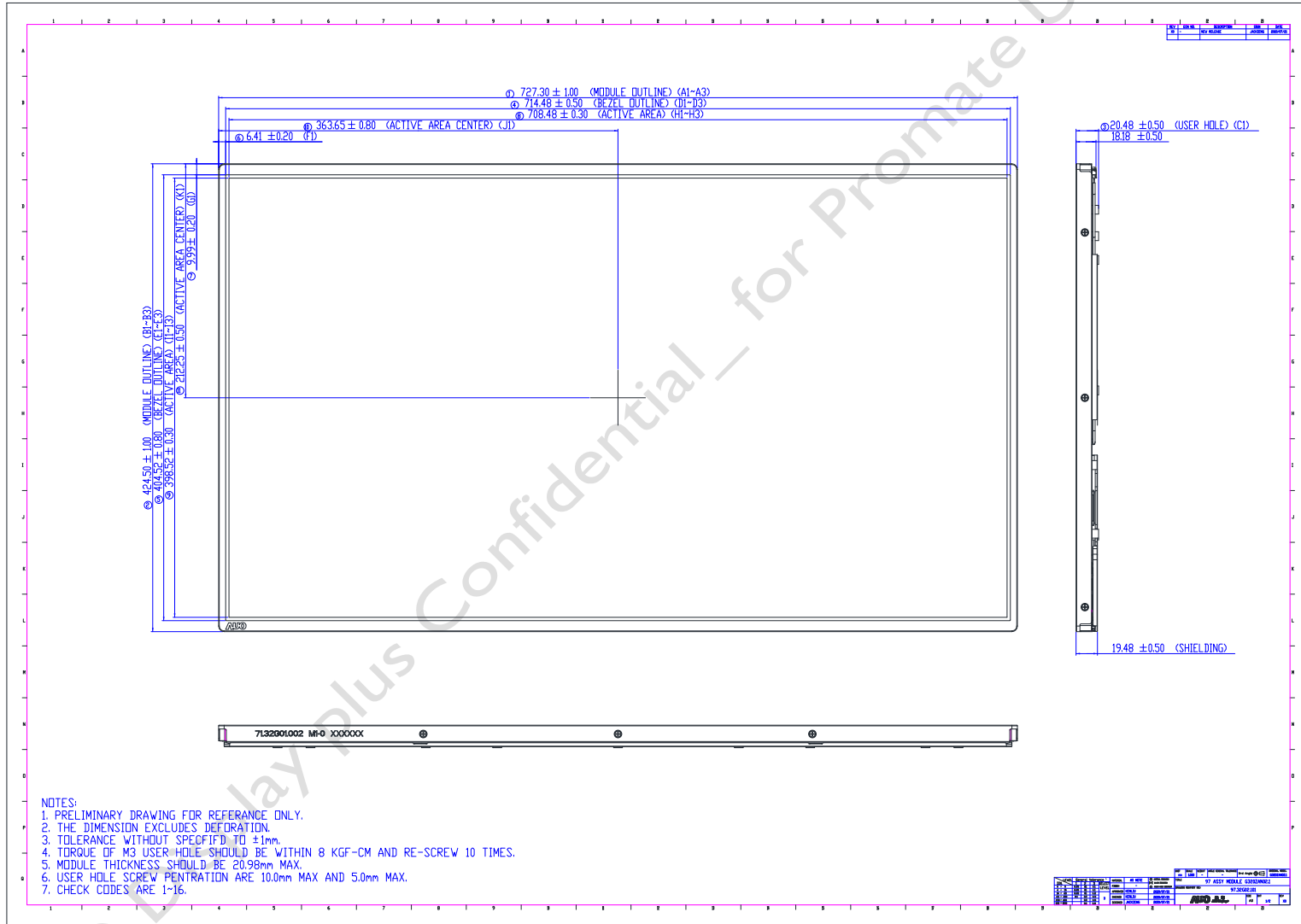
- Self-recoverable. No hardware failures.

Note2:

- 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.

8. Mechanical Characteristics

8.1 LCM Outline Dimension

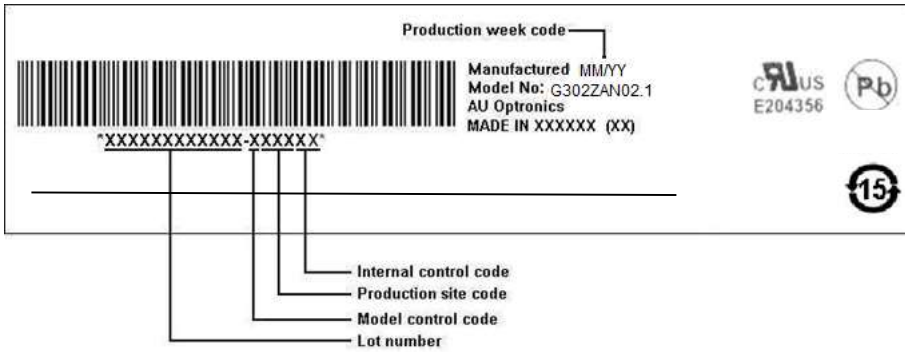


NOTES:

1. PRELIMINARY DRAWING FOR REFERENCE ONLY.
2. THE DIMENSION EXCLUDES DEFORMATION.
3. TOLERANCE WITHOUT SPECIFIED TO $\pm 1\text{mm}$.
4. TORQUE OF M3 USER HOLE SHOULD BE WITHIN 8 KGF-CM AND RE-SCREW 10 TIMES.
5. MODULE THICKNESS SHOULD BE 20.98mm MAX.
6. USER HOLE SCREW PENETRATION ARE 10.0mm MAX AND 5.0mm MAX.
7. CHECK CODES ARE 1-16.

9. Label and Packaging

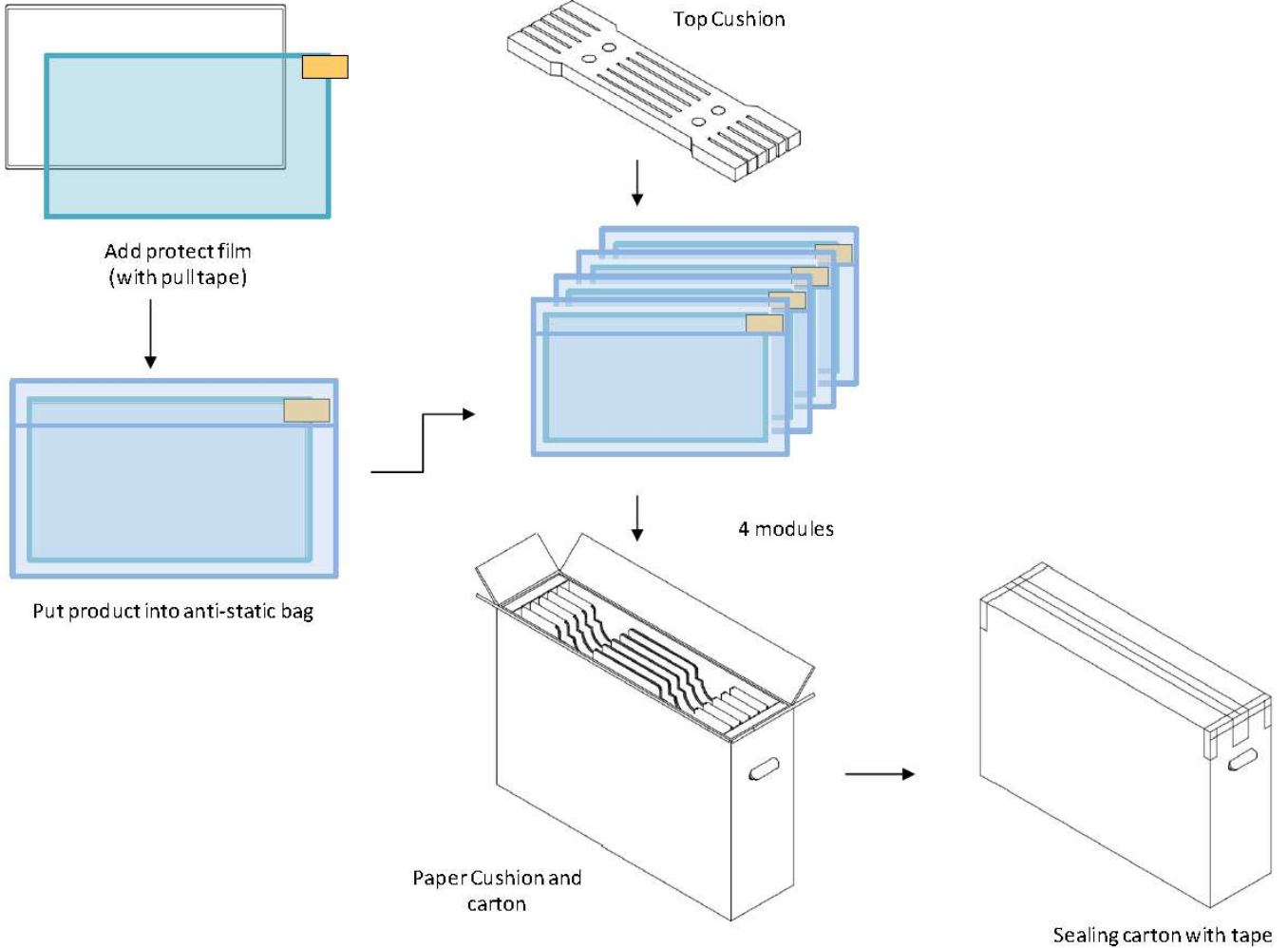
9.1 Shipping Label (on the rear side of TFT-LCD display)



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9.2 Carton Package

1pcs module



Capacity: 4 modules/carton

Weight: 21.5±0.5 kg

Carton Dim.: 820(L)mm* 220(W)mm* 535(H)mm

Pallet Dim.: 1150(L)mm* 840(W)mm* 132(H)mm

Module by air: (1*5)*2 layers, one pallet put 10 boxes, total 40pcs module.

Module by sea: One pallet (1*5)*2 layers + One pallet (1*5)*1 layer, total 60pcs module.

Module by sea (HQ): One pallet (1*5)*2 layers + One pallet (1*5)*2 layers, total 80pcs module



10 Safety

10.1 Sharp Edge Requirements

There will be no sharp edges or comers 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 display module. If toxic materials are used, they will be reviewed and approved by the responsible AUO toxicologist.

10.2.2 Flammability

All components including electrical components that do not meet the flammability grade UL94-VI in the module will complete the flammability rating exception approval process.

The printed circuit board will be made from material rated 94-VI 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 display assembly, provisions will be made to keep them from being inserted backwards.

10.4 National Test Lab Requirement

The display module will satisfy all requirements for compliance to:
UL 60950-1 second edition U.S.A. Information Technology Equipment