

AU OPTRONICS CORPORATION

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Tentative

Module Specification for 10,4" TFT-LCD MODULES

Model Name: B104SN01

| Approved by | Checked by | Prepared by |
|-------------|------------|-------------|
| | | |

Quality Management Division / AU Optronics Corporation

| Customer | Checked & Approved by |
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A. Physical specifications

| NO. | Item | Specification | Remark |
|-----|---------------------------|----------------------------------|--------|
| 1 | Display resolution(pixel) | 800(H)× 600(V) | |
| 2 | Active area(mm) | 211.2(H)× 158.4(V) | |
| 3 | Screen size(inch) | 10.4(Diagonal) | |
| 4 | Pixel pitch(mm) | 0.264(H)× 0.264(V) | |
| 5 | Color configuration | R. G. B. Vertical stripe | |
| 6 | Overall dimension(mm) | 236(W)× 174.3(H)× 5.7(D) (Max) | Note 1 |
| 7 | Weight(g) | 285± 10 | |

Note 1: Refer to Fig. 1.

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B. Electrical specifications

1.Pin assignment

(1).Input signal interface

| Pin no | Symbol | Function | Etc. |
|--------|-----------------|--------------------------------|------|
| 1 | V _{CC} | +3.3 V power supply | |
| 2 | V _{CC} | +3.3 V power supply | |
| 3 | GND | Ground | |
| 4 | GND | Ground | |
| 5 | RxIN0- | LVDS receiver signal channel 0 | |
| 6 | RxIN0+ | | |
| 7 | GND | Ground | |
| 8 | RxIN1- | LVDS receiver signal channel 1 | |
| 9 | RxIN1+ | | |
| 10 | GND | Ground | |
| 11 | RxIN2- | LVDS receiver signal channel 2 | |
| 12 | RxIN2+ | | |
| 13 | GND | Ground | |
| 14 | CKIN- | LVDS receiver signal clock | |
| 15 | CKIN+ | | |
| 16 | GND | Ground | |
| 17 | NC | No Connection | |
| 18 | NC | No Connection | |
| 19 | GND | Ground | |
| 20 | GND | Ground | |

CN1 (20P) connector : HRS DF 19K-20P-1H or Compatible

(2) LVDS transmitter/receiver signal mapping

| | Symbol | Function | |
|---------|--------|------------------|--------------------------|
| TxIN0 | R0 | Red data (LSB) | 6 bit red display data |
| TxIN1 | R1 | Red data | |
| TxIN2 | R2 | Red data | |
| TxIN3 | R3 | Red data | |
| TxIN4 | R4 | Red data | |
| TxIN5 | R5 | Red data (MSB) | |
| TxIN6 | G0 | Green data (LSB) | 6 bit green display data |
| TxIN7 | G1 | Green data | |
| TxIN8 | G2 | Green data | |
| TxIN9 | G3 | Green data | |
| TxIN10 | G4 | Green data | |
| TxIN11 | G5 | Green data (MSB) | |
| TxIN12 | B0 | Blue data (LSB) | 6 bits blue display data |
| TxIN13 | B1 | Blue data | |
| TxIN14 | B2 | Blue data | |
| TxIN15 | B3 | Blue data | |
| TxIN16 | B4 | Blue data | |
| TxIN17 | B5 | Blue data (MSB) | |
| TxIN18 | Hs | Horizontal sync | |
| TxIN19 | Vs | Vertical sync | |
| TxIN20 | DE | Data enable | |
| TxCLKIN | CLK | Clock | Dot clock |

2. Absolute maximum ratings

(GND = 0 V)

| Parameter | Symbol | Values | | Unit | Remark |
|-----------------------|----------|--------|--------------|----------|---------|
| | | Min. | Max. | | |
| Power voltage | V_{CC} | -0.3 | 4 | V_{DC} | At 25°C |
| Input signal voltage | V_{LH} | -0.3 | $V_{CC}+0.3$ | V_{DC} | At 25°C |
| Operating temperature | Top | -10 | +60 | °C | Note 1 |
| Storage temperature | T_{ST} | -20 | +70 | °C | Note 1 |

Note 1: The relative humidity must not exceed 90% non-condensing at temperatures of 40°C or less. At temperatures greater than 40°C, the wet bulb temperature must not exceed 39°C. When operate at low temperatures, the brightness of CCFL will drop and the life time of CCFL will be reduced.

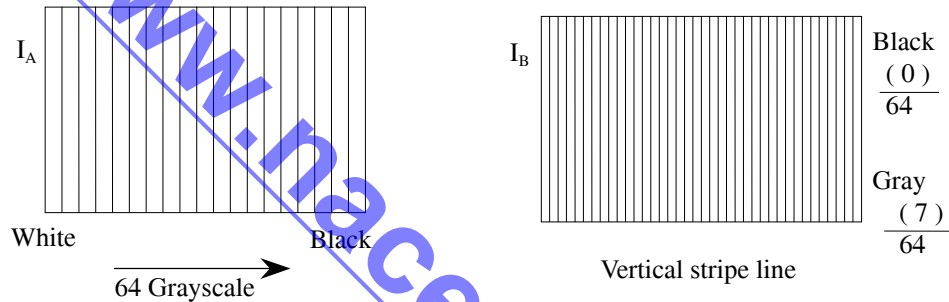
Note 2: The unit should not be exposed to corrosive chemicals.

3. Electrical characteristics

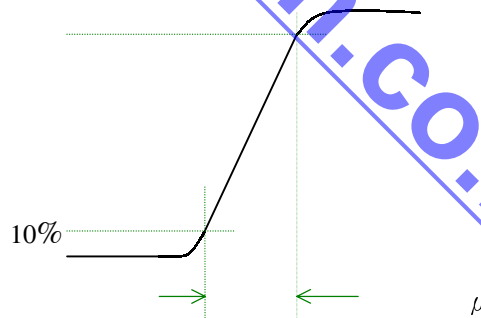
a. Typical operating conditions

| | Item | Symbol | Min. | Typ. | Max. | Unit | Remark |
|----------------------|----------------------|------------|--------------|------|--------------|--------|--------|
| Power supply voltage | Input voltage | V_{CC} | 3.0 | 3.3 | 3.6 | V | |
| | Current consumption | I_A | | 310 | | mArms | Note 1 |
| | | I_B | | | 330 |  |  | mArms |
| | Inrush current | I_{RUSH} | - | - | 1500 | mApeak | Note 2 |
| Internal logic | Low voltage | V_{IL} | 0 | - | $0.3 V_{CC}$ | | |
| | High voltage | V_{IH} | $0.7 V_{CC}$ | - | V_{CC} | | |
| | Power ripple voltage | V_{RP} | - | - | 100 | mVp-p | |

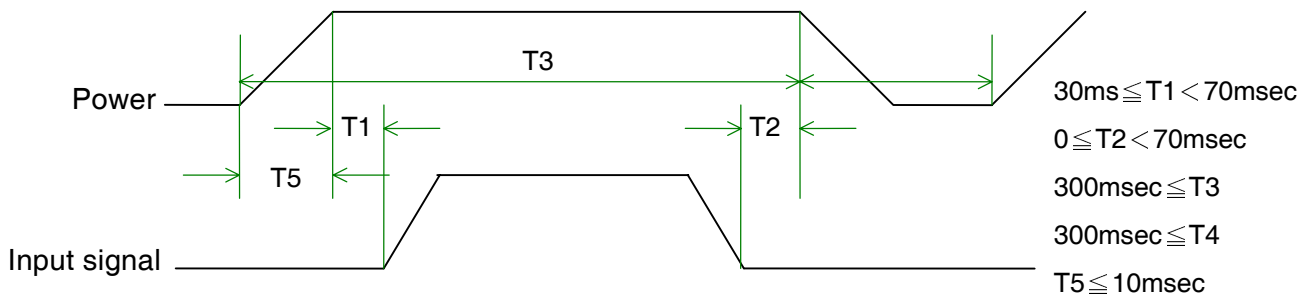
Note 1: Effective value (mArms) at $V_{CC} = 3.3 V/25^{\circ}C$.



Note 2: Refer to the following power-on condition.



Sequence of Power-on/off and signal-on/off



Apply the lamp voltage within the LCD operating range. When the backlight turns on before the LCD operation or the LCD turns off before the backlight turns off, the display may momentarily become abnormal.

Caution

The above on/off sequence should be applied to avoid abnormal function in the display.

In case of handling:

Make sure to turn off the power when you plug the cable into the input connector or pull the cable out of the connector.

b. Display color v.s. input data signals

| Display colors | | Data signal (0 : Low level, 1: High level) | | | | | | | | | | | | | | | | | |
|-----------------|---------|--|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| | | R5 | R4 | R3 | R2 | R1 | R0 | G5 | G4 | G3 | G2 | G1 | G0 | B5 | B4 | B3 | B2 | B1 | B0 |
| Basic colors | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Red | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Magenta | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Green | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Cyan | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Yellow | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 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 |
| Red grayscale | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Dark | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ↕ | | | | | | | | | | | | | | | | | | |
| | bright | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Green grayscale | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ↕ | | | | | | | | | | | | | | | | | | |
| | bright | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blue grayscale | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | ↕ | | | | | | | | | | | | | | | | | | |
| | bright | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 |
| | Blue | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |

Note : Each basic color can be displayed in 64 gray scales using the 6 bit data signals. By combining the 18-bit data signals(R,G,B), the 262, 144 colors can be achieved on the display.

c. Input signal timing

Timing diagrams of input signal are shown in Fig 2.

(1). Timing characteristics of input signals

(a) DE mode

| Item | Symbol | Min. | Typ. | Max. | Unit | Remark |
|---------------------|--------|------|------|------|------|--------|
| Clock frequency | Fck | 38 | 40 | 42 | MHz | |
| Horizontal blanking | Thb1 | 50 | 256 | 500 | Clk | |
| Vertical blanking | Tvb1 | 10 | 28 | 150 | Th | |

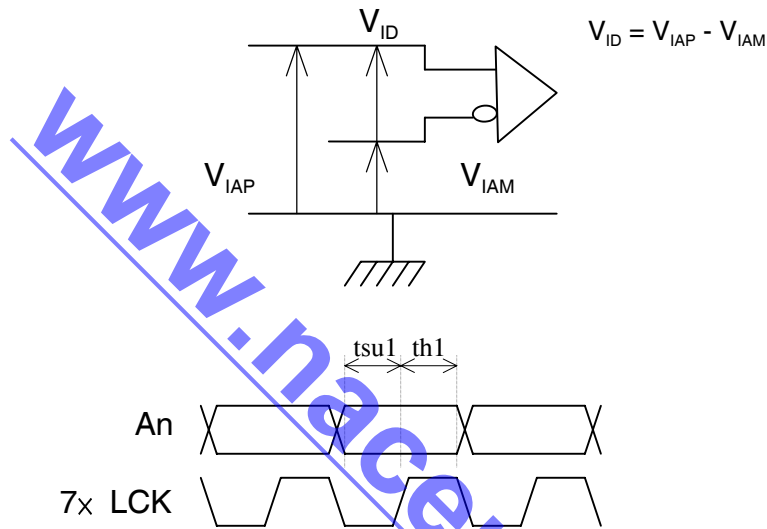
(b) HV mode

| Item | Symbol | Min. | Typ. | Max. | Unit | Remark |
|-------------------------|--------|------|------|------|------|--------|
| Clock frequency | Fck | 38 | 40 | 48 | MHz | |
| Hsync period | Th | 850 | 1056 | 1300 | Clk | |
| Hsync pulse width | Thw | 10 | 128 | - | Clk | |
| Hsync front porch | Thf | 15 | 40 | - | Clk | |
| Hsync back porch | Thb | 10 | 88 | - | Clk | |
| Hsync blanking | Thb1 | 50 | 256 | 500 | Clk | |
| Vsync period | Tv | 610 | 628 | 750 | Th | |
| Vsync pulse width | Tvw | 1 | 4 | - | Th | |
| Vsync front porch | Tvf | 0 | 1 | - | Th | |
| Vsync blanking | Tvb1 | 10 | 28 | 150 | Th | |
| Hsync/Vsync phase shift | Tvpd | 2 | 320 | - | Clk | |

| Item | Symbol | Value | Unit | Description |
|--------------------------|--------|-------|------|--|
| Horizontal display start | The | 218 | Clk | After falling edge of Hsync, counting 218clk, then getting valid data from 219th clk's data. |
| Vertical display start | Tve | 25 | Th | After falling edge of Vsync, counting 25 Th, then getting 26 th Th's data. |

(2). The timing condition of LVDS

| Item | Symbol | Min. | Typ. | Max. | Unit |
|-------------------------------|--------|-------------------|------|-------------------------|------|
| The differential level | \| VID \| | 0.1 | - | 0.6 | V |
| The common mode input voltage | VIC | $\frac{ VID }{2}$ | - | $2.4 - \frac{ VID }{2}$ | V |
| The input setup time | tsu1 | 500 | - | - | ps |
| The input hold time | th1 | 500 | - | - | ps |



d. Display position

| | | | | | | |
|------------|------------|-------|------------|-------|--------------|--------------|
| D(1,1) | D(2,1 ) | ..... | D(X,1 ) | ..... | D(799,1) | D(800,1) |
| D(1,2) | D(2,2 ) | ..... | D(X,2 ) | ..... | D(799,2) | D(800,2) |
| ⋮ | | | ⋮ | | ⋮ | ⋮ |
| D(1,Y) | D(2,Y ) | ..... | D(X,Y ) | ..... | D(799,Y) | D(800,Y) |
| ⋮ | | | ⋮ | | ⋮ | ⋮ |
| D(1,599) | D(2,599 ) | ..... | D(X,599 ) | ..... | D(799,599) | D(800,599) |
| D(1,600) | D(2,600 ) | ..... | D(X,600 ) | ..... | D(799,600) | D(800,600) |

e.Backlight driving conditions

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Remark |
|-----------------------|--------|-------|------|------|-------|-----------|
| Lamp voltage | V_L | - | 488 | - | Vrms | Note 1 |
| Lamp current | I_L | - | 4.3 | - | mArms | Note 1 |
| Power consumption | P_L | - | 2.1 | - | W | Note 2 |
| Lamp starting voltage | V_s | | TBD | | Vrms | T=0°C |
| | | | TBD | | | T=25°C |
| Frequency | F_L | - | 60 | - | KHz | Note 3 |
| Lamp life time | L_L | 10000 | - | - | Hr | Note 1, 4 |

Note 1: T= 25°C, $I_L = 4.3$

Note 2: Inverter should be designed with the characteristic of lamp. When you are designing the inverter, the output voltage of the inverter should comply with the following conditions.

- (1).The area under the positive and negative cycles of the waveform of the lamp current and lamp voltage should be area symmetric(the symmetric ratio should be larger than 90%).
- (2).There should not be any spikes in the waveform.
- (3).The waveform should be sine wave as possible.
- (4).Lamp current should not exceed the maximum value within the operating temperature (It is prohibited to over the maximum lamp current even if operated in the non-guaranteed temperature). When lamp current over the maximum value for a long time, it may cause fire. Therefore, it is recommend that the inverter should have the current limiter circuit.

Note 3: Lamp frequency may produce interference with horizontal synchronous frequency and this may cause line flow on the display. Therefore lamp frequency shall be detached from the horizontal synchronous frequency and its harmonics as far as possible in order to avoid interference. In case using the inverter by PWM control, PWM frequency may interference with frame frequency. We suggest that PWM frequency is same as frame frequency.

Note 4: Brightness to be decrease to the 50% of the initial value.

Note 5: CN2 connector(backlight): JST BHSR-02VS-1

Mating connector: JST SM02B-BHSS-1-TB

| Pin no. | Symbol | Function | Remark |
|---------|--------|-------------------------|--------------------|
| 1 | H | CCFL power supply(H.V.) | Cable color: Pink |
| 2 | L | CCFL power supply(GND) | Cable color: White |

C. Optical specifications (Note 1, Note 2, Note 3)

| Item | Symbol | Condition | Specification | | | Unit | Remark |
|---|------------|--------------------|----------------------|----------------------|------------------|------|----------|
| | | | Min. | Typ. | Max. | | |
| Response time Rising time Falling time | Tr Tf | $\theta = 0^\circ$ | - - - | 20 30 - | 40 50 - | ms | Note 4 |
| Contrast ratio | CR | $\theta = 0^\circ$ | 150 | 250 | - | | Note 5 |
| Viewing angle Top Bottom Left Right | | $CR \geq 10$ | 10 30 40 40 | 15 35 45 45 | - - - - | deg. | Note 8 |
| Brightness | Y_L | $\theta = 0^\circ$ | 130 | 150 | - | nit | Note 6,7 |
| Color chromaticity(CIE) | Wx | $\theta = 0^\circ$ | - | (0.31) | - | | |
| | Wy | | - | (0.33) | - | | |
| | Rx | | - | - | - | | |
| | Ry | | - | - | - | | |
| | Gx | | - | - | - | | |
| | Gy | | - | - | - | | |
| | Bx | | - | - | - | | |
| | By | | - | - | - | | |
| White uniformity | δ_w | | - | - | 1.8 | | Note 9 |

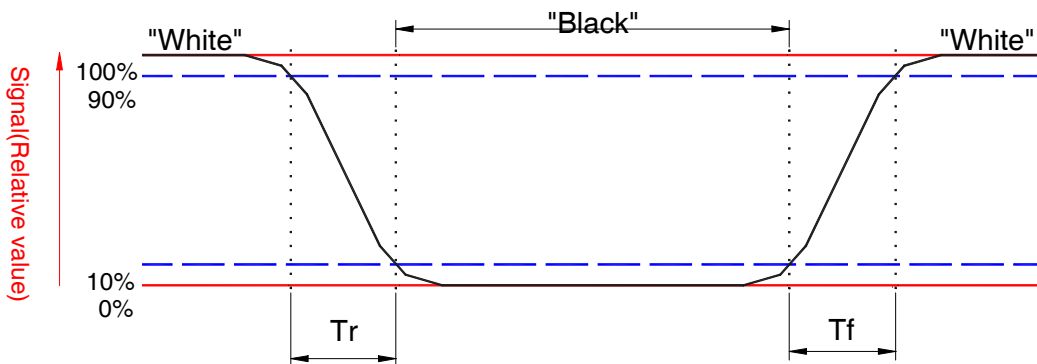
Note 1: Ambient temperature = 25°C.

Note 2: To be measured in dark room after backlight warm up 30 minutes.

Note 3: To be measured with a viewing cone of 1° by Topcon luminance meter BM-5A.

Note 4: Definition of response time:

The output signals of photodetector 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 5. Definition of contrast ratio:

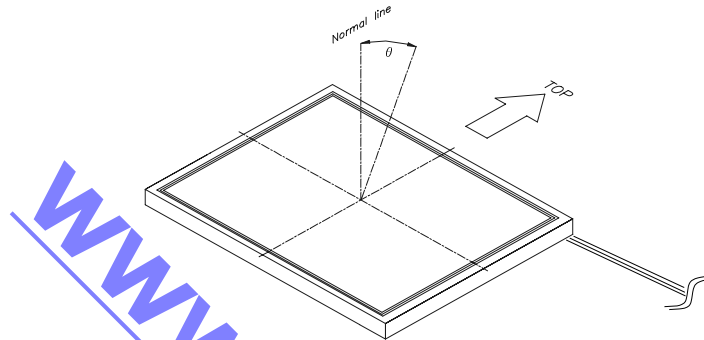
Contrast ratio is calculated with the following formula.

$$\text{Contrast ratio (CR)} = \frac{\text{Photodetector output when LCD is at "White" state}}{\text{Photodetector output when LCD is at "Black" state}}$$

Note 6: Definition of brightness: This shall be measured at center of the screen.

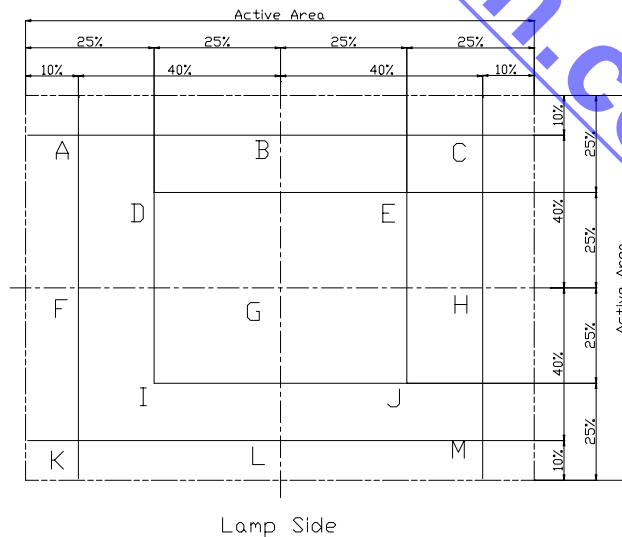
Note 7: Driving conditions for CCFL : $I_L=4.3 \text{ mA}$, 60KHz Frequency

Note 8: Definition of viewing angle:



Note 9: Definition of white uniformity:

White uniformity is defined as the following with thirteen measurements (A-M)



$$\delta_w = \frac{\text{Maximum Luminance of thirteen points (brightness)}}{\text{Minimum Luminance of thirteen points (brightness)}}$$

D. Reliability test items(Note 1)

| Test tem | Test Condition | judgement | Remark |
|--|---|---|-----------|
| High temperature storage | 70°C, 240Hrs | 1.Function OK 2.No serious image quality degradation | Note 1, 2 |
| Low temperature storage | -20°C, 240Hrs | 1.Function OK 2.No serious image quality degradation | Note 1, 2 |
| High temperature & high humidity operation | 40°C, 90%RH, 240Hrs (No condensation) | 1.Function OK 2.No serious image quality degradation | Note 1, 2 |
| High temperature operation | 60°C, 240Hrs | 1.Function OK 2.No serious image quality degradation | Note 1, 2 |
| Low temperature operation | -10°C, 240Hrs | 1.Function OK 2.No serious image quality degradation | Note 1, 2 |
| Temperature cycling (non-operation) | -20°C~70°C 1H, 10mins, 1H, 5cycles | 1.Function OK 2.No serious image quality degradation | Note 1, 2 |
| Electrostatic discharge (non-operation) | 150 pF,150Ω,10kV,1 second, 9 position on the panel, 10 times each place | 1.Function OK 2.No serious image quality degradation | |
| Vibration (non-operation) | Sweep:1G, 10Hz~ 500Hz~ 10Hz/2.5min 2 hour for each direction X, Y, Z (6 Hrs in total) | 1.Function OK 2.No serious image quality degradation | Note 1, 2 |
| Mechanical shock (non-operation) | (50G, 11ms), ± X, ± Y, ± Z once for each direction | 1.Function OK 2.No serious image quality degradtion | Note 1, 2 |

Note 1: Evaluation should be tested after storage at room temperature for one hour.

Note 2: There should be no change which might affect the practical display function when the display quality test is conducted under normal operating condition.

E. Display quality

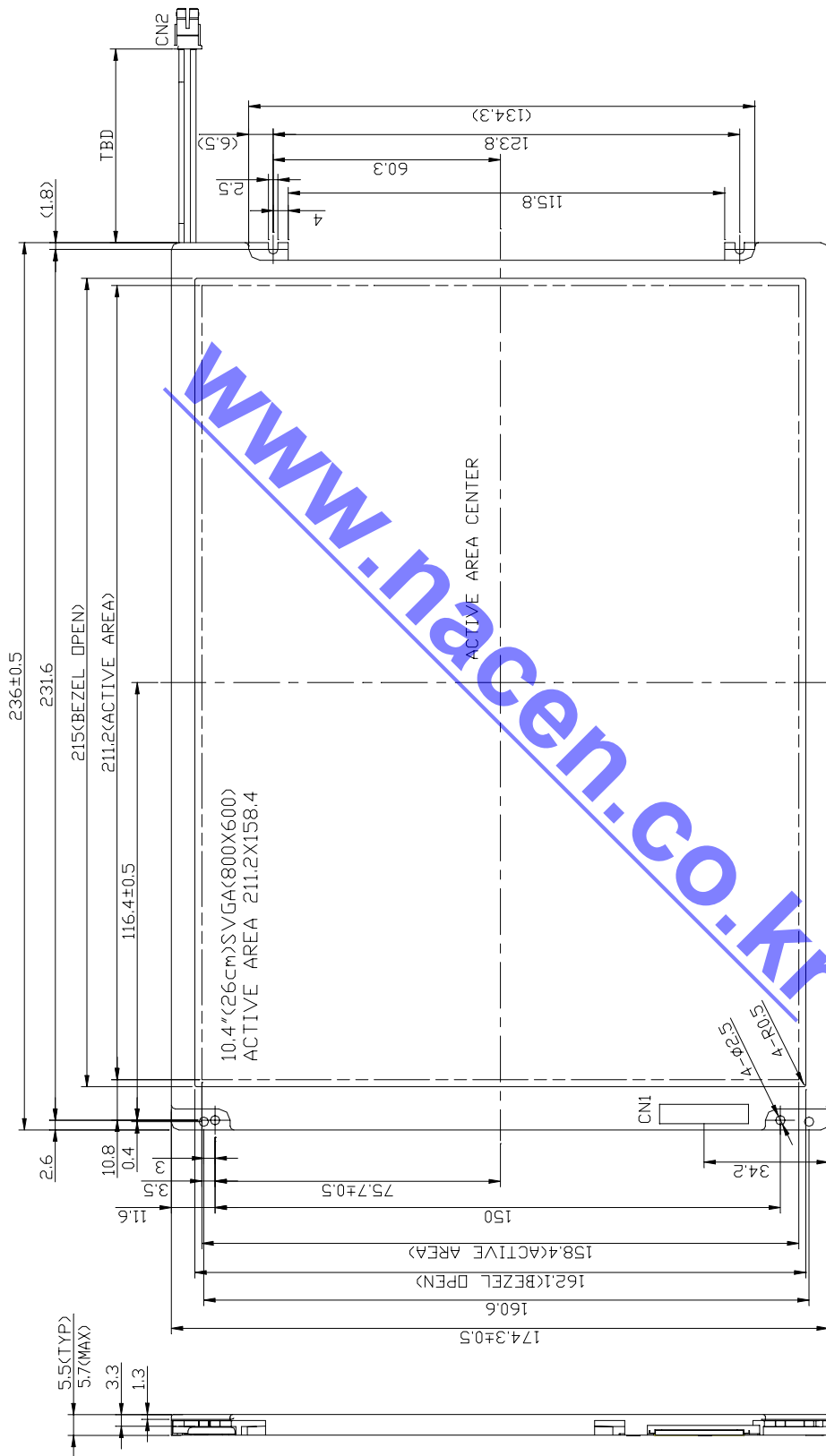
The display quality of the color TFT-LCD module should be in compliance with the AU Optronics OQC inspection standard.

F. Handling precaution

The Handling of the TFT-LCD should be in compliance with the AU Optronics handling principle standard.

G. Packing form :TBD

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CN1(20P) connector:HRS DF 19K-20P-1H or compatible
 CN2(backlight)connector:JST BHSR-02VS-1
 Mating connector:JST SM02B-BHSS-1-TB

Fig.1 LCM outline dimensions

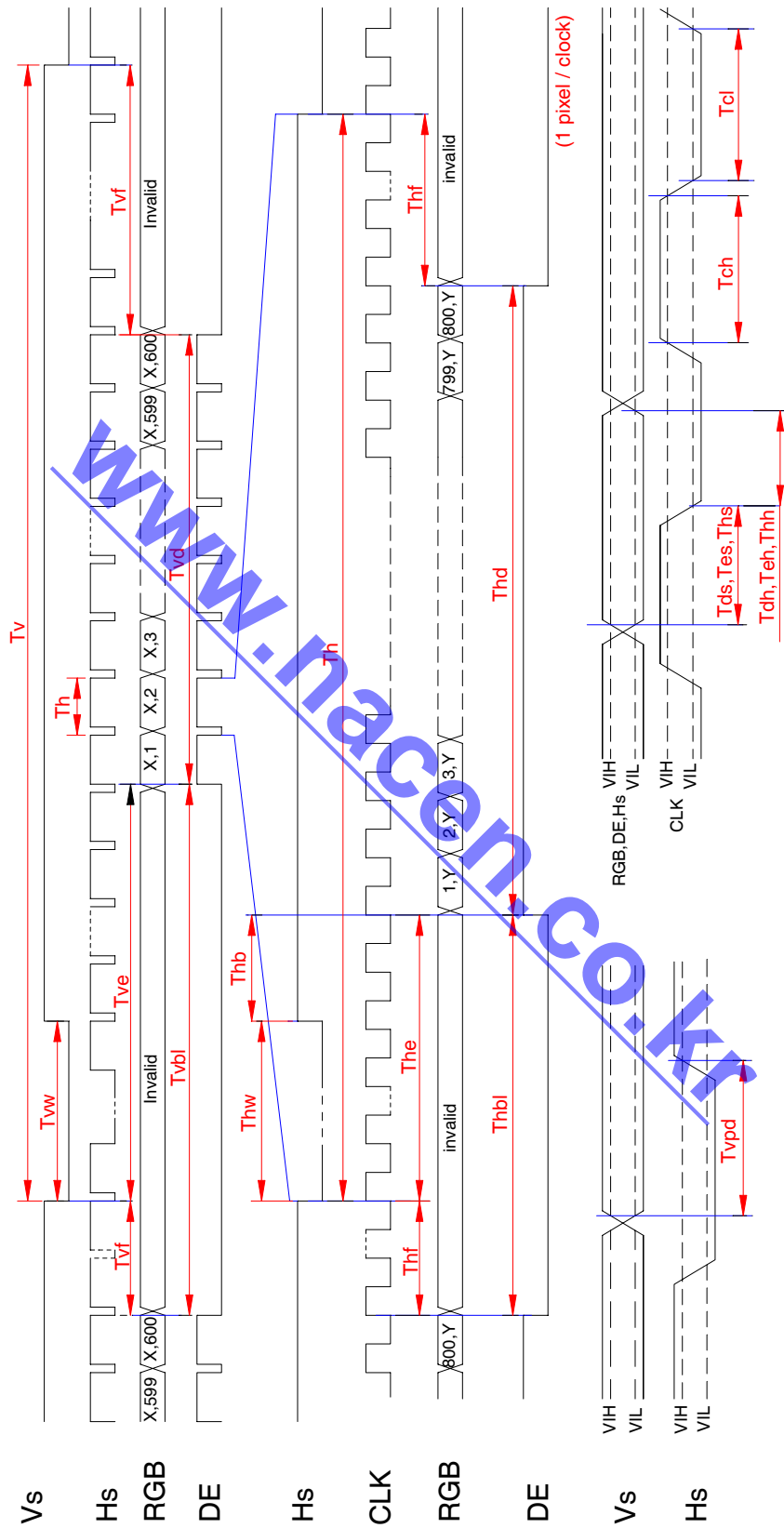


Fig.2 Timing chart