



Chunghwa Picture Tubes, Ltd.

Technical Specification

To:

Date : 2000/6/28

CPT TFT-LCD

MODEL NO : CLAA150XA03

ACCEPTED BY:

V1.1

| APPROVED BY | CHECKED BY | PREPARED BY |
|-------------|------------|------------------------------------|
| | | TFT-LCD Plant Application Dept. |

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REVISION STATUS

| Revision Notice | Description | Rev. Date |
|-----------------|---|-----------|
| * | First revision | |
| * | 3. ELECTRICAL CHARACTERISTICS Power Supply Current for LCD $I_{cc}=400\text{mA (typ)} \rightarrow 350\text{mA (typ)}$ 5. INTERFACE TIMING DENA $t_{WDL}=4t_{CLK} \rightarrow 6t_{CLK}$, $t_{HBP}=4t_{CLK} \rightarrow 6t_{CLK}$, $t_{VBP}=4t_H \rightarrow 6t_{CLK}$ | 2000/2/1 |
| | | |
| | | |

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1. OVERVIEW

CLAA150XA03 is 15.0" color TFT-LCD (Thin Film Transistor Liquid Crystal Display) module composed of LCD panel, driver ICs, control circuit and backlight.

By applying 8 bit digital data, 1024×768, 16.7M-color images are displayed on the 15.0" diagonal screen. Input power voltage is 5.0V for LCD driving.

Interface of data and control signals is Typ. 32.5MHz digital. 2 pixel data are transmitted per cycle. General specifications are summarized in the following table:

| ITEM | SPECIFICATION |
|--------------------------------|--|
| Display Area(mm) | 304.1(H)×228.1(V) (15.0-inch diagonal) |
| Number of Pixels | 1024(H)×768(V) |
| Pixel Pitch(mm) | 0.297(H)×0.297(V) |
| Color Pixel Arrangement | RGB vertical strip |
| Display Mode | normally white TN |
| Number of Colors | 16.7M(8bits/color) |
| Brightness(cd/m ²) | 200(cd/m ²)(Typ.) |
| Viewing Angle | -60~60(H),-55~45(V)(Typ.) |
| Wide Viewing Angle Technology | Optical Compensation Film |
| Surface Treatment | Anti-glare |
| Electrical Interface | CMOS(VIN=3~5V,2 pixel/clock) |
| Total Module Power(w) | 11.0(Typ.) |
| Optimum Viewing Angle | 6 o'clock |
| Module Size(mm) | 350.0(W)×266.5(H)×14.5(D) |
| Module Weight(g) | 1300 |
| Backlight Unit | 2 replaceable CCFLs edge-light(top/bottom) |

The LCD Products listed on this document are not suitable for use of aerospace equipment, submarine cables, nuclear reactor control system and life support systems. If customers intend to use these LCD products for above application or not listed in "Standard" as follows, please contact our sales people in advance.

Standard: Computer, Office equipment, Communication equipment, Test and Measurement equipment, Machine tool, Industrial robot, Audio and Visual equipment, Other consumer products.

2. ABSOLUTE MAXIMUM RATINGS

| ITEM | SYMBOL | MIN. | MAX. | UNIT |
|------------------------------|------------------|-----------------|------|------|
| Power Supply Voltage for LCD | VCC | 0 | 7.0 | V |
| Logic input Voltage | High | V _{IH} | 6.1 | V |
| | Low | V _{IL} | -0.5 | V |
| Operation Temperature *1) | Top | 0 | 50 | °C |
| Storage Temperature *1) | T _{stg} | -20 | 60 | °C |

[Note]:

*1) Humidity

Relative Humidity ≤ 95% (T_a ≤ 40°C)

Wet Bulb Temperature ≤ 39°C (T_a ≥ 40°C)

3. ELECTRICAL CHARACTERISTICS

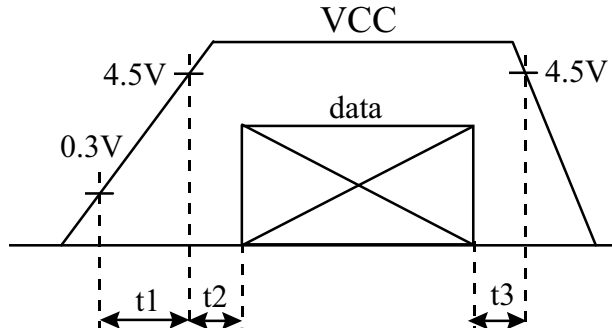
(a) TFT-LCD

| ITEM | SYMBOL | MIN | TYP | MAX | UNIT | Remark |
|----------------------------------|--------|-----------------|-----|-------|-------|-----------------------|
| Power Supply Voltage for LCD | VCC | 4.5 | 5.0 | 5.5 | V | Note1 |
| Power Supply Current for LCD | ICC | - | 350 | (680) | mA | Note2 |
| Permissible Input Ripple Voltage | VRP | - | - | 100 | mVp-p | V _{cc} =5.0V |
| Input Threshold Voltage | High | V _{TH} | 2.2 | 3.3 | V | |
| | Low | V _{TL} | 0 | - | 0.8 | V |

[Note 1]

VCC-turn-on conditions:

- $t1 \leq 10 \text{ ms}$
- $0 < t2 \leq 10 \text{ ms}$
- $0 < t3 \leq 30 \text{ ms}$



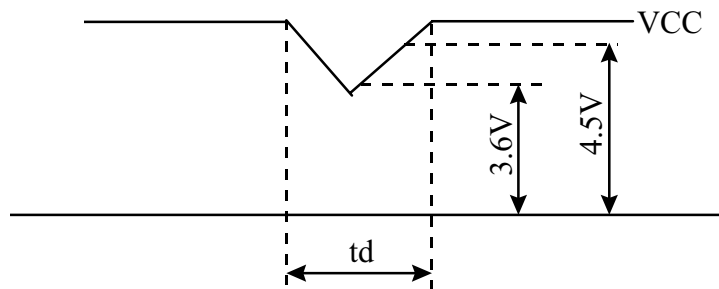
VCC-dip conditions

- 1) When $3.6\text{V} \leq \text{VCC} < 4.5\text{V}$

$t_d \leq 10 \text{ ms}$

- 2) $\text{VCC} < 3.6\text{V}$

VCC-dip conditions should also follow the VCC-turn-on conditions.

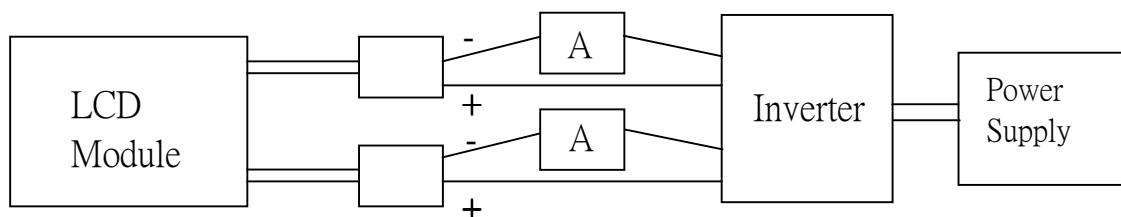


[Note 2] Typical current situation : 256-gray-bar pattern, 768 line mode, $\text{VCC} = +5.0\text{V}$

(b) Backlight

| ITEM | SYMBOL | MIN | TYP | MAX | UNIT | REMARK |
|-----------------------|--------|-------|-----|-----|------|-------------------------------------|
| Lamp Voltage | VL | - | 625 | - | V | IL=7.0mA |
| Lamp Current | IL | 5.0 | 7.0 | 8.5 | mA | Note1 |
| Interter Frequency | FI | 30 | 40 | 50 | kHz | |
| Starting Lamp Voltage | VS | 1700 | - | - | V | Ta=0°C |
| | | 1500 | - | - | V | Ta=25°C |
| Lamp life Time | LT | 25000 | - | - | hr | IL=7.0Ma Continuous Operation |

[Note 1] Lamp Current measurement method (The current meter is inserted in cold line)



4. INTERFACE PIN CONNECTION

(a) CN1(Data Signal and Power Supply)

Used connector:IL-FHR45S-HF(JAE)

| Pin No | Symbol | Function |
|--------|--------|---|
| 1 | GND | |
| 2 | CLK | Dot clock |
| 3 | GND | |
| 4 | DENA | Data enable |
| 5 | GND | |
| 6 | VD | Vertical sync |
| 7 | GND | |
| 8 | HD | Horizontal sync |
| 9 | GND | |
| 10 | NC | (HMS) |
| 11 | GND | |
| 12 | BO7 | Blue odd data(MSB) |
| 13 | BO6 | Blue odd data |
| 14 | BO5 | Blue odd data |
| 15 | BO4 | Blue odd data |
| 16 | GND | |
| 17 | BO3 | Blue odd data |
| 18 | BO2 | Blue odd data |
| 19 | BO1 | Blue odd data |
| 20 | BO0 | Blue odd data(LSB) |
| 21 | GND | |
| 22 | GO7 | Green odd data(MSB) |
| 23 | GO6 | Green odd data |
| 24 | GO5 | Green odd data |
| 25 | GO4 | Green odd data |
| 26 | GND | |
| 27 | GO3 | Green odd data |
| 28 | GO2 | Green odd data |
| 29 | GO1 | Green odd data |
| 30 | GO0 | Green odd data(LSB) |
| 31 | GND | |
| 32 | RO7 | Red odd data(MSB) |
| 33 | RO6 | Red odd data |
| 34 | RO5 | Red odd data |
| 35 | RO4 | Red odd data |
| 36 | GND | |
| 37 | RO3 | Red odd data |
| 38 | RO2 | Red odd data |
| 39 | RO1 | Red odd data |
| 40 | RO0 | Red odd data(LSB) |
| 41 | VCC | |
| 42 | VCC | |
| 43 | TEST | Should be open during operation(Internal test only) |
| 44 | TEST | Should be open during operation(Internal test only) |
| 45 | TEST | Should be open during operation(Internal test only) |

(b) CN2(Data Signal)

Used connector:IL-FHR-30S-HF(JAE)

| Pin No. | Symbol | Function |
|---------|--------|----------------------|
| 1 | GND | |
| 2 | BE7 | Blue even data(MSB) |
| 3 | BE6 | Blue even data |
| 4 | BE5 | Blue even data |
| 5 | BE4 | Blue even data |
| 6 | GND | |
| 7 | BE3 | Blue even data |
| 8 | BE2 | Blue even data |
| 9 | BE1 | Blue even data |
| 10 | BE0 | Blue even data(LSB) |
| 11 | GND | |
| 12 | GE7 | Green even data(MSB) |
| 13 | GE6 | Green even data |
| 14 | GE5 | Green even data |
| 15 | GE4 | Green even data |
| 16 | GND | |
| 17 | GE3 | Green even data |
| 18 | GE2 | Green even data |
| 19 | GE1 | Green even data |
| 20 | GE0 | Green even data(LSB) |
| 21 | GND | |
| 22 | RE7 | Red even data(MSB) |
| 23 | RE6 | Red even data |
| 24 | RE5 | Red even data |
| 25 | RE4 | Red even data |
| 26 | GND | |
| 27 | RE3 | Red even data |
| 28 | RE2 | Red even data |
| 29 | RE1 | Red even data |
| 30 | RE0 | Red even data(LSB) |

(c)CN3,4(BACKLIGHT)

Backlight-side connector: BHR-03VS-1(JST)

Inverter-side connector: SM02(8.0)B-BHS-1(JST)

| Pin No. | Symbol | Function |
|---------|--------|--------------------|
| 1 | CTH | VBLH(High voltage) |
| 3 | CTL | VBLH(High voltage) |

[Note] : VBLH-VBLL = VL

5. INTERFACE TIMING

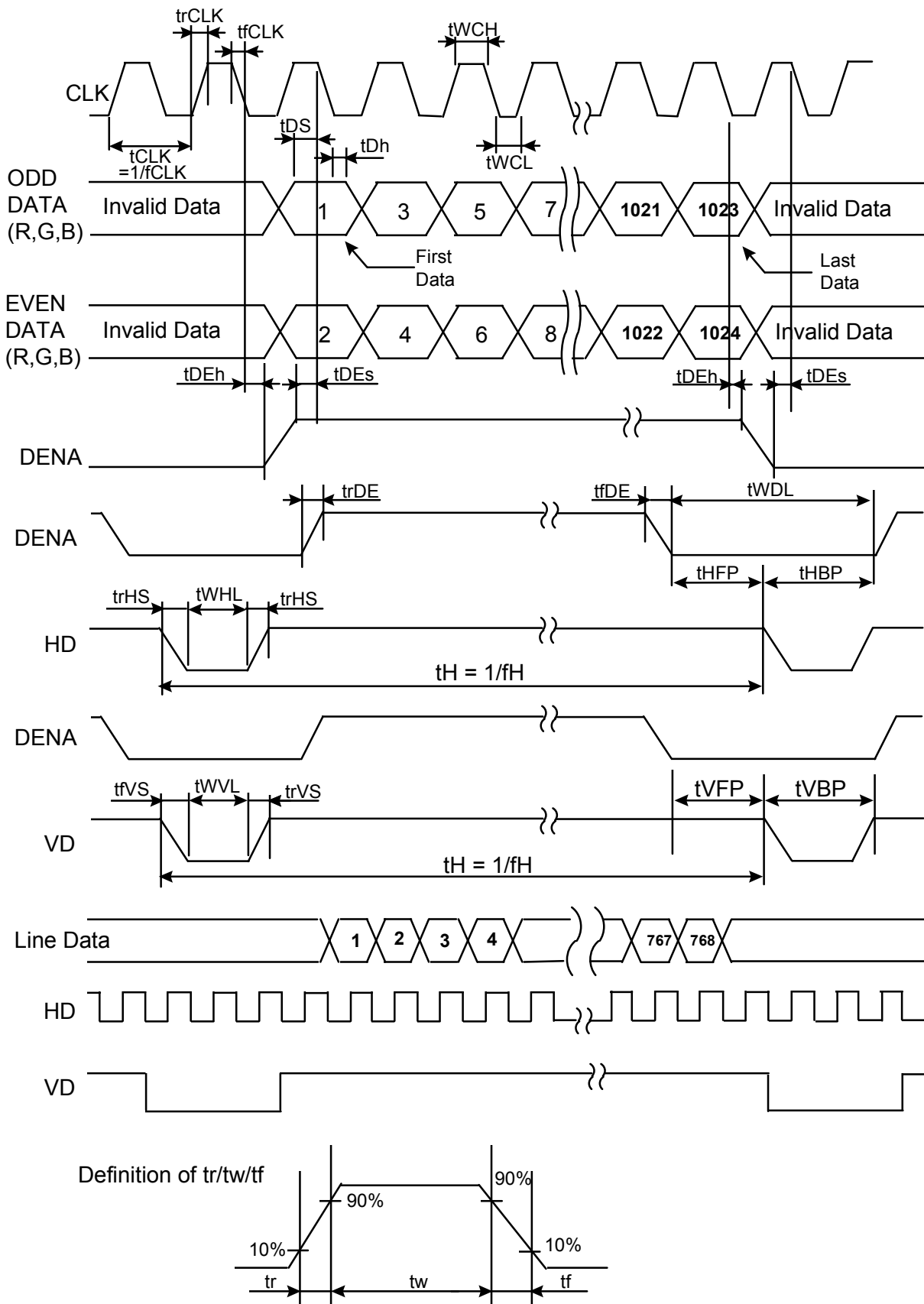
(a) Timing Specifications :

| | ITEM | SYMBOL | MIN | TYP | MAX | UNIT |
|----------------------------|------------------------|--------|------|------|------|------|
| DCLK *1)*4) | Frequency | fCLK | 30 | 32.5 | 40 | MHz |
| | Period | tCLK | 25.0 | 30.8 | 33.3 | ns |
| | Low Width | tWCL | 0.3 | 0.5 | 0.7 | tCLK |
| | High Width | tWCH | 0.3 | 0.5 | 0.7 | tCLK |
| | Rise Time | tr | - | - | 5 | ns |
| | Fall Time | tf | - | - | 5 | ns |
| DATA(R,G,B,DE NA,HD,VD) | Set up Time | tDs | 2.3 | - | - | ns |
| | Hold Time | tDh | 7.3 | - | - | ns |
| | Rise Time | tr | - | - | 5 | ns |
| | Fall Time | tf | - | - | 5 | ns |
| DENA *3) | Low width | tWDL | 6 | - | - | tCLK |
| | Horizontal Front Porch | tHFP | 0 | - | - | tCLK |
| | Horizontal Back Porch | tHBP | 6 | - | - | tCLK |
| | Vertical Front Porch | tVFP | 0 | - | - | tH |
| | Vertical Back Porch | tVBP | 6 | - | - | tH |
| HD *2) *4) | Frequency | fH | - | 48.4 | 62.5 | kHz |
| | Period | tH | 16 | 20.7 | - | us |
| | Low width | tWHL | 1 | - | - | tCLK |
| VD *2) | Frequency | fV | 55 | 60 | 75 | Hz |
| | Period | tV | 13.3 | 16.7 | 18.2 | ms |
| | Low width | tWVL | 1 | - | - | tH |

[Note] :

- 1) Data is latched at fall edge of DCLK in this specification.
- 2) Polarities of HD and VD are negative in this specification.
- 3) DENA(Data Enable) should always be positive polarity as shown in the timing specification.
- 4) DCLK should appear during all blanking period, and HD should appear during blanking period of frame cycle.

(b)Timing Chart :



(c)Color Data Assignment :

| COLOR | INPUT DATA | R DATA | | | | | | | | G DATA | | | | | | | | B DATA | | | | | | | |
|-------------|------------|-----------|----|----|----|----|----|----|-----------|-----------|----|----|----|----|----|----|-----------|-----------|----|----|----|----|----|----|-----------|
| | | R7 MSB | R6 | R5 | R4 | R3 | R2 | R1 | R0 LSB | G7 MSB | G6 | G5 | G4 | G3 | G2 | G1 | G0 LSB | B7 MSB | B6 | B5 | B4 | B3 | B2 | B1 | B0 LSB |
| 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 |
| | RED(255) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | GREEN(255) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | BLUE(255) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| | CYAN | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| | MAGENTA | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| | YELLOW | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 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 | |
| RED | RED(0) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | RED(1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | RED(2) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | |
| | RED(254) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | RED(255) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| GREEN | GREEN(0) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | GREEN(1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | GREEN(2) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | |
| | GREEN(254) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | GREEN(255) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| BLUE | BLUE(0) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | BLUE(1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | |
| | BLUE(2) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | |
| | BLUE(254) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | | |
| | BLUE(255) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | |

[Note] :

(1)Definition of gray scale:

Color(n) : n indicates gray scale level.

Higher n means brighter level.

(2)Data:1-High,0-Low.

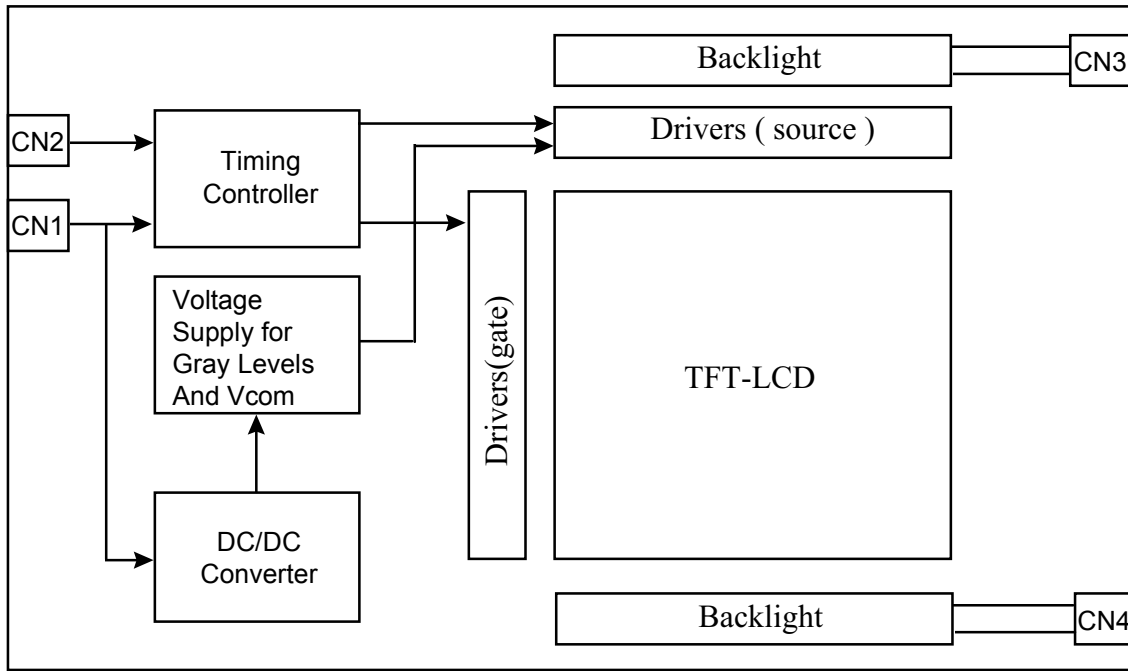
(3)This assignment is applied to both odd and even data.

(d)Color Data Assignment :

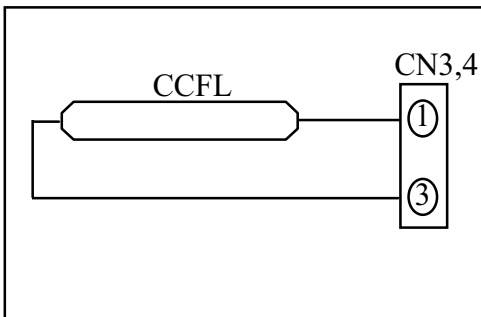
| | | | | | | |
|----------|----------|----|----------|----|-------------|-------------|
| D(1,1) | D(2,1) | .. | D(X,1) | .. | D(1023,1) | D(1024,1) |
| D(1,2) | D(2,2) | .. | D(X,2) | .. | D(1023,2) | D(1024,2) |
| .. | .. | + | .. | + | .. | .. |
| D(1,Y) | D(2,Y) | .. | D(X,Y) | .. | D(1023,Y) | D(1024,Y) |
| .. | .. | + | .. | + | .. | .. |
| D(1,767) | D(2,767) | .. | D(X,767) | .. | D(1023,767) | D(1024,767) |
| D(1,768) | D(2,768) | .. | D(X,768) | .. | D(1023,768) | D(1024,768) |

6. BLOCK DIAGRAM

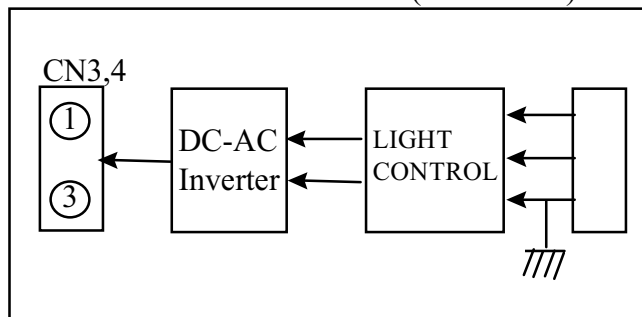
TFT-LCD Module



BACK LIGHT

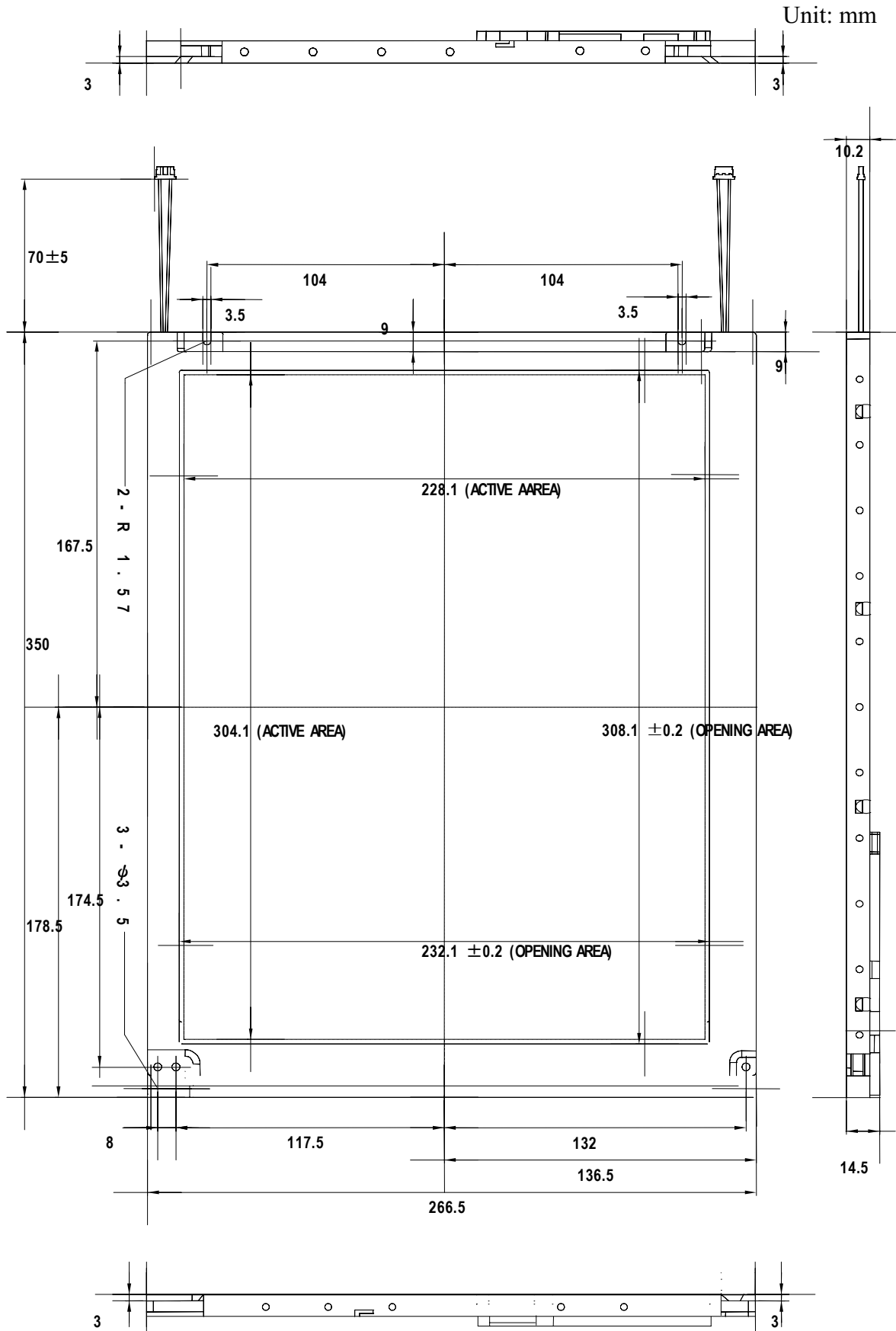


INVERTER CIRCUIT (OUT SIDE)



7. MECHANICAL SPECIFICATION

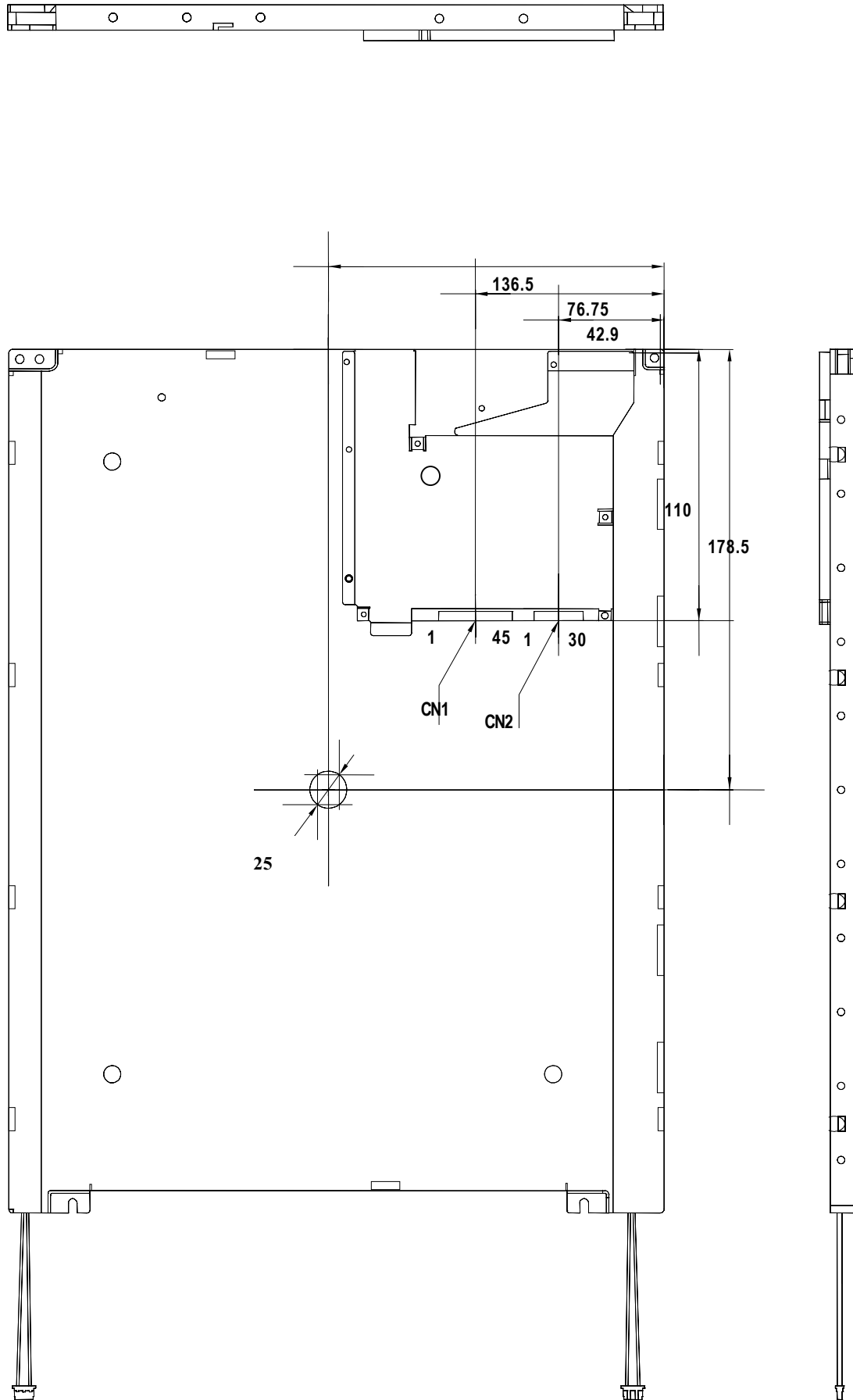
(a) Front side



Tolerance is ± 0.5 mm unless noted

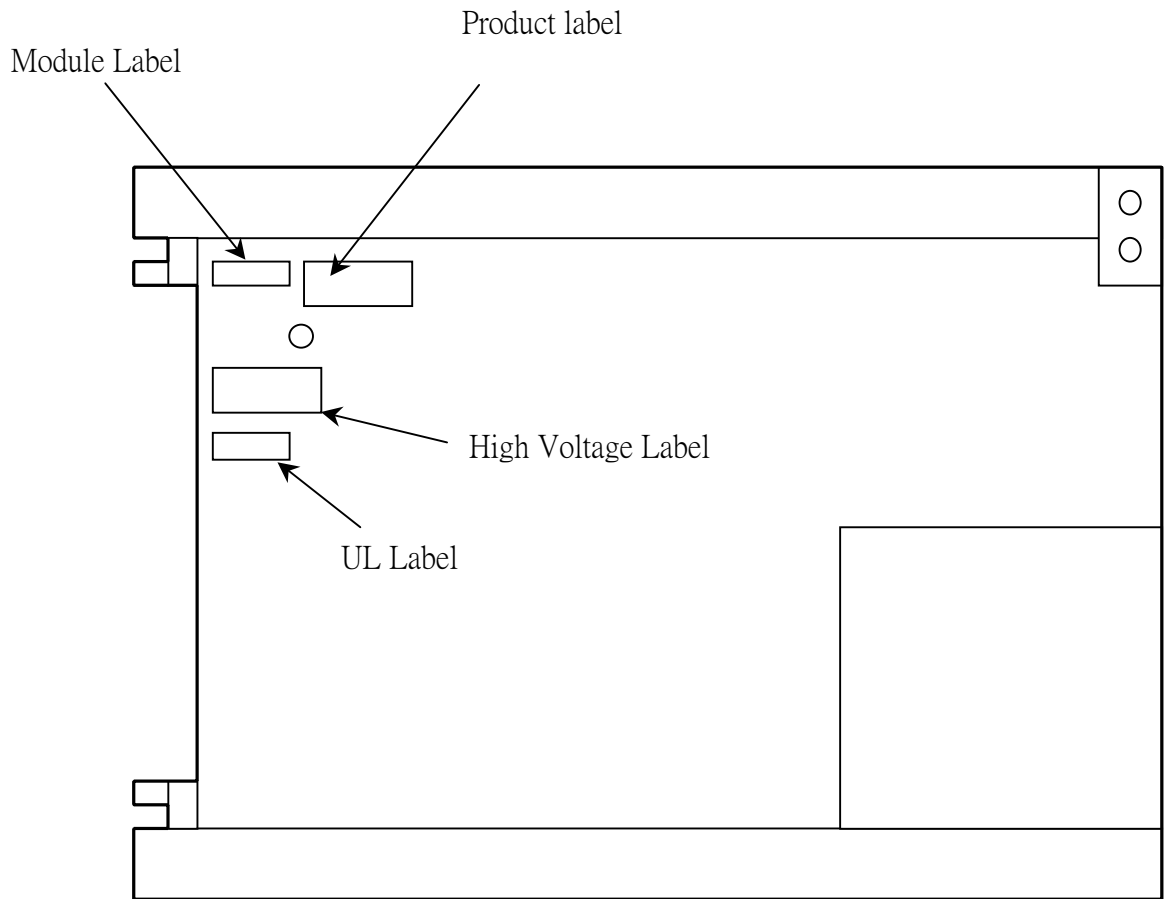
(b) Rear side

Unit: mm

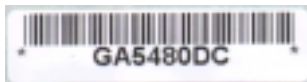


Tolerance is ± 0.5 mm unless noted

(c)Label position :



Modula Label :



Product Label :



High Voltage Label :



UL Label :



CTAAXXXX for UL apply, other safety apply use CLAAXXXX.

8.OPTICAL CHARACTERISTICS

Ta=25°C, VCC=5.0V

| ITEM | SYMBOL | CONDITION | MIN. | TYP. | MAX. | UNIT |
|-------------------|------------|------------------------------|--------|--------|-------|-------------------|
| Contrast Ratio | CR | $\varphi = \theta = 0^\circ$ | (200) | 350 | - | - |
| Luminance | Normal | $\varphi = \theta = 0^\circ$ | 160 | 200 | 250 | cd/m ² |
| | Uniformity | ΔL | - | - | 30 | % |
| Response Time | tr | $\varphi = \theta = 0^\circ$ | - | 13 | - | ms |
| | tf | $\varphi = \theta = 0^\circ$ | - | 27 | - | ms |
| Viewing Angle | Horizontal | $CR \geq 10$ | -50~50 | -60~60 | - | ° |
| | Vertical | | -45~40 | -55~45 | - | ° |
| Image sticking | tis | 2 hours | - | - | 2 | s |
| Color Coordinates | Red | x | 0.567 | 0.597 | 0.627 | - |
| | | y | 0.313 | 0.343 | 0.373 | |
| | Green | x | 0.286 | 0.316 | 0.346 | |
| | | y | 0.536 | 0.566 | 0.596 | |
| | Blue | x | 0.123 | 0.153 | 0.183 | |
| | | y | 0.101 | 0.131 | 0.161 | |
| | White | x | 0.280 | 0.310 | 0.340 | |
| | | y | 0.298 | 0.328 | 0.358 | |

These items are measured using BM-5A(TOPCON) OR LCD-7000 (Otsuka Electronic) under the dark room condition(no ambient light).

*) Condition: IL=7.0mA, Inverter frequency: 40kHz.

Definition of these measurement items are as follows:

(a)Definition of Contrast Ratio

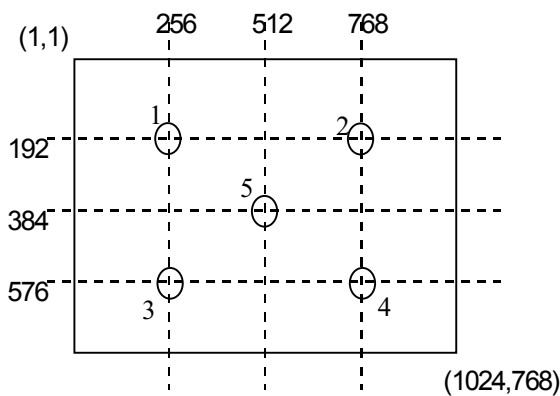
$$CR = \text{ON(White)Luminance} / \text{OFF(Black)Luminance}$$

(b)Definition of Luminance and Luminance uniformity :

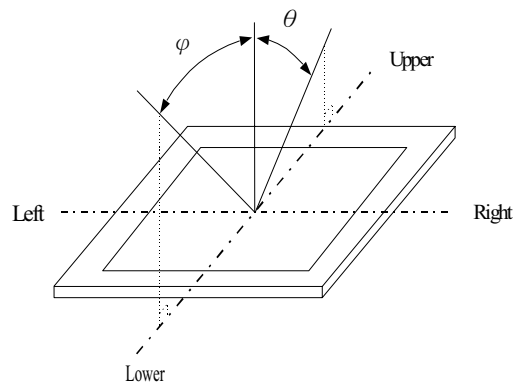
$$L = [L_{(MAX)} / L_{(MIN)} - 1] \times 100$$

Measure White Luminance on the below 5 points

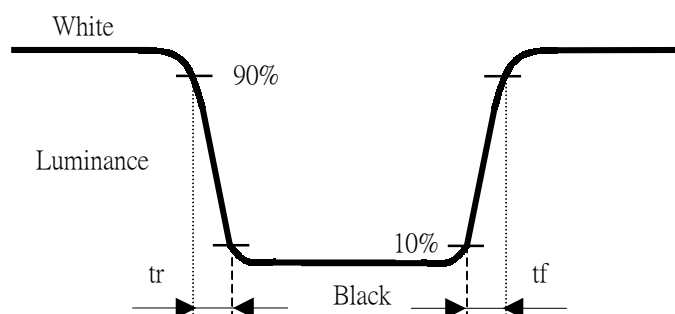
MEASUREMENT POINTS



(c)Definition of Viewing Angle(θ, ψ)

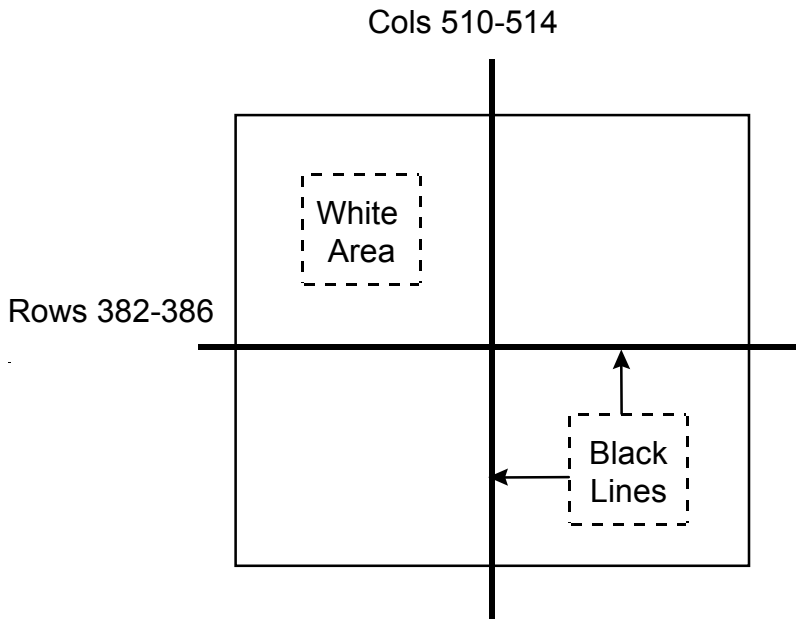


(d)Definition of Response Time



(e) Image sticking:

Continuously display the test pattern shown in the figure below for two-hours. Then display a completely white screen. The previous image shall not persist more than two seconds at 25°C.

TEST PATTERN FOR IMAGE STICKING TEST**9.RELIABILITY TEST CONDITIONS**

(a) Temperature and Humidity

| ITEM | CONDITION |
|---|--|
| HIGH TEMPERATURE HIGH HUMIDITY OPERATION | 40°C,95%RH,240h (No condensation) |
| HIGH TEMPERATURE OPERATION | 50°C,240h |
| LOW TEMPERATURE STORAGE | -20°C,240h |
| THERMAL SHOCK | BETWEEN -20°C (1hr)AND 60°C (1hr),5 CYCLES |
| HIGH TEMPERATURE STORAGE | 60°C,240h |
| LOW TEMPERATURE OPERATION | 0°C,240h |

(b) Shock & Vibration

| ITEM | CONDITION |
|------------------------------|--|
| SHOCK (NON-OPERATION) | Shock level:980m/s ² (100G) Waveform: half sinusoidal wave, 2ms Number of shocks: one shock input in each direction of three mutually perpendicular axes for a total of six shock inputs |
| VIBRATION (NON-OPERATION) | Vibration level: 9.8m/s ² (1.0G) zero to peak Waveform: sinusoidal Frequency range: 5 to 500 Hz Frequency sweep rate: 0.5 octave/min Duration: one sweep from 5 to 500 to 5 Hz in each of three mutually perpendicular axis(each x,y,z axis: 1 hour, total 3 hours) |

(c) Judgment standard

The judgment of the above test should be made as follow:

Pass : Normal display image with no obvious non-uniformity and no line defect.

Partial transformation of the module parts should be ignored.

Fail : No display image, obvious non-uniformity, or line defects.

10.INSPECTION STANDARDS

(a) Scope

This Incoming Inspection Standard shall be applied to TFT-LCD modules (hereinafter called the “LCMs”) supplied by CPT (hereinafter called the “Supplier”)to Customer.

(b) Incoming Inspection Right

The Customer shall have the right to conduct at its own cost and expense. an incoming inspection of the LCMs at the destination specified in the relevant B/L(Bills of Lading) in accordance with the LCM’s specifications separately agreed upon and the inspection criteria set forth in this article.

The Customer shall notify the Supplier in written of the inspection Standard within 40 days from the date of the B/L.

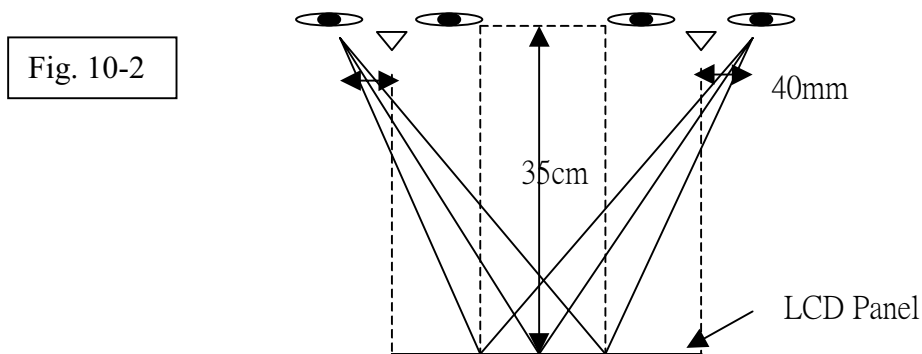
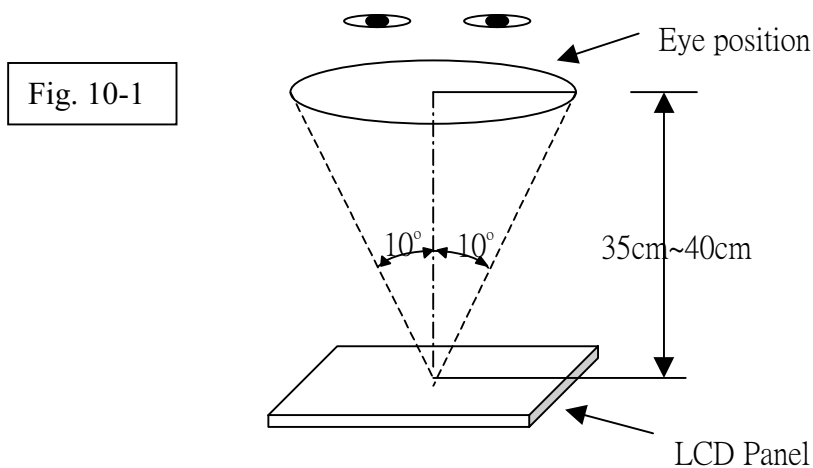
Should the Customer fail to notify the results to Supplier within 40 days period, the right to reject the LCMs should then lapse, and the said LCMs shall be deemed to have been accepted by the Customer.

(c) Inspection conditions is as follows:

- (1) Viewing distance is approximately 35 cm
- (2) Viewing angle is normal to the LCD panel as fig. 10-1($\pm 10^\circ$)
- (3) Exceptional case: inspection of image-sticking, etc.($\pm 40^\circ$)

(d) Special condition:

- (1) Viewing distance is close for inspection of adjacent dots and distance between defect dots.
- (2) Viewing condition of “Shot block non-uniformity from oblique angle” is as fig. 10-2.
- (1) Ambient temperature are approximately 25°C
- (4) Ambient illuminance is from 300 to 500 lux.



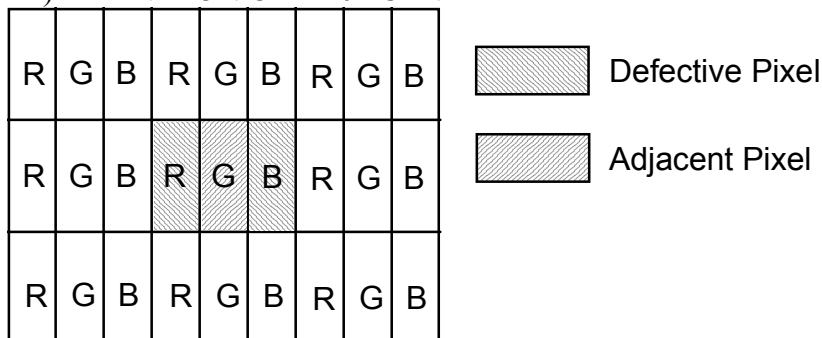
(e) Defect is defined as follows:

Visible through 5% transmission ND filter

| DEFECT TYPE | | LIMIT | |
|-------------------|--|---|------------|
| VISUAL DEFECT | SCRATCH | $0.01\text{mm} \leq W \leq 0.05\text{mm}$ $L \leq 10\text{mm}$ | $N \leq 4$ |
| | | $0.01\text{mm} \leq W$ $10\text{mm} < L$ | $N = 0$ |
| | | $0.05\text{mm} < W$ | $N = 0$ |
| | DENT | $0.15\text{mm} \leq \varphi \leq 0.4\text{mm}$ | $N \leq 4$ |
| | | $0.4\text{mm} < \varphi$ | $N = 0$ |
| | BLACK SPOT | $0.15\text{mm} \leq \varphi \leq 0.5\text{mm}$ | $N \leq 4$ |
| | | $0.5\text{mm} < \varphi$ | $N = 0$ |
| | LINT | $L \leq 3\text{mm}$ | $N \leq 4$ |
| $3\text{mm} < L$ | | $N = 0$ | |
| NEWTON RINGS | | NOT ALLOWED | |
| ELECTRICAL DEFECT | BRIGHT DOT | $N \leq 8$ (Green:5) | |
| | DARK DOT | $N \leq 8$ | |
| | TOTAL DOT | $N \leq 10$ | |
| | TWO ADJACENT DOT BRIGHT DOT DARK DOT | ≤ 2 PAIRS ≤ 2 PAIRS | |
| | THREE OR MORE ADJACENT DOT | NOT ALLOWED | |
| | DISTANCE BETWEEN DEFECTS BRIGHT DOT DARK DOT | $\geq 15\text{mm}$ $\geq 15\text{mm}$ | |
| | LINE DEFECT | NOT ALLOWED | |

*1)W:width ,L:Lenth ,N:number, φ :diamete

*2) DEFINITION OF ADJACENT



The defects that are not defined above and considered to be problem shall be reviewed and discussed by both parties.

11. HANDLING PRECAUTIONS FOR TFT-LCD MODULE

Please pay attention to the followings in handling- TFT-LCD products.

(a) ASSEMBLY PRECAUTION

- (1) Please use the mounting hole on the module side in installing and do not beading or wrenching LCD in assembling. And please do not drop, bend or twist LCD module in handling.
- (2) Please design display housing in accordance with the following guide lines.
 - (2.1) Housing case must be destined carefully so as not to put stresses on LCD all sides and not to wrench module. The stresses may cause non-uniformity even if there is no non-uniformity statically.
 - (2.2) Keep sufficient clearance between LCD module back surface and housing when the LCD module is mounted. Approximately 1.0 mm of the clearance in the design is recommended taking into account the tolerance of LCD module thickness and mounting structure height on the housing.
 - (2.3) When some parts, such as, FPC cable and ferrite plate, are installed underneath the LCD module, still sufficient clearance is required, such as 0.5mm. This clearance is, especially, to be reconsidered when the additional parts are implemented for EMI countermeasure.
 - (2.4) Design the inverter location and connector position carefully so as not to give stress to lamp cable, or not to interface the LCD module by the lamp cable.
 - (2.5) Keep sufficient clearance between LCD module and the others parts, such as inverter and speaker so as not to interface the LCD module. Approximately 1.0mm of the clearance in the design is recommended.
- (3) Please do not push or scratch LCD panel surface with any-thing hard. And do not soil LCD panel surface by touching with bare hands. (Polarizer film, surface of LCD panel is easy to be flawed.)
- (4) Please do not press any parts on the rear side such as source TCP, gate TCP, control circuit board and FPCs during handling LCD module. If pressing rear part is unavoidable, handle the LCD module with care not to damage them.
- (5) Please wipe out LCD panel surface with absorbent cotton or soft cloth in case of it being soiled.
- (6) Please wipe out drops of adhesives like saliva and water on LCD panel surface immediately. They might damage to cause panel surface variation and color change.
- (7) Please do not take a LCD module to pieces and reconstruct it. Resolving and reconstructing modules may cause them not to work well.
- (8) Please do not touch metal frames with bare hands and soiled gloves. A color change of the metal frames can happen during a long preservation of soiled LCD modules.
- (9) Please pay attention to handling lead wire of backlight so that it is not tugged in connecting with inverter.

(b) OPERATING PRECAUTIONS

- (1) Please be sure to turn off the power supply before connecting and disconnecting signal input cable.
- (2) Please do not change variable resistance settings in LCD module. They are adjusted to the most suitable value. If they are changed, it might happen LCD does not satisfy the characteristics specification.
- (3) Please consider that LCD backlight takes longer time to become stable of radiation characteristics in low temperature than in room temperature.
- (4) A condensation might happen on the surface and inside of LCD module in case of sudden change of ambient temperature.

- (5) Please pay attention to displaying the same pattern for very long time. Image might stick on LCD. If then, time going on can make LCD work well.
- (6) Please obey the same caution descriptions as ones that need to pay attention to ordinary electronic parts.

(c) PRECAUTIONS WITH ELECTROSTATICS

- (1) This LCD module use CMOS-IC on circuit board and TFT-LCD panel, and so it is easy to be affected by electrostatics. Please be careful with electrostatics by the way of your body connecting to the ground and so on.
- (2) Please remove protection film very slowly on the surface of LCD module to prevent from electrostatics occurrence.

(d) STORAGE PRECAUTIONS

- (1) When you store LCDs for a long time, it is recommended to keep the temperature between 0°C ~40°C without the exposure of sunlight and to keep the humidity less than 90%RH.
- (2) Please do not leave the LCDs in the environment of high humidity and high temperature such as 60°C 90%RH.
- (3) Please do not leave the LCDs in the environment of low temperature; below -20°C.

(e) SAFETY PRECAUTIONS

- (1) When you waste LCDs, it is recommended to crush damaged or unnecessary LCDs into pieces and wash them off with solvents such as acetone and ethanol, which should later be burned.
- (2) If any liquid leaks out of a damaged-glass cell and comes in contact with the hands, wash off thoroughly with soap and water.

(f) OTHERS

- (1) A strong incident light into LCD panel might cause display characteristics' changing inferior because of polarizer film, color filter, and other materials becoming inferior. Please do not expose LCD module direct sunlight and strong UV rays.
- (2) Please pay attention to a panel side of LCD module not to contact with other materials in preserving it alone.
- (3) For the packaging box, please pay attention to the followings:
 - (3.1) Packaging box and inner case for LCD are designed to protect the LCDs from the damage or scratching during transportation. Please do not open except picking LCDs up from the box.
 - (3.2) Please do not pile them up more than 5 boxes. (They are not designed so.) And please do not turn over.
 - (3.3) Please handle packaging box with care not to give them sudden shock and vibrations. And also please do not throw them up.
 - (3.4) Packing box and inner case for LCDs are made of cardboard. So please pay attention not to get them wet. (Such like keeping them in high humidity or wet place can occur getting them wet.)
- (4) Please pay attention to UL mark, there will be one model name on the UL mark as following : CTAA150XA03 (CTAXXXX) .