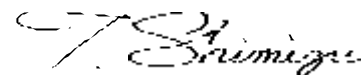


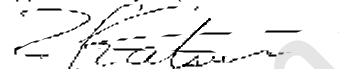
LCD Module Technical Specification

First Edition
Oct 10, 2002
Final Revision
Jan 14, 2003

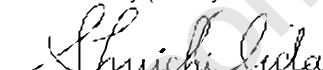
Type No. **T-51638D084-FW-A-AA**



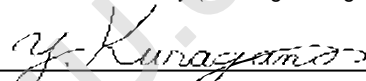
Approved by (Production Engineering)



Checked by (Quality Assurance Division)



Checked by (ACI Engineering Division)



Prepared by (Production Engineering Group)

| No. | Item | Page |
|-----|---|------|
| -- | CONTENTS | 1 |
| 1 | OVERVIEW | 2 |
| 2 | ABSOLUTE MAXIMUM RATINGS | 3 |
| 3 | ELECTRICAL CHARACTERISTICS | 3 |
| 4 | INTERFACE PIN CONNECTION | 5 |
| 5 | INTERFACE TIMING | 6 |
| 6 | BLOCK DIAGRAM | 9 |
| 7 | MECHANICAL SPECIFICATION | 10 |
| 8 | OPTICAL CHARACTERISTICS | 12 |
| 9 | RELIABILITY TEST CONDITION | 14 |
| 10 | INSPECTION STANDARDS | 15 |
| 11 | HANDLING PRECAUTIONS FOR TFT-LCD MODULE | 16 |
| -- | PACKAGING SPECIFICATION | 19 |
| -- | PRODUCT NUMBER LABELING FORMS | 23 |
| -- | LAMP UNIT FOR 8.4 VGA | 25 |

1. OVERVIEW

T-51638D084-FW-A-AA is 8.4" color TFT-LCD (Thin Film Transistor Liquid Crystal Display) module composed of LCD panel, driver ICs, control circuit, and backlight unit.

By applying 6 bit digital data, 640×480 , 262,144-color images are displayed on the 8.4" diagonal screen. Input power voltage is single 3.3V for LCD driving.

Inverter for backlight is not included in this module. General specifications are summarized in the following table:

| ITEM | SPECIFICATION |
|---------------------------------------|--|
| Display Area (mm) | 170.9(H) \times 128.2 (V) (8.4-inch diagonal) |
| Number of Dots | 640×3 (H) \times 480 (V) |
| Pixel Pitch (mm) | 0.267 (H) \times 0.267 (V) |
| Color Pixel Arrangement | RGB vertical stripe |
| Display Mode | normally white |
| Number of Colors | 262,144 |
| Contrast ratio | 450 |
| Optimum Viewing Angle(Contrast ratio) | 6 o'clock |
| Brightness (cd/m ²) | 450 |
| Module Size (mm) | 199.5 (W) \times 149.0 (H) \times 11.5 (D) |
| Module Mass (g) | 360(Typ) |
| Backlight Unit | CCFL, 2-tubes, edge-light, replaceable |
| Surface Treatment | Anti-glare and hard-coating 3H |

Characteristic value without any note is typical value.

The LCD product described in this specification is designed and manufactured for the standard use in OA equipment and consumer products, such as computers, communication equipment, industrial robots, AV equipment and so on.

Do not use the LCD product for the equipment that require the extreme high level of reliability, such as aerospace applications, submarine cables, nuclear power control systems and medical or other equipment for life support.

OPTREX assumes no responsibility for any damage resulting from the use of the LCD product in disregard of the conditions and handling precautions in this specification.

If customers intend to use the LCD product for the above items or other no standard items, please contact our sales persons in advance.

2. ABSOLUTE MAXIMUM RATINGS

| ITEM | SYMBOL | MIN. | MAX. | UNIT |
|------------------------------|------------------|------|------|-------|
| Power Supply Voltage for LCD | VCC | 0 | 4.0 | V |
| Logic Input Voltage | VI | 0 | 6.0 | V |
| Lamp Voltage | VL | 0 | 1500 | Vrms |
| Lamp Current | IL | 0 | 8.0 | mArms |
| Lamp Frequency | FL | -- | 80 | kHz |
| Operation Temperature *1) | T _{op} | 0 | 60 | °C |
| Storage Temperature *1) | T _{stg} | -20 | 65 | °C |

[Note]

*1) Top,Tstg ≤ 40°C : 90%RH max. without condensation

Top,Tstg > 40°C : Absolute humidity shall be less than the value of 90%RH at 40°C without condensation.

3. ELECTRICAL CHARACTERISTICS

(1) TFT- LCD

Ambient Temperature: Ta = 25°C

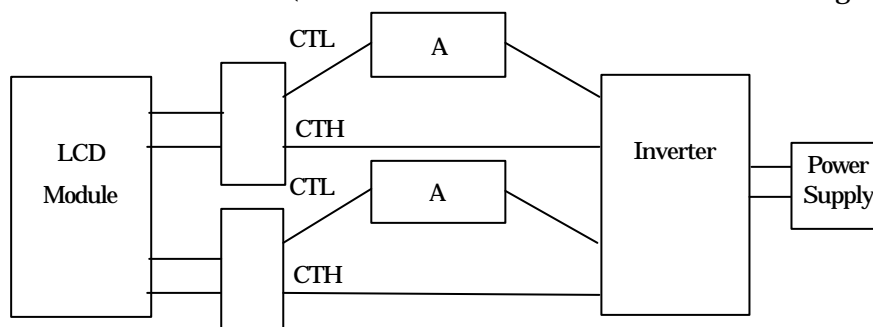
| ITEM | | SYMBOL | MIN. | TYP. | MAX. | UNIT | Remarks |
|---------------------------------|------|--------|------|------|------|-------|----------------------------|
| Power Supply Voltages for LCD | | VCC | 3.0 | 3.3 | 3.6 | V | Note A) (See next page) |
| Power Supply Currents for LCD | | ICC | -- | 240 | 400 | mA | Note B) (See next page) |
| Permissive input ripple Voltage | | VRP | -- | -- | 100 | mVp-p | VCC=+3.3V |
| Logic Input Voltage | High | VIH | 2.4 | -- | 5.5 | V | VCC=MAX |
| | Low | VIL | 0 | -- | 0.8 | V | VCC=MIN |

(2) Backlight

Ta = 25°C

| ITEM | SYMBOL | MIN. | TYP. | MAX. | UNIT | Remarks |
|-----------------------|--------|-------|------|------|-------|----------------|
| Lamp Voltage | VL | -- | 450 | -- | Vrms | IL = 6.5 mArms |
| Lamp Current | IL | 3.0 | 6.5 | 7.0 | mArms | *1) |
| Lamp Frequency | FL | 30 | -- | 60 | kHz | *2) |
| Starting Lamp Voltage | VS | 670 | -- | -- | Vrms | |
| Lamp Life Time | LT | 50000 | -- | -- | h | |

*1) Lamp Current measurement method (The current meter is inserted in low voltage line.)

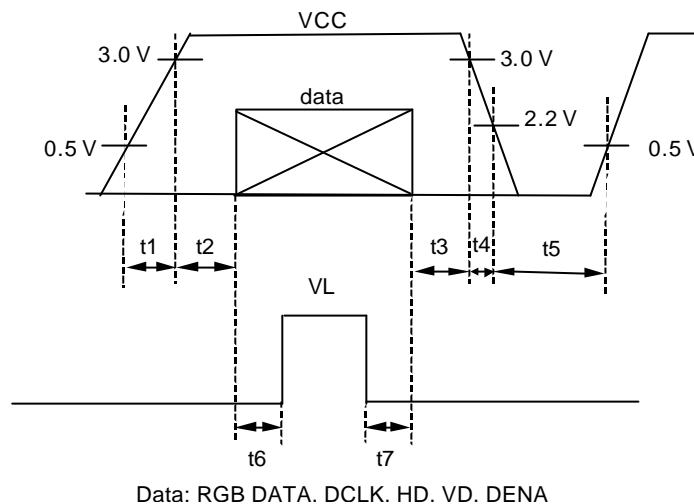


*2) Lamp frequency of inverter may produce interference with horizontal synchronous frequency, and this may cause horizontal beat on the display. Therefore, please adjust lamp frequency, and keep inverter as far from module as possible or use electronic shielding between inverter and module to avoid the interference.

[Note]

A) Power and signals sequence:

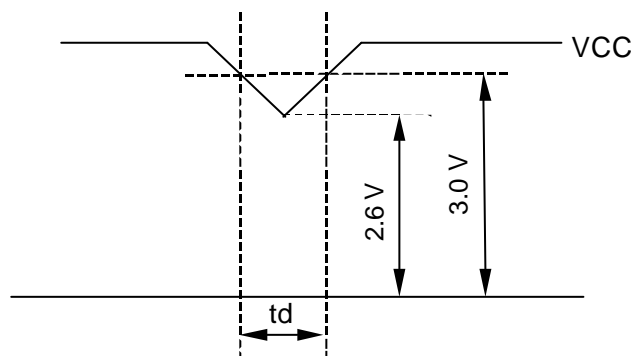
$$\begin{array}{ll} t1 \leq 10 \text{ ms} & 400 \text{ ms} \leq t5 \\ 0 < t2 \leq 50 \text{ ms} & 200 \text{ ms} \leq t6 \\ 0 < t3 \leq 50 \text{ ms} & 0 \leq t7 \\ 0 \leq t4 \leq 50 \text{ ms} & \end{array}$$



VCC-dip conditions:

- 1) When $2.6 \text{ V} \leq VCC < 3.0 \text{ V}$, $t_d \leq 10 \text{ ms}$
- 2) When $VCC < 2.6 \text{ V}$

VCC-dip conditions should also follow the power and signals sequence.



B) Typical current condition:

64- gray- bar-pattern

480 line mode

$VCC = +3.3 \text{ V}$, $f_H = 31.5 \text{ kHz}$, $f_V = 60 \text{ Hz}$, $f_{CLK} = 25 \text{ MHz}$

Normal value, not peak value

4. INTERFACE PIN CONNECTION

CN 1(INTERFACE SIGNAL)

Used connector: DF9B-31P-1V(Hirose)

Corresponding connector: DF9B-31S-1V(Hirose)

| Pin No. | Symbol | Function |
|---------|--------|---|
| 1 | GND | |
| 2 | DCLK | Clock signal for sampling catch data signal |
| 3 | HD | Horizontal sync signal |
| 4 | VD | Vertical sync signal |
| 5 | GND | |
| 6 | R0 | Red data signal(LSB) |
| 7 | R1 | Red data signal |
| 8 | R2 | Red data signal |
| 9 | R3 | Red data signal |
| 10 | R4 | Red data signal |
| 11 | R5 | Red data signal(MSB) |
| 12 | GND | |
| 13 | G0 | Green data signal(LSB) |
| 14 | G1 | Green data signal |
| 15 | G2 | Green data signal |
| 16 | G3 | Green data signal |
| 17 | G4 | Green data signal |
| 18 | G5 | Green data signal(MSB) |
| 19 | GND | |
| 20 | B0 | Blue data signal(LSB) |
| 21 | B1 | Blue data signal |
| 22 | B2 | Blue data signal |
| 23 | B3 | Blue data signal |
| 24 | B4 | Blue data signal |
| 25 | B5 | Blue data signal(MSB) |
| 26 | GND | |
| 27 | DENA | Data enable signal(to settle the viewing area) |
| 28 | VCC | 3.3 V Power Supply |
| 29 | VCC | 3.3 V Power Supply |
| 30 | TEST | This pin should be open. Test signal output for only internal test use. |
| 31 | REV | Reverse scan control. L = Normal, H = Reverse |

*) The shielding case is connected with GND

CN 2 , CN 3 (BACKLIGHT)

Backlight-side connector: BHR-02(8.0)VS-1N(JST)

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

| Pin No. | Symbol | Function |
|---------|--------|--------------------|
| 1 | CTH | VBLH(High Voltage) |
| 3 | CTL | VBLL(Low Voltage) |

[Note]VBLH-VBLL = VL

5. INTERFACE TIMING

(1) Timing Specifications

| ITEM | | SYMBOL | MIN. | TYP. | MAX. | UNIT |
|-------------------------------------|------------------------|-----------|------|------|------|-----------|
| DCLK *1), *4) | Frequency | f_{CLK} | 20 | 25 | 30 | MHz |
| | Period | t_{CLK} | 33.3 | 40 | 50 | ns |
| | Low Width | t_{WCL} | 10 | -- | -- | ns |
| | High Width | t_{WCH} | 10 | -- | -- | ns |
| DATA (R,G,B,DENA, HD, VD) *1) | Set up time | t_{DS} | 5 | -- | -- | ns |
| | Hold time | t_{DH} | 5 | -- | -- | ns |
| DENA *3) | Horizontal Active Time | t_{HA} | 640 | 640 | 640 | t_{CLK} |
| | Horizontal Front Porch | t_{HFP} | 0 | 16 | -- | t_{CLK} |
| | Horizontal Back Porch | t_{HBP} | 19 | 144 | -- | t_{CLK} |
| | Vertical Active Time | t_{VA} | 480 | 480 | 480 | t_H |
| | Vertical Front Porch | t_{VFP} | 1 | 10 | -- | t_H |
| | Vertical Back Porch | t_{VBP} | 8 | 35 | -- | t_H |
| HD *2), *4) | Frequency | f_H | 27 | 31.5 | 38 | kHz |
| | Period | t_H | 26.3 | 31.7 | 37.0 | μs |
| | Low Width | t_{WHL} | 5 | 96 | -- | t_{CLK} |
| VD *2) | Frequency | f_V | 55 | 60 | 70 | Hz |
| | Period | t_V | 14.2 | 16.7 | 18.2 | ms |
| | Low Width | t_{WVL} | 2 | 2 | -- | t_H |

[Note]

*1) DATA is latched at fall edge of DCLK in this timing specification.

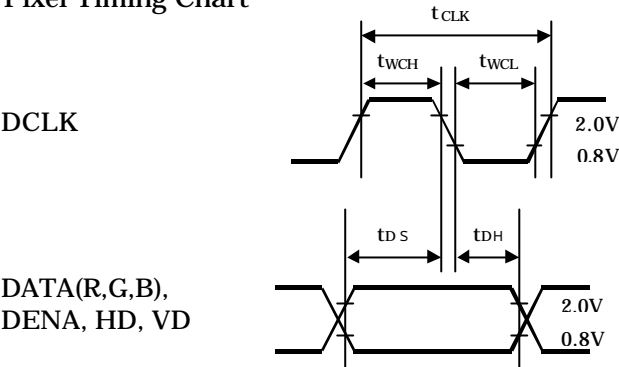
*2) Polarities of HD and VD are negative in this specification.

*3) DENA (Data Enable) should always be positive polarity as shown in the timing specification.

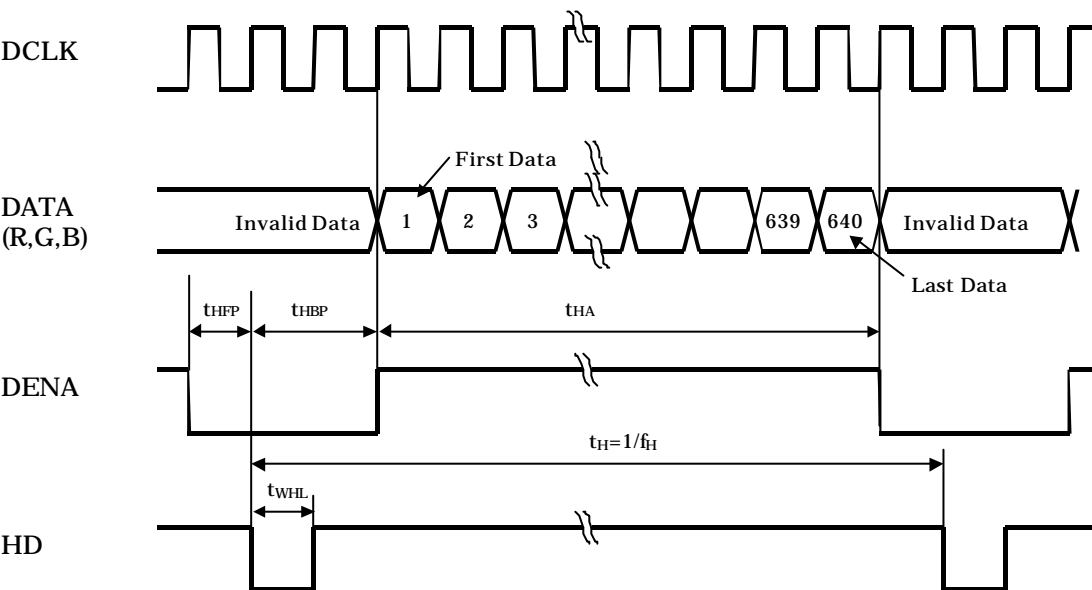
*4) DCLK should appear during all invalid period, and HD should appear during invalid period of frame cycle.

(2) Timing Chart

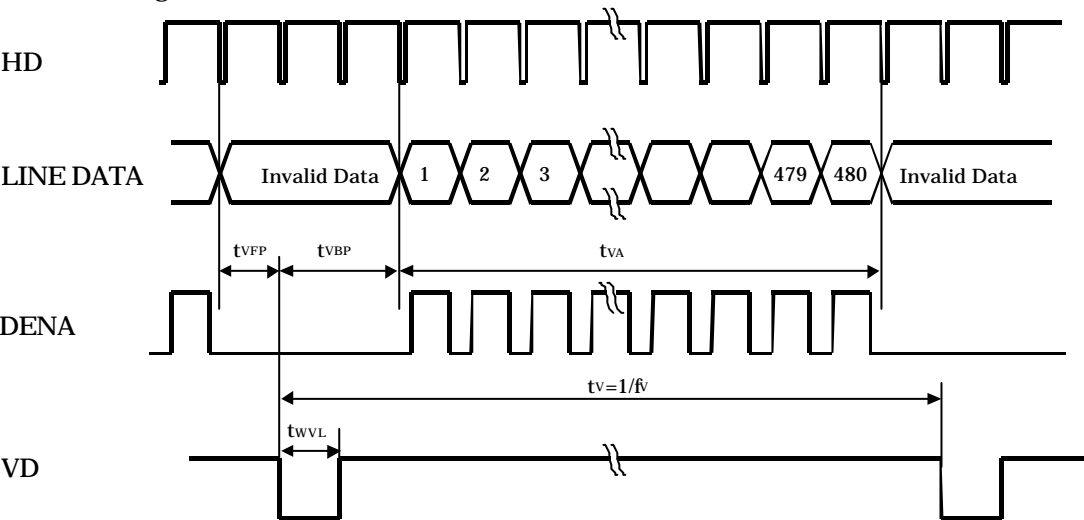
a. Pixel Timing Chart



b. Horizontal Timing Chart



c. Vertical Timing Chart



(3) Color Data Assignment

| COLOR | INPUT DATA | R DATA | | | | | | G DATA | | | | | | B DATA | | | | | |
|----------------|---------------|--------|----|----|----|----|-----|--------|----|----|----|----|-----|--------|----|----|----|----|-----|
| | | R5 | R4 | R3 | R2 | R1 | R0 | G5 | G4 | G3 | G2 | G1 | G0 | B5 | B4 | B3 | B2 | B1 | B0 |
| | | MS | | | | | LSB | MS | | | | | LSB | MS | | | | | LSB |
| | | B | | | | | B | | | | | | B | | | | | | |
| BASIC COLOR | BLACK | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | RED(63) | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | GREEN(63) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | BLUE(63) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| | CYAN | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | MAGENTA | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 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 | RED(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 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | RED(2) | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | RED (62) | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | RED(63) | 1 | 1 | 1 | 1 | 1 | 1 | 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 |
| | GREEN (1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | GREEN(2) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | GREEN(62) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | GREEN(63) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 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 |
| | BLUE(1) | 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 | 1 | 0 |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | BLUE(62) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 |
| | BLUE(63) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |

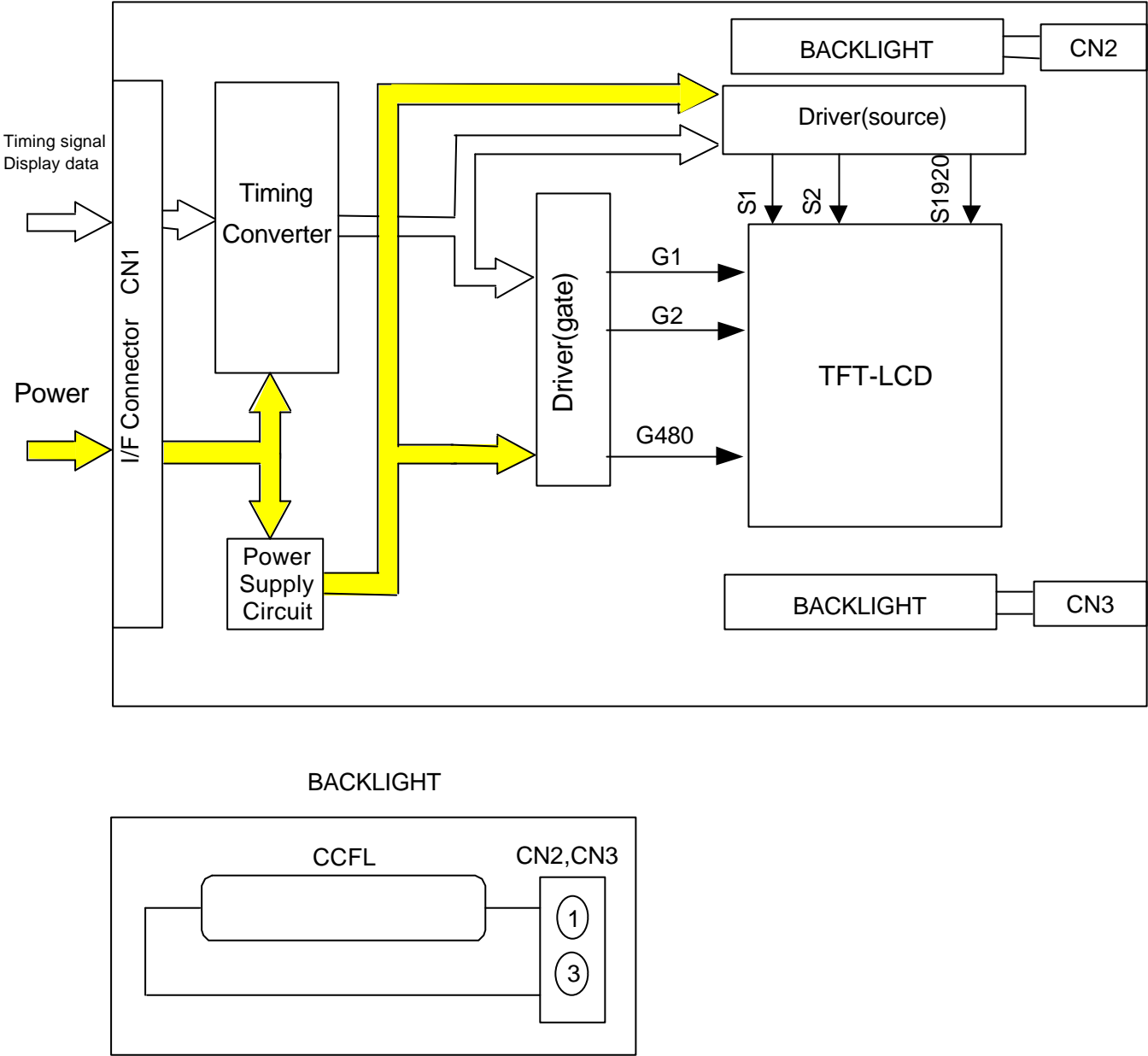
[Note]1) Definition of gray scale

Color (n) --- n indicates gray scale level.

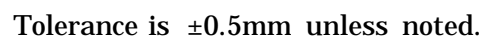
Higher n means brighter level.

2) Data 1:High, 0: Low

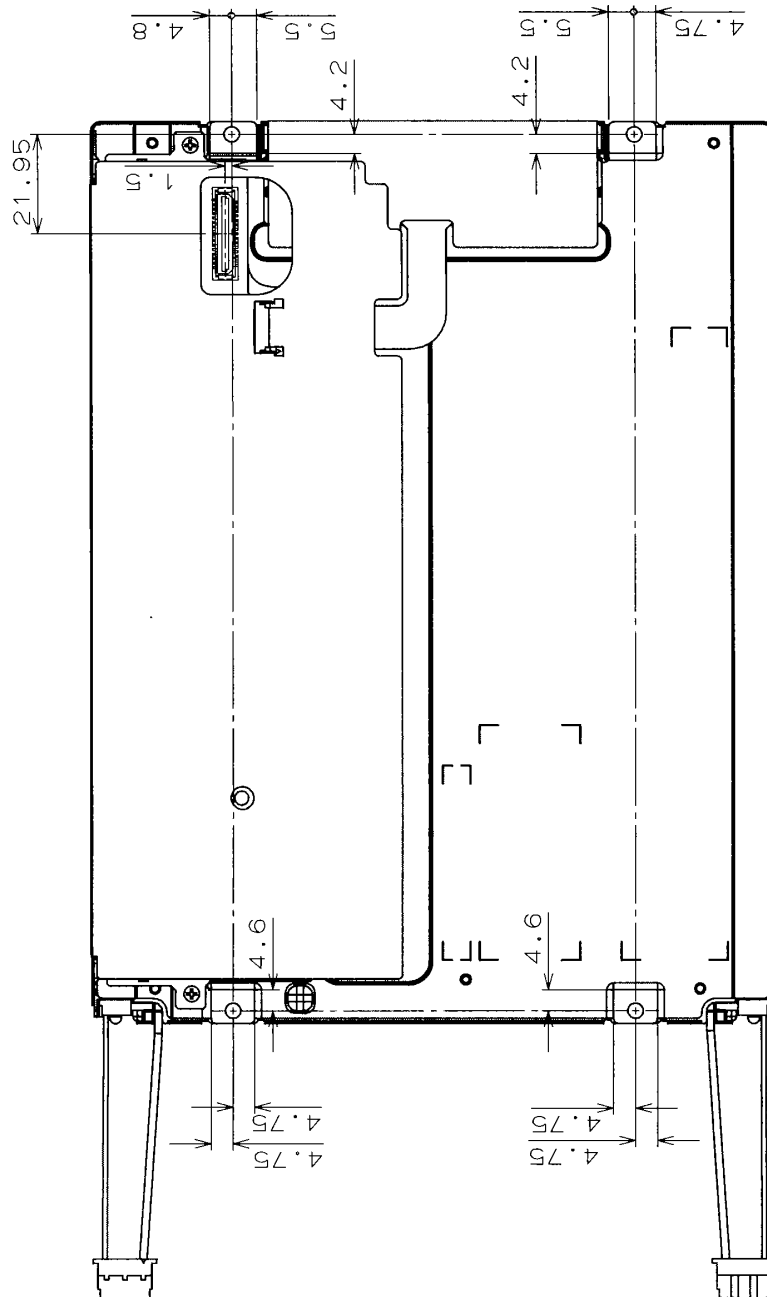
6. BLOCK DIAGLAM



(1) **Front Side**



(2) Rear Side



8.4"VGA
02.03.05
单位: mm
標準公差: ±0.5

Tolerance is $\pm 0.5\text{mm}$ unless noted.

[Note]

We recommend you referring to the detailed drawing for your design.

Please contact our company sales representative when you need the detailed drawing.

8. OPTICAL CHARACTERISTICS

Ta = 25°C, VCC = 3.3 V, Input Signals: Typ. Values shown in Section 5

| ITEM | | SYMBOL | CONDITION | MIN. | TYP. | MAX. | UNIT | Remarks |
|-------------------|------------|----------|---------------------------|-------|--------|-------|-------------------|---------|
| Contrast Ratio | | CR | $\theta = \phi = 0^\circ$ | -- | 450 | -- | -- | *1)*3) |
| Luminance | | Lw | $\theta = \phi = 0^\circ$ | -- | 450 | -- | cd/m ² | *2)*3) |
| Response Time | | tr | $\theta = \phi = 0^\circ$ | -- | 8 | -- | ms | *3)*4) |
| | | tf | $\theta = \phi = 0^\circ$ | -- | 27 | -- | ms | *3)*4) |
| Viewing Angle | Horizontal | ϕ | CR ≥ 10 | -- | -65~65 | -- | ° | *3) |
| | Vertical | θ | | -- | -60~50 | -- | ° | *3) |
| Image Sticking | | tis | 2 h | -- | -- | 2 | s | *5) |
| Color Coordinates | Red | Rx | $\theta = \phi = 0^\circ$ | 0.542 | 0.572 | 0.602 | -- | *3) |
| | | Ry | | 0.302 | 0.332 | 0.362 | | |
| | Green | Gx | | 0.285 | 0.315 | 0.345 | | |
| | | Gy | | 0.493 | 0.523 | 0.553 | | |
| | Blue | Bx | | 0.125 | 0.155 | 0.185 | | |
| | | By | | 0.118 | 0.148 | 0.178 | | |
| | White | Wx | | 0.283 | 0.313 | 0.343 | | |
| | | Wy | | 0.294 | 0.324 | 0.354 | | |

[Note]

These items are measured using CS1000(MINOLTA) for color coordinates, and CS1000 or BM-5A(TOPCON) for others under the dark room condition (no ambient light) after more than 30 minutes from turning on the lamp unless noted.

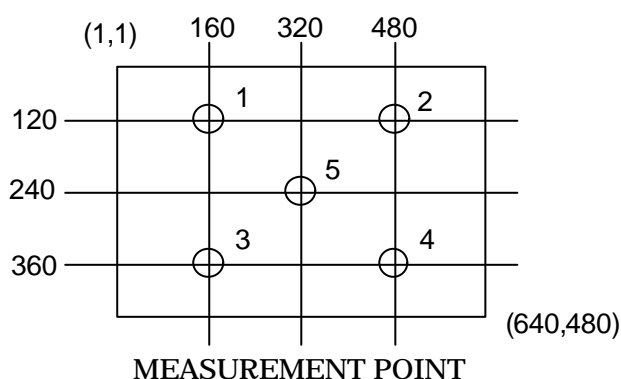
Condition: IL = 6.5 mArms, FL = 60kHz

*1) Definition of Contrast Ratio

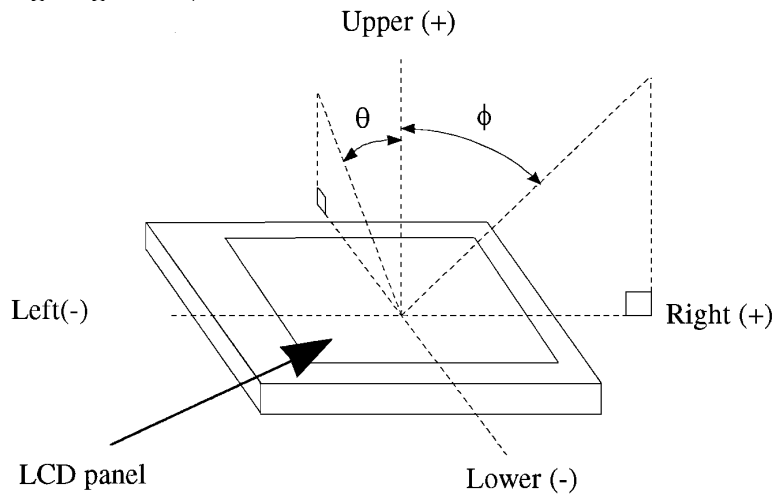
CR=ON (White) Luminance / OFF(Black) Luminance: average of 5 points shown in a figure below

*2) Definition of Luminance

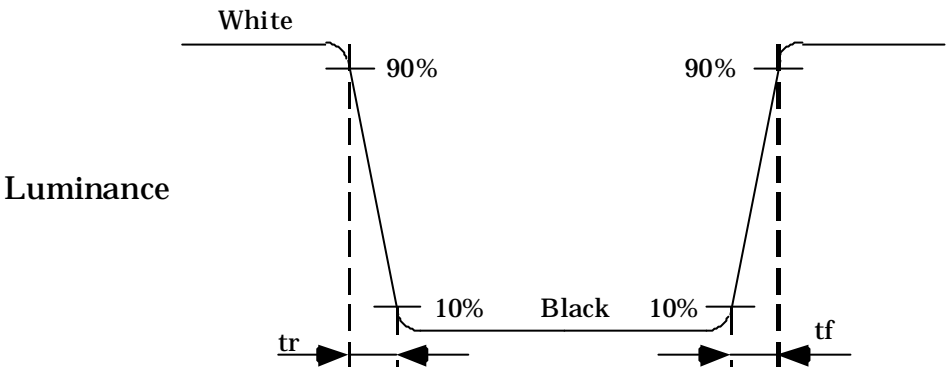
Lw= ON (White) Luminance: average of 5 points shown in a figure below



*3) Definition of Viewing Angle (θ , ϕ)



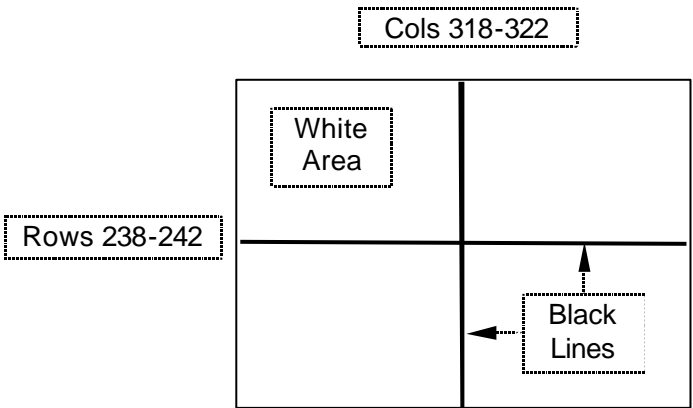
*4) Definition of Response Time



*5) 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 CONDITION

(1) Temperature and Humidity

| TEST ITEM | CONDITIONS |
|---|--|
| HIGH TEMPERATURE HIGH HUMIDITY OPERATION | 40°C, 90%RH, 240 h |
| HIGH TEMPERATURE STORAGE | 65°C, 96 h |
| LOW TEMPERATURE STORAGE | -20°C, 96 h |
| THERMAL SHOCK(NON-OPERARION) | BETWEEN -20°C (1h) and 65°C(1h), 5 CYCLES |

(2) Shock & Vibration

| ITEM | CONDITIONS |
|------------------------------|---|
| SHOCK (NON-OPERATION) | Shock level: 1470m/s ² (150G) Waveform: half sinusoidal wave, 2ms Number of shocks: one shock input in each direction of three mutually perpendicular axis 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 500Hz Frequency sweep rate: 0.5 octave /min Duration: one sweep from 5 to 500 Hz in each of three mutually perpendicular axis(each x,y,z axis: 1 hour, total 3 hours) |

(3) Judgment standard

The judgment of the above tests 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.