



To:

APPROVAL SIGNATURE

## SPECIFICATION

FOR

TOSHIBA MATSUSHITA DISPLAY TECHNOLOGY

TFT-LCD MODULE

**LTA070A250A**

SPECIFICATION No.: \_\_\_\_\_  
LTA070A250A-11

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**Revision History**

| Date | Sheet<br>(New) | Item | Old | New | Reason |
|------|----------------|------|-----|-----|--------|
|      |                |      |     |     |        |

## Caution and Handling Precaution

For your end user's safety, it is strongly advised that the items with "\*" should be included in the instruction manual of the system which may be issued by your organization.

Toshiba Matsushita Display Technology always endeavor to maintain sufficient quality of the LCD panel in process of designing and manufacturing, however, to avoid causing extended damages such as accidents resulting in injury or death, fire accidents, or social damages if the LCD panel fails, please adopt safe design as a whole set, by adopting redundant design, taking measure in set design to prevent fire-spreading, over-current, or incorrect operation, etc.

## For Safety

### Warning

#### 1) SPECIAL PURPOSES

- a) Toshiba Matsushita Display Technology's Standard LCD modules have not been customized for operation in extreme environments or for use in applications where performance failures could be life-threatening or otherwise catastrophic.
- b) Since they have not been designed for operation in extreme environments, they must never be used in devices that will be exposed to temperatures above 50 degrees Celsius or below 0 degrees Celsius, to X-ray or Gamma-ray radiation, or to abnormally high levels of vibration or shock which exceed Toshiba Matsushita Display Technology's specification limits.
- c) In addition, since Toshiba Matsushita Display Technology's Standard LCD modules have not been designed for use in applications where performance failures could be life-threatening or catastrophic, they must never be installed in aircraft navigation control systems (such as, but not limited to Traffic Collision Avoidance System and Air Traffic Indicator), in military defense or weapons systems, in critical industrial process-control systems (e.g., those involved in the production of nuclear energy), or in critical medical device or patient life-support systems.

#### 2) ELECTRIC SHOCK

DISCONNECT POWER SUPPLY before handling LCD modules. In order to prevent electric shock, DO NOT TOUCH the electrode part, cables, connectors, and the fluorescent lamp's (hereinafter called "FL") circuit part of a module in which FL tubes are built in as a light source of a backlight or a front light. High voltage is supplied to these parts while power supply is turned on.

**3) FL CABLE CONNECTION**

Make sure to insert the module FL connector to the inverter connector in correct position and correct polarity. If incorrect, this may cause smoke or burn of electrical parts by high voltage of FL circuit. If there is a possibility that the connector has been inserted incorrectly, re-insert the connector only after you confirm the module and FL power is completely off. When disconnecting the connector, do not pull on the cable.

DO NOT USE the mating FL connector that Toshiba Matsushita Display Technology does not specify. Otherwise, Toshiba Matsushita Display Technology shall not be liable for any damages caused by the connector.

**Caution****1)\* DISASSEMBLING OR MODIFICATION**

DO NOT DISASSEMBLE OR MODIFY the modules.

Sensitive parts inside LCD module may be damaged, and dusts or scratches may mar the displays. Toshiba Matsushita Display Technology does not warrant the modules, if customer disassembled or modified them.

**2)\* BREAKAGE OF LCD PANEL**

DO NOT INGEST liquid crystal material, DO NOT INHALE this material, and DO NOT PERMIT this material to contact the skin, if glass of LCD panel is broken.

If liquid crystal material contacts the skin, mouth or clothing, take the following actions immediately.

In case contact to the eye or mouth, rinse with large amount of running water for more than 15 minutes. In case contact to the skin or clothing, wipe it off immediately and wash with soap and large amount of running water for more than 15 minutes. The skin or clothing may be damaged if liquid crystal material is left adhered.

In case ingestion, rinse out the mouth well with water. After spewing up by drinking large amount of water, get medical treatment.

**3)\* GLASS OF LCD PANEL**

BE CAREFUL WITH CHIPS OF GLASS that may cause injuring fingers or skin, when the glass is broken.

Since FL is also made of glass, when FL is built in, handle it with due caution as well.

**4) ABSOLUTE MAXIMUM RATINGS**

DO NOT EXCEED the absolute maximum rating values under the worst probable conditions caused by the supply voltage variation, input voltage variation, variation in parts' constants, environmental temperature, etc., otherwise LCD module may be damaged.

**5) POWER PROTECTION CIRCUIT**

Employ protection circuit for power supply, whenever the specification specifies it.

A suitable protection circuit should be applied, based on each system design.

**6) DISPOSAL**

Always comply all applicable environmental regulations, when disposing of LCD module.

**7) EDGES OF PARTS**

Be careful with handling the metal frame (bezel) of a module. Even though burr disposal treatment is performed, it may cause injuring. Be careful with edges of glass parts and touch panel identically. For designing the system, give special consideration that the wiring and parts do not touch those edges.

**8)\* LUMINANCE DECREASE OF FL**

When FL becomes extremely dark and its color changes from white to pink, stop the use of the module immediately. FL, at the end of its life with its discharge color turns into pink as the characteristics of FL, may adversely affect the module at the end part of FL due to temperature raising caused by depletion of the mercury which is contained in FL tube, or may have a possibility of breakage.

**9) RECOMMENDED OPERATING CONDITIONS**

Don't exceed "the recommended operation conditions" in this specification. (The LCD module should be used within "the recommended operation conditions".)

The performance and quality of the LCD module are warranted only when the LCD module is used within "the recommended operation conditions". Toshiba Matsushita Display Technology never warrants the performance and quality of the LCD module when you use the LCD module over "the recommended operation conditions", although within "the absolute maximum rating".

To use the LCD module over "the recommended operation conditions" may have bad influence on the characteristics and reliability of the LCD module and may shorten the life of the LCD module.

Therefore, when designing the whole set, not to be over "the recommended operation conditions", you should fully take care of supply voltage change, characteristic of connection parts, surge of input-and-output line, and surrounding temperature.

**For Designing the System****2-1 DESIGNING ENCLOSURE****1) MECHANICAL DIMENSIONS**

Refer to the individual specification for LCD module's mechanical dimensions.

**2) MOUNTING HOLES**

LCD module should be assembled to the system by using all mounting holes specified in the individual specification with the specified screws.

In addition, some modules may not be necessary to use all the mounting holes. Make comprehensive judgments on the entire system.

**3)\* BENDING / TWISTING**

Make sure to design the enclosure that bending/twisting forces are not applied to LCD module during and after the installation into the system.

**4) GASES FROM SETTING MATERIAL**

Some plastic materials and shock absorbing materials (rubber) used in the system may generate gases that may cause the deterioration of the polarizer laminated on LCD's panel or internal parts of the module. Prior confirmation is required.

**5) GASES FROM PACKAGING MATERIAL**

Some materials used for packaging (for which sulfuric acid is used in the recycling process) generate gases that may cause the deterioration of the polarizer laminated on LCD's panel or internal parts of the module. Prior confirmation is required.

**6) Afterimage**

Afterimage may appear for a few seconds to tens of seconds when power supplies off, however, it is not abnormal phenomenon. To make this phenomenon unremarkable, the set side should be taken measures to turn VSS (Gate Driver Negative Voltage) close to the off quickly, or once after viewing white then turn off, and so on.

**2-2 DESIGNING POWER SUPPLIES AND INPUT SIGNALS TO LCD MODULE****1) CAPACITY OF POWER SUPPLY**

Refer to individual specification for details for capacity of power supply, and apply some protection circuit including fuses for power supply lines.

**2) SEQUENCE OF POWER SUPPLIES AND INPUT SIGNALS**

Power supply lines should be designed as follows.

Power supplies should always be turned on before the input signals are applied to LCD module, and the input signals should be disconnected before power supplies are turned off.

The detailed sequence of power supplies and signals are described in the individual specification.

In addition, refer to individual specifications for unused terminals.

**3) FL CABLE CONNECTION**

Make sure to connect correctly high-voltage wire and low-voltage wire between FL tube and inverter unit.

If high-voltage wire and low-voltage wire are connected incorrectly, it may cause insufficient brightness or unstable operation of FL, and smoke or burn of the parts.

**4) PREVENTION OF IMAGE STICKING**

Design the system not to display same pattern for a long time in order to prevent image sticking on the panel. Note that incorrect sequence of power supplies and input signals may cause the sticking on the panel, too.

**5) GROUNDING OF METAL FRAME**

Grounding of metal frame of LCD module is generally effective to prevent radiation interference from the system design.

However, the necessity of grounding, or effective grounding method should be dependent on each system design.

## 2-3 DESIGNING FOR BETTER VISIBILITY

### 1) PANEL ANGLE

Visibility of LCD module deeply depends on the viewing directions. The position and the angle of LCD module in the system should be designed so that the best visibility can be obtained at the actual usage

### 2) WINDOW OPENING

Dimensions of window opening of the system's enclosure should be designed as smaller than "Viewing Area" and larger than "Active Area" specified in individual specification in order to obtain better appearance.

### 3) PROTECTIVE COVER

In case of severe environmental condition like outdoor usage, a proper transparent protective cover (lens) over LCD module is recommended to apply in order to prevent scratches, and invasion of dust, water, etc., from the system's window onto LCD module.

Ultra-violet ray cut filter is recommended to apply onto LCD module for outdoor operation. Strong ultra-violet ray may cause damage the panel. However, in that case, transmittance-luminance will decrease. Careful selection of material is required.

## 2-4 DESIGNING FL POWER SUPPLY CIRCUIT

Input FL starting voltage (VSFL) should be longer than two seconds. If it were not, it may cause unstable operation of FL.

Inverter should be design to stop output when the inverter is no-load to FL tubes (due to breakage of FL, etc.) to prevent high-voltage generation.

When high voltage is applied to FL continuously without normal operation of FL (due to output leakage within FL wiring circuit, etc.) it may cause smoke or burn. To prevent excess current, design the inverter with a protection circuit such as a current limiter (excess current detection) to stop inverter output.

## For Installation in Assembly

### 3-1 ESD (ELECTRO-STATIC DISCHARGE) PREVENTION

The C-MOS LSIs used in LCD module is very sensitive to ESD. The following caution should be taken when installing LCD module to an enclosure of the system in order to prevent damage of C-MOS LSIs used in LCD module.

#### 1) HUMIDITY

Ambient humidity of working area is recommended to be higher than 50%RH in order to avoid ESD.

**2) GROUNDING**

- 2-1) Grounded electro-conductive mats are recommended to be covered on the floor of working area and surface of working benches.
- 2-2) The grounding should be done through a resistor of 0.5-1M ohms in order to prevent spark of ESD.
- 2-3) Person handling LCD modules should be grounded with wristband.
- 2-4) Tools like soldering iron and screwdrivers and working benches should be grounded.

**3) IONIZER**

Using ionizer (an antistatic blower) is recommended at working area in order to reduce electro-static voltage.

**4) REMOVING PROTECTION FILM**

When removing protection film from LCD panel, peel off the film slowly (more than three seconds) from the edge of the panel with round-ended tweezers or adhesive tape while blowing with ionizer toward the peeling face to minimize ESD which may damage electrical circuit.

- 5) **Be careful with touching metal portion of testing instruments in order to prevent unnecessary ESD.**
- 6) **Do not touch the electrode area of PCB and electrical parts like LSI, capacitor, connector pin, etc.**

**3-2 DUST AND STAIN PREVENTION****1) WORKING AREA**

Reduce dust level in working area. Especially the level of metal particle should be decreased, otherwise electrical circuit in LCD module may be damaged due to short circuit by metal particles.

**2) PROTECTION FILM**

LCD module may be shipped with "protection film" on LCD panel in order to prevent from scratches and dust.

It is recommended to remove the film at later process of assembling.

**3) FINGER PRINT**

Use finger stalls or soft and dust-free gloves in order to keep clean appearance of LCD module when handled for incoming inspection and assembly.



**4)\* WIPING OFF DUST ON THE PANEL**

When LCD panel becomes dirty, wipe the panel surface off softly with absorbent cotton or another soft cloth.

If necessary, breathe upon the panel surface and then wipe off immediately and softly again.

If the dirt cannot be wiped off, follow the instructions described in individual specification.

Be careful not to spill organic solvents into the inside of LCD module. The solvents may damage driver IC and PCB area used inside module.

The polarizer laminated to LCD panel and adhesives may be damaged by the solvents, so do not use any organic solvents for wiping off LCD panel.

**5) ADHESIVE ON LCD PANEL**

Be careful not to attach adhesive, grease, etc., on LCD panel, because it is difficult to remove them without any damages on LCD panel.

**6)\* WATER SPOTS ON THE PANEL**

Avoid the dewing or water condensation.

Wipe off a spot or spots of water or mist on LCD panel softly with absorbent cotton or another cloth as soon as possible if happened, otherwise discoloration or stain may be caused.

**3-3 BENDING / TWISTING OF LCD MODULE DURING ASSEMBLY****1) INSTALLING LCD MODULE TO THE ENCLOSURE**

Do not bend or twist LCD module even momentary when LCD module is installed into an enclosure of the system.

**2) FASTENING SCREWS**

Fasten screws for mounting holes uniformly, otherwise bending / twisting force may be applied to LCD module.

**3) INTERFACE / FL CABLES**

Do not fasten screws, with catching interface cables or FL cables between LCD module and the enclosure.

This may cause bending of LCD module, or become the cause of a failure by damaging cables.

### 3-4 MECHANICAL FORCES

#### 1)\* **STRONG MECHANICAL SHOCK**

Refrain from strong mechanical shock like dropping from the working bench or knocking against hard object.

These may cause panel crack, damage of FL or other miss-operation.

#### 2)\* **EXCESSIVE FORCE**

Refrain from excessive force like pushing the surface of LCD panel. This may cause scratches or breakage of the panel, or a failure of the module.

#### 3)\* **SCRATCHES ON THE PANEL**

Do not put heavy object such as tools, books, etc., and do not pile up LCD modules.

Be careful not to touch surface of the polarizer laminated to the panel with any hard and sharp object. The polarizer is so soft that it can be easily scratched, even the protect film covers it.

#### 4) **CONNECTORS**

When inserting or disconnecting the connectors to LCD module, be sure not to apply force against PCB nor connecting cables, otherwise internal connection of PCB and TAB drivers may be damaged.

#### 5) **FL CABLES**

Be careful not to pull the FL cables in order to avoid mechanical damage in FL lamp and soldering area.

While mounting, do not bind or twist the FL cables, or the Lamp current may not be applied as designed.

### 3-5 OPERATION

Be sure that the following caution should be taken under assembly and inspection of the system.

#### 1) **POWER SUPPLY**

Power supplies should always be turned off in connecting process.

Do not connect or disconnect the power cables and connectors with power applied to LCD module.

#### 2) **INPUT SIGNAL**

The signal should be applied after power supplies are turned on.

The signal should be removed before power supplies are turned off.

The detailed sequence of power supplies and signals are described in individual specifications.

## For Transportation and Storage

### 1) TEMPERATURE

Do not store LCD modules in high temperature, especially in high humidity for a long time (approximately more than one month).

It is strongly recommended to store LCD modules where the temperature is in the range of 0 to 35 degrees Celsius and the humidity is lower than 70%.

### 2) LOW TEMPERATURE

Liquid crystal material may be coagulated and LCD panel may be damaged at the lower temperature than storage temperature range described in individual specification.

### 3) ULTRA VIOLET RAY

Store LCD module without exposure to direct sunlight or fluorescent lamps in order to prevent the module from strong ultra violet ray.

### 4) CLEANLINESS

Keep the module in clean place, because any dust, hard particle may damage the polarizer, or dust invades the inside of the module.



### 5)\* CONDENSATION OF WATER

Avoid condensation of water on LCD module, otherwise it may cause miss-operation or defects. Keep away LCD module from such ambient.

### 6) PACKAGING

In case of transportation or storage after opening the original packaging, LCD modules are recommended to be repacked into the original packaging with the same method, especially with same kind of desiccant.

# CONTENTS

|   |          |
|---|----------|
| Revision History .....  | 1        |
| Caution and Handling Precaution .....   | 2        |
| For Safety .....  | 2        |
|  Warning ..... | 2        |
|  Caution ..... | 2        |
| For Designing the System.....   | 2        |
| For Installation in Assembly .....  | 2        |
| For Transportation and Storage.....   | 2        |
| <b>1 Scope .....</b>  | <b>2</b> |
| <b>2 Specifications.....</b>  | <b>2</b> |
| <b>2.1. General specifications .....</b>  | <b>2</b> |
| <b>2.2. Absolute maximum ratings.....</b>   | <b>2</b> |
| <b>2.3. Mechanical specifications .....</b>   | <b>2</b> |
| 2.3.1 Device outside view .....   | 2        |
| <b>2.4. Electrical specification.....</b>   | <b>2</b> |
| 2.4.1 Circuit block diagram.....  | 2        |
| 2.4.2 Timing chart .....  | 2        |
| 2.4.3 Timing characteristics of input signals .....   | 2        |
| 2.4.4 Interface .....   | 2        |
| 2.4.5 Sequence for power on/off and signal on/off .....   | 2        |
| <b>3 Recommended operating conditions.....</b>  | <b>2</b> |
| <b>4 Product specification.....</b>   | <b>2</b> |
| <b>4.1. Mechanical test.....</b>  | <b>2</b> |
| 4.1.1 Appearance.....   | 2        |
| 4.1.2 Outline dimension .....   | 2        |
| 4.1.3 .Serial number label .....  | 2        |
| <b>4.2. Electrical characteristic test .....</b>  | <b>2</b> |
| 4.2.1 Common test conditions.....   | 2        |
| 4.2.2 Electrical standard.....  | 2        |
| <b>4.3. Optical characteristic test.....</b>  | <b>2</b> |
| 4.3.1 Common test conditions.....   | 2        |
| 4.3.2 Optical characteristic standard .....   | 2        |
| <b>4.4. Display quality .....</b>   | <b>2</b> |
| 4.4.1 Common test conditions.....   | 2        |
| 4.4.2 Display quality standard and judgment criteria .....                                      | 2        |
| <b>4.5. Reliability test .....</b>  | <b>2</b> |
| <b>5 Package Specification .....</b>  | <b>2</b> |
| <b>6 Measuring method for optical characteristic and display quality.....</b>                   | <b>2</b> |

## 1 Scope

This specification is applicable to Toshiba Matsushita Display Technology's Full Color TFT-LCD module "LTA070A250A" designed for portable DVD monitor use.

## 2 Specifications

### 2.1. General specifications

| Items                | Specifications  | Note  |
|----------------------|---|---|
| Screen size          | 18cm (7-Type) diagonal screen   |   |
| Display mode         | TN full color, Transmitting type  | Normally white  |
| Contents             | TFT-cell, Drivers-IC, Backlight-unit                                    |   |
| Viewing direction    | 6 o'clock (in direction of maximum CR)                                  | Refer to figure A (Next sheet)                                      |
| Driving method       | a-Si TFT active matrix, Line sequential scanning<br>Non-Interlace drive |   |
| Input signal         | Sync.   | Horizontal/Vertical start pulse and clock<br>Vertical (gate) enable |
|                      | Signal  | Specified analog RGB signals (H-line inverted)                      |
|                      | Common  | H-line alternate signal   |
| Number of pixels     | 480(W) x 234(H)   | Note 1  |
| Number of sub-pixels | 1440(W) x 234(H)  | Note 1  |
| Pixel pitch          | 0.321(W) x 0.370(H)   | [Unit: mm]  |
| Pixel arrangement    | RGB stripe  | Note 1  |
| Outline dimension    | 166.0(W) x 100.0(H) x 7.0(D) (typ.)                                     | [Unit: mm]  |
| Backlight            | FL side light (L type 1 lamp)   |   |
| Surface treatment    | Anti-glare coating on LCD panel surface. Wide view film                 |   |
| Weight               | 175 (typ.)  | [Unit: g]   |

Note 1: Pixel arrangement

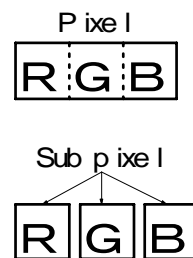
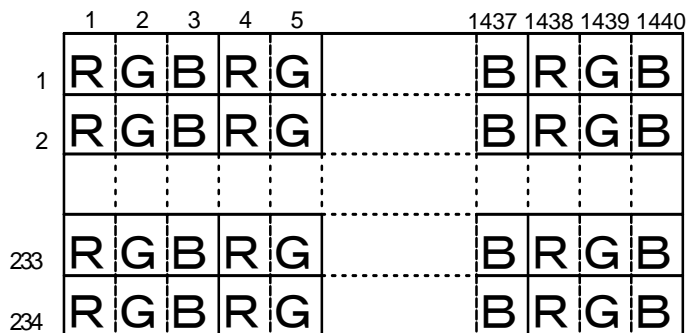
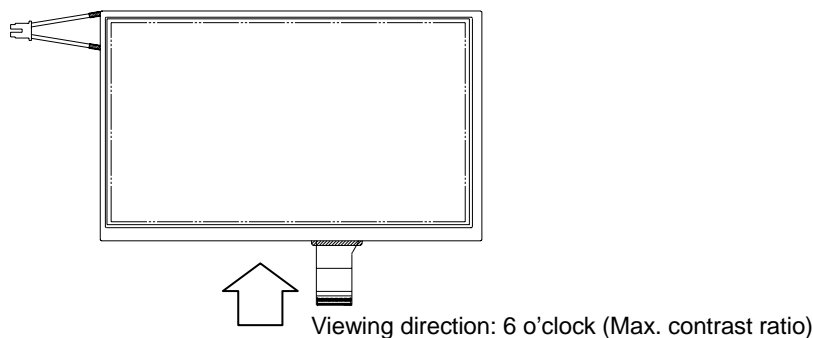


Figure A: Viewing direction



## 2.2. Absolute maximum ratings

(Note 1)

| CHARACTERISTICS                 | SYMBOL | CONDITION | MIN.      | MAX.     | UNIT   | REMARKS   |
|---------------------------------|--------|-----------|-----------|----------|--------|-----------|
| Logic voltage                   | VDD    | Ta=25°C   | -0.3      | 6.5      | V      |           |
| Source driver voltage           | VEE    | Ta=25°C   | -0.3      | 6.5      | V      |           |
| Logic signal voltage            | VIN    | Ta=25°C   | -0.3      | VDD+0.3  | V      |           |
| Analog input voltage            | VANA   | Ta=25°C   | -0.2      | VEE+0.2  | V      | Note 4    |
| Gate driver<br>Positive voltage | VGON   | Ta=25°C   | -0.3      | 45.0     | V      | VSS=0     |
| Gate driver<br>Negative voltage | VSS    | Ta=25°C   | VGON-45.0 | VGON+0.3 | V      |           |
| Back light input voltage        | VBL    | Ta=25°C   | -         | 3000     | ACVrms |           |
| Operation temp                  | Top    | -         | -20       | 70       | °C     | Note 2, 3 |
| Operation humidity              | Hop    | -         | -         | 90       | %(RH)  |           |
| Storage temp                    | Tstg   | -         | -30       | 80       | °C     | Note 3    |
| Storage humidity                | Hstg   | -         | -         | 95       | %(RH)  |           |

Note 1: Do not exceed the maximum rating values under the worst probable conditions taking into account the supply voltage variation, input voltage variation, variation in part constants, and ambient temperature and so on. Otherwise the module may be damaged.

Note 2: The temperature of the module rises under the influence of the backlight. Please design that all parts of this module do not to exceed maximum operation temperature (Top).

Note 3: The temperature on TFT-LCD panel surface.

Note 4: Terminals: VB, RED, GREEN, BLUE

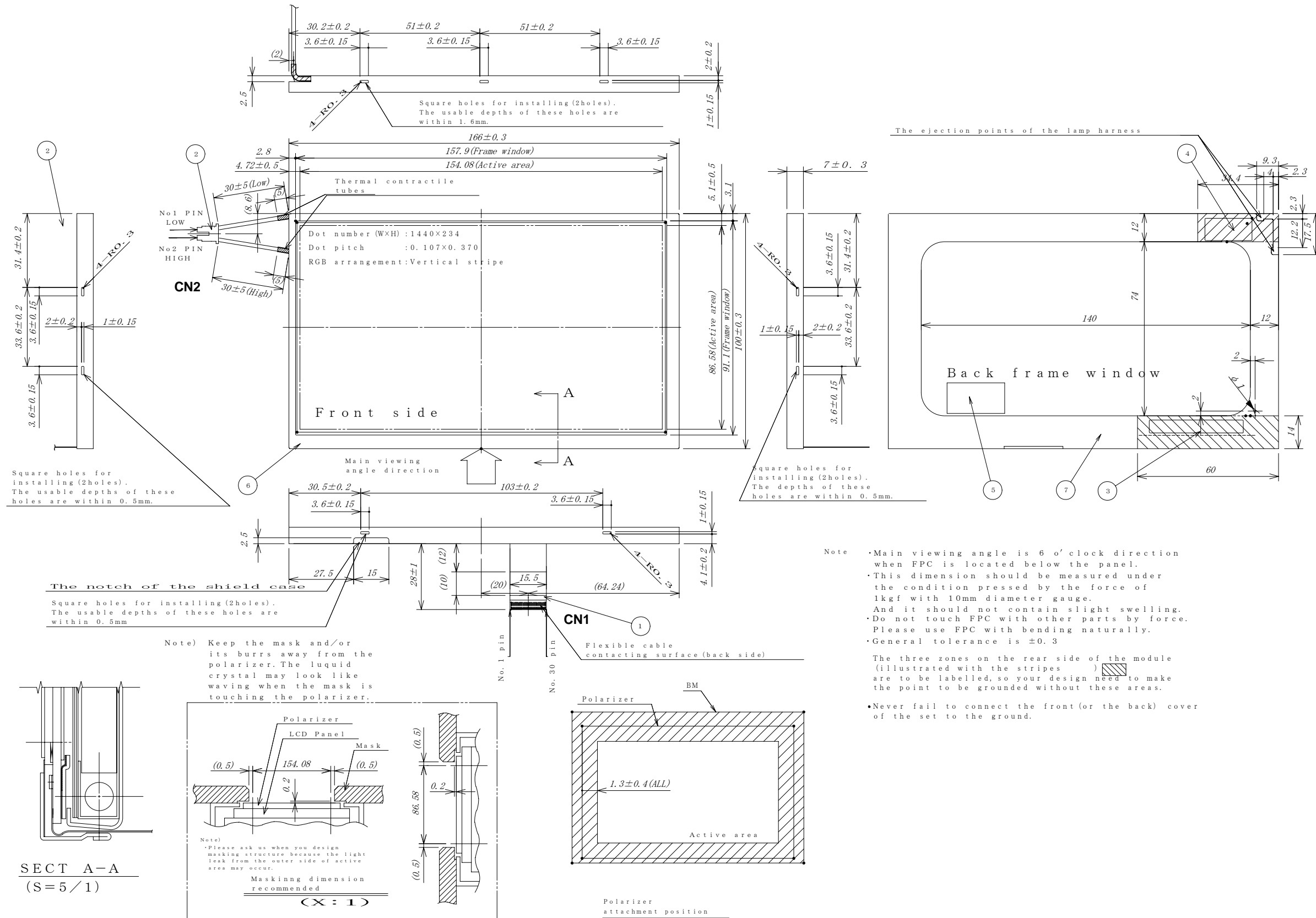
## 2.3. Mechanical specifications

### 2.3.1 Device outside view

| Item              | Specification                   | Unit | Remarks |
|-------------------|---------------------------------|------|---------|
| Outline dimension | 166.0 (W) x 100.0 (H) x 7.0 (D) | mm   | Typ.    |
| Active area:      | 154.08 (W) x 86.58 (H)          | mm   |         |
| Viewing area      | 156.08 (W) x 88.58 (H)          | mm   |         |

Device outside view

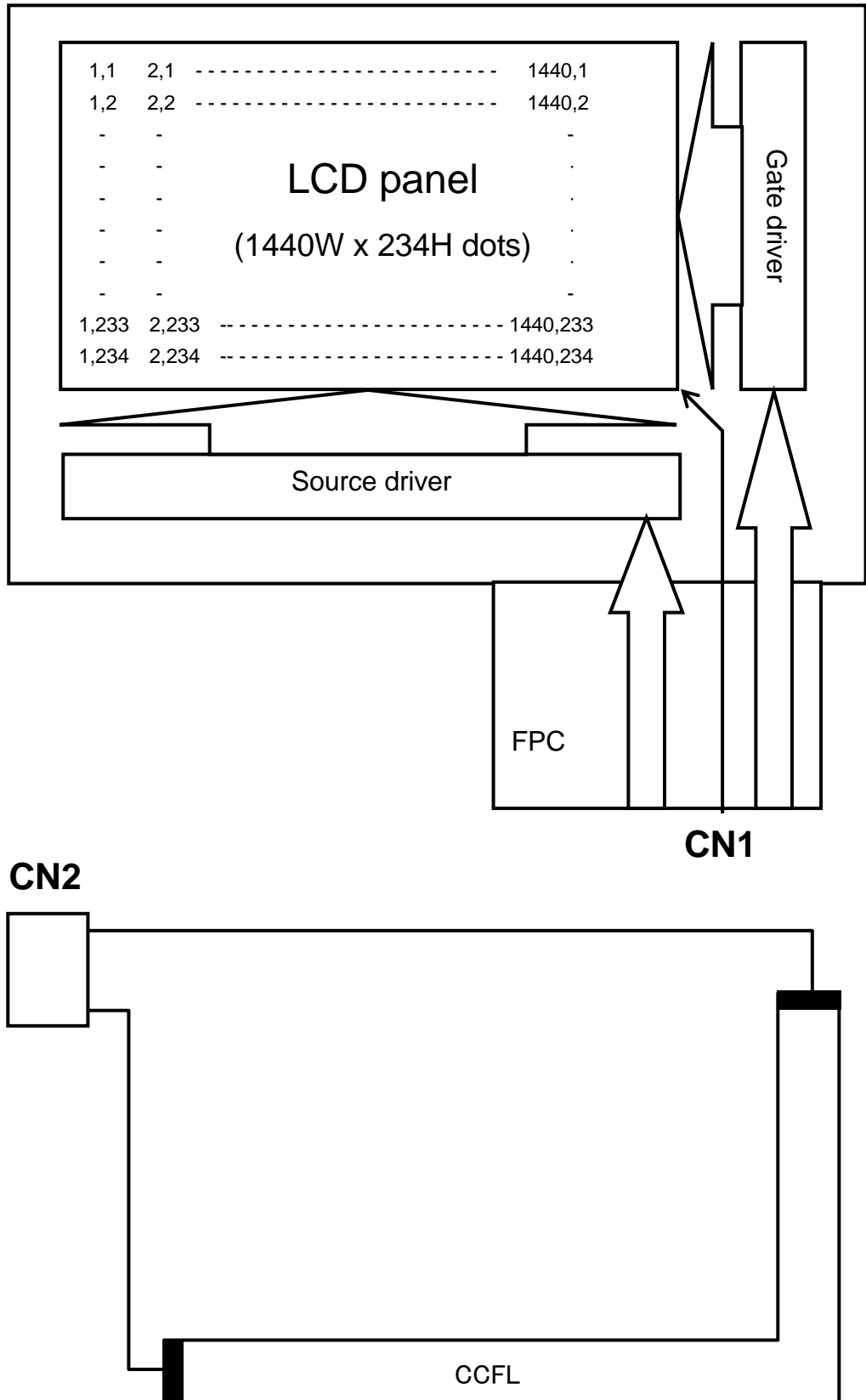
Unit: mm



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## 2.4. Electrical specification

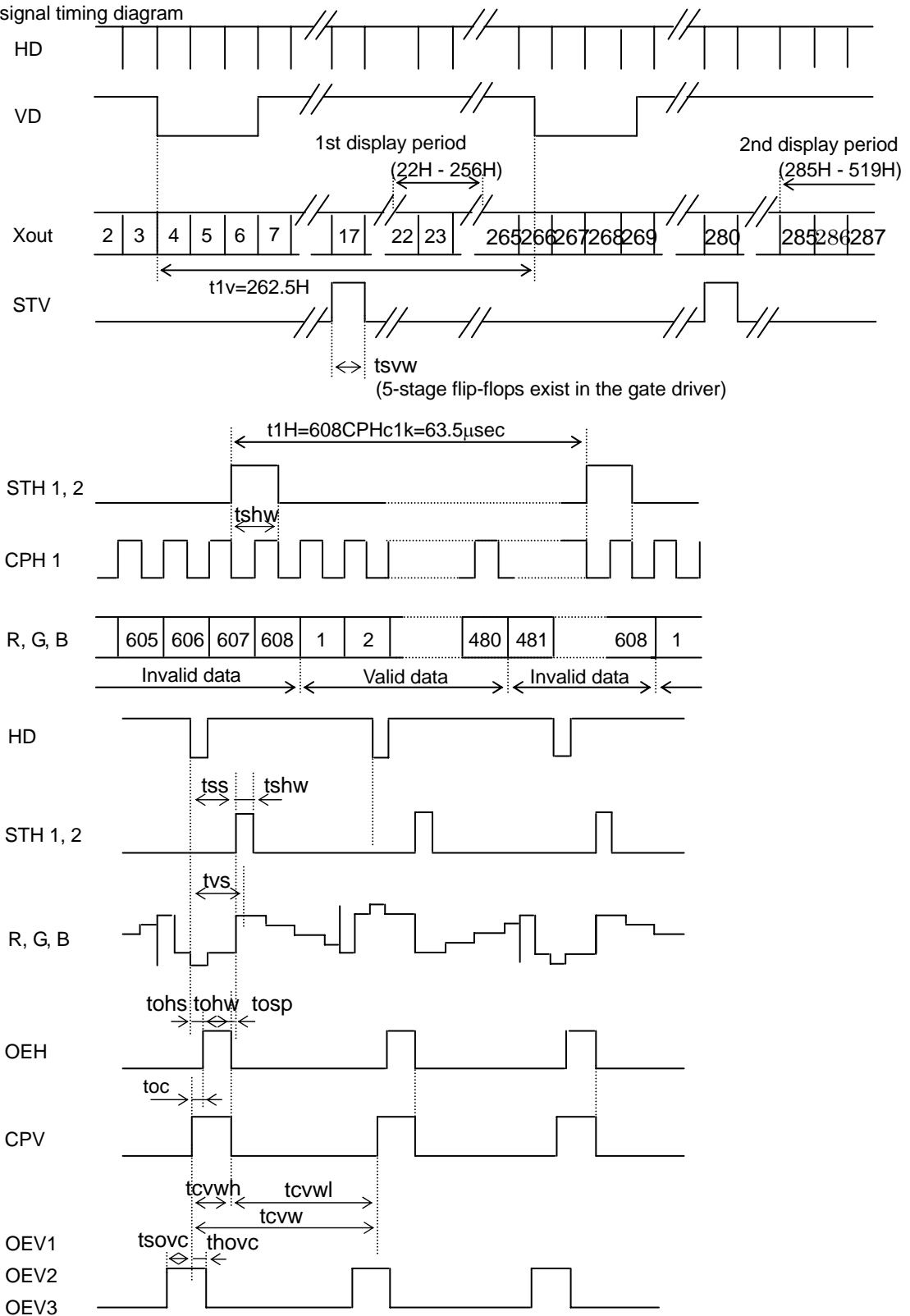
### 2.4.1 Circuit block diagram





**2.4.2 Timing chart**

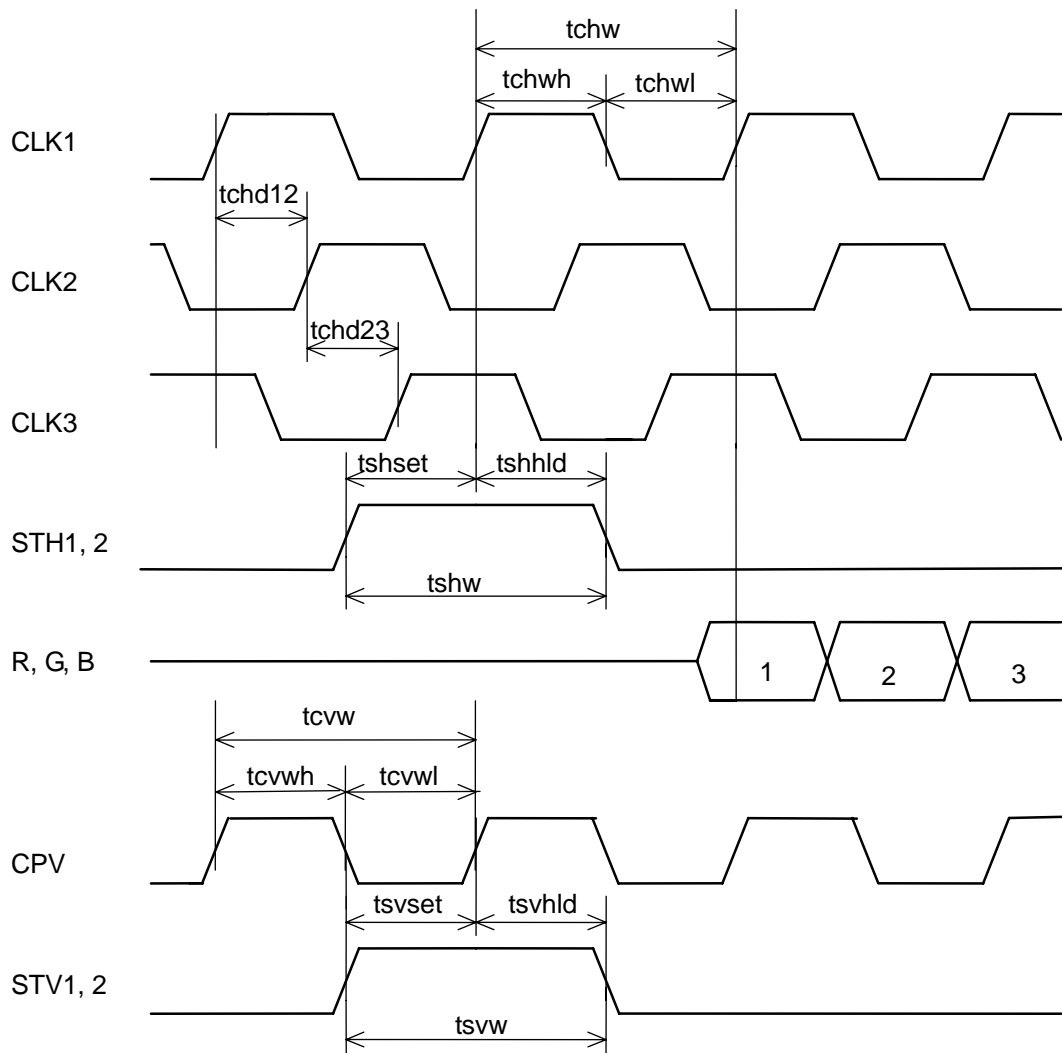
(1) Video signal timing diagram



\*At the full scan mode

Note: At the time of a power on sequence, OEV should hold on "Hi" at least 1 field scanning period ( $t1V$ ), after STV and CPV are outputted.

(2) Control signal timing diagram



## 2.4.3 Timing characteristics of input signals

| CHARACTERISTICS   | SYMBOL | MIN   | TYP   | MAX     | UNIT | REMARKS               |
|---|--------|-------|-------|---------|------|-----------------------|
| 1 Field scanning period                                       | t1V    | -     | 262.5 | -       | H    |                       |
| 1 Line scanning period  | tylH   | -     | 63.5  | -       | μs   |                       |
| Source driver operating frequency                             | fhc    | 1.00  | 9.56  | 10.00   | MHz  | CLK<br>Full scan mode |
|   | fhc    |       |       | (14.4)  | MHz  | Side panel area       |
| Signal sampling pulse width                                   | tchwh  | 100.0 | 104.6 | 1000.0  | ns   |                       |
| Signal sampling pulse delay                                   | tchd   | 31.4  | 34.9  | 38.4    | ns   | tchd 12,23            |
| Signal sampling pulse width(H)                                | tchwh  | 47.1  | 52.3  | 57.5    | ns   |                       |
| Signal sampling pulse width(L)                                | tchwl  | 47.1  | 52.3  | 57.5    | ns   |                       |
| Source start signal pulse width                               | tshw   | 30.0  | 104.6 | 208.0*  | ns   | *tshset=tshhld        |
| Source start signal setup time                                | tshset | 20.0  | 52.3  | -       | ns   |                       |
| Source start signal hold time                                 | tshhld | 10.0  | 52.3  | -       | ns   |                       |
| Source output enable pulse width                              | tohw   | 7.5   | 8.0   | 8.5     | μs   |                       |
| Source start signal rising time                               | tss    | 1.45  | 9.85  | 10.96   | μs   |                       |
| Video input signal start point                                | tvS    | 1.59  | 10.00 | 11.11   | μs   |                       |
| Phase difference between OEH & CPV                            | toc    | 1.5   | 2.3   | -       | μs   |                       |
| Phase difference of the standup of CPV,<br>and standup of OEV | tsovc  | 1.0   | 1.5   | 2.0     | μs   |                       |
| Phase difference of the standup of CPV,<br>and falling of OEV | thovc  | 2.0   | 3.0   | 4.0     | CLK  |                       |
| Gate clock period   | tcvw   | 10.0  | 63.5  | -       | μs   |                       |
| Gate clock pulse width (H)                                    | tcvwh  | 5.0   | 10.3  | 58.5    | μs   |                       |
| Gate clock pulse width (L)                                    | tcvwl  | 5.0   | 53.2  | 58.5    | μs   |                       |
| Gate start signal pulse width                                 | tsvw   | 5.0   | 63.5  | 126.0** | μs   | **tsvset=tsvhld       |
| Gate start signal setup time                                  | tsvset | 2.00  | 31.75 | -       | μs   |                       |
| Gate start signal hold time                                   | tsvhld | 2.00  | 31.75 | -       | μs   |                       |
| Phase difference between OEH & STH                            | tosp   | 0.11* | 0.5   | -       | μs   | *At<br>fhc=9.56MHz    |
| Phase difference between SYNC & OEH                           | tohs   | -     | 1.4   | 1.9     | μs   |                       |

## Note:

Rise time (tr) and fall time (tf) of source driver logic signal are less than 6ns.

Rise time (tr) and fall time (tf) of gate driver logic signal are less than 50ns.

Rise time (tr) and fall time (tf) of OEH are less than 200ns.

Rise time (tr) and fall time (tf) of OEV are less than 200ns.

Rise time (tr) and fall time (tf) is defined as the time from 0% to 63.2%.

## 2.4.4 Interface

[CN1] LCD FPC Cable (30pin-0.5mm pitch)

Mating connector: IL-FPR series (30pin-0.5mm pitch/Gilded type)/Japan Aviation Electronics Industry, Limited

| Pin NO | SYMBOL | Function  | Remarks |
|--------|--------|---|---------|
| 1      | VCOM   | Voltage applied to color filter substrate             | Note 1  |
| 2      | STH1   | Source scanning start signal 1                        | Note 3  |
| 3      | VB     | Source output current adjustment                      |         |
| 4      | RED    | Red video signal                                      | Note 1  |
| 5      | GREEN  | Green video signal                                    | Note 1  |
| 6      | BLUE   | Blue video signal                                     | Note 1  |
| 7      | OEH    | Source driver output enable                           |         |
| 8      | VDD    | Power line for logic                                  | Note 1  |
| 9      | MODE   | Sampling mode change (H: Simultaneous, L: Sequential) | Note 4  |
| 10     | CLK1   | Source driver clock input 1                           | Note 4  |
| 11     | CLK2   | Source driver clock input 2                           | Note 4  |
| 12     | CLK3   | Source driver clock input 3                           | Note 4  |
| 13     | RL     | Right / Left scanning change                          | Note 3  |
| 14     | STH2   | Source scanning start Signal 2                        | Note 3  |
| 15     | VEE    | Power line for source driver IC                       | Note 1  |
| 16     | GND    | Ground  |         |
| 17     | VCOM   | Voltage applied to color filter substrate             | Note 1  |
| 18     | STV2   | Gate scanning start signal 2                          | Note 2  |
| 19     | OEV3   | Gate driver output enable 3                           |         |
| 20     | OEV2   | Gate driver output enable 2                           |         |
| 21     | OEV1   | Gate driver output enable 1                           |         |
| 22     | CPV    | Gate driver scanning clock pulse                      |         |
| 23     | U/D    | Up/Down scanning change                               | Note 2  |
| 24     | STV1   | Gate scanning start signal 1                          | Note 2  |
| 25     | NC     | Non connect   |         |
| 26     | VSS    | Gate driver negative voltage                          | Note 1  |
| 27     | GND    | Ground  |         |
| 28     | VDD    | Power line for logic                                  | Note 1  |
| 29     | NC     | Non connect   |         |
| 30     | VGON   | Gate driver positive voltage                          | Note 1  |

[CN2] FL power source (connector: BHSR-02VS-1 / J.S.T. Mfg. Co., Ltd.)

Mating connector: SM02 B-BHSS-1 / J.S.T. Mfg. Co., Ltd.

| No. | Symbol           | Functions                           | I/O   | Remarks |
|-----|------------------|-------------------------------------|-------|---------|
| 1   | V <sub>FLL</sub> | FL power supply for Backlight (GND) | Input | White   |
| 2   | V <sub>FLH</sub> | FL power supply for Backlight (HOT) | Input | Pink    |

Note 1: Refer to 2.4.5Sequence for power on/off and signal on/off for Input supply voltage sequence.

Note 2: Switch scanning direction of UP/DOWN as follows:

|               | UD | STV1   | STV2   | Remarks |
|---------------|----|--------|--------|---------|
| Reverse shift | Hi | Input  | Output |         |
| Order shift   | Lo | Output | Input  | Usual   |

Note 3: Switch scanning direction of RIGHT/LEFT as follows:

|               | RL | STH1   | STH2   | Remarks |
|---------------|----|--------|--------|---------|
| Order shift   | Hi | Input  | Output | Usual   |
| Reverse shift | Lo | Output | Input  |         |

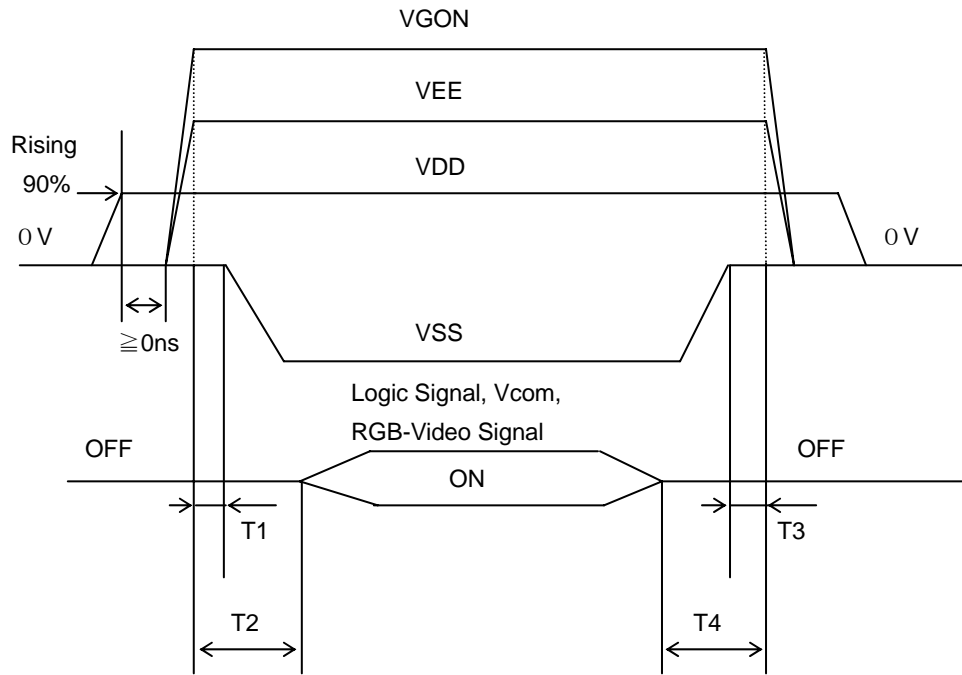
Note 4: Set source sampling mode as follows:

|                      | MODE | CLK1  | CLK2  | CLK3  |
|----------------------|------|-------|-------|-------|
| Sequential sampling  | Lo   | Input | Input | Input |
| Synchronous sampling | Hi   | Input | Hi    | Hi    |

Note 5: Refer to 4.2.2Electrical standard and 2.4.3Timing characteristics of input signals for each electrical specification.

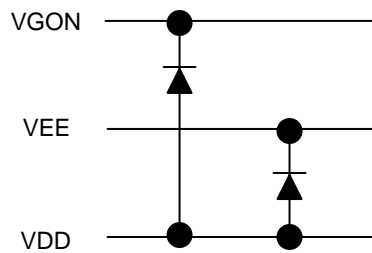
Note 6: Refer to 2.3.1Device outside view for arrangement of Input/Output terminals.

2.4.5 Sequence for power on/off and signal on/off



1)  $10\text{ms} \leq T1 < T2, 0 < T3 < T4 \leq 10\text{ms}$

2) Please use the schottky Barrier Diode among VDD, VEE and VGON, as follows;



### 3 Recommended operating conditions

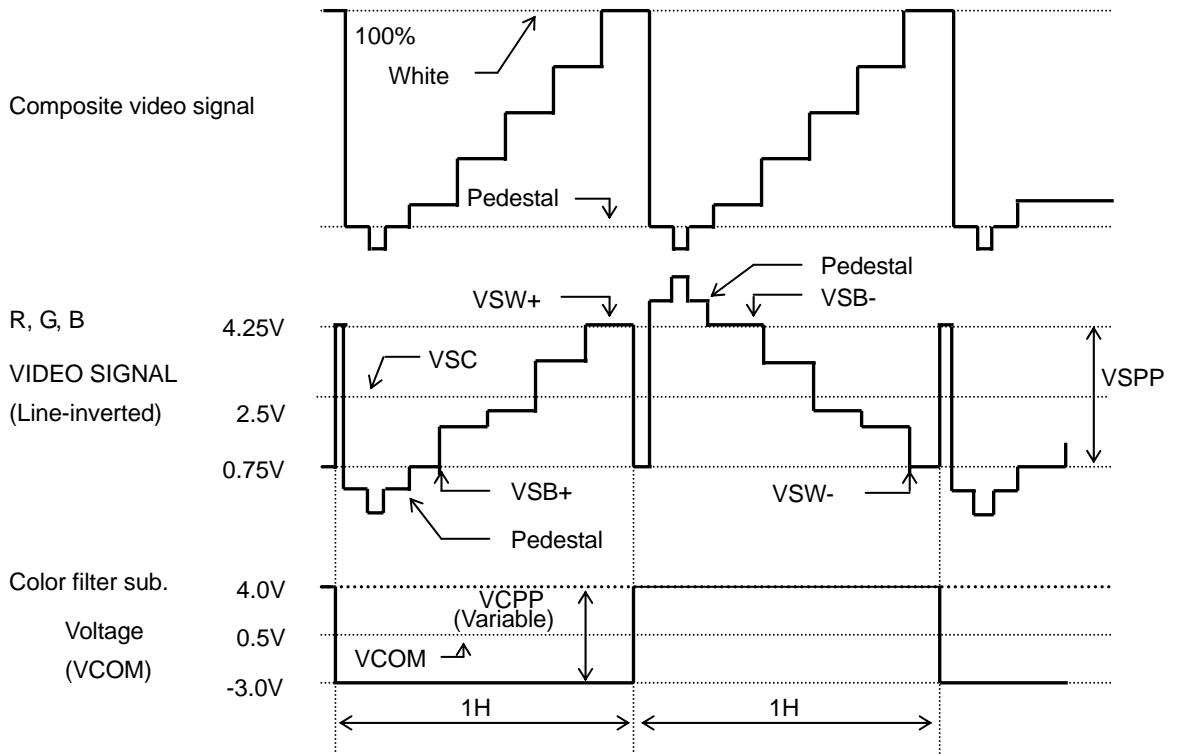
(Note 1)

| ITEM                                     | SYMBOL    | MIN.      | TYP.  | MAX.      | UNIT    | REMARKS                            |
|--|-----------|-----------|-------|-----------|---------|------------------------------------|
| IC logic voltage                         | VDD       | 2.7       | 3.3   | 3.6       | V       |                                    |
| Source driver IC voltage                 | VEE       | 4.5       | 5.0   | 5.5       | V       |                                    |
| Logic signal input voltage               | VIL       | 0         | -     | 0.20*VDD  | V       |                                    |
|  | VIH       | 0.80*VDD  | -     | VDD       | V       |                                    |
| Black input voltage (+)                  | VSB+      | (0.20)    | 0.75  | (VSW+)    | V       | R,G,B, VEE=5.0V Note2,3            |
| White input voltage (+)                  | VSW+      | (VSB+)    | 4.25  | (4.80)    | V       | R,G,B, VEE=5.0V Note2,3            |
| Black input voltage (-)                  | VSB-      | (VSW-)    | 4.25  | (4.80)    | V       | R,G,B, VEE=5.0V Note2,3            |
| White input voltage (-)                  | VSW-      | (0.20)    | 0.75  | (VSB-)    | V       | R,G,B, VEE=5.0V Note2,3            |
| Source signal width                      | VSPP      | -         | 3.5   | VEE-0.4   | Vpp     | R,G,B, VEE=5.0V Note 3             |
| Source driver center voltage             | VSC       | VEE/2-0.2 | VEE/2 | VEE/2+0.2 | V       | R,G,B, VEE=5.0V Note 3             |
| Source output current adjustment         | VB        | 1.8       | 2.0   | 2.2       | V       | VEE=5.0V<br>VSPP=3.5V<br>VCPP=7.0V |
| Gate driver positive voltage             | VGON      | 16.0      | 17.0  | 18.0      | V       |                                    |
| Gate driver negative voltage             | VSS       | -14.0     | -13.0 | -12.0     | V       |                                    |
| V center applied to color filter sub.    | VCOM      | -0.5      | 0.5   | 1.5       | V       | Note 3,4                           |
| V amplitude applied to color filter sub. | VCPP      | 3.0       | 7.0   | 9.0       | Vpp     | Note 3                             |
| (VSPP+VCPP)/2                            | -         | -         | -     | 5.5       | V       |                                    |
| FL input current                         | $I_{FL}$  | 3.0       | 6.5   | 7.0       | mA(rms) |                                    |
| FL driving voltage                       | $V_{FL}$  | -         | 600   | -         | V (rms) | $I_{FL}$ =6.5mA(rms) Note 5        |
| FL driving frequency                     | $f_{FL}$  | 30        | 40    | 80        | kHz     | Note 6                             |
| FL starting voltage                      | $V_{SFL}$ | 1900      | -     | -         | V (rms) | -20°C Note 7                       |

Note 1: The recommended operating conditions show the ranges in which the device can operate normally. Operation beyond the limit of the recommended operating conditions is not assured, even though operating conditions are within the limit of the absolute maximum ratings.

Note 2: H-line inverted drive.

Note 3: Source signal width (VSPP) and V amplitude applied to color filter sub. (VCP) ;  
 RGB video signal and VCOM should be inverted every 1H as follows (an example of input timing).  
 VCOM driving circuit should be designed with 50Ω or less output impedance.



- Note 4: Adjust for minimum flicker.
- Note 5: FL input current values are reference.
- Note 6: Recommended for Horizontal frequency: 40.0kHz
- Note 7: Initial value.



## 4 Product specification

### 4.1. Mechanical test

#### 4.1.1 Appearance

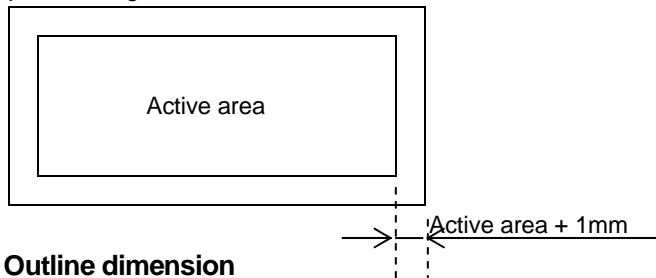
(1) Standard measurement conditions;

Illumination: Approximately 500 (lx)  
 Distance between eyes and LCD: Approximately 0.3 (m)  
 Driving condition: Non-operation

(2) Appearance specification

| Inspection parts                         | Items  | Standard  | Remarks          |          |                |            |                      |                                 |               |    |        |
|--|--|---|------------------|----------|----------------|------------|----------------------|---------------------------------|---------------|----|--------|
| Cell                                     | Front side scratch   | <table border="1"> <tr> <th>Line width (mm)</th> <th>Judgment</th> </tr> <tr> <td><math>W &lt; 0.05</math></td> <td>Neglect</td> </tr> <tr> <td><math>0.05 \leq W &lt; 0.15</math></td> <td>Total length <math>\leq 50\text{mm}</math></td> </tr> <tr> <td><math>0.15 \leq W</math></td> <td>NG</td> </tr> </table> | Line width (mm)  | Judgment | $W < 0.05$     | Neglect    | $0.05 \leq W < 0.15$ | Total length $\leq 50\text{mm}$ | $0.15 \leq W$ | NG | Note 1 |
|  |  | Line width (mm)   | Judgment         |          |                |            |                      |                                 |               |    |        |
|  | $W < 0.05$   | Neglect   |                  |          |                |            |                      |                                 |               |    |        |
|  | $0.05 \leq W < 0.15$                                       | Total length $\leq 50\text{mm}$   |                  |          |                |            |                      |                                 |               |    |        |
|  | $0.15 \leq W$  | NG  |                  |          |                |            |                      |                                 |               |    |        |
|  | Spot   | <table border="1"> <tr> <th>Size (sub pixel)</th> <th>Judgment</th> </tr> <tr> <td><math>D &lt; 1</math></td> <td>Neglect</td> </tr> <tr> <td><math>1 \leq D &lt; 3</math></td> <td>1 dark sub pixel</td> </tr> <tr> <td><math>3 \leq D</math></td> <td>NG</td> </tr> </table>                                      | Size (sub pixel) | Judgment | $D < 1$        | Neglect    | $1 \leq D < 3$       | 1 dark sub pixel                | $3 \leq D$    | NG |        |
|  | Size (sub pixel)   | Judgment  |                  |          |                |            |                      |                                 |               |    |        |
| $D < 1$                                  | Neglect  |   |                  |          |                |            |                      |                                 |               |    |        |
| $1 \leq D < 3$                           | 1 dark sub pixel   |   |                  |          |                |            |                      |                                 |               |    |        |
| $3 \leq D$                               | NG   |   |                  |          |                |            |                      |                                 |               |    |        |
| Rear side scratch                        | Same as front scratch standard.<br>(Condition: front view) |   |                  |          |                |            |                      |                                 |               |    |        |
| Flaw                                     | Display of the module should be maintained.                |   |                  |          |                |            |                      |                                 |               |    |        |
| Dirt                                     | No dirt that cannot be cleaned easily.                     |   |                  |          |                |            |                      |                                 |               |    |        |
| Discoloration                            | No conspicuous discoloration.                              |   |                  |          |                |            |                      |                                 |               |    |        |
| Shield case<br>(Black front shield case) | Scratch  | <table border="1"> <tr> <th>Line width (mm)</th> <th>Judgment</th> </tr> <tr> <td><math>W &lt; 3.0</math></td> <td>Neglect</td> </tr> <tr> <td><math>3.0 \leq W</math></td> <td>Total length <math>\leq 90\text{mm}</math></td> </tr> </table>  | Line width (mm)  | Judgment | $W < 3.0$      | Neglect    | $3.0 \leq W$         | Total length $\leq 90\text{mm}$ |               |    |        |
|  |  | Line width (mm)   | Judgment         |          |                |            |                      |                                 |               |    |        |
|  | $W < 3.0$  | Neglect   |                  |          |                |            |                      |                                 |               |    |        |
|  | $3.0 \leq W$   | Total length $\leq 90\text{mm}$   |                  |          |                |            |                      |                                 |               |    |        |
|  | Spot   | <table border="1"> <tr> <th>Diameter (mm)</th> <th>Judgment</th> </tr> <tr> <td><math>D &lt; \phi 3.0</math></td> <td><math>n \leq 3</math></td> </tr> <tr> <td><math>\phi 3.0 \leq D</math></td> <td>NG</td> </tr> </table>  | Diameter (mm)    | Judgment | $D < \phi 3.0$ | $n \leq 3$ | $\phi 3.0 \leq D$    | NG                              |               |    |        |
| Diameter (mm)                            | Judgment   |   |                  |          |                |            |                      |                                 |               |    |        |
| $D < \phi 3.0$                           | $n \leq 3$   |   |                  |          |                |            |                      |                                 |               |    |        |
| $\phi 3.0 \leq D$                        | NG   |   |                  |          |                |            |                      |                                 |               |    |        |
| Dirt                                     | No dirt that cannot be cleaned easily.                     |   |                  |          |                |            |                      |                                 |               |    |        |
| Burr                                     | No injurious burrs.  |   |                  |          |                |            |                      |                                 |               |    |        |
| Interface connector and Backlight cable  | Scratch  | No scratch.   |                  |          |                |            |                      |                                 |               |    |        |
|  | Distortion   | No distortion.  |                  |          |                |            |                      |                                 |               |    |        |

Note 1: Inspection range: Active area + 1mm

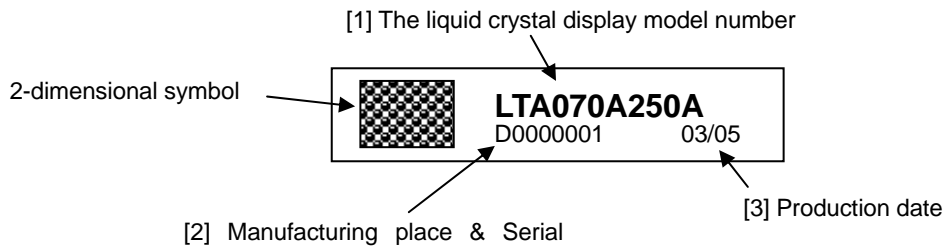


#### 4.1.2 Outline dimension

Refer to 2.3.1 Device outside view

**4.1.3 Serial number label**

- (1) Product label
  - a) Label indications



| Items         |   | Contents  |
|---------------|---|---|
| Product label | [1] LCD model number                    | LTA070A250A   |
|               | [2] Manufacturing place & Serial number | Structure of indication<br><u>A 0000001</u><br>(a) (b)<br><br>(a) Manufacturing place<br><br>(b) Serial number<br>Decimal system, seven figures |
|               | [3] Production date                     | Structure of indication<br><u>03 / 05</u><br>(c) (d)<br><br>(c) Year code<br>2003 → 03<br>(d) Month code<br>May → 05                            |

b) Others

- Bar cord: 2-dimensional symbol
- Stuck place: refer to 2.3.1 Device outside view.

(2) Caution label



\* Stuck place: refer to 2.3.1 Device outside view.

## 4.2. Electrical characteristic test

### 4.2.1 Common test conditions

Ambient temperature:  $T_a$  25±2°C  
 Ambient humidity:  $H_a$  40-70% (RH)  
 Supply voltage: Refer to 3Recommended operating conditions typ. value.  
 VDD=+3.3V, VEE=+5.0V, VGON=+17.0V, VSS=-13.0V  
 Input signal: Refer to 3Recommended operating conditions. typ. value.  
 VSC=+2.5V, VCPP=7.0V(p-p), VCOM=Adjust for minimum flicker.  
 Timing spec: Refer to 3Recommended operating conditions. typ. value.  
 Inverter: HIU-742A; 16.5pF (HARISON TOSHIBA LIGHTING Corp.) or equivalent  
 FL input current: Refer to 3Recommended operating conditions. typ. value.  $I_L=6.5\text{mA}$   
 FI driving frequency: Refer to 3Recommended operating conditions. typ. value.  $f_L=40\text{kHz}$   
 Measured after 30 minutes operation.

### 4.2.2 Electrical standard

| ITEM                                   | SYMBOL | MIN   | TYP   | MAX   | UNIT | REMARKS                         |
|--|--------|-------|-------|-------|------|---------------------------------|
| Logic supply current                   | IDD    | -     | 1.79  | 3.60  | mA   | VDD=3.3V Note 1                 |
| Source driver IC supply current        | IEE    | -     | 19.60 | 39.20 | mA   | VEE=5.0V,<br>VB=2.0V,<br>Note 1 |
| Gate driver IC positive supply current | IGH    | -     | 0.12  | 1.00  | mA   | VGON=17.0V Note 1               |
| Gate driver IC negative supply current | ISS    | -1.00 | -0.30 | -     | mA   | VSS=-13.0V Note 1               |

Note 1: It is not a peak current value but a regular one.

### 4.3. Optical characteristic test

#### 4.3.1 Common test conditions

Same as 4.2.1 Common test conditions.

Refer to 6 Measuring method for optical characteristic and display quality for measurement method.

#### 4.3.2 Optical characteristic standard

| CHARACTERISTICS               | SYM<br>BOL | CONDITION  |        |           | STANDARD VALUE |       |       | UNIT              | Measuring<br>Method              |
|-------------------------------|------------|------------|--------|-----------|----------------|-------|-------|-------------------|----------------------------------|
|                               |            | $\theta$   | $\phi$ | C.        | MIN.           | TYP.  | MAX.  |                   |                                  |
| 1.Luminance *note             | L          | 0°         | 0°     | /         | 300            | 400   | -     | cd/m <sup>2</sup> | IL=6.5mArms                      |
| 2.Contrast Ratio              | Cmax       | Best angle |        |           | -              | 100   | 300   | -                 | -                                |
| 3.White color<br>chromaticity | X          | 0°         | 0°     | -         | 0.275          | 0.315 | 0.355 | -                 | -                                |
|                               | Y          | 0°         | 0°     | /         | 0.300          | 0.340 | 0.380 | -                 | -                                |
| 4.Brightness uniformity       | -          | 0°         | 0°     | /         | 0.7            | -     | -     | -                 | -                                |
| 5.Vertical viewing<br>Angle   | $\theta_U$ | -          | 0°     | $\geq 10$ | 20             | 30    | -     | °                 | -                                |
|                               | $\theta_D$ | -          | 0°     | $\geq 10$ | 40             | 60    | -     | °                 | -                                |
| 6.Horizontal<br>Viewing Angle | $\phi_L$   | 0°         | -      | $\geq 10$ | 45             | 60    | -     | °                 | -                                |
|                               | $\phi_R$   | 0°         | -      | $\geq 10$ | 45             | 60    | -     | °                 | -                                |
| 7.Response Time               | $\tau_r$   | 0°         | 0°     | /         | -              | 11    | 22    | ms                | -                                |
|                               | $\tau_d$   | 0°         | 0°     | /         | -              | 22    | 44    | ms                | -                                |
| 8.Backlight life              | -          | -          | -      | -         | (10000)        | -     | -     | h                 | Continuous<br>lighting<br>Note 1 |

Note 1: Period till Brightness falls 50% from the initial value. This value is a reference value at continuous lighting.

### 4.4. Display quality

#### 4.4.1 Common test conditions

Same as 4.2.1 Common test conditions

#### 4.4.2 Display quality standard and judgment criteria

(A) Display quality standard

| Items          |                       | Definition   | Standards |
|----------------|-----------------------|--|-----------|
| Display defect | Line                  | Black, white, color line.<br>Horizontal or vertical line missing.  | No defect |
|                | Sub-pixel             | 1) Bright sub-pixel<br>Bright defect (Black background: VSPP=3.5V)<br>2) Dark sub-pixel<br>Dark defect (White Background: VSPP=3.5V) | Note 1    |
| Screen quality | Smear                 | Spot defect which brightness isn't uniform.  | Note 2    |
|                | Unevenness            | Partial brightness or chromatic non-uniformity.  |           |
|                | Non-uniformity streak | Streak shaped or chromatic non-uniformity.   |           |
|                | Reverse               | Concentrated unevenness (sub-pixel unit).  |           |
|                | Others                | Trash between LCD and backlight. , etc.  |           |

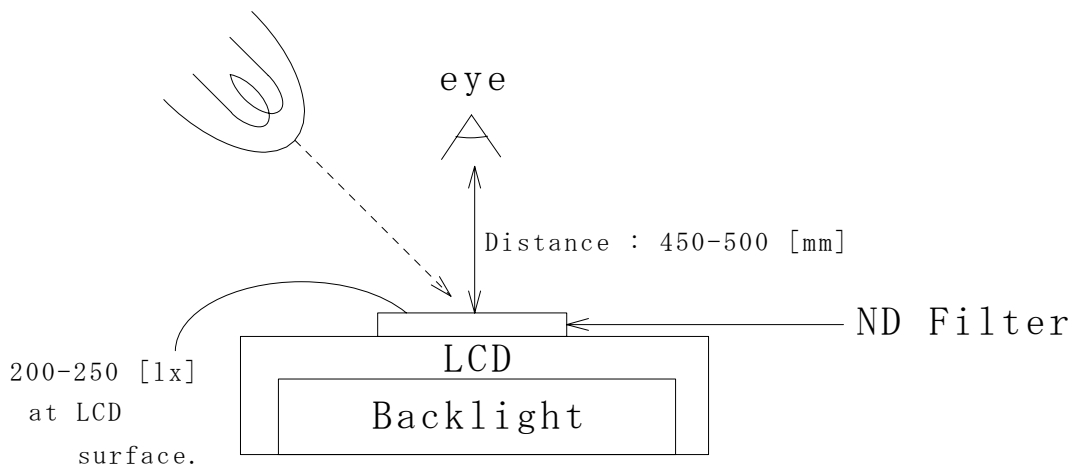
Note 1: Sub-pixel defect specifications

Bright sub-pixels are classified into the following three categories using appropriate Neutral Density (ND) Filter.  
Bright sub-pixel (which are) not visible through 2.5% ND Filter are not counted as bright sub-pixel.

Note 2: Screen quality defects (smear etc.), which cannot be found by using 2.5% ND filter, shall not be counted as defects.  
Inspection condition: Same as sub-pixel defects condition.

(B) Dot defect judgment criteria and inspection condition

Inspection condition of sub-pixel defects



Observation time: 5 [sec.]  
Surface brightness: 300-350 [cd/m<sup>2</sup>]

Judgment criteria

## (1) Sub-pixel defect

| Items            | Maximum count | Specifications                             |           |         |
|------------------|---------------|--|-----------|---------|
| Bright sub-pixel | -             | 0.3% ND                                    | 1.0% ND   | 2.5% ND |
| Level 1          | 0             | Visible                                    | Visible   | Visible |
| Level 1,2        | 3             | Invisible                                  | Visible   | Visible |
| Level 1 to 3     | 5             | Invisible                                  | Invisible | Visible |
| Dark sub-pixel   | 6             | Dark defect (White Background: VSPP=3.5V)  |           |         |
| Total            | 7             | [Bright defect (Level 1+2+3) +Dark defect] |           |         |

## (2) Cluster: (Bright sub-pixel density)

The maximum permissible sub-pixel defects number per specified area are as follows;

|                                      |                                      |
|--------------------------------------|--------------------------------------|
| Bright sub-pixel (Level 2 + Level 2) | 2 defects in $\phi 10\text{mm}$ area |
| Bright sub-pixel (Level 2 + Level 3) | 2 defects in $\phi 10\text{mm}$ area |
| Bright sub-pixel (Level 3 + Level 3) | 2 defects in $\phi 10\text{mm}$ area |
| Dark sub-pixel                       | 2 defects in $\phi 10\text{mm}$ area |
| Total (Bright and dark defects)      | 2 defects in $\phi 10\text{mm}$ area |

## (3) Linked sub-pixel defects

A) Three linked sub-pixel defects are not permissible.

B) Two linked sub-pixel defects ;

Bright + Bright : Regarded as one bright defect and classified into Level 1, 2 or 3.

Dark + Dark : Regarded as two dark defects.

Dark + Bright : Regarded as one dark defect and one bright defect (classified into Level).

(4) If any sub-pixel is counted as bright sub-pixel and dark sub-pixel, the sub-pixel is regarded as bright sub-pixel.

## (5) Dusts (in Cell)

|   | Size                                 | Judgment                             |
|---|--------------------------------------|--------------------------------------|
| 1 | 3 sub-pixels $\leq x$                | NG                                   |
| 2 | 2 sub-pixels $\leq x < 3$ sub-pixels | Regarded as two linked dark defects. |
| 3 | 1 sub-pixel $\leq x < 2$ sub-pixels  | Regarded as one dark defect.         |
| 4 | $\leq x < 1$ sub-pixel               | Uncounted.                           |

## (6) Dusts (in Backlight)

|   | Criterion                 | Judgment                  |
|---|---------------------------|---------------------------|
| 1 | $x \leq 0.2\text{mm}^2$ * | Count is dark dot defects |
| 2 | $0.2\text{mm}^2 < x$      | NG                        |

\* $0.2\text{mm}^2$  criterion: based on Japanese Mint Bureau.

## 4.5. Reliability test

| TEST ITEM   | TEST CONDITION  | JUDGMENT   |
|---|---|--|
| (1) Operation at high temperature                   | 70 °C 192h<br>(LCD panel surface temperature)   | After test, display should maintain the contents of 4.4Display quality |
| (2) Operation at low temperature                    | -20°C 192h<br>(Ambient temperature)   |  |
| (3) Operation at high temperature and high humidity | 55°C 90% 192h<br>(Ambient temperature)  |  |
| (4) High temperature exposure                       | 80°C 192h   |  |
| (5) Low temperature exposure                        | -30°C 192h  |  |
| (6) Heat shock                                      | -20°C / 70°C<br>(0.5h/0.5h) 50 cycles   |  |
| (7) Electrostatic withstanding voltage              | Panel surface :150pF ± 15 kV 150Ω<br>(Direct discharge, five times)<br>FPC input terminal: 100pF ± 200V 0Ω                          | Operate normally after test  |
| (8)Product drop test                                | 490m/s <sup>2</sup> , 11msec<br>Half-sine pulse<br>Once for each direction of X, Y and Z.   |  |
| (9) Product vibration test                          | 10 - 57 Hz: width 0.075mm<br>58 - 500 Hz: 9.8m/s <sup>2</sup> peak<br>11 minutes / cycle<br>3 hours (one hour each for X, Y and Z.) |  |
| (10) Packaged drop test                             | Bottom surface: 40cm Others : 25cm<br>Once for four surfaces, two sides, one Corner   | Operate normally after test.<br>There are not remarkable defects.      |
| (11) Packaged vibration test                        | 5 - 50 Hz<br>Z direction 9.8m/s <sup>2</sup> /54 minutes<br>X, Y direction 4.9m/s <sup>2</sup> /27 minutes                          |  |

Note: Driving conditions for operation test are same as 4.2.1Common test conditions except above one of temperature and humidity.


The test (2) - (11) are performed at the backlight off condition.

The test (3) is performed at non-dew condensed condition.

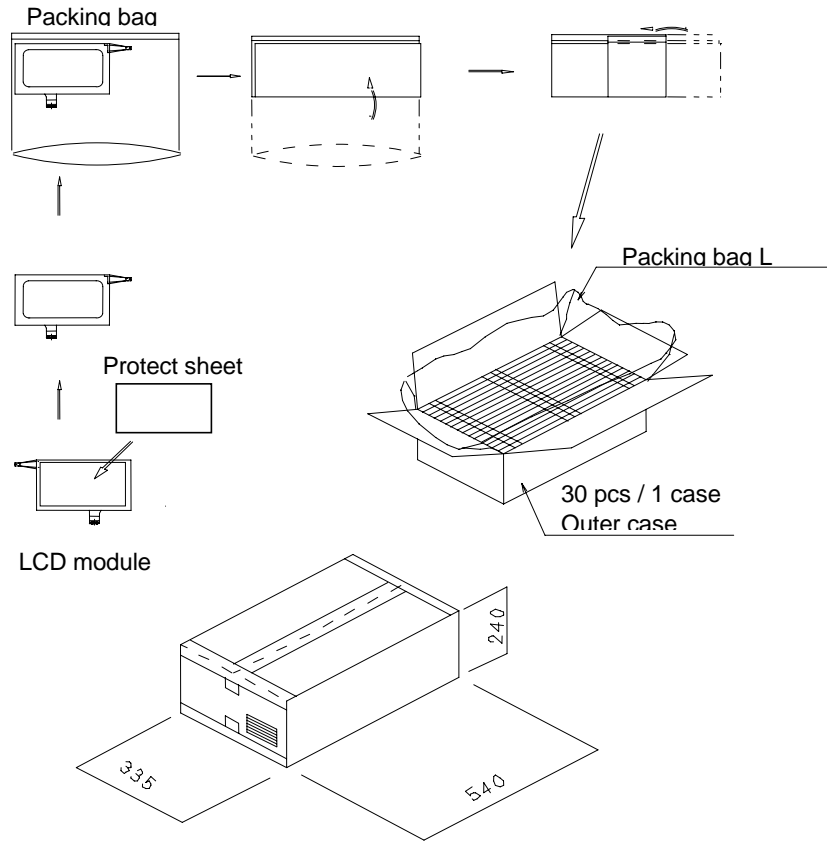
Judgment is performed after one-hour exposure at room temperature after test.

### 5 Package Specification

- (1) The LCD module is put into the packing bag with anti - electrostatics treatment, and then it is put into the outer case at the condition that the maximum quantity is 30.
- (2) Below mentioned contents are directly printed on the outer case, or the label which describes below mentioned contents is stuck to the outer case.

|  |  |
|--|--|
| CUSTOMER :   |  |
| TYPE :   | LTA070A250A  |
| QUANTITY :   | (Ex.) 30   |
| COUNTRY :  | (Ex.) MADE IN JAPAN or MADE IN CHINA   |
| CARTON No. :   | (Ex.) Bar code   |
|  |  |
| <b>*K5B0002 34970250 0000120*</b>  |  |
|  | TMD<br>Serial number Management No<br>Production month<br>Production year<br>Manufacturing place |
| Lot No. :  | Production date (Ex.) 5B3A (20050221)  |

- (3) The drawing for packaging



- (4) Acceptable number of piling: 8 sets



## 6 Measuring method for optical characteristic and display quality

### (1) Measuring method for brightness

Measuring instrument

TOPCON BM-5A (measuring field = 1°)

Measuring point

Center of the display area ( $\theta = 0^\circ$ ,  $\phi = 0^\circ$ )

$\theta$  : viewing angle against vertical axis

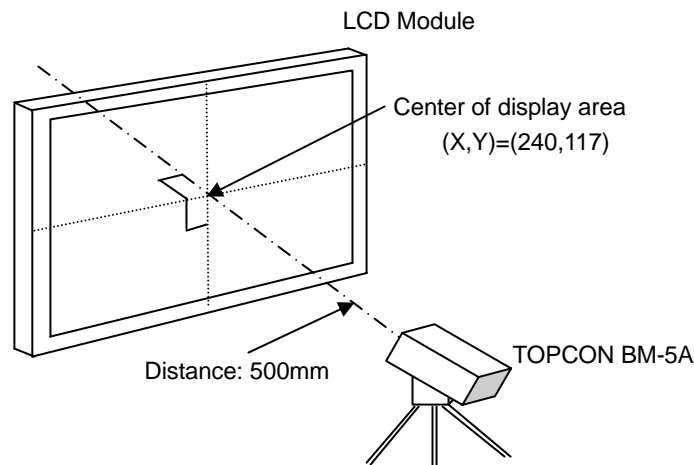
$\phi$  : viewing angle against horizontal axis

Measuring method

Measure the brightness  $B$  ( $\text{cd}/\text{m}^2$ ) and white color chromaticity  $X$ ,  $Y$  supplying signal voltage to get maximum brightness at the display pattern to be all white.

The distance from screen to "BM-5A" is 500mm.

Measure it after a lapse of at least 30 min. since a backlight is turned on.



### (2) Measuring method for contrast

Measuring instrument

TOPCON BM-5A (measuring field=1°.)

Measuring point

Center of the display area: Exactly same point as that of measuring brightness

Measuring method

Set the LCD module at  $\theta = \theta_0$ ,  $\phi = \phi_0$

$\theta$  : viewing angle in vertical axis

$\phi$  : viewing angle in horizontal axis

$\theta_0$ ,  $\phi_0$  are the best angle to get the maximum contrast.

Measure maximum brightness "Y1"(Vlc=0v) and minimum brightness "Y2"(Vlc=5v).

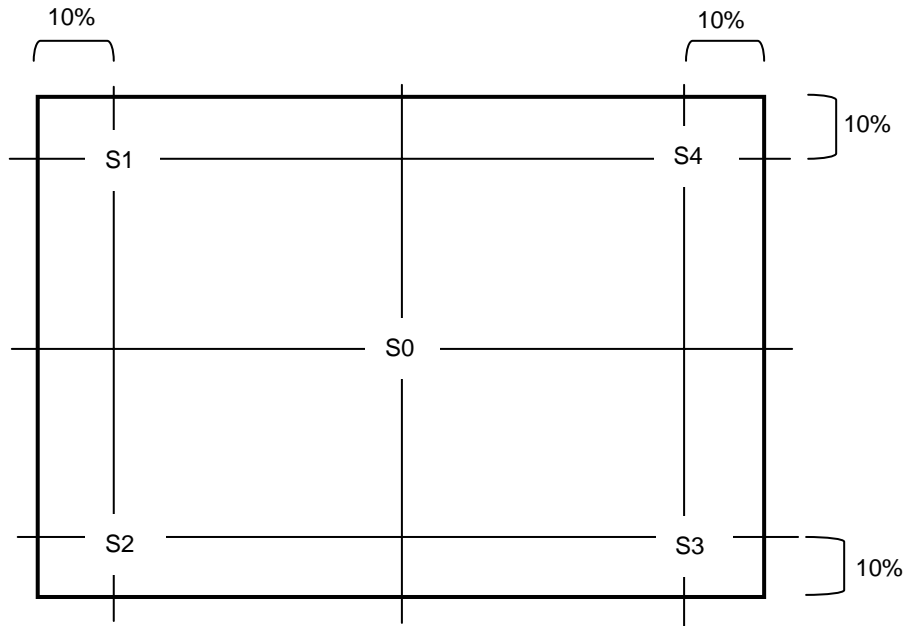
The contrast ratio  $C$  is  $Y1/Y2$ .

Where, Vlc means the effective voltage applied to liquid crystal in LCD panel.

(3) Definition of the brightness uniformity

Measure 5 points (S0 - S4) and define the brightness uniformity using the following formula.

Brightness uniformity = (The minimum brightness among S1 - S4)/S0



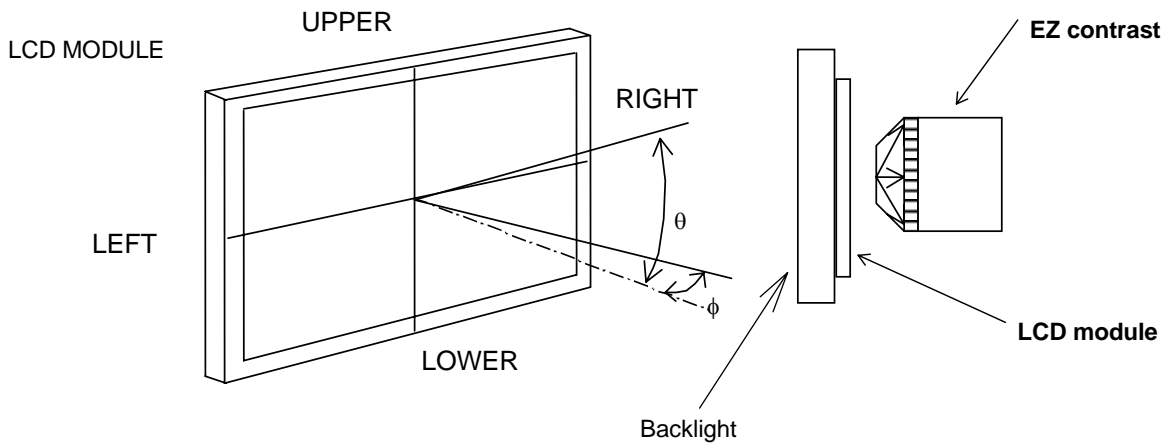
(4) Measuring method for viewing angle

Measuring instrument

ELDIM: EZ contrast

Measuring point

Center of the display area



θU: Upper side viewing angle

θL: Lower side viewing angle

φ L: Left side viewing angle

φ R: Right side viewing angle

Record upper, lower, right, left angles of contrast 10 from circular chart data of EZ contrast.

## (5). Measuring method for response time

## Measuring instrument

Ohtsuka Electric. LCD evaluation equipment LCD-7000

Measuring spot size (aperture size) is  $\phi 12\text{mm}$ .

## Measuring point

center of the display area

## Measuring method

Set LCD module at  $\phi = 0^\circ$  and  $\theta = 0^\circ$ 

Apply the signal voltage at maximum contrast ratio and switch LCD-cell off/on/off.

(Make screen white, then black and white)

When normalizing each brightness level corresponding to the display signal "OFF" and "ON" as shown in the figure below, the rise time  $\tau_r$  is defined as the time until the brightness level goes down to 10% from 90% after display signal changed from OFF to ON and also fall-time  $\tau_d$  is defined as the time until the brightness level goes up to 90% from 10% after display signal changes from "ON" to "OFF".

