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# SHARP

LIQUID CRYSTAL DISPLAY GROUP  
SHARP CORPORATION

## SPECIFICATION

SPEC No. LCD-2902

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APPLICABLE GROUP

Liquid Crystal Display  
Group

DEVICE SPECIFICATION FOR

### TFT-LCD module

MODEL No. LQ4NC01  
LQ4NC02

*Received from  
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CUSTOMER'S APPROVAL

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## (1) Introduction

Sharp Color TFT-LCD module is the active matrix LCD (Liquid Crystal Display) produced by making the most of Sharp's expertise in liquid-crystal and semiconductor technologies.

The active device is amorphous silicon TFT (Thin Film Transistor). The module accepts full color video signals (composite video and analog RGB) conforming to the NTSC(M) system standard.

When additionally provided with the backlight-driving DC/AC inverter, it is applicable to pocket TVs and various display monitors.

## (2) Features

- TFT-active matrix-LCD drive system
- 234V x 479H (total 112,086) dots (delta configuration)
- Slim, lightweight and compact
  - ① Active-area / Outline-area=53%    ② Thickness=20.7mm    ③ Weight=180g
- Built-in video interface circuit (including chroma demodulator, picture tone, video AGC circuit) and control circuit responsive to composite video signal
- Also responsive to standard analog RGB video signals
- Further RGB signals can be superimposed on composite video signal  
(In this case, RGB signals shall be digital input signal for 8 colors display)
- High quality full color rendition with backlight source incorporated.
- Viewing angle: 6 o'clock direction. (LQ4NC01)  
12 o'clock direction. (LQ4NC02)

## (3) Construction and Outline

The module consists of a TFT-LCD panel, driver ICs, control PWB mounted with electronic circuits, fluorescent tube, reflector, frame, front and rear shielding cases.

(Backlight-driving DC/AC inverter is not built in the module.)

- \* Illustration of TFT-LCD panel : See Fig. 1.
- \* Construction of TFT-LCD module : See Fig. 2.
- \* Outline dimensions of TFT-LCD module : See Fig. 3.

## (4) Module geometry

Table 1

| Parameter         | Specifications            | Unit | Remarks    |
|-------------------|---------------------------|------|------------|
| Display format    | 479(W)x234(H)             | dots |            |
| Active area       | 81.9(W)x61.8(H)           | mm   |            |
| Screen size       | 4(diagonal)               | inch |            |
| Dot pitch         | 0.171(W)x0.264(H)         | mm   |            |
| Dot configuration | R.G.B Delta configuration | -    |            |
| Outline dimension | 110.2(W)x85.8(H)x20.7(D)  | mm   | [Note 4-1] |
| Weight            | 180±10                    | g    |            |

[Note 4-1] Excluding protrusions /

## (5) Input / Output terminals

## 5-1) TFT-LCD panel driving section

Table 2

| PinNo. | Symbol           | i/o | Description   | Remarks   |
|--------|------------------|-----|---|-----------|
| 1      | HSY              | o   | Internal horizontal sync. signal(In phase with VBS)                   |           |
| 2      | VSY              | o   | Internal vertical sync. signal(In phase with VBS)                     |           |
| 3      | TST              | -   | This shall be electrically opened during operation.                   |           |
| 4      | NC               | -   | This shall be electrically opened during operation.                   |           |
| 5      | TST              | -   | This shall be electrically opened during operation.                   |           |
| 6      | GND              | i   | Ground  |           |
| 7      | VSW              | i   | Selection signal of two sets of video signals                         | [Note5-1] |
| 8      | GND              | i   | Ground  |           |
| 9      | V <sub>bpc</sub> | i   | DC bias voltage adjusting terminal of common electrode driving signal | [Note5-2] |
| 10     | VSH              | i   | Positive power supply voltage   |           |
| 11     | VBS              | i   | Composite video signal  | [Note5-3] |
| 12     | BRT              | i   | Brightness adjusting terminal   | [Note5-4] |
| 13     | CNT              | i   | Contrast adjusting terminal   | '         |
| 14     | COL              | i   | Color gain adjusting terminal   | '         |
| 15     | TIN              | i   | Tint adjusting terminal   | '         |
| 16     | VSL              | i   | Negative power supply voltage   |           |
| 17     | VRI              | i   | Color video signal (Red)  | [Note5-5] |
| 18     | VGI              | i   | ' (Green)   | '         |
| 19     | VBI              | i   | ' (Blue)  | '         |
| 20     | GND              | i   | Ground  |           |

In the following descriptions, "High" means  $V_{EH}$  and "Low" means "GND".

**[Note5-1]** Selects input signals, composite or RGB

- ① When VSW is "High" or open, composite video signal (Pin No.13) is selected.
- ② When VSW is "Low", RGB signal set (Pin No.17 through 19) is selected.

**[Note5-2]** Common electrode driving signal ( $V_{COM}$ ) generated in the module is observed on the pin. Should be opened during operation, as the DC component of  $V_{COM}$  ( $V_{CBC}$ ) is adjusted to the optimum value with  $V_{EH}$  and  $V_{EL}$  being the typical values on shipping.

But, in case of change of the optimum value (for example, lowering of the power source), it should be re-adjusted by the built-in variable resistor ( $V_{CBC}$ ) or external circuit shown in Fig.5.

Refer to (Appendix-3) "Adjusting method of optimum DC bias voltage" for re-adjusting.

**[Note5-3]** Similary in case of RGB input, apply composite video signal or composite sync. signal (with negative polarity) for sync. separator.

**[Note5-4]** Brightness, Contrast, Color gain and Tint are adjusted by the DC voltage supplied to each pin. (Contrast, color gain, and tint are not available for RGB signal input)

They are adjusted to the optimum value on shipping, but, they can be re-adjusted by the built-in variable resistor (BRT,CNT,COL,TIN) or external circuit shown in Fig.5.

(However, as the contrast is adjusted to maximize display characteristics, it is recommended not to readjust it and to remain outer adjustment terminals open.)

**[Note5-5]** ① Responsive to 0~0.7Vpp analog RGB signal when VSW is fixed to "Low"

- ② In case of superimposing on composite video signal as on screen display (ref; Note 5-1), RGB signals shall be digital signal (Low:0Vp-p High:>2Vp-p available for 8 colors display)

## 5-2) Backlight driving section

Table 3

| PinNo. | Symbol | i/o | Description                                    | Remarks   |
|--------|--------|-----|--|-----------|
| L1     | VBL 1  | i   | Input for thermal fuses                        | [Note5-6] |
| L2     | NC     | -   | No connection                                  |           |
| L3     | VF 1   | i   | Power supply for fluorescent tube filament (1) |           |
| L4     | VF 2   | i   |  | [Note5-7] |
| L5     | VF 3   | i   | Power supply for fluorescent tube filament (2) |           |
| L6     | VF 4   | i   |  |           |
| L7     | NC     | -   | No connection                                  |           |
| L8     | VBL 2  | o   | Output from thermal fuses                      | [Note5-6] |

[Note5-6] Thermal fuses are connected between the L1 and L8 terminals in the backlight unit. When connected with input power line of DC/AC inverter for backlight, the terminals can protect the backlight unit against excessive temperature rise at the lamp electrodes.

[Note5-7] Should be grounded by the backlight driving DC/AC inverter, as the L4 terminal is connected with the reflector.

It will be grounded by the optional DC/AC inverter.

(For internal electrical connection of backlight unit, see Fig.(i) below.)

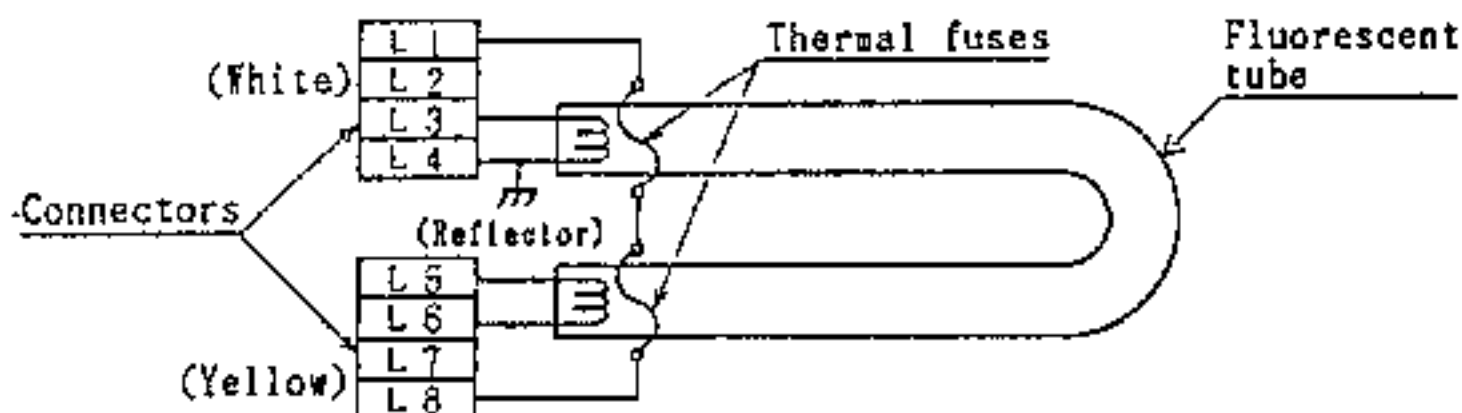


Fig. (i) Wiring diagram of backlight unit

Caution: Shielding case is separated from GND terminal and electrically open.

## (6) Absolute maximum ratings

## 6-1) TFT-LCD panel driving section

Table 4

GND=0V Ta=25°C

| Parameter  | Symbol        | MIN          | MAX          | Unit | Remarks   |    |
|--|---------------|--------------|--------------|------|-----------|----|
| Positive power supply voltage                      | $V_{SH}$      | -0.3         | +6.0         | V    |           |    |
| Negative power supply voltage                      | $V_{SL}$      | -9.0         | +0.3         | V    |           |    |
| Video input signal 1                               | $V_{i1}$      | -            | 2.0          | Vp-p | [Note6-1] |    |
| Video input signal 2                               | $V_{i2}$      | -            | $V_{SH}-0.3$ | Vp-p | [Note6-2] |    |
| Digital input/output signals                       | VI            | -0.3         | $V_{SH}+0.3$ | V    | [Note6-3] |    |
| DC bias voltage of common electrode driving signal | $V_{cdc}$     | $V_{SL}-0.3$ | -1.5         | V    |           |    |
| Picture adjusting terminal voltage                 | $V_{pic}$     | -0.3         | $V_{SH}-0.3$ | V    | [Note6-4] |    |
| Storage temperature                                | Tstg          | -25          | 60           | °C   | [Note6-5] |    |
| Operating temperature                              | Panel temp.   | $T_{opp}$    | 0            | 60   |           | °C |
|  | Ambient temp. | $T_{opa}$    | 0            | 40   |           | °C |

[Note6-1] VBS terminal (composite video signal)

[Note6-2] VRI, VGI, VBI terminals (RGB signals)

[Note6-3]  $\overline{HSY}$ ,  $\overline{VSY}$ , VSW terminals

[Note6-4] BRT, CNT, COL, TIN terminals

[Note6-5] Maximum wet-bulb temperature 38°C or less.

No dew condensation.

## 6-2) Backlight driving section

Table 5

Ta=25°C

| Parameter        | Symbol | MIN | MAX | Unit | Remarks |
|------------------|--------|-----|-----|------|---------|
| Filament voltage | $V_f$  | -   | 8.5 | Vrms |         |

## (7) Electrical characteristics

## 7-1) Recommended operating conditions

## A) TFT-LCD panel section

Table 6

GND=0V Ta=25°C

| Parameter   | Symbol               | MIN             | TYP  | MAX  | Unit             | Remarks   |           |
|---|----------------------|-----------------|------|------|------------------|-----------|-----------|
| Positive power supply voltage                         | V <sub>2H</sub>      | +4.8            | +5.0 | +5.2 | V                |           |           |
| Negative power supply voltage                         | V <sub>2L</sub>      | -7.6            | -8.0 | -8.4 | V                |           |           |
| Video input signal amplitude<br>(peak level)          | V <sub>BS</sub>      | 0.7             | 1.0  | 1.3  | V <sub>p-p</sub> | [Note7-1] |           |
|   | V <sub>RGB</sub> (1) | —               | 0.7  | —    | V <sub>p-p</sub> | [Note7-2] |           |
|   | V <sub>RGB</sub> (2) | 2.0             | —    | 4.0  | V <sub>p-p</sub> | [Note7-3] |           |
| Video input signal DC component                       | V <sub>DC</sub>      | -1.0            | 0    | +1.0 | V                | [Note7-4] |           |
| Digital input<br>voltage                              | High level           | V <sub>IH</sub> | +3.5 | —    | V <sub>IH</sub>  | V         | [Note7-5] |
|   | Low level            | V <sub>IL</sub> | 0    | —    | +1.5             | V         |           |
| Digital output<br>voltage                             | High level           | V <sub>OH</sub> | +3.5 | —    | V <sub>IH</sub>  | V         | [Note7-6] |
|   | Low level            | V <sub>OL</sub> | 0    | —    | +1.5             | V         |           |
| DC bias voltage of common<br>electrode driving signal | V <sub>CCO</sub>     | -4.5            | -3.5 | -2.5 | V                | [Note7-7] |           |

[Note7-1] VBS (composite video signal) Input impedance : 75Ω

Amplitude of sync. signal : >0.2V<sub>p-p</sub>

[Note7-2] VRI, VGI, VBI terminals (RGB signals for analog display)

Input impedance : >10kΩ

[Note7-3] VRI, VGI, VBI terminals (RGB signals for superimposing)

Input impedance : >10kΩ

[Note7-4] VBS, VRI, VGI, VBI terminals

[Note7-5] VSW terminal

Input impedance : >50kΩ

[Note7-6] HSY, VSY terminals (Internal sync. signals).

Load resistance : >20kΩ

[Note7-7] Adjusted for each module so as to attain maximum contrast ratio.

Refer to Appendix-3 for adjusting.



## B) Backlight driving section

Table 7

Ta=25°C

| Parameter        | Symbol | MIN | TYP | MAX | Unit   | Remarks              |
|------------------|--------|-----|-----|-----|--------|----------------------|
| Lamp voltage     | $V_L$  | 95  | 110 | 125 | Vrms   | (just for reference) |
| Lamp current     | $I_L$  | 13  | 15  | 18  | mA rms |                      |
| Filament voltage | $V_f$  | 6.0 | 6.5 | 7.0 | Vrms   |                      |
| Filament current | $I_f$  | 58  | 66  | 74  | mA rms |                      |
| Frequency        | $f_L$  | 20  |     | 50  | kHz    |                      |
| Kick-off voltage | $V_s$  | 600 | / - | -   | Vrms   | [Note7-8]            |

[Note7-8] The reflector should be grounded.

※ DC/AC inverter for driving hot cathode fluorescent tube (HCFT) is not built in the module.

DC/AC inverter for external connection (Model No.: LQOJ06) is optionally available.

## 7-2) Power consumption

Table 8

Ta=25°C

| Parameter   |                         | Symbol   | Condition         | MIN | TYP  | MAX  | Unit | Remarks    |
|---|-------------------------|----------|-------------------|-----|------|------|------|------------|
| Power consumption by the panel section            | Positive supply current | $I_{sH}$ | $V_{sH} = +5.0V$  | -   | +90  | +115 | mA   |            |
|   | Negative supply current | $I_{sL}$ | $V_{sL} = -8.0V$  | -   | -55  | -80  | mA   |            |
|   | Total                   | $W_s$    |                   | -   | 0.89 | 1.22 | W    | [Note7-9]  |
| Power consumption by the fluorescent tube section |                         | $W_L$    | On rated lighting | -   | 1.7  | 2.3  | W    | [Note7-10] |

[Note7-9] Excluding power consumption by the backlight.

[Note7-10] Calculated reference value ( $I_L \times V_L$ ).

## 7-3) Circuit diagram

The circuit block diagram of TFT-LCD module is shown in Fig.4.

(For detail, refer to (Appendix-1) and (Appendix-2).)

The recommended external circuit for TFT-LCD module is shown in Fig.5.

Caution: Turn on or off the power supply ( $V_{sH}$  and  $V_{sL}$ ) at the same time.

Be sure to supply all power voltages before inputting input signals.

## 7-4) Input/Output signal waveforms

Shown in Fig. 6

Caution: Input standard composite video (or sync.) signal matching for NTSC(M) system in VBS.

A long time input of non-standard sync. signal may cause flicker or degradation of display quality.

## 7-5) Input/Output signal timing chart

Shown in Fig. 7

Table 9 shows the timing specifications.

Table 9

 $f_H = 15.7\text{kHz}, f_V = 60\text{Hz}$ 

| Parameter                         |                    | Symbol       | MIN    | TYP    | MAX     | Unit            | Remarks            |
|-----------------------------------|--------------------|--------------|--------|--------|---------|-----------------|--------------------|
| Horizontal sync.                  | Input pulse width  | $\tau_{H11}$ | 4.2    | 4.7    | 5.7     | $\mu\text{sec}$ |                    |
|                                   | Output pulse width | $\tau_{H12}$ | 2.3    | 4.7    | 7.1     | $\mu\text{sec}$ | $f=f_H$ [Note7-11] |
| Horizontal sync. phase difference |                    | $\tau_{pd}$  | -0.1   |        | 2.7     | $\mu\text{sec}$ | [Note7-12]         |
| Vertical sync. output pulse width |                    | $\tau_{vs}$  | 243    | 256    | 269     | $\mu\text{sec}$ | $4/f_H$            |
| Vertical sync. phase difference   |                    | $\tau_{pv}$  | 121/90 | 127/95 | 133/100 | $\mu\text{sec}$ | [Note7-13]         |

(Supply voltage condition:  $V_{SH} = +5V, V_{SL} = -8V$ )

[Note7-11] Adjusted by variable resistor (H-POS).

[Note7-12] Variable range by variable resistor (H-POS)

(Positive when  $\overline{HSY}$  proceeds VBS.)

Adjusted value :  $\tau_{pd} = 1.3 \pm 0.7 \mu\text{sec}$

[Note7-13] Odd field/Even field (  $2/f_H / 1.5/f_H$  )

## 7-6) Display time range

(a) Horizontally

12.0~61.9  $\mu\text{sec}$  from the falling edge of  $\overline{HSY}$ .

(b) Vertically

19~252K from the falling edge of  $\overline{VSY}$ .

## (B) Optical characteristics

| Parameter           |       | Symbol            | Condition           | MIN     | TYP   | MAX   | Unit   | Remarks       |
|---------------------|-------|-------------------|---------------------|---------|-------|-------|--------|---------------|
| Viewing angle range |       | $\Delta\theta 11$ | CR $\geq$ 10        | 30 (10) | —     | —     | Degree | LQ4HC01       |
|                     |       | $\Delta\theta 12$ | CR $\geq$ 10        | 10 (30) | —     | —     | Degree | (LQ4HC02)     |
|                     |       | $\Delta\theta 2$  | CR $\geq$ 10        | 45      | —     | —     | Degree | [Note 8-1, 2] |
| Contrast ratio      |       | CRmax             | $\theta = 0^\circ$  | 30      | —     | —     |        | [Note 8-2, 3] |
| Response time       | Rise  | $\tau r$          | $\theta = 15^\circ$ | —       | 30    | —     | ms     | [Note 8-2]    |
|                     | Decay | $\tau d$          |                     | —       | 50    | —     | ms     | [Note 8-4]    |
| Brightness          |       | $Y_L$             |                     | 100     | 120   | —     | nt     | [Note 8-5]    |
| Color temperature   |       | $K_L$             | $\theta = 0^\circ$  | —       | 7900  | —     | K      | [Note 8-5]    |
| White chromaticity  |       | $x$               |                     | 0.247   | 0.297 | 0.347 |        |               |
|                     |       | $y$               |                     | 0.262   | 0.312 | 0.362 |        |               |

[Note 8-1] Viewing angle range is defined as follows.

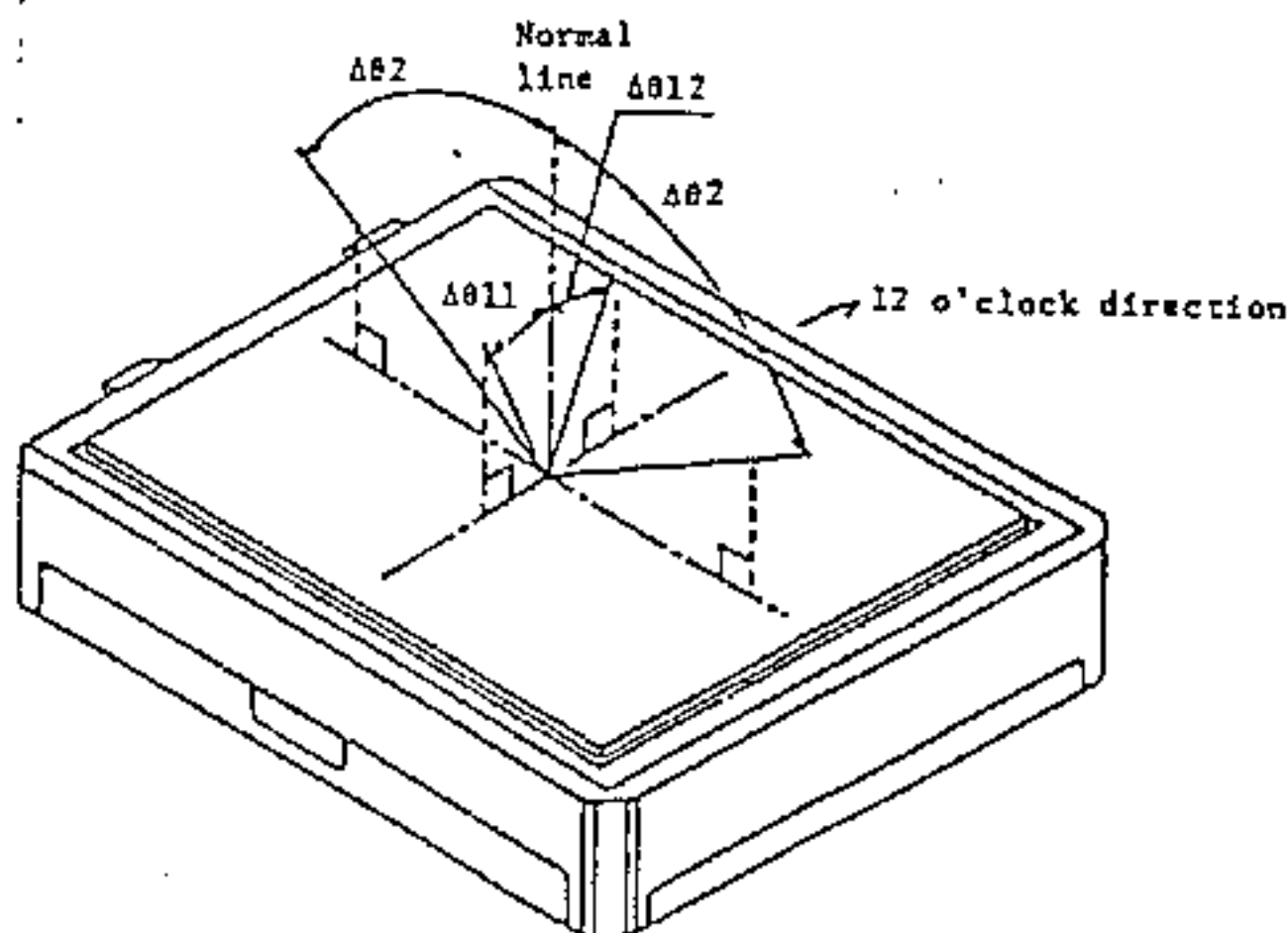


Fig.(j) Definition of viewing angle range

[Note 8-2] Applied voltage for measuring optical characteristics

- a)  $V_{cac}$  must be adjusted by the (1) Flicker measuring method or the (2) Contrast measuring method described in the (Appendix-3) "Adjusting method of optimum common electrode DC bias voltage".
- b) Brightness adjusting terminal (BRT) should be opened.
- c) Video signal of reference black level and 100% white level must be input.

[Note 8-3] Contrast ratio is defined as follows.

Contrast ratio is calculated with the following formula in the optical characteristics measuring method shown in Fig. 8.

Contrast ratio (CR)

$$= \frac{\text{Photodetector output with LCD being "white"}}{\text{Photodetector output with LCD being "black"}}$$

[Note 8-4] Input signals are applied to the area measured to make the area "white" and "black" respectively, and change with time in the photodetector output is measured in the optical characteristics measuring method shown in Fig. 8.

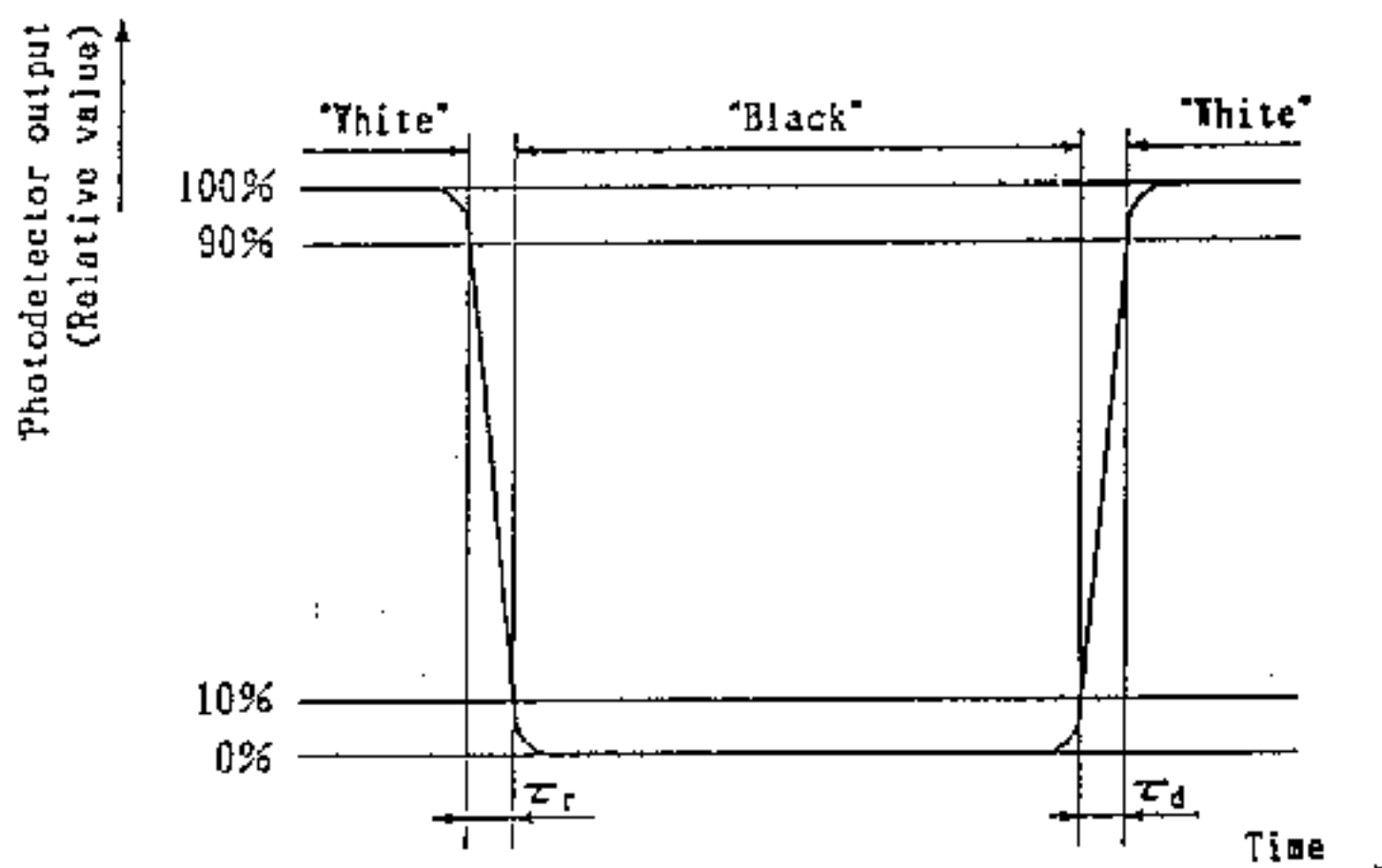


Fig. (iii)

[Note 8-5] Measured on the center area of the panel at a viewing cone 1° by TOPCON luminance meter BM-7.

## (9) Mechanical characteristics

## 9-1) External appearance

There shall not be any conspicuous defects. (See Fig. 3. "Outline dimensions of TFT-LCD module".)

## 9-2) Panel toughness

The panel shall not break when the panel center is pressed with 2 kg force by 15 mm dia. smooth flat surface.

(Caution): The least force can cause functional troubles if it is applied on the active area for a long time.

## 9-3) Maximum resin region

As shown in the illustration below, resin may fill up to the same level as a line connecting the upper ridges of a panel and a shielding case.

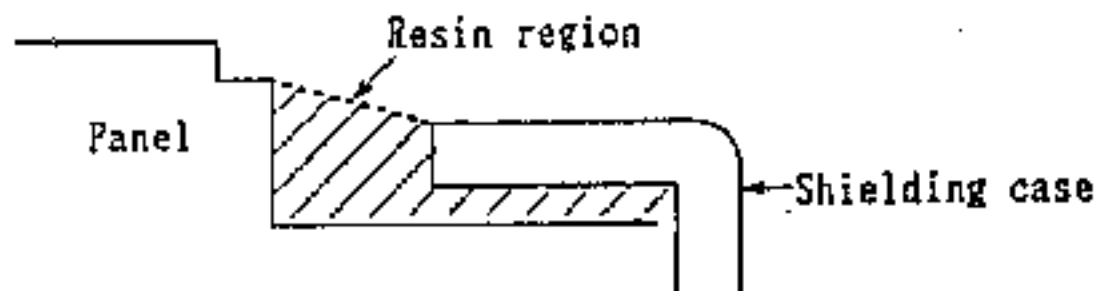


Fig. (iv)

## 9-4) I/O connector performance

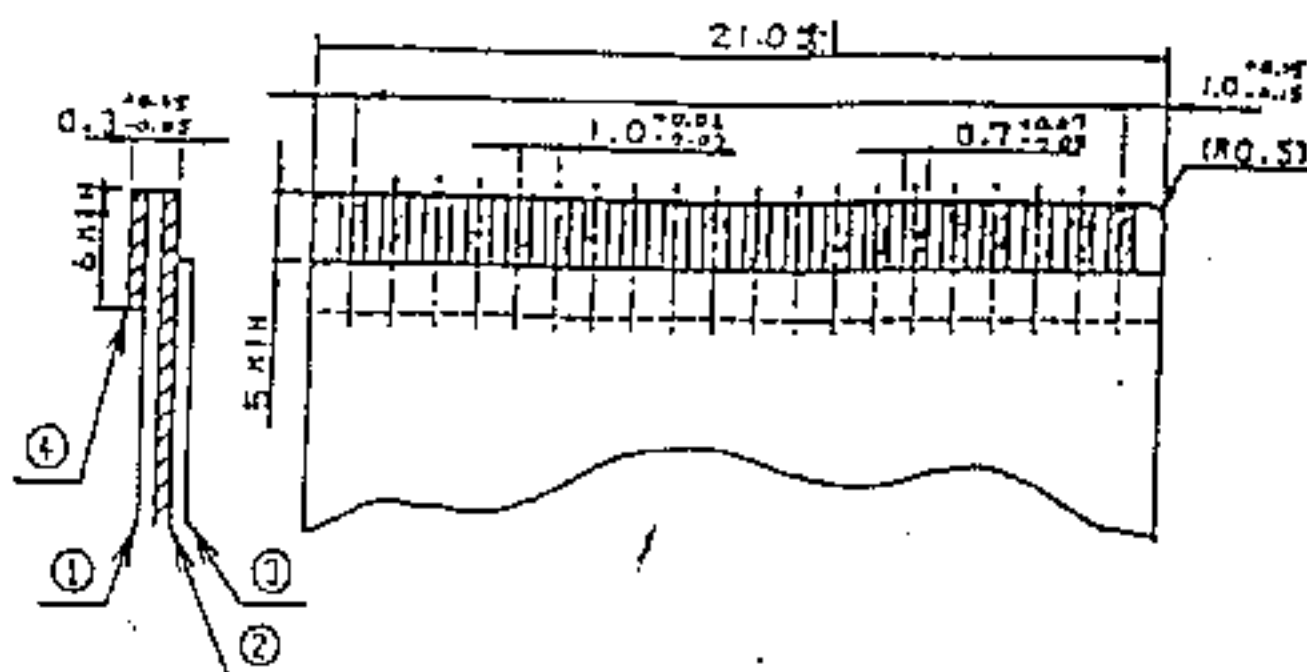
## A) I/O connector of LCD panel driving circuit ( FPC connector 20 pins)

1) Applicable FPC: Shown in Fig. (v).

2) Terminal holding force: 100 g or larger/pin

(Each terminal is pulled out at a rate of  $25 \pm 3$  mm/min.)

3) Insertion/pulling durability: Contact resistance not larger than double the initial value after applicable FPC is inserted and pulled out 20 times.



| Ref. No | Name              | Material  |
|---------|-------------------|---|
| ①       | Base material     | Polyimide or equivalent material (25 $\mu$ m thick)                           |
| ②       | Copper foil       | Copper foil (35 $\mu$ m thick),<br>solder plated in 2 to 12 $\mu$ m thickness |
| ③       | Coverlay          | Polyimide or equivalent material  |
| ④       | Reinforcing plate | Polyester polyimide or equivalent material<br>(188 $\mu$ m thick)             |

Fig. (k) Applicable FPC for I/O connector (1.0 mm pitch)

- B) I/O connector of backlight driving circuit (PH connector 4 pins x2 pcs.)
- i) Applicable connector housing: PHR-4 (produced by Japan Solderless Terminal)
  - ii) Terminal holding force: 100 g or more/pin  
(Pulled out at a rate of 1 through 5 mm/sec.)
  - iii) Insertion/pulling durability: Contact resistance not larger than double the initial value after connectors are inserted and pulled out 20 times.

#### (10) Display quality

The display quality of the color TFT-LCD module shall be in compliance with the Delivery Inspection Standard (Separate Sheet LDI-89901).

## (11) Handling instructions

### 11-1) Mounting of module

The TFT-LCD module is designed to be mounted on equipment using the mounting tabs in the four corners of the module rear face.

On mounting the module, as the M2.6 tapping screw (fastening torque is 5 through 6 kg·cm) is recommended, be sure to fix the module on the same plane, taking care not to warp or twist the module.

### 11-2) Precautions in mounting

① Polarizer which is made of soft material and susceptible to flaw must be handled carefully. Protective film (laminator) is applied on the surface to protect it against scratches and dirt. It is recommended to peel off the laminator immediately before the use, taking care of static electricity.

#### ② Precautions in peeling off the laminator

##### A) Working environment

When the laminator is peeled off, static electricity may cause dust to stick to the polarizer surface. To avoid this, the following working environment is desirable.

a) Floor: Conductive treatment of 1 MΩ or more on the tile

(Conductive mat or conductive paint on the tile)

b) Clean room free from dust and with an adhesive mat on the doorway

c) Humidity: 50 % to 70 % RH

d) Workers shall wear conductive shoes, conductive work clothes, conductive gloves and an earth band.

##### B) Working procedures

a) Direct the wind of discharging blower somewhat downward to ensure that module is blown sufficiently. Keep the distance between module and discharging blower within 20 cm. (See Fig. (vi-i).)

b) Attach adhesive tape to the laminator part near discharging blower so as to protect polarizer against flaw. (See Fig. (vi-ii).)

c) Peel off laminator, pulling adhesive tape slowly to your side taking 5 or more second.

d) On peeling off the laminator, pass the module to the next work process to prevent the module to get dust.

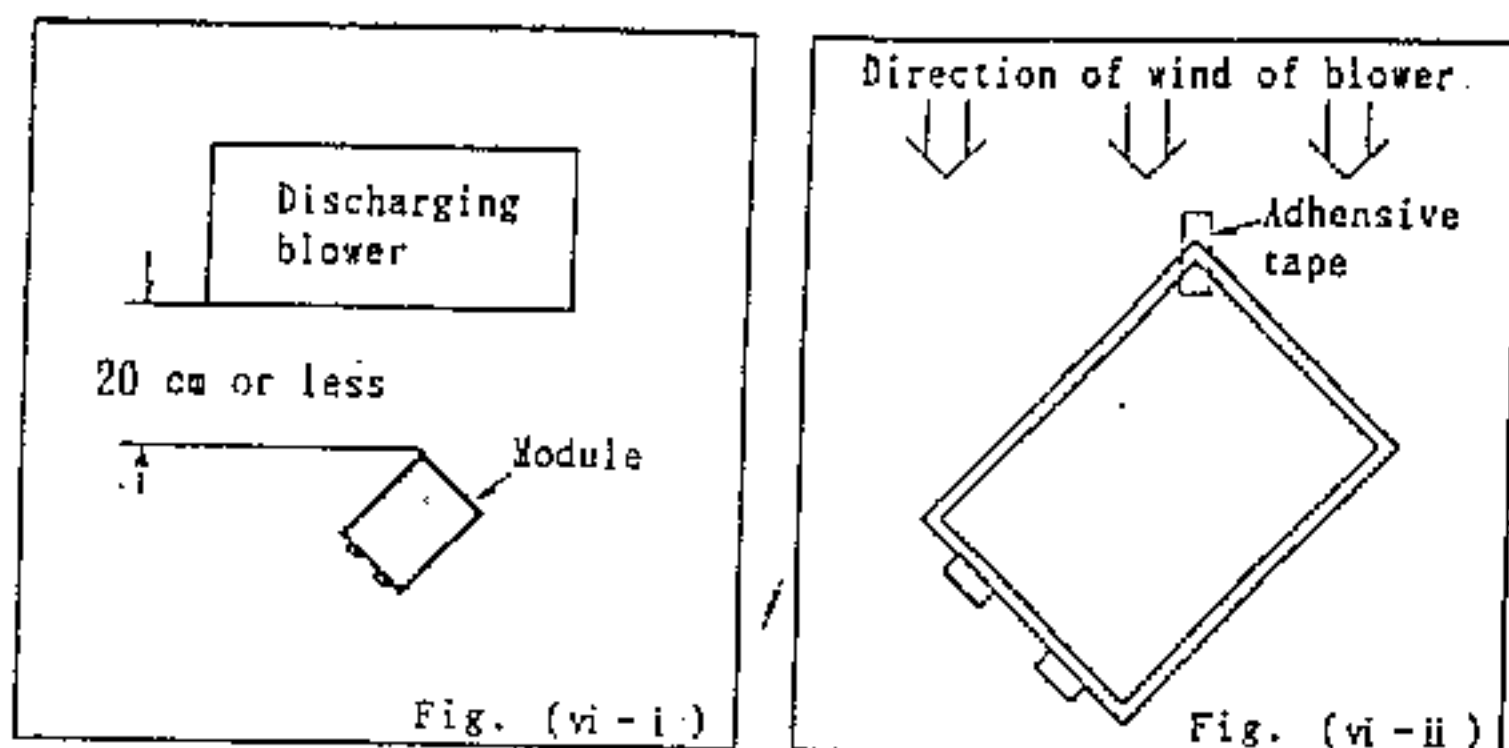


Fig. (vi)

## e) Method of removing dust from polarizer

- Blow off dust with  $N_2$  blower for which static electricity preventive measure has been taken. Ionized air gun (Hugle Electronics Co.) is recommended.
- Since polarizer is vulnerable, wiping should be avoided. If wiping is unavoidable, wipe it carefully with lens cleaning cloth, breathing on it. "Belleseime" (Kanebo, Ltd.) is desirable.

- ③ When metal part of the TFT-LCD module (shielding lid and rear case) is soiled, wipe it with soft dry cloth. For stubborn dirt, wipe the part, breathing on it.
- ④ Wipe off water drop or finger grease immediately. Long contact with water may cause discoloration or spots.
- ⑤ TFT-LCD module uses glass which breaks or cracks easily if dropped or bumped on hard surface. Handle with care.
- ⑥ Since CMOS LSI is used in this module, take care of static electricity and earth your body when handling.

## 11-3) Precautions in adjusting module

Adjusting volumes on the rear face of the module have been set optimally before shipment. Therefore, do not change any adjusted values. If adjusted values are changed, the specifications described here may not be satisfied.



## 11-4) Others

- ① Do not expose the module to direct sunlight or intensive ultraviolet rays for many hours; liquid crystal is deteriorated by ultraviolet rays.
- ② Store the module at a temperature near the room temperature. At lower than the rated storage temperature, liquid crystal solidifies, causing the panel to be damaged. At higher than the rated storage temperature, liquid crystal turns into isotropic liquid and may not recover.
- ③ If LCD panel breaks, there may be a possibility that the liquid crystal escapes from the panel. Since the liquid crystal is injurious, do not put it into the eyes or mouth. When liquid crystal sticks to hands, feet or clothes, wash it out immediately with soap.
- ④ Observe all other precautionary requirements in handling general electronic components.

## (12) Shipping requirements

12-1) Packing form is shown in Fig. 9.

## 12-2) Carton storage condition

- ① Number of layers of cartons in pile : 10 layers Max.
- ② Environmental condition :
  - Temperature            0 °C to 40 °C
  - Humidity                60 %RH or less (at 40 °C)  
No dew condition even at a low temperature and high humidity
  - Atmosphere            Harmful gases such as acid and alkali which corrode electronic components and wires must not be detected.
  - Storage period        About 3 months
  - Opening of package    To prevent TFT-LCD module from being damaged by static electricity, adjust the room humidity to 50 %RH or higher and provide an appropriate measure for electrostatic earthing before opening the package.

## (13) Reliability test items

Reliability test items for the TFT-LCD module are shown in Table 11.

Reliability Test Items for TFT-LCD Module

Table 11

| No. | Test items  | Conditions   |
|-----|---|--|
| 1   | High temperature storage test                     | $T_a = 60\text{ }^\circ\text{C}$ 240 H   |
| 2   | Low temperature storage test                      | $T_a = -25\text{ }^\circ\text{C}$ 240 H  |
| 3   | High temperature and high humidity operation test | $T_a = 40\text{ }^\circ\text{C} \cdot 95\% \text{RH}$ 240 H  |
| 4   | High temperature operation test                   | $T_a = 40\text{ }^\circ\text{C}$ 240 H   |
| 5   | Low temperature operation test                    | $T_a = 0\text{ }^\circ\text{C}$ 240 H  |
| 6   | Electrostatic discharge test                      | $\pm 200\text{ V} \cdot 200\text{ pF}$ ( $0\ \Omega$ ) Once for each terminal  |
| 7   | Shock test  | 100 G · 6 ms, $\pm X; \pm Y; \pm Z$ 3 times for each direction<br>(JIS C7021, A-7 Condition C)   |
| 8   | Vibration test                                    | Frequency range: 10 ~ 55 Hz<br>Stroke : 1.5 mm<br>Sweep : 10 Hz ~ 55 Hz ~ 10 Hz<br>2 hours for each direction of X, Y, Z (6 hours in total)<br>(JIS C7021, A-10 Condition A) |
| 9   | Heat shock test                                   | $-25\text{ }^\circ\text{C} \sim +60\text{ }^\circ\text{C} / 5$ cycles (2 hours/cycle)<br>(1 H) (1 H)   |

## 【 Result Evaluation Criteria 】

Under the display quality test conditions with normal operation state, there shall be no change which may affect practical display function.

## (14) Others

If any problem occurs in relation to the description in the present specifications or other relevant items, it shall be eliminated in all sincerity through discussion.

COCOM

This product falls under "strategic product" according to the export trade control ordinance in force. And export of the item requests an export license issued by the related authorities.

Please confirm us whether the license is necessary since the ordinance may be revised by the authorities.

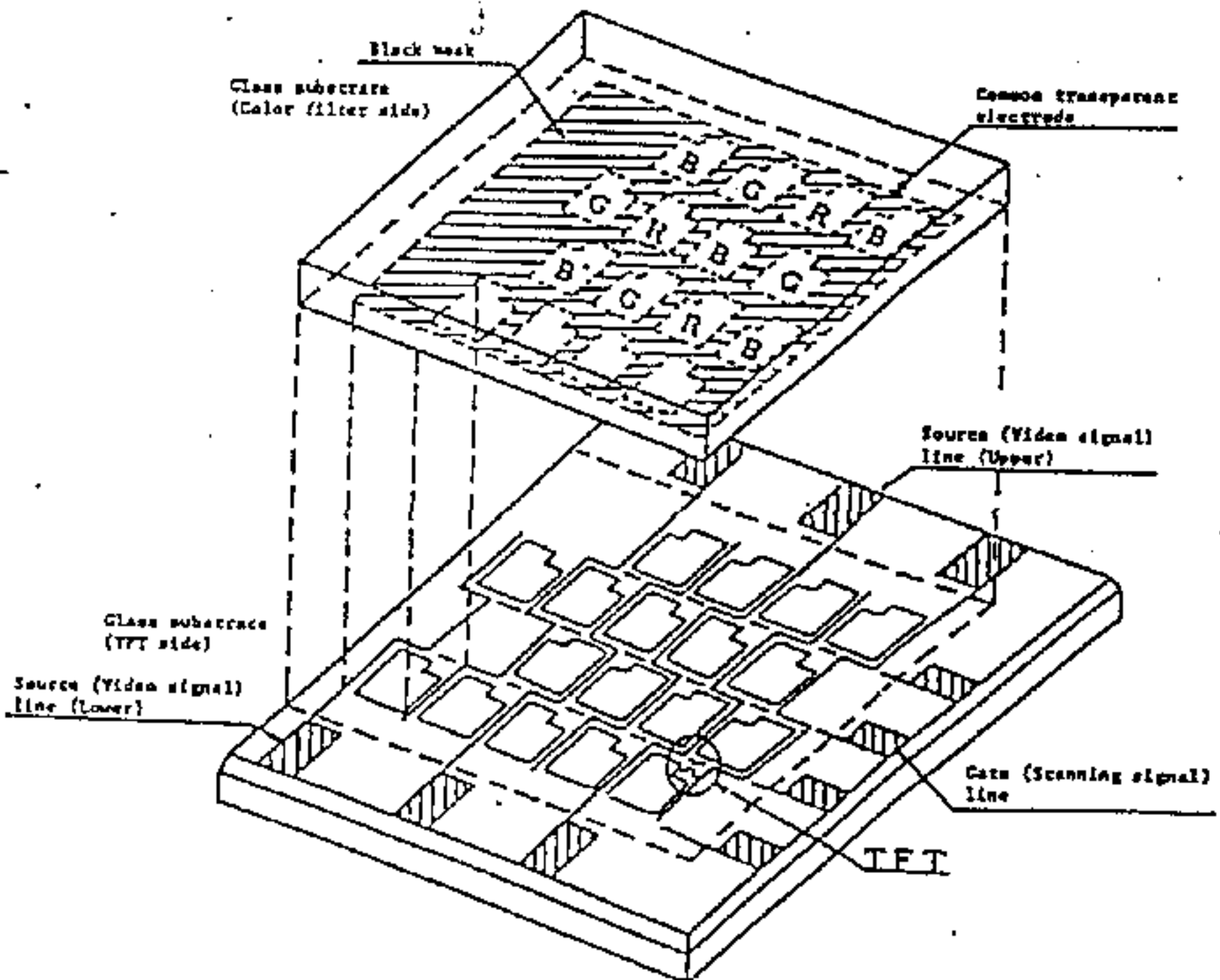
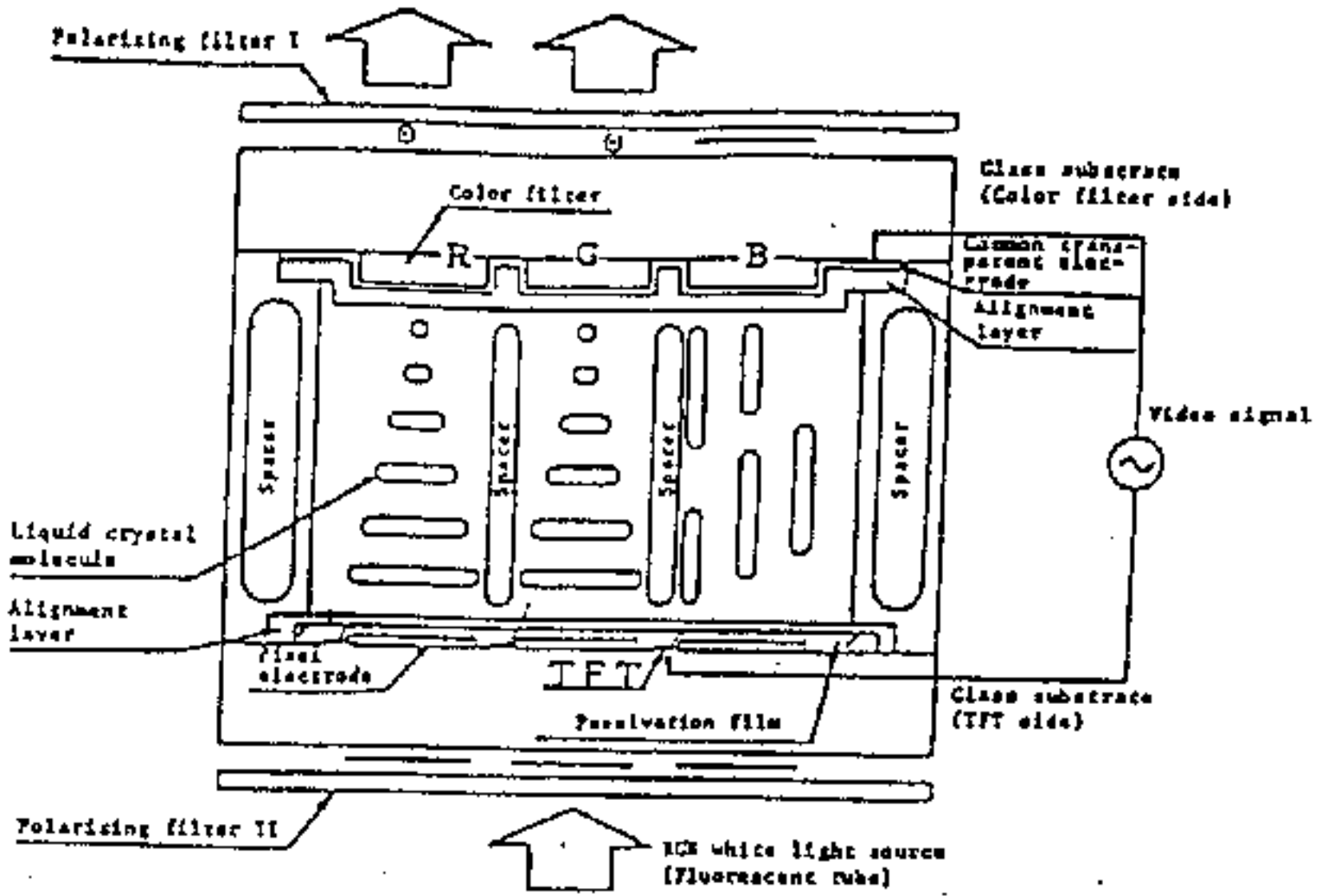


Fig. 1 Illustration of TFT-LCD panel

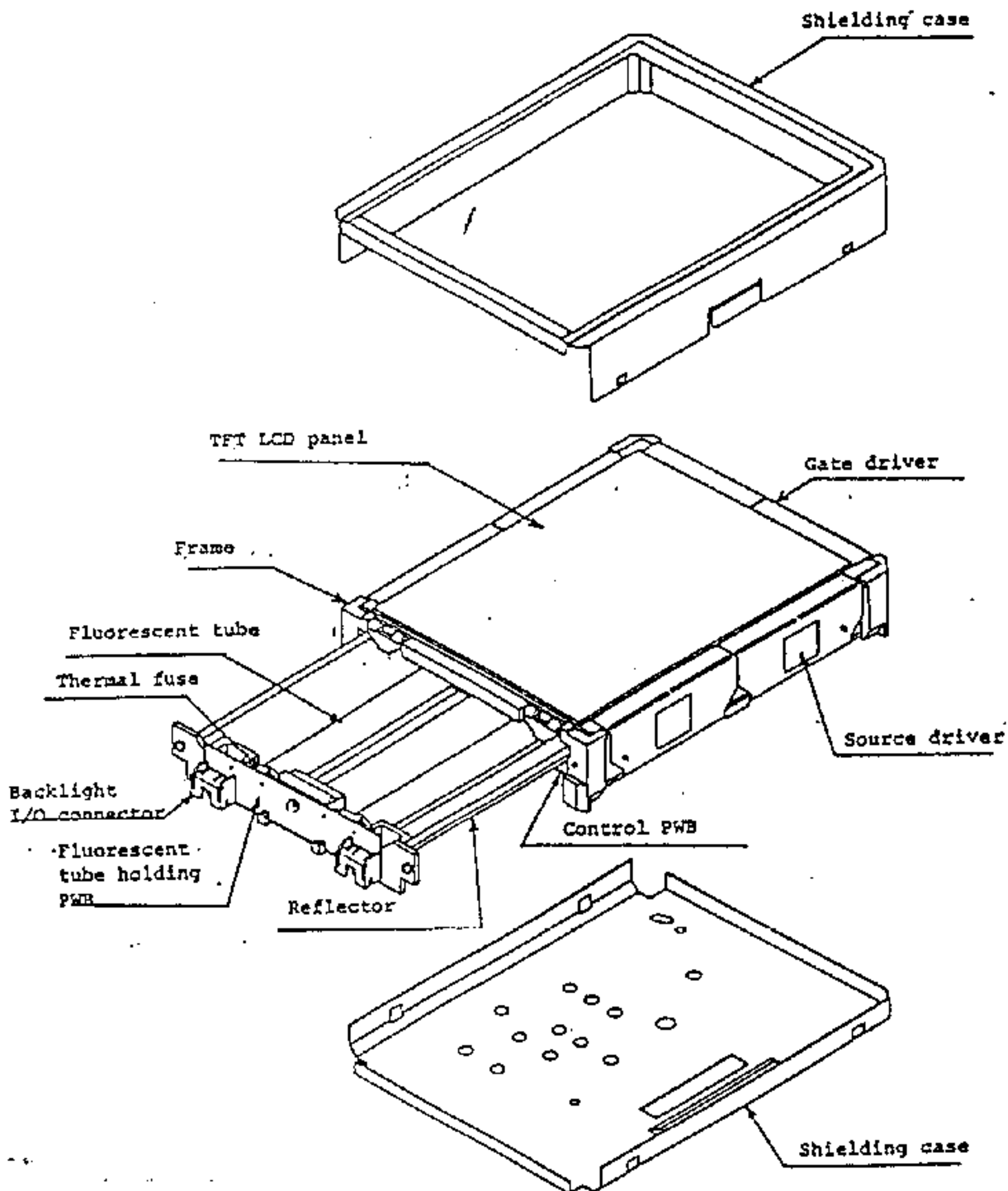


Fig. 2 Construction of TFT-LCD module

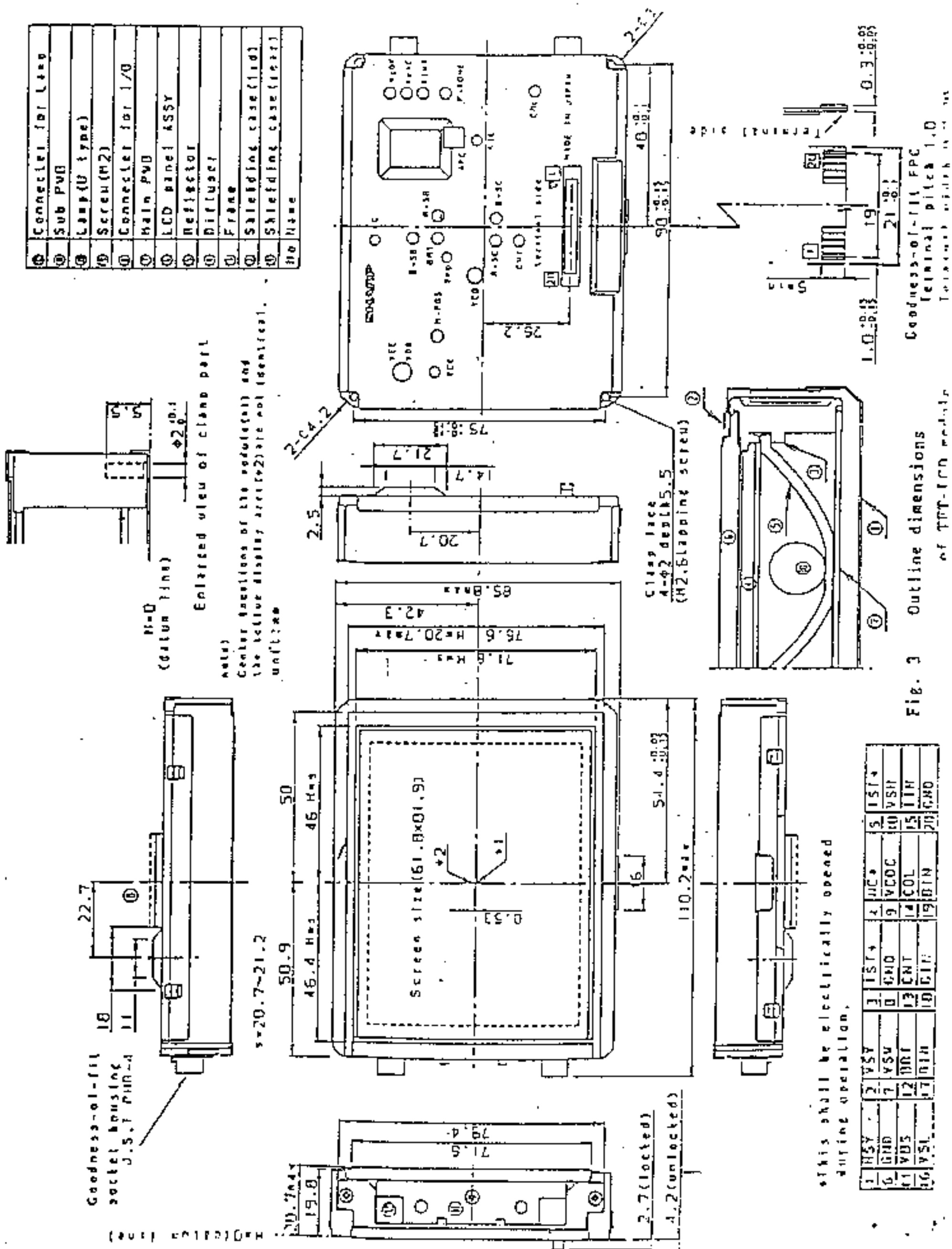


Fig. 3 Outline dimensions of TFT-LCD module

|    |                       |
|----|-----------------------|
| ①  | Connector for Lamp    |
| ②  | Sub PVD               |
| ③  | Lamp (U type)         |
| ④  | Screw (M2)            |
| ⑤  | Connector for I/O     |
| ⑥  | Main PVD              |
| ⑦  | LCD panel ASSY        |
| ⑧  | Reflector             |
| ⑨  | Diffuser              |
| ⑩  | Frame                 |
| ⑪  | Shielding case (lid)  |
| ⑫  | Shielding case (rear) |
| No | Name                  |

Enlarged view of clamp part  
 (datum line)  
 Note:  
 Center locations of the hole(s) and the hole display area(s) are not identical.

This shall be electrically opened during operation.

|    |     |    |     |    |      |    |      |    |      |
|----|-----|----|-----|----|------|----|------|----|------|
| 1  | VSY | 2  | VSV | 3  | IST+ | 4  | UC+  | 5  | IST+ |
| 6  | GND | 7  | VSV | 8  | GND  | 9  | VCOC | 10 | VSH  |
| 11 | VDS | 12 | INT | 13 | CNT  | 14 | COL  | 15 | TH   |
| 16 | VSL | 17 | INT | 18 | INT  | 19 | INT  | 20 | GND  |

Goodness-01-111 FPC  
 Terminal pitch 1.0

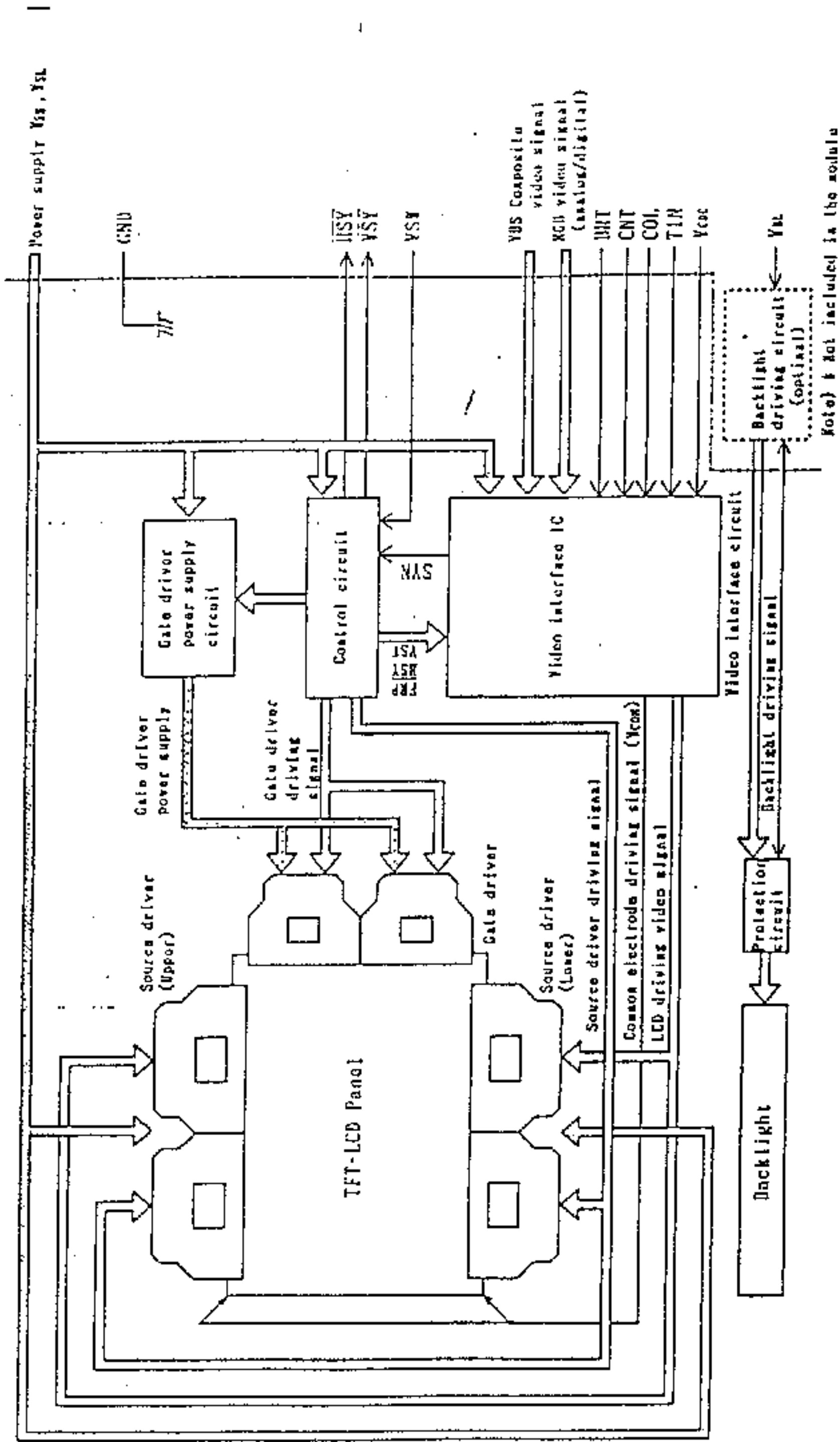


Fig. 4 Circuit block diagram of TFT-LCD module

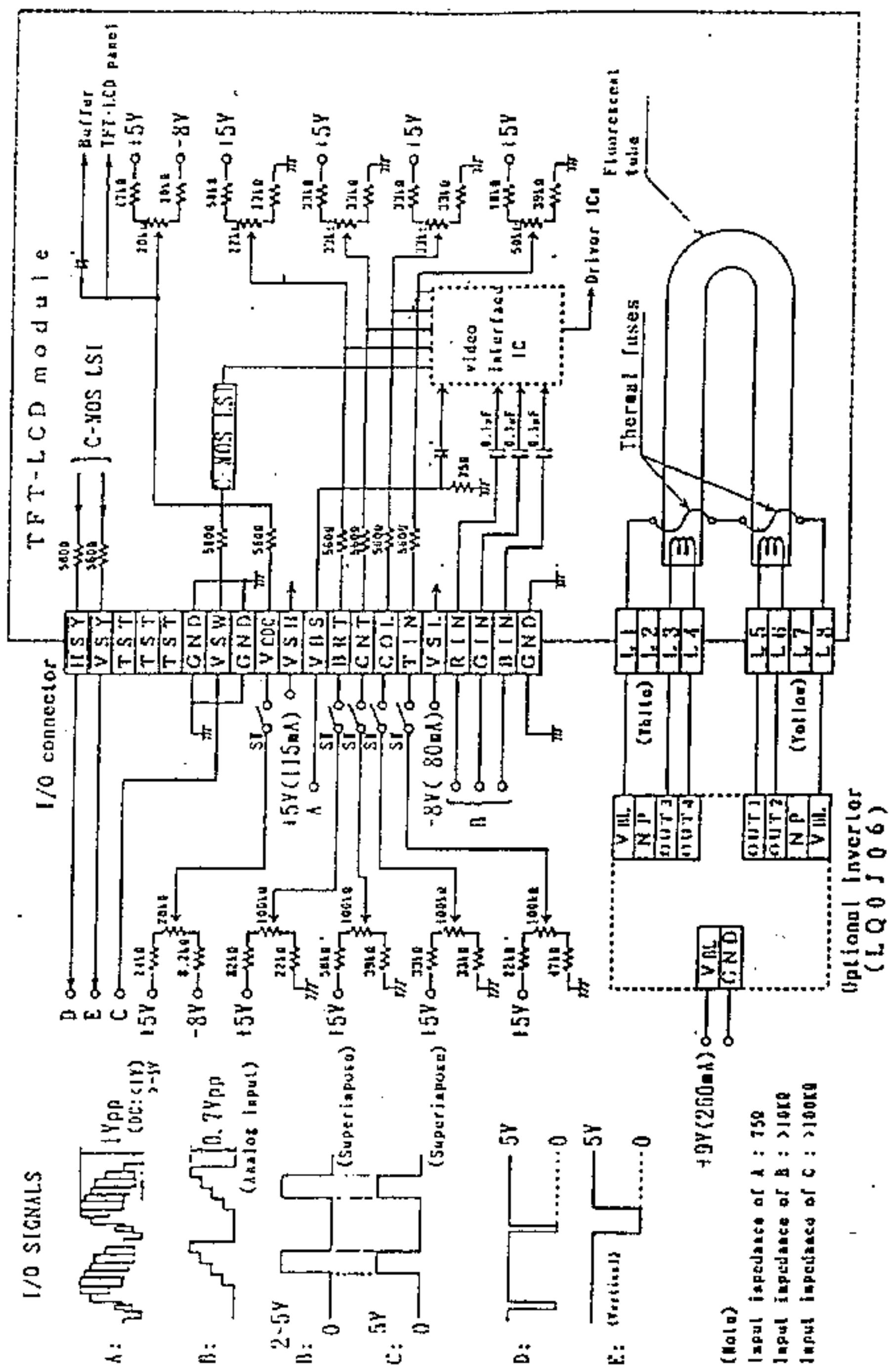


Fig. 5 Recommended circuit for TFT-LCD module



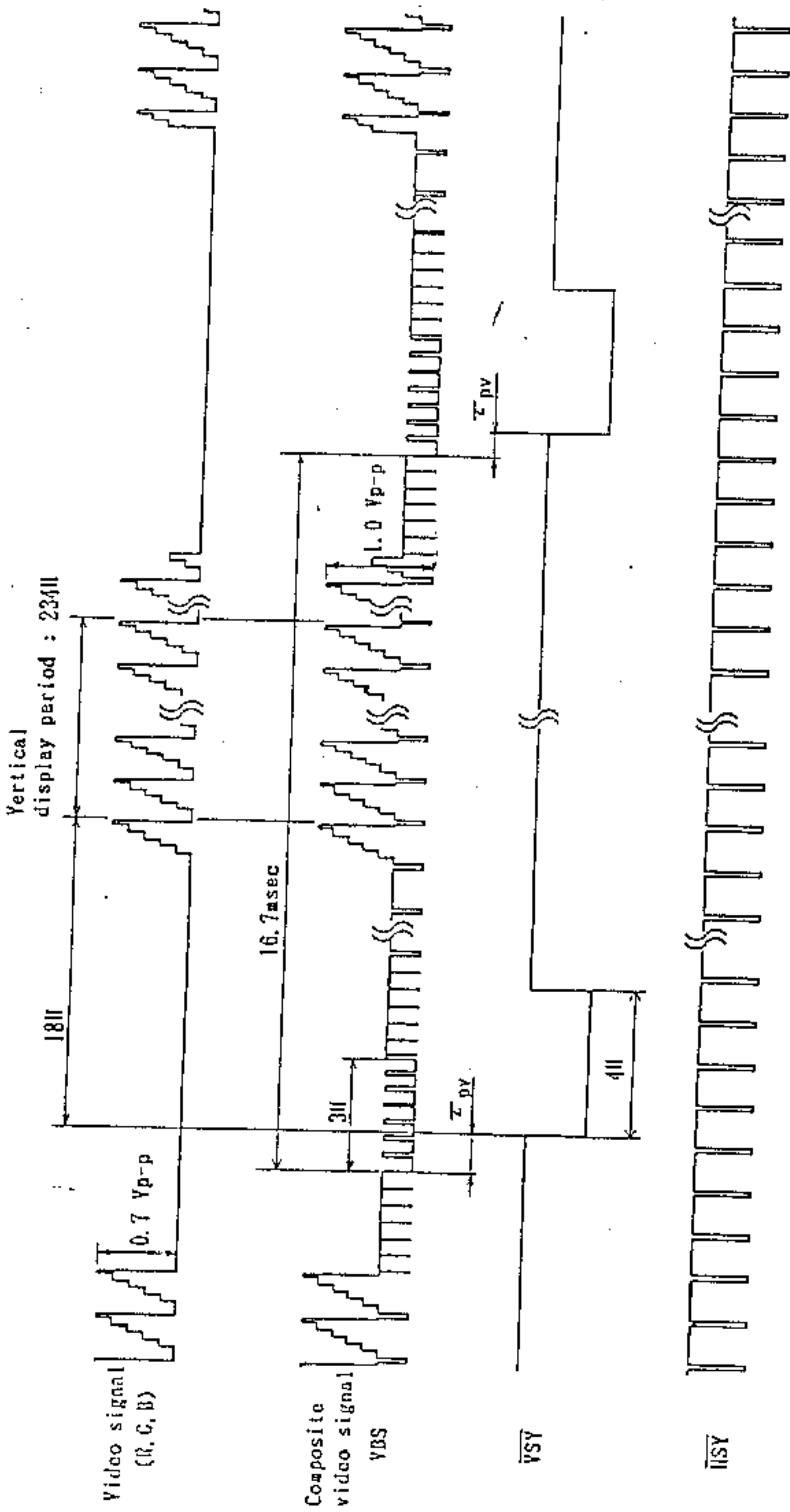


Fig. 6 Input/output signal waveforms

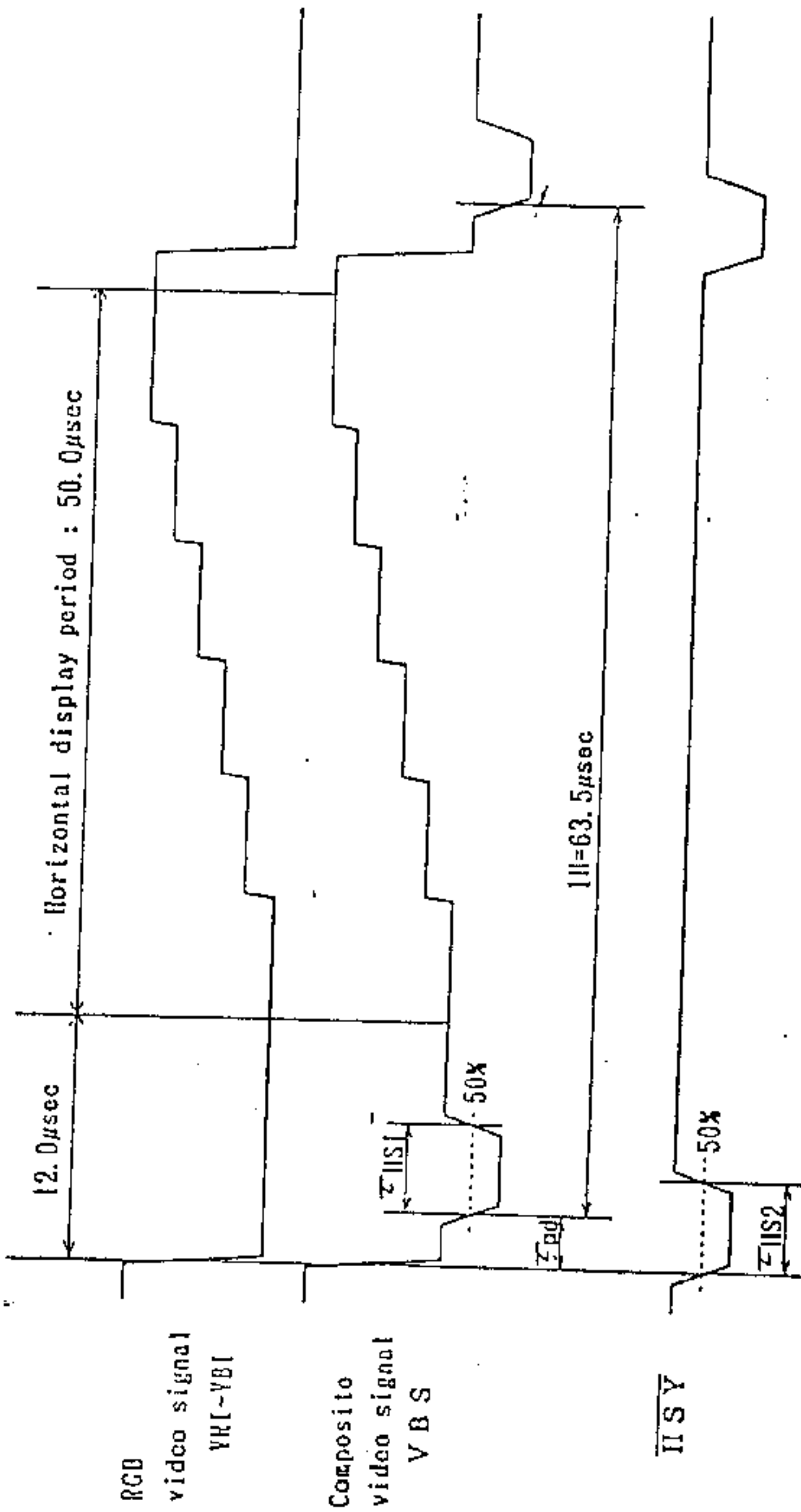


Fig. 7 Input/output signal timing chart