Figure 6. Input/Output Signal Waveforms

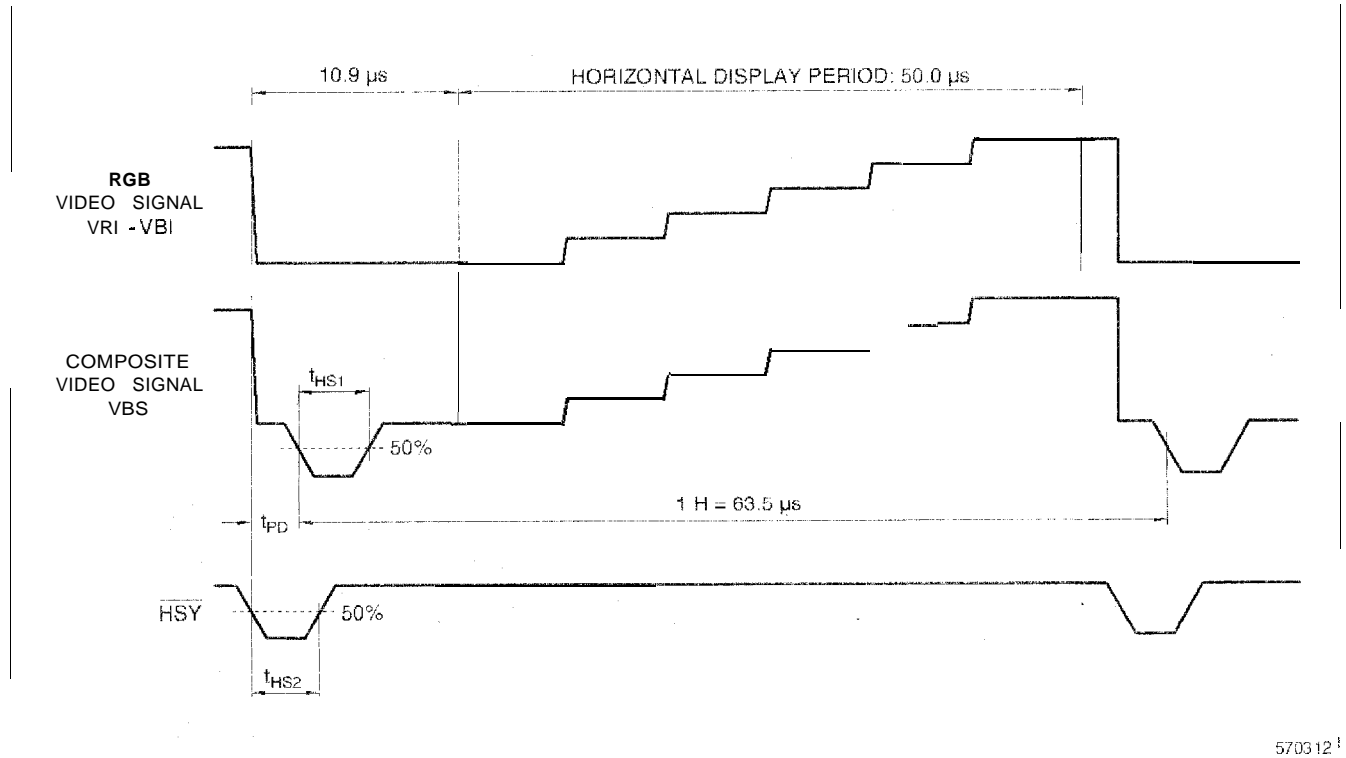**Figure 7. input/Output Signal Timing Chart**

TIMING CHARACTERISTICS – INPUT/OUTPUT SIGNALS ($V_{SH} = +5$ V, $V_{SL} = -8$ V)
($f_H = 15.7$ kHz, $f_V = 60$ Hz)

SYMBOL	PARAMETER	CONDITION	MIN.	TYP.	MAX.	UNIT	NOTE
t_{HSI}	Horizontal Sync — Input Pulse Width	–	4.2	4.7	5.7		–
t_{HS2}	Horizontal Sync – Output Pulse Width	$f = f_H$	2.3	3.0	4.6	ms	1
tpd	Horizontal Sync Phase Difference	–	−1.5	–	1.3		2
tvs	Vertical Sync Output Pulse Width	$4/f_H$	243	256	269		–
tpv	Vertical Sync Phase Difference	–	67/33	73/39	79/45		3

NOTES:

1. Adjusted by variable resistor (H-POS).
2. Variable range by variable resistor (H-POS). (Positive when HSY proceeds VBS.) Adjusted value. tpd = 0 1 µs i0.7 µs
3. **Odd** field/Even field $(1/f_H/0.5/f_H)$.

Display Time Range

● Horizontally: 10.9 µs to 61 .O µs from the falling edge of HSY.

● Vertically: 19H to 258H from the falling edge of VSY.

OPTICAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITION	MIN.	TYP.	MAX.	UNIT	NOTE
$\Delta\theta\,11$			30 (10)	–	–		LQ6NC01
$\Delta\theta\,12$	Viewing Angle Range	CR $\geq$10	10 (30)	–	–	degrees	(LQ6NC02)
$\Delta\theta\,2$			45	–	–		1, 2
CR$_{MAX}$	Contrast Ratio	$\theta = 0°$	30	–	–	–	2, 3
t_R	Response Time – Rise	$\theta = 15°$	–	30	–	ms	2
t_D	Response Time – Decay		–	50	–	ms	4
Y_L	Brightness	–	100	120	–	nt	5
K_L	Color Temperature		–	7900	–	K	
x	White Chromaticity	$\theta = 0°$	0.247	0.297	0.347	–	5
y			0.262	0.312	0.362	–	

NOTES:

1. Viewing angle range is defined in Figure 8

2. Applied voltage for measuring optical characteristics,
   a V$_{CDC}$ must be adjusted by the Flicker measuring method or the Contrast measuring method described in 'Adjusting Method of Optimum Common Electrode DC Bias Voltage '
   b rightness adjusting terminal (BRT) should be opened.
   c. Video signal of reference black level and 100% white level must be input.

3. Contrast ratio is calculated with the following formula in the optical characteristics measuring method shown in Figure 10:

$$\text{Contrast ratio (CR)} = \frac{\text{Photodetector output with LCD being 'white'}}{\text{Photodetector output with LCD being 'black'}}$$

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 Figure 10.

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

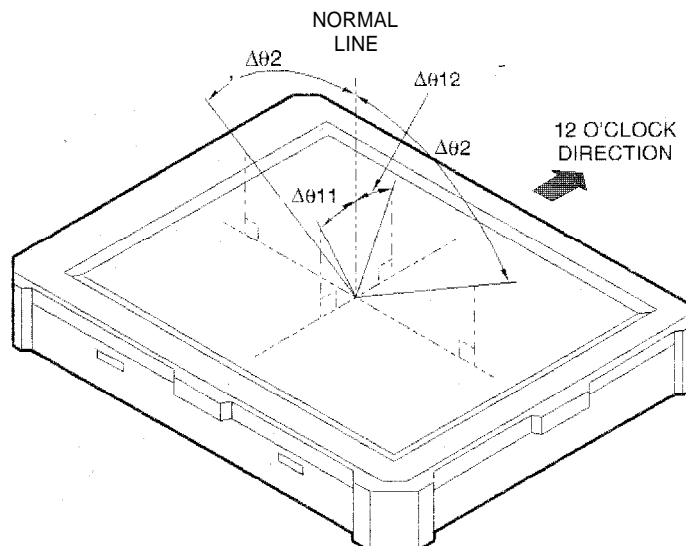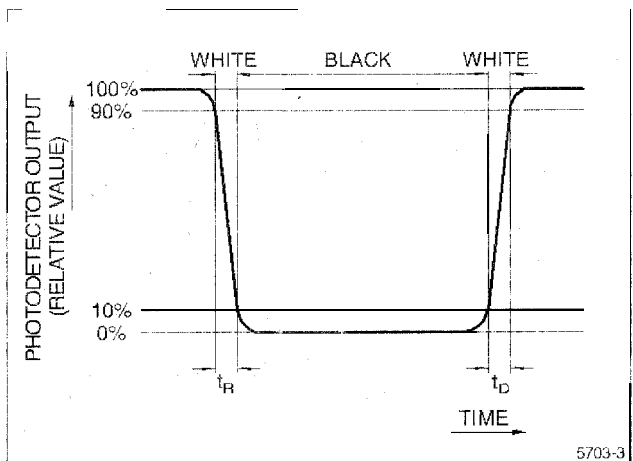Figure 8. Definition of Viewing Angle Range

Figure 9. Definition of Response Time

MECHANICAL CHARACTERISTICS

External Appearance

There shall not be any conspicuous defects. (See Outline Dimensions diagram.)

Panel Durability

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

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

I/O Connector Performance

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

- **Applicable FPC: Shown in Figure 11.**
- **Terminal holding force: 100 g or larger/pin. (Each terminal is pulled out at a rate of 25 ±3 mm/minute)**
- **Insertion/pulling durability. Contact resistance not larger than double the initial value after applicable FPC is inserted and pulled out 20 times.**
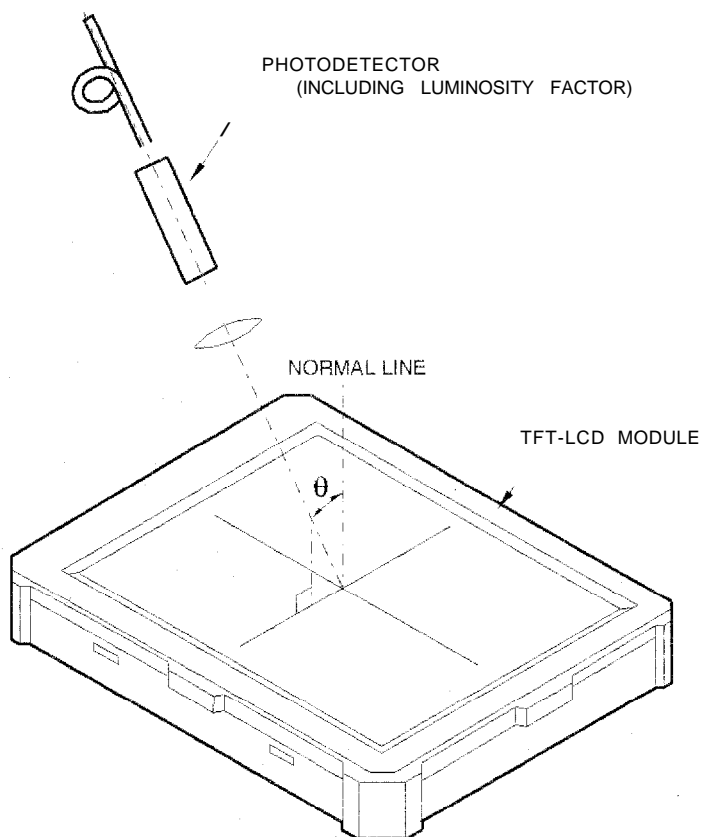

Figure 10. Optical Characteristics Measuring Method

I/O Connector of Backlight Driving Circuit (XH connector 3 pins x 2 pcs.)

- Applicable connector' housing: XHP-3 (produced by Japan Solderless Terminal)
- Terminal holding force: 100 g or more/pin. (Pulled out at a rate of 1 through 5 mm/second)
- Insertion/pulling durability: Contact resistance not larger than double the initial value after connectors are inserted and pulled out 20 times.

DISPLAY QUALITY

The display quality of the color TFT-LCD module shall be in compliance with the Delivery Inspection Standard (Separate Sheet LDI-90522).

HANDLING INSTRUCTIONS

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. When mounting the module, use the M3 tapping screw (fastening torque is 5 through 6 kg-cm). Be sure to fix the module on the same plane, taking care not to warp or twist the module. Be sure that the power source is off when inserting/pulling out I/O connector of the module.

Precautions in Mounting

- The polarizer, which is made of soft material and susceptible to flaws, must be handled carefully. A protective film (laminator) is applied to the surface to protect it against scratches and dirt. Peel off the laminator just before using to avoid static electricity.
- Use caution when peeling off the laminator.

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:

- Floor: Conductive (anti-electrostatic) treatment of 1 MΩ or more on the tile or a conductive mat or conductive paint on the tile
- Clean, dust-free room with an adhesive mat placed in the doorway
- Humidity: 50% to 70% RH
- 'Workers shall wear conductive (anti-electrostatic) shoes, conductive work clothes, conductive gloves and a ground strap.
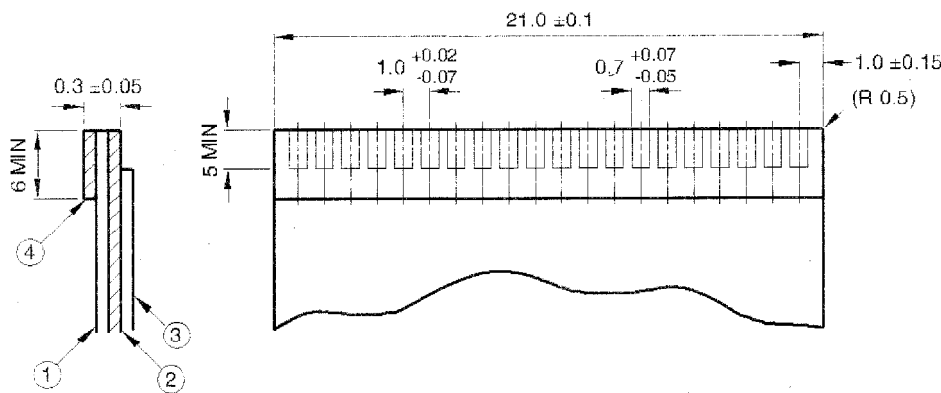
REFERENCE NUMBER	NAME	MATERIAL
①	Base Material	Polyimide or equivalent material (25 μm thick)
②	Copper foil	Copper foil (35 μm thick) solder plated in 2 to 12 μm thickness
③	Coverlay	Polyimide or equivalent material
④	Reinforcing plate	Polyester, polyimide or equivalent material (188 μm thick)

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Figure 11.   Applicable FPC For I/O Connector (1 .0 mm pitch)

Working Procedures

- Direct the wind of the heated ionized air discharging blower somewhat downward to ensure that the module is blown sufficiently. Keep the distance between module and the blower within 20 cm (see Figure 12A).

- Attach adhesive tape to the laminator part near the discharging blower to protect polarizer against flaws (see Figure 12B).

- Feel off laminator, pulling adhesive tape slowly to your side taking five or more seconds. It is important it take more than five seconds.

- After peeling off the laminator, pass the module to the next work process immediately without getting the module dusty.

- Method of removing dust **from polarizer:**

  - Blow off dust with N_2 blower for which static electricity preventive measures have been taken. An ionized air gun (Hugle Electronics Co.) is recommended.

  - Since the 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.

- When metal parts of the TFT-LCD module (shielding lid and rear case) are soiled, wipe them with a soft, dry cloth. For stubborn dirt, wipe the part, breathing gently on it.

- Wipe off liquid immediately since it can cause color changes and staining.

- The LCD is made of glass plates. Use care when handling it to avoid breakage.

- This unit contains CMOS LSIs which are sensitive to electrostatic charges. Take care to protect the unit from electrostatic discharge.

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 in this technical literature may not be satisfied.

Other Precautions

- Do not expose the module to direct sunlight, strong ultraviolet light, etc., for prolonged periods.

- Store the unit at normal room temperature to prevent the LC from converting to iiquid (due to excessive temperature changes).

- If the LCD panel breaks, the liquid crystal may escape from the panel. The liquid crystal is harmful, so do not put it into the eyes or mouth. When liquid crystal sticks to hands, feet or clothes, wash it out immediately with soap.

- Observe all other precautionary requirements in handling general electronic components.
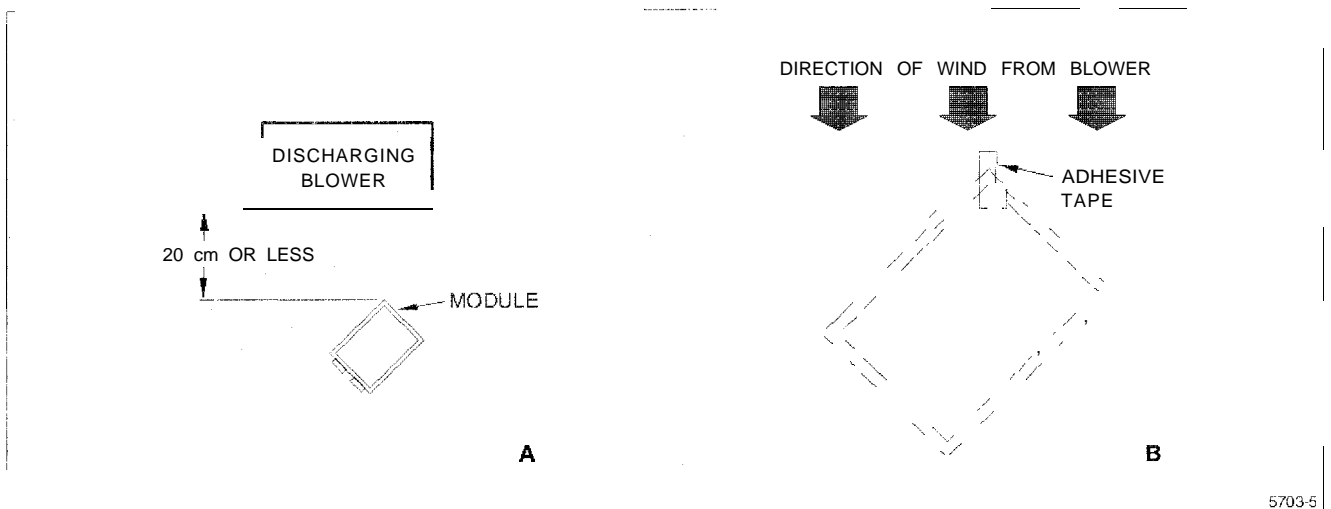

Figure 12.   Proper Use of Discharging Blower