LQ6RA52
TFT-LCD Module

FEATURES

- Dual Mode Type (NTSC(M) and PAL(B, G) Standards)
- MBK-PAL or MaBiKi-PAL Which Enables the 234-Scanning Lines Panel to Display a Picture With Virtually 273-Scanning Lines
- TFT Active Matrix LCD Drive System
- 74,880 Pixels (RGB Stripe Configuration)
- Slim, Lightweight, and Compact:
  - Active Area/Outline Area = 54%
  - Thickness: 23.5 mm
  - Mass: 235 g
- Built-in Video Interface Circuit and Control Circuit Responsive to Two Sets of Standard RGB Analog Video Signals Which can be Superimposed
- High-Quality, Full-Color Rendition With Backlight Source Incorporated
- Viewing Angle: 12/6 O'Clock Direction

DESCRIPTION

The SHARP LQ6RA52 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 standards.

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

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

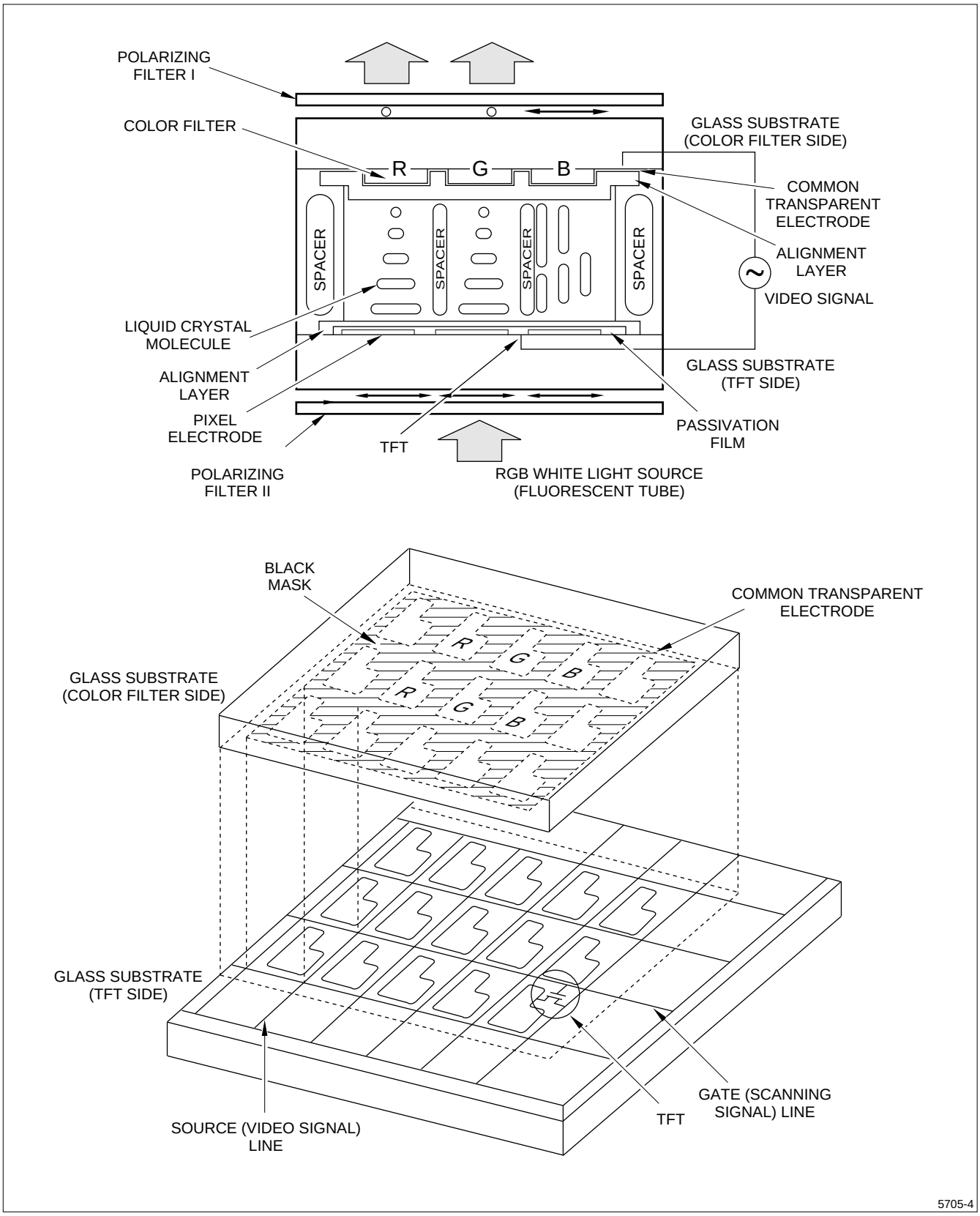


Figure 1. LQ6RA52 TFT-LCD Panel

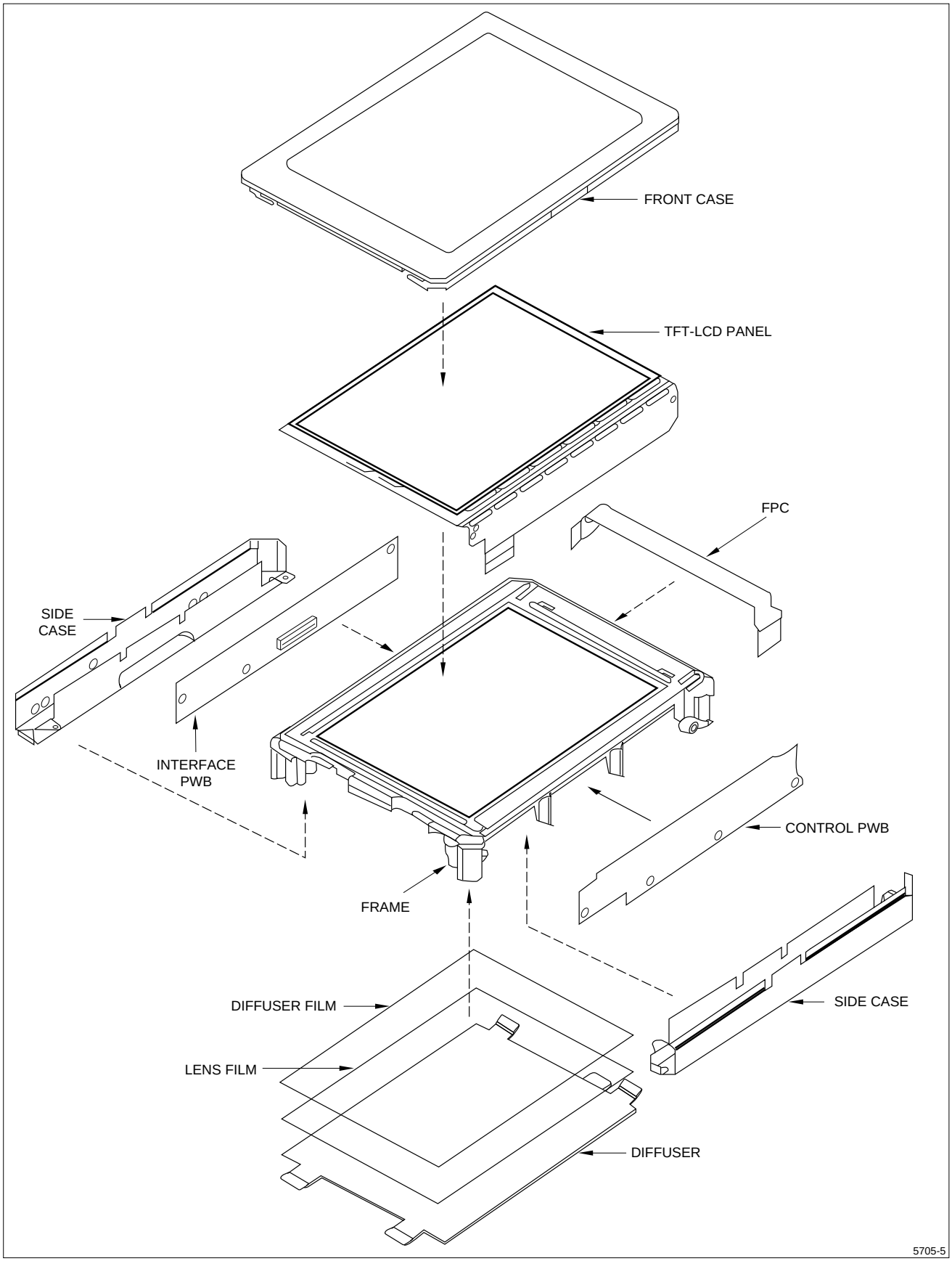


Figure 2. LQ6RA52 TFT-LCD Module Construction

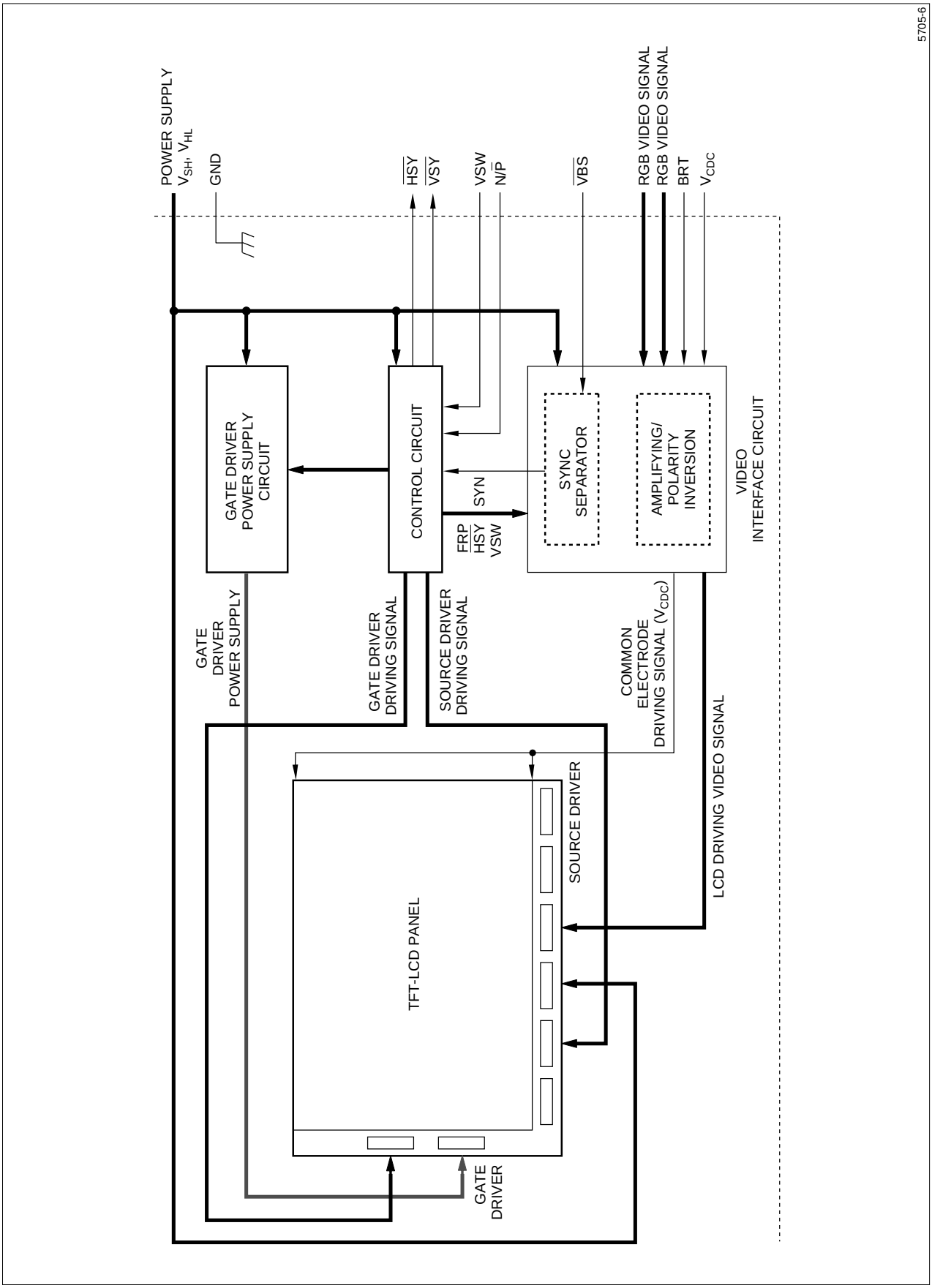


Figure 3. LQ6RA52 Block Diagram

MECHANICAL SPECIFICATIONS

PARAMETER	SPECIFICATIONS	UNIT	NOTE
Display Format	74.880	pixels	–
	960 (W) × 234 (H)	dots	–
Active Area	112.3 (W) × 83.5 (H)	mm	–
Screen Size	14.0 (Diagonal)	cm	–
Dot Pitch	0.117 (W) × 0.357 (H)	mm	–
Dot Configuration	RGB Stripe Configuration	–	–
Outline Dimensions	149.2 (W) × 116.4 (H) × 23 (D)	mm	1
Weight	235 ± 20	g	–

NOTE:
1. Excludes protrusions.

ABSOLUTE MAXIMUM RATINGS (GND = 0 V, t_A = 25°C)

SYMBOL	PARAMETER	MIN.	MAX.	UNIT	NOTE
V_{SH}	Positive Power Supply Voltage	–0.3	+6.0	V	–
V_{SL}	Negative Power Supply Voltage	–9.0	+0.3	V	–
V_{IA}	Analog Input Signal	–	2.0	V	1
V_{ID}	Digital Input/Output Signals	–0.3	V_{SH} +0.3	V	2
V_{CDC}	DC Bias Voltage of Common Electrode Driving Signal	VSL	V_{SH}	V	–
V_{BRT}	Brightness Adjusting Terminal Voltage	0	V_{SH}	V	–
tstg	Storage Temperature	–30	85	°C	3
topr	Operating Temperature – Panel Temperature	–30	85	°C	–

NOTES:
1. $\overline{VBS}$, VR1, VG1, VB1, VR2, VG2, VB2 terminals (Video signal).
2. $\overline{HSY}$, $\overline{VSY}$, VSW, N/$\overline{P}$ terminals.
3. Maximum wet-bulb temperature ≤38°C. No dew condensation.
   Panel temperature shall not exceed 85°C due to heat generation of the lamp.

INPUT/OUTPUT TERMINALS – TFT-LCD PANEL DRIVING SECTION

PIN NUMBER	SYMBOL	I/O	DESCRIPTION	NOTE
1	$\overline{HSY}$	O	Internal Horizontal Sync Signal (In Phase with $\overline{VBS}$)	–
2	$\overline{VSY}$	O	Internal Vertical Sync Signal (In Phase with $\overline{VBS}$)	–
3	TST	O	This Shall be Electrically Opened During Operation	–
4	N/$\overline{P}$	I	Terminal for Display Mode Change of NTSC and PAL	1
5	HRV	I	Turning the Direction of Horizontal Scanning	2
6	VRV	I	Turning the Direction of Vertical Scanning	3
7	VSW	I	Selection Signal of Two Sets of Video Signals	4
8	GND	I	Ground	–
9	V_{CDC}	I	DC Bias Voltage Adjusting Terminal of Common Electrode Driving Signal	5
10	V_{SH}	I	Positive Power Supply Voltage	–
11	$\overline{VBS}$	I	Composite Video Signal for Sync Separator	6
12	BRT	I	Brightness Adjusting Terminal	7
13	VR1	I	Color Video Signal (Red) 1	–
14	VG1	I	Color Video Signal (Green) 1	–
15	VB1	I	Color Video Signal (Blue) 1	–
16	V_{SL}	I	Negative Power Supply Voltage	–
17	VR2	I	Color Video Signal – Red 2	–
18	VG2	I	Color Video Signal – Green 2	–
19	VB2	I	Color Video Signal – Blue 2	–
20	GND	I	Ground	–

NOTES:

In the following descriptions, 'High' means 'V_{SH}' and 'Low' means 'GND.'

1. Selects display mode:
   a. When N/$\overline{P}$ is 'High' or open, the module operates in NTSC (M) mode.
   b. When N/$\overline{P}$ is 'Low,' the module operates in PAL (BG) mode.
2. Turns the direction of horizontal scanning:
   a. When HRV is 'High,' the direction of horizontal scanning is normal.
   b. When HRV is 'Low,' the direction of horizontal scanning is reverse.
3. Turns the direction of vertical scanning:
   a. When VRV is 'High,' the direction of vertical scanning is normal.
   b. When VRV is 'Low,' the direction of vertical scanning is reverse.
4. Selects a set of RGB video signals:
   a. When VSW is 'High' or open, composite video signal (Pin Number 13 through 15) is selected.
   b. When VSW is 'Low,' RGB signal set (Pins Number 17 through 19) is selected.
5. 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_{CDC}) is adjusted to the optimum value with V_{SH} and V_{SL} being the typical values before shipping. In case of change of the optimum value (lowering of the power source), it should be readjusted by the built-in variable resistor (V_{CDC}) or external circuit.
   Refer to 'Adjusting Method of Optimum Common Electrode DC Bias Voltage' for readjusting (Figure 12).
4. Responsive to standard composite sync signal with negative polarity of the same amplitude level as that of the composite video signal.
5. Brightness (black level of video signal) is adjusted by the DC voltage supplied to the pin. Brightness is adjusted to the optimum value on shipping, but it can be readjusted by the built-in variable resistor (BRT) or external circuit (Figure 2).

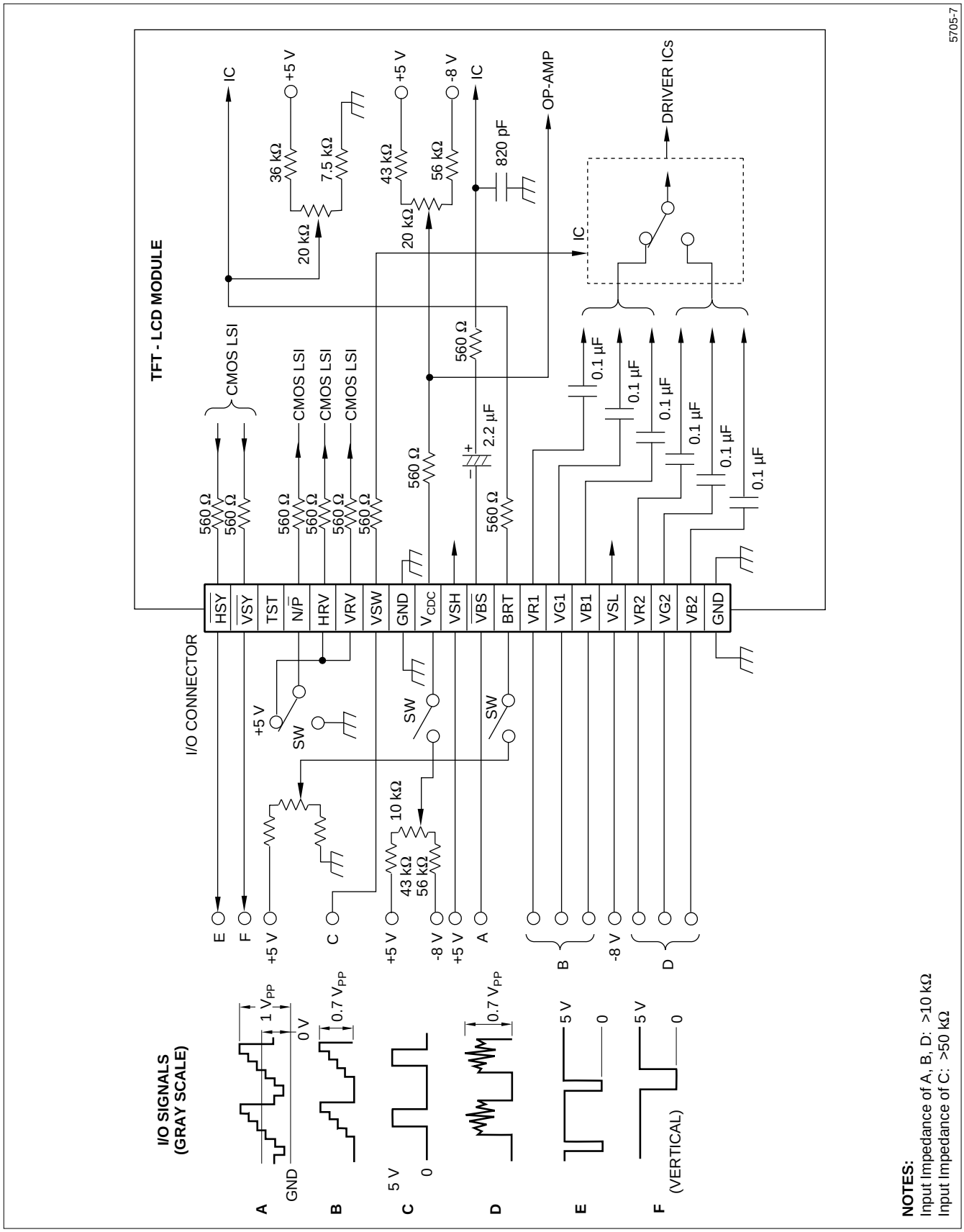


Figure 4. Recommended Circuit for TFT-LCD Module

RECOMMENDED OPERATING CONDITIONS – TFT-LCD PANEL SECTION (GND = 0 V, t_A = 25°C)

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT.	NOTE
V_{SH}	Positive Power Supply Voltage	+4.8	+5.0	+5.2	V	–
V_{SL}	Negative Power Supply Voltage	–8.2	–8.0	–7.8	V	–
$\overline{VBS}$	Analog Input Voltage – Amplitude	0.7	1.0	2.0	V	1
V_I	Analog Input Voltage – DC Component	–	0.7	–	V	1, 2
V_{IDC}	Sync Signal Input Voltage	–1.0	0	+1.0	V	3
V_{IH1}	Digital Input Voltage – High Level	+3.7	–	V_{SH}	V	4
V_{IL1}	Digital Input Voltage – Low Level	0	–	+1.0	V	
V_H	Digital Input Voltage – Histeresis	0.4	–	–	V	
V_{IH2}	Digital Input Voltage – High Level	+4.0	–	VSH	V	–
V_{IL2}	Digital Input Voltage – Low Level	0	–	+0.3	V	
V_{OH}	Digital Output Voltage – High Level	+3.5	–	V_{SH}	V	5
V_{OL}	Digital Output Voltage – Low Level	0	–	+1.5	V	–
V_{CDC}	DC Bias Voltage of Common Electrode Driving Signal	–1.8	–0.3	+1.2	V	6
V_{BRT}	Terminal Voltage of Brightness Adjustment	0.7	1.0	1.5	V	–

NOTES:

1. Input impedance: >10 kΩ.
2. VRI, VGI, VBI, VR2, VG2, VB2 terminals (Video signals).
3. $\overline{VBS}$, VR1, VG1, VB1, VR2, VG2, VB2 terminals (Video signals).
4. N/$\overline{P}$, VSW terminals. Input impedance: >50 kΩ.
5. $\overline{HSY}$, $\overline{VSY}$ terminals (Internal sync signals). Load resistance: >20 kΩ.
6. Adjusted for each module so as to attain maximum contrast ratio.

POWER CONSUMPTION (t_A = 25°C)

SYMBOL	PARAMETER	CONDITION	MIN.	TYP.	MAX.	UNIT
I_{SH}	Positive Supply Current	V_{SH} = +5.0 V V_{SL} = –8.0 V	–	+150	+200	mA
I_{SL}	Negative Supply Current		–	–100	–150	mA
W_S	Total		–	1.55	2.20	W

INPUT/OUTPUT SIGNAL TIMING CHART
(NTSC(M): F_H = 15.7 kHz, F_V = 60 Hz, PAL (BG): F_H = 15.6 kHz, F_V = 50 Hz)

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT	NOTE
T_{HS1}	Horizontal Sync – Input Pulse Width	4.2	4.7	5.7	µs	–
T_{HS2}	Horizontal Sync – Output Pulse Width	2.7	4.3	8.5	µs	$f = \frac{f_H}{2}$
T_{PD}	Horizontal Sync Output Pulse Width	0.2	–	3.0	µs	3
T_{VS}	Vertical Sync Output Pulse Width	241	254	267	µs	$4/f_H$
T_{PV}	Vertical Sync Phase Difference	67/33	73/39	79/45	µs	4

NOTES:

1. Supply voltage condition: V_{SH} = +5.0 V, V_{SL} = –8.0 V).
2. Adjusted by Variable resistor (H-POS).
3. Variable range by Variable resistor (H-POS) (positive when $\overline{HSY}$ proceeds $\overline{VBS}$).
   Adjusted value: $T_{PD} = 1.6 \pm 0.7$ µs.
4. Odd field/Even field ($1/f_H/0.5/f_H$).

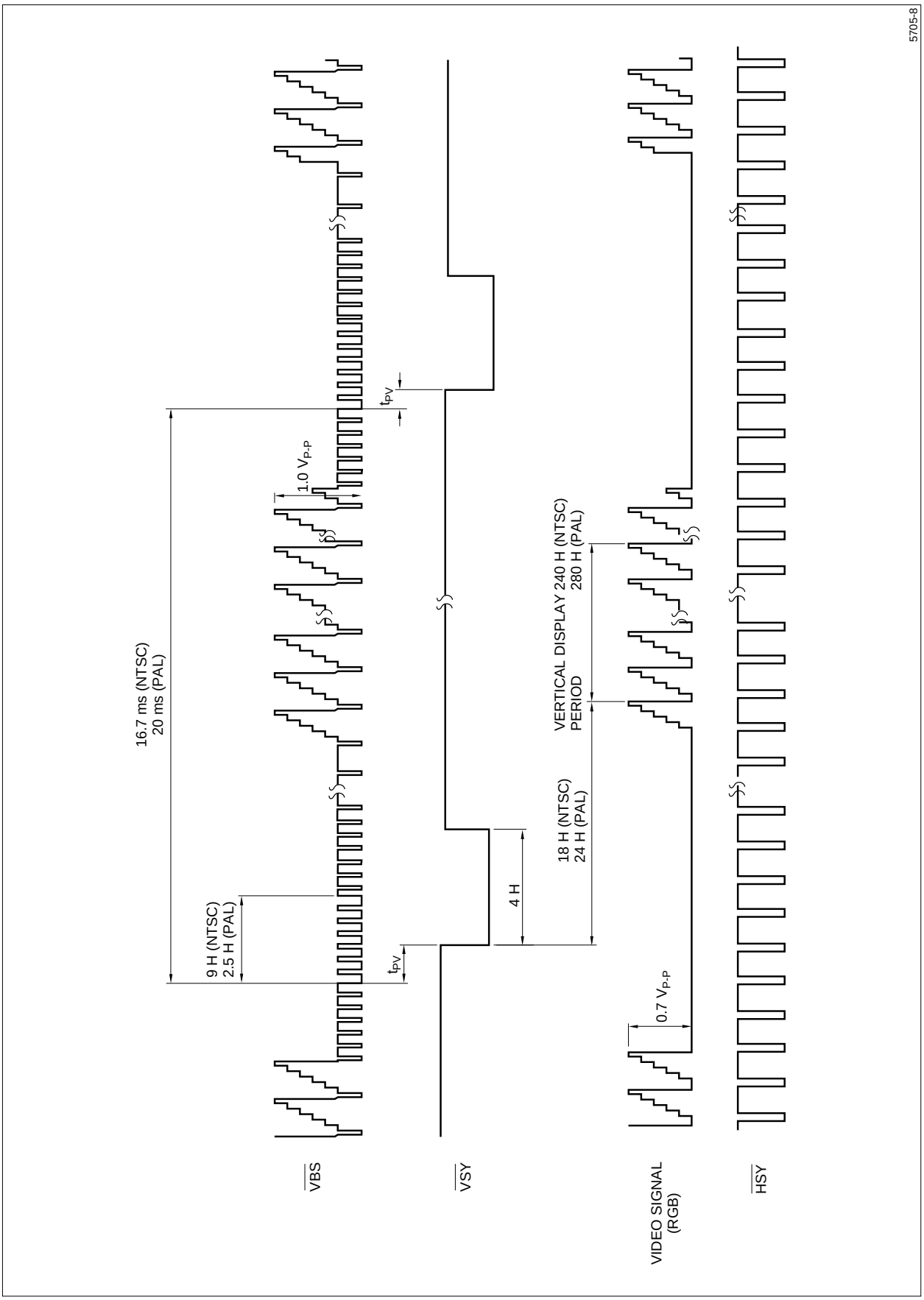


Figure 5. Input/Output Signal Waveforms

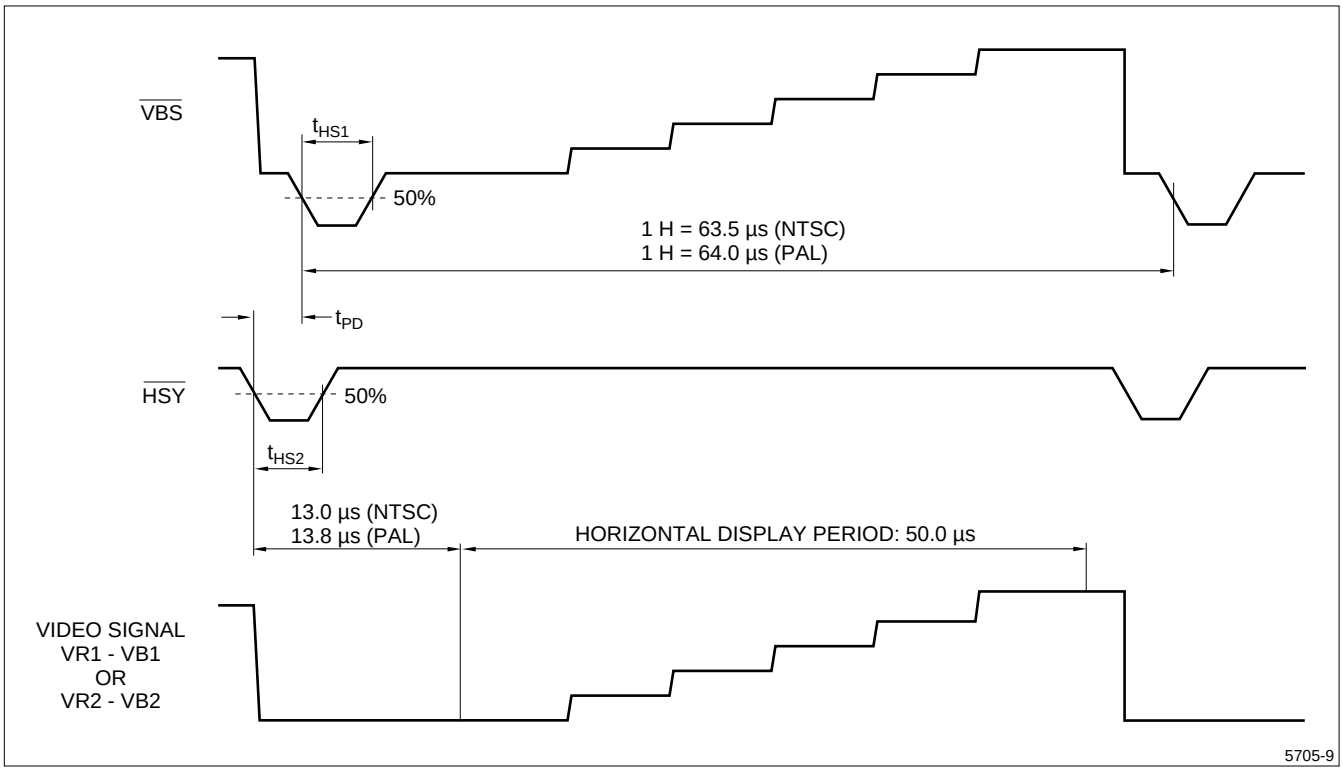


Figure 6. Input/Output Signal Timing Chart

Display Time Range

When sync signal of NTSC (M) system is applied (N/$\overline{P}$ terminal = V_{SH}):

- Horizontally: 13.0 µs to 63.0 µs from the falling edge of $\overline{HSY}$.
- Vertically: 20H to 253H from the falling edge of $\overline{VSY}$.

When sync signal of PAL (BG) system is applied (N/$\overline{P}$ terminal = GND):

- Horizontally: 13.8 µs to 63.8 µs from the falling edge of $\overline{HSY}$.
- Vertically: 26H to 298H from the falling edge of $\overline{VSY}$.

OPTICAL CHARACTERISTICS (t_A = 25°C)

SYMBOL	PARAMETER	CONDITION	MIN.	TYP.	MAX.	UNIT	NOTE
$\Delta\theta$ 11	Viewing Angle Range	CR ≥ 10	10	–	–	degrees	2, 3
$\Delta\theta$ 12			30	–	–		
$\Delta\theta$ 2			45	–	–		
CR_{MAX}	Contrast Ratio	Optimum viewing angle	60	–	–	–	3, 4
t_R	Response Time – Rise	θ = 0°	–	30	60	ms	3, 5
t_D	Response Time – Decay	θ = 0°	–	50	100	ms	
Tr	Transmission	θ = 0°	3.8	4.8	–	%	6
Δx	Chromaticity Shift	–	–0.025	–	+0.050	–	7
Δy			–0.014	–	+0.046	–	

NOTES:

1. Measurement shall be executed with no diffuser.
2. Viewing angle range is defined in Figure 5.
3. Applied voltage for measuring optical characteristics:
   a. V_{CDC} must be adjusted to attain maximum contrast ratio.
   b. White $V_I = V_{I50} \pm 1.5$ V
      Black $V_I = V_{I50} \pm 2.0$ V
      V_{I50}: The analog input voltage (V_{IAC}) when transmission is 50%.
      Transmission 100% is defined as the panel transmission with all the input terminals of the module electrically open.
4. Contrast ratio is defined as follows: $\text{Contrast ratio (CR)} = \frac{\text{Photodetector output with LCD being 'white'}}{\text{Photodetector output with LCD being 'black'}}$
5. Response time is obtained by measuring the transition time of photodetector output when input signals are applied so as to make the area 'black' to and from 'white' (Figure 6).
6. Transmission is defined as follows: $\text{Transmission} = \frac{\text{Photodetector output voltage when measuring the brightness of the LCD panel placed on the light source with no applied voltage}}{\text{Photodetector output voltage when measuring the light source brightness}}$ (θ = 0°)
7. Chromaticity shift is the difference of that of the light source and the panel placed on it. The light source chromaticity is supposed to be (x = 0.320, y = 0.340).

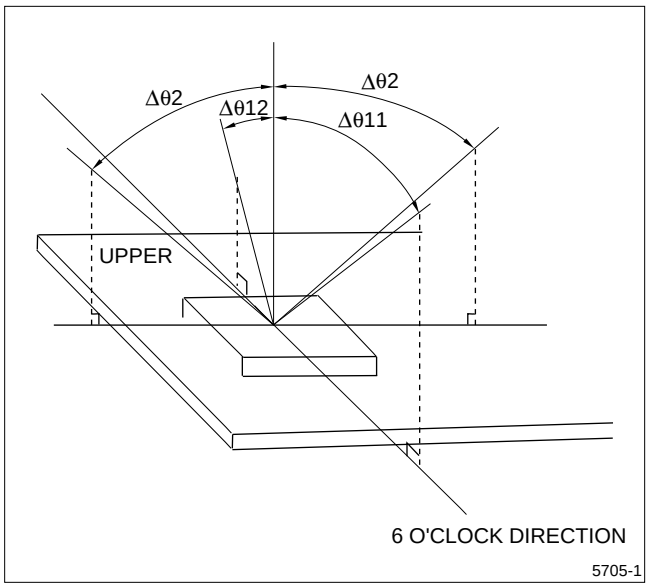


Figure 7. Definition of Viewing Angle

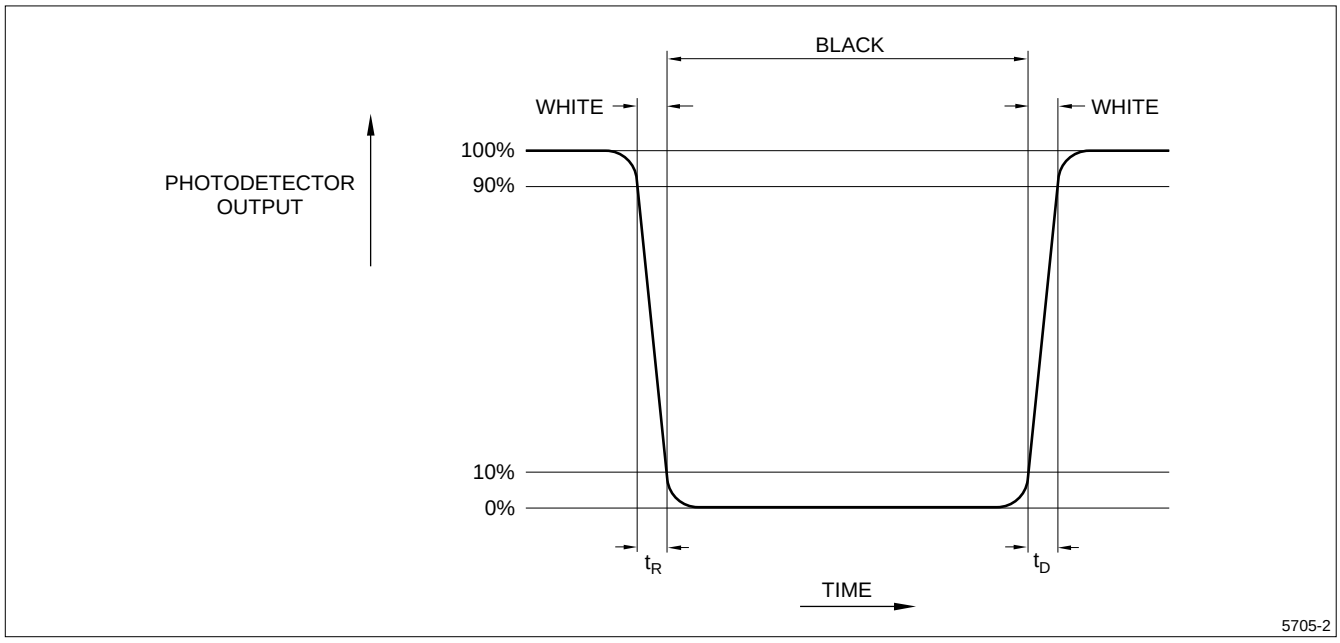


Figure 8. Photodetector Output

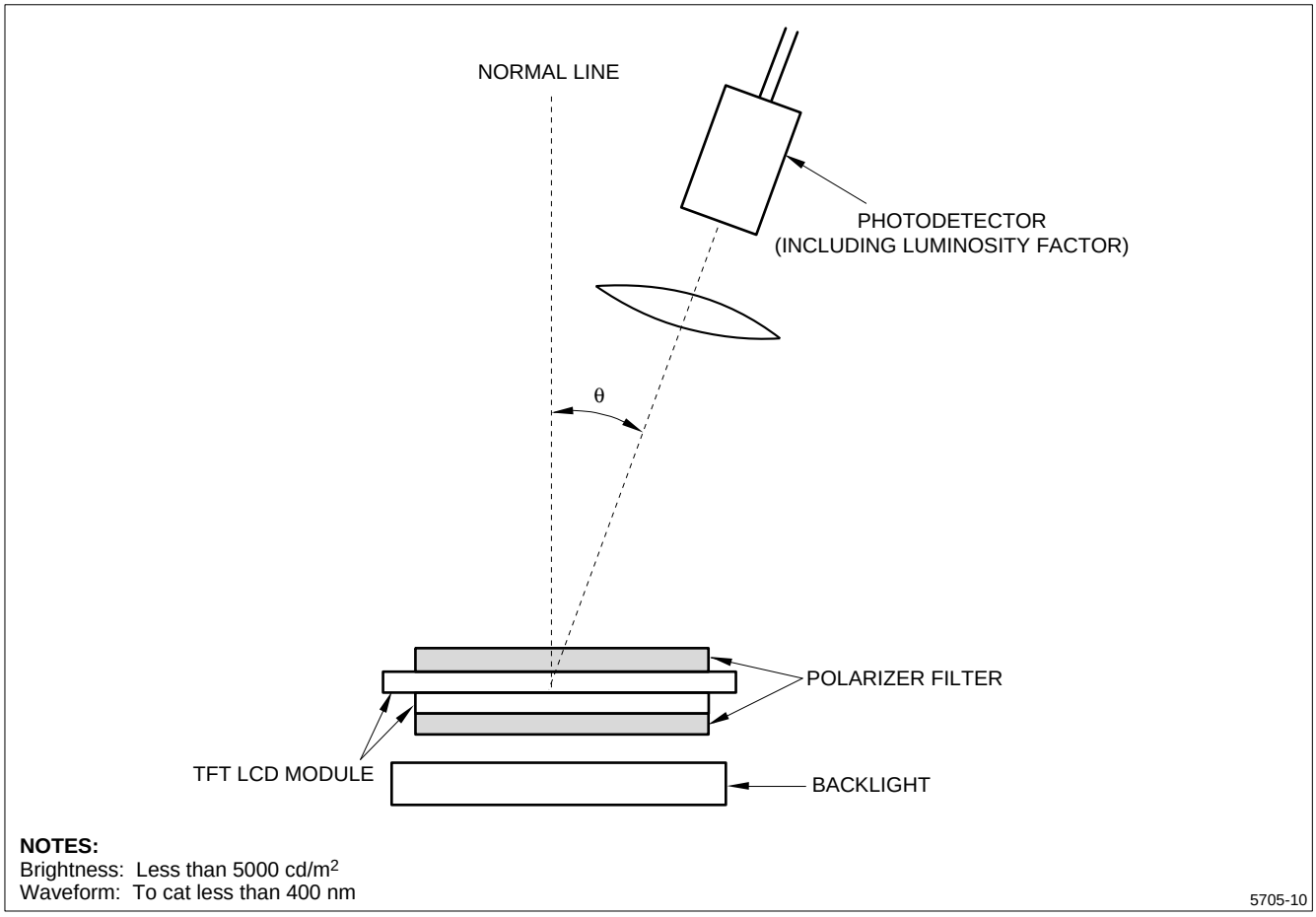


Figure 9. Optical Characteristics Measuring Method

MECHANICAL CHARACTERISTICS

External Appearance

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

Panel Durability

The panel will not break when the center is pressed with 19 N force by a 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

- Applicable FPC
- Terminal holding force: 0.9 N 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.

DISPLAY QUALITY

The display quality of the color TFT-LCD module shall be in compliance with the Incoming Inspection Standard.

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 0.5 through 0.6 Nm). Be sure to fix the module on the same plane, taking care not to warp or twist the module.

Precautions in Mounting

- The polarizer is made of soft material and susceptible to flaws. Handle carefully. Protective film (laminator) is applied on the surface to protect it against scratches and dirt. Remove the laminator just before using to avoid static electricity.

Precautions When Peeling off the Laminator

Working Environment

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

- Floor: Conductive 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.
  Temperature: 15°C – 27°C
- Workers shall wear conductive shoes, conductive work clothes, conductive gloves, and a ground strap.

Working Procedures

- Direct the wind of the heat-ionized air discharging blower somewhat downward to ensure that the module is blown sufficiently. Keep the distance between the module and the discharging blower within 20 cm (Figure 8).
- Attach adhesive tape to the laminator part near the discharging blower to protect polarizer against flaws (Figure 8).
- Peel off laminator, pulling adhesive tape slowly to your side, taking five or more seconds.
- After peeling off the laminator, pass the module to the next work process immediately without getting the module dusty.
- Methods to remove dust from polarizer:
  - Blow off dust with N_2 blower for which static electricity preventive measures have been taken. Using 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 a 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 TFT-LCD module is made of glass. Use care when handling it to avoid breakage.
- This unit contains CMOS LSI which is sensitive to electrostatic charges. Use care to protect the unit from electrostatic discharge.

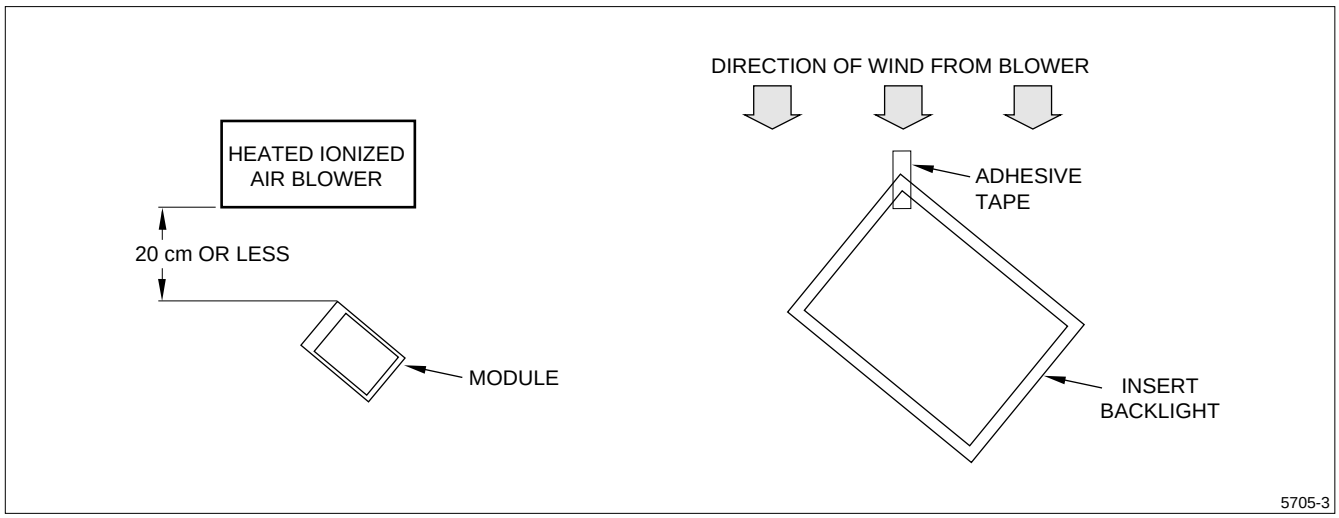


Figure 10. Heated Ionized Air Blower Precautions

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 or ultraviolet light, etc., for prolonged periods.
- Store the module at normal room teperature to prevent the LC from converting to liquid (due to excessive temperature changes).
- If the LCD panel breaks, the liquid crystal may escape from the panel. 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.

SHIPPING REQUIREMENTS

The packing form is shown in Figure 9.

Carton Storage Conditions

- Number of layers of cartons in pile: 10 layers maximum.
- Environmental conditions:
  - Temperature: 0°C to 40°C.
  - Humidity: 60% RH or less (at 40°C). No dew condensation 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: Approximately three months.
  - Opening of Package: To prevent the 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 grounding before opening the package.

Result Evaluation Criteria

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

OTHER INFORMATION

If any problem should arise from this specification, the supplier and user should work out a mutually acceptable solution.

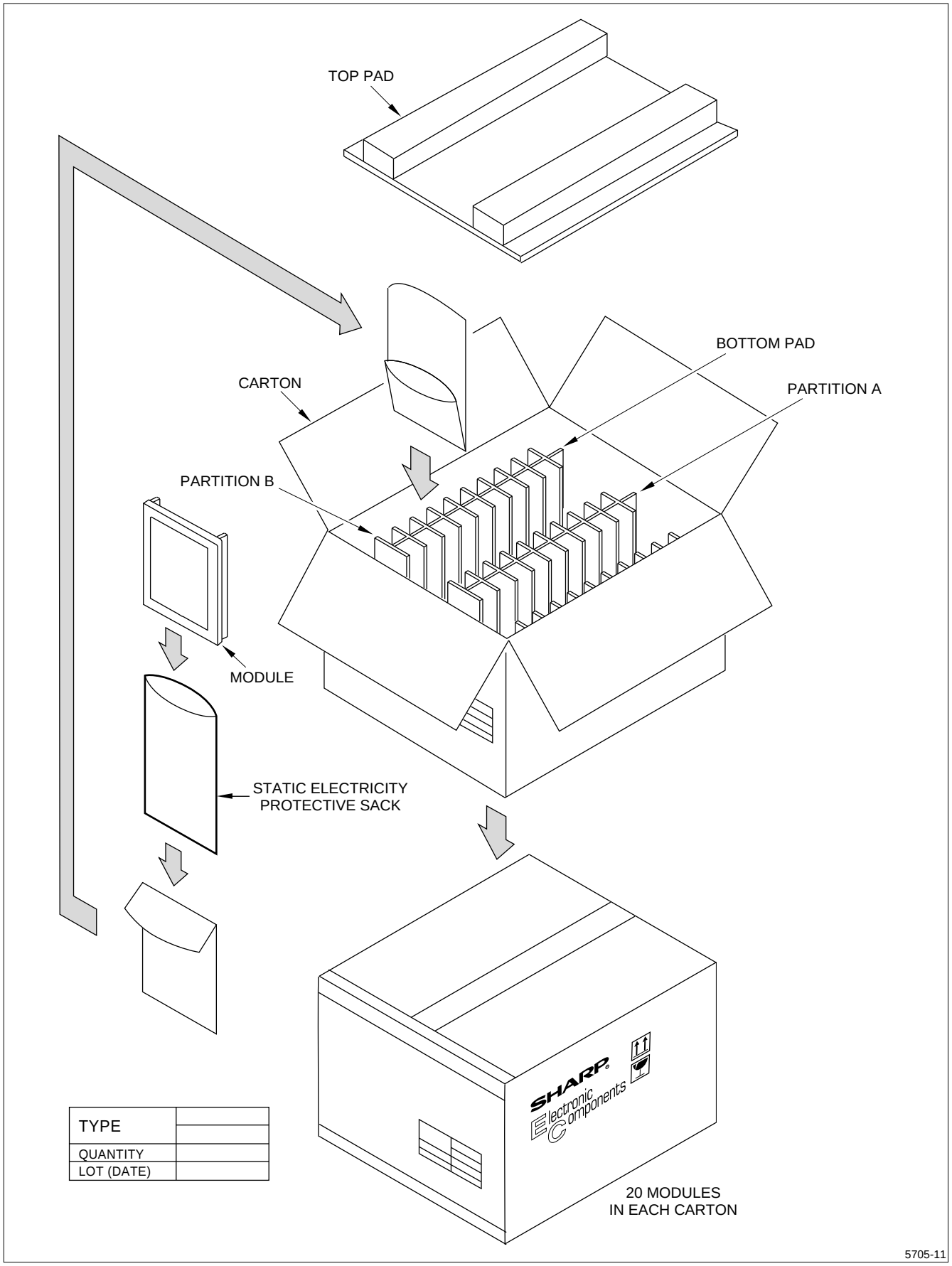


Figure 11. Packing Form

RELIABILITY TEST CONDITIONS

NUMBER	TEST ITEM	CONDITIONS
1	High Temperature Storage Test	t_P = +85°C, 240 H
2	Low Temperature Storage Test	t_P = –30°C, 240 H
3	High Temperature and High Humidity Operating Test	t_P = +60°C, 95% RH, 240 H
4	High Temperature Operating Test	t_P = +85°C, 240 H
5	Low Temperature Operating Test	t_P = –30°C, 240 H
6	Electrostatic Discharge Test	±200 V, 200 pF (0 Ω), Once for each terminal
7	Shock Test	980m/s^2, 6 ms, ±X/±Y/±Z, three times for each direction (JIS C7021, A-7 Condition C)
8	Vibration Test	Frequency range: 8 to 33.3 Hz, Stroke: 1.3 mm Sweep: 33.3 Hz to 400 Hz Two hours for each direction of X/Y/Z, Four hours for direction of Z (Eight hours total) (JIS D1601)
9	Heat Shock Test	–30°C to +85°C/200 cycles (0.5 H) (0.5 H)

NOTE:

t_P = Panel Temperature.

CONSTRUCTION OF TFT-LCD MODULE

The circuit diagram is shown in Figure 1.

TFT-LCD module is composed of an LCD panel, driver ICs, a control circuit for the driver ICs, a video signal processing circuit (video interface circuit) unique to the LCD, and a backlight (Figure 10).

The driver ICs are divided into two types: a source driver (data driver) which receives RGB signals and sends them sequentially by one horizontal line of the LCD panel, and a gate driver (scan driver) which scans 240 gate lines of the LCD panel.

The module displays an image on the LCD panel as it receives power supplies (V_{SH}, V_{SL}), RGB video signals, DC bias voltage of common electrode driving signal (V_{CDC}), composite video signal or composite synchronizing signal ($\overline{VBS}$), selection signal of two sets of video signals (VSW), and brightness adjusting DC voltage (BRT) from the exterior.

The composite video signal is subject to synchronous separation in the module and used to write a video signal accurately on each pixel on the module.

The control circuit receives composite synchronizing signal separated in the video interface circuit, generates clock pulses synchronized with the composite synchronizing signal and gate and source drivers-driving signals, and outputs internal horizontal synchronizing signal ($\overline{HSY}$), internal vertical synchronizing signal ($\overline{VSY}$), and polarity inversion signal (FRP).

The voltage level of RGB video signals applied to the liquid crystal layer of each pixel through the source driver IC and TFT is about 3.7 V_{P-P} from black to white level. In order to prevent the electro-chemical decomposition of the liquid crystal, it is necessary to apply AC voltage to the liquid crystal. For this purpose, the polarity of the video signals must be alternated. Since the amplification and polarity inversion of the video signals are performed in the video interface circuit in the module using the polarity inversion signal (FRP), composite video signal of 1.0 V_{P-P} or standard analog RGB signals of 0.7 V_{P-P} may be used for both of the inputs to the module.

Power supplies to this module are 5 V (V_{SH}), 0 V (GND), and –8 V (V_{SL}). Control IC operates on a 0 V to 5 V line so that it outputs $\overline{HSY}$ and $\overline{VSY}$ at 0 V to 5 V level. Power supplies to the video interface circuit are V_{SH} and V_{SL}.

VSW is used to select composite or RGB video signals. VSW selects composite video signal when it is 'High' or open, and selects RGB signals when it is 'Low'.

N/$\overline{P}$ is used to select display mode.

When it is 'High' or open, the module operates in NTSC (M) mode, and when it is 'LOW,' the module operates in PAL (BG) mode.

BRT and V_{CDC} are adjusted to the optimum value on shipping.

EXAMPLE OF TFT-LCD TV

Figure 11 shows a block diagram example of the TFT-LCD module applied to a TV set. The block enclosed by the dotted line is the TFT-LCD module. Other signal-processing systems are the same as those in ordinary CRT-TVs.

The following seven signals must be supplied to this module from the exterior:

- Composite video signal: $\overline{VBS}$
- Standard analog RGB video signals in two sets
- Signal for changing display mode N/$\overline{P}$
- Signal for selecting input video signals: N/$\overline{P}$
- Signal for selecting input video signals: VSW
- DC bias voltage of common electrode driving signal: V_{CDC}
- Brightness adjusting DC voltage: BRT

The following two signals are output from this module to the exterior:

- Internal horizontal synchronizing signal: $\overline{HSY}$
- Internal vertical synchronizing signal: $\overline{VSY}$

When this module is applied to a TV set, for example, $\overline{HSY}$ and $\overline{VSY}$ are used to display selected channel number and characters on the screen.

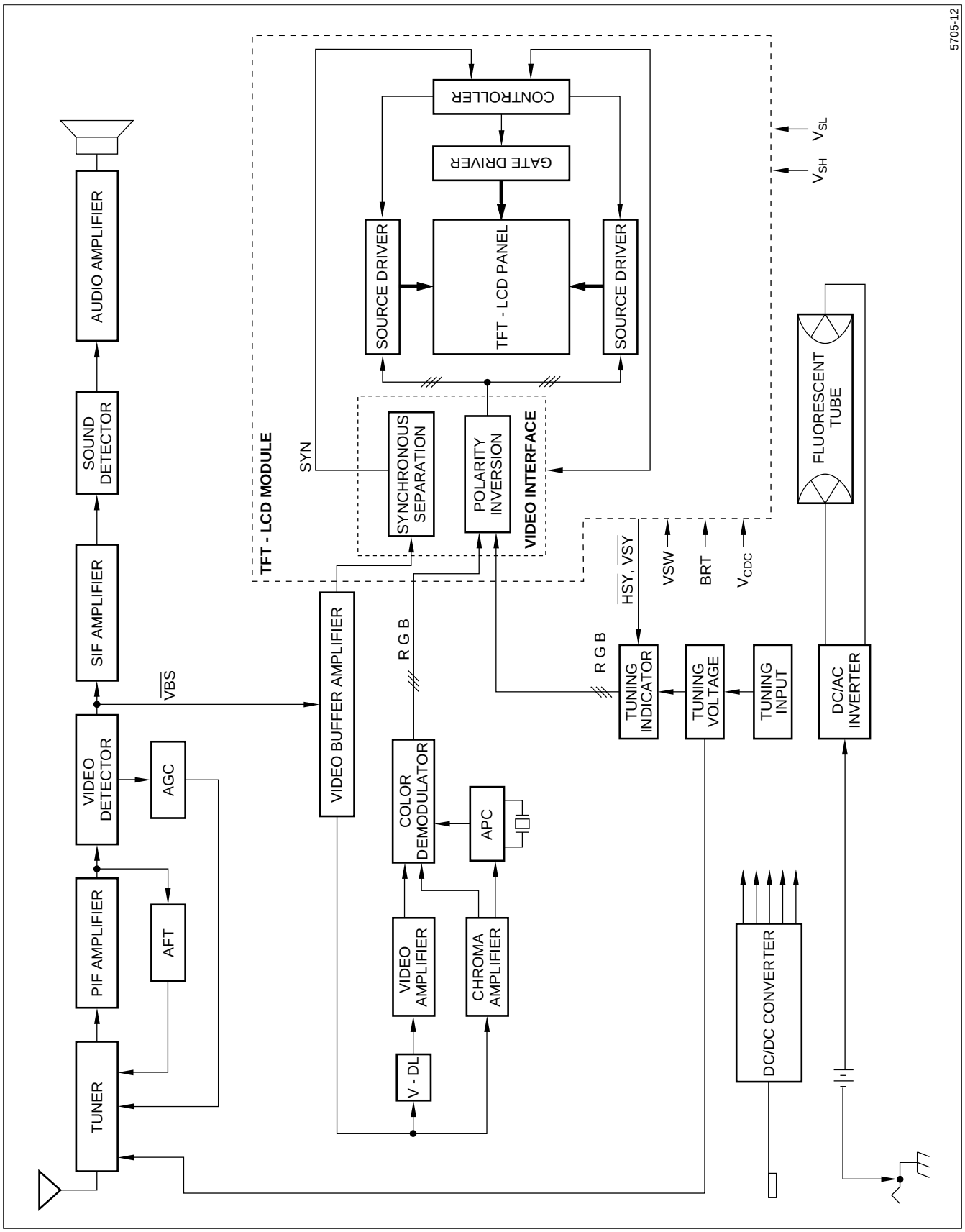


Figure 12. Block Diagram of TFT-LCD TV Set

ADJUSTING METHOD OF OPTIMUM COMMON ELECTRODE DC BIAS VOLTAGE

To obtain optimum DC bias voltage of common electrode driving signal (V_{CDC}), photoelectric devices are very effective, and the accuracy is within 0.1 V. (In a visual examination method, the accuracy is about 0.5 V because of the difference among individuals.)

To gain optimum common electrode DC bias voltage, there are two methods which use photoelectric devices. The value of optimum DC bias voltage is the same in both methods:

- Measurement of Flicker: DC bias voltage is adjusted to minimize NTSC: 50 Hz (30 Hz), PAL 50 Hz (25 Hz) flicker.
- Measurement of Contrast: DC bias voltage is adjusted so as to minimize the photoelectric output voltage.

Measurement of Flicker

Photoelectric output voltage is measured by an oscilloscope in a system similar to that shown in Figure 12.

DC bias voltage must be adjusted to minimize the NTSC: 50 Hz (30 Hz), PAL 50 Hz (25 Hz) flicker with DC bias voltage changing slowly (Figure 13).

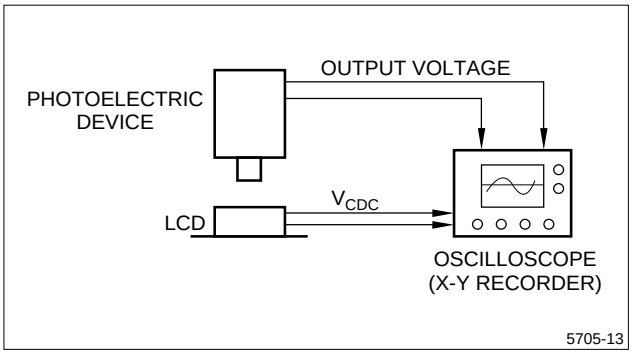


Figure 13. Measurement System

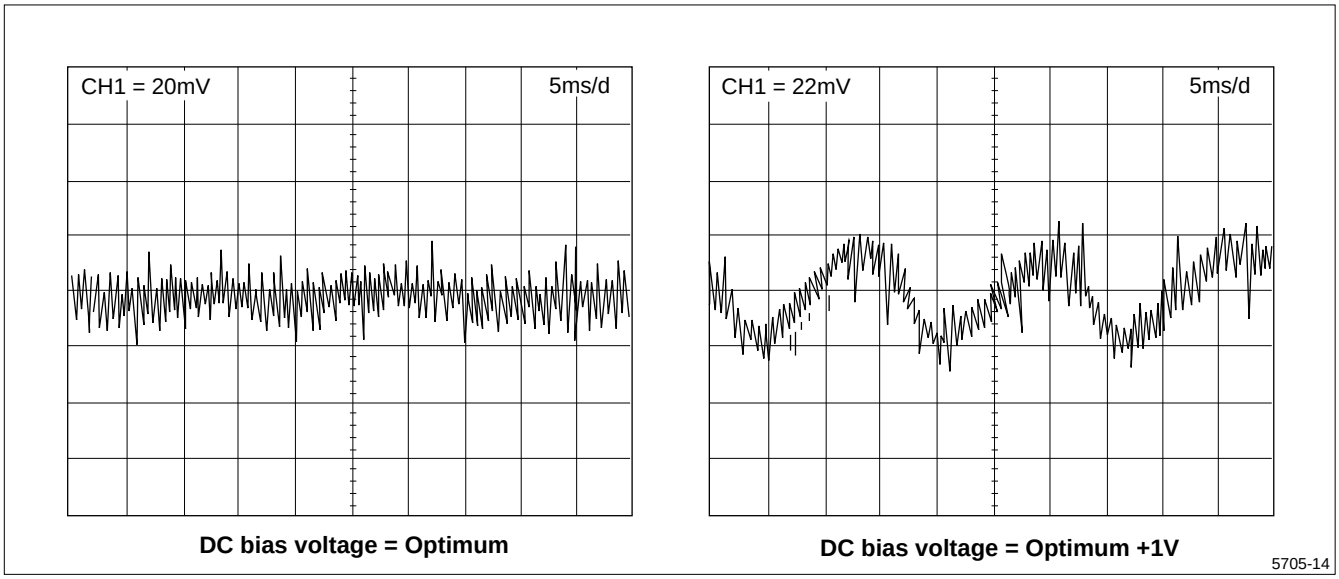


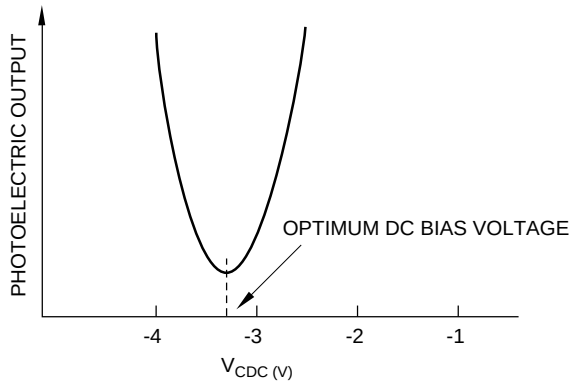
Figure 14. Waveforms of Flicker

Measurement of Contrast

Photoelectric output voltage is measured by oscilloscope or X-Y recorder by using the test setup shown in Figure 12. Common electrode DC bias voltage must be adjusted to minimize the photoelectric output voltage with DC bias voltage changing slowly (Figure 14).

Optimum common electrode DC bias voltage is almost equal between half tone and black level, making it difficult to decide the optimum point at black level.

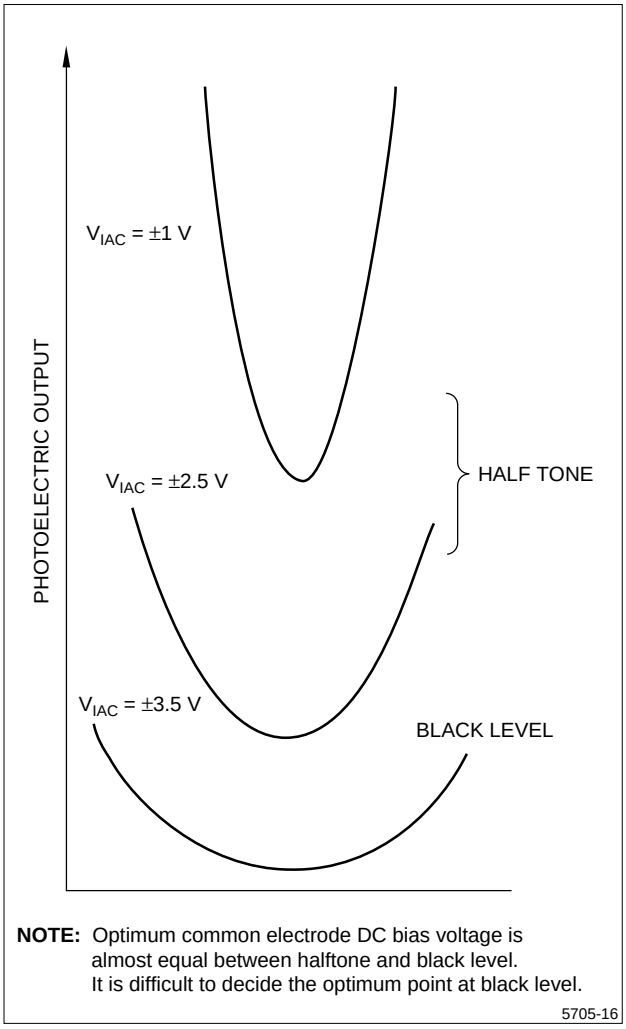
The value of minimum point is not definite because the DC response is slow. The optimum point cannot be attained.



NOTES:
1. Measurement is more accurate at half tone as compared with other gradation level. Change of photoelectric output is small at black level.
2. DC bias voltage must be adjusted slowly. The value of optimum DC bias changing fast is different from that when changing slowly because DC response is slow.
3. The final adjustment of DC bias voltage must be made by changing from positive to negative.

5705-15

Figure 15. Optimum Common Electrode DC Bias Voltage by Measurement of Contrast



NOTE: Optimum common electrode DC bias voltage is almost equal between halftone and black level. It is difficult to decide the optimum point at black level.

5705-16

Figure 16. Relation Between Gradation Level and DC Bias Voltage

ELECTRICAL DISPLAY ROTATING FUNCTION

This module LQ6RA52 has the following optical characteristics.

This TFT module has the 12 o'clock viewing angle panel as shown in Figure 16. It is possible to use a 6 o'clock viewing angle by using the 'electrical display rotating function.' It is necessary to rotate the module 180° mechanically (Figures 17 and 18).

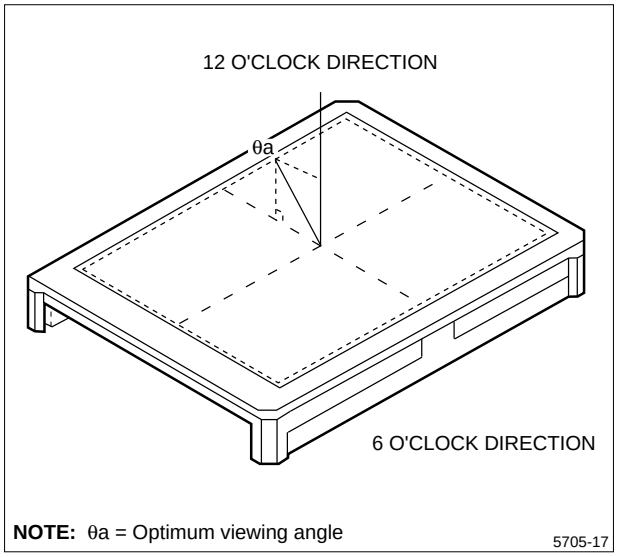


Figure 17. 12 O'Clock Viewing Angle Panel

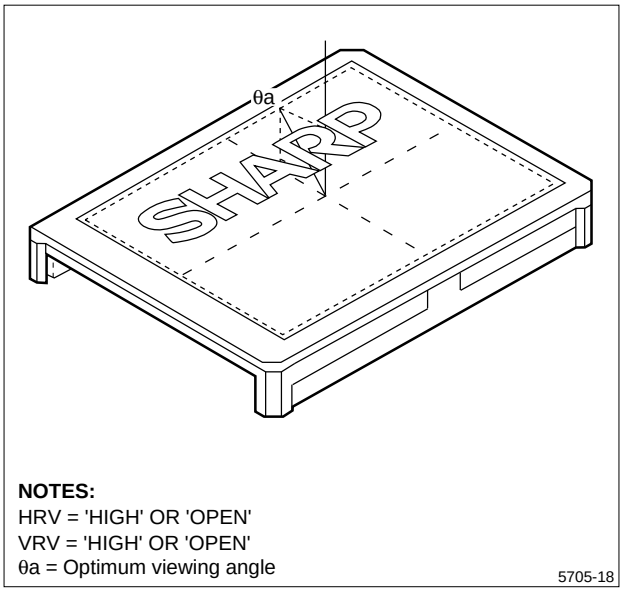


Figure 18. 12 O'Clock Direction Type

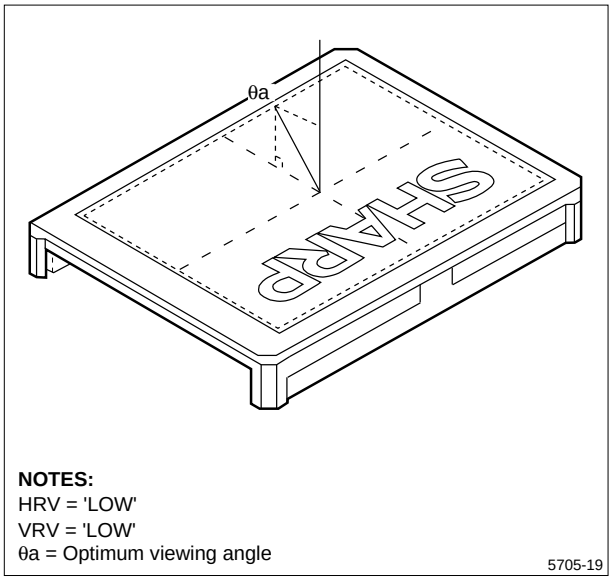
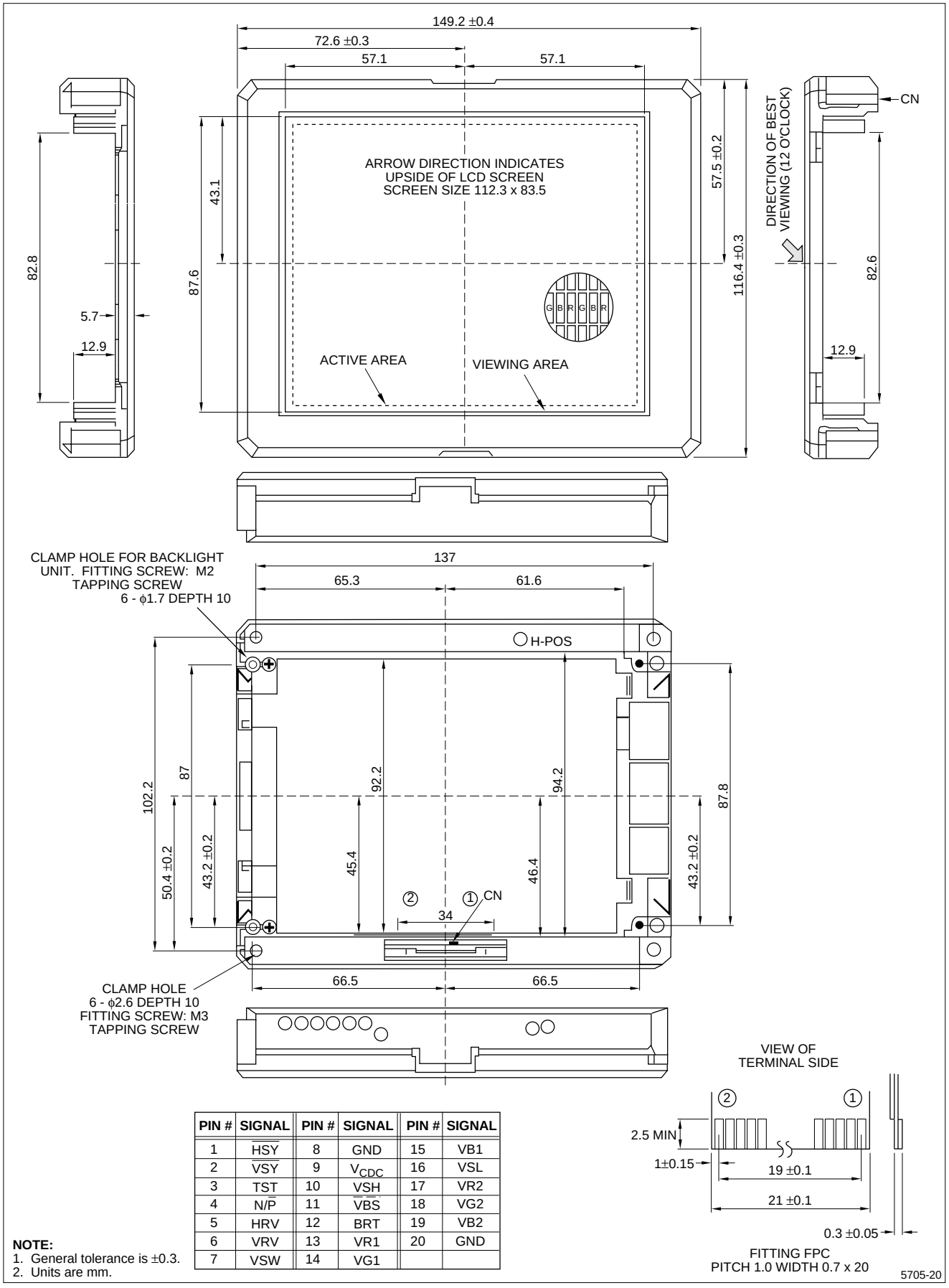


Figure 19. 6 O'Clock Direction Type

OUTLINE DIMENSIONS



PIN #	SIGNAL	PIN #	SIGNAL	PIN #	SIGNAL
1	$\overline{HSY}$	8	GND	15	VB1
2	$\overline{VSY}$	9	V_{CDC}	16	VSL
3	TST	10	$\overline{VSH}$	17	VR2
4	N/$\overline{P}$	11	$\overline{VBS}$	18	VG2
5	HRV	12	BRT	19	VB2
6	VRV	13	VR1	20	GND
7	VSW	14	VG1		

NOTE:
1. General tolerance is ±0.3.
2. Units are mm.