

PREPARED BY: _____	DATE _____	<h1 style="margin: 0;">S H A R P</h1> <p style="margin: 10px 0;">LIQUID CRYSTAL DISPLAY GROUP SHARP CORPORATION</p> <h2 style="margin: 0;">SPECIFICATION</h2>	SPEC No. LD-7601
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			APPLICABLE GROUP Liquid Crystal Display Group

DEVICE SPECIFICATION FOR

TFT-LCD module

MODEL No.

LQ9 P 161

CUSTOMER'S APPROVAL

DATE _____

BY _____

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1. Application

This specification applies to a color TFT-LCD module, LQ9P161.

2. Overview

This module is a color active matrix LCD module incorporating amorphous silicon TFTs (Thin Film Transistors). This module is composed of a high-transmissivity-type color TFT-LCD panel, driver ICs, control circuit and power SUPPLY circuit. Graphics and texts can be displayed on a 640x3x480 dots panel with 4,096 colors by supplying 12 bit data signals(4bit/color), four timing signals, +5V DC supply voltage for TFT-LCD panel driving.

[Features]

- ◎ Low power consumption.
- ◎ High transmissivity.

3. Mechanical Specifications

Parameter	Specifications	Unit
Display size	21 (8.4") Diagonal	cm
Active area	170.9(H) × 129.6(V)	mm
Pixel format	640(11) × 480(V)	pixels
	(1 pixel = R + G + B dots)	
Pixel pitch	0.267(H) × 0.270(V)	mm
Pixel arrangement	R, G, B vertical stripe	
Display mode	Normally white	
Unit outline dimensions	242.5(W) × 179.4(H) × 7.5(D)	mm
Mass	330 ± 20	g
Surface treatment	Clear, hard-coating(2H)	

The outline dimensions is shown in Fig.1

4. Input Terminals

4-1. TFT-LCD panel driving

The module-side connector:DF9BA-31P-1V (Hirose Electric Co., Ltd.)

CNI The user-side connector :DF9-31S-1V ("), □ is blank, A or B,

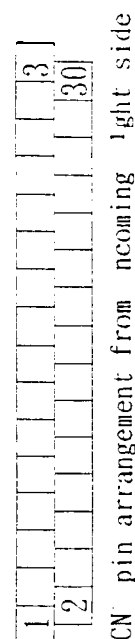
Pin No.	Symbol	Function	Remark
1	R0	RED data signal (LSB)	
2	GND		
3	RI	RED data signal	
4	Vsync	Vertical synchronous signal	【Note1】
5	R2	RED data signal	
6	Hsync	Horizontal synchronous signal	【Note1】
7	R3	RED data signal(MSB)	
10	CK	Clock signal for sampling each data signal	
11	G0	GREEN data signal (LSB)	
13	G1	GREEN data signal	
14	NBH	Horizontal display mode select signal	【Note3】
15	GND		
16	TST	This should be electrically opened during operation	
17	G2	GREEN data signal	
18	TST	This should be electrically opened during operation	
19	G3	GREEN data signal (MSB)	
22	Vcc	+5 V power supply	
23	BO	BLUE data signal (LSB)	
24	Vcc	+5V power supply	
25	B1	BLUE data signal	
26	TST	This should be electrically opened during operation	
27	GND		
28	ENAB	Signal to settle the horizontal display position	[Note2]
29	B2	BLUE data signal	
30	GND		
31	B3	BLUE data signal (MSB)	

※The shielding case is connected with GND in the module.

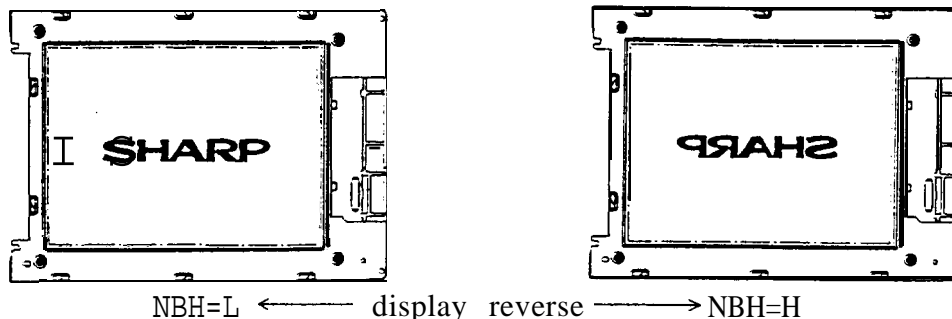
【Note1】 One of 480-, 400- and 350-line mode is selected depending on the polarity combination of the both synchronous signals.

mode	480-line	400-line	350-line
Hsync	negative	negative	positive
Vsync	negative	positive	negative

【Note2】 The horizontal display start timing is settled in accordance with a rising edge of ENAB signal. In case ENAB is fixed “Low”, the horizontal display start timing is determined as described in 7-2. Do not keep ENAB “High” during operation.



【Note3】



5. Absolute Maximum Ratings

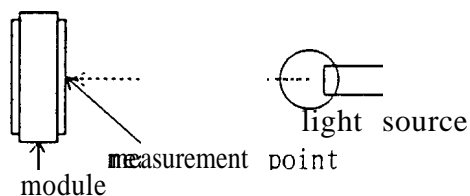
Parameter	Symbol	Condition	Ratings	Unit	Remark
Input voltage	V_i	$T_a=25^\circ\text{C}$	$-0.3 \sim V_{CC}+0.3$	V	【Note1】
Vcc supply voltage	V_{CC}	$T_a=25^\circ\text{C}$	$0 \sim +6$	v	
Storage temperature	T_{stg}	—	$-25 \sim +60$	°c	【Note2】
Operating temperature (Ambient)	T_{opa}	—	$0 \sim +50$	°c	
Panel surface temperature	T_p	—	$0 \sim +60$	°C	
Light source wave length	λ_i	—	≥ 400	nm	
Light source illumination intensity	I_i	—	$\leq 300,000$	lx	【Note3,4】

【Note1】 CK, R0~R3, G0~G3, B0~B3, Hsync, Vsync, ENAB, NBH

【Note2】 Humidity: 95%RH Max. at $T_a \leq 40^\circ\text{C}$.Maximum wet-bulb temperature at 39°C or less at $T_a > 40^\circ\text{C}$.

No condensation.

【Note3】 Measurement point: panel surface



【Note4】 Light source shall be placed at incoming light side. (see fig.1)

6. Electrical Characteristics

6-1. TFT-LCD panel driving

 $T_a = 25^\circ\text{C}$

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Vcc	Supply voltage	+4.75	+5.0	+5.25	v	【Note1】
	Supply current	—	105	250	mA	【Note2】
Permissible input ripple voltage	V_{RP}	—	—	100	mVp-p	V_{CC}
Input voltage (Low)	V_{iL}	—	—	0.2VCC	v	【Note3】
Input voltage (High)	V_{iH}	0.7VCC	—	—	v	
Input current (low)	I_{iL1}	—	—	1.0	μA	$V_i=0\text{V}$ 【Note4】
	I_{iL2}	2.0	—	30.0	μA	$V_i=0\text{V}$ 【Note5】
Input current (High)	I_{iH1}	—	—	1.0	μA	$V_i=V_{CC}$ 【Note6】
	I_{iH2}	2.0	—	30.0	μA	$V_i=V_{CC}$ 【Note7】

【Note1】

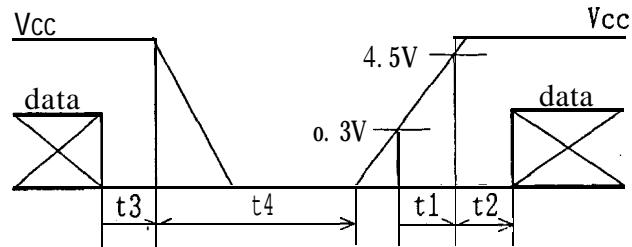
On-off condition
for supply voltage

$$0 < t_1 \leq 10\text{msec}$$

$$0 < t_2 \leq 10\text{msec}$$

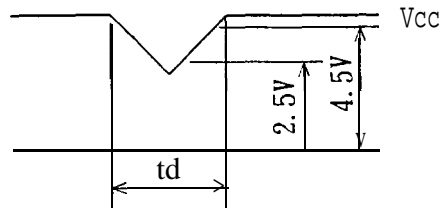
$$0 < t_3 \leq 1\text{sec}$$

$$t_4 \geq 10\text{msec}$$



Vcc-dip conditions

- 1) $2.5\text{V} \leq V_{cc} < 4.5\text{V}$
 $t_d \leq 10\text{msec}$
- 2) $V_{cc} < 2.5\text{V}$



Vcc-dip conditions should also follow the Vcc-turn-on conditions

【Note2】 The typical value of I_{cc} is measured in the following condition.

Black pattern.

All of the timing parameters are typical value (480 line mode).

$V_{cc} = +5\text{V}$

【Note3】 CK, R0~R3, G0~G3, B0~B3, Hsync, Vsync, ENAB, NBH

【Note4】 CK, R0~R3, G0~G3, B0~B3, Hsync, Vsync, ENAB

[Note5] NBH

【Note6】 CK, R0~R3, G0~G3, B0~B3, Hsync, Vsync, NBH

【Note7】 ENAB

7. Timing Characteristics of input signals

The timing diagrams of the input signals are shown in Fig. 2-①~③.

7-1. Timing characteristics

Parameter		Symbol	Mode	Min.	Typ.	Max.	Unit	Remark
Clock	Frequency	1/Tc	all	—	25.18	28.33	MHz	
	High time	Tch	"	5	-	-	ns	
	Low time	Tcl	"	10	-	-	ns	
Data	Setup time	Tds	"	5	-	-	ns	
	Hold time	Tdh	"	10	-	-	ns	
Horizontal sync. signal	Period	TH	"	30.00	31.78	-	μs	
			"	770	800	900	clock	
	Pulse width	THp	"	2	96	200	clock	
Vertical sync. signal	Period	TV	480	515	525	560	line	
			400	445	449	480	line	
			350	447	449	510	line	
	Pulse width	TVp	all	2	"	34	line	
Horizontal display period		THd	"	640	640	640	clock	
Hsync-Clock phase difference		THc	"	10	-	Tc-10	ns	
Hsync-Vsync phase difference		TVh	"	0	-	TH-THp	clock	

Note) In case of lower frequency, the deterioration of the display quality, flicker etc. , may be occurred.

7-2. Horizontal display position

The horizontal display position is determined by ENAB signal and the input data corresponding to the rising edge of ENAB signal is displayed at the left end of the active area.

Parameter		Symbol	Mode	Min.	Typ.	Max.	Unit	Remark
ENAB signal	Setup time	Tes	all	5	-	Tc-10	ns	
	Pulse width	Tep	"	2	640	640	clock	
Hsync-ENAB signal phase difference		The	"	44	-	164	clock	

Note) When ENAB is fixed "Low", the display starts from the data of C104(clock) as shown in Fig. 2-①~③. Be careful that the module do not work when ENAB is fixed "High".

7-3. Vertical display position

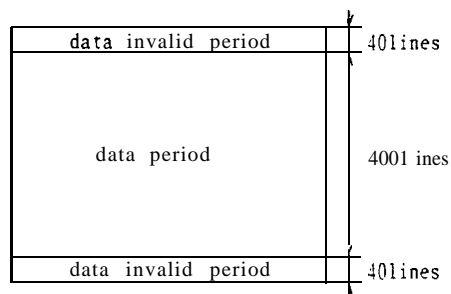
The vertical display position is automatically centered in the active area at each mode of VGA, 480-, 400- and 350-line mode. Each mode is selected depending on the polarity of the synchronous signals described in 4-1(Note1).

In each mode, the data of TVn is displayed at the top line of the active area. And the display position will be centered on the screen like the following figure when the period of vertical synchronous signal. TV, is typical value.

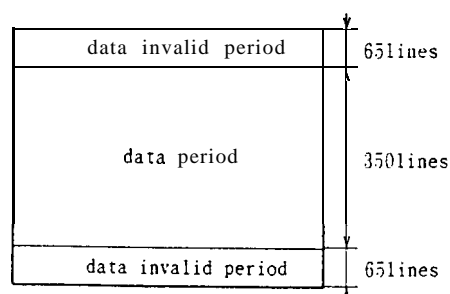
In 400- and 350-line mode, the data in the vertical data invalid period is also displayed. So, inputting all data "0" is recommended during vertical data invalid period.

ENAB signal has no relation to the vertical display position.

mode	V-data start(TVs)	V-data period(TVd)	V-display start(TVn)	Unit	Remark
480	34	480	34	line	
400	34	400	443-TV	line	
350	61	350	445-TV	line	



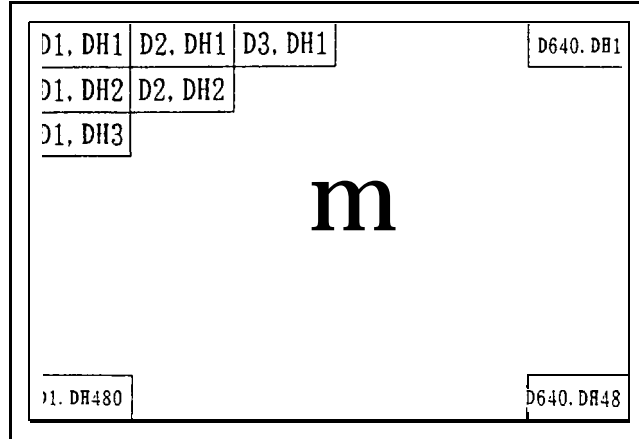
400-line mode (TV=449)



350-line mode (TV=449)

7-4. Input Data Signals and Display Position on the screen

Display position of input data (480-line mode)
(H·V)



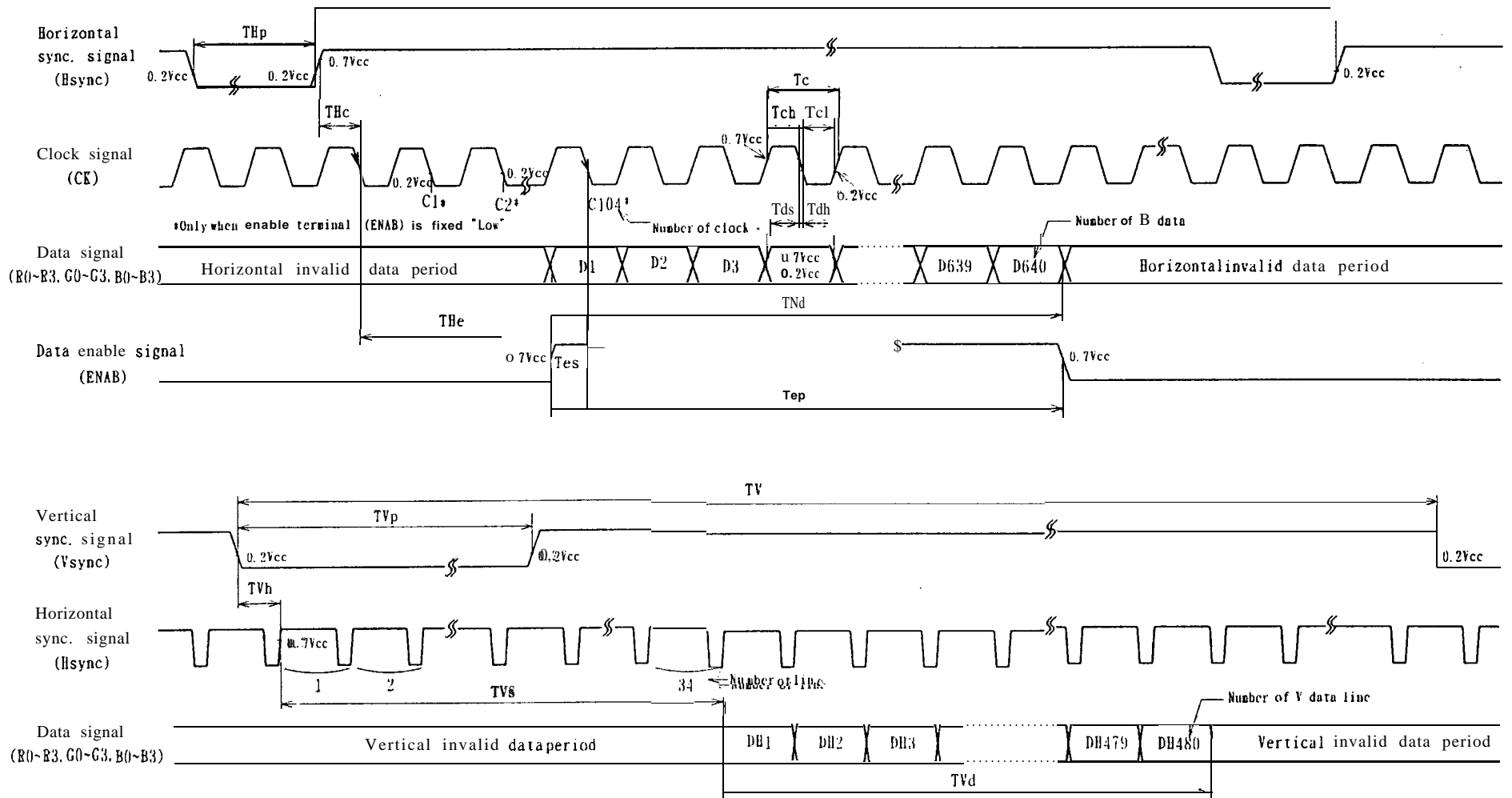


Fig.2-① Input signal waveforms (480-line mode)

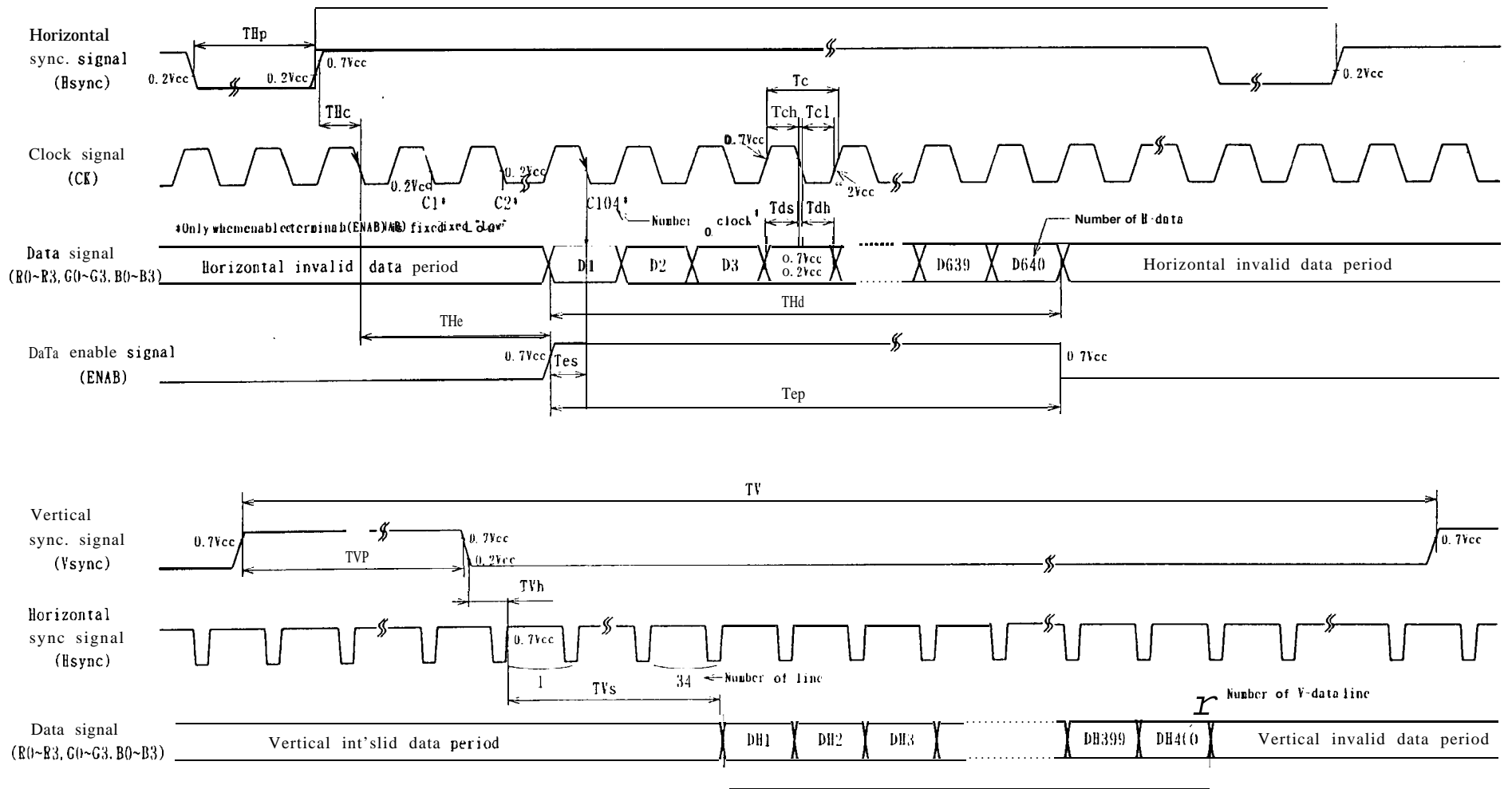


Fig.2-② Input signal waveforms (400-line mode)

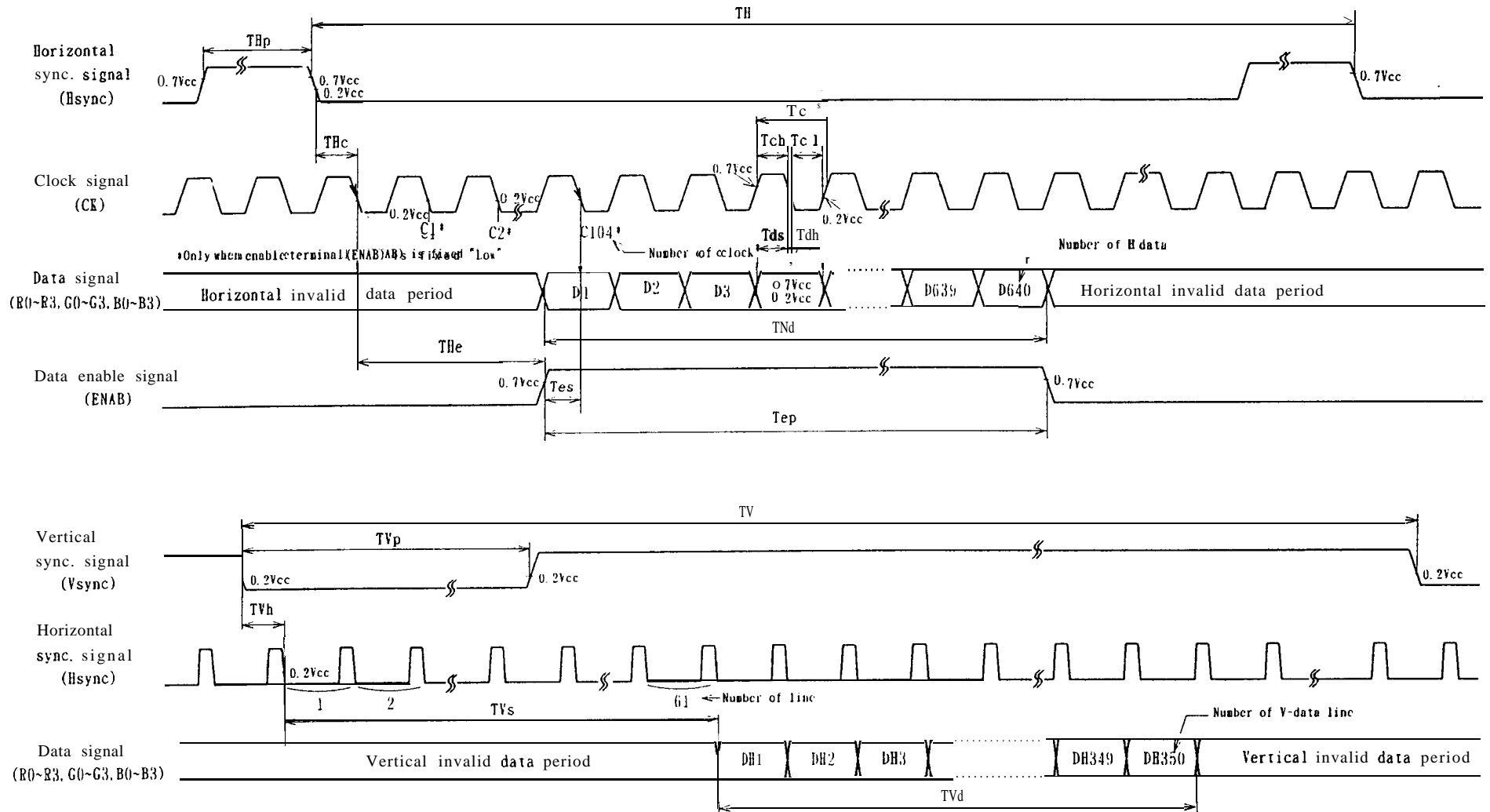


Fig. 2-③ Input signal waveforms (350-line mode)

8. Input Signals, Basic Display Colors and Gray Scale of Each Color

	Color & Gray		Data signal													
	scale(GS)	GS	RO	R1	R2	R3	GO	G1	G2	G3	BO	B1	B2	B3		
Basic color	Black	-	0	0	0	0	0	0	0	0	0	0	0	0		
	Blue	-	0	0	0	0	0	0	0	0	1	1	1	1		
	Green	1	1	0	0	0	0	1	1	1	1	1	1	0	0	0
	Light blue	-	0	0	0	0	1	1	1	1	1	1	1	1		
	Red	-	1	1	1	1	0	0	0	0	0	0	0	0		
	Purple	-	1	1	1	1	0	0	0	0	1	1	1	1		
	Yellow	-	1	1	1	1	1	1	1	1	0	0	0	0		
	White	-	1	1	1	1	1	1	1	1	1	1	1	1		
	Black	GS0	0	0	0	0	0	0	0	0	0	0	0	0		
Gray Scale of Red	↑	I G S	1	1	0	0	0	1	0	0	0	0	0	0		
	Darker	GS2	0	1	0	0	0	0	0	0	0	0	0	0		
	↑	↓														
	0	↓														
	Brighter	GS13	1	0	1	1	0	0	0	0	0	0	0	0		
↓	GS14	0	1	1	1	0	0	0	0	0	0	0	0			
Red	GS15	1	1	1	1	0	0	0	0	0	0	0	0			
Black	GS0	0	0	0	0	0	0	0	0	0	0	0	0			
Gray Scale of Green	↑	I G S	1	1	0	0	0	0	1	1	0	0	0	0		
	Darker	GS2	0	0	0	0	0	0	1	0	0	0	0	0		
	↑	↓														
	0	↓														
	Brighter	GS13	0	0	0	0	1	0	1	1	0	0	0	0		
↓	GS14	0	0	0	0	0	1	1	1	0	0	0	0			
Green	GS15	0	0	0	0	1	1	1	1	0	0	0	0			
Black	GS0	0	0	0	0	0	0	0	0	0	0	0	0			
Gray Scale of Blue	↑	GS1	0	0	0	0	0	0	0	0	1	0	0	0		
	Darker	GS2	0	0	0	0	0	0	0	0	0	1	0	0		
	↑	↓														
	0	↓														
	Brighter	GS13	0	0	0	0	0	0	0	0	1	0	1	1		
↓	GS14	0	0	0	0	0	0	0	0	0	1	1	1			
Blue	GS15	0	0	0	0	0	0	0	0	1	1	1	1			

0: Low level voltage
1: High level voltage

Each basic color can be displayed in 16 gray scales from 4 bit data signals, According to the combination of total 12 bit data signals, the 4,096-colors display can be achieved on the screen.

9. Optical Characteristics

Ta=25℃, Vcc=+5V

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing angle range	Horizontal	$\theta_{21, 22}$	CR>10	35	-	-	Deg.	【Note1, 51】
	Vertical	θ_{11}		30	-	-	Deg.	
		θ_{12}		10	-	-	Deg.	
Contrast ratio		CR	Optimum viewing angle	150	-	-		[Note2, 51]
Response time	Rise	τ_r	$\theta = 0^\circ$	-	2.0	-	ms	【Note3, 51】
	Decay	τ_d		-	4.0	-	MS	
Transmissivity		t_r		7.0	9.1	-	%	【Note4, 5】
Chromaticity shift		Δx		-0.031	-0.001	+0.029		【Note5, 61】
		Δy		-0.006	+0.024	+0.054		

(Optical characteristics of backlight for measurement)

luminance : $\geq 3500\text{cd/m}^2$ wave length : $\geq 400\text{nm}$

Note) The optical characteristics shall be measured in a dark room or equivalent state with the method shown in Fig.3.

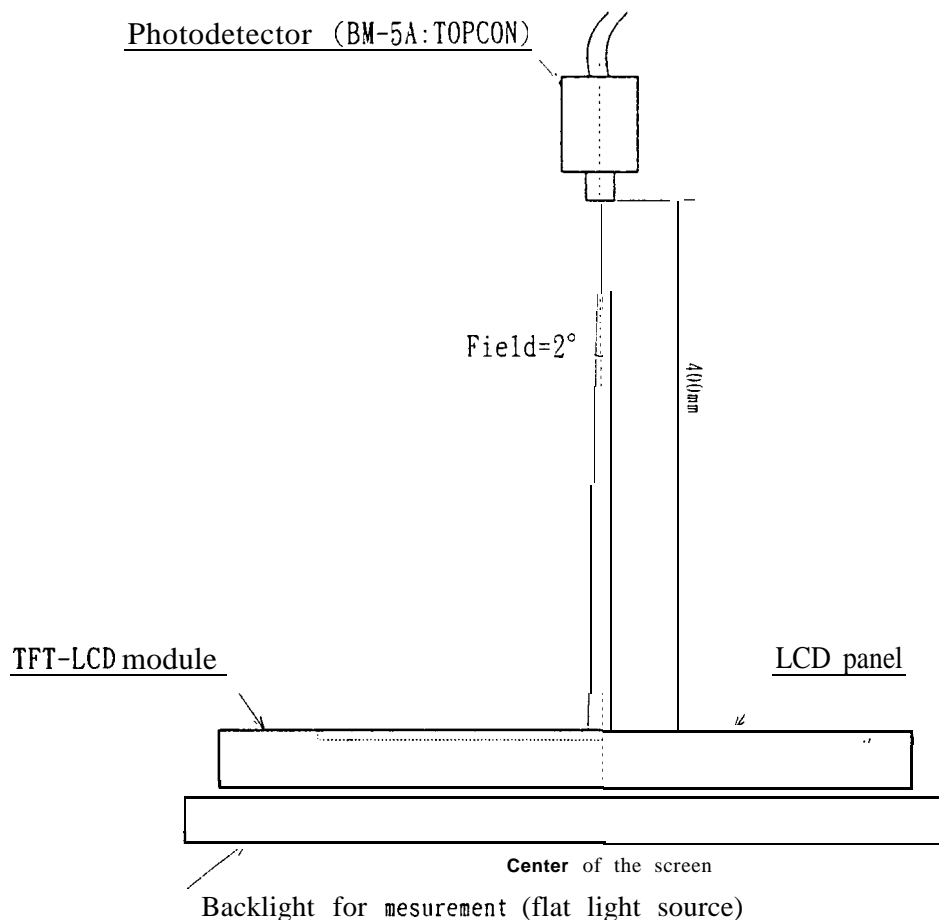
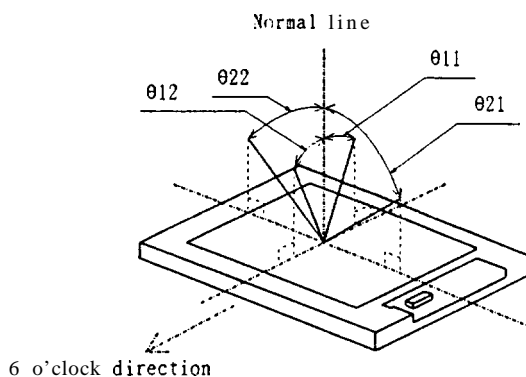


Fig.3 Optical characteristics measurement method

【Note1】 Definitions of viewing angle range:



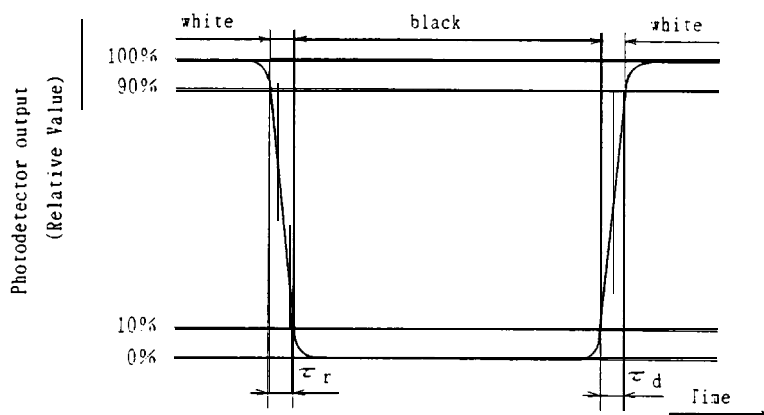
【Note2】 Definition of contrast ratio:

The contrast ratio is defined as the following.

$$\text{Contrast Ratio (CR)} = \frac{\text{Luminance (brightness) of "white"}}{\text{Luminance (brightness) of "black"}}$$

【Note3】 Definitions of response time:

The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white".



【Note4】 Definitions of Transmissivity:

$$\text{Transmissivity} = \frac{\text{light detected level of the transmission through the LCD panel}}{\text{light detected level of the Original light source}}$$

【Note5】 The values are measured at center of the screen

【Note6】 Chromaticity shift is the difference of those of those of the light source and the module placed on it.

The values are measured with standard illuminant: C ($x=0.310, Y=0.316$)

10. Display Quality

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

11. Handling Precautions

11-1) Be sure to insert the cable into the connector or take out of the connector after turning off the power SUPPLY on the set side.

11-2) Precautions in mounting

- a) When installing the module, be sure to fix the module on the same plane, taking care not to warp or twist the module.
- b) Since the polarizer is made of soft material, care must be taken not to scratch the surface. Protective laminated film is attached on the outgoing light side surface glass to protect from scratches or dirt. It is recommended that the laminated film is peeled off, just before the use, with strict attention to electrostatic charges.

※ Precautions when peeling off the laminated film:

I) Working environment

When the laminated film is peeled off, there may be cases that some particles like dust are stuck by electrostatic charges, so the following working environment is recommended.

(i) Floor: Anti-electro-static treatment more than 1MΩ on the tile.

(ii) Spread an adhesive mat at a doorway in the clean room.

(iii) Humidity: 50% to 70%, Temperature: 15°C to 27°C

(iv) Worker needs anti-electro-static shoes, anti-electro-static work wear, anti-electro-static gloves and earth band,

II) Working way

(i) Keep the distance between the module and the heated ionized air blower within 20cm. The module shall be well blown to the wind of the blower. (Fig. ①)

(ii) Attach an adhesive tape to a corner of the laminated film near the heated ionized air blower. (Fig. ②)

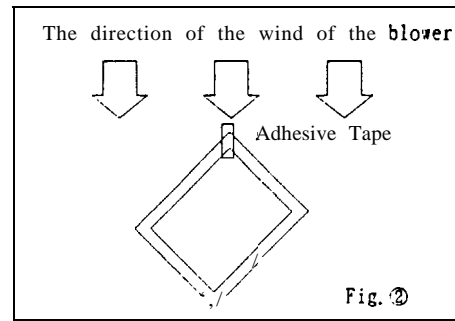
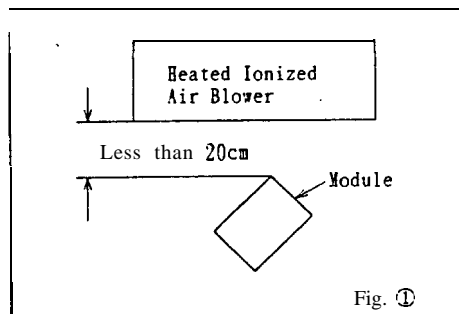
(iii) Peel the laminated film pulling the adhesive tape to your side. It is important that it takes more than 5 seconds to peel off the laminated film.

(iv) The module after peeling laminated film must be moved to next work immediately without getting dust.

(v) The way to remove 'dust' from the polarizer

• Blow it off by nitrogen blow that is taken measures against electrostatic charges. Ionized air gun is recommended.

• Since polarizer is easily damaged. In unavoidable case, wipe it carefully by the cloth like a wiper for lens, breathing on it.



11-3) Others

- a) Wipe off water drop immediately. Long contact with water may cause discoloration or spots.
- b) When the panel surface is soiled, wipe it with absorbent cotton or other soft cloth.
- c) Since the panel is made of glass, it may break or crack if dropped or bumped on hard surface. Handle with care.
- d) Since CMOS LSI is used in this module, take care of static electricity and ground your body when handling.
- e) Observe all other precautionary requirements in handling components.

12. Packing form

- a) Piling number of cartons : MAX. 7
 - b) Package quantity in one carton : MAX. 10
 - c) Carton size : 413(W) \times 288(H) \times 351(D)mm
 - d) Total mass of 1 carton filled with full modules : 6000g
- Packing form is shown in Fig. 4.

13. Reliability test items

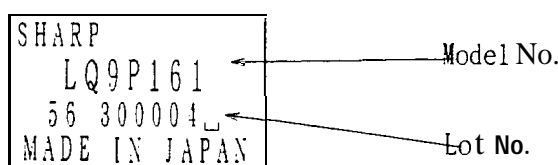
No.	Test item	Conditions
1	High temperature storage test	Ta=60℃ 240h
2	Low temperature storage test	Ta=-25℃ 240h
3	High temperature&high humidity operation test	Ta=40℃;95%RH 240h (No condensation)
4	High temperature operation test	Ta=50℃ 240h
5	Low temperature operation test	Ta=0℃ 240h
6	Vibration test (non-operating)	Frequency:10~57Hz/Vibration width (one side) :0.075mm :58~500Hz/Gravity:9.8m/s ² Sweep time: 11 minutes Test period: 3 hours (1 hour for each direction of X, Y, Z)
7	Shock test (non-operating)	Max. gravity : 490m/s ² Pulse width: 11ms. sine wave Direction: ±X, ±Y, ±Z once for each direction.

[Result Evaluation Criteria]

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

14. Others

1) Lot No. Label



- 2) Adjusting volumes have been set optimally before shipment, so do not change any adjusted values. If adjusted values are changed, the data mentioned in this specification may not be satisfied.
- 3) Disassembling the module can cause permanent damage and should be strictly avoided.
- 4) Please be careful since image retention may occur when a fixed pattern is displayed for a long time.
- 5) If any problem occurs in relation to the description of this specification, it shall be resolved through discussion with spirit of cooperation.

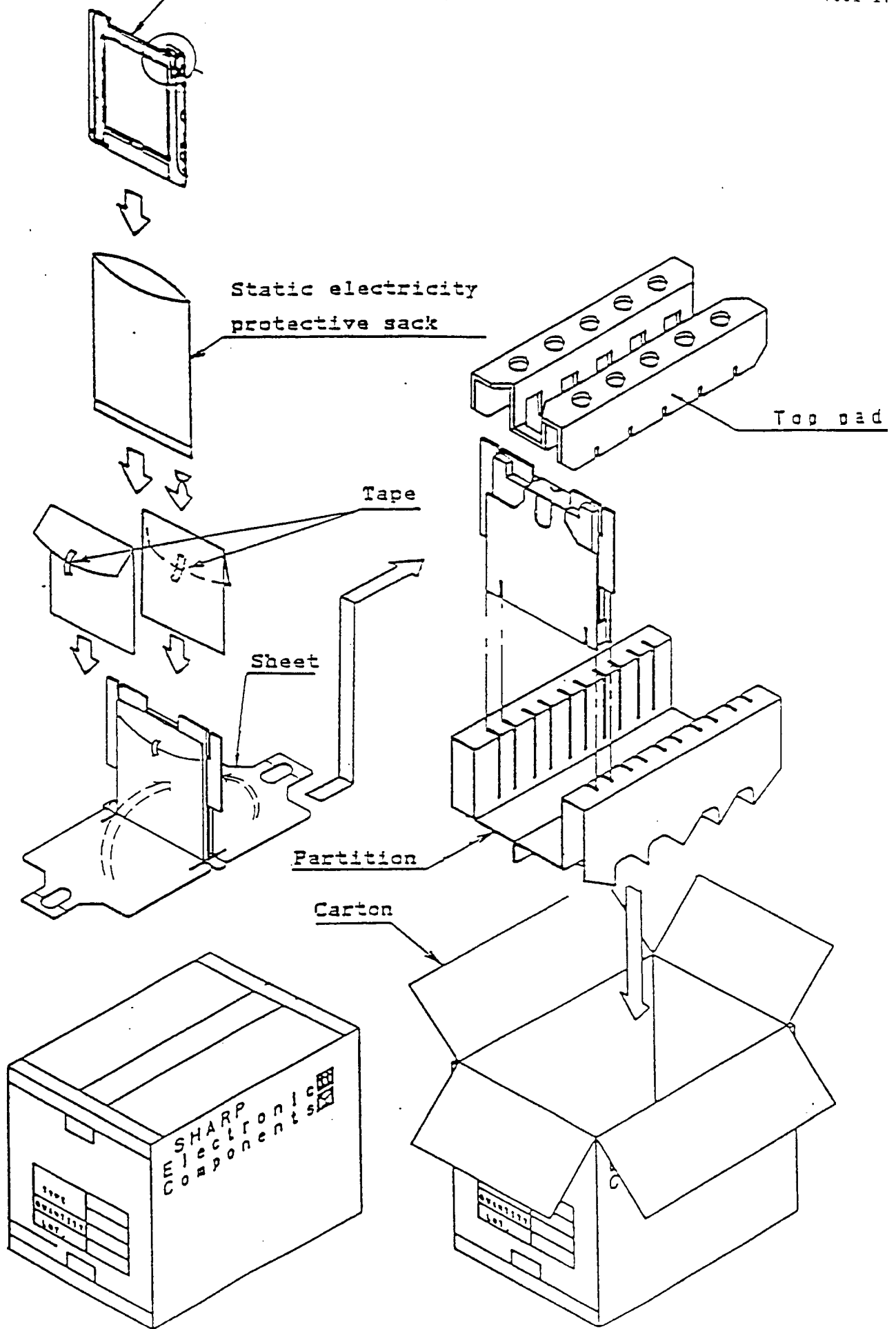


Fig. 4 Packing form

