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DEVICE SPECIFICATION FOR

TFT-LCD Module

MODEL No.

LQ10D321

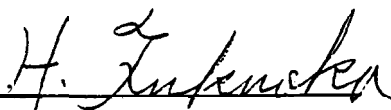
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BY _____

PRESENTED

BY



H. FUKUOKA

Department General Manager

Engineering Department 2

TFT LCD Development Center

LIQUID CRYSTAL DISPLAY GROUP

SHARP CORPORATION

1. Application

This specification applies to color TFT-LCD module, LQ10D321.

2. Overview

This module is a color active matrix LCD module incorporating amorphous silicon TFT (Thin Film Transistor). It is composed of a color TFT-LCD panel, driver ICs, control circuit and power supply circuit and a backlight unit. Graphics and texts can be displayed on a $640 \times 3 \times 480$ dots panel with 262,144 colors by supplying 18 bit data signal (6bit/color), four timing signals, +5V DC supply voltage for TFT-LCD panel driving and supply voltage for backlight.

The TFT-LCD panel used for this module is a low-reflection and higher-color-saturation type. Therefore, this module is also suitable for the multimedia use.

Optimum viewing direction is 6 o'clock.

Backlight-driving DC/AC inverter is not built in this module.

3. Mechanical Specifications

Parameter	Specifications	unit
Display size	26 (10.4") Diagonal	cm
Active area	211.2(H) × 158.4(V)	mm
Pixel format	640(H) × 480(V)	pixel
	(1 pixel = R + G + B dots)	
Pixel pitch	0.330(H) × 0.330(V)	mm
Pixel configuration	R.G.B vertical stripe	
Display mode	Normally white	
Unit outline dimensions *1	246.5(W) × 179.4(H) × 9.5(D)	mm
Mass	500 \pm 1%	g
Surface treatment	Anti-glare and hard-coating 2H	
	Haze value =25 ± 5%	

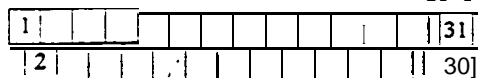
* 1.Note: **excluding** backlight cables.

Outline dimensions is shown in Fig. 1

4. Input Terminals

4-1. TFT-LCD panel driving

CN1 Used connector:DF9BA-3 1P-IV (Hirose Electric Co., Ltd.)



Corresponding connector: DF9 -31S-1V (")

DF9A-31S-1V

DF9B-31S-iv

CN1 pin arrangement from module surface
(Transparent view)

Pin No.	Symbol	Function	Remark
1	GND		
2	CK	Clock signal for sampling each data signal	
3	Hsync	Horizontal synchronous signal	[Note1]
4	Vsync	Vertical synchronous signal	[Note1]
5	GND		
6	R0	R E D data signal(LSB)	
7	R1	R E D data signal	
8	R2	R E D data signal	
9	R3	R E D data signal	
10	R4	R E D data signal	
11	R5	R E D data signal(MSB)	
12	GND		
13	G0	G R E E N data signal(LSB)	
14	G1	GREEN data signal	
15	G2	G R E E N data signal	
16	G3	G R E E N data signal	
17	G4	GREEN data signal	
18	G5	G R E E N data signal(MSB)	
19	GND		
20	B0	B L U E data signal(LSB)	
21	B1	B L U E data signal	
22	B2	B L U E data signal	
23	B3	BLUE data signal	
24	B4	B L U E data signal	
23	B5	B L U E data signal(MSB)	
26	GND		
27	ENAB	Signal to settle the horizontal display position "	[Note2]
28	Vcc	+5.0V power supply	
29	Vcc	+5.0v power supply	
30	TST	This should be electrically opened during operation	
31	TST	This should be electrically opened during operation	

※The shielding case is connected with GND.

[Note1] 480 line, 400 line or 350 line mode is selected by the polarity combination of the both synchronous signals.

[Note2] The horizontal display stint **timing** is settled in accordance with a rising timing of ENAB signal. In case ENAB is fixed "Low", the horizontal start **timing** is determined as described in 7-2. Don't keep ENAB High" during operation.

Mode	480 lines	400 lines	350 lines
Hsync	negative	negative	positive
Vsync	negative	positive	negative

4-2. Backlight driving

used connector : BHR-03VS-1(JST)

CN2

Corresponding connector : SM02(8.0)B-BHS(JST)

Pin no.	symbol	function
1	v HIGH	Power supply for lamp (High voltage side)
2	NC	This is electrically opened.
3	V _{LOW}	Power supply for lamp (Low voltage side)

5. Absolute Maximum Ratings

Parameter	Symbol	Condition	Ratings	unit	Remark
Input voltage	v,	T _a =25℃	-0.3 ~ V _{CC} +0.3	V	【Note1】
+5V supply voltage	V _{CC}	T _a =25℃	0 ~ +6	V	
Storage temperature	T _{stg}	-	-25 ~ +60	℃	【Note2】
Operating temperature (Ambient)	T _{op}	-	0 ~ +50	℃	

【Note1】 CK, R0~R5, G0~G5, B0~B5, Hsync, Vsync, ENAB

【Note2】 Humidity : 95%RH Max. at T_a ≤ 40℃Maximum wet-bulb temperature at 39℃ or less at T_a > 40℃.

No condensation.

6. Electrical Characteristics

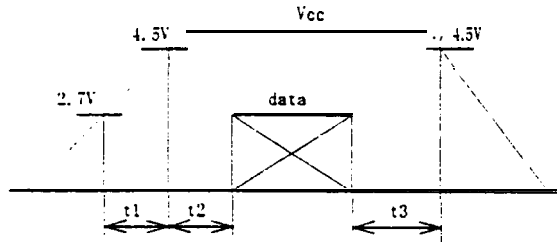
6-1. TFT-LCD panel driving

T_a = 25℃

Parameter		Symbol	Min.	Typ.	Max.	unit	Remark
+5V	Supply voltage	V _{CC}	+4.5	+5.0	+5.5	V	【Note1】
	Current dissipation	I _{CC}	-	180	300	mA	【Note2】
Permissible input ripple voltage		V _{RP}	-	-	100	mVp-p	V _{CC} =+5V
Input voltage (Low)		V _{IL}	-	-	0.3V _{CC}	v	【Note3】
Input voltage (High)		V _{IH}	0.7V _{CC}	-	-	V	
Input current (low)		I _{OL}	-	-	1.0	μA	V _I =0V 【Note3】
Input current (High)		I _{OH1}	-	-	1.0	μA	V _I =V _{CC} 【Note4】
		I _{OH2}	-	-	60.0	μA	V _I =V _{CC} 【Note5】

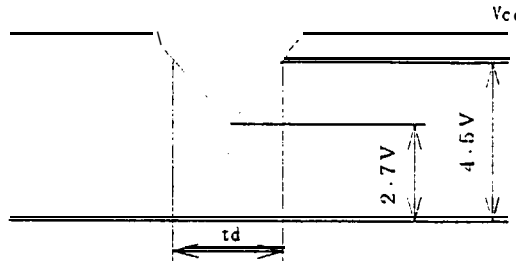
【Note1】 Vcc-turn-on conditions

- $t1 \leq 10ms$
- $0 < t2 \leq 10ms$
- $0 < t3 \leq 1s$



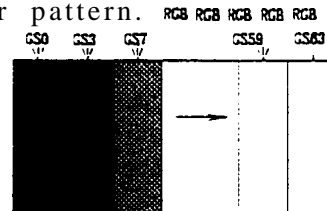
Vcc-dip conditions

- 1) $2.7V \leq Vcc < 4.5V$
 $td \leq 10ms$
- 2) $Vcc < 2.7V$



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

【Note2】 Typical current situation: 16-gray-bar pattern.
480 line mode
Vcc=+5.0V



【Note3】 CK,R0~R5,G0~G5,B0~B5,Hsync,Vsync,ENAB

【Note4】 CK,R0~R5,G0~G5,B0~B5,Hsync,Vsync

【Note5】 ENAB

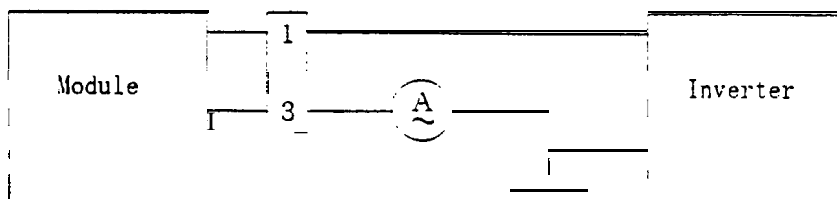
6-2. Backlight driving

The backlight system is an edge-lighting type with single CCFT (Cold Cathode Fluorescent Tube). The characteristics of single lamp are shown in the following table,

Ta=25°C

Parameter	Symbol	Min.	Typ.	Max.	unit	Remark
Lamp current	IL	2.5	3.0	4.5	mArms	【Note1】
Lamp power consumption	PL	-	1.6	-	W	【Note2】
Lamp frequency	FL	20	35	60	KHz	【Note3】
Kick-off voltage	Vs	-	-	1100	Vrms	Ta=2j°C
		-	-	1300	Vrms	Ta=0°C 【Note4】
Lamp life time	LL	1 0000	-	-	hour	【Note5】

【Note1】 Lamp current is measured with current meter for high frequency as shown below.



* 3pin is V_{LOW}

【Note2】 At the condition of Y_L = 70cd/m²

[Note3] **Lamp frequency** may produce interference with horizontal synchronous frequency, and this may cause beat on the display. Therefore lamp frequency shall be detached as much as possible from the horizontal synchronous frequency and from the harmonics of horizontal synchronous to avoid interference.

[Note4] The open output voltage of the **inverter** shall be maintained for more than **1sec**; otherwise the lamp may not be turned on.

[Note5] Lamp life time is defined that it applied either ① or ② under this condition
(Continuous turning on at **Ta=25°C, IL=4.5mA rms**)

① **Brightness** becomes 50% of the **original** value under standard condition.

② Kick-off voltage' at **Ta=0°C** exceeds maximum value, **1300 Vrms**.

Note) The performance of the backlight, for example life time or **brightness**, is much influenced by the characteristics of the DC-AC **inverter** for the lamp. When you **design** or order the inverter, please make sure that a poor lighting caused by the mismatch' of the backlight and the inverter (miss-lighting, flicker, etc.) never occur. when you confirm it, the module should be operated in the same condition as it is installed in your instrument.

7. Timing Characteristics of input signals

Timing diagrams of input signal 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	32.00	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	Cycle	TH	"	30.00	31.78	-	μs
			"	770	800	900	clock
	Pulse width	THp	"	2	96	200	clock
Vertical sync. signal	Cycle	TV	480	515	525	560	line
			400	445	449	480	line
			350	447	449	510	line
	Pulse width	TVp	all	1	—	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 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	Min.	Typ.	Max.	unit	Remark
Enable signal	Setup time	Tes	5	—	Tc-10	ns	
	Pulse width	Tep	2	640	640	clock	
Hsync-Enable signal phase difference		THE	44	—	164	clock	

Note) When ENAB is fixed “Low”, the display starts from the data of C 104(clock) as shown in Fig.2-①~③. Be careful that the module does not work when ENAB is fixed “High”.

7-3. Vertical display position

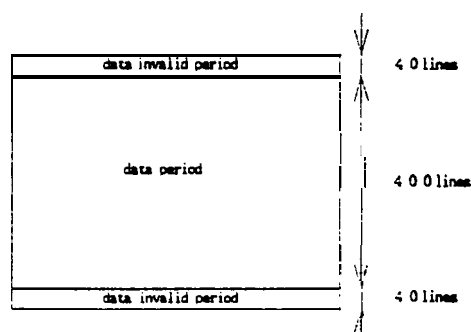
The vertical display position is automatically centered in the active area at each mode of VGA ,480 -,400-, and 350-line mode Each mode is selected depending on the polarity of the synchronous signals described in 4-1(Note1).

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.

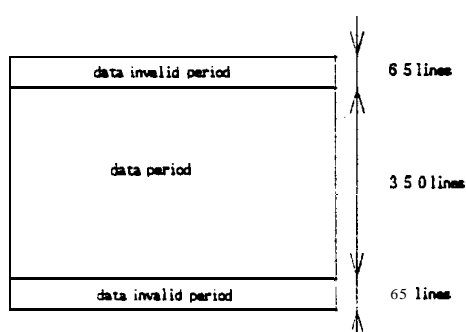
In 400-, and 350-line mode, the data in the vertical data invalid period is also displayed. So ,inputting all data “0” is recommended during vertical data invalid period.

ENAB signal has no relation to the vertical display position.

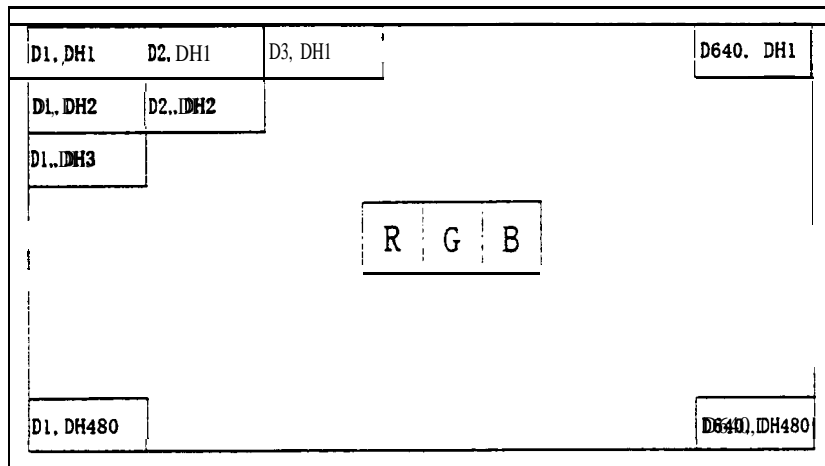
mode	V-data start(TVs)	V-data period(TVd)	V-display start(TVn)	V-display period	unit	Remark
480	34	480	34	480	line	
400	34	400	443-TV	480	line	
350	61	350	445-TV	480	line	



400 lines mode (TV=449)



350 lines mode (TV=449)

7-4. Input Data **Signals** and **Display** Position on the screenDisplay position of input **data**(480 lines mode)
(H. V)

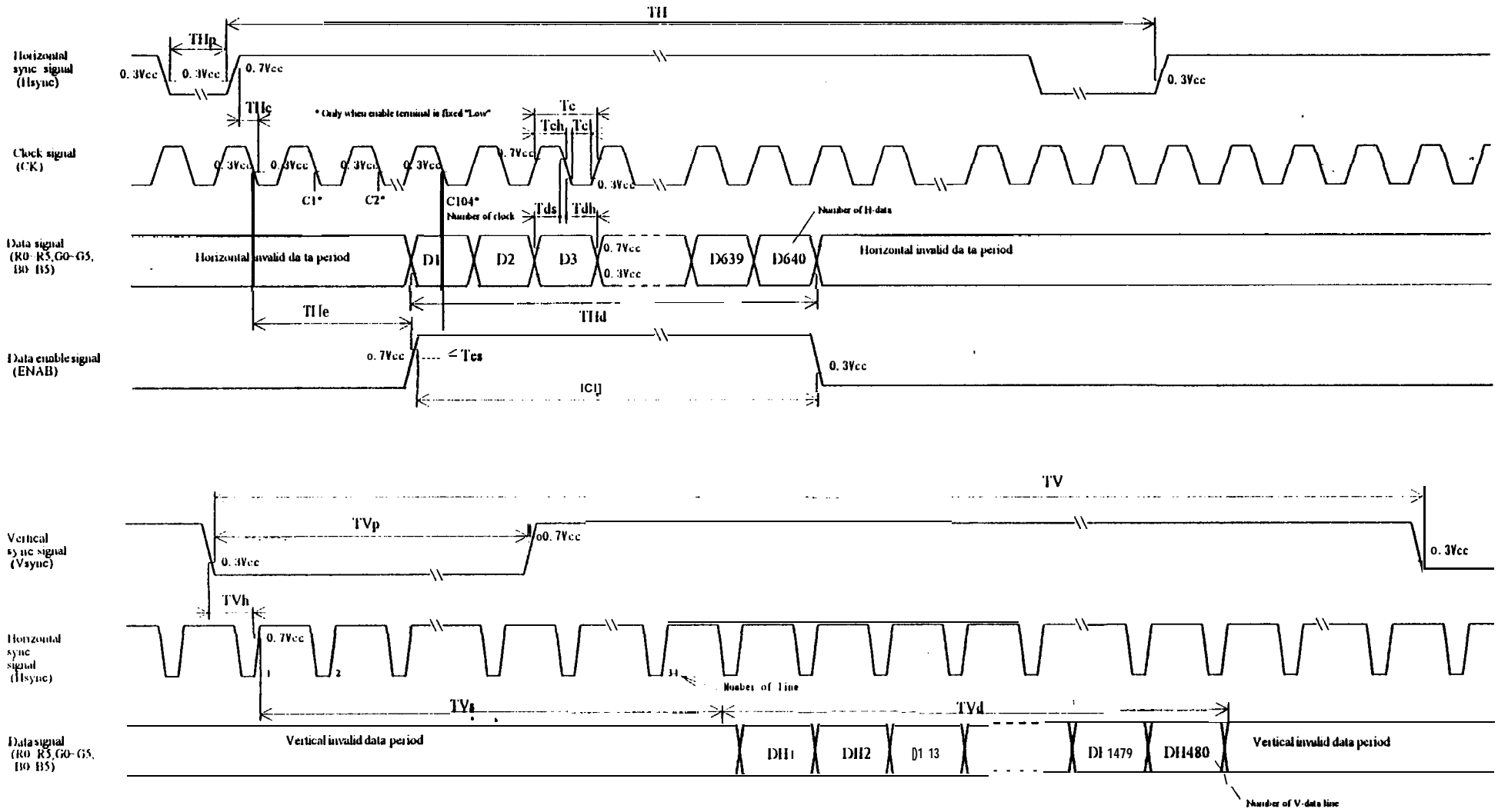


Fig 2-1 Input signal waveforms (480 line mode)

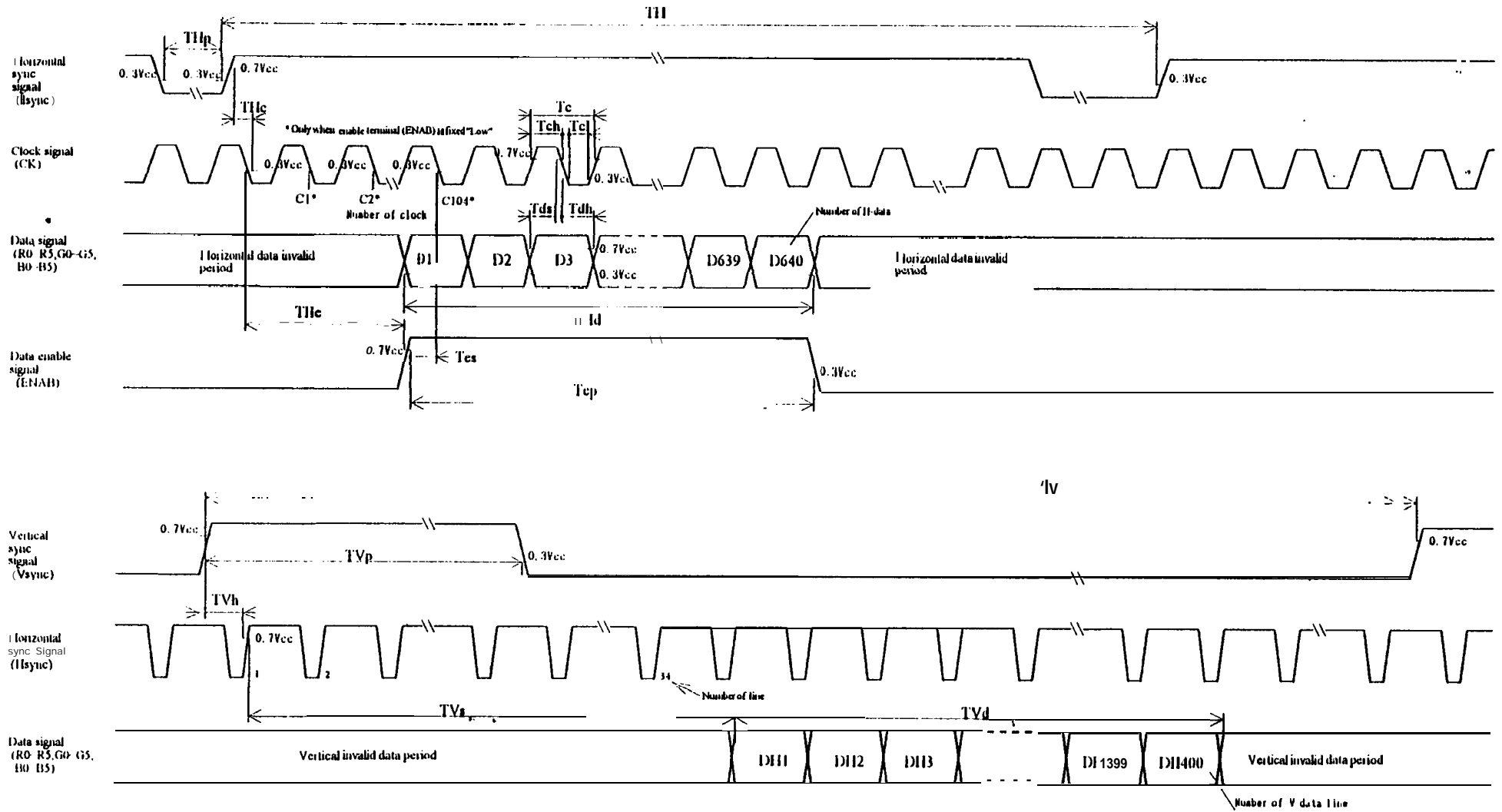


Fig.2-2 Input signal waveforms (400 line mode)

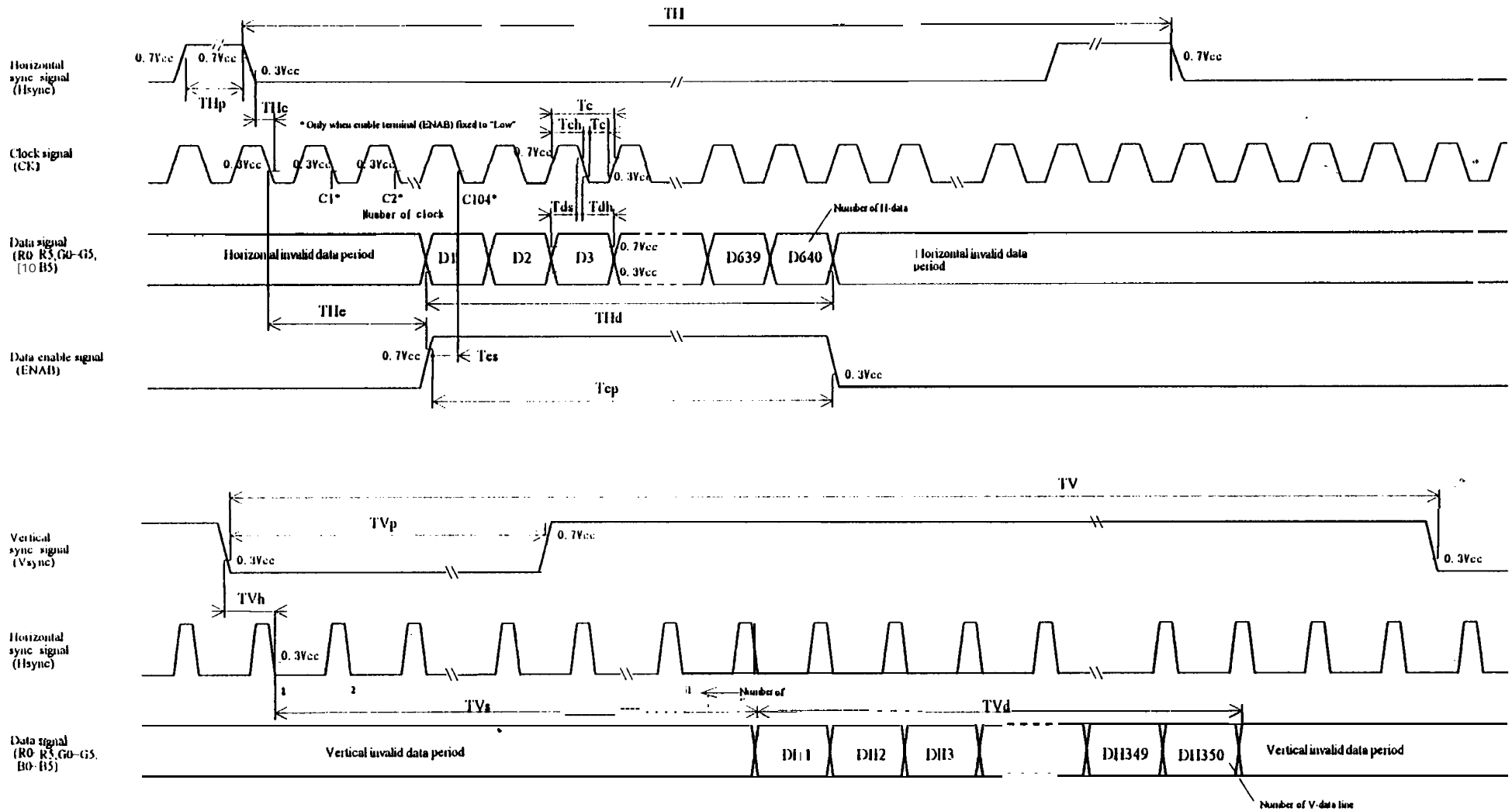


Fig.2-3 Input signal waveforms (350 line mode)

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

	Colors & Gray scale	Data signal																		
		GrayScale	RO	R1	R2	R3	R4	R5	GO	G1	G2	G3	G4	G5	BO	B1	B2	B3	B4	B5
Basic color	Black	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue	-	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Green	-	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Cyan	-	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Red	-	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Magenta	-	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Yellow	-	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
	White	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Gray Scale of red	Black	GS0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	↑ Darker	GS1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		GS2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	↑ ↓	↓				↓						↓						↓		
		↓				↓						↓						↓		
	Brighter ↓	GS6	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
		GS62	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Red	GS63	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	
Gray Scale of green	Black	GS0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	↑ Darker	GS1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
		GS2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	↑ ↓	↓				↓						↓						↓		
		↓				↓						↓						↓		
	Brighter ↓	GS61	0	0	0	0	0	0	1	0	1	1	1	1	0	0	0	0	0	0
		GS62	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0
Green	GS63	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	
Gray Scale of blue	Black	GS0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	↑ Darker	GS1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
		GS2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	↑ ↓	↓				↓						↓						↓		
		↓				↓						↓						↓		
	Brighter ↓	GS61	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1
		GS62	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
Blue	GS63	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	

0 :Low level voltage, 1: High level voltage

Each basic color can be displayed in 64 gray scales from 6 bit data signals. According to the combination of total 18bit data signals, the 262, 144-color display can be achieved on the screen.

9. Optical Characteristics

Ta=25°C, Vcc=±5V

Parameter	Symbol	Condition	Min.	Typ.	Max.	unit	Remark
Viewing angle range	Horizontal	CR>10	35	—	—	Deg.	【Note1,4】
	Vertical		10	-	-	Deg.	
			e 12	30	-	-	
Contrast ratio	C R	6 =0°	100	—	—		【Note2,4】
Response time	Rise		—	30	-	m s	【Note3,4】
	Decay		—	50	—	m s	
Chromaticity of white	x		0.263	0.313	0.363		【Note4】
	y		0.279	0.329	0.379		
Luminance of white 【Note4】	Y _{L1}		50	70	-	cd/m ²	I _L =3.0mArms
	Y _{L2}		60	80	-	cd/m ²	I _L =3.4mArms
	Y _{L3}	80	100	-	cd/m ²	I _L =4.0mArms	
White Uniformity	δ _w	—	—	1.45		【Note5】	

※The measurement shall be executed 30 minutes after lighting at rating. (typical condition: I_L=3.0mArms)

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

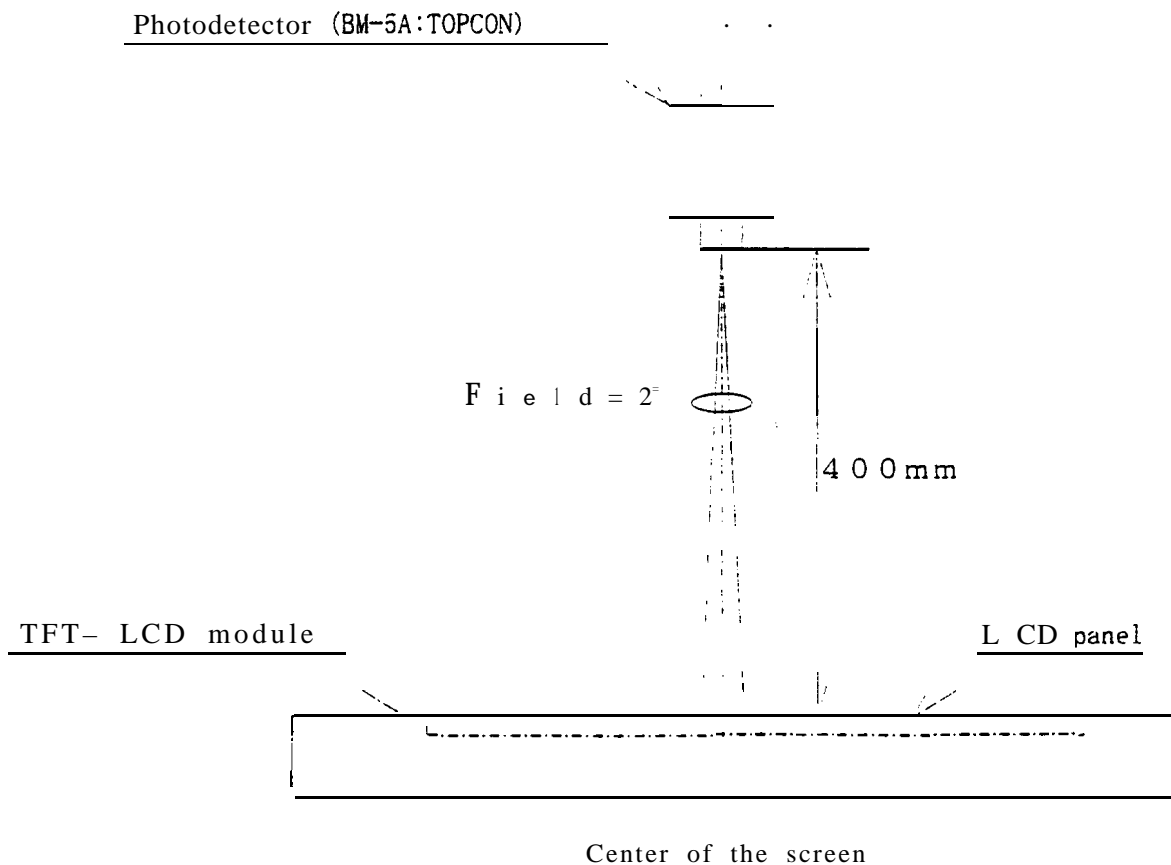
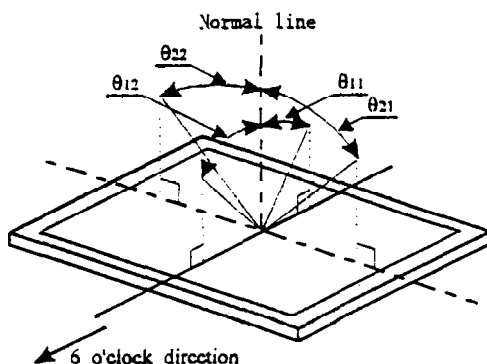


Fig. 3 Optical characteristics measurement method

[No*11] Definitions of viewing **angle** range:



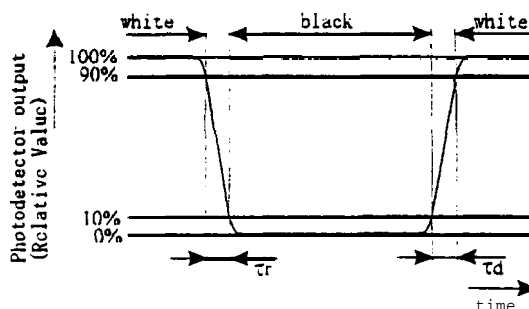
[Note21] **Definition** of contrast ratio:

The contrast ratio is **defined** as the following.

$$\text{Contrast Ratio (CR)} = \frac{\text{Luminance (brightness) with all pixels white}}{\text{Luminance (brightness) with ail pixels black}}$$

[Note31] **Definition** of response time:

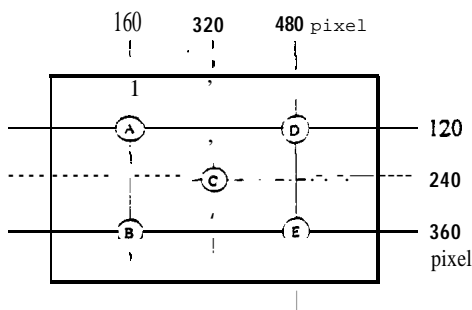
The response time is defied as the **following** figure and shall be measured by switching the input signal for "black" and "white"



[Note41] This shall be measured at center of the screen.

[Note5] Definition of white **uniformity**:

White **uniformity** is defined as the following with five measurements (A~E).



$$\delta_w = \frac{\text{Maximum Luminance of five points (brightness)}}{\text{Minimum Luminance of five points (brightness)}}$$

10. Display **Quantity**

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

11. **Handling** Precautions ,

- a) Be sure to turn off the power supply when inserting or **disconnecting** the cable.
- b) Be sure to design the cabinet so that the module **can** be **installed** without **any extra** stress such as warp or*.
- c) **Since the** front polarizer is easily **damaged**, pay attention not to scratch it.
- d) Wipe off water drop immediately. Long **contact** with water may cause discoloration or spots.
- e) When the panel **surface** is **soiled**, wipe it with absorbent cotton or other **soft** cloth.
- f) **Since** the panel is made of glass, it may break or crack if dropped or bumped on hard surface. Handle with care.
- g) Since CMOS LSI is used in this module, **take** care of static **electricity** and injure the human earth when handling.
- h) Observe **all other precautionary** requirements in handling components.
- i) This module has its circuitry PCBS on the rear side and should be carefully handled in order not to be stressed.
- j) Laminated film is attached to the module surface to prevent it from **being** scratched Peel the **film** off slowly, just before the use, with **strict** attention to electrostatic charges. Ionized air **shall** be blown over during the action. Blow off 'dust' on the polarizer **by using** an ionized nitrogen **gun**, etc.

12. Packing form

- a) Piling number of cartons : MAX. 7
- b) Package **quantity** in one carton : 10pts
- c) Carton size : 298(W) × 295(H) × 362(D)mm
- d) Total mass of 1 carton filled with full modules : 6800g

Packing form is shown in Fig.4

13. Reliability test items

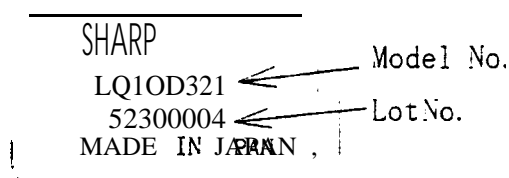
No.	Test item	Conditions
1	High temperature storage test	Ta=60°C 240h
2	Low temperature storage test	Ta=-25°C 240h
3	High temperature & high humidity operation test	Ta=40°C ; 95%RH 240h (No condensation)
4	High temperature operation test	Ta=50°C 240h
5	Low temperature operation test	Ta=0°C 240h
6	Vibration test (non- operating)	Frequency : 10-5 Vibration width (one side) :0.075mm :38 ~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 : 1 lms, half 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 volume have been set optimally before shipment. so do not change **any** adjusted value.

If adjusted value is **changed**, the 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.

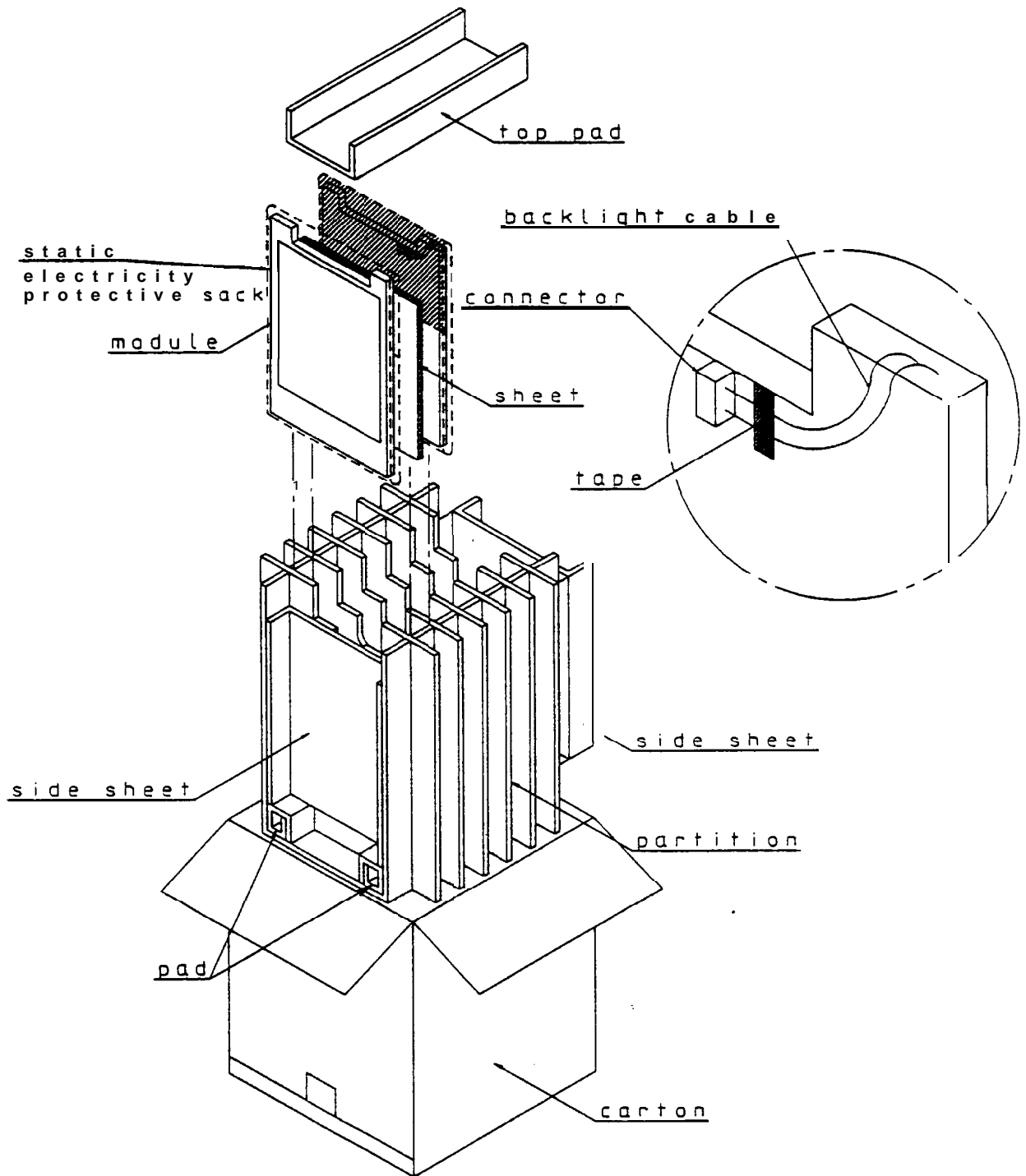


Fig. 4 Packing form

