

REPAIRED BY : DATE	<h1>SHARP</h1> <p>LIQUID CRYSTAL DISPLAY GROUP SHARP CORPORATION</p> <h2>SPECIFICATION</h2>	SPEC No. LD7506 B
		FILE No.
APPROVED BY : DATE		ISSUE : May .15 .1995
		PAGE : 17 pages
		APPLICABLE GROUP Liquid Crystal Display Group

DEVICE SPECIFICATION FOR
TFT-LCD Module
 MODEL No.
LQ10D345

CUSTOMER' S APROVAL

DATE _____

BY _____

PRESENTED

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LIQUID CRYSTAL DISPLAY GROUP

SHARP CORPORATION

1. Application

This specification applies to color TFT-LCD module, LQ 1 0D345.

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

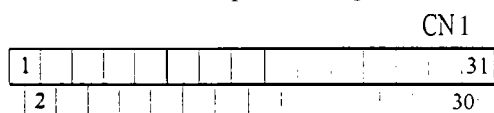
Parameter	Specifications	Unit
Display size	26 (10.4") Diagonal	cm
Active area	211.2(H) \times 158.4(V)	mm
Pixel format	640(H) \times 480(V)	pixel
	(1 pixel = R + G + B dots)	
Pixel pitch	(.330(H) \times (.330(V))	mm
Pixel configuration	R.G.B vertical stripe	
Display mode	Normally white	
Unit outline dimensions *1	265.0(W) \times 195.0(H) \times 11.0(D)	mm
Mass	680 ⁻¹⁰ ₋₂₀ .	g
Surface treatment	Anti-glare and hard-coating 2H Haze value = $25 \pm 5\%$	

* 1. Note: excluding backlight cables.

Outline dimensions is shown in Fig. 1

4. Input Terminals

4-1. TFT-LCD panel driving



CN1 pin arrangement from module surface
(Transparent view)

CN1 Used connector: DF9BA-31 P-IV (Hirose Electric Co., Ltd.)

Corresponding connector: DF9-31 S-IV (“)

DF9A-31 S-iv

DF9B-31 S-iv

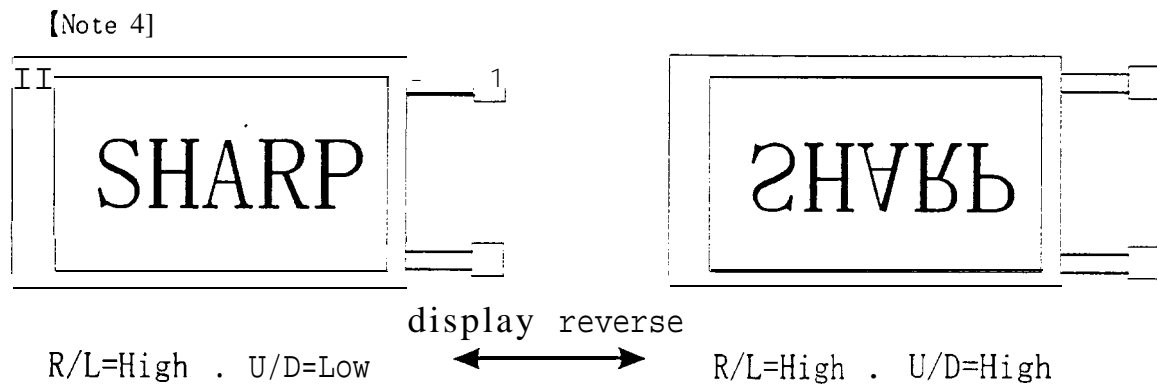
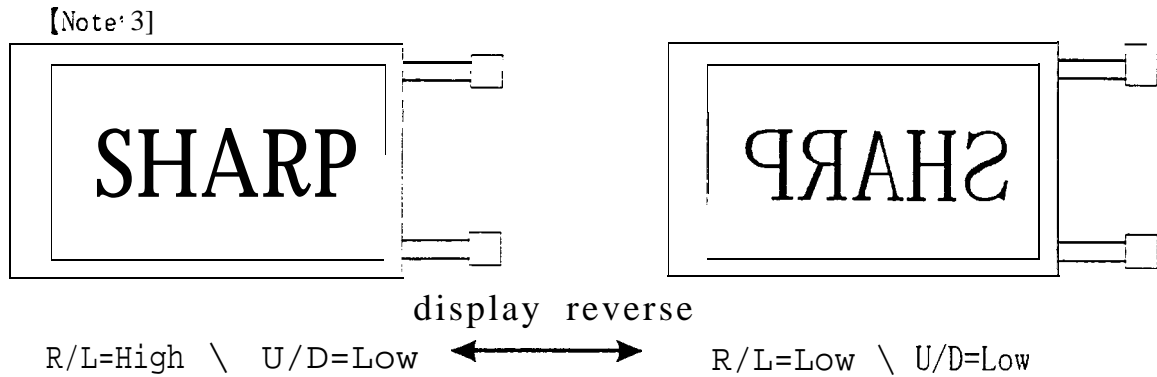
Pin No.	Symbol	Function	Remark
1	GND		
2	CK	Clock signal for sampling each data signal	
3	Hsync	Horizontal synchronous signal	【Note1】
4	Vsync	Vertical synchronous signal	【Note1】
5	GND		
6	R0	R E D data signal(LSB)	
7	R1	R E D data signal	
8	R2	R E D data signal	
9	R3	R E D data signal	
10	R4	R E D data signal	
11	R5	R E D data signal(MSB)	
12	GND		
13	G0	G R E E N data signal(LSB)	
14	G1	G R E E N data signal	
15	G2	G R E E N data signal	
16	G3	G R E E N data signal	
17	G4	G R E E N 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	B L U E data signal	
24	B4	B L U E data signal	
25	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	R/L	Horizontal display mode select signal	【Note3】
31	U/D	Vertical display mode select signal	【Note4】

※The shielding case is connected with GND.

【Note1】 **1480** line, 400 line or 350 line mode
is selected by the polarity combination
of the both synchronous signals.

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

【Note2】 The horizontal display start 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.



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 _I	T _a =25 °C	-0.3 ~ V _{CC} +0.3	V	[Note 11]
+5V supply voltage	V _{CC}	T _a =25 °C	0 ~ +6	V	
Storage temperature	T _{stg}	-	-25 ~ +60	°C	[Note 21]
Operating temperature (Ambient)	T _{opa}	-	0 ~ +50	°C	

【Note1】 CK, R0~R5, G0~G5, B0~B5, Hsync, Vsync, ENAB, R/L, U/D

【Note2】 Humidity : 95%RH Max. at T_a ≤ 40°C.

Maximum wet-bulb temperature at 39°C or less at T_a > 40°C.

No condensation.

6. Electrical Characteristics

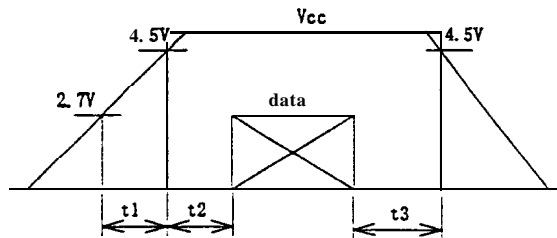
6-1. TFT-LCD panel driving

Ta=25°C

Parameter		symbol	Min.	Typ.	Max.	unit	Remark
+ 5V	Supply voltage	V _{CC}	+4.5	+5.0	+5.5	V	【Note1】
	Current dissipation	I _{CC}	-	280	450	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 _{OL1}	-	-	1.0	μA	V _I =0V 【Note4】
		I _{OL2}	-	-	60.0	μA	V _I =0V 【Note5】
Input current (High)		I _{OH1}	-	-	1.0	μA	V _I =V _{CC} 【Note6】
		I _{OH2}	-	-	60.0	μA	V _I =V _{CC} 【Note7】

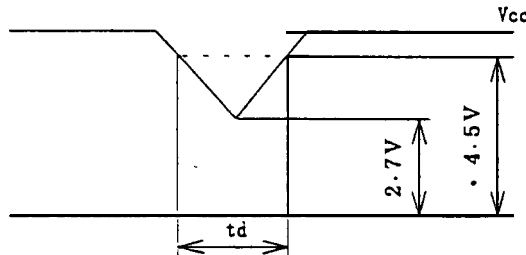
【Note1】 “ V_{CC}-turn-on conditions

- t1 ≤ 10ms
- 0 < t2 ≤ 10ms
- 0 < t3 ≤ 1s



V_{CC}-dip conditions

- 1) 2.7V ≤ V_{CC} < 4.5V
t_d ≤ 10ms
- 2) V_{CC} < 2.7V



V_{CC}-dip conditions should also follow the V_{CC}-turn-on conditions

【Note2】 Typical current situation : 16-gray-bar pattern.

480 line mode

V_{CC}=+5.0V

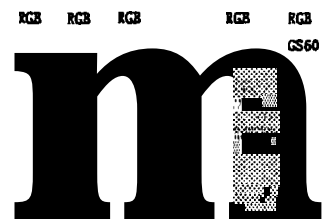
【Note3】 CK,R0-R5,G0-G5,B0-B5,Hsync,Vsync,ENAB ,R/L,U/D

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

【Note5】 R/L

【Note6】 CK,R0-R5,G0-G5,B0-B5,Hsync,Vsync

【Note7】 ENAB,U/D



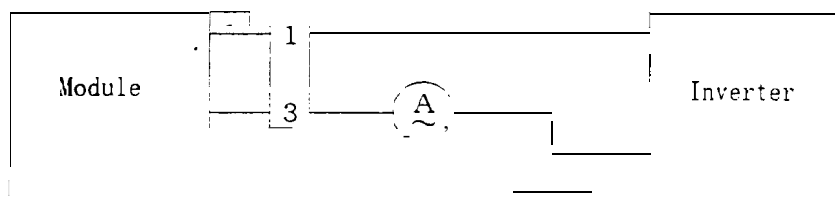
6-2. Backlight driving

The backlight system is an edge-lighting type with ^{a pair of} ~~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	4.2	6.0	mArms	[Note 1]
Lamp power consumption	PL	—	2.1	—	W	【Note2】
Lamp frequency	FL	20	35	60	KHz	[Note3]
Kick-off voltage	Vs	—	—	1100	Vrms	Ta=25 °C
		—	—	1300	Vrms	Ta=0 °C 【Note4】
Lamp life time	LL	10000	—	—	hour	[Note5]

【Note 1】 Lamp current is measured with current meter for high frequency as shown below.



* 3pin is V_{LOW}

【Note2】 At the condition of $Y_L = 200 \text{cd/m}^2$

[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 1 sec: otherwise the lamp may not be turned on.

【Note5 1】 Lamp life time is defined that it applied either ① or ② under this condition
(Continuous turning on at Ta=25 °C, IL=6.0mArms)

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.

-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	Cycle	TH	"	30.00	31.78	—	μs	
			"	750	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

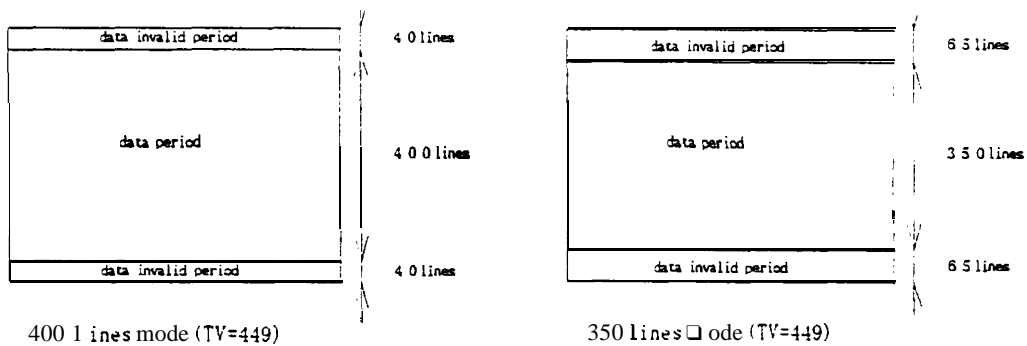
The vertical display position is automatically centered in the active area at each mode of VGA ,480-,400-, and 350-line mode . Each mode is selected depending on the polarity of the synchronous signals described in 4-1(Notel).

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.

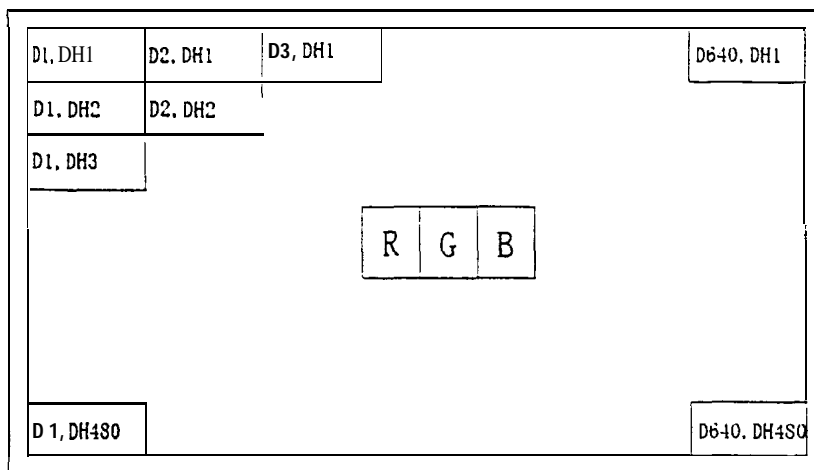
ENAB signal has no relation to the vertical display position.

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	

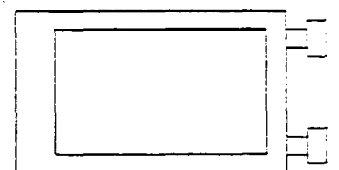


7-4. Input Data Signals and Display Position on the screen

Display position of input data (480 lines mode)
(H, V)



UP



R/L=H
U/D=L

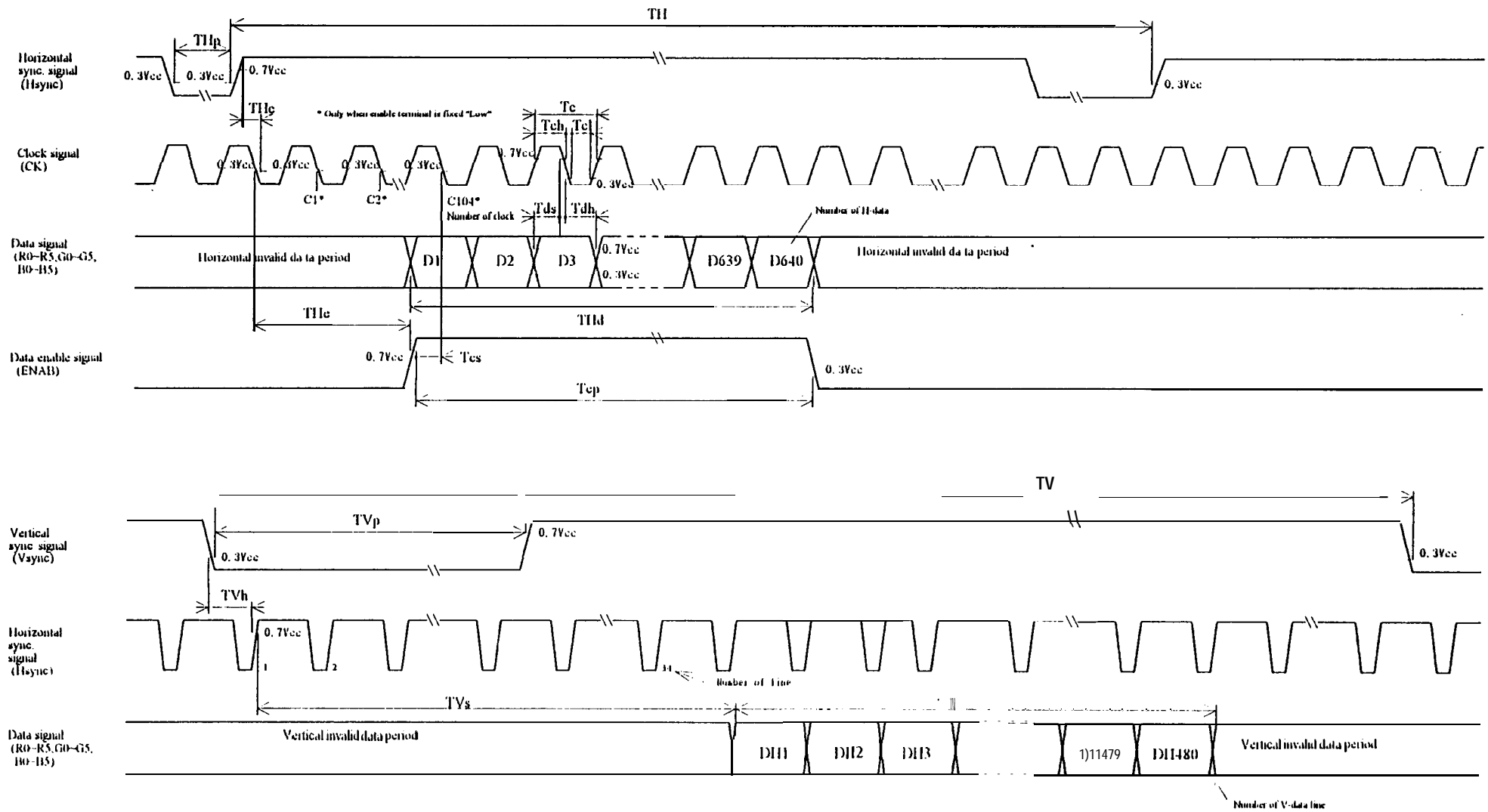
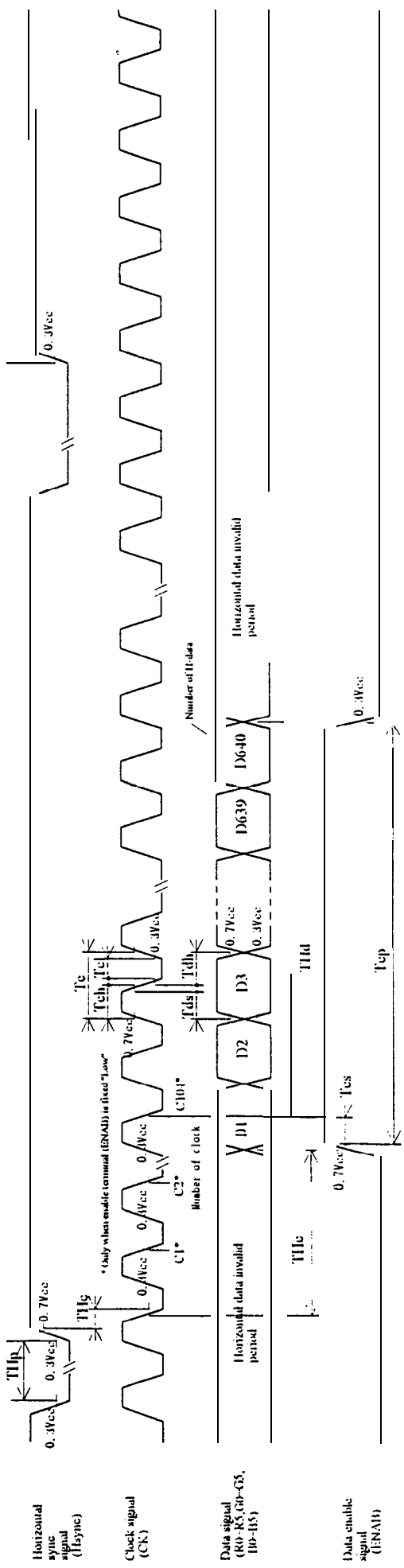


Fig 2-1 Input signal waveforms (480 line mode)

TU1



TV

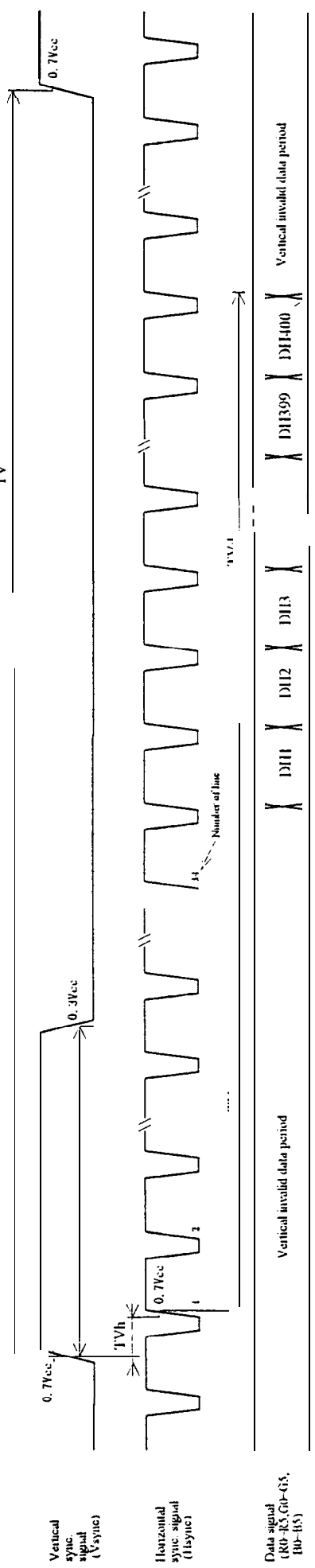


Fig.2-2 Input signal waveforms (400 line mode)

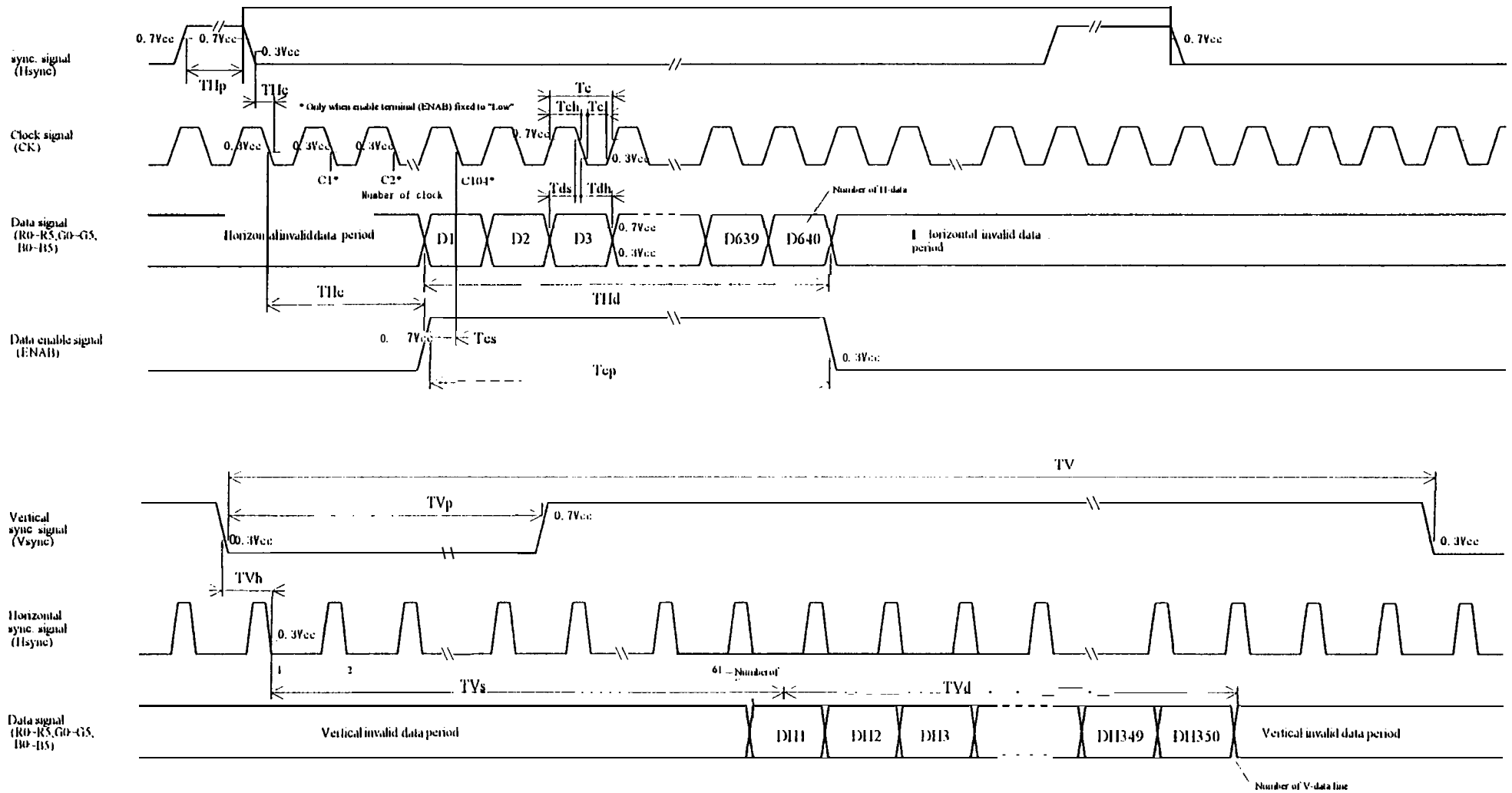


Fig.2-3 Input signal waveforms (350 line mode)

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

	Colors & gray scale	Data signal																		
		rayScale	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																			
Gray Scale of red	Black	GS0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	↑	GS1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Darker	GS2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	↑	↓				↓					↓						↓			
	↓	↓				↓					↓						↓			
	Brighter	GS61	1	0	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
	↑	GS1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	Darker	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
	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	0	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	
	↑	GS1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	
	Darker	GS2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	
	↑	↓				↓					↓						↓			
	0	↓				↓					↓						↓			
	Brighter	GS61	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	1	1	1	1	1	
	Blue	GS63	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 18 bit 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	021,822	CR>10	35	—	—	Deg.	【Note1,4】	
	Vertical	611		10	—	—	Deg.		
		$\theta 12$		30	—	—	Deg.		
Contrast ratio		C R	$\theta =0^\circ$	100	—	—		【Note2,4】	
Response time	Rise	τr	$\theta =0^\circ$	—	30	—	m s	【Note3,4】	
	Decay	τd		—	50	—	m s		
Chromaticity of white		X		—	U.313	—		【Note4】	
		Y		—	0.329	—			
Luminance of white'		Y_{L1} 【Note4】			160	200	—	cd/m ²	$I_L=4.2mArms$
White Uniformity		δw			—	—	1.45		【Notes5】

※The measurement shall be executed 30 minutes after lighting at rating. (typical condition: $I_L=4.2mArms$)
The optical characteristics shall be measured in a dark room or equivalent state with the method shown in Fig.3 below.

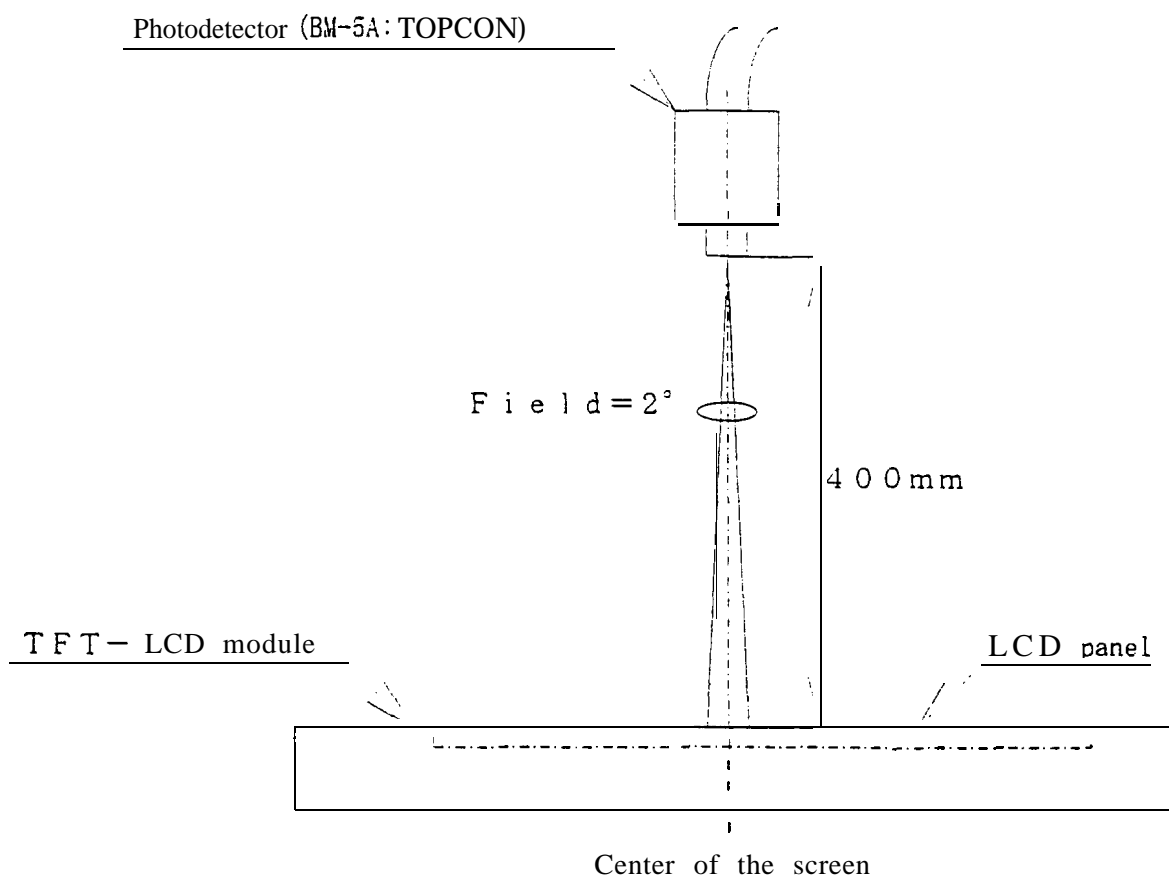
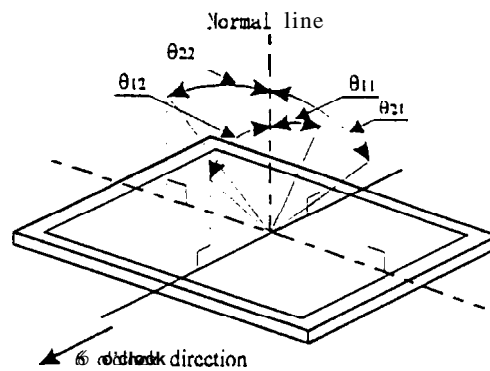


Fig. 3 Optical characteristics measurement method

【Note1 1. Definitions of viewing angle range:



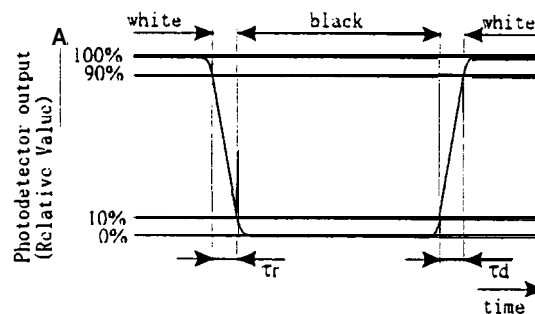
【Note2] Definition of contrast ratio:

The contrast ratio is defined as the following.

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

【Note3 1 Definition of response time:

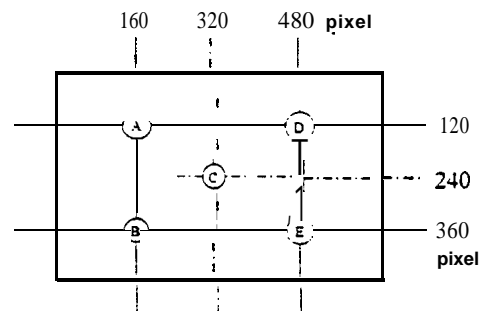
The response time is defined as the following figure and shall be measured by switching the input signal for “black” and “white”



【Note4] 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 **twist**.
- 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 precaution- 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 : **10pcs**
- c) Carton size : **460(W) × 300(D) × 380(H)mm**
- d) Total mass of 1 carton filled with full modules : **8750g**

Packing form is shown in **Fig.4**

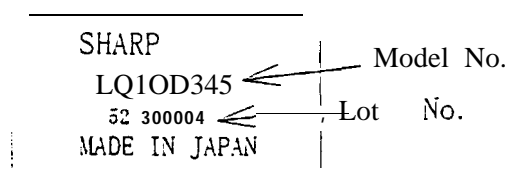
3. reliability test items		
No.	Test item	Conditions
1	High temperature storage test	Ta=60°C 240h
2	Low temperature storage test	Ta=-25°C 240h
3	High temperature & high humidity operation test	Ta=40°C : 95%RH 240h (No condensation)
4	High temperature operation test	Ta=50°C 240h
5	Low temperature operation test	Ta=0°C 240h
6	Vibration test (non- operating)	Frequency : 10~57Hz/Vibration width (one side) : 0.075mm : 5 S ~ 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 ms, 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.

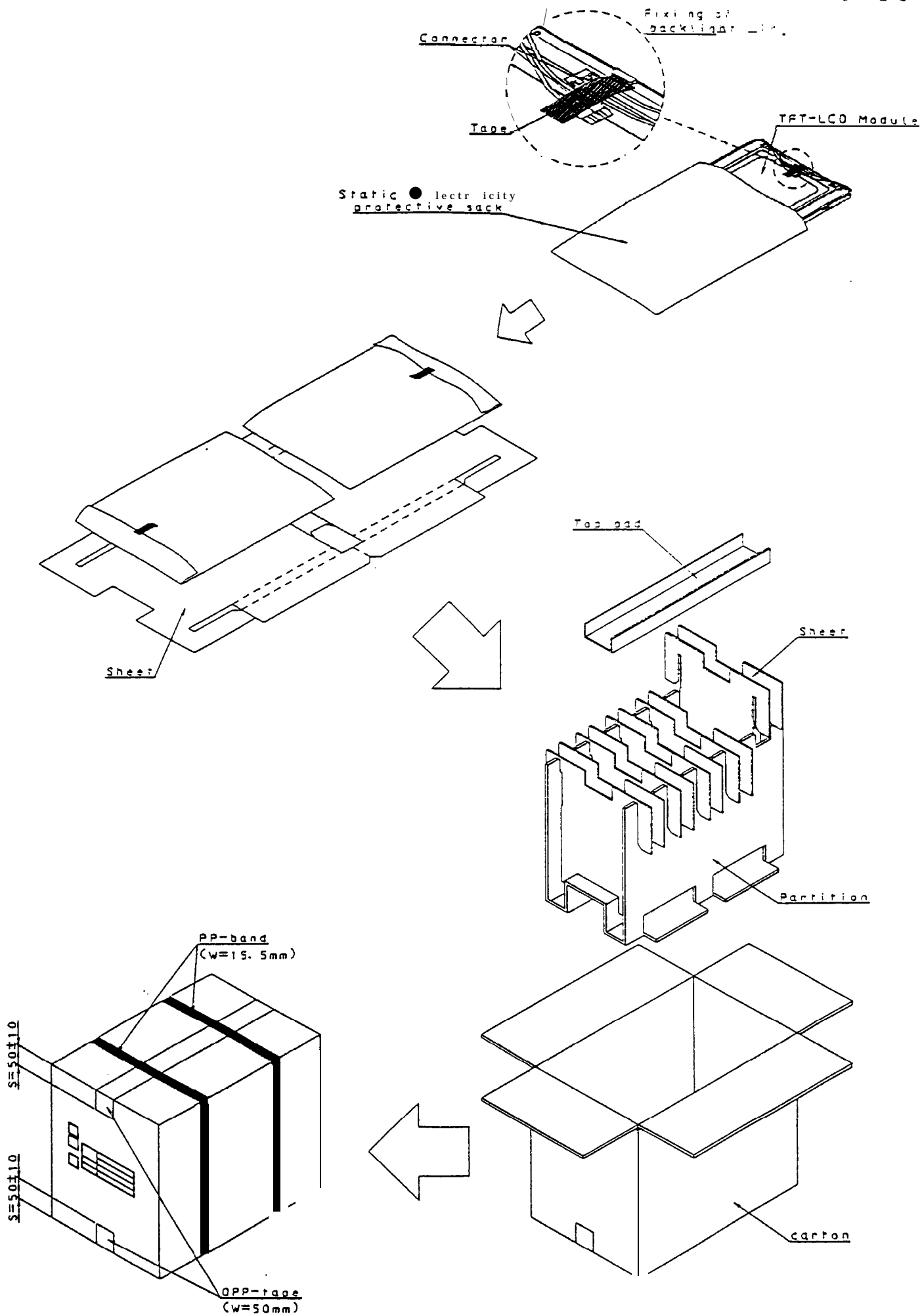
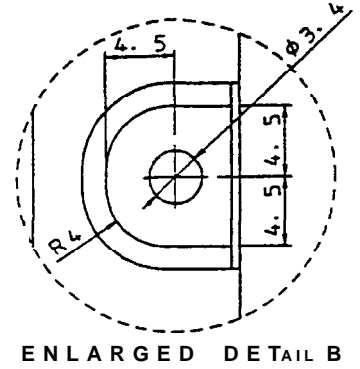
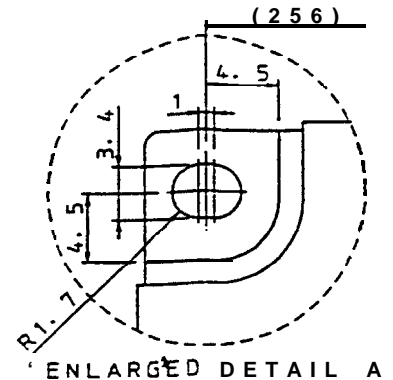
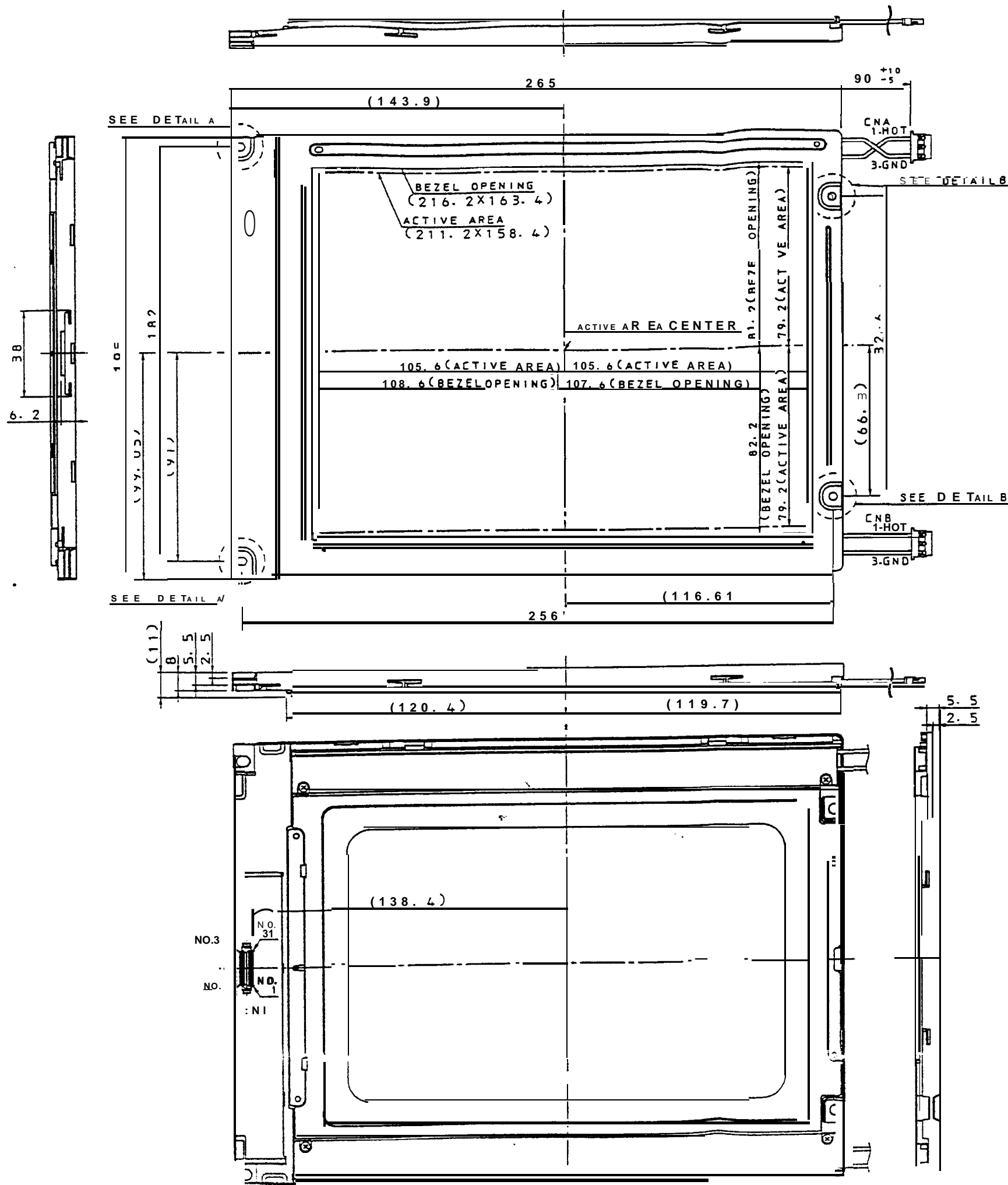
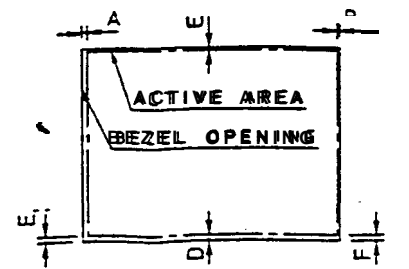


Fig 4, Packing form



BEZEL/DISPLAY POSITION



- ⊙ TOLERANCE X-DIRECTION A: 3.0 ± 0.8
- ⊙ TOLERANCE X-DIRECTION B: 2.0 ± 0.8
- ⊙ TOLERANCE Y-DIRECTION C: 2.0 ± 0.8
- ⊙ TOLERANCE Y-DIRECTION D: 3.0 ± 0.8
- ⊙ OBLIQUITY OF DISPLAY AREA |E-F| < 0.8

NOTES
 *UNSPECIFIED TOLERANCE TO BE ± 0.5

FIG1. LQ10D345 OUTLINE DIMENSIONS