

PREPARED BY: _____	DATE _____	<h1>SHARP</h1> <p>LIQUID CRYSTAL DISPLAY GROUP SHARP CORPORATION</p> <h2>SPECIFICATION</h2>	SPEC No. LD-4404
APPROVED BY: _____	DATE _____		FILE No. _____
			ISSUE: Apr. 20. 1992
			PAGE : 15 pages
			APPLICABLE GROUP Liquid Crystal Display Group

DEVICE SPECIFICATION FOR

TFT-LCD Module

MODEL No.
LQ9D011

For Apple

CUSTOMER'S APPROVAL

DATE _____

BY _____

PRESENTED
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SHARP CORPORATION

LQ9D011 SPECIFICATION RECORDS OF REVISION

MODEL No. : LQ9D011
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Page	No.	Revision Points	Issue Date	
			DEC 13, 1991 (Technical literature)	APR 20, 1992 (Specification)
P3.	6-1-a)	Input voltage(Low) (ENB)	-	0.8 (V)
		【NOTE1】	-	Addition
P4.	6-2	Horizontal sync. signal(TH)	31.87 (typ)	30.58-31.87-35.75 (min) (typ) (max)
P10	8.	Incoming standard No.	-	Addition
P12.	10-d)	Total weight of 1 carton filled with full module	7500g	8500g
P13.	12-1)	Lot No. label		Revised
	12-4)	Precaution	-	Addition
P15.		Lot number label	-	Addition

1. Application

This specification applies to color TFT-LCD module, LQ9D011.

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. Graphics and texts can be displayed on 640×3×480 dots panel in 512 colors by supplying 9 bit data signal, four kinds of timing signals, +5V DC supply voltage and supply voltage for backlight. Optimum viewing angle is 6 o'clock direction.

400 lines and 350 lines modes in addition to the 480 lines mode can be also applied for this module.

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

3. Mechanical Specifications

Parameter	Specifications	Unit
Screen size	8.4 (Diagonal)	inch
Effective display area	170.88(W)×129.6(H)	mm
Display pixels	640×480	pixel
	(1 pixel=R+G+B dots)	
Pixel pitch	0.267(W)×0.27(H)	mm
Pixel configuration	R, G, B vertical stripe	
Display mode	Normally white	
Unit outline dimensions *1	243.5 (W)×180(H)×12(D)	mm
Weight	575±20	g
Surface treatment	anti-glare and hard-coating 2H	

*1. Note: excluding backlight cables.

Outline dimensions is shown in Fig. 1.

4. Input Terminals

4-1) TFT-LCD panel driving

CN1 (Interface signal)

Used connector:DF13-15P-1.25H (Hirose Electric Co., Ltd.)

Corresponding connector:DF13-15S-1.25C ()

Pin No.	Symbol	Function	Polarity
1	CK	Clock signal for sampling each data signal	
2	GND		
3	Hsync	Horizontal sync. signal	【Notel】
4	Vsync	Vertical sync. signal	【Notel】
5	R0	RED data signal (LSB)	positive
6	R1	RED data signal	positive
7	R2	RED data signal (MSB)	positive
8	GND		
9	G0	GREEN data signal (LSB)	positive
10	G1	GREEN data signal	positive
11	G2	GREEN data signal (MSB)	positive
12	GND		
13	B0	BLUE data signal (LSB)	positive
14	B1	BLUE data signal	positive
15	B2	BLUE data signal (MSB)	positive

CN2(Signal & Power supply)

Used connector:DF13-6P-1.25H (Hirose Electric Co., Ltd.)

Corresponding connector:DF13-6S-1.25C ()

Pin No.	Symbol	Function	Polarity
1	Vcc	+5V power supply	
2	Vcc	+5V power supply	
3	GND		
4	GND		
5	ENAB	Data enable signal(to settle the viewing area)	positive
6	TST	This shall be electrically opened during operation	

【Notel】 Polarity of the sync.
signals.

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

※The shielding case is connected with signal GND.

4-2) Backlight

Used connector : EHR-2 (JST), Corresponding connector : S2B-EH (JST)

CNA, CNC (color:red)

CNB, CND (color:white)

Pin No.	Symbol	Function
1	V _{HIGH}	Power supply for lamp (High voltage side)
2	NC	

Pin No.	Symbol	Function
1	NC	
2	V _{LOW}	Power supply for lamp (Low voltage side)

*Cable length : CNA&CNC 50±10mm, CNB&CND 90±10mm (refer to Fig.1)

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】
+5V supply voltage	V_{cc}	$T_a=25^\circ\text{C}$	$-0.3 \sim +7$	V	
Storage temperature	T_{stg}	-	$-25 \sim +60$	$^\circ\text{C}$	【Note2】
Operating temperature (Ambient)	T_{opa}	-	$0 \sim +50$	$^\circ\text{C}$	

【Note1】 CK, R0~R2, G0~G2, B0~B2, Hsync, Vsync, ENAB

【Note2】 Humidity : 95%RH Max. at $T_a \leq 40^\circ\text{C}$.

Maximum wet-bulb temperature 39°C or less at $T_a > 40^\circ\text{C}$.

No condensation.

6. Electrical Characteristics

6-1. Electrical Characteristics & current dissipation

6-1-a) TFT-LCD panel driving

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

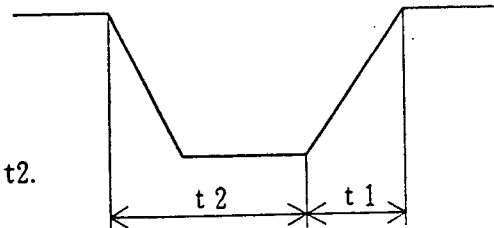
Parameter		Symbol	Min.	Typ.	Max.	Unit	Remark
+5V	Supply voltage	V_{cc}	+4.75	+5.0	+5.25	V	【Note1】
	Current dissipation	I_{cc}	-	400	600	mA	【Note2】
Input voltage (Low) (excluding ENAB)		V_{iL}	-	-	1.5	V	$V_{cc}=+5V$
Input voltage (Low) (ENAB)		V_{iLE}	-	-	0.8	V	
Input voltage (High)		V_{iH}	+3.5	-	-	V	
Permissive input ripple voltage		V_{RP}	-	-	50	mVp-p	V_{cc}
Input leakage current		I_{oL}	-10	-	0	μA	$V_i=0V$
		I_{oH}	0	-	+10	μA	$V_i=V_{cc}$

【Note1】

t_1 : rise time ($\leq 100\text{msec}$)

t_2 : power off time ($\geq 150\text{msec}$)

Don't turn on again in the period t_2 .



【Note2】 Typical current situation is defined 8-color-bar pattern.
(at 480 lines mode, $V_{cc}=5V$)

6-1-b) Backlight

LD4404-4

The backlight system is an edge lighting type. (a couple of CCFT)

The characteristics of single lamp are shown in the following table.

Ta=25°C

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Lamp voltage	V_L	—	400	—	Vrms	Just for reference
Lamp current	I_L	4.5	5.0	5.5	mA rms	
Lamp power consumption	P_L	—	2.0	—	W	【Note 1】
Frequency	F_L	20	—	60	KHz	【Note 2】
Kick-off voltage	V_s	—	—	1000	Vrms	Ta=25°C
		—	—	1200	Vrms	Ta=0°C
Lamp life time		10000	—	—	hour	【Note 3】

【Note 1】 Calculated value for reference. ($I_L \times V_L$)

【Note 2】 Lamp frequency may produce interference with horizontal sync. frequency, causing beat on the display.

Therefore lamp frequency shall be as different as possible from the ones of Horizontal sync. and harmonics horizontal sync. to avoid interference.

【Note 3】 Brightness becomes 50% of the original brightness at standard condition.

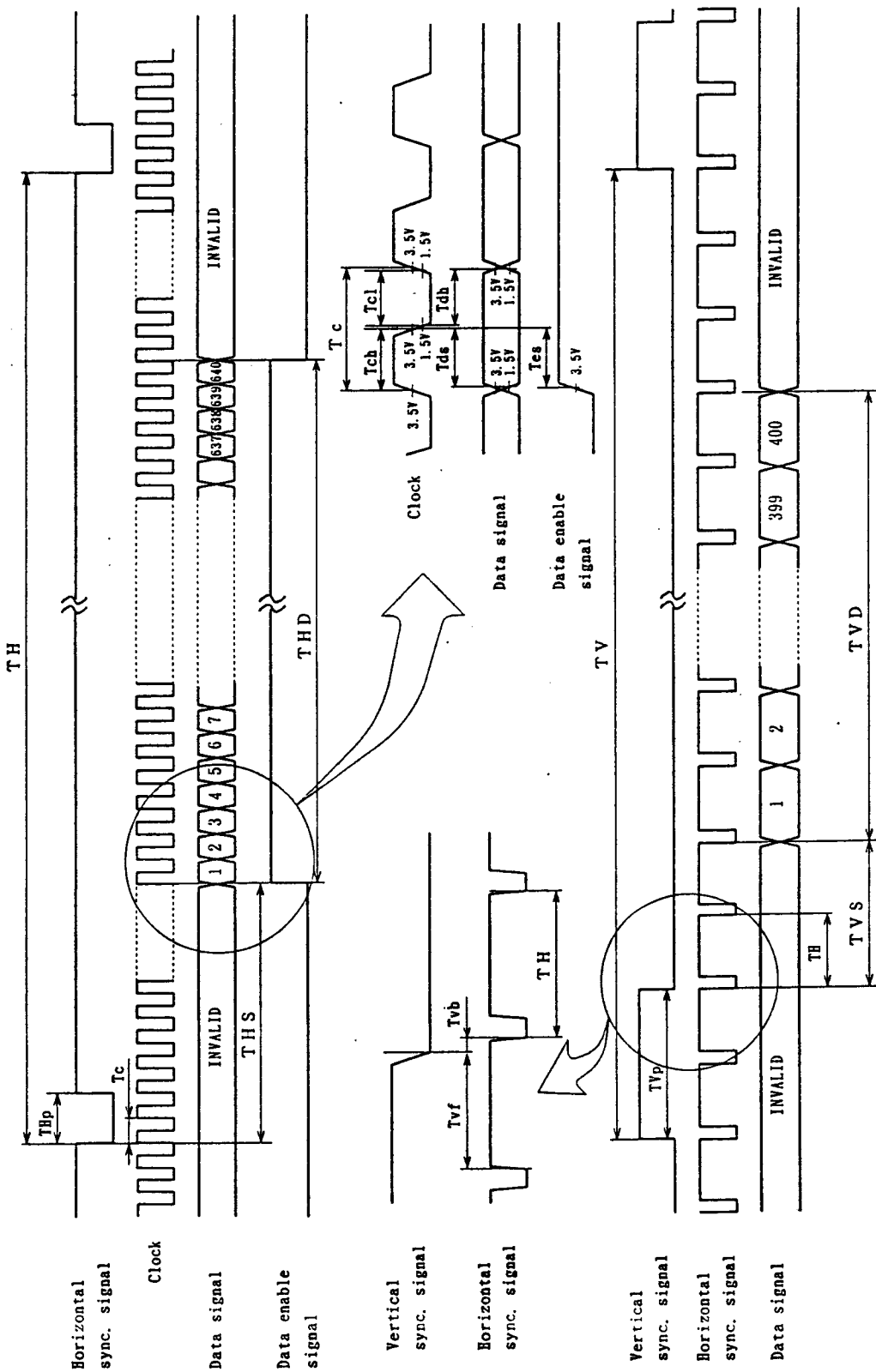


Fig. 2-2 Input signal waveforms (400 lines mode)

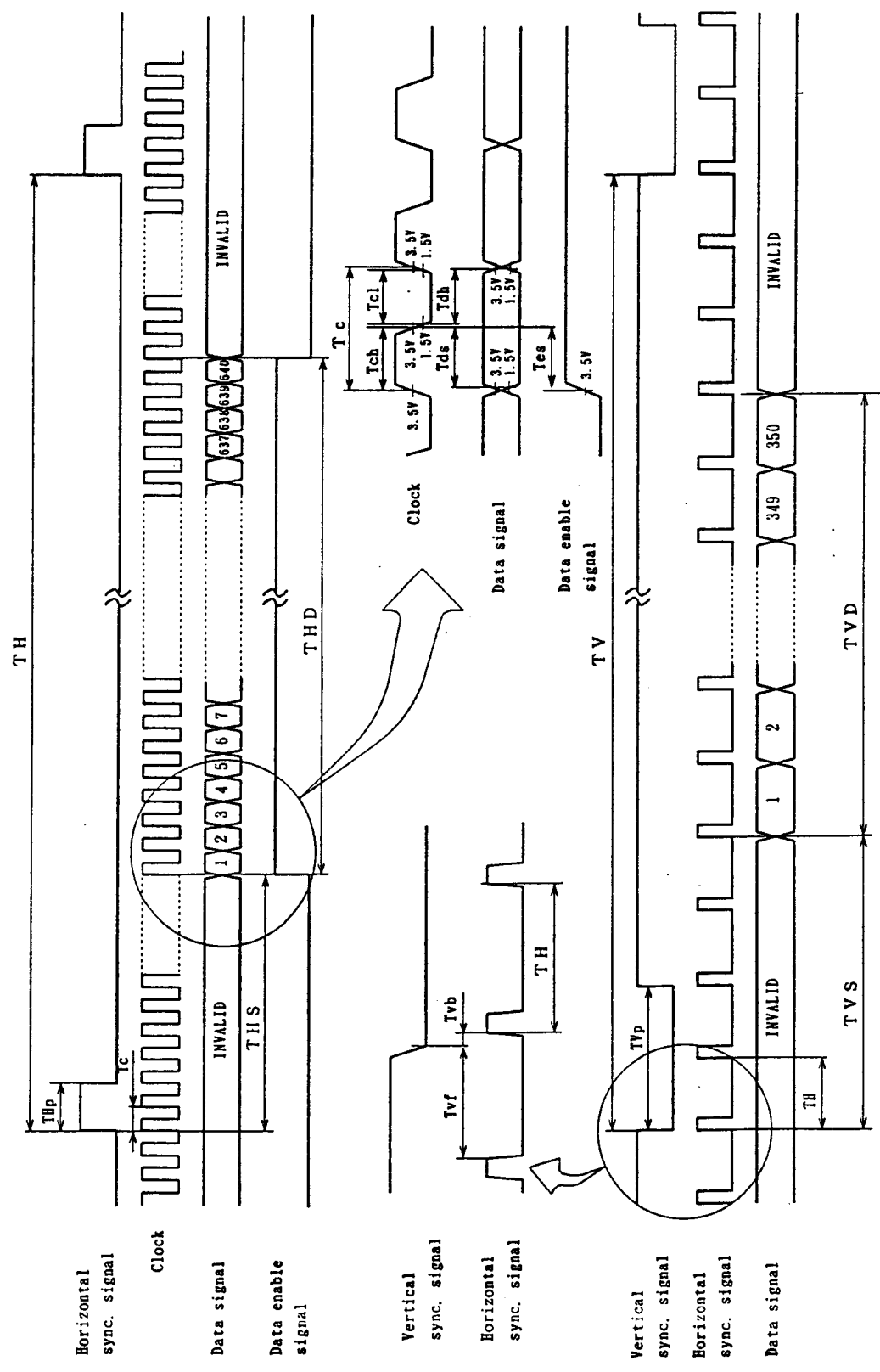


Fig. 2-3 Input signal waveforms (350 lines mode)

6-4. Input Signals, Basic Display Colors and Gray Scale of Each Color

	color & Gray scale	Data signal								
		R0	R1	R2	G0	G1	G2	B0	B1	B2
Basic color	Black	0	0	0	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	1	1	1
	Green	0	0	0	1	1	1	0	0	0
	Light blue	0	0	0	1	1	1	1	1	1
	Red	1	1	1	0	0	0	0	0	0
	Purple	1	1	1	0	0	0	1	1	1
	Yellow	1	1	1	1	1	1	0	0	0
	White	1	1	1	1	1	1	1	1	1
Gray Scale of Red	Black	0	0	0	0	0	0	0	0	0
	↑	1	0	0	0	0	0	0	0	0
	Darker	0	1	0	0	0	0	0	0	0
	↑	1	1	0	0	0	0	0	0	0
	↓	0	0	1	0	0	0	0	0	0
	Brighter	1	0	1	0	0	0	0	0	0
	↓	0	1	1	0	0	0	0	0	0
	Red	1	1	1	0	0	0	0	0	0
Gray Scale of Green	Black	0	0	0	0	0	0	0	0	0
	↑	0	0	0	1	0	0	0	0	0
	Darker	0	0	0	0	1	0	0	0	0
	↑	0	0	0	1	1	0	0	0	0
	↓	0	0	0	0	0	1	0	0	0
	Brighter	0	0	0	1	0	1	0	0	0
	↓	0	0	0	0	1	1	0	0	0
	Green	0	0	0	1	1	1	0	0	0
Gray Scale of Blue	Black	0	0	0	0	0	0	0	0	0
	↑	0	0	0	0	0	0	1	0	0
	Darker	0	0	0	0	0	0	0	1	0
	↑	0	0	0	0	0	0	1	1	0
	↓	0	0	0	0	0	0	0	0	1
	Brighter	0	0	0	0	0	0	1	0	1
	↓	0	0	0	0	0	0	0	1	1
	Blue	0	0	0	0	0	0	1	1	1

0: Low level
voltage
1: High level
voltage

Each color is displayed in 8 gray scales from 3 bit data signals input. According to the combination of total 9 bit data, 512 colors are displayed.

7. Optical Characteristics

Ta=25℃, Vcc=+5V

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Remark	
Viewing angle range	Horizontal	$\theta 21, 22$	CR > 10	45	-	-	Deg.	【Note1, 4】
	Vertical	$\theta 11$		10	-	-	Deg.	
		$\theta 12$		30	-	-	Deg.	
Contrast ratio	C R	Optimum viewing angle	60	-	-		【Note2, 4】	
Response time	Rise	τr	$\theta = 0^\circ$	-	30	-	ms	【Note3, 4】
	Decay	τd		-	50	-	ms	
Chromaticity of white	x			-	0.316	-		【Note4】
	y			-	0.320	-		
Luminance of white	Y_L		50	70	-	nt		
White Uniformity	δ_w		-	-	1.25		【Note5】	

※The measurement shall be executed 15-20 minutes after lighting at rating. The optical characteristics shall be measured in a dark room or equivalent state with the method shown in Fig.3 below.

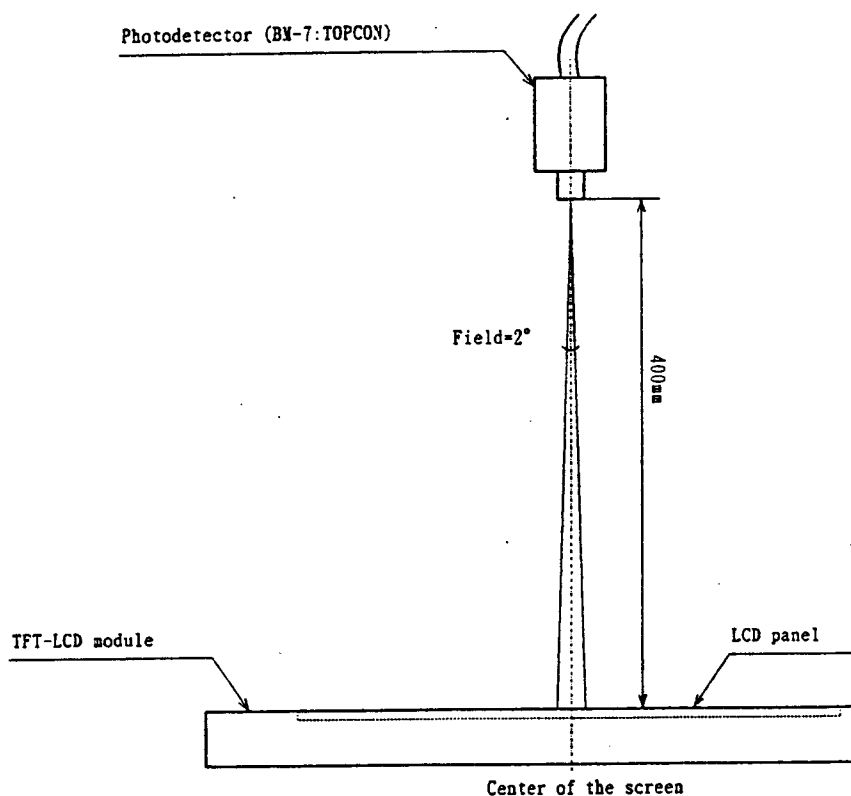
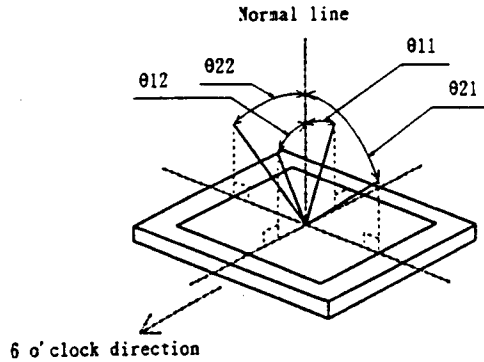


Fig.3 Optical characteristics measurement method

【Note1】 Definitions of viewing angle range:



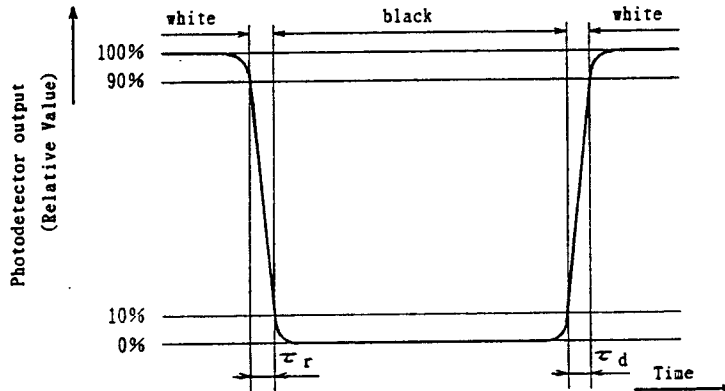
【Note2】 Definition of Contrast Ratio:

The contrast ratio is defined as the following.

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

【Note3】 Definitions of Response Time:

The response time shall be measured like the following figure by switching the input signals for "black" ON and OFF.

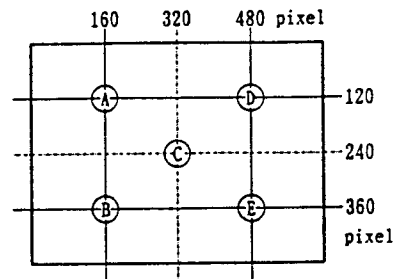


【Note4】 They shall be measured at center of the screen.

【Note5】 Definition of White Uniformity

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

$$\frac{\text{Maximum Luminance (brightness)}}{\text{Minimum Luminance (brightness)}}$$



8. Display quality

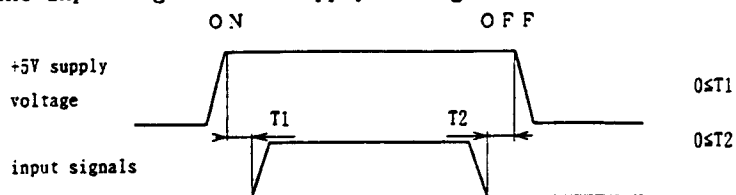
The display quality of the color TFT-LCD module shall be in compliance with the Delivery Inspection Standard.

9. Handling Precautions

9-1) 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.

9-2) Power ON/OFF sequential timing

To prevent the latch-up of the circuit in the module, keep the sequential timing between the input signals and supply voltage as follows.



9-3) Others

- 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 front polarizer is easily damaged, pay attention not to scratch it.
- c) Wipe off water drop immediately. Long contact with water may cause discoloration or spots.
- d) When the panel surface is soiled, wipe it with absorbent cotton or other soft cloth.
- e) Since the module uses glass, it may break or crack if dropped or bumped on hard surface. Handle with care.
- f) Since CMOS LSI is used in this module, take care of static electricity and ground your body when handling.
- g) Observe all other precautionary requirements in handling components.

10. Packing form

- a) Piling number of cartons : MAX. 5
- b) Package quantity in one carton : MAX. 10
- c) Carton size : 420(W)×355(H)×300(D)
- d) Total weight of 1 carton filled with full modules : 8500g

Packing form is shown in Fig. 4.

11. Reliability test items

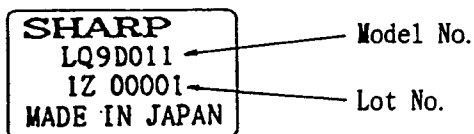
No.	Test item	Conditions
1	High temperature storage test	Ta=60℃ 240H
2	Low temperature storage test	Ta=-25℃ 240H
3	High temperature & high humidity operation test	Ta=40℃;95%RH 240H (No condensation)
4	High temperature operation test	Ta=50℃ 240H (The panel temp. must be less than 60℃)
5	Low temperature operation test	Ta=0℃ 240H
6	Vibration test (non-operating)	Frequency:10~57Hz/Vibration width (one side):0.075mm :58~500Hz/Gravity:1G Sweep time : 11 minutes Test period : 3 hours (1 hour for each direction of X, Y, Z)
7	Shock test (non-operating)	Max. gravity : 50G 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.

12. 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 technical literature may not be satisfied.
- 3) Disassembling the module can cause permanent damage and should be strictly avoided.
- 4) If any problem occurs in relation to the description of this specification, it shall be resolved through discussion with spirit of cooperation.

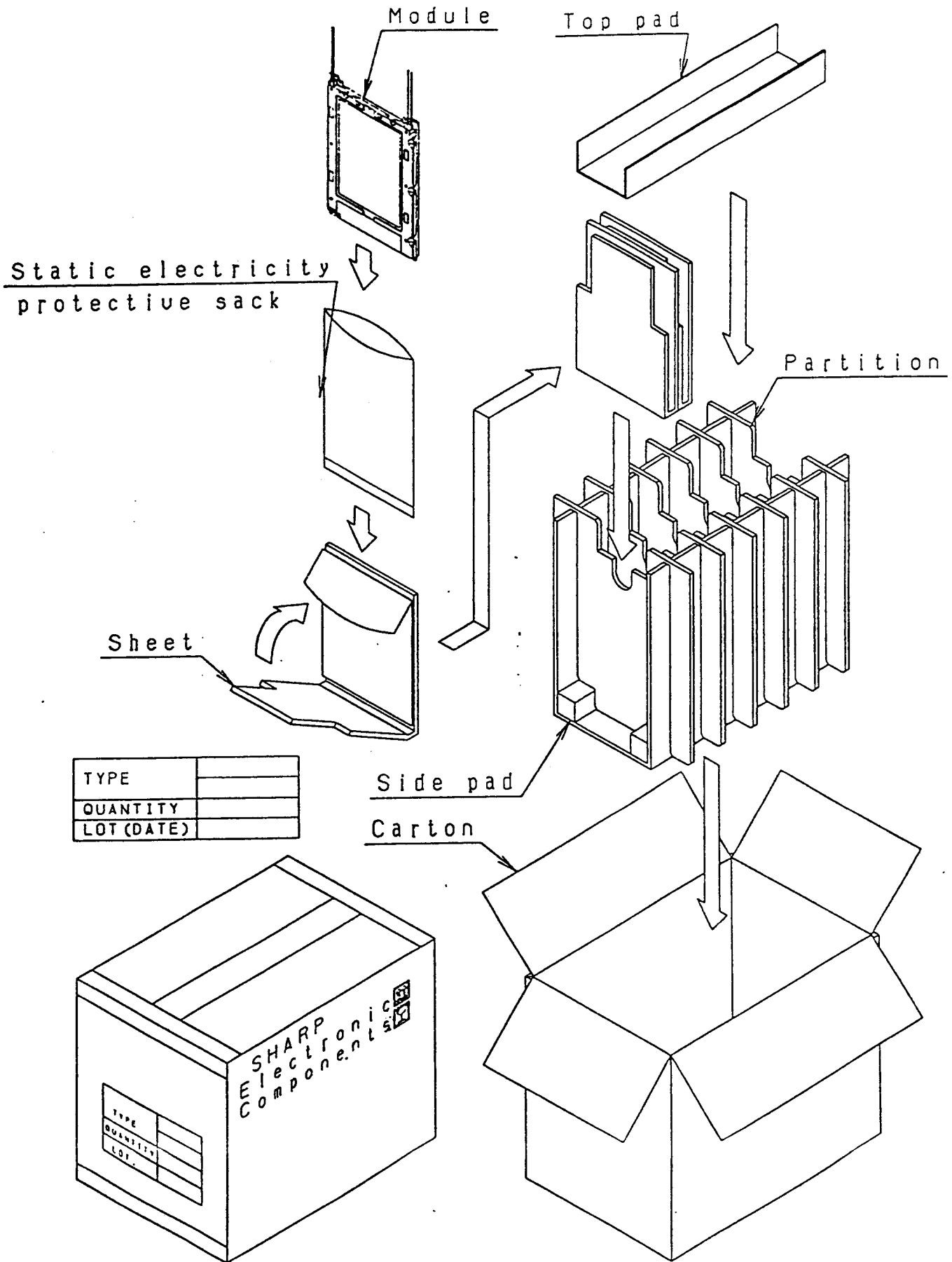
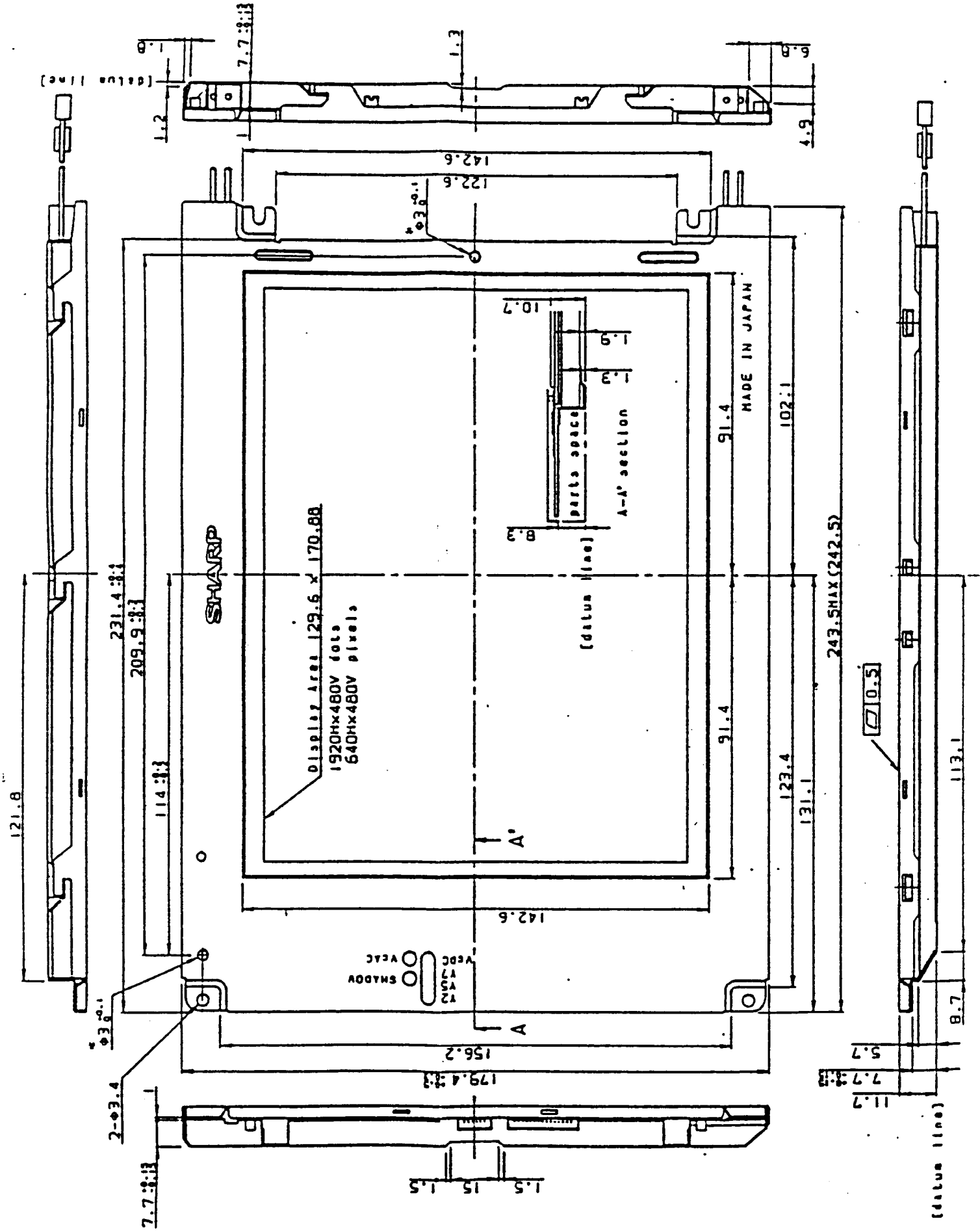
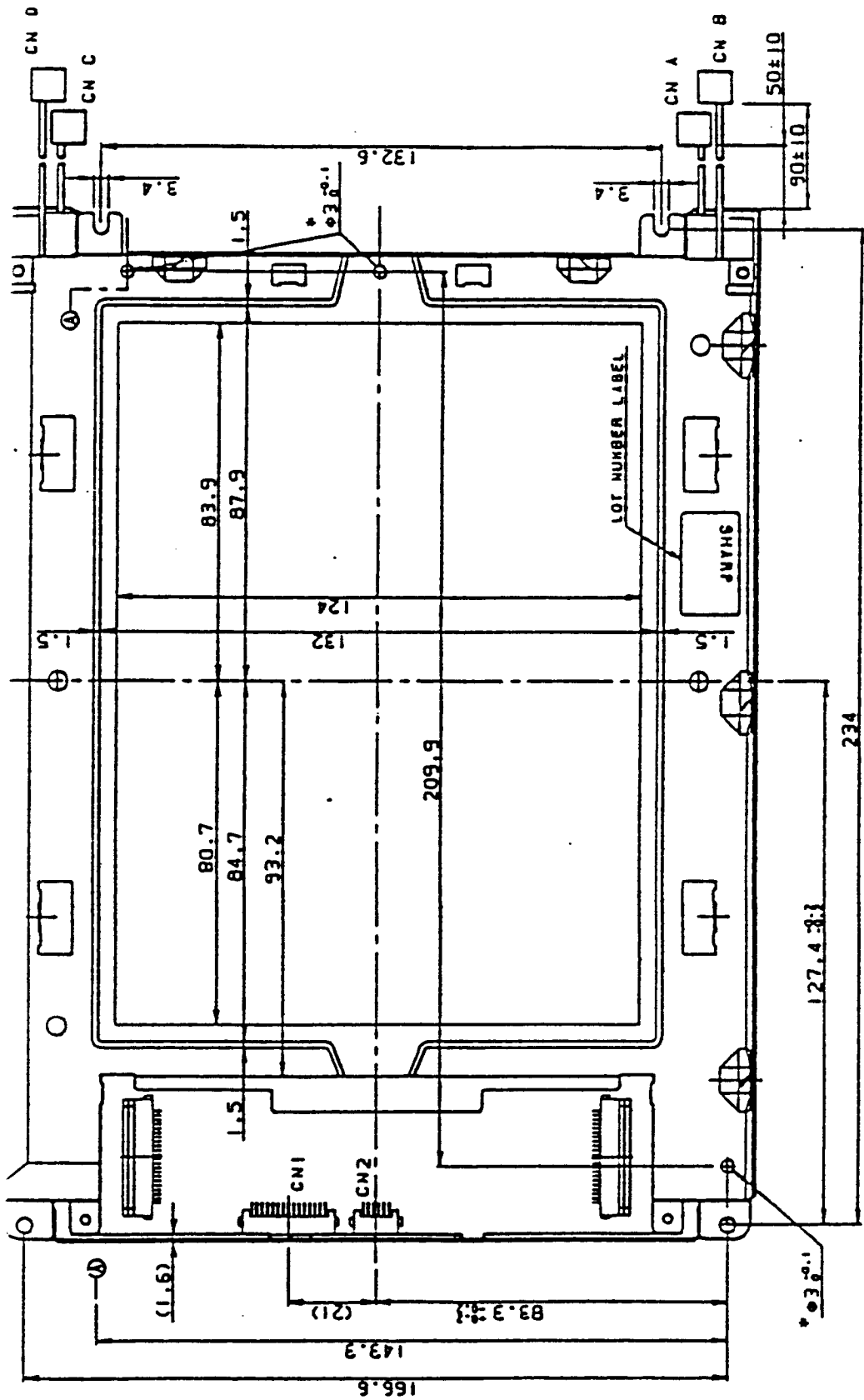


Fig4 Packing form





General tolerance is ± 0.3

*These holes($\phi 3$) can be used for aligning this module to your product. Hole depth is 1.5mm from module surface.

FIG. 1 OUTLINE DIMENSIONS