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	APPLICABLE GROUP Tenri Liquid Crystal Display Group	

DEVICE SPECIFICATION FOR  
**TFT-LCD Module**  
MODEL No.  
**LQ12S01**

CUSTOMER' S APROVAL

DATE \_\_\_\_\_

BY \_\_\_\_\_

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## 1. Application

This specification applies to a color TFT-LCD module, LQ12S01.

## 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 800 X 3 X600 dots panel with 262,144 colors by supplying 18 bit data signals (**6bit/color**), four timing signals, +3.3V DC supply voltage for TFT-LCD panel driving and supply voltage for backlight.

The **TFT-LCD** panel used for this module has **very** high aperture ratio. A low-reflection and higher-color-saturation type color filter is also used for this panel. Therefore, high-brightness and high-contrast image, which is suitable for the **multimedia** use, can be obtained by using this module.

Optimum viewing direction is 6 o'clock.

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

### [Features]

- 1) High aperture panel ; high-brightness or low power consumption.
- 2) Brilliant and high contrast image.
- 3) Small footprint and thin shape.
- 4) Light weight.

## 3. Mechanical Specifications

Parameter	Specifications	unit
Display size	31 (12.1") Diagonal	cm
Active area	246.0 (H) X 184.5 (V)	mm
Pixel format	800 (H) X 600 (V)	pixel
	(1 pixel = R + G + B dots)	
Pixel pitch	0.3075 (H) X 0.3075 (V)	mm
Pixel configuration	R,G,B vertical stripe	
Display mode	'Normally white	
Unit outline dimensions *1	275.0 (W) X 199.0 (H) X 7.4(D)	mm
Mass	[530]	g
Surface treatment	Anti-glare and hard-coating 2H Low reflection (~1.5%)	

\*1.Note: excluding backlight cables.

Outline dimensions is shown in Fig. 1 (Drawing No.: 2D-95Z-559)



**[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

CN2 : BHR-03VS-1(JST)

Mating connector: SMOZ(8.0)B-BHS(JST)

Pin no.	symbol	function
1	V <sub>HIGH</sub>	Power supply for lamp (High voltage side)
2	NC	This is electrically opened.
3	LOW	Power supply for lamp (Low voltage side)

#### 5. Absolute Maximum Ratings

Parameter “	Symbol	Condition	Ratings	unit	Remark
Input voltage	V <sub>I</sub>	Ta=25°C	-0.3 ~ V <sub>CC</sub> +0.3	V	<b>[Note1]</b>
+3.3V supply voltage	V <sub>CC</sub>	Ta=25°C	0 ~ +6	v	
Storage temperature	T <sub>stg</sub>	-	-25 ~ +60	°C	<b>[Note2]</b>
Operating temperature (Ambient)	T <sub>opa</sub>	-	0 ~ +50	°C	

**[Note1]** 1 CK,R0~R5,G0~G5,B0~B5,Hsync,Vsync,ENAB

**[Note2]** Humidity : 95%RH Max. at Ta≤40°C.

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

No condensation.

#### 6. Electrical Characteristics

##### 6-1 .TFT-LCD panel driving

Ta=25°C

Parameter		Symbol	Min.	Typ.	Max.	unit	Remark
V <sub>CC</sub>	Supply voltage	V <sub>CC</sub>	+3.0	+3.3	+3.6	v	<b>[Note1]</b>
	Current dissipation	I <sub>CC</sub>	-	370	630	m A	<b>[Note2]</b>
Permissible input ripple voltage		V <sub>RP</sub>	-	-	100	mVp-p	V <sub>CC</sub> =+3.3V
Input voltage (Low)		V <sub>IL</sub>	-	-	0.3V <sub>CC</sub>	v	
Input voltage (High)		V <sub>IH</sub>	0.7V <sub>CC</sub>	-	-	V	<b>[Note3]</b>
Input current (low)		I <sub>OL</sub>	-	-	1.0	μ A	V <sub>I</sub> =0V <b>[Note3]</b>
Input current (High)		I <sub>OH1</sub>	-	-	1.0	μ A	V <sub>I</sub> =3.3V <b>[Note4]</b>
		I <sub>OH2</sub>	-	-	30.0	μ A	V <sub>I</sub> =3.3V <b>[Note5]</b>

**【Note1】**

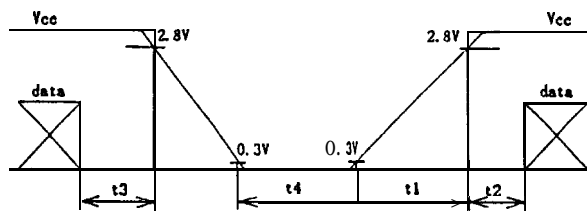
On-off conditions for supply voltage

$0 < t1 \leq 10ms$

$0 < t2 \leq 50ms$

$0 < t3 \leq 1s$

$t4 > 1s$

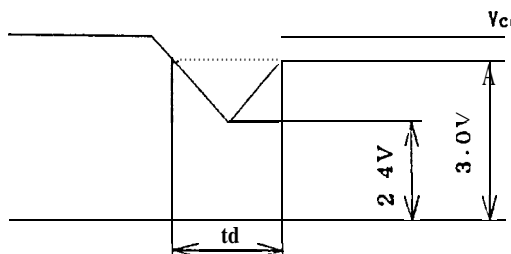


Vcc-dip conditions

1)  $2.4V \leq Vcc < 3.0V$   
 $td \leq 10ms$

2)  $Vcc < 2.4V$

Vcc-dip conditions should also follow the On-off conditions for supply voltage



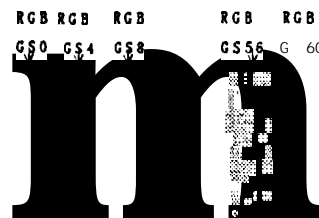
**【Note2】** Typical current situation: 16-gray-bar pattern.

$Vcc = +3.3V$

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

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

**【Note5】** ENAB



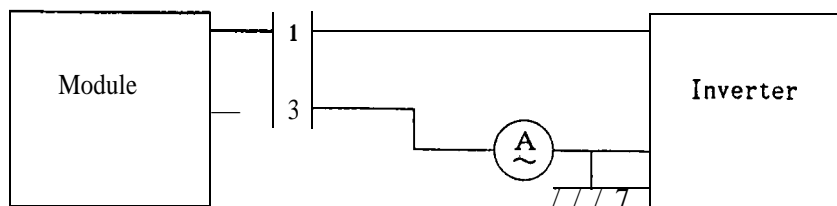
6-2. Backlight driving

The backlight system is an edge-lighting type with single CCFT (Cold Cathode Fluorescent Tube).

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

Parameter	Symbol	Min.	Typ.	Max.	unit	Remark
Lamp current range	$I_L$	1.5	2.5	5.5	mArms	<b>【Note1】</b>
Lamp power consumption	PL	—	1,6	—	w	$Y_L = 70cd/m^2$
Lamp frequency	$F_L$	20	35	60	KHz	<b>【Note2】</b>
Kick-off voltage	$V_s$	—	—	1300	Vrms	$T_a = 25^\circ C$
		—	—	1400	Vrms	$T_a = 0^\circ C$ <b>【Note3】</b>
Lamp life time	$L_L$	10000	—	—	hour	<b>【Note4】</b>

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



\* 3pin is  $V_{LOW}$

[Note2] 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.

**【Note3】** The voltage above this value should be applied to the lamp for more than 1 second to start-up. Otherwise **the** lamp may not be turned on.

[Note4] Lamp life time is defined as the time when either ① or ② occurs in the continuous operation under the condition of  $T_a=25^{\circ}\text{C}$  and  $I_L=5.5\text{mA rms}$ .

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

② Kick-off voltage at  $T_a=0^{\circ}\text{C}$  exceeds maximum value, 1400 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.

### 7-1. Timing characteristics

Parameter	Symbol	Min.	Typ.	Max.	unit	Remark
Clock	Frequency	$1/T_c$	—	40.0	42.0	MHz
	High time	$T_{ch}$	5	—	—	ns
	Low time	$T_{cl}$	5	—	—	ns
	Duty ratio	$T_h/T$	40	50	60	%
Data	Setup time	$T_{ds}$	3	—	—	ns
	Hold time	$T_{dh}$	10	—	—	ns
Horizontal sync. signal	Cycle	$TH$	20.8	26.4	—	$\mu\text{s}$
			832	1056	—	clock
	Pulse width	$TH_p$	2	128	200	clock
Vertical sync. signal	Cycle	$TV$	628	666	798	line
	Pulse width	$TV_p$	2	4	6	line
Horizontal display period	$TH_d$	800	800	800	clock	
Hsync-Clock phase difference	$TH_c$	10	—	$T_c-10$	ns	
Vertical data start position	$TV_s$	23	23	23	line	
Hsync-Vsync phase difference	$TV_h$	0	—	$TH-TH_p$	clock	

Note) In case of lower frequency, the deterioration of display quality, flicker etc., maybe 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	800	Th-lo	clock
Hsync-Enable signal phase difference	THe	58	88	170	clock	

Note) When ENAB is fixed “Low”, the display starts from the data of **C88(clock)** as shown in Fig.2.

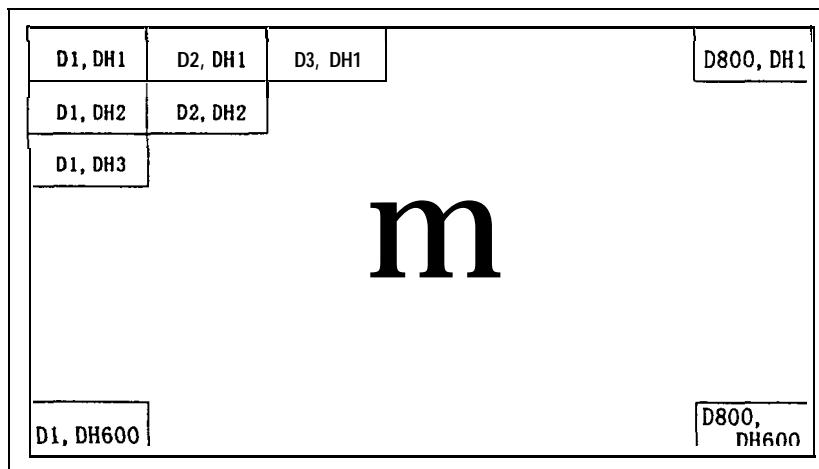
Be **careful** that the module does@ work when ENAB is fixed “High”,

## 7-3. Vertical display position

The vertical display position, Tvs, is fixed “23” (line).

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

Display position of input data  
(H, V)



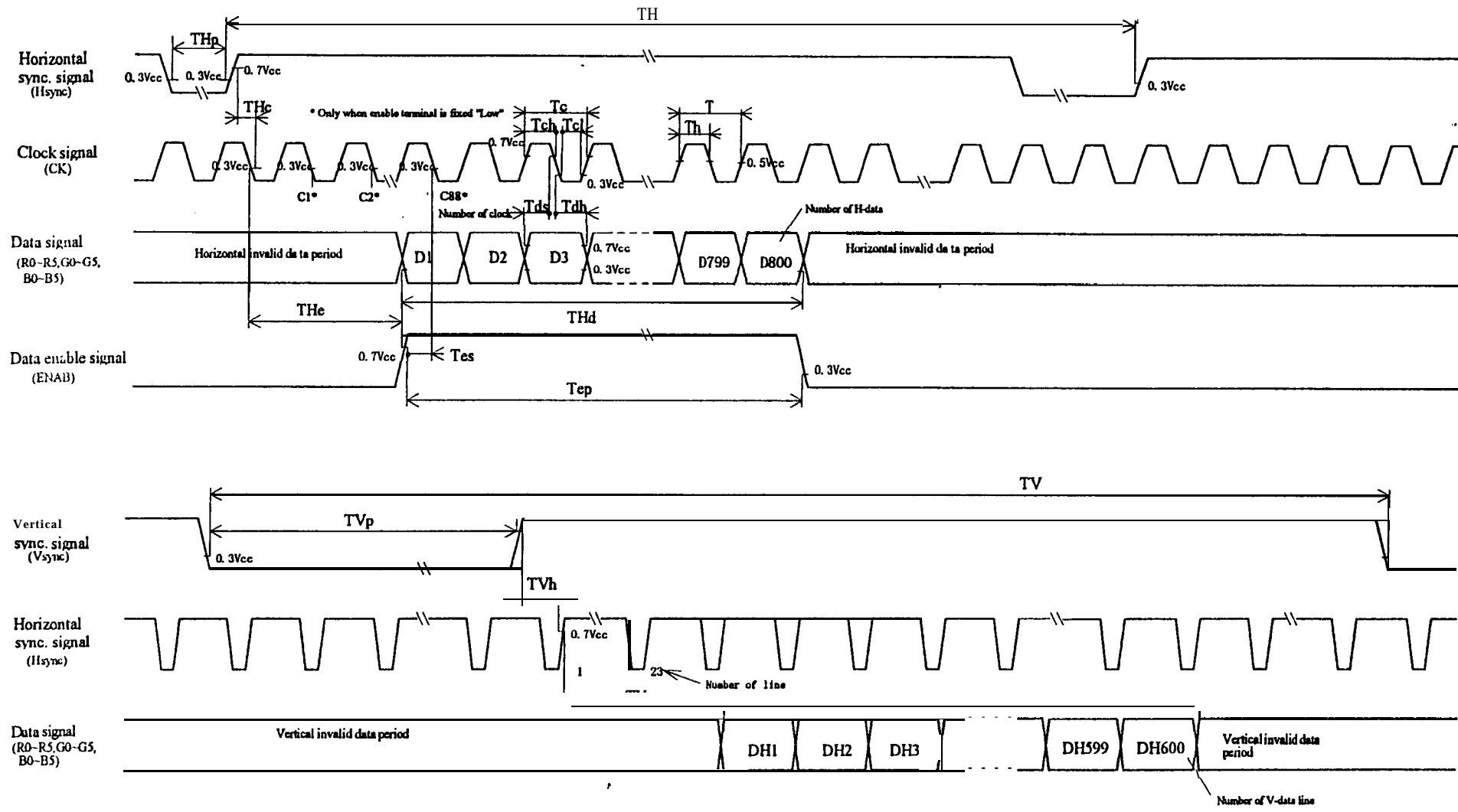


Fig.2 Input signal waveform

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	B0	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	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
	↑ 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	0	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	Gso	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 18 bit data signals, the 262,144-color display can be achieved on the screen.

9. Optical Characteristics

Ta=25°C, Vc=1.3V

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing angle range	Horizontal	921,622	<b>CR&gt;10</b>	45	—	—	Deg.	<b>【Note1,4】</b>
	Vertical	$\theta_{11}$		10	—	—	Deg.	
		$e_{12}$		30	—	—	Deg.	
Contrast ratio		C Rn	$e = 0^\circ$	150	—	—		<b>【Note2,4】</b>
		C Ro	Optimum viewing angle	—	300	—		
Response time	Rise	$\tau_r$	$e = 0^\circ$	—	<b>30</b>	—	m s	<b>【Note3,4】</b>
	Decay	$\tau_d$		—	50	—	m s	
Chromaticity of white		x	$e = 0^\circ$	0.263	0.313	0.363		<b>【Note4】</b>
		y		0.279	0.329	0.379		
Luminance of white <b>【Note4】</b>		$Y_{L1}$		50	70	—	c d/m <sup>2</sup>	$I_L=2.5mA_{rms}$
		$Y_{L2}$		—	130	—	c d/m <sup>2</sup>	$I_L=5.5mA_{rms}$
White Uniformity		$\delta_w$		—	—	1.45		<b>【Note5】</b>

※The measurement shall be executed 30 minutes after lighting at rating. (typical condition:  $I_L=2.5mA_{rms}$ )

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

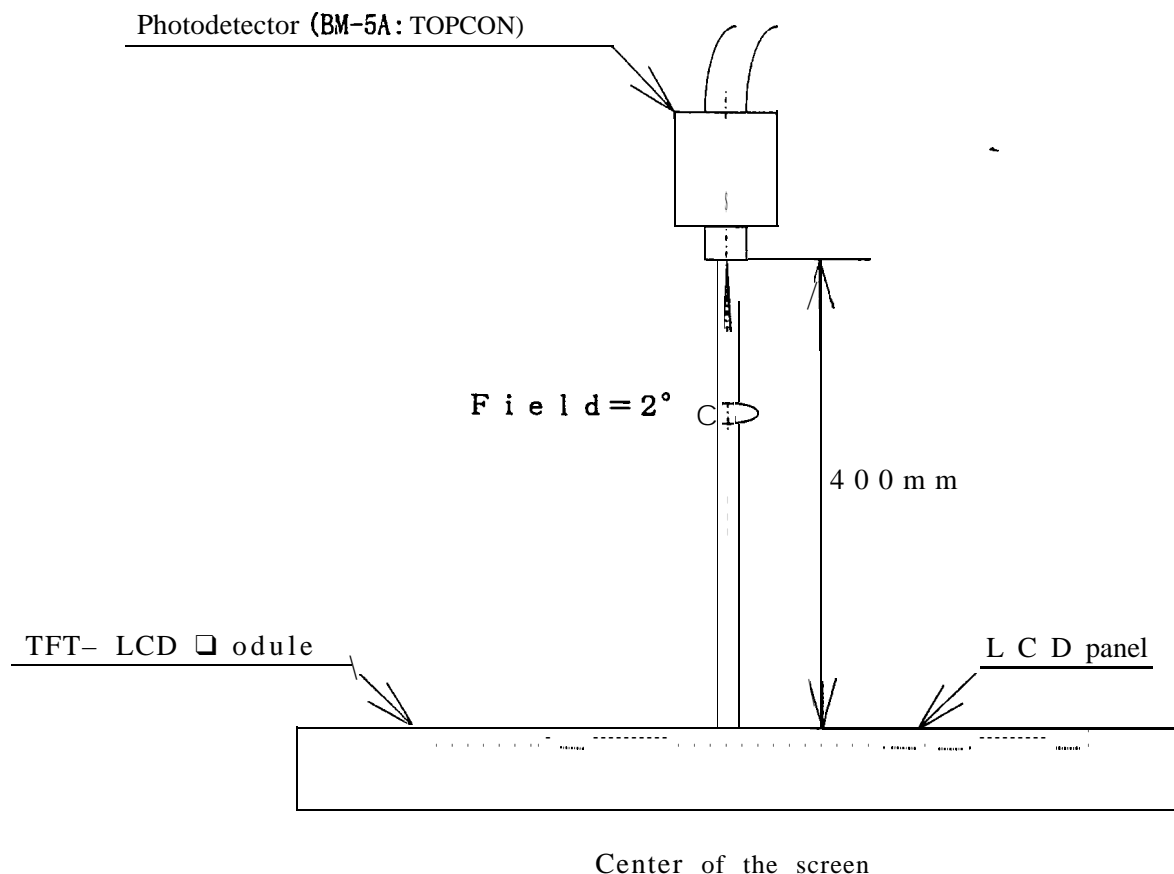
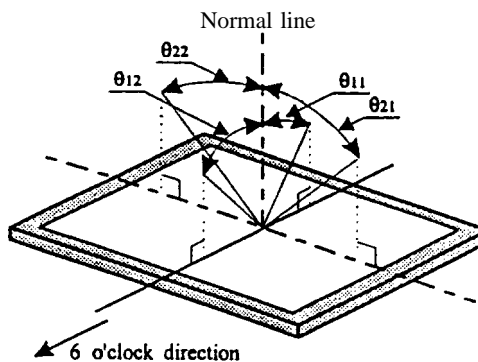


Fig. 3 Optical characteristics measurement method

**[Note1] Definitions of viewing angle range “**



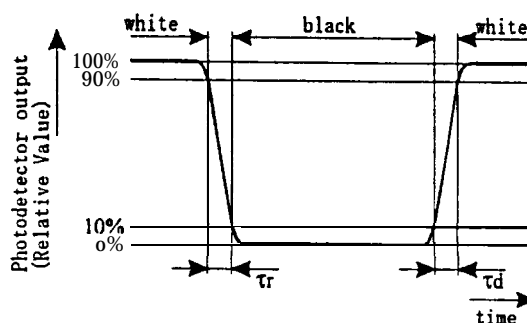
**[Note2] Definition of contrast ratio:**

The contrast ratio is defined as the following.

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

**[Note3] Definition of response time:**

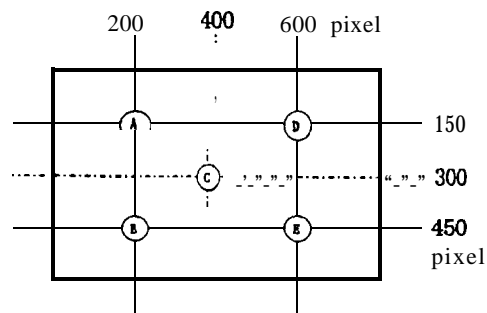
The response time is defined as the following figure and shall be measured by switching the input signal for “black” and “white” .



**[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 Quality

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 precautionary requirements in handling components.
- i) This **module** has its **circuitry** PCBs on the rear side and should be handled **carefully** 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 the 'dust' on **the** polarizer by using an ionized nitrogen gun, etc..
- k) **Black** PET sheet **covers** some electric components and handle with special care to avoid **mechanical** stress and shock on this PET surface.

## 12. 'Packing form

- a) Piling number of cartons : **MAX.7**
- b) Package quantity in one carton: **10pcs**
- c) Carton size: 315(W) X **380(H)** X **380(D)mm**
- d) Total mass-of one carton filled with **full** modules : **[7800g]**

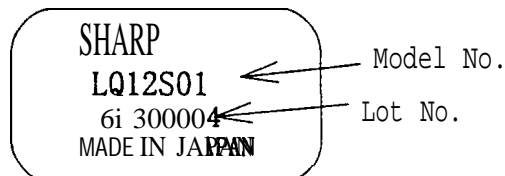
Packing form is shown in Fig.4

### 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 (The panel temp. must be less than 60°C)
5	Low temperature operation test	Ta=0°C 240H
6	Vibration test (non- operating)	Frequency: 10~57Hz/Vibration width (one side) :0.075mm : 58~500Hz/Gravity:9.8m/s <sup>2</sup> 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 <sup>2</sup> Pulse width: 11 ms, sine wave Direction: ±X, ±Y, ±Z once for each direction.

#### 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.

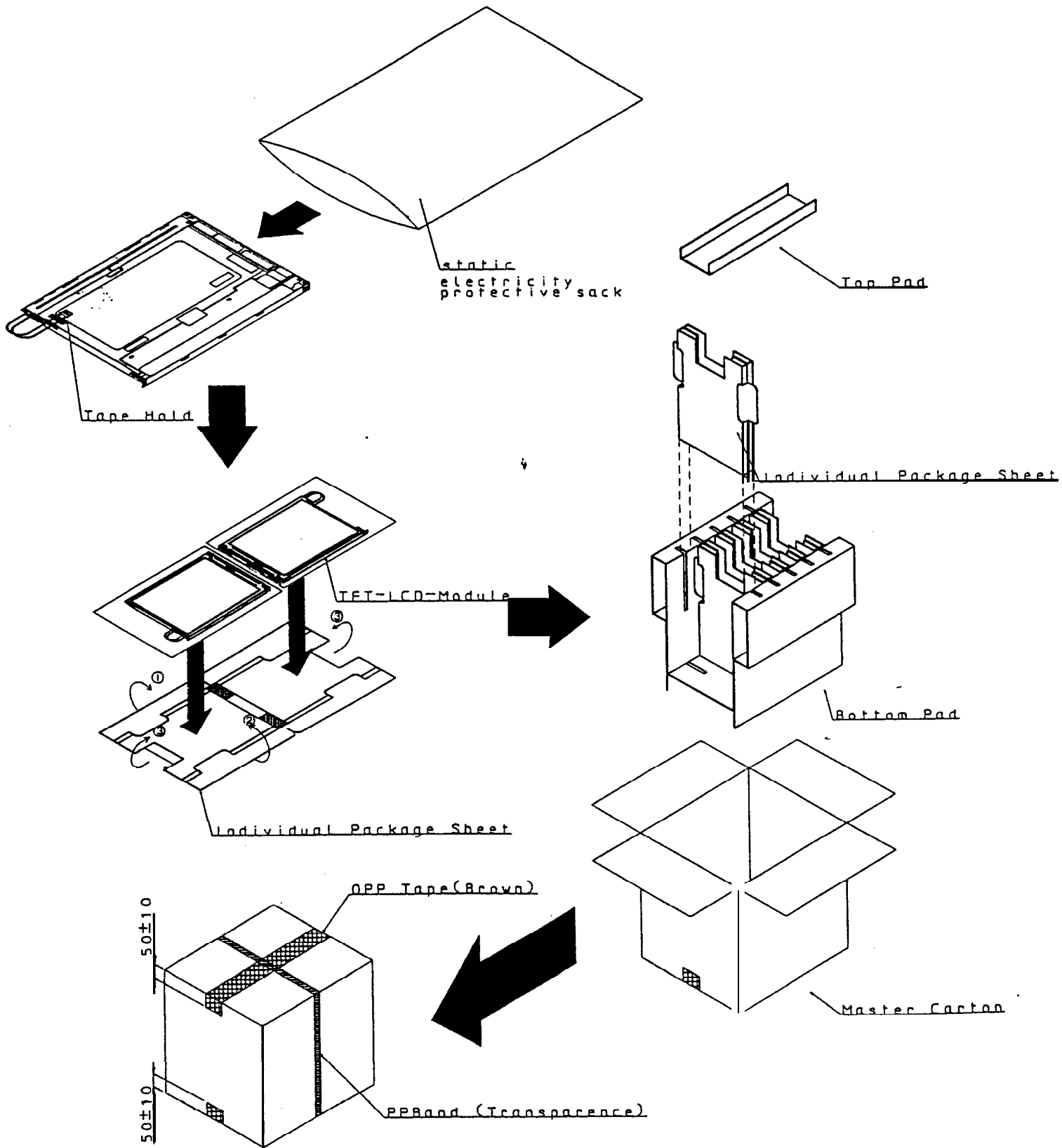


Fig4. packing form



Fig. 1 OUTLINE DIMENSIONS

CN1: INTERFACE CONNECTOR  
 DF9B-41P-1V(HIROSE)  
 CN2: CCT CONNECTOR  
 BHR-03VS-1(JST)

NOTES: 1) UNSPECIFIED TOLERANCE 1.0 BE ±0.5mm  
 2) WARP AND FLATTING FOR BEZEL AND CHASSIS ARE EXCLUDED FROM THICKNESS AND DIMENSION OF THE UNIT

