SHARP

LQ080T5GG01

Color TFT LCD Module

(Model Number: LQ080T5GG01)

Specifications

Spec No.: LD-12406

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	LIQUID CRYSTAL DISPLAY GROUP SHARP CORPORATION **SPECIFICATION**	APPLICABLE GROUP LIQUID CRYSTAL DISPLAY GROUP

DEVICE SPECIFICATION FOR

TFT - LCD module

MODEL No. LQ080T5GG01

CUSTOMER'S APPROVA

DATE _____

BY _____

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(1) Summary

This module utilizes amorphous silicon thin film transistors and a 16:9 aspect ratio. A 8.0 active matrix liquid crystal display allows full color to be displayed.
An outline of the module is given in Table 1.

(2) Features

- Utilizes a panel with a 16:9 aspect ratio, which makes the module suitable for use in wide-screen systems.
- The 8.0 screen produces a high resolution image that is composed of 112,320 pixel elements in a stripe arrangement.
- Wide viewing field angle technology is employed. (The most suitable viewing angle is in the 6 o'clock direction.)
- By adopting an active matrix drive, a picture with high contrast is realized.
- Reflection due to external light is minimized through the use of a low reflection, black matrix and an antiglare (AG) plate.
- A thin, light and compact module.
  The ratio of effective display area to external surface area: 77.7%
  Thickness: 8.8 mm
  Mass: 250g
- By adopting a high aperture panel, high transmittance color filter and high transmittance polarizing plates, transmittance ratio is realized.
- An inverted video display in the vertical and horizontal directions is possible

(3) Structure and External Shape

External measurements for the module are given in Fig. 1, and the structure of the module is shown in Fig. 2 The module is composed of the TFT-LCD panel, drivers, FPC, frame, backlight, sealed front case, and sealed back case.
(Control circuit, backlight-driving DC/AC inverter is not built in this module.)

(4)Mechanical specifications

table 1

Parameter	Specifications	Units	Remarks
Display format	112,320 (1pixel=R+G+B dots)	pixels	
Dot format	1440(W)×234(H)	dots	
Active area	176.4 (W) ×99.22 (H)	mm	
Screen size (Diagonal)	20.2 [8.0"]	cm	
Dot pitch	0.1225 (W) ×0.424 (H)	mm	
Pixel configuration	R,G,B Stripe configuration		
Outline dimension	193.3(W)×116.5(H)×8.8(D)	mm	[Note1-1]
Mass	250±20	g	

[Note1-1] Typical values are given. For detailed measurements and tolerances, please refer to Fig. 1.

(5)Input / Output terminal

5-1)TFT-LCD panel driving part

table 2

(Hi＝VSH、Lo＝GND)

Pin No.	Symbol	i/o	Description	Remarks
1	VGH	i	Power supply for gate driver(High level).	
2	OPEN	—	Open	
3	OPEN	—	Open	
4	MODE2	i	Control signal for gate driver.	【Note2-1】
5	MODE1	i	Control signal for gate driver.	【Note 2-1】
6	VR	i	Switching signal of scanning direction for gate driver.	【Note 2-2】
7	SPS	i	Start signal for gate driver.	
8	CLS	i	Clock signal for gate driver.	
9	VCC	i	Power supply for logic circuit in gate driver.	
10	OPEN	—	Open	
11	OPEN	—	Open	
12	VSS	i	Power supply for logic circuit in gate driver(Low level).	
13	OPEN	—	Open	
14	OPEN	—	Open	
15	VGL	i	Power supply for gate driver(Low level).	
16	COM	i	Common electrode driving signal	
17	GND	i	Ground	
18	CLD	i	Clock signal for source driver.	
19	SPIO	i/o	Start signal for source driver.	
20	CTR	i	Control signal for source driver.	【Note2-3】
21	PS	i	Control signal for source driver.	【Note2-4】
22	HR	i	Switching signal of scanning direction for source driver.	【Note2-2】
23	SPOI	i/o	Start signal for source driver.	
24	GND	i	Ground	
25	VA(B)	i	Color video signal (Blue)	
26	VB(G)	i	Color video signal (Green)	
27	VC(R)	i	Color video signal (Red)	
28	GND	i	Ground	
29	VSHA1	i	Power supply for source driver	
30	VSHA2	i	Power supply for source driver	
31	VSHL2	i	Power supply for source driver	
32	VSHL1	i	Power supply for source driver	

【Note 2-1】 Refer to 7-7)

【Note 2-2】 Refer to 7-5)

【Note 2-3】 Refer to 7-2)

【Note 2-4】 Refer to 7-8)

Caution : The front shield case and the reverse side one are separated from the GND terminal.
Between front shield case and reverse side one, the electric continuity is not guaranteed.

5-2) Backlight fluorescent tube driving part

table 3

terminal	No.	Symbol	i/o	Function	Remarks
CNA	1	VL1A	i	Input terminal (high voltage side)	
	2	NC	—	Non connection	
	3	VL2A	i	Input terminal (low voltage side)	

(6)Absolute maximum ratings

table 4

GND＝0V

Parameter			Symbol	MIN	MAX	Unit	Note
Power supply for source driver [terminal 4-1]			VSH	-0.3	+6.0	V	Ta＝25℃
Power supply for gate driver	TFT driving circuit	High level	VGH	-0.3	+33.0	V	〃
		Low level	VGL	VSS-0.3	VSS+33.0	V	〃
	Logic circuit	High level	VCC	VSS-0.3	VSS+7.0	V	〃
		Low level	VSS	VGH-33.0	VGH+0.3	V	〃
Analog input signals [terminal 4-2]			VIA	-0.3	VSH+0.3	V	〃
Digital input signals [terminal 4-3]			VID	-0.3	VSH+0.3	V	〃
Digital output signals [terminal 4-4]			VOD	-0.3	VSH+0.3	V	〃
Common electrode driving signal			VCDC	-4	+6	V	〃
Storage temperature			Tstg.	-30	85	℃	【Note 4-1,2】
Operating temperature (panel surface)			Topr1	-30	85	℃	【Note 4-2,3,4】
Operating temperature (Ambient temperature)			Topr2	-30	65	℃	【Note 4-4,5】

[terminal 4-1] VSHA1, VSHA2, VSHL1, VSHL2,

[terminal 4-2] VA(B), VB(G), VC(R)

[terminal 4-3] MODE1, MODE2, VR, SPS, CLS, CLD, CTR, HR, PS, SPIO, SPOI

[terminal 4-4] SPIO, SPOI

【Note 4-1】 This rating applies to all parts of the module and should not be exceeded.

【Note 4-2】 Maximum wet-bulb temperature is 58℃. Condensation of dew must be avoided as electrical current leaks will occur, causing a degradation of performance specifications.

【Note 4-3】 Please measure it in the effective display range of the panel.

【Note 4-4】 The operating temperature only guarantees operation of the circuit. For contrast, speed response, and other factors related to display quality, determine operating temperature using the formula Ta=+25℃

【Note 4-5】 Ambient temperature when the backlight is lit (reference value).

(7)Electrical characteristics

7-1)Recommended operating conditions

A)TFT-LCD panel driving section

table 5

GND＝0 V, Ta＝25℃

Parameter				Symbol	MIN	TYP	MAX	Unit	Remarks
Power supply for source driver [Terminal 5 － 1]				VSH	+5.0	+5.3	+5.5	V	【Note5-1】
Power supply for gate driver	TFT driving circuit	High level		VGH	+12.5	+13.0	+13.5	V	
		Low level	AC	VGLAC	±0	±4.0	±5.0	Vp-p	【Note5-1】
			DC	VGLDC	-8.8	-9.5	-9.8	V	【Note5-1,2】
	Logic circuit	High level		VCC	-10.4	-10.9	-11.4	V	【Note5-1】
		Low level		VSS	-15.5	-16.0	-16.5	V	
Analog input signal [Terminal 5 － 2]		AC component		VIAC	∓2.0	-	±2.0	V	【Note5-3】
		DC component		VIDC	VSM-0.1	VSM	VSM+0.1	V	【Note5-4】
Digital input voltage [Terminal 5 － 3]		High level		VIDGH	VSH-1.0	-	VSH	V	
		Low level		VIDGL	0	-	1.0	V	
Digital input current [Terminal 5 － 3]		High level		IIDGH	-	-	1.0	μA	VIDGH=VSH
		Low level		IIDGL	-	-	1.0	μA	VIDGL=0V
Digital input signal [Terminal 5 － 4]		High level		VIDSH	VSH-1.0	-	VSH	V	
		Low level		VIDSL	0	-	1.0	V	
Digital input current [Terminal 5 － 5]		High level		IIDSH1	-	1.0	10	μA	VIDSH=VSH
		Low level		IIDSL1	-	1.0	10	μA	VIDSL=0V
Digital input current [Terminal 5 － 6]		High level		IIDSH2	-	3.0	60	μA	VIDSH=VSH
		Low level		IIDSL2	-	3.0	60	μA	VIDSL=0V
Digital input current [Terminal 5 － 7]		High level		IIDSH3	-	3.0	60	μA	VIDSH=VSH
		Low level		IIDSL3	-	0.2	2.4	mA	VIDSL=0V
Common electrode driving signal [Terminal 5 － 8]		AC component		VCAC	±0.5	±3.9	±5.0	Vp-p	【Note 5-3】
		DC component		VCDC	+0	+1.9	+3.0	V	【Note 5-5】

Cautionary Matter: When applying or disconnecting power, please be sure that such action is simultaneously carried out for all power supplies. In addition, apply input signals only after power has been turned on.

[terminal 5-1]VSHA1, VSHA2, VSHL1, VSHL2
[terminal 5-2]VA(B), VB(G), VC(R)
[terminal 5-3]MODE1, MODE2, VR, SPS, CLS
[terminal 5-4]SPIO, SPOI, CLD, CTR, HR, PS
[terminal 5-5]SPIO, SPOI
[terminal 5-6]CLD, CTR
[terminal 5-7]HR, PS
[terminal 5-8]COM

【Note5-1】 Any change in voltage after adjusting VCDC should be less than 0.1 V.

【Note5-2】 The AC element must make it into the same amplitude in the commonness electrode drive signal and the same phase.

【Note5-3】 Positive and negative amplitudes should be equal. When the AC input voltage is －／＋, FRPV and T are in phase. When the AC input voltage is ＋／－, FRPV and T are 180° out of phase. The MIN value produces a white display, and the MAX value produces a black display.

【Note5-4】 VSM=VSH/2.
Any change in voltage after adjusting VCDC should be less than 0.1 V.

【Note5-5】 To obtain the maximum value of contrast, each module must be adjusted to an optimum voltage.

B)Backlight driving section

table 6

Parameter	Symbol	MIN	TYP	MAX	Unit	Remarks
lamp voltage	VL7	840	930	1020	Vrms	IL=6.0mArms
lamp current	IL	4.0	6.0	7.0	mArms	ordinary state
	ILB	-	-	9.0	mArms	within 5 minutes at low temperature
lamp frequency	fL	35	-	70	kHz	
kick-off voltage	VS	-	-	2280	Vrms	Ta=+0℃
【Note6-1】		-	-	2300	Vrms	Ta=-30℃

(Inverter：HIU－766(11pF) f=52kHz Harison Electric co. Ltd.)

Cautionary Matter: Please use the inverter which has the one of the sine wave. With regards to the inverter, it should be negative/positive wave symmetry and the spike wave should not be occurred.

【Note 6-1】 When the metallic shielding cases of the module is connected to the ground pattern of the inverter circuit surely.

7-2)CTR terminal

This is control signal of switching sample holder circuit. Please set the high or low level synchronizing with SPD signal during the period each horizontal line.

※ High level = VSH, Low level = GND

7-3)Electrical characteristics

table7 V_{SH}=5.3V, GND=0V, Ta=25℃

Parameter		Symbol	MIN	TYP	MAX	Unit	Remarks	Note
SOURCE	Operating Clock frequency	f_{CK}	-	-	7.0	MHz	CLD	
	High level clock width	t_{WHC}	50.0	-	-	ns		
	Low level clock width	t_{WLC}	50.0	-	-	ns		
	Clock rise time	t_{RC}	-	-	10.0	ns	CLD,SPIO, SPOI	
	Clock fall time	t_{FC}	-	-	10.0	ns		
	High level pulse width	t_{WSP}	1/f_{CK}	-	-	ns	SPIO,SPOI	
	Data set up time	t_{SUSP}	10.0	-	-	ns	CLD,SPIO, SPOI	
	Data hold time	t_{HSP}	15.0	-	-	ns		
	PS signal set up time	t_{SUSPS}	1/2 f_{CK}	-	-	ns	PS	
	CTR signal set up time	t_{SUCTR}	1/2 f_{CK}	-	-	ns	CTR	
GATE	Operating Clock frequency	f_{CL}	-	-	80.0	kHz	CLS	
	Minimum clock pulse with	t_{WL}	0.5	-	-	μs		
	Clock rise time	t_{rCL}	-	-	100.0	ns		
	Clock fall time	t_{fCL}	-	-	100.0	ns		
	Data set up time	t_{SU}	100.0	-	-	ns	CLS,SPS	
	Data hold time	t_{H}	300.0	-	-	ns		
	Mode set up time	t_{SUM}	300.0	-	-	ns	CLS,MODE1 MODE2	
	Pulse rise time	t_{rSP}	-	-	100	ns	SPS	
	Pulse fall time	t_{fSP}	-	-	100	ns		

7-4)Input signal timing chart

Refer FIG.4

7-5)Signal for reverse scanning

table 8

Mode	HR	VR
Normal mode	Hi	Lo
Right/Left reverse mode	Lo	Lo
Up/Down reverse mode	Hi	Hi
Right/Left & Up/Down reverse mode	Lo	Hi

caution) Lo=GND , Hi=VSH

"HR" HR switches input-output of the SPIO/SPOI terminal.

HR = Hi: SPIO: input terminal of start signal for source driver, SPOI: output terminal

HR = Lo: SPOI: input terminal of start signal for source driver, SPIO: output terminal

7-6) Current dissipations

table 9

Ta＝25℃

Parameter		Symbol	Conditions	MIN	TYP	MAX	Unit
Current for source driver	Hi	I_{SH}	V_{SH}=+5.3V	-	45	72	mA
Current for gate driver	Hi	I_{GH}	V_{GH}=+13.0V	-	0.1	1.0	mA
	Lo	I_{GL}	V_{GLDC}=-9.3V	-	0.1	1.0	mA
	Logic	I_{CC}	V_{CC}=-10.9V	-	0.1	1.0	mA
		I_{SS}	V_{SS}=-16.0V	-	0.2	1.0	mA
Lamp power consumption		WL	Normal driving	-	5.6	-	W

Condition : CLS=31kHz, SPS=60Hz, SPD=63.5 μ s, CLD=7.0MHz(Duty=50%), CTR=127.0 μ s

MODE1=MODE2=Hi

In case of using standard control circuit and selecting Normal mode.

7-7)Control terminal [MODE1, MODE2] (for gate driver)

They are the terminal switching output mode of gate driver. They must be fixed Hi level at the normal mode. Please switch high and low as Fig.4-B in case of stringed vertical direction of the picture.

table 10

MODE1	MODE2	Outputting mode
Hi	Hi	Normal mode (1 line writing)
Lo	Hi	2 line same time writing mode
Hi	Lo	Testing mode
Lo	Lo	Testing mode

Caution) Lo=GND , Hi=VSH

7-8)Control terminal [PS] (for source driver)

It is the setting up terminal of power saving. High: Normal operation, Low: It makes power saving at the same time cuts off a driver IC unofficial decision electric current source if it makes a sauce driver liquid crystal drive output terminal into a high impedance state. At the time of using please pay attention the rush electric currents.

Please use still "High" normally.

(8)Optical characteristics

Table 11 Ta=25℃

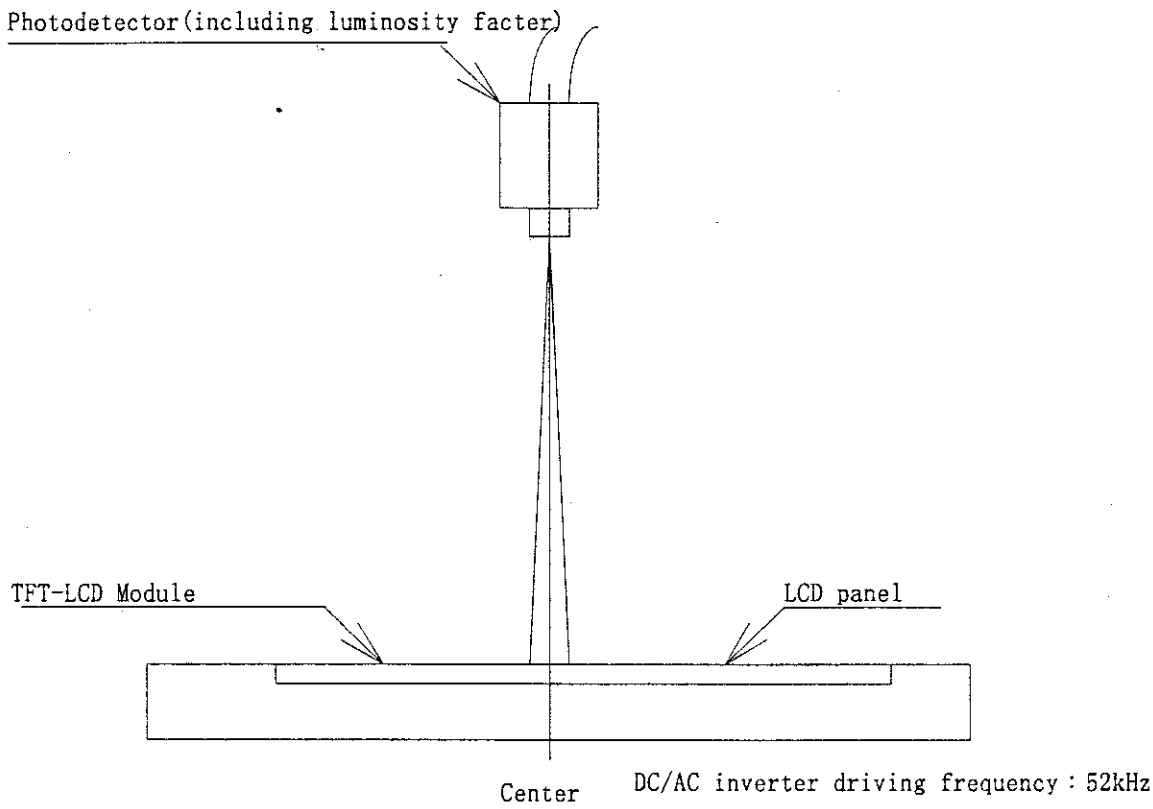
Parameter		Symbol	Condition	Min	Typ	Max	Unit	Remarks
Viewing angle range		△θ11	CR≧5	60	65	-	° (degree)	【Note 11-1,2,3】
		△θ12		50	55	-	° (degree)	
		△θ2		60	65	-	° (degree)	
Contrast ratio		CRmax	Optimal	60	-	-		【Note 11-2,3】
Response time	Rise	τr	θ＝0°	-	30	60	ms	【Note 11-2,4】
	Fall	τd		-	50	100	ms	
Luminance		Y	IL=6.0mArms	320	400	-	cd/m²	【Note 11-5】
White chromaticity		x	IL=6.0mArms	0.263	0.313	0.363		【Note 11-5】
		y	IL=6.0mArms	0.279	0.329	0.379		
lamp life time	+25℃	-	continuation	10,000	-	-	hour	【Note 11-6】
	-30℃	-	intermission	2,000	-	-	time	【Note 11-7】

DC/AC inverter for external connection shown in following.

Harison Co.: HIU-766(11pF) 52kHz

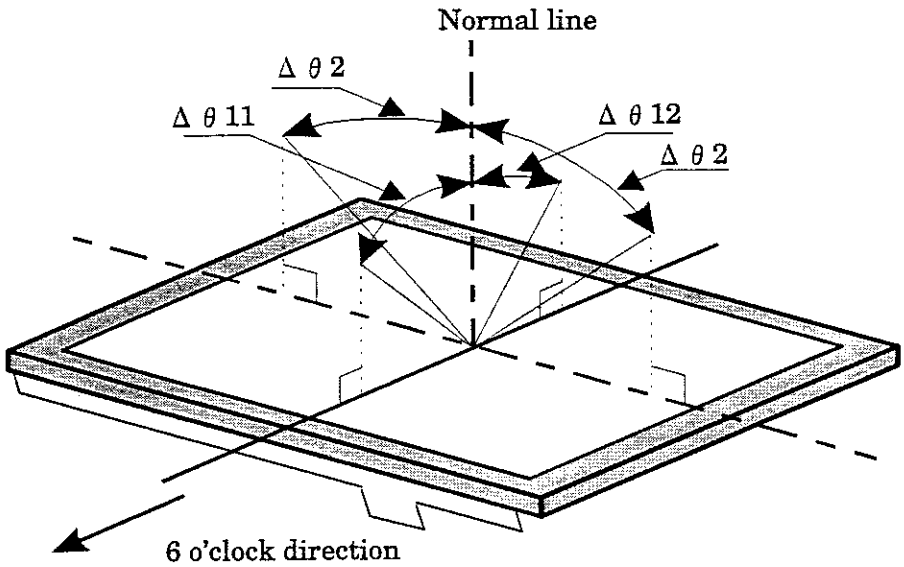
※measuring after 30minutes

※Please make sure enough with an actual model for unevenness arises in luminance, at the reason of installation states of the module, the leading line of taking around for the lamp and matching with the inverter.



mesuring method for optical characteristics

【Note 11-1】 Viewing angle range is defined as follows.



definition for viewing angle

【Note 11-2】 Applied voltage condition:

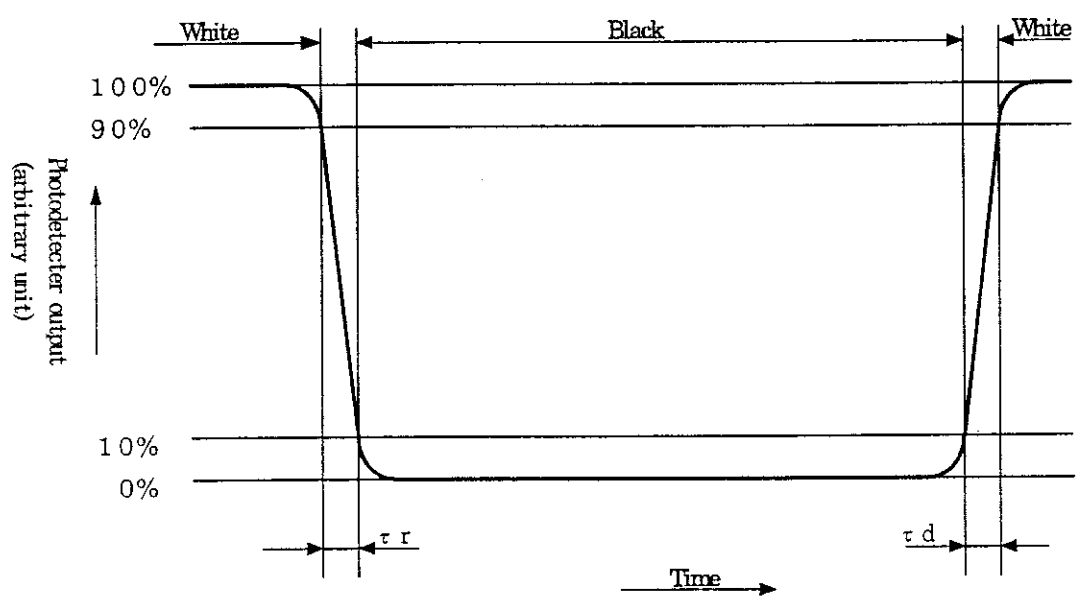
(1) VCDC is adjusted so as to attain maximum contrast ratio.

(2) Input ±1.90V at VIAC.
When VI50= transmission is 50% at Voltage-Transmission curve,
Black level : Vi50=±2.5V, White level :Vi50 = ∓ 1.5V

【Note 11-3】 Contrast ratio is defined as follows:

$$\text{Contrast ratio(CR)} = \frac{\text{Photo detector output with LCD being "white"}}{\text{Photo detector output with LCD being "black"}}$$

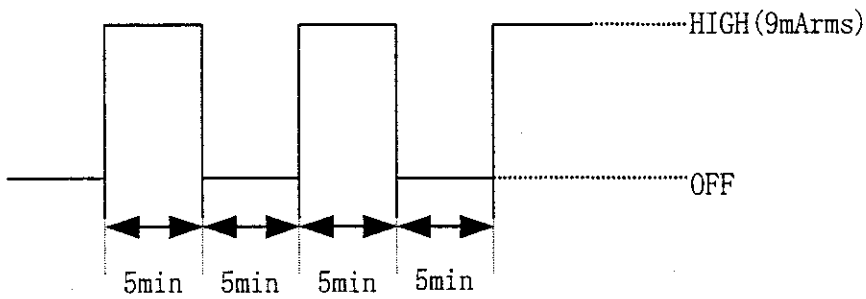
【Note 11-4】 Response time is obtained by measuring the transition time of photo detector output, when input signals are applied so as to make the area "black" to and from "white".



【Note 11-5】 Measured on the center area of the panel at a viewing cone 1° by TOPCON luminance meter BM-7.(After 30 minutes operation)
DC/AC inverter driving frequency:52kHz

【Note 11-6】 Lamp life time is defined as the time when either or occurs in the continuous operation under the condition of lamp current IL=4~7mArms and PWM dimming 100%~5% (Ta=25℃)
Brightness not to become under 50% of the original value.

【Note 11-7】 The intermittent cycles is defined as a time when brightness not to become under 50% of the original value under the condition of following cycle.
Ambient temperature:-30℃



(9)Mechanical characteristics

9-1) External appearance
Do not exist extreme defects. (See Fig. 1)

9-2) Panel toughness
The panel shall not be broken, when 19N is pressed on the center of the panel by a smooth sphere having 15 mm diameter.
Caution: In spite of very soft toughness, if, in the long-term, add pressure on the active area, it is possible to occur the functional damage.

9-3) I/O connector performance
A)Input/output connectors for the operation of LCD module
1)Applicable FPC : FCI:SFV32R-1STE3
2)FPC flexibility : Slit on the film cover lay
If it had been tested bending under radius 0.6 mmR and bending angle 90 degrees condition, the FPC should not be cut at 30 times in or less.

B)I/O connector of backlight driving circuit 【JST】

Symbol	Used Connector	Corresponding connector
CNA	BHR-02(8.0)VS-1N	SM02(8.0)B-BHS-TB (assembled on PWB)
		SM02(8.0)B-BHS-IN (assembled on PWB)
		BHMR-03V (interconnecter)

(10) Display quality

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

(11) Handling instructions

11-1) Mounting of module

The TFT-LCD module is be sure to fix the module on the same plane, taking care not to wrap or twist the module.
Don't reach the pressure of touch-switches of the set side to a module directly, because images may be disturbed.
Please power off the module when you connect the input/output connector.
Please connect the metallic shielding cases of the module and the ground pattern of the inverter circuit surely. If that connection is not perfect, there may be a possibility that the following problems happen.

a). The noise from the backlight unit will increase.
b). The output from inverter circuit will be unstable. Then, there may be a possibility that some problems happen.
c). In some cases, a part of module will heat.

11-2) Precautions in mounting

Polarizer which is made of soft material and susceptible to flaw must be handled carefully

Method of removing dust from polarizer

- Blow off dust with N2 blower for which static electricity preventive measure has been taken.
  Ionized air gun (Hugle Electronics Co.) is recommended.
- Since polarizer is vulnerable, wiping should be avoided.
  But when the panel has stain or grease, we recommend to use adhesive tape to softly remove them from the panel.
- When metal part of the TFT-LCD module (shielding lid and rear case) is soiled, wipe it with soft dry cloth. For stubborn dirt's, wipe the part, breathing on it.
- Wipe off water drops or finger grease immediately. Long contact with water may cause discoloration or spots.
- TFT-LCD module uses glass which breaks or cracks easily if dropped or bumped on hard surface. Handle with care.
- Since CMOS LSI is used in this module, take care of static electricity and earth your body when handling.

11-3) Caution of product design

The LCD module shall be protected against water salt-water by the waterproof cover.
Please take measures to interferential radiation from module, to do not interfere surrounding appliances.

11-4) Others

① Do not expose the module to direct sunlight or intensive ultraviolet rays for many hours; liquid crystal is deteriorated by ultraviolet rays.
② Store the module at a temperature near the room temperature. At lower than the rated storage temperature, liquid crystal solidifies, causing the panel to be damaged. At higher than the rated storage temperature, liquid crystal turns into isotropic liquid and may not recover.
③ The voltage of beginning electric discharge may over the normal voltage because of leakage current from approach conductor by to draw lump read lead line around.
④ If LCD panel breaks, there may be a possibility that the liquid crystal escapes from the panel. Since the liquid crystal is injurious, do not put it into the eyes or mouth. When liquid crystal sticks to hands, feet or clothes, wash it out immediately with soap.
⑤ Observe all other precautionary requirements in handling general electronic components.

(12) Shipping form

12－1)Packing form (Refer Fig.3)

12－2) Carton keeping conditions

①The cartons can be piled up maximum 7 layers.

②Environments

Temperature	:	０～４０℃
Humidity	:	６０%ＲＨ or less (at ４０℃)
		No dew condensation at low temperature and high humidity.
Atmosphere	:	Harmful gas such as acid or alkaline that bites electronic components and/or wires, must not be detected.
Periods	:	About 3 months
Opening of the package		: In order to prevent the LCD module from breakdown by electrostatic charges, please control the humidity over 50%RH and open the package taking sufficient countermeasures against electrostatic charges, such as earth, etc..

(13) Reliability test

table 12

Remark) Temperature condition is based on operating temperature conditions No. (6) – table4.

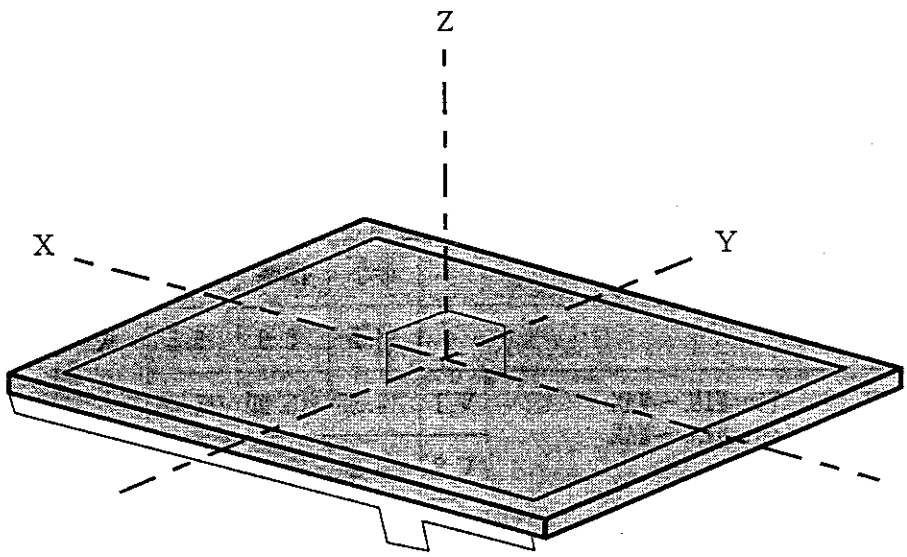
No.	Test items	Test condition
1	High temperature strong test	Ta = +85℃ 240h
2	Low temperature strong test	Ta = -30℃ 240h
3	High temperature and high humidity operation test	Ta = +60℃, 90%RH 240h
4	High temperature operating test	Tp = +85℃ 240h
5	Low temperature operating test	Ta = -30℃ 240h
6	Electro static discharge test	±200V・200pF (0Ω) 1 time for each terminals
7	Shock test	980m/s²・6ms, ±X；±Y；±Z 3 times for each direction (JIS C0041, A-7 Condition C)
8	Vibration test	Frequency range :8～33.3Hz Stroke : 1.3mm Sweep : 33.3Hz～400Hz Acceleration : 28.4m/s² Cycle : 15 minutes X, Z 2 hours for each directions, 4 hours for Y direction (total 8 hours) 【caution】(JIS D1601)
9	Heat shook test	-30℃ ～ 85℃ / 200 cycles (0.5h) (0.5h)

【Note】 Ta = Ambient temperature, Tp = Panel temperature

【Check items】 In the standard condition, there shall be no practical problems that may affect the display function.

【It is the goal specification with a mass production article, and there also is an item which you are not satisfied of this condition in a prototype level.】

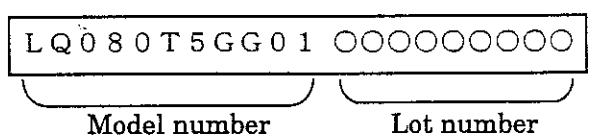
【caution】 X, Y, Z direction are shown as follow



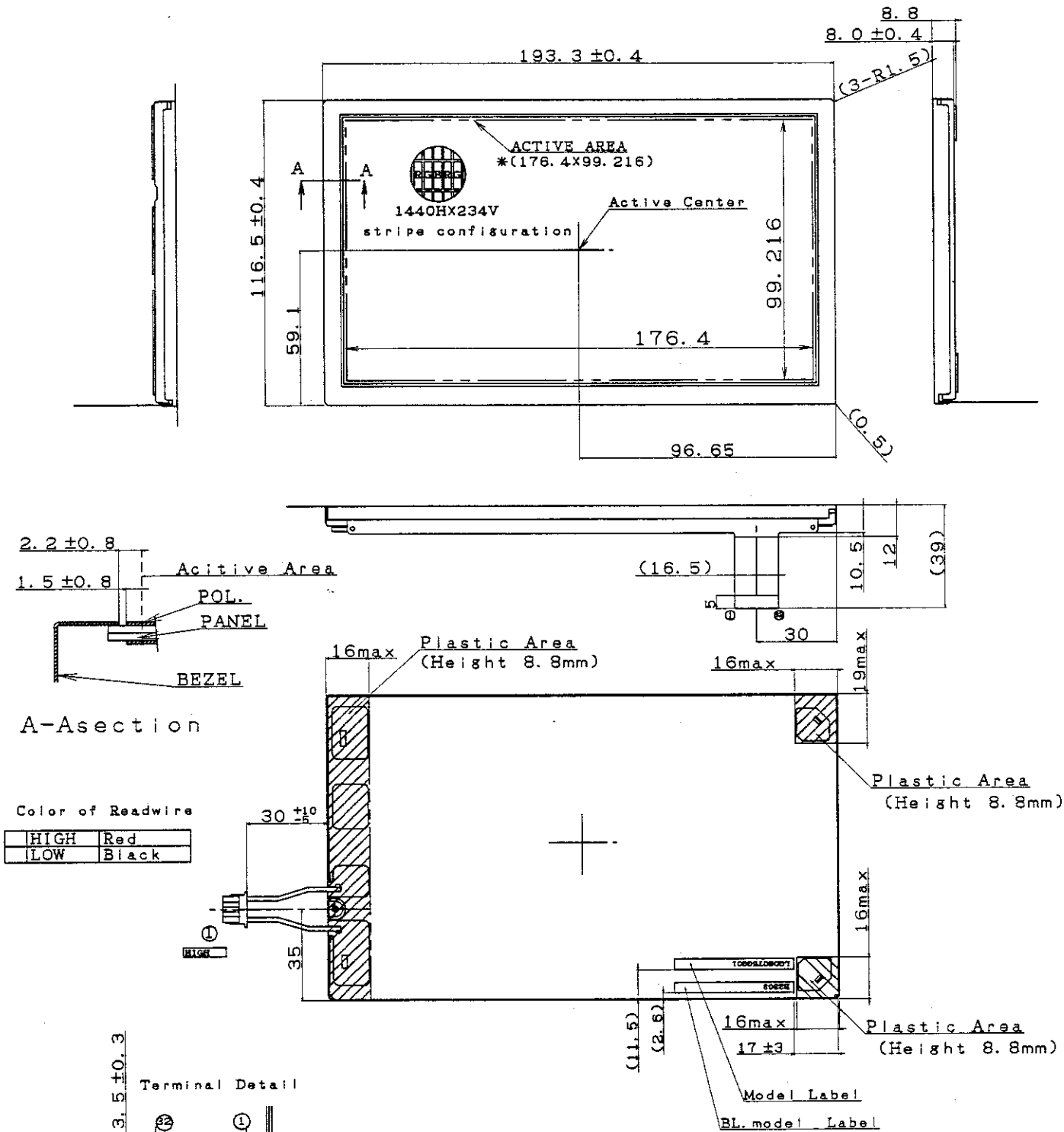
(14) Indication of lot number label

①Attached location of the label : See Fig. 1

②Indicated contents of the label



Contents of lot number	: 1st	･･ year 2000⇒0
	: 2nd	･･ Production month 1,2,3,･･･9,X,Y,Z
	: 3rd～7th	･･ Serial numbers 00001～
	: 8th	･･ identification mark blank,A,B,C etc
	: 9th	･･ Production factory code



NOTES

1. UNSPECIFIED TOLERANCE TO BE ±0.5
2. WARP AND FLATING FOR BEZEL AND REARCASE ETC. ARE EXCLUDED FROM THICKNESS AND DIMENSION OF THE UNIT.

OUTLINE DIMENSIONS

LQ080T5GG01

Unit:mm

Fig.1 Outline Dimensions

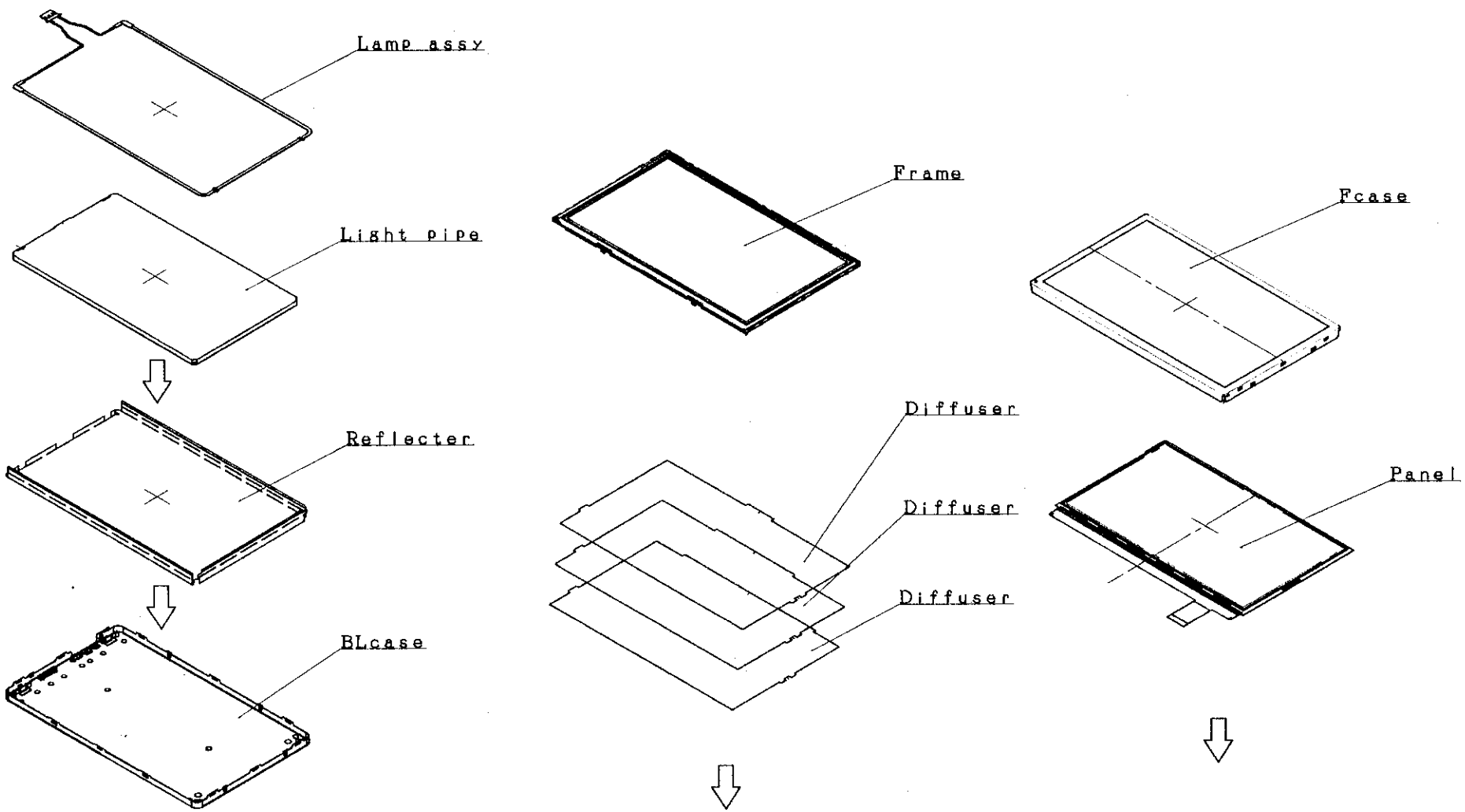


Fig.2 Structure Of the Module

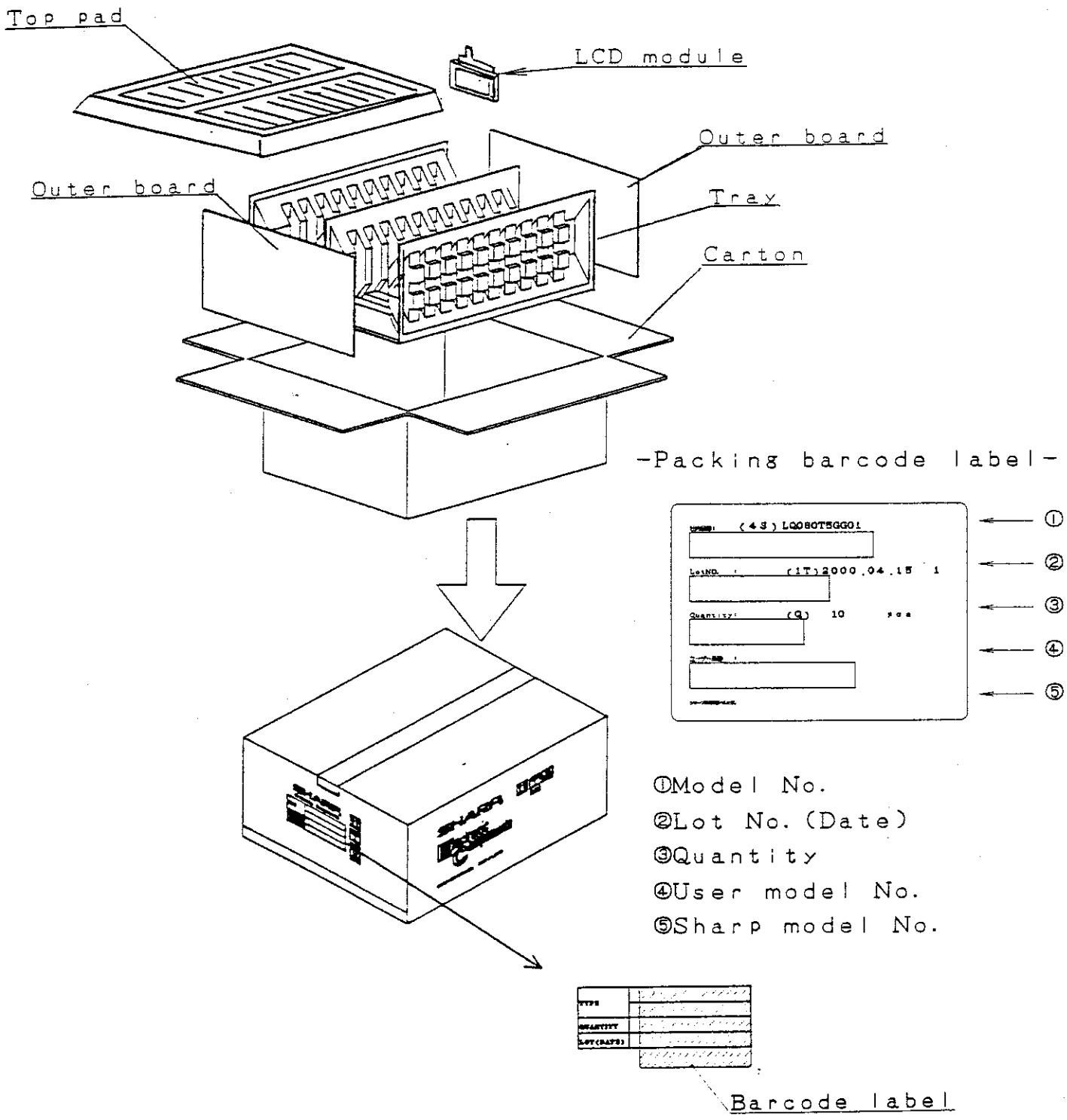


Fig.3 Packing Form

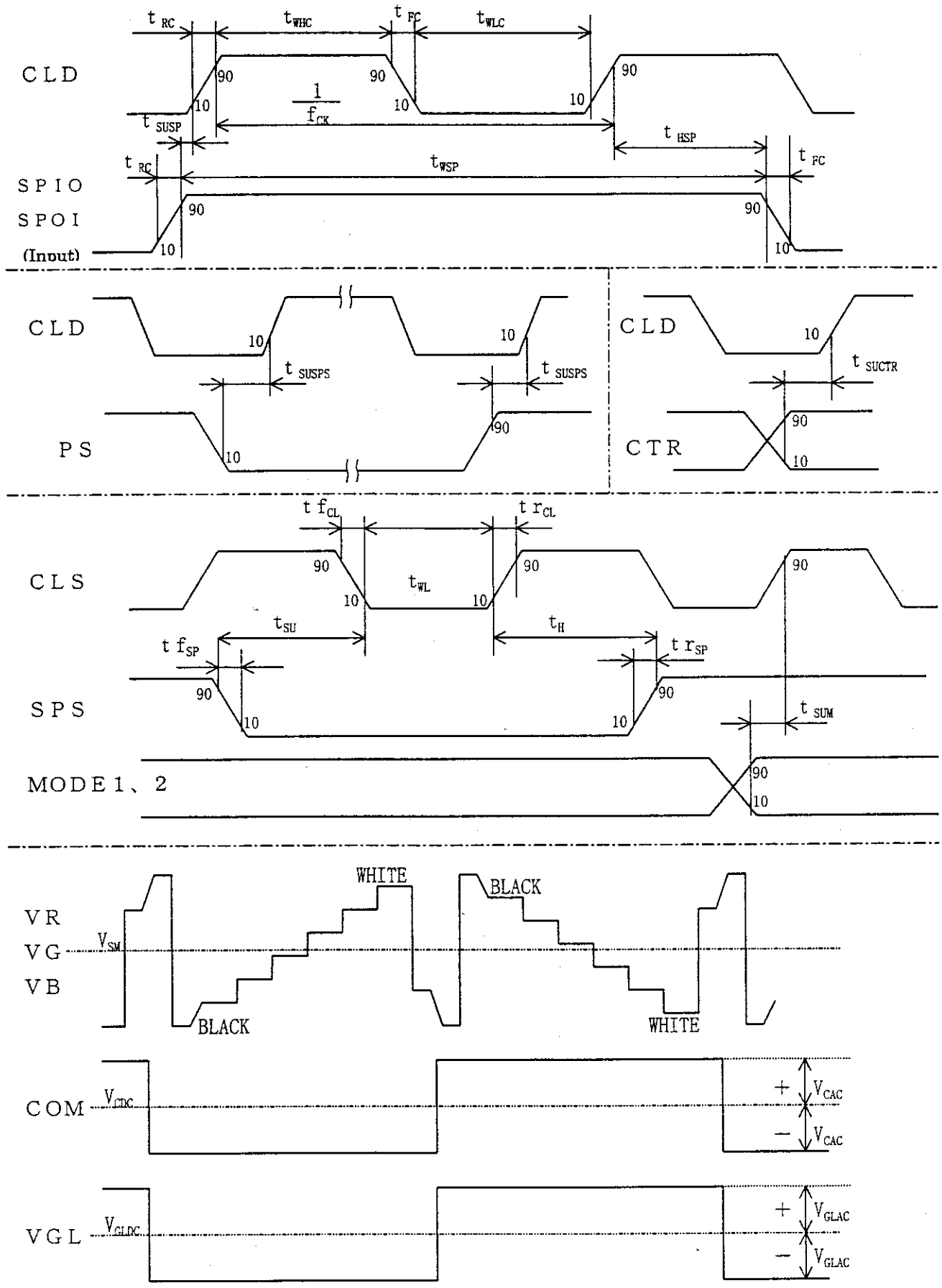


Fig.4-A Input signal timing chart

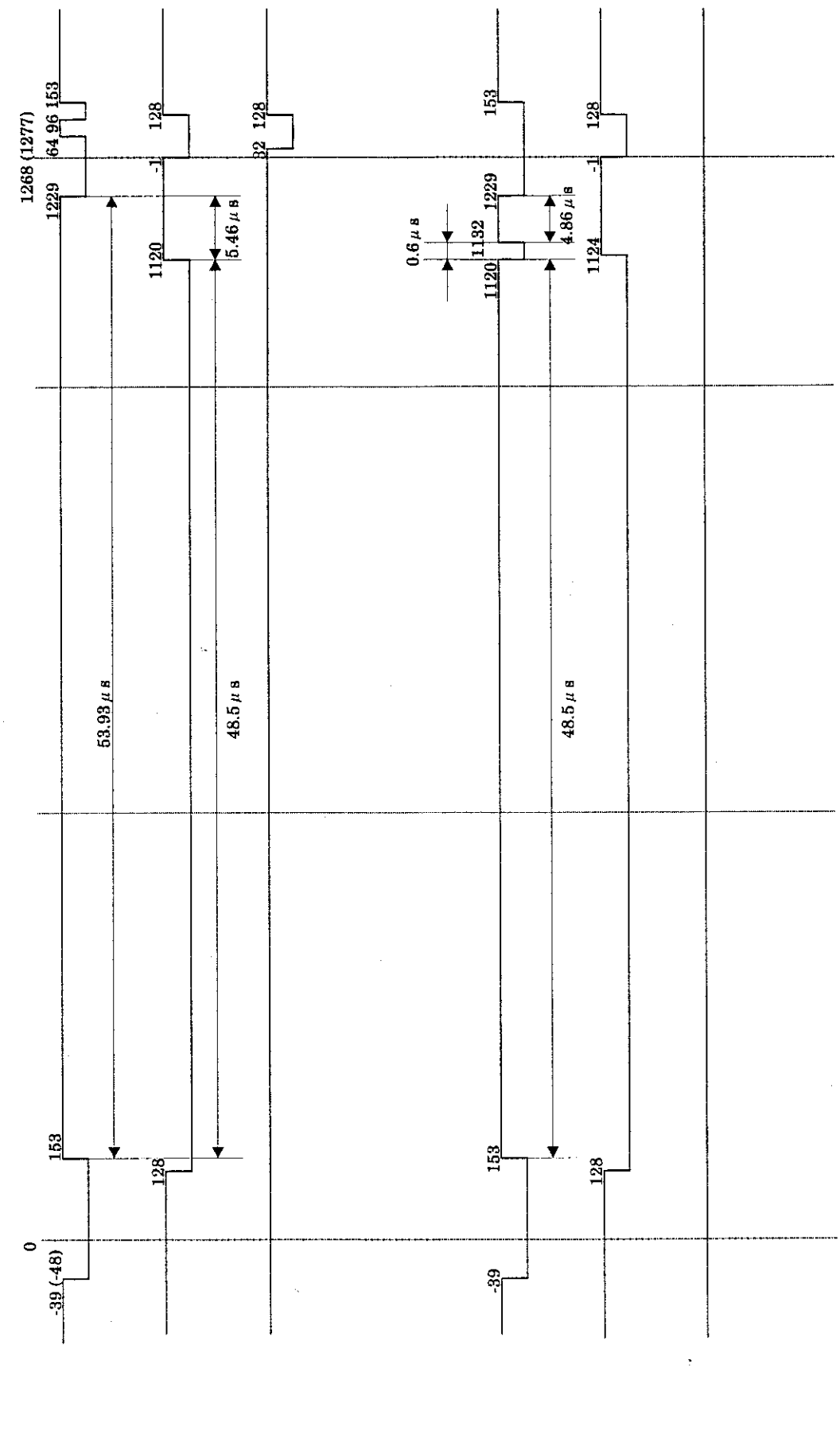
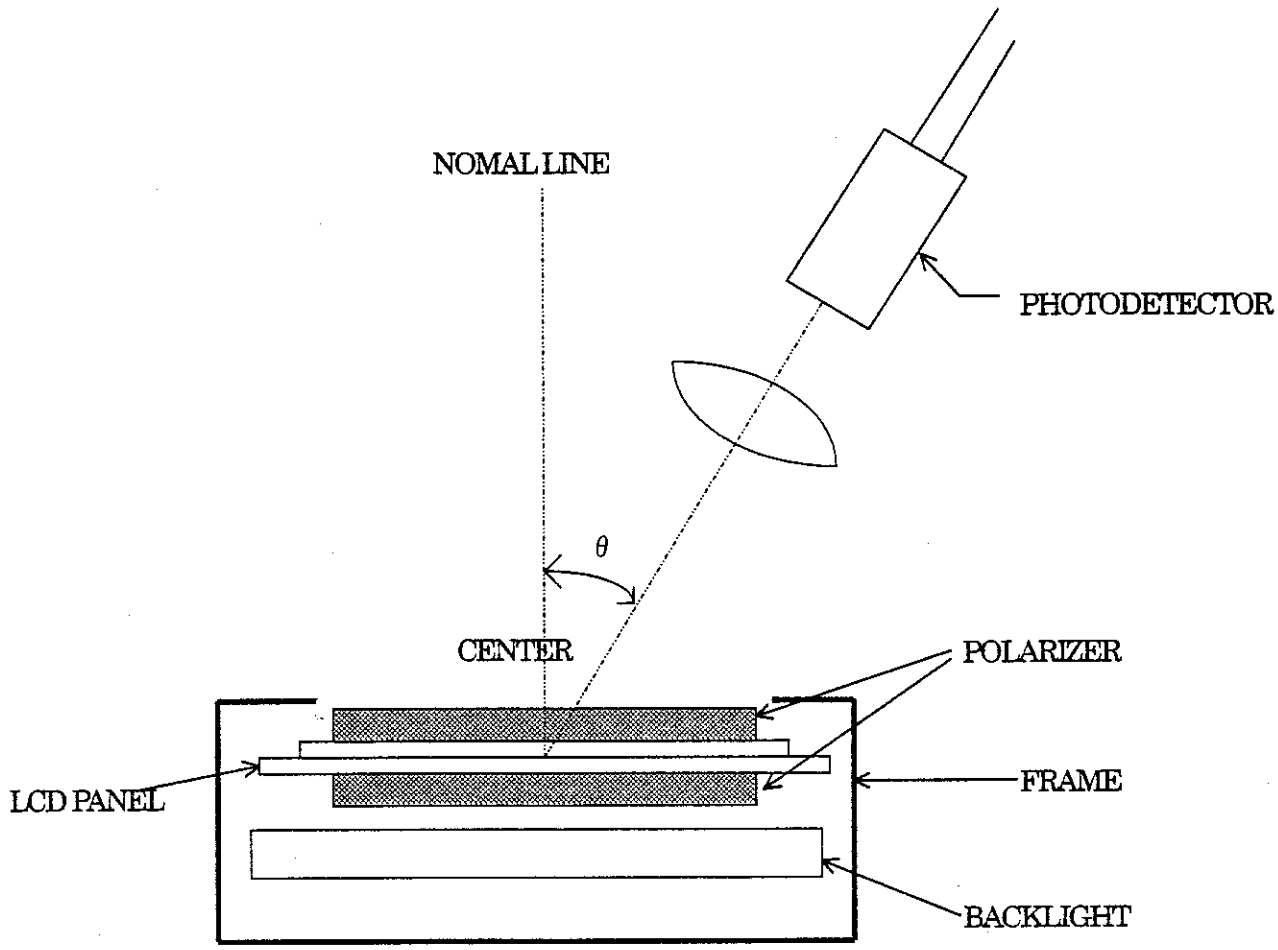


Fig.4-B Input signal timing chart (In case of vertical picture stretched)



＊Backlight lighting condition

Inver driving frequencies :
52kHz

Fig.5. Optical characteristics measurement method

(Appendix)

Adjusting method of optimum common electrode DC bias voltage

To obtain optimum DC bias voltage of common electrode driving signal (VCDC), photoelectric devices are very effective, and the accuracy is with 0.1V. (In visual examination method, the accuracy is about 0.5V because of the difference among individuals.)
To gain optimum common electrode DC bias, there is the method that uses photoelectric devices.

Measurement of flicker

DC bias voltage is adjusted so as to minimize NTSC : 60Hz(30Hz) / PAL : 50Hz(25Hz) flicker.

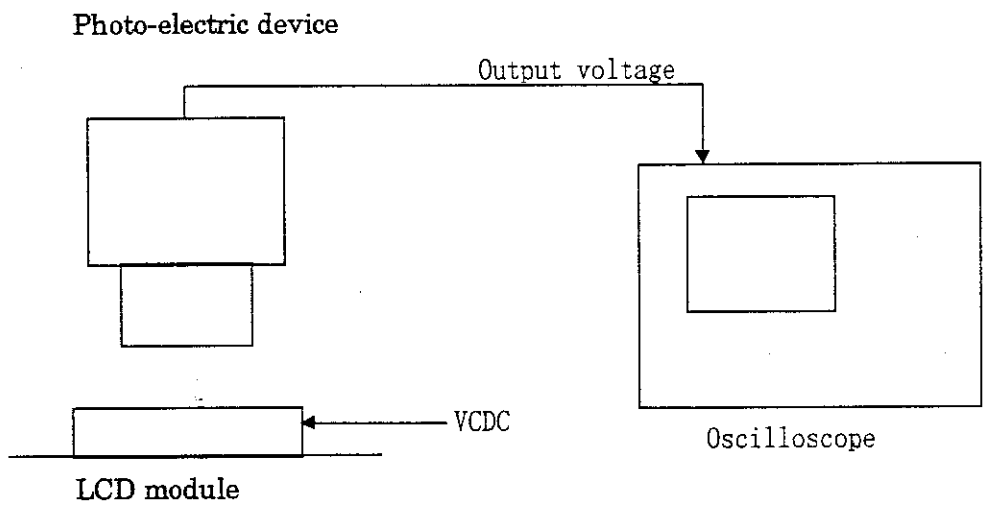
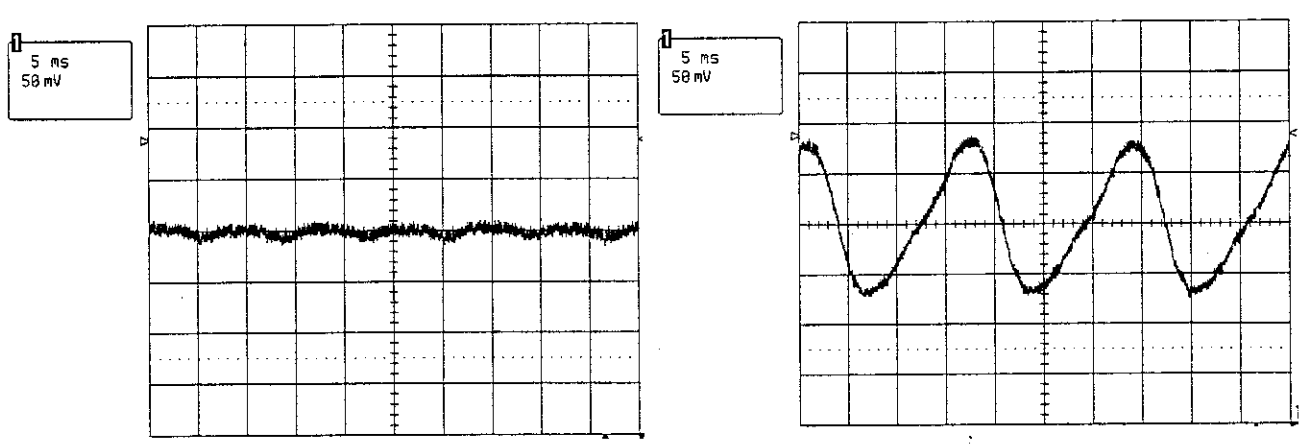


Fig. A Measurement system

《Measurement of flicker》

Photoelectric output voltage is measured by an oscilloscope at a system show in Fig. A.
DC bias voltage must be adjusted so as to minimize the NTSC : 60Hz (30Hz) / PAL : 50Hz (25Hz) flicker with DC bias voltage changing slowly. (Fig.B)



DC bias : Optimum　　DC bias : Optimum + 1

Fig. B Waveforms of flicker

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