ACX502BMU-7

Transflective 3.5 Type Polysilicon TFT LCD with Backlight

Revision Record

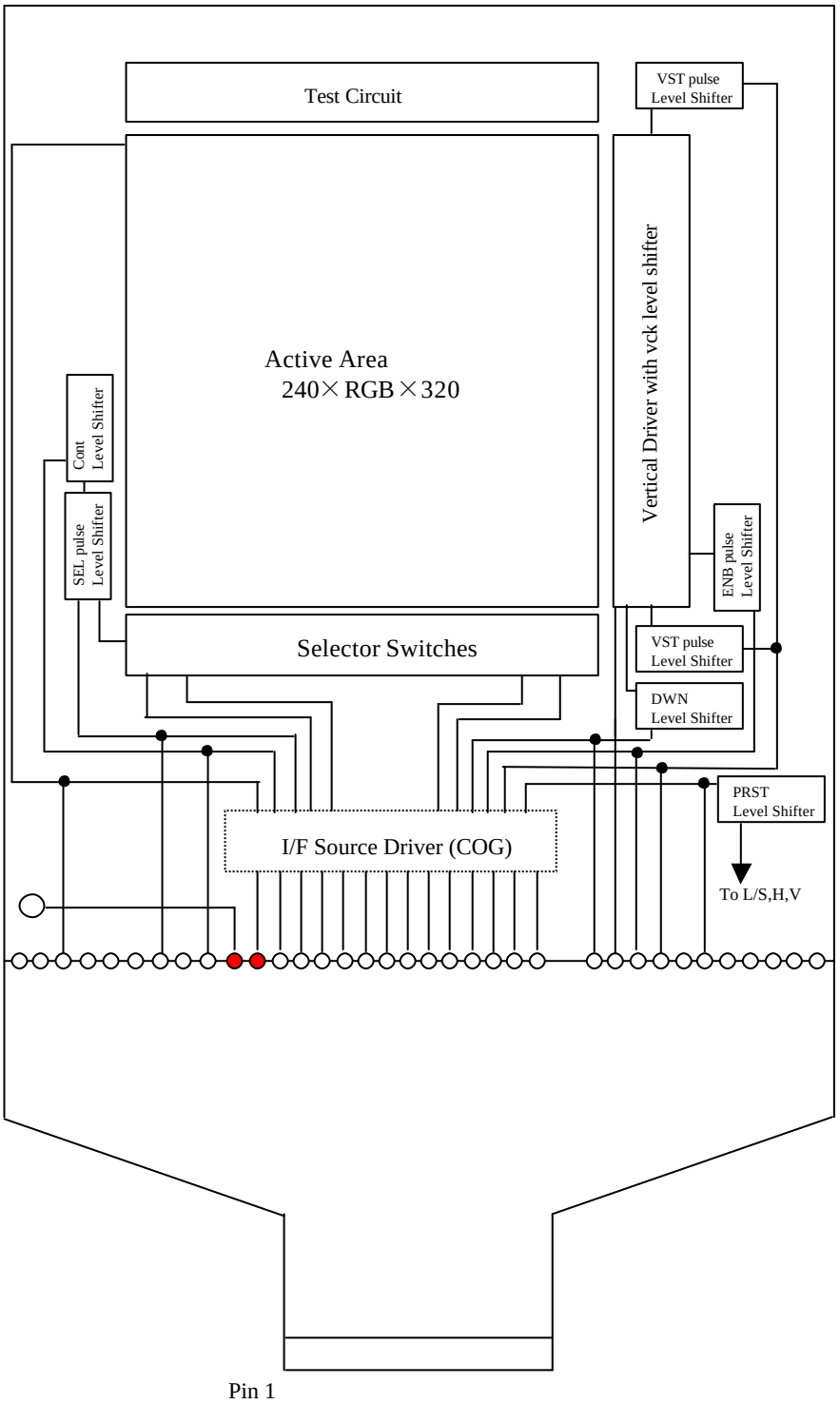
Tentative Ver 0.0	19-Dec-02	Tentative Release
Tentative Ver 1.0	8-Jan-03	VDD2 Specification,Backlight
		specification
Tentative Ver 2.0	9-Jan-03	Discruption of Function
		Delete HSYNC and VSYNC
Tentative Ver 3.0	21-Jan-03	Defect Limitation
		Pin Description
		Leak Current of Logic Defined
		Uniformity revised
Tentative Ver 4.0	3-Mar-03	Color Specification(p25)
Tentative Ver 5.0		VVSS2 revised
Tentative Ver.6.0	31-Mar-03	Optical Spec revised
Tentative Ver.7.0	4-Apr-03	Defect & LED spec. revised(p14,26~28)
Tentative Ver.8.0	28-Apr-03	Reliability test condition
Tentative Ver.9	30-Apr-03	Vcom center added
Final Ver.1	12-May-03	White spec revised
		Noise spec

Front Page

See Other File

1. Block Diagram

The panel block diagram is as shown below.

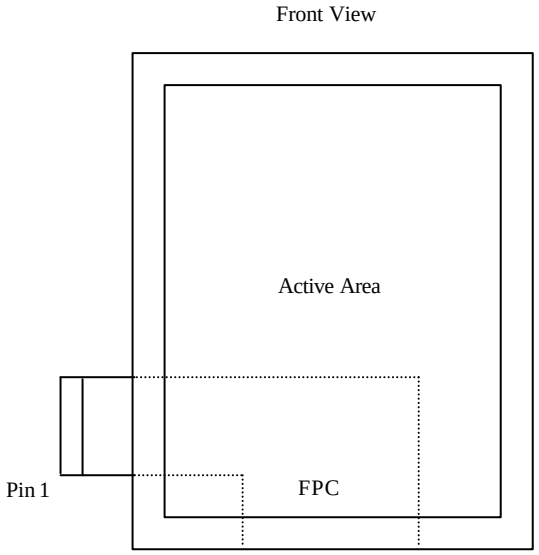


2. Absolute Maximum Ratings (VSS=0V)

•H driver power supply voltage	HVDD	-1.0 to +10.5 V
•V driver power supply voltage	VVDD	-1.0 to +10.5 V
•H driver power supply voltage	HVSS3	-7.5 to +1.0 V
•V driver power supply voltage	VVSS2	-7.5 to +1.0 V
•Output voltage	VCOM-OC,VBS	-0.3 to VDD2+0.3 V
•Input voltage	DENB,MCK,PCI,RST,VCOM-IC, U/D,L/R	-0.3 to VDD1+0.3 V
•Source Driver logic supply voltage	VDD1	-0.3 to +4.6 V
•Source Driver analog supply voltage	VDD2	-0.3 to +6.0 V
•Data signal input pin voltage	R00-05,G00-05,B00-05	-0.3 to VDD1+0.3 V
•Operating Temperature	Topr	0 to 40 C
•Storage Temperature	Tstg	-20 to 60 C
•Back light current(@1LED)	Ibl	30 mA
•LED input voltage	LED(R+), LED(R-), LED(L+), LED(L-)	4.0 V
•T/P input voltage	yU,xR,yL,xL	7.0 V

3. Pin Location of Panel Block

The FPC pin assignment is described in the next page. The location of Pin 1 is shown below.



4. Pin Description of FPC Connector

Pin No.	Name	I/O	Function		Pin No.	Name	I/O	Function
1	GND				31	G02	I	Data Bit Input
2	yU	I	Lower electrode Y		32	G03	I	Data Bit Input
3	xR	I	Lower electrode X		33	G04	I	Data Bit Input
4	yL	I	Upper electrode Y		34	G05	I	Data Bit Input
5	xL	I	Upper electrode X		35	GND		
6	VSS		GND		36	R00	I	Data Bit Input
7	VCOM-IC	I	VCOM Signal Input for LCD Panel		37	R01	I	Data Bit Input
8	VCOM-IC	I	VCOM Signal Input for LCD Panel		38	R02	I	Data Bit Input
9	VSS		GND		39	R03	I	Data Bit Input
10	HVSS3		-3V Input (LCD Panel Power Source)		40	R04	I	Data Bit Input
11	HVDD		9V Input (LCD Panel Power Source)		41	R05	I	Data Bit Input
12	VCOM-OC	O	VCOM Signal of IC Output		42	GND		
13	VCOM-OC	O	VCOM Signal of IC Output		43	VDD1		3V Input (IC Power Source)
14	VBS	O	VBS Output		44	VSS1		GND
15	VSS2		GND		45	VSS1		GND
16	VDD2		5V Input (IC Power Source)		46	MCK	I	Master Clock Input
17	RST	I	Reset Input		47	VSS1		GND
18	NC		NC		48	DENB	I	Data Enable Signal Input
19	VSS2		GND		49	PCI	I	Power Control Input
20	VDD1		3V Input (IC Power Source)		50	TEST1	I	Connect to GND
21	VSS1		GND		51	TEST2	I	Connect to GND
22	B00	I	Data Bit Input		52	PINV	I	Up/down and right/left inversion
23	B01	I	Data Bit Input		53	VSS2		GND
24	B02	I	Data Bit Input		54	VDD2		5V Input (IC Power Source)
25	B03	I	Data Bit Input		55	PCO	O	Power Control Output
26	B04	I	Data Bit Input		56	VVDD		9V Input (LCD Panel Power Source)
27	B05	I	Data Bit Input		57	VVSS2		-6.5V Input (LCD Panel Power Source)
28	GND				58	LED(-)	I	Cathode of LED
29	G00	I	Data Bit Input		59	LED(+)	I	Anode of LED
30	G01	I	Data Bit Input		60	VVSS		GND

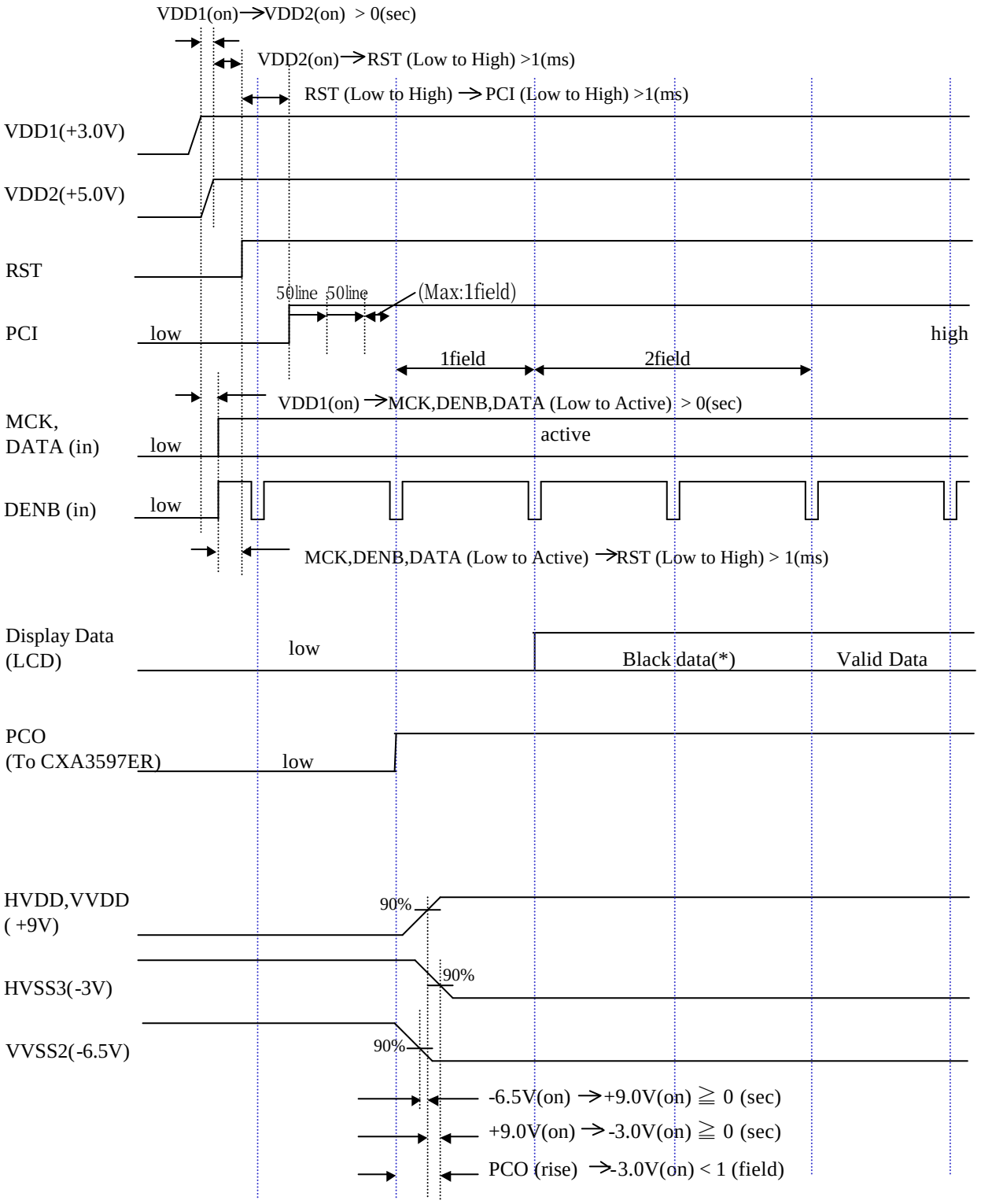
5. Operating Condition

Item	Symbol	Min.	Typ.	Max.	Unit	Pin/Remark
Power supply 1	HVDD	8.5	9.0	9.5	V	HVDD
Power supply 2	VVDD	8.5	9.0	9.5	V	VVDD
Power supply 3	HVSS3	-3.5	-3.0	-2.5	V	HVSS3
Power supply 4	VVSS2	-6.5	-6.0	-5.7	V	VVSS2
Power supply 5	VDD1	2.7	3.0	3.6	V	VDD1
Power supply 6	VDD2	4.75	5.00	5.25	V	VDD2(*1)
Ripple voltage	Vrp	—	—	100	mVpp	HVDD,VVDD,HVSS3,VVSS2, VDD1,VDD2(*2)
Data/pulse input (Low)	VIL	—	—	0.3VDD1	V	All data input pins
Data/pulse input (High)	VIH	0.7VDD1	—	—	V	
Pull Down Resister	Rpd	1M	3.8M	6.7M	Ohm	All data input pins, DENB, MCK, PINV, PCI, RST, TEST1, TEST2
Pull Up Resister	Rpu	50K	250K	500K	Ohm	RST
Common voltage center	VcomC	1.70	2.05	2.30	V	VCOM
Common voltage swing	VcomA	4.75	5.00	5.25	V	VCOM
Vertical frequency	fv	50	60	65	Hz	
Horizontal frequency	fh	16.8	20.16	21.84	kHZ	
CLK frequency	fdot	4.57	5.48	5.94	MHz	MCK
CLK pulse width	tclk	168.4	182.5	218.8	nsec	MCK
CLK high pulse width	tch	20	—	—	nsec	MCK
CLK low pulse width	tcl	20	—	—	nsec	MCK
Data setup time	tds	20	—	—	nsec	DATA
Data hold time	tdh	20	—	—	nsec	DATA
DENB setup time	tdes	20	—	—	nsec	DENB
DENB hold time	tdeh	20	—	—	nsec	
PCI setup time	tpcs	20	—	—	nsec	PCI
PCI hold time	tpch	20	—	—	nsec	
Horizontal Blanking Time	HBLK	-	32	-	clk	DENB
Vertical Blanking Time	VBLK	-	16	-	line	DENB

(*1) : The gamma correction voltage is set to achieve the optimum at VDD2=5.0V.
Use the voltage at a level as close to 5.0V as possible.

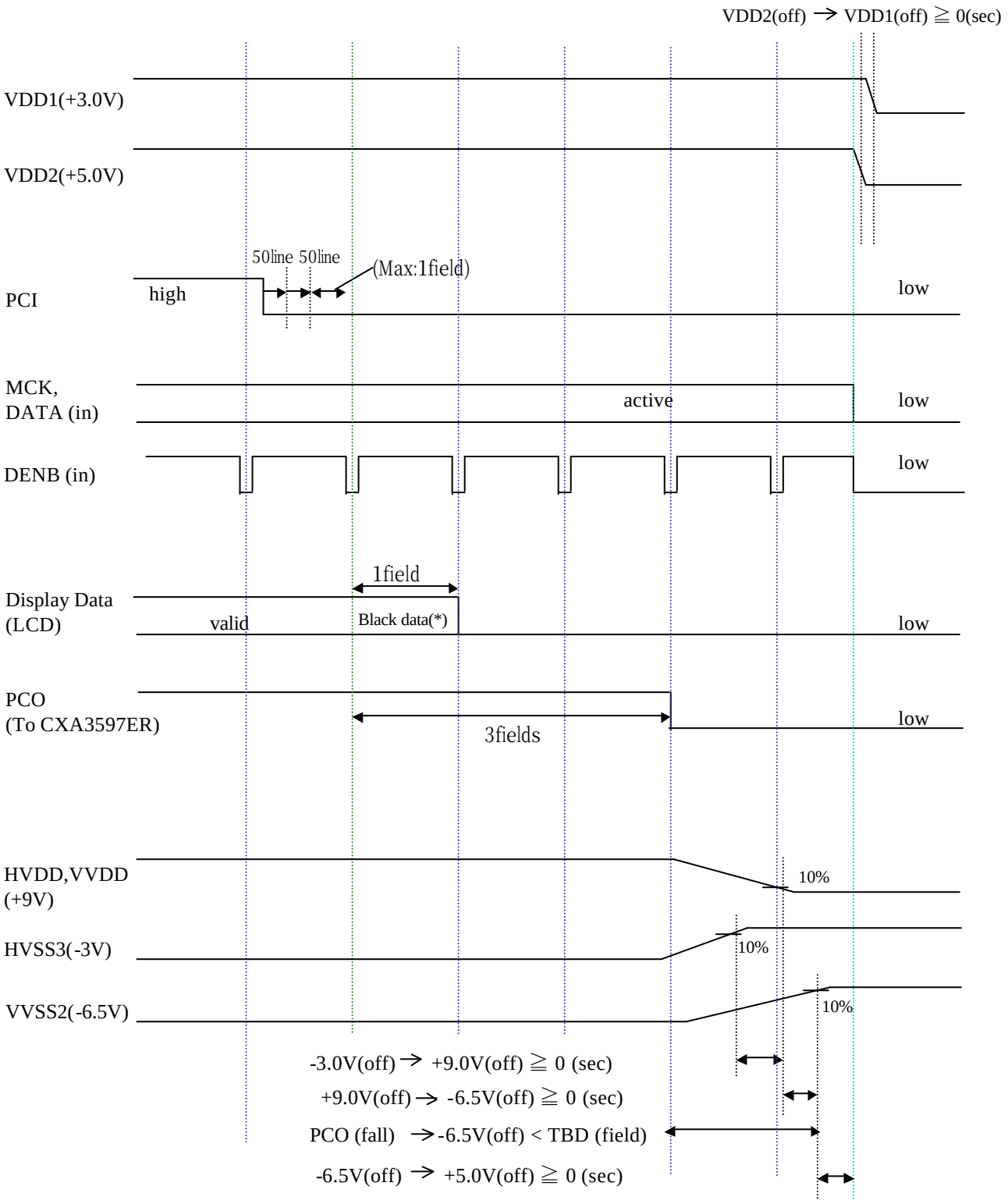
(*2) : VDD2 is analog voltage supply therefore use as less ripple as possible.

6. Power ON Sequence



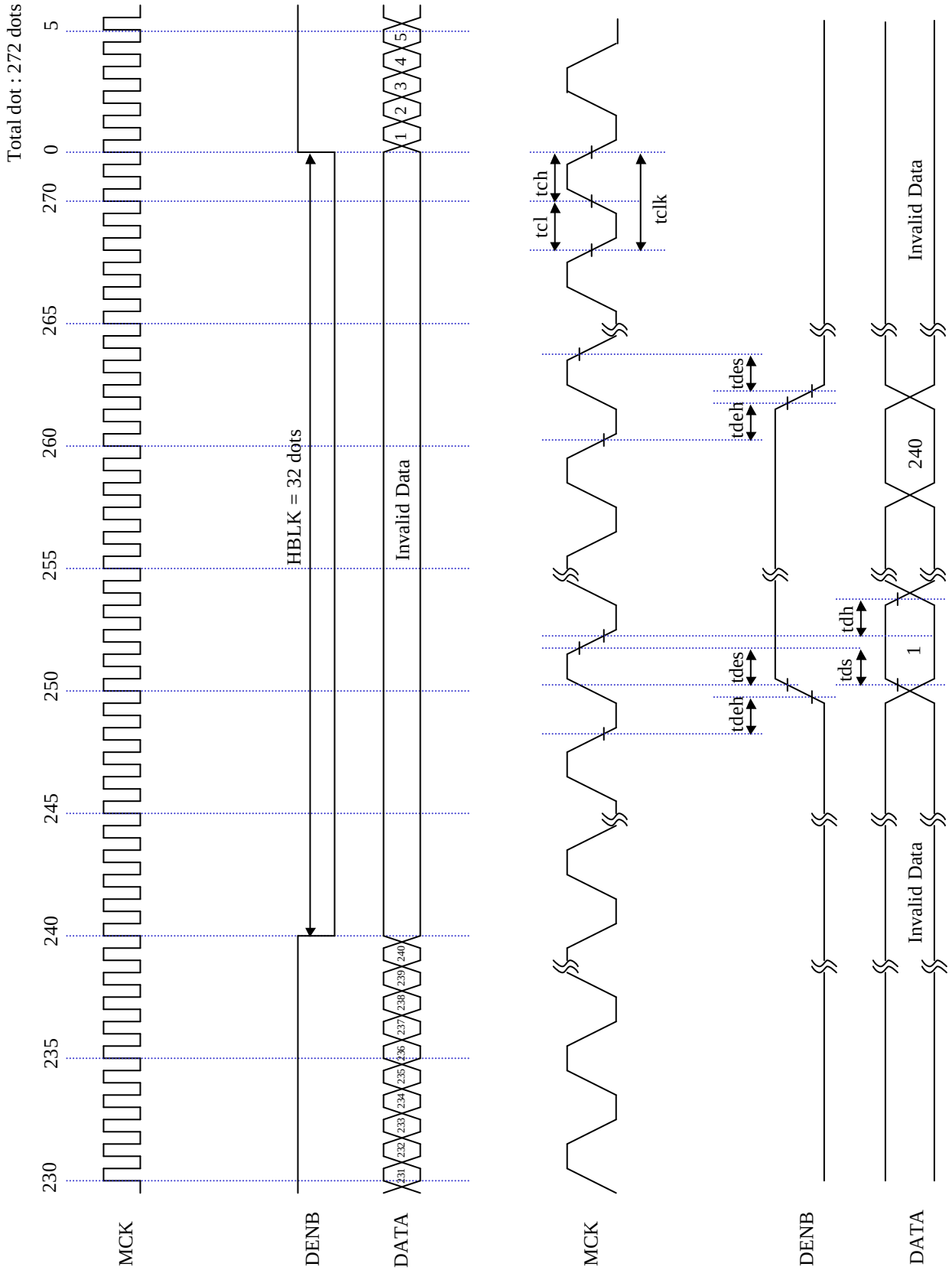
(*)Driver IC outputs black data automatically.

7. Power OFF Sequence

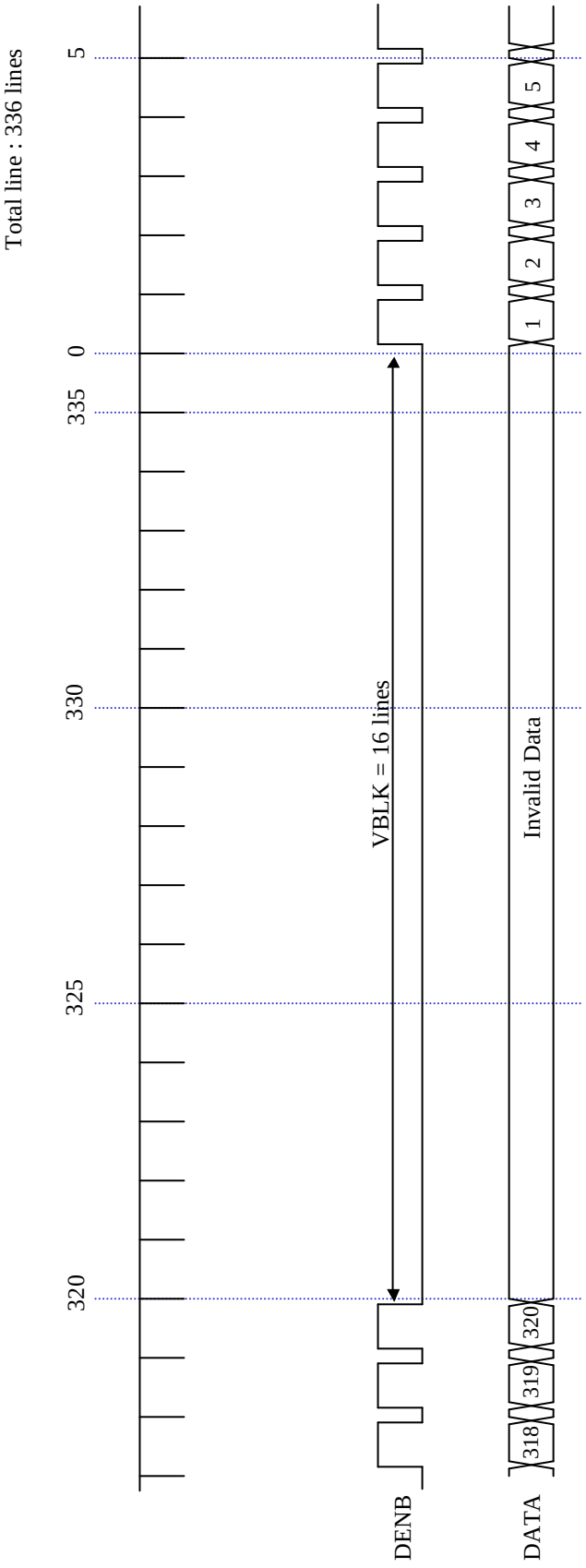


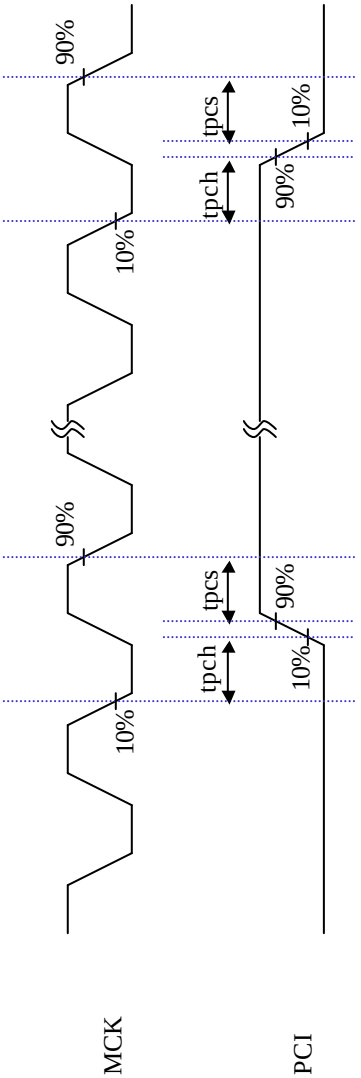
(*)Driver IC outputs black data automatically.

8. Horizontal Direction Input Signal Timing Chart



9. Vertical Direction Input Signal Timing Chart





10. Electrical Characteristics

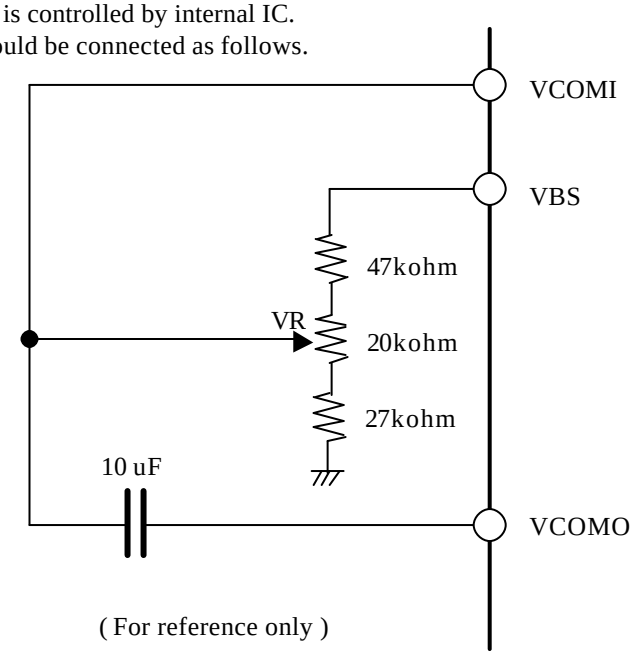
(Vertical direction 16 steps gray scale pattern)

HVDD=VVDD=9V, VSS=0V, HVSS2=-3V,VVSS2=-6.5V,VIH=3.0V, VIL=0V, Ta=25 ° C

Item	Symbol	Spec.			Unit
		Min.	Typ.	Max.	
HVDD Current consumption	IHVDD1	-	0.20	-	mA
VVDD Current consumption	IVVDD1	-	0.09	-	mA
HVSS2 Current consumption	IHVSS31	-	0.16	-	mA
VVSS2 Current consumption	IVVSS21	-	0.02	-	mA
VDD1 Current consumption	IVDD11	-	0.32	-	mA
VDD2 Current consumption	IVDD21	-	5.60	-	mA

11. Description of Function

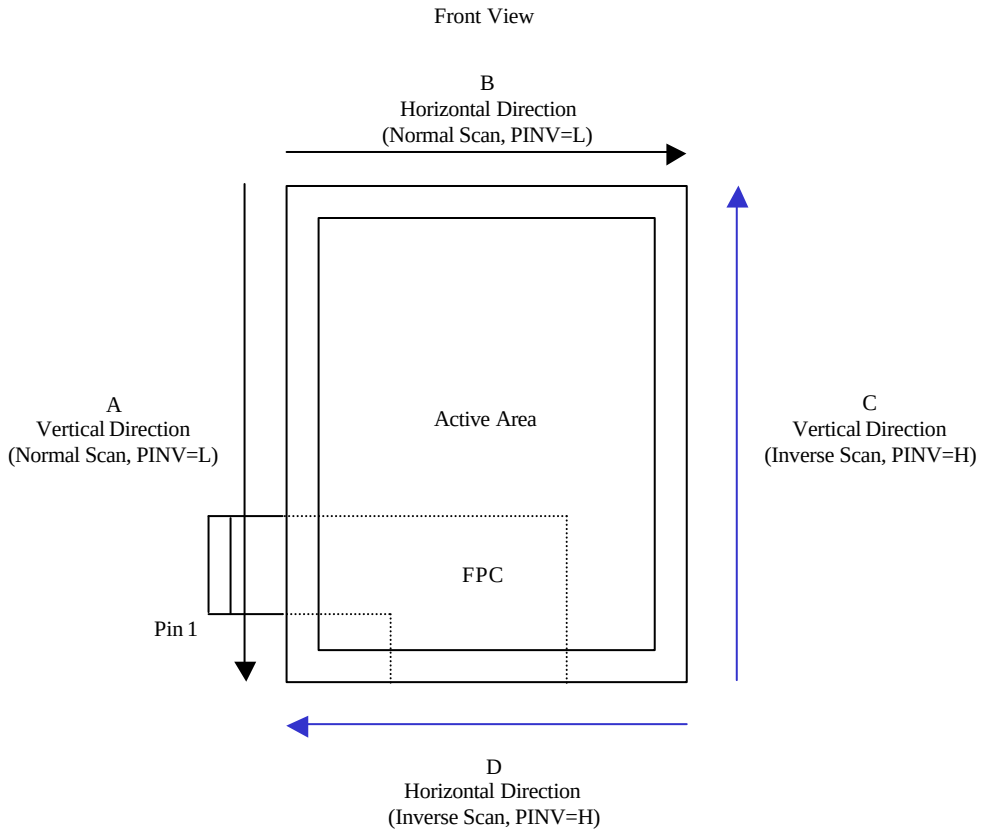
•VBS : This is DC output for register array that adjust VCOM DC offset.
VBS is controlled by internal IC.
It should be connected as follows.



(For reference only)

12. Scanning Direction

The scanning direction for the vertical period and for the horizontal period are A and B or C and D respectively as shown below. These scanning directions are from a front view.



13. Operating condition of back light

Ta=25C

Item	Symbol	Units	Description	Condition
			Typ.	
Voltage @ 1LED	VL	V	3.60	25C
Current	IL	mA	20	25C
Power Consumption of 6LED	P	W	0.432	25C

(*) These items shall depend on the used LED driver

14. Back light

14-1. Back light Life

The Back light life shall be greater than 5000 hours at 25C. The operating Back light life is defined as having ended when the illumination of light has reached 50% of the initial value.

14-2. LED Number

6 LEDs shall be used in the backlight.

15. Audio Noise

The audio noise generated by LCD module with 1 dot checker pattern driven with typical condition shall be measured in the system-5 in Fig.-6.Revised noise by revision A shall not be greater than 16 dbA. Measure frequency range is from 20Hz to 20kHz and this measure shall be done in the shielding room.

16. Touch Panel

116-1) Rating

15-1-1) Maximum voltage

DC7V

15-1-2) Usable temperature range

From -10℃ to 55℃
(At only Touch panel, humidity from 20% to 90%. No dew condensation shall be acceptable)

15-1-3) Storage temperature range

From -30℃ to 70℃
(At only Touch panel, humidity from 20% to90%. No dew condensation shall be acceptable)

16-2) Electrical Performance

15-2-1) Resistance between terminals

Direction "X" (Glass side) : 200～800Ω (TYP.400Ω)
Direction "Y" (Film side) : 200～600 Ω (TYP.400Ω)

15-2-2) Linearity

Direction"X":1.5% or less
Direction"Y":1.5% or less
*Measurement as per attached Appendix.1

15-2-3) Insulation resistance

DC25V and 20M Ω or more

16-3) Chattering

10 msec or less

* Measurement as per attached Appendix. 2

16-4) Mechanical Performance

16-4-1) Input

Through a special stylus or finger

16-4-2) Activation force

Input with finger: 0.8N or less. (TYP.0.15N)
Input with stylus: 0.8Nor less. (TYP.0.15N)

* Measurement as per attached Appendix. 3

16-4-4) Surface hardness

Hardness of pencil 3H or more according to JIS-K5400

16-5) Optical Performance

16-5-1)Optical clarity

Total Transmission 80% or more (TYP.83%) According to JIS-K7105

16-6) Reliability

16-6-1) Exposure to high temperature

Put it in a vessel at the condition of 70℃ for 240 hours. Moreover, let it alone for 24 hours or more in a room temperature and measure it. The measurement must satisfy the under-mentioned items.

•Resistance between terminals : According to Section 2.1.
•Linearity : According to Section 2.2.
•Insulation resistance : According to Section 2.3.

16-6-2) Exposure to low temperature

Put it in a vessel at the condition of -30℃ for 240 hours. Moreover, let it alone for 24 hours or more in a room temperature and measure it. The measurement must satisfy the under-mentioned items.

•Resistance between terminals : According to Section 2.1.
•Linearity : According to Section 2.2.
•Insulation resistance : According to Section 2.3.

16-6-3) Exposure to high temperature and high humidity

Put it in a vessel at the condition of 60°C and 90%RH for 240 hours. Moreover, let it alone for 24 hours or more in a room temperature and measure it. The measurement must satisfy the under- mentioned items.

- Resistance between terminals : According to Section 2.1.
- Linearity : According to Section 2.2.
- Insulation resistance : According to Section 2.3.

16-7) Durability

16-7-1) Hand writing friction resistance

Write one hundred fifty thousand capital and small alphabetical characters with a special-stylus in an area 20mm×20mm and measure it. The measurement must satisfy the under-mentioned items. Then, writing force shall be 2.45N and writing speed 5,000 characters per hour.

- Resistance between terminals : According to Section 2.1.
- Linearity : According to Section 2.2.
- Insulation resistance : According to Section 2.3

16-8) Precautions

16-8-1) Input must be performed through a special stylus or finger. Do not pile up the products nor put any heavy thing on it.

16-8-2) Do not give any shock nor vibration to the product and not drop it.

16-8-3) Do not apply water, organic solvent nor chemicals such as acid and alkali to the product. Do not put the product in such atmosphere.

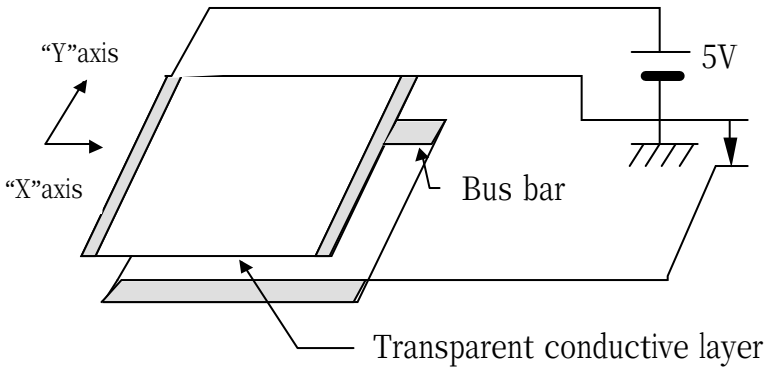
16-8-4) Upon carrying the products, be sure to hold the glass edge. Do not touch an operating surface or it may be stained or damaged. Never pull the cable nor give any considerable force to the peripheral circuit , or cable may be broken.

16-8-5) When any dust or stain is observed on a film surface, C lean it using a commercial cleaner for lenses of glass or something like that.

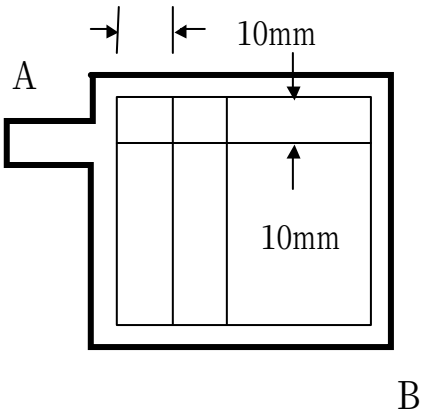
[Appendix 1: How to measure the linearity]

Definition of linearity

In Fig. 1, when the DC5V is impressed between the "X" directional electrode and "Y" directional electrode of table alternately, the voltage between the depressed point and the reference surface shall be the output voltage (Eox and Eoy). As shown in Fig. 2, measure the point on 10mm grid enclosed by the positions "A" and "B", which are located at the inside of visible area the specified distance away from the edge , has been depressed.



<Fig.1>



<Fig.2>

When the output voltage corresponding to every measurement position is plotted as shown in Fig.3, the difference between the voltage enclosed by the positions "A" and "B" and the output voltage at the same position shall be "△Ex" (or "△Ey") and the electric potential difference "EABx" (or "EABy") between "A" and "B" shall be defined as the linearity.

Linearity of Touch panel (X)=(△Ex/EABx)×100%
Linearity of Touch panel (Y)=(△Ey/EABy)×100%

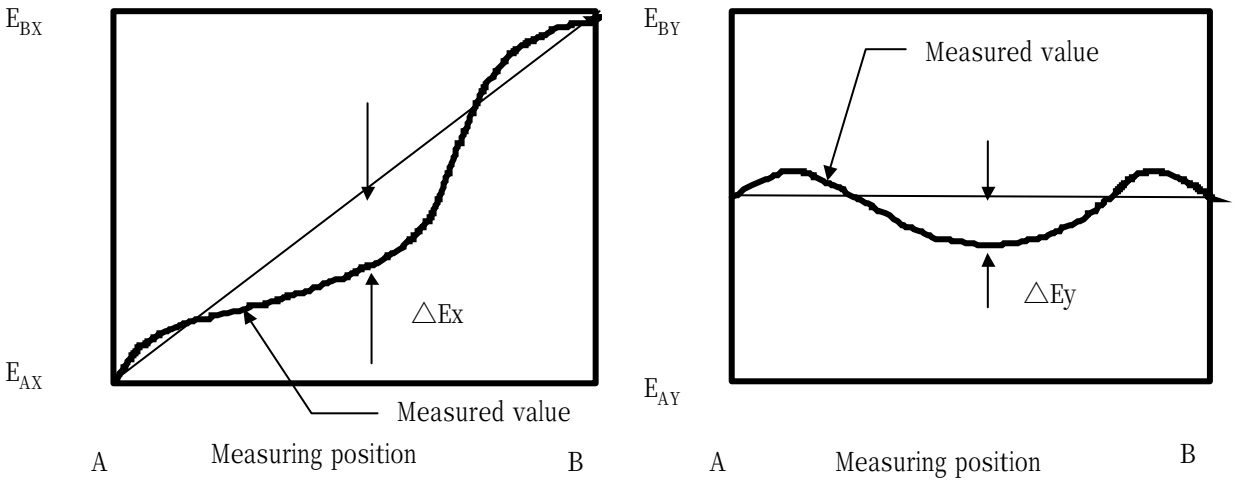


Fig.3

Measurement of linearity

A measured value shall be a maximum value in absolute value tolerance when every nodal point on a grid shown in Fig.5 has been pressed under wiring conditions described in Fig.4.

<Hitting conditions>

Load: 0.8N
Measuring jig:: 0.8R resin pen
Measuring area : 6×8

<Measuring circuit>

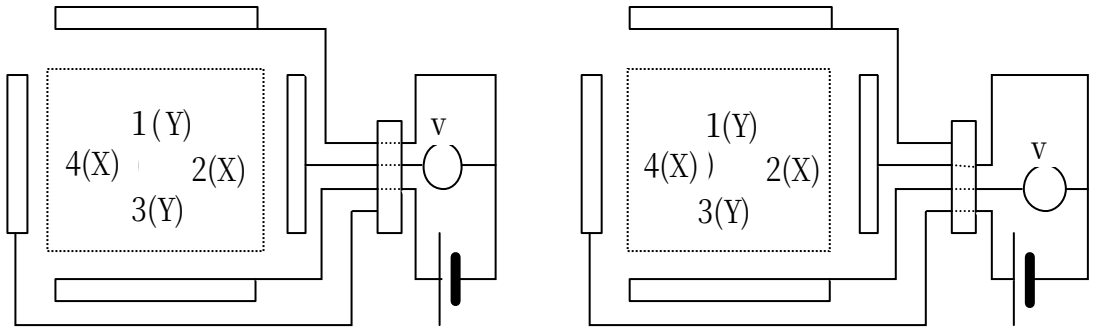


Fig.4

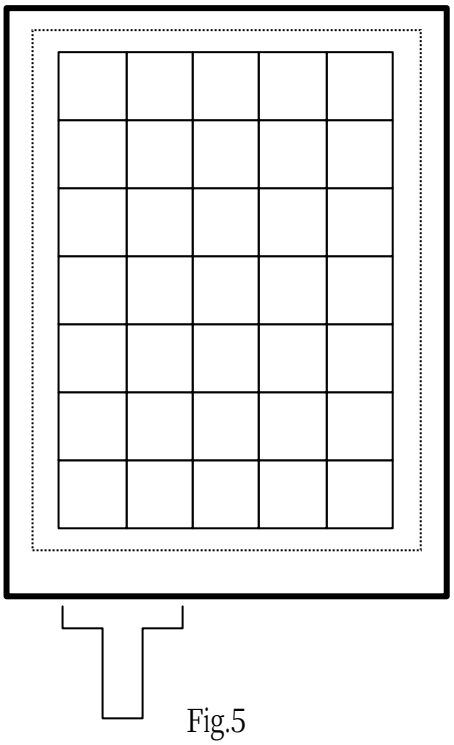


Fig.5

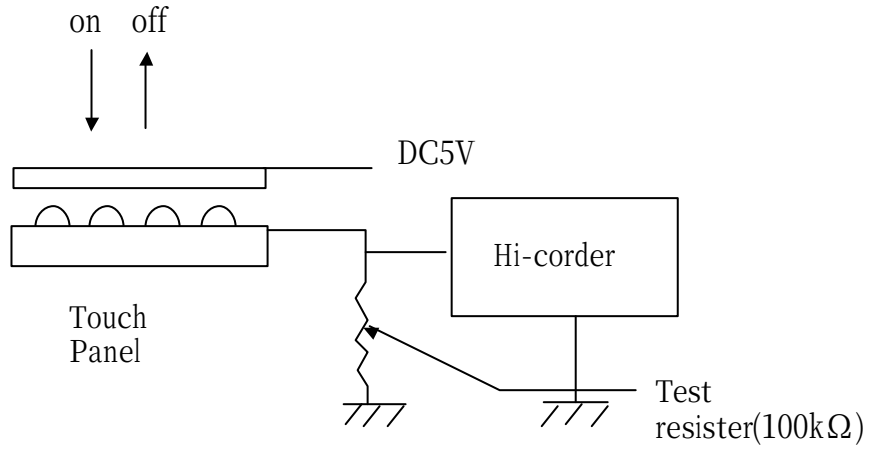
[Appendix2: How to measure chattering]

□ Measuring machine : Hioki 8802 MEMORY Hi CORDER
□ Measuring conditions : Measuring voltage 5V
Testing resistor 100kΩ
Switching Hold a R8 silicon rod and speed as usual finger input.

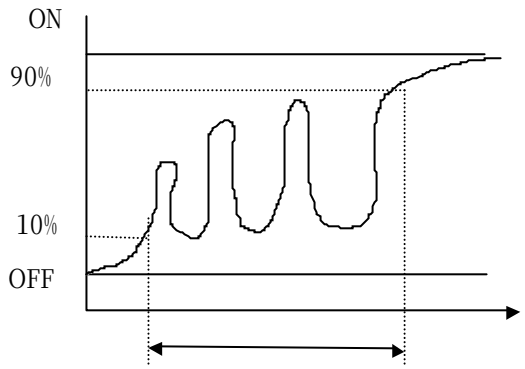
Measurement of rise time / fall time

Rise time When the switch has been turned on, the voltage at both ends of touch panel in the under-mentioned measuring circuit draws the under-mentioned chart. Measure the changing time from 10% and 90% of stable measuring voltage.

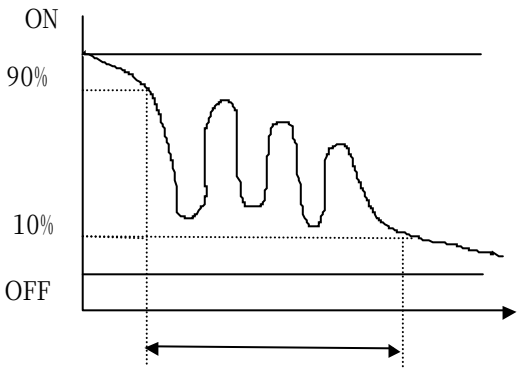
Fall time When the switch has been turned off, the voltage at both ends of touch panel in the under-mentioned measuring circuit draws the under-mentioned chart. Measure the changing time from 90% and 10% of stable measuring voltage.



<Measuring Circuit>



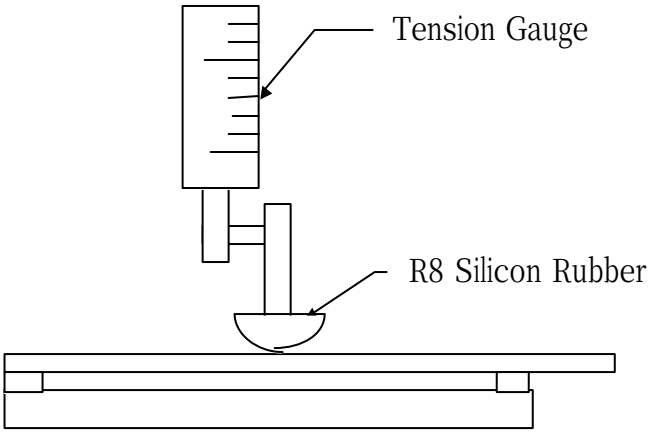
Rise Time



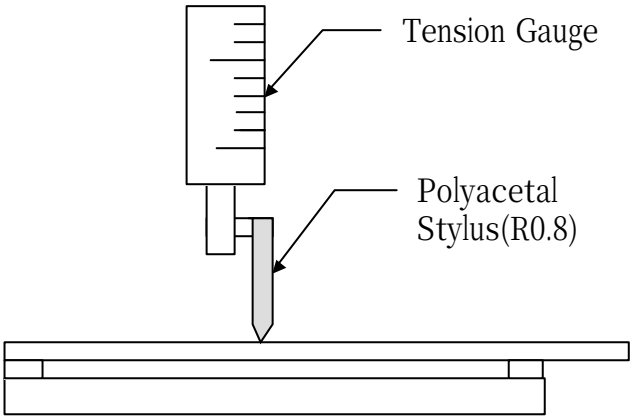
Fall Time

[Appendix 3: Measurement of operating force]

When DC 5V is impressed to the "X" side, force is loaded by a silicone head of R8 and Hs 60° and a voltage value is stable, such force shall be the operation force. Upon pen operation, a polyacetal stylus of R0.8 shall be used.



<Measurement of Finger Input>



<Measurement of Pen Input>

17. Electro-optical characteristics

Ta= 25C, With back light turning off

Item		Symbol	Description			Unit	Condition
			Min.	Typ.	Max.		
Reflectivity		R	6	13	—	%	1
Contrast ratio		CR	3	7	—		2
White chromaticity	x	xfloff	0.30	0.33	0.36	CIE	3
	y	yfloff	0.33	0.36	0.39	CIE	
Response time	on	Ton	—	10	30	msec	4
	off	Toff	—	15	40	msec	
Viewing angle	Top-Bottom	VAtb	60	90	—	degree	5
	Left-Right	VAlr	60	90	—	degree	
V-R characteristic	V90	V90	3.00	3..30	3.60	V	6
	V50	V50	2.15	2.45	2.75	V	
	V10	V10	1.70	2.00	2.30	V	

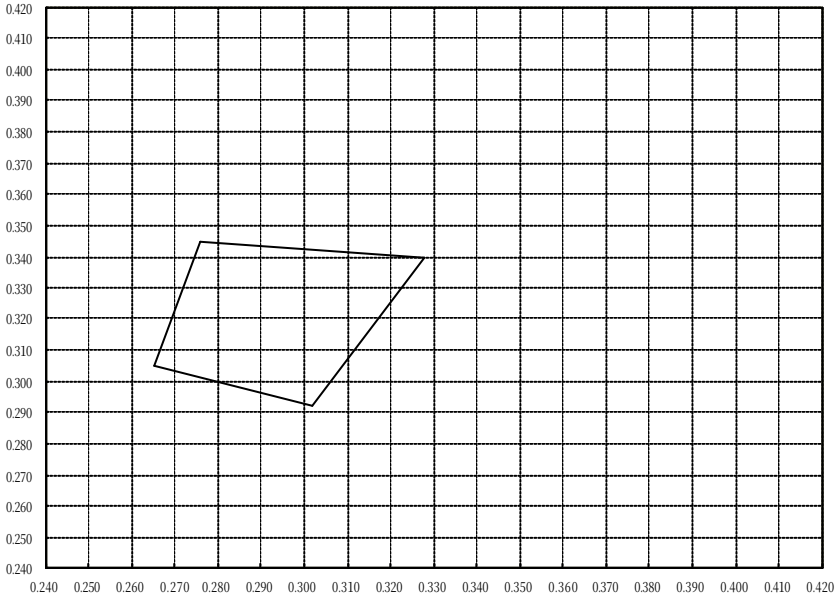
Ta=25C,With back light turning on

Item	Symbol	Description			Unit	Note
		Min.	Typ.	Max.		
Luminance*	Lcfl	51	71	-	cd/m^2	7
Luminance uniformitiy*	Flunif	75	80	-	-	8
Contrast ratio	CRfl	60	80	-	-	9
Rx	-	0.50	0.53	-	-	
Ry	-	0.31	0.34	0.37	-	
Gx	-	0.29	0.32	0.35	-	
Gy	-	0.44	0.47	-	-	
Bx	-	-	0.17	0.20	-	
By	-	-	0.22	0.25	-	

*Backlight condition:20mA@LED(440mW)

White Chromaticity when backlight turned on (with b3 &b5 backlight)

White Chromaticity when backlight turned on (with a0 backlight)



18. Reliability Specification

18-1) Environmental Test

1)Environment Test

	Item	Conditions			
1	High temperature operating	60°C		240h	
2	High temperature storage	70°C		240h	
3	Low temperature operating	-10°C		240h	
4	Low temperature storage	-30°C		240h	
5	High temperature and humidity operating	40°C	95%	240h	
6	High temperature and humidity storage	60°C	90%	240h	
7	Low pressure operating	571hpa(15,000ft), RT, 48h			
8	Low pressure non-operating	303hpa(40,000ft), RT, 48h			
9	Heat shock	-30 to +60°C, 5cycles			

* Items 3 to 6 : No condensation of dew.

18-2) Vibration Test

2)Vibration Test

	Item	Conditions
10	Sinusoidal vibration to operating	0.5g Zero-to peak, 10 to 500Hz, 0.25 octave/minutes sweep rate. One sweep, 10 to 500 to 10Hz, along each axis.
11	Sinusoidal vibration to non operating	1.5g Zero-to peak, 10 to 500Hz, 0.5 octave/minutes sweep rate. One sweep, 10 to 500 to 10Hz, along each axis.
12	Random vibration to operating	0.002G*G/Hz, 10 to 500Hz, nominal 1Grms in each axis.
13	Random vibration to non operating	0.016G*G/Hz, 10 to 500Hz, nominal 2.8Grms in each axis.

*1) There shall be one shock input in each direction of three mutually perpendicular axes for total of six shock inputs.

Notes :

1. Check items
   In the standard condition, there shall be no practical problems that may affect the display function. Items 10 to 13, the modules should suffer no visible cosmetic damage.

2. Inspection condition
   Tested module shall be inspected after kept it under room temperature (15 to 35°C) and humidity (45 to 65%) for 2 hours.

3. In items 5 and 6, the degradation of polarizers are ignored.

19. Defect/ Cosmetic Specification

19-1) Inspection Condition

The defects of the LCD module shall be visually inspected under described conditions as in FIGURE 1.Backlight will be turned on/off in transmissive/ reflective mode.

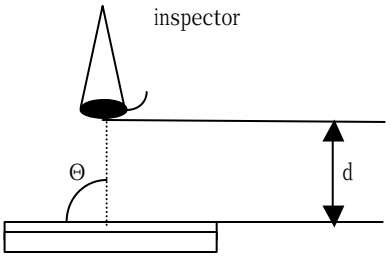


FIGURE 1

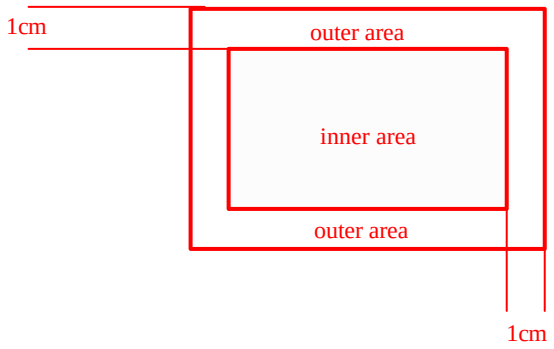
CONDITION ITEMS	CONDITION
d	35±5cm
Panel Surface Illumination (Reflective and Cosmetic Inspection)	1100～1500 lx
Ambient Temperature	25°C
Ambient Illumination	100～300 lx
Viewing Angle Θ	90±5 °
Backlight luminance	70±10Nit

In all inspections,any defects not apparent within 10 second shall be ignored.

19-2) Electrical Defect (Internal Defect)

Electrical defect is defined as bright or dark sub pixel in each pattern.

VISUAL DEFECTS		ALLOWED	CHECK PATTERNS
Bright Dots	single	outer::Red+Green+Blue≦2 inner:Red+Green+Blue≦1	RGBW & Black raster(R,T)
	2 adjacent	0	RGBW & Black raster(R,T)
	3 or more adjacent	0	RGBW & Black raster(R,T)
Dark Dots	single	Total Number≦2	RGBW & Black raster(R,T)
	2 adjacent (horizontal)	0	RGBW & Black raster(R,T)
Dark or Bright Lines		0	RGBW & Black raster(R,T)
All Dot Defects		Total Number≦3	RGBW & Black raster(R,T)



inner area + outer area = effective area of LCD glass

19-3) Distance between electrical defect

ELECTRICAL DEFECTS	ALLOWABLE(mm)
Bright Dots	S≧10
Dark Dots	S≧10
Any Allowable Defects	S≧10

19-4) Non Uniformity

The non-uniformity of the module is due to the deviation of the partial optical performance and this shall be rejected based on the limitation samples defined with proper ways.

19-5) Polarizer Defect

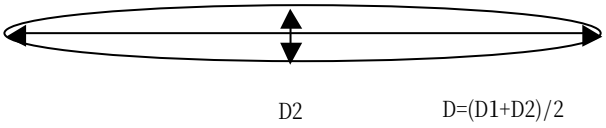


FIGURE 18-7a Definition of Dent,bubble and Spot

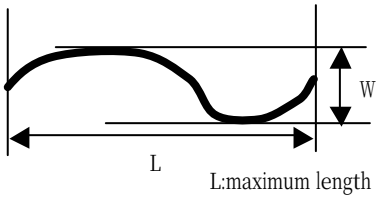


FIGURE 17-5b Definition of Scratch,Lint and Hair

Polarizer Defect	Countable Defect	Reject Criteria	Check Raster
Polarizer Scratch		W > 0.06 and L > 2.0	White (off)(R)
Polarizer Dents	D < 0.15	N > 5	White (off)(R)
Polarizer Bubble	0.1 < D < 0.15	D > 0.15 or N > 3	White (off)(R)

19-6) Cosmetic Defect

These defects shall be visible when all the power turned off.

Visual Defect	Countable	Reject Criteria	Check Raster
Lint/Scratch	0.02<W≦0.03 and L≦3 0.03<W≦0.05 and L≦2	N>3 N>3 0.05<W and 2<L	Off
Cosmetic Spot	0.1<D≦0.2 0.2<D≦0.3	N>3 N>3 D>0. 3 or total N>5	Off

19-7)White/Dark Spot

These defects shall be visible when the backlight turned on.

Visual Defect	Countable	Reject Criteria	Check Raster
Dark/White Spot	0.1<D≦0.25	D>0.25 or N>2	White/Black(T)
Bright/Dark Line(Lint/Hair)	W1≦0.1 W2≦0.03 and L≦1.0	W1>0.1 or W2>0.03 or L>1.0 or countable>2	White/Black(T)

19-8)Newton Ring

This is due to optical interference in the touch panel.This shall be rejected based on the limitation sample.

19-9)Fish Eye

This defect shall be caused by foreign substance in the touch panel film.This shall be rejected based on the limitation sample.

20. Note

1. Reflectivity (R)
In the system-1(see Fig.1(a),(b)), calculate the reflectance factor by using the formula (1).

$$R = R(White) = \frac{\text{Output from the "White" displayed panel}}{\text{Output from the reflectance standard}} \times \text{reflectance factor of the reflectance standard} \quad \ldots(1)$$

2. Contrast ratio (CR)
In the system-1(see Fig.1(a),(b)), measure the reflectance factor of "White" and "Black" respectively and calculate by using the formula (2).

$$CR = \frac{R(White)}{R(Black)} \quad \ldots(2)$$

3. White chromaticity (xfloff, yfloff)
In the system-2(see Fig.2), measure the white chromaticity. The illumination source and viewing area are D65 and 2 ° respectively.

4. Response time (Ton, Toff)
In the system-3(see Fig.3), measure the electro-optical response time.

5. Viewing angle (VAtb, VAlr)
In the measurement system-1(see Fig.1(c)), viewing area is defined by the area which makes the CR>=2.

6. V-R characteristic (V90, V50, V10)
In the system-1(see Fig.1(a), (b)), measure the signal amplitude across the liquid crystal where R(relative)=90% and R(relative)=50% and R(relative)=10%(see Fig.4).

7.Luminance (Lcfl)
In the measurement system-4 (see Fig. 5), measure the luminance and calculate using the formula (3).

Lcfl = (Luminance (1) +Luminance (3) +Luminance (5) +Luminance (7) +Luminance (9)) / 5 …(3)

8.Luminance Uniformity (Flunif)
In the measurement system-4 (see Fig. 5), measure the luminance and calculate using the formula (4).

Flunif = Luminance (maximum spot) / Luminance (minimum spot) …(4)

9. Contrast ratio (CRfl)
In the measurement system-4 (see Fig. 5(a)), measure the luminance of "White" and "Black" respectively and calculate using the formula (5).

$$CRfl = \frac{Luminance(White)}{Luminance(Black)} \quad \ldots(5)$$

10. White chromaticity (xflon, yflon)
In the system-4(see Fig. 5(a)), measure the white chromaticity.

Basic measurement condition

(1) Driving voltage
typical condition

(2) Measurement temperature
+25°C otherwise specified

(3) Measurement point
One point on the center of panel otherwise specified

(4) Light source and viewing area
D65 and 2 °

(5) Display "White" : All R, G and B signal data are high (signal amplitude across the liquid crystal : ±4.0V)
Display "Black" : All R, G and B signal data are low (signal amplitude across the liquid crystal: ±1.0V)
Front light is turned off otherwise specified

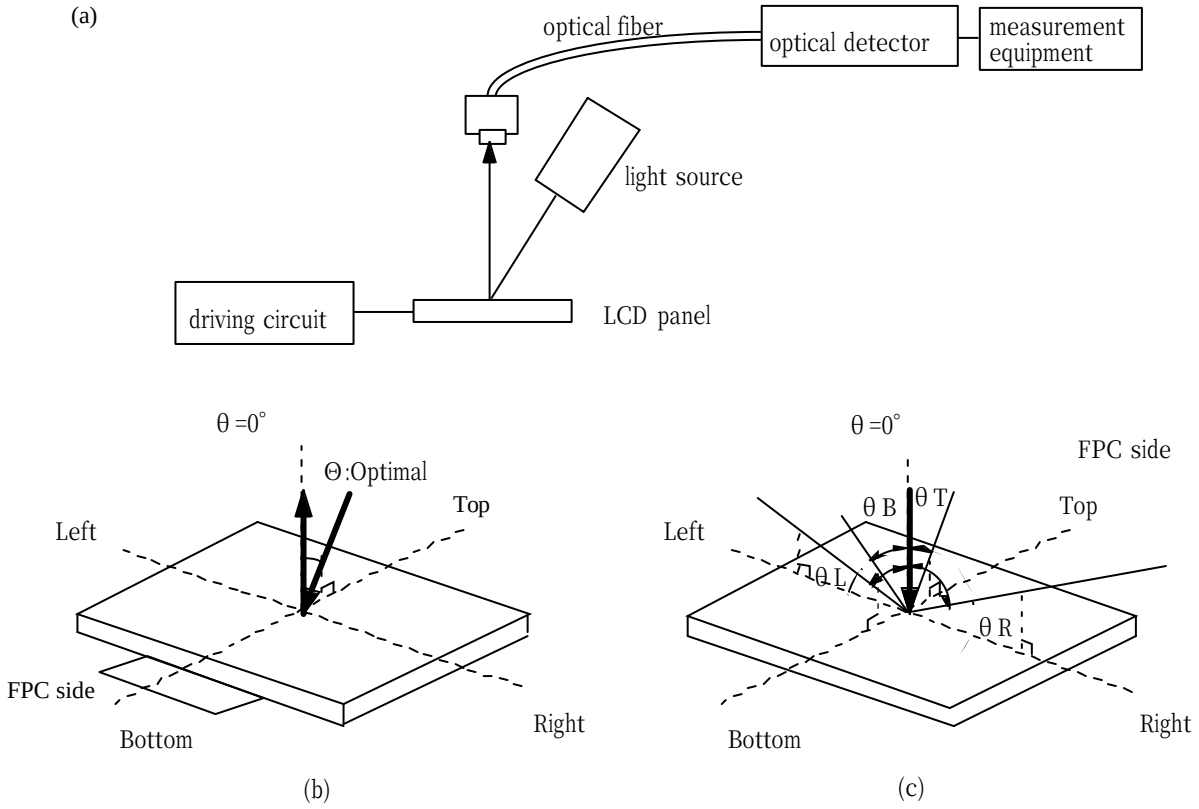


Fig.1 Measurement system-1

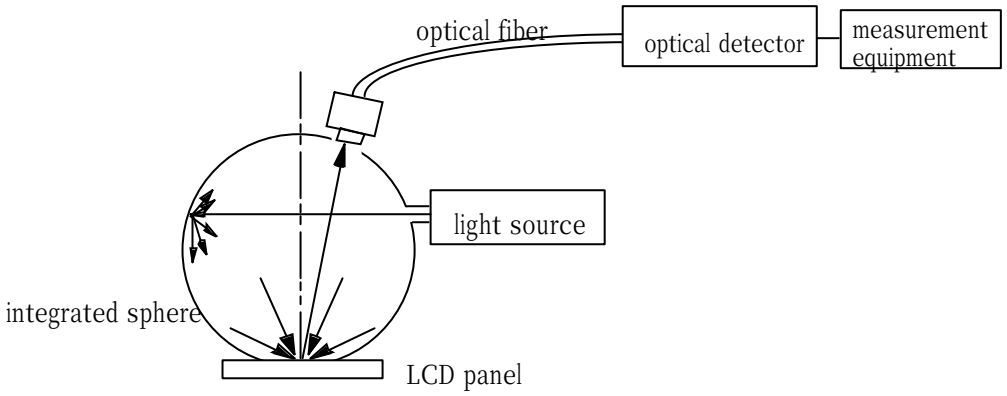


Fig.2 Measurement system-2

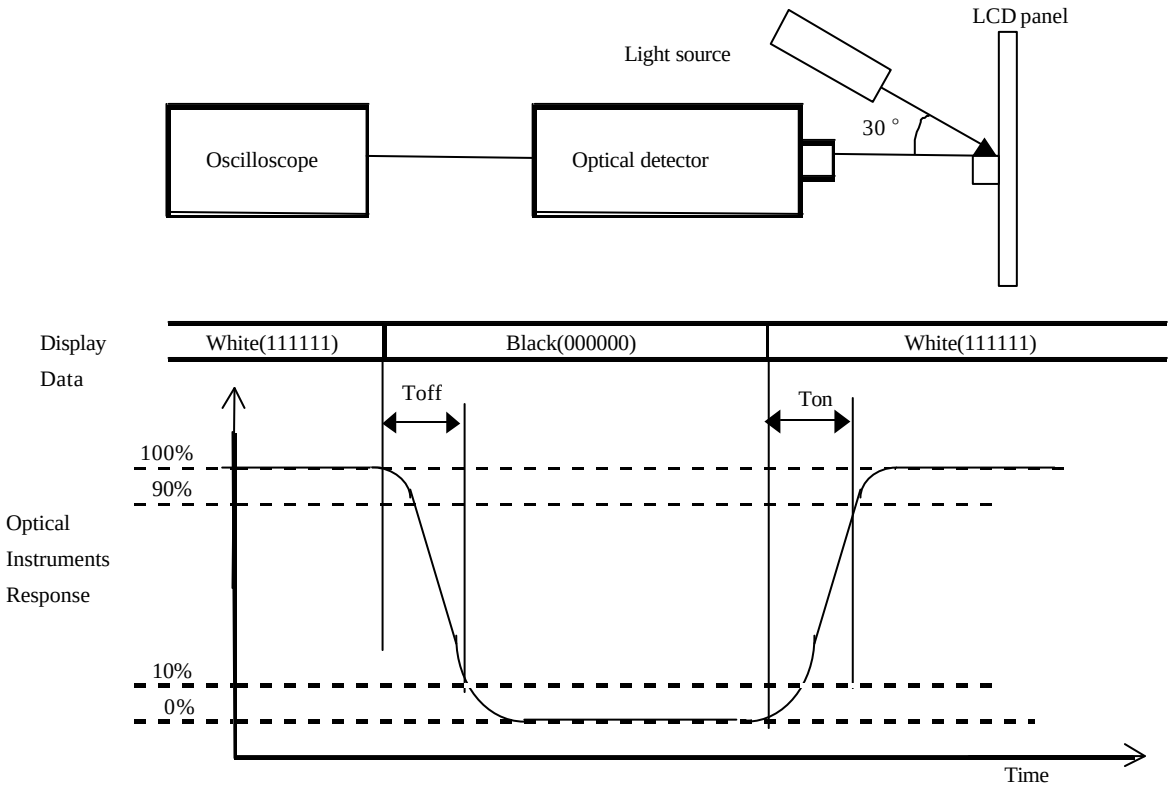


Fig.3 Measurement system-3

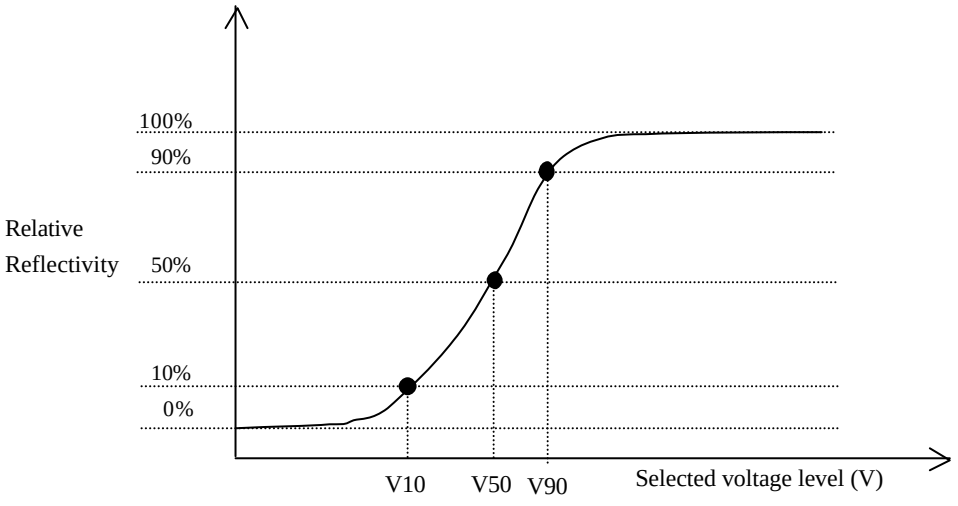
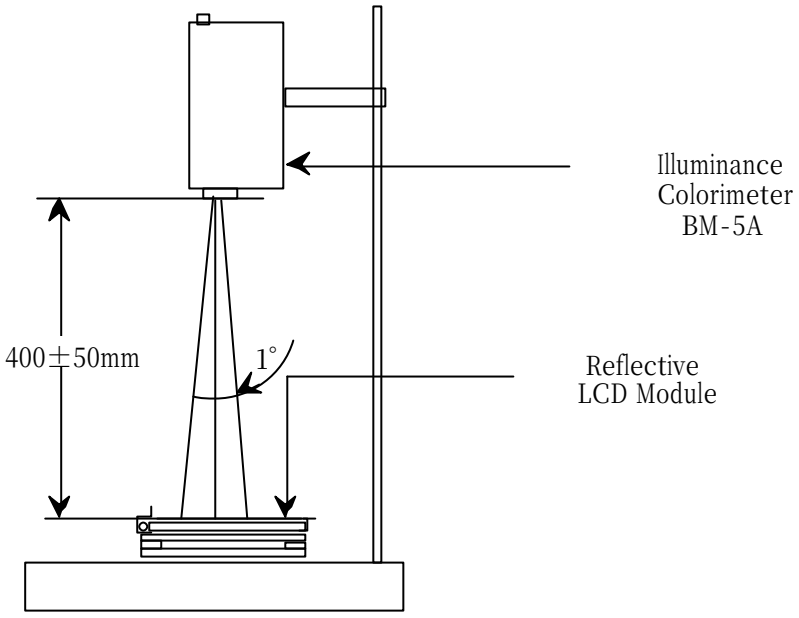
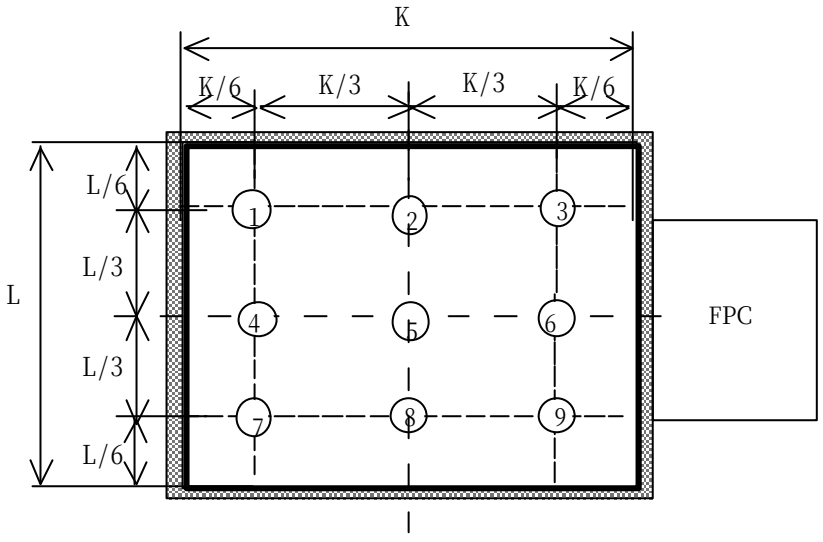


Fig.4 V-R characteristics

** Liquid crystal voltage = |Selected voltage level - Common voltage + Reference voltage center - Common voltage center |
See page17 for ‘Selected voltage level ‘.



(a) The apparatus for Luminance measurement



(b) The spot locations for luminance measurement

Fig.5 Measurement system-4

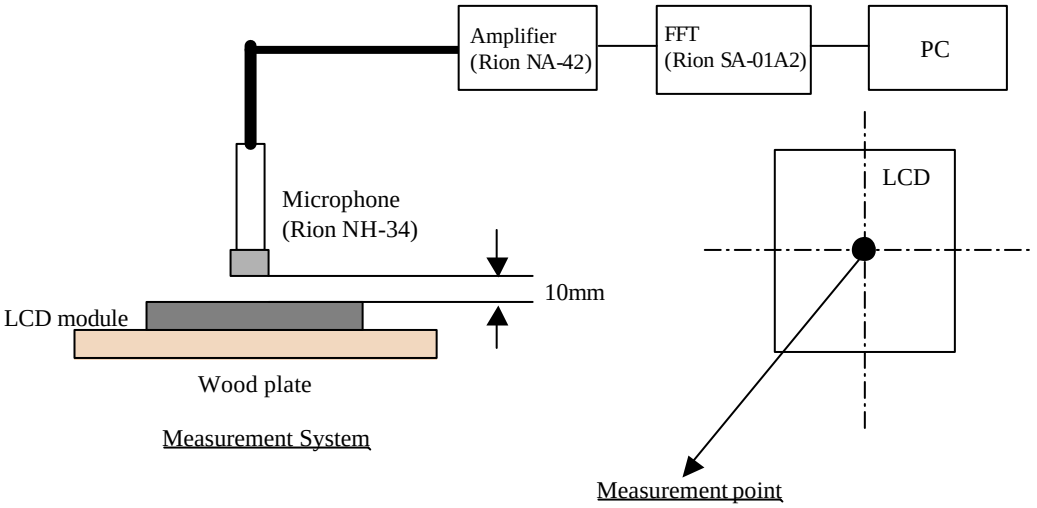


Fig.6 Measurement system-5

21. Note on handling

(1) Static charge prevention

Be sure to take the following protective measures. TFT-LCD panels are easily damaged by static charges.

A) Use non-chargeable gloves, or simply use bare hands.
B) Use an earth-band when handling.
C) Do not touch any electrodes of a panel.
D) Wear non-chargeable clothes and conductive shoes.
E) Install grounded conductive mats on the working floor and working table.
F) Keep panels away from any charged materials.
G) Use ionized air to discharge the panels.

(2) Protection from dust and dirt

A) Operate in a clean environment.
B) Do not touch the front light surface. The surface is easily scratched .
C) Use ionized air to blow dust off the panel.

(3) Other handling precautions

A) Do not twist or bend the flexible PC board especially at the connection region because the board is easily deformed.
B) Do not drop the module.
C) Do not twist or bend the module.
D) Keep the module away from heat sources.
E) Do not dampen the module with water or other solvents.
F) Avoid storage or using the module at high temperatures or high humidity , as this may result in damage.