SPEC. NO.	TQ3C-8EAC0-E1FGWC120-01
DATE	June 29, 1999

S P E C

FOR : KICC

TYPE:KCS057QV1AD-G23

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KYOCERA CORPORATION
KAGOSHIMA HAYATO PLANT
LCD DIVISION

This specification is subject to change without notice.
Consult Kyocera before ordering.

Original	Designed by :Engineering Dept.			Confirmed by :QA Dept.	
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Rev. No.	Date	Page	Descriptions
01	July 1, 1999	2	3-1. Mechanical Specifications of LCD ~Change weight.
		4	5. Electrical Characteristics ~Change contents.
		5	6. Optical Characteristics ~Change contents.
		—	19. Outline Drawing ~Change Outline Drawing.

1. Application

   This data sheet defines the specification for a (320×3)×240 dot, STN color
   dot matrix type Liquid Crystal Display with CFL backlight and Touch Panel.

2. Construction and Outline

   (320×3)×240 dots, COB type LCD with CFL backlight and Touch Panel.
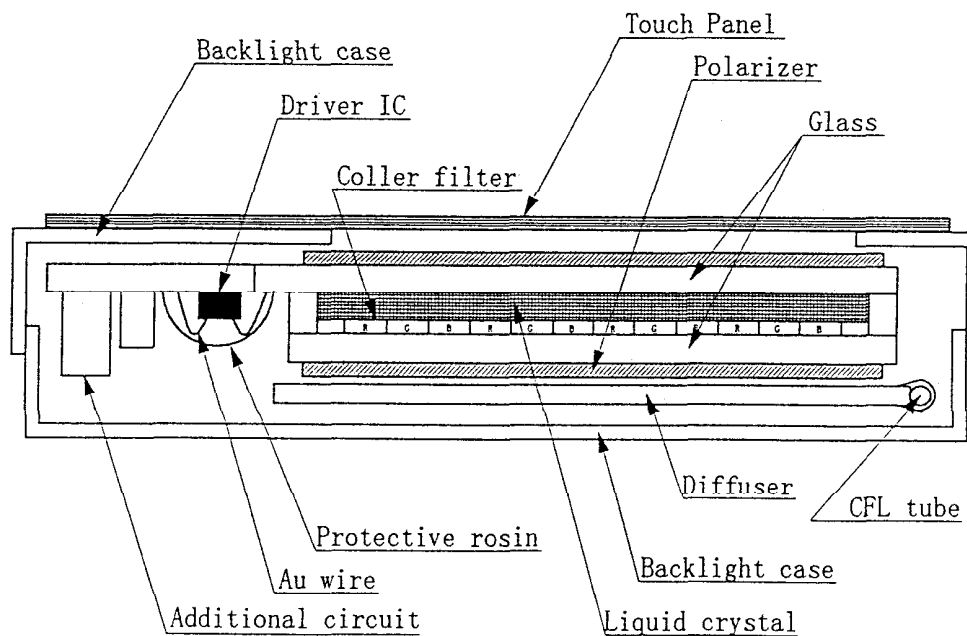
   Backlight system   : Side-edge type CFL (1 tube).

   Inverter   : Option.
                         Recommended Inverter : PH-BLC08-K3 (HITACHI MEDIA ELECTRONICS)
                         or equivalent.

   Polarizer   : Glare treatment.

   Additional circuit : Bias voltage circuit, Randomizing circuit.

   Touch Panel   : Analog type . Non-Glare treatment.

3. Mechanical Specifications

3-1 Mechanical Specifications of LCD

ITEM	SPECIFICATION	UNIT
Outline dimensions	154.6 (W) × 114.8 (H) × 10.3 (D)	mm
Effective viewing area	118.18 (W) × 89.38 (H)	mm
Dot number	(320×3) (W) × 240 (H)	Dots
Dot size	0.10 (W) × 0.34 (H)	mm
Dot pitch	0.12 (W) × 0.36 (H)	mm
Display color *1	White *2	—
Base color *1	Black *2	—
Weight	240	g

*1 Due to the characteristics of the LC material, the color vary with environmental
     temperature.
*2 Negative-type display

    Display data "H" :R,G,B Dots ON : White
    Display data "L" :R,G,B Dots OFF : Black

3-2 Mechanical Specifications of touch panel

ITEM	SPECIFICATION	UNIT
Input	Radius-0.8 stylus or Finger	—
Actuation Force	(10～80)	g
Transparency	Typ. (79)	%
Surface hardness	pencil hardness 3H or more according to JIS-K5400	—

4. Absolute Maximum Ratings

4-1 Electrical absolute maximum ratings

Temp. = 25 ℃

ITEM	SYMBOL	MIN.	MAX.	UNIT
Supply voltage for logic	VDD	0	7.0	V
Supply voltage for LCD driving	VEE	0	44.0	V
Input voltage	Vin	0	VDD	V
Touch Panel Supply voltage	Vtp	0	7.0	V
Touch Panel Input Current	Itp	0	(1.0)	mA

4-2 Environmental absolute maximum ratings

ITEM		SYMBOL	MIN	MAX	UNIT
Operating temperature	*1	Top	0	50	℃
Storage temperature	*2	Tsto	-20	60	℃
Operating humidity	*3	Hop	10	*4	%RH
Storage humidity	*3	Hsto	10	*4	%RH
Vibration		—	*5	*5	—
Shock		—	*6	*6	—

*1 LCD's display quality shall not be guaranteed at the temperature range of : below 0℃ and upper 40℃.

*2 Temp. = -20℃ < 24Hr. , Temp = 60℃ < 24Hr.
No vibration and shock.

*3 Non-condensation.

*4 Temp. ≦ 40℃, 85% RH Max.
Temp. > 40℃, Absolute Humidity shall be less than 85%RH at 40℃.

*5

Frequency	10~55 Hz	Converted to acceleration value : (0.03~0.91G)
Vibration width	0.15 mm	
Interval	10-55-10 Hz	1 minute

2 hours in each direction X/Y/Z (6 hours as total)
EIAJ ED 2531

*6 Acceleration: 50 G
Pulse width : 11 msec
3 times in each direction : ±X/±Y/±Z.
EIAJ ED-2531

5. Electrical Characteristics
5-1. LCD

Temp. = 25℃,   VDD = +5.0V ± 5%

ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Supply voltage for logic	VDD	—	4.75	5.00	5.25	V
LCD driving voltage *1	Vop=	0 ℃	25.5	26.5	27.5	V
	VEE	25 ℃	24.4	25.4	26.4	V
		40 ℃	24.1	25.1	26.1	V
Input voltage	Vin	"H" level	0.8VDD	—	VDD	V
		"L" level	0	—	0.2VDD	V
Clock frequency	f cp		2.02	2.16	12.0	MHz
Frame frequency *2	f $_{FRM}$		70	75	80	Hz
Current consumption for logic	IDD		—	3.0	4.5	mA
Current consumption for LCD driving	IEE	*3	—	7.5	11.3	mA
Power consumption	Pdisp		—	210	325	mW

*1 Maximum contrast ratio is obtained by adjusting the LCD supply voltage
(Vop= VEE) for driving LCD.

*2 In consideration of display quality, it is recommended that frame frequency is
set in the range of 70-80Hz. When you have to use higher frame and clock
frequencies, confirm the LCD's performance and quality prior to finalizing the
frequency values. Generally, as frame and clock frequencies become higher,
current consumption will get bigger and display quality will be degraded.

*3 Display high frequency pattern, (see below).
VDD = 5.0V , Vop = VEE , f $_{FRM}$ = 75 Hz , fcp = 2.16MHz
Pattern:

5-2. Touch Panel

5-2-1. Terminal resistance
Between XL and XR : (250 ∼ 750) Ω
Between YU and YL : (250 ∼ 850) Ω

5-2-2. Linearity
±1.0%

5-2-3. Insulation resistance
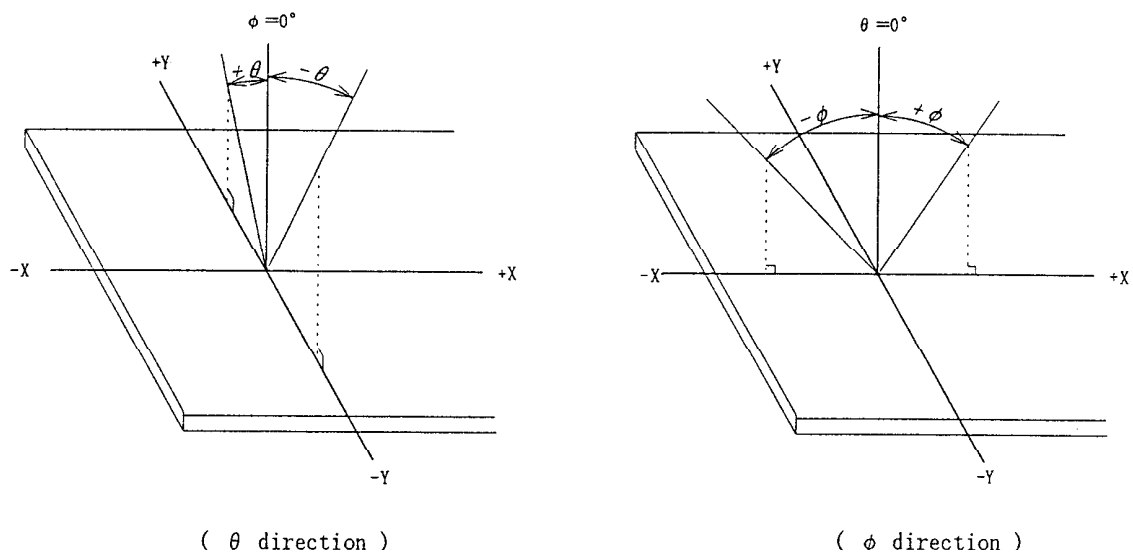10MΩ or more at DC25V

6. Optical Characteristics

Temp. = 25℃

ITEM		SYMBOL	CONDITION		MIN.	TYP.	MAX.	UNIT
Response time	Rise	Tr	$\theta = \phi = 0°$		—	220	320	ms
	Down	Td	$\theta = \phi = 0°$		—	110	210	ms
Viewing angle range	θ	CR≧2	$\phi = 0°$		-30	—	30	deg.
	ϕ		$\theta = 0°$		-50	—	50	deg.
Contrast ratio		CR	$\theta = \phi = 0°$		20.0	40.0	—	—
Chromaticity coordinates	Red	x	$\theta = \phi = 0°$		0.50	0.55	0.60	
		y			0.30	0.35	0.40	
	Green	x	$\theta = \phi = 0°$		0.26	0.31	0.36	
		y			0.47	0.52	0.57	
	Blue	x	$\theta = \phi = 0°$		0.11	0.16	0.21	
		y			0.12	0.17	0.22	
	White	x	$\theta = \phi = 0°$		0.27	0.32	0.37	—
		y			0.30	0.35	0.40	
	Black	x	$\theta = \phi = 0°$		0.25	0.30	0.35	
		y			0.26	0.31	0.36	

Optimum contrast is obtained by adjusting the LCD driving voltage(Vop)
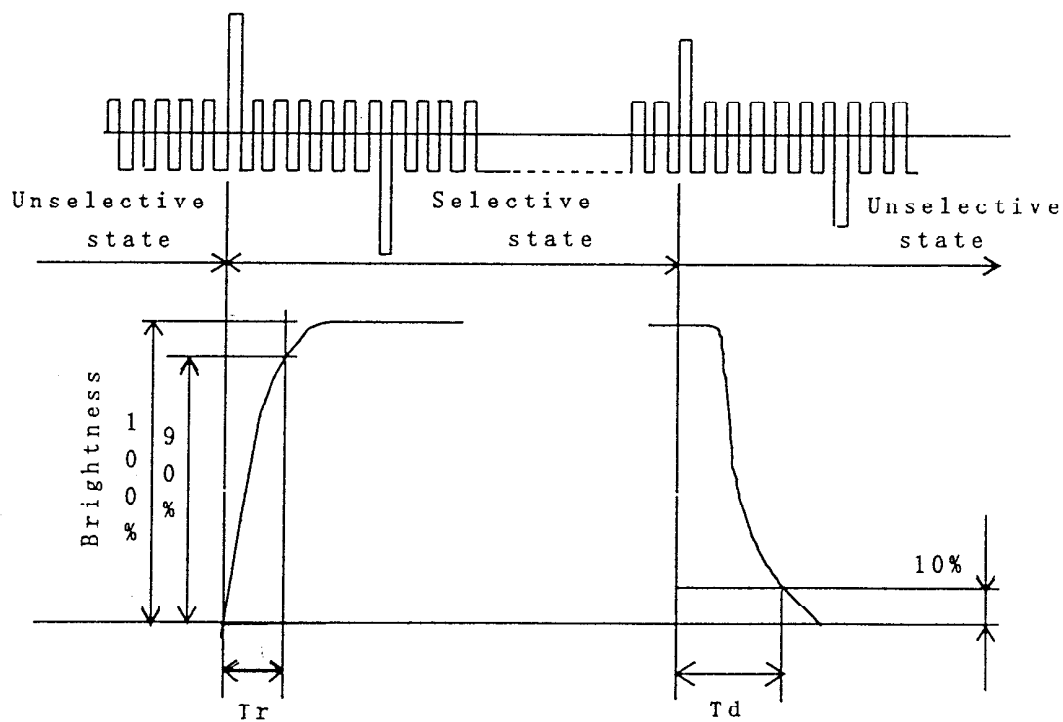while at the viewing angle of $\theta = \phi = 0°$

6-1 Contrast ratio is defined as follows:

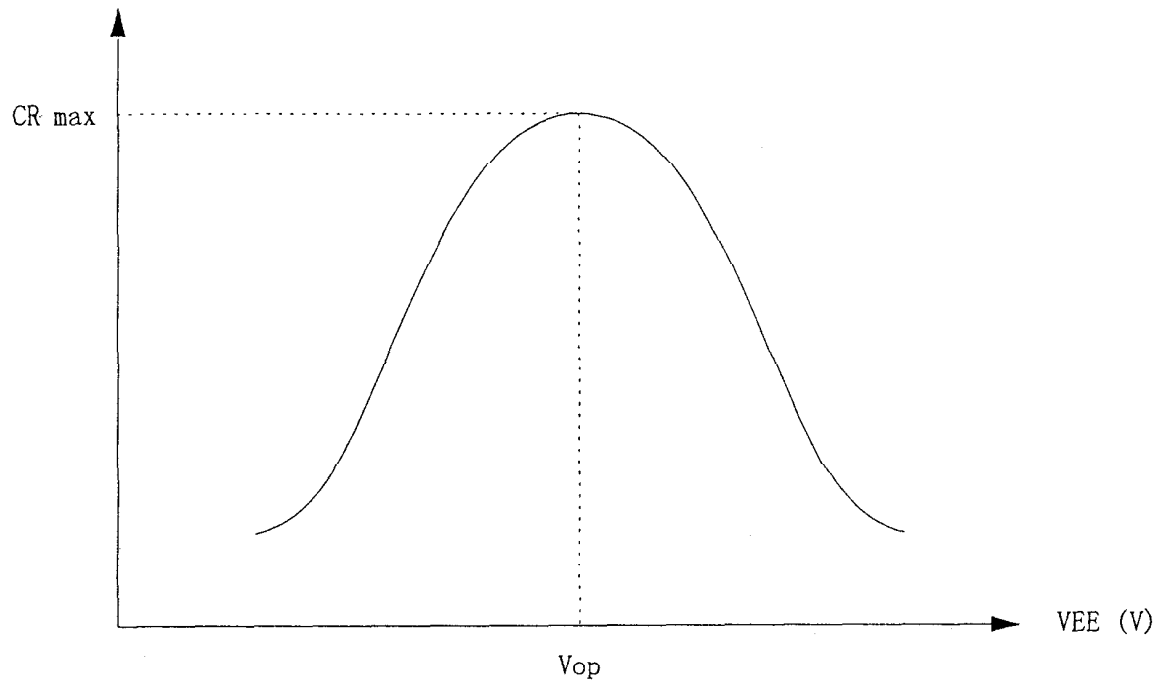$$CR = \frac{\text{Brightness all pixels "White"}}{\text{Brightness all pixels "Black"}}$$

- 5 -
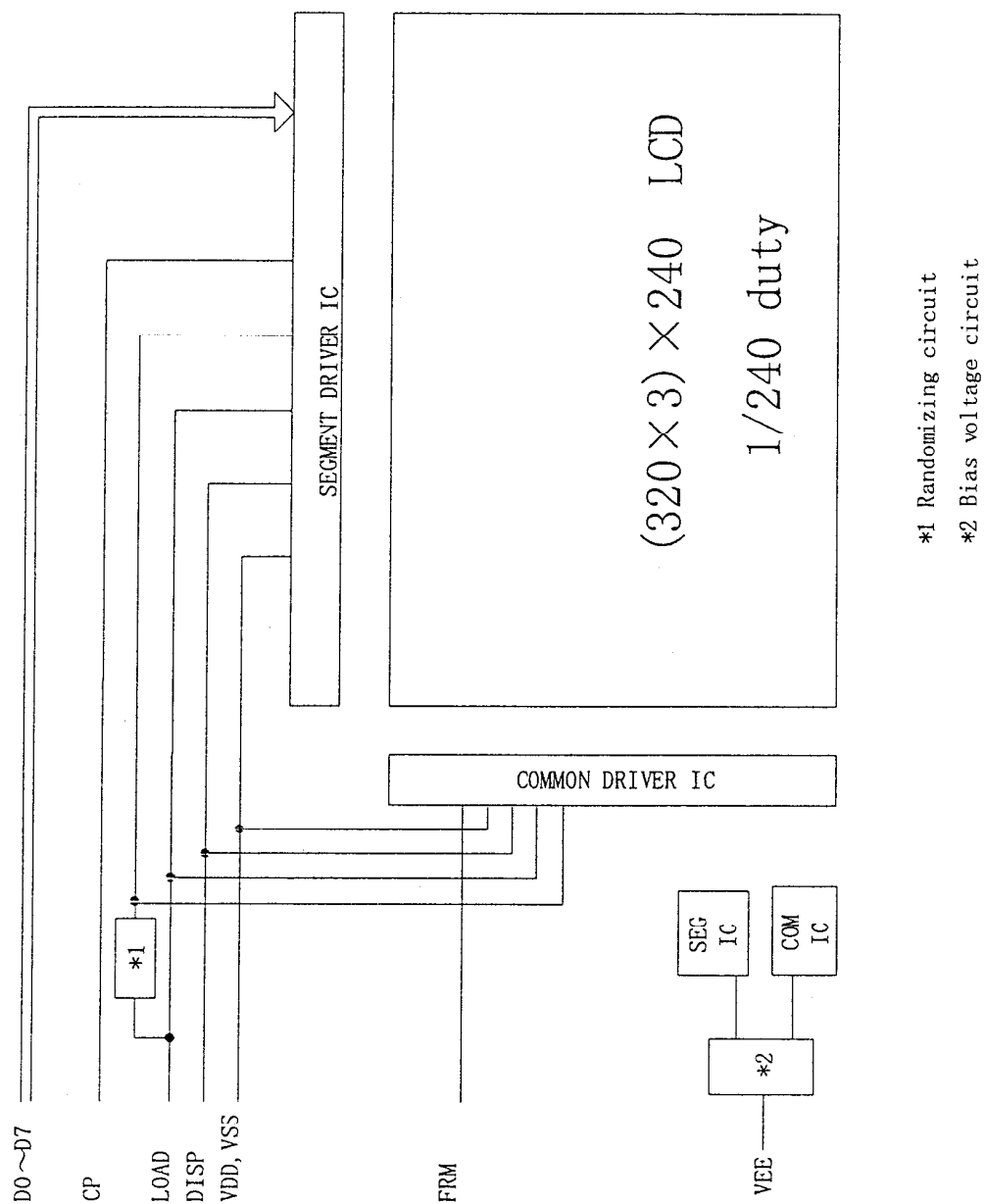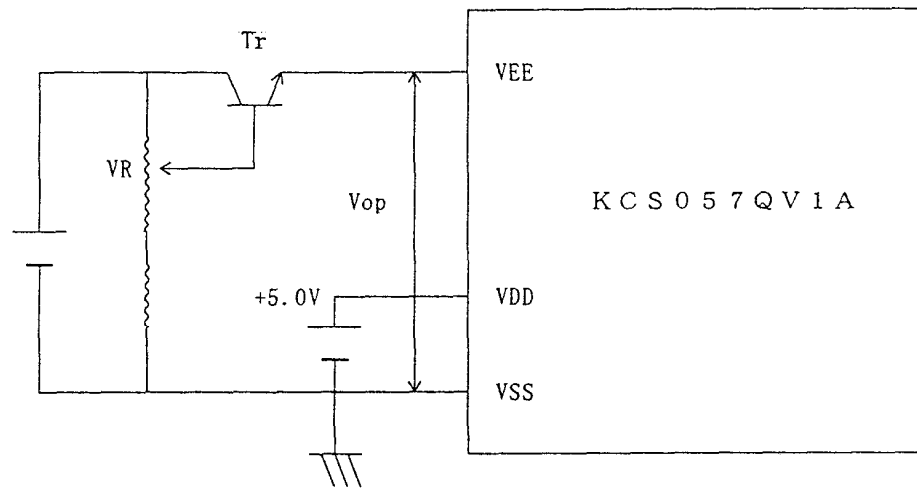
6-2. Definition of viewing angle

(θ direction)

(φ direction)

6-3. Definition of response time

6-4. Definition of Vop

7. Circuit Block Diagram of LCD

SEGMENT DRIVER IC

(320×3)×240 LCD

1/240 duty

COMMON DRIVER IC

*1

SEG IC

COM IC

*2

D0～D7

CP

LOAD
DISP
VDD, VSS

FRM

VEE

*1 Randomizing circuit
*2 Bias voltage circuit

7-1.Power supply

8. Interface signals

8-1. LCD

CN1 : 53261-1510(Molex)

PIN NO.	SYMBOL	DESCRIPTION	LEVEL
1	FRM	Synchronous signal for driving scanning line	H
2	LOAD	Data signal latch clock	H → L
3	CP	Data signal shift clock	H → L
4	DISP	Display control signal	H(ON),L(OFF)
5	VDD	Power supply for logic	—
6	VSS	GND	—
7	VEE	Power supply for LCD	—
8	D7	Display data	H(ON),L(OFF)
9	D6		
10	D5		
11	D4		
12	D3		
13	D2		
14	D1		
15	D0		

Recommended matching connector   : 51021-1500(Molex)

NOTE) This pin assignment is the reverse of what Molex defined.
Remember that for your designing.

8-2. CFL

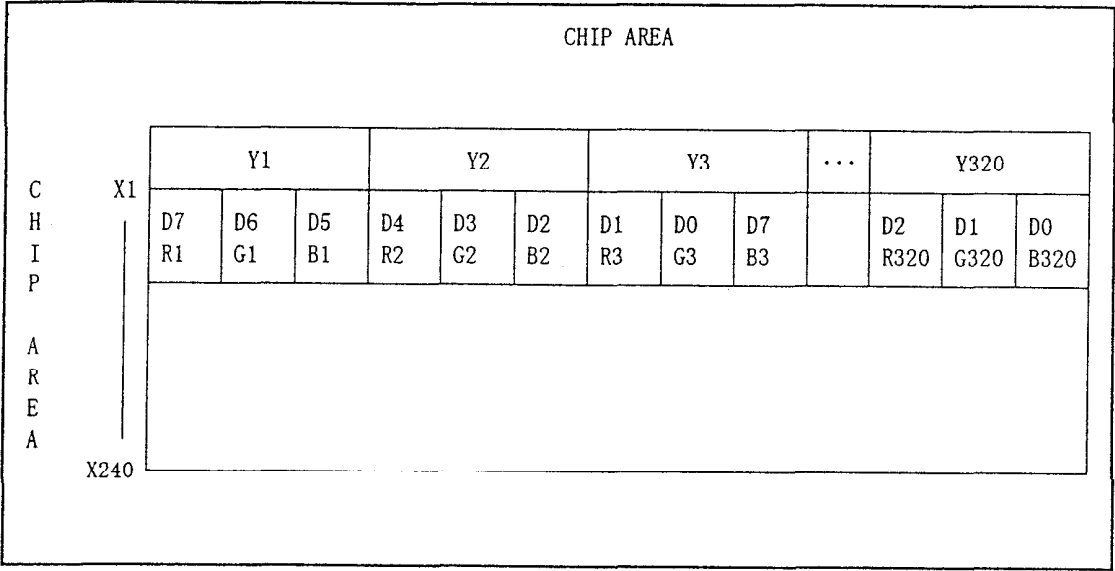| PIN No	SYMBOL	DESCRIPTION	LEVEL
1	HV	Power supply for CFL	AC
2	NC	—	—
3	GND	Ground line(from inverter)	—

LCD side connector   : BHR-03VS-1   (JST)
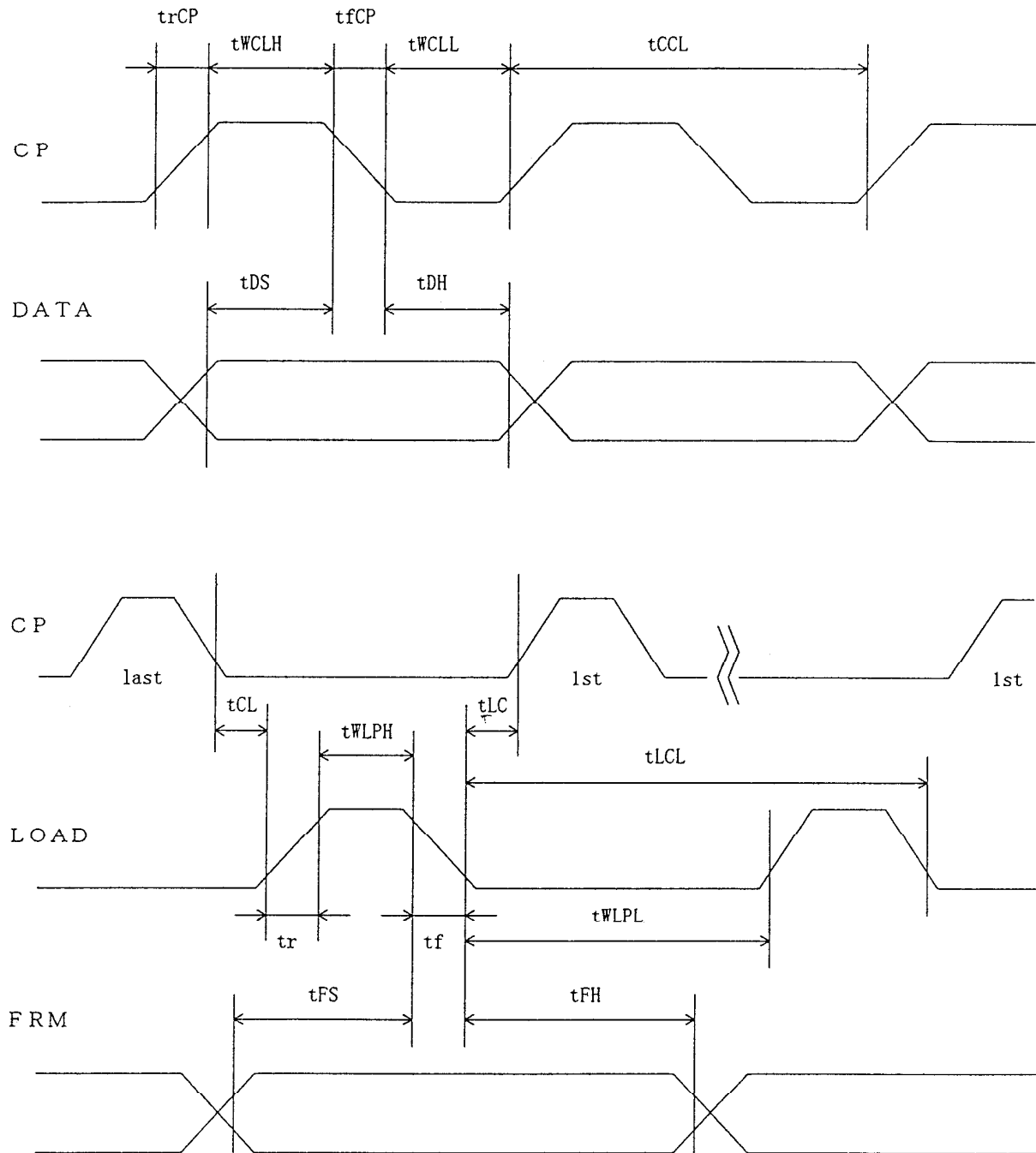Recommended matching connector : SM02-(8.0)B-BHS-1 (JST)

8-3. Touch panel

PIN No	SYMBOL	DESCRIPTION
1	yU	y-Upper terminal
2	xL	x-Left terminal
3	yL	y-Lower terminal
4	xR	x-Right terminal

9. Interface Timing Chart

LOAD	
CP	
D7	G318 R1 B3 G318 R1
D6	B318 G1 R4 B318 G1
D5	R319 B1 G4 R319 B1
D4	G319 R2 B4 G319 R2
D3	B319 G2 R5 B319 G2
D2	R320 B2 G5 R320 B2
D1	G320 R3 B5 G320 R3
D0	B320 G3 R6 B320 G3
FRM	

CP × (320×3) / 8 pulse

LOAD

×1   ×2   ×240   ×1

D0～D7

FRM

		CHIP AREA											
		Y1			Y2			Y3			...	Y320		
X1		D7 R1	D6 G1	D5 B1	D4 R2	D3 G2	D2 B2	D1 R3	D0 G3	D7 B3		D2 R320	D1 G320	D0 B320
X240														

(Left margin label, vertical: C H I P A R E A)

11. Input Timing Characteristics

CP

trCP   tWCLH   tfCP   tWCLL   tCCL

DATA

tDS   tDH

CP

last   1st   1st

tCL   tLC   tLCL

LOAD

tWLPH

tr   tf   tWLPL

FRM

tFS   tFH

- 13
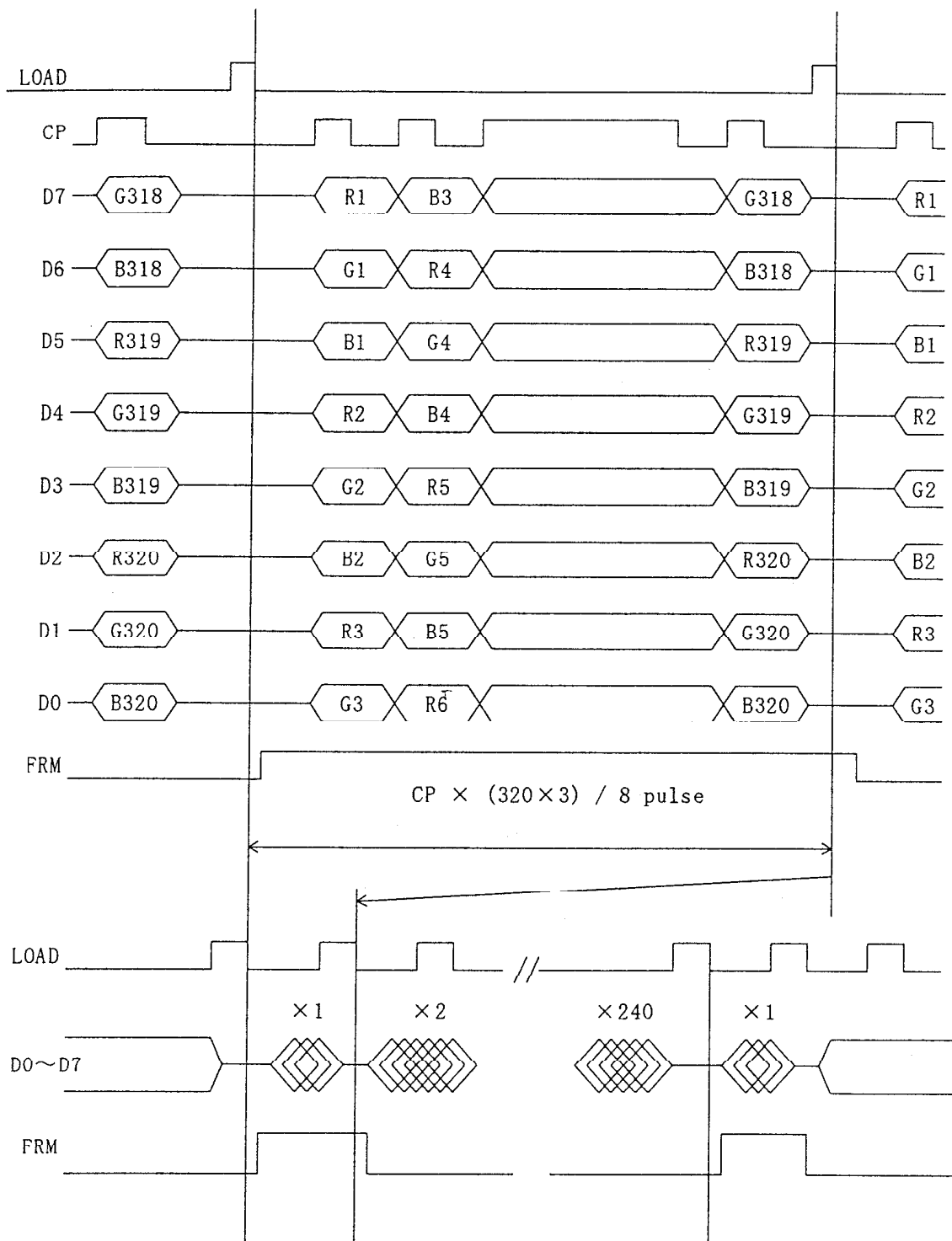
Input characteristics ;   VDD = +5.0V ± 5%   Temp. = 25 ℃

ITEM		SYMBOL	MIN.	MAX.	UNIT
CP Cycle	*1	tCCL	82	—	ns
CP "H" Pulse Width		tWCLH	28	—	ns
CP "L" Pulse Width		tWCLL	28	—	ns
CP Rise Up Time	*2	trCP	—	30	ns
CP Fall Down Time	*2	tfCP	—	30	ns
Data Set Up Time		tDS	28	—	ns
Data Hold Time		tDH	20	—	ns
LOAD "H" Pulse Width		tWLPH	55	—	ns
LOAD "L" Pulse Width		tWLPL	370	—	ns
LOAD Cycle		tLCL	400	—	ns
CP→LOAD Delay Time		tCL	0	—	ns
LOAD→CP Delay Time		tLC	0	—	ns
Input Signal Rise Up Time		tr	—	30	ns
Input Signal Fall Down Time		tf	—	30	ns
FRM Data Set Up Time		tFS	100	—	ns
FRM Data Hold Time		tFH	30	—	ns

*1 CP Cycle is adjust so that FRM signal is 75Hz.
*2 The formula of condition
　　　①trCP, tfCP < {tCCL − (tWCLH + tWCLL)} / 2
　　Please use on condition that ① is filled.

12. Supply Voltage Sequence Condition

DO NOT apply DC voltage to the LCD panel. DC voltage induce irreversible electrochemical reactions and reduce LCD life. Always follow the power supply ON/OFF sequence of VDD first, input signal second, VEE third and finally DISP. This will prevent DC driving of the LCD or CMOS LSI latch up as shown below.

VDD

Input signal

VEE

DISP

1sec. MIN.   1 sec. MIN.

0～50ms

0～50ms

0～100ms   100ms MIN.

0sec. MIN.   0sec. MIN.
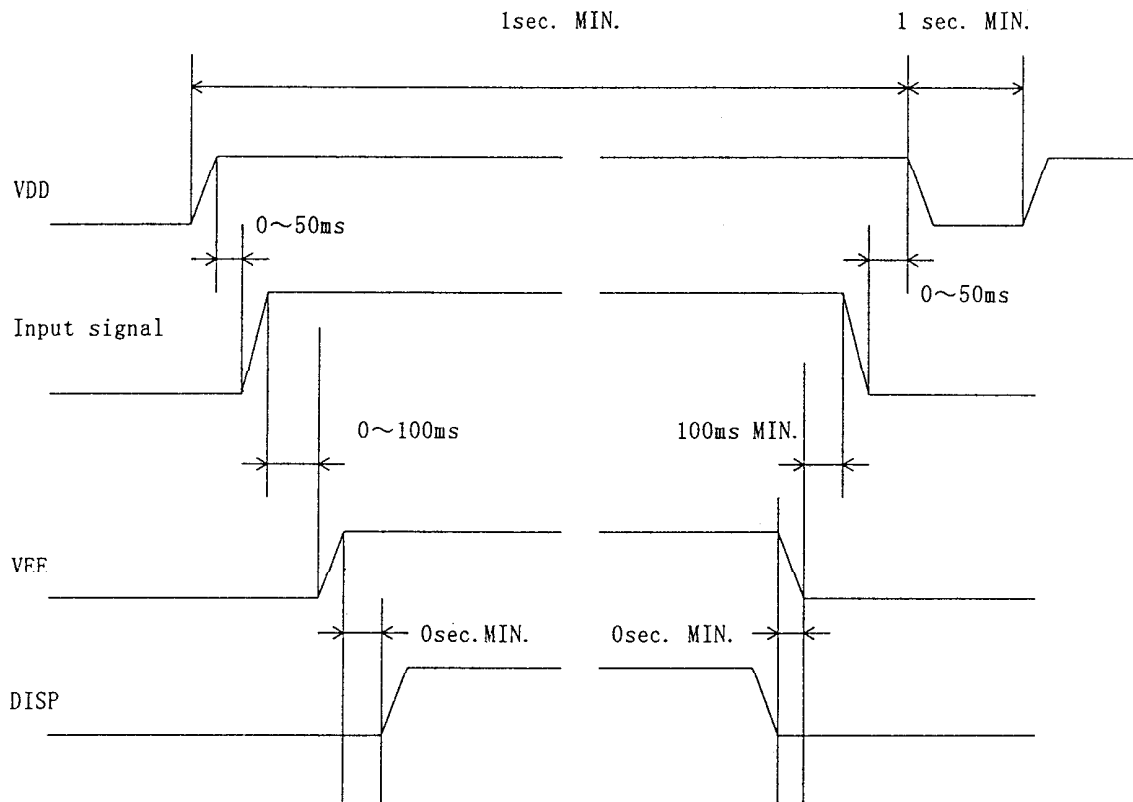
1 3 . Backlight Characteristics

13-1. CFL ratings

Measuring Inverter:PH-BLC08-K3 (HITACHI MEDIA ELECTRONICS)   Temp.= 25℃

ITEM	SYMBOL	MIN.	TYP.	MAX.	NOTE
Starting discharge Voltage *1	VS	—	—	795 Vrms.	0 ℃
		—	—	530 Vrms.	25 ℃
Discharging tube current	IL	2.0 mArms.	5.0 mArms.	6.0 mArms.	—
Discharging tube voltage	VL	—	320 Vrms.	—	—
Operating life *2 (IL=5.0 mArms.)	T	25,000Hr	40,000 Hr.	—	—
Operating frequency	F	30 kHz	—	100 kHz	—

*1 The Non-load output voltage (VS) of the inverter should be designed to have
   some margin, because VS may increase due to the leak current which may be
   caused by wiring of CFL cables. (Reference value: 1035 Vrms MIN.)
*2 When the illuminance or quantity of light has decreased to 50 % of the initial
   value.

13-2. Surface Brightness of LCD module(IL = 5.0 mArms.)   Temp.=25℃

ITEM	MIN.	TYP.	MAX.	UNIT
Brightness	(110)	(160)	—	cd/m^2

(Measuring points)
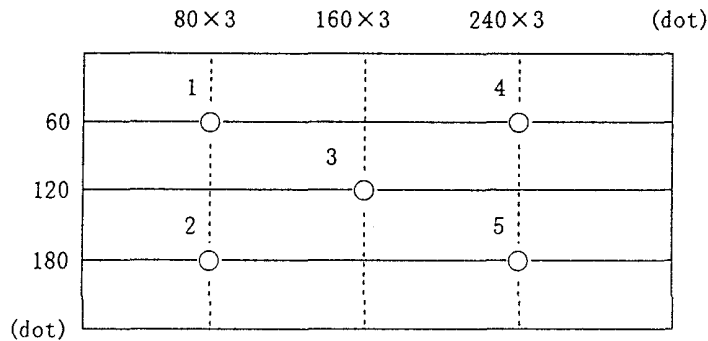
1) Rating is defined as the average brightness inside the viewing area.
2) 30 minutes after CFL is turned on. (Ambient Temp.=25℃)
3) The inverter should meet the eccentric conditions;
   -Sine, symmetric waveform without spike in positive and negative.

14-1. Electrical
In customer's design, please remember the following considerations.

1. Do not use the current regulated circuit.
2. Keep the current limit with top and bottom layer. (See Sec, 4-1)
3. Analog T/P can not sense two point touching separately.
4. A contact resistance is appeared at the touch point between top and bottom layer.
   After this resistance has stable read the T/P position data.
5. Analog T/P is also a "Capacitor" in an equivalent circuit.
   Design your sensing circuit and low-pass filter with considering this "Capacitor"
   value.

14-2. Software
1. Do the "User Calibration".
2. "User Caribration" may be needed with long term using.
   Include "User Caribration" menu in your software.

14-3. Mechanical Design
14-3-1. Each "Area"
   Please confirm the following information before starting your design.

(a) Key Area
"Key Area" is an area where T/P specifications(Linearity, Durability, Actuation force,
etc.) are guaranteed.

1) Do a touch data sensing and calibration inside this area.
2) In normal cases it is a same size as your flat display's "active area".
3) The ITO layer durability near the edge of Key area is less stronger than the
   center.

(b) Transparent Insulation-paste Area.
Insulation-paste is printed with 1.0mm distance outer from "Key Area".

1) The purpose is to avoid potential shorting problem from the bezel housing edge from
   or housing "stick" when molding.
2) Consider your housing edge position to keep 1.0mm distance from this paste line.
   (See. Fig. 1)
3) The cross section of this edge is taper shape. So if it is over the display's
   active area, it will be shining as a prism.

(c) Prohibition Area
Input by pen and finger is prohibited in this area.
Because of the thickness around T/P, the ITO layer on the PET film will be expanded
and as a conclusion it will be cracked if pressed. (See. Fig. 2)

1) We strongly recommend that the bezel should protect this area.
2) An exposure of this area and stylus contact should be avoided.
3) When assembling at the customer, do not press this area with tools.
4) Consider your design to avoid the pressure by the housing bezel.

14-3-2. Example of Housing Design.

1) If an consumer will put a palm on housing in normal usage care should be taken as follows.

2) Keep the gap, for example 0.3 to 0.7mm, between bezel edge and T/P surface.
The reason is to avoid the bezel edge from contacting T/P surface that may cause a "short" with bottom layer. (See. Fig. 1)

3) Insertion a cushion material is recommended.

4) The cushion material should be limited just on the busbar insulation past area.
If it is over the transparent insulation paste area a "short" may be occurred.

14-3-3. Mounting on display and housing bezel

1) In all cases, the T/P should be supported form the backside of the glass.

2) Do not to use an adhesive tape to bond it on the front of T/P and hang it to the housing bezel.

3) Never expand the T/P top layer (PET-film) like a balloon by internal air pressure. The life of the T/P will be extremely short.

4) if a dew will be on the heat-sealed area or exposed traces at the end of a flexible tail, the migration of silver can occur. This will cause sometimes a short circuit.

If your final product will used in a humid circumstance or will be moved from humid, warm environments to cold ones, a dew condensation can occur.

Consider a water seal with your housing bezel.
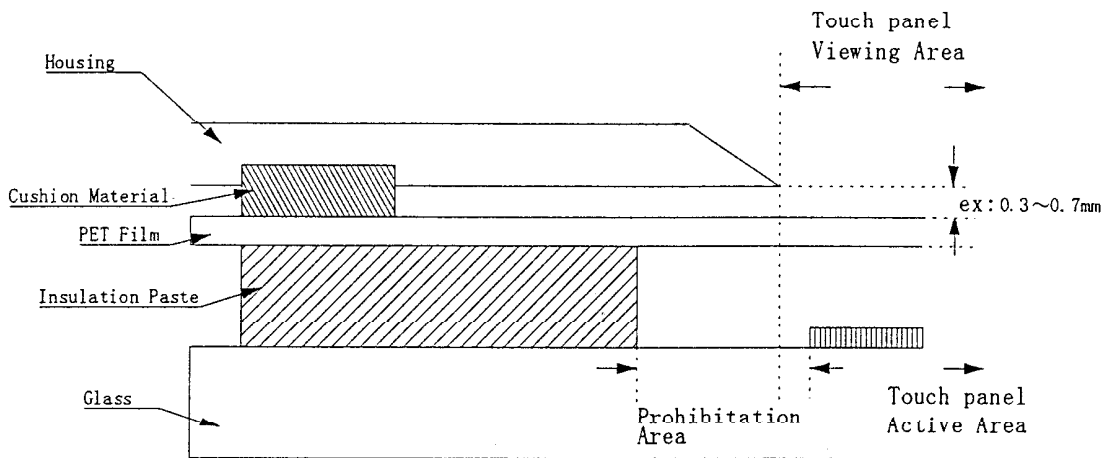
Fig. 1
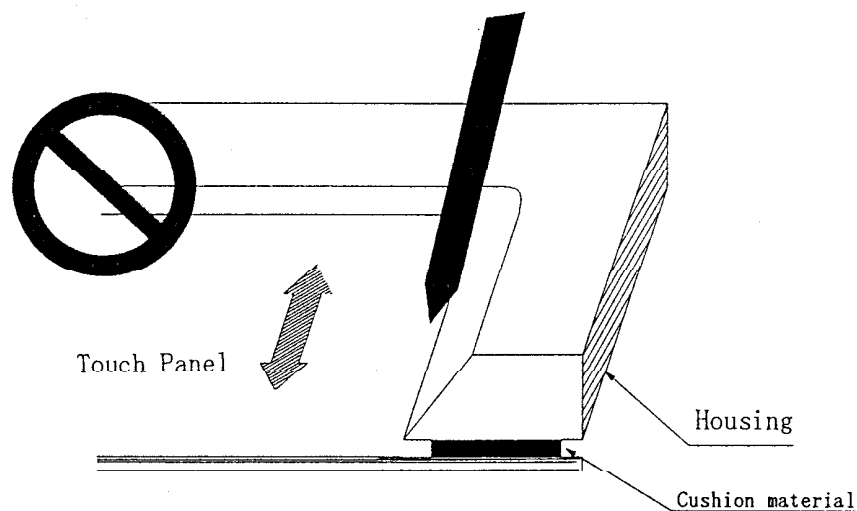
Fig. 2

1 5. Lot Number Identification

The lot number shall be indicated on the back of the backlight case of each LCD.

KCS057QV1AD-G23- □ □-□ □

DATE
MONTH
YEAR
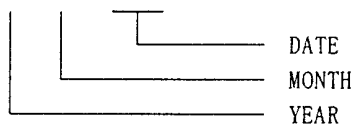
YEAR	1999	2000	2001	2002	2003	2004
CODE	9	0	1	2	3	4

MONTH	JAN.	FEB.	MAR.	APR.	MAY	JUN.
CODE	1	2	3	4	5	6

MONTH	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
CODE	7	8	9	X	Y	Z

1 6. Warranty

16-1. Incoming inspection

Please inspect the LCD within one month after your receipt.

16-2. Production Warranty

Kyocera warrants its LCDs for a period of 12 months after receipt by the purchaser, and within the limits specified. Kyocera shall, by mutual agreement, replace or rework defective LCDs that are shown to be Kyocera's responsibility.

17-1. Installation of the LCD

1. Please ground either of the mounting (screw) holes located at each corner of an LCD module, in order to stabilize brightness and display quality.

2. A transparent protection plate shall be added to protect the LCD and its polarizers.

3. The LCD shall be installed so that there is no pressure on the LSI chips.

4. The LCD shall be installed flat, without twisting or bending.

5. The display window size should be the same as the effective viewing area.

6. In case you use outside frame of effective viewing area as outward appearance of your product, unevenness of its outward appearance is out of guarantee.

7. Do not pull the CFL lead wires and do not bend the root of the wires. Housing should be designed to protect CFL lead wires from external stress.

17-2. Static Electricity

1. Since CMOS ICs are mounted directly onto the LCD glass, protection from static electricity is required. Operation should wear ground straps.

17-3. LCD Operation

1. The LCD shall be operated within the limits specified. Operation at values outside of these limits may shorten life, and/or harm display images.

2. Vop must be adjusted to optimize viewing angle and contrast.

3. Operation of the LCD at temperature below the limit specified may cause image degradation and/or bubbles. It may also change the characteristics of the liquid crystal. This phenomenon may not recover. The LCD shall be operated within the temperature limits specified.

17-4. Storage

1. The LCD shall be stored within the temperature and humidity limits specified. Store in a dark area, and protected the LCD from direct sunlight or fluorescent light.

2. The LCD should be packaged to prevent damage.

17-5. Screen Surface

1. <u>DO NOT</u> store in a high humidity environment for extended periods. Image degradation, bubbles, and/or peeling off of polarizer may result.

2. The front polarizer is easily scratched or damaged. Prevent touching it with any hard material, and from being pushed or rubbed.

3. The LCD screen may be cleaned with a soft cloth or cotton pad. Methanol, or Isopropyl Alcohol may be used, but insure that all solvent residue is removed.

4. Water may cause damage or discoloration of the polarizer. Clean any condensation or moisture from any source immediately.

5. Always keep the LCD free from condensation during testing. Condensation may permanently spot or stain the polarizers.

18. Reliability Data / Environmental Test

TEST ITEM	TEST CONDITION	TEST TIME	RESULT
High Temp. Atmosphere	70℃	240 Hr.	Display Quality : No defect Display Function : No defect Current Consumption : No defect
Low Temp. Atmosphere	-20℃	(120) Hr.	Low Temp. Bubble : None Solid Crystallization of Liquid Crystal : None Display Quality : No defect Display Function : No defect Current Consumption : No defect
High Temp. Humidity Atmosphere	40℃ 90%RH	240 Hr.	Display Quality : No defect Display Function : No defect Peel-off of Organic Sealing : None Current Consumption : No defect
Temp. Cycle	-20℃ 0.5 Hr. R.T. 0.5 Hr. 70℃ 0.5 Hr.	10cycles	Display Quality : No defect Display Function : No defect Peel-off of Organic Sealing : None Bubble on Cell : None
High Temp. Operation	60℃ Vop	500 Hr.	Display Quality : No defect Current Consumption : No defect
Finger Touch	silicon rubber (3φ, R3, Hs60) hitting force 300g hitting speed twice a second	one million times	Display Quality : No defect Current Consumption : No defect (Hs:Hardness)
Writing Friction	polyacetal slide force 250g slide speed 130mm/sec slide distance 25mm one way	a hundred thousand times	Display Quality : No defect Current Consumption : No defect

* Each test item uses a test LCD only once. The tested LCD is not used in any other tests.

* The LCD is tested in circumstances in which there is no condensation.

* The tested LCD is inspected after 24 hours of storage at room temperature and room humidity after each test is finished.

* The reliability test is not an out-going inspection.

* The result of the reliability test are for your reference purpose only. The reliability test is conducted only to examine the LCD's capability.

SECTION A-A

insert direction →
connector
13
PCB

Terminal Surface
0.3 ±.01

3.5 ±.03 (Bezel)
6.3 ±.03 (Bezel)

114.8
106.8 ±.03
2-4 min
83.5
53.4 ±.03
8.2
99 (Touch Panel)
10 ±1
2-φ3.2 ±0.05 HOLE

2-4 min
70 ±.2
18.1
No 15
CN 1
No 01
A
A

65.9
2.51
2.51
L-R0.5

Active Area (115.8×86.38)
Touch Panel Key Area
Viewing Area (118.18×89.38)
Touch Panel Viewing Area
Bezel Opening (120.20±0.3×91.40±0.3)
Bezel opening Center
320(H)(R,G,B)*240(V) dots

129.5 (Touch Panel)
81 ±.05
148.6 ±.03
151.6
55 ±.10
65

63.6

2-4 min
2-4 min
2-3.2 ±0.15
73
81 ±.03

No 3(White)
No 2(Red)
CN2

DETAIL B (3/1)
P125X3 = 3.75
6.25 ±.03
125 ±.03
0.8 ±.02
L-R0.5
5.2
No.1 yU
No.2 xL
No.3 yL
No.4 xR

Note
1. connectors CN1: 53261-1510 (MOLEX)
   CN2: BHR-03VS-1(JST)
2. Matching Connector: 51021-1500 (MOLEX)
   SM02-(8.0)B-BHS-1(JST)
3. Recommended Matching Connector(Touch Panel)Series 6216 (ELCO)
   Series FE-FFS(JST)
4. The drawing seen from the front, information is displayed
   on the screen in the direction of from the upper hand
   left corner to the right.
5. Tolerance without indication ±0.5

Touch Panel Pin-assign
yU
xL
yL
xR
xL
yU
yL
xR

Replaceable Lamp Unit

2.5 ±.03
3
1.8
10.3
8.5

DOT SIZE
P0.36
0.34
P0.12
0.10
R G B
R G B
0.34
P0.36

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FOR : KICC

KYOCERA INSPECTION STANDARD

TYPE : KCS057QV1AD-G23

This specification is subject to change without notice.
Consult Kyocera before ordering.

Original	Designed by :Engineering Dept.			Confirmed by :QA Dept.	
Issue Data	Prepared	Checked	Approved	Checked	Approved
March 10, 1999	S. Kojima	K. Yaga	T. Minami	S.Hayashi	Y. Yoshita
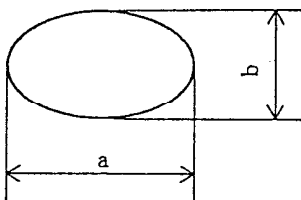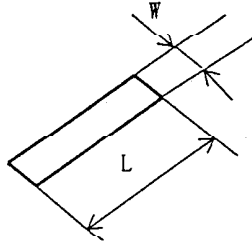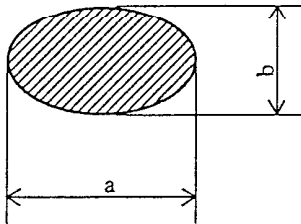
Revision   Record

Date	Designed by : Engineering Dept.			Confirmed by : QA Dept.	
	Prepared	Checked	Approved	Checked	Approved

Rev. No.	Date	Page	Descriptions
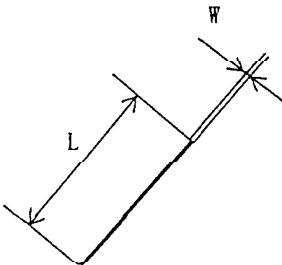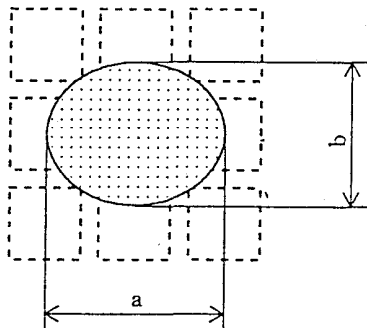
Visuals specification

1)Note

Item	Note	
General	1.When defects specified in this Inspection Standards are inspected, operating voltage(Vop) shall be set at the level where optimized contrast is available. Display quality is applied up to effective viewing area. (Bi-Level INSPECTION) 2.This inspection standard about the image quality shall be applied to any defect within the effective viewing area and shall not be applicable to outside of the area. 3.Should any defects which are not specified in this standard happen, additional standard shall be determined by mutual agreement between customer and Kyocera. 4.Inspection conditions Luminance : 500 Lux minimum . Inspection distance : 300 mm (from the sample) Temperature : 25 ± 5 ℃ Direction : right above	
Definition of Inspection item	Pinhole, Bright spot Black spot, Scratch Foreign particle	The color of a small area is different from the remainder. The phenomenon dose not change with voltage.
	Contrast variation	The color of a small area is different from the remainder. The phenomenon changes with voltage.
	Polarizer (Scratch, Bubble, Dent)	Scratch, Bubble and Dent in the polarizer which can be observed in on / off state.

2) Standard

Inspection item	Judgement standard
Pinhole, Bright spot Black spot, Foreign particle	 d = (a + b) / 2 	Category	Size (mm)	Acceptable number
---	---	---
A	d ≦ 0.2	neglected
B	0.2 < d ≦ 0.3	5
C	0.3 < d ≦ 0.5	3
D	0.5 < d	0	
Scratch,Foreign particle	 |	Width (mm)	Length (mm)	Acceptable No.
---	---	---	---
A	W ≦ 0.03	—	neglected
B		L ≦ 2.0	neglected
C	0.03< W ≦0.1	2.0 < L ≦ 4.0	3
D		4.0 < L	0
E	0.1 < W	—	According to 'Circular'	
Contrast variation	 d = (a + b) / 2 	Category	Size (mm)	Acceptable number
---	---	---
A	d ≦ 0.5	neglected
B	0.5 < d ≦ 0.7	3
C	0.7 < d	0	

Inspection item	Judgement standard
Polarizer (Scratch, Bubble, Dent)	(1) Scratch

	Width (mm)	Length (mm)	Acceptable No.
A	W ≦ 0.1	—	neglected
B	0.1 < W ≦ 0.3	L ≦ 5.0	neglected
C		5.0 < L	0
D	0.3 < W	—	0

(2) Bubble (dent)

$$d = (a + b) / 2$$

Category	Size (mm)	Acceptable number
A	d ≦ 0.2	neglected
B	0.2 < d ≦ 0.3	5
C	0.3 < d ≦ 0.5	3
D	0.5 < d	0