SPEC. NO.	TQ3C-8EAC0-F1CW002-00
DATE	JUNE 20, 2000

SPEC

FOR:

TYPE:KRS038AA0AL-G25

CONTENTS

KYOCERA CORPORATION
KAGOSHIMA HAYATO PLANT
LCD DIVISION

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

Original Issue Data	Designed by :Engineering Dept.			Confirmed by :QA Dept.	
	Prepared	Checked	Approved	Checked	Approved
June 20, 2000		M. Fujitani			T. Uchino

Revision Record

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

Rev. No.	Date	Page	Descriptions

Caution

1. This general specification can be changed, just for your reference only. Kyocera will release specification later exclusive for you. Please refer to it as the formal document of specification.

2. This LCD is supposed to be for general electric appliances such as audio, office automation, industrial applications, home appliances and game machines. Do not use the LCD as a display for a medical instrument that is required extremely high reliability and its failure and malfunction may affect human lives. In the case you did, Kyocera will not take responsibility for it.

3. Kyocera may scrap the tooling or stop supplying the LCD, after 2 year time frame from your latest purchase of the LCD.

1. Application

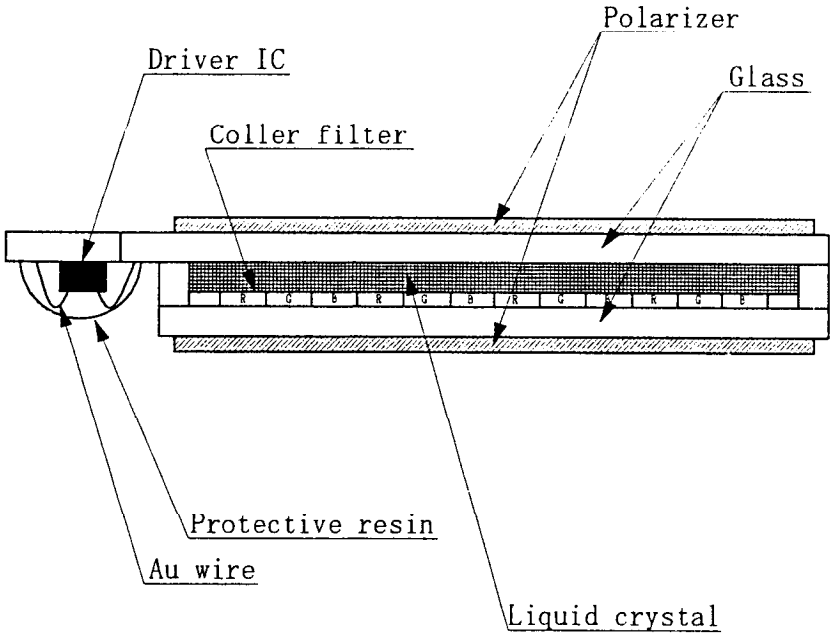
This data sheet defines the specification for a (240×3)×320 dot, STN reflective color dot matrix type Liquid Crystal Display.

2. Construction and Outline

(240×3)×320 dots, COB type LCD.

Polarizer : Glare treatment.

Additional circuit : None



This drawing is showing conception only.

3. Mechanical Specifications

ITEM	SPECIFICATION	UNIT
Outline dimensions	70.9 (W) × 89.5 (H) × 3.0max (D)	mm
Effective viewing area	59.6 (W) × 78.8 (H)	mm
Dot number	240×R.G.B (W) × 320 (H)	Dots
Dot size	0.06 (W) × 0.22 (H)	mm
Dot pitch	0.08 (W) × 0.24 (H)	mm
Display color *1	White *2	—
Base color *1	Black *2	—
Weight	(27)	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

4. Absolute Maximum Ratings

4-1 Electrical absolute maximum ratings

ITEM	SYMBOL	MIN.	MAX.	UNIT
Supply voltage for logic	VDD	0	7.0	V
Supply voltage for LCD driving *1	V0-V5	0	38.0	V
Input voltage *2	Vin	0	VDD	V

*1 V0 ≧ V1 ≧ V2 ≧ V3 ≧ V4 ≧ V5 = 0(V)

*2 Input voltage : CP, LOAD, FRM, DF, DISP, D0～D7

4-2 Environmental absolute maximum ratings

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

*1 Temp. = -20℃ < 48 Hr. , Temp = 60℃ < 168 Hr.
Store LCD panel at normal temperature/humidity. Keep it free from vibration and shock. LCD panel that is kept at low or high temperature for a long time can be defective due to the other conditions, even if the temperature satisfies standard

*2 Non-condensation.

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

5. Electrical Characteristics

ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Supply voltage for logic	VDD	—	3.0	3.3	3.6	V
LCD driving voltage *1	Vop= V0-V5	0 ℃	29.9	30.9	31.9	V
		25 ℃	29.1	30.1	31.1	V
		50 ℃	28.3	29.3	30.3	V
Input voltage	Vin	"H" level	0.8VDD	—	VDD	V
		"L" level	0	—	0.2VDD	V
Clock frequency	fcp		2.02	2.16	10.0	MHz
Frame frequency *2	f_{FRM}		70	75	—	Hz
Randomizing frequency *3	f_{DF}		300	—	800	Hz
Current consumption for logic	IDD	*5	—	0.8	1.0	mA
		*6	—	0.6	0.8	
Current consumption for LCD driving *4	IEE	*5	—	2.4	3.1	mA
		*6	—	1.1	1.4	
Power consumption *4	Pdisp	*5	—	74	99	mW
		*6	—	35	46	

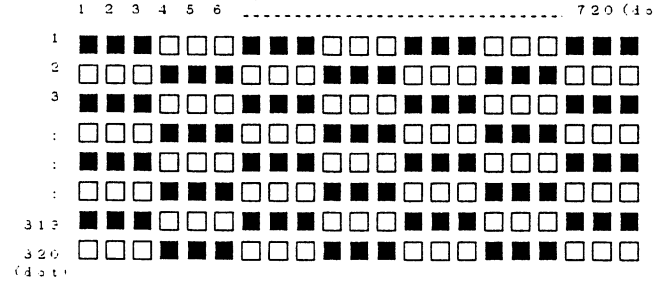
*1 Maximum contrast ratio is obtained by adjusting the LCD supply voltage (Vop= V0-V5) for driving LCD.

*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.

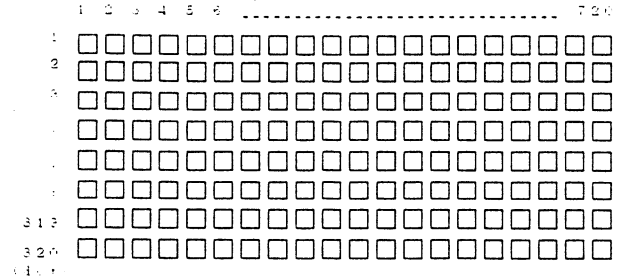
*3 It is recommended that randomizing frequency be set in the range of 300-800Hz. At finalizing the frequency ,confirm with actual tests that phenomena like flickering and/or horizontal lines do not appear on screen.

*4 Include recommended circuit. Refer 17.recommended additional circuit.

*5 Display high frequency pattern, (see below).
VDD = 3.3V , Vop = V0-V5 , f_{FRM} = 75 Hz , fcp = 2.16MH



*6 Display high frequency pattern, (see below).
VDD = 3.3V , Vop = V0-V5 , f_{FRM} = 75 Hz , fcp = 2.16MHz



6. Optical Characteristics

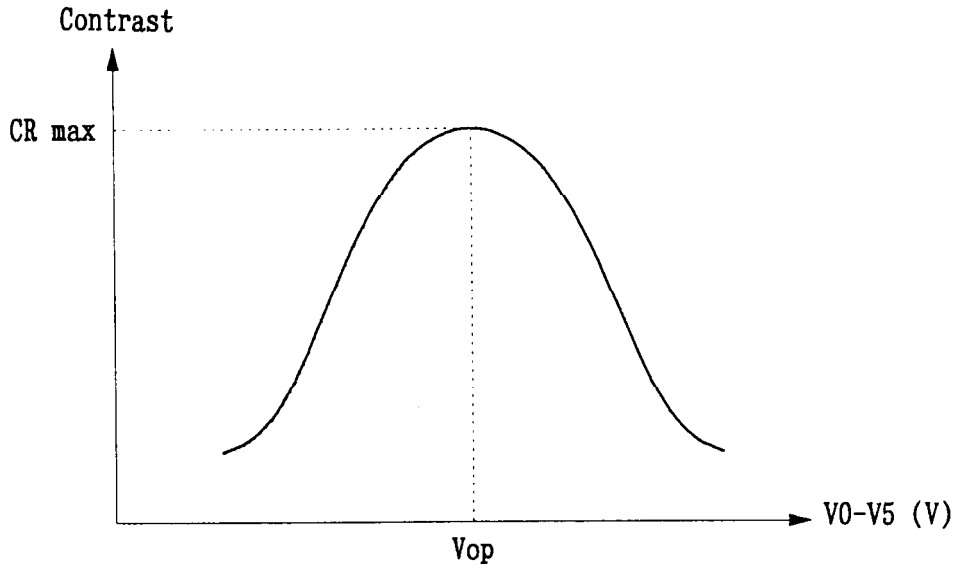
6-1. Reflective mode

Measuring Spot = ϕ6mm , Temp. = 25℃

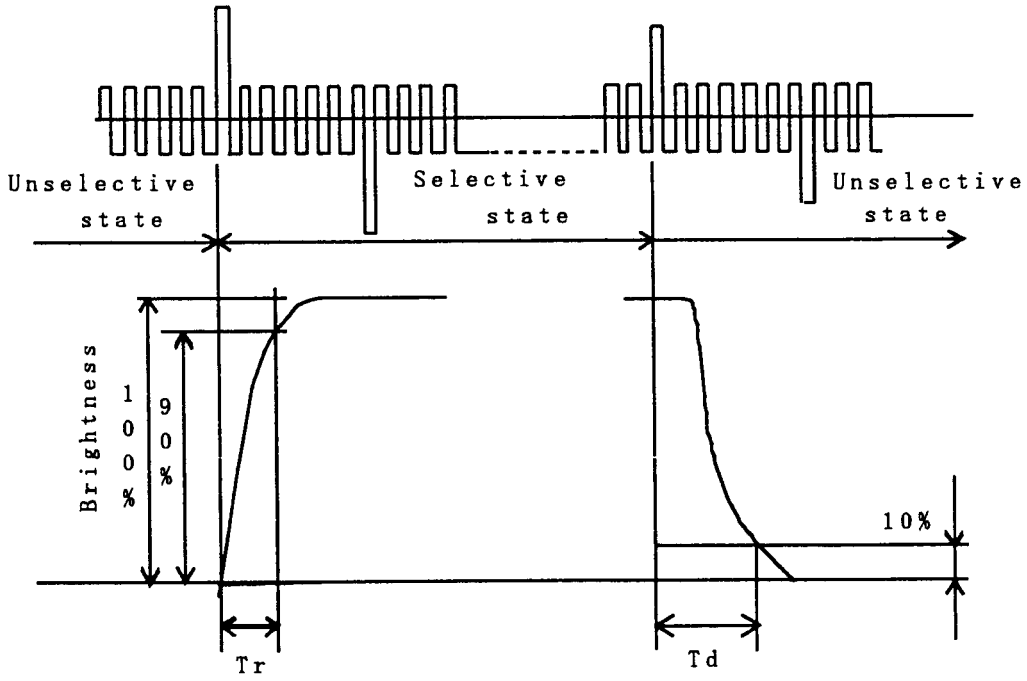
ITEM		SYMBOL	CONDITION		MIN.	TYP.	MAX.	UNIT
Response time	Rise	Tr	$\theta = \phi = 0^{\circ}$		—	250	350	ms
	Down	Td	$\theta = \phi = 0^{\circ}$		—	150	250	ms
Viewing angle range		θ	CR≧2	$\phi = 0^{\circ}$	-50	—	50	deg.
		ϕ		$\theta = 0^{\circ}$	-30	—	40	deg.
Contrast ratio		CR	$\theta = \phi = 0^{\circ}$		3.5	7.0	—	—
Reflectance		ρ	—		8.0	16.0	—	%
Chromaticity coordinates	White	x	$\theta = \phi = 0^{\circ}$		0.26	0.31	0.36	—
		y			0.28	0.33	0.38	

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

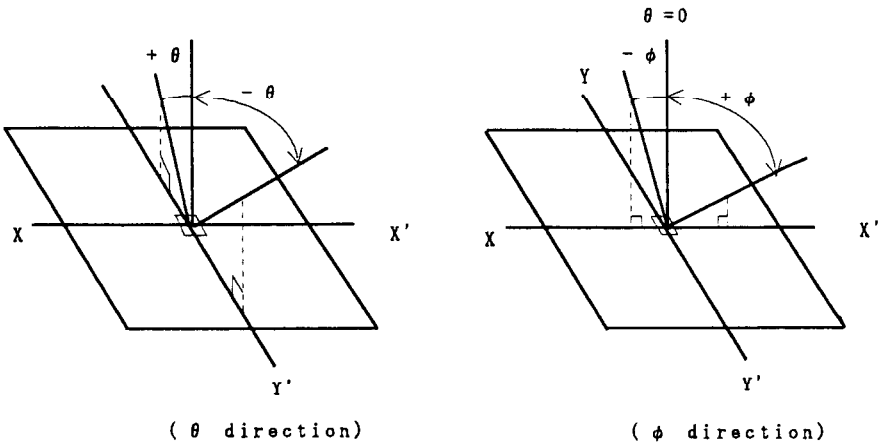
6-2. Definition of Vop



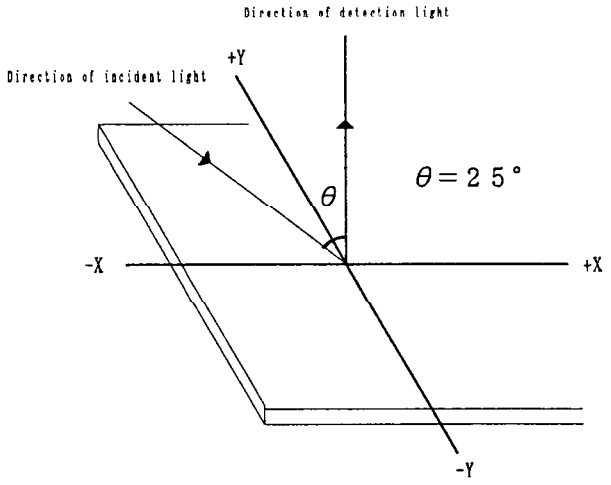
6-3. Definition of response time



6-4. Definition of viewing angle



6-5. Measurement method of reflectance



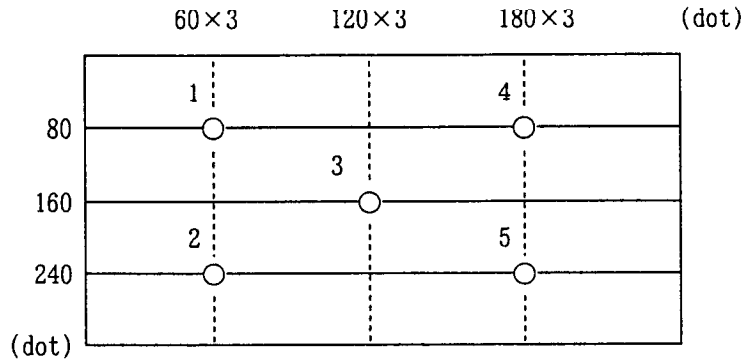
6-6. Definition of Contrast (Reflective Mode)

$$\text{C R(Contrast)} = \frac{\text{Reflectance at all pixels "White"}}{\text{Reflectance at all pixels "Black"}}$$

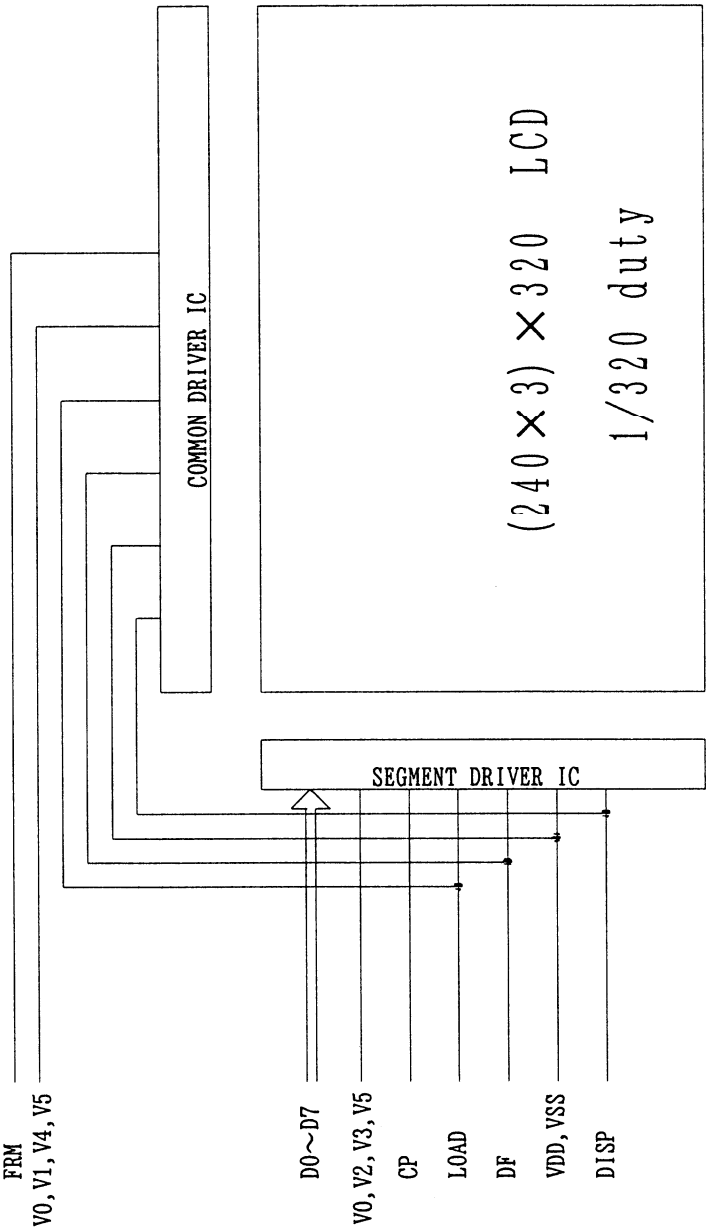
6-7. Definition of Reflectance:

$$\rho\text{(Reflectance)} = \frac{\text{Measured Reflection Brightness}}{\text{Reflection Brightness against Standard White Board}}$$

6-8. Measuring points



7 . Circuit Block Diagram



8. Interface signals

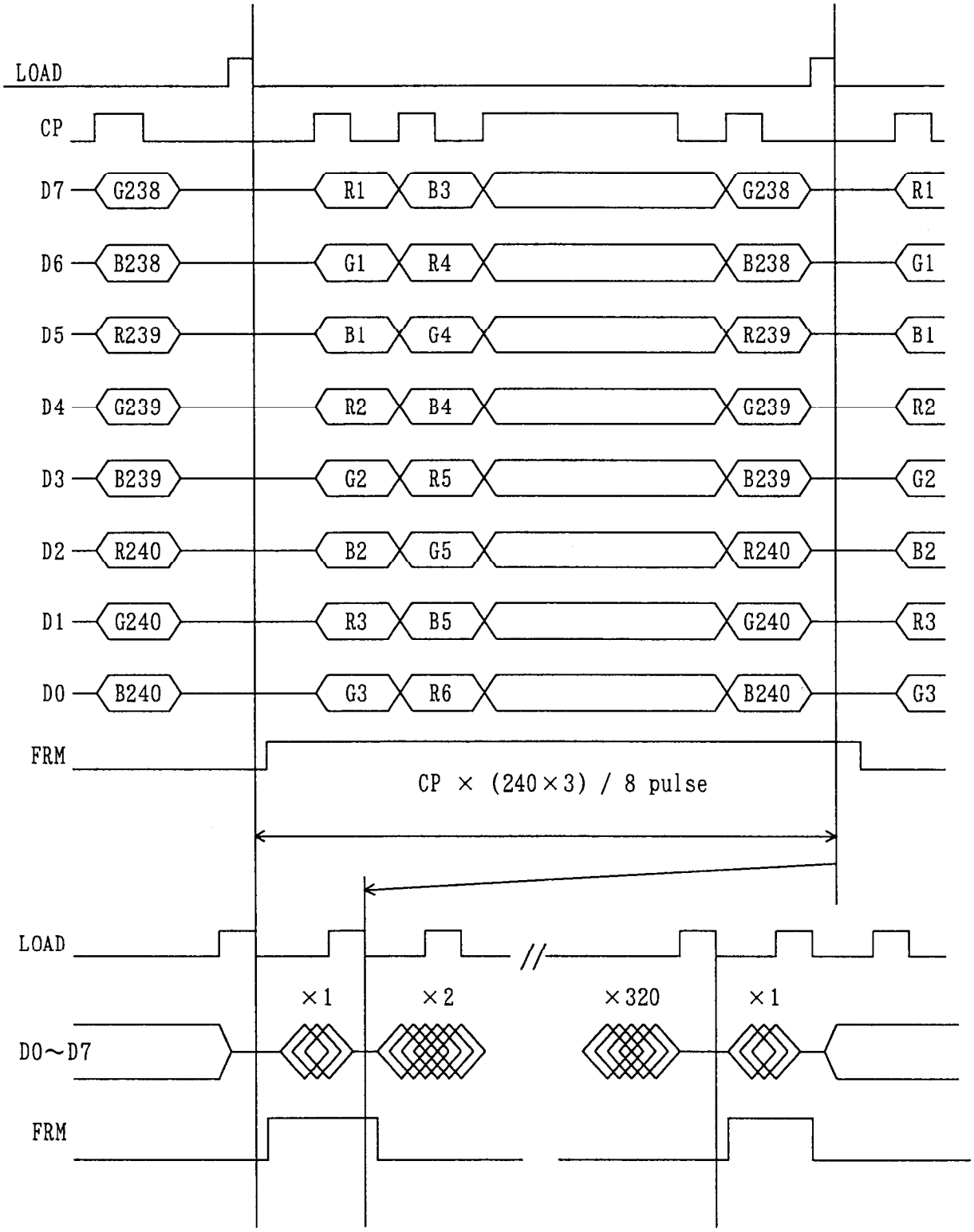
LCD

CN1 :

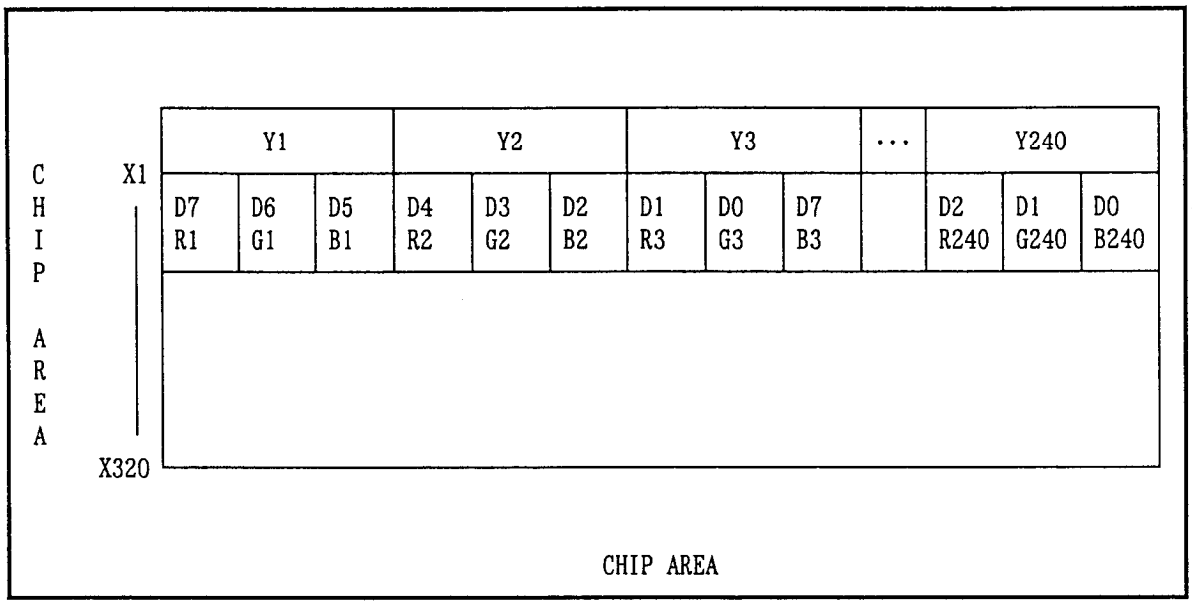
PIN NO.	SYMBOL	DESCRIPTION	LEVEL
1	FRM	Synchronous signal for driving scanning line	H
2	LOAD	Data signal latch clock	H → L
3	CP	Data signal shift clock	H → L
4	DISP	Display control signal	H(ON),L(OFF)
5	VDD	Power supply for logic	—
6	VDD	Power supply for logic	—
7	VSS	GND	—
8	DF	AC signal for driving	—
9	V0	*	—
10	V1	*	—
11	V2	*	—
12	V3	*	—
13	V4	*	—
14	V5	*	—
15	D7	Display data	H(ON),L(OFF)
16	D6		
17	D5		
18	D4		
19	D3		
20	D2		
21	D1		
22	D0		

*V0 ~ V5 : Refer 17. Recommended Bias Votage Circuit for driving LCD.

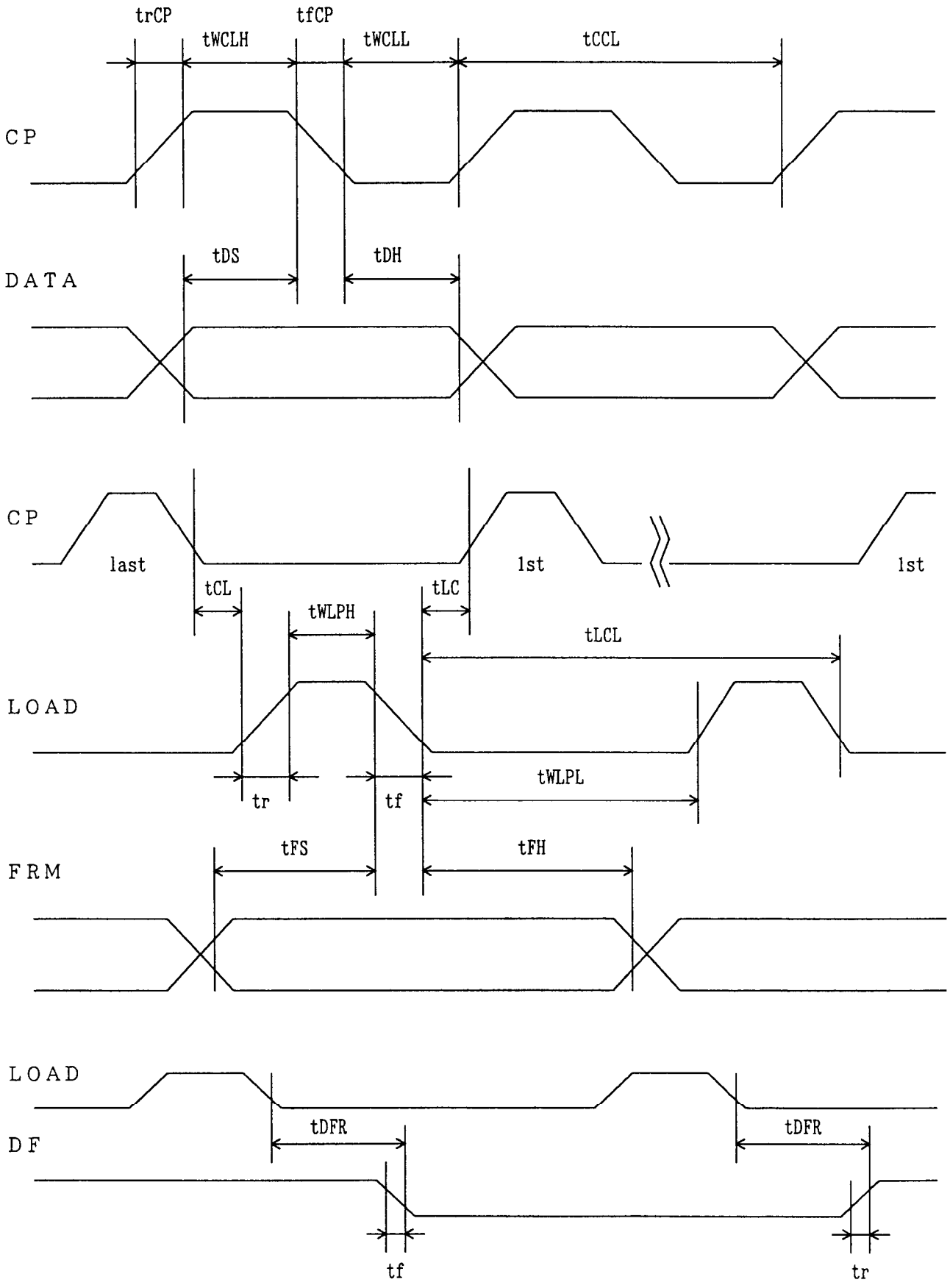
9 . Interface Timing Chart



1 0 . Data and Screen



11.Input Timing Characteristics



11-1.Switching characteristics

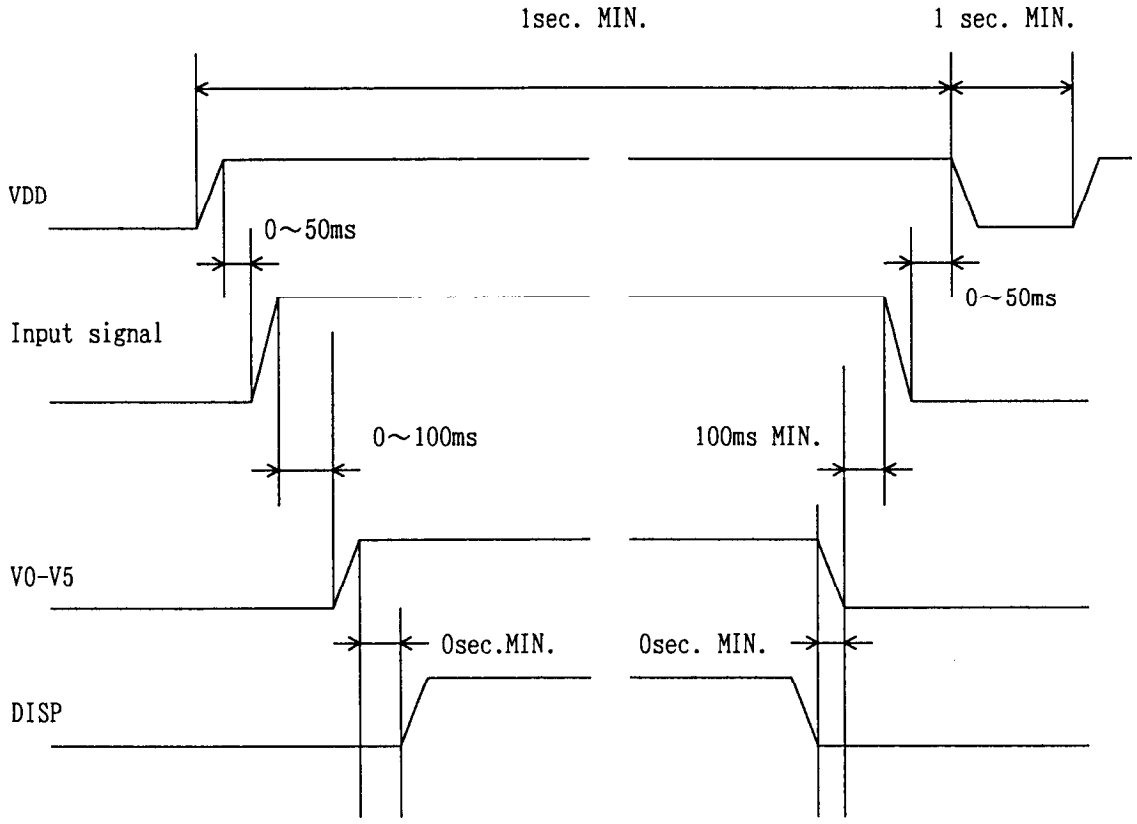
Input characteristics ; VDD = +3.3V ± 0.3V, Temp. = 25 ℃

ITEM	SYMBOL	MIN.	MAX.	UNIT
CP Cycle *1,*2	tCCL	100	—	ns
CP "H" Pulse Width *2	tWCLH	40	—	ns
CP "L" Pulse Width *2	tWCLL	40	—	ns
CP Rise Up Time *2	trCP	—	30	ns
CP Fall Down Time *2	tfCP	—	30	ns
Data Set Up Time	tDS	25	—	ns
Data Hold Time	tDH	20	—	ns
LOAD "H" Pulse Width	tWLPH	100	—	ns
LOAD "L" Pulse Width	tWLPL	4900	—	ns
LOAD Cycle *3	tLCL	5000	—	ns
CP→LOAD Delay Time	tCL	0	—	ns
LOAD→CP Delay Time *4	tLC	200-tWLPH	—	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
DF Delay Time	tDFR	—	300	ns

*1 CP Cycle is adjust so that FRM signal is 75Hz.
*2 The formula of condition
①trCP + tfCP ≦ tCCL - (tWCLH + tWCLL)
②trCP,tfCP ≦ 30 ns
Please use on condition that ①,② are filled.
*3 LOAD Cycle is const.
*4 tLC ≧ 0

1 2 . 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, V0-V5 third and finally DISP. This will prevent DC driving of the LCD or CMOS LSI latch up as shown below.



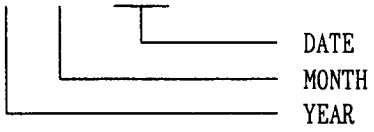
* The above sequence should be designed as to keep each normal figure on condition that liquid crystal module is loaded on your system.

* Control the input signal and V0 - V5 to the above ON - OFF timing when you switch ON/OFF the display during VDD and DISP are on.
And also design the circuit as V0 - V5's OFF level become GND level.

13. Lot Number Identification

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

KRS038AA0AL-G25- □ □-□ □



YEAR	2000	2001	2002	2003	2004	2005
CODE	0	1	2	3	4	5

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

14. Warranty

14-1. Incoming inspection

Please inspect the LCD within one month after your receipt.

14-2. 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.

15. Precautions for use

15-1. Installation of the LCD

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

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

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

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

5. 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.

15-2. Static Electricity

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

2. Aluminum foil covering the terminal electrodes should remain in place until installed.

15-3. 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.

15-4. 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.

15-5. Screen Surface

1. DO NOT 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.

16. Reliability Data / Environmental Test

TEST ITEM	TEST CONDITION	TEST TIME	RESULT
High Temp. Atmosphere	70 °C	240 Hr.	Display Quality : No defect Display Function : No defect Current Consumption : No defect
Low Temp. Atmosphere	-20 °C	240 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 °C 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 °C 0.5 Hr. R.T. 0.5 Hr. 70°C 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	50 °C Vop	500 Hr.	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.

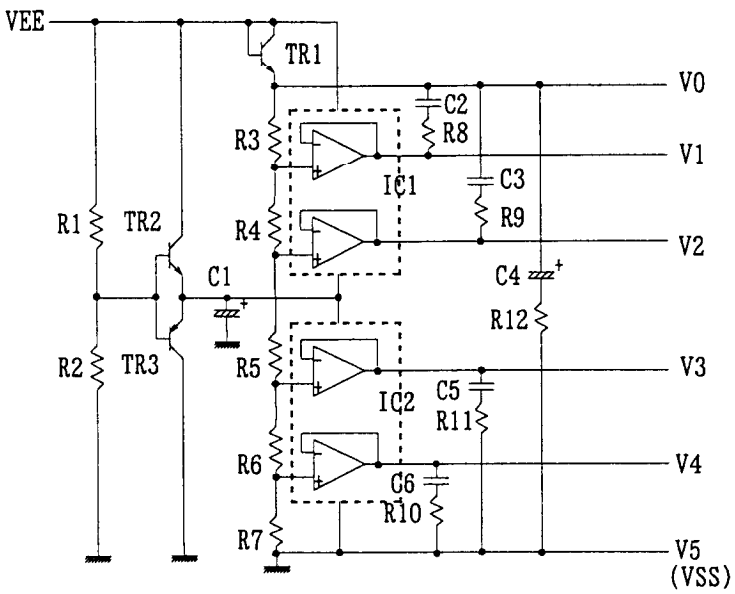
* The LCD is tested in circumstances in which there is no condensation.

* 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.

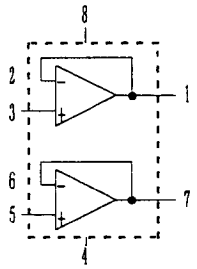
* The results of the reliability test are for your reference purpose only.
The reliability test is conducted only to examine the LCD's capability.

17. Recommended additional circuit
a) Recommended Bias Voltage for Driving LCD



R3,4 = 15.0kΩ ± 0.5%
R6,7 = 15.0kΩ ± 0.5%
R5 = 220.0kΩ ± 1.0%

IC1, IC2



These value above are theoreticaly calculated. Fine tuning might be required in some cases.
For fine tuning value of the resistor shall be adjusted to conform with the follwing equation.

| V0-V1 | = | V1-V2 | = | V3-V4 | = | V4-V5 |

Recommended parts for Bios voltage circuit

①SEMI CONDUCTOR

Symbol	Type	Maker Name	note
IC1	MC33172D	MOTOROLA	
IC2	MC33172D	MOTOROLA	
TR1	2SC2412K	ROHM	
TR2	2SC2412K	ROHM	
TR3	2SA1037AK	ROHM	

②RESISTOR

Symbol	Characteristic	Example(Maker Name)	note
R1	100K/1608/J	CR10-104J	(KYOCERA)
R2	100K/1608/J	CR10-104J	(KYOCERA)
R3	15K/1608/D	RR0816R-153-D	(SUSUMU)
R4	15K/1608/D	RR0816R-153-D	(SUSUMU)
R5	220K/1608/F	RK73H1J-220KΩF	(KOA)
R6	15K/1608/D	RR0816R-153-D	(SUSUMU)
R7	15K/1608/D	RR0816R-153-D	(SUSUMU)
R8	15Ω/1608/J	CR10-150J	(KYOCERA)
R9	15Ω/1608/J	CR10-150J	(KYOCERA)
R10	15Ω/1608/J	CR10-150J	(KYOCERA)
R11	15Ω/1608/J	CR10-150J	(KYOCERA)
R12	15Ω/1608/J	CR10-150J	(KYOCERA)

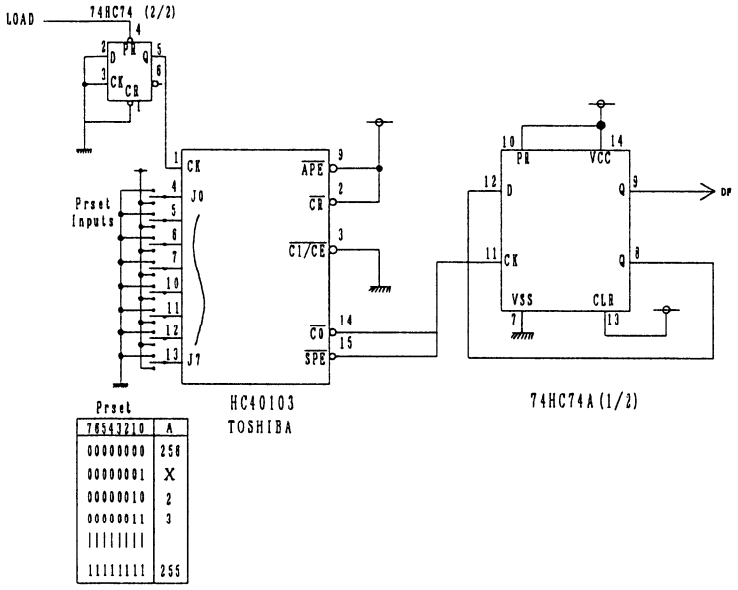
③CAPACITOR

Symbol	Characteristic	Example(Maker Name)	note
C1	4.7μ/35V	MF35FD4R7MC6 (NIPPON CHEMI-CON)	Electrolytic capacitor
C2	B/4.7μF/10V/3216/M	LMK316BJ475ML (TAIYO YUDEN)	Ceramic Capacitor
C3	B/4.7μF/10V/3216/M	LMK316BJ475ML (TAIYO YUDEN)	Ceramic Capacitor
C4	4.7μ/50V	MF50FD4R7MC8 (NIPPON CHEMI-CON)	Electrolytic capacitor
C5	B/4.7μF/10V/3216/M	LMK316BJ475ML (TAIYO YUDEN)	Ceramic Capacitor
C6	B/4.7μF/10V/3216/M	LMK316BJ475ML (TAIYO YUDEN)	Ceramic Capacitor

b) Example of Randomizing Circuit

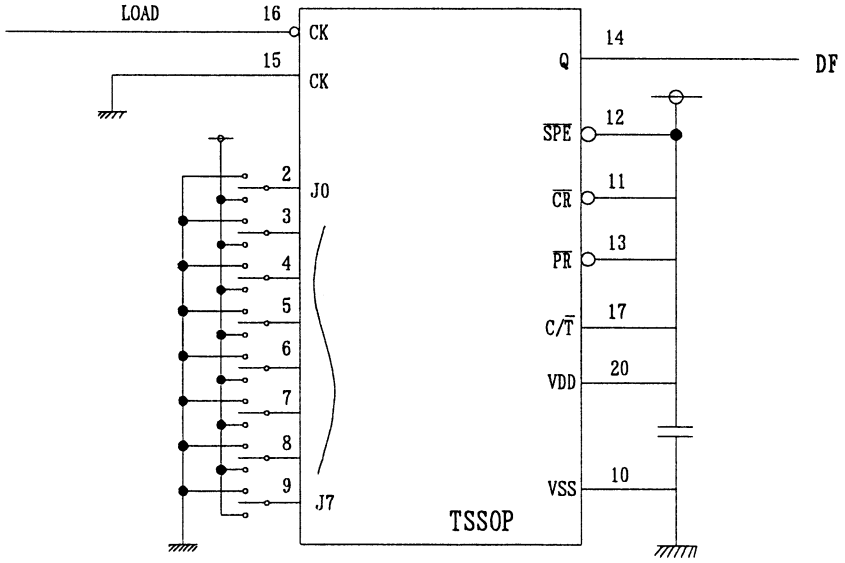
Randomizing circuit is recommended in order to reduce "cross-talk" phenomenun of displayed images. (Tailing, vertical strips,etc)
Its detail is subject to change according to actual operating condition and application of the LCD . Should you have any question when installing an actual randomizing circuit, please ask Kyocera for details .

b-1)



There may be flickering on screen according to some LOAD signal frequencies. If in happens , set PRESET INPUTS terminals to select optimized conditions .

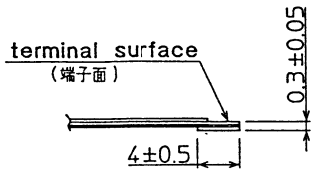
b-2)

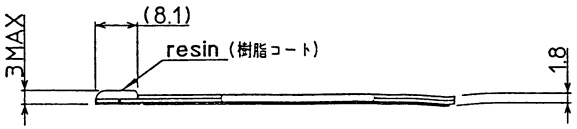


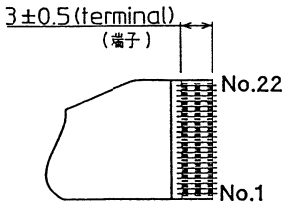
HD151011TEL

HITACHI

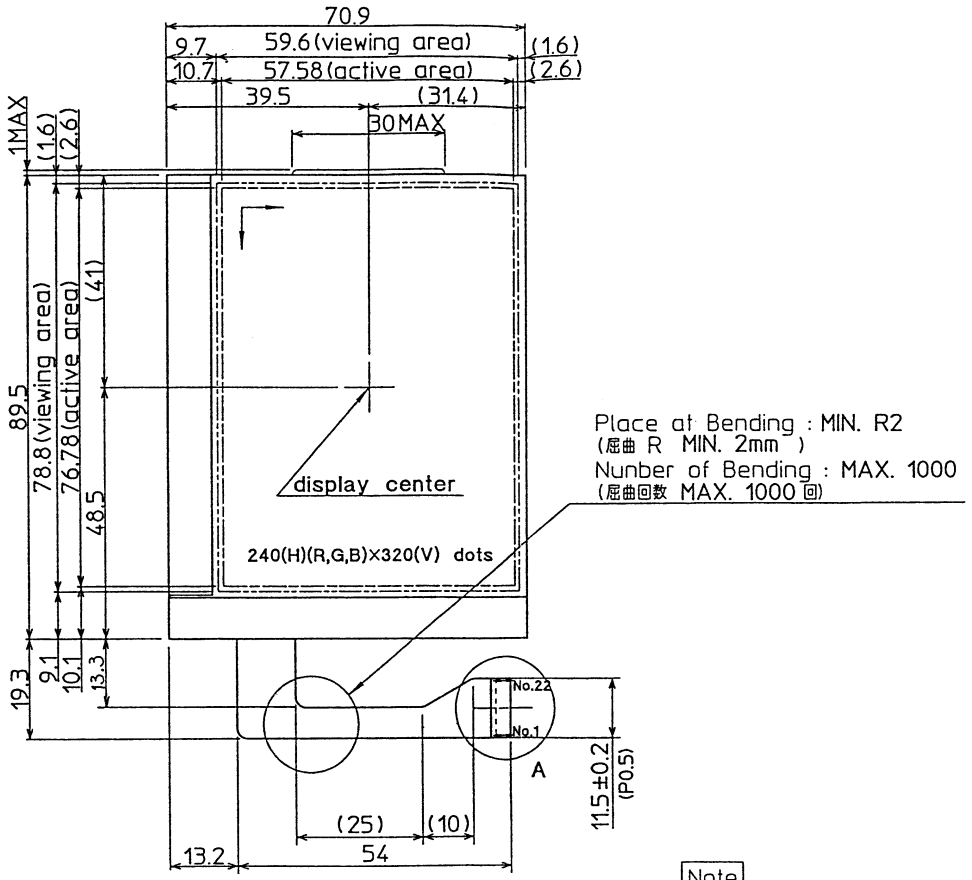
Rev	No	Description	Drwn	Chk	App



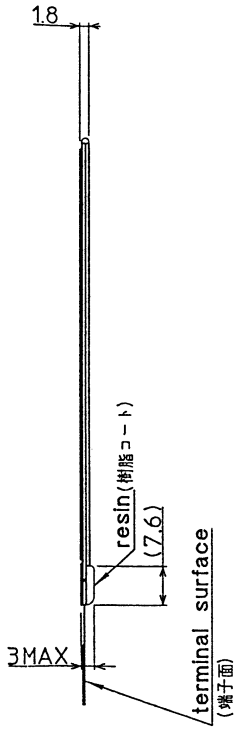


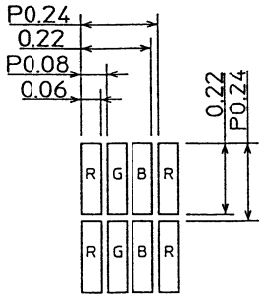


DETAIL A 2:1



Place at Bending : MIN. R2
(屈曲 R MIN. 2mm)
Number of Bending : MAX. 1000
(屈曲回数 MAX. 1000 回)





DOT SIZE

Note

1 FPC Matching Connector : 22FLH-SM1 (JST)
(FPC適合コネクター) 04 6239 022 001 800 (ELCO)

2 The drawing is the front view of the LCD. Information is displayed starting at the upper left hand corner, moving right then down to the lower right hand corner.
(LCDの正面図において、画像データの表示は左上コーナーから始まり、右へ進み下へ送られ右下コーナーへ向かう。)

3 Tolerance without indication; ±0.5
(指示無き公差)

Material 材質	Treatment 処理	Approved	Checked	Drawn	Traced	Scale	Title	KYOCERA	Year-Month-Day	Size
		'00.05.31	'00.05.31			1:1	KRS038AA0AL		00.05.30	3
Quantity 製作数	Description; 備考			今村			Outline Dimensions	Drawing No.	121A5001200	

SPEC. NO.	TQ3C-8EAC0-E2CW002-00
DATE	JUNE 20, 2000

FOR:

KYOCERA INSPECTION STANDARD

TYPE : KRS038AA0AL-G25

KYOCERA CORPORATION
KAGOSHIMA HAYATO PLANT
LCD DIVISION

Original	Designed by :Engineering Dept.			Confirmed by :QA Dept.	
Issue Data	Prepared	Checked	Approved	Checked	Approved
June 20, 2000	K. Yogo	M. Fujitani	J. Matsumoto	[illegible]	T. Uchinono

Revision Record

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

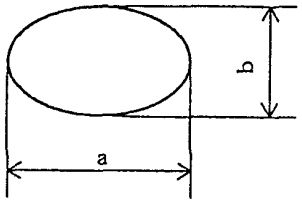
Rev. No.	Date	Page	Descriptions

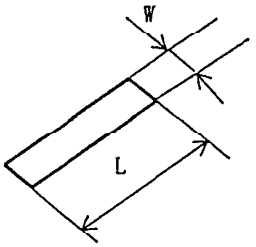
Visuals specification

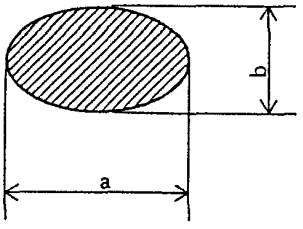
1) Note

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.

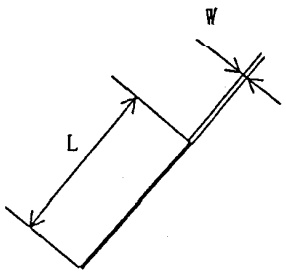
2) Standard

<table>
<tr><th>Inspection item</th><th>Judgement standard</th></tr>
<tr><td>Pinhole, Bright spot
Black spot,
Foreign particle</td><td>


d = (a + b) / 2
<table>
<tr><th>Category</th><th>Size (mm)</th><th>Acceptable number</th></tr>
<tr><td>A</td><td>d ≦ 0.2</td><td>neglected</td></tr>
<tr><td>B</td><td>0.2 < d ≦ 0.3</td><td>5</td></tr>
<tr><td>C</td><td>0.3 < d ≦ 0.5</td><td>3</td></tr>
<tr><td>D</td><td>0.5 < d</td><td>0</td></tr>
</table>
</td></tr>
<tr><td>Scratch, Foreign particle</td><td>


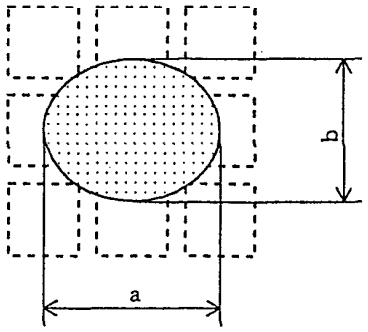
<table>
<tr><th></th><th>Width (mm)</th><th>Length (mm)</th><th>Acceptable No.</th></tr>
<tr><td>A</td><td>W ≦ 0.03</td><td>—</td><td>neglected</td></tr>
<tr><td>B</td><td rowspan="3">0.03< W ≦0.1</td><td>L ≦ 2.0</td><td>neglected</td></tr>
<tr><td>C</td><td>2.0 < L ≦ 4.0</td><td>3</td></tr>
<tr><td>D</td><td>4.0 < L</td><td>0</td></tr>
<tr><td>E</td><td>0.1 < W</td><td>—</td><td>According to ' Circular '</td></tr>
</table>
</td></tr>
<tr><td>Contrast variation</td><td>


d = (a + b) / 2
<table>
<tr><th>Category</th><th>Size (mm)</th><th>Acceptable number</th></tr>
<tr><td>A</td><td>d ≦ 0.5</td><td>neglected</td></tr>
<tr><td>B</td><td>0.5 < d ≦ 0.7</td><td>3</td></tr>
<tr><td>C</td><td>0.7 < d</td><td>0</td></tr>
</table>
</td></tr>
</table>

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