

FOR:KICC

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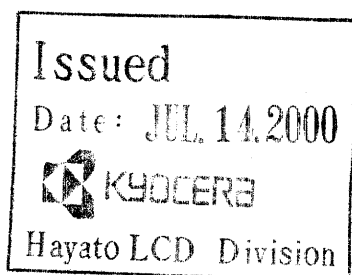
S P E C I F I C A T I O N

KHS038AA1AJ-G83

APPROVED BY : _____
(NAME PRINTED/TITLE)

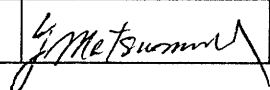
SIGNATURE : _____

DATE : _____



TENTATIVE

KYOCERA CORPORATION
KAGOSHIMA HAYATO PLANT
LCD DIVISION

Designed by :Engineering Dept.		
Prepared	Checked	Approved
T.Yamaguchi	M.Fujitani	

	SPEC.NO.	TQ3C-8EAC0-E1CWN08-00
	DATE	June 20.2000

S P E C

FOR : _____

TYPE : KHS038AA1AJ-G83

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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.	
Issue Data	Prepared	Checked	Approved	Checked	Approved
June 20.2000	T.Yamaguchi	M.Fujitani	J.Matsushima	S.Hayashi	J.Yoshida

Revision Record

Date	Designed by : Engineering Dept.			Confirmed by : QA Dept.	
	Prepared	Checked	Approved	Checked	Approved
Rev. No.	Date	Page	Descriptions		

Caution

- 1.This Kyocera LCD module has been specifically designed for use only in electronic devices in the areas of audio control, office automation, industrial control, home appliances, etc. The modules should not be used in medical applications where module failure could result in physical harm or loss of life, and Kyocera expressly disclaims any and all liability relating in any way to the use of the module in such medical applications.
- 2.Customer agrees to indemnify, defend and hold Kyocera harmless from and against any and all actions, claims, losses, damages, liabilities, awards, costs and expenses, including legal fees, resulting from or arising out of Customer's use, or sale for use, of Kyocera modules in medical applications.
- 3.Kyocera shall have the right, which Customer hereby acknowledges, to immediately scrap or destroy tooling for Kyocera modules for which no Purchase Orders have been received from the Customer in a two-year period.

1. Application

This data sheet defines the specification for a $(240 \times 3) \times 320$ dot, STN transfective color dot matrix type Liquid Crystal Display with CFL backlight.

2. Construction and Outline

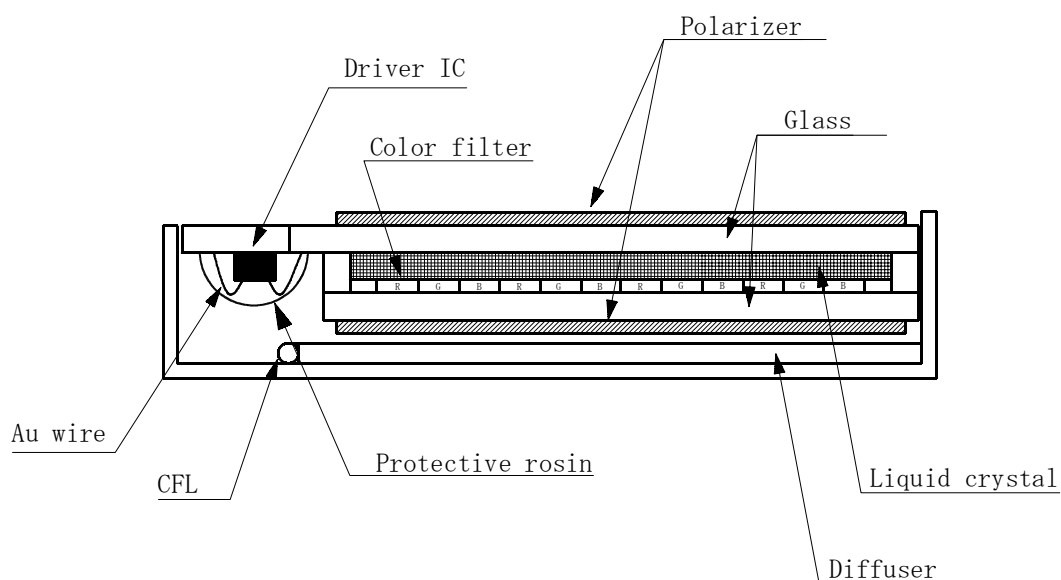
$(240 \times 3) \times 320$ dots, COB type LCD with CFL backlight.

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 : None



This drawing is showing conception only.

3. Mechanical Specifications

ITEM	SPECIFICATION	UNIT
Outline dimensions	73.0 (W) × 94.0 (H) × 6.7 (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	(65)	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 signal voltage *2	Vin	0	VDD	V

*1 $V_0 \geq V_1 \geq V_2 \geq V_3 \geq V_4 \geq V_5 = 0(V)$

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

4-2 Environmental absolute maximum ratings

ITEM	SYMBOL	MIN	MAX	UNIT
Operating temperature	Top	0	50	°C
Storage temperature *1	T _{STO}	-20	60	°C
Operating humidity *2	Hop	10	*3	%RH
Storage humidity *2	H _{STO}	10	*3	%RH
Vibration	—	*4	*4	—
Shock	—	*5	*5	—

*1 Temp. = -20°C < 48 Hr. , Temp = 60°C < 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°C, 85% RH Max.
Temp. > 40°C, Absolute Humidity shall be less than 85%RH at 40°C.

*4

Frequency	10~55 Hz	Converted to acceleration value : (0.3~9m/s ²)
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.

*5 Acceleration: 490m/s²
Pulse width : 11 msec
3 times in each direction : ±X/±Y/±Z.
EIAJ ED-2531.

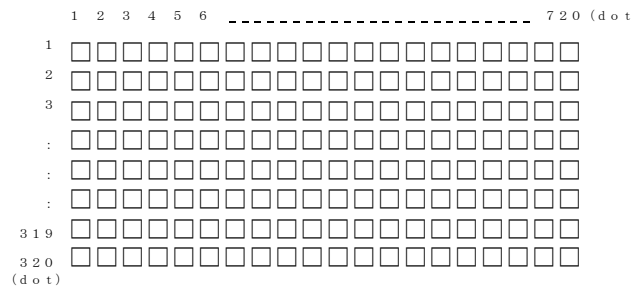
5. Electrical Characteristics

Temp. = 25°C, VDD = +3.3V±0.3V

ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Supply voltage for logic	VDD	—	3.0	3.3	3.6	V
LCD driving voltage *1	V_{op} =V0-V5	0 °C	(30.4)	(31.4)	(32.4)	V
		25 °C	(29.2)	(30.2)	(31.2)	V
		50 °C	(28.6)	(29.6)	(30.6)	V
Input voltage	Vin	"H" level	0.8VDD	—	VDD	V
		"L" level	0	—	0.2VDD	V
Clock frequency	f _{cp}	—	2.02	2.16	10.0	MHz
Frame frequency *2	f _{FRM}	—	70	75	80	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)	mA
Current consumption for LCD driving *4	IEE	*5	—	(2.4)	(3.1)	mA
		*6	—	(1.1)	(1.4)	mA
Power consumption *4	Pdisp	*5	—	(75)	(100)	mW
		*6	—	(36)	(46)	mW

- *1 Maximum contrast ratio is obtained by adjusting the LCD supply voltage (V_{op}= 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 18.recommended additional circuit.

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



6. Optical Characteristics

6-1. Reflective mode

Measuring Spot = ϕ 6mm , Temp. = 25°C

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
Contrast ratio		CR	$\theta = \phi = 0^\circ$	(2.5)	(5.0)	—	—
Reflectance		ρ	—	(4.0)	(6.0)	—	%

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

* Definition of Reflectance:

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

* Definition of Contrast

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

6-2. Transmissive mode

Measuring Spot = ϕ 6mm , Temp. = 25°C

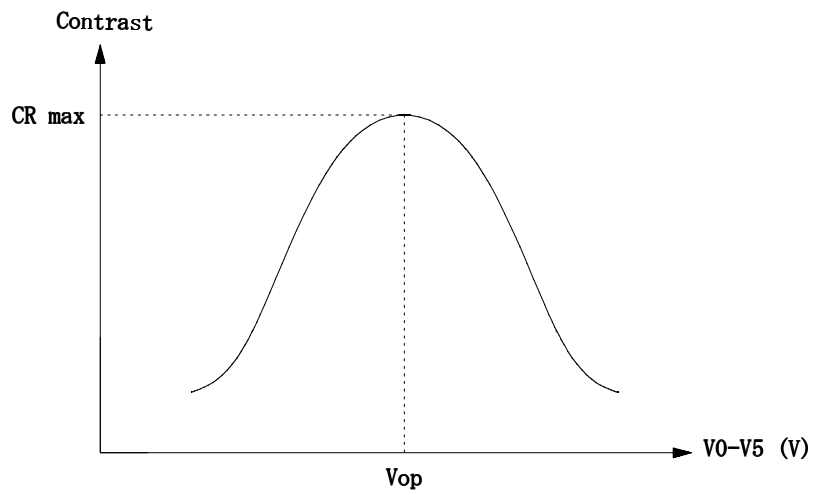
ITEM		SYMBOL	CONDITION		MIN.	TYP.	MAX.	UNIT
Response time	Rise	Tr	$\theta = \phi = 0^\circ$		—	(250)	(350)	ms
	Down	Td	$\theta = \phi = 0^\circ$		—	(150)	(250)	ms
Viewing angle range		θ	$CR \geq 2$	$\phi = 0^\circ$	(-20)	—	(30)	deg.
		ϕ		$\theta = 0^\circ$	(-50)	—	(45)	deg.
Contrast ratio		CR	$\theta = \phi = 0^\circ$		(7.5)	(15.0)	—	—
Brightness (Il=2.5mA)		L	—		(12)	(20)	—	cd/m ²
Chromaticity coordinates	Red	x	$\theta = \phi = 0^\circ$		(0.32)	(0.37)	(0.42)	—
		y			(0.24)	(0.29)	(0.34)	
	Green	x	$\theta = \phi = 0^\circ$		(0.25)	(0.30)	(0.35)	
		y			(0.32)	(0.37)	(0.42)	
	Blue	x	$\theta = \phi = 0^\circ$		(0.18)	(0.23)	(0.28)	
		y			(0.19)	(0.24)	(0.29)	
	White	x	$\theta = \phi = 0^\circ$		(0.27)	(0.32)	(0.37)	
		y			(0.29)	(0.34)	(0.39)	

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

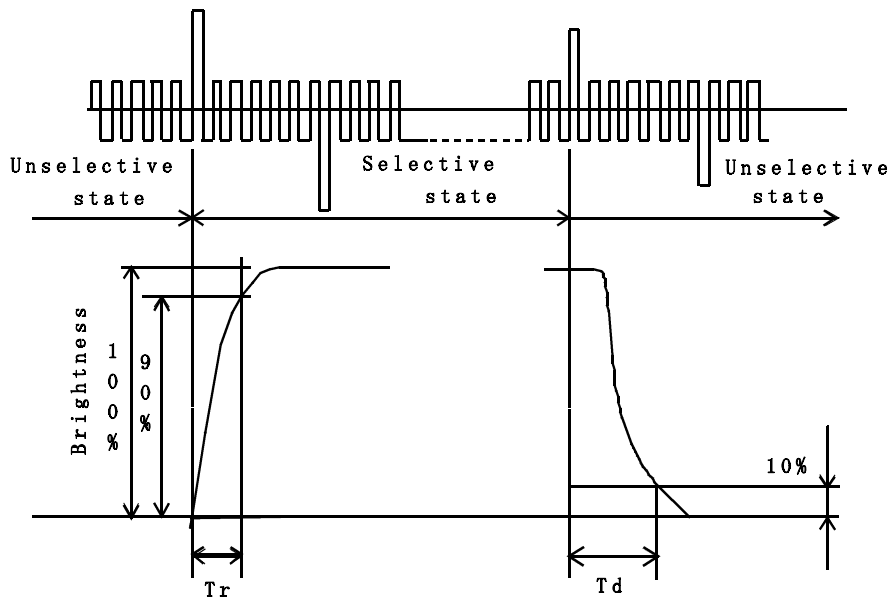
* Contrast ratio is defined as follows :

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

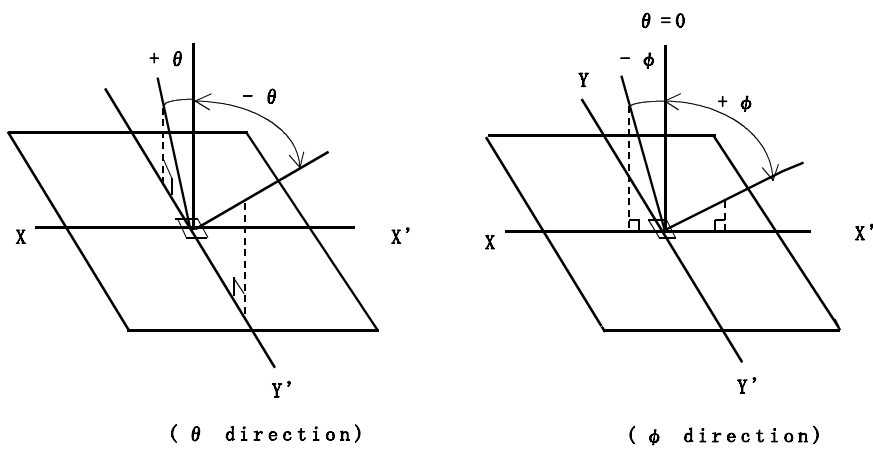
6-3. Definition of V_{op}



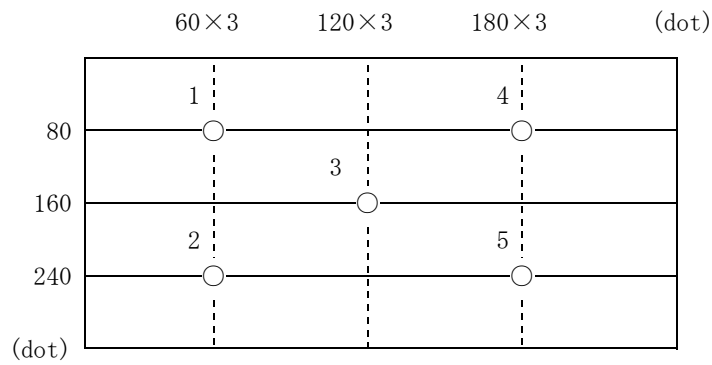
6-4. Definition of response time



6-5. Definition of viewing angle

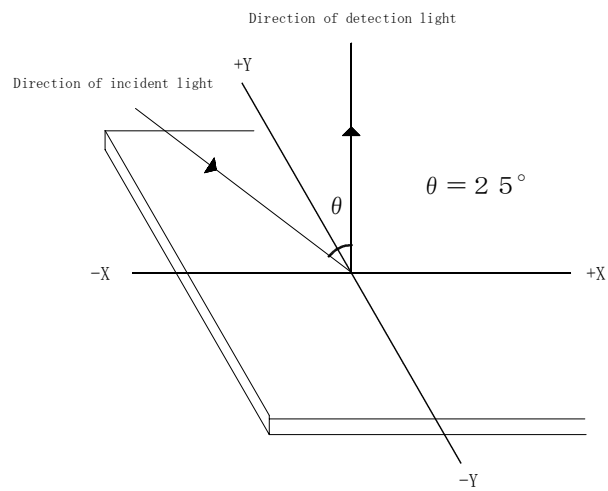


6-6. Measuring points

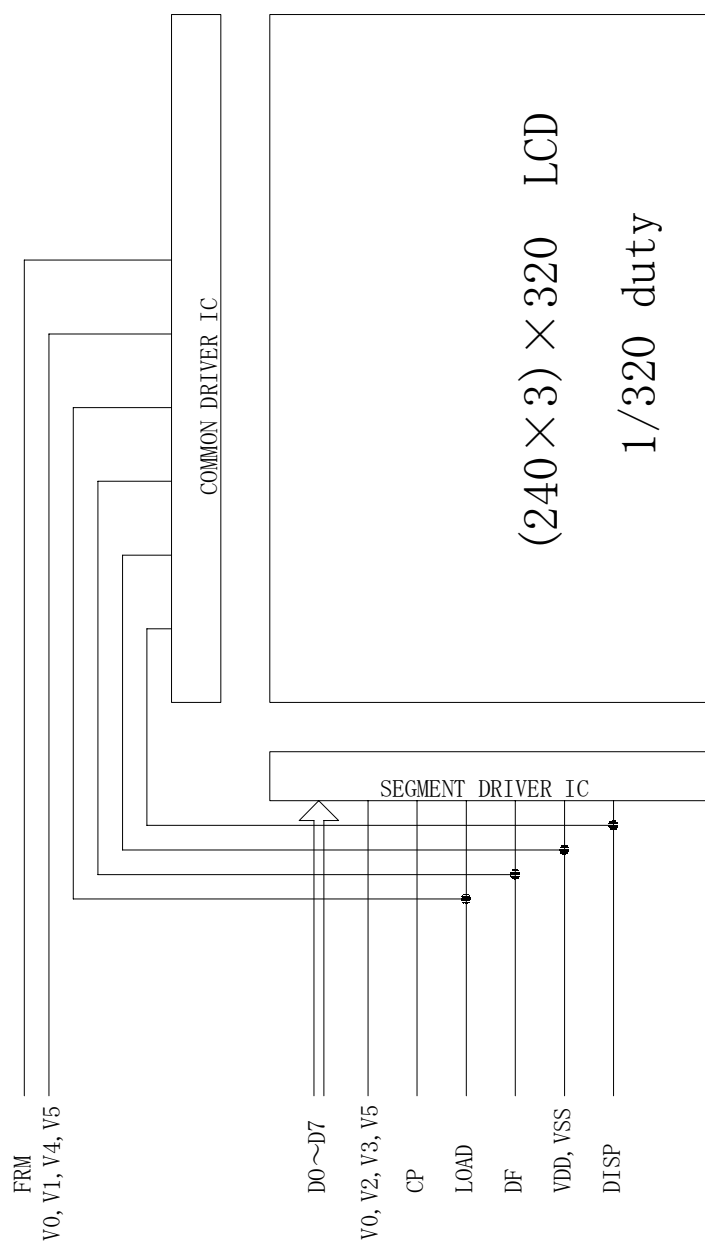


- 1) Rating is defined as the average brightness inside the viewing area.
- 2) 30 minutes after CFL is turned on. (Ambient Temp. = 25°C)
- 3) The inverter should meet the eccentric conditions;
-Sine, symmetric waveform without spike in positive and negative.
- 4) Measuring Inverter : PH-BLC-08-K3 (HITACHI MEDIA ELECTRONICS)

6-7. Measurement method of reflectance



7. Circuit Block Diagram



8. Interface signals

8-1. 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 18. Recommended Bias Voltage Circuit for driving LCD.

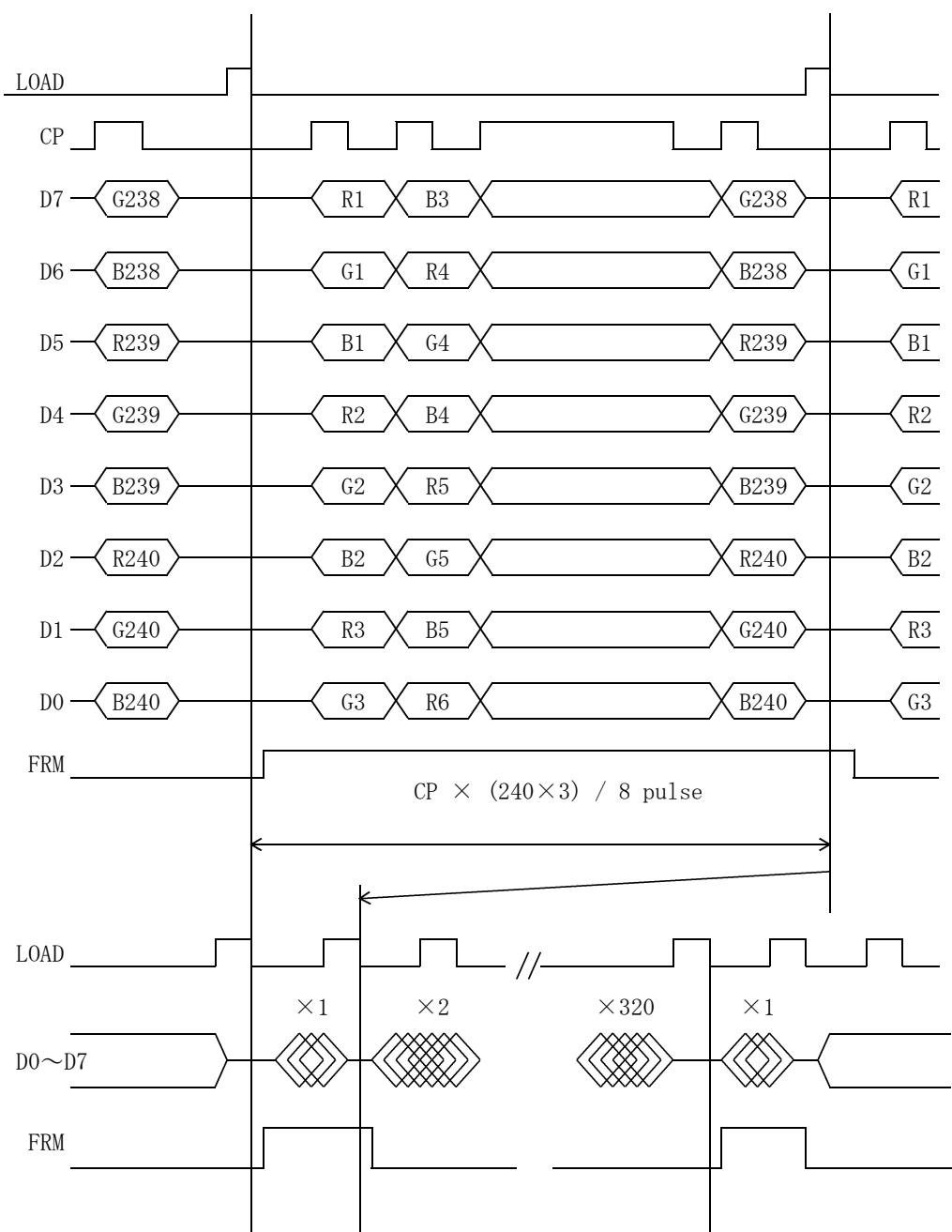
8-2. CFL

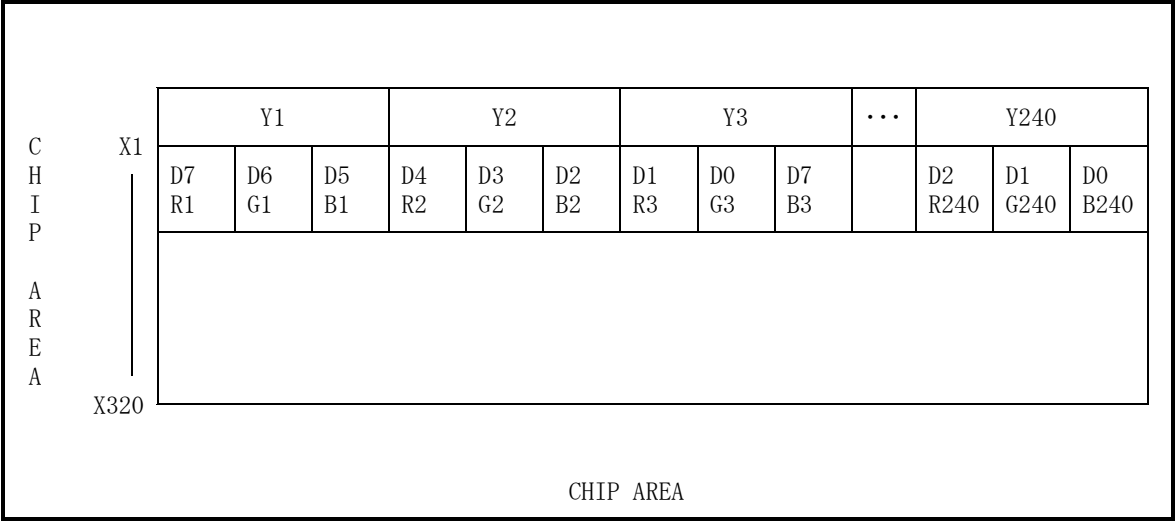
PIN No	SYMBOL	DESCRIPTION	LEVEL
1	HV	Power supply for CFL	AC
2	NC	—	—
3	GND	Ground line (from inverter)	—

LCD side connector : BHR-03VS-1 (JST)

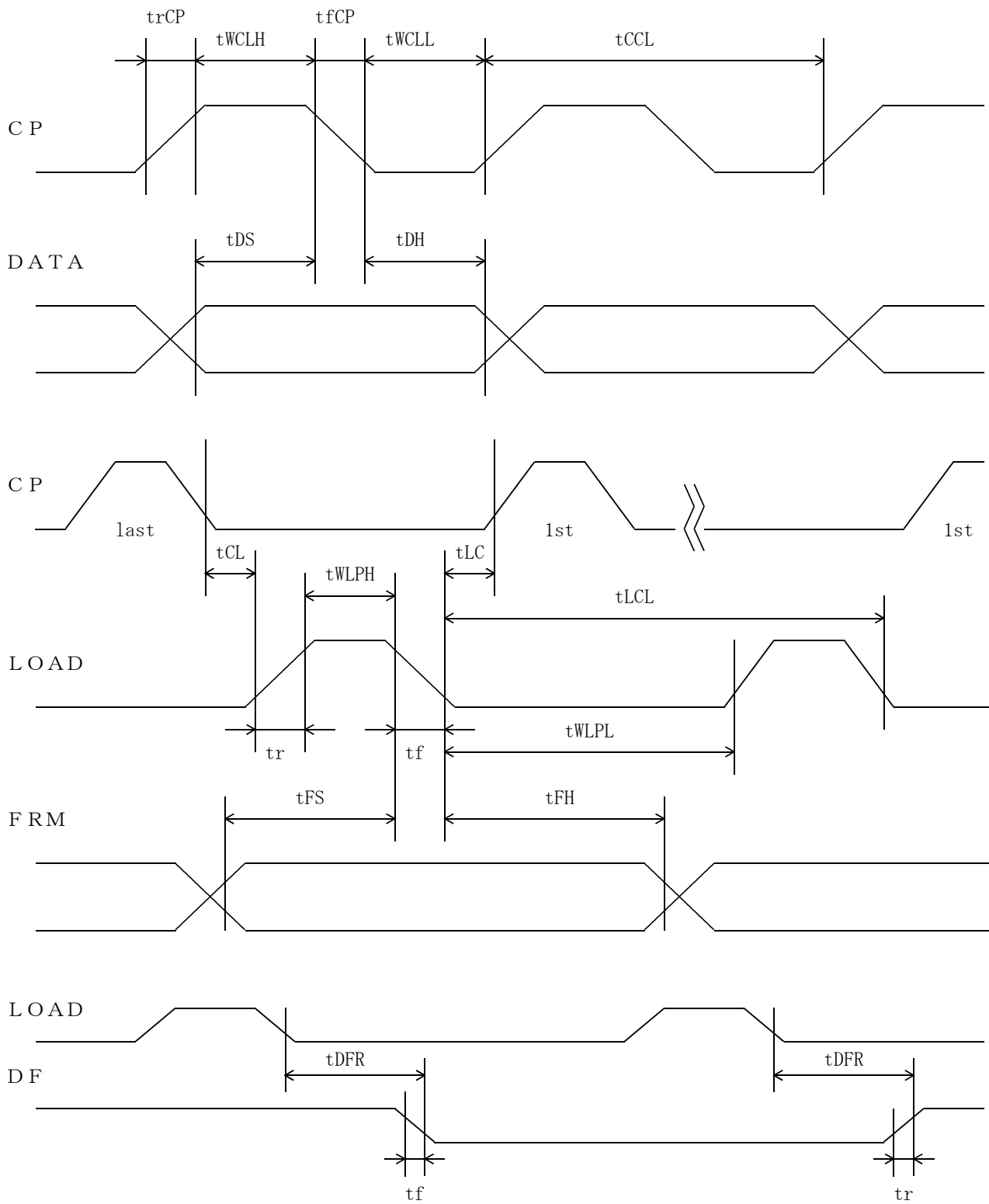
Recommended matching connector : SM02-(8.0)B-BHS-1 (JST)

9. Interface Timing Chart





11. Input Timing Characteristics



11-1. Switching characteristics

Input Characteristics ; VDD = +3.3V $\pm$ 0.3V, Temp. = 25 $^{\circ}$ C

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	0	300	ns

*1 CP Cycle is adjust so that FRM signal is 75Hz.

*2 The formula of condition

$$\textcircled{1} trCP + tfCP \leq tCCL - (tWCLH + tWCLL)$$

$$\textcircled{2} trCP, tfCP \leq 30 \text{ ns}$$

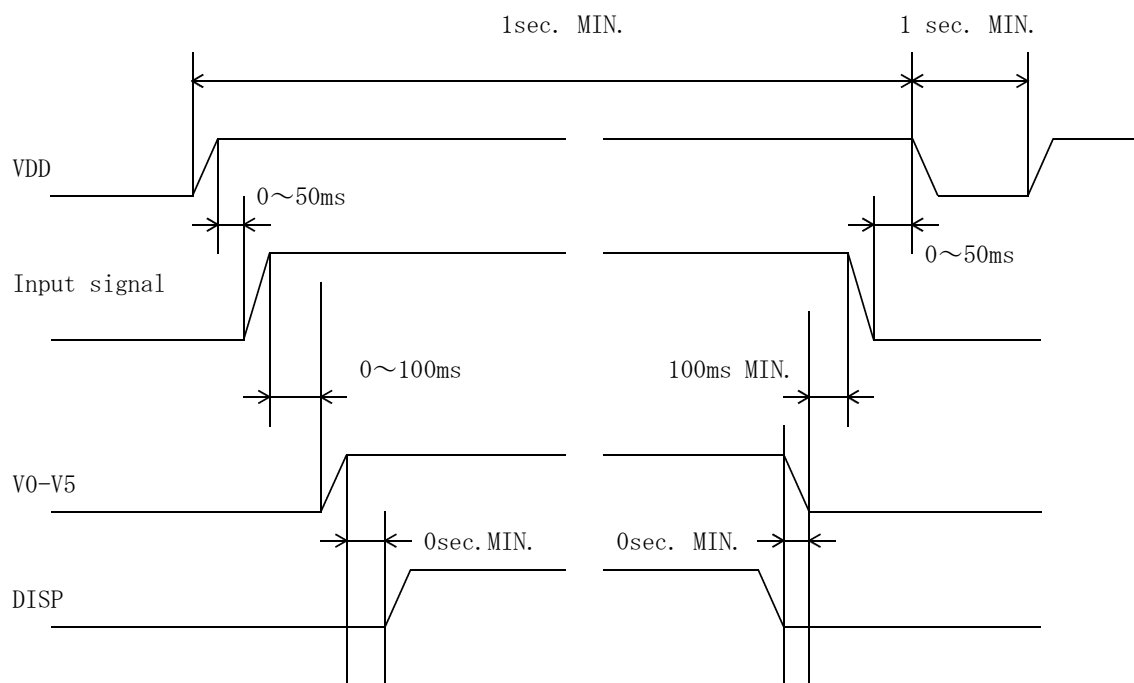
Please use on condition that $\textcircled{1}$, $\textcircled{2}$ are filled.

*3 LOAD Cycle is const.

*4 tLC $\geq$ 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.

1 3 . Backlight Characteristics

CFL ratings

Temp. = 25°C

ITEM	SYMBOL	MIN.	TYP.	MAX.	NOTE
Starting discharge Voltage *1	VS	—	—	(720) Vrms.	0 °C
		—	—	(440) Vrms.	25 °C
Discharging tube current *2	IL	(2. 0)mArms.	(2. 5)mArms.	(6. 0)mArms.	—
Discharging tube voltage	VL	—	(275) Vrms.	—	—
Operating life (IL= 2. 5 mArms.) *3	T	(27, 000) Hr	(40, 000) Hr.	—	—
Operating frequency	F	(50) 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: (936) Vrms MIN.)

*2 Do not apply more than (6.0)mA discharge tube current. Because CFL maybe broken due to over current.

*3 When the illuminance or quantity of light has decreased to 50 % of the initial value. Average life time of CFL will be decreased when LCD is operating at lower and higher temperature.

1 4. Lot Number Identification

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

KHS 038AA1AJ-G83- □ □-□ □

DATE _____
 MONTH _____
 YEAR _____

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

15. Warranty

15-1. Incoming inspection

Please inspect the LCD within one month after your receipt.

15-2. 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.

1 6. Precautions for use

16-1. 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.
6. 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.

16-2. 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.

16-3. 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.

16-4. 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.

16-5. 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.

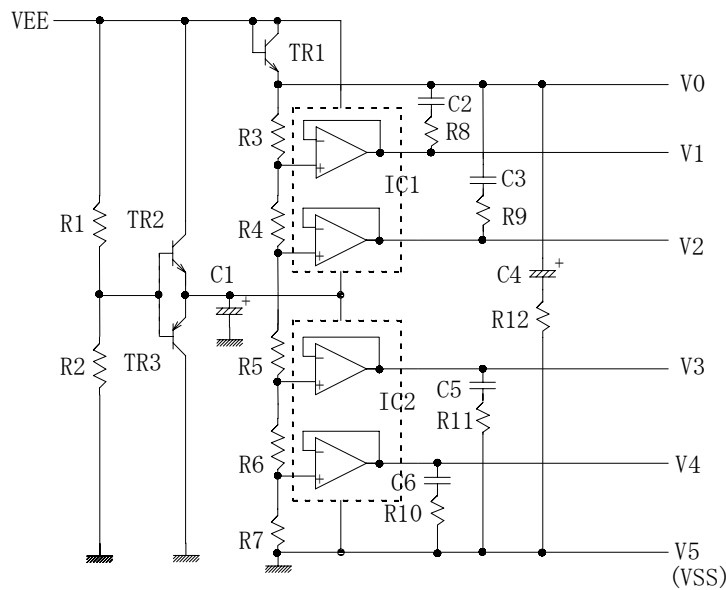
17. Reliability Data / Environmental Test

TEST ITEM	TEST CONDITION	TEST TIME	RESULT
High Temp. Atmosphere	60℃	240 Hr.	Display Quality : No defect Display Function : No defect Current Consumption : No defect
Low Temp. Atmosphere	-20℃	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℃ 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. 60℃ 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℃ 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.

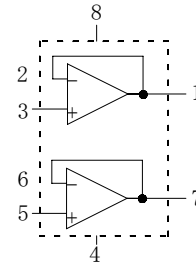
18. Recommended additional circuit

a) Recommended Bias Voltage for Driving LCD



$$\begin{aligned} R3, 4 &= 15.0k\Omega \pm 0.5\% \\ R6, 7 &= 15.0k\Omega \pm 0.5\% \\ R5 &= 220.0k\Omega \pm 1.0\% \end{aligned}$$

IC1, IC2



These value above are theoretically 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-220KΩ F	(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

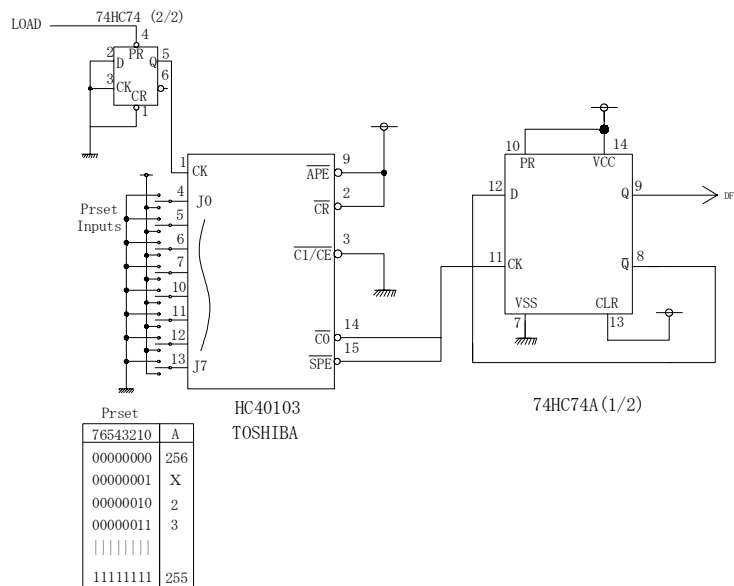
Symbol	Characteristic	Example (Maker Name)	note
C1	4.7μ/35V	MF35FD4R7MC6 (NIPPON CHEMI-CON)	Electrolytic capacitor
C2	B/4.7μF/10V/3216/M	LMK316BJ475ML (TAIYO YUDEN)	Ceramic Capacitor
C3	B/4.7μF/10V/3216/M	LMK316BJ475ML (TAIYO YUDEN)	Ceramic Capacitor
C4	4.7μ/50V	MF50FD4R7MC8 (NIPPON CHEMI-CON)	Electrolytic 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" phenomenon of displayed images. (Tailing, vertical strips, etc.)

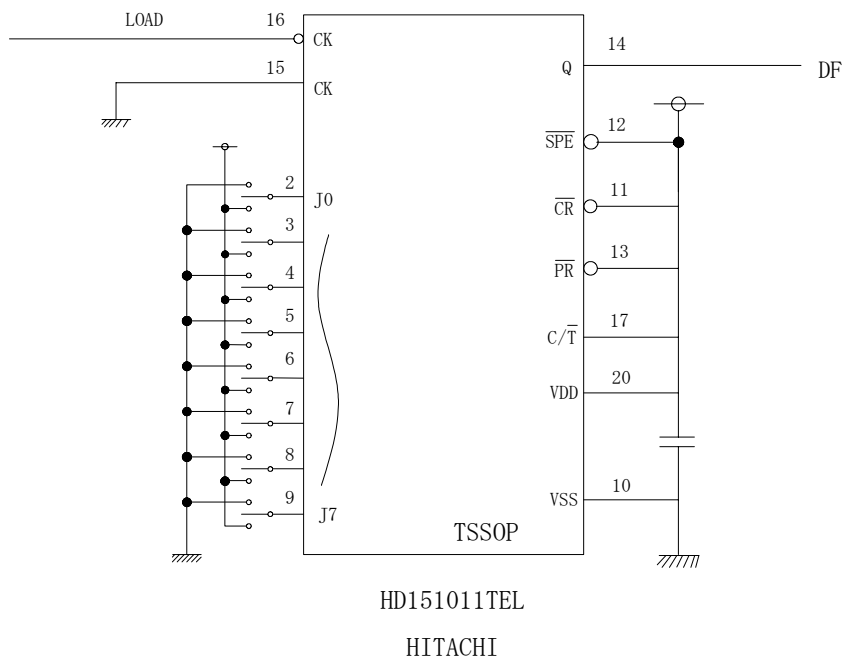
Its detail is subject to change according to actual operating condition and application of the LCD. Should you have any question when installing an actual randomizing circuit, please ask Kyocera for details.

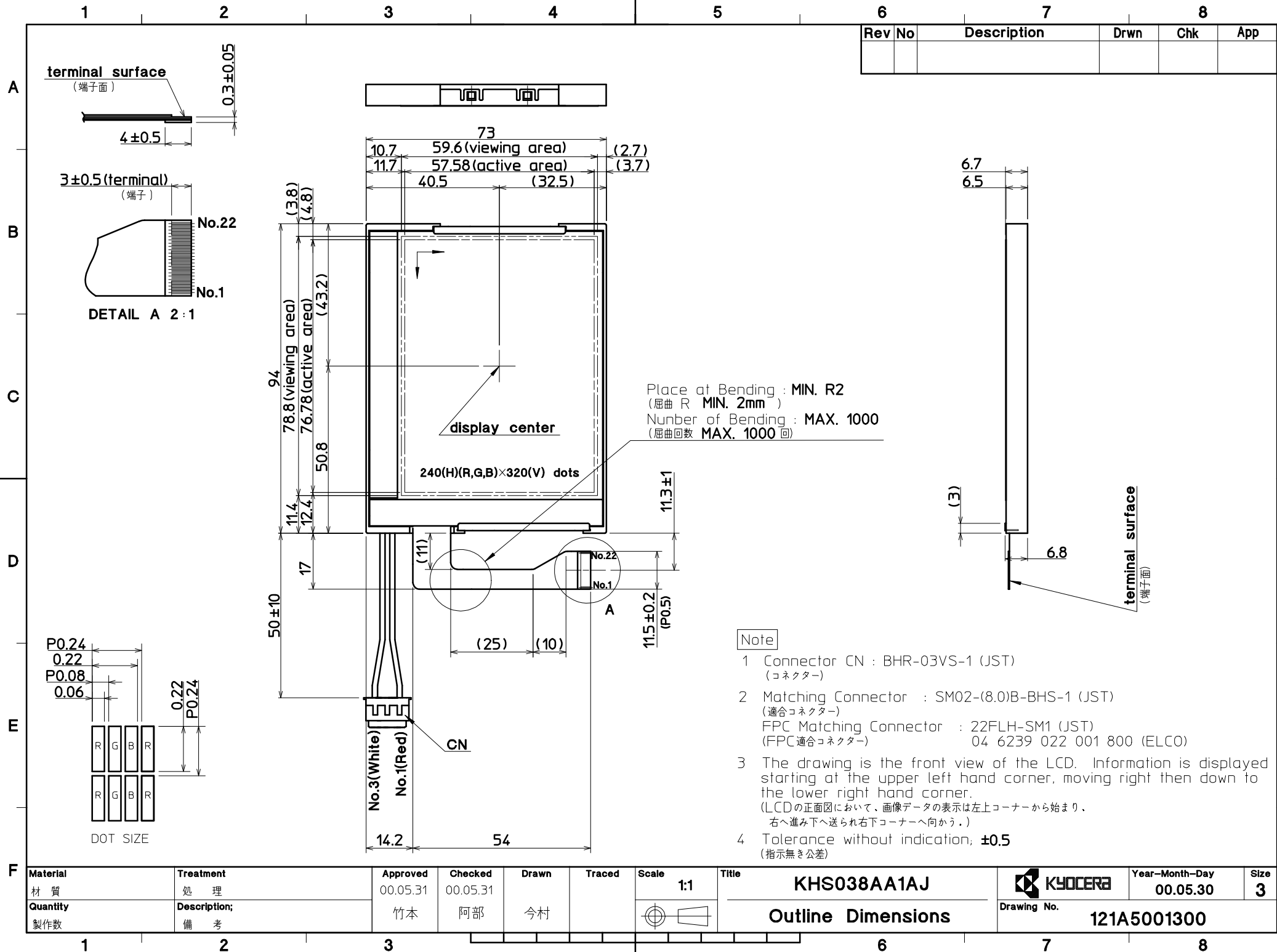
b-1)



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)





	Document NO.	TQ3C-8EAC0-E2CWN08-00
	DATE	June 20.2000

FOR : _____

KYOCERA INSPECTION STANDARD

TYPE : KHS038AA1AJ-G83

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	T. Yamaguchi	M. Fujitani	<i>[Signature]</i>	S. Hayashi	Y. Yoshida

Revision Record

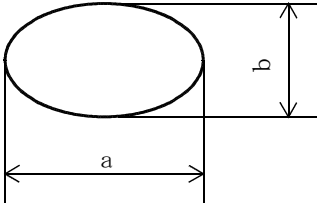
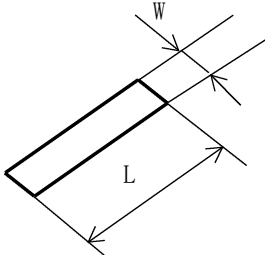
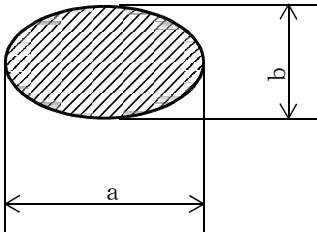
Date	Designed by : Engineering Dept.			Confirmed by : QA Dept.	
	Prepared	Checked	Approved	Checked	Approved
Rev. No.	Date	Page	Descriptions		

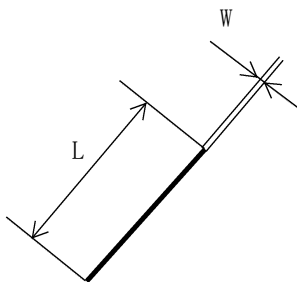
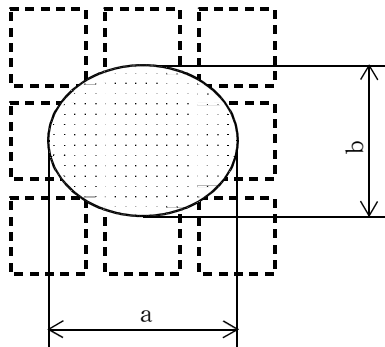
Visuals specification

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 °C 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	 $d = (a + b) / 2$ <table><tr><th>Category</th><th>Size (mm)</th><th>Acceptable number</th></tr><tr><td>A</td><td>$d \leq 0.2$</td><td>neglected</td></tr><tr><td>B</td><td>$0.2 < d \leq 0.3$</td><td>5</td></tr><tr><td>C</td><td>$0.3 < d \leq 0.5$</td><td>3</td></tr><tr><td>D</td><td>$0.5 < d$</td><td>0</td></tr></table>	Category	Size (mm)	Acceptable number	A	$d \leq 0.2$	neglected	B	$0.2 < d \leq 0.3$	5	C	$0.3 < d \leq 0.5$	3	D	$0.5 < d$	0							
Category	Size (mm)	Acceptable number																					
A	$d \leq 0.2$	neglected																					
B	$0.2 < d \leq 0.3$	5																					
C	$0.3 < d \leq 0.5$	3																					
D	$0.5 < d$	0																					
Scratch, Foreign particle	<table><tr><th></th><th>Width (mm)</th><th>Length (mm)</th><th>Acceptable No.</th></tr><tr><td>A</td><td>$W \leq 0.03$</td><td>—</td><td>neglected</td></tr><tr><td>B</td><td rowspan="3">$0.03 < W \leq 0.1$</td><td>$L \leq 2.0$</td><td>neglected</td></tr><tr><td>C</td><td>$2.0 < L \leq 4.0$</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>		Width (mm)	Length (mm)	Acceptable No.	A	$W \leq 0.03$	—	neglected	B	$0.03 < W \leq 0.1$	$L \leq 2.0$	neglected	C	$2.0 < L \leq 4.0$	3	D	$4.0 < L$	0	E	$0.1 < W$	—	According to Circular
	Width (mm)	Length (mm)	Acceptable No.																				
A	$W \leq 0.03$	—	neglected																				
B	$0.03 < W \leq 0.1$	$L \leq 2.0$	neglected																				
C		$2.0 < L \leq 4.0$	3																				
D		$4.0 < L$	0																				
E	$0.1 < W$	—	According to Circular																				
Contrast variation	 $d = (a + b) / 2$ <table><tr><th>Category</th><th>Size (mm)</th><th>Acceptable number</th></tr><tr><td>A</td><td>$d \leq 0.5$</td><td>neglected</td></tr><tr><td>B</td><td>$0.5 < d \leq 0.7$</td><td>3</td></tr><tr><td>C</td><td>$0.7 < d$</td><td>0</td></tr></table>	Category	Size (mm)	Acceptable number	A	$d \leq 0.5$	neglected	B	$0.5 < d \leq 0.7$	3	C	$0.7 < d$	0										
Category	Size (mm)	Acceptable number																					
A	$d \leq 0.5$	neglected																					
B	$0.5 < d \leq 0.7$	3																					
C	$0.7 < d$	0																					

Inspection item	Judgement standard																		
Polarizer (Scratch, Bubble, Dent)	(1) Scratch 																		
	<table><tr><th></th><th>Width (mm)</th><th>Length (mm)</th><th>Acceptable No.</th></tr><tr><td>A</td><td>$W \leq 0.1$</td><td>—</td><td>neglected</td></tr><tr><td>B</td><td rowspan="2">$0.1 < W \leq 0.3$</td><td>$L \leq 5.0$</td><td>neglected</td></tr><tr><td>C</td><td>$5.0 < L$</td><td>0</td></tr><tr><td>D</td><td>$0.3 < W$</td><td>—</td><td>0</td></tr></table>		Width (mm)	Length (mm)	Acceptable No.	A	$W \leq 0.1$	—	neglected	B	$0.1 < W \leq 0.3$	$L \leq 5.0$	neglected	C	$5.0 < L$	0	D	$0.3 < W$	—
	Width (mm)	Length (mm)	Acceptable No.																
A	$W \leq 0.1$	—	neglected																
B	$0.1 < W \leq 0.3$	$L \leq 5.0$	neglected																
C		$5.0 < L$	0																
D	$0.3 < W$	—	0																
	(2)Bubble (dent)  $d = (a + b) / 2$																		
	<table><tr><th>Category</th><th>Size (mm)</th><th>Acceptable number</th></tr><tr><td>A</td><td>$d \leq 0.2$</td><td>neglected</td></tr><tr><td>B</td><td>$0.2 < d \leq 0.3$</td><td>5</td></tr><tr><td>C</td><td>$0.3 < d \leq 0.5$</td><td>3</td></tr><tr><td>D</td><td>$0.5 < d$</td><td>0</td></tr></table>	Category	Size (mm)	Acceptable number	A	$d \leq 0.2$	neglected	B	$0.2 < d \leq 0.3$	5	C	$0.3 < d \leq 0.5$	3	D	$0.5 < d$	0			
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