

ENGINEERING SPECIFICATIONS

LIQUID CRYSTAL DOT MATRIX DISPLAY MODULE

10.4 inch VGA, Dual Scan Color STN

LM-CG53-22NDK

(640×R·G·B×480 dots)

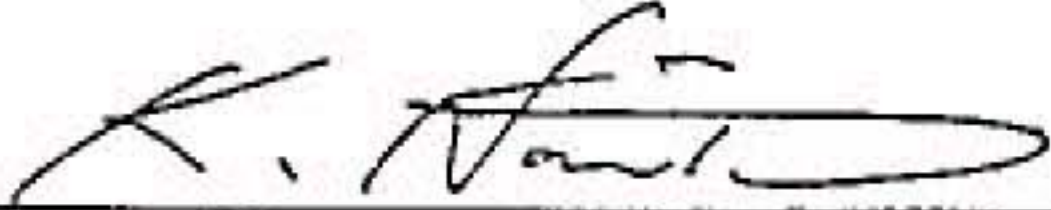
(With cold fluorescent backlight)


Nonglare type

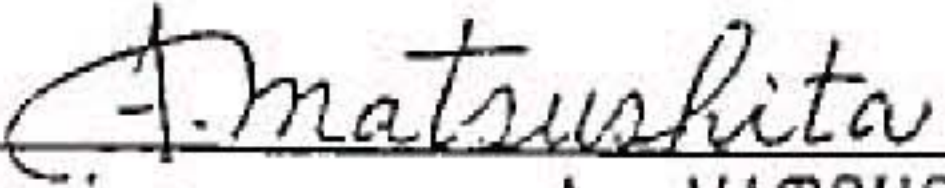
(TENTATIVE)

Oct. 26, 1995
Rev.1 Jan. 25, 1996
Rev.2 Feb. 8, 1996
Rev.3 Jul. 4, 1996

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This specifications may be changed without any notice
in order to improve performance or quality.

MECHANICAL CHARACTERISTICS

Item	Specification	Unit
Package dimensions	243(W) × 179.4(H) × 7 ± 0.5(D)	mm
Structure	640(W) × R·G·B(W) × 480(H)	dot
Dot size	0.09(W) × 0.31(H)	mm
Dot pitch	0.11(W) × 0.33(H)	mm
Effective area	216.2(W) × 163.4(H)	mm
Weight	Approx. 390	g

ELECTRICAL ABSOLUTE MAXIMUM RATINGS

Item	Symbol	MIN.	MAX.	Unit	Remark
Power supply for logic	$V_{DD}-V_{SS}$	0	6.0	V	$T_a=25^\circ\text{C}$
Input voltage	V_i	0	V_{DD}	V	$T_a=25^\circ\text{C}$

ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	$T_a=25^\circ\text{C}$			Unit
			MIN.	TYP.	MAX.	
Power supply for Logic	$V_{DD}-V_{SS}$		3.0	—	5.5	V
Contrast adjust voltage (1/240 duty)	$V_{COX}-V_{SS}$	Note 1 $T_a=5^\circ\text{C}$	0.8	—	—	V
		$T_a=25^\circ\text{C}$	—	2.1	—	V
		$T_a=40^\circ\text{C}$	—	—	2.8	V
Input signal voltage	V_{iH}	High level	0.7 V_{DD}	—	V_{DD}	V
	V_{iL}	Low Level	0	—	0.3 V_{DD}	V
Supply current (Logic)	I_{DD}	$V_{DD}=5.0\text{V}$ Note 2	—	50	250	mA
		$V_{DD}=3.3\text{V}$ Note 2	—	70	380	mA

Note 1) The viewing angle θ at which the optimum contrast is obtained can be set by adjusting $V_{COX}-V_{SS}$. Refer to *1 for the definition of θ .

Note 2) Under the following conditions :

① Max. value : $V_{COX}-V_{SS} = 0.8\text{V}$

Typ. value : $V_{COX}-V_{SS} = 2.1\text{V}$

② Max. value : Black/White stripe pattern



Typ. value : Display data LD0-LD7, LD0-LD7="High" (White)

③ Frame frequency = 74 Hz

■ ENVIRONMENTAL CONDITIONS

Item	Storage		Operating		Remark
	MIN.	MAX.	MIN.	MAX.	
Ambient temperature	-20°C	60°C	5°C	40°C	Note 1
Humidity	Note 2		Note 2		No condensation
Vibration		2.0 G		—	10-55 Hz, X/Y/Z Except for resonant frequency
Shock		50 G		—	XYZ 11 ms

Note 1) Care should be taken so that the LCD unit may not be subjected to the temperature out of this specification.

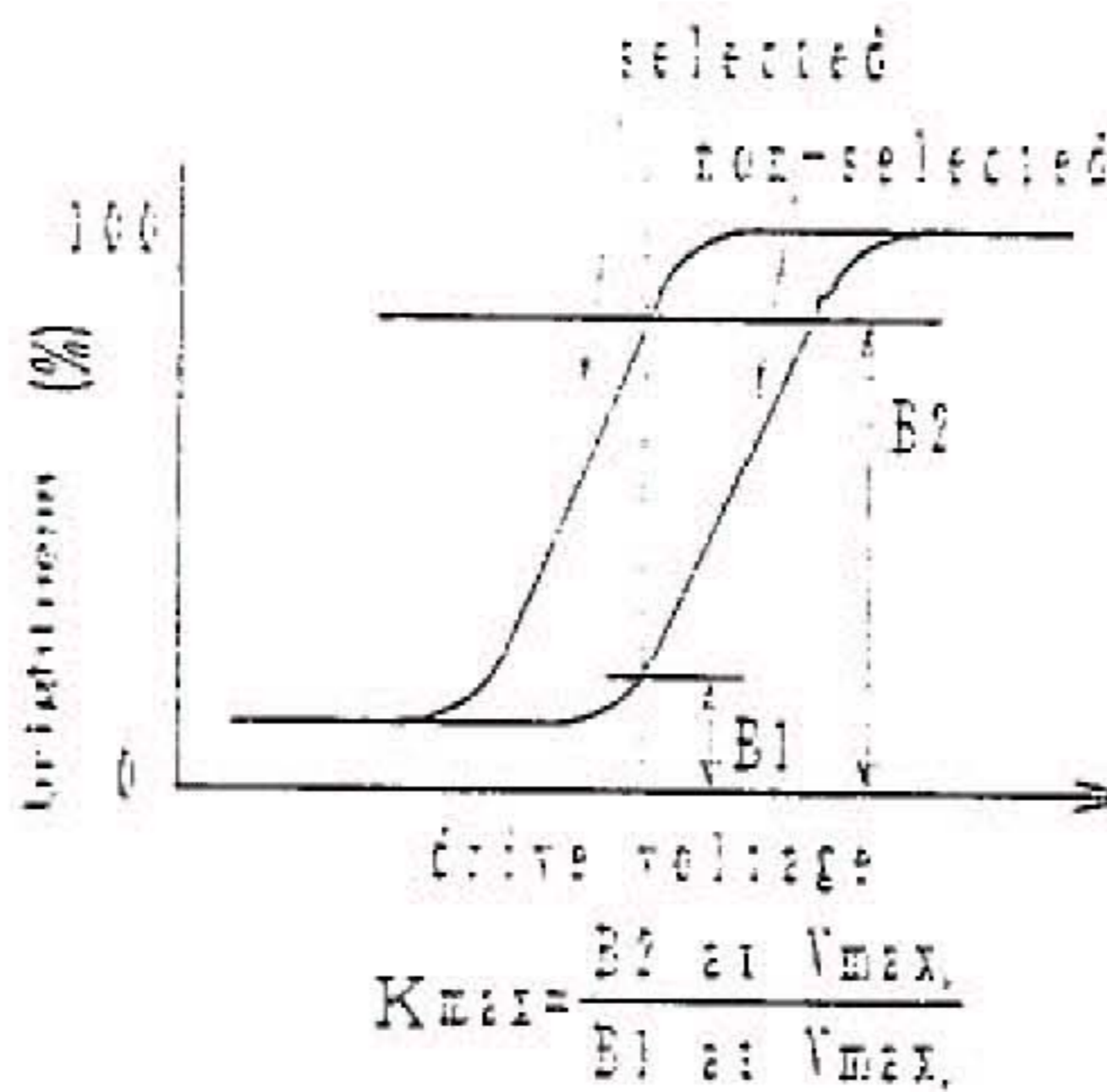
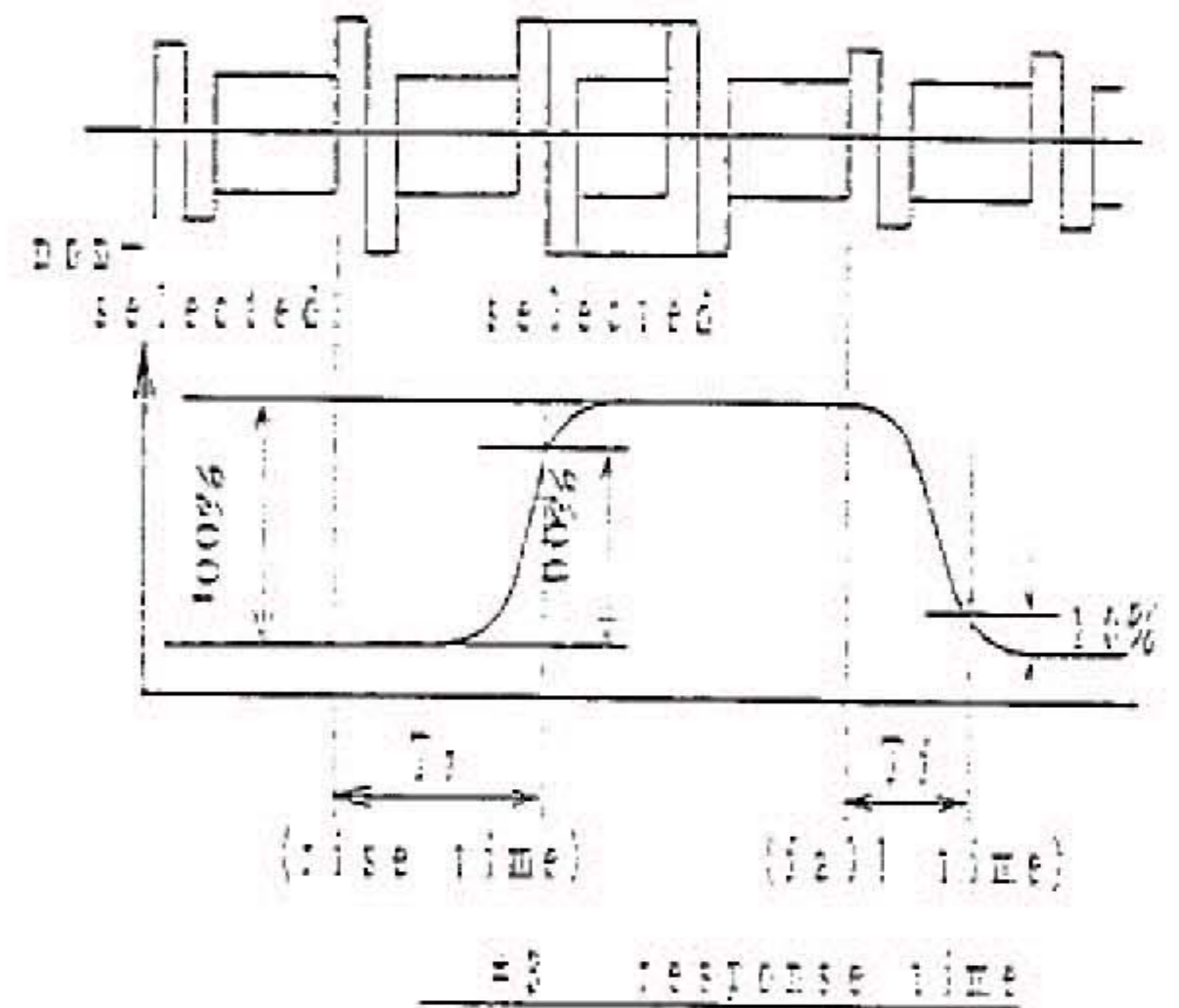
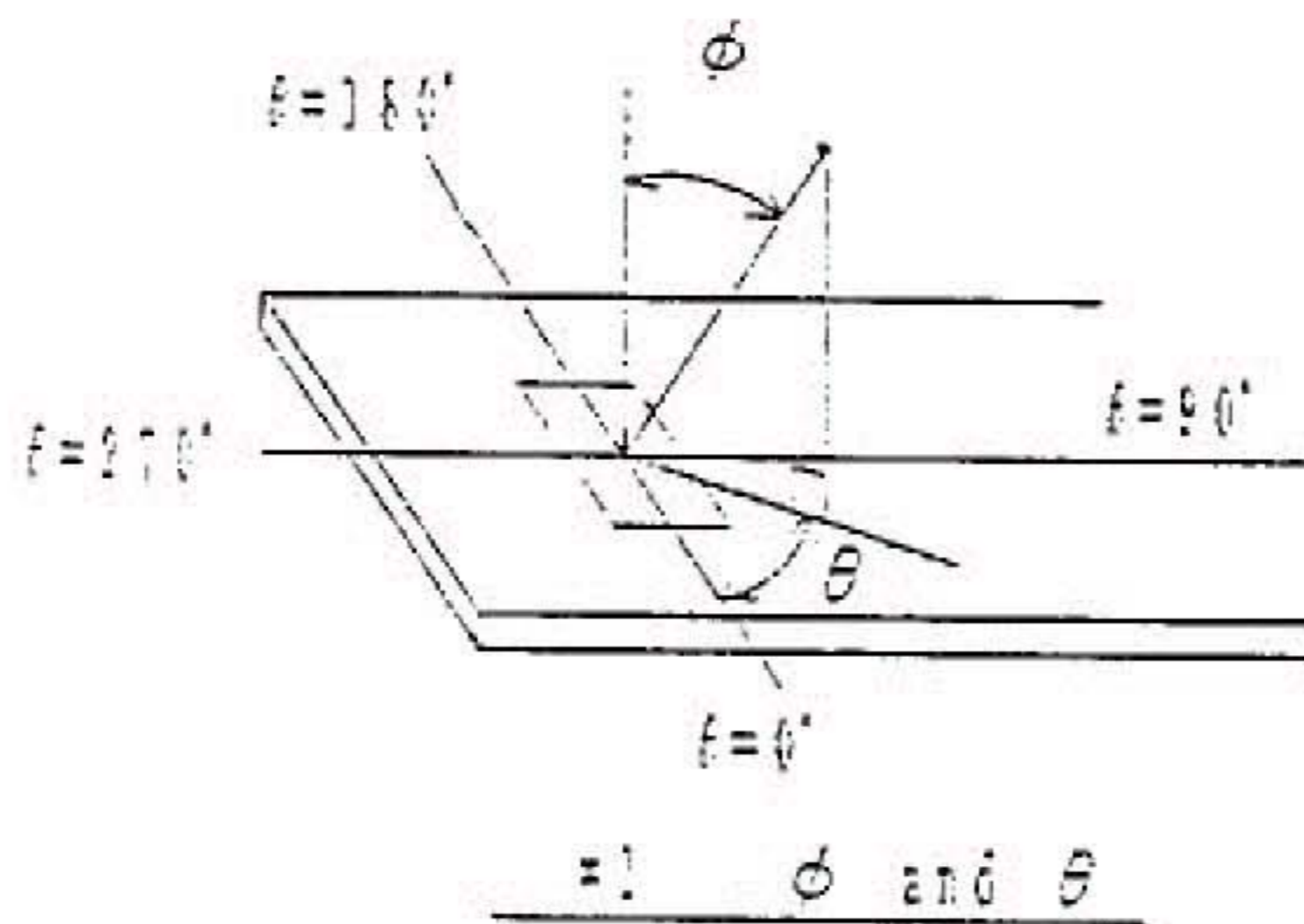
Note 2) $T_a \leq 40^\circ\text{C}$: 85% RH MAX.

$T_a > 40^\circ\text{C}$: Absolute humidity shall be less than that in 85%RH/40°C.

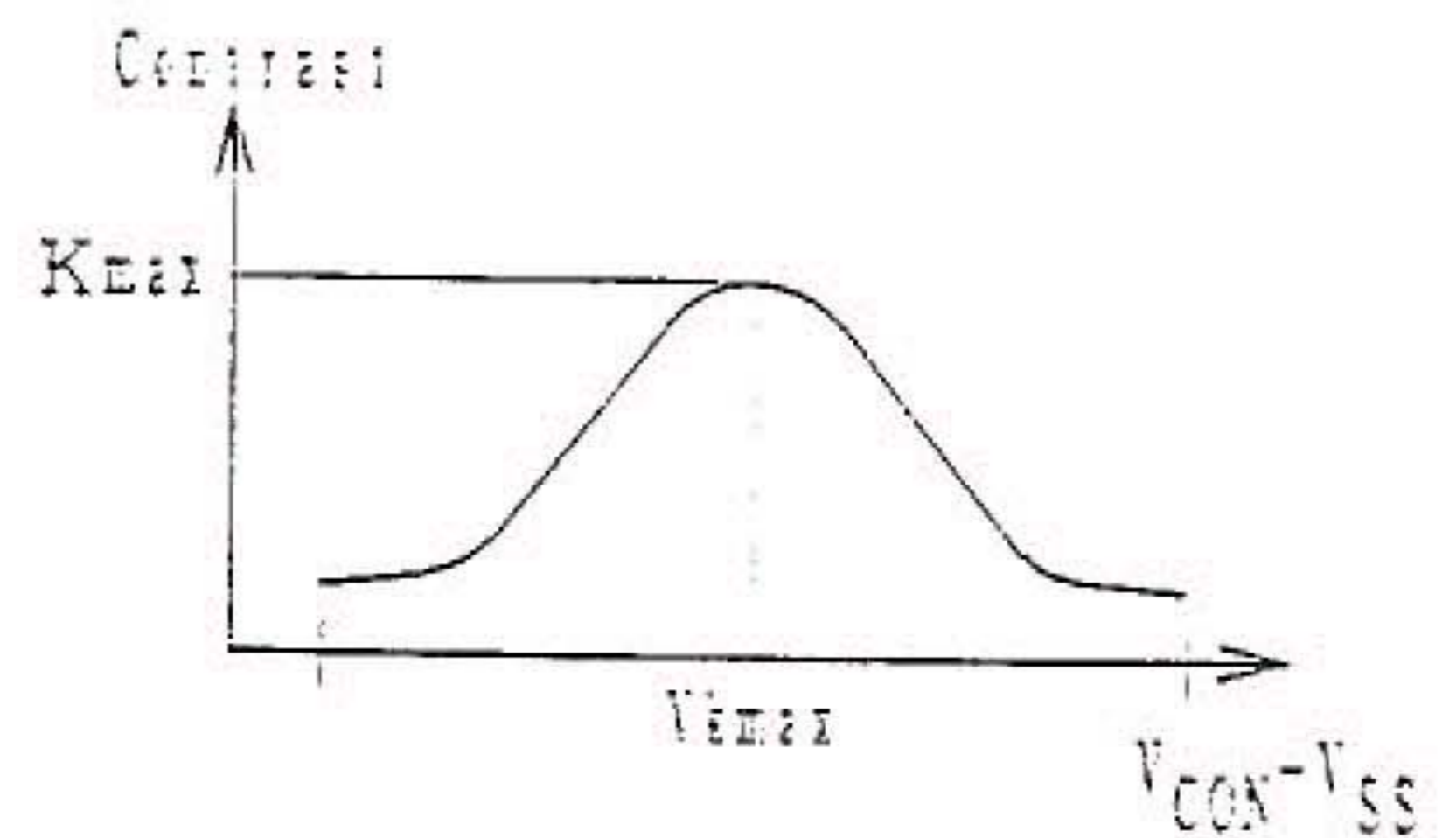
■ OPTICAL CHARACTERISTICS (1)

$V_{DD}-V_{SS}=3.3V$, $V_{CON}-V_{SS}=V_{Kmax}$, $T_a=25^\circ C$

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Remark	
Viewing angle range	ϕ	$K > 2$	$\theta = 0^\circ$	15	—	—	deg.	* 1
			$\theta = 90^\circ$	30	—	—		
			$\theta = 180^\circ$	20	—	—		
			$\theta = 270^\circ$	30	—	—		
Contrast ratio	K_{max}	$\phi = 0^\circ$	15	35	—	—	* 2 * 4	
Response time	Rise	t_r	$\phi = 0^\circ$	—	150	—	$\mu s.$	* 3
	Fall	t_f	$\phi = 0^\circ$	—	120	—	$\mu s.$	



* 2 contrast ratio 'K'



* 4 definition of V_{Kmax} .

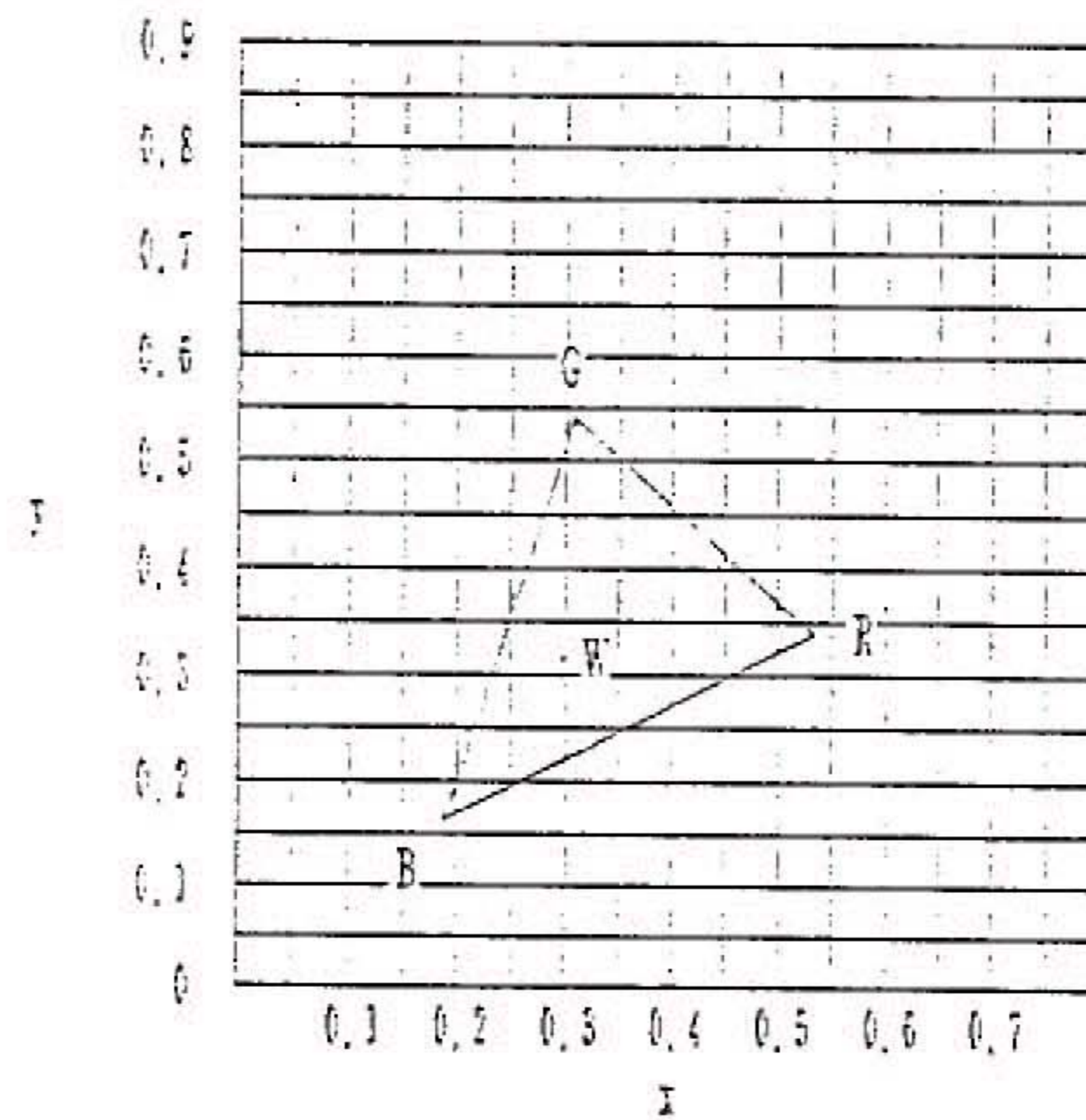
■ OPTICAL CHARACTERISTICS(2)

$V_{DD}-V_{SS}=3.3V$, $V_{CON}-V_{SS}=V_{Kmax}$, $T_a = 25^{\circ}C$

Item	Symbol	Condition	Typ.	Unit	Note
Color of CIE Coordinate	Red	x	0.53	—	*5
		y			
	Green	x	0.31	—	
		y			
	Blue	x	0.19	—	
		y			
	White	x	0.30	—	
		y			

Tolerance : ± 0.05

*5. Measuring at position 3 on Fig.1
CIE chromaticity diagram



■ OPTICAL CHARACTERISTICS (3)

Surface Brightness of LCD

Item	Min.	Typ.	Max.	Unit
Brightness	50	70	—	cd/m ²

Note) The brightness shall be the average of the following 5 point.

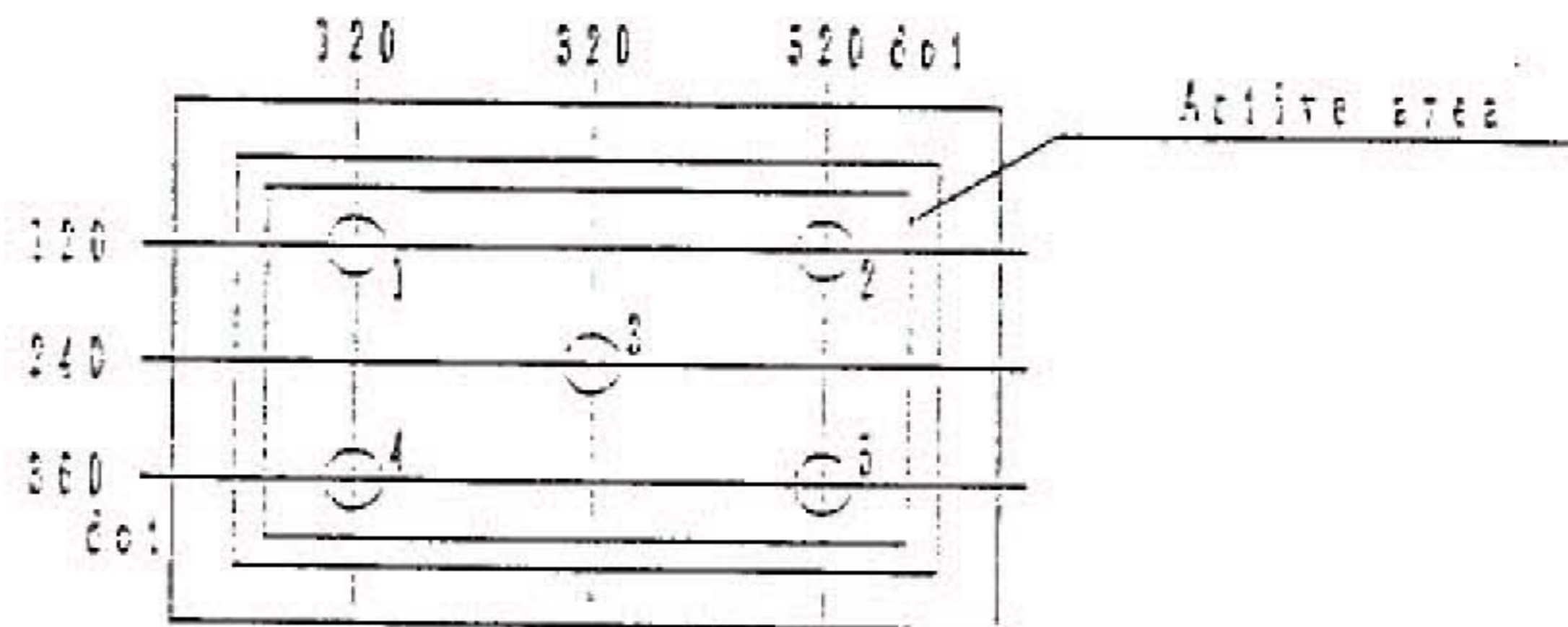


Fig. 1 Measuring points

Measurement equipment : BM-7 (TOPCON Corporation) or CA-1000(MINOLTA)

Measurement condition

- ① Ambient temperature : 25°C
- ② LCD : All digits WHITE, $V_{DD} = 3.3V$, $V_{CON} - V_{SS} = V_{Kmax}$,
Frame frequency=74Hz
 $LD_0 - LD_7 = HIGH(WHITE)$, $LD_8 - LD_9 = HIGH(WHITE)$
- ③ Measurement after 30 minutes of CFL operating.
- ④ $I_L = 3.5 \text{ mA}_{RMS}$

■ BACKLIGHT CHARACTERISTICS

CFL RATINGS

$T_a = 25^\circ\text{C}$, Within no conductor closed.

Item		Max. allowable value
Non-load output voltage (V_s)	1200 V _{RMS} Min. (*)	—
Lamp current (I_L)	3 mA _{RMS} - 5 mA _{RMS}	5 mA _{RMS}
Lamp voltage (V_L)(at 3.5 mA)	580 V _{RMS} Typ.	—
Operating life (at 3.5 mA)	10000 hours Min.	—

(*) The Non-load output voltage(V_s) of the inverter should be designed to have some margin(reference value:1400V_{RMS} MIN.), because V_s may be increased due to the leak current which may be caused by wiring of CFL cables.

Function	Pin no.	Function	Remarks
FLM	1	VSYNC	
M	2	M	
/DISP OFF	3	ENVCC	
CL1	4	HSYNC	
VSS	5	GND	
CL2	6	SHFCLK	
VSS	7	GND	
UD0	8	Display data for upper column drive	
UD1	9	Display data for upper column drive	
UD2	10	Display data for upper column drive	
UD3	11	Display data for upper column drive	
UD4	12	Display data for upper column drive	
UD5	13	Display data for upper column drive	
UD6	14	Display data for upper column drive	
UD7	15	Display data for upper column drive	

LD0	16	Display data for lower column drive	
LD1	17	Display data for lower column drive	
LD2	18	Display data for lower column drive	
LD3	19	Display data for lower column drive	
LD4	20	Display data for lower column drive	
LD5	21	Display data for lower column drive	
LD6	22	Display data for lower column drive	
LD7	23	Display data for lower column drive	
VDD	24	VCC	
VSS	25	GND	
VSS	26	GND	
VDD	27	VCC	
VDD	28	VCC	
VCON	29	VEE LCD adjust voltage (0.8V to 2.8V)	
VCON	30	VEE LCD adjust voltage (0.8V to 2.8V)	

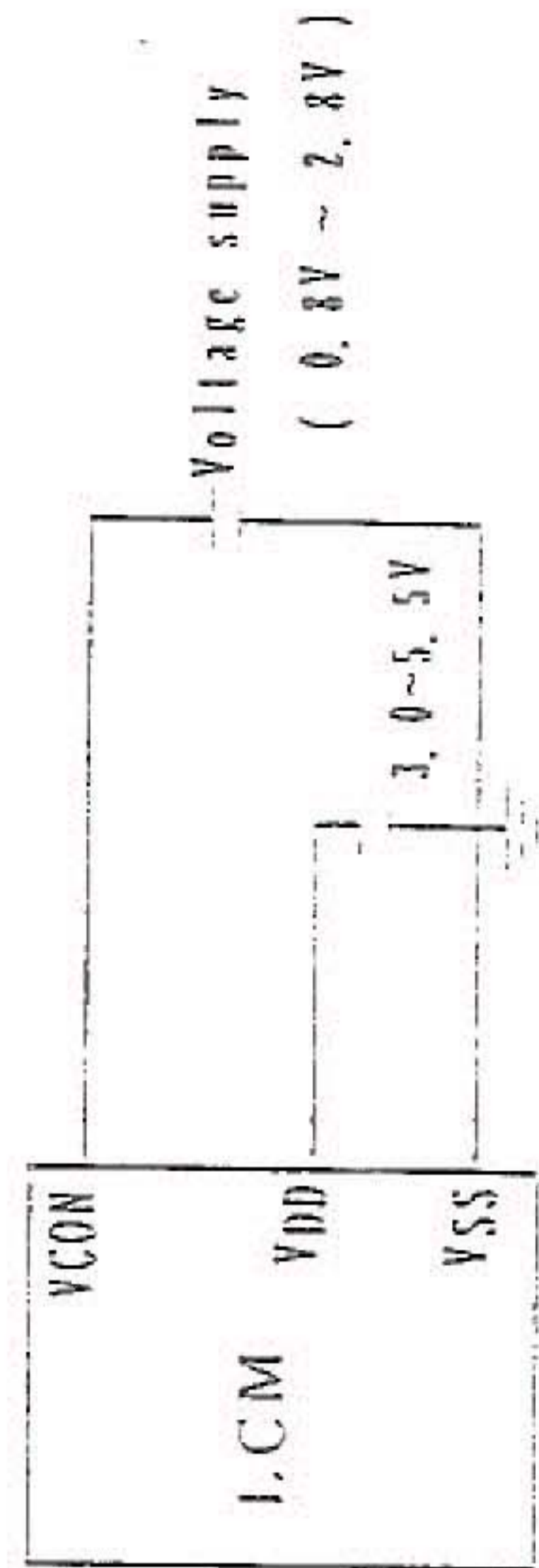
■ DISPLAY VS. DATA CORRESPONDING DIAGRAM

X	Y	1913 1914 1915 1916 1917 1918 1919 1920							
		1	2	3	4	5	6	7	8
1	R0	G0	B0	R1	G1	B1	R2	G2	R639
	UD7	UD6	UD5	UD4	UD3	UD2	UD1	UD0	UD0
2	R0	G0	B0	R1	G1	B1	R2	G2	R639
	UD7	UD6	UD5	UD4	UD3	UD2	UD1	UD0	UD0

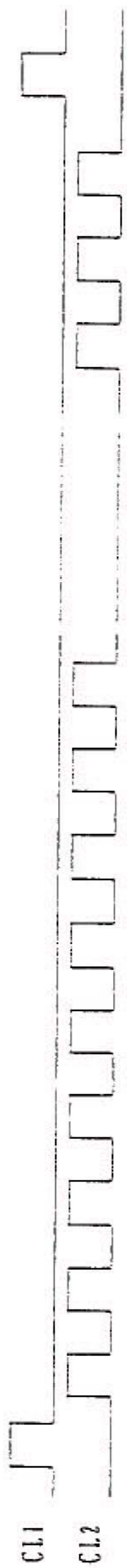
239	R0	G0	B0	R1	G1	B1	R2	G2	R639
	UD7	UD6	UD5	UD4	UD3	UD2	UD1	UD0	UD0
240	R0	G0	B0	R1	G1	B1	R2	G2	R639
	UD7	UD6	UD5	UD4	UD3	UD2	UD1	UD0	UD0
241	R0	G0	B0	R1	G1	B1	R2	G2	R639
	LD7	LD6	LD5	LD4	LD3	LD2	LD1	LD0	LD0
242	R0	G0	B0	R1	G1	B1	R2	G2	R639
	LD7	LD6	LD5	LD4	LD3	LD2	LD1	LD0	LD0

179	R0	G0	B0	R1	G1	B1	R2	G2	R639
	LD7	LD6	LD5	LD4	LD3	LD2	LD1	LD0	LD0
180	R0	G0	B0	R1	G1	B1	R2	G2	R639
	LD7	LD6	LD5	LD4	LD3	LD2	LD1	LD0	LD0

■ POWER SUPPLY



■ TIMING CHART



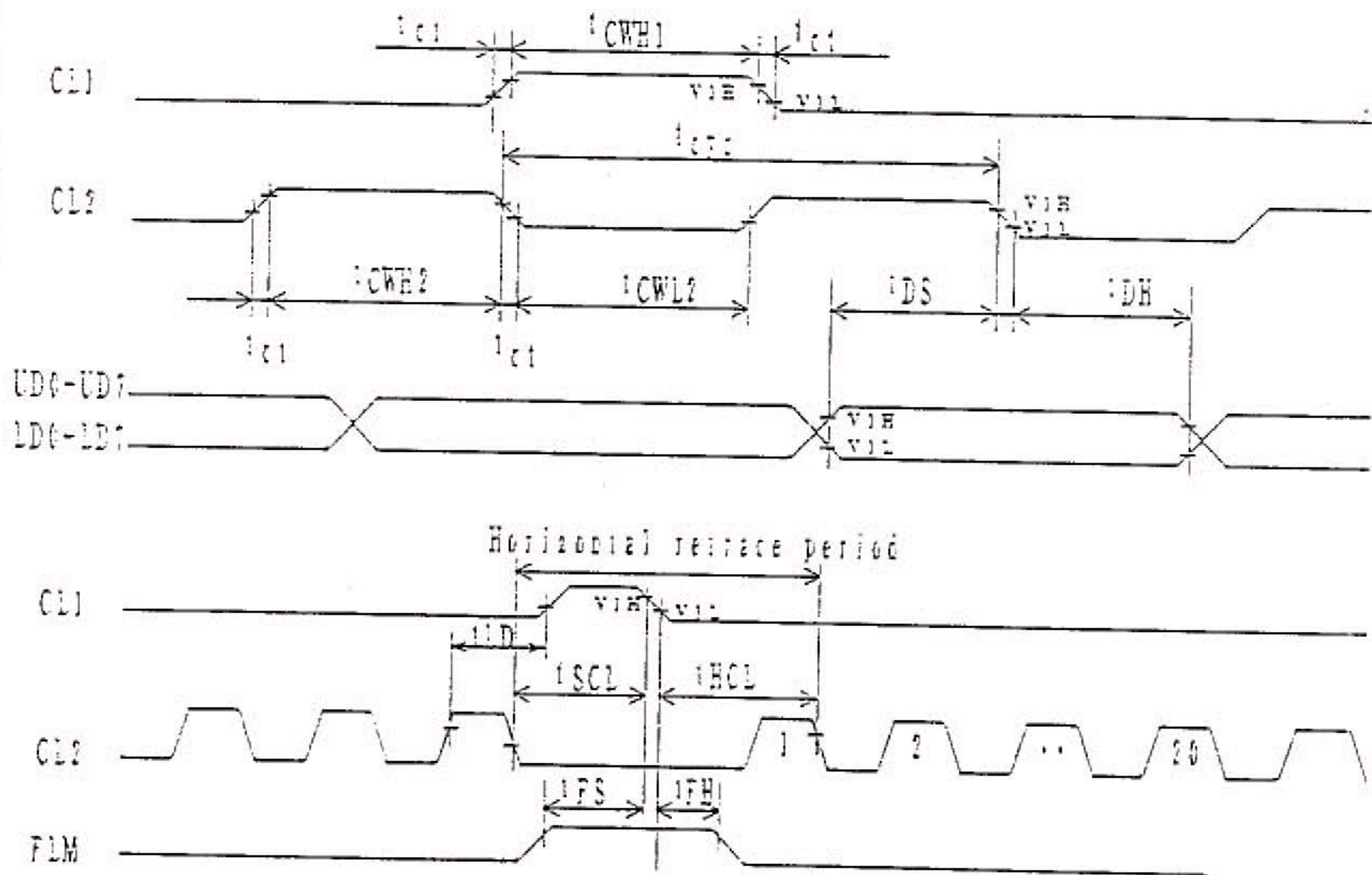
UD7	R0	B2	G5	R8	B10	G13	R16	B18	R632	B634	G637
UD6	G0	R3	B5	G8	R11	B13	G16	R19	G632	R635	B637
UD5	B0	G3	R6	B8	G11	R14	B16	G19	B632	G635	R638
UD4	R1	B3	G6	R9	B11	G14	R17	B19	R633	B635	G638
UD3	G1	R4	B6	G9	R12	B14	G17	R20	G633	R636	B638
UD2	B1	G4	R7	B9	G12	R15	B17	G20	B633	G636	R639
UD1	R2	B4	G7	R10	B12	G15	R18	B20	R634	B636	G639
UD0	G2	R5	B7	G10	R13	B15	G18	R21	G634	R637	B639

LD7	R0	B2	G5	R8	B10	G13	R16	B18	R632	B634	G637
LD6	G0	R3	B5	G8	R11	B13	G16	R19	G632	R635	B637
LD5	B0	G3	R6	B8	G11	R14	B16	G19	B632	G635	R638
LD4	R1	B3	G6	R9	B11	G14	R17	B19	R633	B635	G638
LD3	G1	R4	B6	G9	R12	B14	G17	R20	G633	R636	B638
LD2	B1	G4	R7	B9	G12	R15	B17	G20	B633	G636	R639
LD1	R2	B4	G7	R10	B12	G15	R18	B20	R634	B636	G639
LD0	G2	R5	B7	G10	R13	B15	G18	R21	G634	R637	B639

AC ELECTRICAL CHARACTERISTICS

$V_{DD}=3-4.5V$ $T_a=25^\circ C$

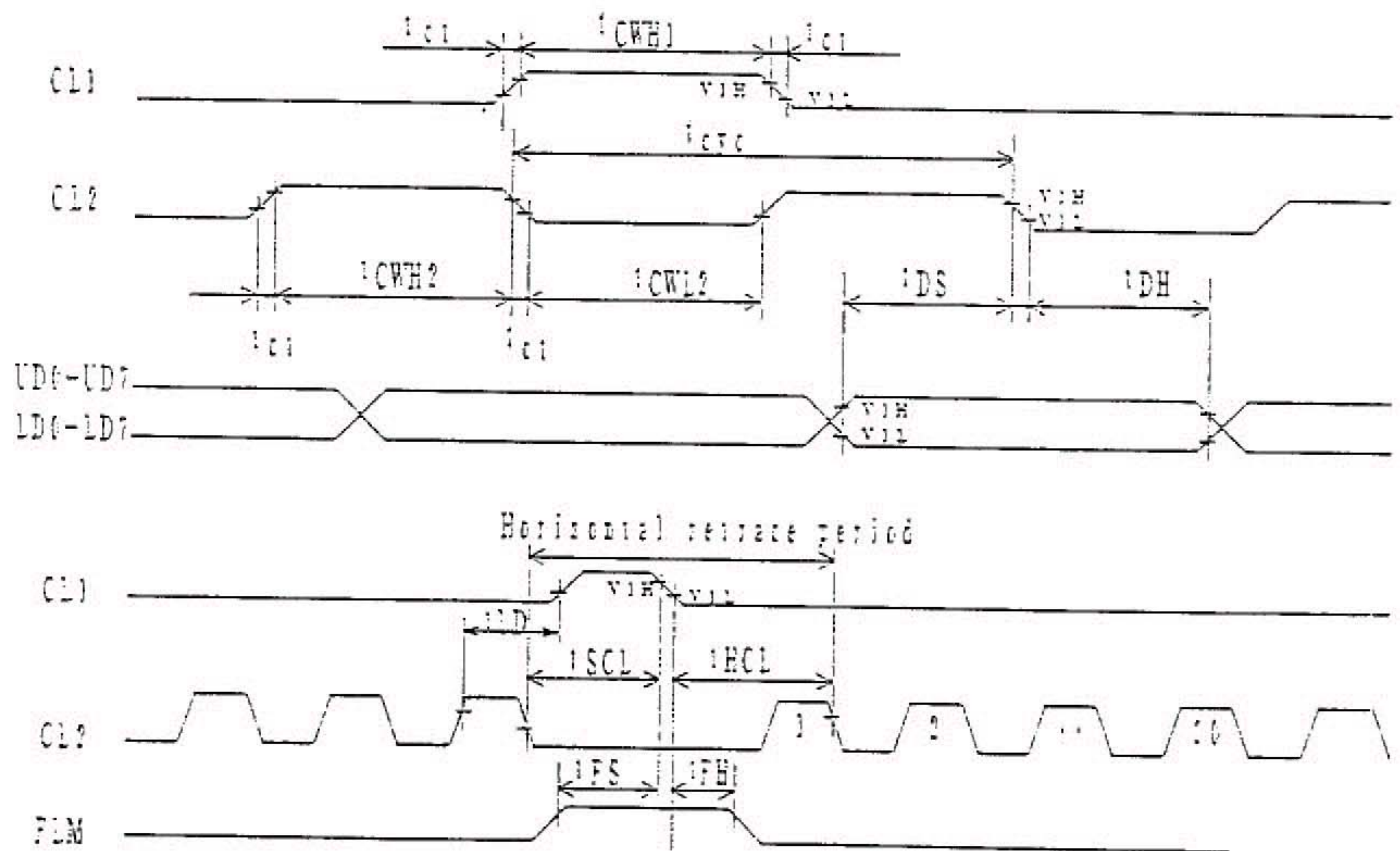
Item	Symbol	Min.	Typ.	Max.	Unit
Clock Cycle time	t_{cyc}	76	—	—	ns
CL2 High level width	t_{CWH2}	25	—	—	ns
CL2 Low level width	t_{CWL2}	25	—	—	ns
CL1 High level width	t_{CWH1}	50	—	—	ns
CL2 setup time	t_{SCL}	100	—	—	ns
CL2 hold time	t_{HCL}	100	—	—	ns
CL2 → CL1 rise time	t_{LD}	0	—	—	ns
Clock rise/fall time	t_{c1}	—	—	50	ns
Data setup time	t_{DS}	20	—	—	ns
Data hold time	t_{DH}	20	—	—	ns
FLM setup time	t_{FS}	100	—	—	ns
FLM hold time	t_{FH}	30	—	—	ns
Frame frequency	f_{FLM}	70	74	130	Hz



AC ELECTRICAL CHARACTERISTICS

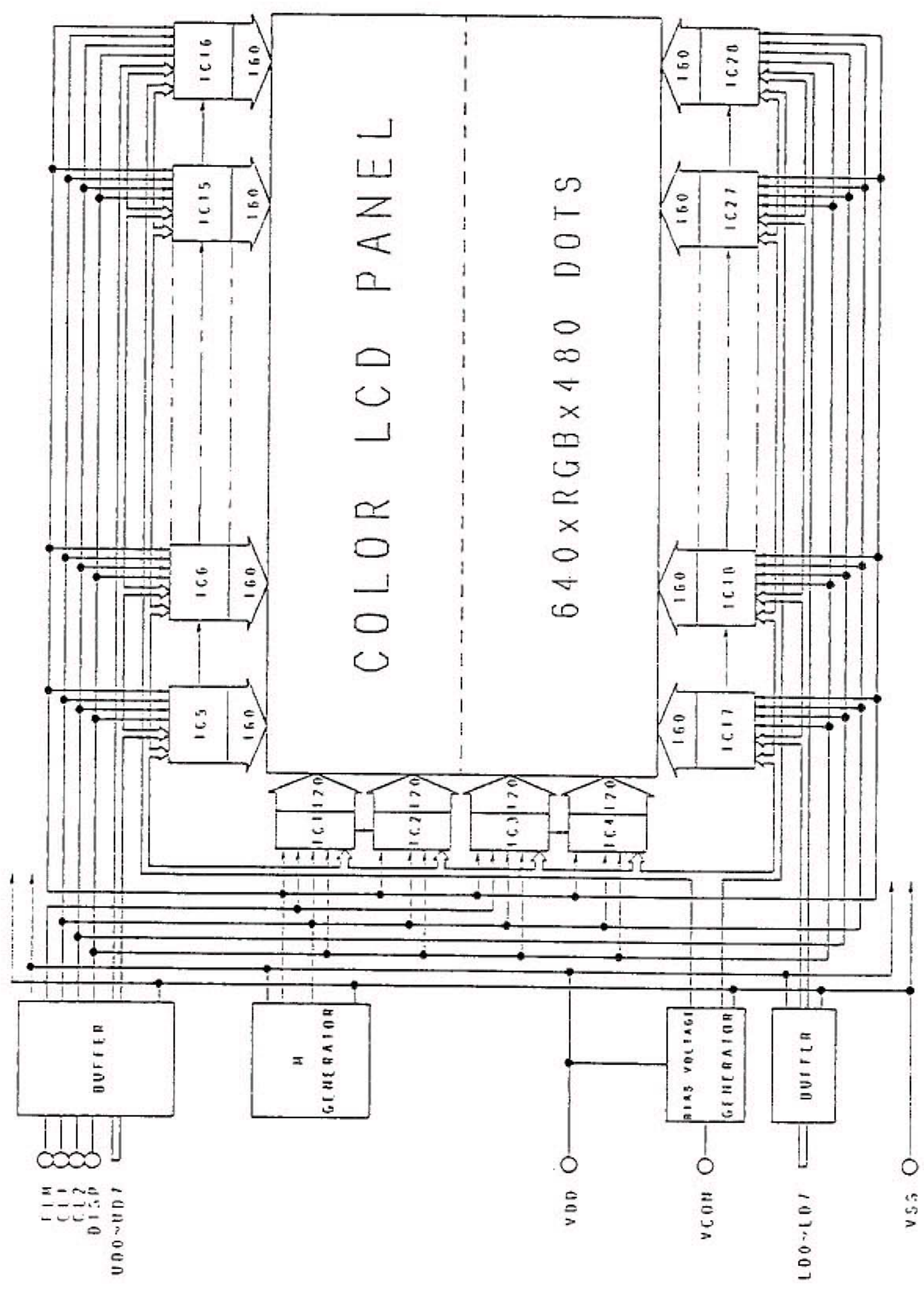
$V_{DD}=5V \pm 10\%$ $T_a=25^\circ C$

Item	Symbol	Min.	Typ.	Max.	Unit
Clock Cycle time	t_{cyc}	62	—	—	ns
CL2 High level width	t_{cwh2}	15	—	—	ns
CL2 Low level width	t_{cwl2}	15	—	—	ns
CL1 High level width	t_{cwh1}	50	—	—	ns
CL2 setup time	t_{scl}	100	—	—	ns
CL2 hold time	t_{hcl}	100	—	—	ns
CL2 → CL1 rise time	t_{ld}	0	—	—	ns
Clock rise/fall time	t_{c1}	—	—	50	ns
Data setup time	t_{ds}	10	—	—	ns
Data hold time	t_{dh}	10	—	—	ns
FLM setup time	t_{fs}	100	—	—	ns
FLM hold time	t_{fh}	30	—	—	ns
Frame frequency	f_{FLM}	70	74	130	Hz

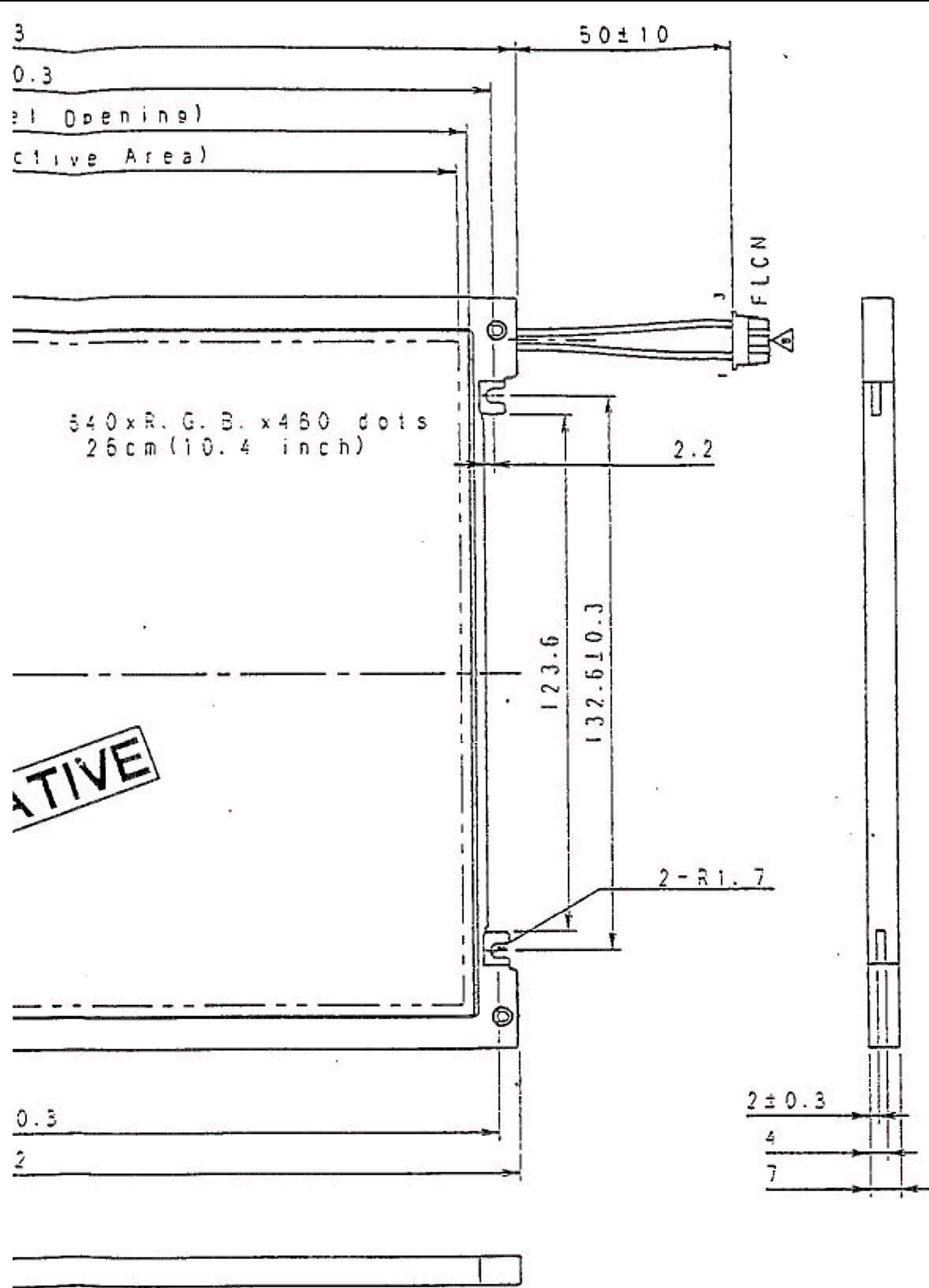


*

■ BLOCK DIAGRAM



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3P-1V (HIROSE) FLCN PIN-1: HIGH
 3VS-1 (JST) PIN-3: GND

ALL SIGNAL TOLERANCE ±0.5
 OTHERWISE SPECIFIED

Unit: mm

■ Example to prevent LCD DC apply by using DISP

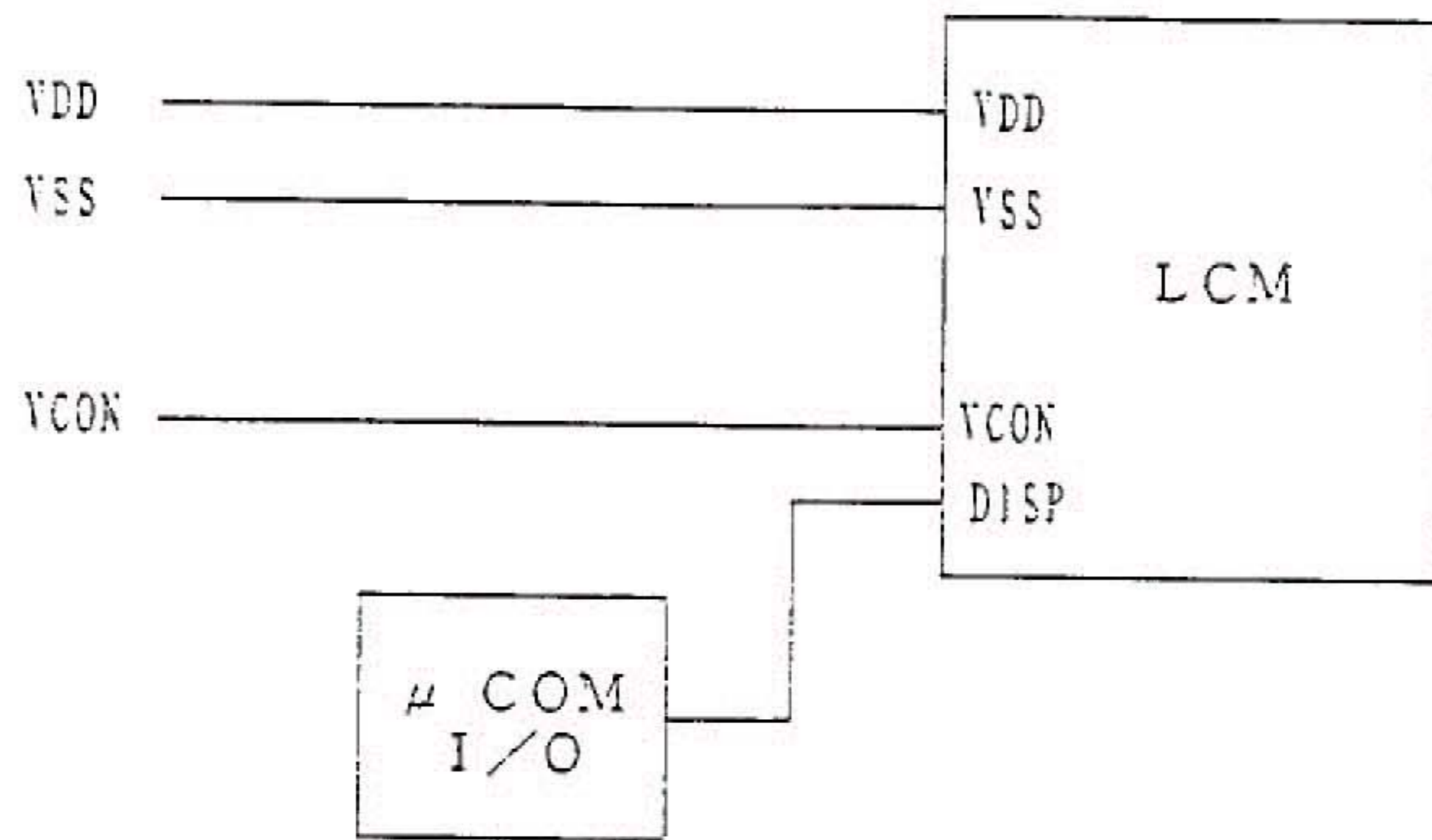


Fig. 4 Example to prevent LCD DC apply by using DISP

Connect I/O port of micro-computer in the main system with DISP and control it. Until initialization of LC control LSI is finished after power ON, signal(M) isn't generated, so that DC voltage is applied to the LCD panel. (Refer to Fig.3.) During this time, switch I/O port(DISP) to 'L' and force apply voltage to the LCD panel into 0V. After initialization of LC control LSI, switch I/O port(DISP) to 'H', so that the LCD panel is returned to the normal driving voltage. (Refer to Fig.5.)

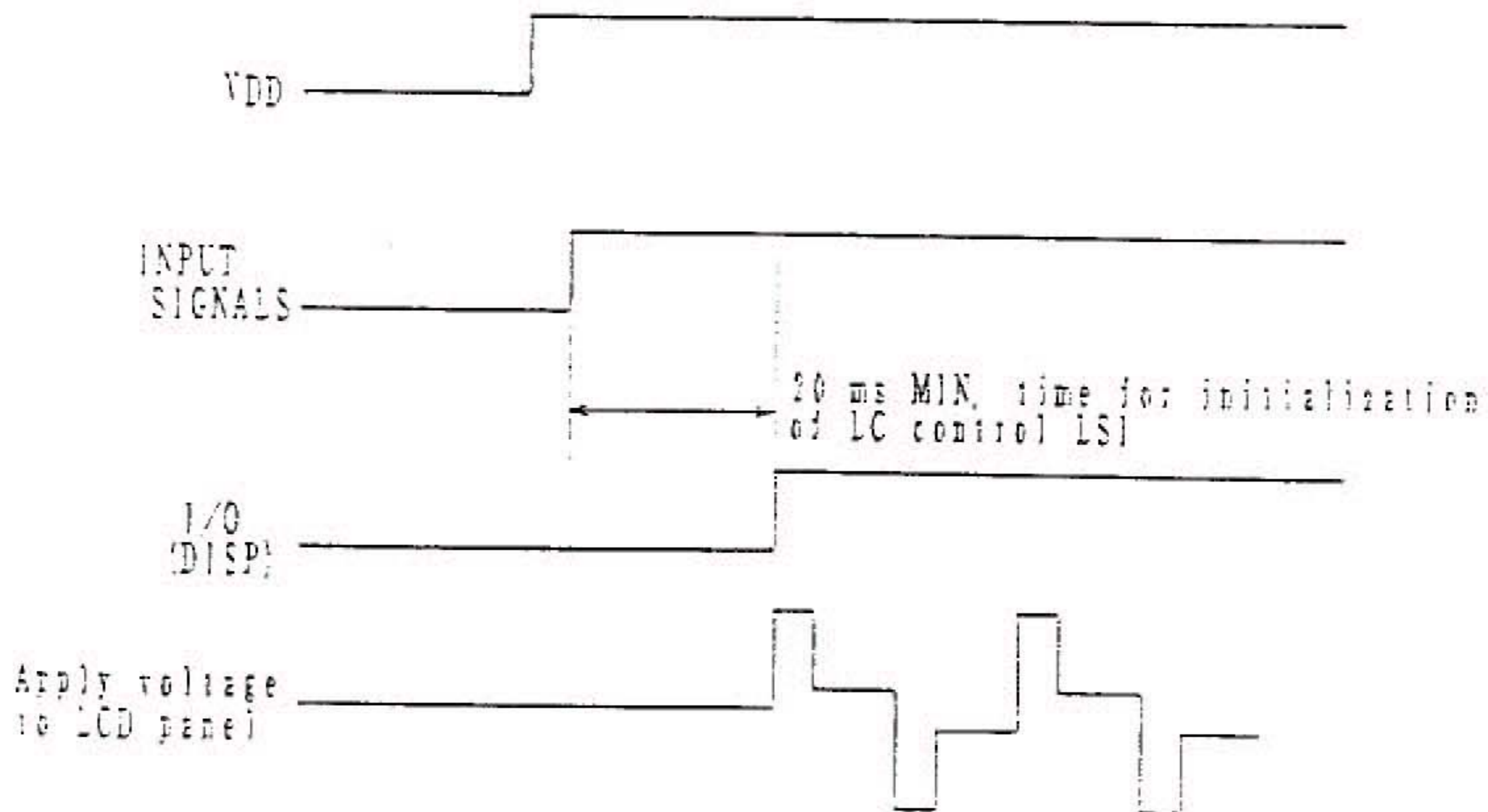


Fig. 5 Timing chart without DC apply to the LCD panel.

■ PRECAUTION FOR USING

1. Handling

- (1) Do not touch, press or rub the display panel with a hard, stiff tool or the like (e.g. tweezers) since the polarizers on the surface are easily scratched.
- (2) Do not use organic solvents to clean the display panel as these solvents may adversely affect the polarizer. To clean the display panel dampen a bit of absorbent cotton with petroleum benzine and gently wipe the panel, or stick contaminations by using a scotch tape.
- (3) Do not touch terminals of electrodes of P.W.B. or LSI leads.
- (4) Avoid using or storing the LCM under high temperature and high humidity conditions. At the storing, it is recommended that the device is packaged in a conductive polyethylene bag and placed under the condition where the temperature is relatively lower (10 to 30°C), and the direct sunlight or fluorescent lamp must be cut off.
- (5) The casing for the module shall be designed taking account of the rise in temperature because of the heat from the backlight so that good quality of images can be provided on the screen.
- (6) Do not suck in, drink or hands off the liquid crystal when it is flown out of the display element due to it's damage.
Wipe the liquid crystal off and wash up with soap or alcohol immediately when hands, clothes, etc. are stuck.
- (7) Wash the liquid crystal with pure water for more than 15 minutes and have medical treatment by the doctor when it gets in the eyes.
- (8) Follow to the ordinances or the regulations set by the self-governing body in disposing of CFLs.

2. Operation

- (1) Do not connect or disconnect the LCM from the main system while power is being supplied.
- (2) Use the module within specified temperature; lower temperature causes the retardation of blinking speed of the display; higher temperature makes overall display discolor. When the temperature gets to be within normal limits, the display will operate normally.
- (3) Adjust the operating voltage for driving (V_{CC}) so that the display shows optimum contrast.

- (4) When supplying an M signal from the external unit to a graphic display of LCM, set the duty to $50\% \pm 1\%$. If the duty deviates too greatly from the value, a DC voltage will be applied to the liquid crystal, which could induce an electrochemical reaction and reduce the life of the LCM.
- (5) At the operating control voltage for driving (V_{con}) varies, the brightness of the display varies likewise.
When V_{con} is supplied from the VR, which is composed between VDD and VSS, the variation of the power supply effect to the display, in the case of the stability of the power supply VDD being worse.

3. Workmanship

- (1) Never disassemble the module. After disassembling, in case that the module is assembled again and shows a disordered operation, the responsibility of the failure will not lie with vendor.
- (2) Care should be taken as not to be charged static electricity, as the circuit of the module contains a CMOS LSI. The workman's body should be grounded with an earth-band. The material which prevents static electricity should be selected for a working clothes.

4. Precautions for handling of CFL cable

- (1) Suspended capacity
Take enough precaution with wiring of the CFL cable when incorporating the module in PC unit, and suspended capacity caused by the external mold.
- (2) High-frequency noise
Confirm with PC unit and, if necessary, measures should be taken.