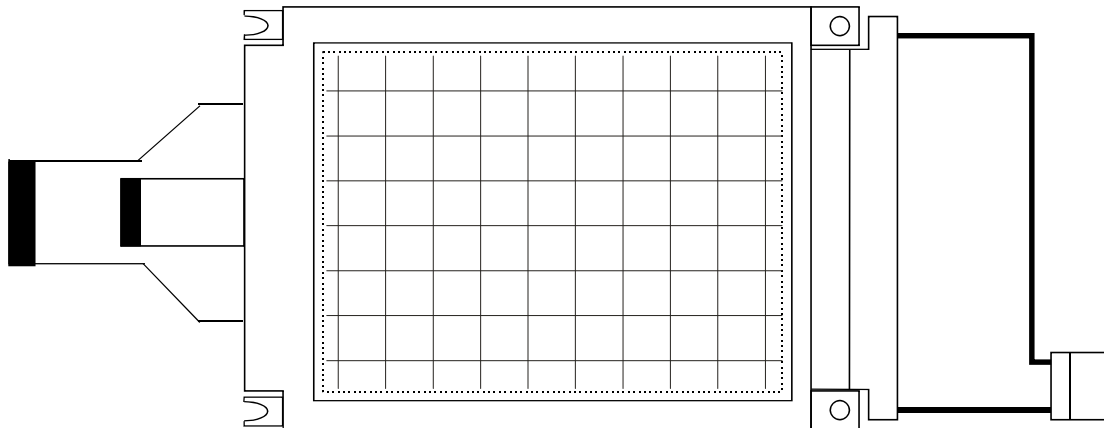




PRODUCT SPECIFICATION

HDM3224TS-2

320 x 240 GRAPHICS
LCD DISPLAY MODULE



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1. MECHANICAL DATA

(1) Product No.	HDM3224TS-2
(2) Module Size	168 (W)mm x 111.0 (H)mm x 9.0 (D)mm (CCFT B.L.)
(3) Dot Size	0.345 (W)mm x 0.345 (H)mm
(4) Dot Pitch	0.36 (W)mm x 0.36 (H)mm
(5) Number of Dots	320 (W) x 240 (H)Dots
(6) Duty	1/240
(7) LCD Display Mode	STN: <input type="checkbox"/> Gray <input type="checkbox"/> Yellow <input type="checkbox"/> Blue FSTN: <input type="checkbox"/> Black and White(Normal Black/Negative Image) <input type="checkbox"/> Black and White(Normal White/Positive Image) Rear Polarizer: <input type="checkbox"/> Reflective <input type="checkbox"/> Transflective <input type="checkbox"/> Transmission <input type="checkbox"/> 6 O'clock <input type="checkbox"/> 12 O'clock
(8) Viewing Direction	
(9) Backlight	CCFT
(10) Controller	Excluded
(11) DC/DC Converter	Excluded
(12) Weight	230 g(APPROX)

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2. ABSOLUTE MAXIMUM RATINGS

(1) ELECTRICAL ABSOLUTE RATINGS

VSS=0V STANDARD

ITEM	SYMBOL	MIN	MAX	UNIT	COMMENT
Power Supply for Logic	VDD-VSS	-0.3	7.0	V	
Power Supply for LCM	VLCD-VSS	0	30.0	V	
Input Voltage	VI	-0.3	VDD	V	
CCFL Driving Voltage	VFL	260	-	Vrms	
CCFL Input Current	IFL	-	5	mA rms	
Static Electricity	-	-	-	-	Note 1

(2) ENVIRONMENTAL ABSOLUTE MAXIMUM RATINGS

ITEM	WIDE TEMP.			
	OPERATING		STORAGE	
	MIN.	MAX.	MIN.	MAX.
Ambient Temperature	-20	70	-30	80
Humidity (Without Condensation)	Note 2,3,5		Note 2,4	

Note 1 LCM should be grounded during handling LCM.

Note 2 Background color will change slightly depending on ambient temperature.
This phenomenon is reversible.

Note 3 $T_a \leq 70^\circ\text{C}$: 75%RH max
 $T_a > 70^\circ\text{C}$: Absolute humidity must be lower
than the humidity of 75%RH at 70°C

Note 4 T_a at -30°C will be < 48hrs, at 80°C will be < 120hrs


Note 5 Operation temp not include CCFL Lamp

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3. ELECTRICAL CHARACTERISTICS

3-1. ELECTRICAL CHARACTERISTICS OF LCM

(VDD = 5V±5%)

ITEM		SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT		
Power Supply for Logic		VDD-VSS	-	4.75	5.0	5.25	V		
Recommended LC Driving Voltage (Wide Temp. LCM)		VLCD-VSS	Duty=1/240 Bias=1/13	-20°C	24.5	24.9	25.3	V	
				0°C	23.1	23.5	23.9		
				25°C	22.1	22.5	22.9		
				50°C	21.0	21.4	21.8		
				70°C	20.3	20.7	21.1		
Input Voltage		VIH	H level	0.7VDD	-	VDD	V		
		VIL	L level	0	-	0.3VDD	V		
Power Supply Current		IDD	FLM = 70 Hz VSS = 0 V VLCD-VSS= 22.5 V	-	0.6	0.9	mA		
		ILCD	PATTERN : 	-	6.9	10.4	mA		
LCM	Surface Luminance	CCFL	T384E6CK	VSS=0V VLCD-VSS=22.5V	PATTERN: (Dots All Off)	-	48	-	cd/m ²
			T384E6K			-	12	-	
			T384G6K		PATTERN: (Dots All ON)	-	220	-	
			T384G6CK			-	170	-	
			T384E6CK						
			T384E6K						
T384G6K									
T384G6CK									

3-2.ELECTRICAL CHARACTERISTICS OF BACKLIGHT

Used lamp : Rating

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	REMARK
Lamp Voltage	V _L	-	260	-	Vrms	-
Lamp current	I _L	2	5	6	mArms	(*1)
Lamp power consumption	P _L	-	1.30	-	W	(*2)
Lamp frequency	F _L	20	35	50	KHz	
Lamp life time	L _L	-	20000	-	hrs	I _L = 5 mArms

(*1) It is recommended that I_L be not more than 5.0 mArms so that heat radiation of CCFT backlight may least affect the display quality .

(*2) Power consumption excluded inverter loss .

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4.OPTICAL CHARACTERISTICS

(For Wide Temperature Mode LCM)

AT Vop

ITEM MODE		Cr(Contrast Ratio)										θ (Viewing Angle)		ϕ (Viewing Angle)	
		-20°C		0°C		25°C		50°C		70°C		25°C		25°C	
		MIN.	TYP.	MIN.	TYP.	MIN.	TYP.	MIN.	TYP.	MIN.	TYP.	MIN.	TYP.	MIN.	TYP.
T	E	-	6.0	-	6.0	-	5.0	-	4.5	-	4.3	-	64	-	±30
	G	-	9.8	-	10.0	-	10.0	-	8.0	-	7.8	-	86	-	±25
note		NOTE 6										NOTE 5			

note:

T : TRANSMISSION

E : BLUE 6 O'clock

G : NORMALLY BLACK 6 O'clock

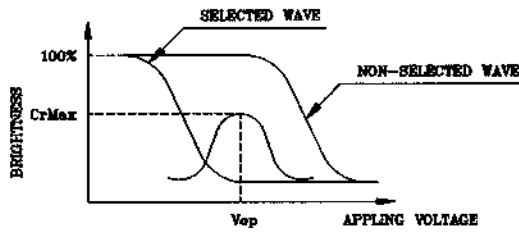
AT $\phi=0^\circ$ $\theta=0^\circ$

ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	NOTE
Response Time (rise)	Tr	-20°C	-	3300	5000	ms	NOTE 2
		0°C	-	700	1100		
		25°C	-	80	120		
		50°C	-	70	110		
		70°C	-	60	90		
Response Time (fall)	Tf	-20°C	-	2400	3600	ms	NOTE 2
		0°C	-	500	800		
		25°C	-	70	110		
		50°C	-	60	90		
		70°C	-	50	80		

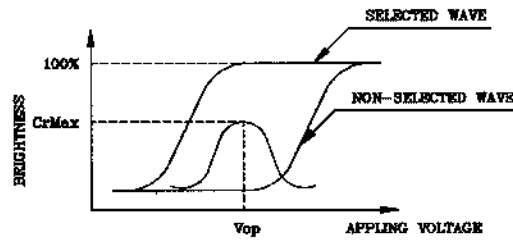
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(NOTE 1)

Definition of Operation Voltage(Vop)



(positive type)



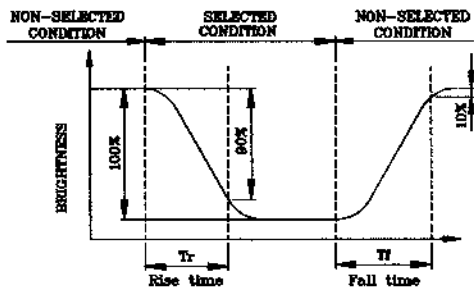
(negative type)

*Conditions

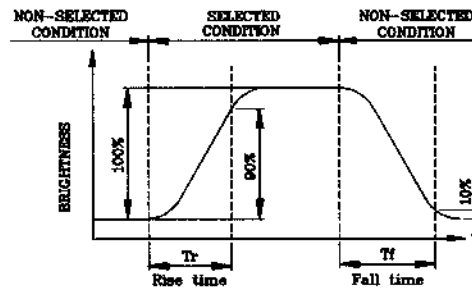
Viewing Angle : 0
 Frame Frequency : 70Hz
 Applying Waveform : 1/N duty 1/a bias

(NOTE 2)

Definition of Response Time(Tr,Tf)



(positive type)



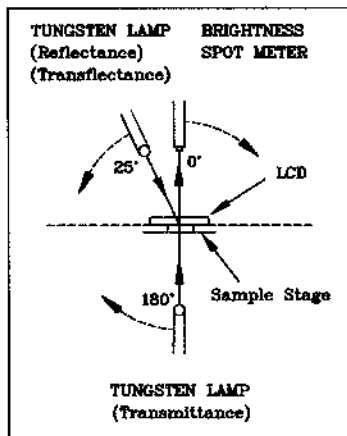
(negative type)

*Conditions

Operating Voltage : Vop
 Viewing Angle (θ,φ) : (0,0)
 Frame Frequency : 70Hz
 Applying Waveform : 1/N duty 1/a bias

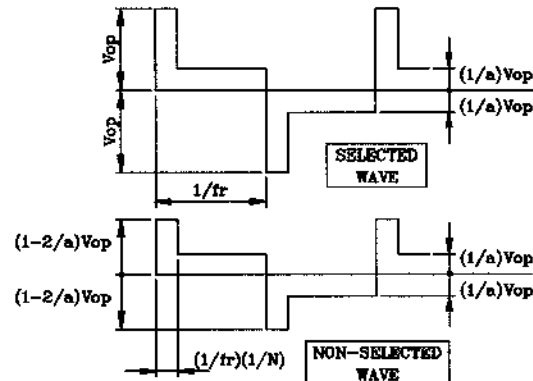
(NOTE 3)

Description of Measuring Equipment and Driving Waveforms



CONST.
TEMP.
CHAMBER

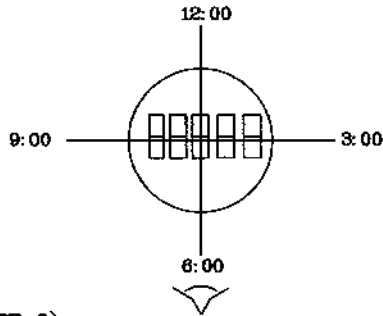
Multiplex Driving (1/N duty 1/a bias)



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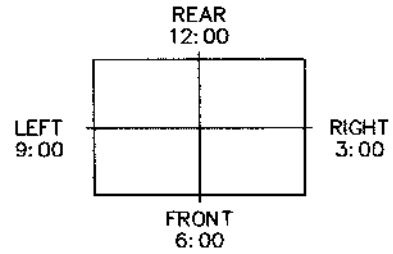
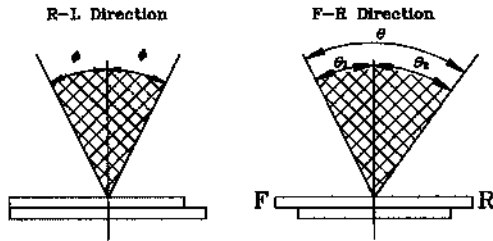
(NOTE 4)

Definition of Viewing Direction



(NOTE 5)

Definition of Viewing Angle



*For This Product
The Viewing Direction Is 6 O'clock
So $\theta_1 > \theta_2$

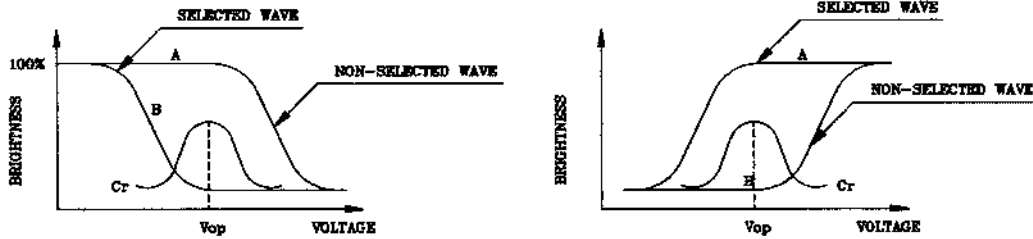
$$\theta = \theta_1 + \theta_2$$

*Conditions

- Operating Voltage : V_{op}
- Frame Frequency : 70Hz
- Applying Waveform : 1/N duty 1/a bias
- Contrast Ratio : larger than 2

(NOTE 6)

Definition of Contrast Ratio (Cr)



(positive type)

(negative type)

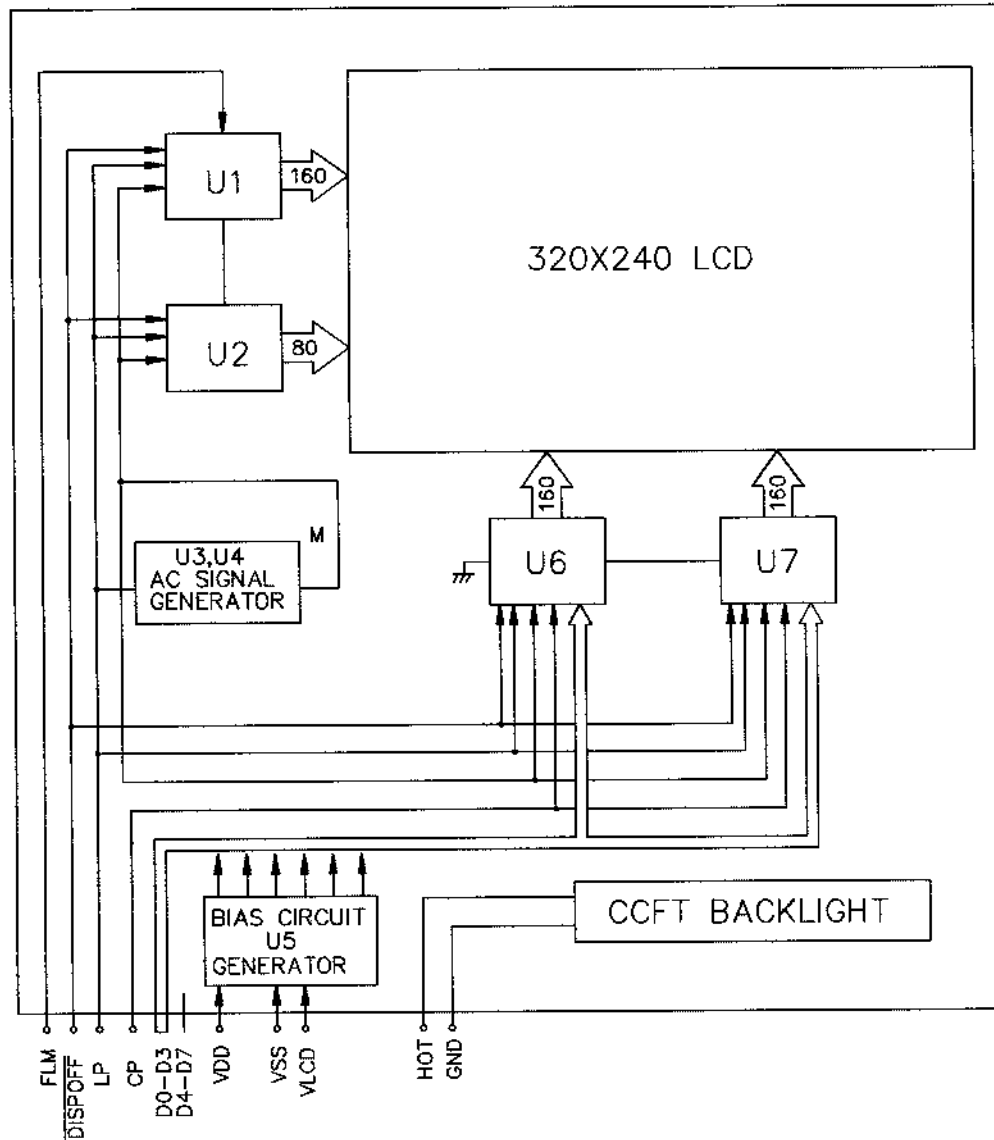
$$\text{Contrast Ratio : } Cr = A/B$$

*Conditions

- Viewing Angle : 0
- Frame Frequency : 70Hz
- Applying Waveform : 1/N duty 1/a bias

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5. BLOCK DIAGRAM



* AC SIGNAL SETTING

J1	J2	J3	J4	J5	J6	J7	J8
L	H	L	L	H	L	L	L

6. INTERNAL PIN CONNECTION

PIN ASSIGNMENT OF I/O CONNECTION

Pin No.	SYMBOL	LEVEL	FUNCTION
1	FLM	H/L	FIRST LINE MARKER
2	LP	H→L	DATA LATCH SIGNAL
3	CP	H→L	DATA SHIFT CLOCK SIGNAL
4	DISPOFF	H/L	H: ON/L: OFF
5	VDD	—	POWER SUPPLY FOR LOGIC
6	VSS	—	GND
7	VLCD	—	POWER SUPPLY FOR LCD DRIVER (+)
8	D0	H/L	Display Data
9	D1	H/L	Display Data
10	D2	H/L	Display Data
11	D3	H/L	Display Data
12	D4	—	No Connection
13	D5	—	No Connection
14	D6	—	No Connection
15	D7	—	No Connection
16	VSS	—	GND

PIN ASSIGNMENT OF CCFL CONNECTION

Pin No.	SYMBOL	LEVEL	FUNCTION
1	HOT	—	Power Supply for CCFL(HOT)
2	NC	—	No Connection
3	NC	—	No Connection
4	GND	—	Power Supply for CFL(GND)

T/P Interface

Pin No.	Symbol	Pin No.	Symbol
1	N.C	11	R4
2	C10	12	R5
3	C9	13	R6
4	C8	14	R7
5	C7	15	N.C
6	C6	16	C1
7	N.C	17	C2
8	R1	18	C3
9	R2	19	C4
10	R3	20	C5

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CUPERTINO, CA 95014

Q.A.:
JK

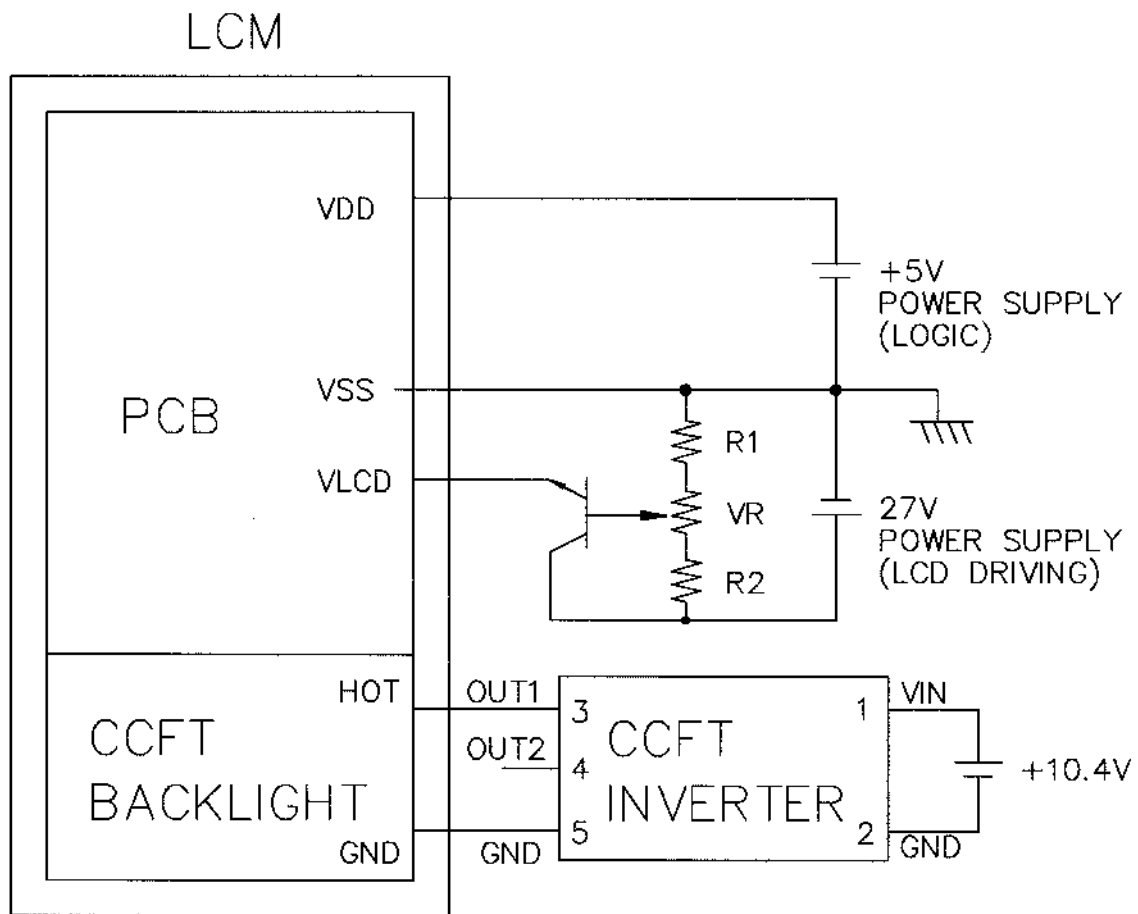
REV.:
1.0

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7. POWER SUPPLY



1. $R1 + VR + R2 = 10K \sim 20K \Omega$

2. RECOMMENDED CCFT INVERTER : CXA-M10L-L(TDK)
CXA-L10L-L(TDK)

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8. TIMING CHARACTERISTICS

8-1. INTERFACE TIMING

VDD=4.5~5.5V

Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Clock Cycle	t _C	Fig. a	125	-	-	ns
SCP Pulse Width	t _{SWH} , t _{SWL}	Fig. a	50	-	-	ns
Data Set Up Time	t _{DSU}	Fig. a , Fig. b	80	-	-	ns
Data Hold Time	t _{DHD}	Fig. a , Fig. b	50	-	-	ns
SCP Rise/Fall Time	t _r , t _f	Fig. a , Fig. b	-	-	50	ns
LP Rise Time	t _{LRP}	Fig. a	50	-	-	ns
LP Fall Time	t _{LFP}	Fig. a	50	-	-	ns
LP Pulse Width	t _{LW}	Fig. a	45	-	-	ns
SCP To LP Delay Time	t _{SL}	Fig. a	40	-	-	ns
LP To SCP Delay Time	t _{LS}	Fig. a	40	-	-	ns
LP "H" Pulse Width	t _{CWH}	Fig. b	30	-	-	ns
LP "L" Pluse Width	t _{CWL}	Fig. b	195	-	-	ns

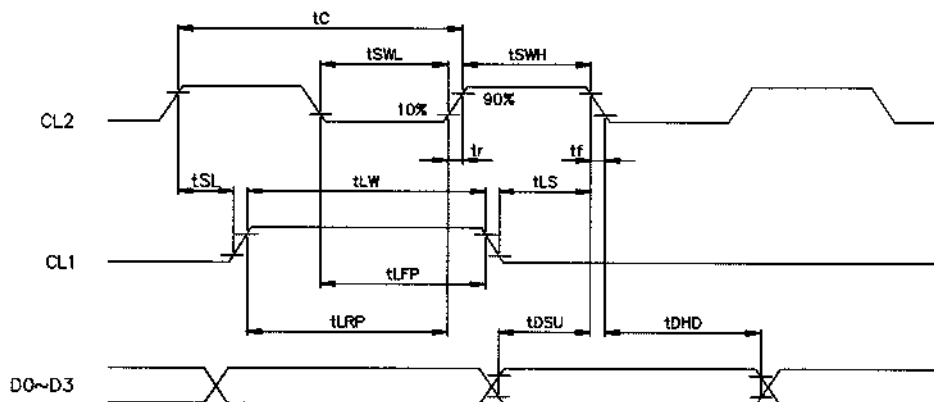


Fig . a Interface timing (SEGMENT)

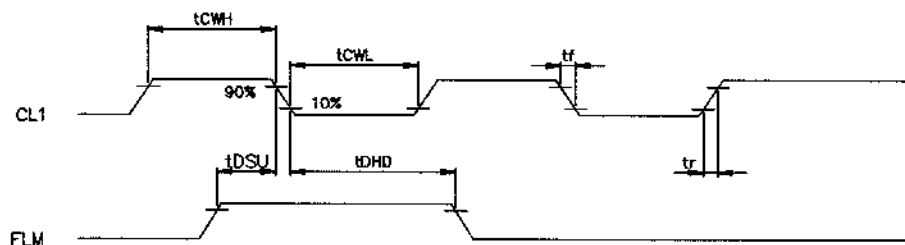
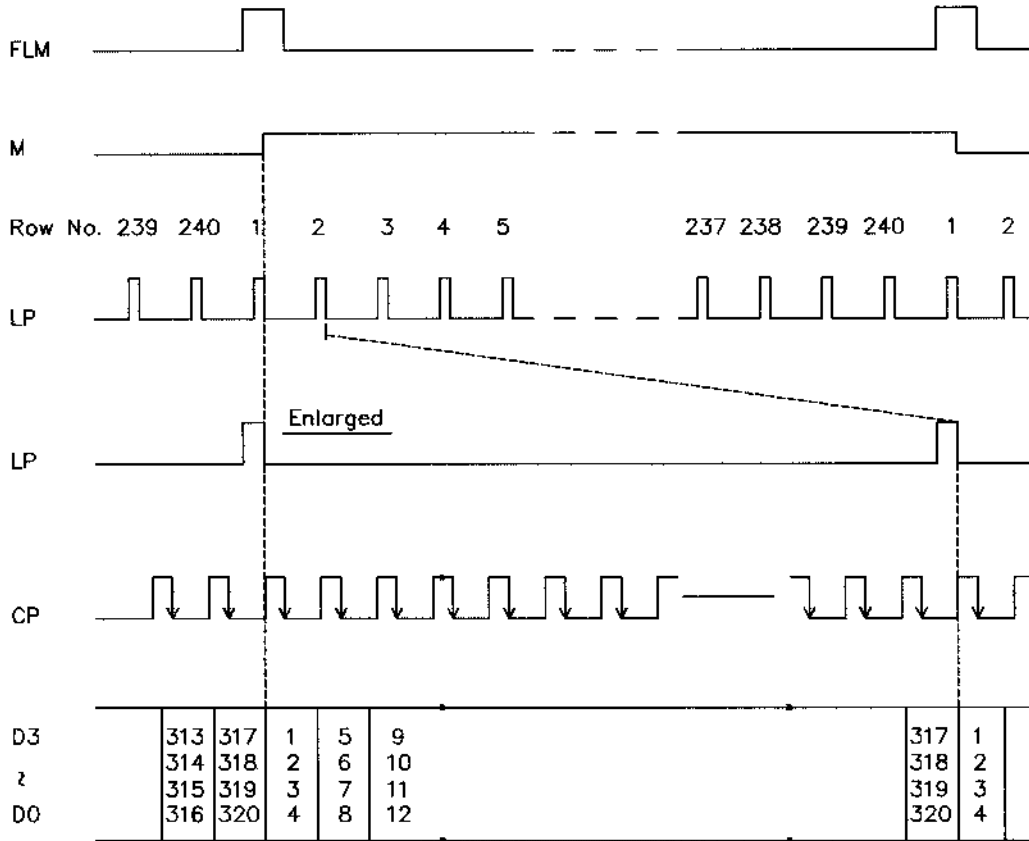


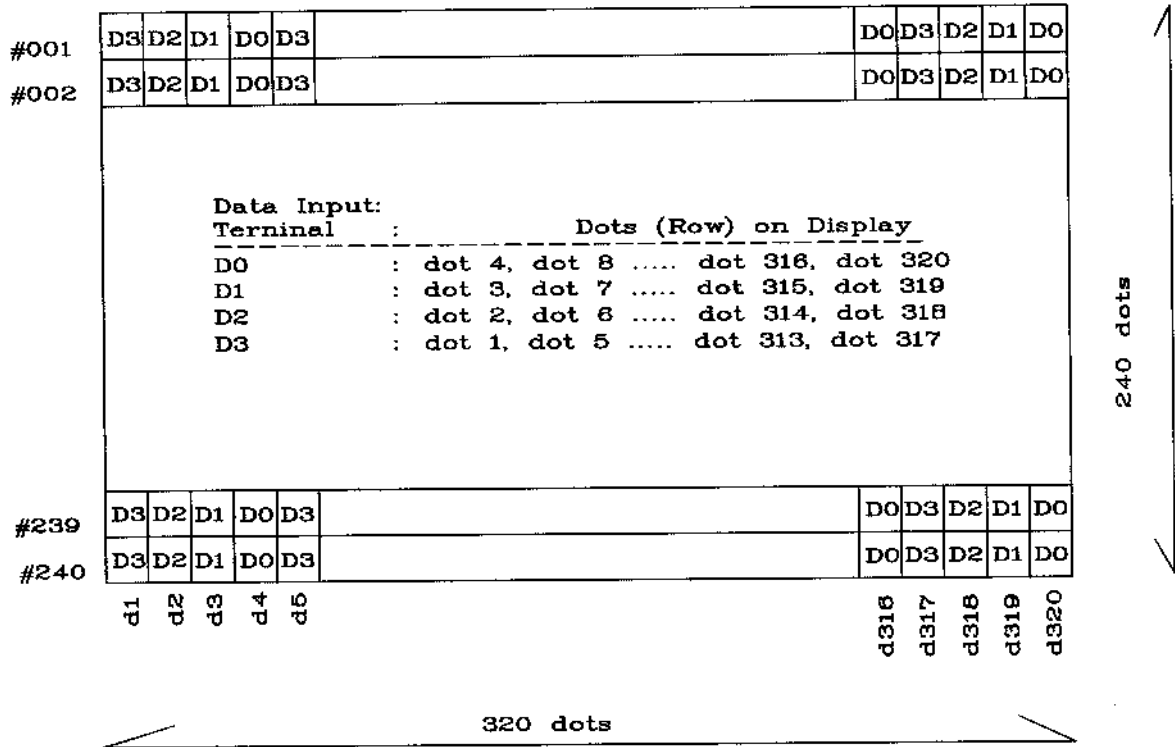
Fig . b Interface timing (COMMON)

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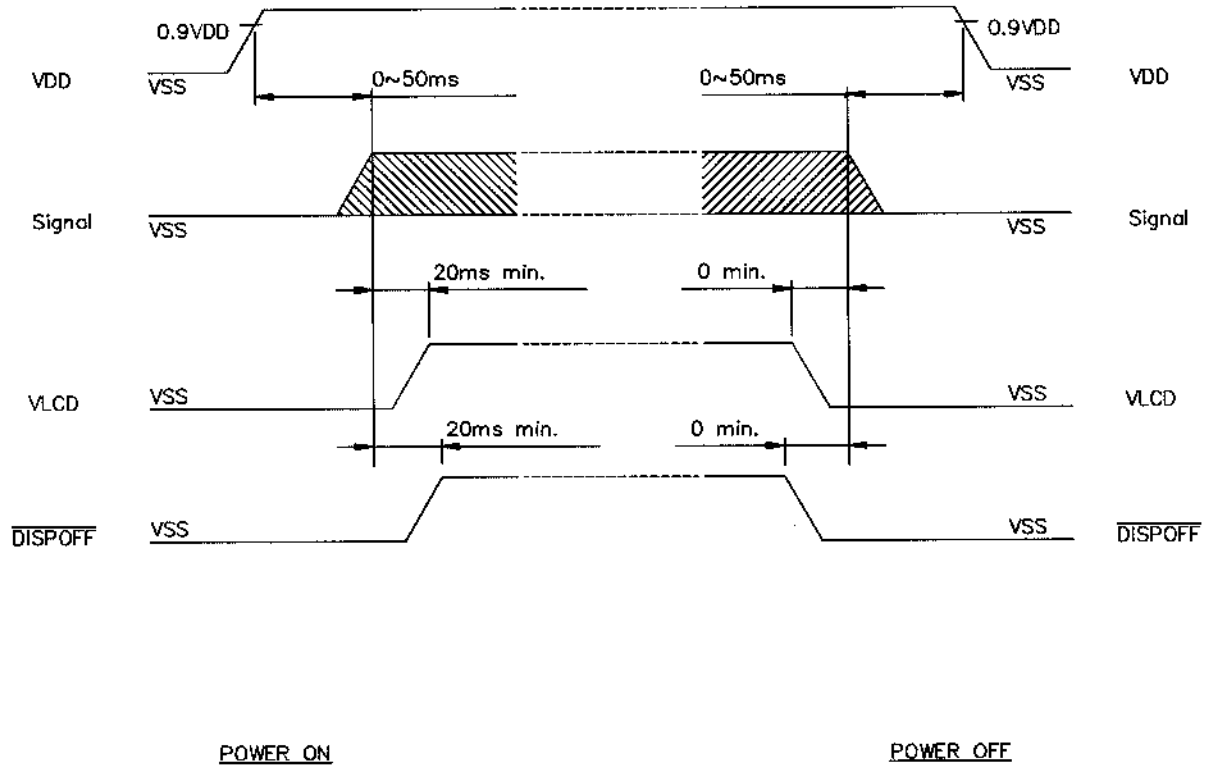
8-2. TIMING CHART OF INPUT SIGNALS



8-3.DISPLAY PATTERN



8-4. POWER ON/OFF TIMING



The missing pixels may occur when the LCM is driven beyond above power interface timing sequence.

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9. RELIABILITY TEST

NO	ITEM	CONDITION			STANDARD	NOTE
1	High Temp. Storage	70°C	120HR		Appearance without defect	
2	Low Temp. Storage	-20°C	120HR		Appearance without defect	
3	High Temp. & High Humi. Storage	40°C 90%RH	120HR		Appearance without defect	
4	Thermal Shock	-20°C, 30min → 25°C, 5min → 70°C, 30min → 25°C, 5min (1cycle)			Appearance without defect	5 cycles

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NOTICE:

• SAFETY

- 1.If the LCD panel breaks, be careful not to get the liquid crystal to touch your skin.
- 2.If the liquid crystal touches your skin or clothes, please wash it off immediately by using soap and water.

• HANDLING

- 1.Avoid static electricity which can damage the CMOS LSI.
- 2.Do not remove the panel or frame from the module.
- 3.The polarizing plate of the display is very fragile. So, please handle it very carefully.
- 4.Do not wipe the polarizing plate with a dry cloth, as it may easily scratch the surface of plate.
- 5.Do not use ketonics solvent & Aromatic solvent, use with a soft cloth soaked with a cleaning naphtha solvent.

• STORAGE

- 1.Store the panel or module in a dark place where the temperature is $25^{\circ}\text{C}\pm 5^{\circ}\text{C}$ and the humidity is below 65% RH.
- 2.Do not place the module near organics solvents or corrosive gases.
- 3.Do not crush, shake, or jolt the module.

• TERMS OF WARRANT

- 1.Acceptance inspection period
The period is within one month after the arrival of contracted commodity at the buyer's factory site.
- 2.Applicable warrant period
The period is within twelve months since the date of shipping out under normal using and storage conditions.

• THE OPERATING LIFE TIME OF BACK LIGHT

- CCFT : 20,000hrs for lamp—current 5mA, 35KHz, 25°C
(Operating life time is defined as follows : The final brightness is at 50% of original brightness.)

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