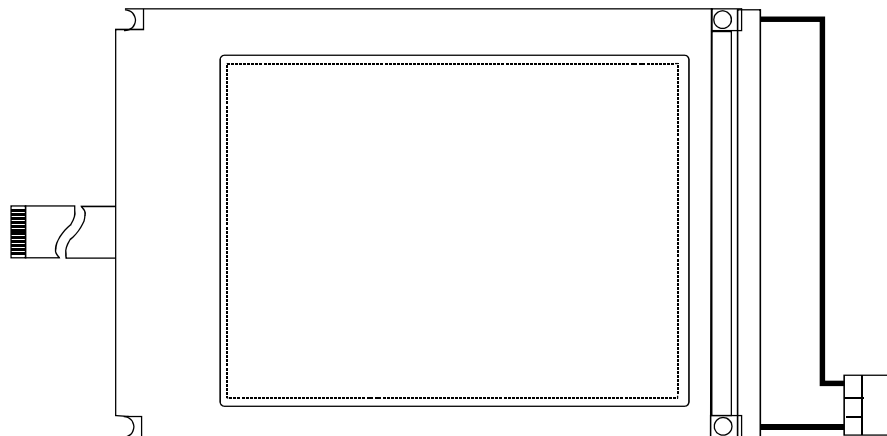




PRODUCT SPECIFICATION

HDM3224C

320x240 COLOR GRAPHICS
LCD DISPLAY MODULE



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1. MECHANICAL DATA

(1) Product No.	HDM3224C
(2) Module Size	168.0 (W)mm x 111.0 (H)mm x 7.4(D)mm
(3) Dot Size	0.09 (W)mm x 0.33 (H)mm
(4) Dot Pitch	0.12 (W)mm x 0.36 (H)mm
(5) Number of Dots	320 xRGB(W) x 240 (H)Dots
(6) Duty	1/240
(7) LCD Display Mode	FSTN: Color STN Module REAR POLARIZER: Color Transmissive Type
(8) Viewing Direction	6 O'clock
(9) Backlight	CCFL
(10) Controller	Excluded
(11) DC/DC Converter	Excluded
(12) Weight	280 g(approx.)

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2. ABSOLUTE MAXIMUM RATINGS

(1) ELECTRICAL ABSOLUTE RATINGS

VSS=0V

ITEM	SYMBOL	MIN	MAX	UNIT	COMMENT
Power Supply for Logic	VDD-VSS	-0.3	7.0	V	
Power Supply for LCD Drive	VLCD-VSS	0	42.0	V	
Input Voltage	VI	-0.3	VDD+0.3	V	
Static Electricity	-	-	-	-	Note 1

(2) ENVIRONMENTAL ABSOLUTE MAXIMUM RATINGS

ITEM	NORMAL TEMP.			
	OPERATING		STORAGE	
	MIN.	MAX.	MIN.	MAX.
Ambient Temperature	0	50	-20	60
Humidity (Without Condensation)	Note 2,4		Note 3,4	

Note 1 LCM should be grounded during handling LCM.

Note 2 $T_a \leq 50^\circ\text{C}$: 85%RH max
 $T_a > 50^\circ\text{C}$: Absolute humidity must be lower
 than the humidity of 85%RH at 50°C


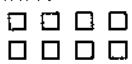

Note 3 T_a at -20°C will be < 48 hrs, at 60°C will be < 120 hrs

Note 4 Background will color change slightly depending on ambient temperature.
 That phenomenon is reversible.

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3. ELECTRICAL CHARACTERISTICS

3-1.CHARACTERISTICS OF LCM

ITEM		SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	
Logic Circuit Power Supply		VDD-VSS	Ta= 25°C	4.5	5.0	5.5	V	
Input Voltage		VIH	H level	0.8VDD	-	VDD	V	
		VIL	L level	0	-	0.2VDD	V	
Recommended LCD Driving Voltage (Normal Temp. LCM)		VLCD-VSS	Duty=1/240 Bias=1/13 VDD=5.0V	0°C	23.2	23.6	24.0	V
				25°C	22.2	22.6	23.0	
				50°C	21.0	21.4	21.8	
Supply Current for Logic		IDD	VDD-VSS = 5.0V VLCD-VSS = 22.6V Ta= 25°C	-	2.0	6.0	mA	
Supply Current for LCD		ILCD	PATTERN: 	-	8.0	15.0	mA	
LCM	Surface Luminance	L	PATTERN: (Dots All On of White Color) 	-	67.5	-	cd/m ²	
			PATTERN: (Dots All Off) 	-	2.7	-		
Recommended Frame Frequency for Optimum Coctrast		FLM	-	115	120	125	Hz	

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3-2.ELECTRICAL CHARACTERISTICS OF BACKLIGHT

Used lamp : Rating

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	REMARK
Lamp Voltage	V _L	-	320	-	Vrms	T _a = 25°C
Lamp current	I _L	4	5	6	mArms	(*1) T _a = 25°C
Lamp power consumption	P _L	-	1.6	-	W	(*2) T _a = 25°C
Lamp frequency	F _L	20	35	50	KHz	T _a = 25°C
Starting voltage	V _S	-	455	-	Vrms	T _a = 0°C
		-	350	-	Vrms	T _a = 25°C
Lamp life time	L _L	-	20000	-	hrs	I _L =5mArms, T _a =25°C

(*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

4-1.Optical Char. of Normal Temp. Mode

AT Vop

ITEM MODE		Cr(Contrast Ratio)						θ (Viewing Angle)		ϕ (Viewing Angle)	
		0°C		25°C		50°C		25°C		25°C	
		MIN.	TYP.	MIN.	TYP.	MIN.	TYP.	MIN.	TYP.	MIN.	TYP.
T	M	-	40	-	35	-	5	-	90	-	±58
NOTE		NOTE 6						NOTE 5			

note:

T: TRANSMISSIVE
M: FOR 6 O'CLOCK STN MODULE

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

ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	NOTE
Response Time (rise)	Tr	0°C	-	550	750	ms	NOTE 2
		25°C	-	230	330		
		50°C	-	100	140		
Response Time (fall)	Tf	0°C	-	270	370	ms	NOTE 2
		25°C	-	80	110		
		50°C	-	60	85		

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4-2. Color of CIE Coordinate

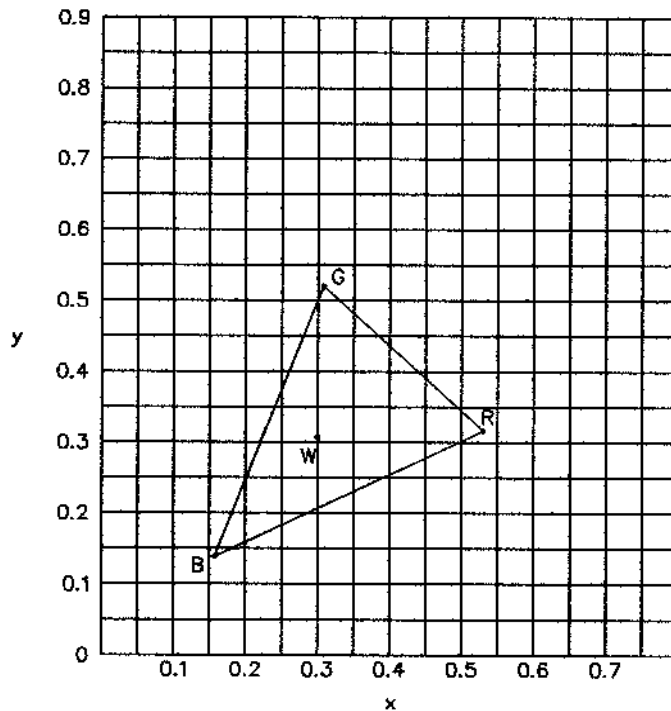
Ta = 25°C

ITEM		SYMBOL	CONDITION	VALUE	BRIGHTNESS (cd/m ²)	NOTE
Color of CIE Coordinate	Red	X	$\phi=0^\circ, \theta=0^\circ$	0.531	21.0	Note*
		y		0.318		
	Green	X		0.305	50.0	
		y		0.521		
	Blue	X		0.163	18.0	
		y		0.139		
	White	X		0.302	75.0	
		y		0.311		

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

Tolerance : ±0.05

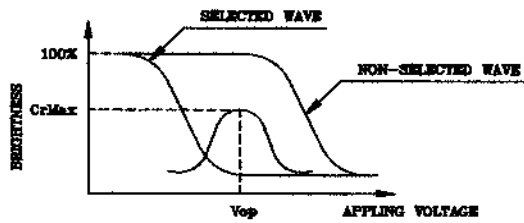
Fig.1



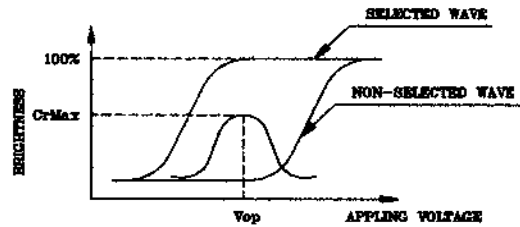
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(NOTE 1)

Definition of Operation Voltage(Vop)



(positive type)



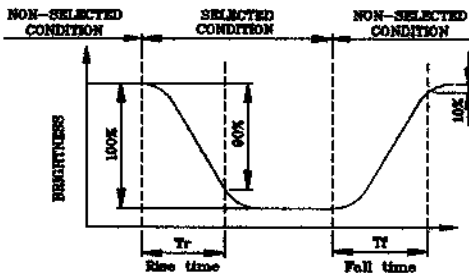
(negative type)

*Conditions

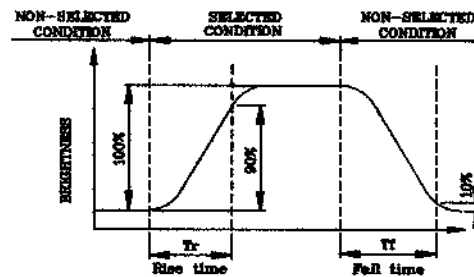
- Viewing Angle : 0
- Frame Frequency : 120Hz
- Applying Waveform : 1/N duty 1/a bias

(NOTE 2)

Definition of Response Time(Tr,Tf)



(positive type)



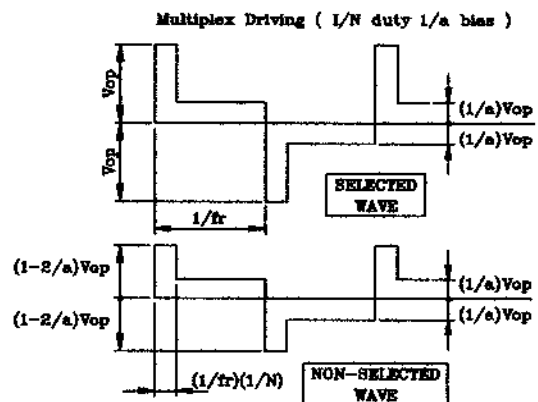
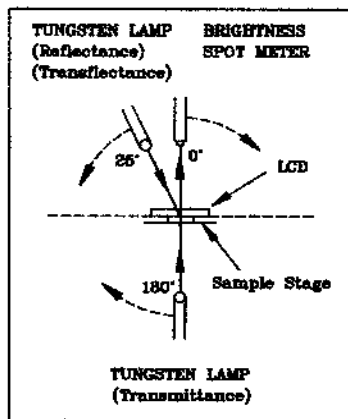
(negative type)

*Conditions

- Operating Voltage : Vop
- Viewing Angle (θ,φ) : (0,0)
- Frame Frequency : 120Hz
- Applying Waveform : 1/N duty 1/a bias

(NOTE 3)

Description of Measuring Equipment and Driving Waveforms



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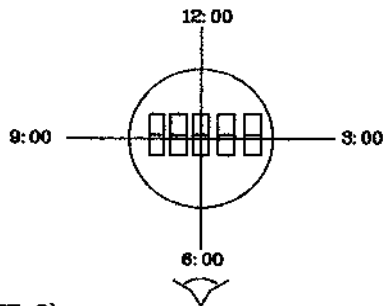
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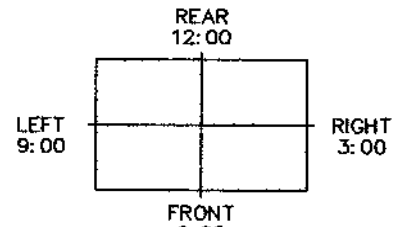
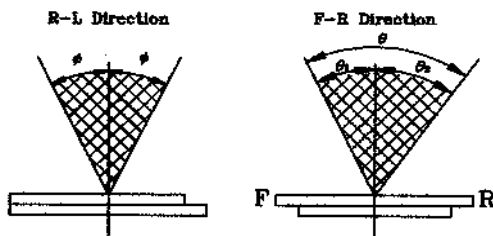
(NOTE 4)

Definition of Viewing Direction



(NOTE 5)

Definition of Viewing Angle



*For This Product

The Viewing Direction is 6 O'clock
So $\theta_1 > \theta_2$

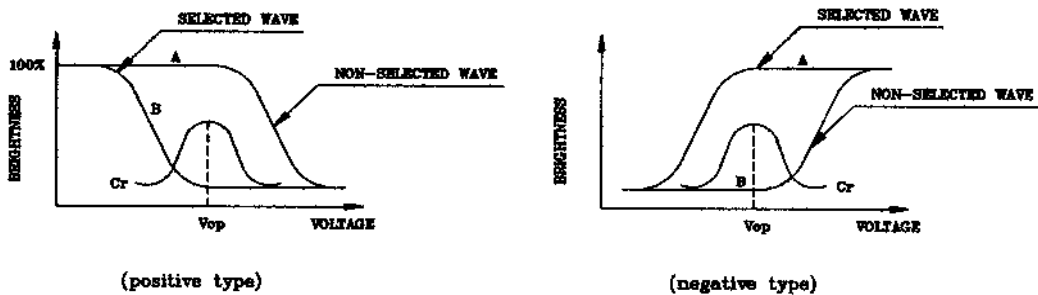
$$\theta = \theta_1 + \theta_2$$

*Conditions

Operating Voltage : V_{op}
Frame Frequency : 120Hz
Applying Waveform : 1/N duty 1/a bias
Contrast Ratio : larger than 2

(NOTE 6)

Definition of Contrast Ratio (Cr)



Contrast Ratio : $Cr = A/B$

*Conditions

Viewing Angle : 0
Frame Frequency : 120Hz
Applying Waveform : 1/N duty 1/a bias

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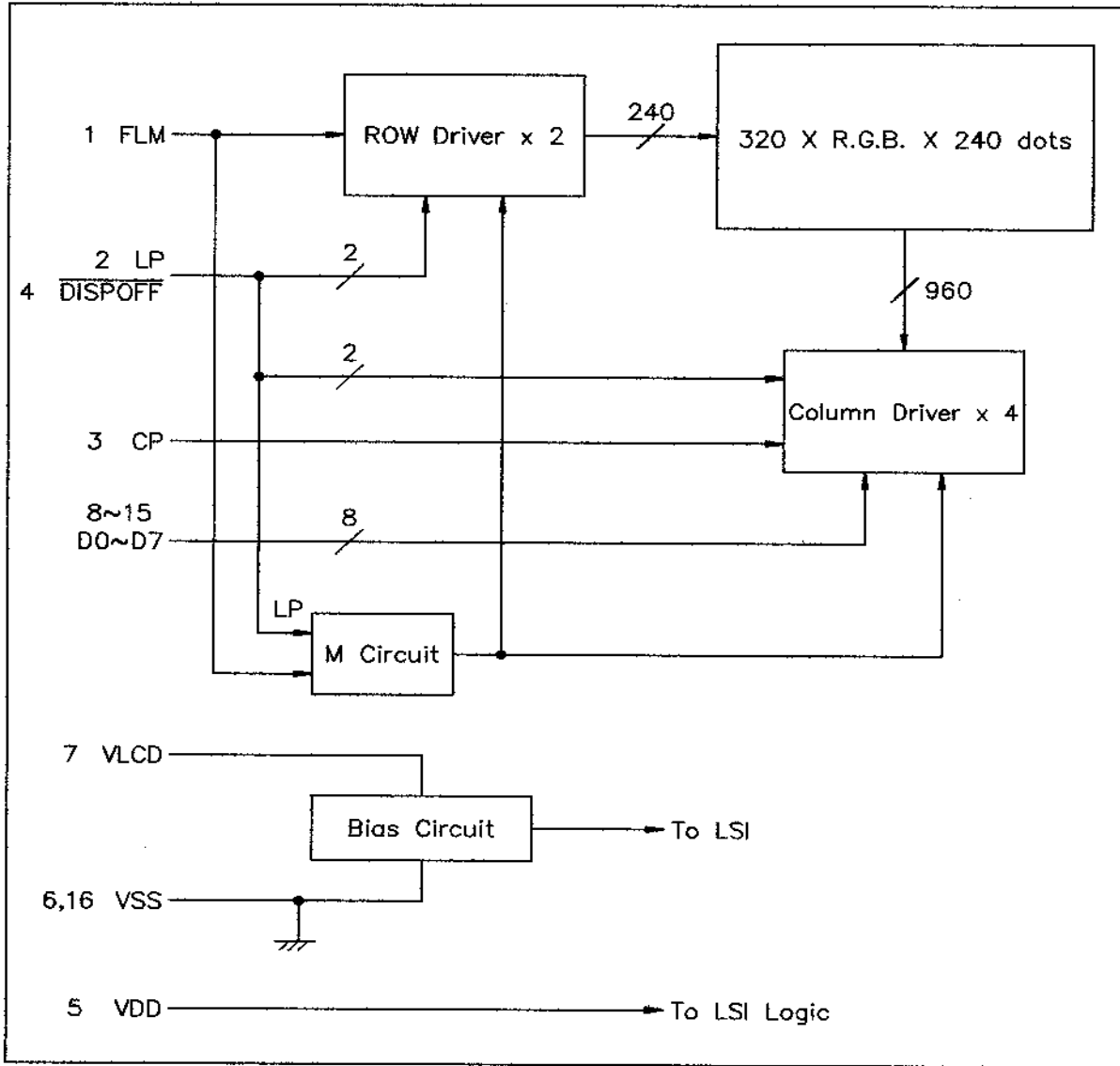
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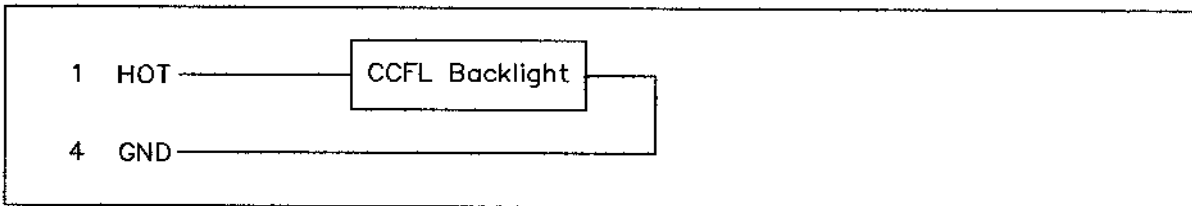
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5. BLOCK DIAGRAM

LCD



CCFL



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6. INTERNAL PIN CONNECTION

LCD

Pin No.	Symbol	Level	Function
1	FLM	H/L	First Line Marker
2	LP	H-L	Data Latch Signal
3	CP	H-L	Clock Signal for Shifting Data
4	DISPOFF	H/L	Display Control Signal, H : Display on L : Display off
5	VDD	-	Power Supply for Logic
6	VSS	-	Power Supply (0V,GND)
7	VLCD	-	Power Supply for LCD Drive
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	H/L	Display Data
13	D5	H/L	Display Data
14	D6	H/L	Display Data
15	D7	H/L	Display Data
16	VSS	-	Power Supply (0V,GND)

CCFL

Pin No.	Symbol	Level	Function
1	HOT	-	Power Supply for CCFL(HOT)
2	NC	-	Non-connection
3	NC	-	Non-connection
4	GND	-	Power Supply for CCFL(GND)

LCD INTERFACE CABLE :

FFC,N16,Pitch 1.0 mm (Thickness = 0.3 mm)

CORRESPONDABLE LCD CONNECTOR :

MOLEX 52207-1690 or COMPATIBLE

CCFL CONNECTOR :

M63M83-04 (MITSUMI)

CORRESPONDABLE CCFL CONNECTOR :

M60-04-30-134P or M60-04-30-114P or M61M73-04 (MITSUMI)

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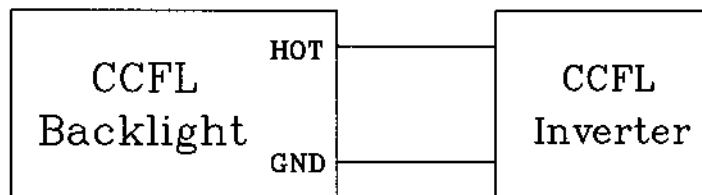
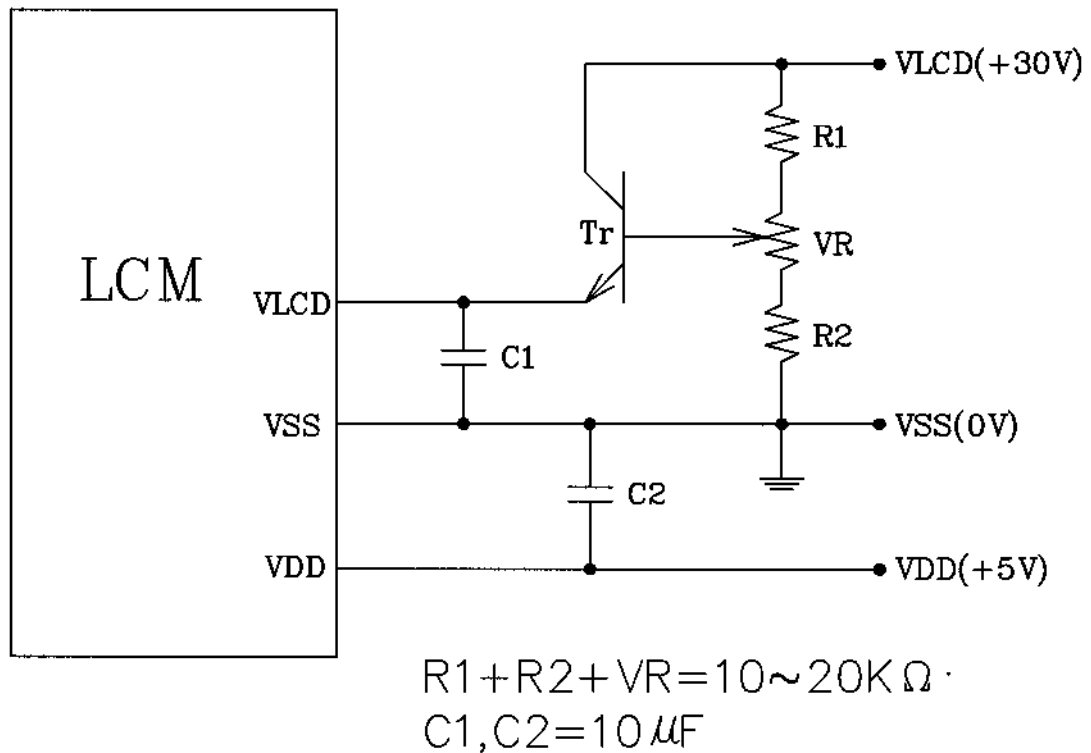
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7. POWER SUPPLY



Recommended CCFL Inverter : TDK CXA-L10L
 TDK CXA-M10L-L

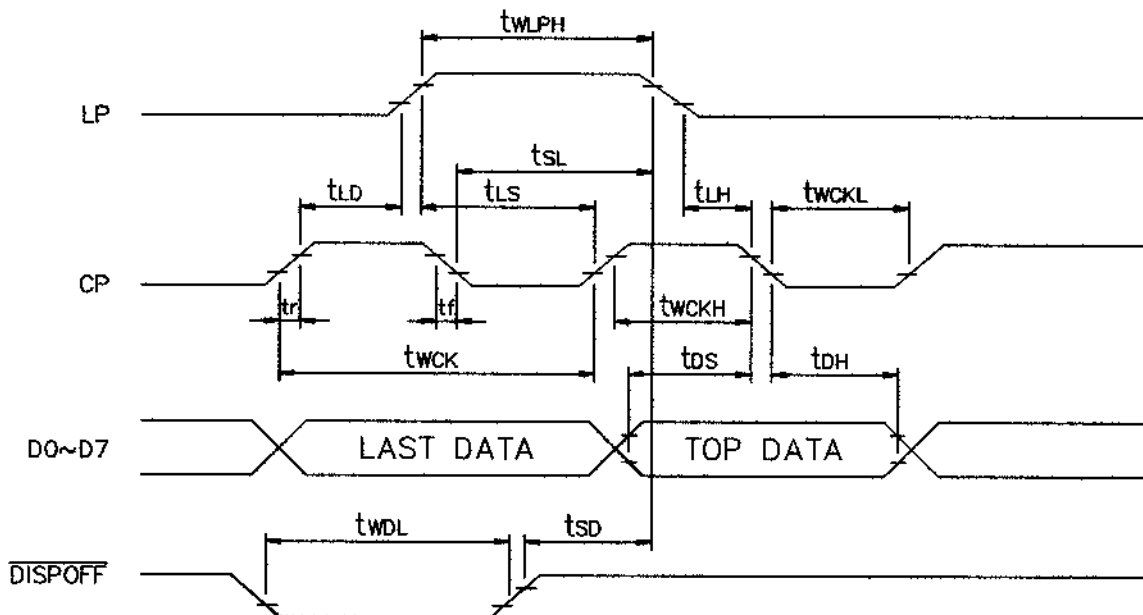
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8. TIMING CHARACTERISTICS

8-1. INTERFACE TIMING

VDD=5.0V ± 10%

Parameter	SYMBOL	MIN.	MAX.	UNIT
CLOCK PULSE CYCLE TIME	t_{wck}	40	—	ns
CLOCK PULSE HIGH LEVEL WIDTH	t_{wckH}	12	—	ns
CLOCK PULSE LOW LEVEL WIDTH	t_{wckL}	14	—	ns
LATCH PULSE HIGH LEVEL WIDTH	t_{wLPH}	15	—	ns
CP→LP RISE TIME	t_{LD}	5	—	ns
CP→LP FALL TIME	t_{SL}	25	—	ns
LP→CP RISE TIME	t_{LS}	25	—	ns
LP→CP FALL TIME	t_{LH}	25	—	ns
CLOCK PULSE RISE/FALL TIME	t_r, t_f	—	50	ns
DATA SETUP TIME	t_{DS}	5	—	ns
DATA HOLD TIME	t_{DH}	15	—	ns
DISPOFF LOW LEVEL WIDTH	t_{WDL}	1.2	—	μs
DISPOFF CANCELLATION TIME	t_{SD}	100	—	ns



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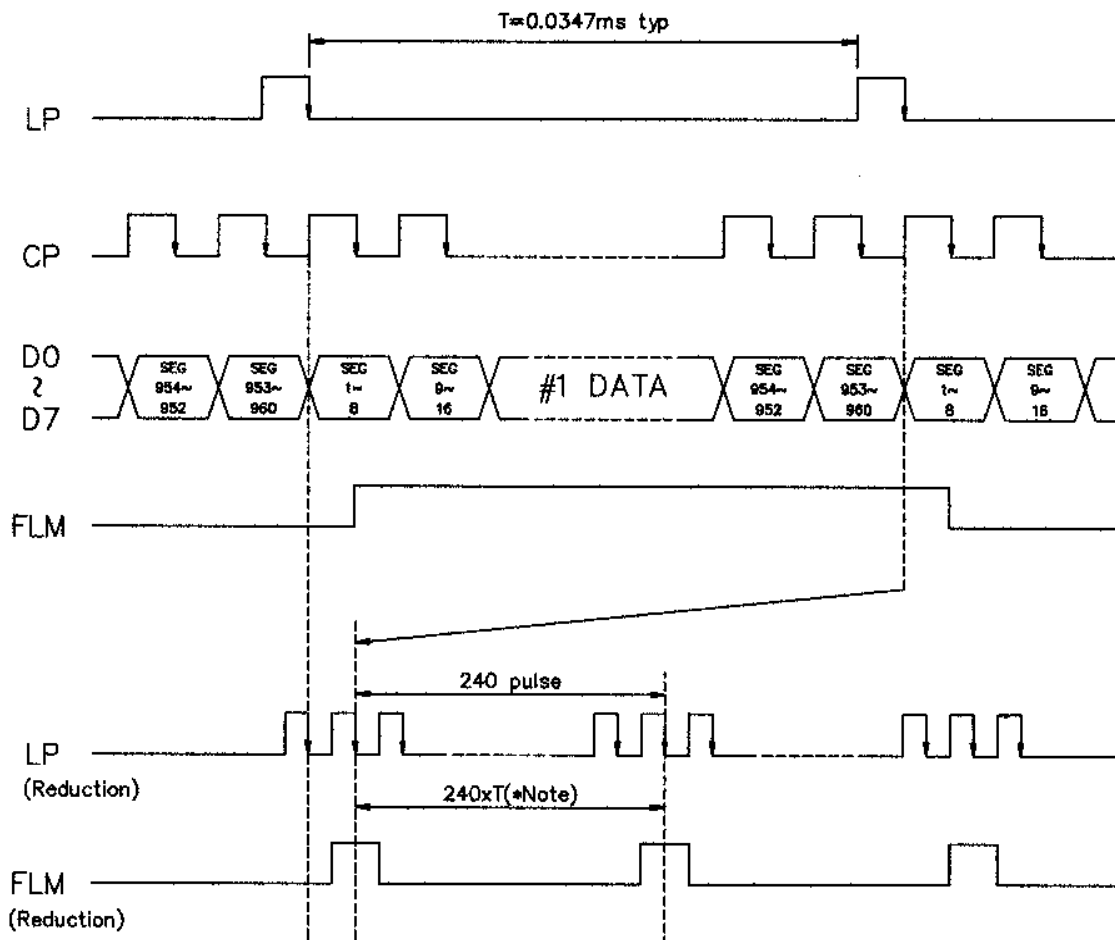
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8-2.TIMING CHART OF INPUT SIGNAL



*Note :

If you have problem of display quality , you may modify the LP pulse to improve .

Method :1.Increase one pulse of LP.

2.Check the display quality.

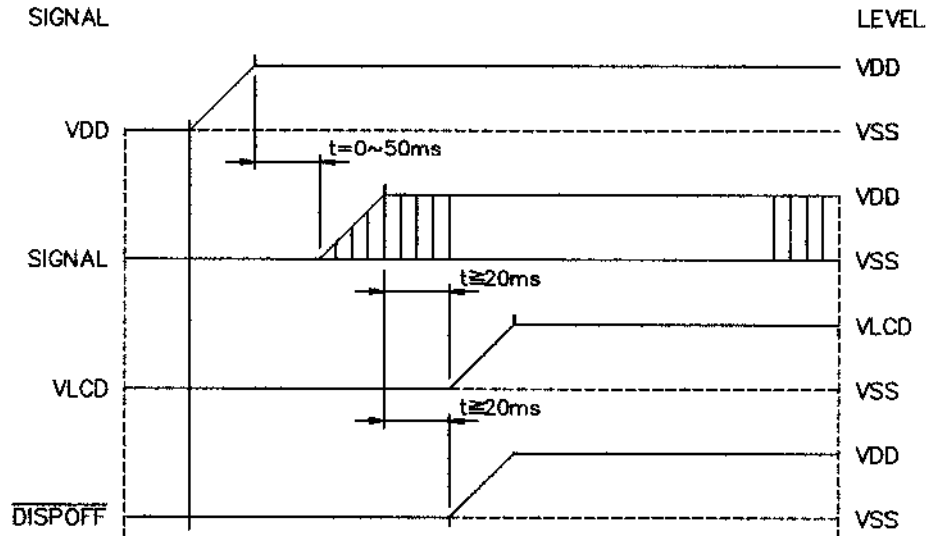
3.If display quality N.G. , redo item 1.

4.If you try many value (ex: 240~260) , you can't get the best quality . The display error may cause by others.

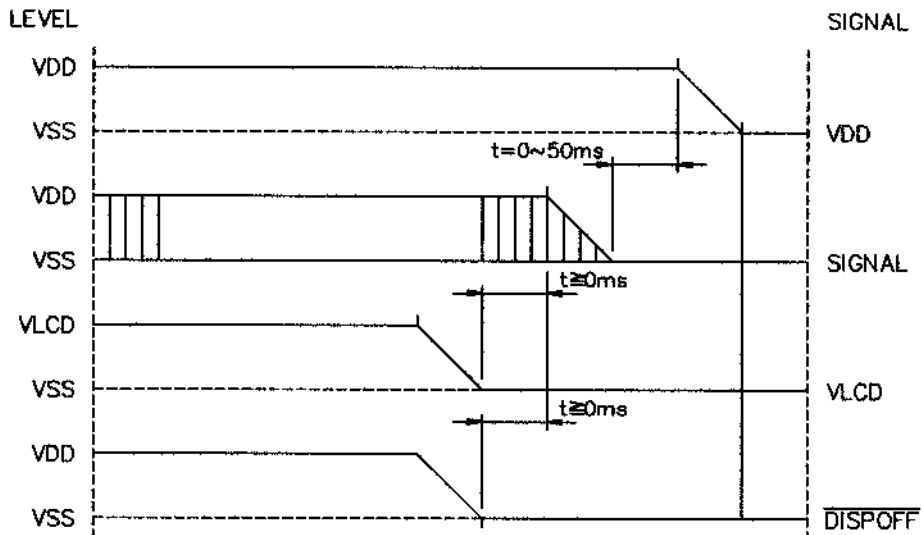
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8-3.POWER ON/OFF TIMING

ON SEQUENCE



OFF SEQUENCE



Please maintain the above sequence when turning on and off the power supply of the module. If $\overline{\text{DISPOFF}}$ is supplied to the module while internal alternate signal for LCD driving(M) is unstable, DC component will be supplied to the LCD panel. This may cause damage the LCD module.

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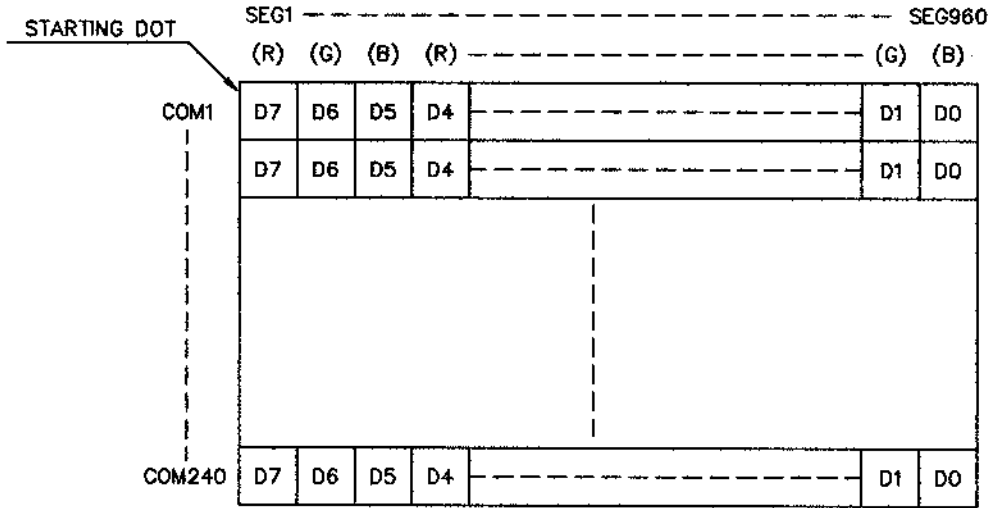
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8-4.DISPLAY PATTERN



D0~D7 are 8 bits transmitted data, where D0 is LSB and D7 is MSB.

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

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.

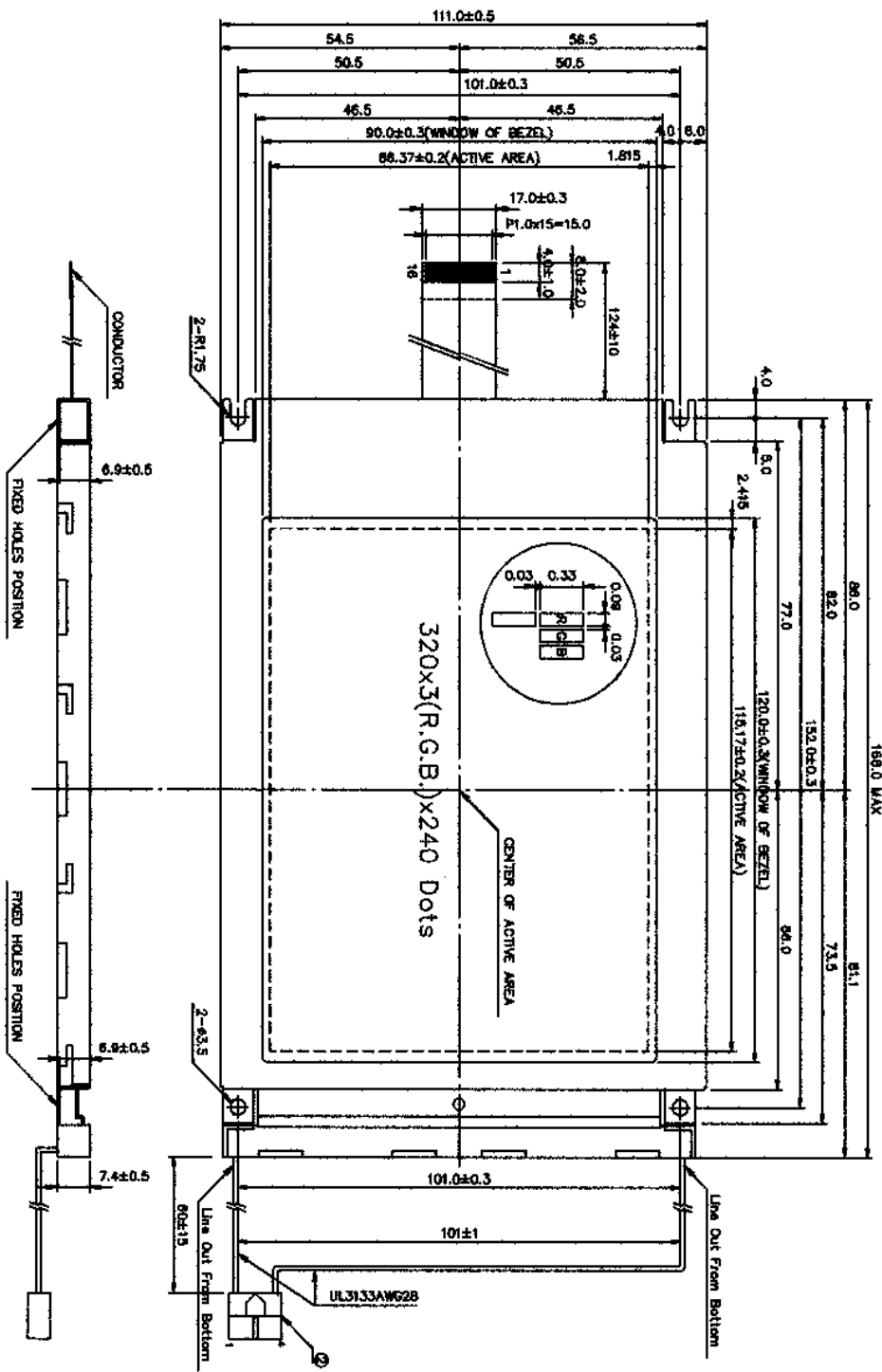
- TERMS OF WARRANT

- 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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NOTE :

1. RESOLUTION : 320 X 3(R.G.B.) X 240 DOTS
 2. CONTROLLER : EXCLUDED
 3. DC/DC CONVERTER : EXCLUDED
 4. ⊕ INTERFACE CONNECTOR
FFC, M16 P1.0mm
 5. ⊙ COFT CONNECTOR
M63M83-04(MITSUBISHI)
5. TOLERANCE NO SPECIFIED : $\pm 0.5\text{mm}$

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