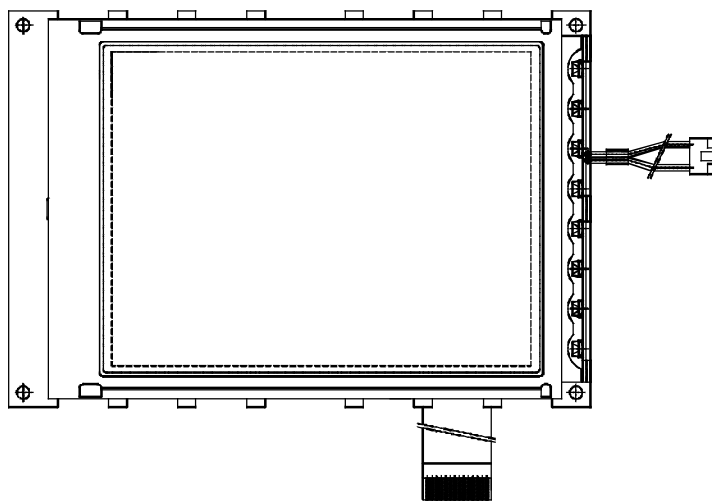




PRODUCT SPECIFICATION

HDM3224L-1

320X240 (1/4 VGA) GRAPHICS
LCD DISPLAY MODULE



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1. MECHANICAL DATA

(1) Product No.	HDM3224L-1
(2) Module Size	160.0 (W)mm x 109.0 (H)mm x MAX.11.0 (D)mm
(3) Dot Size	0.33 (W)mm x 0.33 (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: Blue Mode Rear Polarizer: Transmission(Smoke Gray)
(8) Viewing Direction	6 O'clock
(9) Backlight	LED B/L(White)
(10) Weight	199 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	
Input Voltage	VI	-0.3	VDD+0.3	V	
Static Electricity	-	-	-	-	Note 1

Note 1 LCM should be grounded during handling LCM.

(2) ENVIRONMENTAL ABSOLUTE MAXIMUM RATINGS

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

Note 2 Ta \leq 70°C : 75%RH max
 Ta > 70°C : Absolute humidity must be lower
 than the humidity of 75%RH at 70°C

Note 3 Ta at -30°C will be < 48hrs, at 80°C will be < 120hrs

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

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3. ELECTRICAL CHARACTERISTICS

3-1. ELECTRICAL CHARACTERISTICS

(VDD = 5.0V±5%)

ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	
Power Supply for Logic	VDD-GND	-	4.75	5.0	5.25	V	
Input Voltage	VIH	H level	0.7VDD	-	VDD	V	
	VIL	L level	0	-	0.3VDD	V	
Recommended LC Driving Voltage	VDD-VO	Duty=1/240	-20°C	25.2	25.5	25.8	V
			0°C	23.6	23.9	24.2	
			25°C	22.8	23.1	23.4	
			50°C	21.3	21.6	21.9	
			70°C	20.3	20.6	21.9	
Power Supply Current	IDD	FLM = 70 Hz VDD = 5.0 V VEE = -24.0 V VDD-VO = 23.1 V	-	4.51	6.77	mA	
	IEE	PATTERN : □ ■ □ ■ □ ■ ■ □ ■ □ ■ □	-	3.85	5.78	mA	
Surface Luminance	L	(Dots All On)	-	133	-	cd/m ²	
		(Dots All Off)	-	23.1	-		

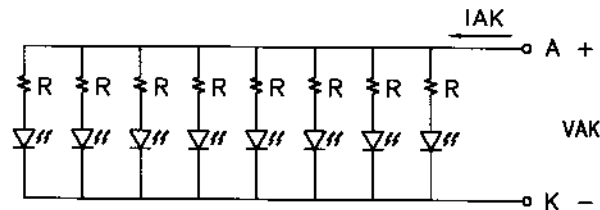
3-2.ELECTRICAL CHARACTERISTICS OF BACKLIGHT

Used LED Rating

Temp.=25°C

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	REMARK
Peak forward current	I_P	-	-	240	mA	-
Maximum reverse voltage	V_R	-	-	5	V	-
Applied forward current	I_{AK}	-	150	160	mA	at $V_{AK} = 5.0$ V
Applied forward voltage	V_{AK}	-	5.0	-	V	at $I_{AK} = 150$ mA
LED power consumption	P_F	-	0.75	-	W	-
LED life time	LL	-	10000	-	hrs	at $V_{AK} = 150$ mA (*1)

(*1) LED life time is defined as follows : The final brightness is at 50% of original brightness .



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4.OPTICAL CHARACTERISTICS

AT Vop

ITEM MODE		Cr(Contrast Ratio)										θ (Viewing Angle)		θ (Viewing Angle)	
		-20℃		0℃		25℃		50℃		70℃		25℃		25℃	
		MIN.	TYP.	MIN.	TYP.	MIN.	TYP.	MIN.	TYP.	MIN.	TYP.	MIN.	TYP.	MIN.	TYP.
N	S	2.5	4.0	3.5	5.0	4.0	5.5	3.0	4.5	2.0	3.0	-	67	-	±32
NOTE		NOTE 6										NOTE 5			

NOTE :

N : TRANSMISSION
S : BLUE

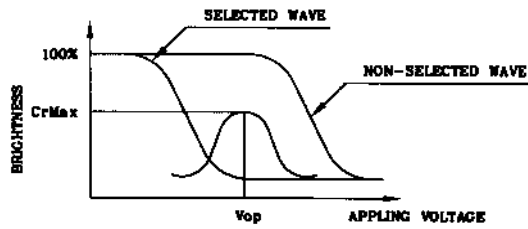
AT $\theta=0^\circ$ $\theta=0^\circ$

ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	NOTE
Response Time (rise)	Tr	-20℃	3200	4000	6000	ms	NOTE 2
		0℃	240	300	450		
		25℃	100	120	180		
		50℃	65	80	120		
		70℃	45	60	90		
Response Time (fall)	Tf	-20℃	1600	2000	3000	ms	NOTE 2
		0℃	350	450	670		
		25℃	110	140	210		
		50℃	45	60	90		
		70℃	40	50	75		

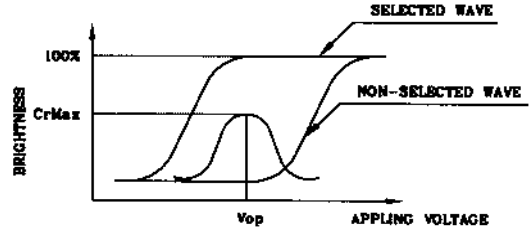
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(FIG 1)

Definition of Operation Voltage(Vop)



(positive type)



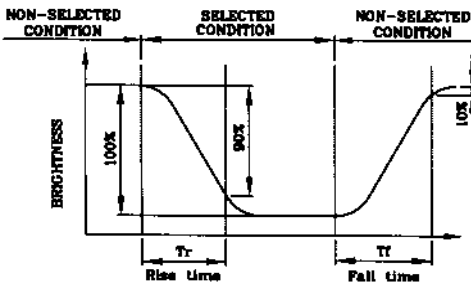
(negative type)

*Conditions

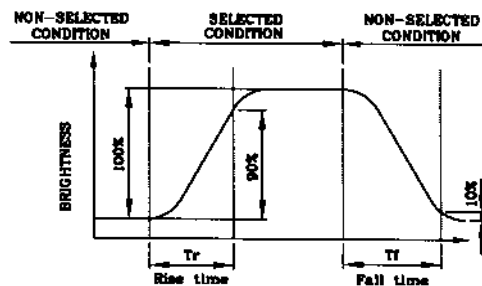
Viewing Angle : 0
 Frame Frequency : 70Hz
 Applying Waveform : 1/N duty 1/a bias

(FIG 2)

Definition of Response Time(Tr,Tf)



(positive type)



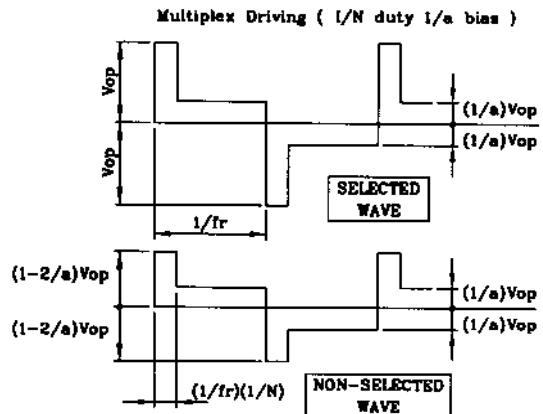
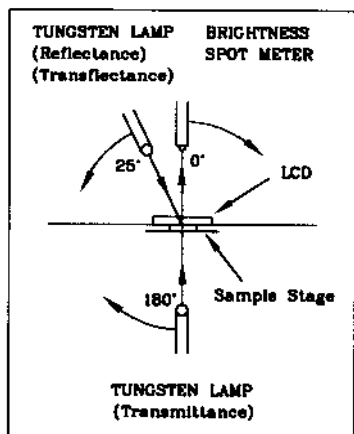
(negative type)

*Conditions

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

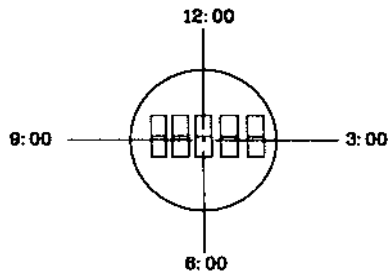
(FIG 3)

Description of Measuring Equipment and Driving Waveforms



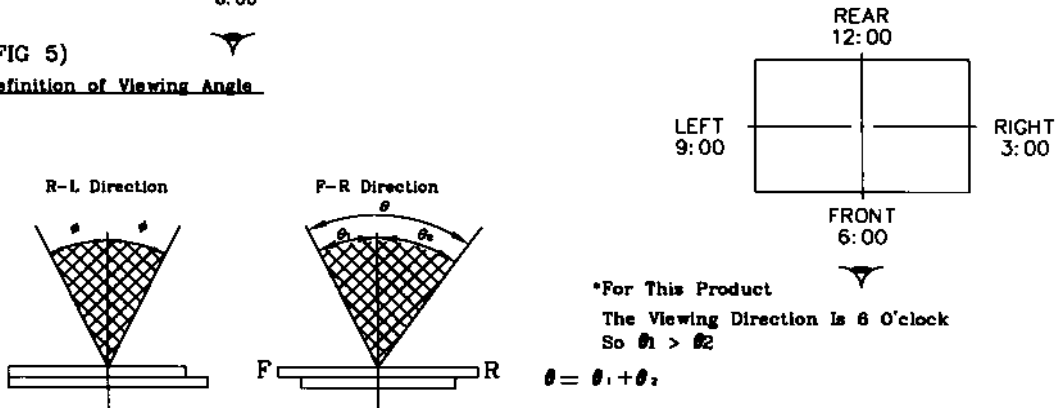
(FIG 4)

Definition of Viewing Direction



(FIG 5)

Definition of Viewing Angle

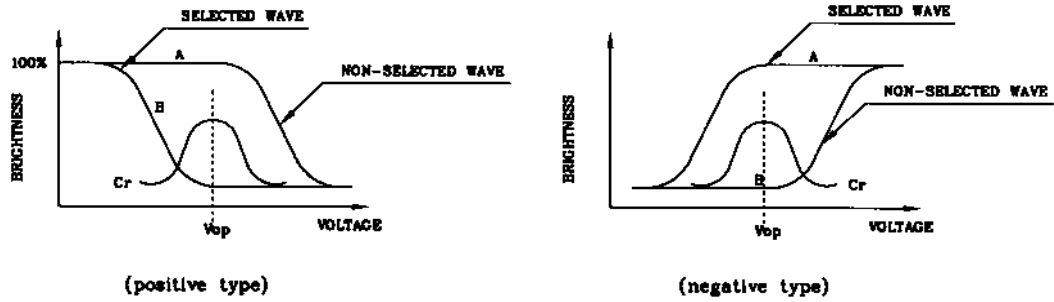


*Conditions

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

(FIG 6)

Definition of Contrast Ratio (Cr)



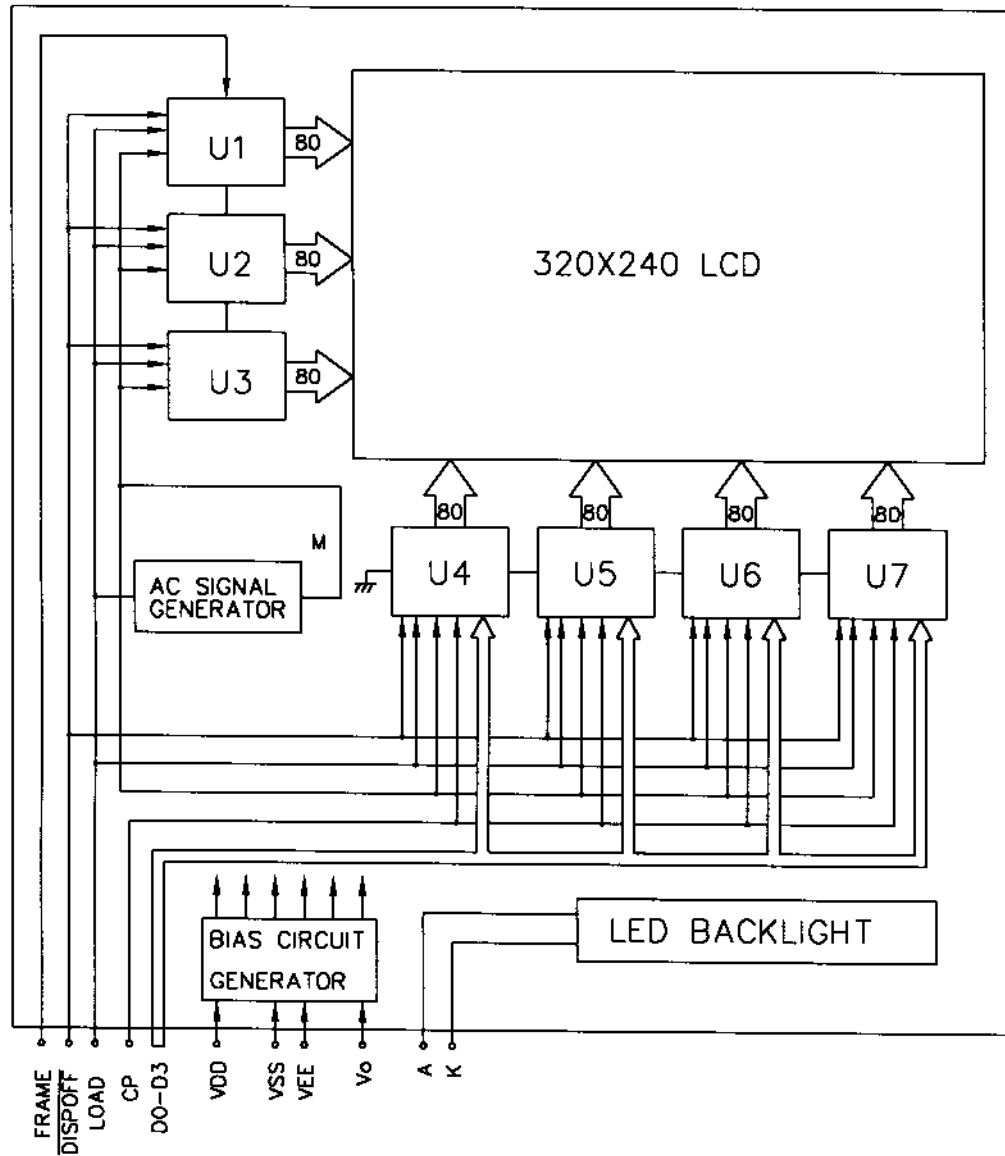
Contrast Ratio : $Cr = A/B$

*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	H	L	L	L	L	L

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6. INTERNAL PIN CONNECTION

CN1: PITCH 1.25mm WIDTH 18.75mm

PIN NO.	SYMBOL	LEVEL	FUNCTION
1	D0	H/L	DISPLAY DATA SIGNAL
2	D1		
3	D2		
4	D3		
5	DISPOFF	H/L	H: ON/L: OFF
6	FRAME	H	SCAN START-UP SIGNAL
7	NC	-	NO CONNECTION
8	LOAD	H-L	INPUT DATA LATCH SIGNAL
9	CP	H-L	DATA INPUT CLOCK SIGNAL
10	VDD	-	POWER SUPPLY FOR LOGIC(+5V)
11	VSS	-	SIGNAL GROUND(OV)
12	VEE	-	POWER SUPPLY FOR LCD
13	VO	-	LCD CONTRAST ADJUST VOLTAGE
14	FGND	-	FRONT PANNEL GROUND

CN2: J.A.E./IL-G-4S-S3C2

PIN NO.	SYMBOL	LEVEL	FUNCTION
1	A	-	POWER SUPPLY VOLTAGE FOR LED
2	NC	-	-
3	NC	-	-
4	K	-	GROUND

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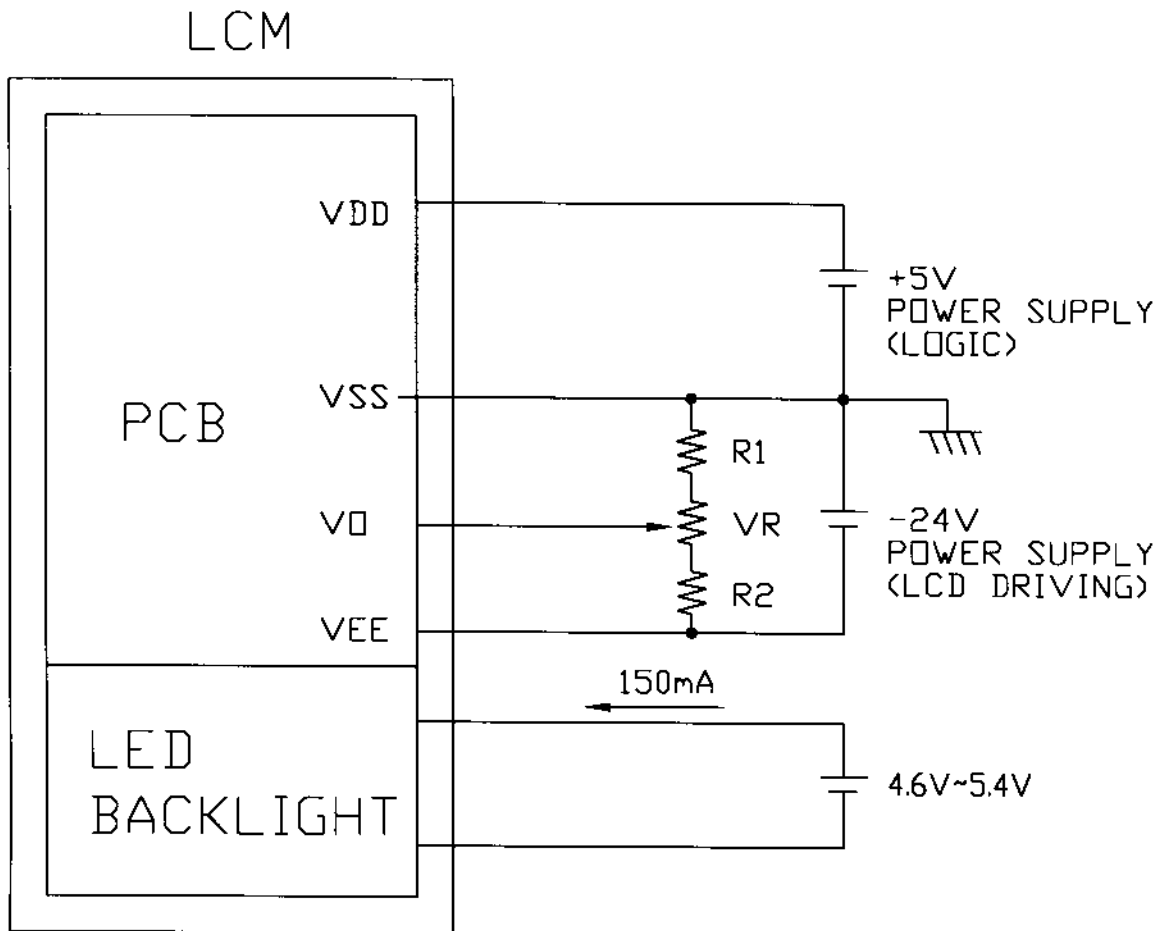
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7. POWER SUPPLY



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

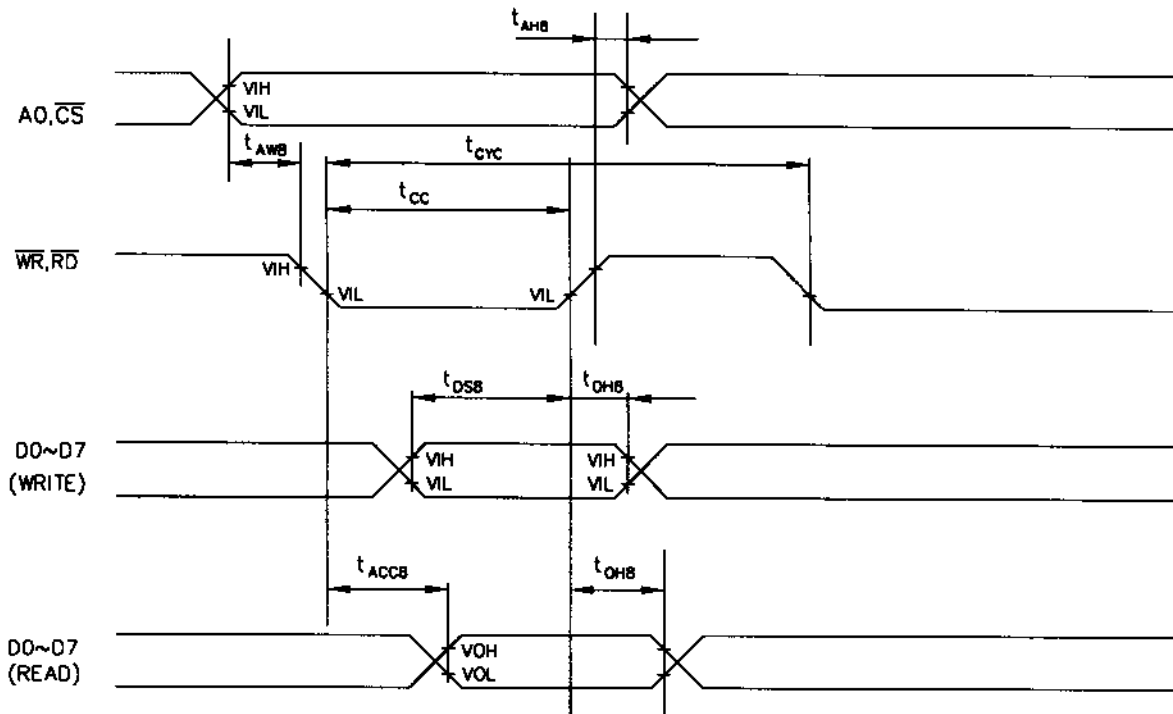
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8. TIMING CHARACTERISTICS

8-1. READ/WRITE CHARACTERISTICS(8080 FAMILY MPU)

VDD=5.0V±5%

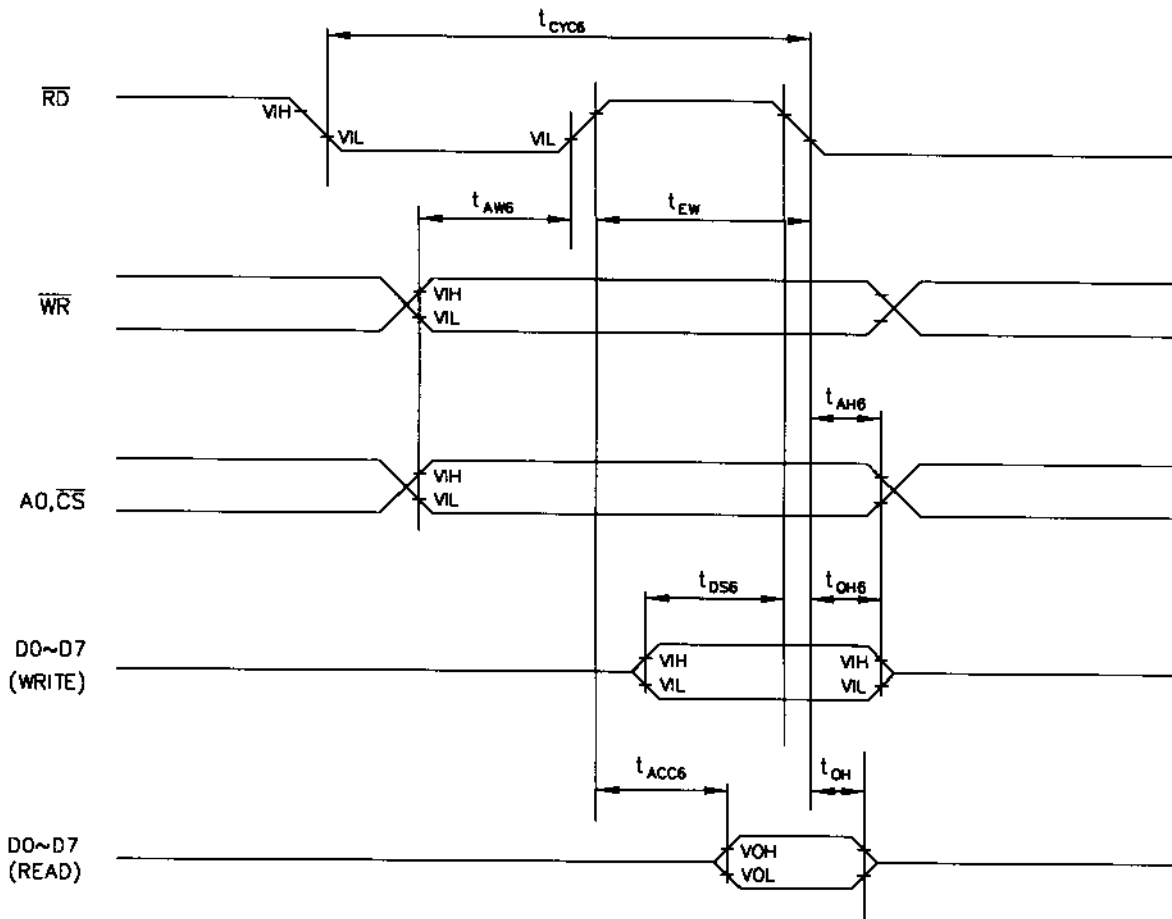
ITEM	ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT
A0, \overline{CS}	ADDRESS HOLD TIME	t_{AHB}	10	-	-	ns
	ADDRESS SETUP TIME	t_{AWB}	0	-	-	ns
$\overline{WR}, \overline{RD}$	SYSTEM CYCLE TIME	t_{CYC}	1	-	-	ns
	STROBE PULSE WIDTH	t_{CC}	120	-	-	ns
D0 to D7	DATA HOLD TIME	t_{DHB}	5	-	-	ns
	DATA SETUP TIME	t_{DSB}	120	-	-	ns
	RD ACCESS TIME	t_{ACCB}	-	-	50	ns
	OUTPUT DISABLE TIME	t_{OHB}	10	-	50	ns



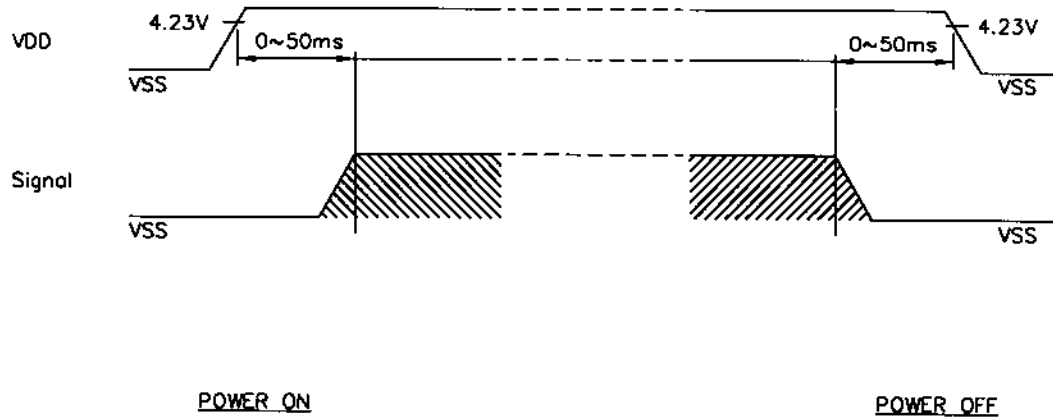
8-2.READ/WRITE CHARACTERISTICS(6800 FAMILY MPU)

VDD=5.0V±5%

ITEM	ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT
A0, \overline{CS} , \overline{WR}	ADDRESS HOLD TIME	t_{AH6}	0	-	-	ns
	ADDRESS SETUP TIME	t_{AS6}	0	-	-	ns
	SYSTEM CYCLE TIME	t_{CYC6}	1	-	-	ns
D0 to D7	DATA HOLD TIME	t_{DH6}	0	-	-	ns
	DATA SETUP TIME	t_{DS6}	100	-	-	ns
	ACCESS TIME	t_{ACC6}	-	-	85	ns
	OUTPUT DISABLE TIME	t_{OH6}	10	-	50	ns
\overline{RD}	ENABLE PULSE WIDTH	t_{RDW}	120	-	50	ns



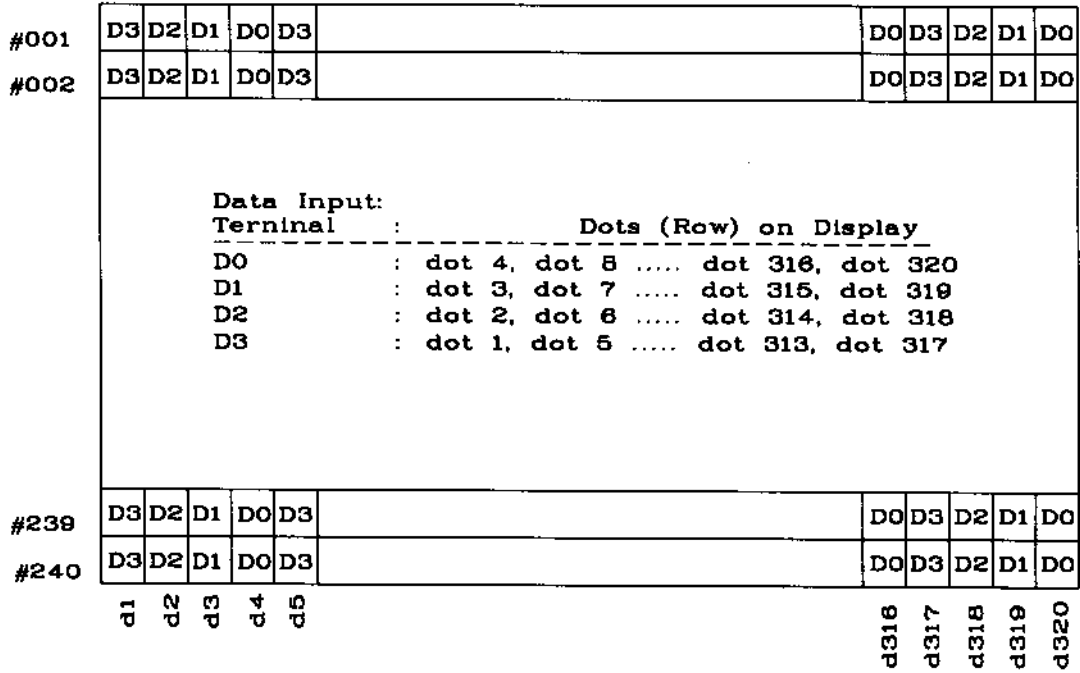
8-3. POWER ON/OFF TIMING



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

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8-4.DISPLAY PATTERN



240 dots

320 dots

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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NOTE:

- 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 ketanics solvent & Aromatic solvent, use with a soft cloth soaked with a cleaning naphtha solvent.

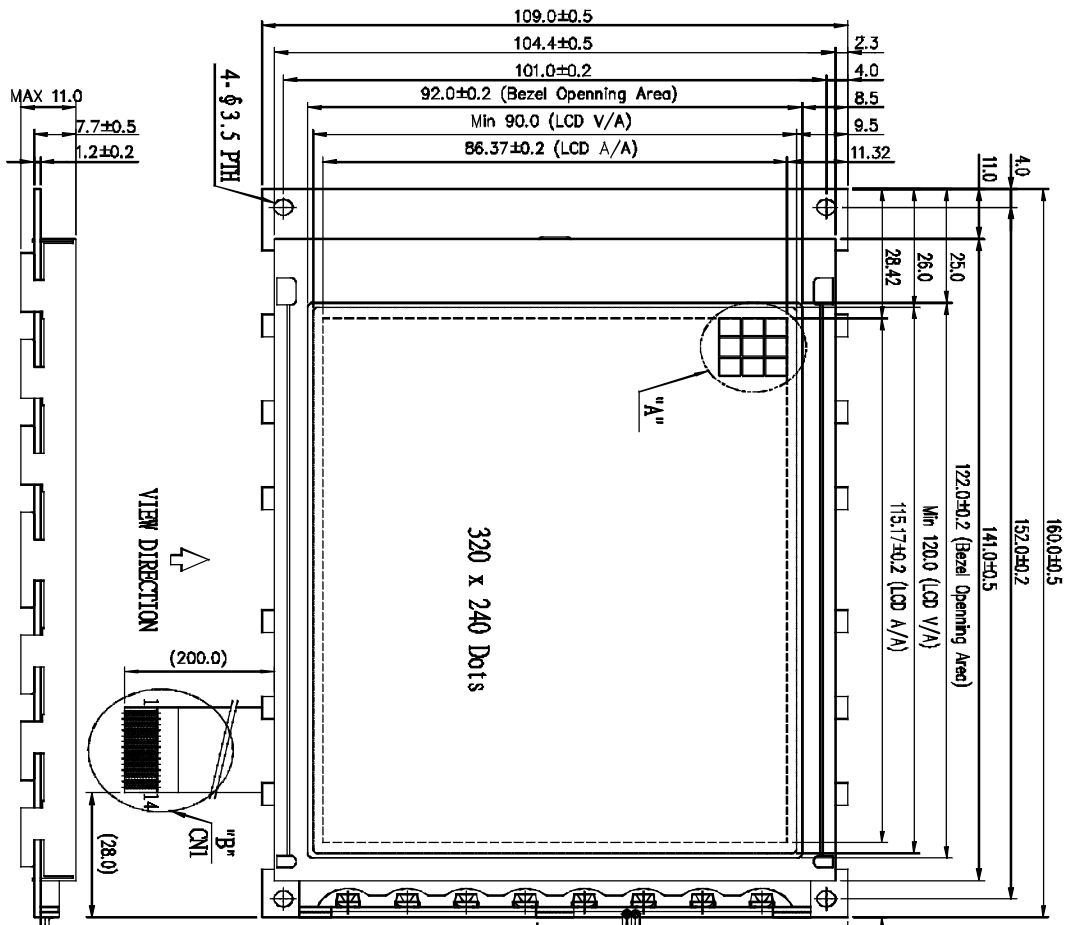
- STORAGE

- 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.

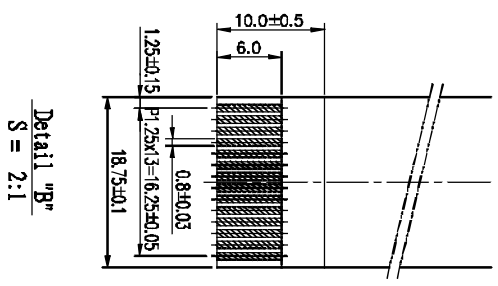
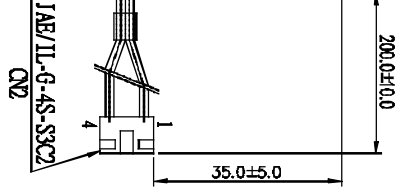
- TERMS OF WARRANT

- 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.

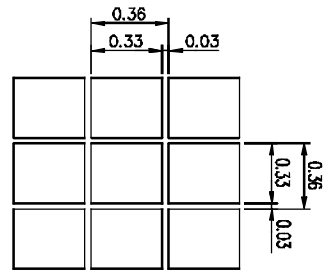
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ON: PITCH 1.25mm WIDTH 18.75mm
 CN2: I.A.E./TL-G-4S-SSC2



Detail "B"
 S = 2:1



Detail "A"
 S = 40:1

- NOTES :
1. RESOLUTION : 320 x 240 DOTS
 2. DRIVER IC: "SAMSUNG" KS90986
 3. BACKLIGHT: LED
 4. FRAME: SSCC (0.5t)

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