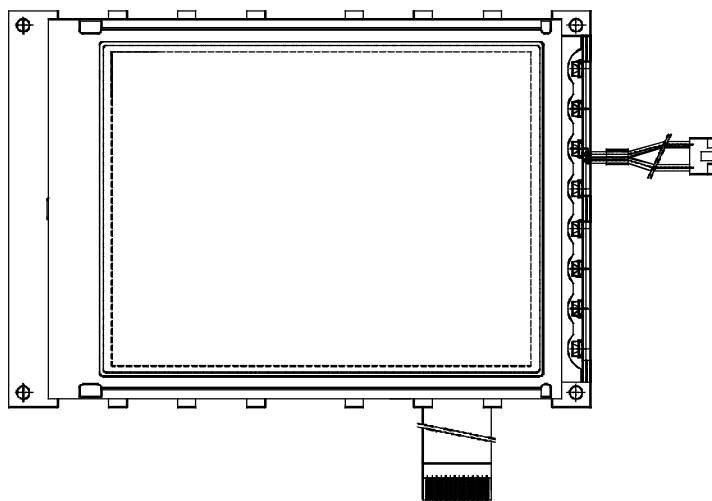




## PRODUCT SPECIFICATION

# HDM3224L-1

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



|                                                          |             |              |            |               |
|----------------------------------------------------------|-------------|--------------|------------|---------------|
| HANTRONIX, INC.<br>10080 BUBB RD.<br>CUPERTINO, CA 95014 | Q.A.:<br>JK | REV.:<br>1.0 | HDM3224L-1 | SHEET 1 OF 18 |
|                                                          |             |              |            | DATE: 5/1/03  |

# 1. MECHANICAL DATA

|                       |                                                            |
|-----------------------|------------------------------------------------------------|
| (1) Product No.       | <b>HDM3224L-1</b>                                          |
| (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<br>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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**HDM3224L-1**

SHEET 2 OF 18

DATE:

5/1/03

## 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 ≤ 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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|                                                                 |                 |                  |                   | DATE: 5/1/03  |

# 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              |
|                                |         |                                                                                                                                                                                                    | 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<br>VDD = 5.0 V<br>VEE = -24.0 V<br>VDD-VO = 23.1 V                                                                                                                                     | —      | 4.51 | 6.77   | mA                |
|                                | IEE     | PATTERN :<br><div> <div>□</div> <div>■</div> <div>□</div> <div>■</div> <div>□</div> <div>■</div> </div> <div> <div>■</div> <div>□</div> <div>■</div> <div>□</div> <div>■</div> <div>□</div> </div> | —      | 3.85 | 5.78   | mA                |
| Surface Luminance              | L       | (Dots All On)                                                                                                                                                                                      | —      | 133  | —      | cd/m <sup>2</sup> |
|                                |         | (Dots All Off)                                                                                                                                                                                     | —      | 23.1 | —      |                   |

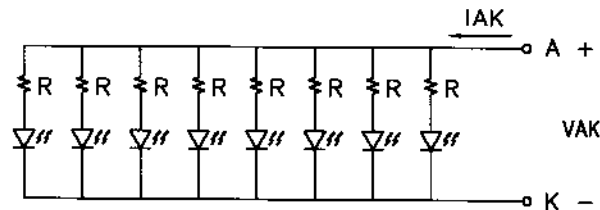
### 3-2.ELECTRICAL CHARACTERISTICS OF BACKLIGHT

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           | $L_L$    | —    | 10000 | —    | hrs  | at $V_{AK} = 150$ mA<br>(*1) |

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



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SHEET 5 OF 18

DATE:  
5/1/03

## 4.OPTICAL CHARACTERISTICS

AT Vop

| ITEM<br>MODE |   | Cr(Contrast Ratio) |      |      |      |      |      |      |      |      |      | $\theta$ (Viewing Angle) |      | $\theta$ (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  $\phi=0^\circ$   $\theta=0^\circ$

| 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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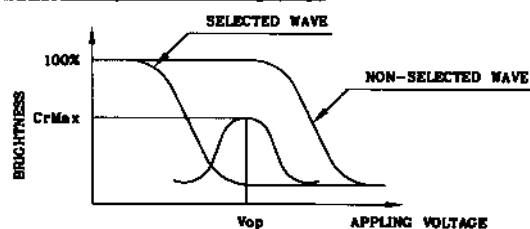
HDM3224L-1

SHEET 6 OF 18

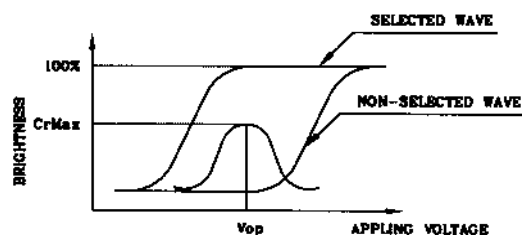
DATE:

5/1/03

(FIG 1)

Definition of Operation Voltage(Vop)

(positive type)



(negative type)

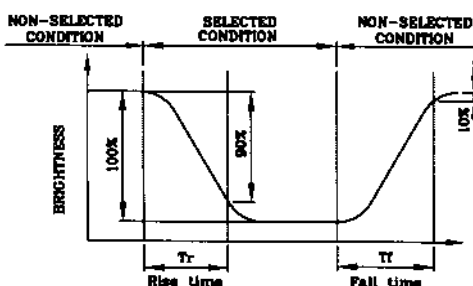
## \*Conditions

Viewing Angle : 0

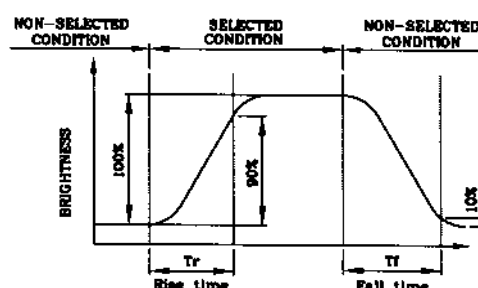
Frame Frequency : 70Hz

Applying Waveform : 1/N duty 1/a bias

(FIG 2)

Definition of Response Time( $T_r, T_f$ )

(positive type)



(negative type)

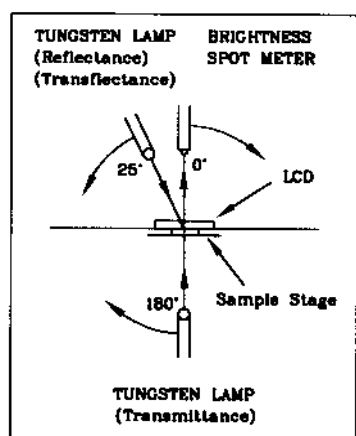
## \*Conditions

Operating Voltage :  $V_{op}$ Viewing Angle ( $\theta, \phi$ ) : (0,0)

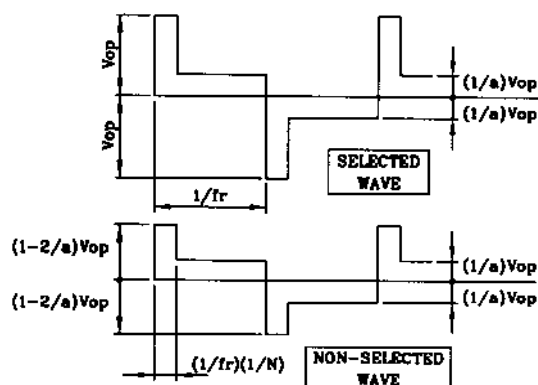
Frame Frequency : 70Hz

Applying Waveform : 1/N duty 1/a bias

(FIG 3)

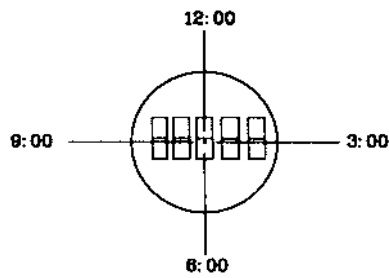
Description of Measuring Equipment and Driving WaveformsCONST.  
TEMP.  
CHAMBER

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



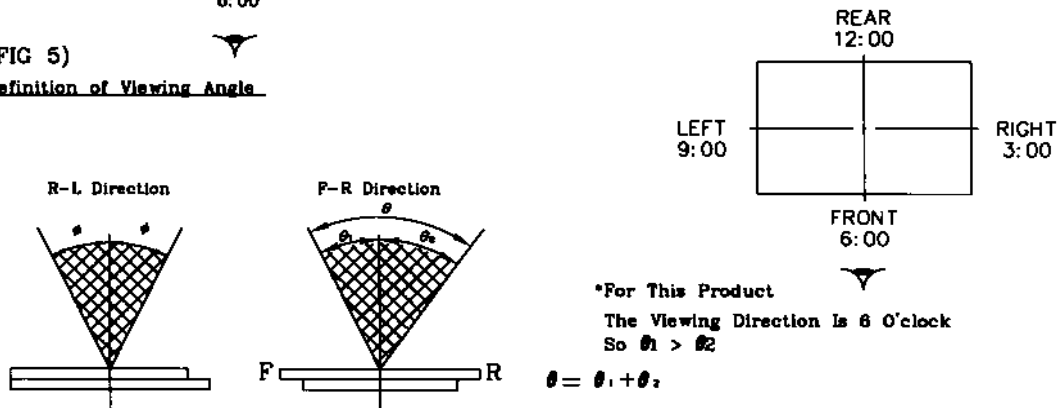
(FIG 4)

Definition of Viewing Direction



(FIG 5)

Definition of Viewing Angle

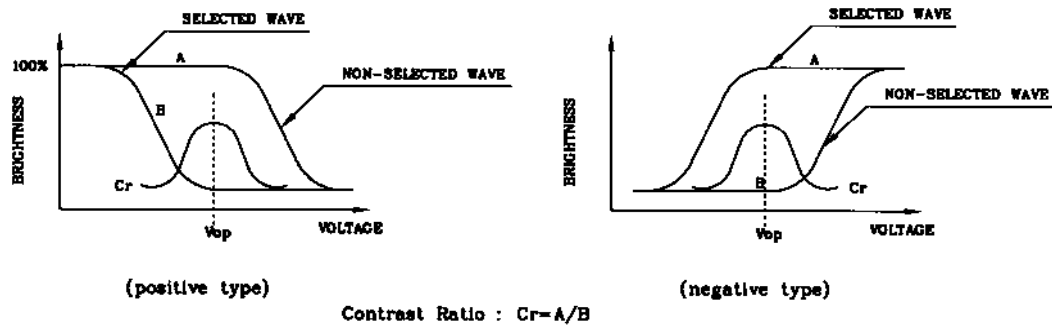


\*Conditions

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

(FIG 6)

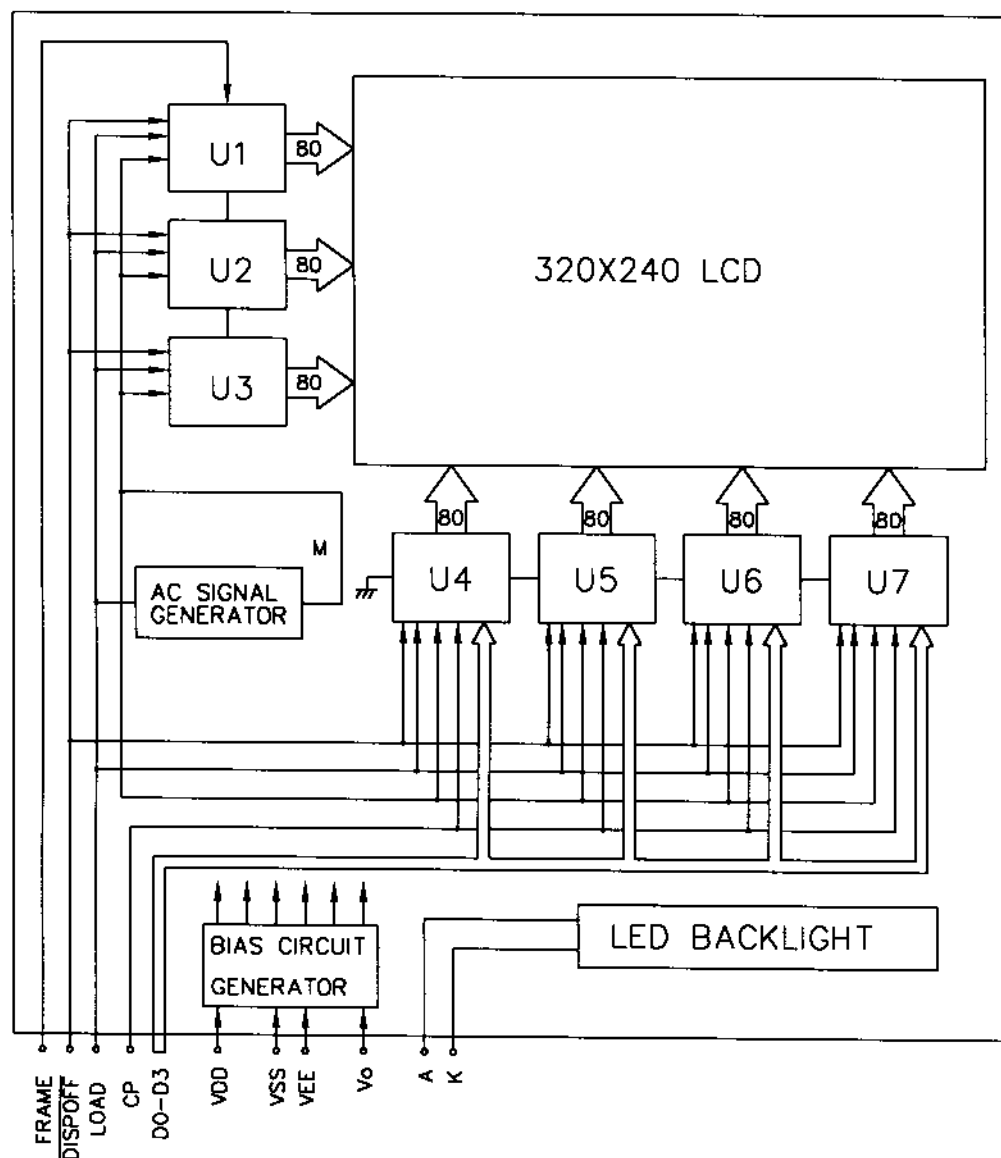
Definition of Contrast Ratio (Cr)



\*Conditions

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

## 5. BLOCK DIAGRAM



\* AC SIGNAL SETTING

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

## 6.INTERNAL PIN CONNECTION

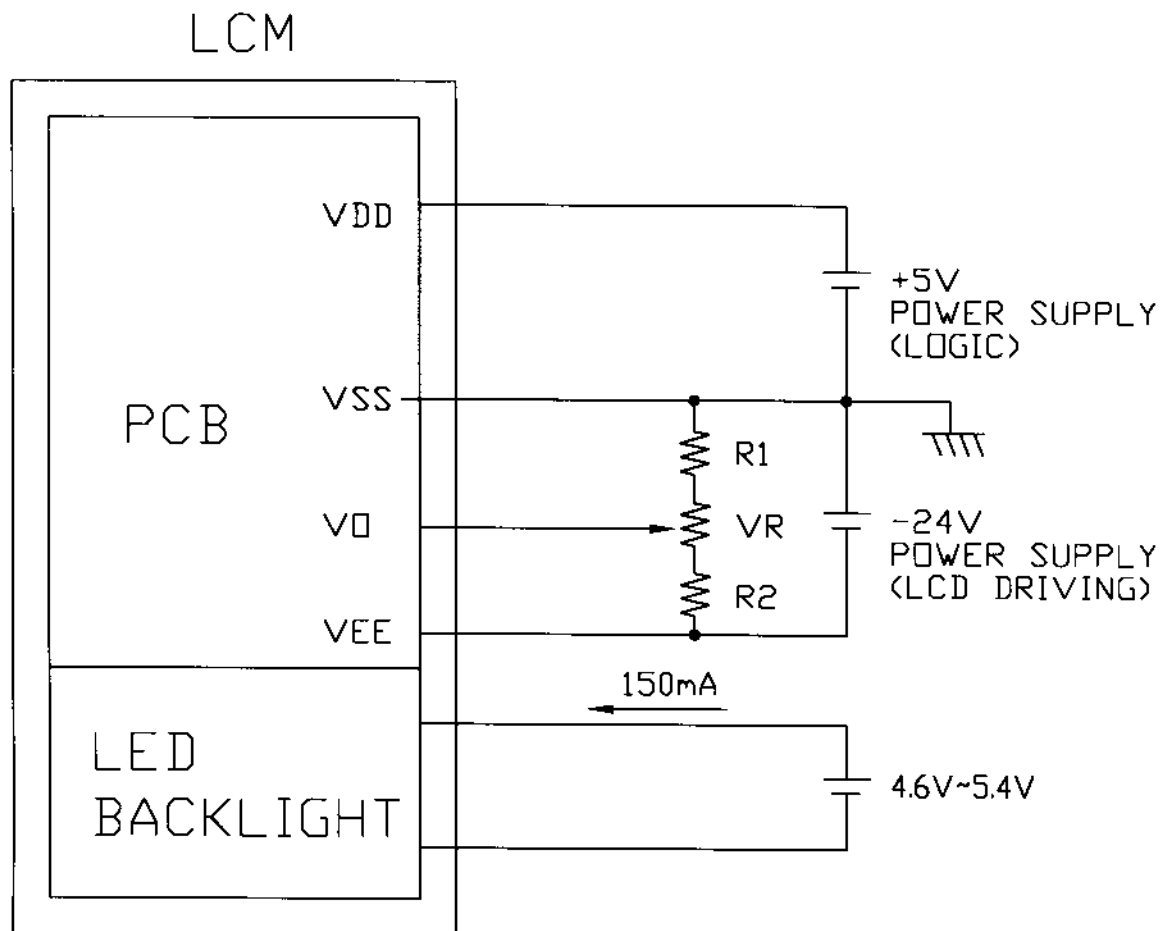
CN1: PITCH 1.25mm WIDTH 18.75mm

| 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(0V)           |
| 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                       |

## 7. POWER SUPPLY



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

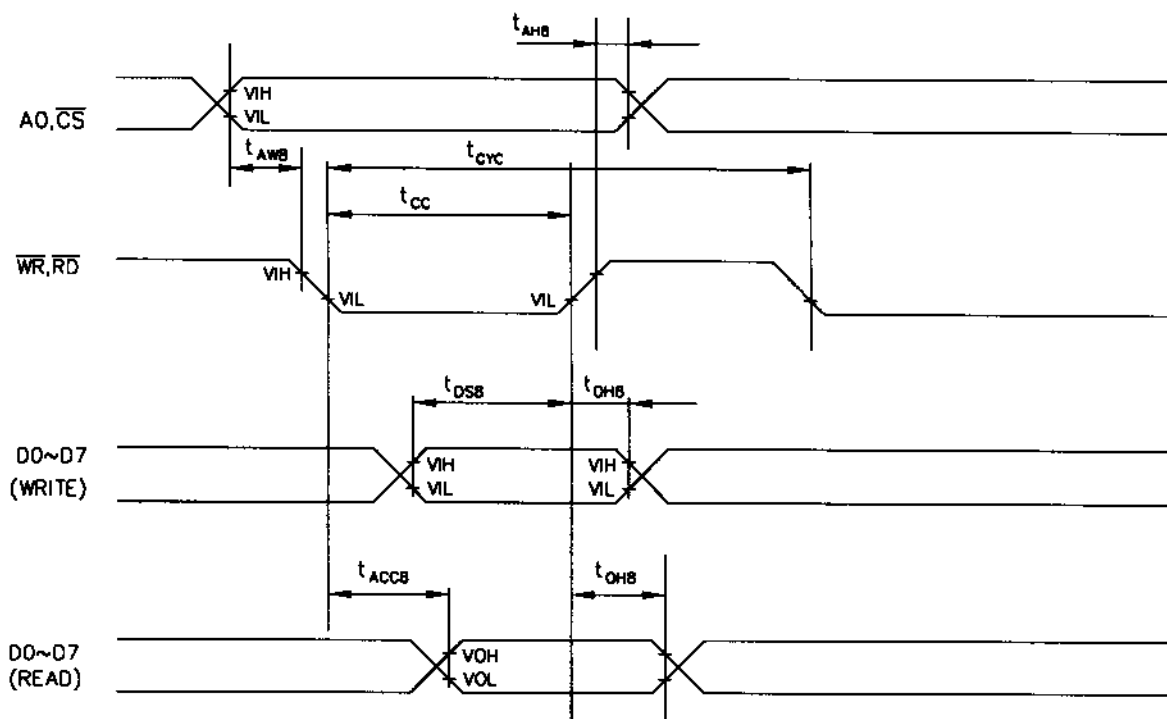
|                                                                 |             |              |                   |                |
|-----------------------------------------------------------------|-------------|--------------|-------------------|----------------|
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|                                                                 |             |              |                   | DATE: 5/1/03   |

## 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  | $t_{AWS}$  | 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   |



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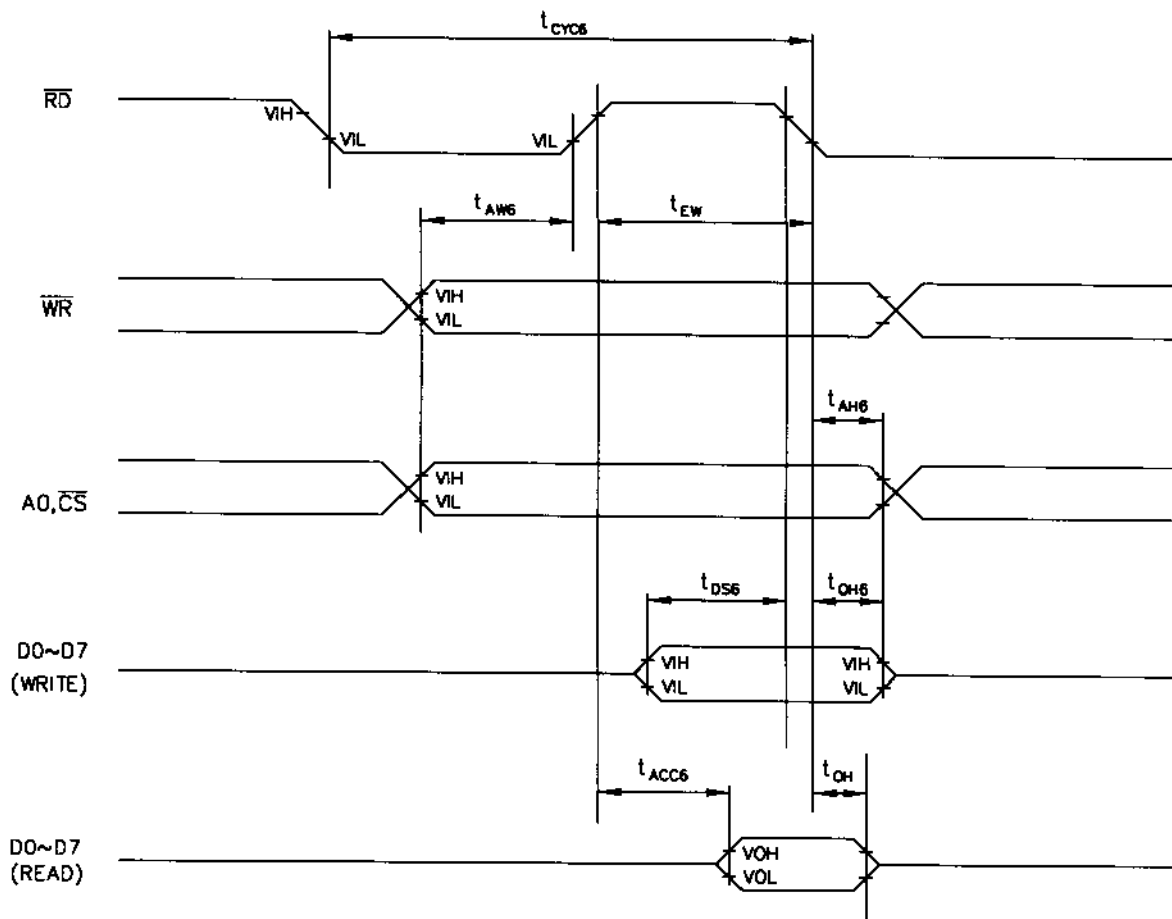
SHEET 12 OF 18

DATE: 5/1/03

## 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   |



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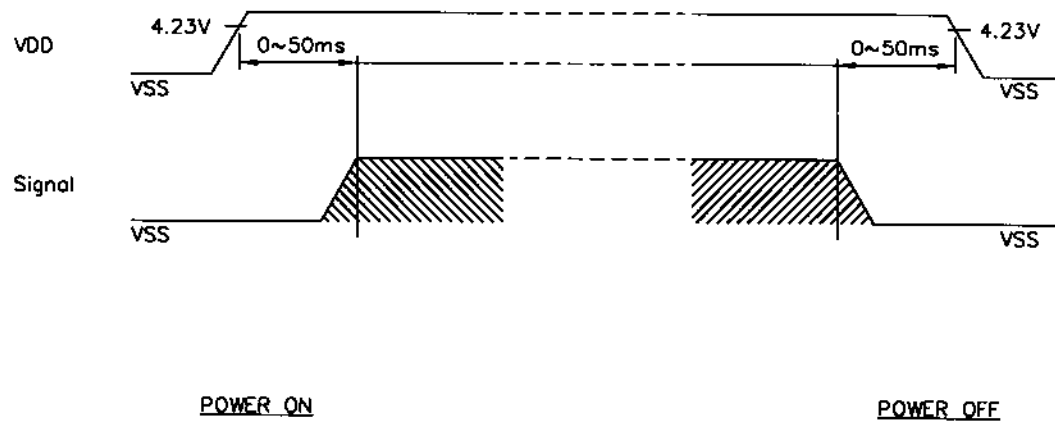
HDM3224L-1

SHEET 13 OF 18

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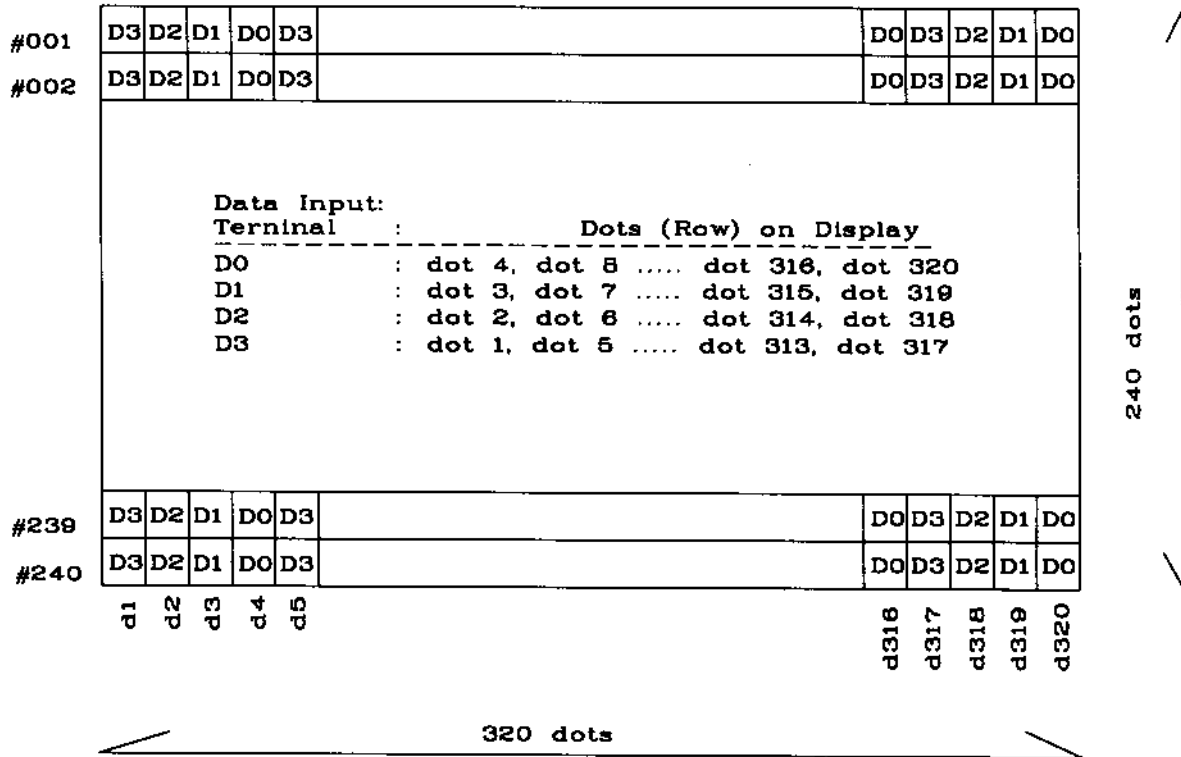
5/1/03

### 8-3. POWER ON/OFF TIMING



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

# 8-4.DISPLAY PATTERN



## 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<br>→ 70°C, 30min → 25°C, 5min<br>(1cycle) |       |  | Appearance without defect | 5 cycles |

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**HDM3224L-1**

SHEET 16 OF 18

DATE:

5/1/03

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.

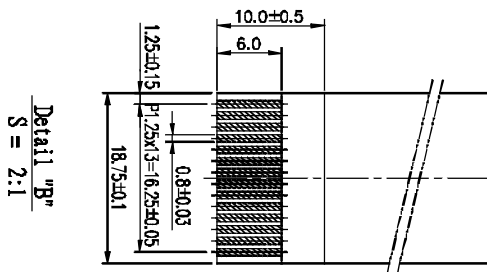
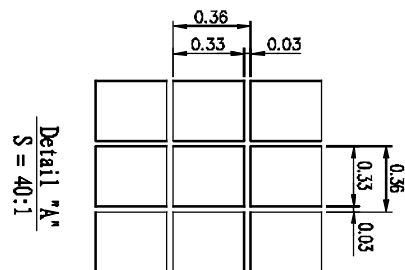
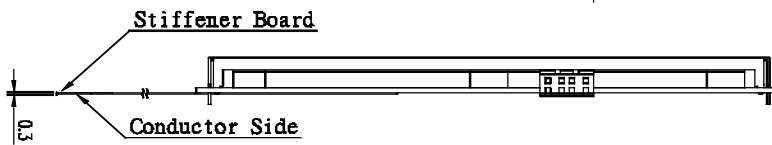
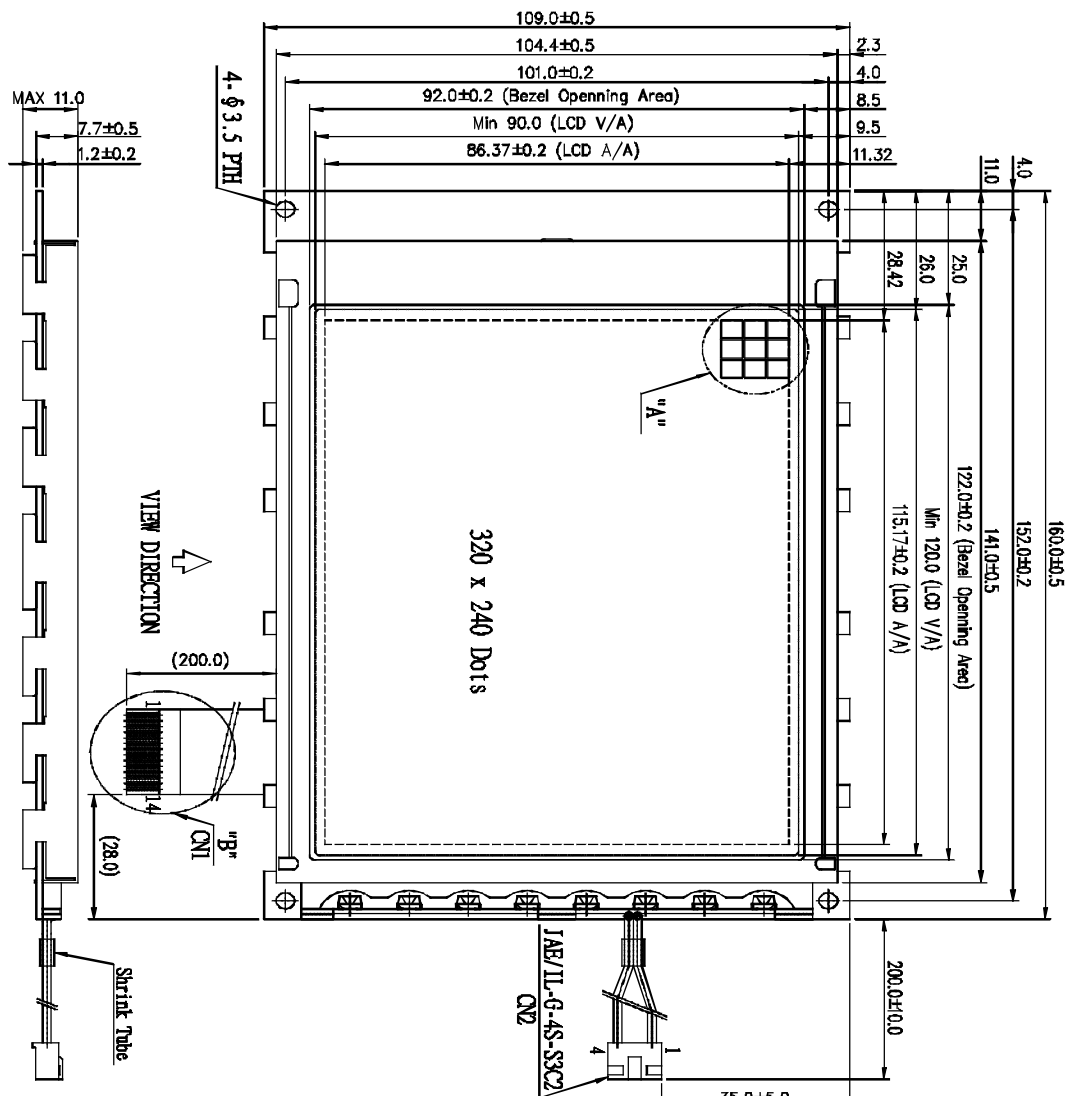
- STORAGE

- 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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|                                                          |             |              |            | DATE: 5/1/03   |



- NOTES :
1. RESOLUTION : 320 x 240 DOTS
  2. DRIVER IC: "SAMSUNG" KS0086
  3. BACKLIGHT: LED
  4. FRAME: SECC (0.5t)

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HDM3224L-1

SHEET 18 OF 18

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