

BOLYMIN

**SPECIFICATIONS FOR
LCD MODULE**

MODEL NO.
BP320240EFPDBn87a\$
VER.01



FOR MESSRS:

ON DATE OF:

APPROVED BY:

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1. Numbering System

| | | | | | | | | | |
|-----------------|-----------------|----------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------------------|
| <u>B</u> | <u>P</u> | <u>320240</u> | <u>E</u> | <u>F</u> | <u>P</u> | <u>D</u> | <u>:</u> | <u>B</u> | <u>n87a\$</u> |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

| | | | |
|----------|--|--|---|
| 0 | Brand | Bolymin | |
| 1 | Module Type | C= character type G= graphic type P= TAB/TCP type | O= COG type F= COF type L=OLED |
| 2 | Format | 2002=20 characters, 2 lines 12232= 122 x 32 dots | |
| 3 | Version No. | A type | |
| 4 | LCD Color | G=STN/gray Y=STN/yellow-green C=color STN | B=STN/blue F=FSTN T=TN |
| 5 | LCD Type | R=positive/reflective P=positive/transflective | M=positive/transmissive N=negative/transmissive |
| 6 | Backlight type/color | L=LED array/ yellow-green H=LED edge/white R=LED array/red G=LED edge/yellow-green F=RGB Q=LED edge/red A=LED edge/amber N=No backlight | D=LED edge/blue E=EL/white B=EL/blue C=CCFL/white Y=LED Bottom/yellow O=LED array/orange K=LED edge/green A=LED edge/amber |
| 7 | CGRAM Font (applied only on character type) | J=English/Japanese Font E=English/European Font G=Chinese(simple) F=Chinese(traditional) | C=English/Cyrillic Font H=English/Hebrew Font A=English/Arabic Font |
| 8 | View Angle/ Operating Temperature | B=Bottom/Normal Temperature H=Bottom/Wide Temperature U=Bottom/Ultra wide Temperature | T=Top/Normal Temperature W=Top/Wide Temperature C=9H/Normal Temperature E=Top/ultra wide temperature |
| 9 | Special Code | 3=3 volt logic power supply n=negative voltage for LCD c=cable/connector xxx=to be assigned on datasheet | t=temperature compensation for LCD p=touch panel |

2. General Specification

(1) Mechanical Dimension

| Parameter | Stand Value | Unit |
|----------------|--------------------------|------|
| Number of dots | 320x240 | dots |
| Module size | 85.0*93.3* 6.7 - LED B/L | mm |
| Dot size | 0.225(W) × 0.225(H) | mm |
| Dot pitch | 0.24(W) × 0.24(H) | mm |
| Viewing area | 81.8 (W) × 62.0 (H) | mm |

(2) Controller IC : RAI08835

(3) Temperature Range

| | |
|-----------|-------------|
| | Normal |
| Operating | 0 ~ +50°C |
| Storage | -10 ~ +60°C |

3. Absolute Maximum Ratings

| Parameter | Symbol | Min | Max | Unit |
|------------------------------|---------|------|---------|------|
| Logic Circuit Supply Voltage | VDD-VSS | -0.3 | 7.0 | V |
| LCD Driving Voltage | -- | -0.3 | 26.0 | V |
| Input Voltage | VI | -0.3 | VDD+0.3 | V |

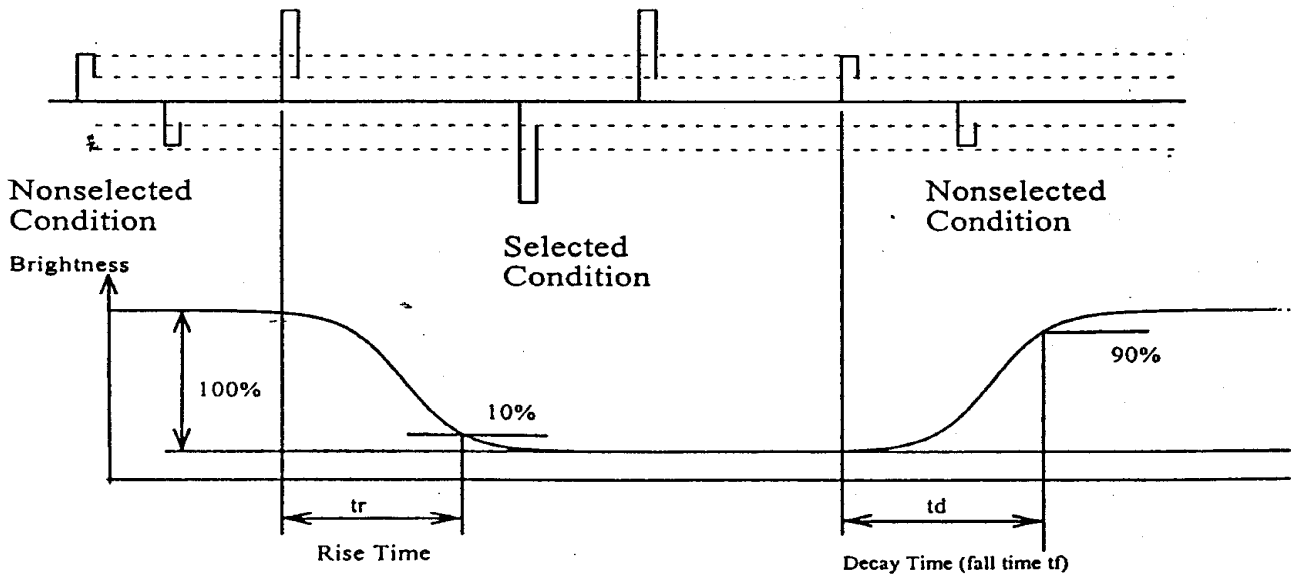
4. Electro-Optical Characteristics

| Parameter | Symbol | Condition | Min | Typ | Max | Unit | Note |
|---|-----------------|-------------|---------|------------|---------|------|--------|
| ----- Electronic Characteristics ----- | | | | | | | |
| Logic Circuit Supply Voltage | VDD-VSS | -- | 2.6 | 3.3 | 5.5 | V | |
| LCD Driving Voltage | VADJ-VDD | 25°C | 2.5 | 2.8 | 4.6 | V | |
| Input Voltage | V _{IH} | -- | 0.7 VDD | -- | VDD | V | |
| | V _{IL} | -- | VSS | -- | 0.3 VDD | V | |
| Supply Current Logic | ICC | VCC = 3.3V | -- | 15 | -- | mA | |
| Logic Supply Current(B/L on) | ICC | VCC = 3.3V | | 55 | | mA | |
| ----- Optical Characteristics ----- | | | | | | | |
| Contrast | CR | FSTN type | | 7 | | | Note 1 |
| Rise Time | t _r | 25°C | -- | 305 | 450 | ms | Note 2 |
| Fall Time | t _f | 25°C | -- | 120 | 180 | ms | |
| Viewing Angle Range | θ _f | 25°C & CR≥2 | -- | 40 | -- | Deg. | Note 3 |
| | θ _b | | -- | 35 | -- | | |
| | θ _l | | -- | 35 | -- | | |
| | θ _r | | -- | 35 | -- | | |
| Frame Frequency | f _F | 25°C | -- | 70 | -- | Hz | |

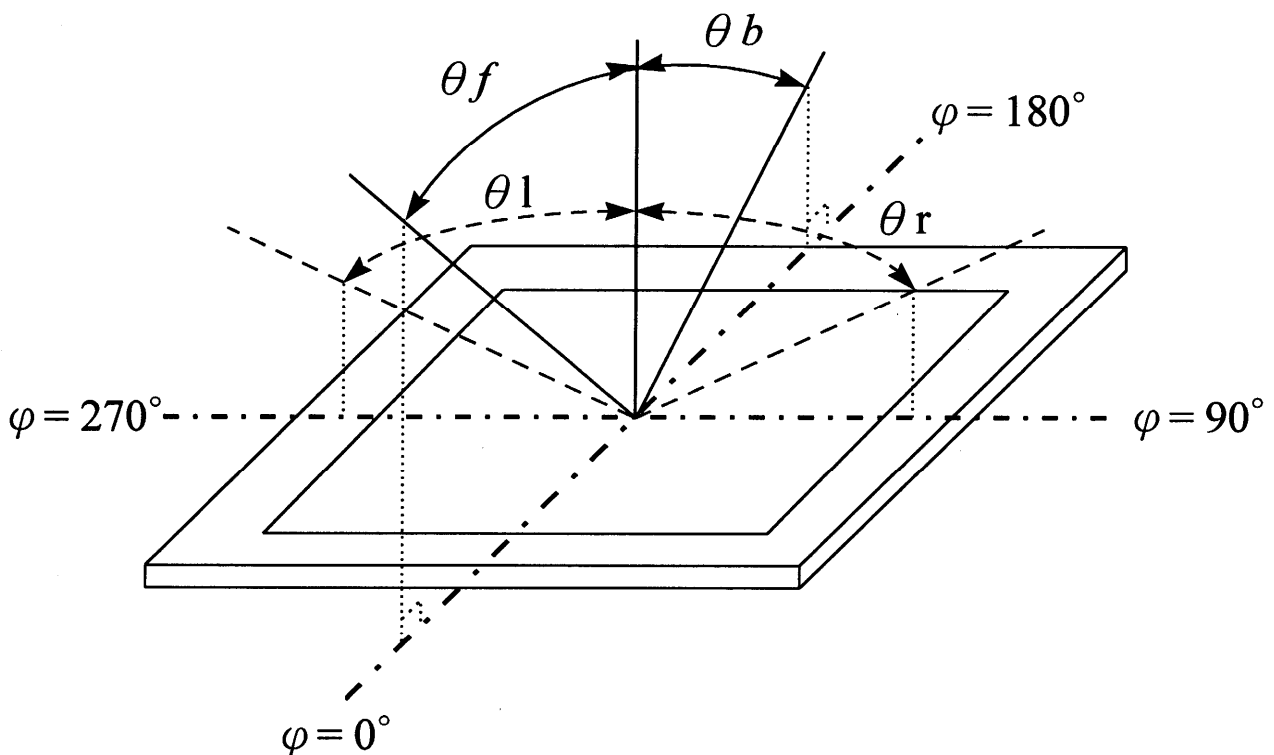
(NOTE 1) Contrast ratio :

$$CR = (\text{Brightness in OFF state}) / (\text{Brightness in ON state})$$

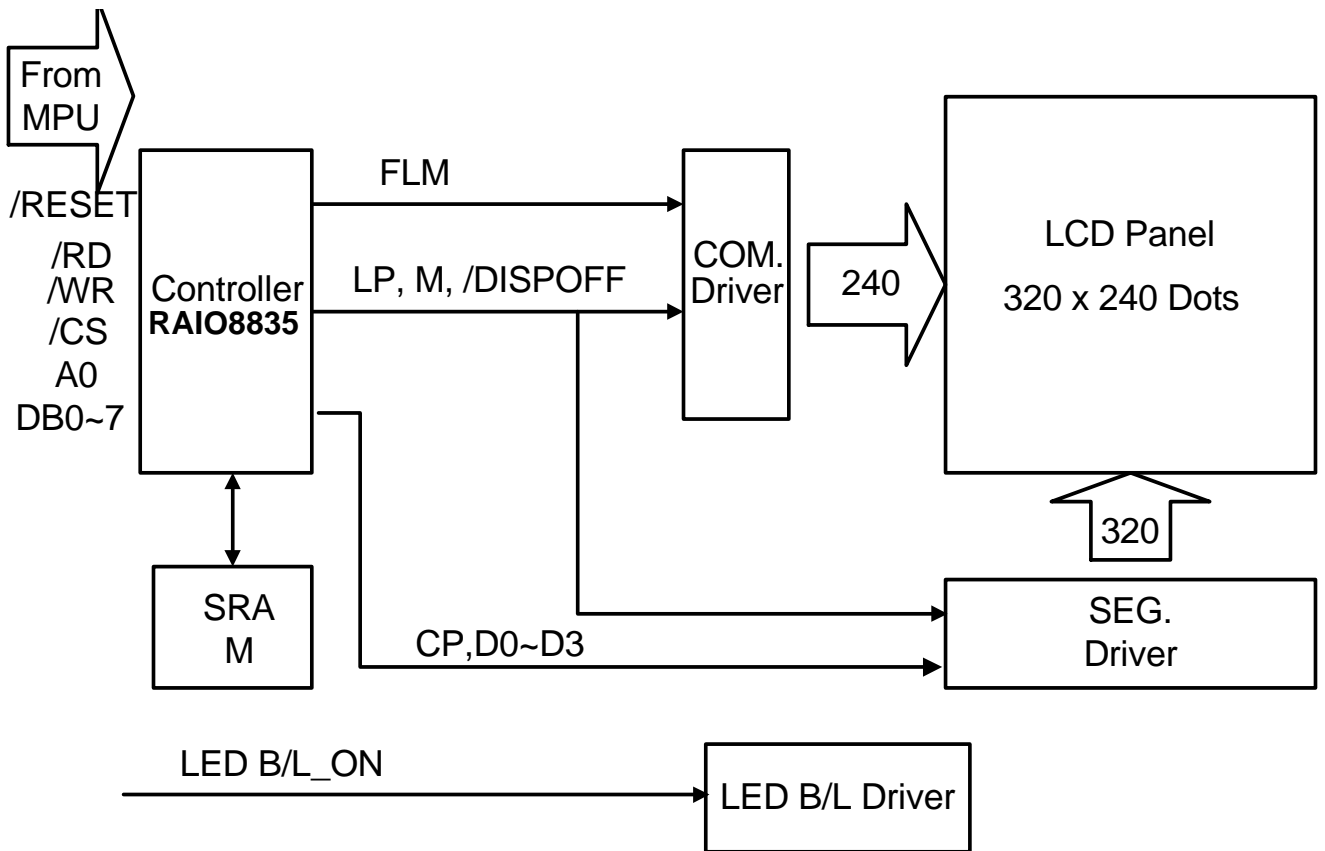
(NOTE 2) Response time :



(NOTE 3) Viewing angle



5. Block Diagram



6. Interface Pin Function

| PIN NO. | SIGNAL | LEVEL | FUNCTION | |
|---------|---------|-------|--|-------------------|
| 1 | /RESET | H/L | Reset Signal | |
| 2 | /RD | H/L | 80 Series: Read Signal 68 Series: Enable Signal (E) | |
| 3 | /WR | H/L | 80 Series: Write Signal 68 Series: R/W Signal | |
| 4 | /CS | H/L | Chip Select Signal | |
| 5 | A0 | H/L | Data Type Selection | |
| 6 ~ 13 | DB0~DB7 | H/L | Data Input (8 bits) | |
| 14 | VCC | - | Power Supply for Logic (+3.3V) | |
| 15 | VSS | - | Power Supply (Ground : 0V) | |
| 16 | VCTL | - | Contrast Adjustment Input | |
| 17 | NC | | No Connection | |
| 18* | SK / X1 | - | Serial Clock Signal in X Axis | Touch Panel Left |
| 19* | DO / X2 | - | Data Output Signal in X Axis | Touch Panel Right |
| 20* | DI / Y1 | - | Data In Upper Signal in Y Axis | Touch Panel |
| 21* | CS / Y2 | - | Chip Select Lower Signal in Y Axis | Touch Panel |
| 22* | INT | - | Interrupt | |
| 23 | A | | Power supply for LED backlight (+3.2V) | |
| 24 | K | | Power supply for LED backlight (Ground:0V) | |

18~22: SK, DO, DI, CS, INT for Touch Panel controller ADS7846
/ X1, X2, Y1, Y2 for Touch Panel (without ADS7846)

7. Timing Characteristics

a.8080 Family Interface Timing

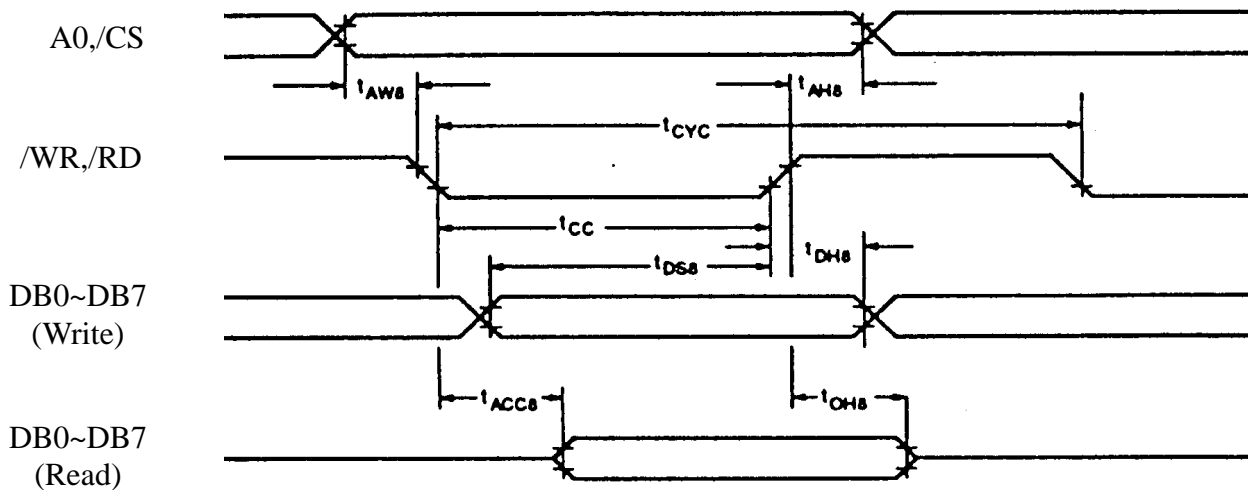
| Parameter | Condition | Symbol | Min | Max | Unit | Remark |
|---------------------|--------------------------|--------|------|-----|------|---------|
| Address Hold Time | CL=100 pF VDD=2.7~4.5 | tAH8 | 10 | | ns | A0,/CS |
| Address Setup Time | | tAW8 | 0 | | ns | |
| System Cycle Time | | tCYC | Note | | ns | /WR,/RD |
| Strobe Pulse Width | | tOC | 150 | | ns | |
| Data Setup Time | | tDS8 | 120 | | ns | DB0~DB7 |
| Data Hold Time | | tDH8 | 5 | | ns | |
| /RD Access Time | | tACC8 | - | 80 | ns | |
| Output Disable Time | | tOH8 | 10 | 55 | ns | |

Note: For memory control and system control commands:

$$t_{CYC8} = 2t_C + t_{OC} + t_{CEA} + 75 > t_{ACV} + 245$$

For all other commands:

$$t_{CYC8} = 4t_C + t_{OC} + 30$$



b. 6800 Family Interface Timing

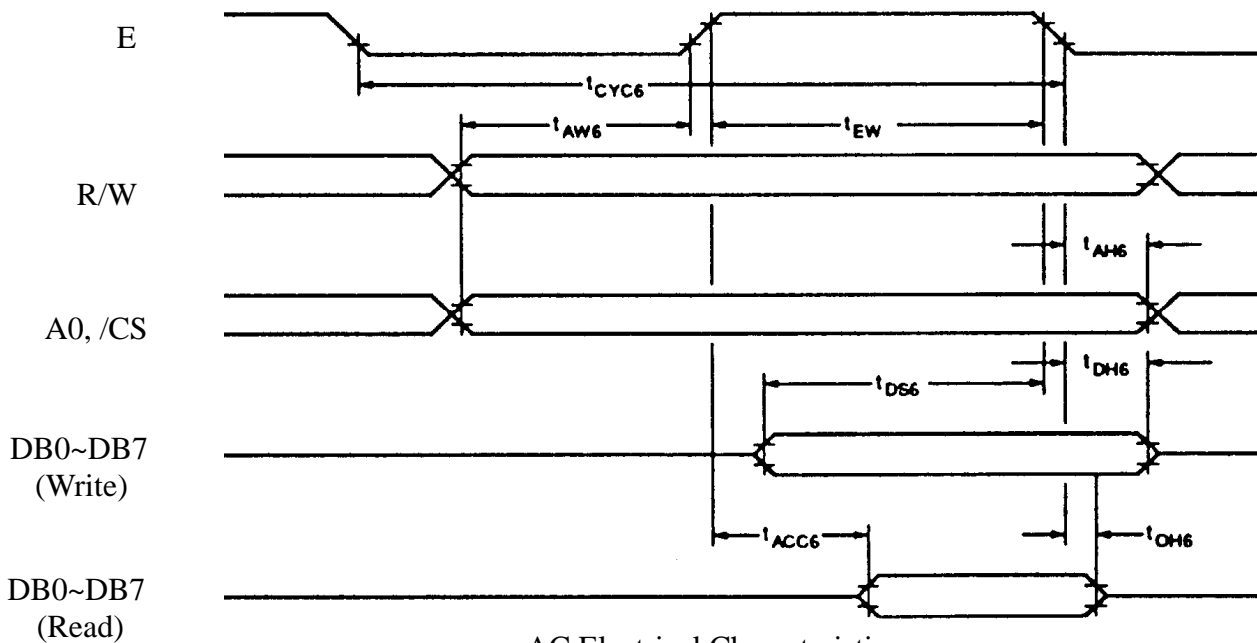
| Parameter | Condition | Symbol | Min | Max | Unit | Remark |
|---------------------|--------------------------|--------|------|-----|------|----------------|
| System Cycle Time | CL=100 pF VDD=2.7~4.5 | tCYC6 | Note | | ns | A0,/CS, R/W |
| Address Setup Time | | tAW6 | 10 | | ns | |
| Address Hold Time | | tAH6 | 0 | | ns | |
| Data Setup Time | | tDS6 | 120 | | ns | DB0~DB7 |
| Data Hold Time | | tDH6 | 0 | | ns | |
| Output Disable Time | | tOH6 | 10 | 75 | ns | |
| Access Time | | tACC6 | - | 130 | ns | |
| Enable Pulsewidth | | tEW | 150 | - | ns | E |

Note: For memory control and system control commands:

$$t_{CYC6} = 2t_C + t_{EW} + t_{CEA} + 75 > t_{ACV} + 245$$

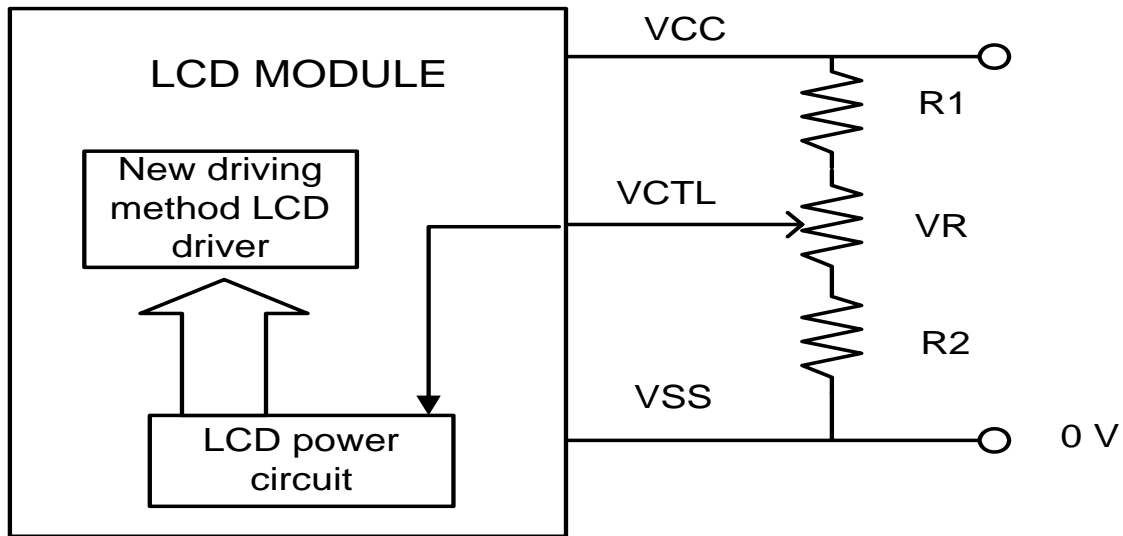
For all other commands:

$$t_{CYC6} = 4t_C + t_{EW} + 30$$



AC Electrical Characteristics

8. Power Supply Example



Note: VR = 20 K, R1=5K, R2=10K

9. Jumper Setting

| Item | Option | Jumper Setting | Remark |
|--------------|---------------------|------------------------|--------|
| Display Type | Portrait (default) | Pin 1,2 short on J1&J2 | |
| | Landscape | Pin 2,3 short on J1&J2 | |
| MPU | 80 family (default) | J80 | |
| | 68 family | J68 | |

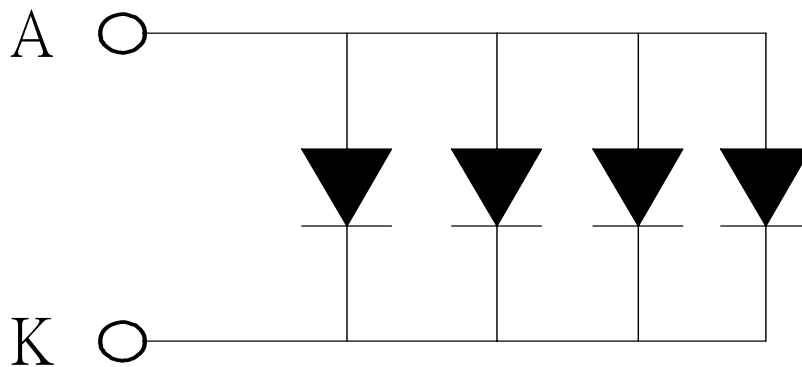
10. Backlight Information

10.1 Specification

LED edge / Blue

| Parameter | Symbol | Min | Typ | Max | Unit | Test Condition |
|--------------------|------------------|-----|-------|-----|-------------------|------------------------|
| Supply Current | I _{LED} | — | 80 | — | mA | V=3.2V |
| Supply Voltage | V | 3.0 | 3.2 | 3.4 | V | — |
| Reverse Voltage | V _R | — | — | 10 | V | — |
| Wave Length | λ_p | 465 | — | 471 | nm | — |
| Luminous Intensity | I _V | — | — | — | cd/m ² | I _{LED} =80mA |
| Life Time | — | — | 50000 | — | Hr. | I _{LED} =80mA |
| Color | Blue | | | | | |

LED Dice number = 4



11. Instruction Set

| Class | Command | Code | | | | | | | | | | | Hex | Command Description | Command read parameters | | |
|-----------------|-------------|------|-----|----|----|----|----|----|----|----|------|------|----------|---|--------------------------------|---------|-------|
| | | /RD | /WR | A0 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | | | Number of byters | Section | |
| System Control | SYSTEM SET | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 40 | Initialized Device and display | 8 | 8.2.1 |
| | SLEEP IN | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 53 | Enter Standby mode | 0 | 8.2.2 | |
| Display Control | DISP ON/OFF | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | D | 58, 59 | Enable and disable display and display flashing | 1 | 8.3.1 | |
| | SCROLL | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 44 | set Display start address and display regions | 10 | 8.3.2 | |
| | CSRFORM | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 5D | Set cursor byte | 2 | 8.3.3 | |
| | CGRAM ADDR. | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 5C | Set start address of character generator RAM | 2 | 8.3.6 | |
| | CSRDIR | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | CD 1 | CD 0 | 4C to 4F | Set direction of cursor movement | 0 | 8.3.4 | |
| | HDOT SCR | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | | 1 | 0 | 5A | set horizontal scroll position | 1 | 8.3.7 | |
| | OVLAY | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 5B | set display overlay format | 1 | 8.3.5 | |
| Drawing Control | CSRW | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 46 | set cursor address | 2 | 8.4.1 | |
| | CSRR | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 47 | read cursor address | 2 | 8.4.2 | |
| Memory Control | MWRITE | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 42 | write to display memory | - | 8.5.1 | |
| | MREAD | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 43 | read from display memory | - | 8.5.2 | |

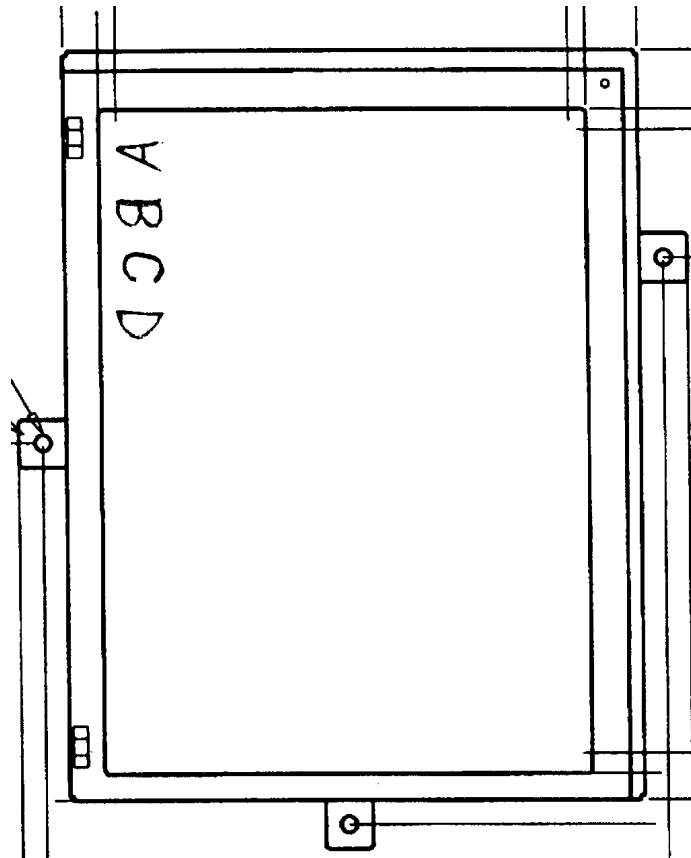
Note:

- In general, the internal registers of the RAIO8835 are modified as each command parameter is input. However, the microprocessor does not have to set all the parameters of a command and may send a new command before all parameters have been input. The internal registers for the parameters that have been input will have been changed but the remaining parameter registers are unchanged.
 - 2 bytes parameters(where two bytes are treated as 1 data item) are handled as following:
 - CSRW, CSRR: Each byte is processed individually. The microprocessor may read or write just the low byte of the cursor address.
 - SYSTEM SET, SCROLL, CGRAM ADR. : Both parameter bytes are processed together. If the command is changed after half of the parameter has been input, the single byte is ignored.
- APL and APH are 2-byte parameters, but are treated as two 1-byte parameters.
- Please refer to RAIO8835 LCD Controller Data Book for detail.

12. Inner Data Format

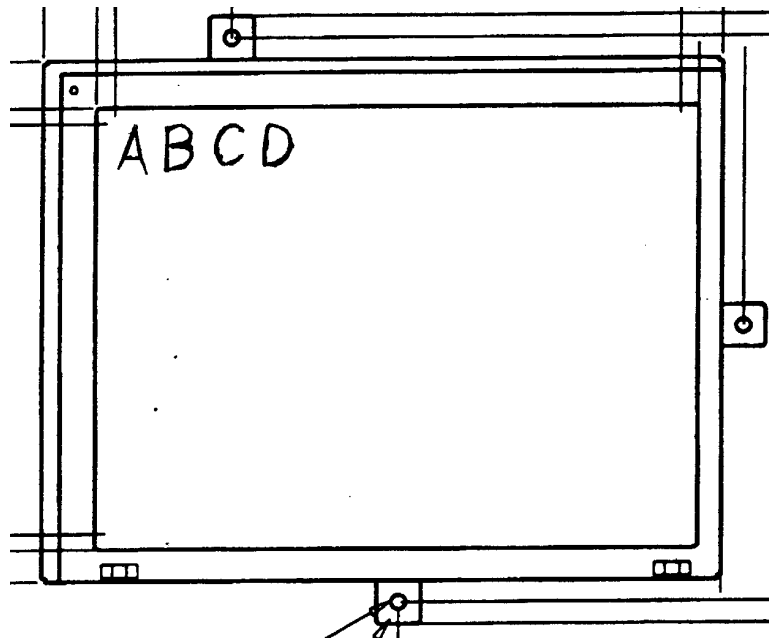
| | COM1 | | | | | | | | COM240 |
|------|-----------|----|----|--|--|--|--|--|--------|
| #1 | D3 | D3 | D3 | | | | | | D3 |
| #2 | D2 | D2 | D2 | | | | | | D2 |
| | D1 | D1 | D1 | | | | | | D1 |
| | D0 | D0 | D0 | | | | | | D0 |
| | D3 | | | | | | | | D3 |
| | | | | | | | | | |
| | D2 | D2 | | | | | | | D2 |
| | D1 | D1 | | | | | | | D1 |
| #320 | D0 | D0 | | | | | | | D0 |

Portrait Display Type (Top View)



| | | | | | | | | | | | | | | | |
|------|------|----|----|----|----|----|--|--|---|--|--------|----|----|----|----|
| | → | | | | | | | | | | | | | | |
| | SEG1 | | | | | | | | | | SEG320 | | | | |
| #1 | D3 | D2 | D1 | D0 | D3 | D2 | | | - | | | D3 | D2 | D1 | D0 |
| #2 | D3 | D2 | D1 | D0 | D3 | D2 | | | | | | D3 | D2 | D1 | D0 |
| | | | | | | | | | | | | | | | |
| #240 | D3 | D2 | D1 | D0 | D3 | D2 | | | | | | D3 | D2 | D1 | D0 |

Landscape Display Type(Top View)



* Regardless Portrait or Landscape type, both are 1/240 duty. The only difference is the opposite scan direction on Common driver. The character mode of S1D13700 could only be used on Landscape type. The character will be Mirrored on Portrait type.

13. Quality And Reliability

13.1 Test Conditions

Tests should be conducted under the following conditions :

Ambient temperature : $25 \pm 5^{\circ}\text{C}$

Humidity : $60 \pm 25\% \text{ RH}$.

13.2 Sampling Plan

Sampling method shall be in accordance with MIL-STD-105E, inspection level II, normal inspection, and single sampling plan tables for normal, tightened, and reduced inspection.

13.3 Acceptable Quality Level

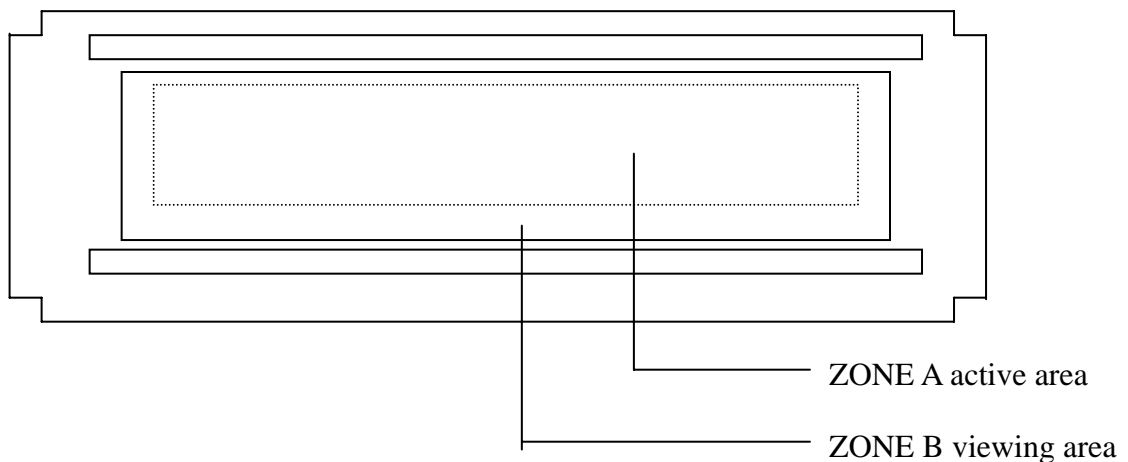
A major defect is defined as one that could cause failure to or materially reduce the usability of the unit for its intended purpose. A minor defect is one that does not materially reduce the usability of the unit for its intended purpose or is an infringement from established standards and has no significant bearing on its effective use or operation.

13.4 Appearance

An appearance test should be conducted by human sight at approximately 30 cm distance from the LCD module under fluorescent light. The inspection area of LCD panel shall be within the range of following limits.

13.5 Inspection Quality Criteria

| Item | Description of defects | Class of Defects | Acceptable level (%) | | |
|----------------------|---|------------------|----------------------|-------|-----|
| Function | Short circuit or Pattern cut | Major | 0.65 | | |
| Dimension | Deviation from drawings | Major | 1.5 | | |
| Black spots | Ave . dia . D | area A | area B | Minor | 2.5 |
| | $D \leq 0.2$ | Disregard | | | |
| | $0.2 < D \leq 0.3$ | 3 | 4 | | |
| | $0.3 < D \leq 0.4$ | 2 | 3 | | |
| | $0.4 < D$ | 0 | 1 | | |
| Black lines | Width W, Length L | A | B | Minor | 2.5 |
| | $W \leq 0.03$ | disregard | | | |
| | $0.03 < W \leq 0.05$ | 3 | 4 | | |
| | $0.05 < W \leq 0.07, L \leq 3.0$ | 1 | 1 | | |
| | See line criteria | | | | |
| Bubbles in polarizer | Average diameter D $0.2 < D < 0.5$ mm for N = 4 , D > 0.5 for N = 1 | Minor | 2.5 | | |
| Color uniformity | Rainbow color or newton ring. | Minor | 2.5 | | |
| Glass Scratches | Obvious visible damage. | Minor | 2.5 | | |
| Contrast ratio | See note 1 | Minor | 2.5 | | |
| Response time | See note 2 | Minor | 2.5 | | |
| Viewing angle | See note 3 | Minor | 2.5 | | |



14. Appendix (Drawing)

14 -1 Drawing

