

A Brighter Solution

AMP DISPLAY INC.

### SPECIFICATIONS

|                          |                         |
|--------------------------|-------------------------|
| <b>CUSTOMER</b>          |                         |
| <b>CUSTOMER PART NO.</b> |                         |
| <b>AMP PART NO.</b>      | AT-160160A(pure driver) |
| <b>APPROVED BY</b>       |                         |
| <b>DATE</b>              |                         |

**Approved For Specifications**

**Approved For Specifications & Sample**

### AMP DISPLAY INC

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| APPROVED BY | CHECKED BY | ORGANIZED BY |
|-------------|------------|--------------|
|             |            |              |

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Date : 2001/12/11

## RECORD OF REVISION

| Revision Date | Contents  |
|---------------|---|
| 1999/9/25     | New Release   |
| 2000/6/8      | Add the T/P controller option   |
| 2000/6/30     | Modify the Supply Current (Page 5)<br>Add the ZIF connector recommendation (Page 9) |
| 2000/9/6      | Change the driver to NT7701   |
| 2000/9/28     | Add power on / off sequence   |
| 2001/8/27     | Add the interface and back-view on the drawing                                      |

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## 1 FEATURES

- (1) Display format : 160 × 160 dot-matrix
- (2) Construction : FSTN LCD, TAB IC and PCB.
- (3) Option : EL backlight, EL driver, Touch Panel, T/P controller MK715.
- (4) Common & Segment Driver : NT7701.
- (5) Built-in M signal circuit.
- (6) 5V or 3.3V single power input. Built-in DC/DC converter for LCD driving.
- (7) Normal / Extended temperature type.
- (8) 80 or 68 Family MPU Selectable by Jumper Setting

## 2 NUMBERING SYSTEM

**AT-160160A**                                
**1 2 3 4 5 6**

| No | Code Value | Description                     | Remark   |
|----|------------|---------------------------------|--|
| 1  | F          | FSTN type LCD                   | LCD Type   |
| 2  | A          | Reflective type / 6:00 view     | Polarizer / Viewing Angel  |
|    | B          | Reflective type / 12:00 view    |  |
|    | I          | Transflective type / 6:00 view  |  |
|    | J          | Transflective type / 12:00 view |  |
|    | T          | Negative type / 6:00 view       |  |
|    | U          | Negative type / 12:00 view      |  |
| 3  | None       | Without backlight               | Backlight type   |
|    | E          | EL                              |  |
| 4  | None       | Without backlight               | Backlight color  |
|    | B          | Blue                            |  |
|    | W          | White                           |  |
| 5  | 50         | None                            | EL driver & Touch Panel option<br>* If the T/P controller MK715 is needed, please indicate while ordering. |
|    | 52         | With EL driver                  |  |
|    | T50        | With Touch Panel                |  |
|    | T52        | With EL driver & Touch Panel    |  |
| 6  | None       | Normal temperature type         | LCM temperature type   |
|    | H          | Extended temperature type       |  |

### 3 MECHANICAL DATA

| Parameter                       | Stand Value                     | Unit |
|---------------------------------|---------------------------------|------|
| Dot size                        | 0.33(W) × 0.33(H)               | mm   |
| Dot pitch                       | 0.35(W) × 0.35(H)               | mm   |
| Viewing area                    | 60.1(W) × 60.0(H)               | mm   |
| Module size                     | 69.0(W) × 69.5(H) × 6.0 max (T) | mm   |
| Module size<br>(EL back-light)  | 69.0(W) × 69.5(H) × 6.6 max (T) | mm   |
| Module size<br>(w/ Touch panel) | 69.0(W) × 69.5(H) × 8.0 max (T) | mm   |

### 4 ABSOLUTE MAXIMUM RATINGS

| Parameter                    |                 | Symbol   | Min  | Max     | Unit |
|------------------------------|-----------------|----------|------|---------|------|
| Logic Circuit Supply Voltage |                 | VDD-VSS  | -0.3 | 7.0     | V    |
| LCD Driving Voltage          |                 | VADJ-VSS | -0.3 | 26.0    | V    |
| Input Voltage                |                 | VI       | -0.3 | VDD+0.3 | V    |
| Normal temp. type            | Operating Temp. | TOP      | 0    | 50      | °C   |
|                              | Storage Temp.   | TSTG     | -20  | 70      | °C   |
| Extended temp. type          | Operating Temp. | TOP      | -20  | 70      | °C   |
|                              | Storage Temp.   | TSTG     | -30  | 80      | °C   |

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## 5 ELECTRO-OPTICAL CHARACTERISTICS

| Parameter                              | Symbol   | Condition      | Min     | Typ  | Max     | Unit | Note   |
|--|----------|----------------|---------|------|---------|------|--------|
| ----- Electronic Characteristics ----- |          |                |         |      |         |      |        |
| Logic Circuit Supply Voltage           | VDD-VSS  | --             | 2.7     | --   | 5.5     | V    |        |
| LCD Driving Voltage                    | VADJ-VSS | 25°C           | --      | 19.0 | --      | V    |        |
| Input Voltage                          | VIH      | --             | 0.8 VDD | --   | VDD     | V    |        |
|  | VIL      | --             | VSS     | --   | 0.2 VDD | V    |        |
| Logic Supply Current                   | IDD      | VDD = 5V       | 22      | 27   | 32      | mA   |        |
| Supply Current for EL driver           |          | VDD = 5V       | --      | 40   | --      | mA   |        |
| ----- Optical Characteristics -----    |          |                |         |      |         |      |        |
| Contrast                               | CR       | 25°C           | 7.1     | 7.25 | 7.38    |      | Note 1 |
| Rise Time                              | Tr       | 25°C           | 266     | 280  | 302     | ms   | Note 2 |
| Fall Time                              | Tf       | 25°C           | 87      | 94   | 98      | ms   |        |
| Viewing Angle Range                    | θ f      | 25°C &<br>CR≥2 | 42      | 43   | 44      | Deg. | Note 3 |
|  | θ b      |                | 31      | 33   | 34      |      |        |
|  | θ l      |                | 38      | 38   | 38      |      |        |
|  | θ r      |                | 37      | 37   | 38      |      |        |
| Frame Frequency                        | fF       | 25°C           | --      | 64   | --      | Hz   |        |

### 5.1 EL Back-light Electrical Specification

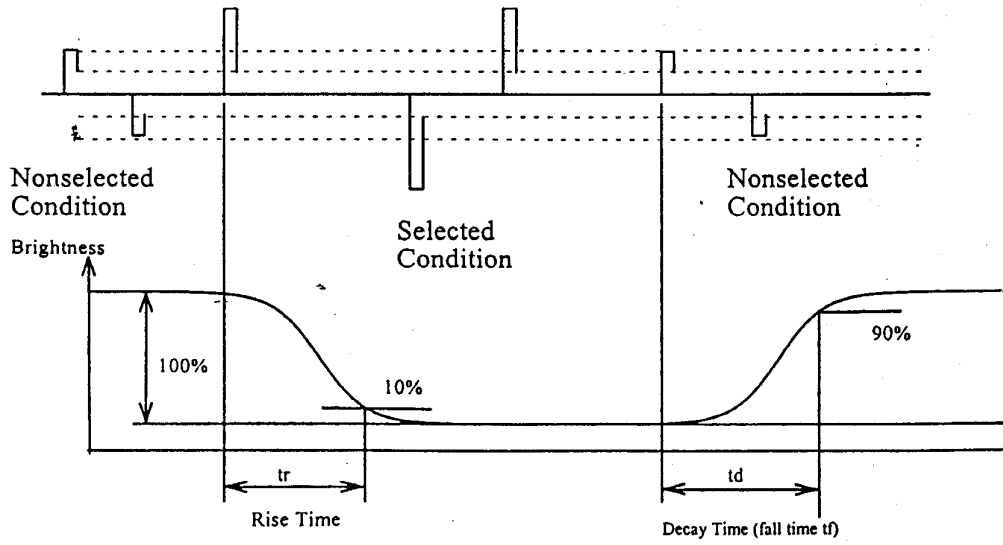
| Parameter                  | Specification   | Unit                 |
|----------------------------|-----------------|----------------------|
| Color                      | Blue / White    | -                    |
| Voltage                    | Vrms = 60       | V(AC)                |
| Frequency                  | Sine Wave = 380 | Hz                   |
| Current Density            | 0.12            | mA / cm <sup>2</sup> |
| Bare EL Initial Brightness | 15              | cd / m <sup>2</sup>  |
| LCM Initial Brightness     | 5               | cd / m <sup>2</sup>  |

(NOTE 1) Contrast ratio :

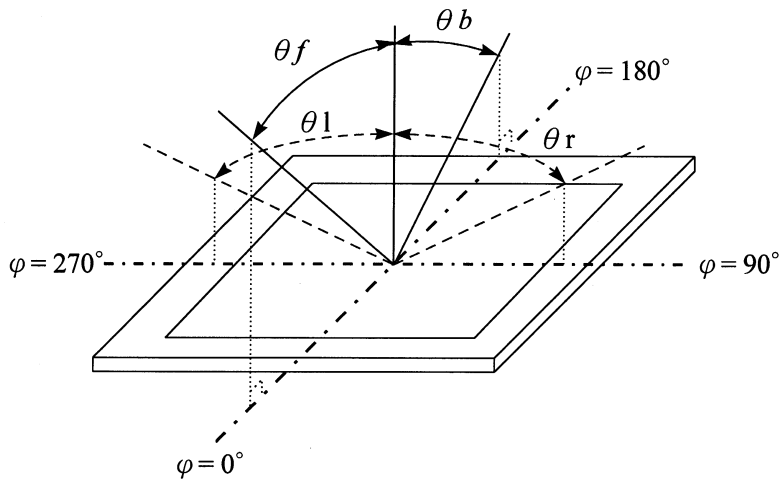
$$CR = (\text{Brightness in OFF state}) / (\text{Brightness in ON state})$$


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( NOTE 2 ) Response time :



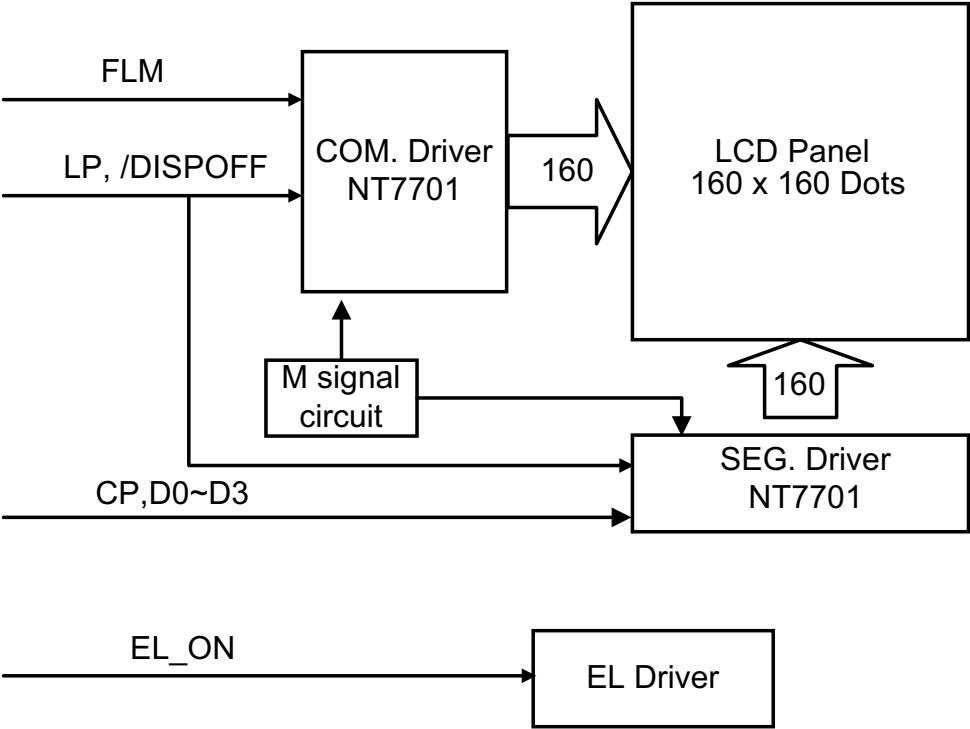
(NOTE 3) Viewing angle



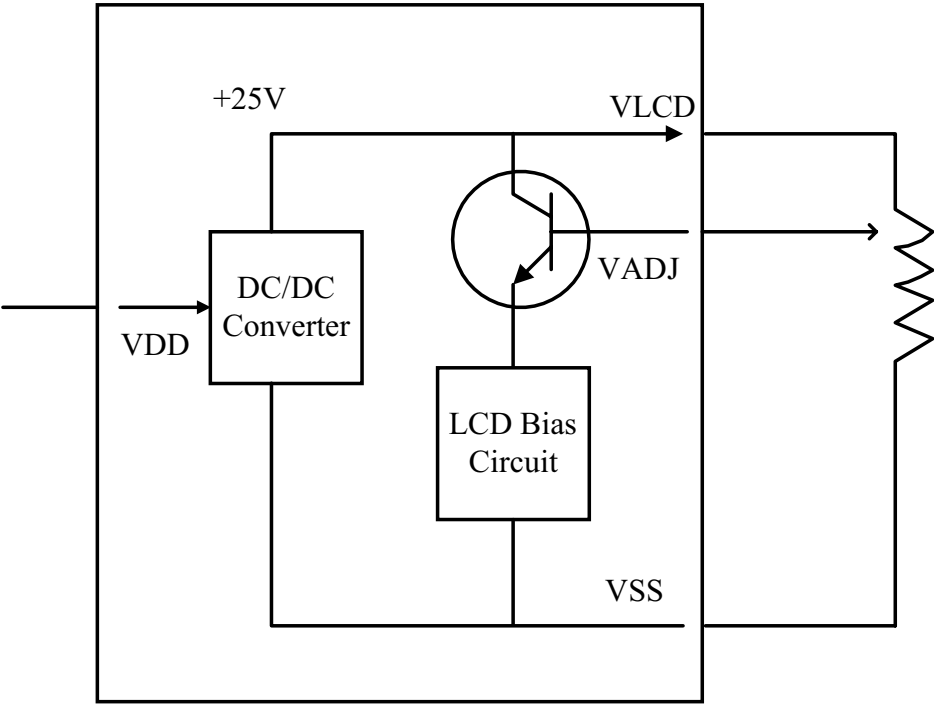
## 5.2 Touch Panel Electrical Specification

| Parameter             | Specification               | Condition  |
|-----------------------|-----------------------------|--|
| ON Resistance         | 351 $\Omega$ ~ 702 $\Omega$ | X Axis   |
|                       | 154 $\Omega$ ~ 893 $\Omega$ | Y Axis   |
| Insulating Resistance | More than 20M $\Omega$      | DC 25 V  |
| Chattering            | Less Than 10 ms             | DC 5V, Load of resistance(1mA),<br>switching Time 2m/sec |
| Endurable Voltage     | 25 V for 1 min              |  |

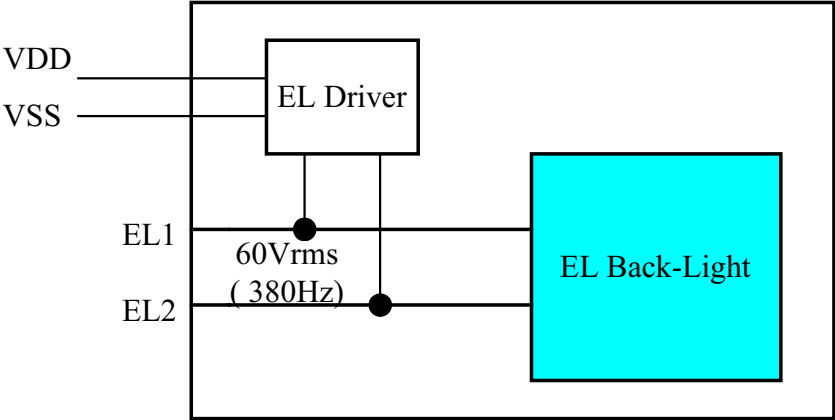
6 BLOCK DIAGRAM



# 7 POWER SUPPLY CIRCUIT



## While using EL back-light





## 8 INTERFACE DEFINITION

CN1: Interface of pure driver

| PIN NO. | SIGNAL   | LEVEL | FUNCTION   |
|---------|----------|-------|--|
| 1~4     | D0~D3    | H/L   | Data Input(4 bits)   |
| 5       | /DISPOFF | H/L   | H: Display ON(default) L: Display OFF                              |
| 6       | FLM      | H/L   | First Line Marker  |
| 7       | NC (M)   | --    | No Connection (M signal input while not built-in M signal circuit) |
| 8       | LP       | H/L   | Data Latch Signal  |
| 9       | CP       | H/L   | Clock Signal   |
| 10      | VDD      | -     | Power Supply for Logic(+5V)  |
| 11      | VSS      | -     | Power Supply(Ground:0V)  |
| 12      | VLCD     | -     | Positive voltage output (+25V)                                     |
| 13      | VADJ     |       | Contrast Adjustment Input<br>( VADJ-VSS = LCD driving voltage )    |
| 14      | EL_ON    | H/L   | EL On/Off Signal; H: EL On L: EL Off                               |
| 15*     | SK / X1  | -     | Serial Clock<br>Touch Panel Right Signal in X Axis                 |
| 16*     | DO / X2  | -     | Data Output<br>Touch Panel Left Signal in X Axis                   |
| 17*     | DI / Y1  | -     | Data In<br>Touch Panel Upper Signal in Y Axis                      |
| 18*     | CS / Y2  | -     | Chip Select<br>Touch Panel Lower Signal in X Axis                  |
| 19*     | INT      | -     | Interrupt  |
| 20      | NC       | -     | No Connection  |

\* 15~19 : SK, DO, DI, CS, INT for Touch Panel controller MK715

/ X1, X2, Y1, Y2 for Touch Panel (without MK715)

**Recommended ZIF Connector** for CN1 : 20 pin / Molex 52207-2090 / Top contact

CN3: LCM with Built-In Controller(No Use in this LCM)

| PIN NO. | SIGNAL | LEVEL | FUNCTION      |
|---------|--------|-------|---------------|
| 1-24    | NC     | --    | No Connection |

## 9 TIMING CHARACTERISTICS

Segment Mode 1 ( $V_{SS}=0V$ ,  $V_{DD}=4.5\sim 5.5V$ ,  $V_0=15$  to 30, and  $T_A=-20$  to  $+85^\circ C$ , unless otherwise noted.)

| Parameter                                 | Symbol                              | Min. | Typ. | Max. | Unit    | Condition                     |
|---|-------------------------------------|------|------|------|---------|-------------------------------|
| Shift clock period                        | twck                                | 71   | -    |      | ns      | $t_r, t_f \leq 10ns$ , Note 1 |
| Shift clock "H" pulse width               | twckH                               | 23   | -    |      | ns      |                               |
| Shift clock "L" pulse width               | twckL                               | 23   | -    |      | ns      |                               |
| Data setup time                           | tDS                                 | 10   | -    |      | ns      |                               |
| Data hold time                            | tDH                                 | 20   | -    |      | ns      |                               |
| Latch pulse "H" pulse width               | twLPH                               | 23   | -    |      | ns      |                               |
| Shift clock rise to Latch pulse rise time | tLD                                 | 0    | -    |      | ns      |                               |
| Shift clock fall to Latch pulse fall time | tSL                                 | 25   | -    |      | ns      |                               |
| Latch pulse rise to Shift clock rise time | tLS                                 | 25   | -    |      | ns      |                               |
| Latch pulse fall to Shift clock rise time | tLH                                 | 25   | -    |      | ns      |                               |
| Input signal rise time                    | t <sub>r</sub>                      |      | -    | 50   | ns      | Note 2                        |
| Input signal fall time                    | t <sub>f</sub>                      |      | -    | 50   | ns      | Note 2                        |
| Enable setup time                         | tS                                  | 21   | -    |      | ns      |                               |
| $\overline{DISPOFF}$ Removal time         | tSD                                 | 100  | -    |      | ns      |                               |
| $\overline{DISPOFF}$ enable pulse width   | twDL                                | 1.2  | -    |      | $\mu s$ |                               |
| Output delay time (1)                     | tD                                  |      | -    | 40   | ns      | CL=15pF                       |
| Output delay time (2)                     | t <sub>pd1</sub> , t <sub>pd2</sub> |      | -    | 1.2  | $\mu s$ | CL=15pF                       |
| Output delay time (3)                     | t <sub>pd3</sub>                    |      | -    | 1.2  | $\mu s$ | CL=15pF                       |

Note

1. Take the cascade connection into consideration.
2.  $(t_{ck} - tw_{ckH} - tw_{ckL})/2$  is maximum in the case of high speed operation.

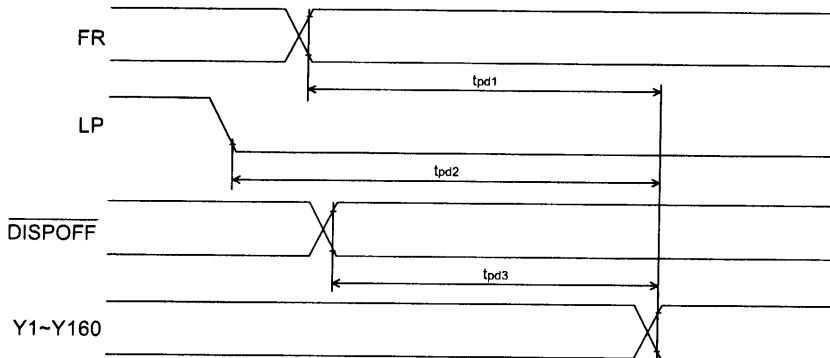
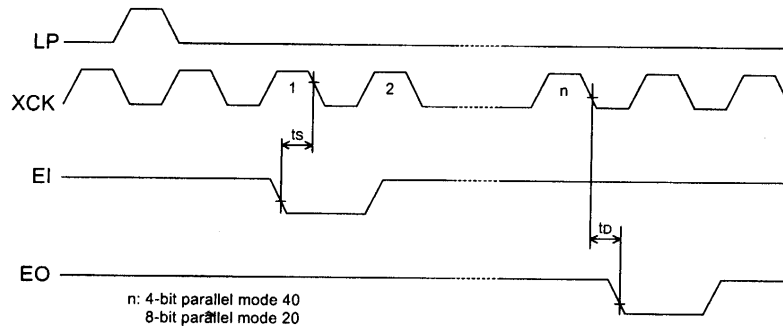
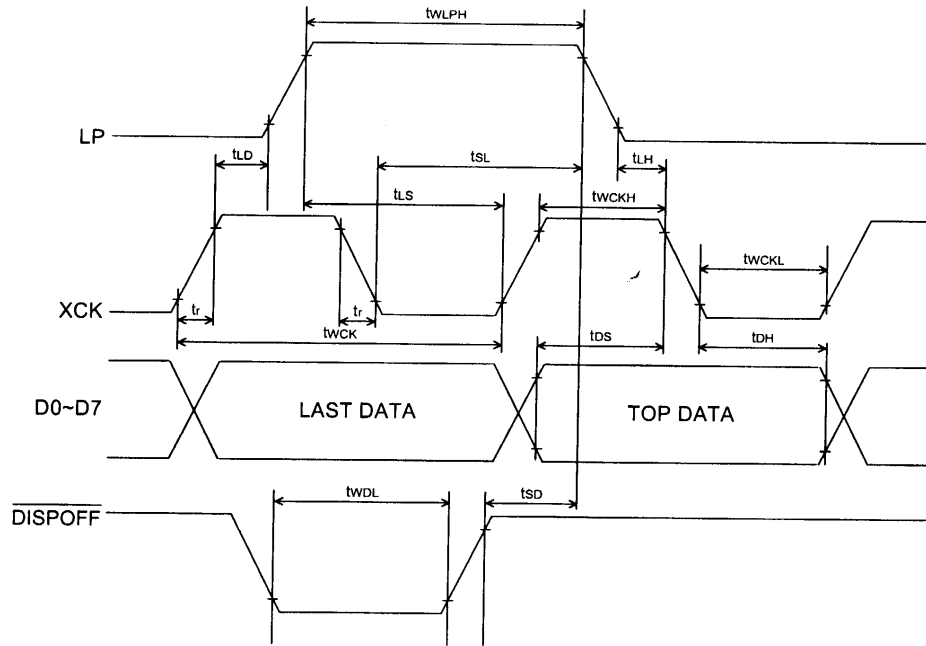
Segment Mode 2 ( $V_{SS}=0V$ ,  $V_{DD}= 2.5\sim 4.5V$ ,  $V_0=15$  to 30, and  $T_A=-20$  to  $+85^\circ C$ , unless otherwise noted.)

| Parameter                                 | Symbol             | Min. | Typ. | Max. | Unit    | Condition                     |
|---|--------------------|------|------|------|---------|-------------------------------|
| Shift clock period                        | twck               | 125  | -    |      | ns      | $t_r, t_f \leq 11ns$ , Note 1 |
| Shift clock "H" pulse width               | twckH              | 51   | -    |      | ns      |                               |
| Shift clock "L" pulse width               | twckL              | 51   | -    |      | ns      |                               |
| Data setup time                           | tbs                | 30   | -    |      | ns      |                               |
| Data hold time                            | tdh                | 40   | -    |      | ns      |                               |
| Latch pulse "H" pulse width               | twLPH              | 51   | -    |      | ns      |                               |
| Shift clock rise to Latch pulse rise time | tLD                | 0    | -    |      | ns      |                               |
| Shift clock fall to Latch pulse fall time | tSL                | 51   | -    |      | ns      |                               |
| Latch pulse rise to Shift clock rise time | tLS                | 51   | -    |      | ns      |                               |
| Latch pulse fall to Shift clock fall time | tLH                | 51   | -    |      | ns      |                               |
| Input signal rise time                    | $t_r$              |      | -    | 50   | ns      | Note 2                        |
| Input signal fall time                    | $t_f$              |      | -    | 50   | ns      | Note 2                        |
| Enable setup time                         | ts                 | 36   | -    |      | ns      |                               |
| $\overline{DISPOFF}$ Removal time         | tsp                | 100  | -    |      | ns      |                               |
| $\overline{DISPOFF}$ enable pulse width   | twDL               | 1.2  | -    |      | $\mu s$ |                               |
| Output delay time (1)                     | td                 |      | -    | 78   | ns      | $C_L=15pF$                    |
| Output delay time (2)                     | $t_{pd1}, t_{pd2}$ |      | -    | 1.2  | $\mu s$ | $C_L=15pF$                    |
| Output delay time (3)                     | $t_{pd3}$          |      | -    | 1.2  | $\mu s$ | $C_L=15pF$                    |

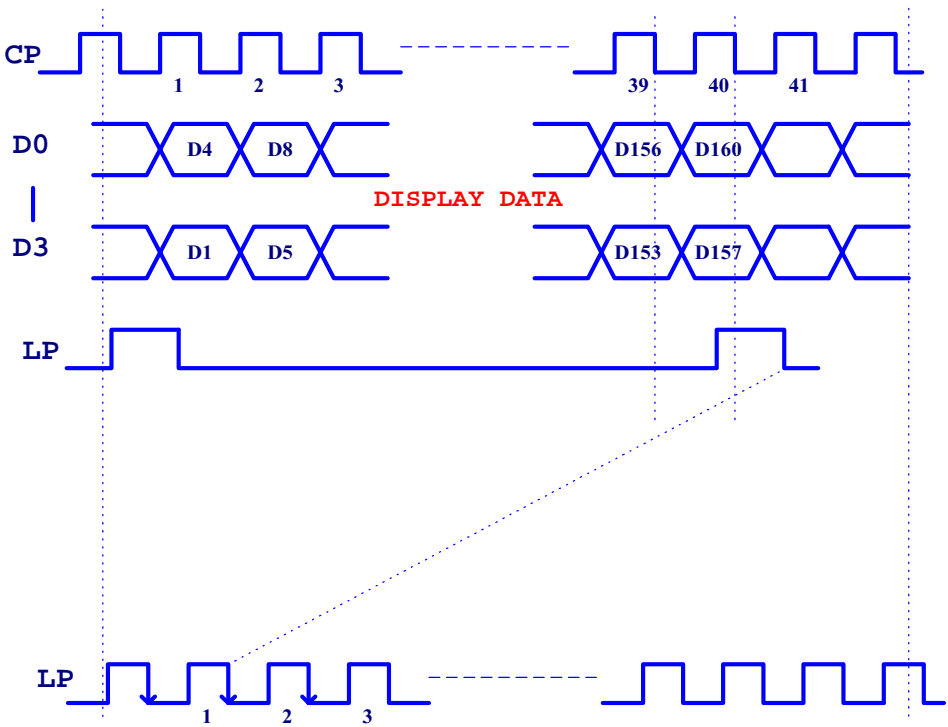
Note

1. Take the cascade connection into consideration.
2.  $(t_{ck} - twckH - twckL) / 2$  is maximum in the case of high speed operation.

Timing waveform of Segment Mode



### 9.1 Controller Interface Timing Chart



### 9.2 Display Data Format

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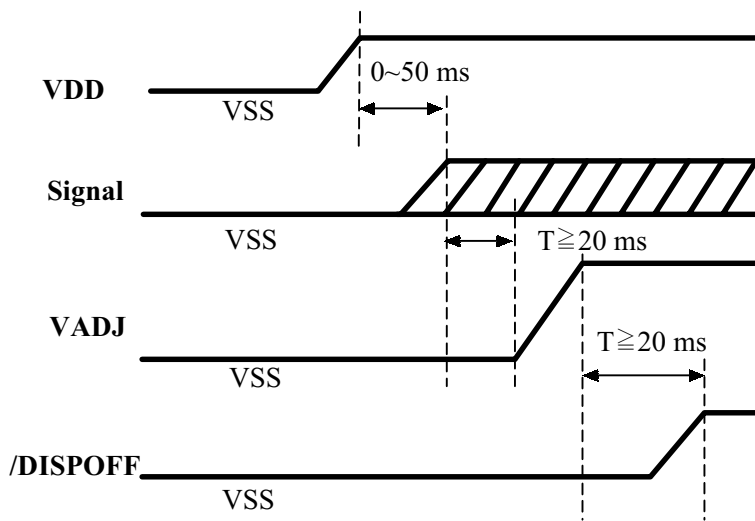
|      |           |    |    |    |  |   |  |  |        |    |    |    |
|------|-----------|----|----|----|--|---|--|--|--------|----|----|----|
|      | SEG1      |    |    |    |  |   |  |  | SEG160 |    |    |    |
| #1   | <b>D3</b> | D2 | D1 | D0 |  | - |  |  | D3     | D2 | D1 | D0 |
| #2   | D3        | D2 | D1 | D0 |  |   |  |  | D3     | D2 | D1 | D0 |
|      |           |    |    |    |  |   |  |  |        |    |    |    |
| #160 | D3        | D2 | D1 | D0 |  |   |  |  | D3     | D2 | D1 | D0 |

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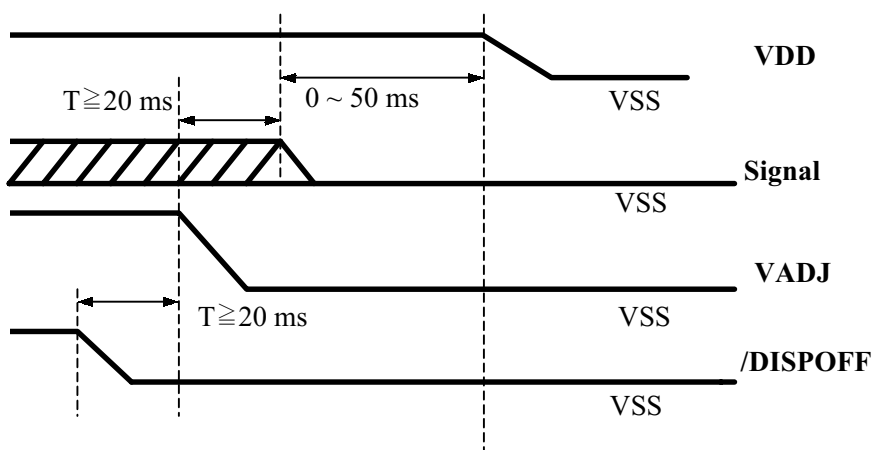
### 9.3 Power ON/OFF Sequence

Please maintain the blow sequence when turning on and off the power supply of the module. If /DISPOFF is supplied to the module while internal alter signal for LCD driving (M) is unstable, DC component will be supplied to the LCD panel. This may cause damage the LCD module.

#### POWER ON SEQUENCE



#### POWER OFF SEQUENCE



## **10 QUALITY AND RELIABILITY**

### **10.1 TEST CONDITIONS**

Tests should be conducted under the following conditions :

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

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

### **10.2 SAMPLING PLAN**

Sampling method shall be in accordance with MIL-STD-105E , level II, normal single sampling plan .

### **10.3 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.

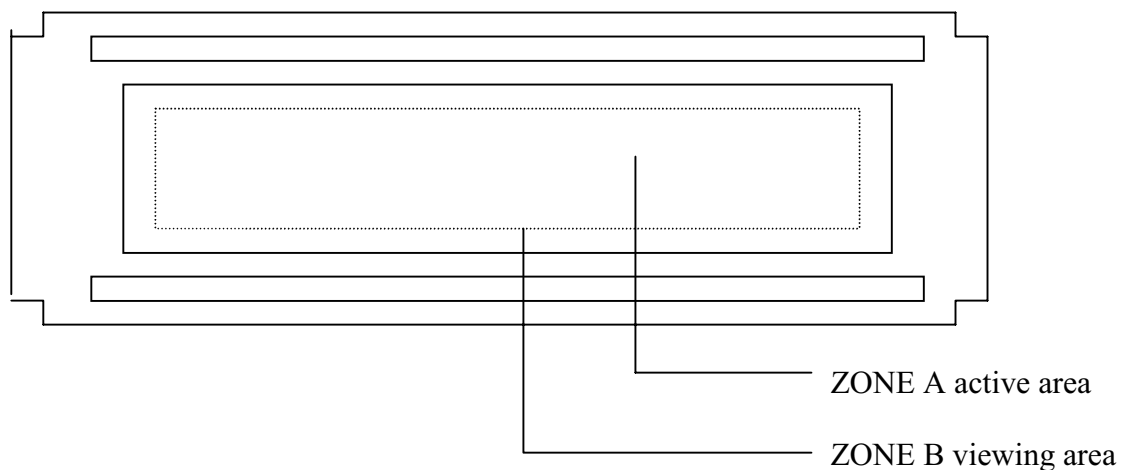
### **10.4 APPEARANCE**

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

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## 10.5 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                  |





## 10.6 RELIABILITY

| Test Item                  | Test Conditions   |   | Note |
|----------------------------|---|---|------|
|                            | Normal Temp. type   | Extended Temp. type   |      |
| High Temperature Operation | 50±3°C , t=96 hrs   | 70±3°C , t=96 hrs   |      |
| Low Temperature Operation  | 0±3°C , t=96 hrs  | -20±3°C , t=96 hrs  |      |
| High Temperature Storage   | 70±3°C , t=96 hrs   | 80±3°C , t=96 hrs   | 1,2  |
| Low Temperature Storage    | -20±3°C , t=96 hrs  | -30±3°C , t=96 hrs  | 1,2  |
| Temperature Cycle          | -20°C ~ 25°C ~ 70°C<br>30 m in. 5 min. 30 min.<br>( 1 cycle )<br>Total 5 cycle  | -30°C ~ 25°C ~ 80°C<br>30 min. 5 min. 30 min.<br>( 1 cycle )<br>Total 5 cycle | 1,2  |
| Humidity Test              | 40 °C, Humidity 90%, 96 hrs   |   | 1,2  |
| Vibration Test (Packing)   | Sweep frequency : 10 ~ 55 ~ 10 Hz/1min<br>Amplitude : 0.75mm<br>Test direction : X.Y.Z/3 axis<br>Duration : 30min/each axis |   | 2    |

Note 1 : Condensation of water is not permitted on the module.

Note 2 : The module should be inspected after 1 hour storage in normal conditions  
(15-35°C , 45-65%RH).

Definitions of life end point :

- Current drain should be smaller than the specific value.
- Function of the module should be maintained.
- Appearance and display quality should not have degraded noticeably.
- Contrast ratio should be greater than 50% of the initial value.

## **11 HANDLING PRECAUTIONS**

- (1) A LCD module is a fragile item and should not be subjected to strong mechanical shocks.
  - (2) Avoid applying pressure to the module surface. This will distort the glass and cause a change in color.
  - (3) Under no circumstances should the position of the bezel tabs or their shape be modified.
  - (4) Do not modify the display PCB in either shape or positioning of components.
  - (5) Do not modify or move location of the zebra or heat seal connectors.
  - (6) The device should only be soldered to during interfacing. Modification to other areas of the board should not be carried out.
  - (7) In the event of LCD breakage and resultant leakage of fluid do not inhale, ingest or make contact with the skin. If contact is made rinse immediately.
  - (8) When cleaning the module use a soft damp cloth with a mild solvent, such as Isopropyl or Ethyl alcohol. The use of water, ketone or aromatic is not permitted.
  - (9) Prior to initial power up input signals should not be applied.
  - (10) Protect the module against static electricity and observe appropriate anti-static precautions.
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