

# LCD Module Technical Specification

First Edition  
Aug 25, 2005  
Final Revision  
Apr 13, 2012

Type No. **F-51320GNB-LW-AEN**

Customer : **STANDARD**

Customer's Product No : -----

## KYOCERA Display Corporation

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## Revision History

| Rev. | Date          | Page  | Comment   |
|------|---------------|-------|---|
| 1    | May 9, 2008   | 24~26 | Revise of Precautions Relating Product Handling and Warranty. |
| 2    | Apr. 13. 2012 | -     | Changing company's name                                       |

## 1. General Specifications

|                    |   |  |
|--------------------|---|--|
| Operating Temp.    | : | min. 0°C ~max. 50°C  |
| Storage Temp.      | : | min. -20°C ~max. 70°C  |
| Dot Pixels         | : | 128 (W) × 64 (H) dots  |
| Dot Size           | : | 0.48 (W) × 0.48 (H) mm   |
| Dot Pitch          | : | 0.50 (W) × 0.50 (H) mm   |
| Viewing Area       | : | 66.8 (W) × 35.5 (H) mm   |
| Outline Dimensions | : | 89.7 (W) × 49.8* (H) × 6.0** (D) mm<br>* Without FPCUV<br>** Without Fook of LED Backlight   |
| Weight             | : | 33.8g max.   |
| LCD Type           | : | NTD-20635<br>( STN / Blue-mode / Transmissive )  |
| Viewing Angle      | : | 6:00   |
| Data Transfer      | : | 8-bit parallel data transfer   |
| Backlight          | : | LED Backlight / White  |
| Drawings           | : | Dimensional Outline UE-310595B   |
| RoHS regulation    | : | To our best knowledge, this product satisfies material requirement of RoHS regulation.<br>Our company is doing the best efforts to obtain the equivalent certificate from our suppliers. |

## 2. Electrical Specifications

### 2.1. Absolute Maximum Ratings

GND=0V

| Parameter                        | Symbol                            | Conditions                  | Min.  | Max.                 | Units |
|----------------------------------|-----------------------------------|-----------------------------|-------|----------------------|-------|
| Supply Voltage (Logic)           | V <sub>DD-GND</sub>               | -                           | -0.3  | 7.0                  | V     |
| Supply Voltage (Booster Circuit) | V <sub>DD-GND</sub>               | With Triple (In case of 5V) | -6.0  | +0.3                 | V     |
|                                  |                                   | With Quad (In case of 3V)   | -4.5  | +0.3                 |       |
| Supply Voltage 1 (LCD Drive)     | V <sub>5</sub> , V <sub>OUT</sub> | -                           | -18.0 | +0.3                 | V     |
| Input Voltage                    | V <sub>IN</sub>                   | -                           | -0.3  | V <sub>DD</sub> +0.3 | V     |

### 2.2. DC Characteristics

T<sub>a</sub>=25°C, GND=0V

| Parameter                   | Symbol              | Conditions                | Min.                  | Typ. | Max.                  | Units |
|-----------------------------|---------------------|---------------------------|-----------------------|------|-----------------------|-------|
| Supply Voltage (Logic)      | V <sub>DD-GND</sub> | With Triple               | 4.5                   | -    | 5.5                   | V     |
|                             |                     | With Quad                 | 2.7                   | -    | 3.3                   |       |
| Supply Voltage (LCD Drive)  | V <sub>DD-V5</sub>  | Shown in 3.1              |                       |      |                       | V     |
| "High" Level Input Voltage  | V <sub>IH</sub>     | -                         | 0.8 × V <sub>DD</sub> | -    | V <sub>DD</sub>       | V     |
| "Low" Level Input Voltage   | V <sub>IL</sub>     | -                         | GND                   | -    | 0.2 × V <sub>DD</sub> | V     |
| "High" Level Output Voltage | V <sub>OH</sub>     | I <sub>OH</sub> =-0.1mA   | 0.8 × V <sub>DD</sub> | -    | V <sub>DD</sub>       | V     |
| "Low" Level Output Voltage  | V <sub>OL</sub>     | I <sub>OL</sub> =0.1mA    | GND                   | -    | 0.2 × V <sub>DD</sub> | V     |
| Supply Current              | I <sub>DD</sub>     | V <sub>DD-GND</sub> =5.0V | -                     | 1.18 | 1.77                  | mA    |

## 2.3.AC Characteristics

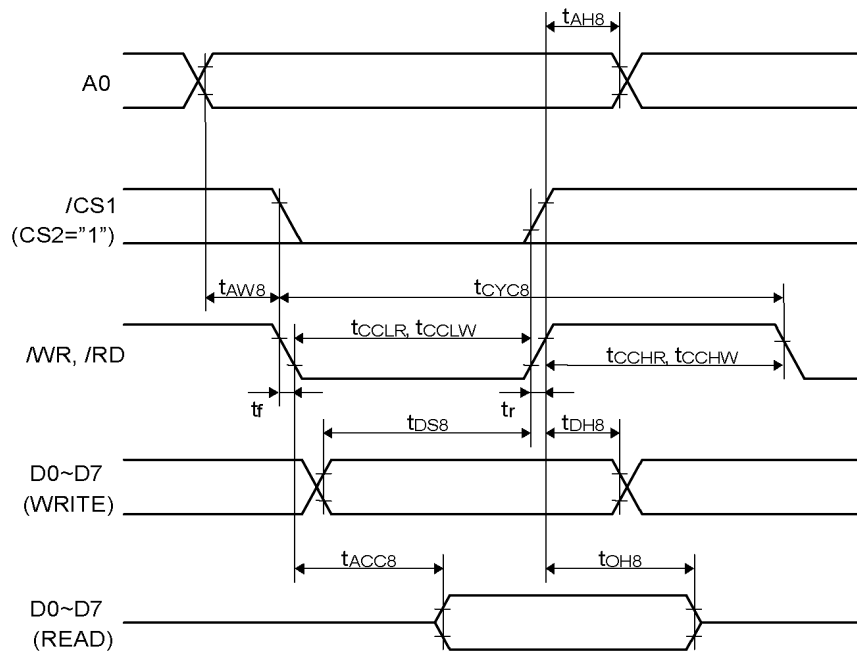
### 2.3.1.Read/Write Operation Sequence (80 series CPU)

$V_{DD}=5.0V\pm 10\%$

| Parameter                   |       | Symbol     | Min. | Max. | Units |
|-----------------------------|-------|------------|------|------|-------|
| Address Setup Time          |       | $t_{AW8}$  | 0    | -    | ns    |
| Address Hold Time           |       | $t_{AH8}$  | 0    | -    | ns    |
| System Cycle Time           |       | $t_{CYC8}$ | 166  | -    | ns    |
| Control Low Pulse Width     | WRITE | $t_{CCLW}$ | 30   | -    | ns    |
|                             | READ  | $t_{CCLR}$ | 70   | -    | ns    |
| Control High Pulse Width    | WRITE | $t_{CCHW}$ | 30   | -    | ns    |
|                             | READ  | $t_{CCHR}$ | 30   | -    | ns    |
| Data Setup Time             |       | $t_{DS8}$  | 30   | -    | ns    |
| Data Hold Time              |       | $t_{DH8}$  | 10   | -    | ns    |
| $\overline{RD}$ Access Time |       | $t_{ACC8}$ | -    | 70   | ns    |
| Output Disable Time         |       | $t_{OH8}$  | 5    | 50   | ns    |

$V_{DD}=2.7\sim 4.5V$

| Parameter                              |       | Symbol     | Min. | Max. | Units |
|--|-------|------------|------|------|-------|
| Address Setup Time                     |       | $t_{AW8}$  | 0    | -    | ns    |
| Address Hold Time                      |       | $t_{AH8}$  | 0    | -    | ns    |
| System Cycle Time                      |       | $t_{CYC8}$ | 300  | -    | ns    |
| Control Low Pulse Width                | WRITE | $t_{CCLW}$ | 60   | -    | ns    |
|  | READ  | $t_{CCLR}$ | 120  | -    | ns    |
| Control High Pulse Width               | WRITE | $t_{CCHW}$ | 60   | -    | ns    |
|  | READ  | $t_{CCHR}$ | 60   | -    | ns    |
| Data Setup Time                        |       | $t_{DS8}$  | 40   | -    | ns    |
| Data Hold Time                         |       | $t_{DH8}$  | 15   | -    | ns    |
| $\overline{RD}$ Access Time (CL=100pF) |       | $t_{ACC8}$ | -    | 140  | ns    |
| Output Disable Time                    |       | $t_{OH8}$  | 10   | 100  | ns    |



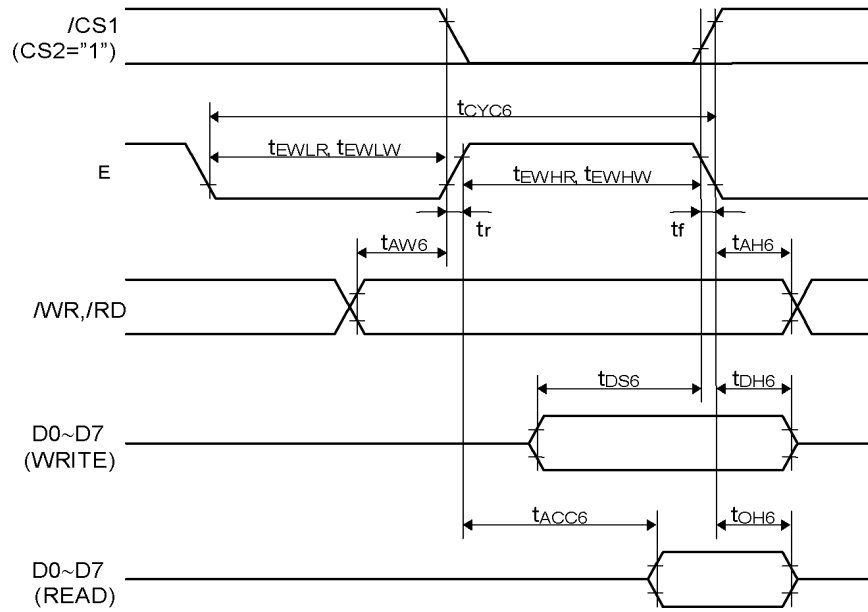
### 2.3.2. Read/Write Operation Sequence (68 series CPU)

$V_{DD}=5.0V\pm 10\%$

| Parameter               |       | Symbol     | Min. | Max. | Units |
|-------------------------|-------|------------|------|------|-------|
| Address Setup Time      |       | $t_{AH6}$  | 0    | -    | ns    |
| Address Hold Time       |       | $t_{AW6}$  | 0    | -    | ns    |
| System Cycle Time       |       | $t_{CYC6}$ | 166  | -    | ns    |
| Data Setup Time         |       | $t_{DS6}$  | 30   | -    | ns    |
| Data Hold Time          |       | $t_{DH6}$  | 10   | -    | ns    |
| Access Time (CL=100pF)  |       | $t_{ACC6}$ | -    | 70   | ns    |
| Output Disable Time     |       | $t_{OH6}$  | 10   | 50   | ns    |
| Enable High Pulse Width | READ  | $t_{EWHR}$ | 70   | -    | ns    |
|                         | WRITE | $t_{EWHW}$ | 30   | -    | ns    |
| Enable Low Pulse Width  | READ  | $t_{EWLR}$ | 30   | -    | ns    |
|                         | WRITE | $t_{EWLW}$ | 30   | -    | ns    |

$V_{DD}=2.7\sim 4.5V$

| Parameter               |       | Symbol     | Min. | Max. | Units |
|-------------------------|-------|------------|------|------|-------|
| Address Setup Time      |       | $t_{AH6}$  | 0    | -    | ns    |
| Address Hold Time       |       | $t_{AW6}$  | 0    | -    | ns    |
| System Cycle Time       |       | $t_{CYC6}$ | 300  | -    | ns    |
| Data Setup Time         |       | $t_{DS6}$  | 40   | -    | ns    |
| Data Hold Time          |       | $t_{DH6}$  | 15   | -    | ns    |
| Access Time (CL=100pF)  |       | $t_{ACC6}$ | -    | 140  | ns    |
| Output Disable Time     |       | $t_{OH6}$  | 10   | 100  | ns    |
| Enable High Pulse Width | READ  | $t_{EWHR}$ | 120  | -    | ns    |
|                         | WRITE | $t_{EWHW}$ | 60   | -    | ns    |
| Enable Low Pulse Width  | READ  | $t_{EWLR}$ | 60   | -    | ns    |
|                         | WRITE | $t_{EWLW}$ | 60   | -    | ns    |





### 2.3.3. Display Control Timing Characteristics

#### Reset Input Timing

V<sub>DD</sub>=5.0±10%

| Parameter             | Symbol          | Min. | Typ. | Max. | Units |
|-----------------------|-----------------|------|------|------|-------|
| Reset time            | t <sub>R</sub>  | -    | -    | 0.5  | μs    |
| Reset "L" Pulse Width | t <sub>RW</sub> | 0.5  | -    | -    |       |

#### Reset Input Timing

V<sub>DD</sub>=2.7~4.5V

| Parameter             | Symbol          | Min. | Typ. | Max. | Units |
|-----------------------|-----------------|------|------|------|-------|
| Reset time            | t <sub>R</sub>  | -    | -    | 1    | μs    |
| Reset "L" Pulse Width | t <sub>RW</sub> | 1    | -    | -    |       |

#### Output Timing

V<sub>DD</sub>=5.0±10%

| Parameter     | Symbol           | Min. | Typ. | Max. | Units |
|---------------|------------------|------|------|------|-------|
| FR Delay Time | t <sub>DFR</sub> | -    | 10   | 40   | ns    |

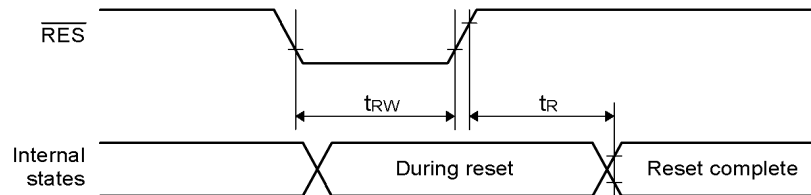
#### Output Timing

V<sub>DD</sub>=2.7~4.5V

| Parameter     | Symbol           | Min. | Typ. | Max. | Units |
|---------------|------------------|------|------|------|-------|
| FR Delay Time | t <sub>DFR</sub> | -    | 20   | 80   | ns    |

Note 1 :Valid only when the master mode is selected.

Note 2:All timing is based on 20% and 80% of V<sub>SS</sub>.

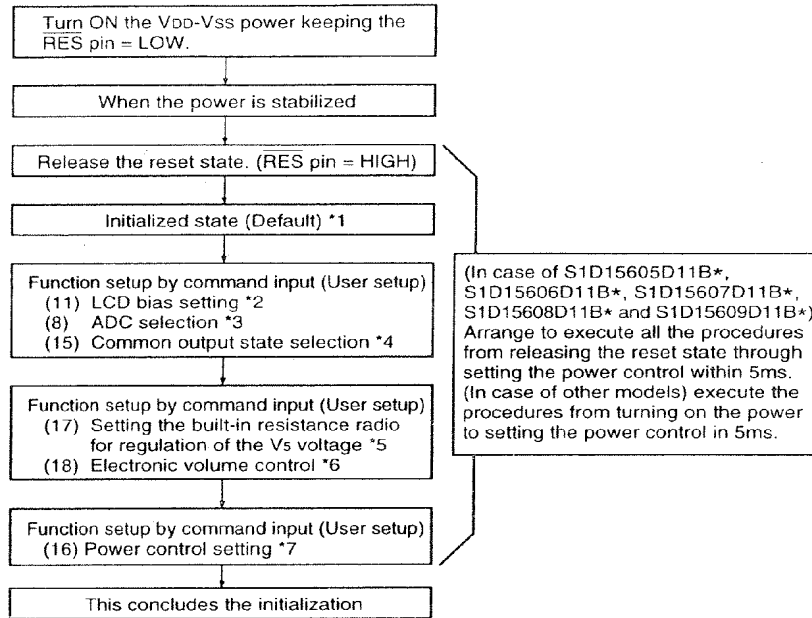


## Instruction Setup: Reference (reference)

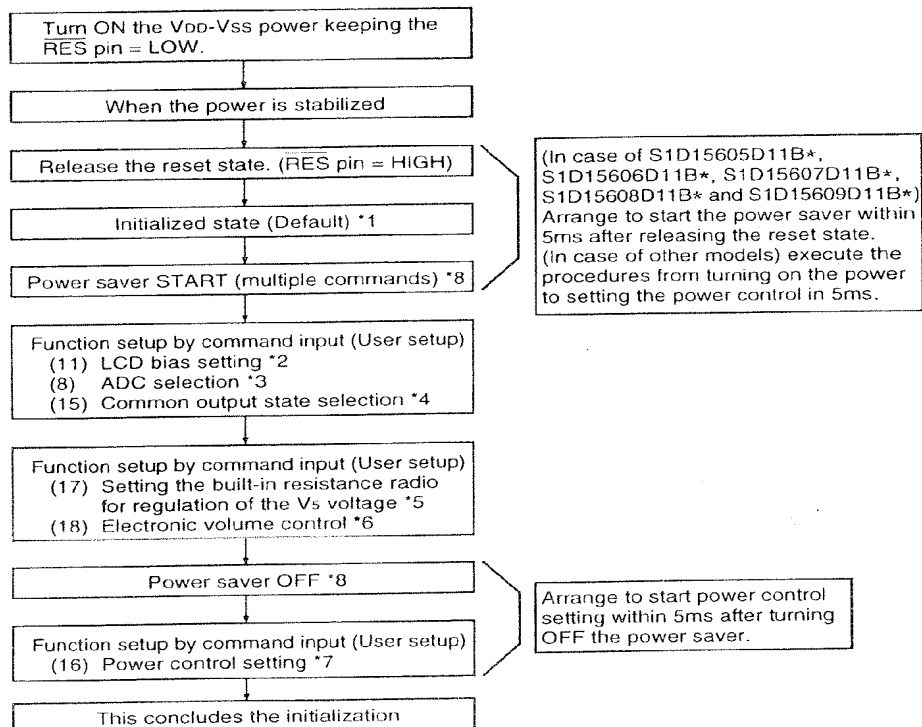
### (1) Initialization

Note: With this IC, when the power is applied, LCD driving non-selective potentials V<sub>2</sub> and V<sub>3</sub> (SEG pin) and V<sub>1</sub> and V<sub>4</sub> (COM pin) are output through the LCD driving output pins SEG and COM. When electric charge is remaining in the smoothing capacitor connecting between the LCD driving voltage output pins (V<sub>1</sub> ~ V<sub>5</sub>) and the V<sub>DD</sub> pin, the picture on the display may become totally dark instantaneously when the power is turned on. To avoid occurrence of such a failure, we recommend the following flow when turning on the power.

① When the built-in power is being used immediately after turning on the power:



② When the built-in power is not being used immediately after turning on the power:

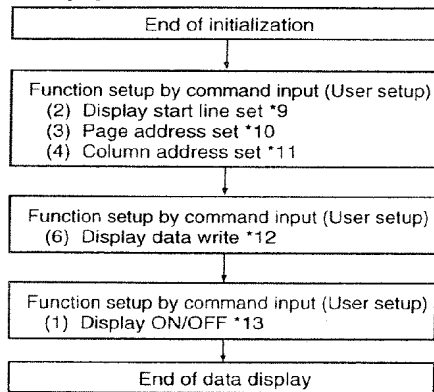


\* The target time of 5ms will result to vary depending on the panel characteristics and the capacitance of the smoothing capacitor. Therefore, we suggest you to conduct an operation check using the actual equipment.

Notes: Refer to respective sections or paragraphs listed below.

- \*1: 6. Description of functions; "Resetting circuit" (The contents of DDRAM can be variable even in the initial setting (Default) at the reset state.)
- \*2: 7. Command description; "(11) LCD bias setting"
- \*3: 7. Command description; "(8) ADC selection"
- \*4: 7. Command description; "(15) Common output state selection"
- \*5: 6. Description of functions; "Power circuit" & "(17) Command description; Setting the built-in resistance ratio for regulation of the V<sub>5</sub> voltage"
- \*6: 6. Description of functions; "Power circuit" & "(18) Command description; Electronic volume control"
- \*7: 6. Description of functions; "Power circuit" & "(16) Command description; Power control setting"
- \*8: 7. The power saver ON state can either be in sleep state or stand-by state.  
Command description; "Power saver START (multiple commands)"

(2) Data Display

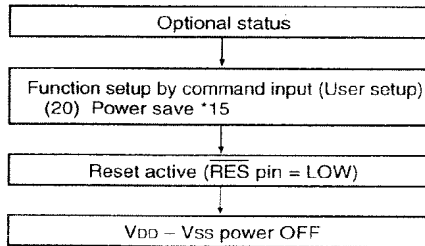


Notes: Reference items

- \*9: Command Description; Display start line set
- \*10: Command Description; Page address set
- \*11: Command Description; Column address set
- \*12: Command Description; Display data write
- \*13: Command Description; Display ON/OFF  
Avoid displaying all the data at the data display start (when the display is ON) in white.

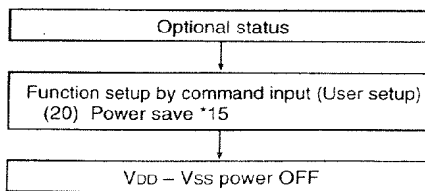
(3) Power OFF \*14

- In case of S1D15605D11B\*, S1D15606D11B\*, S1D15607D11B\*, S1D15608D11B\* and S1D15609D11B\*,



Set the time (t<sub>L</sub>) from reset active to turning off the V<sub>DD</sub> - V<sub>SS</sub> power (V<sub>DD</sub> - V<sub>SS</sub> = 1.8 V) longer than the time (t<sub>H</sub>) when the potential of V<sub>5</sub> - V<sub>1</sub> becomes below the threshold voltage (approximately 1 V) of the LCD panel. For t<sub>H</sub>, refer to the <Reference Data> of this event. When t<sub>H</sub> is too long, insert a resistor between V<sub>5</sub> and V<sub>DD</sub> to reduce it.

- In case of other models,



Set the time (t<sub>L</sub>) from power save to turning off the V<sub>DD</sub> - V<sub>SS</sub> power (V<sub>DD</sub> - V<sub>SS</sub> = 1.8 V) longer than the time (t<sub>H</sub>) when the potential of V<sub>5</sub> - V<sub>1</sub> becomes below the threshold voltage (approximately 1V) of the LCD panel.

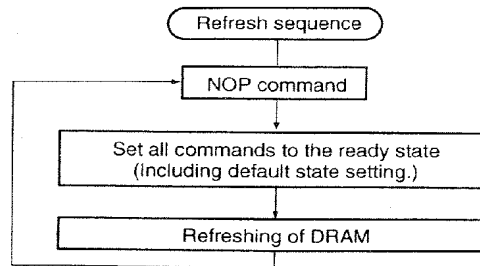
- t<sub>H</sub> is determined depending on the voltage regulator external resistors R<sub>a</sub> and R<sub>b</sub> and the time constant of V<sub>5</sub> - V<sub>1</sub> smoothing capacity C<sub>2</sub>.
- When an internal resistor is used, it is recommended to insert a resistor R between V<sub>DD</sub> and V<sub>5</sub> to reduce t<sub>H</sub>.

Notes: Reference items

- \*14: The logic circuit of this IC's power supply V<sub>DD</sub> - V<sub>SS</sub> controls the driver of the LCD power supply V<sub>DD</sub> - V<sub>5</sub>. So, if the power supply V<sub>DD</sub> - V<sub>SS</sub> is cut off when the LCD power supply V<sub>DD</sub> - V<sub>5</sub> has still any residual voltage, the driver (COM, SEG) may output any uncontrolled voltage. When turning off the power, observe the following basic procedures:
  - After turning off the internal power supply, make sure that the potential V<sub>5</sub> ~ V<sub>1</sub> has become below the threshold voltage of the LCD panel, and then turn off this IC's power supply (V<sub>DD</sub> - V<sub>SS</sub>).
- 6. Description of Function, 6.7 Power Circuit
- \*15: After inputting the power save command, be sure to reset the function using the  $\overline{\text{RES}}$  terminal until the power supply V<sub>DD</sub> - V<sub>SS</sub> is turned off. 7. Command Description (20) Power\_Save
- \*16: After inputting the power save command, do not reset the function using the RES terminal until the power supply V<sub>DD</sub> - V<sub>SS</sub> is turned off. 7. Command Description (20) Power\_Save

(4) Refresh

It is recommended that the operating modes and display contents be refreshed periodically to prevent the effect of unexpected noise.



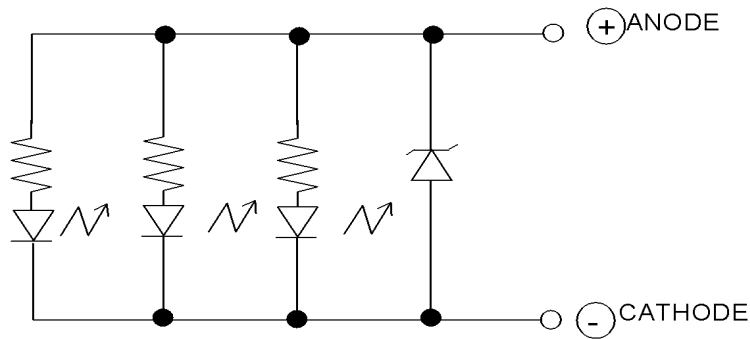
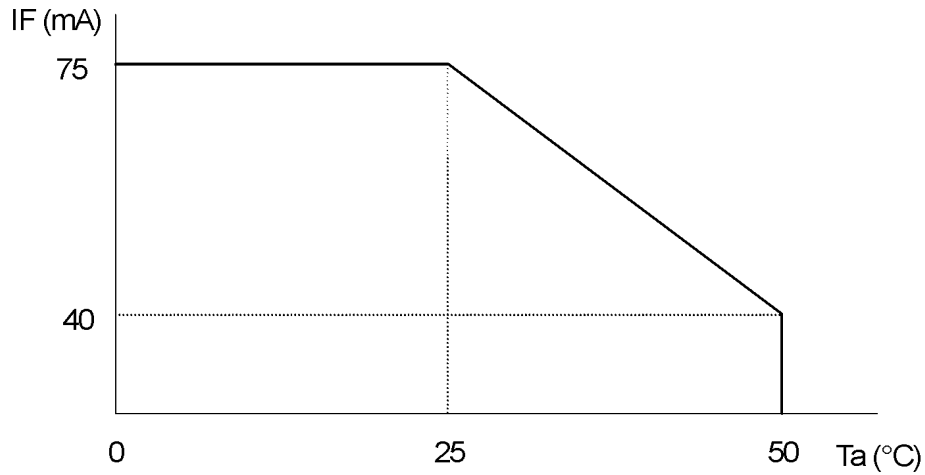
## 2.4. Lighting Specifications

### 2.4.1. Absolute Maximum Ratings

Ta=25°C (1Unit)

| Parameter             | Symbol         | Conditions | Min. | Typ. | Max.  | Units |
|-----------------------|----------------|------------|------|------|-------|-------|
| Foward Current        | I <sub>F</sub> | Note 1     | -    | -    | 75    | mA    |
| Reverse Voltage       | V <sub>R</sub> | -          | -    | -    | 8     | V     |
| LED Power Dissipation | P <sub>D</sub> | -          | -    | -    | 0.375 | W     |

Note 1 : Refer to the foward current derating curve.



### 2.4.2. Operating Characteristics

Ta=25°C

| Parameter                      | Symbol         | Conditions           | Min. | Typ. | Max. | Units             |
|--------------------------------|----------------|----------------------|------|------|------|-------------------|
| Foward Voltage                 | V <sub>F</sub> | I <sub>F</sub> =40mA | -    | 5.0  | -    | V                 |
| Luminance of Backlight Surface | L              | I <sub>F</sub> =40mA | 70   | 90   | -    | cd/m <sup>2</sup> |

### 3. Optical Specifications

#### 3.1. LCD Driving Voltage

| Parameter                                    | Symbol       | Conditions | Min. | Typ. | Max. | Units |
|--|--------------|------------|------|------|------|-------|
| Recommended<br>LCD Driving Voltage<br>Note 1 | $V_{DD}-V_5$ | Ta= 0°C    | -    | -    | 9.6  | V     |
|  |              | Ta=25°C    | 8.3  | 8.9  | 9.5  | V     |
|  |              | Ta=50°C    | 8.0  | -    | -    | V     |

Note 1 : Voltage (Applied actual waveform to LCD Module) for the best contrast. The range of minimum and maximum shows tolerance of the operating voltage. The specified contrast ratio and response time are not guaranteed over the entire range.

#### 3.2. Optical Characteristics

Ta=25°C, 1/65 Duty, 1/7 Bias,  $V_{OD}=8.9V$  (Note 4),  $\theta= 0^\circ$ ,  $\phi=-^\circ$

| Parameter             | Symbol       | Conditions                         | Min. | Typ. | Max. | Units |
|-----------------------|--------------|------------------------------------|------|------|------|-------|
| Contrast Ratio Note 1 | CR           | $\theta= 0^\circ$ , $\phi=-^\circ$ | -    | 6    | -    |       |
| Viewing Angle         |              | Shown in 3.3                       |      |      |      |       |
| Response Time         | Rise Note 2  | $T_{ON}$                           | -    | 100  | 200  | ms    |
|                       | Decay Note 3 | $T_{OFF}$                          | -    | 230  | 350  | ms    |

Note 1 : Contrast ratio is defined as follows. ( $CR = L_{ON} / L_{OFF}$ )

$L_{ON}$  : Luminance of the ON segments

$L_{OFF}$ : Luminance of the OFF segments

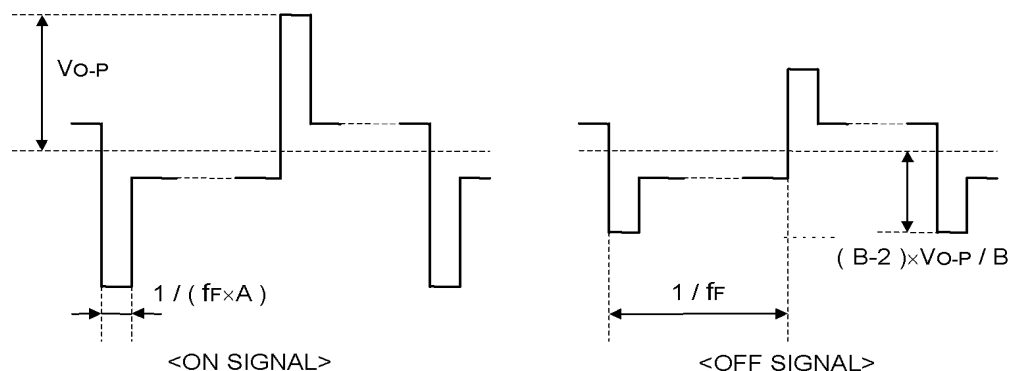
Measuring Spot:3mm $\phi$

Note 2 : The time that the luminance level reaches 90% of the saturation level from 0% when ON signal is applied.

Note 3 : The time that the luminance level reaches 10% of the saturation level from 100% when OFF signal is applied.

Note 4 : Definition of Driving Voltage  $V_{OD}$

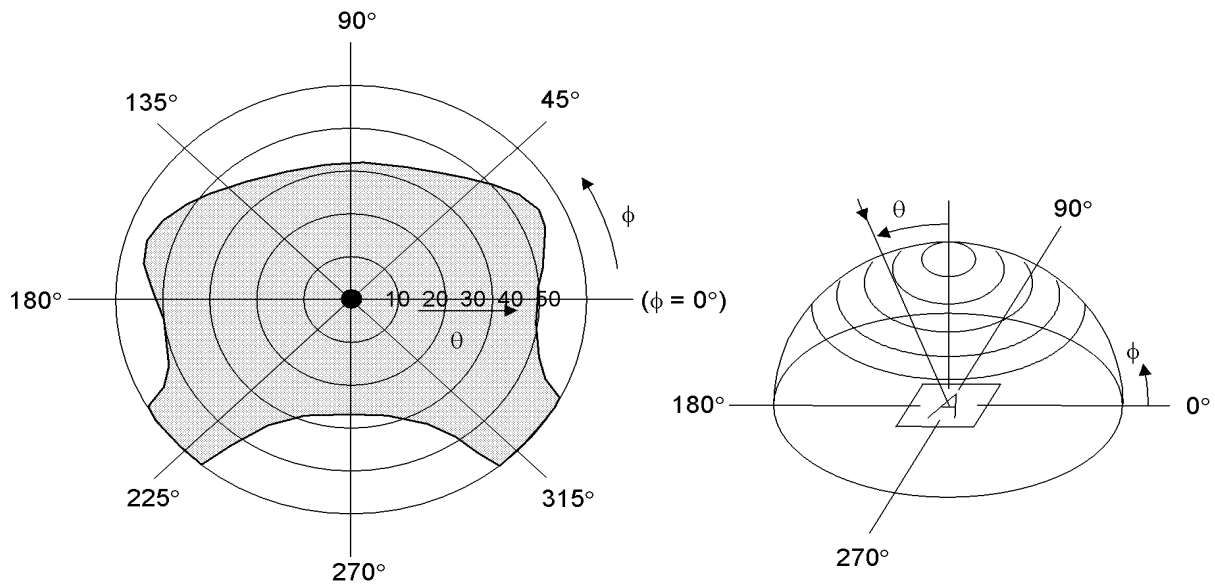
Assuming that the typical driving waveforms shown below are applied to the LCD Panel at 1/A Duty - 1/B Bias (A: Duty Number, B: Bias Number). Driving voltage  $V_{OD}$  is defined as the voltage  $V_{O-P}$  when the contrast ratio ( $CR=L_{ON} / L_{OFF}$ ) is at its maximum.



### 3.3. Definition of Viewing Angle and Optimum Viewing Area

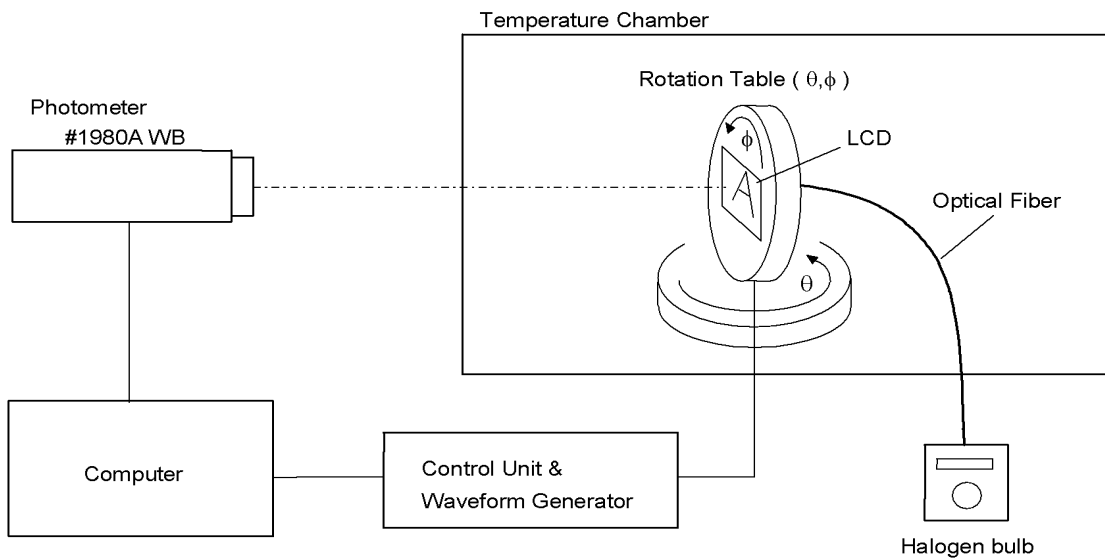
\*Point ● shows the point where contrast ratio is measured. :  $\theta = 0^\circ$ ,  $\phi = 0^\circ$

\*Driving condition : 1/65 Duty, 1/7 Bias,  $V_{OD}=8.9V$ ,  $f_F=85Hz$



\*Area  shows typ.  $CR \geq 2$  (Measuring Spot: 3mm $\phi$ )

### 3.4. System Block Diagram



## 4. I/O Terminal

### 4.1. Pin Assignment

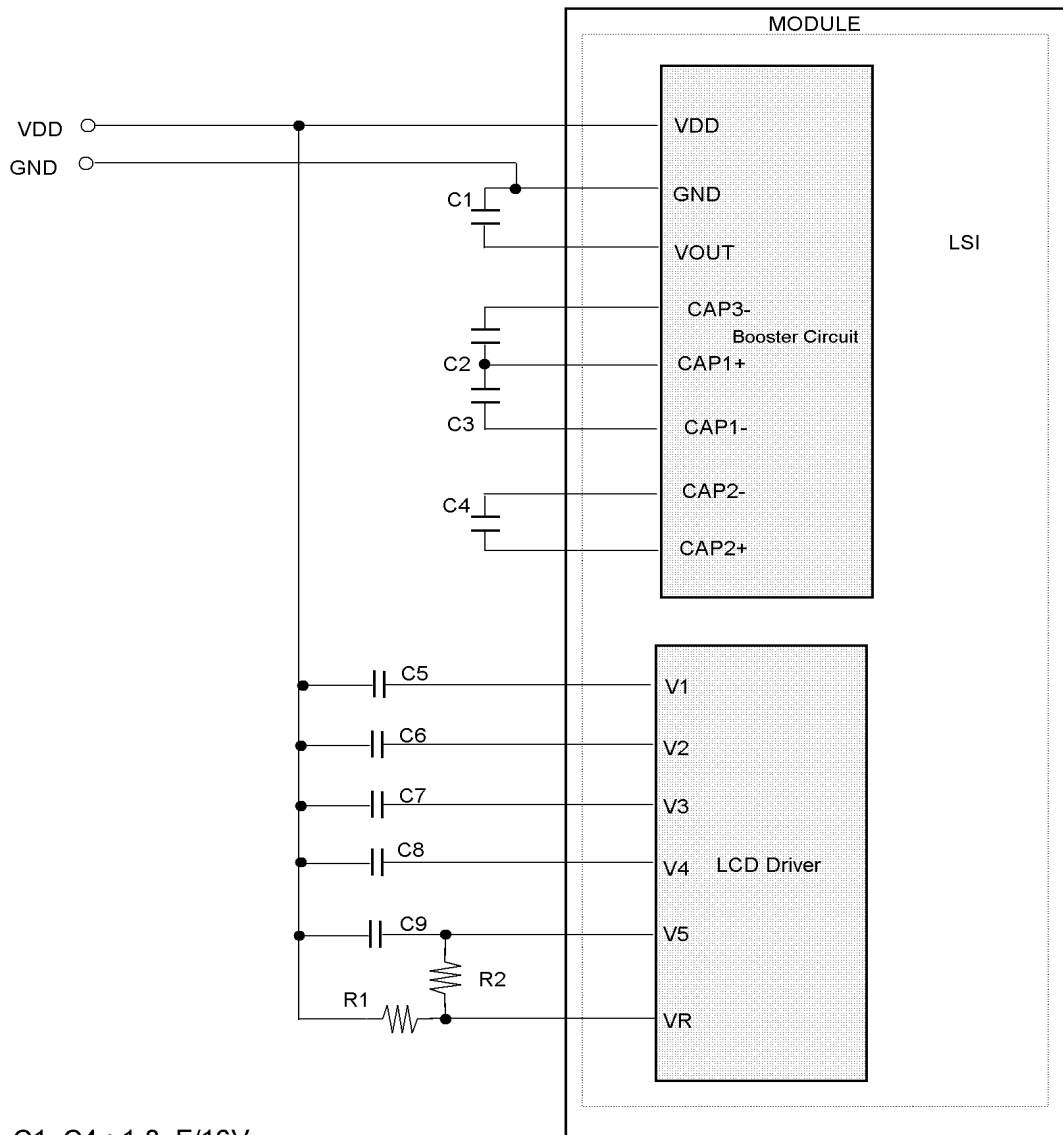
#### CN1

| No. | Symbol           | Function  |
|-----|------------------|---|
| 1   | NC               | Non-connection  |
| 2   | /CS1             | Chip Select Signal L : Active                                   |
| 3   | /RES             | Reset Signal L : Reset  |
| 4   | A0               | H : D0~D7 are Display Data L : D0~D7 are Instructions           |
| 5   | /WR              | Write Signal L : Active   |
| 6   | /RD              | Read Signal L : Active  |
| 7   | D0               | Data Bus Line   |
| 8   | D1               | Data Bus Line   |
| 9   | D2               | Data Bus Line   |
| 10  | D3               | Data Bus Line   |
| 11  | D4               | Data Bus Line   |
| 12  | D5               | Data Bus Line   |
| 13  | D6               | Data Bus Line   |
| 14  | D7               | Data Bus Line   |
| 15  | V <sub>DD</sub>  | Power Supply for Logic  |
| 16  | GND              | Power Supply ( 0V, GND )  |
| 17  | V <sub>OUT</sub> | DC/DC Voltage Converter Output                                  |
| 18  | CAP3-            | DC/DC Voltage Converter Capacitor 3 Negative Connection         |
| 19  | CAP1+            | DC/DC Voltage Converter Capacitor 1 Positive Connection         |
| 20  | CAP1-            | DC/DC Voltage Converter Capacitor 1 Negative Connection         |
| 21  | CAP2-            | DC/DC Voltage Converter Capacitor 2 Negative Connection         |
| 22  | CAP2+            | DC/DC Voltage Converter Capacitor 2 Positive Connection         |
| 23  | V <sub>1</sub>   | Power Supply for LCD Drive V <sub>1</sub> = 1/7, V <sub>5</sub> |
| 24  | V <sub>2</sub>   | Power Supply for LCD Drive V <sub>2</sub> = 2/7, V <sub>5</sub> |
| 25  | V <sub>3</sub>   | Power Supply for LCD Drive V <sub>3</sub> = 5/7, V <sub>5</sub> |
| 26  | V <sub>4</sub>   | Power Supply for LCD Drive V <sub>4</sub> = 6/7, V <sub>5</sub> |
| 27  | V <sub>5</sub>   | Power Supply for LCD Drive V <sub>5</sub> , V <sub>OUT</sub>    |
| 28  | VR               | Voltage Adjustment Pin  |
| 29  | C86              | Interface Mode Select Signal H : 68 series L : 80 series        |



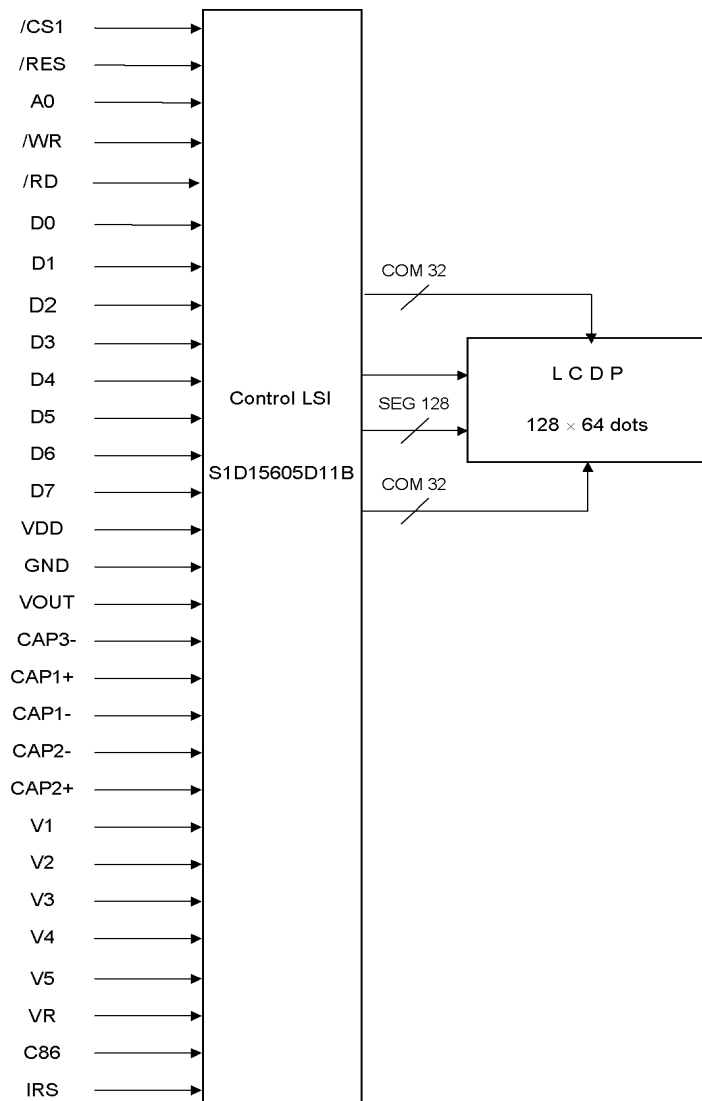
|    |     |   |
|----|-----|---|
| 30 | IRS | <p>This terminal selects the resistors for the V5 voltage level adjustment.</p> <p>IRS="H" :Use the internal resistors</p> <p>IRS="L" :Do not use the internal resistors. The V5 voltage level is regulated by an external resistive voltage divider attached</p> |
|----|-----|---|

4.2. Example of Power Supply



C1~C4 : 1.0 $\mu$ F/16V  
 C5~C8 : 0.68 $\mu$ F/16V  
 R1 : 270K $\Omega$  $\pm$ 0.2%  
 R2 : 1.1M $\Omega$  $\pm$ 0.2%

### 4.3. Block Diagram



## 5. Test

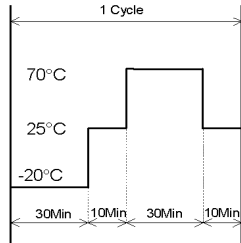
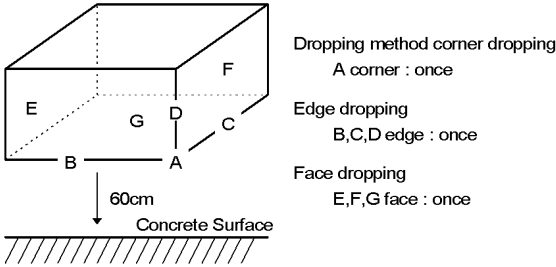
No abnormal function and appearance are found after the following tests.

Conditions: Unless otherwise specified, tests will be conducted under the following condition.

Temperature :  $20\pm 5^\circ$

Humidity :  $65\pm 5\%RH$

Tests will be not conducted under functioning state.

| No. | Parameter                  | Conditions   | Notes |
|-----|----------------------------|--|-------|
| 1   | High Temperature Operating | $50^\circ C \pm 2^\circ C$ , 96hrs (operation state)   | 1     |
| 2   | Low Temperature Operating  | $0^\circ C \pm 2^\circ C$ , 96hrs (operation state)  | 2     |
| 3   | High Temperature Storage   | $70^\circ C \pm 2^\circ C$ , 96hrs   | 3     |
| 4   | Low Temperature Storage    | $-20^\circ C \pm 2^\circ C$ , 96hrs  | 2,3   |
| 5   | Damp Proof Test            | $40^\circ C \pm 2^\circ C$ , 90~95%RH, 96hrs   | 2,3   |
| 6   | Temperature Cycle Test     | 5 Cycle  <p>The function test shall be conducted after 1 hours storage at the normal temperature and</p> | 2     |
| 7   | Shock Test                 | To be measured after dropping from 60cm high the concrete surface in packing state.                    |       |

Note 1 :It should be checked at the actual driving condition under the high temperature.

Note 2 :No dew condensation to be observed.

Note 3 :The function test shall be conducted after 4 hours storage at the normal temperature and humidity after removed from the test chamber.

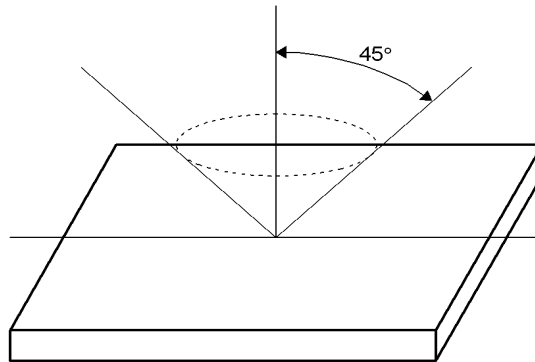
## 6. Appearance Standards

### 6.1. Inspection conditions

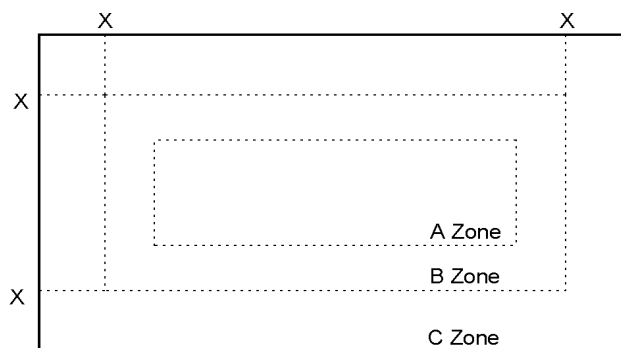
The LCD shall be inspected under 40W white fluorescent light.

The distance between the eyes and the sample shall be more than 30cm.

All directions for inspecting the sample should be within 45° against perpendicular line.



### 6.2. Definition of applicable Zones



X : Maximum Seal Line

A Zone : Active display area

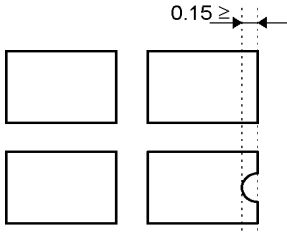
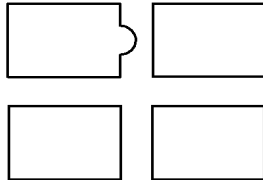
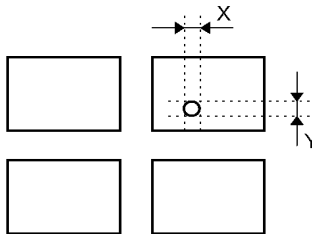
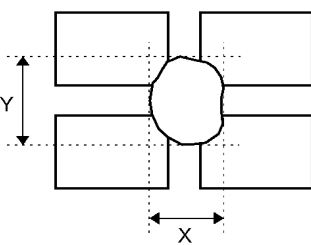
B Zone : Out of active display area ~ Maximum seal line

C Zone : Rest parts

A Zone + B Zone = Validity viewing area

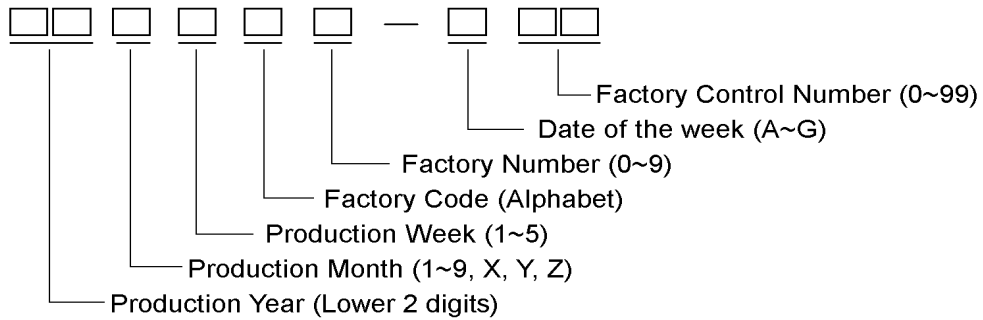
6.3.Standards

| No.                    | Parameter                                 | Criteria  |                        |                   |  |  |  |   |   |   |              |   |   |   |                    |   |   |   |                     |   |   |   |                     |   |   |   |           |   |   |   |      |  |                   |  |  |        |        |   |   |   |   |               |   |   |   |              |               |   |   |   |              |              |   |   |   |   |           |                     |  |  |
|------------------------|---|---|------------------------|-------------------|--|--|--|---|---|---|--------------|---|---|---|--------------------|---|---|---|---------------------|---|---|---|---------------------|---|---|---|-----------|---|---|---|------|--|-------------------|--|--|--------|--------|---|---|---|---|---------------|---|---|---|--------------|---------------|---|---|---|--------------|--------------|---|---|---|---|-----------|---------------------|--|--|
| 1                      | Black and White Spots, Foreign Substances | <p>(1) Round Shape</p> <table border="1" data-bbox="613 300 1390 615"> <thead> <tr> <th data-bbox="613 300 927 390">Zone<br/>Dimension (mm)</th> <th colspan="3" data-bbox="927 300 1390 342">Acceptable Number</th> </tr> <tr> <th data-bbox="613 342 927 390"></th> <th data-bbox="927 342 1078 390">A</th> <th data-bbox="1078 342 1235 390">B</th> <th data-bbox="1235 342 1390 390">C</th> </tr> </thead> <tbody> <tr> <td data-bbox="613 390 927 432"><math>D \leq 0.1</math></td> <td data-bbox="927 390 1078 432">*</td> <td data-bbox="1078 390 1235 432">*</td> <td data-bbox="1235 390 1390 432">*</td> </tr> <tr> <td data-bbox="613 432 927 474"><math>0.1 &lt; D \leq 0.2</math></td> <td data-bbox="927 432 1078 474">3</td> <td data-bbox="1078 432 1235 474">5</td> <td data-bbox="1235 432 1390 474">*</td> </tr> <tr> <td data-bbox="613 474 927 516"><math>0.2 &lt; D \leq 0.25</math></td> <td data-bbox="927 474 1078 516">2</td> <td data-bbox="1078 474 1235 516">3</td> <td data-bbox="1235 474 1390 516">*</td> </tr> <tr> <td data-bbox="613 516 927 558"><math>0.25 &lt; D \leq 0.3</math></td> <td data-bbox="927 516 1078 558">0</td> <td data-bbox="1078 516 1235 558">1</td> <td data-bbox="1235 516 1390 558">*</td> </tr> <tr> <td data-bbox="613 558 927 615"><math>0.3 &lt; D</math></td> <td data-bbox="927 558 1078 615">0</td> <td data-bbox="1078 558 1235 615">0</td> <td data-bbox="1235 558 1390 615">*</td> </tr> </tbody> </table> <p data-bbox="634 625 1102 657"><math>D = ( \text{Long} + \text{Short} ) / 2</math> * : Disregard</p> <p>(2) Line Shape</p> <table border="1" data-bbox="613 703 1390 972"> <thead> <tr> <th colspan="2" data-bbox="613 703 927 745">Zone</th> <th colspan="3" data-bbox="927 703 1390 745">Acceptable Number</th> </tr> <tr> <th data-bbox="613 745 771 787">X (mm)</th> <th data-bbox="771 745 927 787">Y (mm)</th> <th data-bbox="927 745 1078 787">A</th> <th data-bbox="1078 745 1235 787">B</th> <th data-bbox="1235 745 1390 787">C</th> </tr> </thead> <tbody> <tr> <td data-bbox="613 787 771 829">-</td> <td data-bbox="771 787 927 829"><math>0.03 \geq W</math></td> <td data-bbox="927 787 1078 829">*</td> <td data-bbox="1078 787 1235 829">*</td> <td data-bbox="1235 787 1390 829">*</td> </tr> <tr> <td data-bbox="613 829 771 871"><math>2.0 \geq L</math></td> <td data-bbox="771 829 927 871"><math>0.05 \geq W</math></td> <td data-bbox="927 829 1078 871">3</td> <td data-bbox="1078 829 1235 871">3</td> <td data-bbox="1235 829 1390 871">*</td> </tr> <tr> <td data-bbox="613 871 771 913"><math>1.0 \geq L</math></td> <td data-bbox="771 871 927 913"><math>0.1 \geq W</math></td> <td data-bbox="927 871 1078 913">3</td> <td data-bbox="1078 871 1235 913">3</td> <td data-bbox="1235 871 1390 913">*</td> </tr> <tr> <td data-bbox="613 913 771 972">-</td> <td data-bbox="771 913 927 972"><math>0.1 &lt; W</math></td> <td colspan="3" data-bbox="927 913 1390 972">In the same way (1)</td> </tr> </tbody> </table> <p data-bbox="634 982 1073 1014">X : Length Y : Width * : Disregard</p> <p data-bbox="597 1024 987 1056">Total defects shall not exceed 5.</p> | Zone<br>Dimension (mm) | Acceptable Number |  |  |  | A | B | C | $D \leq 0.1$ | * | * | * | $0.1 < D \leq 0.2$ | 3 | 5 | * | $0.2 < D \leq 0.25$ | 2 | 3 | * | $0.25 < D \leq 0.3$ | 0 | 1 | * | $0.3 < D$ | 0 | 0 | * | Zone |  | Acceptable Number |  |  | X (mm) | Y (mm) | A | B | C | - | $0.03 \geq W$ | * | * | * | $2.0 \geq L$ | $0.05 \geq W$ | 3 | 3 | * | $1.0 \geq L$ | $0.1 \geq W$ | 3 | 3 | * | - | $0.1 < W$ | In the same way (1) |  |  |
| Zone<br>Dimension (mm) | Acceptable Number                         |   |                        |                   |  |  |  |   |   |   |              |   |   |   |                    |   |   |   |                     |   |   |   |                     |   |   |   |           |   |   |   |      |  |                   |  |  |        |        |   |   |   |   |               |   |   |   |              |               |   |   |   |              |              |   |   |   |   |           |                     |  |  |
|                        | A   | B   | C                      |                   |  |  |  |   |   |   |              |   |   |   |                    |   |   |   |                     |   |   |   |                     |   |   |   |           |   |   |   |      |  |                   |  |  |        |        |   |   |   |   |               |   |   |   |              |               |   |   |   |              |              |   |   |   |   |           |                     |  |  |
| $D \leq 0.1$           | *   | *   | *                      |                   |  |  |  |   |   |   |              |   |   |   |                    |   |   |   |                     |   |   |   |                     |   |   |   |           |   |   |   |      |  |                   |  |  |        |        |   |   |   |   |               |   |   |   |              |               |   |   |   |              |              |   |   |   |   |           |                     |  |  |
| $0.1 < D \leq 0.2$     | 3   | 5   | *                      |                   |  |  |  |   |   |   |              |   |   |   |                    |   |   |   |                     |   |   |   |                     |   |   |   |           |   |   |   |      |  |                   |  |  |        |        |   |   |   |   |               |   |   |   |              |               |   |   |   |              |              |   |   |   |   |           |                     |  |  |
| $0.2 < D \leq 0.25$    | 2   | 3   | *                      |                   |  |  |  |   |   |   |              |   |   |   |                    |   |   |   |                     |   |   |   |                     |   |   |   |           |   |   |   |      |  |                   |  |  |        |        |   |   |   |   |               |   |   |   |              |               |   |   |   |              |              |   |   |   |   |           |                     |  |  |
| $0.25 < D \leq 0.3$    | 0   | 1   | *                      |                   |  |  |  |   |   |   |              |   |   |   |                    |   |   |   |                     |   |   |   |                     |   |   |   |           |   |   |   |      |  |                   |  |  |        |        |   |   |   |   |               |   |   |   |              |               |   |   |   |              |              |   |   |   |   |           |                     |  |  |
| $0.3 < D$              | 0   | 0   | *                      |                   |  |  |  |   |   |   |              |   |   |   |                    |   |   |   |                     |   |   |   |                     |   |   |   |           |   |   |   |      |  |                   |  |  |        |        |   |   |   |   |               |   |   |   |              |               |   |   |   |              |              |   |   |   |   |           |                     |  |  |
| Zone                   |   | Acceptable Number   |                        |                   |  |  |  |   |   |   |              |   |   |   |                    |   |   |   |                     |   |   |   |                     |   |   |   |           |   |   |   |      |  |                   |  |  |        |        |   |   |   |   |               |   |   |   |              |               |   |   |   |              |              |   |   |   |   |           |                     |  |  |
| X (mm)                 | Y (mm)                                    | A   | B                      | C                 |  |  |  |   |   |   |              |   |   |   |                    |   |   |   |                     |   |   |   |                     |   |   |   |           |   |   |   |      |  |                   |  |  |        |        |   |   |   |   |               |   |   |   |              |               |   |   |   |              |              |   |   |   |   |           |                     |  |  |
| -                      | $0.03 \geq W$                             | *   | *                      | *                 |  |  |  |   |   |   |              |   |   |   |                    |   |   |   |                     |   |   |   |                     |   |   |   |           |   |   |   |      |  |                   |  |  |        |        |   |   |   |   |               |   |   |   |              |               |   |   |   |              |              |   |   |   |   |           |                     |  |  |
| $2.0 \geq L$           | $0.05 \geq W$                             | 3   | 3                      | *                 |  |  |  |   |   |   |              |   |   |   |                    |   |   |   |                     |   |   |   |                     |   |   |   |           |   |   |   |      |  |                   |  |  |        |        |   |   |   |   |               |   |   |   |              |               |   |   |   |              |              |   |   |   |   |           |                     |  |  |
| $1.0 \geq L$           | $0.1 \geq W$                              | 3   | 3                      | *                 |  |  |  |   |   |   |              |   |   |   |                    |   |   |   |                     |   |   |   |                     |   |   |   |           |   |   |   |      |  |                   |  |  |        |        |   |   |   |   |               |   |   |   |              |               |   |   |   |              |              |   |   |   |   |           |                     |  |  |
| -                      | $0.1 < W$                                 | In the same way (1)   |                        |                   |  |  |  |   |   |   |              |   |   |   |                    |   |   |   |                     |   |   |   |                     |   |   |   |           |   |   |   |      |  |                   |  |  |        |        |   |   |   |   |               |   |   |   |              |               |   |   |   |              |              |   |   |   |   |           |                     |  |  |
| 2                      | Air Bubbles (between glass & polarizer)   | <table border="1" data-bbox="613 1108 1390 1377"> <thead> <tr> <th data-bbox="613 1108 927 1192">Zone<br/>Dimension (mm)</th> <th colspan="3" data-bbox="927 1108 1390 1150">Acceptable Number</th> </tr> <tr> <th data-bbox="613 1192 927 1234"></th> <th data-bbox="927 1192 1078 1234">A</th> <th data-bbox="1078 1192 1235 1234">B</th> <th data-bbox="1235 1192 1390 1234">C</th> </tr> </thead> <tbody> <tr> <td data-bbox="613 1234 927 1276"><math>D \leq 0.3</math></td> <td data-bbox="927 1234 1078 1276">*</td> <td data-bbox="1078 1234 1235 1276">*</td> <td data-bbox="1235 1234 1390 1276">*</td> </tr> <tr> <td data-bbox="613 1276 927 1318"><math>0.3 &lt; D \leq 0.4</math></td> <td data-bbox="927 1276 1078 1318">3</td> <td data-bbox="1078 1276 1235 1318">*</td> <td data-bbox="1235 1276 1390 1318">*</td> </tr> <tr> <td data-bbox="613 1318 927 1360"><math>0.4 &lt; D \leq 0.6</math></td> <td data-bbox="927 1318 1078 1360">2</td> <td data-bbox="1078 1318 1235 1360">3</td> <td data-bbox="1235 1318 1390 1360">*</td> </tr> <tr> <td data-bbox="613 1360 927 1377"><math>0.6 &lt; D</math></td> <td data-bbox="927 1360 1078 1377">0</td> <td data-bbox="1078 1360 1235 1377">0</td> <td data-bbox="1235 1360 1390 1377">*</td> </tr> </tbody> </table> <p data-bbox="634 1388 792 1419">* : Disregard</p> <p data-bbox="597 1430 987 1461">Total defects shall not exceed 3.</p>   | Zone<br>Dimension (mm) | Acceptable Number |  |  |  | A | B | C | $D \leq 0.3$ | * | * | * | $0.3 < D \leq 0.4$ | 3 | * | * | $0.4 < D \leq 0.6$  | 2 | 3 | * | $0.6 < D$           | 0 | 0 | * |           |   |   |   |      |  |                   |  |  |        |        |   |   |   |   |               |   |   |   |              |               |   |   |   |              |              |   |   |   |   |           |                     |  |  |
| Zone<br>Dimension (mm) | Acceptable Number                         |   |                        |                   |  |  |  |   |   |   |              |   |   |   |                    |   |   |   |                     |   |   |   |                     |   |   |   |           |   |   |   |      |  |                   |  |  |        |        |   |   |   |   |               |   |   |   |              |               |   |   |   |              |              |   |   |   |   |           |                     |  |  |
|                        | A   | B   | C                      |                   |  |  |  |   |   |   |              |   |   |   |                    |   |   |   |                     |   |   |   |                     |   |   |   |           |   |   |   |      |  |                   |  |  |        |        |   |   |   |   |               |   |   |   |              |               |   |   |   |              |              |   |   |   |   |           |                     |  |  |
| $D \leq 0.3$           | *   | *   | *                      |                   |  |  |  |   |   |   |              |   |   |   |                    |   |   |   |                     |   |   |   |                     |   |   |   |           |   |   |   |      |  |                   |  |  |        |        |   |   |   |   |               |   |   |   |              |               |   |   |   |              |              |   |   |   |   |           |                     |  |  |
| $0.3 < D \leq 0.4$     | 3   | *   | *                      |                   |  |  |  |   |   |   |              |   |   |   |                    |   |   |   |                     |   |   |   |                     |   |   |   |           |   |   |   |      |  |                   |  |  |        |        |   |   |   |   |               |   |   |   |              |               |   |   |   |              |              |   |   |   |   |           |                     |  |  |
| $0.4 < D \leq 0.6$     | 2   | 3   | *                      |                   |  |  |  |   |   |   |              |   |   |   |                    |   |   |   |                     |   |   |   |                     |   |   |   |           |   |   |   |      |  |                   |  |  |        |        |   |   |   |   |               |   |   |   |              |               |   |   |   |              |              |   |   |   |   |           |                     |  |  |
| $0.6 < D$              | 0   | 0   | *                      |                   |  |  |  |   |   |   |              |   |   |   |                    |   |   |   |                     |   |   |   |                     |   |   |   |           |   |   |   |      |  |                   |  |  |        |        |   |   |   |   |               |   |   |   |              |               |   |   |   |              |              |   |   |   |   |           |                     |  |  |

| No. | Parameter  | Criteria   |
|-----|--|--|
| 3   | The Shape of Dot                                     | <p>(1) Dot Shape (with Dent)</p>  <p>As per the sketch of left hand.</p> <p>(2) Dot Shape (with Projection)</p>  <p>Should not be connected to next dot.</p> <p>(3) Pin Hole</p>  <p><math>(X+Y) / 2 \leq 0.2\text{mm}</math><br/>(Less than 0.1mm is no counted.)</p> <p>(4) Deformation</p>  <p><math>(X+Y) / 2 \leq 0.2\text{mm}</math></p> <p>Total acceptable number : 1/dot, 5/cell<br/>(Defect number of (4) : 1pc.)</p> |
| 4   | Polarizer Scratches                                  | Not to be conspicuous defects.   |
| 5   | Polarizer Dirts                                      | If the stains are removed easily from LCDP surface, the module is defective.   |
| 6   | Complex Foreign Substance Defects                    | Black spots, line shaped foreign substances or air bubbles between glass & polarizer should be 5pcs maximum in total.  |
| 7   | Distance between Different Foreign Substance Defects | $D \leq 0.2$ : 20mm or more<br>$0.2 < D$ : 40mm or more  |

## 7. Code System of Production Lot

The production lot of module is specified as follows.



## 8. Type Number

The type number of module is specified as follows.

F-51320AE

## 9. Applying Precautions

Please contact us when questions and/or new problems not specified in this Specifications arise.

## 10. Precautions Relating Product Handling

The Following precautions will guide you in handling our product correctly.

1) Liquid crystal display devices

1. The liquid crystal display panel used in the liquid crystal display module is made of plate glass. Avoid any strong mechanical shock. Should the glass break handle it with care. The polarizer adhering to the surface of the LCD is made of a soft material. Guard against scratching it.



2) **Care of the liquid crystal display module against static electricity discharge.**

1. **When working with the module, be sure to ground your body and any electrical equipment you may be using. We strongly recommend the use of anti static mats (made of rubber), to protect worktables against the hazards of electrical shock.**
2. **Avoid the use of work clothing made of synthetic fibers. We recommend cotton clothing or other conductivity-treated fibers.**
3. **Slowly and carefully remove the protective film from the LCD module, since this operation can generate static electricity.**

3) When the LCD module must be stored for long periods of time:

1. Protect the modules from high temperature and humidity.

Conditions:            Temperature: 0°C~40°C  
                                 Humidity : Less than 60%RH  
                                 No dew condensation to be observed.

2. Keep the modules out of direct sunlight or direct exposure to ultraviolet rays.
3. Protect the modules from excessive external forces.

4) Use the module with a power supply that is equipped with an overcurrent protector circuit, since the module is not provided with this protective feature.

5) Do not ingest the LCD fluid itself should it leak out of a damaged LCD module. Should hands or clothing come in contact with LCD fluid, wash immediately with soap.

6) Conductivity is not guaranteed for models that use metal holders where solder connections between the metal holder and the PCB are not used. Please contact us to discuss appropriate ways to assure conductivity.

7) For models which use CFL:

1. High voltage of 1000V or greater is applied to the CFL cable connector area. Care should be taken not to touch connection areas to avoid burns.
2. Protect CFL cables from rubbing against the unit and thus causing the wire jacket to become worn.
3. The use of CFLs for extended periods of time at low temperatures will significantly shorten their service life.
4. After storing the product (or LCD) under low temperature and/or in dark atmosphere for a long period of time, CCFL may take longer time to reach its specified brightness.

8) For models which use touch panels:

1. Do not stack up modules since they can be damaged by components on neighboring modules.
2. Do not place heavy objects on top of the product. This could cause glass breakage.



9) For models which use COG, TAB, or COF:

1. The mechanical strength of the product is low since the IC chip faces out unprotected from the rear. Be sure to protect the rear of the IC chip from external forces.
2. Given the fact that the rear of the IC chip is left exposed, in order to protect the unit from electrical damage, avoid installation configurations in which the rear of the IC chip runs the risk of making any electrical contact.

10) Models which use flexible cable, heat seal, or TAB:

1. In order to maintain reliability, do not touch or hold by the connector area.
2. Avoid any bending, pulling, or other excessive force, which can result in broken connections.

11) In case of buffer material such as cushion / gasket is assembled into LCD module, it may have an adverse effect on connecting parts (LCD panel-TCP / HEAT SEAL / FPC / etc., PCB-TCP / HEAT SEAL / FPC etc., TCP-HEAT SEAL, TCP-FPC, HEAT SEAL-FPC, etc.) depending on its materials. Please check and evaluate these materials carefully before use.

12) In case of acrylic plate is attached to front side of LCD panel, cloudiness (very small cracks) can occur on acrylic plate, being influenced by some components generated from polarizer film. Please check and evaluate those acrylic materials carefully before use.

## 11. Warranty

This product has been manufactured to your company's specifications as a part for use in your company's general electronic products. It is guaranteed to perform according to delivery specifications. For any other use apart from general electronic equipment, we cannot take responsibility if the product is used in medical devices, nuclear power control equipment, aerospace equipment, fire and security systems, or any other applications in which there is a direct risk to human life and where extremely high levels of reliability are required. If the product is to be used in any of the above applications, we will need to enter into a separate product liability agreement.

1. We cannot accept responsibility for any defect, which may arise from additional manufacturing of the product (including disassembly and reassembly), after product delivery.
2. We cannot accept responsibility for any defect, which may arise after the application of strong external force to the product.
3. We cannot accept responsibility for any defect, which may arise due to the application of static electricity after the product has passed your company's acceptance inspection procedures.
4. When the product is in CFL models, CFL service life and brightness will vary according to the performance of the inverter used, leaks, etc. We cannot accept responsibility for product performance, reliability, or defect, which may arise.
5. We cannot accept responsibility for intellectual property of a third party, which may arise through the application of our product to your assembly with exception to those issues relating directly to the structure or method of manufacturing of our product.
6. We will not be held responsible for any quality issue(s) after two years and beyond from its production date indicated on the lot number (please refer to "Code System of Production Lot" indicated earlier in this specification).