

# SPECIFICATION FOR LCD MODULE

Model No. TM162ABCWG

|               |       |
|---------------|-------|
| Prepared by:  | Date: |
| Checked by :  | Date: |
| Verified by : | Date: |
| Approved by:  | Date: |

**TIANMA MICROELECTRONICS CO., LTD**

## REVISION RECORD

| Date      | Ver.   | Ref. Page | Revision No. | Revision Items |
|-----------|--------|-----------|--------------|----------------|
| 2003/7/25 | Ver1.0 |           |              |                |

## 1. General Specifications:

1.1 Display type: STN/Y-G Mode

1.2 Display color\*<sup>1</sup>:

Display color: Blue-Black

Background\*<sup>2</sup>: Yellow-Green

1.3 Polarizer mode: Transflective/Positive

1.4 Viewing Angle: 6:00

1.5 Driving Method: 1/16 Duty 1/5 Bias

1.6 LCD Operating Voltage: 2.4-5.5V

1.7 Logic Voltage: 4.5V

1.8 Backlight : LED(Yellow,4.1V)

1.9 Controller: S6A0032X01-B0CY

1.10 Data Transfer: 8 Bit Parallel

1.11 Operating Temperature: -20----+70

Storage Temperature: -30----+80

1.12 Outline Dimensions: Refer to outline drawing on next page

1.13 Dot Matrix: 16 Characters × 2 Line

1.14 Dot Size: 0.55 × 0.65 (mm)

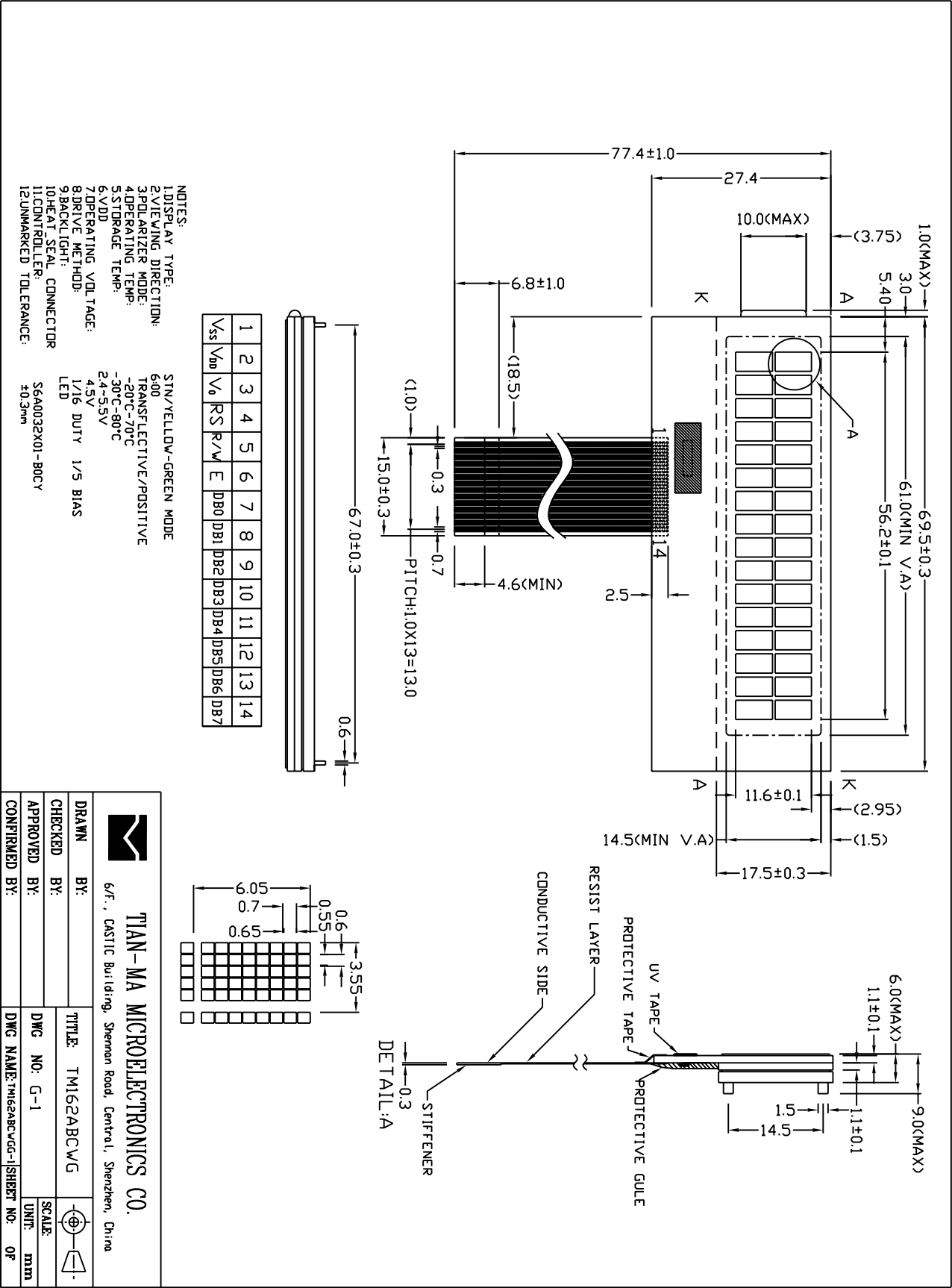
1.15 Dot Pitch: 0.60 × 0.70 (mm)

1.16 Weight: 20g (Approx)

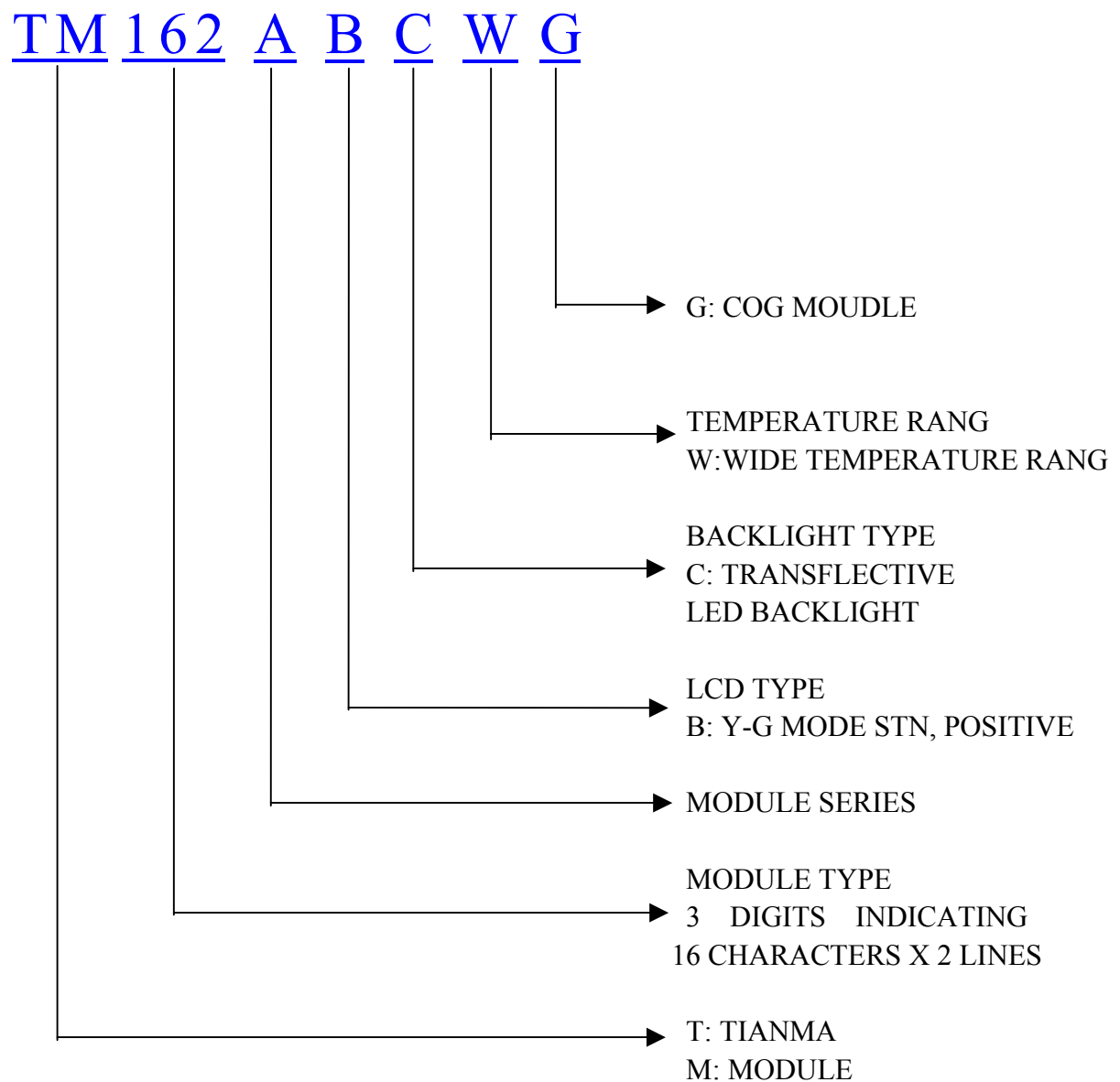
\*<sup>1</sup> Color tone is slightly changed by temperature and driving voltage.

\*<sup>2</sup> Color tone will be changed by backlight.

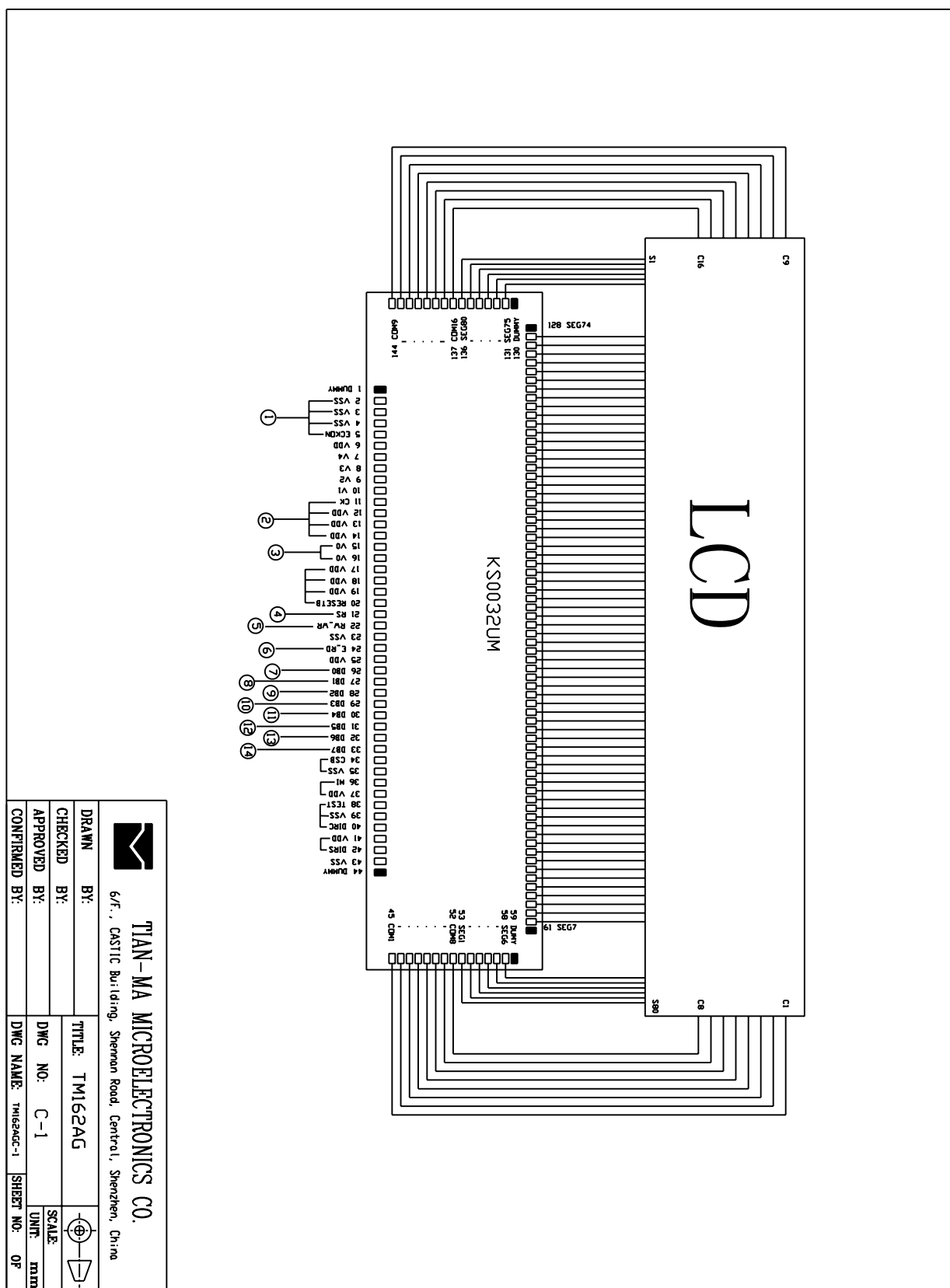
2. Outline Drawing



### 3. LCD Module Part Numbering System



#### 4. Circuit Block Diagram



## 5. Absolute Maximum Ratings

| Item                        | Symbol            | Min. | Max. | Unit | Remark             |
|-----------------------------|-------------------|------|------|------|--------------------|
| Power Supply Voltage        | $V_{DD} - V_{SS}$ | -0.3 | 7.0  | V    |                    |
| LCD Driving Voltage         | $V_{LCD}$         | -0.3 | 13.0 |      |                    |
| Operating Temperature Range | $T_{OP}$          | -20  | +70  |      | No<br>Condensation |
| Storage Temperature Range   | $T_{ST}$          | -30  | +80  |      |                    |

## 6. Electrical Specifications and Instruction Code

### 6.1 Electrical characteristics

| Item                          |      | Symbol                                  | Min.        | Typ. | Max.         | Unit |
|-------------------------------|------|-----------------------------------------|-------------|------|--------------|------|
| Supply Voltage<br>(Logic)     |      | $V_{DD} - V_{SS}$                       | -           | 5.0  | -            | V    |
| Supply Voltage<br>(LCD Drive) |      | $V_{LCD}$                               | -           | 4.5  | -            | V    |
| Input<br>Signal<br>Voltage    | High | $V_{IH}$<br>( $V_{DD}=5.0$ )            | $0.7V_{DD}$ | -    | $V_{DD}+0.3$ | V    |
|                               | Low  | $V_{IL}$<br>( $V_{DD}=5.0$ )            | -0.3        | -    | $0.2V_{DD}$  | V    |
| Supply current<br>(Logic)     |      | $I_{DD}$<br>( $V_{DD} - V_{SS} = 5.0$ ) | -           | -    | 500          | uA   |
| Supply current<br>(LED)       |      | $I_{LED}$                               | -           | -    | 60           | mA   |

## 6.2 Interface Signals

| Pin No. | Symbol | Level | Description                                      |
|---------|--------|-------|--------------------------------------------------|
| 1       | VSS    | 0V    | Ground                                           |
| 2       | VDD    | 5.0V  | Power supply voltage                             |
| 3       | V0     | 4.5V  | Power supply voltage for LCD                     |
| 4       | RS     | H/L   | Register selection input(H: data L: instruction) |
| 5       | R/W    | H/L   | Read or write selection input(H: read L: write)  |
| 6       | E      | H/L   | Read or write enable signal                      |
| 7       | DB0    | H/L   | Data bit 0                                       |
| 8       | DB1    | H/L   | Data bit 1                                       |
| 9       | DB2    | H/L   | Data bit 2                                       |
| 10      | DB3    | H/L   | Data bit 3                                       |
| 11      | DB4    | H/L   | Data bit 4                                       |
| 12      | DB5    | H/L   | Data bit 5                                       |
| 13      | DB6    | H/L   | Data bit 6                                       |
| 14      | DB7    | H/L   | Data bit 7                                       |

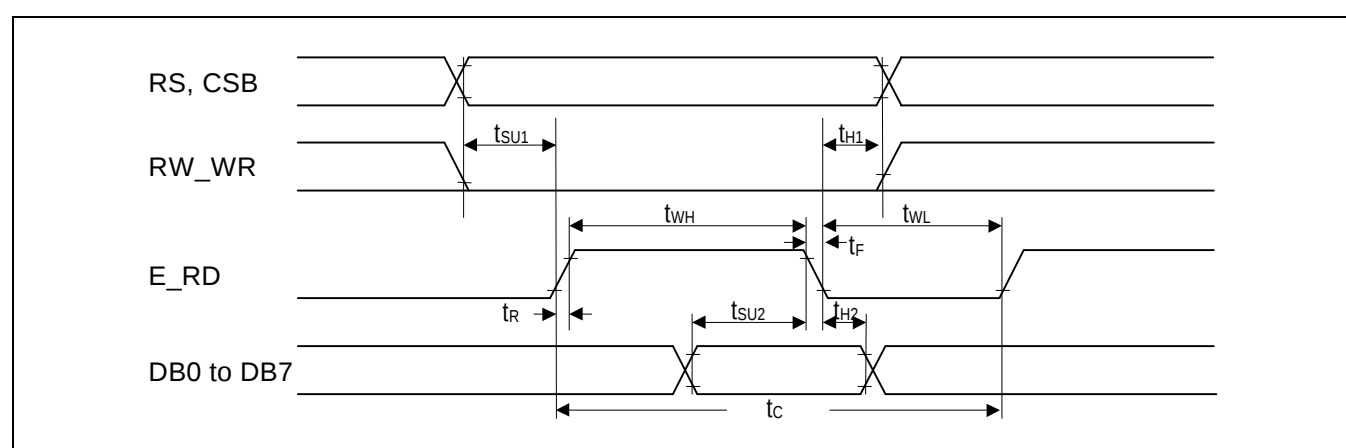
## 6.3 Interface Timing Chart

AC Characteristics( $V_{DD}=2.4V\sim 5.5V$ ,  $T_a=-30\sim +85^{\circ}C$ )

### 6800-series MPU Interface & Write Instruction

#### AC Characteristics (6800-series Write Instruction)

| Condition                                                    | Characteristic         | Symbol     | Min. | Typ. | Max. | Unit |
|--------------------------------------------------------------|------------------------|------------|------|------|------|------|
| $V_{DD} = 2.4V$ to $3.6V$ ,<br>$T_a = -30$ to $+85^{\circ}C$ | E cycle time           | $t_C$      | 650  |      | -    | ns   |
|                                                              | Pulse rise / fall time | $t_R, t_F$ | -    | -    | 25   |      |
|                                                              | E pulse width high     | $t_{WH}$   | 450  | -    | -    |      |
|                                                              | E pulse width low      | $t_{WL}$   | 150  | -    | -    |      |
|                                                              | RS and CSB setup time  | $t_{SU1}$  | 60   | -    | -    |      |
|                                                              | RS and CSB hold time   | $t_{H1}$   | 30   | -    | -    |      |
|                                                              | DB setup time          | $t_{SU2}$  | 100  | -    | -    |      |
|                                                              | DB hold time           | $t_{H2}$   | 50   | -    | -    |      |
| $V_{DD} = 3.6V$ to $5.5V$ ,<br>$T_a = -30$ to $+85^{\circ}C$ | E cycle time           | $t_C$      | 350  |      | -    | ns   |
|                                                              | Pulse rise / fall time | $t_R, t_F$ | -    | -    | 25   |      |
|                                                              | E pulse width high     | $t_{WH}$   | 250  | -    | -    |      |
|                                                              | E pulse width low      | $t_{WL}$   | 100  | -    | -    |      |
|                                                              | RS and CSB setup time  | $t_{SU1}$  | 40   | -    | -    |      |
|                                                              | RS and CSB hold time   | $t_{H1}$   | 10   | -    | -    |      |
|                                                              | DB setup time          | $t_{SU2}$  | 40   | -    | -    |      |
|                                                              | DB hold time           | $t_{H2}$   | 10   | -    | -    |      |

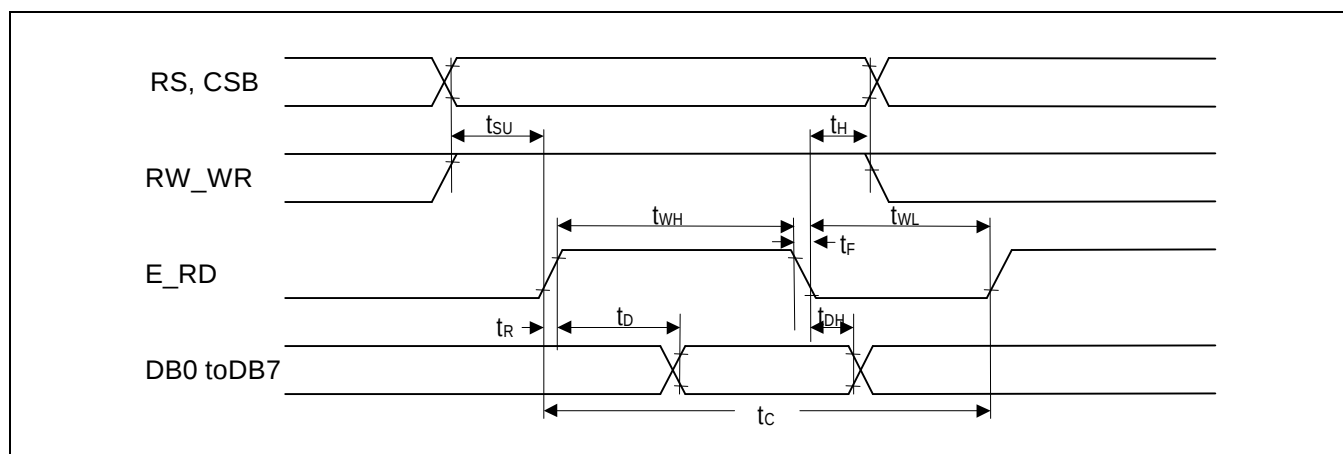


Write Bus Mode Timing (6800-series MPU Interface)

## 6800-series MPU Interface & Read Instruction

### AC Characteristics (6800-series Read Instruction)

| Condition                                             | Characteristic         | Symbol                          | Min. | Typ. | Max. | Unit |
|-------------------------------------------------------|------------------------|---------------------------------|------|------|------|------|
| V <sub>DD</sub> = 2.4V to 3.6V,<br>Ta = -30 to +85 °C | E cycle time           | t <sub>C</sub>                  | 650  |      | -    | ns   |
|                                                       | Pulse rise / fall time | t <sub>R</sub> , t <sub>F</sub> | -    | -    | 25   |      |
|                                                       | E pulse width high     | t <sub>WH</sub>                 | 450  | -    | -    |      |
|                                                       | E pulse width low      | t <sub>WL</sub>                 | 150  | -    | -    |      |
|                                                       | RS and CSB setup time  | t <sub>SU</sub>                 | 60   | -    | -    |      |
|                                                       | RS and CSB hold time   | t <sub>H</sub>                  | 30   | -    | -    |      |
|                                                       | DB output delay time   | t <sub>D</sub>                  | -    | -    | 360  |      |
|                                                       | DB output hold time    | t <sub>DH</sub>                 | 20   | -    | -    |      |
| V <sub>DD</sub> = 3.6V to 5.5V,<br>Ta = -30 to +85 °C | E cycle time           | t <sub>C</sub>                  | 350  |      | -    | ns   |
|                                                       | Pulse rise / fall time | t <sub>R</sub> , t <sub>F</sub> | -    | -    | 25   |      |
|                                                       | E pulse width high     | t <sub>WH</sub>                 | 250  | -    | -    |      |
|                                                       | E pulse width low      | t <sub>WL</sub>                 | 100  | -    | -    |      |
|                                                       | RS and CSB setup time  | t <sub>SU</sub>                 | 40   | -    | -    |      |
|                                                       | RS and CSB hold time   | t <sub>H</sub>                  | 10   | -    | -    |      |
|                                                       | DB output delay time   | t <sub>D</sub>                  | -    | -    | 120  |      |
|                                                       | DB output hold time    | t <sub>DH</sub>                 | 10   | -    | -    |      |



Read Bus Mode Timing (6800-series MPU Interface)

## 6.4 Instruction Code

### INSTRUCTION DESCRIPTION

Instruction Table

| Instruction                | RS | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 | Description                                                                                                        |
|----------------------------|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------------------------------------------------------------------------------------------------------------------|
| *Clear display             | 0  | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 1   | Write "20H" to DDRAM and set DDRAM address to "00H" from AC                                                        |
| Return home                | 0  | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 1   | -   | DDRAM address is set to 00h from AC and the cursor returns to 00h position. The contents of DDRAM are not changed. |
| Entry mode set             | 0  | 0   | 0   | 0   | 0   | 0   | 0   | 1   | I/D | SH  | Assign cursor moving direction and enable the shift of entire display                                              |
| Display ON / OFF control   | 0  | 0   | 0   | 0   | 0   | 0   | 1   | D   | C   | B   | Set display (D), cursor (C), and blinking of cursor (B) ON / OFF control                                           |
| Cursor or display shift    | 0  | 0   | 0   | 0   | 0   | 1   | S/C | R/L | -   | -   | Set cursor moving and display shift control bit, and the direction, without changing of DDRAM data                 |
| Function set               | 0  | 0   | 0   | 0   | 1   | DL  | -   | -   | -   | -   | Set interface data length (DL: 4-bit / 8-bit) instruction                                                          |
| CGRAM address set          | 0  | 0   | 0   | 1   | 0   | 0   | A3  | A2  | A1  | A0  | Set CGRAM address in address counter.                                                                              |
| DDRAM address set          | 0  | 0   | 1   | A6  | A5  | A4  | A3  | A2  | A1  | A0  | Set DDRAM address in address counter.                                                                              |
| Read busy flag and address | 0  | 1   | BF  | A6  | A5  | A4  | A3  | A2  | A1  | A0  | Whether in internal operation or not can be known by reading BF, The contents of address counter can also be read  |
| Write data                 | 1  | 0   | D7  | D6  | D5  | D4  | D3  | D2  | D1  | D0  | Write data into DDRAM / CGRAM                                                                                      |
| Read data                  | 1  | 1   | D7  | D6  | D5  | D4  | D3  | D2  | D1  | D0  | Read data from DDRAM / CGRAM                                                                                       |

("-": Don't care)

#### NOTES:

1. Instruction execution time depends on the internal process time of KS0032, therefore it is necessary to provide a time larger than one MPU interface cycle time (tc) between execution of two successive instructions.
2. "Clear Display" instruction has 850μs execution time (when fosc = 40.0kHz), so check the Busy flag or wait for more than 850μs after using "Clear Display" instruction.

## 6.5 Character generator ROM(S6A0032)

### CHARACTER GENERATOR ROM (CGROM)

CGROM has 5 x 8-dot 254 characters. The CGROM character code 00h and 01h are CGRAM character data area.

CGROM Character Code (00)

| Upper<br>4bit<br>Lower<br>4bit | LLLL                | LLLH | LLHL | LLHH | LHLL | LHLH | LHHL | LHHH | HLLL | HLLH | HLHL | HLHH | HHLL | HHLH | HHHL | HHHH |
|--------------------------------|---------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| LLLL                           | CGRAM<br>CHAR<br>#1 | ■    | ■    | 0    | a    | P    | `    | P    | _    | ●    | —    | 夕    | ミ    | α    | P    |      |
| LLLH                           | CGRAM<br>CHAR<br>#2 | ■    | !    | 1    | A    | Q    | a    | 9    | _    | 0    | 。    | ア    | チ    | △    | △    | △    |
| LLHL                           |                     | ■    | \    | "    | 2    | B    | R    | b    | r    | _    | 0    | 「    | イ    | ツ    | ×    | β    |
| LLHH                           |                     | ■    | !!   | #    | 3    | C    | S    | c    | s    | ■    | 0    | 」    | ウ    | テ    | モ    | ε    |
| LHLL                           |                     | ■    | 0    | 7    | \$   | 4    | D    | T    | d    | t    | ■    | フ    | 、    | エ    | ト    | μ    |
| LHLH                           |                     | ■    | 0    | 5    | %    | 5    | E    | U    | e    | u    | ■    | ±    | ・    | オ    | ナ    | 1    |
| LHHL                           |                     | ■    | 0    | —    | &    | 6    | F    | V    | f    | v    | ■    |      |      | ヲ    | カ    | ニ    |
| LHHH                           |                     | ■    | 0    | 4    | '    | 7    | G    | W    | g    | w    | *    |      |      | ア    | キ    | ヌ    |
| HLLL                           |                     | ■    | 0    | ↑    | (    | 8    | H    | X    | h    | x    |      | 1    |      | イ    | ク    | ネ    |
| HLLH                           |                     | ■    | 0    | ↓    | )    | 9    | I    | Y    | i    | y    |      | 2    |      | ウ    | ケ    | ル    |
| HLHL                           |                     | ■    | 0    | ■    | *    | :    | J    | Z    | j    | z    |      | 3    |      | エ    | コ    | ハ    |
| HLHH                           |                     | ■    | 0    | ■    | +    | ;    | K    | [    | k    | <    |      | 4    |      | オ    | サ    | ヒ    |
| HHLL                           |                     | ■    | 0    | ■    | ,    | <    | L    | ¥    | l    |      |      | 5    |      | カ    | シ    | フ    |
| HHLH                           |                     | ■    | 0    | ■    | —    | =    | M    | ]    | m    | >    | ■    | 6    |      | ユ    | ス    | ハ    |
| HHHL                           |                     | ■    | 0    | ■    | .    | >    | N    | ^    | n    | ÷    | ■    | 7    |      | セ    | ホ    | フ    |
| HHHH                           |                     | ■    | 0    | ■    | /    | ?    | 0    | _    | o    | +    | ■    | 8    |      | ッ    | ソ    | マ    |

## 7. Optical Characteristics

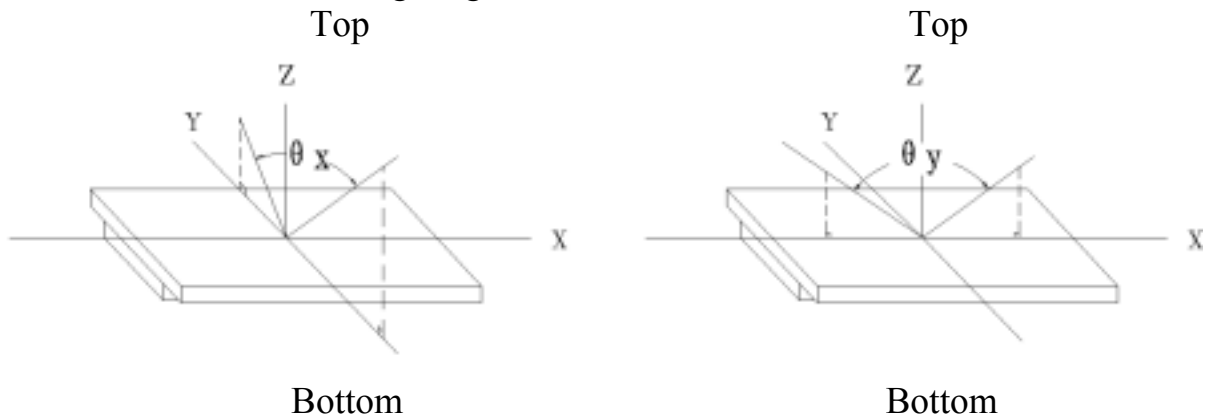
### 7.1 Optical Characteristics

Ta=25

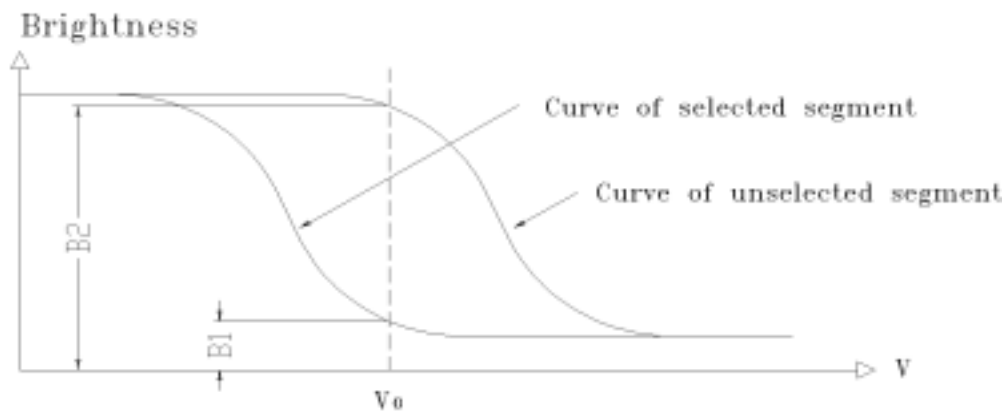
| Item           |          | Symbol     | Condition                                    |                      | Min. | Typ. | Max. | Unit |
|----------------|----------|------------|----------------------------------------------|----------------------|------|------|------|------|
| Viewing Angle  |          | $\theta_x$ | $C_r \geq 2$                                 | $\theta_y = 0^\circ$ | -35  | --   | 20   | Deg  |
|                |          | $\theta_y$ |                                              | $\theta_x = 0^\circ$ | -30  | --   | 30   |      |
| Contrast Ratio |          | $C_r$      | $\theta_x = 0^\circ$<br>$\theta_y = 0^\circ$ |                      | 4.0  | -    | -    |      |
| Response Time  | Turn on  | $T_{on}$   | $\theta_x = 0^\circ$<br>$\theta_y = 0^\circ$ |                      | -    | -    | 250  | ms   |
|                | Turn off | $T_{off}$  |                                              |                      | -    | -    | 250  |      |

## 7.2 Definition of Optical Characteristics

### 7.2.1 Definition of Viewing Angle



### 7.2.2 Definition of Contrast Ratio

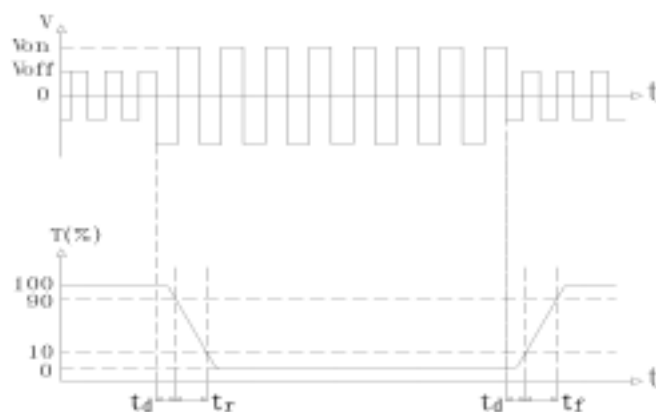


$$\text{Contrast Ratio} = B2/B1 = \frac{\text{unselected state brightness}}{\text{selected state brightness}}$$

Measuring Conditions:

- 1) Ambient Temperature: 25 ;
- 2) Frame frequency: 78Hz

### 7.2.3 Definition of Response time



Turn on time:  $t_{on} = t_d + t_r$

Turn off time:  $t_{off} = t_d + t_f$

Measuring Condition:

- 1) Operating Voltage: 4.5V
- 2) Frame frequency: 78Hz

## 8. Reliability

### 8.1 Content of Reliability Test

Ta=25

| No. | Test Item                          | Content of Test                                                                                                                                                                                                                                                                                                                                 | Test condition                                    |
|-----|------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|
| 1   | High Temperature Storage           | Endurance test applying the high storage temperature for a long time                                                                                                                                                                                                                                                                            | 80 240H<br>Restore 4H at 25                       |
| 2   | Low Temperature Storage            | Endurance test applying the low storage temperature for a long time                                                                                                                                                                                                                                                                             | -30 240H<br>Restore 4H at 25                      |
| 3   | High Temperature /Humidity Storage | Endurance test applying the high temperature and high humidity storage for a long time                                                                                                                                                                                                                                                          | 60 90%RH<br>240H<br>Restore 4H at 25              |
| 4   | Temperature Cycle                  | Endurance test applying the low and high temperature cycle<br><div style="text-align: center;"> <math>-30 \xleftrightarrow{30\text{min}} 25 \xleftrightarrow{5\text{min}} 80 \xleftrightarrow{30\text{min}} 25 \xleftrightarrow{5\text{min}}</math><br/> <math>\leftarrow \text{-----} \rightarrow</math><br/>           1 cycle         </div> | -30 /80<br>10 cycles<br>Restore 4H at 25          |
| 5   | Vibration Test (package state)     | Endurance test applying the vibration during transportation                                                                                                                                                                                                                                                                                     | 10Hz~150Hz,<br>100m/s <sup>2</sup> ,<br>120min    |
| 6   | Shock Test (package state)         | Endurance test applying the shock during transportation                                                                                                                                                                                                                                                                                         | Half- sine wave,<br>300m/s <sup>2</sup> ,<br>18ms |
| 7   | Atmospheric Pressure Test          | Endurance test applying the atmospheric pressure during transportation by air                                                                                                                                                                                                                                                                   | 25kPa 16H<br>Restore 2H                           |

## 8.2 Failure Judgment Criterion

| Criterion Item           | Test Item No.                                                          |   |   |   |   |   |   | Failure Judgement Criterion         |
|--------------------------|------------------------------------------------------------------------|---|---|---|---|---|---|-------------------------------------|
|                          | 1                                                                      | 2 | 3 | 4 | 5 | 6 | 7 |                                     |
| Basic Specification      | √                                                                      | √ | √ | √ | √ | √ | √ | Out of the basic Specification      |
| Electrical specification | √                                                                      | √ | √ |   |   |   |   | Out of the electrical specification |
| Mechanical Specification |                                                                        |   |   |   | √ | √ |   | Out of the mechanical specification |
| Optical Characteristic   | √                                                                      | √ | √ | √ |   |   | √ | Out of the optical specification    |
| Note                     | For test item refer to 8.1                                             |   |   |   |   |   |   |                                     |
| Remark                   | Basic specification = Optical specification + Mechanical specification |   |   |   |   |   |   |                                     |

## 9. QUALITY LEVEL

| Examination<br>or Test                                                                                                                        | At Ta=25<br>(unless otherwise stated)                                                                 | Inspection     |      |      |    |                               |
|-----------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|----------------|------|------|----|-------------------------------|
|                                                                                                                                               |                                                                                                       | Min.           | Max. | Unit | IL | AQL                           |
| External<br>Visual<br>Inspection                                                                                                              | Under normal illumination<br>and eyesight condition, the<br>distance between eyes and<br>LCD is 25cm. | See Appendix A |      |      | II | Major<br>0.65<br>Minor<br>1.5 |
| Display<br>Defects                                                                                                                            | Under normal illumination<br>and eyesight condition,<br>display on inspection.                        | See Appendix B |      |      | II | Major<br>0.65<br>Minor<br>1.5 |
| Note: Major defects: Open segment or common, Short, Serious damages, Leakage<br>Miner defects: Others<br>Sampling standard conforms to GB2828 |                                                                                                       |                |      |      |    |                               |

## **10. Precautions for Use of LCD Modules**

### **10.1 Handling Precautions**

10.1.1 The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.

10.1.2 If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.

10.1.3 Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

10.1.4 The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

10.1.5 If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:

- Isopropyl alcohol
- Ethyl alcohol

Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:

- Water
- Ketone
- Aromatic solvents

10.1.6 Do not attempt to disassemble the LCD Module.

10.1.7 If the logic circuit power is off, do not apply the input signals.

10.1.8 To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

- a. Be sure to ground the body when handling the LCD Modules.
- b. Tools required for assembly, such as soldering irons, must be properly ground.
- c. To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.
- d. The LCD Module is coated with a film to protect the display surface. Be care when peeling off this protective film since static electricity may be generated.

## 10.2 Storage precautions

10.2.1 When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.

10.2.2 The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:

Temperature :           0     ~   40

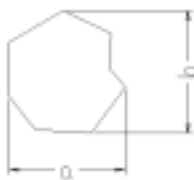
Relatively humidity:   ≤ 80%

10.2.3 The LCD modules should be stored in the room without acid, alkali and harmful gas.

10.3 The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.

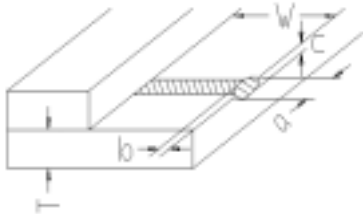
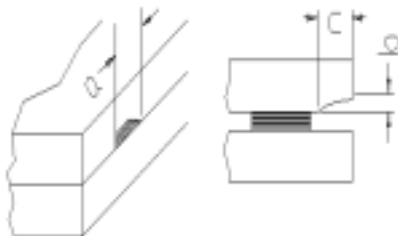
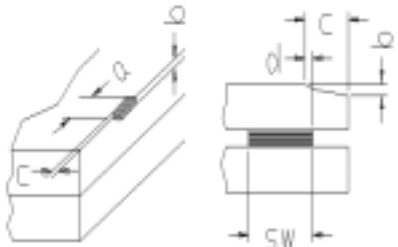
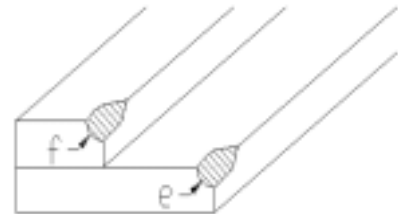
## Appendix A

### Inspection items and criteria for appearance defects

| Items                           | Contents                                                                            | Criteria                                      |                                                                    |                                    |
|---------------------------------|-------------------------------------------------------------------------------------|-----------------------------------------------|--------------------------------------------------------------------|------------------------------------|
| Protective Glue                 |                                                                                     | No clear defects                              |                                                                    |                                    |
| Cover Tape                      |                                                                                     | Covering all of the chip and no clear crimple |                                                                    |                                    |
| Leakage                         |                                                                                     | Not permitted                                 |                                                                    |                                    |
| Rainbow                         |                                                                                     | According to the limit specimen               |                                                                    |                                    |
| Polarizer                       | Wrong polarizer attachment                                                          | Not permitted                                 |                                                                    |                                    |
|                                 | Bubble between polarizer and glass                                                  | Not counted                                   | Max. 3 defects allowed                                             |                                    |
|                                 |                                                                                     | $\phi<0.3\text{mm}$                           | $0.3\text{mm} \leq \phi \leq 0.5\text{mm}$                         |                                    |
|                                 | Scratches of polarizer                                                              | According to the limit specimen               |                                                                    |                                    |
| Black spot<br>(in viewing area) |  | Not counted                                   | Max. 3 spots allowed                                               | Max. 3 spots<br>(lines)<br>allowed |
|                                 |                                                                                     | $X<0.20\text{mm}$                             | $0.20\text{mm} \leq X \leq 0.5\text{mm}$                           |                                    |
|                                 |                                                                                     | $X=(a+b)/2$                                   |                                                                    |                                    |
| Black line<br>(in viewing area) |  | Not counted                                   | Max. 3 lines allowed                                               |                                    |
|                                 |                                                                                     | $a<0.02\text{mm}$                             | $0.02\text{mm} \leq a \leq 0.05\text{mm}$<br>$b \leq 2.0\text{mm}$ |                                    |
| Progressive cracks              |  | Not permitted                                 |                                                                    |                                    |

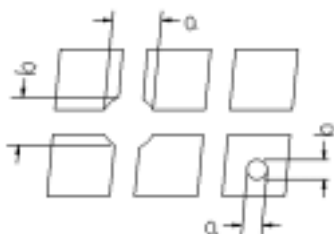
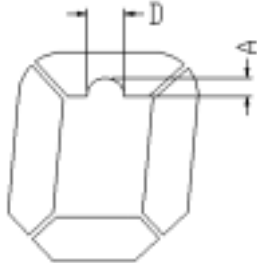
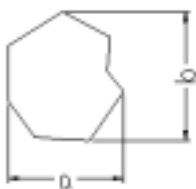
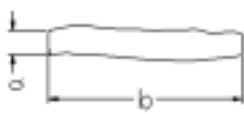
## Appendix A

### Inspection item and criteria for appearance defects (continued)

| Items        | Contents                                                                            | Criteria                                                                            |                                              |         |                       |                       |                       |
|--------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|----------------------------------------------|---------|-----------------------|-----------------------|-----------------------|
| Glass Cracks | Cracks on pads                                                                      | a                                                                                   | b                                            | c       | Max. 2 Cracks allowed | Max. 5 cracks allowed |                       |
|              |    | ≤ 3mm                                                                               | ≤ W/5                                        | ≤ T/2   |                       |                       |                       |
|              |                                                                                     | ≤ 2mm                                                                               | ≤ W/5                                        | T/2<C<T |                       |                       |                       |
|              | Cracks on contact side                                                              | a                                                                                   | b                                            |         | Max. 2 cracks allowed |                       |                       |
|              |   | ≤ 3mm                                                                               | ≤ T/2                                        |         |                       |                       |                       |
|              |                                                                                     | ≤ 2mm                                                                               | T/2<b<T                                      |         |                       |                       |                       |
|              |                                                                                     | C shall be not reach the seal area                                                  |                                              |         |                       |                       |                       |
|              | Cracks on non-contact side                                                          | a                                                                                   | b                                            |         | Max. 2 cracks allowed |                       |                       |
|              |  | ≤ 3mm                                                                               | ≤ T/2                                        |         |                       |                       |                       |
|              |                                                                                     | ≤ 2mm                                                                               | T/2<b<T                                      |         |                       |                       |                       |
|              |                                                                                     | C ≤ 0.5mm                                                                           |                                              |         |                       |                       |                       |
|              |                                                                                     | d ≤ SW/3                                                                            |                                              |         |                       |                       |                       |
|              | Corner cracks                                                                       |  | e<2.0mm <sup>2</sup><br>f<2.0mm <sup>2</sup> |         |                       |                       | Max. 3 cracks allowed |

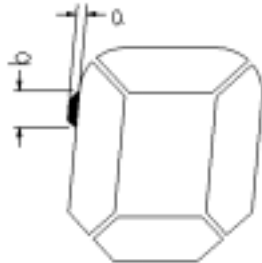
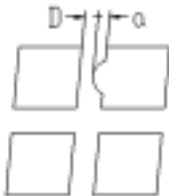
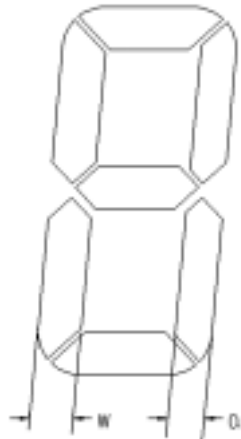
## Appendix B

### Inspection items and criteria for display defects

| Items                                 | Contents                                                                            | Criteria                        |                                  |                             |
|---------------------------------------|-------------------------------------------------------------------------------------|---------------------------------|----------------------------------|-----------------------------|
| Open segment or open common           |                                                                                     | Not permitted                   |                                  |                             |
| Short                                 |                                                                                     | Not permitted                   |                                  |                             |
| Wrong viewing angle                   |                                                                                     | Not permitted                   |                                  |                             |
| Contrast radio uneven                 |                                                                                     | According to the limit specimen |                                  |                             |
| Crosstalk                             |                                                                                     | According to the limit specimen |                                  |                             |
| Pin holes and cracks in segment (DOT) |   | Not counted                     | Max.3 dots allowed               | Max.3 dots allowed          |
|                                       |                                                                                     | X<0.1mm                         | 0.1mm ≤ X ≤ 0.2mm                |                             |
|                                       |                                                                                     | X=(a+b)/2                       |                                  |                             |
|                                       |  | Not counted                     | Max.2 dots allowed               |                             |
|                                       |                                                                                     | A<0.1mm                         | 0.1mm ≤ A ≤ 0.2mm                |                             |
|                                       |                                                                                     | D<0.25mm                        |                                  |                             |
| Black spot (in viewing area)          |  | Not counted                     | Max.3 spots allowed              | Max.3 spots (lines) allowed |
|                                       |                                                                                     | X<0.1mm                         | 0.1mm ≤ X ≤ 0.2mm                |                             |
|                                       |                                                                                     | X=(a+b)/2                       |                                  |                             |
| Black line (in viewing area)          |  | Not counted                     | Max.3 lines allowed              |                             |
|                                       |                                                                                     | a<0.02mm                        | 0.02mm ≤ a ≤ 0.05mm<br>b ≤ 0.5mm |                             |

## Appendix B

### Inspection items and criteria for display defects (continued)

| Items                             | Content                                                                             | Criteria                                                                                                      |                                                  |                             |
|-----------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|--------------------------------------------------|-----------------------------|
| Transfor-<br>mation<br>of segment |    | Not counted                                                                                                   | Max. 2 defects allowed                           | Max.3<br>defects<br>allowed |
|                                   |                                                                                     | $x < 0.1\text{mm}$                                                                                            | $0.1\text{mm} \leq x \leq 0.2\text{mm}$          |                             |
|                                   |                                                                                     | $x=(a+b)/2$                                                                                                   |                                                  |                             |
|                                   |    | Not counted                                                                                                   | Max. 1 defects allowed                           | Max.3<br>defects<br>allowed |
|                                   |                                                                                     | $a < 0.1\text{mm}$                                                                                            | $0.1\text{mm} \leq a \leq 0.2\text{mm}$<br>$D>0$ |                             |
|                                   |  | Max.2 defects allowed<br>$0.8W \leq a \leq 1.2W$<br><br>a=measured value of width<br>W=nominal value of width |                                                  |                             |