

SPECIFICATION FOR LCD MODULE

Model No. TM162EBAWG2

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

TIANMA MICROELECTRONICS CO., LTD

REVISION RECORD

| Date | Ref. Page | Revision No. | Revision Items | Check & Approval |
|-------------|------------------|---------------------|-----------------------|-----------------------------|
| | | | | |

1 General Specifications:

1.1 Display type: STN/Yellow-Green

1.2 Display color*:

Display color: Blue-Black

Background: Yellow-Green

1.3 Polarizer mode: Reflective/Positive

1.4 Viewing Angle: 6:00

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

1.6 Without Backlight

- Color tone is slightly changed by temperature and driving voltage.

1.7 Display Fonts: 5 x 7 dots(1 Character)

1.8 Data Transfer: 8 Bit Parallel

1.9 Front Polarizer: SHC-125U

Rear Polarizer: SHC-125M

1.10 Operating Temperature: -20----+70°C

Storage Temperature: -30----+90°C

1.11 Outline Dimensions: Refer to outline drawing on next page

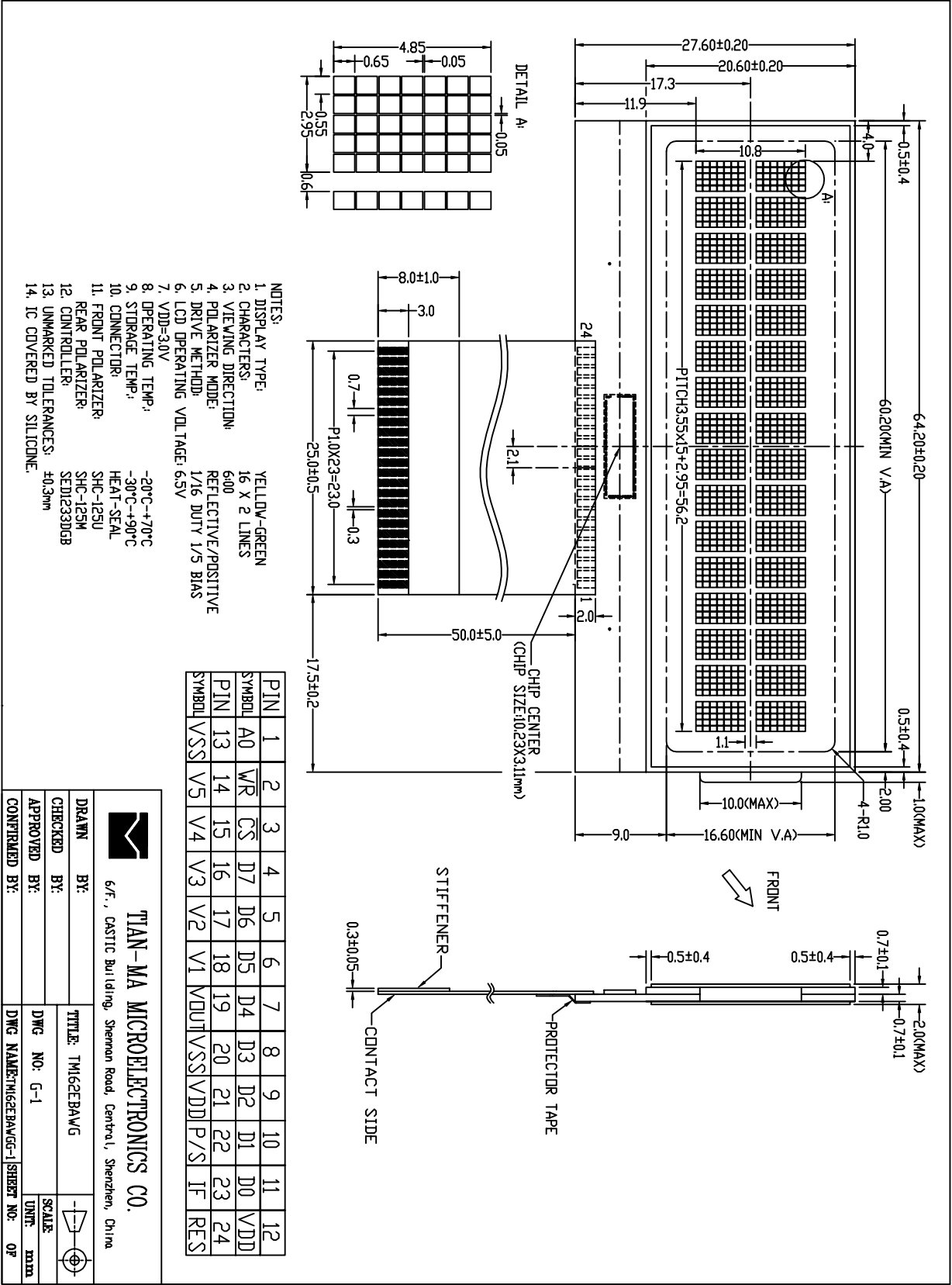
1.12 Dot Matrix: 16 Characters X 2

1.13 Dot Size: 0.55X0.65(mm)

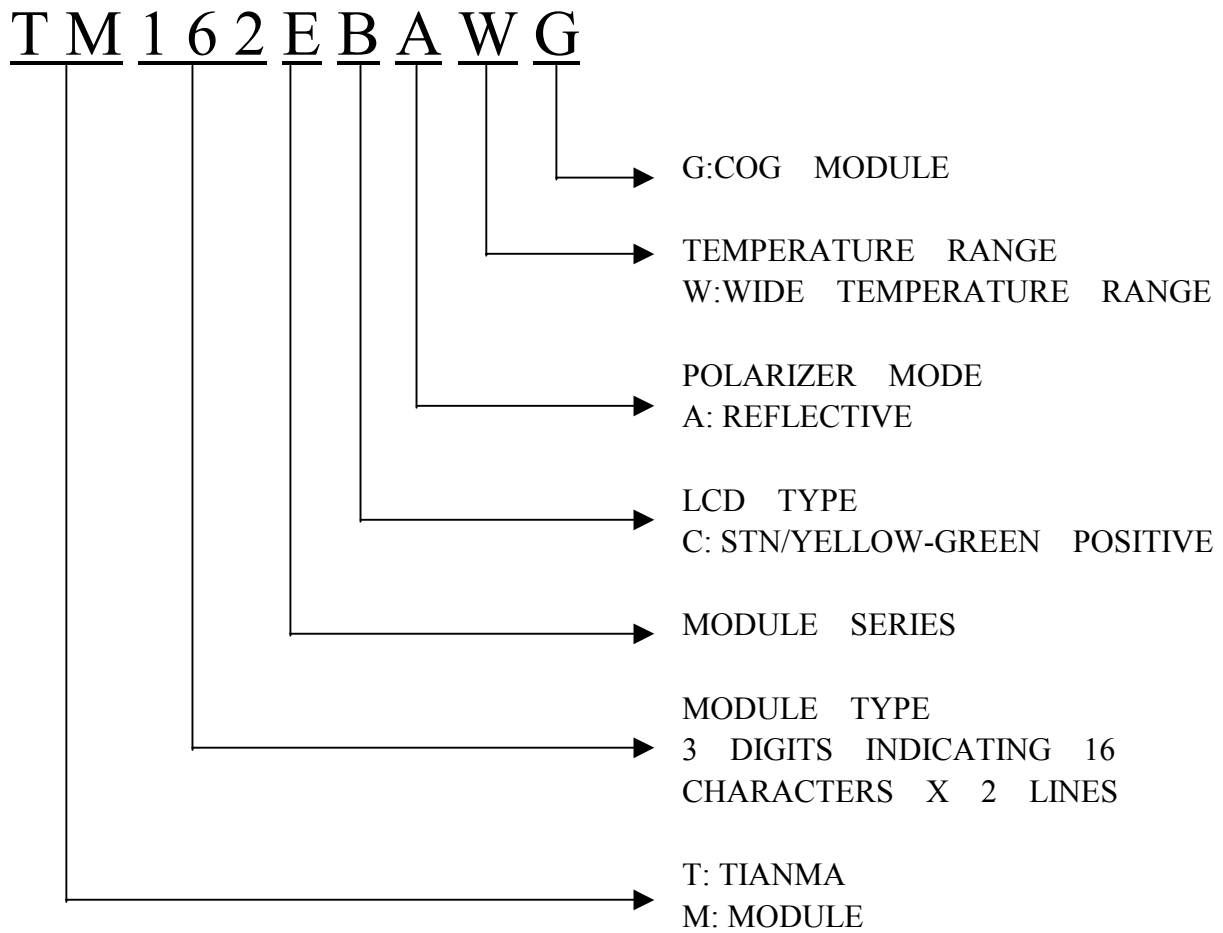
1.14 Dot Pitch: 0.6X0.7 (mm)

1.15 Weight: 10g

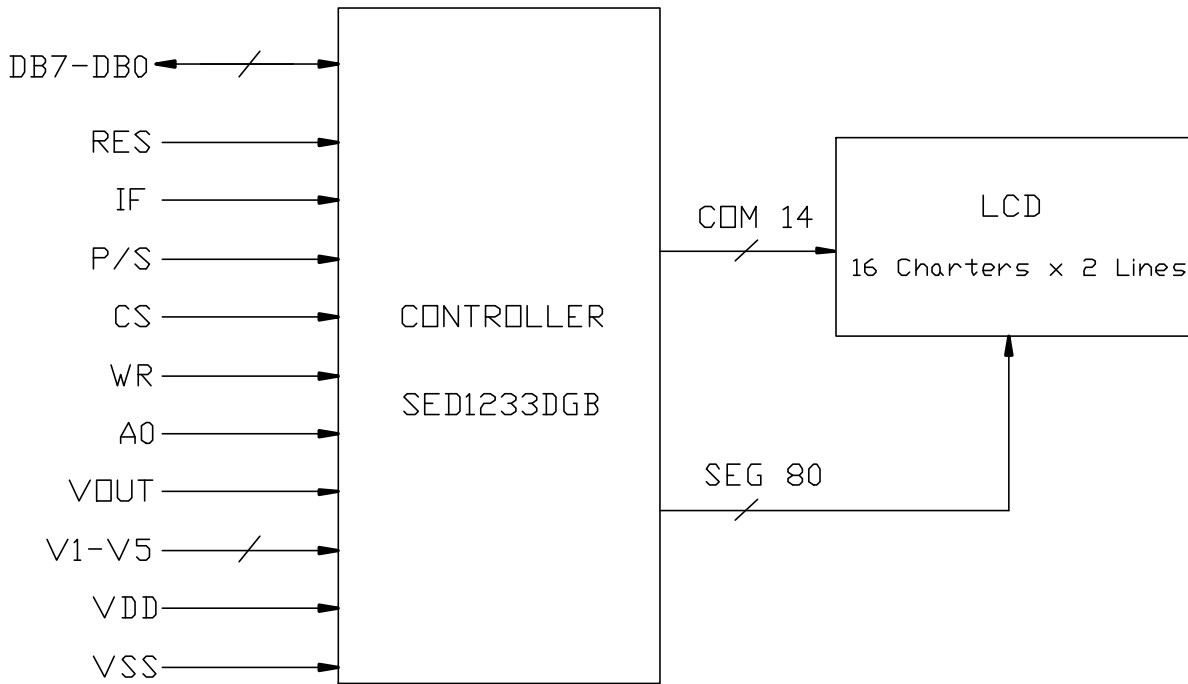
2 Outline Drawing



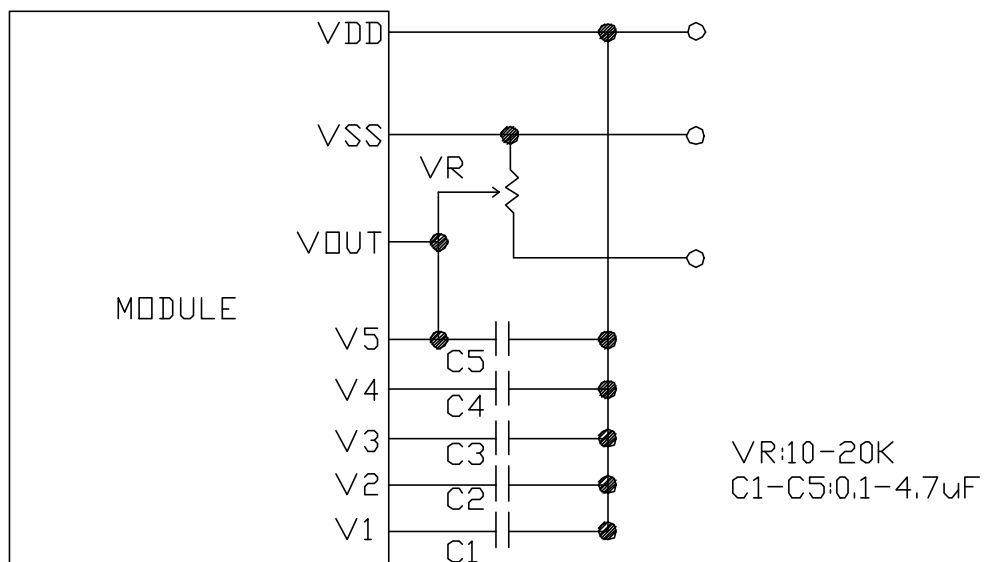
3 LCD Module Part Numbering System



4 Circuit Block Diagram



Block Diagram Example of Power Supply



Both the boosting circuit and the voltage control circuit are not used in this module. Therefore, connect V5 pin with Vout pin and supply the LCD driving voltage from the outside.

5 Absolute Maximum Ratings

| Item | Symbol | Min. | Max. | Unit | Remark |
|-----------------------------|-----------------|------|------|------|--------------------|
| Power Supply Voltage | $V_{DD}-V_{SS}$ | -0.3 | 6.0 | V | |
| LCD Driving Voltage | V_{LCD} | -0.3 | 13.0 | | |
| Operating Temperature Range | T_{OP} | -20 | +70 | °C | No Condensation |
| Storage Temperature Range | T_{ST} | -30 | +90 | | |

6 Electrical Specifications and Instruction Code

6.1 Electrical characteristics

| Item | | Symbol | Min. | Typ. | Max. | Unit |
|-------------------------------|------|-------------------------------------|-------------|------|--------------|------|
| Supply Voltage (Logic) | | $V_{DD}-V_{SS}$ | 2.4 | 3.0 | 3.6 | V |
| Supply Voltage (LCD Drive) | | V_{LCD} | 5.5 | 6.5 | 7.5 | V |
| Input Signal Voltage | High | V_{IH} ($V_{DD}=3.0$) | $0.7V_{DD}$ | - | $V_{DD}+0.3$ | V |
| | Low | V_{IL} ($V_{DD}=3.0$) | -0.3 | - | $0.2 V_{DD}$ | V |
| Supply current (Logic) | | I_{DD} ($V_{DD}-V_{SS}=3.0$) | - | 50 | 100 | uA |

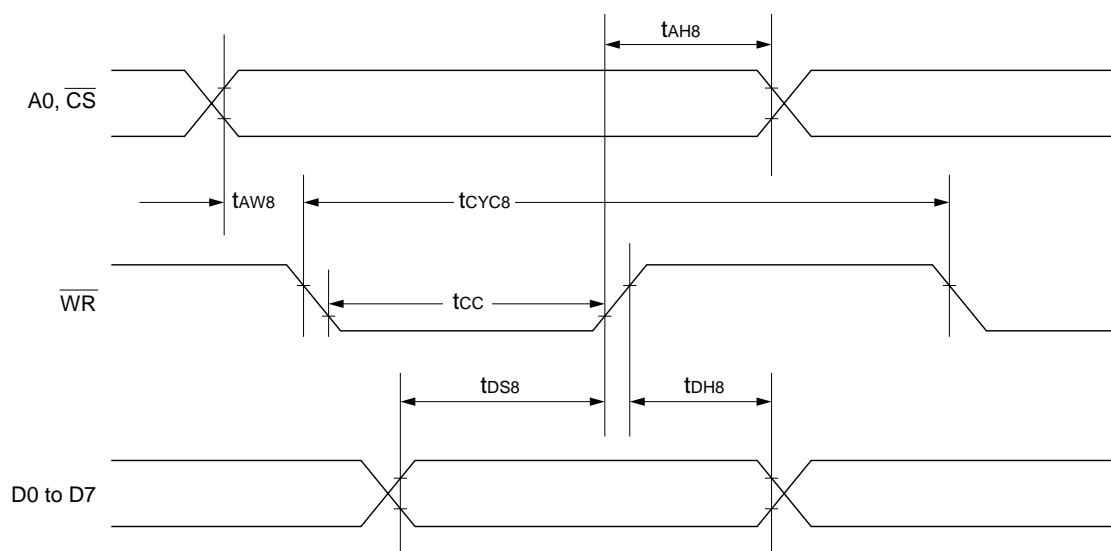
6.2 Interface Signals

| Pin No. | Symbol | Level | Description |
|---------|------------------------|-------|---|
| 1 | A0 | H/L | H:D0-D7 are display data L:D0-D7 are controller command |
| 2 | $\overline{\text{WR}}$ | H/L | 80 family MPU:WR Signal Input L:Active 68 family MPU:Enable clock input |
| 3 | $\overline{\text{CS}}$ | H/L | Chip selects signal L:Active |
| 4 | D7 | H/L | Data Bus Line |
| 5 | D6 | H/L | Data Bus Line |
| 6 | D5 | H/L | Data Bus Line |
| 7 | D4 | H/L | Data Bus Line |
| 8 | D3 | H/L | Data Bus Line |
| 9 | D2 | H/L | Data Bus Line |
| 10 | D1 | H/L | Data Bus Line |
| 11 | D0 | H/L | Data Bus Line |
| 12 | Vdd | 3.0V | Supply Voltage |
| 13 | Vss | 0V | Ground |
| 14 | V5 | - | Connect to Vdd and a capacitor of 0.1—4.7 uF |
| 15 | V4 | - | Connect to a capacitor of 0.1—4.7 uF |
| 16 | V3 | - | Connect to a capacitor of 0.1—4.7 uF |
| 17 | V2 | - | Connect to a capacitor of 0.1—4.7 uF |
| 18 | V1 | - | Connect to a capacitor of 0.1—4.7 uF |
| 19 | Vout | - | Supply Voltage(LCD Drive) |
| 20 | Vss | - | Ground |
| 21 | Vdd | - | Supply Voltage (+3.0V) |
| 22 | P/S | H/L | H:Parallel Data Transfer L:Serial Data Transfer |
| 23 | IF | H/L | Interface Data Length Select H:8-bits Parallel L:4-bit Parallel |
| 24 | RES | H/L | Reset Signal |

6.3 Interface Timing Chart

TIMING CHARACTERISTICS

(1) System Bus Write Characteristic I (80 series MPU)



[V_{SS} = -3.6 V to -2.4 V, T_a = -30 to 85°C unless otherwise specified]

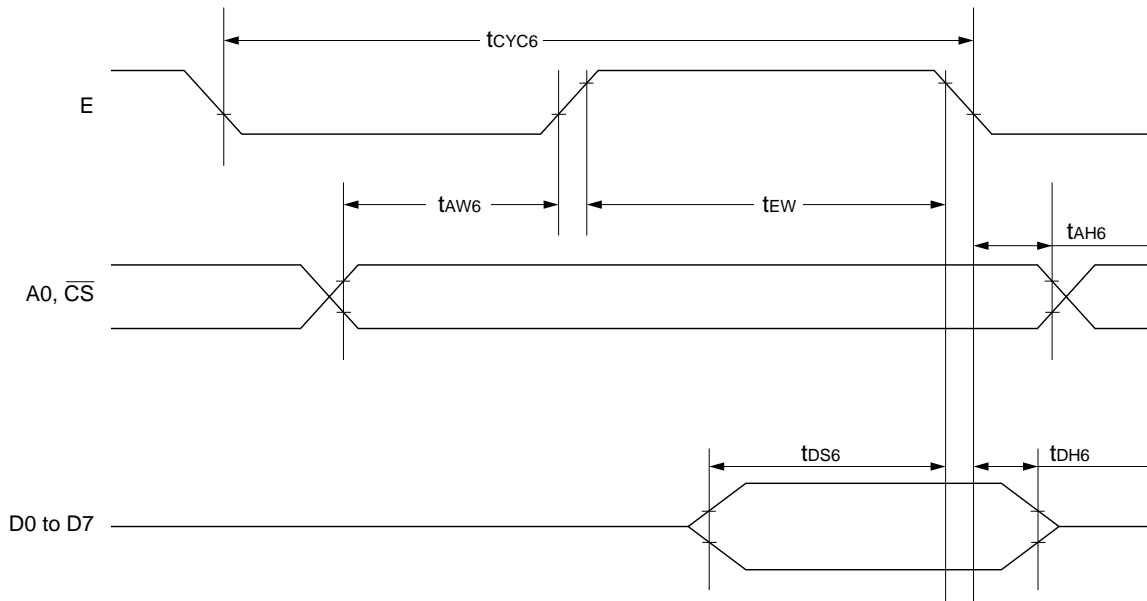
| Item | Signal | Symbol | Measuring condition | Min. | Max. | Unit |
|---|---------------------|------------|------------------------|------|------|------|
| Address hold time | $A0, \overline{CS}$ | t_{AH8} | | 30 | | ns |
| Address setup time | | t_{AW8} | | 60 | | ns |
| System cycle time | \overline{WR} | t_{CYC8} | V _{SS} = -3.0 | 500 | | ns |
| | | | -2.7 | 550 | | |
| | | | -2.4 | 650 | | |
| Control pulse width (\overline{WR}) | | t_{CC} | V _{SS} = -3.0 | 100 | | ns |
| | | | -2.7 | 120 | | |
| | | | -2.4 | 150 | | |
| Data setup time | $D0 \sim D7$ | t_{DS8} | | 100 | | ns |
| Data hold time | | t_{DH8} | | 50 | | ns |

*1: For the rise and fall of an input signal, set a value not exceeding 25 ns.

*2: Every timing is specified on the basis of 20% and 80% of V_{SS}.

*3: For $A0$ and \overline{CS} , the same time is not required. Input signals so that $A0$ and \overline{CS} may satisfy t_{AW8} and t_{AH8} respectively.

(2) System Bus Write Characteristic II (68 series MPU)



[Vss = -3.6 V to -2.4 V, Ta = -30 to 85°C unless otherwise specified]

| Item | Signal | Symbol | Measuring condition | Min. | Max. | Unit |
|--------------------|---------------------|------------|----------------------------|-------------------|------|------|
| System cycle time | A0, \overline{CS} | t_{CYC6} | Vss = -3.0 -2.7 -2.4 | 500 550 650 | | ns |
| Address setup time | | t_{AW6} | | 60 | | |
| Address hold time | | t_{AH6} | | 30 | | ns |
| Data setup time | D0 ~ D7 | t_{DS6} | | 100 | | ns |
| Data hold time | | t_{DH6} | | 50 | | ns |
| Enable pulse width | E | t_{EW} | Vss = -3.0 -2.7 -2.4 | 100 120 150 | | ns |

*1: t_{CYC6} denotes the cycle of the E signal in the \overline{CS} active state. t_{CYC6} must be reserved after \overline{CS} becomes active.

*2: For the rise and fall of an input signal, set a value not exceeding 25 ns.

*3: Every timing is specified on the basis of 20% and 80% of Vss.

*4: For A0 and \overline{CS} , the same timing is not required. Input signals so that A0 and \overline{CS} may satisfy t_{AW6} and t_{AH6} respectively.

6.4 Instruction Code

| Command | Code | | | | | | | | | | | Function |
|--------------------------------|------|----|------|---------|----|----|-----|----|------------|-----|--|----------|
| | A0 | WR | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | | |
| (1) Cursor Home | 0 | 0 | 0 | 0 | 0 | 1 | * | * | * | * | | |
| (2) Static Display Control | 0 | 0 | 0 | 0 | 1 | 0 | * | * | SD1 SD0 | | | |
| (3) Display ON/OFF Control | 0 | 0 | 0 | 0 | 1 | 1 | C | B | DC | D | | |
| (4) Power Save | 0 | 0 | 0 | 1 | 0 | 0 | * | * | 0 | PS | | |
| (5) Power Control | 0 | 0 | 0 | 1 | 0 | 1 | 0 | VC | VF | P | | |
| (6) System Set | 0 | 0 | 0 | 1 | 1 | 0 | N2 | N1 | * | CG | | |
| (7) Electronic Volume Register | 0 | 0 | 0 | 1 | 1 | 1 | MSB | | | LSB | | |
| (8) RAM Address Set | 0 | 0 | 1 | ADDRESS | | | | | | | | |
| (9) RAM Write | 1 | 0 | DATA | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

| | | Lower 4 Bit of Code | | | | | | | | | | | | | | | |
|----------------------|---|---------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F |
| Higher 4 Bit of Code | 0 | | | | | | | | | | | | | | | | |
| | 1 | | | | | | | | | | | | | | | | |
| | 2 | | | | | | | | | | | | | | | | |
| | 3 | | | | | | | | | | | | | | | | |
| | 4 | | | | | | | | | | | | | | | | |
| | 5 | | | | | | | | | | | | | | | | |
| | 6 | | | | | | | | | | | | | | | | |
| | 7 | | | | | | | | | | | | | | | | |
| | 8 | | | | | | | | | | | | | | | | |
| | 9 | | | | | | | | | | | | | | | | |
| | A | | | | | | | | | | | | | | | | |
| | B | | | | | | | | | | | | | | | | |
| | C | | | | | | | | | | | | | | | | |
| | D | | | | | | | | | | | | | | | | |
| | E | | | | | | | | | | | | | | | | |
| | F | | | | | | | | | | | | | | | | |

7 Optical Characteristics

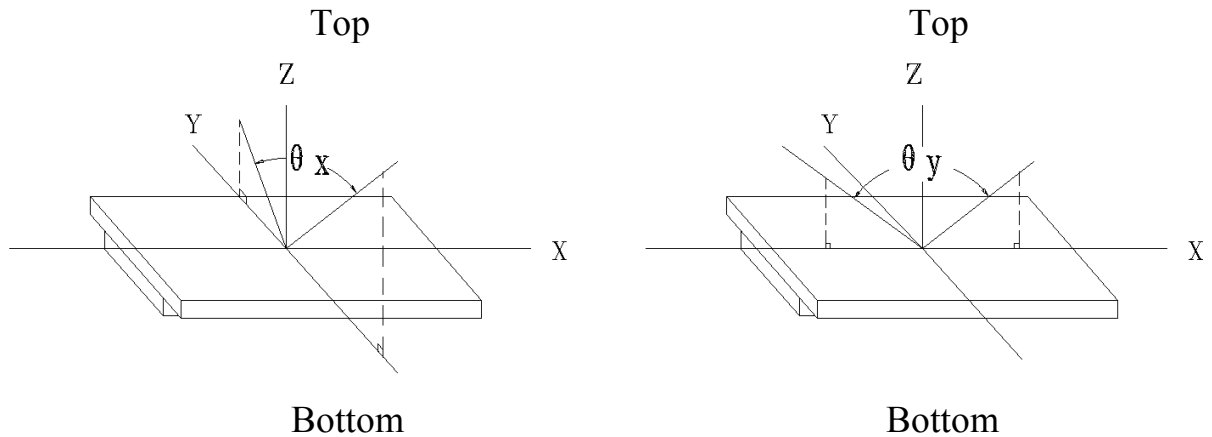
7.1 Optical Characteristics

Ta=25°C

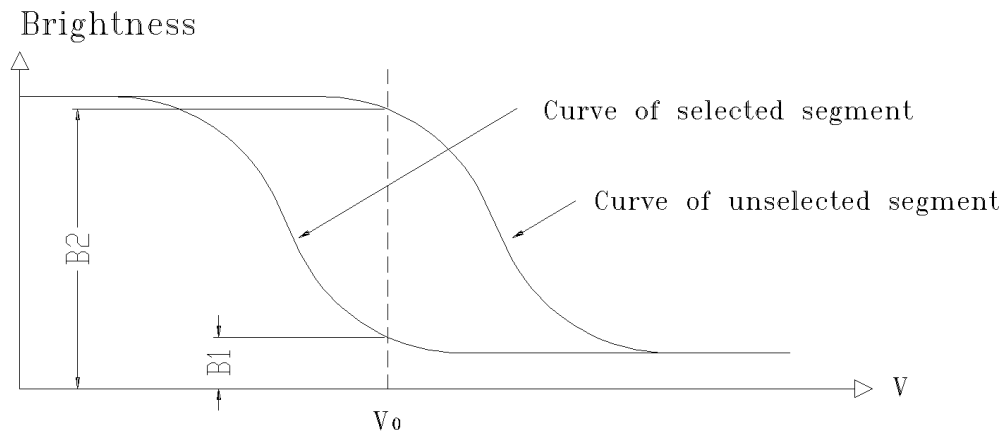
| Item | | Symbol | Condition | | Min. | Typ. | Max. | Unit |
|----------------|----------|------------|--|----------------------|------|------|------|------|
| Viewing Angle | | θ_x | $C_r \geq 2$ | $\theta_y = 0^\circ$ | -35 | -- | 20 | Deg |
| | | θ_y | | $\theta_x = 0^\circ$ | -30 | -- | 30 | |
| Contrast Ratio | | C_r | $\theta_x = 0^\circ$ $\theta_y = 0^\circ$ | | 4 | - | - | |
| Response Time | Turn on | T_{on} | $\theta_x = 0^\circ$ $\theta_y = 0^\circ$ | | - | - | 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

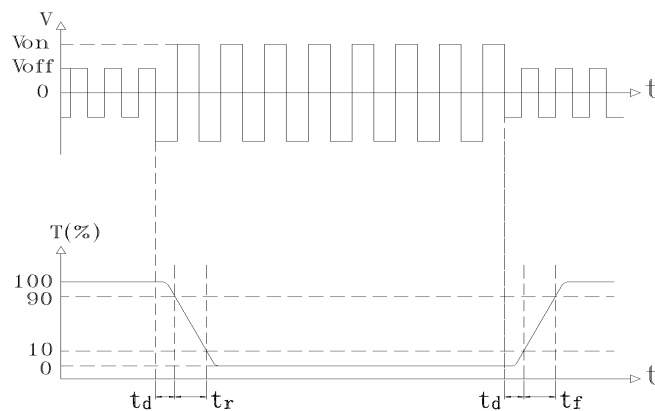


$$\text{Contrast Ratio} = B2/B1 = \frac{\text{unselected state brightness}}{\text{selected state brightness}}$$

Measuring Conditions:

1) Frame frequency: 100.0Hz

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: 6.5V

2) Frame frequency: 100.0Hz

8 Reliability

8.1 Environmental Test

Ta=25°C

| No. | Test Item | Content of Test | Test condition |
|-----|------------------------------------|---|---|
| 1 | High Temperature Storage | Endurance test applying the high storage temperature for a long time | 85°C 240H |
| 2 | Low Temperature Storage | Endurance test applying the low storage temperature for a long time | -30°C 240H |
| 3 | High Temperature Operation | Endurance test applying the electric stress (voltage & current) and the thermal stress to the element for a long time | 70°C 240H |
| 4 | Low Temperature Operation | Endurance test applying the electric stress under low temperature for a long time | -20°C 240H |
| 5 | High Temperature /Humidity Storage | Endurance test applying the high temperature and high humidity storage for a long time | 60°C 95%RH 240H 80°C 95%RH 48H (Non condensation) |
| 6 | Temperature Cycle | Endurance test applying the low and high temperature cycle $\begin{array}{ccccccc} -30^{\circ}\text{C} & \longleftrightarrow & 25^{\circ}\text{C} & \longleftrightarrow & 90^{\circ}\text{C} & \longleftrightarrow & 25^{\circ}\text{C} \\ 30\text{min} & & 5\text{min} & & 30\text{min} & & 5\text{min} \\ \longleftarrow & & & & & & \longrightarrow \\ & & & & & & 1 \text{ cycle} \end{array}$ | -30°C/90°C 10 cycles |
| 7 | Vibration Test (package state) | Endurance test applying the vibration during transportation | 10Hz~500Hz, 100m/s ² , 120min |
| 8 | Shock Test (package state) | Endurance test applying the shock during transportation | Half- sine wave, 300m/s ² , 18ms |
| 9 | Atmospheric Pressure Test | Endurance test applying the atmospheric pressure during transportation by air | 25kPa 16H |

8.2 Failure Judgment Criterion

| Criterion Item | Test Item No. | | | | | | | | | Failure Judgement Criterion |
|--------------------------|--|---|---|---|---|---|---|---|---|-------------------------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
| 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 or Test | At T _{amb} =25℃ (unless otherwise stated) | Inspection | | | | |
|---|---|-------------|------|------|----|-------------------------------|
| | | Min. | Max. | Unit | IL | AQL |
| External Visual Inspection | Under normal illumination and eyesight condition, the dis-tance between eyes and LCD is 25cm. | See annex A | | | II | Major 0.4 Minor 0.65 |
| Display Defects | Under normal illumination and eyesight condition, display on inspection. | See annex B | | | II | Major 0.4 Minor 0.65 |
| Note: Major defects: Open segment or common, Short, Serious damages, Leakage Miner defects: Others 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 : $0^{\circ}\text{C} \sim 40^{\circ}\text{C}$

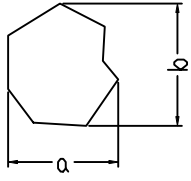
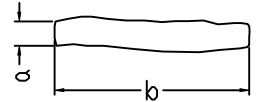
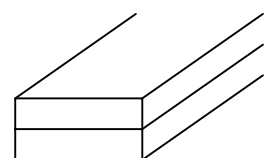
Relatively humidity: $\leq 80\%$

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.

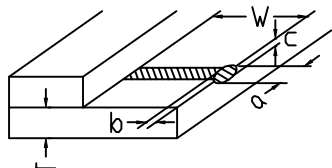
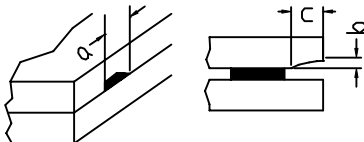
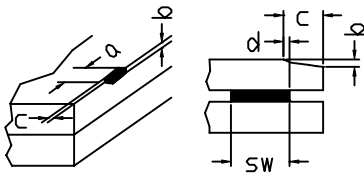
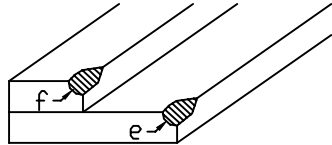
Annex A

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 | | Accoding to the limit specimen | | |
| Polarizer | Wrong polarizer attachment | Not permitted | | |
| | Bubble between polarizer and glass | not counted | Max. 3 defect allowed | |
| | | $\phi < 0.3\text{mm}$ | $0.3\text{mm} \leq \phi \leq 0.5\text{mm}$ | |
| | Scratches of polarizer | Accoding to the limit specimen | | |
| Black spot (in viewing area) |  | not counted | Max. 3 spots allowed | Max. 3 spots (lines) allowed |
| | | $X < 0.20\text{mm}$ | $0.20\text{mm} \leq X \leq 0.5\text{mm}$ | |
| | | $X = (a+b)/2$ | | |
| Black line (in viewing area) |  | not counted | Max. 3 lines allowed | |
| | | $a < 0.02\text{mm}$ | $0.02\text{mm} \leq a \leq 0.05\text{mm}$ $b \leq 2.0\text{mm}$ | |
| Progressive cracks |  | Not permitted | | |

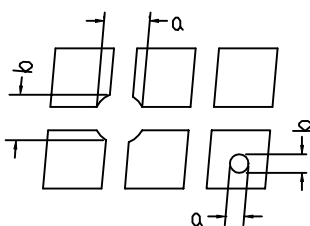
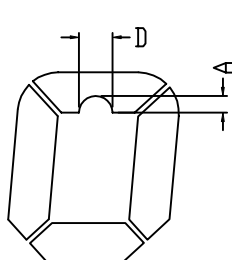
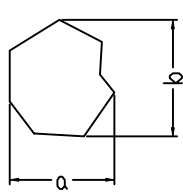
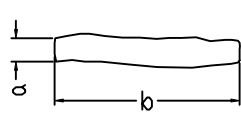
Annex A

Inspection items 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 | | | |
| | | <3mm | ≤W/5 | >T/2 | | | |
| | 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 ² f<2.0mm ² | | | | Max. 3 cracks allowed |

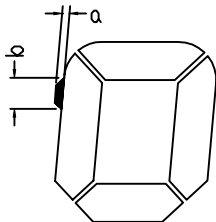
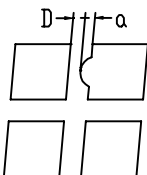
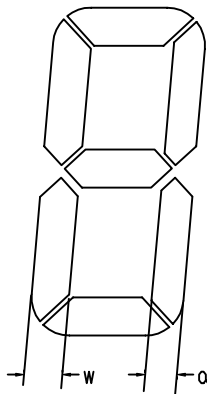
Annex B

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 ratio 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 |
| | | $X<0.1\text{mm}$ | $0.1\text{mm}\leq X\leq 0.2\text{mm}$ | |
| | | $X=(a+b)/2$ | | |
| |  | Not counted | Max. 2 dots allowed | |
| | | $A<0.1\text{mm}$ | $0.1\text{mm}\leq A\leq 0.2\text{mm}$ $D<0.25\text{mm}$ | |
| | | | | |
| Black spot (in viewing area) |  | Not counted | Max. 3 spots allowed | Max. 3 spots (lines) allowed |
| | | $X<0.1\text{mm}$ | $0.1\text{mm}\leq X\leq 0.2\text{mm}$ | |
| | | $X=(a+b)/2$ | | |
| Black line (in viewing area) |  | Not counted | Max. 3 lines allowed | |
| | | $a<0.02\text{mm}$ | $0.02\text{mm}\leq a\leq 0.05\text{mm}$ $b\leq 0.5\text{mm}$ | |

Annex B

Inspection items and criteria for display defects (continued)

| Items | Contents | Criteria | | |
|-----------------------------------|---|--|---|------------------------------|
| Transfor- mation of segment |  | Not counted | Max. 2 defects allowed | Max. 3 defects allowed |
| | | $X<0.1\text{mm}$ | $0.1\text{mm}\leq X\leq 0.20\text{mm}$ | |
| | | $X=(a+b)/2$ | | |
| |  | Not counted | Max. 1 defects allowed | |
| | | $a<0.1\text{mm}$ | $0.1\text{mm}\leq a\leq 0.20\text{mm}$ $D>0$ | |
| |  | Max. 2 defects allowed $0.8W\leq a\leq 1.2W$ a =measured value of width W =nominal value of width | | |