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# HTM12864H

## LCD Module User Manual

Shenzhen HOT Display Technology Co., Ltd.

| Rev. | Descriptions      | Date      |
|------|-------------------|-----------|
| 01   | Prelimiay Release | 2012-7-13 |

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# 1. Basic Specifications

## 1.1 Display Specifications

|                     |                               |
|---------------------|-------------------------------|
| 1>LCDDisplayMode    | STN, Positive, Transflective  |
| 2>Viewing Angle     | 6H                            |
| 3>Driving Method    | 1/64 Duty, 1/9 Bias           |
| 4>Interface         | 6800 MPU interface(8 Bit Bus) |
| 5>Backlight:        | 4 Pcs White LED (Parallel)    |
| 6>Controller/Driver | SBN0064G or EQUIV             |

## 1.2 Mechanical Specifications

|                     |  |
|---------------------|--|
| 1>Outline Dimension | 63.20X52.20 X11.50mm (See attached Outline Drawing for Data) |
| 2>Active Area       | 49.88(L)x31.32(W)  |
| 3>Pixel Pitch       | 0.49(L)x0.39(W)  |

## 1.3 Absolute Maximum Ratings

| Items                     | Symbol              | MIN. | MAX.                 | Unit | Condition           |
|---------------------------|---------------------|------|----------------------|------|---------------------|
| Power Supply Voltage      | V <sub>CC</sub>     | -0.3 | +5.5                 | V    | V <sub>SS</sub> =0v |
| Input Voltage             | V <sub>IN</sub>     | -0.3 | V <sub>DD</sub> +3.1 | V    | V <sub>SS</sub> =0v |
| LCD Driver Supply Voltage | V <sub>GH-VSS</sub> | -    | -12.0                | V    | -                   |
| Operating Temperature     | T <sub>OP</sub>     | -20  | +70                  | °C   | No Condensation     |
| Storage Temperature       | T <sub>st</sub>     | -30  | +80                  | °C   | No Condensation     |
| Storage Humidity          | H <sub>d</sub>      | -    | T <sub>a</sub> <40   | °C   |                     |

## 1.4 DC Electrical Characteristics

| Items                | Symbol          | MIN.      | TYP. | MAX.                | Unit | Condition             |
|----------------------|-----------------|-----------|------|---------------------|------|-----------------------|
| Logic Supply Voltage | IOVCC           | 1.65      | 4.5  | 5.5                 | V    | -                     |
| Input High Voltage   | V <sub>IH</sub> | 0.7 IOVCC | --   | IOVCC               | V    | -                     |
| Input Low Voltage    | V <sub>IL</sub> | -0.3      | -    | 0.3 V <sub>DD</sub> | V    | -                     |
| Output H Voltage     | V <sub>OH</sub> | 0.8 IOVCC |      | -                   | V    | -                     |
| Output L Voltage     | V <sub>OL</sub> | -         | -    | 0.2 IOVCC           | V    | -                     |
| Supply Current       | I               | -         | -    | 60                  | mA   | V <sub>bl</sub> =4.5V |

## 2. Absolute Maximum Ratings

| Items                 | Symbol          | MIN. | MAX.                 | Unit | Condition            |
|-----------------------|-----------------|------|----------------------|------|----------------------|
| Supply Voltage        | V <sub>DD</sub> | -0.3 | +5.5                 | V    | V <sub>SS</sub> = 0V |
| Input Voltage         | V <sub>IN</sub> | -0.3 | V <sub>DD</sub> +0.3 | V    | V <sub>SS</sub> = 0V |
| Operating Temperature | T <sub>OP</sub> | -20  | +70                  | °C   | No Condensation      |
| Storage Temperature   | T <sub>st</sub> | -30  | +80                  | °C   | No Condensation      |

## 3. Electrical Characteristics

### 3.1 DC Characteristics

| Items                                    | Symbol          | MIN.            | TYP.  | MAX.                  | Unit | Condition                    |
|--|-----------------|-----------------|-------|-----------------------|------|------------------------------|
| Operating Voltage                        | V <sub>DD</sub> | 4.5             | 5.0   | 5.5                   | V    | V <sub>DD</sub>              |
| Input High Voltage                       | V <sub>IH</sub> | 2.0             | -     | V <sub>DD</sub>       | V    | /CS1,/RES,RS,R/W,<br>E,D0~D7 |
| Input Low Voltage                        | V <sub>IL</sub> | V <sub>SS</sub> | -     | 0.3 x V <sub>DD</sub> | V    |                              |
| Output High Voltage                      | V <sub>OH</sub> | 2.4             | -     | V <sub>DD</sub>       | V    | D0~D7                        |
| Output Low Voltage                       | V <sub>OL</sub> | -               | -     | 0.4                   | V    | D0~D7                        |
| Input Leakage Current                    | I <sub>LI</sub> | -1.0            | -     | 1.0                   | μA   | V <sub>DD</sub>              |
| Output Leakage Current                   | I <sub>Lo</sub> | -               | 1.5   | -                     | mA   | V <sub>DD</sub>              |
| Supply Step-up output<br>voltage Circuit | VLCDIN          | -8.0            | -10.0 | -12.0                 | V    | V <sub>SS</sub>              |

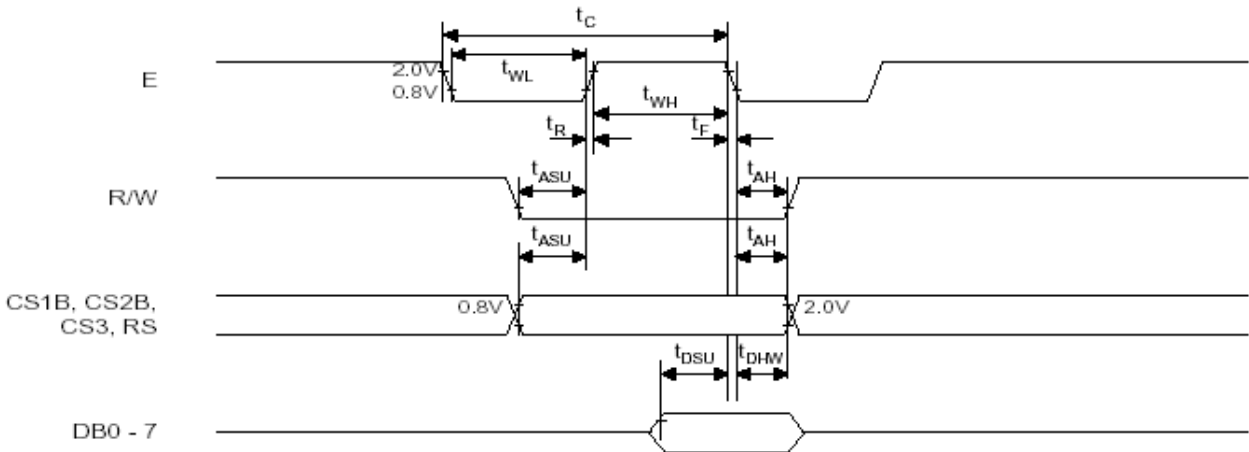
### 3.2 LED Backlight Circuit

| Items           | Symbol             | MIN. | TYP. | MAX. | Unit | Condition       |
|-----------------|--------------------|------|------|------|------|-----------------|
| Forword Voltage | V <sub>f</sub> BLA | -    | 5.0  | -    | V    | V <sub>DD</sub> |
| Forword Current | I <sub>f</sub> BLA | -    | 60   | 80   | mA   | 4 PCS LED       |

### 3.3 AC Characteristics

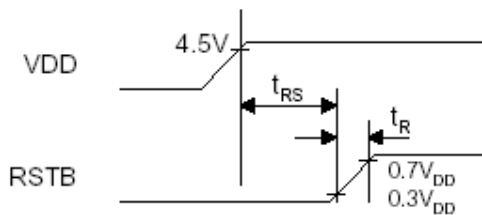
#### 6800 Mode System Bus Timing

| Characteristic         | Symbol    | Min  | Typ | Max | Unit |
|------------------------|-----------|------|-----|-----|------|
| E cycle                | $t_C$     | 1000 | -   | -   | ns   |
| E high level width     | $t_{WH}$  | 450  | -   | -   | ns   |
| E low level width      | $t_{WL}$  | 450  | -   | -   | ns   |
| E rise time            | $t_R$     | -    | -   | 25  | ns   |
| E fall time            | $t_F$     | -    | -   | 25  | ns   |
| Address set-up time    | $t_{ASU}$ | 140  | -   | -   | ns   |
| Address hold time      | $t_{AH}$  | 10   | -   | -   | ns   |
| Data set-up time       | $t_{DSU}$ | 200  | -   | -   | ns   |
| Data delay time        | $t_D$     | -    | -   | 320 | ns   |
| Data hold time (write) | $t_{DHW}$ | 10   | -   | -   | ns   |
| Data hold time (read)  | $t_{DHR}$ | 20   | -   | -   | ns   |

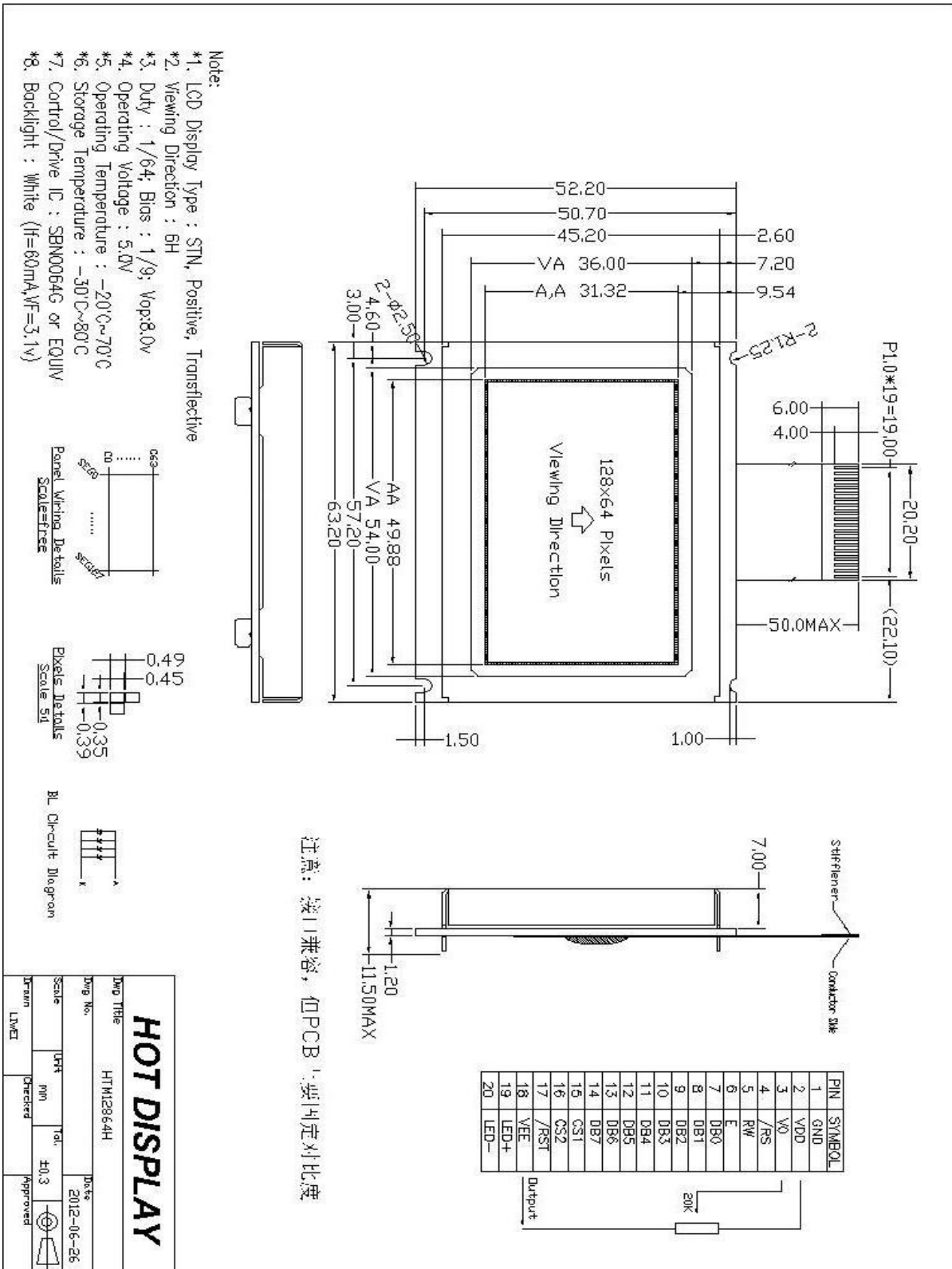


### 3.4 Rest Timing

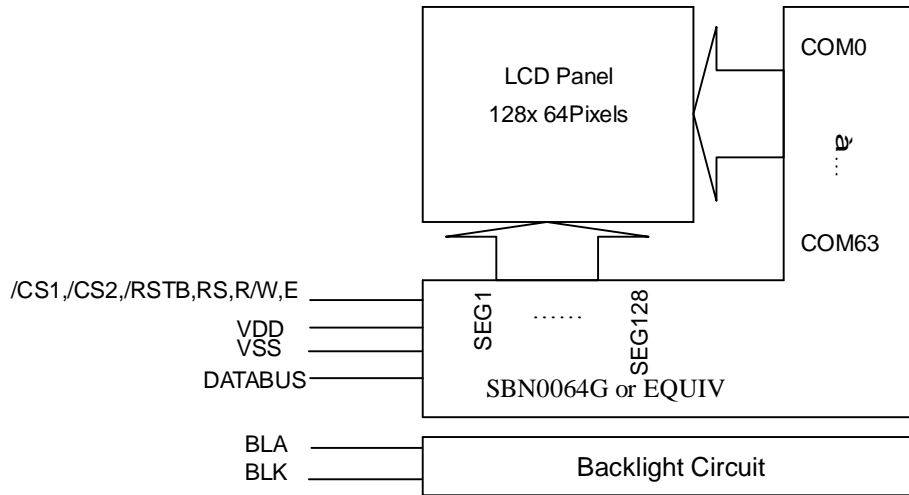
| Item       | Symbol   | Min | Typ | Max | Unit |
|------------|----------|-----|-----|-----|------|
| Reset time | $t_{RS}$ | 1.0 | -   | -   | us   |
| Rise time  | $t_R$    | -   | -   | 200 | ns   |



### 4. Structure Block



#### 4.1 Circuit Diagram



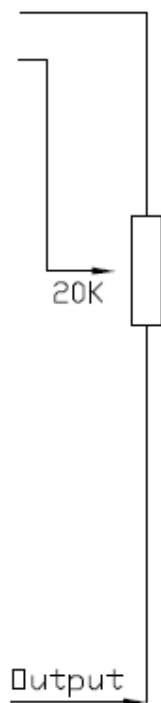
#### 4.2 Terminal Function

| Pin No. | Pin Name | Function                               |
|---------|----------|--|
| 1       | GND      | VSS                                    |
| 2       | VDD      | LCD Positive(5.0V)                     |
| 3       | V0       | LCD Adjust                             |
| 4       | RS       | H:Data; L: Instruction                 |
| 5       | R/W      | H:Read ; L: Write.                     |
| 6       | E        | Enable signal.                         |
| 7~14    | DB0~DB7  | Data Buss                              |
| 15      | /CS1     | Chip selection input 1 (Low effective) |
| 16      | /CS2     | Chip selection input 2 (Low effective) |
| 17      | /RST     | Reset Signal input                     |
| 18      | VEE      | About -10.0V                           |
| 19      | LED+     | Bcaklight Positive(5.0V)               |
| 20      | LED-     | Bcaklight Negative(VSS)                |

## 5. Function specifications

### 5.1 The Parallel Interface

| PIN | SYMBOL |
|-----|--------|
| 1   | GND    |
| 2   | VDD    |
| 3   | V0     |
| 4   | /RS    |
| 5   | RW     |
| 6   | E      |
| 7   | DB0    |
| 8   | DB1    |
| 9   | DB2    |
| 10  | DB3    |
| 11  | DB4    |
| 12  | DB5    |
| 13  | DB6    |
| 14  | DB7    |
| 15  | CS1    |
| 16  | CS2    |
| 17  | /RST   |
| 18  | VEE    |
| 19  | LED+   |
| 20  | LED-   |





## 5.2 Display Commands

| Instruction                    | RS | R/W | DB7        | DB6 | DB5                         | DB4   | DB3 | DB2          | DB1 | DB0 | Function  |  |
|--------------------------------|----|-----|------------|-----|-----------------------------|-------|-----|--------------|-----|-----|---|--|
| Display on/off                 | L  | L   | L          | L   | H                           | H     | H   | H            | H   | L/H | Controls the display on or off. Internal status and display RAM data is not affected. L: OFF, H: ON                       |  |
| Set address (Y address)        | L  | L   | L          | H   | Y address (0 - 63)          |       |     |              |     |     | Sets the Y address in the Y address counter.  |  |
| Set page (X address)           | L  | L   | H          | L   | H                           | H     | H   | Page (0 - 7) |     |     | Sets the X address at the X address register.   |  |
| Display start line (Z address) | L  | L   | H          | H   | Display start line (0 - 63) |       |     |              |     |     | Indicates the display data RAM displayed at the top of the screen.  |  |
| Status read                    | L  | H   | Busy       | L   | On / Off                    | Reset | L   | L            | L   | L   | Read status.<br>BUSY L: Ready<br>H: In operation<br>ON/OFF L: Display ON<br>H: Display OFF<br>RESET L: Normal<br>H: Reset |  |
| Write display data             | H  | L   | Write data |     |                             |       |     |              |     |     |   | Writes data (DB0:7) into display data RAM. After writing instruction, Y address is increased by 1 automatically. |
| Read display data              | H  | H   | Read data  |     |                             |       |     |              |     |     |   | Reads data (DB0: 7) from display data RAM to the data bus.   |

```

void WrateC(uchar cmd)
{
Cselect();
R_S=0;
RW=0;
P1=cmd;
E=1;
E=0;
CS1=1;CS2=1;
}
void WriteData(uchar dat)
{
Cselect();
R_S=1;
RW=0;
P1=dat;
E=1;
E=0;

```

```

CS1=1;CS2=1;}
void Cselect()
{
if(chip_select==0)
{CS1=0;CS2=1;}
if(chip_select==1)
{CS1=1;CS2=0;}
}
void Setadd(uchar column,uchar page)
{
if(column<64)
chip_select=0;
else
{ chip_select=1; column-=63; }
WrateC(page+0xB8);
WrateC(column+0x40);
}

```

**5.3 Basic Operating Sequence  
Initialization Sequence**

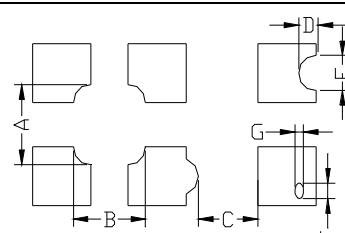
|  | Code Function |    |    |    |    |    |    |    |    |     | Note  |  |
|--|---------------|----|----|----|----|----|----|----|----|-----|---|--|
|  | A0            | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | hex |   |  |
| Turn on Power Supply VDD & VSS While maintaining /RES at LOW | -             | -  | -  | -  | -  | -  | -  | -  | -  | -   | -   |  |
| Wait until power supply is stabilized                        | -             | -  | -  | -  | -  | -  | -  | -  | -  | -   | -   |  |
| Release the /RES Reset Signal (/RES = High)                  | -             | -  | -  | -  | -  | -  | -  | -  | -  | -   |   |  |
| START LINE   | 0             | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | C0H | Sets the X address at the X address register. |  |
| DISPLAY ON   | 0             | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 3FH |   |  |
| SET PAGE   | 0             | 1  | 0  | 1  | 1  | 8  | 0  | 0  | 0  | B8H | Sets the X address at the X address register. |  |
| SET ADDRESS  | 0             | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 40H | Sets the Y address in the Y address counter.  |  |
| WRITE DATA   | 1             | X  | X  | X  | X  | X  | X  | X  | X  | XXH | DISPLAY DATA                                  |  |

**Example: Clear The LCD**

```

void ClearLCD()
{
    uchar page,column;
    chip_select=0;
    WrateC(0x3f);
    WrateC(0xC0);
    chip_select=1;
    WrateC(0x3f);
    WrateC(0xC0);
    for(page=0;page<8;page++)
    {
        for(column=0;column<128;column++)
        {
            Setadd(column,page);
            WriteData(0x00);
        }
    }
}
    
```

## 6. Inspection Standards

| Item   | Criterion for defects   | Defect type |
|--|---|-------------|
| 1) Display on inspection                                 | (1) Non display<br>(2) Vertical line is deficient<br>(3) Horizontal line is deficient<br>(4) Cross line is deficient  | Major       |
| 2) Black / White spot                                    | Size $\Phi$ (mm)      Acceptable number<br>$\Phi \leq 0.3$ Ignore (note)<br>$0.3 < \Phi \leq 0.45$ 3<br>$0.45 < \Phi \leq 0.6$ 1<br>$0.6 < \Phi$ 0  | Minor       |
| 3) Black / White line                                    | Length (mm)    Width (mm)      Acceptable number<br>$L \leq 10$ $W \leq 0.03$ Ignore<br>$5.0 \leq L \leq 10$ $0.03 < W \leq 0.04$ 3<br>$5.0 \leq L \leq 10$ $0.04 < W \leq 0.05$ 2<br>$1.0 \leq L \leq 10$ $0.05 < W \leq 0.06$ 2<br>$1.0 \leq L \leq 10$ $0.06 < W \leq 0.08$ 1<br>$L \leq 10$ $0.08 < W$ follows 2) point defect<br>Defects separate with each other at an interval of more than 20mm | Minor       |
| 4) Display pattern                                       |  <p style="text-align: center;"> <math>\frac{A+B \leq 0.28}{2}</math>    <math>0 &lt; C</math>    <math>\frac{D+E \leq 0.25}{2}</math>    <math>\frac{F+G \leq 0.25}{2}</math> </p> <p>Note: 1) Up to 3 damages acceptable<br/> 2) Not allowed if there are two or more pinholes every three-fourth inch.</p>         | Minor       |
| 5) Spot-like contrast irregularity                       | Size $\Phi$ (mm)      Acceptable Number<br>$\Phi \leq 0.7$ Ignore (note)<br>$0.7 < \Phi \leq 1.0$ 3<br>$1.0 < \Phi \leq 1.5$ 1<br>$1.5 < \Phi$ 0<br>Note: 1) Conformed to limit samples.<br>2) Intervals of defects are more than 30mm.   | Minor       |
| 6) Bubbles in polarizer                                  | Size $\Phi$ (mm)      Acceptable Number<br>$\Phi \leq 0.4$ Ignore (note)<br>$0.4 < \Phi \leq 0.65$ 2<br>$0.65 < \Phi \leq 1.2$ 1<br>$1.2 < \Phi$ 0  | Minor       |
| 7) Scratches and dent on the polarizer                   | Scratches and dent on the polarizer shall be in the accordance with "2) Black/white spot", and "3) Black/White line".   | Minor       |
| 8) Stains on the surface of LCD panel                    | Stains which cannot be removed even when wiped lightly with a soft cloth or similar cleaning.   | Minor       |
| 9) Rainbow color   | No rainbow color is allowed in the optimum contrast on state within the active area.  | Minor       |
| 10) Viewing area encroachment                            | Polarizer edge or line is visible in the opening viewing area due to polarizer shortness or sealing line.   | Minor       |
| 11) Bezel appearance                                     | Rust and deep damages that are visible in the bezel are rejected.   | Minor       |
| 12) Defect of land surface contact                       | Evident crevices that are visible are rejected.   | Minor       |
| 13) Parts mounting                                       | (1) Failure to mount parts<br>(2) Parts not in the specifications are mounted<br>(3) For example: Polarity is reversed, HSC or TCP falls off.   | Minor       |
| 14) Part alignment                                       | (1) LSI, IC lead width is more than 50% beyond pad outline.<br>(2) More than 50% of LSI, IC leads is off the pad outline.   | Minor       |
| 15) Conductive foreign matter (solder ball, solder hips) | (1) $0.45 < \Phi$ , $N \geq 1$<br>(2) $0.3 < \Phi \leq 0.45$ , $N \geq 1$ , $\Phi$ : Average diameter of solder ball (unit: mm)<br>(3) $0.5 < L$ , $N \geq 1$ , L: Average length of solder chip (unit: mm)   | Minor       |
| 16) Bezel flaw   | Bezel claw missing or not bent  | Minor       |
| 17) Indication on name plate (sampling indication label) | (1) Failure to stamp or label error, or not legible.(all acceptable if legible)<br>(2) The separation is more than 1/3 for indication discoloration, in which the characters can be checked.  | Minor       |

## 8. Handling Precautions

### 8.1 Mounting method

A panel of LCD module made by our company consists of two thin glass plates with polarizers that easily get damaged.

And since the module is so constructed as to be fixed by utilizing fitting holes in the printed circuit board (PCB), extreme care should be used when handling the LCD modules.

### 8.2 Cautions of LCD handling and cleaning

When cleaning the display surface, use soft cloth with solvent (recommended below) and wipe lightly.

- Isopropyl alcohol
- Ethyl alcohol
- Trichlorotrifluoroethane

Do not wipe the display surface with dry or hard materials that will damage the polarizer surface.

Do not use the following solvent:

- Water
- Ketene
- Aromatics

### 8.3 Caution against static charge

The LCD module uses C-MOS LSI drivers. So we recommend you:

Connect any unused input terminal to  $V_{dd}$  or  $V_{ss}$ . Do not input any signals before power is turned on, and ground your body, work/assembly areas, assembly equipment to protect against static electricity.

### 8.4 Packaging

- Module employs LCD elements, and must be treated as such. Avoid intense shock and falls from a height.
- To prevent modules from degradation, do not operate or store them exposed directly to sunshine or high temperature/humidity.

### 8.5 Caution for operation

-It is an indispensable condition to drive LCD module within the limits of the specified voltage since the higher voltage over the limits may cause the shorter life of LCD module.

-An electrochemical reaction due to DC (direct current) causes LCD undesirable deterioration so that the uses of DC (direct current) drive should be avoided.

-Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD module may show dark color in them. However those phenomena do not mean malfunction or out of order of LCD module, which will come back in the specified operating temperature.

### 8.6 Storage

In the case of storing for a long period of time, the following ways are recommended:

- Storage in polyethylene bag with the opening sealed so as not to enter fresh air outside in it. And with not desiccant.
- Placing in a dark place where neither exposure to direct sunlight nor light is. Keeping the storage temperature range.
- Storing with no touch on polarizer surface by any thing else.

### 8.7 Safety

-It is recommendable to crush damaged or unnecessary LCD into pieces and to wash off liquid crystal by either of solvents such as acetone and ethanol, which should be burned up later.

-When any liquid leaked out of a damaged glass cell comes in contact with your hands, please wash it off well at once with soap and water.