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## LCD MODULE SPECIFICATION FOR CUSTOMER'S APPROVAL

**CUSTOMER** : \_\_\_\_\_

**MODULE TYPE** : NMTG-S12864BFYHSGY-B

**APPROVED BY: (FOR CUSTOMER USE ONLY)**

| Approved by   | Checked by  |  | Made by   |
|---|---|--|---|
|  |  |  |  |



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**SPECIFICATION FOR**  
**LIQUID CRYSTAL DISPLAY MODULE**  
**MODEL NO. : NMTG-S12864BFYHSGY-B**

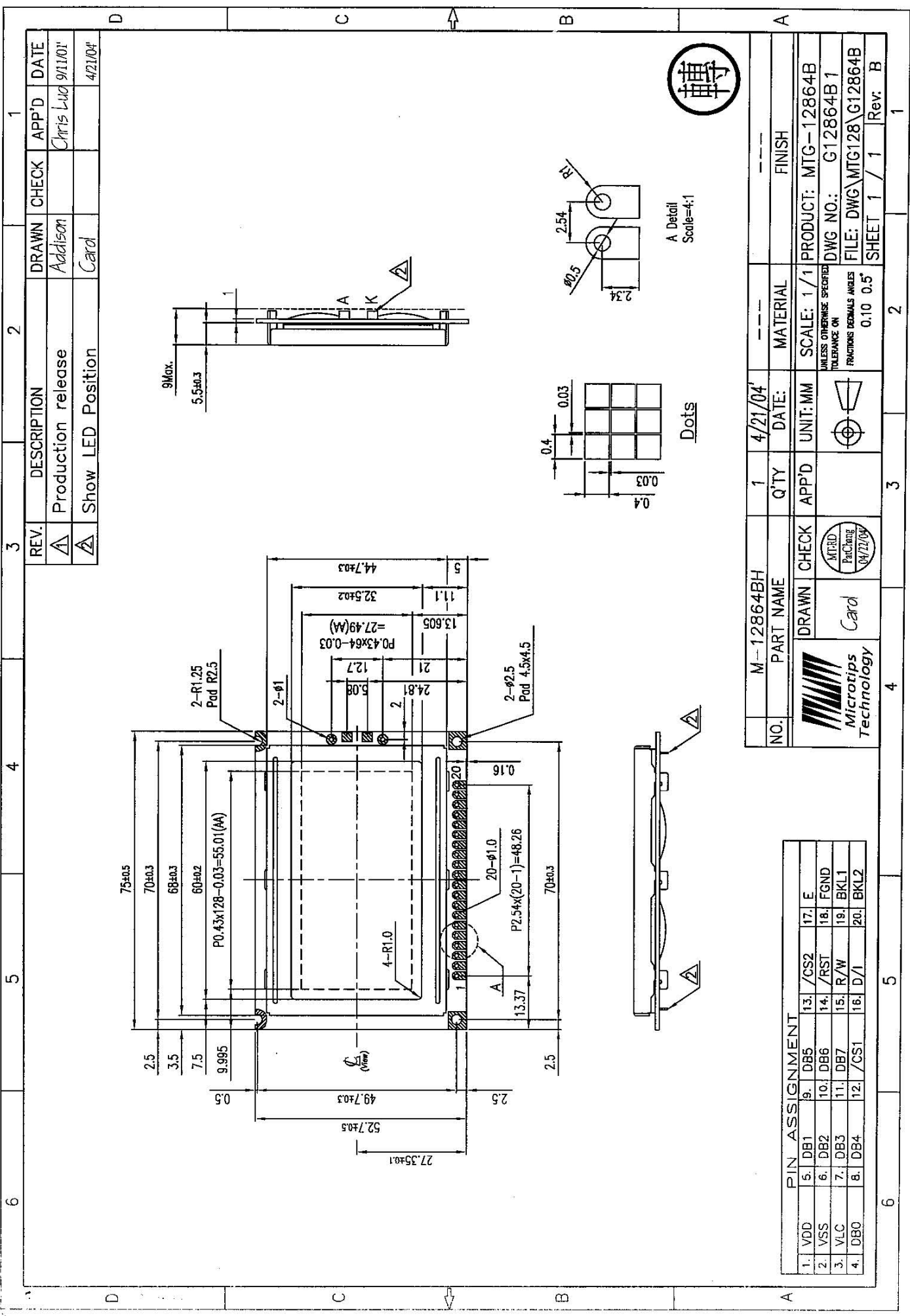
|                   |  |                               |  |  |                                       |
|-------------------|--|-------------------------------|--|--|---------------------------------------|
| View Direction    | <input checked="" type="checkbox"/> 6 O'clock    |                               | <input type="checkbox"/> 12 O'clock                  |  |                                       |
| LCD Type          | <input type="checkbox"/> FSTN Positive           |                               | <input type="checkbox"/> FSTN Negative               |  |                                       |
|                   | <input type="checkbox"/> STN Gray                |                               | <input checked="" type="checkbox"/> STN Yellow Green |  | <input type="checkbox"/> STN Blue     |
| Rear Polarizer    | <input type="checkbox"/> Reflective              |                               | <input checked="" type="checkbox"/> Transflective    |  | <input type="checkbox"/> Transmissive |
| Backlight Type    | <input checked="" type="checkbox"/> LED          | <input type="checkbox"/> EL   |  | <input checked="" type="checkbox"/> Internal Power |                                       |
|                   |  | <input type="checkbox"/> CCFL |  | <input type="checkbox"/> External Power            |                                       |
| Backlight Color   | <input type="checkbox"/> White                   |                               | <input type="checkbox"/> Amber                       |  | <input type="checkbox"/> Blue Green   |
|                   | <input checked="" type="checkbox"/> Yellow Green |                               | <input type="checkbox"/> Other                       |  |                                       |
| Temperature Range | <input type="checkbox"/> Normal                  |                               | <input checked="" type="checkbox"/> Wide             |  | <input type="checkbox"/> Super Wide   |
| EL Driver IC      | <input type="checkbox"/> Build-in                |                               | <input checked="" type="checkbox"/> Not Build-in     |  |                                       |
| Touch Screen      | <input type="checkbox"/> With                    |                               | <input checked="" type="checkbox"/> Without          |  |                                       |
| LCD LSI           | SBN640G21 / SBN0064G-D                           |                               |  |  |                                       |

**TO BE VERY CAREFUL !**

The LCD driver ICs are made by CMOS process, which are very easy to be damaged by static charge, make sure the user is grounded when handling the LCM.



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|      |                    |         |       |           |         |
|------|--------------------|---------|-------|-----------|---------|
| REV. | DESCRIPTION        | DRAWN   | CHECK | APP'D     | DATE    |
| A    | Production release | Addison |       | Chris Luo | 9/11/01 |
| B    | Show LED Position  | Card    |       |           | 4/21/04 |

| PIN ASSIGNMENT |           |
|----------------|-----------|
| 1. VDD         | 5. DB1    |
| 2. VSS         | 6. DB2    |
| 3. V1C         | 7. DB3    |
| 4. DB0         | 8. DB4    |
| 9. DB5         | 13. /CS2  |
| 10. DB6        | 14. /RST  |
| 11. DB7        | 15. R/W   |
| 12. /CS1       | 16. D/I   |
| 17. E          | 18. FGND  |
|                | 19. BK1.1 |
|                | 20. BK1.2 |

|                      |           |             |      |   |         |            |                     |                    |     |
|----------------------|-----------|-------------|------|---|---------|------------|---------------------|--------------------|-----|
| NO.                  | M-12864BH | Q'TY        | 1    | DATE:   | 4/21/04 | MATERIAL   | ---                 | FINISH             | --- |
| PART NAME            |           | APP'D       |      | UNIT:MM   |         | SCALE: 1/1 | PRODUCT: MTG-12864B |                    |     |
| DRAWN                |           | CHECK       | Card | UNLESS OTHERWISE SPECIFIED TOLERANCE ON FRACTIONS DECIMALS ANGLES |         | 0.10 0.5   | DWG NO.:            | G12864B 1          |     |
| MTCED                |           | Part Change |      | 04/22/04  |         |            | FILE:               | DWG\MTG128\G12864B |     |
| Microtips Technology |           | Card        |      | 04/22/04  |         |            | SHEET               | 1 / 1              |     |
|                      |           | 3           |      | 2   |         |            |                     | Rev. B             |     |

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## GENERAL SPECIFICATION

| Item                    | Content   |
|-------------------------|---|
| Display Resolution      | 128(W)×64(H)  |
| Dimensional Outline(mm) | 75.0(W)×52.7(H)×9.0max(D)                                 |
| Dot Size                | 0.40(W)mm×0.40(H)mm                                       |
| Dot Pitch               | 0.43(W)mm×0.43(H)mm                                       |
| Display mode            | Transflective/ Positive Type                              |
| Circuit                 | Common-Driver IC, Segment-driver IC with build-in SRAM    |
| Interface               | Data (D0~D7), D/I, R/W, E, RST, CS1, CS2, V <sub>EE</sub> |

## ABSOLUTE MAXIMUM RATING

### (1) Electrical Absolute Ratings

| Item                      | Symbol                           | Min. | Max.                 | Unit | Note   |
|---------------------------|----------------------------------|------|----------------------|------|--------|
| Power Supply for Logic    | V <sub>DD</sub> -V <sub>SS</sub> | -0.3 | 7.0                  | Volt | -      |
| Power Supply for LCD      | V <sub>DD</sub> -V <sub>EE</sub> | -0.3 | 19.0                 | Volt | -      |
| Input Voltage             | V <sub>I</sub>                   | -0.3 | V <sub>DD</sub> +0.3 | Volt | -      |
| Current for LED backlight | -                                | -    | 200                  | mA   | -      |
| Static Electricity        | -                                | -    | -                    | -    | Note 1 |

Note 1: Operator should be grounded during handling LCM.

### (2) Environmental Absolute Maximum Ratings

| Item                           | Normal Temperature |       |          |       | Wide Temperature |       |          |       |
|--------------------------------|--------------------|-------|----------|-------|------------------|-------|----------|-------|
|                                | Operating          |       | Storage  |       | Operating        |       | Storage  |       |
|                                | Max,               | Min.  | Max,     | Min.  | Max,             | Min.  | Max,     | Min.  |
| Ambient Temperature            | 0°C                | +50°C | -20°C    | +70°C | -20°C            | +70°C | -30°C    | +80°C |
| Humidity(without condensation) | Note 2,4           |       | Note 3,5 |       | Note 4,5         |       | Note 4,6 |       |

Note 2 Ta ≤ 50°C: 80% RH max

Ta > 50°C: Absolute humidity must be lower than the humidity of 85%RH at 50°C

Note 3 Ta at -20°C will be < 48hrs at 70°C will be < 120hrs when humidity is higher than 75%.

Note 4 Background color changes slightly depending on ambient temperature. This phenomenon is reversible.

Note 5 Ta ≤ 70°C: 75RH max

Ta > 70°C: absolute humidity must be lower than the humidity of 75%RH at 70°C

Note 6 Ta at -30°C will be < 48hrs, at 80 °C will be < 120hrs when humidity is higher than 75%.



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## ELECTRICAL CHARACTERISTICS

| Item                                     | Symbol                       | Condition   | Min.         | Typ            | Max.     | Unit | note |
|--|------------------------------|---|--------------|----------------|----------|------|------|
| Power Supply for Logic                   | $V_{DD}-V_{SS}$              | -   | 4.5          | 5.0            | 5.5      | Volt | -    |
| Input Voltage                            | $V_{IL}$                     | L level   | 0            | -              | 0.8      | Volt | -    |
|  | $V_{IH}$                     | H level   | $V_{DD}-2.2$ | -              | $V_{DD}$ | Volt | -    |
| LCM Recommend LCD Module Driving Voltage | $V_{DD}-V_{EE}$              | $T_a=-20^{\circ}\text{C}$   | 9.14         | 9.64           | 10.14    | Volt | -    |
|  |                              | $T_a=25^{\circ}\text{C}$  | 8.60         | 9.10           | 9.60     |      |      |
|  |                              | $T_a=70^{\circ}\text{C}$  | 8.06         | 8.56           | 9.06     |      |      |
| Power Supply Current for LCM             | $I_{DD}(\text{LED B/L OFF})$ | $V_{DD}=5.0\text{V}$<br>$T_a=25^{\circ}\text{C}$<br>$V_{DD}-V_{EE}=10.3\text{V}$<br>$V_{LED}=5.0\text{V}$ | -            | 1.5            | 1.8      | mA   | -    |
|  | $I_{EE}$                     |   | -            | 0.6            | 1.0      |      |      |
|  | $I_{LED}$                    |   | -            | 100            | 150      |      |      |
| Power Supply for EL Backlight            | $V_{EL}$                     |   | -            | 100V/<br>400Hz | -        | -    | -    |

## OPTICAL CHARACTERISTICS

| Item          | Symbol     | Condition  | Min. | Typ | Max. | Unit | note |
|---------------|------------|--|------|-----|------|------|------|
| Viewing Angle | Front-Back | $\theta=0^{\circ}$                                       | 30   | 92  | -    | deg. | -    |
|               | Left-Right | $\theta=0^{\circ}$                                       | 60   | 90  | -    | deg. | -    |
| Rise Time     | $T_r$      | $V_{DD}-V_{EE}=10.3\text{V}$<br>$T_a=25^{\circ}\text{C}$ | -    | 90  | 220  | mS   | -    |
| Fall Time     | $T_f$      |  | -    | 210 | 200  |      |      |
| Contrast      | Cr         |  | 2.0  | 6.0 | -    |      |      |



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## INTERFACE PIN ASSIGNMENT

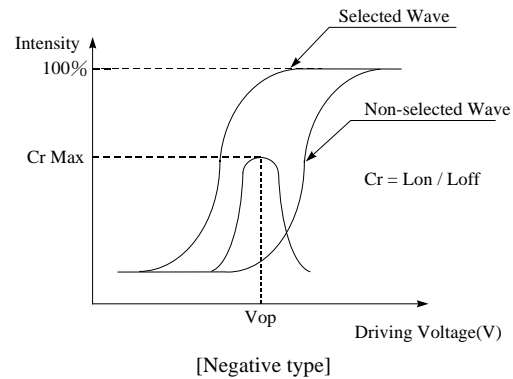
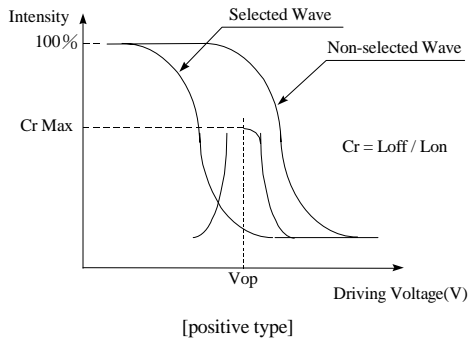
| Pin No.      | Pin Out          | I/O | Description  |
|--------------|------------------|-----|--|
| 1            | V <sub>DD</sub>  | -   | Logic supply voltage   |
| 2            | V <sub>SS</sub>  | -   | GND  |
| 3            | V <sub>EE</sub>  | -   | Supply Voltage for LCD panel.  |
| 4<br> <br>11 | DB0<br> <br>DB7  | I/O | Data bus. 3-state I/O common terminal.   |
| 12           | /CS1             | I   | Chip-select for the left half of the display. Active LOW.  |
| 13           | /CS2             | I   | Chip-select for the right half of the display. Active LOW.   |
| 14           | /RST             | I   | Setting the RES signal to Low level can initialize the following registers.<br>1. ON/OFF register 0 set(Display off)<br>2. Display start line register 0 set(display starts from line 0)<br>After releasing reset, this condition can be changed only by software. |
| 15           | R/W              | I   | Read/Write<br>R/W=high : Data of DB0~DB7 can be read by CPU.<br>R/W=low : Data of DB0~DB7 can be written into LCD driver IC at the falling edge of E when CS1 and CS2 is high.   |
| 16           | D/I              | I   | Data/Instruction<br>D/I=high : Indicates that data of DB0~DB7 is display data.<br>D/I=low : Indicates that data of DB0~DB7 is instruction.   |
| 117          | E                | I   | Enable<br>When write(R/W=low) : Data of DB0~DB7 is latched at the fall of E<br>When read(R/W=high) : Data is read while E is at high level.  |
| 18           | FGND             | -   | Frame Ground   |
| 19           | BKL <sub>A</sub> | -   | Power supply for backlight.<br>(4.2V/100~150 mA DC for LED backlight, 110V/400Hz AC for EL)  |
| 20           | BKL <sub>K</sub> | -   |  |



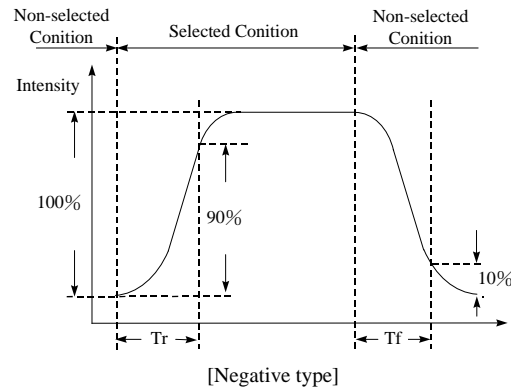
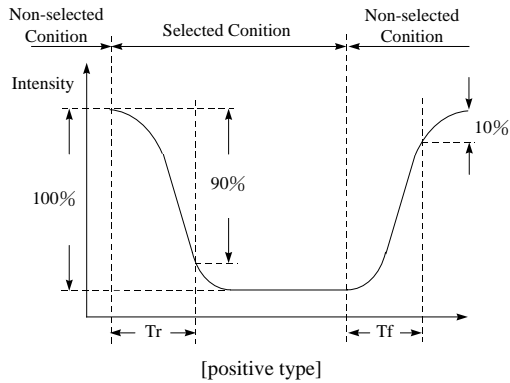
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**[Note 7] Definition of Operation Voltage (Vop)**



**[Note 8] Definition of Response Time (Tr, Tf)**

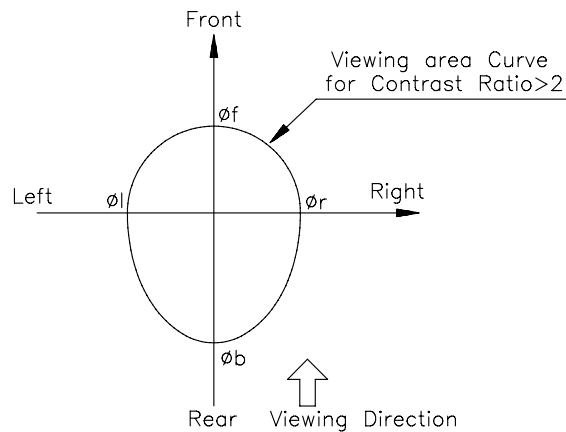


**Conditions:**

Operating Voltage : Vop  
 Frame Frequency : 64 Hz

Viewing Angle ( $\theta, \phi$ ):  $0^\circ, 0^\circ$   
 Driving Wave form : 1/N duty, 1/a bias

**[Note 9] Definition of Viewing Direction**

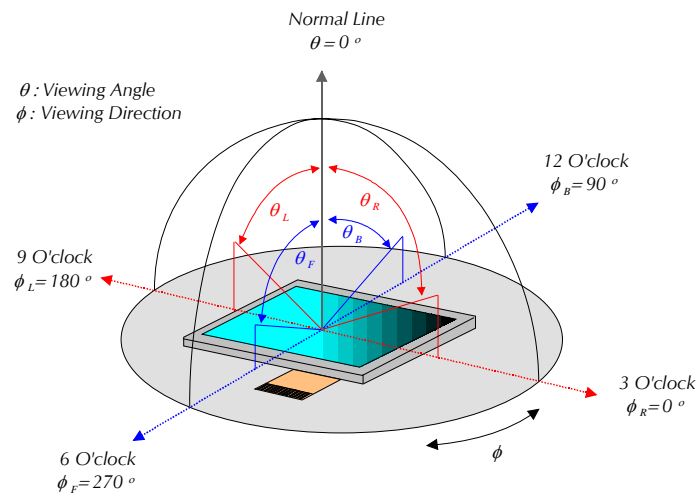


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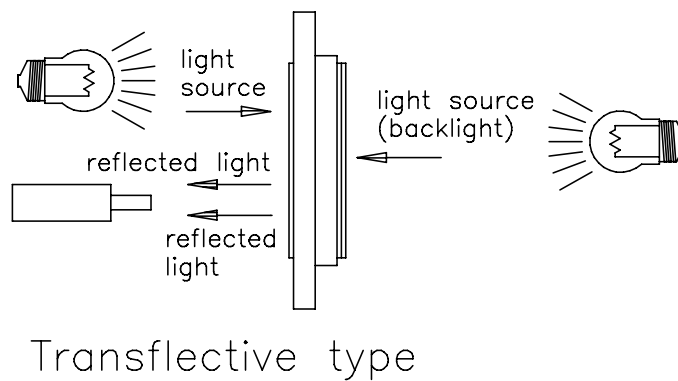
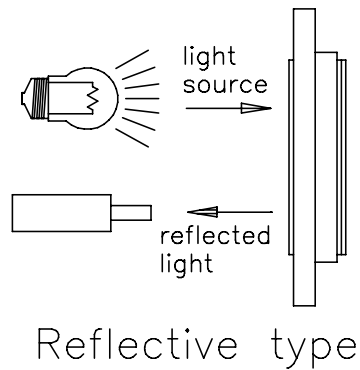


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**[Note 10] Definition of viewing angle**



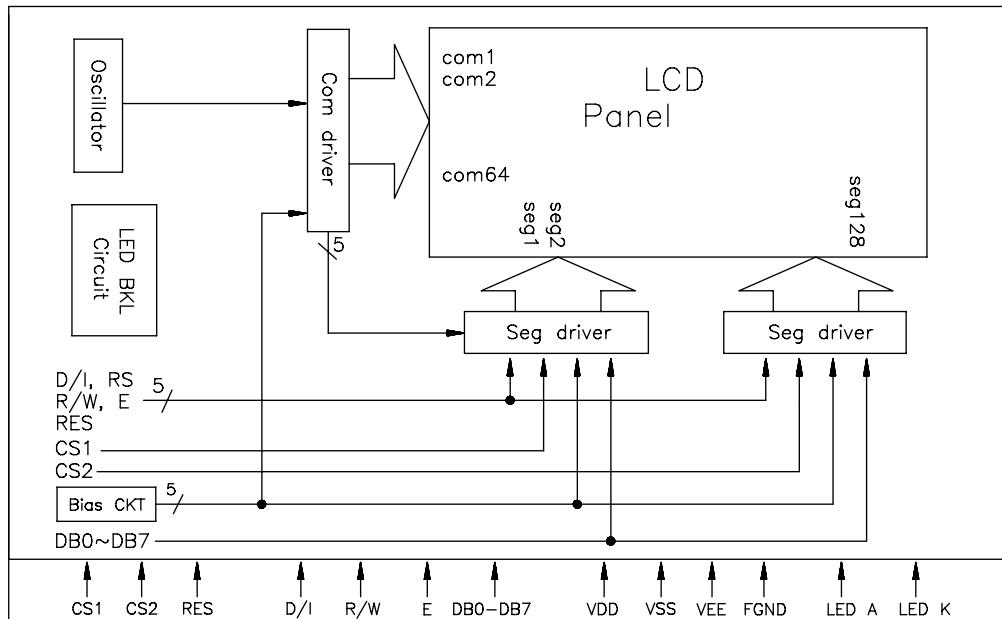
**[Note 11] Description of Measuring Equipment**



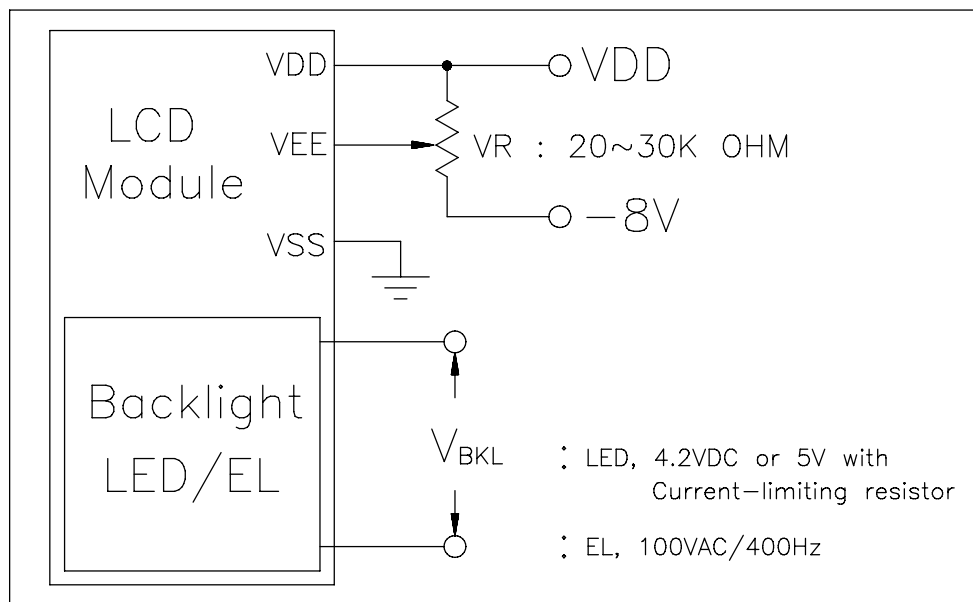
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## BLOCK DIAGRAM



## POWER SUPPLY



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## TIMING CHARACTERISTICS

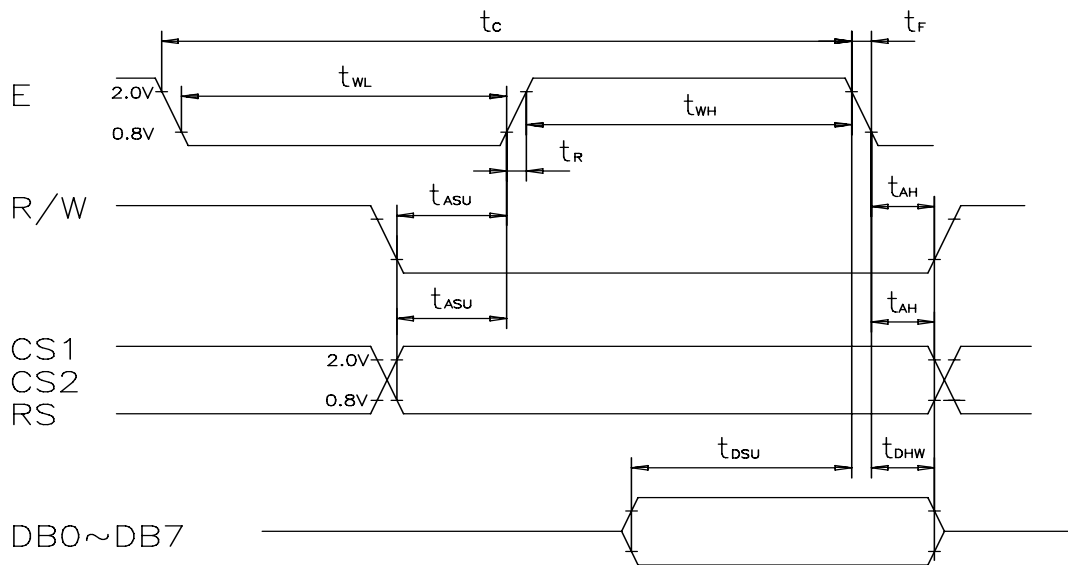
MPU interface timing: ( $V_{SS}=0V$ ,  $V_{DD}=4.5V\sim 5.5V$ ,  $T_a=-20$  to  $60^{\circ}C$ )

| Item                  | Symbol    | Min. | Typ. | Max. | Unit |
|-----------------------|-----------|------|------|------|------|
| E Cycle Time          | $t_C$     | 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 Setup Time    | $t_{ASU}$ | 140  | -    | -    | ns   |
| Address Hold Time     | $t_{AH}$  | 10   | -    | -    | ns   |
| Data Setup 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   |

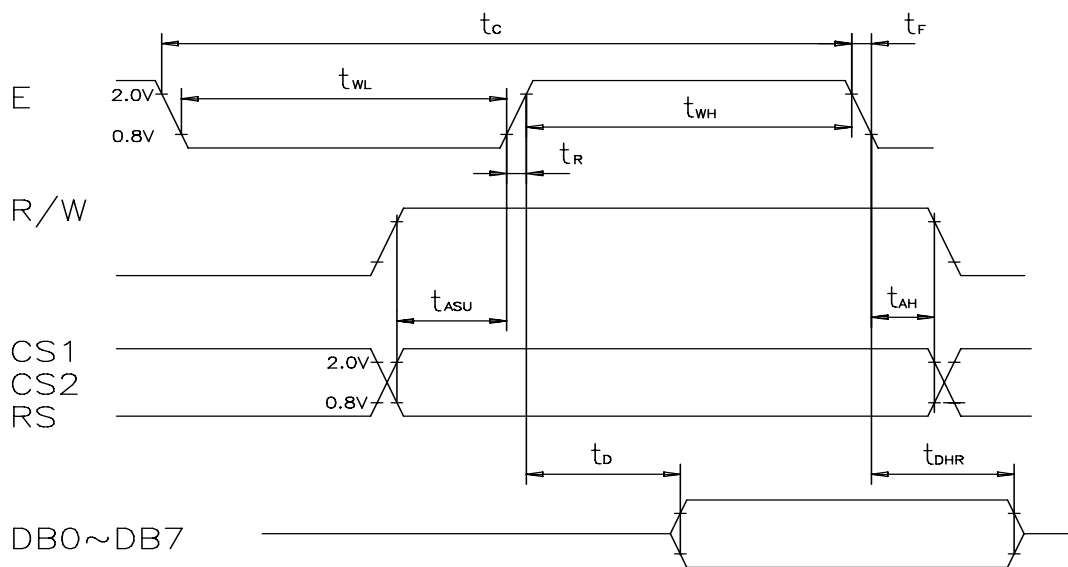


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MPU Write Timing



MPU Read Timing



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## DISPLAY COMMANDS

The display commands shown below control the internal state of the LCD driver ICs. Commands are sent from CPU to LCD module for the display control.

| Command                 | RS | R/W | DB7        | DB6 | DB5                      | DB4   | DB3 | DB2       | DB1 | DB0 | Function  |  |
|-------------------------|----|-----|------------|-----|--------------------------|-------|-----|-----------|-----|-----|---|--|
| Display ON/OFF          | 0  | 0   | 0          | 0   | 1                        | 1     | 1   | 1         | 1   | 1/0 | To control the display ON or OFF. The internal status and display RAM data are not affected.<br>0:OFF, 1:ON   |  |
| Set address (Y address) | 0  | 0   | 0          | 1   | Y address (0~63)         |       |     |           |     |     | To set the Y address in the Y address counter.  |  |
| Set page (X address)    | 0  | 0   | 1          | 0   | 1                        | 1     | 1   | Page(0~7) |     |     | To set the X address at the X address register.   |  |
| Display Start Line      | 0  | 0   | 1          | 1   | Display Start Line(0~63) |       |     |           |     |     | To indicate the display data RAM displayed at the top of the screen.  |  |
| Status Read             | 0  | 1   | Busy       | 0   | ON/OFF                   | Reset | 0   | 0         | 0   | 0   | To read status of the LCD controller IC:<br>Busy<br>0:Ready, 1: In operation<br>ON/OFF:<br>0:Display ON, 1:Display OFF<br>Reset:<br>0:Normal, 1:Reset |  |
| Write display data      | 1  | 0   | Write Data |     |                          |       |     |           |     |     |   | To write data into display data RAM. Y address is increased by 1 after this command. |
| Read Display data       | 1  | 1   | Read Data  |     |                          |       |     |           |     |     |   | To read data from display data RAM to the data bus.                                  |



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## MEMORY MAPPING

Relationship between RAM data and display

|               |          | RAM Y address(Y0 ~Y127) |       |       |       |       |       | Data  |       |       |       |       |       |   |           |
|---------------|----------|-------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|---|-----------|
| 1st page(X=0) | Line 0→  | 0                       | 1     | 1     | 1     | 0     | 0     | ..... | 0     | 0     | 1     | 0     | 0     | 0 | ←DB0(LSB) |
|               | Line 1→  | 1                       | 0     | 0     | 0     | 1     | 0     | ..... | 0     | 0     | 1     | 1     | 0     | 0 | ←DB1      |
|               | Line 2→  | 1                       | 0     | 0     | 0     | 1     | 0     | ..... | 0     | 0     | 1     | 0     | 1     | 0 | ←DB2      |
|               | Line 3→  | 1                       | 0     | 0     | 0     | 1     | 0     | ..... | 0     | 0     | 1     | 0     | 1     | 0 | ←DB3      |
|               | .....    | 1                       | 1     | 1     | 1     | 1     | 0     | ..... | 0     | 0     | 1     | 0     | 0     | 0 | ←DB4      |
|               | .....    | 1                       | 0     | 0     | 0     | 1     | 0     | ..... | 1     | 1     | 1     | 0     | 0     | 0 | ←DB5      |
|               | .....    | 1                       | 0     | 0     | 0     | 1     | 0     | ..... | 1     | 1     | 1     | 0     | 0     | 0 | ←DB6      |
|               | Line 7→  | 0                       | 0     | 0     | 0     | 0     | 0     | ..... | 0     | 0     | 0     | 0     | 0     | 0 | ←DB7(MSB) |
| 2nd page(X=1) | Line 8→  | 1                       | 1     | 1     | 1     | 0     | 0     | ..... | 0     | 1     | 1     | 1     | 0     | 0 | ←DB0(LSB) |
|               | Line 9→  | 1                       | 0     | 0     | 0     | 1     | 0     | ..... | 0     | 1     | 0     | 0     | 1     | 0 | ←DB1      |
|               | Line 10→ | 1                       | 0     | 0     | 0     | 1     | 0     | ..... | 0     | 1     | 0     | 0     | 1     | 0 | ←DB2      |
|               | .....    | 1                       | 1     | 1     | 1     | 0     | 0     | ..... | 1     | 1     | 1     | 0     | 1     | 0 | ←DB3      |
|               | .....    | 1                       | 0     | 0     | 0     | 1     | 0     | ..... | 0     | 1     | 0     | 0     | 1     | 0 | ←DB4      |
|               | .....    | 1                       | 0     | 0     | 0     | 1     | 0     | ..... | 0     | 1     | 0     | 0     | 1     | 0 | ←DB5      |
|               | .....    | 1                       | 1     | 1     | 1     | 0     | 0     | ..... | 0     | 1     | 1     | 1     | 0     | 0 | ←DB6      |
|               | Line 15→ | 0                       | 0     | 0     | 0     | 0     | 0     | ..... | 0     | 0     | 0     | 0     | 0     | 0 | ←DB7(MSB) |
| .....         | .....    | .....                   | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |   |           |
| 8th page(X=7) | Line 56→ | 1                       | 0     | 0     | 0     | 1     | 0     | ..... | 0     | 0     | 0     | 0     | 0     | 0 | ←DB0(LSB) |
|               | .....    | 1                       | 0     | 0     | 0     | 1     | 0     | ..... | 0     | 0     | 0     | 0     | 0     | 0 | ←DB1      |
|               | .....    | 1                       | 0     | 0     | 0     | 1     | 0     | ..... | 0     | 1     | 0     | 0     | 1     | 0 | ←DB2      |
|               | .....    | 1                       | 1     | 1     | 1     | 1     | 0     | ..... | 1     | 0     | 1     | 0     | 1     | 0 | ←DB3      |
|               | .....    | 1                       | 0     | 0     | 0     | 1     | 0     | ..... | 1     | 0     | 0     | 1     | 0     | 0 | ←DB4      |
|               | .....    | 1                       | 0     | 0     | 0     | 1     | 0     | ..... | 1     | 0     | 0     | 1     | 0     | 0 | ←DB5      |
|               | Line 62→ | 1                       | 0     | 0     | 0     | 1     | 0     | ..... | 0     | 1     | 1     | 0     | 1     | 0 | ←DB6      |
|               | Line 63→ | 0                       | 0     | 0     | 0     | 0     | 0     | ..... |       |       |       |       |       |   | ←DB7(MSB) |



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## ADDRESS CONFIGURATION OF DISPLAY DATA RAM

|      |        | Y address |             |     |           |
|------|--------|-----------|-------------|-----|-----------|
|      |        | 0         | 1 2 3 ..... | 126 | 127       |
| X=0→ | DB0    | Page0     |             |     | Line0     |
|      | To DB7 |           |             |     | To Line7  |
| X=1→ | DB0    | Page1     |             |     | Line8     |
|      | To DB7 |           |             |     | To Line15 |
| X=2→ | DB0    | Page2     |             |     | Line16    |
|      | To DB7 |           |             |     | To Line23 |
| X=3→ | DB0    | Page3     |             |     | Line24    |
|      | To DB7 |           |             |     | To Line31 |
| X=4→ | DB0    | Page4     |             |     | Line32    |
|      | To DB7 |           |             |     | To Line39 |
| X=5→ | DB0    | Page5     |             |     | Line40    |
|      | To DB7 |           |             |     | To Line47 |
| X=6→ | DB0    | Page6     |             |     | Line48    |
|      | To DB7 |           |             |     | To Line55 |
| X=7→ | DB0    | Page7     |             |     | Line56    |
|      | To DB7 |           |             |     | To Line63 |

Address configuration of Display Data RAM



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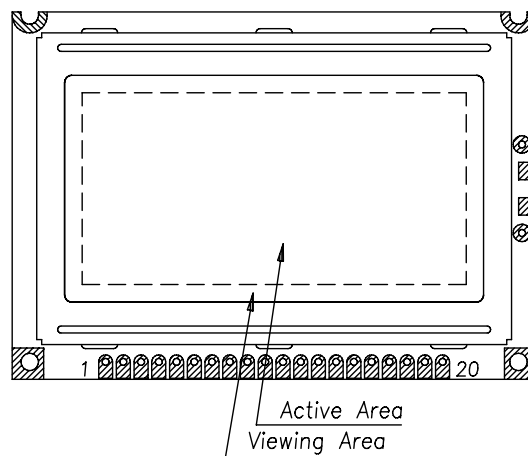
## RELIABILITY TEST

| No | Item                             | Conditions  |           | Note                 |
|----|----------------------------------|---|-----------|----------------------|
| 1  | High Temp. Operation             | 70°C  | 240 Hr    | --                   |
| 2  | High Temp. Storage               | 80°C  | 240 Hr    | --                   |
| 3  | Low Temp. Operation              | -20°C   | 240 Hr    | --                   |
| 4  | Low Temp. Storage                | -30°C   | 240 Hr    | --                   |
| 5  | High Temp./Humid Storage         | 60°C 90%RH  | 240 Hr    | --                   |
| 6  | Thermal Shock                    | -20°C ,30min<br>+60°C ,30min  | 10 cycles | --                   |
| 7  | Vibration Test<br>( IEC-68-2-6 ) | Frequency : 10~55 Hz<br>Duration : 20 times, 6<br>min/time<br>Amplitude : 0.75 mm | -         | --                   |
| 8  | Shock<br>( IEC 68-2-27)          | Duration : 11 mS<br>Acceleration : 100g   | -         | X, Y, Z<br>direction |

## APPEARANCE CHECK

CONDIITON OF APPEARANCE CHECK:

- (1)Specimen shall be checked by eyes in distance of 30cm under 40w-fluorescence lamp.
- (2)Checking direction shall be in 45 degree from perpendicular line op specimen surface.



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## HANDLING PRECAUTIONS

- (1) Treat polarizer very carefully since it is easy to be damaged.
- (2) When cleaning the display surface, use soft cloth (e.g. gauss) with a solvent (recommended below) and wipe lightly.
  - ◆ ethyl alcohol
  - ◆ iso-procolol

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

Do not use the following solvents:

- ◆ water
- ◆ ketone
- ◆ aromatics

- (3) Direct current causes electro-chemical reaction with remarkable degradation of the display quality. Give careful consideration to prevent direct current at ON/OFF timing and during operation.
- (4) Avoid strong shock and drop from the height.
- (5) To prevent LCD panels from degradation, do not operate or store them exposed directly to sunshine or high temperature/humidity.
- (6) Give careful consideration to avoid electrical static discharge with causes uneven contrast.
- (7) Even a small condensation on the contact pads (terminals) causes electro-chemical reaction which makes missing row and column. Give careful attention to avoid condensation. When assembling with zebra connector, clean the surface of the pads with alcohol and keep the air very clean.



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## LCD PRODUCT QUALITY STANDARD

### DISPLAY APPEARANCE

| No | Item                                      | Criteria   |
|----|---|--|
| 1  | inclusions (black spot, white spot, dust) | (1) round type<br>diameter mm(a*)      no of defect*<br>$a \leq 0.20$ neglect<br>$0.20 < a \leq 0.35$ 5max<br>$0.35 < a$ none<br>(2) linear type<br>length mm(l)      width mm(W)      no. of defect<br>na $W \leq 0.03$ neglect<br>$l \leq 3$ $0.03 < W \leq 0.08$ 6<br>$3 < l$ $0.08 < W$ none |
| 2  | scratch                                   | 1. scratch on protective film is permitted.<br>2. scratch on polarizer shall be as follow:<br>(1) round type<br>diameter mm(a*)      no of defect<br>$a \leq 0.15$ neglect<br>$0.15 < a \leq 0.20$ 2 max<br>$0.20 < a$ none<br>(2) linear type<br>be judged by 1.-(2) linear type                |
| 3  | dent                                      | diameter < 1.5mm   |
| 4  | bubble                                    | not exceeding 0.5mm average diameter is acceptable between glass and polarizing film   |
| 5  | pin hole                                  | $(a+b)/2 \leq 0.15\text{mm}$<br>maximum number: ignored<br>$0.15 < (a+b)/2 \leq 0.20\text{mm}$<br>maximum number:10  |
| 6  | dot defect                                | $(a+b)/2 \leq 0.20\text{mm}$<br>maximum number: ignored<br>$0.20 < (a+b)/2 \leq 0.30\text{mm}$<br>maximum number:5<br>x=width  |
| 7  | contrast irregularity(spot)               | diameter spec      no of defect<br>$a \leq 0.50\text{mm}$ neglect<br>$0.50 < a \leq 0.75$ 5<br>$0.75 < a \leq 1.00$ 3<br>$1.00 < a$ none   |
| 8  | dot width                                 | design width $\pm 15\%$  |
| 9  | color tone and uniformity                 | obvious uneven color is not permitted  |



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## 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 13 months guarantee starts from the date code.
- 2 We cannot accept responsibility for any defect, which may arise from additional manufacturing of the product (including disassembly and reassembly), after product delivery.
- 3 We cannot accept responsibility for any defect, which may arise after the application of strong external force to the product.
- 4 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.
- 5 We cannot accept responsibility for industrial property, which may arise through the use of your product, with exception to those issues relating directly to the structure or method of manufacturing of our product. Microtips-origin longer than one year from Microtips production.



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