



THINGWELL ELECTRONICS

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SPECIFICATION FOR LCM MODULE

MODULE NO.: LCM12864A-35

REVISION NO.: A

Customer Approval:

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| | SIGNATURE |
|-------------|-----------|
| PREPARED BY | |
| VERIFIED BY | |
| APPROVED BY | |



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RECORDS OF REVISION

| Date | Rev. | Description | Page | Design by |
|------------|------|---|------|-----------|
| 2012/7/12 | 0 | New Sample. | - | - |
| 2021/10/25 | 0 | ADD LE00802-R Pins according customer's requirement. | - | - |
| | | | - | - |
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1. SPECIFICATIONS

1.1 Features

| Item | Standard Value |
|-------------------|-----------------------------------|
| Display Type | 128 X 64 DOTS |
| LCD Type | STN(BLUE), NEGATIVE, TRANSMISSIVE |
| Driver Condition | LCD Module : 1/64Duty , 1/9Bias |
| Viewing Direction | 6 O'clock |
| Backlight Type | WHITE SIDE Light |
| Interface | 8-bit MPU interface |
| Driver IC | AIP31107, AIP31108 |

1.2 Mechanical Specifications

| Item | Standard Value | Unit |
|-------------------|--------------------------|------|
| Outline Dimension | 75(L) * 52.7(W) * 9.5(T) | mm |
| Viewing Area | 60(L) * 32.6(W) | mm |
| Dot size | 0.39(W) × 0.39(H) | mm |
| Dot pitch | 0.43(W) × 0.43(H) | mm |
| Character size | ----- | mm |

1.3 Absolute Maximum Ratings

| Item | Symbol | Condition | Min. | Max. | Unit |
|-----------------------------|-----------------|------------|------|-----------|------|
| System Power Supply Voltage | VDD | - | -0.3 | 5.5 | V |
| LCD Driver Supply Voltage | VLCD | - | -0.3 | +12.0 | V |
| Input Voltage | V _{IN} | - | -0.3 | VDD + 0.3 | V |
| Operating Temperature | T _{OP} | - | -20 | 70 | °C |
| Storage Temperature | T _{ST} | - | -30 | 80 | °C |
| Storage Humidity | H _D | Ta < 40 °C | 20 | 90 | %RH |



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1.4 Backlight Characteristics

LCD Module without LED Backlight

Electrical / Optical Characteristics

Ta =25°C

| Item | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|-------------------------------------|-------------|---------------------|------|------|------|-------------------|
| Forward Voltage | Vf | If=80mA | 3.0 | 3.1 | 3.2 | V |
| Reverse Current | Ir | If=5v | | | -- | uA |
| Average Brightness | IV | If=80mA | | | | cd/m ² |
| Wavelength (Without LCD) | λd | If=80mA | -- | -- | -- | nm |
| Luminous Intensity (without LCD) | Lv Sub | If=80mA | | | | cd/m ² |
| Uniformity | $\Delta\%$ | IvMin / IvMax *100% | -- | - | - | % |
| Color | WHITE | | | | | |



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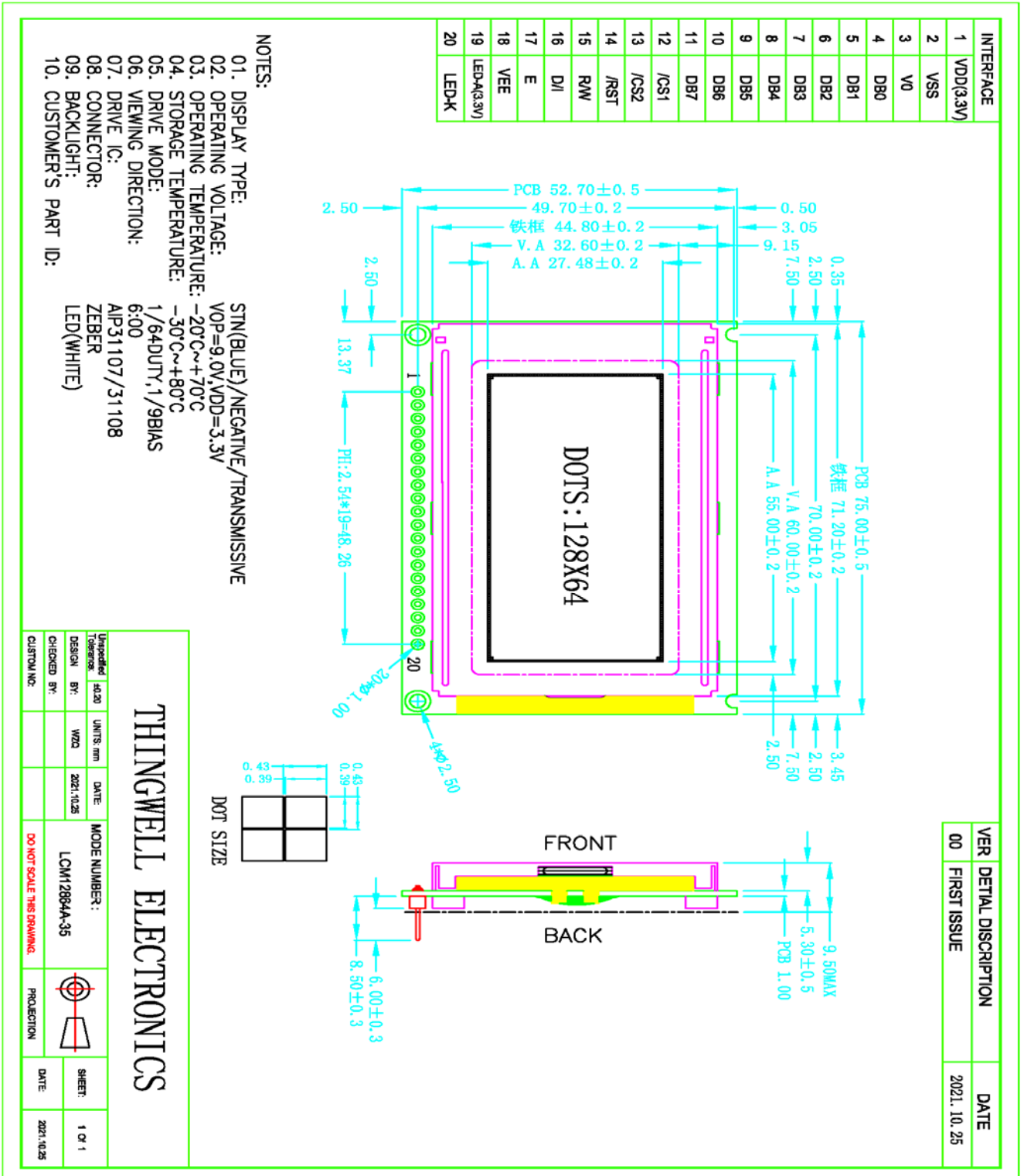
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2. MODULE STRUCTURE

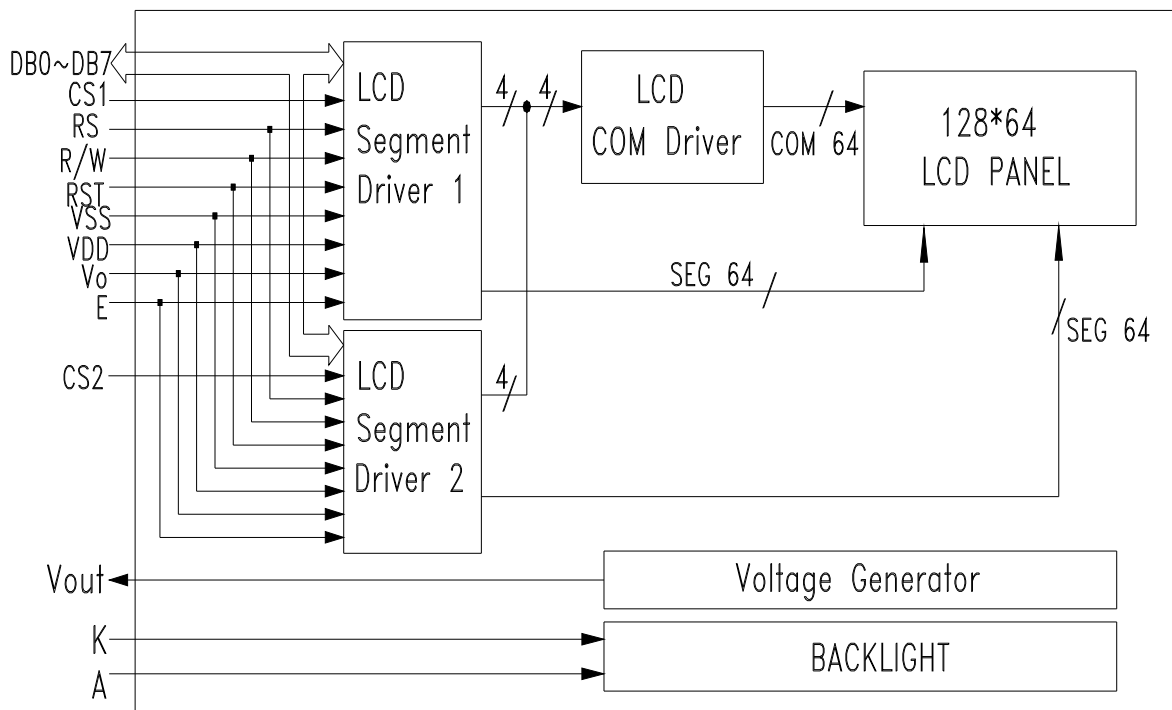
2.1 Counter Drawing

2.1.1 LCM Mechanical Diagram



2.2 Interface Pin Description

| No. | Symbol | Function |
|-------|-----------|---|
| 1 | VDD | Supply Voltage for Logic (+3.3V) |
| 2 | VSS | Ground (0V) |
| 3 | VO | Contrast Adjustment |
| 4--11 | DB0—DB7 | Data Bus |
| 12 | /CS1 | Chip Select active “L” |
| 13 | /CS2 | Chip Select active “L” |
| 14 | /RST | Reset signal , active “L” |
| 15 | R/W | Read/Write Select |
| 16 | D/I | Data/Instruction Select |
| 17 | E | Enable Signal |
| 18 | VEE(Vout) | Output/Negative voltage for LCD driving |
| 19 | LED_A | LED Power Supply +(3.3V) |
| 20 | LED_K | LED Power Supply -(0V) |



2.3 Timing Characteristics

DC Characteristics ($V_{DD}=4.5\sim 5.5V$, $V_{SS}=0V$, $V_{DD}-V_{EE}=8\sim 17V$, $T_a=-30\sim +85^\circ C$)

| Characteristic | Symbol | Condition | Min | Typ | Max | Unit | Note |
|--------------------------------|-----------|--|-------------|-----|-------------|-----------|------|
| Input High Voltage | V_{IH1} | - | $0.7V_{DD}$ | - | V_{DD} | V | *1 |
| | V_{IH2} | - | 2.0 | - | V_{DD} | V | *2 |
| Input Low Voltage | V_{IL1} | - | 0 | - | $0.3V_{DD}$ | V | *1 |
| | V_{IL2} | - | 0 | - | 0.8 | V | *2 |
| Output High Voltage | V_{OH} | $I_{OH}=-200\mu A$ | 2.4 | - | - | V | *3 |
| Output Low Voltage | V_{OL} | $I_{OL}=1.6mA$ | - | - | 0.4 | V | *3 |
| Input Leakage Current | I_{LKG} | $V_{IN}=V_{SS}\sim V_{DD}$ | -1.0 | - | 1.0 | μA | *4 |
| Three-state(OFF) Input Current | I_{TSL} | $V_{IN}=V_{SS}\sim V_{DD}$ | -5.0 | - | 5.0 | μA | *5 |
| Driver Input Leakage Current | I_{DIL} | $V_{IN}=V_{EE}\sim V_{DD}$ | -2.0 | - | 2.0 | μA | *6 |
| Operating Current | I_{DD1} | During Display | - | - | 100 | μA | *7 |
| | I_{DD2} | During Access Access Cycle=1MHz | - | - | 500 | μA | *7 |
| On Resistance | R_{ON} | $V_{DD}-V_{EE}=15V$ $I_{I,QAD}=0.1mA$ | - | - | 7.5 | $K\Omega$ | *8 |

AC Characteristics

(1) Clock Timing

| Characteristic | Symbol | Min | Typ | Max | Unit |
|----------------------------|-----------|------|-----|-----|---------|
| CLK1, CLK2 Cycle Time | t_{CY} | 2.5 | - | 20 | μS |
| CLK1 'LOW' Level Width | t_{WL1} | 625 | - | - | ns |
| CLK2 'LOW' Level Width | t_{WL2} | 625 | - | - | |
| CLK1 'HIGH' Level Width | t_{WH1} | 1875 | - | - | |
| CLK2 'HIGH' Level Width | t_{WH2} | 1875 | - | - | |
| CLK1-CLK2 Phase Difference | t_{D12} | 625 | - | - | |
| CLK2-CLK1 Phase Difference | t_{D21} | 625 | - | - | |
| CLK1, CLK2 Rise Time | t_R | - | - | 150 | |
| CLK1, CLK2 Fall Time | t_F | - | - | 150 | |

(2) Display Control Timing

| Characteristic | Symbol | Min | Typ | Max | Unit |
|-----------------------|----------|-----|-----|-----|---------|
| FRM Delay Time | t_{DF} | -2 | - | +2 | μS |
| M Delay Time | t_{DM} | -2 | - | +2 | μS |
| CL 'LOW' Level Width | t_{WL} | 35 | - | - | μS |
| CL 'HIGH' Level Width | t_{WH} | 35 | - | - | μS |

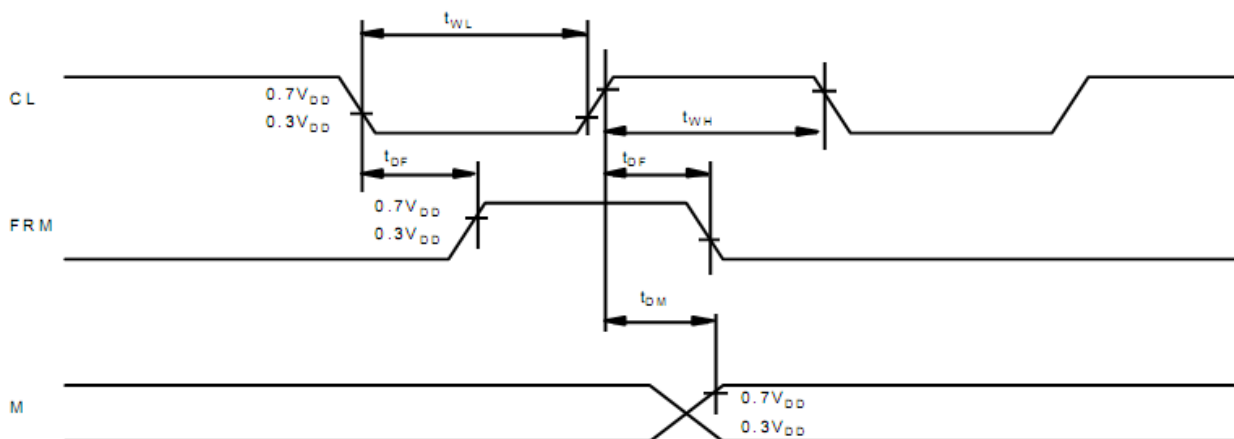


Fig 2. Display control signal waveform

(3) MPU Interface

| Chatacteristic | 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 |

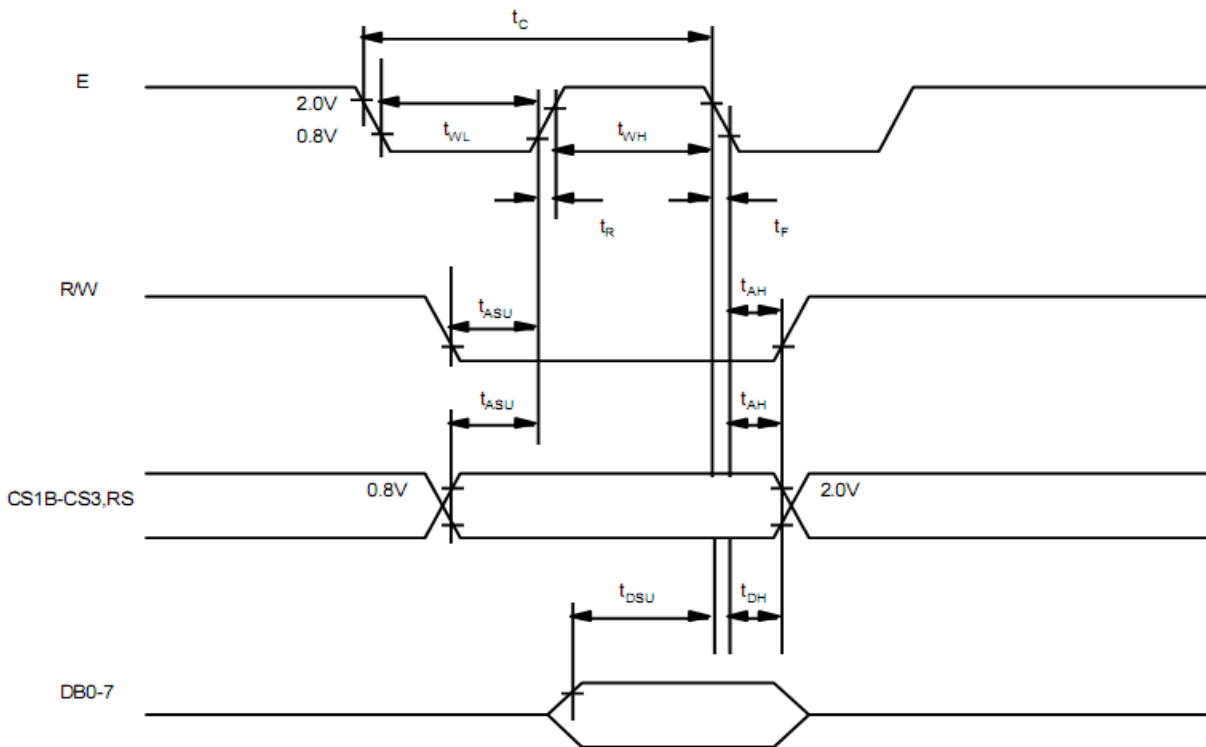


Fig 3. MPU write timing



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4. Reset

Reset can be initialized system by setting RSTB terminal at low level when turning power on, receiving instruction from MPU. When RSTB becomes low, following procedure is occurred.

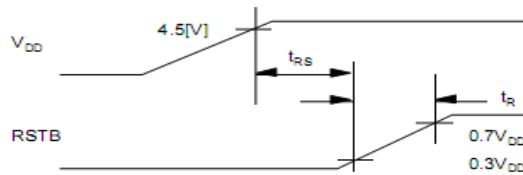
1. Display off
2. Display start line register become set by 0.(Z-address 0)

While RSTB is low, any instruction except status read can be accepted. Reset status appears at DB4. After DB4 is low, any instruction can be accepted.

The Conditions of power supply at initial power up are shown in table 1.

Table 1. Power Supply Initial Conditions

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



2.4 Instruction Table

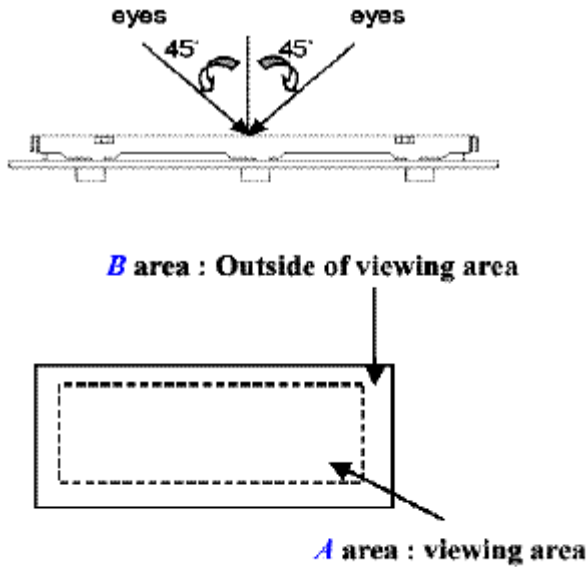
◆ Display Control Instruction

| 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 | 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 | 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 | B U S Y | L | O N / O F F | R E S E T | L | L | L | L | Read status. BUSY L: Ready H: In operation ON/OFF L: Display ON H: Display OFF RESET L: Normal 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. |

2.5 Inspection Specification

- ◆ Inspection Standard : MIL-STD-105E Table Normal Inspection Single Sampling Level II .
- ◆ Equipment : Gauge、MIL-STD、Powertip Tester、Sample
- ◆ Defect Level : Major Defect AQL 0.4; Minor Defect AQL 1.5 .
- ◆ OUT Going Defect Level : Sampling .
- ◆ Manner of appearance test :

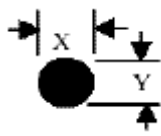
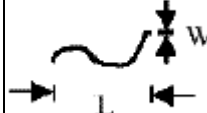
- (1). The test be under 40W×2 fluorescent light ' and distance of view must be at 30 cm.
- (2). The test direction is base on about around 45° of vertical line. (Fig. 1)
- (3). Definition of area . (Fig. 2)

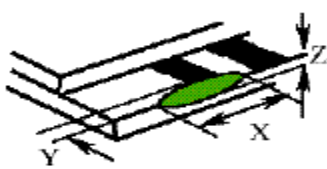


◆ Specification:

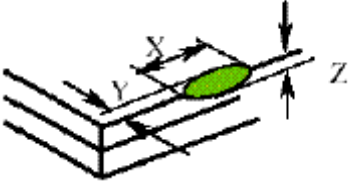

| NO | Item | Criterion | level |
|----|--|---|-------|
| 01 | Product condition | 1.1 The part number is inconsistent with work order of Production. | Major |
| | | 1.2 Mixed production types. | Major |
| | | 1.3 Assembled in inverse direction. | Major |
| 02 | Quantity | 2.1 The quantity is inconsistent with work order of production. | Major |
| 03 | Outline dimension | 3.1 Product dimension and structure must conform to Structure diagram. | Major |
| 04 | Electrical Testing | 4.1 Missing line character、 dot and icon. | Major |
| | | 4.2 No function or no display. | Major |
| | | 4.3 Output data is error. | Major |
| | | 4.4 LCD viewing angle defect. | Major |
| | | 4.5 Current consumption exceeds product specifications. | Major |
| 05 | Black or white dot、 scratch、 contamination Round type | 5.1 Round type: 5.1.1 display only : <input type="checkbox"/> White and black spots on display $\leq 0.25\text{mm}$, no more than Four white or black spots present. <input type="checkbox"/> Densely spaced : NO more than two spots or lines within 3mm | Minor |

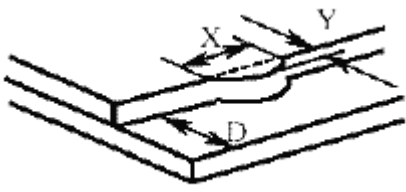
◆ Specification :

| NO | Item | Criterion | level |
|----|---|--|-------|
| 05 | Black or white dot、scratch、contamination Round type  $\Phi = (x+y)/2$  | 5.1.2 Nom-display : Dimension (diameter : Φ) Acceptance(Q'ty) $\Phi \leq 0.10\text{mm}$ Accept no dense $0.10\text{mm} < \Phi \leq 0.20\text{mm}$ 3 $0.20\text{mm} < \Phi \leq 0.25\text{mm}$ 2 Total 4 5.1.3 Line type: Dimension (diameter : Φ) Acceptance (Q'ty) Length width A area B area --- $w \leq 0.03\text{mm}$ Accept no dense Don't count $L \leq 3.0\text{mm}$ $0.03\text{mm} < \Phi \leq 0.05\text{mm}$ Don't count 4 $L \leq 2.5\text{mm}$ $0.05\text{mm} < \Phi \leq 0.075\text{mm}$ Don't count --- $w > 0.075\text{mm}$ As round type | Minor |

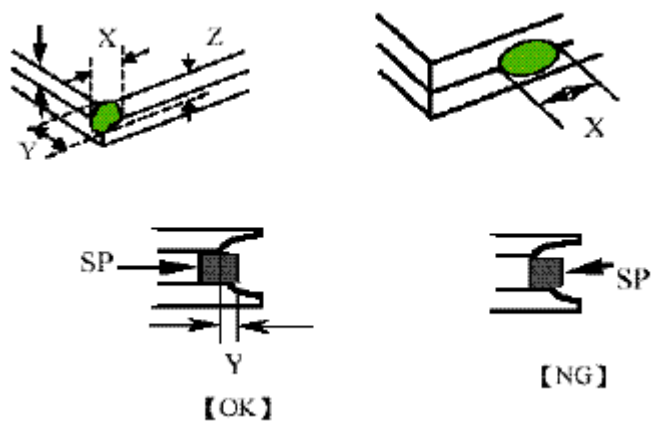
| | | | |
|----|--------------------|---|-------|
| 06 | Polarizer Bubble | <p>Dimension (diameter : Φ)</p> <p>A area</p> <p>Acceptance(Q'ty)</p> <p>B area</p> <p>$\Phi \leq 0.20\text{mm}$</p> <p>Accept no dense</p> <p>Don't count</p> <p>$0.20\text{mm} < \Phi \leq 0.50\text{mm}$</p> <p>3</p> <p>Don't count</p> <p>$0.50\text{mm} < \Phi \leq 1.00\text{mm}$</p> <p>2</p> <p>Don't count</p> <p>$\Phi > 1.00\text{mm}$</p> <p>0</p> <p>Don't count</p> <p>Total quantity</p> <p>4</p> <p>Don't count</p> | Minor |
| 07 | The crack of glass | <p>● Glass Crack:</p> <p>7.1 Crack on the circuit of electrode terminal :</p>  <p>X</p> <p>Y</p> <p>Z</p> <p>Front</p> <p>$X \leq 1/5 a$</p> <p>$Y \leq 1/2 D$</p> <p>$Z \leq t$</p> <p>Back</p> <p>Neglect</p> | Minor |

◆ Specification :

| NO | Item | Criterion | Level |
|----|---|---|-------|
| 07 | <p>The crack of glass</p> <p>X: The length of Crack</p> <p>Y: The width of crack</p> <p>Z: The thickness of crack</p> <p>D: terminal length</p> <p>T: The thickness of glass</p> <p>A : The length of glass</p> | <p>● Glass Crack:</p> <p>7.2 General glass crack and corner edge:</p> <p>7.2.1</p>  <p>X Y Z Neglect Out A area Neglect</p> <p>7.2.2</p>  <p>X Y Z Neglect Out A area Neglect</p> | Minor |

| | | | |
|--|--|---|-------|
| | | <p>7.3 Glass remain:</p>  <p>X Y</p> <p>Neglect $\leq 1/3 d$</p> | Minor |
|--|--|---|-------|

◆Specification :

| NO | Item | Criterion | Level |
|----|---|---|-------|
| 07 | <p>The crack of glass</p> <p>X: The length of Crack</p> <p>Y: The width of crack</p> <p>Z: The thickness of crack</p> <p>D: terminal length</p> <p>T: The thickness of glass</p> <p>A : The length of glass</p> | <p>7.4 Corner crack and medial crack:</p>  <p>X Y Z $\leq 1/5a$</p> <p>Crack can't enter viewing area $\leq 1/2t$ $\leq 1/5a$</p> <p>Crack can't exceed the half of width of SP $1/2t < Z \leq 2t$</p> | Minor |
| 08 | Backlight elements | <p>8.1 Backlight can't work normally.</p> <p>8.2 Backlight doesn't light or color is wrong.</p> <p>8.3 Illumination source flickers when lit.</p> | Major |



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| | | | |
|----|--------------------|---|-------|
| 09 | General appearance | 9.1 pin type must match type in specification sheet | Major |
| | | 9.2 No short circuits in components on PCB or FPC | Major |
| | | 9.3 Product packaging must be the same as specified on packaging specification sheet. | Major |
| | | 9.4 The folding and peeling off in polarizer are not acceptable | Major |
| | | 9.5 The PCB or FPC between B/L assembled distance (PCB or FPC) is $\leq 1.5\text{mm}$ | Major |