



Radiant Electronics Limited

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SPECIFICATION FOR LCM MODULE

MODULE NO.: RD12864M-3

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 |
|-----------|------|-------------|------|-----------|
| 2011/7/19 | 0 | New Sample. | - | - |
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1. SPECIFICATIONS

1.1 Features

| Item | Standard Value |
|-------------------|----------------------------------|
| Display Type | 12864 DOTS |
| Driver Condition | LCD Module : 1/32Duty , 1/5Bias |
| Viewing Direction | 6 O'clock |
| Interface | 8BIT or Serial bus MPU interface |
| Driver IC | ST7920 or eqv |

| Model No.: | Color | LCD Type | Backlight Type |
|--------------|-----------------------|-------------------------------------|----------------|
| RD12864M-3-B | White on Blue | STN, NEGATIVE (BLUE), TRANSMISSIVE | SIDE WHITE |
| RD12864M-3-Y | Black on Yellow-Green | STN, POSITIVE (Y-G), TRANSMISSIVE | SIDE Y-G |
| RD12864M-3-G | Black on Gray | STN, POSITIVE (GRAY), TRANSFLECTIVE | SIDE WHITE |

1.2 Mechanical Specifications

| Item | Standard Value | Unit |
|-------------------|-----------------------------|------|
| Outline Dimension | 93(L) *70(W) * Max 12.5 (T) | mm |
| Viewing Area | 72(L) * 40(W) | mm |
| Dot size | 0.48(W) × 0.48(H) | mm |
| Dot pitch | 0.52(W) × 0.52(H) | 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 | VOUT _{IN} | - | 4.8 | 5.0 | V |
| Input Voltage | V _{IN} | - | -0.3 | VDD + 0.2 | V |



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| | | | | | |
|-----------------------|-----------------|------------|-----|----|-----|
| Operating Temperature | T _{OP} | - | -20 | 70 | °C |
| Storage Temperature | T _{ST} | - | -30 | 80 | °C |
| Storage Humidity | H _D | Ta < 40 °C | 20 | 90 | %RH |

1.4 Backlight Characteristics

LCD Module without LED Backlight

Electrical / Optical Characteristics

Ta =25°C

| Item | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|-------------------------------------|--------------------|---|------|------|------|-------------------|
| Forward Voltage | V _f | I _f =80mA | 3.0 | 3.1 | 3.2 | V |
| Reverse Current | I _r | I _f =8v | | | -- | uA |
| Average Brightness | I _V | I _f =80mA | | | | cd/m ² |
| Wavelength (Without LCD) | λ _d | I _f =80mA | -- | -- | -- | nm |
| Luminous Intensity (without LCD) | L _v Sub | I _f =80mA | | | | cd/m ² |
| Uniformity | Δ% | I _V Min / I _V Max *100% | -- | - | - | % |



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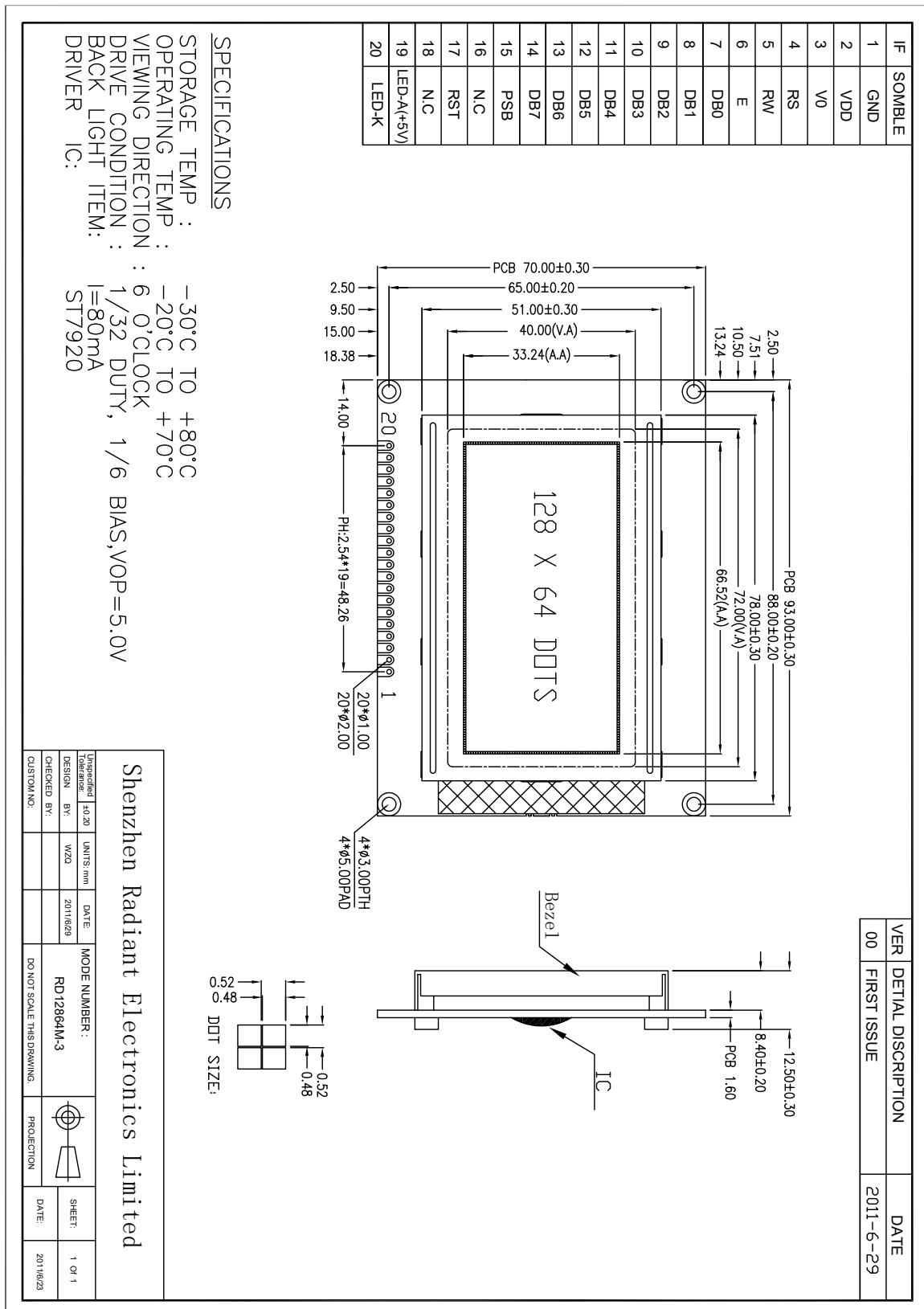
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2. MODULE STRUCTURE

2.1 Counter Drawing

2.1.1 LCM Mechanical Diagram





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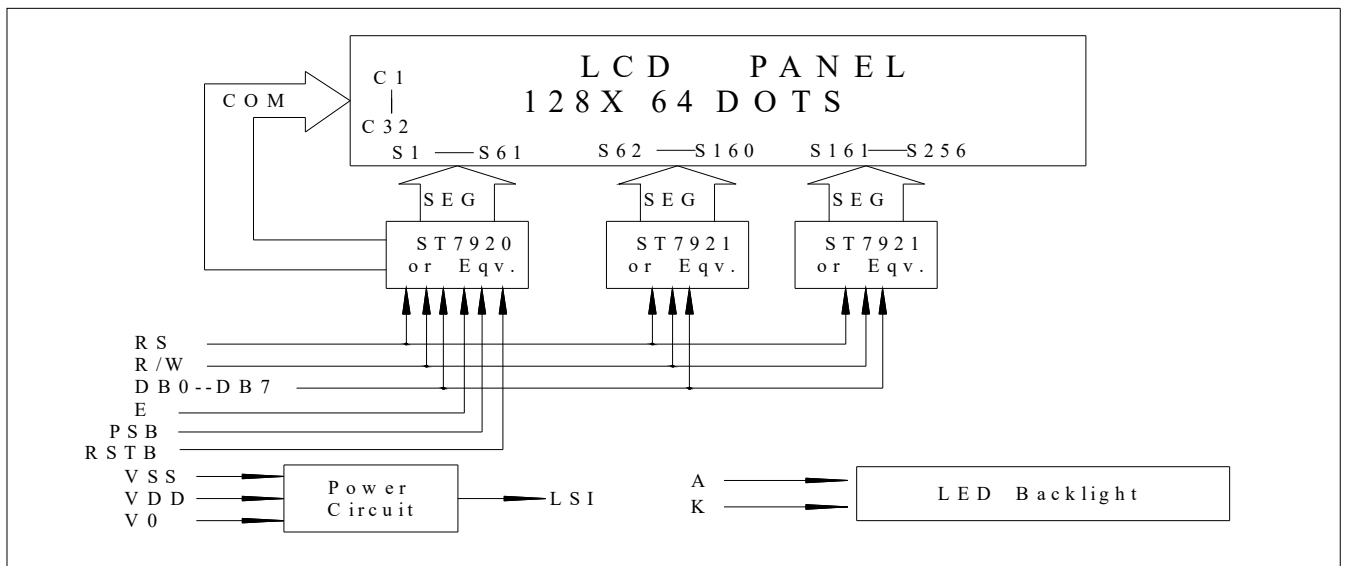
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2.2 Interface Pin Description

| Pin No. | Symbol | Function | |
|---------|---------|---|--|
| 1 | VSS | Ground (0V) | |
| 2 | VDD | Power supply input for driver IC (+5V) | |
| 3 | VO | LCD driver supply voltages | |
| 4 | RS(CS) | Register select input pin - RS = "H": D0 to D7 are display data - RS = "L": D0 to D7 are control data | Serial mode: CS=1 :chip enable CS=0 :chip enable |
| 5 | RW(SID) | Read write control 0:write 1:read (serial data input) | |
| 6 | E(SCLK) | Enable trigger (serial clock) | |
| 7-10 | DB0~DB3 | Lower nibble data bus for 8 bit interface | |
| 11-14 | DB4~DB7 | Higher nibble data bus for 8 bit interface and data bus for 4 bit interface | |
| 15 | PSB | Interface selection:0:serial mode 1:8/4-bits parallel bus mode | |
| 16 | NC | No used | |
| 17 | RST | Reset signal | |
| 18 | VEE | No used | |
| 19 | LED+ | BACKLIGHT+ (5V) | |
| 20 | LED- | BACKLIGHT- (0V) | |





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2.3 Timing Characteristics

AC Characteristics ($T_A = 25^\circ\text{C}$, $V_{DD} = 4.5\text{V}$) Parallel Mode Interface

| Symbol | Characteristics | Test Condition | Min. | Typ. | Max. | Unit |
|---|-----------------------|------------------|-------|------|------|---------------|
| <i>Internal Clock Operation</i> | | | | | | |
| f_{OSC} | OSC Frequency | R = 33K Ω | 480 | 540 | 600 | KHz |
| <i>External Clock Operation</i> | | | | | | |
| f_{EX} | External Frequency | - | 480 | 540 | 600 | KHz |
| | Duty Cycle | - | 45 | 50 | 55 | % |
| T_R, T_F | Rise/Fall Time | - | - | - | 0.2 | μs |
| <i>Write Mode (Writing data from MPU to ST7920)</i> | | | | | | |
| T_C | Enable Cycle Time | Pin E | 1200 | - | - | ns |
| T_{PW} | Enable Pulse Width | Pin E | 140 | - | - | ns |
| T_R, T_F | Enable Rise/Fall Time | Pin E | - | - | 25 | ns |
| T_{AS} | Address Setup Time | Pins: RS,RW,E | 10 | - | - | ns |
| T_{AH} | Address Hold Time | Pins: RS,RW,E | 20 | - | - | ns |
| T_{DSW} | Data Setup Time | Pins: DB0 - DB7 | 40 | - | - | ns |
| T_H | Data Hold Time | Pins: DB0 - DB7 | 20 | - | - | ns |
| <i>Read Mode (Reading Data from ST7920 to MPU)</i> | | | | | | |
| T_C | Enable Cycle Time | Pin E | 1200 | - | - | ns |
| T_{PW} | Enable Pulse Width | Pin E | 140 | - | - | ns |
| T_R, T_F | Enable Rise/Fall Time | Pin E | - | - | 25 | ns |
| T_{AS} | Address Setup Time | Pins: RS,RW,E | 10 | - | - | ns |
| T_{AH} | Address Hold Time | Pins: RS,RW,E | 20 | - | - | ns |
| T_{DDR} | Data Delay Time | Pins: DB0 - DB7 | - | - | 100 | ns |
| T_H | Data Hold Time | Pins: DB0 - DB7 | 20 | - | - | ns |
| <i>Interface Mode with LCD Driver(ST7921)</i> | | | | | | |
| T_{CWH} | Clock Pulse with High | Pins: CL1, CL2 | 800 | - | - | ns |
| T_{CWL} | Clock Pulse with Low | Pins: CL1, CL2 | 800 | - | - | ns |
| T_{CST} | Clock Setup Time | Pins: CL1, CL2 | 500 | - | - | ns |
| T_{SU} | Data Setup Time | Pin: D | 300 | - | - | ns |
| T_{DH} | Data Hold Time | Pin: D | 300 | - | - | ns |
| T_{DM} | M Delay Time | Pin: M | -1000 | - | 1000 | ns |



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DC Characteristics ($T_A = 25^{\circ}C$, $V_{DD} = 4.5 V - 5.5 V$)

| Symbol | Characteristics | Test Condition | Min. | Typ. | Max. | Unit |
|------------|---|---|--------------|------|-------------|---------|
| V_{DD} | Operating Voltage | - | 4.5 | - | 5.5 | V |
| V_{LCD} | LCD Voltage | $V_0 - V_{SS}$ | 3.0 | - | 7 | V |
| I_{CC} | Power Supply Current | $f_{OSC} = 540KHz$, $V_{DD} = 5V$ $R_f = 33K\Omega$ | - | 0.45 | 0.75 | mA |
| V_{IH1} | Input High Voltage (Except OSC1) | - | $0.7V_{DD}$ | - | V_{DD} | V |
| V_{IL1} | Input Low Voltage (Except OSC1) | - | -0.3 | - | 0.6 | V |
| V_{IH2} | Input High Voltage (OSC1) | - | $V_{DD} - 1$ | - | V_{DD} | V |
| V_{IL2} | Input Low Voltage (OSC1) | - | - | - | 1.0 | V |
| V_{OH1} | Output High Voltage (DB0 - DB7) | $I_{OH} = -0.1mA$ | $0.8V_{DD}$ | - | V_{DD} | V |
| V_{OL1} | Output Low Voltage (DB0 - DB7) | $I_{OL} = 0.1mA$ | - | - | 0.4 | V |
| V_{OH2} | Output High Voltage (Except DB0 - DB7) | $I_{OH} = -0.04mA$ | $0.8V_{DD}$ | - | V_{DD} | V |
| V_{OL2} | Output Low Voltage (Except DB0 - DB7) | $I_{OL} = 0.04mA$ | - | - | $0.1V_{DD}$ | V |
| I_{IEAK} | Input Leakage Current | $V_{IN} = 0V$ to V_{DD} | -1 | - | 1 | μA |
| I_{PUP} | Pull Up MOS Current | $V_{DD} = 5V$ | 75 | 80 | 85 | μA |



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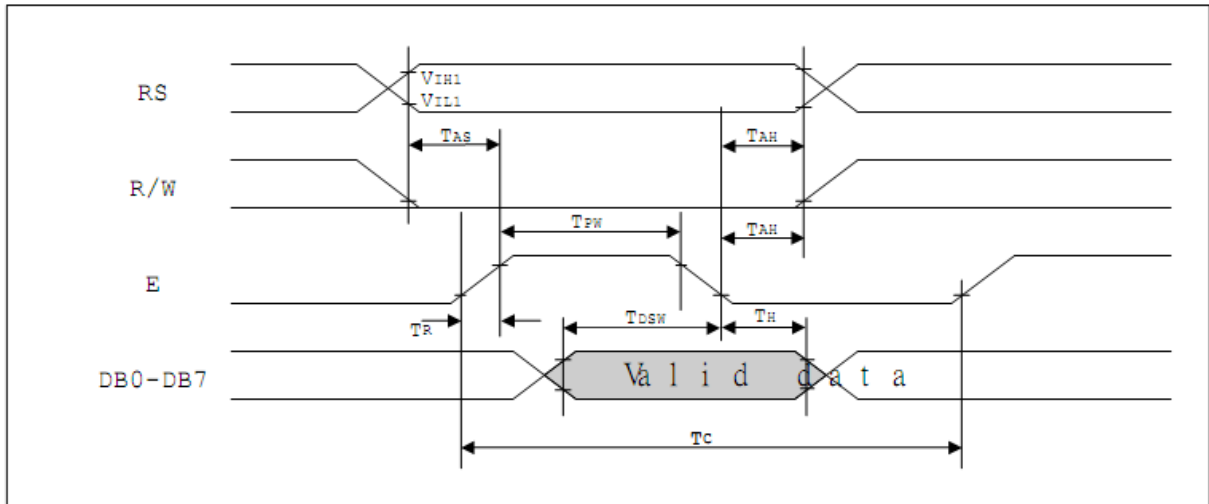
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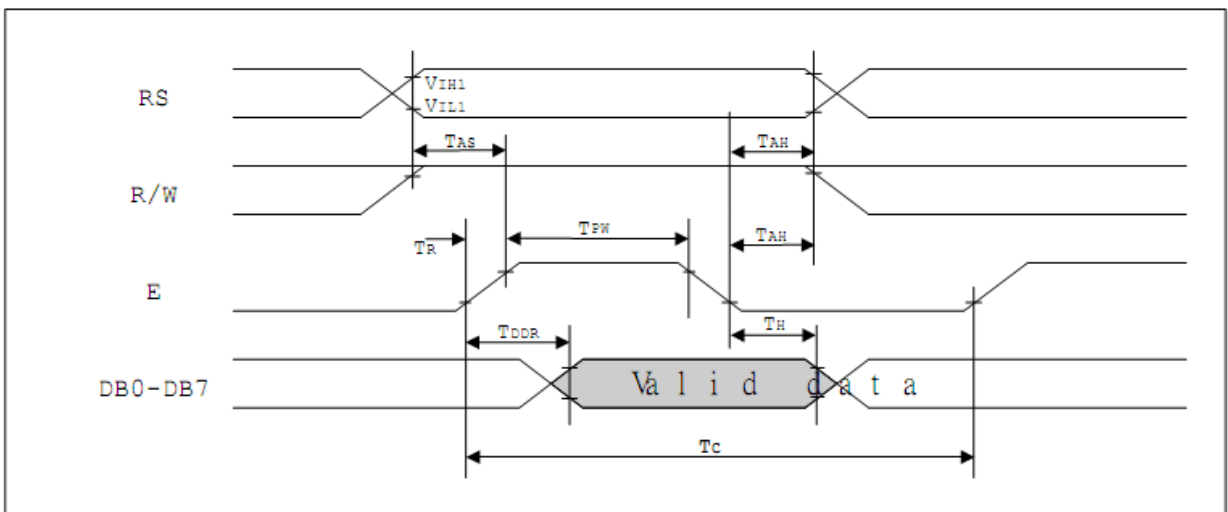
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8 bit interface timing diagram

- MPU write data to ST7920



- MPU read data from ST7920





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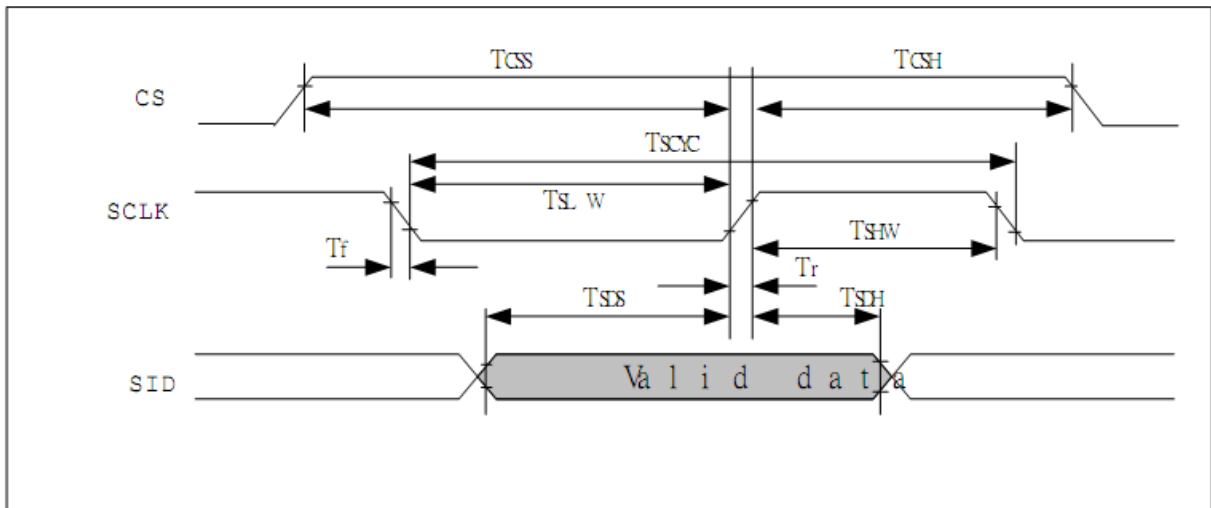
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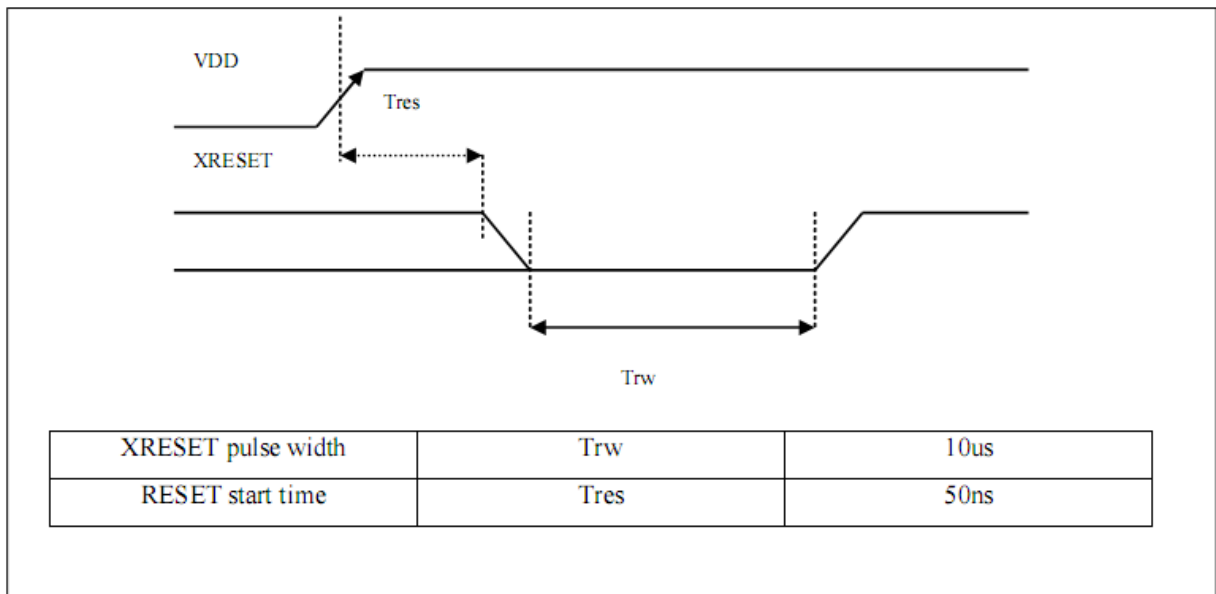
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Serial interface timing diagram

- MPU write data to ST7920



External reset timing





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2.4 Instruction Table

Instruction set 1: (RE=0: basic instruction)

| Ins | code | | | | | | | | | | Description | Exec time (540KHZ) |
|-----------------------------|------|----|-----|-------|-----|-----|-----|-----|------|-------|--|-----------------------|
| | RS | RW | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 | | |
| CLEAR | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | Fill DDRAM with "20H", and set DDRAM address counter (AC) to "00H" | 1.6 ms |
| HOME | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 X | Set DDRAM address counter (AC) to "00H", and put cursor to origin ; the content of DDRAM are not changed | 72us |
| ENTRY MODE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | I/D S | Set cursor position and display shift when doing write or read operation | 72us |
| DISPLAY ON/OFF | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | D | C B | D=1: display ON C=1: cursor ON B=1: blink ON | 72 us |
| CURSOR DISPLAY CONTROL | 0 | 0 | 0 | 0 | 0 | 0 | 1 | S/C | R/L | X X | Cursor position and display shift control ; the content of DDRAM are not changed | 72 us |
| FUNCTION SET | 0 | 0 | 0 | 0 | 0 | 1 | DL | X | 0 RE | X X | DL=1 8-BIT interface DL=0 4-BIT interface RE=1: extended instruction RE=0: basic instruction | 72 us |
| SET CGRAM ADDR. | 0 | 0 | 0 | 1 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Set CGRAM address to address counter (AC) Make sure that in extended instruction SR=0 (scroll or RAM address select) | 72 us |
| SET DDRAM ADDR. | 0 | 0 | 1 | 0 AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Set DDRAM address to address counter (AC) AC6 is fixed to 0 | 72 us |
| READ BUSY FLAG (BF) & ADDR. | 0 | 1 | BF | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Read busy flag (BF) for completion of internal operation, also Read out the value of address counter (AC) | 0 us |
| WRITE RAM | 1 | 0 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Write data to internal RAM (DDRAM/CGRAM/IRAM/GDRAM) | 72 us |
| READ RAM | 1 | 1 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Read data from internal RAM (DDRAM/CGRAM/IRAM/GDRAM) | 72 us |



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Instruction set 2: (RE=1: extended instruction)

| Inst. | code | | | | | | | | | | description | Exec. time (540KHZ) |
|-------------------------------------|------|----|-----|-----|-----|-----|-----|-----|-----|-----|--|------------------------|
| | RS | RW | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 | | |
| STAND BY | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | Enter stand by mode, any other instruction can terminate (Com1..32 halted, only Com33 ICON can display) | 72 us |
| SCROLL or RAM ADDR. SELECT | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | SR=1: enable vertical scroll position SR=0: enable IRAM address (extended instruction) SR=0: enable CGRAM address(basic instruction) | 72 us |
| REVERSE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | R1 | R0 | Select 1 out of 4 line (in DDRAM) and decide whether to reverse the display by toggling this instruction R1,R0 initial value is 00 | 72 us |
| EXTENDED FUNCTION SET | 0 | 0 | 0 | 0 | 1 | DL | X | 1 | RE | G | DL=1 8-BIT interface DL=0 4-BIT interface RE=1: extended instruction set RE=0: basic instruction set G=1 :graphic display ON G=0 :graphic display OFF | 72 us |
| SET IRAM or SCROLL ADDR | 0 | 0 | 0 | 1 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | SR=1: AC5~AC0 the address of vertical scroll SR=0: AC3~AC0 the address of ICON RAM | 72 us |
| SET GRAPHIC RAM ADDR. | 0 | 0 | 1 | 0 | 0 | 0 | AC3 | AC2 | AC1 | AC0 | Set GDRAM address to address counter (AC) First set vertical address and the horizontal address by consecutive writing Vertical address range AC5...AC0 Horizontal address range AC3... AC0 | 72 us |



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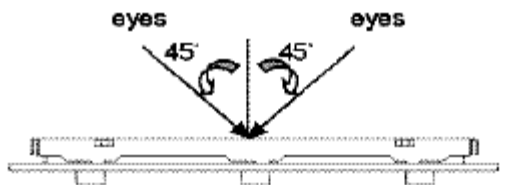
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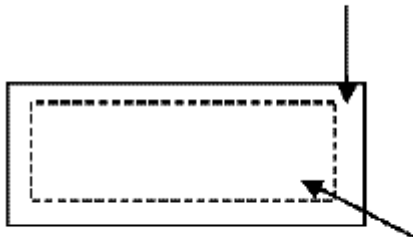
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2.5 Inspection Specification

- ◆ 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)



B area : Outside of viewing area



A area : viewing area

◆ 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 : ·White and black spots on display $\leq 0.25\text{mm}$, no more than Four white or black spots present. ·Densely spaced : NO more than two spots or lines within 3mm | Minor |



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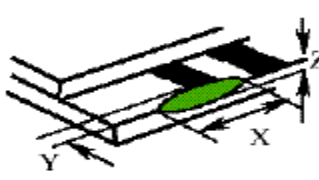
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| | | | |
|----|--------------------|---|-------|
| 06 | Polarizer Bubble | <p>Dimension (diameter : Φ)</p> <p>A area</p> <p>Acceptance(Q'ty)</p> <p>B area</p> <p>$\Phi \leq 0.20\text{mm}$</p> <p>Accept no dense</p> <p>Don't count</p> <p>$0.20\text{mm} < \Phi \leq 0.50\text{mm}$</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 |



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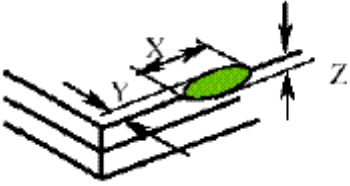

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◆ Specification :

| 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 |



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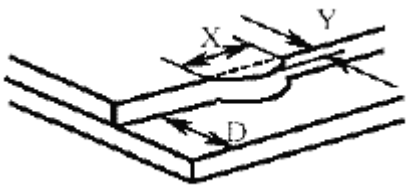
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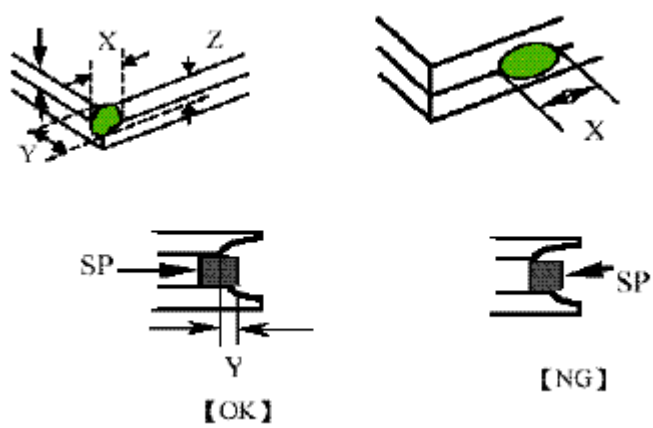
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| | | | |
|--|--|---|-------|
| | | <p>7.3 Glass remain:</p>  <p>X Y</p> <p>Neglect $\leq 1/3 d$</p> | Minor |
|--|--|---|-------|

◆ 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 width of SP $1/2t < Z \leq 2t$</p> | Minor |
| 08 | Backlight elements | 8.1 Backlight can't work normally. | Major |
| | | 8.2 Backlight doesn't light or color is wrong. | Major |



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|----|--------------------|---|-------|
| | | 8.3 Illumination source flickers when lit. | Major |
| 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 the same as specified on packaging specification sheet. | Major |
| | | 9.4 The folding and peeled 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 |