# Graphic Display Module

## Part Number

## G12864G-FTY-LW653

Overview:

- 128x64 dots
- Module Size: 72.0x46.0mm
- Viewing Area: 66.0x 32.7 mm
- LCD Type: FSTN
- 80 or 68 MPU Interfaces
- Operating Temp: -20°to 70°C
- Storage Temp: -30°to 80°C

- Bottom View
- Transmissive
- 3V LCD
- 5V LED backlight
- Controller: ST7565R
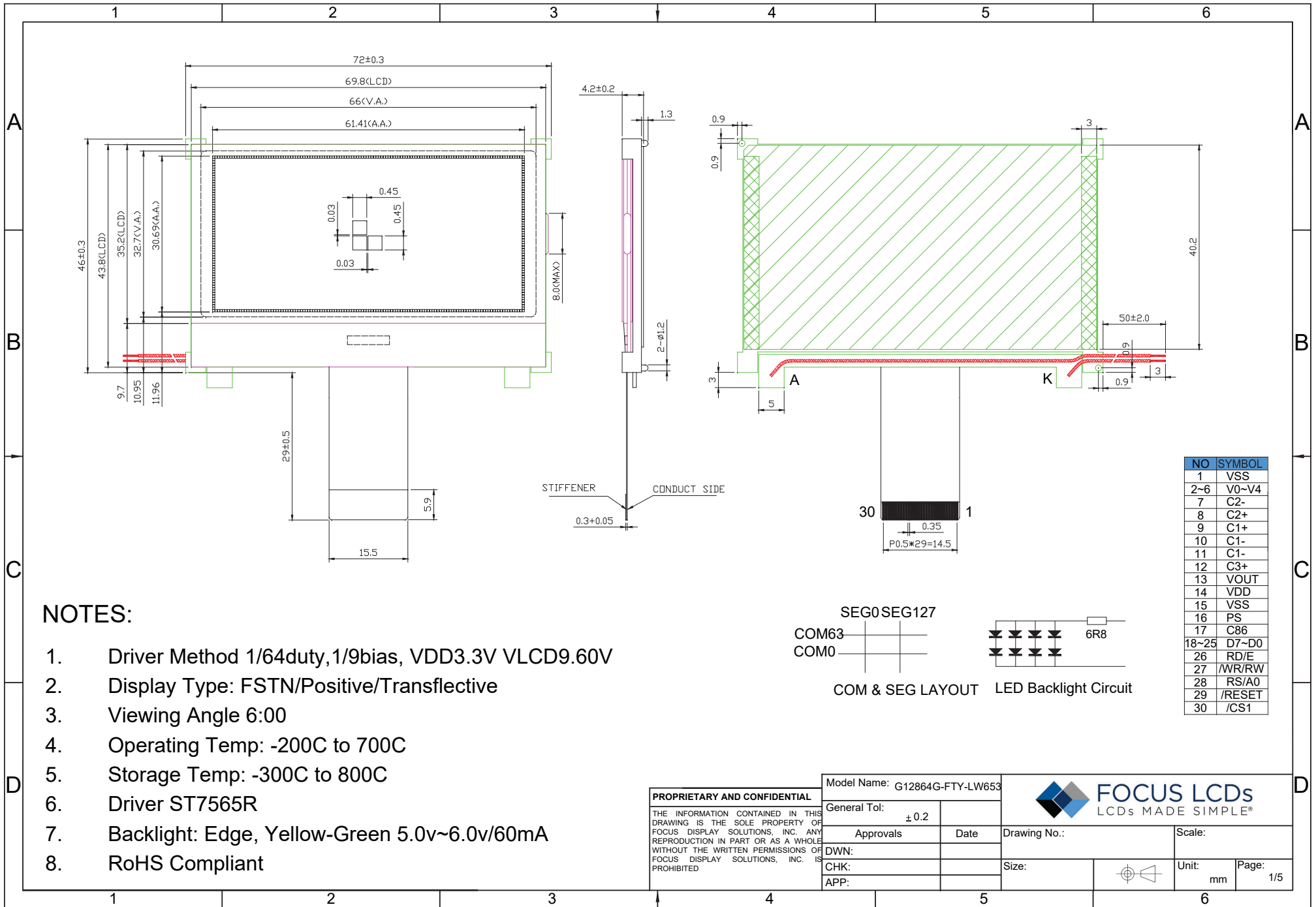- RoHS Compliant

## Graphic LCD Features

Resolution: 128x64 dots

Interfaces: 8-bit parallel, 8080 and 6800

| General Information Items | Specification Main Panel | Unit | Note |
|---|---|---|---|
| Viewing Area | 66.0(L) x 32.7(W) | mm | - |
| LCD Type | FSTN | - | - |
| Viewing Direction | 6:00 | o'clock | - |
| Rear Polarizer | Transflective | - | - |
| Number of Pixels | 128x64 | dots | - |
| Backlight Type | LED | - | 5V |
| Backlight Color | Yellow-Green | - | - |
| Controller IC | ST7565R | - | - |
| Interfaces | MPU | - | 80 or 60 |
| DC to DC Circuit | Built In | - | - |
| Operating temperature | -20～+70 | ℃ | - |
| Storage temperature | -30～+80 | ℃ | - |

## Mechanical Information

| Item | | Min | Typ. | Max | Unit | Note |
|---|---|---|---|---|---|---|
| Module size | Length (L) | | 72.0 | | mm | - |
| | Width (W) | | 46.0 | | mm | - |
| | Height (H) | | 4.2 | | mm | - |

# 1. Outline Dimensions

72±0.3
69.8(LCD)
66(V.A.)
61.41(A.A.)

4.2±0.2
1.3

0.45
0.03
0.45
0.03

8.0(MAX)

46±0.3
43.8(LCD)
35.2(LCD)
32.7(V.A.)
30.69(A.A.)

0.9
0.9
3
40.2
50±2.0
0.9
3
0.9
3

9.7
10.95
11.96

2-Ø1.2

A
K

29±0.5
5.9
15.5

5
3

STIFFENER
CONDUCT SIDE
0.3+0.05

30    1
0.35
P0.5*29=14.5

SEG0 SEG127
COM63
COM0

6R8

COM & SEG LAYOUT    LED Backlight Circuit

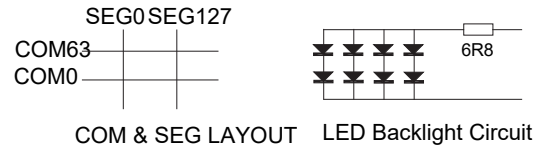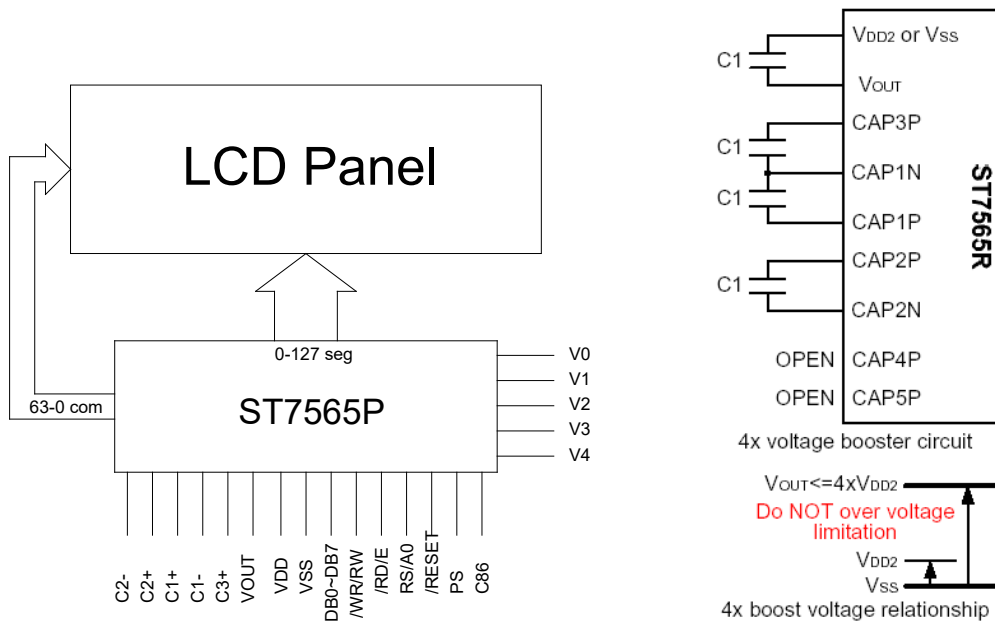| NO | SYMBOL |
|---|---|
| 1 | VSS |
| 2~6 | V0~V4 |
| 7 | C2- |
| 8 | C2+ |
| 9 | C1+ |
| 10 | C1- |
| 11 | C1- |
| 12 | C3+ |
| 13 | VOUT |
| 14 | VDD |
| 15 | VSS |
| 16 | PS |
| 17 | C86 |
| 18~25 | D7~D0 |
| 26 | RD/E |
| 27 | /WR/RW |
| 28 | RS/A0 |
| 29 | /RESET |
| 30 | /CS1 |

## NOTES:

1. Driver Method 1/64duty,1/9bias, VDD3.3V VLCD9.60V
2. Display Type: FSTN/Positive/Transflective
3. Viewing Angle 6:00
4. Operating Temp: -200C to 700C
5. Storage Temp: -300C to 800C
6. Driver ST7565R
7. Backlight: Edge, Yellow-Green 5.0v~6.0v/60mA
8. RoHS Compliant

Model Name: G12864G-FTY-LW653

General Tol: ± 0.2

| Approvals | Date |
|---|---|
| DWN: | |
| CHK: | |
| APP: | |

Drawing No.:
Scale:
Size:
Unit: mm
Page: 1/5

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## 2. Block Diagrams



Capacitance 1uF~2.2uF

*NOTE: See IC controller spec ST7565R for more information on internal voltage regulating circuits.*

## 3. Input Terminal Pin Assignment

Recommended Connector: FH12S-30S-0.5SH(55)

| Pin no. | Symbol | External connection | Function |
|---------|--------|---------------------|----------|
| 1 | VSS | Power supply | Signal ground for LCM |
| 2~6 | V0~V4 | | Power supply LCD External capacitor about 0.47uF~1uF. |
| 7 | C2- | | For voltage booster circuit. External capacitor about 1uF~2.2Uf. |
| 8 | C2+ | | |
| 9 | C1+ | | |
| 10 | C1- | | |
| 11 | C1- | | |
| 12 | C3+ | | |
| 13 | VOUT | | DC/DC voltage converter |
| 14 | VDD | | Power supply for logic for LCM |
| 15 | VSS | | Signal ground for LCM |
| 16 | P/S | MPU | This is the parallel input/serial data input switch terminal. |
| 17 | C86 | MPU | This is the MPU interface switch terminal. |
| 18~25 | DB7~DB0 | MPU | This is an 8-bit-directional data bus. |
| 26 | /RD/E | MPU | Operation (data read/write) enable signal |
| 27 | /WR/RW | MPU | Read/write select signal |
| 28 | RS/A0 | MPU | Select registers. 0: instruction; 1: data register |
| 29 | /RSET | MPU | External reset PIN. Must be fixed to VDD low active. |
| 30 | /CS1 | MPU | Chip select in serial interface low active |

## 4. LCD Optical Characteristics

### 4.1 Optical Specifications

*FSTN Type Display Module*                                              *(Ta=25˚C, VDD=3.0V)*

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|------|--------|-----------|------|------|------|------|
| Viewing angle | $\theta 2 - \theta 1$ | CR=2.0 | 70 | - | - | deg |
| | $\Phi$ | | - | $\pm 30$ | - | |
| Contrast ratio | CR | $\Phi=0$, $\theta=25$ | 3 | 5 | - | - |
| Response time (rise) | tr | | - | 150 | 250 | ms |
| Response time (fall) | tf | | - | 200 | 300 | |

# 5. Electrical Characteristics

## 5.1 Absolute Maximum Rating (Ta=25 ˚C, VSS=0V)

| Item | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Power voltage logic | VDD-VSS | 0.3 | - | 3.6 | V |
| Input voltage | VIN | -0.3 | - | VDD+0.3 | |
| Power supply for LCD | VO-VSS | -0.3 | - | 13.5 | |
| Operating temperature range | VOP | -20 | - | +70 | ℃ |
| Storage temperature range | VST | -30 | - | +80 | |

NOTE:  *If the absolute maximum rating of the above parameters is exceeded, even momentarily, the quality of the product may be degraded. Absolute maximum ratings specify the values which the product may be physically damaged if exceeded. Be sure to use the product within the range of the absolute maximum ratings.*

## 5.2 DC Electrical Characteristics

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Supply voltage for LCD | V0-VSS | Ta =25℃ | - | 9.0 | - | V |
| Supply voltage for logic | VDD | | 2.85 | 3.0 | 3.15 | |
| Supply current | IDD | Ta=25℃, VDD=3.0V | - | 0.5 | - | mA |
| Backlight supply voltage | VF | | - | 4.7 | - | V |
| Backlight supply current | ILED | VF=4.7V | - | 80 | - | mA |

(Ta=25℃, VDD=3.0V)

| Item | Signal | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Reset time | | tR | - | - | 1.0 | us |
| Reset 'L' pulse width | /RES | tRW | 1.0 | - | - | |

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# 6. Signal Timing Characteristics

## 6.1 8-bit Parallel Timing Characteristics (80-series)

| Parameter | Signal | Symbol | Min | Max | Unit | Note |
|---|---|---|---|---|---|---|
| Address hold time | | $t_{AH8}$ | 0 | -- | ns | |
| Address setup time | A0 | $t_{AW8}$ | 0 | -- | ns | |
| Address cycle time | | $t_{CYC8}$ | 240 | -- | ns | |
| Enable L pulse width (write) | WR | $t_{CCLW}$ | 80 | -- | ns | |
| Enable H pulse width (write) | | $t_{CCHW}$ | 80 | -- | ns | |
| Enable L pulse width (read) | RD | $t_{CCLR}$ | 140 | -- | ns | |
| Enable H pulse width (read) | | $t_{CCHR}$ | 80 | -- | ns | |
| Write data setup time | | $t_{DS8}$ | 40 | -- | ns | |
| Write address hold time | DB0-DB7 | $t_{DH8}$ | 0 | -- | ns | |
| Read access time | | $t_{ACC8}$ | -- | 70 | ns | CL=100pF |
| Read output disable time | | $t_{OH8}$ | 5 | 50 | ns | CL=100pF |
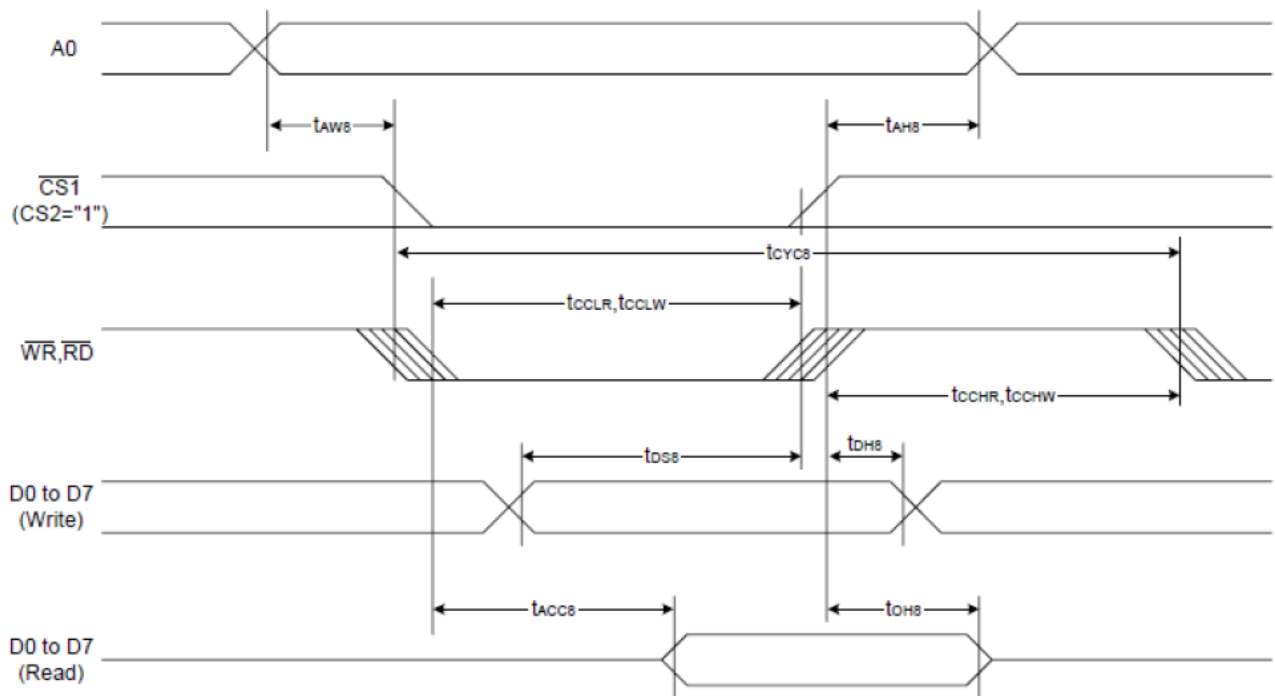
## 6.2   8-bit Parallel Timing Characteristics (68-series)

| Parameter | Signal | Symbol | Min | Max | Unit | Note |
|---|---|---|---|---|---|---|
| Address hold time | A0 | $t_{AH6}$ | 0 | -- | ns | |
| Address setup time | | $t_{AW6}$ | 0 | -- | ns | |
| Address cycle time | | $t_{CYC6}$ | 240 | -- | ns | |
| Enable L pulse width (write) | WR | $t_{CCLW}$ | 80 | -- | ns | |
| Enable H pulse width (write) | | $t_{CCHW}$ | 80 | -- | ns | |
| Enable L pulse width (read) | RD | $t_{CCLR}$ | 80 | -- | ns | |
| Enable H pulse width (read) | | $t_{CCHR}$ | 140 | -- | ns | |
| Write data setup time | DB0-DB7 | $t_{DS6}$ | 40 | -- | ns | |
| Write address hold time | | $t_{DH6}$ | 0 | -- | ns | |
| Read access time | | $t_{ACC6}$ | -- | 70 | ns | CL=100pF |
| Read output disable time | | $t_{OH6}$ | 5 | 50 | ns | CL=100pF |
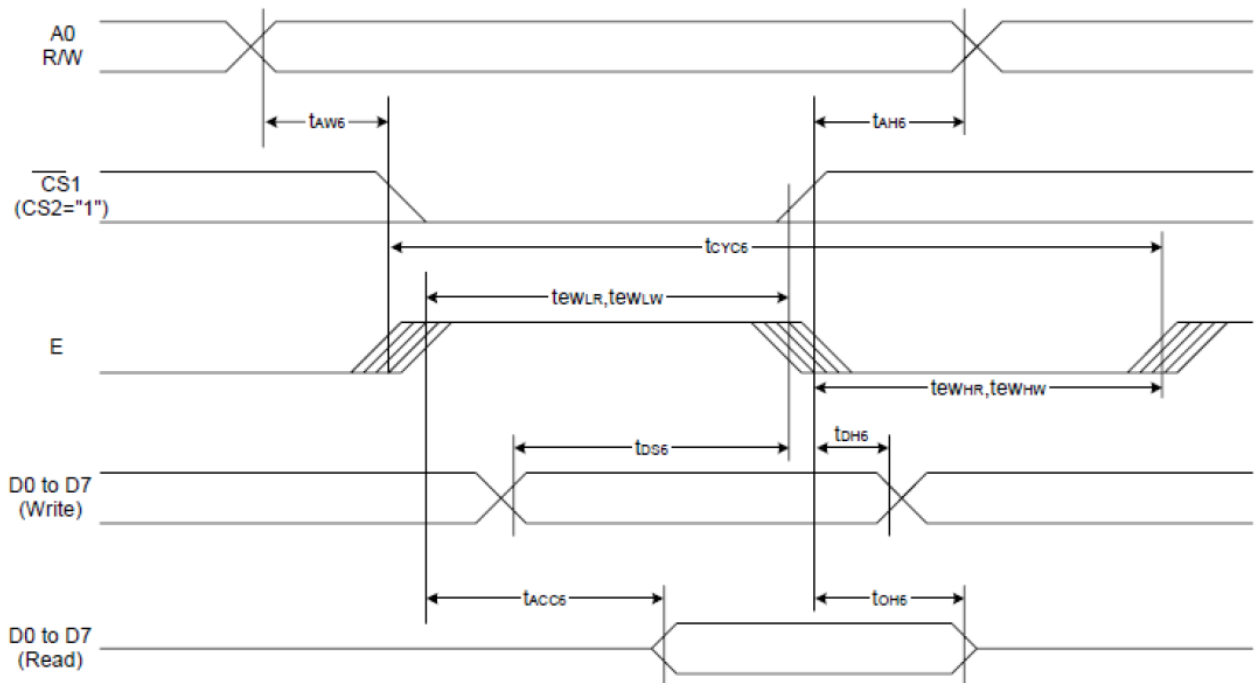
## 6.3    Reset Timing
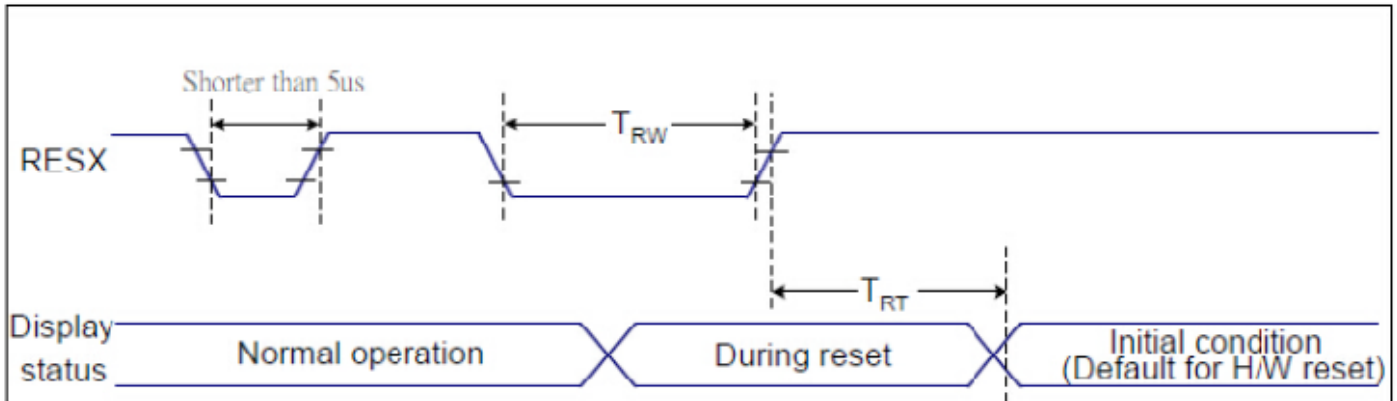


| Related Pins | Symbol | Parameter | Min | Max | Unit |
|---|---|---|---|---|---|
| RESX | TRW | Reset pulse duration | 10 | - | us |
| | TRT | Reset cancel | - | 5 (Note 1,5) | ms |
| | | | | 120 (Note 1, 6, 7) | ms |

Notes:

1. The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NVM (or similar device) to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5ms after a rising edge of RESX.

2. Spike due to an electrostatic discharge on RESX line does not because irregular system reset according to the table below:

| RESX Pulse | Action |
|---|---|
| Shorter than 5us | Reset Rejected |
| Longer than 9us | Reset |
| Between 5us and 9 us | Reset starts |

3. During the resetting period, the display will be blanked (the display is entering blanking sequence, which maximum time is 120ms, when reset starts in Sleep Out mode. The display remains the blank state in Sleep in mode) and then return to Default condition for Hardware Reset.

4. Spike Rejection also applies during a valid reset pulse as shown below:
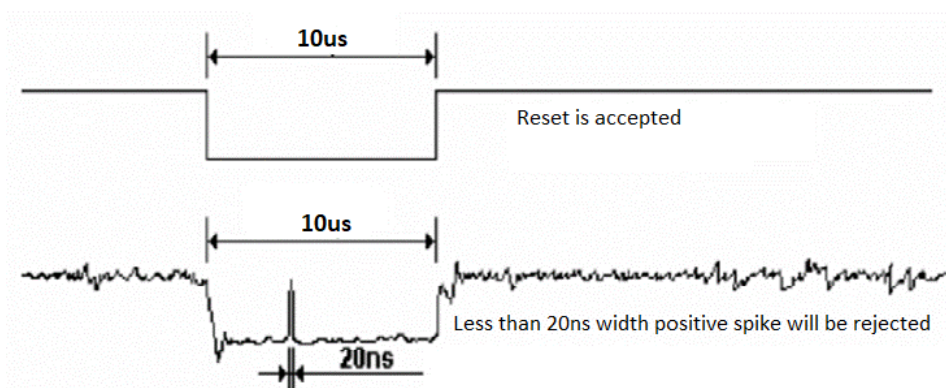


5. When Reset applied during Sleep In Mode.
6. When Reset applied during Sleep Out Mode.
7. It is necessary to wait 5ms after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120ms.

## 7. Commands for Initialization of the Display

| Command | A0 | RD | WR | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Description |
|---------|----|----|----|----|----|----|----|----|----|----|----|-------------|
| Display On/Off | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0/1 | Display on/off, 0: OFF, 1:ON |
| Display start line set | 0 | 1 | 0 | 0 | 1 | Display start address | | | | | | Sets RAM start address |
| Page address set | 0 | 1 | 0 | 1 | 0 | 1 | 1 | Page address | | | | Sets RAM page address |
| Column address set | 0 | 1 | 0 | 0 0 | 0 0 | 0 0 | 1 0 | MS col address / LS col address | | | | Sets most MSB of RAM column address |
| Status read | 0 | 0 | 1 | Status | | | | 0 | 0 | 0 | 0 | Reads status of data |
| Display data write | 1 | 1 | 0 | Write data (D3-D1) | | | | | | | | Writes data to RAM |
| Display data read | 1 | 0 | 1 | Read data (D3-D1) | | | | | | | | Reads data from RAM |
| Display normal/reverse | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | Sets display in normal or reverse mode. 0:normal, 1:reverse |
| Display all points On/Off | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | Display all points. 0: normal, 1: all points on |
| LCD bias set | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0/1 | Set LCD voltage bias ratio. 0: 1/9 bias, 1: 1/7 bias |
| Read modify write | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | Column address increment |
| End | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | Clear read/modify/write |
| Reset | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | Internal reset |
| Power control set | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | Operating Mode | | | Internal power supply operating mode |
| V0 voltage regulator, internal resistor ratio set | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | Res. ratio | | | Select internal resistor ratio (Rb/Ra) mode |
| Electronic volume mode set | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | Set V0 output voltage |
| Electronic volume register set | 0 | 1 | 0 | 0 | 0 | Electronic volume | | | | | | Electronic volume value |
| Sleep mode set | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0: Sleep mode, 1: Normal mode |
| Booster ratio set | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | Select booster ratio 00: 2x, 3x, 4x 01:5x, 11: 6x |
|  |  |  |  | 0 | 0 | 0 | 0 | 0 | 0 | Step Up | | |
| NOP | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | Command for non-operation |
| Test | 0 | 1 | 0 | 1 | 1 | 1 | 1 | | | | | Test for IC Command - Do not use this test |

*Additional information can be found in the IC controller specification sheet ST7565R.*

## 8.  Cautions and Handling Precautions

### 8.1  Handling and Operating the Module

1.  When the module is assembled, it should be attached to the system firmly. Do not warp or twist the module during assembly work.
2.  Protect the module from physical shock or any force. In addition to damage, this may cause improper operation or damage to the module and back-light unit.
3.  Note that polarizer is very fragile and could be easily damaged. Do not press or scratch the surface.
4.  Do not allow drops of water or chemicals to remain on the display surface. If you have the droplets for a long time, staining and discoloration may occur.
5.  If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.
6.  The desirable cleaners are water, IPA (Isopropyl Alcohol) or Hexane. Do not use ketene type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.
7.  If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, legs, or clothes, it must be washed away thoroughly with soap.
8.  Protect the module from static, it may cause damage to the CMOS ICs.
9.  Use fingerstalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
10.  Do not disassemble the module.
11.  Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.
12.  Pins of I/F connector shall not be touched directly with bare hands.
13.  Do not connect, disconnect the module in the "Power ON" condition.
14.  Power supply should always be turned on/off by the item Power On Sequence & Power Off Sequence.


### 8.2  Storage and Transportation

1.  Do not leave the panel in high temperature, and high humidity for a long time. It is highly recommended to store the module with temperature from 0 to 35 ℃ and relative humidity of less than 70%
2.  Do not store the Graphic LCD module in direct sunlight.
3.  The module shall be stored in a dark place. When storing the modules for a long time, be sure to adopt effective measures for protecting the modules from strong ultraviolet radiation, sunlight, or fluorescent light.
4.  It is recommended that the modules should be stored under a condition where no condensation is allowed. Formation of dewdrops may cause an abnormal operation or a failure of the module. In particular, the greatest possible care should be taken to prevent any module from being operated where condensation has occurred inside.
5.  This panel has its circuitry FPC on the bottom side and should be handled carefully in order not to be stressed.

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