DISPLAY Elektronik GmbH

# DATA SHEET

## LCD MODULE

# DEM 128064G FGH

***Product Specification*** ***Version: 1***

**13/Jan/2009**

# GENERAL SPECIFICATION

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## MODULE NO. :

# DEM 128064G FGH

CUSTOMER P/N:

| Version No. | Change Description | Date |
|---|---|---|
| 0 | Original Version | 12.12.2008 |
| 1 | Update Item 1 & Item 7 | 13.01.2009 |
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PREPARED BY: XYP DATE: 13.01.2009

APPROVED BY: MH DATE: 13.01.2009

# CONTENTS

## 1. FUNCTIONS & FEATURES

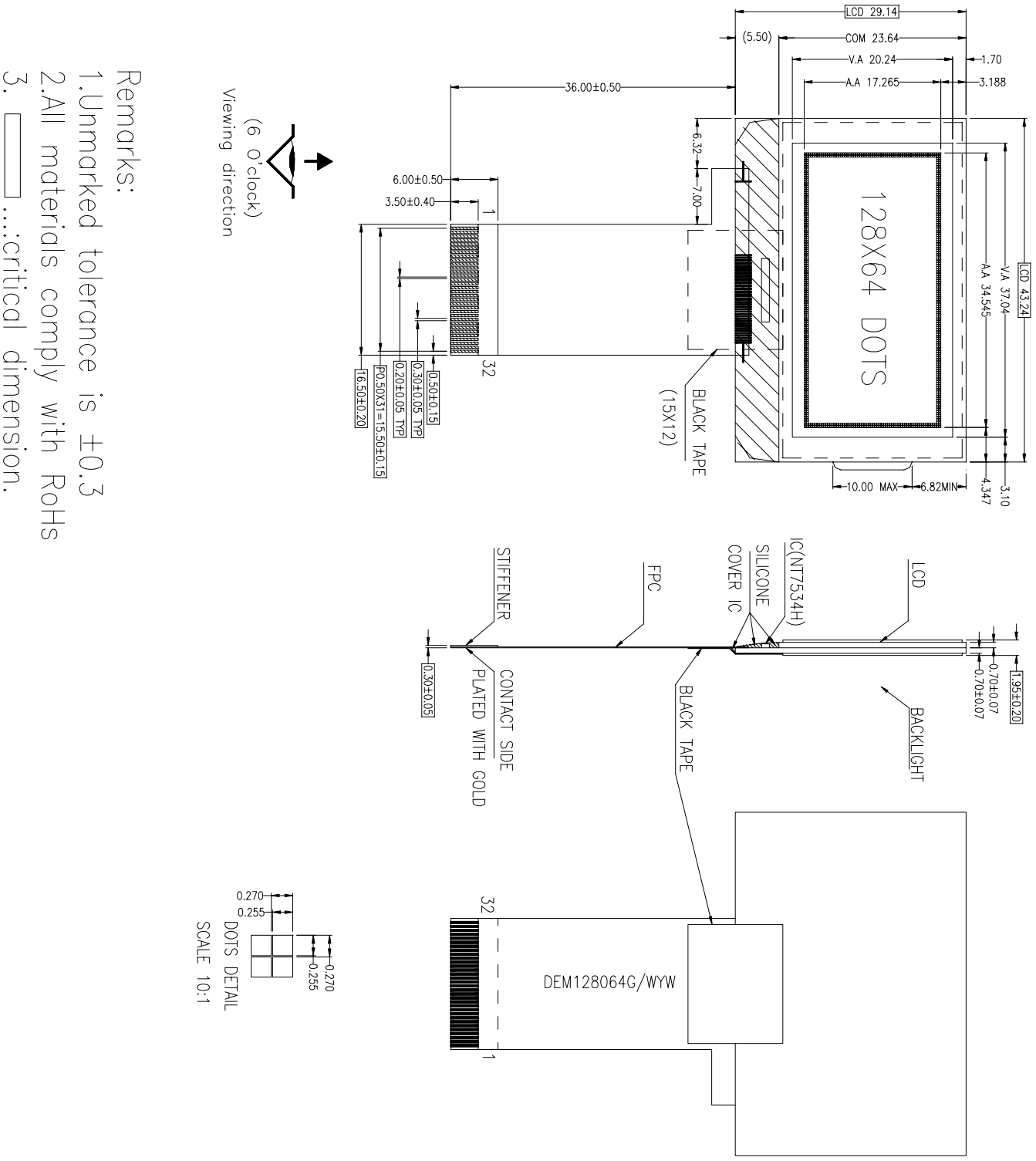
| MODULE NAME | LCD Type |
|---|---|
| DEM 128064G FGH | FSTN Reflective Positive Mode |

- Viewing Direction : 6 o'clock
- Driving Scheme : 1/ 65 Duty, 1/ 9 Bias,
- Power supply : 3.3 Volt (typ.)
- $V_{LCD}$(V0-Vss) : 10.7 Volt (typ.)
- Display Format : 128 x 64 Dots, COG
- Interface : Parallel & Serial
- LCD Driver : NT7534H (Novatek)
- Operating Temperature : -20°C to +70°C
- Storage Temperature : -30°C to +80°C

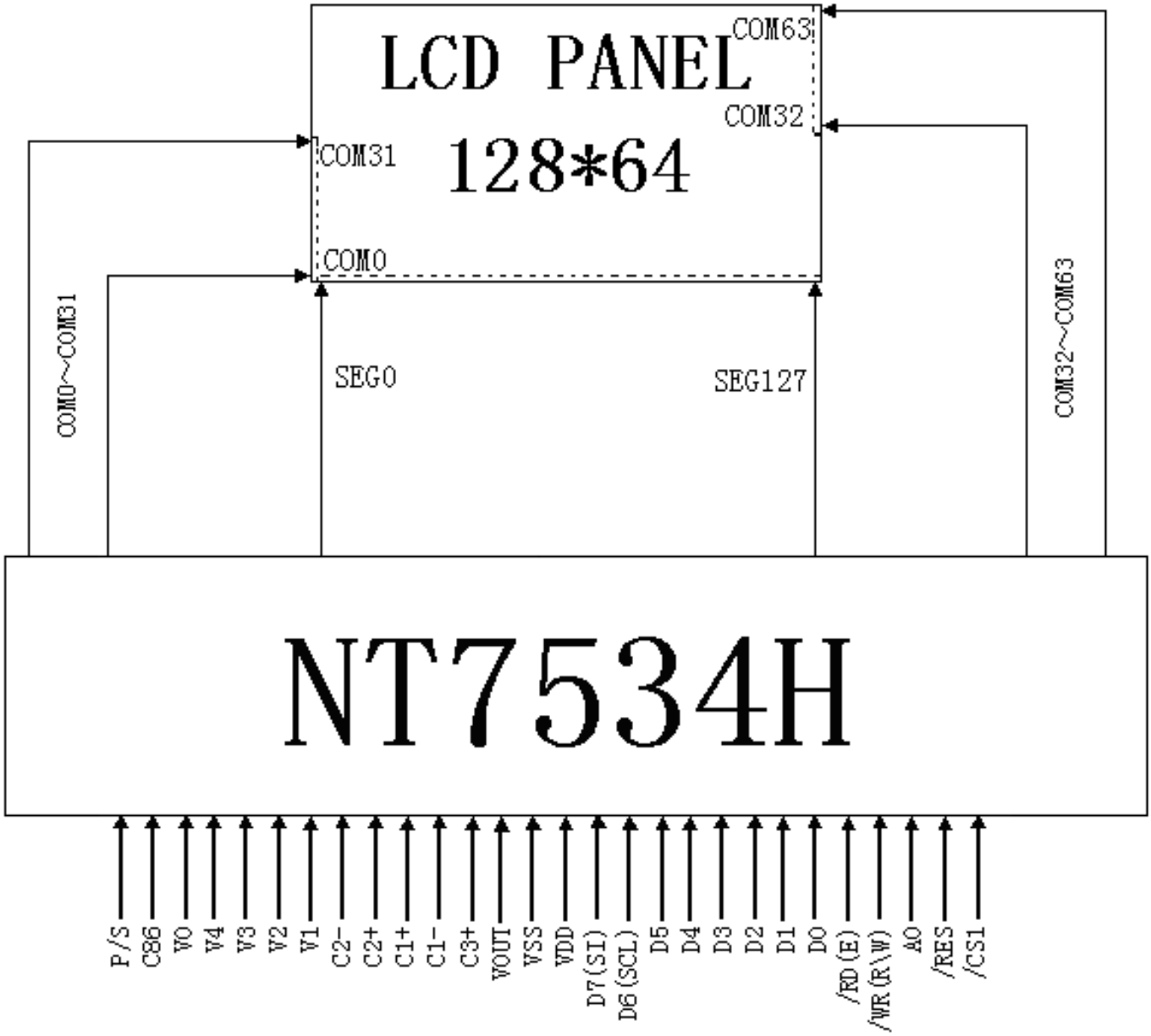
## 2. MODULE ARTWORK

- Module Size : 43.24 x 29.14 x 1.95 mm (without FPC)
- Viewing Area : 37.04 x 20.24 mm
- Active Area : 34.545 x 17.265 mm
- Dot Size : 0.255 x 0.255 mm
- Dot Pitch : 0.27 x 0.27 mm
- Dot Gap : 0.15mm

## 3. EXTERNAL DIMENSIONS ( unit: mm)



## 4. BLOCK DIAGRAM



## 5. PIN ASSIGNMENT.

<table>
<tr><th>PIN NO.</th><th>Symbol</th><th>Description</th></tr>
<tr><td>1</td><td>NC</td><td>No connect</td></tr>
<tr><td>2</td><td>NC</td><td>No connect</td></tr>
<tr><td>3</td><td>NC</td><td>No connect</td></tr>
<tr><td>4</td><td>NC</td><td>No connect</td></tr>
<tr><td>5</td><td>P/S</td><td>This is the parallel data input/serial data input switch terminal<br>P/S = “H”: Parallel data input<br>P/S = “L”: Serial data input<br>The following applies depending on the P/S status:
<table>
<tr><th>P/S</th><th>Data/command</th><th>Data</th><th>Read/Write</th><th>Serial Clock</th></tr>
<tr><td>“H”</td><td>A0</td><td>D0 to D7</td><td>/RD,/WR</td><td>-</td></tr>
<tr><td>“L”</td><td>A0</td><td>SI(D7)</td><td>Write only</td><td>SCL(D6)</td></tr>
</table>
When P/S = “L”, D0 to D5 are HZ. D0 to D5 may be “H”, “L” or Open. /RD (E) and /WR (R/W) are fixed to either “H” or “L”. With serial data input, RAM display data reading is not supported.</td></tr>
<tr><td>6</td><td>C86</td><td>This is the MPU interface switch terminal<br>C86 = “H”: 6800 Series MPU interface<br>C86 = “L”: 8080 Series MPU interface.</td></tr>
<tr><td>7</td><td>V0</td><td rowspan="5">LCD driver supplies voltages. The voltage determined by the LCD cell is impedance-converted by a resistive driver or an operation amplifier for application. Voltages should be according to the following relationship:<br>V0 ≥ V1 ≥ V2 ≥ V3 ≥ V4 ≥ VSS2<br>When the on-chip operating power circuit is on, the following voltages are supplied to V1 to V4 by the on-chip power circuit. Voltage selection is performed by the LCD Bias Set command.
<table>
<tr><th>LCD bias</th><th>V1</th><th>V2</th><th>V3</th><th>V4</th></tr>
<tr><td>1/4bias</td><td>3/4 V0</td><td>2/4 V0</td><td>2/4 V0</td><td>1/4 V0</td></tr>
<tr><td>1/5bias</td><td>4/5 V0</td><td>3/5 V0</td><td>2/5 V0</td><td>1/5 V0</td></tr>
<tr><td>1/6bias</td><td>5/6 V0</td><td>4/6 V0</td><td>2/6 V0</td><td>1/6 V0</td></tr>
<tr><td>1/7bias</td><td>6/7 V0</td><td>5/7 V0</td><td>2/7 V0</td><td>1/7 V0</td></tr>
<tr><td>1/8bias</td><td>7/8 V0</td><td>6/8 V0</td><td>2/8 V0</td><td>1/8 V0</td></tr>
<tr><td>1/9bias</td><td>8/9 V0</td><td>7/9 V0</td><td>2/9 V0</td><td>1/9 V0</td></tr>
</table></td></tr>
<tr><td>8</td><td>V4</td></tr>
<tr><td>9</td><td>V3</td></tr>
<tr><td>10</td><td>V2</td></tr>
<tr><td>11</td><td>V1</td></tr>
<tr><td>12</td><td>C2-</td><td>Capacitor 2- pad for internal DC/DC voltage converter</td></tr>
<tr><td>13</td><td>C2+</td><td>Capacitor 2+ pad for internal DC/DC voltage converter</td></tr>
<tr><td>14</td><td>C1+</td><td>Capacitor 1+ pad for internal DC/DC voltage converter</td></tr>
<tr><td>15</td><td>C1-</td><td>Capacitor 1- pad for internal DC/DC voltage converter</td></tr>
<tr><td>16</td><td>C3+</td><td>Capacitor 3+ pad for internal DC/DC voltage converter</td></tr>
<tr><td>17</td><td>VOUT</td><td>DC/DC voltage converter output</td></tr>
<tr><td>18</td><td>VSS</td><td>Ground</td></tr>
<tr><td>19</td><td>VDD</td><td>Power supply input</td></tr>
<tr><td>20</td><td>D7(SI)</td><td rowspan="8">This is an 8-bit bi-directional data bus that connects to an 8-bit or 16-bit standard MPU data bus. When the serial interface is selected (P/S=“L”), then D7 serves as the serial data input terminal (SI) and D6 serves as the serial clock input terminal (SCL). At this time, D0 to D5 are set to high impedance. When the chip select is inactive, D0 to D7 are set to high impedance.</td></tr>
<tr><td>21</td><td>D6(SCL)</td></tr>
<tr><td>22</td><td>D5</td></tr>
<tr><td>23</td><td>D4</td></tr>
<tr><td>24</td><td>D3</td></tr>
<tr><td>25</td><td>D2</td></tr>
<tr><td>26</td><td>D1</td></tr>
<tr><td>27</td><td>D0</td></tr>
</table>

| | | |
|---|---|---|
| 28 | /RD(E) | When connected to an 8080 MPU, it is active LOW. This pad is connected to the /RD signal of the 8080MPU, and the NT7534 data bus is in an output status when this signal is "L". When connected to a 6800 Series MPU, this is active HIGH. This is used as an enable clock input of the 6800 series MPU |
| 29 | /WD(R/W) | When connected to an 8080 MPU, this is active LOW. This terminal connects to the 8080 MPU /WR signal. The signals on the data bus are latched at the rising edge of the /WR signal.<br>When connected to a 6800 Series MPU, this is the read/write control signal input terminal.<br>When R/W = "H": Read<br>When R/W = "L": Write |
| 30 | A0 | This is connected to the least significant bit of the normal MPU address bus, and it determines whether the data bits are data or a command.<br>A0 = "H": Indicate that D0 to D7 are display data<br>A0 = "L": Indicates that D0 to D7 are control data |
| 31 | /RSE | When /RES is set to "L", the settings are initialized. The reset operation is performed by the /RES signal level |
| 32 | /CS1 | This is the chip select signal. When /CS1="L" and CS2="H", then the chip select becomes active, and data/command I/O is enabled. |

## 6. ABSOLUTE MAXIMUM RATINGS

| Parameter | Symbol | Min. | Max. | Uuit |
|---|---|---|---|---|
| Power | $V_{DD}$ | -0.3 | +4.0 | V |
| Voltage converter output | Vout,V0 | -0.3 | +15.0 | V |
| Input voltage | $V_{IN}$ | -0.3 | $V_{DD}$+0.3 | V |
| Operating temperature | Topr | -20 | +70 | °C |
| Storage temperature | Tstg | -30 | +80 | °C |

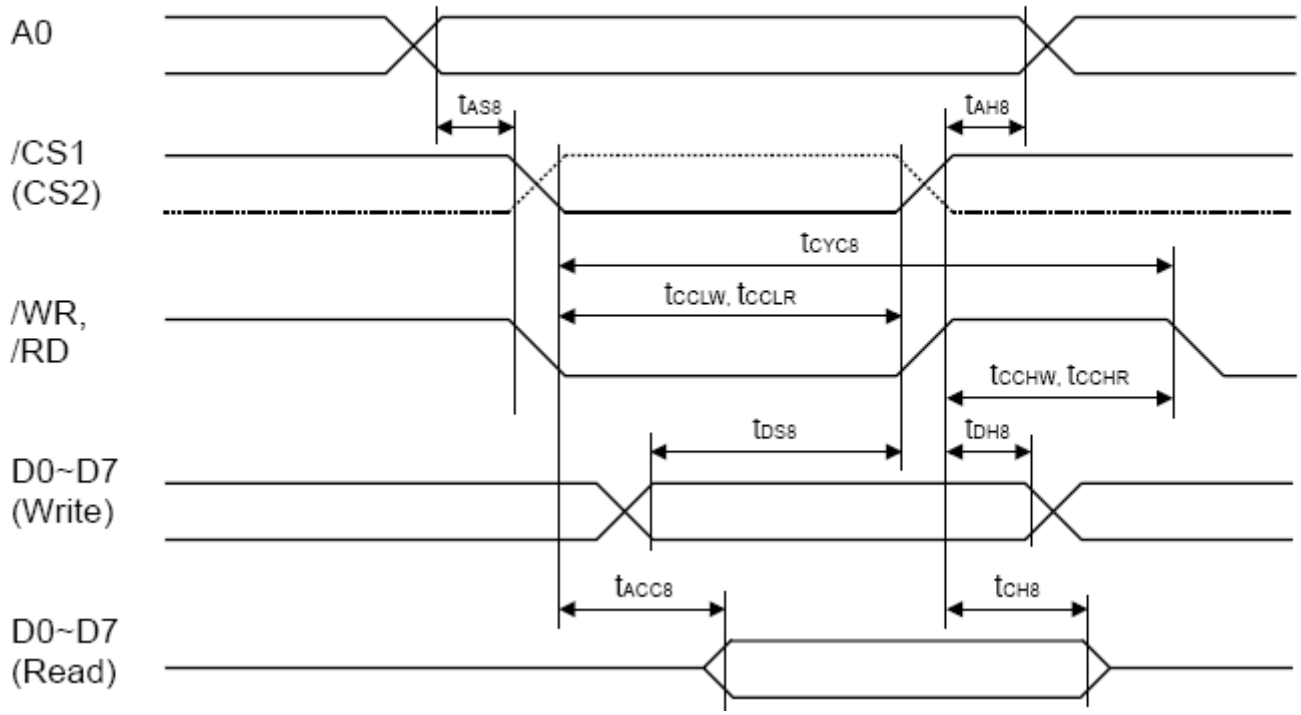
## 7. ELECTRICAL CHARACTERISTICS

### 7-1. DC Characteristics

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Condition |
|---|---|---|---|---|---|---|
| Operating Voltage | $V_{DD}$ | 3.0 | 3.3 | 3.6 | V | |
| LCD Voltage | $V_{LCD}$ | 10.4 | 10.7 | 11.0 | V | V0-Vss |
| $I_{DD}$ | Current consumption | - | 20 | 35 | uA | $V_{DD}$=3.3V,V0=10.7V, built-in boosting power supply off, display on, Display data=checker and no access Ta=25°C |
| | | - | 90 | 160 | uA | $V_{DD}$=3.3V,V0=10.7V, 4x built-in boosting power supply, display on, Display data=checker and no access, Temperature radiant is -0.05%/°C, Ta=25°C |
| | | - | 150 | 255 | uA | $V_{DD}$=3.3V, V0=10.7V, 4x built-in boosting power supply, display on, Display data=checker and no access, Temperature gradient is -0.05%/°C, Ta=25°C |

## 7-2. AC Characteristics

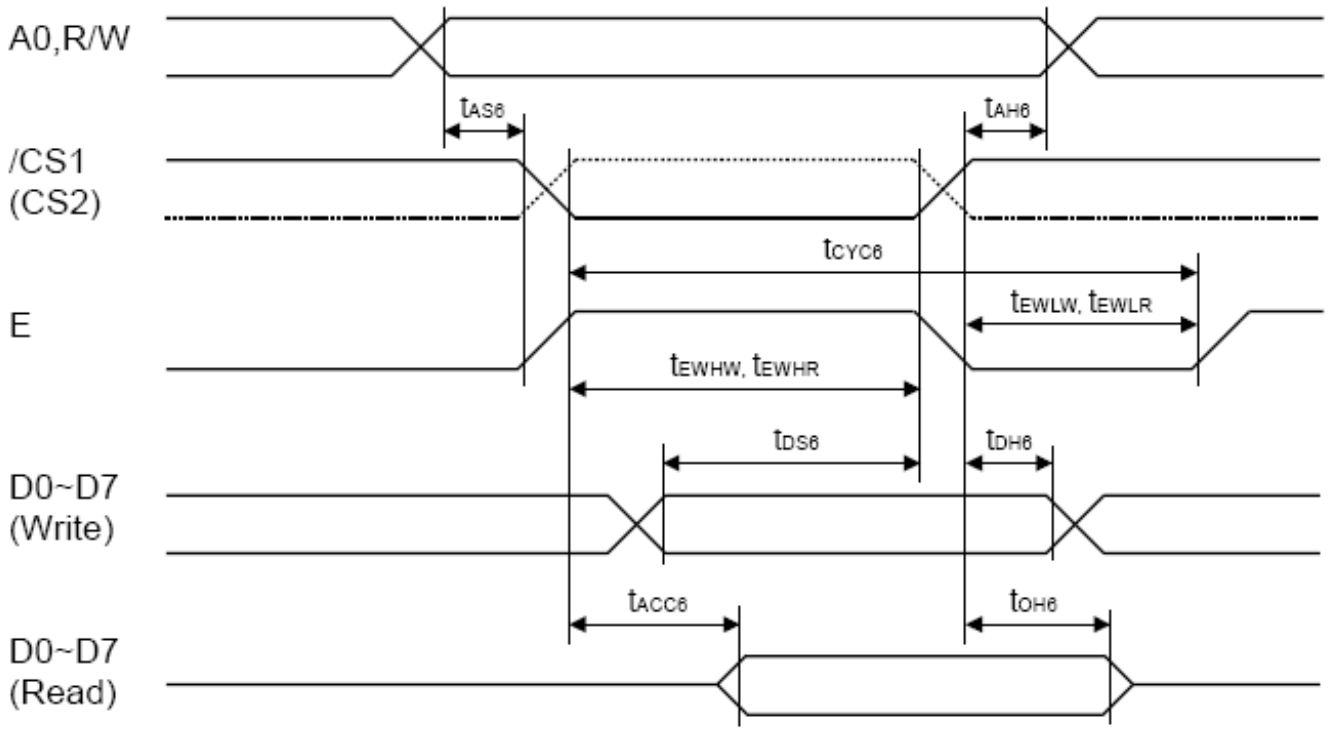
System Buses Read/Write Characteristics (for 8080 Series MPU)




| Symbol | Parameter | Min. | Typ. | Max. | Unit | Condition |
|---|---|---|---|---|---|---|
| $T_{AH8}$ | Address hold time | 0 | - | - | ns | A0 |
| $T_{AS8}$ | Address setup time | 0 | - | - | ns | |
| $t_{CYC8}$ | System cycle time | 240 | - | - | ns | |
| $t_{CCLW}$ | Control low pulse width (write) | 90 | - | - | ns | /WR |
| $t_{CCLR}$ | Control low pulse width (read) | 120 | - | - | ns | /RD |
| $t_{CCHW}$ | Control high pulse width (write) | 100 | - | - | ns | /WR |
| $t_{CCHR}$ | Control high pulse width (read) | 60 | - | - | ns | /RD |
| $T_{DS8}$ | Data setup time | 40 | - | - | ns | D0~D7 |
| $T_{DH8}$ | Data hold time | 10 | - | - | ns | |
| $t_{ACC8}$ | /RD access time | - | - | 140 | ns | D0~D7, CL = 100pF |
| $T_{CH8}$ | Output disable time | 5 | - | 50 | ns | |

*1. The input signal rise time and fall time ($t_r$, $t_f$) is specified at 15ns or less.
($t_r + t_f$) < ($t_{CYC8}$ - $t_{CCLW}$ - $t_{CCHW}$) for write, ($t_r + t_f$) < ($t_{CYC8}$ - $t_{CCLR}$ - $t_{CCHR}$) for read.
*2. All timing is specified using 20% and 80% of VDD as the reference.
*3. $t_{CCLW}$ and $t_{CCLR}$ are specified as the overlap interval when /CS1 is low (CS2 is high) and /WR or /RD is low.

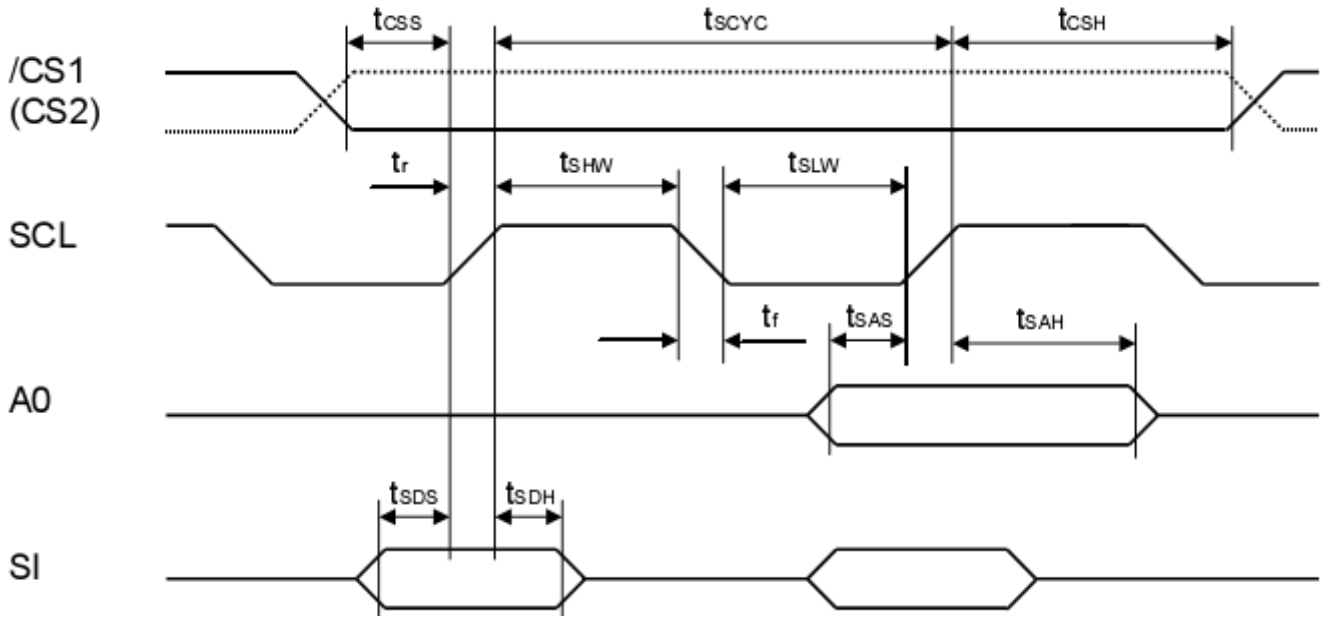
System Buses Read/Write Characteristics (for 6800 Series MPU)




| Symbol | Parameter | Min. | Typ. | Max. | Unit | Condition |
|---|---|---|---|---|---|---|
| $t_{AH6}$ | Address hold time | 0 | - | - | ns | A0, R/W |
| $t_{AS6}$ | Address setup time | 0 | - | - | ns | |
| $t_{CYC6}$ | System cycle time | 240 | - | - | ns | |
| $t_{EWHW}$ | Control high pulse width (write) | 90 | - | - | ns | E |
| $t_{EWHR}$ | Control high pulse width (read) | 120 | - | - | ns | E |
| $t_{EWLW}$ | Control low pulse width (write) | 100 | - | - | ns | E |
| $t_{EWLR}$ | Control low pulse width (read) | 60 | - | - | ns | E |
| $t_{DS6}$ | Data setup time | 40 | - | - | ns | D0~D7 |
| $t_{DH6}$ | Data hold time | 10 | - | - | ns | |
| $t_{ACC6}$ | /RD access time | - | - | 140 | ns | D0~D7 CL = 100pF |
| $t_{OH6}$ | Output disable time | 5 | - | 50 | ns | |

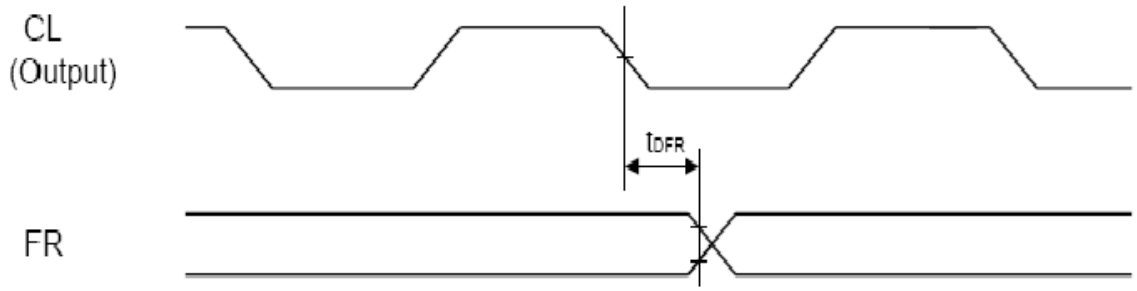
*1. The input signal rise time and fall time ($t_r$, $t_f$) is specified at 15ns or less.
($t_r + t_f$) < ($t_{CYC6} - t_{EWLW} - t_{EWHW}$) for write, ($t_r + t_f$) < ($t_{CYC6} - t_{EWLR} - t_{EWHR}$) for read.
*2. All timing is specified using 20% and 80% of VDD as the reference.
*3. $t_{EWHW}$ and $t_{EWHR}$ are specified as the overlap interval when /CS1 is low (CS2 is high) and E is high.

Serial Interface Timing



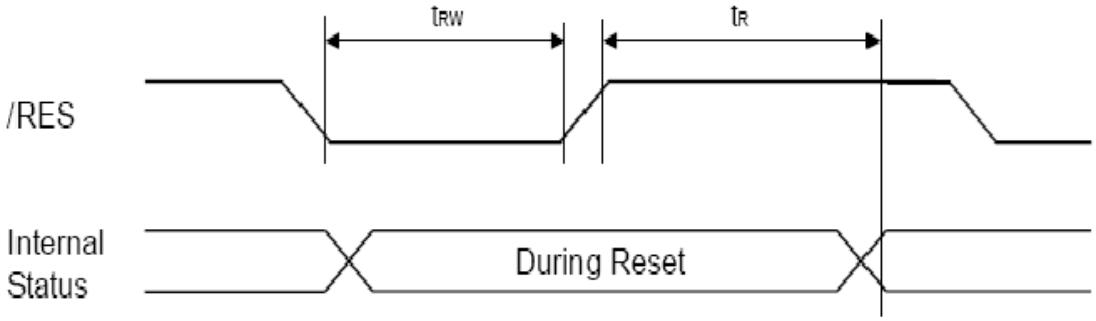

| Symbol | Parameter | Min. | Typ. | Max. | Unit | Condition |
|---|---|---|---|---|---|---|
| $t_{SCYC}$ | Serial clock cycle | 120 | - | - | ns | SCL |
| $t_{SHW}$ | Serial clock H pulse width | 60 | - | - | ns | SCL |
| $t_{SLW}$ | Serial clock L pulse width | 60 | - | - | ns | SCL |
| $t_{SAS}$ | Address setup time | 30 | - | - | ns | A0 |
| $t_{SAH}$ | Address hold time | 20 | - | - | ns | A0 |
| $t_{SDS}$ | Data setup time | 30 | - | - | ns | SI |
| $t_{SDH}$ | Data hold time | 20 | - | - | ns | SI |
| $t_{CSS}$ | Chip select setup time | 20 | - | - | ns | /CS1, CS2 |
| $t_{CSH}$ | Chip select hold time | 40 | - | - | ns | /CS1, CS2 |

Display Control Timing




| Symbol | Parameter | Min. | Typ. | Max. | Unit | Condition |
|---|---|---|---|---|---|---|
| $t_{DFR}$ | FR delay time | - | 20 | 80 | ns | CL = 50 pF |

Reset Timing




| Symbol | Parameter | Min. | Typ. | Max. | Unit | Condition |
|---|---|---|---|---|---|---|
| $t_R$ | Reset Time | - | - | 1.0 | µs | |
| $t_{RW}$ | Reset low pulse width | 10 | - | - | µs | /RES |

## 8. INSTRUCTION DESCRIPTION

| Command | A0 | /RD | /WR | Code | | | | | | | | | Function |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Hex | |
| (1)Display OFF | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0<br>1 | AEh<br>AFh | Turn on LCD panel when high, and turn off when low |
| (2)Display start line set | 0 | 1 | 0 | 0 | 1 | Display start address | | | | | | 40h<br>To<br>7Fh | Specifies RAM display line for com0 |
| (3)Page address set | 0 | 1 | 0 | 1 | 0 | 1 | 1 | Page address | | | | B0h<br>To<br>B8h | Set the display data RAM page in page address register |
| (4)Column address set | 0 | 1 | 0 | 0 | 0 | 0 | 1 | Higher column address | | | | 00h<br>To<br>18h | Set 4 higher bits and 4 lower bits of column address of display data RAM in register |
| | 0 | 1 | 0 | 0 | 0 | 0 | 0 | Lower column address | | | | | |
| (5)Read status | 0 | 0 | 1 | Status | | | | 0 | 0 | 0 | 0 | XX | Read the status information |
| (6)Write display data | 1 | 1 | 0 | Write data | | | | | | | | XX | Write data in display data RAM |
| (7)Read display data | 1 | 0 | 1 | Read data | | | | | | | | XX | Read data from display data RAM |
| (8)ADC select | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0<br>1 | A0h<br>A1h | Set the display data RAM address SEG output correspondence |
| (9)Normal/Reverse display | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0<br>1 | A6h<br>A7h | Normal indication when low .but full indication when high |
| (10)Entire display on/off | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0<br>1 | A4h<br>A5H | Select normal display (0) or entire display on |
| (11)LCD bias set | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0<br>1 | A2h<br>A3h | Sets LCD driving voltage bias ratio |
| (12)Read –modify-write | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | E0h | Increments column address counter during each write |
| 13) End | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | EEh | Releases the Read-Modify -Write |
| (14) Reset | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | E2h | Resets internal functions |
| (15) Common Output Mode Select | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0<br>1 | * | * | * | C0h<br>to<br>CFh | Select COM output scan direction invalid data |
| (16) Power Control Set | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | Operation Status | | | 28h<br>to<br>2Fh | Select the power circuit operation mode |
| 17) V0 Voltage Regulator Internal Resistor ratio Set | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | Resistor Ratio | | | 20h<br>to<br>27h | Select internal resistor ratio Rb/Ra mode |
| (18) Electronic Volume mode Set Electronic Volume Register Set | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 81h | |
| | 0 | 1 | 0 | * | * | Electronic Control Value | | | | | | XX | Sets the V0 output voltage electronic volume register |
| (19) Set Static indicator ON/OFF | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0<br>1 | ACh<br>ADh | Sets static indicator ON/OFF<br>0: OFF, 1: ON |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Set Static Indicator Register | 0 | 1 | 0 | * | * | * | * | * | * | Mode | | XX | Sets the flash mode |
| (20) Power Save | 0 | 1 | 0 | - | - | - | - | - | - | - | - | - | Compound command of Display OFF and Entire Display ON |
| (21) NOP | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | E3h | Command for non-operation |
| (22) Oscillation Frequency Select | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0<br>1 | E4h<br>E5h | Select the oscillation frequency |
| (23) Partial Display mode Set | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0<br>1 | 82h<br>83h | Enter/Release the partial display mode |
| (24) Partial Display Duty Set | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | Duty Ratio | | | 30h<br>37h | Sets the LCD duty ratio for partial display mode |
| (25) Partial Display Bias Set | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | Bias Ratio | | | 38h<br>3Fh | Sets the LCD bias ratio for partial display mode |
| (26) Partial Start Line Set | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | D3h | Enter Partial Start Line Set |
| Partial Start Line Set | 0 | 1 | 0 | 1 | 1 | Partial Start Line | | | | | | XX | Sets the LCD Number of partial display start line |
| (27) N-Line Inversion Set | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 85h | Enter N-Line inversion |
| Number of Line Set | 0 | 0 | * | * | * | * | Number of Line | | | | | XX | Sets the number of line used for N-Line inversion |
| (28) N-Line Inversion Release | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 84h | Exit N-Line Inversion |
| (29) DC/DC Clock Set | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | E6h | Set DC/DC Clock Frequency |
| DC/DC Clock Division Set | 0 | 1 | 0 | 1 | 1 | 0 | 0 | Clock Division | | | | XX | Set the Division of DC/DC Clock Frequency |
| (30) Test Command | 0 | 1 | 0 | 1 | 1 | 1 | 1 | * | * | * | * | F1h to FFh | IC test command. Do not use! |
| (31) Test Mode Reset | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | F0h | Command of test mode reset |

**NOTE:** Do not use any other command, or system malfunction may result

## 9. LCD MODULES HANDLING PRECAUTIONS

- The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.
- If the display panel is damaged and the liquid crystal substance inside it leaks out, do not get any in your mouth. If the substance come into contact with your skin or clothes promptly wash it off using soap and water.
- Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.
- The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarize carefully.
- To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

  -Be sure to ground the body when handling the LCD module.

  -Tools required for assembly, such as soldering irons, must be properly grounded.

  -To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.

  -The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.
- Storage precautions

  When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps. Keep the modules in bags designed to prevent static electricity charging under low temperature / normal humidity conditions (avoid high temperature / high humidity and low temperatures below -20°C). Whenever possible, the LCD modules should be stored in the same conditions in which they were shipped from our company.

## 10. OTHERS

- Liquid crystals solidify at low temperature (below the storage temperature range) leading to defective orientation of liquid crystal or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subjected to a strong shock at a low temperature.
- If the LCD modules have been operating for a long time showing the same display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. Abnormal operating status can be resumed to be normal condition by suspending use for some time. It should be noted that this phenomena does not adversely affect performance reliability.
- To minimize the performance degradation of the LCD modules resulting from caused by static electricity, etc. exercise care to avoid holding the following sections when handling the modules:
  - Exposed area of the printed circuit board
  - Terminal electrode sections.