**DISPLAY Elektronik GmbH**

# DATA SHEET

# LCD MODULE

# DEM 128064Q FGH-PW

***Product Specification*** ***Version: 5***

**08.02.2018**

# GENERAL SPECIFICATION

## MODULE NO. :

# DEM 128064Q FGH-PW

CUSTOMER P/N:

| VERSION NO. | CHANGE DESCRIPTION | DATE |
|---|---|---|
| 0 | Original Version | 22.01.2018 |
| 1 | Correct segment layout drawing/Correct pin18 and pin 21 symbol etc. | 24.01.2018 |
| 2 | Change the FPC to the LCD bottom side | 29.01.2018 |
| 3 | Change the IC to UC1601x; Correct the AC characteristics;Correct the LCD layout;Correct the BL drawing. | 05.02.2018 |
| 4 | Correct A/K direction in page4/page5; Correct "LCD ARTWORK" in the header line on page21 | 06.02.2018 |
| 5 | Correct BL A/K direction in the module drawing and BL drawing. | 08.02.2018 |
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PREPARED BY: PS DATE: 08.02.2018

APPROVED BY: MH DATE: 08.02.2018

# CONTENTS

# 1. FUNCTIONS & FEATURES

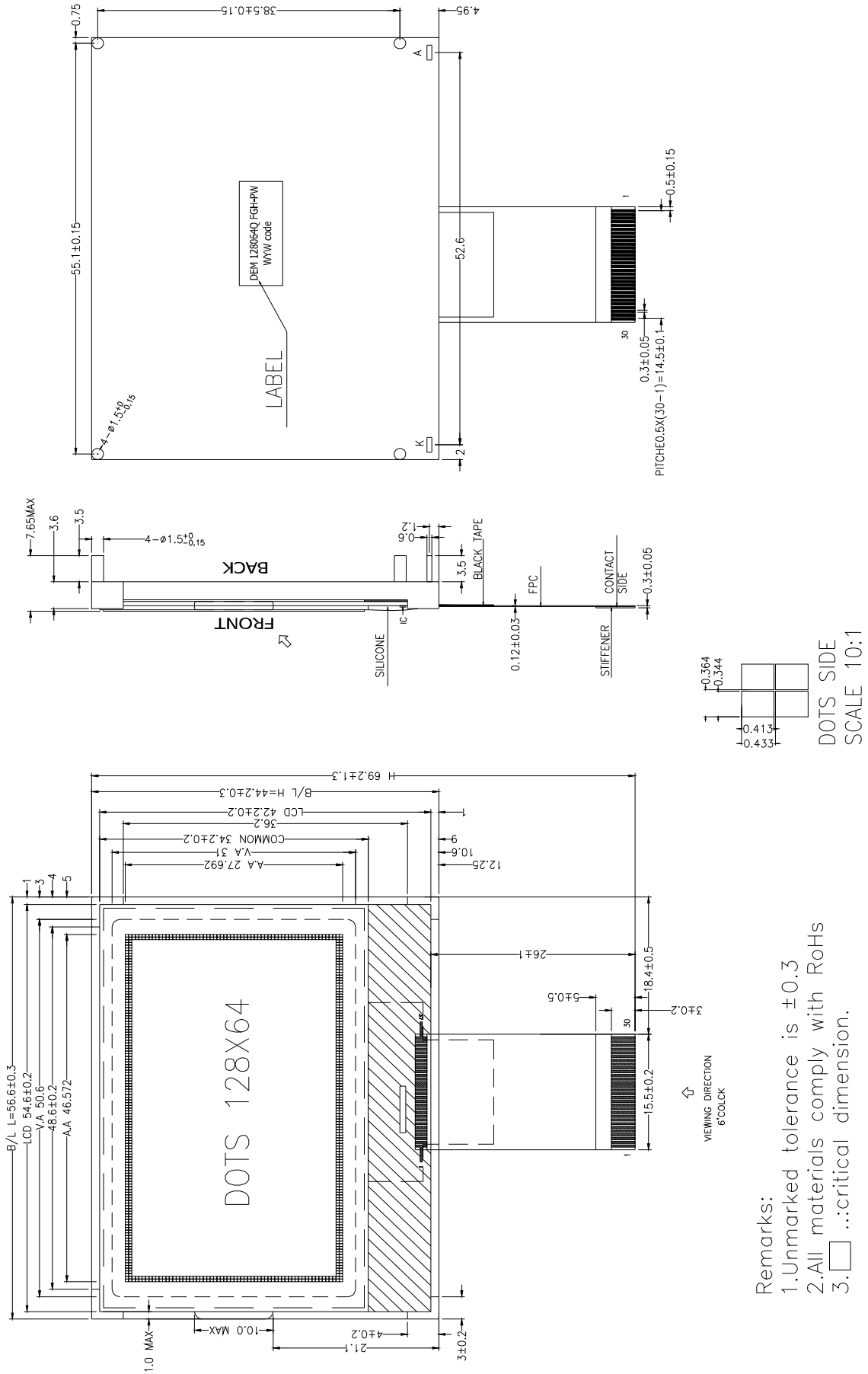
| MODULE NAME | LCD TYPE |
|---|---|
| DEM 128064Q FGH-PW | FSTN Transflective Positive |

- Viewing Direction : 6 O'clock
- Driving Scheme : 1/65 Duty, 1/9 Bias
- Power Supply Voltage : 3 Volt (typ.)
- $V_{LCD}$ : 10.2 Volt (typ.)
- Display Contents : 128 x 64 Dots
- Driver IC : UC1601x

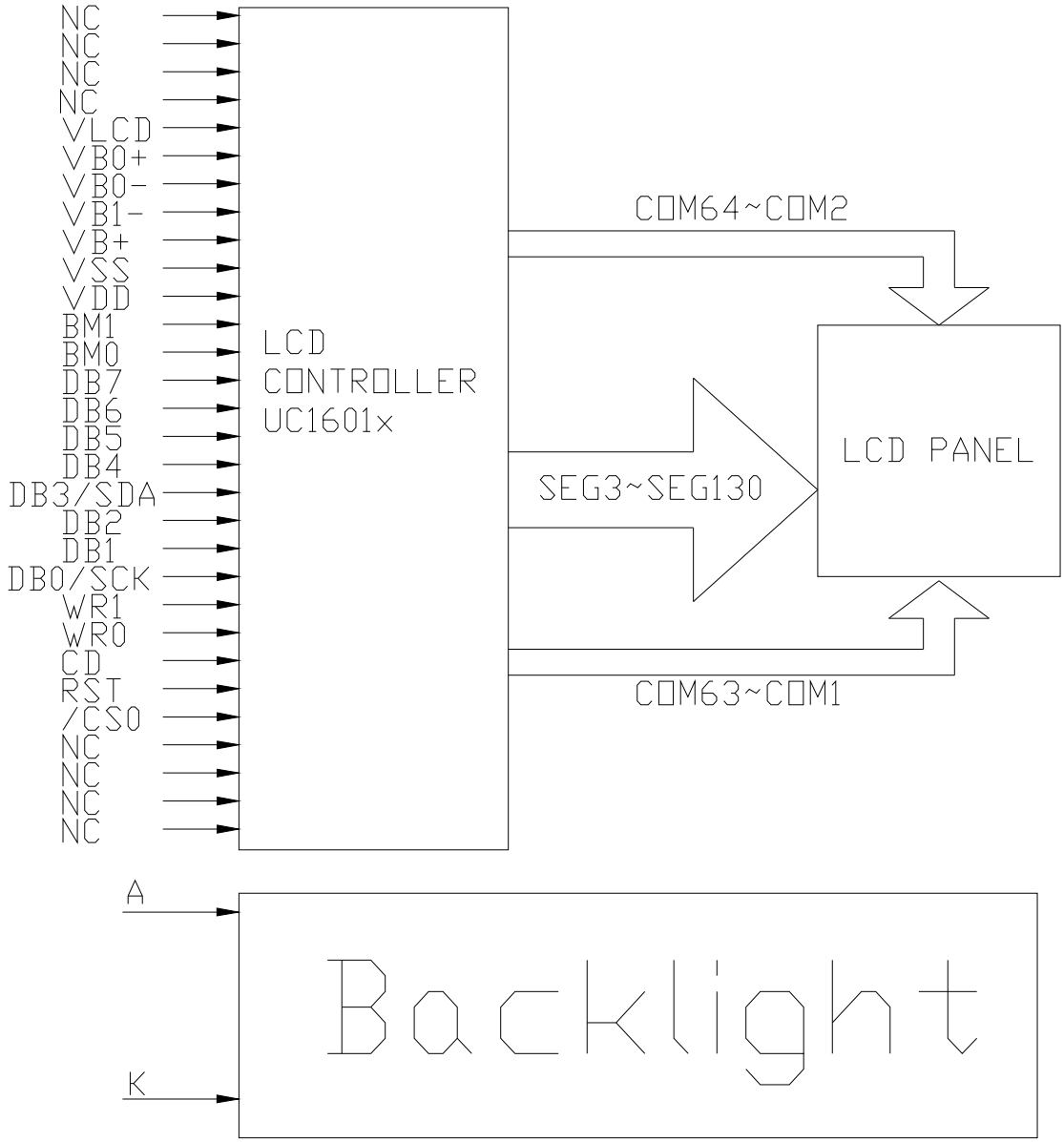
# 2. MECHANICAL SPECIFICATIONS

- Module Size : 56.60 x 44.20 x 3.60 mm
- Viewing Area : 50.60 x 31.00 mm
- Active Area : 46.572 x 27.692 mm

# 3. EXTERNAL DIMENSIONS



## 4. BLOCK DIAGRAM

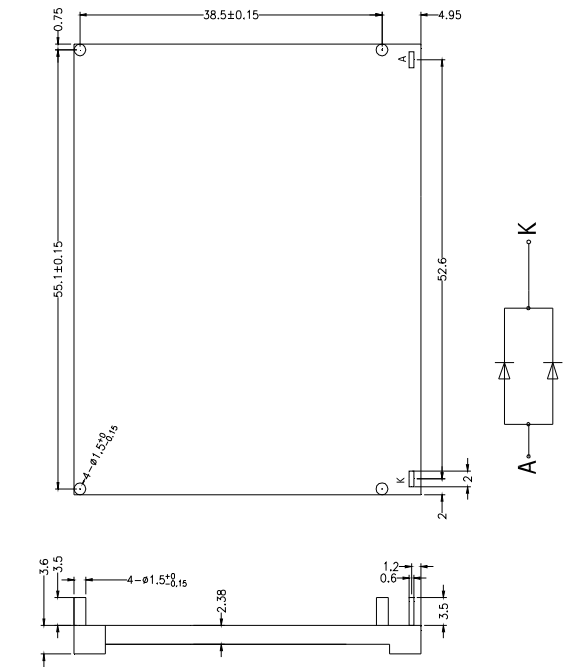


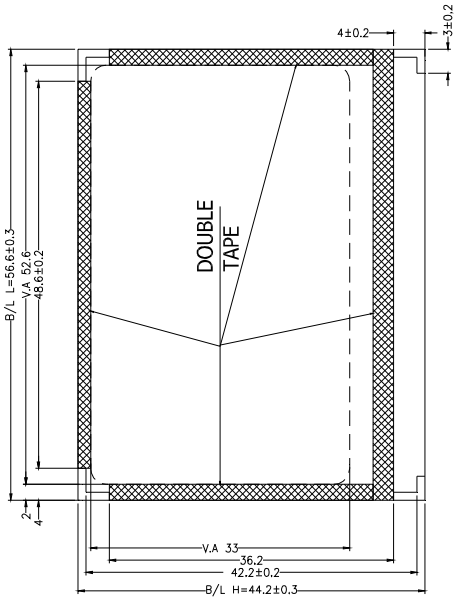
# 5. PIN ASSIGNMENT

<table>
<tr><th>Pin No</th><th>Symbol</th><th>Description</th></tr>
<tr><td>1~4</td><td>NC</td><td>No Connection</td></tr>
<tr><td>5</td><td>VLCD</td><td>Main LCD Power Supply</td></tr>
<tr><td>6</td><td>VB0+</td><td rowspan="4">LCD Bias Voltages.These aer the voltage sources to provide SEG driving currents. These voltages are generated internally Connect capacitors of $C_{bx}$ value between $V_{bx+}$ and $V_{bx-}$</td></tr>
<tr><td>7</td><td>VB0-</td></tr>
<tr><td>8</td><td>VB1-</td></tr>
<tr><td>9</td><td>VB1+</td></tr>
<tr><td>10</td><td>VSS</td><td>Power Ground</td></tr>
<tr><td>11</td><td>VDD</td><td>Power supply terminal VCC</td></tr>
<tr><td>12</td><td>BM1</td><td rowspan="2">Bus mode: “HL”:8080 “HH”:6800<br>BM[1:0] “LH”:S9 “LL”:S8</td></tr>
<tr><td>13</td><td>BM0</td></tr>
<tr><td>14</td><td>DB7</td><td rowspan="8">Bi-directional bus for both serial and parallel host interfaces in serial modes connect DB0 to SCK,DB3 to SDA
<table>
<tr><th></th><th>BM=1X (8-bit)</th><th>BM=00 (S8)</th><th>BM=01 (S9)</th><th>BM=01 ($I^2C$)</th></tr>
<tr><td>D0</td><td>D0</td><td>SCK</td><td>SCK</td><td>SCK</td></tr>
<tr><td>D1</td><td>D1</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td>D2</td><td>D2</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td>D3</td><td>D3</td><td>SDA</td><td>SDA</td><td>SDA</td></tr>
<tr><td>D4</td><td>D4</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td>D5</td><td>D5</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td>D6</td><td>D6</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>D7</td><td>D7</td><td>1</td><td>1</td><td>1</td></tr>
</table></td></tr>
<tr><td>15</td><td>DB6</td></tr>
<tr><td>16</td><td>DB5</td></tr>
<tr><td>17</td><td>DB4</td></tr>
<tr><td>18</td><td>DB3/SDA</td></tr>
<tr><td>19</td><td>DB2</td></tr>
<tr><td>20</td><td>DB1</td></tr>
<tr><td>21</td><td>DB0/SCK</td></tr>
<tr><td>22</td><td>WR1</td><td rowspan="2">WR[1:0]controls the read/write operation of the host interface See Host Interface section for details<br>In parallel mode the meaning of WR[1:0]depends on which interface it is in 6800 or 8080 mode in serial interface modes these two pins are not used Connect them to Vss</td></tr>
<tr><td>23</td><td>WR0</td></tr>
<tr><td>24</td><td>CD</td><td>Select Control data or Display data for read/write operation in S9 CD pin is not used Connect CD to Vss when not used<br>“L”:Control data “H”:Display data</td></tr>
<tr><td>25</td><td>RST</td><td>Reset</td></tr>
<tr><td>26</td><td>/CS0</td><td>When /CS=L, then the chip select becomes active</td></tr>
<tr><td>27~30</td><td>NC</td><td>No Connection</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>1</td><td>A</td><td>Anode of LED Backlight</td></tr>
<tr><td>2</td><td>K</td><td>Cathode of LED Backlight</td></tr>
</table>

# 6. BACKLIGHT CHARACTERISTICS

| Item | Symbol | MIN. | TYP. | MAX. | Unit | Condition |
|---|---|---|---|---|---|---|
| Forward Voltage | Vf | 2.7 | 3 | 3.1 | V | T=25°C<br>If= 30 mA |
| Colour Coordinate | X | 0.26 | / | 0.32 | | |
| | Y | 0.26 | / | 0.32 | | |
| Luminance | Lv | 150 | 220 | / | cd/㎡ | |
| Uniformity | Avg | 70 | | | % | |




Remarks:
1.Unmarked tolerance is ±0.3
2.All materials comply with RoHs
3.□ ..:critical dimension.

## 7. ABSOLUTE MAXIMUM RATINGS

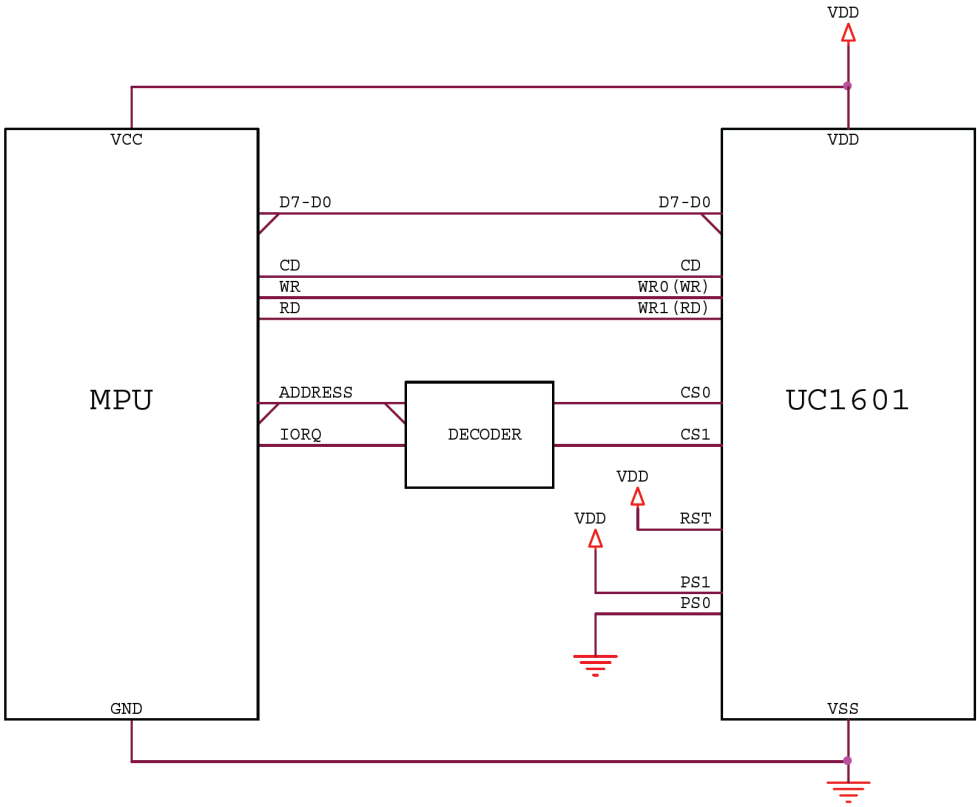
| Parameter | Symbol | Min | Max | Unit |
|---|---|---|---|---|
| Digital Power Supply Voltage | $V_{DD}$ | -0.3 | +4.0 | V |
| Analog Power Supply Voltage | $V_{DD2}$ | -0.3 | +4.0 | V |
| Analog Circuit Supply Voltage | $V_{DD3}$ | -0.3 | +4.0 | V |
| Voltage Difference between VDD and VDD2/3 | VDD2/3-VDD | ----- | 1.2 | V |
| LCD Generated Voltage | $V_{LCD}$ | 0.8 | 11.5 | V |
| Any Input/Output | VIN/VOUT | -0.4 | $V_{DD}$+0.3 | V |
| Operating Temperature | $T_{opr}$ | -20 | 70 | □ |
| Storage Temperature | $T_{STR}$ | -30 | 80 | □ |

## 8. DC CHARACTERISTICS

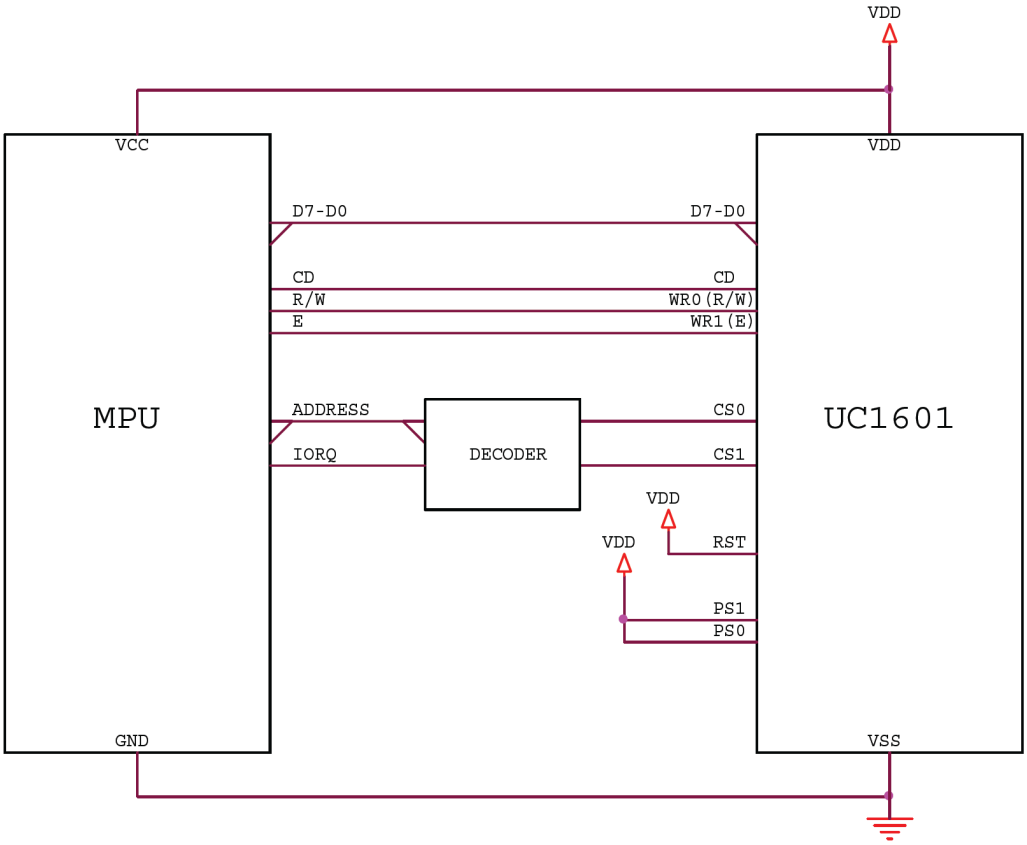
| ITEM | SYMBOL | CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Power Supply for LCM | VDD | --- | 2.7 | 3 | 3.3 | V |
| LCD Module Driving Voltage | VLCD | VDD2/3 ≥ 2.4V,25℃ | 9.7 | 10.2 | 10.7 | V |
| Supply Current for LCM | IDD | --- | --- | t.b.d. | --- | mA |

# 9. Voltage Generator Circuit

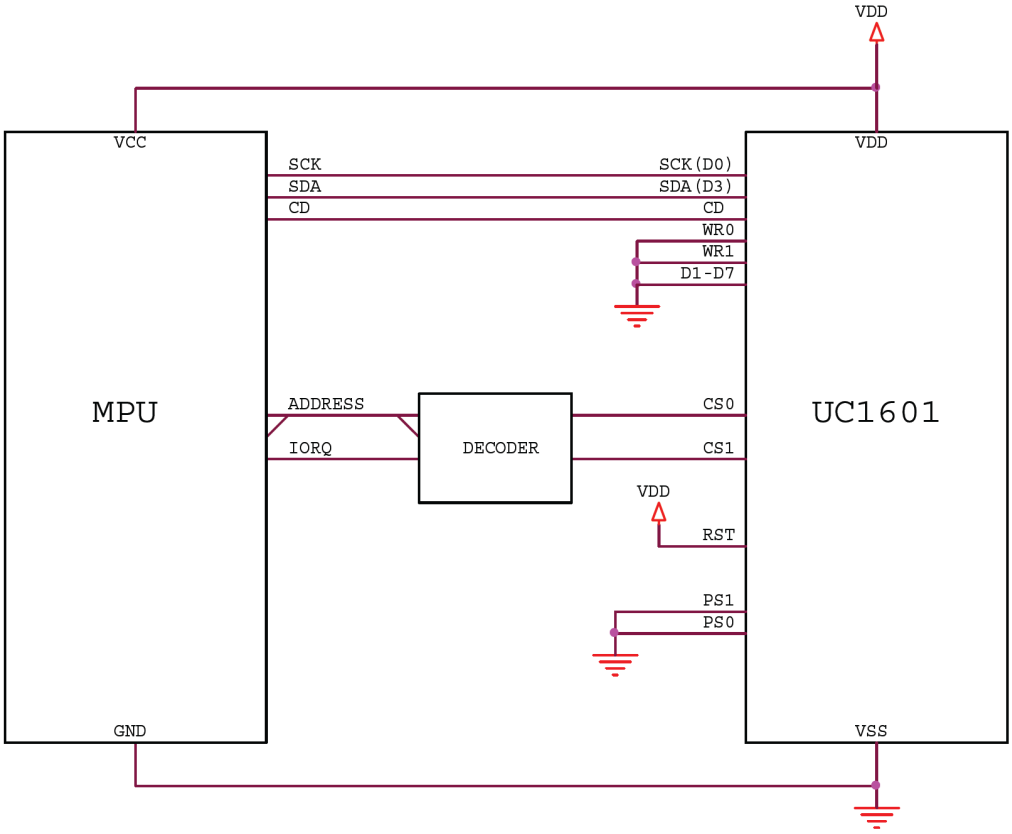
## 9-1 8080/8bit Parallel Mode Reference Circuit



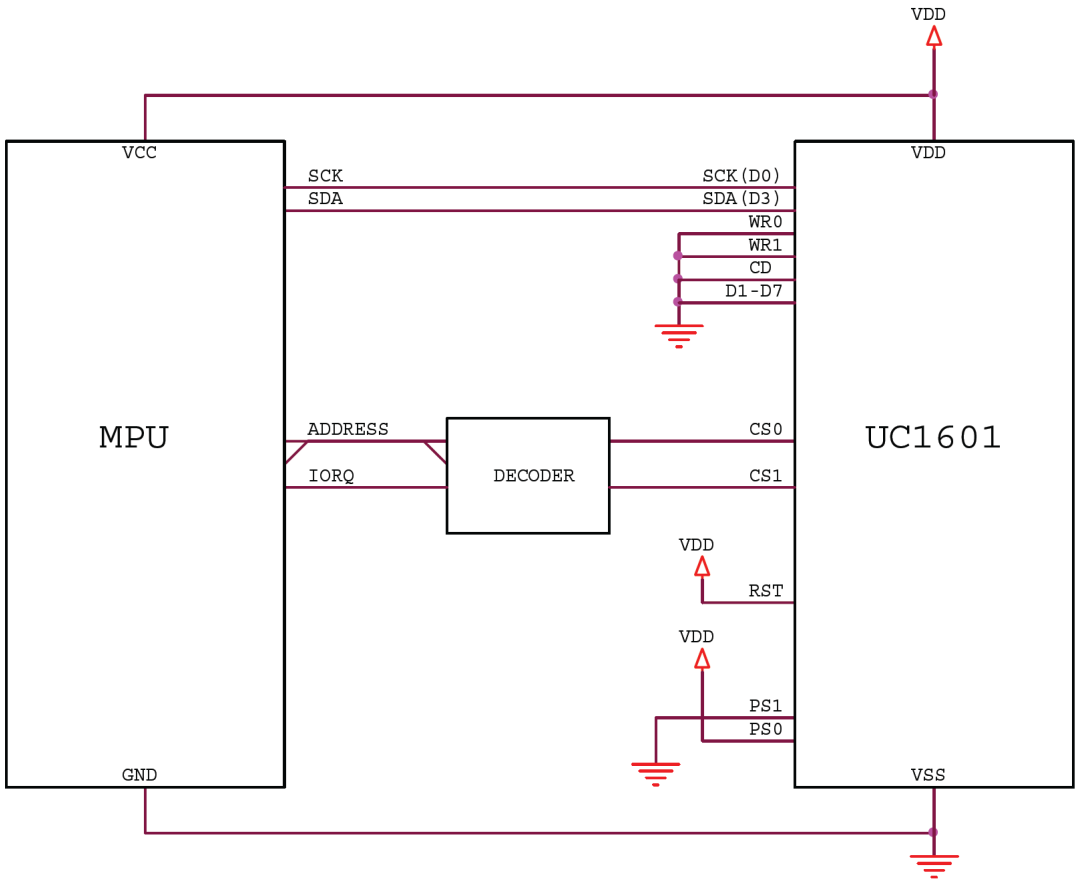

## 9-2 6800/8bit Parallel Mode Reference Circuit

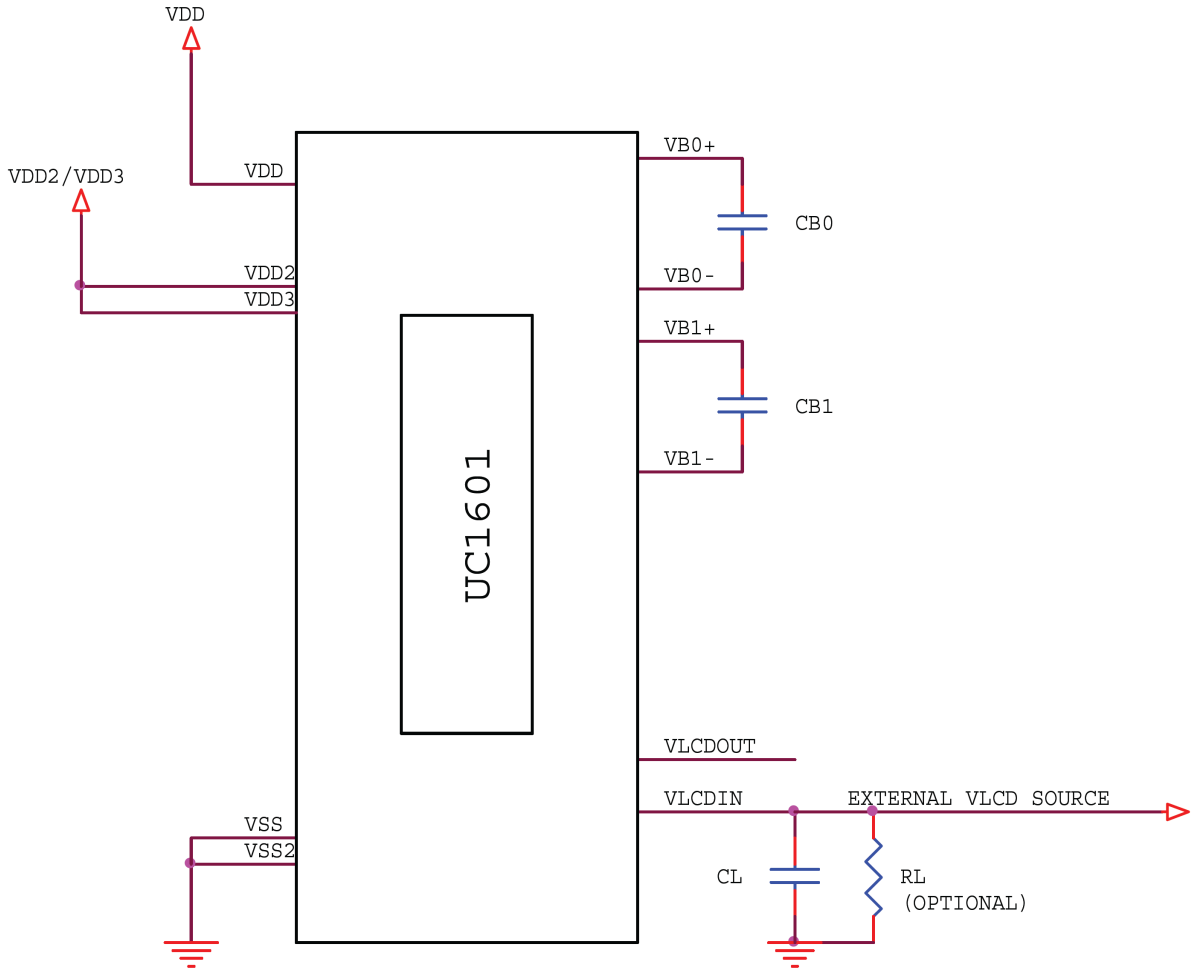


## 9-3 Serial-8 Serial Mode Reference Circuit




## 9-4 Serial-9 Serial Mode Reference Circuit






Note

Recommended component values:

CB: 100x~200x LCD load capacitance or 1.0uF (2V), whichever is higher.

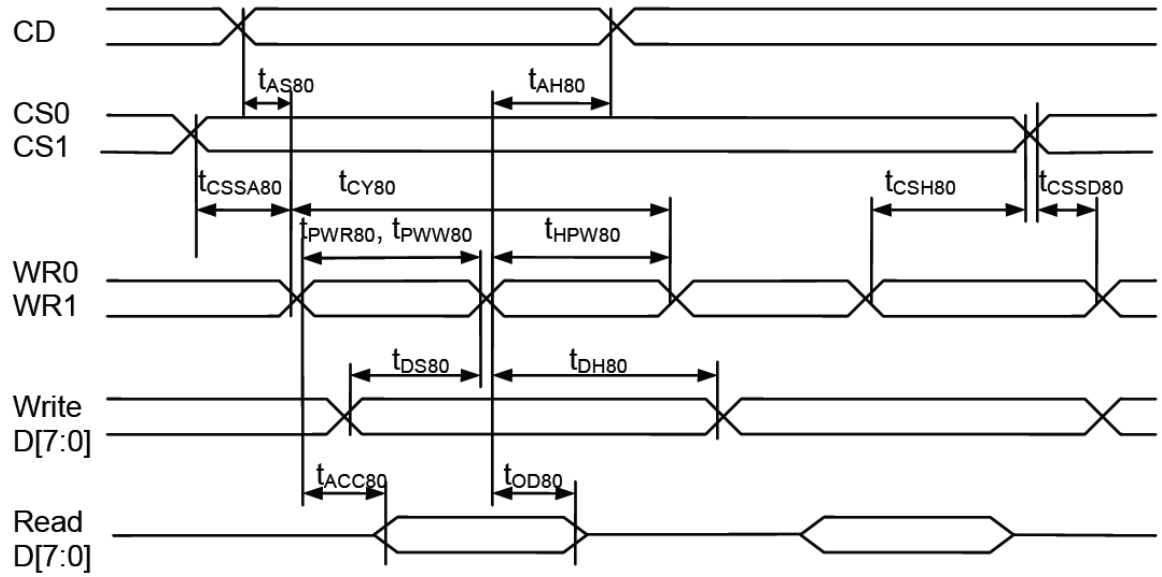
CL: 10nF ~ 30nF (25V) is appropriate for most applications.

RL: 10MΩ. Acts as a draining circuit when the power is abnormally shut down.

The illustrated resistor values are for reference only. Please optimize for specific requirements of each application.

# 10. AC Characteristics

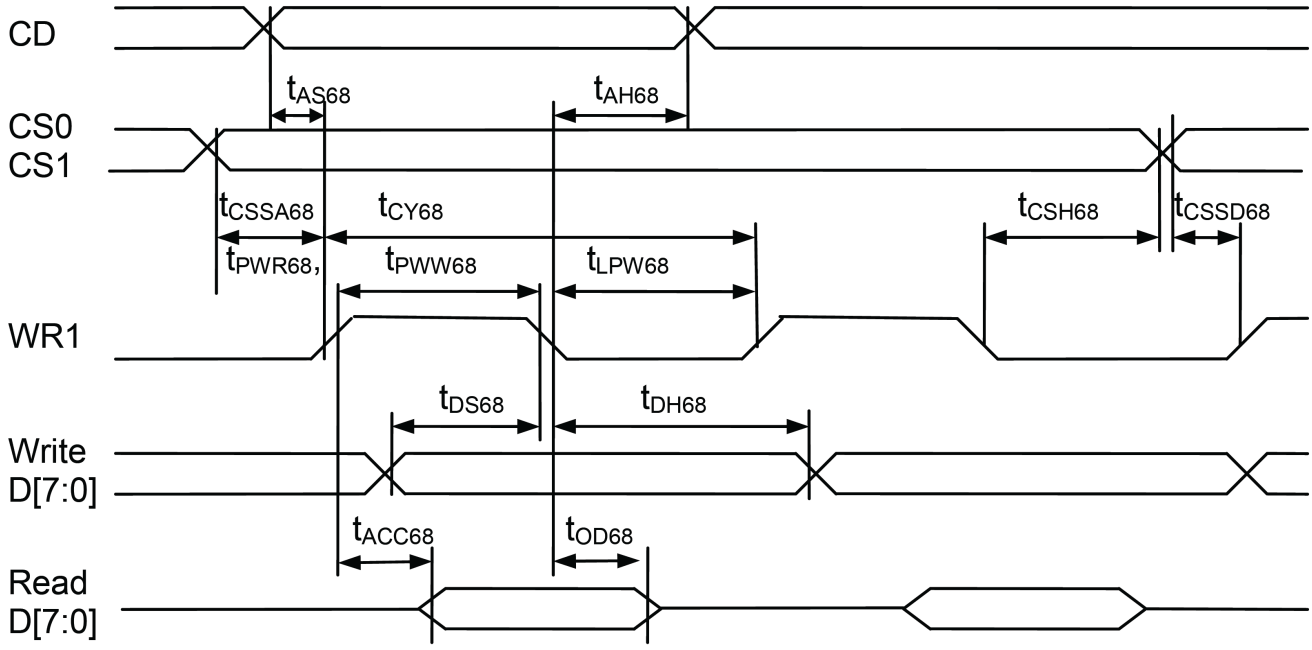
## 10-1 System Bus Timing for 8080 Series MPU




**Parallel Bus Timing Characteristics (for 8080 MCU)**

| Symbol | Signal | Description | Condition | Min. | Max. | Unit |
|---|---|---|---|---|---|---|
| | | | (Read / Write) | | | |
| $t_{AS80}$<br>$t_{AH80}$ | CD | Address setup time<br>Address hold time | | 0<br>40 | – | nS |
| $t_{CSSA80}$<br>$t_{CSSD80}$<br>$t_{CSH80}$ | CS1/CS0 | Chip select setup time | | 10<br>10<br>20 | – | nS |
| $t_{CY80}$ | WR1 / WR0 | System cycle time | | 165 | – | nS |
| $t_{PWR80}$ / $t_{PWW80}$ | | Pulse width | | 65 / 65 | | |
| $t_{HPW80}$ | | High pulse width | | 65 | | |
| $t_{DS80}$<br>$t_{DH80}$ | D0~D7<br>(Write) | Data setup time<br>Data hold time | | 30<br>20 | – | nS |
| $t_{ACC80}$<br>$t_{OD80}$ | D0~D7<br>(Read) | Read access time<br>Output disable time | $C_L$ = 100pF | –<br>10 | 50<br>50 | nS |

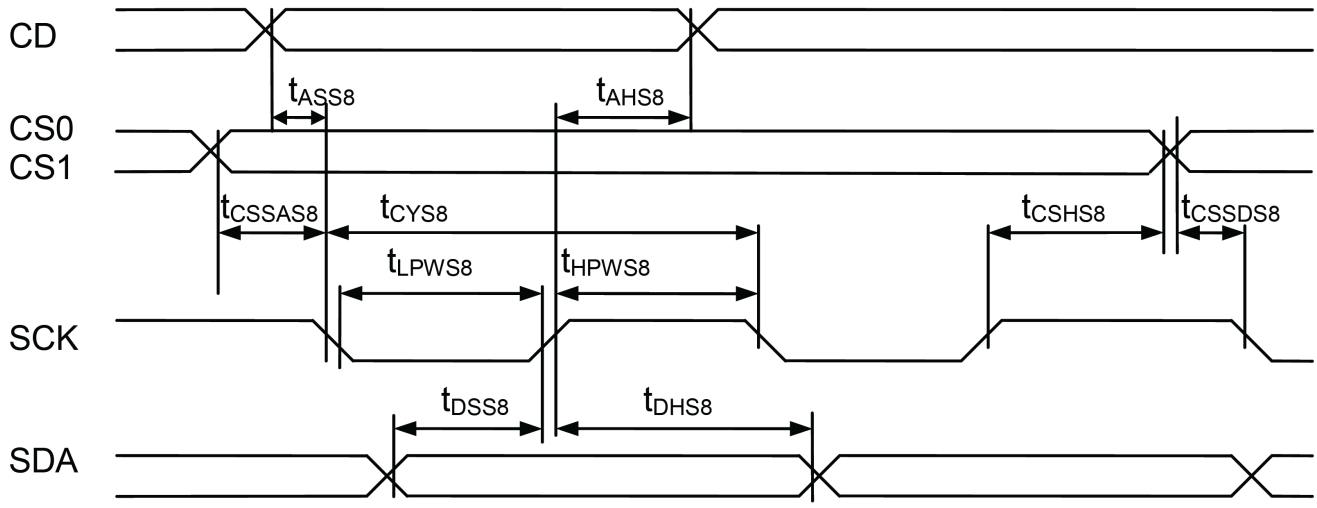
## 10-2 System Bus Timing for 6800 Series MPU




**Parallel Bus Timing Characteristics (for 6800 MCU)**

| Symbol | Signal | Description | Condition | Min. | Max. | Unit |
|---|---|---|---|---|---|---|
| | | | | (Read / Write) | | |
| $t_{AS68}$<br>$t_{AH68}$ | CD | Address setup time<br>Address hold time | | 0<br>40 | – | nS |
| $t_{CSSA68}$<br>$t_{CSSD68}$<br>$t_{CSH68}$ | CS1/CS0 | Chip select setup time | | 10<br>10<br>20 | – | nS |
| $t_{CY68}$ | WR1 | System cycle time | | 160 | – | nS |
| $t_{PWR68}$ / $t_{PWW68}$ | | Pulse width | | 65 / 65 | | |
| $t_{LPW68}$ | | Low pulse width | | 65 | | |
| $t_{DS68}$<br>$t_{DH68}$ | D0~D7<br>(Write) | Data setup time<br>Data hold time | | 30<br>15 | – | nS |
| $t_{ACC68}$<br>$t_{OD68}$ | D0~D7<br>(Read) | Read access time<br>Output disable time | $C_L$ = 100pF | –<br>10 | 50<br>50 | nS |

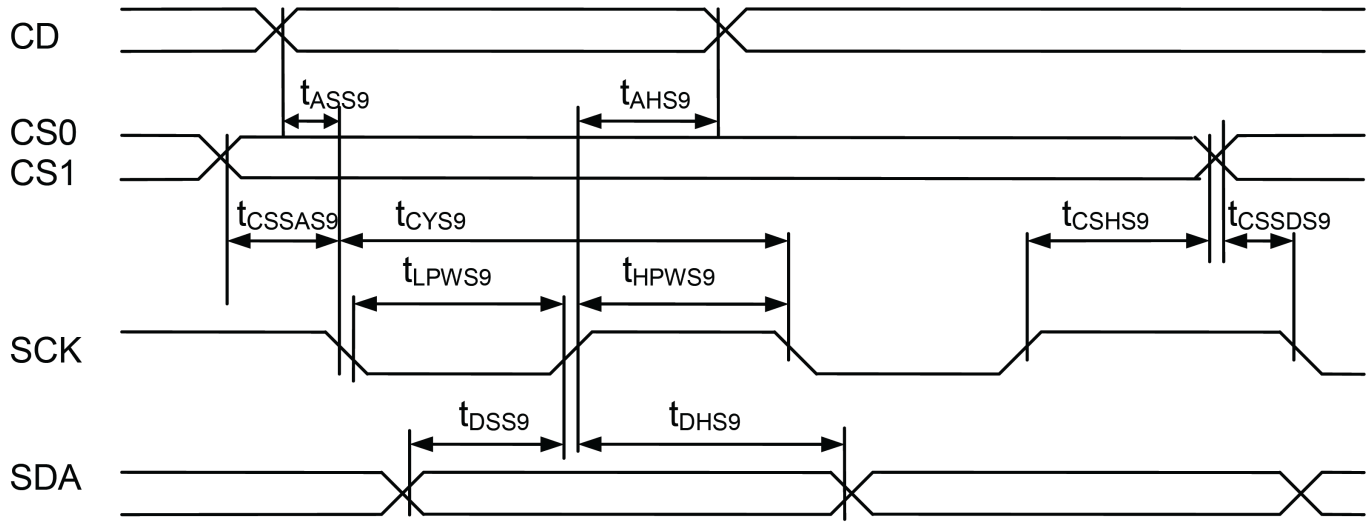
## 10-3 System Bus Timing for 4-Line Serial Interface




**Serial Bus Timing Characteristics (for S8)**

| Symbol | Signal | Description | Condition | Min. | Max. | Unit |
|---|---|---|---|---|---|---|
| | | | | (Read / Write) | | |
| $t_{ASS8}$ | CD | Address setup time | | 0 | – | nS |
| $t_{AHS8}$ | | Address hold time | | 40 | – | nS |
| $t_{CSSAS8}$<br>$t_{CSSDS8}$<br>$t_{CSHS8}$ | CS1/CS0 | Chip select setup time | | 10<br>10<br>20 | – | nS |
| $t_{CYS8}$ | SCK | System cycle time | | 160 | – | nS |
| $t_{LPWS8}$ | | Low pulse width | | 65 | | |
| $t_{HPWS8}$ | | High pulse width | | 65 | | |
| $t_{DSS8}$<br>$t_{DHS8}$ | SDA | Data setup time<br>Data hold time | | 30<br>15 | – | nS |

## 10-4 High-Voltage Mixed-Signal IC




**Serial Bus Timing Characteristics(for S9)**

| Symbol | Signal | Description | Condition | Min. | Max. | Unit |
|---|---|---|---|---|---|---|
| | | | | (Read / Write) | | |
| $t_{ASS9}$ | CD | Address setup time | | 0 | – | nS |
| $t_{AHS9}$ | | Address hold time | | 40 | – | nS |
| $t_{CSSAS9}$<br>$t_{CSSDS9}$<br>$t_{CSHS9}$ | CS1/CS0 | Chip select setup time | | 10<br>10<br>20 | | nS |
| $t_{CYS9}$ | SCK | System cycle time | | 160 | – | nS |
| $t_{LPWS9}$ | | Low pulse width | | 65 | | |
| $t_{HPWS9}$ | | High pulse width | | 65 | | |
| $t_{DSS9}$<br>$t_{DHS9}$ | SDA | Data setup time<br>Data hold time | | 30<br>15 | – | nS |

# 11. COMMAND TABLE

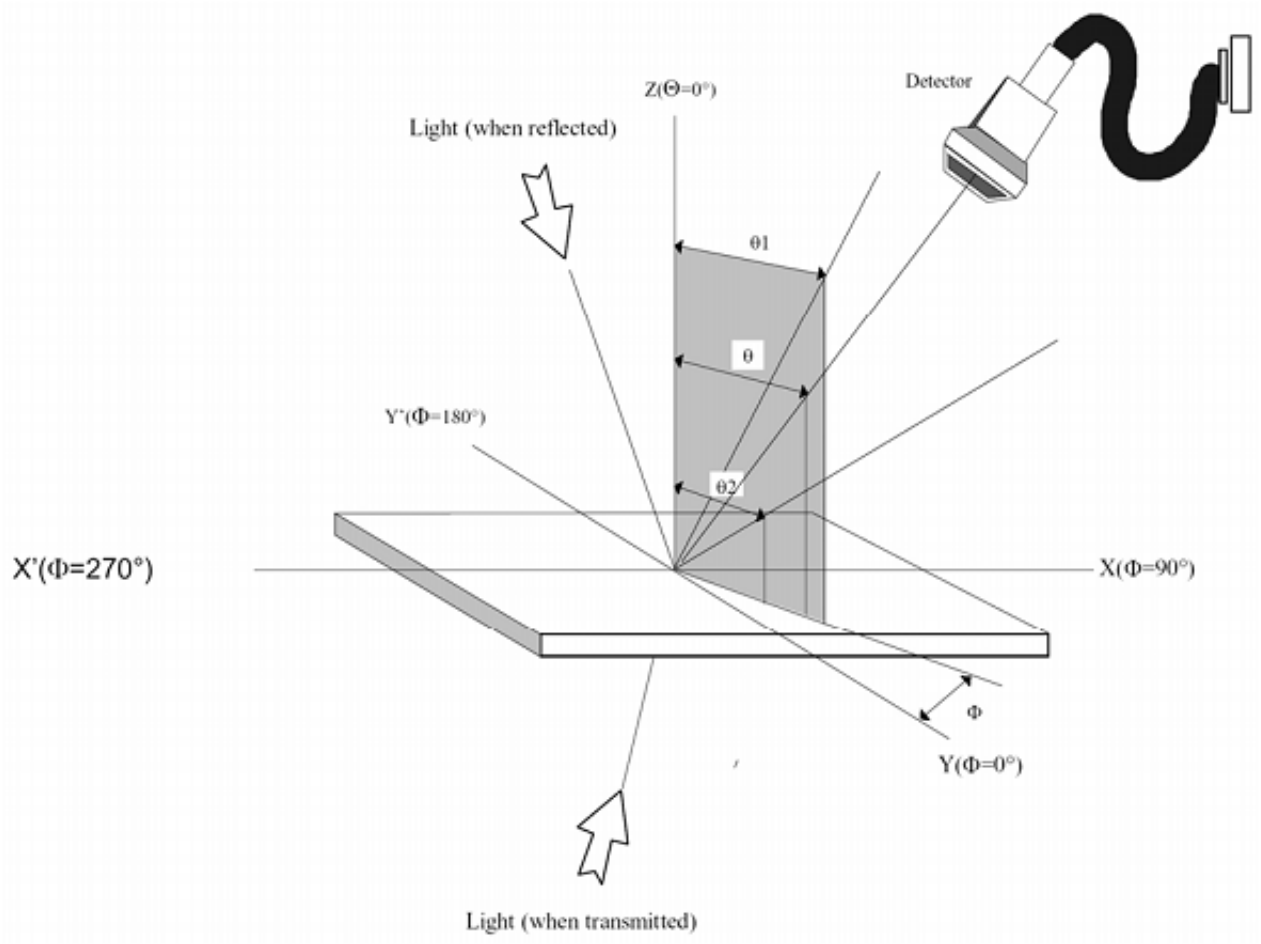
| | Command | C/D | W/R | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Action | Default |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | Write Data Byte | 1 | 0 | # | # | # | # | # | # | # | # | Write 1 byte | N/A |
| 2. | Read Data Byte | 1 | 1 | # | # | # | # | # | # | # | # | Read 1 byte | N/A |
| 3. | Get Status | 0 | 1 | - | MX | MY | RS | WA | DE | – | | N/A | |
| 4. | Set Column Address LSB | 0 | 0 | 0 | 0 | 0 | 0 | # | # | # | # | Set CA [3:0] | 0 |
| | Set Column Address MSB | 0 | 0 | 0 | 0 | 0 | 1 | # | # | # | # | Set CA [7:4] | 0 |
| 5. | Set Multiplexing Rate | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | # | # | Set MR [1:0] | 11b: 65 |
| 6. | Set Temp. Compensation | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | # | # | Set TC[1:0] | 00b: -0.05%/°C |
| 7. | Set Panel Loading | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | # | Set PC[0] | 0b: ≤ 15nF |
| 8. | Set Pump Control | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | # | # | Set PC[2:1] | 11b |
| 9. | Set Adv. Program Control | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | R | Set APC[R][7:0], | N/A |
| | (double-byte command) | 0 | 0 | # | # | # | # | # | # | # | # | R = 0, or 1 | |
| 10. | Set Scroll Line | 0 | 0 | 0 | 1 | # | # | # | # | # | # | Set SL[5:0] | 0 |
| 11. | Set Page Address | 0 | 0 | 1 | 0 | 1 | 1 | # | # | # | # | Set PA[3:0] | 0 |
| 12. | Set $V_{BIAS}$ Potentiometer | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | Set PM[7:0] | C0H |
| | (double-byte command) | 0 | 0 | # | # | # | # | # | # | # | # | | |
| 13. | Set RAM Address Control | 0 | 0 | 1 | 0 | 0 | 0 | 1 | # | # | # | Set AC[2:0] | 001b |
| 14. | Set Frame Rate | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | # | Set LC[3] | 0b |
| 15. | Set All-Pixel-ON | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | # | Set DC[1] | 0 |
| 16. | Set Inverse Display | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | # | Set DC[0] | 0 |
| 17. | Set Display Enable | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | # | Set DC[2] | 0 |
| 18. | Set LCD Mapping Control | 0 | 0 | 1 | 1 | 0 | 0 | 0 | # | # | 0 | Set LC[2:1] | 0 |
| 19. | System Reset | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | System Reset | N/A |
| 20. | NOP | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | No operation | N/A |
| 21. | Set Test Control | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | TT | | For testing only. | N/A |
| | (double-byte command) | 0 | 0 | # | # | # | # | # | # | # | # | Do not use. | |
| 22. | Set LCD Bias Ratio | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | # | # | Set BR[1:0] | 11b: 9 |
| 23. | Reset Cursor Update Mode | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | AC[3]=0, CA=CR | N/A |
| 24. | Set Cursor Update Mode | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | AC[3]=1, CR=CA | N/A |

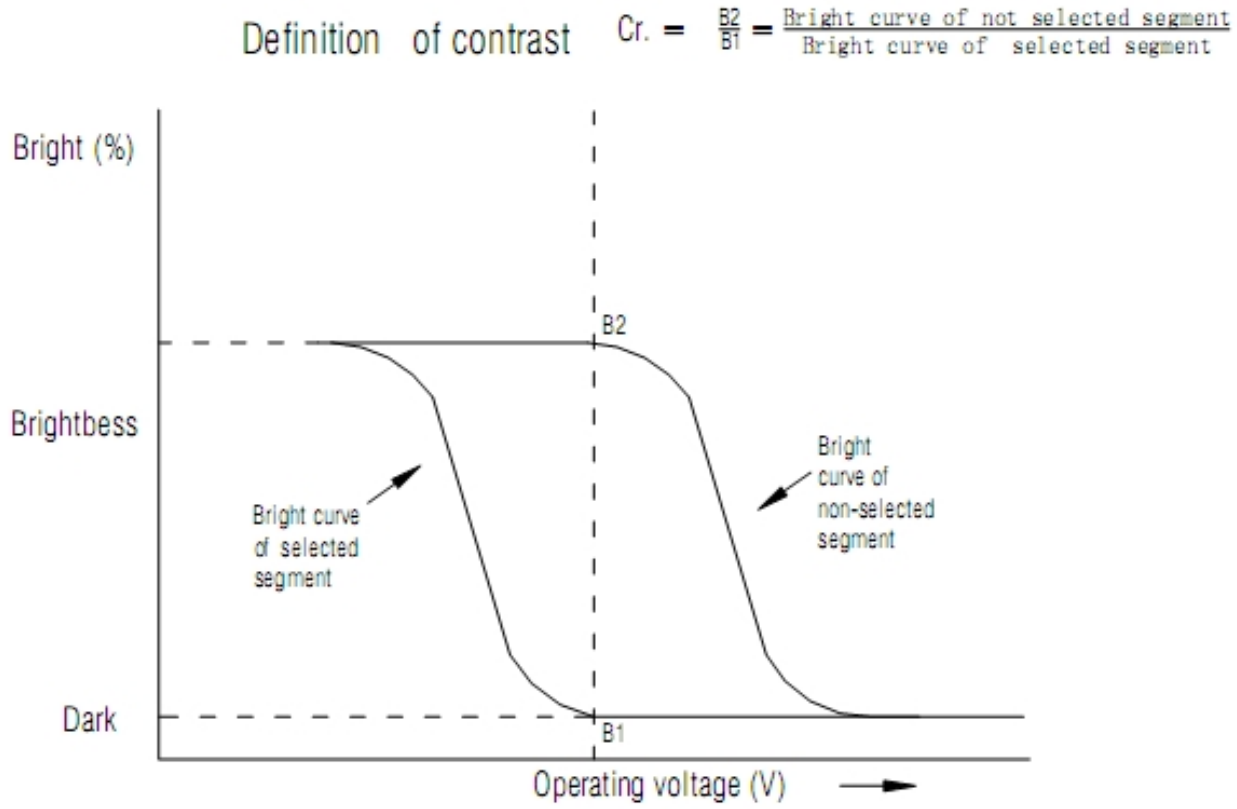
* Any bit patterns other than what is listed above may result in NOP (No Operation).

# 12. LCD ELECTRICAL& OPTICAL CHARACTERISTICS

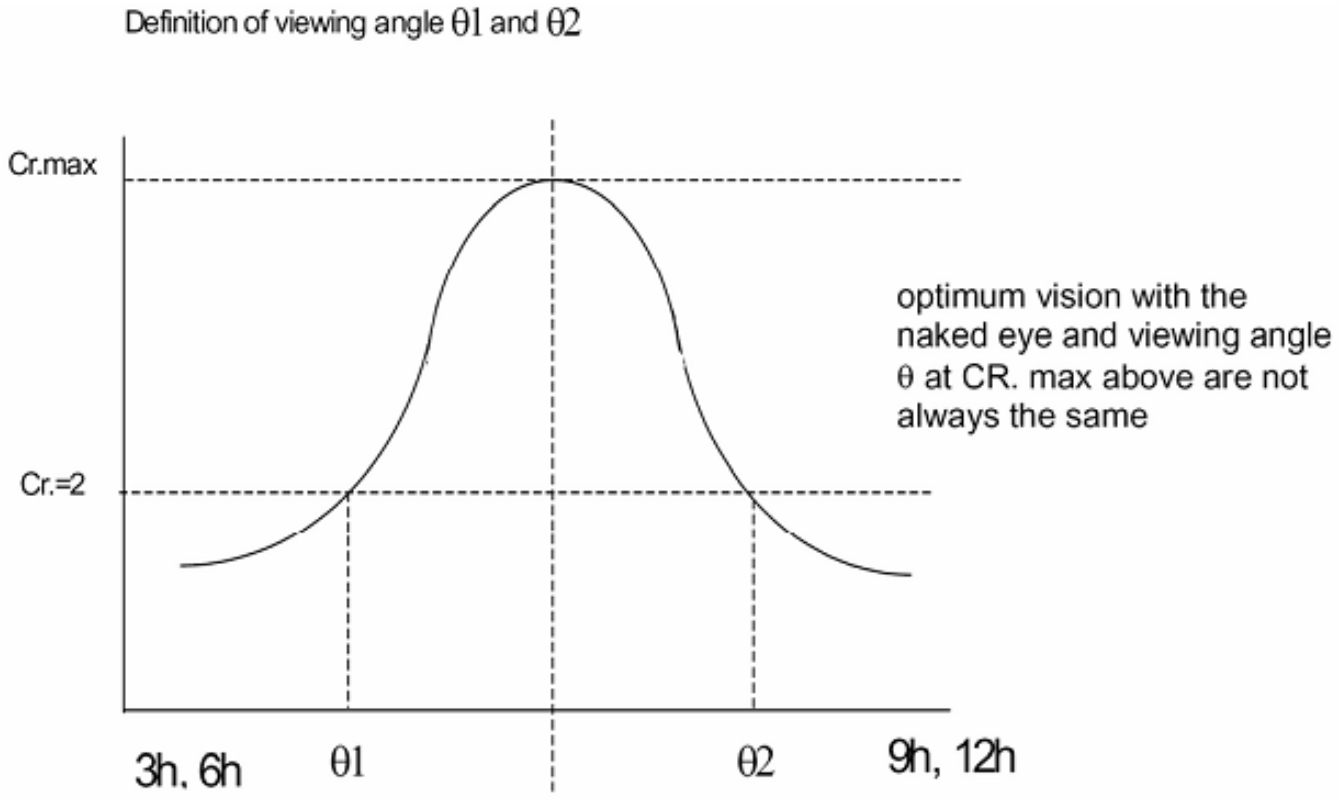
| Item | Symbol | Description | Condition | Temp. | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|---|
| Operating Voltage for LCD | $V_{LCD}$=VDD-VO | | | | 9.7 | 10.2 | 10.7 | V |
| | Vop | | Ta=-20°C | | 11.4 | 11.9 | 12.4 | |
| | | | Ta=+25°C | | 9.7 | 10.2 | 10.7 | |
| | | | Ta=+70°C | | 9.2 | 9.7 | 10.2 | |
| Contrast | Cr | | VDD=3V±3% | 25℃ | 3.0 | --- | --- | |
| Viewing angle | θ | 6 o'clock axis ( θ=0°) | Cr≥2.0 VDD=3V±3% | 25℃ | --- | 30 | --- | |
| Response time | Tr | Rise | | 25℃ | --- | --- | 198 | ms |
| | Tf | Fall | | 25℃ | --- | --- | 176 | |

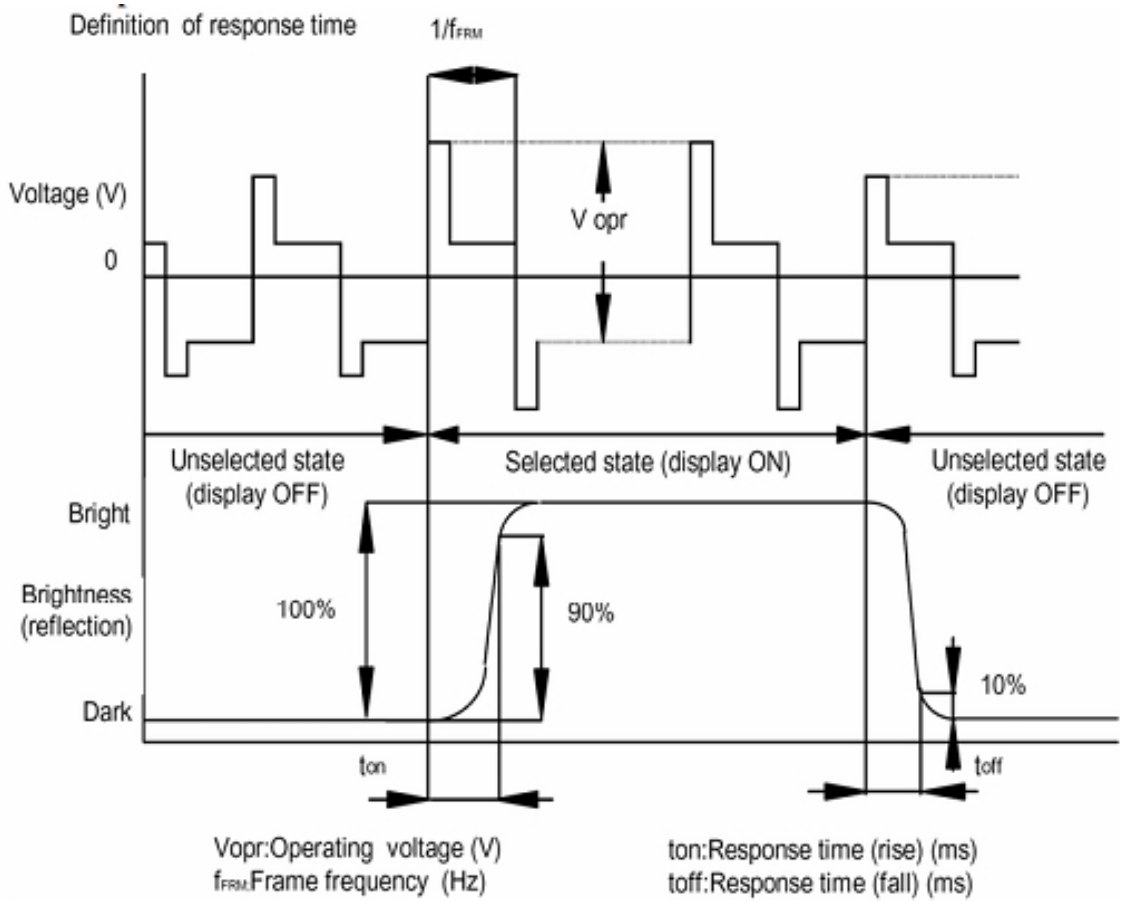
12.1 Definition of Characteristics.





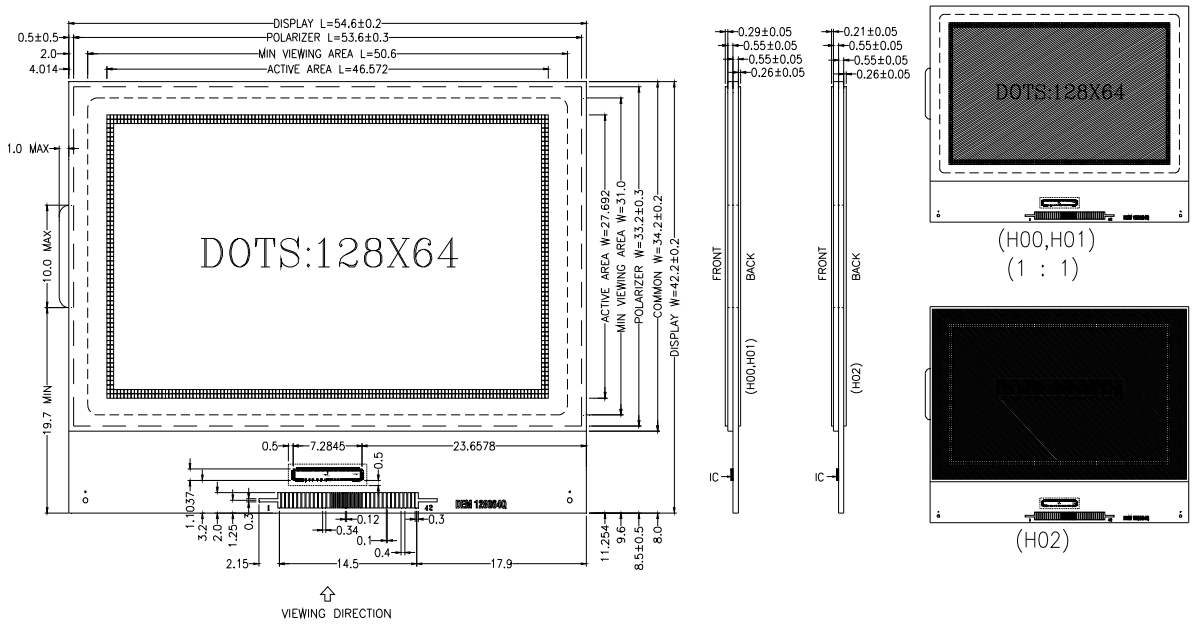

12.2 Definition of Viewing Angle




Definition of response time
1/fFRM
Voltage (V)
0
V opr
Unselected state
(display OFF)
Selected state (display ON)
Unselected state
(display OFF)
Bright
Brightness
(reflection)
Dark
100%
90%
10%
ton
toff
Vopr:Operating voltage (V)
fFRM:Frame frequency (Hz)
ton:Response time (rise) (ms)
toff:Response time (fall) (ms)

# 13. LCD ARTWORK

## 13-1. LCD ARTWORK



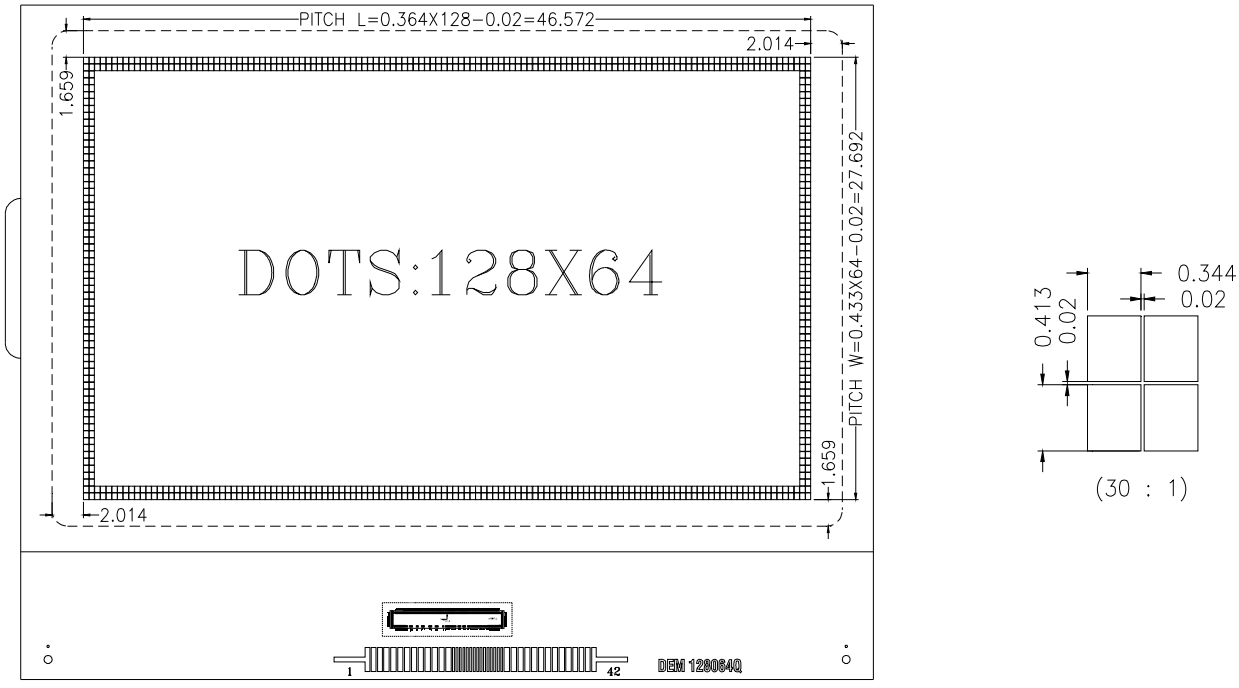

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN MM
TOLERANCES:±0.2MM

PIN Interface(LCD)

| PIN | 1 | 2~6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NAME | ESD | NC | VLCD | VB0+ | VB0− | VB1− | VB1+ | VSS | VDD | BM1 | BM0 | D7 | D6 | D5 |

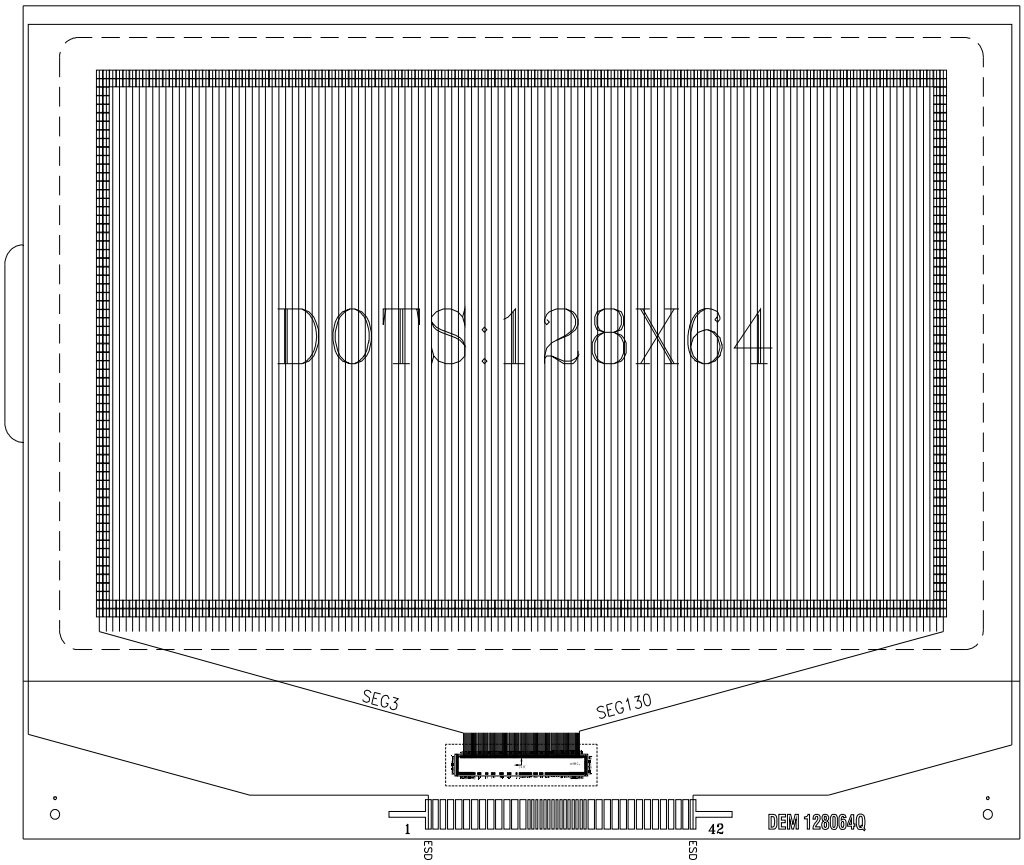
| PIN | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29~41 | 42 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NAME | D4 | D3 | D2 | D1 | D0 | WR1 | WR0 | CD | RST | CS0 | NC | ESD |

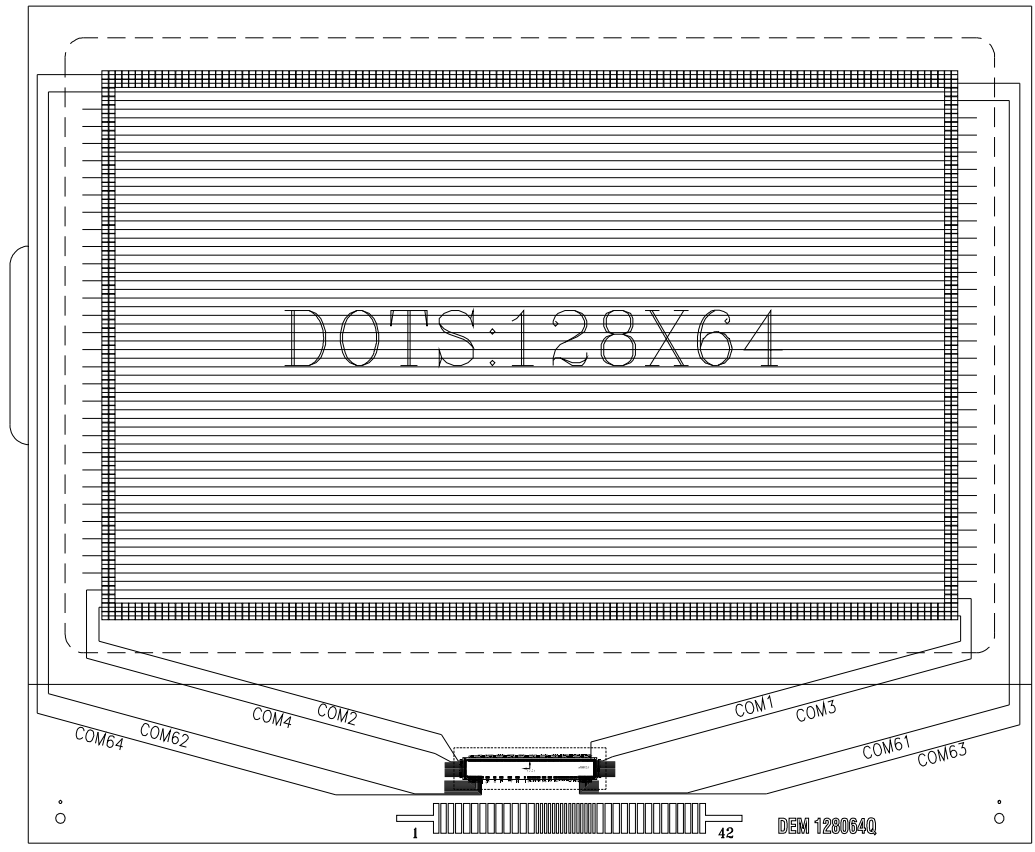
## 13-2. Labelling



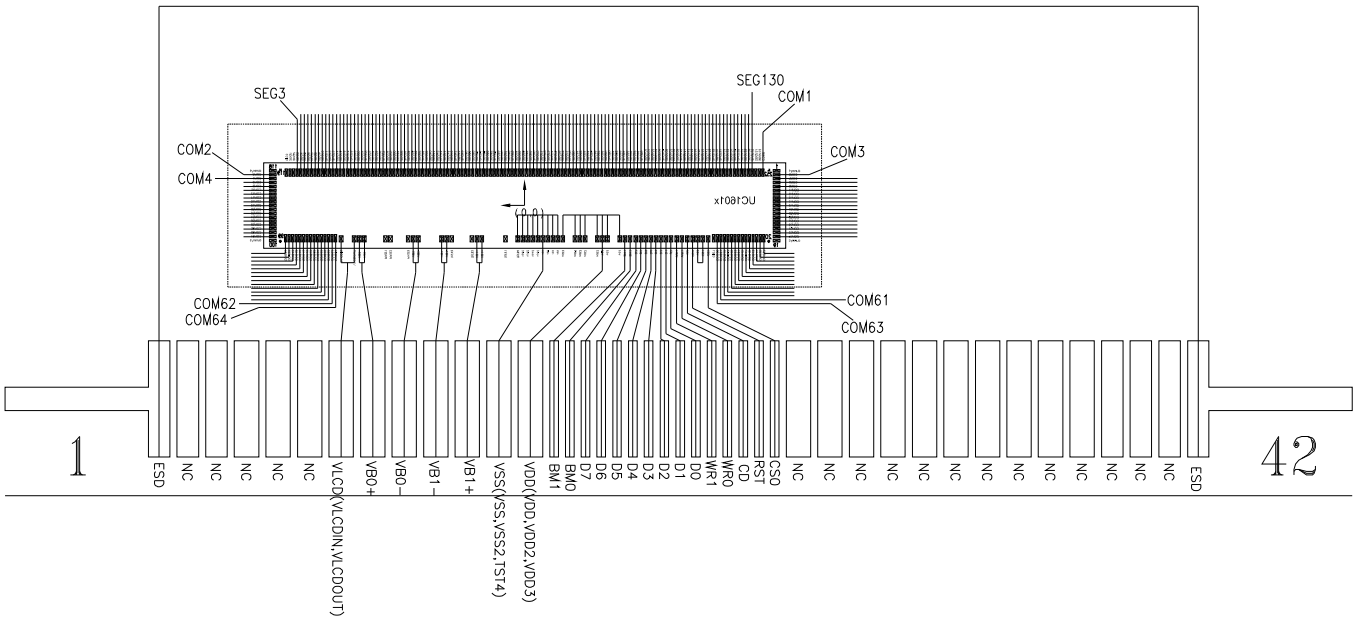

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN MM
TOLERANCES:±0.2MM

## 13-3. SEG LAYOUT & COM LAYOUT



### 13-4. IC LAYOUT




## 14. ACCEPT QUALITY LEVEL (AQL)

Inspection Plan: ANSI Z-1.4, Normal Inspection Level II, Single Sampling Plan

## 15. RELIABILITY TEST

Operating life time: 50000 hours (at room temperature without direct irradiation of sunlight)
Reliability characteristics shall meet following requirements.

| Test Item | Test Condition |
|---|---|
| High Temperature Storage | +80°C x 96hrs |
| Low Temperature Storage | -30°C x 96hrs |
| High Temperature Operation | +70°C x 96hrs |
| Low Temperature Operation | -20°C x 96hrs |
| High Temperature, High Humidity | +70°C x 90%RH x 96hrs |
| Thermal Shock | -20°C x 30min → +25°C x 10s → +70°C x 30min<br>10Cycles |
| Vibration Test | Frequency x Swing x Time<br>40Hz x 4mm x 4hrs |
| Drop Test | Drop height x No. of drops<br>1.0m x 6drops |

## 16. LCD MODULES HANDLING PRECAUTIONS

- Please remove the protection foil of polarizer before using.
- 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 0°C). Whenever possible, the LCD modules should be stored in the same conditions in which they were shipped from our company.

## 17. 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