



# CLOVER DISPLAY LTD.

## LCD MODULE SPECIFICATION

**Model: CV4162B - \_ \_ - \_ \_ - \_ \_**

|               |                  |
|---------------|------------------|
| Revision      | 09               |
| Engineering   | Timmy Kwan       |
| Date          | 11 December 2009 |
| Our Reference | 4904             |

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**MODE OF DISPLAY****Display mode**

- ☐ TN positive  
☐ TN negative  
 STN : ☐ Yellow green  
           ☐ Grey  
           ☐ Blue (negative)  
☐ FSTN positive  
☐ FSTN negative

**Display condition**

- ☐ Reflective type  
☐ Transflective type  
☐ Transmissive type  
☐ Others

**Viewing direction**

- ☐ 6 O' clock  
☐ 12 O' clock  
☐ 3 O' clock  
☐ 9 O' clock

**LCD MODULE NUMBER NOTATION:**

CV4162B- M Y - S F - N 6 - T  
           |       | | | | | | |  
           (1)    (2) (3) (4) (5) (6) (7) (8)

\*(1)---Model number of standard LCD Modules

\*(2)---Backlight type

- N – No backlight  
 E – EL backlight  
 L – Side-lited LED backlight  
 M– Array LED backlight  
 C – CCFL

\*(3)---Backlight color

- N – No backlight  
 A – Amber  
 B – Blue  
 O– Orange  
 W–White  
 Y – Yellow green

\*(4)---Display mode

- T – TN  
 V – TN (Negative)  
 S – STN Yellow green  
 G – STN Grey  
 B – STN Blue (Negative)  
 F – FSTN  
 N – FSTN (Negative)

\*(5)---Rear polarizer type

- R – Reflective  
 F – Transflective  
 T – Transmissive

\*(6)---Temperature range

- N – Normal  
 W– Extended

\*(7)---Viewing direction

- 6 – 6 O'clock  
 2 – 12 O'clock  
 3 – 3 O'clock  
 9 – 9 O'clock

\*(8)---Special code for other requirements

(Can be omitted if not used)

- T – Touch panel (Analog)  
 P – Touch panel (Digital)

**GENERAL DESCRIPTION**

Display mode : 16 characters x 2 lines LCD module  
 Interface : 4-bit or 8-bit parallel  
 Driving method : 1/16 duty, 1/5 bias  
 Controller IC : Sitronix ST7066U or equivalent  
 For the detailed information, please refer to the IC specifications

**MECHANICAL DIMENSIONS**

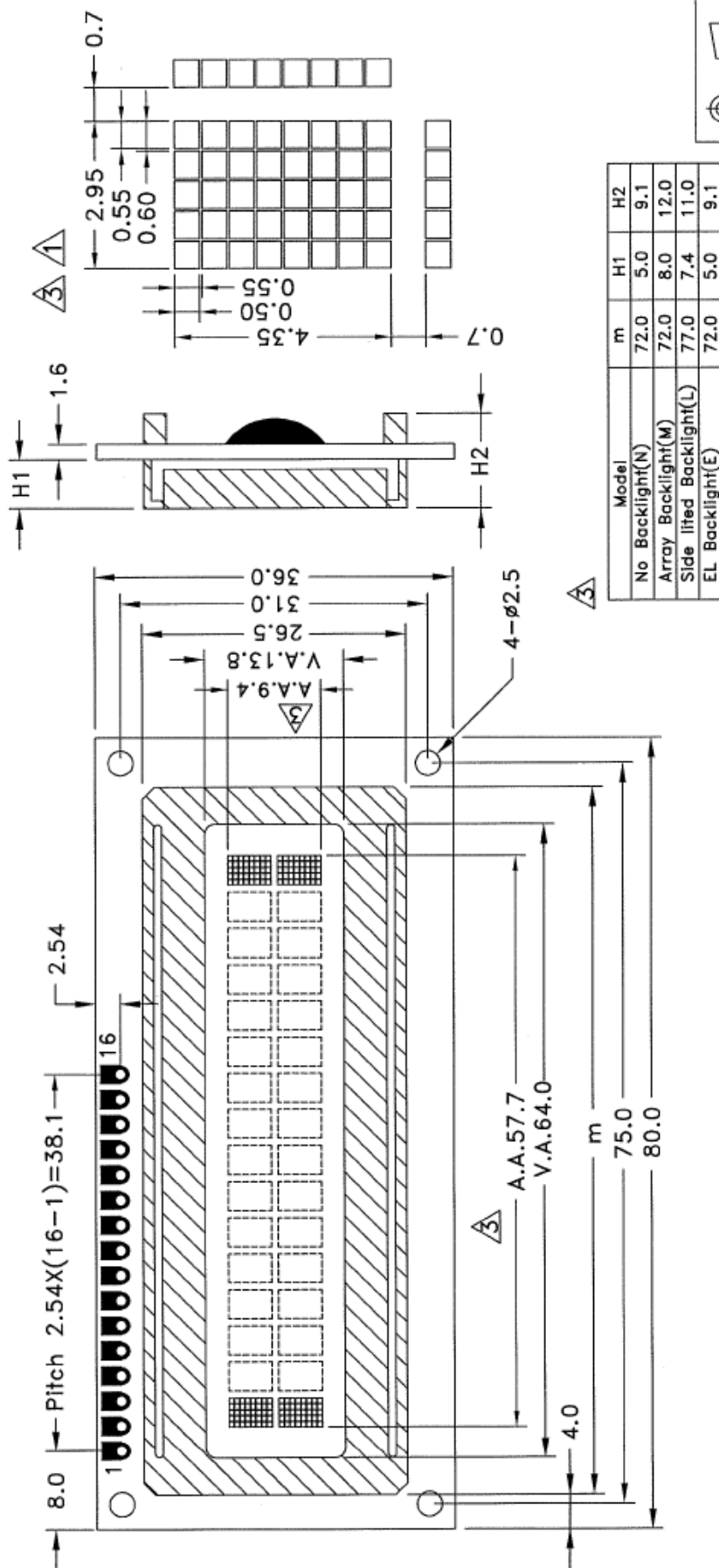
| Item              | Dimension                |     | Unit | Item                | Dimension       |      | Unit |
|-------------------|--------------------------|-----|------|---------------------|-----------------|------|------|
| Outline Dimension | 80.0(L)x36.0(W)x (H1/H2) |     | mm   | Character Pitch     | 3.65(L)x5.05(W) |      | mm   |
| Viewing Area      | 64.0(L)x13.8(W)          |     | mm   | Dot Size            | 0.55(L)x0.50(W) |      | mm   |
| Character Size    | 2.95(L)x4.35(W)          |     | mm   | —                   | —               |      | —    |
| No Backlight (N)  | H1                       | 5.0 | mm   | Side Backlight (L)  | H1              | 7.4  | mm   |
|                   | H2                       | 9.1 | mm   |                     | H2              | 11.0 | mm   |
| EL Backlight (E)  | H1                       | 5.0 | mm   | Array Backlight (M) | H1              | 8.0  | mm   |
|                   | H2                       | 9.1 | mm   |                     | H2              | 12.0 | mm   |

**CONNECTOR PIN ASSIGNMENT**

| Pin No. | Symbol | Function                 | Pin No. | Symbol | Function                           |
|---------|--------|--------------------------|---------|--------|------------------------------------|
| 1       | VSS    | Ground                   | 9       | DB2    | Data Bus Line                      |
| 2       | VDD    | Supply voltage for logic | 10      | DB3    |                                    |
| 3       | V0     | Input voltage for LCD    | 11      | DB4    |                                    |
| 4       | RS     | Register Select Input    | 12      | DB5    |                                    |
| 5       | R/W    | Read/Write               | 13      | DB6    |                                    |
| 6       | E      | Enable Signal            | 14      | DB7    |                                    |
| 7       | DB0    | Data Bus Line            | * 15    | BL-    | Supply Voltage for Backlight (VE-) |
| 8       | DB1    |                          | * 16    | BL+    | Supply Voltage for Backlight (VE+) |

Note (\*): Pin 15,16 are used for backlight version

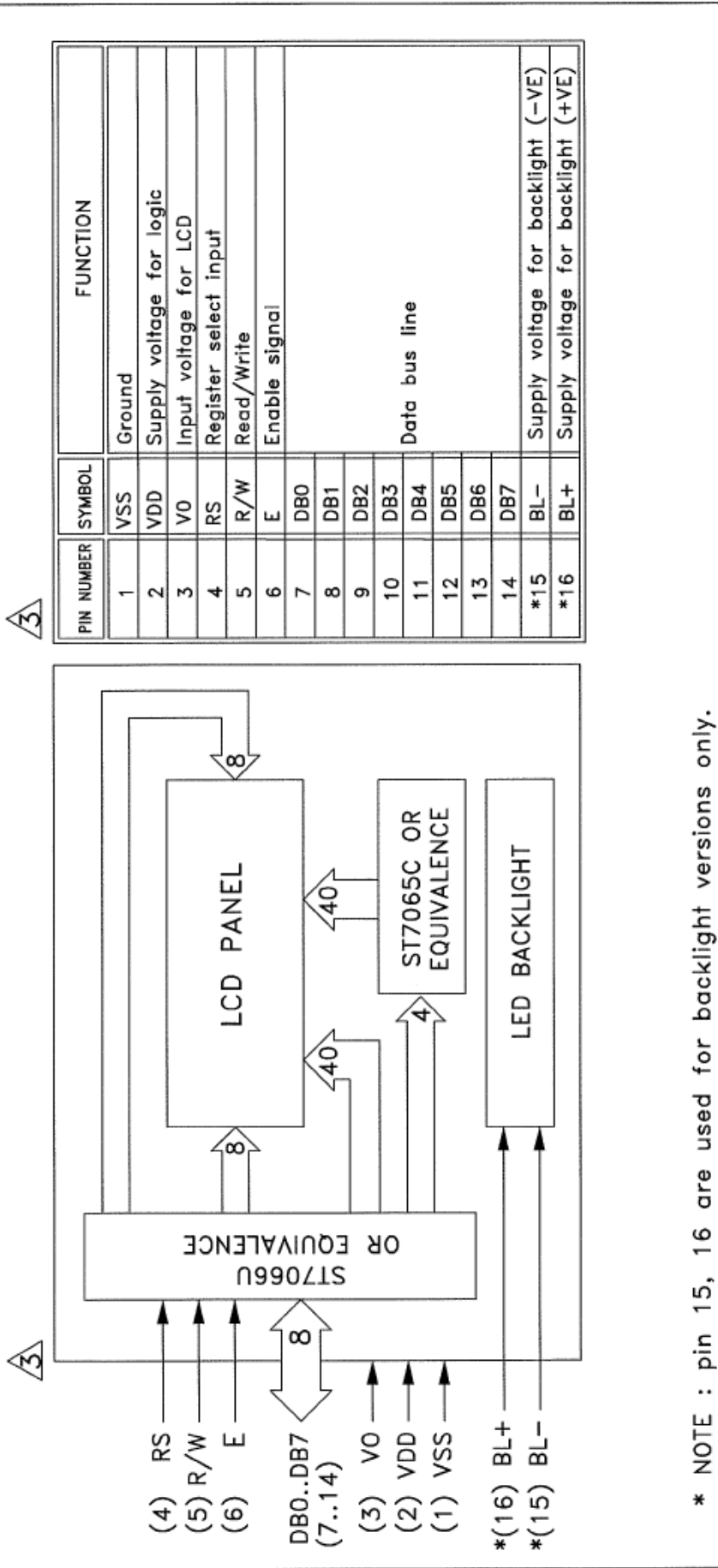
| MARK     | REASON                                                  | PREPARED | DATE      |
|----------|---------------------------------------------------------|----------|-----------|
| <u>A</u> | Correct the character pitch and add the white color B/L | Roger    | 25 Jan 06 |
| <u>A</u> | Change the yellow green B/L characteristic              | Roger    | 23 Aug 06 |
| <u>A</u> | Change IC & character size                              | Timmy    | 22 Feb 08 |
| <u>A</u> | Change backlight current                                | Timmy    | 09 Dec 09 |



| Model                   | m    | H1  | H2   |
|-------------------------|------|-----|------|
| No Backlight(N)         | 72.0 | 5.0 | 9.1  |
| Array Backlight(M)      | 72.0 | 8.0 | 12.0 |
| Side littd Backlight(L) | 77.0 | 7.4 | 11.0 |
| EL Backlight(E)         | 72.0 | 5.0 | 9.1  |

|                                    |                                                         |                 |            |  |                                                                                                              |                |                                                                                                                  |  |
|------------------------------------|---------------------------------------------------------|-----------------|------------|--|--------------------------------------------------------------------------------------------------------------|----------------|------------------------------------------------------------------------------------------------------------------|--|
| TOLERANCE IF NOT SPECIFY<br>±0.5mm |                                                         | SCALE<br>N.T.S. | UNIT IN mm |  |  CLOVER DISPLAY LTD. (HK) |                | SHEET<br>1 OF 3                                                                                                  |  |
| REV.                               | REVISION RECORD                                         |                 | DATE       |  | CUSTOMER                                                                                                     | APPROVED       | MODEL NO. CV4162B                                                                                                |  |
| 00                                 | 1st ISSUE                                               |                 | 03 SEP 04  |  | STANDARD                                                                                                     |                | TITLE: MODULE DIMENSION                                                                                          |  |
| 01                                 | Correct the character pitch and odd the white color B/L |                 | 25 JAN 06  |  |                                                                                                              |                | DRAWN BY: FAN                                                                                                    |  |
| 02                                 | Change the yellow green B/L characteristic              |                 | 23 Aug 06  |  | AGENT                                                                                                        |                | DATE : 09 DEC 09                                                                                                 |  |
| 03                                 | Change IC & character size                              |                 | 22 Feb 08  |  |                                                                                                              |                | CHECKED BY :                  |  |
| 04                                 | Change backlight current                                |                 | 09 DEC 09  |  |                                                                                                              |                | DATE : 09 DEC 09                                                                                                 |  |
|                                    |                                                         |                 |            |  | CUSTOMER REF.                                                                                                | OUR REF. X4904 | APPROVED BY:  DATE : 10/12/06 |  |

COUNTER DRAWING OF PIN OUT & BLOCK DIAGRAM



**ELECTRICAL CHARACTERISTICS**

Conditions: VSS=0V, @Ta=25°C

| Item                  | Symbol         | MIN. | TYP. | MAX. | Unit | Item                   | Symbol          | MIN.   | TYP. | MAX. | Unit |
|-----------------------|----------------|------|------|------|------|------------------------|-----------------|--------|------|------|------|
| Supply Voltage        | VDD            | 4.75 | 5.00 | 5.25 | V    | “H”Level Input Voltage | V <sub>IH</sub> | 0.7VDD | —    | VDD  | V    |
| Supply Current        | IDD            | —    | 1.27 | 1.90 | mA   | “L”Level Input Voltage | V <sub>IL</sub> | -0.3   | —    | 0.6  | V    |
| Input Voltage for LCD | V <sub>0</sub> | -0.2 | 0.0  | 0.2  | V    | —                      | —               | —      | —    | —    | —    |

**EL:**

| Item              | Symbol          | MIN. | TYP. | MAX. | Unit             | Condition        |
|-------------------|-----------------|------|------|------|------------------|------------------|
| Backlight Voltage | V <sub>EL</sub> | —    | 100  | 150  | V <sub>rms</sub> | Frequency= 400Hz |

**Side-lited LED**

Constant voltage driving:

| Item                    | Symbol | MIN. | TYP. | MAX. | Unit | Condition  |
|-------------------------|--------|------|------|------|------|------------|
| White Backlight current | IBL    | —    | 20   | 23   | mA   | VBL = 5.0V |

Constant current driving:

| Item                           | Symbol | MIN. | TYP. | MAX. | Unit | Condition  |
|--------------------------------|--------|------|------|------|------|------------|
| Blue Backlight Voltage         | VBL    | 3.2  | 3.4  | 3.6  | V    | IBL = 40mA |
| Yellow Green Backlight Voltage | VBL    | —    | 4.0  | 4.2  | V    | IBL = 40mA |

**Array LED**

Constant current driving:

| Item                           | Symbol | MIN. | TYP. | MAX. | Unit | Condition  |
|--------------------------------|--------|------|------|------|------|------------|
| Yellow Green Backlight Voltage | VBL    | 3.85 | 4.05 | 4.25 | V    | IBL =110mA |

**ABSOLUTE MAXIMUM RATINGS**

Please make sure not to exceed the following maximum rating values under the worst application conditions

| Item                  | Symbol           | Rating (for normal temperature) | Rating (for wide temperature) | Unit |
|-----------------------|------------------|---------------------------------|-------------------------------|------|
| Supply Voltage        | VDD              | -0.3 to 7                       | -0.3 to 7                     | V    |
| Input Voltage         | V <sub>T</sub>   | -0.3 to VDD +0.3                | -0.3 to VDD +0.3              | V    |
| Operating Temperature | T <sub>opr</sub> | 0 to 50                         | -20 to 70                     | °C   |
| Storage Temperature   | T <sub>stg</sub> | -10 to 60                       | -30 to 80                     | °C   |

## INSTRUCTIONS

| Instruction                | Instruction Code |     |     |     |     |     |     |     |     |     | Description                                                                                                                      | Description Time<br>(270KHz) |
|----------------------------|------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|----------------------------------------------------------------------------------------------------------------------------------|------------------------------|
|                            | RS               | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |                                                                                                                                  |                              |
| Clear Display              | 0                | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 1   | Write "20H" to DDRAM. and set DDRAM address to "00H" from AC                                                                     | 1.52 ms                      |
| Return Home                | 0                | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 1   | x   | Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed. | 1.52 ms                      |
| Entry Mode Set             | 0                | 0   | 0   | 0   | 0   | 0   | 0   | 1   | I/D | S   | Sets cursor move direction and specifies display shift. These operations are performed during data write and read.               | 37 us                        |
| Display ON/OFF             | 0                | 0   | 0   | 0   | 0   | 0   | 1   | D   | C   | B   | D=1:entire display on<br>C=1:cursor on<br>B=1:cursor position on                                                                 | 37 us                        |
| Cursor or Display Shift    | 0                | 0   | 0   | 0   | 0   | 1   | S/C | R/L | x   | x   | Set cursor moving and display shift control bit, and the direction, without changing DDRAM data.                                 | 37 us                        |
| Function Set               | 0                | 0   | 0   | 0   | 1   | DL  | N   | F   | x   | x   | DL:interface data is 8/4 bits<br>N:number of line is 2/1<br>F:font size is 5x11/5x8                                              | 37 us                        |
| Set CGRAM address          | 0                | 0   | 0   | 1   | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Set CGRAM address in address counter                                                                                             | 37 us                        |
| Set DDRAM address          | 0                | 0   | 1   | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Set DDRAM address in address counter                                                                                             | 37 us                        |
| Read Busy flag and address | 0                | 1   | BF  | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.           | 0 us                         |
| Write data to RAM          | 1                | 0   | D7  | D6  | D5  | D4  | D3  | D2  | D1  | D0  | Write data into internal RAM (DDRAM/CGRAM)                                                                                       | 37 us                        |
| Read data from RAM         | 1                | 1   | D7  | D6  | D5  | D4  | D3  | D2  | D1  | D0  | Read data from internal RAM (DDRAM/CGRAM)                                                                                        | 37 us                        |

Note:

Be sure the ST7066U is not in the busy state (BF = 0) before sending an instruction from the MPU to the ST7066U. If an instruction is sent without checking the busy flag, the time between the first instruction and next instruction will take much longer than the instruction time itself. Refer to Instruction Table for the list of each instruction execution time.

## FUNCTION DESCRIPTION

### ● Clear Display

|      | RS | RW | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
|------|----|----|-----|-----|-----|-----|-----|-----|-----|-----|
| Code | 0  | 0  | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 1   |

Clear all the display data by writing "20H" (space code) to all DDRAM address, and set DDRAM address to "00H" into AC (address counter). Return cursor to the original status, namely, bring the cursor to the left edge on first line of the display. Make entry mode increment (I/D = "1").

### ● Return Home

|      | RS | RW | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
|------|----|----|-----|-----|-----|-----|-----|-----|-----|-----|
| Code | 0  | 0  | 0   | 0   | 0   | 0   | 0   | 0   | 1   | x   |

Return Home is cursor return home instruction. Set DDRAM address to "00H" into the address counter. Return cursor to its original site and return display to its original status, if shifted. Contents of DDRAM does not change.

### ● Entry Mode Set

|      | RS | RW | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
|------|----|----|-----|-----|-----|-----|-----|-----|-----|-----|
| Code | 0  | 0  | 0   | 0   | 0   | 0   | 0   | 1   | I/D | S   |

Set the moving direction of cursor and display.

- **I/D : Increment / decrement of DDRAM address (cursor or blink)**  
 When I/D = "High", cursor/blink moves to right and DDRAM address is increased by 1.  
 When I/D = "Low", cursor/blink moves to left and DDRAM address is decreased by 1.  
 \* CGRAM operates the same as DDRAM, when read from or write to CGRAM.
- **S: Shift of entire display**  
 When DDRAM read (CGRAM read/write) operation or S = "Low", shift of entire display is not performed. If S = "High" and DDRAM write operation, shift of entire display is performed according to I/D value (I/D = "1" : shift left, I/D = "0" : shift right).

| S | I/D | Description                    |
|---|-----|--------------------------------|
| H | H   | Shift the display to the left  |
| H | L   | Shift the display to the right |



## FUNCTION DESCRIPTION(CONT.)

## ● Display ON/OFF

|      |    |    |     |     |     |     |     |     |     |     |
|------|----|----|-----|-----|-----|-----|-----|-----|-----|-----|
|      | RS | RW | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
| Code | 0  | 0  | 0   | 0   | 0   | 0   | 1   | D   | C   | B   |

Control display/cursor/blink ON/OFF 1 bit register.

- **D : Display ON/OFF control bit**  
When D = "High", entire display is turned on.  
When D = "Low", display is turned off, but display data is remained in DDRAM.
- **C : Cursor ON/OFF control bit**  
When C = "High", cursor is turned on.  
When C = "Low", cursor is disappeared in current display, but I/D register remains its data.
- **B : Cursor Blink ON/OFF control bit**  
When B = "High", cursor blink is on, that performs alternate between all the high data and display character at the cursor position.  
When B = "Low", blink is off.

## ● Cursor or Display Shift

|      |    |    |     |     |     |     |     |     |     |     |
|------|----|----|-----|-----|-----|-----|-----|-----|-----|-----|
|      | RS | RW | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
| Code | 0  | 0  | 0   | 0   | 0   | 1   | S/C | R/L | x   | x   |

Without writing or reading of display data, shift right/left cursor position or display. This instruction is used to correct or search display data. During 2-line mode display, cursor moves to the 2nd line after 40th digit of 1st line. Note that display shift is performed simultaneously in all the line. When displayed data is shifted repeatedly, each line shifted individually. When display shift is performed, the contents of address counter are not changed.

| S/C | R/L | Description                                                  | AC Value |
|-----|-----|--------------------------------------------------------------|----------|
| L   | L   | Shift cursor to the left                                     | AC=AC-1  |
| L   | H   | Shift cursor to the right                                    | AC=AC+1  |
| H   | L   | Shift display to the left. Cursor follows the display shift  | AC=AC    |
| H   | H   | Shift display to the right. Cursor follows the display shift | AC=AC    |

## ● Function Set

|      |    |    |     |     |     |     |     |     |     |     |
|------|----|----|-----|-----|-----|-----|-----|-----|-----|-----|
|      | RS | RW | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
| Code | 0  | 0  | 0   | 0   | 1   | DL  | N   | F   | x   | x   |

**FUNCTION DESCRIPTION(CONT.)**

- **DL : Interface data length control bit**  
When DL = "High", it means 8-bit bus mode with MPU.  
When DL = "Low", it means 4-bit bus mode with MPU. So to speak, DL is a signal to select 8-bit or 4-bit bus mode.  
When 4-bit bus mode, it needs to transfer 4-bit data by two times.
- **N : Display line number control bit**  
When N = "Low", it means 1-line display mode.  
When N = "High", 2-line display mode is set.
- **F : Display font type control bit**  
When F = "Low", it means 5 x 8 dots format display mode  
When F = "High", 5 x 11 dots format display mode.

| N | F | No. of Display Lines | Character Font | Duty Factor |
|---|---|----------------------|----------------|-------------|
| L | L | 1                    | 5x8            | 1/8         |
| L | H | 1                    | 5x11           | 1/11        |
| H | x | 2                    | 5x8            | 1/16        |

- **Set CGRAM Address**

|      |    |    |     |     |     |     |     |     |     |     |
|------|----|----|-----|-----|-----|-----|-----|-----|-----|-----|
|      | RS | RW | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
| Code | 0  | 0  | 0   | 1   | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 |

Set CGRAM address to AC.

This instruction makes CGRAM data available from MPU.

- **Set DDRAM Address**

|      |    |    |     |     |     |     |     |     |     |     |
|------|----|----|-----|-----|-----|-----|-----|-----|-----|-----|
|      | RS | RW | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
| Code | 0  | 0  | 1   | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 |

Set DDRAM address to AC.

This instruction makes DDRAM data available from MPU.

When 1-line display mode (N = 0), DDRAM address is from "00H" to "4FH".

In 2-line display mode (N = 1), DDRAM address in the 1st line is from "00H" to "27H", and DDRAM address in the 2nd line is from "40H" to "67H".

**FUNCTION DESCRIPTION(CONT.)**● **Read Busy Flag and Address**

|      |    |    |     |     |     |     |     |     |     |     |
|------|----|----|-----|-----|-----|-----|-----|-----|-----|-----|
|      | RS | RW | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
| Code | 0  | 1  | BF  | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 |

When BF = "High", indicates that the internal operation is being processed. So during this time the next instruction cannot be accepted.

The address Counter (AC) stores DDRAM/CGRAM addresses, transferred from IR.

After writing into (reading from) DDRAM/CGRAM, AC is automatically increased (decreased) by 1.

● **Write Data to CGRAM or DDRAM**

|      |    |    |     |     |     |     |     |     |     |     |
|------|----|----|-----|-----|-----|-----|-----|-----|-----|-----|
|      | RS | RW | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
| Code | 1  | 0  | D7  | D6  | D5  | D4  | D3  | D2  | D1  | D0  |

Write binary 8-bit data to DDRAM/CGRAM.

The selection of RAM from DDRAM, CGRAM, is set by the previous address set instruction : DDRAM address set, CGRAM address set. RAM set instruction can also determine the AC direction to RAM.

After write operation, the address is automatically increased/decreased by 1, according to the entry mode.

● **Read Data from CGRAM or DDRAM**

|      |    |    |     |     |     |     |     |     |     |     |
|------|----|----|-----|-----|-----|-----|-----|-----|-----|-----|
|      | RS | RW | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
| Code | 1  | 1  | D7  | D6  | D5  | D4  | D3  | D2  | D1  | D0  |

Read binary 8-bit data from DDRAM/CGRAM.

The selection of RAM is set by the previous address set instruction. If address set instruction of RAM is not performed before this instruction, the data that read first is invalid, because the direction of AC is not determined. If you read RAM data several times without RAM address set instruction before read operation, you can get correct RAM data from the second, but the first data would be incorrect, because there is no time margin to transfer RAM data.

In case of DDRAM read operation, cursor shift instruction plays the same role as DDRAM address set instruction : it also transfer RAM data to output data register. After read operation address counter is automatically increased/decreased by 1 according to the entry mode. After CGRAM read operation, display shift may not be executed correctly.

\* In case of RAM write operation, after this AC is increased/decreased by 1 like read operation. In this time, AC indicates the next address position, but you can read only the previous data by read instruction.

**DISPLAY DD RAM AND CHARACTER POSITION**

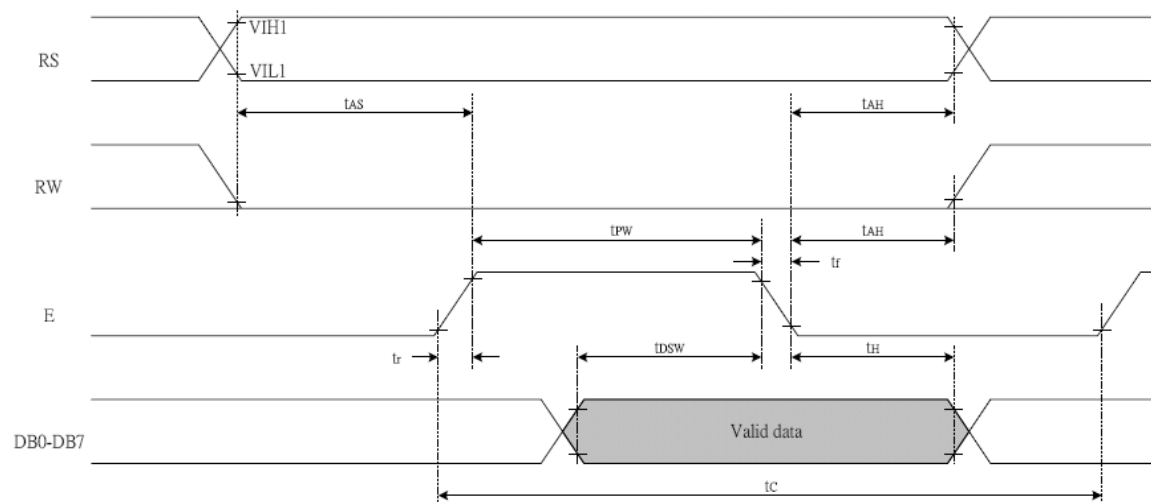
16x2, 1/16 DUTY CYCLE

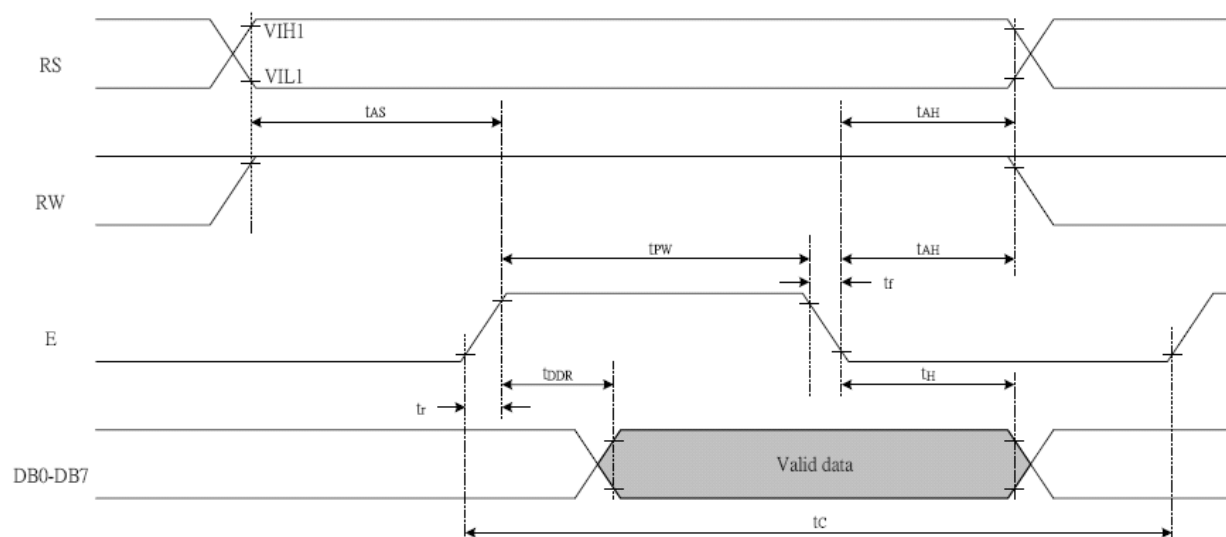
|        |    |    |           |    |                  |
|--------|----|----|-----------|----|------------------|
|        | 1  | 2  |           | 16 | DISPLAY POSITION |
| line 1 | 00 | 01 | . . . . . | 0F | DD RAM ADDRESS   |
| line 2 | 40 | 41 | . . . . . | 4F |                  |

**TIMING CHARACTERISTICS OF COMPATIBLE CONTROLLER CHIPS**

TA = 25°C, VCC = 5V

| <i>Write Mode (Writing data from MPU to ST7066U)</i> |                       |                 |      |   |     |    |
|------------------------------------------------------|-----------------------|-----------------|------|---|-----|----|
| T <sub>C</sub>                                       | Enable Cycle Time     | Pin E           | 1200 | - | -   | ns |
| T <sub>PW</sub>                                      | Enable Pulse Width    | Pin E           | 140  | - | -   | ns |
| T <sub>R,T<sub>F</sub></sub>                         | Enable Rise/Fall Time | Pin E           | -    | - | 25  | ns |
| T <sub>AS</sub>                                      | Address Setup Time    | Pins: RS,RW,E   | 0    | - | -   | ns |
| T <sub>AH</sub>                                      | Address Hold Time     | Pins: RS,RW,E   | 10   | - | -   | ns |
| T <sub>DSW</sub>                                     | Data Setup Time       | Pins: DB0 - DB7 | 40   | - | -   | ns |
| T <sub>H</sub>                                       | Data Hold Time        | Pins: DB0 - DB7 | 10   | - | -   | ns |
| <i>Read Mode (Reading Data from ST7066U to MPU)</i>  |                       |                 |      |   |     |    |
| T <sub>C</sub>                                       | Enable Cycle Time     | Pin E           | 1200 | - | -   | ns |
| T <sub>PW</sub>                                      | Enable Pulse Width    | Pin E           | 140  | - | -   | ns |
| T <sub>R,T<sub>F</sub></sub>                         | Enable Rise/Fall Time | Pin E           | -    | - | 25  | ns |
| T <sub>AS</sub>                                      | Address Setup Time    | Pins: RS,RW,E   | 0    | - | -   | ns |
| T <sub>AH</sub>                                      | Address Hold Time     | Pins: RS,RW,E   | 10   | - | -   | ns |
| T <sub>DDR</sub>                                     | Data Setup Time       | Pins: DB0 - DB7 | -    | - | 100 | ns |
| T <sub>H</sub>                                       | Data Hold Time        | Pins: DB0 - DB7 | 10   | - | -   | ns |

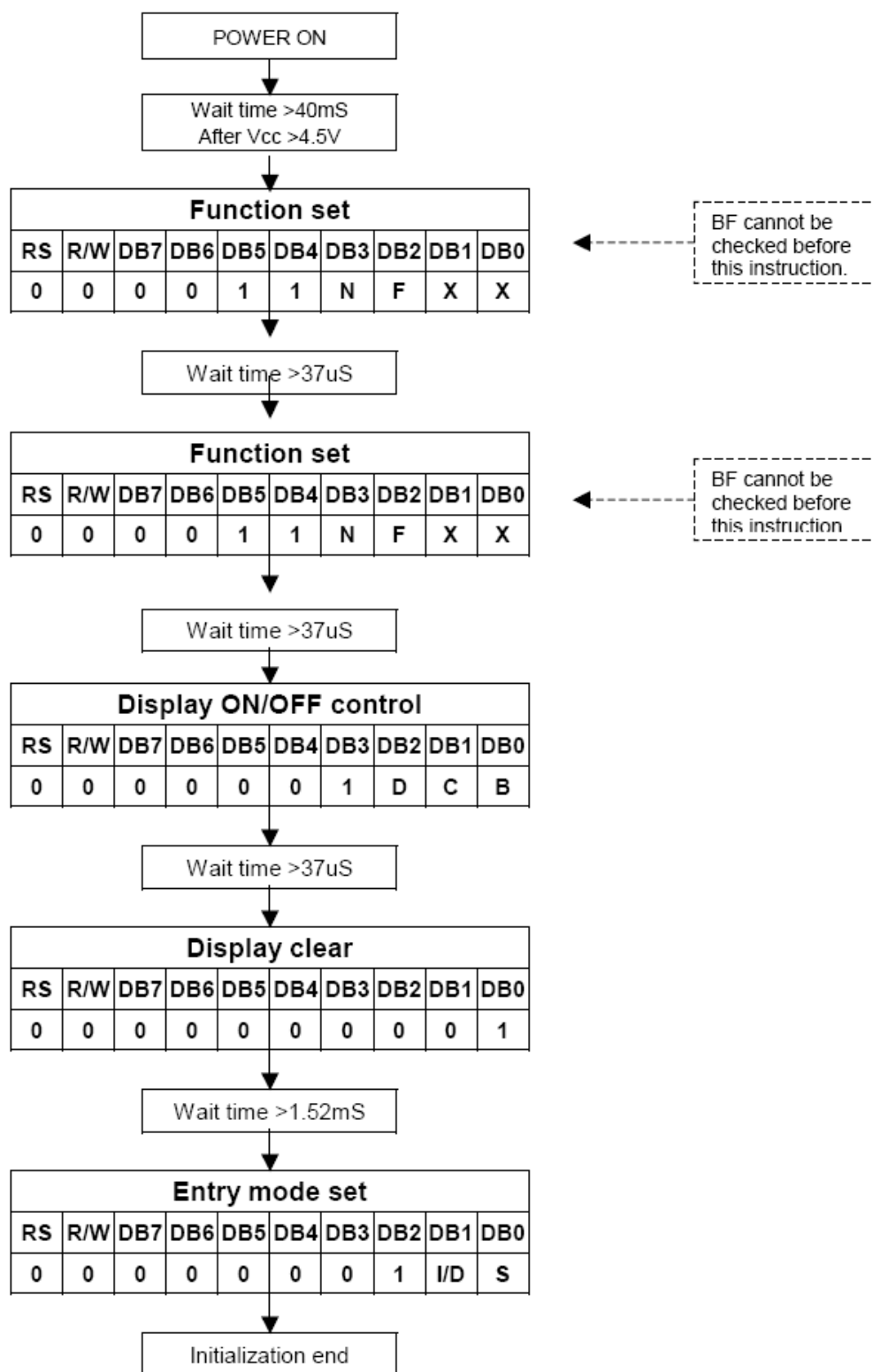
**Write Mode Timing Diagram (Writing Data from MPU to ST7066U)**

**Read Mode Timing Diagram (Reading Data from ST7066U to MPU)****THE RESET CIRCUIT**

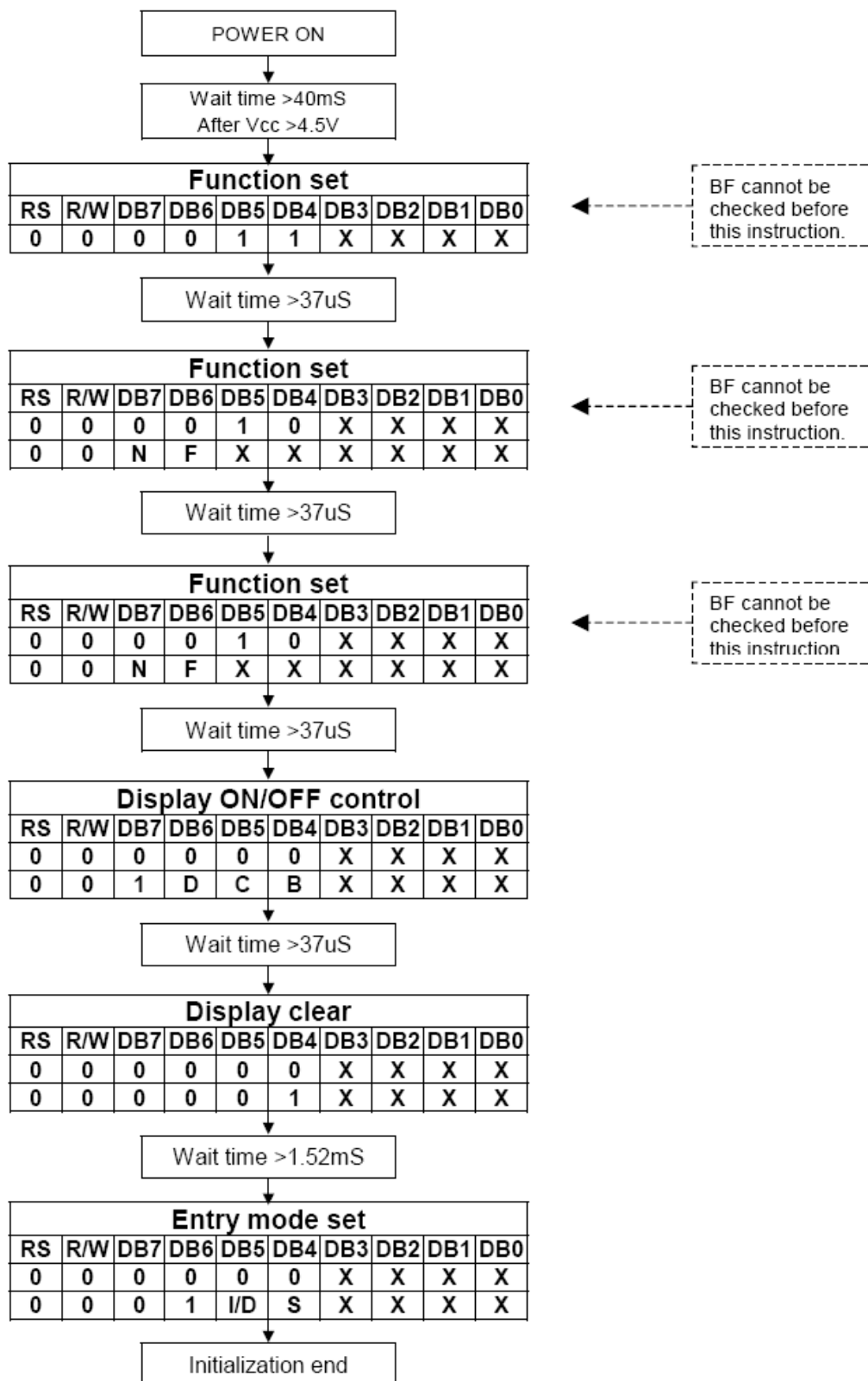
An internal reset circuit automatically initializes the ST7066U when the power is turned on. The following instructions are executed during the initialization. The busy flag (BF) is kept in the busy state until the initialization ends (BF = 1). The busy state lasts for 40 ms after VCC rises to 4.5 V.

1. Display clear
2. Function set:
  - DL = 1; 8-bit interface data
  - N = 0; 1-line display
  - F = 0; 5x8 dot character font
3. Display on/off control:
  - D = 0; Display off
  - C = 0; Cursor off
  - B = 0; Blinking off
4. Entry mode set:
  - I/D = 1; Increment by 1
  - S = 0; No shift

## Initialization for 8-Bit Interface



## Initialization for 4-Bit Interface



**ELECTRO-OPTICAL CHARACTERISTICS**

MEASURING CONDITION: POWER SUPPLY =  $V_{OP}$  / 64 Hz  
 TEMPERATURE =  $23 \pm 5$  °C  
 RELATIVE HUMIDITY =  $60 \pm 20$  %

| Item                                  | Symbol             | Unit | TYP. TN | TYP. STN |
|---------------------------------------|--------------------|------|---------|----------|
| RESPONSE TIME                         | T <sub>on</sub>    | ms   | 130     | 150      |
|                                       | T <sub>off</sub>   | ms   | 170     | 190      |
| CONTRAST RATIO                        | Cr                 | -    | 8       | 15       |
| VIEWING ANGLE (6 O'clock)<br>(Cr ≥ 2) | V <sub>3:00</sub>  | °    | 70      | 45       |
|                                       | V <sub>6:00</sub>  | °    | 45      | 70       |
|                                       | V <sub>9:00</sub>  | °    | 70      | 45       |
|                                       | V <sub>12:00</sub> | °    | 5       | 60       |

THE ELECTRO-OPTICAL CHARACTERISTICS ARE MEASURED VALUE BUT NOT GUARANTEED ONES.

**RELIABILITY OF LCD MODULE**

| ITEM                         | TEST CONDITION<br>FOR NORMAL TEMPERATURE                                                                                 | TEST CONDITION<br>FOR WIDE TEMPERATURE                                                                                   | TIME      |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|-----------|
| High temperature operating   | 50°C                                                                                                                     | 70°C                                                                                                                     | 240 hours |
| Low temperature operating    | 0°C                                                                                                                      | -20°C                                                                                                                    | 240 hours |
| High temperature storage     | 60°C                                                                                                                     | 80°C                                                                                                                     | 240 hours |
| Low temperature storage      | -10°C                                                                                                                    | -30°C                                                                                                                    | 240 hours |
| Temperature-humidity storage | 40°C 90% R.H.                                                                                                            | 60°C 90% R.H.                                                                                                            | 96 hours  |
| Temperature cycling          | -10°C to 60°C<br>30 Min Dwell                                                                                            | -30°C to 80°C<br>30 Min Dwell                                                                                            | 5 cycle   |
| Vibration Test at LCM Level  | Freq 10-55 Hz<br>Sweep rate: 10-55-10 at 1 min<br>Sweep mode Linear<br>Displacement: 2 mm p-p<br>1 Hour each for X, Y, Z | Freq 10-55 Hz<br>Sweep rate: 10-55-10 at 1 min<br>Sweep mode Linear<br>Displacement: 2 mm p-p<br>1 Hour each for X, Y, Z | —         |



**QUALITY STANDARD OF LCD MODULE**

|     |                                         |                         |                                                                                                                                                  |
|-----|-----------------------------------------|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.0 | <b>Sampling Method</b>                  |                         |                                                                                                                                                  |
|     | Sampling Plan : MIL STD 105 E           |                         |                                                                                                                                                  |
|     | Class of AQL : Level II/Single Sampling |                         |                                                                                                                                                  |
|     | Critical : 0.25% Major 0.65% Minor 1.5% |                         |                                                                                                                                                  |
|     |                                         |                         |                                                                                                                                                  |
| 2.0 | <b>Defect Group</b>                     | <b>Failure Category</b> | <b>Failure Reasons</b>                                                                                                                           |
|     | Critical Defect<br>0.25%(AQL)           | Malfunction             | Open<br>Short<br>Burnt or dead component<br>Missing part/improper part P.C.B.<br>Broken                                                          |
|     | Major Defect<br>0.65%(AQL)              | Poor Insulation         | Potential short<br>High current<br>Component damage or scratched<br>or Lying too close improper coating                                          |
|     |                                         | Poor Conduction         | Damage joint<br>Wrong polarity<br>Wrong spec. part<br>Uneven/intermittent contact<br>Loose part<br>Copper peeling<br>Rust or corrosion or dirt's |
|     | Minor Defect<br>1.5%(AQL)               | Cosmetic Defect         | Minor scratch<br>Flux residue<br>Thin solder<br>Poor plating<br>Poor marking<br>Crack solder<br>Poor bending<br>Poor packing<br>Wrong size       |

## HANDLING PRECAUTIONS

### (1) CAUTION OF LCD HANDLING & CLEANING

The polarizing plate on the surface of the panel is made from organic substances. Be very careful for chemicals not to touch the plate or it leads the polarizing plate to deteriorate.

If the use of a chemical is unavoidable, wipe the panel lightly with soft materials, such as gauze and absorbent cotton, soaked in a solvent.

\*Usable solvent: Alcohol (ethanol, IPA and the like)

\*Appropriate solvent: Ketones, ethyl alcohol

Avoid wiping with a dry cloth, since it could damage the surface of the polarizing plate and others.

Do not expose to direct sunlight or fluorescent light for a long time

### (2) CAUTION AGAINST STATIC CHARGE

The LCD modules use CMOS LSI drivers, so customers are recommended that any unused input terminal would be connected to  $V_{DD}$  or  $V_{SS}$ , do not input any signals before power is turned on, and ground your body, work/assembly areas, assembly equipment to protect against static electricity.

### (3) ESD PRECAUTION

Inputs and outputs are protected against electrostatic discharge in normal handling. However, to be totally safe, it is recommended to take normal precautions appropriate to handling LCM module. For example: product surface grounding. Always take ESD precaution when handling the *LCD Module*. Components are exposed for direct finger touches and can be damaged unless ESD precaution is taken.

### (4) PACKAGING

Avoid intense shock and falls from a height and do not operate or store them exposed to direct sunshine or high temperature/humidity for long periods.

### (5) CAUTION FOR OPERATION

The viewing angle can be adjusted by varying the LCD driving voltage VO.

Driving voltage should be kept within specified range, excess voltage shortens display life.

Response time increases with decrease in temperature.

Display may turn black or dark Blue at temperature above its operational range; this is however not destructive and the display will return to normal once the temperature falls back to range.

Mechanical disturbance during operation (such as pressing on the viewing area) may cause the segments to appear “fractured”. They will recover once the display is turned off.

Condensation at terminals will cause malfunction and possible electrochemical reaction. Relative humidity of the environment should therefore be kept below 60%.

### (6) SAFETY

Liquid crystal may leak out of a damaged LCD, it is recommended to wash off the liquid crystal by using solvents such as acetone or ethanol and should be burned up later.

If any liquid leak out of a damaged glass cell comes in contact with your hands, wash it off with soap and water immediately.

## WARRANTY

CLOVER will replace or repair any of her LCD module in accordance with her LCD specification for a period of one year from date of shipment. The warranty liability of Clover is limited to repair and/or replacement. Clover will not be responsible for any subsequent or consequential event.