# LMB162ABC
## LCD Module User Manual

## Shenzhen TOPWAY Technology Co., Ltd.

| Rev. | Descriptions | Release Date |
|------|--------------|--------------|
| 0.1 | Prelimiay release | 2005-03-17 |
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## Table of Content

# 1. Basic Specifications

## 1.1 Display Specifications

1) LCD Display Mode    : STN, Positive, Transflective
2) Display Color    : Display Data = "1" : Deep Blue (*1)
           : Display Data = "0" : Yellow Green (*2)
3) Viewing Angle    : 6H
4) Driving Method    : 1/16 duty, 1/5 bias
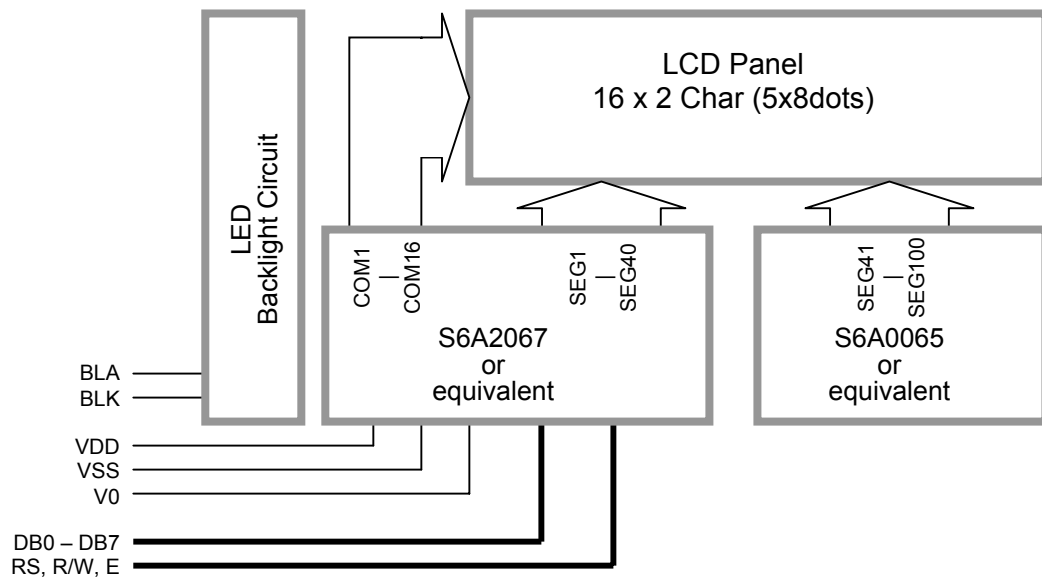5) Back Light    : Yellow-Green LED backlight

Note:
*1. Color tone may slightly change by Temperature and Driving Condition.
*2. The Color is defined as the inactive / background color

## 1.2 Mechanical Specifications

1) Outline Dimension    : 80.0 x 36.0 x 15.8MAX
                   (See attached Outline Drawing for details)

## 1.3 Block Diagram

## 1.4 Terminal Functions

| Pin No. | Pin Name | I/O | Descriptions |
|---|---|---|---|
| 1 | VSS | Power | Power supply, Ground (0V) |
| 2 | VDD | Power | Positive power supply |
| 3 | V0 | Power | LCD contrast reference supply |
| 4 | RS | Input | Register Select<br>    RS=HIGH: transferring display data<br>    RS=LOW: transferring instruction data |
| 5 | R/W | Input | Read / Write Control bus:<br>    R/W=HIGH: Read mode selected<br>    R/W=LOW: Write mode selected |
| 6 | E | Input | Data Enable |
| 7<br>:<br>14 | DB0<br>:<br>DB7 | I/O | Bi-directional tri-state Data bus<br>    In 8 bit mode, DB0 ~ DB7 are in use<br>    In 4 bit mode, DB4 ~ DB7 are in use, DB0~DB3 leave open |
| 15 | BLA | Power | Backlight positive supply |
| 16 | BLK | Power | Backlight negative supply |

## 2. Absolute Maximum Ratings

| Items | Symbol | Min. | Max. | Unit | Condition |
|---|---|---|---|---|---|
| Supply Voltage | $V_{DD}$ | 0 | 6.0 | V | $V_{SS}$ = 0V |
| Input Voltage | $V_{IN}$ | 0 | $V_{DD}$ | V | $V_{SS}$ = 0V |
| Operating Temperature | $T_{OP}$ | -20 | 70 | °C | No Condensation |
| Storage Temperature | $T_{ST}$ | -30 | 80 | °C | No Condensation |

Cautions:
Any Stresses exceeding the Absolute Maximum Ratings may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

## 3. Electrical Characteristics

### 3.1 DC Characteristics

$V_{SS}$=0V, $V_{DD}$=5.0V $T_{OP}$=25°C

| Items | Symbol | MIN. | TYP. | MAX. | Unit | Condition / Application Pin |
|---|---|---|---|---|---|---|
| Operating Voltage | $V_{DD}$ | 4.7 | 5.0 | 5.3 | V | VDD |
| Input High Voltage | $V_{IH}$ | 0.8x$V_{DD}$ | - | $V_{DD}$ | V | RS, R/W, E, DB0 ~ DB7 |
| Input Low Voltage | $V_{IL}$ | $V_{SS}$ | - | 0.5 | V | |
| Output High Voltage | $V_{OH}$ | 0.7x$V_{DD}$ | - | $V_{DD}$ | V | $I_{OH}$=-0.1mA, DB0 ~ DB7 |
| Output Low Voltage | $V_{OL}$ | $V_{SS}$ | - | 0.5 | V | $I_{OL}$=0.1mA, DB0 ~ DB7 |
| Operating Current | $I_{DD}$ | - | 1.3 | 3.0 | mA | VDD |

### 3.2 LED Backlight Circuit Characteristics

$V_{BLK}$=0V, $If_{BLA}$=100mA, $T_{OP}$=25°C

| Items | Symbol | MIN. | TYP. | MAX. | Unit | Applicable Pin |
|---|---|---|---|---|---|---|
| Forward Voltage | $Vf_{BLA}$ | - | 4.9 | - | V | BLA |
| Forward Current | $If_{BLA}$ | - | - | 150 | mA | BLA |

Cautions:
Exceeding the recommended driving current could cause substantial damage to the backlight and shorten its lifetime.



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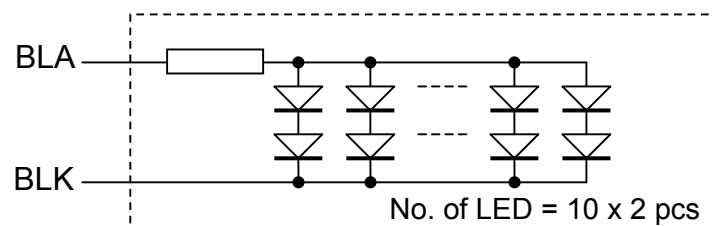
### 3.3 AC Characteristics

$V_{SS}$=0V, $V_{DD}$ =5.0V, $T_{OP}$ =25°C

| Item | Symbol | MIN. | TYP. | MAX. | Unit |
|------|--------|------|------|------|------|
| E cycle time | tc | 650 | - | - | ns |
| E high level width | tpw | 290 | - | - | ns |
| E rise time | tr | - | - | 16 | ns |
| E fall time | tf | - | - | 16 | ns |
| Address set-up time | tas | 50 | - | - | ns |
| Address hold time | tah | 13 | - | - | ns |
| Data set-up time | tdsw | 100 | - | - | ns |
| Data delay time | tddr | - | - | 150 | ns |
| Data hold time | th | 13 | - | - | ns |
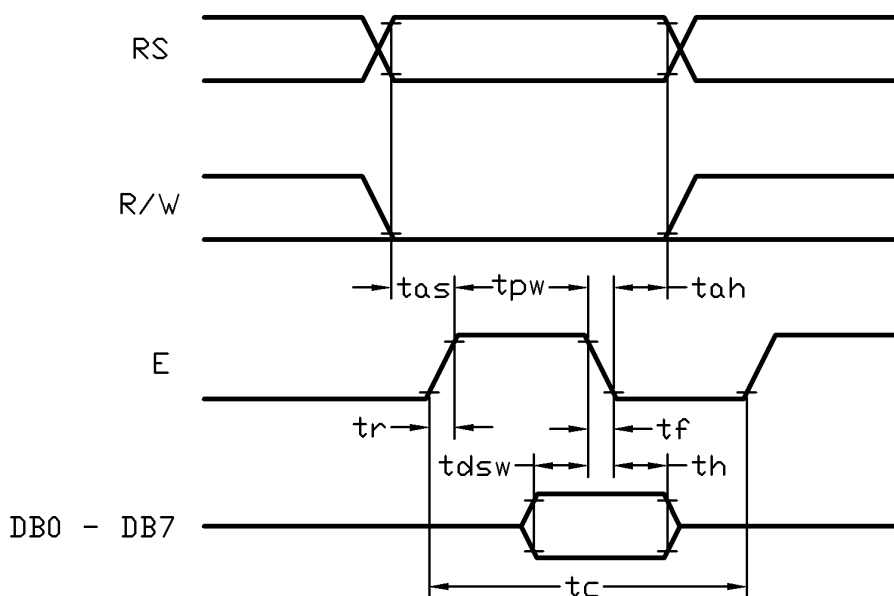


**Host Write Timing Diagram**
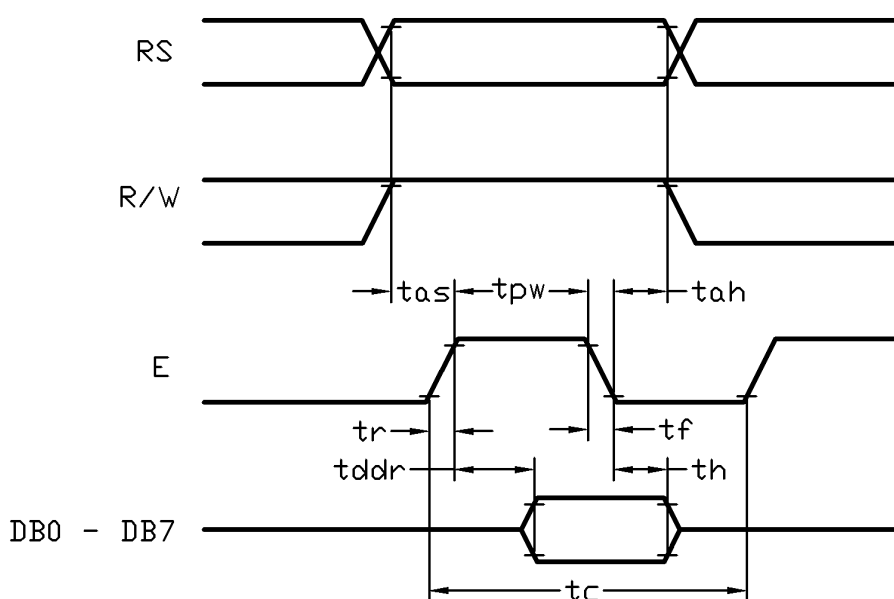


**Host Read Timing Diagram**

# 4. Function Specifications

## 4.1 Basic Setting

To drive the LCD module correctly and provide normally display, please use the following setting
- N=1, 2-line display
- F=0, 5x8 dots font
- D=1, display on

Note:
*1. These setting/commands should issue to the LCD module while start up.
*2. See the Display Commands section for details.

## 4.2 Resetting the LCD module

When turning on the VDD and VSS p ower supply, LCD module will execute the reset routine automatically. It takes about 50ms. After the reset routine, the LCD module status will be as follow:
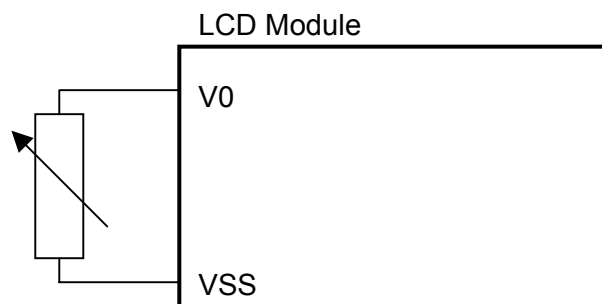
- Display clear
- DL=1,      8-bit interface
- N=0,      1-line display
- F=0,      5x8 dot character font
- D=0,      Display off
- C=0,      Cursor off
- B=0,      Blinking off
- I/D=1,      Increment by 1
- S=0,      No shift

Note:
*1. Reset routine could not generate the Basic Setting

## 4.3 Adjusting the LCD display contrast

A Variable-Resistor must be connected to the LCD module for providing a reference supply to V0. Adjusting the VR will result the change of LCD display contrast. The recommended value of VR is 5k Ohm.

LCD Module

V0

VSS

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     www.topwaysz.com
www.DataSheet4U.com

## 4.4 Display Memory Map

There are two main memory-areas in the LCD module for display.
- Character Generator RAM (CGRAM)
- Display Data RAM (DDRAM)

### 4.4.1 Character Generator RAM (CGRAM)

Character Generator RAM is for storing the User-defined Characters (5x8 dots font).
Totally 8 User-defined Characters (character code = 00h ~ 07h) could be created.

The User-defined Character Codes are 00h and 07h. They could be called into DDRAM as normal character.

| User-defined Character Code | CGRAM Address | CGRAM Data (Font Pattern) | |
|---|---|---|---|
| | | D7 ~ D5 | D4 ~ D0 |
| 00h (08h) | 00h 01h : 06h 07h | Not Use | 5 x 8 dots font pattern |
| 01h (09h) | 08h 09h : 0Eh 0Fh | Not Use | 5 x 8 dots font pattern |
| 02h (0Ah) | 10h 11h : 16h 17h | Not Use | 5 x 8 dots font pattern |
| 03h (0Bh) | 18h 19h : 1Eh 1Fh | Not Use | 5 x 8 dots font pattern |
| 04h (0Ch) | 20h 21h : 26h 27h | Not Use | 5 x 8 dots font pattern |
| 05h (0Dh) | 28h 29h : 2Eh 2Fh | Not Use | 5 x 8 dots font pattern |
| 06h (0Eh) | 30h 31h : 36h 37h | Not Use | 5 x 8 dots font pattern |
| 07h (0Fh) | 38h 39h : 3Eh 3Fh | Not Use | 5 x 8 dots font pattern |

**CGRAM Address Map**

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### 4.4.2   Display Data RAM (DDRAM)

ROM Characters (Character Code = 10h ~ FFh) could be written into DDRAM for displaying the Character (5x8 dots font). User-defined Characters (Character Code = 00h ~ 07h) stored in CGRAM could also be use. Calling Character Code 08h ~ 0Fh will call out User-defined Characters 00h ~ 07h respectively.

| DDRAM Address | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 00h | 01h | 02h | 03h | | .. | .. | .. | | 0Ch | 0Dh | 0Eh | 0Fh |
| | | | | 16 x 2 Characters (5x8 dots font) | | | | | | | | |
| 40h | 41h | 42h | 43h | | .. | .. | .. | | 4Ch | 4Dh | 4Eh | 4Fh |
| DDRAM Address | | | | | | | | | | | |

**DDRAM Address Map**

Note:
*1. The mapping is based on top view of the LCD module
*2. N=1, 2-line display
*3. F=0, 5x8 dots font
*4. D=1, display on

## 4.5 Display Commands

| No. | Instructions | Code | | | | | | | | | | Function |
|-----|--------------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|----------|
| | | RS | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 | |
| 1 | Clear Display | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | Write "20h" to DDRAM and set DDRAM address (AC) to "00h" |
| 2 | Return Home | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | x | Set DDRAM address (AC) to "00h" and return cursor to its original position if shifted (DDRAM contents are not change) |
| 3 | Entry Mode Set | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | I/D | S | Set cursor moving direction and specify display shift, during data read and write of DDRAM and CGRAM. S=1, screen shifting;   S=0, no screen shifting I/D=1, AC=AC+1 and if S=1, screen shift left I/D=0, AC=AC-1 and if S=0, screen shift right |
| 4 | Display ON/OFF | 0 | 0 | 0 | 0 | 0 | 0 | 1 | D | C | B | D=1, display on;   D=0, display off C=1, cursor on;   C=0, cursor off B=1, cursor blinking on;  B=0, cursor blinking off |
| 5 | Cursor or Display Shift | 0 | 0 | 0 | 0 | 0 | 1 | S/C | R/L | x | x | Move the cursor or shift the display, where DDRAM contents. S/C=1, shift screen;   S/C=0, shift cursor R/L=1, to right-side;   R/L=0, to left side (if S/C=1, AC will not be changed) |
| 6 | Function Set | 0 | 0 | 0 | 0 | 1 | DL | N | F | x | x | DL=1, 8-bit interface;   DL=0, 4-bit interface N=1, 2-line display;   N=0, 1-line display F=1, 5x11 dots font;   F=0, 5x8 dots font |
| 7 | Set CGRAM address | 0 | 0 | 0 | 1 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Set CGRAM address in address counter |
| 8 | Set DDRAM address | 0 | 0 | 1 | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Set DDRAM address in address counter |
| 9 | Read Busy flag & address | 0 | 1 | BF | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Check the system status and get the address counter content (AC6~AC0). BF=1, busy;   BF=0, ready |
| 10 | Write data to RAM | 1 | 0 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Write the data into internal RAM, where the address counter pointing at. |
| 11 | Read data from RAM | 1 | 1 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Read the data from internal RAM, where the address counter pointing at. |

Note:
*1. Do not use any other command not listed, or the system malfunction may result.
*2. For the details of the Display Commands, please refer to S6A2067 datasheet.

## 5. Design and Handling Precaution

1. The LCD panel is made by glass. Any mechanical shock (eg. dropping form high place) will damage the LCD module.
2. Do not add excessive force on the surface of the display, which may cause the Display color change abnormally.
3. The polarizer on the LCD is easily get scratched. If possible, do not remove the LCD protective film until the last step of installation.
4. Never attempt to disassemble or rework the LCD module.
5. Only Clean the LCD with Isopropyl Alcohol or Ethyl Alcohol. Other solvents (eg. water) may damage the LCD.
6. When mounting the LCD module, make sure that it is free form twisting, warping and distortion.
7. Ensure to provide enough space (with cushion) between case and LCD panel to prevent external force adding on it, or it may cause damage to the LCD or degrade the display result.
8. Only hold the LCD module by its side. Never hold LCD module by add force on the heat seal or TAB.
9. Never add force to component of the LCD module. It may cause invisible damage or degrade of the reliability.
10. LCD module could be easily damaged by static electricity. Be careful to maintain an optimum anti-static work environment to protect the LCD module.
11. When peeling off the protective film from LCD, static charge may cause abnormal display pattern. It is normal and will resume to normal in a short while.
12. Take care and prevent get hurt by the LCD panel sharp edge.
13. Never operate the LCD module exceed the absolute maximum ratings.
14. Keep the signal line as short as possible to prevent noisy signal applying to LCD module.
15. Never apply signal to the LCD module without power supply.
16. IC chip (eg. TAB or COG) is sensitive to the light. Strong lighting environment could possibly cause malfunction. Light sealing structure casing is recommend.
17. LCD module reliability may be reduced by temperature shock.
18. When storing the LCD module, avoid exposure to the direct sunlight, high humidity, high temperature or low temperature. They may damage or degrade the LCD module