Bona Fide Technology

Product Specification

BYMC4002DW02LW01

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2.0 Record of revision

Rev	Date	Item	Page	Comment	Originator	Checked By
0.0	15/11/11			Initial Release	ChenShanBing	zhonghong

3. General specification

Item	Contents	Unit
LCD type	STN Y/G	---
LCD duty	1/16	---
LCD bias	1/5	---
Viewing direction	6	o'clock
Module size (W×H×T)	182.0×33.5×10.9/13.6	mm
Active area(W×H)	147.5×11.5	mm
Number of dots(W×H)	40×2	characters
Dot Size(W×H))	0.6×0.65	mm
Dot Pitch(W×H))	0.65×0.7	mm
Temperature range	Operating: -20 to 70 Storage:-30 to 80	℃
Backlight	White LED	---

B	X	MC	40	02	X	X	02	X	X	XX
1	2	3	4	5	6	7	8	9	10	11

1. Brand:

   B: Bona

2. LCD Type:

   T: TN, Positive C: TN, Negative D: BTN, Negative H: HTN, Positive

   Y: STN Yellow Green G: STN Grey B: STN Blue, Negative

   S: STN Purple, Negative F: FSTN, Positive (Black White)

   N: FSTN, Negative (Blue, Single Retardation)

   U: FFSTN, Negative (Black/White, Double Retardation).

3. Type of display:

   MC: Matrix Character Type; MG: Matrix Graphic Type;

   CM: Custom Mode

4. Resolution:

   Number of character (Character mode, 2digits);

   Number of columns (Graphic mode, 2 or 3digits);

   Year code (Alphanumeric, 2digits).

5. Resolution:

   Number of lines (Character mode, 2digits);

   Number of rows (Graphic mode, 2 or 3digits);

   Reference No only (Alphanumeric, 3digits).

6. Viewing an gle:

   D: 6:00 O'clock U: 12 O'clock C: Center.

7. Temperature Rage:

   S: Standard temperature range W: Wide temperature range;

   E: Extended Wide Temp range.

8. Serial number:

   For design reference.

9. Back light Type:

   N: None L: LED E: EL C: CCFL

10. Back light color:

   W: White Y: Yellow Green B: Blue O: Orange A: Amber

   R: Red G: Green D: Double color T: RGB color N: No back light.

11. Serial number:

   00: Standard LCD Module 01~99: Refer to Factory for other version.

4.0 Absolute maximum ratings

(1) Electrical Absolute Ratings

Item	Symbol	Min.	Max.	Unit	Note
Power Supply for Logic	V_{CC}	0	5.25	Volt	Note 1
Power Supply for LCD	V_{LCD}	0	8	Volt	
Input Voltage	V_I	0	V_{CC}	Volt	
Current for LED backlight		---	80	mA	V_{CC} =5V

Note 1: Operator should be grounded during handling LCM

（2）Environmental Absolute Maximum Ratings

Item	Normal Temperature				Wide Temperature			
	Operating		Storage		Operating		Storage	
	Min.	Max,	Min.	Max,	Min.	Max,	Min.	Max,
Ambient Temperature	0℃	+50℃	-10℃	+60℃	-20℃	+70℃	-30℃	+80℃
Humidity(without condensation)	Note 2,4		Note 3,5		Note 4,5		Note 4,6	

Note 2 Ta≦50℃: 80% RH max

Ta>50℃: Absolute humidity must be lower than the humidity of 85%RH at 50 ℃

Note 3 Ta at -20℃ will be<48hrs at 70℃will be <120hrs when humidity is higher than 75%.

Note 4 Background color changes slightly depending on ambient temperature. This phenomenon is reversible.

Note 5 Ta≦70℃: 75RH max

Ta>70℃: absolute humidity must be lower than the humidity of 75%RH at 70 ℃

Note 6 Ta at -20℃ will be <48hrs, at 80 ℃will be <120hrs when humidity is higher than 75%

5. Electrical characteristics

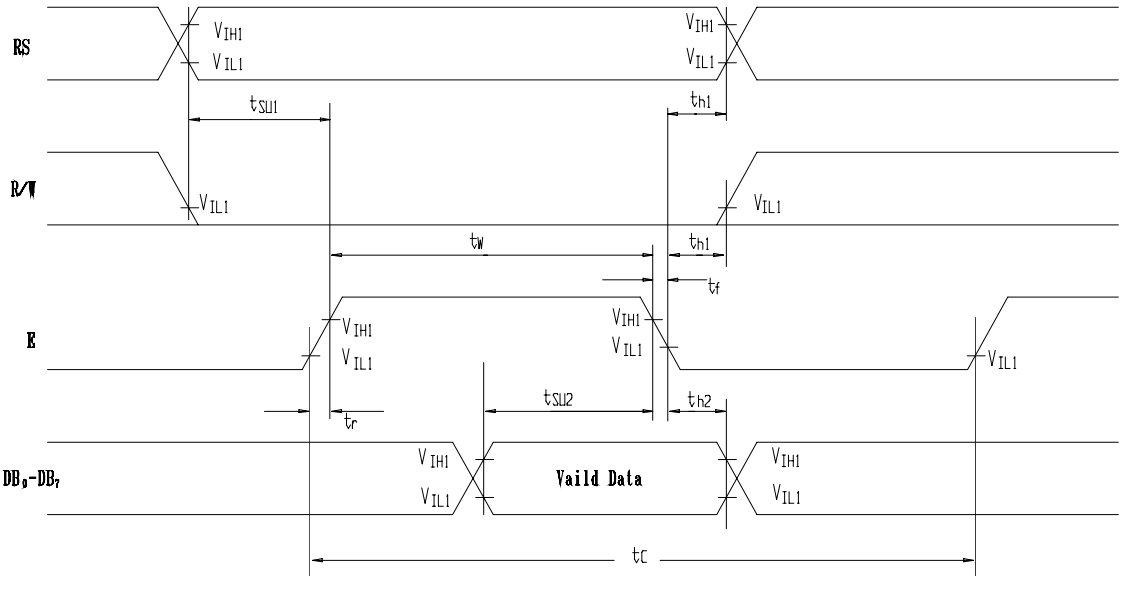
DC Characteristics (VCC=5V, GND=0V, Ta=25℃)

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Power Supply for Logic	V_{CC}-GND	---	---	5.0	5.25	**Volt**
Input Voltage	V_{IL}	---	0	---	$0.2V_{CC}$	Volt
	V_{IH}	---	$0.8V_{CC}$	---	V_{CC}	Volt
Output Voltage	V_{OL}	---	0	---	$0.2\ V_{CC}$	Volt
	V_{OH}	---	$0.75\ V_{CC}$	---	V_{CC}	Volt
LCM Recommend LCD Module Driving Voltage	V_{LCD} ($V_{CC} - V_0$)	T_a=0℃	---	---	---	Volt
		T_a=25℃	3	4.5	6	
		T_a=50℃	---	---	---	
Power Supply Current for LCM	I_{DD}(B/L OFF)	---	---	---	1.1	mA
	I_{LED}(B/L ON)	---	---	---	60	
Power Supply for LED Backlight	V_{BLA}- V_{BLK}	Ta=25℃	---	5.0	---	V

AC Characteristics (VCC=5V, GND=0V, Ta=25℃)

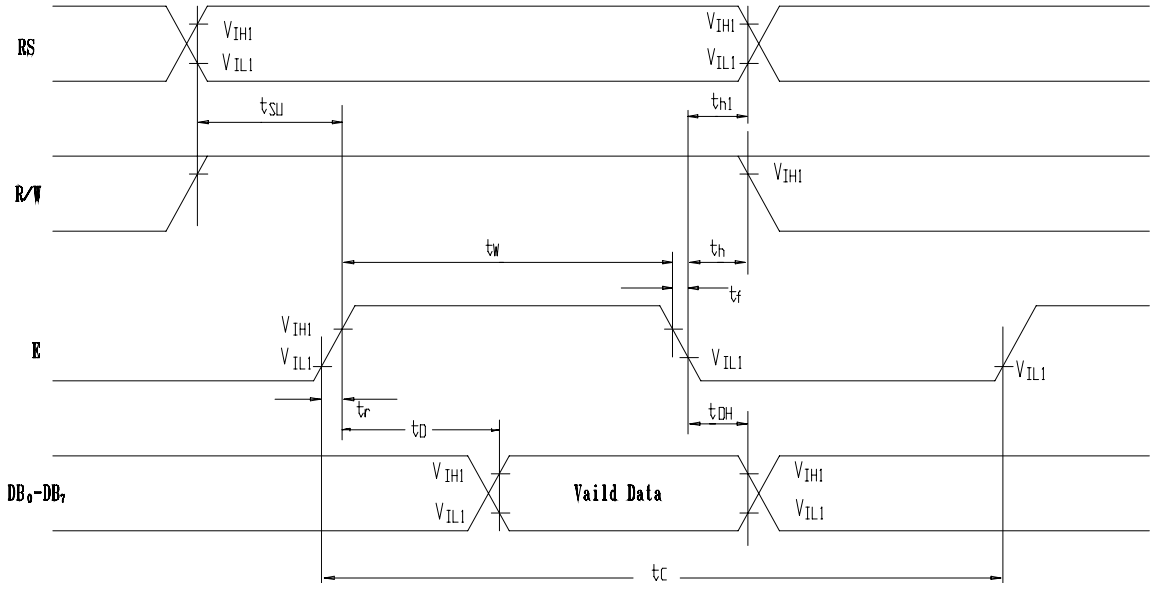
1. Write Mode (Writing data from MPU to ST7066U)

Symbol	Characteristics	Test Condition	Min.	Typ.	Max.	Unit
T_C	Enable Cycle Time	Pin E	1200	---	---	ns
T_{PW}	Enable Pulse Width	Pin E	140	---	---	ns
T_R,T_F	Enable Rise/Fall Time	Pin E	---	---	25	ns
T_{AS}	Address Setup Time	Pins: RS,RW,E	0	---	---	ns
T_{AH}	Address Hold Time	Pins: RS,RW,E	10	---	---	ns
T_{DSW}	Data Setup Time	Pins: DB0 - DB7	40	---	---	ns
T_H	Data Hold Time	Pins: DB0 - DB7	10	---	---	ns



2. Read Mode (Reading Data from ST7066U to MPU)

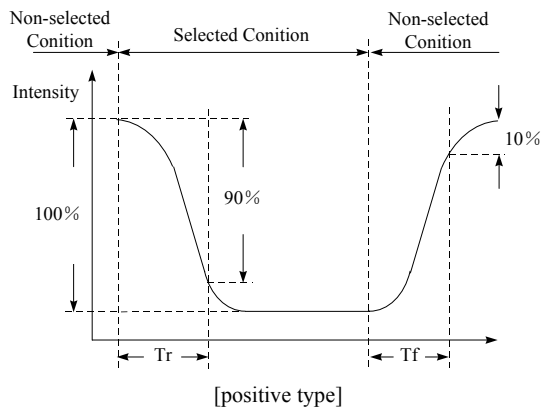
Symbol	Characteristics	Test Condition	Min.	Typ.	Max.	Unit
TC	Enable Cycle Time	Pin E	1200	-	-	ns
TPW	Enable Pulse Width	Pin E	140	-	-	ns
TR,TF	Enable Rise/Fall Time	Pin E	-	-	25	ns
TAS	Address Setup Time	Pins: RS,RW,E	0	-	-	ns
TAH	Address Hold Time	Pins: RS,RW,E	10	-	-	ns
TDDR	Data Setup Time	Pins: DB0 - DB7	-	-	100	ns
TH	Data Hold Time	Pins: DB0 - DB7	10	-	-	ns



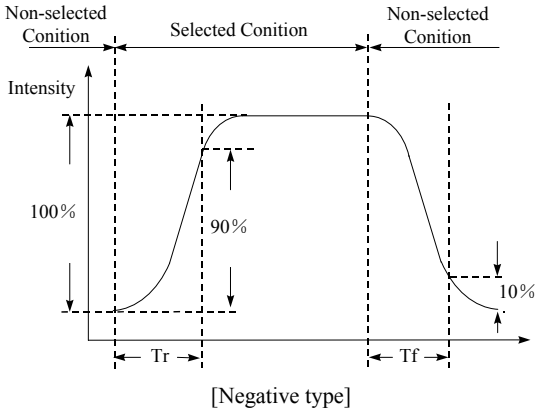
6. Environmental requirement

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	note
Viewing angle range	θ_f (12 o'clock)	When Cr≧2	35	---	---	Degree	Note 2 Note 3 Note 4
	θ_b (6 o'clock)		30	---	---		
	θ_l (9 o'clock)		30	---	---		
	θ_r (3 o'clock)		30	35	---		
Rise Time	T_r	V_{DD}-V_0=8.7V Ta=25℃		112		mS	Note 1
Fall Time	T_f			250			
Contrast	Cr		---	5. 4	---		

[Note 1] Definition of Response Time (Tr, Tf)



[positive type]



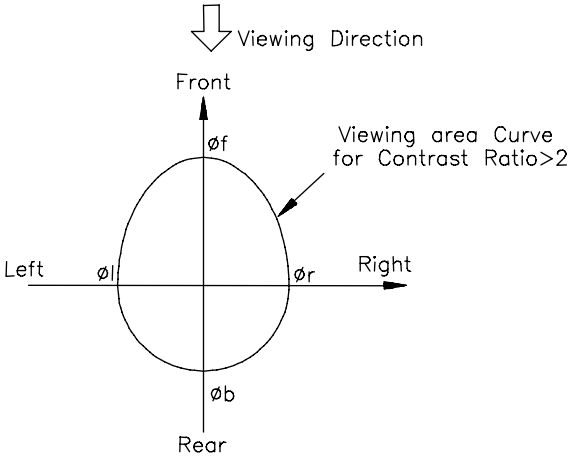
[Negative type]

Conditions:

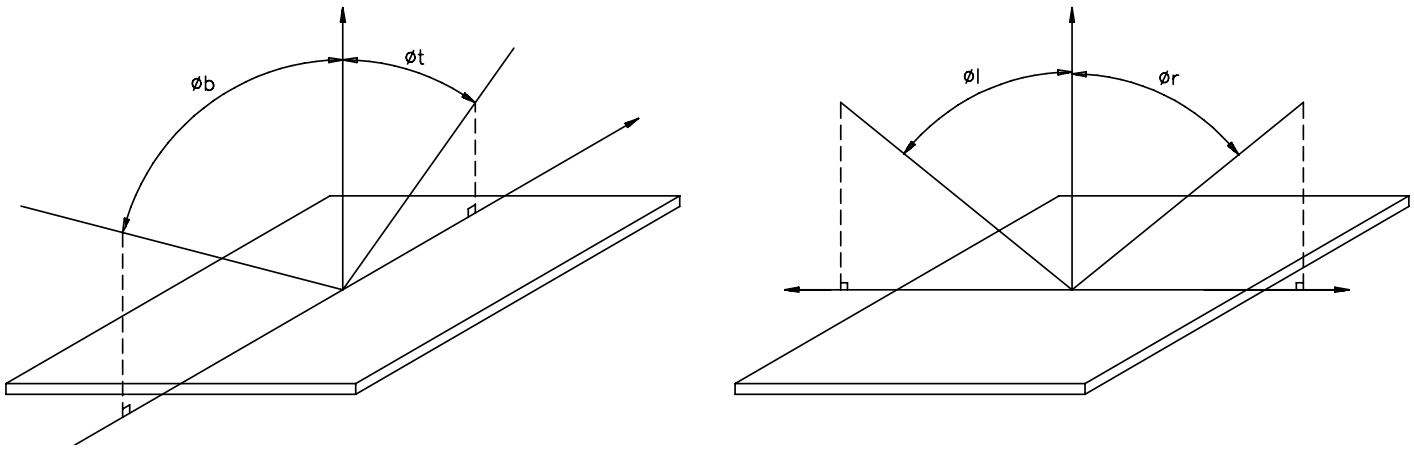
Operating Voltage : Vop　　Viewing Angle(θ , Φ): 0° , 0°

Frame Frequency : 64 Hz　　Driving Wave form : 1/N duty, 1/a bias

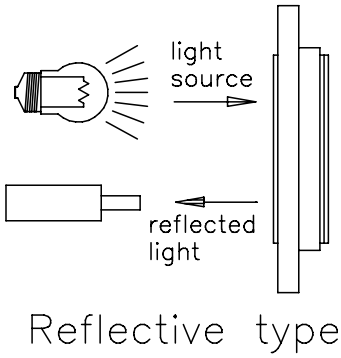
[Note 2] Definition of Viewing Direction



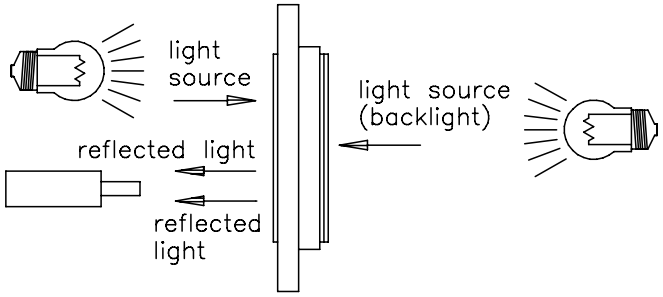
[Note 3] Definition of viewing angle



[Note 4] Description of Measuring Equipment



Reflective type



Transflective type

7. OPERATING PRINCIPLES & METHODS

Instruction	Instruction Code											Description Time (270KHz)
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description	
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 C=1:cursor on 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 N:number of line is 2/1 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

1. Display Clear

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
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, hence, bring the cursor to the left edge on first line of the display. Entry mode is set to increment mode (I/D = “1”)

2. Return Home

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
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.

3. Entry Mode Set

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	1	1/D	S

Set the moving direction of cursor and display.

1/D : Increment / decrement of DDRAM address (cursor or blink)

When 1/D = “High”, cursor/blink moves to right and DDRAM address is increased by 1.

When 1/D = “Low”, cursor/blink moves to left and DDRAM address is increased by 1.

*CGRAM operates the same as DDRAM, when read from or write to CGRAM.

S: Shift of entire display

When S = “High”, after DDRAM write, the entire display of all lines is shifted to the right (1/D= “0”) or to the left (1/D = “1”). But it will seem as if the cursor does not move.

When S = “Low”, or DDRAM read, or CGRAM read/write operation, shift of entire display is not performed.

4. Display ON/OFF Control

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
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 1/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. if fosc has 270 kHz frequency, blinking has 370 ms interval.

When B = “Low”, blink is off.

5. Cursor or Display Shift

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	S/C	R/L	-	-

Without writing or reading of display data, shift right/left cursor position or display.

This instruction is used to correct or search display data. (Refer to Table 6)

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.

Table 6. Shift Patterns According To S/C And R/L Bits

S/C	R/L	Operation
0	0	Shift cursor to the left, Address Counter is decreased by 1
0	1	Shift cursor to the right, Address Counter is increased by 1
1	0	Shift all the display to the left, cursor moves according to the display
1	1	Shift all the display to the right, cursor moves according to the display

6. Function Set

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	1	DL	N	X	X	X

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. Hence, DL is a signal to select 8-bit or 4-bit bus mode.

In 4-bit bus mode, it is required to transfer 4-bit data two times.

N : Display line number control bit

When N = “Low”, it means 2-line display mode.

When N = “High”, 4-line display mode is set.

F: Display font type control bit

When F= “0”, 5*7 dots format display mode.

When F= “1”, 5*10 dots format display mode.

7. Set CGRAM Address

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0

8.Set CGRAM Address to AC.

This instruction makes CGRAM data available from MPU.

9.Set DDRAM Address

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	AC6	AC5	AC4	AC3	AC2	AC1	AC0

This instruction makes CGRAM data available from MPU.

In 1-line display mode (N=0) DDRAM address is from “00H” to “4FH”.

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

10.Read Busy Flag & Address

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0

This instruction shows whether KSOO70B is in internal operation or not. If the resultant BF is High, the internal operation is in progress and you have to wait until BF to be Low. Then the next instruction can be performed. In this instruction you can read the value of address counter.

11.Write Data To RAM

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
1	0	D7	D6	D5	D4	D3	D2	D1	D0

Write binary 8-bit data to DDRAM/CGRAM.

The selection of RAM from DDRAM, and CGRAM is set by the previous address set instruction : DDRAM address set, and 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.

12.Read Data From RAM

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
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, as the direction of AC is not determined. If you read RAM data several times without RAM address set instruction before read operation, the correct RAM data can be from the second, but the first data would be incorrect, as there is no time margin to transfer RAM data. In 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, AC is increased/decreased by 1 as in read operation after this. In this time, AC indicates the next address position, but you can read only the previous data can only be read by read instruction

8. RELIABILITY

Environmental Test				
No.	**Test Item**	**Content of Test**	**Test Condition**	**Applicable Standard**
1	High temperature storage	Endurance test applying the high storage temperature for a long time.	80 °C 200 hrs	------
2	Low temperature storage	Endurance test applying the low storage temperature for a long time.	-30 °C 200 hrs	------
3	High temperature operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	70 °C 200 hrs	------
4	Low temperature operation	Endurance test applying the electric stress under low temperature for a long time.	-20 °C 200 hrs	------
5	High temperature / Humidity storage	Endurance test applying the high temperature and high humidity storage for a long time.	70 °C , 90 %RH 96 hrs	MIL-202E-103B JIS-C5023
6	High temperature / Humidity operation	Endurance test applying the electric stress (Voltage & Current) and temperature / humidity stress to the element for a long time.	50 °C , 90 %RH 96 hrs	MIL-202E-103B JIS-C5023
7	Temperature cycle	Endurance test applying the low and high temperature cycle. - 10°C ⇌ 25°C 5min ⇌ 60°C 30mi 1	-10°C / 60°C 10 cycles	------
Mechanical Test				
8	Vibration test	Endurance test applying the vibration during transportation and using.	10~22Hz → 1.5mmp-p 22~500Hz → 1.5G Total 0.5hrs	MIL-202E-201A JIS-C5025 JIS-C7022-A-10
9	Shock test	Constructional and mechanical endurance test applying the shock during transportation.	50G half sign wave 1l msedc 3 times of each direction	MIL-202E-213B
10	Atmospheric pressure test	Endurance test applying the atmospheric pressure during transportation by air.	115 mbar 40 hrs	MIL-202E-105C
Others				
11	Static electricity test	Endurance test applying the electric stress to the terminal.	VS=800V , RS=1.5 kΩ CS=100 pF 10 time	MIL-883B-3015.1

Inspection after test: Inspection after 2～4 hours storage at room temperature ,the sample shall be free from defects:

1. Air bubble in the LCD.
2. Sealleak
3. Non-display.
4. Missing segments.
5. Glass crack.
6. Current Idd is twice higher than initial value.

9. QUALITY GUARANTEE

No	Item	Criteria
1	inclusions (black spot, white spot, dust)	(1)round type diameter mm(a*) no of defect* a≦0.20 neglect 0.20＜a≦0.35 5max 0.35＜a none (2)linear type length mm(l) width mm(W) no. of defect na W≦0.03 neglect l≦3 0.03＜W≦0.08 6 3＜l 0.08＜W none
2	scratch	1.scratch on protective film is permitted. 2.scratch on polarizer shall be as follow: (1)round type diameter mm(a*) no of defect a≦0.15 neglect 0.15＜a≦0.20 2 max 0.20＜a none (2)linear type be judged bye 1.-(2) linear type
3	dent	diameter ＜ 1.5mm
4	bubble	not exceeding 0.5mm average diameter is acceptable between glass and polarizing film
5	pin hole	(a+b)/2 ≦ 0.15mm maximum number: ignored 0.15＜(a+b)/2≦0.20mm maximum number:10
6	dot width	design width ±15%
7	dot defect	(a+b)/2≦0.20mm maximum number: ignored 0.20＜(a+b)/2≦0.30mm maximum number:5 x=width
8	contrast irregularity(spot)	diameter spec no of defect a≦0.50mm neglect 0.50＜a≦0.75 5 0.75＜a≦1.00 3 1.00＜a none
9	color tone and uniformity	obvious uneven color is not permitted

10.The table of DDRAM address and character

10-1 DDRAM address table

Display position		1	2	3	……	38	39	40
DDRAM Address	The first row	00H	01H	02H	……	25H	26H	27H
	The second row	40H	41H	42H	……	65H	66H	67H

The screen display 40*2 characters

Display position		1	2	3	……	22	23	24
DDRAM Address	The first row	00H	01H	02H	……	25H	26H	27H
	The second row	40H	41H	42H	……	65H	66H	67H

For shift left

Display position		1	2	3	……	22	23	24
DDRAM Address	The first row	01H	02H	03H	……	26H	27H	00H
	The second row	41H	42H	43H	……	66H	67H	40H

For shift right

Display position		1	2	3	……	22	23	24
DDRAM Address	The first row	27H	00H	01H	……	24H	25H	26H
	The second row	67H	40H	41H	……	64H	65H	66H

10-2 Character table*

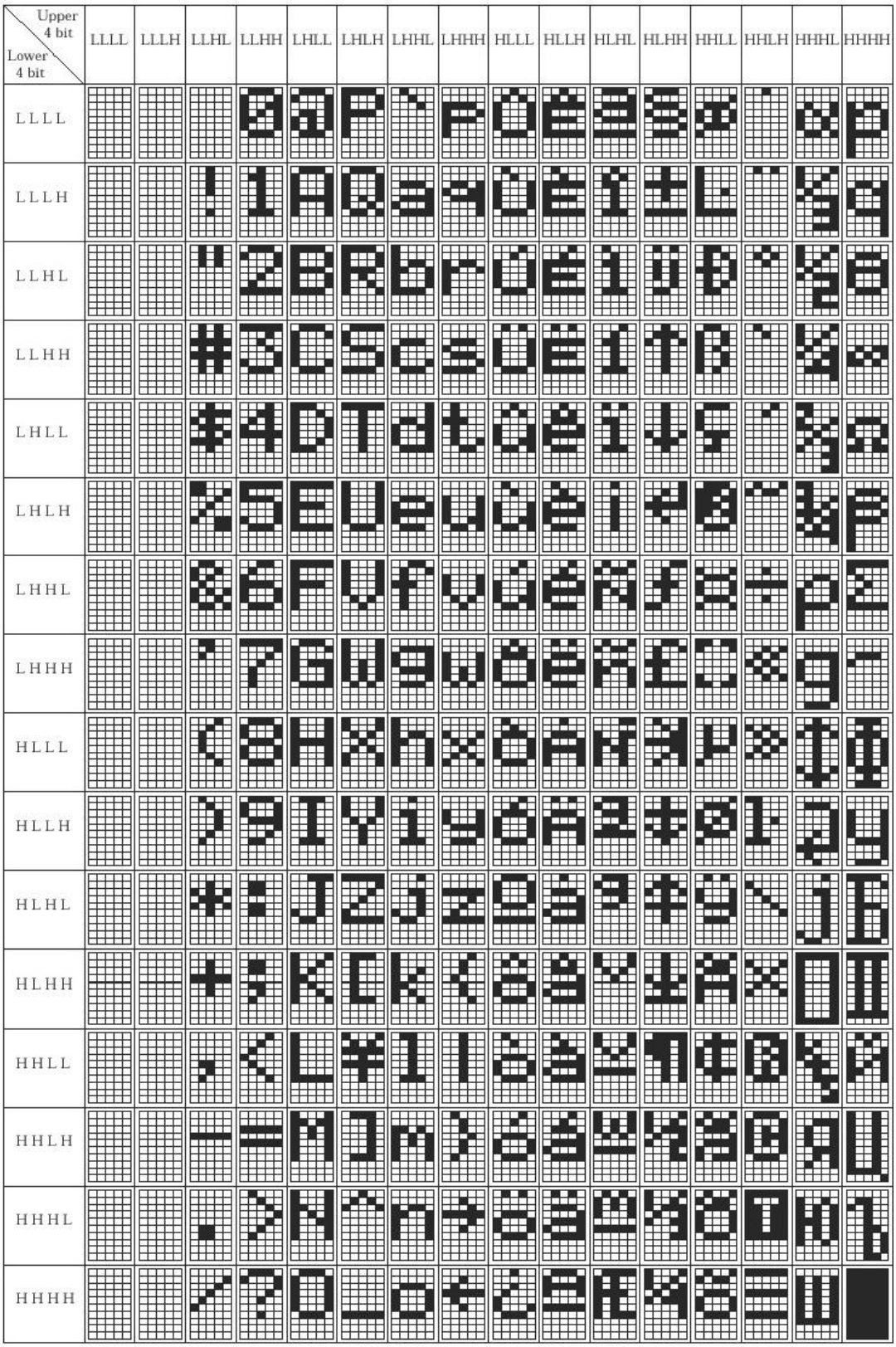
(1) English and Japanese character table



(2) English and Russian character table

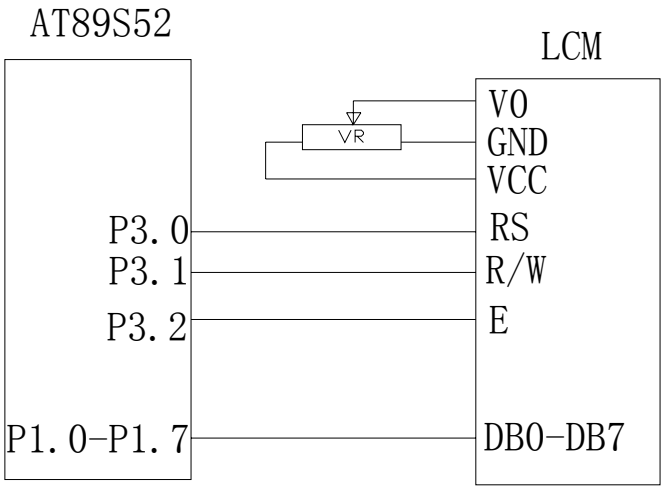


(3) English and Owen character table



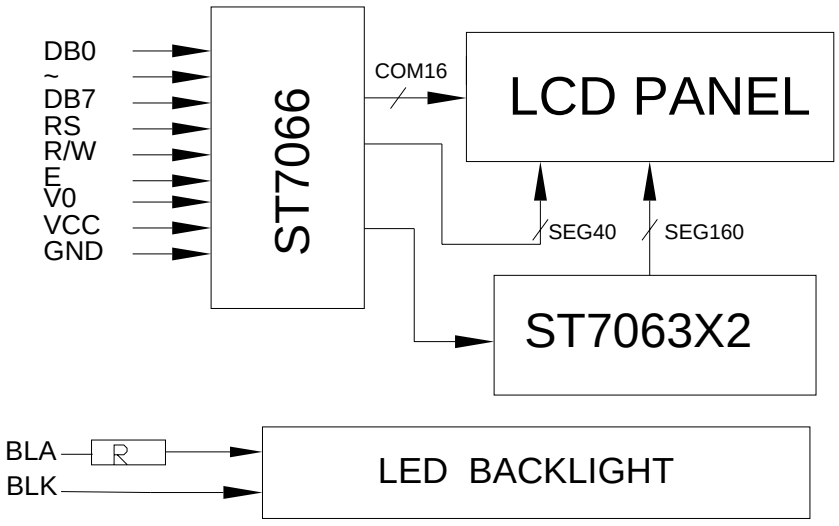
NOTE: The module only contain one character table , English and Japanese character table will be chose, when you have no requirement. .

（1）Interface circuit:



11.Interface

Pin No.	Symbol	Level	Description
1	GND	---	Ground.
2	VCC	3.3/5.0V	Power supply.
3	V0	---	Bias supply voltage input to drive the LCD.
4	RS	H/L	Serial data input or output with Pull-high resistor
5	R/W	H/L	Select read or write. 0: Write 1: Read
6	E	H/L	Starts data read/write.
7~14	DB0~DB7	H/L	Data bus.
15	BLA	---	Backlight anode.
16	BLK	---	Backlight cathode.



12. Precaution for using LCM

1. Liquid Crystal Display (LCD)

LCD is made up of glass, organic sealant, organic fluid and polymer based polarizers. The following precautions should be taken when handling.

b) Keep the temperature within the range of use and storage. Excessive temperature and humidity could cause polarization degredation, polarizer peel off or bubble.

c) Do not contact the exposed polarizer with anything harder than HB pencil lead. To clean dust off the display surface, wipe gently with cotton, chamois or other soft material soaked in petroleum benzin.

d) Wipe off saliva or water drops immediately. Contact with water over a long period of time may cause polarizer deformation or colour fading, while an active LCD with water condensation on its surface will cause corrosion of ITO electrodes.

e) Glass can be easily chipped or cracked from rough handling, especially at corners and edges.

f) Do not drive LCD with DC voltage.

2. Liquid Crystal Display Modules.

2.1 Mechanical Considerations

LCM are assembled and adjusted with a high degree of precision. Avoid excessive shocks and do not make any alterations or modification. The following should be noted.

a) Do not tamper in any way with the tabs on the metal frame.

b) Do not modify the PCB by drilling extra holes, changing its outline, moving its component or modifying its pattern.

c) Do not touch the elastomer connector, especially insert a backlight panel (for example, EL)

d) When mounting a LCM make sure that the PCB is not under any stress such as bending or twisting. Elastomer contacts are very delicate and missing pixels could result from slight dislocation of any of the elements.

a) Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed and lose contact, resulting in missing pixels.

2.2 Static Electricity

LCM contains CMOS LSI's and the same precaution for such devices should apply, namely

a) The operator should be grounded whenever he/she comes into contact with the module. Never touch any of the conductive parts such as the LSI pads, the copper leads on the PCB and the interface terminals with any parts of the human body.

b) The modules should be kept in antistatic bags or other containers to static for storage.

c) Only properly grounded soldering irons should be used.

d) If an electric screwdriver is used, it should be well grounded and shielded from commutator spark.

e) The normal static prevention measures should be observed for work clothes and working benches, the latter conductive (rubber) mat is recommended.

f) Since dry air is inductive to statics, a relative humidity of 50-60% is recommended.

2.3 Soldering

a) Solder only to the I/O terminals.

b) Use only soldering irons with proper grounding and no leakage.

c) Soldering temperature: 280 °C

d) Soldering time: 3 to 4 sec

e) Use eutectic solder with resin flux fill.

f) If flux is used, the LCD surface should be covered to avoid flux spatters. Flux residue should be removed afterwards.

2.4 Operation

a) The contras can be adjusted by varying the LCD driving voltage V0
b) Driving voltage should be kept within specified range, excess voltage shortens display life.
c) Response time increases with decrease in temperature.
d) Display may turn black or dark blue at temperature above its operational range, this is (however not pressing on the viewing area) may cause the segments to appear "fractured".
e) Mechanical disturbance during operation (such as pressing on the viewing area) may cause the segments to appear "fractured".

2.5 Storage

If any fluid leaks out of the damage glass cell, wash off any human part that comes into contact with soap and water. Never swallow the fluid. The toxicity is extremely low but caution should be exercised at all the time.

2.6 Limited Warranty

Unless otherwise agreed between BONA Fide Technology and customer, BONA Fide Technology will replace or repair any of its LCD and LCM which is found to be defective electrically and visually when inspected in accordance with BONA Fide Technology acceptance standards, for a period of one year from date of shipment. Confirmation of such date shall be based on freight documents. The warranty liability of BONA Fide Technology is limited to repair and/or replacement on the terms set forth above. BONA Fide Technology will not responsible for any subsequent or consequential events.

13.Outline drawing

