YM1604C

LCD Module User Manual

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REV	Descriptions	Release Date
0.1	Prelimiay release	2008-03-15

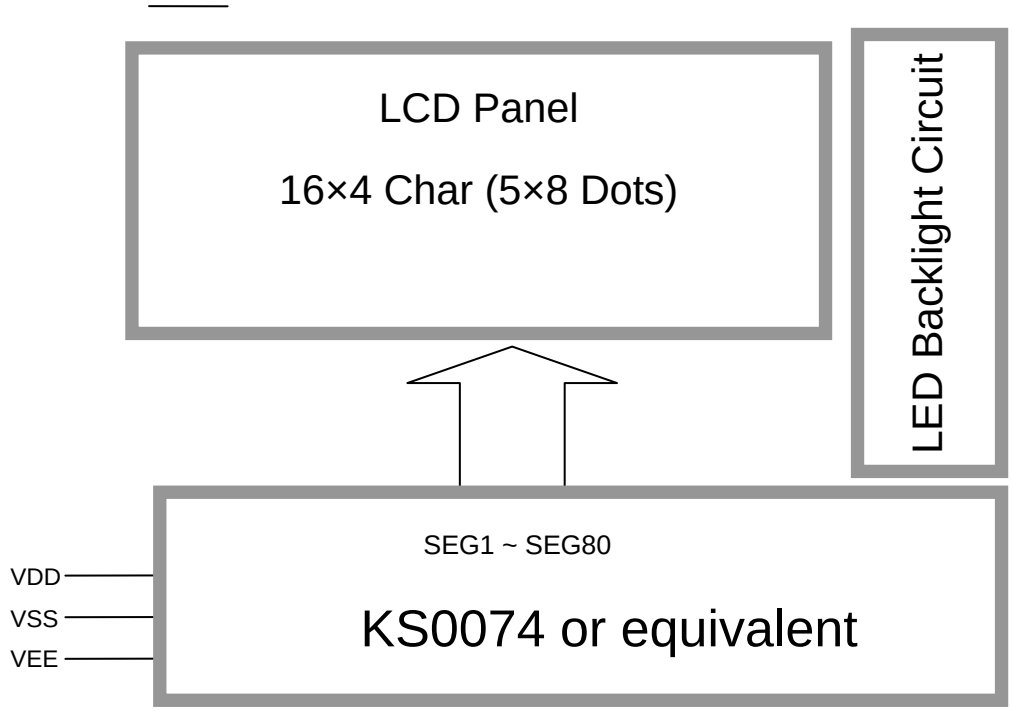
Table of Content

1.0 Basic Specification

1.1 Display and Mechanical Specification

ITEM	STANDARD VALUE	UNIT
Display Type	16 Characters X 4 Lines	--
LCD Type	Blue STN/ Tran missive/Positive	--
LCD Duty	1/32 Duty	--
LCD Bias	1/6 Bias	--
Viewing Direction	6:00	--
Backlight Type	Edge LED Backlight with white color	--
Interface	6800/8080 series or Serial Interface	--
Driver IC	KS0074	--
Module Dimension	77.0(L)×51.0(W) ×13.0(H) (MAX)	mm
Visual Area	61.70(L) ×25.20(W)	mm
Dot size	0.55 ×0.55	mm
Dot Pitch	0.60 ×0.60	mm

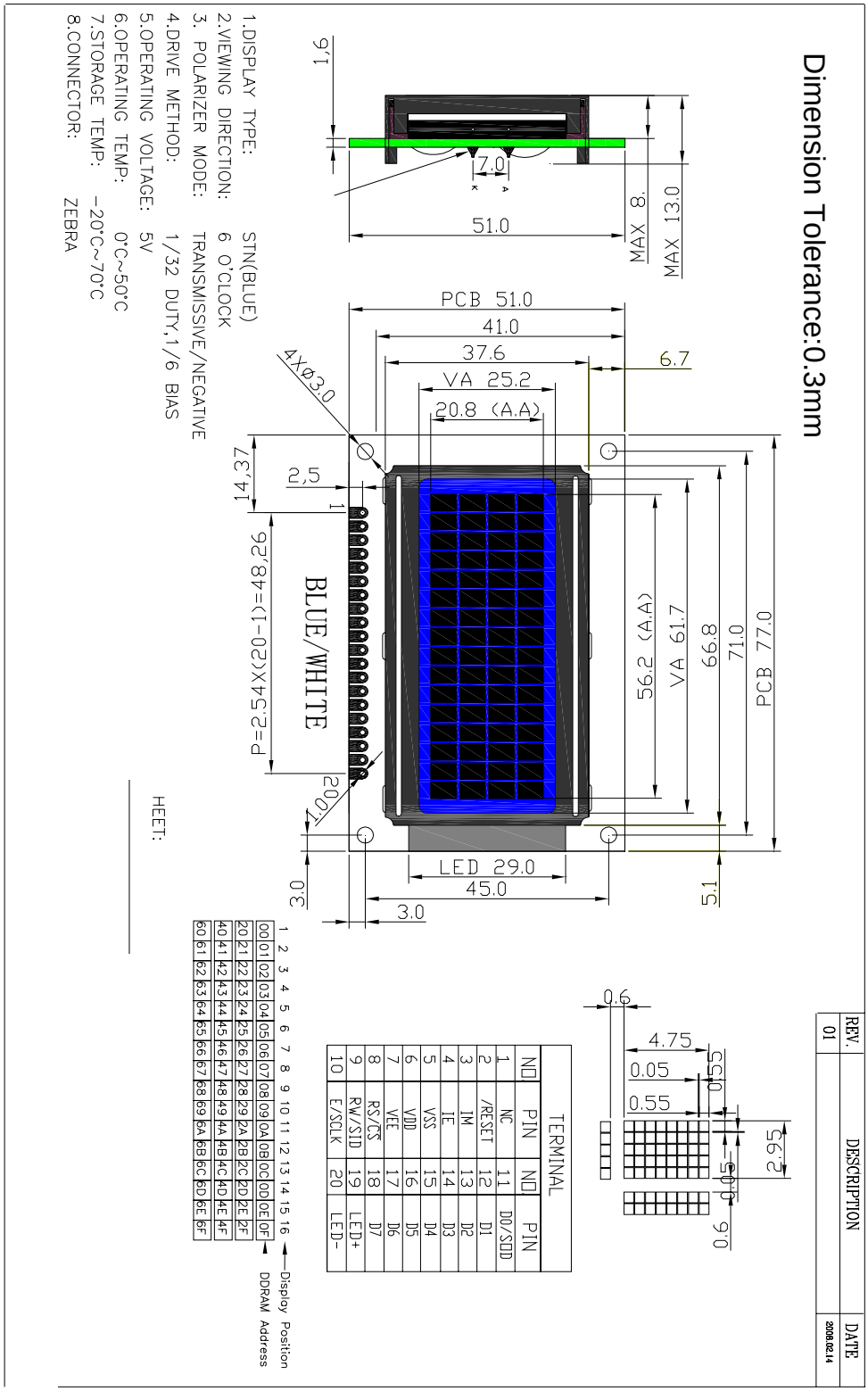
1.2 Block Diagram



1.3 Terminal Functions

Pin Num	Pin Name	Full Name	I/O	Descriptions
1	NC	-	-	No connection, leave open
2	RESET	Reset pin	Input	Initialized to Low
3	IM	Interface mode selection	Input	Select Interface mode with the MPU. When IM=”Low”: Serial mode, When IM=”High”:4-bit/8-bit bus mode.
4	IE	Select pin of Instruction set	Input	When IE= “High” , Instruction set is selected as Table 6 . When IE= “Low”, Instruction set is selected as Table 10.
5	VSS	-	Power	Negative Power Supply, Ground(0V)
6	VDD	-	Power	Positive Power Supply
7	VEE	-	Power	LCD contrast reference supply
8	RS/CS	Register select/Chip select	Input	When bus mode, used as register selection input. When RS/CS=”High”, Data register is selected. When RS/CS = “Low” , Instruction register is selected. When serial mode, used as chip selection input. When RS/CS = “Low” , selected. When RS/CS= “High”, not selected. (low access enable)
9	RW/SID	Read/Write /Serial input data	Input	When bus mode, used as read/write selection input. When RW/SID= “High”, read operation. When RW/SID= “Low” , write operation. When serial mode, used for data input pin.
10	E/SCLK	Read/Write Enable/Serial clock	Input	When bus mode, used as read/write enable signal. When serial mode, used as serial clock input pin.
11	DB0/SOD	Data bus 0 bit/ Serial output data.	Power	When 8-bit bus mode, used as lowest bi-directional data l During 4-bit bus mode, open this pin. When serial mode, used as serial data output pin. If not in read operation, open this pin.
12-14	DB1-DB3	Data bus 1-7	Input Output	When 8-bit bus mode, used as low order bi-directional data bus.During 4-bit bus mode or serial mode, open these pins.
15-18	DB4-DB7			When 8-bit bus mode, used as high order bi-directional data bus. In case of 4-bit bus mode, used as both high a low order
19	LED +	-	Power	Backlight positive supply
20	LED -	-	Power	Backlight negative supply

1.4 Mechanical Drawing



2. Absolute Maximum Ratings

Items	Symbol	Min	Max.	Unit	Condition
Supply Voltage	V_{DD}	0	+5.0	V	V_{SS}=0V
Input Voltage	V_{IN}	0	V_{DD}	V	V_{SS}=0V
Operating Temperature	T_{OP}	0	+50	℃	No Condensation
Storage Temperature	T_{ST}	-20	+70	℃	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

VSS=0V,VDD=3.3V TOP=25℃

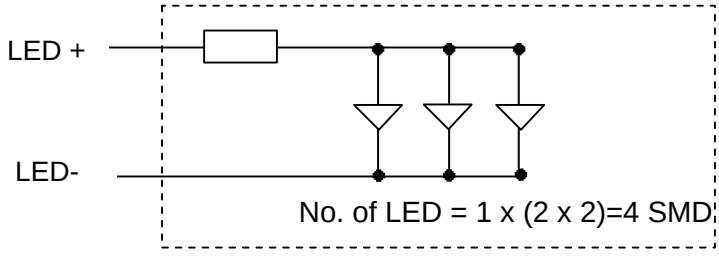
Items	Symbol	MIN	TYP.	MAX.	Unit	Condition/Application pin
Operating Voltage	VDD	2.7	-	5.5	V	-
Input High Voltage	V_{1H}	0.7V_{DD}		V_{DD}	-	-
Input Low Voltage	V_{IL}	-0.3	-	0.2V_{DD}		V_{DD}=2.7 – 3.0
		-0.3	-	0.6		V_{DD}= 3.0 - 5.5
Output High Voltage	V_{0H}	0.75V_{DD}	-	-	V	I_{0H}=-0.1m A,DB0～DB7
Output Low Voltage	V_{0L}	-	-	0.2V_{DD}	V	I_{0L}=-0.1m A,DB0～DB7
Operating Current	I_{DD}	-	0.15	0.3	mA	Internal oscillation or external clock. (V_{DD}=3.0v, fosc=270kHz

3.2 LED Backlight Circuit Characteristics

Items	Symbol	MIN	TYP.	MAX.	Unit	Application pin
Forward Voltage	Vf_{LED+}	-	3.0	-	V	LED+
Forward Current	If_{LED+}	-	-	60	mA	LED+

Cautions:

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



3.3 AC Characteristics (VDD= 4.5 to 5.5V ,Ta= -30 to 85℃)

Mode	Items	Symbol	MIN	TYP.	MAX.	Unit
Write mode (Refer to figure A)	E cycle time	tc,	500	-	-	ns
	E rise/fall time	tr , tf	-	-	20	
	E pulse width (high,low)	tw	230	-	-	
	R/W and RS setup time	Tsu1	40	-	-	
	R/W and RS hold time	th1	10	-	-	
	Data setup time	tsu2	60	-	-	
	Data hold time	th2	10	-	-	
Read mode (Refer to figure B)	E cycle time	tc,	500	-	-	ns
	E rise/fall time	tr , tf	-	-	20	
	E pulse width (high,low)	tw	230	-	-	
	R/W and RS setup time	tsu	40	-	-	
	R/W and RS hold time	th	10	-	-	
	Data output delay time	tD	-	-	160	
	Data hold time	tDH	5	-	-	
Serial interface mode (Refer to figure C)	Serial clock cycle time	tc	0.5	-	20	us
	Serial clock rise / fall time	tr,tf	-	-	50	ns
	Serial clock width (high , low)	tw	200	-	-	
	Chip select setup time	tsu1	60	-	-	
	Chip select hold time	th1	20	-	-	
	Serial input data setup time	tsu2	100	-	-	
	Serial input data hold time	th2	100	-	-	
	Serial output data delay time	tD	-	-	160	
	Serial output data hold time	tDH	5	-	-	

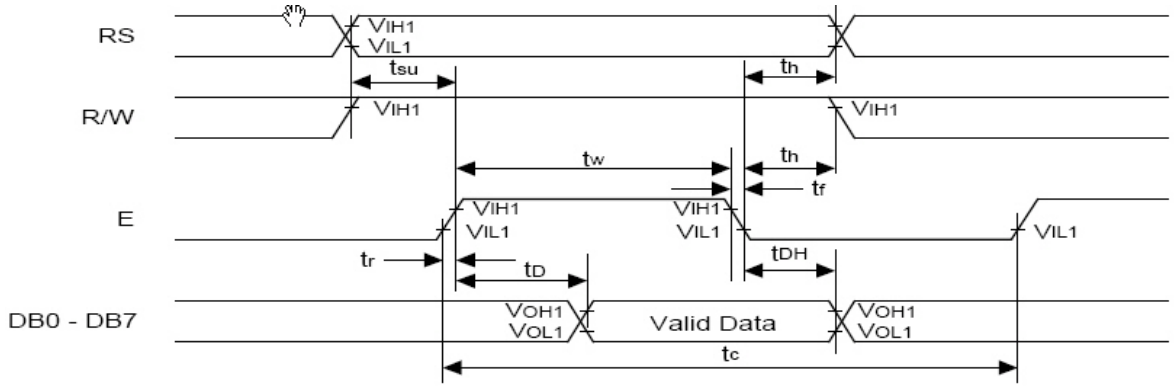


Figure A : Write Mode

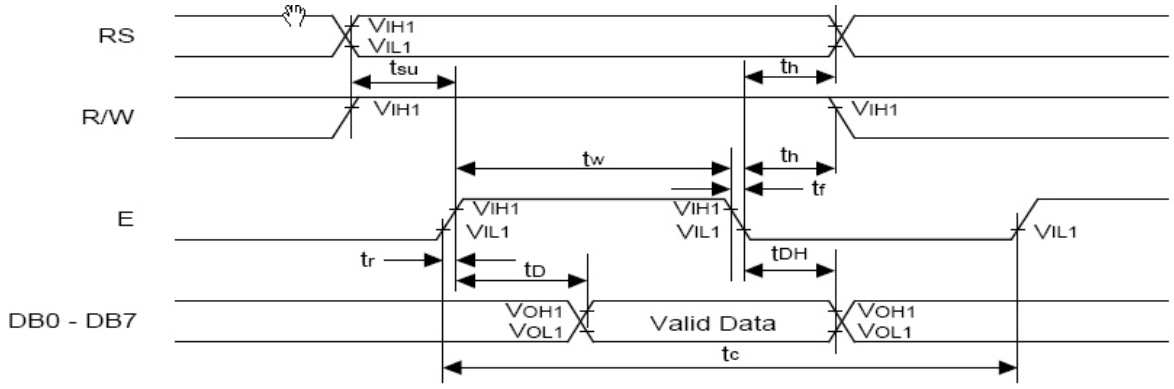


Figure B : Read Mode

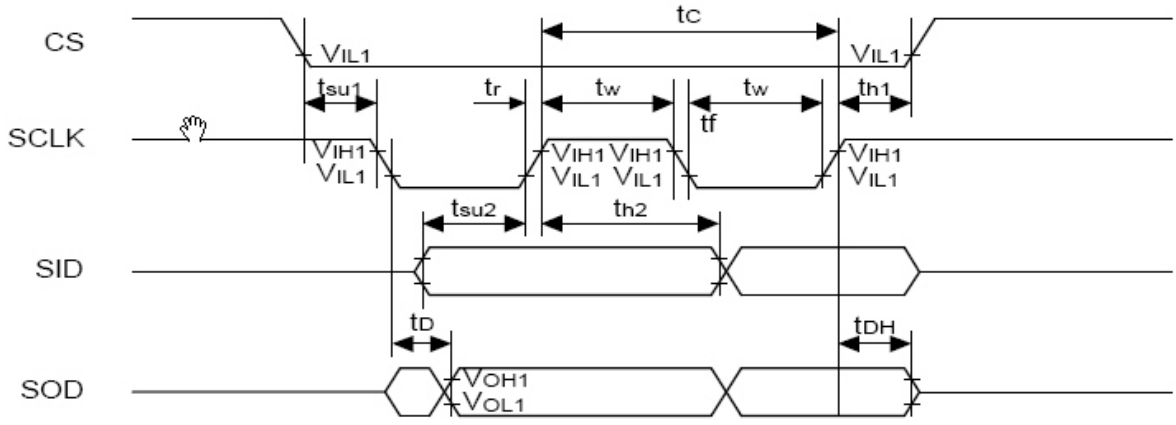


Figure C : Serial interface mode

4. Function Description

4.1 System Interface

KS0074 has all three kinds interface type with MPU: serial, 4-bit bus and 8-bit bus. Serial and bus (4-bit/8-bit) is selected by IM input, and 4-bit bus and 8-bit bus is selected by DL bit in the instruction register. During read or write operation, two 8-bit registers are used. one is data register (DR), the other is instruction register (IR). The data register (DR) is used as temporary data storage place for being written into or read from DDRAM/CGRAM/SEGRAM, target RAM is selected by RAM address setting instruction. Each internal operation, reading from or writing into RAM, is done automatically.

So to speak, after MPU reads DR data, the data in the next DDRAM/CGRAM/SEGRAM address is transferred into DR automatically. Also after MPU writes data to DR, the data in DR is transferred into DDRAM/CGRAM/SEGRAM automatically. The Instruction register (IR) is used only to store instruction code transferred from MPU. MPU cannot use it to read instruction data. To select register, use RS/CS input pin in 4-bit/8-bit bus mode (IM = "High") or RS bit in serial mode (IM = "Low").

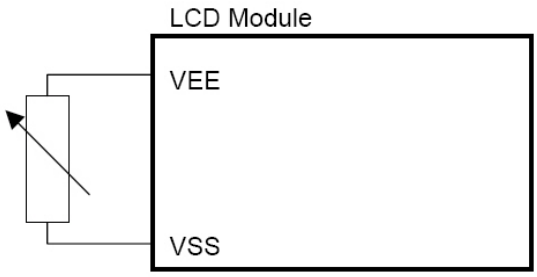
RS	RW	Operation
0	0	Instruction write operation (MPU writes Instruction code into IR)
0	1	Read busy flag (DB7) and address counter (DB0 - DB6)
1	0	Data write operation (MPU writes data into DR)
1	1	Data read operation (MPU reads data from DR)

4.2 Busy Flag

When BF = "High", it indicates that the internal operation is being processed. So during this time the next instruction cannot be accepted. BF can be read, when RS = Low and R/W = High (Read Instruction Operation), through DB7 Before executing the next instruction, be sure that BF is not High.

4.3 Adjusting the display contrast

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



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 Display Data Ram (DDRAM)

DDRAM stores display data of maximum 80 x 8 bits (80 characters). DDRAM address is set in the address counter (AC) as a hexadecimal number. (Refer to Figure 1.)

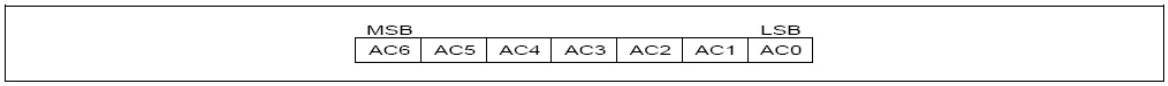


Figure 1. DDRAM Address

5-dot 4-line Display

In case of 4-line display with 5-dot font, the address range of DDARM is 00H-13H, 20H-33H, 40H-53H, 60H-73H. (refer to Figure 2)

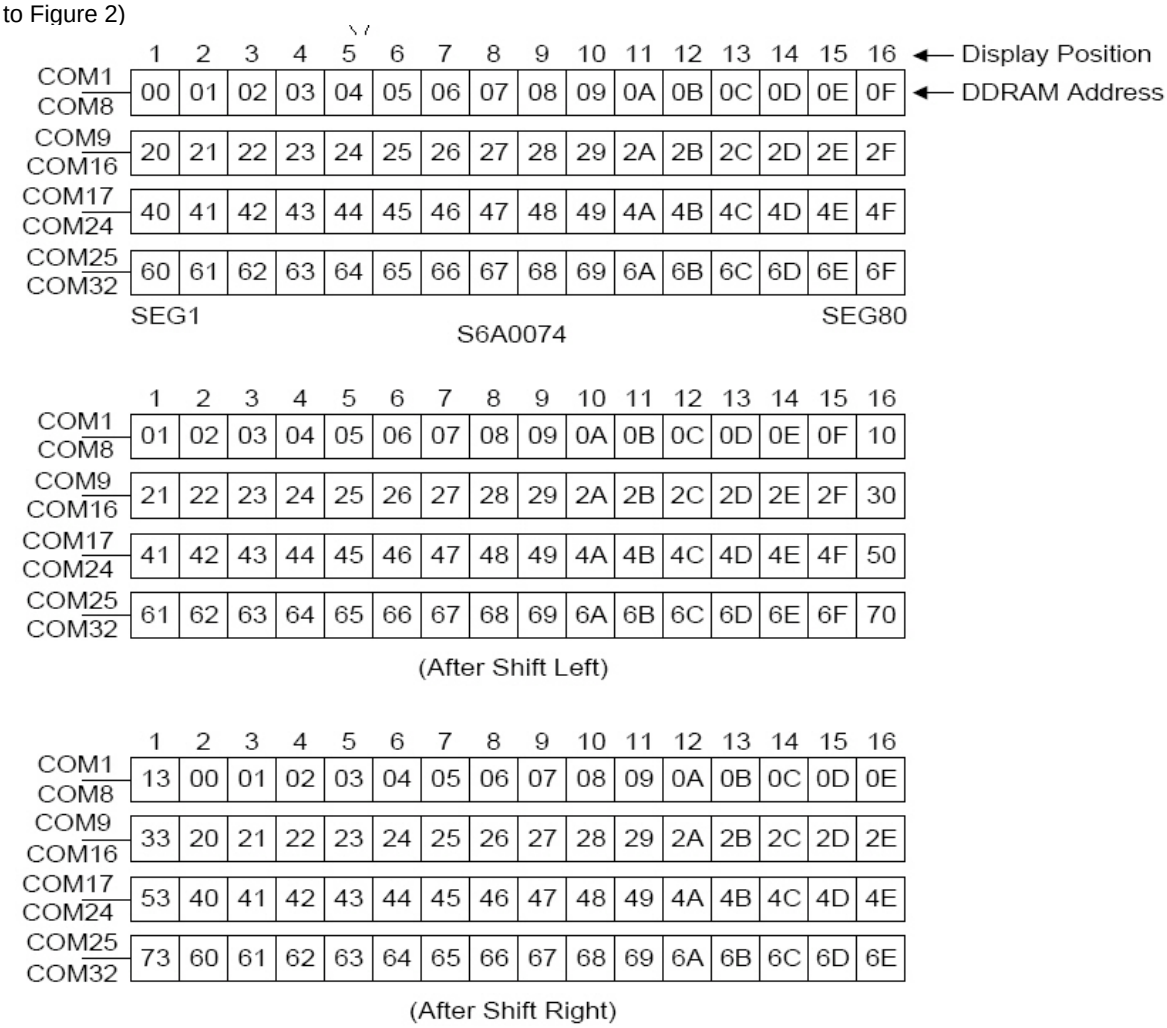


Figure 2 4-Line X 16 ch .Display (5-dot Font Width)

4.4.2 Character Generator Ram (CGRAM)

CGRAM has up to 5 X 8 dots 8 characters. By writing font data to CGRAM, user defined character can be used(refer to Figure 3).

5X8 dots Character Pattern

Figure 3. Relationship Between Character Code (DDRAM) and Character Pattern (CGRAM)

Character Code (DDRAM data)								CGRAM Address						CGRAM Data								Pattern Number
D7	D6	D5	D4	D3	D2	D1	D0	A5	A4	A3	A2	A1	A0	P7	P6	P5	P4	P3	P2	P1	P0	
0	0	0	0	x	0	0	0	0	0	0	0	0	0	B1	B0	x	0	1	1	1	0	Pattern 1
											0	0	1				1	0	0	0	1	
											0	1	0				1	0	0	0	1	
											0	1	1				1	1	1	1	1	
											1	0	0				1	0	0	0	1	
											1	0	1				1	0	0	0	1	
											1	1	0				1	0	0	0	1	
											1	1	1				0	0	0	0	0	
0	0	0	0	x	1	1	1	1	1	1	0	0	0	B1	B0	x	1	0	0	0	1	Pattern 8
											0	0	1				1	0	0	0	1	
											0	1	0				1	0	0	0	1	
											0	1	1				1	1	1	1	1	
											1	0	0				1	0	0	0	1	
											1	0	1				1	0	0	0	1	
											1	1	0				1	0	0	0	1	
											1	1	1				0	0	0	0	0	

4.5 Instruction Description (IE = “HIGH”)

Table 1

Instruction	RE	Instruction Code										Description	Execution Time (fosc = 270kHz)
		RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Function set	0	0	0	0	0	1	DL	N	RE (0)	DH	REV	Set interface data length (DL = "1": 8-bit, DL = "0": 4-bit), numbers of display line when NW = "0", (N = "1": 2-line, N = "0" : 1-line), extension register, RE("0"), shift/scroll enable DH = "1": display shift enable DH = "0": dot scroll enable. reverse bit REV = "1": reverse display, REV = "0": normal display.	39μs
	1	0	0	0	0	1	DL	N	RE (1)	BE	0	Set DL, N, RE("1") and CGRAM/SEGRAM blink enable (BE) BE = "1/0": CGRAM/SEGRAM blink enable/disable	39μs
Set CGRAM address	0	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter.	39μs
Set SEGRAM address	1	0	0	0	1	X	X	AC3	AC2	AC1	AC0	Set SEGRAM address in address counter.	39μs
Set DDRAM address	0	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter.	39μs
Set scroll quantity	1	0	0	1	X	QC5	QC4	QC3	QC2	QC1	QC0	Set the quantity of horizontal dot scroll.	39μs
Read busy flag and address	X	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Can be known whether during internal operation or not by reading BF. The contents of address counter can also be read. BF = "1": busy state, BF = "0": ready state.	0μs
Write data	X	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM / CGRAM / SEGRAM).	43μs
Read data	X	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM / CGRAM / SEGRAM).	43μs

Table 2

Instruction	RE	Instruction Code										Description	Execution Time (fosc = 270kHz)
		RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Clear display	X	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRAM. and set DDRAM address to "00H" from AC.	1.53ms
Return home	0	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.	1.53ms
Power down mode	1	0	0	0	0	0	0	0	0	1	PD	Set power down mode bit. PD = "1": power down mode set, PD = "0": power down mode disable	39μs
Entry mode set	0	0	0	0	0	0	0	0	1	I/D	S	Assign cursor moving direction. I/D = "1": increment, I/D = "0": decrement and display shift enable bit. S = "1": make display shift of the enabled lines by the DS4 - DS1 bits in the shift enable instruction. S = "0": display shift disable	39μs
	1	0	0	0	0	0	0	0	1	1	B/D	Segment bi-direction function. BID = "0": Seg1 → Seg80, BID = "1": Seg80 → Seg1.	
Display ON/OFF control	0	0	0	0	0	0	0	1	D	C	B	Set display/cursor/blink on/off D = "1" : display on, D = "0" : display off, C = "1" : cursor on, C = "0" : cursor off, B = "1" : blink on, B = "0" : blink off.	39μs

Table 3

Instruction	RE	Instruction Code										Description	Execution Time (fosc = 270kHz)
		RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Extended function set	1	0	0	0	0	0	0	1	FW	B/W	NW	Assign font width, black/white inverting of cursor, and 4-line display mode control bit. FW = "1": 6-dot font width, FW = "0": 5-dot font width, B/W = "1": black/white inverting of cursor enable, B/W = "0": black/white inverting of cursor disable NW = "1": 4-line display mode, NW = "0": 1-line or 2-line display mode.	39μs
Cursor or display shift	0	0	0	0	0	0	1	S/C	R/L	x	x	Cursor or display shift. S/C = "1" : display shift, S/C = "0" : cursor shift, R/L = "1" : shift to right, R/L = "0" : shift to left.	39μs
Shift enable	1	0	0	0	0	0	1	DS4	DS3	DS2	DS1	(when DH = "1") Determine the line for display shift DS1 = "1/0": 1st line display shift enable/disable DS2 = "1/0": 2nd line display shift enable/disable DS3 = "1/0": 3rd line display shift enable/disable DS4 = "1/0": 4th line display shift enable/disable.	39μs
Scroll enable	1	0	0	0	0	0	1	HS4	HS3	HS2	HS1	(when DH = "0") Determine the line for horizontal smooth scroll. HS1 = "1/0": 1st line dot scroll enable/disable HS2 = "1/0": 2nd line dot scroll enable/disable HS3 = "1/0": 3rd line dot scroll enable/disable HS4 = "1/0": 4th line dot scroll enable/disable.	39μs

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NOTE:

During internal operation, Busy Flag (DB7) is read high. Busy Flag check must be proceeded the next instruction. Busy flag check must be proceeded the next instruction.

When an MPU program with Busy Flag (DB7) checking is made, 1/2 Fosc (is necessary) for executing the next instruction by the falling edge of the “E” signal after the Busy Flag (DB7) goes to “Low”.

5. Design and Handling Precaution

1.0 The LCD panel is made by glass. Any mechanical shock (eg. dropping form high place) will damage the LCD module.

2.0 Do not add excessive force on the surface of the display, which may cause the Display color change abnormally.

3.0 The polarizer on the LCD is easily get scratched. If possible, do not remove the LCD protective film until the last step of installation.

4.0 Never attempt to disassemble or rework the LCD module.

5.0 Only Clean the LCD with Isopropyl Alcohol or Ethyl Alcohol. Other solvents (eg. water) may damage the LCD.

6.0 When mounting the LCD module, make sure that it is free form twisting, warping and distortion.

7.0 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.

8.0 Only hold the LCD module by its side. Never hold LCD module by adds force on the heat seal or TAB.

9.0 Never add force to component of the LCD module. It may cause invisible damage or degrade of the reliability.

10.0 LCD module could be easily damaged by static electricity. Be careful to maintain an optimum anti-static work environment to protect the LCD module.

11.0 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.

12.0 Take care and prevent get hurt by the LCD panel sharp edge.

13.0 Never operate the LCD module exceed the absolute maximum ratings.

14.0 Keep the signal line as short as possible to prevent noisy signal applying to LCD module.

15.0 Never apply signal to the LCD module without power supply.

16.0 IC chip (eg. TAB or COG) is sensitive to the light. Strong lighting environment could Possibly cause malfunction. Light sealing structure casing is recommend.

17.0 LCD module reliability may be reduced by temperature shock.

18.0 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