LCD1602指令集解读

LCD1602指令集(11个)

1、清屏指令（clear display） RS=0 ,R/w=0, 01H

功能：清除液晶显示器，即将DDRAM中的内容全部填入20H（空白字符）

光标撤回显示屏左上方

将地址计数器（AC）设为0，

光标移动方向为从左向右，并且DDRAM的自增量为1(I/D=1).

Clear Display

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, namely, bring the cursor to the left edge on the first line of the display. Make the entry mode increment(I/D=HIGH)

2、光标归位指令（Return Home）RS=0 ,R/w=0, 0000_001X

功能：将地址计数器(AC)设为00H，

DDRAM内容保持不变，光标移至左上脚

Return Home

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

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 do not change.

3、进入模式设置指令（Entry Mode Set）

功能：设定每次定入1位数据后光标移位方向并且设定次写入一个字符是否移动。

I/D = 0 光标左移，DDRAM地址自增1 I/D = 1 光标右移，DDRAM地址自增1 （当从CGRAM中读取或写入数据时，CGRAM操作与DDRAM相同）

SH = 0 且 DDRAM是读操作（CGRAM读或写），整个屏幕不移动

SH = 1 且 DDRAM是写操作，整个屏幕移动，移动方向由I/D决定

Entry Mode Set

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

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 reading from or writing to CGRAM.

SH: Shift of entire display

When DDRAM read (CGRAM read/write) operation or SH=”Low”, shifting of entire display is not performed. If SH=High, and DDRAM write operation, shift of entire display is performed according to I/D value(I/D=High, shift left, I/D=Low, shift right).

4、显示开关控制（Display ON/OFF Control）

功能：D = 1，显示功能开 D = 0，显示功能关，但是DDRAM中的数据依然保留

C = 1，有光标 C = 0，没有光标

B = 1，光标闪烁 B = 0，光标不闪烁

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

D: Display ON/OFF control bit
When D=High, entire display is turned on.
When D=Low, display is turned off, but display data remains 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 preserves its data.
B: Cursor Blink ON/OFF control bit
When B=High, cursor blink is on ,which performs alternately between all the high data and display characters at the cursor position. When B=Low, Blink is off.

5、设置显示屏或光标移动方向的指令

功能：整屏的移动或光标移动

S/C =0 R/L =0 光标左移， 地址计数器减1（即显示内容和光标一起左移）

S/C =0 R/L =1 光标右移， 地址计数器加1（即显示内容和光标一起右移）

S/C =1 R/L =0 显示内容左移， 光标不移动

S/C =1 R/L =1 显示内容右移， 光标不移动

Cursor or Display Shift

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	1	S/C	R/L	-	-

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

S/C	R/L	Operation
0	0	Shift cursor to the left, AC is decreased by 1
0	1	Shift cursor to the right, AC 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

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6、功能设定指令

功能：设定数据总线位数、显示的行数及字形。

DL=1 ,数据总线是8位 DL=0 ,数据总线是4位

N =0 ,显示一行 N=1 ,显示两行

F =0 , 5*8 点阵/字符 F=1 ,5*11点阵/字符

Function set

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

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. When 4-bit bus mode, it needs to transfer 4-bit data twice.
N: Display line number control bit
When N=Low, 1-line display mode is set.

When N=High,2-line display mode is set.
F: Display font type control bit
When F=Low, 5X8 dots format display mode is set .
When F=High, 5X11 dots format display mode.

7、设定 CGRAM地址指令

功能：设定下一个要存入数据的CGRAM地址

DB5DB4DB3为字符号，即将显示该字符用到的字符地址

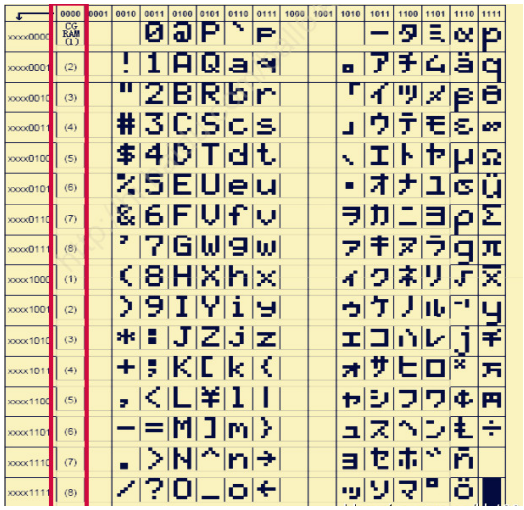
DB2DB1DB0为行号

Set CGRAM Address

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

Set CGRAM address to AC. This instruction makes CGRAM data available from MPU.

补充理解：在芯片中内置了192个常用字符的字模，存于CGROM（character generate ROM）中，还有8个允许用户自定义字符（也就是可以显示八个中文字）的RAM，也就是CGRAM。具体描述为下图：



当输入的地址是41H时，显示字符A.

由上图可知：

我想将自定义的一个汉子或图形放在第六个CGRAM中，所以可以确定字符码就为101（字符码000-->111），

所以 DB5DB4DB3 = 101

因此CGRAM的地址设置为01101X'X'X

这是要输入字符5的过程（原理如下图所示）

01101000 0x07

01101001 0x10

.....

01101111 0x00

Relationship between Character Code and CGRAM

Character code	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	x x x 0 1 1 1 0	Pattern1
	0 0 1	x x x 1 0 0 0 0	
	0 1 0	x x x 1 0 0 0 0	
	0 1 1	x x x 0 1 1 1 0	
	1 0 0	x x x 0 0 0 0 1	
	1 0 1	x x x 0 0 0 0 1	
	1 1 0	x x x 0 1 1 1 0	
	1 1 1	x x x 0 0 0 0 0	
0 0 0 0 x 1 1 1	0 0 0 0	x x x 0 1 1 1 0	Pattern8
	0 0 1	x x x 1 0 0 0 1	
	0 1 0	x x x 1 0 0 0 1	
	0 1 1	x x x 1 1 1 1 1	
	1 0 0	x x x 1 0 0 0 1	
	1 0 1	x x x 1 0 0 0 1	
	1 1 0	x x x 1 0 0 0 1	
	1 1 1	x x x 0 0 0 0 0	

字符码 *正确定DDRAM的地址后输入00H，就可以显示5

对应相同

8、设置DDRAM地址

Set DDRAM Address

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
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=Low),DDRAM address is from "00H" to "4FH"In 2-line display mode(N=High), DDRAM address in the1st line is from "00H" to "27H" and DDRAM address in the 2nd line is from "40H" to "67H".

DDRAM的地址与显示屏对照关系（N=LOW）

10. Reflector of Screen and Display RAM

Display position	1-1	1-2	1-3	1-4	1-5	1-6	1-7	1-8	1-9	1-10
DDRAM address	00	01	02	03	04	05	06	07	08	09
Display position	1-11	1-12	1-13	1-14	1-15	1-16				
DDRAM address	0A	0B	0C	0D	0E	0F				
Display position	2-1	2-2	2-3	2-4	2-5	2-6	2-7	2-8	2-9	2-10
DDRAM address	40	41	42	43	44	45	46	47	48	49
Display position	2-11	2-12	2-13	2-14	2-15	2-16				
DDRAM address	4A	4B	4C	4D	4E	4F				

-1 means first character of line 1 on screen

9、读取忙信号或AC地址指令

如果BF=1 忙碌，无法接收数据或指令

BF=0可以接收数据、指令

读取地址计数器的内容

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 IC is in internal operation or not. If BF is high internal operation is in progress and should wait until BF is to be Low, which by then the next instruction can be performed. In this instruction you can also read the value lf the address counter.

10、向DDRAM或CGRAM写入数据

写指令 输 入： RS=L， RW=L， E= 下 降沿脉冲， DB0 ~ DB7= 指令 码

写数据 输 入： RS=H， RW=L， E= 下 降沿脉冲， DB0 ~ DB7= 数据

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, 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 the entry mode.

11、从DDRAM或者CGRAM读数据

读状态 输 入： RS=L， RW=H， E=H 输出： DB0 ~ DB7= 状态字

读数据 输 入： RS=H， RW=H， E=H 输出： DB0 ~ DB7= 数据

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 the address set instruction of RAM is not performed before this instruction, the data that has been read first is invalid, as the direction of AC is not yet determined. If RAM data is read several times without RAM address instructions set before read operation, the correct RAM data can be obtained from the second. But the first data would be incorrect, as 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 transfers 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.