1.- Port Connectivity and Functions

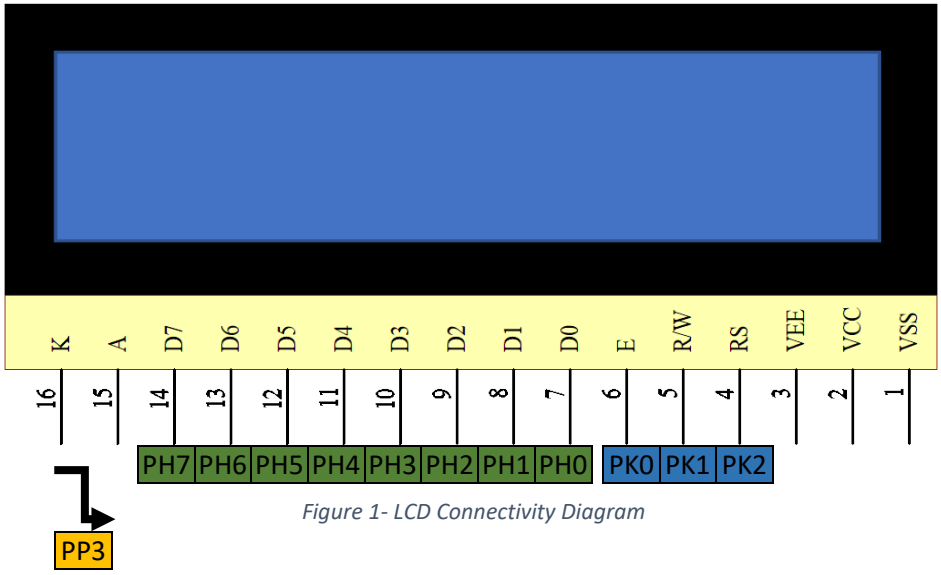

Figure 1- LCD Connectivity Diagram

MCU PIN	SIGNAL	FUNCTION
PK2	RS	0: Instruction Register (for write) Busy flag, addr. counter (for read) 1: Data Register (for write and read)
PK1	$R/\overline{W}$	Read or Write
PK0	E	Enable, latch data: pull HIGH, then LOW
PH7..PH0	DATA/COMMAND	DB7..DB0

Table 1- Port Connectivity

HD44780U

Pin Functions

Signal	No. of Lines	I/O	Device Interfaced with	Function
RS	1	I	MPU	Selects registers. 0: Instruction register (for write) Busy flag: address counter (for read) 1: Data register (for write and read)
R/$\overline{W}$	1	I	MPU	Selects read or write. 0: Write 1: Read
E	1	I	MPU	Starts data read/write.
DB4 to DB7	4	I/O	MPU	Four high order bidirectional tristate data bus pins. Used for data transfer and receive between the MPU and the HD44780U. DB7 can be used as a busy flag.
DB0 to DB3	4	I/O	MPU	Four low order bidirectional tristate data bus pins. Used for data transfer and receive between the MPU and the HD44780U. These pins are not used during 4-bit operation.

Table 2 -Pin Functions. See datasheet, page 8

Table 1 Register Selection

RS	R/$\overline{W}$	Operation
0	0	IR write as an internal operation (display clear, etc.)
0	1	Read busy flag (DB7) and address counter (DB0 to DB6)
1	0	DR write as an internal operation (DR to DDRAM or CGRAM)
1	1	DR read as an internal operation (DDRAM or CGRAM to DR)

Table 3- Register Selection. See datasheet, page 9

2.- Instructions

Look at pages 24 -27 of the datasheet.

HD44780U

		RS	R/$\overline{W}$	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	
Clear display	Code	0	0	0	0	0	0	0	0	0	1	
Return home	Code	0	0	0	0	0	0	0	0	1	*	Note: * Don't care.
Entry mode set	Code	0	0	0	0	0	0	0	1	I/D	S	
Display on/off control	Code	0	0	0	0	0	0	1	D	C	B	
Cursor or display shift	Code	0	0	0	0	0	1	S/C	R/L	*	*	Note: * Don't care.
Function set	Code	0	0	0	0	1	DL	N	F	*	*	
Set CGRAM address	Code	0	0	0	1	A	A	A	A	A	A	

Higher order bit ← → Lower order bit

Figure 11 Instruction (1)

Table 4- Instructions Part 1. See datasheet, page 28

DL: Sets the interface data length. Data is sent or received in 8-bit lengths (DB7 to DB0) when DL is 1, and in 4-bit lengths (DB7 to DB4) when DL is 0. When 4-bit length is selected, data must be sent or received twice.

Table 7 Shift Function

S/C	R/L	
0	0	Shifts the cursor position to the left. (AC is decremented by one.)
0	1	Shifts the cursor position to the right. (AC is incremented by one.)
1	0	Shifts the entire display to the left. The cursor follows the display shift.
1	1	Shifts the entire display to the right. The cursor follows the display shift.

Table 8 Function Set

N	F	No. of Display Lines	Character Font	Duty Factor	Remarks
0	0	1	5 × 8 dots	1/8	
0	1	1	5 × 10 dots	1/11	
1	*	2	5 × 8 dots	1/16	Cannot display two lines for 5 × 10 dot character font

Note: * Indicates don't care.

Table 5 - Function codes. See datasheet, page 29

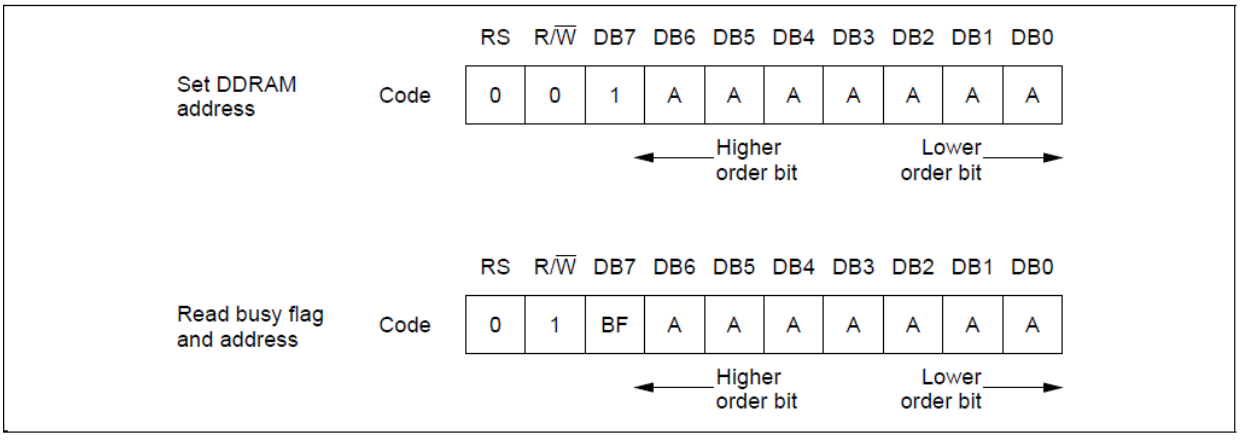

Figure 13 Instruction (2)

Table 5- Instructions Part 2. See datasheet, page 30

The addresses for the various character locations are as follows:

Line on screen	Address (decimal)	Address (hexadecimal)
First	0 to 19	$00 to $13
Second	64 to 83	$40 to $53
Third	20 to 39	$14 to $27
Fourth	84 to 103	$54 to $67

Table 6 -Addressing on 4 line displa. See course notes, page 78

3.- Initialization sequence

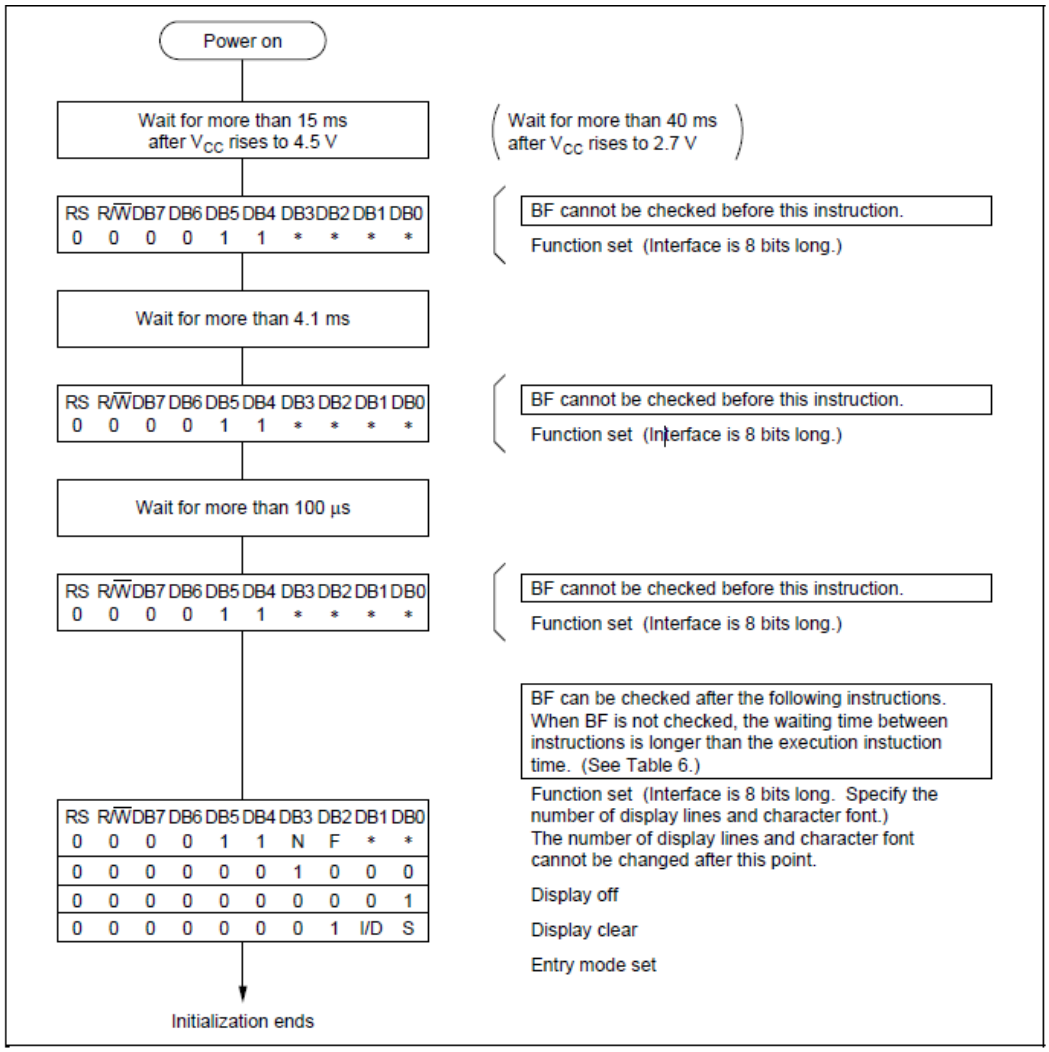

Figure 23 8-Bit Interface

Table 7- Initialization. See datasheet, page 45

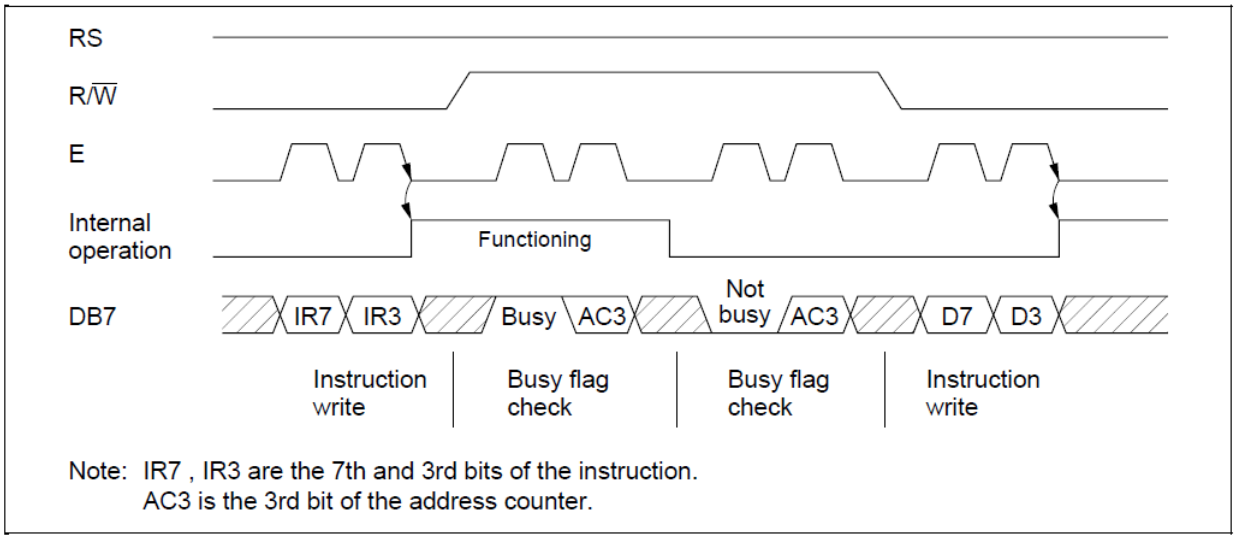

Figure 17 Example of 4-Bit Data Transfer Timing Sequence