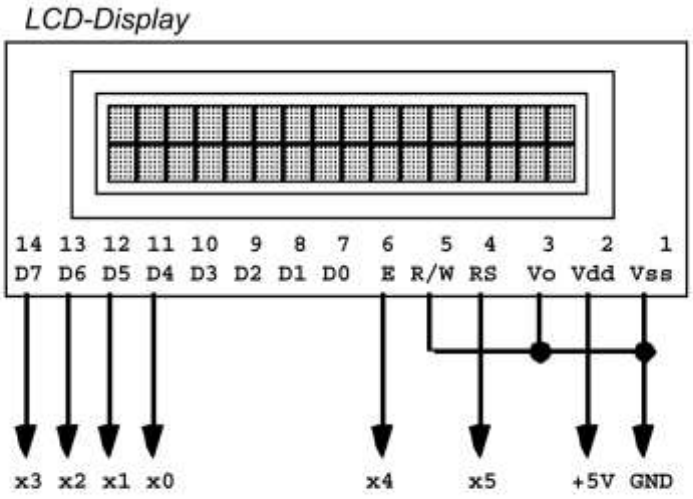
1DT301, Computer Technology I, autumn 2019.
Lab. 5: Display JHD202

Goal for this lab:
To read and understand the data sheet for the display unit JHD202, write a program that initiate the display and displays text that is coming from the serial port.

Presentation of results:

Present each task for the teacher when you have solved the task.
Use text in the program (comments) to explain the function. Each program should also have a head like the example in previous labs.



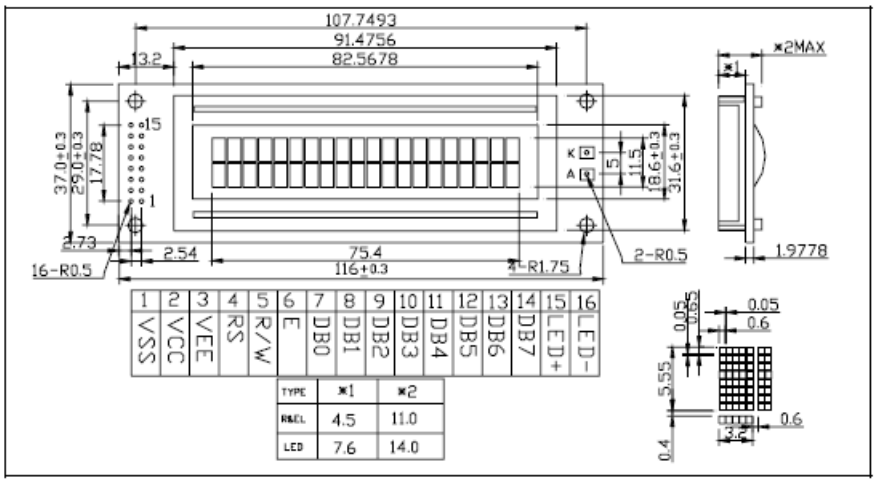
Figur 8.1: LCD-displayen och dess anslutning mot datorkortet

Task 1: Write a program that displays a character on the display.
Write a program in Assembly that displays the character %. Look in the data sheet how to initiate the display. The data sheet you'll find on https://www.student.vxu.se/.
The display will be connected as in the figure above. 4-bit-mode should be used, since only RS, E, D7, D6, D5 and D4 are connected to I/O-pins on the STK600.
(The program *lab5_init_display.asm* gives you a good start…)

Task 2: Electronic bingo machine.
You should create an electronic bingo generator. The generator should create random numbers between 1 and 75. The numbers should be displayed on the display. Clear the display before a new value is displayed. Use interrupt and a pushbutton for the input.

Task 3: Serial communication and display.
Use program modules from lab 4 and write a program that receives a character on the serial port and displays each character on the display.

Task 4: Modify the program in task 3.
Modify the program in task 3 so that 4 lines of text can be displayed. Each textline should be displayed during 5 seconds, after that the text on line 1 should be moved to line 2 and so on. The text should be entered from the terminal program, PUTTY, via the serial port.



PIN CONFIGURATION

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
VSS	VCC	VEE	RS	R/W	E	DB0	DB1	DB2	DB3	DB4	DB5	DB6	DB7	LED+	LED-

AC Characteristics Read Mode Timing Diagram

Table 12. AC Characteristics (V_{DD} = 4.5V ~ 5.5V, Ta = -30 ~ +85°C)

Mode	Characteristic	Symbol	Min.	Typ.	Max.	Unit
Write Mode (Refer to Fig-6)	E Cycle Time	tc	500	-	-	ns
	E Rise / Fall Time	t_R,t_F	-	-	20	
	E Pulse Width (High, Low)	tw	230	-	-	
	R/W and RS Setup Time	tsu1	40	-	-	
	R/W and RS Hold Time	t_{H1}	10	-	-	
	Data Setup Time	tsu2	80	-	-	
	Data Hold Time	t_{H2}	10	-	-	
Read Mode (Refer to Fig-7)	E Cycle Time	tc	500	-	-	ns
	E Rise / Fall Time	t_R,t_F	-	-	20	
	E Pulse Width (High, Low)	tw	230	-	-	
	R/W and RS Setup Time	tsu	40	-	-	
	R/W and RS Hold Time	t_H	10	-	-	
	Data Output Delay Time	t_D	-	-	120	
	Data Hold Time	t_{DH}	5	-	-	

Table 13. AC Characteristics (V_{DD} =2.7V ~ 4.5V, Ta = -30 ~ +85°C)

Mode	Characteristic	Symbol	Min.	Typ.	Max.	Unit
Write Mode (Refer to Fig-6)	E Cycle Time	tc	1000	-	-	ns
	E Rise / Fall Time	$t_R$$t_F$	-	-	25	
	E Pulse Width (High, Low)	tw	450	-	-	
	R/W and RS Setup Time	tsu1	60	-	-	
	R/W and RS Hold Time	t_{H1}	20	-	-	
	Data Setup Time	tsu2	195	-	-	
	Data Hold Time	t_{H2}	10	-	-	
Read Mode (Refer to Fig-7)	E Cycle Time	tc	1000	-	-	ns
	E Rise / Fall Time	t_R,t_F	-	-	25	
	E Pulse Width (High, Low)	tw	450	-	-	
	R/W and RS Setup Time	tsu	60	-	-	
	R/W and RS Hold Time	t_H	20	-	-	
	Data Output Delay Time	t_D	-	-	360	
	Data Hold Time	t_{DH}	5	-	-	