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Homework 7

(Answer in this sheet)

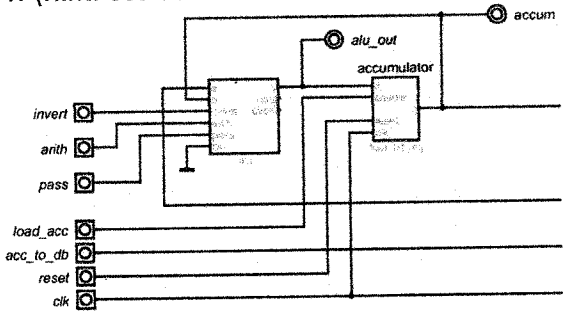
1 **[10 pts]** How do you have to set up the control signals to transfer a numeric value from the main memory (RAM) to the Accumulator register on the Brainless Microprocessor?

Control Signal	Value
Use PC	1
Load MAR	0
Arith	0
Invert	1
pass	1
Load ACC	1
ACC to Data Bus	0
Read	1
Write	0
Load IR	0

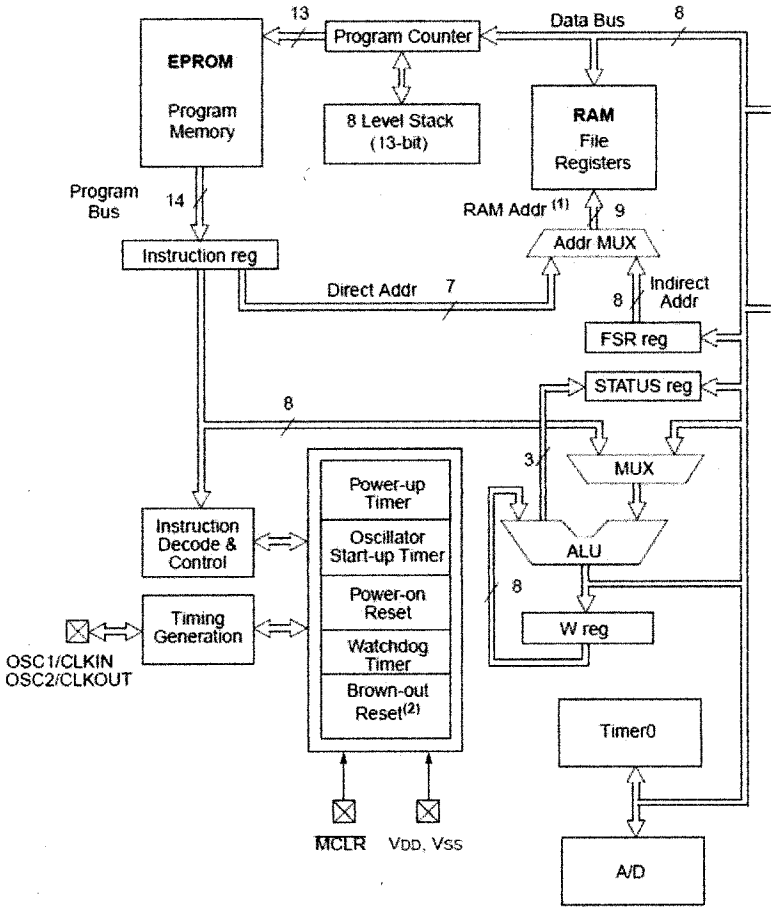
2 **[10 pts]** How do you have to set up the control lines to ADD a numeric value from the main memory (RAM) to the value held in the Accumulator register on the Brainless Microprocessor?

Control Signal	Value
Use PC	1
Load MAR	0
Arith	1
Invert	1
pass	0
Load ACC	0
ACC to Data Bus	1
Read	1
Write	0
Load IR	0

3 **[10 pts]** Use the following circuit to build a similar ALU-Accumulator circuit but with 8 bits word size instead of 4? (Hint: Use two of these circuits. Show the needed connections, the input data bits and the output data bits)



4 **[Extra credit: 5 pts]** Is the following Microchip PIC CPU based on Harvard or Princeton architecture?



The Microchip is Harvard.

5 **[10 pts]** Design an instruction that subtracts an operand held in the main memory from a value stored in the accumulator register.

	Instruction	Subtract			
	Opcode	3			
	Present State	0	1	2	3
Description	Pin number				
Next_step[1:0]	13:12				
-	11:10				
Use_pc	9				
Load_mar	8				
arith	7				
invert	6				
pass	5				
load_acc	4				
acc_to__db	3				
read	2				
write	1				
load_ir	0				
	HEX Equivalent				

6 **[10 pts]** Design an instruction that zeros the content of the accumulator register.

	Instruction	Subtract			
	Opcode	3			
	Present State	0	1	2	3
Description	Pin number				
Next_step[1:0]	13:12				
-	11:10				
Use_pc	9				
Load_mar	8				
arith	7				
invert	6				
pass	5				
load_acc	4				
acc_to__db	3				
read	2				
write	1				
load_ir	0				
	HEX Equivalent				

7 **[Extra credit: 10 pts]** Write a program that subtracts 5 from 3. Show how the program will be stored in memory. What result do you expect to see on a hex display?

Address **Contents** **Comment**

Address	Contents		comments
1000	MVI	C,00	[C] ← 00, MVI instructions is of 2 size
1002	MVI	A,5	[A] ← [H]
1004	MVI	L,3	L will contain 3
1006	SUB	L	[A] ← [A] - [L]
1007	JNC	200B	Jump if there is no borrow
100A	INR	C	C will be incremented by 1
100B	STA	2502	[A] → [2502], Result
100E	MOV	A,C	[A] ← [C]
1010	STA	2503	[A] → [2503], Borrow
1013	HLT		Stop final step