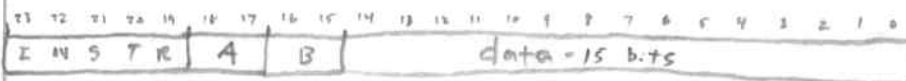


Instruction Architecture

- 15-bit addresses
- 16-bit data, 4 registers
- 24-bit instructions
- Instruction format:
- CLK ↓ new instruction
- CLK ↑ commit changes
- 74HC series preferred
- CLK low out of RST

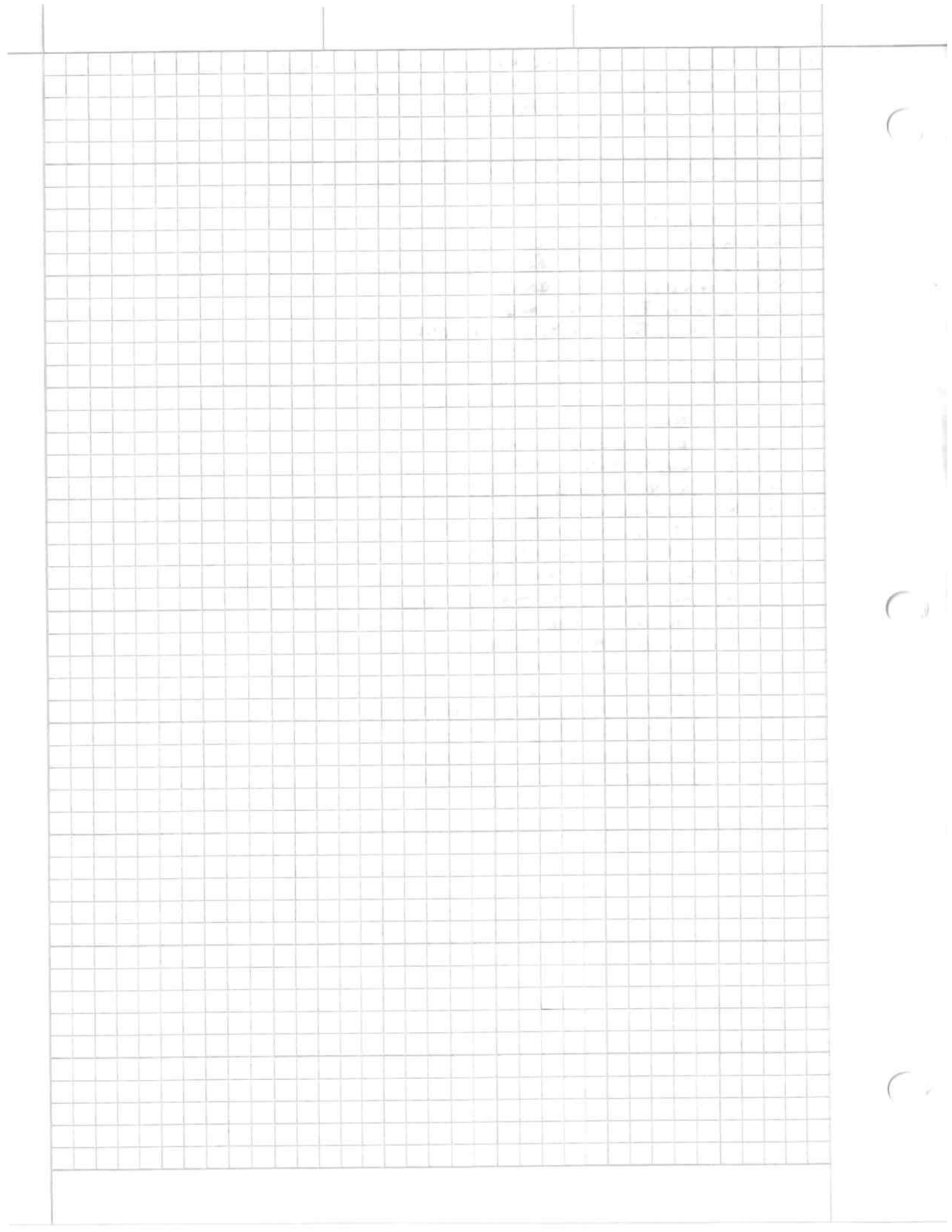


- 64-pin backplane

0-15	A data	58	CLK
16-31	B data	59	RST
32-55	Instruction	60	INT0
56	A write/read	61	INT1
57	B write/read	62	+3.3V
		63	GND

- Instructions

00	0 0 0 0 0	NOP
01	0 0 0 0 1	LD RAM@[data] into A
02	0 0 0 1 0	LDR RAM@[B] into A
03	0 0 0 1 1	MOV A into B
04	0 0 1 0 0	MOVD data into B
05	0 0 1 0 1	ST data into RAM[B]
06	0 0 1 1 0	STR A into RAM[B]
07	0 0 1 1 1	STD A into RAM@[data]
08	0 1 0 0 0	ALU instr A (op) B → A OP = data
09	0 1 0 0 1	SR shift A right one bit
0A	0 1 0 1 0	SL shift A left one bit
0B	0 1 0 1 1	JMP jump to [data]
0C	0 1 1 0 0	JMPR jump to [A]
0D	0 1 1 0 1	JMPZ jump to [data] if B=0
0E	0 1 1 1 0	JMPRZ jump to [A] if B=0
0F	0 1 1 1 1	JMPNZ jump to [data] if B≠0
10	1 0 0 0 0	JMPRNZ jump to [A] if B≠0
11	1 0 0 0 1	
12	1 0 0 1 0	
13	1 0 0 1 1	
14	1 0 1 0 0	
15	1 0 1 0 1	
16	1 0 1 1 0	
17	1 0 1 1 1	
18	1 1 0 0 0	
19	1 1 0 0 1	
1A	1 1 0 1 0	
1B	1 1 0 1 1	
1C	1 1 1 0 0	
1D	1 1 1 0 1	
1E	1 1 1 1 0	
1F	1 1 1 1 1	



Instruction Architecture

- addresses 15-bit (13 bits in-instruction)
- registers 16-bits wide, qty 4
- instructions 24-bits wide

- CLK ↓ : new instruction
- CLK ↑ : comm. changes

Load/Store instructions (module 00)

23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	INSTR					A	B	data - 13 bits														

0	0	0	0	0	0	0	NOP																		
0	0	0	x	0	1	1	LD RAM@[data] → A																		
0	0	1	x	0	1	1	LDR RAM@[B] → A																		
0	0	0	1	1	0	0	ST data → RAM[data]																		
0	0	1	1	1	0	0	STR A → RAM[B]																		
0	0	1	0	1	0	0	STD data → RAM[B]																		

PUKE data → A?
(15 bits)

Arithmetic and Logic (module 01)

23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	1	INSTR				A	B	C	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

all instructions map to the DM74LS181 in active-high mode, for inputs:

23 22 21 20 19 18 17
0 1 m S₀ S₁ S₂ S₃ A (op) B → C

Shift and Jump (module 10)

23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	0	INSTR				A	B	data-13 bits															

1 0 0 1 0 1 1 ← JMP, have 15 data bits
MOV copy A → B

1 0 0 0 0 1 1 SR shift reg. A right one bit, store in B

1 0 1 0 0 0 0 JMP Jump to [data]

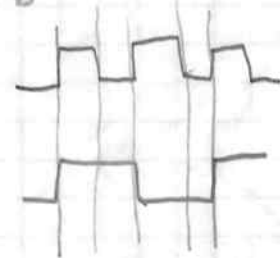
1 0 1 1 0 0 0 JMPR Jump to [A]

1 0 1 0 1 1 0 JMPZ Jump to [data] if B=0

1 0 1 1 1 1 0 JMPRZ Jump to [A] if B=0

1 0 1 0 1 0 0 JMPNZ Jump to [data] if B≠0

1 0 1 1 1 0 0 JMPRNZ Jump to [A] if B≠0



Input/Output (module 11)

22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	I N S T R				A	B															

1 1 : KEY read pending scan code from keyboard, store in A

1 1 : PRINT print char in B to position in A

1 1 : GR0 blank pixel at [A]

1 1 : GR1 set pixel at [A]



1. The first part of the problem is to find the area of the region bounded by the curve $y = \sin x$ and the x-axis from $x = 0$ to $x = \pi$.

2. The second part is to find the area of the region bounded by the curve $y = \cos x$ and the x-axis from $x = \frac{\pi}{2}$ to $x = \frac{3\pi}{2}$.

3. The third part is to find the area of the region bounded by the curve $y = \tan x$ and the x-axis from $x = 0$ to $x = \frac{\pi}{2}$.

4. The fourth part is to find the area of the region bounded by the curve $y = \cot x$ and the x-axis from $x = \frac{\pi}{2}$ to $x = \pi$.

5. The fifth part is to find the area of the region bounded by the curve $y = \sec x$ and the x-axis from $x = 0$ to $x = \frac{\pi}{2}$.

6. The sixth part is to find the area of the region bounded by the curve $y = \csc x$ and the x-axis from $x = \frac{\pi}{2}$ to $x = \pi$.

7. The seventh part is to find the area of the region bounded by the curve $y = \sinh x$ and the x-axis from $x = 0$ to $x = 1$.

8. The eighth part is to find the area of the region bounded by the curve $y = \cosh x$ and the x-axis from $x = 0$ to $x = 1$.

9. The ninth part is to find the area of the region bounded by the curve $y = e^x$ and the x-axis from $x = 0$ to $x = 1$.

10. The tenth part is to find the area of the region bounded by the curve $y = \ln x$ and the x-axis from $x = 1$ to $x = e$.

11. The eleventh part is to find the area of the region bounded by the curve $y = x^2$ and the x-axis from $x = 0$ to $x = 1$.

12. The twelfth part is to find the area of the region bounded by the curve $y = x^3$ and the x-axis from $x = 0$ to $x = 1$.

13. The thirteenth part is to find the area of the region bounded by the curve $y = x^4$ and the x-axis from $x = 0$ to $x = 1$.

15 14 13 12 11 10 9 8 | 7 6 5 4 3 2 1 0 |

ADD
SUB
LOAD
STORE

A-data
B-data
C-data - ? → ALU?
instr
~~reg addr~~ ~~16~~

Power + reset + clock + bus probes

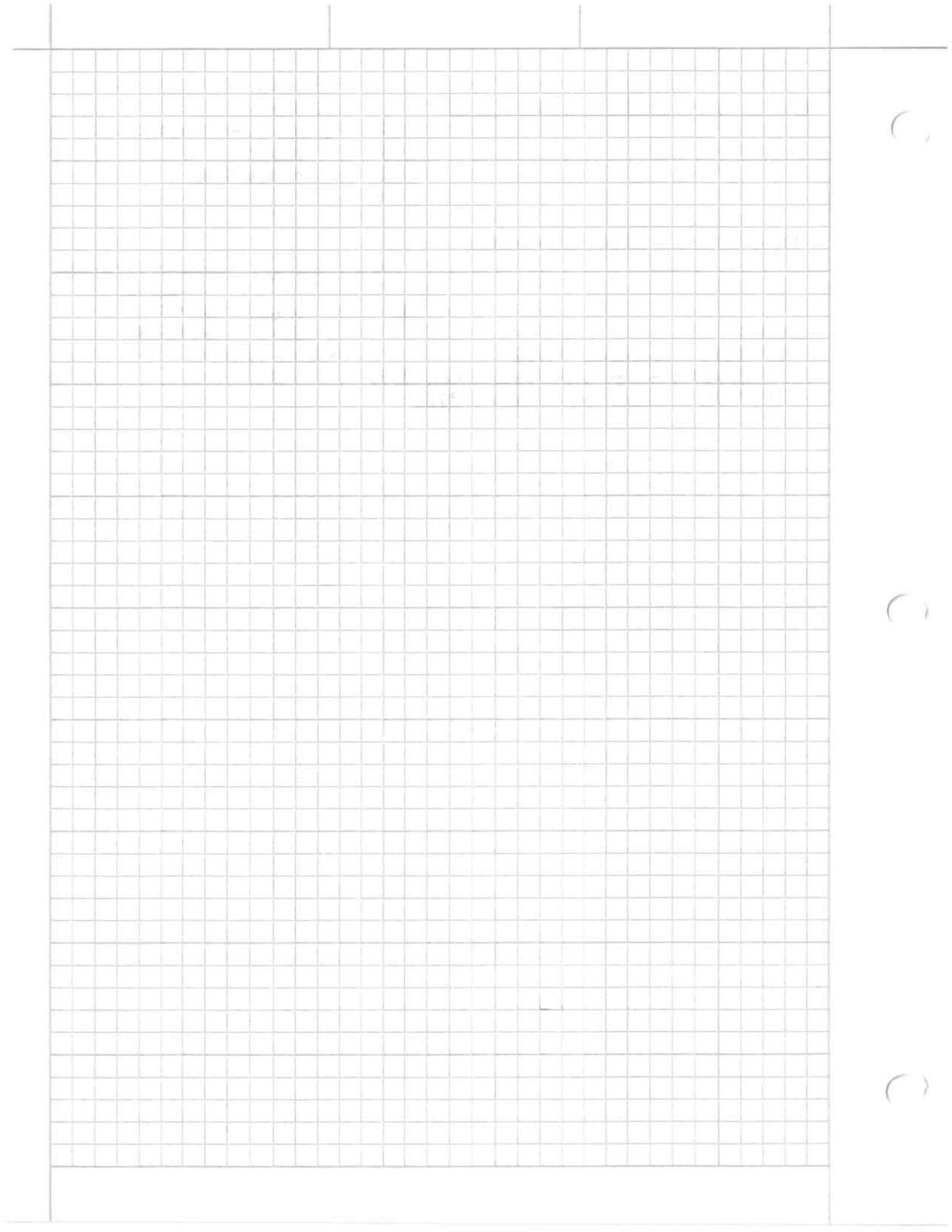
ALU: always answers into 00

Mouse:

854-8030 - Busboard 11ea
571-5536385-5 - right angle 64pin male 16ca
571-5650861-5 - vert 64pin female 17ea

12-bit
A bus - 8 + 2 + 1
B bus - 8 + 2 + 1
RST, AND, TV, CLK, - 4
control - 6

AMPAD



AMPAD™

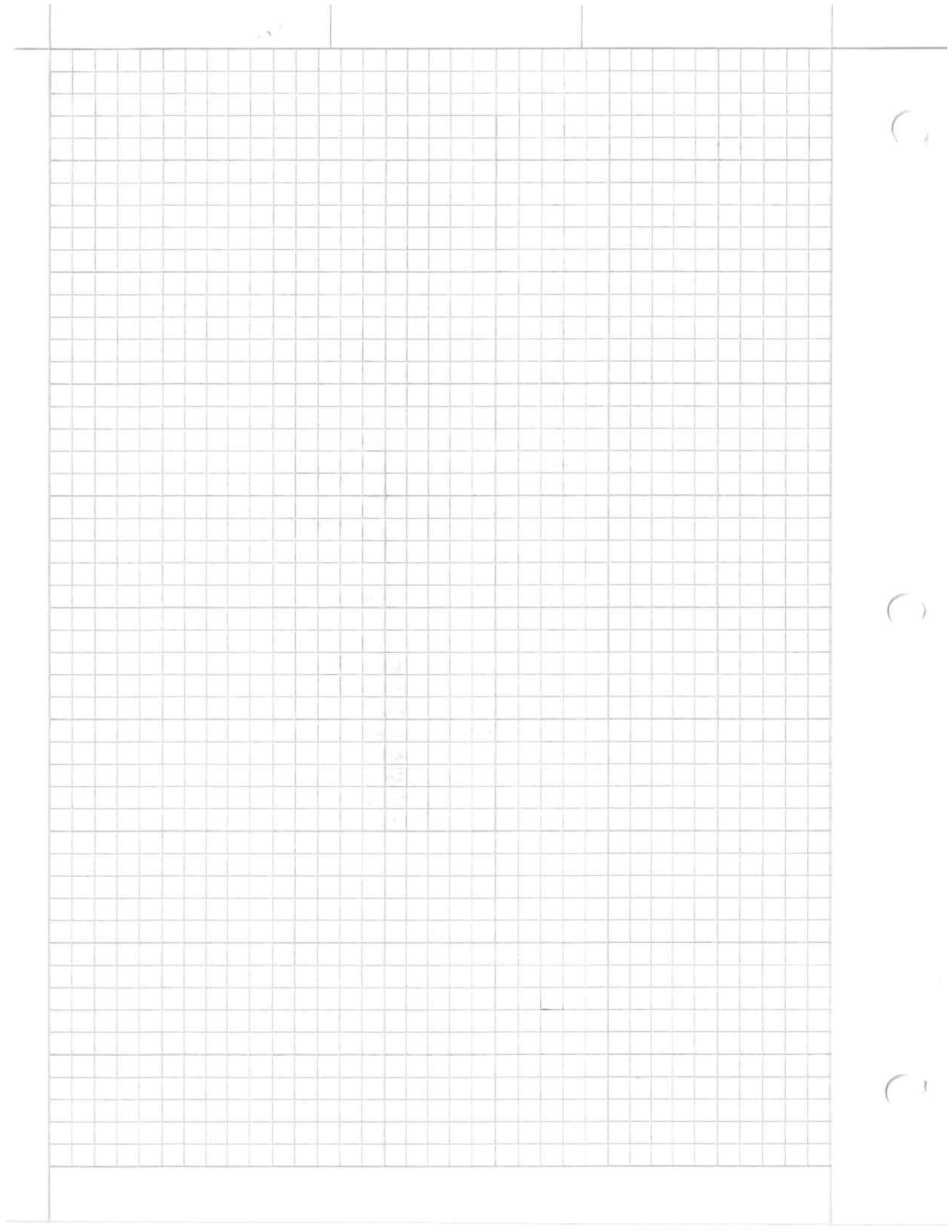
14.4 → 8.2

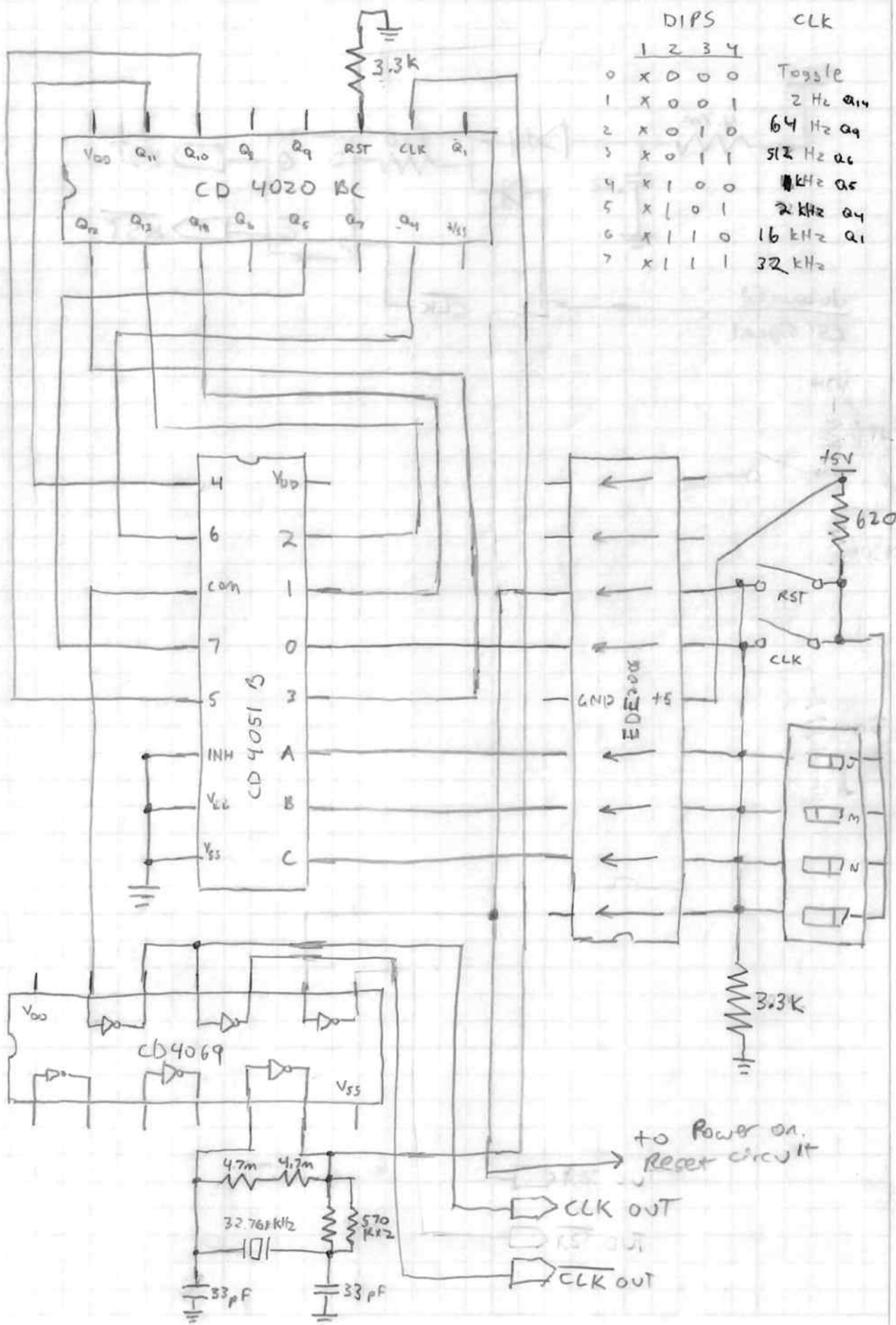
← Conn (male)

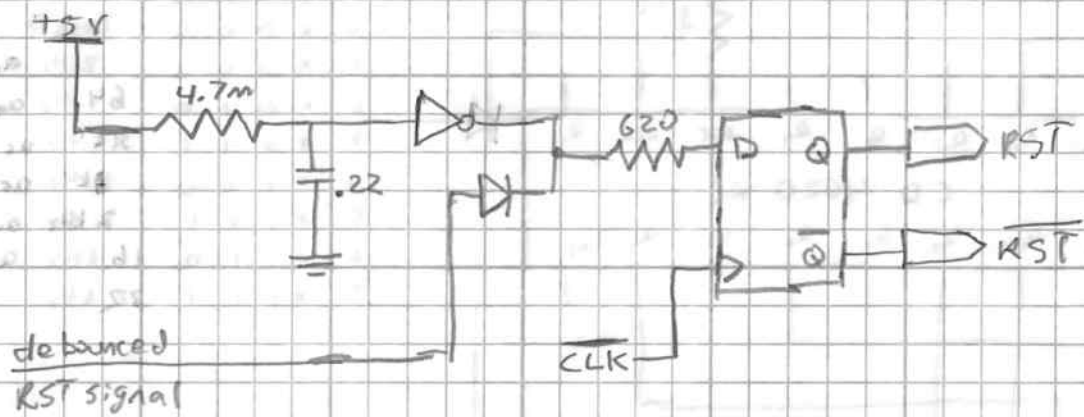
Thin Thick

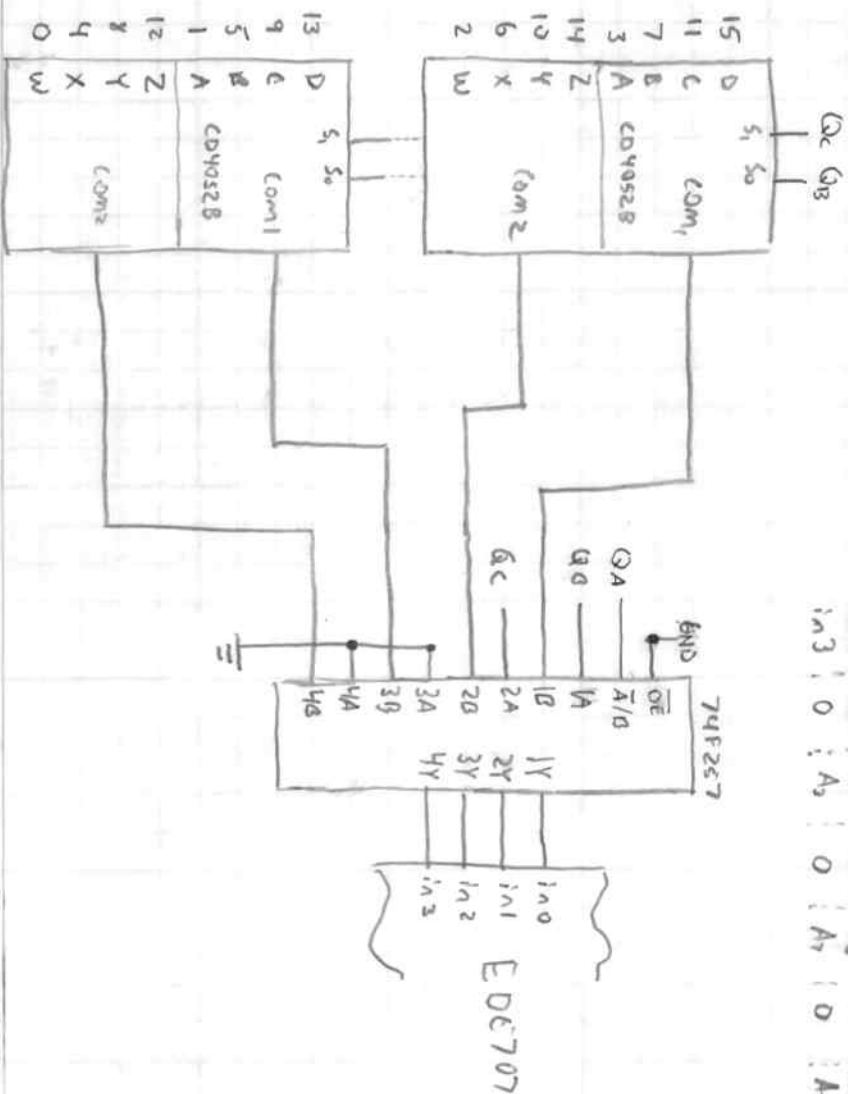
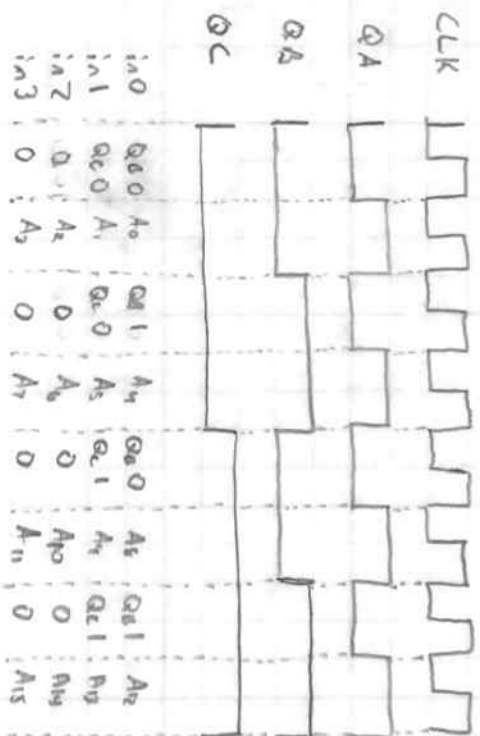
Conn (female) →

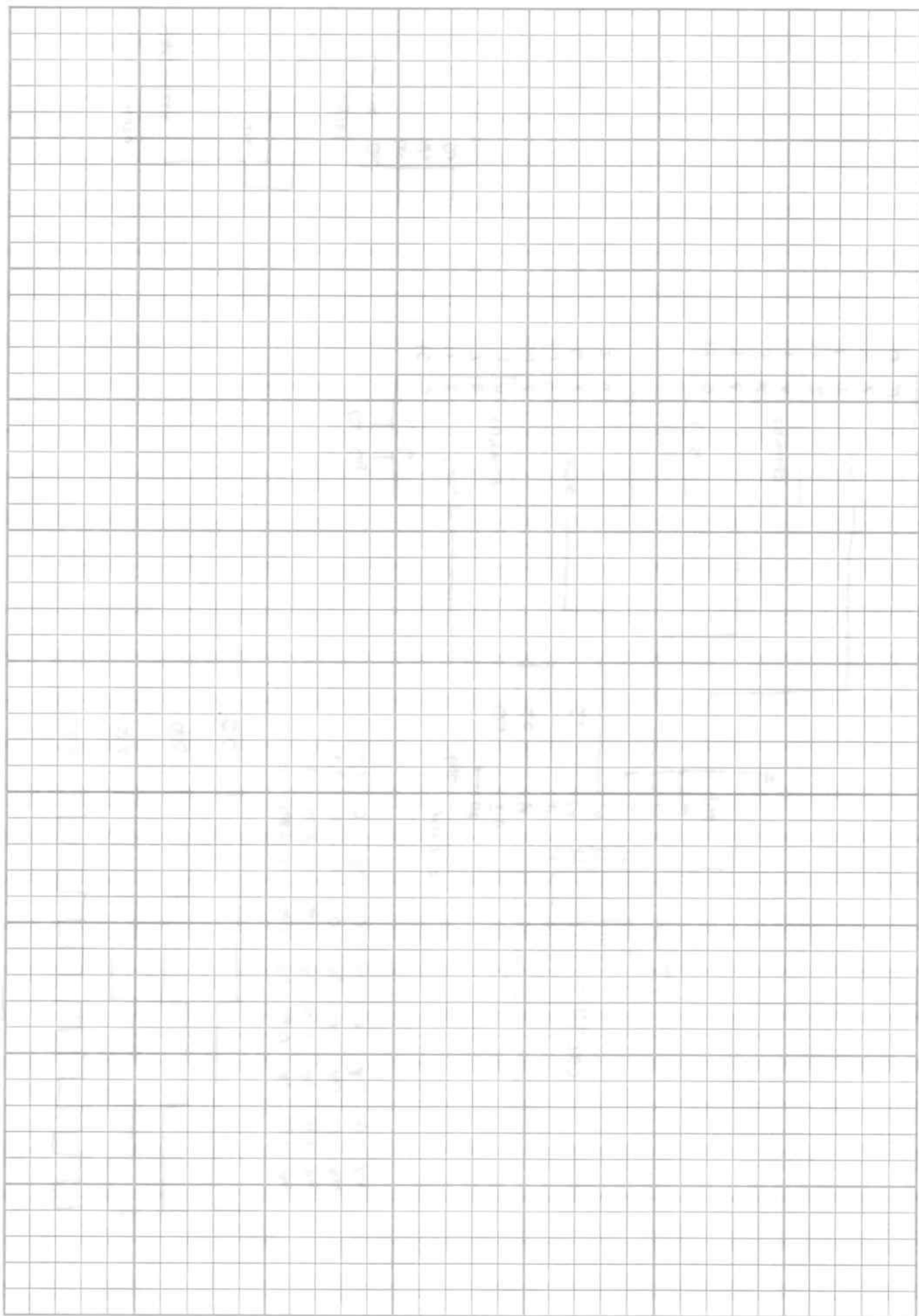
		1	2		
		3	4		
		5	6		
LSB 0	7	8	0	LSB	
1	9	10	1		
2	11	12	2		
3	13	14	3		
4	15	16	4		
5	17	18	5		
6	19	20	6		
7	21	22	7		
8	23	24	8		
9	25	26	9		
10	27	28	10		
11	29	30	11		
12	31	32	12		
13	33	34	13		
14	35	36	14	MSB	
MSB 15	37	38	15	LSB	
LSB 0	39	40	16	MSB	B select
1	41	42	17	LSB	
2	43	44	18	MSB	A select
3	45	46	19	LSB	
4	47	48	20		
5	49	50	21	OPCODE	
6	51	52	22		
7	53	54	23	MSB	
8	55	56		B read/write	
9	57	58		A read/write	
10	59	60		CLK	
11	61	62		CLK2	
12	63	64		RST	
13	65	66		INT	
14	67	68		+3.3V	
MSB 15	69	70		GND	
	71	72			
	73	74			
	75	76			











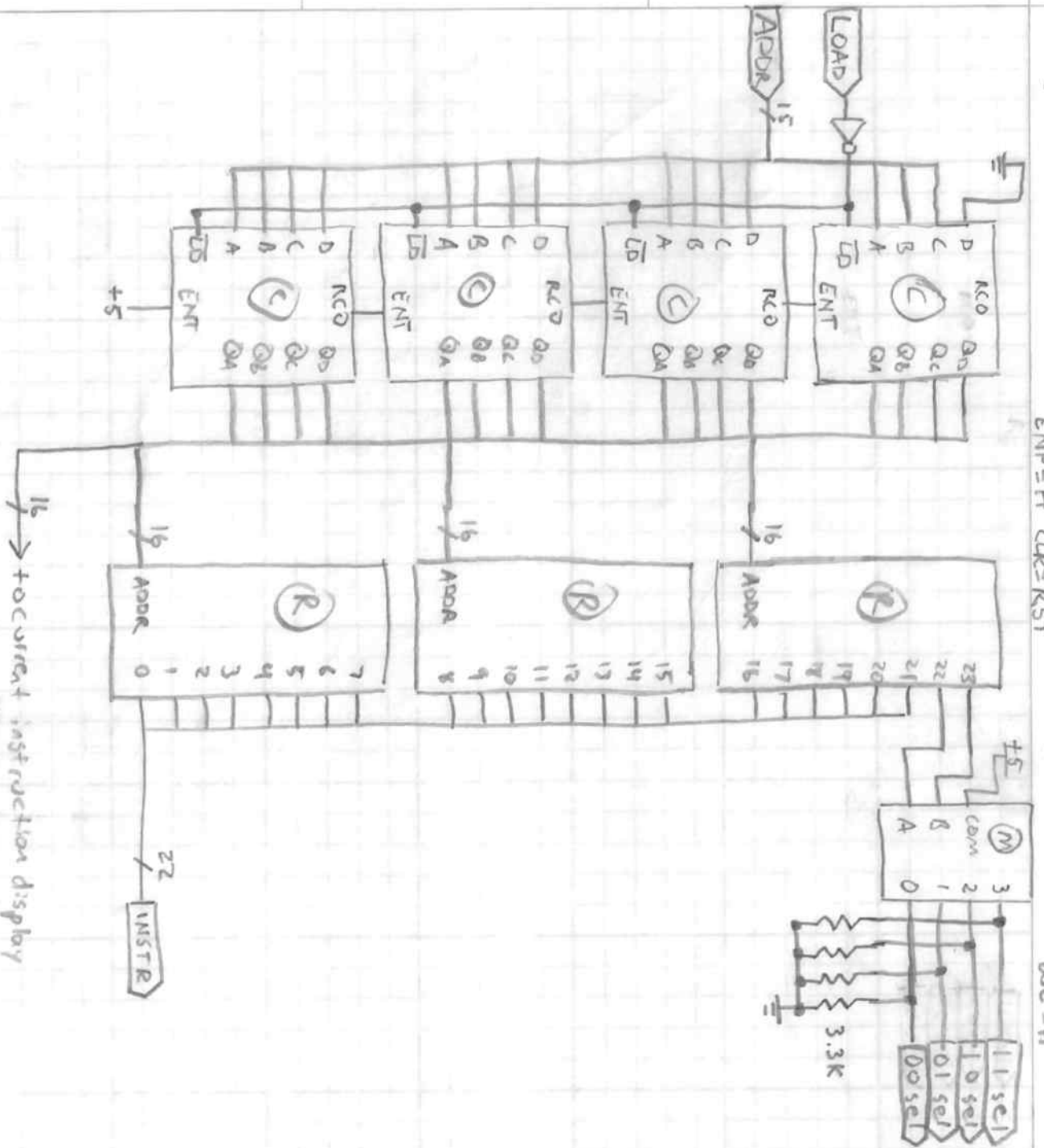
Program Counter

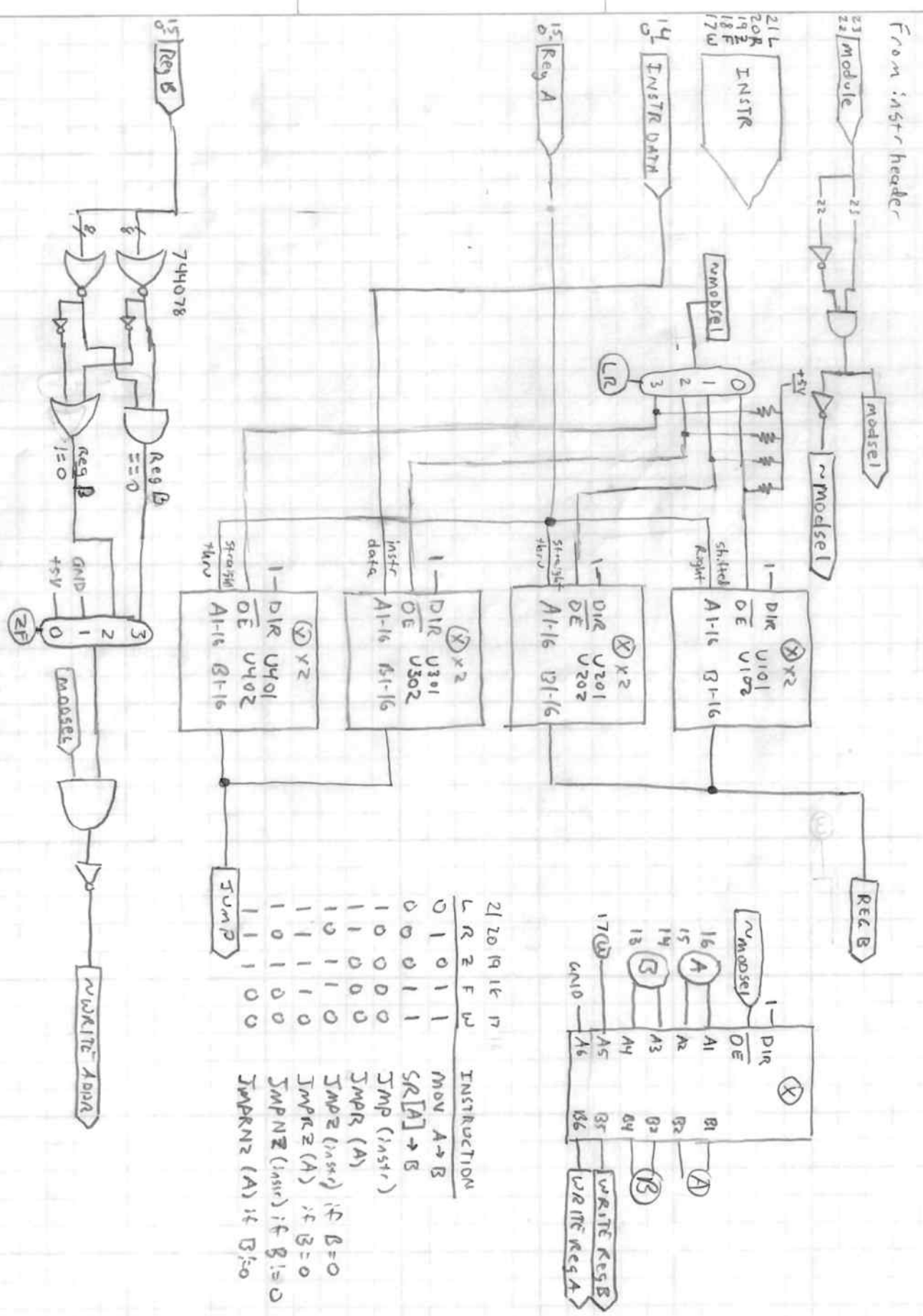
(C) SN74161 CLK=CLK
ENP=H CLR=RST

(R) AT28C256

$\overline{CE} = \overline{OE} = L$
 $\overline{WE} = H$

(M) CD4052B





10000

10000

10000

10000

10000

10000

10000

10000

10000

10000

10000

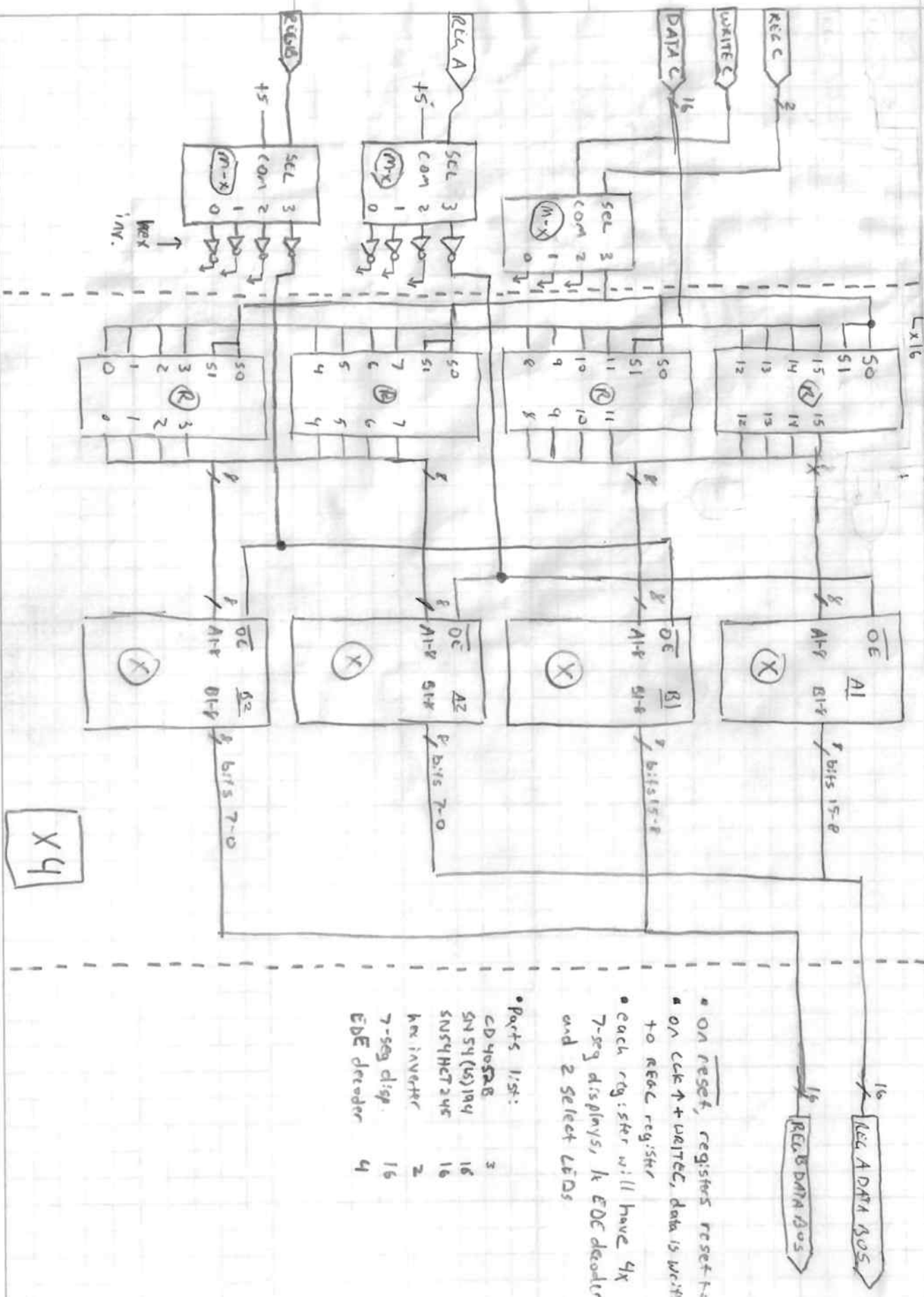
10000

10000

10000

Register File

- ① - CD4052B X3
- ② - SN54194 4-bit register
- ③ - SN54HCT245 8-bit receiver



- On reset, registers reset to zero
- On CLK + WRITE, data is written to read register
- Each register will have 4x 7-seg displays, 1 EDC decoder and 2 select LEDs

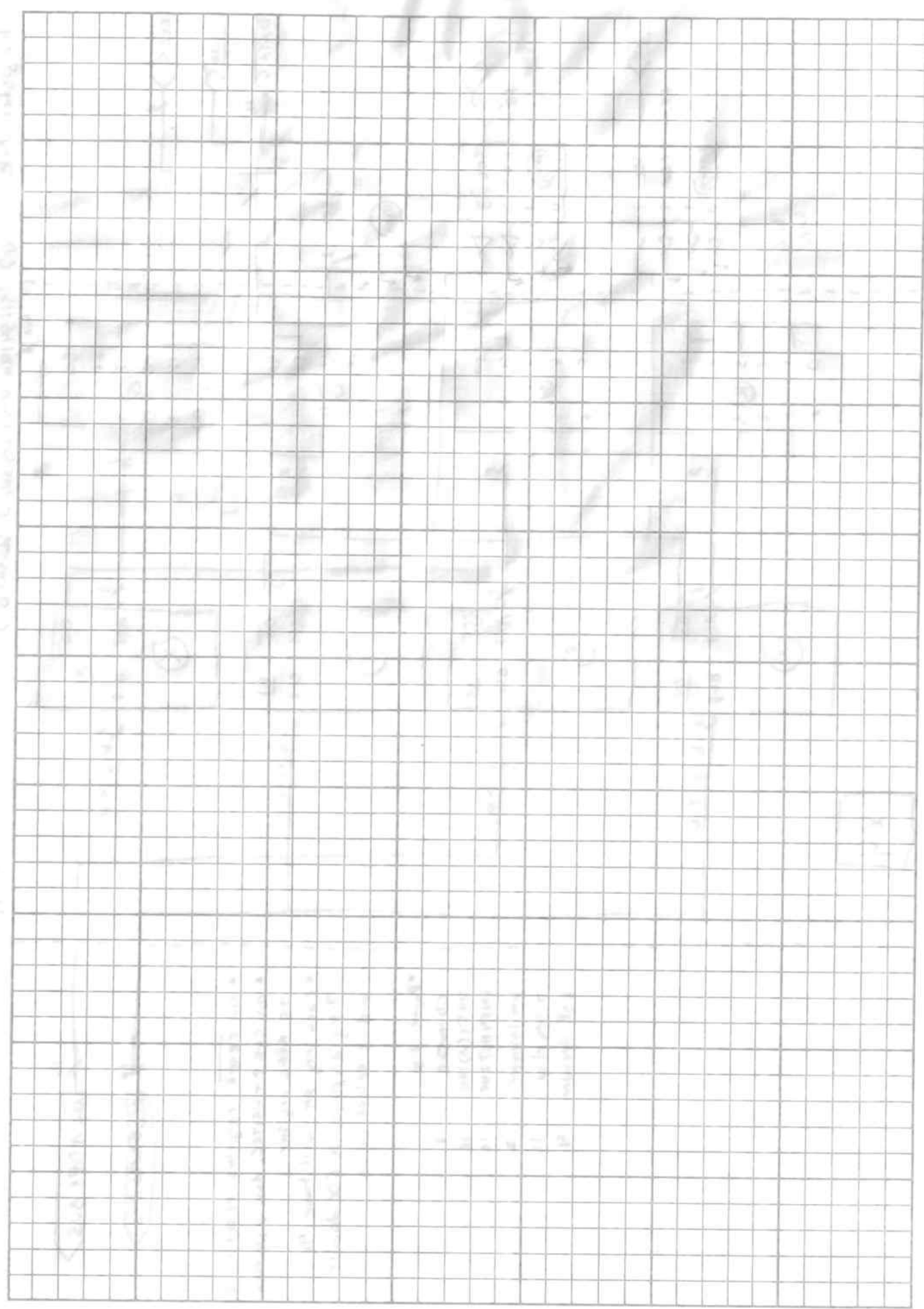
Parts list:

CD4052B	3
SN54194	16
SN54HCT245	16
hex inverter	2
7-seg disp.	16
EDC decoder	4

4x

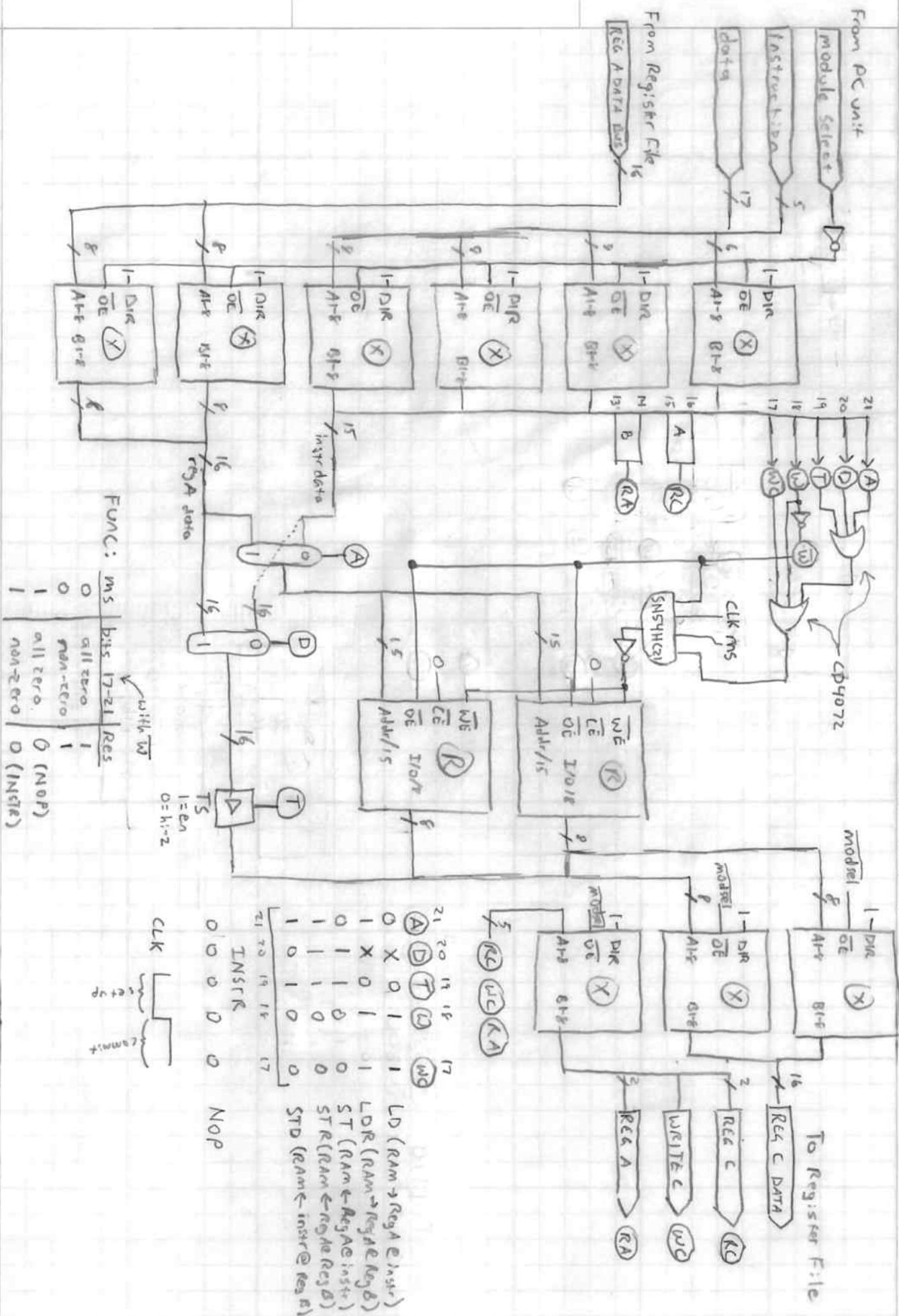
1/2 inch by 1/2 inch squares

1/2 inch by 1/2 inch squares

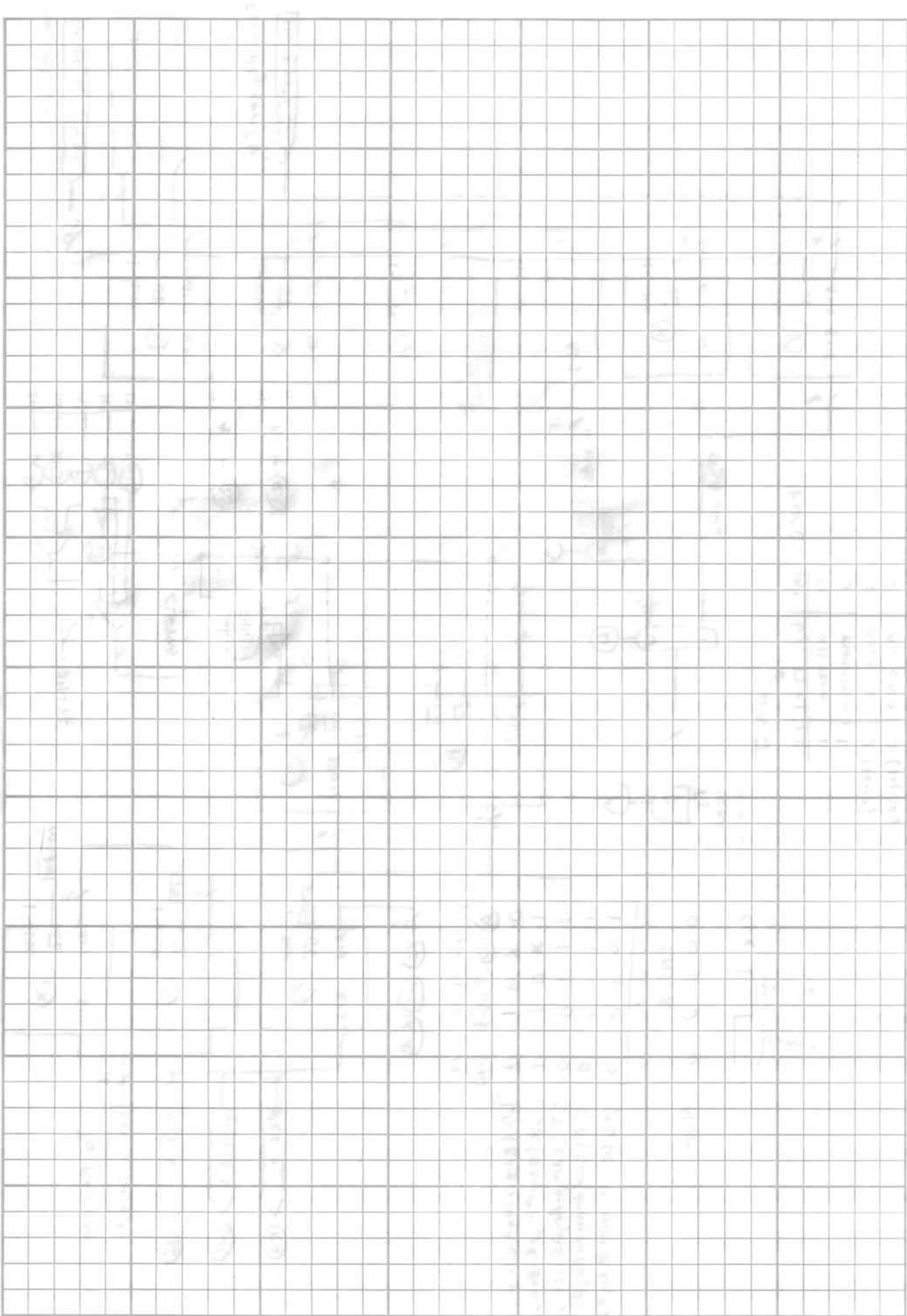


Load/Store unit - module 00

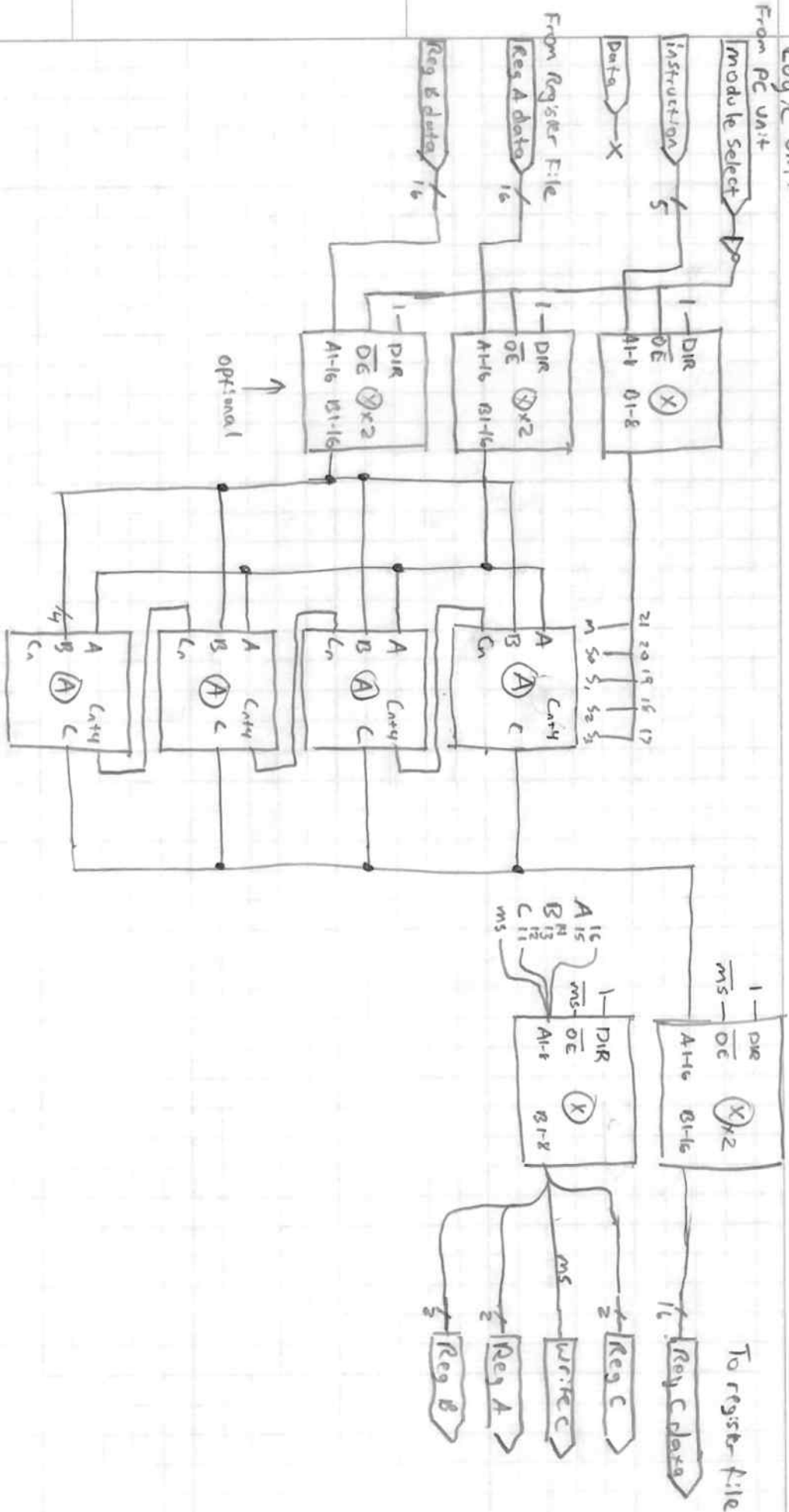
① - SN54HCT245 8-bit receiver ② - CV62256 SRAM TS = MM74HC126
 DIR = H MUXES = 4x MM74HC125 + 4x MM74HC126 Inverter = SN74HC04N



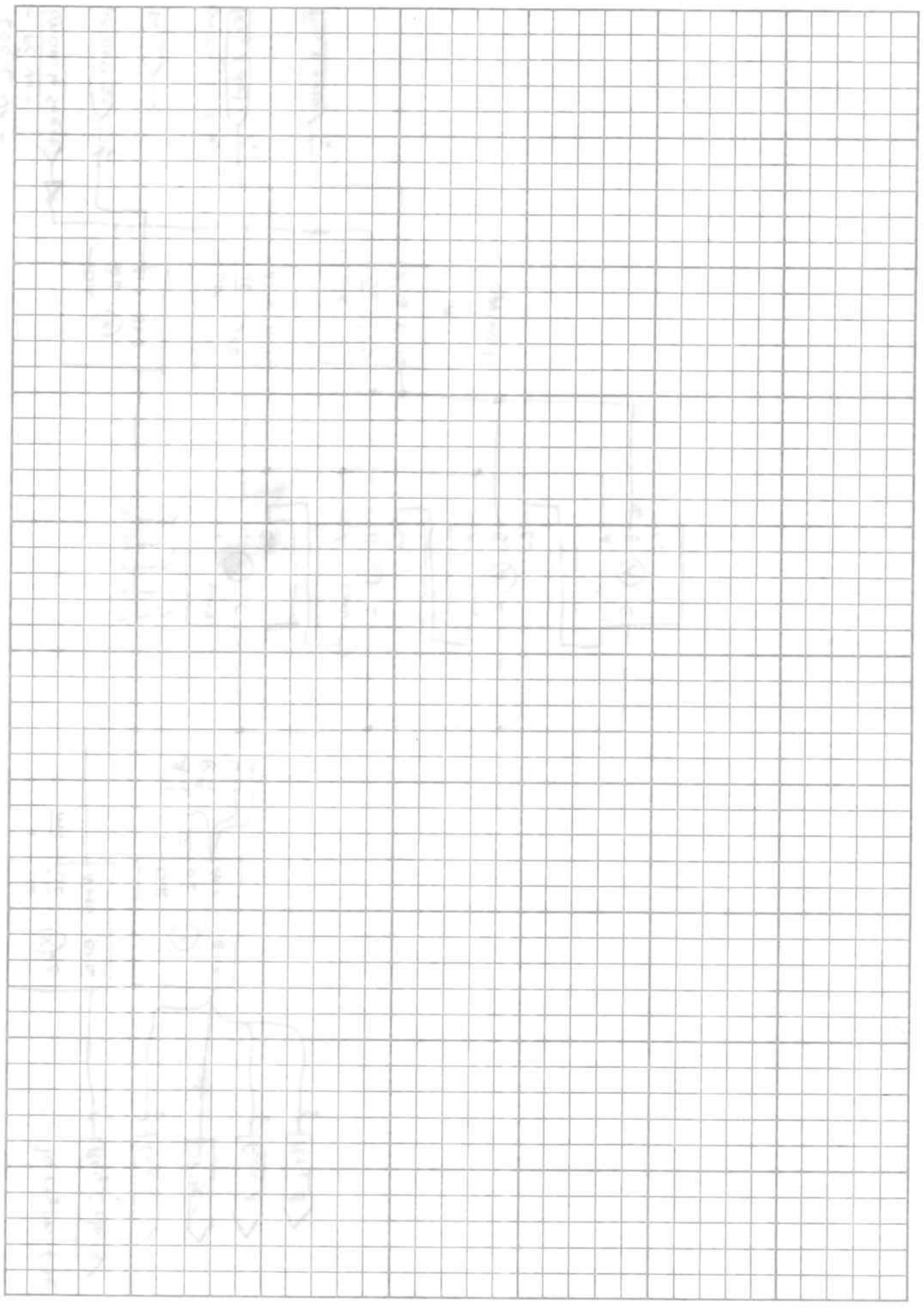
Handwritten notes on the left margin, including the date "10/10/10" and other illegible text.



Handwritten notes on the right margin, including the date "10/10/10" and other illegible text.



10. 10. 1964. 10. 10. 1964. 10. 10. 1964.



10. 10. 1964. 10. 10. 1964. 10. 10. 1964.