Sequential binary multiplication

for SM Numbers

multiplier 2

1 + 7 biti → 111 (2:0)

declare register : Acumulator A[7:0], înmult. Q[7:0], Deînmult. M[7:0]

Counter [2:0]

declare BUS INBUS[7:0] OUTBUS[7:0]

BEGIN: A := 0 , COUNT := 0 ; { C_0 := atribuire

INPUT: M := INBUS ; } C_1 → op. exec. în paralel

Q := INBUS ; → secvențial (frecv. clk)

TEST1: if Q[0] = 0 → goto RSHIFT ; $P_i := P_i + x_i \cdot Y$; $P_{i+1} := P_i * 2^{-1}$

ADD: A[7:0] := A[6:0] + M[6:0] ; } C_2

(7 biți + carry)

RSHIFT: A[7] := 0 , A[6:0].Q := A.Q[7:1] ; } C_3

INCR: count := count + 1 ;

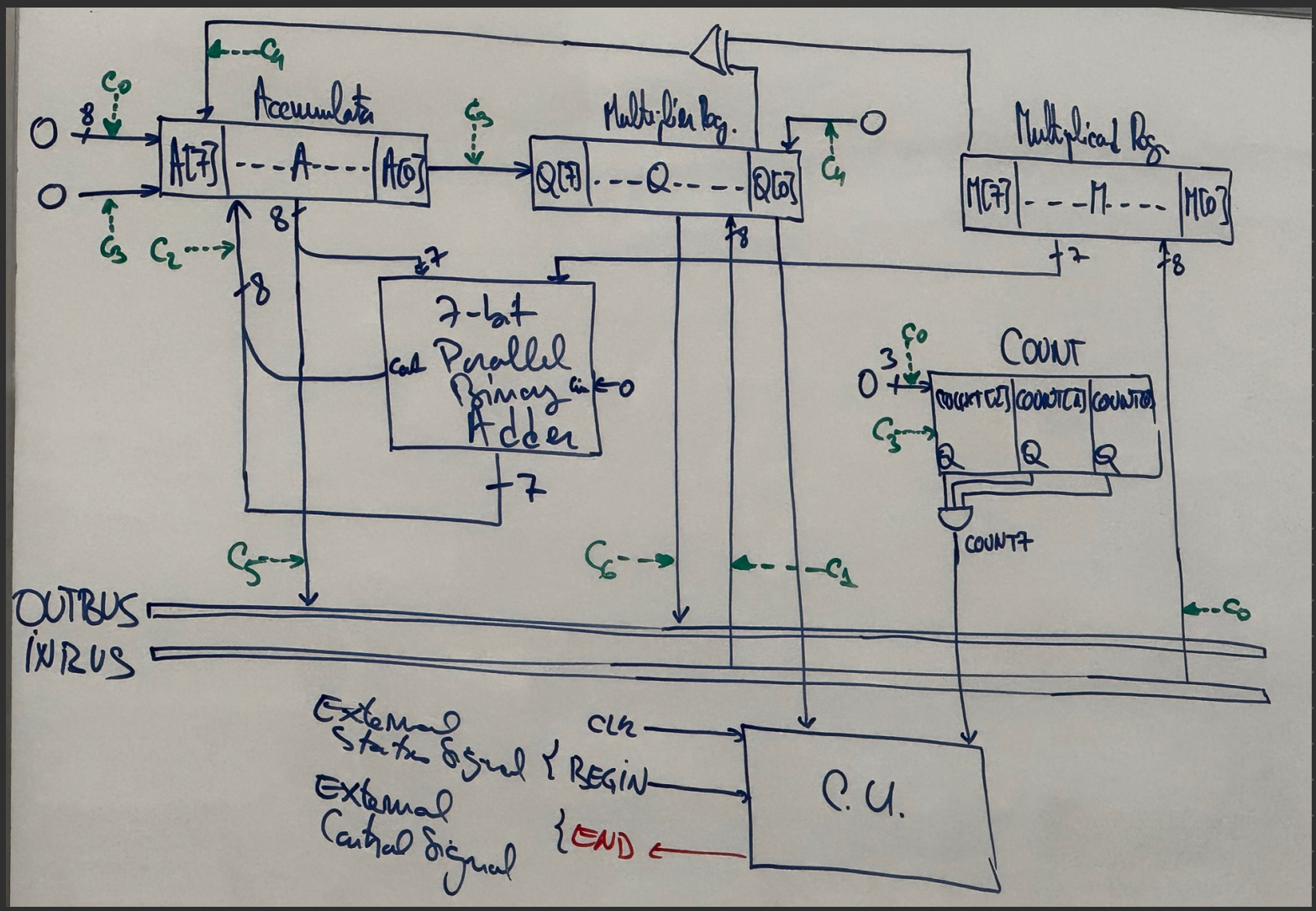
TEST2: if count 7 ≠ 1 then go to TEST1

SIGN: A[7] := Q[0] exor M[7] , Q[0] := 0 ; C_4

OUTPUT: OUTBUS := A ; → C_5

OUTBUS := Q ; → C_6

END: ——


A[7] ... A ... A[0]
Q[7] ... Q ... Q[0]
M[7] ... M ... M[0]
Accumulator
COUNT
Multiplier
multiplicand
COUNT7
OUT BUS
IN BUS
Accumulator
Multiplier Reg.
Multiplicand Reg.
7-bit Parallel Binary Adder
COUNT
COUNT7
OUTBUS
INBUS
External Status Signal
External Control Signal
START
END
CLR
C.U.

x = 5 bit y = 6 bit

$x = -7 * 2^{-4}$ $y = +29 \cdot 2^{-5}$

$x =$ 1.0111 $y =$ 0.11101

4 bit

A	Q	M	Count[2:0]	ACS
00000		011101	000	C_0
+ 11101	1011(1)			C_1
01110 1				C_2
00111 0	1101(1)		001	C_3
+ 11101				
10100 1				C_2
01010 1	11101		010	C_3
+ 11101				
11001 0				C_2
01100 1	01110		011	C_3
00110 0	1011(1)		100	C_3
1.01100	10111		count=4	C_4
1.01100				C_5
	1.01100			C_6

Exor

$$P = 1.01100\,10111 = -\frac{1100\,10111}{512}$$

$$= .793$$

Pseudo language

registers, buses Σ name, width

concatenation operator

$A[6:0], Q$

Synchronous exec.

- non-conflicting -> ,
- sequential -> ;

Assignment -> := loading

Flow Control -> go to

x, y SM 5 bit integer

$x = +13 = 01101_0$

$y = -11 = 11011_0$

$13 \cdot 2^{-4} * (-11) 2^{-3}$

$= -143 \cdot 2^{-8}$

$P = P_9 P_8 \cdots P_0$

(10 bit: 1 sign)

$P_9 \; P_8 P_7 \cdots P_0$

x y

A	Q	M	count
00000		11011	000
+ 10111	01101		
01011			
00101	10110		001
00010	11011		010
+ 10111			
01101			011
00110	11101		
+ 10111			
10001			count 4
01000	11110		100

Exit

10100 | 01111

$P = 1\,0.100\;0.1111 = -143$

$x = -1.1875$

$y = -1.8125$