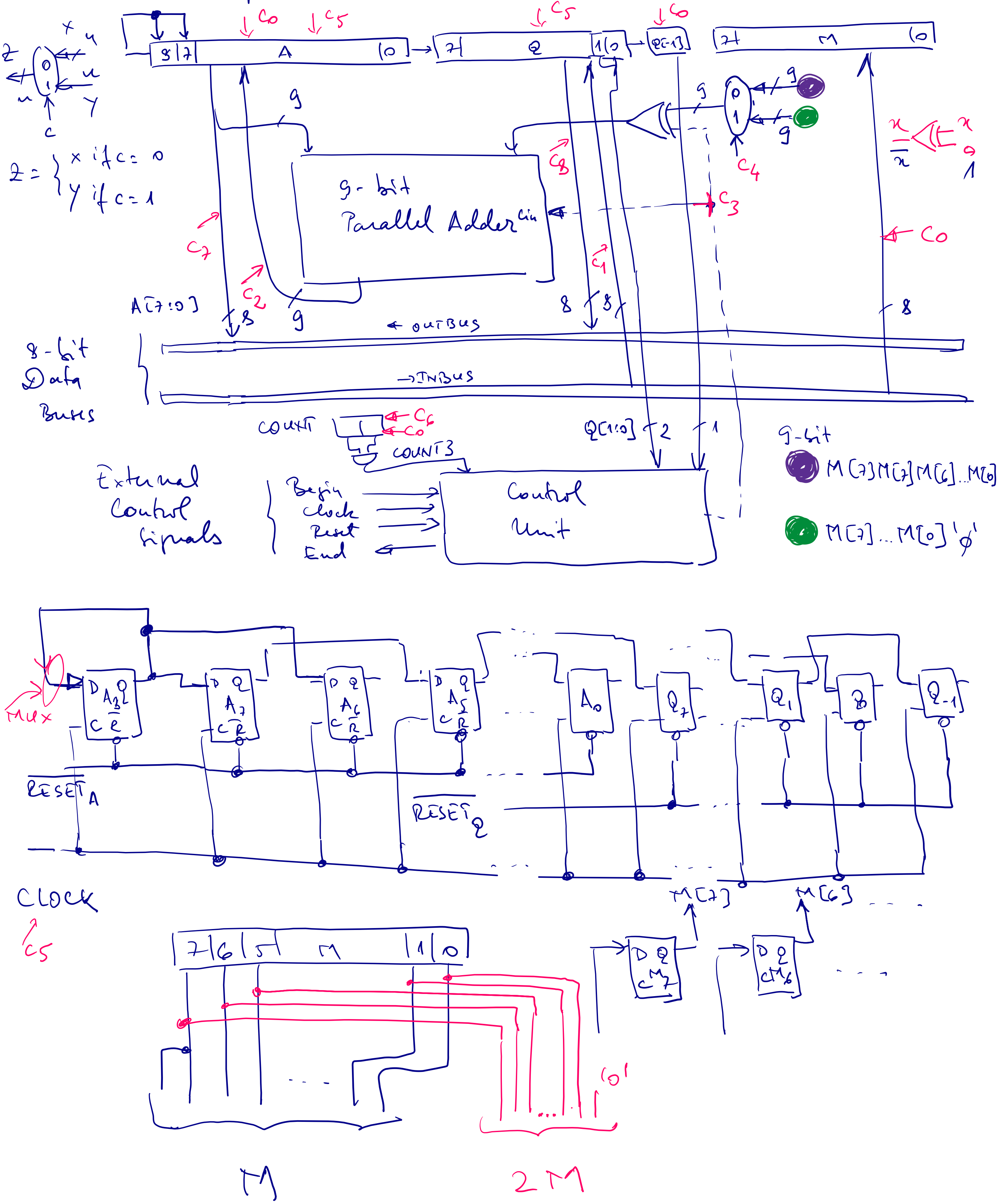
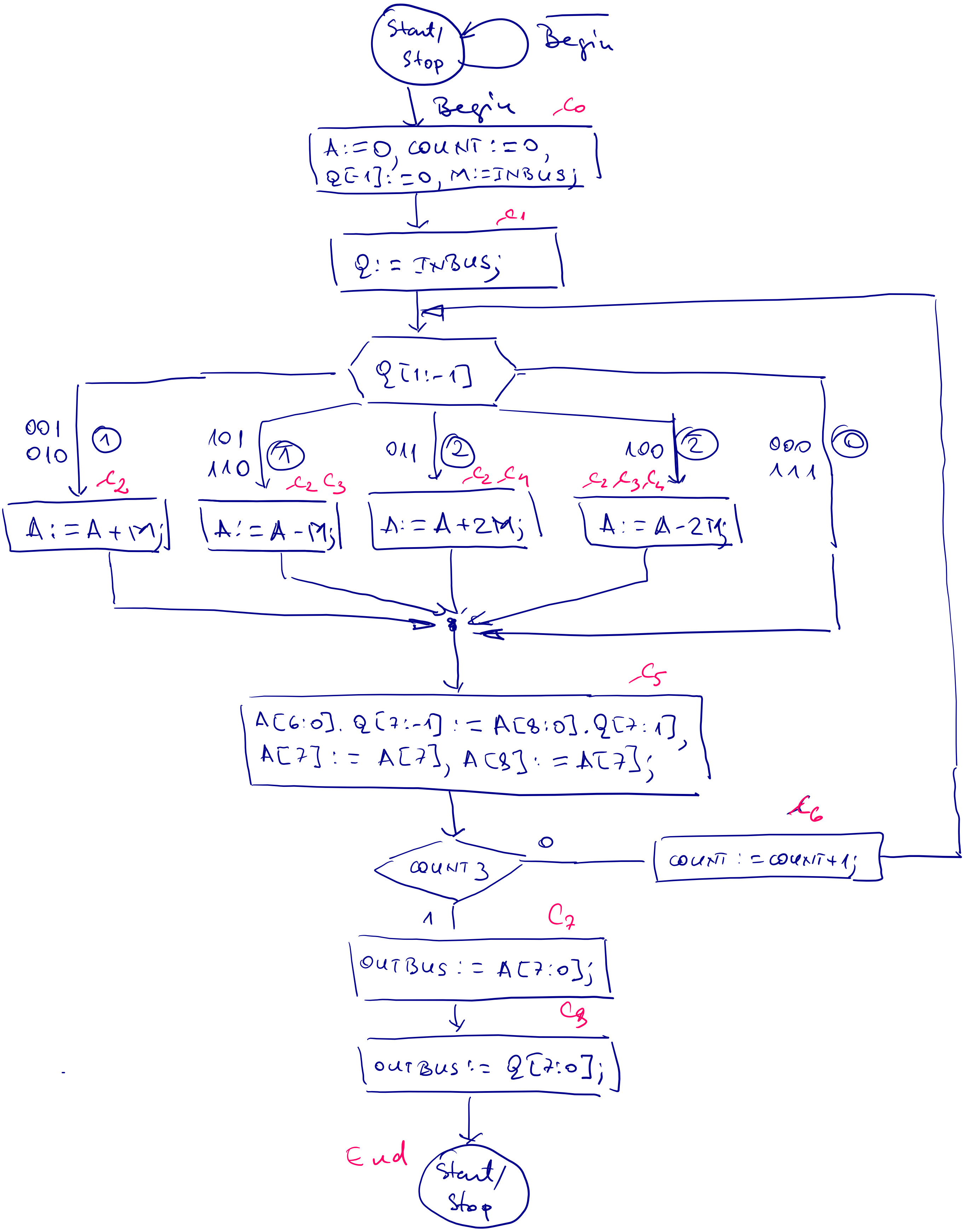
## 1.3.3 HW Implementation of the Radix-4 Booth algorithm






## 1.3.4 Increasing the radix (radix-8)

$$\begin{array}{l} \qquad\quad x_7 \ldots \quad x_3\,x_2\,x_1\,x_0\;\; x_{-1} \\ X = 1\;1\,0\,0\,1\;0\,1\,1\,1\,;\,0 \\ \qquad\quad 2 \qquad\quad 1 \qquad\quad 0 \end{array}$$

| $x_{i+2}$ | $x_{i+1}$ | $x_i$ | $x_{i-1}$ | OP |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 1 |
| 0 | 0 | 1 | 0 | 1 |
| 0 | 0 | 1 | 1 | 2 |
| 0 | 1 | 0 | 0 | 2 |
| 0 | 1 | 0 | 1 | 3 |
| 0 | 1 | 1 | 0 | 3 |
| 0 | 1 | 1 | 1 | 4 |
| 1 | 0 | 0 | 0 | $\bar{4}$ |
| 1 | 0 | 0 | 1 | $\bar{3}$ |
| 1 | 0 | 1 | 0 | $\bar{3}$ |
| 1 | 0 | 1 | 1 | $\bar{2}$ |
| 1 | 1 | 0 | 0 | $\bar{2}$ |
| 1 | 1 | 0 | 1 | $\bar{1}$ |
| 1 | 1 | 1 | 0 | $\bar{1}$ |
| 1 | 1 | 1 | 1 | 0 |

$+M \times 2^{i+1} =$
$= 2M \times 2^{i+1}$

$-M \times 2^{i+1} + M \times 2^{i+2} =$
$2^{i+1}(-M + 2M)$
$= 2M \times 2^{i}$

$M \times 2^{i} - M \times 2^{i+1} + M \times 2^{i+2} =$
$= 2^{i}(M - 2M + 4M) = 3M \times 2^{i}$

$-M \times 2^{i} + M \times 2^{i+2} = 2^{i}(-M + 4M) =$
$= 3M$

$91 - 64 = 27$
$27 - 16 = 11$

decimal

$-91 \times$
$-23$
$273$
$182$
$\boxed{+2093}$ ✓

Example
$X = -91 \;;\; Y = -23$

$X = 1101\ 1011_{SM}$
$= \boxed{1010\ 0101}_{C2}$

$Y = 1001\ 0111_{SM}$
$= \boxed{1110\ 1001}_{C2}$

| COUNT | A | Q | Q[-1] | M |
|---|---|---|---|---|
| 00 | 00 0000 0000 | 11010 0101 | 0 | 1110 1001 |
| + | 00 0100 0101 | | -3M | |
| | 00 0100 0101 | | | |
| | 00 0000 1000 | 10111 0100 | 1 | |
| 01 + | 00 0100 0101 | | | |
| | 00 0100 1101 | | | |
| | 00 0000 1001 | 10110 1110 | 1 | |
| 10 + | 00 0001 0111 | | | |
| | 00 0010 0000 | | | |
| | 000 0000 100 | 00010 1101 | 1 | |

$M = \boxed{11\ 1110\ 1001}$
$-M = 00\ 0001\ 0111$
$2M = 11\ 1101\ 0010$
$-2M = 00\ 0010\ 1110$
$3M = 11\ 1011\ 1011$
$-3M = 0001000101$

$4M = 11\ 1010\ 0100$
$-4M = 000101\ 1100$

$13$
$32$
$2048$
$\boxed{+2093}$ ✓