

1. Solution

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...
LOAD          #0          Set RESULT to 0
LOOP STORE    RESULT
INPUT         3          Input next ASCII character
SUBTRACT     #3A16
JUMP IF POSITIVE DONE    Between 3016 and 3916?
ADD          #0A16
JUMP IF NEGATIVE DONE
STORE       DIGIT       DIGIT ← ASCII - 3016
LOAD       RESULT
MULTIPLY   #A16       RESULT ← RESULT*10+DIGIT
ADD       DIGIT
STORE    RESULT
JUMP     LOOP
DONE LOAD  RESULT      Output RESULT
OUTPUT  7

```

2. Bollinger 9.8

(a) $Motor + (Motor + Start \cdot Clamp\ 1 \cdot Clamp2) \cdot \overline{Stop} \cdot Clamp1 \cdot Clamp2$
 $= (Motor + Start) \cdot \overline{Stop} \cdot Clamp1 \cdot Clamp2$

(b) LOAD #0

Loop STORE Motor (Temp)

OUTPUT 0

INPUT 1

OR Motor (Temp)

STORE Temp

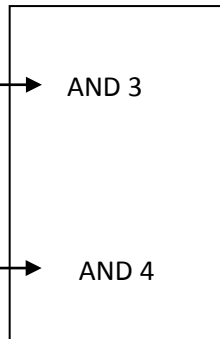
INPUT 2

COMPLEMENT

AND Temp.

Alternate solution

STORE Temp }
INPUT 3 }
AND Temp }



STORE Temp. }
INPUT 4 }
AND Temp. }

Jump Loop

(c) Load, AND, OR $5 \times 4 \times 10^{-6} = 20 \mu\text{sec}$

Store, $4 \times 5 \times 10^{-6} = 20 \mu\text{sec}$

Input $4 \times 4 \times 10^{-6} = 16$

Output $1 \times 5 \times 10^{-6} = 5$

Jump $2 \times 4 \times 10^{-6} = 4$

Complement $1 \times 2 \times 10^{-6} = \underline{2}$ (+

67 μsec .

Alternate

Load, and, or $5 \times 4 \times 10^{-6} = 20$

Store $2 \times 5 \times 10^{-6} = 10$

Input $2 \times 4 = 8$

Output $1 \times 5 = 5$

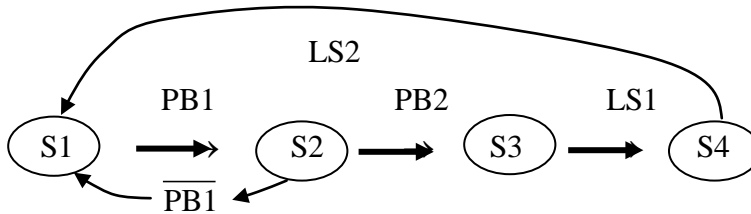
Jump $1 \times 4 = 4$

Complement $1 \times 2 = \underline{2}$

49 μsec .

3. Bollinger 9.18

One way to automate the machine is to leave steps 1 and 2 as it is, but add limit switches to automate steps 3 and 4 so that the operator can tend another machine while the saw in advancing and retracting. Limit switch LS1 should be placed so that it is activated when the saw reaches the desired final position. Limit switch LS2 should be placed so that it is activated when the saw is in a fully retracted position. (There could be other variations)



Sol1=0	Sol1=1	Sol1=1	Sol1=1
Sol2=0	Sol2=0	Sol2=1	Sol2=1
Sol3=0	Sol3=0	Sol3=1	Sol3=0

$$\begin{aligned}
 S1 &= (S1 + LS2 + \overline{PB1}) \cdot \overline{PB1} \\
 &= S1 \cdot \overline{PB1} + LS2 \cdot \overline{PB1} + \overline{PB1} = (S1 + 1) \cdot \overline{PB1} + LS2 \cdot \overline{PB1} \\
 &= \overline{PB1} + LS2 \cdot \overline{PB1} = (1 + LS2) \cdot \overline{PB1} = \overline{PB1}
 \end{aligned}$$

$$\begin{aligned}
 S2 &= (S2 + PB1) \cdot (\overline{PB2} + \overline{PB1}) \\
 &= (S2 + PB1) \cdot (\overline{PB2} \cdot \overline{PB1}) \\
 &= S2 \cdot \overline{PB1} \cdot \overline{PB2} + PB1 \cdot \overline{PB2} \\
 &= (S2 + 1) \cdot \overline{PB1} \cdot \overline{PB2} = \overline{PB1} \cdot \overline{PB2}
 \end{aligned}$$

$$S3 = (S3 + PB2) \cdot \overline{LS1}$$

$$S4 = (S4 + LS1) \cdot LS2$$

$$SOL1 = S2 + S3 + S4$$

$$SOL2 = S3 + S4$$

$$SOL3 = S3$$

4.

$$\begin{aligned} & A \cdot B + \overline{A \cdot C} + C \cdot \overline{D} + \overline{B} \cdot \overline{D} \\ &= \underbrace{A \cdot B + \overline{A}} + \overline{C} + C \cdot \overline{D} + \overline{B} \cdot \overline{D} \\ &= \underbrace{A \cdot B + (1+B) \cdot \overline{A}} + \overline{C} + C \cdot \overline{D} + \overline{B} \cdot \overline{D} \\ & \quad \swarrow \text{red arrow} \\ &= \overline{A} + B + \overline{C} + C \cdot \overline{D} + \overline{B} \cdot \overline{D} \\ &= \overline{A} + \overline{C} + \overline{D} + B + \overline{B} \cdot \overline{D} \\ &= \overline{A} + \overline{C} + \overline{D} + B + \overline{D} \\ &= \overline{A} + B + \overline{C} + \overline{D} \end{aligned}$$

$$\begin{aligned} & (A+B) \cdot (A + \overline{B} + C) \\ &= (A+B) \cdot A + A \cdot \overline{B} + B \cdot \overline{B} + (A+B) \cdot C \\ &= A + A \cdot \overline{B} + (A+B) \cdot C \\ &= A + (A+B) \cdot C \\ &= A + A \cdot C + B \cdot C \\ &= A + B \cdot C \end{aligned}$$