



# Lab-10

## Adder and Subtractor

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### Objectives



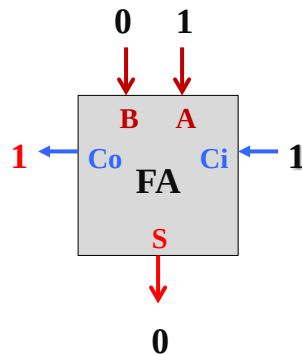
- Understand the fundamental of one-bit **full adder**.
- Can combine a number of one-bit full adders to be a **n-bit adder**.
- Understand the fundamental of one-bit **full subtractor**.
- Understand the fundamental of a n-bit adder/subtractor.
- Implement a **4-bit Adder/Subtractor using TTL 7483**.

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# Full Adder (FA) in Binary



| Input |   |   | Output |   |
|-------|---|---|--------|---|
| Ci    | B | A | Co     | S |
| 0     | 0 | 0 | 0      | 0 |
| 0     | 0 | 1 | 0      | 1 |
| 0     | 1 | 0 | 0      | 1 |
| 0     | 1 | 1 | 1      | 0 |
| 1     | 0 | 0 | 0      | 1 |
| 1     | 0 | 1 | 1      | 0 |
| 1     | 1 | 0 | 1      | 0 |
| 1     | 1 | 1 | 1      | 1 |

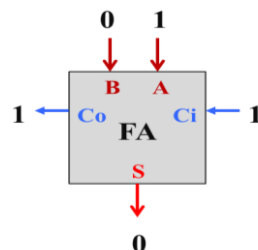
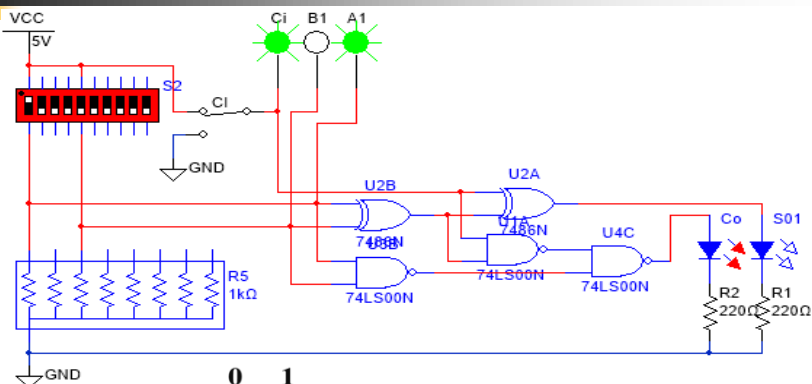
$$S = C_i \oplus A \oplus B$$
$$C_o = C_i (A \oplus B) + AB$$

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# Binary Full Adder



$$S = C_i \oplus A \oplus B$$
$$C_o = C_i (A \oplus B) + AB$$

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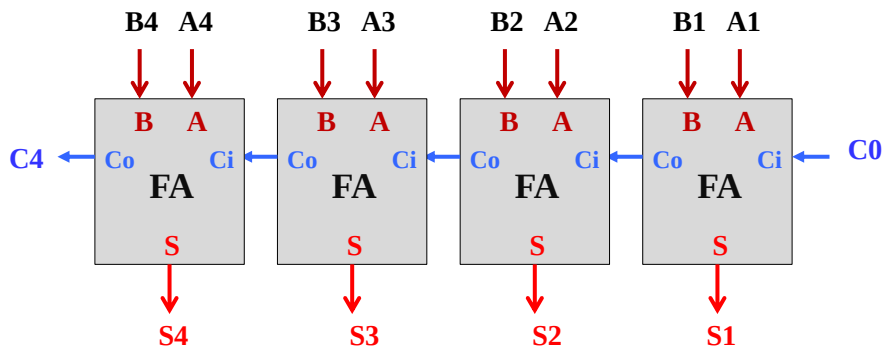
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## 4-Bit Binary Adder

$$A + B = A_4 A_3 A_2 A_1 + B_4 B_3 B_2 B_1 + C_0$$

$$= C_4 \underline{S_4 S_3 S_2 S_1}$$



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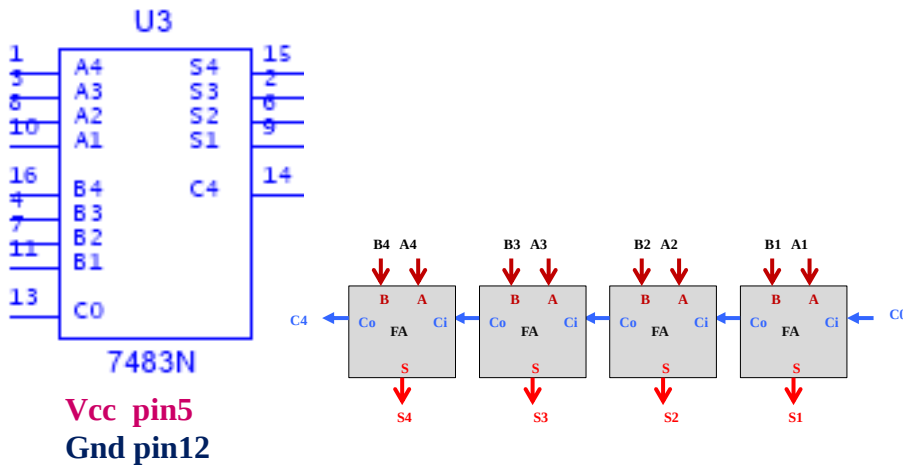
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## TTL 7483 : 4-Bit Binary Adder

$$A + B = A_4 A_3 A_2 A_1 + B_4 B_3 B_2 B_1 + (C_0=0)$$

$$= C_4 \underline{S_4 S_3 S_2 S_1}$$



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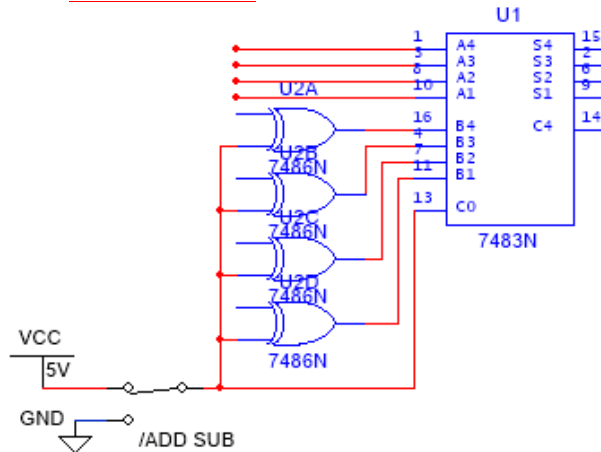


## 4-Bit Binary Subtractor

$$A - B = A + (-B)$$

$$= A_4 A_3 A_2 A_1 + [(B_4 B_3 B_2 B_1)'1S + (C_0=1)]$$

$$= C_4 \underline{S_4 S_3 S_2 S_1}$$



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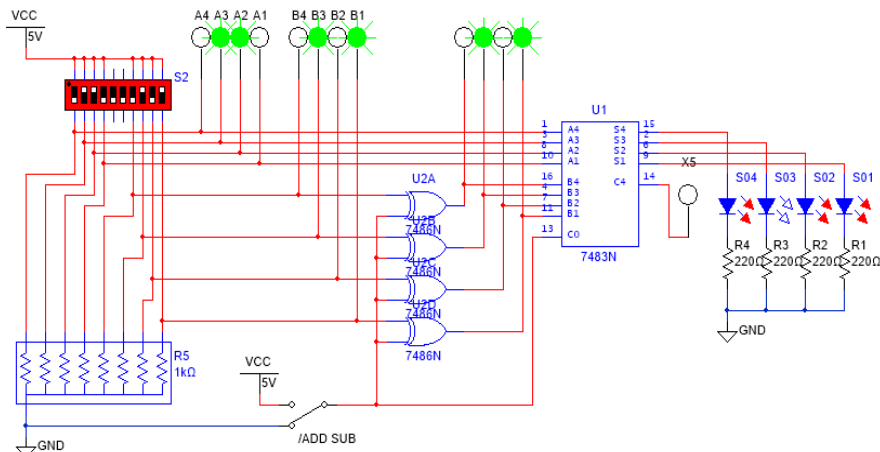
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## 4-Bit Adder & Subtractor

$$A + B = A_4 A_3 A_2 A_1 + [B_4 B_3 B_2 B_1 + (C_0=0)]$$

$$= 0110 + 0101 + 0 = 01011 = C_4 \underline{S_4 S_3 S_2 S_1}$$



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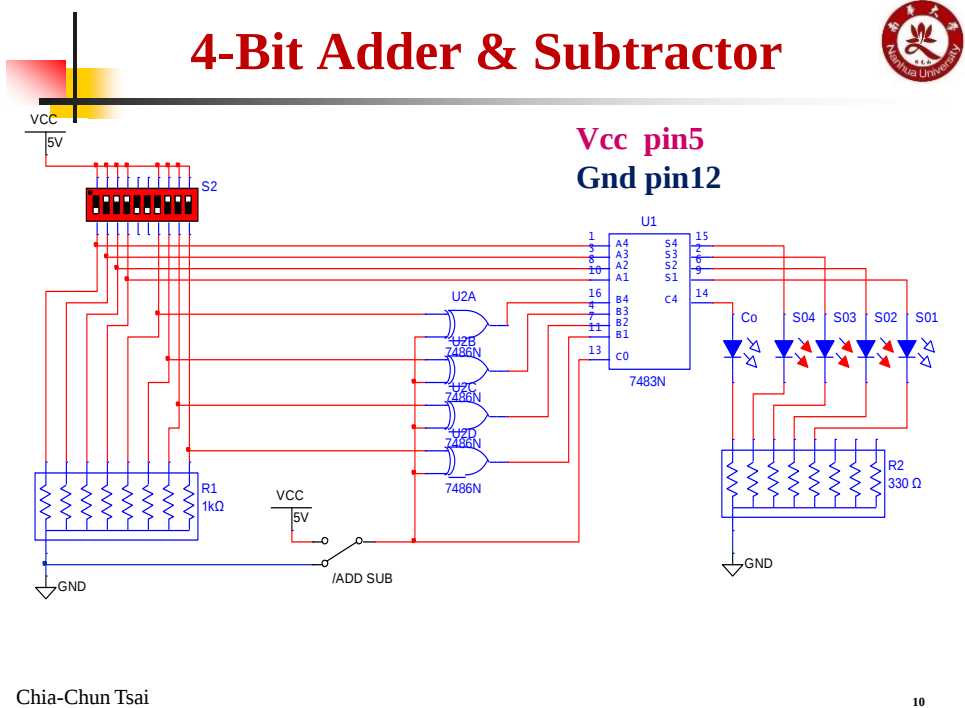
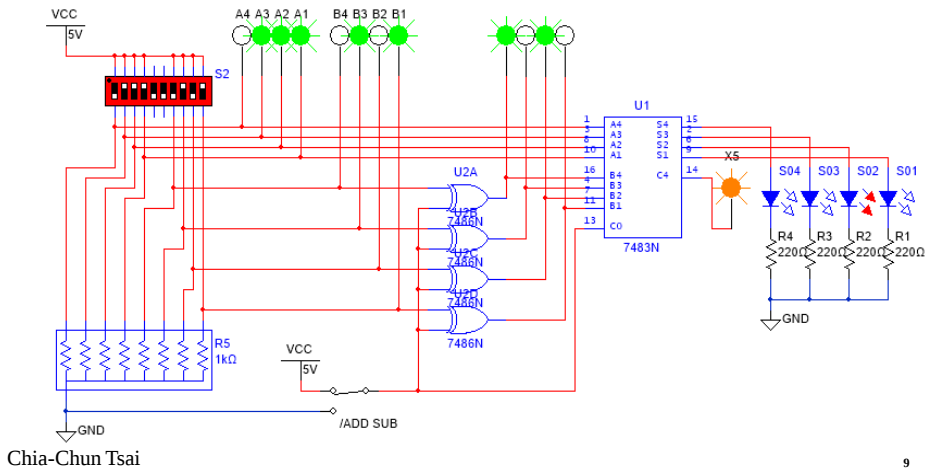
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# 4-Bit Adder & Subtractor



$$A - B = A_4 A_3 A_2 A_1 + [(B_4 B_3 B_2 B_1)'1S + (C0=1)]$$

$$= 0111 - 0101 = 0111 + 1010 + 1 = 1\ 0010 = \text{C4 } \textcolor{red}{S4} \textcolor{red}{S3} \textcolor{red}{S2} \textcolor{red}{S1}$$



## Verify 4-Bit Adder/Subtractor



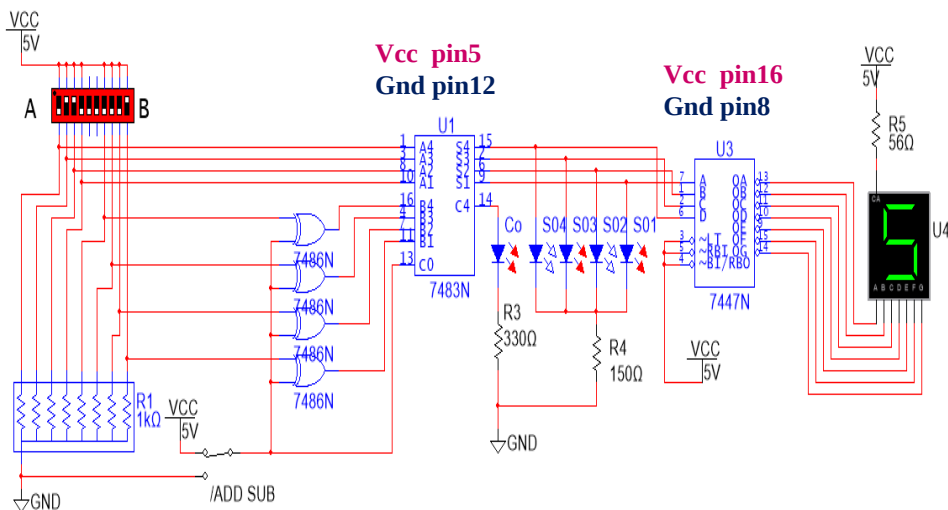
$$\begin{aligned}
 A + B &= A_4 A_3 A_2 A_1 + [B_4 B_3 B_2 B_1 + (C_0=0)] \\
 &= 0110 + 0101 + 0 = 01011 = C_4 \underline{S_4 S_3 S_2 S_1} \\
 &= 0111 + 0111 + 0 = ? \\
 &= 1001 + 0011 + 0 = ?
 \end{aligned}$$

$$\begin{aligned}
 A - B &= A_4 A_3 A_2 A_1 + [(B_4 B_3 B_2 B_1)'1S + (C_0=1)] \\
 &= 0111 - 0101 = 0111 + 1010 + 1 = 10010 = C_4 \underline{S_4 S_3 S_2 S_1} \\
 &= 1011 - 0111 = ? \\
 &= 0111 - 0111 = ?
 \end{aligned}$$

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## 4-Bit Adder & Subtractor

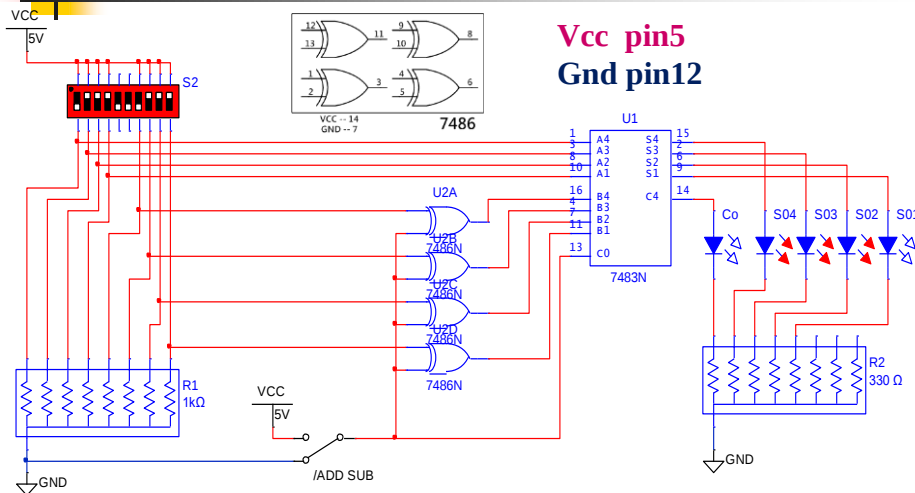


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## Experiment-1

### 4-Bit Adder & Subtractor



$$S=A+B = 0111 + 0111 + 0 = 0\ 1110 = C4\ S4\ S3\ S2\ S1$$

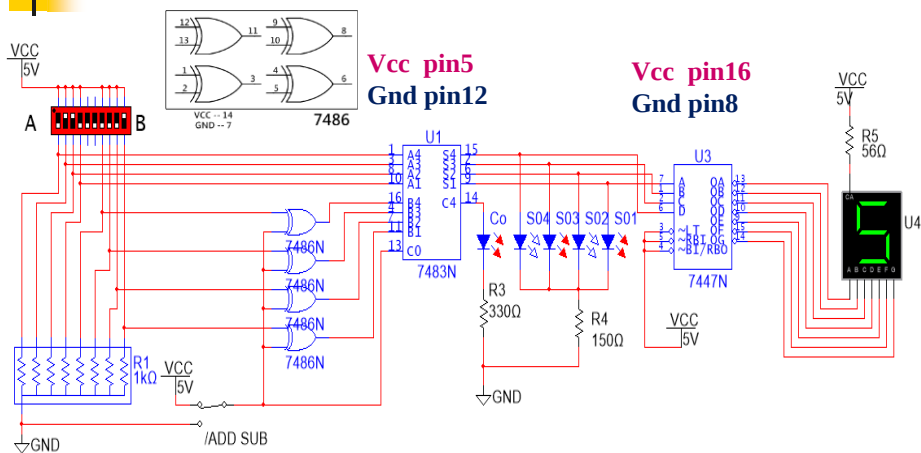
$$S=A-B = 0110 - 0101 = 0110 + 1010 + 1 = 1\ 0001 = C4\ S4\ S3\ S2\ S1$$

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## Experiment-2

### 4-Bit Adder & Subtractor



$$S=A-B = 0110 - 0001 = 0110 + 1110 + 1 = 1\ 0101 = C4\ S4\ S3\ S2\ S1$$

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