

ENCS2110

DIGITAL ELECTRONICS AND COMPUTER ORGANIZATION LABORATORY

Pre-Lab Experiment #2

Comparators, Adders and Subtractor

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Date: 01/3/2021

# Half-Adder:



Half-Adder

|  |  |  |  |
| --- | --- | --- | --- |
| X | Y | Carry | Sum |
| 0 | 0 | 0 | 0 |
| 0 | 1 | 0 | 1 |
| 1 | 0 | 0 | 1 |
| 1 | 1 | 1 | 0 |

Boolean Function:

* Sum = XY
* Carry = X’Y +XY’

# Full-Adder:



Full-Adder

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| X | Y | Cin | Cout | Sum |
| 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 |

Truth Table

Boolean Function:

* Sum = X’Y’Cin’ + X’YCIn’ + XY’Cin’ + XYCin
* Carry = XY + XCin + XCin

# Half-Subtractor:



Half-Subtractor

|  |  |  |  |
| --- | --- | --- | --- |
| A | B | Borrow | Diff |
| 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 0 |
| 1 | 0 | 1 | 1 |
| 1 | 1 | 1 | 0 |

Truth Table

Boolean Function:

* Diff = A’B + AB’
* Borrow = A’B

# Full-Subtractor:



Full-Subtractor

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| A | B | Bin | Diff | BOUT |
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | 1 |
| 1 | 0 | 0 | 1 | 0 |
| 1 | 0 | 1 | 0 | 0 |
| 1 | 1 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 |

Truth Table

Boolean Function:

* Borrow = A’Bin + A’B + BBin
* Diff = A’B’Bin + AB’Bin’ + A’BBin + ABBin

# One-Bit Comparator:



1-bit Comparator

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| INPUTS | | OUTPUTS | | |
| B | A | A > B | A = B | A < B |
| 0 | 0 | 1 | 0 | 1 |
| 0 | 1 | 0 | 1 | 1 |
| 1 | 0 | 1 | 1 | 0 |
| 1 | 1 | 1 | 0 | 1 |

Truth Table

# Three-Bit Comparator:



Three-Bit comparator

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| A2 | A1 | A0 | B2 | B1 | B0 | A>B | A<B | A=B |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 |
| 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 |
| 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 |
| . | . | . | . | . | . | . | . | . |
| . | . | . | . | . | . | . | . | . |
| 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 |
| 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 |