CSE 315
Microprocessors & Microcontrollers

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October 18, 2014

Recap

Before Eid Vacation

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- ATmega16 Digital I/O

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- ATmega16 Digital I/O
- ATmega16 Architecture & Memory

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- ATmega16 Digital I/O
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- ATmega16 Features

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- ATmega16 Features
- AVR Timer Mechanism
- AVR Interrupt Mechanism

Today's Topic

Analog-to-Digital Conversion
in
ATmega16/32

Typical Digital System Characteristics

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1-bit ADC

What about n-bit ADC?

ADC Jargons

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- Sampling

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- Quantization

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- Resolution/Step Size

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- Sampling
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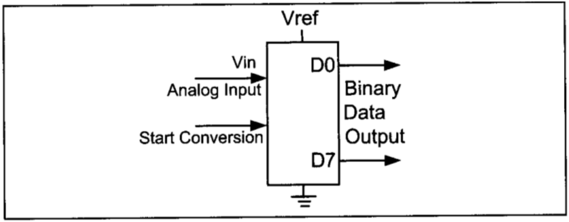
- Conversion Time
- V_{ref}
- Digital Data Output

n-bit ADC Block Diagram

n-bit ADC Block Diagram



Resolution/Step Size

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- Find the step size if,
  - $n = 8, V_{ref} = 2.56V$
  - $n = 10, V_{ref} = 2.56V$

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- For, $n = 9$ and $V_{ref} = 2.56V$, find the D_{out} if,

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- For, $n = 9$ and $V_{ref} = 2.56V$, find the D_{out} if,
  - $V_{in} = 0.8V$

Digital Data Output

- $D_{out} = \left\lfloor \frac{V_{in}}{stepsize} \right\rfloor$
- For, $n = 9$ and $V_{ref} = 2.56V$, find the D_{out} if,
  - $V_{in} = 0.8V$
  - $V_{in} = 2.1V$

Analog-to-Digital Conversion Technologies

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- Successive Approximation

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- Integration

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Successive Approximation ADC

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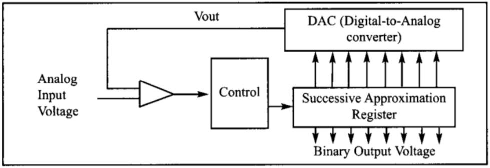
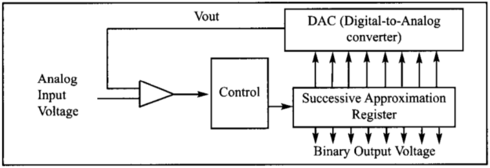
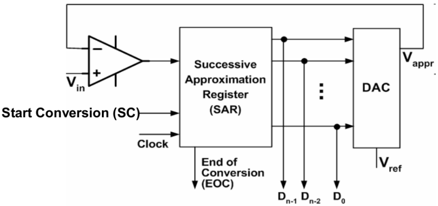


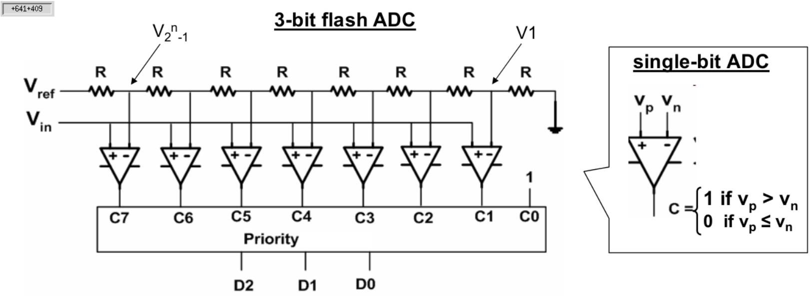
Successive Approximation ADC





Flash ADC

Flash ADC


+641+409
3-bit flash ADC
V2^n-1
V1
R R R R R R R R
Vref
Vin
1
C7 C6 C5 C4 C3 C2 C1 C0
Priority
D2 D1 D0
single-bit ADC
vp vn
C = 1 if vp > vn
0 if vp ≤ vn

Reference

- The avr microcontroller & embedded system, *Chapter 13*
  - Muhammad Ali Mazidi
  - Sarmad Naimi
  - Sepehr Naimi