

EE 230

Lecture 38

Data Converters

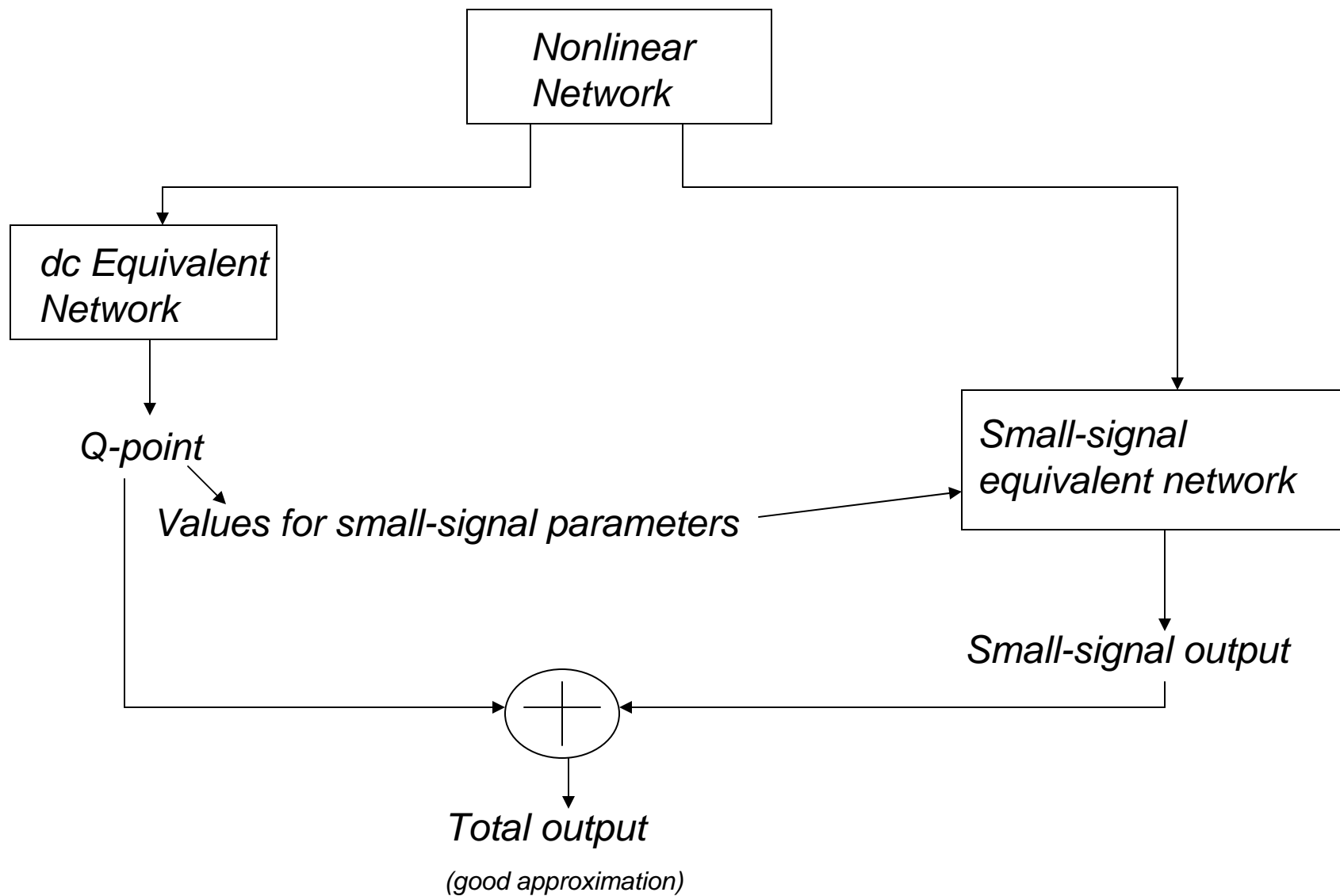
Review from Last Time:

Standard Approach to small-signal analysis of nonlinear networks

- 1. Linearize nonlinear devices*
- 2. Replace all devices with small-signal equivalent*
- 3. Solve linear small-signal network*

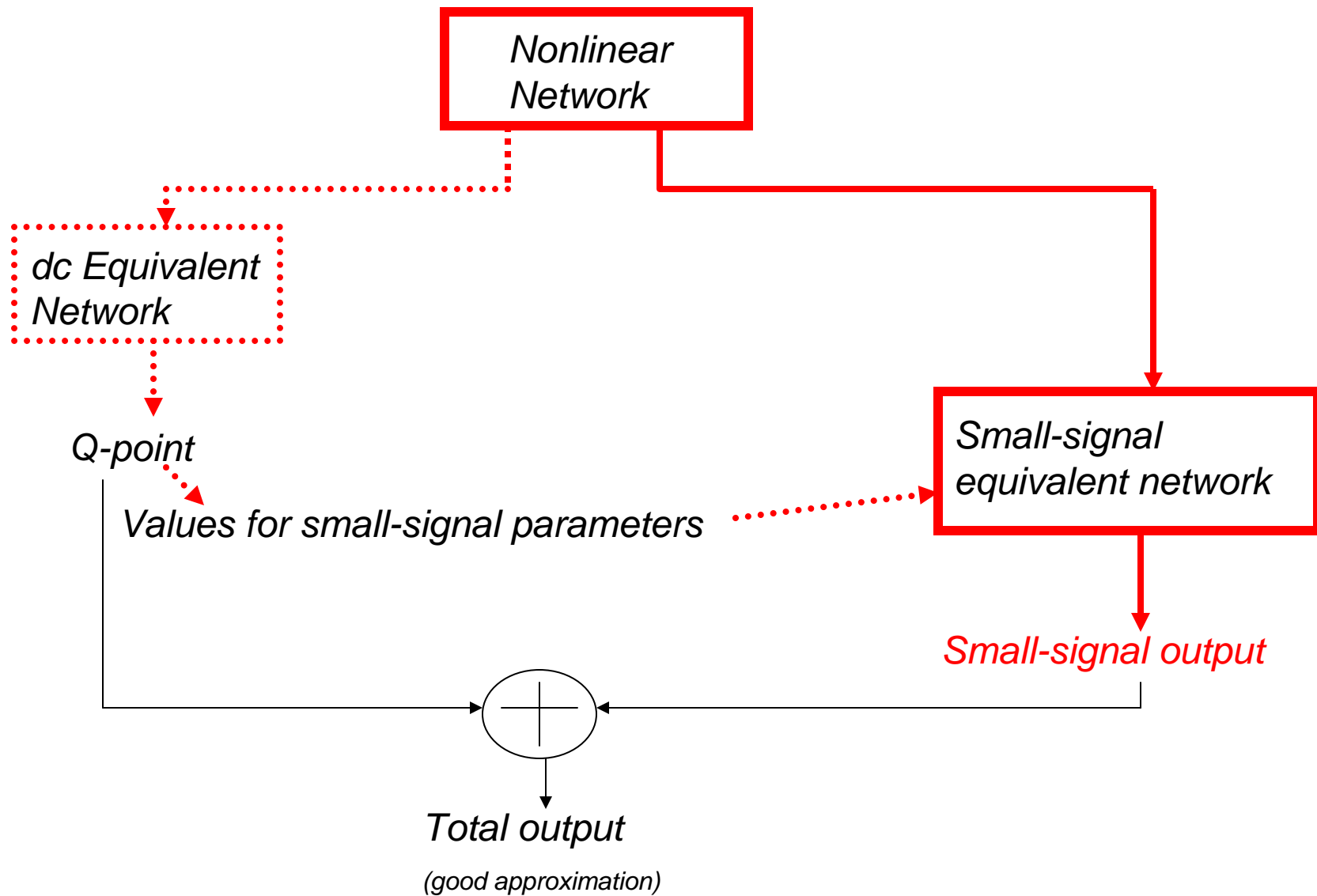
Review from Last Time:

Standard Approach to analysis of nonlinear networks



Review from Last Time:

Standard Approach to small-signal analysis of nonlinear networks



Review from Last Time:

Engineering Issues for Using Data Converters

1. Inherent with Data Conversion Process

- Amplitude Quantization
 - Time Quantization
- (Present even with Ideal Data Converters)

2. Nonideal Components

- Uneven steps
 - Offsets
 - Gain errors
 - Response Time
 - Noise
- (Present to some degree in all physical Data Converters)

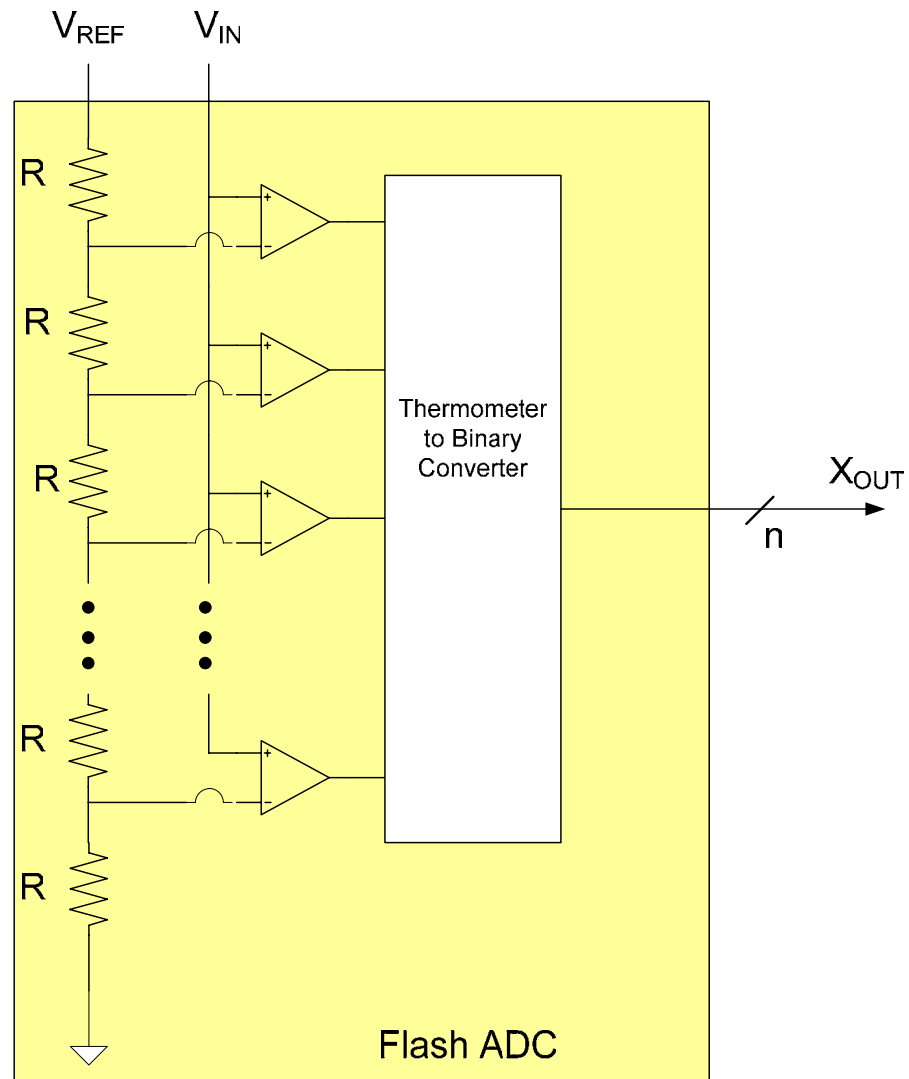
How do these issues ultimately impact performance ?

Types of ADCs

- Flash
- Pipelined
- Folded
- Serial
 - Single-slope
 - Dual-slope
- Interpolating
- Iterative (Algorithmic, Cyclic)
- Successive Approximation (SAR)
- Oversampled (Delta-Sigma)
- Charge Redistribution
- Several others

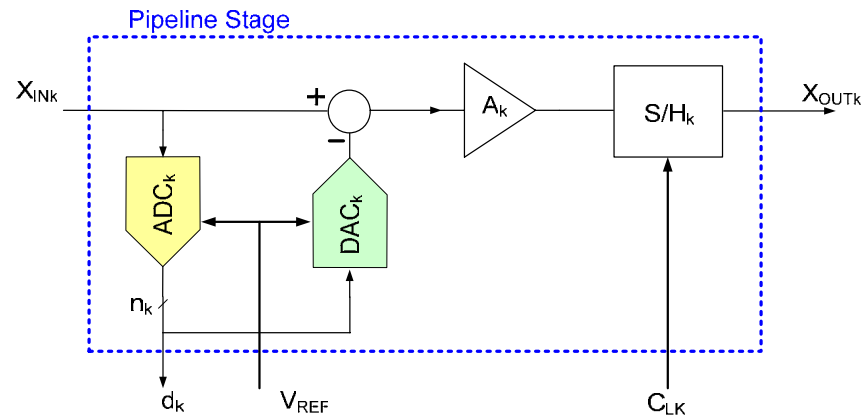
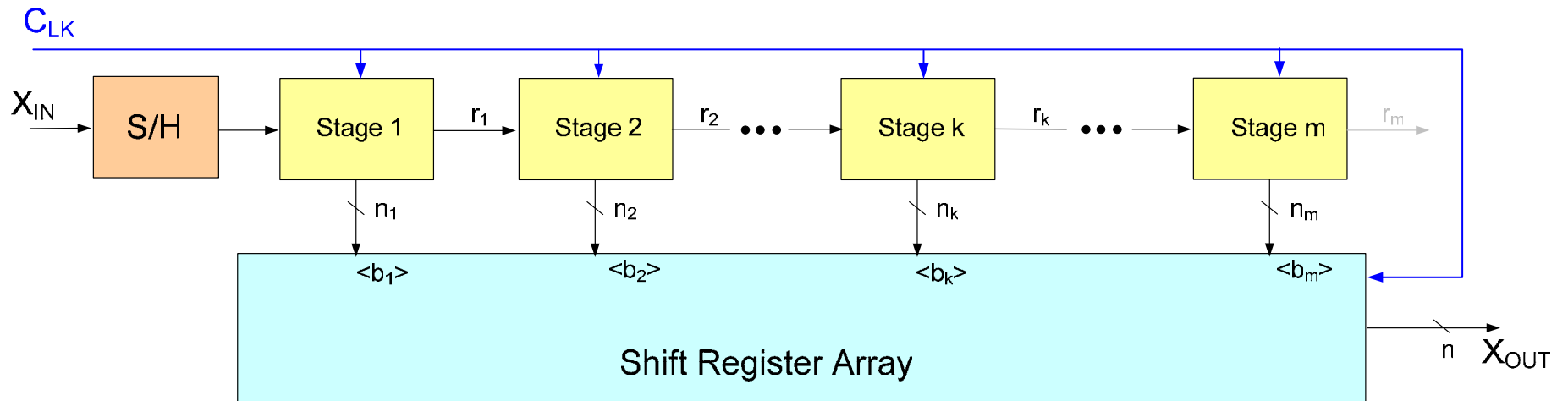
Types of ADCs

Flash ADC



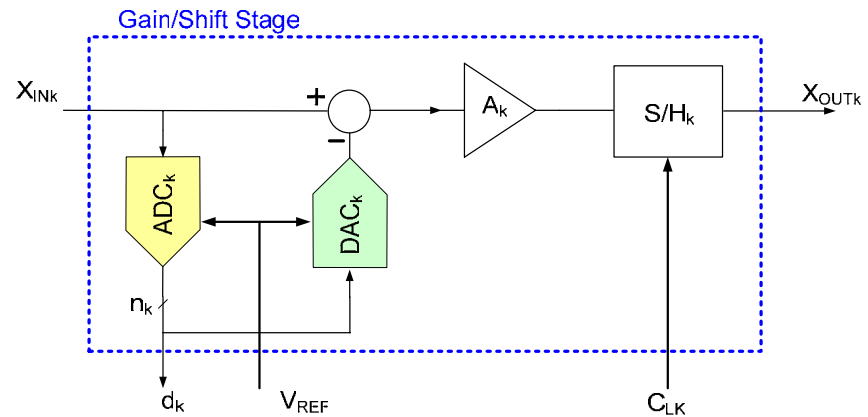
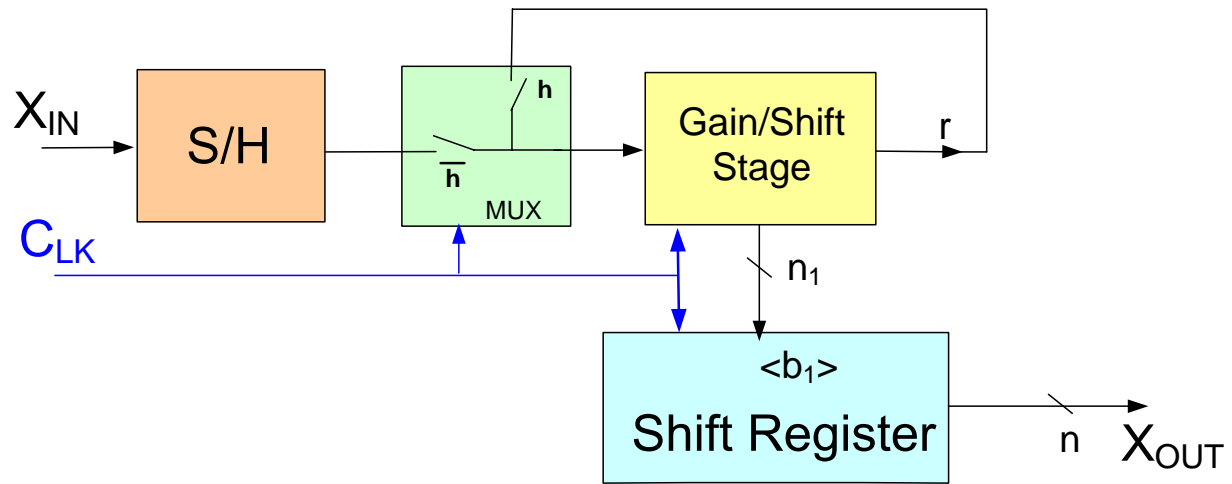
Types of ADCs

Pipelined ADC



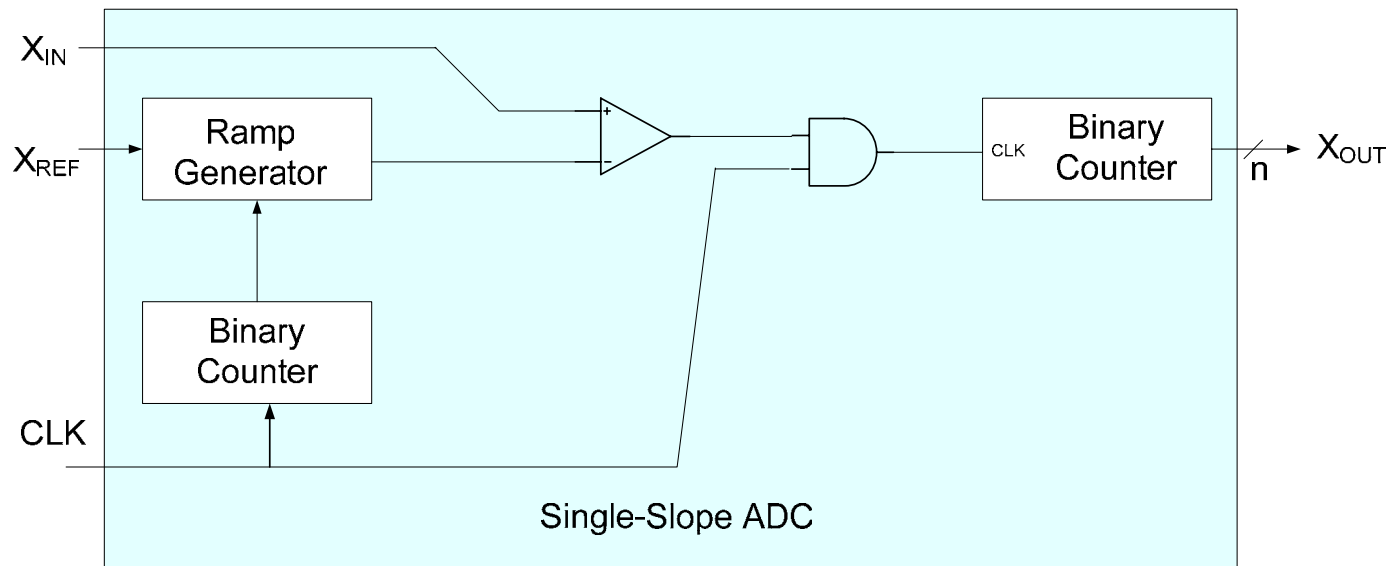
Types of ADCs

Cyclic ADC



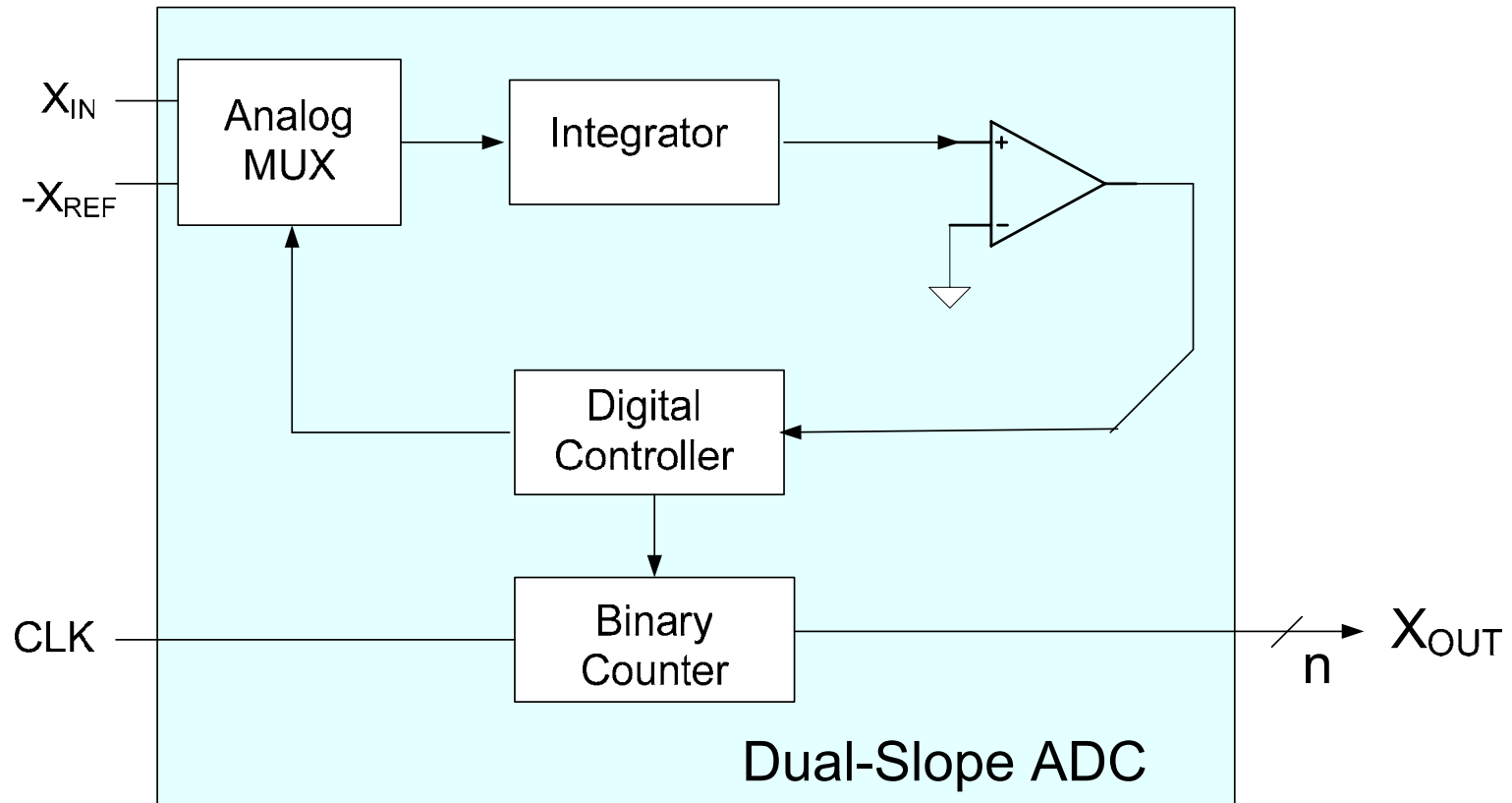
Types of ADCs

Single-Slope ADC



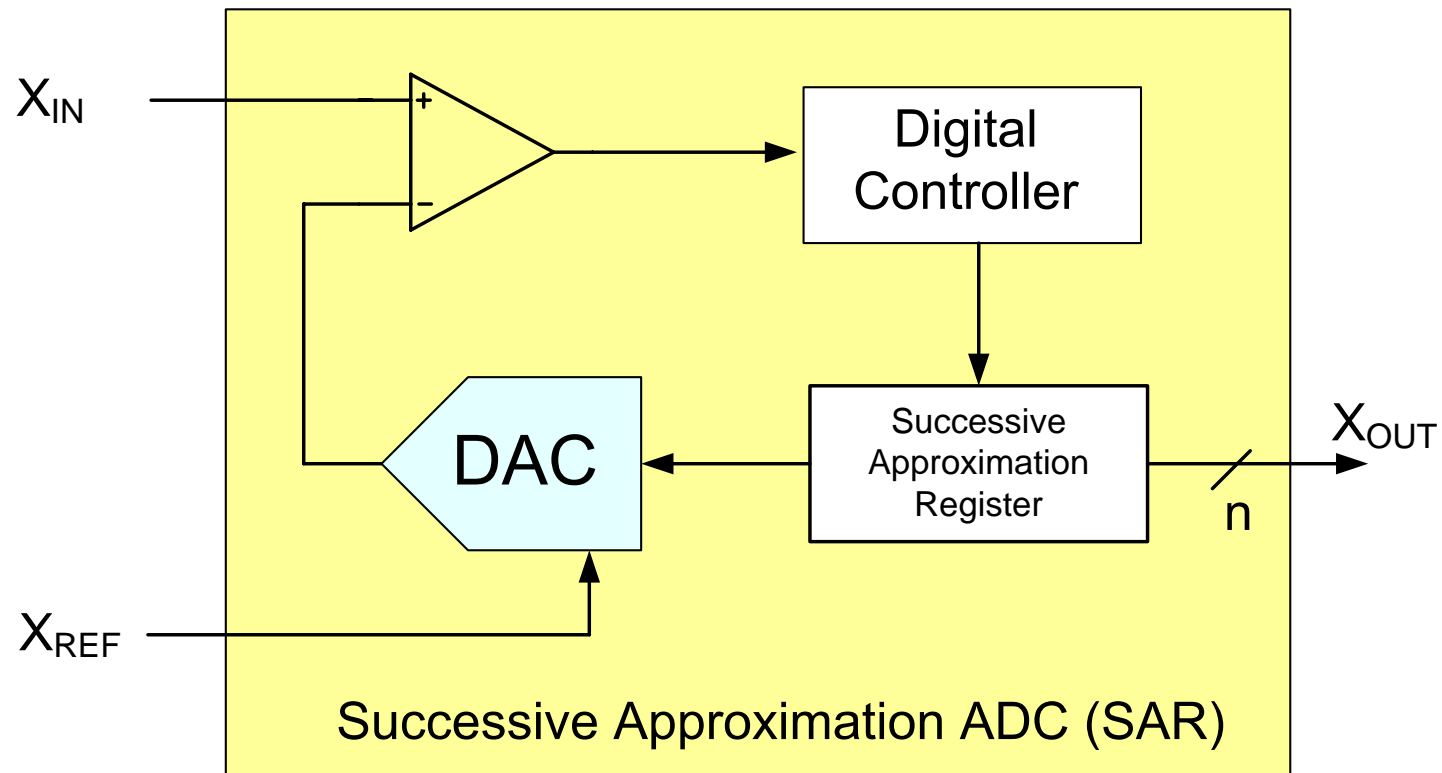
Types of ADCs

Dual-Slope ADC



Types of ADCs

SAR ADC

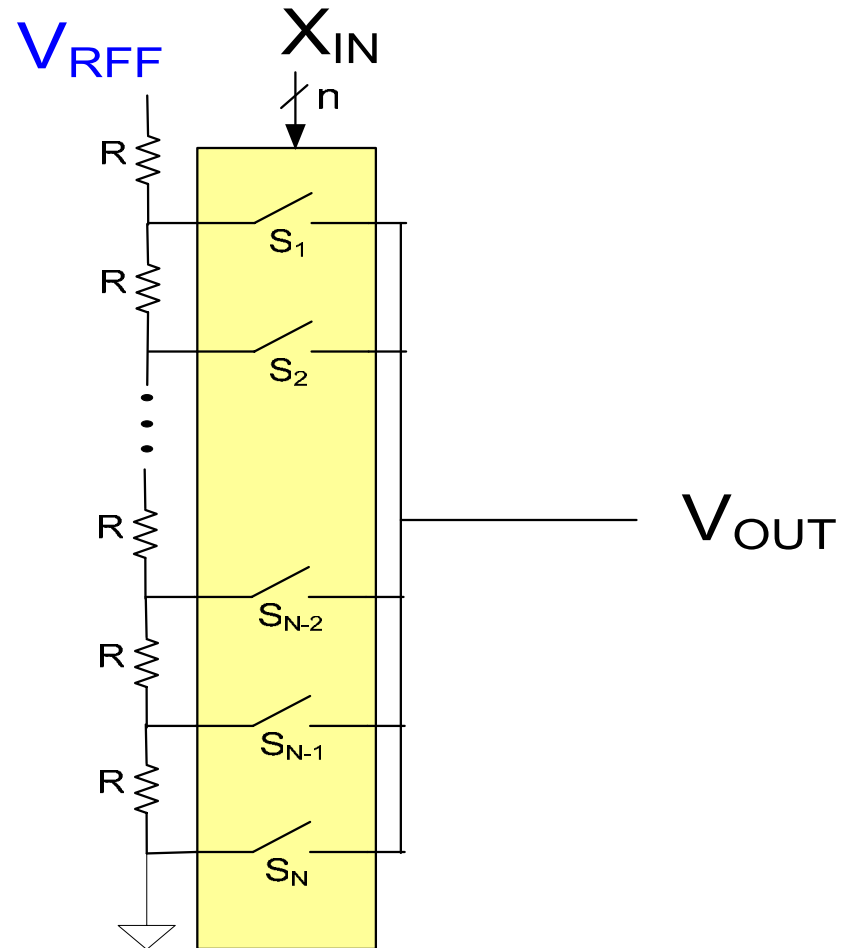


Types of DACs

- Current steering
- R-String
- Ladder (R-2R)
- Parallel
- Pipelined
- Subranging
- Charge Redistribution
- Algorithmic
- Serial
- Subranging
- Oversampled (Delta-Sigma)
- Several others

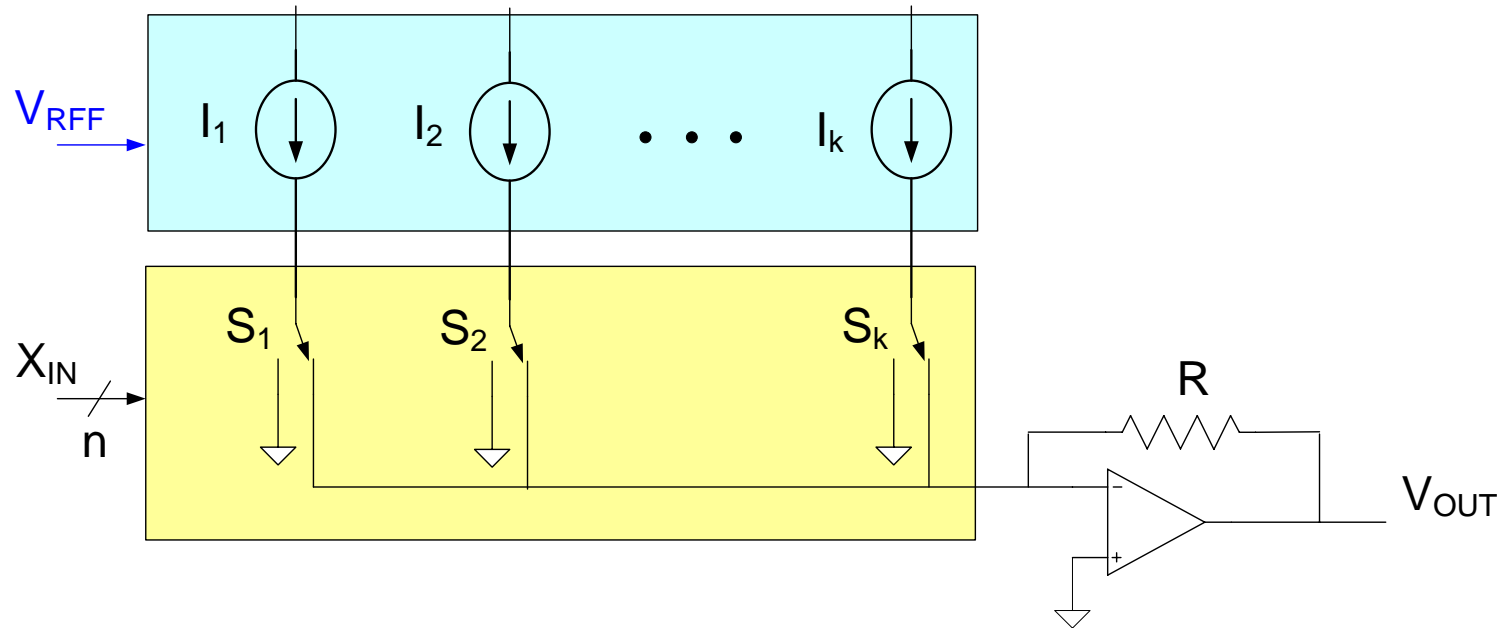
Types of DACs

R-string DAC



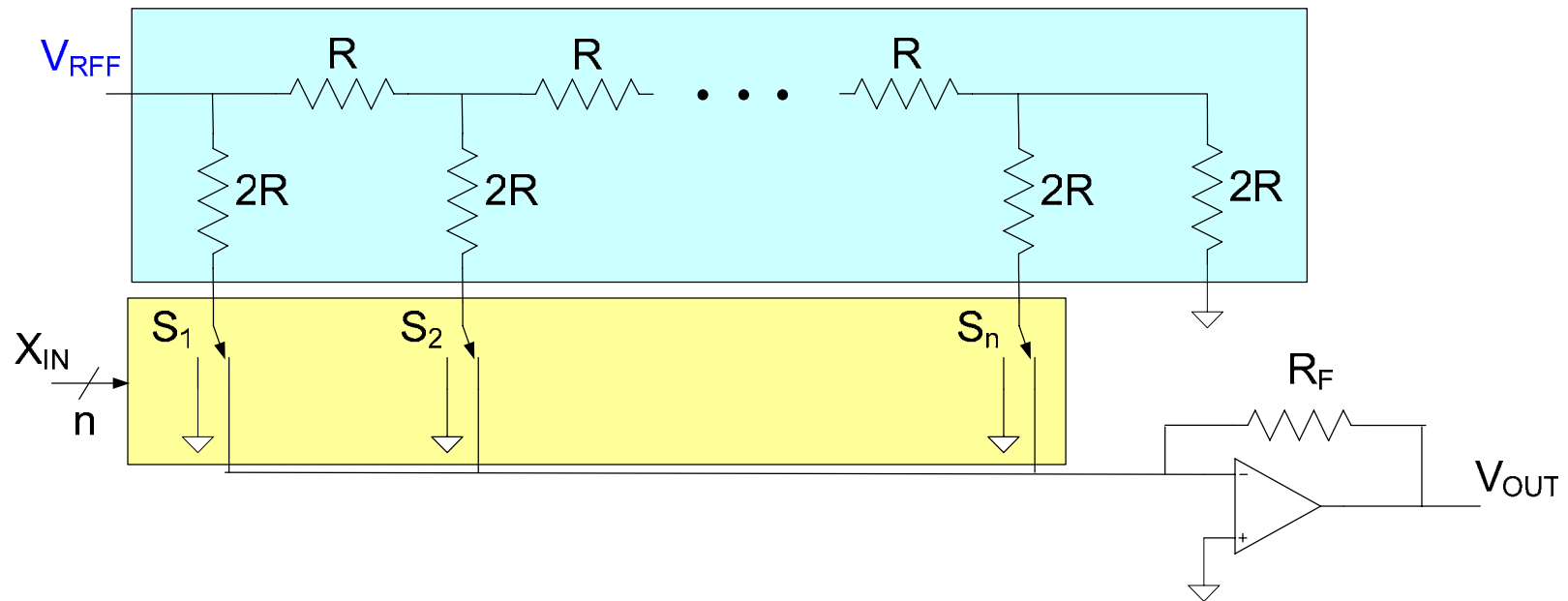
Types of DACs

Current-steering DAC



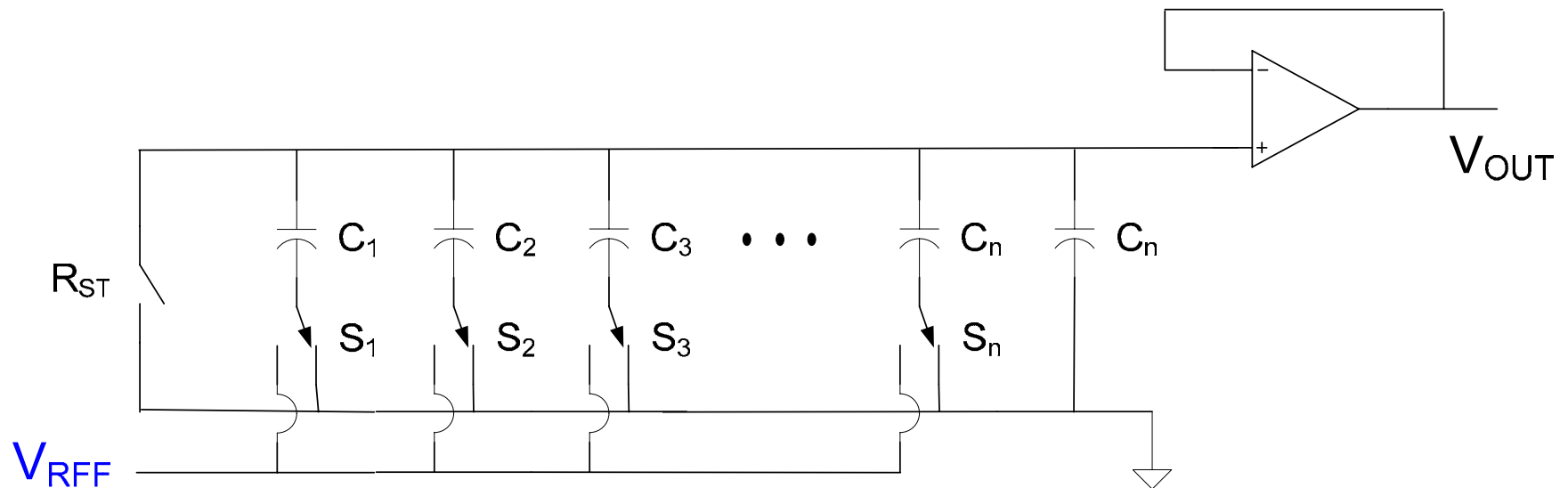
Types of DACs

Ladder DAC (R-2R)



Types of DACs

Charge-Redistribution DAC



$$C_k = \frac{C}{2^{k-1}}$$

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