
ME 120 Experimental Methods

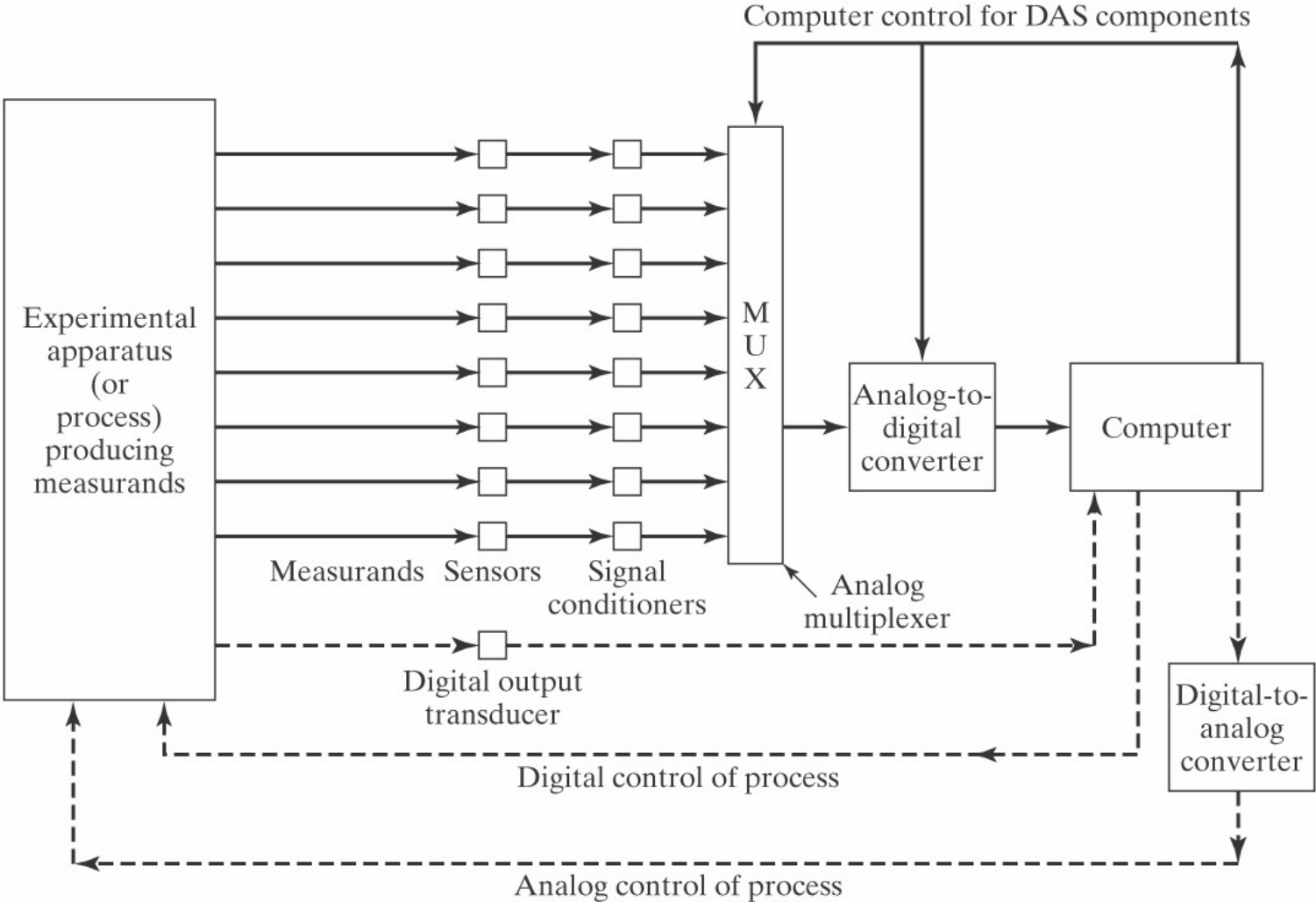
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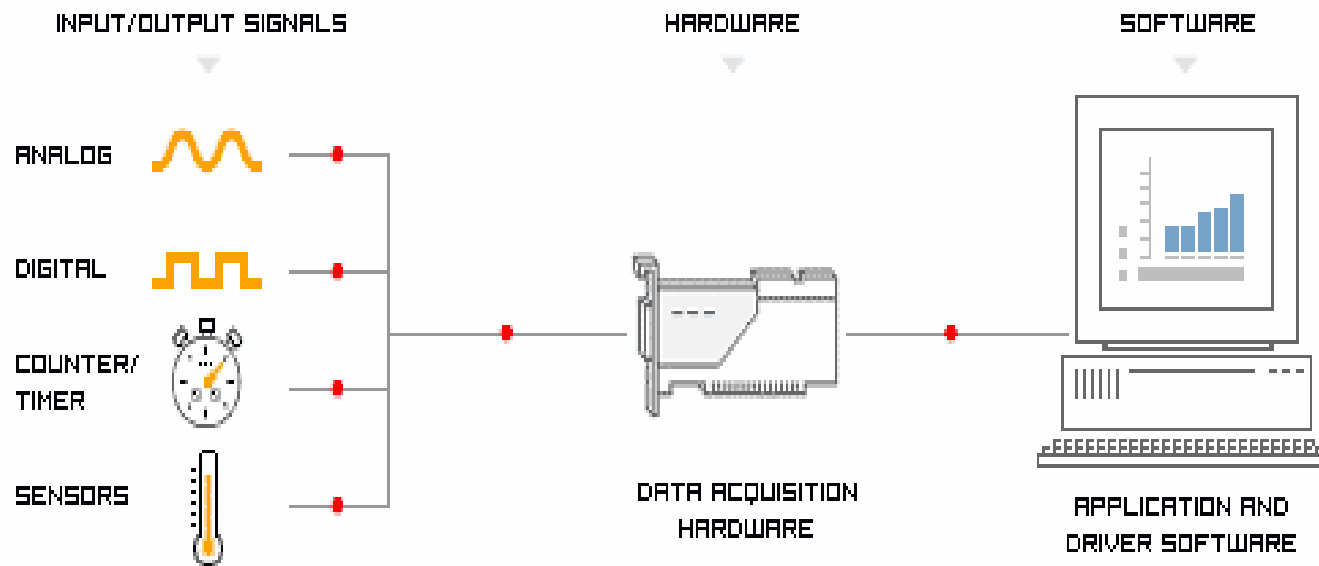
Data Acquisition

Computerized Data Acquisition (DAQ) System



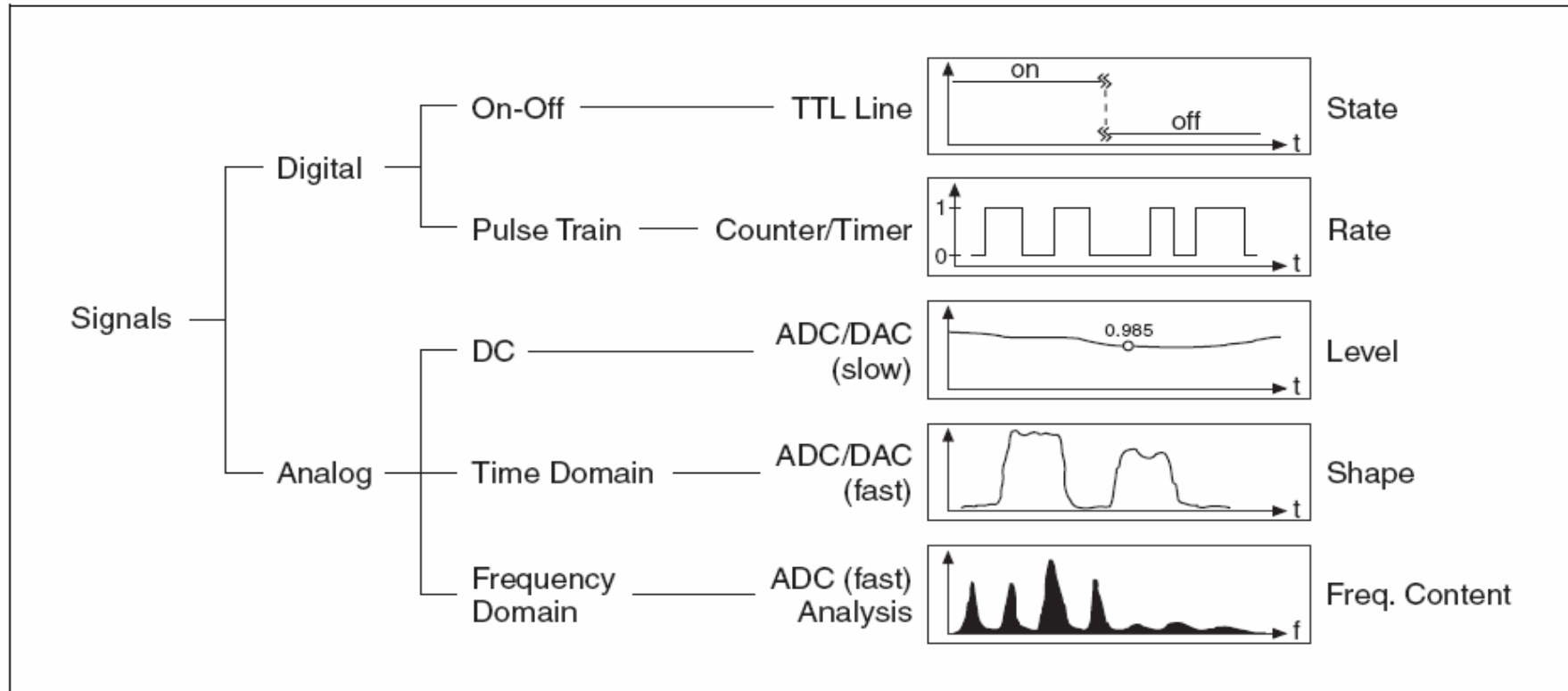
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PC-BASED DATA ACQUISITION



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Signal Types



Number Representation

- ❑ Decimal (Base10)
- ❑ Binary (Base2)
- ❑ 8bits->byte
- ❑ 8bit number 0 to 255
- ❑ Negative decimal numbers – represented by 2's complement
- ❑ 4bit=>0 to 15 OR -8 to +7

Resolution

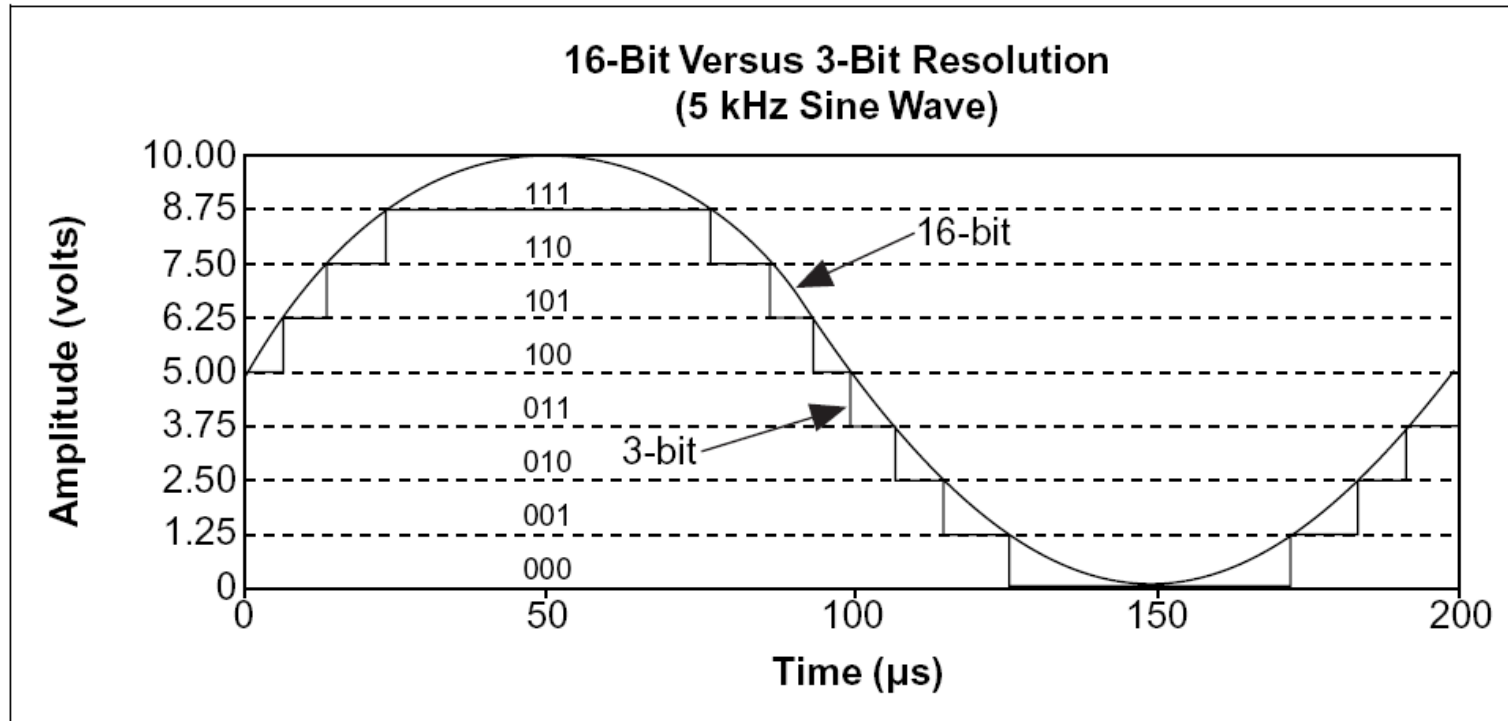


Figure 5-4. The Effects of Resolution on ADC Precision

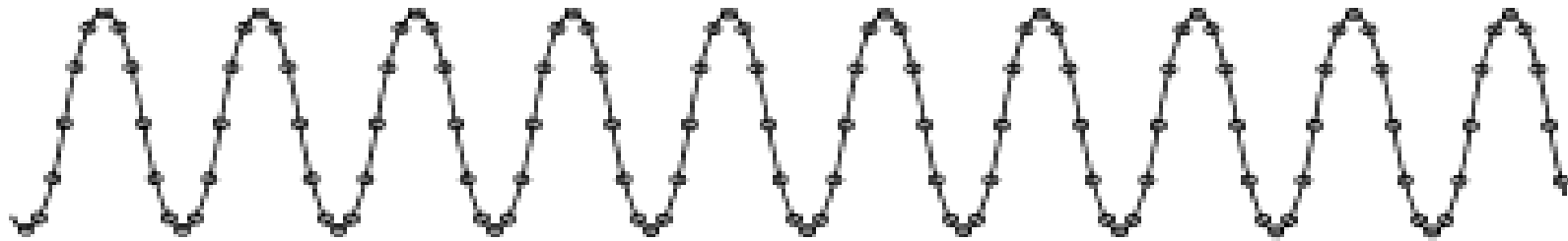
Aliasing

- ❑ Analog signals after digitization (sampling +quantization) are processed by digital systems.
- ❑ Aliasing occurs due to under-sampling. The Nyquist Theorem specifies that no analog signal must have frequencies greater than half the sampling frequency.

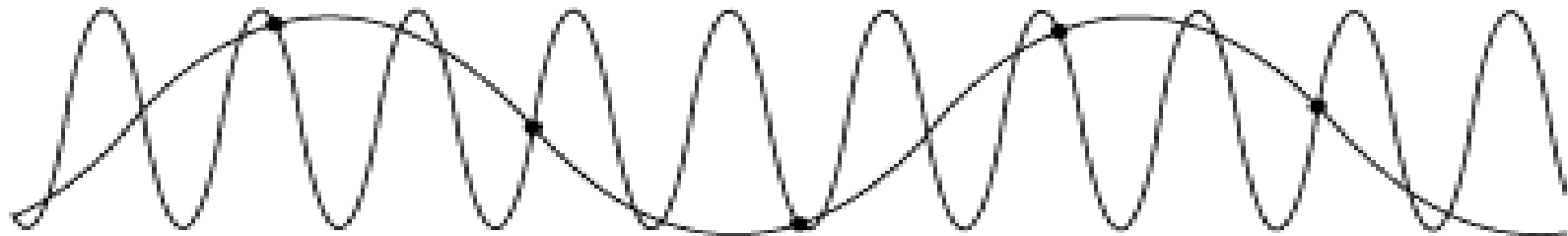
$$F_{\max} \leq 0.5 \text{ SF}$$

- ❑ When this condition is not satisfied the digital frequency is not a true copy of the analog frequency and **aliasing occurs!**

Aliasing Example



Adequately Sampled Signal



Aliased Signal Due to Undersampling

Range and Resolution

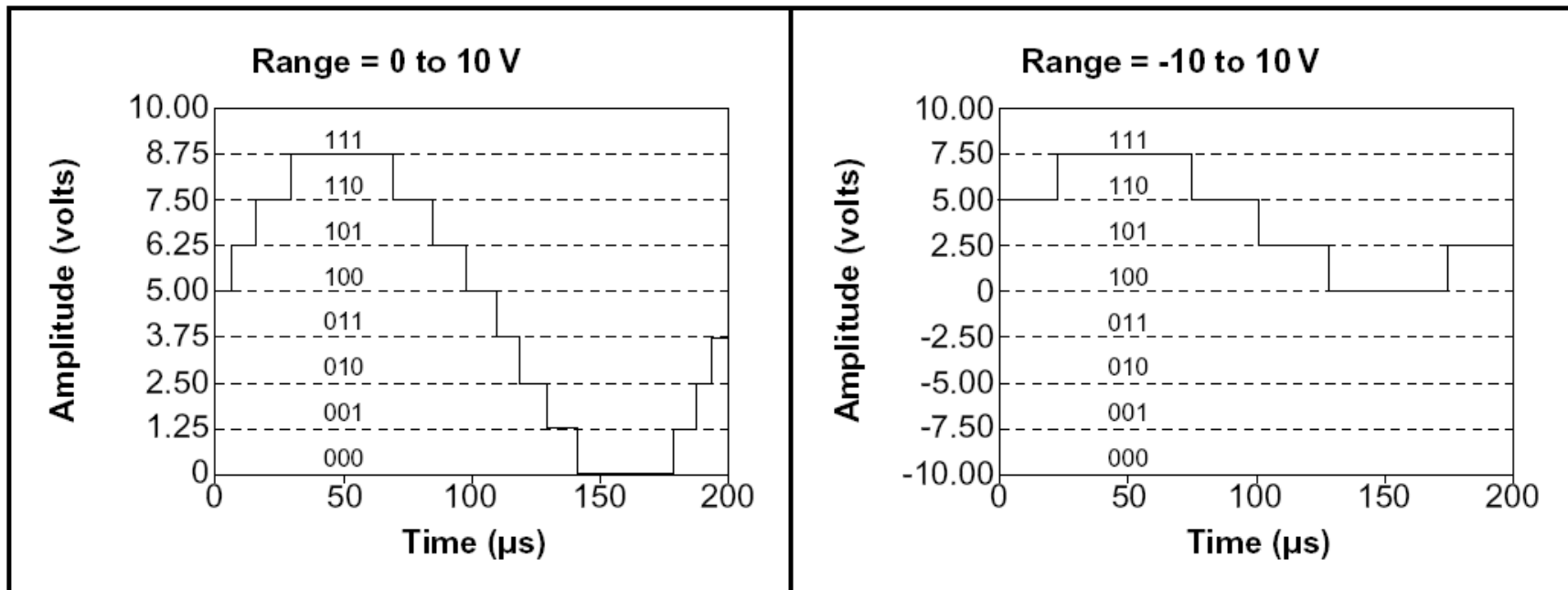
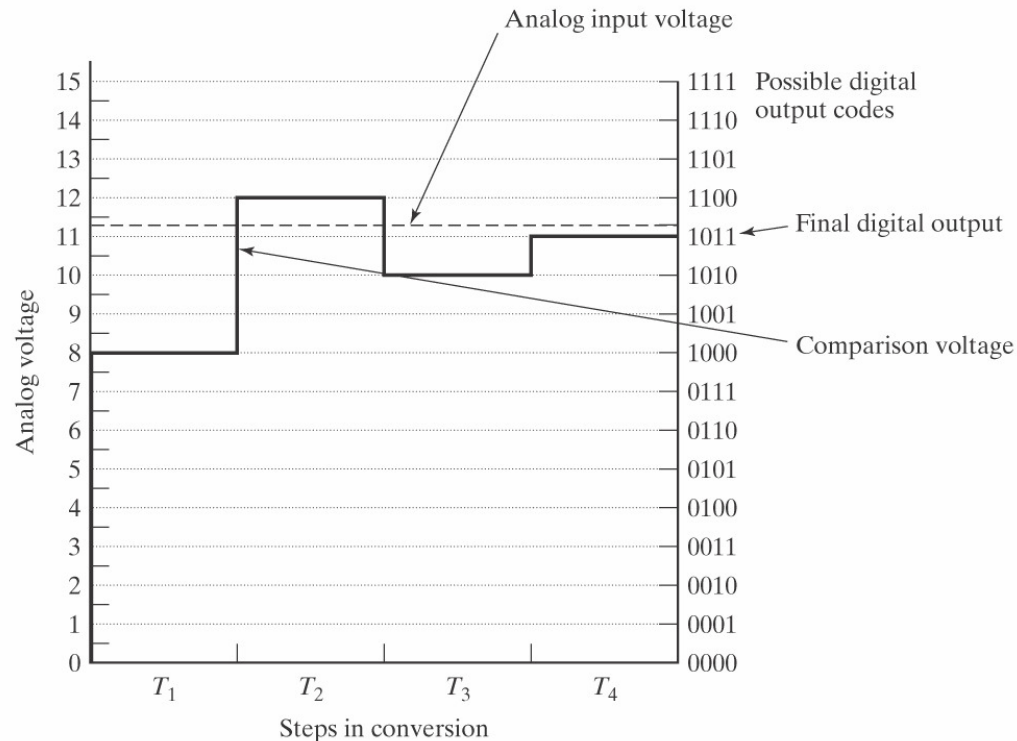


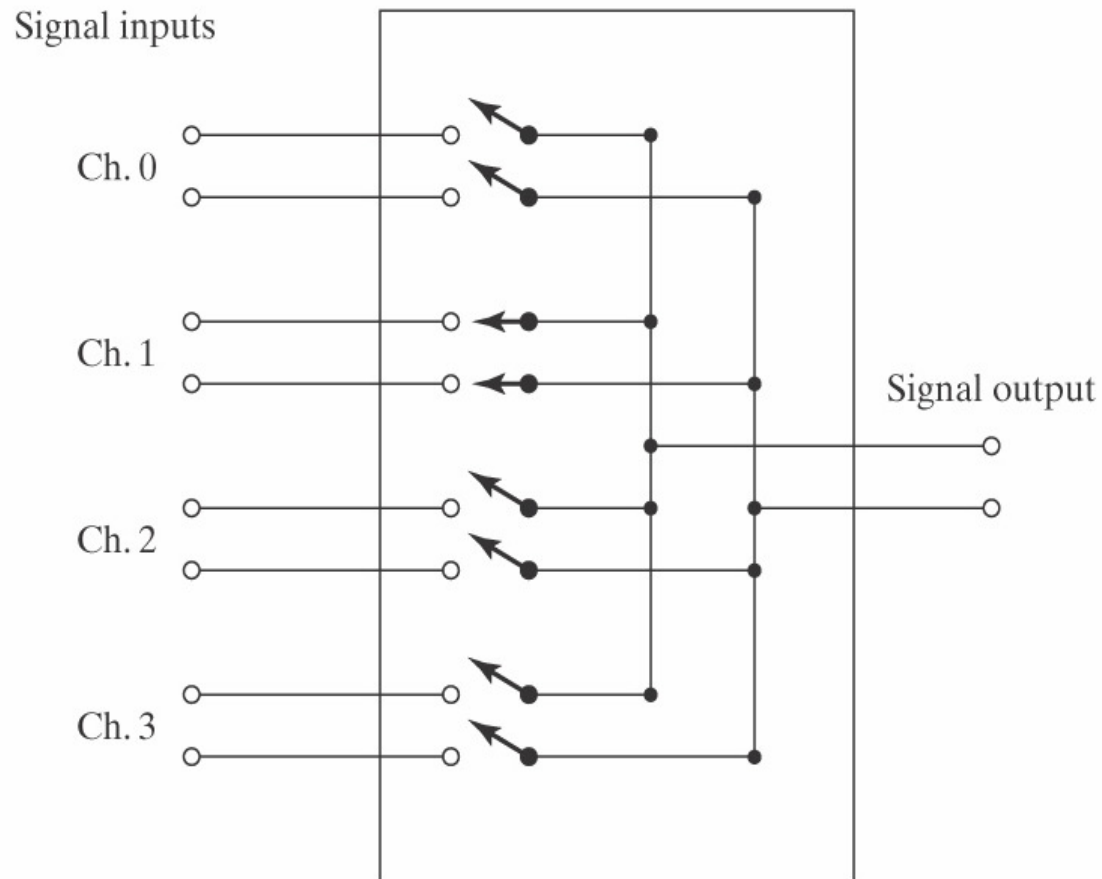
Figure 5-5. The Effects of Range on ADC Precision

A/D Resolution and Quantizing Error

- ❑ Analog inputs converted to digital values are subject to “quantizing” error.
- ❑ What is the (worst case) magnitude of this error?

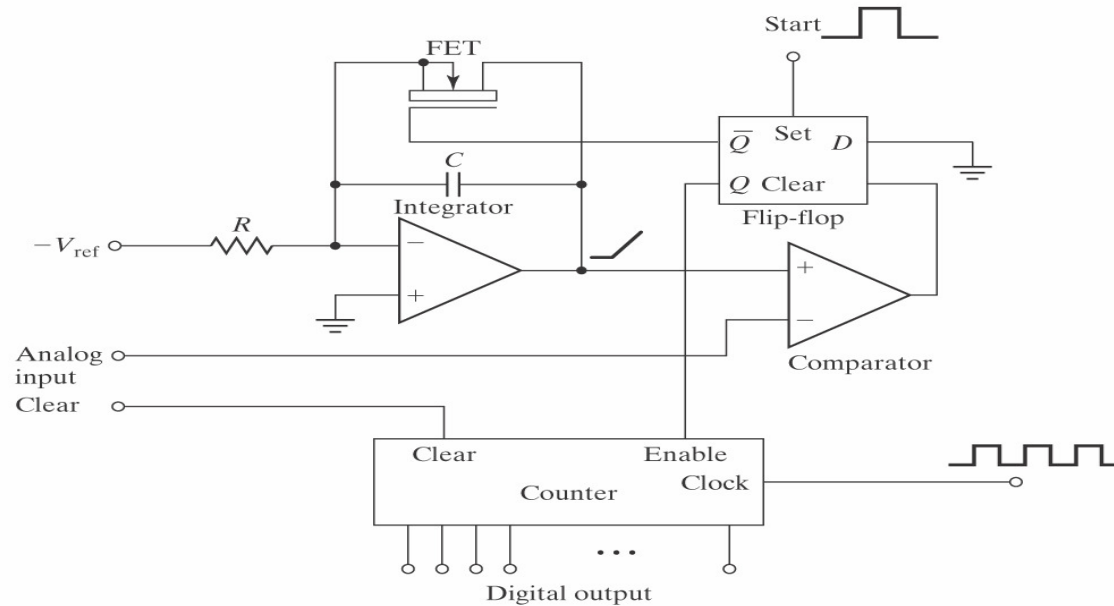


Multiplexing



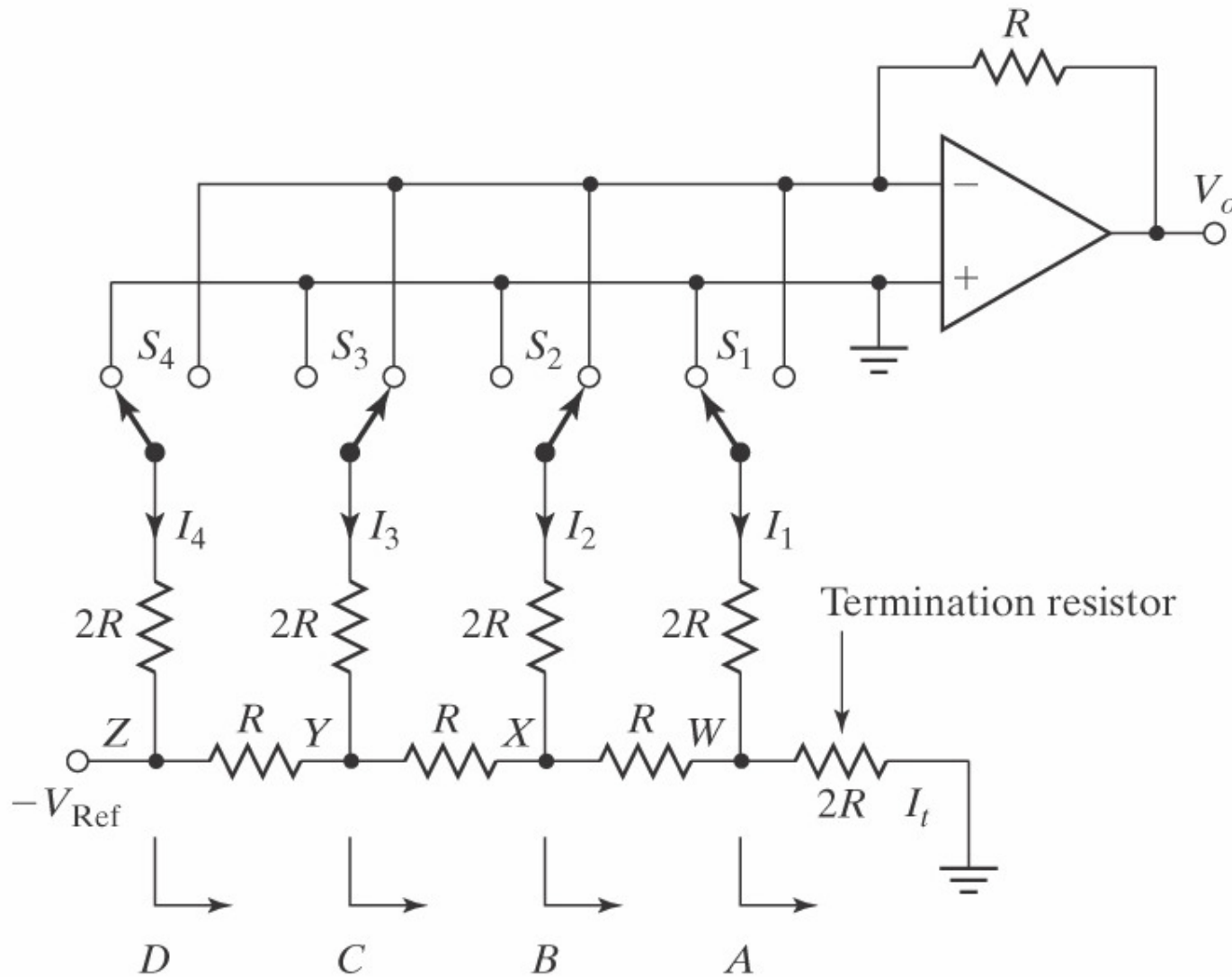
MUX is an essentially an Electronic Switch using which the computer reads information from various channels one at a time

Analog-to-Digital (A/D) Conversion



- Number of bits used to represent the signal
- Input Range – Unipolar/Bipolar
- Conversion speed

Digital to Analog (D/A) Conversion



Amplification

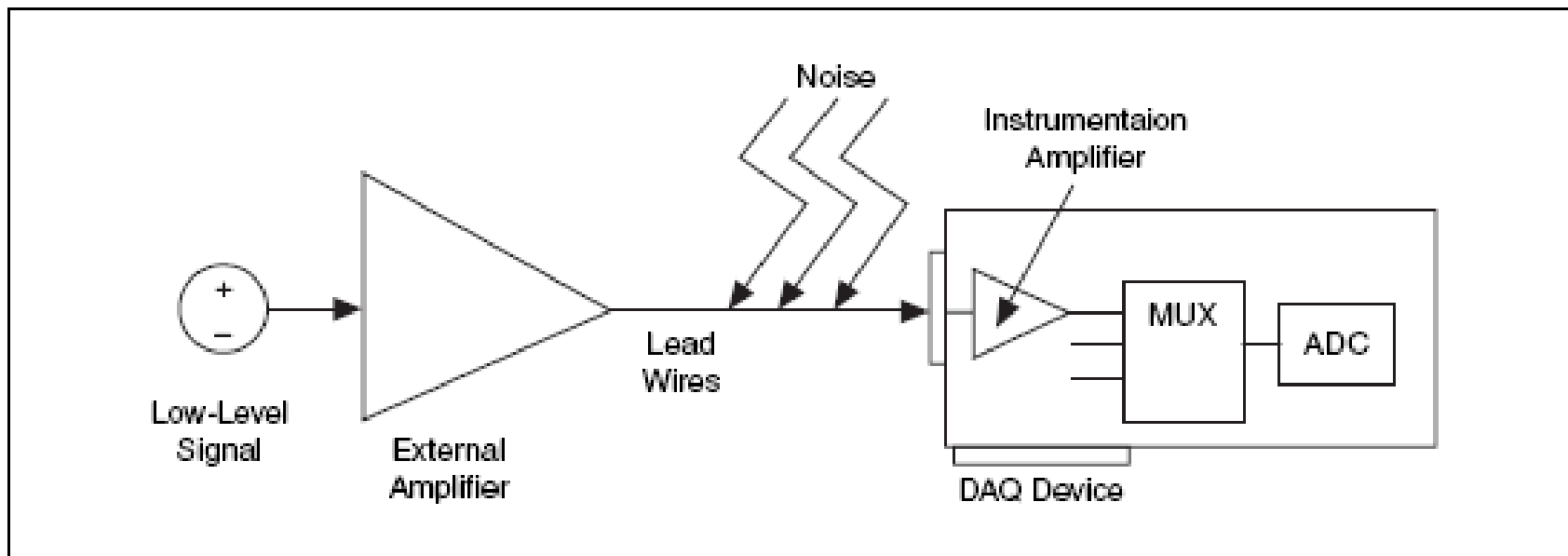


Figure 4-4. Amplifying Signals near the Source to Increase Signal-to-Noise Ratio (SNR)

Single-Ended Measurements

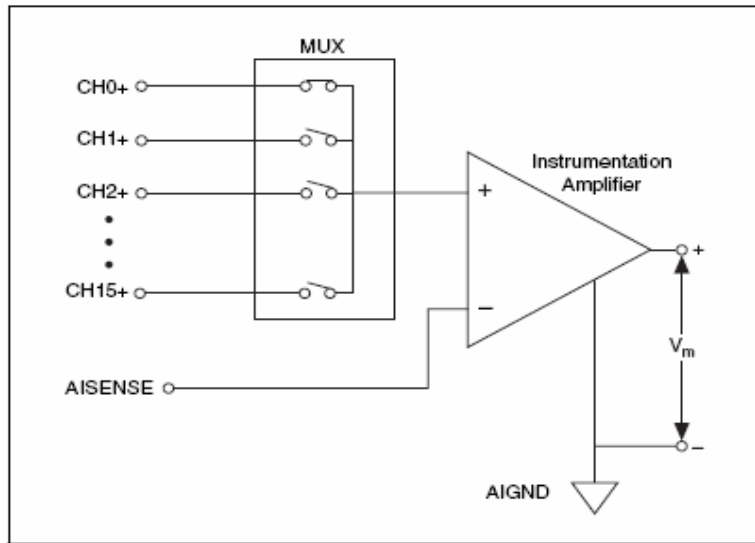


Figure 4-7. Referenced Single-Ended Measurement System

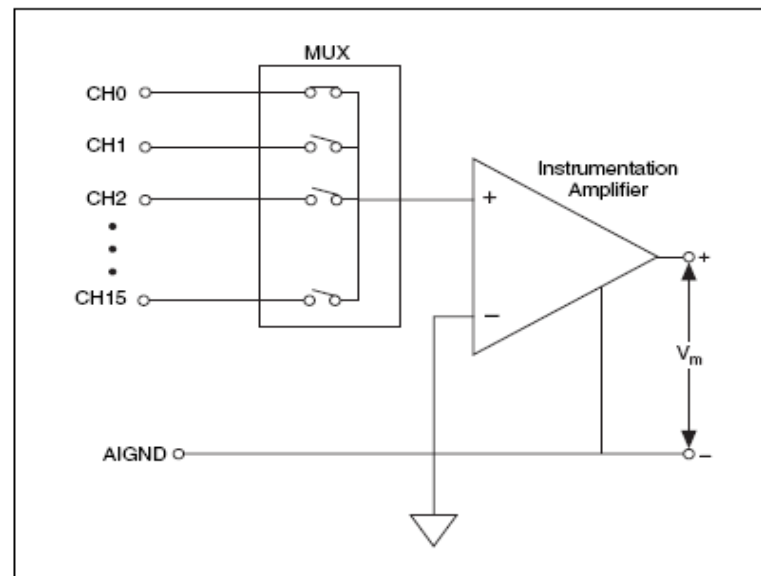


Figure 4-8. NRSE Measurement System

Differential Measurements

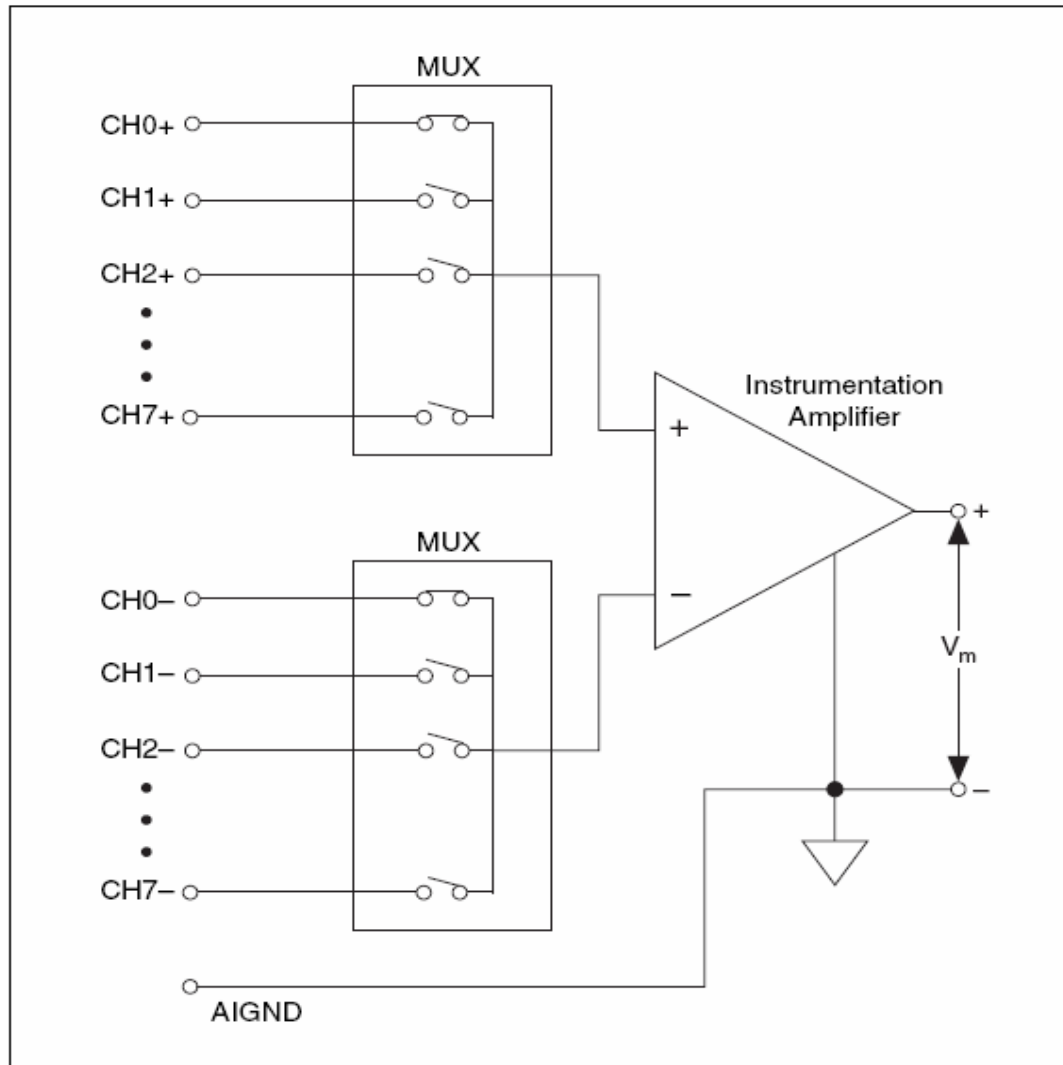


Figure 4-5. Differential Measurement System

Trade-Offs
vs. Single-Ended?