SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

COIMBATORE-35

Accredited by NBA-AICTE and Accredited by NAAC – UGC with A++ Grade

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

19EET202 / DIGITAL ELECTRONICS AND LINEAR INTEGRATED CIRCUITS

II YEAR / III SEMESTER

UNIT-V: OPERATIONAL AMPLIFIER AND TIMER IC

ADC TECHNIQUES

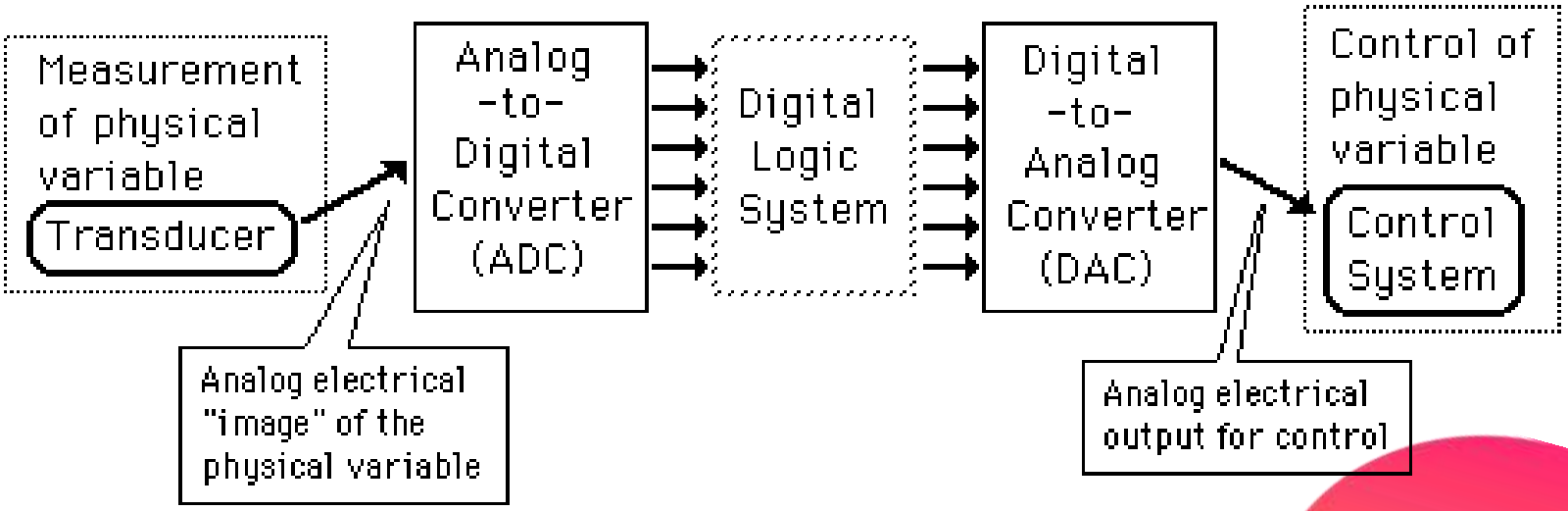
Topics

- Analog to Digital Conversion (ADC)
  - Digital ramp
  - Successive approximation
  - Flash
  - Applications

ADC Basic Principle

- The basic principle of operation is to use the comparator principle to determine whether or not to turn on a particular bit of the binary number output.
- It is typical for an ADC to use a digital-to-analog converter (DAC) to determine one of the inputs to the comparator.

Data Collection and Control



ADC Various Approaches

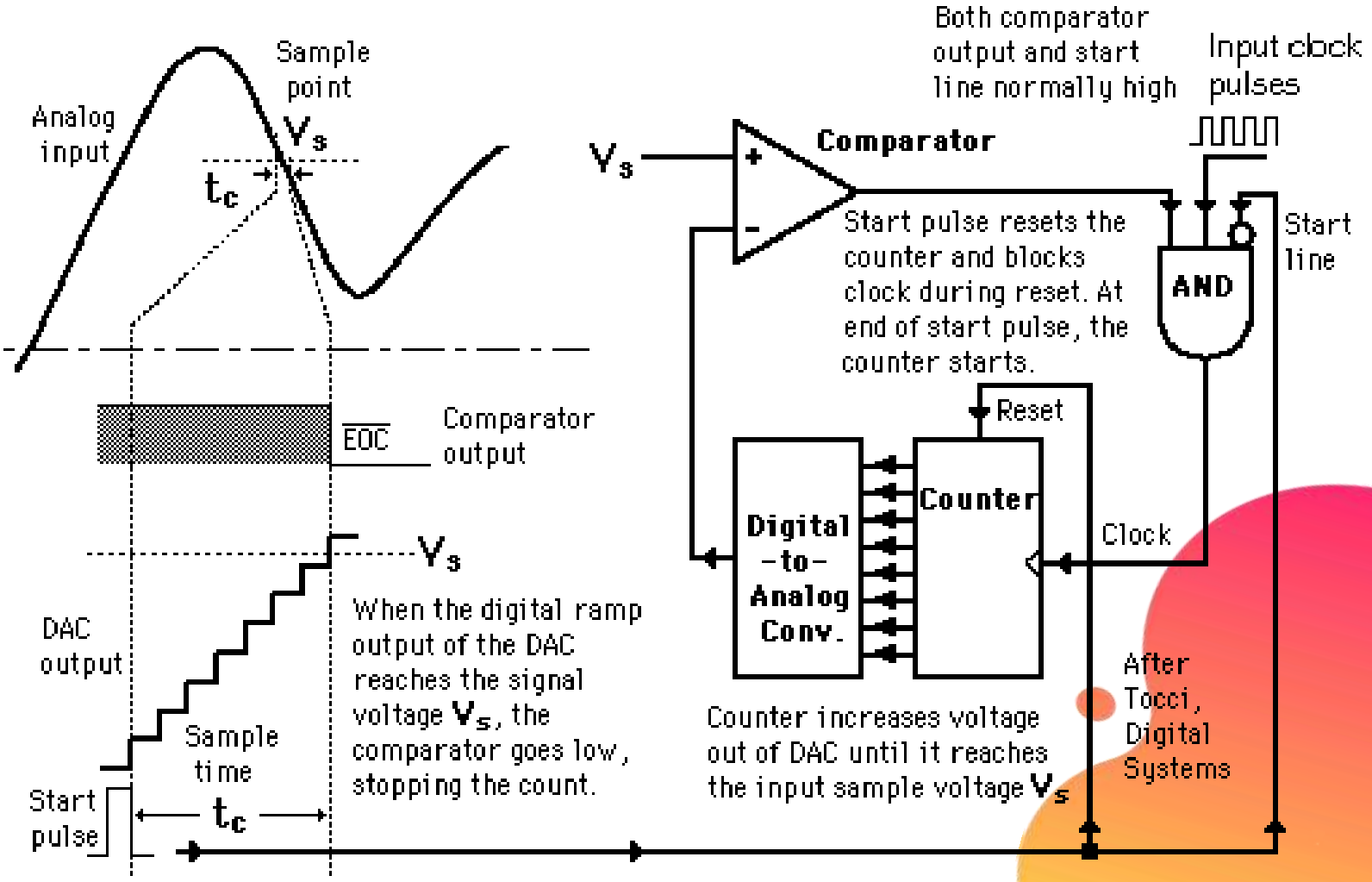
- 3 Basic Types

- Digital-Ramp ADC (Dual slope ADC)
- Successive Approximation ADC
- Flash ADC

Digital-Ramp ADC

- Conversion from analog to digital form inherently involves comparator action where the value of the analog voltage at some point in time is compared with some standard.
- A common way to do that is to apply the analog voltage to one terminal of a comparator and trigger a binary counter which drives a DAC.

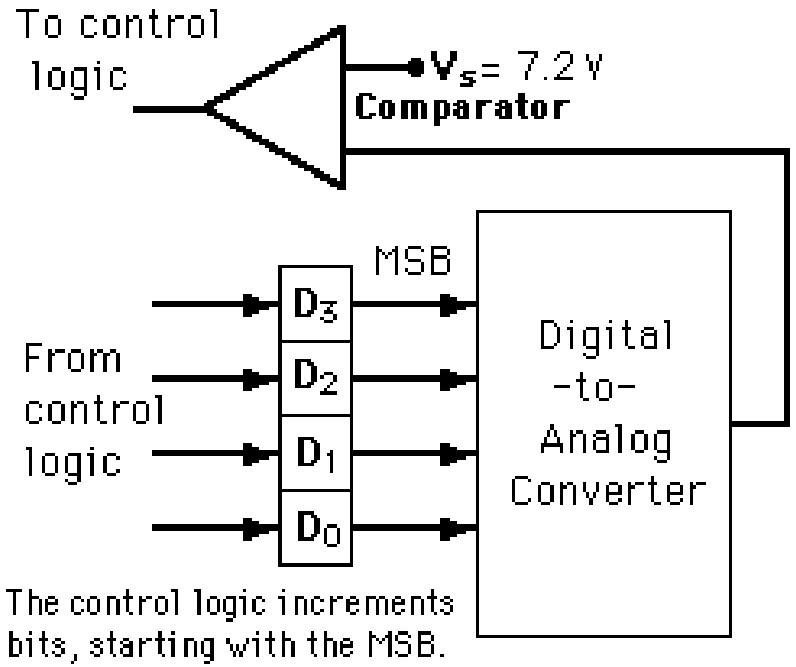
Digital-Ramp ADC



Digital-Ramp ADC

- The output of the DAC is applied to the other terminal of the comparator.
- Since the output of the DAC is increasing with the counter, it will trigger the comparator at some point when its voltage exceeds the analog input.
- The transition of the comparator stops the binary counter, which at that point holds the digital value corresponding to the analog voltage.

Successive approximation ADC



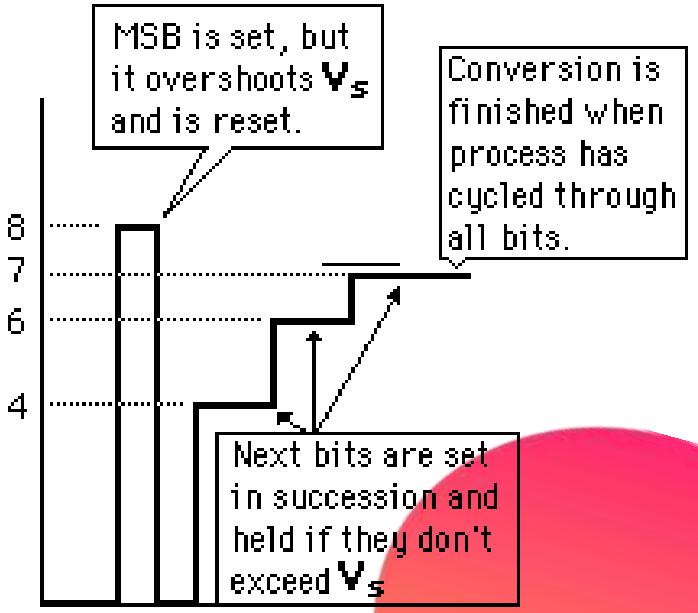
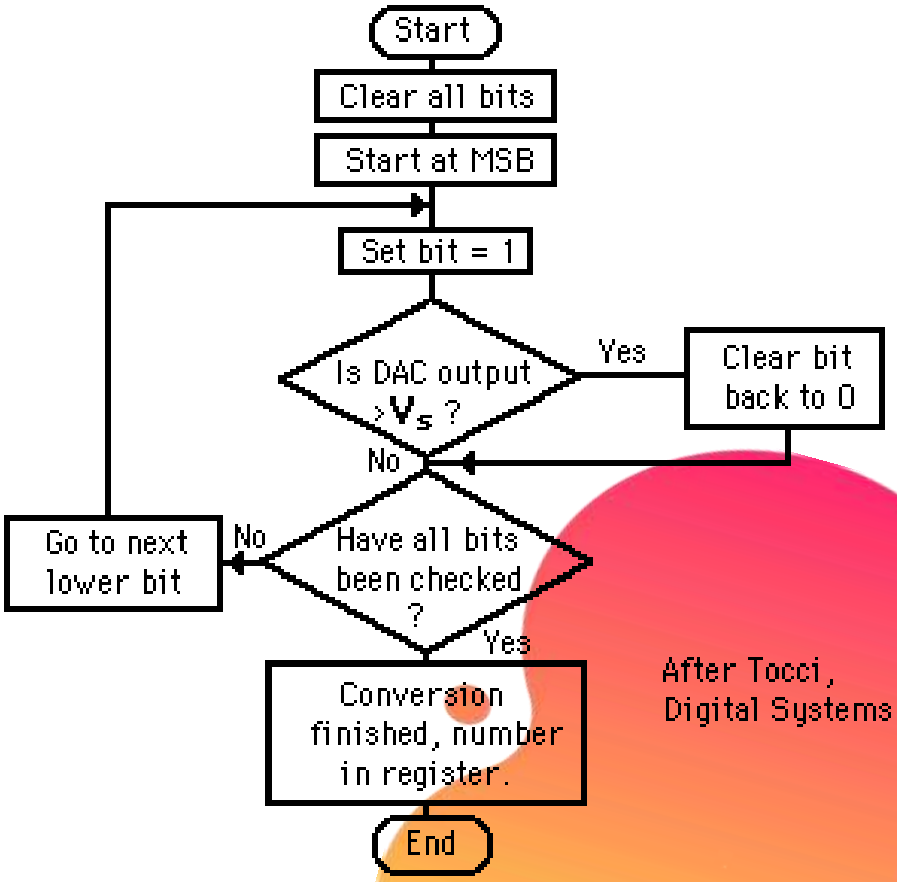


Illustration of 4-bit SAC with 1 volt step size

Successive approximation ADC

- Much faster than the digital ramp ADC because it uses digital logic to converge on the value closest to the input voltage.
- A comparator and a DAC are used in the process.

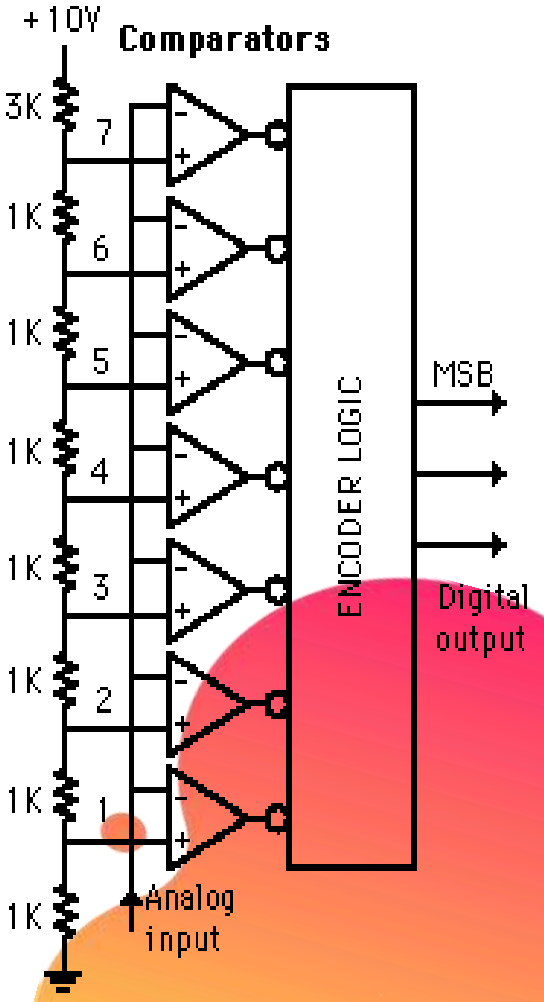


After Tocci, Digital Systems

Flash ADC

- It is the fastest type of ADC available, but requires a comparator for each value of output.

  (63 for 6-bit, 255 for 8-bit, etc.)
- Such ADCs are available in IC form up to 8-bit and 10-bit flash ADCs (1023 comparators) are planned.
- The encoder logic executes a truth table to convert the ladder of inputs to the binary number output.



Illustrated is a 3-bit flash ADC with resolution 1 volt

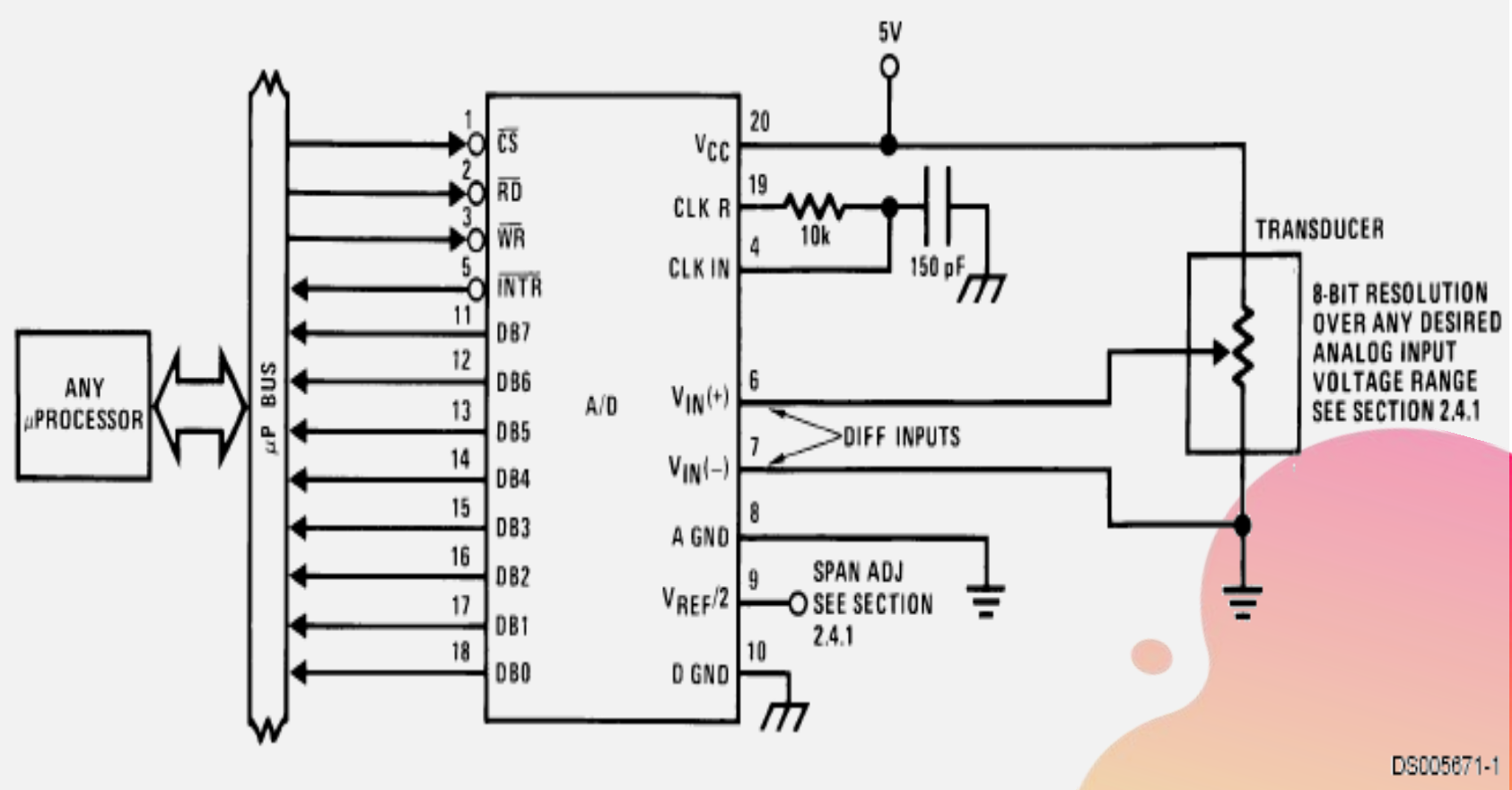
Flash ADC

- The resistor net and comparators provide an input to the combinational logic circuit, so the conversion time is just the propagation delay through the network - it is not limited by the clock rate or some convergence sequence.

ADC080x, 8-Bit µP Compatible A/D Converters

- **CMOS 8-bit successive approximation A/D converters that use a differential potentiometer ladder—similar to the 256R products.**
- **These converters are designed to allow operation with the NSC800 and INS8080A derivative control bus with TRI-STATE output latches directly driving the data bus.**
- **These A/Ds appear like memory locations or I/O ports to the microprocessor and no interfacing logic is needed.**
- **Differential analog voltage inputs allow increasing the common-mode rejection and offsetting the analog zero input voltage value.**
- **In addition, the voltage reference input can be adjusted to allow encoding any smaller analog voltage span to the full 8 bits of resolution.**

ADC080x, interfacing



Q & A

Thank You