Lesson 2
Analog Sensors

Analog sensors

- Analog sensor gives analog output as per the physical condition, such as temperature
- Measures the variations in the parameters with respect to a reference or normal condition and provide the value of sensed parameter after appropriate calculations
- Parameter can be resistance or capacitance change when the value changes

Analog sensor

- Uses the sensor and associated electronic analog
- Circuit
- Analog sensors generate analog outputs as per the
- physical environmental parameters
- Temperature, strain, pressure, force, flex, vapours, magnetic field, or proximity distances.
- Resistance of the sensing component may show
- measurable changes with surrounding pressure or strain or
- magnetic field or humidity.

Analog sensor

- Resistance of the sensing component may show measurable changes with surrounding pressure or strain or magnetic field or humidity
- Resistance of a pressure sensor increases on pressure which creates strain on the sensor

Flex Sensor

- A flex sensor, for example, of 2.2 inch or 4.5 inch length
- Resistance across the sensor strip increases on flexing
- Changed path and deflection of the sensing resistor

Resistance Sensor Examples for temperature

- A temperature sensor senses the change in temperature when that exhibits the measurable change in a characteristic circuit parameter:
- Resistance change in a wire or thermistor
- Current through a reverse biased p-n diode change
- Current output from an integrated circuit for giving current change proportional to the temperature change

Resistance Sensor Example for organic vapours

- A gas sensor senses the change in gas concentration when that exhibits the measurable change in a characteristic circuit parameter:
- Resistance of a sensor of organic-solvent vapours shows measurable drop with the vapours concentration in the vicinity.

Resistance Sensor for Light Intensity Example

- Resistance of a photo-conductor shows measurable drop in presence of light
- The conductivity (reciprocal of resistance) of sensor increasing depending on the radiation intensity

Resistance Sensor for Strain Example

- Resistance of a strain sensor shows measurable increase in presence of strain
- The resistance change is due to dimensional (length and breadth) changes depending on the strain created due to applied stress

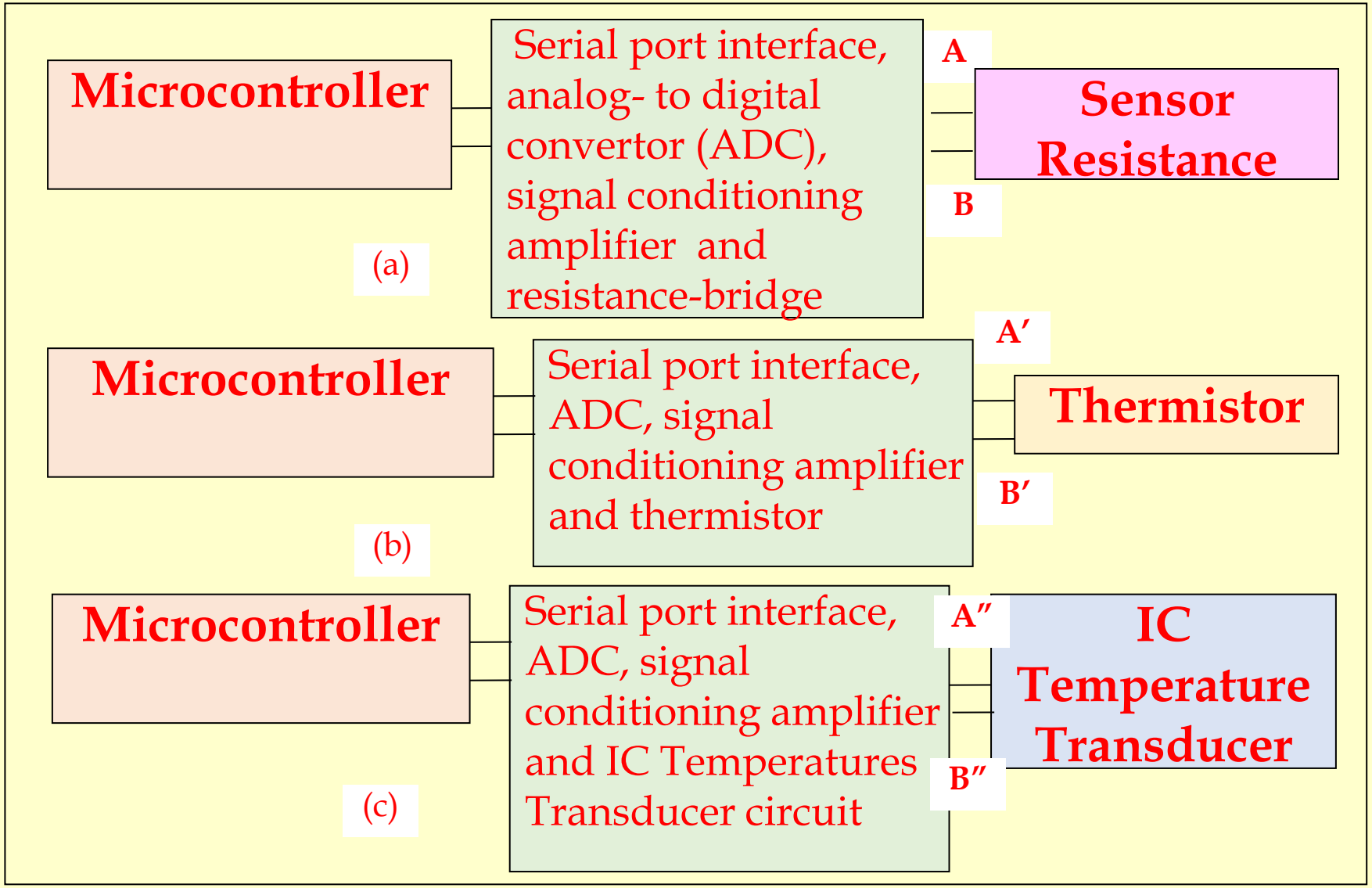

Fig. 7.1 (a) Microcontroller serial port connected to sub-circuits: serial port interface, analog-to digital convertor (ADC), signal conditioning amplifier and resistance-bridge (b) Alternative circuits for using a thermistor or readily available sensor with circuitry or an IC based temperature transducer

Capacitive-Sensor Examples of Relative humidity (RH%) sensors

- RH% sensor when the capacitance of sensing component shows variation with humidity
- Circuit computes RH% from the observed capacitance at the given temperature

Capacitive-Sensor Example of Proximity Sensor

- Proximity sensor when the capacitance of sensing component shows variation with proximity to a specific object, such as metal part or finger.

Capacitive-Sensor Example of Level sensor

- A level sensor capacitor shows variation with level of filler in a container and computes the level upto which the container fills.

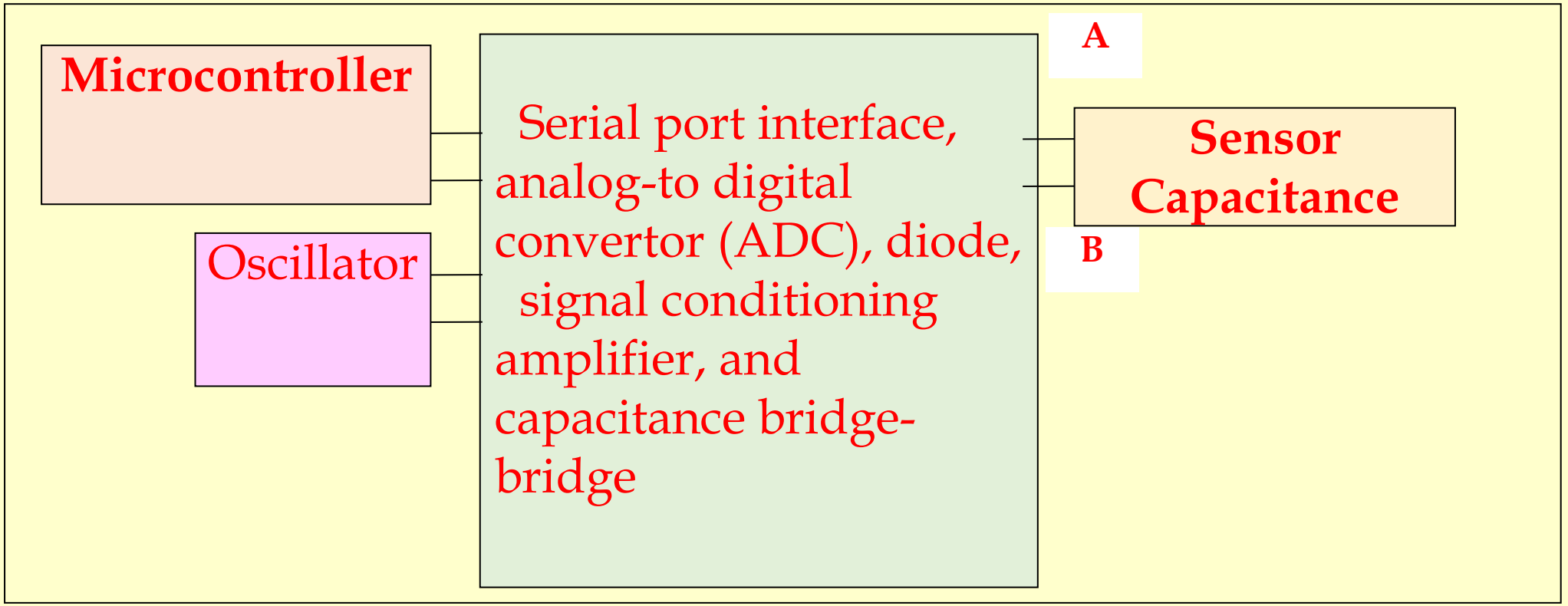

Fig. 7.2 Microcontroller electronic circuit; port connected to sub-circuits; serial port interface, analog-to digital convertor (A/D), diode, signal conditioning amplifier, and capacitance-bridge

Analog sensor circuit

- Uses an ADC internal in a microcontroller or
- External ADC in the circuit between the sensor and a microcontroller port
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Analog to Digital Converter (ADC)

- ADC converts input signals to digital number.
- An 8-bit port accepts 8-bit input which corresponds to 0 to 255 from the ADC
- A microcontroller may consist of in-circuit ADC or multiple
- inputs ADC
- Alternatively, a port accepts digital input consisting of 1s
- and 0s through an external ADC.

Signal Conditioning

- The sensor output voltages low in mV
- ADC range is between Vref- and Vref+. Which is around 2V
- Signal conditioning amplifier amplifies sensor output up to this range.
- Signal conditioning amplifier also provide an offset voltage in the output, as sensor output may not be 0 for the minimum value required to be read

Sampling ADC

- Sampling means that ADC accepting the input signals at the specified periodic intervals
- Converting them into digits
- An interval is set as per the signal frequency and other needs.
- Sampling ADC needed in recording of voice or music
- Sampling ADC receives signals from microphone for recording voice or music

Summary

We learnt

- Analog sensor gives analog output which converts to digital number using amplifier and ADC
- Measures the variations in the parameters with respect to a reference or normal condition
- Provides the value of sensed parameter after appropriate calculations
- Parameter can be resistance or capacitance change when the value changes

Summary

- Temperature, light intensity, strain, and other parameters sensed using resistive sensors
- Relative humidity, liquid level, touched position sensed using capacitive sensor

End of Lesson 2 on Analog Sensors