Chapter 8

Digital and Analog Interfacing Methods
Lesson 11 Part a

Analog Input and Temperature and pressure measuring Interfaces
Vdc or a.c. from an oscillator. Whetstone Bridge
Whetstone Bridge

• All four arms Resistances equal when $R' = 0$, bridge is balanced
• Output = 0V for any analog input when bridge is balanced
Whetstone Bridge

• Assume \( R' \) is resistance of the sensor of a physical quantity.
• All but one Resistance is equal, the output depends on the ratio of \((R + R')/R\), bridge is not balanced
• Output not \( = 0 \text{V} \) for a non-zero analog input when bridge is not balanced
• All Resistances are of the same order, bridge gives maximum sensitivity
RTD (Resistance change on Temperature Detector) senses temperature by resistance changes

\[ R' = R_0[1 + \alpha_T T + \beta_T T^2] \]

or

\[ R' = R_0[1 - \alpha_T T - \beta_T T^2] \]

Temperature

\[ = T \]

RTD Sensor Interface
Bismuth Resistance change on Pressure
Senses Pressure by resistance changes

\[ P' = P_0 \left[ 1 + \alpha_p P + \beta_p P^2 \right] \]

or \[ P' = P_0 [1 - \alpha_p P - \beta_p P^2] \]

Pressure Sensor Interface

Pressure = P

To MCU
ADC input

Signal conditioner

R’
Bi

Vdc

R
GND

R

R
Signal Conditioner

• Design such that output obtained = 0 V for input to ADC when temperature or pressure is at certain minimum limiting value and ADC output is 00000000.

• For obtaining reference Voltage input $V_{\text{ref}}$ to ADC when temperature or pressure is at certain maximum limiting value and ADC output is 11111111.
dc oscillator → ac

Temp. sensor bridge

Keypad

Temp. Display

TxD, RxD

Computer

S/H

Signal conditioner Amplifier

MCU

EEPROM

ADC at MCU

Computer calculation and saving of calibration parameter in EEPROM
Computer calculation and saving of calibration parameter in EEPROM
TxD and RxD Interface to Computer

• Keypad for entering the sample name, physical parameter name, time and date of measurements and other features
• Computer calculation of calibration parameters $\alpha_T$ and $\beta_T$, $\alpha_p$ and $\beta_p$ and saving in EEPROM
• Periodic calculation and revision of calibration parameters and saving in EEPROM (if required)
TxD and RxD Interface to Computer

- Computer records permanently the readings at different instances
- Computer graphical presentations for parameter as a function of time
Summary
We learnt

Analog Inputs from sensors

- Whetstone bridge
- Signal conditioning amplifier and S/H circuit
- MCU ADC input
End of Lesson 11 Part a

Analog Input and Temperature and pressure measuring Interfaces