KECUDO

SENSOR FOUNDATIONS · BOOK 1 OF 2





Sensor Types, Functions & Uses

How sensors work, what each kind measures and where engineers use them

13 Chapters ◆ 78 Practice Problems ◆ 25-Question Quiz

2026 EDITION · ENGINEERING SERIES

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Chapter 1 · From the real world to a number

What Is a Sensor?

A sensor is a device that responds to a physical quantity (the **measurand**: temperature, light, force, distance) and turns it into a signal a circuit can read, almost always a voltage, a current, a resistance or a digital number.



transducer: changes one form of energy into another (here, heat into an electrical signal)

FIG 1.1 · The measurement chain. Every sensor in this book fits this picture; only the sensing element changes.

Term	Meaning	Example
Sensor	detects a quantity and produces a signal	thermistor, microphone
Transducer	converts energy from one form to another	speaker, piezo disc
Actuator	the opposite of a sensor: signal → action	motor, relay, heater
Active sensor	needs excitation power to work	strain gauge, RTD
Self-generating	makes its own signal	thermocouple, solar cell, piezo

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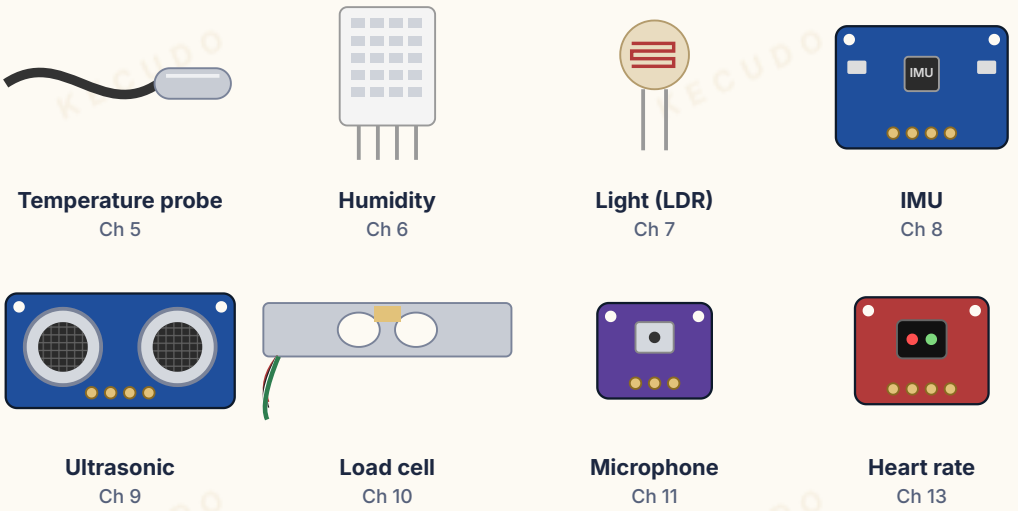


FIG 1.2 · A first look at the sensor families in this book. All drawings are simplified; real parts vary.

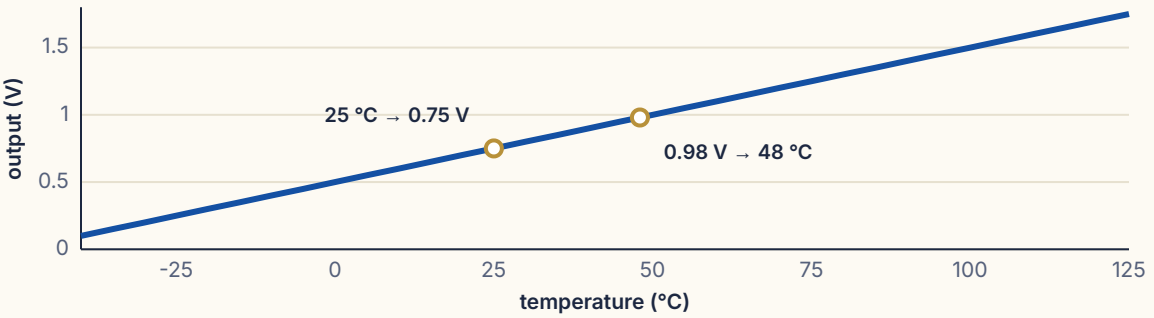


*FIG 1.3 · A linear sensor's **transfer function**: the TMP36 analog temperature IC outputs 0.5 V plus 10 mV per °C.*

Worked example · read a linear sensor

1. Transfer function: V = 0.5 + 0.010 × T, so T = (V − 0.5) / 0.010.
2. The ADC reads 0.98 V: T = (0.98 − 0.5) / 0.010 = **48 °C**.
3. At 25 °C the output is 0.5 + 0.25 = **0.75 V**, the datasheet's check point.

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Chapter 2 · Accuracy is not precision

Specs That Matter & Reading a Datasheet

Two sensors can both claim to measure 0–100 °C and still behave very differently. The datasheet tells you how: its range, resolution, accuracy, response time and drift decide whether a part suits your job.



FIG 2.1 · Accuracy is closeness to the true value (the gold centre); precision is how tightly repeat readings cluster.

Spec	Question it answers	Typical wording
Range	What values can it measure?	−40 to +85 °C
Resolution	Smallest change it can report	0.01 °C
Accuracy	How far from the truth, worst case?	±1.0 °C
Repeatability	Same input, same output?	±0.1 °C
Sensitivity	Output change per unit input	10 mV/°C
Response time	How fast does it settle?	τ = 1 s (63 %)
Hysteresis · drift	Depends on history? Changes with age?	±0.5 %RH/yr

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Chapter 3 · Sort by what, then by how

The Sensor Family Map

There are thousands of sensor part numbers, but they fall into a handful of families. Engineers sort them two ways: by **what** they measure (the measurand) and by **how** they measure it (the physical principle).

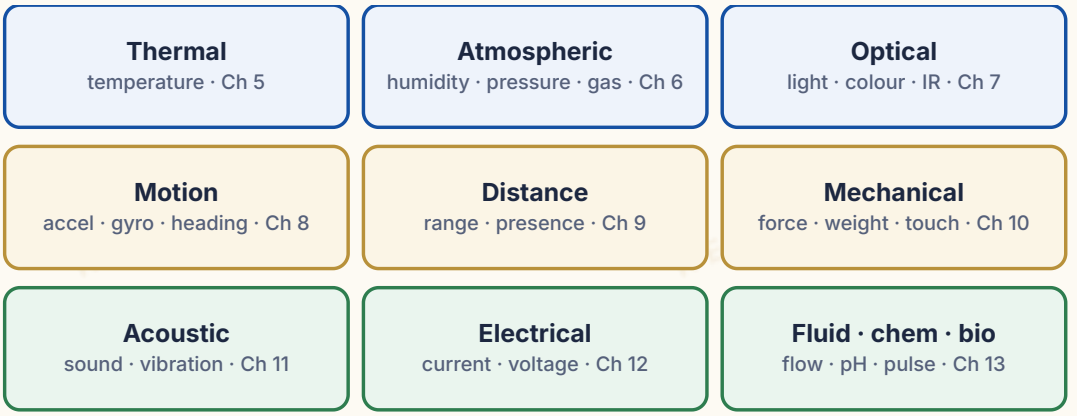


FIG 3.1 · Nine families by measurand. Chapters 5–13 take them one at a time.

Principle	What changes	Example sensors
Resistive	resistance	thermistor, RTD, LDR, strain gauge, FSR
Capacitive	capacitance	humidity, touch, soil moisture, MEMS pressure
Magnetic	magnetic field	Hall sensor, magnetometer, current sensor
Piezoelectric	charge under stress	knock / vibration sensor, ultrasonic transducer
Optical	photons → current	photodiode, ToF ranger, PPG heart-rate
Thermoelectric	voltage from ΔT	thermocouple, thermopile (IR thermometer)

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Part A · Basics

1. A device that turns a physical quantity into an electrical signal is a…

A. actuator

B. sensor

C. relay

D. regulator

2. Closeness of a reading to the true value is called…

A. precision

B. resolution

C. accuracy

D. sensitivity

3. Which sensor generates its own voltage?

A. thermocouple

B. thermistor

C. LDR

D. strain gauge

4. Which bus uses only one data wire plus ground?

A. SPI

B. I²C

C. UART

D. 1-Wire

5. A PIR sensor detects…

A. distance in mm

B. moving warm bodies

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Thank you for learning with Kecudo.

NEXT IN THE SERIES

Book 2: Choosing, Buying & Building

Pick the right grade and interface, buy from the right shop at the right price, and build complete sensor projects.

Book 1 Sensor Types, Functions & Uses · Book 2 Choosing, Buying & Building with Sensors

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