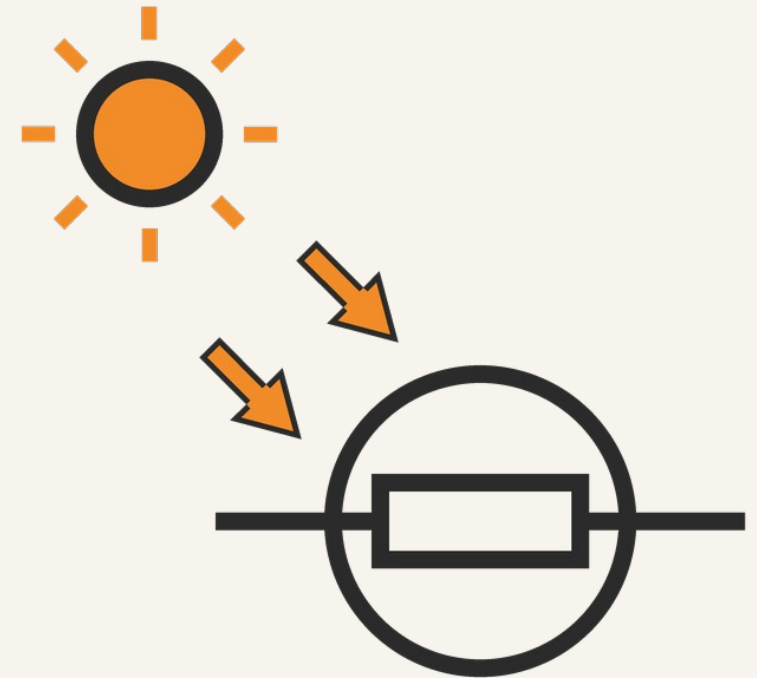


BOOKLET 3 • ELECTRONICS AND ANALOGUE
CONTROL

Input and Output Devices

The components that let a circuit
sense the world, and act on it.

National 5 Engineering Science



Daily Review

Lesson 3 — Electrical Power

- 1 State the three power relationships.
- 2 What is the unit of power?
- 3 A 12 V lamp takes 0.5 A. Find the power.
- 4 0.2 A through 100 Ω . Find the power.
- 5 State Ohm's Law.

PART 1

Transducers

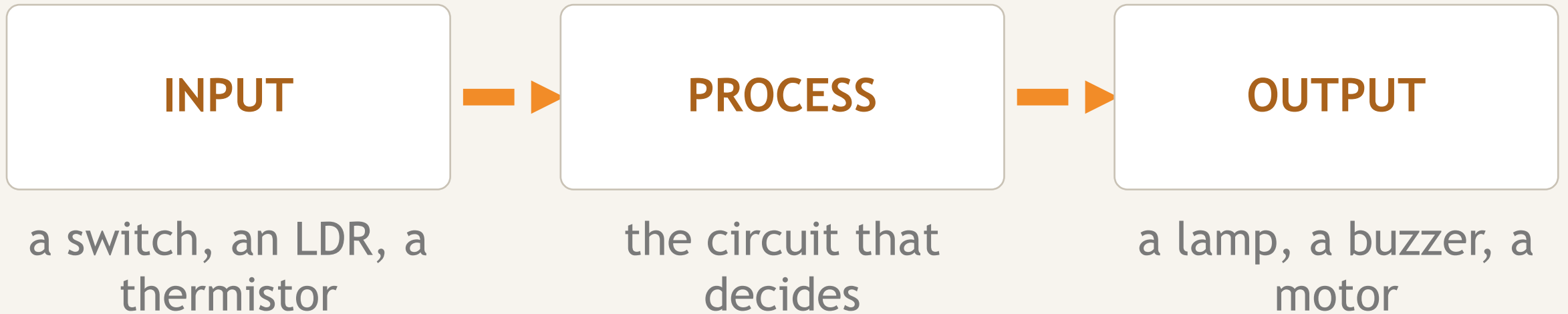
Every engineered system takes something in, does something with it, and puts something out.

By the end of this part...

- 1 I can identify common input transducers
- 2 I can identify common output transducers
- 3 I can describe what a sensor does in an engineered system

Input, process, output

Booklet p.17



What a transducer is

Booklet p.17

Input transducer

Changes a real-world input into an electrical signal.

Output transducer

Changes an electrical signal into a real-world output.

Common input transducers

Booklet p.17

Component	Reacts to...	Engineering example
Switch	pressed or moved	machine start button
Variable resistor	turned by hand	volume control
LDR	light falling on it	automatic street light
Thermistor (NTC)	temperature	oven temperature

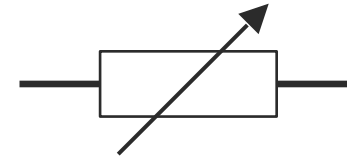
Their symbols – the two you turn or press

Booklet p.4-5 – the symbols you drew in Lesson 1



Switch

opens and closes the circuit

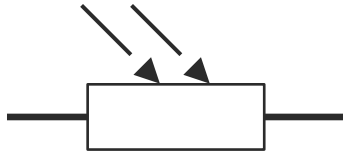


Variable resistor

adjusted by hand

Their symbols – the two that sense

Booklet p.4-5 – the symbols you drew in Lesson 1



LDR

resistance changes with light



Thermistor (NTC)

resistance changes with
temperature

Common output transducers

Booklet p.17

Component	Output	Engineering example
Lamp / LED	light	warning indicator
Buzzer	sound	alarm system
Motor	movement	fan, pump, robot arm
Relay	switches another circuit	switches a big motor

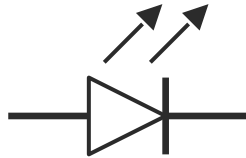
Their symbols – light, sound and movement

Booklet p.4-5 – the symbols you drew in Lesson 1



Lamp

produces
light



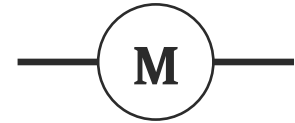
LED

lights one
way round



Buzzer

produces
sound



Motor

rotates

Your turn – TASK 3

Booklet p.17 – TASK 3: Match the Sensor

Complete the Input transducer column.
One word per row – the component name.
Five engineering jobs, five sensors.

Booklet p.17 – TASK 3: Match the Sensor

TASK 3 – Answers

ANSWERS

Booklet p.17 – Match the Sensor

Engineering job	Input transducer
Switch on a security light when it gets dark	LDR
Turn on a fan when a room gets too warm	Thermistor (NTC)
Sound an alarm when an oven door opens	Switch (microswitch)
Dim a lamp by turning a knob	Variable resistor
Detect a person on a floor sensor	Switch (pressure pad)

Show me — input or output?

SHOW ME BOARDS

- 1 A buzzer in a reversing alarm.
- 2 An LDR on a street light.
- 3 A motor in a cooling fan.
- 4 A thermistor in an oven.
- 5 A push button that starts a machine.

Show me – input or output?

SHOW ME BOARDS

EXTRA PRACTICE

- 1 A lamp on a control panel.
- 2 A variable resistor used as a volume control.
- 3 A relay switching a mains heater.
- 4 A microswitch on a machine guard.
- 5 An LED showing that a circuit is live.

Show me – which transducer?

SHOW ME BOARDS

- 1 Detect when a fridge door is left open.
- 2 Switch a greenhouse fan on when it gets hot.
- 3 Turn a garden light on at dusk.
- 4 Warn a driver that a seatbelt is unfastened.
- 5 Let a user set the speed of a model car.

Show me – which transducer?

SHOW ME BOARDS

EXTRA PRACTICE

- 1 Detect when a lift has reached a floor.
- 2 Switch a heater off when a room is warm enough.
- 3 Turn a car's headlights on in a tunnel.
- 4 Show that a kettle has finished boiling.
- 5 Let a user set the brightness of a lamp.

Checkpoint

- 1 Name two input transducers and say what each reacts to.
- 2 Name two output transducers and say what each produces.
- 3 A relay is an output transducer, but it produces no light, sound or movement. What does it do, and why is that useful?

Daily Review

Part 1 — Transducers

- 1 What does an input transducer do?
- 2 Name an output transducer that produces sound.
- 3 What does an LDR react to?
- 4 Draw the symbol for a thermistor.
- 5 Name an input transducer for a machine guard.

PART 2

How the Sensors Behave

An LDR and a thermistor are both just resistors that change — and both change the same way round.

By the end of this part...

- 1 I can describe how an LDR reacts to changing light level
- 2 I can describe how an NTC thermistor reacts to temperature
- 3 I can compare calculated, simulated and measured values

How an LDR behaves

Booklet p.18

In bright light

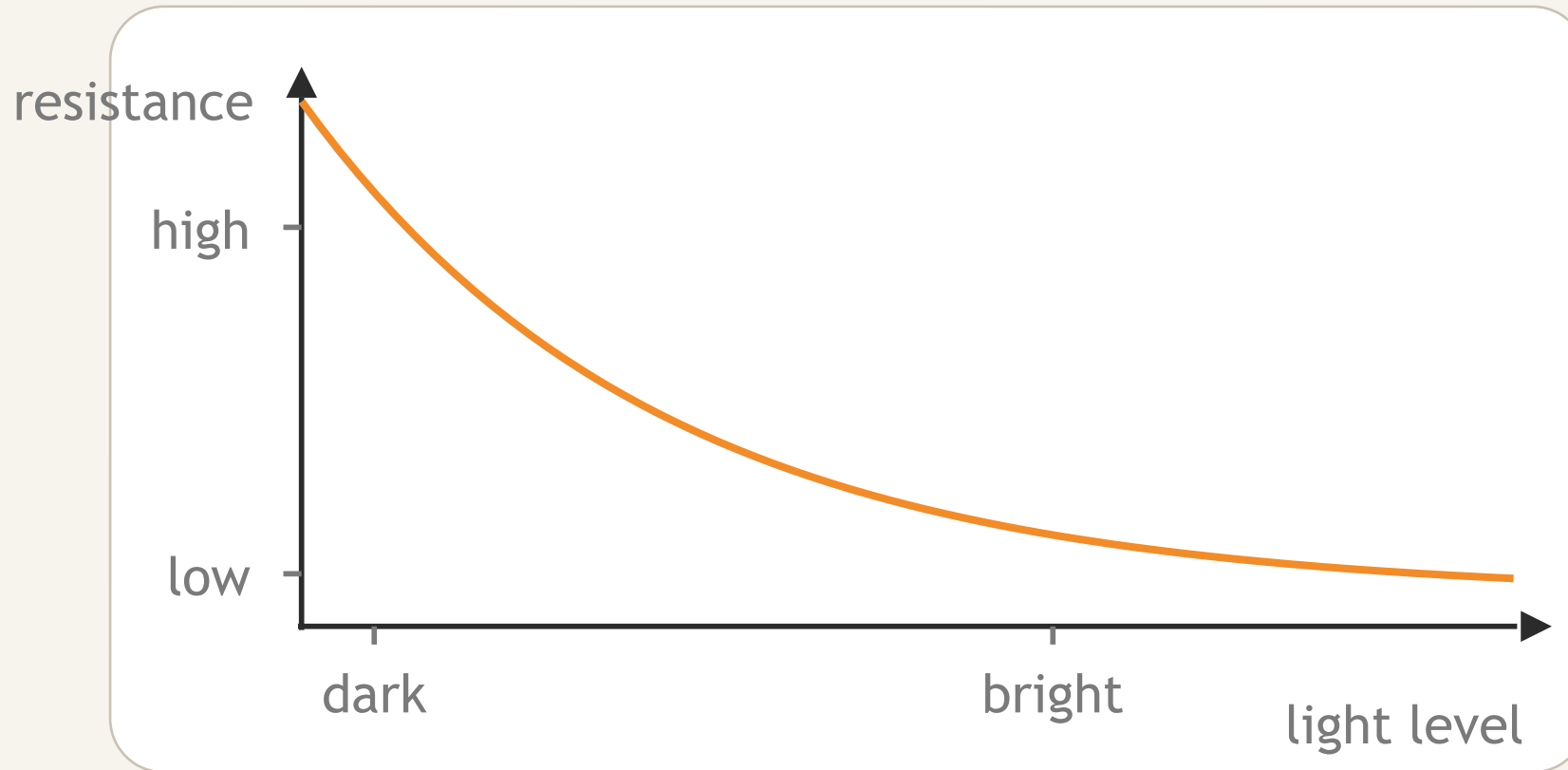
The resistance is low — a few hundred ohms.

In darkness

The resistance is high — often hundreds of kilohms.

The LDR's characteristic

Booklet p.18



More light, less resistance.

How an NTC thermistor behaves

Booklet p.18

When it is hot

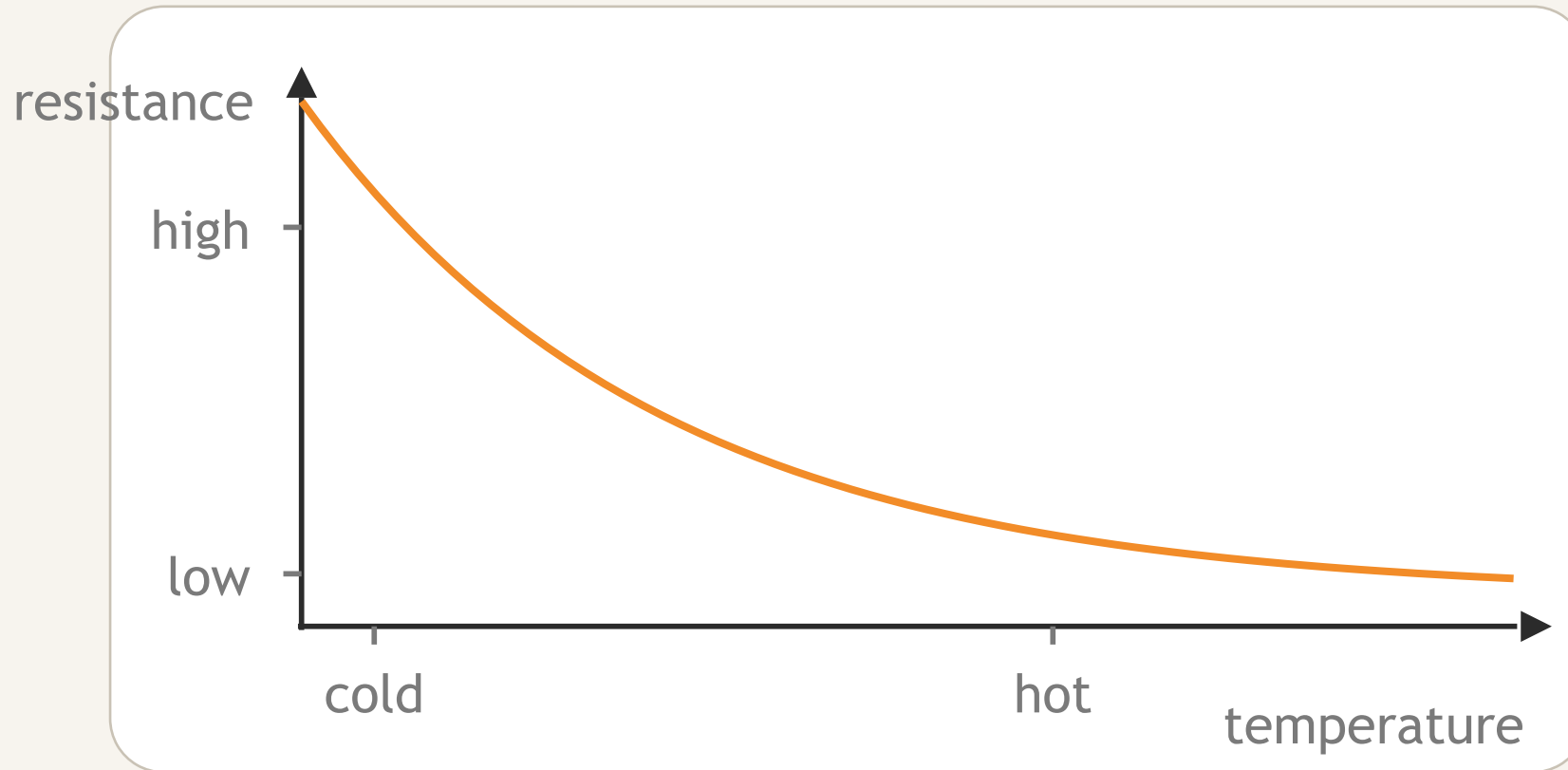
The resistance is low.

When it is cold

The resistance is high.

The thermistor's characteristic

Booklet p.18



More heat, less resistance. Same shape as the LDR.

Watch out

THE MISTAKE

- "NTC means the resistance goes negative"
- "Dark makes the LDR conduct better"
- "Hot makes the thermistor resist more"

THE CORRECT ANSWER

- It means resistance FALLS as heat rises
- Dark means HIGH resistance
- Hot means LOW resistance

PRACTICAL — collect the data

Booklet p.18 — Collect the data

Aim

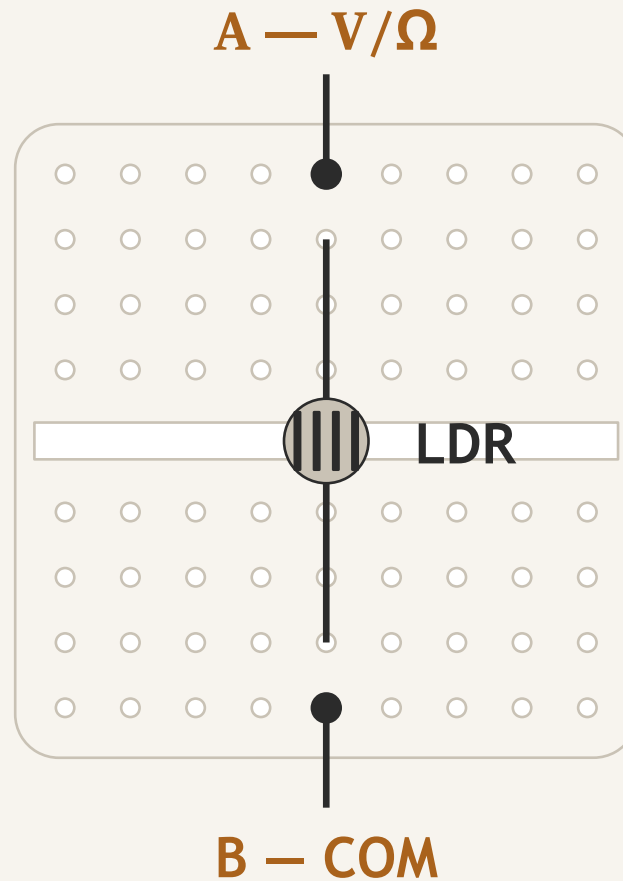
To measure how the resistance of an LDR and an NTC thermistor change.

Equipment

LDR · NTC thermistor ·
breadboard · connecting leads ·
multimeter · lamp · beaker of
warm water

The board layout

Booklet p.18 – the sensor bridges the centre channel



Your turn – the practical

Booklet p.18 – Collect the data

Set the multimeter to measure resistance (Ω).
Read the LDR at five light levels.
Read the thermistor at four temperatures.
Write every reading in your booklet table.

Booklet p.18 – Collect the data

What your tables should show

ANSWERS

Booklet p.18 – Collect the data

LDR row	Reading	Thermistor row	Reading
very bright	lowest	Fire	lowest
normal room light	middle	Hand	middle
very dark	highest	Ice	highest

The trend is marked, not the numbers.

Your turn – the practice questions

Booklet p.19-20 – PRACTICE: Input and Output Devices

Answer questions 1 to 10 in your booklet.
The marks are printed beside each question.
Questions 6 and 7 use your own readings
from the practical, not a number from the
board.

Booklet p.19-20 – PRACTICE, Q1-10

PRACTICE – Answers, Q1-4

ANSWERS

Booklet p.19-20 – Input and Output Devices

Q	The answer	Marks
1	changes a real-world input into an electrical signal	1
2	changes an electrical signal into a real-world output	1
3	the resistance increases	1
4	the resistance increases	1

PRACTICE – Answers, Q5-7

ANSWERS

Booklet p.19-20 – Input and Output Devices

Q	The answer	Marks
5	input: thermistor · output: motor (the fan)	2
6	your own LDR reading for room light – typically a few hundred ohms to a few kilohms	1
7	your own thermistor reading for the Hand row, which is the ~30 °C one – lower than the Room row	1

PRACTICE — Answers, Q8-10

ANSWERS

Booklet p.19-20 — Input and Output Devices

Q	The answer	Marks
8	a lamp and an LED	2
9	a small circuit switches a much larger one, and the two stay electrically separate	2
10	a switch — a microswitch or limit switch on the guard	1

Exam practice

National 5 Engineering Science 2024 Q10 – a kettle

Part	What it asks	Marks
10(a)	read a type 2 thermistor's resistance at 85 °C off the graph	1

The paper gives you the characteristic. Read it the way you read your own.

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LOOKING AHEAD

Voltage Dividers

Turning a changing resistance into a changing voltage.

Plenary

- 1 What does an input transducer do?
- 2 Name three output transducers and what each produces.
- 3 Describe how an LDR's resistance changes as it gets darker.
- 4 Describe how an NTC thermistor's resistance changes as it gets hotter.
- 5 Choose an input and an output transducer for an oven-door alarm.

- 1 What does an output transducer do?
- 2 Name three input transducers and what each reacts to.
- 3 Describe how an LDR's resistance changes as it gets brighter.
- 4 Describe how an NTC thermistor's resistance changes as it cools.
- 5 Choose an input and an output transducer for an automatic street light.

Extension

- 1 Why is an LDR no use as a sensor inside a sealed metal box?
- 2 A thermistor is put in a kettle. Why does it respond faster than a thermometer in the same water?
- 3 Suggest a system that needs two different input transducers, and say what each one is for.

- 1 Why is a thermistor no use for measuring how fast something is moving?
- 2 An LDR is fitted outside a house. Why might it switch a security light on during the day?
- 3 Suggest a system that needs two different output transducers, and say what each one is for.