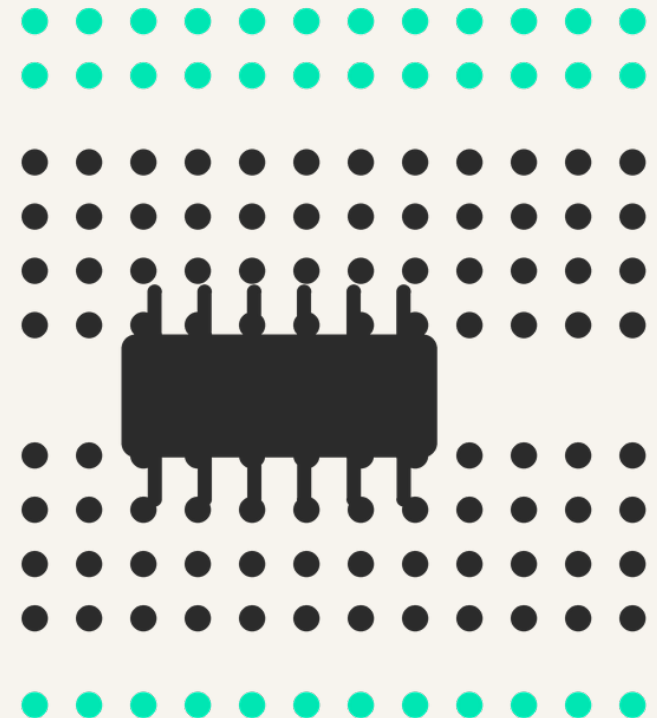


N5 ELECTRONICS • LOGIC

Breadboard Prototyping

Prove the design before you commit it to solder.

National 5 Practical Electronics



LEARNING INTENTION

To build and fault-find a working logic circuit on prototype board.

Daily Review

SHOW ME BOARDS

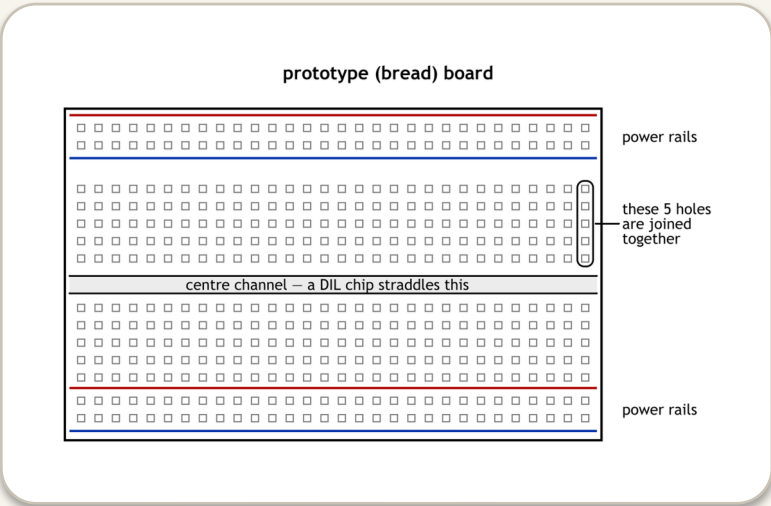
- 1 Which pin is +5 V on a 14-pin chip, and which is 0 V?
- 2 Which resistor makes a closed switch read logic 1?
- 3 What value of pull-down resistor?
- 4 Where do the probe's red and black wires connect?
- 5 What do you do with the input pins of a spare gate?

By the end of this lesson...

- 1 I can build a logic circuit on a prototype board from a circuit diagram.
- 2 I can follow the wiring colour convention.
- 3 I can find a fault using a logic probe.

How the board connects

Booklet section 9. The holes are joined for you — you have to know how.



Part of the board	How it is connected
the long rails, top and bottom	every hole along a rail is joined — used for +5 V and 0 V
the main blocks	each column of five holes is joined; columns are separate
the centre channel	a DIL chip straddles it, each pin in its own column

Wire colours, and item IDs

Used in industry, and marked by SQA.

- RED wire for power connections only.
- BLACK wire for ground (0 V) only.
- Any other colour for signals. Always use at least three colours.
- No red or black? Pick two others and record the choice.
- Give every part an item ID — R1, IC1, SW1 — and keep it everywhere.

Show Me — Which holes are joined?

SHOW ME BOARDS

- 1 How many holes are joined together in one column of a main block?
- 2 Are two neighbouring columns joined to each other?
- 3 Which part of the board carries +5 V along its whole length?
- 4 Why must a chip straddle the centre channel?
- 5 Which colour of wire goes to the 0 V rail?

Which holes are joined?

SHOW ME BOARDS

EXTRA PRACTICE

- 1 A resistor's two legs are in the same column. What have you built?
- 2 Which colour of wire may carry a signal?
- 3 How many colours of wire should a board use, at least?
- 4 Why give every component an item ID?
- 5 Give two reasons for prototyping before soldering.

Your turn

Build your own Problem 1 or Problem 2 solution.
Chip across the channel: red to pin 14, black to pin 7.
Each input a switch with a 10 k pull-down.
Output through 470 Ω to an LED, then to 0 V.
Spare gate inputs to 0 V. Check before you switch on.

PRACTICAL TASK 4 — Build on prototype board

PRACTICAL TASK 4 – Expected results

Use the column for the problem YOU built. Your measured column should match it exactly.

A	B	Problem 1 (Z)	Problem 2 (Z)
0	0	0	0
0	1	1	0
1	0	1	1
1	1	1	0

Problem 1 is $Z = A \text{ OR } B$. Problem 2 is $Z = A \text{ AND } (\text{NOT } B)$.

If it does not work

Booklet section 9 — work down the list with the probe, in this order.

- Is the chip the right way round? Find pin 1 at the notch.
- Is pin 14 at +5 V and pin 7 at 0 V? Probe them.
- Are the chip's two rows of pins in separate columns?
- Does each input read logic 0 with its switch open?
- Is the LED the right way round?

Watch Out

THE MISTAKE

- Any colour of wire will do.
- The chip can sit inside one half of the board.
- Name the components on the circuit diagram only.

THE CORRECT ANSWER

- RED for power, BLACK for 0 V, three colours at least.
- It must straddle the channel, or opposite pins short.
- Give every part an item ID and use it on every document.

Checkpoint

SHOW ME BOARDS

- 1 Describe how the holes in one main block are connected.
- 2 Explain why a DIL chip must straddle the centre channel.
- 3 Your output LED never lights. Give two checks, and say what each proves.

Exam Practice

Prototyping and fault-finding. Bring the paper; nothing is reproduced here.

Paper	Question	Marks	What it asks
N5 2024	5 (a)	2	Two reasons for simulating before constructing
N5 2024	5 (b)	3	Identify three errors in a circuit
N5 2025	5	4	Identify four errors in a simulation

LOOKING AHEAD

Stripboard: build it for keeps

Next: the same circuit, but soldered, tested and yours to take away.

Plenary

SHOW ME BOARDS

- 1 How many holes are joined in one column of a main block?
- 2 Which colour of wire is for power only?
- 3 Which colour is for 0 V only?
- 4 Why must a chip straddle the centre channel?
- 5 Name two item IDs you used today.

Plenary

SHOW ME BOARDS

EXTRA PRACTICE

- 1 Which part of the board is joined along its whole length?
- 2 How many colours of wire, at least?
- 3 What does the probe show at a floating point?
- 4 Give one reason for prototyping before soldering.
- 5 Where would you find the fault if the chip runs hot?

Extension

- 1 Your LED is always on. List the three faults that could cause that.
- 2 Why does the output need a $470\ \Omega$ resistor at all?
- 3 The circuit works until you touch the board. What is wrong?

Extension

EXTRA PRACTICE

- 1 Why is a prototype board unsuitable for a finished product?
- 2 How would you prototype a design needing two chips?
- 3 What would you record now to make the stripboard build easier?