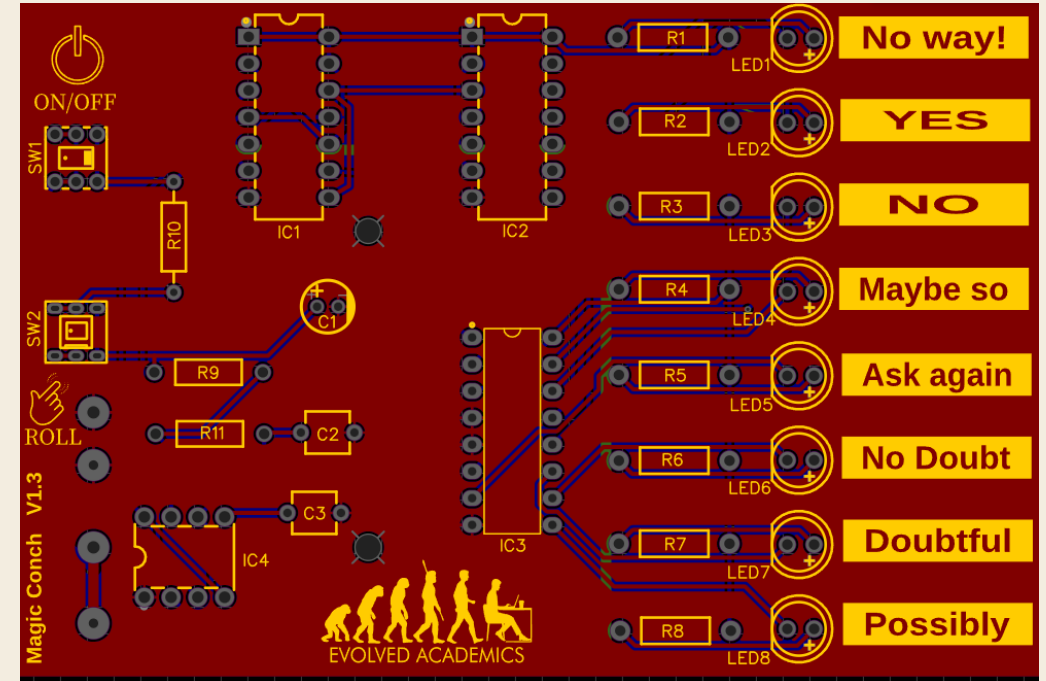


Build a board that answers your questions

- 1 Press and hold ROLL: the lights change quickly.
- 2 Let go: one light stays on beside an answer.
- 3 You will solder the parts, check your work, then test it.



Original V1.3 board artwork. Match labels on your board.

CHECK

Keep batteries out until your teacher approves the finished board.

Here is what you will do

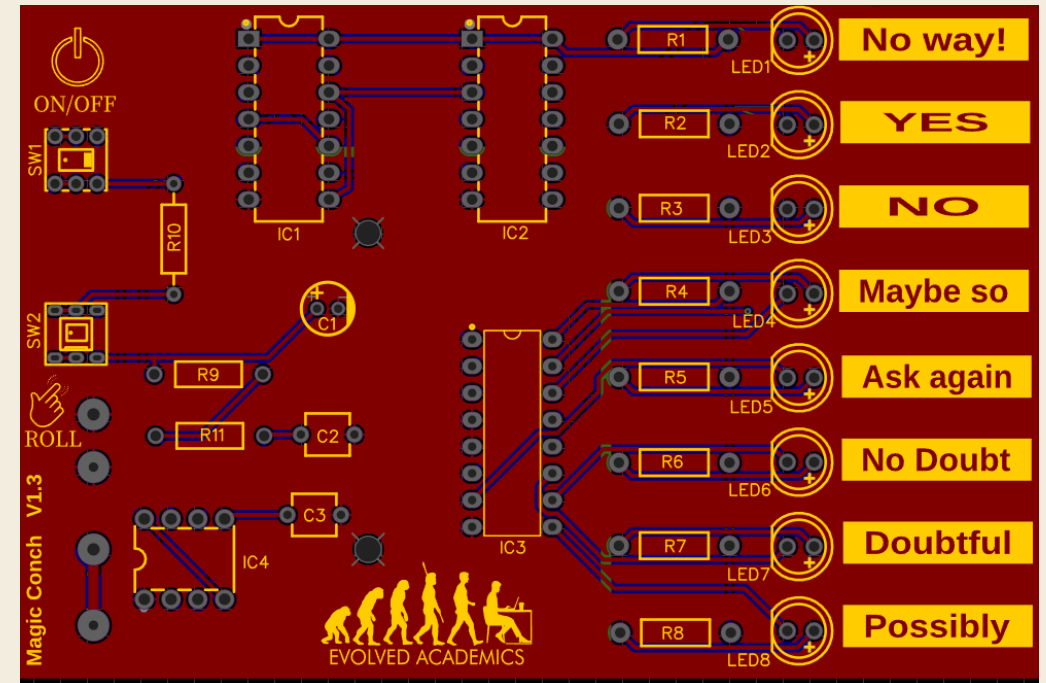
- 01** Open your kit. Count the parts using the parts list.
- 02** Watch a soldering demonstration. Try a practice joint.
- 03** Follow the part-by-part slides to assemble your board.
- 04** Have a partner and your teacher check it before adding chips.
- 05** Add batteries with permission. Press ROLL and test your answers.

CHECK

You do not need to know the part names yet. We will identify them together.

Check that this guide matches your kit

- 1 Find the version printed on your board.
This guide covers V1.3 / V1.4 hardware.
- 2 You should have two pushbuttons and chips marked 74LS74, 74HC138, and 555.
- 3 If the board or parts differ, stop and ask your teacher for the matching guide.



Original V1.3 board artwork. Match labels on your board.

CHECK

Pictures show V1.3. On V1.4, some R and LED numbers are in different rows.

Count the small parts

HOW MANY	PART	HOW TO RECOGNIZE IT
11	Resistors	Small bodies with colored bands
8	LEDs (the lights)	Red bulbs, each with two metal legs
1	Small capacitor: 474	Read the tiny printed number
1	Small capacitor: 103	Read the tiny printed number
1	47 μ F capacitor	Cylinder with a stripe down one side

CHECK

Missing a part or unsure what it is? Ask before soldering.

Count the remaining parts

HOW MANY	PART	WHAT TO CHECK
1	Circuit board	Printed outlines show where parts go
4	Empty chip sockets	Two 14-pin, one 16-pin, one 8-pin
4	Chips	Two 74LS74, one 74HC138, one 555
2	Pushbutton switches	One stays down; one springs back
1	Battery holder	Holds three AA batteries

CHECK

You will need 3 AA batteries at the end. Ask your teacher where to get them.

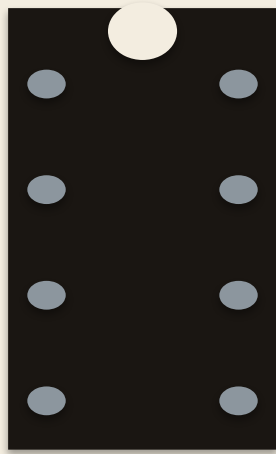
Set up a safe soldering station

- 1 Put on safety glasses. Tie back long hair and clear your work area.
- 2 Use the classroom fume extractor or ventilation. Keep your face out of the fumes.
- 3 Touch only the iron's handle. Return it to its stand every time you put it down.

CHECK

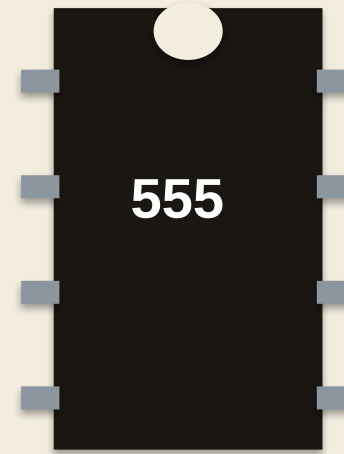
No food or drinks at the bench. Wash your hands after soldering.

A socket is a holder. A chip goes inside it.



SOCKET: holes on top

Solder the empty socket to the circuit board.



CHIP: number on top

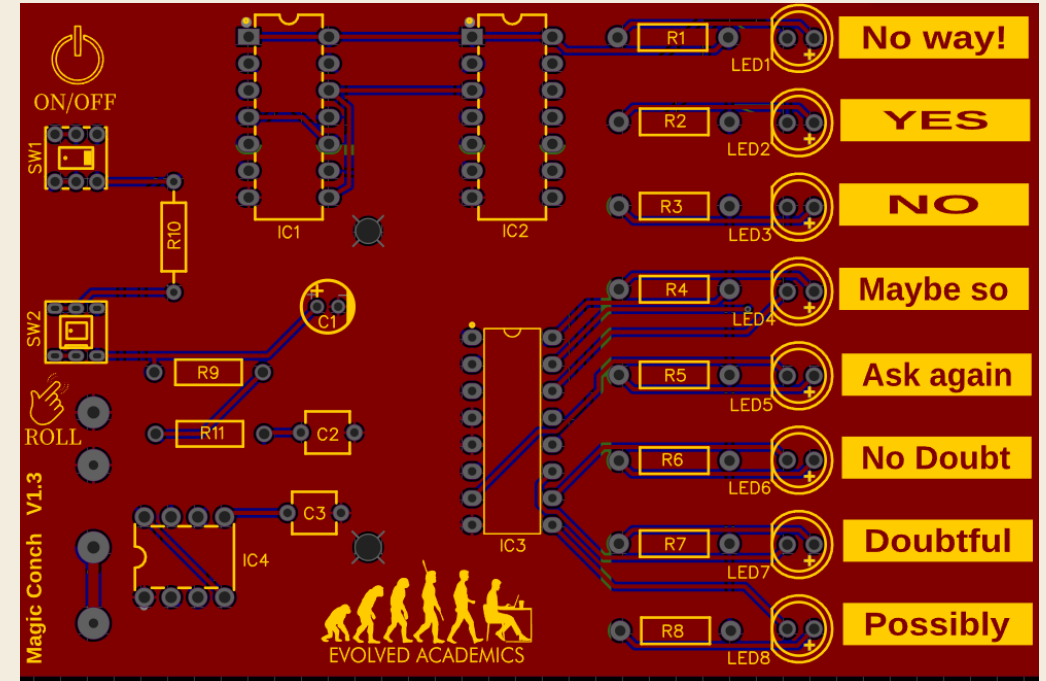
Push the chip into its socket after the inspection.

CHECK

Do not solder the chips. These are simplified drawings of the 8-pin parts.

Find the front of your board

- 1 The FRONT has the answer words and outlines for the parts.
- 2 Keep the words upright when comparing your board with these pictures.
- 3 Most parts go in from the front. Turn the board over to solder their legs.



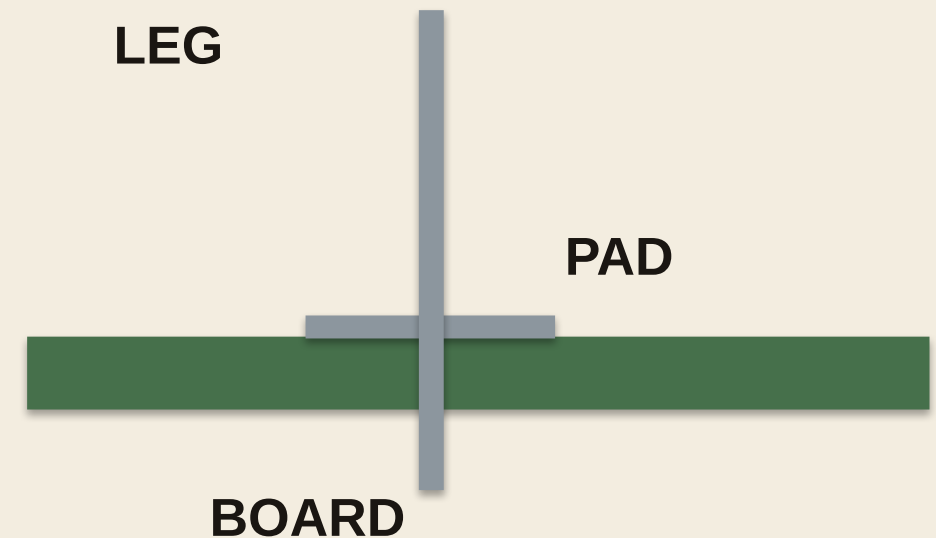
Original V1.3 board artwork. Match labels on your board.

CHECK

The battery holder is the exception: it mounts on the back.

Practice joining one leg to one pad

- 1** A lead is a part's metal leg. A pad is the metal ring around a hole.
- 2** Place the iron tip against both the pad and the leg at the same time.
- 3** Feed a little solder into that heated meeting point.



Side view • simplified diagram

CHECK

Heat both pieces of metal. Do not just drop melted solder onto a cold pad.

Finish the joint, then let it cool

- 1 When solder spreads around the leg and onto the pad, stop feeding solder.
- 2 Pull the solder wire away first. Then lift the iron and return it to the stand.
- 3 Keep the part still while the solder hardens. Ask your teacher to check your practice joint.

CHECK

If solder will not flow, stop and ask for help. Do not keep heating the board.

Check the connection, not just the shine

LOOK FOR	WHAT IT MEANS
Solder joins the leg AND the pad	The joint should be smooth, without gaps
A ball sitting on the leg	The solder may not have bonded to the pad
Solder connecting neighboring pads	A bridge: ask for help before powering up
A matte surface	Not enough by itself to call a joint bad

CHECK

Some lead-free solder looks matte. Do not reheat every joint just to make it shiny.

Clip only the extra length of the leg

- 1 Keep your safety glasses on. Point the cutters away from faces.
- 2 Hold the loose end so it cannot fly across the room.
- 3 Cut the leg just above the solder joint. Do not cut into the joint or the board.

CHECK

Socket and switch pins are already short; do not clip them just to follow a routine.

Sort the resistors before inserting any

QUANTITY	VALUE	BOARD LABEL
8	180 Ω	R1 through R8
1	10 k Ω	R9
1	1 k Ω OR 1.2 k Ω	R10 - use the supplied kit value
1	18 k Ω	R11

CHECK

Ω means ohms. k Ω means thousands of ohms. Ask if you cannot identify a value.

If your resistors have 4 color bands

180 Ω



brown / gray / brown / gold

10 k Ω



brown / black / orange / gold

1 k Ω



brown / black / red / gold

1.2 k Ω



brown / red / red / gold

18 k Ω



brown / gray / orange / gold

CHECK

Read toward the separated last band. If uncertain, have the value checked with a meter.

If your resistors have 5 color bands

180 Ω



brown / gray / black / black / brown

10 k Ω



brown / black / black / red / brown

1 k Ω



brown / black / black / brown / brown

1.2 k Ω



brown / red / black / brown / brown

18 k Ω



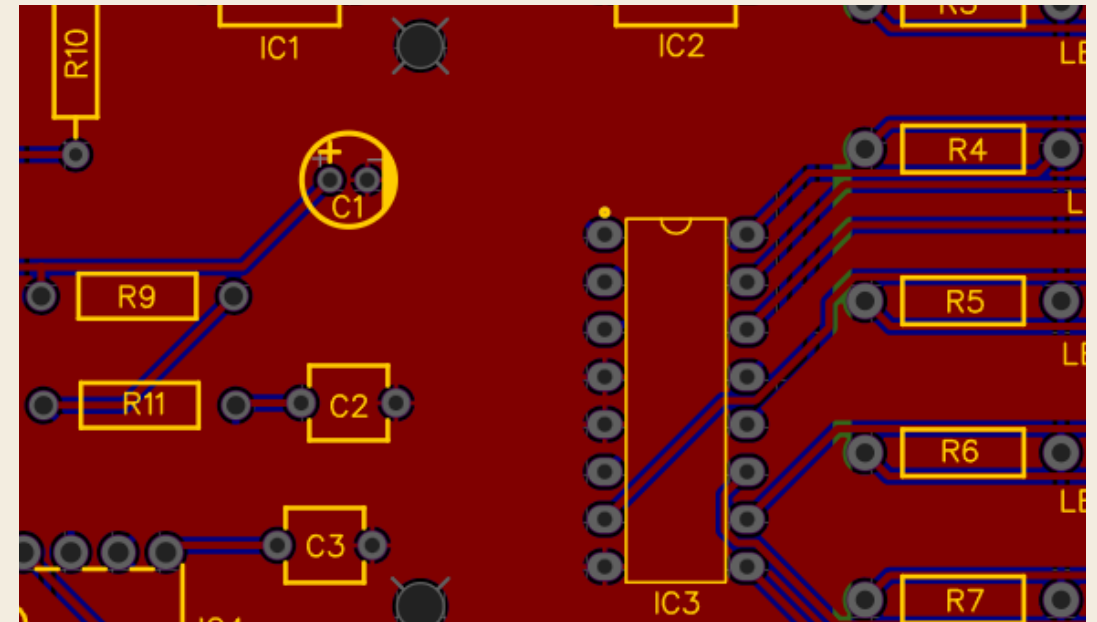
brown / gray / black / red / brown

CHECK

Read toward the separated last band. If uncertain, have the value checked with a meter.

Install the 11 resistors

- 1 Match each resistor's value to the R label. The eight 180 Ω parts go at R1-R8.
- 2 Bend the legs to fit the two holes. Insert from the front and rest the body against the board.
- 3 Hold it in place, turn the board over, solder both legs, then clip the extra length.



Original V1.3 board artwork. Match labels on your board.

CHECK

Have your partner check R9, R10 and R11 before you solder them.

Match each empty socket to its outline

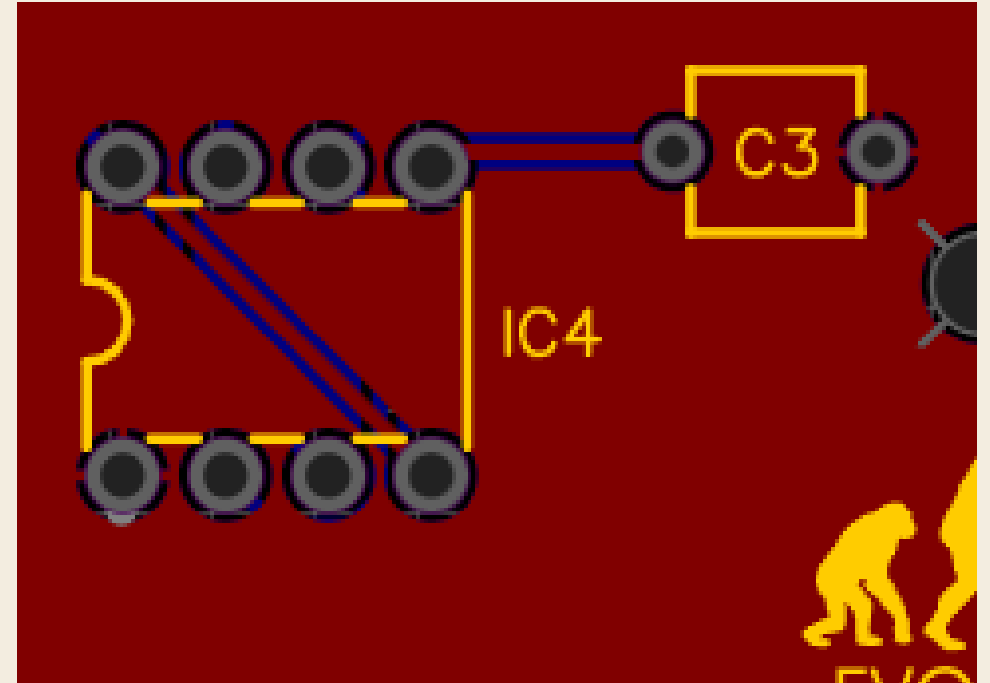
SOCKET	GOES AT	NOTCH DIRECTION*
14 pins: 7 holes per side	IC1	Up
14 pins: 7 holes per side	IC2	Up
16 pins: 8 holes per side	IC3	Up
8 pins: 4 holes per side	IC4	Left

CHECK

*With the answer words upright. The notch is the small half-circle cutout.

Check the notch before soldering

- 1 Match the socket's half-circle notch to the notch printed on the board.
- 2 Solder two pins at diagonally opposite corners. Check that the socket sits flat.
- 3 If it is flat, solder the other pins. If it is tilted, ask for help adjusting it.



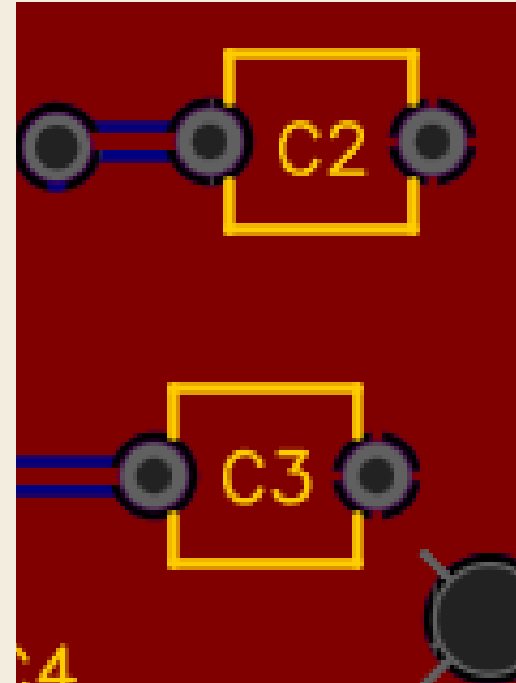
Original V1.3 board artwork. Match labels on your board.

CHECK

IC4 is turned sideways: its notch points LEFT. Leave all four sockets empty.

Read 474 and 103 on the small capacitors

- 1 Find the part marked 474. Put its legs through the two holes at C2.
- 2 Find the part marked 103. Put it at C3. Either direction works for these two parts.
- 3 Solder both legs of each part from the back. Let the joints cool, then clip.



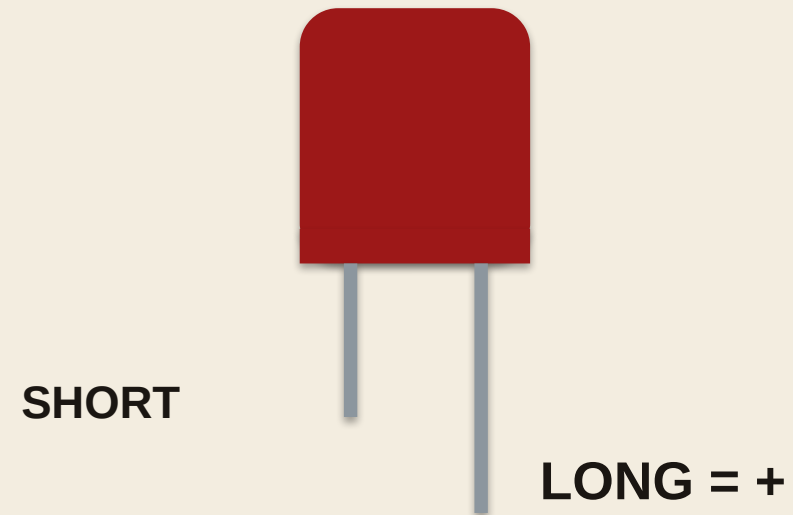
Original V1.3 board artwork. Match labels on your board.

CHECK

Use the printed number, not the body color. 474 goes at C2; 103 goes at C3.

The LED's long leg goes in the + hole

- 1 Find the longer leg before cutting anything. That is the positive (+) leg.
- 2 Find the + mark at an LED outline. Put the long leg in that hole.
- 3 Match the flat edge of the LED's rim to the flat edge printed on the board.



Simplified LED diagram

CHECK

Direction matters. An LED installed backward will not light normally.

Install one LED, then repeat seven times

- 1 With the words upright, the long leg goes in the right-hand + hole.
- 2 Solder one leg. Turn the board over and check that the LED is straight.
- 3 Solder its second leg and clip. Repeat for the remaining seven LEDs.



Original V1.3 board artwork. Match labels on your board.

CHECK

Before soldering each LED: long leg at +; flat rim matches the flat printed edge.

Put the striped capacitor at C1

- 1 Find the cylinder marked 47 μ F. Its stripe marks the negative (-) side.
- 2 Put the positive, longer leg in C1's + hole. The stripe faces the filled half of the outline.
- 3 Ask your partner to check the direction. Then solder both legs and clip.



Original V1.3 board artwork. Match labels on your board.

CHECK

C1 can overheat if reversed. With the words upright: + left, stripe right.

Press each switch to tell them apart

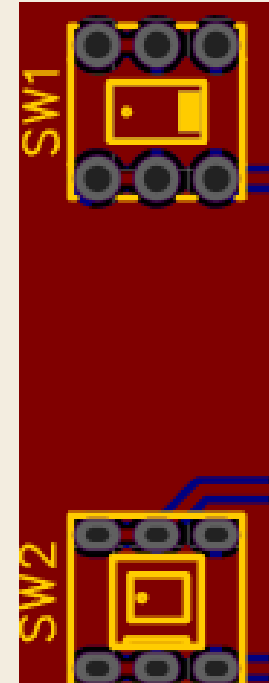
WHEN YOU PRESS AND RELEASE IT...	PUT IT HERE
It clicks and stays down. A second press releases it.	SW1 ON/OFF
It springs back up as soon as you let go.	SW2 ROLL

CHECK

Do not guess from appearance. Test both switches with your fingers.

Fit the switches without forcing the pins

- 1 Put the switch that stays down at SW1. Put the one that springs back at SW2.
- 2 Match the small dot on the switch body to the dot printed inside its outline.
- 3 Solder two opposite corner pins. Check that it sits flat, then solder the other four.



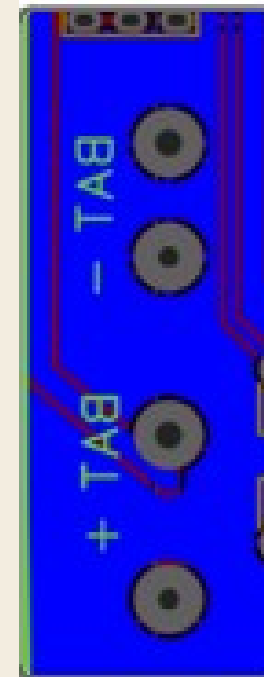
Original V1.3 board artwork. Match labels on your board.

CHECK

All six pins must fit naturally. If they do not, stop and check the direction.

Mount the battery holder on the BACK

- 1 Turn the board over. Hold the empty battery holder against the back.
- 2 Match the holder's + terminal to BAT + and its - terminal to BAT -.
- 3 Use the pair of holes that fits your holder. Have your teacher check before soldering.



Back-side BAT markings from the original build guide

CHECK

Solder the holder's terminals from the FRONT. The unused alternative holes stay empty.

Stop: check the solder side with a partner

- 1 Check every installed pin: solder should join the pin to its pad.
- 2 Look closely between socket pins. No solder should connect neighboring pads.
- 3 Check for loose parts and long wire ends that could touch another connection.

CHECK

Unused battery-holder holes and mounting holes do NOT need solder.

Now check the direction of the parts

PART	CHECK BEFORE ADDING CHIPS
All 8 LEDs	Flat rims match the printed flat edges
C1	Stripe at the negative side; positive leg at +
Sockets	IC1 / IC2 / IC3 notches up; IC4 notch left
C2 / C3	474 at C2; 103 at C3
Switches / holder	SW1 stays down; SW2 springs back; BAT + / - match

CHECK

Show your teacher both sides. Do not add chips or batteries until approved.

Match the chip number to the socket label

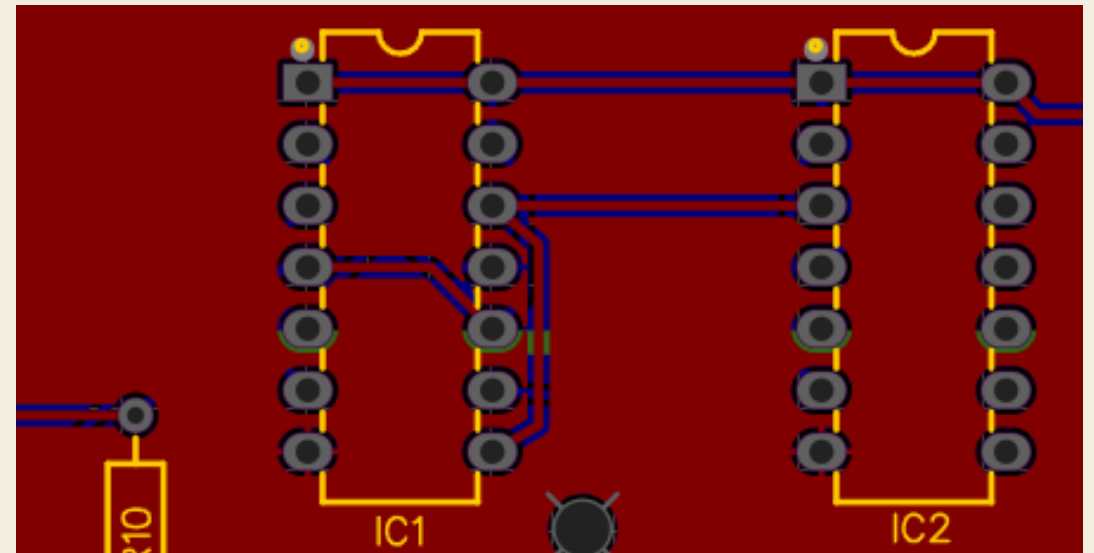
READ ON THE CHIP	SOCKET	NOTCH DIRECTION
74LS74 (14 legs)	IC1	Up
74LS74 (14 legs)	IC2	Up
74HC138 (16 legs)	IC3	Up
555 (8 legs)	IC4	Left

CHECK

Prefixes may vary. If the main number differs, ask before inserting the chip.

Line up every chip leg before pressing

- 1 Face the chip's notch the same way as the socket notch AND the printed board notch.
- 2 Line up every leg with a socket hole. Press gently and evenly; do not force it.
- 3 Look along both sides. If a leg is outside a hole or bent underneath, ask for help.



Original V1.3 board artwork. Match labels on your board.

CHECK

Keep the iron in its stand. Chips plug into sockets; they are not soldered.

Add batteries, then test the two buttons

- 1 With power OFF, insert 3 AA batteries. Match each battery to the holder's + and - marks.
- 2 Press ON/OFF. Hold ROLL: the lights should change quickly.
- 3 Release ROLL: one answer should stay lit. Try several times; answers can repeat.

CHECK

If there is unusual heat, smoke or smell: switch off, stop, and call your teacher.

If it does not work, start with what you see

WHAT YOU SEE	CHECK WITH YOUR TEACHER
No lights while holding ROLL	Battery direction, ON/OFF, holder connections
Lights do not change while holding ROLL	555 at IC4; its notch, legs and socket joints
One answer never lights	That LED's direction and its solder joints
Lights keep changing after release	Correct switch at SW2; switch connections

CHECK

Remove batteries before any soldering or chip adjustment. Change one thing, then retest.

Show that your board works

- 1 Demonstrate: hold ROLL, release it, and point to the selected answer.
- 2 Explain one direction check you made: an LED, C1, or a chip notch.
- 3 Switch off. Turn off the iron, collect clipped wire ends, and wash your hands.

CHECK

If it needs more work, record the symptom and the next check instead of guessing.