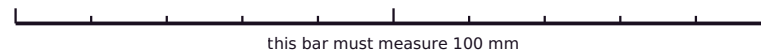


PAPER MOSQUITO

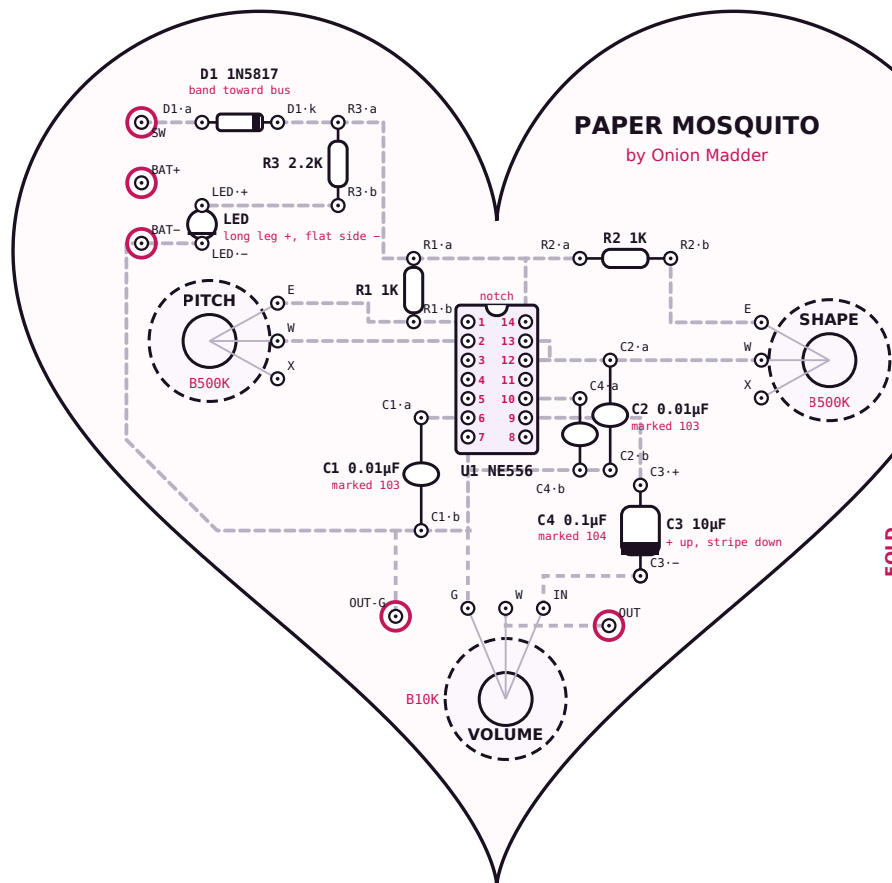
an NE556 Atari Punk Console as a paper circuit · fold sheet, print at 100% / Actual size

Onion Madder // messopedals.com · paper-circuit method after Peter Blasser / Ciat-Lonbarde



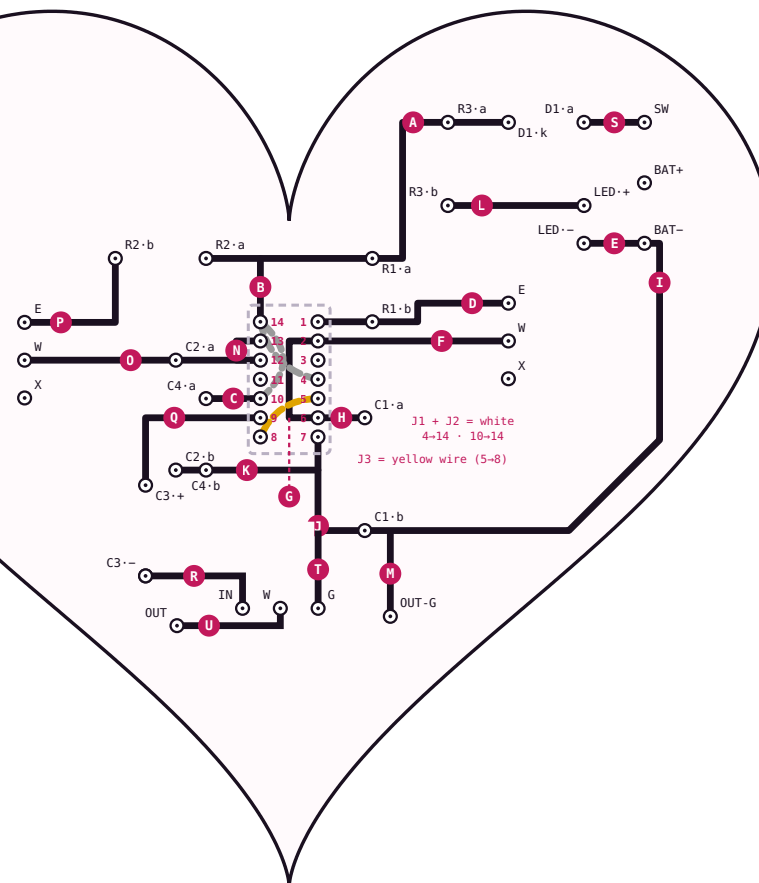
FRONT - parts side

parts go in from this face · knobs up



BACK - solder side

folds behind the front · mirror image · bare wire along every line



∞ glue up first, then cut along the heart outline through all four layers · don't cut the fold

build-up: blank sheet folded + glued as the core, then this sheet folded around it and glued = 4 sheets thick

Paper Mosquito

the dead-bug Mosquito's NE556 Atari Punk Console, rebuilt as a heart-shaped paper circuit

A paper circuit is a circuit board you print: the drawing is the board, the holes are poked with an awl, and the traces are bare wire laid along the lines on the back. The method is Peter Blasser's (Ciat-Lonbarde), and this is about the gentlest way into it: one chip, a dozen small parts, and it drones the moment it powers up. It is the **Dead-Bug Mosquito's** circuit with a polarity diode and a power LED added, so if you have built that one, every connection here will look familiar.

66 steps. Page 1 is the fold sheet; everything after it is the recipe.

Reading the sheet

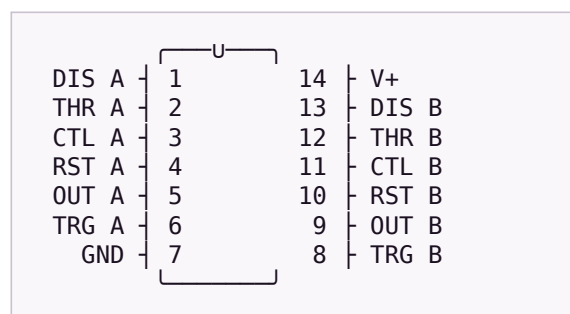
Front: each part is drawn where it sits, with its value printed next to it. The faint dashed lines are only a preview of what connects on the back, so you can see where a part goes without flipping the board. The five ringed holes are for wires going off the board: BAT+ and BAT− for the battery, SW for the toggle's return, OUT and OUT-G for the jack. PITCH and SHAPE have three holes each: E (an end lug), W (the wiper, its middle lug) and X (the other end, left empty). VOLUME uses all three: IN, W and G.

Back: every bold black line is a trace you make with bare wire or a bent part leg, tagged with a pink letter so the steps can name it. The dashed gray and yellow arcs are the three insulated wires. Small pink numbers beside the chip holes are its pin numbers.

What you'll need

- **1× NE556 dual timer** · *spot it:* NE556 printed on top, notch/dot = pin 1. It solders straight to the paper, no socket.
- **2× B500K pots (pitch and shape)** · *spot it:* marked B500K; middle lug is the wiper (a B1M works too, just a wider range)
- **1× B10K pot (volume)** · *spot it:* marked B10K (B5K is fine)
- **1× 1N5817 Schottky diode (D1)** · *spot it:* small black body, gray or silver band marks the cathode
- **1× LED, any color, + 1× 2.2K resistor (R3)** · *spot it:* LED: long leg +, flat side of the rim –; 2.2K is red-red-red (1K is brighter, drains the battery faster)
- **2× 1K resistors (R1, R2)** · *spot it:* brown-black-red; non-polar
- **2× 0.01 µF ceramic (C1, C2)** · *spot it:* tiny disc printed 103
- **1× 0.1 µF ceramic (C4)** · *spot it:* disc printed 104
- **1× 10 µF electrolytic (C3)** · *spot it:* little can; stripe marks the – leg, long leg is +
- **Bare tinned wire** · *spot it:* for the traces on the back
- **Insulated wire, white + yellow** · *spot it:* J1, J2 white; J3 yellow
- **SPST toggle, battery, jack or 8 Ω speaker** · *spot it:* 9V, or 2+ vape cells in series
- **A second sheet of plain printer paper, glue stick, an awl** · *spot it:* the blank sheet becomes the core; any sharp point works in place of an awl

The chip, from above



Parts go in from the printed front, so the chip on the front reads exactly like this map. On the back it's mirrored, which is why the back half of the sheet prints pin numbers next to every hole.

Before you start

Paper burns. Keep the iron moving, quick joints, and don't rest it on the sheet. Work over something that isn't flammable, and keep a damp sponge handy.

Chip straight in. The NE556 is soldered straight to the paper with no socket, and most parts end at one of its pins. Keep each joint quick: touch, flow, lift.

Bare traces on the back can short. The only place they run close is trace G under the chip, so keep it centered between the two rows of pins.

Loud and shrill. It's still an APC. Start with VOLUME low.

Print, fold, glue, poke

The sheet is the circuit board, and it's four sheets of paper thick. A plain sheet folded in half and glued to itself makes the core, then the printed hearts fold around the core and glue on, one heart on each face. The back heart is a mirror image of the front, so once it's folded the holes line up on both faces.

Print at 100% / "Actual size". Fit-to-page shrinks it and the holes stop matching the chip's legs.

STEP	DO
1	Print page 1 on plain printer paper at 100% / Actual size.
2	Measure the 100 mm bar at the top right of the sheet. If it isn't 100 mm, fix the print scale and print again.
3	Fold a second, blank sheet of printer paper in half.
4	Glue-stick the whole inside of the blank sheet, close it, and press it flat. That's the core: two sheets thick.
5	Fold the printed sheet along the FOLD line, printing on the outside, so the two hearts sit back to back.
6	Unfold it again and glue-stick the back of the FRONT heart.
7	Press the core onto the glued back of the FRONT heart.
8	Glue-stick the back of the BACK heart, fold it over onto the other face of the core, and press it flat. Now it's four sheets thick.
9	Let the glue set for a few minutes, then cut along the heart outline through all four layers. Don't cut across the FOLD hinge.
10	Poke the 14 U1 holes from the front with an awl or other sharp point, straight down through all four layers.
11	Poke the other 32 dots the same way. Check the back and open any hole that didn't come all the way through.

Start in the middle: the chip

Everything builds outward from the chip. Each part goes in from the printed front, then on the back you bend its legs along its trace to the chip pin it belongs to and solder it there. Every part you add is anchored to the middle, so the whole thing gets stiffer as you go instead of floppier.

Quick dabs only. Paper scorches if you sit on it: touch, flow, lift.

STEP	DO
12	Push the NE556 into the U1 holes from the front, notch toward the top edge (the drawn notch).
13	On the back, bend pins 1, 7, 8 and 14 outward slightly so the chip can't fall out.
14	Insulated white wire J1 from pin 4 to pin 14. Solder at pin 4 only.

15	Insulated white wire J2 from pin 10 to pin 14. Solder both wires at pin 14 together, then J2 at pin 10.
16	Insulated yellow wire J3 from pin 5 to pin 8. Solder at both pins.
17	Trace N: short bare wire from pin 13 to pin 12. Solder at both pins.
18	Trace G: bare wire from pin 2 down the middle, under the chip, to pin 6, centered between the two rows of pins. Solder at pin 2 and pin 6.
19	Trace J: bare wire from pin 7 down to the ground-bus line. Solder at pin 7 only; the far end gets soldered with the bus.

Next ring out: the caps

The three small caps sit right beside the chip. Each one goes in from the front, and on the back one leg bends along its trace to a chip pin.

Leave the legs long until each one is soldered, then snip the tail.

STEP	DO
20	C4, 0.1 μ F (marked 104): legs into C4·a and C4·b from the front.
21	On the back, bend C4·a's leg along trace C to pin 10. Solder at C4·a and at pin 10.
22	Bend C4·b's leg along trace K until it crosses trace J. Solder at C4·b and where it touches J.
23	C2, 0.01 μ F (marked 103): legs into C2·a and C2·b from the front.
24	On the back, bend C2·a's leg along trace O to pin 12. Solder at C2·a and at pin 12.
25	Bend C2·b's leg along trace K to C4·b. Solder at C2·b and at C4·b.
26	C1, 0.01 μ F (marked 103): legs into C1·a and C1·b from the front.
27	On the back, bend C1·a's leg along trace H to pin 6. Solder at C1·a and at pin 6.
28	Solder C1·b's leg in its hole and leave the tail long. The ground bus lands on it later.

Out to the resistors and the output cap

Same move, one ring further out. The resistor legs are long enough to reach their traces on their own.

STEP	DO
29	R1, 1K (brown-black-red): legs into R1·a and R1·b from the front.
30	On the back, bend R1·b's leg along trace D to pin 1. Solder at R1·b and at pin 1.
31	R2, 1K: lies sideways. Legs into R2·a and R2·b from the front.
32	On the back, bend R2·b's leg down trace P to its corner. Solder at R2·b only; the shape pot joins it later.
33	C3, 10 μ F electrolytic: long + leg into C3·+, striped leg into C3·-, from the front. Lay the can flat over its drawing.

- 34** Trace Q: bare wire from pin 9 along the line to C3·+. Solder at pin 9 and at C3·+.
- 35** Bend C3·–’s leg along trace R so its end sits over the VOLUME IN hole. Solder at C3·– only; the volume pot joins it later.

Power corner: diode and LED

The top corner is the power entry. D1 is a 1N5817 that only lets current through one way, so a battery clipped on backwards just does nothing instead of cooking the chip. R3 and the LED tell you the board is on.

D1’s band is the side current leaves from. It points toward the bus, away from the SW pad. Backwards, the whole board stays dead.

STEP	DO
36	D1, 1N5817: band end into D1·k, plain end into D1·a, from the front.
37	Trace S: on the back, bend D1·a’s leg along the line to the SW pad. Solder at D1·a and at SW.
38	R3, 2.2K (red-red-red): legs into R3·a and R3·b from the front.
39	LED: long leg into LED·+, short leg (flat side of the rim) into LED·–, from the front.
40	Trace L: on the back, bend R3·b’s leg along the line to LED·+. Solder at R3·b and at LED·+.
41	Trace E: bend LED·–’s leg along the line to the BAT– pad. Solder at LED·– and at BAT–.

The two buses

Power dips under the heart’s top notch, ground follows the left curve around to the bottom. Each one is a single bare wire, soldered wherever a part or trace meets it.

STEP	DO
42	Trace B: bare wire from pin 14 straight up to the V+ bus line. Solder at pin 14.
43	Trace A, V+ bus: bare wire from D1·k through R3·a, down the line, then across through R1·a to R2·a. Solder at D1·k, at R3·a, at R1·a, where it meets trace B, and at R2·a.
44	Trace I, ground bus: bare wire from the BAT– pad, around the left curve, then along the bottom line to where it meets trace J. Solder at C1·b and at J; the BAT– end is already soldered.

The pots, outermost

The pots go in last because they’re the heaviest. Push each pot’s lugs through from the front, shaft up, middle lug (the wiper) in W. With solder-lug pots, solder a short wire to each lug and push the wires through instead.

STEP	DO
45	PITCH pot, B500K: lugs into the PITCH holes E, W and X.
46	Trace F: bare wire from PITCH W to pin 2. Solder at W and at pin 2.
47	Trace D: bare wire from PITCH E along the line to R1·b. Solder at E and at R1·b. X stays empty.
48	SHAPE pot, B500K: lugs into the SHAPE holes E, W and X.
49	Trace O: bare wire from SHAPE W to C2·a. Solder at W and at C2·a.

- | | |
|----|--|
| 50 | Trace P: bare wire from SHAPE E to the corner of R2's leg. Solder at E and where it touches R2's leg. X stays empty. |
| 51 | VOLUME pot, B10K: lugs into the VOLUME holes IN, W and G. |
| 52 | Solder VOLUME IN, where C3—'s leg is already sitting. |
| 53 | Trace T: bare wire from VOLUME G straight up to the ground bus, where trace J meets it. Solder at G and at the bus. |
| 54 | Trace U: bare wire from VOLUME W down and across to the OUT hole. Solder at W and at OUT. |
| 55 | Trace M: bare wire from the OUT-G hole up to the ground bus. Solder at OUT-G and at the bus. |
| 56 | Snip every leg tail that sticks past its joint. |

Off the board

The battery clips straight onto the board, and the toggle hangs off two pads on flying leads so it can go wherever your enclosure wants it. Solder each wire on the back.

Leave the battery unclipped until the meter checks.

- | STEP | DO |
|------|---|
| 57 | Battery snap red (+) to the BAT+ pad. |
| 58 | Battery snap black (–) to the BAT– pad. |
| 59 | A wire from the BAT+ pad to one lug of the SPST toggle. |
| 60 | A wire from the other toggle lug to the SW pad. |
| 61 | Jack tip (or speaker +) to the OUT hole. |
| 62 | Jack sleeve (or speaker –) to the OUT-G hole. |

Check, then play

Meter it before you listen. These readings are with the chip in.

- | STEP | DO |
|------|--|
| 63 | Clip the battery on, toggle on with VOLUME low. The LED should light. |
| 64 | Meter pin 14 to pin 7: battery voltage minus about 0.3 V (the diode's drop). |
| 65 | Meter pin 4 to pin 7, then pin 10 to pin 7: same reading as pin 14 both times. |
| 66 | Bring VOLUME up. It should drone right away. Sweep PITCH, then SHAPE. |

Voltage check

METER BETWEEN	EXPECT (toggle on, LED lit)
BAT+ pad → BAT− pad	battery voltage (9V, or 7.4V on two vape cells)
Pin 14 → pin 7	battery voltage minus about 0.3 V
Pin 4 → pin 7, pin 10 → pin 7	same as pin 14 (the resets)
Pin 5 → pin 8, with the meter on continuity	beep (J3)

If it won't sing

SYMPTOM	CHECK
LED off, board dead	D1 in backwards (band must face the bus), battery snap reversed (D1 blocks it, nothing gets hurt), or the toggle wires not on BAT+ and SW.
LED on, but silent	First turn VOLUME up. Then J1 and J2: pins 4 and 10 must read battery voltage. Then J3, then pin 14 and pin 7.
Silent, chip warm	Two bare traces touching on the back, most likely trace G brushing a pin. Hold the heart up to a light and look at the back under the chip.
Faint, or only a tick	C3 the wrong way around (+ goes in C3+), or C1/C2 not reaching ground through traces I/K.
LED on but dim, or flickers with the sound	Normal-ish on a tired battery. A fresh 9V fixes it.
Putt-putt motorboating	C4 not soldered at both ends, or a cold joint on trace C or K.
A pot does nothing at one end	Normal: that is the 1K stopping it at zero. Does nothing at all: lug in the wrong hole, or the wiper isn't in W.
Paper scorched or a hole tore	Glue a scrap of paper over the back, re-poke, carry on. It is paper.

Things to try

- Body contacts: solder a bare-wire staple onto trace D and another onto trace F, a few millimeters apart on the front. A fingertip across them bridges the pitch pot, so you play pitch by touch (works best with PITCH turned toward its slow end). An LDR across the same two points makes it follow light.
- Pins 3 and 11 are left open, like the Mosquito. A 100K from either into a jack gives you the CV inputs from the Mosquito page.
- Hang an NE555 one-shot off pin 5 for the “one and a half” mod. Draw its traces onto your sheet in pen first.
- Color the front in. Blasser's sheets are half schematic, half drawing, and nothing on the front side carries current.

The APC descends from Forrest M. Mims III's “Stepped Tone Generator.” The paper-circuit method is Peter Blasser's / Ciat-Lonbarde's. This layout and the words are Onion Madder's.