Coati Open Source Spider — Building manual

Version 1.0

https://coati.pimienta.org/electronics/spider/design

Contents

Soldering tips

- Before soldering a component, check whether it has to be soldered from the top, from the bottom, or both. Do not solder on one side if it is not needed, except maybe for plugs and other mechanical parts in order to make them stronger.
- To solder a component, solder one of the contact first, then melt this contact and adjust the placement of the component before letting the contact cool down and solidify, and solder the other contacts.
- When soldering electrolytic capacitors, press them well onto the PCB to make sure that they are not stick out of the rest of components.
- Always shutdown the devices that you are assembling before soldering or mounting components.

Multiplying factors

Bigger than one

Symbol	Name	Value	Equivalents	
k	kilo	× 1000		0.001 k = 1
M	mega	× 1000000	1000 k = 1 M	0.001 M = 1 k
G	giga	× 1000000000	1000 M = 1 G	0.001 G = 1 M
T	tera	× 1000000000000	1000 G = 1 T	0.001 T = 1 G

Smaller than one

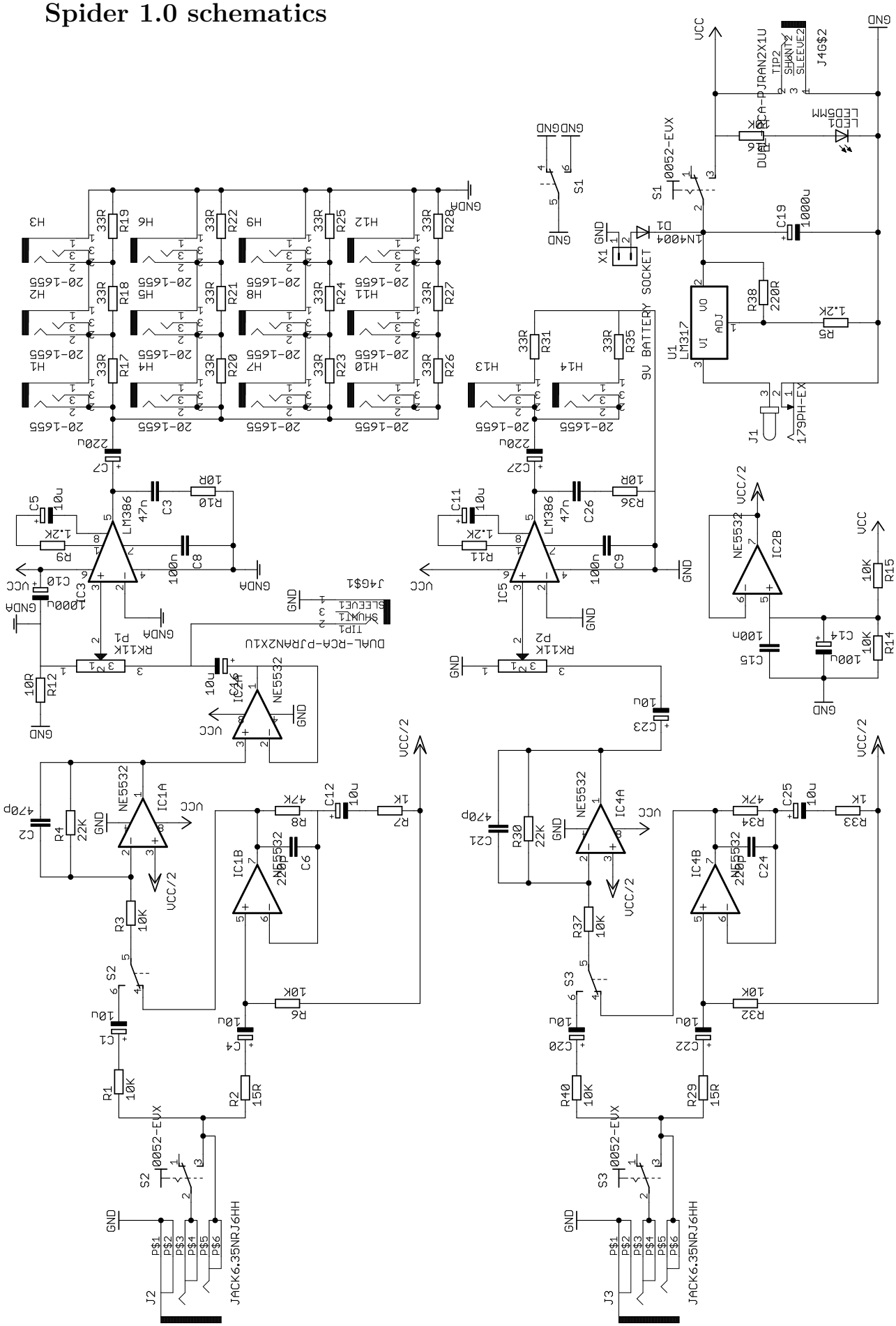
Symbol	Name	Value	Equivalents	
m	milli	× 0.001	1000 m = 1	0.001 m = 1 µ
µ	micro	× 0.000001	1000 µ = 1 m	0.001 µ = 1 n
n	nano	× 0.000000001	1000 n = 1 µ	0.001 n = 1 p
p	pico	× 0.000000000001	1000 p = 1 n	

Resistor color codes

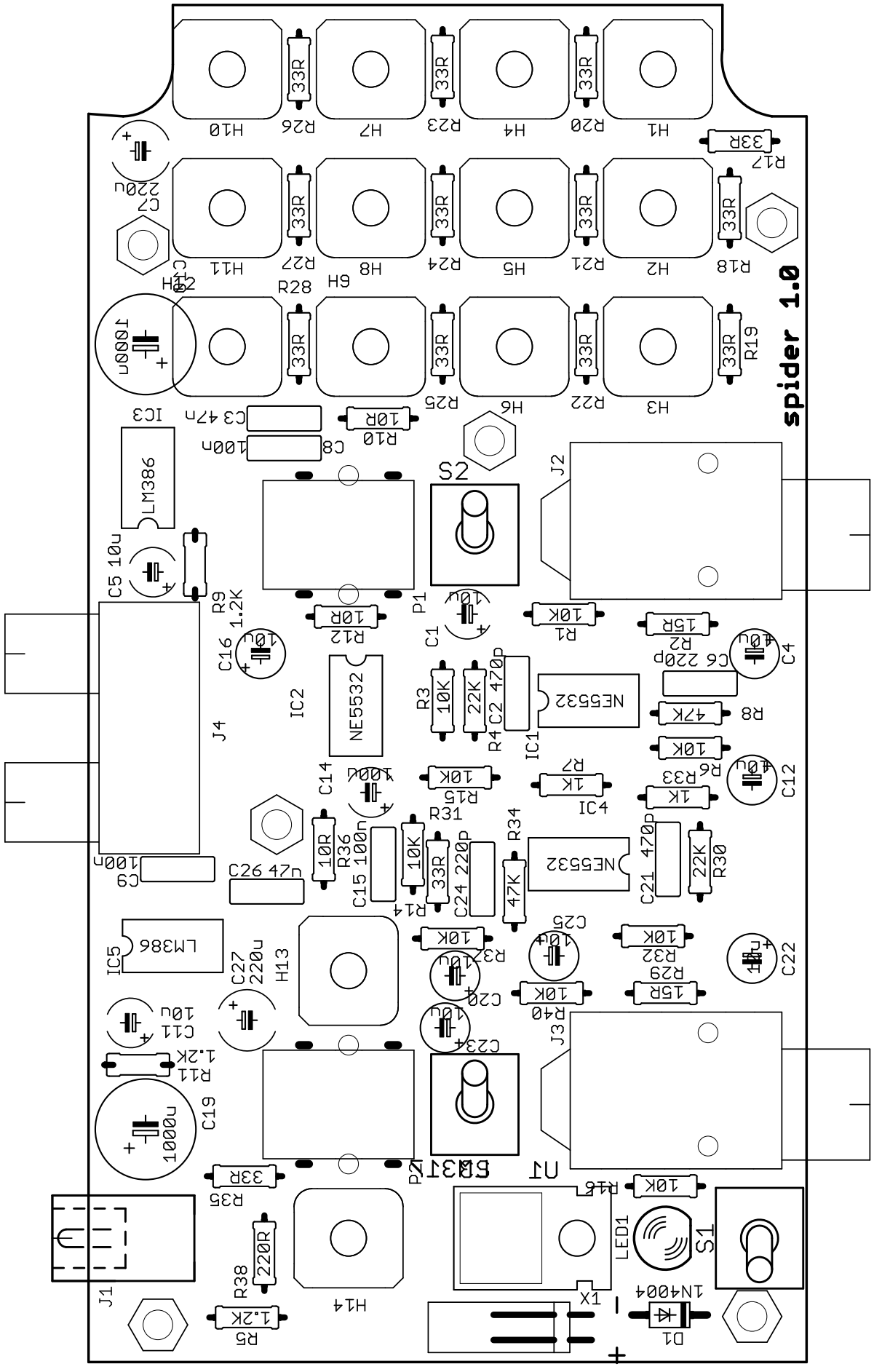
Color	1st band	2nd band	3rd band: Multiplier	4th band: Tolerance
Black	0	0	×1 Ω	
Brown	1	1	×10 Ω	±1% (F)
Red	2	2	×100 Ω	±2% (G)
Orange	3	3	×1 kΩ	
Yellow	4	4	×10 kΩ	
Green	5	5	×100 kΩ	±0.5% (D)
Blue	6	6	×1 MΩ	±0.25% (C)
Violet	7	7	×10 MΩ	±0.1% (B)
Gray	8	8	×100 MΩ	±0.05% (A)
White	9	9	×1 GΩ	
Gold			×0.1 Ω	±5% (J)
Silver			×0.01 Ω	±10% (K)
None				±20% (M)

Copied from Wikipedia.

Spider 1.0 schematics



Spider 1.0 board



Parts list for Spider 1.0

Part	Value	Quantity	Mouser reference
Resistors			
R10, R12, R36	10 Ω	3	291-10-RC
R2, R29	15 Ω	2	291-15-RC
R17 to R28, R31, R35	33 Ω	14	291-15-RC
R38	220 Ω	1	291-220-RC
R7, R33	1 kΩ	2	291-1K-RC
R5, R9, R11	1.2 kΩ	3	291-1.2K-RC
R1, R3, R6, R14, R15, R16, R32, R37, R40	10 kΩ	9	291-10K-RC
R4, R30	22 kΩ	2	291-22K-RC
R8, R34	47 kΩ	2	291-47K-RC
Potentiometers			
P1, P2	10 kΩ log, Alps RK11K	2	688-RK11K1130A07
Knob	Eagle 450-476X or 450-466Xs	2	black: Eagle 450-476 grey: Eagle 450-466
Capacitors			
C6, C24	220 pF	2	594-S221K25Y5PN6TK5R
C2, C21	470 pF	2	594-S471K25Y5PN6TJ5R
C3, C26	47 nF	2	871-B32529C1473J189
C8, C9, C15	100 nF	3	871-B32529C104K189
C1, C4, C5, C11, C12, C16, C20, C22, C23, C25	10 µF	10	140-REA100M1VBK0511P
C14	100 µF	1	140-REA101M1ABK0511P
C7, C27	220 µF	2	140-REA221M1ABK0611P
C10, C19	1000 µF	2	140-REA102M1ABK1012P
Integrated circuits			
IC1, IC2, IC4	NE5532	3	595-SA5532PE4
IC3, IC5	LM386N-3	2	926-LM386N-3/NOPB
U1	LM317	1	511-LM317T
DIL8 socket	Mill-Max 110-99-308-41-001000	5	575-199308
Electromechanical parts			
S1, S2, S3	Mountain Switch 0052-EVX	3	108-0052-EVX
X1	3M 961102-5604-AR	1	961102-5604-AR
Battery clip	Eagle 123-4016/M-GR	1	123-4016/M-GR
Plugs			
H1 to H14	TruConnect 20-1655	14	Rapid: 20-1655
J1	Kobiconn 179PH-EX	1	163-179PH-EX
J2, J3	Rean NRJ6HH	2	550-25301
J4	Switchcraft PJRAN2X1U	1	502-PJRAN2X1U02X
Misc			

Part	Value	Quantity	Mouser reference
LED1	Cree C535A-WJN-CS0V0151	1	941-C535AWJNCS0V0151
D1	1N4004	1	512-1N4004
Hardware			
Enclosure	Hammond 1599EBAT	1	black: 546-1599EBKBAT grey: 546-1599EGYBAT economic: 546-1599ESGYBAT
Heat sink	Aavid Thermalloy 6237BG	1	532-6237B
Spacer	Raf M2110-3005-AL	6	761-M2110-3005-AL
Bolt	M3	6	

Building instructions for Spider 1.0

Make sure you read our soldering tips.

PCB drill sizes

- ø 0.8: all drills unless documented otherwise.
- ø 1.0: leads of the potentiometers P1 and P2, battery connector X1, and diode D1.
- ø 1.2: leads of the LM317 U1, and interruptors S1, S2, and S3.
- ø 1.5: leads of the input jacks J2 and J3, central lead of the headphone plugs H1 to H14.
- ø 2.0: plastic anchors of the input jacks J2 and J3.
- ø 2.5: small leads of the power plug J1, anchors of the potentiometers P1 and P2, lateral leads of the headphone plugs H1 to H14, and leads of the extension plug J4.
- ø 3.0: big lead of the power plug J1 and spacers.

Enclosure drills

Panel

0. Print the layer “Screenprint” of the board design on the side of the enclosure which has the battery lid.
1. Drill all the holes first at ø 2 and then at ø 5.
2. Drill the holes of the potentiometers and headphone plugs at ø 7.

Sides

0. Close the enclosure with its screws. Drill first at ø 2 and then at ø 5 to be able to adjust the placement:

- Power plug J1: ø 7. Center on the junction between the two parts of the enclosure.
- Input jacks J2 and J3: ø 9. Center on the junction between the two parts of the enclosure.
- Extension plug J4: ø 10. Center 1.0 mm above the junction of the two parts of the enclosure.

Preparation

0. Solder the 5 DIL8 sockets. The socket pins which have to be soldered on top have a longer shape to ease soldering.
1. Mount the spacers.
2. Test for short-circuits between the pins of the sockets.

Power supply

0. Solder J1, U1, R5, R38, C19, X1, S1, R16, LED1, and D1.
1. Plug the heat sink on the LM317 U1. Bend the larger part of the LM317 leads to fit the heat sink in its correct position. Solder U1. Beware: it is all-right for the heat sink to touch the central lead of the LM317 but not the other ones. Then separate a bit the LM317 from the PCB to make sure it doesn't touch the other components.
2. Solder J1 both on top and on the bottom of the PCB to make it stronger.
3. Solder LED1 so its base is 11 mm above the PCB.
4. Plug the DC transformer and measure 8 V between the lateral lead of J1 (GND) and the central lead of the LM317 (VCC).
5. Unplug the DC transformer and connect a 9 V battery. Verify that the LED lights on with the battery only.

Virtual ground

0. Solder R14, R15, C14, and C15.
1. Mount IC2.
2. Measure 8 V between pin 8 of IC2 (VCC) and GND.
3. Measure 4 V between pin 5 of IC2 (VCC/2) and GND.
4. Measure 4 V between pin 6 of IC2 (VCC/2) and GND.

Floor line amplification

0. Solder J3, S3, R40, C20, R37, R30, C21, and C23.
1. Mount IC4.
2. With an oscilloscope, visualize the signal of a line input on pin 1 of IC4.
3. To feed a continuous sine signal into the line input you can run the following command in Linux:

   speaker-test -t sine

Floor power amplifier

0. Solder P2, C9, C26, R36, C27, R11, C11, R31, R35, H13, and H14.
1. Mount IC5.

R11 sets the gain of the LM386. As explained in the datasheet, without this resistor, the gain is set to 20, with a resistor of 1.2 kΩ to 50, and with a shunt to 200. Let's puts a 1.2 kΩ resistor by default.

0. Listen to a line input in the 2 headphone plugs.

Floor microphone amplification

0. Solder R29, R32, C22, C24, R34, C25, and R33.
1. Listen to a microphone input in the headphone plugs.

Interpretation line amplification

0. Solder J2, S2, R1, C1, R3, R4, C2, and C16.
1. Mount IC1.
2. With an oscilloscope, visualize the signal of a line input on pin 1 of IC1.

Interpretation power amplifier

0. Solder R12, P1, C8, C3, R10, C7, C10, R9, C5, R28, H12, R27, H11, R26, and H10.
1. Mount IC3.

R9 sets the gain of the LM386. As explained in the datasheet, without this resistor, the gain is set to 20, with a resistor of 1.2 kΩ to 50, and with a shunt to 200. Let's puts a 1.2 kΩ resistor by default.

0. Solder C10 on the bottom of the PCB.
1. Listen to a line input in the 3 headphone plugs.

Interpretation microphone amplification

0. Solder R2, C4, R6, C6, R8, C12, and R7.
1. Listen to a microphone input in the headphone plugs.

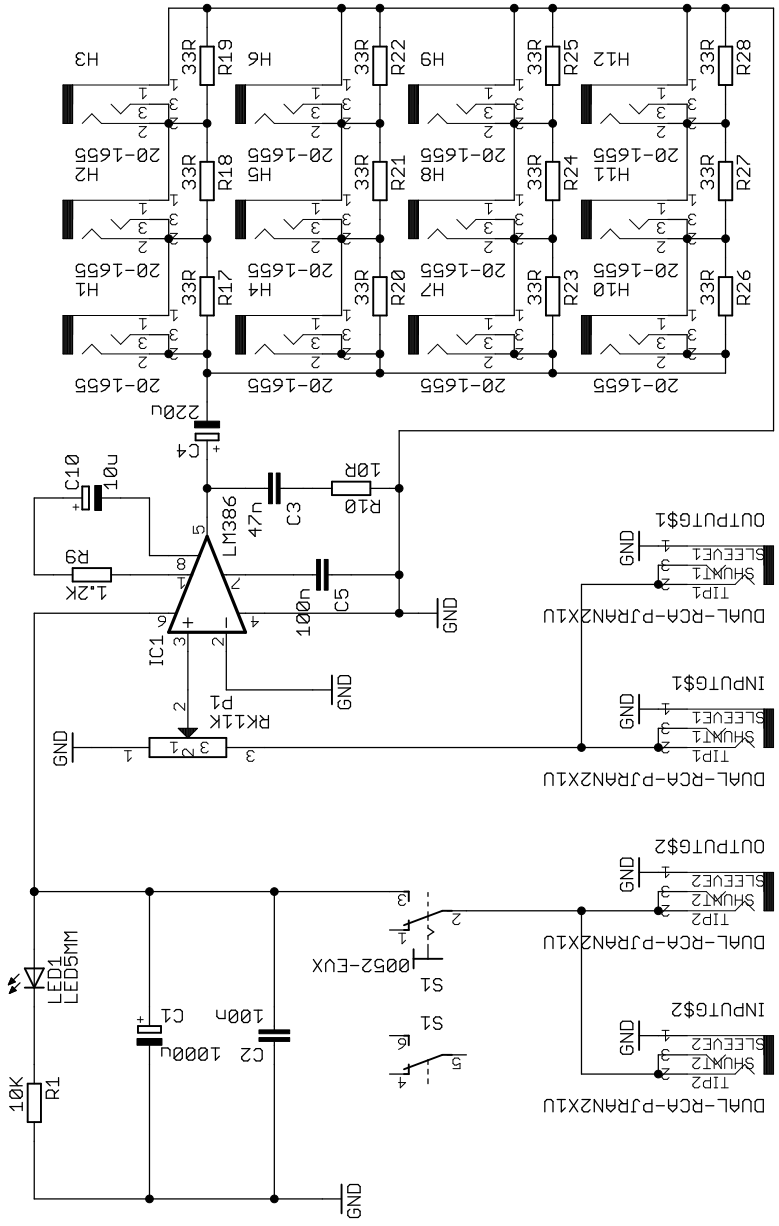
Interpretation headphone plugs

0. Solder R20, R21, R22, R23, R24, R25, R26, R27, R28, H4, H5, H6, H7, H8, H9, H10, H11, and H12.
1. Listen to a microphone input in the 12 headphone plugs.

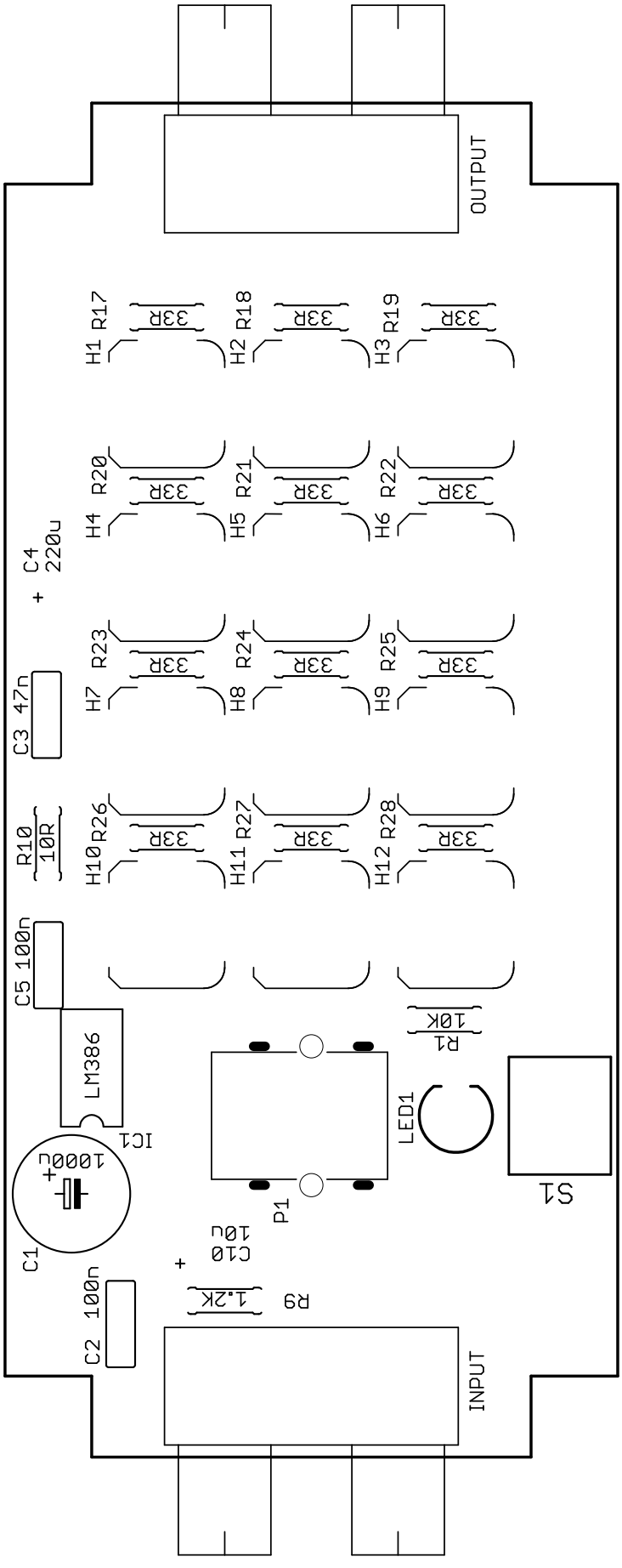
Extension plug

0. Solder J4.
1. Measure 8 V between the pin of the red RCA plug and GND.
2. With an oscilloscope, visualize an audio signal on the pin of the black RCA plug.

Extension 1.0 schematics



Extension 1.0 board



Parts list for Spider extension 1.0

Part	Value	Quantity	Mouser reference
R10	10 Ω	1	291-10-RC
R17 to R28	15 Ω	12	291-33-RC
R9	1.2 kΩ	1	291-1.2K-RC
R1	10 kΩ	1	291-10K-RC
P1	10 kΩ log, Alps RK11K	1	688-RK11K1130A07
C3	47 nF	1	871-B32529C1473J189
C2, C5	100 nF	2	871-B32529C104K189
C10	10 µF	1	140-REA100M1VBK0511P
C4	220 µF	1	140-REA221M1ABK0611P
C1	1000 µF	1	140-REA102M1ABK1012P
H1 to H12	TruConnect 20-1655	12	Rapid: 20-1655
IC3	LM386N-3	1	926-LM386N-3/NOPB
DIL8 socket	Mill-Max 110-99-308-41-001000	1	575-199308
LED1	Cree C535A-WJN-CS0V0151	1	941-C535AWJNCS0V0151
INPUT, OUTPUT	Switchcraft PJRAN2X1U	2	502-PJRAN2X1U02X
S1	Mountain Switch 0052-EVX	1	108-0052-EVX
Hardware			
Enclosure	Hammond 1599B	1	black: 546-1599B-BK grey: 546-1599BS-GY economic: 546-1599BS-GY

Building instructions for extension 1.0

Make sure you read our soldering tips.

PCB drill sizes

- ø 0.8: all drills unless documented otherwise.
- ø 1.0: leads of the potentiometer P1.
- ø 1.2: leads of the interruptor S1.
- ø 1.5: central lead of the headphone plugs H1 to H12.
- ø 2.5: anchors of the potentiometer P1, lateral leads of the headphone plugs H1 to H12, and leads of the RCA plugs INPUT and OUTPUT.

Enclosure drills

Panel

0. Print the layer “Screenprint” of the board design on the side of the enclosure which has apparent screw holes.
1. Drill all the holes first at ø 2 and then at ø 5.
2. Drill the holes of the potentiometers and headphones plugs at ø 7.

Sides

0. Close the enclosure with its screws. Drill first at ø 2 and then at ø 5 to be able to adjust the placement:

- RCA plugs INPUT and OUTPUT: ø 10. Center 1.0 mm above the junction of the two parts of the enclosure.

Preparation

0. Solder the DIL8 socket of the LM386.
1. Test for short-circuits between the pins of the socket.

Power supply

0. Solder INPUT, OUTPUT, S1, C2, C1, R1, and LED1.
1. Solder LED1 so its base is 11 mm above the PCB.
2. Mount the LM386.
3. Plug the extension to a Spider, and verify that the LED lights on.
4. Measure 8 V between the shields of the RCA plugs and pin 6 of the LM386 (VCC).

Power amplifier

0. Solder P1, R9, C10, C8, C3, R10, C7, R26, R27, R28, H10, H11, and H12.

R9 sets the gain of the LM386. As explained in the datasheet, without this resistor, the gain is set to 20, with a resistor of 1.2 kΩ to 50, and with a shunt to 200. Let's puts a 1.2 kΩ resistor by default.

0. Plug the extension to a Spider, and listen to the signal from the Spider in the 3 headphone plugs.

Interpretation

0. Solder R17, R18, R19, R20, R21, R22, R23, R24, R25, H1, H2, H3, H4, H5, H6, H7, H8, and H9.
1. Plug the extension to a Spider, and listen to the output of the Spider in all the 12 headphone plugs.