This document describes the assembly process of the V5.8 integrator. There are five main steps:

1. populate and solder the PCB
2. prepare the housing by drilling connector and switch holes
3. mount switches and solder to PCB
4. install power, signal and ground connectors in housing
5. install wires connecting PCB to connectors

There is one step which might be desirable to perform before assembling the PCB. The switch hole locations are critical, because the switches occupy fixed locations on the PCB. The switch leads have PCB lugs, but those do not fit tightly inside the PCB mounting holes. Because the switches might come from different suppliers, it is not reasonable to expect that they do. Therefore, I developed a method to ensure that the switches will fit into the housing holes after PCB assembly. The trick is to first mount all the switches in place in the housing, and then solder the PCB to them. This way, the PCB can be removed and re-inserted with confidence that the switch shafts will align with the holes in the housing.

The switch hole centers are perfectly aligned with the center contact lug. Because of that, it is possible to use the bare PCB as a marking template for the housing holes. You can use a fine “sharpie” (permanent marker) to make drill targets on the housing by placing the PCB on the housing top and rotating the marker inside the hole, to make a dot.

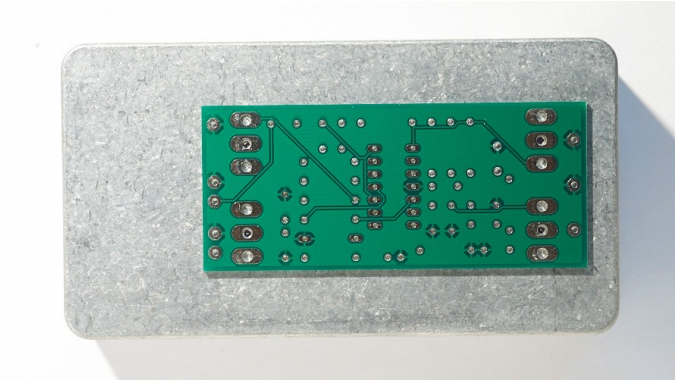

Figure 1

I have used this method without problems, but you have to ensure that the PCB itself is not contaminated with ink. I have a spare PCB that I use exclusively for this purpose. Since the parts kit has only one PCB, I suggest that you use an alternative method to measure and mark the holes, but you can still use the PCB to confirm the accuracy of the locations. Nevertheless, I mention the technique in case it is helpful in some way.

Because the holes are laid out in decimal inches, a piece of perfboard with 0.1” centers can be used instead to make a drilling template, or just to check alignment in the same way as the PCB. The four switches are mounted in a rectangle measuring 0.7”x2.3”, therefore you can measure 7 holes across and 23 holes down on such a perfboard, and the holes will match the switch locations.

In a production environment, the appropriate dimensions would be matched by the CNC that is used to drill the housing, but in the case of a small quantity build like this, a little creativity is needed. The important thing to remember at this stage, is that if you want to use the PCB “as a ruler”, now is the time because once it gets components on it, it is too awkward to use for that purpose.

All the other holes, I mark with a ruler and small permanent marker strictly by hand. If you are reasonably careful, this method will achieve acceptable tolerances for the part locations. The switch locations can also be laid out with a ruler, but in all cases I recommend checking whatever marks you make with the PCB before you begin drilling holes. Optionally, you can make a shallow chamfer in the LED hole making a light reflector, using a countersink bit. Don’t make this deep, keep it very short.

Hammond 1590B drilling guide:

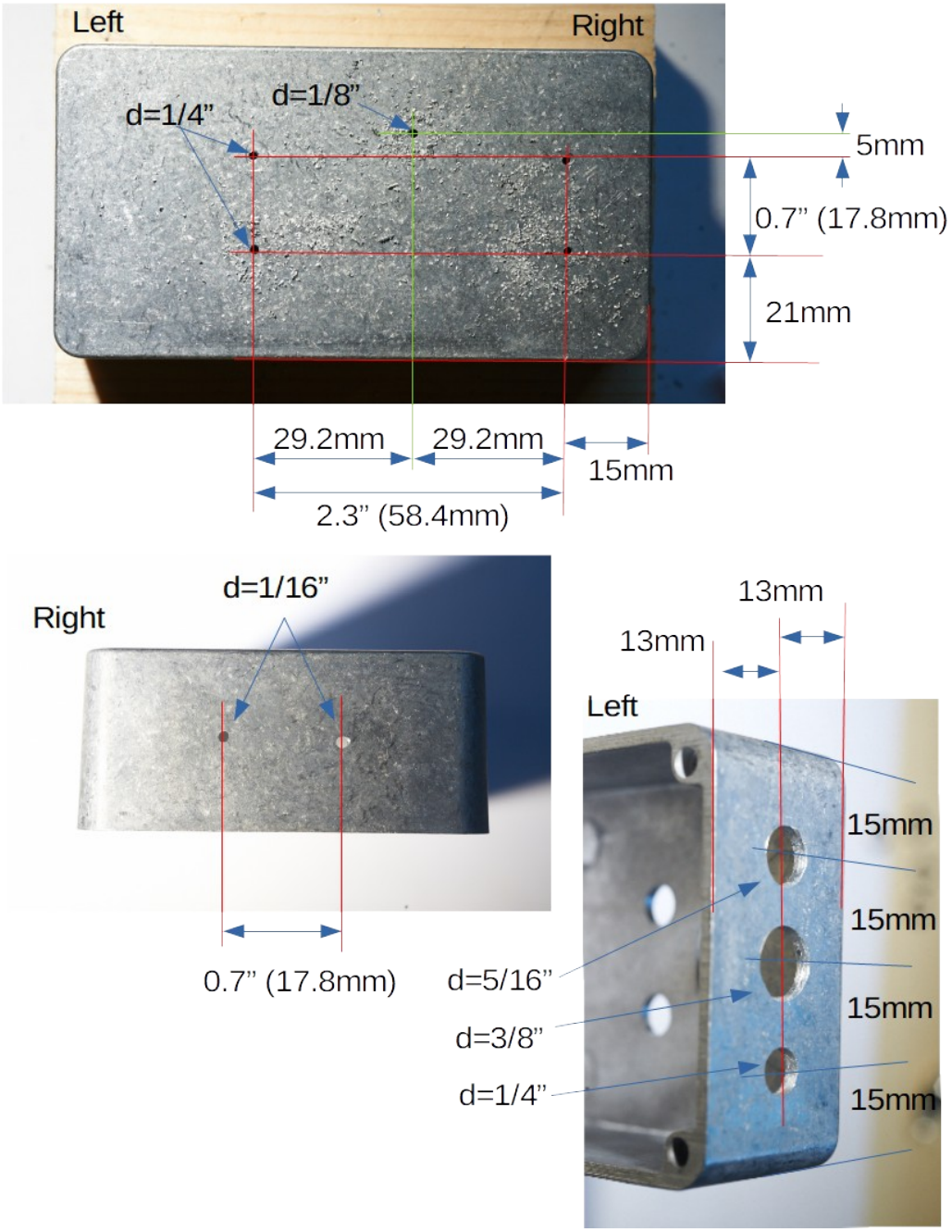

Figure 2

Ensure that the rectangular “Hammond” logo is on the input (right) side of the device. This is to keep the switches on the flat part of the housing interior:

Figure 3

1. First, place and solder all the resistors:

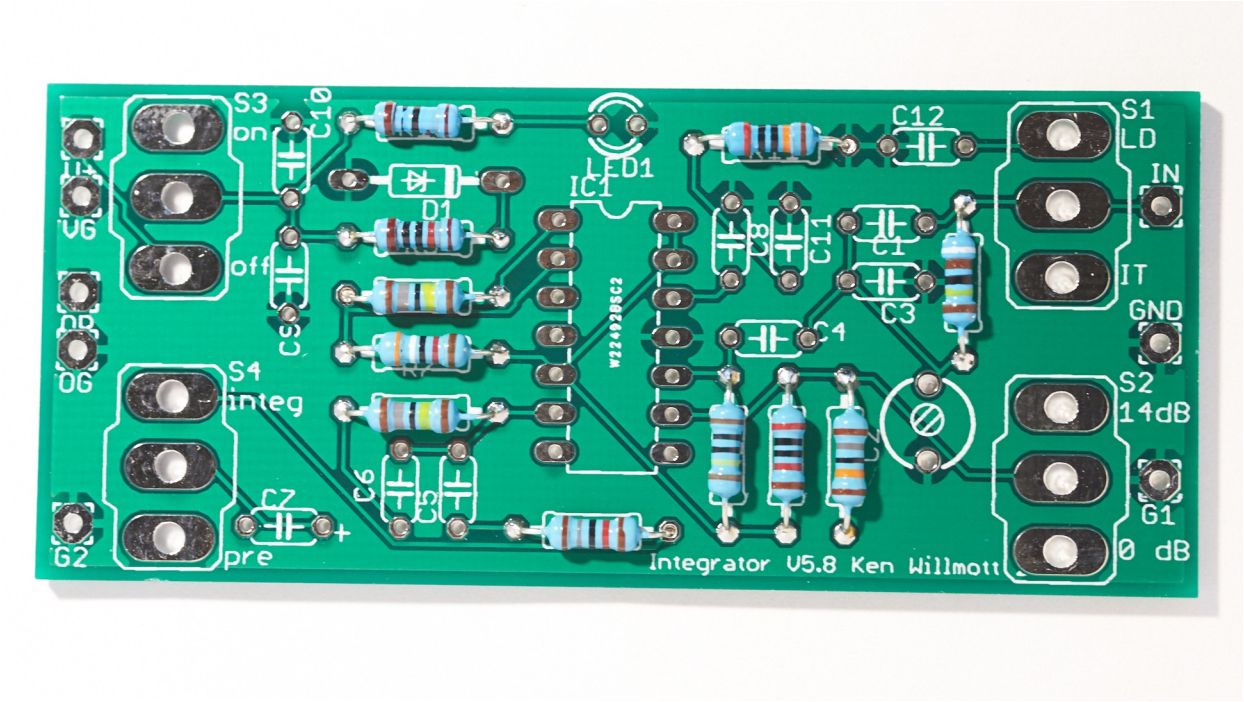

Figure 4
(1% tolerance resistors shown)

2. Place and solder the IC socket. Ensure that the socket notch matches the notch on the PCB screen print:

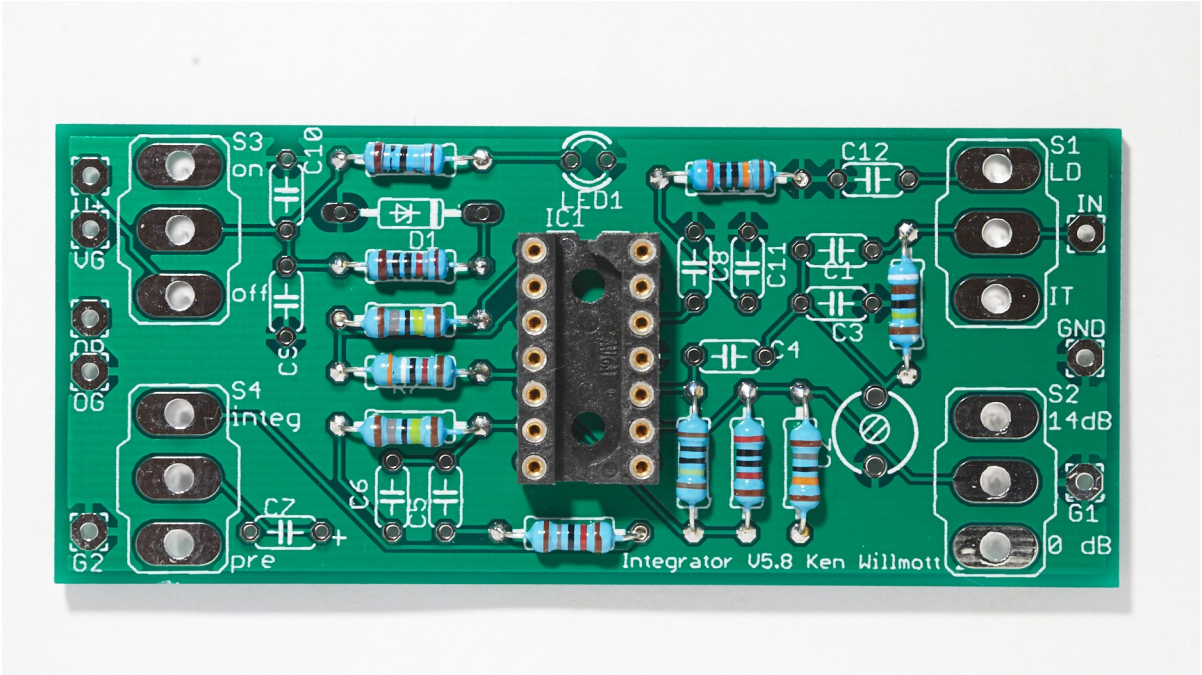

Figure 5

3. Place and solder C4, C8, C9 (0.1uF code 104)

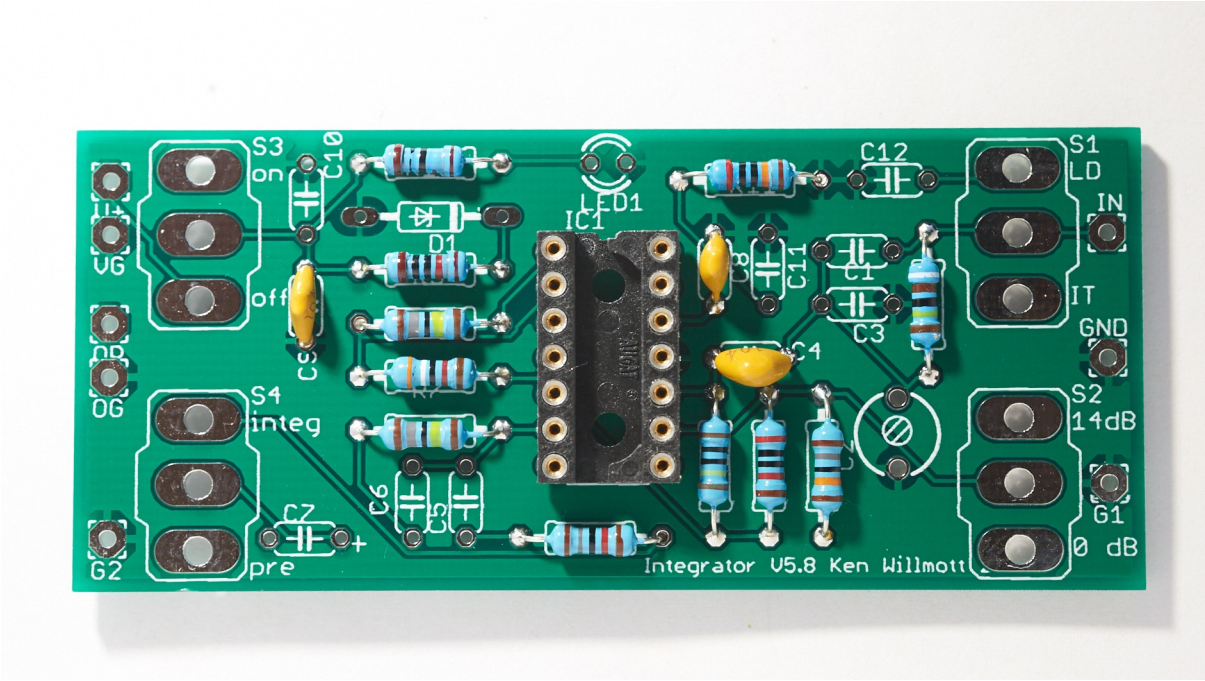

Figure 6

4. Place and solder

C6 10nF code 103
C3 20pF code 200
C12 4.7nF code 472
C11 470pF code 471

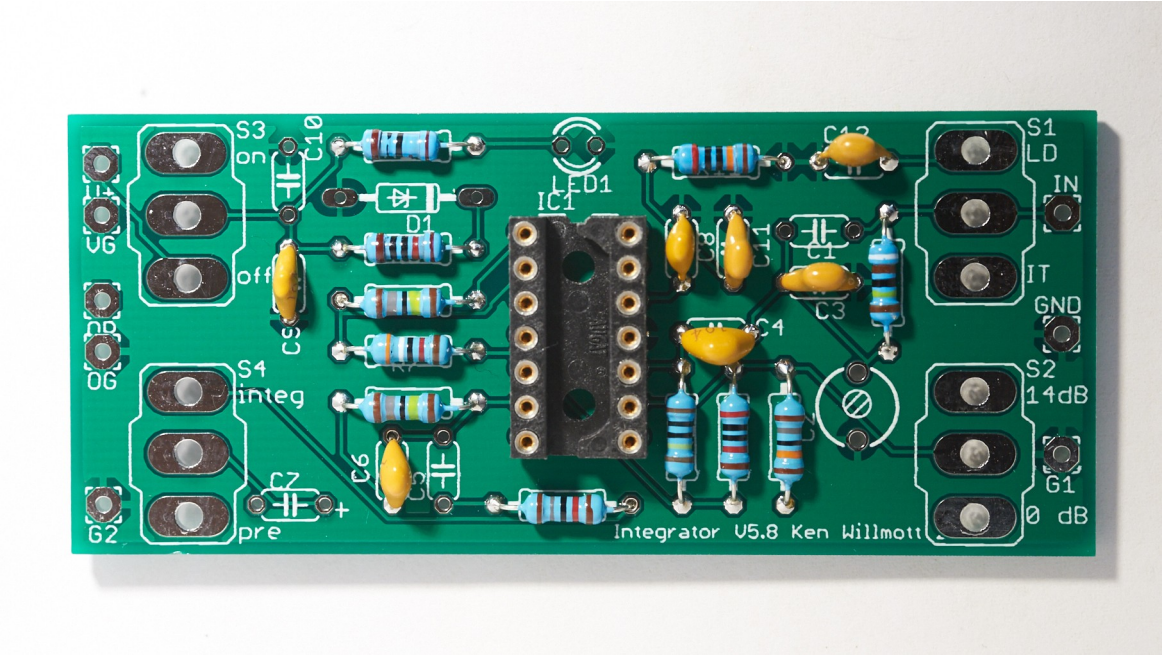

Figure 7

5. Place and solder

C7 10uF code 106

C5, C10 1.0uF code 105

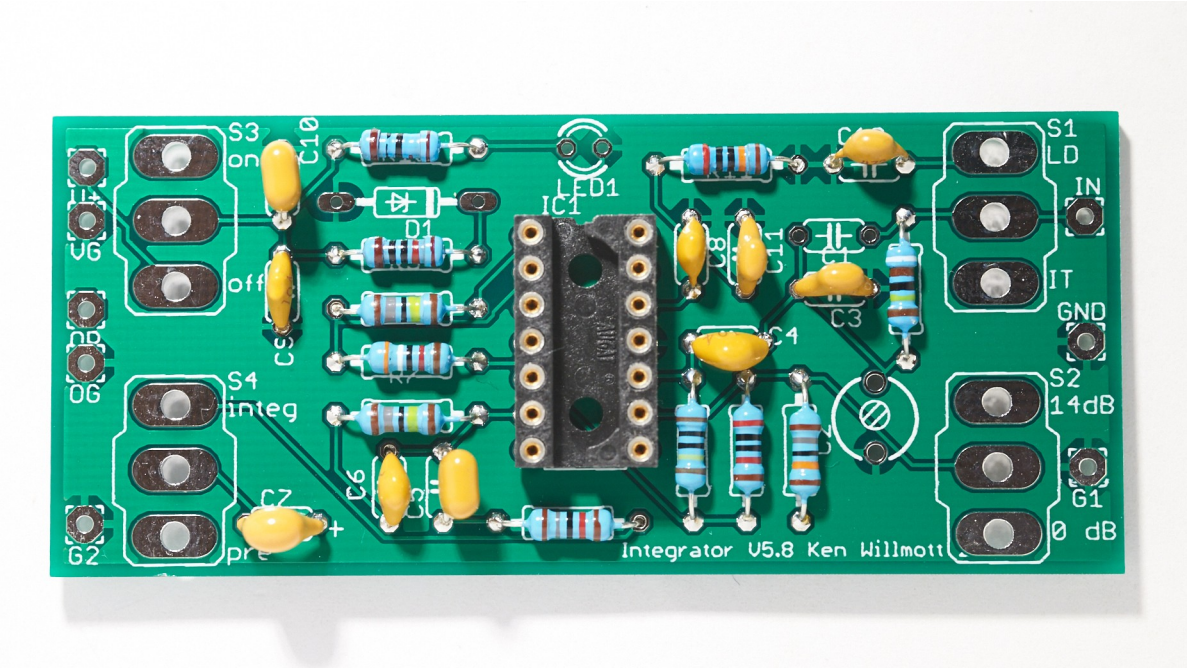

Figure 8

6. Place and solder Zener diode D1. Ensure that the black band on the cathode of the diode is aligned with the band marking on the PCB, as shown here:

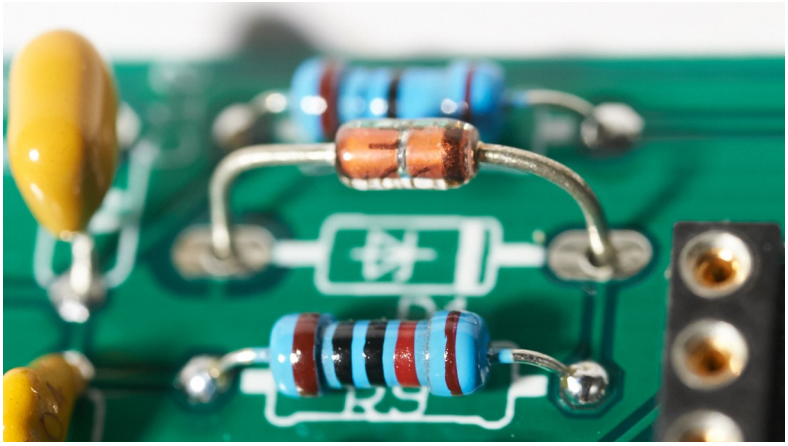

Figure 9

The board should now look like this:

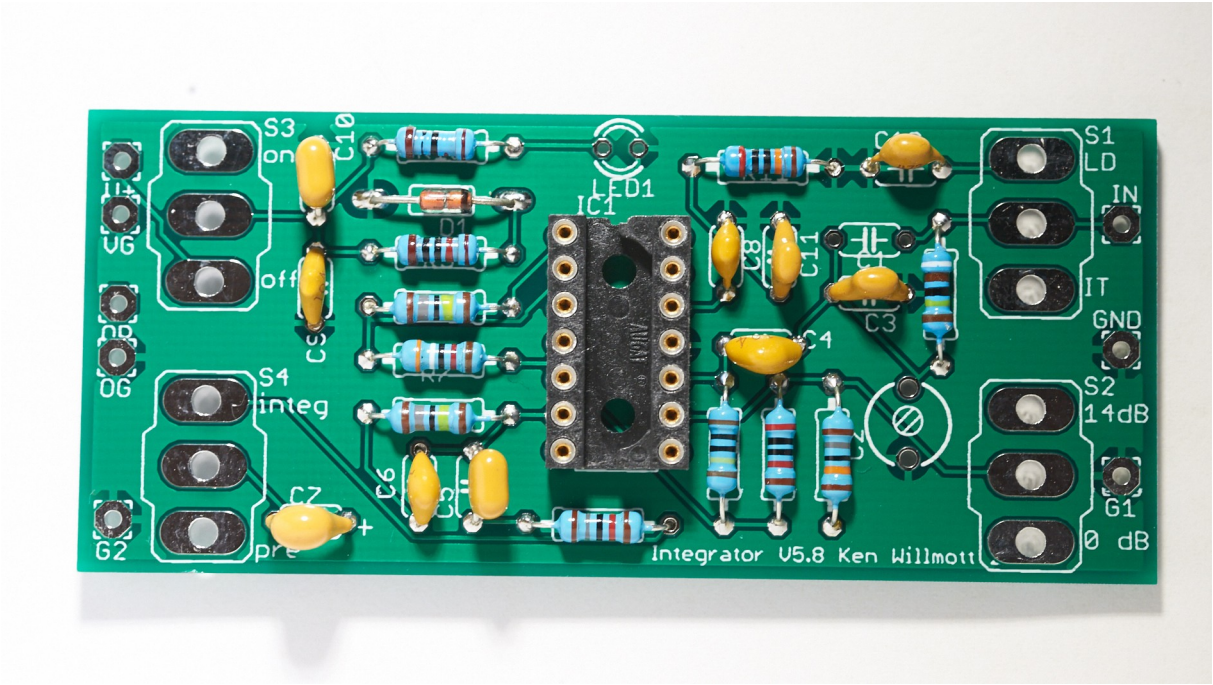

Figure 10

7. Place and solder the variable capacitor C2. If the board will be mounted in an enclosure where the capacitor adjustment screw is only accessible from the back of the board (the standard case), mount it there, where it can be reached after the installation is complete. Position the flat portion of the C2's housing so that it faces the middle of the board and solder from the component side:

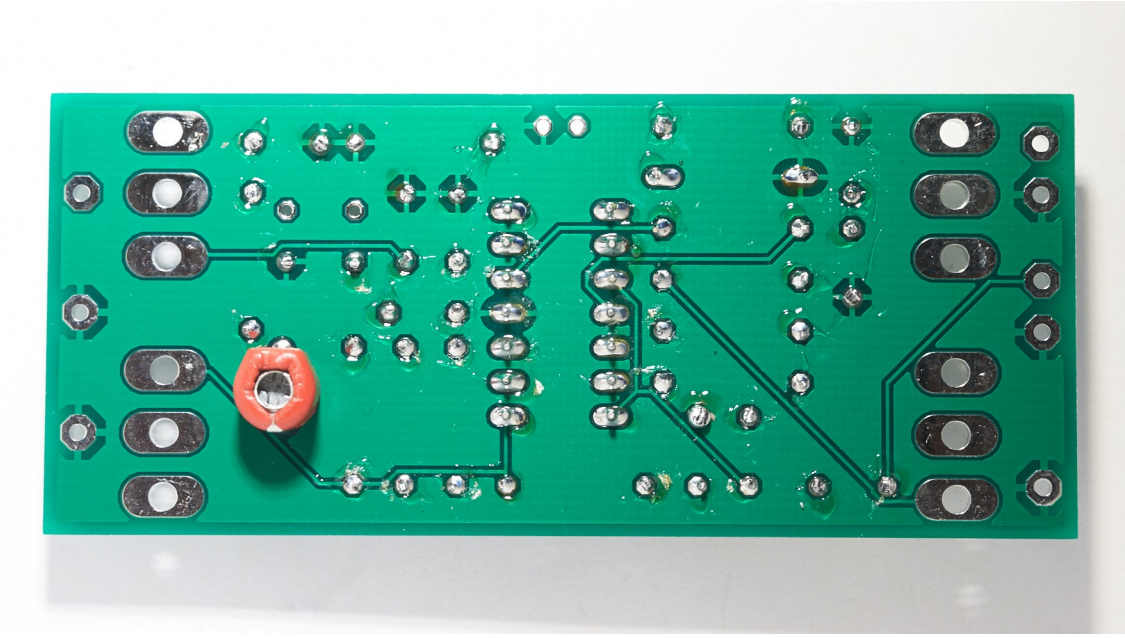

Figure 11

8. Perform a close final inspection to detect missed or cold solder joints. It is recommended, but not essential, to remove solder flux residue with a flux remover, contact cleaner or 99% isopropyl alcohol and gentle brushing with a medium stiffness brush such as an old toothbrush. You may decide to do this later, with all the switches and wires installed as shown later in figure 22.

The LED and switches should be installed with the switches temporarily installed in the unit housing. Prepare the switches for installation. Adjust the lower hex nut on all switches so that they are all as far down as possible while keeping them all at an equal height:

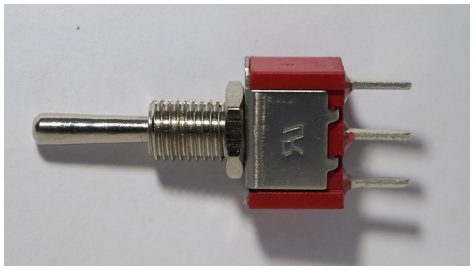

Figure 12

Place the washer on the shaft, with the alignment tab facing the terminals:

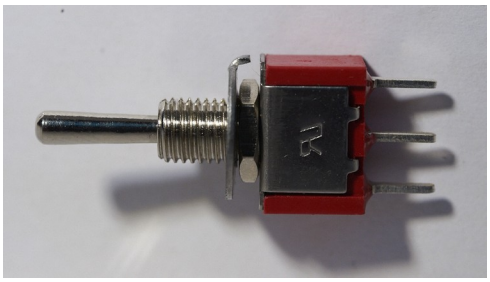

Figure 13

Place the compression (lock) washer on the shaft:

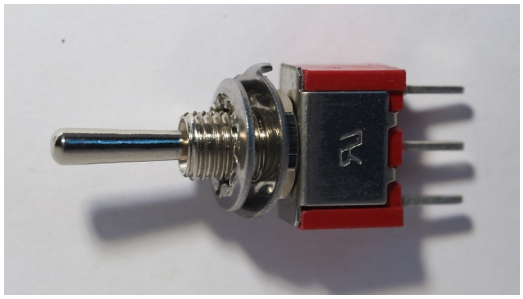

Figure 14

Position the switches with all the washers into the housing, with all the lower hex nuts all in the same position on the shaft as described above. Make sure that all the lugs are as straight as possible, place the hex nuts on the front of the switch panel, and tighten gently:

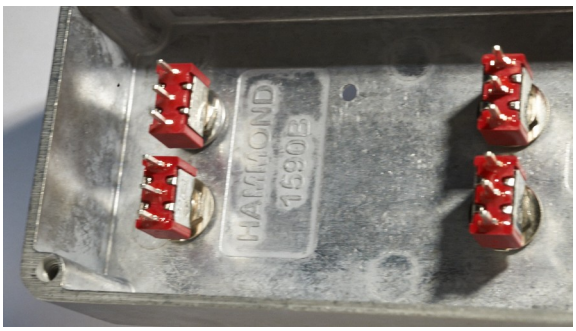

Figure 15

Insert the LED in place on the PCB, making sure that the leads have the correct polarity (generally, the anode is longer).

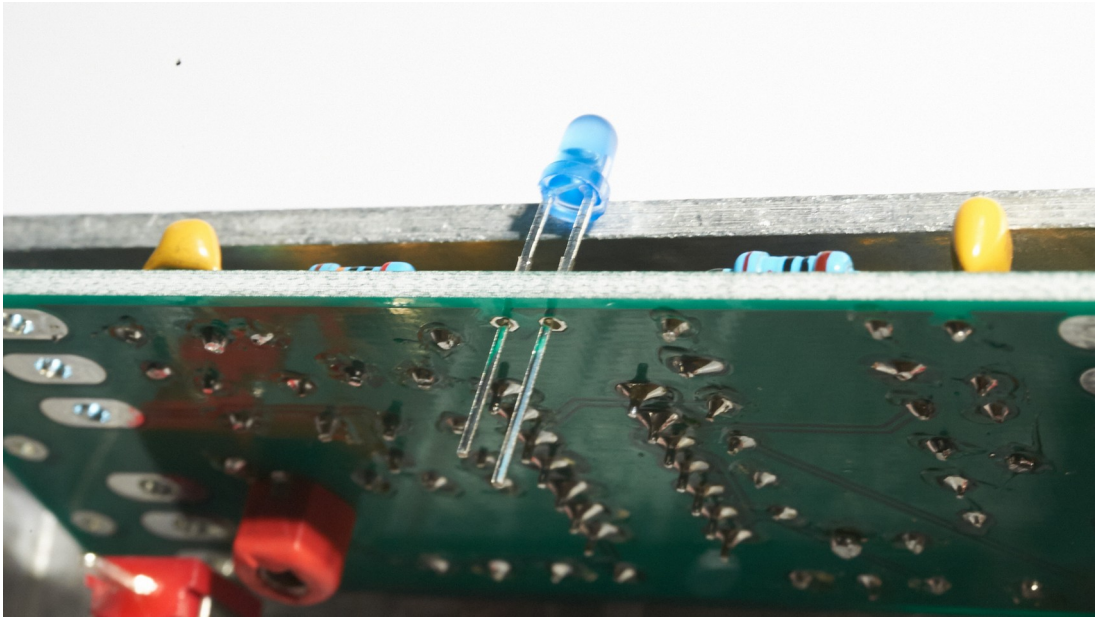

Figure 16

Carefully attach the PCB and LED in place on the switches. It is difficult to do this without the LED falling out so it requires a bit of patience to perform. It may be helpful to tilt the whole assembly sideways and/or grip the protruding LED leads gently while you do it.

Flip the upper toggle handles up and the lower toggle handles down, to “spread the legs” and support the assembly for soldering.

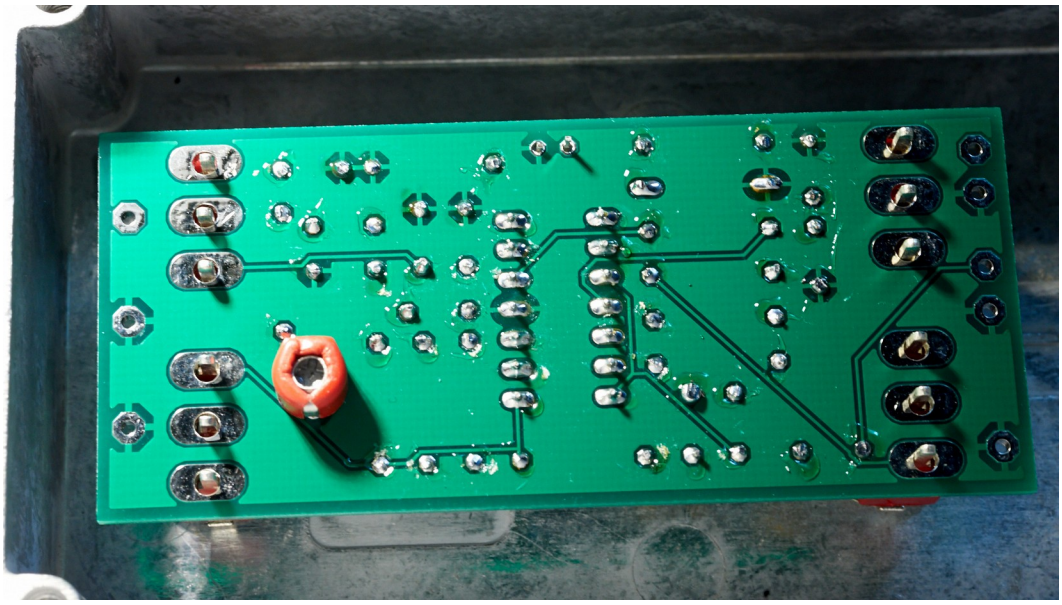

Figure 17

Push the board down to firmly seat the PCB on the switch lugs. Check the board orientation one more time and then solder the switch contacts. **Do not solder the LED leads yet.**

Place the assembly on top of a surface that runs between the switches, such as a piece of wood 2”x4”. This will push and level the top of the LED so that it is perfectly flush with the panel top:

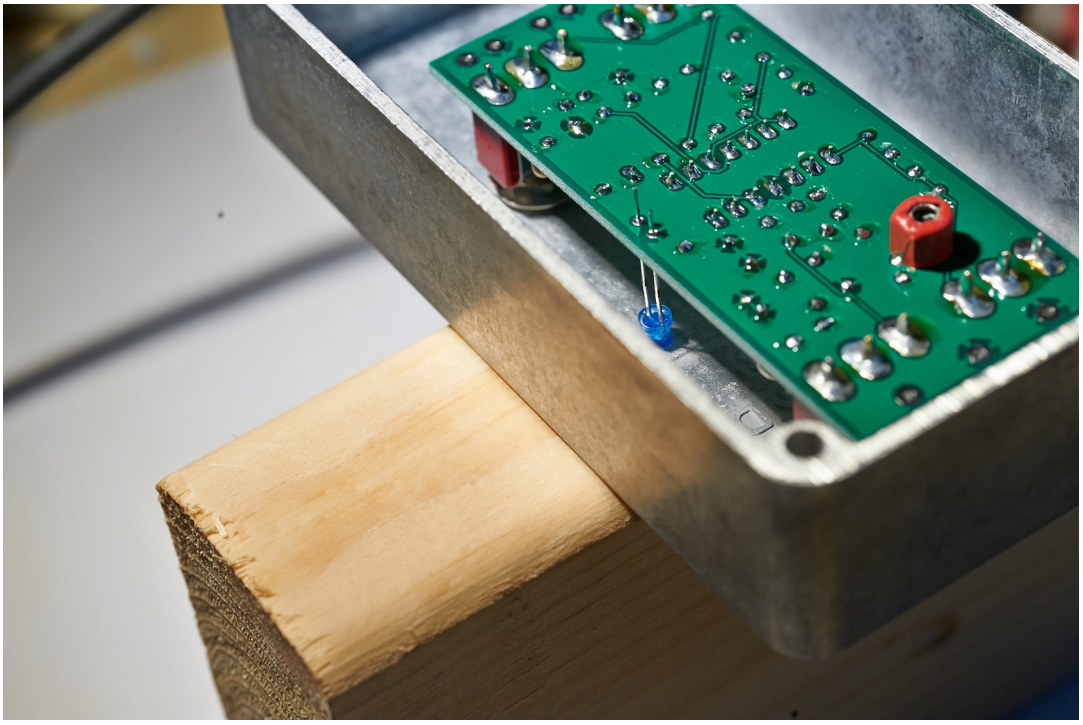

Figure 18

Now solder the LED leads. Remove the front panel nuts and remove the PCB/switch assembly from the housing. It will look like this:

Figure 19

(in this photo, the front panel nuts have been replaced to avoid getting lost)

Insert the OP amp IC into the IC socket. **Do not forget!** You can not see it once the unit is assembled. Ensure that the legs fit straight into the sockets without bending, and that the orientation notch on the IC matches the orientation notch on the IC socket.

Mount the power connector, BNC output connector, and auxiliary ground banana jack into the holes that you have drilled in the housing:

Figure 20

Cut and strip hookup wires as shown. The input wires must be flexible multi-conductor wire. The others can be flexible or solid, but solid wire is easier to work with:

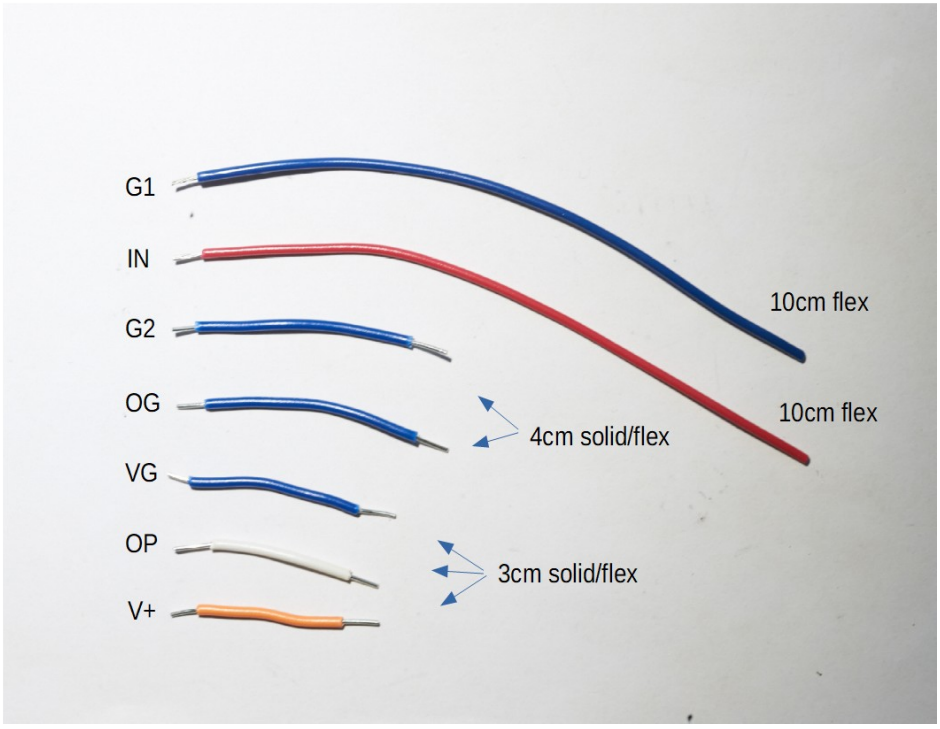

Figure 21

Place and solder the hookup wires:

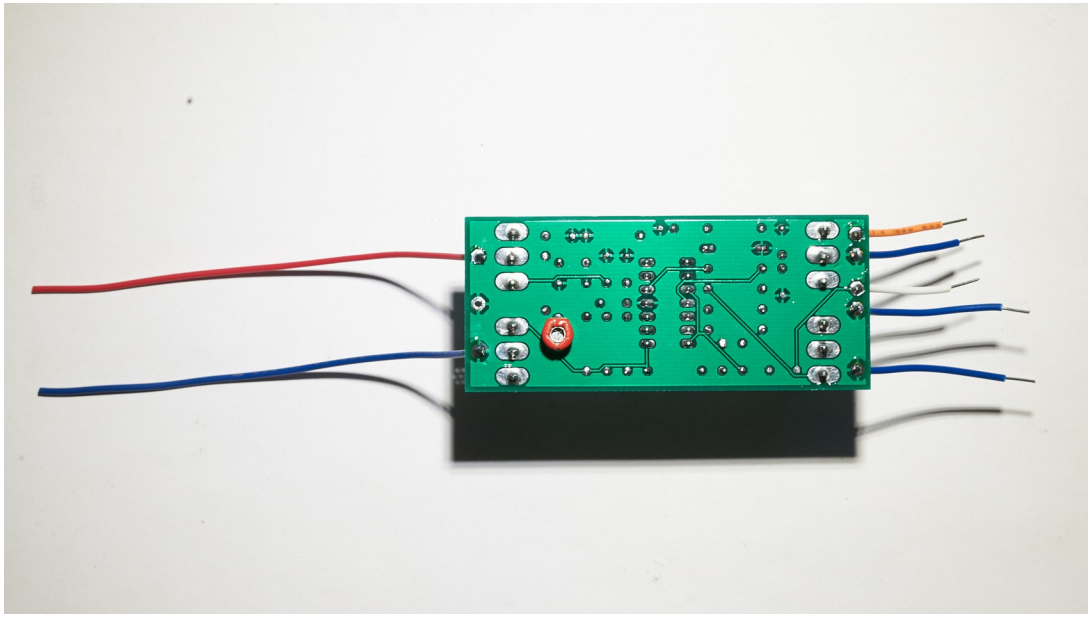

Figure 22

Optionally clean the PCB with flux remover. Now is a good time to do a final visual inspection of both the housing and the PCB assembly.

Feed the IN and G1 wires through the housing holes from the inside. If you did this right, they will line up perfectly but it is easy for them to get pinched. Ensure that all the washers are on the switches, and that the lower nuts are in alignment. Insert the assembly into the housing. It helps to hold the board upright and insert from the bottom using gravity to prevent the washers from falling out. At this point the switches make the assembly quite tall and so this step requires some care and patience. Once the switch handles are through the housing, and the input wires are straight, you can put the front panel hex nuts on to secure the assembly.

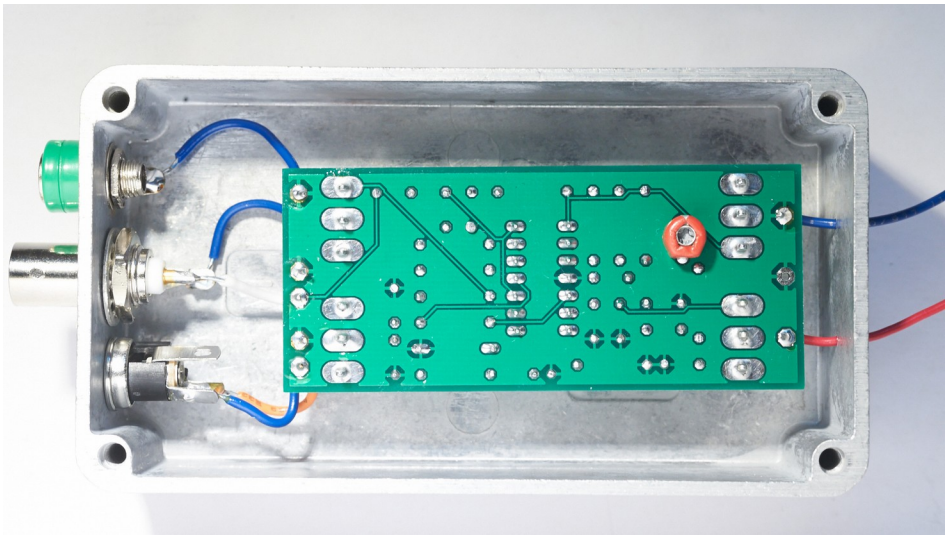

Figure 23

Place and solder the hookup wires:

- G2 to the auxiliary ground banana jack. Optionally, a banana jack that has a direct ground connection to the housing can be used. In that case, the wire can be omitted. However, if a painted housing is used, the connection might be compromised. Hence, it is a good policy to wire it.
- OG to the ground connection of the BNC jack
- OP to the signal connection of the BNC jack
- VG to the (-) connection of the power jack
- V+ to the (+) connection of the power jack

Strip the ends of the test leads IN and V1. Attach and solder clip leads:

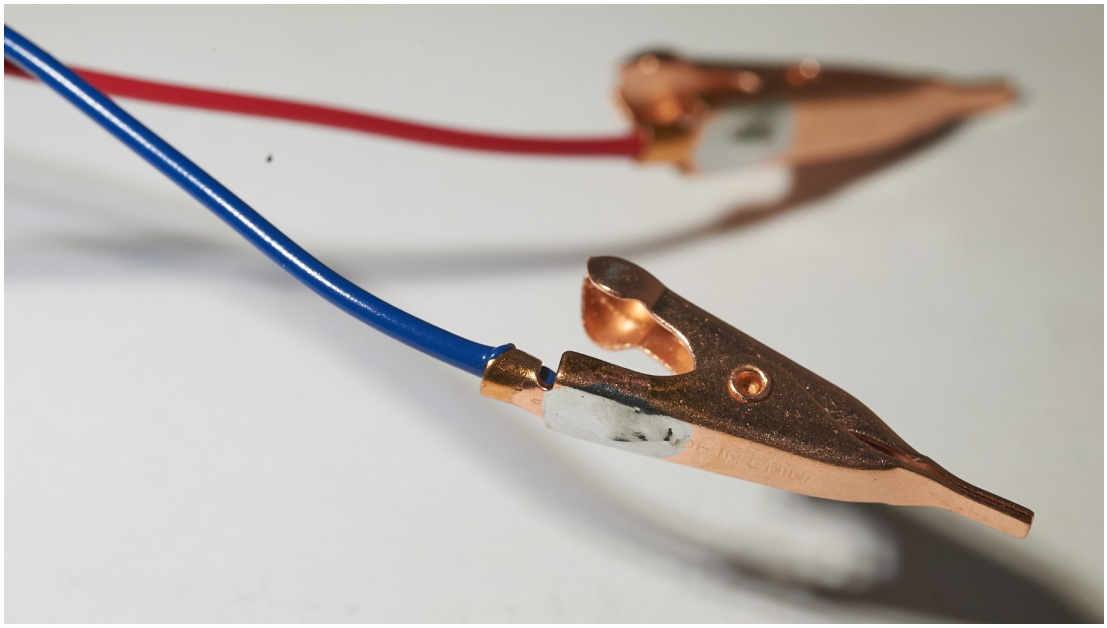

Figure 24

The unit is now complete, except that the final checkout and input network calibration can be performed before the back cover is put on.

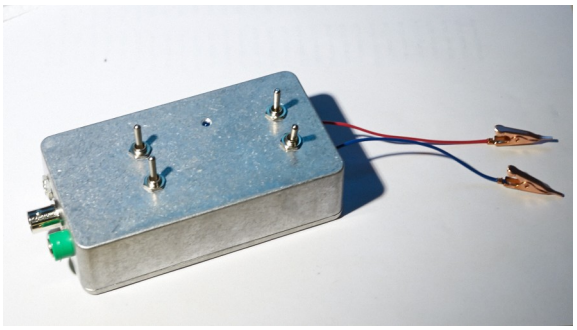

Figure 25