VMM method for electronics prototyping

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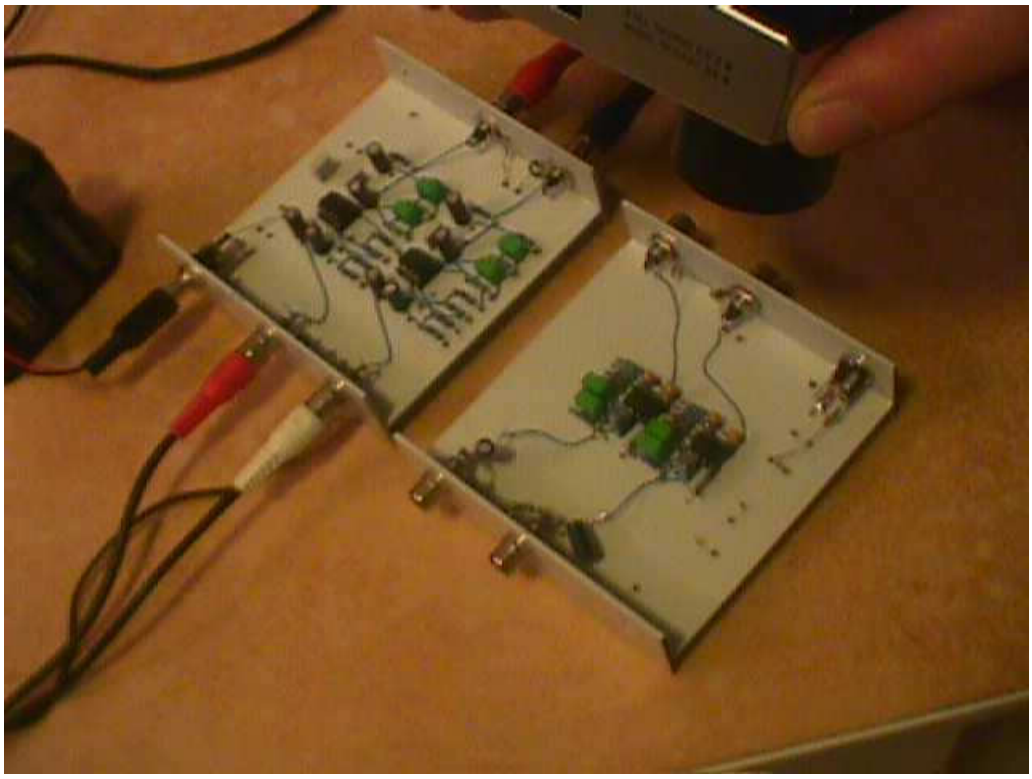
Basics

VMM is a method to implement dense disk built electronic circuit connections without special tools.

VMM enables dense-performance couplings on the building, the method conducted in circuit boards can be used for integrated land use and voltage levels. The method is based on standard circuit board material, thin wiring and liitinholkkien creative use.

In 2002, VMM-developed method is a continuation of Electronics World July 1998 newspaper article. It is specially introduced a prototype and single, without making a pattern transfer film and chemicals, using simple tools. VMM methodology is particularly suitable for a number of IC chips containing linkages which do not unduly passive discrete components. VMM methodology is well suited for construction of prototypes. It suits well for digital electronics and audio circuits.



Picture 1: Audio circuit implemented using VMM method (Veikko Pöyhönen)

Basic construction

VMM methodology the idea is that the standard components of connection points are equipped with bushes, which the self-components are placed. In this way, the project carried out in the disc sleeve and wiring prepared first, and when all is in this respect self-produced components are installed. Since all components are the bushes, can be easily removed and replaced later.
Signal wiring is a coupling wire above the circuit board. When the wiring on the circuit board, a very easy switching is shown how the various components are wired

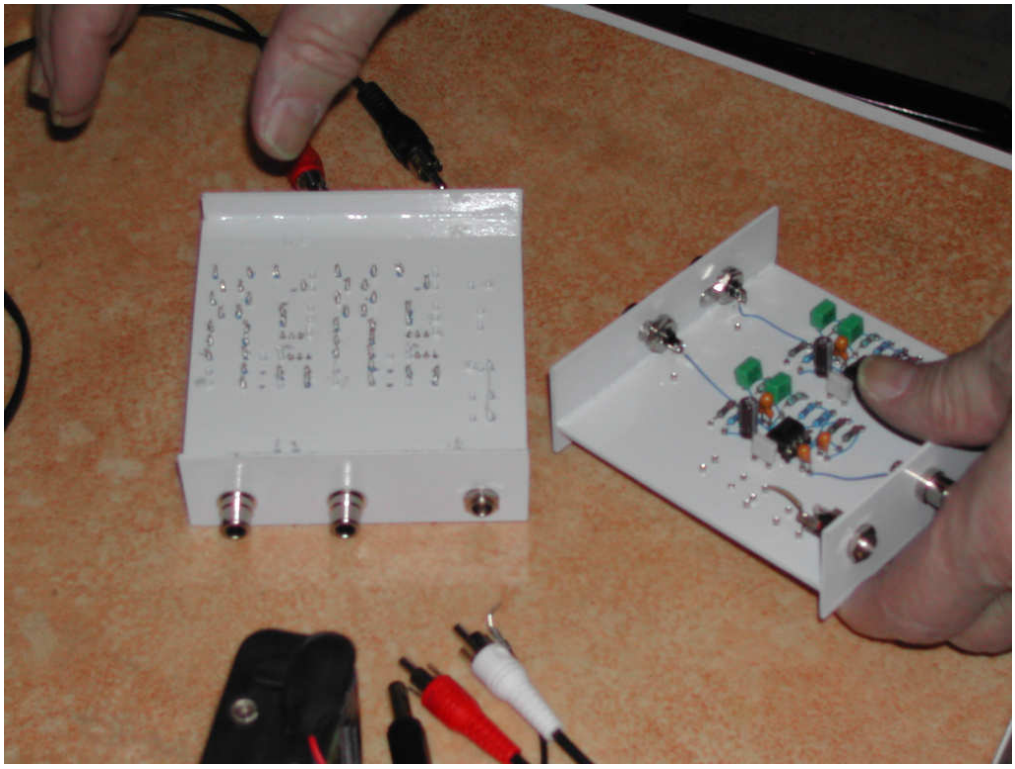
together and to avoid the circuit board beneath the resulting overcrowding if there trying to put the wiring and the coupling wire connection sleeve. Wiring runs sleeve gland. Associated with normal cords sleeve circular mount technology (Wire Wrap transformation method), but also a variety of compression fittings or brazings can use the cable to connect to.

Self-drive circuit is used as a mechanical coupling base drive, the ground plane and the operating voltage supply. Basic form on the top plate is a ground plane and the underside of the voltage level. PCB copper surface using a single ground plane to ensure a good and solid ground plane with different points of tension are not easy to shake. When the operating voltages is fed to the second level along a single copper, achieving a very stable power supply, which is well suited to the sensitive analog-linkages with the rapid digital circuits. In this way, implemented at the country and provide a practical input voltage as good as the input voltage to achieve what is called the multi-layer circuit board implementations that use their own land and the input voltage levels (very low voltage to the input impedance of the transmission lines). Earth and the supply voltage, this solution works well as demanding as the analog to digital linkage.

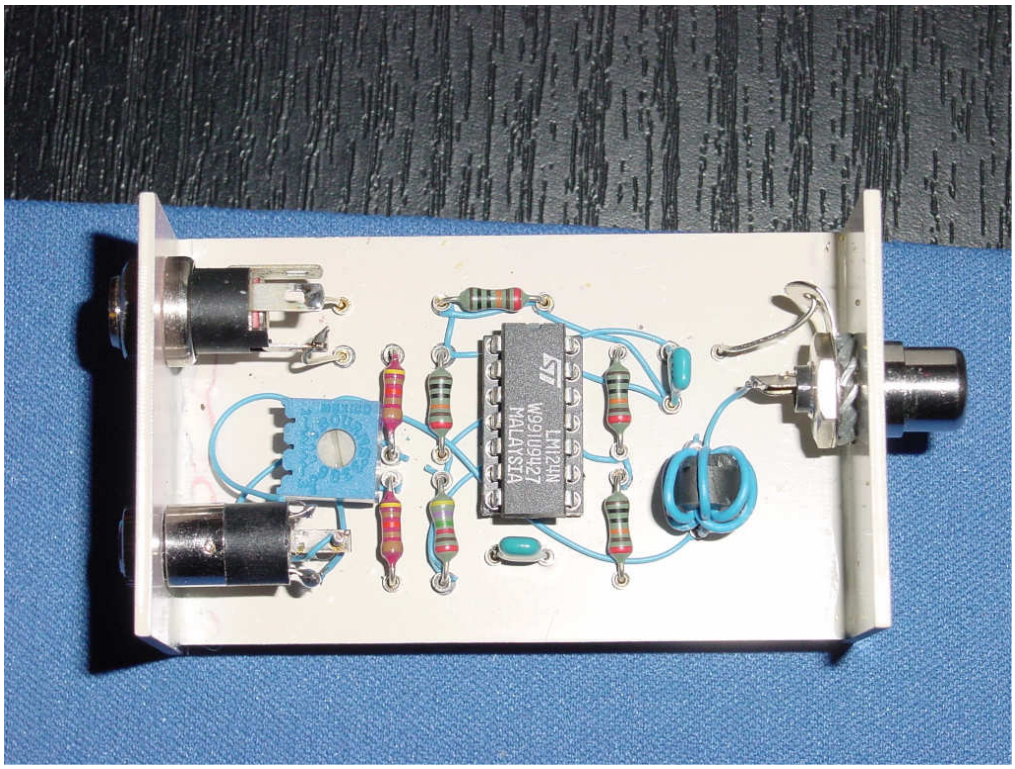
If there is need for more supply voltages, additional power wiring can be wired separately underneath the circuit board underneath the signal wires thicker. Remember that the upper ground plane and the underside of primary voltage level of the other tensions in the signals, either wired or Sub wiring structure. Primary input voltage should choose the most demanding power supply, ie. the system is connected to digital technology the digital circuits is a voltage input.

Coupling plate and the two side panels mounted on the end. These terminal boards to provide a venue to draw the linkage connections with the outside world as well as provide a partial enclosure of the linkage protection. When the circuit board is away from the side plates, the coupling may very well depend on their stand on the table and not be afraid of the damage or short circuit.

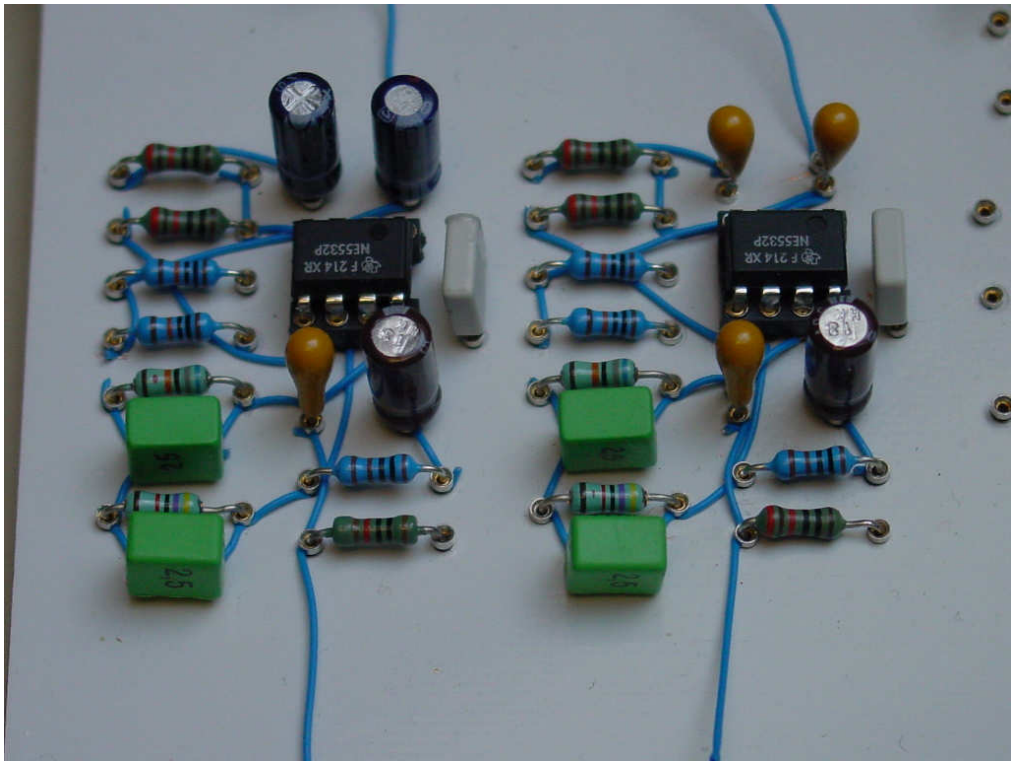
Circuit boards and the side plates are painted with paint. Painting to protect against accidental short-circuit switching and the switching of the good will built-sighted. The painting also protects the circuit board copper surfaces, and paint under any scrap connections oxidation. VMM method of the prototype is quite possible to carry out the circuit board without the painting, measuring the appearance of the linkage is a little vague, easy wiring and there must especially beware of possible short circuits.



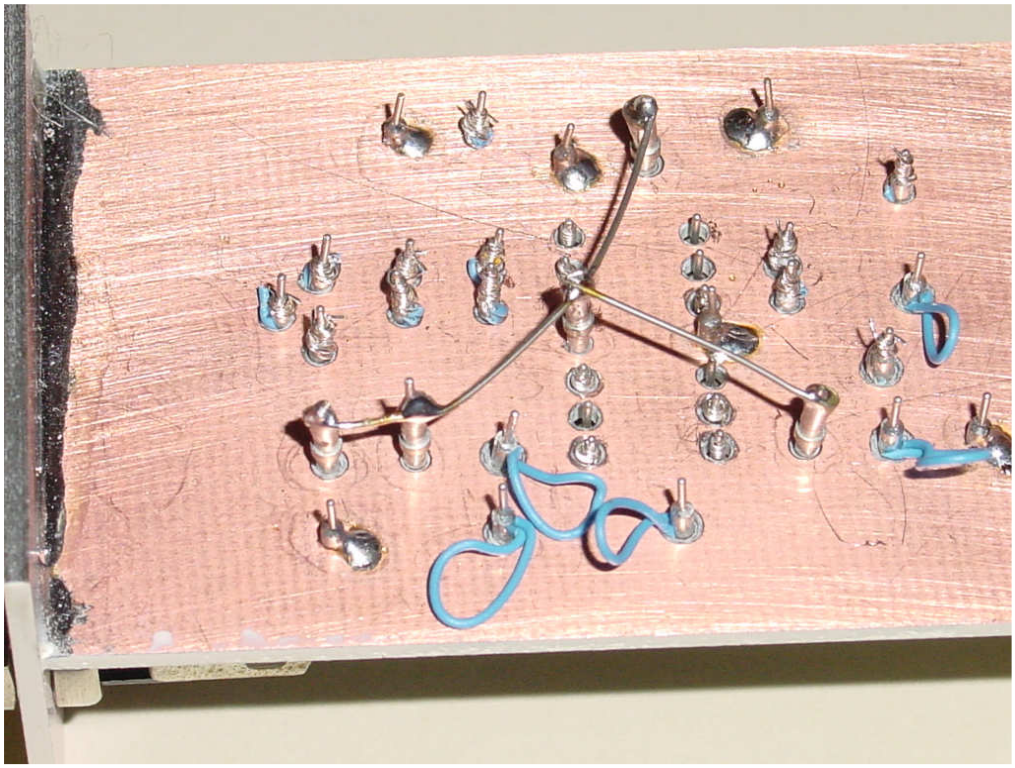
Picture 2: VMM method in use (Tomi Endahl)



Picture 3: VMM method example use (Jouko Paloheimo)



Picture 4: Close-up view to VMM construction (Jouko Paloheimo)

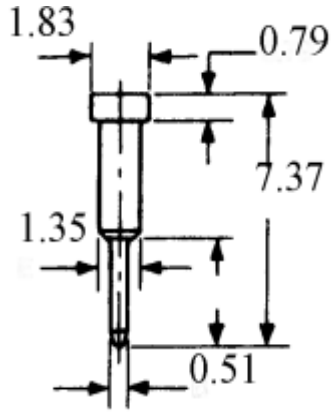


Picture 5: Example how additional voltage feed can be added to circuit wired using VMM method. This circuit is constructed to a circuit board that is not painted. (Jouko Paloheimo)

Materials

PCB Material: The most suitable material is dual sided glass fiber-based 1.6 mm thick disc of copper layer thickness is 18 microns (35 microns also possible).

Connection sleeves: Sleeve unplugged from IC socket. Sleeve will be shown in the picture below. The corresponding rotation position nozzle fittings may be used. There is a wide range, and the dimensions of the sleeves of different manufacturers and design differ slightly from each other.



Picture 6: Technical dimensions of one connection sleeve found to be good for VMM (Jouko Paloheimo)

Wire: Insulated Wire Wrap wire with nominal thickness 0.25 mm.

Paint: Printed circuit boards painted with spray paint. The recommended paint color is white. Paint finish is not necessary.

Soldering: electronics soldering tin wire and a suitable water-soluble flux

Tools

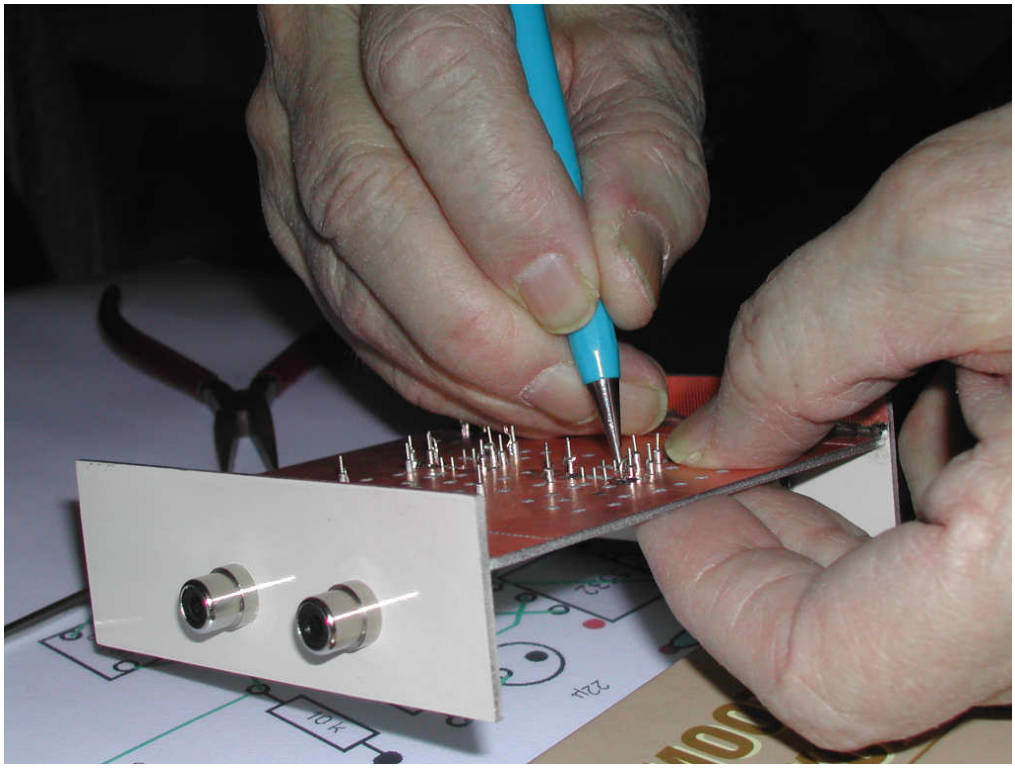
Drilling machine: You need a drill to make holes. Drilling machine should be installed on the supporting frame or should be used with drilling machines. Drill support should have an adjustable drilling depth setting. Drill spindle must be such that it can be very necessary to draw the drill bits (0.7 - 2.5 mm).

Drill Blades: You need a suitable selection of different size drill blades. Smallest blade thickness is necessary grounding wire holes (0.7 mm). The test case you need a reading of the sheath 1.4 mm, 1.7 mm and 2.1 mm thick drill bits. Since connection sleeved come in many forms, you may need further drill sizes for good result. Sheath model in addition to the hole size is also dependent on many factors: the hardness of epoxy circuit board, glass fiber coarseness, the tissue levels of quality, the condition of the drill / boredom, speed, feed rate, etc. So, the correct hole size cannot be determined exactly, other than by experimentation. Remember to reserve funds items, because the thin drill bits break easily (especially durable otherwise) and glass fiber-based circuit board blunt the normal metal items quickly.

Wire insulation removing tool: Recommended tool is self-made from tweezers (instructions for making wire stripper later in this document).

Picture 7: DIY tool to remove wire insulation (Tomi Engdahl)

Rotary Joint Tool: The best for this purpose is self-made rotary tool mount (instructions later). Also ready-made WIREWRAP tools can be used.



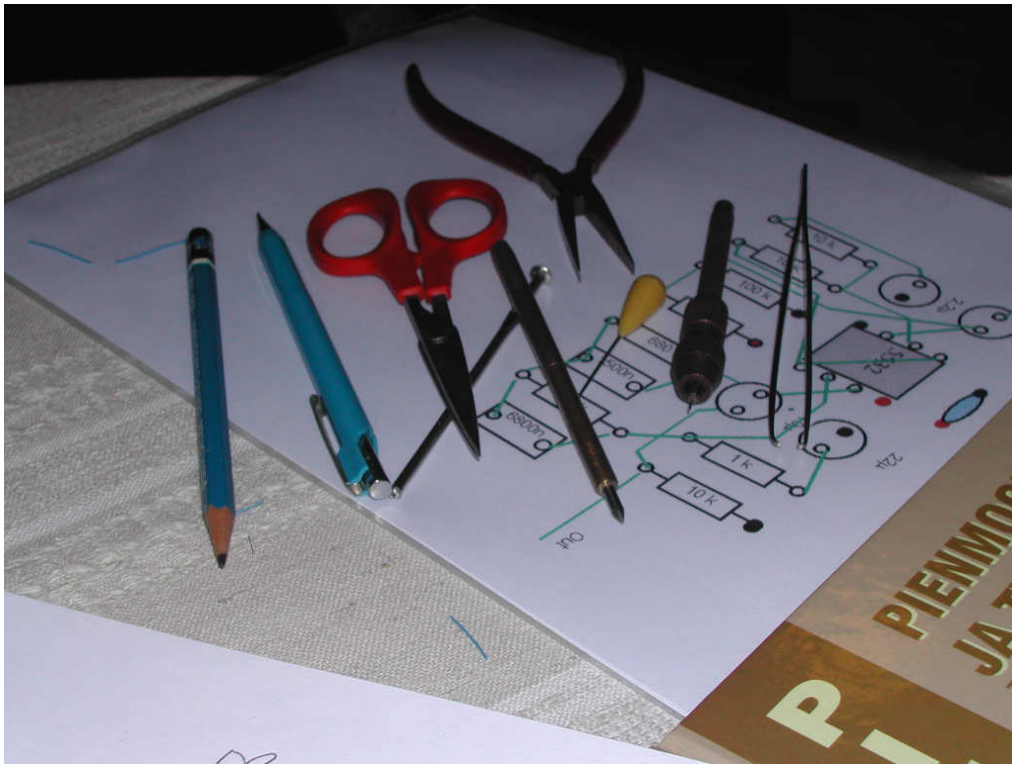
Picure 8: DIY wire wrapping tool made of pen in use (Tomi Engdahl)

Hole matrix: Hole matrix is needed for drilling holes to exactly right places (helps drilling). Hole matrix holes should be in 0.1 "(2.54 mm) division. Vero-board is well suited for this task.

Cutters: Small cutters is needed to cut the wires.

Bushing installation tool: Sleeve pusher tool (self-made according to the instructions later) is attached to the drill used in drilling stem. The sleeves are pushed into place using the mounting tool and drill mount to get enough force (non-rotating drill sleeve for installation).

Picture 9: Sleeve installation tool mounted to a drilling (Tomi Engdahl)



Picture 10: Most important tools (Tomi Engdahl)

Instructions

Next instructions relates to VMM main forms of the method, in which the lower side is the ground plane and the underside of the main voltage level; and any other voltages are generated sleeves and wires below. The signal is wired circuit board with a thin outer shell of the connection cable.

Prepare circuit boards

Cut the circuit board to the final length.
If you are using end plates, cut them into final dimensions and make the necessary holes in the end plates.

Make drilling stack

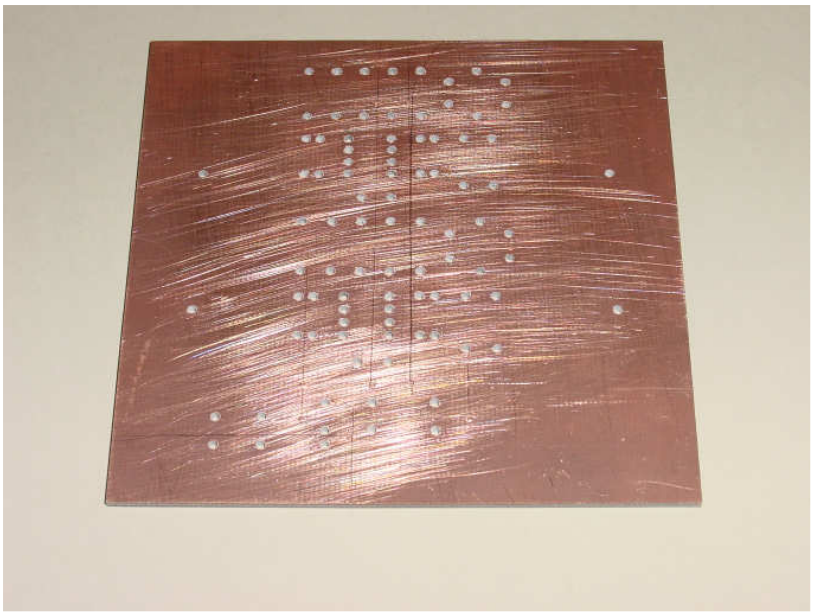
Drilling stack includes the following components: a base plate + + actual circuit board controlling the aperture plate + hole pattern.
Stack these parts overlap. Fix drilling stack parts so that they do not move during drilling (you can use the binding posts, through-bolts, etc.).

Drill holes

All holes are drilled 1.4 mm blade. (The optimum hole size will depend on the sleeve and the drilling).

Open stack

Open drilling stack. Align the sanding paper with the printed circuit board drilled the worst of the burrs off.



Picture 11: Printed circuit board drilling and deburring after removal (Jouko Paloheimo)

Drill inlays

Drill inlays follow the instructions below:
Normal bulk components (resistors, capacitors, transistors) into the holes on the

underside of the ground plane drilled a low countersinking so that no contact with the underside of the copper surface.
IC circuit ground connections are drilled 2,1mm dipping so that the surface of the sleeve inserted into the hole is flush with the board surface. The ground plane plate into the holes drilled below the countersinking so low that no contact with the underside of the copper surface. Ground connections score of 0.7 mm drill hole in a rigid connecting wire. This drilled 0.7 mm hole is widened to plate underneath so that the hole thru the flying wire does not touch the underside of the circuit board.
IC-circuits the power supply into the holes drilled in the immersion 2.1 mm so that the surface of the sleeve inserted into the hole is flush with the board surface.

The hole expansion

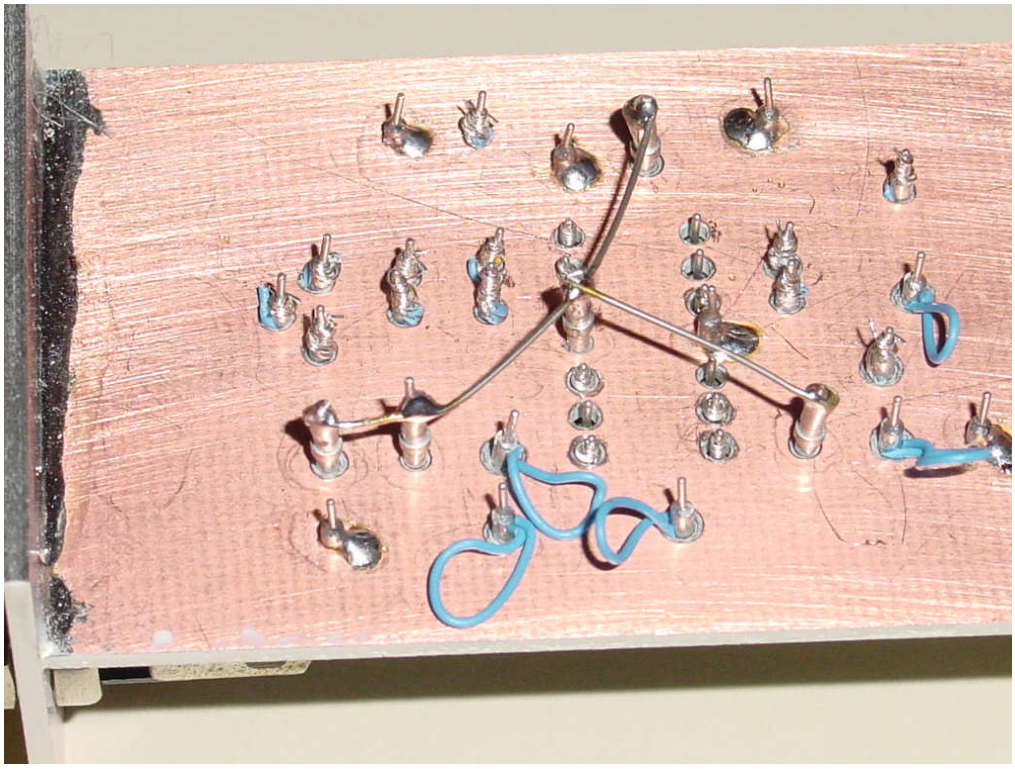
All outstanding and holes extends 1,7mm drill. These holes are drilled in addition to low countersinking of both sides of the disc.

End pieces Installation

The underside of the circuit board copper at each end close to the edge grooves to discern the printed circuit board to get the band of copper circuit board from the rest of the copper parts. Because the ends are soldered to the circuit board on both sides of the plate, preventing the driving voltage side and the ground side short circuit in these grooves.
Solder the end pieces to the circuit board. Use a soldering IC in place and effective enough with a soldering iron. Clean flux from surfaces.

Ground wire soldering

IC circuit ground wires are threaded through the small polymers and watered from above onto the printed circuit board (= soldered to the ground plane). Consistently lower end is left free and the insulator.



Picture 11: The left side shows the end plate soldered to the circuit board (Jouko Paloheimo)

Painting of upper side

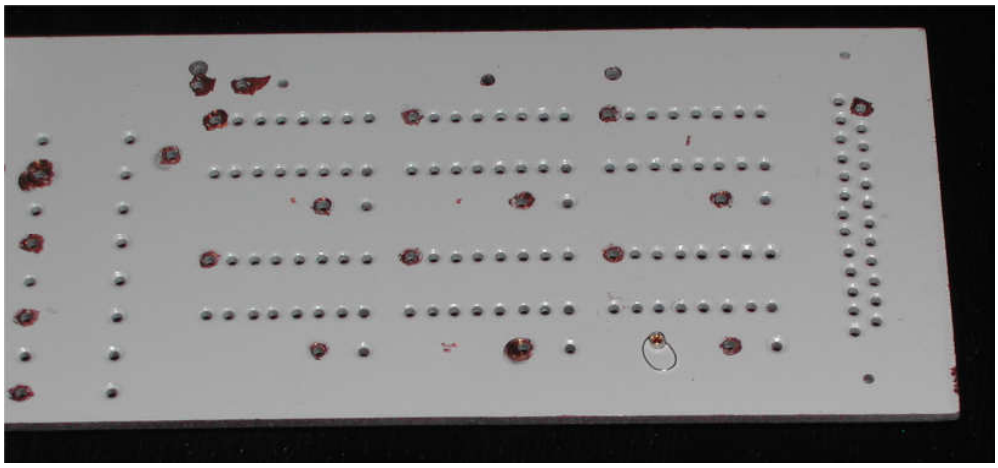
Handling of the circuit board and the end pieces surfaces for painting (cleaning, roughening, etc.). Keep the underside of the circuit board protected and paint with spray.

Ground connections coupling

Normal discrete component holes in the ground plane (not IC-holes) extending the drilling 1.7 mm blade. The ground plane is inserted into the 2 holes to reveal the switch wire to fill and bushings are pressed into place. Stranded wire ensures that the sleeve having contact with the upper surface of the plate to the ground plane. If you want to make sure you can still join by soldering.

IC circuit ground plane, the bushings are pressed into place. Grounding wire connecting the shell to get to the side of the sleeve and soldered.

Check with a multimeter or other suitable measuring device, there is no short circuit and earth voltage levels. If a short circuit has come to remove the sleeve bore, correct the fault and squeeze the site of a new sleeve. Connectors when installing, you should always measure in at a few of the sleeve installation intervals of the short-circuit is not born, so any fault the place is easy to locate (one of the few previous measurements after the sleeve).



Kuva 12: Top size painted circuit board with grounding posts (Tomi Engdahl)

Voltage feeding bushings

The voltage feed bushings inserted into the holes and soldered to the bottom position. Check with a multimeter or other suitable measuring device, there is no short circuit and earth voltage levels. If a short circuit has come to correct the problem. Connectors when installing, you should always measure in at a few of the sleeve installation intervals of the short-circuit is not born, so any fault the place is easy to locate (one of the few previous measurements after the sleeve).

Bottom side painting

Bottom of the board is coated with spray paint so that the upper level is protected

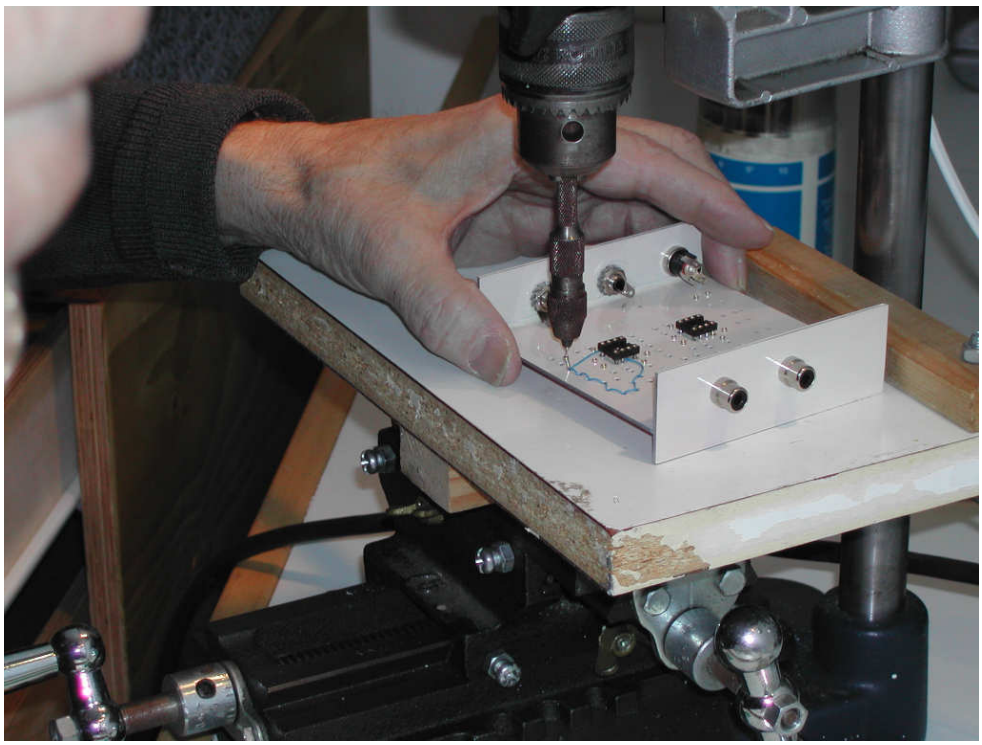
IC socket wiring and installation

The IC positions may be required internal wiring.
IC sockets pressed into place upon voltage feed and ground bushings.

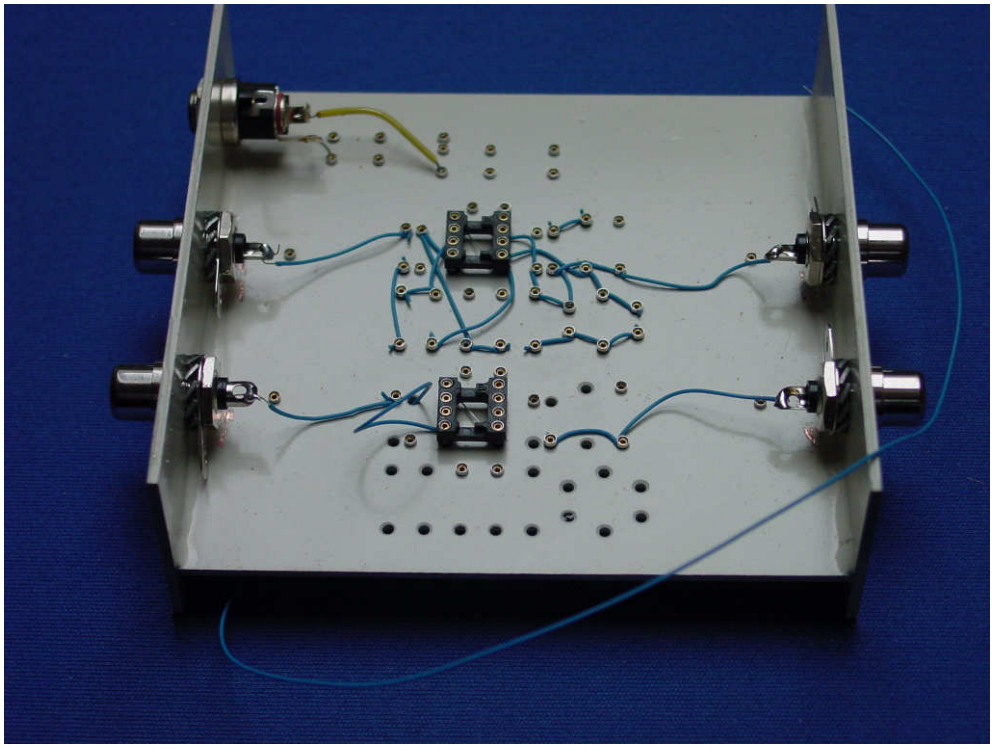
Wiring and sockets

IC stocks go wires threaded through the plate above the position of the peak and hole in between. The circuit board under the future management part of the shell to the stripping tools. Cord into the IC position leg rotation by the rotary tool joint. If necessary, the rotary joint can ensure soldering.

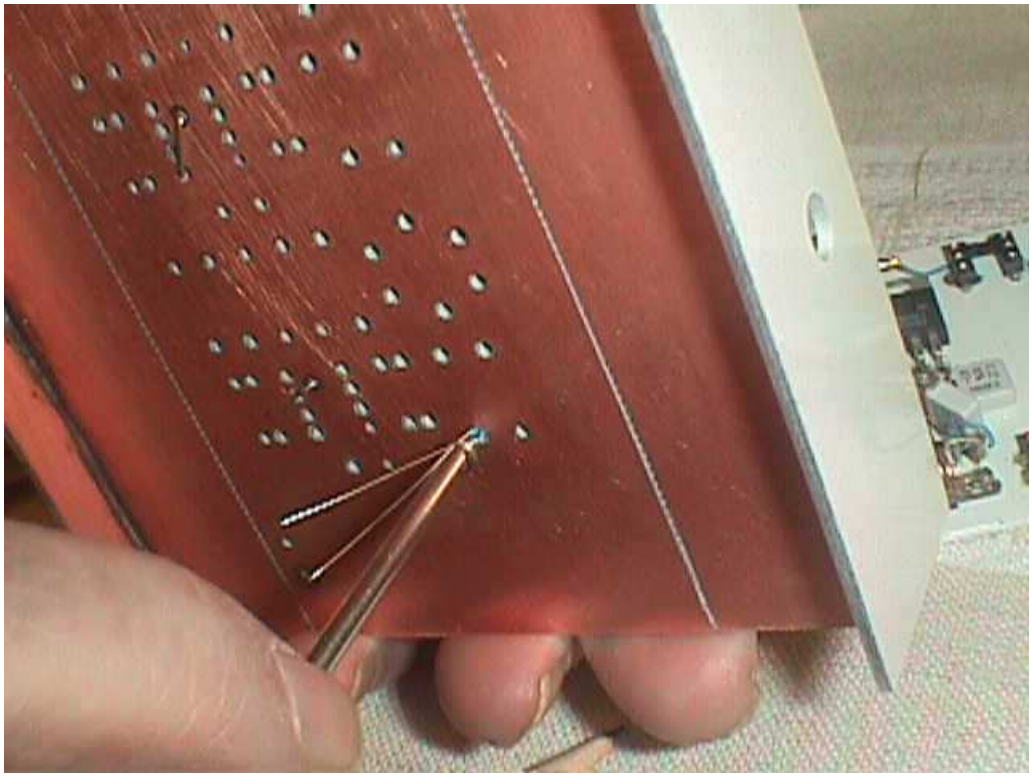
Discrete wiring the cable is first inserted into the sleeve from the top down through the hole. Subsequently, the sleeve is pressed into the hole of the sleeve installation tool. This requires a degree of power. Exact sleeve installation is easiest when the bushing installation tool is attached to the drilling jig to drill tip, and a power drill is used to help the sleeve printing (drill and drill stand the weight ratios help in obtaining power). The sleeve is pressed, the switch goes below the cord are peeled and attached to the bottom of the rotary sleeve. Cord should not peel too close pirilevyn copper surface, it is good to leave a few mm of extra insulation and a "wire loop" before the rotation of the joint. If necessary, the rotary joint can ensure soldering.



Picture 13: Bushing installation with special tool and drilling machine as press (Tomi Engdahl)



Picture 14: Circuit in the middle of wirign and bushing installation (Jouko Paloheimo)



Picture 15: Bushing installation with manual tool (Veikko Pöyhönen)

Component installation

Components pressed on stocks and sleeves.
Install any connectors and switches to the end plates.
After this the circuit is ready for testing.

Please note for the best final result

The distance between the bushings may vary theoretically up to 1 mm. This is, of course, on which side of the wires are in the hole. In practice, the deviation does not cause problems.

Compression fitting method - short work instruction

Main form where top side is the ground plane and the underside of the main voltage level; and other voltages are wired.
• PCB and the end plates are cut to the final dimensions
• End caps perforated as appropriate
• Establish a porauspakka: baseplate + actual board + guiding hole in the plate hole pattern +
• All holes are drilled 1.4 mm blade *; pack will be demolished and emery paper aligned to the worst burrs off
• IC circuit power supply into the holes drilled in the immersion 2,1 mm so that the surface of the sleeve inserted into the hole is flush with the board surface. Maaliitosten score of 0.7 mm drill hole in a rigid connecting wire.
• Additional ground plane, the holes are drilled in the plate below the low countersinking so that no contact with the underside of the copper surface. Also, 0.7 mm hole avarretaan below.
• Additional voltage level above the plate into the holes drilled in the countersinking low so that the sleeve contacts the shoulder formed above the surface of the copper. The underside of the holes need only a burr removal.
• All other holes of 1.7 mm drill bit is extended and these holes are drilled in both sides of the low countersinking.
• The bottom side is made of copper grooves to prevent a short circuit when the ends are soldered on both sides of the plate.
• End caps are soldered to the circuit board; Clean the surfaces fluksista.
• Chipset and end pieces for painting surfaces are treated.
• Repainted shower so that the underside is protected
• Ground holes (with the exception of the IC-holes) extending the drilling 1.7 mm blade.
• The ground plane is inserted into the 2 holes to reveal the switch wire to fill and bushings are pressed into place.
• IC circuit ground plane, the bushings are pressed into place and the connecting wire is soldered to the side of the sleeve. Check that there is no short circuit of Agriculture and voltage levels.
• The voltage level bushings inserted into the holes and soldered to the bottom position. Again tarkistaan
• Disk underside is painted with a shower, so that the top level is protected
• IC Sockets, with possible internal connections must be carried out, pressed into place.
• Carry out the wiring and Sleeving.
• Components pressed into place
* Hole size will depend on the sleeve and the drilling

VMM with the power supply circuit board surface instructions

VMM methodology
where the voltage is shown as a separate area of the underside of the
• PCB and the end plates are cut to the final dimensions
• End caps perforated as appropriate
• The circuit board is drilled all of the actual drill holes of 1.4 mm
• IC circuit power supply into the holes drilled in the two LMM dipping so that the surface of the sleeve inserted into the hole is flush with the surface of the disc
• Additional voltage level above the plate into the holes drilled in the countersinking so low that no contact with the above copper surface. The underside of the holes need only a burr removal.
• All other holes extends 1.7 mm drill
• Also, these holes are drilled in a low countersinking on both sides
• Chipset and end pieces for painting surfaces are treated.
• End caps are soldered to the circuit board; Clean the surfaces fluksista.
• Repainted shower so that the underside is protected
• Agriculture and the voltage level of the bushings inserted into the holes and soldered to the bottom position
• Disk underside is painted with a shower, so that the top level is protected
• IC Sockets, with possible internal connections must be carried out, pressed into place.
• Carry out the wiring and Sleeving.

VMM with wired power supply

VMM method in which the wired voltage supply

• Printed circuit board and the end plates are cut to final dimensions
• Paatykappaleet perforated as appropriate
• The circuit board is drilled all of the actual drill holes of 1.4 mm
• IC circuit virransyottoreikiin drilled two LMM dipping so, that into the hole inserted into the sleeve surface is flush with the surface of the disc
• Additional voltage levels of the holes drilled in the plate just above the low countersinking so that no contact with the copper surface on either side
• All other holes extends 1.7 mm drill
• Also, these holes are drilled in a low countersinking on both sides
• Chipset and paatykappaleiden surfaces with painting.
• Paatykappaleet soldered to the circuit board; Clean the surfaces fluksista.
• Repainted shower so, that the underside is protected
• Ministry of Agriculture and a voltage bushings inserted into the holes. Ground sockets soldered and
a voltage bushings in place to ensure liimapisaralla.
• Establish a voltage wire mat separate instructions
• Disk underside is painted with a shower so that the upper level is protected
• IC Sockets with any internal connection is completed, pressed into place.
• Carry out the wiring and Sleeving.

Variation2

Variartion 1

Both sides of the ground plane; voltages are wired as either signals or with the bottom wire structure. Also combinations possible.

Variation 2

The upper side of the ground plane and the underside of the part of the ground plane and the trenches separated by one or more voltage range

Manufacture of tools

Bushing installation tool

The sleeve installation tool needs to be such that the sleeve may be a printed circuit board without damaging it. Bushing installation tool is typically suitably sharpened metal pin which can be mounted drill stem.

Picture 16: Two different bushing sleeve installation tools (Veikko Pöyhönen)

Wire insulation remover

Wire insulation peeler is made of small tweezers. First the tips of the tweezers is hyphenated in some way. After this, the tips filed on either side of a small angular with a file having a depth of about 0.2 mm in the center of the triangle-shaped groove. Each side of the three-tweezers to keep the grooves occur precisely against each other so that they can accommodate the space remaining between the root and used to just 0.25 mm thick metallic conductor connecting wire. Edges of the groove is sharpened by filing the tips of tweezers more. The aim is that the tips of the tweezers used to cut a thin plastic connecting wire / Teflon casing easily, but do not damage the metal wires in the middle.

Use: Peeler is set so that the peelable cord hits the other side of the triangle groove in the middle. Forceps pressed onto wherein the cord insulation is cut across. Cut the insulation is removed by pulling on the forceps (tweezers still pressed) towards the free end of the line.

Picture 17: Wire insulation removing tool (Tomi Engdahl)

Wire wrap wire twisting tool

Pencil pen (0.5 mm of lead or thinner) can be used as a tool rotary joint. Remove the pen and lead, and the tool is ready for use.

Information sources and writers

The text is written and edited by Tomi Engdahl. The text is borrows short pices of Jouko Paloheimo’s work instructions with the author's permission.

The photographs are taken by Tomi Engdahl, Jouko Paloheimo and Veikko Pöyhönen.

The sleeve drawing is made by Jouko Paloheimo.

Information source:

- Jouko Paloheimon notes
- Hand’s on introduction by Jouko Paloheimon
- Article Jouko Paloheimo & Rae Perälä: Wiring a prototype, Electronics World July 1998, sivut 600-602