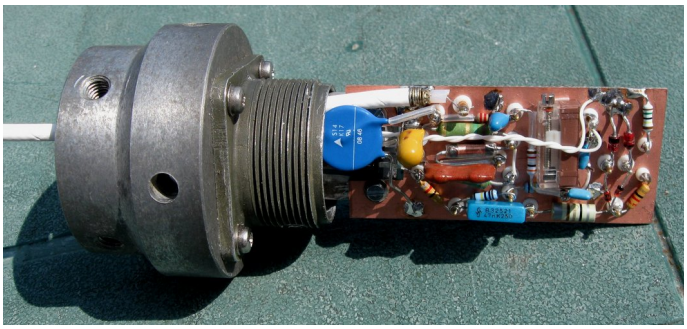


Old DX-one™ Active Antenna
Rebuilt with New Amplifier

„DX-one™ MkIII“

DX-one™ is a Trademark owned by RF-Systems, NL, URL www.rf-systems.nl

Preface: The Small Print

When using the information on these pages for your work please note the following terms and conditions. By using any of the information presented you accept these terms. Thank you!

Restoration Projects Philosophy

The purpose of many restoration projects described here is to bring the antique equipment back into working condition close to original specifications while generally preserving their historic electronic and mechanical design. This means that often new components (e.g. capacitors) need to be used - in many cases NOS will not do - which sometimes require small mechanical modifications to the set.

This treatment does not conform to "museum" standards that require everything to be left or restored to original. This is an entirely different approach. It is up to you to decide what you want to do.

Modifications and Homebrew Projects

The projects shown are for information only with the main goal to motivate fellow amateurs and hobbyists to start on similar projects. Comments for improvements are always welcome. They are always "prototypes" and not a kit. You'll have to find your own parts. No warranty is given nor implied that they actually work in your situation.

And please note that a modified piece of equipment looses its collector value - but brings joy to its successful operator!

Copyright

Some of the circuit diagrams, manual pages or software used and edited are covered by copyrights of their original publishers and intended here for personal use only. No complete manuals can be found, there are already many sources on the web for this purpose.

My personal designs are covered by the GNU licence agreements. Pictures and other documents may not be republished without indicating the source.

Regulations

Many of the described obsolete radios (or computers) no longer fulfill today's requirements for e.g. electrical safety, EMC, used bandwidth, levels of harmonics or spurs or intermodulation. While at times suitable corrective action is included in my descriptions, many times it is not. It is your responsibilty to make sure your equipment conforms to the requirements in your own country.

Safety while Working on the Projects

*It is your own responsibility and all-important to always observe proper safety procedures in your work. Some of these projects - certainly almost all vacuum-tube circuits - involve high voltages, some lethal indeed. Make sure you understand what you are doing or else get some qualified help here. Just look at **this page** to see some tips on this one.*

Always "Switch to Safety" when you work on your equipment! Please pay attention to proper grounding of all metal chassis and enclosures and consider the use of GFCI breakers to your shack/workbench.

This information and much more can be found on my website hb9aik.ch

1. What happened?

My old DX-one™ (early version) was - and now is again - installed in our remote location which is surrounded by mountains. It sits on a 3m Mast and feeds RF-signals through a 30m RG213/U underground cable to a series of receivers through a R&S antenna distribution amplifier.

Antenna as pictured in 2014

Now one day this spring no output was observed on the receivers and after checking all cables, power feed etc. it was found that the amplifier in the DX-one™ apparently failed.

So what now as RF-Systems is no longer in business?

The first step was to „open“ i.e. cut the lower end (where the amplifier is). As it remained unclear what type of MOSFET was used, the circuit showed some corrosion damage and the components were sealed anyway it was decided not to try and repair it.

The amplifier was removed and the circuit analyzed by carefully removing some of the hard epoxy hiding the components and by measurements of accessible or removed parts taken.

The basic circuit was thus recovered but some significant guesswork remained. It should also be noted that this is an early version and the Mk2 by RF-Systems showed improved performance and has likely not exactly the circuit analyzed here.

2. Design of the new amplifier

The new amplifier was developed starting with the re-engineered DX-one™ design ideas. This meant e.g. a single power MOSFET as active device providing gain at good IM levels. This design approach differs from the currently quite popular source/emitter follower circuits[1].

A mechanical solution had also to be found to re-install the antenna on its base using available components. The pictures show some of this, a piece of preformed PVC allows to insert the antenna tubing on top of the somewhat larger diameter of the amplifier base.

The amplifier is built on double sided epoxy material providing a good ground plane and using Teflon™ insulated support pins pressed into holes for the components. The output transformer is placed on the bottom side to provide good separation from the input.

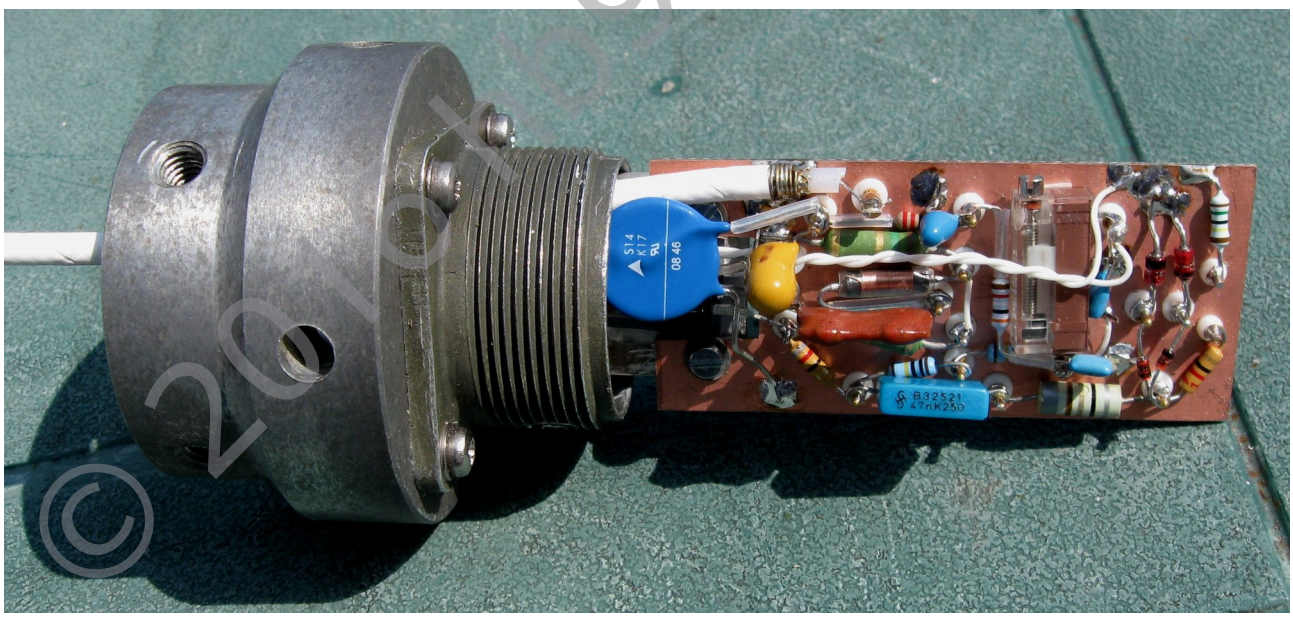
The amplifier uses the Mitsubishi™ MOSFET RF 30MHz power transistor RD06HHF1 in class A, running at 15V and 300mA. This transistor has successfully been used in linear class A amplifiers[2].

Frequency compensation and negative feedback are placed in the source of the MOSFET so that a satisfactory frequency response to well over 30MHz is achieved.

Input to the gate is protected by Schottky diode/zener pairs and the power input clamped by a VDR. An input choke and series resistor prevent potential VHF oscillations.

A solid aluminum block is used to transfer dissipated heat to the round antenna base – a significant improvement to the original design. To further increase thermal stability, DC feedback in the source and a temperature sensing transistor on the heat sink were added.

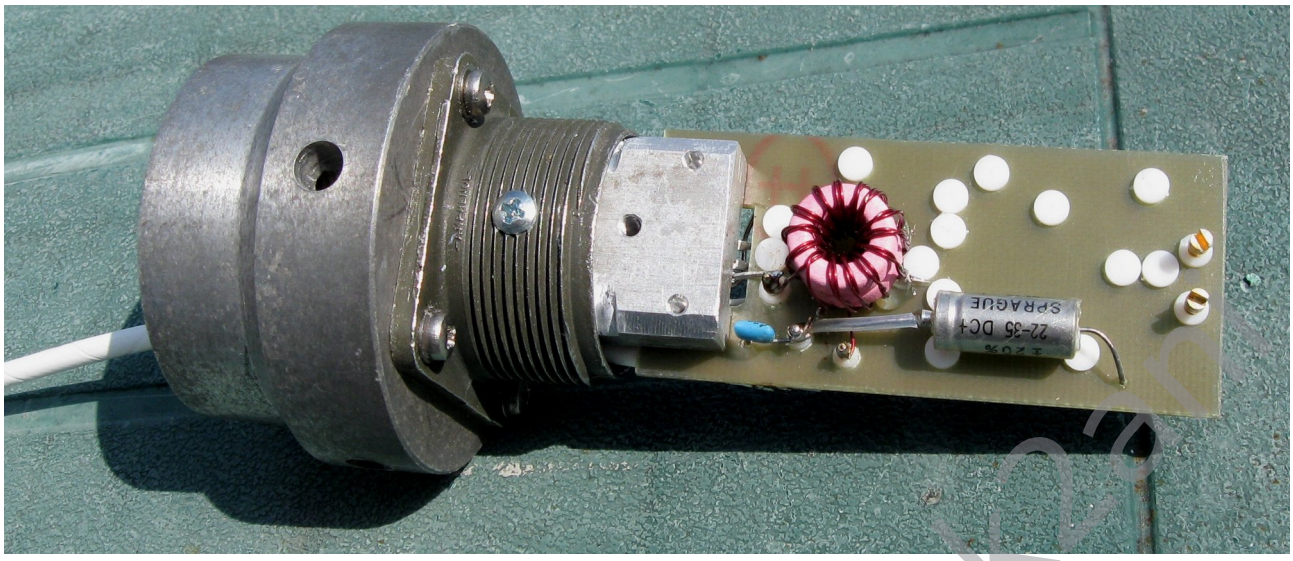
The following pictures show the final V1.1 implementation after first two breadboard versions were built. The circuit diagram is to be found at the end of this document.



Top view

1 e.g. „Complementary Push-Pull Amplifiers for Active Antennas: A Critical Review“, Chris Trask/N7ZWY, Rev. 15-09-2013

2 „Breitbandige QRP-Linearendstufe mit HF-Leistungs-MOSFET“, Harald Arnold/DL2EWN, ©Box73 Amateurfunkservice GmbH 2008



Bottom view

3. Practical Results

The amplifier was tested using a 50ohm source (HP8640B) and measuring the output on a Marconi TF2603 RF-millivoltmeter and HP8552B/8554B spectrum analyzer. Gain was measured to be about +20dB which is more than the +10dB given for the original antenna.

The maximum reference point was defined as the output level where $2f_o$ < -40dB i.e. where distortion just starts. In the current design V1.1 this means 0.6Vrms or +8.6dBm, there is room for improvement and a tradeoff with gain!

As the antenna was urgently needed on site and we are surrounded by mountains and not strong RF transmitters nearby, V1.1 was taken to the field. The results on the bands so far observed are no different from before the failure. The received level is close to the levels seen on the tuned dipole used on 40/80/160m which is convenient in my multireceiver setup and no IM problems have been detected.

4. More Practical Results and Next Step

After quite some time using the antenna and comparing it with the NVIS levels received with a tuned dipole antenna[1], new results are available. The main disadvantage proved to be the S/N ratio on 160 and 80m where the dipole clearly outperformed the DX-one™. The noise figure of the amplifier needs to be measured and the use of a different circuit for comparisons is envisaged to determine the NVIS performance of the DX-one™.

Having just received another DX-one™ with a defective amplifier it is planned to build another amplifier and try to improve the performance figures as well as actually measure IM and noise values.

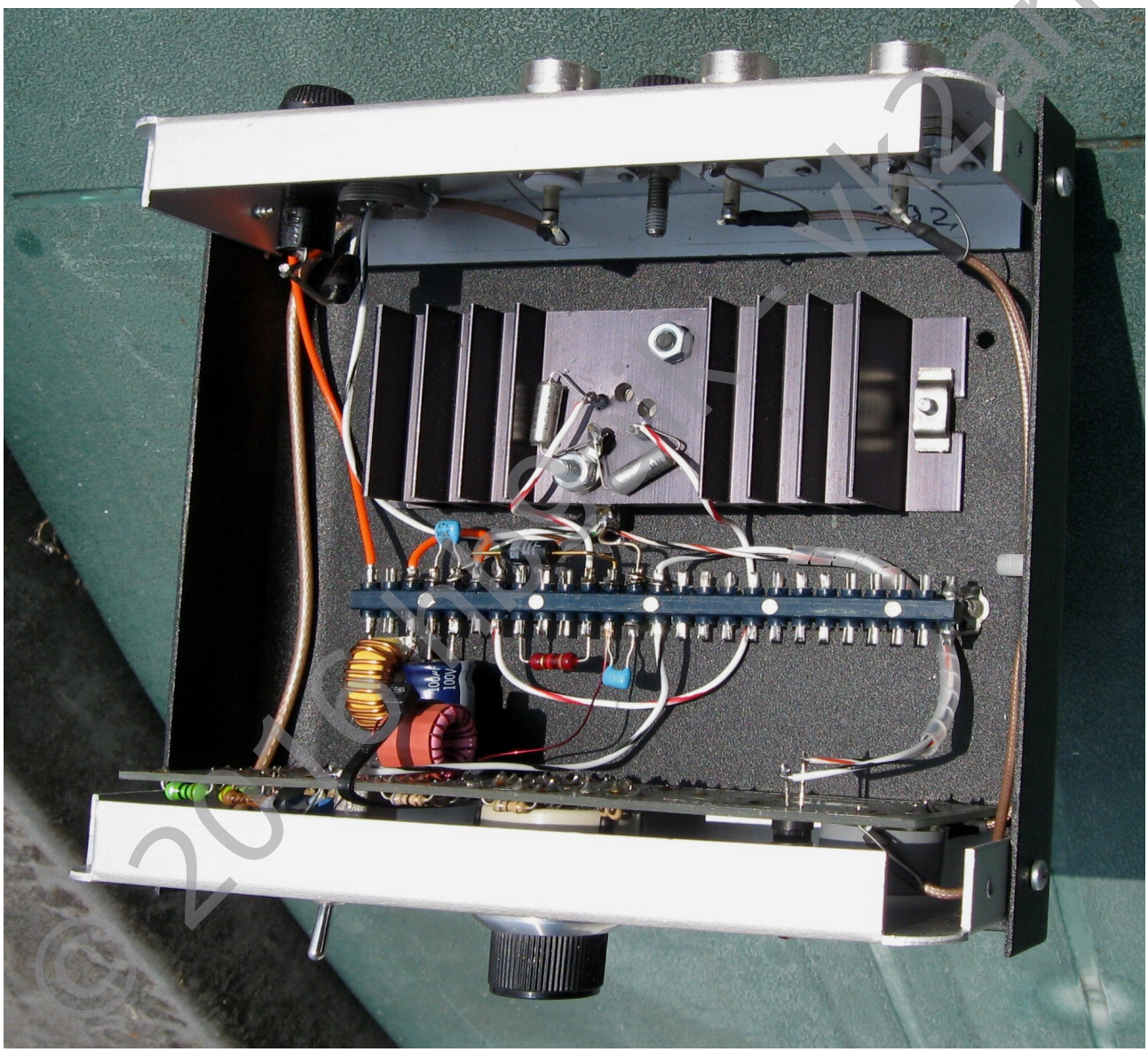
Any comments or inputs will be gratefully received!

1 The dipole is 2 x 20m inverted-V in a fan configuration with its apex 8m and the ends 2.5m above ground. It is tuned by an automatic antenna tuner AG-430.

5. Modification of Remote Unit

The remote unit needs to provide +15VDC rather than 24V as before and in my case also is supplied by the +28V rail from a battery (in nice weather charged by solar panels) rather than AC mains.

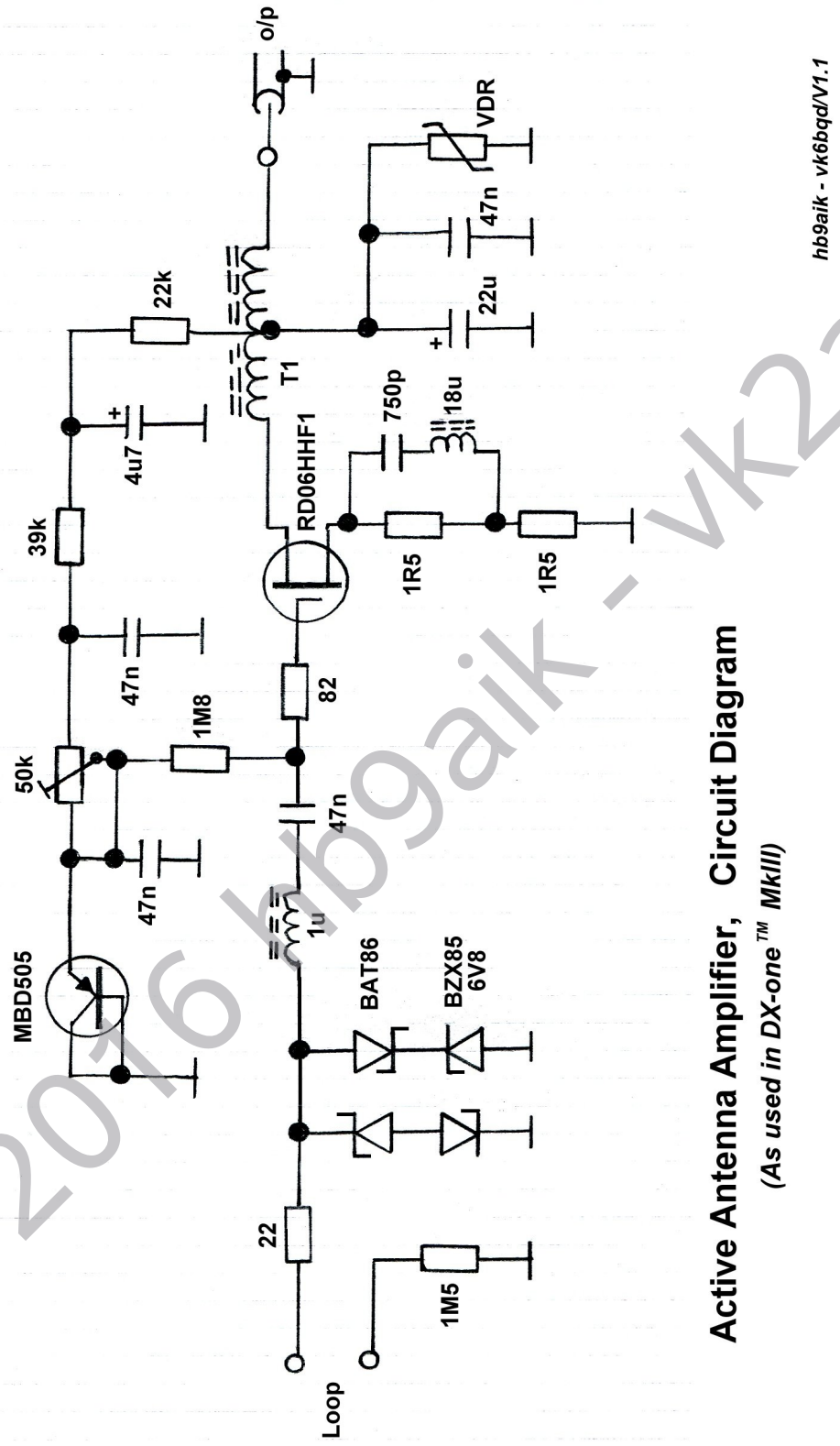
The result is shown in the picture below: a +15V regulator IC provides a short circuit proof supply to the antenna. The series choke to the coaxial cable was also redesigned as the original was found to be underrated for the required current. An input filter on the battery supply attenuates any RF or spikes from entering the circuit (see picture below).



Remote control unit with +15V regulator

6. Circuit Diagram of the Amplifier

The diagram on the following page shows the earlier described and pictured circuit of the new amplifier. No diagram is shown for the power regulator.



Note: The „Loop" is actually a figure-8-folded wire, one end terminated with 1.5Mohm to ground and the other end connected to the high-impedance amplifier input. The DX-one™ is not a magnetic loop but rather a cleverly designed capacitive antenna.