
Control unit with attenuator for automatic surplus ATUs using modern transceivers

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Topic covered:

Surplus military and avionics ATUs from earlier decades are analog machines - despite their digital control circuits. They require „constant“ RF power during tuning while presenting wild SWR excursions to the source.

Modern transceivers - except perhaps units with a "tuner" output - will cut back power at high SWR to protect their finals. As the tuning ATU measures reflected power and looks for a minimum or a dip, it might stop and think to have found a match - of course it did not. Quite to the contrary: it found a high SWR!

A temporary attenuator of 4-6dB switched into the transmit path will suffice to please the transceiver and to allow correct operation. This is shown on a sample project.

With the setup described, or something similar, just apply power in CW or FM and turn on „tune“ - it will work!

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 loses 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.

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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 responsibility 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 <https://hb9aik.ch>

KG control unit for e.g. the AGD-415 ATU using modern transceivers

Description:

The control unit KG is designed to supply AC power to the ATU for its operation and signal to the digital control circuits of the ATU the beginning of a tuning cycle as well as receive the „end of tune“ signal from the ATU logic. All of this is done without a separate control cable though the coax carrying the HF to and from the transceiver and thus this system is convenient to use in the field. It does this by activating a higher level of AC voltage (the lower level runs the fan continuously in the 1kW ATU) and detecting a drop in the AC current at the end of the tuning cycle.



Fig 1: View of the front panel (modified unit).

The blue-framed C sockets (the fuses originally placed here are now mounted on the chassis inside) feed the HF to the attenuator and back to the control unit.

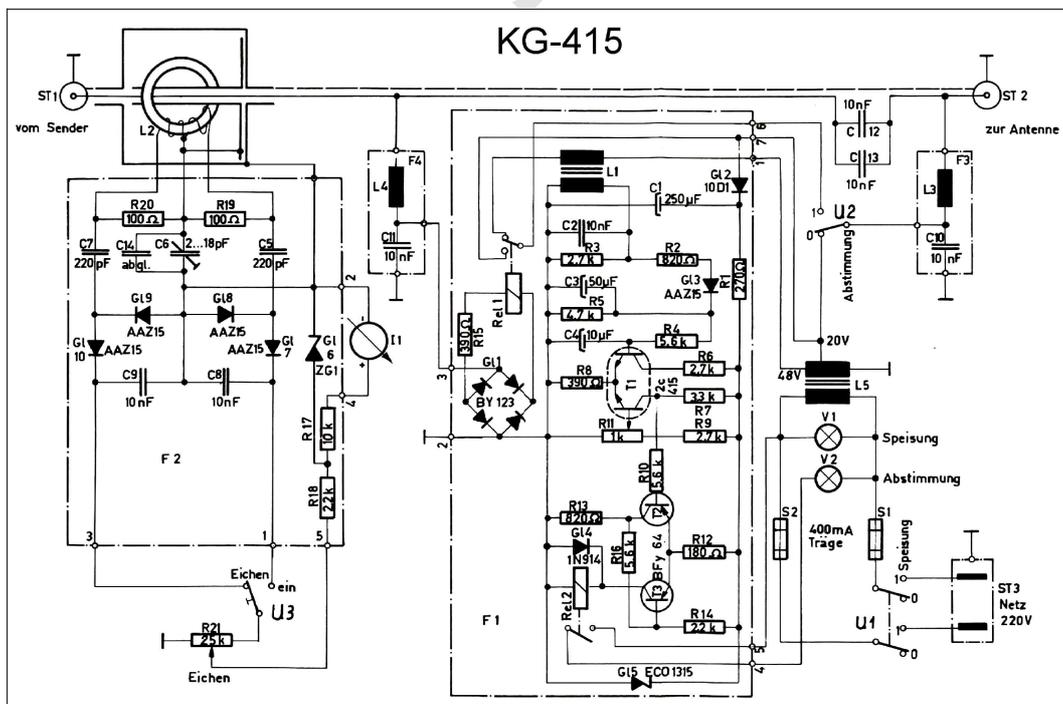


Fig 2: Circuit diagram of unmodified KG

On the left hand side the 1kW SWR bridge and in the center the analog control circuitry. On the right is the power transformer and the AC feed to the ATU.

Purpose of modification:

Modification of the control unit for the AGD-415 for the use with modern transceivers (in my case originally a TS-140), which reduce the power considerably at high SWR for their own protection. The AGD-415 however (like many other automatic tuning devices from this era, e.g. the Collins 180L-2/3 also in use here) requires a more or less constant HF tuning power of about 5-10 watts at the selected frequency to allow correct operation of the internal control logic. If the output falls low on a high SWR condition and the ATU logic is designed to look for minimum or a drop in returned power, the ATU will stop right there thinking the dip indicated it found a match. Obviously it has not.

Functional Description:

When the tuning cycle is activated by the original switch on the unit, a 50 ohm power attenuator (P up to 100W) of around 7dB is automatically placed between the transmitter and the antenna tuner. This means that the return loss is a minimum of 14dB or the worst SWR <1:1.5. The transmitter, which for the AGD has to deliver around 50W during this time, does thus not reduce its output power during the entire tuning process. The process is now completed without an erroneous end signal due to foldback. Later experience shows, that such a high attenuation is not usually required, satisfactory operation is achieved with 4-5dB loss – the KG was the prototype application here. The fine unused CADDOCK power resistors were bought as a mixed bag at a hamfest.

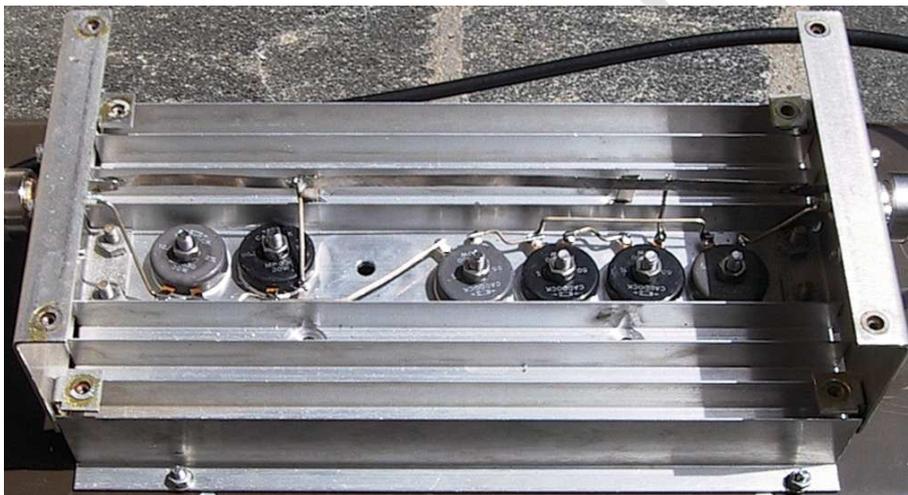


Fig 3: View of the power attenuator (screening cover removed).

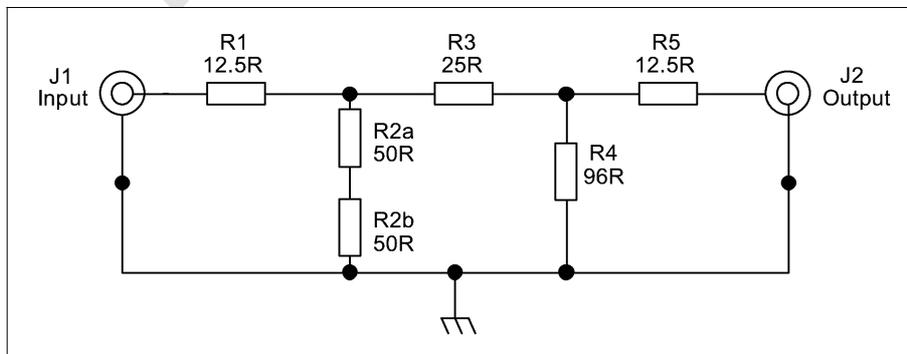


Fig 4: 50 ohm 100W power attenuator circuit diagram

The attenuator consists of two identical 50 ohm T-attenuators combined into one. On the input side R2 is split to better dissipated the heat. Depending on the foldback characteristic of the transceiver used, one half only could be tried and used.

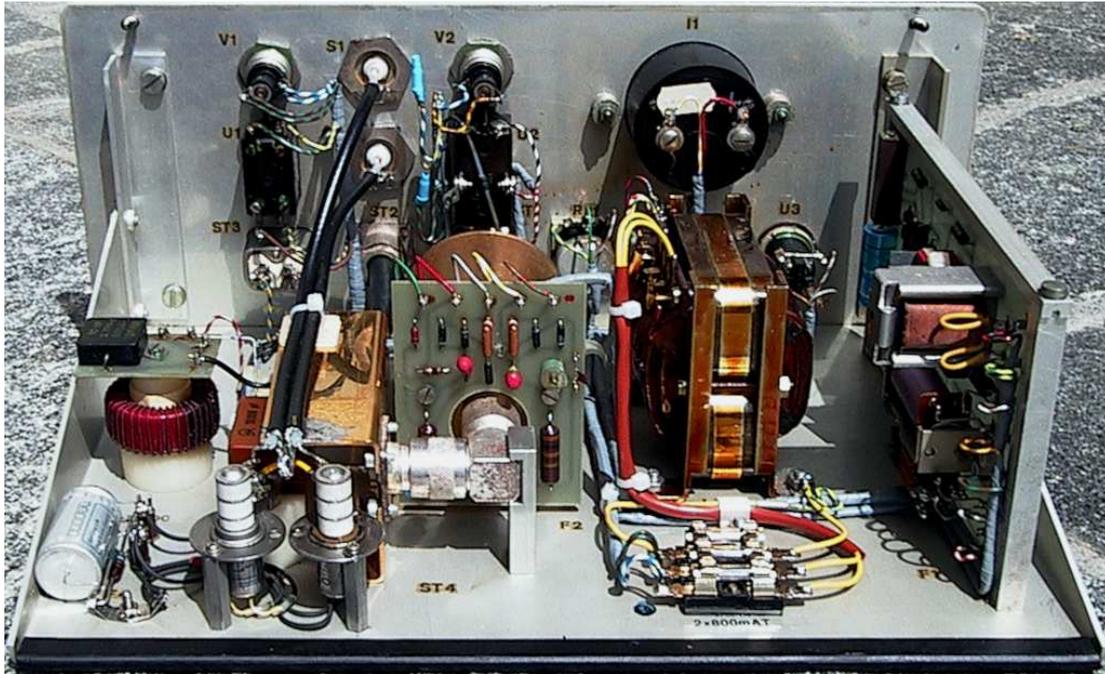


Fig 5: Inside view of the control unit KG.

On the left side the simple 28VDC supply for the two vacuum relays next to it. They switch the HF to the C-sockets on the front panel. In the foreground on the right the fuses, some of which were originally mounted on the front panel. In the center the SWR bridge and the power transformer. On the right hand side the card with the analog control circuits.

While the two relays are placed after the SWR bridge, it would really be preferable to switch the HF in front of the measuring bridge (so that the SWR on the antenna can be observed during the tuning process). Due to the mechanical design of the KG and the SWR-bridge, this was unfortunately not possible.

Conclusion:

The modified KG has proven itself over many years and the concept has since been applied to other antenna tuner control systems. One here involves a Collins HF-8023 power amplifier which is feeding a vertical antenna with (set to low power) a Collins 180L-3 avionics tuner. This application is designed to work fully automatic once “tune” is initialized from the HF-80 system.

Very recently, in QST June 2021, Phil Salas, AD5X has published a text explaining this method as similar problems as with surplus automatic tuners appear using automatically tuned magnetic loops. Hopefully this text further illustrates the concept.

Note: all circuit diagrams for the AGD-415 ATU are found here:

<https://hb9aik.ch/radio/AGD-415.pdf>