G-QRP Club

The G0FUW HB-ATU

Construction Information

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"It is vain to do with more what can be done with less" - William of Occam c1287 - 1347

About the G-QRP Club

Founded in 1974, the G-QRP Club is the largest QRP Club in the world. The club exists to promote interest and growth in low power amateur radio communication; 5 watts or less on CW, 10W on SSB. Membership is open to any licensed radio amateur or short wave listener anywhere in the world.

The club publishes a quarterly journal called SPRAT, which is sent free to members. SPRAT contains many circuits, technical hints and ideas for QRP construction projects, together with club news, contest and award information and other items of interest to QRP operators. SPRAT is an exclusive QRP journal and contains much practical information in each issue.

The club operates a club sales department where components are available at special prices to club members. We also publish QRP books which are available to members.

If you are not a member, and would like to find out more, please take a look at our website; www.gqrp.com. For a sample SPRAT and a membership form, please send your name and address to our membership secretary:

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Introduction

This project came about when I needed an antenna tuning (matching?) unit to go with my G3RJV PW Severn project; the first ever radio I built. I started it in June 1983 and, at the time of writing in 2026, it is 'nearly finished'. Joking apart, it has been on the air and has had many modifications over the years and woudl benefit from a few more. The photo below shows the transceiver.

ATU Circuit Description

The circuit is an unashamed copy of the Heathkit HFT-9, which has been out of production since 1991. The T-match circuit is 100% conventional with two variable capacitors and a switched single variable inductor. The original Heathkit info is reproduced on the next page.

I added a resistive SWR bridge from the G3RJV Teme project from Practical Wireless, circa 1984.

I also added a plug and socket arrangement on the rear panel to allow the SWR bridge and the ATU to be used together, or independently and with balanced or unbalanced feeder.

I have used the unit on and off for nealy 40 years and it continues to work as it should.

Original Heathkit Information

CIRCUIT DESCRIPTION

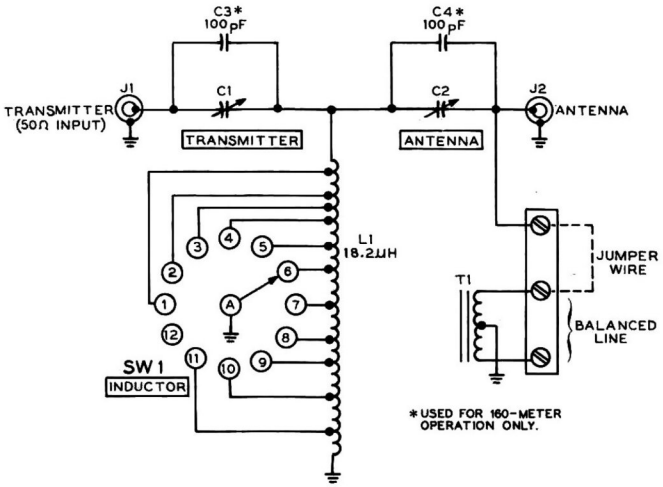
Refer to the Schematic Diagram while you read this "Circuit Description."

The Antenna Tuner is an adjustable RF transformer that matches an unknown load, presented by an antenna and its feedline, to the required 50-ohm transmitter impedance.

Coupling capacitor C2 matches the load impedance fed back to the tuned circuit formed by capacitor C1 and inductor L1. The total resonant impedance across the tuned circuit depends upon the L/C ratio of C1 and L1, and the load impedance as transformed by C2. Capacitor C1 performs capacitive tapping and results in a 50-ohm impedance at Transmitter input connector J1.

Capacitors C3 and C4 extend the frequency range down to 1.8 MHz. These capacitors should not be installed unless you use the Antenna Tuner on the 160-meter band and cannot obtain the proper results without them. Installation of these capacitors may restrict the upper end of the frequency range to something less than 30 MHz.

A 4:1 balun coil, T1, is provided so you can use the Antenna Tuner with balanced lines.



Schematic of the Heathkit® Antenna Tuner Model HFT-9

General Construction Info

The Variable Capacitors are 'general purpose' polyvaricons which both gangs parallelled to give something around 300-500pF as maximum. If using LF bands, a high voltage fixed capacitor can be added but I have never bothered. Take care with polyvaricons; I melted my original set when I accidentally put 10W of 10m FM into the unit. I have also used 'proper' metal air-spaced variables with built-in slow motion drives and they worked well. Other than ensuring that neither the capacitor sides is grounded, not much is critical in this design!

The variable inductor is made from a perfboard former ensuring 0.1" spacing between the turns. Diameter is 3" and length is 2". It is tapped at the following points above ground: 18, 17, 16, 15, 13, 11, 9, 7, 5, 3, 2. The final switch position is not connected to the inductor.

The bottom of the inductor is bolted to the case and it was in the Heathkit original. I have also tried a version with the inductor horizontal, held above the case by insulated pillars. Despite being told 'that will never work like that', I could not determine any difference between the two configurations.

The switch for the inductor taps is a 1-pole 12 way rotary switch. Again, I was told it would have to be some ceramic based high voltage unit, but the standard off-the-shelf unit has performed well for all these years. If it were a QRO ATU, things might be a bit different, but for QRP power, QRP components seem to work.

The balun offers a 4:1 transformation with 12 turns of bifilar hook-up wire on a T-68-6 toroid. Lots of info on how to make such things in old SPRATs.

The SWR bridge is quite clever in that it is build on the back of a 4-pole 3-way rotary switch. In position 1 you set full scale deflection (FSD) and your rig has a load of about 50 ohms. in position 2 (SWR) the bridge indicates the degree of mis-match your antenna is presenting and allows you to adjust the ATU for a perfect, or almost perfect, match. If you are so inclined, you can calibrate the 2:1 spot but I have always been able to get pretty close to 1:1 with the ATU in circuit.

The whole unit is built into an aluminium case about 5" x 4" x 7" that was purchased from the much missed Minfford engineering company. A metal case is preferred due to the RF whizzing around inside in box. The top half of the case is covered with black sticky-backed plastic and the front panel is sprayed grey with car primer, labelled with Letraset rub down letters/numbers and a coat of clear car lacquer added for protection. If I was doing it today, I would probably use some front panel design software and print it on card.

Phono sockets are used throughout. They are perfectly adequate for HF QRP but you could use SO239 or BNC if you prefer.

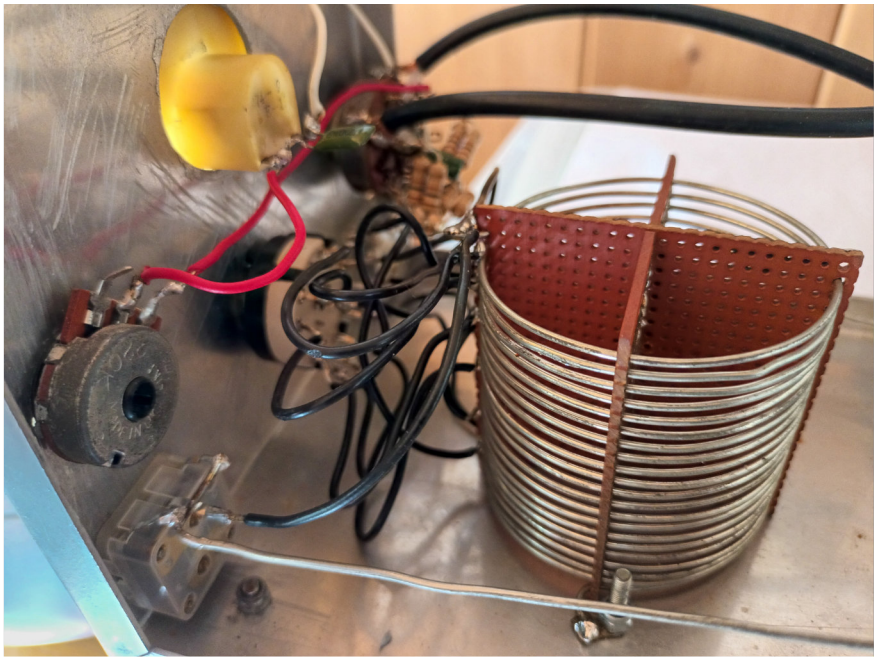
Front Panel

The SWR indicator is an old VU meter picked up at a rally or Hamfest. About 100uA FSD. You can calibrate in SWR if you really care!

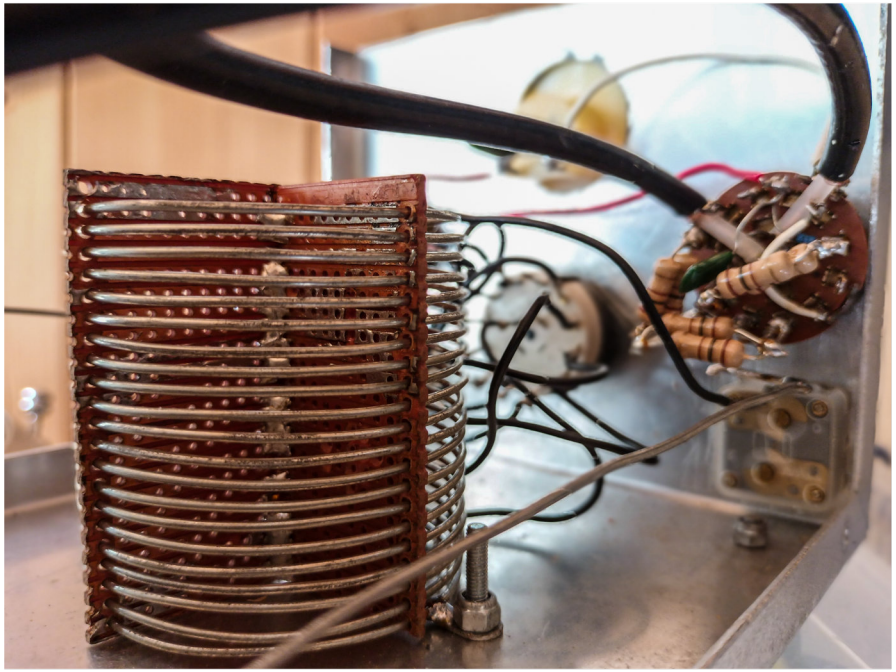
It is maybe worth saying that you should not rotate the inductance switch whilst transmitting in to the unit. Use the routing, TX, stop, switch L, TX, stop, repeat until you see a dip in the SWR. Then twiddle the VC controls to fine tune the dip. If it is not quite there, stop and switch L one more click. I generally start with the VCs at mid-point of their travel so you can twiddle either way.

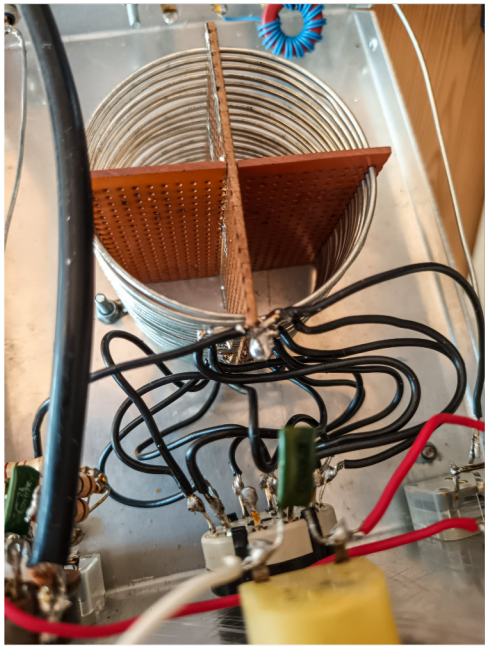
Rear Panel

Short lengths of RG58 with phono plugs on both ends are used to make the patch leads. Clealy, you could omit some of the sockets if you want less flexibility.



Inside view from right and left





Inside view of front connections and Balun placement

SWR Indicator

The info below comes from Practical Wireless February 1985. The top diagram shows the circuit of the SWR bridge and the 'Teme' ATU.

On my unit the variable resistor R5, which sets FSD on transmit, is a panel mounted potentiometer. This enables the unit to be used with a range of QRP radios.

The ATU part of the project is an L-match, rather than the T-match of the Heathkit circuit. You should be able work out the interconnects for yourself.

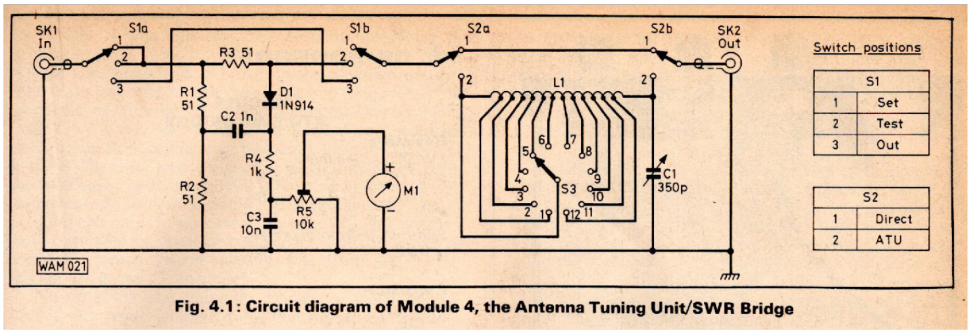


Fig. 4.1: Circuit diagram of Module 4, the Antenna Tuning Unit/SWR Bridge

The lower diagram shows the G3RJV way of building a resisitve SWR bridge on the back of a 4-pole 3-way switch. I used 2 x 100 ohm 1W resistors in paralel for R1, 2 & 3. That handles 5W of CW or 10W of SSB without them melting.

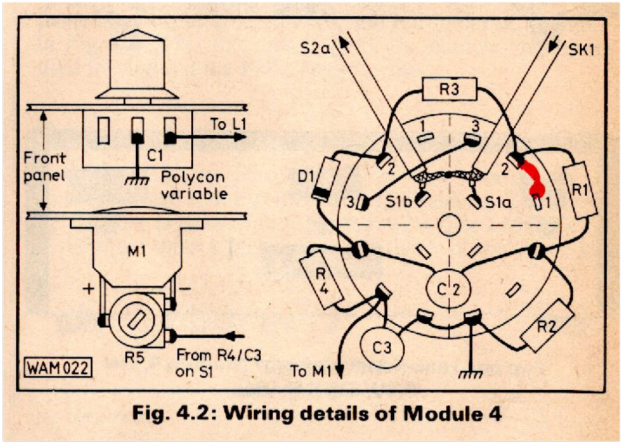


Fig. 4.2: Wiring details of Module 4