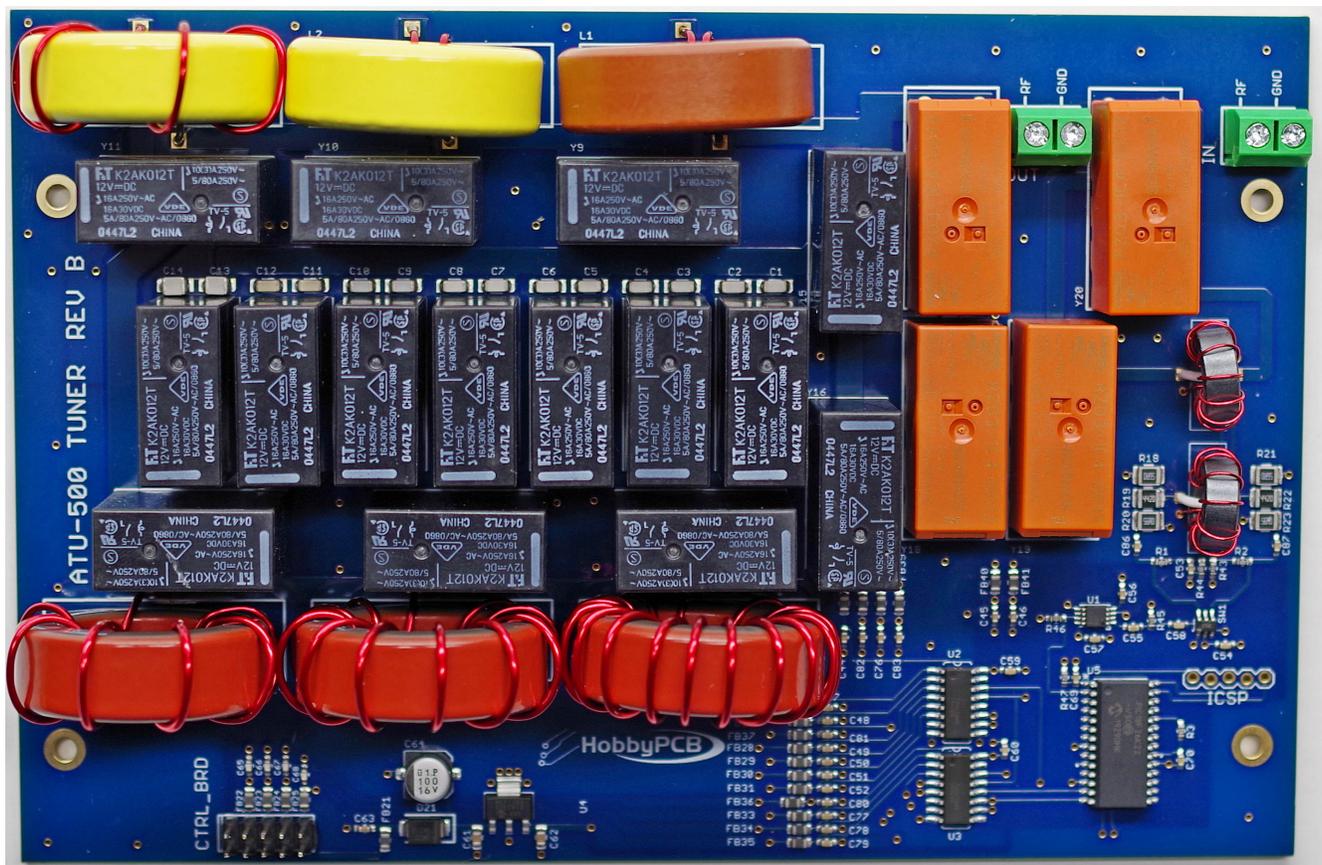


ATU-500 Assembly Instructions

Run 1 - 2021



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WA2EJ
12 January 2021

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1. INTRODUCTION

This assembly manual covers the ATU-500 HF Antenna Tuning Unit manufactured by HobbyPCB, LLC

The ATU-500 is automatic antenna tuner capable of matching RF loads with VSWRs of 6:1 or less in the 3 – 30 MHz band at power levels up to 500W and 3:1 or less at 1.8 MHz

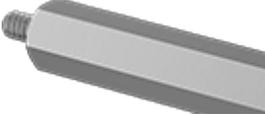
The ATU 500 is designed to be installed on the Hardrock-500 amplifier support package.

ITEM	SPECIFICATION
Manufacturer	HobbyPCB, LLC.
Model Number	ATU-500
Tuning Bands	160, 80, 60, 40, 30, 20, 17, 15, 12, 10 meter Amateur Radio Bands
DC Power	12V DC Nominal, 2A Maximum
Inductor	63 steps 50 nH to 3.2 uH
Capacitor	127 steps 22pF to 2800pF
Tuning Network	L network with capacitor in input or output
Tuning Range	6:1 Maximum
Size	7" X 4.63" X 2" (178mm by 118mm by 51mm)

2. General Assembly Instructions

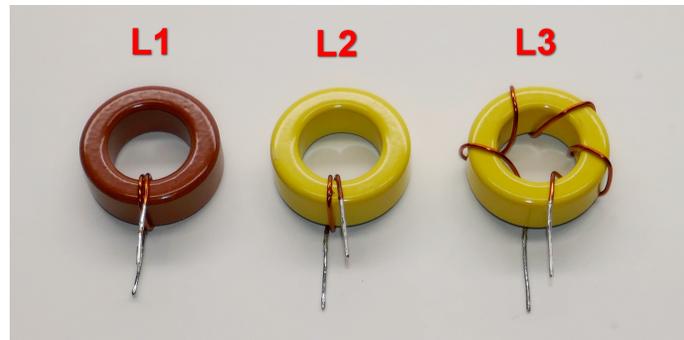
The ATU-500 PCB is supplied with the majority of the components already installed on the board. The builder needs to install the six toroidal tuning inductors and the transformers for the directional coupler. Then the ATU PCB is installed in the Hardrock-500 amplifier using two coax jumpers and a small ribbon cable.

3. ATU-500 INVENTORY

DESCRIPTION	PICTURE	QUANTITY
M-F STAND-OFF #4-40 X 1-1/4"		4
T130-0 TOROID TAN 2 TURNS		1
T130-6 TOROID YELLOW 2 TURNS, 5 TURNS		2
T130-2 TOROID RED 7 TURNS, 11 TURNS 16 TURNS		3
FT50-43 TOROID BLACK 10 TURNS		2
#22 TEFLON WIRE (color may vary)		3"
RG58/U COAX CABLE		2'
RIBBON CABLE - 8CM (2") 2X5 PIN 0.1"		1

4. Toroids

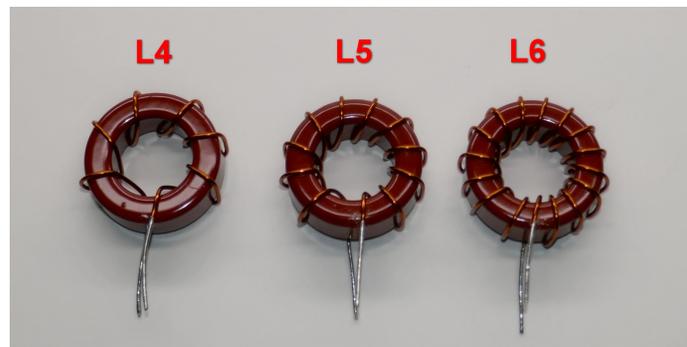
In this section we will install the pre-wound toroids onto the ATU-500 PCB:



Step 1: L1 – 2 turns of #18 enameled wire on a T130-0 (tan) toroid core. Insert to inductor into the PCB at the marked location, solder and trim excess leads.

Step 2: L2 – 2 turns of #18 enameled wire on a T130-6 (yellow) toroid core. Insert to inductor into the PCB at the marked location, solder and trim excess leads.

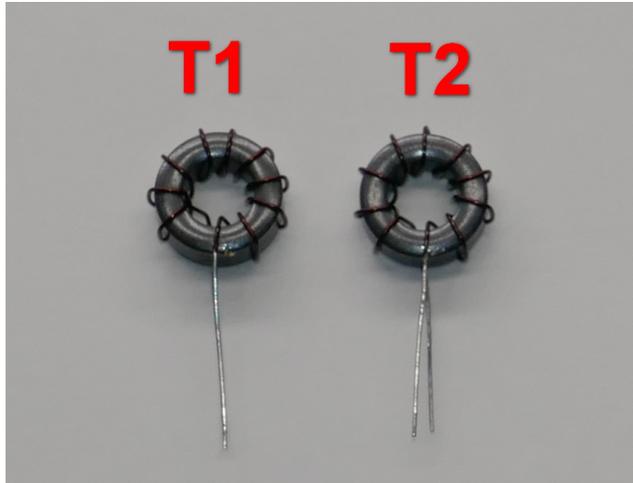
Step 3: L3 – 5 turns of #18 enameled wire on a T130-6 (yellow) toroid core. Insert to inductor into the PCB at the marked location, solder and trim excess leads.



Step 4: L4 – 7 turns of #18 enameled wire on a T130-2 (red) toroid core. Insert to inductor into the PCB at the marked location, solder and trim excess leads.

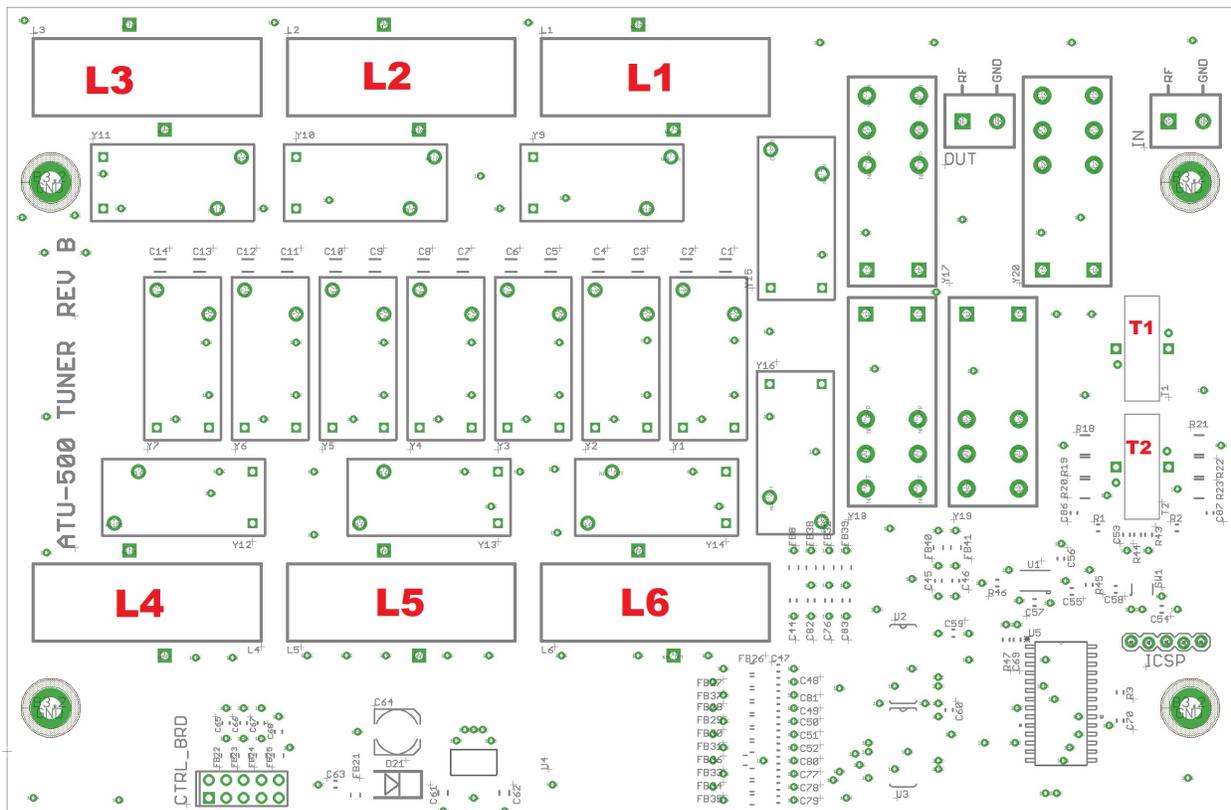
Step 5: L5 – 11 turns of #18 enameled wire on a T130-2 (red) toroid core. Insert to inductor into the PCB at the marked location, solder and trim excess leads.

Step 6: L6 – 16 turns of #18 enameled wire on a T130-26 (red) toroid core. Insert to inductor into the PCB at the marked location, solder and trim excess leads.



□ **Step 7: T1,T2** – 10 turns of #26 enameled wire on a FT50-43 (gray) toroid core. Insert to transformers into the PCB at the marked location, solder and trim excess leads. *Be sure to insert the #26 wire in the small holes on either side of the transformer, the larger holes are for #22 wire in the next step.*

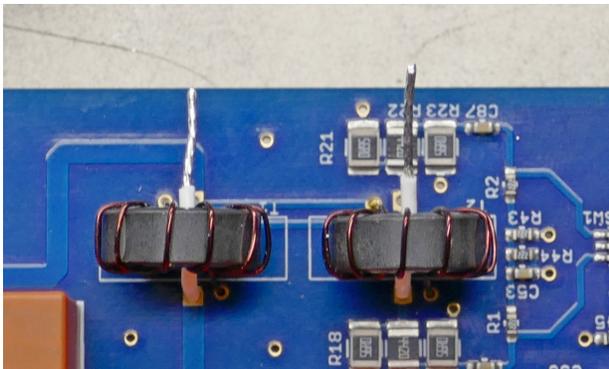
This drawing shows where L1 – L6, T1 and T2 are located on the ATU-500 PCB:



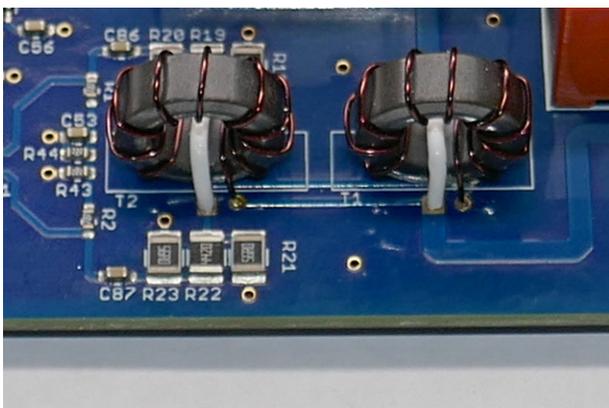
□ **Step 8: T1,T2** – 1 turn windings – Cut two equal length pieces from the #22 Teflon wire, the actual length is about 1.5” (4 cm). strip the ends of the wires so that ½” (13mm) of insulation remains. Tin the ends of the wires.



□ **Step 9: T1,T2** – 1 turn windings – pass one end of each wire through the center of T1 and T2 and insert the end into the hole in the PCB. Solder the wires into the holes and trim any excess with diagonal cutters.



□ **Step 10: T1,T2** – 1 turn windings – insert the free end of the wires into the holes on the opposite side of T1 and T2 cores. Solder the wires into the holes and trim any excess with diagonal cutters.



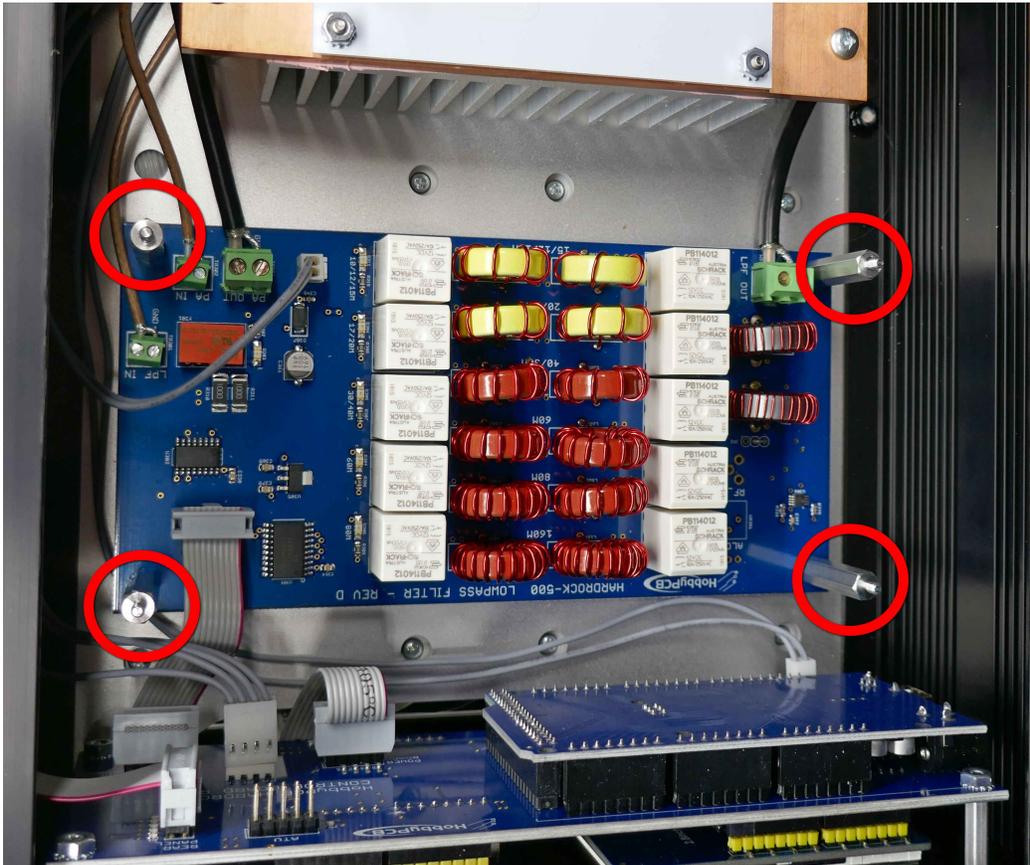
5. Integration

In the section we will integrate the ATU-500 with the Hardrock-500 amplifier.

□ **Step 1: Prepare the Hardrock-500** – Disconnect the Hardrock -500 from all external connections including AC power, RF connections and data interfaces.

□ **Step 2: Remove the top cover** – Remove the 6 screws the hold the top cover and place them in a safe location.

□ **Step 3: ATU Standoffs** – Remove the four #4-40 hex nuts that hold the LPF board in the amplifier and place them in a safe location. Install four #4-40X1 ¼” M-F spacers in place of the hex nuts.



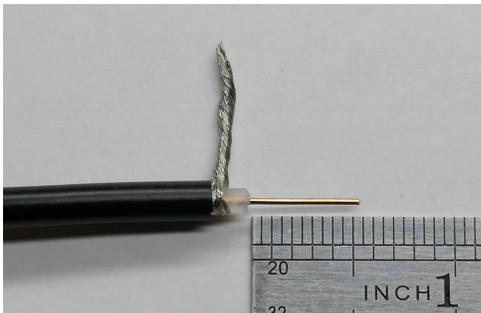
□ **Step 4: ATU PCB** – Place the ATU-500 PCB on the four #4-40 standoffs and secure with the four #4-40 hex nuts removed in step 3. The IN and OUT terminal blocks are toward the back of the amp, the 10-pin header should be next to the control board.

Step 5: COAX Prep – Cut two 10” (25.5 cm) pieces of RG58 coax and remove ¾” (19mm) of the outer jacket. Be careful not to nick any of the shield wires.

PRO TIP – Cut the supplied wire in half, prepare one end of each wire then cut the wire to length so you’ll have a little extra in case you don’t get it right the first time.



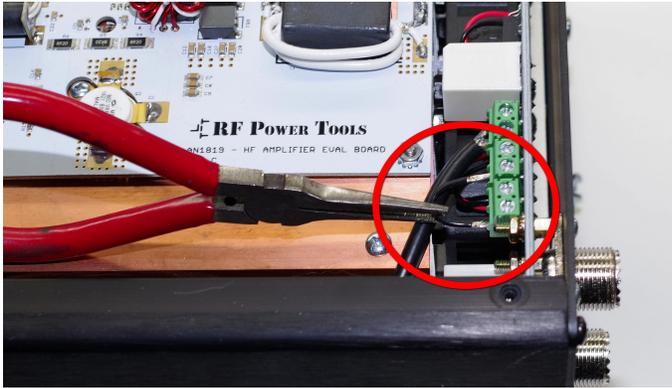
Step 6: COAX Prep – Carefully un-braid the shield wires and gather them on one side of the cable. Strip the dielectric from 0.5” (12 mm) of the center conductor for each end of the cables (four places).



Step 7: COAX Prep – Tin the exposed braid without getting too close to the jacket or dielectric to avoid melting either one. Bend the shield wires and the center conductors as shown.

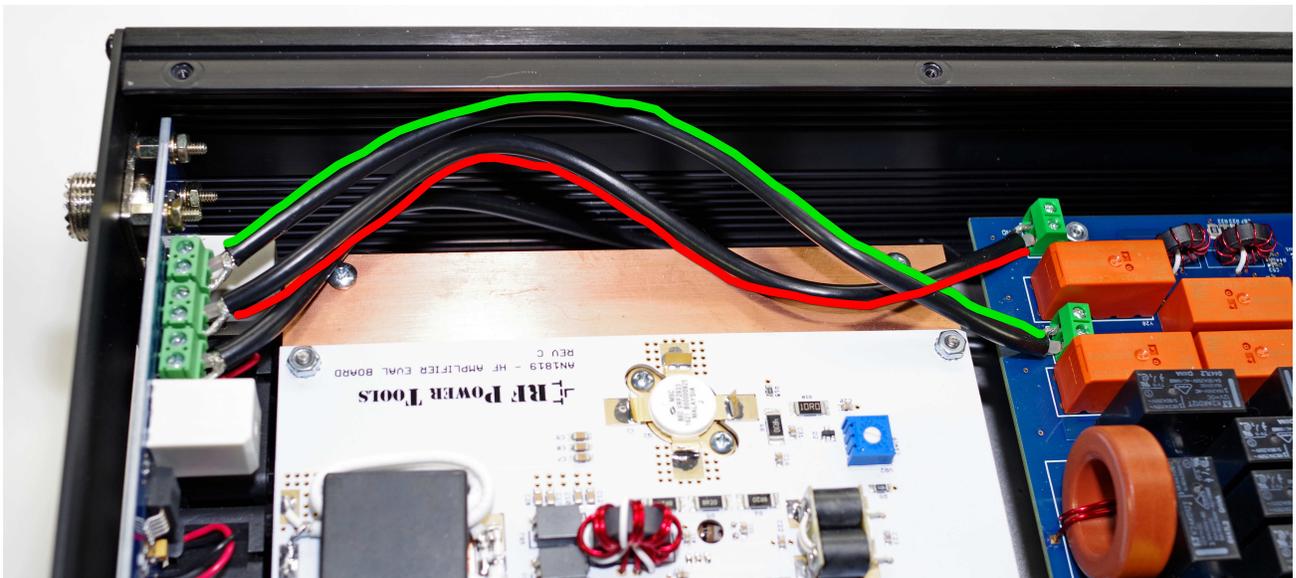


□ **Step 8: Remove Jumper** – Loosen all four screw terminals in the ATU-IN and ATU-OUT terminal blocks on the rear panel PCB. The remove and discard the short jumper wire going between ATU-IN (RF) and ATU-OUT(RF).



□ **Step 9: ATU-IN jumper** – Insert one of the coax jumpers into the ATU-IN terminal block and tighten the terminals. Be certain that the center conductor is in the RF terminal and the shield is in the GND terminal. Connect the other end to the IN terminal block on the ATU-500 boards.

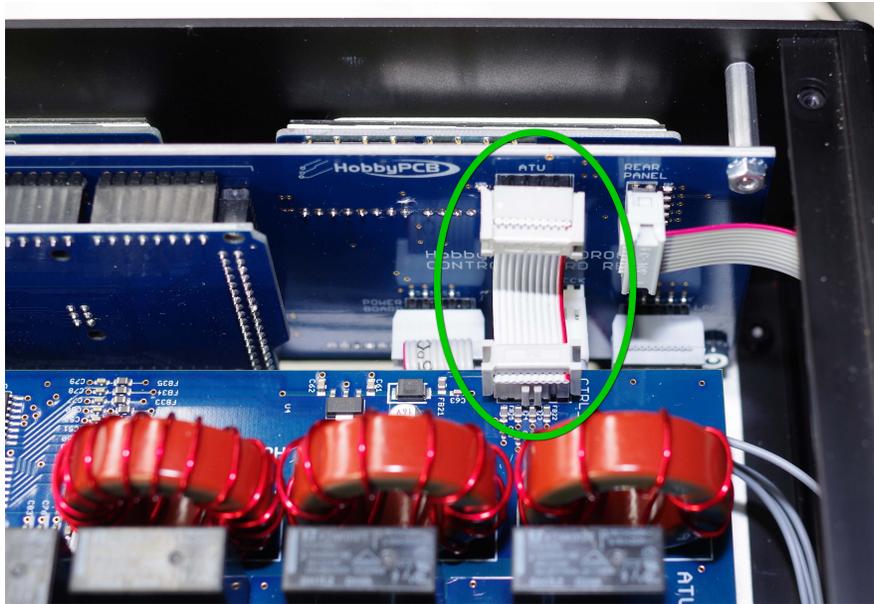
□ **Step 10: ATU-OUT jumper** – Insert the other coax jumper into the ATU-OUT terminal block and tighten the terminals. Be certain that the center conductor is in the RF terminal and the shield is in the GND terminal. Connect the other end to the OUT terminal block on the ATU-500 board, again observing RF and GND connections.



The red line shows the ATU-IN; the green line shows ATU-OUT

Route the coax runs from the rear panel board to the side of the AN-1819 amplifier deck, not directly over the top of the amplifier.

Step 11: Ribbon Cable – Connect one end of the short ribbon cable to the 10 pin connector on the front panel board labeled ATU. Connect the other end to the CTRL-BRD connector on the ATU.



Step 12: Replace the top cover – Replace the top cover and secure with the six top cover screws removed in step 2.

6. Operation

In the section covers operation of the ATU-500 with the Hardrock-500 amplifier.

When you turn the Hardrock-500 on, if the ATU-500 is installed and connected correctly, the right hand LCD will contain controls for the ATU.



The two controls for the ATU are TUNE and ATU.

The ATU control selects whether the ATU is bypassed (BYP) or actively applying a tuning solution (ON).

Tuning solutions are stored in EEPROM for each band and each antenna so if the ATU had been tuned on the selected band/antenna combination the previous tuning solution will be applied.

The ATU can be used with or without the 500W amplifier as can the antenna selection.

You must apply RF to the input of the Hardrock-500 so the ATU can tune the antenna. If your radio does not have a TUNE mode you'll need to select a mode that causes the radio to create a RF signal like AM, FM, CW, RTTY. Keying the radio in SSB does not produce enough RF for the ATU to complete a tuning cycle.

The TUNE control is used to initiate an auto-tune cycle. The ATU will only tune when the TUNE button is pressed, it does not tune based on high SWR or any other external factors. If you want it to tune, press the TUNE button and apply RF energy. Pressing the TUNE button again, while the ATU is tuning immediately stops the tuning cycle.

Tuning the ATU – When you press the TUNE button if the ATU is on BYP (bypass) it will switch to ‘ON’. The status window will display ‘Tuning’ and the ATU will wait for RF to be applied.



The tuning action is different depending on the state of the amp:

Hardrock-500 Operating Conditions	ATU Action
MODE = ‘OFF’	The ATU waits for RF and starts tuning when RF is present. If tuning is successful the tuning solution is applied and can be used with the amp on or off.
MODE = ‘PTT’ Amp is not keyed	The ATU waits for RF and starts tuning when RF is present, the amp is not brought on-line while the ATU is tuning. If tuning is successful the tuning solution is applied and next time the amp is keyed the amp is brought on-line with the ATU.
PTT = ‘ON’ Amp is keyed	The amp is taken off-line and the ATU tunes when RF is present. If tuning is successful the tuning solution is applied and next time the amp is keyed the amp is brought on-line with the ATU.
PTT = ‘ON’ Amp has tripped the high SWR condition	The amp is taken off-line and the ATU tunes when RF is present. If tuning is successful the tuning solution is applied and next time the amp is keyed the amp is brought on-line with the ATU and the error condition will be cleared.

When Tuning is initiated and RF is applied, the amp first checks the current tune state of the amplifier. If the VSWR is better than 1.2:1 a tuning is not performed and the ATU status is 'Tuned'.

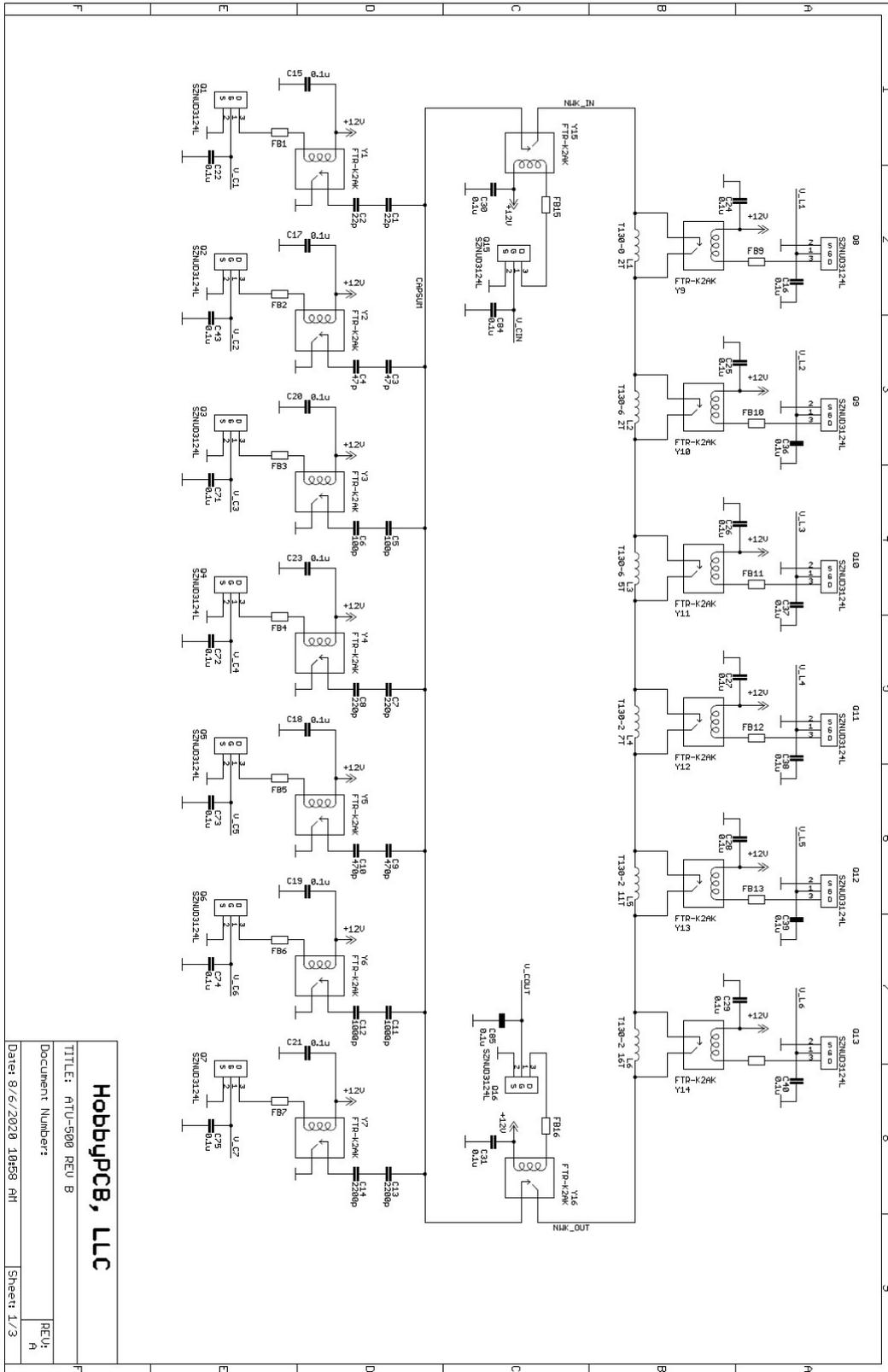
The ATU then checks the bypass path and if the SWR is better than 1.3:1 a tuning is not performed and the ATU status is 'Tuned'. If the SWR is higher than 6:1 a tuning is not performed and the ATU status is 'Hi SWR', indicating that the current antenna cannot be used at this frequency without additional matching.

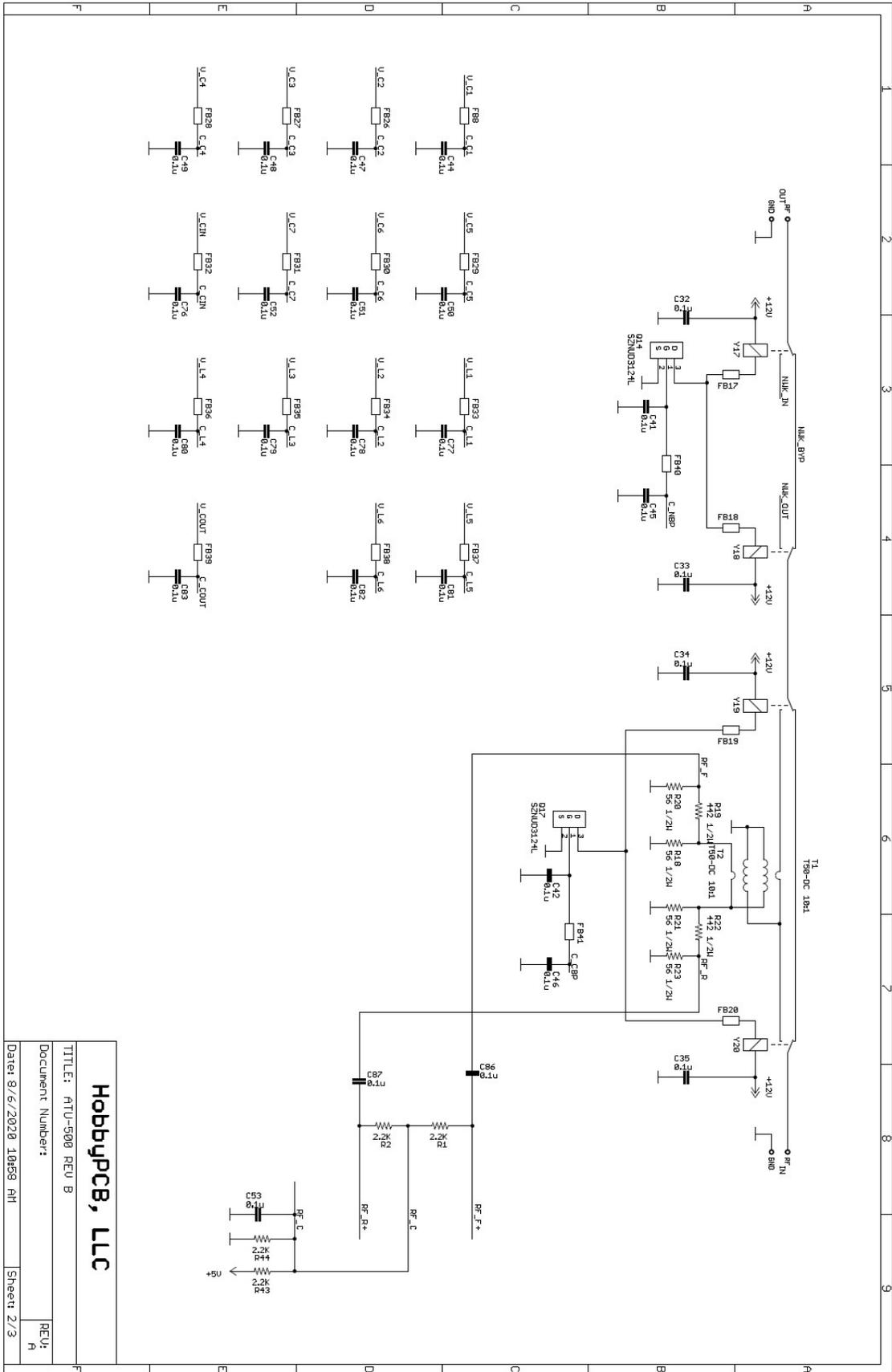
If the load SWR is higher than 1.3:1 and lower than 6:1 the ATU starts a tuning cycle. If the RF power drops below 00.5W for more than a second, the ATU discontinues tuning and the status is 'Lo Power'. If the ATU completed tuning and the final SWR is greater than 2:1 the ATU status is 'Failed' indicating that a suitable tuning solution could not be found.

If the tuning cycle completes and the final SWR is less than 2:1 the tuning solution is applied and the ATU status is 'Tuned'.



Appendix A – Schematics





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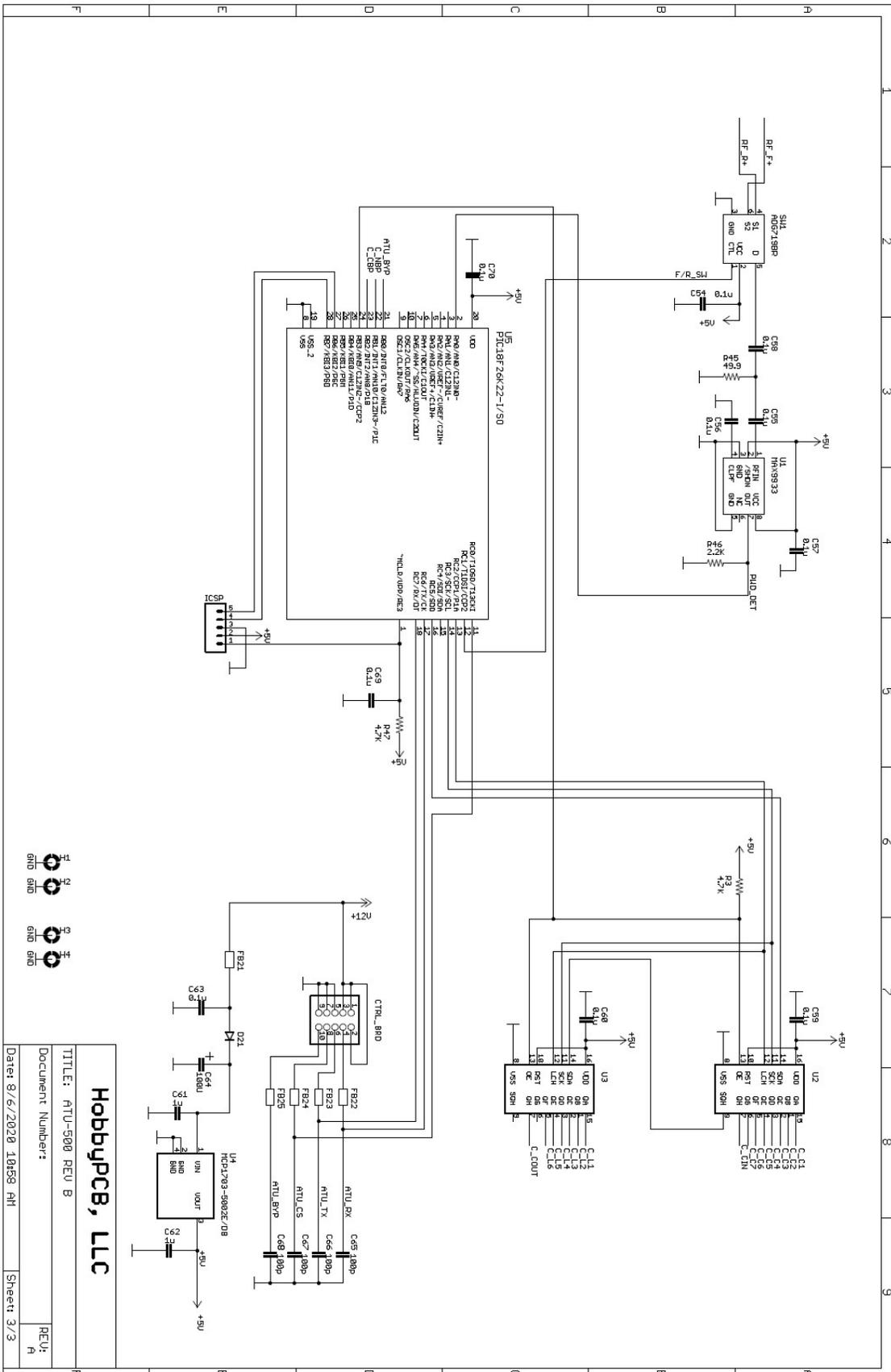
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