Kenwood TS-50 to Icom and LDG ATU Interface

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Introduction

This article describes the result of my investigations into connecting automatic ATUs to the Kenwood TS-50 HF transceiver. I wanted to use my TS-50 in a mobile environment, but was irritated by the lack of integration between it and the Icom AH-2 automatic ATU that I was also planning to use. All of the mode and power switching required to get the automatic ATU to tune seemed to me to be a waste of effort, and possibly dangerous while driving. There had to be a better way.

I started off by looking on the web for information – but there appeared to be very little out there. On www.mods.dk, my usual first port of call for these sorts of things, the closest I got was a writeup by DF6KR on TS-50 to AT-50 serial communications – these two boxes talk using a 4800bps inverted serial communications scheme. Having found this I decided that a small microcontroller could easily emulate the AT-50 and provide control to a dumber ATU. However, by accident while collecting further information on the serial protocol I made a wiring error and an interesting discovery.

Dumb Mode

It turns out that the ATU interface on the TS-50 can work in two different modes. As well as the serial interface scheme there is a second mode. If you link the TS and TT signals on the ACC (ATU) connector then the TS-50 detects this at powerup and goes into this alternative 'dumb' ATU control mode.

This mode has the following features:

1. The AT TUNE button starts to work. Pressing the AT TUNE button on the rig will temporarily select low power, and key the transmitter in CW mode. Pressing the button again will cancel this and return the rig to normal operation. If the tune operation is not cancelled within 30 seconds the TS50 starts beeping at you to remind you that the transmitter is still active. Thus with no changes other than a loopback wire you can have a single button to perform the necessary transmitting for atu autotuning.

2. While the rig is idle the TS signal sits at 5V. During the AT TUNE operation it drops to 0V, taking TT with it (as they're looped). You can detect this state change and use it to trigger an ATU tune cycle.

3. If during the ATU tune cycle you break the TS/TT loop for a short period (a few hundred milliseconds) and allow TT to float high then the AT tune operation ceases, and TS returns to 5V. This will allow a simple circuit to monitor the 'key transmitter' line from the ATU, and temporarily break the TS/TT loopback when transmitters keying ceases, to end the TS-50 transmit cycle.

Note that (at least on my TS-50) the TS and TT interface signals comprise the centre column of contacts on the ACC connector. TS is on the bottom, and TT on the top. On one of the mods sites I've seen a different set of pinouts for the ACC connector - this is either wrong or there's more than one possible wiring setup out there.

Note also that the TS-50 does its 'dumb mode' detection at power up. It brings TS high, then pulses it low for about 120ms. Any 'tune detect' circuit should thus make sure that TS has stayed low for longer than this before starting the antenna tune cycle.

Interface Circuit

The attached diagram shows the circuit I used to make the interface to an Icom AH-2 ATU work. The TS/TT loopback is provided by (one quarter of) a 74HC4066 analog switch device. This device loops back TS to TT whenever the control input on pin 13 is high, which is most of the time. Note that the control inputs for the unused switches on the 74HC4066 (pins 5, 6 and 12) are grounded.

The top half of the 74HC123 dual monostable is used to deliver a positive pulse of approximately 500ms duration when a negative edge is sensed on the TS/TT loop, indicating that a tune operation has commenced. This pulse turns on the BC549 transistor, grounding the TUNE signal and initiating tuning on the ATU.

The bottom half of the 74HC123 is used to detect a positive edge on the KEY signal (on the LDG RT-11 ATU this is called 706-OUT, probably because the Icom interface uses it) from the ATU, signifying that the ATU has finished keying the transmitter. Upon sensing this, it delivers a negative pulse of approximately 500ms duration to the switch input of the 74HC4066, breaking the TS/TT loopback for this period. This tells the rig that tuning is complete.

Power for the interface is provided using a 74L05 miniature 5V regulator, running from the 12V feed from the TS-50 ATU connector. The resistor and zener on the regulator input are to provide extra protection from ignition spikes in a mobile environment - but may not be so necessary as the TS-50 has an internal protection diode. Note that I've not included a fuse on the drawing - the TS50 has an internal 4A fuse on the ATU interface 12V output line - but on reflection putting a low current fuse in the power feed prior to the voltage regulator is probably a good idea. The circuit itself should draw no more than a few milliamps.

This circuit could probably be improved with better understanding of the TS-50. It's still based on my observation that looping back TS/TT puts the ATU interface into 'dumb' mode. My initial attempt at a design took a logic interface approach to the TS/TT connection, but I found that in some circumstances it appeared that TT was also driving the loop, and so this approach didn't work. The use of the 74HC4066 is thus a little bit of laziness - as an analog switch it's the closest thing to a real loop I could easily control, and it stops me from having to understand the full complexities of the interface. In my original breadboard I used a normal CMOS 4066 rather than the 74HC flavour. It worked fine, but Len (a greybeard hardware engineer friend who kindly reviewed my design) suggested that the 74HC version has a lower on resistance and will work better with 5V logic levels on the switch input.

My interface works happily with the Icom AH-2 ATU - I believe the AH-3 and AH-4 also have the same interface. The LDG Electronics RT-11 has an effectively identical interface, too. Note that if the ATU tunes very quickly (< 0.5 second) at times then you may need to reduce the length of the TUNE pulse, otherwise it may try to tune a second time just as the transmitter turns off. You'd do this by reducing the values of the resistor and/or the capacitor on pins 14 and 15 of the 74HC123. Pulse duration is about 0.45 times the product of the resistor and capacitor values.

ACC Connector

You can make an adequate if not beautiful substitute for a real ACC plug on the TS-50 from a broken ATX style (modern) PC power supply. If you don't have one in your junkbox you may be able to charm one out of your local PC clone shop - mine didn't even charge me, which may say something about PC power supply reliability! The main connector that goes onto the PC motherboard from these power supplies is the correct pitch, but has far too many contacts, some of the wrong shape. With some judicious scalpel work you can reduce the connector to six contacts, and then remove all of the plastic on the three of these that go into the circular holes, leaving only the pins. This latter part of the process is easiest done with the metal pins removed, which you can do with a fine screwdriver and a bit of fiddling.

Once you've formed the connector and proved it fits you can then also cut away sufficient of the locking tab that the connector will hold in place correctly despite being offset by half a pin from its correct location.

Of course, if you can find a retailer who'll sell a small quantity JST brand ELP-06V plugs and associated pins then you have no need of this workaround. I've not been so lucky thus far.

Summary and Disclaimer

With a handful of cheap components it is possible to connect a TS-50 to several different automatic ATUs. This exercise solved a problem for me – I hope it makes life easier for you too. I'm always interested in feedback on this design – so feel free to get in touch at the email address above if you have comments.
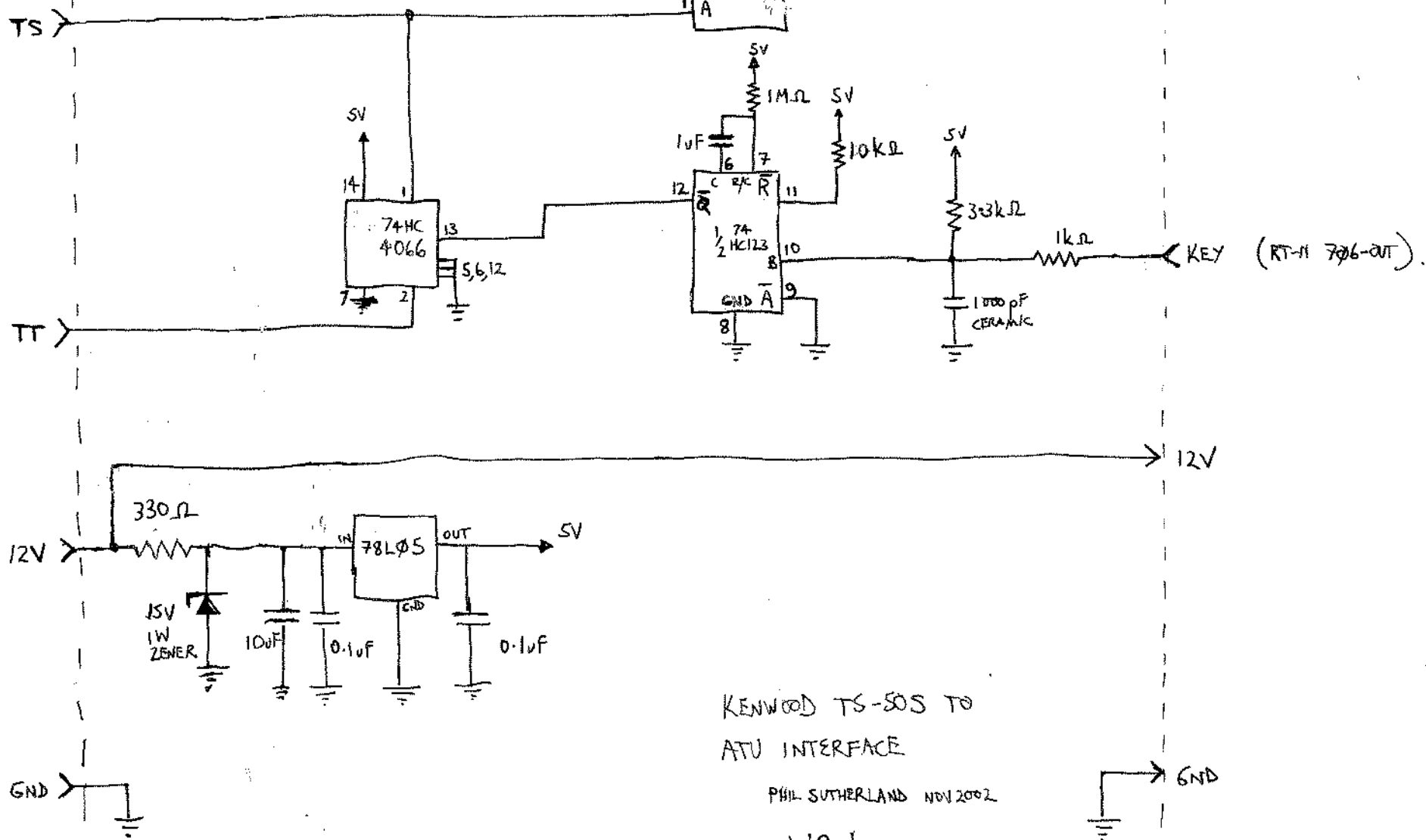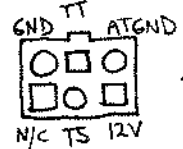
Please also understand - this article is published in good faith, and I'm using the circuit myself, but in the end the responsibility for any blown up rigs or ATUs is yours alone. Take care.

KENWOOD TS-50

ATU connector as viewed on back of rig.

GND TT ATGND

N/C TS 12V

ATU

ICOM AH-2
LDG RT-11
etc.

5V

1MΩ

1μF

5V 5V

10k

10k

10k

14 15

R C R/C Q 13

BC549

3·3k

1000 pF CERAMIC

TUNE

2 B 74 ½ HC123

1 Ā Vcc 16

TS

5V

1MΩ 5V

1μF

5V

10kΩ

5V

3·3kΩ

1kΩ

KEY (RT-11 796-OUT).

14 1

74HC 4066

13

5,6,12

7 2

6 7

12 C R/C R 11

Q̄ ½ 74 HC123

GND Ā 10 9

8

1000 pF CERAMIC

TT

12V

330Ω

12V

15V 1W ZENER

10μF

0.1μF

IN 78LØ5 OUT

GND

0.1μF

5V

KENWOOD TS-50S TO

ATU INTERFACE

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GND

GND