Instructions for Antenna tuning Noise Bridge.

These instructions supplement the information given in the RADCOM article.

Theory of operation:

This tune indicator consists of a 50ohm fixed impedance noise bridge that is permanently connected in the aerial line, ready to be switched in at any time.

When switched into circuit, the aerial with its ATU is connected to one side of the bridge, and an accurate 50ohm resistor is internally connected to the other side. In the middle of the bridge is your receiver. When the ATU is not tuned, the bridge is unbalanced and the receiver hears lots of noise from the Noise Bridge. Once the ATU is adjusted it looks like 50 ohms, the bridge is balanced and the noise heard in the receiver drops to nothing. With the component values shown, the Noise Bridge will operate up to 50MHz or more.

If the transmitter is inadvertently operated into the bridge, diodes D2&D3 clamp damaging voltages around Q6. Do not test the protection for long periods! Maybe a better system would be to make the switch a 3 pole relay, which could drop out if an RF sensing circuit was triggered by the transmitter.

Note- the noise generator circuit is isolated from the RF connectors, and the grounds do not join. This is to allow the noise generator to float and help equalise any imbalances in the bridge drive.

Also, the primary of the BALUN has a floating winding. This helps balance the drive to the secondaries, especially the capacitive coupling. Think of the primary as a See Saw, with the centre connection as the fulcrum, and whatever the driven end does, the floating end does the opposite.

Changes to the RADCOM article:

Firstly, to correct a printing error, the link on the ON-OFF switch was missed out of the diagram in the RADCOM article, and R8/R11 were swapped on the overlay.

Since the article was written, a year ago, I have enhanced the design and improved the noise generator circuit. This involves changing the bias resistors from 470k to 47k and reducing the coupling capacitors from 10nF to 1nF.

This Printed Circuit Board (Version B) has had a re-work, and all components are now accommodated on the board properly. The earlier version used the *Galbraith* Noise Bridge* PCB, and did not make proper provision for D2, D3, R12, R13 and the LED resistor R14. Note the RF ground end of R12/13 is now connected to the mounting hole near T1 for its earth connection.

Lastly, the indicator LED circuit has been added to the PCB, and the LED can be soldered directly to the back of the board, or connected using wires.

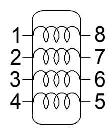
Construction:

I built the unit into a 64 x 115mm diecast box with the aerial switch and power switch combined into a 3-pole double throw toggle switch mounted close to the aerial BNC connectors. Another construction idea would be to build it inside the ATU.

Note the RF connectors are close to the switch to preserve the high frequency performance. Also the PCB is mounted on *metal* pillars to provide the RF ground. Keep all the RF connections short for best performance at the higher frequencies.

Making the transformer Balun:

The heart of the Noise Bridge, the transformer, should really be called a balun, as it converts the unbalanced output of the noise generator to a perfectly balanced noise source across the bridge. It will be noted that this design has an unused winding on pin 7. This is to completely balance the capacitance coupling between primary and secondary. Some experimentation took place to determine the best ferrite, and this type provided a good noise level up to 145MHz. A little care should be taken in winding this component.



Lead-out of windings on T1, shown separated for clarity.

1. Twist together 4 x180mm strands of 0.3mm enamel copper wire. Aim to have a twist of about 40 rotations over this length.
2. Wind ten turns of the twisted bundle through the centre hole, note one turn is equivalent to one pass through the centre hole. Evenly wind the turns around the toroid so that the start is very close to the finish.

3. Separate the ends and remove the insulating enamel. This can be done with a soldering iron on most wire types now.
4. Use a buzzer or ohmmeter to identify the four pairs of windings. Arrange them as in the diagram Figure 4. This is the lead out pattern needed for the PCB.
   I used masking tape to keep the strand ends together throughout the twisting and winding process, and a marking on the tape shows the pair orientation for placing into the PCB.
   The PCB tracks connect the windings in the correct phase as long as the pair groups are maintained as in Figure 4.

Testing:

Connect a receiver to the transceiver connector, apply power using a 9volt battery. The noise level should be more than S9+20dB on 3.5Mhz and at least S9 at 28MHz. Connect a 100R-carbon pot across the aerial connector and the noise should almost disappear (dip) when the pot is rotated past 50ohms. If these conditions are not observed, check the order of windings on T1. Check all components and values. Using headphones, check the noise level across the Base Emitter of Q3, Q4, Q5, each should have an increasing noise level. Check the audio oscillator using an AM receiver, a 900Hz tone should be present with the noise.
DC voltages: Q4 collector 1.5v, Q5 collector 1.5v, Q6 collector 5v.

References:

1/ *Noise Bridge ZL3KB, NZART Breakin magazine. September 1998
2/ Silent antenna tuner ZL3KB, RADCOM magazine, April 2001
** This is a general purpose Resistance / Reactance measuring Noise bridge, useful up to frequencies of 50MHz or more. Printed Circuit boards are available from NZART Branch05, PO Box 1733, Christchurch.*

Parts list

Qnty	PartType	Designators
2	100R 1watt non inductive	R12 R13
1	1K	R7
1	2K2	R14
1	15K	R11
4	10K	R3 R4 R5 R6
3	100K	R1 R2 R10
2	47K	R8 R9
7	10nF Ceramic	C1 C2 C7
4	1nF Ceramic	C3 C4 C5 C6
1	FT50-61 or FT50-43 Ferrite core	T1
3	BC337 or any audio NPN	Q1 Q2 Q3
2	1N4004	D2 D3
1	1N4148	D1
1	LED	D4
3	(PH)2N2369A, BSX20, BSX19, 2N2222A	Q4 Q5 Q6
1	Switch Double Throw Three pole.	SW1 Ganged
1	Battery 9v with battery connector.	

Notes on Parts list:

I once saw an "Electronics Australia" article had as a footnote: "*All resistors and capacitor values can be adjusted up or down by one preferred value*". I think this is true in this design too, except for R12 and R13, but it is best to try and keep to the original values, I haven't tried all combinations!
To help prevent damage in inadvertent transmitter operation, it is best to use 1watt resistors for R12&R13.
Transistors Q4,Q5,Q6 can be any NPN with an fT of around 600MHz, but the 2N2369A gives good noise output up to 50MHz. The noise output with 2N2222A fitted will start to sag above 30MHz, and watch their pin-out, they *can* be opposite that shown on the layout here! .
Q1,Q2,Q3 can be any audio NPN type, but AVOID the low noise types!
The switch can be any miniature toggle switch, rated at around 125vac at 2A. This should handle the current of a 100w transmitter easily.

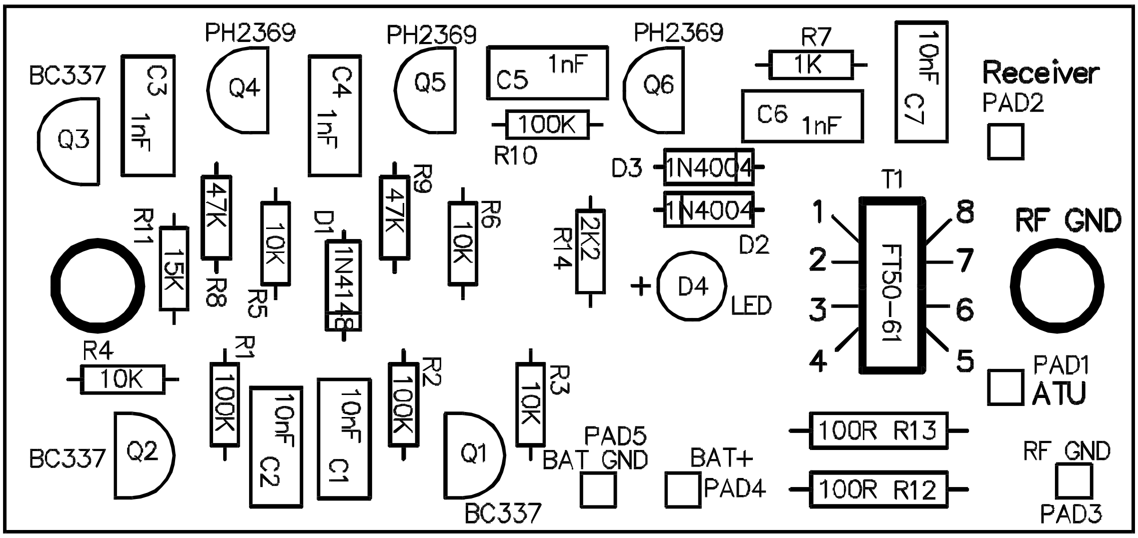


Figure 1 Layout of Issue B Printed Circuit Board

View into 64 x 115mm Diecast box

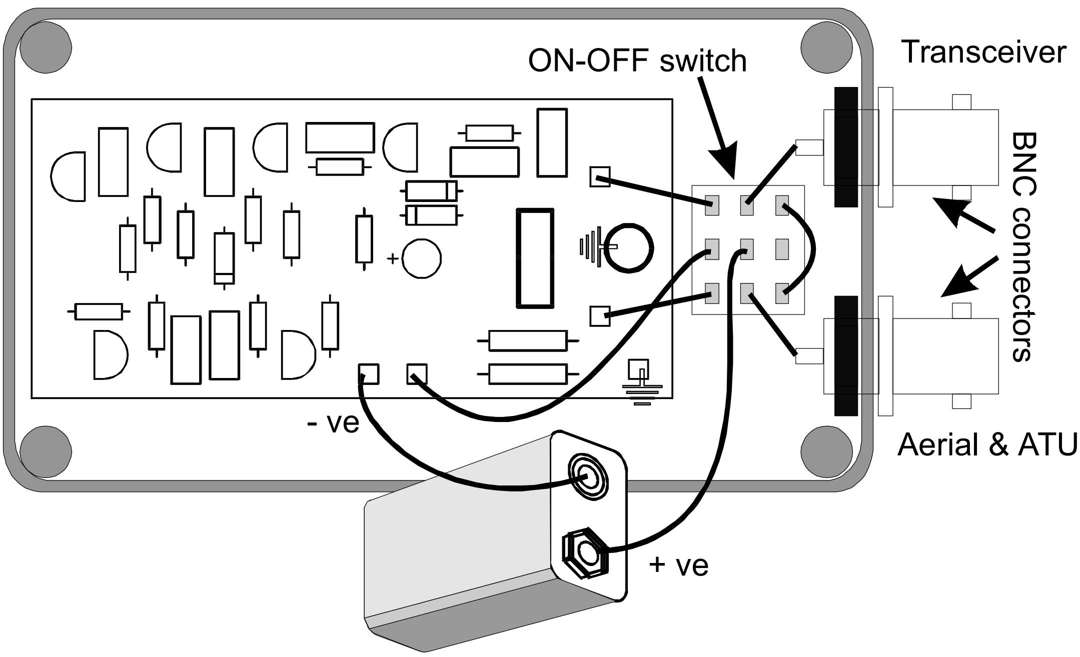


Figure 2 Internal view of Tune Indicator
(note *metal* spacers are needed under PCB for RF ground)

Figure 3 Circuit Diagram

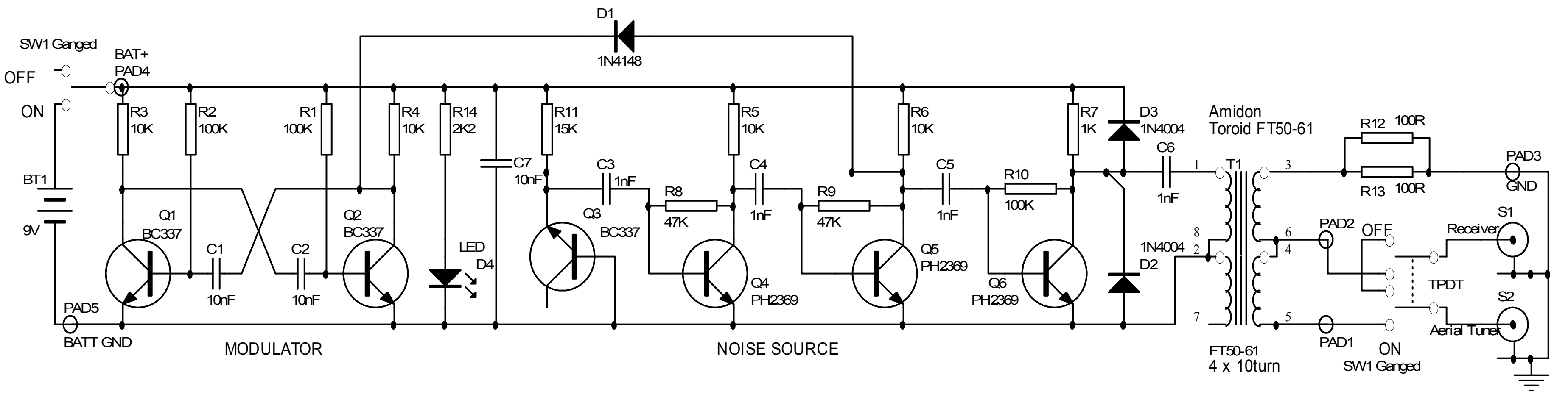


Figure 3. Circuit diagram of Antenna Tuner Bridge