SOTABEAMS™
AMATEUR RADIO FOR THE GREAT OUTDOORS

BOXA-TEST

a BOXA-LINE product

The BOXA-TEST is a useful test fixture that provides four separate load impedances. These are characterised from DC to 30 MHz and are ideal for testing and calibrating antenna analysers and SWR bridges, comparing antenna tuning units and testing transmitters. The BOXA-TEST has a dissipation of 5 Watts.

The BOXA-TEST is available as an easy-to-make kit or as a ready-made unit. The BOXA-TEST can either be fitted into our neat custom enclosure or mounted in your own enclosure.

Building the BOXA-TEST is easy and fun. It will take less than an hour to build and is suitable for a beginner.

Revison History

09-Dec-2014	First issued
03-Feb-2015	Correction to parts list (10k resistors)

BOXA-TEST Packing List

It's a good idea to check that you have all the parts before you get started:

Item	Number	Comments
10 K Ohm 3 Watt Resistor	2	brown-black-orange
100 Ohm 3 Watt Resistors	10	colour code brown-black-brown
BNC sockets	4	PCB mounted
Plastic spacer	1	
Printed circuit board	1	
OPTIONAL ENCLOSURE KIT		
Laser cut front panel	1	
Laser cut rear panel	1	
Aluminium enclosure	1	
Panel fixing screws	8	
Self adhesive feet	4	

If anything is missing, just get in touch for help.

Richard@sotabeams.co.uk

Errata

None

BOXA-TEST Instructions

The BOXA-TEST kit is easy to make and you will end up with a very useful set of test loads.

Step by step instructions together with lots of photographs will make it easy to build your BOXA-TEST. It will take around 30 minutes work.

Spotted a mistake or need help?

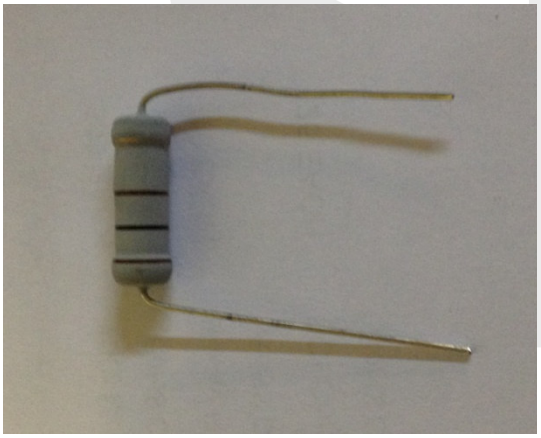
Please let me know!

Email Richard@sotabeams.co.uk, telephone +44 (0) 7976 688359

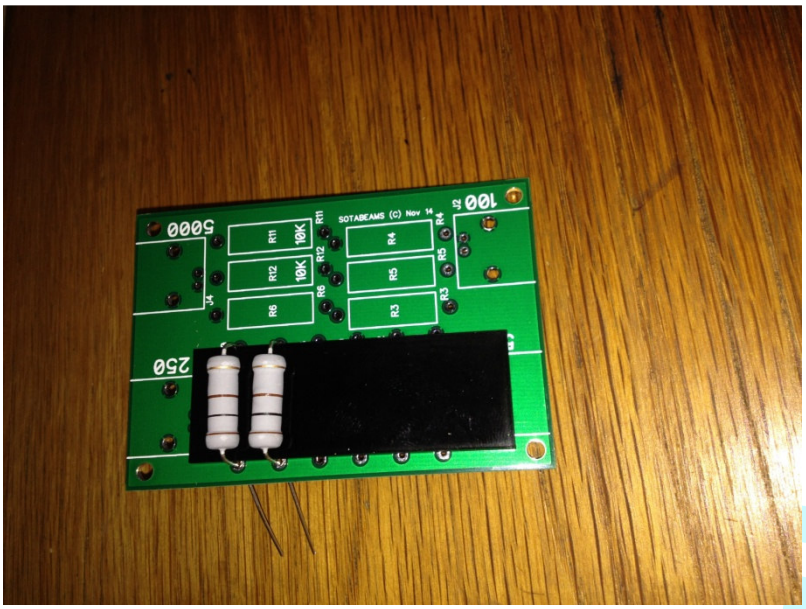
Step by step instructions

1. Identify the 10 x 100 Ohm resistors and the plastic spacer.

2. Remove two of the resistors from their retaining paper and bend the leads at right angles to the body of the resistor. Note we will be installing two resistors at a time as this makes it easier to remove the plastic spacer. The purpose of the spacer is to help to install the resistors 3 mm above the surface of the PCB. By installing the resistors above the board, their heat dissipation is improved.



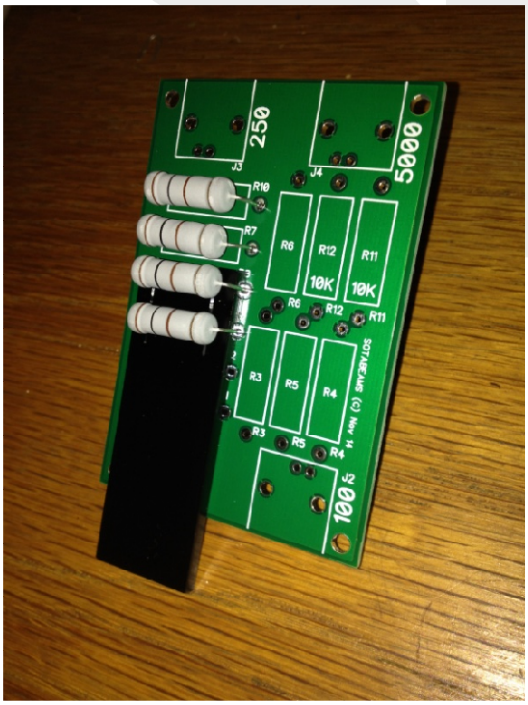
3. Lay the plastic spacer on the **top** surface of the printed circuit board (pcb) and install the resistors (R10 and R7) as shown. Make sure that the resistors are in contact with the spacer. Hint – for a professional look, mount them all the same way round.



4. Solder the resistor leads where they poke through on the underside of the PCB and trim the leads. Hint – don't be tempted to install more than 2 resistors at a time or you will find it hard/impossible to remove the spacer.

5. Remove the spacer.

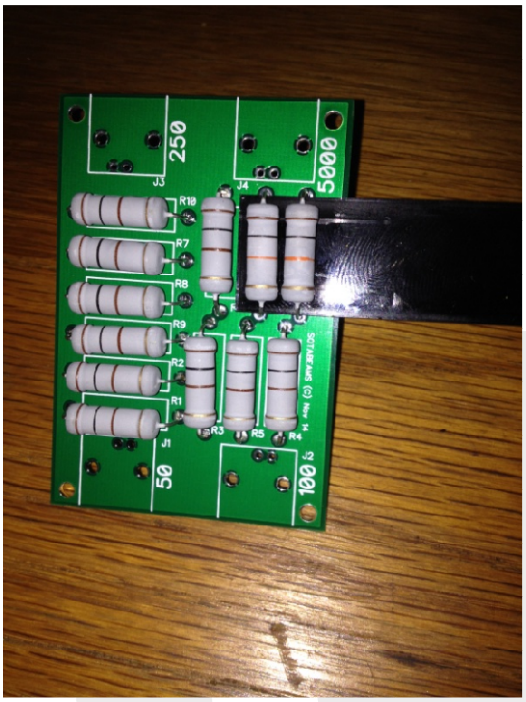
6. Repeat the process with resistors R8 and R9; then R2 and R1.



7. Next install R3 R4 and R5 (100 Ohm). Again use the spacer. You can install all three at once this time.

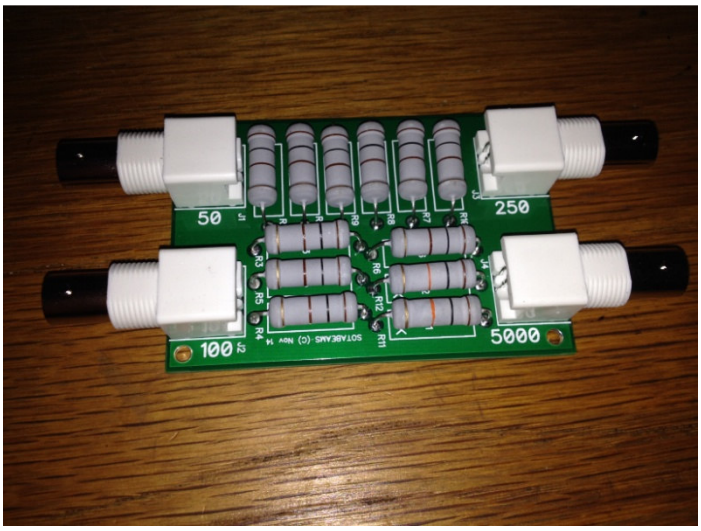
8. You should now have one 100 ohm resistor left. Using the spacer install this resistor in position R6.

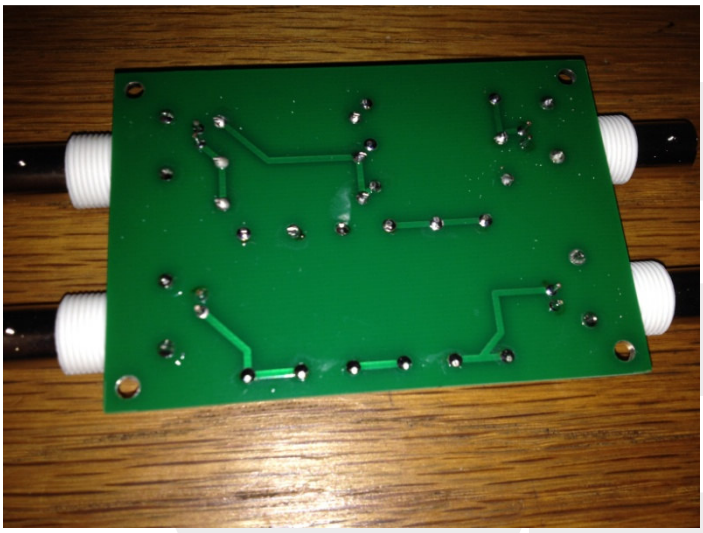
9. Finally, using the spacer, install R11 and R12 (10 k Ohms – brown-black-orange).



This completes installation of the load resistors.

10. Clip the four BNC sockets into position and solder them in place. Be careful when soldering the connection pins. they are close together and it is easy to get solder bridges between them.





This completes the construction of the PCB.

Optional enclosure instructions

1. If you have the BOX-TEST enclosure kit, located the BOX-TEST laser cut front panels.

2. Check the edges of panels are smooth. In the event that there are sharp edges, file smooth.

3. If the panels have been supplied with protective masking paper or plastic in place, carefully remove this.

4. The panels can be polished with a soft cotton cloth and alcohol or water before installation.

5. Install the front panel (labelled BOX-TEST 5 Watts HF) so that the 50 Ohm and 100 Ohm BNC sockets poke through the correct holes and the engraving is on the outside of the panel.

6. Attach the panel to the BNC sockets using a serrated washer and nut on each BNC socket. Do not tighten the nuts at this stage.

7. Stick the four self adhesive feet on the bottom of the aluminium box – this is the plain side, the top has milled grooves.

8. Slide the completed PCB into the enclosure in the bottom set of grooves.

9. Using four of the eight self-tapping screws, screw the panel into the enclosure. If the holes do not line up, check that the PCB is in the correct grooves.

DO NOT OVERTIGHTEN THE SCREWS – if you do so you may crack the plastic panel.

10. Slide the remaining plastic panel over the 250/5000 Ohm BNCs. Screw in the four self tapping screws and finally attach the BNC sockets to the panel using a serrated washer and nut on each BNC.

11. Tighten all four nuts on the BNC sockets.

Your BOXA-TEST is now ready to test.

Testing

Using a multi-meter, check that the resistance measured across each BNC is correct

(+/- 5%).

Your BOXA-TEST is good to go!

Fault finding

The most likely problem on this board is a poor solder joint on the resistors. If the resistance that you measure is too high, re-solder these connections.

If you get stuck, send me an e-mail for help! Richard@sotabeams.co.uk

Use

The BOXA-TEST is useful for several tasks around the shack.

Testing antenna analysers

Check antenna analysers using the 50, 100 and 250 Ohms. Connect the analyser to the BOXA-TEST via a short lead. It should read 1:1, 2:1 and 5:1 when connected to the loads. If you connect your antenna analyser to the 5,000 Ohm load it should indicate a very high VSWR. Very few antenna analysers can accurately measure such a high VSWR.

You can also use the BOX-TEST as a quick way to test the calibration of network analysers. Note however that the BOX-TEST should not be used to calibrate a network analyser; this must be done with precision loads.

Testing and calibrating VSWR bridges

Using a transmitter (5 Watts) you can check VSWR bridge. This is useful for checking their calibration over a wide range of frequencies.

Transmitter testing

For transmitter testing you can use the 5 Watt 50 Ohm load. Using a dummy load in this way means that you are not radiating a signal. It is the best way to tune up a transmitter and to check your transmitted signal without casing interference to other stations.

The other load resistances can be a useful test of PA stability.

Comparing antenna tuners

The BOXA-TEST is useful for testing and comparing antenna tuners. For example to compare two 80-10m tuners start on 80m and see which loads the tuners will match. One way of doing this would be to use a table something like the one below.

Key

Green = VSWR better than 2:1

Yellow = VSWR between 2:1 and 3:1.

Red = VSWR > 3:1

..of course you can do it your way!

Example tuner comparison test table

	Tuner 1				Tuner 2			
Band	100Ω	250 Ω	5000 Ω		100Ω	250 Ω	5000 Ω	
80								
40								
30								
20								
17								
15								
10								

Testing end-fed half-wave tuners

End-fed half-wave antennas have a high impedance and most general purpose tuners will not match them reliably. The BOX-TEST (5,000 Ohms) is useful for testing EFHW tuners as this is a good simulation of the end impedance of an EFHW antenna.

Measuring cable loss

Use the BOXA-TEST to measure cable loss by connecting the 250 Ohm load to the end of a cable and measuring the VSWR at the other end. The following table converts VSWR to cable loss. Great for seeing if your cable deteriorates with time!

Cable loss (dB)	VSWR
0.0	5.0
0.5	3.9
1.0	3.3
1.5	2.8
2.0	2.5
2.5	2.2
3.0	2.0
3.5	1.9
4.0	1.7
4.5	1.6
5.0	1.5
5.5	1.5
6.0	1.4

Testing RF transformers

Use the loads to test RF transformers. For example if you connect the BOXA-TEST (250 Ohms) to one end of a 4:1 un-un, the impedance should be transformed to 250/4 = 62.5 Ohms = VSWR 1.25:1