

AA2 Kit Construction 1

The **HOWES AA2** is an RF preamplifier and impedance converting module designed to enable the user to construct an active receiving antenna that can produce similar results to much larger conventional antennas.

Brief Specification

Input Impedance- High impedance FET (field effect transistor) input stage, with VHF choke.

Output Impedance: Nominal 50 Ohm, unbalanced.

Power Requirements: 12 to 14V DC. The module will draw approx. 25mA from the supply.

Frequency range: 150kHz to 30MHz (long, medium and shortwave bands).

Tools Required:

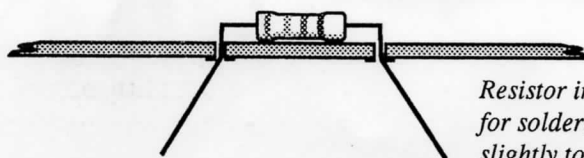
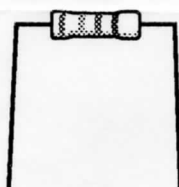
Fine tipped soldering iron of about 30W (or if thermostatically controlled, 50 or 60W). Long nosed pliers, small side cutters, and a sharp knife for scraping off coil insulation ready for soldering.

Please read all the paperwork through at least once, before starting work.

Building The Kit

It's best to wind and varnish the VHF choke, L2 first. This can then be drying while you get on with building the rest of the kit. Refer to the Parts List for winding details. Assembly of the board (PCB) itself starts with the fitting of the terminal pins. These are fitted to the holes with circles round them. Refer to the Parts List page for details of where they go. The pins are inserted from the wiring (foil) side of the board and stick out of the component (with printed parts locations) side of the board. Insert the pins by hand, then resting the board over the edge of the bench, use a hot soldering iron and just a touch of solder to press them firmly home, flush into the board. **Be careful** not to slip with the hot iron as you do this.

Resistor with leads bent ready for insertion into PCB



Resistor inserted into PCB ready for soldering. Note leads bent out slightly to hold resistor in place.

Resistors

Next fit the resistors. Refer to the parts list, select the first resistor, bend its leads as shown in the diagram, and insert it into the PCB in the location marked for it on the board. Now bend the leads out just enough to prevent it falling out of the board, making sure the body of the component is resting on the board as shown. You can now solder the resistor's leads to the tracks on the board. Refer to the notes on soldering, if you are new to this.

With a few of the joints being quite close together in this compact module, it is best to visually check the component's track and where it leads to, before soldering the joint. Then check it again after soldering, to make sure you haven't "bridged" any solder across to a nearby track or joint. The most expert constructor can experience this problem, so it is worth taking the trouble to check for this as you make each joint. It is much nicer when something works first time! When you have fitted the first resistor, cut the excess length of lead off as close to the joint as you can (without removing the joint itself!). Do not cut leads to length, until they have been soldered. When this is done, select the next resistor from the Parts List, and solder this in its rightful place on the board. Continue with fitting the resistors until they are all soldered in position.

Axial Inductor

When all the resistors are in place, fit the inductor L3. This looks rather like a fat resistor, but has an overall blue or green background colour. There are two of these in the kit (one is for the coax powering option).

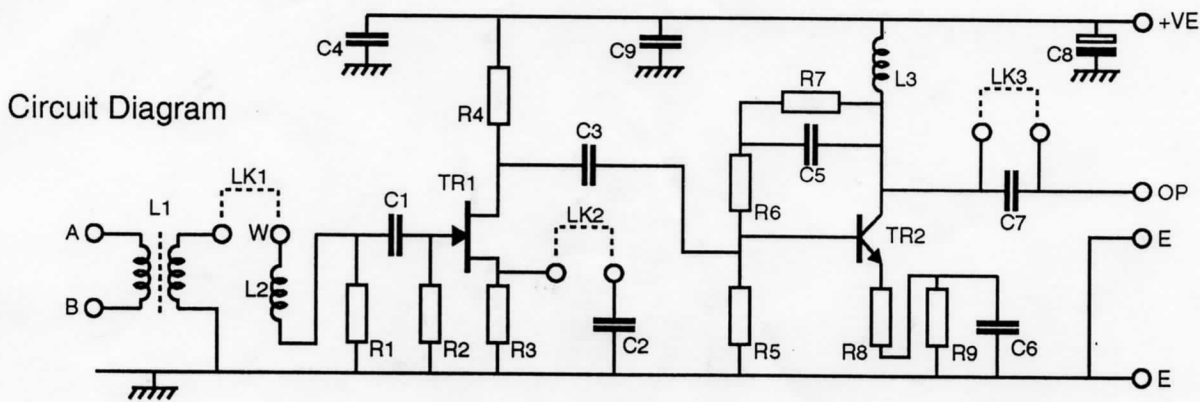
Capacitors

Fit the capacitors next. Keep the leads short, and make sure you fit C8 the right way round.

HOWES

(Continued)

AA2 Circuit Diagram and Notes on Soldering



Links

Link the terminal pins together with a short wire (offcut capacitor lead etc.) as required to configure the various options.

LK1 - fit link for dipole antenna.

LK2 - Gain select link. Gain is at maximum with link fitted.

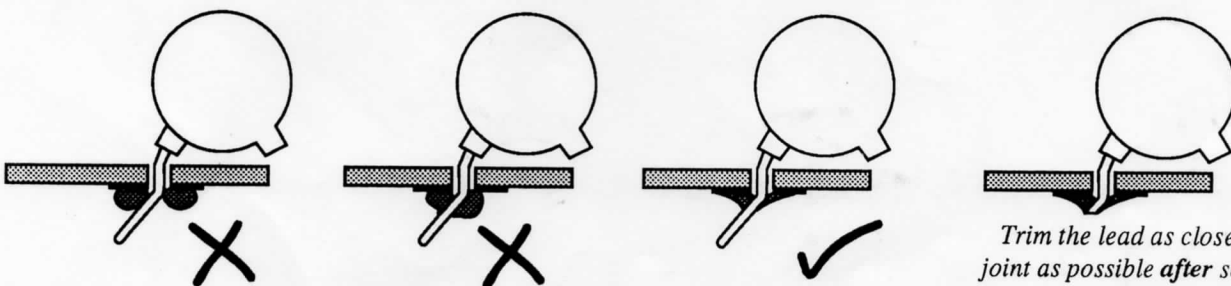
LK3 - Fit for coax powered module only.

Testing the module with RF test equipment

The AA2 has a high input impedance and a nominal 50Ω output. If you have access to RF test equipment and use a 50Ω signal source and 50Ω measuring device to test the module, you may at first glance have the illusion of seeing very little gain – remember the AA2 does not have a 50Ω input impedance – the gain is there, you just have to remember the theory! Test equipment is normally calibrated for a constant impedance system, the difference between the input impedance of the AA2 and 50Ω is the equivalent of a lot of dBs! The easiest way to see if the unit is working, is to connect up the pick-up wire as shown in the instructions, and feed the output to a receiver or spectrum analyser.

Soldering Information.

To solder properly, you must use the correct type of iron, and the right quality of solder. Use a small tipped soldering iron of about 30 Watts (unless it is a thermostatically controlled device, when a 50 or 60W item is recommended). Do not use an underpowered iron on this kit, as it will not enable the solder to flow freely on the larger areas of copper on the PCB. Only use electronic type multi-cored solder. *Never* use any extra flux.



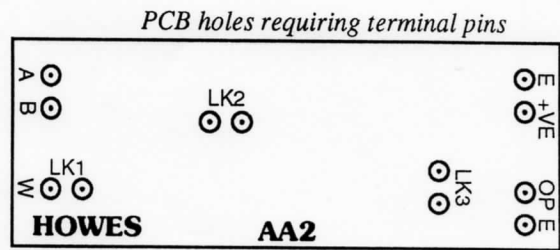
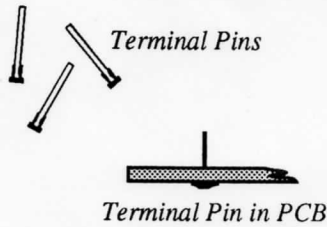
Trim the lead as close to the joint as possible after soldering

You should hold the hot iron in contact with both the lead and track for about a second or so, to heat them up. Then, keeping the iron in place, touch the solder onto the junction of lead, track and iron, and wait for a further second or so for the solder to flow along the lead and track to form a good joint. Don't use too much solder, just enough to flow right round the lead covering the PCB hole completely. Now remove the iron from the joint. The iron should have been in contact with the work piece for a total time of about four seconds in all.

AA2 Parts List

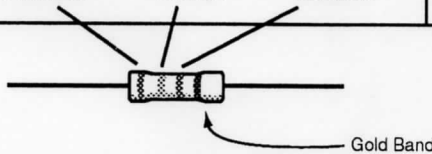
Terminal Pins

These are fitted to the holes shown in the diagram (12 pins in all). These holes all have circles printed around them on the PCB.



Resistors

Part No.	Value	Colour Code			Fitted	Checked
R1	1M5	Brown	Green	Green		
R2	82k	Grey	Red	Orange		
R3	330R	Orange	Orange	Brown		
R4	1k2	Brown	Red	Red		
R5	270R	Red	Violet	Brown		
R6	270R	Red	Violet	Brown		
R7	2k2	Red	Red	Red		
R8	10R	Brown	Black	Black		
R9	47R	Yellow	Violet	Black		



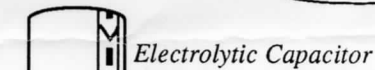
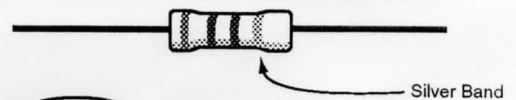
Capacitors

Value	Marking Information	Part Numbers
1nF	marked 102	C1
.01µF	marked 103	C2 C3 C4 C5 C6 C7
.1µF	marked 104	C9
100µF	marked 100µF	C8*

* Make sure you fit C8 the right way round. The long lead goes to the hole marked "+". The minus signs on the side of the device indicate the lead going to the hole marked "-" on the PCB.

Axial Inductor L3

This looks rather like a resistor.



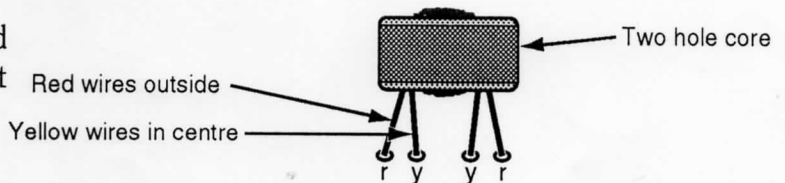
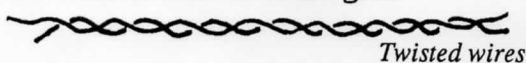
Transistors

TR1 is a BF245 (FET) fit this as the outline on the board indicates. Keep the leads short. The type number is marked on the device.

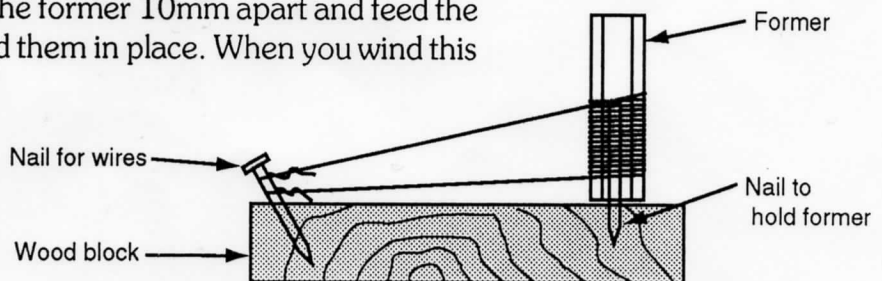
TR2 is a special RF power transistor type 2N4427. Fit the plastic spacer bush to its leads, so that it is exactly the right height above the PCB.

Inductors

L1. Twist the red and yellow wires together, and wind three turns on the two hole balun core. Fit it to the PCB as shown on the right:-



L2. This has 25 turns of enamelled wire. Make a simple winding jig with a couple of nails and a block of wood and varnish the wire to hold it in place. Alternatively, if you have a 1mm PCB drill you can drill two holes through the former 10mm apart and feed the ends of the wires through the holes to hold them in place. When you wind this coil make sure the winding is near one end of the former, rather than in the centre, or the former could obstruct the LK1 terminal pins when fitted to the board. This former replaces the original form, as it is more robust.



AA2 Module Wiring (continued)

Coax Powering the Module

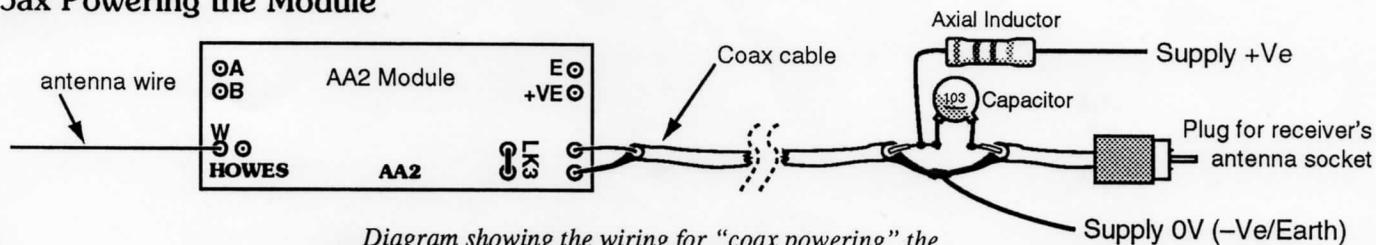


Diagram showing the wiring for "coax powering" the AA2 module. Note LK3 link made on module.

Coax powering the AA2 module is a convenient way of doing things when the antenna is mounted remotely, in the loft, on a mast etc. It saves having a separate set of power leads going to the module. The power is fed up the same coax as is used for the signals coming from the unit. This requires a small additional circuit at the receiver end to separate the DC voltage from the signals. The parts for this are provided with the kit (an axial inductor - colour coded Red Red Brown Silver and a capacitor marked 103).

Suggested Construction

The AA2 is a very versatile unit, and can be used to build many types of active antenna installation. It has been designed so that it can fit within standard 1.5" plastic water pipe, this enables a straightforward way of building a waterproof antenna for outside use (see diagram below right). Plastic pipe and fittings are available quite cheaply at any good DIY shop. Don't just tape up the ends of the pipe though - birds tend to rip insulating tape to bits!

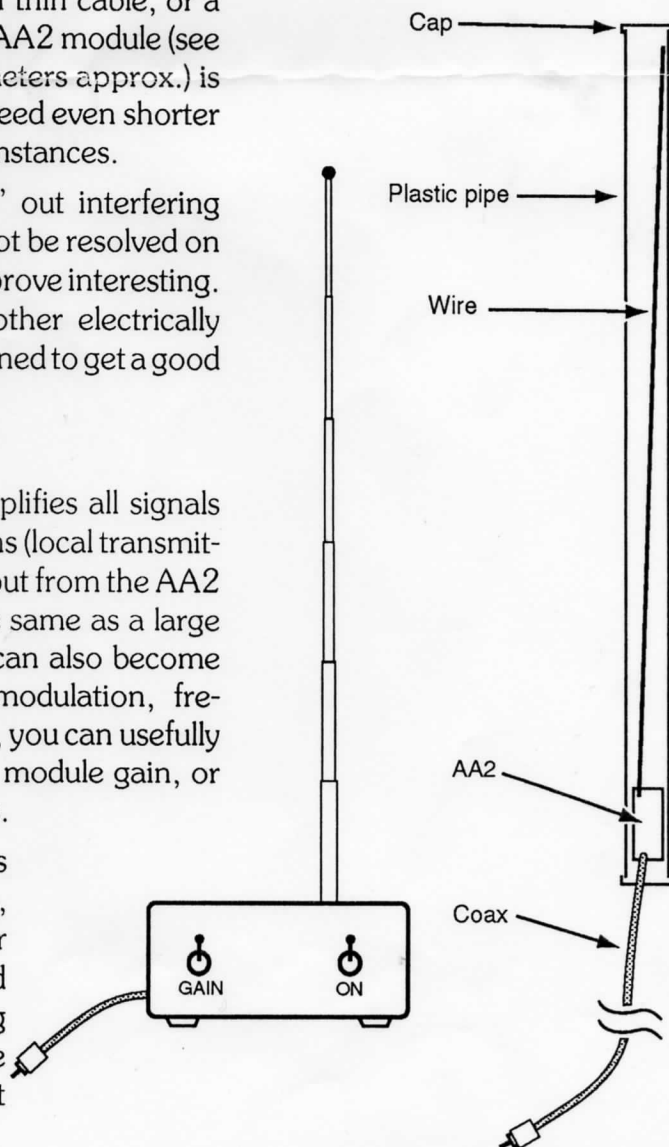
Indoors the antenna wire itself can be simply a piece of thin cable, or a telescopic whip type mounted on a case containing the AA2 module (see illustration). A wire length of up to six to eight feet (2 meters approx.) is recommended. This can be experimented with, and indeed even shorter antennas can be used quite successfully in many circumstances.

A short rotary dipole offers the opportunity to "null" out interfering signals, and therefore be able to hear stations that can not be resolved on fixed antennas. Experiments along these lines may well prove interesting. Note: you do need to site the antenna away from other electrically conducting items and have the coax down lead well screened to get a good result.

User Information.

The AA2 is a broad-band preamp unit. As such it amplifies all signals within its frequency range. Under strong signal conditions (local transmitter, night time propagation around 7MHz etc.), the output from the AA2 module can be so great as to overload the receiver (the same as a large wire antenna would do), and indeed the module itself can also become overloaded under these circumstances. When intermodulation, frequency doubling and other symptoms of overload occur, you can usefully remove (or switch) link LK2 on the PCB to reduce the module gain, or reduce the antenna length to decrease the signal levels.

Keep the AA2 away from local sources of interference as far as you can. Electric motors, heating thermostats, computers, televisions, fluorescent lights and many other items can produce electrical noise which can be radiated from the item itself, and also from the mains wiring going to the equipment. If you find you are picking up noise from any item, you may find it worthwhile to experiment with the siting of the antenna.



AA2 Kit Construction 2

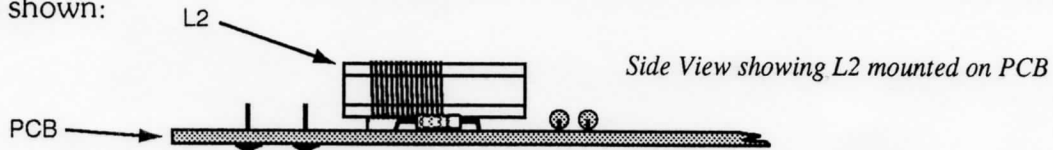
Semiconductors

When the capacitors are in place, fit the two transistors. These must go in the board the correct way round as the printed outlines indicate. TR2 has a plastic spacer to hold it off the board just the correct distance. Slide this onto the leads before inserting them into the board.

Inductors

The next job is to wind L1 and fit it to the board, the coloured wires going to the appropriate holes (r for red, y for yellow). Be careful as you remove the insulation from the ends of the wire for soldering, that you don't "nick" the conductor, or it might fracture later. See the Parts List page for more details.

L2 is the last item to solder in place. When the varnish is dry, insert the leads into the PCB and lay the choke along the board as shown:



Using a sharp knife, scrape the insulation off the leads where they emerge from the holes ready for soldering. Tin the coil leads first (apply some solder to the leads), and then solder them to the PCB tracks. Check you get a good joint here with well tinned leads. These L2 connections are probably the most likely to suffer a "dry joint" (bad connection).

Your AA2 module is now complete, and you can wire it up for testing. BUT, before you do this, please check over the parts placement and the solder joints first. This isn't a complex kit, and with a little care, it should work first time.

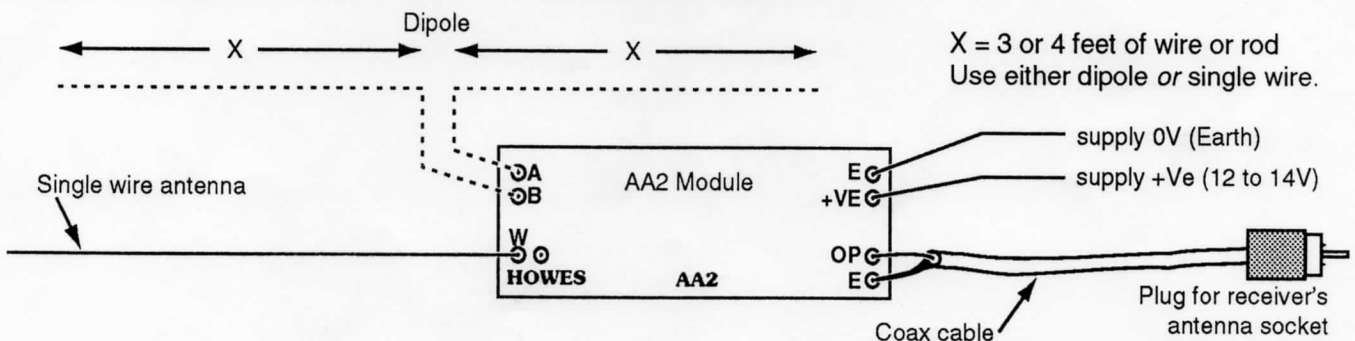
Module Wiring Information

When the module has been assembled, it can be wired up as shown in the diagram. Decide if the unit is going to be powered via a separate set of DC power leads, or powered by means of the output coax. Solder a linking wire (an offcut capacitor lead) between the terminal pins marked "LK3" if you are going to use coaxial powering. Do not do this if you are going to use direct powering of the module.

Antenna wire/rod

We recommend the use of a 6 to 8 feet (about 2m) overall length of wire or metal rod as the signal pick-up element for use with the AA2. This wire or rod must connect directly to the module, not via coax cable. Use either a single wire or the dipole option depending on mechanical convenience for your project. The single wire input will give better results on longwave, but there is little difference on shortwave bands.

Direct Powering. (see next sheet for coax powering diagram)



Linking link "LK2" increases the gain of the module, and will be useful under many circumstances. However the extra gain may cause overloading of the receiver, or indeed the AA2 module, under some strong signal conditions. You can fit a switch to alter the gain setting, provided you keep the leads very short (not more than an inch, 25mm or so). Link LK1 is wired up if a dipole antenna is going to be used, rather than a single wire.