Product Review

INAC AH-1430 Loop Antenna

Reviewed by Peter Hartfield VK3PH

Photo 1: The loop backyard portable.

When I was asked by the editor if I had some time to review a magnetic loop antenna, I jumped at the opportunity. Where I'm located in Lysterfield Victoria on the edge of Melbourne's eastern suburbs, the noise floor on HF is generally prohibitive (S9+). I heard that loop antennas are just the thing for a lower noise threshold and they are also good value where you have limited space available (both positives at my location).

This loop was supplied by Frank Woolfe of Long Distance Telecommunications in Port Augusta South Australia. These products are sourced from INAC in Spain where they have a range of loops to suit different band and power requirements. Frank shipped me an INAC AH-1430 which is designed for the 20, 17, 15, 12 and 10 m bands (14 to 30 MHz).

When he advised me that the loop had shipped, I waited with careful anticipation. Within 2 days the box arrived, it was unpacked and I had it setup in the backyard on a portable aluminium tripod, see Photo 1. The package dimensions are 950 x 800 x 150 mm and the mass approximately 4.5 kg.

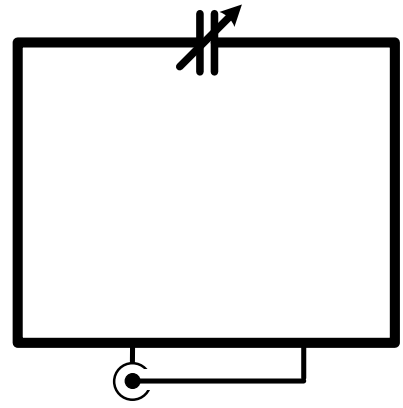

Figure 1: Magnetic loop schematic.

How loops work

Before I get into the analysis, it's prudent to provide a brief overview

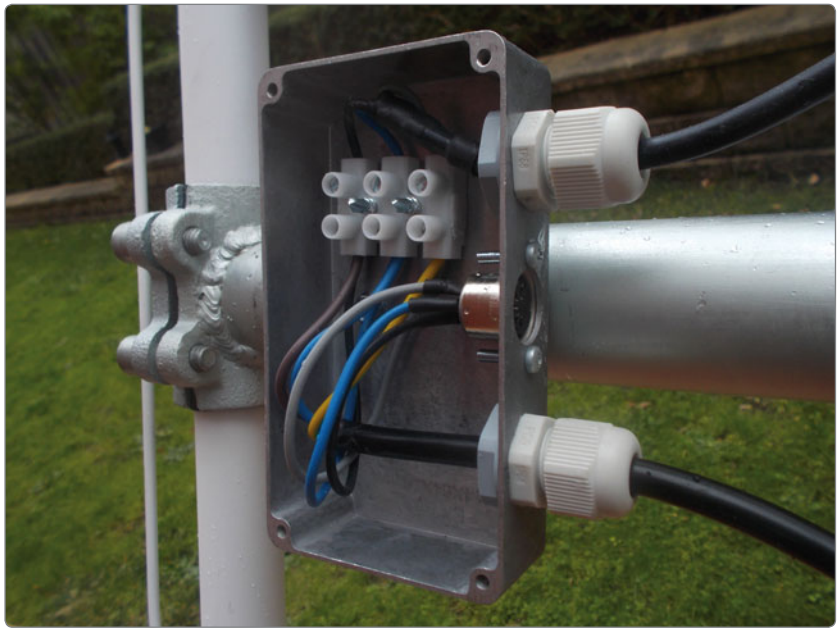

Photo 2: The connection box.

of how these loops work. A loop antenna is built using a loop of wire, tubing or other type of electrical conductor. There are two distinct types of loop design; the small loop (or magnetic loop) with a size much smaller than a wavelength and the resonant loop with a circumference approximately equal to the wavelength.

The shape and size of the magnetic loop is not particularly important although most are circular, hexagonal or square and less than one tenth of a wavelength in circumference. See Figure 1 for a schematic. The variable capacitor at the top of the loop is used for tuning and in the case of the AH-1430, is controlled by a remote servo-motor mounted inside the plastic coupler box. The coaxial feed-line is connected to the loop via a gamma matching rod.

The Q of this antenna is very high. This means that it can only operate efficiently over a narrow frequency range (5-10 kHz typical). Almost every time you change frequency, you will have to change the setting of the variable capacitor. This is done by peaking the capacitor for maximum received noise at the desired operating frequency. If the reflected power is high, the capacitor is tweaked until it's acceptable.

The vertically oriented antenna's figure 8 shaped radiation pattern maximum is in the plane of the loop with nulls at right angles to the plane of the loop. Vertical oriented loops function perfectly well close to ground level. When horizontally mounted, the antenna pattern is omnidirectional with nulls straight up and straight down. This orientation is very uncommon.

Construction

The INAC AH-1430 is constructed from aluminium, copper, steel and PVC plastic. The main loop is constructed from 20 mm copper tubing with a steel mounting bracket provided (with 40 mm clamping diameter). The variable capacitor and servo-motors are encased in a cylindrical PVC housing at the top of the loop. The tuning control cable is connected via a die-cast box and the cable to the servo-motors is run inside the copper pipe.

The coaxial feed-line is connected via a PL259 socket mounted at the base of the copper tube. The kit came with a 5 m control cable with 5 pin male DIN connectors on each end. This is sufficient for portable use however, for a more permanent installation a longer cable will be required. I wired a 3 conductor cable, 10 m in length into the control box via the plastic ferrule provided. INAC supplied a terminal block with 3 core cable connected to a 5 pin male DIN plug for this purpose.

The only issue I see with this design is that the 5 pin DIN socket on the connection box is exposed to the weather. I suggest that INAC should have provided a rubber seal to cover the DIN socket for a more permanent installation even though it's on the bottom of the box. See Photo 2.

The loop dimensions are 79 x 63 cm, an overall height of 98 cm with the mounting bracket installed. INAC provide the hex key required to install the bracket.

Specifications

The specifications for the loop vary depending on the model, the one I was provided (AH-1430) has the following electrical specifications (according to the manual):

Frequency range: 10.000 MHz to 29.900 MHz
Input impedance: 50 Ω
SWR: 1.2:1

Frequency	Power	Bandwidth (-3 dB)	Gain over Dipole
10 MHz	140 W (PEP)	60 kHz	-5.7 dB
16 MHz	140 W (PEP)	90 kHz	-3.8 dB
22 MHz	160 W (PEP)	120 kHz	-2.1 dB
24 MHz	180 W (PEP)	140 kHz	-1.8 dB
30 MHz	210 W (PEP)	160 kHz	-0.9 dB

The above conflicts with the specifications given on the INAC web site which say that the AH-1430 has the following electrical specifications:

Frequency range: 13.800 MHz to 30.000 MHz
Input impedance: 50 Ω
SWR: better than 1.5:1
Power: from 140 W to 210 W depending on the frequency
Gain: from -0.9 dB to -5.7 dB depending on the frequency

Manuals

I found the manuals a little difficult to read as some of the key points get lost in translation. They do however, provide the basic information you need to get the loop installed and working. There are two manuals; one for the loop and the other for the loop control unit.

The loop manual provides topics such as a description of the antenna, most notable features (including the specifications), where to place the antenna, how to adjust the antenna and standard warranty information.

The loop control unit manual provides the technical specifications (see below), circuit diagram, component layout diagram and discussion about various servo-motors.

The technical specifications for the loop controller are as follows:

Supply voltage: 9 to 15 VDC
Current: 1.5 A at 13.8 V
Fuse: 3 A
Main drive rotation: 270°
Operation time: 3 s from 0 to 180°
Servomotor rotation: 190°
Unit size: 70 (W) x 45 (H) x 125 (D) mm

Initial testing

The initial testing was performed with the loop mounted on an aluminium tripod in the backyard approximately 1.5 m off the ground (see Photo 1).

I used a YouKits FG-01 (1 to 60 MHz) antenna analyser to take the following measurements:

		Test 1		Test 2	
Frequency	**Band**	**SWR**	**Impedance**	**SWR**	**Impedance**
32.200 MHz		1.3:1	62 Ω	1.3:1	64 Ω
29.900 MHz	10 m	1.4:1	55 Ω	1.2:1	56 Ω
28.500 MHz	10 m	1.2:1	58 Ω	1.3:1	56 Ω
24.900 MHz	12 m	1.4:1	33 Ω	1.5:1	30 Ω
21.200 MHz	15 m	2.1:1	83 Ω	1.8:1	78 Ω
18.100 MHz	17 m	1.7:1	70 Ω	1.3:1	50 Ω
14.100 MHz	20 m	1.3:1	64 Ω	1.6:1	44 Ω
12.000 MHz		1.7:1	68 Ω	3.8:1	127 Ω

The SWR can generally be improved on most frequencies however, I found both the course and fine adjustment to be rather sensitive. The frequency range of the loop supplied is 12.000 to 32.200 MHz with an SWR of better than 1.5:1 achievable on all of the amateur bands (10, 12, 15, 17 and 20 m).

Photo 3: The 20 m band measurement.

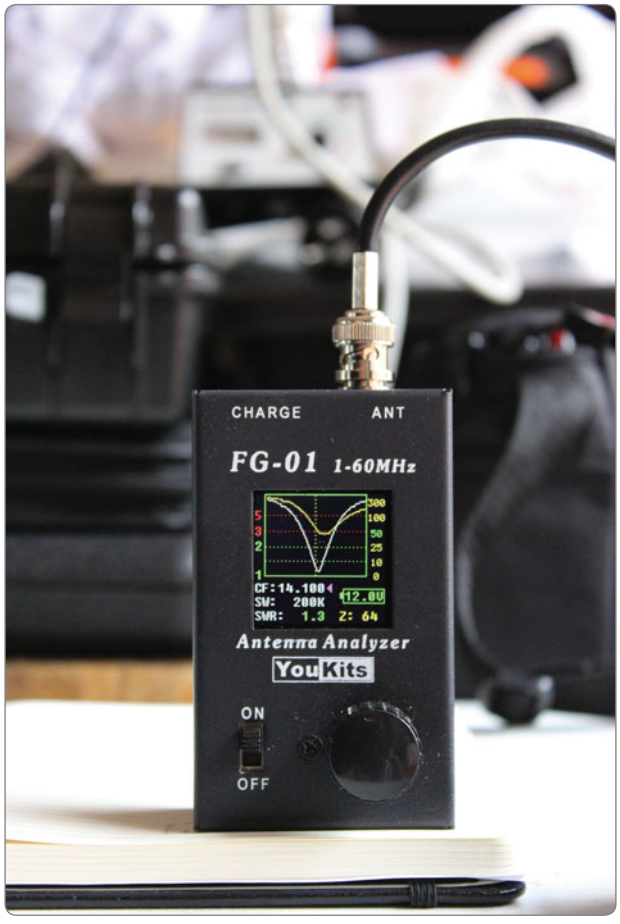

Photo 4: The 10 m band measurement.

The bandwidth is very narrow on 14.000 MHz becoming broader as the frequency is increased to 30.000 MHz. See Photo 3 and Photo 4.

Incidentally, Frank reported the following results when he connected an INAC AH-1430 magnetic loop to his HP 8920B RF communications test set:

Frequency	Return loss	VSWR
14.100 MHz	15.00 dB	1.433
14.200 MHz	14.61 dB	1.457
14.300 MHz	13.47 dB	1.538
18.100 MHz	10.75 dB	1.817
21.100 MHz	36.26 dB	1.031
21.200 MHz	24.00 dB	1.135
21.300 MHz	19.17 dB	1.247
24.950 MHz	26.32 dB	1.102
28.100 MHz	12.27 dB	1.644
28.200 MHz	13.57 dB	1.531
29.000 MHz	17.74 dB	1.298
29.500 MHz	18.53 dB	1.269
30.000 MHz	18.50 dB	1.270

Installation

The next step was to install the loop on a mast in the backyard so that I could do some comparison with a dipole and a multi-band vertical. I dropped the loop into my light duty rotator and mounted the whole lot on top of a 6 m portable mast. See Photo 5.

This was a fairly easy proposition as the mast tilts over into the backyard. I connected 10 m of coax and 2 x 10 m of 3 core flex (one for the rotator controller and the other for the loop tuner). The loop tuning control cable was connected via the spare plastic ferule, see Photo 2 and at the other end via the adaptor provided (3 terminal block to 5 pin DIN connector – see Photo 6).

Then I set up a table out the back under the pergola to test the loop on air. The setup consists of rotator controller, Yaesu FT-857D, MFJ antenna tuner (really only to measure the forward and reflected power), the INAC loop tuner and 2 batteries (one for the loop and the other to power the radio), see Photo 7.

Photo 5: The loop mounted on a mast.

On air

I'm located in a fairly noisy area for HF although the first thing I noticed was that the base noise level was lower on the loop than either the dipole or the vertical. This was most pronounced on 20 m, about 1 to 2 S points below the conventional antennas. The difference was not so great on the higher bands. Now comparing signals is a little hard when DX is fading in and out however the signal to noise was noticeably better on the loop than on the dipole or vertical.

Rotating the antenna didn't seem to make much difference for the DX signals. There was some noticeable directionality when listening to local signals (they could be almost nulled-out by turning the loop). The noise is obviously emanating from every angle at my location as turning the loop had no impact on the noise floor.

Reports from stations in Europe on 20 m were 59 on all three antennas so it's reasonable to assume that the small compact loop antenna performs equally as well as a half wave dipole or vertical. I didn't get much of a chance to test it on the other bands as there weren't many openings at the time of testing.

Conclusion

I would certainly recommend one of these for anyone that has space restrictions or single source noise problems on HF at their location. I found the loop easy to install and operate, although the tuning unit was a little sensitive at times. Portable operation is a breeze as the loop fits neatly into the car boot

Photo 6: Terminal block to 5 pin DIN connector.

Photo 7: The portable on-air setup.

and will sit on top of a lightweight tripod without too much worry. The AH-1430 performs well on all amateur bands 20, 17, 15, 12 and 10 m (14 to 30 MHz).

The loop has a very narrow bandwidth on 20 m and almost certainly requires retuning if you change frequency. That's when the remote tuning control comes in handy. It has a much broader bandwidth on the 10 m band. The documentation is good (enough to get you started) and additional information can be found on the INAC web site.

The only problem now I have finished the review is that I have to send it back! Thanks to Frank Woolfe of Long Distance Telecommunications in Port Augusta South Australia for supplying the loop for review.