73 Review

by Joe Holman KA7LDN and Garth Hitchens KG7GA

The IsoLoop™ HF Antenna

Small, efficient and portable.

Advanced Electronic Applications, Inc.
PO Box 2160
2006-196th Street
Lynnwood WA 98036-0918
Tel. (206) 775-7373
Price Class: $350

If you enjoy portable HF operation, need an antenna that can be quickly set up for emergency situations, or just plain live in an apartment or tight space that doesn't allow large antennas, AEA might have the answer for you. Their IsoLoop antenna is a 32-inch-square tuned loop antenna designed to operate from 14 MHz to 30 MHz. It's compact enough to be placed in small areas, such as your attic or your outside deck. We operated with the antenna in an attic, bedroom, radio room, on top of a building, on a deck, and on the ground (mounted on a 6-foot mast).

You can mount the IsoLoop either vertically or horizontally. We had good results working DX from the Seattle area when the IsoLoop in the antenna was mounted in the horizontal plane. We worked New Zealand, Argentina, the USSR, and many other countries. When the IsoLoop was mounted in the vertical plane we worked Japan, Australia, the UK, and other countries. The radiation characteristics of the antenna are quite different between the two orientations.

Documentation

AEA provides a 16-page manual with the IsoLoop. The manual begins with a description of the features, theory of operation, and the specifications of the antenna.

Most of the manual is dedicated to assembling, mounting, and tuning the antenna. It includes three separate diagrams that are drawn very well and labeled so that any amateur can identify the parts.

The manual also provides four radiation field patterns corresponding to how you have the antenna mounted. One shows the radiation pattern if the antenna is mounted vertically; the latter three show radiation patterns if the antenna is mounted horizontally at half-wave length, quarter-wave length, or close to the ground. At the end of the manual there is a schematic diagram and a parts pictorial of the LC-1, plus the wire pinouts for the LC-1 Loop Controller.

Quality of Construction

The overall construction of the IsoLoop is very good. The aluminum section of the antenna consists of about ¾-inch aluminum tubing which is very strong and durable. The motor section of the antenna is encased in a plastic shield that gives great protection from the rain.

Photo A. The IsoLoop.

The two sides of the rain shield are attached with 14 snap rivets. The snap rivets can be removed very easily in case you need to take the rain shield off to examine the motor mechanism. Also, the rain shield has a couple of small holes in the bottom to drain out any accumulated moisture.

The two separate sections of the antenna are held in place by two couplers which tighten down on the aluminum tubing. In between the couplers, a bar is placed for mounting the antenna on a tripod. The bar is made of wood encased by Fiberglas™.

The Fiberglas seems to be the weakest part of the construction of the antenna. We noticed some minor cracking near the couplers after we tightened them to the bar, even though we were relatively careful to follow the instructions against over-tightening. Because the Fiberglas covers a wood core, the structural integrity of the antenna is not affected.

Theory of Operation

A very popular myth of amateur radio antenna theory states that "bigger is better," and that small antennas cannot ever hope to approach the performance of a full-sized antenna. Proponents of this myth sometimes cite reasoning such as "the capture area is smaller," and therefore a smaller antenna "captures" less signal. The flaws in this reasoning are not particularly obvious and are well beyond the scope of this review. For now, let it suffice to say that the efficiency of an antenna is not dependent upon its size, but upon its losses.

A full-sized resonant antenna (dipole or vertical) has a "radiation resistance" of about 50–75 ohms. Any power dissipated by this resistance is radiated as a signal. Because the resistance of the antenna conductors (loss resistance) is usually very low, often below 1 ohm, a full-sized antenna is very efficient. Most of the power is dissipated by the radiation resistance (as signal) and very little is lost to the resistance in the antenna conductors.

When an antenna is considerably shortened, the radiation resistance drops dramatically and the feed impedance becomes capacitive. To match such an antenna to a 50 ohm transmitter, a series inductor (commonly known as a "loading coil") is required to tune out the capacitance of the shortened antenna. Because a significantly shortened antenna has a much lower radiation resistance, the losses of the loading coil become very significant and the antenna's efficiency is reduced dramatically.

The IsoLoop takes a very different approach to solving this problem. A shortened loop also has a very low radiation resistance, but its feed impedance is inductive. By forming a parallel resonant circuit with a tunable low-loss capacitor, and minimizing any and all resistive losses, it is possible to

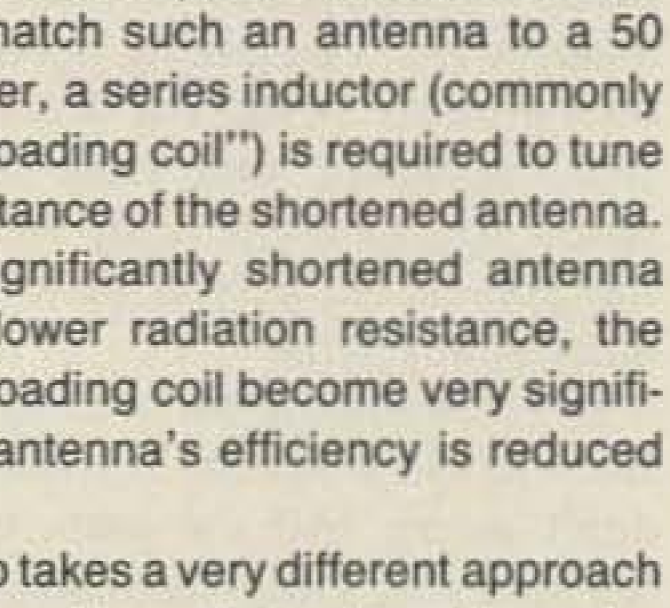

Photo B. The LC-1 control box.

get very high efficiencies. Small transmitting loops have been around for quite a while, having been used by the army for portable operation in Southeast Asia. Ted Hart W5QJR describes the more recent versions in *The ARRL Antenna Book*.

What is new about the IsoLoop is that AEA has used patented techniques to reduce loss without resorting to expensive techniques such as vacuum variable capacitors. This has made the IsoLoop remarkably cost effective.

Mounting

The IsoLoop is primarily designed to be mounted in a horizontal configuration. This provides an omnidirectional radiation pattern with maximum radiation aimed at relatively low angles for good DX performance.

When mounted horizontally, the vertical radiation pattern of the IsoLoop is affected by its height above ground. When it is very close to the ground, maximum radiation is concentrated around 30 degrees. As the antenna is raised, the lobe becomes lower, down to 20 degrees at a quarter-wavelength above ground, and around 13 degrees at a half-wavelength. Like a dipole, the higher the antenna is mounted, the lower the angle of radiation and the better the DX performance. Radiation from the horizontally mounted IsoLoop is horizontally polarized.

The IsoLoop can also be mounted vertically. This provides a completely different characteristic, easily visualized as a vertical doughnut oriented in the plane of the loop (radiation at all vertical angles in the plane of the loop). Nulls in the pattern exist at low radiation angles perpendicular to the plane of the loop, corresponding to the "hole" in the doughnut.

Vertical orientation can be useful for two reasons. First, the "holes" in the pattern can be used to null-out interfering stations. Second, at low heights above ground, better performance at low radiation angles may be obtained. The radiation is vertically polarized in this position.

In either configuration, special attention must be paid to the "dressing" of the feedline and control cable. These must be routed as directly as possible toward the center of the loop, where they are fed through the mast. If this is not done, antenna performance will be affected, and large amounts of RF can be induced onto the cabling, causing feed-line radiation and a "hot" radio chassis.

When the IsoLoop is correctly assembled and installed, closely following the directions and cautions in the manual, feedline radiation is basically nonexistent.

Usage

The tuning of the IsoLoop is remotely controlled by the LC-1 Loop Controller. (See Photo B.) The LC-1 controls a stepper motor which is coupled to the large air-dielectric tuning capacitor mounted in the antenna, allowing the loop to be tuned for any frequency in the 14–30 MHz range.

AEA supplies a 50 foot shielded control cable which connects between the remote tuning box and the IsoLoop (a 100' control cable is available as an option). A small AC adapter (included, domestic only) powers the LC-1.

The LC-1 has two controls: a dual-position momentary contact toggle switch, which selects either forward or backward tuning, and a dial which sets the tuning speed. To tune to a particular portion of the band, turn the speed control to full speed, and push the tuning switch in either direction, then wait for a noise peak in the receiver. After hearing the noise peak (up to about 15 seconds, depending on where you were previously tuned), slow the tuning speed down, and use the forward/reverse switch to manipulate the noise peak until it is the loudest. After maximizing the noise peak, you sometimes need to retune the antenna slightly in order to get SWR down to 1.5:1 or less while transmitting.

Once tuned, the loop is usable over a fairly small bandwidth (from about 15 to 75 kHz, depending on the band) before the SWR gets high enough (2:1) that retuning is necessary. At this point, retuning is easier. Simply click the tuning switch in the appropriate direction to move the stepper motor one or two steps while watching the SWR. Generally, it takes 20 to 30 seconds to tune the IsoLoop to be usable on a different band, and 5 to 10 seconds to tune it to a different portion of the same band.

Tuning the LC-1 Loop Controller can be tricky if you don't read the documentation. The documentation gives good instructions on how to control the speed of the controller and how to get your SWR as low as possible.

Performance Test Set-Up

We compared the performance of the AEA IsoLoop against a Cushcraft R5 half-wave vertical (all bands) and a full-sized attic dipole on 10 and 20 meters. The R5 was chosen as it covers the same set of bands as the IsoLoop, is in (roughly) the same price range, and has a similar radiation pattern. AEA's literature makes comparisons with a dipole, and suggests the attic as a possible mounting place for their antenna, making an attic dipole a natural comparison antenna as well.

Most of the tests against the R5 were done using tripods and temporary masts on the flat roof of an industrial building on a hill. We performed tests against the attic dipole in an attic relatively free of metal structures—wood framed with cedar shingles—and on dry days to minimize the effects of a damp roof. The R5 was present at these tests as well, being ground-mounted outside the house.

We also tested the IsoLoop in various other locations, including a sun deck about 10 feet off of the ground, on a mast on the ground, and on the roof of a house. The loop was also tested in both the vertical and horizontal configurations in many of these locations.

The transceivers used for testing included a Yaesu FT-767GX, an ICOM IC-741, and a Ten-Tec Omni-V. Cabling for most tests was through Belden RG-213/U or Belden 9913.

Initial Results

We worked a number of stations on 10, 15 and 20 meters on a variety of days, both DX and stateside. On 20 and 10 meters the IsoLoop was consistently 3–4 S-units below the R5, and 2–3 S-units below the attic dipole, both on receive and transmit. Fifteen meter comparisons showed slightly better performance, narrowing the gap between the antennas one S-unit or so.

This didn't seem right so we contacted Mike Lamb of AEA. He told us that we likely had a problem with the connection of the two halves of the antenna. Following his instructions, we used emery cloth to clean the ends of the aluminum tubing, then firmly tightened the couplers which connect them.

The difference was dramatic. The antenna was now generally on a par with our reference antennas. As it turned out, the poor connection between the two antenna halves had introduced enough resistance to cause a lot of power loss in the connection. AEA has updated the manual to include instructions on how to circumvent this problem.

More Test Results

Once we had the IsoLoop working correctly we again performed a series of tests. With the IsoLoop mounted horizontally, 34 feet above ground, the signal strengths (both received and reported) on average were approximately equal to the attic dipole on 10 and 20 meters, with both antennas at similar heights. In some cases one antenna or the other would have an edge, likely depending on the angle of radiation required to make the contact.

Comparing the antenna with the R5 gave similar results. In general, the ground-mounted R5 had a very slight edge in signal strength, but it was more susceptible to noise pickup. Signals from low angles were generally within 1 S-unit on the meter when comparing the two.

Under ideal conditions, with both antennas a half-wavelength above ground and no surrounding structures, the antenna appears to average within one sixth of an S-unit (1 dB) of a dipole on 10 meters, and within half an S-unit (3 dB) or so on 20 meters. Neither of these differences are easily readable on an S-meter, and the IsoLoop has less noise pickup.

When mounted vertically, the IsoLoop seemed much less dependent upon mounting height, and performed rather well even when mounted only several feet above the ground.

Table 1. Specifications

Frequency coverage	14 to 30 MHz
Nominal impedance	50 ohms
Power rating	150 watts
VSWR	< 1.4:1 (no nearby objects)
Temperature range	0 to 50 degrees Celsius operating −50 to 60 degrees Celsius storage
Dimensions	32 inches square
Max. mast diameter	1¼ inches
Shipping weight	12 pounds
Coax connector	UHF (SO-239)
Gain	Approximately that of a dipole
LC-1 power	12 VDC (adapter included, North America only)
Ant. tuner required?	No
Warranty	90 days, requires receipt

When mounted at a half-wavelength above ground, however, the DX performance was noticeably better in the horizontal orientation.

Noise Rejection

One interesting characteristic of the IsoLoop is that for signals received equally on the reference antennas and the IsoLoop, the background noise was generally lower on the IsoLoop.

On the roof of the industrial building, a number of signals that were hard to copy on the R5 vertical because of industrial RFI were very easily copied on the IsoLoop. This was likely due to the horizontal polarization of the IsoLoop's radiation pattern, combined with the tight bandpass which helps prevent receiver front-end overload by out of band QRM.

Even when compared to a horizontal antenna, the geometry of the loop seems less likely to be susceptible to atmospheric noise pickup than a dipole. Although this results in a signal-to-noise improvement in receiving, it of course has no effect on the transmitted signal.

Things We Liked

SIZE: The IsoLoop is only about 32 inches on a side, and square. This is the smallest HF antenna we've ever used, and it fits easily in most attics, although one must be careful to keep it in the clear and out of the range of (two to three feet away from) nearby conductive objects which will detune it.

PORTABILITY: The antenna is very easy to set up and take down. It only took us 10 minutes or so to install the antenna on a temporary mast and tripod on a flat rooftop.

NOISE REJECTION: The tight bandpass of the IsoLoop effectively improves the front-end selectivity of the receiver. The loop design and horizontal polarization seem to help filter out local QRM under many conditions.

Things We Didn't Like

RETUNING: No matter how you cut it, having to retune the antenna frequently as you tune across a band is tedious. If you tune while transmitting to get a good SWR reading, you are wasting spectrum space and possibly causing QRM.

POWER HANDLING: This antenna only handles 150 watts. Don't expect to use it with a linear—you would fry the air-dielectric variable capacitor.

We believe you will be pleasantly surprised, as we were, with the operating characteristics of the IsoLoop. Overall, we found that the IsoLoop performs quite comparably to a dipole or vertical. We definitely recommend it to any amateur who needs a small or portable antenna. 73

Joe Holman KA7LDN and Garth Hitchens KG7GA can be contacted at P.O. Box 37, Redmond WA 98073-0037.