RF-PRO-1B®
Active Magnetic Loop Antenna

DXE-RF-PRO-1B
DXE-RF-PRO-1B-INS Revision 0c

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Introduction

The DX Engineering rotatable **DXE-RF-PRO-1B** Active Magnetic Loop Antenna is designed for reception of signals over the range of 100 kHz to 30 MHz. The RF-PRO-1B® can be mounted to a pole, mast or any flat surface. The included very high dynamic-range low-noise preamplifier is designed for minimum intermodulation distortion in the presence of very high-level signals that would normally overload most preamplifiers. This rotatable loop antenna is **receive ONLY**.

Features

- Same technology and quality as Pixel Technologies and InLogis loop antennas
- Unique Loop architecture provides enhanced performance
- Magnetic loop that rejects near field electrical noise
- Up to 30 dB rejection of locally radiated noise compared to whip antennas
- Figure eight directivity and deep nulls to further reduce interference from local or distant signals
- Very low IMD, 27 dB Low-Noise Clifton Laboratories Norton Preamp insures good performance in both strong and weak signal environments
- Useable coverage range: 100 kHz to 30 MHz
- Rejects power line noise
- Rugged construction, easily mounts to a pole or flat vertical surface, 3/4 inch dia. aluminum loop, supplied with preamplifier, power inserter and DC power supply
- No manual tuning necessary
- No Home Owners Association problems; low profile, easy to camouflage and works at a few feet above ground level
- Modular design for easy installation and maintenance
- Internal transmit / receive relay disconnects the antenna / preamplifier from receiver when transmitting

Antenna Design

The RF-PRO-1B® Loop Antenna consists of a rigid 3/4 inch diameter light-weight aluminum loop and a balanced broadband preamplifier that is housed in a separate enclosure mounted close to the antenna on its mast bracket. A 20 volt DC regulated power inserter unit is provided. The antenna and preamplifier has been designed to permit the use of 75 ohm cable (RG-6 is recommended and is available from DX Engineering). For best results the antenna should be positioned a minimum of 15 feet away from any buildings or other sources of interference. The loop antenna may be rotated to take advantage of the directional properties of this type of antenna.
Not Your Father’s Loop Antenna

Based on the work of Dr. Carl Baum for the U.S. Air Force his “Moebius Strip Shielded Magnetic Loop Antenna” architecture outperforms much larger antennas. Dr. Baum was a Senior Scientist at the U.S. Air Force Research Laboratory and is the recipient of several awards from the IEEE (Institute of Electrical and Electronic Engineers) for his work.

Developed for a classified U.S. Air Force project involving the measurement of EMP (Electro Magnetic Pulse) from nuclear weapons, this loop design has wide application to antennas for low-noise, interference-free radio reception over a wide frequency range. The designer of this magnetic loop antenna version coupled this antenna to a custom made low-noise preamplifier originally developed by Clifton Laboratories.

Magnetic Loop Antenna Advantages

Most active antennas are the whip type and respond mainly to the electrostatic-field portion of an electro-magnetic radio wave. This Magnetic Loop responds primarily to the magnetic-field and this ensures high rejection of nearby electric-fields. The intensity of the electric field is usually higher than the magnetic-field when an antenna is close to interference sources such as TVs, florescent lamps, power line wiring, etc. By rejecting the electric-field there is a reduction in local interference compared to other types of active and passive antennas. Interference reduction is further enhanced by the deep nulls of the antenna’s 'Figure-Eight' directivity pattern that can be used to null out or reduce interference coming from a specific local or distant direction. The electrical field is often much stronger than the magnetic field. When lined up properly the loop will enable better copy for weak signals which could not be copied by other antennas.

Intermodulation

Some active antennas generate intermodulation products which can appear as spurious signals interfering with reception. This interference or second and third order intermodulation is caused by non linearity in the preamplifier, producing signals which are usually the sum and difference of strong stations and their harmonics. The RF-PRO-1B® Loop (DXE-RF-PRO-1B) has been specifically designed to reduce intermodulation products to a minimum. The third order intercept point is typically +48 dBm (OIP3) and the second order intercept point is greater than +100 dBm (OIP2 typically 110 dBm). The 1 dB compression point of this preamplifier is +27 dBm making the levels of the intermodulation products generally far below the atmospheric and man-made noise.
Cautions:
- This is a **Receive-Only Rotatable Antenna**. Do not connect it to a transmitter as it will be damaged and void your warranty
- **Do not inadvertently connect the (To Preamp) +20 VDC output of the power inserter to your receiver’s antenna input as your receiver may be damaged**
- When operating with nearby transmitting antennas, follow the instructions to avoid overdriving (or damaging) your receiver’s input or damaging the loop’s low-noise preamplifier

General Information

Positioning the Antenna

This antenna has a directional ‘Figure Eight’ pattern with two deep 25-30 dB nulls, so for maximum daytime low-angle ground wave reception of a desired signal it should be oriented so that the plane of the loop rests perpendicular to the ground and should, if extended, pass through the general location of the signal’s transmitter. At night, for reception of high-angle sky waves this antenna is less directional and the nulls are far less prominent.

To take advantage of the directivity of this antenna, it should be mounted on a light duty rotator. For best results it should be located as far away as possible from any metal objects that could distort or shield the antenna’s reception like gutters, downpipes, metal plumbing and aluminum foil backed thermal insulation. It can be positioned indoors or outdoors at least 5 feet above ground level, but for best results it should be as far as possible from sources of interference such as AC power cables, cat 5 network cables, fluorescent lights, light dimmers, computers and flat panel TV’s. If located outdoors it can be camouflaged with shrubbery. Ideally, a location outdoors at least 20 feet away from any buildings will yield superior results. It can be mounted to a pole or attached to a flat surface or wall via the included L-bracket and clamps.

Cable

For best results the coaxial cable run from the indoor power inserter to the external preamplifier should be shielded RG-6 cable with male F connectors on each end. RG-6 cable is available from DX Engineering along with high-quality compression fit water-proof F-connectors that have internal O-rings to keep moisture out.
Use with Near-By Transmitting Antennas

The antenna’s low-noise preamplifier will withstand RF input levels of at least 30 dBm without failure. In tests with a 1,500 Watt transmit RF amplifier and a ¼-wave vertical transmitting antenna it was found that the worst-case loop output power into the preamp was 10 dBm when the antenna was located 25 ft from a vertical radiator and adjusted for maximum coupling. This would indicate that at 25 ft separation, there is a 20 dB safety margin for the preamplifier. The other factor to consider is, with this kind of input signal (+10 dBm), the preamplifier’s 27 dB gain will cause it to saturate and output 1.3 watts into the connected receiver. This high saturated output level is a byproduct of the excellent intermodulation distortion performance of this preamplifier.

While most receivers have some sort of input protection and possibly an internal transmit / receive switch that disconnects or shorts the input when transmitting, we cannot be sure of the radio’s protection limits and DX Engineering cannot be responsible for any damage that may result. Therefore, included in the loop’s power inserter is a relay “KEY” jack that can be actuated by the amplifier keying output of a typical transceiver. When actuated, the relay disconnects power to the antenna preamplifier. A green LED on the power inserter is illuminated when power is applied to the preamplifier. An RCA-plug to RCA-plug cable is included with the accessories to connect the KEY output of your transceiver to the RCA jack on the side of the power inserter. An RCA Y-adapter is also included to enable connecting the KEY signal from your transceiver to other equipment. It is the user’s responsibility to ensure proper keying line connections.

The diagram below shows an Icom IC-7600. Your radio set may differ. Consult your radio instruction manual for details when using a separate receive antenna input.
The relay’s actuation circuit is designed to operate with a typical transceiver’s “KEY” signal. The power inserter has internal DIP switches that can be programmed to harmonize relay actuation with the proper state of the transceiver’s KEY signal.

The default setting is such that when the KEY output is “low” (less than 0.7 VDC) the relay turns on and disconnects the preamplifier’s power and the connection to your receiver is grounded through a resistor. If the KEY signal is “high” or greater than 1.2 VDC the relay is not actuated and power is applied to the preamplifier and connection is made to your receiver. If the KEY input to the power inserter is left open or disconnected, then power is always applied to the preamp.

If your transceiver has a “KEY” output that goes high on transmit, then you can reverse the polarity of the power inserter relay actuation by removing the power inserter’s base plate and programming the DIP switches on the PC board in accordance with the table shown.

<table>
<thead>
<tr>
<th>KEY INPUT</th>
<th>Switch 1</th>
<th>Switch 2</th>
<th>20 VDC ANTENNA POWER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Off</td>
<td>On</td>
<td>Off</td>
</tr>
<tr>
<td>High</td>
<td>Off</td>
<td>On</td>
<td>On</td>
</tr>
<tr>
<td>Low</td>
<td>On</td>
<td>Off</td>
<td>On</td>
</tr>
<tr>
<td>High</td>
<td>On</td>
<td>Off</td>
<td>Off</td>
</tr>
</tbody>
</table>

A simplified schematic of the relay interface circuit is shown. Note that the KEY input is pulled up internally via a 10K ohm resistor to the “high” state.
The loop antenna aluminum tubing must not be grounded. It must remain electrically isolated from its metal L-bracket mount via nylon shoulder washers. **Do not** remove these insulating shoulder washers.

**Mounting to a Rotator**

The picture shows the RF-PRO-1B® Magnetic Loop Antenna mounted to a customer supplied rotator using customer supplied mast.

Many users utilize this configuration to take full advantage of the antenna’s directional characteristics.

Because of the antenna’s low weight and wind loading a very low power rotator can be used typical of the type used with TV antennas (A light duty rotator is available from DX Engineering).

*Hint:* When installing the one foot jumper with F connectors (or any cables with F connectors), the optional **DXE-CIT-1** F Connector Tightening Tool is handy to have in your tool box.
Overall Diagram

This diagram shows the overall wiring scheme. Once familiar with this set up, assembling the antenna and making the actual cable connections is easy.

Be extremely careful to avoid inadvertently connecting the 20 VDC antenna output of the power inserter to the antenna input on your receiver. Although the power inserter has a self-resetting internal fuse that will trip at a current draw above 400 milliamps. Making this connection error will put 20 VDC on the input of your receiver momentarily that could damage some receivers and is not covered by warranty.
Mounting the Preamplifier to the Loop Antenna L-Bracket

The preamplifier is mounted to the L-bracket that is attached to the loop antenna using the included saddle clamp and mounting hardware which also connects the antenna to a short 1-1/4” diameter customer supplied mast (that would then normally go into the rotator). Nylon shoulder-washers and nylon flat washers are used to electrically isolate the metal case of the preamplifier from the mounting pole as shown below. This is required to avoid ground loops. The upper saddle clamp uses the regular hardware (serrated flange hex nut) as shown in the pictures below. The use of Jet-Lube SS-30 anti-seize (JTL-12555) is recommended for all hardware to avoid galling.

The loop antenna and the preamplifier have small weep holes in that face downward to drain any condensation that may accumulate internally. A one foot RG-6 jumper cable is supplied to connect the output of the loop antenna to the input of the preamplifier. When looping this RG-6 jumper, ensure the loop does not rub against the saddle clamp hardware.
Waterproofing F Connectors & Weather Proofing

The included one foot long RG-6 coaxial cable jumper is used to connect the output of the loop to the preamplifier. This cable uses specially designed F-connectors to eliminate moisture ingress. A package of coax seal and electrical tape is supplied for additional weatherproofing.

The coax seal can be cut into strips to make it easier to wrap around the connectors. It is suggested that the electrical tape be used first, then wrap and knead together the coax seal to provide a complete water resistant seal. The reason for using the electrical tape first is when a cable has to be removed, the coax seal can be completely removed and not leave sealing residue on the connector threads.

Power Inserter

The preamplifier’s output is connected to the 20 VDC output of the power inserter via the customer supplied lead-in RG-6 cable. If a lightning protector is used in this coaxial line, it must be capable of passing DC. The power inserter contains a highly filtered linear DC regulator with an internal self resetting fuse that provides protection from short circuits. It is designed for indoor use only. The wall mount transformer provides 24 VAC for the power supply. A PL-259 to type F Connector adapter is provided for the radios that may require it.

RF-PRO-1B® Specifications

- Frequency response: 100 kHz to 30 MHz (Nominal Gain: 27 dB ±3 dB)
- DC power: 20 volts at 240 mA
- OIP3: typically +48 dBm
- OIP2: > 100 dBm (typically 110 dBm)
- 1 dB compression point: +27 dBm
- NF: typically 2 dB (at 10 MHz)
- Antenna Diameter: 38 inches
- Antenna Weight: 3 lbs.
**RF-PRO-1B® Parts List**

<table>
<thead>
<tr>
<th>QTY</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Loop Antenna with L-Bracket</td>
</tr>
<tr>
<td>1</td>
<td>Preamplifier</td>
</tr>
<tr>
<td>2</td>
<td>Saddle Clamps with U-Bolts and Mounting Hardware</td>
</tr>
<tr>
<td>1</td>
<td>Package of Preamplifier Mounting Hardware</td>
</tr>
<tr>
<td>1</td>
<td>Coax Seal package</td>
</tr>
<tr>
<td>1</td>
<td>Roll of Electrical Tape</td>
</tr>
<tr>
<td>1</td>
<td>24 VAC Wall Mount Transformer</td>
</tr>
<tr>
<td>1</td>
<td>3 foot F-male to F-male jumper cable</td>
</tr>
<tr>
<td>1</td>
<td>1 foot F-male to F-male jumper cable</td>
</tr>
<tr>
<td>1</td>
<td>PL-259 to F Connector Adapter</td>
</tr>
<tr>
<td>1</td>
<td>20 VDC Power Inserter</td>
</tr>
<tr>
<td>1</td>
<td>RCA to RCA cable</td>
</tr>
<tr>
<td>1</td>
<td>RCA-Y adapter cable</td>
</tr>
</tbody>
</table>

**Manual Updates**

Every effort is made to supply the latest manual revision with each product. Occasionally a manual will be updated between the time your DX Engineering product is shipped and when you receive it. Please check the DX Engineering web site (www.dxengineering.com) for the latest revision manual.
Technical Support

If you have questions about this product, or if you experience difficulties during the installation, contact DX Engineering at (330) 572-3200. You can also e-mail us at:

DXEngineering@DXEngineering.com

For best service, please take a few minutes to review this manual before you call.

Warranty

All products manufactured by DX Engineering are warranted to be free from defects in material and workmanship for a period of one (1) year from date of shipment. DX Engineering’s sole obligation under these warranties shall be to issue credit, repair or replace any item or part thereof which is proved to be other than as warranted; no allowance shall be made for any labor charges of Buyer for replacement of parts, adjustment or repairs, or any other work, unless such charges are authorized in advance by DX Engineering. If DX Engineering’s products are claimed to be defective in material or workmanship, DX Engineering shall, upon prompt notice thereof, issue shipping instructions for return to DX Engineering (transportation-charges prepaid by Buyer). Every such claim for breach of these warranties shall be deemed to be waived by Buyer unless made in writing. The above warranties shall not extend to any products or parts thereof which have been subjected to any misuse or neglect, damaged by accident, rendered defective by reason of improper installation, damaged from severe weather including floods, or abnormal environmental conditions such as prolonged exposure to corrosives or power surges, or by the performance of repairs or alterations outside of our plant, and shall not apply to any goods or parts thereof furnished by Buyer or acquired from others at Buyer’s specifications. In addition, DX Engineering’s warranties do not extend to other equipment and parts manufactured by others except to the extent of the original manufacturer’s warranty to DX Engineering. The obligations under the foregoing warranties are limited to the precise terms thereof. These warranties provide exclusive remedies, expressly in lieu of all other remedies including claims for special or consequential damages. SELLER NEITHER MAKES NOR ASSUMES ANY OTHER WARRANTY WHATSOEVER, WHETHER EXPRESS, STATUTORY, OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS, AND NO PERSON IS AUTHORIZED TO ASSUME FOR DX ENGINEERING ANY OBLIGATION OR LIABILITY NOT STRICTLY IN ACCORDANCE WITH THE FOREGOING.

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