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Greetings Colleagues!

The need to mount bat detectors on towers at heights in excess of 50 meters is one of the common technical problems that must be overcome while designing and implementing effective pre- and post-construction wind site monitoring plans. Difficulties and expense of erecting the support towers aside, the bat researcher is faced with the dilemma of gaining access to the recorded data. Common solutions to this problem have included the use of telescoping towers, microphone extension cables, and FM or other wireless transmission devices. Unfortunately, all of these methods have inherent physical or electronic deficiencies and limitations.

After consultations with wind research colleagues, bat detector manufacturers, and professional audio and video technicians, I would like to share with you the 'balun method,' which is described on the following pages. Please note that Avian Consulting Services is not a representative for any of the equipment discussed herein, nor does it receive a commission or any other form of compensation from the product manufacturers or distributors.

I hope you find this information useful. In the interest of disseminating information that is beneficial to wind site researchers, feel free to copy and distribute this document. Please let me know if you come across any improvements or unique applications to this method.

Regards,

Mike Balistreri

Mike Balistreri
Owner, Avian Consulting Services

The Balun Method: A Simple and Inexpensive Technique to Transmit Bat Detector Output over Long Distances

Baluns

The balun method relies on two electronic balun units to transmit and receive bat detector signals over long distances. A balun is a small transformer that converts an audio or video signal from unbalanced to balanced and vice-versa (hence the term 'bal*un'). By doing so, baluns make the necessary impedance adjustment for audio-visual signal transmission between different wiring systems. The term 'balun' has somewhat confusingly become synonymous with any device that transmits audio and video over structured cabling, regardless of its signal transformation capabilities.

The balun system described here uses two Intelix AVO-A2MINI-WP-F baluns (Figure 1). These baluns are ultra-high performance units designed for applications where audio quality is critical, such as in high-end residential and broadcast systems. Used in pairs, the AVO-A2MINI-WP-F is an effective solution for transmitting two channels of analog audio over structured cabling. As a further advantage, these baluns are self-powered and do not require any internal or external power source. A pair of baluns costs approximately \$100, drop-shipped from the manufacturer. The Intelix units can be ordered through Full Compass Sound. Contact information is given in the Suppliers section at the end of this document.

Technical specifications for the AVO-A2MINI-WP-F from the manufacturer:

Maximum Distance*	2,500 feet
Bandwidth	20 Hz to 20 kHz
Impedance	600 ohms, unbalanced
Isolation	500 V
Nominal Level	1.0 V
Insertion Loss	1 dB
Common Mode Rejection	Greater than 40 dB
Unshielded Twisted Pair	Maximum capacitance: 20 pf/foot
Cabling Specifications (24 gauge or lower solid copper)	Impedance: 100 ohms @ 1 MHz Attenuation: 6.6 dB/1000 ft. @ 1 MHz <i>Cat 5, Cat 5e, Cat 6, Cat 7 compatible</i>
Connectors	One (1) female 1/8" mini jack to one (1) RJ45
RJ45 Pinout	Channel 1 (R): 1 & 2, pair 2 Channel 2 (L): 3 & 6, pair 3
Temperature	Operating: 32 to 131 F (0 to 55 C) Storage: -4 to 185 F (-20 to 85 C) Humidity: up to 95%
Enclosure	Front: standard decora wall plate Rear: metal casing
Dimensions	4.0" x 1.4" x 1.7"
Weight	0.2 lbs (3.2 oz)
Ordering Information	<i>AVO-A2MINI-WP</i> : single AVOA2MINI-WP in bulk packaging
Warranty	Two years

*Distances and signal quality may be affected by cable grade, cable quality, source and destination equipment, RF and electrical interference, and cable patches. Intelix specifications are based on straight-through cabling with standard grade Cat 5.

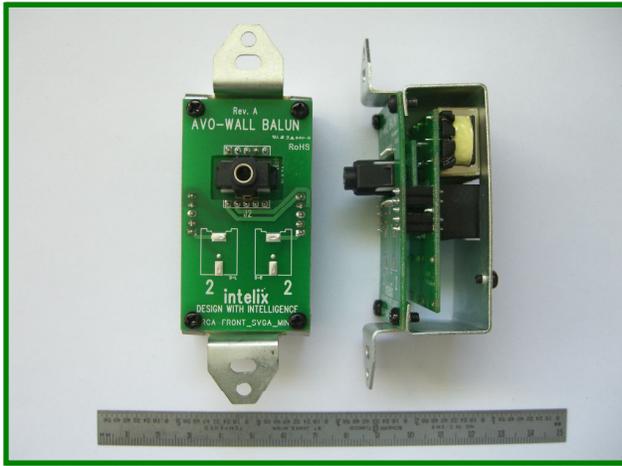


Figure 1. Intelix AVO-A2MINI-WP-F baluns with 3.2 mm female mini-TRS to RJ45 jacks.

Cables

The baluns are designed to work with cables that are typically used to link electronic devices, such as in computer or communications networks. Category 5 cable, commonly referred to as 'Cat 5', is one such cable that is both inexpensive and readily available. If the cable is to be housed within PVC tubing, an interior grade product can be used. Bulk interior Cat 5 cables can be purchased for around \$100 per 300 meters from many local home centers and computer system suppliers. Many suppliers offer interior grade patch cables up to 91 meters that come pre-assembled with RJ45 connectors on each end.

If the cables are to be directly exposed to the elements, an exterior grade product must be used. Direct burial, UV-resistant cables are available from many online suppliers, some of whom offer free shipping. Depending on your location, these cables may be available locally. Exterior grade cables cost about \$160 per 300 meters. If bulk cabling is purchased, you will also need RJ45 connectors and a crimping tool.

The System

Although the system described here uses baluns with 3.2 mm input jacks, Intelix offers a large selection of baluns designed to accommodate a wide range of connectors, including XLR microphone, RCA, BNC, S-video, and others. Suitable adapters could be easily fabricated to accommodate other detector interface connectors, such as the eight-pin design used on Anabat units. A photograph of the balun system in use is given below in Figure 2.



Figure 2. Balun system in use (the device on top of the enclosure is a homemade light sensor).

Tests

To test this system, I constructed an ultrasonic emitter as described in the link given in the Suppliers section. This emitter allowed me to produce ultrasonic signals of relatively consistent frequency and strength. Other equipment used in the tests included the following: Pettersson D240x ultrasonic detector set to time expansion mode, laptop computer running SonoBat Auto Recorder software, 91-meter Cat 5 patch cable, two 0.4-meter stereo extension cables with 3.2 mm male plugs on either end, Raven Lite software, and a 12 volt power supply.

In order to simulate a weak bat call, I lowered the gain on the detector and placed the emitter at the greatest distance from the detector that still permitted signal detection, about 1.5 meters. Twenty reference “calls” were recorded with the bat detector connected to the laptop via one 0.4-meter cable. Following this, 20 test calls were recorded via the two baluns, two shorter patch cables, and the 91-meter Cat 5 cable.

After the recordings were made, waveforms of the 20 reference and 20 test calls were examined using the Raven Lite software. This free software, available from the Cornell Lab of Ornithology, was chosen because it allowed all 20 waveform diagrams to be printed and a single page. This permitted an easy visual match-up of the reference and test calls. This was necessary as the ultrasonic emitter does not produce a constant tone, but rather a repetitive series of varied frequencies. Once the pairings were made, they were analyzed side-by-side in SonoBat. Figures 3–5 show screenshots of three of these comparisons.

As can be seen in the screenshots, there was not any detectable deterioration of the bat detector signal sent through the balun system as compared to the signal recorded directly through the short patch cable. The small acoustic differences that are apparent between the test and reference calls are primarily artifacts of variations caused by the electronics of the ultrasonic emitter.

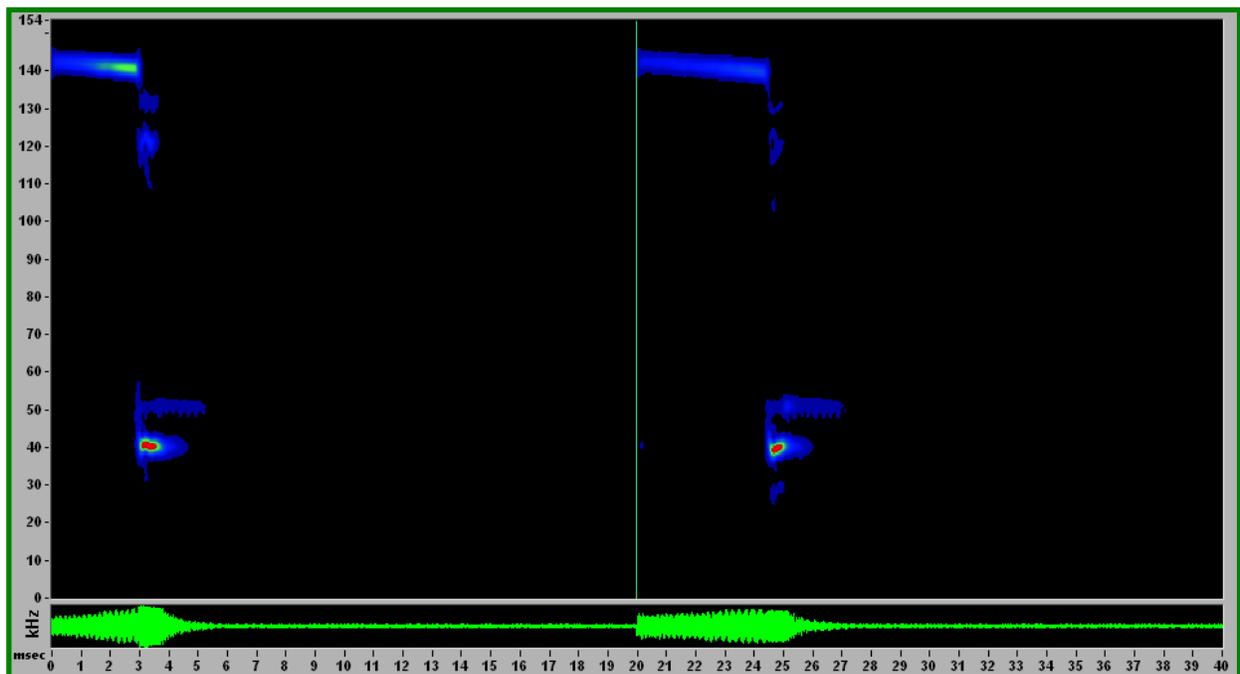


Figure 3. SonoBat screenshot #1 of an ultrasonic signal recorded through a 91-meter Cat 5 cable using the balun system (left), and through a sole 0.4-meter patch cable (right).

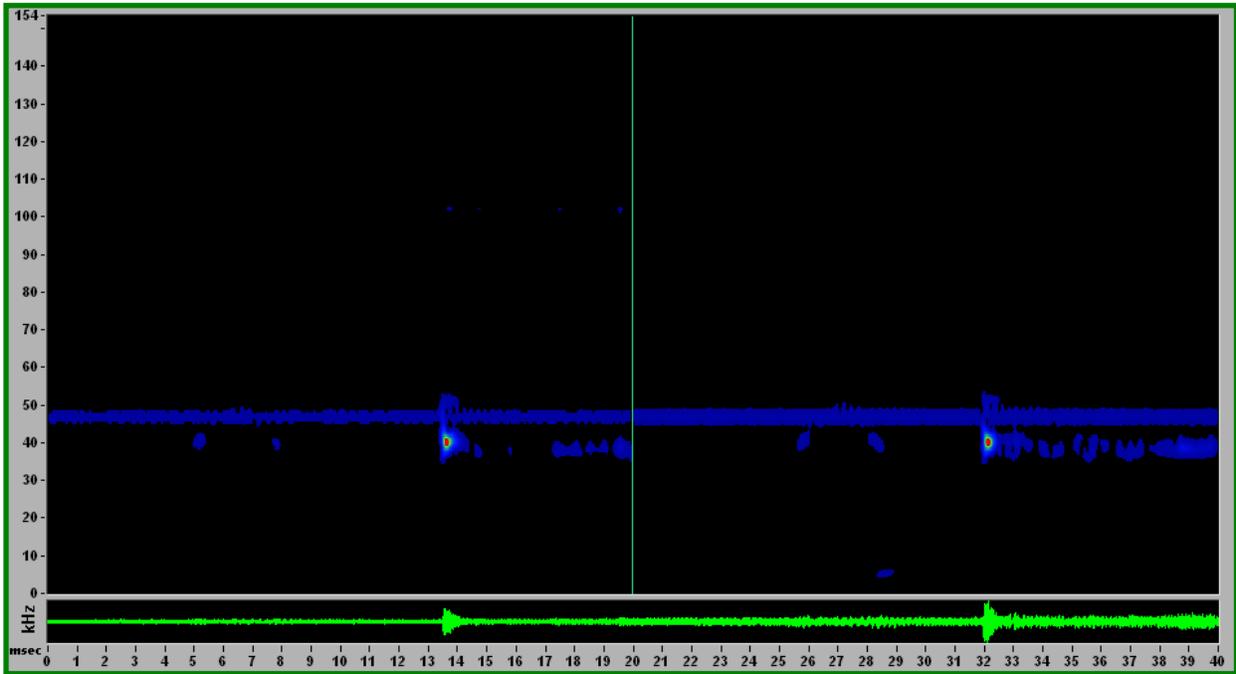


Figure 4. Sonomat screenshot #2 of an ultrasonic signal recorded through a 91-meter Cat 5 cable using the balun system (left), and through a sole 0.4-meter patch cable (right).

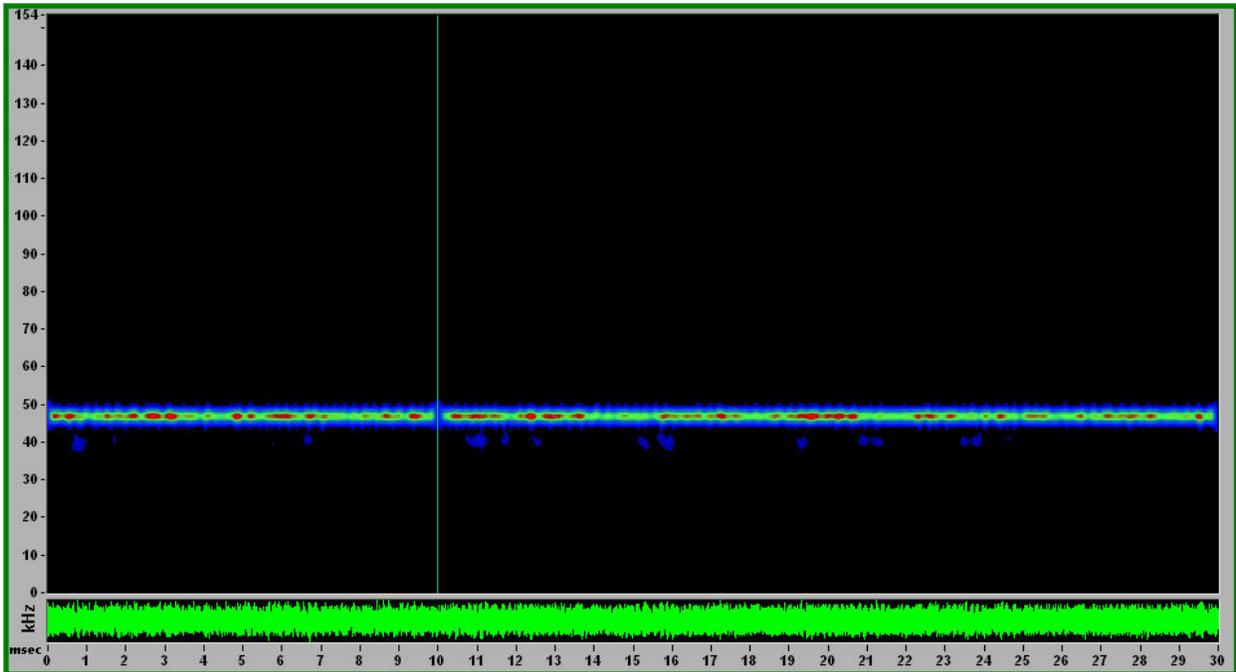


Figure 5. Sonomat screenshot #3 of an ultrasonic signal recorded through a 91-meter Cat 5 cable using the balun system (left), and through a sole 0.4-meter patch cable (right).

Other Advantages

Many bat detector-recorder systems commonly suffer from ground loop interference. This occurs when a detector, which typically runs off of 12 volts, is connected to the same power supply as the recorder, which may run off of four or five volts via a voltage reduction circuitry. This difference in potentials produces an unwanted current that shows up as a low-level background noise on the recordings. This interference can be compensated to some degree by decreasing the input gain on the recorder. However, in doing this, the system becomes less sensitive to the weaker bat calls. The baluns effectively break the ground loop by electronically isolating the detector and recorder, making clean, non-interfered recordings possible.

The system described here is theoretically well suited to a wide range of video and data transmission tasks associated with wind site investigations. The folks at Intelix and Full Compass have been very helpful and are eager to explore unique applications of their products.

Suppliers

Balun Manufacturer

Intelix
2222 Pleasant View Road
Middleton, WI 53562

Cameron Smith
camerons@intelix.com
866-462-8649 ext. 2115
www.intelix.com

Balun Distributor

Full Compass Sound
8001 Terrace Avenue
Middleton, WI 53562

Jason Peterson
jason@fullcompass.com
800-356-5844 ext. 1153
<http://www.fullcompass.com>

Ultrasonic Emitter Plans

I suggest replacing the hex inverter and quad gate with the larger, more easily soldered PDIP equivalents (Mouser #512-MM74HCT04N and #512-MM74HCT08N, respectively).

http://njsas.org/projects/bat_detector/01/batty.html

Electronic Components

Mouser Electronics is an online supplier that does not have any minimum purchase requirements and stocks almost every electronic component imaginable.

<http://www.mouser.com>