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Anabat Bat Detection System: Description and Maintenance Manual

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Abstract

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Anabat bat detection systems record ultrasonic bat calls on cassette tape by using a sophisticated ultrasonic microphone and cassette tape interface. This paper describes equipment setup and some maintenance issues. The layout and function of display panels are presented with special emphasis on how to use this information to trouble-shoot equipment problems. The maintenance section describes opening the equipment, identifying an internal battery, removing panels for maintenance, reinstalling a dislodged light sensor, replacing a broken switch, constructing and replacing a critical battery stack, and making an external power cable. A short discussion on the Anabat software describes how to access, install, and check the Anabat5 program for use with the Anabat equipment. The unit used to access field data collected on a cassette recorder, the zero crossings analysis interface module (ZCAIM), is briefly addressed with a section on how to adjust the tape recorder head skew so that field data can be reproduced accurately on a laboratory recorder. Tips for handling 12-volt rechargeable batteries also are included.

Keywords: Anabat, delay switch, detector, N/S, ultrasonic, ZCAIM.

Contents

Introduction

This paper discusses setup and maintenance of Anabat[1] bat detection equipment used at the Pacific Northwest Research Station, Olympia Forestry Sciences Laboratory (hereafter, Olympia Lab). Elements of the Anabat system are covered, including the Anabat bat detector, the Anabat delay switch, the Anabat ZCAIM (zero crossings analysis interface module), cassette tape recorders, various cables, setup, and two external power supply batteries. Sections describing functional features (including system software, battery maintenance, and cable construction) and some simple repairs and adjustments also are included.

The repair section covers older Anabat units. The manufacturer has recognized problem areas in earlier models and has redesigned later models. The discussion on repair in this paper deals mainly with the Anabat delay switch, the most troublesome part in the unit at the Olympia Lab. The repair section is not meant to be all-inclusive but covers repairs completed at the Olympia Lab. Included are maintenance procedures requiring a minimum of tools that can be accomplished by a person comfortable with electronic and mechanical repairs. Issues that involve troubleshooting at the integrated circuit level are not addressed.

The section on the ZCAIM discusses only a method to check for proper cabling to link a tape recorder or Anabat detector, the ZCAIM module, and a computer printer port. A lengthy manual covering the operation of the Anabat software is available on the Internet (Corben and Titley 1999).

The Anabat units are robust and generally simple to fix. Any Anabat unit not functioning properly should initially be examined to see if it can be repaired on site. A few problems were encountered that were beyond in-house capability to repair. After consultation with the manufacturer, the faulty units were returned to them.

Functional Description of Anabat Components

Overview of the Anabat System

The Olympia Lab's bat detection systems include the Anabat II bat detector, the Anabat II delay switch, a portable cassette tape recorder, two cables, a cassette recorder, D-cell battery pack, and a rechargeable 4- ampere-hour system battery. The detector produces an audible equivalent of the ultrasonic sounds it receives, converts it to an electrical signal, and transmits the converted signal directly to a cassette recorder. The recorder can be operated manually by turning the tape recorder on and off when bat calls are heard to capture ultrasonic bat calls in the field. In unattended operation (used at Olympia), the cassette recorder must be connected to the bat detector through an intermediate device, the delay switch.

The Anabat II delay switch can be connected to both the bat detector and cassette recorder by an appropriate Anabat cable. The delay switch then serves the multiple purposes of taking in ultrasonic data from the bat detector, temporarily storing it, activating the tape recorder and sending the current time information, generating an audio calibration tone, saving ultrasonic data, turning off the recorder, and powering down the bat detector and delay switch to a minimum power draw between bat calls. The remaining components in the Anabat system are peripheral to the detector and delay switch.

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[1] The use of trade or firm names in this publication is for reader information and does not imply endorsement by the U.S. Department of Agriculture of any product or service.

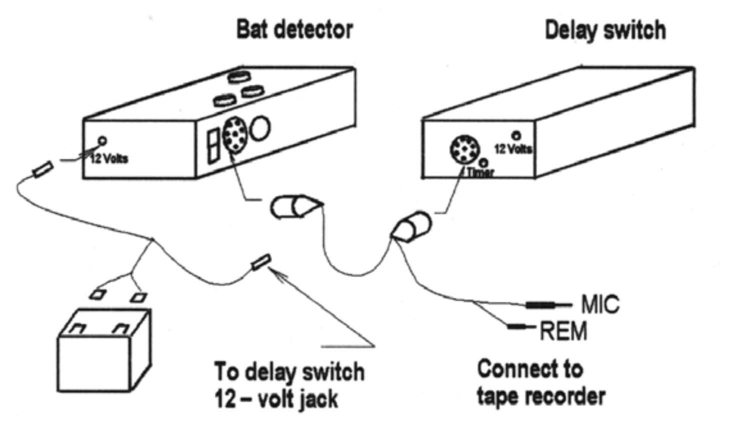

Figure 1—Anabat bat detector, delay switch, battery, and tape recorder cabling system. The round, multiple-pin connectors are labeled to specifically plug into either a detector or delay switch.

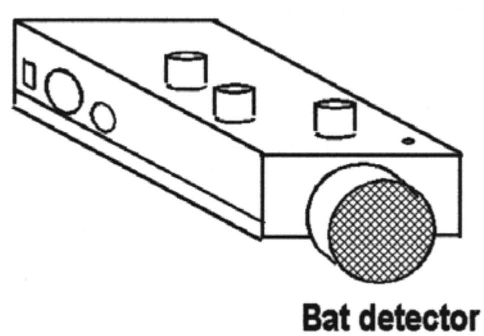

Figure 2—The Anabat bat detector showing the microphone (front); the sensitivity, division ratio, and volume controls (top); and connector jack and timer switch (side). Other controls on the unit, typically used in the stand-alone mode, are not shown in this figure. The unit is about 15 by 10 by 4.5 centimeters (LxWxH).

The detector and delay switch share a common, rechargeable, 4-ampere-hour battery (fig. 1). The battery is connected to the two devices by a common power cable. The Olympia Lab added a secondary battery pack containing two D-cells as part of its system; this power source serves only the cassette recorder.

Anabat Detector Functional Description

The Anabat detector unit contains an ultrasonic microphone, an electronic amplifier, and a digital signal divider. The unit has several controls, switches, jacks, and displays (fig. 2). Rotating control dials for sensitivity, division ratio, and volume are always functional. The “CAL,” “TAPE,” and “MIC” switches (see table 1 for functions of various controls) are not meant to be functional when the detector is used with a delay switch,[2] so they are not shown in figure 2. A 12-volt power jack on the rear of the detector unit is meant for use with an external battery. This jack is a 2.5-millimeter female connector that is center-positive in the circuit. The detector case houses a 9-volt transistor battery, which is bypassed when an external battery is used.[3] The “timer” switch on the side of the unit is used in conjunction with the delay switch to synchronize the bat detector, delay switch operation, and conserve battery power. The timer switch must be turned on during operation (see footnote 2).

Delay Switch Functional Description

The Anabat delay switch synchronizes the Anabat bat detector and the cassette tape recorder. The delay switch has one external control knob, the “OFF-ON-NS” rotary dial switch shown on the front panel in figure 3. This switch allows three states for the delay switch: off, on, and NS (night sensor). In the off setting, the unit is deenergized and not using power. In the on setting, the unit is energized and operating in concert with the bat detector and cassette recorder. In the NS setting, the delay switch is energized but synchronizes bat detector and cassette recorder operation only during periods of darkness. The NS operation is controlled by a light sensor inside the case, about midway between the LCD (liquid crystal display) MODE set button and the word “ON” near the rotary dial switch.[4]

Some of the functions of the front panel light emitting diodes (LEDs) will be familiar to most users, but the purpose of the indicator lamps may not be obvious. Usually, the LCD is diagnostic; it can be used to troubleshoot the time stamp battery. The functions and diagnostic uses of the LEDs and LCD set buttons are detailed in table 1.

External 12-Volt Battery

The Olympia Lab’s Anabat systems are powered with external 12-volt, sealed, lead-acid cells. Typically, Yuasa NP 4-12, 4.0 ampere-hour cells are used, although larger cells are available. The units are about 6.8 by 8.8 by 10 centimeters. Connections are made through two 5-millimeter-wide, male metal tabs on the top of the battery (fig. 4).

Internal Batteries

The bat detector and delay switch both have internal batteries. The detector battery is a replaceable 9-volt transistor battery, accessible through a cover on the bottom of the unit.

The delay switch has two batteries, one replaceable and the other rechargeable. The replaceable battery powers the delay switch LCD and should be replaced when the display is no longer visible (de Oliveira et al. 1998). The rechargeable battery should be kept charged, even when the delay switch is used with an external battery. These batteries are charged for 14 hours through the delay switch rear-panel jack with a Calrad model 45-746, 12-volt, 300-milliamp charger.

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[2] Personal communication. 1 Dec. 1997. David Titley, Titley Electronics, Ballina, Australia.

[3] Titley Electronics. [Brochure]. Anabat II bat detector: instruction for use.

[4] Titley Electronics. [Brochure]. Anabat II delay switch: instruction for use.

Table 1—Functions of the indicators and set buttons on the front panel of the Anabat delay switch

Label	Function	Diagnostic use
ON	Indicates the delay switch is energized when the LED is on	Indicates if internal or external battery is charged
NS	Indicates the delay switch will transfer data only after dark	Indicates if the day-night sensor has become dislodged
LO BAT	Indicates battery has reached about 5 volts	Indicates if internal or external battery is charged
DATA	Flashes when data are being transferred from the bat detector to the delay switch	If it does not flash, it may indicate that a detector or delay switch cable is bad
CAL	Flashes when the calibration tone is being transferred from the bat detector to the delay switch	May indicate that a detector or delay switch cable is bad
TIME	Flashes when the time stamp is being transferred from the delay switch to the cassette recorder	Limited or none. Flashes to indicate when the time stamp is supposed to be sent to the tape. The light will erroneously flash if the time stamp battery is bad and the time stamp is **not** being transferred
Display	Indicates that the time stamp battery is at operating voltage and the time that will be written to tape by the time stamp	Absence of time data in the display indicates that the replaceable delay switch battery is bad and needs to be replaced
MODE	Used to select clock mode and time set mode of the display	
ADJUST	Used to adjust the settings in the time set mode of the display	
TAPE	Used to allow tape recorder to record bat call data	Use tape recorder to confirm whole system operation: data recording, delay switch synchronizing, and battery availability
MIC	Used by operator to put verbal messages on tape	

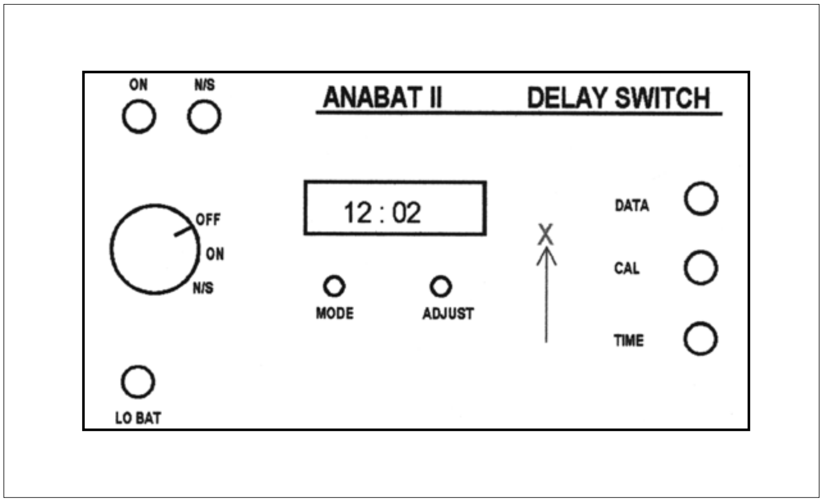

Figure 3—Delay switch front panel. There are six LEDs (ON, NS, LO BAT, DATA, CAL, and TIME) and one clock LCD on the delay switch front panel; Mode and Adjust are pushbuttons used to set the LCD. Some functions of the front panel LEDs will be familiar to most users, but the purpose of the indicator lamps may not be obvious. Usually, the LCD is diagnostic; it can be used to troubleshoot the time stamp battery. The functions and diagnostic uses of the LEDs and LCD set buttons are detailed in table 1.

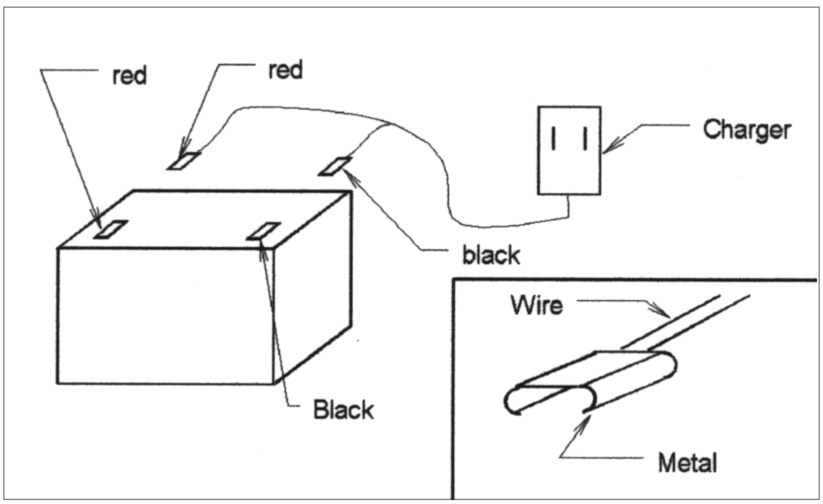

Figure 4—External 12-volt battery connections. The connectors used in conjunction with a battery charger are shown. The same “slip connectors” are used with detector or delay switch power cables.

Power Cables

In-house power cables are used to connect the external 12-volt battery to the bat detector and the delay switch. The cable is a parallel cable, indicating that both the detector and delay switch draw their power from the battery at the same time.

Field Tape Recorder

Data are recorded from the bat detector and delay switch system with a Radio Shack CTR-96 tape recorder. This recorder is an older model and may no longer be available, but any small, music-quality cassette tape recorder should function with the Anabat system. The recorder is joined to the Anabat system through connectors provided on the Anabat sensor-delay switch cable (fig. 1).

An external tape recorder battery pack is used to ensure ample power for the recorder. The external battery packs contain two D-cells (a small cassette recorder normally uses two native AA-cells). The battery pack is fitted with a 10-centimeter cable and an appropriate connector that will fit the external power connector of the recorder.

Rainproof Housing

Protecting the Anabat system from rain and direct moisture in the field is critical. De Oliveira et al. (1998) recommend a waterproof mini-tent with an open front. A large plastic, lidded enclosure with a hole for the sensor is used at the Olympia Lab. The hole in the side of the enclosure has a custom rubber grommet glued to the inside. The hole in the grommet is slightly smaller in diameter than the bat detector microphone, so the grommet inner circle seals snugly around the outer rim of the microphone that has been pushed partially out through the hole in the rubber (fig. 5). Most enclosures can be made rain resistant, but few can be made moistureproof. The Anabat system can be left in the field for short durations, but it should be returned to the laboratory to dry out once a week. Due to the tendency for enclosures to breathe, moisture can build up within the enclosure or even within the Anabat and cassette recorder cases. Such moisture buildup can cause failures in circuitry or the detector microphone.

Anabat5 Software

The operation of the Anabat5 software is described in Corben and Titley (1999). The Anabat5 software, instruction manual, and various software drivers come with the original equipment purchase or are available on the Internet. These files may be found on the World Wide Web through a search engine. The keywords “Anabat,” “Anabat5,” or “Titley Electronics” should find multiple Internet sites with Anabat files. When the 53-kilobyte Anabat5.com file is downloaded, it must be checked for proper operation. The Anabat5 program will operate only in the DOS mode. To operate Anabat5, it is best to exit Windows and restart in DOS mode (use the Windows 95 or 98 command, Start, Shut Down . . . in MS-DOS Mode).

Begin by locating and downloading the 53-kb Anabat5.com file and the 90-kb Anabat5.asc file from the Internet or from a floppy disk. Print the Anabat5.asc file and read at least the first three pages. Transfer the Anabat5.com file to a working directory. Modify the DOS path command to cover the location of the Anabat5.com file. The path can be modified with “sysedit.” To use sysedit, enter the following sequence in Windows 95 or 98: Run, enter “sysedit” and click on OK, modify the path by following the last entry in path with a semicolon, and then enter the path structure to the directory where Anabat5 is located. For example, if Anabat5 is located in a directory named C:\Anabat and the path structure reads Set Path=C:\Hardware, modify the path statement to read C:\Hardware;C:\Anabat, and then go to File/Save. This allows you to execute the Anabat5 software from any DOS directory.

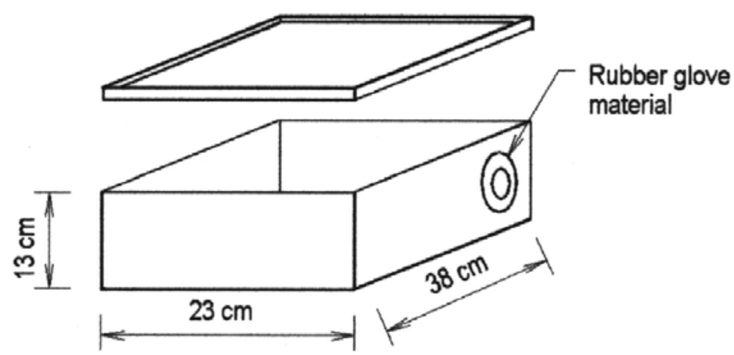

Figure 5—Anabat enclosure used at the Olympia lab. The rubber glove material is cut so that it can be glued over the hole in the box, leaving a hole for the Anabat microphone to fit through.

Testing the ZCAIM and Anabat5 Software

The ZCAIM is used to read the Anabat cassette data. The ZCAIM module is the same size as the delay switch. It has a connector on the back for a printer cable and a connector on the front for a cassette recorder output plug. The only other items on the ZCAIM are a rotating sensitivity control and two LEDs.

After preparing the Anabat5 software as noted above, connect the ZCAIM to the PC printer port with a standard printer cable. Connect the ZCAIM to an Anabat bat detector with a cable having only a round, 8-pin connector on one end and a pair of cassette recorder plugs on the other.

Execute the Anabat5 software and press Enter when prompted. A black-and-white screen with gridlines, crosshairs, and various legends will be displayed. Turn the ZCAIM sensitivity control all the way up and the bat detector volume and sensitivity controls to 5. Enter Shift + N; the screen will change to a graph labeled “RECORDING DATA NOW.” Rub your thumb across your fingers in front of the bat detector sensor; you should observe some screen activity, probably a random pattern of dots. Press the spacebar to exit this screen. To exit Anabat5, enter a backspace to get to the main menu, and then press “X” to exit to DOS.

This procedure confirms only the electronic and cabling connection of the ZCAIM and the operability of the Anabat5 software. To calibrate the system and observe bat calls, refer to the Anabat5.asc software documentation file.

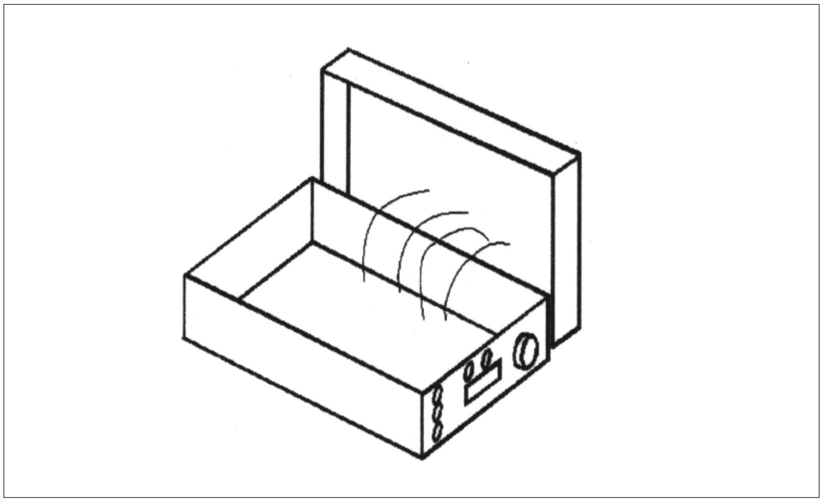

Figure 6—An open delay switch showing the best way to avoid stretching or breaking the wires when the case is opened. The case is upside down with the case bottom lying on one of its long edges.

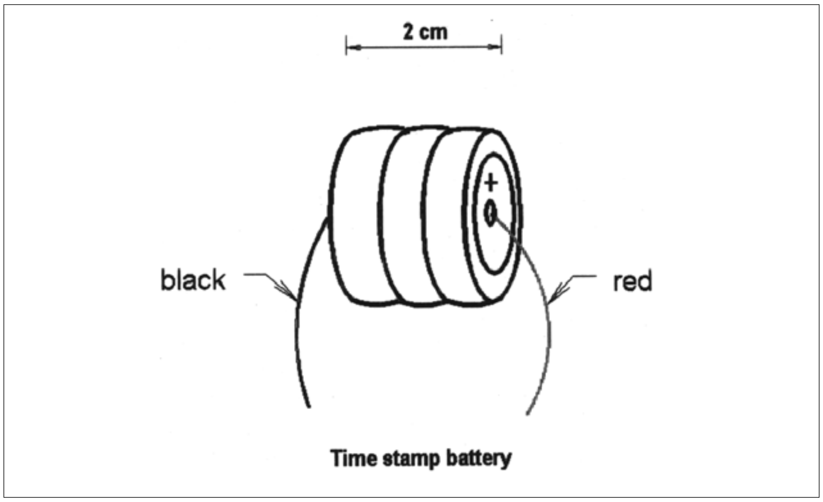

Figure 7—The time stamp battery, located inside the delay switch assembly. It is fastened to the side of the case with double-sided tape.

Repairs and Adjustments

Anabat Delay Switch Repair

Three problems are common to the delay switch: it stops sending time stamps to the cassette, it stops operating in night mode and the front panel rotary switch stops turning the unit on and off. The first problem may be caused by the time stamp battery going dead, the second by the night sensor becoming dislodged, and the third by wear. All can be repaired by the user.

Opening the delay switch—All repairs involve opening the delay switch. Turn the unit on its back and remove the four rubber feet. Remove the screws found under the feet. Carefully lift the bottom of the case up and swing it to the side; take care to not stretch or tug the wires (fig. 6).

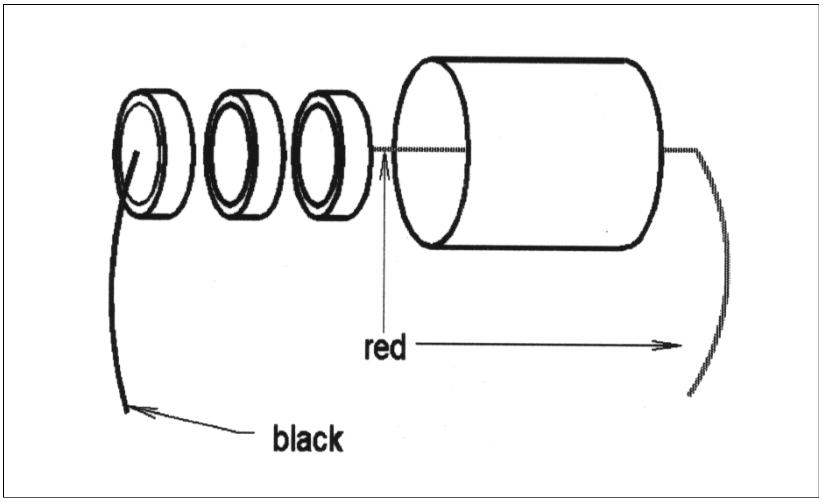

Figure 8—Batteries arranged in a “series stack.”

Replacing the time stamp battery—Two batteries are in the delay switch. The time stamp battery for older delay switches is identified in figure 7. (One version of the delay switch has time stamp batteries with three wires and is not discussed here.) A new battery may be purchased from the manufacturer or one may be constructed. To construct a battery, use three watch-type batteries in a “series stack.” A series stack is three batteries stacked end-to-end, positive (+) to negative (-). Order the batteries with solder tabs and solder a piece of red wire to the positive end of one battery and a piece of black wire to the negative end of another battery. The Olympia Lab units have Panasonic LR-44 batteries. Check the stack voltage and polarity with a voltmeter. Ensure that black is negative and red is positive. The stack must read 4.5 volts. Identify the dead delay switch battery, clip it out, and leave the leads long in the delay switch. Be careful that the loose leads do not touch any circuit elements inside the delay switch. Splice in the new stack and use shrink tubing to insulate the bare wires and the batteries as shown in figure 8.

Remounting the night sensor—To remount the night sensor, open the delay switch case. Notice the dimple on the inside of the front panel at the location shown by the “X” in figure 9. The sensor normally is glued to the inside of the panel at the “X” location and senses light through the plastic facing that covers the aluminum panel body. The delay switch will be upside down, so the dimple will be on your left. If a dimple is located at the indicated spot, the night sensor will be hanging loose nearby. The sensor and its proper mounting location are shown in figure 10.

Ensure that the light-sensitive face is oriented correctly when gluing (with contact cement) the light sensor into place. Apply glue to the edge of the hole and the corners of the sensor. Let the glue get tacky and then press the sensor into place. Hold it until the glue dries. If spring forceps or a clamp is used, be sure the tool does not have enough tension to damage the sensor.

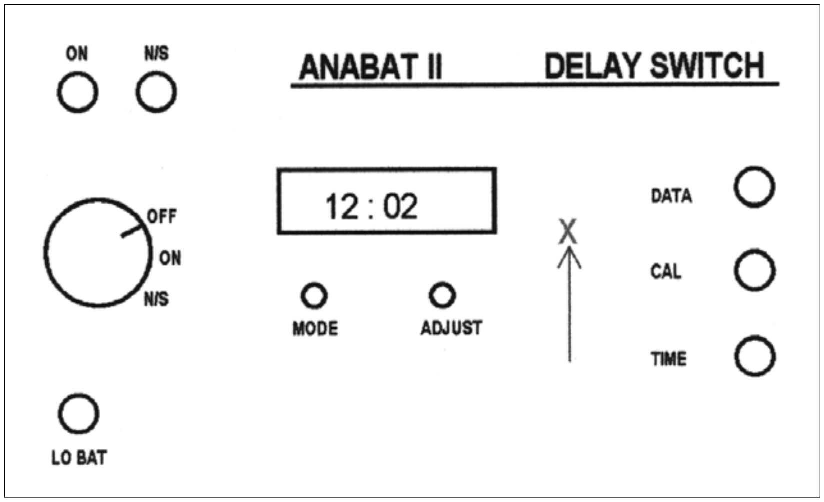

Figure 9—The “X” indicates where the light sensor is located on the inside of the front panel.

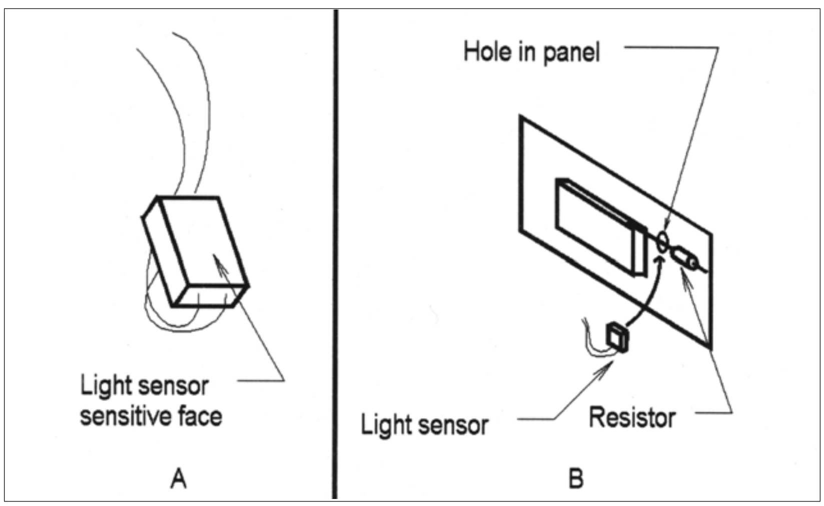

Figure 10—Unattached delay switch light sensor. **(A)** The wires to the sensor are bent away from the light-sensitive face. **(B)** Remount the light-sensitive face over the hole or dimple in the front panel.

Replacing a broken rotary switch—The front panel off-on-NS switch can be replaced. A diagram needs to be drawn of the switch layout, including wire colors and destinations. Then remove the wires from one switch, remove that switch, replace it with a new one, and resolder the wires to the new switch. The replacement switch can be ordered through most electronics shops. The part number we obtained from Titley Electronics was C & K Company part MA00-L1-N-Z-Q-D, series M.

The delay switch front panel must be carefully lifted out to replace the switch (fig. 11). Once the front panel is accessible and the wiring diagram is completed, unsolder the wires. Next, remove the switch knob by using a jeweler’s screwdriver to loosen the setscrew. Finally, remove the locknut holding the switch to the panel. Remove the

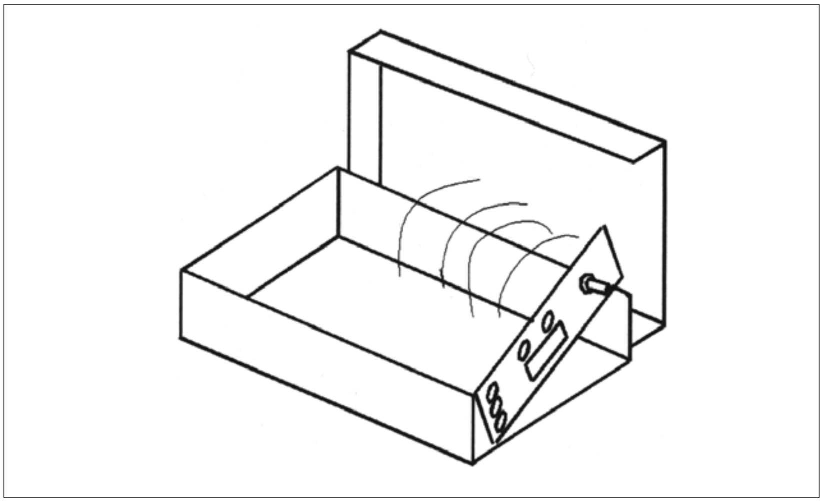

Figure 11—Front panel removed from its mounting guides. Rest it at an angle so that the rotary switch is easy to access.

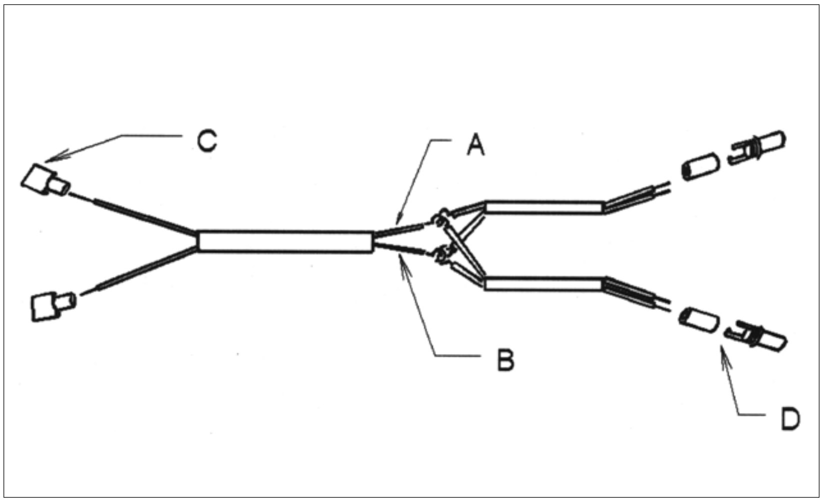

Figure 12—Single-input, two-output cable constructed for Anabat units. **(A** and **B)** Single conductor cable wires, **(C)** battery connections, and **(D)** Anabat power plugs.

switch; it is glued and may need to be either rocked lightly or the glue seam cracked with a knife. Resolder the wires according to the diagram. Closely check the diagram for each switch that is replaced to ensure that the wire colors and destinations are the same.

Constructing a Power Cable

The power cables used with Anabat units at the Olympia Lab are single-input, two-output cables. They are used to take power from a 12-volt battery and deliver it to both a bat detector and a delay switch (fig. 12). The single-input, two-output cables are constructed from two-conductor, 22-gauge, PVC jacketed, stranded electronic cable. The two-conductor cable wires are used to carry the current from the battery connections to the Anabat power plugs. It is critical that heat shrink tubing (called shrink) be used during the construction to keep the wires from touching. This shrink is added to the assembly during construction. After the three-way connection is soldered, the shrink is slid into

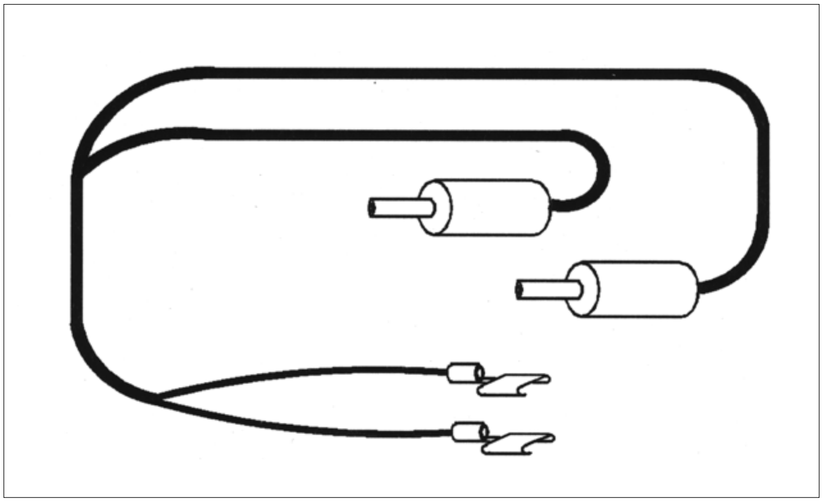

Figure 13—Completed battery, bat detector, and delay switch power cables.

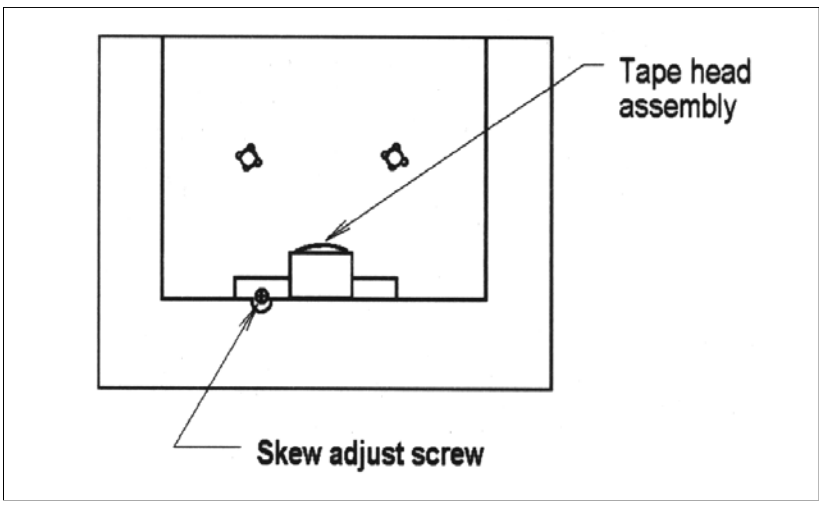

Figure 14—Top view of a cassette tape recorder with the door removed, the play-record button depressed, and no tape in the machine.

place over the metal solder joints and shrunk with a heat gun. The slip connectors used to connect with the battery lugs are standard 3/16-inch female disconnects. The battery disconnects and the Anabat power plugs should be physically sized to actual battery and Anabat units prior to purchase. Completed power cables are shown in figure 13.

A note of caution: Some users may be tempted to power a tape recorder from the same battery used to power the bat detector and delay switch. Some tape recorders used in this fashion can seriously damage the Anabat units.

Adjusting Recorder Skew

A cassette tape recorder is used in the field to record bat calls. A different cassette recorder is used in the lab to transfer data from the tape to the ZCAIM. The cassette recorder used in the field may not record data on the tape in exactly the same way as the lab recorder is set to take it from the tape. The difference is in how the recording and playback heads are aligned (fig. 14).

In normal playback, a tape should produce clear, crisp sounds. When a tape head is out of skew, the sound will be “fuzzy” or “mushy.” The sound of a tape out of skew should not be confused with the sound caused by weak recorder batteries. Weak recorder batteries will produce a sound that rises and falls in tone or is off-frequency; a high pitch indicates weak field recorder batteries, and a low pitch indicates weak ZCAIM recorder batteries. An out-of-skew recorder can produce the right frequency, but it will sound raspy or fuzzy.

To adjust the skew, put a tape containing the bat call information in the cassette deck, leave the door up, and press the play button. When the play-record button is depressed, the tape head assembly moves toward the tape (up, in fig. 14). When the tape head assembly moves toward the tape, the skew adjust screw becomes exposed. The screw can be adjusted with a small screwdriver. Listen for bat calls and turn the skew adjust screw right or left to get the sharpest sound. Start by adjusting a quarter of a turn either way to see what direction enhances the playback. Rarely will more than a half-turn either way be needed to enhance the sound quality. Skew adjustment should be made if the audio bat-call data sound fuzzy or the data quality is a problem.

Improving Lead-Acid Battery Life

The life of a rechargeable, sealed lead-acid battery is determined by three things: discharge, charge, and handling. The charge and discharge are closely related. Handling is a separate issue, which most often relates to how a battery is transported.

Sealed lead-acid battery charge and discharge—A 12-volt lead-acid battery should not be excessively discharged. To gauge the discharge state of the battery, measure the open circuit voltage, which is the voltage between the positive and negative terminals when all equipment but a D.C. voltmeter is disconnected from the battery. The open circuit voltage of a freshly charged battery should be 13 or more volts; a voltage of less than 12 volts indicates a battery that may not perform well in the field, and a voltage of less than 11 volts suggests a battery that may have failed.

Lead-acid batteries used in the field should not be allowed to discharge below 11 volts. Under no circumstance should these batteries be left in the field to discharge completely. A complete discharge is indicated by an open circuit voltage of less than 6 volts. Lead-acid cells that are allowed to completely discharge are often internally damaged and not able to be fully charged again. Lead-acid batteries should be charged in a ventilated space. They generally should reach full charge in 14 hours when used with a matching charger. Longer charge times result in a slight heating, and although no damage will occur if batteries are charged for more than 14 hours, it is recommended that they be removed after that time. At the Olympia Lab, an appliance timer is used to charge batteries. A power strip is plugged into the appliance timer with multiple battery chargers plugged into it.

A failing battery will tend to overheat during charge. If a battery does not reach a full charge within the charging period, it is likely that the battery has been damaged; continued charging will result in continued heating and possible further damage.

Sealed lead-acid cell handling—When a lead-acid cell is discharged, it is particularly sensitive to rough handling. If discharged batteries need to be transported by vehicle, they should be carried in a container with a foam bottom and either foam or bubble plastic wrap encasing the sides. These batteries should not be transported in a way that places them in direct contact with the floor or metal bed of a truck or an automobile trunk.

Conclusion

The supplied information should help with setting up and making some simple repairs to an Anabat unit. You are encouraged to try to make the described repairs. If you are unsuccessful in making repairs or have a problem not discussed here, contact the manufacturer:

David Titley
Titley Electronics
P.O. Box 19
Ballina N.S.W. 2478
Australia
Phone and FAX: 61-2-66-866617
Email: titley@nor.com.au
www: http://www.nor.com.au/business/titley/

The company can advise you of the difficulty level for problems you may have. You may also wish to talk with other Anabat users in your area to determine whether additional repair facilities are nearby.

Acknowledgments

I thank David Titley of Titley Electronics for his advice and direction in the repair of Anabat units. I also wish to thank Eva Patton for training she gave in the use of the ZCAIM and Anabat5 software.

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