TELONICS QUARTERLY™

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Biological Notes

Expandable And Breakaway Collars

We receive frequent inquiries about expandable and/or breakaway collars. While such collars are desirable for a variety of applications, there are special considerations involved.

Breakaway collars are designed to fall off an animal after some elapsed period of time, and many researchers working internationally or in U.S. National Parks request this type. The collars offer a release device which is placed on an animal, subjected to abrasion, extreme temperatures, moisture, and UV exposure, then expected to fall off according to a"predetermined" schedule. The release device is frequendy an environmentally degradable link; thus, consistency of breakaway timing is a function of environmental consistency.

Electronic timers, which time and then trigger breakaway, are occasionally suggested, and could be constructed at a modest increase in cost and weight. However, the electronics must still trigger the actual separation device. A pin must be pulled, clasp released, or material severed; thus, the mechanical problems associated with dirt, freezing, jamming, etc. remain.

Radio breakaways also use mechanical separation devices, and are subject to similar abuse and failure modes. They also require that the animal carry a receiver. This increases current drain on the power supply, increases size and weight of the package carried by the animal, and decreases overall reliability of the system because of increased complexity.

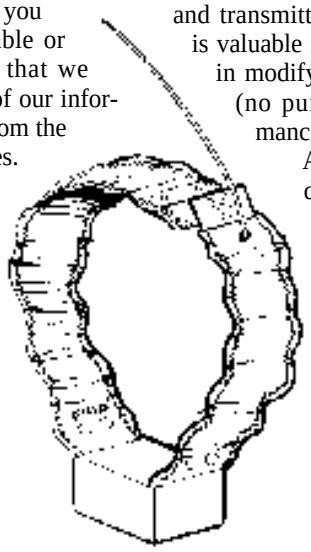
Some expandable collars allow for growth in young animals. Others provide for the neck expansion experienced by male ungulates during rut. The first priority of an expandable collar is that it expand easily enough to avoid harming the animal. Collars designed to expand are necessarily easier for the animal to shed than a collar of fixed circumference. Collars may prematurely expand due to neck rubbing, scratching, social interactions, or even the weight of the transmitter moving as an animal runs. A 100se collar may increase the danger of an animal catching a foot while scratching, or stepping into the collar while feeding. Increasing resistance increases the possibility that the collar will not expand at the desired time. Reasonably good success has been achieved with collars that expand as young ungulates grow. Little work has been conducted with expandable collars on dexterous species such as felids, although a harness has been used with some success. Repeated collar expansion and contraction is frequently desired for seasonal neck expansion, but it is difficult because many materials and designs do not contract to original size and shape after being continuously extended for days, weeks or longer.

Our experience has sometimes shown large differences in the performance of a particular collar depending on species, age, climate, habitat, and even the behavior of specific populations or individuals. Slight variations in materials or construction technique can also have substantial impact on collar performance. Users should be aware that a variation in performance is to be expected. Some collars falI off prematurely; others will remain on longer than desired.

At Telonics, we have a pool of knowledge gained from years of experience working to develop or modify different types of expandable and breakaway collars. We also have the facilities to make a variety of attachment collars. We do not have all the an

swers, however. It is often important to empirically determine information for specific studies, and trials or pre liminary studies can be invaluable. Those of you who f have deployed expandable or breakaway collars have data that we encourage you to share. Most of our information on this subject comes from the field, and we appreciate updates. We would like to know if someone has the "perfect" expandable collar, a good one, or ' something you tried that was a miserable failure. And if you have questions, we are always glad to help.

Bill Burger



Not Everything Can Be Found In A Catalog

Take Advantage Of Our Special Capabilities

For many years Telonics has been providing equipment and technical expertise for a variety of tracking applications. Our research has led us to develop a wide range of specialized support capabilities, and we encourage you to take advantage of them.

Our in-house software expertise is useful in satellite transmitter development. A minor change in hardware, accompanied by changes in the original software code, make it possible for a single type of transmitter to be used in various ways. One transmitter was used in a caribou application with activity sensors, a walrus application with pressure sensors, and a whale application with pressure and temperature sensors.

Our Metal Shop fabricates and assembles special housings, attachment hardware, custom antenna mounting brackets and other metal assemblies. The Plastics Laboratory is equipped to vacuum form specialized housings such as solar powered eagle transmitters. OLlr new Computer Aided Design (CAD) studio allows us to quickly generate schematic drawings and layouts of printed circuit boards.

We also support an antenna design and testing facility for VHF and UHF receiving and transmitting antennas. This capability is valuable in designing new antennas, or in modifying existing antennas to gain (no pun intended) optimal performance within a given size or space.

All our facilities have -=1 developed over the years in response to requests from the field. The facilities are here to support your work and if you would like more information, please don't hesitate to call or write. *Jm Carter*

On The Fine Art Of Technical Specifications

Or How To Get What You Need

In the early days of telemetry, it was enough to simply take your requisition for an "animal transmitter" and submit it to the purchasing agent. He generally bought the equipment from someone you had been working with in the past. Virtually all the hardware in those days was experimental and if you had good success with a particular company, you tended to continue working with them. Over the years, designs have generally become more refined. Many telemetry suppliers produce a better and wider array of equipment today than they did twenty years ago and the approach to purchasing has, for better or worse, become an open bid process for projects run by state and federal agencies. The result has been the necessity to generate specifications which accurately define the product you wish to buy. Various vendors then bid on that product as specified in your Request for Quotation (RFQ), with the purchasing agent accepting low bid.

The military and aerospace communities have been using this "competitive" process for years and have developed systems and procedures for handling detailed technical specifications. However, in the wildlife field, the technical specifications are often given a back seat because they are neither well understood nor adequately presented in most RFQ's. This has been disastrous for many programs. The researcher may wish to purchase a particular configuration used in the past, but doesn't know how to define it adequately or how to distinguish it from other telemetry products. As a result, the RFQ does not define the electrical or mechanical specifications in sufficient detail and suppliers are forced to interpret. The key to the low bid approach for many vendors is to simply meet and not exceed specifications in order to keep costs down. If the product is fully defined, there is no problem. However, if some critical technical parameter is missing or inadequately defined, serious problems arise.

A classic example is hermetic packaging. This process seals the electronics, battery and all interconnections within a hermetically sealed metal container. All external interfaces utilize glass to metal feedthroughs. The result is a seal similar to a can of tuna. The sealed canister has a defined leak rate which is based upon a specific MIL test called a "helium leak bomb" test. The test involves placing the transmitter into a chamber. Helium is then forced into the chamber under a specific pressure. A certain amount of gas penetrates the package because of helium's very small particle size. If the transmitter is hermetically sealed in a metal canister, the leak rates are typically on the order of 1 part in 106 atmospheric CC/second. This is a measurable rate and a well accepted test that has become a standard in the military and aerospace fields. Hermetic sealing has also become a standard in the wildlife field because it is the approach we have been successfully employing over the years in sealing our own transmitting subsystems.

In the beginning years of radio telemetry, manufacturers utilized a much less expensive and less effective approach. They encapsulated the transmitter, battery and associated interconnects into a polymeric material. This encapsulation process is not a true hermetic process. It is, however, far less expensive than hermetic sealing. There's nothing fair nor reasonable about comparing the cost or long term reliability of these two processes. Polymeric sealing is only water resistant. Water is being continually absorbed into the polymer at the molecular level, and it eventually causes failure. The time frame to failure depends on humidity, temperature exposure, density of the polymer and the assembly application technique.

Many RFQ's do not address packaging at all, or they may just state "waterproof." While this term has a practical meaning, it does not have a technical definition. Given this situation, it is the vendor who must decide what is being requested and the vendor has two choices. He can interpret the specification to mean "provide maximum protection against water penetration," i.e. hermetic sealing. However, if he actually provides a true hermetic seal, he will probably lose the bid to another vendor who is simply providing the minimum for which he can be held responsible. The two vendors are bidding on two different items, and the cost difference between the two approaches is substantial.

The physical difference between a hermetically sealed metal package and a polymeric package should be readily apparent to the engineer, purchasing agent and biologist. While no special training is really required to distinguish between products which use these two different approaches, other kinds of differences are far less visible.

Generally speaking, wildlife transmitters are extremely low current, low power devices. They are substantially different technologies than other "transmitters" common to state agencies. Generally, universities and state agencies do not have the direct experience or test equipment to validate the electrical specifications of wildlife telemetry transmitters. The same is true of receivers with their uniquely high sensitivity. Vendors are generally not held accountable for meeting electrical specifications. Some less scrupulous vendors rely on this, and the person caught in the middle is the biologist and/or purchasing agent. They must rely on vendors telling them that they have some sort of "equivalency" that is never really measured and often does not exist. Only after the study program is far along do these subtleties sometimes come back and create serious problems.

In speaking with many researchers and purchasing agents over the years, we have come to the conclusion that it is the responsibility of the people who design telemetry to attempt to explain the technical specifications and remove the "black magic" that surrounds the "art." You, as an end user or as a purchasing agent, have every right to receive technical specifications (and reasonable explanations as to what they mean) from the supplier. Specifications should define the equipment based on performance characteristics and measurable parameters in a fashion consistent with good engineering practices and the military and aerospace communities. With adequate specifications, some basic understanding of those specifications, and a bit of good old common sense, we can readily distinguish between the various telemetry products based on technical merit as well as cost. Not only do you get what you pay for, but what you specify.

Stan Tomkiewicz

Attach An Airplane To Your Antenna!

There's An Easy Way To Do Everything

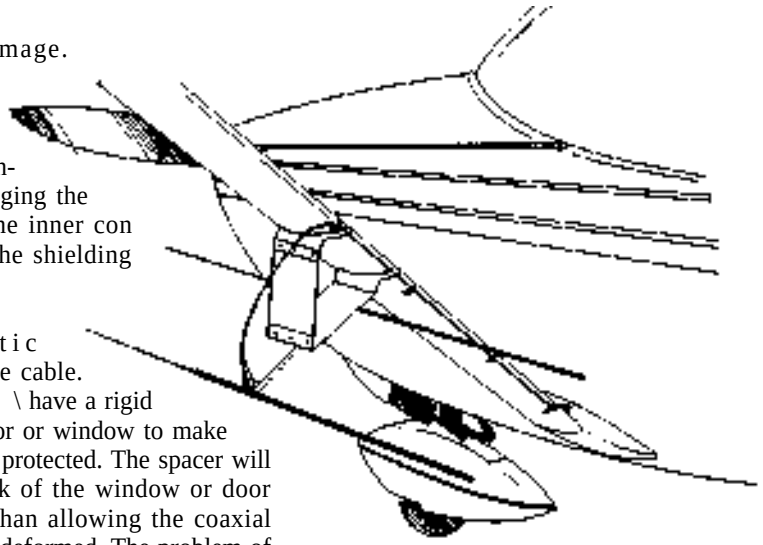
From the early beginnings of radio cess telemetry, people have been looking for ways to attach antennas to various kinds of vehicles. Airplanes are no exception, and the development of aircraft antenna brackets has dramatically extended the performance of our telemetry systems.

There are five models of brackets available and they were designed to fit the most commonly used types of aircraft. The brackets are lightweight, durable and fabricated by a licensed A&P technician using the highest quality aircraft-approved materials. The brackets secure the RA-2A antenna to various models of strutted, fixed-wing aircraft. They attach easily, and deploy the RA2A in a manner which minimizes drag and maximizes operational range and system performance. They have proven successful on a variety of aircraft, with no permanent modification necessary.

In choosing the right brackets for fixed-wing aircraft, great care must be taken to measure the dimensions of the strut to ensure proper fit. Although it may not be readily apparent, strut sizes may vary within the same model of aircraft. For example, two Cessna 172s may not have the same size struts because of a difference in engine size.

When brackets and antennas are mounted on struts, the antennas should be centered on the struts with the tips of the antennas facing fore and aft to offer the least wind resistance. The front of the antenna should be positioned to "look" out toward the tip of the wing and slightly downward, approximately 30 degrees below the horizontal axis of the wing. When mounted in this manner, the aircraft will have very little detuning effect on the "H" antenna.

The coaxial cables must be secured to the trailing edge of the strut by means of duct tape or some other comparable method. The cables should be dressed down the strut and into the cabin, either through the window, under the edge of the door, or through the air vent. Caution must be used in this proccess because cables can easily be crimped or smashed, thus creating a direct short or other damage. Crimping the cables can cause a serious mis-matching condition. By changing the distance from the inner con ductor wire to the shielding braid, changes occur in the characteristic impedance of the cable. It is advisable to \ have a rigid spacer in the door or window to make sure the cable is protected. The spacer will absorb the shock of the window or door closing, rather than allowing the coaxial cable to become deformed. The problem of crimped cables can be avoided altogether by purchasing bulkhead feedthroughs and installing them on the aircraft in a manner which allows the coaxial cables to be run through the wings and into the cabin.



Since harsh environmental conditions may weather cables and accelerate internal corrosion, external cables should be changed periodically (typically, every year with heavy use). If the aircraft is being used in close proximity to the ocean, the interval between cable changes will be shorter. Antennas and cables should be inspected and tested before every flight, and it is a good idea to have a spare set of cables, antennas, and switch box (TAC-2) in case a problem arises. It is also good practice to position a beacon transmitter at the airfield. The switching boxes should be exercised with the beacon transmitter shortly after take-off to ascertain proper system function. If we can't achieve adequate range and direction from the test beacon at the airfield, it's a good bet that no better success will be achieved with transmitters on the animals.

Telemetry receiving subsystems have been installed in aircraft in conjunction with specialized intercoms with great success. The antenna/receiving system can be interfaced with various Telonics intercom systems to increase the utility of the system to the user. When these systems are combined, it is no longer necessary to switch headsets between voice communications and telemetry. The pilot and all observers in the craft are able to listen to the telemetry and communicate easily, wihout the shouting and hand gestures that are usually necessary. Some of our intercom models offer an isolated pilot option which allows the pilot to "switch out" of the cockpit conversation and telemetry monitoring when desired, in order to concentrate on flying or voice communications using the aircraft radios. The intercoms also provide an output jack for VOX tape recorders in cases where it is desirable to document the mission (surveys, search and rescue, etc.).

Regulations vary governing the attachment of equipment to aircraft depending on ownership, use, and location. Users should check with the appropriate authorities regarding requirements. The International Association of Natural Resource Pilots is one source of information with suggestions based on practical experience. You may also wish to refer to the Federal Aviation Regulations for any questions concerning certification requirements. And, of course, Telonics will be glad to help in any way we can. *Gary Jones*

Satellite Update

Our Newest Generation ARGOS PTT

Over the years, many people felt that developing a small, lightweight, cost effective transmitter capable of providing extensive data collection would be a "dream come true." It was the common feeling among researchers regarding conventional VHF transmitters and the attitude also held true for ARGOS satellite PTTs. Well, we're getting close!

Our first requests for an ocean buoy PTT came to us when we were building our second and third generation ARGOS PTTs. They were designed specifically for wildlife applications and the units were successful in several scenarios. However, they were not capable of the kind of data collection required by many oceanographic studies. In response, we designed the ST-4 with the ability to monitor four high accuracy thermistors, and we incorporated onboard data reduction. Now we've gone a step further.

The ST-5 represents our newest generation ARGOS PTT, and it is the most technologically advanced satellite PTT available to the oceanographic and meteorological fields. Units produced prior to the ST-5 utilized surface mount technology, but were assembled by hand on an individual basis. The ST-5 is our first generation to be robotically assembled. This method increases reliability and consistency, while also reducing costs. The unit measures 6.25 X 2.35 X 1.9 inches, weighs 5.3 ounces, and operates over the voltage range 7.0 to 11.0 Vdc. External connection to the ST-5 has been simplified by using a single 25 pin female connector positioned on the end of the package. A standard male DB-25 can be used to connect the package. Thermistor, mercury switches and reed switches can be mounted directly on the PC board, or leads exiting from the DB-25 male connector can be provided.

Numerous capabilities have been incorporated into the unit. The ST-5 will accommodate as many as eight precision thermistors. With calibration, 80 to 150 millidegree accuracy can be achieved using linearized thermistors. Non-linearized thermistors can also be used, achieving 150 millidegrees without calibration. Subsurface or atmospheric pressure is measured with 10 bit resolution by a single pressure transducer. The ST-5 can be designed as a "chain-master" with up to sixteen remote modules measuring temperature and pressure. Various subsurface pressure and temperature data is thus obtainable.

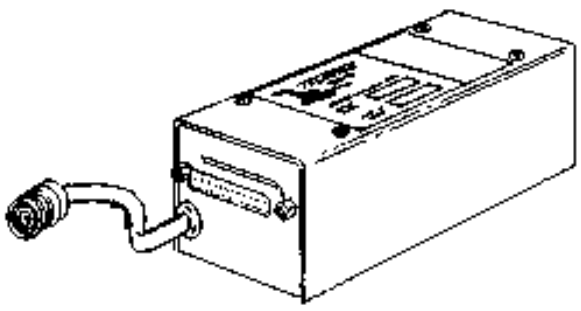
The ST-5 is internally divided into two components. The digital assembly includes data acquisition, serial interface, timing and micro-processor functions. The Radio Frequency assembly is also available independently for those who prefer handling all logic and control functions themselves. Such users provide a digital controller module and complete the unit with their own design. Since the RF assembly has been certified with its controller, the custom design must be recertified by SERVICE ARGOS before deployment when the user provides the control logic.

Remote programming is also possible with the ST-5. A small interface box (model TPI-l) connects between a serial port on an IBM personal computer and the ST-5. ID code, message length and operational duty cycles can be programmed by the user prior to deployment. This capability is extremely useful to people involved in the production of resale buoys, or in high level usage situations where "off-the-shelf" units are required.

For application with other host data collection systems the ST-5 supports an asynchronous serial interface capable of bi-directional communication. The host communicates with the ST-5, and the ST-5 lets the host know that the data was received for uplinking. This bi-directional communication link is very secure and can be used to monitor the communications port and report problems in data communication to the user by transmitting appropriate error codes. Baud rates are factory set and now go as high as 9600 baud.

As a microprocessor controlled device, the versatility of the ST-5 opens the door to a wide variety of applications. Software changes can be made to accommodate a number of data collection sensors applicable to oceanography and meteorology.

Brenda Milam



A Holiday Message

Sending Our Very Best To All Of You

As the holiday season approaches, many of us tend to reflect on our priorities and the things most important to us. It is because of these priorities that Telonics has set aside a time for celebrating the holiday season with our families and close friends. Please note that our laboratory will close on December 23 and we will reopen January 3, 1989, resuming our regular business hours of 7 AM to 4 PM, Mountain Standard Time.

For those of you who have visited our laboratories over the years, you may have seen any one of a number of facilities. We've come a long way since Dave Beaty's garage, the "little red house" or the laboratory behind the shopping center. Our new lab was built six years ago and with the addition of a new wing that was completed three years ago, we have a total of 20,000 square feet of laboratory facilities. Obviously, we've grown considerably over the years. We hope that growth has provided technical solutions to some of the problems you encounter with field research.

We like to describe ourselves as a group of professionals whose fields of expertise extend from the very technical to customer service, and we work hard to communicate effectively with the people doing your ordering, purchasing and invoicing. If you've never visited Telonics or if it's been a while, we hope you'll come in soon. Although we've grown tremendously, we still offer the same family atmosphere that you found in the very beginning.

All of us at Telonics would like to thank you for your continued support and take this opportunity to wish you and yours the happiest of holidays and a safe, prosperous and peaceful NewYear. *Jeannie Russell*

New D-Band Earth Station

Developed to Provide Real Time Data

Unlike geostationary satellites that are placed into orbit some 20,000 miles into space, polar orbiting satellites are typically injected into circular orbit at an altitude of only 600 miles. This makes it practical to transmit data to them effectively, using relatively small transmitter/antenna packages.

The ARGOS Data Collection and Location System (DCLS) "rides" as a passenger on the NOAA Advanced TIROS polar orbiting weather satellites, utilizing a D-Band downlink. All wildlife prograrns and many oceanographic programs requiring satellite position fixing use the ARGOS system.

As our satellite transmitter technologies have progressed over past years, the need to receive this data and calculate positions in real or near real-time at local sites around the world drove us to develop and produce small Earth Stations. At the time of this writing, our new D-Band Earth Stations are receiving and processing DCLS data from NOAA-9, NOAA-10, andNOAA-11.

In addition, the D-band downlink at 2 gigahertz contains high resolution (approximately lkm/pixel) continuous imaging data. Five spectral scan lines are monitored by the ITT Advanced Very High Resolution Radiometer (AVHRR) instrument. Other remote sensor data is also contained in the D-Band downlink that is of significant interest to climatologists, oceanologists, and others in related scientific fields.

The use of the 2 GHz frequency band virtually eliminates the interference which caused substantial loss of data in the earlier VHF satellite receiving systems. Our D-Band parabolic "dish" antenna system is extremely directional. It employs an effective beam width of only a few degrees, and completely eliminates the reception of extraneous signals emanating from behind or to the sides of the antenna. The reception of error- free AVHRR data can be guaranteed to within 5-10 degrees above the horizon.

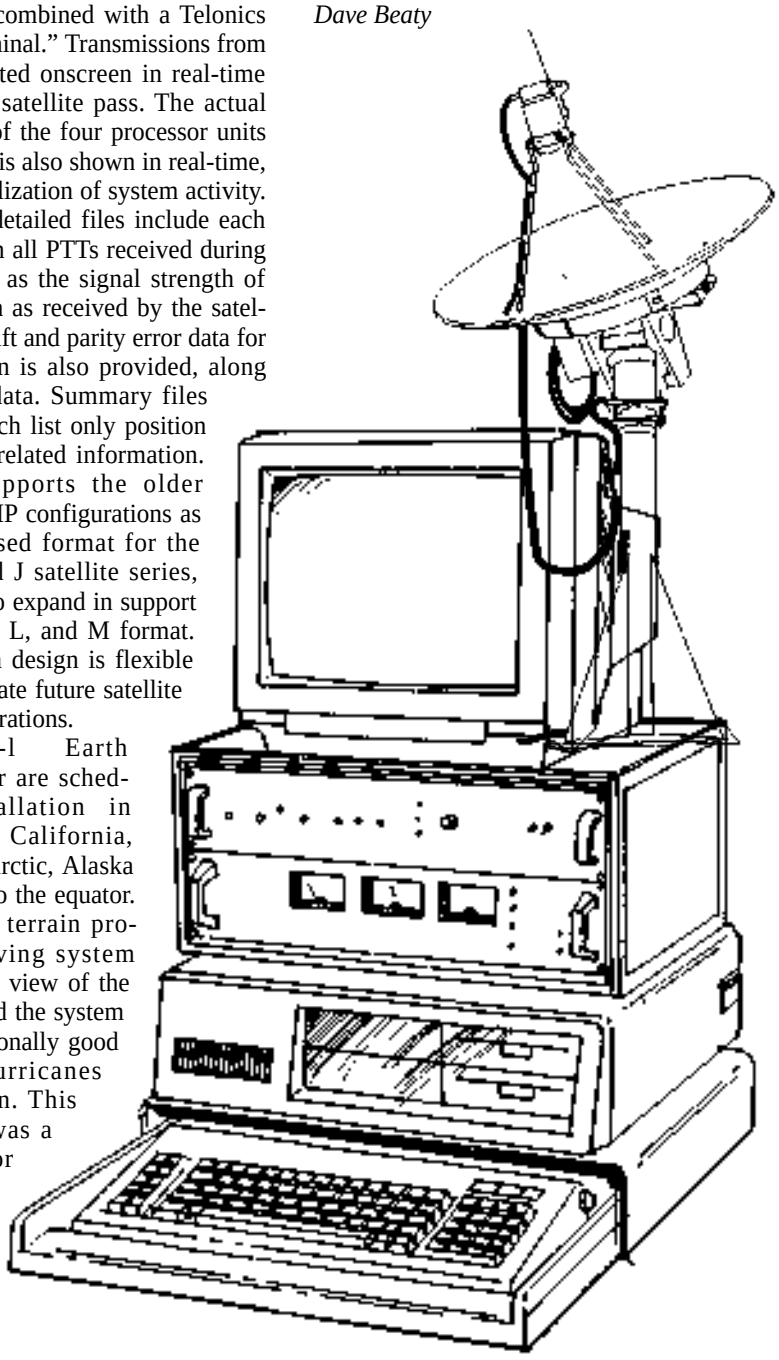
The THRPT-1 Earth Station consists of a low-temperature preamplifier, a circular shielded feed optimized for the application, a 1.2 meter parabolic antenna, and a remotely mounted downconverter utilizing oven-stabilized local oscillators coupled with a new interdigitated filter system. The antenna system feeds a receiver with automatic sweep and frequency control, and a low BER bit synchronizer. DCLS data is then processed and extracted in real-time by a frame-sync/decommutator which can process the full 120 megabyte data flow received in each satellite pass. All operations including antenna positioning and satellite switching are accomplished automatically. System status is displayed on a continual basis by means of a real-time color graphics display. The output of the THRPT-l Earth Station is bit synchronized data with associated clocks.

In DCLS applications, the THRPT-1 Earth Station is combined with a Telonics "Local User Terminal." Transmissions from each PTT are noted onscreen in real-time throughout each satellite pass. The actual activity of each of the four processor units on the spacecraft is also shown in real-time, providing a visualization of system activity. Data outputs in detailed files include each transmission from all PTTs received during the pass, as well as the signal strength of each transmission as received by the satellite. Doppler c shift and parity error data for each transmission is also provided, along with all sensor data. Summary files are provided which list only position and abbreviated related information. The system supports the older NOAA TIROS TIP configurations as well as the revised format for the NOAA H, I, and J satellite series, and is designed to expand in support of the NOAA-K, L, and M format. The basic system design is flexible and will incorporate future satellite data flow configurations.

A THRPT-l Earth Stationstalled, or are scheduled for installation in Arizona, Texas, California, Taiwan, the Antarctic, Alaska and Koson Bay to the equator. Louisiana's flat terrain provides the receiving system with an excellent view of the entire horizon and the system produced exceptionally good images of hurricanes Gilbert and Joan. This real-time data was a valuable tool for Louisiana Emergency Preparedness personnel in planning emergency procedures and possible evacuations. With the Earth Station, LSU has been able to picture the immensity of Hurricane Gilbert, track events in Puget Sound and the Seattle area, measure water temperatures in the Great Lakes, and map recent fires in Yellowstone Park. The University is presently processing data from the AVHRR imager, and will soon be capable of processing data from the sounding and tracking instruments on the spacecraft as well.

In addition to the LSU site, the earth stations have been installed, or are scheduled for installation in Arizona, Texas, California, Taiwan, the Antarctic, Alaska and Korea.

Dave Beaty



Can I Reuse Those Old Radio Collars?

Refurbishing And Retrofitting Are Practical Options

Making use of those old, worn-out, beat up transmitters which have been Iying around the office for years can be worth something in the long run if we give them a little time and thought. After all, the initial development of the proper transmitting subsystems for a particular application required careful consideration of size, weight, attachment, operational life, transmitting range, data collection, and other factors. So the reuse of a transmitter, whether refurbishing or retrofitting, needs the same quality consideration.

Researchers who have refurbished transmitters know that it's not a matter of just changing the battery, but a careful process which restores the unit to virtually new condition. It can take 6-8 weeks and it's critical to begin early.

For those researchers who have never refurbished a transmitter, the following are a few considerations. Refurbishing involves reworking a transmitter to the original specifications, including the same packaging, options and attachment. The process includes a detailed incoming visual examination, consultation with the researcher, incoming electrical test, disassembly, detailed visual examination, detailed preliminary electrical test, necessary component update, installation of a new battery, canister, antenna and attachment, and final electrical and environmental testing for proper performance.

In contrast, retrofitting involves reworking a transmitter to specifications which differ from the original. Even a basic collar attachment design change constitutes a retrofit. Another example would be converting a Deer package to a Moose package with options added, deleted or both. Increased operational life may be achieved in some retrofits by modifying the pulse interval and/or power level. Other kinds of changes may involve reconfiguring the entire transmitter package. While the same frequency determining crystal is used in changing a Wolf transmitter into that of a Kit Fox, the package does require building a new printed wiring board. Since the cost of some modifications might be greater than the cost of a new unit, a retrofit is not always recommended by our laboratory.

To expedite orders of refurbished/ retrofitted transmitters, it is helpful to have the following information: name and agency, phone number, general instructions, and return shipping address. We also sincerely appreciate the excellent cooperation that we receive from researchers, and the transmitter field performance data which is often provided. Information on how things actually work in the field is invaluable for future projects. *Dan Decker*