TELONICS QUARTERLY™

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From Our Midden To Yours

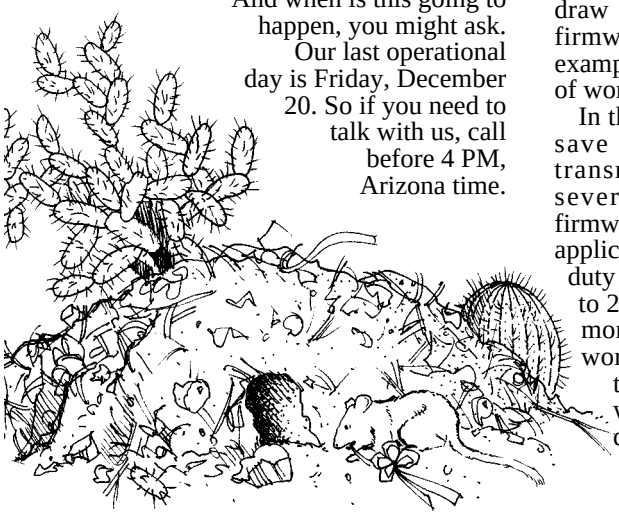
Aberrant behavior is on the rise here at Telonics — which is as good a sign as any that the Christmas holidays are rapidly approaching. The symptoms vary but they are all caused by the same thing, i.e. exponentially accumulated yuletide brain saturation. This fiendish but temporary disorder usually peaks the day before Christmas when we are assaulted by the thirty-seventh presentation of "It's a Wonderful Life" and find ourselves either cheering for Mr. Potter or contemplating the aerodynamic qualities Clarence might exhibit if we pulled one of his newly earned wings out.

This year the strange behavior has even started to infect customers. Just recently we received a FAX from our friend Dr. Cetacean up in Oregon with the cryptic message, "Hast ye seen the white whale?" Immediately, I went to our crack director of biological research, Tadeusz Cowsnowfski, and found him working on his seasonal project — a cookbook entitled "Road Kills: Nutrition and Good Health on a Tight Budget." While I didn't learn anything about Cetacean's message, I found out that cats should always be curried.

If it's this weird now, I thought, imagine what it will be like in about three weeks.

We have found a method for dealing with E.A.Y.B.S. During the holidays we turn off the lab, including Uncle Droid's Mah Jong game that he thinks is safely hidden behind his filing cabinet, jump in our personal road boats, run home and hide under the bed for a week. The therapeutic benefits are enormous.

And when is this going to happen, you might ask. Our last operational day is Friday, December 20. So if you need to talk with us, call before 4 PM, Arizona time.



Otherwise, all you are going to get is Jezebel, the answering machine. We will be closed December 23 - 27, but will return December 30 as our normal sweet selves. January 1 is a holiday, but we'll be back in harness January 2, 1992.

And if you find yourself thinking that the Grinch got a bum rap or you just can't face eating another one of your sister-in-law's lead-filled fruit cakes, run home and hide under your bed for a couple of days — and send the fruit cake to Tadeusz. *Rick Wagner*

SMOP

(Small Matter of Programming)

Telonics first began writing firmware to control our ARGOS satellite transmitters or PTT's in the early 1980's. *(Note: Software becomes known as firmware when loaded into ROM.)* Since that time we have been adding features to meet varying needs. Our projects range from the incorporation of completely new firmware to minor alterations, and are often termed a SMOP — especially by hardware guys!

When Telonics started producing satellite transmitters, we had a limited selection of firmware for controlling the transmitters. It was new to us too! Since then we have developed an extensive library. When a researcher comes to us with a special requirement, we search the library to determine if the requirement can be met by modifying existing code. If this is the case, the modifications can range from most of a day's work (with paperwork and retesting taking the most time) to several days of careful extended effort. If the researcher's requirements are significantly different from what we already have in our library, then we can draw upon our experience to write new firmware. The following are just a few examples to give you a feel for the kind of work done by our software designers.

In the first case, a researcher wanted to save battery power by restricting transmissions to a few hours over a several day interval. Our standard firmware for PTT's designed for wildlife applications already has the capability of duty cycling the transmitter OFF (for up to 255 hours). This same firmware also monitors activity and stores 24 hours worth of data. In this case, however, the long OFF period (> 24 hours) would result in loss of some activity data that was collected during the OFF portion of its duty cycle. Since the acquisition of all activity information was critical to recovering an accurate activity profile, the firmware had to be modified to store all 24-hour activity levels (equal to 8 data bytes). Further, to avoid consuming the extra battery power needed for a single 8-byte transmission, the data were divided into two consecutive 4-byte (32-bit) transmissions. The result was that activity data could be stored for a longer period of time (in this case several days), and then the activity data transmitted in an indexed format utilizing the minimum message length allowable when the transmitter was in the ON portion of its duty cycle. It worked well.

In a second SMOP example involving a non-wildlife application, the researchers already had their own data collection system (a host in place) and they needed to transfer its data to an ARGOS certified transmitter via a serial communications protocol. The transmitter could then uplink the message to a satellite. This approach had been used for some time, but the asynchronous firmware required a transmit command from the host for every transmission. In this application, a user did not want to "wake up" his controller to issue a transmit command. To solve the problem, an 'Auto Repeat' command was added. With this new command, the host instructs the transmitter on how many seconds between transmissions and the number of transmissions to execute. This relieves the burden from the host of consistently commanding the transmitter to transmit, and dramatically reduces the host current consumption because the host can remain in a shutdown mode. This approach has become extremely popular with other users of this code.

The following are some other SMOP's which have resulted in new features:

- the ability to transmit average temperature (with the user being given the option to select both the number of temperature readings to average and the time between temperature readings);
- rearranging the transmitted bit pattern, or reducing the resolution of a data field (truncating a l0-bit field to an 8-bit field) to make the data fit into a shorter data stream;
- in drifting buoys, changing the function of the magnetically operated switch from resetting the transmitter to suppressing transmissions without resetting the duty cycle timing;
- and in short-lived experiments,

making the transmitter completely shut down after the experimental period is completed. This prevents additional ARGOS charges from being incurred after all the important data are collected.

Our transmitters can send either raw or processed data. Raw data is collected from a transducer and transmitted without alteration. If the raw data are transmitted almost immediately, then the term "realtime" is often used to describe this approach to data collection (e.g. a temperature collected just prior to the time of transmission). Processed data, on the other hand, usually takes the form of averaging or summing data over a defined period of time. This "delayed time" approach allows for the collection of data between satellite passes or when the unit is in the OFF portion of its duty cycle. These processed data are then transmitted until a new set of processed data are ready to transmit. How the data are processed depends upon the requirements of individual projects.

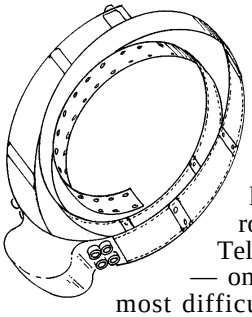
One last comment — in case you have been wondering about the cost of all these neat modifications. It can range from a few hundred to a few thousand dollars of NRE (Non Recurring Engineering). Sometimes this cost is born as a separate item and termed development, but often the cost is amortized over the number of transmitters needed for the research project. The second approach often avoids the administrative expenses of separate R&D budgets and still gets the job done. In most cases, the NRE for modifying existing firmware may prove to be an inexpensive and powerful solution to solving tough problems.

Thomas Oding

Collars and Attachments

If you've only been working with Telonics for the past 15 years, you may not realize how our business began. We started by providing modifications of transmitter circuit designs to the wildlife field as a hobby! VHF telemetry was in its infancy and our "helpful hints" quickly expanded into the actual production of circuit boards. It was quite common for us in those days to provide the transmitter electronics alone. Field researchers would then package them with a battery, cast the configuration and place it on a collar. In those days the packages didn't have to last too long to be considered successful.

Twenty years and 85 staff members later, our role as a partner to the field researcher has expanded considerably. The technical improvements have been dramatic and they've taken place in a leap frog sort of way. First the electronics improved enough to outlast the batteries. Then the batteries improved enough to outlast the packaging. When the packaging improved dramatically too, we went to work on collars and attachments. In fact, we frequently hear from individuals in the field that they have just recovered a functional, large collar configuration that's been out there for seven or eight years! While it's not possible to guarantee that all our packages will perform like these "sweetheart" units, it is now routine to guarantee a three-year operational life in our larger VHF configurations under extremely rigorous conditions. That success depends in part on the quality of collars and attachments. While there are universal standards, Telonics produces many special products to meet individual research needs. *Stan Tomkiewicz*



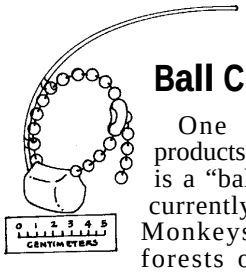
Really, Really Big Collars

What's 4 inches wide and 13 feet long? In our collar room, the answer is a Telonics elephant collar — one of the largest and most difficult manufactured at our facility. Each collar takes three hours to produce from predesigned patterns and durability is the key design criteria. Collars may need to withstand hours of elephant scratching on trees, as well as damage caused by other animals. The wear on the outer urethane belting necessitates that it be double-layered and reinforced with riveted brackets.

In the very first elephant collars we manufactured, the transmitter canister was riveted to the collar and cast in urethane. That didn't prevent elephants from manipulating the transmitter with their trunks until it actually "popped" out of the collar. To solve this problem, a special reinforcing structure has been developed to secure the transmitter into the collar and then the entire unit is cast.

More recently, ARGOS PTT's have been used to track elephants and a VHF transmitter can be placed on the collar as a beacon transmitter. In some cases, the collars are counter-weighted so the ARGOS unit rides on top of the elephant's neck rather than underneath.

An additional modification has been developed at the suggestion of Dr. Fred Koontz of the New York Zoological Society. The modification, a two piece collar, allows for maximum flexibility in positioning the transmitters (or transmitter and counter weight) on various sized elephants. Used in a limited number of evaluational collars, the design shows how the process continues as we learn more about the instrumentation process. *Bruce Thompson*



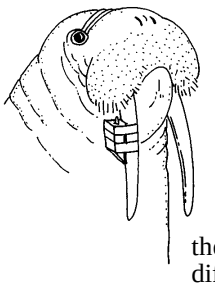
Ball Chain Collars

One of the specialty products we offer at Telonics is a "ball chain" collar. It's currently used on Tarmarin Monkeys inhabiting the forests of Brazil, but was developed for Howler Monkeys many years ago.

The collar is made of small metal balls attached directly to a hermetic canister containing the transmitter electronics. The battery is then attached and a polymer for moisture protection added.

Before the ball chain approach, two different collar designs for the Tarmarin Monkeys were in use. The first was made of nylon and the second of butyl material. While the nylon collar proved to be the best of the two, a problem with nylon was discovered when the monkeys groomed themselves and each other. They would pull on the outside strands of nylon fibers — which in turn caused the inside fibers to bunch up and irritate the neck. The overall design proved to be too heavy and the fit was less than optimum. Changing from the early designs to a ball chain collar reduced the entire configuration's weight and improved the fit. It allowed the monkeys to groom underneath the collar and any irritation to the neck area was eliminated.

Since many Tarmarins (Golden Lion, Panamanian, Cottontop) are endangered species and the instrumented individuals are being reintroduced into formerly occupied ranges, every aspect of handling and telemetry is critically evaluated. Prototypes are thoroughly tested in controlled environments before deployment. *Belinda Fedo*



Walrus Attachments

While marine mammals always present formidable obstacles in attachment procedures, the walrus is particularly difficult. It's hard to use a collar when you can't find a neck!

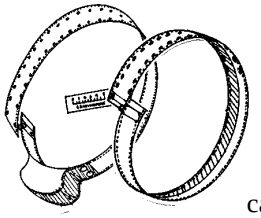
In the late 1970's, VHF transmitting subsystems were successfully attached to walrus tusks. The units were small and designed to fit on the back side of a tooth measuring as much as one yard (meter) in length. As researchers moved to studying walruses with satellite telemetry, the natural attachment point was again the tusk. Although the satellite units were larger (1250 grams) than the early VHF units, relative size and weight must be kept in perspective. Since a walrus can weigh approximately 600-1200 kg (or 600,000 1,200,000 grams), a comparable analogy might be selecting a hood ornament for a VW bug!

In designing a successful package for walruses, durability has to be a prime consideration. The satellite transmitter and batteries are cast inside a canister to keep the unit from being crushed by the pressure exerted upon it when the animal dives to the sea bottom for food. The unit must withstand the impact when walruses engage in banging tusks while on the beach. The whole unit is hermetically sealed to keep out moisture, and then cast a second time as a shock buffer.

With the unit located on the tusk, the antenna needs to be short enough so that it won't interfere with the animal's eyes or whiskers. The TA-7 marine antenna was selected because, at 401.650 MHz, the antenna is appropriately short and stub-like. Special stress reliefs have been placed on the antenna to strengthen and secure the attachment onto the canister.

To assure that transmissions from the satellite unit are synchronous with walrus surfacing, a salt water switch is installed. The external portion of the salt water switch takes the form of two metal buttons. When the animal is out of the water, the switch is open and the unit will transmit immediately and continue transmitting at its usual repetition rate. When the buttons are immersed, the unit will not transmit. This also allows the researcher to determine the amount of time an animal spends in/out of the water. In addition, the form factor of the external casting not only needs to fit the tusk, but must also be shaped to allow water to run off quickly to avoid freeze-up around the switch elements.

Scott Epps



Color Coding

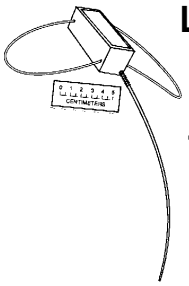
Telonics offers a variety of customer options and one is color coding collars for visual identification from the ground or air. In some cases the color coded collar is used as part of a transmitting subsystem; in other instances no transmitting unit is attached to the collar. The advantage is that researchers can use a color scheme to identify the animal based upon casual observations by either the research team or the public. Of course, visual markers may also impact predator-prey interactions.

While color coding is not a new idea, the materials used are improving. In the old days, color coding was often accomplished with vinyl electrical tape. The problem was that in very cold environments the edge of the tape could become rigid and razor sharp. Conversely, the adhesive on cheap tape became sticky in extremely warm environments and could entangle the animal's fur. Today the color material is made from reinforced vinyl and these problems have been largely eliminated.

Almost any primary and/or secondary color can be used as part of the coding scheme, but highly contrasting colors usually work best. As a personal aside, those professors buying color coded collars for grad student projects should first make sure your student(s) has a color receiver (i.e. not color blind) or even the most intricate color scheme will fail. Yes, it has happened!

All color coding is customized and contrasting panels can be arranged with any color scheme or measurement. If a study is taking place in a dense forest region, researchers can choose a highly visible material. If, on the other hand, camouflaging the radio collar is desirable, dark colors are available.

When a researcher is considering color-coding, cost is a factor. It depends on the number of colors used and the intricacy of the pattern. *David Rex*



LB-400 Turkey Harness

I've only worked at Telonics for three months and one of the first jobs I encountered was building transmitting subsystems for turkeys.

The LB-400 is a new unit measuring about 2.75 x 1.35 x 1.35 inches (6.9 x 3.4 x 3.4 cm). The weight is 110-120 grams. It's designed to work either as a backpack unit for large body birds or in a collar. The LB-400 is unique because it is one of the few totally polymerically sealed (as opposed to hermetically sealed) units that Telonics produces. The LB designation stands for "low bid" and the pricing structure is extremely competitive with other units using polymers as a moisture barrier. The unit also offers good value because our internal water blocks at the point of the antenna exit are far superior to the classic acrylic and epoxy sealed units sold elsewhere. The biggest drawback is that the LB-400 cannot be refurbished...it's cheaper to just buy new ones!

Most of the fielded units are currently being used on turkeys and at least two versions of the backpack configuration are available. In the most popular, a special harness connects to the transmitting unit through two holes. A whip antenna comes out and can be stress-relieved with a spring to provide support. Alternatively, incorporation of highly flexible tubing replacing the spring may further increase the functional antenna life.

The LB-400 transmitting subsystem was primarily developed as a low cost solution with the best implementation of polymer sealing available in the industry. As we get more units into the field, we'll keep you posted. *Lyle Wilde*

TR-4 Receiver Update

A Positive Response

In the Winter 1990 Telonics Quarterly, Dave Beaty discussed new product development with specific emphasis on our TR-4 Telemetry Receiver. Dave pointed out the TR-4's small size (6.75 x 3.5 x 1.75 inches, 17 x 9 x 4 cm), low weight (425 grams including batteries), and that its performance characteristics equaled our TR-2. At that time the TR-4 was in pre-production, but that has now changed.

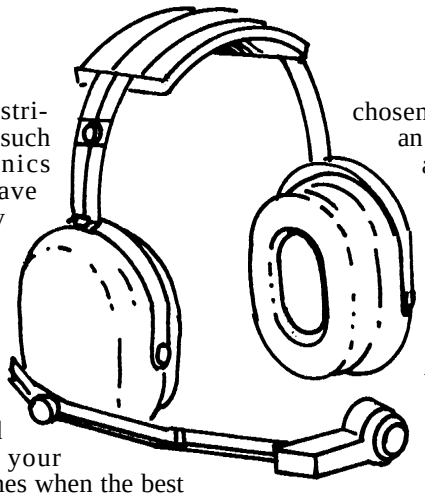
In early 1991, several people assisted us by field testing five of the new receivers to supplement our own testing. After very favorable comments, we made the TR-4 available commercially. Since then, over 80 receivers have been sold and are in use in at least 15 states and 7 countries. (While these numbers might not impress Sony or Panasonic, our emphasis is on producing highly specialized equipment for wildlife and environmental monitoring and we are very pleased.) Users have found the TR-4's sensitivity comparable to, or better than, any of the other telemetry receivers they have used in the past, and have especially liked its portability.

Prior to introducing the TR-4, we wondered whether its availability would reduce demand for our TR-2, but this has not occurred. With its 2 (to as much as 6) MHz continuous frequency coverage and optional companion TS-l Scanner/ Programmer, the TR-2 is still preferred by researchers involved in large scale telemetry projects and/or extensive aerial tracking. The TR-4 is designed for studies involving 100 or fewer transmitters and when tracking is primarily conducted from the ground.

A unique feature of the TR-4 is that the specific frequencies covered can be reprogrammed by users equipped with Telonics TPI Programming Interface and a personal computer. As long as they remain within the overall tuning band of their TR-4, users can add frequencies to unused channels, delete frequencies no longer needed, or otherwise modify the frequencies corresponding to the 100 channels. Although many users will never need to modify the frequencies, being able to quickly and easily do so may prove very useful for agencies, university departments, or individual researchers who work on various projects with unique frequency requirements.

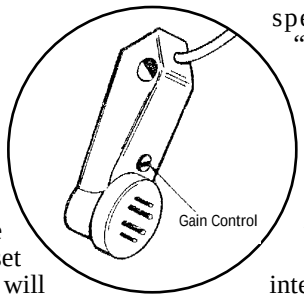
We are extremely pleased with the reception the TR-4 has received from the field. We believe this new low cost unit will aid in numerous research projects in years to come. *Bill Burger*

Garble In, Garble Out



Aircraft audio distribution systems such as the Telonics TADS series have been a true aid by making VHF telemetry signals available to everyone in the aircraft cockpit. Gone are the days of trying to get the pilot to bank left by making extraneous hand gestures and yelling at the top of your voice. But there are times when the best of intentions seem to go awry. Let's say that your intercom system has worked perfectly for a year or two. By some unfortunate circumstance, you have to replace a headset and now the communication in the intercom system is garbled and hard to understand. What to do?

The piece of the puzzle that comes under scrutiny first is the new headset. There is a good possibility that either the gain of the boom microphone is set so high that it is causing the distortion and garbling, or the type of microphone chosen on the new headset is an improper design for the application. (Some types of microphones will never work properly in helicopters with the door removed.) The solution is fairly simple. First, open the squelch all the way so that noise can be heard and adjust the volume to a comfortable setting. Second, adjust the gain of the microphone. Third, set the squelch so that it will open under normal voice levels.



Most dynamic microphones have the capability of gain adjustment. If you are using the Model H10-30 David Clark headset, the stock mircophone features a screwdriver adjustable gain control which will allow the user to adjust the gain of the microphone to accommodate the range of sensitivities found in most aircraft intercom systems. The gain control is found next to the microphone on the same side of the microphone housing assembly. If the problem persists after adjusting the gain of the microphone, it's time to visit the avionics shop where the whole system can be checked and set to optimal operating specifications. Some of the newer "Electret" microphones constantly open the microphone's squelch control no matter where the gain control is set. If you encounter this problem and must operate in an aircraft with very high ambient noise levels, a change in the microphone type may solve your problem.

Generally speaking, "problems" with intercoms and headsets are a rarity and, by means of simple adjustments, can often be easily resolved. If you need further advice, give us a call and we'll be glad to help. *Gary Jones*

TELONICS INC.
TELEMETRY-ELECTRONICS CONSULTANTS
932 E. IMPALA AVENUE
MESA, ARIZONA 85204-6699 U.S.A.
(602) 892-4444
FAX (602) 892-9139
TELEX 160231

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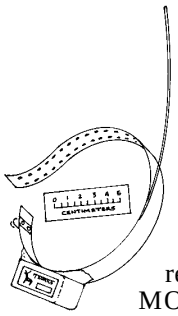
Kit Fox Collars

The Kit Fox transmitter and collar that we presently manufacture most frequently is the result of several years of evolution to the current design.

Kit Fox collars were originally constructed using two layers of 1/16" thick butyl material, and were attached to a MOD-300 transmitter configuration for adults or a MOD-095 configuration for pups.

Although the original collars performed well, some researchers thought a smaller, lighter package would be preferable for Kit Foxes. Researchers at EG&G thus began using a nylon webbing collar, which was lighter and more flexible than the butyl collars, still incorporating the MOD-300 and MOD-095 transmitter configurations.



Next, our development of several new transmitter configurations allowed researchers to select configurations which were smaller and lighter than those originally used while maintaining the desired operational life and performance. Specifically, these developments have resulted in changing from a MOD-300/butyl collar transmitting subsystem to a MOD-080/nylon collar subsystem (See Figure ..) for adult Kit Fox, and changing from a MOD-095/butyl collar subsystem for pups to either a 2A/nylon collar subsystem or a MOD-080/nylon collar subsystem. *Keith Martineau*