# Data Acquisition Systems

*What We Want And Where We're Going*

The computer revolution and widespread availability of personal desktop computers have spurred interest in telemetry receiving systems with the capability of recording information digitally. To accomplish this end, the telemetry data collection process must be controlled by a microprocessor. Data must then be stored in a memory device in the field and later transferred to a "main computer" back in the office.

A basic incompatibility.

In the early stages of development, it was recognized that computers have a basic incompatibility with highly sensitive receiving equipment. A computer can generate a substantial amount of radio frequency (RF) noise. If you place a radio telemetry receiver near, or point a receiving antenna at your computer, you will find that it's a strong source of radio signals. You could probably "track" the computer because the noise generated can be as strong a signal source as some wildlife transmitters.

Suppressing the noise.

The broad-band RF noise generated by computers must be suppressed to meet federal regulations developed by the FCC to govern sources of RF interference. The required spurious signal suppression is adequate to limit interference with most commercial voice and data links; however, telemetry receivers are much more sensitive than commercial receivers. Even after treatment of computers for noise suppression, the "noise sources" can adversely affect telemetry receiving equipment. The problem is amplified when a receiver must be directly connected to a computer; the noise generated by the microprocessor and associated integrated circuits raises the noise floor of the receiver and can drastically reduce the range performance of the system. The faster the computer's processes, generally the more RF noise generated. Further, CRT display screens utilized by computers also generate a vast amount of noise. The noise is introduced not only through the wires connecting the screen to the receiver, but also through the air path. Shielding the computer from the receiver (and the use of specialized interconnects with RF filtering) help to minimize some effects, but the problem often persists to some degree with most commercially available computers.

Other challenges to be met.

We learned many lessons in the 1980's when Telonics developed one of the earliest computer-controlled data acquisition systems. It was never made available because while computers provided a powerful means for controlling and storing data, they also presented problems that we were determined to solve. In some cases, the degradation of receiver sensitivity could reduce range so substantially that the system was workable for short range laboratory or enclosure studies, but was unusable in the field.

Lap-tops opened the door.

As time progressed, commercially developed lap-top computers offered some advantages over desktops. For example, the lap-top could not use a CRT display and still be portable; therefore, the old cathode ray tube was dropped in favor of a liquid crystal display. This reduced the noise. Further, lap-tops eliminated the problem of having to supply 110 VAC to the data acquisition system in the field. They were already portable and designed to operate from either NICAD batteries or from external 12 volt batteries. The disadvantage was that early lap-tops could only operate for limited periods of time.

Designers attempted to reduce current requirements so business travelers could use computers throughout the flight from New York to Los Angeles. Unfortunately, the first commercially available lap-tops (e.g. Radio Shack Model-100) had a limited RAM storage capability. Many of the first systems developed for field use required large amounts of data to be stored on tape. Tape storage could be unreliable. To ensure accuracy, the data was often stored on tape in duplicate or triplicate sets which required a lot of storage space. Further, the tape medium often did not work well at extreme temperatures.

Disk drives and the storage problem.

The storage problem was somewhat alleviated by the development of small portable disk drive systems which operated on battery power. Unfortunately, the systems had their own difficulties. The disk slot allowed entry of dust, causing the heads (which were designed to read and write to the diskette) to become fouled. Although these disk systems were designed for portability, they were not designed to withstand 40 miles of bad road in the bed of a truck. Often they became misaligned and failed in the field. Disk drives were also notorious for generating RF noise and, although battery operated, their current requirements were often unacceptable for long term, unattended operation. In spite of these limitations, Telonics developed the "Fast Data System" in the mid-80's. Based on a small lap-top, the system collected information on tape and was used effectively in several studies. However, it was clear to us that the requirements for field data acquisition in the future would be far more demanding than could be provided with this kind of system.

Commercial data loggers.

The next step in the development process involved researchers who were already using commercial data loggers to collect data in the field. Originally designed to collect information from weather monitoring instrumentation, they represented a significant step forward. In this case, the receiving systems were generally treated as just another "instrument" and the data logger blindly recorded data coming from the receiver-processor unit. In the early days, data had to be stored on tape or disk; consequently, it suffered from many of the limitations associated with early lap-tops. In the past year or two, the development of more sophisticated RAM chips at affordable prices has allowed data loggers to store much of their data on non-rotating, non-volatile memories. Thus, in the past few years, you may have seen colleagues utilizing data loggers in association with telemetry receiving subsystems.

So where are we today?

Perhaps the greatest difficulty still associated with the use of data logging systems for radio telemetry work is the uncertainty in collecting data being transmitted from unrestrained animals. Often, the animal is out of range or the signal strength varies dramatically as the animal is engaged in some type of activity. This uncertainty requires a much more intelligent data collection protocol than that used in hardwired systems, In general, commercial data loggers collect data but do not control the acquisition in a sophisticated manner.

Criteria for the 90's.

Future generations of radio telemetry data acquisition systems must offer a higher degree of intelligence and integration if they're to properly support the field.

• From a hardware perspective, the problems associated with microprocessors in close proximity to sensitive telemetry receivers must be avoided or minimized.

• Memory systems must operate under conditions which actually exist in the field. The units must be shock resistant and capable of operating over the range of worldwide temperature extremes.

• Software programs must incorporate the necessary intelligence to handle radio telemetry data and its unique problems.

• Most importantly, it is essential to realize that individual components make the entire system work. Many of us have broken an antenna cable only to realize that the system no longer functions without that one $8 cable! The same is true in a sophisticated data acquisition system. System performance and reliability are a function of all the components associated with the system, including the transmitter, collar or attachment mechanism, transmitting antenna type, and deployment of the receiving antennas — every component must be functioning properly to achieve the data reliability we expect in the 1990's with a fully functional data acquisition system.

We're getting close.

Telonics is committed to producing the finest equipment available and we never introduce a new product until technology has caught up with field requirements. The receiver/processor portion of the data acquisition system has been completed and we are in the process of integrating the digital control and data acquisition functions. Our projected completion date is early 1991. We're getting very close, and hope our quality and reliability will prove well worth the wait! Stan Tomkiewicz

# New Test Receivers Now Available

*Designed For Short Range Reception Of Transmitters*

One of humanity's common burdens is the need to resolve conflicts between what is wanted, what is needed, and what the budget allows. We have had cause to reflect on this situation recently for two reasons: first, while reviewing our equipment "wants and needs" in the production area where we build and test satellite transmitters and TIPS (Telonics Interactive Programming Systems) and, second, because we wanted to tell you about a pair of new products, the TVR-1 VHF test receiver and TSTR-4 UHF (ARGOS Platform Transmitter Terminal) test receiver. Both receivers are designed for short-range reception of transmitters.

The TVR-1 is designed for reception of signals in the 145-170 MHz band, and the TSTR-4 for ARGOS transmissions at 401.65 MHz. We believe these two receivers perfectly fit the need for a reliable lab or field transmitter test monitor while leaving the study's budget unscathed (i.e. cost is less than a "C" note — $98).

Measuring only 4.5"L x 2.7"W x 1.3"H (11.4 x 6.9 x 3.3 cm), either receiver is small enough to slip easily into your shirt pocket unless, of course, your shirt doesn't have any pockets. Likewise, the light weight (approximately 155 grams) is a definite relief for your aching back; you're already lugging enough stuff around to buckle a bull elephant's knees. A 1.3" x 2.7" (3.3 x 6.9 cm) end panel contains all controls and external connections.

The receivers are simple to operate with a power on-off switch and HIGH-LOW sensitivity switch. The TSTR-4 UHF includes an internal antenna; the TVR-1 has a female BNC connector for attachment of various external antennas. The receivers provide both a visual indicator and audio tone with each received transmission.

An output jack is provided to expand your testing or monitoring capabilities by generating a clean 0 to 7 volt gate whose pulse width is equal to that of the transmitter under test. This output, when connected to an appropriate recording device, can provide a permanent record of transmitter pulse width, repetition rate (period) and on satellite PTT's, duty cycle.

Power is provided by a standard 9 volt alkaline battery accessed by a slide-out cover on the rear of the housing. This provides approximately one month of operation — if you install a fresh battery at the same time you begin barking at the moon and lurking around the foggy bogs, you can always be sure the receiver is ready for reliable service.

The circuitry of these receivers is operational over the temperature range of -40 to +70˚C, but cold end operation is limited by the battery. Shirt pockets were invented, we believe, to keep the receiver battery warm when its owner is testing transmitters out in places trafficked only by large white bears, Russian salt miners, and the insufferably healthy. Please keep the receiver there unless actually in use.

In unison, now, shout "so what can I do with this little whiz bang"? The TVR-1 can be used to verify whether a transmitter is operating, and can be used at deployment to assure that the transmitter you just placed on that goose or bear is turned on and functioning prior to releasing the animal. When "exercising" transmitters during extended storage periods, the TVR-1 can verify transmitter operation. After the test, the unit can be used to confirm that the transmitters are turned off for storage. The receiver can determine presence/absence information at a den site, trap, etc. If such information is recorded via the output jack, individual transmitters can be identified by their unique pulse periods.

The TSTR-4 is an inexpensive, portable means of determining whether a PTT is transmitting. This is especially useful since many people working with PTT's do not have continual access to an uplink receiver, such as our TSUR-B. Repetition periods and duty cycles can be easily verified and when testing is complete, you can be assured that each PTT is properly turned off and the timing functions reset. Additional uses await your imaginations. In the meantime, we hope that we have relieved some of the conflicts between your research needs and financial resources. Rick Wagner & Bill Burger

# Telonics Canada Offers Savings in Both Time and Money

Telonics customers in Canada have special concerns that we have always tried to address. One has been the transit time involved in shipping to and from the U.S., and another has been the increased cost of telemetry equipment once duty, federal sales tax and freight have been added to the initial price. Realizing that budgets are restrictive and time valuable, we want to ensure that our service to Canada is of the same high quality as our equipment.

In 1982, Telonics began offering our Canadian customers an alternative method for ordering VHF equipment. Located in Winnipeg, Manitoba, Telonics Canada is a Canadian company owned and operated by Dr. Vince Crichton. Vince, a practicing wildlife biologist, offers Canadian customers a local source for our VHF telemetry equipment. He also works closely with our staff on every aspect of our products and services.

Many of the advantages offered by Telonics Canada involve shipping costs. The company is able to provide customers with reduced duty and federal sales tax expenses. Transportation costs can also be reduced considerably by the firm's ability to consolidate shipments. In addition, Telonics Canada is able to provide a very rapid system of ground transportation between Arizona and Winnipeg at a much reduced rate. This is particularly important since the lithium batteries used in transmitters are classified as "dangerous goods" by DOT and IATA, and must be shipped on "freight only" aircraft at a higher cost. When all of these various shipping services are combined, they can help to reduce costs significantly.

Telonics Canada also helps in a variety of other ways. They take care of the myriad of regulations governing the import and export of equipment, and ensure that the appropriate documents have been completed. They have established relations with both a brokerage firm and customs officials, and this is a real plus. Both parties have become very familiar with Telonics equipment; therefore, the time involved in processing shipments is decreased. You might recall that when the harmonized custom system was enacted in January 1989, the number of item classifications increased by about 10-fold. Even with this increased complexity, Telonics Canada has been able to continue expediting service.

The major advantage in dealing with the same broker and customs officials is time — shipments can be sent from our laboratory, cleared through customs and in the possession of Telonics Canada within 24 to 36 hours. In some instances, the shipment can be in the hands of our customers within 48 to 72 hours. Even though the equipment is shipped through Winnipeg, customers may receive their order more rapidly than if it had been sent direct.

There are other cost saving opportunities that Telonics Canada has been able to ferret out through the years. All telemetry equipment imported into Canada for use on aircraft in natural resource development can be imported exempt from duty and federal sales tax. In addition, equipment specifically designed for use on aircraft such as the reinforced "H" antenna are also exempt. When all the savings are added, both in time and money, the benefits are significant.

Please note that any VHF equipment purchased through Telonics Canada carries the same warranty as equipment purchased direct. If you choose to utilize the convenience of ordering your VHF equipment through Telonics Canada, you may contact them at the following address:

Dr. Vince Crichton
Telonics Canada
104 Purdue Bay
Winnipeg, Manitoba R3T 3C7
(204) 269-7011

While we certainly encourage our Canadian customers to take advantage of the opportunities available through Telonics Canada, we do not want to discourage any of you who prefer to order from us direct. That option is always available. Due to the complexities involved in satellite telemetry, all inquiries regarding UHF equipment should be directed to Mesa, Arizona, USA. Brenda Milam

Things You Often Ask About...

• Yes, your TS-1 Scanner can be used with an extended range receiver. It will scan 2 MHz at a time. The first digit of the channel selector on the receiver is the determining factor. Give us a call and we'll go over it with you

• It's true, refurbishing transmitters can save you a lot of money. Just talk with either Dan Decker or Kathy Hanson. They'll be happy to provide you with information on pricing and turnaround times.

• Not only are the four elements of your RA-2A antenna tuned to a specific frequency, but so is the "H" section. Do not interchange elements of a different frequency with the "H" section if maximum range and a predictable pattern are desired.

• Yes, Telonics is often invited to conduct seminars in conjunction with various universities and/or game and fish departments. When possible, we'll let you know when one is available in your area.

• You want to send your receiver in for routine cleaning and alignment. Be sure the package includes a billing address, shipping address and phone number where you can be reached. If you're experiencing any kind of difficulty with the unit, be sure and include a brief note explaining the problem. This enables us to give you the best service possible and before you know it, you will have your equipment back in the field working like new!

• Your study starts soon and you want to order new transmitters. Since there are many frequencies and options available, we work with each customer individually to provide the equipment that's best suited to a particular study design. The earlier you contact us and the more information you provide, the better we can serve you promptly.

• Because many of your purchasing departments require a copy of the actual freight bill, invoicing for freight is sometimes delayed until we receive this billing from the freight company. Therefore, there are times when you will receive shipping charges after you have received both the equipment and the invoice.

.• Yes, we do sell aircraft antenna brackets. Information is available on request regarding strut mount brackets for high-winged aircraft. Susie Crow

# Selecting The Right Antenna for ARGOS

*A Few Guidelines*

Antennas are often the most misunderstood aspect of communication systems —the ARGOS satellite system is no exception. Since ARGOS and NOAA control the antenna configuration at the satellite, we will deal specifically with the selection of antennas to be used on ARGOS Platform Transmitter Terminals (PTT's) in non-wildlife applications. The antennas described in this article are omnidirectional. (That is, their radiating pattern is omnidirectional.)

FACTORS WHICH SHOULD BE CONSIDERED WHEN SELECTING AN ANTENNA ARE:

1. The physical configuration of the deployment. (This may include balloons, buoys, yachts and ships.)

2. The proximity of the antenna to metal. (If the antenna is too close to surrounding metal objects, the tuning and radiation pattern of the antenna will be adversely affected.)

3. A variety of environmental factors.

(e.g. salt air exposure, high humidity, high winds, and perhaps excess traffic on a boat or ship where the antenna and/or cable could suffer physical damage.)

4. The presence or absence of ground plane beneath the antenna.

Telonics produces many specialized antennas which can be deployed in a variety of applications. The following anten-

nas are representative.

• The CM000398-401 is a half wave ground plane independent antenna suitable for applications where there is no ground plane available. The antenna must be protected from the elements by a waterproof housing that is transparent to RF.

Antenna gain is 0 dBd.

• The CM001968-401 is a ground plane independent antenna that is designed to withstand the rigors of the shipboard environment. This antenna comes with an attached mounting bracket and a choice of connectors, BNC or TNC, on RG-58 cable with a maximum length of 17 feet.

Antenna gain is 0 dBd.

• The CM000849-002 is a quarter wave antenna which requires ground plane to function properly. This antenna has 0 dBd gain and can be used in situations where the application will provide a suitable ground plane.

• The CM001331-001 supplies its own ground plane with a foreshortened quarter wave radiating element. This type of antenna was designed for spherical buoys when it's necessary to provide a ground plane with an antenna exhibiting quarter wave performance in a reduced dimensional outline.

Since antennas are often used in harsh environments, they require the best installation possible. The antenna cable is the most vulnerable portion of the system and, therefore, should receive the most care. Whenever the cable is crimped, bent at sharp angles or smashed, serious problems are

created which cause loss of data from the transmitter. Every antenna cable should be installed in the location which will afford it the most protection.

Your antenna choice for a given project will be influenced by many factors. In some cases, only one type of antenna will meet the requirements of a particular application. In another case, there might be two or three antennas that will do the job. Please be sure and talk with us about all the factors involved in your particular situation. The right antenna is critical to system performance. Your choices are certainly not limited to the antennas listed above. Sometimes a custom antenna is required, and we have the expertise at Telonics to provide you with custom design services.

Gary Jones

# Index Of Articles Back Issues Are Always Available

Telonics has been publishing the Quarterly for almost two years now and we get quite a few requests for back issues. Some of you ask for multiple copies to use in the classroom. Others want just a single copy that contains new product information or tips on the care and feeding of a particular piece of equipment. The following index covers all our articles to date. If there's anything you've missed, just let us know.

Collars
- Expandable/breakaway collars. (W'88)
- Innovations in collar assembly. (F'89)
- Transmitter attachment collars. (W'89)

General Interest
- Telemetry — a personal view. (F '88)
- Specialized support capabilities. (W '88)
- Technical specifications. (W '88)
- GSA regulations. (Sp '89)
- Federal agency funds solar collars for nocturnal animals. (Sp '89)
- Telonics — a personal view. (Sp '89)

- Cat #12 — equipment analysis helps reconstruct events. (F '89)
- The historical development of data acquisition systems. (W '89)

Helpful Hints
- Antennas, collars, sealants. (Su '89)
- Cables, transmitters, etc. (F '89)

Platform Terminal Transmitters
- ST-5 ARGOS PTT offers new generation of capabilities. (W '88)
- Software advances. (Su '89)
- Avian PTT's. (Su '89)
- Overview of satellite PTT's. (Su '89)
- (TIPS) Interactive Programming System available for ARGOS users. (W '89)

Other Satellite Topics
- Uplink receivers. (F '88)
- New D-band earth station provides real time data. (W '88)
- Satellite telemetry in wildlife applications. (W '89)

Shipping & Handling
- Lithium batteries. (F '88)

VHF Receiving Subsystems
- Choosing the proper antenna. (F '88)
- TR-2 and static electricity. (F '88)
- Airplane antenna attachments. (W '88)
- TDP-2 digital data processor. (Sp '89)
- Special power supply options. (Su '89)
- THB-1 bracket designed for Hughes 500 series helicopters. (W '89)
- Receiver systems and how they relate to the "cowbell". (F '89)

VHF Transmitter Subsystems
- Care, exercise and storage. (F '88)
- Refurbishing and retrofitting. (W '88)
- Temperature sensing. (Sp '89)
- Hybrid circuit technology. (Sp '89)
- Real-time and time-delay sensors help to quantify activity data. (F '88)
- CHP transmitters available for smaller species subsystems. (Su '89)
- Selecting proper batteries. (F '89)