

ATM-900 Series Acoustic Telemetry Modems

INTRODUCTION

The ability to communicate underwater using acoustic energy in place of electromagnetic energy is rapidly becoming commonplace. Indeed, vendors and academic researchers in many advanced countries are pursuing the development of acoustic modems. The emphasis often varies among these efforts: some, especially academic researchers, focus on increased throughput or data rate, others investigate the development of undersea networks, and others concentrate on autonomous schemes enabling modems to establish "optimal" links with each other.

Teledyne Benthos has been developing acoustic telemetry modems for many years. The core components of all our modems are shown in Figure 1. All of our acoustic telemetry modems use these same electronics in different housings to meet differing depth and corrosion requirements. All modems in the ATM-900 Series use the same Digital Signal Processor (DSP), transmit and receive electronics, power supply circuitry and acoustic filtering. The UDB-9400 Universal Deck Box uses slightly modified hardware to enable the use of a remote preamplified transducer attached to a deck cable which can be up to 200 meters in length. The UDB-9400 is capable of receiving data at acoustic rates of up to 15,360bits per second by adding a secondary co-processor. This co-processor can optionally be added to some versions of the ATM-900 Series acoustic telemetry modems.



Figure 1 ATM-900 Series Acoustic Telemetry Modem Boards

GENERAL INFORMATION

The ATM-900 Series modems were designed for oceanographic, military, research and oil and gas allocations. The basic function of the modem is to transmit data from one or more devices to another acoustic modem. These data generated serially by the connected instruments awaken the acoustic modem with no separate acoustic wake-up sequence or special serial characters required. The transmitting modem handles the specific requirements of acoustic wake-up when transmitting to a modem that is expected to be in the sleep state. The serial device onboard the modem is in a very low power state but remains on to capture data with no losses and forwards that data to the transmit buffer once received completely.

Product: ATM-900 Series
Acoustic Modems

Date: April 4, 2011

Input and Transmission of Data

The modem has three modes:

- Command mode
- Online mode
- Data logger mode

In the command mode, the modem itself is being addressed (e.g., ranging commands, battery voltage status). There are specific commands to performing specific tasks related to the modems. When in command mode all data being sent to the modem would be treated as a command. This mode is typical when the user is working directly with the modems.

In the online mode, anything that is sent to the serial port is transmitted exactly as received (e.g., NMEA strings). Data are transmitted based on timing. When there is a predetermined amount of delay between serial data or if one or more of the transmit buffers are completely filled those data are transmitted acoustically. The data are in no way compressed, parsed, or used by the transmitting or receiving modem ensuring data are transmitted without any alteration. Error correction coding (ECC) and cyclic redundancy check (CRC) error checking are added to each data packet and handled by the transmitting and receiving modems to ensure the data are free of errors.

In data logger mode data are stored in the internal flash storage. Data are logged based on timing, keyed sentinel character, fixed length data packet or as each transmit buffer fills. When one of these conditions is met, these data are time tagged and stored as discrete records. The records can be stored, searched, acoustically transmitted, serially output or erased.

ATM-900 Series general specifications:

- Multiple standard operating frequencies
- Three housing configurations available
- 20 watts maximum transmit power
- Transmit rating of up to 185 dB re 1 μ Pa @ 1 m typical
- Maximum standby current 650 milliwatts (typical)
- Maximum sleep current 10.2 milliwatts (typical)
- Standard single RS-232/RS-422 port interface with optional second RS-232 port
- Real-time clock functionality

Standard Operating Frequencies

The three standard broadband operating frequencies for the ATM-900 Series are:

- Low frequency band: 9 – 14 kHz
- Medium frequency band: 16 – 21 kHz
- Interoperability Band C: 22 – 27 kHz

All acoustic functions operate identically in each band.

The low frequency (LF) band is best suited for applications where long range and reliability are required. The LF band is also well suited for short range applications with some simple acoustic tuning by the user. The LF band is where the majority of internal development is done and most commonly used throughout general purpose applications. Regardless of band selection there should not be any other acoustic equipment operating inside the selected frequency band (e.g. when using LF there should not be an operating 12 kHz echo-sounder in use when transmitting or receiving acoustic data).

The medium frequency (MF) band is well suited for medium range applications where acoustic interference may be an issue.

Interoperability Band C is typically used in special cases or where transducer size and weight are a major consideration.

Housing Options

The ATM-900 Series offers three different housing options using two different materials:

- 500 meter polyvinyl chloride (PVC)
- 2000 meter anodized aluminum
- 6000 meter anodized aluminum

The 500 meter polyvinyl chloride (PVC) material is ideal for shallow water applications where corrosion is an issue. The PVC material is now standard for the ATM-900 Series acoustic telemetry modems.

The 2000 and 6000 meter aluminum housings are ideal for deeper water where corrosion is not as prevalent and where high pressure tolerance at an affordable price is required.

ADVANCED FUNCTIONALITY

The ATM-900 Series primarily focus on low power operations, small size, reliability, and flexibility in application. In addition to these requirements the new ATM-900 Series was also designed for many other advanced functions that were not easily achievable with the previous series of modems:

- High volume, high speed serial data recording from attached sensors
- High volume, high speed continuous recordings of wideband acoustic signals
- Enhanced user command line interface
- Configuration parameters to control modem functions and settings

- Advanced data storage and interface
- Navigational Aids for Undersea Platforms
- Time-stamping
- Dual serial port (optional)
- Transponder and pinger modes

Serial Data Recording (Data Logging)

The ATM-900 Series can support high volume recording of either received serial data or of acoustic data received through the modem transducer transmitted from another modem. Data are stored either using internal flash storage (6MB available), or with an attached secondary storage device which supports dual SDHC cards of up to 32GB each for a total of up to 64GB of data storage. When recording serial data, data are received in the native format of the sensor, and move it into time-stamped files. Modem-based retrieval of the data can be accomplished without impact or interruption of the host sensor.

Wideband Acoustic Recording (Acoustic Data Recorder)

The ATM-900 Series can be optioned to support high volume recording of acoustic signals received through the modem transducer. Acoustic data are stored either using internal flash storage (6MB available), or with an attached secondary storage device which supports dual SDHC cards of up to 32GB each for a total of up to 64GB of data storage. When acoustic data are recorded, more than 120dB of dynamic range is available to handle wide amplitude fluctuations. Acoustic recording bands must be preselected and must fall within the range of the electronics and transducer selected.

Enhanced User Command Line Interface

The ATM-900 Series adds an enhanced user command line interface which gives the user more control over things like data

logging, modem configuration and modem operation. A simple scripting language helps to automate processes and reduce host processor requirements in certain applications. Command completion and history functions ease user learning curves and allow the interface to better assist the user.

Configuration by Parameters

The ATM-900 Series changes the way the modem is configured by the user. In place of the legacy S registers there is a more advanced configuration parameter interface. In the past one S register may have controlled many different settings and options which restricted possible settings combinations. The new configuration parameters allow for more settings combinations and easier to read settings, requiring less cross referencing to included documentation.

Advanced Data Storage

The ATM-900 Series adds the ability to log data in a large 6MB flash storage area that is sent to the modem both serially or acoustically. Those data are organized into records based on how they arrive at the receiving modem. If data arrives via the serial port it is put into the flash storage area as discrete records. Each record is created based on timing, keyed sentinel character, fixed length data packet or as each transmit buffer fills. This flash area can be expanded to use an attached secondary storage device which supports dual SDHC cards of up to 32GB each for a total of up to 64GB of data storage. Once the data are in the flash storage area it can be searched, acoustically transmitted, serially output or erased using advanced commands. These commands allow, for example, the user to download every 10th record created on 01/01/2011 from serial port 1 giving the user a sample of data from that day. These

data control variables can be altered by the user to transfer any data existing in the flash storage area that the user requires.

Navigational Aids for Undersea Platforms

For more information on navigational aids for undersea platforms please contact your local Teledyne Benthos representative or a member of the Teledyne Benthos sales team at +1-508-563-1000 or via email at benthos@teledyne.com.

Time Stamping using Real-Time Clock

The internal real-time clock is standard on all ATM-900 Series acoustic telemetry modems. The precision provided by this oscillator meets the requirements for many applications and allows for time stamping of all transmit and receive acoustic events and serial data that are to be logged in the modem flash storage. The ATM-900 Series can also be configured to time sink to an external source (e.g. GPS or atomic clock). Real-time clock accuracy:

- ± 1 minute/year or ± 2 PPM (0° to $+40^\circ\text{C}$)
- ± 4 minute/year or ± 7.5 PPM (-40° to $+85^\circ\text{C}$)

Dual Serial Port Option

The dual serial port feature allows two instruments to be attached to a single ATM-900 Series modem for purposes of data transmission and data logging. The standard acoustic modem configuration allows for input from a single instrument for purposes of transmitting to a remote modem or logging in flash storage. With the dual serial port feature enabled and appropriate cabling, two such instruments can be multiplexed on a single modem. Furthermore, the data input to each modem can be output on assignable serial ports when transmitted to and received by a remote modem. The output port on the

receiving modem is assignable based upon which port the data was input to on the sending side. When the instruments data are being logged, discrete records can be tagged in the flash storage according to which serial port they were received on.

Transponder and Pinger Modes

The ATM-900 Series retains the ability to operate with legacy Teledyne Benthos acoustic release and transponder products. This allows for long base-line navigation (LBL) when combined with the multi-channel receive option. The pinger mode turns the modem into a simple acoustic pinger when commanded through the serial port. When in pinger mode all modem functionality is disabled.

CONCLUSION

The Teledyne Benthos ATM-900 Series acoustic telemetry modems are a major enhancement to previous modem lines offered. While faithfully replicating all acoustic modalities of the earlier series of modems, the new ATM-900 Series provides a long list of special purpose, flexible extensions supporting multiple capabilities beyond “just” underwater communications. These capabilities range from high capacity data logging, through updated data storage and user command line interfaces to real-time clock integration. The modems are supported by a talented staff of sales persons, support engineers, service technicians, and design engineers to ensure customers success when using these products.

