V16A and V16AT Coded Transmitters

INNOVASEA

Transmitters

Used in applications that require any measure of animal activity

The V16AT Accelerometer Temperature Transmitter transmits 3D acceleration and temperature of your fish as it moves within your receiver array. The animal's acceleration signal is measured in terms of $m\ s^{-2}$ (SI units) and it is a vector quantity that is a result of measuring acceleration on 3 axes (X,Y,Z). This acceleration value can be used as a measure of activity of a free ranging animal in nature. **The V16AT available as an accelerometer option only (V16A).**

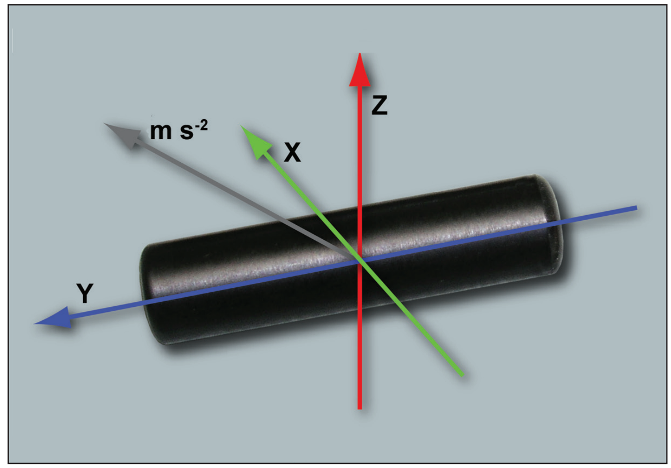

Figure 1: V16AT coded transmitter diagram

The V16AT can be used in an almost endless variety of applications that require any measure of animal activity. Applications may include measuring swimming speed via tail beat acceleration, detecting mortality through predation, seismic blasting, toxic spills, feeding events, spawning activity, nocturnal/diurnal activity, wave action and activity responses to changing oxygen, salinity and temperature in the environment.

V16A/AT Physical Specifications

Features	6L	6H
Length (mm)	95	95
Weight in air (g)	34	34
Weight in water (g)	14.9	14.9
Power output (dB re 1uPa @1m)	152	158
Measurement range $m\ s^{-2}$	±39.2[1]	±39.2[1]
RMS vector range $m\ s^{-2}$ (activity algorithm)	3.4[2] or 4.9[2]	3.4[2] or 4.9[2]
RMS vector range $m\ s^{-2}$ (tailbeat algorithm)	4.9[2]	4.9[2]

[1] Measurement range of the onboard acceleration sensor
[2] RMS acceleration range transmitted acoustically

What Does it Measure (Activity Algorithm)?

The V16AT measures acceleration on 3 axes, X,Y and Z (see Figure 1). The tag calculates a value that represents RMS (root mean square) acceleration that results from the contribution of acceleration from each of the 3 axes.

$$m\ s^{-2} = \sqrt{x^2 + y^2 + z^2} \text{ averaged over T}$$

For example, if a tagged fish accelerates forward then most of the acceleration signal will be measured on the Y axis; however, there would be some degree of X and Z axes acceleration owing to undulation of the animal's body if it is beating its tail. This tag is designed to measure a change in movement of a fish or any object to which the tag is attached. (See Figure 2.)

Operation Modes

You can specify 1 of 2 modes of operation:

1) Activity Algorithm

In this mode, the data transmitted by the V16AT represents the RMS value of acceleration for all axes (X,Y,Z). This mode is intended as a general activity index of the body of a fish. In this mode, acceleration is sampled on each axis at 12.5 Hertz (12.5 measurements/s).

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2) Tailbeat Algorithm

In this mode, the data transmitted by the V16AT represents the RMS value of acceleration for 2 axes (X,Z). This algorithm is designed to measure the acceleration of the undulation of a specific appendage (usually a fish tail). In this mode the Y axis (backward/forward body movements) is ignored. This mode was designed to provide researchers with a more precise measure of activity or swimming speed. Acceleration is sampled on each axis at 12.5 Hertz (12.5 measurements/s).

How Does it Transmit IDs and Data?

We have provided some programming flexibility in the design of this transmitter owing to the variability in swimming behavior of a wide range of species, benthic to pelagic. The programming parameters are Average Delay (sec) and the size of the acceleration sampling window (T) in seconds. The V16AT coded transmitter functions like all standard Vemco two-sensor coded transmitters. It has two coded tag IDs one for the temperature sensor and one for the accelerometer. The acceleration measurement is sampled over a period T. Figure 3 illustrates the sampling and transmission format. Immediately after the tag transmits an ID and temperature value (blue square), the tag begins the acceleration measurement (red line). After T seconds of measurement, the RMS value of acceleration is computed and stored in memory. Once the tag delay time is complete, the tag transmits the accelerometer tag ID and acceleration value (RMS of m s^{-2}) (red square). The tag then waits until the end of the next delay period and transmits the temperature value (blue square). This pattern repeats until end of life is reached.

To calculate the proportion of time that the acceleration is measured simply divide the accelerometer sampling time (T), by twice the average tag delay time. Example: for an average tag delay of 80 seconds with a sampling time (T) of 37 seconds, acceleration (activity) will be measured (37/(80*2)) * 100 = 22% of the time.

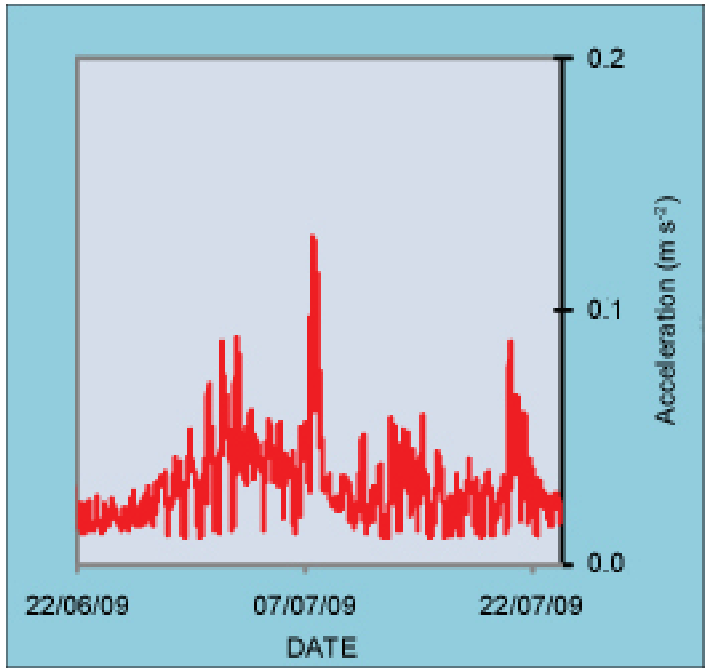

Figure 2: Example of activity of a demersal fish

What Are the Programming Options?

You can specify 1 of 2 algorithms (activity or tailbeat) and the duration of the acceleration sampling time (T) in seconds as well as the tags average delay time in seconds. The swimming behavior of your animal (i.e. burst mode) will be an important factor to consider. Your choice of algorithm, measurement period, Min /Max Off times and transmitter power output all contribute to determine the useful life of the tag. Please contact VEMCO to advise programming options for your study.

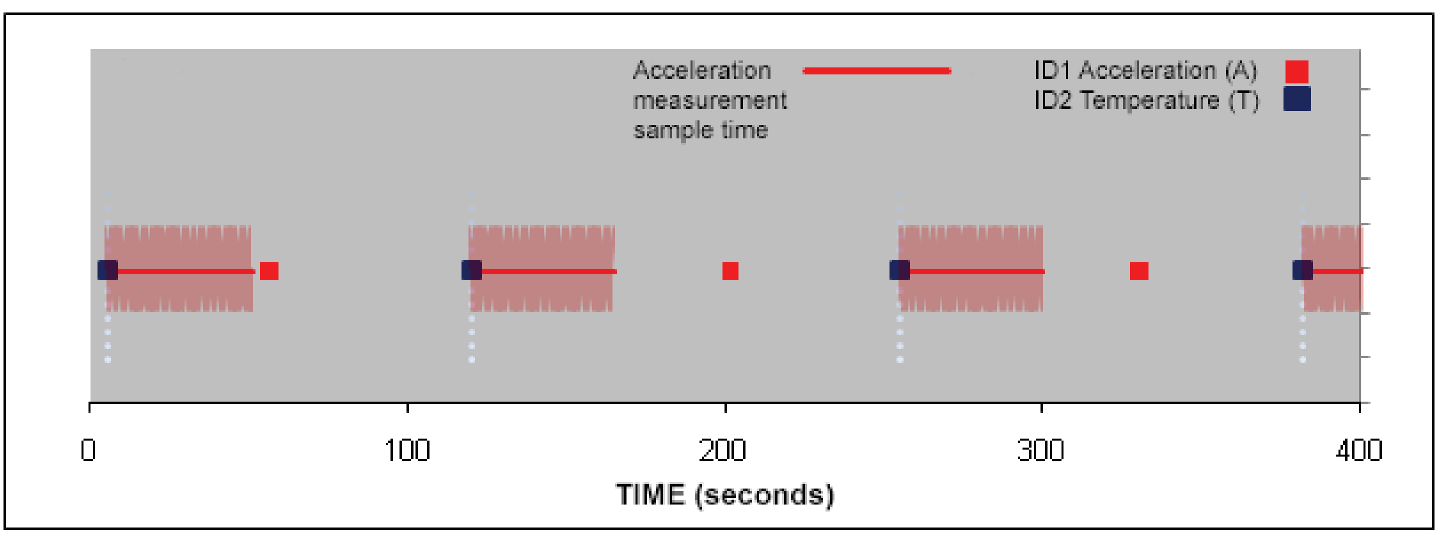

Figure 3: Example of sampling and transmission format for the V16AT. For the V16A, acceleration would be sampled for every delay cycle.

Coded Mode

"Coded" pingers send acoustic pings at 69 kHz that are infrequent and random about an average delay. This ping train includes an ID number which permits identification of the specific tag and sensor data. For dual sensor tags, there are two tag IDs. For applications such as site residency studies and automated monitoring of migrations, coded transmissions are desirable because of significantly increased battery life and the large number of unique IDs available on a single frequency.

Expected Battery Life

The life span of the V16AT and V16A depends on output power [high or low], the delay between ping trains [in seconds] and acceleration measurement settings. As shown in the table below, V16AT coded tags have several standard ping train delays. The V16AT incurs a small current drain prior to activation. Tag life will be reduced if tags are shelved for a significant period of time (months) and V16ATs should be activated within twelve (12) months of delivery. Contact VEMCO sales for information.

Case Options

The V16 comes in two case styles. The internally implanted unit comes in an epoxy case with rounded ends. The externally mounted unit is made of PVC with attachment holes at either end. The externally mounted unit is 22 mm longer than the internal V16 model.

Range Testing Tag

Range testing tags can be provided, at the same output power as your proposed study, to be used to conduct in situ range testing. Range test tags are configured with a FIXED delay and an on-time of two weeks. This is a precautionary measure to ensure that the tag will expire within a reasonable period of time if accidentally dropped overboard. The tag ontime can be reset using the external magnet.

Notes: The transmission rate varies randomly ± 50% about the nominal delay value. For example, a 30 second nominal delay indicates that the tag will transmit randomly sometime between 15 to 45 seconds. The projected battery life is an estimate and users will experience a decrease in battery life if their tags are operating in extreme warm or extreme cold temperatures. VEMCO transmitters are programmed to stop transmitting when they reach their stated battery life. This ensures that tags will operate at published specifications until expiration. VEMCO tags are warranted to be free from defects in material and workmanship for one year from date of delivery.

Model V16A		Battery Life (Days)	
Avg Delay (s)	Samp (s)	Low Power	High Power
60	25	3650	2231
120	35	3650	3618
240	45	3650	3650

Model V16AT		Battery Life (Days)	
Avg Delay (s)	Samp (s)	Low Power	High Power
60	25	3650	2380
120	35	3650	3650
240	45	3650	3650

Examples of V16AT and V16A life expectancy. Note that tags can be programmed for shorter lives, if required. This table shows our most popular nominal delay settings. Please contact VEMCO for more information regarding battery life for other nominal delay settings.