POWER CONSUMPTION EVALUATION FOR AN AWAC AND A GSM MODEM INSTALLED ON THE SARTI BUOY

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Abstract. This paper describes a procedure for measuring the combined electrical power consumption of an AWAC and a GSM modem. The purpose is to calculate the number of batteries and power required to provide and autonomy of 45 days. Experimental results show consumption in the order of 1 W/hr, and from this value adequate batteries are selected.

Introduction

The AWAC (Acoustic Wave and Current profiles) [1] is a sophisticate instrument that provides information about the currents profile and the direction of the waves in a single unit. It can measure the speed and flow direction of the currents, from the bottom to the surface in different layers, as well as long waves height, storm surges, wind waves and transient waves generated by local maritime traffic.

The research group SARTI is installing an AWAC next to the OBSEA underwater laboratory [2], offshore the coasts of Vilanova i la Geltrú (Spain), with the purpose to provide to the scientists real-time information of local currents and waves conditions.

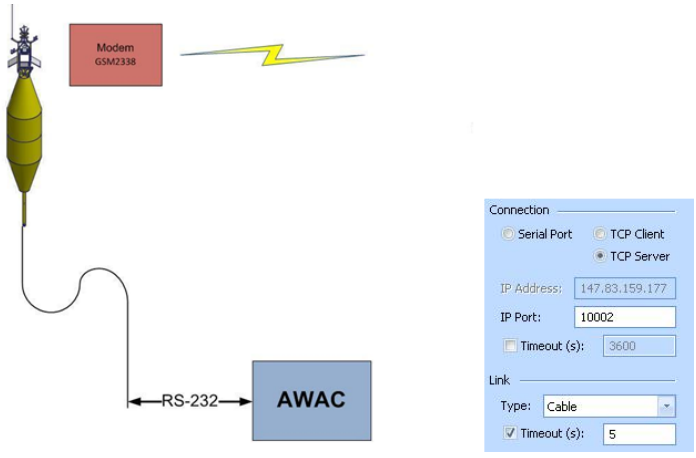
The AWAC will be powered with a pack of batteries installed in a water-tight aluminium cylinder, and the data generated will be sent to a data-center on the coast by a GSM modem installed in a buoy.

The challenge addressed in this paper is to calculate the power consumption of the AWAC and the GSM modem, and determine the dimensions and power of the batteries required to provide autonomy of 45 days, before changing the batteries.

2. System description

The system can be divided in two parts: first the AWAC and the batteries; and second, the GSM modem and the buoy. The AWAC and the batteries are located directly on the seabed, at a depth of 20m.

On the other hand, the GSM modem, a GSM2338 modem [3], is located at the top of the SARTI buoy, in the surface. The connection between the AWAC and the modem is done through a 60m cable using the RS-232 protocol, as shown in Figure 1. On the other hand, the GSM modem is configured as a client and sends the data to an IP address, through the port 10002, Figure 1. For real-time wave measurements, the SeaState [4] software was used, configured as a server listening to the port 10002. On Figure 2, it is possible to observe the AWAC submarine connector pin-out, and the modem connector, respectively.



(left) Figure 1. Modem connections between AWAC and GSM2338. AWAC configuration in SeaState.

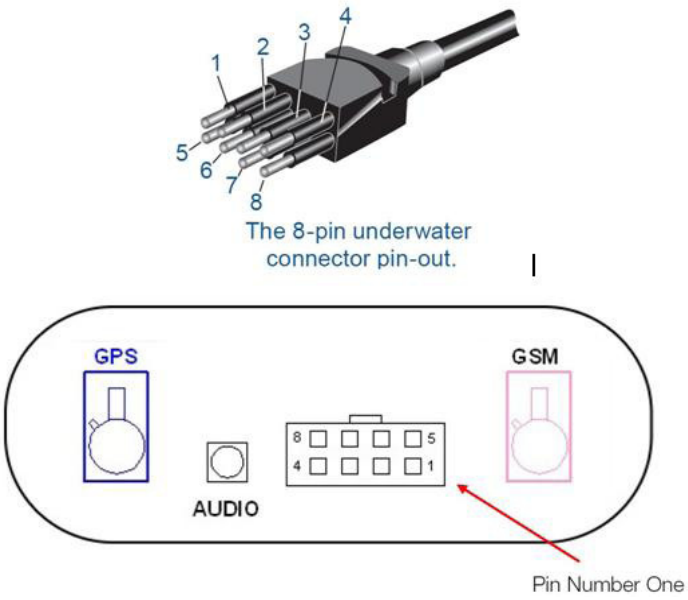


Figure 2. AWAC connector. Modem GSM2338 connector.

Test and Results

Different tests were conducted in order to determine the combined power consumption of the AWAC and the modem.

Test 1: Direct connection between the modem and the AWAC. The GSM modem configured as a client, and the AWAC configured as a server. As a result, this configuration did not work. So, the Test 2 was developed and tried.

Test 2: An intermediate program in LabView was added. The program receives the data sent by the modem to the IP xxx.xxx.xxx, to port 10002, and redirects it to port 10003 (SeaState settings as a client).

To verify the operation of the program a "middle software" monitors the data sent and received by the modem to the port 10002. On the other hand, also the data sent and received by the AWAC to modem is monitored (with a serial protocol analyzer). In this way, it was possible to ensure that the data sent by SeaState to the modem is the same as that generated by the AWAC.

On a first try, when the data was analyzed, it was observed that the data received and sent to the modem was not the same. The modem was not sending 6 of the 786 bytes required to read the instrument configuration. The problem was that the modem had enabled the use of the backspace key (0x08 in hexadecimal), which deletes the previous byte.

After changing the configuration of the modem, and verifying the correct transmission of data, the consumption test was setup.

3. 1 Consumption Test

For testing the electrical consumption, the AWAC and the GSM modem were connected in the laboratory and set to work for 3.8 days, while measuring the current every second. The voltage was constant, at 12 V.

Table 1 shows the minimum, the maximum, and the average current consumption on this period. From these values, the average consumption between AWAC and the modem is estimated to be ≈ 1 W/hr. From this, the average consumption between the AWAC and the modem, during 45 days, is estimated to be ≈ 1080 Wh.

AWAC + MODEM	CONSUMO [A]	
Consumo conjunto 3.8 dias (377.625 muestras)	Promedio	0,08337444
	Minimo	0,346
	Maximo	0,042

Table 1. Consumption AWAC + modem

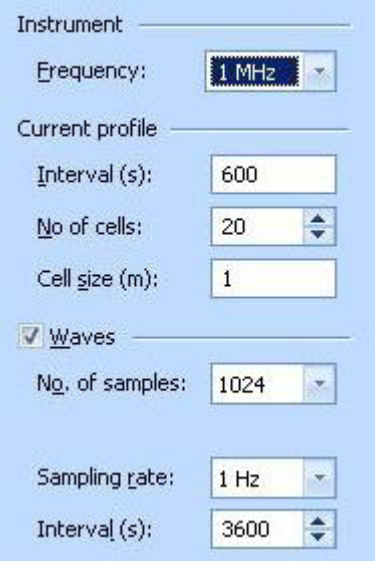


Figure 3. AWAC configuration

The parameters definitions and possible values are as follows:

- Acoustic frequency: 1 MHz, 600 kHz.
- Current profile interval: The time between each current pro file measurement.
- Number of cells and cell size: The number of cells, in combi nation with cell size, determines how far away from the sen sor measurements will be made.
- Waves: select to indicate that the AWAC has to measure waves.
- Number of samples: The wave spectra are calculated from the time series using FFT algorithms. This is why the number of samples is 512, 1024 or 2048. The highest number gives better accuracy, but requires more computational power.
- Sampling rate: As a general rule of thumb, the sampling should be set to 1 Hz for depths greater than 20 meters and 2 Hz for depths less than 20 meters.
- Interval: The time between each wave measurement (time series).

As shown in Figure 4, there are intervals where the AWAC sends data continuously, and there are also intervals where the AWAC sends data intermittently. These intervals depend on the configuration of the software SeaState AWAC and determine the average consumption (Figure 3).

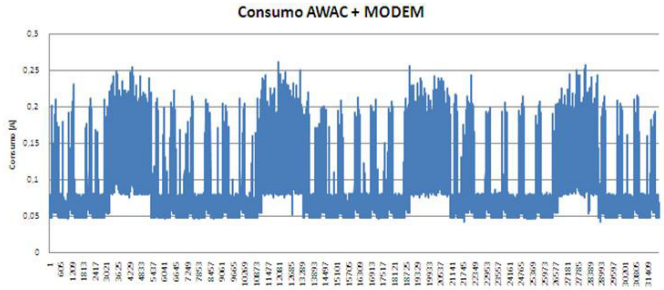
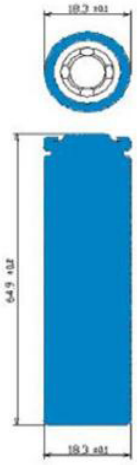


Figure 4. Consumption Graphics; Axis x: samples; Axis y: consumption [A] (Vcc = 12V)

The batteries chosen for this application are the ICR8650, shown in Figure 5. With this type of batteries, it is possible to reach an autonomy of 77 days. This provides a safety margin in case it is not possible to change the batteries at 45 days. Figure 6 shows the characteristic of the batteries, Cycle life vs. Capacity.

Conclusion

In this document a proposal for measuring the power consumption of an AWAC and a GSM modem has been presented. It has been shown that the energy required is approximately 1 W/hr. Consequently, a set of batteries was proposed to warranty and autonomy of at least 45 days.



Model ICR18650 S3		
0.2C Capacity *	Nominal	2200 mAh
	Minimum	2150 mAh
0.5C Capacity	Average	2210 mAh
Dimensions	Diameter	Max. 18.4 mm
	Height	Max. 65.1 mm
Weight (Typical)		43.5grams
Nominal Voltage		3.6V
Internal Impedance		≤ 80 mOhm
Cycle Performance **		≥ 80% of initial capacity at 300 cycles

Figure 5. Battery characteristics

References

[1] http://www.nortek-as.com/en/products/wave-systems/awac
[2] www.obsea.es
[3]http://www.simplesolutions-uk.com/files/GSM2338-00_datasheet.pdf
[4]http://www.nortek-bv.nl/images-repository-1/software/seastate-1/view