# EXTERNAL SENSORS

TAPS is designed to measure acoustical volume backscattering from zooplankton in the context of a basic physical picture of their environment—depth and temperature. Clearly, other factors are also important and there are times when measurements of additional parameters would be useful. Provision has been made to allow user interface of up to two additional sensors to TAPS. The purpose of this section is to describe the kinds of sensors that are suitable for connection to TAPS and how one goes about accomplishing this.

External sensors come in many shapes and sizes, with unique interfaces and power requirements. TAPS cannot oblige every sort of external sensor but this is what TAPS thinks a suitable sensor might look like:

The sensor must run on 12V DC power. Most sensors can accommodate input voltages between about 8-15 V.

Current drains should be low, in keeping with the nature of an internally-powered system like TAPS. Current drains of about 20-50 mA are common on newer sensors. Up to 250 mA can be supplied to each sensor but this will substantially reduce the operating time of TAPS. You will have to compute the effect of external sensors on TAPS operating life yourself. The nominal (new) battery capacity is 5.7 A-hrs. TAPS draws about 350-400 mA operating, giving a nominal operating life of perhaps 14-16 hours. Adding external sensors will decrease this; e.g., adding a 50 mA sensor and a 100 mA sensor will make the total current draw about 500-550 mA. The nominal operating life will now be about 10-11 hours (or slightly less because the amp-hour rating is based upon a 200 mA load; higher load currents yield a lower capacity).

The signal output of an external sensor will probably be either a voltage (fluorometers, irradiance sensors, etc.) or a frequency (most SeaBird sensors). The external sensor interface is designed to accommodate a frequency input on either channel or a voltage input on channel 1. The frequency signal output to the CPU card is a buffered and squared version of the input frequency. The limit on measurable frequencies is about 40 kHz, higher than normally found on frequency-output sensors. The only restriction on the voltage input is that the input be non-negative. Only positive voltages can be converted.

Conversion from a frequency- to a voltage-output sensor on channel 1 involves two steps: A connector must be moved, first, and then the type of sensor must be programmed into the TAPS CPU card.

'Installing' sensors involves merely setting a flag in the TAPS non-volatile memory. This ensures that power will be supplied to the Instrument Interface PCB whenever transceiver power is turned on (see A Typical Cast in the **CAST MODE** section of this manual). This flag also causes the frequency measurement code to be run at the beginning of each data set.

## INSTALLING NEW SENSORS

TAPS is normally supplied with a 3-pin and a 4-pin male connector (unless blanks were expressly requested in the order). The wiring of these jacks may or may not fit your sensor; you may have to rewire these jacks. Finally, you may have to supply suitable interconnect cables.

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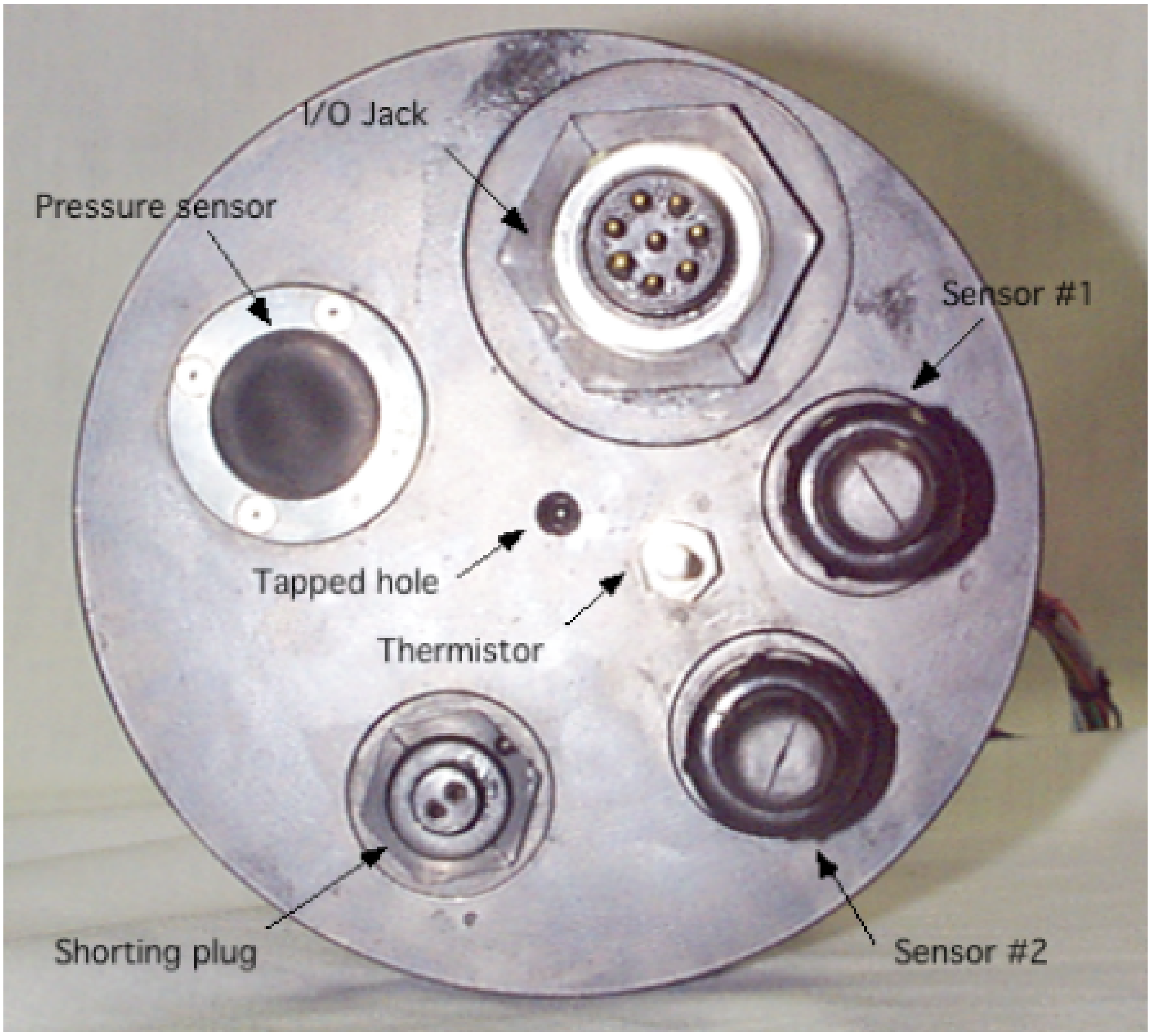


Figure 1. Layout of jacks on the connector endcap.

**PICKING A CHANNEL**

Sensor #1 can be either a voltage- or a frequency-output sensor. The standard I/O jack is a 4-pin bulkhead jack. In addition to changing the flag code for the sensor, it may be necessary to make a physical change to the wiring harness *inside* TAPS. See the section below.

Sensor #2 can only be a frequency-output sensor (e.g., SeaBird SBE-4 conductivity sensor). The standard I/O jack is a 3-pin bulkhead jack.

**SETTING UP SENSOR #1**

There is a physical difference in the wiring required to change between a voltage-output sensor and a frequency-output sensor. A plug has been provided on the wiring harness to simplify this process as much as possible.

You will have to remove the connector endcap of TAPS to make this change. Remove the 4 screws around the periphery of the endcap and set them aside. Remove the large nylon screw in the middle of the connector endcap. Insert the threaded end of the slap-hammer provided with TAPS into this threaded hole. A few gentle taps on the slap-hammer handle should pull the endcap out just past the o-rings.

Remove the slap-hammer from the threaded hole.

At this point, it would be best to have TAPS laying on it's side on a bench. Pull the connector endcap out and lay it on the bench. There is a bundle of wires running from this endcap to the electronics cage inside. In this bundle is a 3-pin Molex-style connector with one wire plugged into it. The female connector is marked with Voltage and Freq to indicate the proper location for the single wire to plug into. Move this wire as required for your external sensor.

To re-install the endcap, first clean and re-grease the o-ring and groove and the o-ring surface inside the pressure case. Carefully stuff the wire harness back into the pressure case and gently slide the endcap back into place. Align the holes in the end of the case with the screw holes in the endcap.

It is often easiest to stand TAPS upright on the transducer end to seat the connector endcap. Use a rag or carpet to protect the anodizing on the transducer endcap. Press firmly on two sides of the connector endcap until it seats fully. Replace the periphery screws and the nylon screw. Test.

## INSTALLING THE SENSOR

The new sensor(s) must be 'installed' in TAPS by reprogramming it to recognize that a sensor has been connected. This involves setting a flag that is checked whenever TAPS turns on the acoustic transceivers to see if sensor power should also be supplied and sensor frequencies measured.

With TAPS connected to a computer in terminal mode and the shorting plug installed, press <CTRL>-P to enter the programming dialog. Select appropriate mode and operating parameters. When you come to the section concerning external sensors, enter the code number best describing your sensor in the correct channel (1 or 2). Save this setup for future use.

Note that it is not necessary to install the sensor even if it is programmed. This does slow down TAPS data collection but no particular harm will be done.

Likewise, it is not necessary to program an external sensor even though it is connected. It will not be powered and no data will be read but no particular harm will be done. This might be kept in mind when the physical setup is such that removing external sensors is difficult but their data is not always desired (or the attendant time delays).

The external instruments can be 'tested' by pressing I. This will cause the instruments to be powered and the data read according to the programmed flag codes. The outputs will be converted and displayed. Then the instruments will be powered off

## DATA CONVERSION

Converting the data obtained from external sensors to the proper engineering units is the responsibility of the user, in general. If the sensor is a frequency-output device, the sensor manufacturer will normally supply equations for converting the frequency to the proper units. The value measured and reported by TAPS will be the sensor frequency.

Voltage output sensors will also normally be provided with conversion equations. First, however, the frequency measured by TAPS must be converted back to a voltage. If the suggested configuration was installed, the actual sensor voltage is found from

$$V = 4.096 * ADC / 16384$$

where ADC is the ADC value output by TAPS.