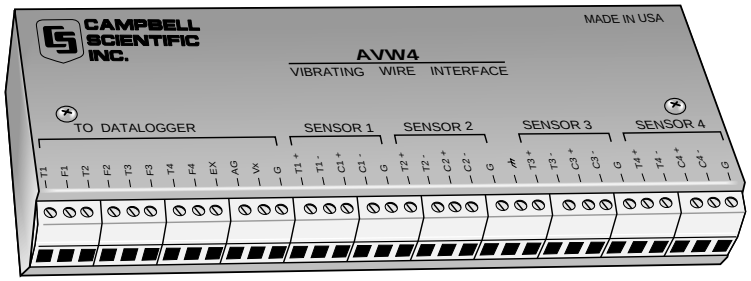
Vibrating Wire Interfaces
Models AVW1 and AVW4

Background
Vibrating wire (or vibrating strip) transducers are commonly used to measure strain, load, pressure, and water level. These sensors output a frequency signal generated by a vibrating filament that can be read by one of the datalogger's analog channels.



Because frequencies rather than voltage levels are measured, these transducers are often better suited than 4- or 6-wire resistive bridge transducers to applications in electrically noisy environments or those requiring long lead lengths. Vibrating wire transducers also have a reputation for long-term stability.

Two measurements are usually made; the first is the frequency of the vibrating wire. The second is an optional temperature measurement that allows compensation of the frequency measurement.

Description
The AVW1 and AVW4 contain circuitry needed to interface vibrating wire or vibrating strip sensors to the datalogger. The AVW1 interfaces one sensor (temperature and pressure) to two single-ended channels, and the AVW4 interfaces four sensors to eight single-ended channels. Please note that the vibrating wire transducers and interfaces are not compatible with our CR200-series, CR7, or CR9000X dataloggers.

Power Consumption
Typically, the current drain during the short (2.4 ms) temperature measurement is 0.4 mA or less. The current drain during the vibrating wire measurement (710 ms to 500 ms) is 32 mA. The interfaces have no quiescent current drain.

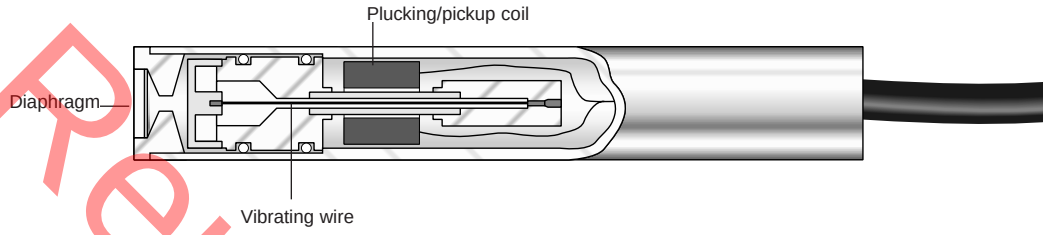
Sensor Models
Although originally designed for the Geokon 4500 series, the AVW1 and AVW4 have also been used successfully with a variety of sensors manufactured by Slope Indicator, Roctest, Gauge Technique, and Geokon. These manufacturers can provide coefficients for measuring their transducers with Campbell Scientific systems.

Signal Conditioning
Some vibrating wire sensors with short leads can be monitored without the AVW1 or AVW4. However, the AVW1 and AVW4 provide important signal conditioning to:

1. Convert the swept frequency excitation of the CR510 and CR10X from 2.5 V to 5 V (peak-to-peak). A 5 V level for Vx is recommended by most manufacturers of vibrating wire sensors. However, a user-supplied voltage source may be substituted to obtain an optimal Vx level for the application. Higher voltage levels pluck the wire harder than the maximum 2.5 V switched excitation. The result is a higher amplitude signal for a longer time.
2. Provide transformer isolation to strip off any dc noise on the signal, improving the ability to detect cycles.
3. Complete the thermistor bridge for the sensor's temperature measurement.
4. Provide additional transient protection for both the temperature and vibrating wire circuits.

Typical Operation

An increase in pressure on the diaphragm decreases the tension on the attached wire (see diagram). This decreases the wire's resonant frequency in the same way that loosening a guitar string decreases its frequency. Thus, the resonant frequency of the vibrating wire sensor decreases with increasing pressure.



Cutaway view showing internal mechanics of vibrating wire sensors.

Vibrating wire/strip transducers are measured by CRBasic's VibratingWire Instruction or Edlog's Instruction 28 (Vibrating Wire). These instructions excite the 'plucking/pickup' coils shown in the diagram with a 'swept' frequency. Typically, the datalogger requires 150 ms to sweep through all the frequencies. This swept frequency causes the wire to vibrate at each of the individual frequencies. Ideally, all frequencies except the resonant frequency of the wire attenuate in a short time. The wire vibrates with the resonant frequency for a relatively long time, and as it does so it cuts the lines of flux in the 'pickup' coils inducing the same frequency on the leads to the datalogger.

After waiting for the non-resonant frequencies to attenuate (20 ms), the datalogger accurately measures how much time it takes to receive a user-specified number of cycles. Knowing the time and the number of cycles, the datalogger then computes the square of the frequency ($=1/T^2$ where T is the period in milliseconds).

Specifications

Frequency Measurement

Frequency Sweep Range: 1000 to 9900 Hz (AVW1/AVW4 transformer performance optimized for > 1000 Hz).

Other specifications depend on datalogger model; see the Period Averaging Measurements specifications in the product literature for the specific datalogger model.

Temperature Measurement

Thermistor Bridge: Optimized for YSI144005/Fenwall 192-302 thermistors; many other temperature sensors are also compatible with measurement through the AVW or can be measured directly by the datalogger.

Multiplexing

When using with the AM16/32B Analog Multiplexer, one AVW1 can monitor 16 strain gages plus thermistors or 32 strain gages without thermistors. Several multiplexers can be connected to one AVW1.

Physical

Operating Temperature Range: -25° to +50°C

Size: AVW1 2.5 x 2.5 x 1.4 inches (65 x 65 x 30 mm)

AVW4 6.7 x 2.9 x 1.4 inches (170 x 75 x 30 mm)

Weight: AVW1 0.3 lbs including mounting bracket (0.14 kg)

AVW4 0.9 lbs including mounting bracket (0.41 kg)

Printed January 2008