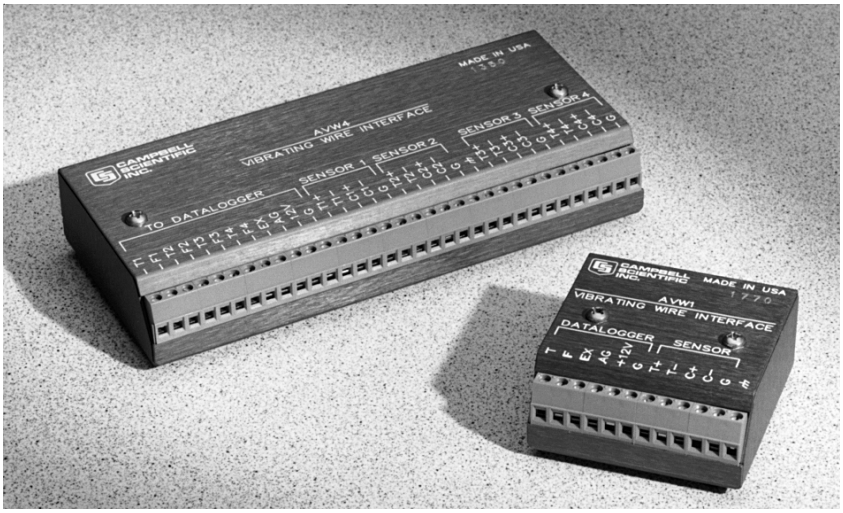
CAMPBELL SCIENTIFIC®
WHEN MEASUREMENTS MATTER

AVW1 and AVW4 Vibrating Wire Interfaces



For monitoring of vibrating wire strain gauges with Campbell Scientific dataloggers

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 on any CR510, CR10(X), CR23X, CR800 series, CR1000, CR3000 or CR5000 analogue channel. Because frequencies rather than voltage levels are measured, these transducers are often better suited than 4- or 6-wire resistive bridge transducers for 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 and the second is an optional temperature measurement that allows compensation of the frequency measurement.

Description

The AVW1 and AVW4 are used to interface vibrating wire strain gauge sensors to compatible Campbell Scientific dataloggers. The AVW1 interfaces one sensor (temperature and pressure) to two single-ended datalogger channels. The AVW4 interfaces four sensors to eight single-ended channels (not available on the CR510).

Power Consumption

For Geokon sensors, the current drain during the very short (2.4ms) temperature measurement is 0.4mA or less. The current drain during the vibrating wire measurement (170ms to 500ms) is 32mA. There is no quiescent current drain.

Key Features

Can be used with several different models of sensor

Provides signal conditioning to improve measurements

Low power consumption

Optional temperature compensation

Compatible with CR510, CR10X, CR23X, CR800 series, CR1000, CR3000 and CR5000

Typical Applications

Vibrating wire strain gauges are used in structural monitoring and other applications requiring the measurement of strain, load, pressure and water depth.

CSL 114 April 2008

Campbell Scientific Ltd., Campbell Park, 80 Hathern Road, Shepshed, Loughborough. LE12 9GX, UK
Tel: +44 (0) 1509 601141 Fax: +44 (0) 1509 601091 *Email: sales@campbellsci.co.uk*
www.campbellsci.co.uk

Sensor Models

Although originally designed specifically for the Geokon 4500 series, the AVW1 and AVW4 have also been used very successfully with other strain gauge models made by Gauge Technique, Roctest, Slope Indicator (VWP series) and Geokon. These manufacturers can provide coefficients for monitoring the output of their sensors 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 that has the following functions:

1. Complete the thermistor bridge for the measurement of the sensor's temperature.
2. Convert the swept frequency excitation from 2.5V (peak-to-peak) to 5V/12V (peak-to-peak), thus 'plucking' the wire harder than the maximum 2.5V switched excitation. The result is a larger magnitude signal for a longer time.

NOTE: Sensors which need 5V excitation rather then 12V can also be used with the AVW1 and AVW4.

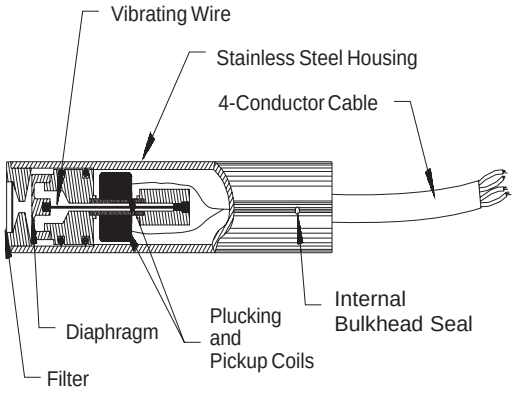
3. Provide transformer isolation to strip off any DC noise on the signal. This improves the ability to detect cycles.
4. Provide additional transient protection for both the temperature and vibrating wire circuits.

Operation (Example with Geokon Transducer)

An increase in pressure on the diaphragm decreases the tension on the wire attached to the diaphragm. A decrease in the wire tension decreases the resonant frequency in the same way that loosening a string on a guitar decreases its frequency. Therefore, the resonant frequency of the vibrating wire sensor decreases with increasing pressure.

The Vibrating Wire Measurement Instruction in the datalogger excites the 'plucking' and 'pickup' coils shown in the diagram with a 'swept' frequency. The datalogger takes 150ms to sweep through all the frequencies. This swept frequency causes the wire to vibrate at each of the individual frequencies. Ideally, all the frequencies except the one matching the resonant frequency of the wire die out in a very 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 'plucking' and 'pickup' coils inducing the same frequency on the leads to the datalogger.

After waiting for the non-resonant frequencies to die out (20ms) 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).



Typical Vibrating Wire Sensor

Specifications

Frequency Measurement
Sweep Frequency Range: 100 – 9900Hz (Optimum performance range >1000Hz)

Other specifications depend on datalogger model – see specifications (Period Averaging Measurement) in the datalogger brochure or manual.

Although the design of the interface coupling transformer means that optimum performance is achieved at frequencies of 1000Hz or more, sensors which operate at frequencies significantly below this can be used successfully with the AVW1 and AVW4. The actual performance of a given sensor will depend on the response of that sensor to the changing drive waveforms and also on the signal level it returns.

See Technical Note 23, available on request, which gives more information on the performance of sensors which operate at frequencies below 1000Hz.

Measurement Time: The time required to make one repetition of the vibrating wire measurement is given below:
150ms to sweep the frequency
+20ms delay
+(1.5 cycles + no. of cycles measured) * period of signal in ms
e.g. 671.5ms for a sensor generating a 1000Hz signal measured for 500 cycles.

No. of Cycles to Average Time Constant of Resonance: Software programmable from 1 to 9999

Reference Accuracy: ±(0.01% of reading + Resolution)

Resolution: 60ns divided by the number of cycles measured. Resolution is reduced by signal noise and for signals with a slow transition through the zero voltage threshold.

Input Sensitivity for Period Measurement: Depends on datalogger model; see separate datalogger brochures.

Temperature Measurement
Thermistor Bridge: Optimised for YSI44005/ Fenwall 192-302 thermistors. Other temperature sensors can be accommodated by direct connection to datalogger.

Multiplexing (not CR510)
When used with AM16/32B Analogue Multiplexers one AVW1 can monitor 16 strain gauges plus thermistors, or 32 gauges without thermistors. Several multiplexers can be connected to one AVW1.

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

Size/Weight: AVW1 65 x 65 x 30mm, 0.14kg
AVW4 170 x 75 x 30mm, 0.41kg

Need help configuring your system? Call our engineers for assistance.

Campbell Scientific products are available from: