Choosing A Vibrating Wire Instrument Solution
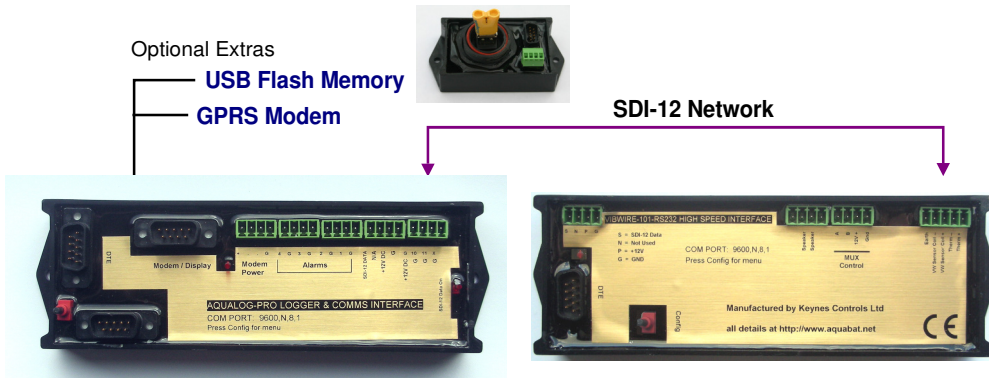
Geotechnical Instrumentation

Last updated 1/3/2010

The following document helps in the choice of a suitable vibrating wire instrumentation to create an integrated measurement system for stand-alone or automatic reporting applications. The instrumentation can operate with a data logger for stand-alone applications, or with a PC for real-time data recording and plotting. All of the vibrating wire sensor interfaces have built in lightning protection.

VibWire-108	8 Channel Vibrating Wire Sensor Interface	http://aquabat.net/VW108Products/vw108range.html
VibWire-101	1..128 Channel Vibrating Wire Sensor Interface	http://www.aquabat.net/vibwire101/vibwire101v103.html
AquaLOG	Data Recorder & Communications Interface	http://www.aquabat.net/Aqualogv103/aqualogv103.html
AQuaDAT	Analogue Sensor Interface - Thermocouple/RTD	http://www.aquabat.net/SAB/aquadat.html
Q-LOG	Free Windows Data Recording & Display Software	http://www.aquabat.net/QLOGFree/qlogv2.html

Single Channel Vibrating Wire Sensor System

Specifications

1 x 4 Wire Vibrating Wire Input
1 x SDI-12/485 network port
Fully encapsulated components
8000 /32000 record storage
Thermistor sensor support
9 - 14V DC Operation
400 - 6 K Hz Frequency range
3 second sampling period
Quick mounting system

Optional expansion to 128 inputs

Optional Extras
— USB Flash Memory
— GPRS Modem

SDI-12 Network

AquaLOG Data Logger

VibWire-101 Vibrating Wire Sensor Interface

Part Number: AquaLOGv101
                VibWire101

Terminal Port Configuration - No Driver Software

Fully encapsulated design - Splash / Sand proof enclosure

Operates with most 3rd party logger support SDI-12/RS485 network Logger supporting industry standard commands.
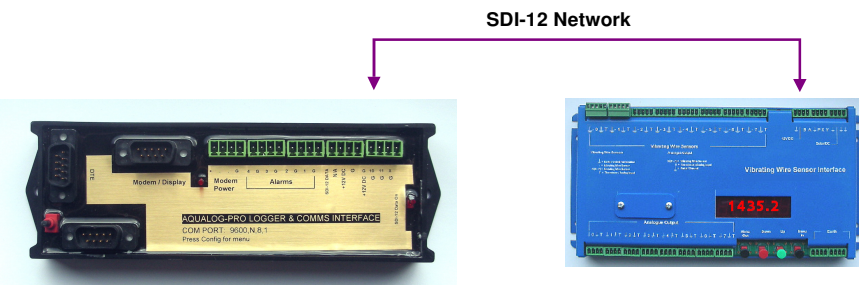
Automatic Sensor Frequency Excitation - No Setup

Low power operation - advanced power management Instrumentation powered off between scans

Frequency Units : Hz, Hz² (Digits), Engineering Values Steinhart-Hart & Beta Value Temperature Correction

1 - 8 Channel Vibrating Wire Sensor System

Specifications

1-8 x 4 Wire Vibrating Wire Inputs
1 x SDI-12 network port
Real-time Frequency Display
32000 record storage
Thermistor sensor support
Auto-resonance Excitation
400 - 6 K Hz Frequency range
3 second sampling period

Advantages

SDI-12 Network

AquaLOG Data Logger

VibWire-108 Vibrating Wire Sensor Interface

Part Number:	AquaLOGV103	Data Logger & Communications interface
	VibWire-108-SDI12	8 Channel vibrating wire sensor interface

Cost effective solution for 2 - 8 channels of vibrating wire sensors

Terminal Port Configuration - No Driver Software Required

Frequency Units : Hz, Hz² (Digits), Engineering Values Steinhart-Hart & Beta Value Temperature Correction

Automatic Sensor Excitation - There is no requirement for any pre-understanding of the sensor operating frequency

Modem

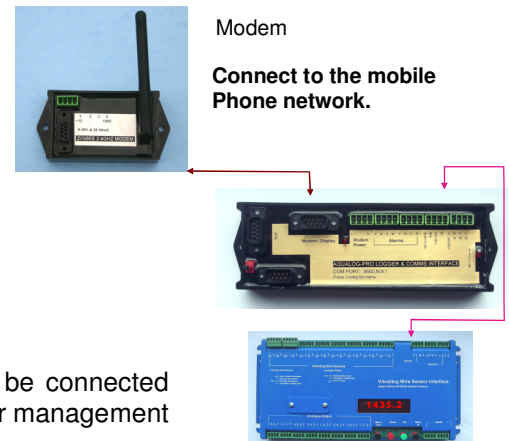**Connect to the mobile Phone network.**

Local Cable Free Application

In applications where a local power supply is available then the VibWire-108 can be connected directly to a modem for local cable free network. In this arrangement there is no power management and the vibrating wire sensor data are transmitted continuously.

VibWire-108-RS485 Multi-drop Network

The VibWire-108 interface has an option that supports the RS485 network for communication to a data logger or PC. The RS485 network enables up to 36 instruments to be deployed onto a single network up to a maximum distance of 1200 m. The VibWire-108 is fully integrated into the Q-LOG application package and when used in collaboration with the media converts then large scale systems are very easy to implement and maintain.

The Q-LOG software scans the network and automatically identifies the instruments on a network. A pull down menu system enables the User to select the number and types of channels being used.

The VibWire-108-RS485 is simple to install by daisy-chaining the instruments as shown below.

The in-built real-time display on the instrument and the menu system built into the instrument enables sensors to be tested locally by the VibWire-108 in the field. No prior sensor characteristics are required since the instrument automatically defines the operating frequency.
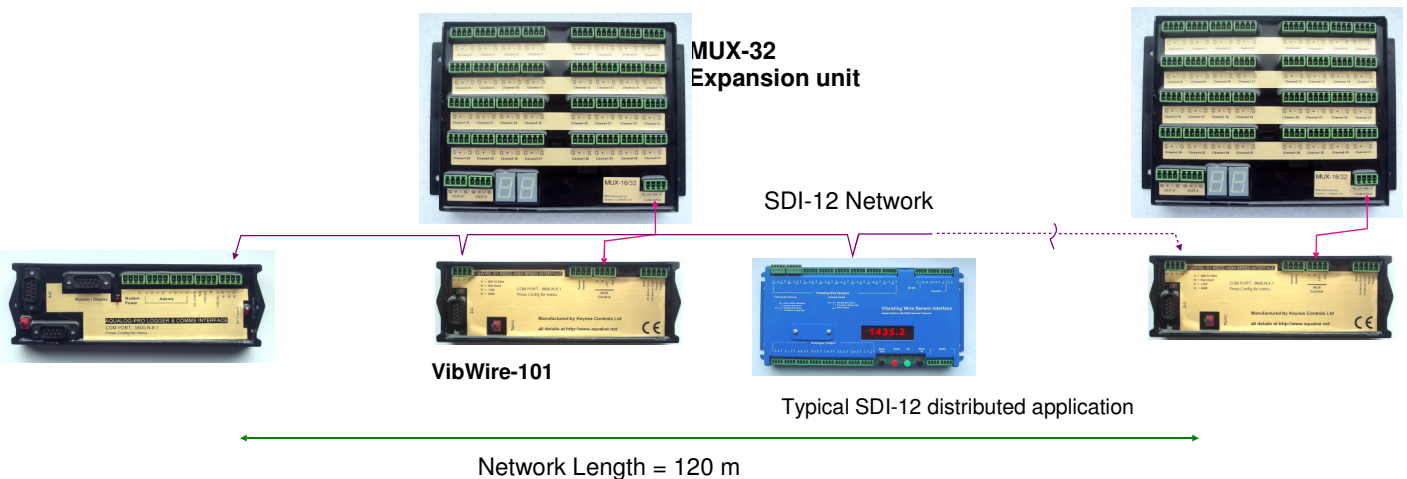

Laptop / PC Computer

Network Length = 1200 m

Maximum number of nodes = 32 = 256 Sensors
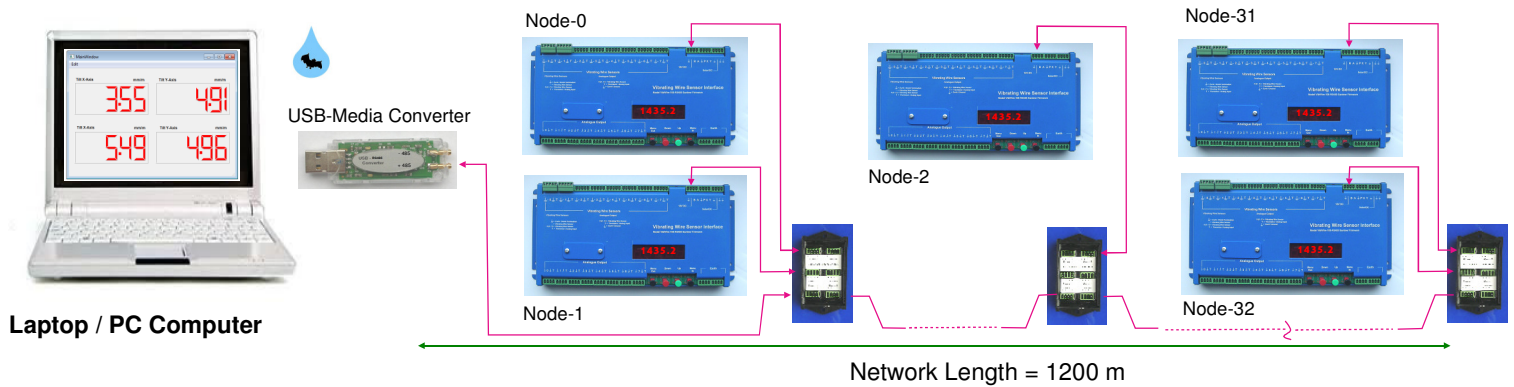
## Small Scale SDI-12 Network Solutions

The SDI-12 network version of the VibWire interfaces are very flexible and enable sensor systems to be deployed onto the network as shown below. It is possible to mix instruments with different channel counts to form a flexible monitoring system.

Many other Geotechnical sensors such as tilt sensors, and in-place-inclinometers are available using the SDI-12 network. These other sensors can be added to a monitoring system as required.

MUX-32 Expansion unit

SDI-12 Network

VibWire-101

Typical SDI-12 distributed application

Network Length = 120 m

Maximum number of nodes = 12 (standard) to 36 on request
Maximum Number Sensor Inputs = 200

Analogue Sensor Expansion Unit
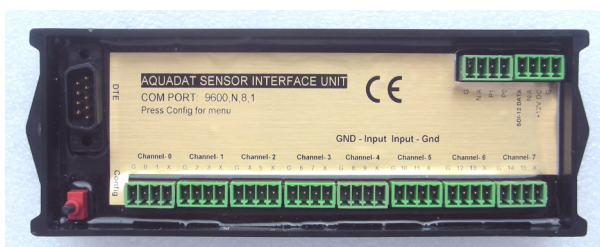
Each AquaDAT sensor interface gives the logger

Auto-ranging analogue sensor inputs

+/- 5V to +/- 10 mV in 12 ranges to ensure highest possible accuracy

16 SE / 8 Differential inputs - any combination there of

Fully User defined sample averaging / channel - remove noise

Fully encapsulated enclosure - fit the AquaDAT near the sensors to reduce

noise and read the results into the logger at a suitable location
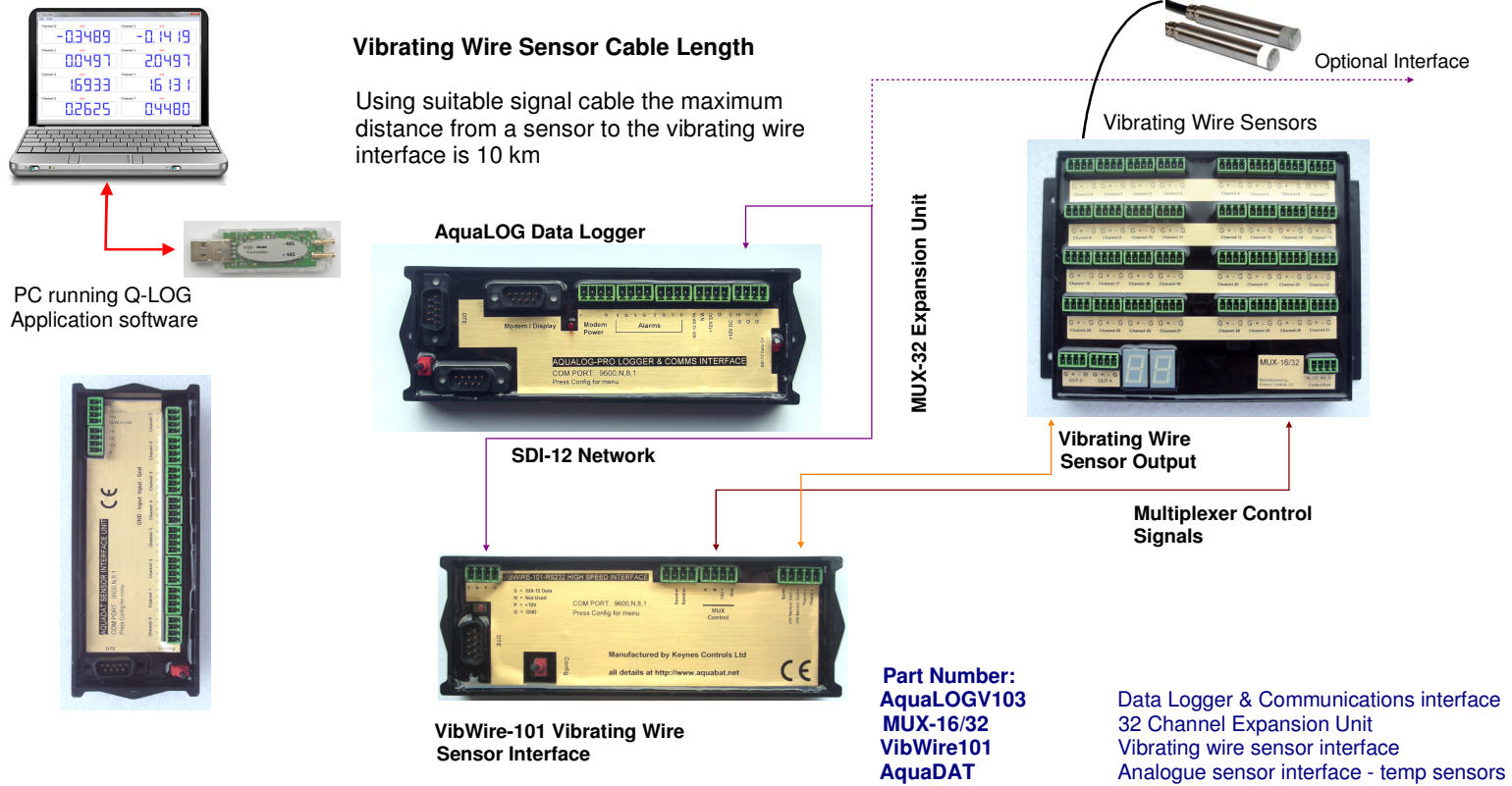
Immersion proof design

Supports Thermistors / Strain Gauge / Thermocouples / Load cells etc

SDI-12 Data Communications

1 - 32 Channel Vibrating Wire Sensor System - Optional Temp Compensation

The instrument system shown below demonstrates the minimum components required to create a 32 channel vibrating wire sensor instrument system with no direct temperature sensor input capability. Most vibrating wire sensors are deployed without the temperature sensor connected since in many applications temperature compensation is not required, or can be post processed at a later date. The temperature of a large structure remains pretty much at the same at all points and so only a limited number of sensors require compensation signals to be acquired.
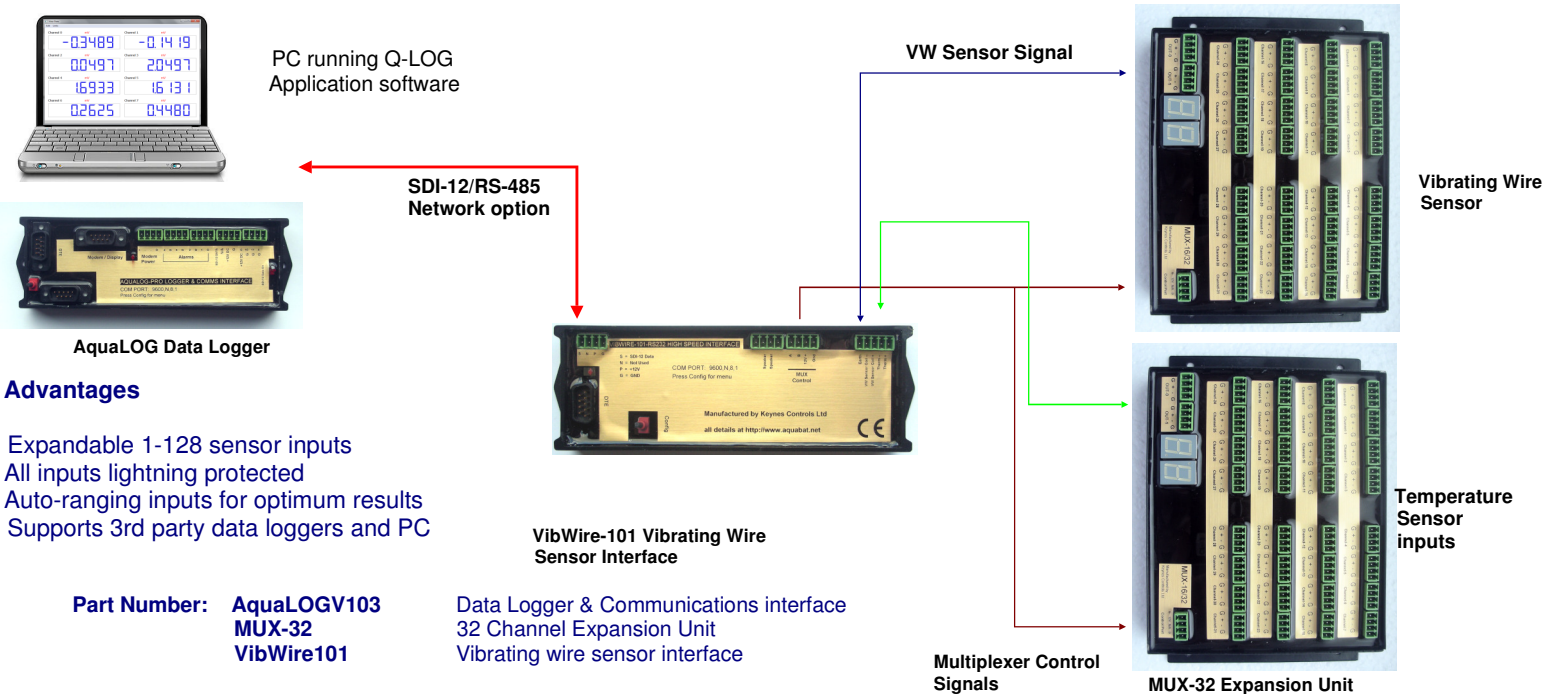
To minimise the complexity of the data acquisition system and to offer the maximum flexibility regarding the choice of temperature sensor inputs then the AquaDAT sensor interface can be used. The AquaDAT supports all the common temperature sensors such as thermocouples and the RTD sensors built into the vibrating wire sensors. The instrumentation can be connected to a PC for local real-time display and storage or to a data logger for remote, stand-alone low power applications.

Vibrating Wire Sensor Cable Length

Using suitable signal cable the maximum distance from a sensor to the vibrating wire interface is 10 km

Optional Interface

Vibrating Wire Sensors

AquaLOG Data Logger

MUX-32 Expansion Unit

PC running Q-LOG
Application software

SDI-12 Network

Vibrating Wire
Sensor Output

Multiplexer Control
Signals

**VibWire-101 Vibrating Wire
Sensor Interface**

Part Number:	
AquaLOGV103	Data Logger & Communications interface
MUX-16/32	32 Channel Expansion Unit
VibWire101	Vibrating wire sensor interface
AquaDAT	Analogue sensor interface - temp sensors

1 - 32 Channel Vibrating Wire Sensor System - with Temp Compensation

The instrument system shown below demonstrates the minimum components required to create a 32 x 4 wire channel vibrating wire sensor instrument system complete with temperature sensor capability. This configuration supports all of the VW sensor temperature sensors.

System expansion enables up to 128 vibrating wire inputs by simply adding additional MUX-32 expansion units. Control of the multiplexer units is from the VibWire-101 sensor interface and will operate with suitable 3rd party loggers and directly in to PC when using a USB-media converter

PC running Q-LOG
Application software

VW Sensor Signal

Vibrating Wire
Sensor

**SDI-12/RS-485
Network option**

AquaLOG Data Logger

Advantages

Expandable 1-128 sensor inputs
All inputs lightning protected
Auto-ranging inputs for optimum results
Supports 3rd party data loggers and PC

**VibWire-101 Vibrating Wire
Sensor Interface**

Temperature
Sensor
inputs

Multiplexer Control
Signals

MUX-32 Expansion Unit

Part Number:		
	AquaLOGV103	Data Logger & Communications interface
	MUX-32	32 Channel Expansion Unit
	VibWire101	Vibrating wire sensor interface

3rd Party Support

The VibWire range of interfaces can be used by third party loggers support SDI-12 communications. A few common manufactures of compatible data loggers are Campbell Scientific and DataTaker. Models such as the CR200, CR800 and CR1000 can all be expanded above the manufacturers specification. The AquaDAT and VibWire range of sensor interfaces can be used with the Campbell products. The Vibrating wire sensor interfaces

Take the example of the Campbell Scientific CR200 is the lowest cost of the Campbell range of data recorders and as such has the lowest specification. The cost increase on the Campbell Loggers to support additional inputs and vibrating wire sensors are expensive but by adding the **AquaLOG** and/or the **VibWire** sensor interfaces then additional sensors can be added to suit an application. The CR200 can be expanded to accept addition analogue inputs and vibrating wire sensor signals

CR200 Data Logger

CR800 Data Logger
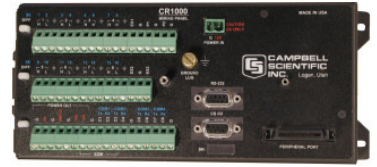
CR1000 Data Logger

SDI-12 Network

All the data loggers shown above can be expanded using the VibWire and AquaDAT sensor interfaces.

VibWire-101 Sensor Interface

MUX-32 Expansion Unit
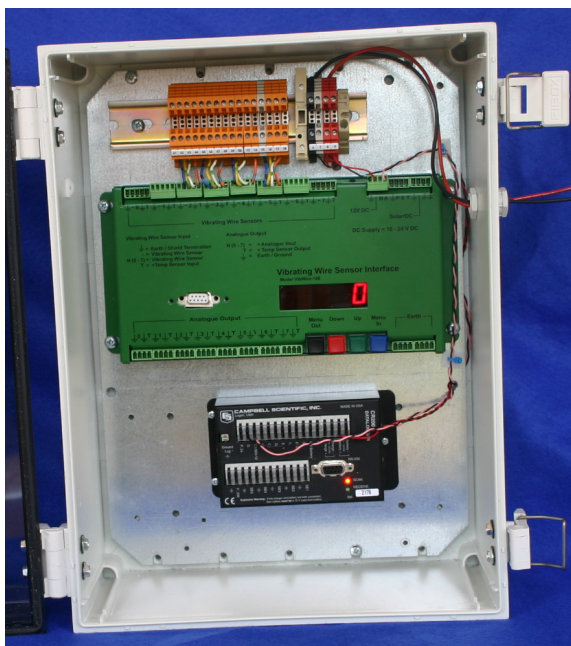
SDI-12 Network - 120 m

Reduce cabling by deploying the sensor Interfaces close to the signal source and use A simple 3 core cable to transmit results digitally To a logger unit.

Systems Expansion

The figure below demonstrates how the CR200 is expanded to have additional temperature and vibrating wire sensor inputs using the VibWire-108 interface unit. The VibWire-108 communicates to the CR200 using the SDI-12 network and transmits all data digitally. Apart from setting the instrument ID number there are no user configuration settings required by the Campbell loggers to make readings. All the Sensor interface units contain their own local lightning protection using gas discharge tubes.

Limitation on Expansion

The limit on the expansion of the Campbell CR200 logger in fact any of the Campbell products are the width of internal data table. The larger the data table then the greater the expansion possible.
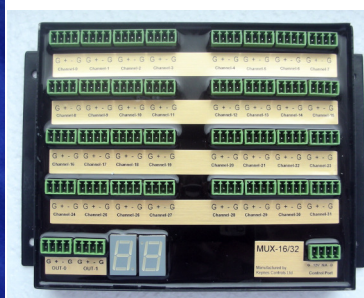
The MUX-16/32 sensor expansion unit is driven directly from the VibWire-101 vibrating wire sensor interface.

MUX-16/32 offers 16 x4 / 32 x 2 switching capability.

Example CR200 expansion with VibWire-108 Interface

Australasia

Biolab (Aust) Pty Ltd trading as Datataker
5 Caribbean Drive,
Scoresby, VIC 3179

Local Configuration

The AquaDAT and VibWire-101/108 interfaces are locally configured and so do not require any special programming understanding for use with the DataTaker product range.

Any of the DataTaker loggers supporting a SDI-12 network can be configured to use the AquaLOG and VibWire-101/108 sensor interfaces. The example below demonstrates how to expand the DT80 to use vibrating wire sensors and additional analogue inputs which are not a standard feature of this logger.

The AquaDAT can be located close to the sensors on a distributed network allowing local digitisation often removing or reducing noise problems caused by long cable runs. Multiple AquaDAT interfaces can be grouped together to create large channel distributed applications.

The VibWire-101 can be expanded from a single to 128 inputs. The limitation on channels are solely due to the size of the data table configured within the logger. All of the VibWire range of interfaces can supply data in engineering units if required.
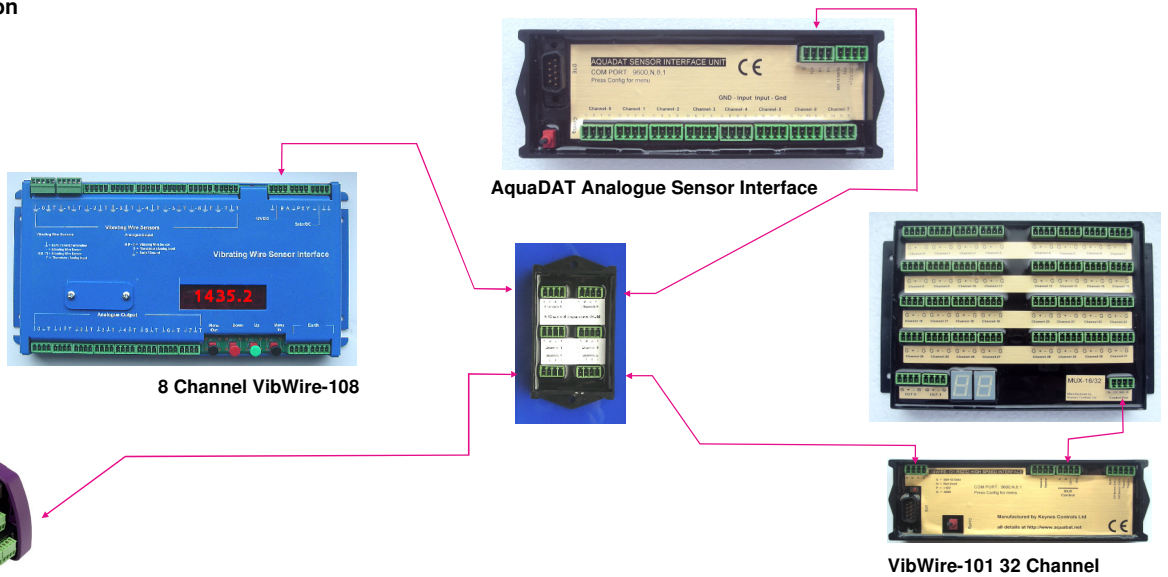

Real-time Display

The real-time display shows the sensor frequency without any need to access data from the data logger

The photograph opposite show how simple it is to expand the DT80 logger to accept 8 channels of vibrating wire sensor inputs.

Multiple SDI-12 Network Ports

Some DataTaker loggers can have multiple SDI-12 ports making expansion very simple operation. The limitation to expanding the Data Taker products is simply their ability handle to data in the internal data tables. A DT80 logger can handle all of VibWire and AquaDAT sensor interfaces.

The VibWire-101 and VibWire-108 interfaces can all be configured to provide data values in engineering units. The terminal port menu system simplifies the sensor configuration and enables sensor tests to be carried out with the need to download data from the logger.

Example VibWire-108 application using the DT80 Logger.

AquaDAT Analogue Sensor Interface

8 Channel VibWire-108

VibWire-101 32 Channel

DT-80 series data logger

AquaData

VibWire-101

**1 - 128 x 4 wire sensor inputs
Lightning protected inputs
Encapsulated enclosure for
harsh environments
Immersion / Corrosion Proof**

**8 Full Differential / 16 Single Ended Inputs
or any mixture of the above
4 & 6 Wire Sensor Support
¼ , ½ , Full Bridge Strain Gauge
User defined signal averaging - 50 / 60 Hz Noise filtering
Immersion / Corrosion proof enclosure
Auto-ranging analogue inputs to ensure optimum resolution**

PC based Data Acquisition Systems

The simplest form of data recording system uses a Microsoft operating system personal computer and the Q-LOG applications software to store and display information from any of the different geotechnical sensors and interfaces. The data acquisition system can be expanded to handle different networks and many individual sensors.

A PC based data recorder system offers practically un-limited data storage capacity, system expansion, easy data viewing using the panel meters and remote data access using all the standard remote access software tools.

USB media converter installed into a Notebook/Laptop PC.
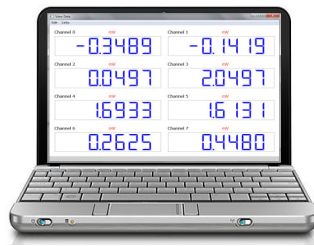
Notebook PC running Q-LOG application software

USB media converter

VibWire-108 Interface

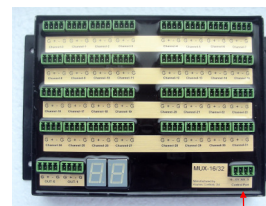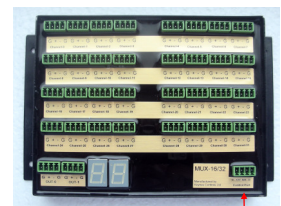## Fixed Site PC based Data Acquisition System Application

MUX16/32 Expansion

MUX16/32 Expansion

VibWire-108 Interface

VibWire-108 Interface

VibWire-101 Interface

VibWire-101 Interface

Select image to download a free copy of Q-log
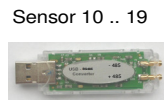
Operates on all Windows Laptop / PC / Tablets

USB-SDI-12 Media Converter

SDI-12 Digital Network

Sensor 10 .. 19

USB-RS-485 Media Converter

Expand the data acquisition system by installing additional digital networks via the PC USB ports. Keynes Controls manufacture the industry standard SDI-12 and RS-485 network media converters.

VibWire-108 Interface

VibWire-108 Interface

Panel meter display for the Q-LOG application software.
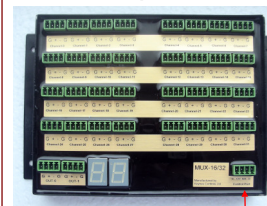
USB-RS-485 Media Converter

MUX16/32 Expansion

AquaDAT Analogue Sensor Interface

VibWire-101 Interface

View Data			
Edit Links			
Channel 0 mV		Channel 1 mV	
-0.3489		-0.1419	
Channel 2 mV		Channel 3 mV	
0.0497		2.0497	
Channel 4 mV		Channel 5 mV	
1.6933		1.6131	
Channel 6 mV		Channel 7 mV	
0.2625		0.4480	