VibWire-101

Single Channel Vibrating Wire Sensor Interface

User Guide & Installation Manual

Version 1.07

Last updated Feb 2016

Contact: Keynes Controls Ltd - sales@keynes-controls.com

WARRANTY

Keynes Controls Ltd warrants its products to be free of defects in materials and workmanship, under normal use and service for a period of 12 months from the date of purchase. If the unit should malfunction, it must be returned to Keynes Controls for evaluation, freight prepaid. Upon examination by Keynes Controls Ltd, if the unit is found to be defective, it will be repaired or replaced at no charge.

However the WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive corrosion or current, heat, moisture or vibration., improper specification misuse outside of the companies control.

Components which wear or become damaged by misuse are not warranted. This includes batteries, fuses and connectors.

Introduction

The VibWire-101 is the basic vibrating wire sensor interface interface manufactured by Keynes Controls Ltd. This User manual is for firmware version 1.3 created after Aug 2011. The various models of the VibWire-101 supports both **static** and **dynamic** measurement operations. It is possible to switch the VibWire-101 from slow to fast sampling under software control. The instrument supports options for SDI-12 or RS-485 digital networks.

Factory Settings

The VibWire-101 is factory set to use industry standard Steinhart-Hart calibration factors suitable for direct use with most temperature sensors fitted into the vibrating wire sensors. The defaults temperature calibration factors are suitable for thermistors based on the following part numbers:

YSI 44005
Vishay 1C 3001 B3
RS Part no: 151-215

The sensors give 3 K Ohm resistance at 25 Deg
The most common material used in these sensors uses material type F from GE sensing.

The VibWire-101 is a single channel stand-alone device and can be expanded using the MUX-16/32 multiplexer units to create systems with up to 128 inputs.

All models are supplied with ID = 0 for network operations.

The operating frequency range for the vibrating wire frequency input is 400 - 6 K Hz and supports most manufactures range of sensors. The VibWire-101 supports 4 wire operation and reads the temperature sensor values for resistive sensors ranging from 120 to 5 K Ohm.

Dynamic Measurements

The VibWire-101 can be configured for single channel high speed measurements, and it is this feature that enables the device to be used for dynamic measurement operations.

Prior Knowledge

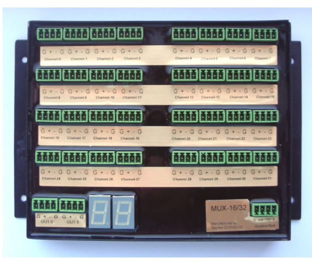
This manual requires the user to have some prior knowledge of SDI-12 commands and suitable data loggers. Worked examples consider the use of the AquaLOG Communication and Data Recording Interface only.

Optional parts that can be used with the VibWire-101

All of the USB-Pro model media converters can power directly the VibWire-108 interfaces and 3rd party sensors. An external power supply can be used when large number of units are being used.

Isolated USB Media Converter

Model No. **USB-SDI12-Pro**
USB-RS485-Pro

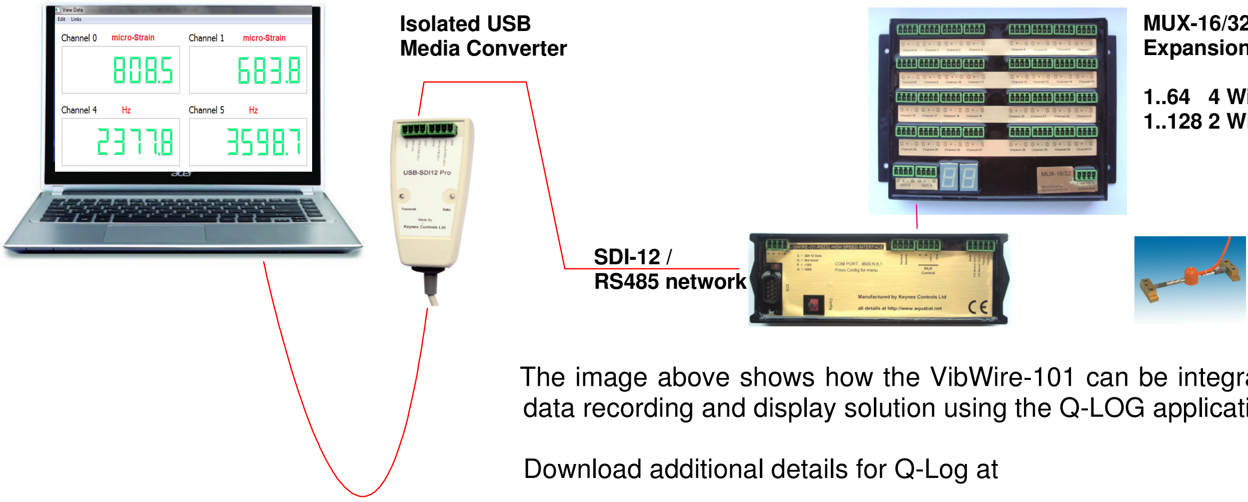


Part No. MUX-16/32
Expansion Unit

1.0 PC / Laptop Data Recording & Display System

Part Numbers :- VibWire-101-SDI12 / VibWire-101-485

Last Updated: March 2014



The image above shows how the VibWire-101 can be integrated into a PC based data recording and display solution using the Q-LOG application software.

Download additional details for Q-Log at

http://www.aquabat.net/QLOGFree/qlogv2.html

Q-LOG will also operate with many third party intelligent sensors .

2.0 MUX CTRL

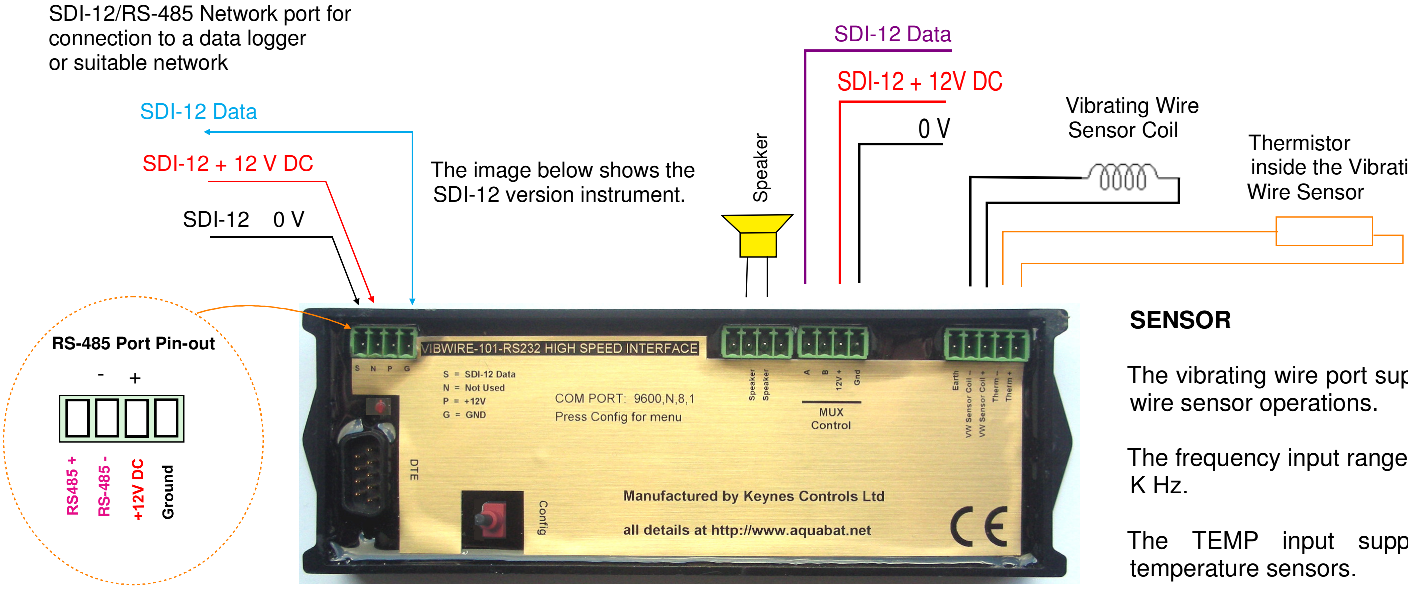
The MUX control port is used by the VibWire-101 to transmit the control signals to the multiplexer expansion interfaces.

The MUX control port operates to the same electrical specification as the SDI-12 port but cannot be used by any other third party device and is not programmable.

Network Port

SDI-12/RS-485 Network port for connection to a data logger or suitable network

The image below shows the SDI-12 version instrument.



VibWire-101

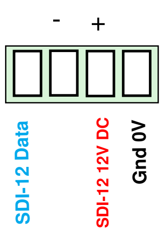
SENSOR

The vibrating wire port supports full 4 wire sensor operations.

The frequency input range is 400 to 6 K Hz.

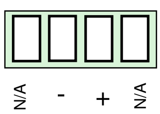
The TEMP input supports most temperature sensors.

SDI-12 Port Pin-out



Communications port for connection to data logger or digital SDI-12 network.

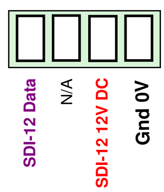
Speaker Port Pin-out



The speaker unit enables the operator to listen to the sensor ping.

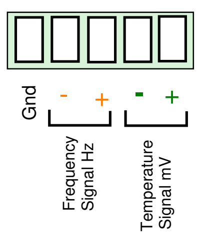
Speaker connection polarity does not matter as the device will operate no matter which round the speaker is installed.

MUX CTRL



Control signals to the MUX-16/32 expansion unit.

Vibrating Wire Sensor Port



4 Wire Vibrating Wire sensor input. Freq + Temp

3.0 Technical Specifications

Number of channels	1 x 4 Wire VW Input - standard
Expansion by MUX-16/32 unit	128 x 2 Wire VW Inputs 64 x 4 Wire VW Inputs
VW sensor coil resistance	t50, 180 - 2 K Ohm (standard):- other ranges on request
Distance of VW sensor to interface	0 .. 10 Km depending on cabling.
VW Excitation	Auto-resonance
Frequency range	400 - 6 KHz (standard) Other ranges on request
Frequency Resolution Accuracy	32 bit resolution 0.001 Hz
Long term stability	± 0.05 % FS max. Per year
Temperature range	- 50 to 70 Deg C
Temperature resolution	0.1 ºC +/- 0.2 Deg Thermistor 10 K Ohm standard 3.3 K Ohm on request
Temperature accuracy	± 0.2 ºC / 0.2 ºF SDI-12/RS-485
Thermistor measurement	A half bridge ratio-metric measurement . Value returned in Deg C. Is used for temperature compensation on VW measurements.
Thermistor excitation	2.5 V DC 50 ppm /Deg C
Input resistance	10 K Ohm 0.1 % Completion resistor (Standard) 3.3 K Ohm on request
Units - Vibration **Temperature**	Freq (Hz), Digits (Hz2), SI Units - Quadratic expansion Temperature Deg C, mV - Raw

Electrical Data

Voltage supply	**SDI-12/RS-485** bus 10.5 to 16V DC
Current compensation SDI-12 Option only	Typical values are @ 12 V DC Excitation
Idle mode **Active / measurement**	1.2 mA typical 8 mA Sensor Scan These values may change slightly between sensors. Use figures as a guide only.
Measuring time **Warm up** **Response**	 250 ms 3 seconds per channel depending on the VW sensor being used -MUX-16/32 Expansion unit
High Speed VW Results via RS 232 Port	20 Readings/Sec (50 milli-Sec) to 40 Readings/Sec (25 milli-Sec) depending on sensor.
Length of data lines **SDI-12** **RS-485**	 0 .. 100 m 0 .. 1 km
SDI-12 Address mode	Supports enhanced addressing 0 .. 9 A .. Z

General Data

Dimensions (mm)	L =260 W = 127 D = 38
Material	Plastic with epoxy encapsulation waterproofing.
SDI-12 Digital Port	SDI-12, 1200 Baud, 7 bit, N stop bit, Even Parity - other speeds on request
CE Conformity	CE conformity according to EN 61000-6
Weight	400 g

Communications

Terminal Port	9 Way Male - 9600 Baud 8 data, No Parity, 1 stop bit, No Flow control - DTE
SDI-12 Digital Port	1200 Baud, 7 bit, N stop bit, Even Parity - other speeds on request
RS-485 Network Settings	1200 Baud, 7 data bit, N stop bit, even parity

4.0 Default Factory Settings

The VibWire-101 is shipped by default using the following factory set configuration operations:

SDI-12/RS-485 ID 0

Temperature measurements - 3 K Ohm at 25 Deg C -

Default MUX-16/32 — when using the VibWire-101 and MUX-16/32 expansion unit

5.0 Testing The VibWire-101 Quick Guide

1. Connect the VibWire-101 to the SDI-12 port of a suitable Logger.
2. Fit a single Vibrating Wire Sensor to the sensor input port of the VW101, ideally making sure the default operating frequency for the chosen sensor is already known.
3. Issue the SDI-12 command **0M! – start measurement**
   0D0! - get sample data

The instrument returns the sensor operating frequency + temp if the sensor is installed.

6.0 Data Type Selection

The Vibwire-101 is a general purpose instrument and can be configured to provide results in:

Hz , Digits (Hz²), SI Units - Temperature Deg C.

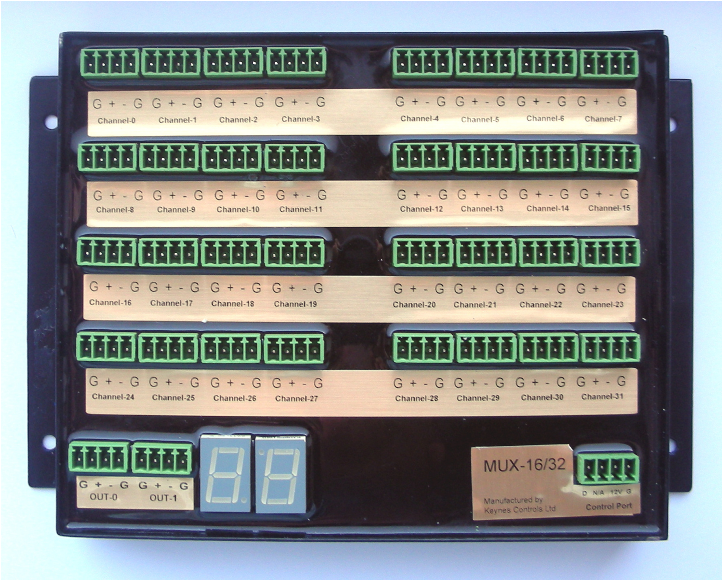
The type of result available depends upon the type and number of vibrating wire sensors to be connected to the instrument. When used as a single channel device the VibWire-101 can return Hz, Digits and SI units. For applications using the MUX-16/32 expansion unit then the VibWire-101 returns data values in Hz and digits.

For applications using the VibWire-101 in large channel count applications then the data type returned to the recording device should be set to digits. Most calculations used to convert the frequency value to engineering values uses a simple quadratic equation which is simplified when the data value is in digits.

For applications requiring large number of channels supply measurements in engineering units use the more advanced VibWire-201-Pro sensor interface.

Refer to details on page 5 for using the terminal port and menu system

7.0 MUX-16/32 Expansion Unit



The image opposite shows the multiplexer expansion unit used by the VibWire-101.

The use of the MUX-16/32 expansion unit is only effective when slow sample rates are required or for low cost applications.

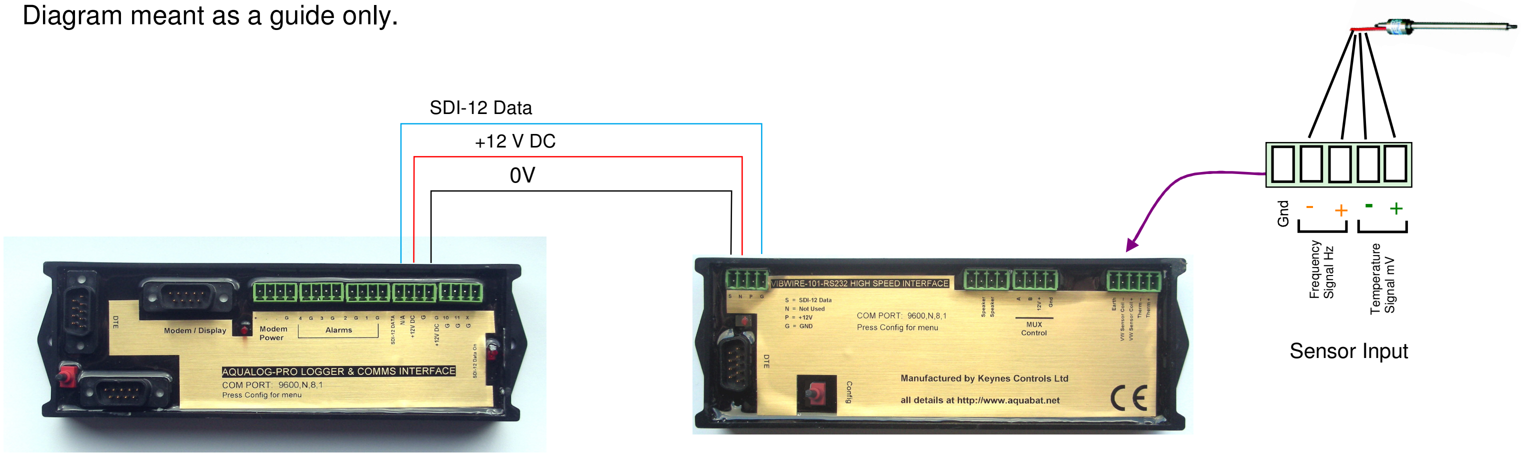
It takes approximately 3 seconds per channel for the VibWire-101 to take a measurement when using the MUX-16/32 .

MUX-16/32
Expansion Unit

1..64 VW x 4 Wire Expansion
1..128 VW x 2 Wire Expansion

Refer to label on the interfaces for correct pin-out in case of difficulty
Diagram meant as a guide only.

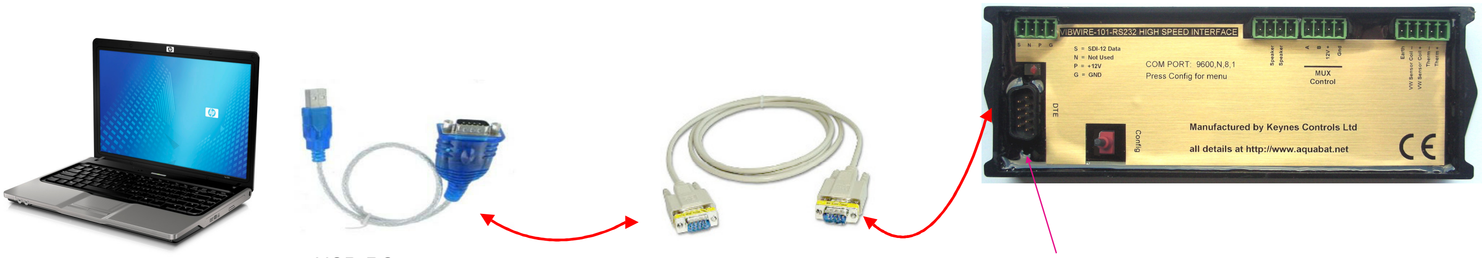
Vibrating Wire Sensor



AquaLOG SDI-12 Logger Unit

VibWire-101 Sensor Interface

8.0 Terminal Port



USB-RS232 Converter

Null modem cable

Terminal Port

9 Pin - DTE

Terminal Type = VT100

The VibWire-101 can be configured using the instrument terminal port.

The following instructions are for the Microsoft Windows Operating system.

Step 1

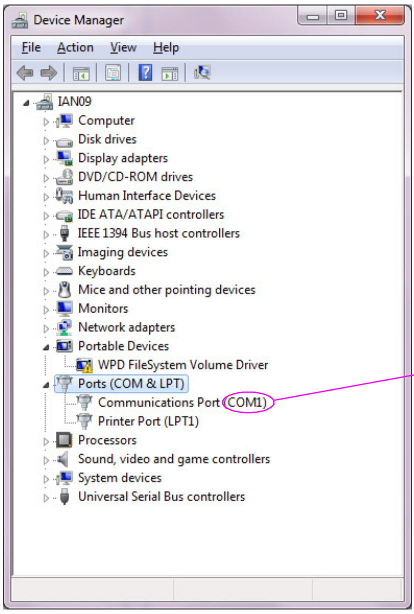
Connect the PC/Laptop to the VibWire-101 using the USB-RS232 interface and null modem cable as shown above. The terminal port is configured as a 9 way DTE device

Step 2

Plug the USB-RS232 adapter into the PC/Laptop.

From the operating system control panel select the "**device manager**" option. A Window similar to that shown opposite will appear.

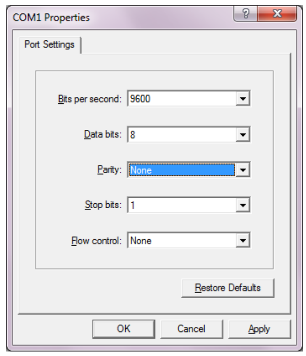
Select the 'Ports (COM & LPT)' option from the menu list to identify the Comm port number used by the USB-RS232 interface.



Microsoft Windows 7 Device Manager Window

Comm Port in use
by the USB-RS232 media converter

Microsoft Hyper-terminal - Connect To Window



Microsoft Hyper-terminal - Comm Port Properties Window

Terminal Port Operation

The terminal port built into the VibWire-101 enables the instrument to be easily configured using the built in menu system to set all the calibration parameters.

There is no software required with this device part from a Terminal emulator, which is supplied free in most operating systems.

Activating the Terminal Port Menu System

The menu system can be accessed and used by any modern terminal emulator software such as Microsoft Hyper-terminal, Token-2 etc. The software has to be **VT 100** compatible.

The example screens above are taken from the Hyper-terminal software, however the communication port settings are the same no matter which package is used.

Step 3

Start the Terminal emulator software and configure the communications port to 9600 Baud, 8 data bits, 1 stop bit, No parity.

The Comm port number used by the USB-RS232 media converter is shown in the Windows 'Device Manager' Window.

Once the laptop is connected to the VibWire-101 terminal port then press the '**Config**' button to activate.

9.0 Menu System

The menu system is very easy to use

From the main menu simply select the type of input to configure.

For optimum temperature conversion use the Steinhart-Hart equations.

For large channel count applications make sure 'digits' is the data type setting.

Important Note
For the menu system to operate the VW101 has to be powered on.

```
        Diagnostics

 1 Take single reading
 2 Set Mux
 3 Set mux and read
 4 Set DAC at frequency
 U Up.   T Top.

Reading sensor
```

Main Menu

1. Device Setup
2. Thermistor setup
3. Sensor Setup
4. Analog settings
5. Diagnostics
6. System Maintanence
7. Exit

The most commonly used menus used by the VibWire-101 are shown below.

These menus are used to configure the VW sensor and thermistor inputs and to take test measurements.

Thermistor type 1

1 Type	1
2 Resistance at T0 (ohms)	3312
3 T0 (Celcuis)	22
4 Beta	5234
5 Steinhart-Hart 0th order (A)	0.0
6 Steinhart-Hart 1st order (B)	0.0
7 Steinhart-Hart 2nd order (0)	0.0
8 Steinhart-Hart 3rd order (C)	0.0
U Up. T Top.	

VW Sensor

1 Frequency proc	1
2 Thermistor type	1
3 Cal A	3.35E-3
4 Cal B	2.56E-4
5 Cal C	2.08E-6
6 Cal D	7.30E-8
U Up. T Top.	

Frequency proc

0 = Hz   1 = Digits (Hz^2) 2 = SI Units

where SI Units are used by Quadratic Expansion

32 x 4 Wire VW Sensor Inputs

MUX ID=2 **Channel 0..15**

MUX ID=2 **Channel 16..31**

VibWire-101

9.1 Selecting a MUX-16/32 Channel and making a test measurement

Example

Select channel 3 on MUX ID=2 and make a test measurement

From the main menu select '**Option 5 - Diagnostics**'

From the 'Diagnostics Menu' Select '**Option 3 - Set MUX and read**'

The following text will be displayed

'Enter Mux code ann'
a is the mux number and nn is the setting'

where setting is the channel number - 0.. 31 or 0.15

Enter '203'

The specified MUX-16/32 interface will switch to channel 3 and take a measurement.

9.1 Storing New Settings

Upon completing the new configuration settings simply press select the 'Config' button again and the menu system will close. All new settings are now stored into the device.

9.2 Diagnostics

The menu system of the VibWire-101 enables the device to make an individual measurements upon demand.

An individual measurement can be made

1. Single channel unit
2. Any specified channel on a MUX-16/32 expansion unit

```
          Diagnostics

 1 Take single reading
 2 Set Mux
 3 Set mux and read
 4 Set DAC at frequency
 U Up.   T Top.

Reading sensor
```

Sensor Results

```
Reading sensor


Results:
Frequency (Hz) = 1930.8
Temperature (mV) = 2491.0
Temperature (R/R0) = 276.77
Temperature (transducer) = 0.99640
Frequency (Hz)     = 1930.8
Frequency (digits) = 3728.3
Transducer Output  = 0.0

press any key to continue
```

Beta Value Thermistor Configuration

Thermistor type 1

1 Type	1
2 Resistance at T0 (ohms)	3312
3 T0 (Celcuis)	22
4 Beta	5234
5 Steinhart-Hart 0th order (A)	0.0
6 Steinhart-Hart 1st order (B)	0.0
7 Steinhart-Hart 2nd order (0)	0.0
8 Steinhart-Hart 3rd order (C)	0.0
U Up. T Top.	

Defines the thermistor calculation type.

This parameter takes priority of any defined thermistor parameters.

The menu above shows the VibWire-101 configured for using the thermistor Beta value for thermistor temperature value readings

Note

For lower accuracy temperature readings or when the calibration factors are not known then the thermistor Beta value, T_0 and R_0 parameters can be assigned.

From the main menu select 'Option 5 - Diagnostics'

Single Channel Operation

When the VibWire-101 operates as a stand-alone device

Option 1 'Take Single Reading'

The device scans and reports the sensor values similar to that shown opposite.

10.0 Temperature Sensor Configuration

The VibWire-108 uses the in-built thermistor inside a VW sensor to measure temperature. The menu system enables two different thermistor sensor details to be predefined and stored into the instrument.

.The menu system enables both the VW sensor linearisation and thermistor temperature equations to be configured. The thermistor resistance and therefore temperature is calculated using the Steinhart-Hart equation. The output SI unit is in Deg C.

The VW sensor linearisation uses the industry standard quadratic equation to convert the VW signal into engineering units.

The parameters for this part of the instrument configuration can be found on the VW sensor calibration data sheet.

Steinhart-Hart Thermistor Configuration for accurate readings

The thermistor configuration menu below demonstrates how to configure the thermistor for use with the Steinhart-Hart calibration factors.

Appendix C shows a sample VW sensor data sheet and where the parameters for the Steinhart-Hart 0, 1st, 2nd and third parameters are found.

```
          Thermistor setup

1 Thermistor Type                      STEINHART
2 Resistance at T0 (ohms)              3300.0
3 T0 (Celcius)                         25.000
4 Beta                                 4000.0
5 Steinhart-Hart 0th order (A)         0.0033540
6 Steinhart-Hart 1st order (B)         2.5627E-4
7 Steinhart-Hart 2nd order (0)         2.0829E-6
8 Steinhart-Hart 3rd order (C)         7.3003E-8
U Up.   T Top._
```

11.0 Common Problems

he VibWire-101 does not scan

Main causes are:

1. Check that the SDI-12 network wiring is installed correctly between the VibWire-101 sensor interface and the data logger.
2. Identify the VibWire-101 SDI ID number and make sure this ID matches the number used in the start measurement command.

   (See page 7 for details of obtaining the SDI-12 ID for the VibWire-101)

3. Use the correct 'Start Measurement' Command **aM!** example 2M! device no MUX-16/32 with ID=2
   5M2! example 1 x MUX-16/32 unit with ID=0 for 16 x 4 wire / 16 x 2 wire

2 x MUX-16/32 units scan at the same time

1. Check the ID numbers of the MUX-16/32 Unit. Ensure that each MUX-16/32 has a unique ID number in the range 0 .. 3.

   Should 2 x MUX-16/32 units have the same ID number then they will switch channels at the same time.

No power to MUX-16/32 when connected to the MUX-CTRL port of the VibWire-101

Check that the power supply cables 0V and +12V DC of the MUX-CTRL port are correctly fitted. The MUX-16/32 power indicator LED will be illuminated as soon as power is applied.

The decimal point on the MUX-16/32 channel display blinks repeatedly when power is connected regardless to the SDI-12 control signal operation.

No Sensor Ping

1. Should no sensor ping be heard when directly connecting a sensor to the Vibrating wire sensor input port then check that the frequency output from the sensor is connected to the correct pins on the sensor input port.

2. If when using the MUX-16/32 interfaces the frequency output from the sensors is shown to be widely wrong or around 20 KHz level then it is likely that the MUX 32 and / or sensors are not wired into the system correctly.

Check The output ports labelled '**Out-0' and** '**Out-1**' are correctly wired for 2 or 4 wire operation. See Page 11 for the correct wiring details.

Check The correct output signal is wired to the MUX-16/32. The cables on a vibrating wire sensor are colour coded. Verify with the manufactures data sheet that the correct output signals are being used.

Check MUX-16/32 units are scanning and the correct input channel has been identified.

ALWAYS USE THE PIN-OUTS SHOWN ON THE INSTRUMENTS FOR THE CORRECT WIRING GUIDE AS THE DOCUMENTATION MAY CHANGE WITHOUT NOTICE.

Only 16 Channels out of 32 are scanning

1. If the VibWire-101 is only scanning 16 out of 32 channels then this is because MUX-16/32 has been set into 4 wire mode.

Check Number of Jogs - control pulses for the MUX-16/32 is correct.

Use SDI-12 Command '**aXJn!**' where a = SDI-12 ID of the VibWire-101 n = 1 for MUX-16/32 (factory default)
n = 2 for DHTech / Some Campbell Scientific Clones.

Example. '4XJ1' sets Jogs = 1 for VibWire-101 with ID=4 driving MUX-16/32 units.

Can I use multiple VibWire-101 instruments on a network

Further VibWire-101 instruments can be used on an SDI-12 network by simply using another SDI-12 ID number for any additional instruments. Each VibWire-101 can be individually configured for operation.

Can I use the VibWire-101 on any third party logger units.

Any data logger supporting SDI-12 network can use the VibWire-101 such as the Campbell Scientific CR200, or any DataTaker models such as DT 51/82E.

It is possible to add vibrating wire sensor support to these products even if the original manufacturer does not support it.

12.0 How do I adjust the manufacture set SDI-12 ID number

The manufactures default SDI-12 ID = 0

Use the command 'xAy! ' where x = 0 and y = new address therefore '**0A5!**' changes the default ID =0 to ID = 5.

12.1 How do I know the SDI-12 ID of the MUX-16/32 units

The default ID number for a single MUX-16/32 unit is 0. This can only be changed with the MUX-16/32 directly connected to a device controlling the SDI-12 network such as the AquaLOG data logger or by a PC when using a SDI-12 media converter.

1. Connect the MUX-16/32 to the Logger using the MUX-CTRL Port for the SDI-12 communication. See details on page 11 for pin-outs. Make sure only a single MUX-16/32 device is connected to the AquaLOG or PC when reconfiguring the expansion unit as this simplifies the operation.

   Using a terminal program or the AquaLOG menu system using the '**SDI-12 Transparent Mode**' option.

   Issue the command **'?!'** *– do not press carriage return as the instrument responds automatically.*

   The MUX-16/32 returns the ID number 0 .. 10

   FULL DETAILS REFER TO THE MUX-16/32 USER MANUAL

12.2 Which terminal emulator software shall I use

Any terminal emulator software supporting VT100 terminal can be used for communications

The recommended software is **toten2** and this can be freely downloaded at: **http://download.cnet.com/windows/**

'Enter token2'

12.3 Microsoft Hyper terminal Software is the most popular terminal emulator software available is is often supplied free with the operating system.

12.4 Selecting 2 or 4 Wire mode

The selection of 2 or 4 wire mode is a feature of the MUX-16/32 or Campbell Scientific multiplexer units.

See the User Manual for the specified product for instructions on how to select 2 or 4 wire mode.

The MUX-16/32 User Manual can be downloaded from the **http://www.aquabat.net** web site.

12.5 Setting the Scan Rate

The scan rate of the VibWire-101 is under control of the data logger unit issuing the '**aMx**!' 'Start Measurement Command'.

Each channel currently takes 3 second to complete a scan.

Should a new '**aMx**!' start measurement command is received before a complete scan off all the channels is received then the multiplexers will be re-set and the scan started again.

See details on page 13 for setting the scan rate for the AquaLOG data logger.

13.0 Scan Time Calculation

The VibWire-101 currently takes 3 seconds to scan a single channel when using a MUX-16/32 expansion port.

4 Wire Mode

Total Scan time (s) 4 wire mode/ MUX-16/32 = 3 x (16) = 48 secs where 16 = channel used in 4 wire mode on MUX-16/32

there for **64 Channel Scan Time** = 48 * 4 = 184 seconds.

2 Wire Mode

Total Scan Time / MUX-16/32 = 3 x 32 = 96 sec therefore 64 channels scan time = 96 * 4 = 384 secs

where 64 channels = 2 x MUX-16/32 in 2 wire mode (32 channel / unit)

14.0 Cleaning & Maintenance

The following procedure should be followed for the care and maintenance of the VibWire-101

.

1) Remove Power from the system.

2) Wash the green sockets with clean fresh water and allow to dry.
Or dry with a clean cloth.

Make sure no water remains inside the green sockets.

Once the unit has dried out simple reconnect the sensors and power and re-start acquisition operations.

Recommended Calibration Period

The recommend re-calibration for this unit is 2 Years continuous operation.

Return the VibWire-101 to Keynes Controls for re-calibration

14.1 Environmental Protection

The VibWire-101 is a protected for the the ingress of dust and moisture

This device is not rated for under water operations.

15.0 Third Party Logger Support

The VibWire-101 can be used with any third party logger supporting an SDI-12 port for communications such as the examples shown below. The VibWire-101 can be used with these loggers and offers them expansion to for vibrating wire sensors.

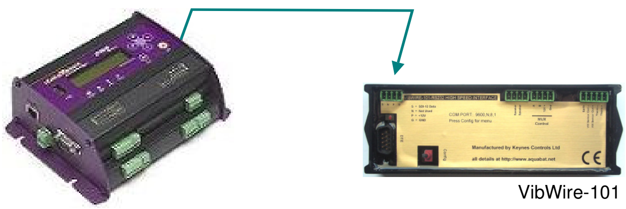
SDI-12 Network

VibWire-101

CR200 Logger

CR200 is manufactured by
Campbell Scientific Inc

SDI-12 Network



VibWire-101

DT82E

Connect the VibWire-101 to the SDI-12 port on the logger units. Refer to the manufactures user guide for pin-out details on the specified logger.

Use commands detailed on pages 6 to gather data from the VibWire-101

Channel expansion can be undertaken above the logger manufactures specification using the MUX-16/32 expansion interface.

16.0 VW-101 SDI-12 Commands

The SDI-12 commands shown below are used by any SDI-12 based data logger to make readings from sensors connected to the VibWire-101 sensor interface when using the MUX-16/32 interfaces for channel expansion.

xAy! Change of address x to y

MUX Control

aXMJ (n=1 or 2) Sets number of jogs (pulses) for each increment on the Campbell Scientific 16 x 4 MUX
aXMS (n=0 or 1) Sets single or dual input on the MUX-16/32

aM! Take single measurement

aM0! Take 16 measurements using Campbell multiplexer (no. 1 to 16)
aM1! Take 16 measurements using Campbell multiplexer (no. 17 to 32)

aM2! Take 16 measurements using Keynes MUX ID=0 (no. 0 to 15)
aM3! Take 16 measurements using Keynes MUX ID=0 (no. 16 to 31)
aM4! Take 16 measurements using Keynes MUX ID=1 (no. 0 to 15)
aM5! Take 16 measurements using Keynes MUX ID=1 (no. 16 to 31)
aM6! Take 16 measurements using Keynes MUX ID=2 (no. 0 to 15)
aM7! Take 16 measurements using Keynes MUX ID=2 (no. 16 to 31)
aM8! Take 16 measurements using Keynes MUX ID=3 (no. 0 to 15)
aM9! Take 16 measurements using Keynes MUX ID=3 (no. 16 to 31)

aD0! Output frequencies 0 to 3
aD1! Output frequencies 4 to 7
aD2! Output frequencies 8 to 11
aD3! Output frequencies 12 to 15
aD4! Output Temperature Values 0 to 3
aD5! Output Temperature Values 4 to 7
aD6! Output Temperature Values 8 to 11
aD7! Output Temperature Values 12 to 15

16.1 VW-101 RS-485 Commands

The RS-485 commands are the same as SDI-12 commands except they are preceded with a '%' symbol.

%xAy! Change of address x to y

MUX Control
%aXMJ (n=1 or 2) Sets number of jogs (pulses) for each increment on the C%aMpbell Scientific 16 x 4 MUX
%aXMS (n=0 or 1) Sets single or dual input on the MUX-16/32

%aM! Take single measurement

%aM0! Take 16 measurements using Campbell multiplexer (no. 1 to 16)
%aM1! Take 16 measurements using Campbell multiplexer (no. 17 to 32)

%aM2! Take 16 measurements using Keynes MUX ID=0 (no. 0 to 15)
%aM3! Take 16 measurements using Keynes Mux #0 (no. 16 to 31)
%aM4! Take 16 measurements using Keynes MUX ID=0 (no. 0 to 15)
%aM5! Take 16 measurements using Keynes Mux #1 (no. 48 to 63)
%aM6! Take 16 measurements using Keynes MUX ID=0 (no. 0 to 15)
%aM7! Take 16 measurements using Keynes Mux #2 (no. 80 to 95)
%aM8! Take 16 measurements using Keynes MUX ID=0 (no. 0 to 15)
%aM9! Take 16 measurements using Keynes Mux #3 (no. 112 to 127)

%aD0! Output frequencies 0 to 3
%aD1! Output frequencies 4 to 7
%aD2! Output frequencies 8 to 11
%aD3! Output frequencies 12 to 15
%aD4! Output thermistor voltages 0 to 3
%aD5! Output thermistor voltages 4 to 7
%aD6! Output thermistor voltages 8 to 11
%aD7! Output thermistor voltages 12 to 15

17.0 VibWire-101 SDI-12 Programming Examples

Stand-alone Single Channel Operation

The following command is used to start a measurement and return the sensor values for a single 4 x Vibrating wire sensor connected directly to the VibWire-101 sensor port.

Query SDI-12 Address

?! —– return the SDI-12 address.

Use this command should only be used when a single VW-101 device is connected to the logger unit. See image opposite for network configuration.

Change the SDI-12 ID number

xAy! x = start ID y = End ID where ID = 0 .. 10

Changing the default factory set SDI-12 ID number

0A3! **—** change the factory set ID =0 to ID =3

Get Test data values from a VibWire-101 using a single 4 Wire vibrating wire sensor. SDI-12 ID number for the VibWire-101 is 3.

3M! —- Start the measurement Operation

The instrument responds similar to ‘0489 ‘ where 48 = time in second to respond and 1 = number of channels being used.

3D0! —- Get data from the VibWire-101

2437.25+123.45 First value = frequency Hz Second value = Temp in mV

0I! - returns firmware type - manufactures device identifier

013KEYNESCOVW101A003 – version 1.3 SDI-12 Keynes Controls manufacture VW-101 product Code
003 version number

17.2 MUX-16/32 Channel Expansion SDI-12 Commands

The following section demonstrates a series of programming examples using the SDI-12 commands needed to acquire data from the VibWire-101 expanded using the MUX-16/32 multiplexer units.

The data is shown stored into the AquaLOG logger data table.

The AquaLOG uses a spread sheet format data table to store results and uses cell references the same as Microsoft Excel Package.

MUX-16/32 Expansion

The commands shown below are an extension to the standard SDI-12 command set.

The VibWire-101 currently supports up to 4 x MUX-16/32 expansion units offering sensor expansion from 1 .. 128 x 2 sensor inputs or 1 .. 64 x 4 wire sensor inputs.

Each MUX-16/32 expansion unit has it's own ID number to identify it on the MUX control network.

Setting the MUX-16/32 ID number is a feature of the device itself and is not set by instructions issued by the VibWire-101.

Download the MUX-16/32 User Manual at: **http://www.aquabat.net/downloads/mux32manualv1.pdf**

MUX-16/32 ID numbers are 0 through to 3.

Instructions to use the MUX-16/32 Expansion Units set in 2 Wire Mode

For 2 wire vibrating wire operation connect the sensors to the MUX-16/32 expansion units as shown on page 11.

The following commands are used to acquire data using the AquaLOG data logger using the VibWire-101 to scan the MUX-16/32 expansion units. The VibWire-101 has an SDI-12 ID = 7

[D] 7M2! 7D0! 7D1! 7D2! 7D3!

This command scans **MUX-0** and return data values for channels 0 through 15. The returned data values are stored consecutively starting at cell 'D' and finishing at Cell 'S' (16 cells further into the data table).

[T] 7M3! 7D0! 7D1! 7D2! 7D3!

Scans channels **16-31** on **MUX-0** and return the results starting at cell '**T**' and finishing at cell '**AI**' in the data table.

similarly commands

[AJ] 7M4! 7D0! 7D1! 7D2! 7D3! – starts measurements and retrieves data from MUX-1 channels 0-15 and represents channels 32..47 on a 128 x 2 wire system.

7M4! Take 16 measurements using Keynes MUX #1 (Channels 32 to 49)

[AZ] 7M5! 7D0! 7D1! 7D2! 7D3! – starts measurements and retrieves data from MUX-1 channels 16-31 and represents channels 48..63 on a 128 x 2 wire system

7M5! Take 16 measurements using Keynes MUX #1 (Channels 48 to 63)

[BP] 7M6! 7D0! 7D1! 7D2! 7D3! – starts measurements and retrieves data from MUX-1 channels 16-31 and represents channels 64..79 on a 128 x 2 wire system

7M6! Take 16 measurements using Keynes Mux #2 (no. 64 to 79)

[CF] 7M7! 7D0! 7D1! 7D2! 7D3! – starts measurements and retrieves data from MUX-1 channels 16-31 and represents channels 80..95 on a 128 x 2 wire system.

7M7! Take 16 measurements using Keynes Mux #2 (no. 80 to 95)

[CV] 7M8! 7D0! 7D1! 7D2! 7D3! – starts measurements and retrieves data from MUX-1 channels 16-31 and represents channels 96..111 on a 128 x 2 wire system

7M8! Take 16 measurements using Keynes Mux #3 (no. 96 to 111)

[DL] 7M9! 7D0! 7D1! 7D2! 7D3! – starts measurements and retrieves data from MUX-1 channels 16-31 and represents channels 112..127 on a 128 x 2 wire system

7M9! Take 16 measurements using Keynes Mux #3 (no. 112 to 127)

17.3 Command Summary

The commands shown below are used by the AquaLOG SDI-12 data logger to acquire data from 128 x 2 wire channels using 4 x MUX-16/32 units connected to a VibWire-101 interface using SDI-12 ID = 7.

To operate in 128 channel mode 4 x MUX-16/32 units are required with ID numbers set 0 .. 3.

[D]	**7M2!**	**7D0!**	**7D1!**	**7D2!**	**7D3!**	- - *Channels 0 .. 15 Mux 0*
[T]	**7M3!**	**7D0!**	**7D1!**	**7D2!**	**7D3!**	- - *Channels 16 .. 31 Mux 0*
[AJ]	**7M4!**	**7D0!**	**7D1!**	**7D2!**	**7D3!**	- - *Channels 32 .. 47 Mux 0*
[AZ]	**7M5!**	**7D0!**	**7D1!**	**7D2!**	**7D3!**	- - *Channels 48 .. 63 Mux 0*
[BP]	**7M6!**	**7D0!**	**7D1!**	**7D2!**	**7D3!**	- - *Channels 64 .. 79 Mux 0*
[CF]	**7M7!**	**7D0!**	**7D1!**	**7D2!**	**7D3!**	- - *Channels 80 .. 95 Mux 0*
[CV]	**7M8!**	**7D0!**	**7D1!**	**7D2!**	**7D3!**	- - *Channels 96 .. 111 Mux 0*
[DL]	**7M9!**	**7D0!**	**7D1!**	**7D2!**	**7D3!**	- - *Channels 112 .. 127 Mux 0*

Explanation

where 2 represents the instruction to scan channels 0 .. 15 on MUX-0
similarly 3 represents the instruction to scan channels 16 .. 31 on MUX-0

[D] 7M2!	**7D0!**	**7D1!**	**7D2!**	**7D3!**	
Start Cell for data storage	**4 x data values Chan 0 ..3**	**4 x data values Chan 4..7**	**4 x data values Chan 8..11**	**4 x data values Chan 12..15**	**2 wire mode**

Note. MUX-16/32 ID numbers are 0..3 and these are used automatically by the VibWire-101 to identify the expansion units connected to the MUX CTRL port.

The MUX ID numbers are not used by any command to scan or retrieve data.

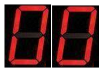
In-case of any trouble identifying channels check and ensure the MUX ID numbers are unique and set to the range 0 through to 3 when appropriate.

17 Commands for scanning MUX-16/32 in 32 x 2 wire mode

Table 1 below shows the commands used to scan the MUX-16/32 unit in 32 x 2 wire mode.

The MUX-16/32 unit has to be set to operate in 32 x 2 Wire mode. This is done via the VibWire-101 setup menu. See page 17, section 25.2 for instruction in setting the 'Scan Mode'.

In 32 x 2 wire mode the channel counter displays the range 0 .. 31.

 to  32 x 2 Wire mode

Channel Select Display

Start Measurement Command	Description	Channel Number	No. Data Values	SDI-12 Get Data Command
aM2!	MUX ID=0 Chan 0..15	Chan 0 .. 15	Returns 16 values x Freq	aD0! aD1! aD2! aD3!
aM3!	MUX ID=0 Chan 16..31	Chan 16 .. 31	Returns 16 values x Freq	aD0! aD1! aD2! aD3!
aM4!	MUX ID=1 Chan 0..15	Chan 32.. 47	Returns 16 values x Freq	aD0! aD1! aD2! aD3!
aM5!	MUX ID=1 Chan 16..31	Chan 48.. 63	Returns 16 values x Freq	aD0! aD1! aD2! aD3!
aM6!	MUX-2 Chan 0..15	Chan 64..79	Returns 16 values x Freq	aD0! aD1! aD2! aD3!
aM7!	MUX-2 Chan 16.31	Chan 80.. 95	Returns 16 values x Freq	aD0! aD1! aD2! aD3!
aM8!	MUX-3 Chan 0..15	Chan 96..111	Returns 16 values x Freq	aD0! aD1! aD2! aD3!
aM9!	MUX-3 Chan 16..31	Chan 112..127	Returns 16 values x Freq	aD0! aD1! aD2! aD3!

Table 1 - 32 x 2 wire scan instructions

Each get data command returns 4 values.

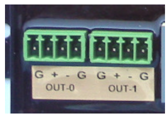


Fig 8 - Output Ports used in 2 Wire mode.

When operating in 2 wire mode, the VibWire-101 scans the MUX-16/32 in blocks of 16 channels.

Under normal operating conditions Channels 0-15 are scanned first and the results stored into a data table. This is followed by the scanning the final block of 16 channels and storing the measurements. Table 1 shows the sequence of the 2 blocks of commands needed to scan the MUX-16/32 unit in 2 wire mode.

17.1 Sequence of commands to read data values

The order in which the MUX-16/32 units are scanned is purely based on the order the measurement instructions are issued to VibWire-101. The recommended command sequence is:

1. Start measurement command. - Chans 0 - 15
2. Read sensor data for Chans 0 - 15 into data table
3. Start measurement command - Chans 16 - 31
4. Read sensor data for Chans 16 - 31 into data table

repeat the operation for each MUX-16/32 unit to be scanned

Example

A VibWire-101 with ID=7 is to scan 2 x MUX-16/32 units configured for 32 x 2 Wire VW sensor inputs. The MUX-16/32 units will use ID=0 and ID=1 on the MUX control port network.

The MUX-16/32 scan mode is setup in the VibWire-101 menu system only. Refer to the VibWire-101 User Manual for full details on this operation.

The SDI-12 commands to make a measurement will be

Start measurement : **7M2!** – VibWire-101 Measurement Command MUX with ID=0 - scans channels 0 - 15
7M3! – VibWire-101 Measurement Command MUX with ID=0 - scans channels 16 - 31
7M4! – VibWire-101 Measurement Command MUX with ID=1 - scans channels 0 - 15
7M5! – VibWire-101 Measurement Command MUX with ID=1 - scans channels 16 - 31

Read data: [Start Cell Data Table] **7M2! 7D0! 7D1! 7D2! 7D3!** - MUX ID=0
[Start Cell + 16 Chars] 7M3! **7D0! 7D1! 7D2! 7D3!** - MUX ID=0
[Start Cell + 32 Chars] 7M4! **7D0! 7D1! 7D2! 7D3!** - MUX ID=1
[Start Cell + 48 Chars] 7M5! **7D0! 7D1! 7D2! 7D3!** - MUX ID=1

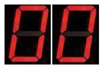
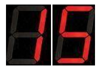
The data table used in all of Keynes Controls data loggers and Q-LOG data display software uses Microsoft Excel Cell References.

18 Commands for scanning MUX-16/32 in 16 x 4 wire mode

Table 2 below shows the commands used to scan the MUX-16/32 unit in 16 x 4 wire mode.

The MUX-16/32 unit has to be set to operate in 16 x 4 Wire mode. This is done via the VibWire-101 setup menu.
See page 17, section 25.2 for instruction in setting the 'Scan Mode'.

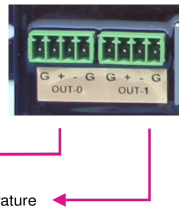
In 16 x 4 wire mode the channel counter displays the range 0 .. 15.

 to  16 x 4 Wire mode

Channel Select Display

Start Measurement Command	MUX Identification	Channel Number	No. Data Values	SDI-12 Get Data Command
aM2!	MUX-0 Chan 0..15	Chan 0 ..15	returns 32 values 16 x Freq + 16 x Temp	aD0! aD1! aD2! aD3! aD4! aD5! aD6! aD7!
aM4!	MUX-1 Chan 0..15	Chan 16.. 31	returns 32 values 16 x Freq + 16 x Temp	aD0! aD1! aD2! aD3! aD4! aD5! aD6! aD7!
aM6!	MUX-2 Chan 0..15	Chan 32..47	returns 32 values 16 x Freq + 16 x Temp	aD0! aD1! aD2! aD3! aD4! aD5! aD6! aD7!
aM8!	MUX-3 Chan 0..15	Chan 48..63	returns 32 values 16 x Freq + 16 x Temp	aD0! aD1! aD2! aD3! aD4! aD5! aD6! aD7!

Fig 9 - Sensor Output Ports



To VW frequency port on the VW101

To temperature port on the VW101

Get data: $\underbrace{\text{aD0! aD1! aD2! aD3!}}_{\text{16 x Freq Readings}}$ $\underbrace{\text{aD4! aD5! aD6! aD7!}}_{\text{16 x Temperature Readings}}$ where each command aD0! returns 4 values

14.1 Sequence of commands to read data values

The order in which the MUX-16/32 units are scanned is purely based on the order the measurement instructions are issued to VibWire-101. Only a single measurement command is required to scan all 16 channels in 4 Wire mode.

The order in which the commands are to be used are:

1. Start measurement command. - Scan Chans 0-15 in 4 Wire mode.
2. Read 32 sensor values into a data table.

repeat the operation for each MUX-16/32 unit to be scanned

Channels used with Port OUT-0 (Frequency)

7D0!	Chan-0	Chan-1	Chan-2	Chan-3
7D1!	Chan-4	Chan-5	Chan-6	Chan-7
7D2!	Chan-8	Chan-9	Chan-10	Chan-11
7D3!	Chan-12	Chan-13	Chan-14	Chan-15

Channels used with Port Out-1 (Temperature)

7D4!	Temp-0	Temp-1	Temp-2	Temp-3
7D5!	Temp-4	Temp-5	Temp-6	Temp-7
7D6!	Temp-8	Temp-9	Temp-10	Temp-11
7D7!	Temp-12	Temp-13	Temp-14	Temp-15

Example

A VibWire-101 with ID=6 is to scan 2 x MUX-16/32 units configured for 16 x 4 Wire VW sensor inputs. The MUX-16/32 units will use ID=0 and ID=1 on the MUX control port network.

The MUX-16/32 scan mode is setup in the VibWire-101 menu system only. Refer to the VibWire-101 User Manual for full details on this operation.

The SDI-12 commands to make a measurement will be

Start measurement : 6**M2!** – Upon of this instruction the VibWire-101 scans MUX-0 (ID=0)

where 6 = ID of the VibWire-101 and M2! is the scan instruction for MUX-16/32 with ID=0

Read data: $\underbrace{\text{6D0! 6D1! 6D2! 6D3!}}_{\text{16 x Freq Readings}}$ $\underbrace{\text{6D4! 6D5! 6D6! 6D7!}}_{\text{16 x Temp Readings}}$

Port OUT-0 Port OUT-1

Complete command for AquaLOG [Start Cell] 6M2! 6D0! 6D1! 6D2! 6D3!
[Start Cell + 16 Chars] 6D4! 6D5! 6D6! 6D7!

Start Cell=D - first available data table cell
Start Cell + 16 Char = T

Repeat for MUX-16/32 unit with ID=1

Start Measurement: **6M4!** – The VibWire-101 will on the receipt of this instruction scans MUX with ID = 1

Complete command for AquaLOG [Start Cell] **6M4!** 6D0! 6D1! 6D2! 6D3!
[Start Cell + 16 Chars] 6D4! 6D5! 6D6! 6D7!

18.0 Wire Mode - Data Structure

The data structure returned by the VibWire-101 when using the MUX-16/32 in 2 wire sensor mode is shown below.

There are no temperature results in this example.

Frequency Readings

AD0 = Freq Chan-0 Hz + Freq Chan-1 Hz + Freq Chan-2 Hz + Freq Chan-3 Hz

AD1 = Freq Chan-4 Hz + Freq Chan-5 Hz + Freq Chan-6 Hz + Freq Chan-7 Hz

AD2 = Freq Chan-8 Hz + Freq Chan-9 Hz + Freq Chan-10 Hz + Freq Chan11 Hz

AD3 = Freq Chan-12 Hz + Freq Chan-13 Hz + Freq Chan-14 Hz + Freq Chan-15 Hz

AD4 = Temp Chan-16 + Temp Chan-17 + Temp Chan-18 Hz + Freq Chan-19 Hz

AD5 = Freq Chan-20 Hz + Freq Chan-21 Hz + Freq Chan-22 Hz + Freq Chan-23 Hz

AD6 = Freq Chan-24 Hz + Freq Chan-25 Hz + Freq Chan-26 Hz + Freq Chan-27 Hz

AD7 = Freq Chan-28 Hz + Freq Chan-29 Hz + Freq Chan-30 Hz + Freq Chan-31 Hz

There is no restriction on what type of signal is switched as the MUX-16/32 can be used for a wide range of applications. To keep the example simple only frequency signal inputs from the vibrating wire sensors is being considered.

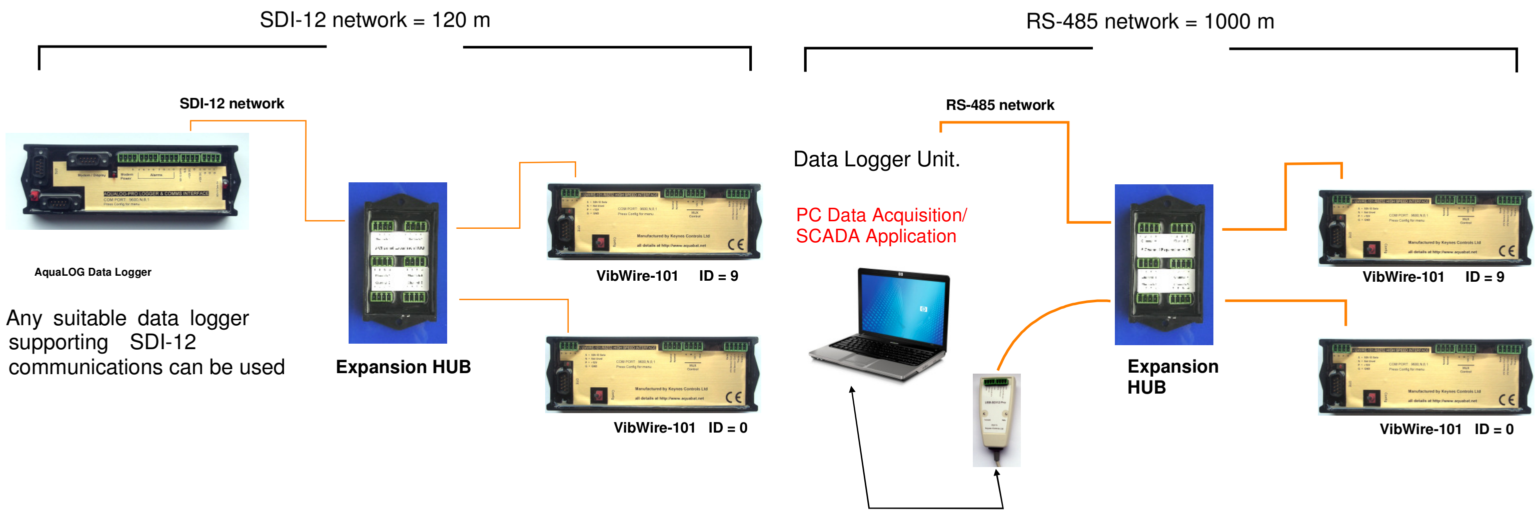
18.1 Multi-instrument SDI-12 / RS-485 Digital Network Operations

Multiple VibWire-101 instruments can be deployed on both of the SDI-12 and RS-485 digital networks.

On most SDI-12 data loggers only 10 x VibWire-101 units can be deployed on a single SDI-12 network. The sensors themselves support advanced addressing and so enable ID numbers in the range 0 .. 9 a .. z. Up to 36 sensors can be connected on a single network string.

A single AquaLOG supports up to 36 x VibWire-101 units or 240 sensors distributed between each interface.

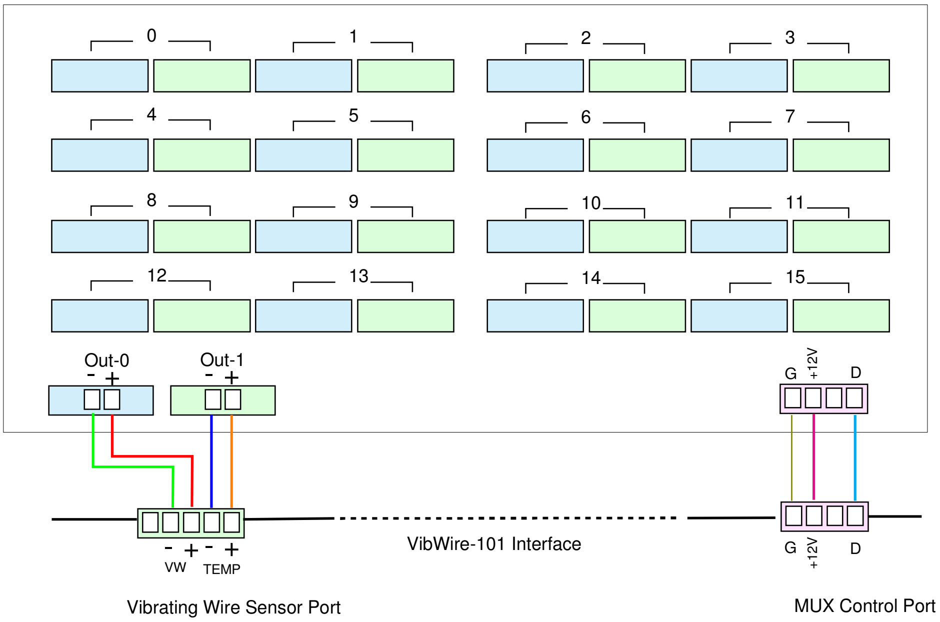
The RS-485 network is used when there is a relatively long distance between the VW-101 and the data logger. A single instrument can be deployed upto 1 km from the logger unit.

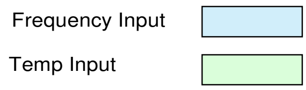


18.2 MUX-16/32 - 16 x 4 Vibrating wire sensor connection

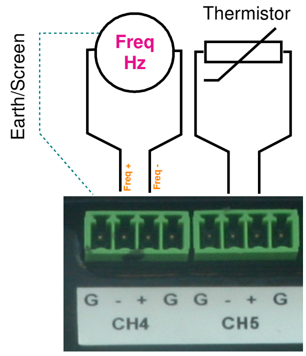
The image below shows how to connect the MUX-16/32 expansion unit to the VibWire-101 when operating in 16 x 4 wire mode.

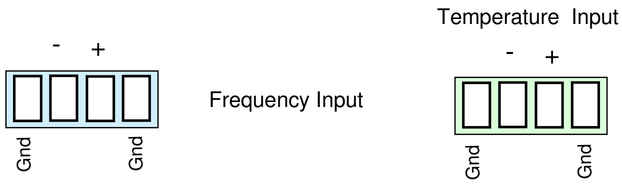
A vibrating wire sensor typically contains a temperature sensor. Ensure that the sensor signals are connected as shown below.





The image below shows how to connect a 4 wire vibrating wire sensor to the MUX-16/32.



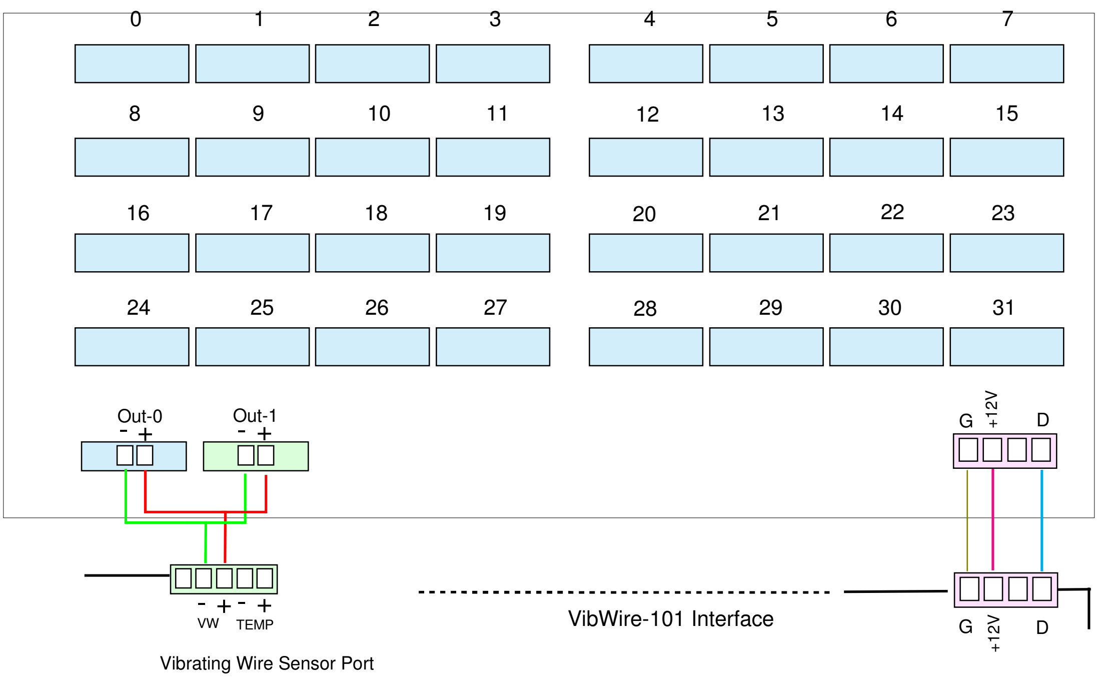


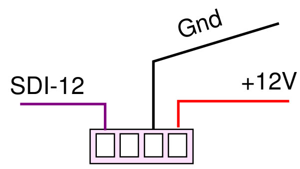
The sensor screen / earth connection can be made to any of the ground connection points. The ground/earth point are labelled ‘G’ on the MUX-16/32.

18.3 MUX-16/32 - 32 x 2 Vibrating wire sensor connection

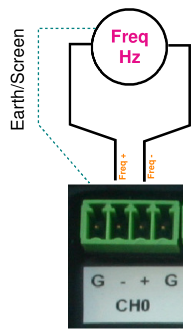
The image below shows how to connect the MUX-16/32 expansion unit to the VibWire-101 when operating in 32 x 2 wire mode.

A vibrating wire sensor typically contains a temperature sensor. Ensure that the sensor signals are connected as shown below.





2 Wire Sensor Connection.



The image below shows how to connect a 2 wire vibrating wire sensor to the MUX-16/32.

18.4 VibWire-101 working with the MUX-16/32 4 Wire Mode

For 4 wire vibrating wire operation connect the sensors to the MUX-16/32 expansion units as shown on page 11.

The following commands are required to acquire data using the AquaLOG data logger using the VibWire-101 to scan the MUX-16/32 expansion units. In this example the VibWire-101 has an SDI-12 ID = 5

The SDI-12 commands shown are extensions to the standard command set and are used by the AquaLOG logger to acquire and store results for a 64 x 4 wire system using 4 x MUX-16/32 expansion units.

[D] 5M2! 5D0! 5D1! 5D2! 5D3!	*- - Channels 0 .. 15 Mux 0 Frequency Hz*
[T] 5D4! 5D5! 5D6! 5D7!	*- - Channels 0 .. 15 Mux 0 Temp*
[AJ] 5M4! 5D0! 5D1! 5D2! 5D3!	*- - Channels 16 .. 31 Mux 1 Frequency Hz*
[AZ] 5D0! 5D1! 5D2! 5D3!	*- - Channels 16 .. 31 Mux 1 Temp*
[BP] 5M6! 5D0! 5D1! 5D2! 5D3!	*- - Channels 32 .. 47 Mux 2 Frequency Hz*
[CF] 5D0! 5D1! 5D2! 5D3!	*- - Channels 32 .. 47 Mux 2 Temp*
[CV] 5M8! 5D0! 5D1! 5D2! 5D3!	*- - Channels 48 .. 63 Mux 3 Frequency Hz*
[DL] 5D0! 5D1! 5D2! 5D3!	*- - Channels 48 .. 63 Mux 3 Temp*

Explanation

Where 2 represents the instruction to scan channels 0 .. 15 on MUX-0
For 4 wire operation use extension 2, 4, 6, 8 to instruct the VW-101 to scan the MUX-16/32 unit.

[D]	**5M2!**	**7D0!**	**7D1!**	**7D2!**	**7D3!**
Start Cell or data storage	**Start Measurement MUX-0**	**4 x Freq Values Chan 0 ..3**	**4 x Freq Values Chan 4..7**	**4 x Freq Values Chan 8..11**	**4 x Freq Values Chan 12..15**

[T] 5D4!	**5D5!**	**5D6!**	**5D7!**	**7D3!**
Start Cell or data storage	**4 x Temp Values Chan 0 ..3**	**4 x Temp Values Chan 4..7**	**4 x Temp Values Chan 8..11**	**4 x Temp Values Chan 12..15**

Note. Raw temperature values are in mV and and are post processed to convert to temp in Deg C / Deg F.

The temperature sensor conversion is often a polynomial and see data sheet from the supplier for full details.

Formula translation from mV to Deg C can be carried out within the logger unit

4 Wire - Data Structure – *refer to page 11 on how the sensors are wired to the MUX-16/32*

Frequency Readings

AD0 = Freq Chan-0 Hz + Freq Chan-1 Hz + Freq Chan-2 Hz + Freq Chan-3 Hz

AD1 = Freq Chan-4 Hz + Freq Chan-5 Hz + Freq Chan-6 Hz + Freq Chan-7 Hz

AD2 = Freq Chan-8 Hz + Freq Chan-9 Hz + Freq Chan-10 Hz + Freq Chan11 Hz

AD3 = Freq Chan-12 Hz + Freq Chan-13 Hz + Freq Chan-14 Hz + Freq Chan-15 Hz

and for temperature readings

AD4 = Temp Chan-0 mV + Temp Chan-1 mV + Temp Chan-2 mV + Temp Chan-3 mV

AD5 = Temp Chan-4 mV + Temp Chan-5 mV + Temp Chan-6 mV + Temp Chan-7 mV

AD6 = Temp Chan-8 mV + Temp Chan-9 mV + Temp Chan-10 mV + Temp Chan-11 mV

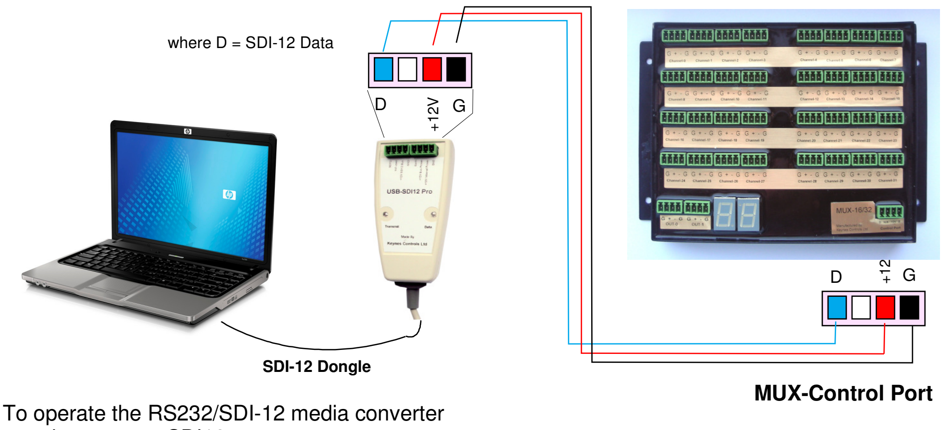
AD7 = Temp Chan-12 mV + Temp Chan-13 mV + Temp Chan-14 mV + Temp Chan-15 mV

19.0 Changing the MUX-ID Number - Hardware Setup

The MUX-16/32 expansion unit ID number is changed exactly like any other SDI-12 address on any similar product. The ID number is changed under software control only.

The default SDI-12 ID = 0.

The images below demonstrate the simplest hardware configurations used for changing the ID number.



To operate the RS232/SDI-12 media converter use the program SDI12test.exe

The image opposite demonstrates the hardware configuration used by PC/Laptop to change the ID number.

A simple terminal program running on the PC and connected to a Comm port is all that is needed to use the dongle.

The dongle converts the RS-232 comm port characters into SDI-12 data.

It is possible to use the AquaLOG data logger with the VibWire-101 connected to the SDI-12 network to undertake the same task.

Download this program from the **http://www.aquabat.net** web site.

20.0 Terminal Port Settings

Use a suitable terminal emulator which is VT100 compatible such as the Microsoft Hypert-terminal or Token-2 software to send control details to the MUX-16/32 unit.

RS232 Comms Setup - Logger Unit

Use 1200 baud 8 data Bits 1 stop bit No Parity

when configuring the terminal port comms on the PC/laptop to communicate with the AquaLOG/ VW101/ VW108 interfaces

20.1 Which terminal emulator software shall I use

Any terminal emulator software supporting VT100 terminal can be used for communications

The recommended software is **toten2** and this can be freely downloaded at: **http://download.cnet.com/windows/**

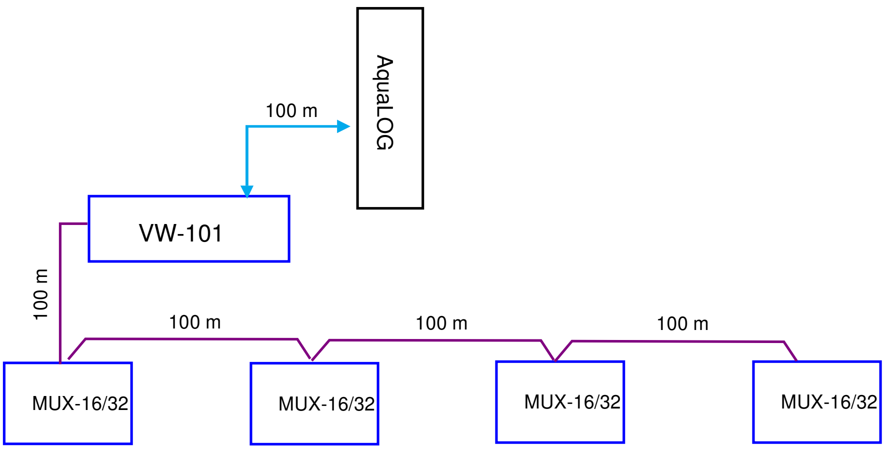
'Enter token2'

12.3 Microsoft Hyper terminal Software is the most popular terminal emulator software available is is often supplied free with the operating system.

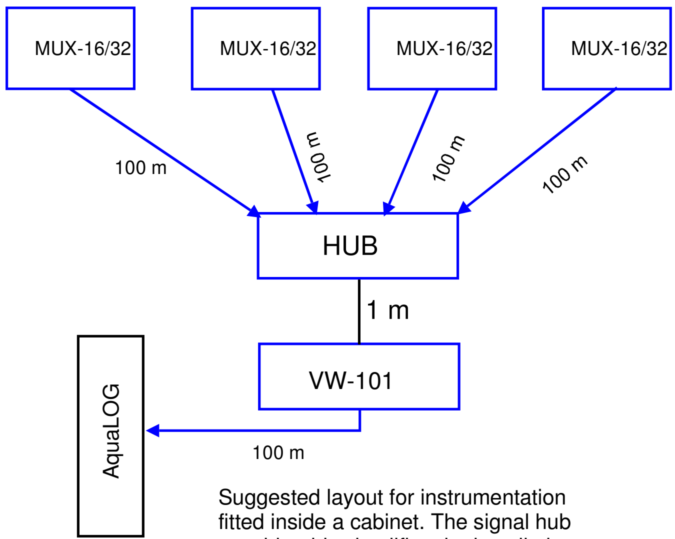
22.0 MUX Control Signal Network Layout

The image below shows the recommended systems layout when the sensor signals are distributed at a number of locations.

The MUX-16/32 control signals are daisy chained.



22.1 Typical Network Layout Guide



Suggested layout for instrumentation fitted inside a cabinet. The signal hub considerably simplifies the installation wiring.

Signal working distance estimate using 1.5 mm ^{2} cable.

Ensure good Earth for operations

23.0 Locating the comm port being used by USB converter

The following instructions are for use with the Microsoft Operating System. Any Windows shown may vary between the different versions of the operating system. For up to date details refer to Microsoft manuals.

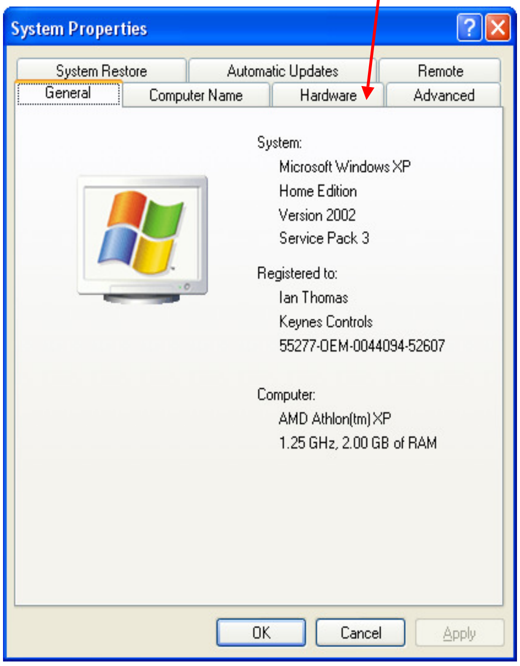
Using the Microsoft PC operating systems

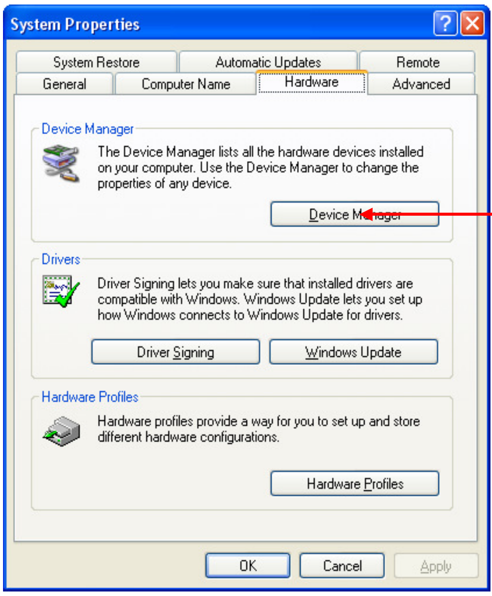
1. **Start** → **Settings** → **Control Panel**

2. Select 'Systems ' option

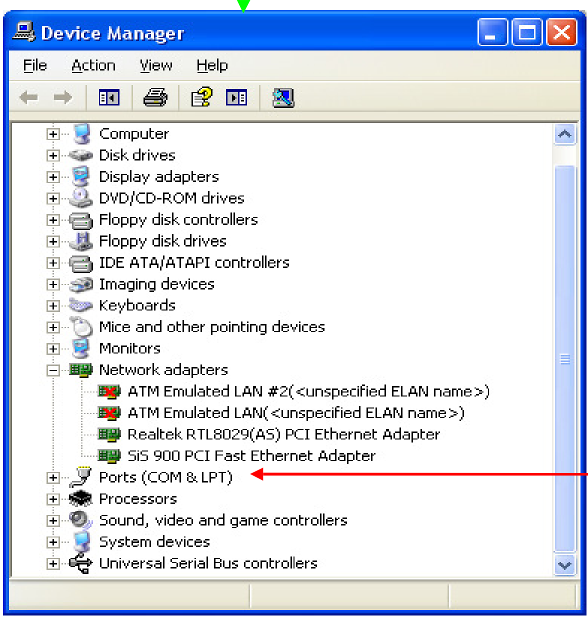
A Window similar to that shown opposite will appear
Select the 'Hardware' Tab

Tab

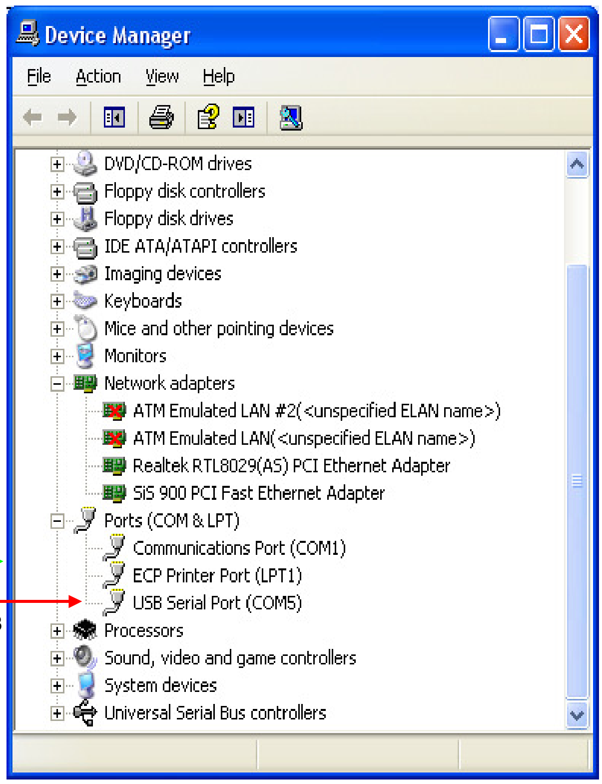




Select '**Device Manager**' Button



Select Ports



Comm Port used by USB converter

The example shows COM5 as the port being used by the USB Converter.

Use the 'USB Serial Port' port number in the Hyper terminal configuration:

24.0 Changing the MUX ID Using Q-Log

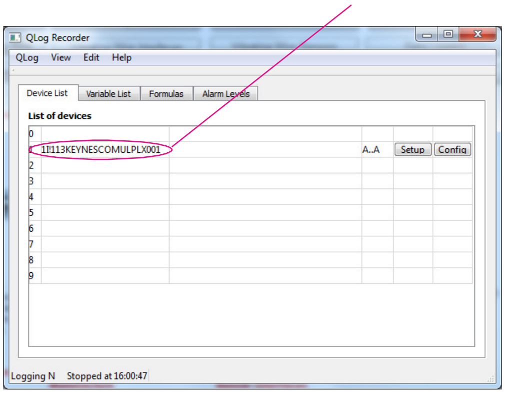
When using multiple MUX-16/32 units with the VibWire-101 to create large channel count systems then each MUX-16/32 unit must have its own unique ID number set for it to be identified on the MUX control signal network. There are full details in the MUX-16/32 User guide and a summary of these instructions is shown below.

Q-Log is the free applications software avail to download from the **http://www.aquabat.net** web site

The image below demonstrates how to change the MUX-16/32 ID number using the Q-Log applications software.

The example demonstrates how to change the MUX-16/32 from ID = 1 to ID = 2

MUX-16/32 ID string



The example above shows a MUX-16/32 unit with ID = 1 identified in the Q-LOG device list upon completion of the 'Scan for device' operation.

Once Q-LOG is up and running

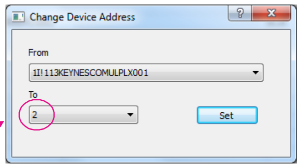
Only change the address using a single device on the SDI-12 network at any one time. This avoids any confusion over which unit is being configured.

1. Connect the MUX-16/32 to the SDI-12 network as shown in drawing below
2. Scan for devices

The LED status indicators will flash

3. Select 'Change Address ' option.

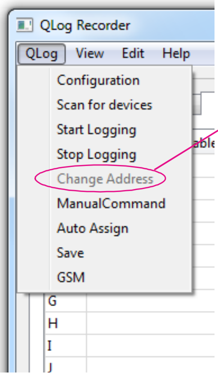
The 'Change Device Address' Window will appear.

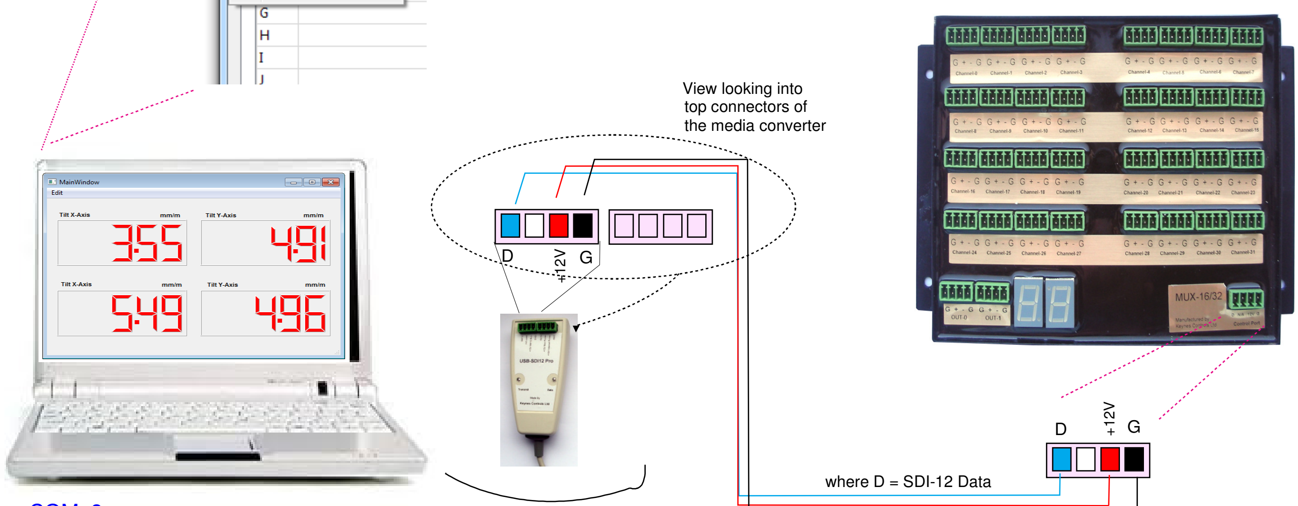


MUX ID = 1

The example shows the Q-Log Change Address Window. The address is being changed from

ID =1 to ID = 2





COM: 8

SDI-12 Dongle

MUX-Control Port

Important Note.

Each MUX-16/32 unit must have a unique network ID set if the units are to work correctly with the VibWire-101 MUX control port.

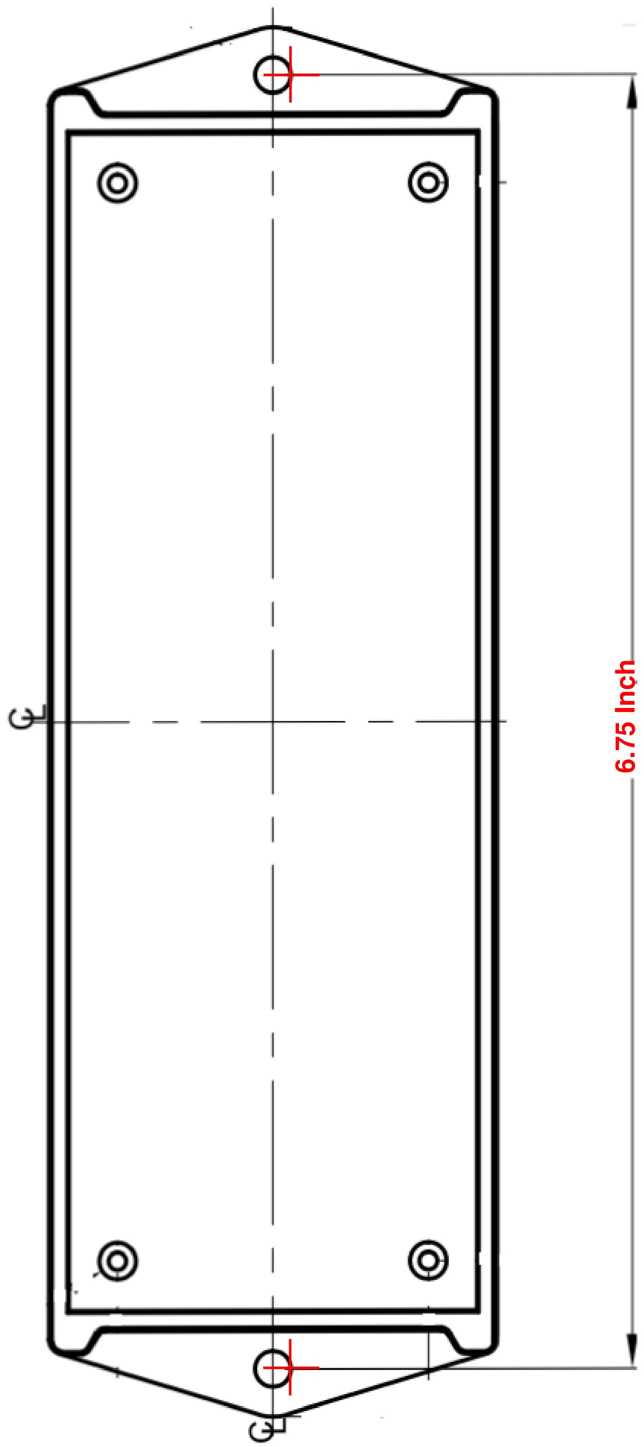
SDI-12 ID String - 1I!13KEYNESCOMULPX001

where 1 = ID number of the device

25.0 Mounting Template

The template below can be used for marking the mounting holes needed to secure the VibWire-101 to an enclosure.

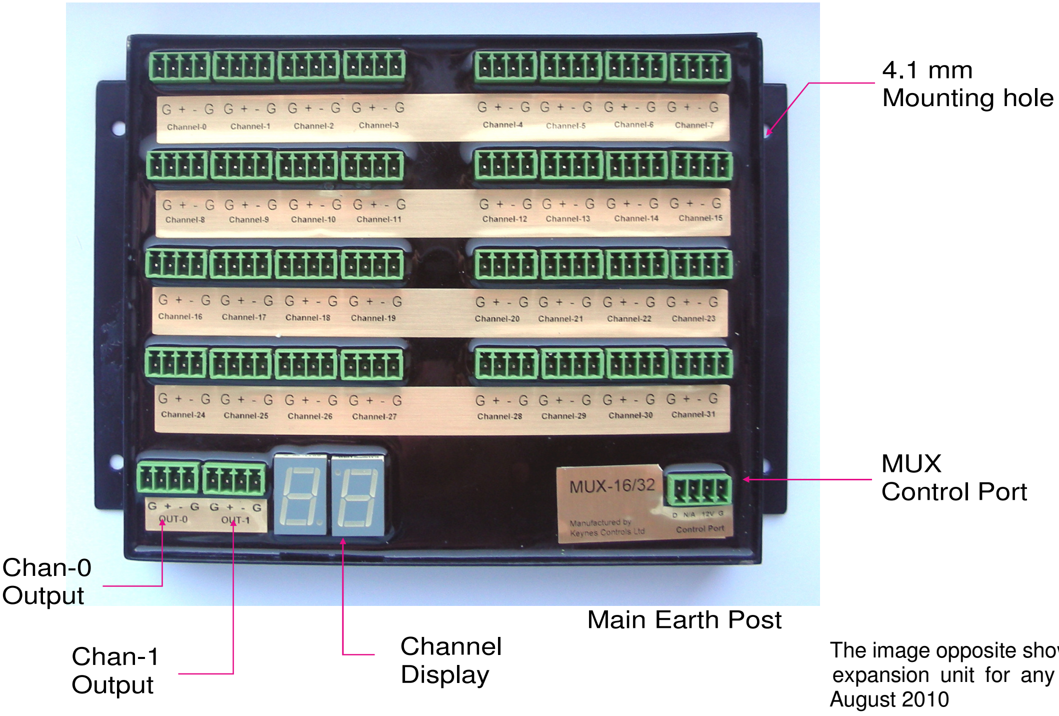
Mounting holes: 4.1 mm



Drawing to scale.

26.0 MUX-16/32 EXPANSION UNIT

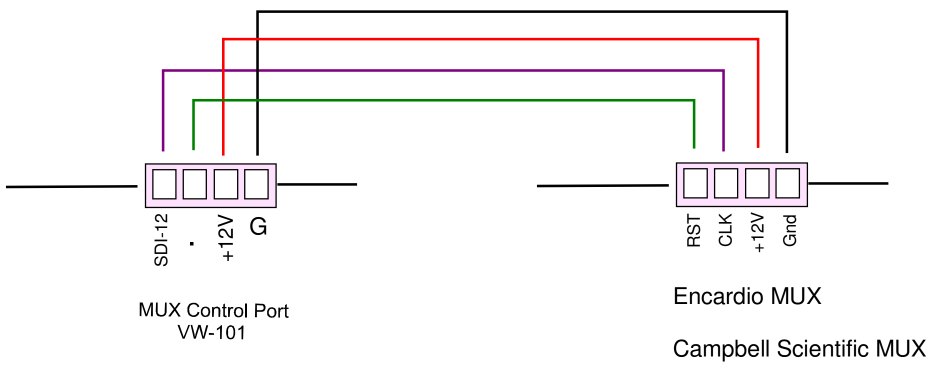
In-case of any trouble identifying channels check and ensure the MUX ID numbers are unique and set to the range 0 through to 3 when appropriate.



The image opposite shows the pin-outs for the MUX-16/32 expansion unit for any system manufactured after 18th August 2010

Refer to the Pin-outs on the labels for exact circuit connection.

Connection to a Campbell Scientific / Clone MUX Expansion Unit



The diagram above shows how to connect a Campbell Scientific / Clone multiplexer expansion

MUX-16/32 Expansion Unit SDI-12 Command Summary

The following commands are included to help with configuration of the VibWire-101 when operating with the MUX-16/32 or Campbell Scientific multiplexer expansion unit.

The following commands are for SDI-12 network operations only.

Changing the MUX-16/32 ID Number using AquaLOG

Use the AquaLOG data logger in transparent mode to issue SDI-12 commands to the MUX-16/32.

Connect the AquaLOG to the PC. Use a RS232 cross over connector to connect the serial port on the AquaLOG unit to a port on a laptop/PC or USB-RS232 converter as shown below.

Using the AquaLOG menu system, select:

Main Menu ‘ Diagnostics (option 9)’ → ‘SDI-12 Transparent Mode (option 8)’

At the terminal prompt enter the command:

0A1! changes the SDI-12 ID number from 0 to 1

xAy! x = start ID number (default 0)
y = end ID number

Selecting the MUX-16/32 Expansion Unit for operation with the VibWire-101

The VibWire-101 sensor is supplied be default to operate with the MUX-16/32 but can be configured to drive a single 16 channel Campbell Scientific MUX.

Use SDI-12 command to set the VibWire-101 to use the MUX-16/32: aXJn!

Example: 0XJ1! — sets the VibWire-101 with ID=0 to use the MUX-16/32
4XJ1! — sets the VibWire-101 with ID=4 to use the MUX-16/32

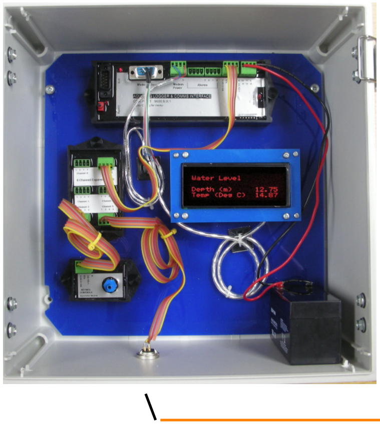
Keynes Controls / Campbell Scientific MUX Selection

The VibWire-101 sensor interface supports up to 4 x MUX-16/32 expansion units or a single 1 x 16 x 4 / 1 x 32 x 2 Campbell Scientific MUX expansion unit.

Use SDI-12 command ‘aXJn!’ to set the MUX type.

0XJ2 – tells the VibWire-101 with ID=0 to use Campbell Mux
3XJ1 - VibWire-101 with ID = 3 to use MUX-16/32

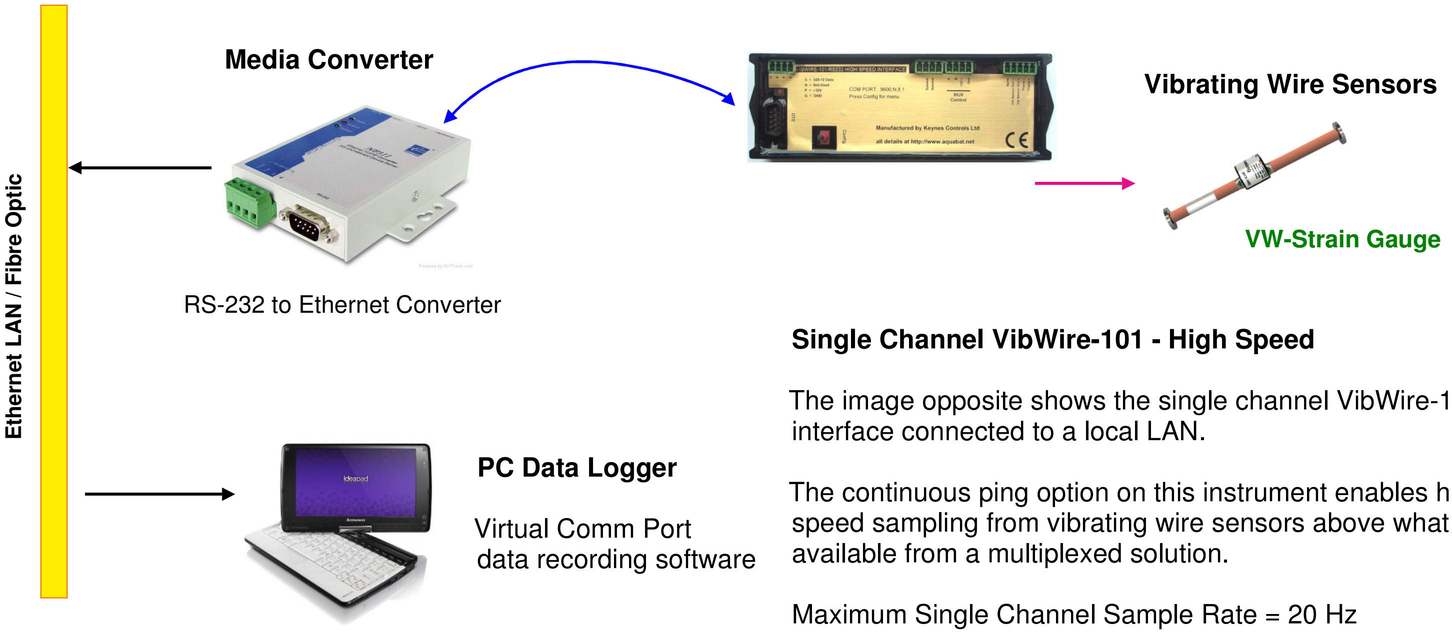
IMPORTANT NOTE: In-case of error. Power off the VibWire-101 after switching between MUX types.



27.0 Data Logger Solution

The image below shows one of the standard data logger systems that is available for use with the VibWire-101 instrumentation. The system can be expanded for Internet remote access or USB Flash memory recording solutions.

High Speed Vibrating Wire Sensor Acquisition Solution



Single Channel VibWire-101 - High Speed

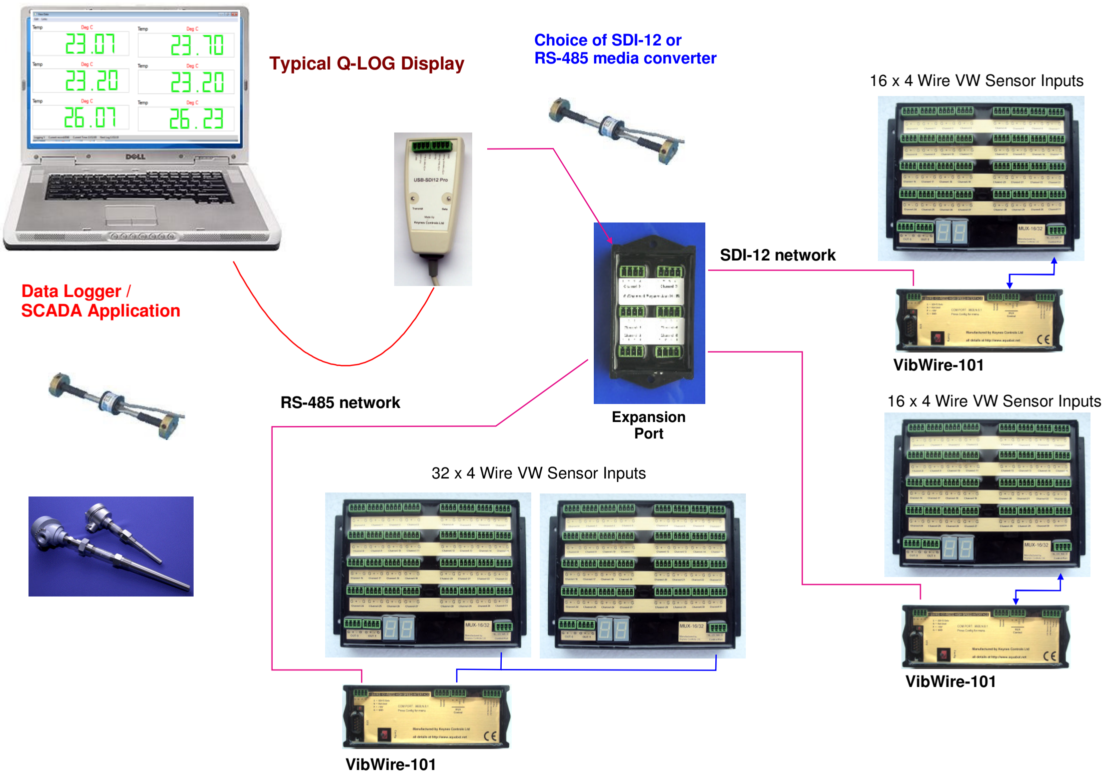
The image opposite shows the single channel VibWire-101 interface connected to a local LAN.

The continuous ping option on this instrument enables higher speed sampling from vibrating wire sensors above what is available from a multiplexed solution.

Maximum Single Channel Sample Rate = 20 Hz

Data is accessed via a virtual comm port by any software that supports serial port data operations.

28.0 PC Data Recording Solution



The image opposite shows a basic instrument solution consisting of 4 sensors.

All of the devices are intelligent and report values directly in engineering units.

The **USB** media converter interfaces the sensor digital network directly to the PC. The use of a PC enables large number of sensors to be recorded.

Expansion of the network is as easy as installing a new media converter on to a USB port.

29.0 Main Menu - Terminal Port

Models VibWire-108-SDI12 and VibWire-108-RS485 support a terminal menu system to enable the instrument to be configured.

Refer to page 22 for details of connecting the instrument to a ‘Terminal Emulator’ program running on a PC.

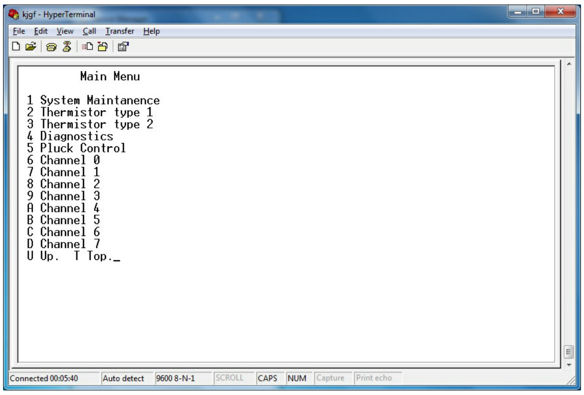


Fig 38 - Main Menu

This is the **Main Menu** that appears on starting the menu system

Quick Menu Guide

1. Option 4 ‘Diagnostics’ - use menu system available here to start a instrument scan on demand and observe data.

5. Option 5 ‘Pluck Control’ - restricts sensor ping frequency Used when poor quality sensors with 3rd harmonic oscillations are encountered.

30.0 Pluck Control

The pluck control system built into the VibWire-101 is a useful feature to activate upon observing unusual spikes in what should be steady state data values for sensors that change little over time.

30.1 Spikes in the VW Sensor Data

Depending on how well a vibrating wire sensor is made the sensor coil could become damaged, or if the sensor extreme physical shock once it is deployed. Damage to the sensor often means the coil seating has been damaged an the sensor can oscillate at a different harmonic than the designed fundamental frequency.

In order to obtain the correct sensor frequency in the face of oscillations from higher harmonics then the pluck control feature is used.

30.2 Setting the Pluck Control

Go to the ‘Pluck Control’ menu as shown below.

Select the channel to be configured.

Enter the ‘Centre Frequency’ for the normal operation of the sensor,

Important Note

The ‘**Initial Pluck** ‘ defines the start frequency of the sensor scan.

By default use the automatic sensor excitation ‘0’ as this gives the best result for the majority of sensors.

The ‘Initial Pluck’ frequency is a global setting and is of use only then the same model of sensor is used on all sensor inputs.

The operating frequency for the VW sensor input is now limited to a minimum frequency of ½ of the ‘Centre Frequency’, and to a maximum of 2 x ‘Centre Frequency’. This range removes the third harmonic oscillation which is a common cause of spikes in VW data .

Worked Example

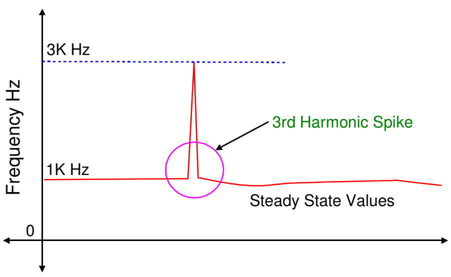


Fig 39 - Spike in data

Example - setup channel 0

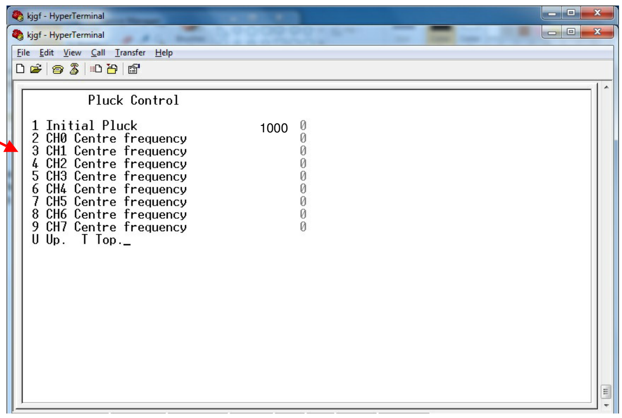
Press item ‘2’

Set Frequency to ‘1000’

Fig 39 opposite demonstrates how a typical spike in a stream of steady state data values will appear to the User.

The spikes in the data are often caused by faulty seating of the sensor coil.

The Pluck Control option will remove the false peaks caused by sensor oscillation away from the fundamental operating frequency.



The pluck control range

Range = (½ x Centre Freq) - Centre Freq - (2 x Centre Freq)

(Low Frequency - Centre Frequency - High Frequency)

Therefore with Centre Freq = 1000 Hz

Centre Frequency	Low Frequency	Mid Frequency	Max Frequency
800	400	800	1600
900	450	900	1800
1000	500	1000	2000
1200	600	1200	2400

Pluck Range = (½ x 1000) - 1000 - (2 x 1000)

(Low Frequency - Centre Frequency - High Frequency)

= 500 Hz to 2 K Hz with 1 K Hz centre frequency

Temperature Measurement

Introduction

The following technical note shows how to obtain the thermistor resistance values for a vibrating wire temperature sensor connected to the temperature input of the VibWire range of sensor interfaces.

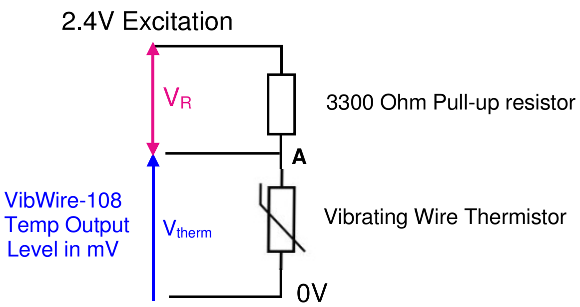
The VibWire-101 is factory set to use the most common Steinhart-Hart calibration factors. The default calibration factors work for most of the temperature sensors used by the sensor manufactures.

User defined calibration factors can be added if required. The calibration factors enable the VibWire-101 to give temperature values in Deg C.

The examples below have been included to show how the temperature values are calculated by the instrument. Page 33 shows the default Steinhart-Hart calibration factor values.

The circuit below shows the VibWire-108 temperature input with pull-up resistor completion

The VibWire-101 and 108 models use 2.4 V excitation for the sensor thermistor.



V_{therm} = Voltage across thermistor

V_R = Voltage across pull up resistor

Example. A VibWire-108/101 provides an output temperature value of 1086 mV then

$I_{therm} = (2.4 - V_{therm}) / 3300$ where 3300 = pull-up resistor value where $V_{therm} = 1.086$ V

therefore

I_{therm} = (Excitation volt - V_{therm}) / $3300_{\text{(Pull-up Resistor)}}$ = (2.4 - 1.086) / 3300 = 1.414 / 3300 = 0.398 mA

using Ohms Law

Note 1086 mV = 1.086 Volts

The Resistance of the Thermistor is calculated

$R_{therm} = V_{therm} / I_{therm} = 1.086 / 0.000398$ = 2727.4 Ohm

Now 2727.4 ohms is the resistance of the thermistor at the at temp (T)

Temperature Conversion

The thermistor resistance value is converted to temperature using the Steinhart-Hart Equation.

$$T = \frac{1}{C_1 + C_2 . \ln\backslash R_{therm} + C_3(\ln R_{therm})^3}$$

where T = absolute temperature in Kelvin R_{therm} in Ohms.

Conversion to Deg C is

$$T(C) = \frac{1}{C_1 + C_2 . \ln R_{therm} + C_3(\ln R_{therm})^3} - 273.15$$

The sensor data sheet will show for the thermistor a calibration equation similar to that below. The values for the parameter C_1, C_2, & C_3 will be listed.

$$(1/T) = C_1 + C_{2.} \mathrm{Ln}(R_{therm}) + C_{3\,.} \mathrm{Ln}(R_{therm})^3 - 273.15$$

Example

In Vibrating Wire sensors is the 44005RC Precision Epoxy NTC Thermistor is commonly used for temperature monitoring applications.

The data sheet for this product can be downloaded at

http://www.aquabat.net/downloads/1350009-2.pdf – The thermistor data sheet is valid to 11/12/2013
refer to the manufactures data sheet for the latest information.

An example Excel spreadsheet that demonstrates the temperature calculations can be downloaded at

http://www.aquabat.net/downloads/ThermistorWorksheet.xls

Example

The VibWire-101 is can be set to give ratiometric or mV temperature values from the built in thermistor of a vibrating wire sensor. depending upon the sensor configuration. Ratiometric values are calculated between the 3300 Ohm pull up resistor and thermistor resistance and is value between 0 – 1. The Vibwire-101 has returned a value of 0.663 from the thermistor.

In the spreadsheet below the VW-101 gives a temperature value (Ratiometric) of 0.663. The constants A, B and C are from the calibration data sheet. The spreadsheet below shows the temperature to be 7 Deg C,

ThermistorWorksheet.xls Screen image

Calculation of temperature based on voltage ratio

Voltage ratio	0.663	Input
Excitation (Ohm)	3300	Fixed
Thermistor resistance	6905	Calculated
Thermistor R0	3000	Thermistor property
A	1.41E-03	Thermistor property
B	2.37E-04	Thermistor property
C	1.02E-07	Thermistor property
Inv Temperature	3.57E-03	
Temperature (Celsius)	7.0	Calculated value

Steinhart-Hart Calibration Parameters obtained from calibration data sheet.

Temperature value

An NTC (Negative Temperature Coefficient) Thermistor is a passive electrical component whose resistance varies inversely with temperature. It is often used as a temperature sensor inside **vibrating wire sensors.**

The relationship between resistance and temperature can be described with the 'beta' formula.

The VibWire-101 range of sensor interfaces offers the beta value temperature calculation as an option within the thermistor set-up. The Beta value thermistor calculation is a simplified version of the Steinhart-Hart equation that is most often used in temperature measurement solutions.

For applications when the Steinhart-Hart calibration factors are not known then the sensor 'Beta' value can often be found on the thermistor manufactures data sheet.

The example below demonstrates how the VibWire-108 calculates temperature

The temperature calculations are undertaken internally within the VibWire-101 and are not yet currently part of the Q-Log software.

$$T = \frac{B}{ln\left(\frac{Re^{\frac{B}{T_0}}}{R_0}\right)}$$

where T = temp in units K (Kelvin)

B = Thermistor Beta value

T_0 = Temperature at 25 ° C

R_0 = Resistance at 25 ° C

and to convert Deg K to Deg C then $T_o = T_k - 273$

Thermistor Calculator v1.0 2014 01 31 | fortmarinus.com | fortmarinus@gmail.com

Element

Thermistor

BC2396CT-ND

NTCLE100E3103JT2

Description and Instructions

Description: A thermistor is a special type of resistor whose resistance varies inversely with temperature. The relationship can be characterized by the 'beta' formula.

Instructions: Enter the B, T_0, and R_0 values for the thermistor (here prepopulated with the values for a 10K therm. Then, enter the measured resistance. The output is the temperature.

Key: Given | Measured | Calculated | Output

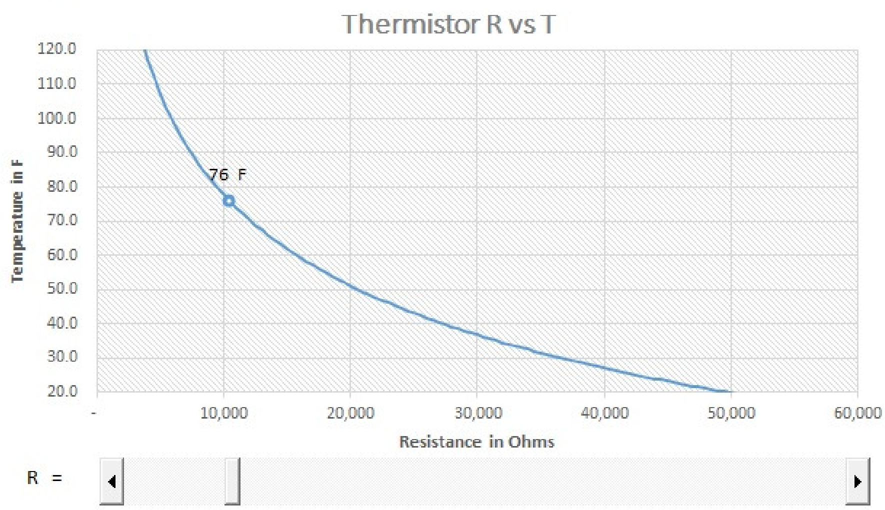
Formula

$$B = \left(\frac{1}{T_0} - \frac{1}{T}\right) \cdot \ln\left(\frac{R_0}{R}\right)$$

$$T = \frac{B}{ln\left(\frac{Re^{\frac{B}{T_0}}}{R_0}\right)}$$

Units Deg K

Graph



Temperature Calculator

Variable	Value	Units	Description
B	3,977.0	Kelvin	B Parameter *(from datasheet)*
T_0	298.0	Kelvin	where T_0 = 25 Deg C
R_0	10,000.0	Ohms	where R_0 = resistance @ 25 Deg C
R	10,318.0	Ohms	
T	297.8	Kelvin	
T	76.4	Fahrenheit	
T	24.8	Celsius	where T = 24.8 Deg C

Resistance of thermistor at 25 Deg C

Sample Vibrating wire Displacement Sensor calibration data sheet

Encardio-rite Electronics Pvt. Ltd.
A-7 Industrial Estate, Talkatora Road, Lucknow, UP-226011 India
E-mail: geotech@encardio.com, lko@encardio.com; Website: www.encardio.com
Tel. +91 (522) 2661039/40/41/42 Fax +91 (522) 2662403

ISO 9001 DNV CERTIFICATED FIRM

TEST CERTIFICATE
DWT Traceable to standard no. : J082301 T8F 281 TC

Customer	:			
P.O. No.	:			
Instrument	:	V W Piezometer	Date	: 02.02.2012
Serial number	:	xxxxx	Temperature	: 19°C
Capacity	:	350 kPa	Atm. Pressure	: 100 kPa

Input pressure (kPa)	Observed value Up1 (Digit)	Down (Digit)	Up2 (Digit)	Average (Digit)	End Point Fit (kPa)	Poly Fit (kPa)
0.0	6555.9	6556.9	6556.9	6556.4	0.0	0.3
70.0	6312.4	6312.6	6312.4	6312.4	69.3	69.5
140.0	6064.0	6064.3	6063.1	6063.5	139.9	140.1
210.0	5817.1	5818.4	5816.2	5816.7	210.0	210.1
280.0	5569.8	5570.7	5568.0	5568.9	280.3	280.3
350.0	5323.3	5323.3	5323.7	5323.5	350.0	349.8
				Error (%FS)	0.21	0.14

Digit : $f^2/1000$
Linear gage factor (G) : 2.8388E-01 kPa/digit
(Use gage factor with minus sign with our read out unit Model : EDI-51V)
Thermal factor(K) : -0.087 kPa/°C
Polynomial constants :
A= -2.2253E-07 B= -2.8085E-01 C= 1.8512E+03

Pressure "P" is calculated with the following equation:
Linear : P(kPa) =G(R0-R1)+K(T1-T0)-(S1-S0)
Polynomial : P(kPa) = A(R1)² + B(R1) + C+K(T1-T0)-(S1-S0)
R1 = current reading & R0 is initial reading in digit.
S1 and T1 = current atmospheric pressure(kPa) and temperature (°C)

Readings at the time of shipment		Date
f	:	Hz
f ²	:	Digit
Temperature	:	°C
Thermistor	:	Ohm
Atm.pressure	:	kPa
Coil resistance	:	Ohm

The terms K(T1-T0) are the temperature compensation terms for this sensor.

Temperature compensated readings only work if the thermsitor operation is defined.

(Zero conditions in the field must be established by recording the reading R0 (digit) along with temperature T0 (°C)and atmospheric pressure S0 (kPa) at the time of installation.If polynomial constants are used, determine value of 'C' as per § 6.2 of user's manual.)

Temperature Measurements

The VibWire-101 is capable of accurate temperature measurements suitable for many geotechnical and laboratory measurements. The thermistor temperature sensor built into most vibrating wire sensors connects directly into the device. The device is factory set to use the parameters below which work directly with most manufactures sensors.

The VibWire-101 can make temperature measurements simultaneously to the frequency measurements when in 16 x 4 Wire mod

Main Menu

1. Device Setup
2. Thermistor setup
3. Sensor Setup
4. Analog settings
5. Diagnostics
6. System Maintanence
7. Exit

Frequency proc

0 = Hz 1 = Digits (Hz²) 2 = SI Units

where SI Units is by Quadratic Expansion

Channel 0

1 Frequency proc	1	
2 Thermistor type	1	1.8512E+03
3 Cal A	3.35E-3	
4 Cal B	2.56E-4	
5 Cal C	2.08E-6	
6 Cal D	7.30E-8	

U Up. T Top.

Common VW Sensor Thermistor Part Numbers

YSI 44005
Vishay 1C 3001 B3
RS Part no: 151-215

The part numbers are for 3 K Ohm thermistor commonly used by most different VW sensor manufacturers to measure temperature.

The sensors give 3 K Ohm resistance at 25 Deg C

The example above is for a VW Piezometer and so the engineering units calculations vary between the different sensor types.

For a Piezometer the local barometric levels are taken into consideration.

The engineering units for this example is K Pa

The term (S1-S0) is a constant offset that allows for local atmospheric conditions and be taken from a barometer module such as models **Barom-SDI12** or **Barom-485**.

The VW sensor units have to be set to 'Digits' that is Hz²/1000.

AquaLOG Communication Interface & Data Logger Configuration

AquaLOG Menu System

The menu system below shows how to use the AquaLOG Data Logger and Communications Interface menu system to set the Scan rate and how to issue commands directly

Main Menu for the AquaLOG data logger.

The menu system below shows the commands to be followed to change the scan rate and issue User defined commands to the VibWire-101 using the AquaLOG.

User Commands

To change the scan rate of the VibWire-101

Select Option **8** to go to the '**Diagnostics**' option.

Issue new configuration instructions at the command prompt.

Main Menu

1 Device Setup
2 Zigbee Mode Settings
3 GPRS Mode Settings
4 USB Memory Stick Settings
5 SDI12 Setup
6 Formulas
7 Alarms
8 Logging Operations
9 Diagnostics
A System Maintenance
U Up. T Top.

Change Scan Rate

To change the scan rate of the VibWire-101

Select Option **8** to go to the '**Logging Operations**' option.

Select Option **1** to go to '**Sample Rate Period (Seconds)** '

Now enter the new update rate in seconds.
1 min = 60   10 min = 600   1 Hr = 3600

The sample rate is set at the same for all sensor inputs on the SDI-12 network.

Diagnostics

1 Test Acquisition
2 View data
3 View data (CSV)
4 Edit Values
5 Test Formulas
6 Test Alarms
7 Edit Alarms
8 SDI-12 Transparent mode
U Up. T Top.

Enter commands e.g. 0M! and wait for response
Commands will be sent to SDI-12 with break char without carriage return.
SDI-12 power is on.

> '*Enter SDI-12 Command*'

Example.

0A8! 8	*Change address from default to ID =8*
8M!80042	*Start measurement on single channel VibWire-101*
8D0!8+1201.37+37.56	

Logging Operations

1 Sample Rate Period (seconds)
2 Logger Info
3 Download Data
4 Reset Logger
U Up. T Top.

Sample Rate Period (seconds)

Current Value 60

> '**Enter new value**'

Refer to the AquaLOG User manual for full instructions for operating the data logger. Download full details from the **http://www.aquabat.net** web site.

Data Recording Options

The images below show connect the VibWire-101 to the AquaLOG data logger, and how to create PC based vibrating wire data acquisition systems.

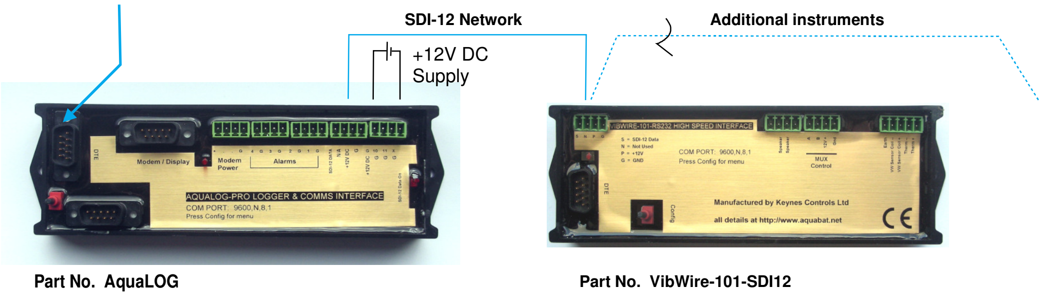
Connect AquaLOG to a PC

The VibWire-101 connects to the AquaLOG as shown below. Simply connect the SDI-12 bus of the logger to the SDI-12 bus on the VibWire-101

To activate the SDI-12 bus simply set the logger into 'Transparent mode' using the terminal port menu system of the logger.

Stores 1..250 sensor inputs

250 Inputs x 8K Records
64 Inputs x 32K Records



Connecting the VibWire-101 to a PC

The VibWire-101 connects to any PC using a USB media converter. The USB media converter is used to send commands across the SDI-12/RS-485 network.

Q-Log Software

To USB Port on the laptop

SDI-12 Network

Part No

USB-SDI12-Pro

Part No. VibWire-101-SDI12

The VibWire-101 can be directly connected to a PC using a USB-SDI12-Pro media converter. Data from the VibWire-101 along with 3rd party sensors can be displayed in theQ-Log software.

USB-RS485-Pro Connection to a VibWire-101-485

The USB-485Pro media converter connects the VibWire-101 directly to a PC using a USB port. The USB-485-Pro not only handles the 485 network signals but also powers the device directly from the computer USB port. The USB-485-Pro is an isolated device and this makes the device ideal for local on site measurement solutions.

Q-Log Software

Part No

USB-485-Pro

RS485 Network

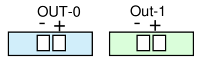
Part No. VibWire-101-485

To USB Port on the laptop

When used with the Q-Log free applications software the a stand-alone data recording systems easy to create

The following pages shows a summary of the logger commands used to controls

MUX - output port



MUX configured frequency output from vibrating wire sensors.

MUX configured temperature sensor output only from vibrating wire sensors.

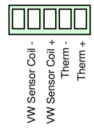
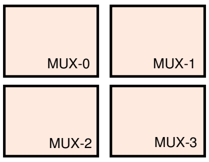


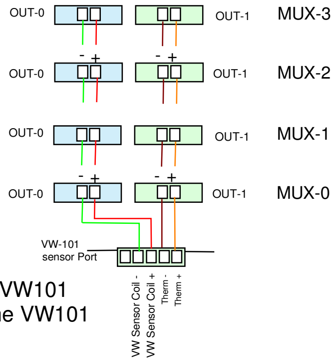
Fig 61



Description

4 x MUX-16/32 units for 16 x 4 wire operations.

Freq + Temp measurements



Wiring Instructions

All of the OUT-0 ports are connected to 'Frequency' input to the VW101
All of the OUT-1 ports are connected to 'Temperature' input to the VW101

Logger SDI-12 Commands

First Cell in data table
a = ID Number of VW-101

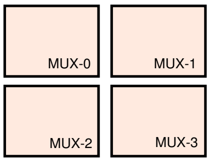
[D] aM2! aD0! aD1! aD2! aD3! 'Frequency results MUX-0'
[T] aD4! aD5! aD6! aD7! Temperature results MUX-0'

[AJ] aM4! aD0! aD1! aD2! aD3! 'Frequency results MUX-1
[AZ] aD4! aD5! aD6! aD7! Temperature results MUX-1'

[BP] aM6! aD0! aD1! aD2! aD3! 'Frequency results MUX-2'
[CF] aD4! aD5! aD6! aD7! Temperature results MUX-2'

[CV] aM8! aD0! aD1! aD2! aD3! 'Frequency results MUX-3'
[DL] aD4! aD5! aD6! aD7! Temperature results MUX-3'

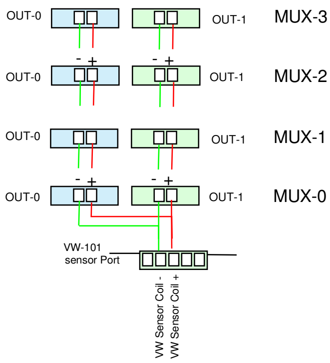
Fig 62



Description

4 x MUX-16/32 units for 32 x 2 wire operations.

Frequency measurements only



Wiring Instructions

All of the MUX output ports for MUX-0 to MUX-3 are all connected to the 'Frequency' input on the VW-101

Logger SDI-12 Commands

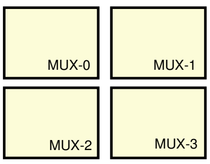
[D] aM2! aD0! aD1! aD2! aD3! 'Frequency results MUX-0 Chan-0 .. 15'
[T] aM3! aD0! aD1! aD2! aD3! 'Frequency results MUX-0 Chan-16 ..31'

[AJ] aM4! aD0! aD1! aD2! aD3! 'Frequency results MUX-1 Chan-0 .. 15'
[AZ] aM5! aD0! aD1! aD2! aD3! 'Frequency results MUX-1 Chan-16 ..31'

[BP] aM6! aD0! aD1! aD2! aD3! 'Frequency results MUX-2 Chan-0 .. 15'
[CF] aM7! aD0! aD1! aD2! aD3! 'Frequency results MUX-2 Chan-16 ..31'

[CV] aM8! aD0! aD1! aD2! aD3! 'Frequency results MUX-3 Chan-0 .. 15'
[DL] aM9! aD0! aD1! aD2! aD3! 'Frequency results MUX-3 Chan-16 ..31'

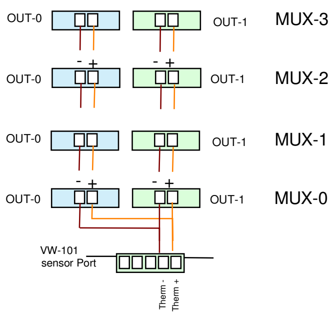
Fig 63



Description

4 x MUX-16/32 units for 32 x 2 wire temperature sensor operations.

Temperature measurements only



Wiring Instructions

All of the MUX output ports for MUX-0 to MUX-3 are all connected to the 'Temp' input on the VW-101

Logger SDI-12 Commands

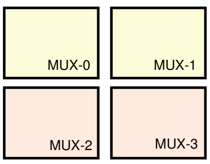
[D] aM2! aD4! aD5! aD6! aD7! 'Temperature results MUX-0 Chan-0 .. 15'
[T] aM3! aD4! aD5! aD6! aD7! 'Temperature results MUX-0 Chan-16 ..31'

[AJ] aM4! aD4! aD5! aD6! aD7! 'Temperature results MUX-1 Chan-0 .. 15'
[AZ] aM5! aD4! aD5! aD6! aD7! 'Temperature results MUX-1 Chan-16 ..31'

[BP] aM6! aD4! aD5! aD6! aD7! 'Temperature results MUX-2 Chan-0 .. 15'
[CF] aM7! aD4! aD5! aD6! aD7! 'Temperature results MUX-2 Chan-16 ..31'

[CV] aM8! aD4! aD5! aD6! aD7! 'Temperature results MUX-3 Chan-0 .. 15'
[DL] aM9! aD4! aD5! aD6! aD7! 'Temperature results MUX-3 Chan-16 ..31'

Fig 64



Description

4 x MUX-16/32 units for

64 x 2 wire Thermistor (Temp) MUX-0 MUX-1
64 x 2 wire VW sensor frequency MUX-2 MUX-3

Logger SDI-12 Commands

[D] aM2! aD4! aD5! aD6! aD7! 'Temperature results MUX-0 Chan-0 .. 15'
[T] aM3! aD4! aD5! aD6! aD7! "Temperature results MUX-0 Chan-16 ..31'

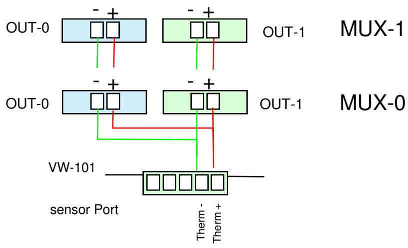
[AJ] aM4! aD4! aD5! aD6! aD7! 'Temperature results MUX-1 Chan-0 .. 15'
[AZ] aM5! aD4! aD5! aD6! aD7! 'Temperature results MUX-1 Chan-16 ..31'

[[BP] aM6! aD0! aD1! aD2! aD3! 'Frequency results MUX-2 Chan-0 .. 15'
[CF] aM7! aD0! aD1! aD2! aD3! 'Frequency results MUX-2 Chan-16 ..31'

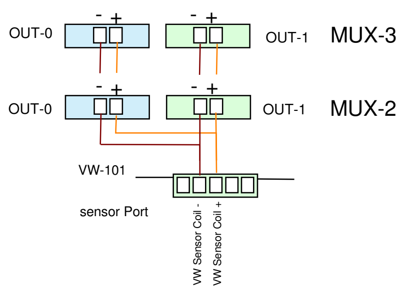
[CV] aM8! aD0! aD1! aD2! aD3! 'Frequency results MUX-3 Chan-0 .. 15'
[DL] aM9! aD0! aD1! aD2! aD3 'Frequency results MUX-3 Chan-16 ..31'

Temperature sensors

Connect the MUX-16/32 unit expansion unit output ports to the VibWire-101 unit as shown below:



Vibrating Wire - Frequency



Connect the MUX-16/32 unit expansion unit output ports to the VibWire-101 unit as shown below:

49 The following examples show for to use of a single MUX|-16/32 unit configured for 32 x 2 wire operations.

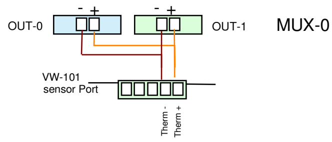
MUX-0

Fig 65

Description

1 x MUX-16/32 units for 32 x 2 wire

temperature sensor operations.



Logger SDI-12 Commands

[D] aM2! aD4! aD5! aD6! aD7! 'Temperature results MUX-0 Chan-0 .. 15'
[T] aM3! aD4! aD5! aD6! aD7! ''Temperature results MUX-0 Chan-16 ..31'

The following logger commands create a data table

using the first 32 x cells in the data table.

The first useable cell in any data table is 'D'.

Wiring Instructions

Temperature measurements only

All of the MUX output ports on MUX-0

are both connected to the 'Temp' input on the VW-101

MUX-0

Description

1 x MUX-16/32 unit for

32 x 2 wire VW sensor frequency

Vibrating Wire - Frequency

Connect the MUX-16/32 unit expansion

unit output ports to the VibWire-101 unit

as shown below:

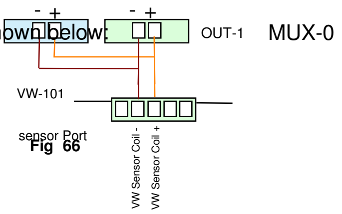


Fig 66

Logger SDI-12 Commands

[D] aM2! aD0! aD1! aD2! aD3! 'Frequency results MUX-0 Chan-0 .. 15'
[T] aM3! aD0! aD2! aD3! aD3! ''Frequency results MUX-0 Chan-16 ..31'

The following logger commands create a data table

using the first 32 x cells in the data table.

The first useable cell in any data table is 'D'.

The following examples show for to use the MUX|-16/32 units configured for 32 x 2 wire operations.

MUX-0

MUX-1

Description

2 x MUX-16/32 units for 32 x 2 wire

temperature sensor operations.

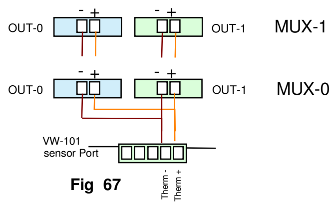


Fig 67

Logger SDI-12 Commands

[D] aM2! aD4! aD5! aD6! aD7! 'Temperature results MUX-0 Chan-0 .. 15'
[T] aM3! aD4! aD5! aD6! aD7! ''Temperature results MUX-0 Chan-16 ..31'

[AJ] aM4! aD4! aD5! aD6! aD7! 'Temperature results MUX-1 Chan-0 .. 15'
[AZ] aM5! aD4! aD5! aD6! aD7! ''Temperature results MUX-1 Chan-16 ..31'

The following logger commands create a data table

using the first 64 x cells in the data table.

The first useable cell in any data table is 'D'.

Wiring Instructions

Temperature measurements only

All of the MUX output ports on MUX-0 and MUX-1

are both connected to the 'Temp' input on the VW-101

MUX-0

MUX-1

Fig 68

Description

1 x MUX-16/32 unit for

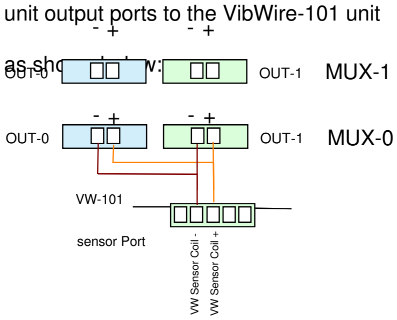
32 x 2 wire VW sensor frequency

Vibrating Wire - Frequency

Connect the MUX-16/32 unit expansion

unit output ports to the VibWire-101 unit

as shown below:



Logger SDI-12 Commands

[D] aM2! aD0! aD1! aD2! aD3! 'Frequency results MUX-0 Chan-0 .. 15'
[T] aM3! aD0! aD1! aD2! aD3! ''Frequency results MUX-0 Chan-16 ..31'

[AJ] aM4! aD0! aD1! aD2! aD3! 'Frequency results MUX-1 Chan-0 .. 15'
[AZ] aM5! aD0! aD1! aD2! aD3! ''Frequency results MUX-1 Chan-16 ..31'

The following logger commands create a data table

using the first 32 x cells in the data table.

The first useable cell in any data table is 'D'.

43 Earth Connection - Multiple Instrument Panels

When the MUX-16/32 unit is being used in a distributed, but locally connected instrument system then the individual instrument boxes should be connected together using a common, but good quality earth connection.

Typically the vibrating instrumentation is mounted onto a metal mounting plate. The individual panels are wired together using the 'Earth' connection.

The unit closest to the main system is earth is then terminated to it. All the systems will now be at the same local earth potential.

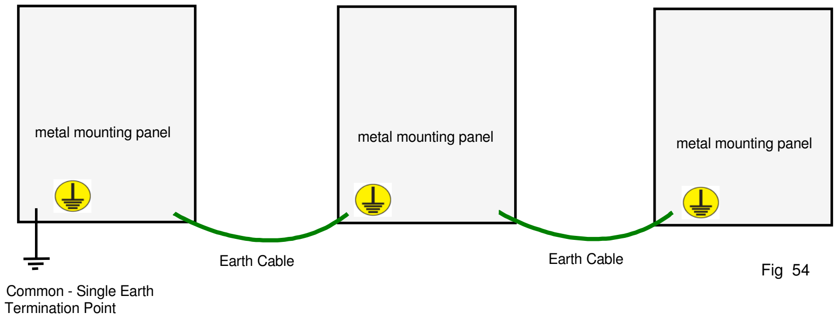


Fig 54

Connecting Sensor Shield to Earth

To minimise the effect of electrical noise and to prevent current loops effects from degrading, or causing false measurements, the sensor cable sheath should be terminated to the system '**Earth**' connection.

The simplest way to terminate the vibrating wire sensor sheath to earth is to connect the screen to the '**G**' earth point on the MUX-16/32 unit.

All the vibrating wire sensors sensor earth sheaths should be correctly terminated to the main system earth.

43.1 Vibrating Wire Sensor Screen Installation

Fig 55 below shows a Vibrating wire strain gauge connected the the MUX-16/32 unit in 4 x wire mode.

The sensor cable screen, which is identified as it does not have a isolated plastic covering.

The screen can be connected to any Earth point on the unit.

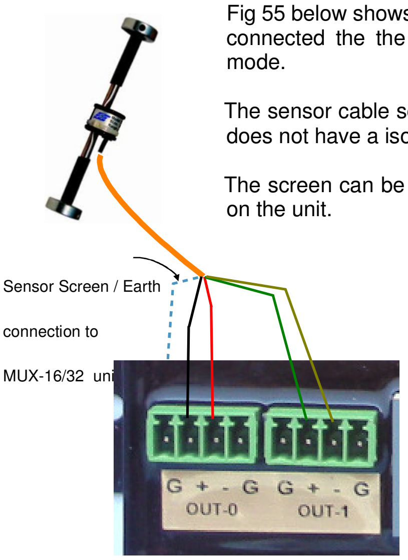
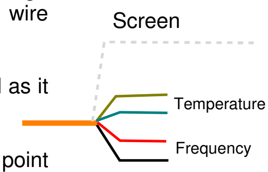
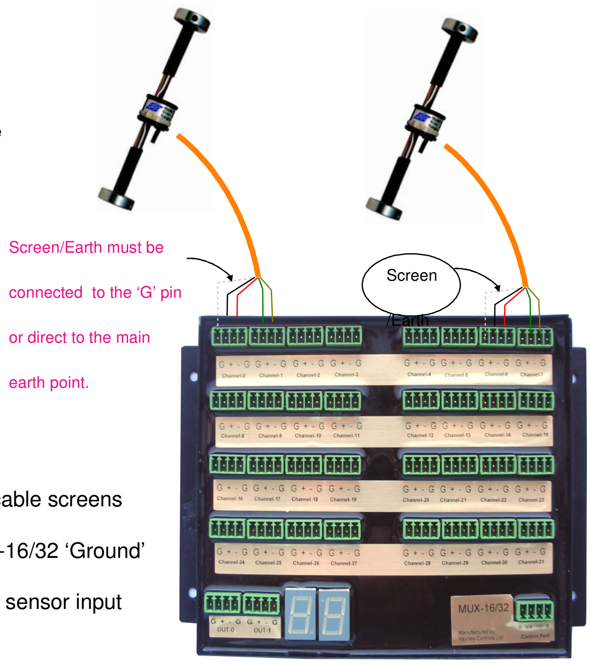


Fig 55





Multiple sensors connected to

MUX-16/32 unit in 4 x Wire mode.

Important Note

All of the vibrating wire sensor cable screens must be terminated to the MUX-16/32 'Ground' connection labelled 'G' on each sensor input channel.

The screen often makes up the 5th core in a

ing wire sensor cable

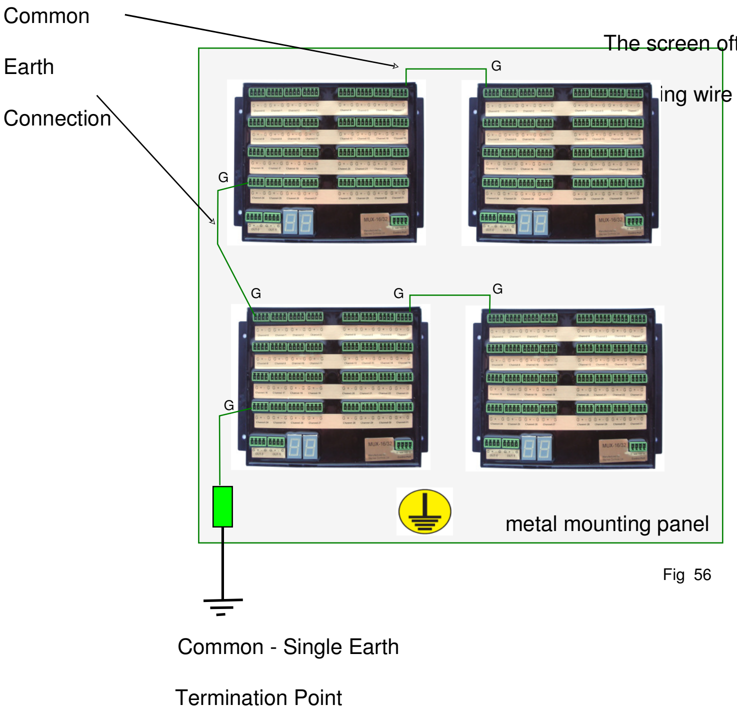


Fig 56

Fig 56 demonstrates how to connect multiple MUX-16/32 expansion units together to minimise interference on any measurement operation.

Make sure that each unit is connected together using a common earth connection.

Any connection labelled '**G**' is a common 'Earth' connection. There are spare 'Earth' connections on the MUX-16/32 units.

The individual units are connected together using a common earth connection.

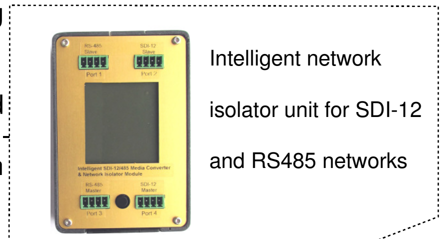
The final unit requires a connection to the main system earth.

44 System Earth & Network Isolation - Multiple Instrumentation Panels

The image below demonstrates how 2 x separate instrument systems are connected together across an SDI-12 network in order to to prevent noise problems from effecting measurements.

The example shows the VibWire-101 and MUX-16/32 expansion units however any other SDI-12 network devices are connected in exactly the same way.

Part No. NP_Isolator-Pro



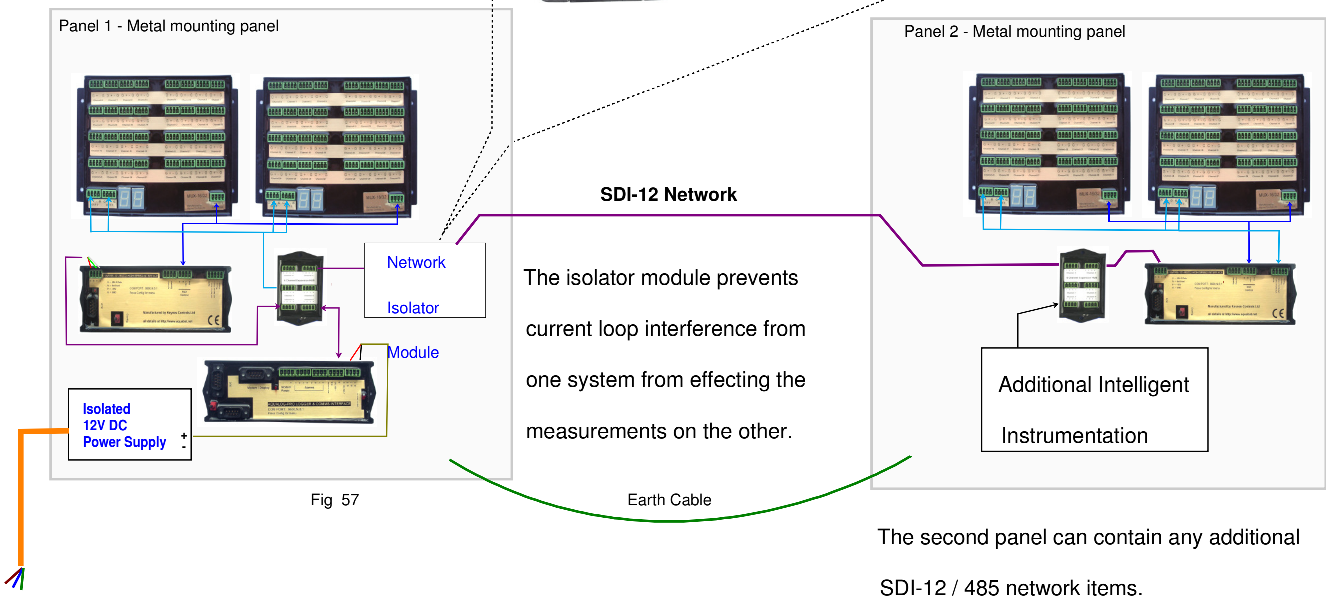


Fig 57

45 Network Isolation to prevent current loop effects

Erratic and unstable measurements of vibrating wire sensor signals is often caused by earth loop problems getting into the sensor wiring or network cables. To prevent this action from disrupting measurements all actions to prevent a current lop circuit from forming have to be undertaken. The first stage of protection is to create and use a common single earth point

46 Common Earth Point

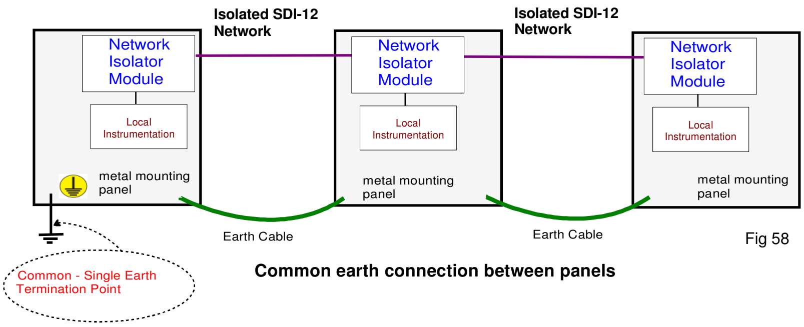


Fig 58

The image opposite shows how to connect multiple systems panels together in order to avoid noise problems.

Noise caused by current loops are often introduced in field applications via network cabling, or via the sensor cabling when a device is located onto a structure which is at a different local potential than

This effect can cause erratic readings on sensors.

When only small distances between separate instrument panels are involved, then a good quality Earth connection should should link the individual metal instrument mounting panels together. See Fig 58 above. A good quality Earth connection free of any corrosion is required.

Only a single connection is to be made to the main systems Earth. This is best taken from the instrument panel closest to the main earth point.

47 Distributed Systems - Earth Connections

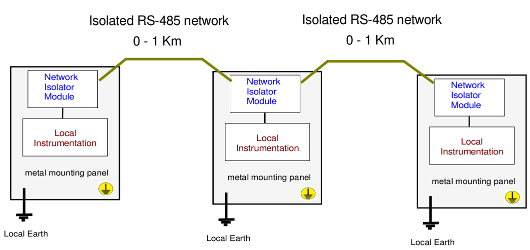


Fig 59

In applications where multiple instrument systems are deployed onto a network, and that the instrument cabinets are deployed some distance apart, typically on a RS-485 network then a common earth connection is no possible or practical.

In this case a local earth has to be made to the instrument cabinet. All of the MUX-16/32 units connected to the 'Earth' as shown in Fig 56 (page 30). A single local earth should be used within the cabinet to fasten to the local system Earth.

The **NP_Isolator** modules should be used to isolate the network cabling from the instrumentation.

Table of Contents