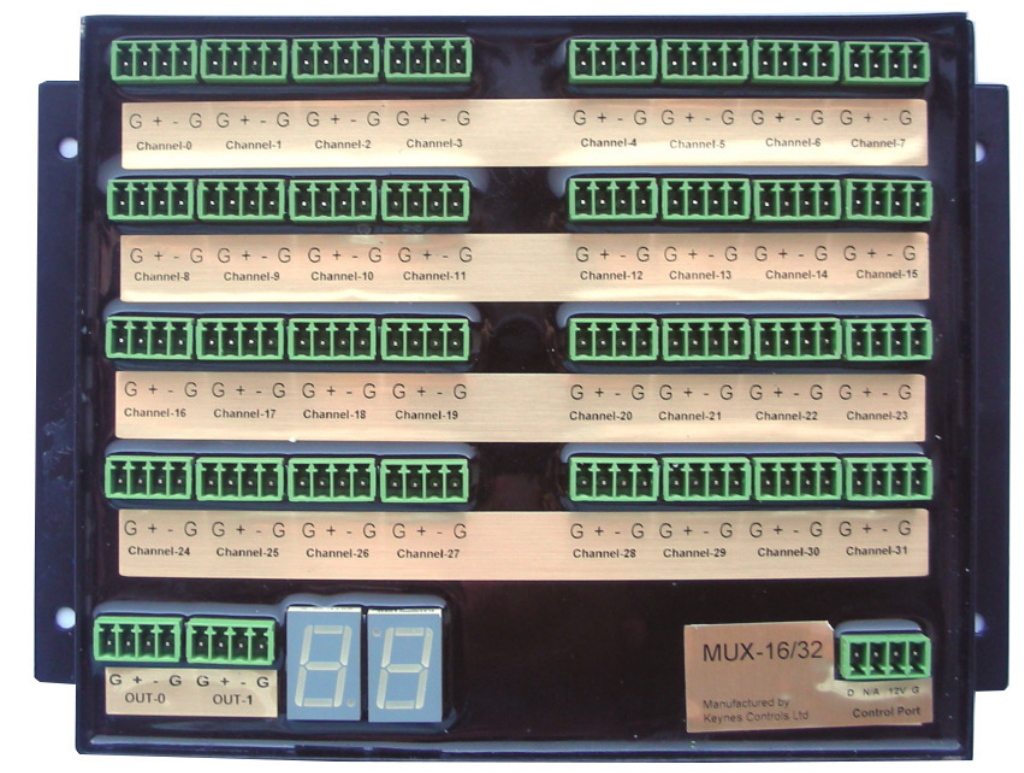
MUX-16/32 Installation & User Guide

Version 1.03



Manufactured by Keynes Controls Ltd

Last updated: June 2015

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1 Introduction

The following manual detail the installation and operation of the MUX-16/32 analogue expansion unit.

This device operates with all of the he VibWire-101 range of vibrating wire sensor interfaces.

The VibWire-101 is a single channel vibrating wire sensor interface and can be expanded to 128 sensor inputs with this device.

The MUX-16/32 is software configured for 32 x 2 wire of 16 x 4 operations.

The document is not a beginners guide to to vibrating wire sensor instrumentation. Some prior knowledge of the sensors and SDI-12 programming instructions will be required.

2 Switching Operations

The MUX-16/32 is a solid state expansion unit for use with the VibWire-101 sensor interface.

The MUX-16/32 uses a dedicated SDI-12 control port to control the switching operations and this control port cannot be used for any other application.

The dedicated control port operates to the full specification of SDI-12 version 1.03 regards to speed and operation characteristics.

Each MUX-16/32 unit is identified by the VibWire-101 using a standard ID number. The MUX-16/32 ID has been integrated into the Keynes Controls Q-Log applications software. The use of the a USB-SDI12 media converter and Q-LOG address change option enables the MUX-16/32 address change to be carried out easily. No programming experience is required to configure this device using Q-LOG.

A Break-Before-Make switching action ensures that only a single sensor signal is passed to the VibWire-101 at any one time. Any MUX-16/32 unit not selected for scanning operations has the output ports disabled.

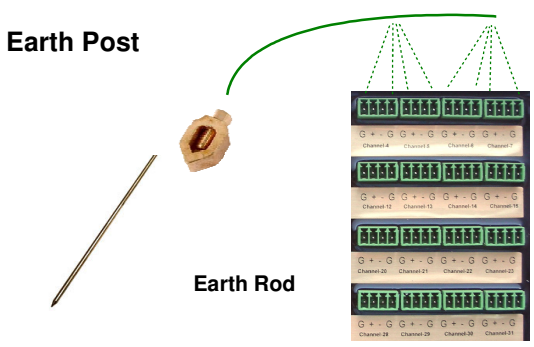
3 Lightning Protection

The MUX-16/32 is a lightning protected device and all electronics is physically isolated from the case. The device is safe from local lightning strikes using in built protection system.

For remote field applications a good quality earth post has to fitted to the MUX-16/32 and all Vibrating wire sensor screens have to be terminated to the earth..

A good quality Earth termination either to a local Earth or to a dedicated earth rod is required for gas discharge tubes to operate.

Fig 1 Earth Post Option



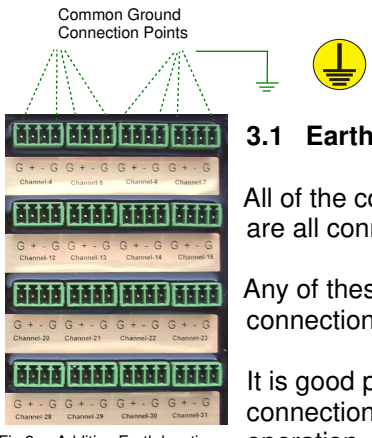


Fig 2 Addition Earth locations

3.1 Earth Points

All of the connection points labelled ‘G’ are all connected in common.

Any of these points can be used for the connection to a good quality earth .

It is good practice to use multiple earth connections to ensure reliable operation.

4 Local Earth

The MUX-16/32 is supplied as standard with gas discharge lightning protection on all inputs. In order for the lightning protection to work then the unit has to be connected to a good quality earth. The MUX-16/32 can be supplied with an Earth Post for local earth connection.

1) Connect a good quality copper cable cable from the central main earth post on the MUX-16/32 to a copper earth spike inserted into the ground adjacent to the interface.

2) When necessary connect the main earth posts together using good large diameter cable and secure the end to a single earth rod.
The gas discharge tubes will only protect the MUX-16/32 for local and not direct lightning strikes.

5 How does the VibWire-101 know how many MUX-16/32 Units are to be used

The MUX-16/32 has been designed to operate with the VibWire-101 vibrating wire sensor interface unit.

The VibWire-101 understands which MUX-16/32 unit to activate depending upon the measurement commands it has received from the logger unit or by the Q-LOG applications software.

6 MUX Selection Commands

The MUX-16/32 unit is selected for scanning by the VibWire-101 unit on the basis of the start measurement command received.

The measurement commands for 32 x 2 wire scan operations are shown in Table 1 on page 10.

The measurement command for 16 x 4 wire operation are shown in Table 2 on page 11

As soon as a start measurement command is received then the VibWire selects the specified MUX-16/32 unit and scans the device.

7 How are stored sensor values after a scan operation sent back to the logger or Q-LOG software

After completing a measurement operation the Vibwire-101 temporarily holds the sensor values, be that for 16 x 4 wire or 32 x 2 wire operation, and awaits instruction to send the data values across the network..

Supported SDI-12 Get Data commands are: **aD0! aD1! aD2! aD3! aD4! aD5! aD6! aD7! - 4 wire mode**

where **a** = ID number of the VibWire-101 device used to scan the MUX-16/32 unit.

Table 1 on page 6 shows the commands used to scan the MUX-16/32 in 32 x 2 wire mode.

Table 2 on page 7 shows the commands used to scan the MUX-16/32 in 16 x 4 wire mode.

The Get data commands can be issued in any order however, they are traditionally used as shown above.

The measurement commands can be seen in the Q-LOG configuration files.

8 Where is the scanning mode set

The scanning mode is set in the menu system on-board the VibWire-101. '**Main Menu - 2 Device Setup**'
The MUX-16/32 unit only has 2 options, they are **SINGLE** and **DUAL**.

SINGLE means 16 x 4 wire sensor inputs and uses only port OUT-0.

DUAL means 32 x 2 wire sensor inputs and uses output ports OUT-0 and OUT-1.

Scanning a MUX-16/32 in 32 x 2 wire mode

1. Make sure the device is set to **DUAL** Mode
2. Set the SDI-12 command to

Start measurement command	aM2! - scan channels 0 to 15	– (MUX ID=0, See details Table 1 page 10)
	aD0! aD1! aD2! aD3!	– Get data channels 0 - 15
	aM3! - scan channels 16 to 31	
	aD0! aD1! aD2! aD3!	– Get data channels 16 - 31

Full wiring and command summary details are shown on page 33.

Read back 32 values from the MUX - each aDx! command returns 4 data values

Example

A VibWire-101 with SDI-12 ID = 6 is to use a single MUX-16/32 with ID=0 to read 16 x 4 wire sensor inputs.

The commands to be used on the logger are:

Start measurement: **6M2! 6D0! 6D1! 6D2! 6D3!** – Starts measurements and reads frequency- 16 channels (4 wire mode)
6D4! 6D5! 6D6! 6D7! **–** reads temp data 16 channels (4 wire mode)

Setting the VibWire to scan in 16 x 4 Wire or 32 x 2 Wire mode is shown on page 17.

Fig 3

9 Cleaning & Maintenance

The following procedure should be followed for the care and maintenance of the MUX-16/32 expansion unit.

1) Remove Power from the system.

2) Clean round the connectors with a cotton bud soaked in a mild solution of soapy water.

3) All the unit to dry before reconnecting the unit.

10 Environmental Protection

The MUX-16/32 unit should be mounted inside an additional IP rated cabinet when deployed for field operations.

11 Common Measurement Problems or Erratic Behaviour

The MUX-16/32 expansion unit is designed to operate with the Keynes Controls VibWire range sensor interfaces.

Single Channel Test

The MUX-16/32 can be preset to a 'User' defined channel. This operation is set only using the menu system built into the VibWire-101 range of devices.

A vibrating wire sensor is connected to an input port on the MUX-16/32 unit

A series of sample measurements are manually taken and the results appear to be random.

IMPORTANT NOTE

Vibrating wire sensor readings are typically very similar values if taken in a small time period.

Vibrating wire sensors are not often used for dynamic applications due to the slow sample rates.

11.1 Items to Check

1. Check that the sensor wires connecting the vibrating wire sensor to the input port on the MUX-16/32 are terminated correctly and good contact to the device is being made.

2. Check that the Channel select indicator status LED is illuminated.

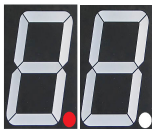


Fig 4

   Status LED indicator flashes only when power is applied to the device.

3. Make sure the vibrating wire sensor cable sheath is connected to the '**Earth**' connection on the MUX-16/32 unit.

   All '**Earth**' connections are labelled 'G' on the device, see photo opposite of the input port.

Fig 5

4. Make sure that the MUX-16/32 unit earth connection is terminated to the system earth.

   A connection is made from any of the input port earth points to the main system earth point. See details in Fig 56 page 30.

5. Test the sensor is wired correctly.

   Make sure the sensor cable screen connects to the metal case of the sensor. Resistance should be low and in the order of 0 - 1 Ohm.

   Make sure that the '**frequency**' signal is connected to the correct input ports for 32 x 2 or 16 x 4 wire mode.
   Make sure the temperature signal is connected to the correct port for 16 x 4 wire mode.

If the measurements are still random then the most likely cause of the problem is caused by current loop effects, and/ or the system has not been correctly terminated to a good 'Earth'.

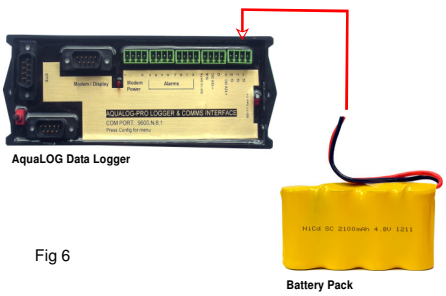


Fig 6

12 Testing the Power Supply on Remote Systems

In applications where a stand-alone instrument system is being powered by a local acquired 12V DC supply, and that is unit is connected to a local but low quality mains supply, but where results appear to be stable for periods in time, but then become erratic in nature but for for no apparent reason.

Most likely cause of problem:

1. The main system earth is not making a good contact to ground.

2. Ground loop signal interference - due to different local Earth potentials causing current flow in local cabling.

3. Several earth points have been used - this may be accidental pickup on sensor cabling.

System Testing

Use a 12V DC battery as the main system power supply to power all instrumentation.

The battery acts as an isolated supply and as such will operate regardless to the effect of the local earth and earth loop effects.

The sample measurements should now be stable.

13 Local Environmental Effects cause noise problems

Noise effects on the sensor reading may occur when there is a sudden change in the local environmental conditions, such as when it rains, or high levels of humidity.

The main cause of this effect is a bad connection to the main system earth, and this can effect in different ways can be any of the instrumentation.

The main system earth is the most likely the cause of the problems.

An easy test that should remove many of the different environmental effects is to power the instrumentation directly from a battery pack. The battery pack acts as a isolated power supply and should

14 Battery Powered Data Logger

The ultimate isolated 12V DC power supply is to use battery pack instead of a mains power supply unit.

Connect a 12V DC battery to the power input on the logger.

The AquaLog data recorder will start its measurement operations as soon as power is applied.
Make sure the logger unit is correctly configured to support the MUX-16/32 units. See pages 33 and 34 for a summary of the measurement instructions.

15 Isolated test measurements using a Windows laptop.

Isolated vibrating wire test measurements using the MUX-16/32 expansion unit using a Windows laptop running the free Q-Log software. The Q-LOG software operates all of the vibrating wire instrumentation and displays the results.

The Vibrating wire instrumentation is powered via the USB-SDI12-Pro from laptop USB port.

For further details see:

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

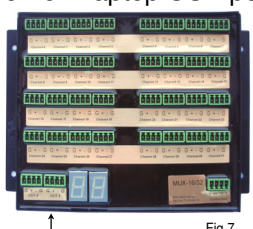
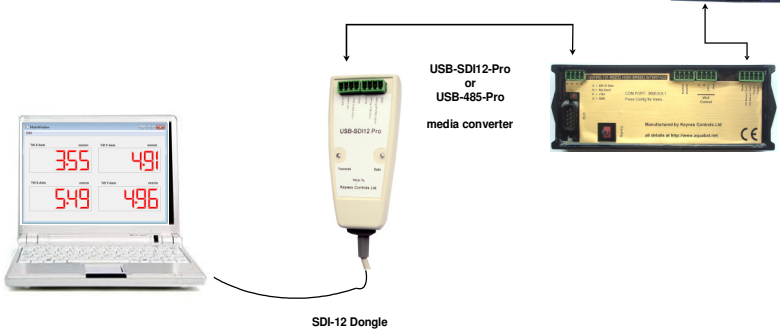


Fig 7



16 Switching between 2 & 4 Wire Mode Operation under SDI-12 Command

The MUX-16/32 expansion unit supports 2 and 4 wire VW sensor operations. The selection between 2 and 4 wire sensors is undertaken using software commands only and these are issued across the MUX-16/32 using the SDI-12 control port. The same procedure for issuing instructions for changing the ID number is followed as is used for selection the mode of operation.

The following SDI-12 command selects 2 or 4 wire sensor operation:

aXDn! (n=0 or 1) Sets 2 or 4 wire operations on the MUX-16/32.

Example SDI-12 command ‘ **0XD1!**‘ sets MUX-342 with ID=0 to 4 Wire mode.

‘**3XD0**’ sets MUX-16/32 with ID=3 to operate in 2 Wire mode.

See page 14 for details on how to issue configuration commands to the MUX-16/32.

17 Changing the MUX-16/32 ID Number using SDI-12 Commands

Details on page 8 show how to change the ID number using Q-LOG Windows software.

The MUX-16/32 supports ID numbers 0 -3

use command xAy! where x = start ID number y = end ID number

Example:

Change ID = 0 (factory default) to ID = 3

Command is **‘0A3!’**

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!

Each get data command returns 4 values.

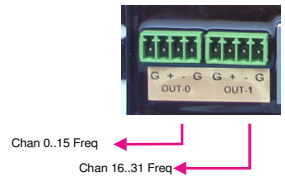


Fig 8 - Output Ports used in 2 Wire mode.

Table 1 - 32 x 2 wire scan instructions

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

Channels used with Port OUT-0 (Frequency)

aD0!	Chan-0	Chan-1	Chan-2	Chan-3
aD1!	Chan-4	Chan-5	Chan-6	Chan-7
aD2!	Chan-8	Chan-9	Chan-10	Chan-11
aD3!	Chan-12	Chan-13	Chan-14	Chan-15

Channels used with Port Out-1 (Temperature)

aD4!	Chan-16	Chan-17	Chan-18	Chan-19
aD5!	Chan-20	Chan-21	Chan-22	Chan-23
aD6!	Chan-24	Chan-25	Chan-26	Chan-27
aD7!	Chan-28	Chan-29	Chan-30	Chan-31

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.

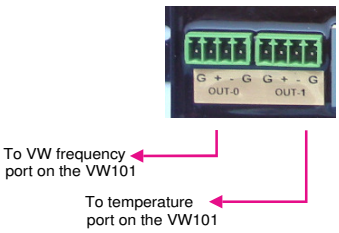
to 16 x 4 Wire mode

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!

Table 2 - 16 x 4 Wire Scan Instructions

Fig 9 - Sensor Output Ports



After each MUX has been scanned, and all 32 sensor readings have been taken, then the following command is required to download the data from the VibWire-101 to a data table in the AquaLOG data logger. The same command should work on any suitable SDI-12 data logger.

Get data: aD0! aD1! aD2! aD3! aD4! aD5! aD6! aD7!

16 x Freq Readings — 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: 6**D0! 6D1! 6D2! 6D3! 6D4! 6D5! 6D6! 6D7!**

16 x Freq Readings Port OUT-0 — 16 x Temp Readings 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!

19 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/QLOGFree/qlogv2.html** 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

SDI-12 ID String - 1!!13KEYNESCOMULPX001

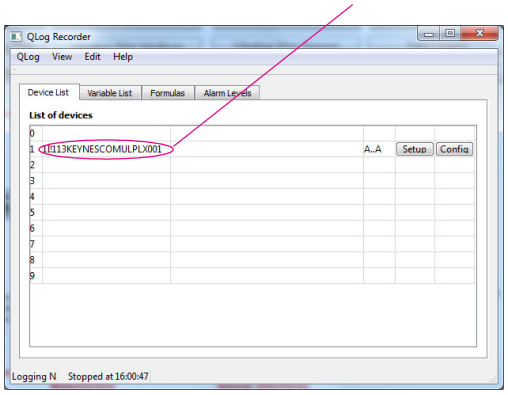


Fig 10

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.

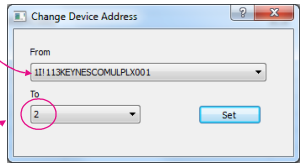
1. Connect the MUX-16/32 to the SDI-12 network as shown in Fig 11.
2. Scan for devices

The LED status indicators will flash

3. Select 'Change Address ' option.

The 'Change Device Address' Window will appear.

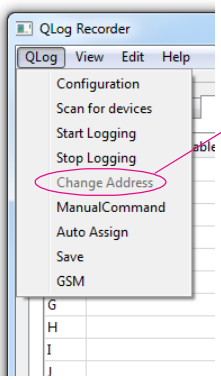
Initial ID number =1



MUX ID = 1

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

ID =1 to ID = 2



Change ID Number
(Address) Configuration options

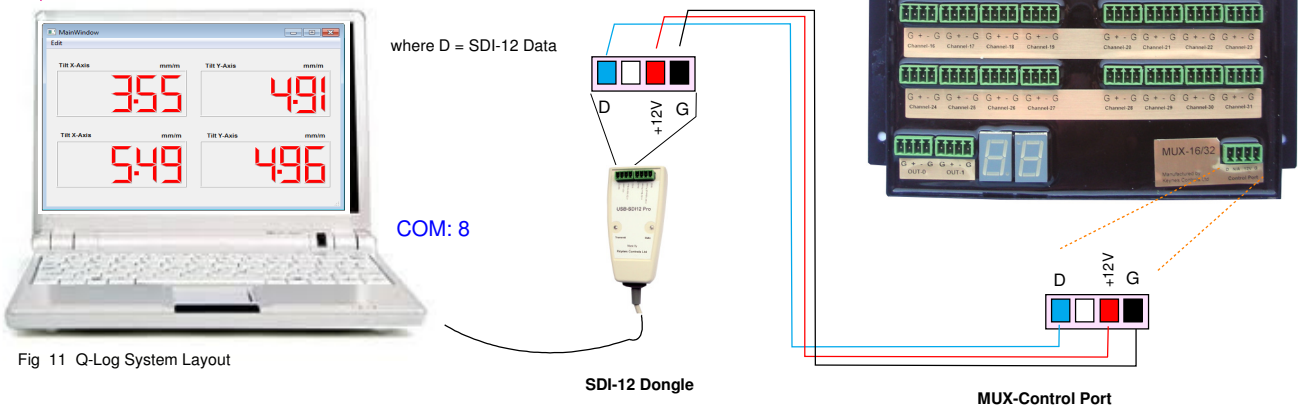


Fig 11 Q-Log System Layout

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.

Download a free copy Q-Log at

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

15.1 Identifier String

SDI-12 ID String - 1!!13KEYNESCOMULPX001

↑

where 1 = ID number of the device

20 Product Layout

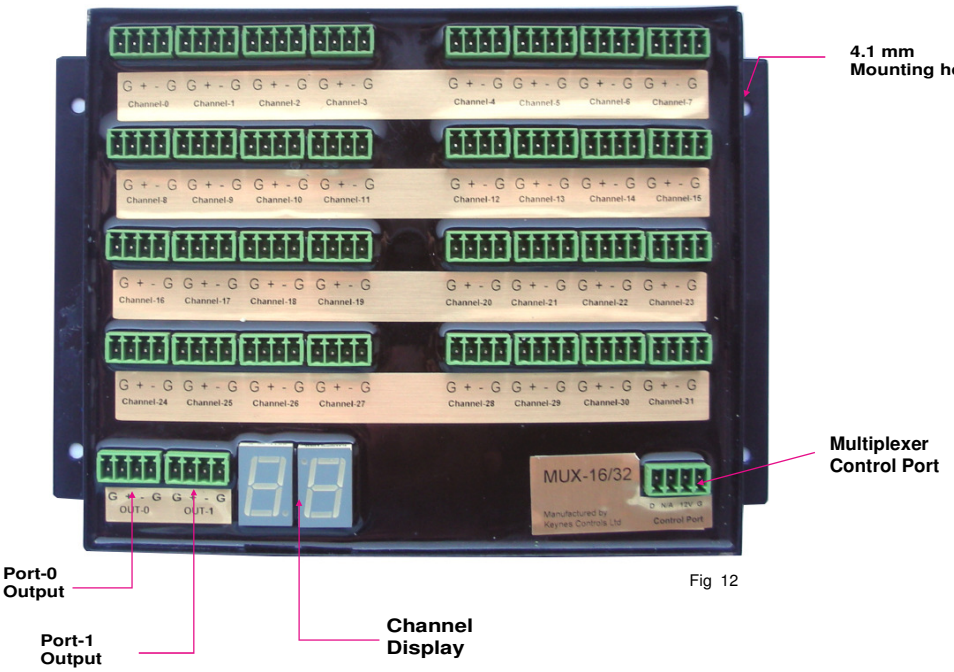
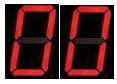


Fig 12


to

16 x 4 Wire mode


to

32 x 2 Wire mode

32 x 2 Wire Frequency Expansion

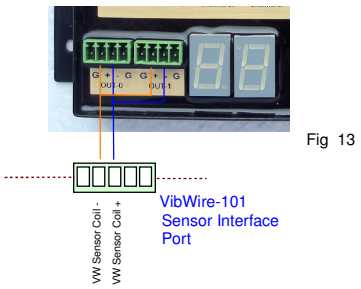


Fig 13

32 x 2 Wire Temperature Expansion

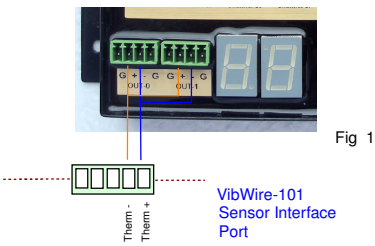


Fig 14

16 x 4 Wire VW Sensor Expansion

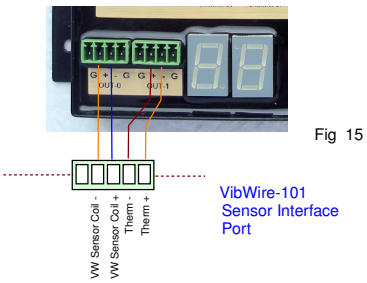


Fig 15

21 Physical Dimensions

Specifications

Length = 185 mm
Depth = 130 mm
Height = 45 mm including earth post
Weight = 1 Kg

Power Supply	At switching only	20 mA @ 12V for 2 sec
Relay Type	Latching	
Switching	32 x 2 way or 16 x 4 way	
Lightning protection	Gas Discharge Tube	
Display	7 Segment - Channel Selection / Power Status	

Wall mounting instructions

A template printed to scale is located on page x of this manual to locate the mounting holes onto a panel or wall

1) Drill a 4.1 mm hole at each location shown opposite

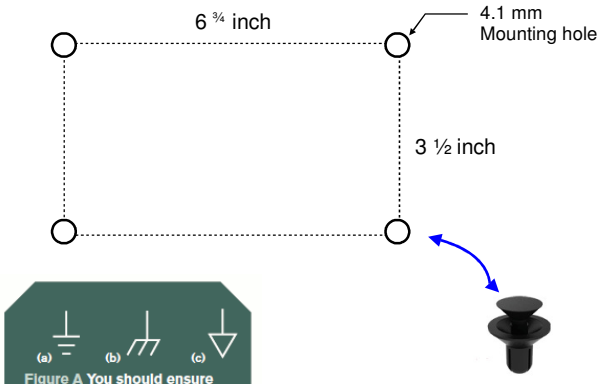
2) Fasten wall mounting plugs into the wall
Screw the MUX to the wall using minimum 4 x 15 mm wood / self taping screws

Screw mounting are not supplied with the MUX-16/32

Panel Mounting Instructions

1) When using the keynes Controls cabinets for instrument assembly simply match the mounting holes on to a suitable location on the base plate and secure with the Plastic snap in rivets.

17.1 Mounting Instructions



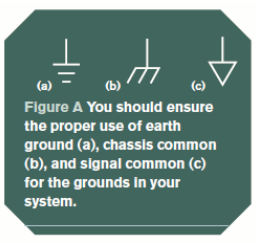
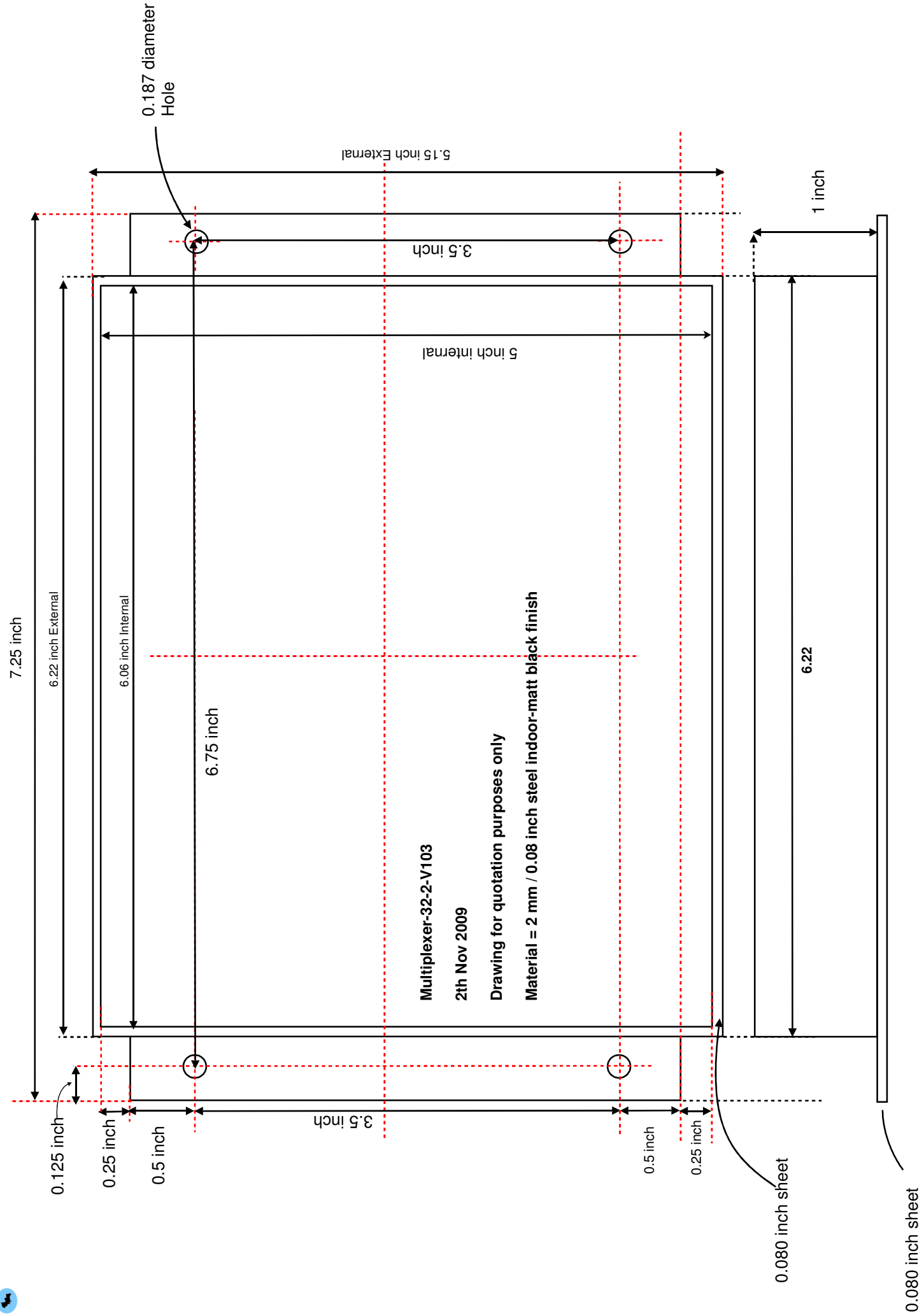


Fig 18


0.187 diameter Hole
5.15 inch External
3.5 inch
5 inch internal
1 inch
7.25 inch
6.22 inch External
6.06 inch Internal
6.75 inch
6.22
Multiplexer-32-2-V103
2th Nov 2009
Drawing for quotation purposes only
Material = 2 mm / 0.08 inch steel indoor-matt black finish
0.125 inch
0.25 inch
0.5 inch
3.5 inch
0.5 inch
0.25 inch
0.080 inch sheet
0.080 inch sheet

Important Note - Sensor Input Options

The MUX-16/32 can be used for switching both frequency and temperature sensor signals.

The VibWire-101 itself cannot distinguish between the sensor types that are connected to the input port so care has to be taken during the wiring of an instrumentation system.

The VibWire-101 is used to measure the frequency and temperature signals connected to the MUX-16/32 unit.

22 Installing the Vibrating Wire Sensor

The image below shows how to connect the frequency output from the coil of a vibrating wire sensor to an input of the MUX-16/32.

Under most cases, It does not matter which side of the coil goes to the + and - inputs of the MUX-16/32 input channels.

Check with the sensor manufactures installation notes for specific instructions for connecting the coil to the instrumentation

The sensor connects to the central 2 pins of the 4 way connector as shown

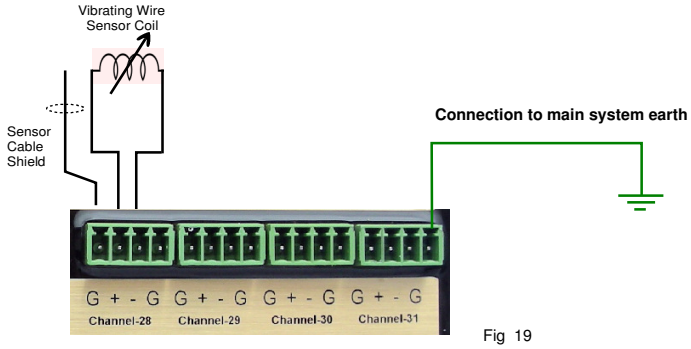


Fig 19

22.1 Installing the Temperature Sensor

The image below shows how to connect the temperature output from a vibrating wire sensor to an input of the MUX-16/32.

Under most cases It does not matter which side temperature sensor is connected to the + and - inputs of the MUX-16/32 input channels.

The MUX-16/32 can switch temperature of frequency signals.

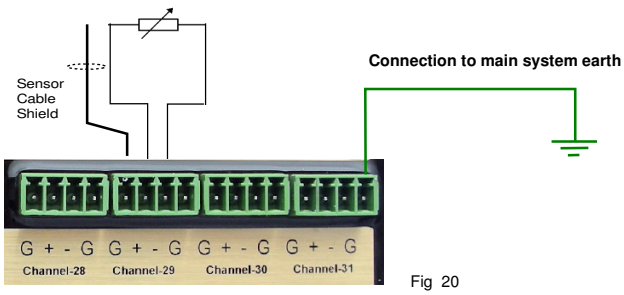


Fig 20

23 System Power Indicator

As soon as the Control signal bus of the VibWire-101 is activated and scanning starts then all MUX-16/32 unit channel display is illuminated as shown below.

The decimal point on the display shows the expansion unit is powered on.

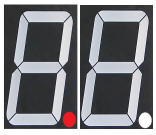


Fig 21

23.1 Channel Selection Indicator

Each MUX-16/32 unit is supplied with a Channel selection display as shown below.

This display shows the activate input channel and is only active during the switch process. The display is illuminated for 2 ½ seconds per channel.

Fig 22

16 x 4 Wire mode

32 x 2 Wire mode

24 Connecting the MUX-16/32 output ports to the VibWire-101 - 16 x 4 Wire Operation

Figure 24 below shows how to connect the output ports on a MUX-16/32 unit to the VibWire-101 for **16 x 4** vibrating wire operations.

What is clearly shown is how the Frequency and temperature signals are separated within the MUX-16/32 and how both the output ports 'OUT-0 ad OUT-1' are connected the VibWire-101 sensor interface.

Note. When the MUX-16/32 is used in 32 x 2 mode then only the output signals from port 'OUT-0' are used.

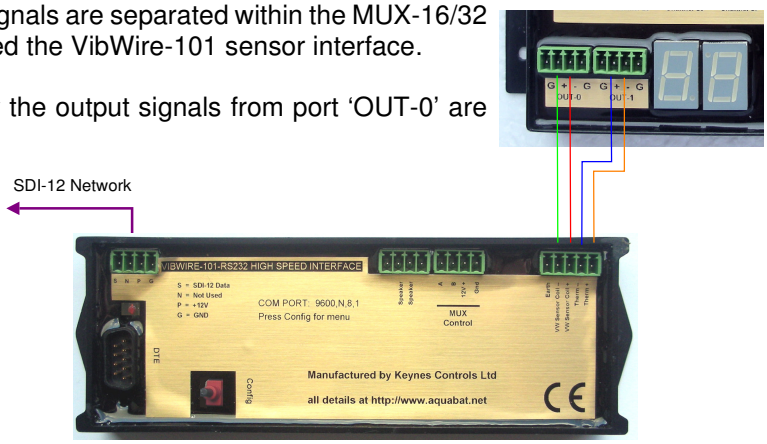


Fig 24 - VibWire-101 Vibrating Wire Interface

24.1 MUX-16/32 - 16 x 4 Vibrating Wire Sensor Connection

Figure 26 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.

Errors in results are most likely caused by incorrect wiring.

Frequency Input

Temp Input

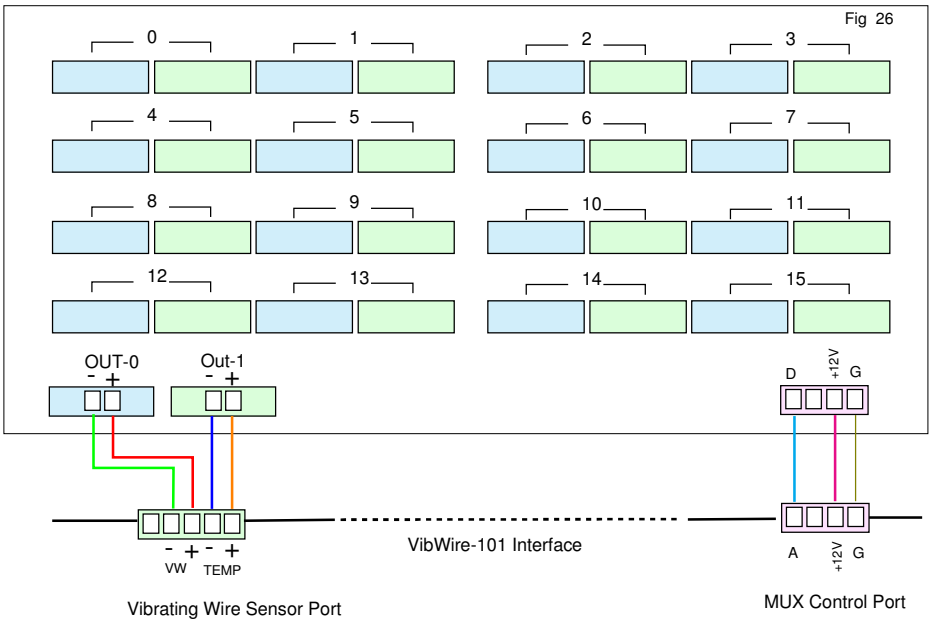


Figure 26 - shows how to connect a 4 wire vibrating wire sensor to the MUX-16/32.

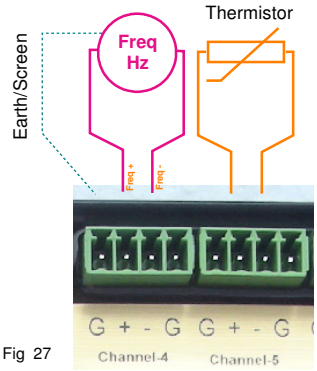
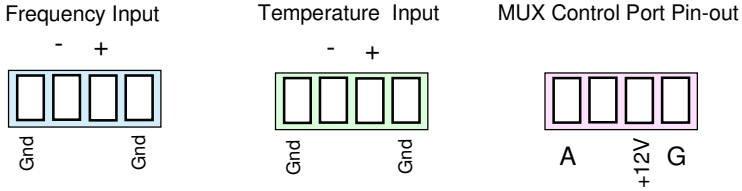


Fig 27

24.2 MUX-16/32 Port Pin-outs - 16 x 4 Wire Operation



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.

25 Scanning Operations

The MUX-16/32 uses control signals from the VibWire-101 to select the active unit.
The control port operates like an SDI-12 port and each expansion unit is accessed using a dedicated ID number.

The control port of the MUX-16/32 can only be used by the VibWire-101 and no other device.

Each MUX-16/32 must have a unique ID number set. The default factory ID = 0. Range 0 .. 3

The relays used by the MUX-16/32 are break before make and only draw power when switching. This ensures that the minimum amount of power is used and that signals from a single sensor are passed to the VibWire-101 interface at any one time.

25.1 MUX-16/32 Channel Selection Table

Table 3 opposite shows the input channel connections for 16 x 4 sensor operations.

Sensor No	Frequency Input Channel	Temp Input Channel
0	0	1
1	2	3
2	4	5
3	6	7
4	8	9
5	10	11
6	12	13
7	14	15
8	16	17
9	18	19
10	20	21
11	22	23
12	24	25
13	26	27
14	28	29
15	30	31

Table 3

25.2 Setting the Scan Mode - 16 x4 Wire or 32 x 2 Wire Operation

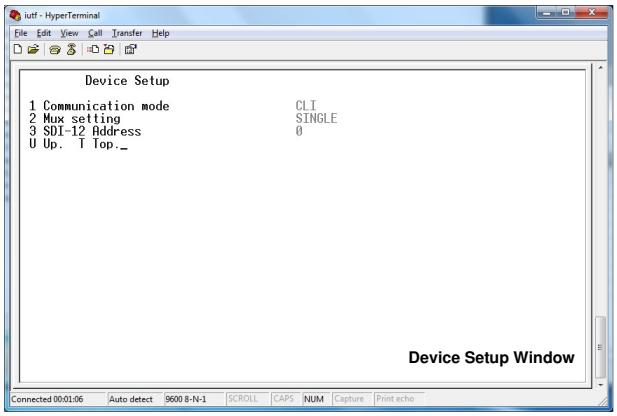
The scan mode for the MUX-16/32 unit is defined using the menu system in the VibWire-101 vibrating wire sensor interface.

The scan mode is defined by 'Option 2 - Mux Setting' parameter. SINGLE = 16 x 4 Wire Operation.
DOUBLE = 32 x 2 Wire Operation

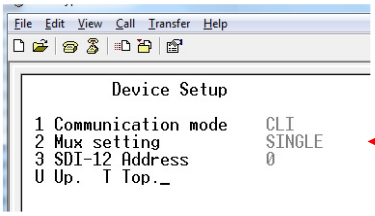
Main Menu VibWire-101

Main Menu

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



Device Setup Window



Set the MUX Scan Operation type here

SINGLE = 16 x 4 Wire Mode

DOUBLE = 32 x 2 Wire Mode

26 Sensor Output Port Wiring Options - Multi System Expansion

The following page shows how to connect the vibrating wire sensor output ports to the VibWire-101 to create large channel count solutions. The diagrams have been included to simplify the installation operations for this device.

32 x 2 Channel Scan Mode

When operating in 32 x 2 wire mode the output signal ports "**OUT-0 and OUT-1"** are wired in parallel, see diagram on page BB.

16 x 4 Channel Scan Mode

In 16 x 4 wire mode then port "OUT-0" is used for frequency signals and port "Out-1" is used for temperature signals.

It is essential that the vibrating wire sensors are wired into the MUX-16/32 in the correct format for 32 x 2 and 16 x 4 wire operations. See details on pages 33 and 34.

Example. Connecting 4 x MUX-16/32 units to a VibWire-101 Sensor Interface

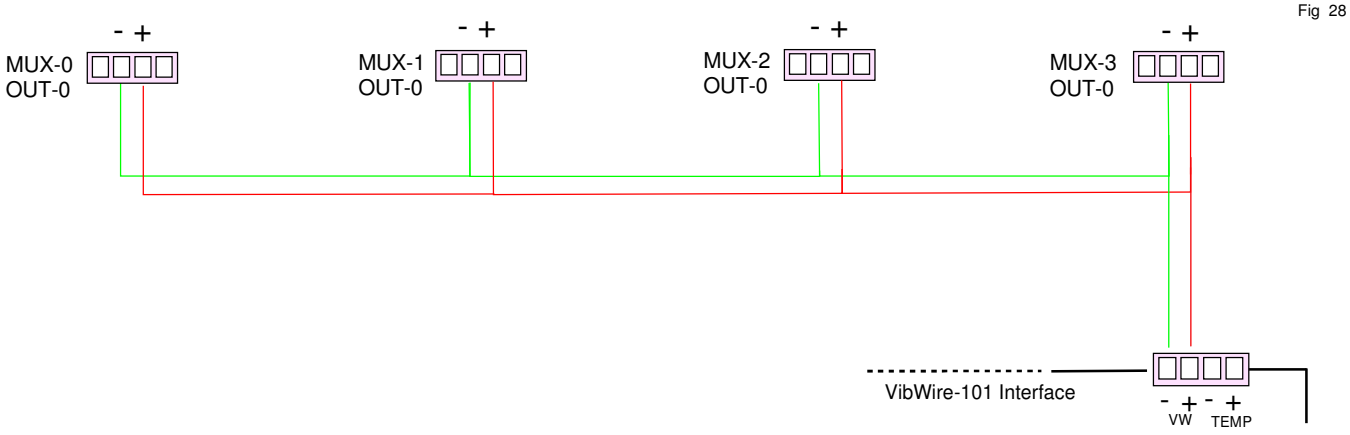
The wiring diagram shown in Fig 15 shows how the MUX-16/32 sensor outputs are connected to the vibrating wire input port on the VibWire-101 sensor interface unit when multiple expansion units are being used.

This particular example shows 4 x MUX-16/32 units set-up for 16 x 4 wire operation.

Additional MUX-16/32 expansion units are daisy chained to the VibWire-101 to meet the specified number of channels.

Due to the time taken to scan a system, currently only maximum of 4 x MUX-16/32 expansion units can be connected to a single VibWire-101 sensor interface.

Fig 28



26.1 Temperature Sensor Connection - OUT-1 Port

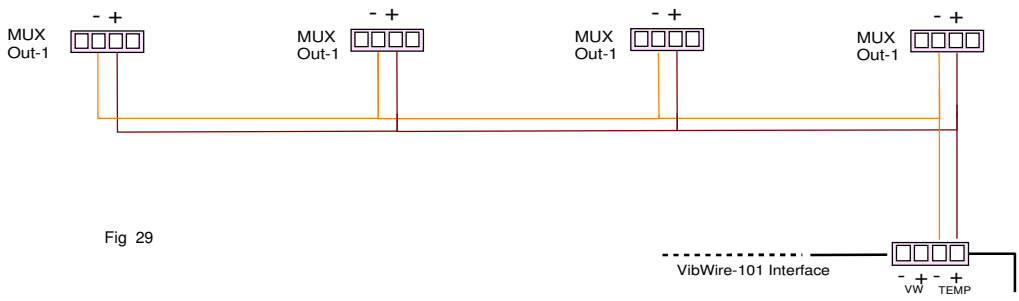
The wiring diagram below shows how the MUX-16/32 temperature sensor output signal is connected to the vibrating wire input port on the VibWire-101 sensor interface unit in 16 x 4 Wire mode only.

Take care to connect the temperate sensor from the Vibrating wire sensor to the correct input of the MUX-16/32 expansion unit.

Note. The temperature signal will not be recorded if the sensor connection is not terminated as shown on page 5.

Temperature signals are only recorded with frequency signals from a vibrating wire sensor when using the MUX-16/32 expansion unit in 16 x 4 wire mode.

Fig 29



27 Connecting the MUX-16/32 output port to the VibWire-101 - 32 x 2 Wire Operation

Figure 30 below shows how to connect the output port on a single MUX-16/32 unit to the VibWire-101 or **32 x 2** operations.

What can be clearly shown is that only output port 'OUT-0' is used on the MUX-16/32 for 32 x 2 sensor output operations.

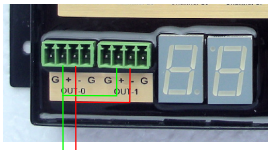
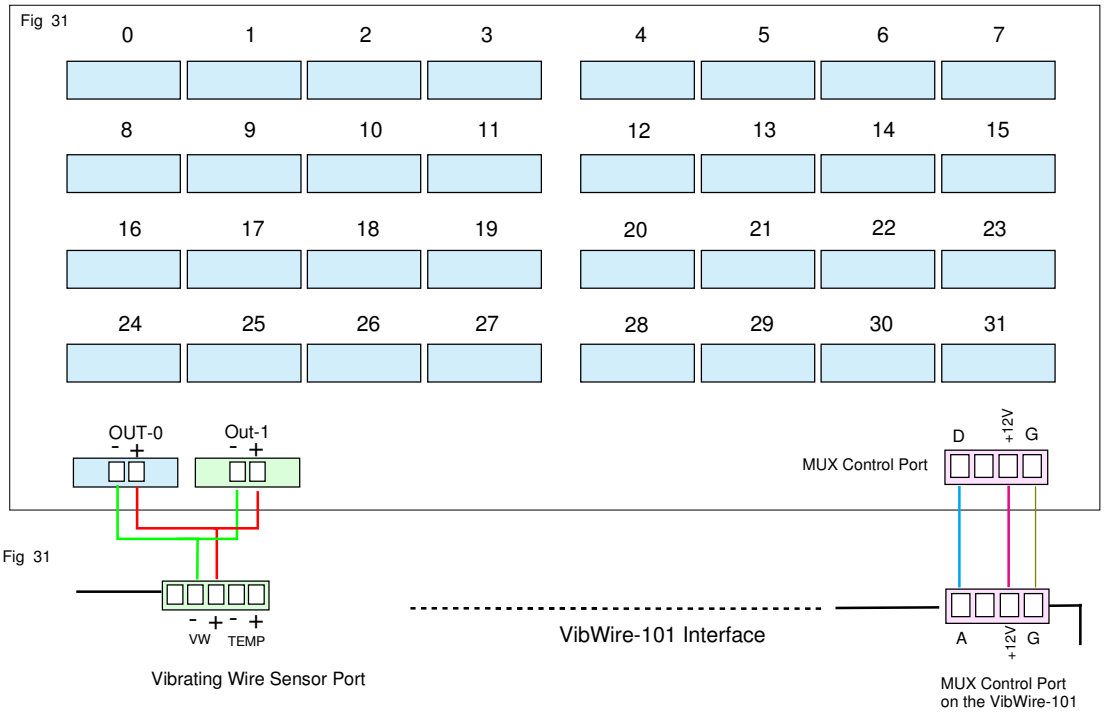


Fig 30 **VibWire-101 Vibrating Wire Interface**

27.1 MUX-16/32 - 32 x 2 Vibrating Wire Mode - Connection to the VibWire-101

Figure 31 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.



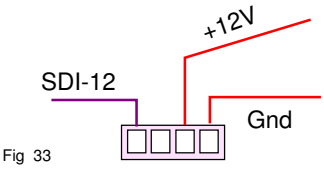


Fig 33

2 Wire Sensor Connection.

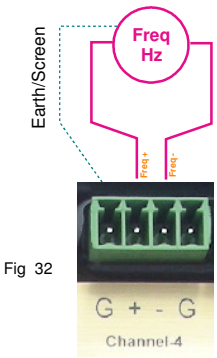


Fig 32

Figure 32 above shows how to connect a 2 wire vibrating wire sensor to the MUX-16/32.

Figures 34 and 35 shows how 4 x MUX-16/32 units are connected together to operate in 32 x 2 mode to form a 128 channel vibrating wire expansion block. Page 33 shows a summary of the SDI-12 measurement commands.

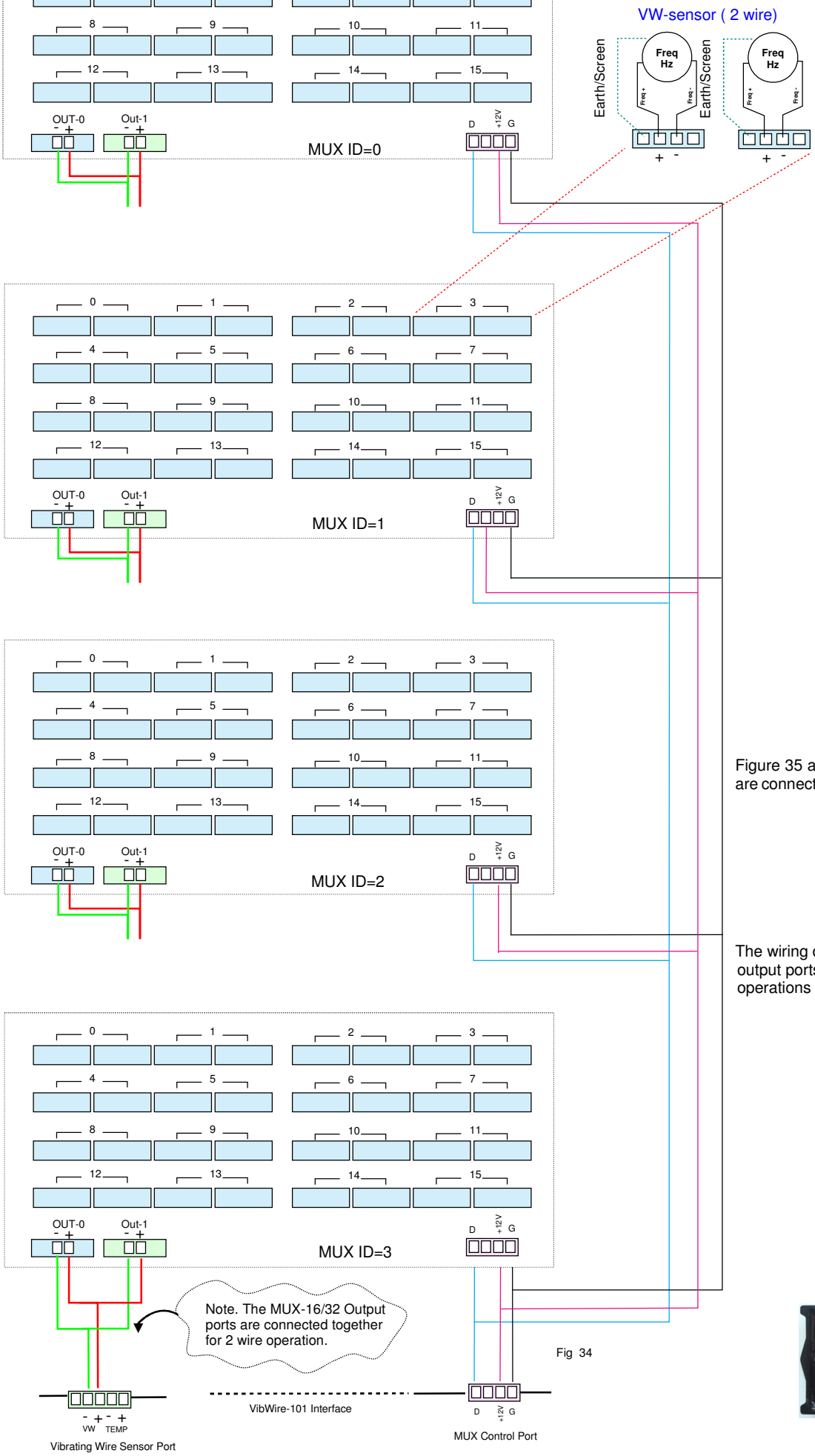


Fig 34

Output Port - MUX-16/32 unit

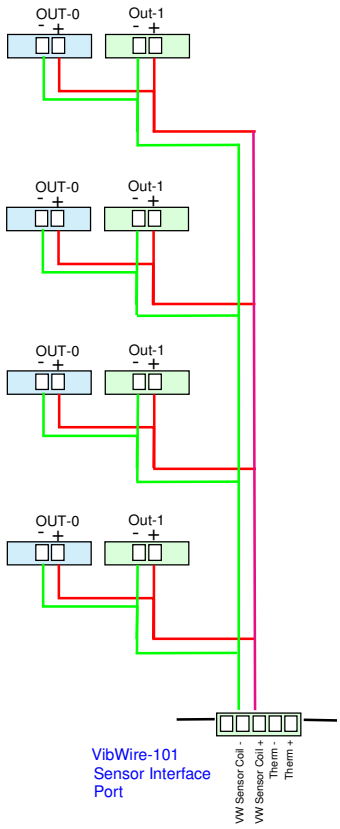
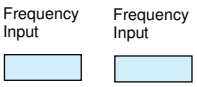


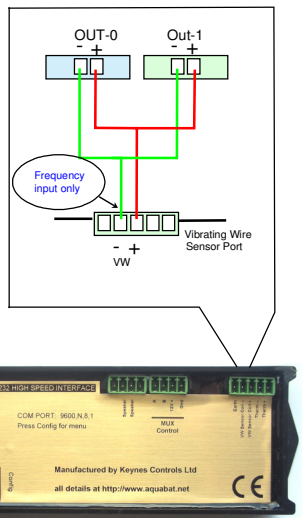
Fig 35 Vibrating Wire Sensor Port

Figure 35 above shows how the MUX16/32 output ports are connected together for 128 x 2 wire sensor operations.



Input channel Key

The wiring diagram shows how to to wire the MUX-16/32 output ports to the VibWire-101 for 32 x 2 wire (Freq) operations only.



VibWire-101 - Vibrating wire sensor Interface

29 64 x Thermistor Temperature Input using the MUX-16/32 Expansion Unit

Figures 38 and 39 demonstrates how 2 x MUX-16/32 analogue expansion units are connected together to operate in 32 x 2 temperature sensor mode. The VibWire-101 currently support thermistor sensor inputs.

The output ports from the MUX-16/32 expansion units are connected to the temperature input ports on the VW-101 vibrating wire sensor interfaces.

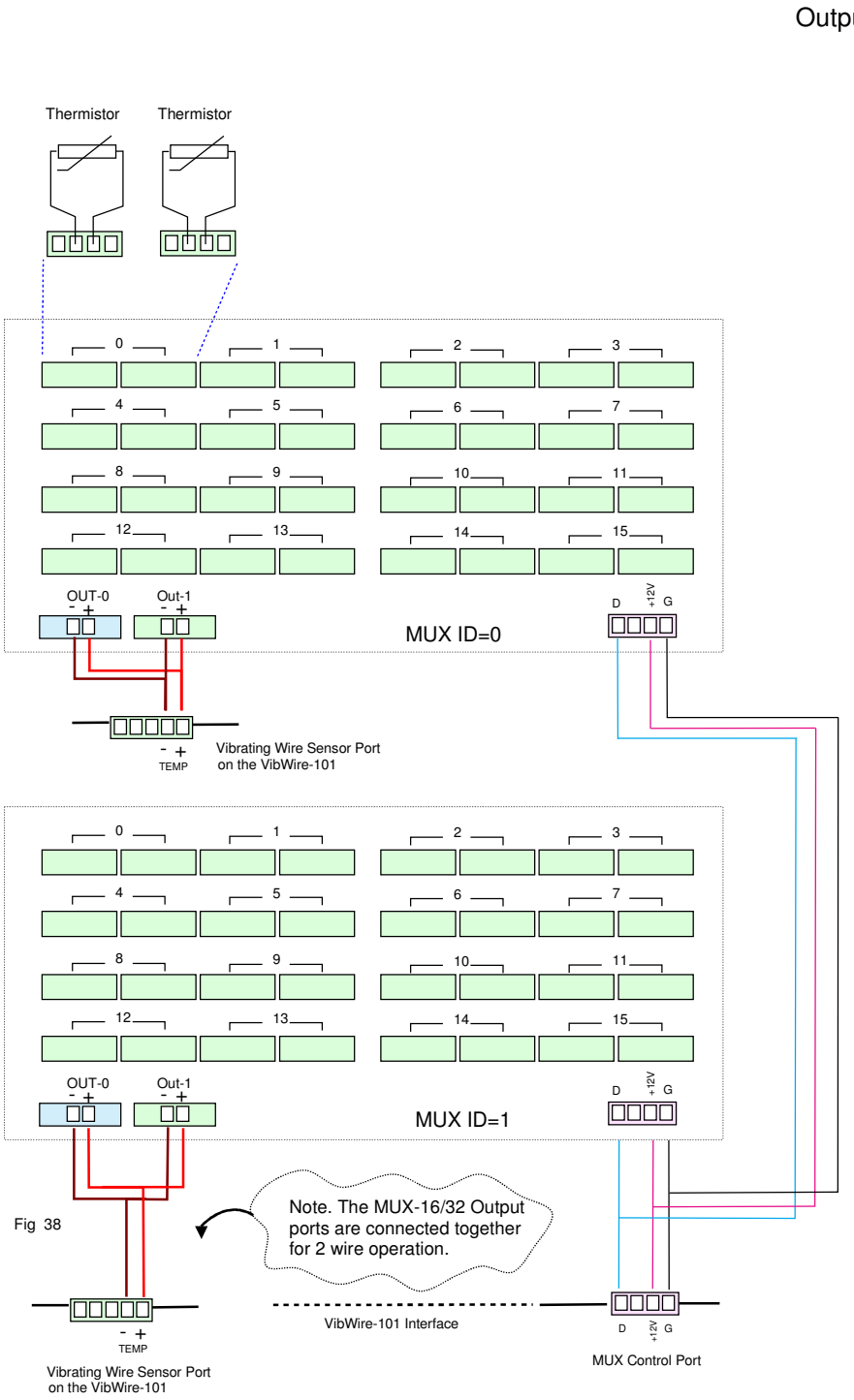


Fig 38

Output Port - MUX-16/32 unit

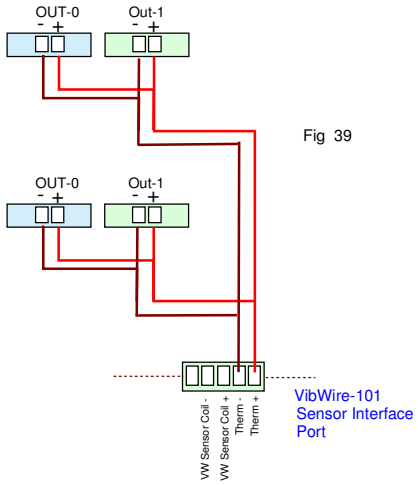
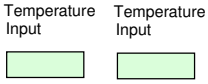


Fig 39

Figure 21 above shows how the MUX16/32 output ports are connected together for 128 x 2 wire sensor operations.



Input channel Key

The wiring diagram shows how to to wire the MUX-16/32 output ports to the VibWire-101 for 32 x 2 wire (Freq) operations only.

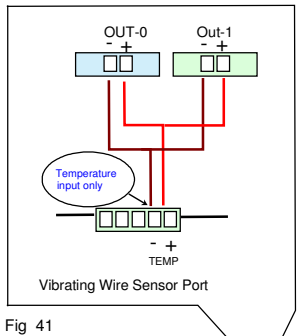


Fig 41

VibWire-101 - Vibrating wire sensor Interface

The MUX-16/32 units are configured to operate in 4 wire vibrating wire sensor mode and so accepts frequency and temperature sensor inputs.

The circuit shown in Fig 42 demonstrates how 4 x MUX-16/32 analogue expansion units are connected together to operate in 16 x 4 mode in order to form a 64 channel vibrating wire sensor expansion block. See pages 33 and 34 for summary of measurement commands.

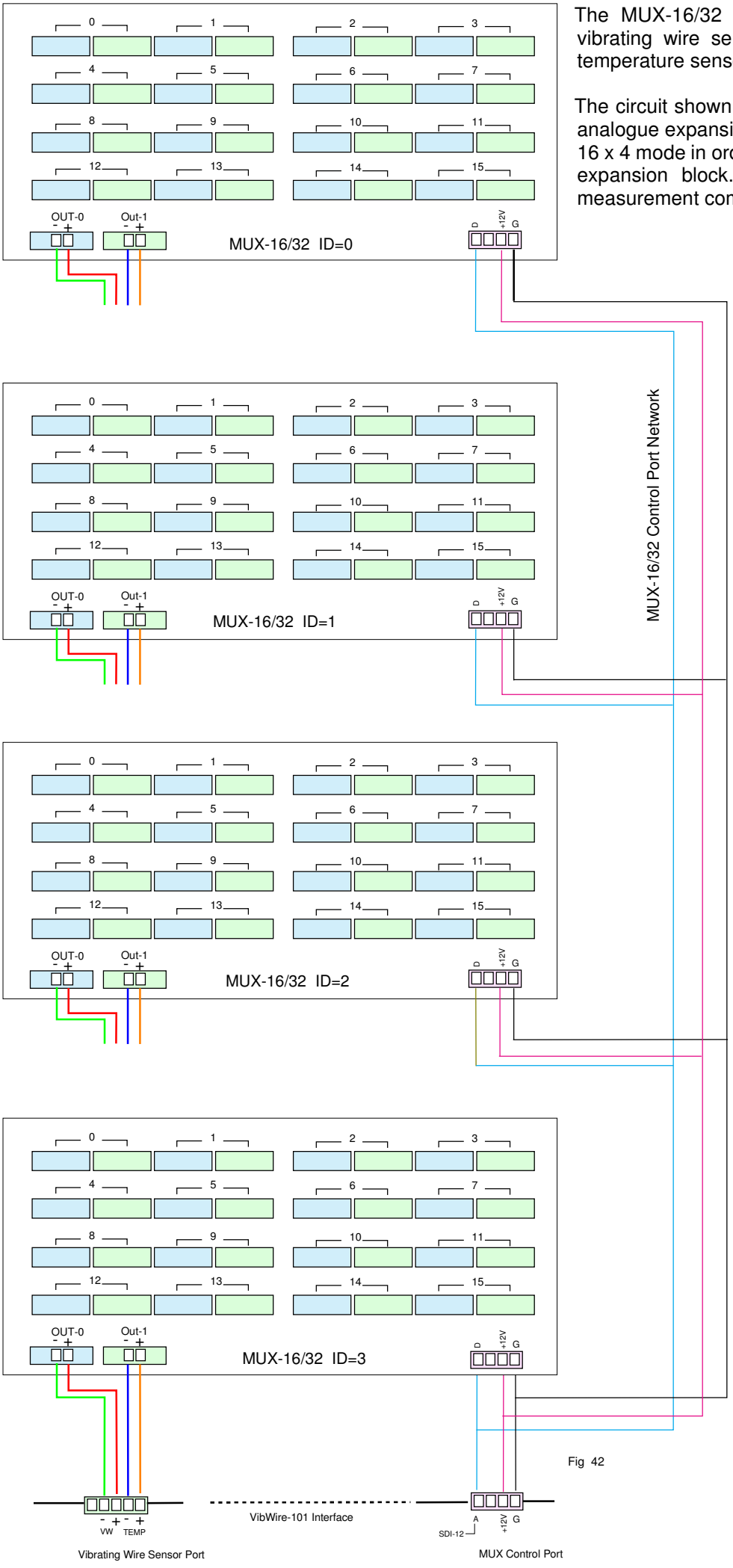


Fig 42

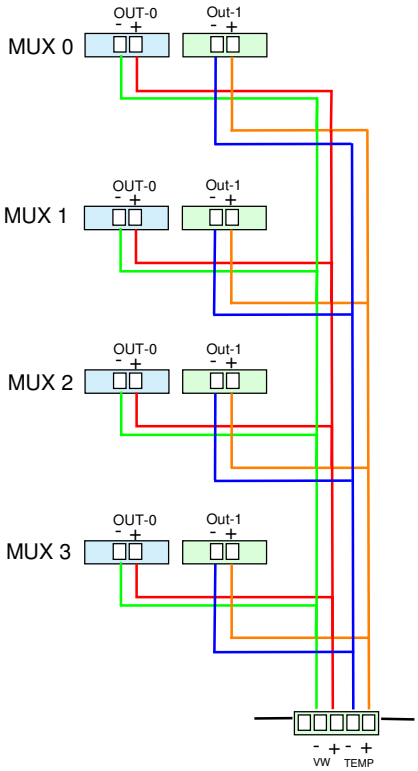
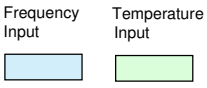


Fig 43 Vibrating Wire Sensor Port

The wiring diagram above shows how the MUX16/32 output ports are connected together for 64 x 4 wire sensor operations.



Input channel Key

31 Output Port Connections - 128 Channel x 2 Wire Mode Sensor System

Fig 44 shows how the 'OUT-0' port on each unit is connected together to create the 128 channel system.

Note the output ports are all wired in parallel.

Only a single MUX-16/32 unit is active at anyone time.

Each MUX-16/32 unit must have a unique ID number for this system to operate correctly.

Port OUT-0 Connection to the VibWire-101 - Frequency signals only

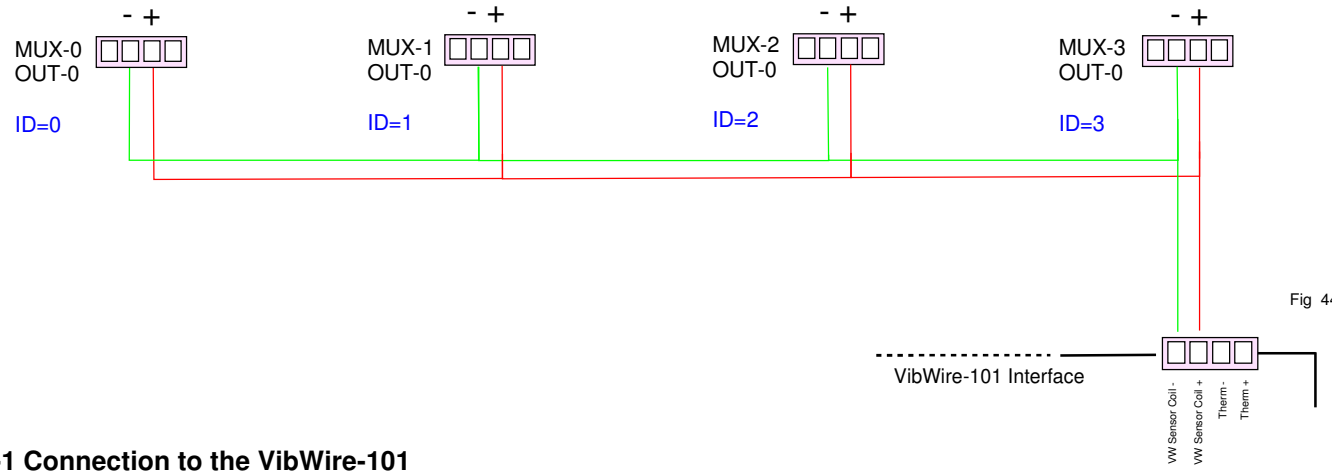


Fig 44

Port OUT-1 Connection to the VibWire-101

The following drawing shows how OUT-1 port is connected to the VibWire-101 in order that the temperature sensor signals can be used.

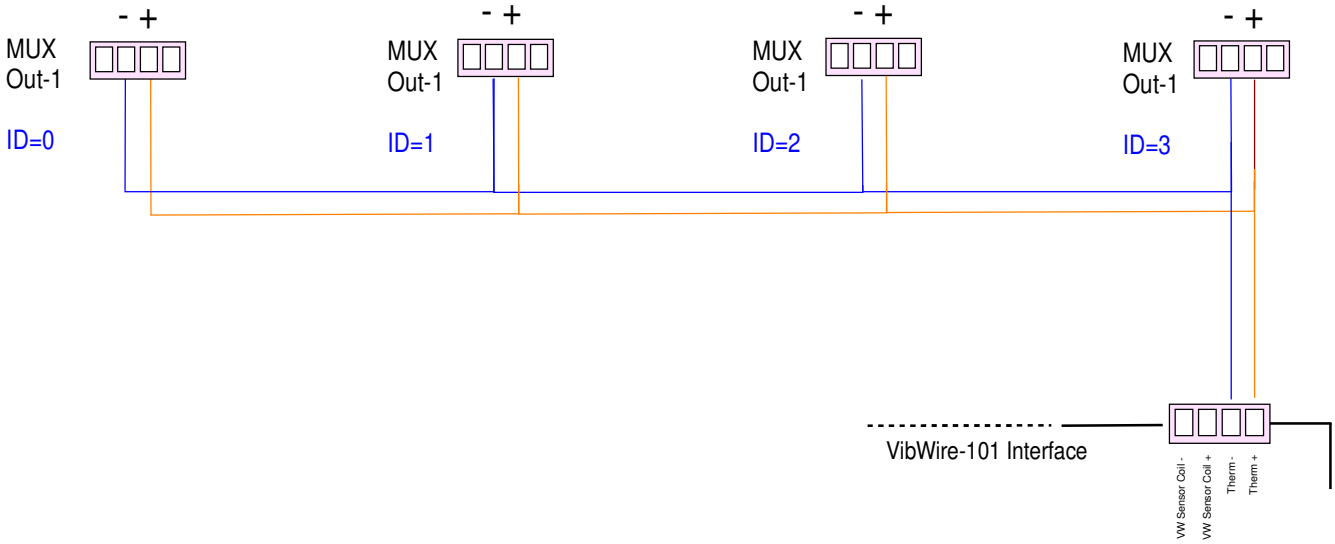


Fig 45

32 MUX-16/32 Control Signal Expansion

Figure 46 demonstrates how the MUX-16/32 control signals are linked together when multiple devices are used for sensor expansion.

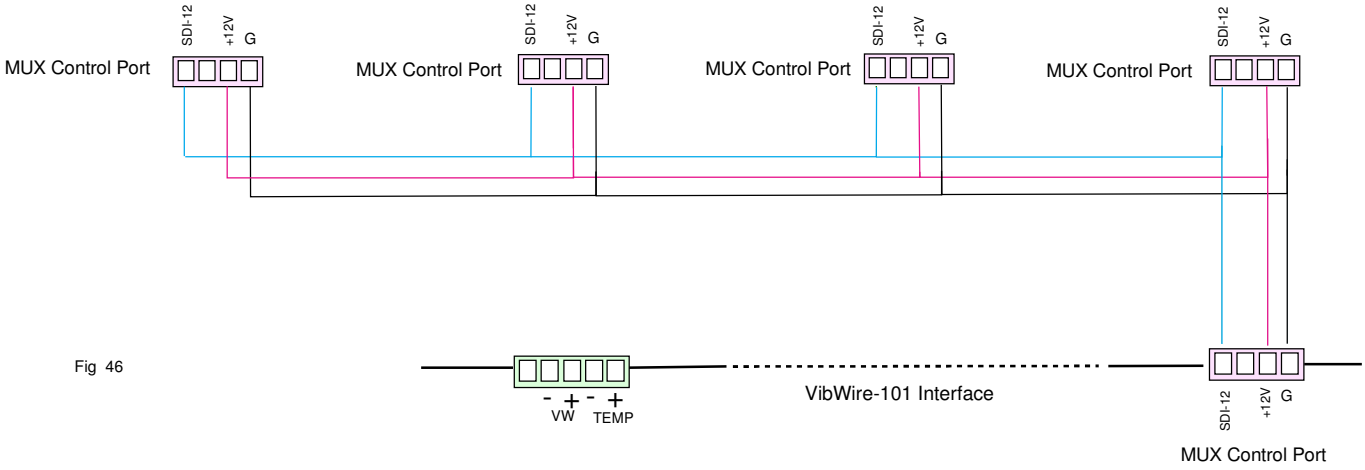


Fig 46

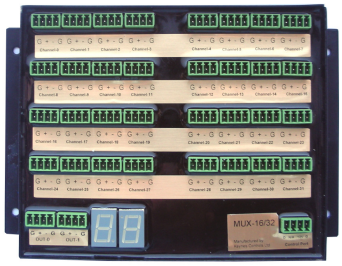


Figure 47 below shows how the MUX-16/32 control signal installation can be simplified using the HUB-SDI12 interface to distribute the control signals originating from the VibWire-101.

Additional HUB-SDI12 units can be linked together in order to add additional MUX-16/32 expansion units to a system

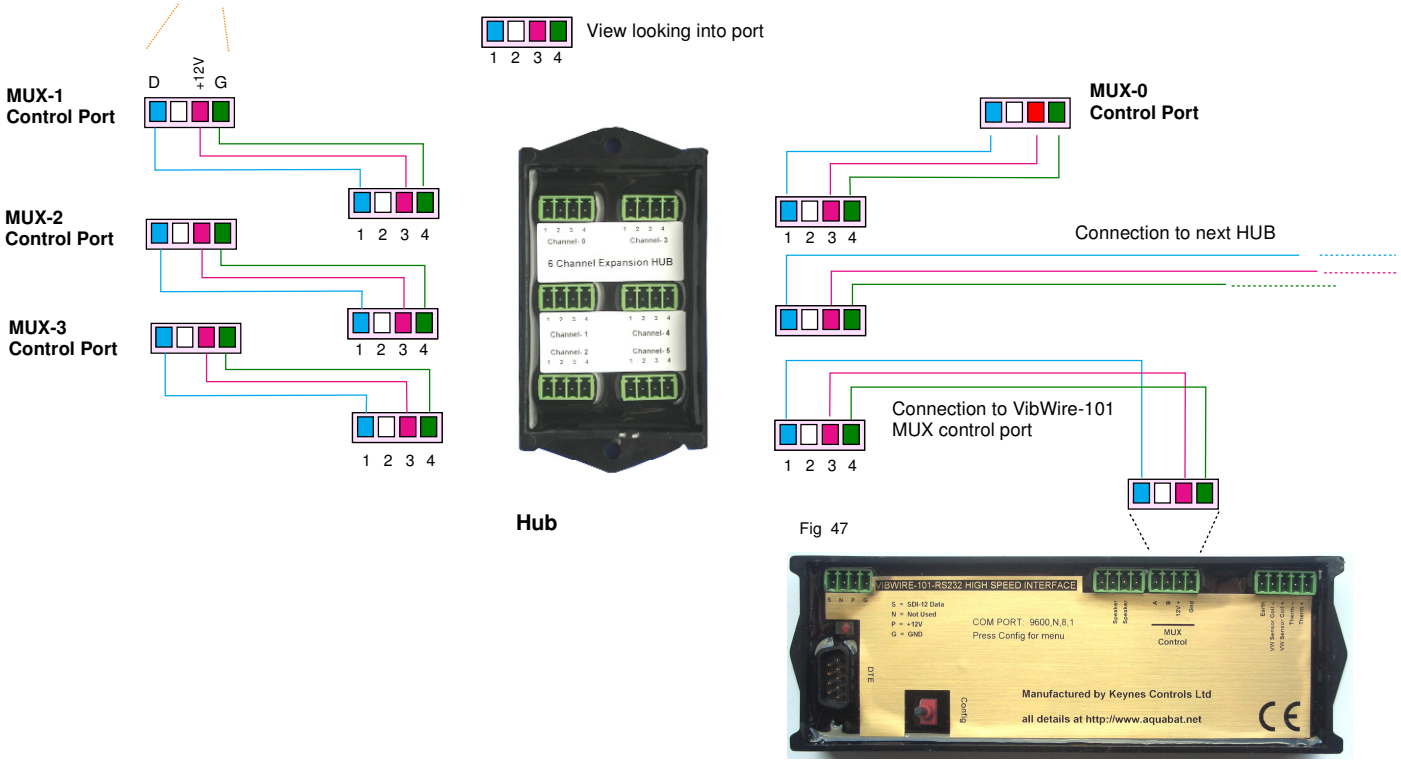


Fig 47

MUX-16/32 Vibrating Wire Interface

33 Channel Expansion Guide

Figure 48 shows how to expand the VW-101 sensor interface to the required number of channels.

Add or remove the MUX-16/32 expansion un its to achieve to desired number of channels.

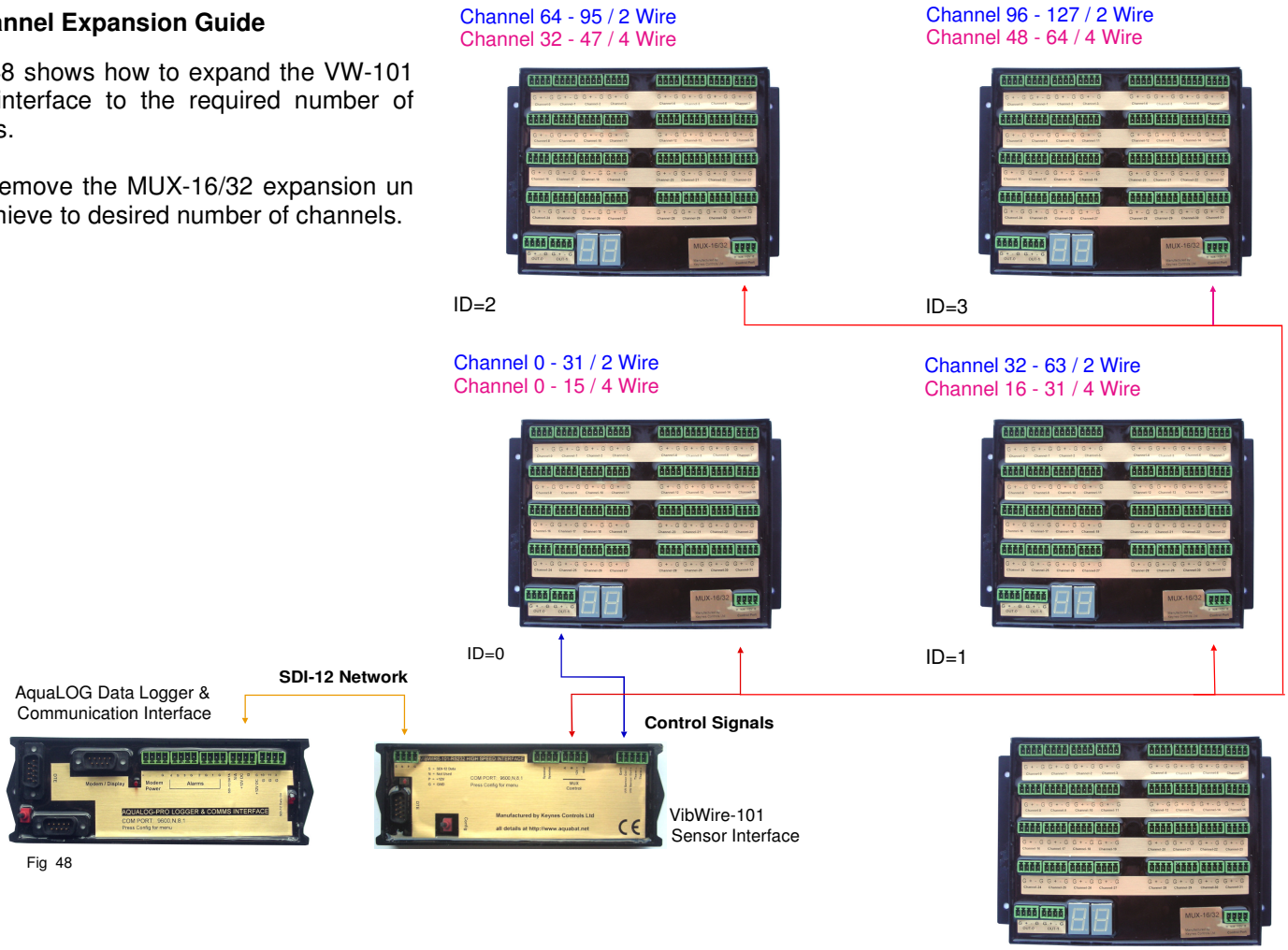


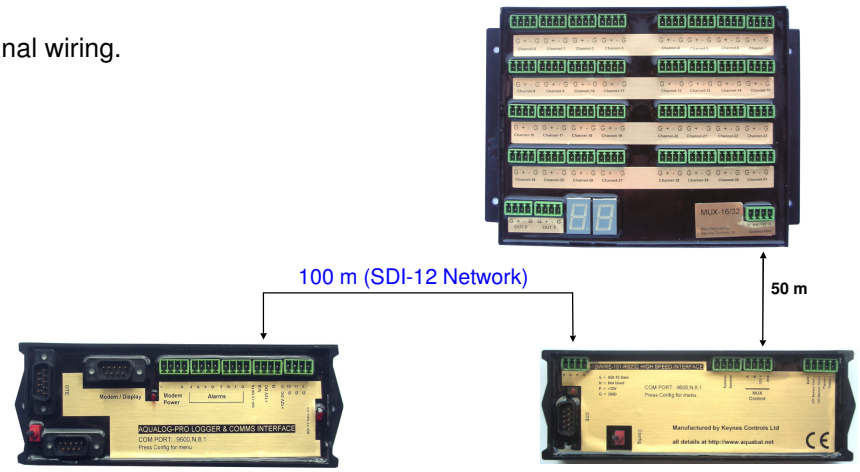
Fig 48

33.1 AquaLOG - MUX-16/32 Typical Layout

The maximum distance that the instruments such as the AquaLOG, VW-101 and the MUX-16/32 can be spaced out is 50 m. This distance mainly depends upon the choice of cable used.

For best results use 1.5 mm cable for the control signal wiring.

Fig 49



34 Testing the MUX-16/32 Unit

The default ID number for a new MUX-16/32 expansion unit = 0

Connect a suitable 12V DC power supply to the control port as shown below and observe the Power Indicator LED flash On and Off. So long as the power indicator LED is illuminated then the MUX-16/32 should operate correctly.

It is a good idea to test individual units before installing into a large system in order to confirm they are operational before attempting to configure the interface software of the data loggers.

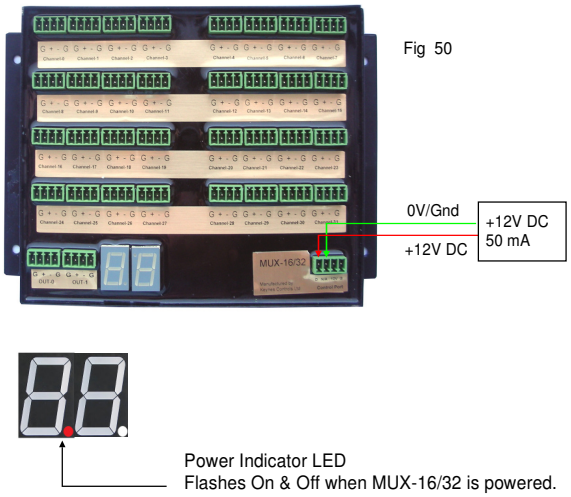


Fig 50

1. Connect the 12V DC supply to the MUX-16/32 via the control port as shown in the image opposite.

2. The Power Indicator LED will illuminate as soon as power is applied to the device.

IMPORTANT NOTE

If the Power Indicator LED is not illuminated check the power supply is correctly connected to the Control Port.

35 Default Factory Settings

The MUX-16/32 unit is preset to MUX Control Port ID = 0

Scan Mode: 16 x 4 Wire

36 Mechanical Switching Operations

The relay switch system used within the MUX-16/32 unit operates as a break-before-make device.

This action ensures that only a single channel can be used at any one time.

It is not possible for multiple sensors to be connected to the output ports at any one time. Only the active MUX-16/32 unit selected at scan time can pass signals to the VibWire-101. The active MUX-16/32 unit is the one selected in the measurement commands as used by the logger unit or Q-LOG software. See summary of the measurement commands on pages 33 and 34 for exact details.

37 Data Table Cell locations

Table 3 below shows typical cell locations used to store data from 4 x MUX-16/32 expansion units when connected to the AquaLOG. The table shows that 64 adjacent cells starting at Cell 'D' for 64 x 4 wire and 128 cells for 32 x 2 wire mode.

Results from the units can be User defined, however the table offers useful guide.

The data table cell references used in the AquaLOG data logger and free Q-LOG display software use Microsoft Excel format.

A single VW-101 device is in use with the Q-LOG software and has been configured to operate with 4 x MUX-16/32 units, then after selecting the '**Auto Assign**' configuration option, the following consecutive cells in the results data table will be used.

The table uses consecutive cells will no spaces to optimise the data storage.

32 x 2 wire mode can be used for Frequency or Temp (thermistor) inputs

Sensor Type	MUX-0		MUX-1		MUX-2		MUX-3	
Number of cells	16	32	48	64				
16 x 4 wire	Freq	Temp	Freq	Temp	Freq	Temp	Freq	Temp
	D .. S	T .. AI	AJ .. AY	AZ .. BO	BP .. CE	CF .. CU	CV .. DK	DL .. EA
32 x 2 Wire	32		64		96		128	
	Freq		Freq		Freq		Freq	
	D .. AI		AJ .. BO		BP .. CU		CV .. EA	
32 x 2 Wire	32		64		96		128	
	Temp		Temp		Temp		Temp	
	D .. AI		AJ .. BO		BP .. CU		CV .. EA	

Table 3 - Cell locations for data table setup.

38 VW-101 Measurement 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.

The same commands are

aAb! Change of address a to b
aXJn! (n=1 or 2) Sets number of jogs (pulses) for each increment on the Campbell Scientific 16 x 4 MUX
aXDn! (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) Not supported

aM2! Take 16 measurements using Keynes Mux #0 (no. 0 to 15)
aM3! Take 16 measurements using Keynes Mux #0 (no. 16 to 31)
aM4! Take 16 measurements using Keynes Mux #1 (no. 0 to 15)
aM5! Take 16 measurements using Keynes Mux #1 (no. 16 to 31)
aM6! Take 16 measurements using Keynes Mux #2 (no. 0 to 15)
aM7! Take 16 measurements using Keynes Mux #2 (no. 16 to 31)
aM8! Take 16 measurements using Keynes Mux #3 (no. 0 to 15)
aM9! Take 16 measurements using Keynes Mux #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 thermistor values 0 to 3
aD5! Output thermistor values 4 to 7
aD6! Output thermistor values 8 to 11
aD7! Output thermistor values 12 to 15

39 Sample Commands

The following examples demonstrate

MUX-16/32 unit with ID=0 is used with a VibWire-101 unit with ID=3 in 4 wire mode. This is a **16 x 4** wire vibrating wire sensor system. The results are stored in the AquaLOG data table starting at **Cell D**. There are 32 data values returned to the logger made up of 16 x Freq and 16 x Temp.

Operating mode - VW101 - Double

[D] 3M2! 3D0! 3D1! 3D2! 3D3!
[T] 3D4! 3D5! 3D6! 3D7!

Example 2

2 off MUX-16/32 units have been pre-configured to operate with addresses ID=2 and ID=3 are used with a VibWire-101 unit. (The individual MUX-16/32 units support address 0 .. 3 only, and are used on the local MUX-Control network. The MUX ID unit is used to select the device prior to a reading being made).

The VibWire-101 has an ID=5 and is used to create a 64 x **2 Wire** vibrating wire sensor system.

The results are stored into the data table starting at cell 'T'.

The measurement commands returns 64 values into the results data table in the AquaLOG data logger.

Operating mode - VW101 - Single

[T] 5M6! 5D0! 5D1! 5D2! 5D3!
[AZ] 5M7! 5D0! 5D1! 5D2! 5D3!

40 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)'

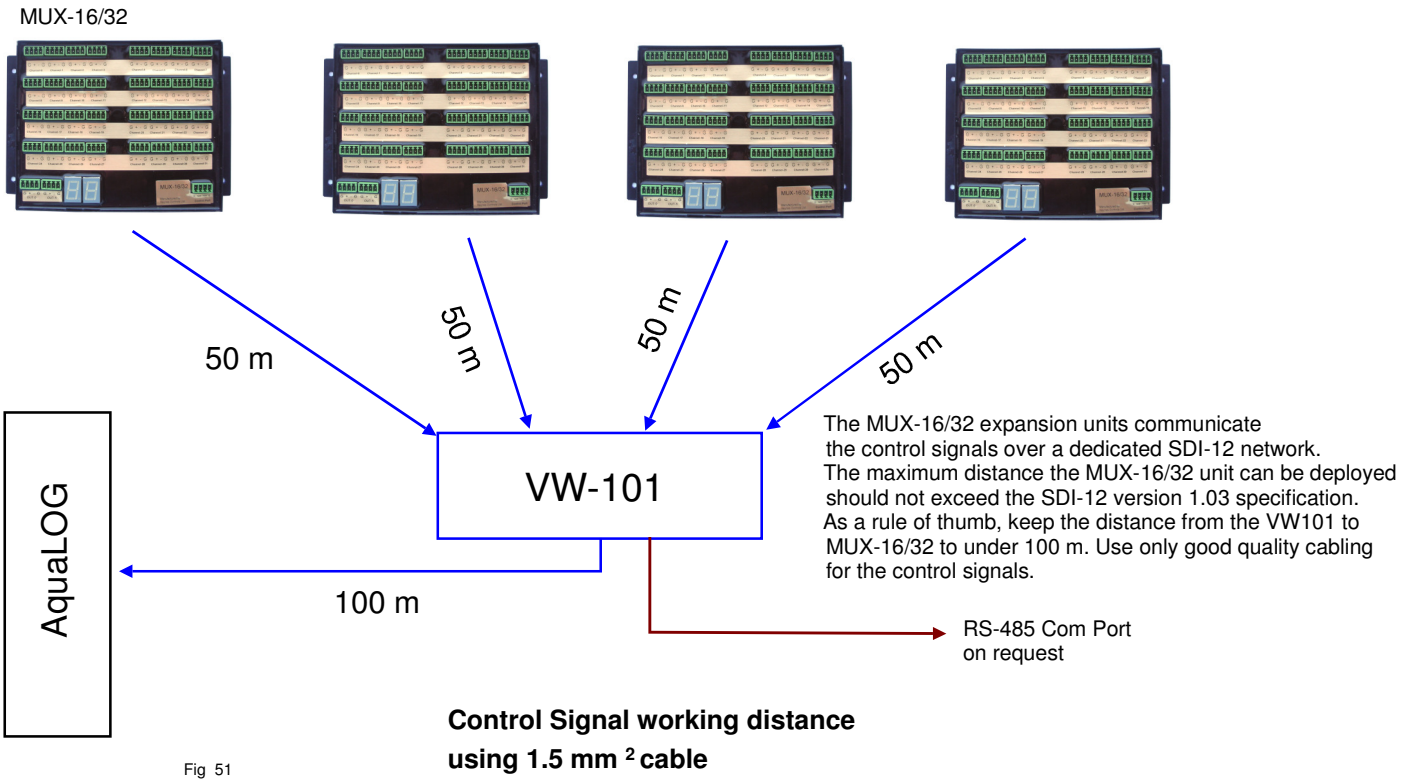
At the terminal prompt enter the command:

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

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

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

41 Layout Guide



Control Signal working distance using 1.5 mm ² cable

Fig 51

42 PC / Laptop Configuration for the MUX-16/32 - Setup Only

The image below shows how to use a PC / Laptop to configure the MUX-16/32 expansion unit while using the AquaLOG data logger in transparent mode to issue SDI-12 commands.

Transparent Mode is a feature of the Data Logger and allows User defined commands to be sent across the SDI-12 network.

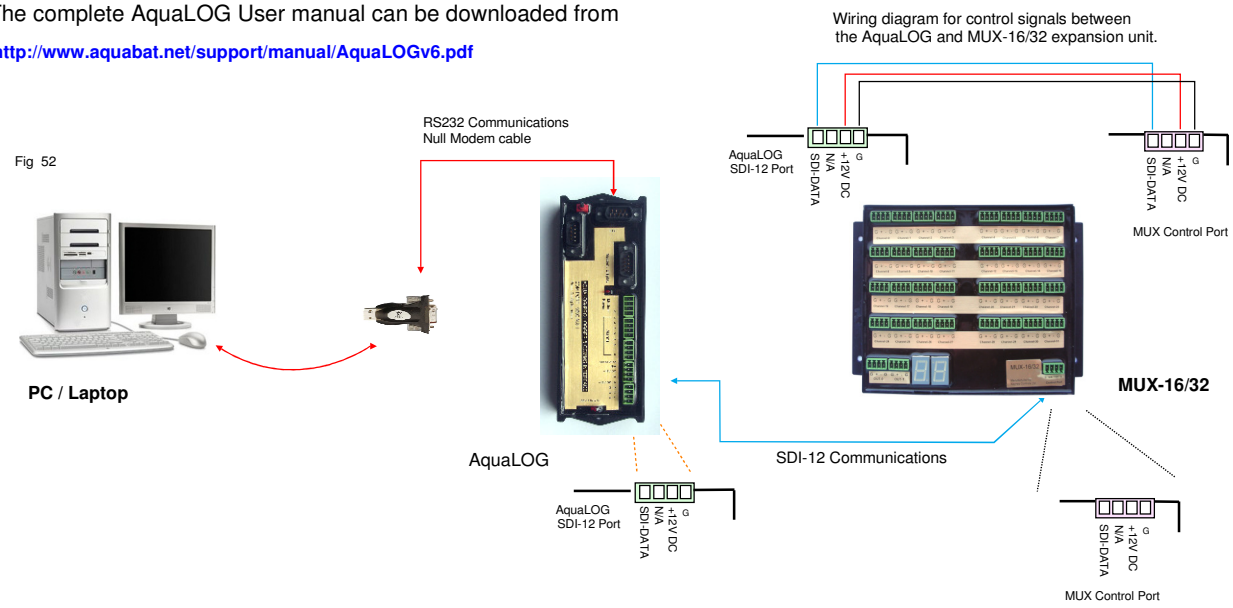
The AquaLOG is used to communicate commands to the MUX-16/32. The AquaLOG acts as the SDI-12 media converter.

Refer to the AquaLOG manual for full menu system operations of this product.

The complete AquaLOG User manual can be downloaded from

http://www.aquabat.net/support/manual/AquaLOGv6.pdf

Fig 52



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 a '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.

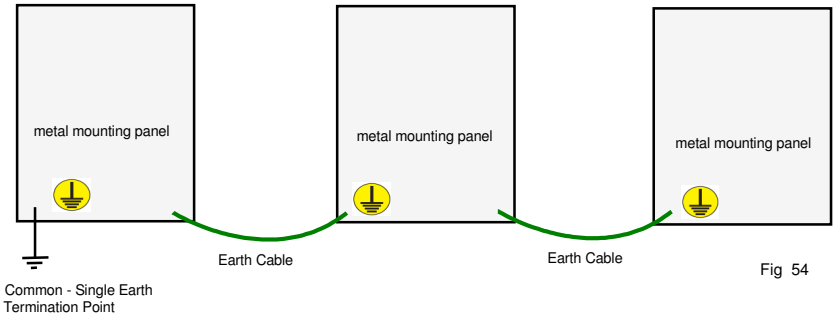


Fig 54

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.

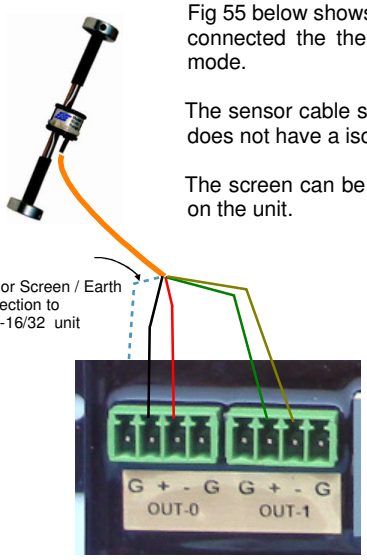
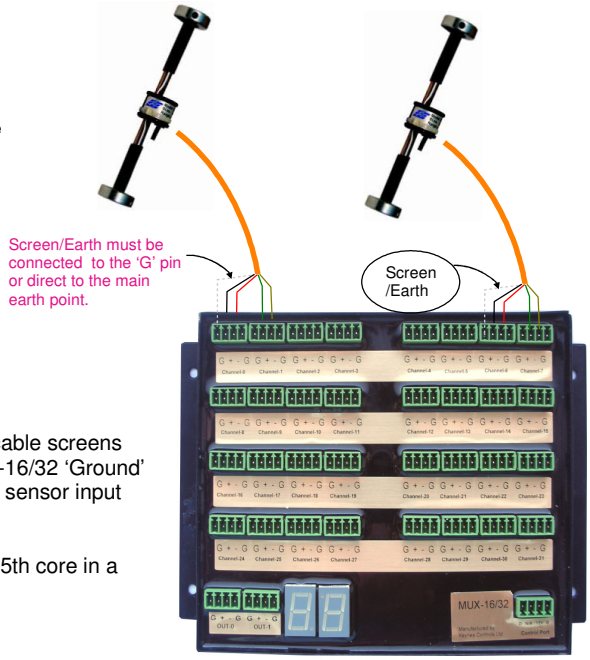


Fig 55



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 Vibrating wire sensor cable.

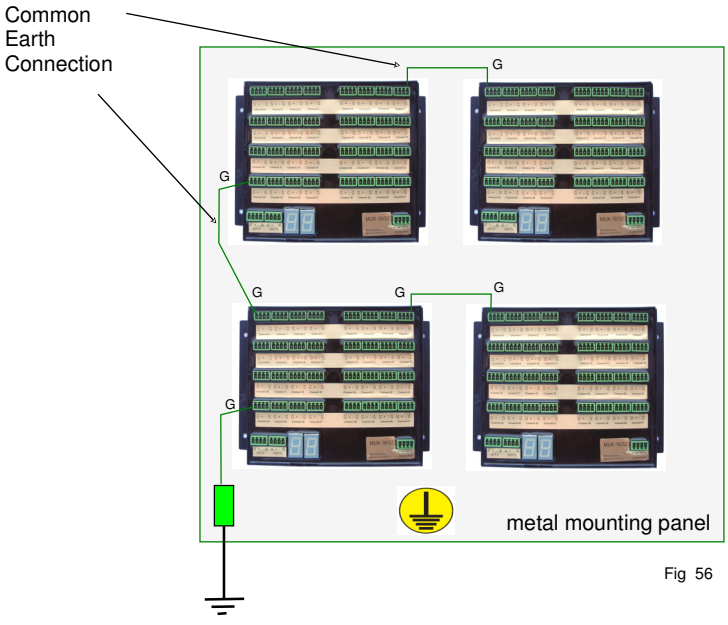


Fig 56

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.

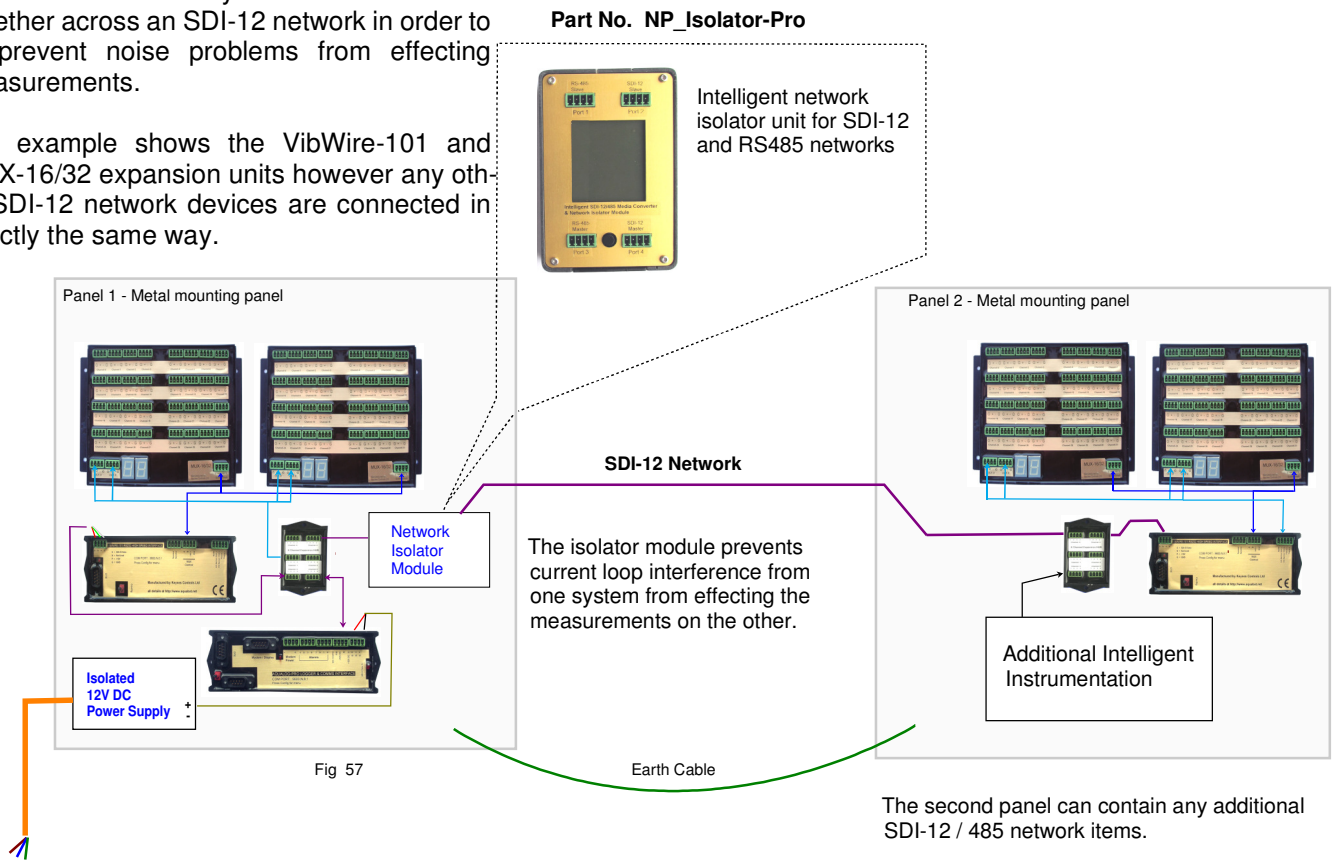


Fig 57

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

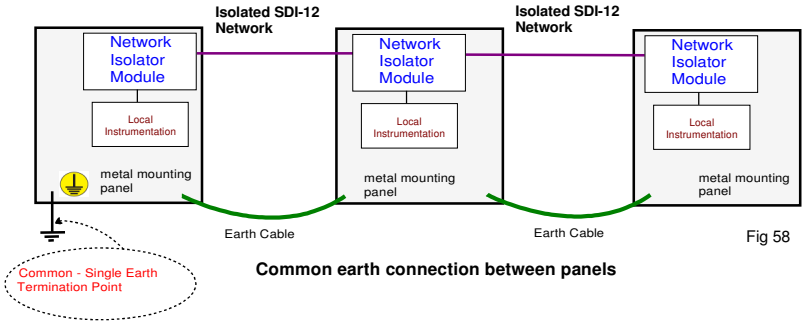


Fig 58

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.

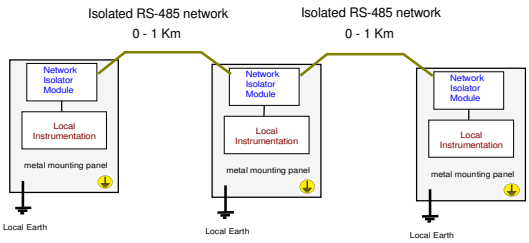


Fig 59

47 Distributed Systems - Earth Connections

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.

48 Examples of Isolated SDI-12 & RS-485 Network Configuration

The Keynes Controls NP-Isolator module is used to prevent current loop problems in network cables used by the SDI-12 and 485 networks.

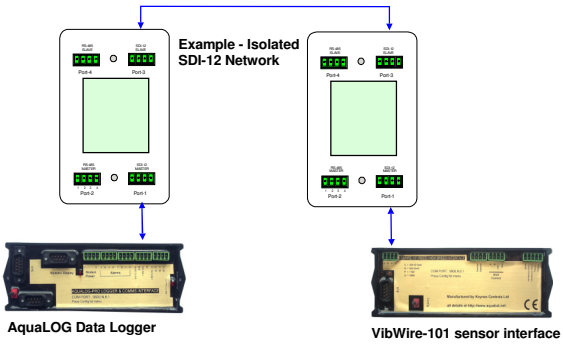


Fig 60 above shows how the Keynes Controls NP-Isolator module is used to create an isolated SDI-12 digital network.

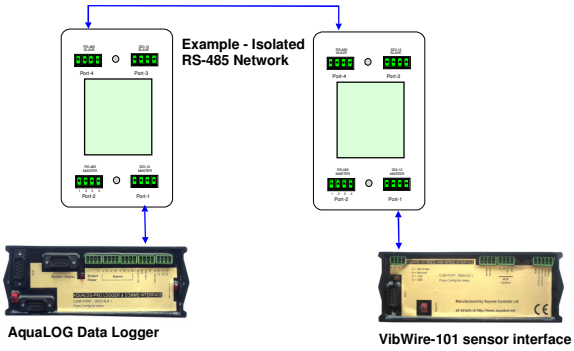
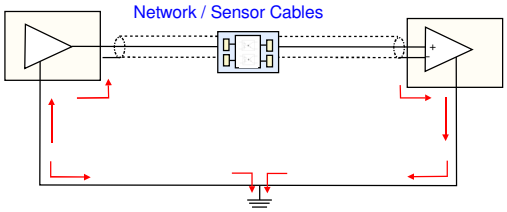
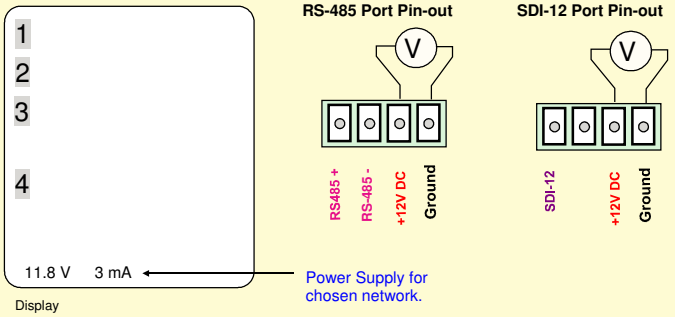


Fig 61 above shows how the Keynes Controls NP-Isolator module is used to create an isolated RS-485 digital network.



The image opposite demonstrates how the network isolator module is is used to stop earth loop effects from causing noise problems on the network lines.

49 Features of the NP_Isolator Module

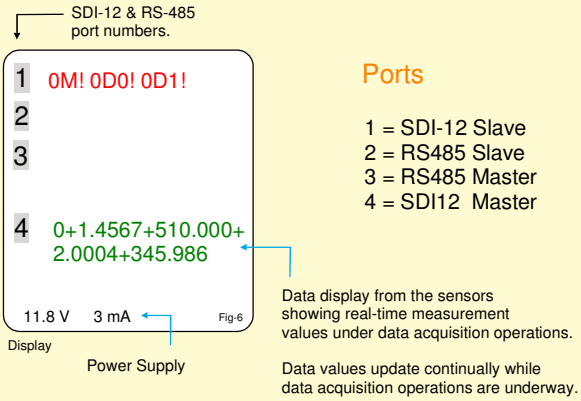


Network Supply Monitor

The **NP_Isolator-Pro** has a built in power supply monitor system that is used to indicate the voltage and current levels being used on the main network power connection.

The power levels are shown on the display

The power supply can vary as the different sensor and interfaces take measurements and report data across the network. A failing sensor can often be detected by the increase in power above the normal operating limits.



Ports

1 = SDI-12 Slave
2 = RS485 Slave
3 = RS485 Master
4 = SDI12 Master

Network Port Identification

The NP_Isolator-Pro module automatically detects sensors on the different ports.

The measurement instructions sent to the different sensors is shown on the ‘Slave’ ports part of the display.

The data values, measured by the sensors, and being sent across the networks to the data logger or PC, is shown in the ‘Master’ ports part on the display.

50 Logger Control Commands

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.

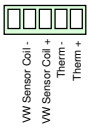
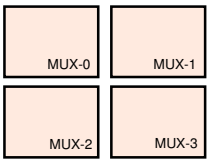


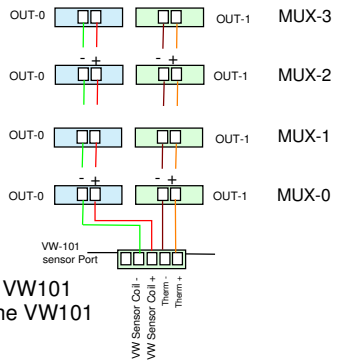
Fig 61



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

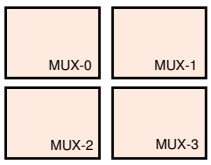
Logger SDI-12 Commands

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'

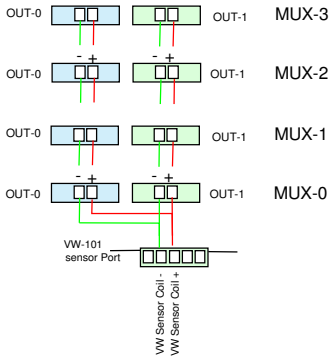
Fig 62



Description

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

Frequency measurements only



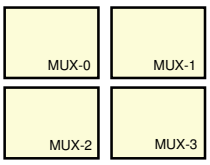
Wiring Instructions

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'

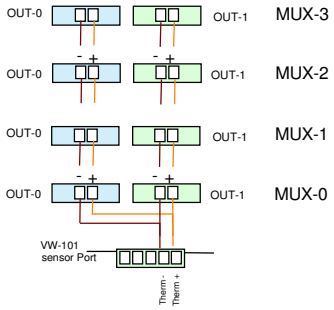
Fig 63



Description

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

Temperature measurements only



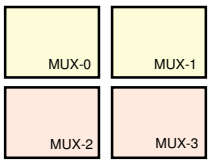
Wiring Instructions

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



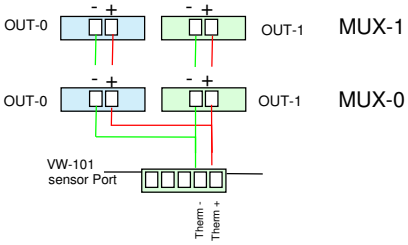
Description

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

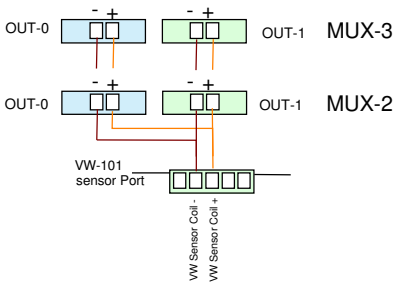
Temperature sensors

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



Vibrating Wire - Frequency

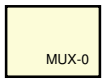
Connect the MUX-16/32 unit expansion unit output ports to the VibWire-101 unit as shown below:



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'

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

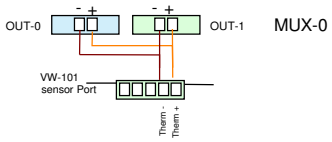


Description

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

Temperature measurements only

Fig 65



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

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

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:

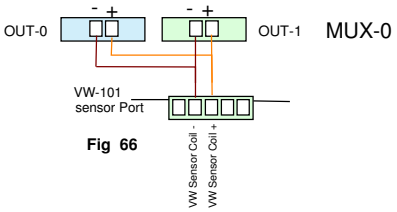


Fig 66

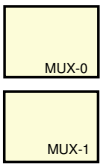
Logger SDI-12 Commands

```
[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.



Description

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

Temperature measurements only

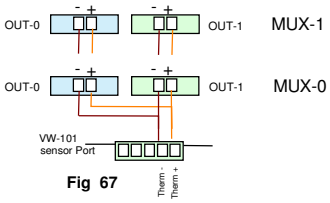


Fig 67

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

All of the MUX output ports on MUX-0 and MUX-1
are both connected to the 'Temp' input on the VW-101

Fig 68

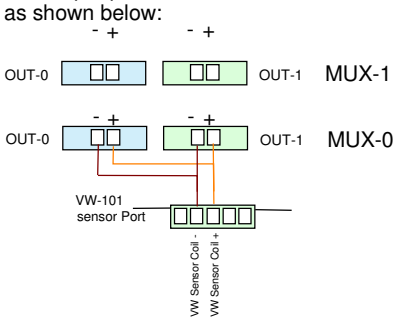
Description

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'.