In-Place-Inclinometer Installation Manual

SDI-12/RS485 Digital Network Device

Vertical I-P-I Chain Operations Only

Last updated Nov 2013

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In-Place-Inclinometer User Manual

The user manual can be downloaded at
http://www.aquabat.net/downloads/UserManual-IPIv4.pdf

1.0 Introduction

The following manual details the instruction to follow to assemble the Keynes Controls In-place-inclinometers to form a vertical measurement chain.

This manual is meant as a guide only and some prior knowledge on the use of In-place-inclinometers is expected.

Where possible Keynes Controls have endeavoured to make sure the parts only fit together in a single way in order to avoid in confusion in any measurement operation.

All of the inclinometers described in this manual use a digital network for data communications. All of the sensors are intelligent and undertake any measurement operation internally within the device,

Full User manual for the programming of this device is available for free download from the Keynes Controls Web site and can be found at **http://www.aquabat.net.**

1.1 Recommended Calibration Period

For best results Keynes Controls recommends that the sensors are re-calibrated on an annual basis.

1.2 Mounting Bolts

All metal parts making up the In-place-inclinometer are constructed from stainless steel. The mounting bolts are M6 and also of stainless steel.

1.3 Successful Measurements

For a successful measurement system to be created the in-place-inclinometers should not be subject to mechanical shock during installation. They shall be located away from any sources of local vibration and use the correctly rated power supply.

Fig 1 - KEYNES CONTROLS In-place-inclinometer

2.0 WARRANTY PROVISIONS

Keynes Controls Ltd . warrants the I-P-I range of tilt sensors for one year from date of purchase by the end user against defects in materials and workmanship under normal operating conditions.

To exercise this warranty contact Technical Support at the phone or e-mail address listed below
for a return material authorization (RMA) and instructions. Complete warranty provisions are posted on our website at **http://www.aquabat.net**

The information in this document is subject to change without notice. Keynes Controls Ltd. has made a reasonable effort to be sure that the information contained herein is current and accurate as of the date of publication.

Keynes Controls Ltd. makes no warranty of any kind with regard to this material, including, but not limited to, its fitness for a particular application. Keynes Controls Ltd will not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this material.

In no event shall Keynes Controls Ltd . be liable for any claim for direct, incidental, or consequential damages arising out of, or in connection with, the sale, manufacture, delivery, or use of any product.

HOW TO CONTACT US

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Berkshire, RG7 1NW

Tel: (0044) 118 327 6067
E-mail: sales@aquabat.net

Important Note

This product contains sensitive electronics and can be damaged by physical shock.

Under no circumstances allow the In-place-Inclinometer to be dropped.

2.1 FIRMWARE & SOFTWARE UPGRADES

The In-place-inclinometer is firmware up-grade able. Contact Keynes Controls Ltd. for details.

If you suspect that your In-place-inclinometer is malfunctioning or requires re-calibration and repair is required then contact us.

you can help assure efficient servicing by following these guidelines:

3.0 Pre-installation Communications Test

On receipt of the I-P-I sensors Keynes Controls recommends that the individual sensors are tested for communications prior to installation.

To simplify the testing Keynes Controls offer free applications software to display test data, and a series of media converters to enable the inclinometers to be attached and operated from a Microsoft Windows Operating System PC.

3.1 Free Applications Software

The free applications software is called Q-Log. It can be downloaded from

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

The Q-Log software enables the data to be observed directly in engineering units and to calibrate sensors.

3.2 Media Converters

The USB-Pro version sensors offer sensor excitation and automatically loading software drivers to make operation as simple as possible.

Simply install the media converter for the desired sensor type into a USB port on a PC.

Connect the In-place-inclinometer to the interface using the pin-out shown on the media converter and read the tilt data back into the applications software in a Windows friendly operating environment,

No programming experience is required to configure a Keynes In-place-inclinometer.

Additional information for the USB media converters can be found at

Model: USB-SDI12-Pro
http://www.aquabat.net/USBSDpro/USBSDI12proConV1.html

Model: USB-RS485-Pro
http://www.aquabat.net/downloads/Installation-USB485-Pro-V1.pdf

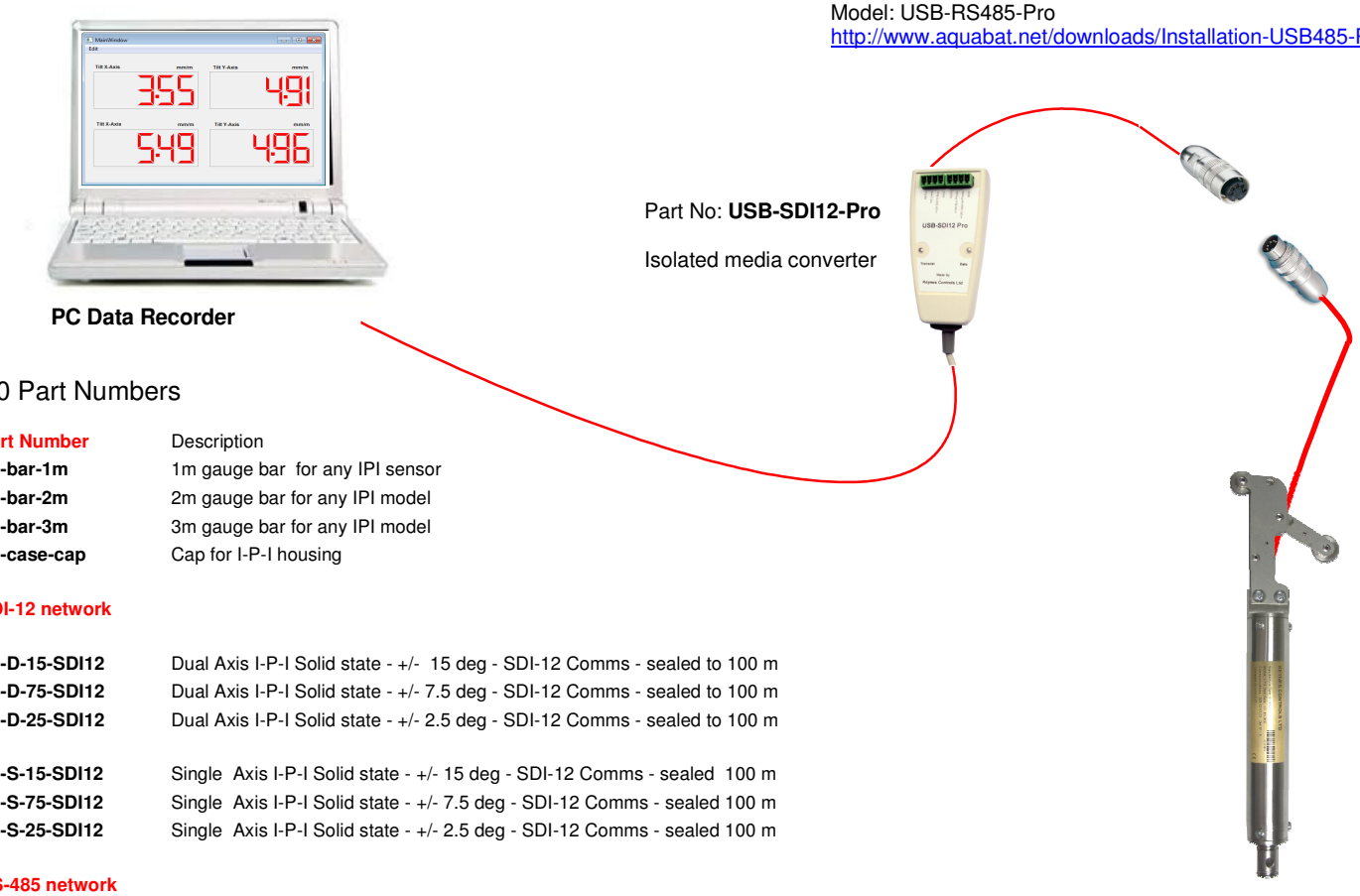


Fig 2 - Basic I-P-I test system setup

4.0 Part Numbers

Part Number	Description
IPI-bar-1m	1m gauge bar for any IPI sensor
IPI-bar-2m	2m gauge bar for any IPI model
IPI-bar-3m	3m gauge bar for any IPI model
IPI-case-cap	Cap for I-P-I housing
SDI-12 network	
IPI-D-15-SDI12	Dual Axis I-P-I Solid state - +/- 15 deg - SDI-12 Comms - sealed to 100 m
IPI-D-75-SDI12	Dual Axis I-P-I Solid state - +/- 7.5 deg - SDI-12 Comms - sealed to 100 m
IPI-D-25-SDI12	Dual Axis I-P-I Solid state - +/- 2.5 deg - SDI-12 Comms - sealed to 100 m
IPI-S-15-SDI12	Single Axis I-P-I Solid state - +/- 15 deg - SDI-12 Comms - sealed 100 m
IPI-S-75-SDI12	Single Axis I-P-I Solid state - +/- 7.5 deg - SDI-12 Comms - sealed 100 m
IPI-S-25-SDI12	Single Axis I-P-I Solid state - +/- 2.5 deg - SDI-12 Comms - sealed 100 m
RS-485 network	
IPI-D-15-485	Dual Axis I-P-I Solid state - +/- 15 deg - RS-485 Comms - sealed 100 m
IPI-D-75-485	Dual Axis I-P-I Solid state - +/- 7.5 deg - RS-485 Comms - sealed 100 m
IPI-D-25-485	Dual Axis I-P-I Solid state - +/- 2.5 deg - RS-485 Comms - sealed 100 m
IPI-S-15-485	Single Axis I-P-I Solid state - +/- 15 deg - RS-485 Comms - sealed 100 m
IPI-S-75-485	Single Axis I-P-I Solid state - +/- 7.5 deg - RS-485 Comms - sealed 100 m
IPI-S-25-485	Single Axis I-P-I Solid state - +/- 2.5 deg - RS-485 Comms - sealed 100 m

5.0 Mechanical Assembly Operations for the Vertical I-P-I Chain

The creation of an In-place-inclinometer chain is a simple operation. Connect the sensor spacer bars to the I-P-I to make a measurement chain of the desired length.

The sensor length is assigned by the overall inclinometer length with a spacer bar to give the desired spacing between the measurement points. The standard measurement points are spaced 0.5, 1, 2 or 3 metres apart. Other distances can be created on request.

5.1 Spacer Bars

The sensor bars are supplied with all mounting bolts and with a factory pre-set rod end baring attached.

Apart from bolting the spacer bar to the In-place-inclinometer, no other mechanical assembly will be required.

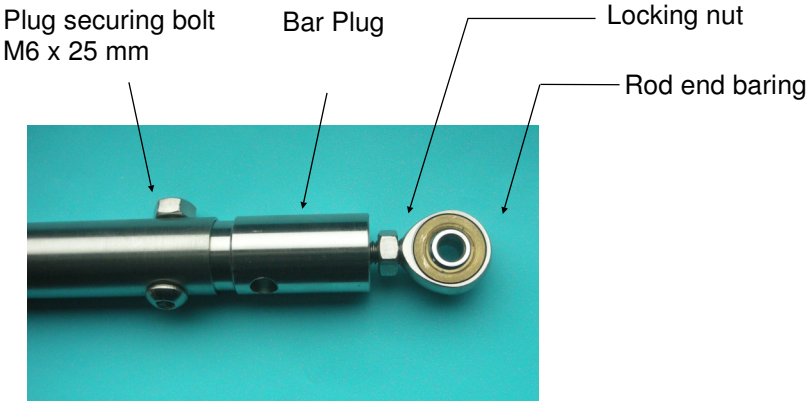


Fig 3 - I-P-I Spacer Bar with plug

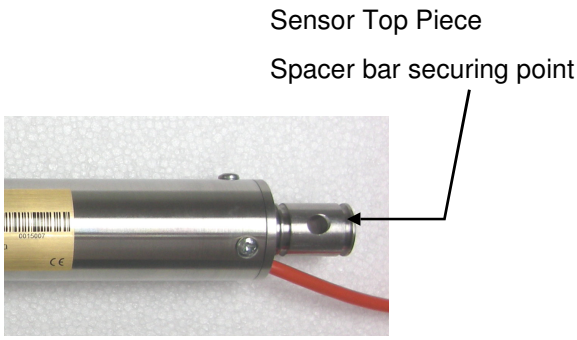


Fig 4 - I-P-I Spacer bar top piece mount position

Figure 6 opposite shows how the wheel assembly is secured onto the In-place-inclinometer.

The wheel assembly is attached to the I-P-I sensor prior to the inclinometer being attached to the I-P-I chain.

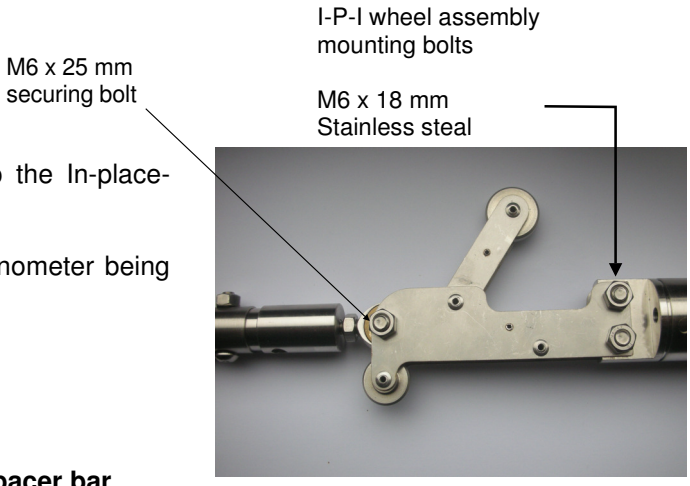


Fig 6 - I-P-I Wheel assembly mounted on a sensor

5.2 Attaching the In-Place-Inclinometer wheel assembly onto a spacer bar

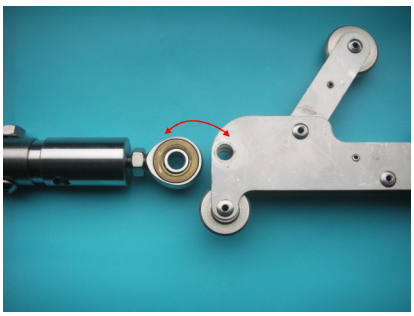


Fig 5 - Fastening the spacer rod to the wheel assembly

Fig 5 opposite shows how the I-P-I wheel assembly connects to the spacer bar.

Line up the rod end baring to the wheel assembly as shown.

Slide the red end baring into the wheel assembly

Secure the wheel assembly to rod end baring using the supplied M6 x 25 mm stainless steel bolt.

Fig 7 I-P-I Completed wheel assembly

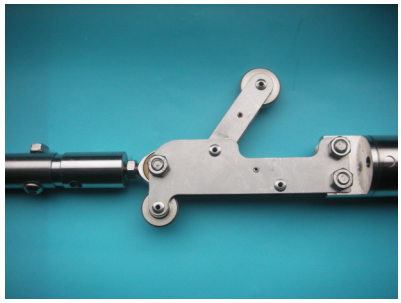


Figure 7 opposite shows the baring end rod secured to the wheel assembly.

The process is repeated for each In-place-inclinometer on the string.

Fig 8 - Complete I-P-I sensor assembly

Fig 8 shows how the In-place-inclinometer should look with the wheel assembly attached.

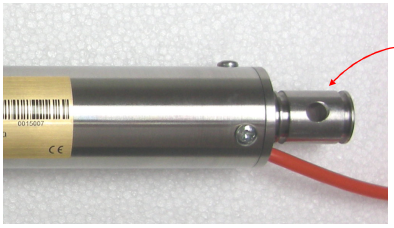
The wheel assembly fits on to all models of the I-P-I sensor in exactly the same manner.

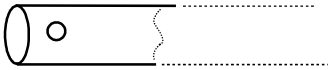
5.3 Fastening the spacer bar to the top of the In-place-inclinometer

The spacer bar only fits onto the I-P-I sensor top in one position and aligns the bar to the next adjacent sensor.

Slide the spacer bar onto the sensor top mounting piece and secure into place with the M6 x FF mm stainless steal bolt. Make sure the securing nut is tightly fastened.

All the spacer bars are secured into place regardless of length in exactly the same manor.





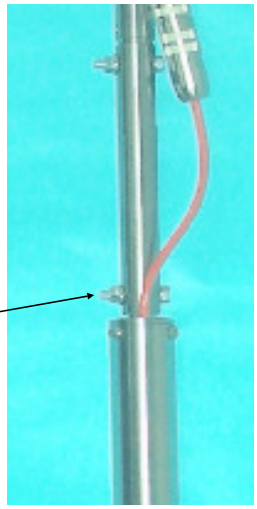


Fig 9 - Securing the spacer bar to the top of the sensor

5.4 Minor adjustments to the spacer bar alignment and length.

The spacer bars are supplied with a factor aligned rod end baring. Once the spacer bar is attached to the sensor it will correctly align the axis of measurement.

In some cases it may be desirable to minor adjustments in the alignment if the bar to correct for any local mechanical irregularities in the sensor casing tubes.

5.5 Rod End Baring

The rock end baring is screwed into the bar plug and secured into place with a locking nut.

1. Slacken the locking nut (See Fig 10)
2. Adjust the rod end baring orientation and length to the new desired position.
3. Secure the rod end baring into place by tightening the locking nut.

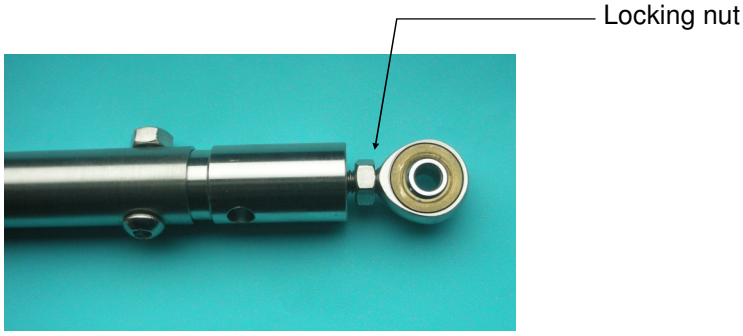


Fig 10 - Spacer bar locking nut

6.0 Digital Network Connection

The In-place-inclinometer when used on an I-P-I chain is supplied with two network connectors attached at each end of the sensor. In order for the sensors to operate they are daisy chained together to form a digital network. Each sensor connects to the adjacent device along the network once the connectors are secured.

The Keynes Controls I-P-I sensors use screw locking IP-68 rated plug and sockets to connect the sensors together. The watertight seal is only formed once the connectors are screwed together. Care has to be taken to make sure the connectors are screwed together tightly prior to deployment on the chain in order to stop the ingress of water to the signal cable cores.

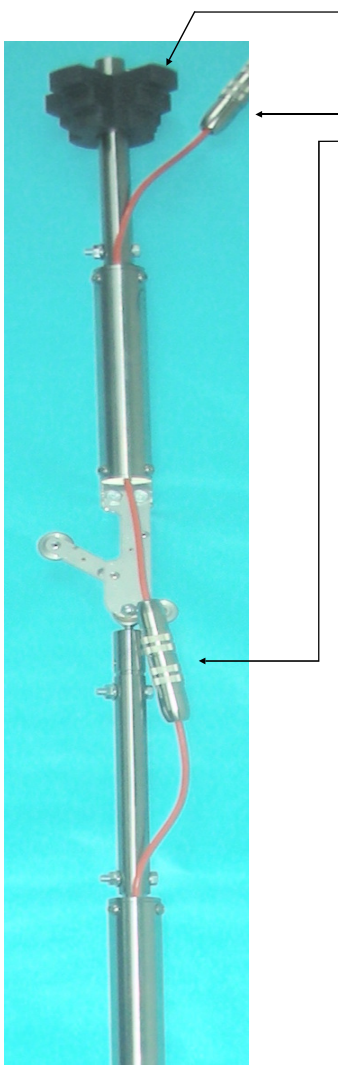


Fig 11 I-P-I Chain Assembly

Fig 12 I-P-I Sensor with network connectors

6.1 Network Types

The Keynes Controls I-P-I sensors support SDI-12 or RS-485 digital network communications.

SDI-12 Network Length

Any In-place-inclinometer chain deployed using the I-P-I sensors must not exceed a maximum length of 100 m from the bottom of the I-P-I chain to the data logger.

RS-485 Network Length

Any In-place-inclinometer chain deployed using the RS-485 network option I-P-I sensors must not exceed a maximum length of 1000 m from the bottom of the I-P-I chain to the data logger or PC.

Digital Network Connection

Fig 13 - Un-sealed network connector

Fig 14 - Sealed network connector making a waterproof connection

6.2 Securing the digital network signal cable

A digital network connects the In-place-inclinometers together on the sensor string and onto the data logger of personal computer system.

The network connectors for adjacent pairs of sensors form a matching male / female pair. Fig 14 shows the network connectors secured together to form a watertight seal.

As each sensor is attached to the I-P-I string connect the network connectors are to be secured in turn.

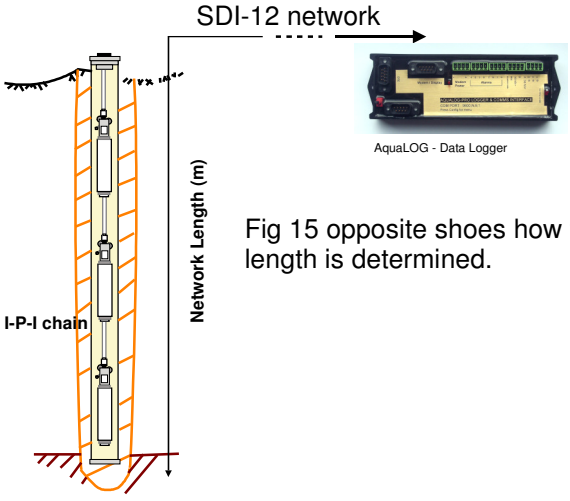


Fig 15 - Connection of the I-P-I to a datalogger

Fig 15 opposite shoes how the network length is determined.

6.3 Network Connection Operations

All of the I-P-I sensors to be deployed on a network chain are supplied with 2 x network connectors as shown in Figure 12.

1. Secure each sensor to the I-P-I chain as shown in Fig 11.
2. Fasten the network connector from the first sensor on the chain to the next one in-line taking care to tighten the screw lock on the connectors to create the watertight seal. See Fig 14
3. The network connectors are factory wired and simply plug together from one sensor to the next. The male plug at one end of the sensor connects to the female socket on the adjacent device.
4. Once the network chain is assembled test the communications to the sensors. It is easier to test the communications for installation into a casing and make corrections as necessary.

7.0 Axis alignment

In order to undertake a successful measurements all of the in-place-inclinometers have to be aligned in the same axis.

The image below demonstrates how the sensors are deployed to ensure the measurement axis are all in the correct orientation.

All of the sensors have to aligned on the same axis for the results to be correct.

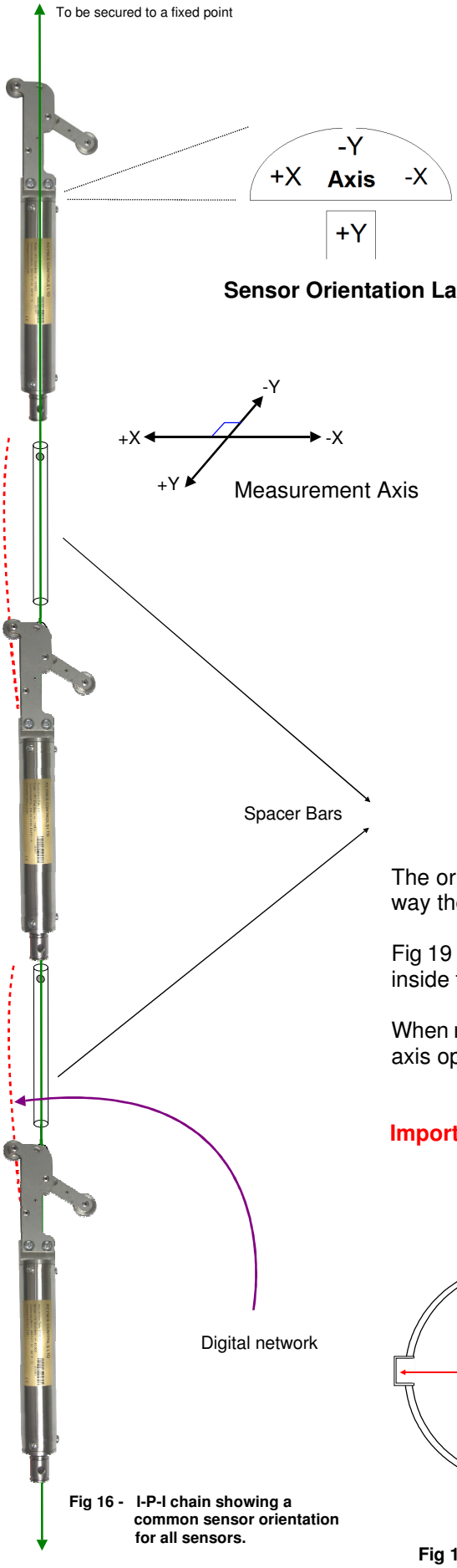


Fig 16 - I-P-I chain showing a common sensor orientation for all sensors.

Important Note - All sensors have to be deployed in the same axis in order for the measurements be be correctly understood.

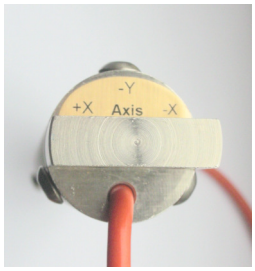
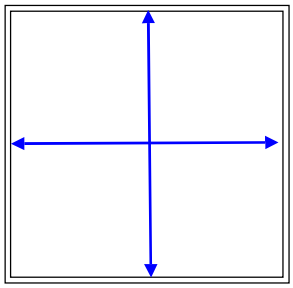


Fig 18 - Sensor orientation

Figure 18 shows the label attached to the sensor that shows the orientation of the critical axis.

7.1 Axis of movement



Rectangular Casing

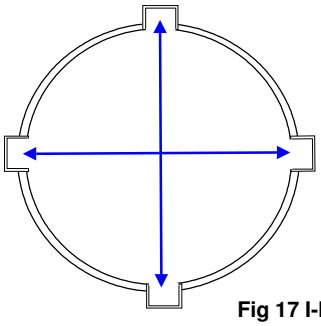


Fig 17 I-P-I Casing

The orientation of the X-Y axis of movement for the sensor is purely defined by the way the device is fitted into the casing.

Fig 19 shows the label fitted to the sensor case and shows the orientation of the axis inside the sensor.

When reading data from the sensor it is the orientation shown on the label that defines axis operation.

Important Note: Take care to record the orientation of the sensors once they are mounted inside the casing. This information will be required to understand the movement of the sensors.

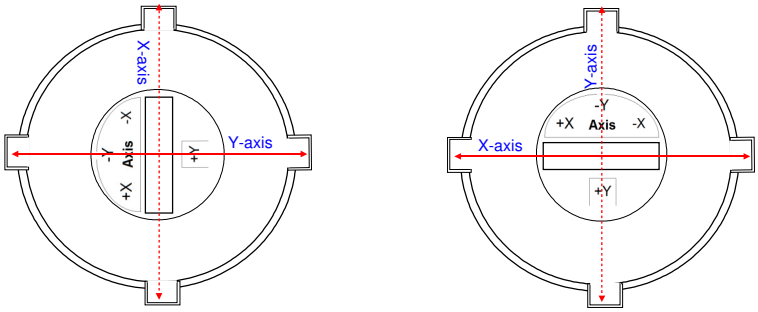


Fig 19 - I-P-I casing showing the different sensor orientation options

7.1 Securing the In-place-inclinometer chain to the casing tube

The I-P-I chain is secured to the casing using the Top Mounting Cap as shown in figure 20. The I-P-I chain is suspended into place once the cap is placed on top of the casing. The weight of the I-P-I chain helps to secure the sensor into place,

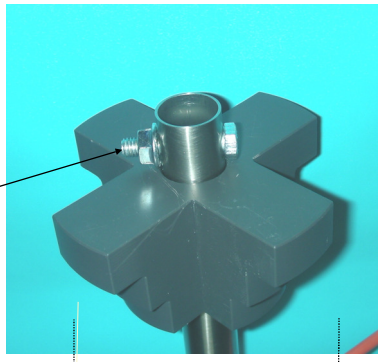
1. Slide the mounting cap over the spacer bar until it is passed the the hole for the securing bolts.

2. Fix into place the securing bolt and tighten.

   The securing bolts are M6 x 25 mm.

3. Lower the top mounting cap into place on to of the casing tube.

Figure 20 - Top cap securing bolt



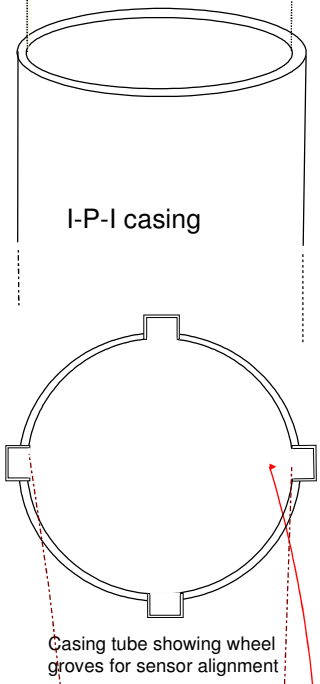
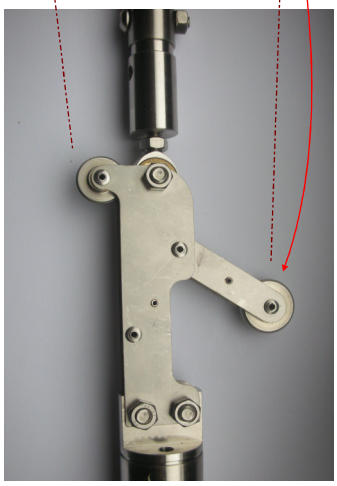


Fig 21 I-P-I Wheel assembly alignment to the casing



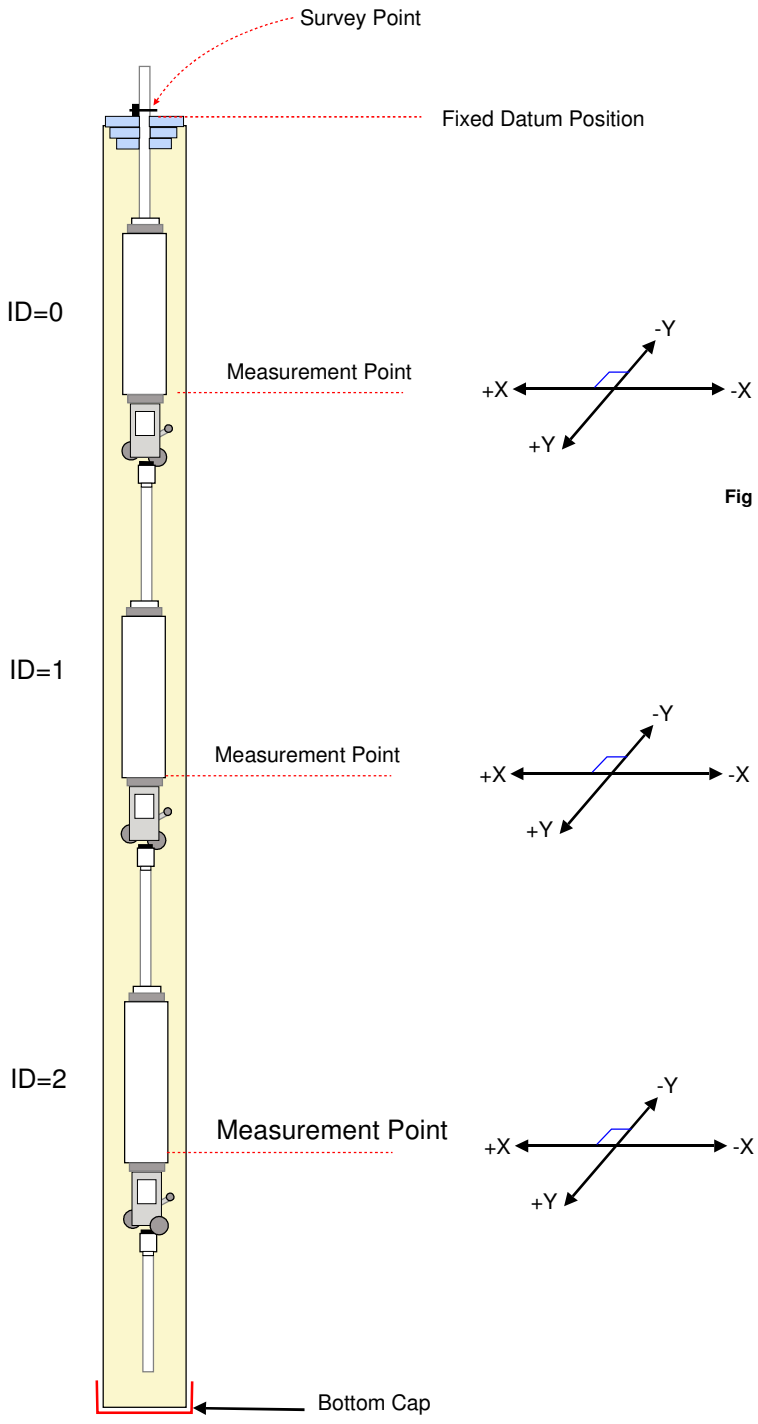


Fig 22 - Measurement Points

7.2 Lowering the I-P-I chain into the casing

Once the I-P-I chain is assembled and tested it can be lowed into the I-P-I casing.

Make sure all the sensors are aligned in the same way prior to installing into the tube.

Line up the wheel assembly with the groves in the casing.
and slowly lower the sensor chain into the casing.

Take care when fitting the sensors into the casing that the chain is not dropped. Should the sensor I-P-I chain be dropped to the bottom of the casing then damage due to mechanical shock.

The Top Mounting Cap secures the I-P-I spacer bar for the top sensor to the top of the I-P-I casing.

Figure 23 opposite shows the spacer bar attached to the top cap and secured into place by an M6 x 25 mm stainless steel bolt.

Top Mounting Cap

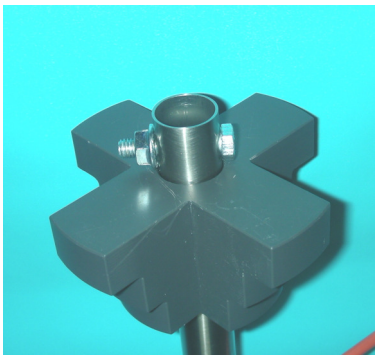
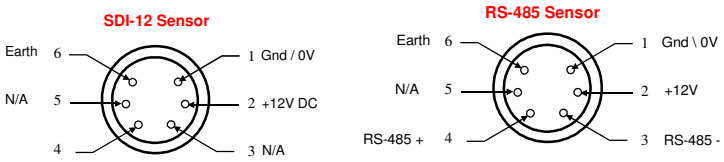


Fig 23

Connections to glass seal - internal to the sensor



8.0 Sensor Connection

Figure 24 below shows the pin-outs for the connector attached to the sensor.

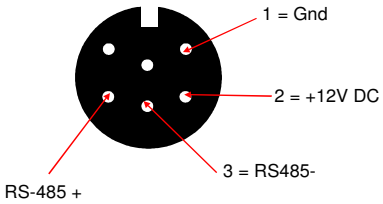
The view is looking into the connector.

Fig 24

8.1 Lumberg Connector Pin-Outs

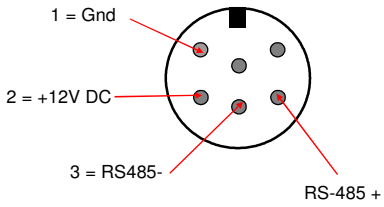
View looking into cable gland port

Female Connector



View looking into connector - Fig 25

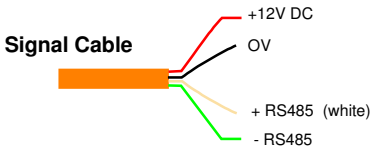
Male Connector



View looking into connector - Fig 26

Lumberg connectors are commonly by Keynes controls to create the digital network between the sensors.

The Pin-out shown on Figures 25 & 26 are for the Lumberg connectors only.



Standard cable colour code

9.0 Advice for successful measurement operations

Once the I-P-I chain is deployed and before data acquisition operations are undertaken take care to:

1. Allow the sensors to settle to the standard operating temperature.

2. Wait for the sensor string to stop moving and to settle after lowering into the casing. Even small movements will be detected by the sensors.

3. Take an initial measurement from each sensor and use this point as the starting position for any future measurements.

   All future measurements should be referenced from the starting datumn position.

9.1 Advice for selecting the sensor chain location

The main criteria for locating the I-P-I sensor, be that a sensor chain, or stand-alone sensors mounted on fixed brackets is that they are placed into a position away from sources of local vibration and have a fixed anchor position. Any local vibration will be detected by the sensors and can cause errors in any measurements.

9.2 Power Supply Rating

For reliable long term operation Keynes Controls recommends that a power supply should have a minimum of 3 x over capacity for the number of sensors in operation.

1 x I-P-I sensor in scan mode = 12 mA Therefore use 40 mA 12V DC Supply

so

6 x I-P-I sensors on a chain = (6 x 12) x 3 = 300 mA 12V DC supply

The following images demonstrate how the sensor tilt angles are interpreted depending upon how the sensor is mounted to the supporting brackets of gauge rods.

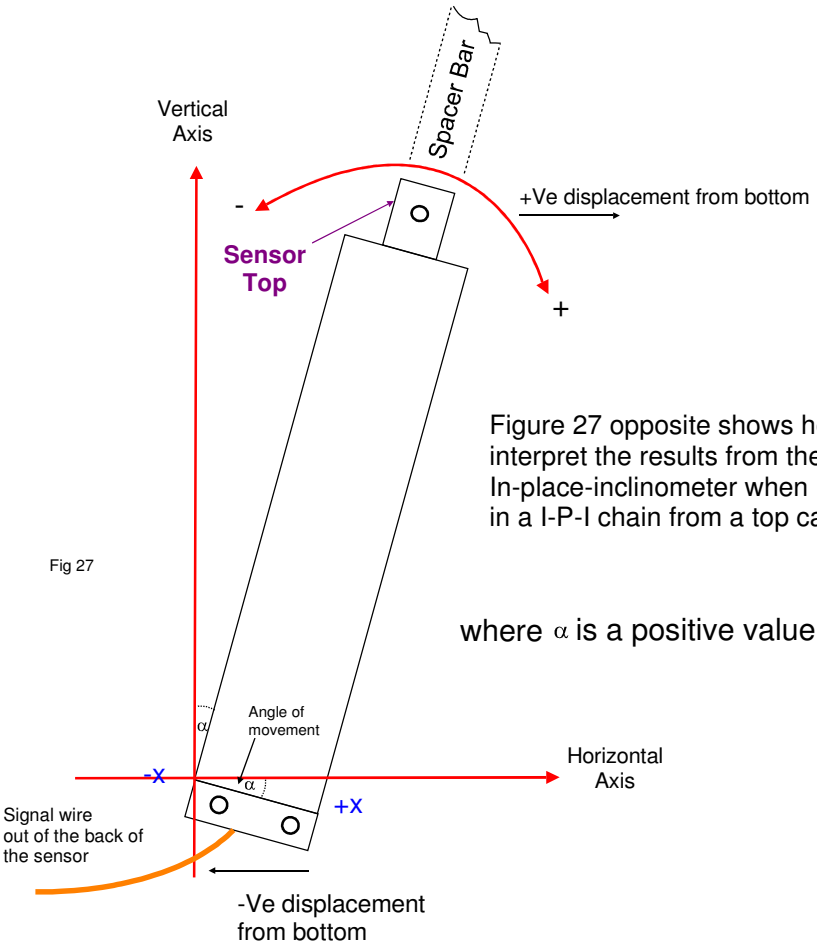


Fig 27

Figure 27 opposite shows how to interpret the results from the In-place-inclinometer when mounted in a I-P-I chain from a top cap.

where α is a positive value angle

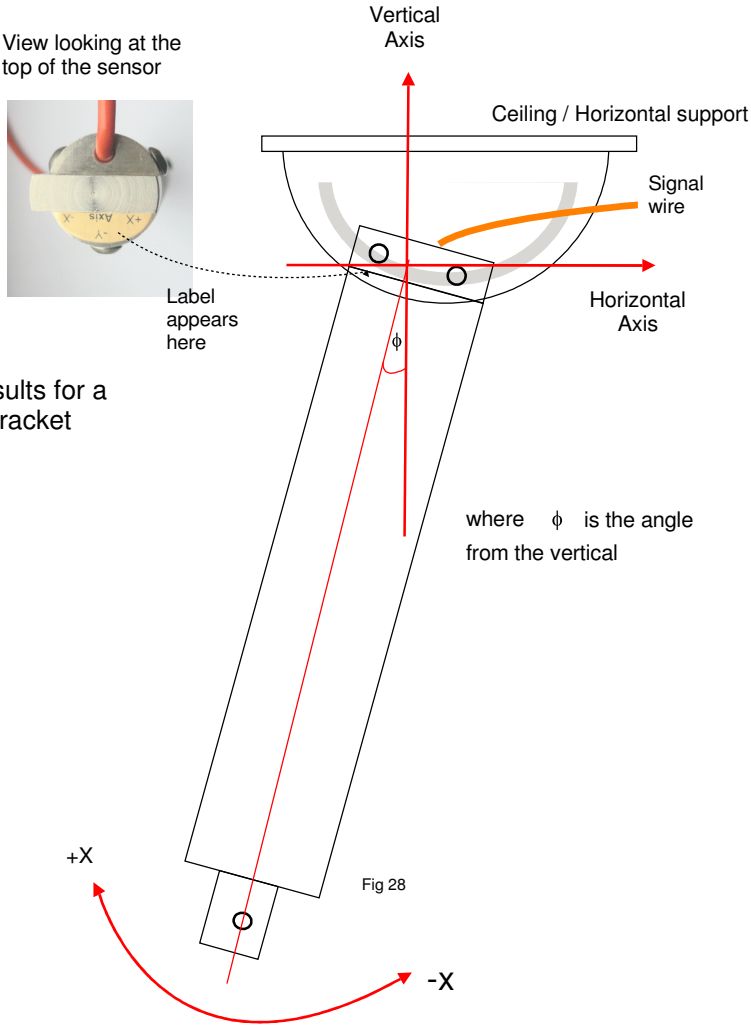


Fig 28

Fig 28 shows how to interpret the sensor results for a sensor fixed to horizontally fixed mounting bracket

USB Media Converter Part No

USB-SDI12-Pro - SDI-12 network interface
USB-RS485-Pro - RS485 network interface

Device Driver Installation

All of the Keynes Controls USB media converters use the Microsoft accredited device driver which loads automatically into a Windows 7, 8 operating system PC so long as a suitable Internet connection is available. Some versions of the operating system have this driver built in.

10.0 Single Sensors or Interfaces Connection

Keynes Controls recommends the use of the circuit below to connect a single sensor or interface to the media converter.

The USB-RS485-Pro can support a number of devices that are directly powered by the interface but the network operations can fail should the device become overloaded. A self resetting fuse will prevent damage to the unit.

10.1 Multiple Sensors - Interface Connection

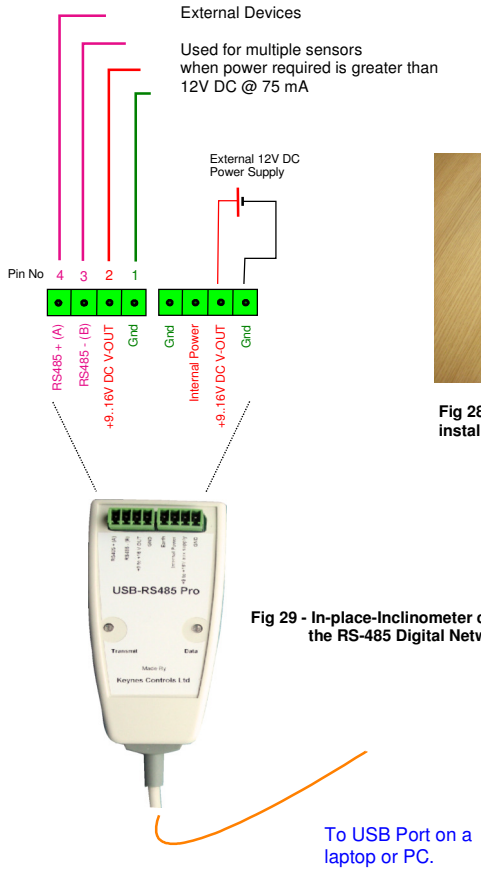
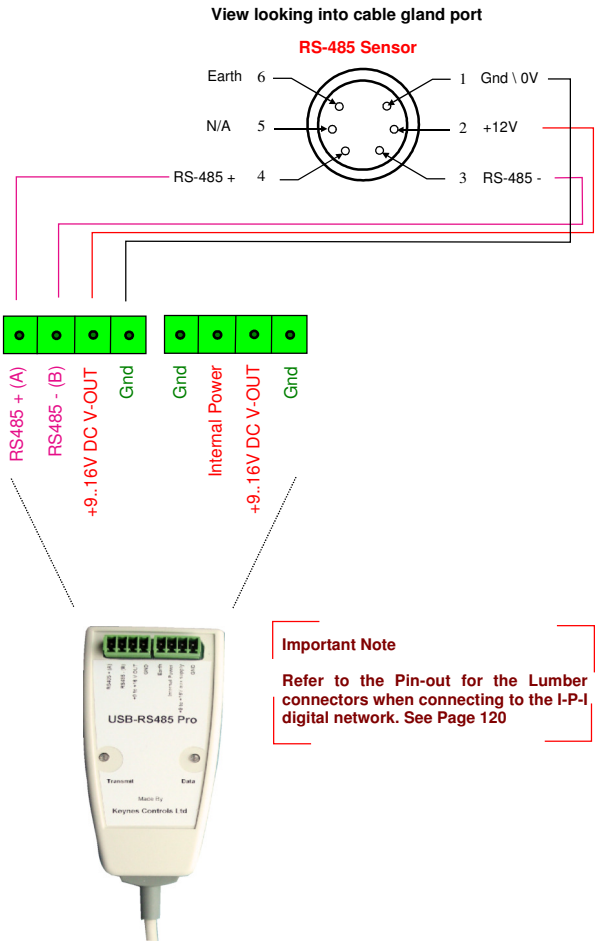


Fig 29 - In-place-Inclinometer connection to the RS-485 Digital Network

Fig 28 - USB-RS485-Pro media converter installed on a laptop computer.

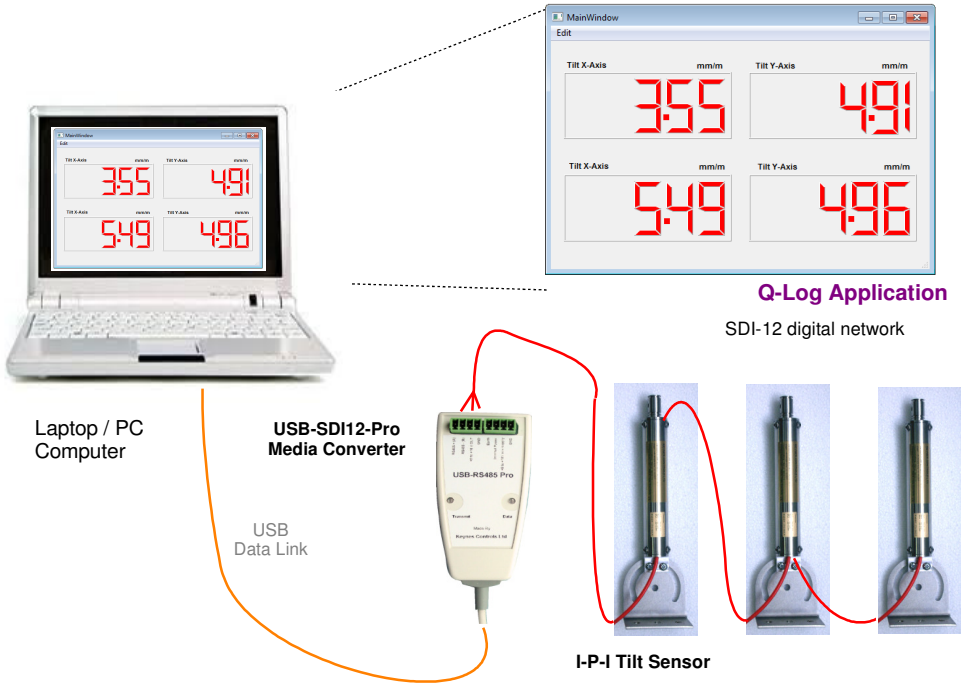


Important Note

Refer to the Pin-out for the Lumber connectors when connecting to the I-P-I digital network. See Page 120

Fig 30 - USB-RS485-Pro connection to a single I-P-I RS485 model sensor

Fig 31 - In-place-inclinometer test system using USB-RS485-Pro media converter and Q-Log applications software



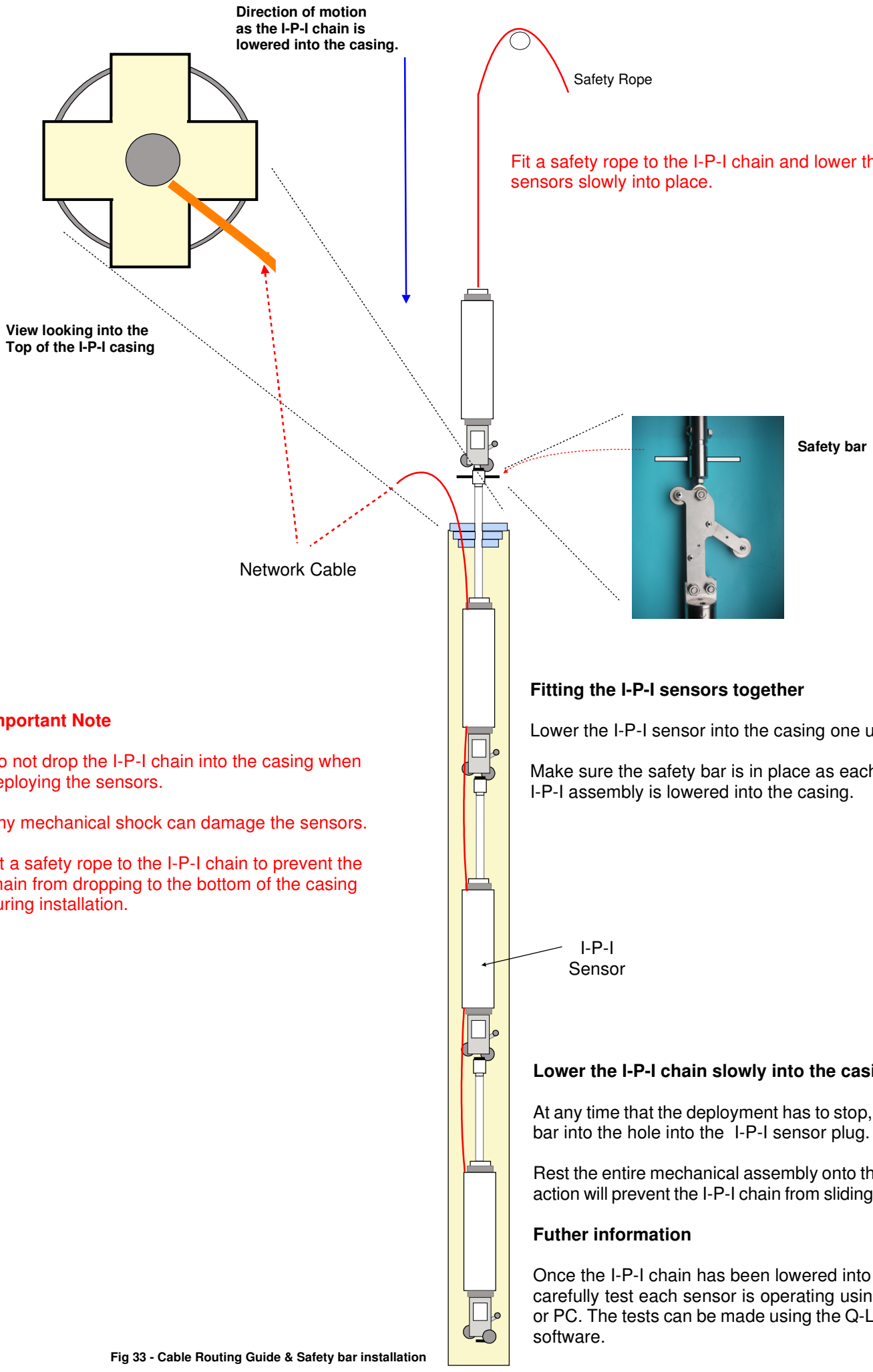
Typical Q-Log Panel Meter Screen

The USB-RS485-Pro is integrated into the free **Q-LOG** Data Acquisition & Display package that is provided by Keynes Controls. for use with with the In-place-inclinometer intelligent sensors.

Additional details can be found at:

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

11.0 Cable Routing



Important Note

Do not drop the I-P-I chain into the casing when deploying the sensors.

Any mechanical shock can damage the sensors.

Fit a safety rope to the I-P-I chain to prevent the chain from dropping to the bottom of the casing during installation.

Fitting the I-P-I sensors together

Lower the I-P-I sensor into the casing one unit at a time.

Make sure the safety bar is in place as each individual I-P-I assembly is lowered into the casing.

Lower the I-P-I chain slowly into the casing.

At any time that the deployment has to stop, slide the safety bar into the hole into the I-P-I sensor plug.

Rest the entire mechanical assembly onto the top plug. This action will prevent the I-P-I chain from sliding into the casing.

Futher information

Once the I-P-I chain has been lowered into place carefully test each sensor is operating using a data logger or PC. The tests can be made using the Q-Log applications software.

Fig 33 - Cable Routing Guide & Safety bar installation

12.0 Physical Dimensions

Rod end baring gap to the wheel assembly is set to 23 mm

Measure the distance using a ruler and lock the distance with the nut.

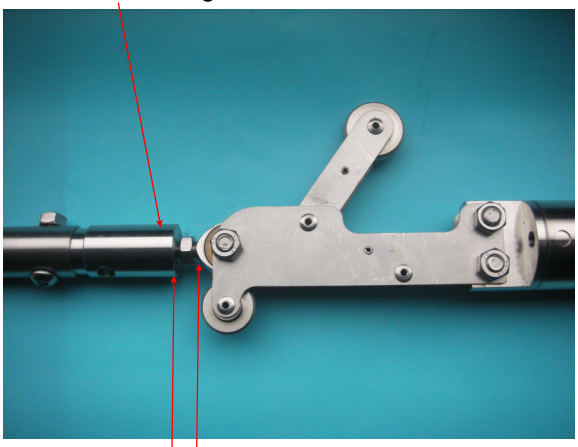


Fig 33 - Rod end baring spacing

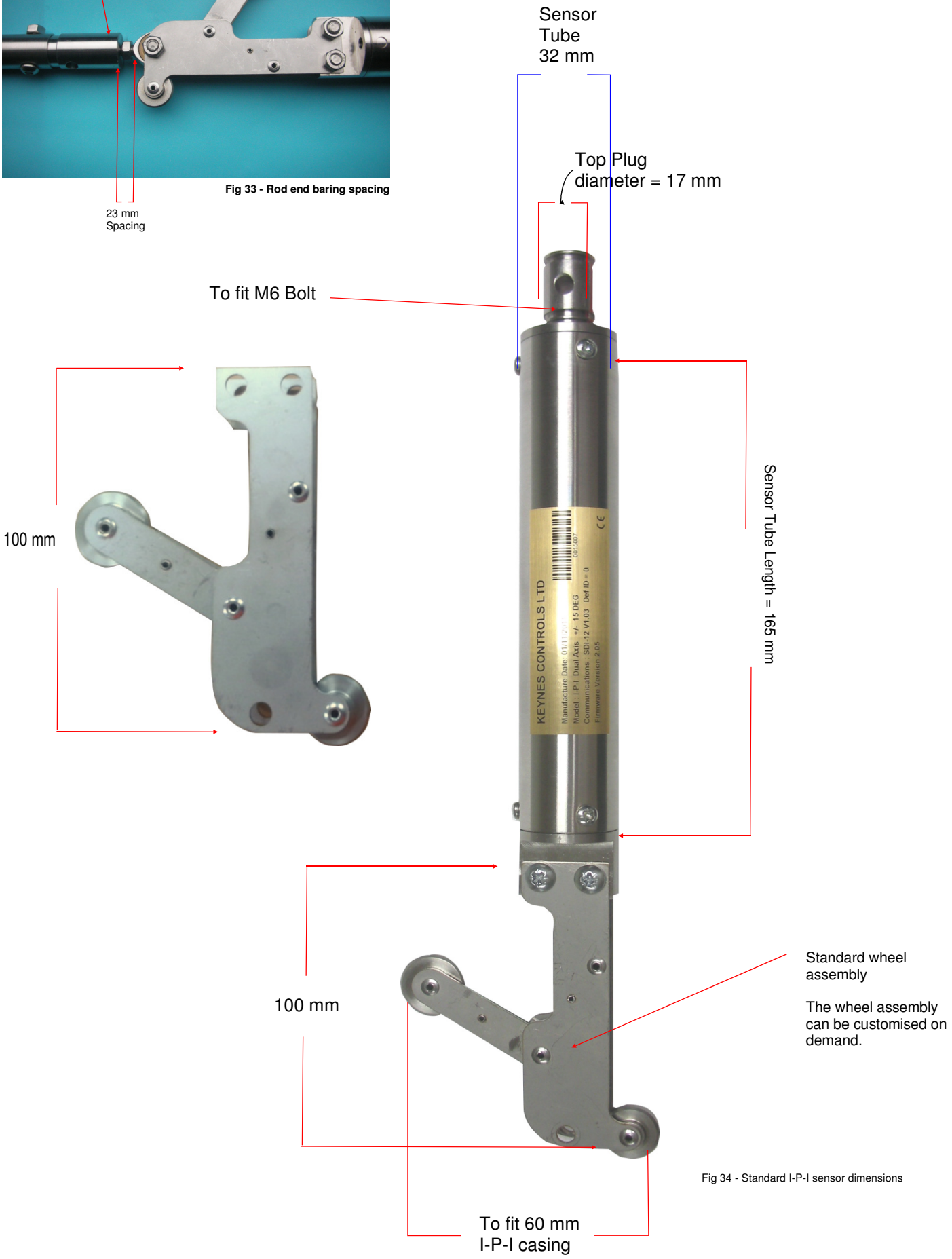
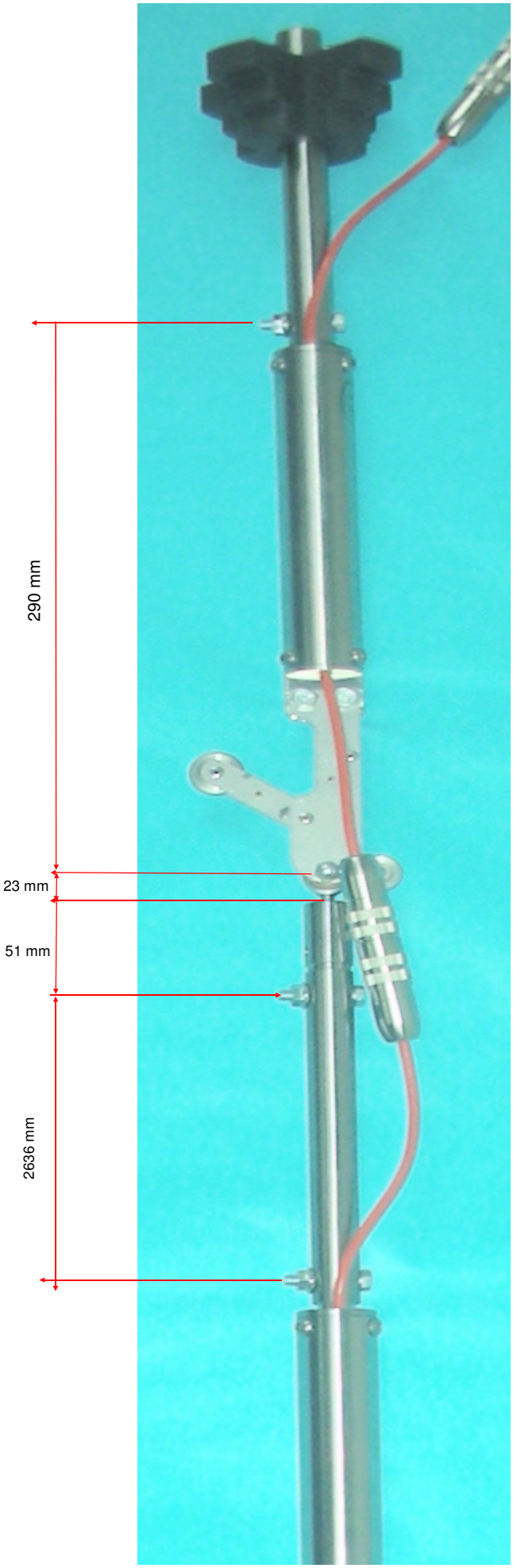


Fig 34 - Standard I-P-I sensor dimensions

12.1 Dimensions for 3 m I-P-I string

Fig 33 shows the dimensions for the mechanical assembly making up a 3 meter In-place-inclinometer chain.



Long Term In-place-inclinometer chain monitoring systems for in-accessible underground locations.

Introduction

For long term continual monitoring of an I-P-I chain when it is to be deployed into a location which is difficult to access or impossible after sensor installation then Keynes Controls recommends that RS-485 network sensors for reliable operation.

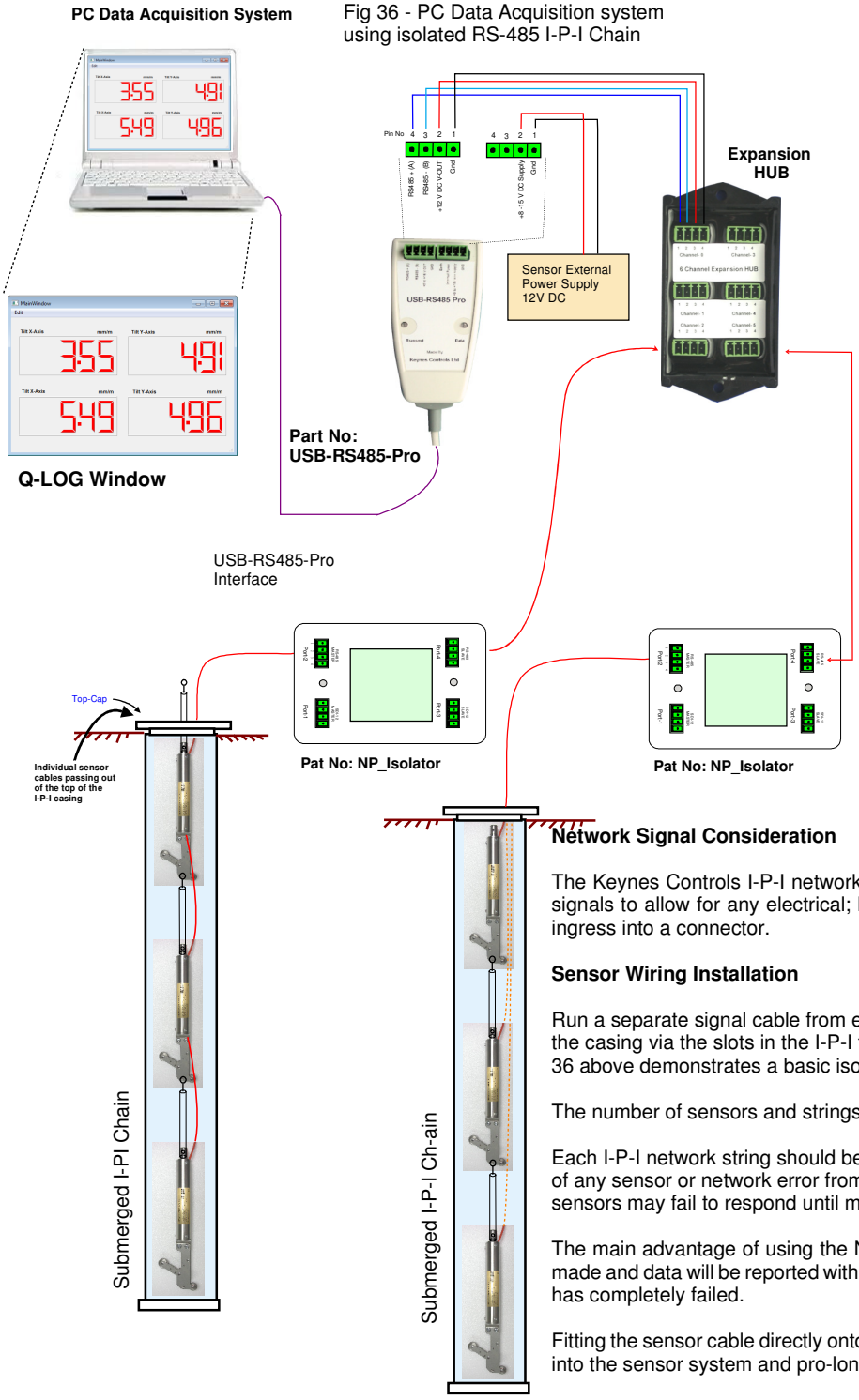


Fig 36 - PC Data Acquisition system using isolated RS-485 I-P-I Chain

Part Numbers

IPI-485-ISOL Isolator block / Signal conditioning

NP-HUB-6 6 Port expansion block

I-P-I Casing

Ideal Deployment Conditions

Under ideal conditions the I-P-I casing should be dry installed as a dry chamber with each section sealed against the ingress of moisture.

The longest possible and reliable operation of the I-P-I sensor chain will occur be when the sensors are kept dry. Anything that can be done to maintain this feature of the I-P-I string is advantageous for a successful measurement system.

Case Flooding

In areas where there is high levels of ground water in the soil then the casing can be effected by buoyancy and this will cause the casing to rise from its initial position. To prevent movement the casing can be flooded to force it to seat into position.

If at all possible secure the casing top to a point that cannot move as this position is the datumn point for the start of any measurements.

Remove the water from the casing by pumping out before deploying the I-P-I string and cables.

Network Signal Consideration

The Keynes Controls I-P-I network isolator block adds signal conditioning to the RS-485 network signals to allow for any electrical; leakage of the network signals that can occur should moisture ingress into a connector.

Sensor Wiring Installation

Run a separate signal cable from each individual along the I-P-I string and pass the cable out of the casing via the slots in the I-P-I top plug. Secure the sensor signal to the instrument box. Fig 36 above demonstrates a basic isolated network configuration.

The number of sensors and strings to be protected is up to the User.

Each I-P-I network string should be isolated from any other on the network. This prevents failure of any sensor or network error from pulling down the complete network. Single or small groups of sensors may fail to respond until maintenance rectifies any error.

The main advantage of using the NP_Isolator-Pro units in a system is that measurements will be made and data will be reported with a Keynes Controls system long after a system with no protection has completely failed.

Fitting the sensor cable directly onto the expansion block remove a possible source of water ingress into the sensor system and pro-longs the life of the instruments.

Long term Measurement Cycle

For long term and reliable measurements, the sensors should only be powered for the duration of the measurement operation and then switched off.

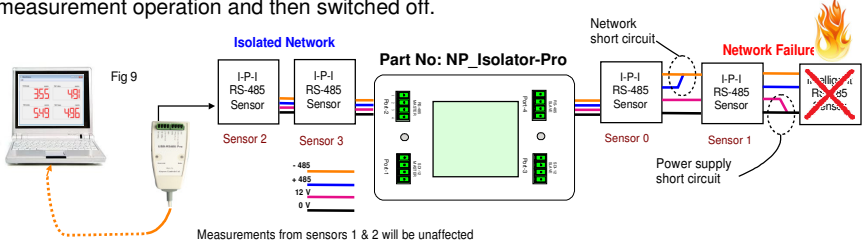
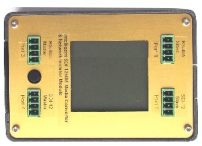


Fig 9

SDI-12 / RS485 Intelligent Network Isolator & Protocol Converter



- **Isolated Network Communication**
- **In-built network power supply monitor**
- **Isolated RS-485 / RS-485 Operations**
- **Protection from hazardous ground loops and voltage spikes.**

Part No: NP_Isolator-Pro

Download further details at:

http://www.aquabat.net/downloads/NP_isolatorv1.pdf

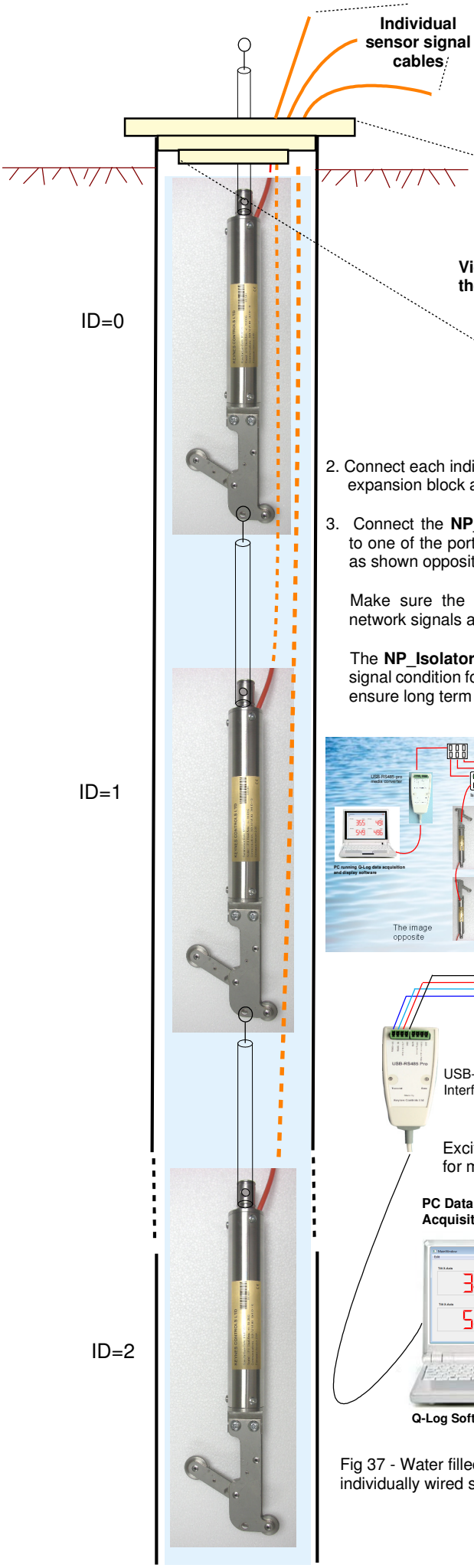
Last updated Aug 2015

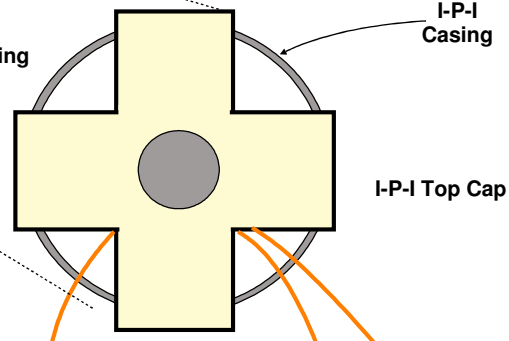
Sensor Installation into a flooded I-P-I Casing

In applications where the I-P-I string has to deployed into a casing which is flooded then the following operations should be followed in order to create a successful measuring system.

1. Each sensor is individually connected to the expansion box mounted upon the surface away from any water of the I-P-I Chain.

   Fasten the I-P-I signal cable to the I-P-I string stainless steel spacer rods using cable plastic cable ties. Take care when installing the I-P-I sensors to secure the sensor cables correctly as each new sensor is installed.



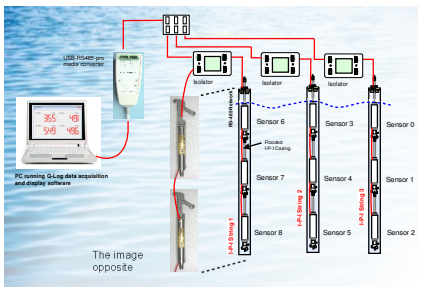


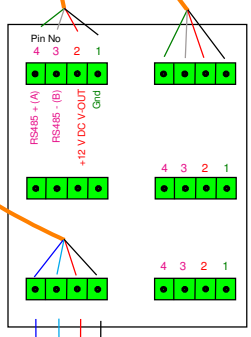
2. Connect each individual sensor to the expansion block as shown opposite.

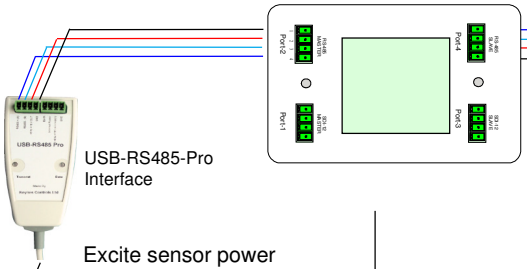
3. Connect the **NP_Isolator-Pro** interface to one of the ports of the expansion hub as shown opposite.

   Make sure the RS-485+ and RS-485 network signals are connected correctly.

   The **NP_Isolator-Pro** interface provides signal condition for the network signals to ensure long term unattended operations.



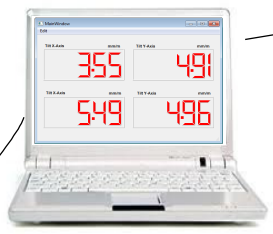




NP_Isolator-Pro

Excite sensor power for measurement operations

PC Data Acquisition System



Q-Log Software

5. Connect the **NP_Isolator-Pro** interface to the data acquisition PC or data controller using a USB-network-Pro isolated media converter.

6. The Isolator module is a network powered device. The sensor measurement commands and measurements returned from the sensors can be observed on the display unit.

7. After completing a measurement switch off the sensors by removing the digital trigger.

IMPORTANT NOTE

The **NP_Isolator-Pro** module uses DC-DC converters to provide excitation, and is powered itself by the network supply.

An failure to the systems power supply wont damage the sensors due to the isolation properties of the DC-DC converter.

Fig 37 - Water filled I-P-I chain with individually wired sensors to the surface.

Long Term Deployment - damp environment - additional waterproofing

Recommended Waterproof Grease for I-P-I Lumberg Connectors

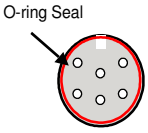
Use the following silicone grease to waterproof the Lumberg connectors before installation of the I-P-I chain

The Lumberg connectors are a lower cost alternative to the Seacon micro-wet-con connectors that used for underwater applications.

When being used for long-term stand alone applications Keynes Controls recommends inserting a small amount of silicon grease be inserted into the female receptor part of the connector.

Part No.	Dow Coning COMPOUND, SILICONE, DC4
Lubricant Type:	Grease
Dispensing Method:	Tube
Chemical Colour:	White
SVHC:	No SVHC (16-Dec-2013)
Colour:	Transparent White
Dielectric Strength:	16kV/mm
Lubricant Applications:	Automotive, Electrical, Mechanical
Operating Temperature Max:	200℃
Operating Temperature Min:	-50℃

Fig 38 - Dow Coning DC4



To make a immersion seal the O-ring has to be fitted inside the female half of the Lumberg connector. Fig 39.

Sealing the Lumberg Connector Prior to Installation

Make sure the connectors are dry before inserting the silicone grease.

Prior to mating the Lumberg connector together inject silicon grease into the receptor of the female side of the connector as shown below. Make sure the grease gets into each pin.

Repeat the grease insertion for each pin

Force some excess grease into the pins by applying pressure using a thumb.

Wipe off any excessive grease but allow a small amount on the front of the connector to remain.

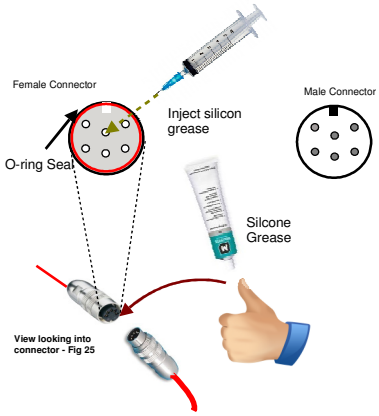


Fig 41 - Injecting silicon grease

Securing the connector

Mate the connectors together and secure by tightening together

Wipe any excessive grease into the join around the connectors.

Connector Shell

Make sure the connector shell is securely fastened to the connector..

If the shell is loose for any reason secure into place using a suitable spanner and the Lumberg locking tool.

Fig 40 - Mated Lumberg I-P-I Connector

Figure 40 shows the I-P-I mated together ready for use.

Waterproof Connectors

For applications where the I-P-I sensors are deployed under water then Keynes Controls use the Seacon range of wet mateable connectors.

These connectors provide waterproof network connections between the sensors on a string and can be safely mated in the dry or underwater.

The connectors offer excellent long term operation and are rated well above the standard 80 m depth detailed for the sensor systems.

Testing the connector prior to long term installation

Once the Seacon I-P-I connector is mated together Keynes Controls recommends that each sealed connector is tested under water to confirm the seal has been completed properly prior to long term installation.

Allow 10 - 20 cm above the connector for a submerged test

Soak for approximately 1 hour before final installation.

Scan the network using Q-Log and suitable interface to identify and gather data.

After 1 hour submergence test then I-P-I can be deployed.

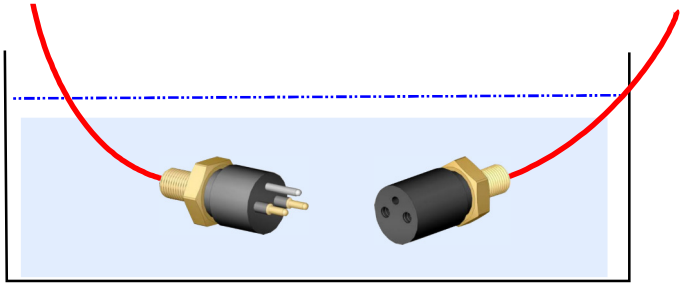


Fig 39- I-P-I Connector on submerged water test