

PENDULUM SYSTEM

HPS-3500/IPS-3000/TP-2000/MR-2500

INSTRUCTION MANUAL



CONTENTS

1.0	INTRODUCTION	Page
1.1	General description	4
1.2	Electro magnetic compatibility	5
1.3	Theory of operation	6
1.4	Components	7
2.0	CONFORMITY	10
3.0	MARKINGS	11
4.0	DELIVERY	12
4.1	Packaging	12
4.2	Handling	12
4.3	Inspection	13
4.4	Storage	
5.0	INSTALLATION	14
5.1	Tools and consumables	14
5.2	HPS-3500 Hanging pendulum	14
5.3	IPS-3000 Inverted pendulum	19
5.4	Through bolts	21
5.5	Support brackets	22
5.6	Mounting plates	24
5.7	Readouts	24
5.8	Typical installations	26
5.9	Wire fitting assembly	27
5.10	TP-2000 readout orientation	30
5.11	MR-2500 readout orientation	30
5.12	Outputs and wiring	31
5.13	Connection to data logger	32
6.0	CONFIGURATION	33
6.1	Selecting the COMM port	33
6.2	Immediate readings	34
6.3	Settings	34
6.4	Sensor address	35
6.5	Parameter setting	37
6.6	Reference feature	37
6.7	Clock setting	39
6.8	Set wire & calibration	39
6.9	Output configuration	40
6.10	CR800/1000 program example	43
6.11	Commands	44
7.0	TAKING READINGS	45
7.1	TP-2000	45
7.2	MR-2500	45

CONTENTS

7.0	DATA HANDLING	46
8.0	MAINTENANCE	47
9.0	TROUBLESHOOTING	47
9.1	TP-2000 Error codes	47
10.0	SPECIFICATION	48
11.0	SPARE PARTS	50
12.0	RETURN OF GOODS	50
13.0	LIMITED WARRANTY	51

1.0 INTRODUCTION

This manual is intended for all users of the **Geosense® Pendulum System** and provides a guide for its installation, operation and maintenance.



It is VITAL that personnel responsible for the installation and use of the Pendulum System READ and UNDERSTAND the manual, prior to working with the equipment.



1.1 General Description

1.1.1 HPS-3500 Hanging Pendulum

The HPS-3500 Hanging Pendulum has a fixed point high up in the structure and a heavy weight is used to generate the tension. The weight is submersed in a fluid to damp movements that may be caused by currents of air up through the pendulum shaft.

1.1.2 IPS-3000 Inverted Pendulum

The IPS-3000 Inverted Pendulum has a fixed point at, or below, the base of the structure and employs a large float in a water filled tank, to generate the tension in the wire.

1.1.3 TP-2000 Readout

The **Geosense® TP-2D-2000 Readout** is a readout device specifically designed to automatically measure and record relative movements of normal and inverted pendulums. It is housed in a robust waterproof housing and is simple to install using a special mounting plate. It is available in three different versions (see specification).

It can be installed as part of a complete new system or be retro-fitted as part of an upgrade to an existing manual system.

Measurements are obtained using highly sensitive and accurate CCD technology which converts the data with temperature correction into either an analogue or digital signal which can be transmitted to a remote data logger. Data can also be stored and read locally with an additional LED display.

1.1.4 MR-2500 Readout

The **Geosense® MR-2500 Readout** is a readout device specifically designed to manually measure and record relative movements of normal and inverted pendulums. It comprises of two Vernier scales, two reading plates and two mirrors mounted at ninety degrees to each other.

1.2 EMC - Electro Magnetic Compatibility

EMC is the electromagnetic interaction of electrical and electronic equipment with other electrical and electronic equipment. All electronic devices have the potential to emit and be affected by electromagnetic fields. With the reduction in size of electrical components and the ever increasing amount of electrical & electronic devices such as mobile phones, two-way radios, safety control systems, signalling, generators, welding equipment, power cables etc in all environments, especially construction sites, there is a huge potential for devices to interfere with each other.

However to ensure compliance and correct operation it is vital that all cables connected to **Geosense TP-2D-2001 Readouts** provide adequate 360 degree screening against EMC and that suitable EMC glands are used for any connection to junction boxes or data logger cabinet. However, as it is likely that **Geosense TP-2D-2001 Readout** will be used in conjunction with data loggers, it is essential that they too are designed and constructed to comply with the relevant CE marking directives (contact Geosense for details).

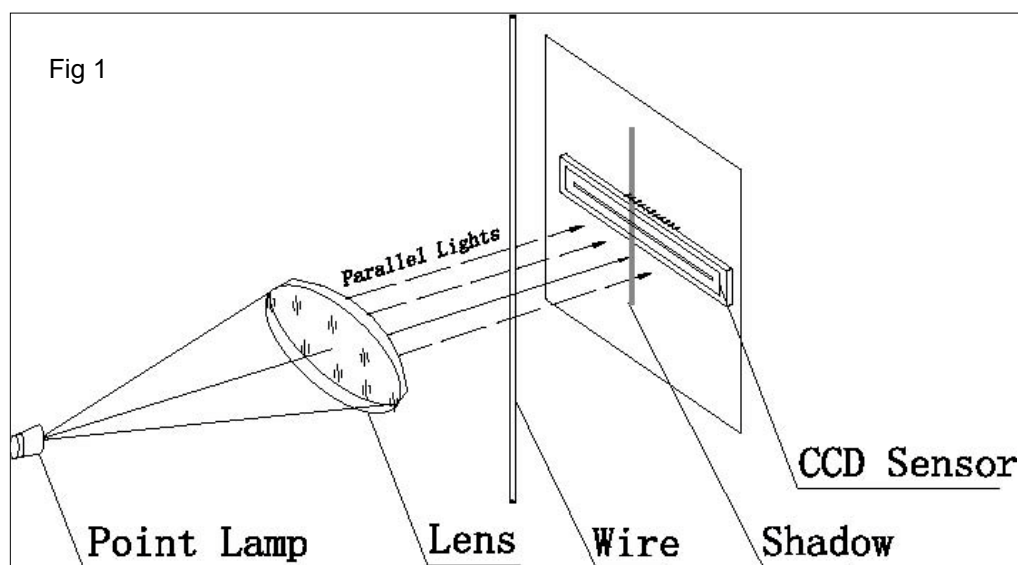


**FAILURE TO PROVIDE SUITABLY SCREENED CABLES &
ENCLOSURES TOGETHER WITH EMC GLANDS COULD RESULT IN
INCORRECT OPERATION OF THE EQUIPMENT**

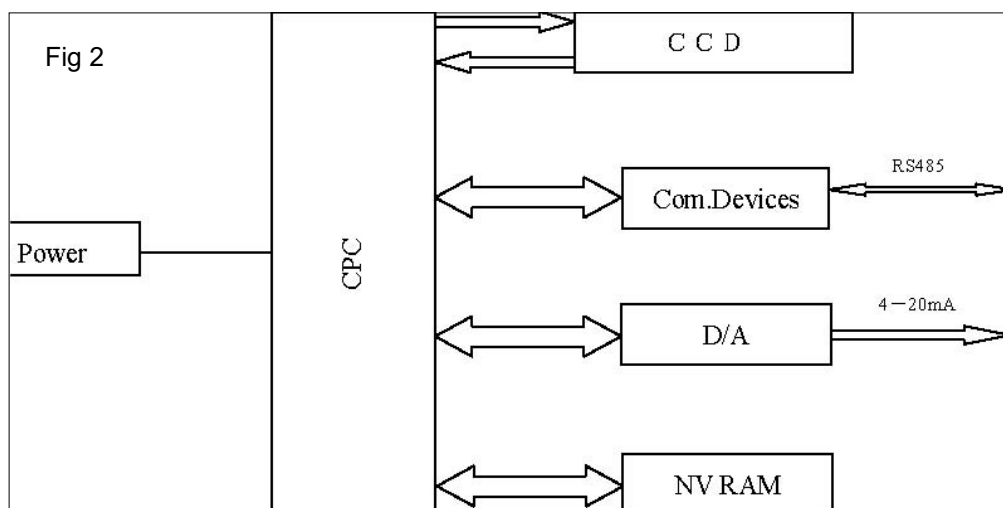


1.3 Theory of operation

The **TP-2D-2001 Readout** pendulum readout, (see Fig 1), uses two high-resolution linear array CCDs (charge coupled device) as the basic sensors. Two collimated light source at 90 degrees to each other shine on two photo-sensitive CCD screens. When the shadow of the pendulum wire falls on the CCD sensors an automatically generated scan of the CCD pixels maps, records and stores digitally on the built-in computer the coordinates of the shadow.



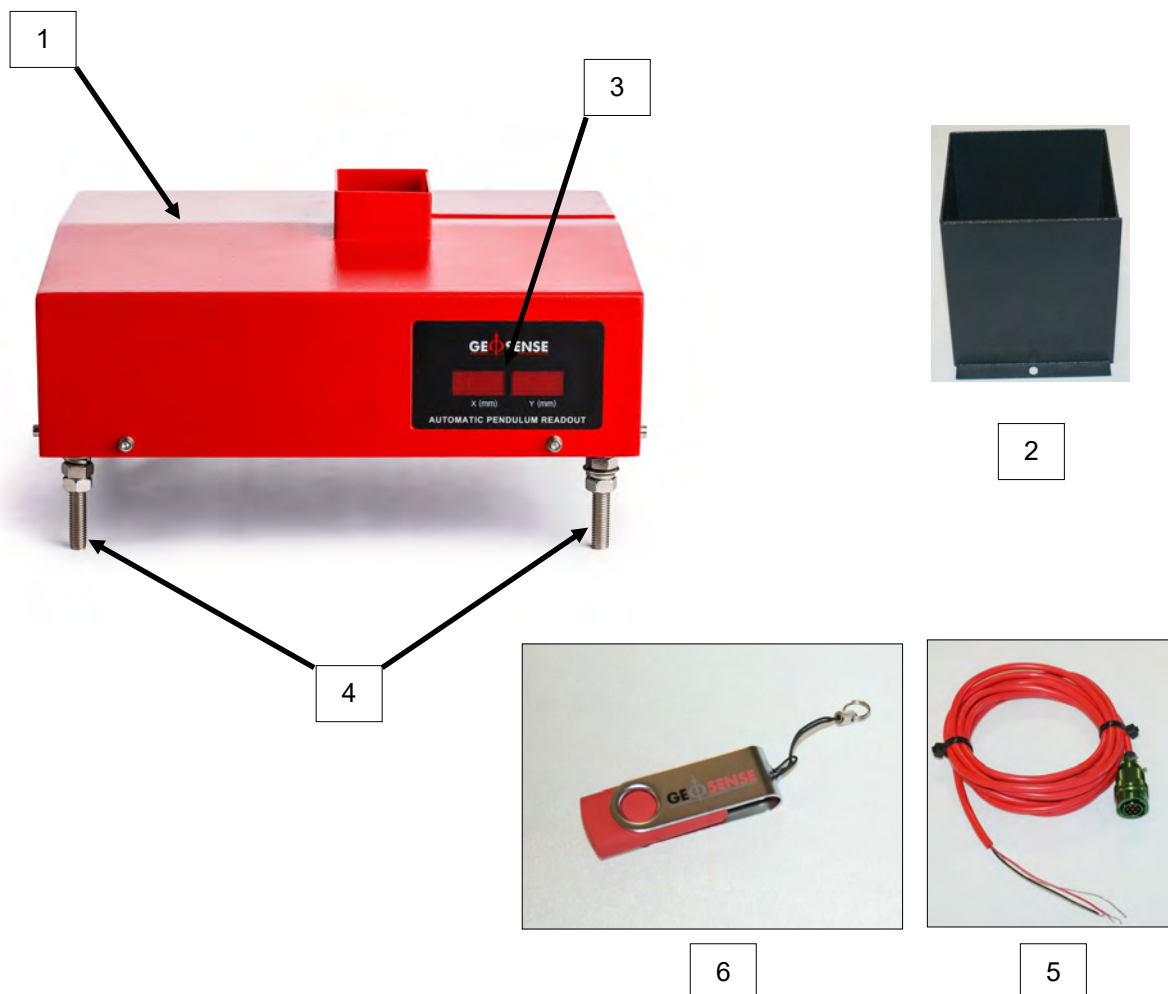
This information is then converted to an analogue signal that enables the position of the pendulum wire to be displayed locally in tenths of millimetre units on two LED panels mounted in the console. The signal can also be transmitted via 4-20mA output or RS485 output to a remote readout site. (See Figure 2).



1.4 Components - TP-2000 Readout

The components consist of the following main items:-

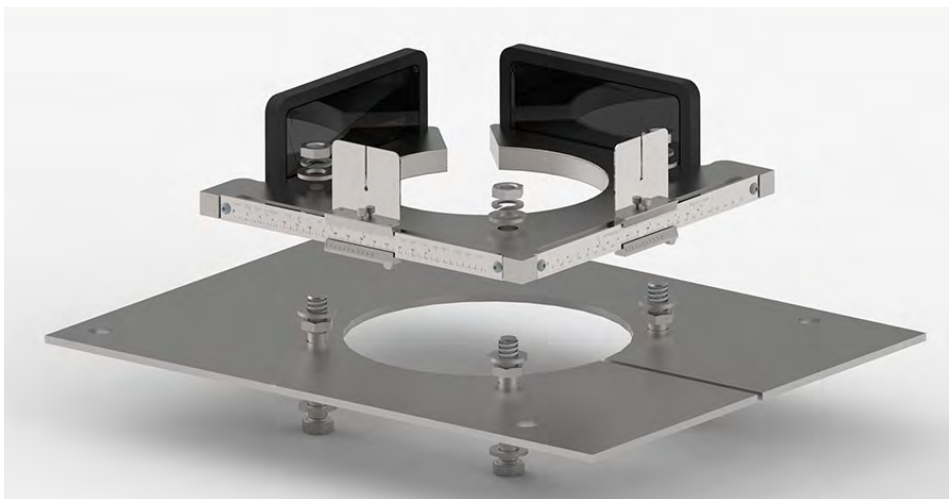
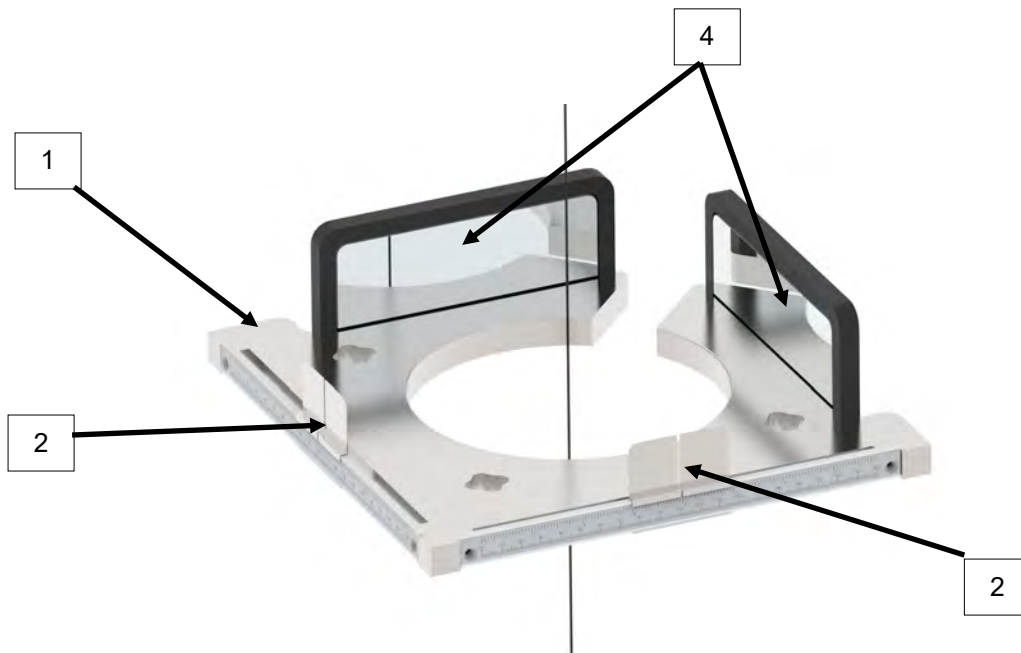
1. Main cabinet which houses the internal optical sensors c/w power lead
2. Light shield (1 x upper + 1 x lower)
3. LCD display
4. Adjustable feet for fixing to support bracket
5. Signal cable (fits to underside of cabinet)
6. Software (USB)



1.5 Components - MR-2500 Manual Readout

The components consist of the following main items:-

1. Main frame & mounting plate
2. Moveable sight reference slot
3. Vernier scale (X & Y axis)
4. Mirror (X & Y axis)



The MR-2500 is a manual optical readout which uses two mirrors set at right angles to each other, two optical sights and Vernier scales to determine the amount of movement of the pendulum wire in the X & Y directions.

See section 6.0 for taking readings.

1.6 Support brackets

The intended position of the readout support bracket should be located so that the pendulum wire is centrally positioned.

Common bracket fixing methods include:

- Drilled type: Through bolts (preferred option)
Expanding Bolts
Plugs and Screws
- Adhesives 'Hard' type epoxy resins are commonly used

The **Geosense® TP-2D-2001 Readout** can be supplied with two types of standard brackets both of which can be modified to suit the individual project requirements.

1.6.1 Standard bracket

The standard bracket is for the mounting of the **TP-2D-2001 Readout** and allows the readout to be positioned in several positions to optimise alignment of the pendulum wire.



1.6.2 Combination bracket

The combination bracket is for the mounting of the **TP-2D-2001** and the **TP Manual Readout** and allows the readouts to be positioned in several positions to optimise alignment of the pendulum wire.



1.6.3 Reservoir bracket

This bracket is used to support the reservoir tank of the IPS-3000 system and can be integrated with the readout Standard or Combination bracket



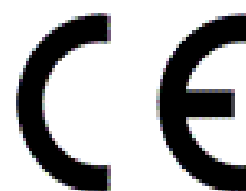
2.0 CONFORMITY

Geosense Ltd

Nova House
Rougham Industrial Estate
Rougham, Bury St Edmunds
Suffolk, IP30 9ND
United Kingdom

Tel: +44 (0)1359 270457, Fax: +44 (0)1359 272860
www.geosense.co.uk

EC Declaration of Conformity



We Geosense Ltd at above address declare that the equipment detailed below, complies with the requirements of the following EU Directives:-

- Electromagnetic Compatibility Directive 2004/108/EC
- General Product Safety Directive (GPSD)2001/95/EC
- Restriction on the use of certain Hazardous Substances RoHS2 2011/65/EU

Equipment description:	Pendulum Readout
Make/Brand:	Geosense
Model Number:	TP-2D-2001

Compliance has been assessed with reference to the following harmonised standards:
EN 61326-1:2013 Electrical equipment for measurement, control and laboratory use.
EMC requirements. General requirements.

EN 61010 (2010) Safety requirements for electrical equipment for measurement, control, and laboratory use. General requirements.

A technical file for this equipment is retained at the above address.



A handwritten signature in black ink, appearing to read "Martin Clegg".

Martin Clegg
Director

Rougham, January 2017

3.0 MARKINGS



READOUT UNIT	PRODUCT	AUTOMATIC PENDULUM	
	TYPE	TP-2D-2001	
	RANGE	50 x 50	Supply: 220V AC
	SERIAL NO	151286	Output 4-20mA
GEOSENSE CE   www.geosense.co.uk t +44(0)1359 270457			

A **Geosense® TP-2D-2001 Readout** is labelled with the following information:-

Manufacturers telephone number & website address

Product group: Readout

Product type: Automatic Pendulum Readout

Model: TP-2D-2001

Range: 50 x 50mm

Input supply: 85-240 Volts AC, 50 to 60 Hz, 10 Watt

Output signal: 4-20mA, RS-485

Serial number: XXXXXX

CE mark

WEEE mark

4.0 DELIVERY

This section should be read by ALL users of **Geosense® Pendulum Systems**

4.1 Packaging

Geosense® Pendulum Systems are packed for transportation to site. Packaging is suitably robust to allow normal handling by transportation companies. Inappropriate handling techniques may cause damage to the packaging and the enclosed equipment. The packaging should be carefully inspected upon delivery and any damage **MUST** be reported to both the transportation company and **Geosense®**.

4.2 Handling

Whilst they are a robust devices, the **Geosense® TP-2D-2001 Readouts** are precision measuring instruments. They and their associated equipment should always be handled with care during transportation, storage and installation.

Once the shipment has been inspected it is recommended that **Geosense® TP-2D-2001 Readout** remain in their original packaging for storage or transportation.

Cable should also be handled with care. Do not allow it to be damaged by sharp edges, rocks for example, and do not pull on the cable as this may damage the internal conductors and could render an installation useless.



DO NOT DROP AS THIS MAY CAUSE DAMAGE TO INTERNAL COMPONENTS

4.3 Inspection

It is important to check all the equipment in the shipment as soon as possible after taking delivery and well before installation is to be carried out. Check that all the components detailed on the documents are included in the shipment. Check that the equipment has not been physically damaged.

Geosense® TP-2D-2001 Readout carry a **unique** identification serial number and are supplied with individual calibration sheets that include their serial numbers, which will be shipped with the tilt meters.



Calibration Sheets contain VITAL information about the Readouts. They should be stored in a safe place and only copies should be taken to site.



4.4 Storage

Geosense® TP-2D-2001 Readouts are precision instruments containing sensitive electronics and whilst they are mounted within a water resistant (IP65) enclosure, the internal circuit board can be affected by excessive moisture.

The components of the HPS-3500 and IPS-3000 are robust and corrosion resistant and no specific storage requirements are necessary although they should be protected from any impact loading and wherever possible stored within their original packaging.

It is also recommended that cables be stored in a dry environment to prevent moisture migrating along inside them in the event of prolonged submersion of exposed ends.

It is important that the pendulum wire does not become bent.

Storage areas should be free from rodents as they commonly damage connecting cables.

5.0 INSTALLATION

This section of the manual is intended for all users of **Geosense® Pendulum Systems** and is intended to provide guidance with respect to their installation. Individual project situations may require adaptations of the standard support brackets.

5.1 Tools & Consumables

The following is a brief list of tools and equipment typically used during the installation:-

- Mounting Brackets and Template
- SDS Electric Drill
- Suitable Drill Bits
- Spirit Level
- Bolts & Fixings or Epoxy Resin
- Set of spanners
- Multi-meter
- Wire cutter / stripper
- Small flat screwdriver

5.2 HPS-3500 Hanging Pendulum

The hanging pendulum system comprises of a weight suspended from a mounting bracket and the weight suspended within a water filled reservoir which is typically covered by oil to prevent evaporation.

The location for the support bracket will be project dependent and may be floor or ceiling mounted.

A drip cover is mounted on the wire to prevent the reservoir filling up with water travelling down the wire.



5.2 HPS-3500 Hanging Pendulum contd...



**IT IS RECOMMENDED TO START FROM THE TOP
(THE SUPPORT BRACKET END)**

STEP 1

Position the support bracket so that the wire is located centrally through the hole.

Attach the wire to the central fitting on the support bracket (see 5.9) and attach to the necessary ceiling or floor using the though bolts supplied.



STEP 2

Feed the wire down to the location of the weight and reservoir.



STEP 3

With the reservoir located centrally and with the lid on place a spacer (approximately 100mm deep) into the bottom of the reservoir.

NOTE: The spacer will be removed once the wire is installed.



5.2 HPS-3500 Hanging Pendulum contd...

STEP 4

Measure the total length of the wire required to ensure the weight remains above the bottom of the reservoir.

STEP 5

Lift up the lid to allow the weight to be placed on top of the spacer block.



STEP 6

Connect the wire to the top of the weight (see 5.9).

STEP 7

Remove the spacer block from under the weight and remove from the reservoir if necessary.

STEP 8

Fill with water and/or oil.



5.2 HPS-3500 Hanging Pendulum contd...

STEP 9

Fit the drip cover support collar onto the wire just above the top of the lid.

Use the nylon socket set screws to secure it in position.



STEP 10

Place the drip cover over the support collar and clip together using the fixings supplied.



THE INSTALLATION IS NOW COMPLETE



5.3 IPS-3000 Inverted Pendulum

The inverted pendulum system comprises of a reservoir in which there is a float which provides an uplift force once filled with water.

A steel bar is grouted into a borehole which acts as an anchor to provide a resistance against the buoyancy of the float thus keeping the wire taught.



STEP 1

Attach the wire to the top of the anchor weight using the special fitting supplied. (See section 5.9)

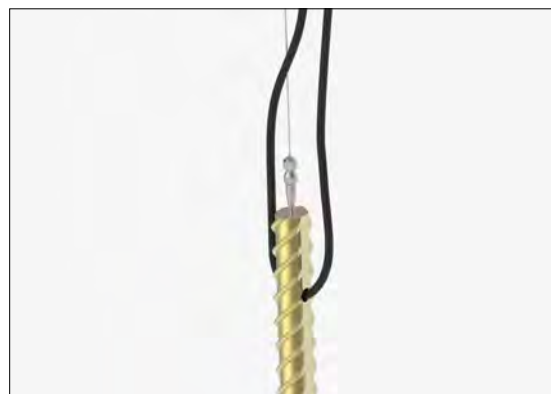


STEP 2

Attach a safety support rope through the cross hole in the top of the weight so that it can be removed once the anchor has been grouted in.

STEP 3

Lower the anchor to the bottom of the borehole. Secure the free end of the wire during this operation.



5.3 IPS-3000 Inverted Pendulum contd...

STEP 4

Place the reservoir (without the lid and float) onto the support bracket.

NOTE: Ensure that the reservoir is positioned so that the liquid sight tube and drain valve are accessible and not vulnerable to damage.

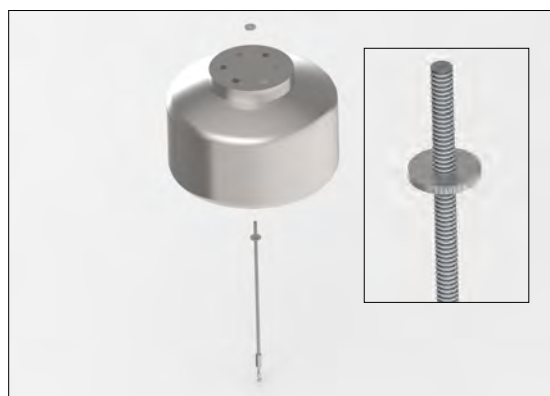


STEP 5

Feed the support rod/studding up through the centre hole in the float.

Fix in the centre hole in the top of the float with the two locking nuts.

NOTE: The wire from the anchor is then going to be connected to the fitting on the bottom of the support rod.



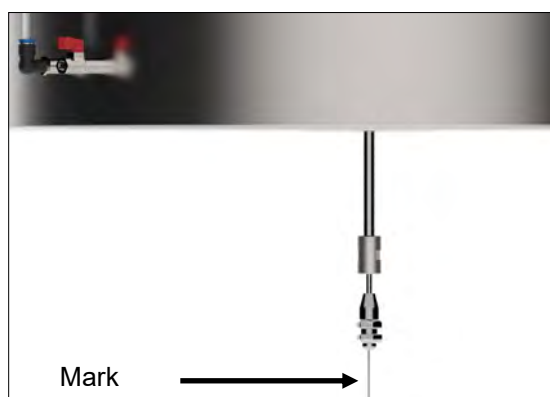
STEP 6

Place the float inside the reservoir.



STEP 7

Mark the wire (pen or tape) near the fitting so that the movement of the wire can be seen as the reservoir tank is filled with water.



5.3 IPS-3000 Inverted Pendulum contd...

STEP 7

Fill the tank with oil and/or water until the float is just fully submerged.

NOTE: It is important to ensure that the wire is located centrally within the borehole and that if the borehole is off vertical that any adjustments can be made.

STEP 8

Check the alignment of the wire within the borehole and if necessary adjust by shortening the wire until it is central.

NOTE: Any small adjustments to the length of the wire can be made using the threaded discs on top of the support bracket on the top of the float.

STEP 9

Grout the borehole as required.

THE INSTALLATION IS NOW COMPLETE



5.4 Installing through bolts

All support brackets use through bolts to attach them.

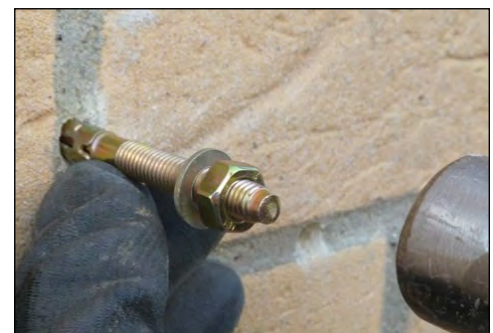
Where possible use a suitable template mark out the location of the fixings on the vertical support brackets



Using an appropriately sized bit, drill to a depth that will accommodate the selected fixings & remove any internal dust



Place the through bolts into the pre-drilled hole and use a hammer to drive it into the hole



5.5 Installing support brackets

The support bracket system uses a modular system which can be adapted to suit individual project requirements. Below is how the standards brackets are used and assembled.

5.5.1 Vertical support brackets - wall mounted

NOTE

For readouts you will need 325mm centres

For inverted pendulum reservoir you will need

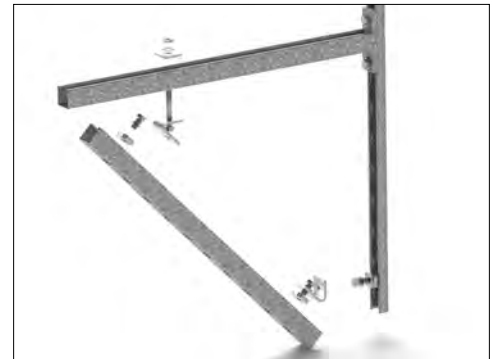


5.5.2 Horizontal cantilever brackets - wall mounted

For manual readouts



5.5 Installing support brackets contd...



5.5.3 45 degree support brackets - wall mounted

For automatic readout and inverted pendulum reservoir



5.5.4 Support bracket - floor mounted

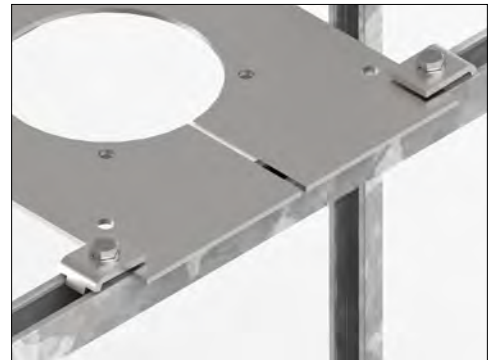
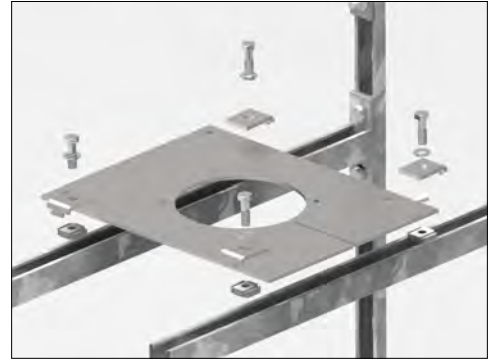
For automatic, manual readout and inverted pendulum reservoir



5.6 Installing readout mounting plates

Mounting plates are required for the readouts which are attached to the support brackets

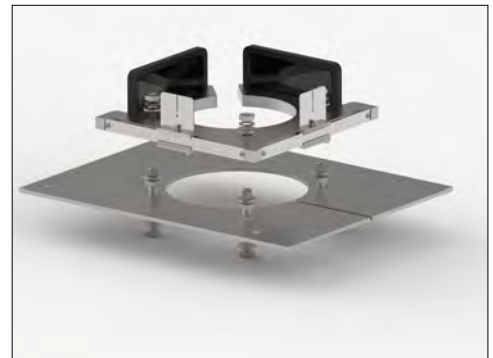
5.6.1 Manual Readout mounting plate



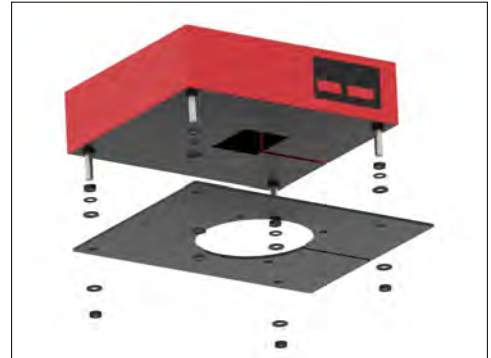
5.7 Installing readouts

Readouts are fixed to the mounting plates.

5.7.1 Manual Readout



5.7 Installing readouts contd...



5.7.2 Automatic Readout



5.8 Typical installations

Inverted pendulum with automatic and manual readouts



Automatic and manual readouts



Manual readout



Automatic readout

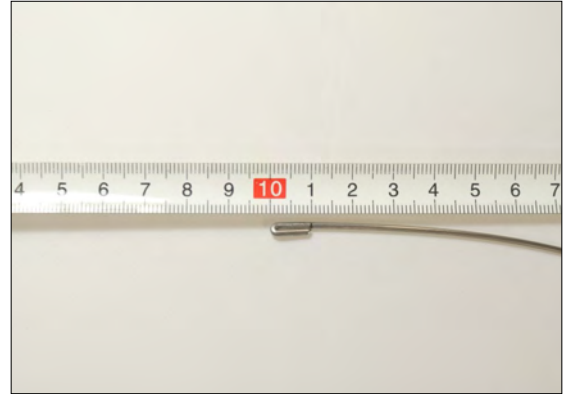


5.9 Wire fitting assembly

The wire is attached using a special swageless fitting as follows:-

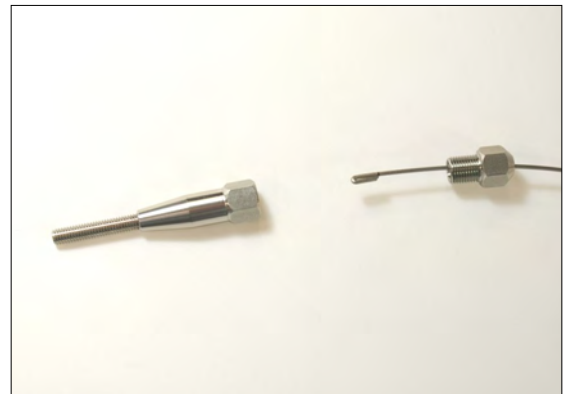
STEP 1

Measure 10mm from the end of the wire and bend back so that it runs parallel with the wire.



STEP 2

Unscrew the nut and feed the wire through.



STEP 3

There is a split wedge which holds the wire inside the fitting.

Place the split wedge onto the wire.

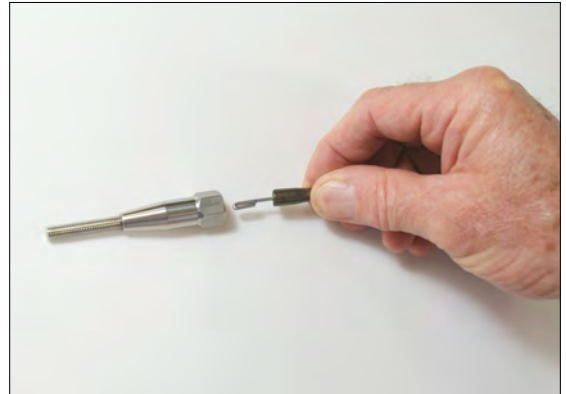


5.9 Wire fitting assembly contd...

The wire is attached using a special swageless fitting as follows:-

STEP 4

Push the wire and wedges into the housing.



STEP 5

Tighten the nut by hand.



STEP 6

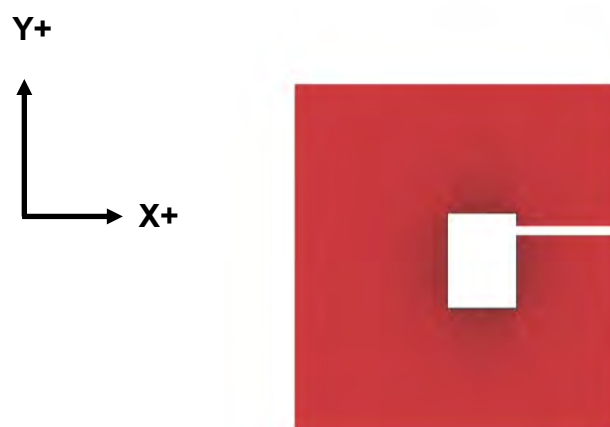
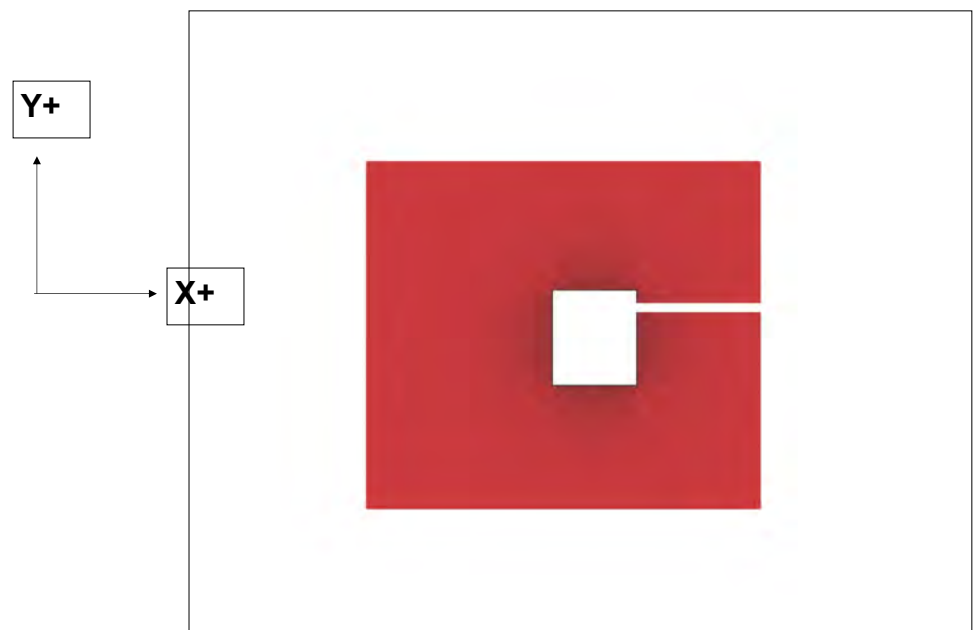
Tighten fully using two 13mm open ended spanners.



5.10 TP-2000 Readout Orientation

Figure 1 below is a top view of the readout cabinet showing the orientation of the X and Y axes.

The arrows indicate the direction of positive changes in the displacements. For dams the usual convention is to orientate the cabinet so that the positive direction of the X axis points downstream with the positive direction of Y pointing towards the left bank.



5.11 MR-2500 Readout

The same convention as for the TP-2000

5.12 Outputs & Wiring

The **Geosense® TP-2D-2001 Readout** is available with two different outputs:-

- **Digital RS-485**

Each readout has a unique network address and up to 32 readouts can be connected together through the RS 485 interface.

When using the RS 485 network the maximum distance to the farthest pendulum should not exceed 1200meters. A 120 ohm resistance must be connected through a parallel connection to the RS 485 connector at the most remote pendulum to decrease signal reflectance.

If the transmission distance exceeds 1200meters a fibre optic cable can be used. With fibre optic cables there is no limit on the transmission distance.

- **Analogue 4-20mA**

The 4-20mA output can be measured using a high precision (0.1%) digital ammeter such as the 20mAlevel of a 4.5 bit digital multimeter or any standard datalogger. If ammeters are used then two are required - one for each axis X and Y.

Wiring

Mains power cable

Core colour	Identification	Function
Red	L	Live
Blue	N	Neutral
Yellow	GND	Earth

Communications cable

10 pin connector RS485 & 4-20mA	Function	Colour
A	4-20mA X axis	Red
B	X axis ground	White
C	4-20mA output Y axis	Black
D	Y axis ground	Green
E	Not used	Not used
F	RS485 T/R-	Red
G	RS485 T/R+	Black
H,J,K	No connection	

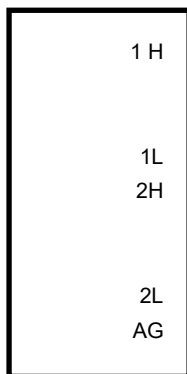
5.13 Connection to data logger

Geosense TP-2D-2001 Readouts can be connected to a Campbell Scientific data logger such as CR800 or CR1000 using the MultiLogger software.

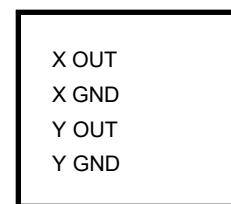
The connections to the data logger should be as follows:-.

4-20mA connection

CR800/1000

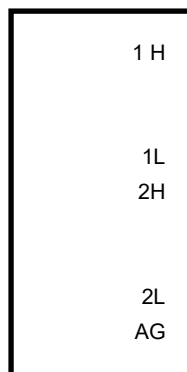


TP-2D-2001

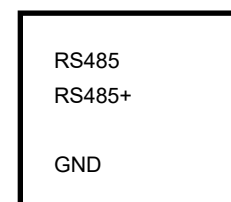


RS-485 connection

CR800/1000



TP-2D-2001



6.0 CONFIGURATION

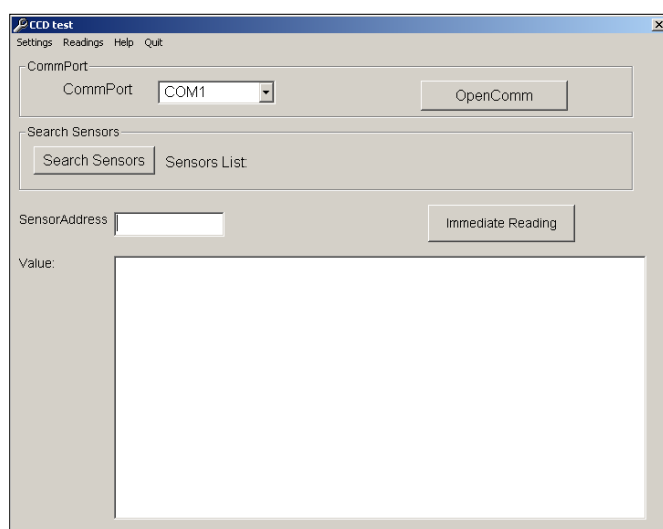
The **TP-2D-2001** readout comes equipped with **CCDTest** software which is used for setting the readout parameters and checking the operation of the unit.

Use the supplied installer to install the software.

On starting the software the following window will open

6.1 Selecting the COMM port

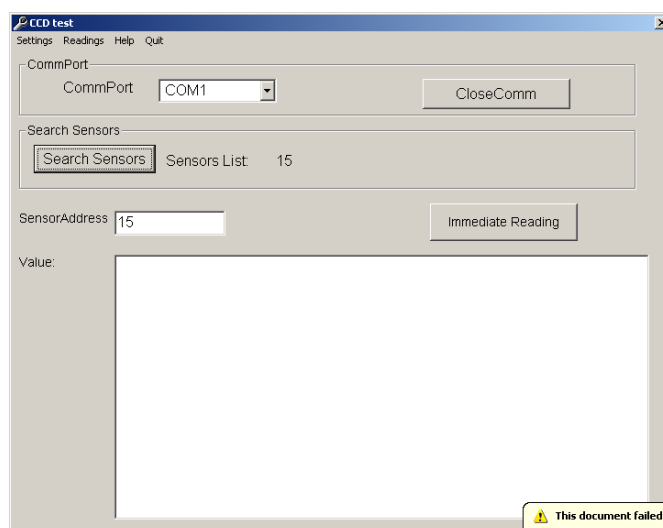
Configure the **CommPort** which has the RS-485 adaptor attached, then click **OpenComm**



Sensors found will be shown in the **Sensors List**.

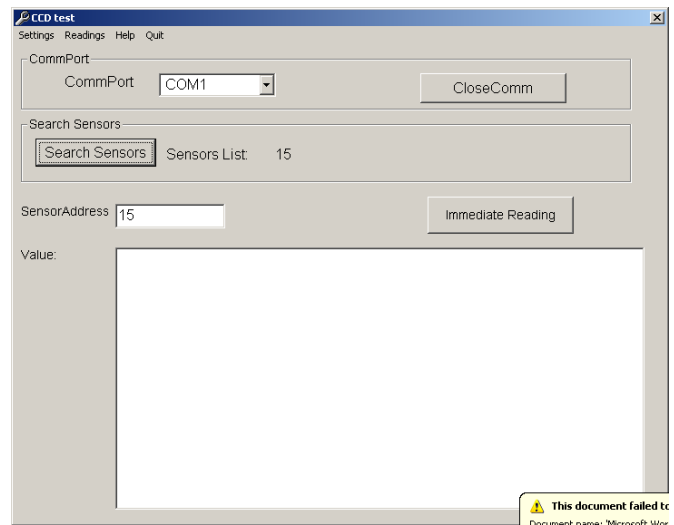
Enter the Sensor Address you wish to communicate with in the **SensorAddress** box.

The example shows address 15 was found and entered in the **SensorAddress** box.



6.2 Immediate Readings

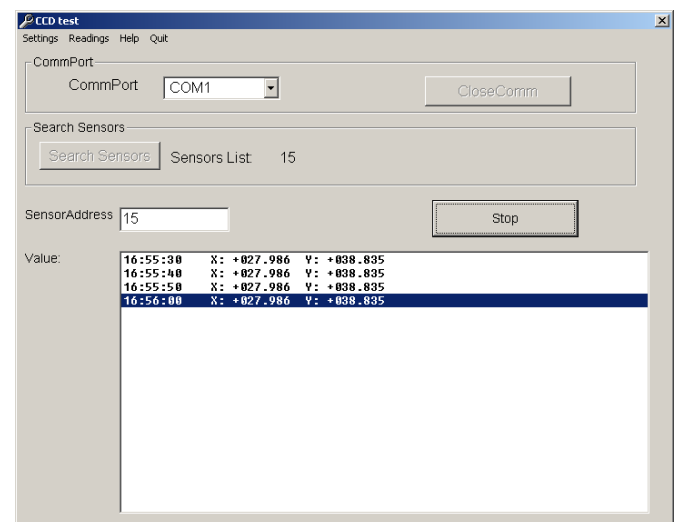
Click **Immediate Reading** to take measurements every 10 seconds from the readout.



The measurements will display in the Value edit with time stamp and X and Y values.

NOTE: If any errors are shown troubleshoot if necessary.

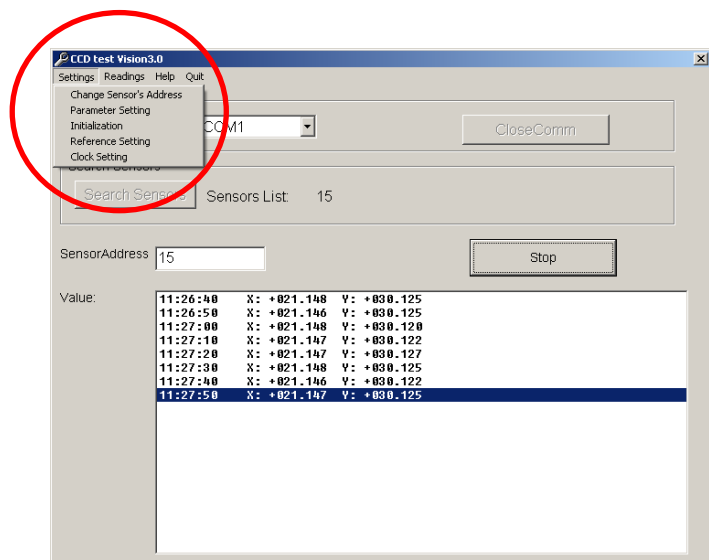
See section ? for an explanation of the error codes.



6.3 Settings

The **CCDTest** software provides several settings related to the configuration of the pendulum, in particular the setting of the Address, the wire configuration, the setting of the Reference values, the setting of the Clock and the orientation of the outputs.

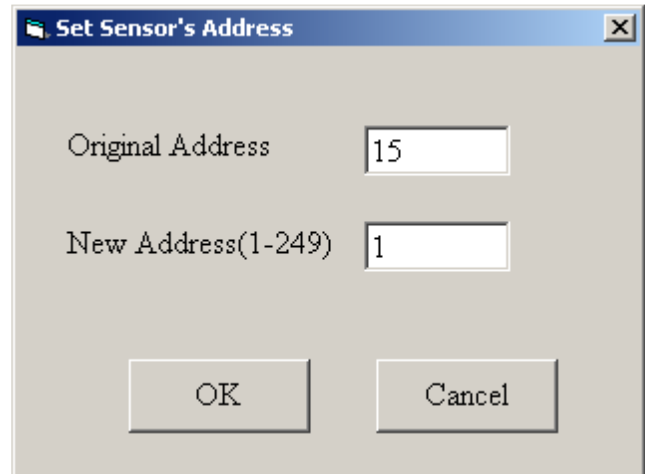
These options are available from the **Settings** menu in the upper left corner of the form.



6.4 Sensor address

Use the **Change Sensor's Address** option from the menu.

The **Set Sensor's** Address box will be displayed

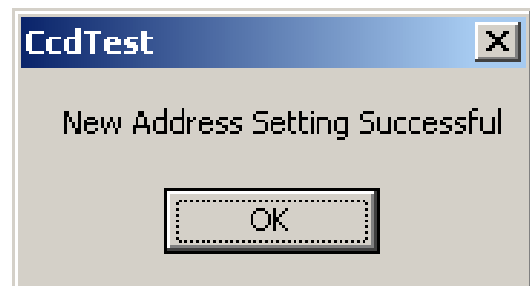
A Windows-style dialog box titled "Set Sensor's Address". It contains two text input fields: "Original Address" with the value "15" and "New Address(1-249)" with the value "1". At the bottom, there are two buttons labeled "OK" and "Cancel".

Original Address	15
New Address(1-249)	1
<div>OK Cancel</div>	

Enter the **Original Address** number in the edit box and click **OK**

The software will attempt to set the address and a status message is displayed.

If it fails the try again.

A small Windows-style dialog box titled "CcdTest". It displays the text "New Address Setting Successful" and has a single "OK" button at the bottom.

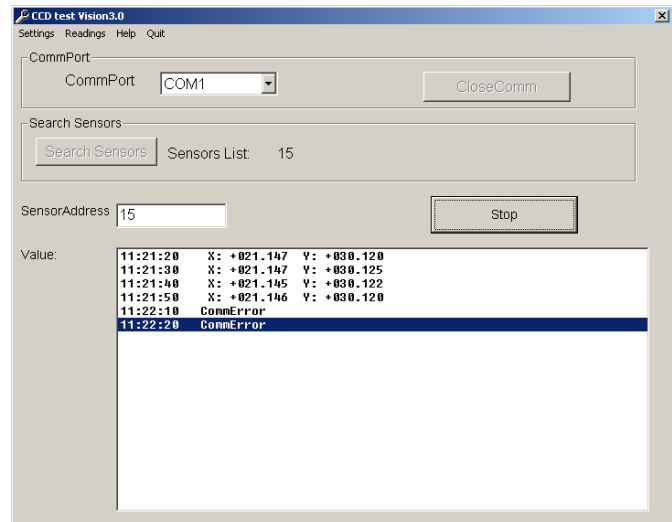
CcdTest
New Address Setting Successful
<div>OK</div>

6.4 Sensor address contd...

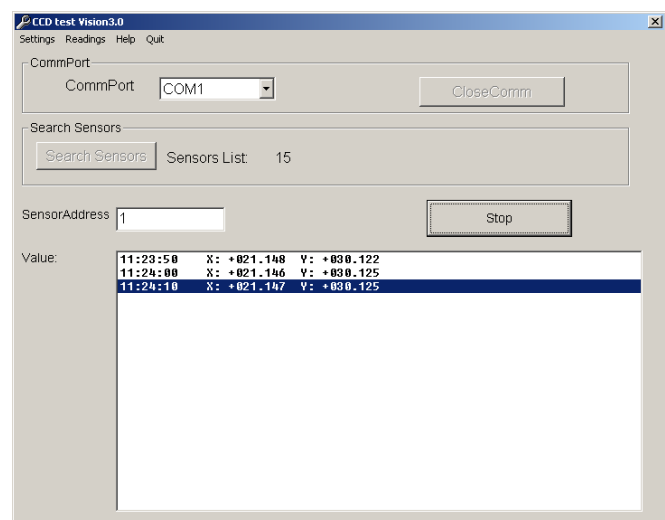
Once successful, click **OK** and then **Cancel** at the Set Sensor's Address form to return to the main form.

NOTE: Once the address is changed you will need to update the **SensorAddress** edit with the new address.

A **CommError** will display until you update the address.



Once the **Sensor Address** is updated the readings should display properly again.



The Value display will clear after stopping and re-starting the Immediate Reading function.

6.5 Parameter Setting

Use the **Parameter Setting** menu item to configure the wire diameter and error band.

Configure the **Pendulum Readout Addr**

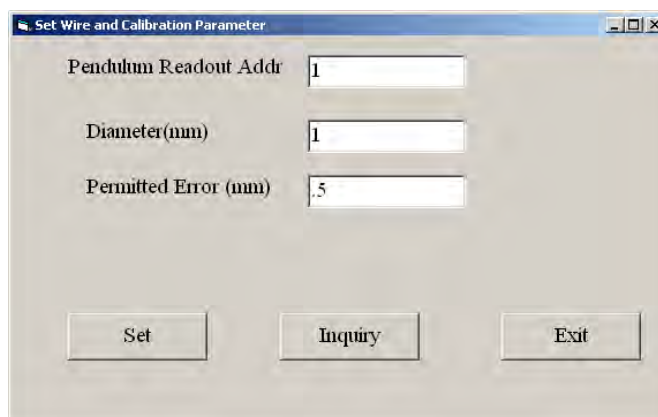
Then enter the wire **Diameter** and **Permitted Error** in millimetre.

NOTE: The Permitted Error is usually entered as 0.5mm.

Click **Set** to adjust the internal pendulum settings.

You can also use the **Inquiry** button to check the current pendulum settings.

Click **Exit** when finished to return to the main form.



The dialog box titled "Set Wire and Calibration Parameter" contains three input fields: "Pendulum Readout Addr" with value 1, "Diameter(mm)" with value 1, and "Permitted Error (mm)" with value .5. At the bottom are three buttons: "Set", "Inquiry", and "Exit".

6.6 Reference Feature

The **Reference Feature** allows adjusting the output of the unit for a given value.

This is often used to maintain continuous data when replacing units in service or moving the units for regular cleaning or other maintenance.

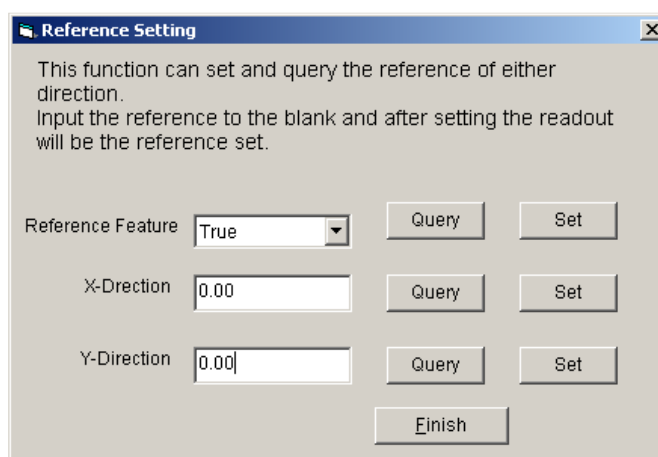
Without the **Reference Feature** the values must be adjusted during post-processing to account for differences in measurements after moving or replacing a unit.

Use the **Reference Setting** menu item to display the Reference Setting form.

Shown the pendulum is configured to show change in movement after installation.

Enter 0.00 for the **X-Direction** and press **Set** to set this value as the X-axis Reference. The software will provide a message indicating successful Reference setting, along with the internal offset (the current absolute measurement) to adjust the output to achieve the desired Reference output.

NOTE: You must have the pendulum address entered in the **SensorAddress** edit on the main form for these options to work



The dialog box titled "Reference Setting" contains a text area with instructions: "This function can set and query the reference of either direction. Input the reference to the blank and after setting the readout will be the reference set." Below this are three rows of controls: "Reference Feature" with a dropdown set to "True", "X-Direction" with a text box containing "0.00", and "Y-Direction" with a text box containing "0.00". Each row has "Query" and "Set" buttons. At the bottom is an "Finish" button.

6.6 Reference Feature contd...

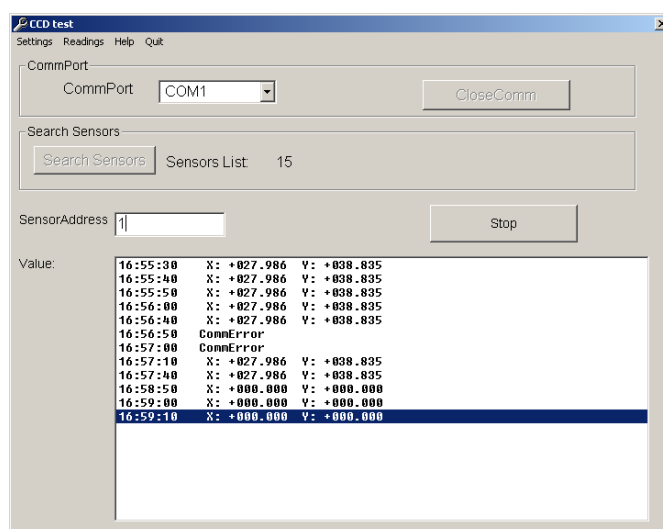
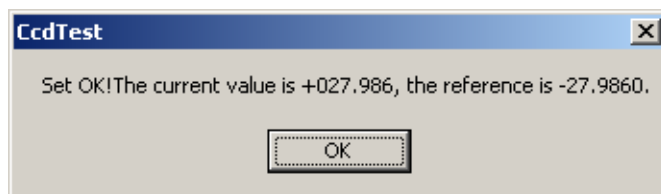
Enter 0.00 for the **Y-Direction** and press **Set**.

AFTER pressing **Set** for both X and Y-Direction then configure True (default) as the Reference Feature and press **Set**. This will configure the unit to use the new X and Y-direction values as the starting values for the display and the 4-20mA output.

Click **OK** when Reference Setting changes are complete.

Once the Reference values are set you should see the display on the pendulum update to the new Reference values.

Close the form by clicking in the upper right corner.



NOTE: When returning to the main form the X and Y values should update to match the display.

Below is an example of how the **Reference** feature helps maintain continuous data.

1. The values from the currently installed pendulum are 27.986 and 38.835 millimetres for X and Y respectively. The References feature is NOT being used so these are absolute values.
2. The unit is removed, cleaned and re-installed. The new readings are 25.456 and 31.894 for X and Y respectively.
3. Use the Reference Setting menu item to display the Reference Setting form. Enter 27.986 and 38.835 as the X and Y-direction References respectively. Set Reference Feature to True. The display will update to show the measurements last recorded prior to

6.7 Clock Setting

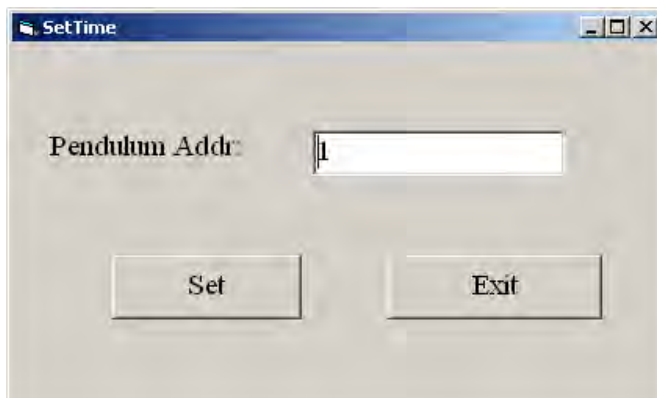
Use the menu item **Clock Setting** to display the **Set Time** form.

Configure the pendulum address and press **Set** to match the internal pendulum clock to the PC clock.

This is useful when the pendulum is logging readings in its internal memory.

Click **Exit** to return to the main form.

Before using Quit to exit the CCDTest software be sure to Stop any automated readings and then use **CloseComm** to close the Comm port.

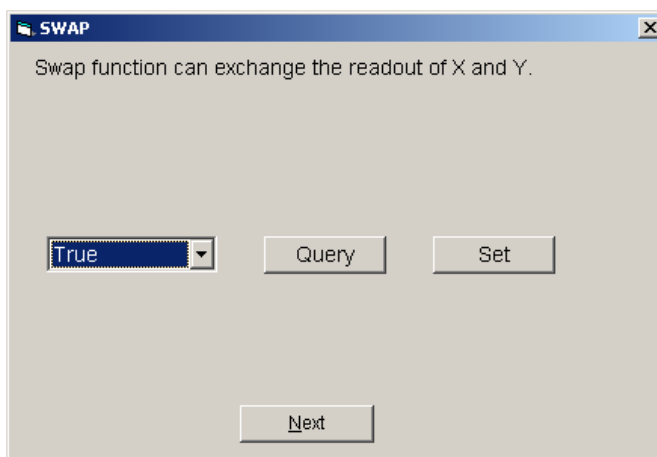


6.8 Set wire and Calibration

Use the menu item Initialization to swap the X and Y axis, this includes reversing the digital display and the 4-20mA outputs of the unit. This menu also provides for reversing the direction of each axis, for example if the X-axis is currently reading 35.78mm it will read 14.22mm if swapped.

These features are useful where the installed orientation of the unit must match the direction of anticipated movement.

When selecting the menu item the Swap form will display. The default is False, however it may be changed to True by selecting from the drop-down menu and pressing Set. Press Query to view the current setting of the pendulum.



6.8 Set wire and Calibration contd...

Click **Next** to continue to the Invert form.
For each axis you may configure reversing the direction of movement.

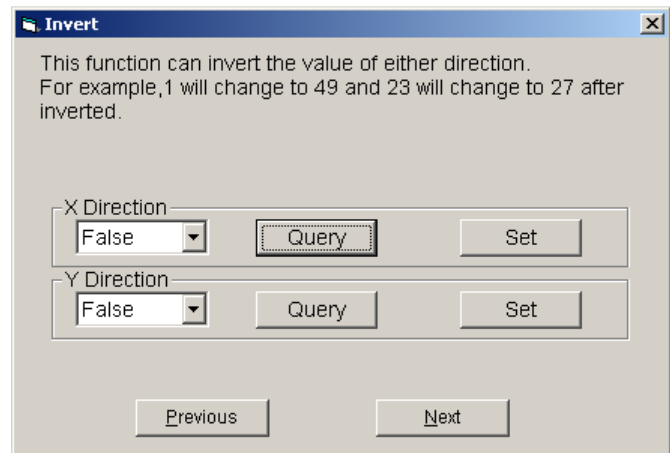
The default is False, use the drop-down for each axis to select True if needed.

Press **Set** to update the pendulum with the setting.

Press **Query** to view the current settings.

When finished press **Next**, this will advance to Reference Setting form, see the previous section for detail on configuring these options.

Press **Previous** to return to the Swap



The Invert dialog box contains the following fields and buttons:

- X Direction:** A dropdown menu set to 'False', a 'Query' button, and a 'Set' button.
- Y Direction:** A dropdown menu set to 'False', a 'Query' button, and a 'Set' button.
- Buttons:** 'Previous' and 'Next' buttons at the bottom.

Text inside the dialog: "This function can invert the value of either direction. For example, 1 will change to 49 and 23 will change to 27 after inverted."

NOTE: The Invert options will configure the axis as it is currently displayed. If Swap is True then setting X Direction to True will invert the direction of what was originally the Y axis.

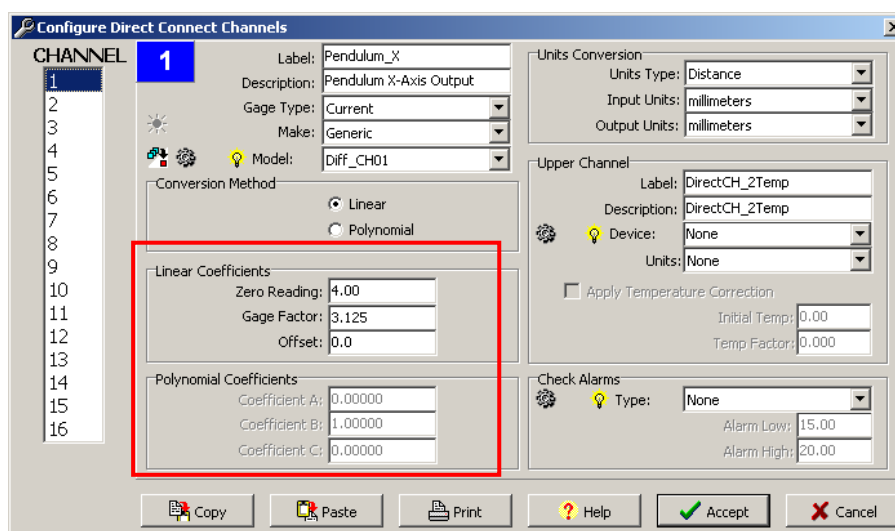
6.9 Output configuration

4-20mA

Direct connections are used for configuring the measurements.

Each channel corresponds to an X or Y-axis measurement which is then converted from mA to millimetres or other units using the calibration coefficients (linear or polynomial)..

X axis



The Configure Direct Connect Channels dialog box shows the configuration for Channel 1. The 'Linear Coefficients' section is highlighted with a red box.

Channel 1 Configuration:

- Label:** Pendulum_X
- Description:** Pendulum X-Axis Output
- Gage Type:** Current
- Make:** Generic
- Model:** Diff_CH01
- Conversion Method:** Linear (selected), Polynomial
- Linear Coefficients:**
 - Zero Reading: 4.00
 - Gage Factor: 3.125
 - Offset: 0.0
- Polynomial Coefficients:**
 - Coefficient A: 0.00000
 - Coefficient B: 1.00000
 - Coefficient C: 0.00000

Units Conversion:

- Units Type: Distance
- Input Units: millimeters
- Output Units: millimeters

Upper Channel:

- Label: DirectCH_2Temp
- Description: DirectCH_2Temp
- Device: None
- Units: None
- ☐ Apply Temperature Correction
- Initial Temp: 0.00
- Temp Factor: 0.000

Check Alarms:

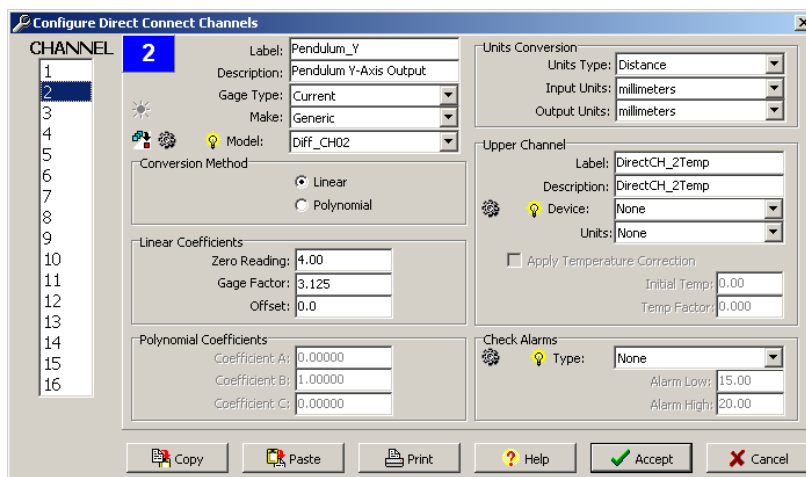
- Type: None
- Alarm Low: 15.00
- Alarm High: 20.00

Buttons: Copy, Paste, Print, Help, Accept, Cancel

6.9 Output configuration contd...

4-20mA contd...

Y axis



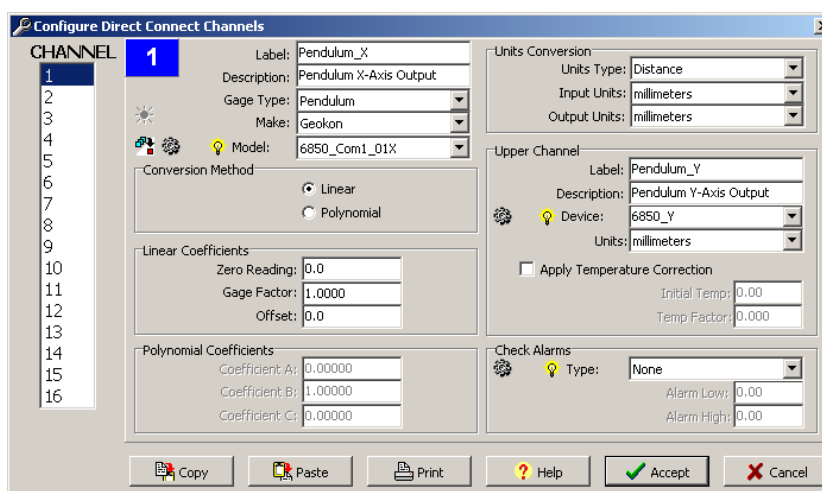
RS-485

NOTE: RS-485 is only compatible with Campbell Scientific CR800 & 1000 data loggers

Two options are available:-

1.) Resultant values converted to other units e.g. mm

Shown below is channel configuration to read the X and Y-axis outputs connected to Com1 on the control module (Control Ports C1 & C2 used for communications) at address 01.

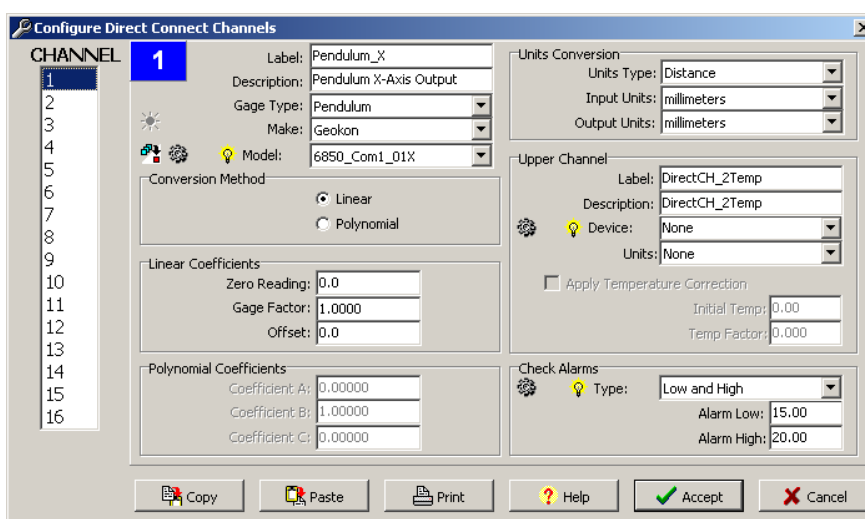


6.9 Output Configuration contd...

2.) Alarms on each measurement.

If your application requires conversions and/or Check Alarms settings then you will need to configure the Y-axis as a separate Channel.

For example, Channel 1 would be configured as shown below

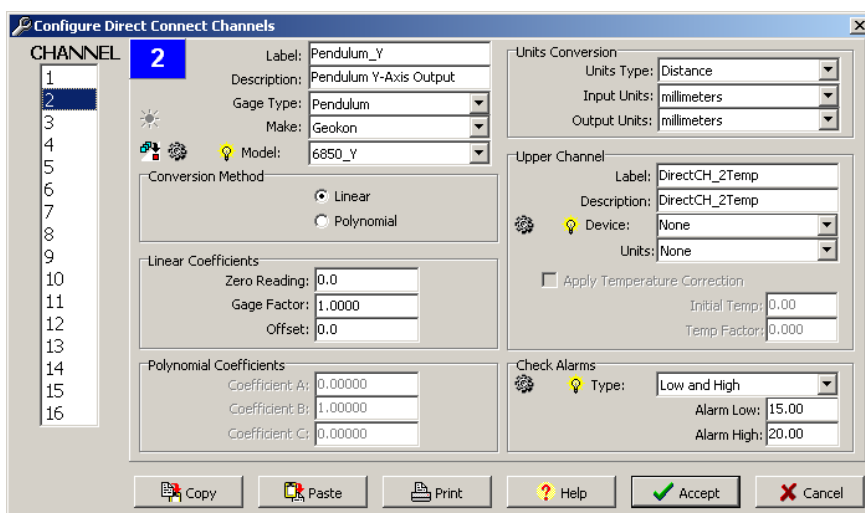


The screenshot shows the 'Configure Direct Connect Channels' dialog box with Channel 1 selected. The configuration is as follows:

- Channel 1:**
 - Label: Pendulum_X
 - Description: Pendulum X-Axis Output
 - Gage Type: Pendulum
 - Make: Geokon
 - Model: 6850_Com1_01X
 - Conversion Method: ☒ Linear, ☐ Polynomial
 - Linear Coefficients:
 - Zero Reading: 0.0
 - Gage Factor: 1.0000
 - Offset: 0.0
 - Polynomial Coefficients:
 - Coefficient A: 0.00000
 - Coefficient B: 1.00000
 - Coefficient C: 0.00000
- Units Conversion:**
 - Units Type: Distance
 - Input Units: millimeters
 - Output Units: millimeters
- Upper Channel:**
 - Label: DirectCH_2Temp
 - Description: DirectCH_2Temp
 - Device: None
 - Units: None
- Check Alarms:**
 - Type: Low and High
 - Alarm Low: 15.00
 - Alarm High: 20.00

Buttons at the bottom: Copy, Paste, Print, Help, Accept, Cancel.

Channel 2 to support the Y-axis measurement would be configured as shown below



The screenshot shows the 'Configure Direct Connect Channels' dialog box with Channel 2 selected. The configuration is as follows:

- Channel 2:**
 - Label: Pendulum_Y
 - Description: Pendulum Y-Axis Output
 - Gage Type: Pendulum
 - Make: Geokon
 - Model: 6850_Y
 - Conversion Method: ☒ Linear, ☐ Polynomial
 - Linear Coefficients:
 - Zero Reading: 0.0
 - Gage Factor: 1.0000
 - Offset: 0.0
 - Polynomial Coefficients:
 - Coefficient A: 0.00000
 - Coefficient B: 1.00000
 - Coefficient C: 0.00000
- Units Conversion:**
 - Units Type: Distance
 - Input Units: millimeters
 - Output Units: millimeters
- Upper Channel:**
 - Label: DirectCH_2Temp
 - Description: DirectCH_2Temp
 - Device: None
 - Units: None
- Check Alarms:**
 - Type: Low and High
 - Alarm Low: 15.00
 - Alarm High: 20.00

Buttons at the bottom: Copy, Paste, Print, Help, Accept, Cancel.

NOTE: This configuration technique limits the number of readouts that can be configured to 8.

6.10 CR800/CR1000 Programming Example

```

'Read the X and Y output of a TP-2000 connected
to COM1 (C1 & C2) at Address 01
'Open our port
SerialOpen (Com1,9600,0,1000,255)
'Clear our counter
ScratchLoc(1) = 0
'Loop 5 times to get measurement
Do
'Make sure buffer is clear
SerialFlush(Com1)
'Send Reading command
SerialOut (Com1,":012101FF"+CHR(13)+CHR(10)," ",0,0)
'Receive response with .25 second timeout
SerialIn(sInBuf,Com1,25," ",30)
'Check for enough characters
if Len(sInBuf) >= 23 then
'Split out response values
Splitstr(ScratchLoc(2),sInBuf," ",3,0)
'Check for error codes
if ScratchLoc(3) = 2000000 or ScratchLoc(4) = 2000000 then
ScratchLoc(3) = -99992
ScratchLoc(4) = -99992
endif
'Check for error code
if ScratchLoc(3) = 3000000 or ScratchLoc(4) = 3000000 then
ScratchLoc(3) = -99993
ScratchLoc(4) = -99993
endif
'Check for error code
if ScratchLoc(3) = 4000000 or ScratchLoc(4) = 4000000 then
ScratchLoc(3) = -99994
ScratchLoc(4) = -99994
endif
'Check for error code
if ScratchLoc(3) = 5000000 or ScratchLoc(4) = 5000000 then
ScratchLoc(3) = -99995
ScratchLoc(4) = -99995
endif
'Check for error code
if ScratchLoc(3) = 6000000 or ScratchLoc(4) = 6000000 then
ScratchLoc(3) = -99996
ScratchLoc(4) = -99996
endif
'No valid response
Else
ScratchLoc(3) = -99999
ScratchLoc(4) = -99999
EndIf
'Short delay before trying again or exiting
Delay(0,250,mSec)
'Increment our counter
ScratchLoc(1) = ScratchLoc(1) + 1
Loop Until (ScratchLoc(1) >= 5) OR (ScratchLoc(3) > -99990)
'Copy our reading whatever it is (ScratchLoc(4) holds Y-Axis value)
m1Reading = ScratchLoc(3)
'Close our serial port
SerialClose (Com1)

```

6.11 Commands

Terminal emulation programs may be programmed with the readout commands to help with troubleshooting and configuration of the units.

Below are typical commands and responses.

Communication parameters are 9600 bps, 8 data bits, 1 stop bit, no parity bit. The baud rate of the pendulum is fixed at 9600 bps.

All commands are prefaced with a colon, “:”, followed by the address of the unit in hexadecimal notation, the command and any parameters and then terminated with “FF” <CR> <LF>. Responses include a two-byte signature (“gg”).

Command	Command	Response
Set Address, where; aa = current address (01-FF) bb = new address (01-FF)	:aa02bbFF	:aa02bbFB
Get X & Y Axis readings, where; aa = address s = sign (+/-) xxx.xxx = x-axis yyy.yyy = y-axis gg = signature	:aa2101FF	:aa2101sxxx.xxxsyyy.yyy gg
Set X-axis Parameters, where; aa = address ww = wire diameter in mm (2 digits no decimal, e.g. 1.0 mm = 10) ee = error in mm (2 digits no decimal, e.g. 0.5 mm = 05)	:aa67wwee010000FF	:aa67wwee010000gg
Set Y-axis Parameters (see above)	:aa69wwee010000FF	:aa69wwee010000gg
Query Reference Setting, where; aa = address	:aa76FF	:aa76rrgg
Set Reference False	:aa7500FF	:aa7500gg
Set Reference True	:aa7501FF	:aa7501gg
Set X-Axis Reference, where; aa = address s = sign (+/-) xxx.xxx = x-axis reference value (entered as an offset)	:aa71Sxxx.xxxFF	:aa71Sxxx.xxxgg
Set Y-Axis Reference, where; aa = address s = sign (+/-) yyy.yyy = y-axis reference value (entered as an offset)	:aa73Syyy.yyyFF	:aa73Syyy.yyygg
Read/Set clock, where; aa = address yy = year mm = month dd = day hh = hour mm = minute ss = second	:aa04FF :aa03yymmddhhmmssFF	:aa04yymmddhhmmssgg :aa03yymmddhhmmssgg

7.0 TAKING READINGS

7.1 TP-2000 Automatic Readout



Direct readings are displayed on the LED screen.

Automatic readings are taken using the datalogger.

6.1.2 MR-2500 Manual Readout

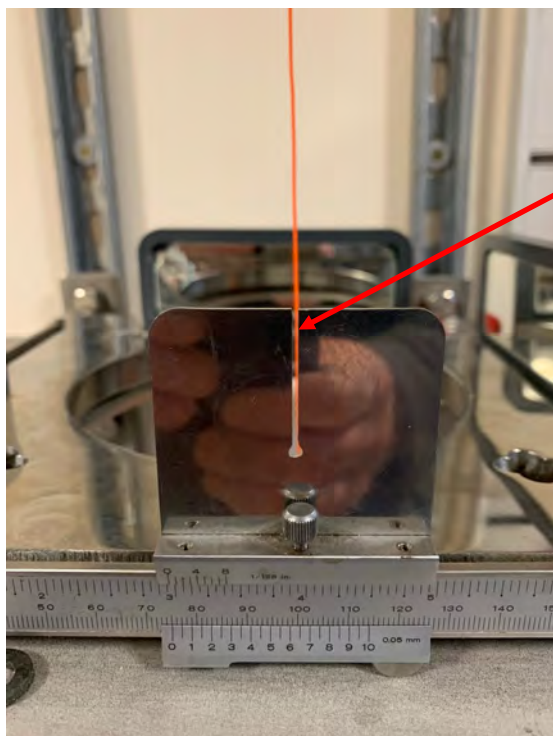


The range of the MR-2500 is 150mm +75/-75mm.

The reading is made using the two Vernier scales.

One is fixed which is the 150mm (6inch) scale and the other is the sliding one which measures in increments of 0.05mm/1/128inch

The scale here shows it lined up to mid-range i.e. 75mm



To take a reading loosen the locking screw on top of the sliding carriage.

Line the wire up in the centre of the sight by sliding the Vernier carriage wire is in the centre of the sight. Tighten the locking screw.



Record the reading on the fixed scale against the ZERO on the sliding scale.

Repeat for both the X and Y axes.

If there has been any movement the wire will no longer be in the centre of the sight.

Repeat the steps above and record the new reading.



For consistency view the sight from the same distance each time

8.0 DATA HANDLING

After installation Initial values of X and Y are obtained.

These are X0 and Y0

Movements of the pendulum wire ΔX and ΔY are then derived from the equations

$$\Delta X = X1 - X0$$

And

$$\Delta Y = Y1 - Y0$$

Where X1 and Y1 are subsequent readings on the X and Y axes.

When using the 4-20mA output the instrument gage factor is 3.125mm/mA



YOU SHOULD ENSURE THAT YOU ALWAYS HAVE A BASE READING AS EVERYTHING IS MEASURED RELATIVE TO THIS. IT IS THE CHANGE IN READING THAT IS IMPORTANT

9.0 MAINTENANCE

HPS-3500 Hanging Pendulum

The following will ensure trouble free operation:-

- Prior to taking readings ensure that the weight is hanging freely within the reservoir tank. If necessary carefully move the position of the reservoir to ensure maximum clearance. Wait until any movement of the weight is occurring before taking any readings.
- Periodically or as required carefully remove any calcareous deposits from all items.

IPS-3000 Inverted Pendulum

The following will ensure trouble free operation:-

- Before taking readings always check the water level in the float tank. Ensure that the float is fully submerged and completely clear of the bottom of the tank.
- If the water in the tank is at the correct level but the float is not sufficiently submerged it may be necessary to slightly re-tension the pendulum wire.

Geosense® TP-2000 Readout is a precision electronic instrument often installed in harsh environments which are high in temperature and humidity. Whilst they are designed to operate within these environments regular maintenance is required to ensure correct operation.

The following will ensure trouble free operation:-

- Ensure the light shield is always installed.
- Ensure the drip shield is always installed.
- Periodically or as required carefully remove any calcareous deposits.

Geosense® MR-2500 Readout

The following will ensure trouble free operation:-

- Ensure the drip shield is always installed.
- Periodically or as required carefully remove any calcareous deposits.

10.0 TROUBLESHOOTING

10.1 Error codes

Code	MultiLogger Code	Description
Err2	-99992	Ambient light is too bright
Err3	-99993	Projected light is too weak
Err4	-99994	Wire is out of range
Err5	-99995	Fault in CCD element
Err6	-99996	Shadows interfering with light (usually caused by moisture)
No display	-99999	Power loss or communication failure

11.0 SPECIFICATION

TP-2000

ITEM	2 - DIMENSIONAL	2 - DIMENSIONAL	3 - DIMENSIONAL
Standard Ranges	(X axis) 0 to 50mm	(X axis) 0 to 50mm	(X axis) 0 to 50mm
	(Y axis) 0 to 50mm	(Y axis) 0 to 100mm	(Y axis) 0 to 100mm
			(Z axis) 0 to 50mm
Resolution	0.01mm	0.01mm	0.01mm
Accuracy	±0.05mm	±0.05mm	±0.05mm
Repeatability	±0.1mm	±0.1mm	±0.1mm
Communication	4-20mA, RS-485	4-20mA, RS-485	4-20mA, RS-485
Display	4-digit LED	4-digit LED	4-digit LED
Data storage	2000 data sets	2000 data sets	1200 data sets
Power supply	85-265 VAC, 50-60 Hz	85-265 VAC, 50-60 Hz	85-265 VAC, 50-60 Hz
Operating temperature	-15°C to + 60°C	-15°C to + 60°C	-15°C to + 60°C
Operating humidity	100% relative humidity (non condensing)	100% relative humidity (non condensing)	100% relative humidity (non condensing)
Dimensions (L X W X H)	380 x 330 x 145mm	425 x 375 x 190mm	425 x 375 x 190mm
Weight	9kg	15kg	16kg
Protection	IP65	IP65	IP65

MR-2500

ITEM	2 - DIMENSIONAL
Standard Range	(X axis) 0 to 150mm
	(Y axis) 0 to 150mm
Resolution	0.05mm
Display	Visual
Operating temperature	-15°C to + 60°C
Operating humidity	100% relative humidity (non condensing)
Dimensions (L X W X H)	250 x 250 x 65mm
Weight	4.5kg
Material	Stainless steel, PVC

11.0 SPECIFICATION contd...

HPS-3500

ITEM	DESCRIPTION
Reservoir tank	
Dimension	Ø675mm x 515mm
Material	Stainless steel
Fluid	SAE50-90 or water-glycol mix
Weight	
Mass	30kg
Dimension	Ø675mm
Material	Mild Steel
Wire	1.6, 2mm
Diameter	1.6, 2mm
Material	Stainless steel

IPS-3000

ITEM	DESCRIPTION
Reservoir tank	
Dimensions	
Material	
Float	
Dimensions	
Material	
Wire	
Diameter	1.6, 2mm
Material	Stainless steel
Anchor	
Dimensions	Ø50mm x 600mm
Weight	4kg



12.0 SPARE PARTS

Generally there will be no need for spares parts.

13.0 RETURN OF GOODS

13.1 Returns procedure

If goods are to be returned for either service/repair or warranty, the customer should contact **Geosense®** for a **Returns Authorisation Number**, request a **Returned Equipment Report Form QF034** and, prior to shipment. Numbers must be clearly marked on the outside of the shipment.

Complete the **Returned Equipment Report Form QF034**, including as much detail as possible, and enclose it with the returned goods and a copy of the form should be faxed or emailed in advance to the factory.

13.2 Chargeable Service or Repairs (Inspection & Estimate)

It is the policy of **Geosense®** that an estimate is provided to the customer prior to any repair being carried out. A set charge for inspecting the equipment and providing an estimate is also chargeable.

13.3 Warranty Claim (See Limited Warranty Conditions)

This covers defects which arise as a result of a failure in design or manufacturing. It is a condition of the warranty that the **Geosense® Pendulum System** must be installed and used in accordance with the manufacturer's instructions and has not been subject to misuse.

In order to make a warranty claim, contact **Geosense®** and request a **Returned Equipment Report Form QF034**. Tick the warranty claim box and return the form with the goods as above. You will then be contacted and informed whether your warranty claim is valid.

13.4 Packaging and Carriage

All used goods shipped to the factory **must** be sealed inside a clean plastic bag and packed in a suitable carton. If the original packaging is not available, **Geosense®** should be contacted for advice. **Geosense®** will not be responsible for damage resulting from inadequate returns packaging or contamination under any circumstances.

13.5 Transport & Storage

All goods should be adequately packaged to prevent damage in transit or intermediate storage.



14.0 LIMITED WARRANTY

The manufacturer, (Geosense Ltd), warrants the **Geosense® Pendulum System** including Readouts manufactured by it, under normal use and service, to be free from defects in material and workmanship under the following terms and conditions:

Sufficient site data has been provided to **Geosense®** by the purchaser as regards the nature of the installation to allow **Geosense®** to select the correct type and range of **Pendulum** and other component parts.

The **Geosense® Pendulum System** shall be installed in accordance with the manufacturer's recommendations.

The equipment is warranted for 1 year from the date of shipment from the manufacturer to the purchaser.

The warranty is limited to replacement of part or parts which, are determined to be defective upon inspection at the factory. Shipment of defective part or parts to the factory shall be at the expense of the Purchaser. Return shipment of repaired/ replaced part or parts covered by this warranty shall be at the expense of the Manufacturer.

Unauthorised alteration and/or repair by anyone which, causes failure of the unit or associated components will void this **LIMITED WARRANTY** in its entirety.

The Purchaser warrants through the purchase of the Geosense® Pendulum System that he is familiar with the equipment and its proper use. In no event shall the manufacturer be liable for any injury, loss or damage, direct or consequential, special, incidental, indirect or punitive, arising out of the use of or inability to use the equipment sold to the Purchaser by the Manufacturer.

The Purchaser assumes all risks and liability whatsoever in connection with the **Geosense® Pendulum System** from the time of delivery to Purchaser.



Geosense Ltd

Nova House . Rougham Industrial Estate . Rougham . Bury St Edmunds . Suffolk . IP30 9ND . England .

Tel: +44 (0) 1359 270457 . Fax: +44 (0) 1359 272860 .

email: info@geosense.co.uk . www.geosense.co.uk