Digital MEMS Horizontal Inclinometer System Installation and User Manual

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REVISION HISTORY

Rev.	Revision History	Date	Prepared By	Approved By
A	Initial Release	March 23, 2012		
B	Formatting update, casing installation section added, and other content updates	April 15, 2025	SM	PL, AA

1 Intended Audience

This guide is for the personnel responsible for installing or using the Digital MEMS Horizontal Inclinometer System. This manual provides steps for installing the system, and how to take readings and interpret them.

This manual assumes the user has a working knowledge of how to use the RST Digital Inclinometer System. The function of the MEMS Horizontal Inclinometer Probe is very similar to the standard vertical probe. The user is advised to refer to the Digital Inclinometer System Instruction Manual (in addition to this manual).

2 Abbreviations and Acronyms

This section lists abbreviations and acronyms used in the document.

Abbreviation or acronym	Definition
MEMS	Micro-Electro-Mechanical Systems

3 Icons and Conventions Used In This Guide

This guide uses the following icons to call attention to important information.

WARNING: This icon appears when an operating procedure or practice, if not correctly followed, could result in personal injury or loss of life.

CAUTION: This icon appears when an operating procedure or practice, if not strictly observed, could result in damage to or destruction of equipment.

NOTE: This icon appears to highlight specific non-safety related information.

4 Safety

WARNING: Always follow safety precautions and use proper personal protective equipment (PPE) including safety glasses and high-visibility clothing when working in the field with this equipment.

5 INTRODUCTION

The RST Micro-Electro-Mechanical Systems (MEMS) Horizontal Inclinometer System represents a breakthrough in inclinometer system technology, providing unprecedented accuracy, efficiency, and ease of use.

The system is comprised of a Digital MEMS Horizontal Inclinometer Probe, Cable System, Reel with battery power, and a Handheld readout device running Mobile Microsoft Windows™ that functions as a readout, analysis, and data storage device.

Wireless communication between the inclinometer control reel and the Handheld Readout Device ensures ease of use and reliability, by removing two weaknesses inherent in conventional analog inclinometer systems. By removing the physical connection between the inclinometer control cable and the readout instrument there is no concern with fragile connectors, cable related failure and related reliability problems. The Achilles heel of any inclinometer control cable reel is the slip ring required to maintain electrical contact as the reel revolves. As the RST system is wireless from the control cable to the readout, a slip ring is not required, and there are no associated electrical continuity problems.

The RST MEMS Horizontal Inclinometer Probe incorporates cutting edge MEMS (Micro-Electro-Mechanical Systems) technology providing high precision and durability. A highly accurate survey of the inclinometer casing is used to establish the initial position of the casing. Any subsequent deviations in the casing from this initial value (i.e. baseline reading) represent changes occurring in the subsurface. The RST MEMS Horizontal Inclinometer System can accurately measure the rate, depth, and magnitude of these deviations.

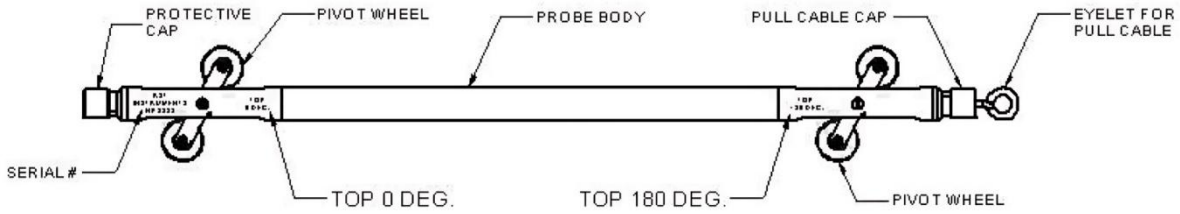


Figure 1: Digital MEMS Horizontal Inclinometer Probe Overview

The RST MEMS Horizontal Inclinometer System is designed to provide complete profiles of differential settlements. Typical applications include monitoring settlement and heave in dams, landfills, embankments and under storage tanks.

The inclinometer casing is installed horizontally in a trench or borehole. It can be open at both ends or closed at the far end, as shown in Figure 2. When closed at the far end, a dead-end pulley and cable-return pipe are also installed. To survey the casing, the probe, control cable, pull-cable, and readout unit are used. The initial survey establishes the casing's profile, and subsequent surveys detect any changes in the profile due to ground movement.

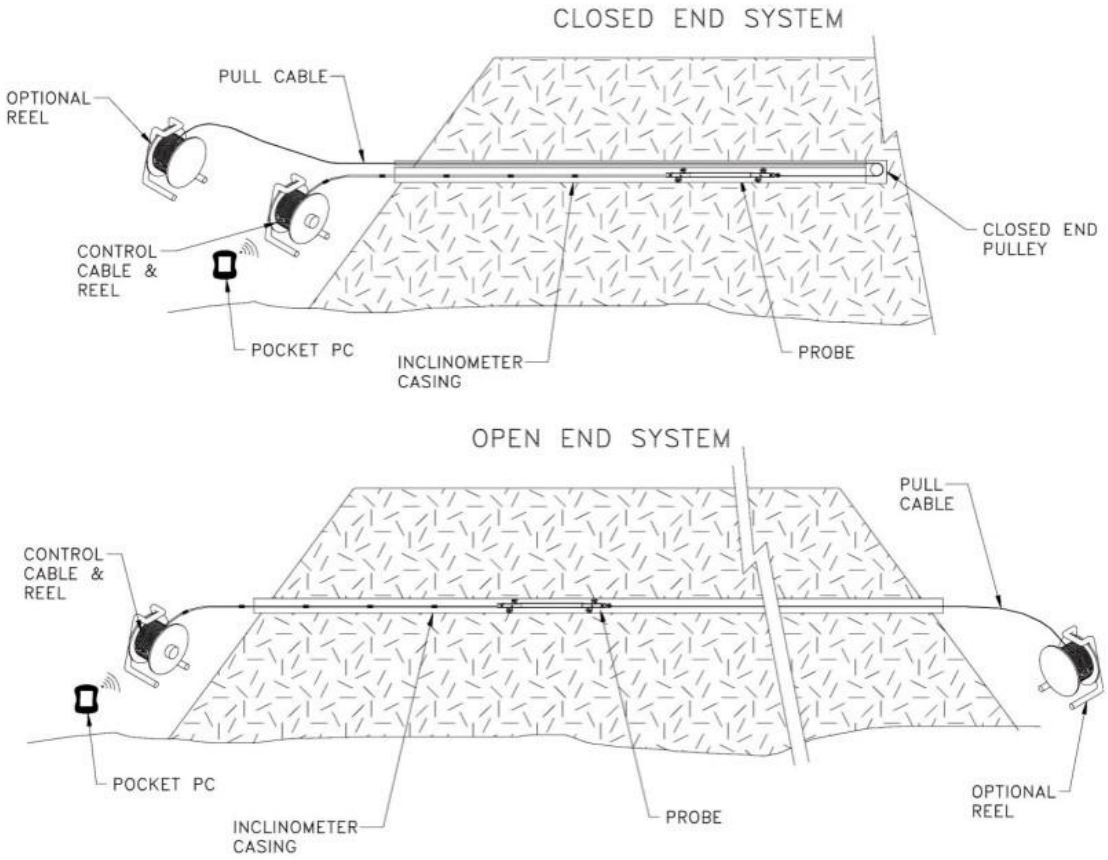


Figure 2: Closed and Open End Digital MEMS Horizontal Inclinometer System

5.1 SYSTEM COMPONENTS

- Inclinometer casing: Inclinometer casing is a pipe specifically designed for inclinometer installations. It has grooves inside that control the probe's orientation and provide a flat surface for tilt measurements. The casing is installed with one pair of vertically aligned grooves, a top groove, and a bottom groove.

- Digital MEMS Horizontal Inclinometer Probe: The horizontal inclinometer probe measures tilt and spiral along the casing. It has wheels that follow the grooves in the casing.

CAUTION: Ensure that the probe is positioned such that its sprung wheels are placed in the top groove and its fixed wheels are in the bottom groove.

- Pull Cable: To start each survey, a stainless-steel pull cable is used to pull the probe to the far end of the casing. When leaving the site, store the pull cable inside the casing. The pull cable should be longer than the casing for easy handling and connection to the reel. If a dead-end pulley is used, the length of the pull cable must be doubled to go through the casing, around the pulley, and through the return pipe.

- Dead-End Pulley: When the far end of the casing is closed, a dead-end pulley and cable return pipe are installed. This allows the pull cable to be operated from the near end of the casing. However, if both ends of the casing are open, the dead-end pulley is not used.

- Control Cable: The control cable establishes the position of the probe and conducts power and signals between the probe and the readout.

- Handheld Readout Device and Digital Inclinometer Software: The Handheld Readout Device records the inclinometer survey and the software allows for data visualization and analysis.

5.2 FEATURES

- Digital precision and efficient data collection with a high-level user interface that has instant USB synchronization with office computers
- Horizontal Inclinometer probe may be used with RST's Vertical MEMS Inclinometer system accessories (cable, reel, Handheld Readout Device)*

NOTE: Although the Horizontal Inclinometer probe can complement the RST Vertical MEMS Inclinometer system, it is important to note that the horizontal probe, cable, and reel are not compatible with the vertical system, which uses an RS485 bus (4-wire cable), while the Digital Inclinometer probe communicates data over the reel power wires (2-wire cable).

5.3 APPLICATIONS

- Monitor settlement or heave under embankments, dams, roadways, storage tanks, and landfills
- Observation of ground movements caused by construction and excavation, such as those involved with tunneling

6 INSTALLATION

An initial survey is required to obtain base line readings. Data from future surveys will be compared to the base line. From the collected data, a profile of the inclinometer casing indicating the magnitude of settlement or heave is produced. Each individual survey requires the probe to be drawn or pulled through the casing, then reversed and passed through the casing again (probe is reversed end for end – not rotated axially 180° as in a vertical inclinometer survey). Measurements are collected at 0.5m intervals with the metric probe or 2 ft. intervals with the imperial probe.

Data is retrieved directly on the Handheld Readout Device via Bluetooth to the Digital Cable Reel. A profile can be generated on the inclinometer readout immediately following the survey. Alternatively, the data may be transferred to a computer and imported into MS Excel or other popular spreadsheet software. RST Inclinalysis™ software can also be used to reduce the data and produce plots quickly and efficiently.

6.1 INSTALLATION PREREQUISITES

6.1.1 Functionality Test

Before field deployment of the unit, RST recommends testing the instrument to verify that it is working correctly.

- Ensure the dust cap on the other end is secured.
- Connect the MEMS Horizontal Probe to the reel via the end with the serial number (Top 0 DEG, see Figure 1).
- Power ON the Digital Reel and then turn ON the Handheld Readout Device.
- Launch the Digital Inclinometer Program and wait for the unit to connect to the reel.
- The status of the connection can be monitored at the bottom of the Main Menu screen. To verify that the wireless connection has been made, press the *Status* button. A screen will appear showing the connections (see Figure 4).
- Under the *Calibration* tab, *Sensor Type* should read “MEMS” & *Probe Type* should read “Digital Horizontal” as shown in Figure 3.

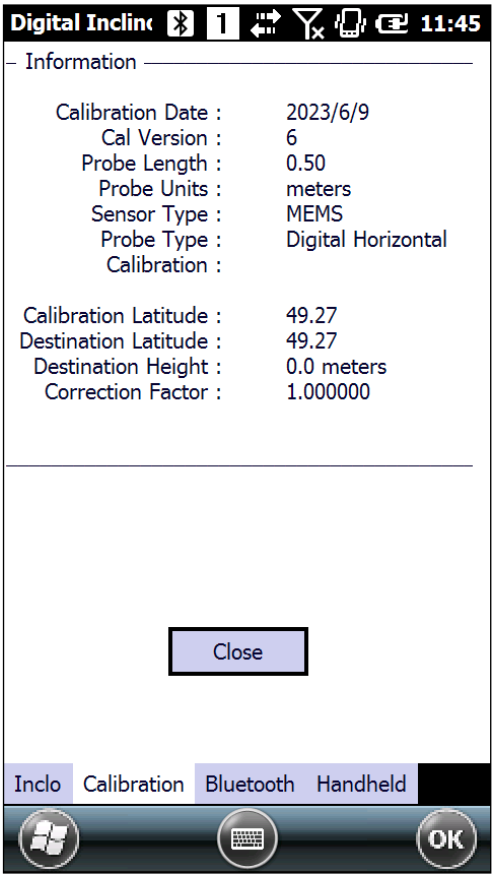


Figure 3: Calibration Screen

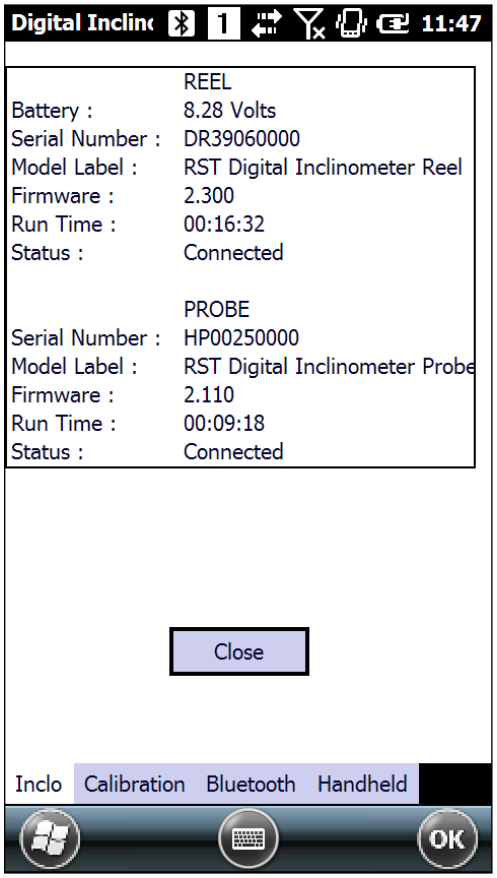


Figure 4: Connection Information Screen

NOTE: If any information field remains blank, it means the connection was unsuccessful. Refer to the Digital Inclinometer System manual for more information.

- Press OK when complete.
- Create a site and a borehole for the instrument.
- Ensure probe type is set to “Horizontal” in borehole settings.
- When complete, press the *Readings* button to display real-time readings from the probe. The readings screen should appear as follows (see Figure 5):

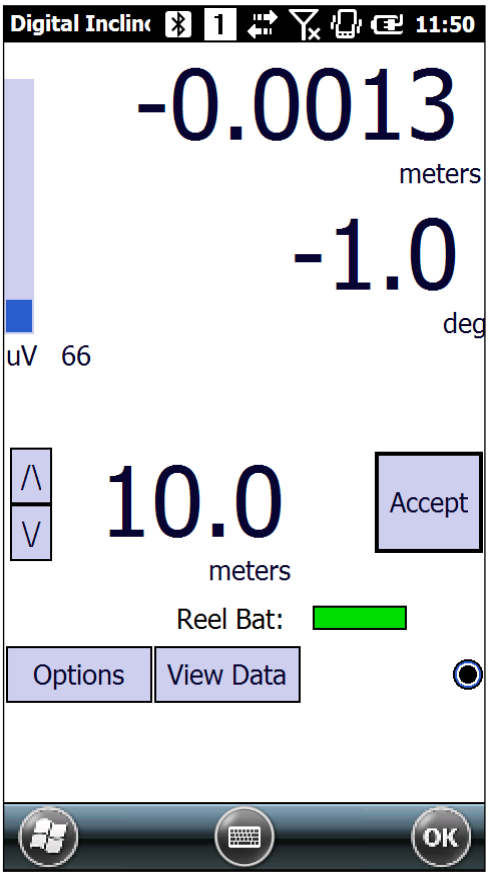


Figure 5: Readings Screen

- Verify that the probe's signal increases or decreases as its angle increases or decreases with respect to the horizontal. A positive deviation is given when the Top 0 DEG end is tilted above the TOP 180 DEG end (see Figure 6). If the system is not functioning as expected, contact RST Instruments Ltd. for technical support.

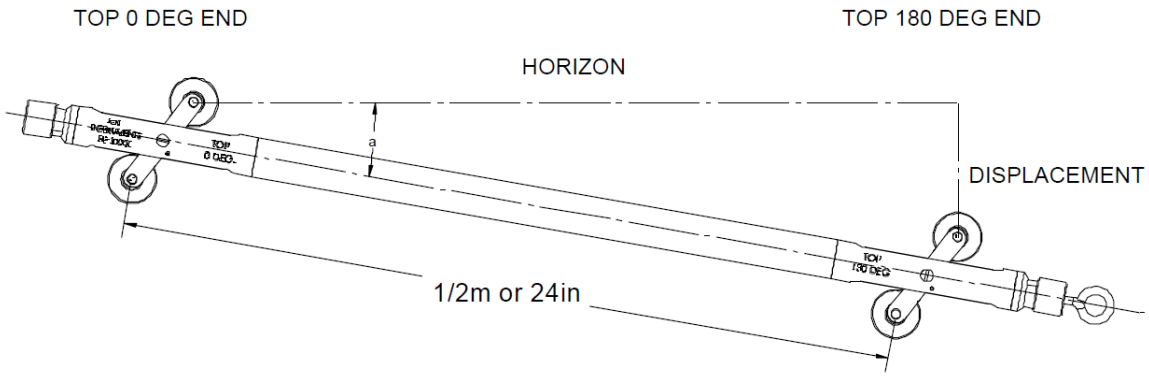


Figure 6: Vertical Displacement Orientation

- Verify that the probe's signal increases or decreases as its angle rotates with respect to the horizontal axis. A positive deviation is given when the MEMS Horizontal Probe rotates clockwise along the horizontal axis (see Figure 7). If the system is not functioning as expected, contact RST Instruments Ltd. For technical support.

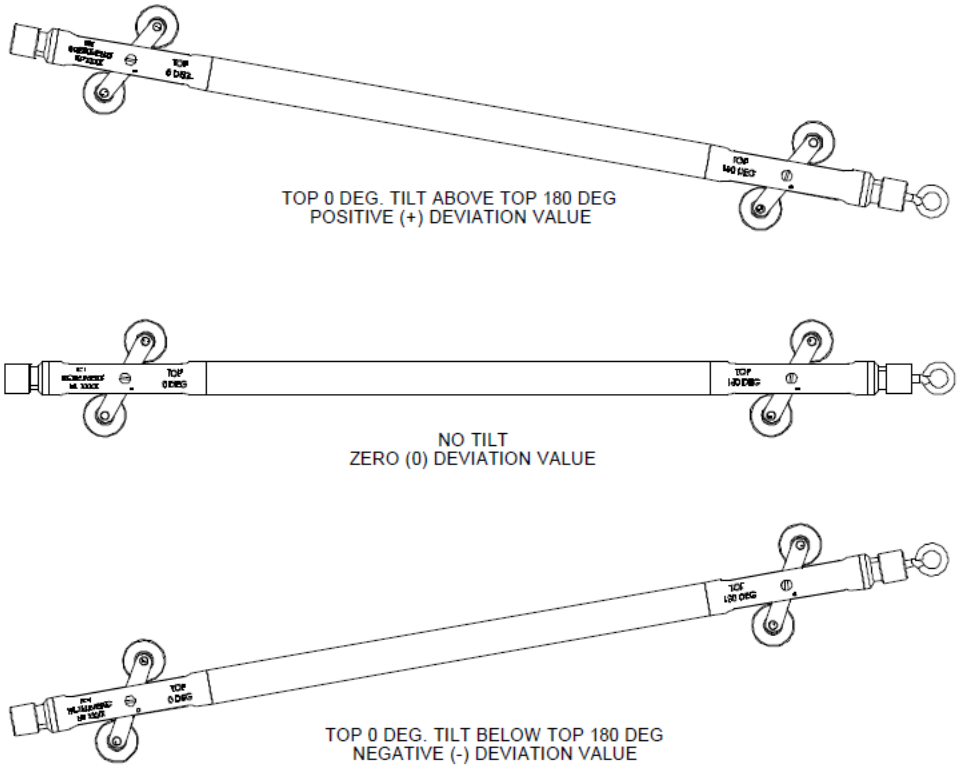


Figure 7: Tilt Sign Convention

6.2 REQUIRED TOOLS AND COMPONENTS

- Digital MEMS Horizontal Inclinometer Probe
- Inclinometer Cable & Digital Reel (site specific length)
- Pull Cable
- Control Cable
- Dead-end Pulley (for closed end system)
- Inclinometer casing (RST Glue & Snap Inclinometer Casing or RST Snap Seal Inclinometer Casing)

6.3 INSTALLATION OF INCLINOMETER CASING

NOTE: Telescoping sections are not recommended or needed.

6.3.1 Installation in Trench or Embankment

Inclinometer casing is usually installed along the prepared foundation for the embankment, or within a shallow trench, and backfilled to protect the instrument from obstructions and damage.

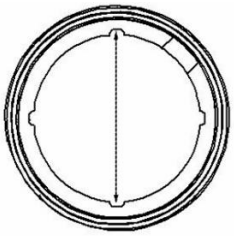
The casing can be open at both ends or closed at the far end.
When the casing is closed at one end, a dead-end pulley and cable-return pipe are installed (see Figure 2).

The inclinometer casing is usually inclined approximately 3% down towards the open end to prevent water ingress. The bottom of the trench must be made linear and smooth to ensure the casing is installed in a straight line for accurate measurements.

A linear and smooth trench bottom, along with sand bedding, ensures proper placement. Backfilling provides cushioning against equipment damage.
Cleaning the guide casing grooves is crucial to avoid tracking issues.
Plumbness is verified during installation, as reading errors increase with groove deviation.

Initial readings are performed after backfilling to check for damage. It is recommended to pass a Dummy Probe through the casing before initial readings are performed. The open end of the guide casing can be surveyed for settlement detection during inclinometer measurements.

CAUTION: One set of grooves in the casing must remain vertical. The use of an alignment tool together with a spirit level is the most efficient and accurate method of achieving this.

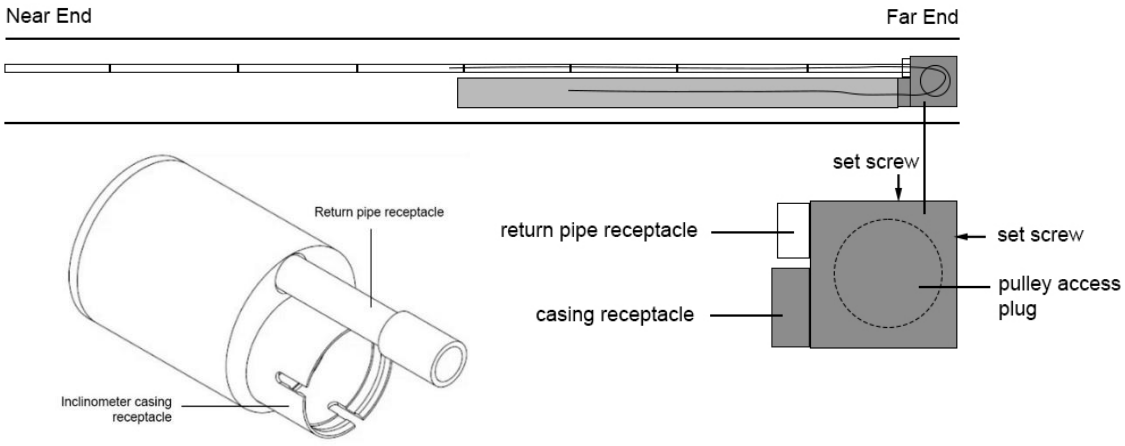


1. Starting with compacted fill, excavate a trench with dimensions approximately 1.7 ft. wide and 2.0 ft. deep. Maintain a gradient of about 3% to allow for drainage.

   Add about a 6” layer of sand at the bottom of the trench.

2. If the system is open ended, skip to Step 3. Assemble the return pipe section-by-section, starting from the near end, while pulling the stainless-steel cable through. Position the dead-end pulley at the far end of the trench, ensuring the pulley access plug is on top. Once the return pipe reaches the pulley, feed the pull cable through the PVC receptacle and casing seat, and securely glue the PVC pipe into the return pipe receptacle.

   If a dead-end pulley is being used in case of a closed end system, attach the first section of casing to the casing receptacle using the screws provided.



3. Assemble the casing, starting at the far end. Ensure that the casing is oriented such that one set of grooves remains vertical, adjusting as necessary after each length is added. The use of a level and alignment tool is recommended to help with proper alignment.

   Pull the stainless-steel cable through as additional casing sections are added.

NOTE: Depending upon the type of casing used, refer to the Glue & Snap Inclinometer Casing Installation Manual or the Snap Seal Inclinometer Casing Installation Manual for detailed instructions on assembling sections of the casing.

CAUTION: During the assembly of the casing, ensure that ends are plugged to keep dirt and debris out.

NOTE: Please note that azimuth correction is not possible horizontal inclinometer installations. If the casing rotates despite all proper precautions, the azimuth would have to be manually corrected in Microsoft Excel.

4. Cover the casing assembly with sand and compact evenly.

5. Remove the plugs. To test the casing, attach control cable and pull cable to the inclinometer probe. Pull the probe through the casing, from the near end to the far end, and then back again to ensure proper alignment of grooves.

6. Re-plug the ends and backfill the trench with selected fill material.

6.3.2 Installation of Inclinometer Casing Using Rebar Cage

1. **Mark the Rebar Cage:**
   a. Identify the level where the casing needs to be installed.
   b. Use the top of the casing height as a reference point to mark the rebar cage. This will make it easier to see during installation.

2. **Install the First Piece of Casing:**
   a. Start from either end or from the open end if a dead-end pulley system is used. Hold the casing at both ends in roughly the correct position.
   b. Check its alignment with a spirit level against the level marks on the rebar cage.

3. **Secure the First Piece:**
   - **a.** Loosely secure the casing with tape to ensure the internal grooves are vertical.
   - **b.** Use the alignment tool horizontally inside the casing and place a spirit level on the plate.
   - **c.** Rotate the casing until it is completely horizontal.
   - **d.** Secure the casing permanently at the outside end using tie wire.

4. **Install Additional Pieces:**

   Install each subsequent piece of casing, supporting the far end of the casing at all times to prevent twisting.

5. **Secure All Pieces:**
   - **a.** Fix each piece of casing with wire at regular intervals to ensure it remains in place.
   - **b.** Continue this process until all required lengths of casing are installed.

6. Support the casing at least every 5 feet and under couplings to prevent upward movement during the pouring of concrete. Securely tie the casing to the supports to ensure stability.

7. Wrap the joints with tape to prevent grout ingress.

8. Avoid pouring concrete directly onto the plastic casing.

NOTE: Ensure that no debris or contaminants enter either end of the two outer casings.

7 OPERATING PROCEDURE

CAUTION: The MEMS Horizontal Inclinometer Probe houses a sensitive sensor and should be handled with care.

DO NOT drop or impact the probe. Doing so will create a significant offset in the probe, permanently damaging the sensors or requiring the probe to be re-calibrated.

RST highly recommends having the probe calibrated on an annual basis to ensure consistent and accurate results.

NOTE: Ensure the Handheld Readout Device is fully charged prior to taking readings.

The procedure outlined below applies to both closed and open-end systems:

1. Run the pull cable through the installed inclinometer casing.
2. Remove the threaded dust caps from each end of the probe and store in a safe place.
3. Thread the pull cable cap onto the connector at the Top 180 DEG end.
4. Connect the pull cable to the eye of the pull-cable cap.
5. Connect the Digital Inclinometer cable to the Top 0 DEG end of the Inclinometer Probe.
6. Insert the probe, Top 180 DEG end first, into the installed Inclinometer Casing **with the wheels located in the bottom groove. Make sure the writings are not upside down.**
7. Pull the probe through the casing until it reaches the far end with the last possible inclinometer cable ferrule snug against the near end of the casing. Make note of how far the probe was inserted, as this will have to be setup on the Handheld Readout Device.
8. Power on the Digital Inclinometer Reel and launch the Digital Inclinometer Program on the Handheld Readout Device. Refer to the Digital Inclinometer Manual for instructions of how to use the RST Digital Inclinometer Program.

   A site and borehole need to be created.
9. After creating a site and borehole, press the *Readings* button to perform a survey. The readings screen should appear as shown in Figure 5.

10. With the inclinometer cable ferrule tight against the end of the casing and the pull cable taut, allow the probe to equalize and then take a reading (i.e. when the noise bar on the side of the unit is at a minimum).

Press *Accept* to advance to the next interval.

11. Pull on the inclinometer cable until the next ferrule can be placed tight against the end of the casing.

12. Repeat steps 10-11 until the last ferrule reading has been logged.

13. The Digital Inclinometer program will then prompt the user to disconnect and rotate the probe. The following screen will appear (see Figure 8):

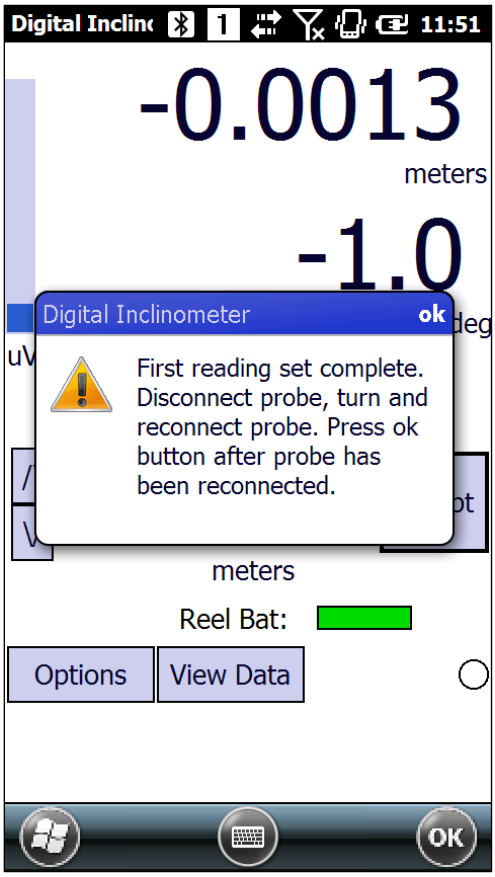


Figure 8: Turn Probe Screen

WARNING: DO NOT press OK until the probe has been turned and reconnected.

14. Disconnect the inclinometer cable from the probe.

15. Remove the eyebolt cap (with pull cable attached) and thread onto the other end of the probe (Top 0 DEG end).

16. Turn (**DO NOT** rotate) the probe 180 degrees and then connect the inclinometer cable to the TOP 180 DEG end of the probe. Re-insert the probe, TOP 0 DEG end first, into the casing **with the wheels located in the bottom groove. Make sure the writings are not upside down.**

17. Press OK and repeat steps 6-12 to take a second set of readings.
    During the second pass, the instrument checksum will be displayed on the readings screen. The checksum can be used to gauge the quality of the reading (i.e. identify if a location error has been made).
    Please refer to the Digital Inclinometer system manual for further information on checksums.

18. Disconnect the inclinometer cable and pull cable and replace Protective Caps.

19. Upon returning to the office, clean the probe and wheel assemblies if needed.

20. Download the Windows Mobile Device Center and WMDC Fixes for Windows 10.

21. After installing Microsoft Windows Mobile Device Center (WMDC) in the Microsoft Windows 10 operating system, the user will most probably need to run the utility outlined in the next step to get it to function fully.

22. Create a Windows Mobile Device Center connection with your desktop PC and copy the data to a safe location. Please refer to the Digital Inclinometer System Manual for more information.

8 DATA REDUCTION

8.1 READINGS

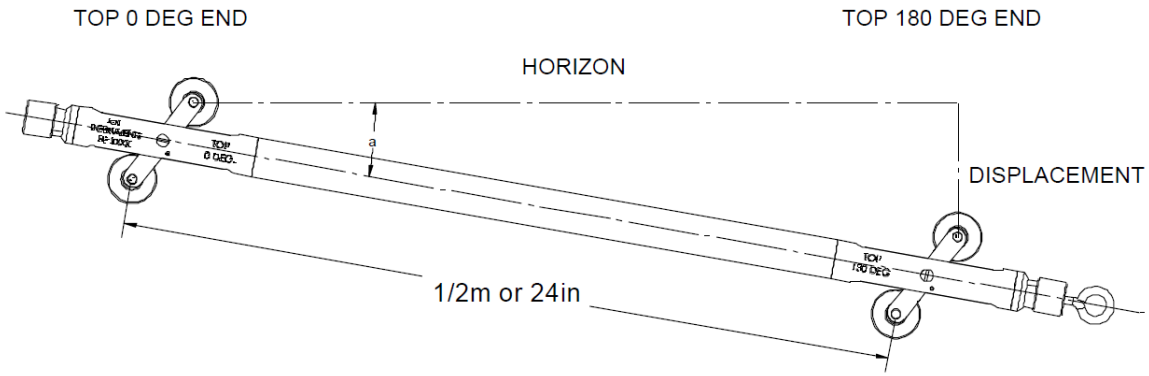
The readings taken represent the vertical displacement, defined by:

(½ m) * (sin (A))

Where, “A” is the angle between the horizon and the longitudinal axis of the probe.

A positive reading from Top 0 DEG end indicates settlement and a negative reading indicates heave. The opposite applies if the Inclinometer Cable is connected to the opposite side (Top 180 DEG end).

For instance, the figure below shows settlement:



Refer to the Digital Inclinometer System Manual for instructions on reducing the data in the field. Data can be plotted on the Handheld Readout Device and errors can be discovered.

Data reduction can be performed in several ways including:

1. Plot the field data on the Handheld Readout Device using the RST Digital Inclinometer Software.
2. Use RST Inclinalysis™ software on your desktop or laptop PC.
3. Import the .csv files directly into Microsoft Excel™.

8.2 SIGN CONVENTIONS

The MEMS Horizontal Inclinometer measures both tilt in horizontal axis and the rotation along horizontal axis. Proper installation of the inclinometer casing attempts to align one set of grooves in line with the vertical plane of expected movement.

When an inclinometer casing is surveyed for the first time (i.e. baseline readings), it is necessary to insert the TOP 180 DEG end of the MEMS Horizontal Probe first into the inclinometer casing so that each time a survey is repeated, the probe will always have the same orientation in the casing.

In practice, it is often difficult to achieve exact orientation of grooves relative to some predetermined direction. The groove closest to the anticipated movement direction is usually chosen as the main reference direction. It is recommended that this direction (A+) be marked on the casing itself to ensure surveys are performed in the same manner each time.

The azimuth of this groove direction can be measured in a clockwise direction from the main reference direction (A+). All subsequent measured inclinometer movements would be referred to this direction.

The RST MEMS Horizontal Inclinometer System uses the industry standard sign convention, where tilt in the direction of the Top 0 DEG end results in a positive deviation and tilt in the direction of the Top 180 DEG end results in a negative deviation (see Figure 9).

Clockwise rotation along the horizontal axis (when the TOP 0 DEG end is toward the user) results in a positive deviation and counterclockwise rotation along the horizontal axis (when the TOP 0 DEG end is toward the user) results in a negative deviation (see Figure 10).

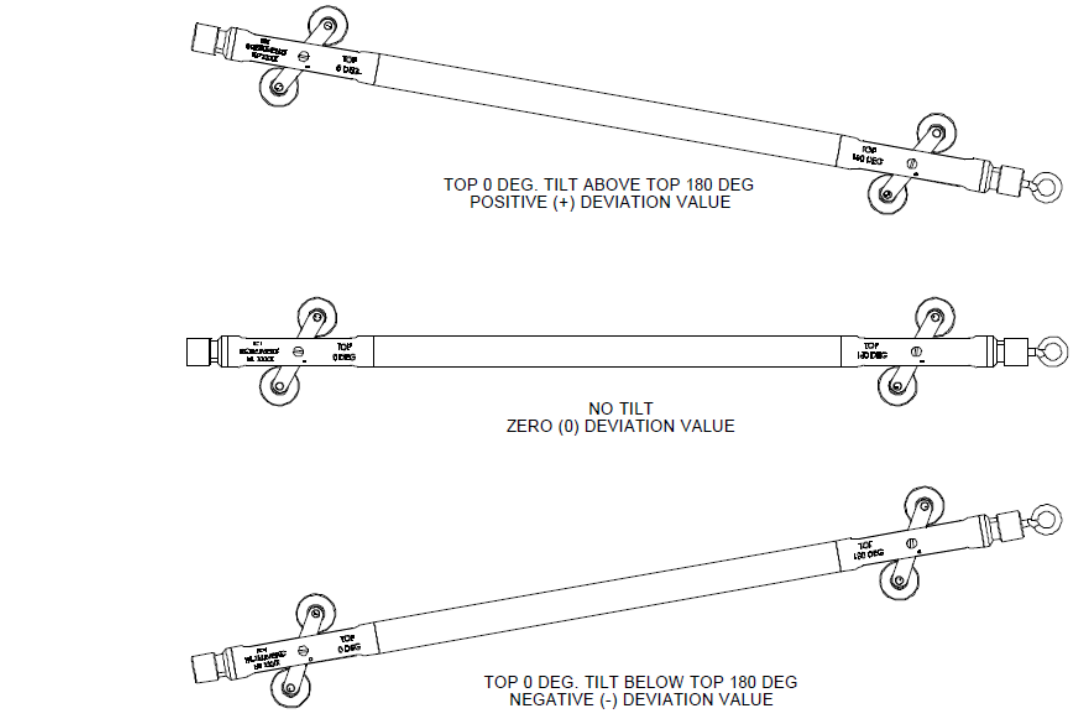


Figure 9: Tilt Sign Convention

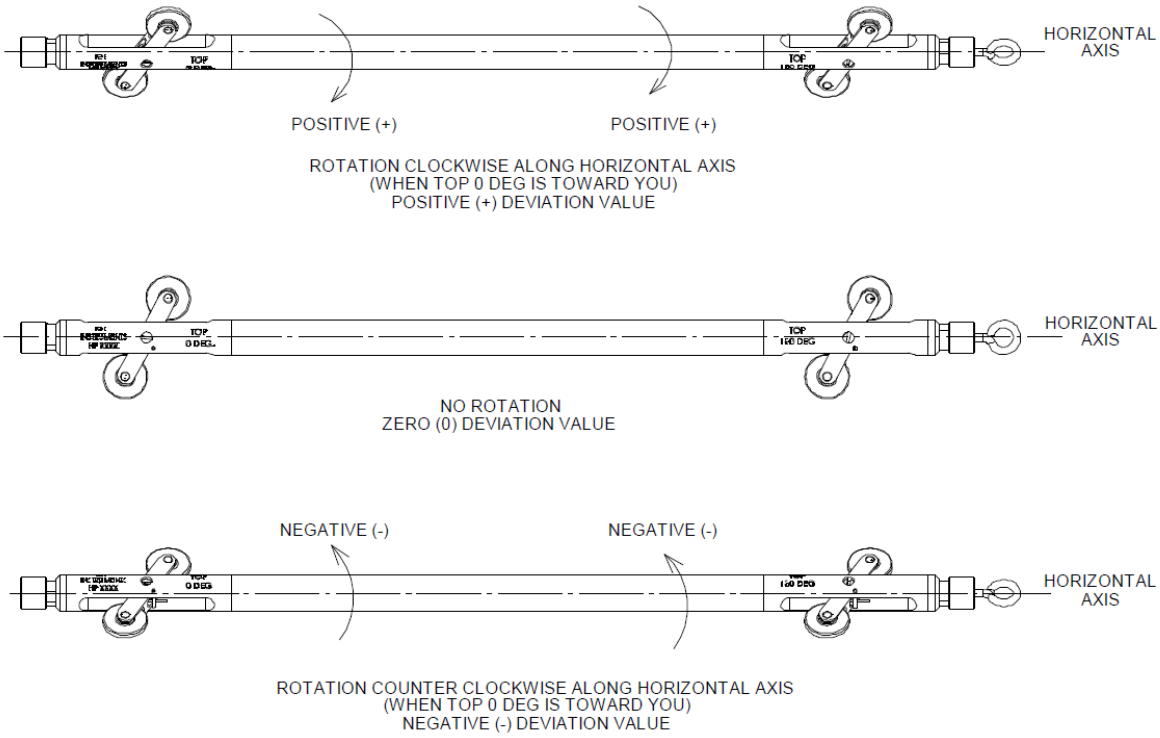


Figure 10: Rotation Sign Convention

9 CARE AND MAINTENANCE

9.1 PROBE & REEL CONNECTORS

Proper care and maintenance of the MEMS Horizontal Inclinometer Probe and reel connectors will ensure trouble-free operation of the MEMS Horizontal Digital Inclinometer System. The following guidelines should be strictly adhered to.

CAUTION: Failure to adhere to these guidelines can result in premature connector wear, and ultimately connector failure.

- Ensure the keyway is aligned before threading the connector together.
- Never over-tighten the bulkhead connectors when mounting. Snug (hand-tight) is more than sufficient.
- Only twist the brass coupling on the connector, do not twist the signal cable itself.
- Avoid sharp bends at the cable entry to the connector.
- Clean the plugs and receptacles with a mild soap and fresh water on a regular basis. Do not allow the connectors to get excessively dirty.
- Rinse out with alcohol, allowing the connector to air dry. Replace dust caps, once the connector is dry.
- On a regular basis, lubricate the mating surfaces with the supplied silicone spray. The supplied product is 3M Silicone Spray part # 6204678-4930-3. DO NOT GREASE and avoid the use of any solvent based lubricants.
- Amount of silicone spray used should be based on the frequency of use of the probe. One light spray to cover all contacts is enough after cleaning of the connector. Ensure the connector is clean and dry before applying the silicone spray.
- Elastomers contained in the connector can be seriously degraded if exposed to solvent, direct sunlight, or high ozone levels for extended periods of time. Always replace dust caps once the connector is clean and dry.
- Always keep the dust caps clean and free of any foreign materials. Do not place the dust caps anywhere they may become contaminated.
- Always use the dust caps and keep the connectors clean to prevent damage in storage and when in use.

CAUTION: In no case should solvent-based lubricants (such as WD-40) be used as a lubricant on the connectors. These products will damage the elastomers in the connectors resulting in loss of communication with the digital probe.

ONLY use the supplied silicon lubricant or RST approved equivalent.

For any queries or clarifications, please contact RST Instruments Ltd.

9.2 INCLINOMETER PROBE

- After the survey, wipe moisture off the inclinometer probe and replace protective caps over connectors.
- Rinse the probe in clean water and dry if necessary. Use mild soap and fresh water for exceptionally dirty probes, avoiding solvents.
- Store the probe in its original case when not in use.
- Avoid excessive shock or vibration to prevent damage to the high precision accelerometers in the probe.
- Keep the probe and its case clean and dry, cleaning and drying upon return to the office if not done in the field.
- Clean parts if exposed to corrosive solutions such as salt water.
- Sealed bearings in the wheels require no maintenance, however, ensure they are kept clean and dry.

9.3 REEL AND CABLE

If required, wipe the cable with a clean rag to dry it off. The cable has a durable polyethylene jacket, simply use water and a mild soap to clean it if necessary.

9.4 READOUT UNIT

To ensure proper functioning of the Handheld Readout Device, please adhere to the following guidelines:

- Keep the unit away from excessive moisture and extreme temperatures. Do not expose the unit to liquids or precipitation. Provided all the plugs are closed, the supplied rugged case meets the IP54 standard for water and dust resistance, as well as being impact-resistant if dropped up to four feet from the ground. The plug covers are made of special material which allows the wireless features of the unit to function even when they are closed.
- Do not place anything on top of the unit to prevent damage to the screen. Also avoid scratching the surface of the screen and banging it against hard objects.

- Clean the unit by wiping the screen and the exterior with a soft, damp cloth moistened only with water.
- Avoid exposing the unit to direct sunlight or strong ultraviolet light for extended periods of time.
- Only use the Handheld Readout Device stylus to prevent scratching the screen. The supplied rugged case incorporates a screen protector on the inside to allow use of the touch screen and buttons while maintaining water and dust resistance.

NOTE: For further reference, please refer to the supplied manufacturer's manuals for the Handheld Readout Device.

9.5 CALIBRATION

RST strongly recommends that the probe be sent in for calibration annually.

Due to the high precision nature of the sensors and the sensitivity of the probe, regular calibration must be done to ensure quality results and continued performance of the probe.

Heavy use in adverse conditions may require calibrations to be done more often.

Calibration should also be performed if the probe has been dropped or become damaged in any way. If checksums become significant and they are not due to errors in probe positioning or noise, the probe likely needs to be re-calibrated.

Calibration should also be performed after any wheel assembly replacement.

Refer to APPENDIX A for a sample calibration sheet.

10 PRODUCT SPECIFICATIONS

Item	Specification
Sensor	MEMS (Micro-Electro-Mechanical Systems) Accelerometer
Measurement Range	± 30° from Horizontal
Casing Size Required	70 mm (2.75”) or 85 mm (3.34”)
Materials	Stainless-Steel
Readout	Rugged Handheld Device

NOTE: For further details on product specifications, ordering information, accessories and additional equipment, please refer to the Digital Horizontal Inclinometer System Brochure.

11 SERVICE, REPAIR AND CONTACT INFORMATION

This product does not contain any user-serviceable parts. Contact RST for product services or repairs.

- For sales information: sales@rstinstruments.com
- For technical support: support@rstinstruments.com
- Service request portal: https://support.rstinstruments.com/support/tickets/new
- Website: www.rstinstruments.com
- Toll free: 1-800-665-5599

RST Canada Office (Head Quarters)

Address: 11545 Kingston Street, Maple Ridge, BC, Canada V2X 0Z5

Telephone: 604-540-1100

Fax: 604-540-1005

Business hours: 7:30 a.m. to 5:00 p.m. (PST) Monday to Friday, except holidays

RST UK Office

Address: Unit 4 Charles Industrial Estate Stowupland Road, Stowmarket Suffolk, UK, IP14 5AH

Telephone: +44 1449 706680

Business hours: 9:00 a.m. to 6:30 p.m. (GMT) Monday to Friday except holidays

Handheld Device Supplier Information

- Supplier: Handheld Group
- Website: https://www.handheldgroup.com
- For technical support: https://www.handheldgroup.com/support-rugged-computers/

APPENDIX A: SAMPLE CALIBRATION SHEET

innovation in geotechnical instrumentation

Calibration Record

RST Instruments Ltd., 11545 Kingston St., Maple Ridge, British Columbia, Canada V2X 0Z5
Tel: 604 540 1100 • Fax: 604 540 1005 • Toll Free: 1 800 665 5599 (North America only)
e-mail: info@rstinstruments.com • Website: www.rstinstruments.com

DIGITAL HORIZONTAL INCLINOMETER PROBE

Customer: [redacted]
Order Number: [redacted]
Model Number: IC32205H 0.5 meters
Serial Number: HP0025
Date: 8-Mar-16 11:53
References: RST-07
Referenced to National Standards Annually

Face Frame Angle	A+/-	Cross Axis Average Left/Right B meters	Deviation Face Right meters	Deviation Face Left meters	Face Error meters	Mean Deviation meters	True Deviation meters	Error meters
30	L	-0.00026	0.25007	-0.25003	0.00004	0.25005	0.25000	-0.00005
15	L	-0.00028	0.12947	-0.12942	0.00005	0.12944	0.12941	-0.00003
0		-0.00030	0.00003	0.00003	0.00005	0.00000	0.00000	0.00000
15	R	-0.00029	-0.12942	0.12947	0.00005	-0.12944	-0.12941	0.00003
30	R	-0.00027	-0.25003	0.25007	0.00004	-0.25005	-0.25000	0.00005

Face Frame Angle	B+/-	Cross Axis Average Left/Right A Degrees	Deviation Face Right Degrees	Deviation Face Left Degrees	Face Error Degrees	Mean Deviation Degrees	True Deviation Degrees	Error Degrees
30	L	0.073	29.995	-30.009	-0.011	30.002	30.000	-0.002
15	L	0.070	14.995	-15.008	-0.013	15.001	15.000	-0.001
0		0.072	-0.007	-0.007	-0.014	0.000	0.000	0.000
15	R	0.070	-15.008	14.995	-0.012	-15.001	-15.000	0.001
30	R	0.071	-30.008	29.995	-0.011	-30.001	-30.000	0.001

Calibrated By: [redacted]