

Horizontal AT Inclinometer System Manual

50333500

50333600

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Safety Guide



WARNING - Before using, read the entire user manual. After reading, store it in a safe place for future reference. Incorrect handling of this product could possibly result in personal injury or physical damage. The manufacturer assumes no responsibility for any damage caused by mishandling that is beyond normal usage as defined in this manual.

NOTE - The information in this manual is subject to change without notice. The manufacturer assumes no responsibility for any errors that may appear in this manual.

About the Symbols

Various symbols are used in this manual and on the product itself to ensure correct usage, to prevent danger to the user and other, and to prevent property damage. The meanings of these symbols are described below. It is important that you read the descriptions thoroughly and fully understand the contents.

Danger High Voltage



This symbol indicates information that, if ignored, could possibly result in personal injury or even death due to electrocution.



Warning

If these warnings are not observed, considerable physical injury or property damage may occur as a result of burns, electrocution, fire or injury.



Warning

When unit is connected via the charger to high voltage AC mains, the possibility of personal injury or even death due to electrocution.



Warning

Charge only indoors.



Warning

Do NOT charge when wet.

System Components

About Inclinometers An inclinometer system includes inclinometer casing, and a portable probe, control cable, and readout.

Inclinometer casing is permanently installed in a near-vertical or horizontal borehole that passes through a zone of suspected movement. The probe, cable, and readout are used to survey the casing.

The first survey establishes the baseline profile of the installed casing. Subsequent surveys will reveal changes in the profile if ground movement has occurred. Plotting these changes reveals the rate, depth, and magnitude of ground movement.

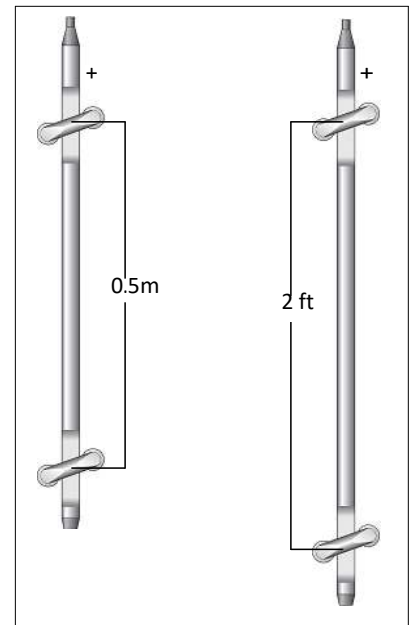
System Components The Horizontal Digitilt AT Inclinometer system includes an inclinometer probe, control cable, Bluetooth reel, cable gate, pull-cable, pull-cap and carabiner, the Digitilt Reader app for certified Android-based tablet or phone, and DigiPro2 software that runs on Windows.



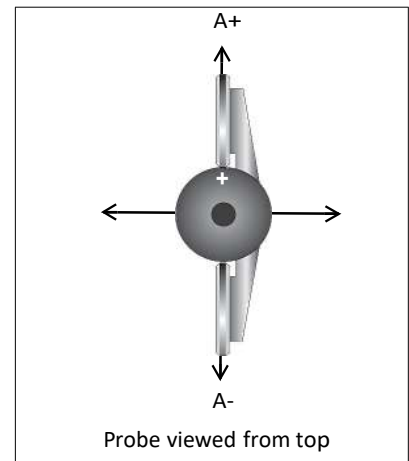
Inclinometer Probe The Horizontal Digitilt AT Inclinometer probe is supplied in metric and English versions.

The metric version has a gauge length of 0.5m. The English version has a gauge length of 2 feet.

A + mark is engraved on the body of the probe. Use this mark to orient the probe during a survey.



Measurement Axes The Horizontal AT Digitilt Inclinometer probe is used to obtain tilt measurements along the length of the casing. It has wheels that track the grooves in the casing. Always orient the probe so that the + mark is facing upwards. There is a tilt sensor inside the probe. The A-axis sensor measures tilt in the plane of the wheels.



When the probe is horizontal, the top + of the probe connector is tilted (raised) in the positive + direction, tilt reading values will be positive, and if the top + of the probe connector is tilted (lowered) in the negative direction below horizontal, tilt values will be negative.

Handling the Probe The inclinometer probe is a sensitive measuring instrument. Therefore, it must be Handled with care.

- Transport the probe in its carrying case, if applicable. If you drive to the site, carry the case in the passenger compartment, preferably on a passenger seat.

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- When transporting the system on site, if you use the clips on the reel to hold the probe, make sure there is slack in the cable or disconnect the probe from the cable to prevent damage to the cable caused by a too tight bend radius.
 - For systems with a removable probe, avoid over-tightening the nut when connecting the control cable to the probe, since this will flatten the O-ring and reduce its effectiveness.
 - When you insert the probe into the casing, cup the wheels with your hands to compress the springs and allow smooth insertion.

-
- When you withdraw the probe from the casing, again cup the wheels with your hands to prevent them from snapping out.
 - The probe is rated for temperatures from -20 to 70 °C (-4 to 158°F). Avoid using the probe in temperatures outside this range.

Control Cable

Control cable is used to control the horizontal location of the inclinometer probe. It also conducts power and readings between probe and reel.

- Metric control cables have half-meter graduations with labels every meter. The first graduation is 0.5 meters from the top wheels of the probe.
- English control cables two-foot graduations with labels every four feet. The first graduation is 2 feet from the top wheels of the probe.

Cable Gate

The cable gate is pushed onto the end of the inclinometer casing to serve as the reference for the depth graduations.

During the survey, successive cable graduations are locked into the cable gate to hold the probe steady for readings.



The cable gate is designed to fit three diameters of grooved inclinometer casing: 85, 70, and 48 mm (3.34, 2.75, and 1.9 inch). Please note that the cable gate will only work with 70 mm (2.75 inch) extruded inclinometer casing where the grooves extend beyond the nominal outside diameter of the casing.

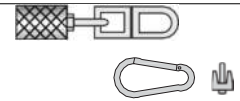
Inclinometer Casing

Inclinometer casing is a special purpose pipe used for inclinometer installations. Grooves inside the casing controls the orientation of the probe and provides a flat surface for tilt measurement. The casing is installed with one pair of grooves aligned vertically so that there is top groove and bottom groove.

Pull-Cap and Carabiner

A special pull-cap is supplied with the probe.

This cap is screwed onto either connector to allow attachment of the pull cable. A snap carabiner (snap clip) is also supplied with the probe. It is permanently attached to the pull cable, providing a quick way to connect and disconnect from the pull cap and probe. If you have more than one installation, you can order additional carabiners. The part number is 02750012.



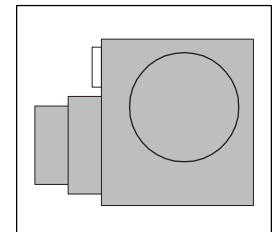
Pull Cable A stainless steel pull cable is used at the start of every survey to pull the probe to the far end of the casing. The pull cable is stored inside the casing when you leave the site.

We recommend that you buy a reel for the pull cable. It is important that the cable is not twisted or kinked.

The pull cable should be longer than the casing to allow easy handling and easy connection to a reel. When a dead-end pulley is used, the length of the pull cable must be doubled. It must go through the casing, around the pulley, and through the return pipe.

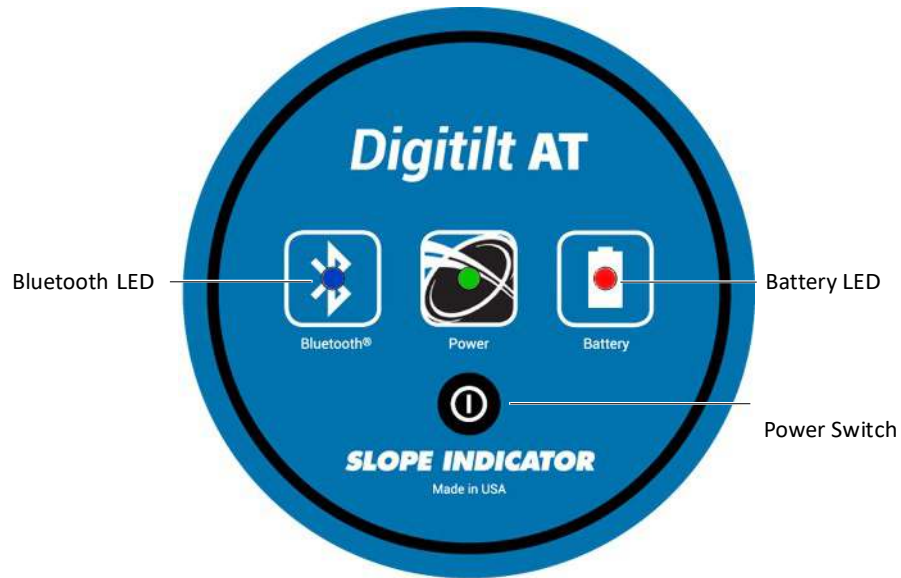
Dead-End Pulley When the far end of the casing is closed, a dead-end pulley and cable return pipe are installed so that the pull cable can be operated from the near end of the casing.

The dead-end pulley is not used when both ends of the casing are open.



Bluetooth Reel The Bluetooth reel transmits commands and readings between the Reader and the probe. A battery pack inside the reel powers both the reel and the probe.

Front Panel LEDs The front panel has three LED lamps and a power switch.



Power Switch & Power LED Press to switch on. Press again to switch off. The Power LED glows green when power is on.

Power is switched off automatically if there is no bluetooth connection for 5 minutes or if there is no communication between reader and probe for 10 minutes.

The power switch can also be used to reset the reel, if necessary. Check that the charge cable is disconnected, then press and hold the power switch for about 10 seconds. The Battery LED blinks once after the reset.

Bluetooth LED The Bluetooth LED blinks while the Bluetooth radio waits for a connection. Blinking is rapid at first and then slows. When a connection is made, the bluetooth LED glows a steady blue.

Battery LED The Battery LED stays off during normal use. A fully charged battery provides about 40 hours of operation.

If the battery charge is too low for operation, the Battery LED and Power LED blink rapidly for a few seconds and then turn off. Charge the battery as soon as possible.

Charging the Battery Plug the AC adaptor into a wall socket. Insert the barrel-plug into the charge socket on the back side of the reel.

The Battery LED first blinks and then changes to a steady red glow when the battery is charging. When the charging is finished, the green Power LED blinks slowly.

You can charge the battery every night. A charging circuit inside the reel limits charge time to 5 hours.

If the battery is fully discharged, a full recharge may take longer than 5 hours. In that case, it is possible to reset the charge timer by disconnecting and then reconnecting the AC adaptor.

The adaptor provides 12 Vdc. Polarity of barrel connectors is + inside and - outside.

Reader The Reader (readout device) is an Android tablet running the Digitilt Reader app.

Android Tablet: Not all Android devices can run the Reader app. Battery life varies with the device. We recommend that you charge the device every night. A typical survey requires 30 to 60 minutes. If you have a demanding survey schedule, an accessory battery pack or a second battery may be useful.

Digitilt Reader App: The Reader app is software that transforms the Android device into a full-featured inclinometer readout. The Reader app is available at <https://durhamgeo.com/downloads/android/digitilt-reader.apk>

DigiPro2 Software DigiPro2 is a Windows program that creates a database to hold inclinometer surveys and generate plots for data analysis and printing. To download DigiPro2 and the DigiPro2 manual:

1. Direct your browser to www.durhamgeo.com
2. Click Support > Resources > Downloads > Software.
3. The manual can be found at > Support > Resources > Downloads > Instrumentation manuals.
4. Run the setup program for DigiPro2.

Installation of Casing

Planning Site conditions vary widely, so these instructions are general rather than specific. Read through the instructions and then make a plan that is suitable for your site.

Casing Size Use either 70mm or 85 mm (3.34" or 2.75") casing. The current version of the horizontal probe (50333500 or 50333600) is compatible with both casing sizes.

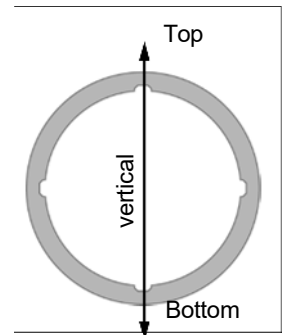
The retired version of the horizontal probe (50302910 or 50302900) requires 85mm (3.34") casing and cannot operate in 70mm casing.

Casing Type Slope Indicator's Standard casing is the recommended casing for horizontal installations. Couplings are glued, so ABS cement is required.

Slope Indicator's QC casing is less convenient. Couplings are harder to snap together, and this makes it difficult to control orientation of the grooves.

Telescoping sections are not needed and not recommended.

Casing Orientation Install the casing with one pair of grooves oriented vertically, so there is a top groove and a bottom groove. Accuracy degrades when grooves are off vertical by more than 3 degrees. Mark the outside of each section of casing to show where the top groove is. This lets you easily check the overall orientation of the casing during assembly and backfilling.



Check the verticality of the top and bottom grooves each time you add a length of casing. Use a plumb bob or carpenter's level.

Keep casing in shipping boxes and in the shade until it is used.

Review casing assembly instructions. Try joining two sections of casing to help predict possible problems.

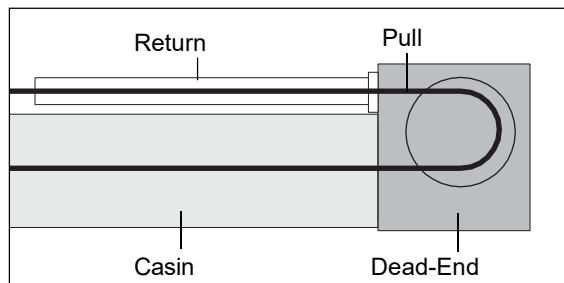
Use clean rags to plug ends of casing. Tie a string onto the rags, to avoid leaving a rag inside.

Pull Cable Pull cable should be longer than the casing to allow easy handling and easy attachment to a reel. If a dead-end pulley is used, the cable length must be doubled.

Put the pull cable on a reel so that it will not kink or carry sand and dirt into the casing.

Dead-End Pulley If the far end of the casing is closed, you must install a dead-end pulley and a return pipe. The dead-end pulley should be oriented vertically, so that the cable will stay on the pulley. That puts the return pipe above the casing, as shown in the drawing below.

Thus, it is probably easiest to assemble the casing first, working toward the pulley. When you reach the pulley, thread the pull cable through the pulley, and then assemble the return pipe, working away from the pulley.



Excavate the Trench Check that the fill has been compacted well before trenching.

Site specifications may suggest a width and depth for the trench, otherwise, make the trench at least 0.5m (1.5') wide and 0.6m (2') deep. A 3% grade is useful for drainage.

Check that the bottom of the trench is free from rocks or other hard materials.

Place a 150 mm (6 inch) layer of sand or other finely graded material on the bottom of the trench and tamp it well so that casing will be supported by a firm, flat surface.

Assemble the Casing Position the reel where you will begin assembly of the casing. Thread the pull cable through each section of casing as it is added.

Follow casing assembly instructions but consider that trenched installations do not require rivets or sealed couplings.

As you work, keep the inside of the casing as clean as possible. For example, placing cardboard under the casing to use as a work surface when you apply glue to casing and couplings and push the two together. Also, plug the end of the casing with a rag when practical.

Check the orientation of the casing (the verticality of the top and bottom grooves) after adding each section of casing. For best results, use a plumb bob or carpenters' level. Also, check the overall orientation of the casing by sighting along the marks you made on the outside of the casing. Keep in mind that it is very difficult - and requires many hands - to correct orientation problems later.

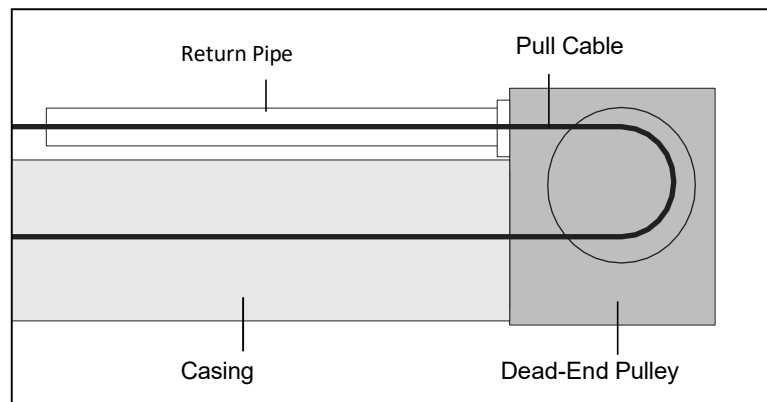
When assembly is complete, inspect couplings, and make check of the overall orientation of the grooves.

Install the dead-end pulley assembly, if required.

Installing a Dead-End Pulley

A dead-end pulley and return pipe for the pull cable must be installed when there is no access to the far end of the casing.

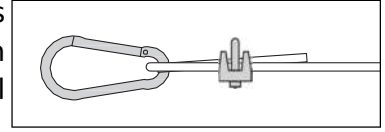
- Cut off the end of the casing, so that the full thickness of the casing is available.
- Orient the dead-end pulley so that the return pipe will be above the inclinometer casing.
- Thread the pull-cable through the dead-end pulley.
- Join the casing to the dead-end pulley using solvent cement and the screws provided.
- Thread the pull-cable into the first section of return pipe and continue assembling the return pipe, working away from the dead-end pulley.



Backfill the Trench 1. Tuck the pull cable into the casing and then plug the ends of the casing to prevent entry of sand and dirt.

2. Place sand or other finely graded material to the sides of the casing and then over the top of the casing to a depth of 150 mm (6 inches). Take care that you do not change the alignment of the casing as you place and tamp the sand.

3. Test that the probe can pass smoothly through the casing. Attach the supplied carabiner to the pull cable, as shown in the drawing.



4. Then screw the pull-cap onto the probe and snap on the pull cable. Refer to reading instructions for attachment of control cable, orientation of probe, etc.

5. Plug ends again and backfills the remainder of trench with finally graded material or select fill. Compact by hand.

6. Later, terminate the ends of the casing as specified by the project engineer. It is useful to place protective housing over the ends of the casing so that it cannot be vandalized.

Pairing Tablet & Reel

About Pairing

Pairing is normally a one-time process. During the pairing process, the tablet and the reel exchange Bluetooth IDs and store them in memory.

Pairing essentially gives permission to the tablet and reel to connect and communicate.

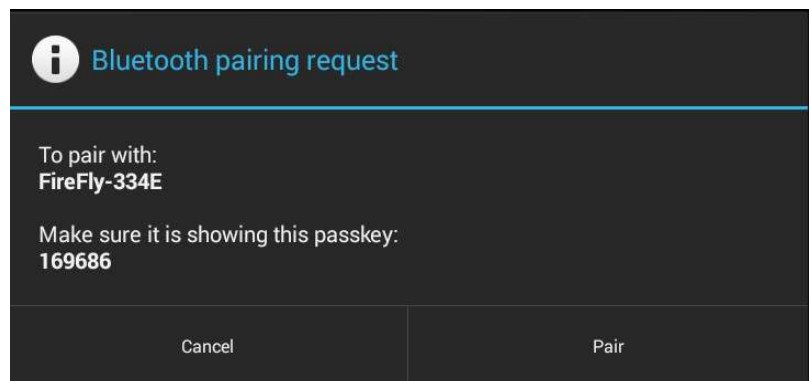
How to Pair

Switch on the Bluetooth reel. The blue LED starts blinking.

1. Switch on the tablet.
 2. Tap the “Settings” icon and find Wireless and Network.
 3. Enable Bluetooth.
 4. Enable “Search for devices.”
(If you don’t see this setting, try tapping the Bluetooth entry.)
 5. After a short delay, the tablet shows Bluetooth devices that are available for pairing. Each device has an ID or name.
 6. Tap the ID that matches the “Bluetooth” label on the back-side of the reel. The example at below shows FireFly-4DC9 as the Bluetooth ID.
7. The tablet will either:
- a. asks for a PIN. Enter 1234.



- b. shows the image below. Press “Pair”



8. Finally, look for a message confirming that the devices is paired.

Reader App Overview

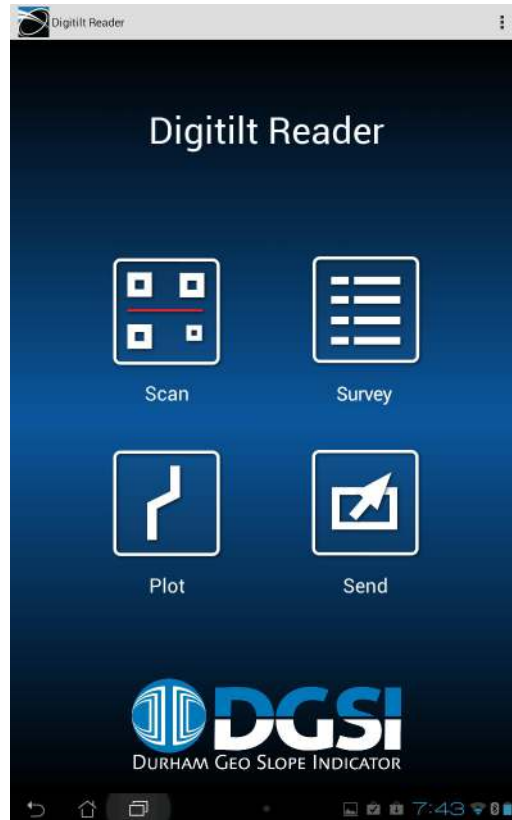
Digitilt Reader App

Tap the Digitilt Reader icon to open the app.

Scan: Tap to start a survey from a QR code.

Plot: Tap to show plots and data.

System Bar: Back, Home, Recent



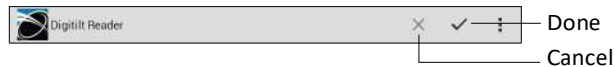
Action Bar: See below.

Survey: Tap to start a survey from the inclinometer list.

surveys by email or Dropbox.

Action Bar

Tap icon to take action. Icons vary with screen.



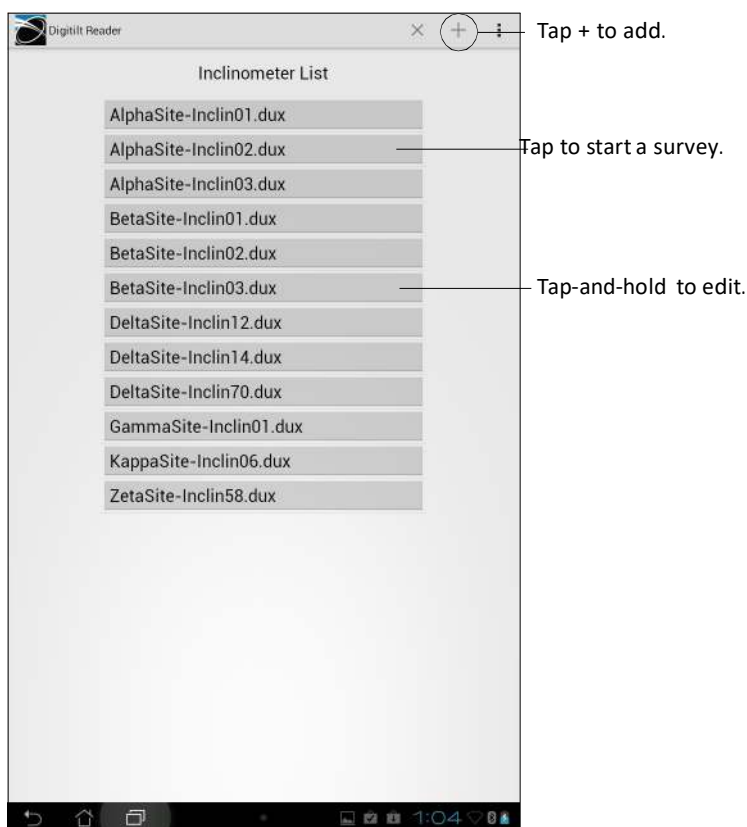
Adding an Inclinometer

The Inclinometer List

The Reader keeps a list of inclinometers along with the survey data for each inclinometer. To see the list, tap the Survey icon.



- To add an inclinometer to the list, tap +.
- To start a survey, tap the inclinometer.
- To edit an inclinometer, tap-and-hold the inclinometer.



Adding an Inclinometer

1. Tap “Survey” to display the list of inclinometers.
2. Tap “Add” to display an inclinometer form.



3. Make entries as explained below. If the keyboard hides part of the form, slide the form upwards with your finger.

A screenshot of the 'Add Inclinometer' form in the Digitilt Reader app. The form has a title bar with 'Digitilt Reader', a close button (X), a checkmark, and a list icon. The form fields are: Site (text input), Inclinometer (text input), Description (text input), A0 Direction (text input with value '0'), Units (dropdown menu with 'metric' selected), Display Unit (dropdown menu with 'mm' selected), Depth Unit (dropdown menu with 'm' selected), Interval (text input with value '0.5'), Top Depth (text input with value '0.5'), and Bottom Depth (text input). The form is titled 'Add Inclinometer'.

4. Tap “Done” when the form is complete.



Fields on the inclinometer form

Site & Inclinometer: These two fields are used together to identify an inclinometer. Each field can contain 12 characters. Spaces, punctuation, and special characters are not allowed.

Description: Optional.

A0 direction: Optional.

Compass heading 0 to 359. **Units:** Tap to switch between metric and English units. **Display Unit:** Tap to switch between mm and Digi-metric or between inch and Digi-English. Digi units are explained in a later chapter.

Depth Unit: Fixed to meters or feet.

Interval: Typically, 0.5 for metric and 2 for English.

Top Depth: Typically, 0.5 for metric and 2 for English.

Bottom Depth: Enter a multiple of 0.5 for metric systems or a multiple of 2 for English systems.

Note: The reader turns a field red if it finds an unacceptable entry. Check that you have entered no spaces, punctuation, or special characters. Also check that top and bottom depths are multiples of the interval.

Survey Basics

Overview An inclinometer survey consists of readings acquired from two passes of the probe through the inclinometer casing. The two passes are known as the 0 pass and the 180 pass, because the probe is reversed for the 180 pass.

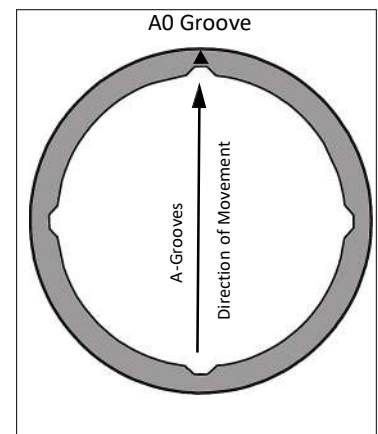
Each pass begins at the far end of the casing. The pull-cable is used to pull the probe to the far end. The control cable is used to position the probe for each reading.

If you have a partner working at the opposite end of the casing, you may need radios or cell phones to coordinate your activities.

Inclinometer Surveys During a survey, the probe is pulled from the far end of the inclinometer casing. This is called a “pass”. A complete survey consists of two passes, a 0 pass and a 180 pass.

A-Grooves Inclinometer casing is installed with one set of grooves aligned with the expected direction of movement. These are the “A” grooves.

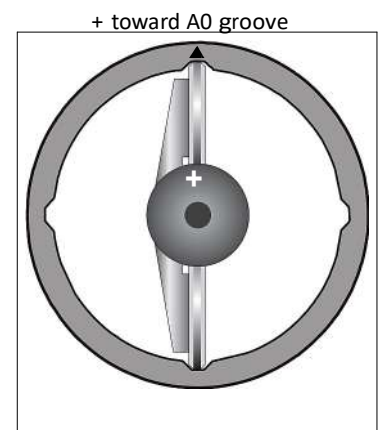
Only the A-grooves are used in the survey. The A0 groove is usually marked for easy identification.



Orientation of Probe for 0 Pass

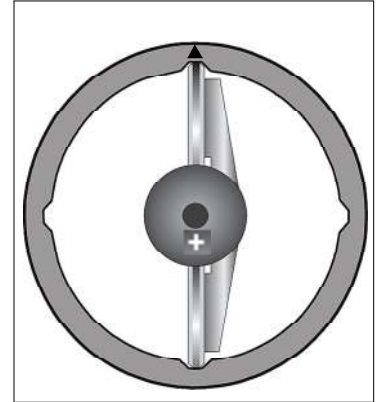
For the 0 pass, insert the probe with the + mark facing the A0 direction.

Ensure + mark appears on the body of the probe above the top wheels.



Orientation of Probe for 180 Pass

For the 180 pass, remove the probe, disconnect the cable and connect it to the other end of the of the probe. Move the pull cable to the end where the control cable was connected to previously. Rotate the probe 180°, (reverse) on y-axis with the + mark on top facing the A0 groove. Reinsert the probe.



Taking 0 Readings

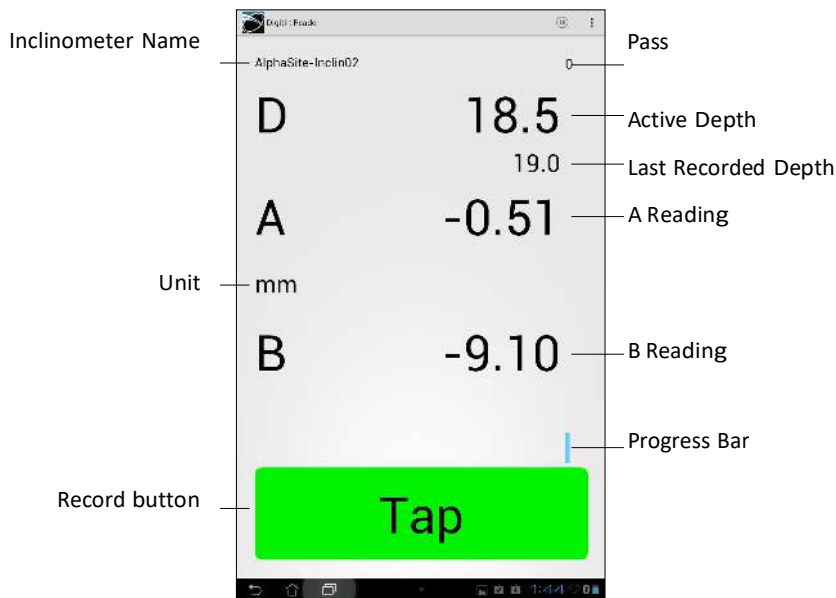
1. Remove protective caps from the ends of the probe. Screw the pull-cap onto closest port to the + mark. The connector is labelled on the top side of the probe body. Snap the carabiner from the pull cable onto the pull-cable cap.
2. Plug the control cable into the connector port without a mark. Gently tighten the nut. Avoid over tightening since this will flatten the O-ring over time and reduce its effectiveness.
3. Power on the readout (Android Device), and insert the probe into the casing, placing the fixed wheels in the bottom groove of the casing.
4. Pull the probe to the far end of the casing. Then use the depth marks on the control cable to precisely place the probe to start reading. The pull cable should be pulled tight.
5. Wait for the A-axis value on the Tablet computer to stabilize, then record the reading. Ignore the B-axis reading, since there is no B-axis sensor.
6. Release the pull cable and pull the probe to the next reading position, indexing the depth mark against the end of the casing (or some other reference). When the reading is stable, record it. The pull cable should be pulled tight again.
7. Repeat the previous step, taking readings at each prompted interval until the probe is at the near end of the casing. Then choose 'continue' on the Tablet computer.

Taking 180 Readings

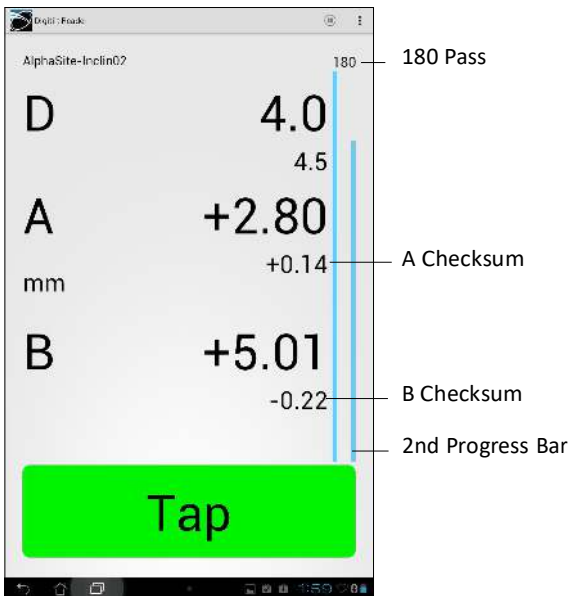
1. Withdraw the probe and swap connectors, attaching the pull cable to the connector without + mark and the control cable to the Connector with the + mark on top.
2. Insert the probe into the casing, oriented with the + mark facing upward.
3. Pull the probe to the far end of the casing. Then use depth marks on the control cable to place the probe at the same starting point as in the 0 pass.
4. Wait for the reading to stabilize, then record it. The pull cable should be pulled tight.
5. Pull the probe to the next reading position, indexing the depth mark just as you did in the 0 pass. When the reading is stable, record it.
6. Repeat the previous step, taking readings at each prompted interval until the probe is at the near end of the casing. Then choose "Done" on the Tablet computer.
7. (Optional). Use the Tablet computer to check that you have a good survey. See the Digitilt Reader manual for details.
8. Withdraw the probe. Unclip the pull cable and store it inside the casing. Lock the casing as required. Keep the pull-cable cap with the probe.

The Survey Screen The survey screen guides you through the survey.

0-Pass Screen The elements of the survey screen are explained below.

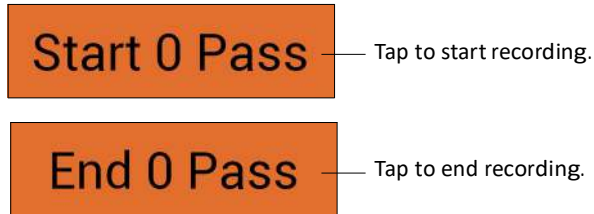


180-Pass Screen The 180-Pass screen adds checksums and a second progress bar.

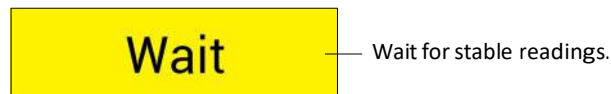


The Record Button The record button has multiple colors and functions.

Start & End The record button is orange at the start and end of each pass. Tap “Start” to enable recording. Tap “End” to disable recording. This prevents accidental recording of readings when you position the probe for each pass.



Wait The record button is yellow when readings are not stable. You can tap the Wait button to record a reading, if necessary.



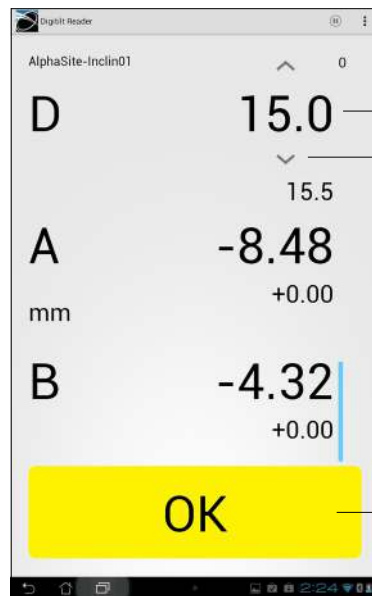
Tap or Pull The record button is green when readings are ready to record. Tap the button to save the reading. The button is dark green after readings are saved.



Changing the Active Depth

If cable depth and “active depth” get out of sync:

1. Tap & hold the active depth until arrows appear.
2. Tap the arrow to change the depth.
3. Move the probe to the new depth
4. Tap OK to resume the survey. The new “in-sync” readings over-write the previous “out-of-sync” readings.



1. Tap & hold the active depth.

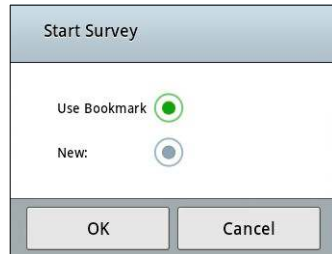
2. Tap arrow to change the depth.

3. Move the probe to the new depth, then tap OK to resume the survey.

Resuming an Interrupted Survey

The Reader keeps a “bookmark” with each recorded reading. If a survey is interrupted, the bookmark lets you resume from the last recorded depth.

1. Display the inclinometer list.
2. Tap the inclinometer to start a survey. A dialog appears.
3. Tap OK to start the survey from the bookmark. To abandon the bookmarked survey and start a new survey, choose New.

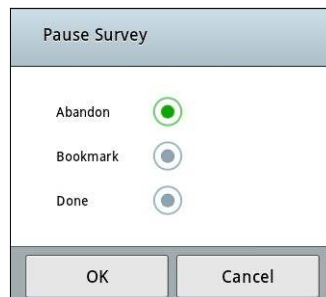


Halting a Survey

1. Tap Pause to halt the survey for any reason.



2. Make a choice, then tap OK.
Or tap Cancel to resume the survey.



Abandon: Deletes the current survey.

Bookmark: Sets a bookmark at the last recorded reading.

Done: Saves the current survey as is. This is useful if you are correcting a few readings and then want to stop.

Survey Run-Through

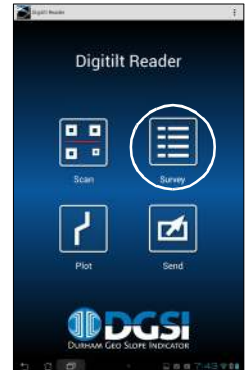
Set Up

1. Switch on Reel and Reader. Tap the Digitilt Reader icon to start the app. Wait for a steady blue glow from the Bluetooth LED to show that a connection has been made.

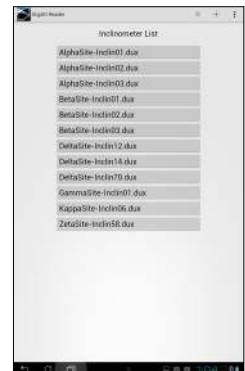


2. Tap "Survey."

You can switch between Tap mode and Hands-free mode at any time. The examples here show Tap mode.



3. Tap an inclinometer to survey.



4. The Reader displays the start depth for the survey.

Insert the probe, with + mark facing the A0 groove, and pull it to the far-end to start depth. If you are surveying below an active LNG tank, the probe should be pulled to the midway point. Once the wait time has passed, pull the probe to the far end.

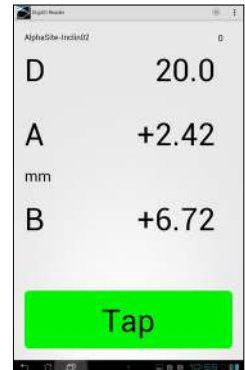


6. Wait ten minutes for temperature adjustment. You can switch off the Reader while you wait.

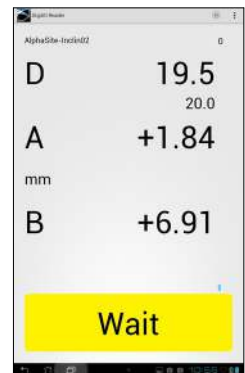
Run the 0-Pass 1. Switch on the Reader and tap
"Start 0 Pass."



2. The A and B readings appear (ignore B reading). Readings are stable, so the record button is green. Tap to record.



3. The Reader displays the next active depth. Pull the probe to this "depth" and pull the pull cable tight. Wait for a stable reading. The last recorded depth appears just below the new active depth.



4. Tap the record button when it is green.

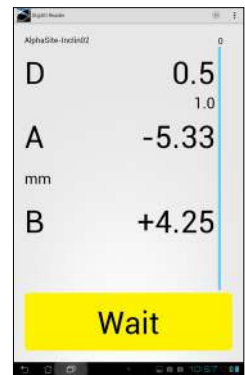
5. The Reader displays the next active depth. Pull the probe to this depth, wait for stable readings, and then tap the record button.

6. Repeat these operations until the probe reaches the top depth.

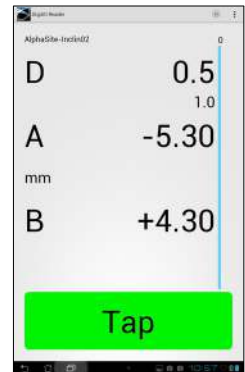


0-Pass continued

Now the Reader displays the top depth.
Pull the probe to this depth and wait for a stable reading.

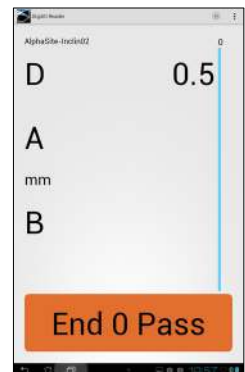


7. Tap when the record button is green.



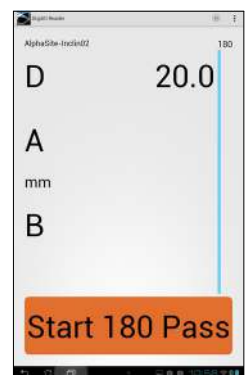
8. Tap End 0 Pass.

This disables recording so you can handle the probe.



9. Now the Reader displays the start depth for the 180-Pass. Recording is still disabled.

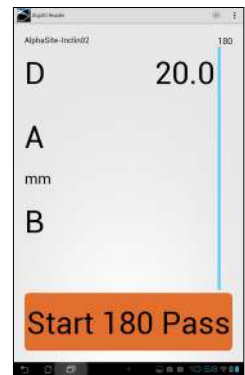
Remove the probe, rotate it 180 degrees (in reverse order), and insert it with the + mark on top and connected to the control cable. Pull it to the far-end to the start depth.



Run the 180 Pass

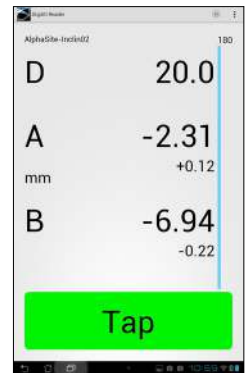
1. Tap “Start 180 Pass.”

This enables recording.

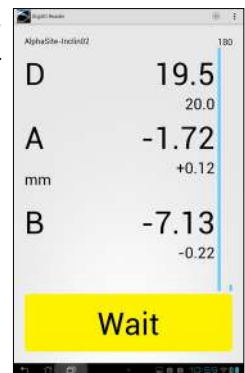


2. Tap the record button when it is green.

You can see checksums now.



3. The Reader displays the next active depth. Pull probe to this depth and wait for a stable reading.



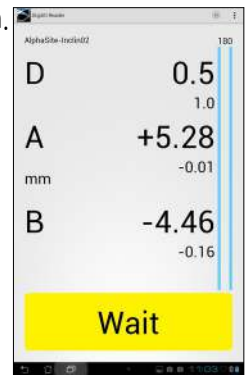
4. Tap the record button when it is green.

5. The Reader displays the next active depth. Pull the probe to this depth, wait for stable readings, and then tap the record button. Repeat these operations until the probe reaches the top depth.

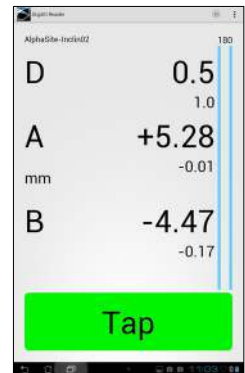


180-Pass continued

6. Now the Reader displays the top depth.
Wait for a stable reading.

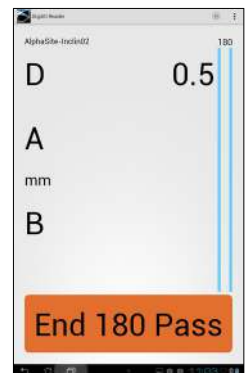


7. Tap the record button when it is green.



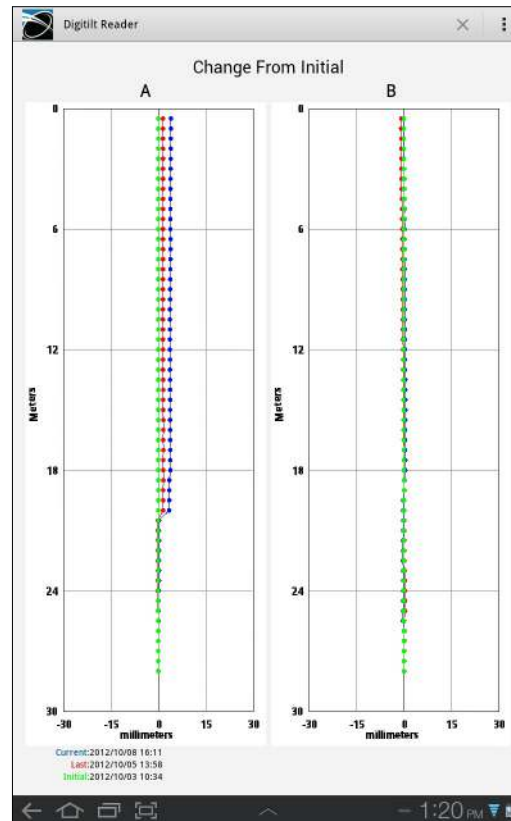
8. Tap “End 180 Pass.”

The survey is complete. The Reader saved readings during the survey so there is no need to save anything now.
When you tap the End button, the Reader takes you to the Plots screen.



Plotting Inclinometer Surveys

Introduction The Reader app can display four types of plots. These are useful for validating the survey. The Reader cannot print plots. Use DigiPro2 for that.



Checksums Checksums are the sum of the 0 and 180 reading at each depth. The ideal checksum is 0. In practice, checksums are typically some non-zero value. Checksum plots are displayed in the reading units used in the survey.

Change from Initial This plot shows changes in profile (cumulative displacement): current-initial, last-initial, and initial-initial (which plots on the 0 line).

Change from Last This plot shows change in profile from the last survey. Calculations are current-last and last-last (which plots on the 0 line).

Profile This plot shows the casing profile (cumulative deviation).

View Data

This shows a table of data. If your checksum plot shows a bad reading, look at the data table to identify the depth and pass (0 or 180) of the bad reading.

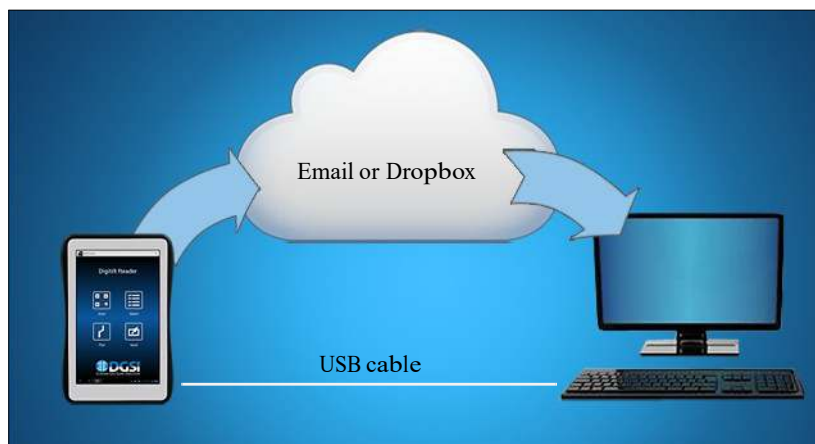
If you are still on site, you can reopen the survey and make the correction with the inclinometer probe. The steps are:

1. Tap and hold the depth of the bad reading.
2. Choose 0 or 180.
3. The Reader displays that depth and a live reading. Orient the probe for 0 or 180, insert it into the casing, and pull it to the depth displayed on the Reader.
4. Click OK to enable recording. Tap the record button to record a replacement reading. Continue upwards as needed or tap the "Pause" button to exit the survey.

Sending Data Files to a PC

Introduction Inclinator data files have a .dux extension. For convenience, we call them “dux” (Digitilt Uniform eXchange) files.

You can send dux files to the PC by email or Dropbox. Or you can transfer files by USB cable and a Windows file manager).



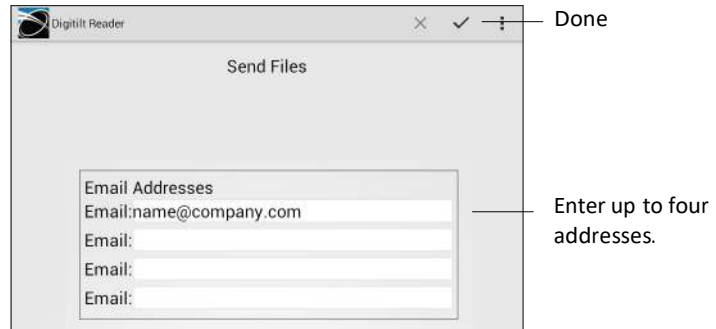
If you need to send files to the tablet or erase surveys from the tablet, please refer to the DigiPro2 User Manual.

Send by Email Email transfers require an internet connection and an email program. The instructions below assume you have a Gmail account, since that is usual with Android devices.

Set Email Recipients 1. Setup is a one-time task. Tap Options - Share.



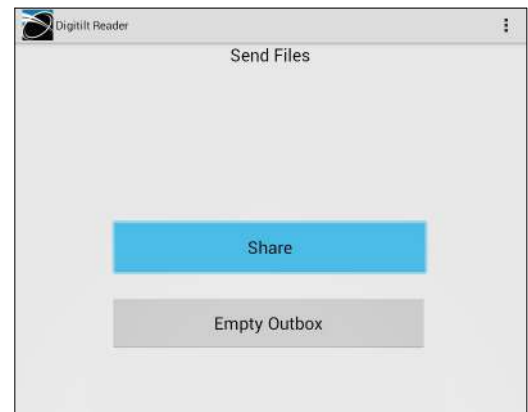
2. Enter one or more email addresses. Then tap Done.



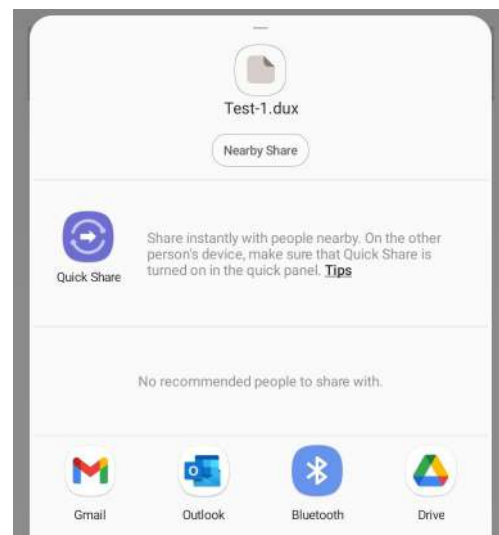
Sending by Email 1. Tap Send.



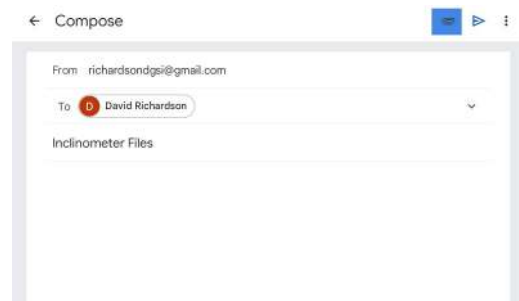
2. Tap Share.



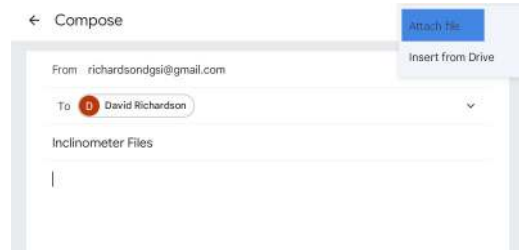
3. Tap Gmail.



4. Tap Attach icon.



5. Tap Attach File.



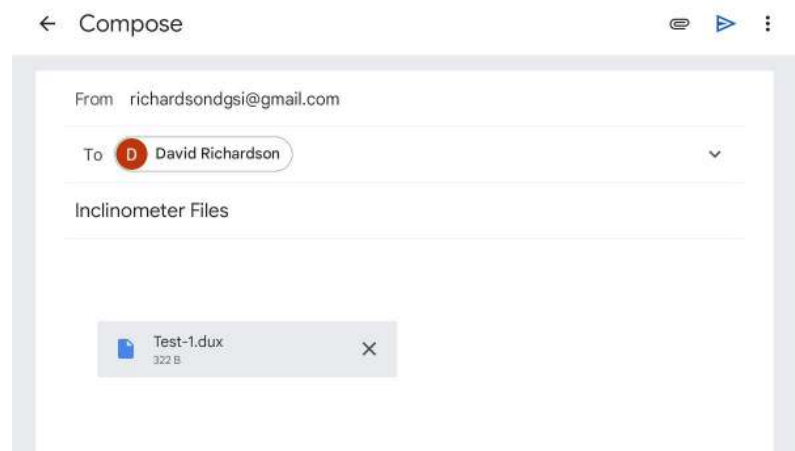
6. Navigate to Internal Storage > Download > Digitilt Reader > Outbox



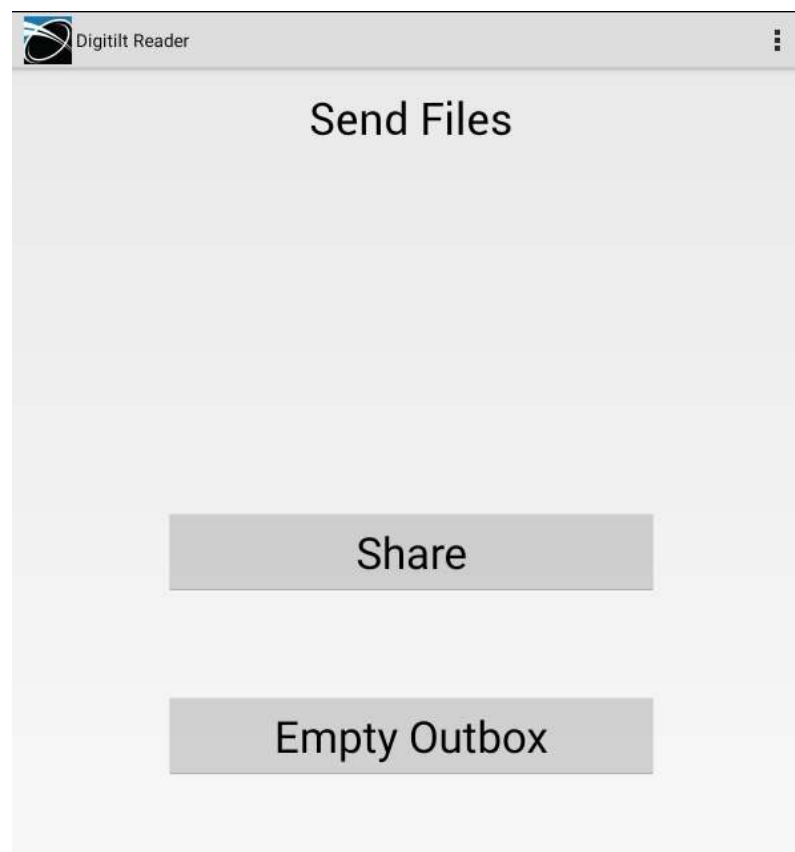
7. Select the desired file(s) to transfer and tap Done.



8. There will be one *.dux file for each inclinometer that was surveyed and they should now be visible as attachments to the email. Press the Send icon.



9. Once the surveys have been emailed, tap the Empty Outbox button to clear the Outbox folder so that only new surveys are sent after the next set of readings.



Send by Dropbox

Dropbox is a “cloud “service. Dropbox transfers are more automated than email transfers. No user actions are required. The dux files sent from the Reader simply appear in the Dropbox folder on your PC.



The convenience of Dropbox is well worth the time that it takes to set up. Other cloud services such as Google Drive can be set up in a similar way.

Set Up Dropbox

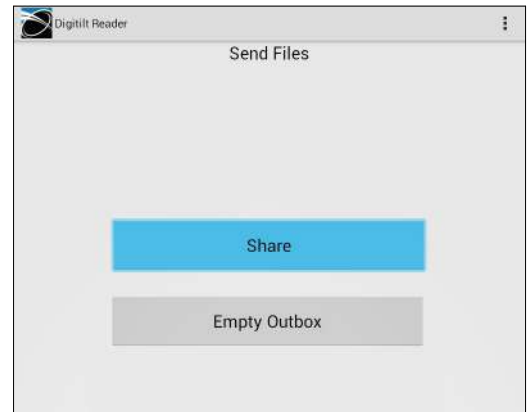
1. Visit Dropbox.com using your web browser. Create a free Dropbox account. Enter an email address for the User ID, then create a Dropbox password. User ID and password are used again in the next steps
2. Download Dropbox for Windows. Run the setup program and then log in to Dropbox, using your User ID and password. Now your PC is linked to Dropbox in the cloud.
3. If you are using DigiPro2, create a default import folder in Dropbox (See the DigiPro2 manual). Otherwise, just create a folder in Dropbox to hold the dux files.
4. Visit the Google Play store using your Android device. Search for Dropbox and install it. You already have a Dropbox account, so log in using your User ID and password. Now the Android device is linked to Dropbox, too.
5. The Dropbox file listing on your Android device now shows the folder you created in step 3. That is where the Reader app will send dux files.

Sending by Dropbox

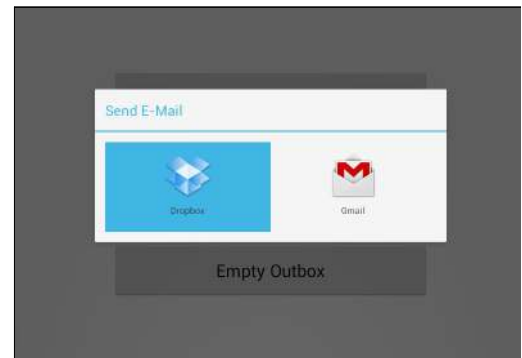
1. Tap Send.



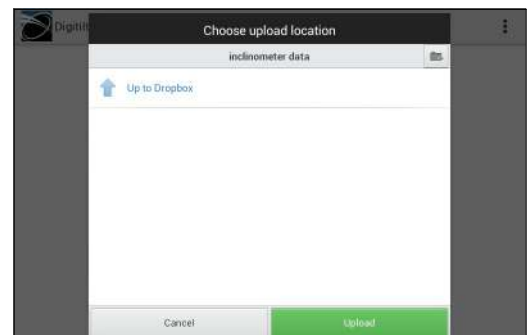
2. Tap Share.



3. Tap Dropbox.

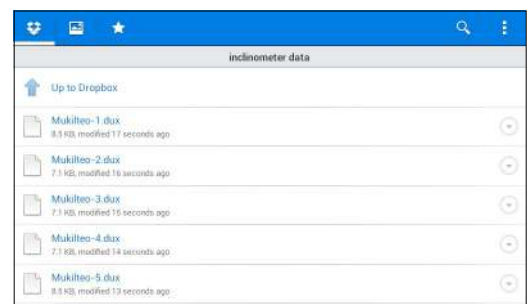


4. Tap Upload. The Reader uploads the dux files to the specified folder.

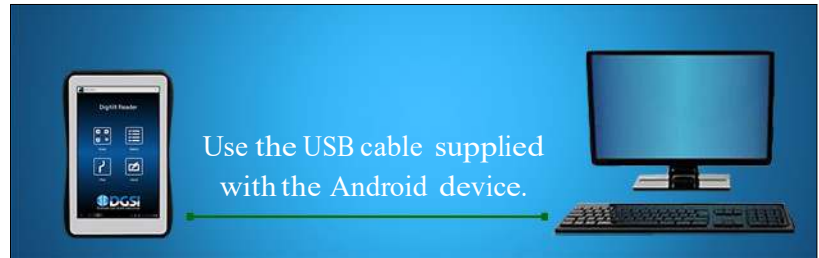


5. Soon afterwards, the files appear in the Dropbox folder on your PC.

(Look in My Documents).



USB Transfers This method requires the USB cable supplied with your Reader device and the Windows file manager (File Explorer).

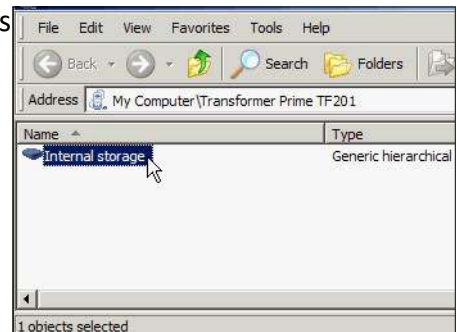


1. Connect the Reader to the PC using the USB cable.

Choose “Open device.”



2. The Reader device appears in the address line. Click on Internal storage.

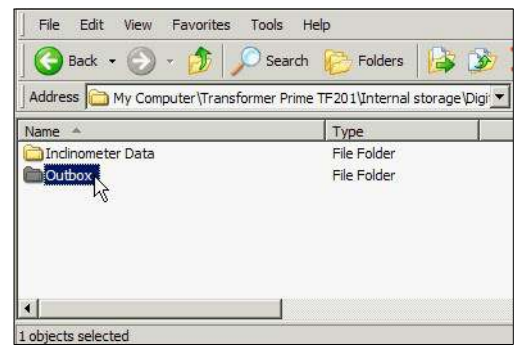


3. Click on the “Download” folder. Then click on the Digitilt Reader folder.

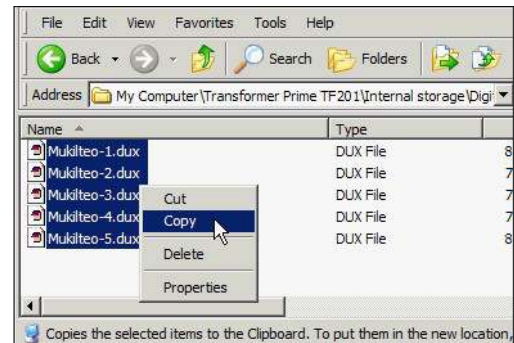


USB Transfers Continued

- Click on the Outbox folder. This folder holds any updated dux files.



- Copy all the dux files in the Outbox.



- Paste the files into a folder on your PC. If you are using DigiPro2, paste them into the default import folder.

Options Menu

Options Tap the Options icon.



Options icon

User A username is saved with the survey. Choose a name from the list. Tap and hold to edit the list.

Sound Choose the sound that the reader makes when you record a reading. You can add your preferred sounds by saving a sound file to the reader's Notification folder. The sound file will then appear in the list of selectable sounds.

Battery Displays battery level of the Reader, but not the Reel.

Probe Displays "live readings" from the probe. Tap the units label to specify different units (Keep in mind that metric units should be used with metric probes and English units should be used with English probes).

Share Set default email addresses for sending data files by email.

About Displays embedded serial number and firmware version.

Themes Light theme shows black text on a light background. Dark theme shows white text on a black background. Choose theme that provides best visibility.

Survey Control These settings can improve your surveys.

Stability: This is the variation allowed for stable readings. The default value is 6 sine units, equivalent to 0.03mm or .001 inch. The Digitilt DataMate - which is the defacto standard - uses a stability threshold that is two times larger. If your readings take a long time to stabilize, consider using a value up to 12.

Motion: When a reading exceeds this number, the reader app assumes the probe is in motion. Used for hands-free mode. If the reader fails to detect your pulls, try setting a lower number. Users who pull slowly need a lower number. Users who pull quickly can use a higher number. Normal values are 80 to 100.

If there is a lot of vibration at the site, tap mode may be your only choice, but you could try setting "motion" to a higher number and then make your pulls quick, rather than slow. The higher number decreases sensitivity to the ground vibration, but you must accelerate the probe faster so that a pull can be detected.

Tap Lockout: This tells the reader how long to display the "saved" message. During that time, the app will not accept new input. The default is 2 seconds.

Pull Lockout: Same as above but used for hands-free mode. Lock-out is more important for hands-free mode. Experiment to find the right lockout timing. New users may be more comfortable with a lockout of 3 seconds or more. Expert users who develop a rhythm may prefer a 2 second lockout.

Exit Turns off the Bluetooth connection and closes the reader app.

Inspection & Maintenance

Probe Inspection

Wheel yoke
(all systems)

Yoke does not return to fully extended position: If yoke is dirty, clean it. If the problem persists, spring may be broken or weak.

Wheel
(all systems)

Does not turn freely: Lubricate wheel bearings with light machine oil.

Connector keyways
(connector systems only)

Wear or corrosion: Worn keyway may degrade O-ring seal. Learn how to connect cable without “hunting.” Remove corrosion and change practice - allow connector to dry after use.

Connector O-ring
(connector systems only)

Flattened, split: Replace if flattened or split.

Connector pins
(connector systems only)

Bent pins: Bent pins are easily broken when straightened. Replacement of connector requires recalibration of probe. Change connection practice.

Probe Maintenance

Moisture Management
(all systems)

Wipe off the control cable and probe when you finish the day’s final survey. Do not store wet cloth with the probe.

Allow the connector to dry thoroughly: remove connector cap and allow connector to air-dry for a number of hours.

Lubricate the wheels. This helps displace moisture.

Wheels
(all systems)

Lubricate the wheels by applying drops of a light machine oil on the wheel bearings. Do not use WD-40 or any other lubricant spray that contains chlorinated solvents. Wheels should be lubricated at the end of each day of usage, prior to storage of the probe.

O-Ring
(connector systems only)

Lubricate regularly with O-ring lube or silicone-based grease. Do not use WD-40 or any other lubricant spray that contains chlorinated solvents.

**Connectors
(connector systems only)**

Clean connectors as necessary. Use a slim cotton swab moistened with alcohol. Be careful not to bend pins.

Do not use electrical contact cleaners, especially sprays. Solvents in these products will attack the neoprene inside the connectors. When attacked, the neoprene swells and reduces the effectiveness of the O-ring seal.

Storage (all systems)	Store probe in dry place. Be sure that the box is dry, the wheels are oiled, the connector is dry.
Control Cable Inspection Cable (all systems)	Twists: Twists indicate poor coiling technique. Change practice: do not pull the cable over the side of the reel - reel off and reel on. Worn markings: user is dragging cable through cable gate. Change practice - pull cable out then up. Kinks and/or gouges: if kinks do not straighten, there is probably internal damage and the likelihood of intermittent reading failures. If any deep gouges, water can enter cable. In both cases, bad sections of cable must be removed, either by shortening the cable or replacing the cable
Connector key (connector systems only)	Wear: Change connection practice - use witness marks. Corrosion: Remove corrosion and change practice - allow connector to dry after use.
Connector rubber insert (connector systems only)	Swelling, poor seal: Rubber swells when attacked by WD-40 or contact cleaners. Swelling may prevent good seals and allow water to enter connector. Return for service if sealing is compromised.
Connector for Probe (connector systems only)	Check O-ring: Do not disassemble this connector. Requires about two hours and a pressure test to reassemble.

Control Cable Maintenance

Moisture Management (all systems)

Wipe off the control cable as you draw the probe up on the last run of the day.

When you return to the office, remove connector caps and allow connectors to air-dry for a number of hours.

Cable (all systems)

When necessary, rinse cable (but not connectors) in clean water or wash the cable in a laboratory-grade detergent, such as Liquinox.

Do not use solvents to clean the cable. Do not submerge the reel.

Connectors (connector systems only)

If it is necessary to clean the connector, use a cotton swab moistened with alcohol. Sockets can be cleaned with a brush.

Do not use spray lubricants or electric contact cleaners. Solvents contained in such products will attack the neoprene inserts in the connectors.

Technical Details

Reading Units The Digitilt AT stores tilt readings as $100000 \times \sin(\theta)$, where θ is the angle of tilt. During the survey, the Reader app displays the following units:

Metric Units • MM of deviation, assuming a 500 mm gauge length.
• Digi-metric, $25000 \times \sin(\theta)$, the metric unit displayed by the Digitilt DataMate readout.

English Units • Inches of deviation, assuming a 24-inch gauge length.
• Digi-English, $20000 \times \sin(\theta)$, the English unit displayed by the Digitilt DataMate readout.

Inclinometer “dux” Files The Digitilt Reader app creates a file for each inclinometer. The file has a .dux extension. For convenience, it is called a dux file. The dux file contains the parameters of the inclinometer (depth, etc.) and all the surveys for that inclinometer. New surveys are appended to the end of the file.

Folders The Digitilt Reader app creates the following folders within the Android system “Download Folder:”

Digitilt Reader: Top Level folder.

Inclinometer Data: This folder holds all the inclinometer (dux) files. The Reader app scans the Inclinometer Data folder to create its list of inclinometers.

Outbox: This folder holds a copy of any dux file that has been updated with a new survey. All the file transfer methods use files from the Outbox folder.

System: Holds the system files. It contains the bookmark file which allows any interrupted survey to be restarted with no loss of data. Most files are machine-readable, not human-readable.

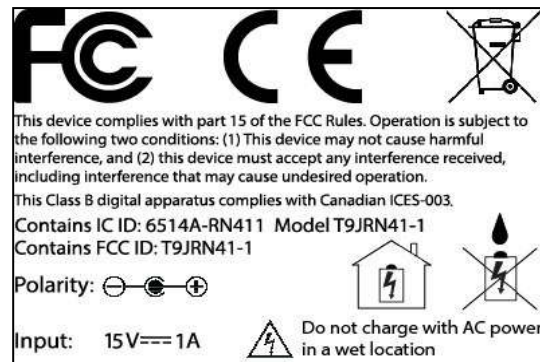
File Management The final repository for your inclinometer data should be a database on your PC or network. The .dux files on the Reader should be regarded as temporary, not long term.

Inclinometer Data: This folder holds the “original” files. As mentioned above, the Reader scans the inclinometer folder to create its list of inclinometers.

- If you want two Readers to have the same list of inclinometers, copy the dux files from one Reader to the other.
- If you want to remove an inclinometer from the list, delete its dux file in the Inclinometer data folder.

Outbox: After you transfer the files from the Reader to the PC, you can delete the files in the Outbox, either with the “Empty Outbox” button on the Reader or via a file manager.

FCC notice The Digitilt AT system reel contains a Bluetooth wireless module: FCC ID T9JRN41-1. The module label may be viewed by removing the Reel control panel.



Regulatory Notices

FCC Statement Warning

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

- 1 - This device may not cause harmful interference, and
- 2 - this device must accept any interference received, including interference that may cause undesired operation.

WARNING

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

For Customers in CANADA

NOTICE: This Class B digital apparatus complies with Canadian ICES-003

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.