

Inclinometers

Inclinometers are used to monitor subsurface deformation. The basic components of an inclinometer are:

1. Inclinometer casing: This component is permanently installed in a borehole. The casing has internal grooves that control the orientation of the measuring device (the probe).
2. Probe & Readout, such as the Digitilt AT system. These components are used to survey the inclinometer casing. The first survey records the initial profile of the casing. Subsequent surveys are compared to the initial to reveal the magnitude, depth, direction, and rate of any ground movement.

The Digitilt AT System

The Digitilt AT system includes the mems-based AT inclinometer probe, a control cable mounted on a reel, a cable gate, and a tablet that runs the Digitilt Reader App.

Probe: The probe is two feet long with a set of wheels at each end. It is used to survey the length of the inclinometer casing at two-foot intervals.

Control Cable: The cable is used to control the depth of the probe during a survey. It has numbered graduations and indexing crimps every two feet.

Cable Gate: The cable gate fits onto the top of the casing. It has a socket for the indexing crimps and provides precise depth control.

Bluetooth Reel: The reel holds the control cable and the rechargeable batteries that power the probe. Fully charged batteries can power the probe for about 40 hours. The front panel of the reel has a power switch and LEDs for Bluetooth, power, and battery.

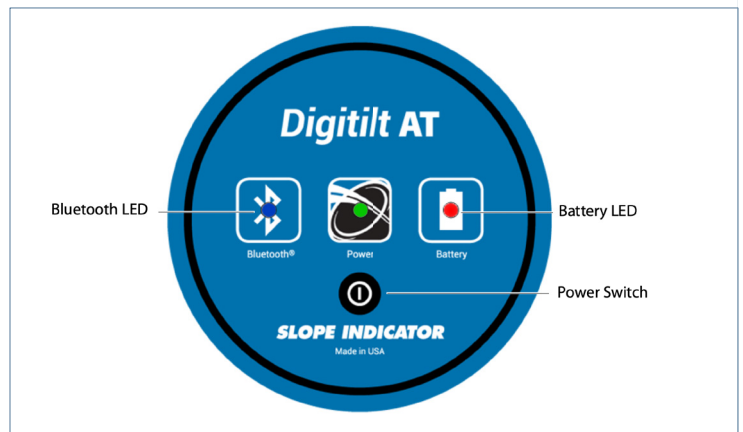
Tablet: The tablet runs the Digitilt Reader App. The tablet is paired with the Bluetooth reel. Battery life varies with screen brightness and tablet specifications.

Digitilt Reader App: The reader app stores a list of inclinometer installations and is used to record each survey. It also displays simple profile plots and checksums.

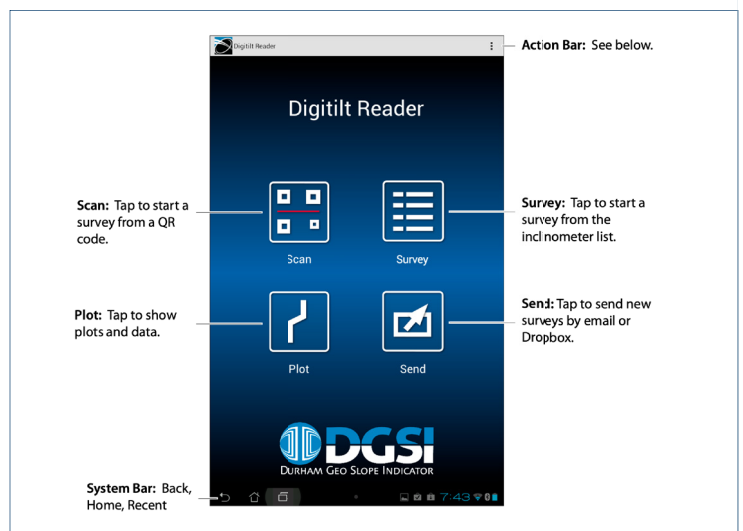
DigiPro2 Software: This optional software for Windows PCs creates inclinometer databases, manages inclinometer data, generates and prints plots and reports, and provides advanced routines for identifying and correcting any systematic errors.



Digitilt AT reel and probe, cable gate, and tablet with Digitilt Reader App



Reel has a power switch and LEDs for bluetooth, power, and battery



Main screen of the Digitilt Reader App

Basic Survey Procedure

Set Up

1. Bring a plastic tarp and a rag with you. The tarp can keep the wet control cable clean. The rag can dry the probe and cable after the survey.
2. Remove the cap from the inclinometer casing. Identify the A grooves, which may be marked with paint or a notch.
3. Insert the probe into the A grooves while holding onto the cable. Check that you have oriented the probe correctly for the 0 pass.
4. Slip the cable gate onto the casing and lock one of the indexing crimps into the cable gate socket.
5. Power on the tablet, start the Reader app, and choose the appropriate inclinometer. It will display the bottom depth.
6. Lower the probe to the bottom depth and wait five or ten minutes to allow the probe to adjust to the temperature inside the casing. Power off the tablet while you wait.

Record the 0 pass

1. Power on the tablet and tap “Start 0 Pass”. You’ll see readings for both the A and B axes. When the readings are stable, the Record button turns green. Tap to record.
2. The Reader now displays the next depth. Raise the probe to this depth. Wait for the green Tap prompt. Tap to record.
3. Repeat this process for each depth, checking that the reader depth and cable depth are in sync.
4. After recording the top depth, tap End 0 Pass. Hold onto the cable, remove the cable gate, and withdraw the probe.

Record the 180 pass

1. Rotate the probe 180 degrees, insert it into the A grooves, and replace the cable gate.
2. Lower the probe to the bottom depth and tap “Start 180 Pass.”
3. Repeat the same steps as in the 0 pass. When you have reached the top depth, record it and then tap End 180 Pass. The survey is saved automatically.
4. The Reader will then display the Plots screen allowing you to check the survey.

User Manual

If you don’t have the user manual for the Digitilt AT system, download it from the DurhamGeo Website: <https://bit.ly/3AN46Xn>

Supplementary Notes

Create a list of inclinometers, page 12

The manual uses “Inclinometer” to refer to the inclinometer casing in the ground. Use the Reader App to create a list of your inclinometers. When you run a survey, you’ll start by choosing one of the inclinometers on the list.

You’ll need to enter a top depth and bottom depth for each inclinometer. Also pay attention to units, which should be English, inches, and mm.

A-Grooves & Orientation page 13

Each survey requires two passes through the casing. The first pass is called the “0” pass and the second pass is called the “180” pass because the probe is rotated 180 degrees for the second pass. Both passes begin from the bottom of the inclinometer. Both passes use the A set of grooves. The B grooves are not used at all.

Look at the illustrations that show the proper orientation of the probe for each pass. Improper orientation is the most common mistake made in inclinometer surveys.

Survey Screen, page 14

This section shows you some screen shots and explains what you’ll see during a survey. The screen shots show metric values, but you’ll be using English values with depths in feet and readings in inches.

Survey Mode

There are two modes for recording a survey: (1) tap mode which involves tapping the screen to record a reading, and (2) hands-free mode which senses cable movement to record a reading.

You’ll probably want to use the default “Tap” mode to start with. Hands-free mode comes with a learning curve and a little frustration, but can be useful if you are wearing gloves or working alone.

Survey mode is set from the options menu at the top of the main screen. See page 33.

Supplementary Notes continued

Survey Run-Through, page 18

This section shows an abbreviated run through of a complete survey and explains how you start and end the “0” pass, and then start and end the “180 pass.

Plotting Surveys, page 23

This shows the simple plotting that is available with the Digitilt Reader App. It is really useful when you are in the field to verify that you obtained a good survey. The Reader app cannot print surveys.

Sending Data to a PC, page 23

You’ll probably want to print the graphs. This requires transferring the surveys to a Windows PC and using DigiPro 2 graphing software.

There are several ways to transfer data: email, direct connect, and dropbox.

DigiPro 2 graphing software

DigiPro 2 graphing software is not included with the rental, but DGSi generously offers a trial version on their website.

The trial version provides 45 runs, which may meet your short-term needs. Longer term, you may decide to purchase it. The download link is <https://bit.ly/3MvrqxM>