CATH-TECH

CP Survey Instruments

Operation Manual for Hexcorder Pro

CIPS/DCVG Survey Instrument

Cathodic Technology Ltd.

15-1 Marconi Court

Bolton, Ontario

Canada L7E 1E2

Ph: ++1-905-857-1050

ctl@cath-tech.com

www.cath-tech.com

ISO 9001:2015 CERTIFICATION ™

Intertek

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Limited Warranty

All Cathodic Technology Limited (Cath-Tech) instruments and equipment are warranted against defects in materials, design or workmanship for a period of two years from date of sale. This warranty excludes damage due to misuse, abuse, tampering or acts of God such as fires, floods, wind damage, lightning etc.

We will repair or replace at our option any defective component, after examination in our manufacturing facility, if the fault is due to defective materials or labour, within two years of the purchase date. For warranty repair, a Returned Goods Authorization (RGA) must be obtained from Cathodic Technology Ltd prior to shipping the defective unit pre-paid to our location.

Note: ***There is no warranty expressed or implied on batteries.***

Cath-Tech Policy

- Cath-Tech extends a two-year in use warranty on all units, which have been designed and manufactured by Cath-Tech.
- Cath-Tech reserves the right to make any changes in design or specification which it deems an improvement, with no liability to make the same changes on existing equipment.
- This warranty is in lieu of all other warranties or guaranties, expressed or implied, which might otherwise exist. The purchaser is relying only upon this guarantee and not upon any representations not herein expressed.
- Any material or equipment being returned to the factory must first have a Returned Goods Authorization (RGA) from Cath-Tech.

Cathodic Technology Limited cannot offer support or warranty coverage for user-supplied tablets. Cathodic Technology Limited is not responsible for any damage or issue caused to a user-supplied tablet while using the Hexcorder Pro.

Tablet User Account

The Xplore tablet is provided pre-configured for use, with the Hexcorder Pro app installed. The tablet is configured to a unique Google account created specifically for it, named as SERIALNUMBER@gmail.com. The user may opt to change the account if they wish.

Welcome

Thank you for selecting the Hexcorder Pro CIPS and DCVG survey instrument.

The Hexcorder Pro utilizes GPS for synchronization with current interrupters and other data logging equipment. This ensures that everything happens at the same time no matter how far apart equipment is or how long it has been out in the field. GPS coordinates are logged for each reading and stored to memory.

Open and inspect your Hexcorder Pro upon receipt. If any damage occurred during shipping, file a claim with the carrier immediately.

The Hexcorder Pro comes complete with:

- Hexcorder Pro on mounting plate with GPS antenna
- Rugged Xplore Android tablet (if applicable)
- Wire dispenser/chainage counter assembly, either hip pack or back pack
- Hexcorder Pro to wire dispenser cable (attached to back pack or in the box for hip pack)
- Battery charger
- 2 x $Cu/CuSO_4$ half cells
- 2 x half cell extension poles
- 2 x Hexcorder Pro to survey pole cables
- Spool of 32AWG survey wire
- 4 point harness
- Hip pack strap (if applicable)
- Carrying case
- Mini USB cable
- Operation manual
- Information CD

Figure 1 - Hexcorder Pro with Hip Pack

Figure 2 - Hexcorder Pro with Backpack

Testing & Calibration

This instrument has been thoroughly tested at the factory to ensure it will perform correctly. A certificate of calibration is included. The calibration is traceable to the National Institute of Standards and Technology (NIST) or the National Research Council of Canada (NRC). The certificate of calibration is valid for one year from the date of issue. The Hexcorder Pro requires re-calibration on a yearly basis; contact Cath-Tech for more information.

Charging the Battery

The battery inside the Hexcorder Pro box is the latest generation of rechargeable Lithium Ion battery, rated for 9000mAh. High quality Samsung-brand lithium cells are used. Do not allow

the battery to freeze, also do not store in a hot location. Fully charge the battery before storing long-term.

It is recommended that you charge the battery for 24 hours upon receiving the unit. When the charger is connected and the Hexcorder Pro is charging, a red LED on the control panel will light up. When charging is complete, this LED will turn green. When connected to the tablet, the Hexcorder Pro will display the battery life near the top right corner as a percentage. The Hexcorder Pro will automatically power down when the battery has been fully depleted.

The tablet also includes rechargeable Lithium Ion batteries, which require charging prior to use. The charging port is located behind a water-tight door on the right-hand side of the tablet (SeeFigure 6). Under normal survey use (100% brightness, screen always on, Wi-Fi turned off) the battery will last approximately 11 hours. Additional external batteries and a reconditioning charger are available for purchase if a longer run time is needed. External battery packs can be changed without shutting the tablet off.

GPS Engine

A standard GPS engine/antenna is supplied with the Hexcorder Pro. It is capable of resolving position information with an accuracy better than 3 meters if the WAAS differential correction is being received (within USA). Optional sub-meter GPS accuracy is available upon request.

The GPS engine is connected to the Hexcorder Pro by a metal circular connector on the outside of the case.

Normally the GPS will lock within 5 minutes, however, if the GPS has been moved far from its last position, has not been used for a long period or if the signal is weak, it may take up to 10 minutes to lock.

If the GPS engine will not lock;

- Place it in a position that has a good view of the sky in all directions, on the roof of a parked car is usually good
- Power on the Hexcorder Pro
- Leave it alone for 10 minutes or so
- Usually the GPS will lock in this situation

Figure 3 - GPS Engine / Antenna

If the GPS loses lock while in survey mode, this is not a problem. The PPS (Pulse Per Second) signal will be internally generated by the receiver's real-time clock and the ON/OFF measurements will still be accurate. The GPS will typically regain lock long before timing drift has any influence on the recorded data.

NOTE: The Hexcorder Pro uses the UTC date and time supplied by the GPS satellite system. The displayed time and time stored in the data can be set to your local time zone in the "parameters" screen, accessed from the Settings tab.

Connections

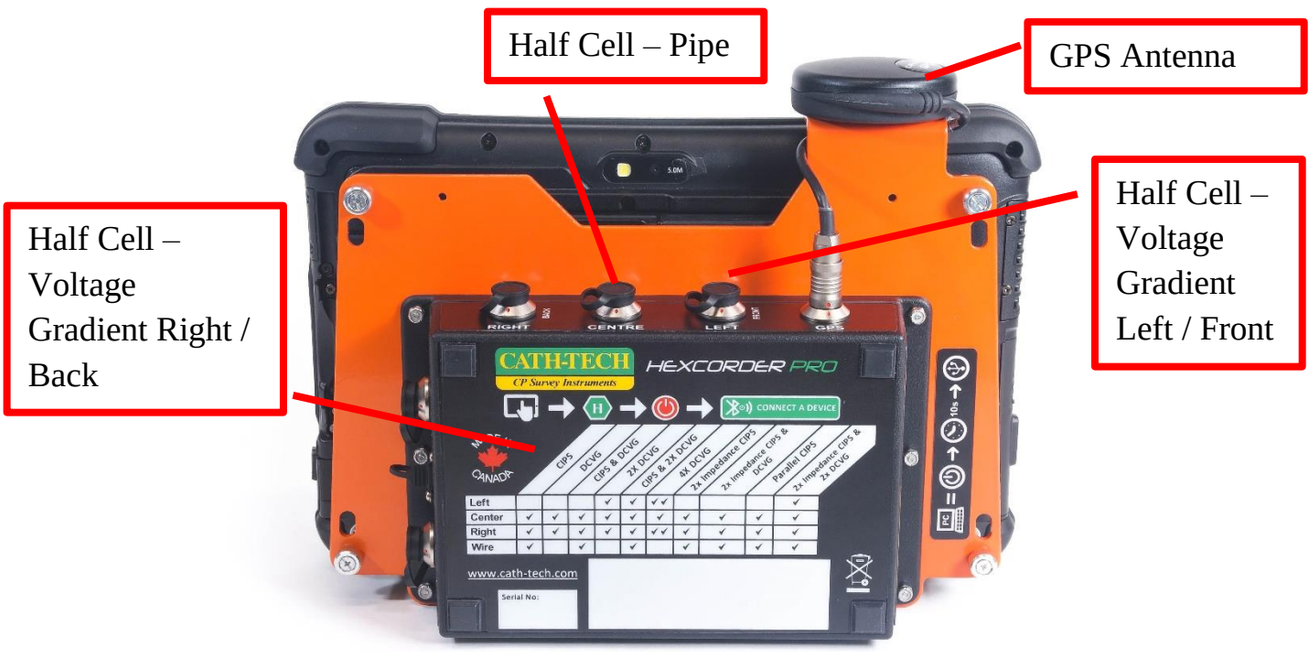


Figure 4 - Hexcorder Pro assembly - Bottom view

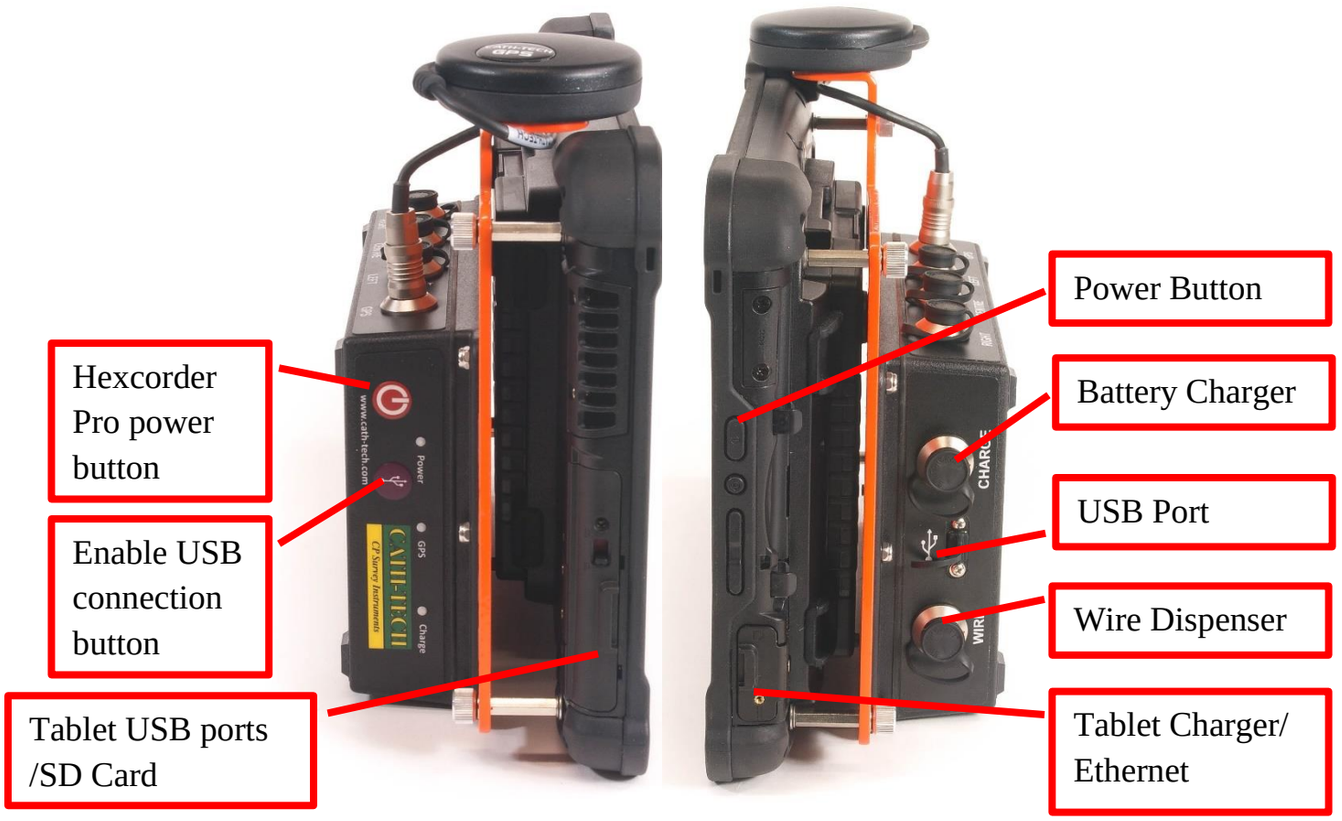


Figure 5 - Hexcorder Pro assembly - left view

Figure 6 - Hexcorder Pro assembly - right view

Threading the Wire

From the spool, the wire passes through the plates of the lower tensioner. Then the wire is wound clockwise around the drum twice. Finally, it passes through the plates of the upper tensioner and out the side of the wire dispenser to be attached to the pipe at the test station.

Connect the lead from the bottom of the spool to the terminal at the base of the wire dispenser.

The wire has a fine enamel coating on it that must be removed with sandpaper to make a good electrical connection.

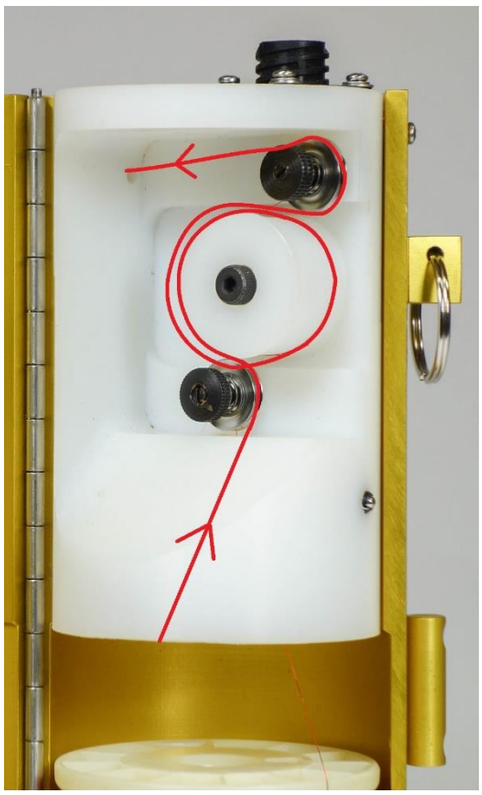


Figure 7 - Wire path through chainage counter

Figure 8 - Two-man survey crew using Hexcorder Pro

Setting Up

To turn on the Hexcorder Pro, press the red power button on the left side of the case. Turn the tablet on by pressing the power button on the right side of the tablet. Hold the power button for 5 seconds to turn the Hexcorder Pro off.

Important Note:

The Hexcorder Pro should be powered on only when you are ready for it to be connected to the tablet; too much idle time and the Bluetooth will no longer be "findable". Simply power cycle the Hexcorder Pro if this occurs.

Run the Hexcorder Pro app from the tablet home screen.

Figure 9 – Hexcorder Pro app icon

Connecting to Tablet

In the app, select the "CONNECT A DEVICE" button, the Select Device window will appear. Select the Hexcorder Pro, identified by its serial number as the Bluetooth name. A connecting window will appear and then disappear when successful. The app will now show the status of the Hexcorder Pro unit (serial number, status icons, and battery power) near the top right corner.

Important Note:

When the app attempts to turn on the tablet Bluetooth receiver, the app will ask for permission to use your "Location". It is required that you allow the app permission otherwise the Bluetooth receiver cannot scan for local Bluetooth devices.

Using Another Tablet

For the best user experience, we **strongly recommend** only using the rugged Android tablet supplied by Cath-Tech. The app can run on other tablets, however battery life, water resistance and daylight readability are not optimal. The minimum specifications to run are Android 6.0 with screen resolution of 1366 x 768 or better, and a 10" diagonal screen size. The tablet must also have Bluetooth 2.0 or better to communicate with the Hexcorder Pro box.

Tablet and App Language

Multiple languages are implemented in the Hexcorder Pro app. They are activated by switching the tablet language to the desired language. If the language selected is supported by the app, it will automatically change. If the language is not supported by the app, it will remain in English.

To change the language on the tablet, select the Settings (gear icon), scroll down to the Personal section, select "Language & Input" and select the first option "Language", then select your desired language from the list. Re-open the Hexcorder Pro app to see the chosen language implemented.

Survey Configuration

Before a survey can be performed the Hexcorder Pro must be configured for the type of survey to be done. The Hexcorder Pro will recall the previous survey settings. Settings are accessed and edited via the SETTINGS tab.

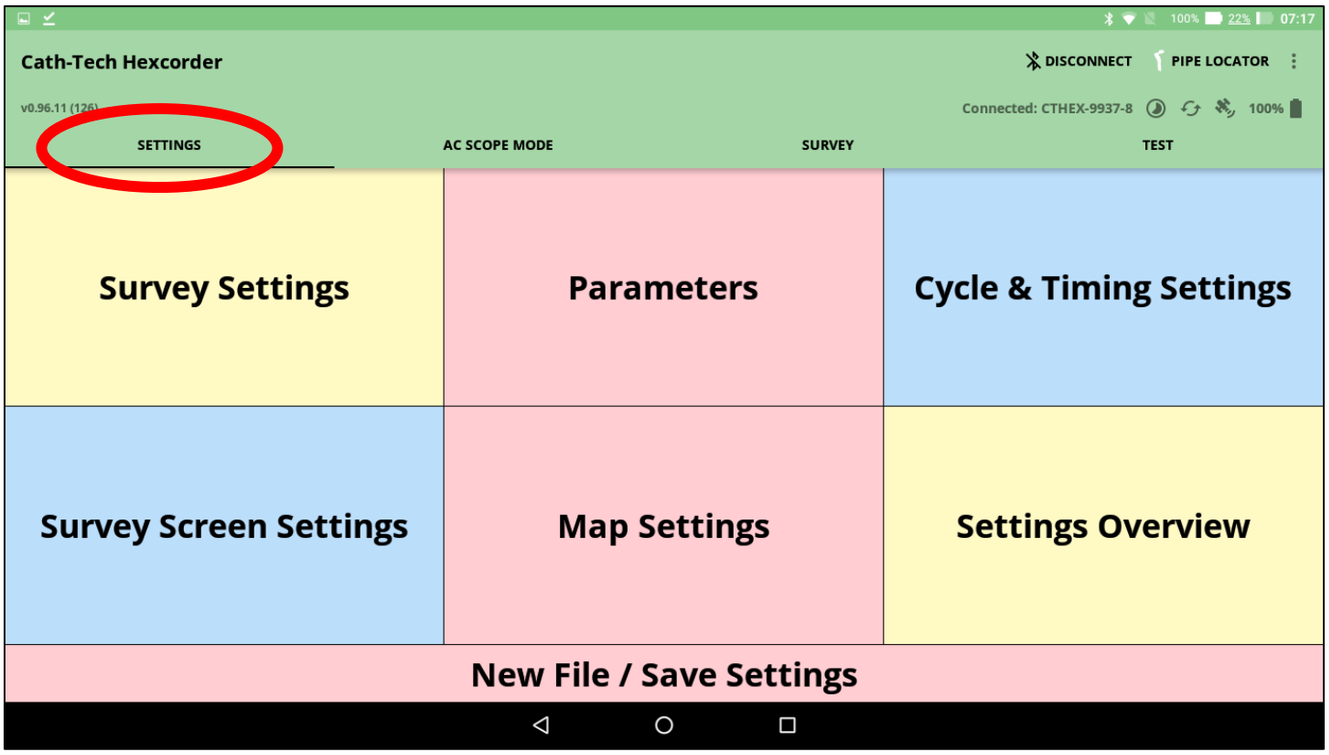


Figure 10 - Settings Tab

Survey Settings Screen

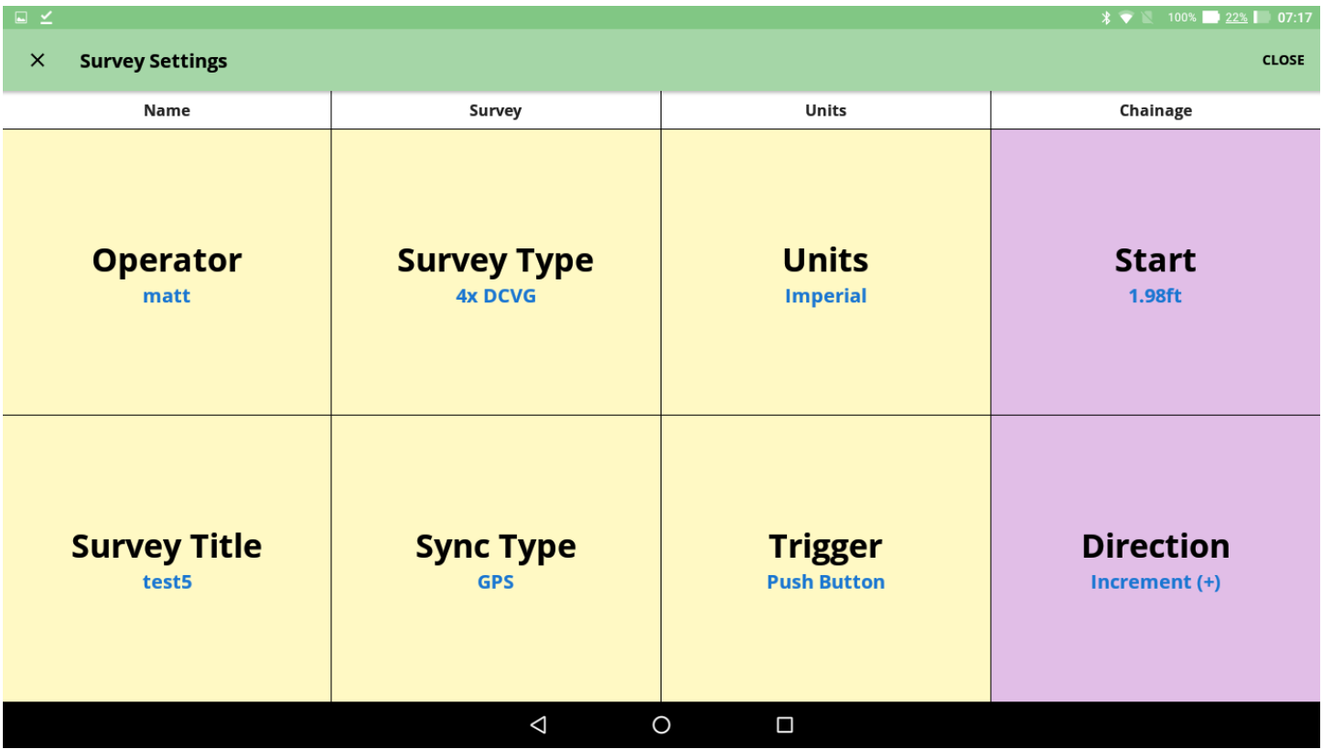


Figure 11 - Survey Settings Screen

From this screen, many survey options are accessible.

Operator

The operator can enter their name. This is an advantage later in data analysis to track the performance of individual operators, and follow up with possible issues. Operator name can be up to 32 characters.

Survey Title

Enter in information about this section of survey. It is often used to identify the line surveyed, starting point, direction, etc. up to 32 characters long. Example: Line 2 upstream from TP16874

Survey Type

The Hexcorder Pro is able to perform ten different survey configurations, based on two different types of survey. CIPS (CIS) Close Interval Potential Survey measures the level of cathodic protection on a structure. Direct Current Voltage Gradient (DCVG) survey detects flaws or holidays in the coating. The Hexcorder Pro is capable of measuring both survey types at the same time, as well as various combinations of the two. The user can select the number of input channels and input impedances, among other options.

- **CIPS (CIS)** – standard pipe to soil potential survey. Center and Right poles are used together so only one pole is required to be on the ground at the time of measurement. Input impedance is selectable from the settings menu at 25M or 250Mohm.
- **DCVG** – Direct current voltage gradient survey (pole to pole Center to Right)
- **CIPS & DCVG** – combined survey, Center pole measures the pipe to soil, Center to Right for DCVG
- **2x DCVG** – three pole survey, DCVG only, Center to Right and Center to Left
- **CIPS & 2x DCVG (Side drain)** – Center pole measures the pipe to soil, Center to Left and Center to Right for DCVG
- **4x DCVG** – Center to Right, Left, Front, Back, respectively
- **Double Impedance CIPS** – 25M and 250M impedance CIPS, Center and Right poles are used (same as #1) *NOTE: Only can be used in areas with <10V AC*
- **Double Impedance CIPS & DCVG** – Center pole measures the pipe to soil, Center to Right for DCVG *NOTE: Only can be used in areas with <10V AC*
- **Parallel CIPS** – pipe to soil readings Center to pipe, as well as Right to pipe
- **Double Impedance CIPS & 2x DCVG** – 25M and 250M impedance CIPS on the Center pole, Center to Right and Center to Left for DCVG *NOTE: Only can be used in areas with <10V AC*

Sync Type

The user can set the Hexcorder Pro to perform in three different synchronization modes

- GPS synchronized, for syncing with GPS enabled interrupters
- High/Low synchronized, for using non-GPS interrupters
- Unsynchronized, for non-interrupted surveys

Units

The user can display and record chainage for the CIPS survey in Metric (meters) or Imperial (feet). Only applicable to surveys with CIPS

Trigger

The user can set the Hexcorder Pro to be triggered in one of three ways

- Pushbutton trigger – The reading will be activated by pressing the survey pole button
- Time – the reading will be activated by the passage of a user-selected number of cycles
- Distance – the reading will be triggered when the chainage increases/decreases by a user-selected amount

Start

Set the starting chainage. Only applicable to surveys with CIPS

Direction

User can set the chainage to count upwards (increment) or count downwards (decrement). Only applicable to surveys with CIPS.

Parameters Screen

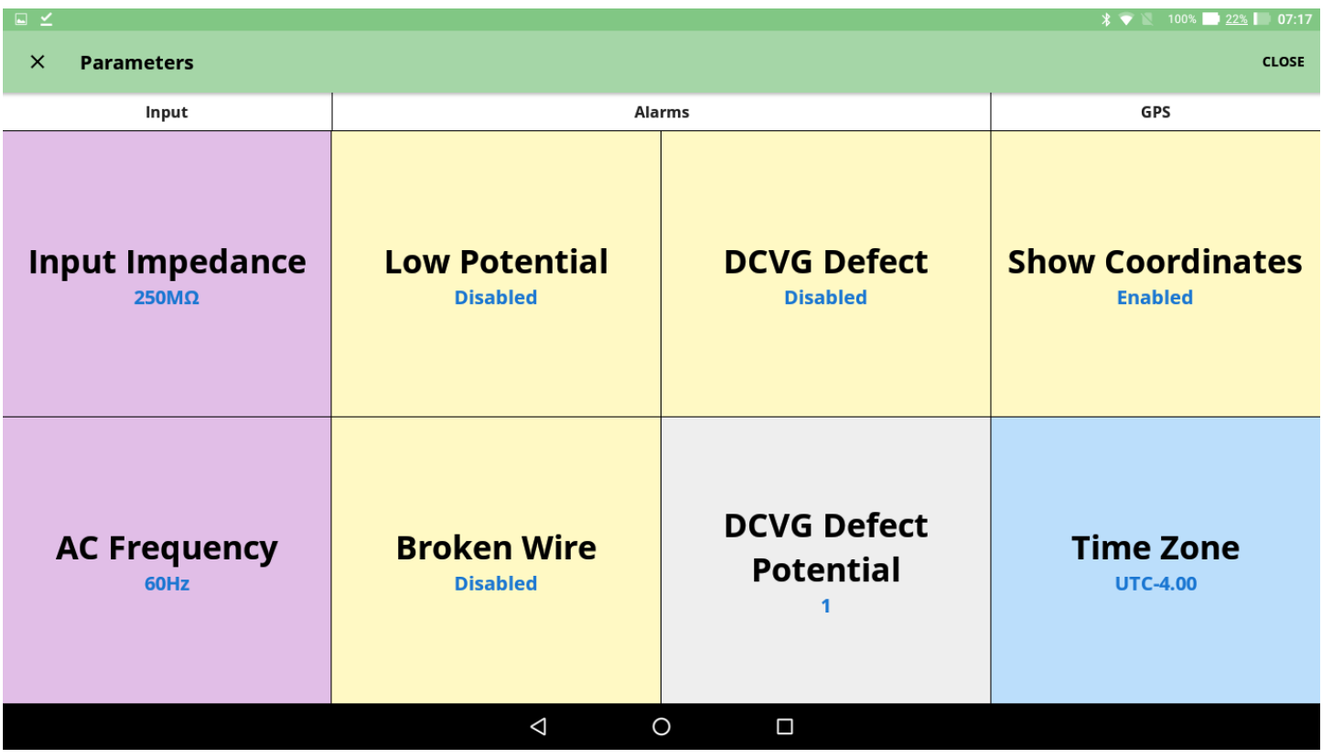


Figure 12 - Parameters Screen

This screen allows many of the parameters of the Hexcorder Pro to be set, such as alarms, GPS, etc.

Input Impedance

The Hexcorder Pro can take CIPS readings in two input impedances; 25MΩ and 250MΩ

- 25MΩ is used in moist, low-resistance soil

- 250MΩ is used in dry, high-resistance soil such as desert conditions
- If the user is operating in a Double Impedance mode, this selected option is ignored, both impedances are used

AC Frequency

The Hexcorder Pro uses software filtering in conjunction with hardware filtering. For the software filtering to work properly it needs to be configured to the local AC frequency. Select either 50Hz or 60Hz depending on the power grid in your area.

Alarms

The Hexcorder Pro has 3 separate alarm features to help you detect and diagnose potential survey issues or equipment problems. Each alarm can be activated or disabled by tapping on it.

- **Low Potential Alarm** – sounds if the CIPS potential changes by 50% from the previous reading. This may indicate poor ground contact causing a misread, or a cable failure.
- **Broken Wire Alarm** – sounds if three readings are taken without a change in the chainage count. Under normal conditions multiple readings without the chainage increasing would indicate a broken trailing wire.
- **DCVG Defect Alarm** – sounds if the DCVG levels exceed the user-selected value. The alarm threshold value is below the DCVG defect enable/disable button.
    - Tap on the value to enter a new value in mV.

Show Coordinates

The user can choose to have the GPS coordinates visible on the survey screen during the survey.

Time Zone

The user can select their local time zone to correct the GPS time from UTC to local time. All data is then stored in local time.

Interruption Cycle & Timing Settings

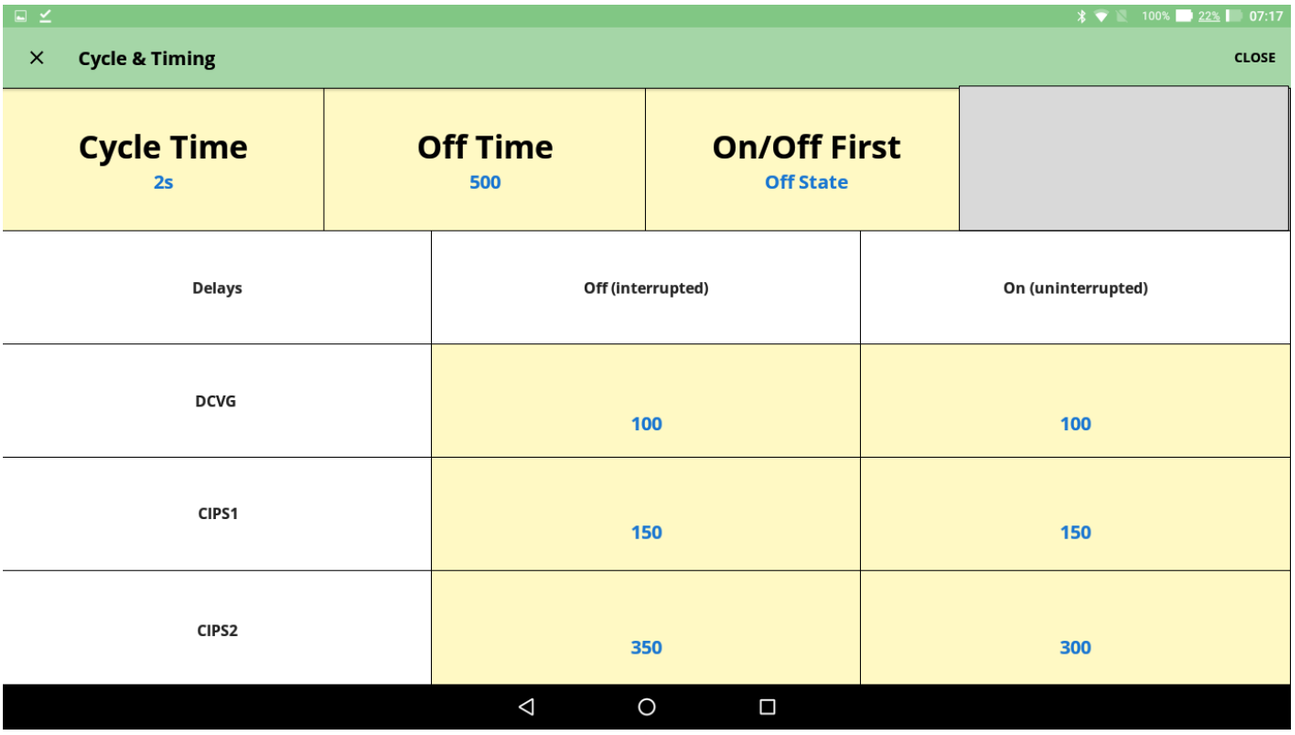


Figure 13 - Cycle & Timing Screen

Cycle Time

Set the cycle time to match the same settings you have applied on your current interrupters. The cycle time must be evenly divisible into 60 seconds. Common cycles are 1s, 2s, 4s, 5s, etc.

OFF Time

The OFF time is set by the user, which should match the off time used by the current interrupters. Typically, the OFF time is about ¼ of the total cycle time. The ON time is calculated from the cycle time minus the OFF time.

ON/OFF First

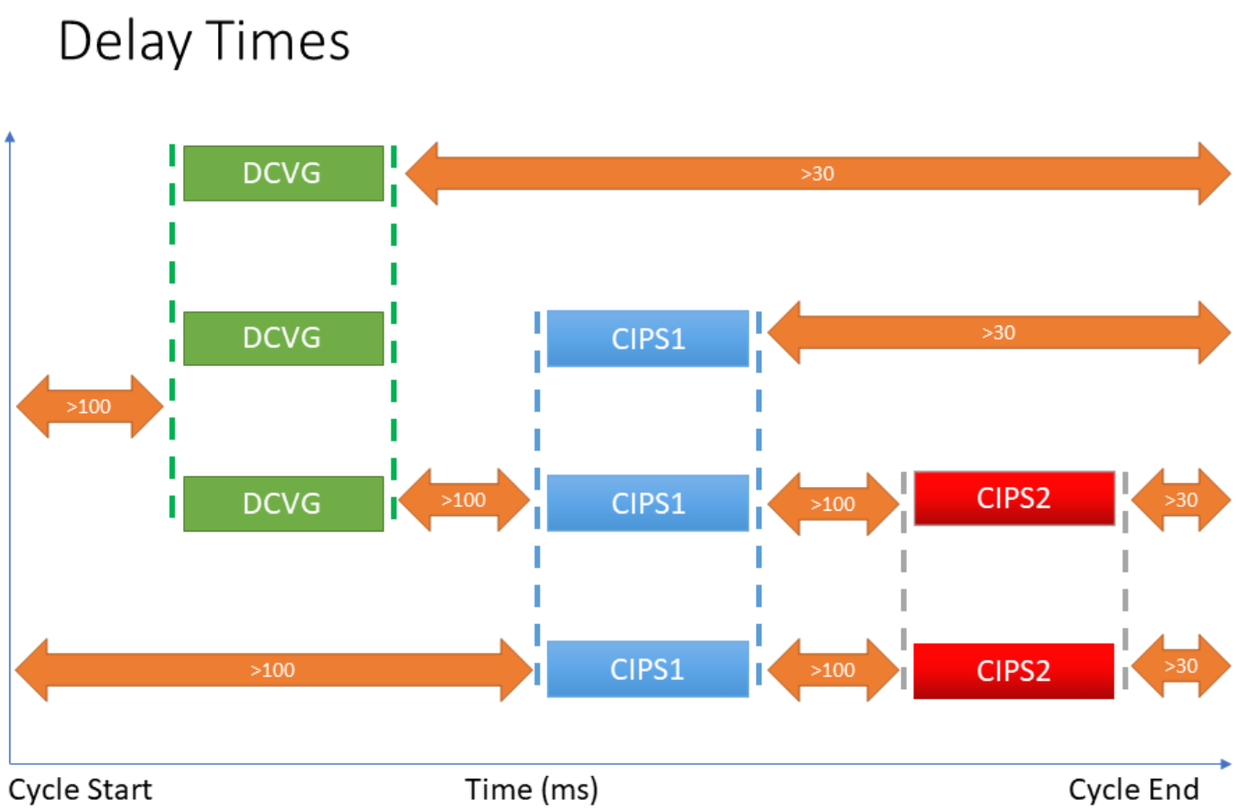
The Hexcorder Pro can measure the OFF or the ON measurement first. Most interrupters function with the OFF occurring at the start of the cycle. Select the correct setting to match YOUR interrupters.

Delay Times

There are six delay time options for controlling the exact time that the Hexcorder Pro takes its measurements within a cycle. The delay times are in milliseconds and are timed from the start of their respective portion of the cycle.

In GPS synchronized mode, the use of delays can improve survey accuracy. When the cathodic protection is first turned on or off, there can be an inductance spike in the voltage due to the capacitance of the coating. A more accurate reading can be obtained by delaying the reading, instead of taking the reading right as the rectifiers turn off. Inductive spikes can be seen on any waveforms taken, this information can be used to adjust delay settings accordingly.

The Hexcorder Pro will notify the user of any errors when the settings are saved.



Cycle & Delay Times

MINIMUM	Cycle		Delays (ms)		
	OFF (ms)	Cycle (s)	DCVG	CIPS1	CIPS2
CIPS	200	1	-	100	-
DCVG	200	1	100	-	-
CIPS + DCVG	200	1	100	170	-
2x DCVG	200	1	100	-	-
CIPS + 2x DCVG	400	1	100	200	-
4 x DCVG	400	1	100	-	-
Double Imp CIPS	400	1	-	100	200
Double Imp CIPS + DCVG	400	1	100	200	300
Parallel CIPS	400	1	-	100	200
Double Imp CIPS 2x DCVG	400	1	100	200	300
RECOMMENDED	Cycle		Delays (ms)		
	OFF (ms)	Cycle (s)	DCVG	CIPS1	CIPS2
CIPS	200	1	-	150	-
DCVG	200	1	100	-	-
CIPS + DCVG	250	1	100	200	-
2x DCVG	200	1	100	-	-
CIPS + 2x DCVG	300	1	100	250	-
4 x DCVG	300	1	100	-	-
Double Imp CIPS	400	2	-	150	300
Double Imp CIPS + DCVG	500	2	100	250	400
Parallel CIPS	400	2	-	150	300
Double Imp CIPS 2x DCVG	500	2	100	300	450

Survey Screen Settings

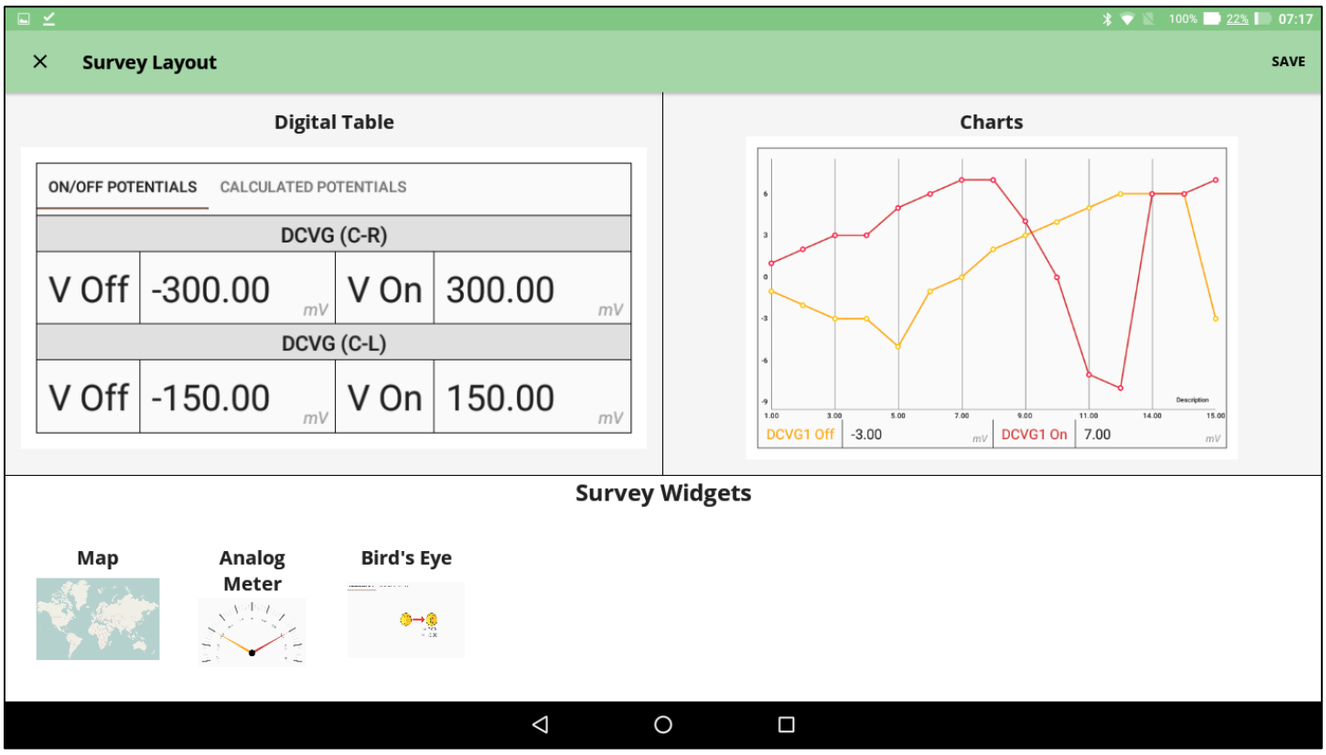


Figure 14 - Survey Screen Settings

Survey Layout Options

The Hexcorder Pro offers five different "widgets" to use during the survey. The screen is split into two halves which can be configured to the user's tastes. Simply touch and drag the widget you want from the selector bar at the bottom to the location you want it and release.

- **Digital Table** – a simple table view which shows the readings in numerical format. (either actual or calculated)
- **Charts** – a real-time graphing view which displays the readings as a line chart as they are recorded. Unlike the digital table display, the chart only shows the recorded readings, not the real-time values. This allows the operator to easily see trends in the survey data.
- **Map** – an openmaps.org-based map screen which uses the Hexcorder Pro GPS to plot the user's path.
- **Analog Meters** – a DCVG view using virtual analog meters instead of digital values, for users who prefer the analog DCVG meters.

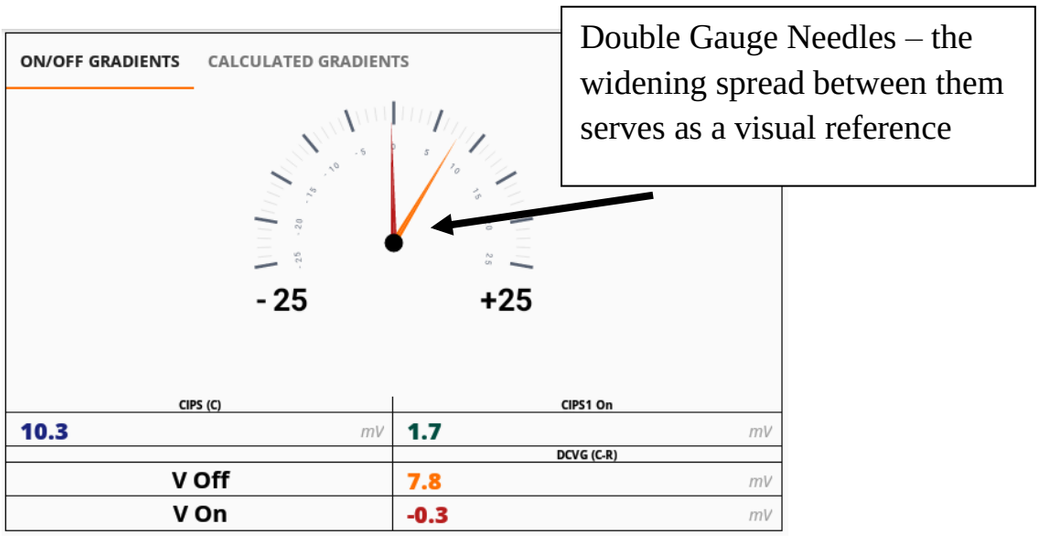


Figure 15 – Analog Meters

- **Bird's eye view** – a DCVG view which shows the arrangement of the survey team measurements from above. This makes it easy for the user to see the flow of stray currents in the soil.

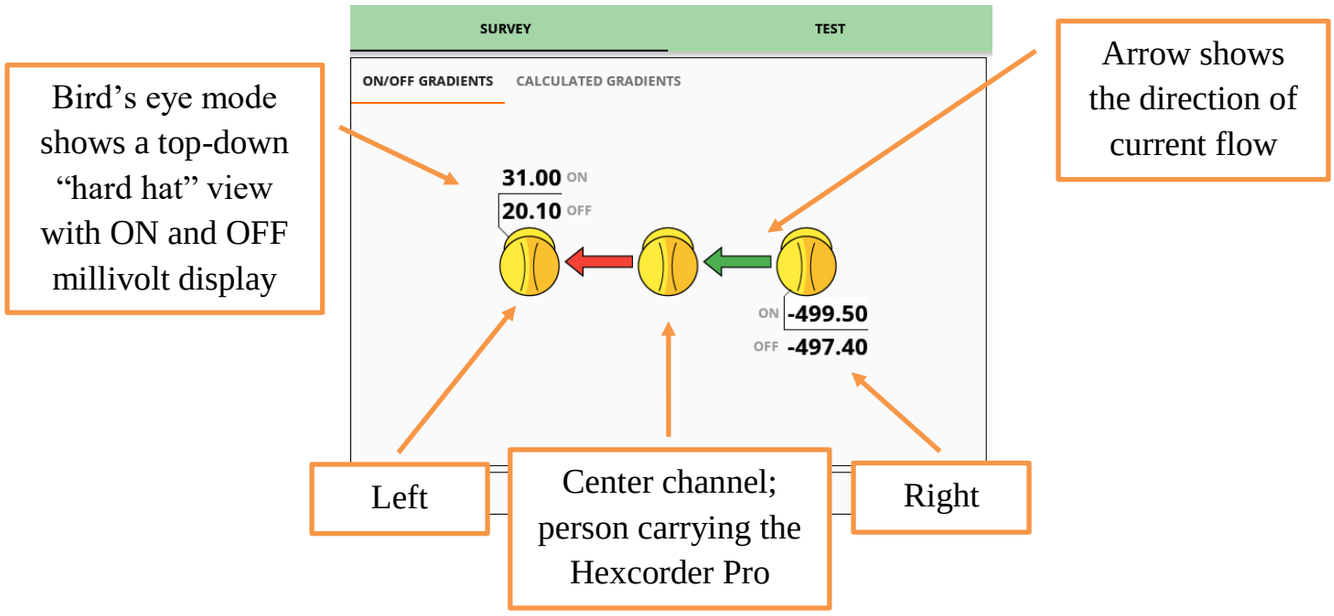


Figure 16 - Birds Eye View

Map Settings

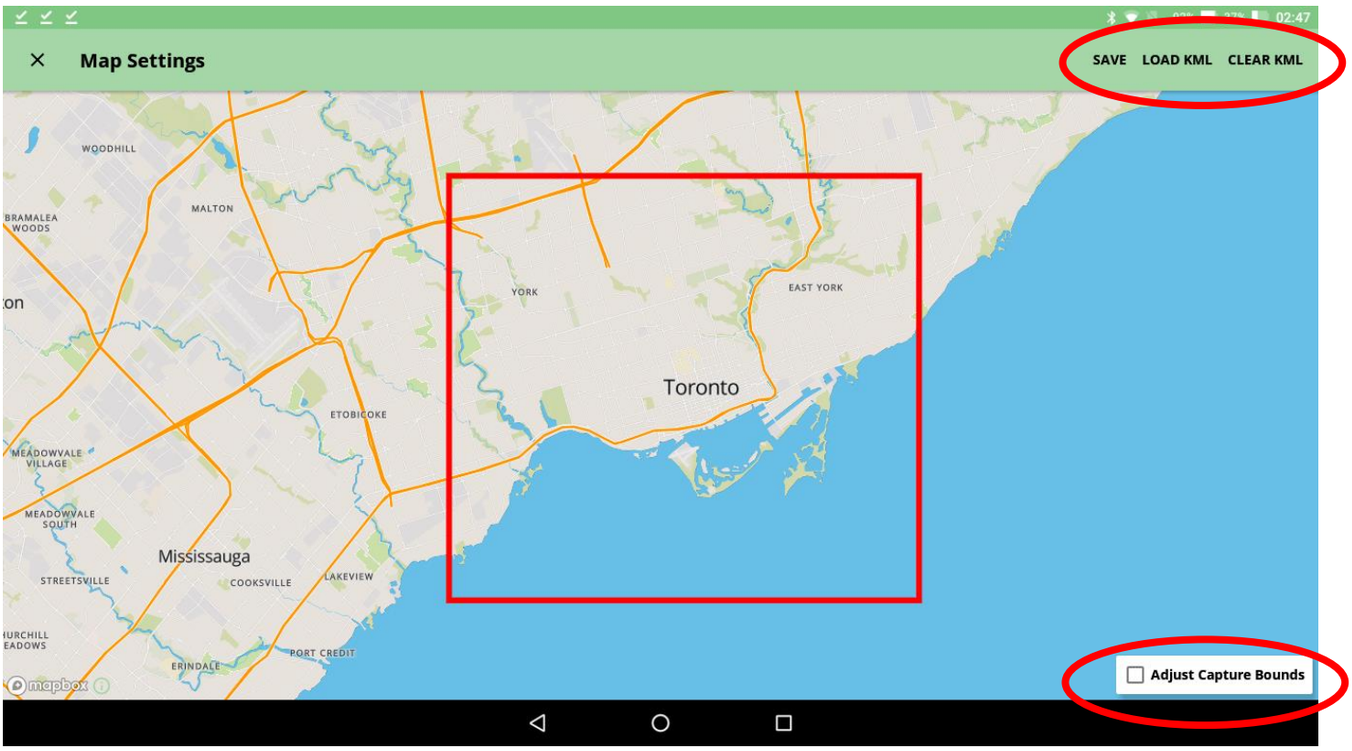


Figure 17 - Map Selection Screen

The Hexcorder Pro uses Openmaps.org for mapping purposes. A Wi-Fi internet connection prior to the survey is necessary for this function to work. Map data can be saved (cached) on the tablet for later use in the field when Wi-Fi is not available.

- Turn on Wi-Fi on the tablet by pulling down the dropdown menu from the top of the screen and toggling the Wi-Fi icon to “On”.
- Connect to a local Wi-Fi network
- Select the “Adjust Capture Bounds” box and use pinch-zoom and drag to move and shape the red box to fit your survey area. (see Figure 17)
- Load KML/Clear KML – Using the buttons in the top right corner of the Map Settings screen, create your own google KML map files from previous survey data and place the file on the tablet memory. Then, select the “Load KML” button and navigate to the KML file you want to load. It will be loaded as a visible line of waypoints on the map, which can give a guiding route during the survey.
- Use pinch zoom until the desired map region is included inside the red box. Press the “SAVE” button in the top right corner and this section of the map will be cached in memory.

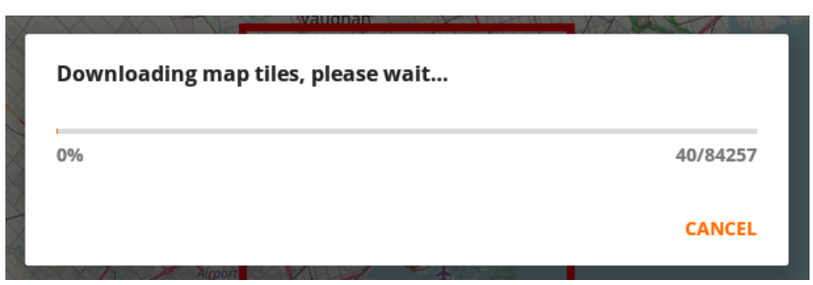


Figure 18 - Map caching message

Later, when the tablet does not have internet access, this map section will still be available to view in the map survey widget.

- When surveying out of Wi-Fi range, turn off Wi-Fi to save battery.

Settings Overview

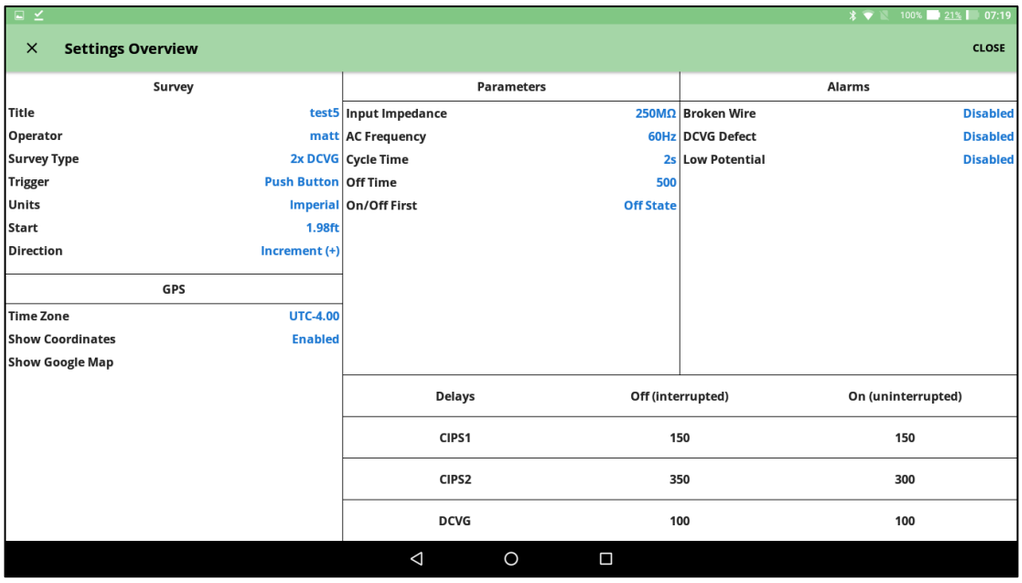


Figure 19 - Survey Settings Overview

The Settings Overview page is a quick reference page to check the settings if the user forgets them during a survey. Rather than having to search the various setting screens, the user can simply check the Settings Overview.

Conserving Tablet Battery Life

The tablet has two batteries; one external and one internal. The total battery power is 100 watt-hours. Due to the nature of survey work, the tablet screen must be set to high brightness to be visible in the sunlight, and the screen must always be on to see the readings. With Wi-Fi turned off, the Xplore tablet will provide approximately 11 hours of continuous use time. Cath-Tech recommends that to prevent the tablet from consuming any additional power, do not install any other apps to the tablet and be sure to fully charge each night before the next day's survey. Additional external batteries with a charging dock are available.

Survey

After setup is complete, the user is ready to begin the survey. Tap the SURVEY tab to access the main survey tab.

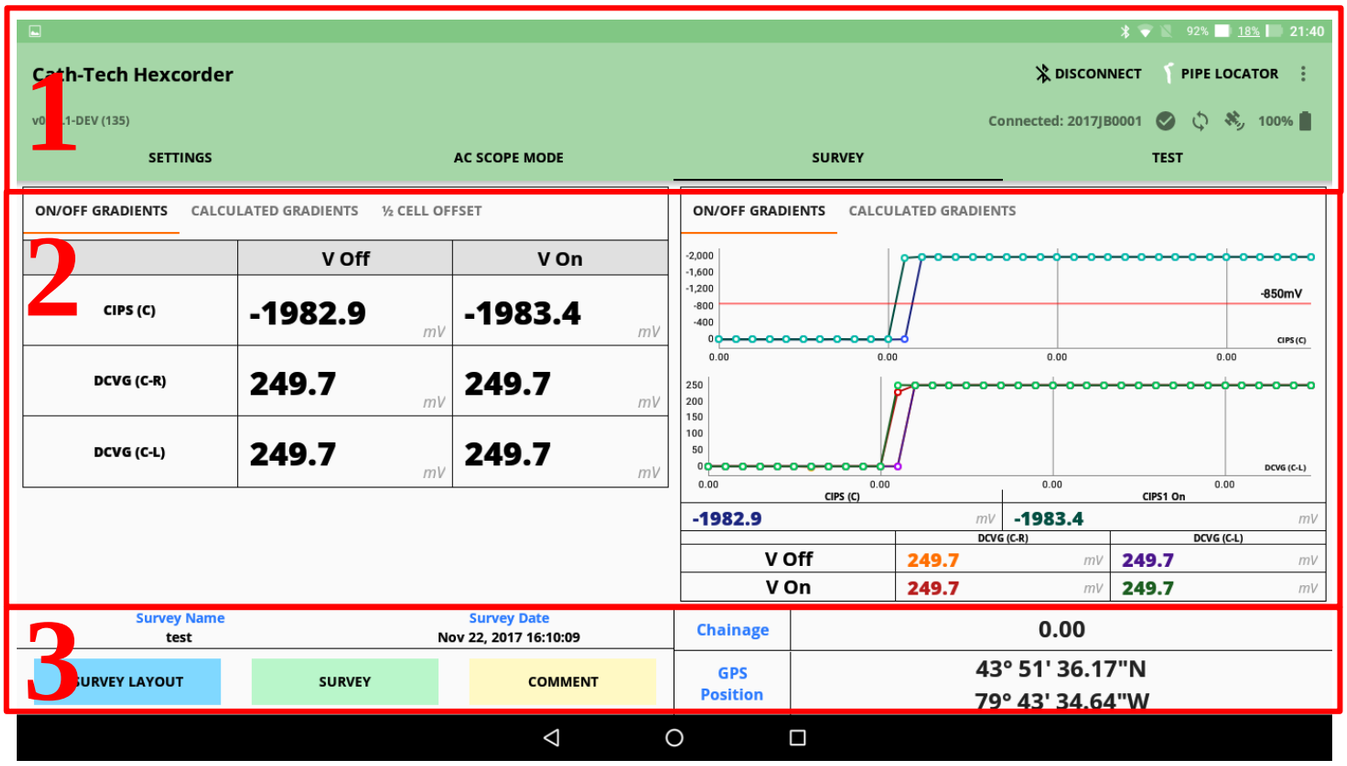


Figure 20 - Survey Screen

There are 3 main areas to this screen. The middle largest area is for the widgets chosen by the surveyor to display data.

1. **Information Bar** – Buttons for connecting/disconnecting the Hexcorder Pro from the Xplore tablet, as well as for connecting a pipe locator
2. **Survey Widgets** – the survey widgets selected by the user appear in this area. Two can be used at a time
3. **Survey Information** – this bar contains the survey start/pause button, access to the survey layout widget screen, as well as survey name, date and time, chainage and GPS location information

Calculated Gradients

In DCVG modes, the user can select to view the DCVG values as separate ON/OFF values or as a calculated gradient value, which automatically subtracts the ON value from the OFF value and displays the difference. This difference is often more useful to the surveyor.

½ Cell Calibration

The user can calibrate their cells in the ½ cell offset tab. Cu/CuSO4 cells are not precise instruments, they are chemical cells. They have minor voltage differences between them all which causes a measurement value error. Using the ½ cell offset tab the user can calibrate their cells to correct for the error.

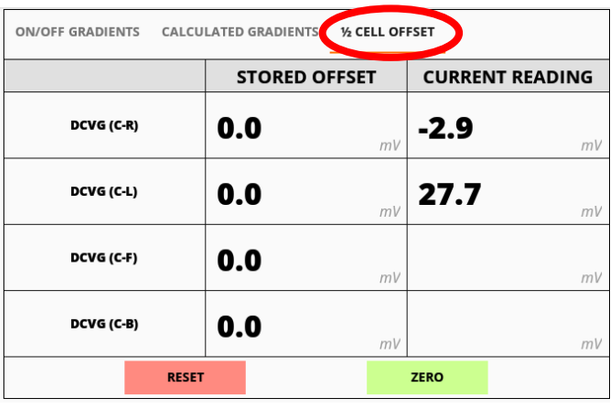


Figure 21 - 1/2 cell offset before zeroing

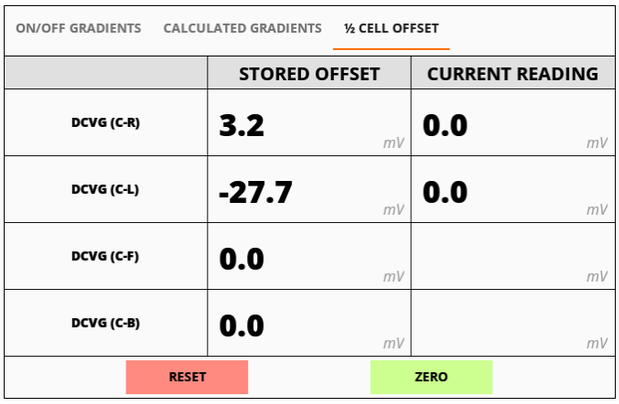


Figure 22 - 1/2 cell offset after zeroing

With the survey running, the user places the tips of the survey poles with the cells attached together. Touching the tips will reduce the non-error voltage to zero. Pressing the green ZERO button will take a reading and apply an offset to the DCVG channel(s) to correct for ½ cell error.

Survey

Press the SURVEY button to start the survey. The button will turn green when the survey is running. If GPS synchronization is enabled, survey mode will not start until the GPS engine is connected and locked. Ensure that the GPS is connected and has a clear view of the sky. Also note that the GPS may take up to 10 minutes to lock. Once the GPS is locked, the values will begin to appear and the Hexcorder Pro will sound a small beep at the start of each cycle.

To pause the survey, press the green SURVEY button and the survey will stop, the button will turn red.

In manual mode, the surveyor presses the button on the top of the half cell extension pole to take a reading. That reading is stored in the file and the record# increases. As the surveyor moves, the trailing wire spools out and the chainage increases. The Hexcorder Pro will only take one reading per interruption cycle no matter how many times the button is pushed.

In any survey mode with DCVG, two (or more) half cells must be on the ground when taking a reading. This can be done by one surveyor who pauses in place until the reading is complete or by utilizing Y-cables and multiple surveyors. When using the Y cable, the surveyor needs to only keep one of the two survey poles on the ground at any given time to be ready to take a signal, allowing for a continuous walking movement.

Comments

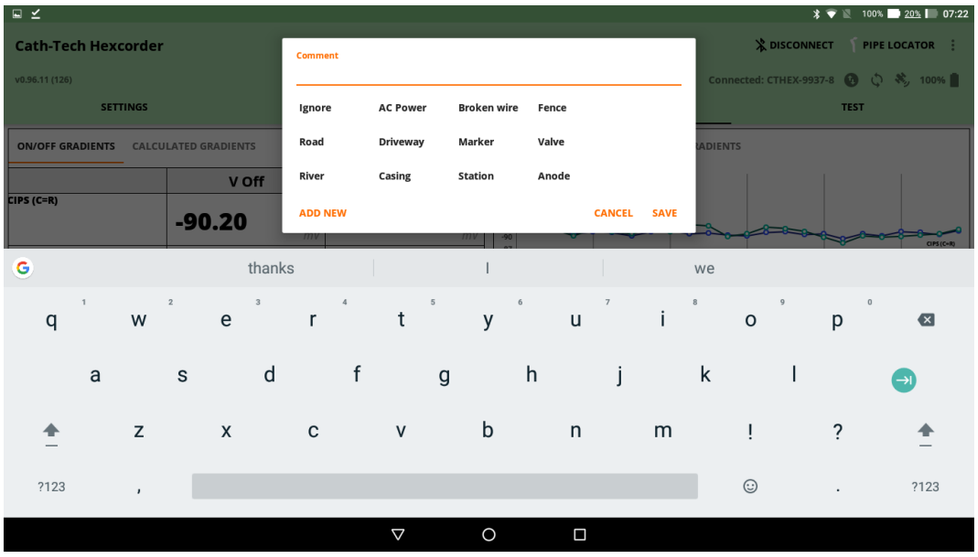


Figure 23 - Adding a comment

If the user wants to add a comment to the data file to indicate a note or location information, they can press the COMMENT button. The survey will pause while the user enters the comment via the tablet keyboard. There is a selection of quick comments available, preloaded with common comment types. The user can add custom comments by typing the comment they want and click "ADD NEW" to add it to the list. The preloaded comments can be edited and deleted by pressing and holding the desired comment.

Survey Personnel & Cable Configurations

There are many possible configurations of personnel and cables depending on the survey type selected. The Hexcorder Pro is supplied with the Wire cable and 2 pole cables for surveys involving Center and Right channels. Additional poles and Y-cables are available for multi-channel DCVG.

Survey Type	Left	Center	Right	Wire
CIPS / CIS		■	■	■
DCVG		■	■	
CIPS & DCVG		■	■	■
2x DCVG	■	■	■	
CIPS & 2x DCVG	■	■	■	■
4x DCVG	■ x2	■	■ x2	
Double Impedance CIPS		■	■	■
Double Impedance CIPS & DCVG		■	■	■
Parallel CIPS		■	■	■
Double Impedance CIPS & 2x DCVG	■	■	■	■

AC Scope Mode

Tap the AC SCOPE tab to enter scope mode. The term ‘scope’ and ‘waveform’ are often used interchangeably in the CP industry. Press the START CAPTURE button and the Hexcorder Pro will record a 1-cycle CIPS reading. GPS lock is required to use the scope function.

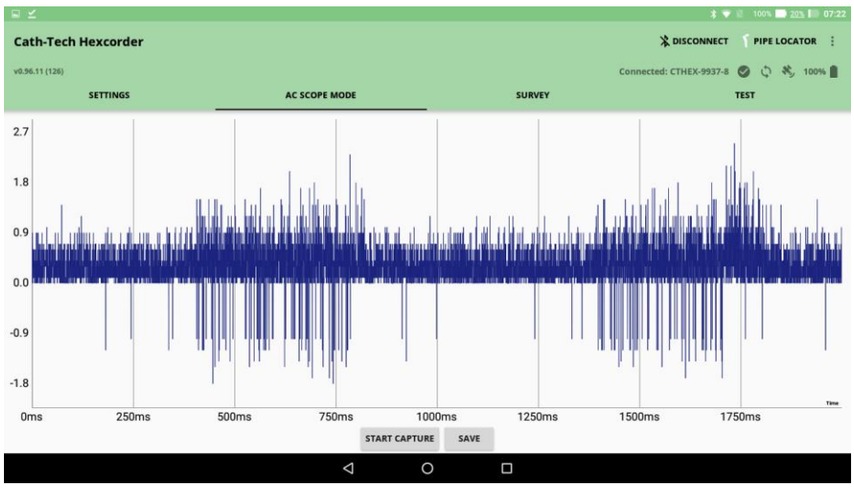


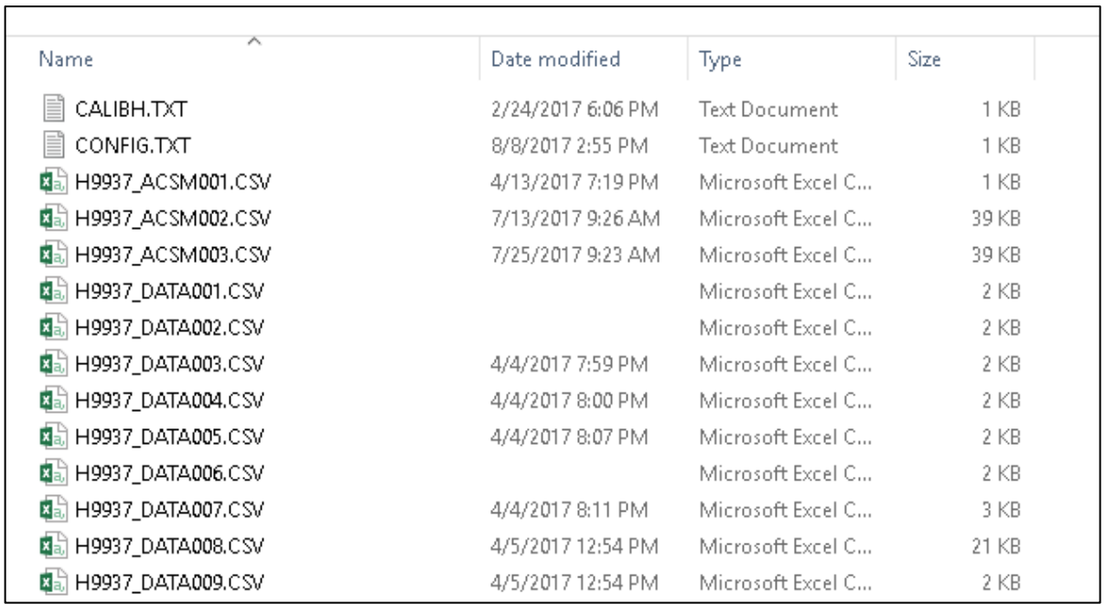
Figure 24 - AC Scope Screen

The reading can be manipulated in the X and Y directions by pinch zooming. The user can store a data file version by pressing the SAVE button. A .CSV file of the values will be stored on the Hexcorder Pro. Scope readings can be useful in detecting misfiring current interrupters, AC from overhead power lines, telluric activity, and foreign influences.

The scope captures 4096 samples per second, up to 30 second cycles. Longer than 30 second cycle times use a reduced sample rate due to memory buffer limitations.

Data Files

Data files on the Hexcorder Pro are accessed via the USB port. Connect the Hexcorder Pro to your PC and turn it on. After 10 seconds, press the USB symbol button. This will allow the PC to access the internal SD storage. The Hexcorder Pro will appear like a standard USB drive.



Name	Date modified	Type	Size
CALIBH.TXT	2/24/2017 6:06 PM	Text Document	1 KB
CONFIG.TXT	8/8/2017 2:55 PM	Text Document	1 KB
H9937_ACSM001.CSV	4/13/2017 7:19 PM	Microsoft Excel C...	1 KB
H9937_ACSM002.CSV	7/13/2017 9:26 AM	Microsoft Excel C...	39 KB
H9937_ACSM003.CSV	7/25/2017 9:23 AM	Microsoft Excel C...	39 KB
H9937_DATA001.CSV		Microsoft Excel C...	2 KB
H9937_DATA002.CSV		Microsoft Excel C...	2 KB
H9937_DATA003.CSV	4/4/2017 7:59 PM	Microsoft Excel C...	2 KB
H9937_DATA004.CSV	4/4/2017 8:00 PM	Microsoft Excel C...	2 KB
H9937_DATA005.CSV	4/4/2017 8:07 PM	Microsoft Excel C...	2 KB
H9937_DATA006.CSV		Microsoft Excel C...	2 KB
H9937_DATA007.CSV	4/4/2017 8:11 PM	Microsoft Excel C...	3 KB
H9937_DATA008.CSV	4/5/2017 12:54 PM	Microsoft Excel C...	21 KB
H9937_DATA009.CSV	4/5/2017 12:54 PM	Microsoft Excel C...	2 KB

Figure 25 - Data file listing

The files are named based on the equipment used and a unique identifier. The ‘H’ at the start indicates that the data is from the Hexcorder Pro. Then the next 4 numbers are the last 4 digits of the serial number to indicate the unit generating the file. Survey data files have the word DATA after the serial number designator, AC scope readings have the letters ACSM in the file name. The last part of the name is a sequential number.

Copy and paste data files to your PC and open them in Excel or an equivalent spreadsheet program. The files are a standard Comma Separated Value (CSV) file, which can be imported into many third-party data management programs.

GPS Datum

Changing the Datum

All GPS units are set to the World Geodetic System 84 datum by default. This is a standard coordinate system used worldwide with reasonable accuracy. The datum used by the Hexcorder Pro can be changed to a local datum, however this will change the GPS coordinates stored in the data, and they will not align with coordinates stored in WGS84.

The GPS datum can be changed by adding a datum file to the Hexcorder Pro SD storage. The datum is stored in a text file which must be named DATUM.TXT. The datum files can be generated by a small windows application that Cath-Tech has developed and is available on our website.

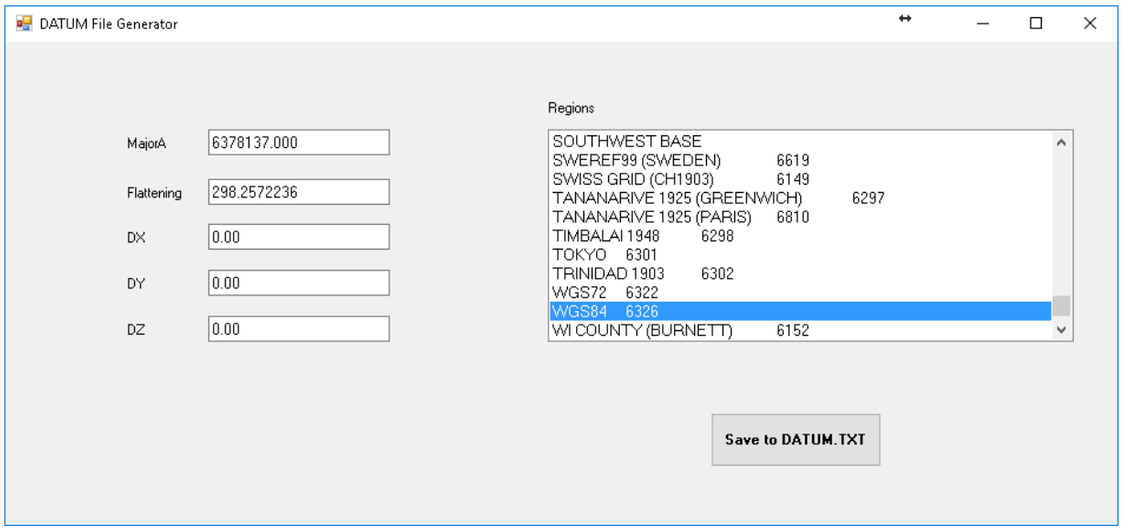


Figure 26 - GPS datum file generator

Select the datum you wish to use and press the “Save to DATUM.TXT” button. It will open a Save As window which you can use to navigate to the Hexcorder Pro SD storage. The correct DATUM.TXT file name is automatically filled in.

Custom datums can be generated using the program if the user has the Major Axis, Flattening value, and DX/DY/DZ values.

Available Earth Datums

ADINDAN
AIN EL ABD (BAHRAIN)
AIN EL ABD (SAUDI ARABIA)
ARATU (BRAZIL)
ARC1950
ARC1960
ASTRO B4 (SOROL ATOLL)
ASTRO BEACON
ASTRO DOS 71/4
ASTRONOMIC STATION 1952
BD72 (BELGIUM 1972)
BEIJING 1954
BOGOTA OBSERVATORY
BUKIT RIMPAH
CAMACUPA
CAMP AREA ASTRO
CAMPO INCHAUSPE (ARGENTINA)
CAPE
CARTHAGE
CHAD (WG1998)
CLARKE 1866 AUTHALIC SPHERE
CORREGO ALEGRE (BRAZIL)
D-48 SLOVENIA
DEALUL PISCULUI 1970
DEIR EZ ZOR (SYRIA)
DUTCH (RD)
EASTER ISLAND 1967
ED50
ED50 (ENGLAND)
ED50 (FINLAND/NORWAY)
ED50 (GREECE)
ED50 (ITALY)
ED50 (NORTH SEA)
ED50 (NORWAY OFFSHORE - N62)
ED50 (NORWAY OFFSHORE - S62)
ED50 (SICILY)
ED50 (SPAIN/PORTUGAL)
ED79
ED87
EGYPT 1907
EGYPT GULF OF SUEZ S-650 TL
ESTIONIA 1997
ETRF2000 - RDN
ETRS89
FD 1958 (IRAQ)
FINLAND/HAYFORD
GDA 94 (AUSTRALIAN GEODETIC 1994)
GGRS87 (GREECE)

GOOGLE MAPS (SPHERE RADIUS 6378137)
GRS80 ELLIPSOID
GUAM 1963
HARTEBEESTHOEK 1994 (S. AFRICA)
HERAT NORTH (AFGHANISTAN)
HERMANNSKOGEL
HJORSEY 1955
HONG KONG 1963
HU TZU SHAN
HUNGARIAN DATUM 1972
IGN72 GRANDE TERRE (NEW CALEDONIA)
INDIAN (BANGLADESH)
INDIAN (MEAN VALUE)
INDIAN (NEPAL)
INDIAN (THAILAND)
INDIAN 1954
INDIAN 1975
INDONESIA 1974
IRELAND 1965
IRELAND 1965 (1975 ADJUSTMENT)
IRENET95
ISN93 (ICELAND)
ISTS 073 ASTRO
JAD2001 (JAMAICA 2001)
JAD69 (JAMAICA 1969)
JGD2000 (JAPAN)
JORDAN
KERTAU 1948
KERTAU 1948 (MALAYSIA)
KKJ (FINNISH GRID)
KOREAN 1985
KOREAN 1995
KOREAN GEODETIC DATUM (KGD)
LA CANOA (VENEZUELA)
LEIGON (GHANA)
LISBON/LISBOA 1937 (DLx)
LKS92 (LATVIA)
LUREF (LUXEMBOURG)
LUZON (PHILIPPINES)
MALONGO 1987
MERCHICH (MOROCCO)
MGI AUSTRIA
MINNA (CAMEROON)
MINNA (NIGERIA)
M'PORALOKO (GABON)
NAD27
NAD27 (ALASKA)
NAD27 (ALEUTIAN ISLANDS EAST)
NAD27 (ALEUTIAN ISLANDS WEST)
NAD27 (BAHAMAS)
NAD27 (CANADA)
NAD27 (CANAL ZONE)
NAD27 (CARIBBEAN)
NAD27 (CENTRAL AMERICA)
NAD27 (CONUS)
NAD27 (CUBA)
NAD27 (GREENLAND)
NAD27 (MEXICO)
NAD27 (SAN SALVADOR)
NAD27 (YUMA PROVING GROUNDS)
NAD83
NAHRWAN (UAE)
NAPARIMA 1972 (TRINIDAD & TOBAGO)
NEW ISRAELI DATUM (NID)
NGO 1948 (GREENWICH MERIDIAN)
NGO 1948 (OSLO MERIDIAN)
NORTH SAHARA 1959
NORTH SAHARA 1959 (HASSI MESSAOUD)
NTF FRANCE (GREENWICH MERIDIAN)
NTF FRANCE (PARIS MERIDIAN)
NZGD2000
NZGD49
OBSERVATORIO 1966
OCOTEPEQUE (COSTA RICA)
OLD HAWAIIAN MEAN
OLD ISRAELI DATUM (OID)
OMAN
ORDNANCE SURVEY 1936 (OSGB36)
PICO DE LAS NIEVES
POINTE NOIRE 1948 (CONGO)
PORTUGESE 1973 (DATUM 73)
POSGAR94 (ARGENTINA)
POTSDAM/DHDN (GERMANY)
PROVISIONAL SOUTH CHILEAN
PRS92 (PHILIPPINES)
PSAD56 (PROV. S. AMERICAN 1956)
PSD93 (OMAN)
PUERTO RICO
QND95 (QATAR)
QORNOQ
REUNION ISLAND
REYKJAVIK 1900
RGF-93
RGNC91-93 (NEW CALEDONIA)
ROME 1940 [MONTE MARIO] (GREENWICH)
ROME 1940 [MONTE MARIO] (ROME)
RT90
S-42 (PULKOVO 1942)
S-42 ALBANIA
S-42 AZERBAIJAN/GEORGIA
S-42 CZECHOSLOVAKIA
S-42 ESTONIA
S-42 GERMANY
S-42 HUNGARY
S-42 KAZAKHSTAN
S-42 LATVIA
S-42 LITHUANIA
S-42 POLAND
S-42 ROMANIA
S-42 RUSSIA
SAO BRAZ
SCHWARZECK (NAMIBIA)
SIRGAS 2000 (BRAZIL)
S-JTSK (CZECH REPUBLIC)
SOLOMON 1968 (GUX 1 ASTRO)
SOUTH AMERICAN 1969
SOUTH AMERICAN 1969 (BRAZIL)
SOUTHEAST BASE
SOUTHWEST BASE
SWEREF99 (SWEDEN)
SWISS GRID (CH1903)
TANANARIVE 1925 (GREENWICH)
TANANARIVE 1925 (PARIS)
TIMBALAI 1948
TOKYO
TRINIDAD 1903
WGS72
WGS84
WI COUNTY (BURNETT)
WI COUNTY (DOUGLAS)
WI COUNTY (SHEBOYGAN)
YACARE (URAGUAY)
ZANDERIJ (SURINAME)

Pipe Locator

Pipe Locator Features

The Hexcorder Pro can be connected to Bluetooth-enabled pipe locators Vivax-Metrotech. Data such as depth of cover and signal strength can be stored in the Hexcorder Pro data file along with the survey data.

Important note:

The Hexcorder Pro app must have permission to use your location, allowing it to search for new Bluetooth devices. When the app asks for permission to use your location (a requirement of Android to allow apps to search for Bluetooth devices) you must allow it or else the tablet will not be able to find your pipe locator.

RadioDetection Pairing

Preparing the RD8000/8100 pipe locator to pair

Pairing to a PDA or PC

Connection requirements:

- Any RD8100 locator.
- A compatible Bluetooth enabled PDA or Bluetooth enabled PC or Laptop.

NOTE: The procedure below describes the pairing process between a RD8100 locator and a PDA. Pairing to a PC follows the same steps for the RD8100 locator and similar steps for your PC or laptop. Consult your PC or laptop Bluetooth pairing instructions to pair with the RD8100 locator.

Pair the RD8100 locator to your PDA using your PDA's Bluetooth software.

NOTE: The procedure for pairing your PDA may differ depending on the PDA make and model. The following procedure should apply to most PDAs.

On the locator:

1. Press the ⏻ key to enter the menu.
2. Scroll to the BT menu using the ⇧ or ⇩ keys.
3. Press the key to enter the BT menu.
4. Scroll up or down to the PAIR menu.
5. Press the key to enter the PAIR menu.
6. Scroll up or down to the BT-PC option.
7. Press the ƒ key and the locator will attempt to pair with your PDA.

These steps should be performed quickly, with minimal delay between steps

First time pairing

1. Power on the tablet
2. Follow the instructions above to ready the locator, the Bluetooth icon on the locator screen will be blinking
3. Open the tablet Bluetooth menu
4. Wait for the locator to be detected. The name will be something like “RD8K” followed by a 4 digit number
5. Select the pipe locator to pair, when prompted enter the passkey “1234”
6. The locator is now paired and known to the tablet

Important note:

The Hexcorder Pro app must have permission to use your location, allowing it to search for new Bluetooth devices. When the app asks for permission to use your location (a requirement of Android to allow apps to search for Bluetooth devices) you must allow it or else the tablet will not be able to find your pipe locator.

Pairing for Use

1. Prepare the Hexcorder Pro and tablet for survey as usual
2. Perform the above steps to prepare the locator for Bluetooth connection
3. Select the Pipe Locator button in the top right corner of the app
4. Select the locator from the list of paired devices
5. When connected, the Bluetooth symbol on the locator will stop blinking and remain solid
6. Check the connection by pressing the button. A message "Received message from the Pipe Locator" will appear on the tablet screen

To save a pipe locator measurement, press the button within 30 seconds of taking a Hexcorder Pro survey measurement. The data from the locator will be inserted in the data file along with the data from that last measurement. There is no message to indicate success, just continue surveying. If the button is pressed outside of that 30 second window, a message will appear on the tablet screen asking if you wish to store the pipe locator data. You can select to store it or not.

Vivax Metrotech Pairing

First time pairing

1. Power on the tablet
2. Open the tablet Bluetooth menu
3. Power on the Vivax Metrotech locator, the name "vLocPro" will appear in the search results
4. Select the vLocPro and wait for it to pair, the name will move to the Paired Devices list

Pairing for Use

1. Prepare the Hexcorder Pro and tablet for survey as usual
2. Turn on Vivax Metrotech locator, there should be a light blue Bluetooth logo in the top right corner.

Figure 27 - VM screen with Bluetooth disconnected

3. Tap the “Pipe Locator” button in the top right corner.

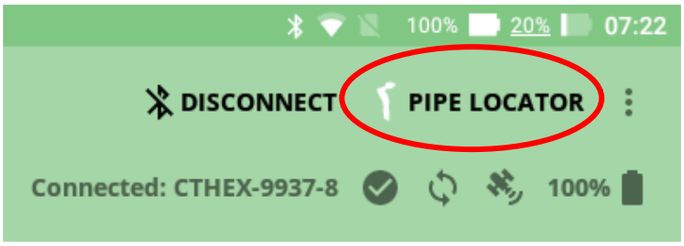


Figure 28 - Pipe Locator button in Hexcorder Pro app

4. Select the vLocPro from the list

Figure 29 - Device selection screen in app

5. The Hexcorder Pro will pair with the pipe locator.

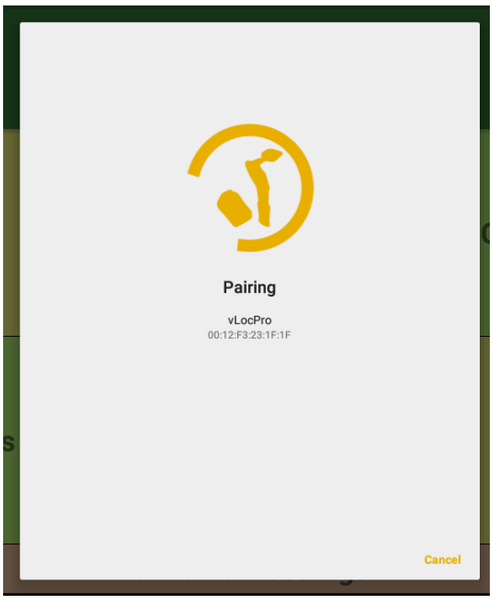


Figure 30 - Pairing message

6. The pipe locator will now show blue Bluetooth symbol.

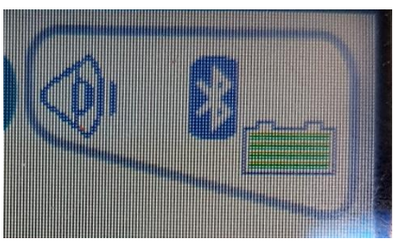


Figure 31 - VM screen with Bluetooth connected

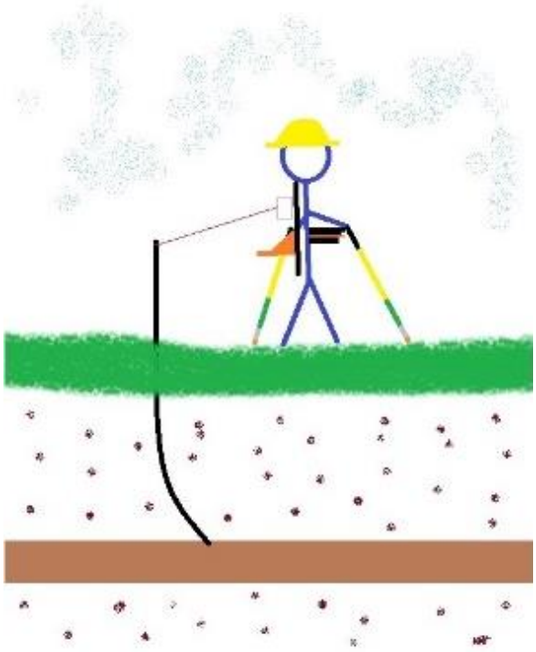
To confirm pairing and pipe locator data transmission, press the “I” button followed by the “+” button on the Pipe locator, a message will display on the tablet reading “Received invalid message from Pipe locator”. This means the message was received but was not automatically associated with a particular reading. During a survey, the Hexcorder Pro will not indicate that it has received successfully. If the pipe locator loses connection with the Hexcorder Pro, a message will be displayed on screen. Loss of connection is also indicated on the pipe locator screen; the Bluetooth icon will fade to light blue instead of solid blue.

Survey Techniques

The Hexcorder Pro is designed and built to perform above ground assessment of cathodic protection and coating integrity for buried metallic structures. Used correctly it can provide an indication of areas that are more likely to corrode or do not meet industry accepted criteria for protection. A background in corrosion or a training course from Cath-Tech is highly recommended prior to surveying for the first time.

The Hexcorder Pro is supplied with all the parts and accessories necessary to start surveying. If an interrupted CIPS or a DCVG survey is to be done, the current interrupters need to be installed in the rectifiers prior to starting. Any stationary data loggers also need to be placed.

CIPS



Turn on the Hexcorder Pro and program it for the survey as described earlier in the manual. Clean off the end of the light survey wire with some emery paper and connect it to the pipe at a convenient test station. Fill the half cells with distilled water then insert the half cells into the poles. Remove the plastic caps from the half cells so the ceramic tip makes contact with the soil. Hook the Hexcorder Pro onto the 4 point harness and connect the survey poles and wire dispenser.

The surveyor should use both survey poles and keep one half-cell in contact with the soil at all times to minimize delay while the half cell stabilizes. In areas where the soil is dry, it may be necessary to wet the soil to reduce half-cell to soil contact resistance.

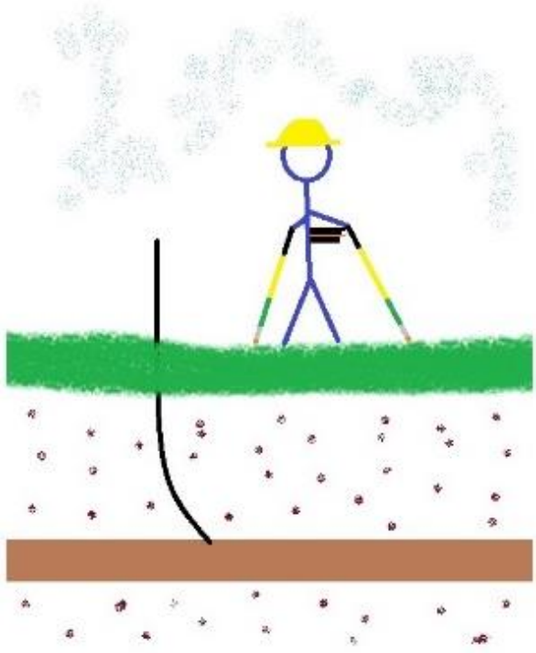
A close interval survey is best accomplished at a comfortable walking speed. Most surveyors prefer a 1 second cycle whereby the rectifier is turned OFF for 200 to 300 milliseconds every second. The one-second cycle will yield a stored reading approximately every two metres at a comfortable walking speed.

To take and store a reading, observe the potential on the Hexcorder Pro display - then when you have a valid pipe-to-soil potential, press one of the buttons on the survey pole. The value you see on the screen at the time of the button press is stored. The values on screen will update once per cycle. These values along with the chainage and GPS coordinates are written to the display every second and stored to memory.

DCVG

DCVG works by measuring the voltage change between two half cells placed on the ground. To undertake a DCVG survey, typically a minimum potential swing of 300-500 mV between the rectifier ON and OFF is sought and the current source output of the rectifiers is adjusted accordingly. The interrupted rectifier enables coating defects to be distinguished based on the potential differences between the half-cells.

The difference between the 'on' and 'off' potentials is recorded at the test point nearest the survey start point, and all other test points encountered.

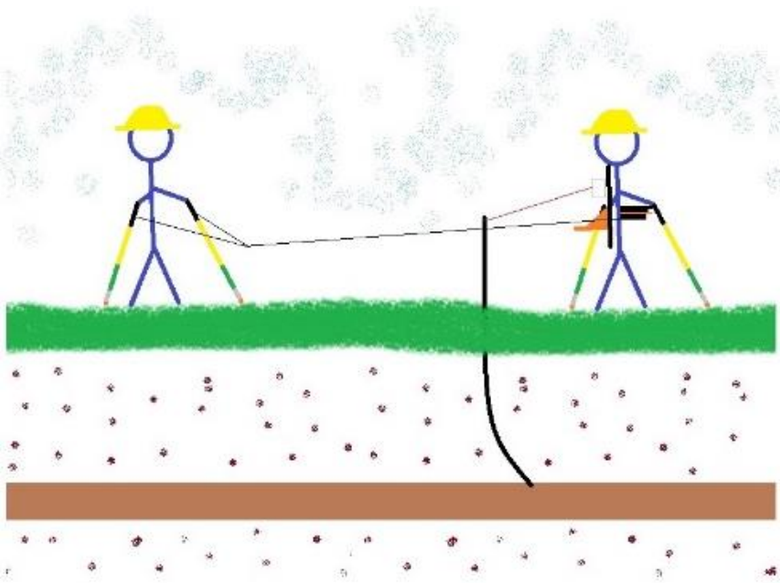


The surveyor walks on top of the pipeline with both half cells. When both half cells are in firm contact with the soil a reading can be taken. If one half cell is in the air, the reading will be incorrect. The half cells can be oriented to the pipe with two methods; lateral and longitudinal. For a lateral DCVG survey, one half cell is kept over the pipe and the other is approximately 2 metres to the side. A longitudinal survey has both half cells over top of the pipe approximately 2m apart.

As a defect is approached a noticeable fluctuation is observed on the Hexcorder Pro at a rate similar to the interruption cycle. The amplitude of the fluctuation increases as the defect is approached. The swing of the values is directional, providing the probes are maintained in similar orientation parallel to the pipeline.

The defect is centered by detailed manoeuvre around the epicentre and the size of the defect estimated by considering signal strength at the defect, difference between 'on' and 'off' potential at adjacent test point and the distance from those points.

Combined Surveys



Combining CIPS and DCVG allows the surveyor to gather data on both the cathodic protection and the coating integrity in one survey. This allows for accurate data correlation after the survey. Combined CIPS & DCVG can be performed by one surveyor or with the assistance of additional surveyors. A combined survey requires a pipe connection for the CIPS reading and two half cells on the soil to capture the gradient between them. Utilizing Y-cables can allow two surveyors to perform a combined survey and walk at a normal pace.

It is critical to know both sets of data; CIPS and DCVG are two halves of one equation. Only by knowing the level of cathodic protection at a coating defect can intelligent choices for remediation be made. It is possible to find a major defect but if the cathodic protection system is adequately protecting it, then it can be left alone. Alternatively, if a pinhole is found and not protected it is a high priority issue that needs repair.

Cables

To reuse Hexcorder MM cables, the adapter CTL-270 is needed

1 Person Survey

As supplied, ready for survey.

Includes:

- CTL-312 GPS
- CTL-267 (or CTL-268) for wire dispenser
- CTL-271, pair, for 2 survey poles

Possible surveys:

- CIPS
- DCVG
- CIPS & DCVG
- Double Impedance CIPS
- Double Impedance CIPS & DCVG

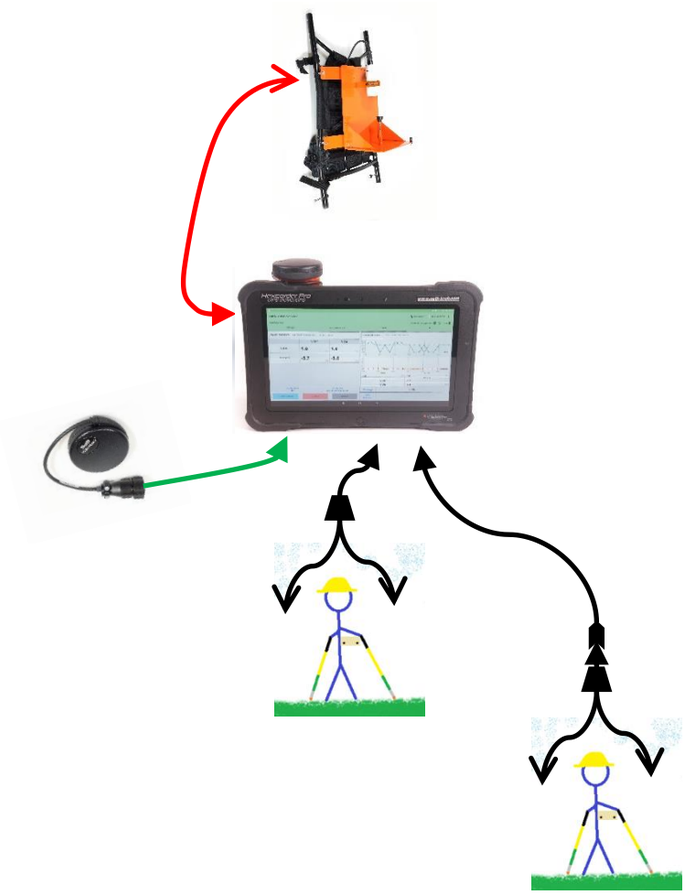
2 Person Survey

Additional supplies needed:

- 2x CTL-131 survey pole
- 2x CTL-272 short Y cable
- Choice of:
  - CTL-273 3m extension
  - CTL-274 6m extension

Possible surveys:

- DCVG
- CIPS & DCVG
- Double Impedance CIPS & DCVG
- Parallel CIPS



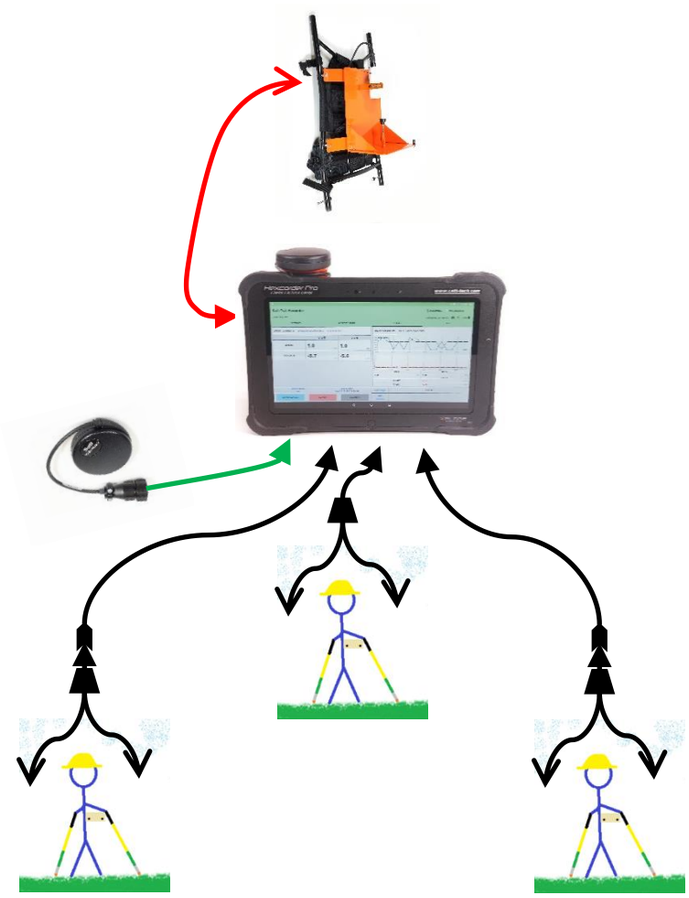
3 Person Survey

Additional supplies needed:

- 4x CTL-131 survey pole
- 3x CTL-272 short Y cable
- 2x choice of:
  - CTL-273 3m extension
  - CTL-274 6m extension

Possible surveys:

- 2x DCVG
- CIPS & 2x DCVG (side drain)
- Double impedance CIPS & 2x DCVG



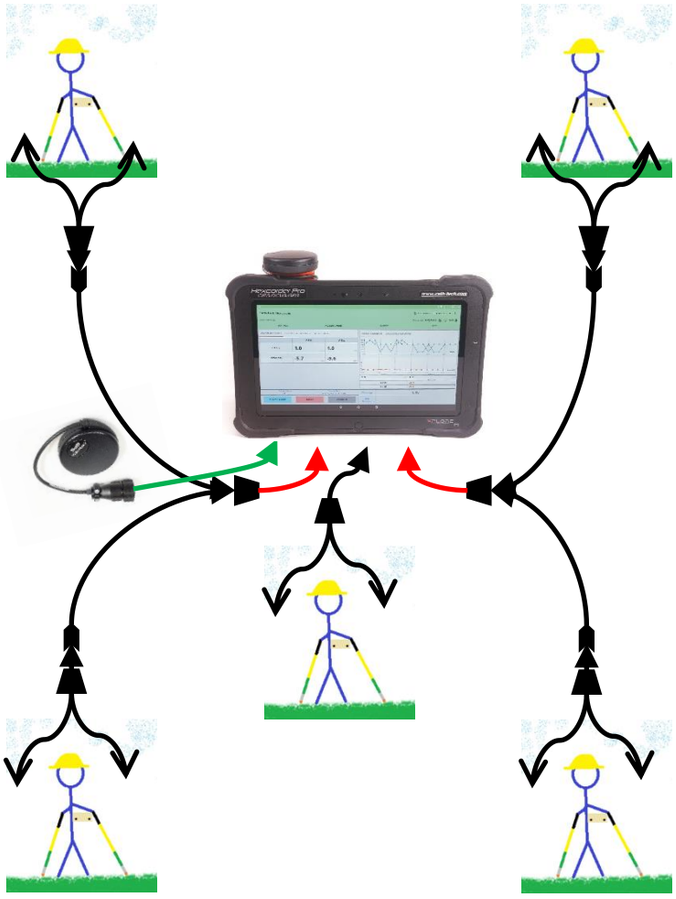
5 Person Survey

Additional supplies needed:

- 8x CTL-131 survey pole
- 5x CTL-272 short Y cable
- 2x CTL-275 splitter for Front / Rear
- 4x choice of:
  - CTL-273 3m extension
  - CTL-274 6m extension

Possible surveys:

- 4x DCVG



Replacement Parts / Accessories

CTL-101
Hip pack wire dispenser
- Does not include cables or survey wire

CTL-131
Half cell extension pole
- Does not include half cell

CTL-103
Counter wheel & axle

CTL-162
Half cell pole replacement switch
- Includes handle assembly

CTL-104
Wire tensioner

CTL-136
Cu CuSO4 half cell with cone tip

CTL-115
4 Point harness for Hexcorder Pro

CTL-141
Small spool wire for hip pack

CTL-116
Strap for Hip Pack

CTL-142
Case small spools (16)

CTL-121
Backpack wire dispenser
- Complete with cable to Hexcorder Pro
- Does not include survey wire

CTL-143
Empty small spool

CTL-122
Wire chainage for backpack

CTL-145
Large spool wire for backpack

CTL-146
Case large spools (4)

CTL-274
6m extension cable

CTL-147
Empty Large Spool

CTL-275
Splitter for Front/Rear

CTL-267
Cable Hex to backpack, 4 wire

CTL-247
115V charger for Hex Pro, NA plug

CTL-268
Cable Hex to hip pack, 4 wire

CTL-248
230V charger for Hex Pro, Euro plug

CTL-271
Cable Hex to half cell pole, pair

CTL-254
Mini USB cable

CTL-272
Short Y cable

CTL-312
GPS 18X, short lead Hexcorder Pro

CTL-273
3m extension cable

CTL-411
Xplore Rugged Android tablet

CTL-412
Charger for Android tablet

CTL-564
Alligator clips pack 10

CTL-537
9V L-ion battery for Hex Pro

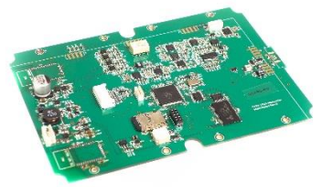
CTL-582
Replacement cable connector, male

CTL-560
Pin for Hex cables, black connectors

CTL-583
Replacement cable connector, female

CTL-561
Socket for Hex cables, black connectors

CTL-642
Circuit board Hex Pro



CTL-562
Black connectors for Hex cables, with backshell

CTL-413
External Battery for Tablet

CTL-563
Pin extractor

CTL-414
External Battery 2-Bay Charger

Troubleshooting

Issue	Possible Solution
Hexcorder Pro won't turn on	Dead battery, plug in with AC power adapter
Tablet won't turn on	Dead battery, plug in with tablet AC power adapter If power LED lights but no screen, broken screen
Hexcorder Pro and tablet won't connect	Power cycle Hexcorder Pro and then immediately try to connect
App crashes during survey	Run the app again, reconnect. The Hexcorder Pro should not need to be power cycled
Unit reads very low ON/OFF values	Check all connections • Half cell pole cables • Wire dispenser cable • Wire spool to wire dispenser • Survey wire to test post • Caps removed from half cells • Distilled water in half cells
Unit won't take readings	• Switch half cell poles (bad switch) • Switch half cell cables (broken cable) • Check for manual survey mode
Readings are very scattered	• Soil conditions, if dry place half cells on green weeds for better contact • Check calibration of half cells • Recalibrate half cell offsets
GPS won't lock	• Ensure good view of sky, no trees/buildings/etc • Check GPS is plugged in correctly
Chainage isn't increasing	• Broken survey wire • Broken wire dispenser cable
Unit won't respond when in survey mode	• Power cycle Hexcorder Pro, reconnect to tablet

Environmental Protection

Waste electrical products should not be disposed of with household waste. Please recycle where facilities exist. Check with your local authority or retailer for recycling advice.

RN42 Bluetooth Transceiver Regulatory Information

United States

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. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Canada

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.

Europe

RN42 EUROPEAN COMPLIANCE TESTING

Certification	Standards	Article	Laboratory	Report Number	Date
Safety	EN 60950-1:2006+A11:2009+A1:2010+A12:2011	[3.1(a)]	Worldwide Testing Services (Taiwan) Co., Ltd.	W6M21402-13966-L	2014-03-24
Health	EN 62479:2010			W6M21402-13966-62479	2014-03-13
EMC	EN 301 489-1 V1.9.2 (2011-09)	[3.1(b)]		W6M21402-13966-E-16	2014-03-13
	EN 301 489-17 V2.2.1 (2012-09)				
Radio	EN 300 328 V1.8.1 (2012-06)	(3.2)		W6M21402-13966-T-45	2014-03-13
Notified Body Opinion	CE0681	—	Eurofins Product Service GmbH	U9M-1404-3736-C-V01	2014-04-15

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