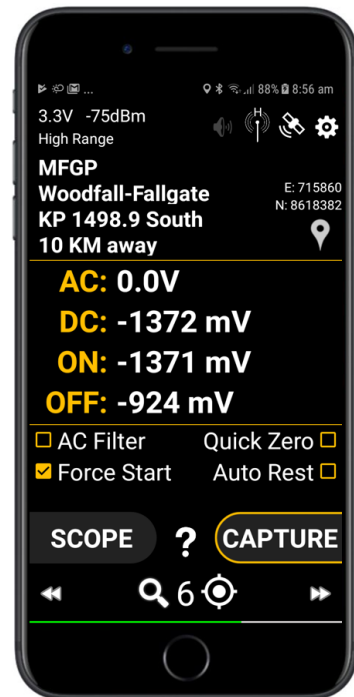




CI Tools - iOS

User Guide



Revision B – draft in progress

20/04/2018

Introduction

Great effort has been taken to ensure that CI-Tools is both intuitive and simple to use. However, if you get stuck, please refer to the Instructional video series or this document for help. Also, don't hesitate to contact us.

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Definitions

AC On Voltage – The steady state AC voltage whilst CP current is being applied.

AC Off Voltage – The steady state AC voltage whilst CP current is interrupted.

Interrupt signature – The trace that shows the pipeline potential just before and just after the current interrupt. The traces shows several characteristics such as the On Potential, IR Drop, and structure depolarisation.

IR-Drop – The measurement error that is caused by measuring a voltage whilst current is flowing through the earth in the vicinity of the test location.

Off Potential – The structures DC electrical potential excluding IR-Drop and before depolarisation has occurred. When it comes to the CP-Pro and CI-Tools there are three ways of defining the Off-potential as follows:

Analysed Off Potential – A measurement of the Instant-Off potential defined as the potential at the instant after the initial IR drop as found through graphical analysis of the signature data by looking for the IR drop and a knee point in the graph.

Timed Off Potential – A measurement of the Instant-Off potential defined as the DC potential measured at a set duration (say 100mS) after the interrupt.

User Off Potential – determined by the surveyor by selecting a point on the interrupt signature.

Preferred Off Potential – A selection of the above three off potentials made by the surveyor before saving the data. A default selection can be set so that the user does not need to select each time. Remember that all of the data is recorded to the database so verification of selection can be completed in the office.

On Potential - The steady state DC voltage whilst CP current is being applied.

Getting Started

Description

CI-Tools will eventually be a hub for integration of various Corrosion Instrument's hardware as well as a place where your survey data can be stored, viewed, and edited with great ease.

At this point the only piece of hardware is the CP-Pro. However, it is still a great hub where your survey data can be generated, stored, viewed and edited with ease.

This User Guide will take you through the steps required for:

- Setting up your database,
- Importing test point data and data from previous Instant-Off Surveys
- Configuration for an Instant-Off survey
- Execution of your first Instant-Off survey

Survey Pre-requisites

There is certain information that CI-Tools needs before it is of much use to you. Basically, you need to tell CI-Tools a little about your assets, how you prefer to do your surveys, are you licenced to use your hardware etc. There are three tasks that you need to complete before starting your first Instant-off survey:

Task	Details
Create a database	Must have at least 1 table which contains data about your test points
Enter hardware licence key	You must enter a valid licence key in order to use connect CI-Tools to your hardware
Configure interrupt cycle	You need to set up the interrupt cycle In CI-Tools to match you CP system current interrupters

In addition you may want to do a few other things to get the most out of CI-Tools

Task	Details
Import past surveys	Importing your historic data allow for graphing and comparisons.
Set up Survey parameters	Modify your On-Lead time and Off-Lag time.
Configure the asset type	Configure your asset type so that tags and labels make more sense to you particularly if your asset is anything other than pipelines.

Throughout this guide “*” is used to highlight the mandatory steps that are required before starting your first Survey. You should ensure that you have completed these before going to the field as they may require internet access. You have also been given a pre-start checklist, please ensure that all of the items are checked before going to the field for the first time.

Device requirements

CI-Tools is a highly integrated application that leverages of many of your iPhones systems.

This Document is specific to iPhones, if you are using or plan to use CI-Tools on an Android Device, please refer to the Android user guide

Item	Minimum Requirement/Recommended
iOS version	>10
iPhone Model	>6S
Display Size	We highly recommend an iPhone with a larger screen however CI-Tools will operate on screens as small as a 6S.
Waterproofing	As your iPhone will become a tool for use outdoors, we recommend the use of a waterproof, shock resistant case
NFC	NFC is used to improve the user experience by storing CP-Pro data.

Table 1- iOS Minimum Operational Requirements

Orientation

There are several convenience methods implemented into CI-Tools you should familiarise yourself with these before using the app.

- You will find ? buttons throughout CI-Tools, these will assist you if you ever get stuck. On the Main Survey Screen, tapping the ? button will enter assist mode where you can touch any item to see what it does.
- The navigation bar at the top of the screen contains the **BACK** button. It is always available but you can hide it by swiping up on the screen. To reveal the back button, swipe down.
- All of the menu buttons in the Settings area contain help messages that will be displayed if you hold the button.
- CI-Tools is backed by its own cloud network. Files are transferred between the app and the cloud for several purposes:
 - Security
 - Convenience
 - Data backup

The volume of this data is only small but it will greatly improve the user experience, so please allow this interface. You should note that failed upload attempts (generally meaning you have no internet service) are queued for upload later. However, to save your mobile data quota, these uploads wont happen until the phone has internet access over WiFi. So please connect to WiFi internet and open CI-Tools whenever you can during and after your survey.

- CI-Tools makes good use of other phone services including:
 - NFC
 - Email
 - Camera
 - Internet
 - Location
 - Bluetooth

If prompted, please allow the app access to these services, the app can't operate as intended without access to these services

Accounts and Login

Before using CI-Tools you must be logged in to your Apple-ID account. CI-Tools uses your Apple-ID to interact with the iCloud. Your basic App settings are backed up in iCloud just like any other app but all app generated data, surveys, photos, charts, images etc are store in the CI-Tools App cloud database, so it won't use any of your iCloud quota, just your credentials.

You will have received a Company Name and a company-wide Password when you received your hardware. To sign in, tap the log-in icon at the bottom of the home screen. Enter a username as well as your company name and password exactly as they were provided to you.

Press **LOG IN** then if your company has multiple sectors/sections/business units/states/sites or entities set up, please select yours from the Sectors dropdown list. You have access to all sectors within your business. However, any data generated by CI-Tools will be allocated to your chosen sector so please ensure you choose correctly or your cloud data will become messy. You can return to this page at any time to change sector without having to log in again. i.e. you can use all sectors but only one at a time.

Databases*

Before CI-Tools can do much, it needs a Database with a “Working Table.”

The Working Table is where all new data is stored.

We recommend creating a new table for each survey.

The Database needs to be populated with some minimum information. The details of this information are provided in Appendix 4 – Database Schema.

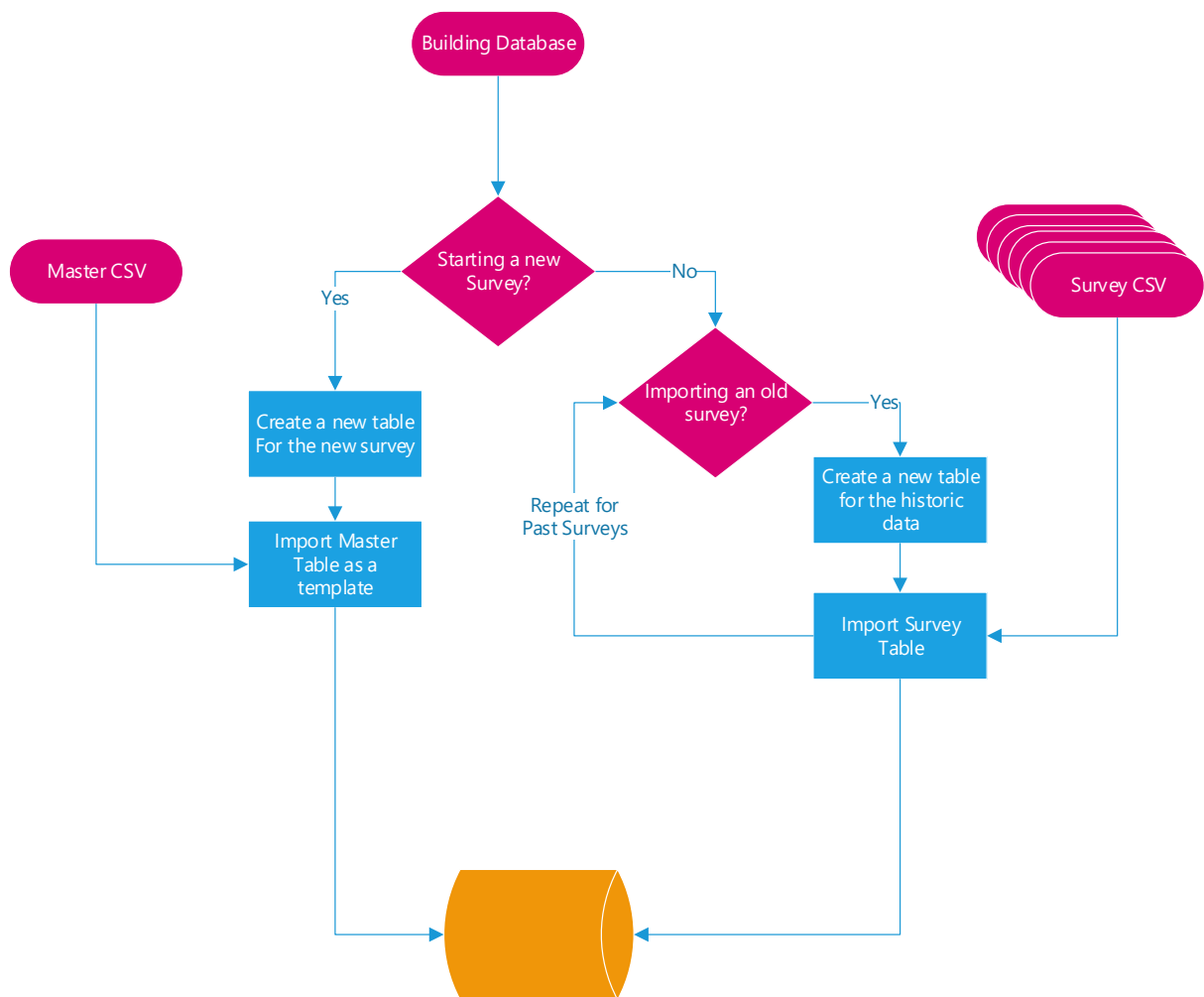


Figure 1-Database Construction overview

Creating CSV Files*

You can populate the database by importing a .CSV spreadsheet file that has information about your CP test points. A template and an example are available on our website and also on the thumb drive that came with your CP-Pro. The CSV Schema is provided in Appendix 4 – Database Schema.

The construction of these CSV files is the single most complex process in using CI-Tools and the CP-Pro. The good news is that once you have done one, the others will be easy and you only have to do each one once!

More good news is that Corrosion Instruments is happy to do this for you, generally free of charge.

We highly recommend starting with the template for the construction of your CSV files, then, it is a matter of dragging and dropping your data into your spreadsheet software and ensuring that the data is in the correct units. The whole process should only take a few minutes.

You will want a single **Master Spreadsheet** which contains data about your test points as well as multiple **Survey Spreadsheets'S** which contain data about your historic CP Surveys (one for each past survey).

Master Spreadsheet - Contains asset data but no measurement data.

Survey Spreadsheets - Contain both asset data and measurement data.

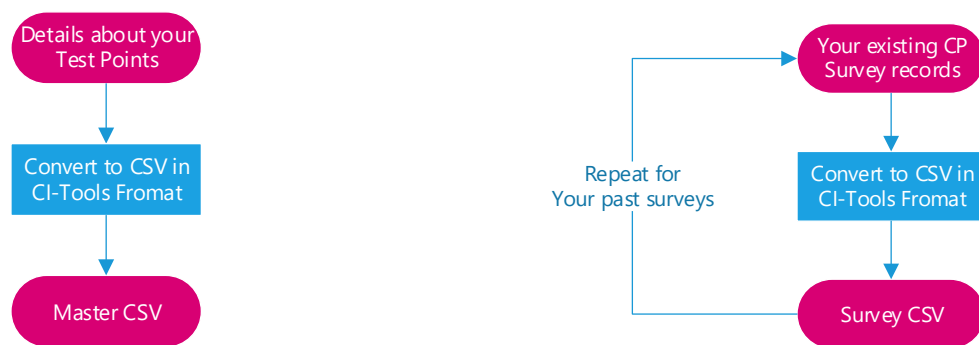


Figure 2 - Construction of Master and Survey spreadsheets

You should populate the first few columns with your asset data do this for both Master and Survey CSV's, for a pipeline asset the data looks like this:

ID - incremented 1 per row starting from "1"

Pipeline – eg "MGFP"

Section – eg "Ashvale-Osthaven", or even better "ASV-OHV"

Location – eg "6.8" you could use KP, MP, serial numbers etc but it is important that these fields be kept purely numeric. For example instead of using "KP6.8" you should simply use "6.8"


Station – eg "Blowdown Stack", this is only required if there is more than one test station at a given location but you could also use this for ques for every testpoint, eg. "Cnr of Smith St".

Protection Criteria – eg "-850", if you do not know the protection criteria, put "0" but please don't leave this blank.

It is important that each test point is uniquely identifiable by: pipeline/section/location/station i.e. no two test points should have the same pipeline, section, location and station.

Once you have entered this data you have all of the minimum required information for a Master spreadsheet! But there is still more to add if you want to get the most out of CI-Tools.

If you have geographic data (UTM Coordinates) for your test points you should include it. This will give you features like “Select Closest Test Point” and view “Distance to Selected Test Point”.

Tip - If you don't have geographic information, you should collect it using the **Pin-Dropper**  on your first survey.

To add geographic information, populate, **Northing**, **Easting** and **Zone** with UTM coordinates Zone is the Zone number only and not the letter.

Data	Requirement
ID	Required
Pipeline	Required
Section	Required
Location	Required (numeric)
Station	Required if you have multiple test points at a single Location
Northing	Add it if you have it (UTM)
Easting	Add it if you have it (UTM)
Zone	Add it if you have it (UTM Zone only – no letter)
Protection Criteria	Required
DB - Locked	You can leave blank
Exclude from Graphs	Mark “1” for any test points that you want to exclude from the Instant-Off survey graphs

Table 2 - Test point data for spreadsheets

*note you can change the titles to suit your asset type, eg. rather than {Pipeline, Section Location} you might want {Site, Tank, Testpoint} just ensure you keep the same order and purpose.

The data that you have now entered to the spreadsheet is all that is required for a fully featured Master spreadsheet.

Save a copy of your template file as a Comma Separated Value (CSV) file and call it something like Template.CSV then put it on the phone in the CI tools folder see - Transferring Data to your Phone*

Now if you want to import your historic CP survey data (we recommend this, as it allows for the construction of some useful graphs, it also helps with fault-finding in the field,) you should populate the rest of the fields as shown below to create Survey files.

Assuming that your historic survey data comes from a Multimeter you should populate:

Data	Action
DATE	Add it if you have it
TIME	Add it if you have it
AC ON VOLTS	Add it if you have it
AC ON TIME	Add it if you have it
AC OFF	Add it if you have it
AC OFF TIME	Add it if you have it
ON POTENTIAL	Add it if you have it
ON TIME	Add it if you have it
TIMED OFF POTENTIAL	Add it if you have it
TIMED OFF TIME	Add it if you have it
CALCULATED OFF POTENTIAL	You won't have this
CALCULATED OFF TIME	You won't have this
USER OFF POTENTIAL	You won't have this
USER OFF TIME	You won't have this
PREFERRED OFF POTENTIAL	Make equal to TIMED_OFF_POTENTIAL
PREFERRED OFF TIME	Make equal to TIMED_OFF_TIME

Table 3 - Measurement data for Spreadsheets

Refer to the document CI-Tools Schema for more details regarding the layout of the CSV files and the Databases

Create one Survey spreadsheet for each Survey that you wish to import to CI-Tools.

Please ensure that you stick to the guidelines set forth in the Appendix 3 – CSV Schema

Transferring Data to your Phone*

So now you have some CSV's on your computer but you need to put them on your phone.

There are a myriad of options here such as Bluetooth, WiFi, cloud services, SD card USB drives etc. However iPhones are not as easy to load files to as Android phones.

Apple would like you to use iTunes however we realise that you probably don't have iTunes installed on your work computer so we have a couple of good alternatives for you.

The iOS file structure does not give you access to most of the phone. CI-tools stores CSV files that are intended for importing, in the file:

```
//CI-Tools/Import Folder
```

You don't have access to this folder from outside of CI-Tools but don't worry, if you put a .CSV file in either the app root folder (using iTunes) or the apps Inbox (every other method) CI-Tools will manage the transfer from there. What's more, CI-Tools will push the files up to iCloud and every other instance of CI-Tools in your company will automatically have access to the files. i.e you only have to load the .csv files to one phone once!

If you have iTunes then that is probably the easiest way to transfer your files to the phone, just connect your phone to your computer using its USB cable, open iTunes, navigate you're your iPhone and click "App Sharing". Ensure that you add the individual .CSV files and not a folder to the apps root folder.

Other than iTunes, our two preferred methods are using a Sandisk Wireless Connect drive or sending the files via email.

Sandisk Wireless Connect

1. Create a folder and load the files to the drive by connecting it (via USB) to your desktop PC
2. Download the "Connect Drive" app from the app store
3. Start the WiFi radio by pressing the button on the drive
4. Connect your phone to the Sandisk WiFi
5. Open the app and find the files that you installed on the drive
6. Tap "select" and select all of the files that you want to transfer to the phone
7. Click the share button (down the bottom next to the trash button)
8. Click "Save to My Downloads"
9. Navigate "Back" then open the app menu

Complete the next steps one at a time for each file

10. Tap select
11. Select one file
12. Tap the share button
13. On the menu that pops up tap "Copy to Corrosion Instruments"

Once you have transferred all of the files to the CI-Tools inbox.

14. Disconnect from the Sandisk Wifi and connect to your usual wifi
15. Launch or relaunch CI-Tools to allow it to transfer the files the rest of the way. A copy of each file will be loaded the cloud and accessible within your company. Alternatively if you don't want to re-launch CI tools, navigate to :

SETTINGS/ DATABASE SETUP/ CREATE DATABASE

And press the refresh button on this screen.

Emails

With CI-Tools closed

1. Attach the files to an email and send it to an account that is registered on your phone. (keep in mind file size and count limits.
2. Open the email on your phone, tap and hold the attachment
3. On the menu that appears, click "Copy to Corrosion Instruments"

16. Launch CI-Tools, the app will take care of the rest of the file transfer and put a copy on the cloud for access by your company. Alternatively if you don't want to re-launch CI tools, navigate to:

SETTINGS/DATABASE SETUP/CREATE DATABASE

And press the refresh button on this screen.

Tip - Please remember that you only need to transfer the files to one phone, you will then be able to access them on all the other phones in your business though you will only be able to see the files for your chosen sector.

Creating Tables*

To create a table:

1. Open CI Tools
2. Click Settings / Database Setup / Create Database
3. Tap the + button and enter the name of your new table
 - a. Names should describe the Survey eg "2016" or "Spring 2016"
4. This will automatically be made the Working Table. If you don't want this to be the working table, select the working table from the list

Importing Data to Tables*

To import data:

1. Navigate to: Settings/Database Setup/Create database.
2. Create new tables by tapping +
3. Select the table to which you want to import – from the top dropdown list
4. Select the .CSV file that you want to import – from the bottom dropdown list
5. Click import

Note – it might take a couple of seconds after opening this screen for the .CSV files to be downloaded from the cloud. If you don't see anything on the bottom dropdown, wait a few seconds and try again. If you still don't see the files that you expect, navigate **BACK** and then reopen this page

For past surveys you will want to import a filled Survey CSV file like "Spring_2016.CSV".

For a planned survey you will want to import your "Master.CSV" file.

Uploading a Database

You can upload a database to your companies Cloud by clicking the Cloud Upload Button



Downloading a Database

If you, or someone within your organisation has previously uploaded a database then you can download it by tapping the Cloud Download Button (...), and then selecting the file which you want to download from the list.



Sharing Database

You can share* a database via email or any of your other configured Share* services by clicking the share button.



Which will open up your Share console.



*Share options vary depending on what services you have set up on your device. Typically these services include things like.

- Email
- Bluetooth
- MMS
- AirDrop
- Microsoft One-Drive
- Google Drive
- Cloud connected physical local drives (like Western Digital My-Cloud)

Exporting a Database

You can export your database to a Comma Separated Value .CSV file.

SETTINGS/DATABASE SETUP/EXPORT DATA

To export to .CSV

1. Select the table you would like to export (or select 'ALL' to export all tables)
2. Give the file a name (otherwise, the table name will be used by default and if you chose the 'ALL' Option then the table names will be used)
3. click 'MAKE UNIQUE' to save the file with a date and time prefix, this will ensure that you will not overwrite other files in the export library.
4. Click 'EXPORT TO CSV'.

Adding an Entry to the Database

You can add an entry to the Working Table by navigating to

SETTINGS/DATABASE SETUP/ADD ENTRY

Select the asset and section that you would like to add the test-point to, then enter the details in the other fields and click "ADD" this row will be appended to the end of the working table.

Deleting Tables and Database

You can delete individual tables or the entire database by navigating

SETTINGS/DATABASE SETUP/DELETE DATABASE

To delete a table, select the table from the dropdown list then tap 'DELETE TABLE'

To delete a database, click 'DELETE DATABASE' this will delete the entire database, including licence keys and field measurements.

Where possible and when required, a backup of your database is made. For example when you delete your database, CI-Tools will attempt to backup your database remotely and locally before deleting it. Corrosion Instruments makes no guarantee that these automatic backups have occurred but if you get in strife please contact us as we can likely help out with recovering your data. It is always a good idea to manually backup data where it is of value by using the Cloud Upload or Share facilities.

That is about all you need to know about databases for use in CI-Tools. Don't forget to make a new table every time you start a new survey.

Licensing

CI-Tools uses licences to allow linking of hardware to software.

Each piece of hardware requires a licence key. Your CI-Tools will be able to communicate with any Corrosion Instruments hardware as long as you have the correct key in your licence database. You should note the following

1. One piece of hardware can be used with multiple instances of CI-Tools (one at a time)
2. One instance of CI-Tools can communicate with multiple pieces of hardware (one at a time)
3. Licence keys will be verified securely online.

Adding a licence key*

1. Navigate to Settings/Licences
2. Type the key where it says Add New Key. Or tap the NFC icon and scan your device.
3. Click add key
4. If your key is valid, it will be added to your list of keys and you will have access to that hardware.

Configuration for CP Survey

You now have your database set up but there are a few other things that you may need to configure prior to completing your first Instant-Off survey

Configure Interrupt Cycle

You need to tell CI-Tools about your CP systems Interrupt cycle.

From the Home screen, navigate to:

SETTINGS/INTERRUPT CYCLE

Enter your On-Seconds, Off-Seconds, and choose if you start a minute with an Off-cycle or On-cycle.

Note* All Corrosion Instruments Interrupters start the minute with the Off-cycle

Your cycle time (Off-Seconds + On-Seconds) must be a factor of 60 seconds. If the entered Cycle Time is not a factor of a minute the Cycle Length will display red. Corrosion Instruments recommends choosing one of the following Cycle Times.

4S, 5S, 6S, 10S, 12S, 15S, 20S, 30S, 60S

If your CP interrupters are currently configured to some other cycle time, please contact Corrosion Instruments and we can test your cycle time.

Configure Asset Type

Navigate to:

SETTINGS/CONFIGURE ASSET

From the dropdown, either choose a pre-set or click Custom and enter your own asset classification titles. These titles are used for classification throughout the CI-Tools

Phone Settings

Corrosion instruments recommends the following phone settings during a survey.

Setting	Set	Note
Bluetooth	On/Disconnected	Ensure that your phone is not connected to any other Bluetooth devices (This includes your car head unit)
Screen Lock	Off	Lock The screen Manually, having a timed lock will likely lead to frustration
Application Power Savings	Off	Application Performance

Table 4- Recommended phone settings

Completing a Survey

Once you have entered the licence key for your CP-Pro and selected a working table, you will be able to enter the “Survey” part of CI-Tools.

- From the Home page click “Survey”
- Select your hardware profile
 - If your phone has NFC, tap the NFC symbol and put the top of your phone near the CP-Pro where it says “CP-Pro”
 - If your phone doesn’t have NFC, Use the drop down list to select the correct device
- Click Next
- Select your CP-Pro from the list of nearby wireless devices that appears. If you don’t see your CP-Pro, ensure that it is On, Awake and not connected to any other phones then click refresh on your phone screen.

Once you have selected your CP-Pro from the list, it will connect to your phone and the SCOPE button should be enabled, you should also see some numbers in the AC and DC fields and status at the top of the screen to indicate that a connection has been made.

We will pause here and introduce the features and items on this screen as they are quite numerous.



Figure 3 - "Meter" this is the main page for on/off surveys

ID	Name	Description	Alternate Functions
1	System Status	Top line: Signal Strength, battery Voltage, sample rate Bottom line: status text	
2	Master Asset	Pipeline/ Site /Asset etc	
3	Daughter Asset	Section/Tank etc	
4	Asset ID	KP/ MP/ Serial etc	
5	Asset Description	Station North/ IJ/ Blowdown etc	
6	Distance	Distance so selected test-point	
7	Auto Rest	Enables/disables Auto Rest which rests the CP-Pro after a period of inactivity	
8	Quick Zero	Automatically and temporarily zero's the range that is in use	
9	AC Filter	Toggle the single cycle AC Filter	
10	Live AC	Live AC RMS millivolts (volt meter)	
11	Lice DC	Live DC millivolts (volt meter)	
12	On Potential	Last on potential (updates every cycle)	
13	Off Potential	Last off potential (updates every cycle)	

14	Scope	Opens the oscilloscope	
15	Previous	Moves to the next test point up in the database	
16	Progress Bar	Show position of interrupt cycle Red=off Green=on	
17	Search	Search for the test point in a list	
18	Remaining Seconds	seconds remaining before the end of the interrupt	
19	Help	enters help mode where you can click on things to see what they do	
20	Select Closest Test Point	selects the closest test point	
21	Next	Moves to the next test point down in the database	
22	Capture	Starts and Automatic measurement	
24	Pin Dropper	Save the current location against the selected test point	
25	Current Coordinates	Your current location	
26	Settings	Opens CP-Pro Settings page	
27	GPS Connected	Shows if you have a valid GPS fix and if you are requesting GPS information	Toggles GPS requests (to save battery)
28	CP-Pro Connected	shows connection to and state of CP-Pro	Tap= toggle rest/wake state Hold = opens a menu of CP-Pro controls
29	Beeper	Toggle the cycle beeper	

Before you take your first measurement you need to do the following:

- Configure timing (unless you are happy with the defaults).
- Select the test point that you want to measure.

Configure timing

To configure some basic timing parameters tap Settings (26) then “Timing Setup” the

On Lead - is the time before the interrupt at which the “On Potential” on the main Survey Screen is recorded. It has no bearing on the value recorded in automatic measurements, the time used for automatic measurements is always 500mS. If for some reason you would like to be able to modify this time please contact us and request the change.

Off Lag - is the time after the interrupt where the “Instant Off” is recorded.

Time Shift - is a compensation value used to account for communication latency or interrupter switching delays.

Note that the AC-Off Potential is always taken 1.000 Seconds after the Interrupt

Meter Calibration

You can calibrate your own CP-Pro in-house to obtain accuracy far greater than what is needed for an instant off survey.

To calibrate you need a reference voltage. Corrosion Instruments sell a 5VDC pocket reference which is accurate to about +/- 0.1%

Before you calibrate, you should determine if you need to calibrate or not. The easiest way to determine if your CP-Pro needs calibration is as follows.

1. Open the Main Survey screen
2. Short the two test terminals together using a test lead
3. Press “Quick Zero” – ensure that both the DC value reads 0000mV
4. Remove the shunting test cable and connect to a known voltage – Our 5.000V references work well
5. Check that the DC reading = 5000mV (if so then no need for DC calibration)

If you need to calibrate the click on Settings then “Calibration”

There are potentially several different sources of calibration data, you can choose to apply any of these sets or you can perform a new calibration. You can also reset all zeros to “0” and gains to “1” if you want a clean slate from which to calibrate.

The potential sources of different calibration data are

- The devices NFC (data from the last Factory calibration)
- Your phones CI-Tools database (the last calibration that you performed)
- Your companies Cloud database (the last calibration for that was performed on this particular CP-Pro)

To perform a Manual Calibration, you need to adjust the Zero and Gain for each of the ranges.

Start by selecting a range. You can toggle between the working ranges by toggling the ATT button at the top of the screen

Zero that range by shorting the two terminals then clicking the **SET** button that corresponds to your chosen range.

To set the gain for your range you should connect a reference voltage to the test terminals, enter the reference voltage in the field labelled “Test Voltage” and click the “SET” button next to the range you are calibrating.

Once you have calibrated both ranges you can Zero AC measurement with the ATT in either position, and the test terminals shorted. Setting the AC gain could be trickier to complete in-house, but we don’t expect that you will ever need to do this.

Quick Zero

You might experience some zero drift in the order of a few mV as temperature deviates significantly from the calibration temperature. You can quickly and easily Zero the unit by clicking “Quick Zero” on the main survey screen. Note that quick zeroing does not effect the calibrated zero as is not saved meaning that if you exit the application and re-enter it you will need to Quick Zero again. Think of it like a Tare button on weigh scales.

Also note that the Quick Zero only Zeros the in-use range. If you are using “Auto-Range” then you should ensure that you Quick Zero both the High and Low Ranges.

Test Point Selection

You need to select the test point that you are going to measure. If you have included geographic coordinates in your database then you can select the closest test point by clicking the crosshair icon (20). Otherwise you can click the magnifying glass (17) and select from a list.

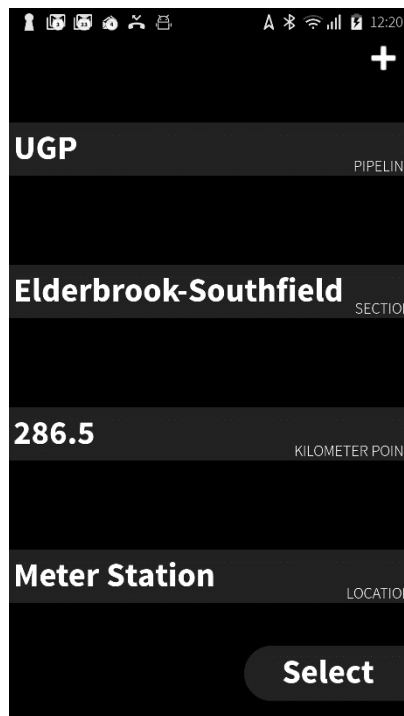


Figure 4-Test Post selection Page

Once you have selected your first test point, subsequent test-points can be selected using the forward/back arrows (15,21) or the crosshair button (20) to find the closest test-point. You should always double check that you have selected the correct test point.

Check The interruption cycle

It is a good idea to check that the progress bar (16) is synchronised with your interrupters. To aid in doing this you can click the “beeper” button (29) which will enable a BEEP at the end of the on and off parts of the interruption cycle. Compare the beeps with either the LED on your interrupter or the “click” if you use mechanical relays. With this check, you are ensuring that synchronisation is accurate to the second (not the mS) you are also checking that you don’t have the ON-cycle and Off-Cycles reversed.

Range Selection

There are two measurement ranges

High Range = $\sim\pm 100V$

Low Range = $\sim\pm 5V$

You can select either of these ranges by holding the CP-Pro Connected Icon (28) and choosing the range from the dropdown menu. You can also select “Auto Range” which will manage range

selection for you. You will likely find that High range will provide more than adequate resolution for an on/off survey, in which case, we suggest making High Range your default..

An out-of-range measurement will cause the measured value to turn Red, if you have chosen Low Range and see a lot of red values, you should change the range to High.

Take an automatic reading

Click "Capture" and wait for the end of the cycle. If something goes wrong you will be notified with "Bad Sample" in which case you can just click "Capture" again.

Your Survey measurement page should look like this:

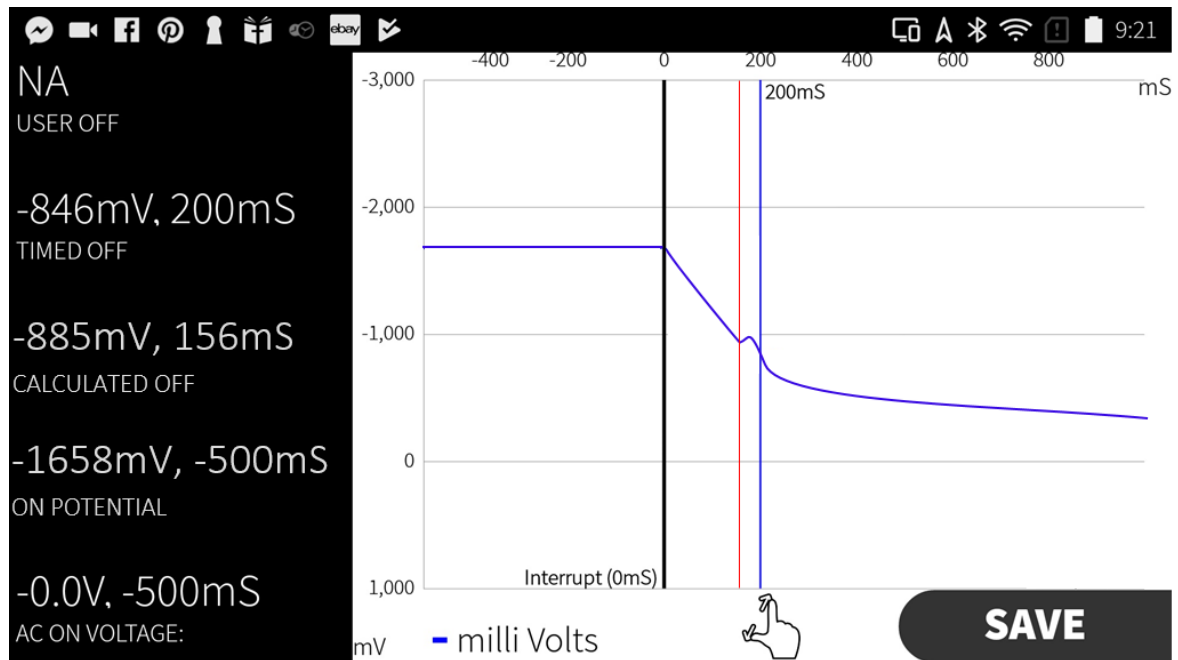


Figure 5- Capture Review Screen - Simulated Instant Off reading

It is important that the user understands every part of this screen.

The screen is split into two parts. The left-hand side displays all of the measured data in numeric form whilst the right-hand side displays it in graphic form.

Numeric display

The numeric display displays all of the measured data in numeric form, this display scrolls up and down.

From top to bottom we have: the three DC Off-potential definitions, On-Potential, AC On and AC-Off. Each of these measurements are display with the time at which they were measured in mS with respect to the interrupt.

At the bottom of the numeric display is the time calibration button and read-out which will be explained in the next section of this guide.

The user-off will only be populated if the user has selected an off potential by touching the curve.

The Calculated-Off potential will only be populated if analysis of the interruption curve yielded a result. Note that this function is disabled in the Beta version.

The numeric display can be minimised by clicking the Chevron to the right of the display, another click will reveal the numeric display.

Graphic Display

The graphical display presents the data in a form that is much more useful to the user, the data here should always be evaluated and verified, this can be done in matter of seconds.

The vertical black line shows when the interrupt should have occurred

The vertical blue line shows the instant that was defined for the timed off potential (in this case 200ms after the interrupt)

The vertical red line shows this instant of the analysed off potential if one was found.

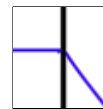
The hand icon button at the bottom of the screen lets the user toggle between zooming X and Y axis independently (like an oscilloscope) or zooming X and Y equally (like a camera).

You can hide the numeric display to show the graphic display in full screen by tapping the chevrons

Data evaluation and verification procedure

This process is critical and should not be skipped. However, in most cases it can be completed intuitively in just a few seconds.

1. Verify interruption synchronisation – the first bend in the curve should line up with the vertical black line at “0mS” if this is not the case, use the time calibration procedure to synchronise the CP-Pro and re-Capture the measurement.



2. Ensure that there is no sign of multiple interruptions. If your interrupters are not synchronised, you cannot get an accurate instant off potential. You will need to deal with your interrupters before you can complete your survey.

3. Verify the location of the Analysed-Off Potential. If there is no Analysed-Off potential or if it looks incorrect, you should not use it as your preferred off potential.



4. Verify the value of the Timed-Off Potential. This will be at whatever time you have specified, however you should ensure that it occurs after the IR drop has stopped.



5. If for some reason you are not happy with either of the timed off or analysed off potentials. You can simply touch a point on the graph to select it as a User-Off potential.
6. Ensure that the numbers on the left all look reasonable, compare them to your protection criteria and past measurements

Review and Save

If you are happy with the measurement, click “SAVE” and you will be presented with a data summary page. You should review all of the data before you hit save, remember that this will override any data that exists in the current survey table for the selected test point. You should also take a couple of actions on this page before clicking “SAVE”.

1. Select your preferred Instant-Off potential
2. Flag for review if you have any doubts about the measurement.
3. If this test point should not be included in pipeline Instant-Off graphs you can exclude it here
4. You can add comments if required
5. You can add a photo if required

Calibrate Time

If you notice that the interruption potential drop doesn't seem to line up the “0mS line” you can very easily calibrate the time shift. From the Capture Review Screen, scroll to the bottom of the Numeric Display pane and you will see a “CALIBRATE” button, tap it. Now when you move your finger across the graph you will be adjusting the Time Shift value rather than the User-Off value. Simply select the correct interrupt point and click apply. You can zoom in on the interrupt point to get better accuracy. However, once zoomed, swiping will pan the screen so you want to tap the point instead of swiping to the point.

Obviously this method of calibrating time can only be used if the error is less than -500ms and +1000ms (otherwise you wouldn't be able to see the interrupt). If the error is greater than this you should investigate why your interrupters are so far out of synchronisation. However, you can compensate still, first you will need to estimate the error using a stopwatch or other means, you can then enter the offset manually in the SETTINGS/TIMING SETUP page. This might take a couple of tries, but once you get the error into the -500ms -> +1000 range you can then use the method described above to calibrate the timing precisely.

AC measurements and display

There a few important points that the user should note about AC measurements and how it is displayed on the graphs and oscilloscope.

Power frequency AC voltage is attenuated in the analogue stages of the CP Pro's input circuitry. Calibration for AV measurements, compensates for this attenuation such that all numeric displays of AC voltage are in Vrms. However, a design decision was made to display the attenuated value rather than the compensated value of AC voltage on both the oscilloscope and the Capture review page. By doing this, AC “noise” is largely masked and the user can see what the DC potential of the protected Structure is doing far more clearly.

The user must keep this in mind, as the peak-peak swing of cyclic potentials should not be taken as an indication of actual amplitude, they should instead be indication of the presence of AC voltage. The numeric readouts should be use to quantify AC voltages.

The below Capture Review Screen provides a good example of why we have made the CP-Pro in this way. To get the reading we used a signal generator to create a 5VAC signal with a DC offset of about -2000mV.

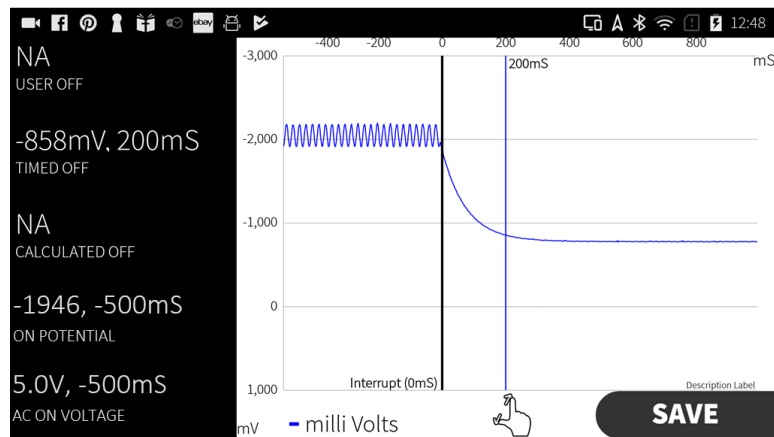


Figure 6- interruption of an AC voltage with a DC offset

You can clearly see the presence of AC potential before the interruption. However, 5Vrms has a peak-peak swing of about 14200mV which, if shown at full scale, would be well outside of the displayed area of the graph and would render the graph all but useless. The displayed cyclic swing is roughly 1/50 of the value of the actual swing.

AC Filtering

The CP-Pro provides a single cycle integrating low pass filter for 50 or 60 Hz (other available on request).

This is an almost perfect filter, the below reading was taken from the same test setup used for Figure 4, notice how all AC swing has disappeared whilst the Timed-Off, in this case, has remained exactly the same.

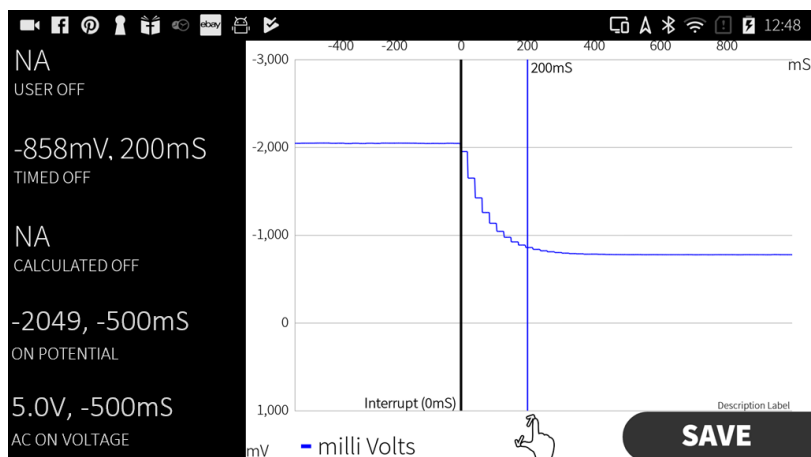


Figure 7- Interruption signature for the same signal as fig-4 but with the AC filter turned on.

Due to the fact that the filter operates over a single cycle rather than multiple cycles. A temporal resolution of 50 samples/second in the construction of the interrupt signature is easily and accurately achievable with the AC filter turned on. Though this is somewhat lower than with the filter turned off, it is still high enough to get an accurate Timed-Off or User-Off potential. Calculation of the Calculated-Off potential will not occur when the AC-Filter is turned on.

What all of this means, is that we expect that the CP-Pro can effectively measure instant-off potentials even on pipelines/sections with very significant amounts of AC interference.

Using the Oscilloscope

The Oscilloscope allows for a great deal of insight to your CP system. You can simultaneously view traces of AC Voltage, DC Voltage and the live value.

The use of the oscilloscope is very intuitive but we will describe the various bells and whistles.

To access the oscilloscope, click the 'SCOPE' button on the main survey page.

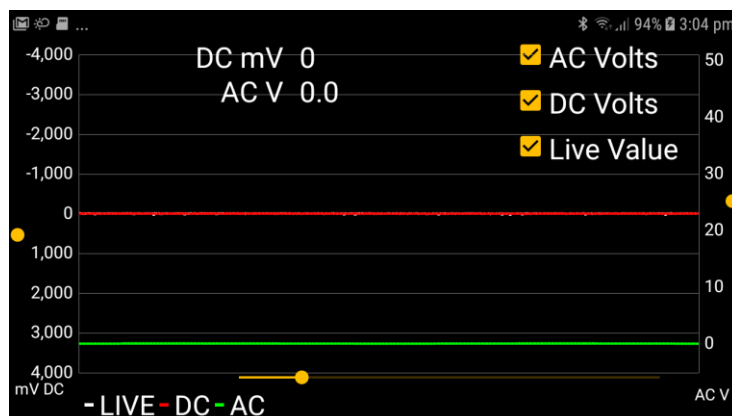
The scope x axis is time without units whilst the left Y axis is DC mV and the right Y axis is DC V please be aware of the distinction in units here.

Each of the three traces can be toggled by clicking the checkboxes in the top right corner.

The time over which the DC voltage is evaluated over can be controlled by the horizontal slider, minimum (left) is one 50Hz cycle, whilst maximum (right) is 30 cycles. You will see why this is important when you start looking closely at CP interrupts.

The time axis can be stretched (zooming on the x plane) by a horizontal pinch or stretch with two fingers.

The yellow handles on the left and right can be used to zoom the left and right axis independently.



Analyse

The Analyse section of CI-Tools allows you to create and view graphs of your CP data.

There are currently four types of graphs but if you would like any other graphs please let us know and we will include them in the next software release for you.

On / Off Potentials

This graph shows the On and Off potentials for a pipeline or pipeline section. To use it, simply select the Pipeline, Section, and Survey then tap select.

You can Off-potentials from up to three other surveys by clicking on the + button.

When the graph is displayed, you can zoom using the two zoom methods which are toggled using the Hand Icon. If you zoom in enough, the values of points will be displayed above the samples. If you click on a point on the graph its value and test-point ID will be displayed.

You can share or store the graph as a JPEG image by clicking the Send Icon in the bottom right corner.

AC Voltages

This graph shows the AC voltages for a pipeline or pipeline section. To use it, simply select the Pipeline, Section, and Survey then tap select.

When the graph is displayed, you can zoom using the two zoom methods which are toggled using the Hand Icon. If you zoom in enough, the values of points will be displayed above the samples. If you click on a point on the graph its value and test-point ID will be displayed.

You can share or store the graph as a JPEG image by clicking the Send Icon in the bottom right corner.

Location History

This graph shows historic data for the On-Potential, Off-potential, and AC Voltages for a single test point. To use it, simply select the test-point then tap 'SELECT'.

When the graph is displayed, you can zoom using the two zoom methods which are toggled using the Hand Icon. If you zoom in enough, the values of points will be displayed above the samples. If you click on a point on the graph its value and test-point ID will be displayed.

You can share or store the graph as a JPEG image by clicking the Send Icon in the bottom right corner.

Interrupt Signatures

This graph shows last interruption signature logged for a single test point. To use it, simply select the test point then tap 'SELECT'.

When the graph is displayed, you can zoom using the two zoom methods which are toggled using the Hand Icon. If you zoom in enough, the values of points will be displayed above the samples. If you click on a point on the graph its value and test-point ID will be displayed.

You can share or store the graph as a JPEG image by clicking the Send Icon in the bottom right corner.

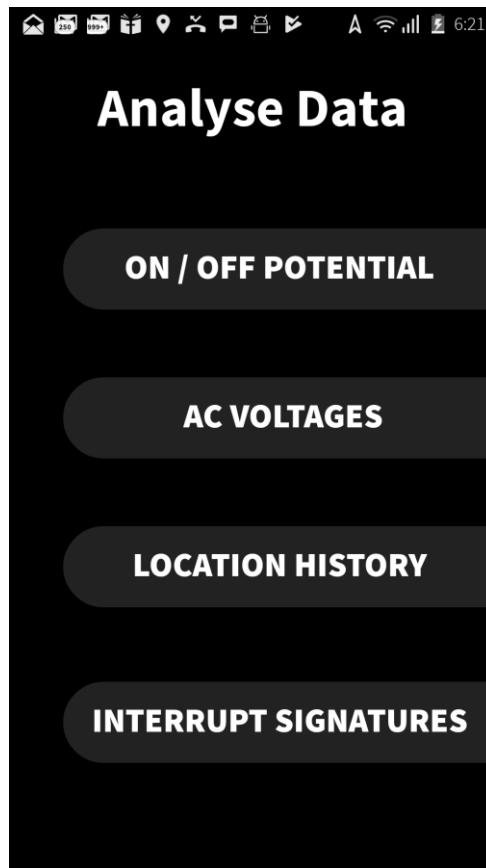


Figure 8 - Screenshot shows 4 default graph types, more are available upon request

PC Software

We are developing a PC program that supports the CP-Pro and CI-Tools.

There will be a light version supplied free with the CP-Pro, and a Pro version offered at an extra cost.

Very briefly, the light version allows for consolidation of data from multiple instances of CI-Tool, it also allows the data to be modified and exported as either a spreadsheet or a database.

The pro version adds a whole suite of graphing and analysis utilities as well as automatic report generation.

More information

We hope that this guide has been informative, and we will be updating the guide as new versions of the CI-Tools are released. We will strive to keep owners updated with the latest documentation however the document will always be available on the website. Please don't hesitate to contact us if you ever have any troubles with the CP-Pro or CI-Tools. Other than being here to help you, we rely on your feedback to improve our products.

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Appendix 1 - Troubleshooting

Problem	Symptoms	Fix (try the first method first and work your way down)
My coordinates are not displayed	No coordinates, Pin dropper is disabled, no distance to test point	Ensure that you have Locations services turned on. If you have an option, choose "Fine Location Services" or "High Accuracy" this will enable the GPS.
The Progress bar and other timed events don't start	Progress bar stays at zero, capture button is not enabled, on and off potentials are not populating	Ensure that you have Locations services turned on. If you have an option, choose "Fine Location Services" or "High Accuracy" this will enable the GPS.
CP-Pro won't turn on	No LEDs lit- wont connect to CI-Tools	-Press Sleep. Then Press Wake. If nothing happens then the batteries are probably flat.
CP-Pro is asleep and wont wake		-Press Sleep then Press Wake. -Remove a battery and re-insert it. -Try new batteries
Low signal from CP-Pro	dBm display is red – maybe intermittent popups saying that your signal is low.	-Move your phone closer to the CP Pro. -learn where your phones Bluetooth antenna is an ensure you are not covering it with your hand - Thick or metallic cases could interfere with the signal, try removing the case if needbe
The CP-Pro has woken from rest of sleep but it doesn't seem to have connected properly or isn't streaming properly	Red voltages, gray voltages, Scope or Capture buttons are not active.	-Tap a blank part of the screen and wait a few seconds -Tap the back button on the phone and re-connect -Tap the back button on the phone, sleep/wake cycle the CP-Pro, reconnect
CI-Tools Keeps crashing		-Go to Android settings and find the app settings. Ensure that no power-saving utilities are applied to CI-Tools, also ensure that CI-Tools has all of the requested permissions. -Go to the Battery/Power management option in the android Settings and ensure that no power management has been applied to CI-Tools.
Timing of "Capture" is not synchronised		-Turn off "Automatic date/time setting" on your phone - Ensure that location Services are turned on and you have a valid GPS fix. -Calibrate the time using the method explained here.
The timing bar/cycle timer has frozen		- This happens by design when you use the oscilloscope or enter the settings menu. It should resume on the next GPS signal or if you press "Force Start" again. - If the timer doesn't restart, tap the back button and re-connect to the CP-Pro.

Appendix 2 - Calibration Record Sheet

Calibrated By	Date	Temperature	Low Range Zero	Low Range Gain	High Range Zero	High Range Gain	AC Zero	AC Gain

Model _____

Serial Number _____

Purchase Date _____

Appendix 3 – CSV Schema

Column	Title	TYPE	Description - Comment	units	EG	
1	TP_ID	Integer	Auto Incrementing database Identifier		1	Test Point Data (included in Master Spreadsheet)
2	PIPELINE	String	Pipeline Name		FBP	
3	SECTION	String	Section Name		FMT-LKL	
4	KP	Float	KP Point, ID, Serial etc - must be numeric and have logical alignment with test points. If nothing else just increment 1,2,3,4 from one end of the pipeline/facility to the other		0.2	
5	LOCATION	String	Used to disambiguate test points. Critical when you have more than one test point at a single "KP"		Fairmont Rd	
6	NORTH	Integer	UTM Northing		43344683	
7	EAST	Integer	UTM Easting		706832	
8	ZONE	String	UTM Zone -Number only no letter		10	
9	PROTECTION_CRITERIA	Integer	Protection Criteria in mV DC		-850	
10	PROTECTED	Boolean	Flag that data is protected. If data is protected, a data import will not overwrite the entry by default, imported data is not protected and field measurement data is protected		0	
11	EXCLUDE_FROM_GRAPHS	Boolean	Is data to be included in on/off graphs? For example, you might want to exclude foreign crossing test		0	
12	DATE	String	Date of the following measurement (DD/MM/YY)		26/12/17	Measurement Data (Not in Master)
13	TIME	String	Time of the following measurement (HH:MM:SS)		14:56:00	
14	AC_ON_VOLTS	Float	AC Millivolts	mV	5	
15	AC_ON_TIME	Integer	time in mS before the interrupt that AC was logged ("-" means before interrupt) you probably don't have this data in which case use "-500"	mS	-500	
16	AC_OFF	Float	AC Millivolts	mV	8	
17	AC_OFF_TIME	Integer	Time in mS after the interrupt that AC was logged. You probably don't have this data, in which case use "1000"	mS	1000	
18	ON_POTENTIAL	Float	On Potential in mV	mV	-1256	
19	ON_TIME	Integer	Time in mS before the interrupt that the On Potential was logged	mS	-500	
20	TIMED_OFF_POTENTIAL	Float	Off Potential defined as the potential a certain time after the interrupt, in mV.	mV	0	
21	TIMED_OFF_TIME	Integer	Time in mS after the interrupt that the Off Timed Potential was logged	mS	0	

22	CALCULATED_OFF_POTENTIAL	Float	The Off Potential that was found by graphical analysis	mV	0
23	CALCULATED_OFF_TIME	Integer	Time in mS after the interrupt that the Analysed Off Potential was logged	mS	0
24	USER_OFF_POTENTIAL	Float	The Off Potential that was picked by touching the graph	mV	0
25	USER_OFF_TIME	Integer	Time in mS after the interrupt of the "User Off Potential"	mS	0
26	PREFERRED_OFF_POTENTIAL	Float	Either: Calculated Off, Timed Off or User Off, as chosen by the user	mV	-884
27	PREFERRED_OFF_TIME	Integer	Time of the preferred Off Potential - you probably don't have this data so just use "200"	mS	200
28	LICENCE	String	The Serial Licence number of the CP-Pro that was used to take the reading (for traceability) - leave blank		
29	USERNAME	String	There registered name of the phone owner - leave blank		
30	FLAG_FOR_REVIEW	Boolean	Flags this measurement for review - make false		0
31	COMMENT	String	Long text entered by the user when they save a reading - leave blank		
32	PHOTO_LINK	String	Write "nil"		nil

1. Populate your spreadsheets with as much data as you can
2. Only columns 1-11 are needed for a Master Spreadsheet
3. For Master Spreadsheets; only columns 1,2,3,4,9 are critical except when
4. If you have multiple test points with the same value for columns 2,3 and 4. Then you need to include unique values in column 5 to differentiate the test points
5. You can leave absent string values blank
6. It is good practice to enter absent numeric values as "0" this might not be critical but could potentially cause errors if left blank.
7. Enter "nil" to the last column, this isn't usually necessary but might be required on some old systems to determine the number of active columns in the spreadsheet

Tip. For iOS systems you can generally get away with leaving unknown columns blank. But use the default values if you run into issues.

Appendix 4 – Database Schema

#	Title	TYPE	Description - Comment	units	EG	Default	
1	TP_ID	Integer	Auto Incrementing database Identifier		1,2,3		Test Point Data (Required for new and historic surveys)
2	PIPELINE	String	Pipeline Name		"Fairmont to Bellview Pipeline" or "FBP"		
3	SECTION	String	Section Name		"Fairmont - Lakeland" or "FMT-LKL"		
4	KP	Float	KP Point, ID, Serial etc - must be numeric and have logical alignment with test points. If nothing else just increment 1,2,3,4 from one end of the pipeline/facility to the other		11.3		
5	LOCATION	String	Used to disambiguate test points. Critical when you have more than one test point at a single "KP"		"Blowdown", "North", "Crossing"		
6	NORTH	Integer	UTM Northing		43344683		
7	EAST	Integer	UTM Easting		706832		
8	ZONE	String	UTM Zone -Number only no letter		10 (not 10P)		
9	PROTECTION_CRITERIA	Integer	Protection Criteria in mV DC		-850	0	
10	PROTECTED	Boolean	Flag that data is protected. If data is protected, a data import will not overwrite the entry by default, imported data is not protected and field measurement data is protected		0, 1 (0=false, 1 = true)	0	
11	EXCLUDE_FROM_GRAPHS	Boolean	Is data to be included in on/off graphs? For example, you might want to exclude foreign crossing test		0, 1 (0=false, 1 = true)	0	
12	DATE	String	Date of the following measurement (DD/MM/YY)		26/12/16		Measurement Data (required for historic surveys)
13	TIME	String	Time of the following measurement (HH:MM:SS)		14:56:00		
14	AC_ON_VOLTS	Float	AC Millivolts	mV	5	0	
15	AC_ON_TIME	Integer	time in mS before the interrupt that AC was logged ("-" means before interrupt)	mS	-500	-500	
16	AC_OFF	Float	AC Millivolts	mV	8	0	
17	AC_OFF_TIME	Integer	time in mS after the interrupt that AC was logged	mS	1000		
18	ON_POTENTIAL	Float	On Potential in mV	mV	-1256	0	
19	ON_TIME	Integer	Time in mS before the interrupt that the On Potential was logged	mS	-500	-500	

20	TIMED_OFF_POTENTIAL	Float	Off Potential defined as the potential a certain time after the interrupt, in mV	mV	-884	0
21	TIMED_OFF_TIME	Integer	Time in mS after the interrupt that the Off Timed Potential was logged	mS	100	0
22	CALCULATED_OFF_POTENTIAL	Float	The Off Potential that was found by graphical analysis	mV	-886	0
23	CALCULATED_OFF_TIME	Integer	Time in mS after the interrupt that the Analysed Off Potential was logged	mS	85	0
24	USER_OFF_POTENTIAL	Float	The Off Potential that was picked by touching the graph	mV	-890	0
25	USER_OFF_TIME	Integer	Time in mS after the interrupt of the "User Off Potential"	mS	76	0
26	PREFERRED_OFF_POTENTIAL	Float	Either: Calculated Off, Timed Off or User Off, as chosen by the user	mV	-890	0
27	PREFERRED_OFF_TIME	Integer	Time of the preferred Off Potential	mS	76	0
28	ADDRESS	String	The Serial Licence number of the CP-Pro that was used to take the reading (for traceability)		SN/12354568	
29	USERNAME	String	The registered name of the phone owner		Bobs iPhone	
30	FLAG_FOR_REVIEW	Boolean	Flags this measurement for review		FALSE	FALSE
31	COMMENT	String	Long text entered by the user when they save a reading		The test post has been knocked over by cattle.	
32	PHOTO_LINK	String	Link to Photo		root/CI-Tools/Stored Data/Photos/ Damaged KP11.3.JPG	

This is the Schema for the survey database. You probably don't need to know about it but it is provided here if you want to integrate the database to third party systems.