M.C. Miller Android Pipeline Survey (PLS) Application User Guide

(07/30/2018)
(Version 1.2.3.0)

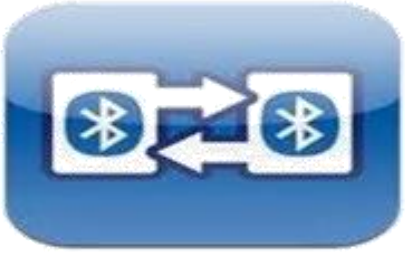
Contents

Introduction

The Android Pipeline Survey Data-logger is a combination of an Android tablet application in conjunction with a MCMiller iBTVM, Bluetooth Voltmeter. The iBTVM unit consists of an integrated digital voltmeter and an integrated WAAS-enabled sub-meter GPS receiver. The Android PLS app takes advantage of the tablet camera functions to provide this type of survey support if needed.

The MCM Pipeline Survey application will execute on most Android tablet brands executing on the latest version of Android operating system software. The iBTVM unit is licensed from MCMiller Co. and when used with the MCM Android Pipeline Survey (PLS) application, it is detected and connected to the PLS app via Bluetooth connection protocol.

Pipeline survey data collected via the Android PLS Data-logger app can be transferred to either a MCMiller ProActive PC-based application or to the MCMiller Android-ESD PC-based application.



Tablet
- Apps
  - iBTVM
  - PLS

iBTVM
- VM
- GPS<m

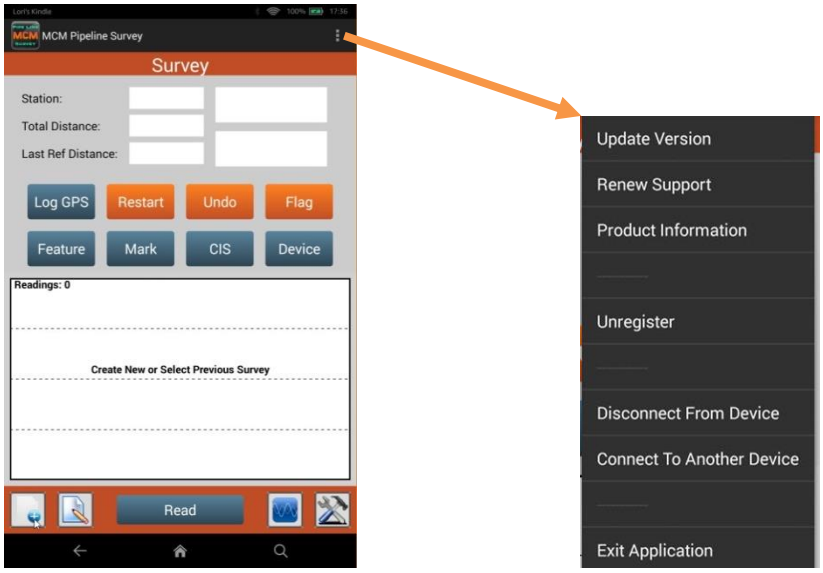
Temporary Notice

Version 1.2.3.0 of the Android PLS app temporarily disables the use of iBTVM reading mode options for ***GPS Sync.*** To provide the **GPS Sync** support, a firmware update needs to be applied to the iBTVM unit. Any PLS app references to **GPS Sync** in this document are to be ignored until the firmware change to the iBTVM unit has been tested and verified. An updated Android PLS app version will be provided to indicate the re-enablement of the **GPS Sync** support.

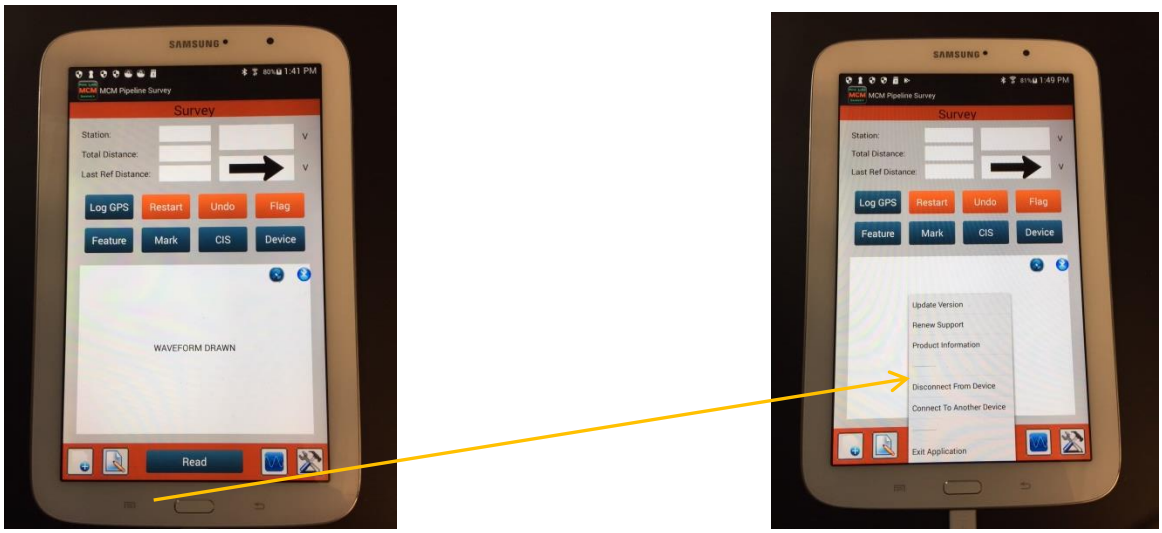
Overview

The purpose of the Android Pipeline Survey (PLS) app is to collect voltage data related to the monitoring of the corrosion protection status of underground steel pipelines. The function of the Android PLS app will include all of the functionality of the MCMiller Gx datalogger PLS app with the exceptions noted later in this document. Several types of surveys can be performed. For all of the survey types, the operator will walk along the pipeline recording voltages measured at regular intervals. The PLS app will record the voltage values and the location of the reading along the pipeline. Additional supplemental data can also be recorded. The types of voltage values recorded differ by the type of voltage measurement selected and the method used to trigger the measurements. The survey types that can be performed by the PLS app are **Continuous CIS**, **Trigger CIS**, **DCVG**, **DCVG/CIS** and **Surface Potential**. Detailed information about the survey types and how they are performed can be found in the CIS, DCVG and Surface Potential training manuals using a MCMiller Gx data logger. The user interface for the Android PLS app is similar to the MCMiller Gx datalogger user interface. Slight changes to the user interface for the Android PLS app are mainly due to the difference in screen size and tablet characteristics.

Android PLS Main Screen



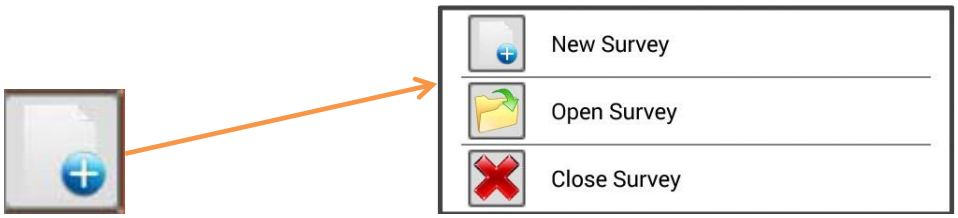
An ***Android app menu*** is provided (3 vertically stacked dots) that can be used to check PLS app information and connection options. Some Android tablet models may provide the ***app menu*** button as a ***physical button***, directly to the left of the main home button. If your device is equipped with this button, the menu will appear at the bottom of the screen.



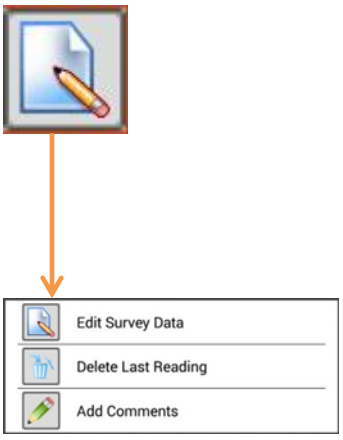
Functions

The PLS app shows a main ***Function*** menu bar at the bottom of the screen. The button selections provide access to ***sub-functions*** that may be used during certain survey events.

- The first button in this section of the screen  … is the ***Surveys*** button that is primarily used at the start of the PLS app to define a ***new*** survey, ***continue or open*** an existing survey, to ***suspend or close*** the survey currently in process…



- The next set of buttons  (***survey data modification***),  (***auxiliary*** functions),  (***survey options***)… provide access to functions to ***view or modify*** data that relates to the current survey in process… or to select ***auxiliary*** functions that can be used in situations encountered during a survey but without affecting the current survey data or setups…

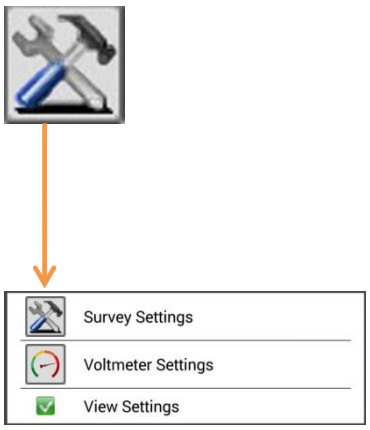


Survey Modifications

- **Edit Survey Data**: Modify current survey data on a limited basis
- **Delete Last Reading**: Deletes the last reading just taken for the current survey
- **Add Comments**: Can add a comment to the last reading just taken for the current survey.

Auxiliary Functions

- **Voltmeter**: Voltmeter Screen, to take a voltage/current reading
- **Waveform**: Waveform Screen, to take or review a survey waveform
- **Pictures**: Pictures Screen, to take or review a survey picture
- **GPS Data**: take a GPS location at any point in the current survey
- **Set Graph Scale**: Modify ***Graph Area y*** axis (vertical left side) scale



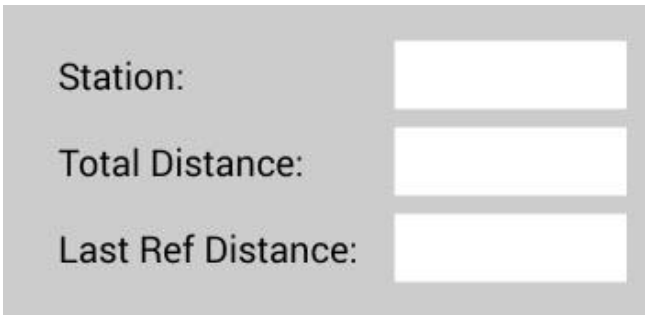
Survey Settings

- **Survey Settings**: Shows the current survey settings via the 5 setup screens, which ***some can be modified***
- **Voltmeter Settings**: Voltmeter Settings for the current survey, ***can be modified***
- **View Settings**: Shows the settings for the current survey, ***not modifiable***

Survey Data Collection Objects

The PLS Main Screen contains buttons and fields related to logging and viewing pipeline survey data. The buttons that are used to log survey related data are indicated by a ***dark*** color… buttons that are indicated by an ***orange*** color are used to ***adjust Flag*** related data (if used). ***Data fields*** are provided to show survey location and survey data… An area shown as a ***whitespace*** section will show in graphical format the progress of the survey and ***actions taken*** during the last 100 readings. The following describes the areas of the PLS Main screen.

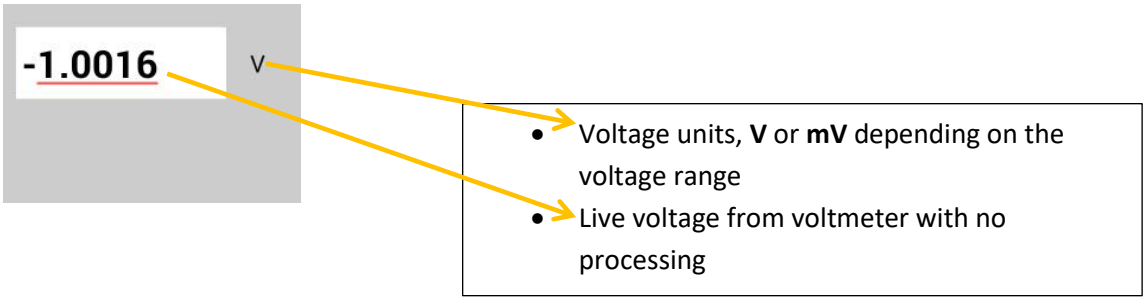
- Location data consisting of:



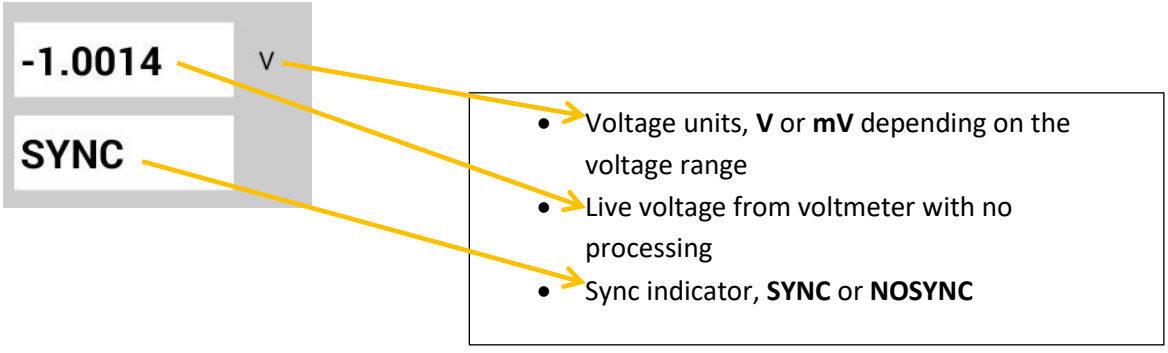
  - **Station**: The current survey location. The value shown is relative to the start of the pipeline survey as entered via the ***Survey Setup 3*** screen ***Location Value*** field. This value can be expressed as miles, feet or ***Station Number*** format or if metric units are being used; as kilometers, meters, or ***Station Number*** format.
  - **Total Distance**: The current distance surveyed in the survey file. It is always expressed in feet or meters.
  - **Last Ref Distance**: The survey distance since the last location reference point (***Survey Flag or Known Station***).

- Voltage data is shown in 2 fields that may vary depending on the type of survey and reading mode:

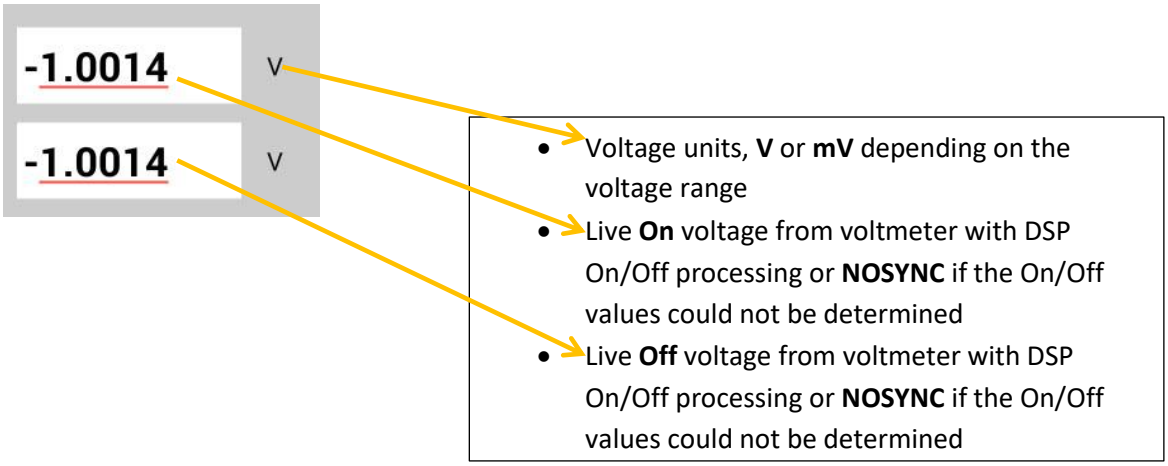
  - ***CIS, Single Read Mode***



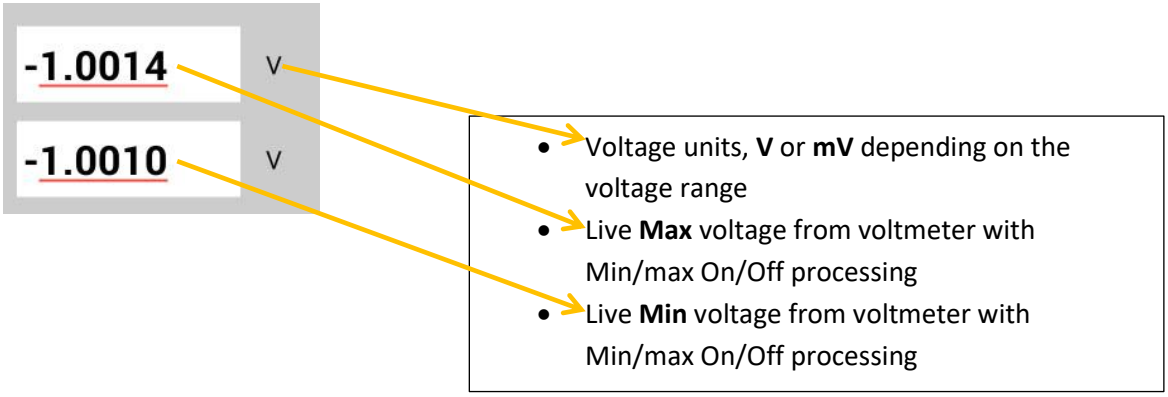
  - ***CIS, Single Read GPS Sync Mode***



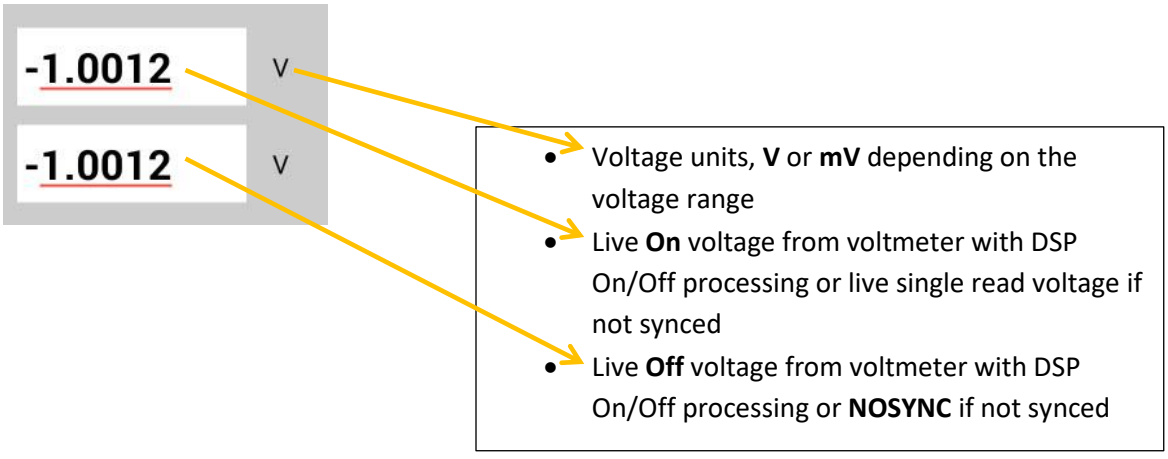
- ***CIS, On/Off DSP Mode***



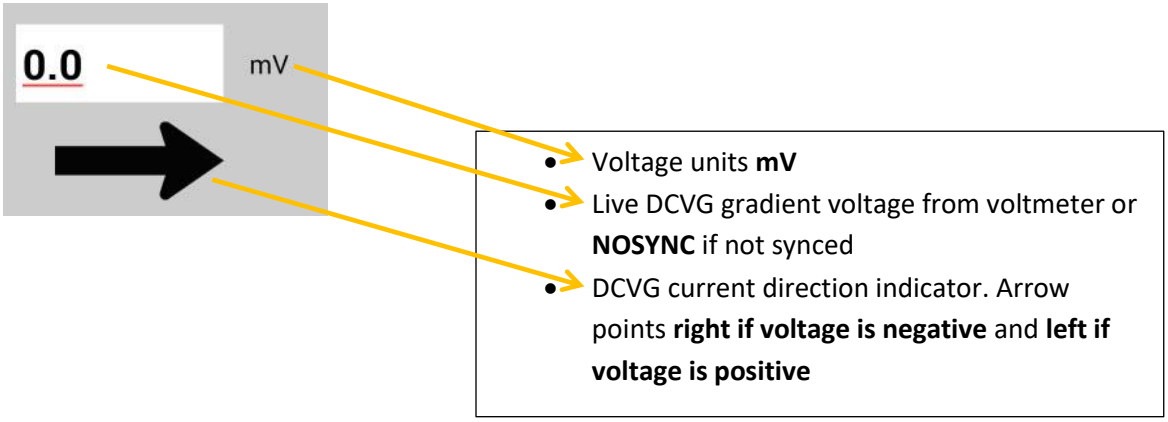
- ***CIS, On/Off, Min/Max Mode***



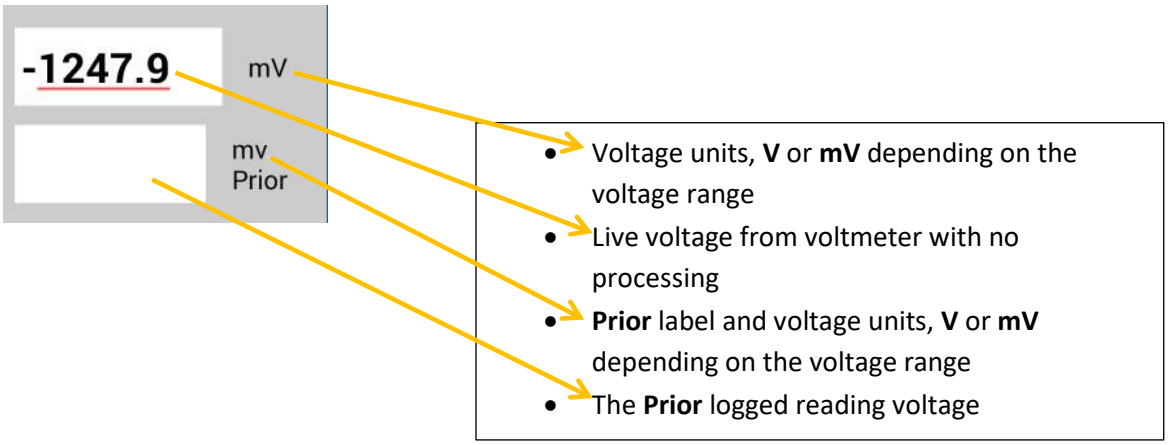
- ***CIS, On/Off GPS Sync Mode***



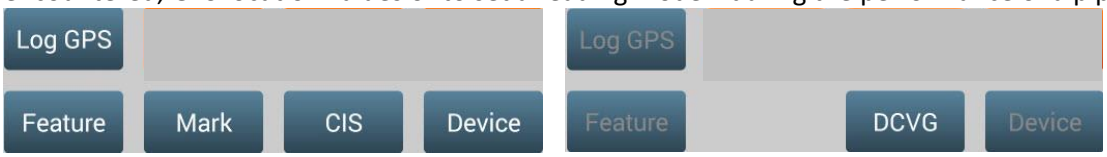
- ***DCVG***



- ***Surface Potential***



- Pipeline DCP/Feature/Location/Mode related buttons**:** To log DCP (Data Collection Point) readings, Features encountered, GPS location values or to set a reading mode… during the performance of a pipeline survey.

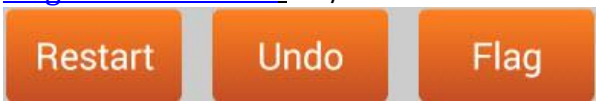


  - ***Feature***: Shows the Feature screen; select a geo-feature that is currently detected while doing the survey. Allows for distance modification.
  - ***Device***: Shows the Device Reading screen; select a currently detected DCP (Device Collection Point) for the purpose of naming, specifying an exact location, and taking a reading.
  - ***Log GPS***: Records the current GPS position and associates the GPS data with the last logged reading.
  - ***CIS/DCVG***: Shown only in CIS/DCVG Combined surveys, toggles the display between CIS and DCVG modes. This allows the user to take the specific part of the combination readings manually.
  - ***Mark***: Shown only in DCVG, CIS/DCVG Combined and Surface Potential surveys, shows the Mark DCVG Anomaly screen or the Surface Potential Side Drain screen.

- Read/Start/Pause buttons**:** To manually log survey data, over-riding any cane setup configuration.

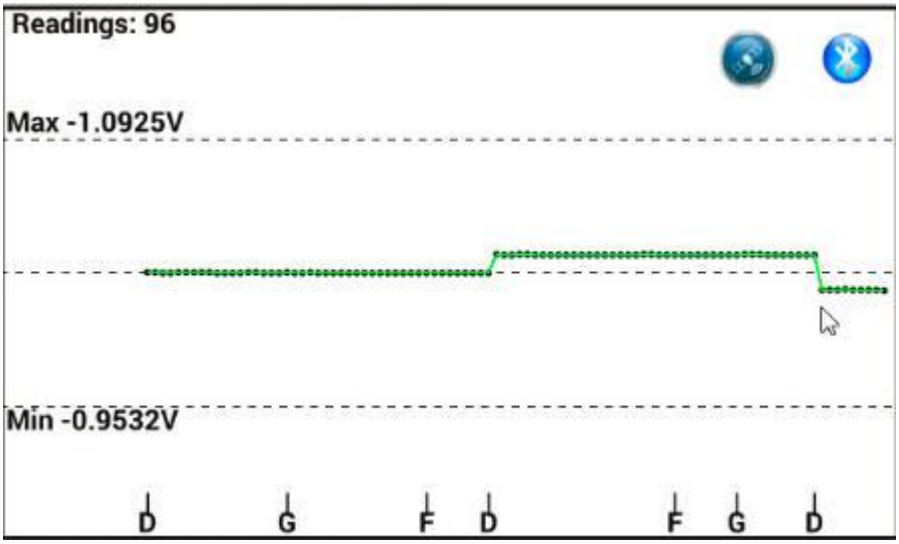
  - ***Read/Start/Pause***: **Read** logs a survey reading in all survey types except Continuous CIS. **Start/Pause** toggles readings on and off in Continuous CIS.

- Flag related buttons: Set/reset the current location as the starting point for the next series of Survey Flags.



  - ***Restart***: Restart next series of survey Flags based on the current survey location.
  - ***Undo*** Flag: Reverts the survey changes caused by the most recent Survey Flag.
  - ***Flag***: A Flag location has been identified; performs a Survey Flag location adjustment.

- Survey Reading Graph: This section of the PLS Main screen displays the progress of the pipeline survey and depicts points along the survey where specific devices, features, and flags were encountered…



  - Displays a line graph of the last **100** survey readings.
  - For Single Read CIS, DCVG and Surface Potential there is a single trace. For On/Off CIS there are two traces (ON and OFF).
  - Normally the **Y** scale auto ranges but the user can manually set the **Y** scale using the ***Auxiliary*** Function Group: **Set Graph Scale**.
    - When auto scaling; if the data point in the graph with the highest absolute value is negative, the **Y** scale will be inverse (negative up/positive down).
  - Single letter labels are using to show locations of
    - Survey Flags,"**F**"
    - Geo-Features, "**G**"
    - Device Readings, "**D**"
    - Marked DCVG or Surface Anomalies, "**M**"

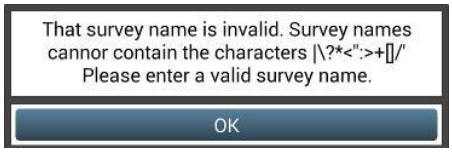
Android PLS Setup Process

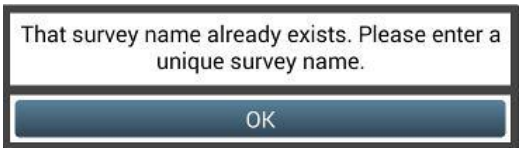
The following section describes the screens and their related functions that are referenced from the PLS Main screen and used to setup, view, or modify a pipeline survey.

From the **Surveys** button  … you can select to setup a ***New Survey***, continue an existing survey, or exit a current active survey…

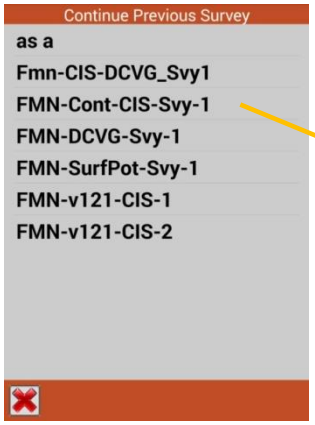
- **New Survey**

- The **New Survey** screen prompts the user to enter the survey filename. If the entered survey name is ***not a valid file name***, the user will be notified and prompted to enter a valid name. If the entered survey name ***already exists***, the user will be notified to provide a unique name.



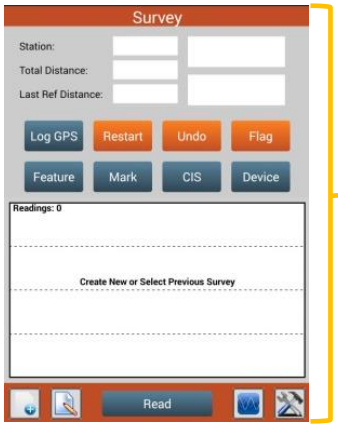


- **Open Survey**



- The **Continue Previous Survey** screen lists the surveys on the Android PLS data logger in alphabetical order and prompts the user to select a survey to open.

- **Close Survey**

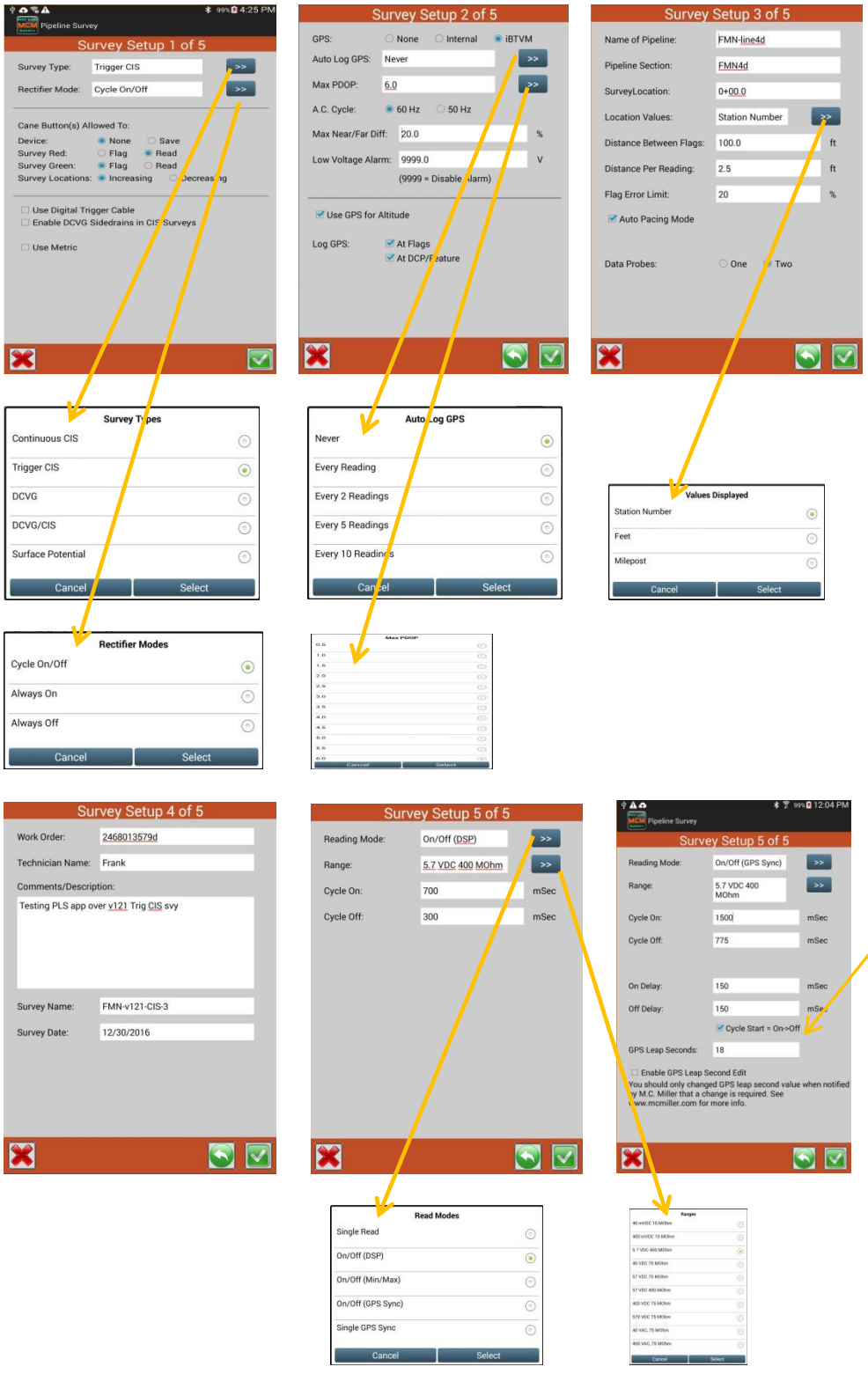


- A '**Close Survey**' selection will close the current survey immediately. The '**Main Screen**' will revert back to a '**null**' presentation.

New Survey Setup

- ***New Survey Settings***:

  The survey settings are split across 5 setup screens. On some screens the visible fields will vary depending on the survey type being setup and certain prior settings. These variations will be noted in the individual screen descriptions. The ***setup screens 1-5 are shown in sequence when creating a new survey*** and will be so noted in the screen header. Note the variation in visible fields when ***GPS Sync*** is selected from the options related to the Setup 5 screen.



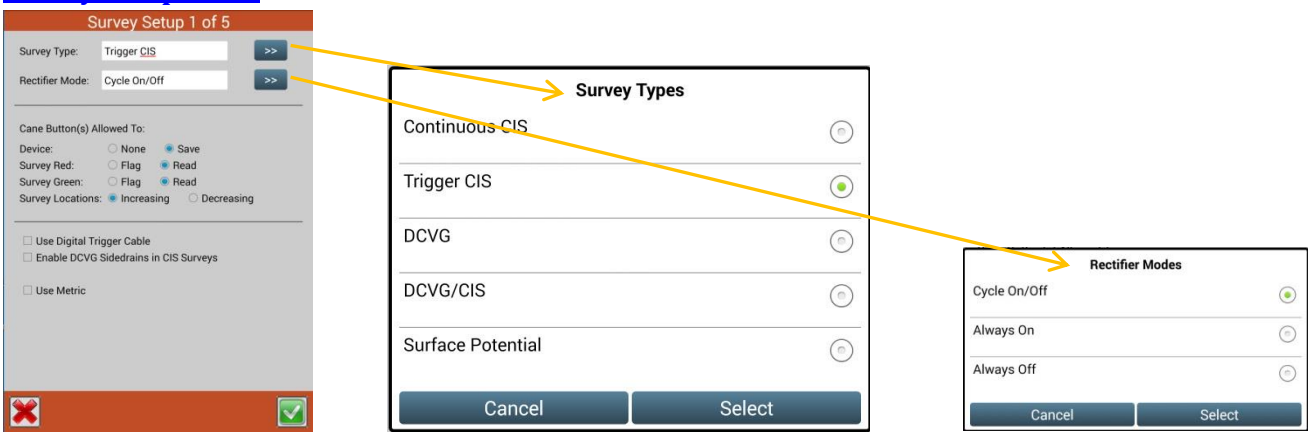
Survey Setup 5 of 5

On/Off (GPS Sync)

Additional Fields

- **GPS Leap Seconds** field will show a value that will initially contain the correct value (for year 2018, this value is 18). Subsequent years may require a new value to be entered; MCMiller will notify users of any change to this value.
  - If so, check the **Enable GPS Leap Second Edit** checkbox and modify **GPS Leap Seconds** field to correct value.

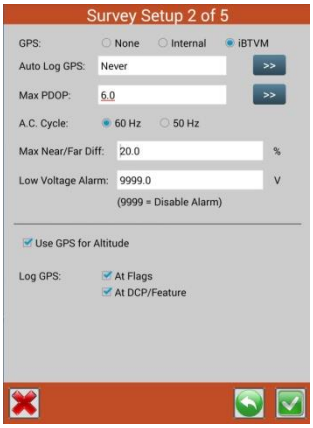
- **Survey Setup 1 of 5**



  - The **Survey Type** is set when the survey is created and cannot be changed after that point. The ***double arrow to the right*** provides selection choices. See above for selection choices.
  - The **Rectifier Mode** dropdown list is used to indicate the state of Pipeline Corrosion Protection being used during the survey. See above for selection choices. For ***Surface Potential*** surveys ***Cycle On/Off is not a valid selection***. For ***DCVG*** and ***CIS/DCVG*** combined surveys ***Cycle On/Off is the only valid selection***.
  - The **Cane Button(s) Allowed To**: section is used to select the functions of the push buttons on the electrode canes (AKA data probes). The setting applies to both the left (red) and right (green) cane buttons.
    - The **Device** choice selects the function of the buttons for the ***Device Reading*** (AKA Data Collection Point) screen.
      - Selecting ***None*** means that no action will be taken when the push button is pressed. Tapping the **Read** button on the Main screen will log the survey reading.
      - Selecting ***Save*** means that the device reading will be saved when the push button is pressed.
    - The **Survey** choice selects the function of the buttons for the ***Main Survey*** screen. The ***left (red)*** and ***right (green)*** cane buttons can be set to the same function or to different functions. Depending on the Survey Type selected, the button choices can vary.
      - For a ***Continuous CIS*** survey the function choices are ***Flag*** which marks a Survey Flag; and ***Pause*** which suspends the taking of a reading (***toggling between pausing and resuming the taking of readings***).
      - For ***Trigger CIS***, ***DCVG*** and ***Surface Potential*** surveys the function choices are ***Flag*** which marks a Survey Flag; and ***Read*** which logs a survey reading.
      - For ***DCVG/CIS*** combined surveys the ***right (green) cane button is not available*** and the ***only cane button function choice for the left (red) can button*** is ***Read*** which logs a survey reading.
    - Your ***Survey Location*** selection of ***Increasing*** or ***Decreasing*** will depend on your walking direction over the pipe with respect to the pipe's stationing. You would select ***Increasing*** if the station number will be increasing as you perform the survey and you would select ***Decreasing*** if the station number will be decreasing as you perform the survey.
    - The ***Survey Other*** section provides survey choices that may be applicable to the Survey Type that was selected.
      - The **Use Digital Trigger Cable** checkbox specifies that an automatic triggering cable is being used with the selected CIS survey. ***Note***: with this specification, the ***Distance Per Reading*** field on the ***Setup 3*** screen should be set to 2.5 feet (or 1 meter), since the counter is calibrated for this distance.
      - The **Enable DCVG Sidedrains in CIS Surveys** checkbox is shown only for ***Continuous CIS*** and ***Trigger CIS*** surveys. When checked the ***Mark DCVG*** device reading will be enabled.
      - The **Soil Resistivity Distance Units** section is shown only for **Surface Potential** surveys.
        - You will have the option to manually enter a value for soil resistivity measured at the location of a ***marked SP*** anomaly, which will allow the ProActive software to calculate a ***Corrosion Factor*** value. The units **Ω.cm** or **Ω.m** for ***soil resistivity*** that will appear on the SP anomaly ***marking*** screen, for your manual data entry, will depend on your selection here in the **Soil Resistivity Distance Units** field (**CM** or M)

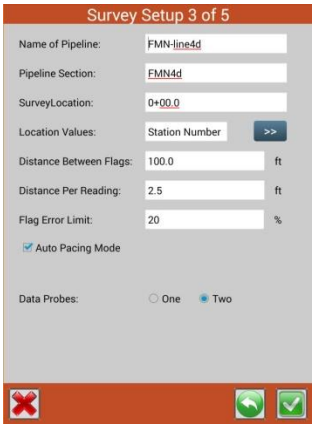
- The **DCVG Anomaly Max mV = Tot mV 1st read** checkbox is only visible for DCVG and DCVG/CIS combined surveys. ***If this box is checked***, the ***Max mV voltage*** recorded at an anomaly location ***will automatically become the first voltage value used by the data-logger's software to calculate the Total mV (total voltage gradient).*** Otherwise, ***if this box is un-checked***, you ***will have to repeat the Max mV recording a second time as part of the Total mV determination process***.
- The **Use Metric** checkbox, if checked, sets the reading interval (distance between triggered readings) and the flag internal (survey flag spacing) to be displayed on the **Setup 3 of 5** screen in ***meters***, as opposed to feet.

- **Survey Setup 2 of 5**



  - The **GPS** selection shows a choice of which GPS ***resident hardware*** to use…
    - **None** means that no GPS location data will be logged…
    - **Internal** means that you have selected to use the GPS support in your Android tablet…
    - **iBTVM** means you have selected the GPS support in the **iBTVM**, which has ***sub-meter*** support…
  - The **Auto Log GPS** drop down list sets how often the GPS position will be included in the data when a ***survey reading*** is logged. The choices will be :
    - **Never**, meaning that GPS location data will not be logged when a survey reading is logged.
    - **Every Reading**, every survey reading will also have its GPS location data logged.
    - **Every 2 Readings**, every 2nd survey reading will also have its GPS location data logged.
    - **Every 5 Readings**, every 5th survey reading will also have its GPS location data logged.
    - **Every 10 Readings**, every 10th survey reading will also have its GPS location data logged.
  - The **Max PDOP** value can be set from a ***low of 0.5*** to a ***high of 10.0*** in increments of 0.5 … ***PDOP*** is a value indicating the **relative accuracy the GPS data**. The lower the PDOP the higher the accuracy. The ***Max PDOP is just a warning value***. The operator is alerted if the PDOP is higher than the Max PDOP setting.
  - The **AC Cycle** choices are 60 Hz and 50 Hz. Select 60Hz for all U.S. applications. This is an important selection with regard to the AC filtering system that's applied to all of the DC voltage channels.
  - The **Max. Far/Near Diff** value controls a ***reconnect alarm*** for CIS surveys. The value is the maximum allowable Percent difference between the ***Reconnect – Far Ground*** device reading and the ***Reconnect – Near Ground*** device reading. If the difference is greater than the limit, the ***Far/Near ground reading Error*** will be shown. This setting is only visible for Continuous CIS, Trigger CIS and DCVG/CIS combined surveys.
  - The **Low Voltage Alarm** value controls an audible voltage alarm for CIS surveys. A value of ***9999*** disables the alarm. If a negative value is entered the alarm would sound when the survey voltage is less negative than the alarm setting. For example, if the alarm value is ***-0.850*** volts then a survey voltage of ***-0.7 volts would trigger*** the alarm and a survey voltage value of ***-0.9 volts would not trigger*** the alarm. This setting is only visible Continuous CIS, Trigger CIS and DCVG/CIS combined surveys.
  - The **Use GPS for Altitude** checkbox, if checked, will log ***altitude data*** in addition to the Lat/Long data whenever GPS data are logged. (Note: Altitude data on some GPS units are not particularly accurate).
  - The **Log GPS:** selection checkboxes specifies whether GPS data is to be logged automatically **At Flags** and/or **At DCP/Features** when encountered…
    - **At Flags** specifies that GPS data will be logged automatically at survey flags when either the flag button is tapped (directly on the Survey Main screen) or when the push-button switch on the designated ***flag cane*** is pressed.
    - **At DCP/Feature** specifies that GPS data will be logged automatically when a **Device** button is ***tapped*** on the Survey Main screen and a ***Device reading*** is logged. If the **Feature** button is tapped on the Survey Main screen and a ***geo-feature*** is registered.
    - **At Side Drain/Anomaly** checkbox will be shown only for Surface Potential, DCVG and DCVG/CIS combined surveys. GPS data will be logged automatically for ***marked*** anomalies.
    - If this box is checked, GPS data will be logged automatically when ***SP*** anomalies are ***marked***.

- [Survey Setup 3 of 5]



  - Entering data for the **Name of Pipeline** and **Pipeline Section** is ***optional*** and any text data or no data will be accepted. These fields can be helpful when the pipeline survey is transferred to ProActive to identify where the survey was taken…
  - **Survey Location:** During the initial survey setup, the ***Survey Location*** is the location for the ***start of the survey*** on a pipeline. It is entered when the survey is created and cannot be changed by the user after that point. The ***Survey Location*** can be the ***actual pipeline location*** for the start of the survey (if known) or it could be a ***relative starting point*** (0+00) of the survey. If it is a relative starting point, then the actual start of the survey can be determined when the survey is transferred to ProActive.
    NOTE: When viewing this screen from the ***Survey Settings→Survey Segment Settings*** screen, the ***Survey Location*** field will show the current survey location of the survey and editing of the value is disabled. The location will be stored based on the setting of the ***Use Metric*** checkbox from the 1st setup screen. Feet if the ***Use Metric*** is unchecked or meters if checked.
  - **Location Values:** A selection list to the right of **Location Values** controls how location values will be displayed.
    - **Station Number**, in the station number format the location value is displayed as the text value of the location in feet with a **'+'** inserted between the tens digit and the hundreds digit. For example, if the location in feet is 12345.6 then the station number format would be 123+45.6. If the feet value is less than 100 the leading zeros will be used as in 0+07.5. If using metric the **'+'** goes between the hundreds digit and the thousands digit of the location in meters. For example, 12+345.6 meters, displayed to 1 place to the right of the decimal point (Meters if using metric)
    - **Milepost**, miles displayed to 4 places to the right of the decimal point (***Kilometers if using metric***).
    - **Feet,** feet will be displayed to 1 place to the right of the decimal point (***Meters if using metric***).
  - **Distance Between Flags**: you can type in the survey flag interval (distance between survey flags) for the section of pipeline being measured, assuming that survey flags have been laid out. Typically, survey flags are located at 100 feet intervals. In such a case, you would have a new reference (a stationing correction) every 100 feet. **Note:** ***If survey flags are not in use, enter zero in this field***. In this case, tapping accidentally on the Flag button will not adversely impact your stationing.
  - **Distance Per Reading**: you can type in the interval distance, in feet (or meters for the metric case), expected between readings. Typically, in CIS work this expected interval distance is 2.5 feet (or 1 meter in the metric case). **Note**: 2.5 feet (or 1 meter) should be selected for the **Distance Per Reading** when readings are to be triggered using an automatic triggering cable, since the counter is calibrated for this distance.
  - **Flag Error Limit**: Is a percentage based on the maximum permissible error between the actual number of readings logged between 2 survey flags and the expected number of readings. For example, if the maximum permissible error is set to 20% in the **Flag Error Limit**… If the reading interval (Distance Per Reading) is expected to be 2.5 feet and the survey flag separation (Distance Between Flags) is 100 feet, this means that 40 readings are **expected**. If, however, only 30 readings are **actually** logged between survey flags, an error window will appear on the screen, since there is a 25% difference between the expected and actual number of

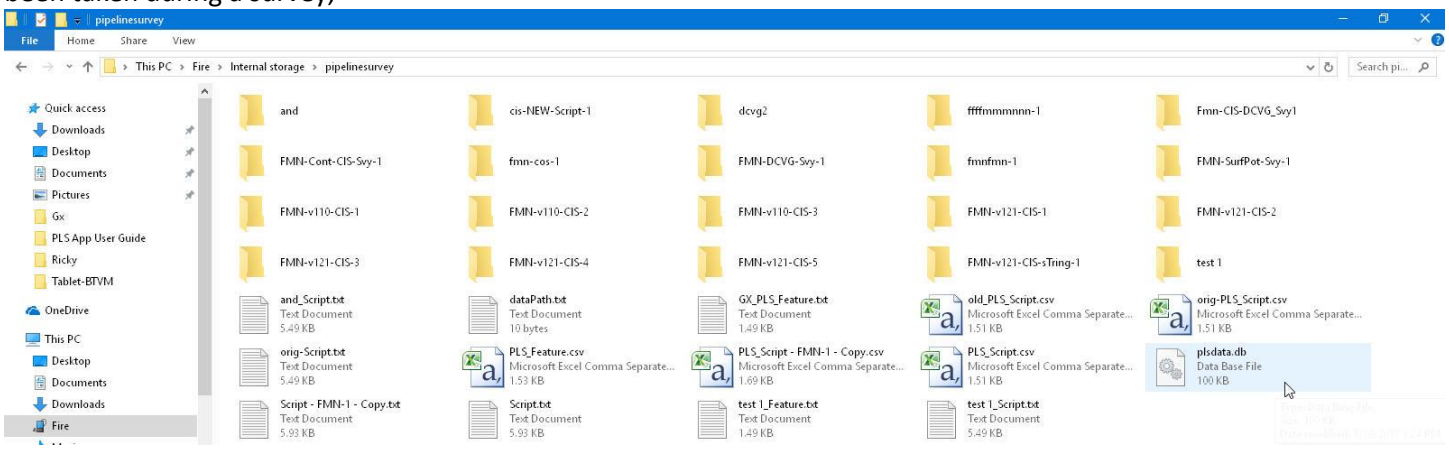
readings in this example. No error window will appear if the difference is less than 20%. For this example, you could have a minimum of 32 readings and a maximum of 48 readings between survey flags to stay within the 20% (max.) error allowance.

- **Auto Pacing Mode**: This is ***optional***… If the checkbox is checked, you would like the readings to be uniformly spaced between any two survey flags, regardless of the actual locations of the readings between the two flags. By checking the box labeled, **Auto Pacing Mode**, you will enable the data-logger to automatically adjust the reading locations in order to evenly-space the readings between two survey flags.
- **Data Probes**: In the case of the ***Trigger CIS*** mode, you can use one data-probe or two data-probes for the CIS. Highlight the appropriate radio button, based on your situation.
- **Auto Learn Read Rate**: This checkbox only appears for a ***Continuous CIS*** survey and is ***optional***… In ***Continuous CIS*** mode, readings are logged based on timing. For example, if you indicate that you require 40 readings to be logged between 100 foot survey flags and that it will take you 60 seconds to walk 100 feet (**Time Between Flags**), the data-logger will log readings every 1.5 seconds. You can have the data-logger ***learn*** your walking pace, which might turn out to be different from ***60 seconds for 100 feet***, by checking the box labeled **Auto Learn Read Rate**. In which case, the software will adjust the timing between logged readings accordingly in order to target 40 logged readings between 100 foot survey flags, in this example.
- **Time Between Flags**: field only appears for a ***Continuous CIS*** survey… It is an estimated value that represents the time in ***seconds*** that it will take to walk the distance that you specified for the **Distance Between Flags** field. **Note**: Pre-measured (equally-spaced) survey flags are required for ***Continuous CIS*** and, if the pipeline does not run through an open area, extensive pausing may be required.

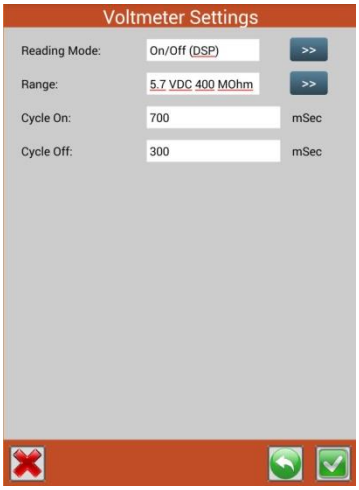
- **Survey Setup 4 of 5**

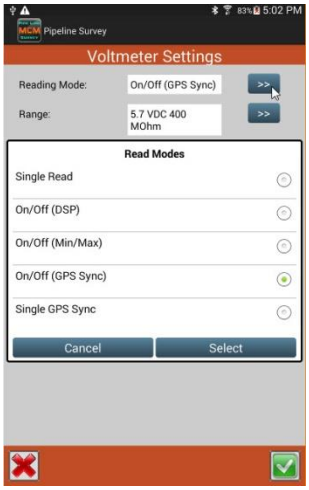
  - **Work Order**: This field is ***optional***… enter the work order number associated with the survey, if known.
  - **Technician Name**: This field is ***optional…*** enter the name of the person performing the survey.
  - **Comments/Descriptions**: This field is ***optional…*** you can enter any general comments you might have regarding the survey (perhaps weather conditions, soil conditions, special circumstance, etc.).
  - **Survey Name**: This field is not modifiable… it shows the name of the survey that was specified at the time of the survey setup via ***New Survey***…
  - **Survey Date**: This field is not modifiable… it shows the date of the survey at the time of the survey setup via ***New Survey*** creation…

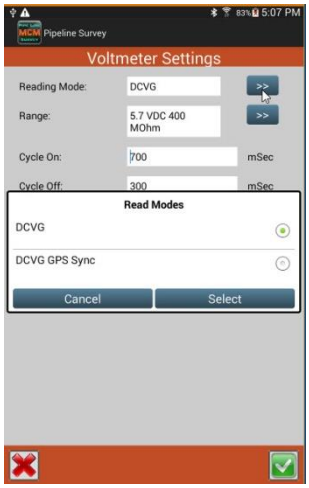
Pipeline survey data is located in the ***pipelinesurvey*** folder on your Android tablet. The ***survey readings data*** and ***waveforms*** for a survey are located in the ***plsdata.db*** SQL database. Folders having the same name as the name specified for a pipeline survey are created in the ***pipelinesurvey*** folder for the purpose of containing ***pictures/photos*** that may have been taken during a survey,



- **Survey Setup 5 of 5**







  - The **Reading Mode** list shows the voltmeter reading processing types available for selection. Up to 5 choices are available for selection. Your selection of **reading mode** should be made with reference to your previous selection of **Rectifier Mode** from the ***Setup 1*** screen and ***current-Interrupter Control*** being used on the pipeline being surveyed.
    - **Single Read**: This reading mode would be selected if you were performing a ***non-interrupted CIS***, with either the rectifiers ***ON*** continuously [Always ON] or ***OFF*** continuously [***depolarized pipeline***].
    - **On/Off (DSP)**: This voltmeter mode would be selected if you were performing a ***rectifier current-interrupted CIS***. In this mode, the software uses ***digital signal processing*** (D.S.P.) to determine the voltage during the ON portion of the interruption cycle and the voltage during the OFF portion of the cycle, for each successive cycle. ***Note***: A measurable difference between the ON and the OFF voltage readings is required for this reading mode, (ie, a measurable IR drop is required). ***Note:*** In this reading mode, you do not have to concern yourself with selecting recording times for the On and Off readings, for each cycle, with respect to the On-to-Off transitions and the Off-to-On transitions of the waveform, as the software determines appropriate locations on the waveform for you. This is in contrast to the GPS Sync reading mode (see below).
    - **On/Off (Min/Max)**: This reading mode should be selected if you were performing a ***rectifier current-interrupted CIS*** and ***there was considerable interference indicated on the waveform***. In such a case, in the absence of well-defined steps (IR drops), the software determines an average value for the maxima and an average value for the minima occurring in the waveform as being representative of the On and the Off value per cycle.
    - **On/Off (GPS Sync):** This reading mode can only be selected if you are using the **iBTVM** GPS receiver ***AND GPS controlled current-interrupters***. ***Note:*** A primary feature of this reading mode is that the readings data are GPS time-stamped. Therefore, applications such as telluric current compensation tools can be applied to such data. With this reading mode, you can select the recording times on the waveform for both the On and Off readings, with respect to the On-to-Off transitions and the Off-to-On transitions of the waveform, as opposed to the software determining appropriate locations on the waveform for you (as in the case of the On/Off (DSP) reading mode – see above). With this reading mode selected, the screen will display additional fields that require setup information.
    - **Single GPS Sync**: This reading mode is similar to the **Single Read** mode except that in this case the data-logger uses the GPS clock signal to associate readings with the actual time they were made. ***Note:*** Currently, only the **iBTVM** GPS Receiver can be selected for this reading mode. ***Note:*** A primary feature of this reading mode is that the readings data are GPS time-stamped. Therefore, applications such as telluric current compensation tools can be applied to such data.
    - **DCVG**: This reading mode selection is shown when a DCVG survey type has been specified on a ***Setup 1 screen***…

- **DCVG GPS Sync:** This reading mode selection is shown when a DCVG survey type has been specified on a ***Setup 1 screen*…**

- The **Range** list sets the voltmeter range. *The recommended setting for **Range for CIS is ±5.7 Volts DC**, which provides an associated input impedance value of **400MOhm**. This setting provides a relatively-fast response time (~80 ms), which is important in fast cycle interruption applications. Also, the 400MOhm input impedance minimizes reading errors associated with any high source resistance measurements, and, the ±5.7 V DC Range should be **suitable for most On and Off CIS reading values**.* The choices are:
  - 40 mVDC 10 MOhm
  - 400 mVDC 10MOhm
  - 5.7 VDC 400 MOhm
  - 40 VDC 75 MOhm
  - 57 VDC 75 MOhm
  - 57 VDC 400 MOhm
  - 400 VDC 75 MOhm
  - 570 VDC 75 MOhm
  - 40 VAC 75 MOhm
  - 400 VAC 75 MOhm

For the On/Off readings modes, ***Cycle On and Off*** setting fields will be shown. The specific ***Cycle On*** and ***Cycle Off*** times are setup based on the times that the ***current interrupters have entered for On and Off times***. ***Note:*** Ideally, the interruption cycle period (On time plus Off time – a single waveform cycle) should be less than the time between triggered readings on a CIS or DCVG survey. For short waveform periods (1 second, for example) this is not a concern, as a typical walking pace would translate to a time between triggered readings. ***However***, care should be taken if longer waveform periods are in effect (for example, several seconds), in which case a slower than normal walking (and triggering) pace would have to be employed in order to avoid recording several same value readings until the waveform data are refreshed (i.e., until a new cycle of data is used). of greater than 1 second.

- **Cycle On**: The ***On*** time setup on the current-interrupter for the pipeline being surveyed. This time is entered in milliseconds.
- **Cycle Off:** The ***Off*** time setup on the current-interrupter for the pipeline being surveyed. This time is entered in milliseconds.

The field values entered for **On Delay** and **Off Delay** should be based on knowledge of the current-interrupter waveform, particularly in terms of any transition spiking. The idea is to select sampling times that will avoid any spiking. For example, if 150 ms was selected for the ***Off Delay***, the data-logger would record the voltage value sampled 150 ms after the rectifier-current was switched from the ON to the OFF state. Also, if 150 ms was selected for the ***On Delay,*** the data-logger would record the voltage value sampled 150 ms after the rectifier-current was switched from the OFF to the ON state. The use of the ***Waveform*** selection from the ***auxiliary*** functions described previously can help in determining these settings.

- **On Delay**: The time the voltage value is stable when sampled after the current was switched from the ***OFF to the ON state***. This time is entered in milliseconds.

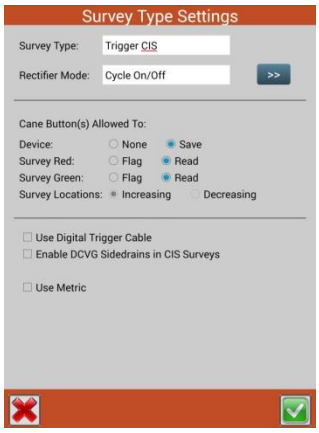
- **Off Delay:** The time the voltage value is stable when sampled after the current was switched from the ***ON to the OFF state***. This time is entered in milliseconds.

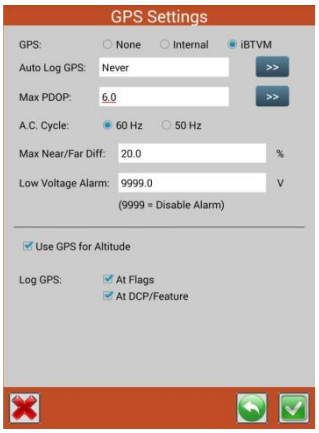
- **Cycle Start = On->Off**: This checkbox reflects the state of how the current-interrupter was setup to start… if your interruption cycle starts with the current in the ***ON state*** (the first transition is from ON to OFF), ***check*** the checkbox… if the current-interrupter start was setup in the ***OFF state*** (the first transition is from OFF to ON) ***uncheck*** the checkbox…

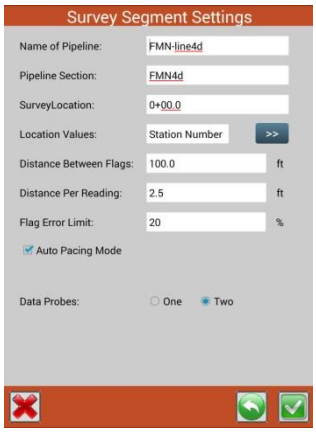
Android PLS Survey Options

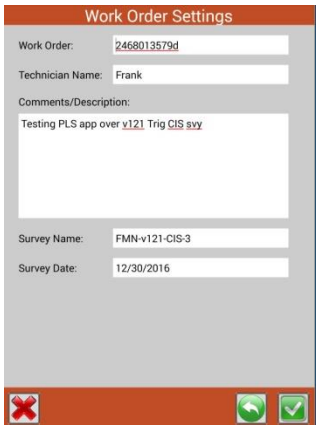
Once a new survey has been setup, the settings related to the current survey in process can be viewed or modified. The ***surveys option***  button provides access to the following sub-functions:

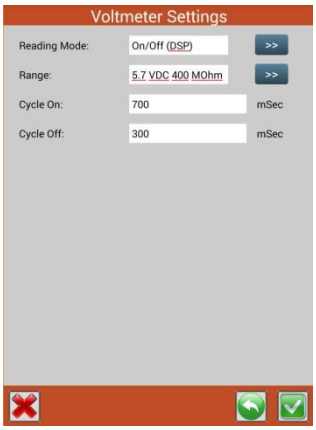
- **Survey Settings**
  - When selected, the same setup screens will be presented as was used when the survey was initially setup… but the ***screen header name reflects the functional settings being affected***. Note that most of the original survey setup fields are presented for modification… however; you ***can't*** change the ***Survey Type***…



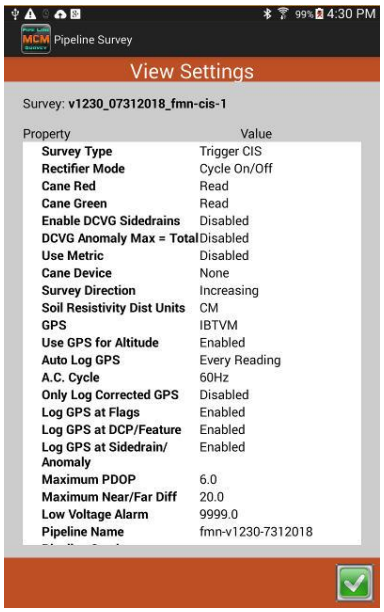


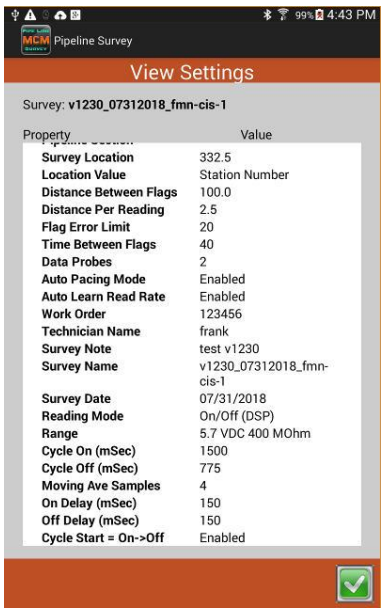






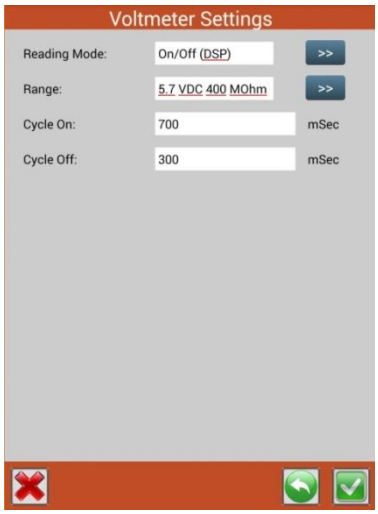
- **View Settings**





- The **View Settings** screen shows all if the survey settings in a single scrollable list.
  - The **Survey** field shows the name of the survey that is opened and in process.
  - The **Property** and **Value** section shows the name of the fields and their current values that have been setup for the in process survey… These fields are not modifiable…

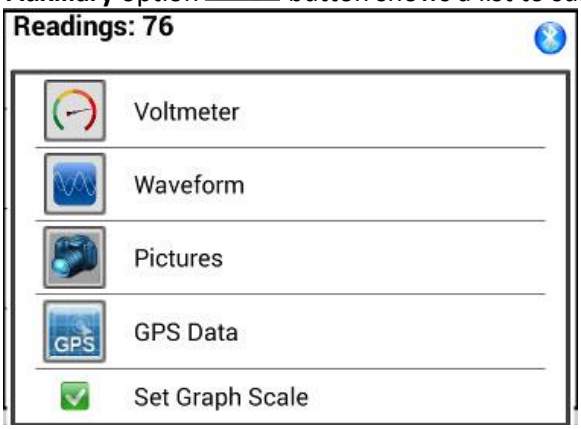
- **Voltmeter Settings**



- The **Voltmeter Settings** screen provides an option to modify current survey's ***voltmeter settings*** that were originally defined via the ***Setup 5*** screen. Choices will be provided as shown in the previous **Survey Setup 5 of 5** descriptions.

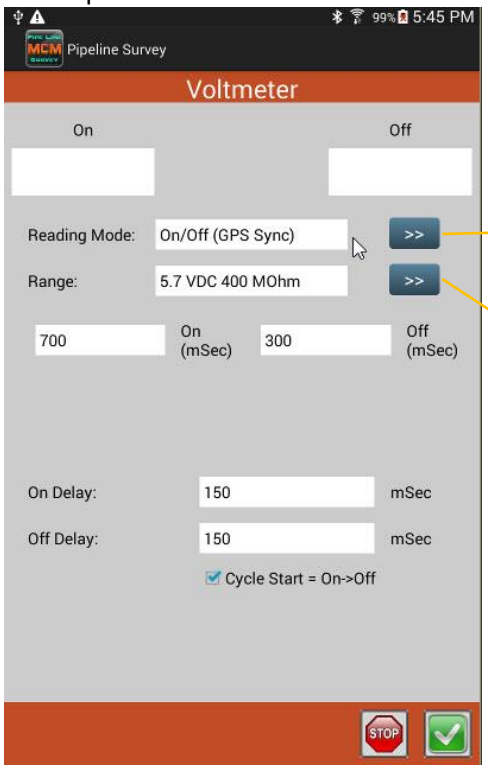
Android PLS Auxiliary Options

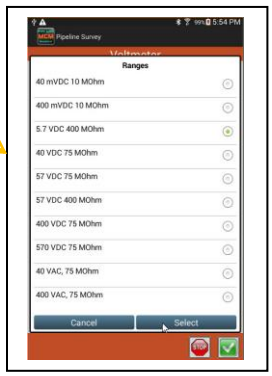
The **Auxiliary** option  button shows a list to sub-functions that can be accessed with or without a survey open:



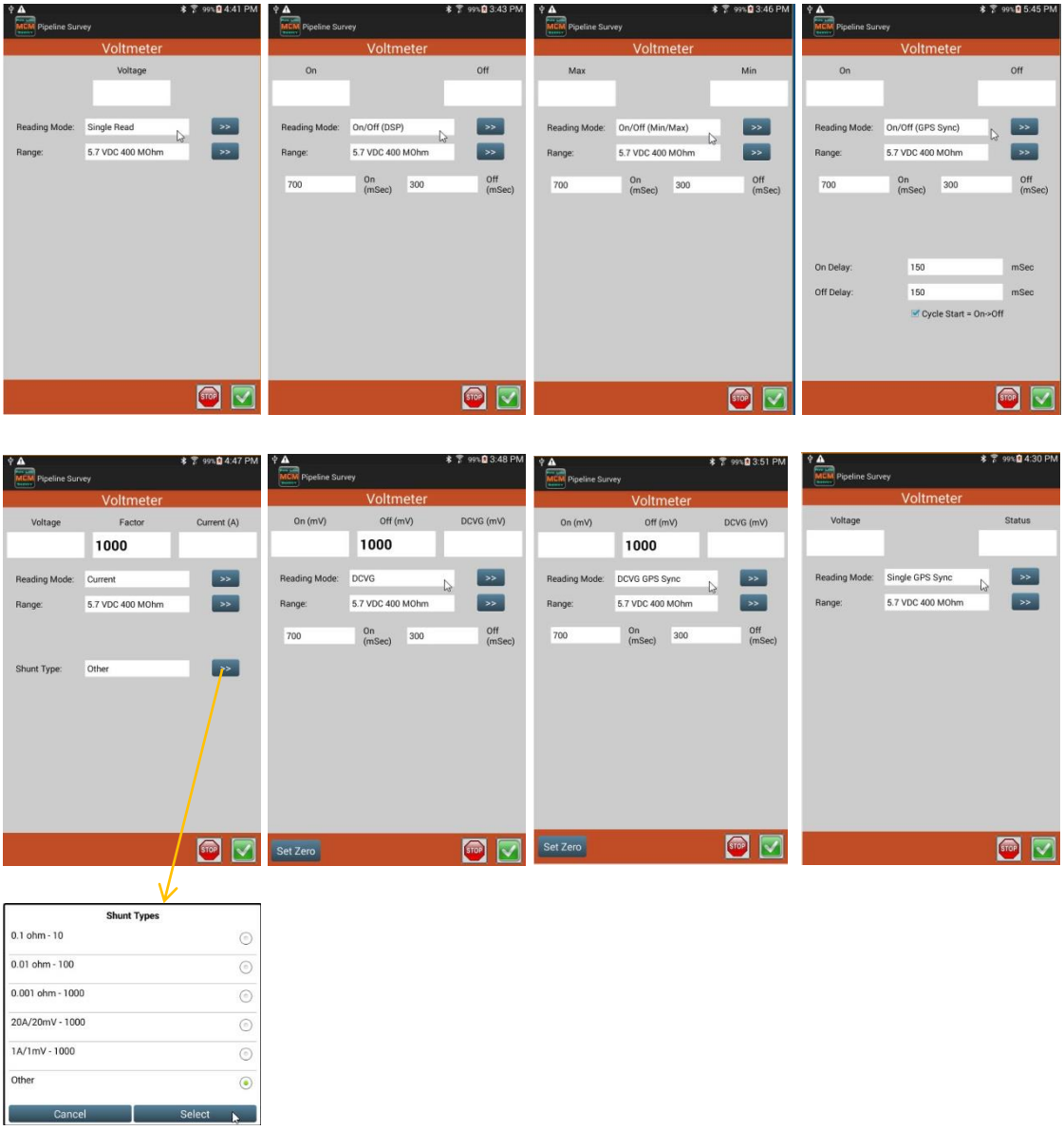
- ## Voltmeter

  - When the Voltmeter selection  is ***tapped***… The current voltmeter setup in effect will be presented. The Voltmeter screen can be shown with or without a survey open. The Voltmeter screen shows voltmeter data with settings that are independent from the survey voltmeter settings. The voltmeter screen settings will default to the survey voltmeter settings but changing the voltmeter screen settings will not affect the survey voltmeter settings. To make voltmeter settings changes (***Range*** and ***Read Mode***), tap on the menu buttons in the **Range** and **Read Mode** fields and select the options as required. For example, if ***On/Off (GPS Sync)*** was the current setting of the voltmeter, then the following screen would be presented, then tapping the double arrow for **Read Mode** options would present other selections… likewise for **Range…**



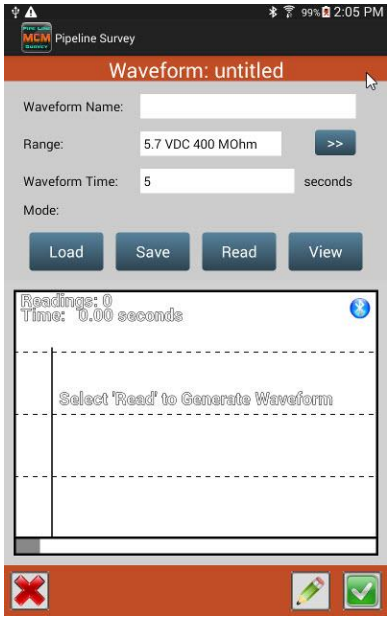


- The Voltmeter screens displayed and the visible settings depend on the **Read Mode** selected. Other selected screens can be:



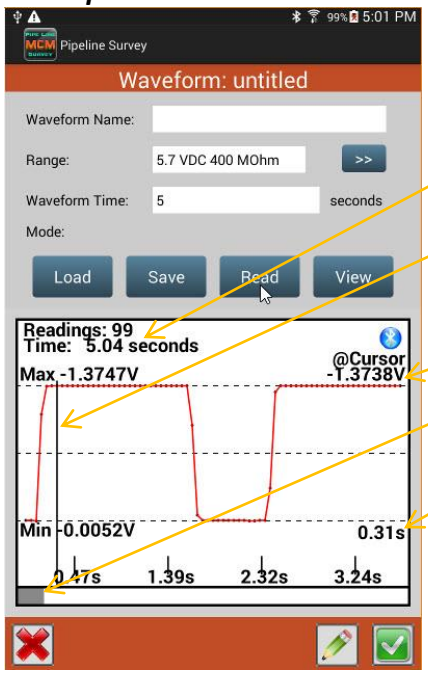
- **Waveform**

- When the **Waveform** selection  is ***tapped***… The initial waveform screen is presented.



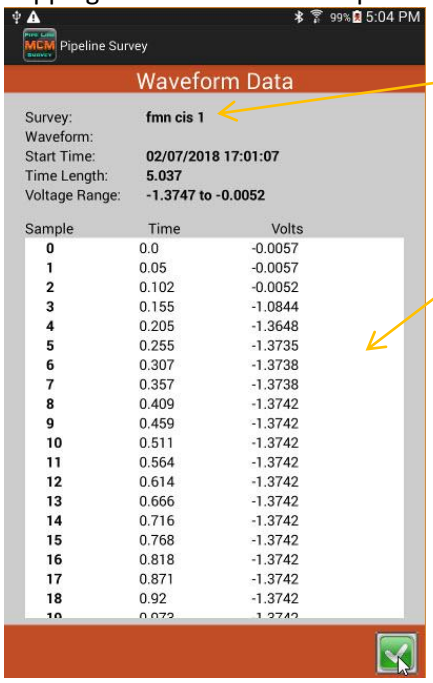
- The **Waveform** screen can be shown with or without a survey open.
- The waveform voltmeter setting (**Range**) is independent from the survey voltmeter settings. The waveform voltmeter setting will default to the survey voltmeter setting but changing the waveform voltmeter setting will not affect the survey voltmeter setting.
- When the **Read** button is tapped, voltage values will be recorded at an approximate rate of 20 rd/s for the preset period of time.
- The voltage values are displayed on a scrollable line graph.
- The X axis is time relative to the start of the waveform.
- The graph has a ***sliding vertical cursor*** which is used to show the ***voltage*** and ***time*** at specific points in the waveform.
- The waveform data can also be view in a table format.
- The waveform data can be ***saved***. ***If a survey is open*** when the waveform was read and saved, then the waveform data will be ***associated with the last logged survey reading***.
- The **Waveform Time** field can be set to ***capture*** the waveform over a specified amount of time in ***seconds***…
- Comments can be entered for a waveform…

- Once your **Range** and **Waveform Time** fields are set to your requirements, then tapping the **Read** button will ***capture*** the waveform…



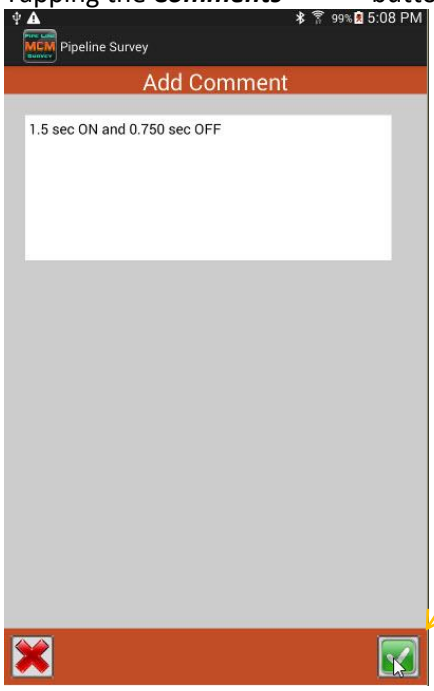
- ***How many readings taken over specified time***
- ***Sliding vertical cursor***
  - ***@Cursor*** values
    - ***Voltage***
    - ***Time***
- ***Scrollable Line graph***

- Tapping the **View** button will present a screen showing the captured waveform data in tabular format…



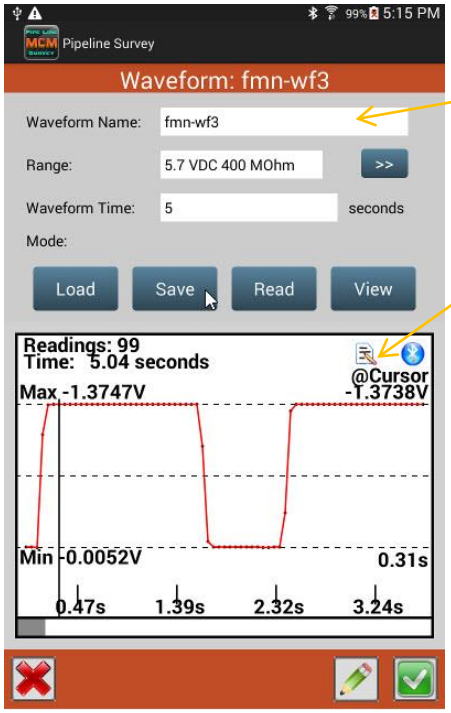
- Waveform taken during this survey…
- Scrollable ***view*** to remaining samples…

- Tapping the ***Comments***  button lets the user enter related comments associated with the waveform…



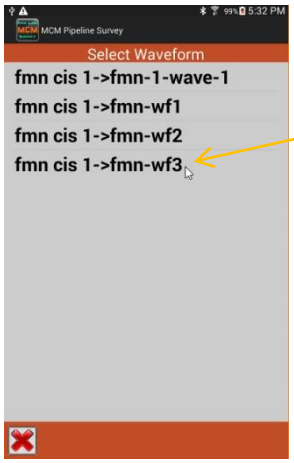
- Tap the ***Check***  button to save your comments…

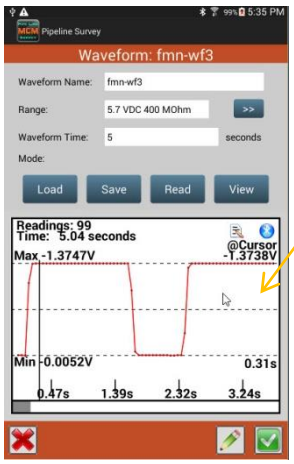
- Once a waveform has been reviewed, the user can save the waveform by entering a **Waveform Name** and tapping the **Save** button…



- Enter **Waveform Name**
- If a ***comment*** was entered for the waveform, a comment icon is shown…

- Saved waveforms can be loaded and viewed. Tapping the **Load** button brings up a **Select Waveform** screen…

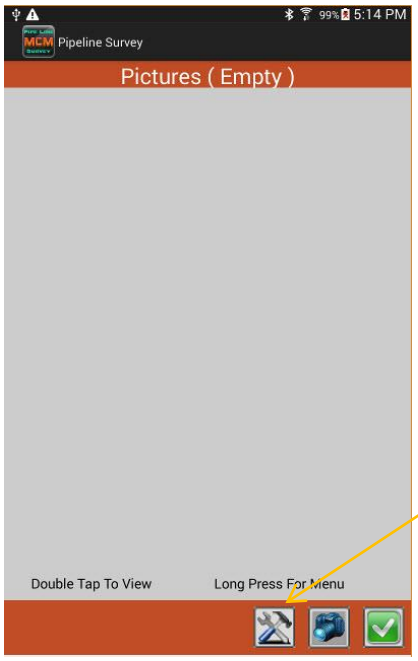




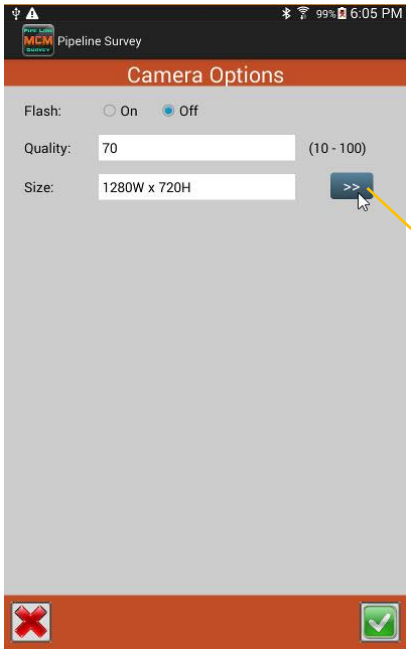
- Just tapping the name of the saved waveform will **Load** the waveform…
- Waveform is shown similar to how it was saved…

- **Pictures**

  - When the **Pictures**  selection is tapped… the user can take pictures at most points during a pipeline survey… a **Pictures** screen is presented…



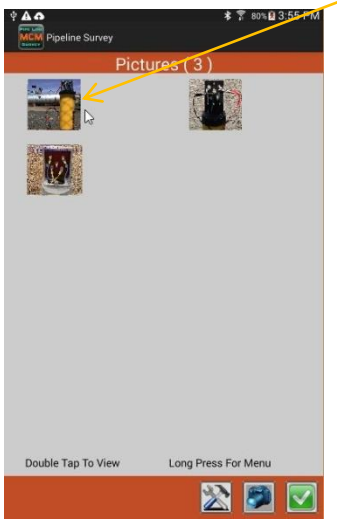
- The **Pictures** option is only available during a pipeline survey… a survey has to be open…
- Pictures can be associated with a specific ***survey reading***, ***Geo-Feature***, ***Device Reading***, ***DVCG Anomaly*** or ***Surface Potential Side Drain***…
- The pictures are displayed as thumbnails.
  - Pictures can be viewed ***full-screen***…
  - Pictures can be deleted…
- Camera settings related to ***flash***, ***quality***, and ***picture size*** are provided via the ***Camera Options*** button…

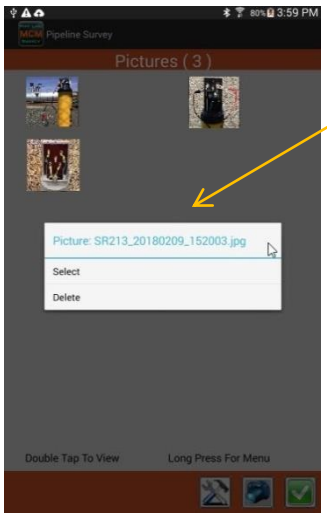


- Tapping the **Camera**  button at the bottom of the Pictures screen will present the camera view to enable the user to take a picture…

- ***Rear*** or ***Front*** camera selection button
- ***Flash*** or ***No Flash*** button
- ***Take the Picture*** button

- After picture taken, choices are presented of what to do with the picture…
  - Just ***EXIT***, this will take you back to the main Pictures screen…
  - ***Retake*** the picture
  - ***Save*** the picture just taken… this will take you back to the main Pictures screen…
  - ***Tap and Hold*** on the ***thumbnail*** is what is meant by verbiage ***Long Press for Menu*** at the bottom of the screen… a menu is presented.
  - Tapping on ***Select*** from the menu or doing a ***Double Tap to View*** on the thumbnail will present a ***full screen*** view of the picture…





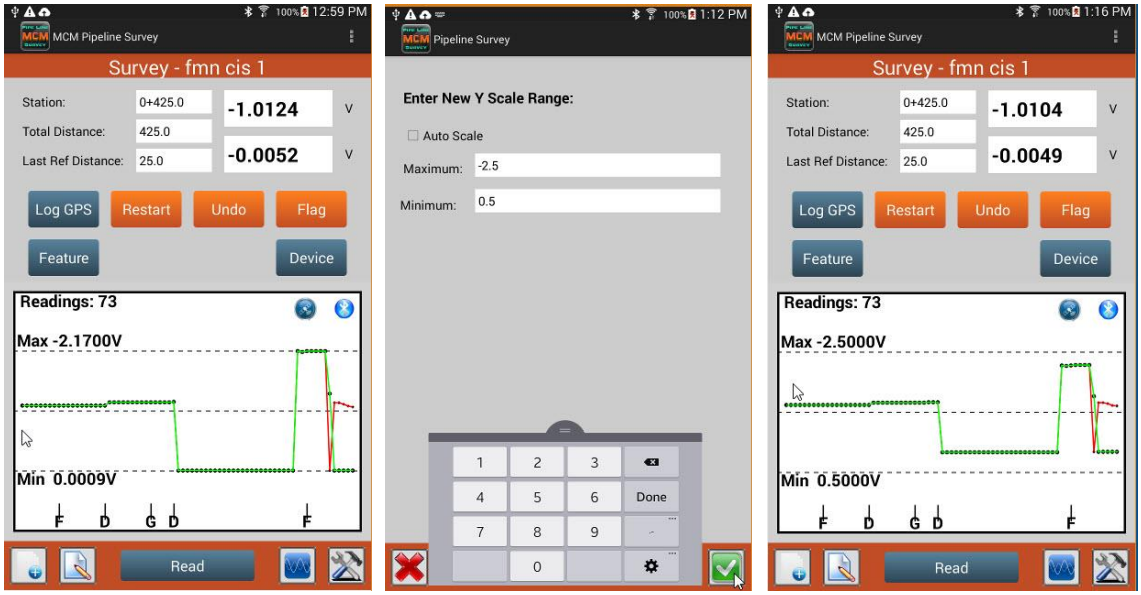
- When in full screen picture view, to return back to the Pictures main screen the user will have to use the ***Return*** button on the Android tablet…

- **GPS Data**

  - Tapping the **GPS Data**  selection will present the **GPS Data** screen. The current support for this screen is just to show the related GPS data at the user's specific location. This function can be used to determine if GPS data is being ***acquired*** at the current location. Tapping the Check  button will cause a return back to the **Survey** screen…

- **Set Graph Scale**

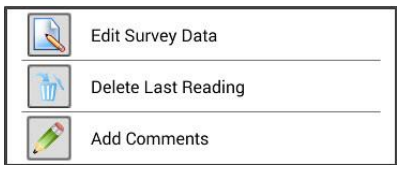
  - Tapping the **Set Graph Scale**  selection (via the **Auxiliary**  button) while in the ***Surveys main screen*** will provide the user the ability to change the ***graphing Y*** scale parameters…



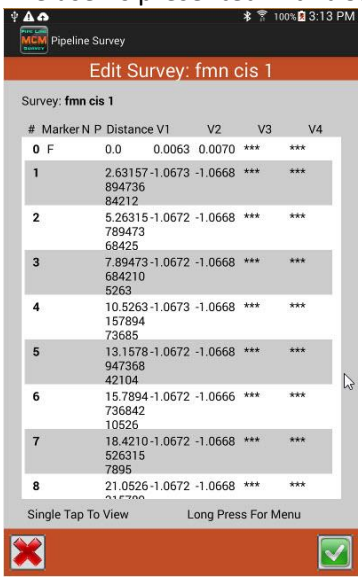
Android PLS Survey Modifications

The current survey in process can have its' ***data*** reviewed/edited (to a degree) to ***eliminate bad readings or related data***.

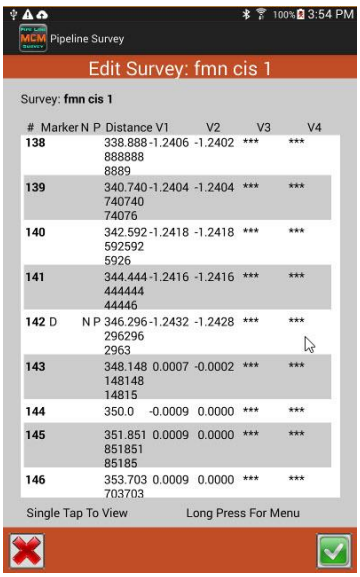
Tapping the ***Survey Modification***  button on the **Survey** main screen will show a list of available sub-functions.

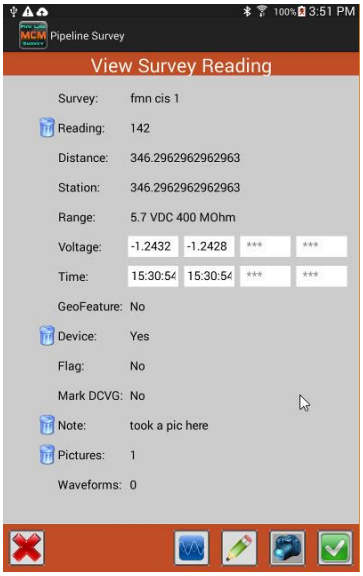


- ## Edit Survey Data
  - The user is presented with a ***scrollable*** **Edit Survey** screen that shows ***all*** readings taken for the current survey.



- The **Edit Survey** screen presents a ***summary entry*** for each reading taken… showing any related ***markers***, ***distance***, reading ***values…***
- ***Markers*** indicate ***other*** data related to the reading:
  - **D** – device
  - **G** – geo-feature
  - **F** – flag
  - **P** – picture
  - **N** – note/comment
  - **W** – waveform
  - **M** – anomaly
- ***Tapping*** an entry or doing a ***long press*** will present menu to **view** the selected reading and related data…

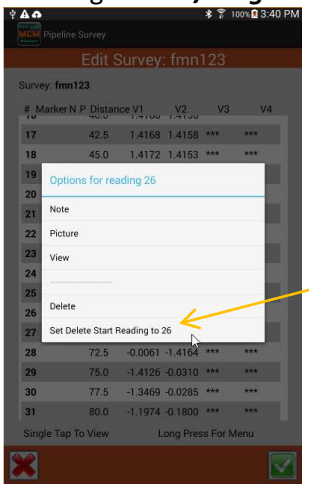


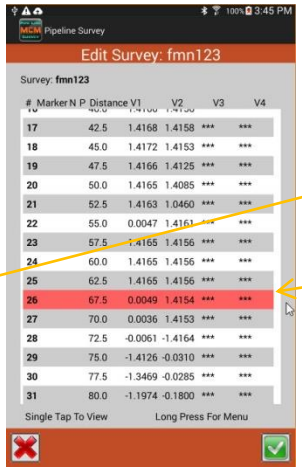


- The **View Survey Reading** screen shows more details about the reading data.
  - **Distance** & **Station** values
  - **Voltage** & **Time** values
- Any ***related*** data associated with this reading is shown…
  - Any **Device** readings taken
  - Any **Geo-Feature** associated with this location
  - Any **Flag** associated with this reading's station location
  - Any **Picture** and/or **Note** taken at this location
  - Any **Waveform** taken at this location can be loaded and viewed via the  button.
  - For a DCVG survey, a **Mark DCVG** may be shown, indicating an ***anomaly*** was detected
- From this screen, the user can take a picture and/or add a comment

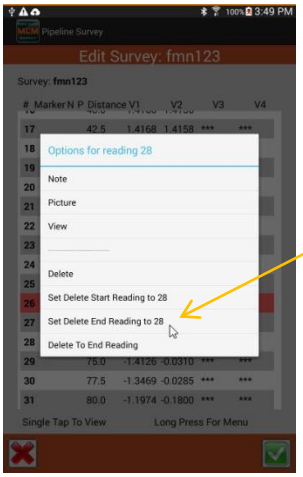
- The **Edit Survey Data** function provides the user with the capability to ***delete***:
  - A ***specific reading*** via the icon
  - ***Specific related data*** via the icon
  - A ***block of readings within a survey***
  - From a ***specific reading to the last reading in a survey***

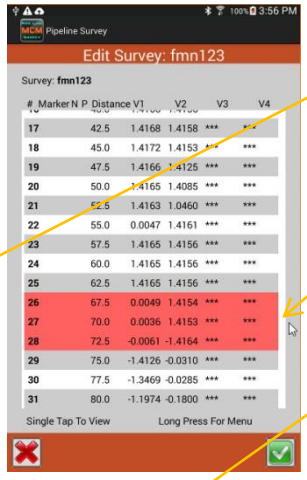
  A ***confirmation*** message must be acknowledged for any delete action to take place…
- Deleting a ***block/range*** of readings…

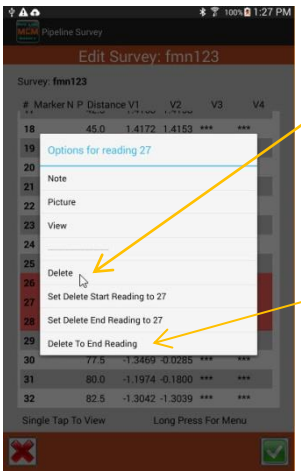


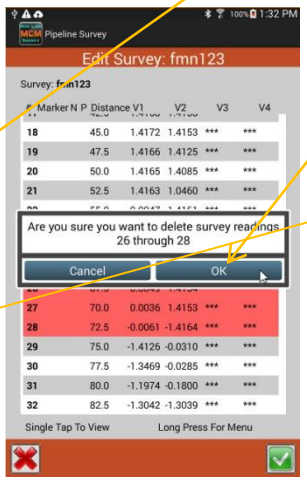


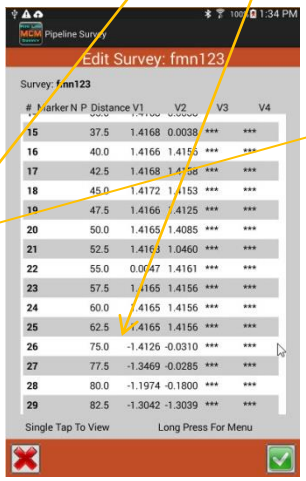
- Reading # 26 to 28 to be deleted… do a ***Long Press*** on Rd # 26 to get a menu
  - On the menu ***Tap*** the 'Set Delete Start Reading to 26' entry…
  - Edit Survey screen shows Rd # 26 highlighted…
- do a ***Long Press*** on Rd # 28 to get a menu
  - On the menu ***Tap*** the 'Set Delete End Reading to 28' entry…
  - Edit Survey screen shows Rd # 26 to Rd # 28 highlighted…
- do a ***Long Press*** anywhere on highlighted rows to get a menu
  - On the menu ***Tap*** the 'Delete' entry…
- A ***Confirmation window*** is presented, tap ***OK*** to delete the rows
- The **Edit Survey** screen now shows readings have been deleted, note the distance/stationing… a ***gap*** will remain







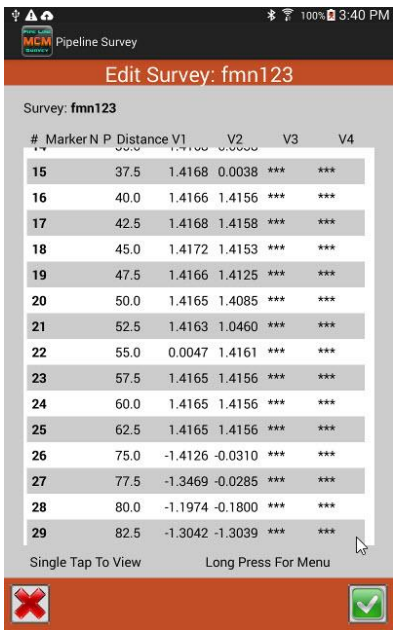


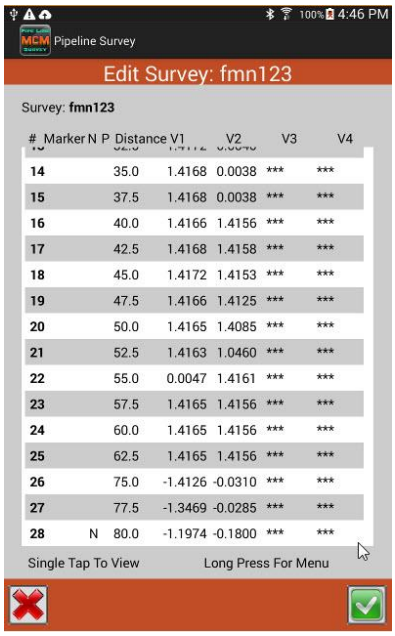


- If readings are ***deleted to the end of survey*** then any new reading will continue from the last remaining reading and there will not be a gap. All of the readings in a survey cannot be deleted. At least one reading must always remain.

- **Delete Last Reading**

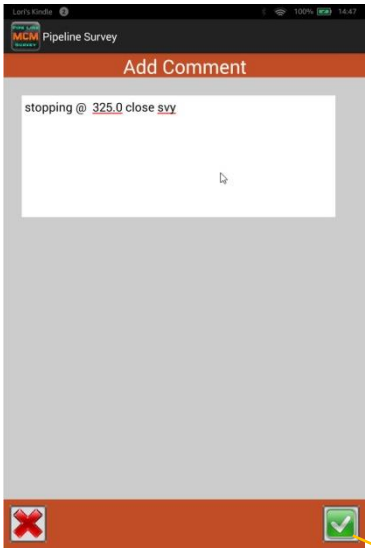
  - Tapping the **Delete last Reading**  selection on the ***Survey Modification***  list will cause the ***last taken reading*** to be deleted.

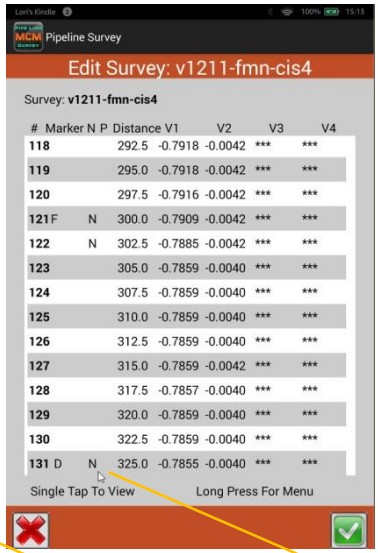


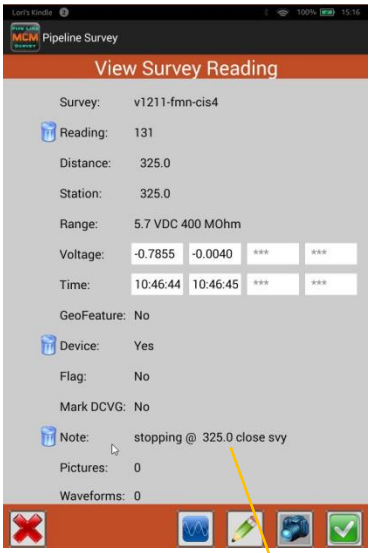


- **Add Comments**

  - Tapping the **Add Comments**  selection on the ***Survey Modification***  list will cause the ***Add Comment*** screen to appear so a comment can be added to the current survey







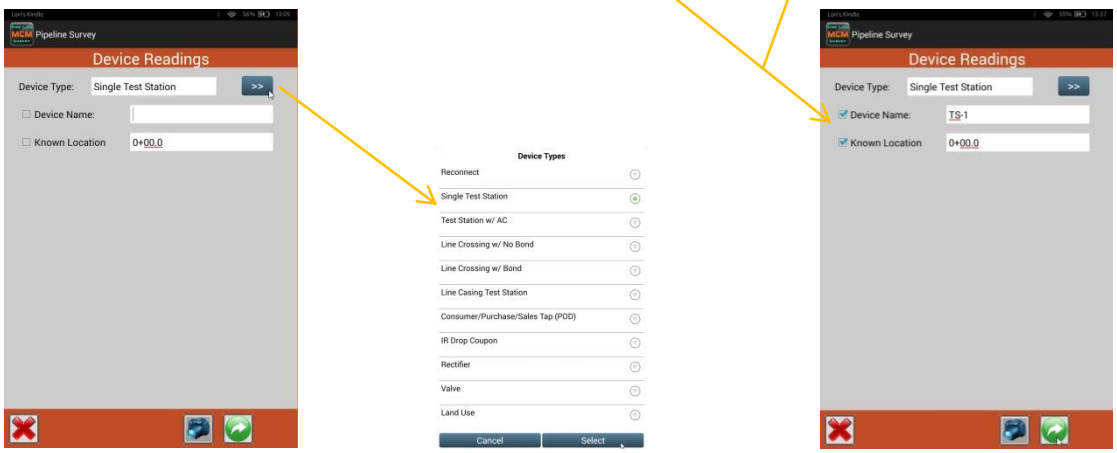
- Tap the ***checkmark*** button to save your comment.
- The entered ***comment*** will be ***linked*** to the last reading taken…
- A **Note** marker will be created on reading to indicate a comment is present…
- Opening the reading (to view details) will ***show a portion of the comment entered***…

Device and Feature Screens

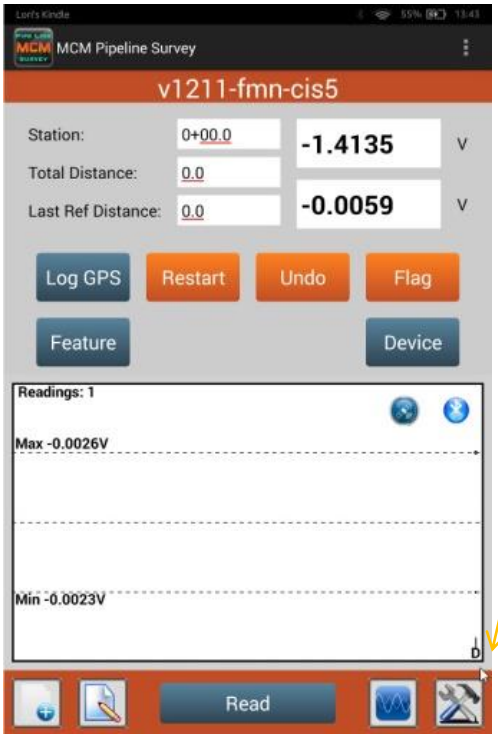
As you prepare to do a pipeline survey you may want to record other pipe-to-soil potentials at ***device/DCP (Data Collection Point)*** locations associated with the survey. The **Device** 

button can be tapped to identify the device where these types of readings are being taken.

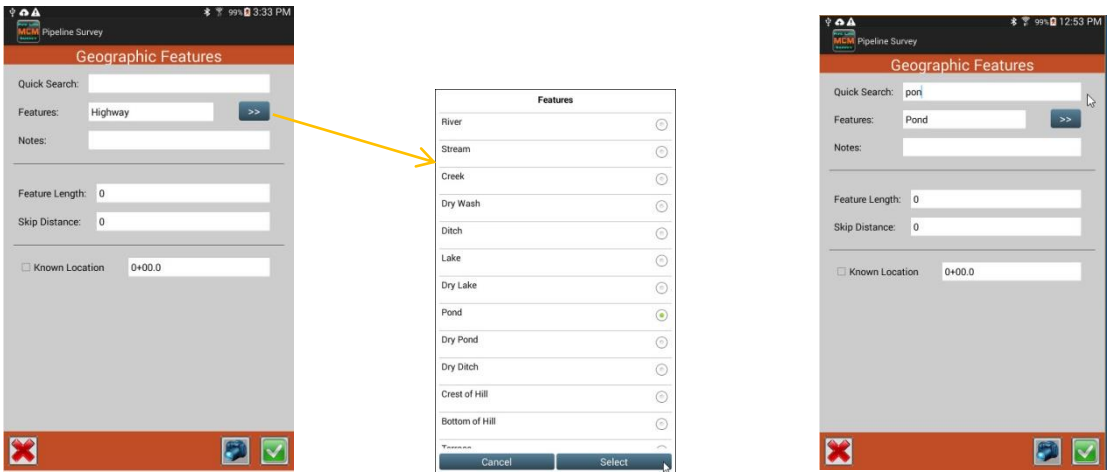
- ## Device button
  - Will Bring-up the **Device Readings** screen that is initially used to identify the **Device Type** for which a reading is to be taken. In addition (optionally), one could enter a ***name*** and ***location*** for the device…



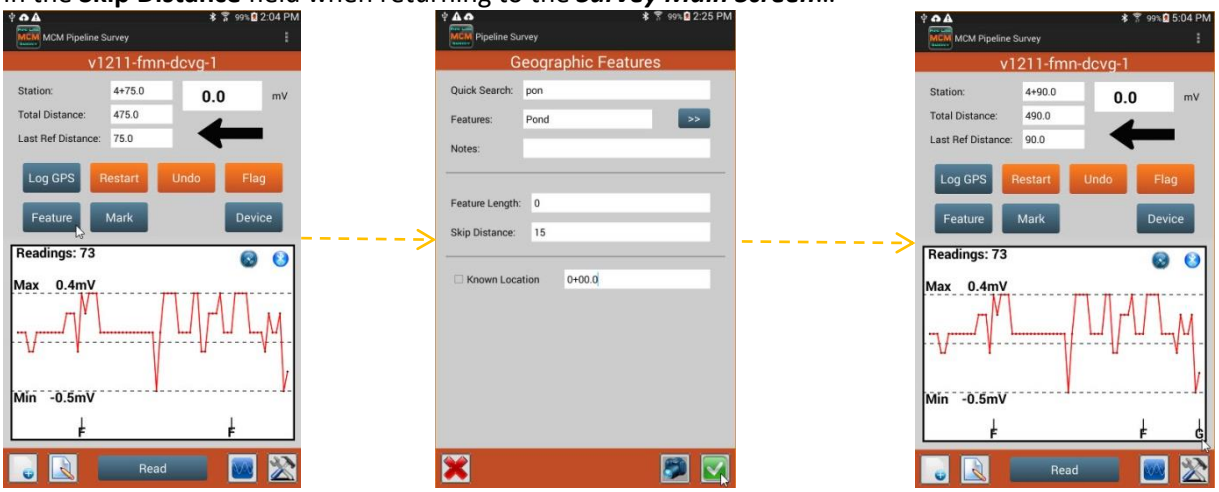
  - Tapping the  ***Next*** button will now bring-up the '**… Voltage**' screen where you can enter the reading voltage to be taken. Depending on what ***Device Type*** was selected, '**… Voltage**' screen(s) specific to the ***Device Type*** will be shown. ***Remarks/Comments*** related to the reading can also be entered. Once completed, tapping the  ***check to save*** button will step to the next '**… Voltage**' screen or return back to the main survey screen. Note the '**D**' marker in the ***Graph section*** once returned to the ***Main Survey*** screen…



- **Feature button**
  - Will Bring-up the **Geographic Features** screen that provides the user a function to enter ***items/observations/features*** that were encountered during the survey and may have ***influenced/affected*** the distance/stationing of the survey data. A ***feature*** identified during the survey will also be listed when the survey data is transferred to the **MCMiller ProActive *CP Data Management*** or ***ESD*** software**.**
  - The ***type*** of **Feature** encountered can be selected from a **Features *list*** or via a **Quick Search** by typing the name of a feature and perhaps getting a ***hit***… a **Notes** field can be used for additional info related to the **Feature**…



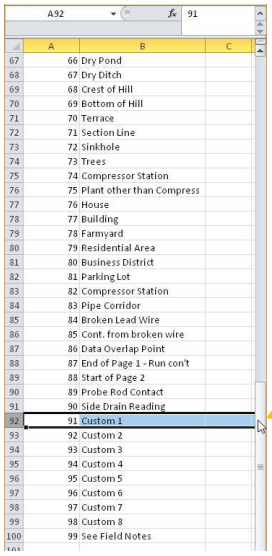
  - The **Feature length** and **Skip Distance** fields provide the user to identify the size of an encountered ***feature*** and possible impact the ***feature*** may have on current stationing. The **Skip Distance** field can be used to ***adjust*** stationing based on the ***feature*** that was encountered. The stationing will be adjusted based on the value entered in the **Skip Distance** field when returning to the ***Survey Main Screen***…



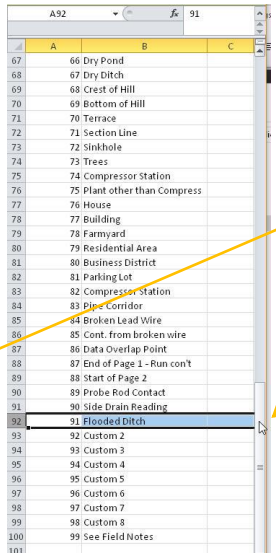
  - You can enter a **Feature Length** value if you wish, although this entry does not have any impact on the stationing. In addition, you can check off the box labeled, **Known Station** and enter a station value if you know that the current stationing is incorrect. This will give the software a new location reference going forward.

- **Device and Feature List Update**

Adding entries to the **Device** or **Feature** list can be accomplished by modifying the ***PLS_Script.csv*** (Device list) file. Before making any updates to a ***master list,*** it is recommended that a backup of the list be done prior to an update attempt. Changing a ***master list*** will not affect existing surveys; each survey stores a copy of the lists in use when the survey was created.



66	Dry Pond
67	Dry Ditch
68	Crest of Hill
69	Bottom of Hill
70	Terrace
71	Section Line
72	Sinkhole
73	Trees
74	Compressor Station
75	Plant other than Compress
76	House
77	Building
78	Farmyard
79	Residential Area
80	Business District
81	Parking Lot
82	Compressor Station
83	Pipe Corridor
84	Broken Lead Wire
85	Cont. from broken wire
86	Data Overlap Point
87	End of Page 1 - Run con't
88	Start of Page 2
89	Probe Rod Contact
90	Side Drain Reading
91	Custom 1
92	Custom 2
93	Custom 3
94	Custom 4
95	Custom 5
96	Custom 6
97	Custom 7
98	Custom 8
99	See Field Notes



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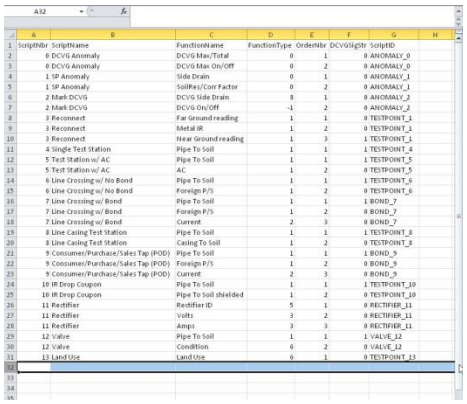
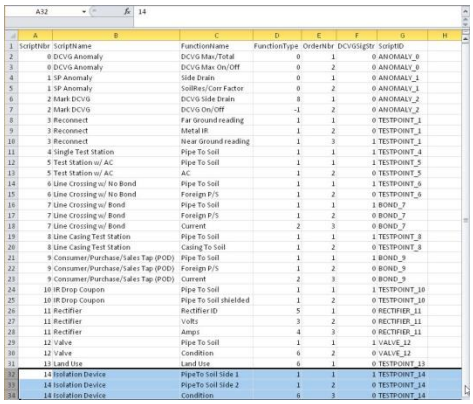
83	Pipe Corridor
84	Broken Lead Wire
85	Cont. from broken wire
86	Data Overlap Point
87	End of Page 1 - Run con't
88	Start of Page 2
89	Probe Rod Contact
90	Side Drain Reading
91	Flooded Ditch
92	Custom 2
93	Custom 3
94	Custom 4
95	Custom 5
96	Custom 6
97	Custom 7
98	Custom 8
99	See Field Notes

- The **Feature** list entry ***Custom 1*** was modified to show ***Flooded Ditch***…



ScriptNbr	ScriptName	FunctionName	FunctionType	OrderNbr	DCVGSigStr	ScriptID
0	DCVG Anomaly	DCVG Max/Total	0	1	0	ANOMALY_0
0	DCVG Anomaly	DCVG Max On/Off	0	2	0	ANOMALY_0
1	SP Anomaly	Side Drain	0	1	0	ANOMALY_1
1	SP Anomaly	SoilRes/Corr Factor	0	2	0	ANOMALY_1
2	Mark DCVG	DCVG Side Drain	8	1	0	ANOMALY_2
2	Mark DCVG	DCVG On/Off	-1	2	0	ANOMALY_2
3	Reconnect	Far Ground reading	1	1	0	TESTPOINT_1
3	Reconnect	Metal IR	1	2	0	TESTPOINT_1
3	Reconnect	Near Ground reading	1	3	1	TESTPOINT_1
4	Single Test Station	Pipe To Soil	1	1	1	TESTPOINT_4
5	Test Station w/ AC	Pipe To Soil	1	1	1	TESTPOINT_5
5	Test Station w/ AC	AC	1	2	0	TESTPOINT_5
6	Line Crossing w/ No Bond	Pipe To Soil	1	1	1	TESTPOINT_6
6	Line Crossing w/ No Bond	Foreign P/S	1	2	0	TESTPOINT_6
7	Line Crossing w/ Bond	Pipe To Soil	1	1	1	BOND_7
7	Line Crossing w/ Bond	Foreign P/S	1	2	0	BOND_7
7	Line Crossing w/ Bond	Current	2	3	0	BOND_7
8	Line Casing Test Station	Pipe To Soil	1	1	1	TESTPOINT_8
8	Line Casing Test Station	Casing To Soil	1	2	0	TESTPOINT_8
9	Consumer/Purchase/Sales Tap (POD)	Pipe To Soil	1	1	1	BOND_9
9	Consumer/Purchase/Sales Tap (POD)	Foreign P/S	1	2	0	BOND_9
9	Consumer/Purchase/Sales Tap (POD)	Current	2	3	0	BOND_9
10	IR Drop Coupon	Pipe To Soil	1	1	1	TESTPOINT_10
10	IR Drop Coupon	Pipe To Soil shielded	1	2	0	TESTPOINT_10
11	Rectifier	Rectifier ID	5	1	0	RECTIFIER_11
11	Rectifier	Volts	3	2	0	RECTIFIER_11
11	Rectifier	Amps	3	3	0	RECTIFIER_11
12	Valve	Pipe To Soil	1	1	1	VALVE_12
12	Valve	Condition	6	2	0	VALVE_12
13	Land Use	Land Use	6	1	0	TESTPOINT_13



ScriptNbr	ScriptName	FunctionName	FunctionType	OrderNbr	DCVGSigStr	ScriptID
0	DCVG Anomaly	DCVG Max/Total	0	1	0	ANOMALY_0
0	DCVG Anomaly	DCVG Max On/Off	0	2	0	ANOMALY_0
1	SP Anomaly	Side Drain	0	1	0	ANOMALY_1
1	SP Anomaly	SoilRes/Corr Factor	0	2	0	ANOMALY_1
2	Mark DCVG	DCVG Side Drain	8	1	0	ANOMALY_2
2	Mark DCVG	DCVG On/Off	-1	2	0	ANOMALY_2
3	Reconnect	Far Ground reading	1	1	0	TESTPOINT_1
3	Reconnect	Metal IR	1	2	0	TESTPOINT_1
3	Reconnect	Near Ground reading	1	3	1	TESTPOINT_1
4	Single Test Station	Pipe To Soil	1	1	1	TESTPOINT_4
5	Test Station w/ AC	Pipe To Soil	1	1	1	TESTPOINT_5
5	Test Station w/ AC	AC	1	2	0	TESTPOINT_5
6	Line Crossing w/ No Bond	Pipe To Soil	1	1	1	TESTPOINT_6
6	Line Crossing w/ No Bond	Foreign P/S	1	2	0	TESTPOINT_6
7	Line Crossing w/ Bond	Pipe To Soil	1	1	1	BOND_7
7	Line Crossing w/ Bond	Foreign P/S	1	2	0	BOND_7
7	Line Crossing w/ Bond	Current	2	3	0	BOND_7
8	Line Casing Test Station	Pipe To Soil	1	1	1	TESTPOINT_8
8	Line Casing Test Station	Casing To Soil	1	2	0	TESTPOINT_8
9	Consumer/Purchase/Sales Tap (POD)	Pipe To Soil	1	1	1	BOND_9
9	Consumer/Purchase/Sales Tap (POD)	Foreign P/S	1	2	0	BOND_9
9	Consumer/Purchase/Sales Tap (POD)	Current	2	3	0	BOND_9
10	IR Drop Coupon	Pipe To Soil	1	1	1	TESTPOINT_10
10	IR Drop Coupon	Pipe To Soil shielded	1	2	0	TESTPOINT_10
11	Rectifier	Rectifier ID	5	1	0	RECTIFIER_11
11	Rectifier	Volts	3	2	0	RECTIFIER_11
11	Rectifier	Amps	4	3	0	RECTIFIER_11
12	Valve	Pipe To Soil	1	1	1	VALVE_12
12	Valve	Condition	6	2	0	VALVE_12
13	Land Use	Land Use	6	1	0	TESTPOINT_13
14	Isolation Device	PipeTo Soil Side 1	1	1	1	TESTPOINT_14
14	Isolation Device	PipeTo Soil Side 2	1	2	0	TESTPOINT_14
14	Isolation Device	Condition	6	3	0	TESTPOINT_14

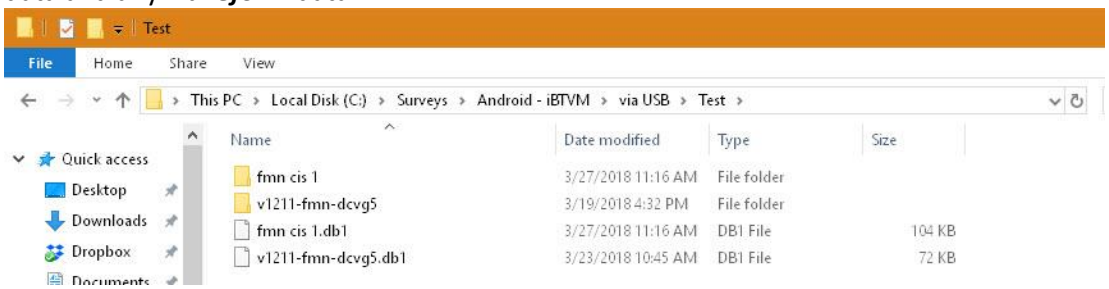
- The **Device** list was expanded to show an ***Isolated Device*** entry having 2 readings to be taken along with a ***textual comment*** entry…

- **PLS Survey Transfer to ProActive**

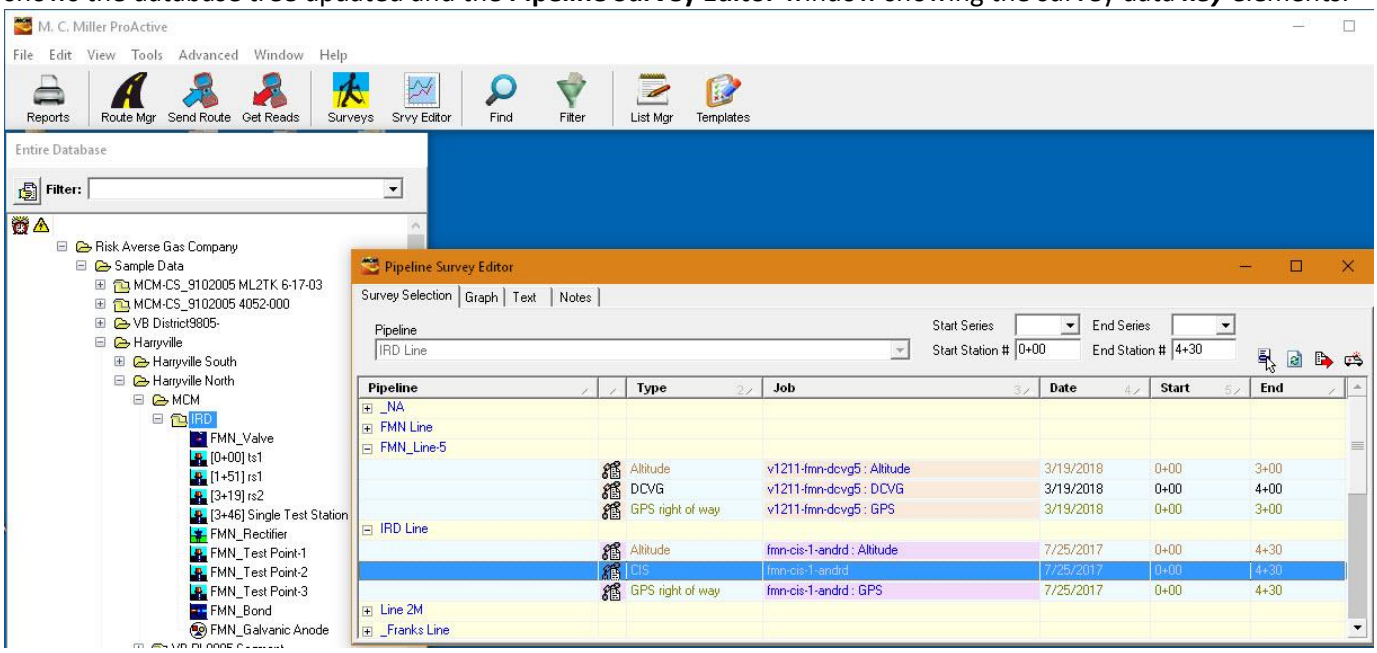
  As mentioned in Pipeline_survey_data all PLS ***raw*** data resides in the ***pipelinesurvey*** folder on your Android tablet. This survey data can now be transferred to MCM's CP data management system, **ProActive**, which allows integration of pipeline survey data in a database system and offers extensive reporting (both textual and graphical) capabilities on the survey data. The transfer of the pipeline survey data to the ProActive software (residing on the user's PC) is accomplished via the Android tablet being connected to the PC via a USB cable. The PC must have the ***Windows Mobile Device Center*** application and a USB driver with Android Debug Bridge (***ADB***) capability installed. A driver with ADB capability may be downloaded from the tablet brand's website being used with the PLS application.

  - The ProActive '***Surveys***' function with a *Data Logger* specification of ***Android*** will invoke ***driver*** software to perform the survey transfer. A ***backup*** of the pipeline survey data during the transfer can be accomplished by specifying the '***Copy to Local Folder***' option and a directory path/folder to save the data. A successful transfer will result in 2 data objects being saved:
    - ***PLS survey name*** folder
    - ***PLS survey name.db1***

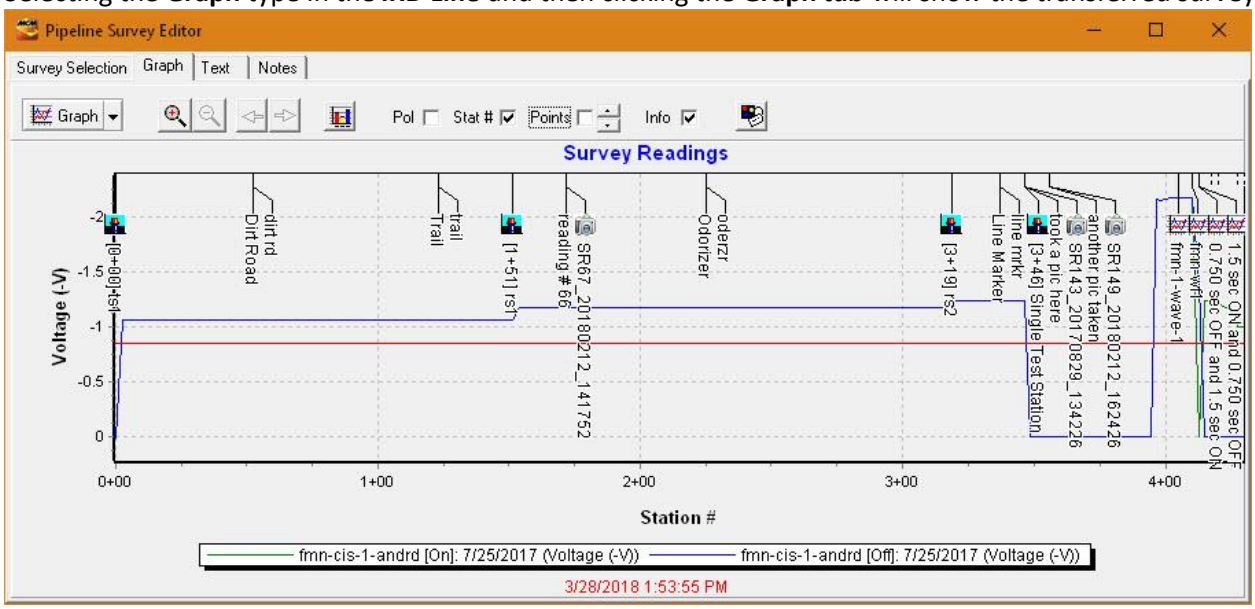
    The ***PLS survey name*** is the name of the survey as it was created/specified on the PLS app… The ***folder*** object will contain any pictures/photos taken during the survey. The '***.db1***' filetype is a ***SQL*** database containing the survey data and any ***waveform*** data…



  - A successful '***Surveys***' function will update the ProActive ***database tree*** to reflect any ***Devices*** or ***Anomalies*** that were found during the survey. The ProActive '***Srvy Editor***' function can then be used to review survey data. The below picture shows the results of the transfer of a CIS survey example to ProActive. The **Entire Database** window shows the database tree updated and the **Pipeline Survey Editor** window showing the survey data ***key*** elements.



- Selecting the **Graph** type in the ***IRD Line*** and then clicking the **Graph *tab*** will show the transferred survey data…



Note: checking the **Info** checkbox shows an additional level of detail for the transferred survey. This level of detail shows that **Devices, Features, Pictures,** and **Waveforms** were specified during this survey…

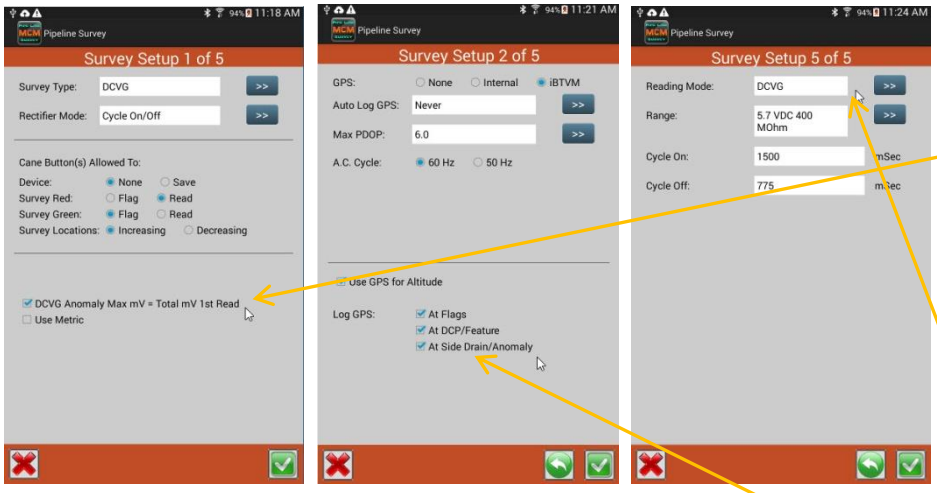
DCVG Survey Screen Support

Unlike Close Interval Potential Surveys (***CIPS*** or ***CIS)***, Direct Current Voltage Gradient (***DCVG***) surveys do not involve an electrical connection to the pipe, other than, temporarily, to determine IR drop values at pipe connection locations. Instead, readings on DCVG surveys involve soil-to-soil potential difference measurements, as opposed to pipe-to-soil potential difference measurements.

DCVG surveys are performed in the rectifier-current ON/OFF mode, ie, the rectifier current is switched ON and OFF in a cyclic fashion. This allows soil-to-soil potential differences to be recorded during the ON portion of the current cycle and also during the OFF portion of the current cycle. To understand more of the ***physical principles*** related to performing DCVG surveys, one can review the ***MCMiller DCVG Training Reference*** document.

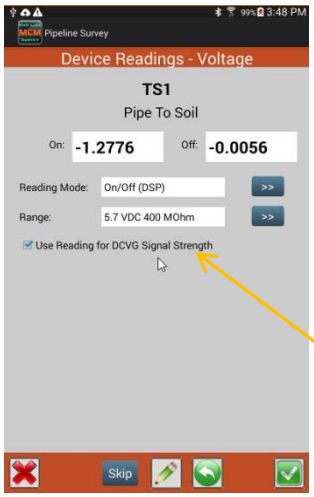
The following section describes Android PLS app screens having fields related to DCVG survey support…

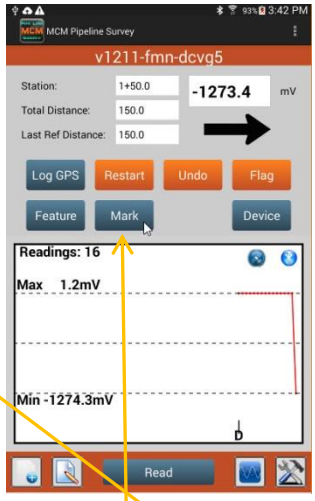
- ## DCVG Survey Setup Screens

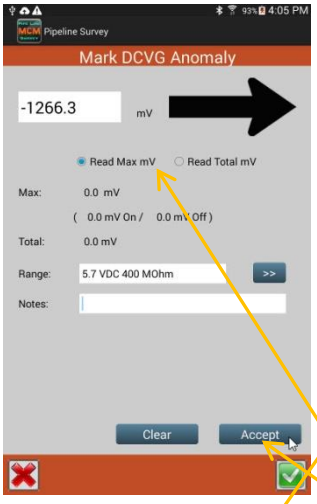


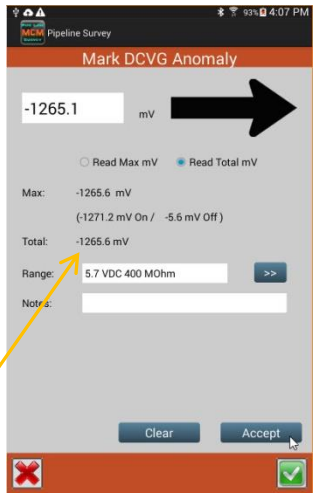
- Setting-up for a ***NEW*** DCVG type survey, setup screens 1, 2 and 5, *note* selectable fields, normally defaulted.
  - **…Max mV = Total mV 1st Read if checked,** the Max mV voltage recorded at an anomaly location will automatically become the first voltage value used by the data-logger's software to calculate the ***Total mV*** (total voltage gradient). Otherwise, if this box is un-checked, you will have to repeat the Max mV recording a second time as part of the Total mV determination process.
  - If this box is checked, GPS data will be logged automatically when DCVG anomalies are ***'marked'***
  - DCVG surveys are performed with the rectifier-current switched ON and OFF in a cyclic fashion, the **DCVG** selection provides this '**Reading Mode',** [Same as On/Off (DSP)] The other available choice is **DCVG GPS Sync.** ***Note:*** DCVG surveys require a measurable difference between **On** and **Off** voltages, i.e., they require a significant IR drop.

- **DCVG Survey *In Process* Screens**

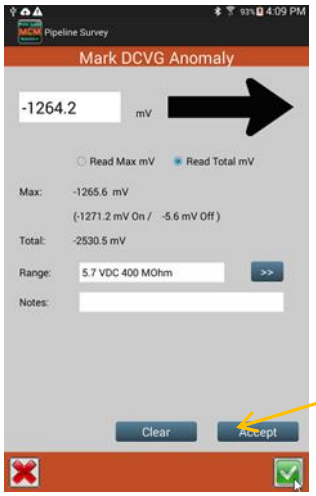


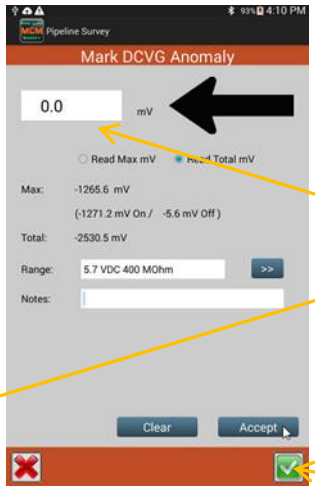


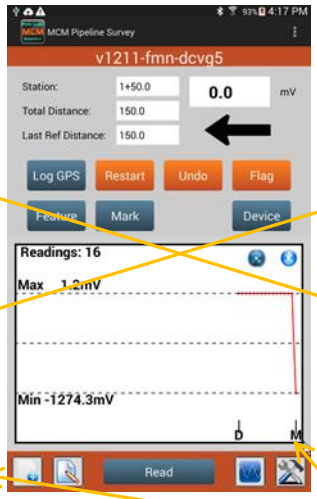




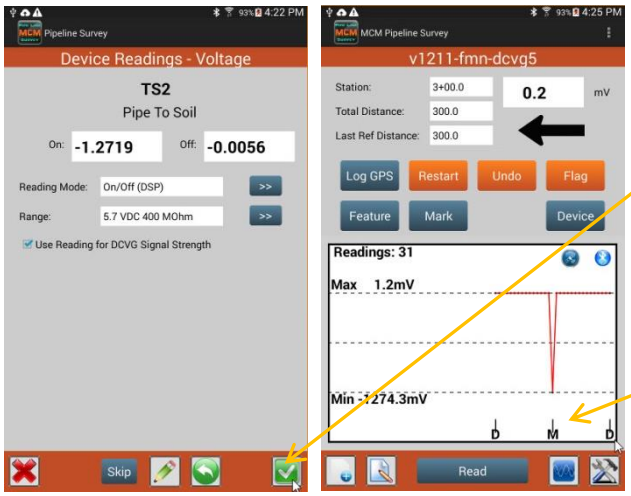
- The **On** and **Off** ***pipe-to-soil*** potentials measured (per cycle) at the ***starting test station*** will be displayed on the **Device Readings** screen. Make sure that the checkbox labeled, '**Use Reading for DCVG Signal Strength'** is checked. This will mean that the software will have its first value for IR drop to use in its %IR calculations. The above procedure should be performed at each pipe connection opportunity (test station) so that the software will be able to apply appropriate IR drop values for each ***bracketed*** '**marked**' anomaly.
- As you enter a defect's voltage gradient field, you will observe an increase in the DCVG voltage values displayed on the Survey screen. When you observe a peak (maximum value) in the DCVG voltage readings, you would interrupt the triggering to perform the '**Mark**' process.
- You will notice that the software automatically applies the '***Max mV***' value as the first value in the '***Total mV***' determination.







- You should then proceed to move the electrodes to their second positions and you should '**Accept**' the second reading. You should proceed in this fashion until you are outside of the defect's voltage gradient field, ie, the DCVG voltage reading is essentially ***zero*** (typically DCVG voltages less than about ±5mV would be considered essentially zero, on the 5.7V, 400MΩ voltmeter setting).
- At this point, you should tap on the '***Save***' button which will save all of the data associated with this defect.
- You return to the main survey screen, note the '**M**' marker

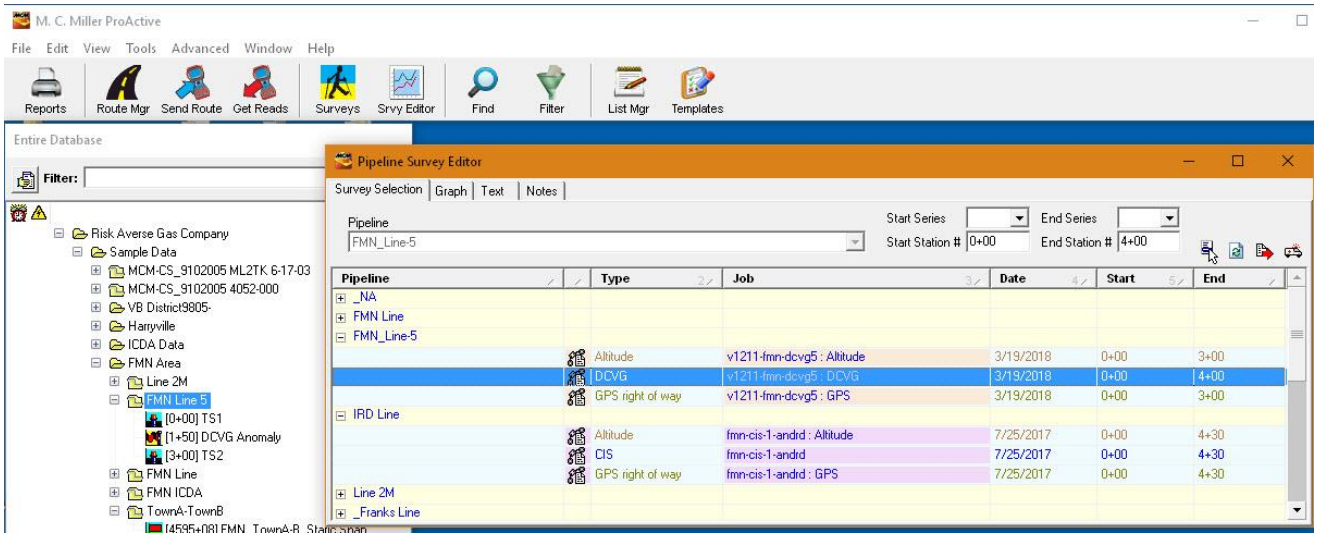


- Subsequent taking of pipe-to-soil potentials should be performed at each pipe connection (***Test Station***) opportunity so that the software will be able to apply appropriate IR drop values for each '***marked***' anomaly.
- ***Note*** the ***bracketing*** of a marked anomaly by test stations for this example in the main survey screen graph area…

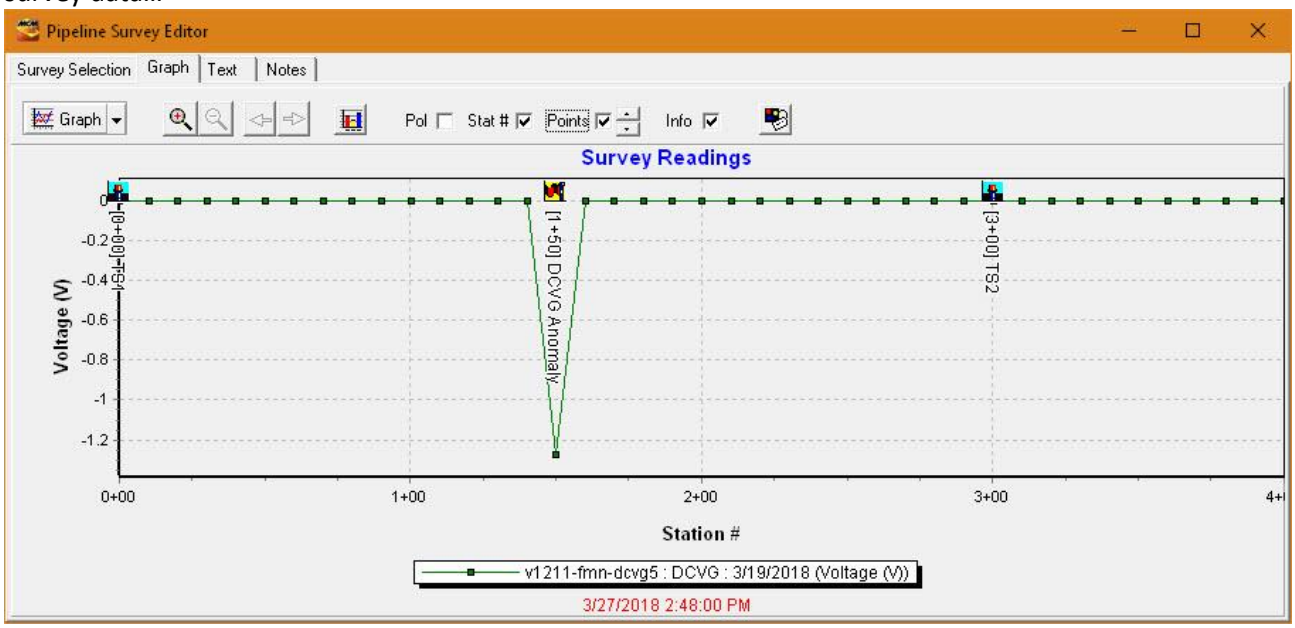
- ## DCVG Survey Transfer to ProActive

As mentioned in PLS_Survey_Transfer_to_ProActive all PLS ***raw*** data resides in the ***pipelinesurvey*** folder on your Android tablet.

- A successful '***Surveys***' function will update the ProActive ***database tree*** to reflect any ***Devices*** and/or ***Anomalies*** that were found during the survey. The ProActive '***Srvy Editor***' function can then be used to review survey data. The below picture shows the results of the transfer of a DCVG survey example to ProActive. The **Entire Database** window shows the database tree updated and the **Pipeline Survey Editor** window showing the survey data ***key*** elements.



- Selecting the **Graph** type in the ***FMN_Line-5*** **Pipeline** and then clicking the **Graph *tab*** will show the transferred survey data…



Note: checking the **Info** and **Points** checkboxes shows an additional level of detail for the transferred survey.

Surface Potential Survey Screen Support

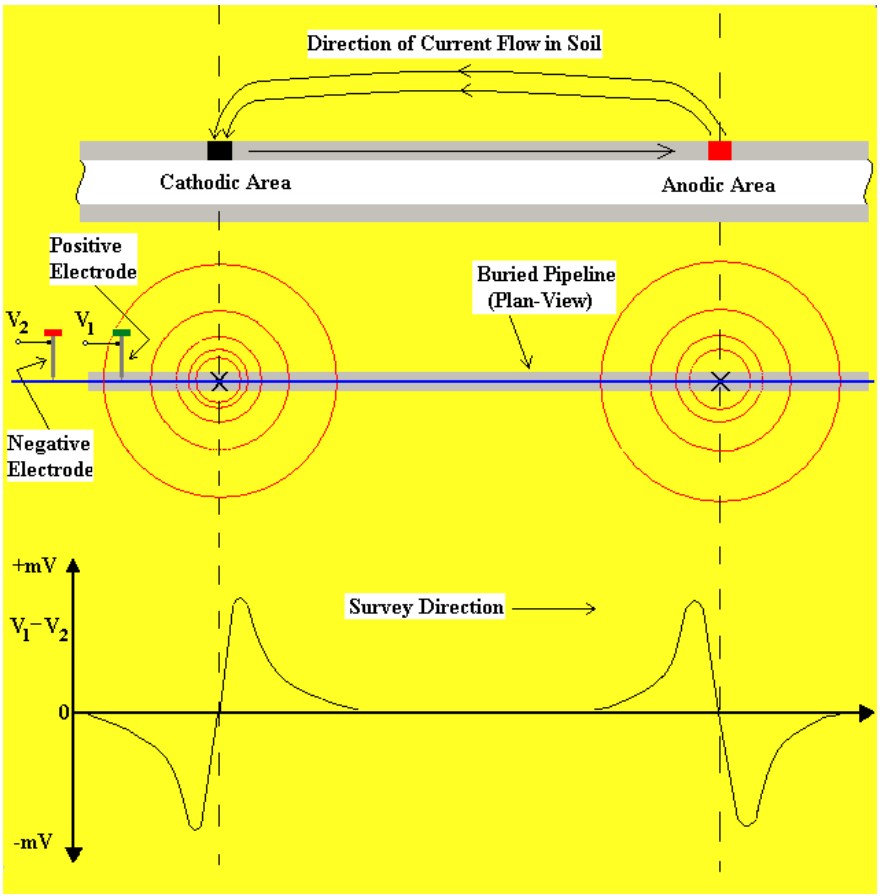
The **Surface Potential** (SP) pipeline survey method is similar to the DCVG survey method, at least in terms of how the reference electrodes are employed to measure the difference in potential between two points on the surface of the soil above a buried pipeline. SP surveys, however, are typically performed on uncoated or poorly-coated pipelines, whereas DCVG surveys are usually performed on well-coated pipe that has an impressed current source providing the ***signal strength***.

Localized current flow can give rise to potential gradients on the surface of the soil above a buried pipe due, for example, to the presence of corrosion cells (combinations of anodic and cathodic areas) on the pipe, and the goal of an SP survey is to locate such potential gradient fields.

In the case of bare pipe, typically only about 10-15 % of the pipe will be subject to galvanic corrosion and, in addition, typically this small percentage is made up of small, highly-localized, corrosion areas (anodic areas) that are randomly-distributed along the length of the pipe. Thus, an ***above-the-ground*** survey technique that can accurately locate these isolated areas is invaluable.

The objective of SP surveys is to locate ***anodic*** areas existing along a segment of pipeline, as evidenced by potential gradient fields having a particular polarity presenting themselves on the surface of the soil directly above the anodic areas. Once any anodic areas have been located, remedial action can be taken, such as the installation of ***sacrificial*** anodes to suppress current flow from the corroding area, with a view to preventing further external corrosion in that particular area.

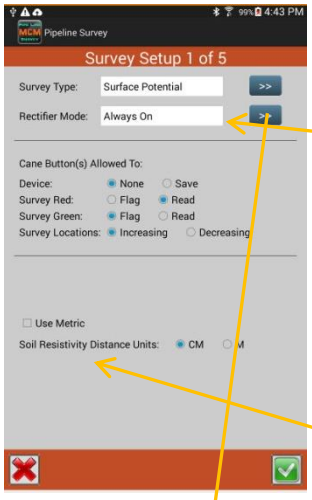
One way to perform a SP pipeline survey is to use the, so-called, ***In-Line*** method. In this case, the reference electrodes are both positioned over the pipe and their separation is kept fixed as the operator, or operators in the case of large electrode spacing (for example, a 20 feet spacing), walks down the length of the pipeline section. With a view to detecting localized anodic areas and accurately measuring the longitudinal voltage profile, the survey needs to be close-interval in nature.

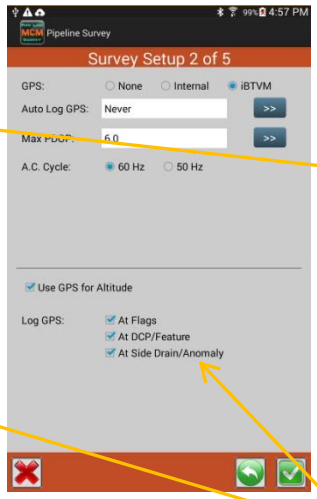


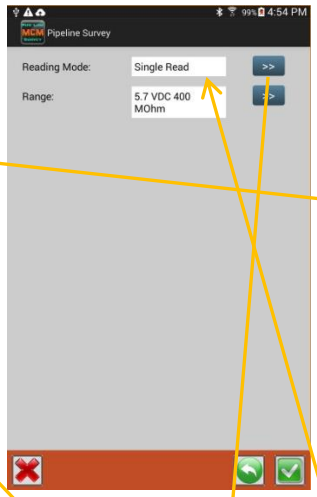
The *In-Line* method of conducting SP surveys. Soil-to-soil potential difference readings are plotted in the bottom part of the Diagram against the position along the pipeline of the center point between the reference electrodes

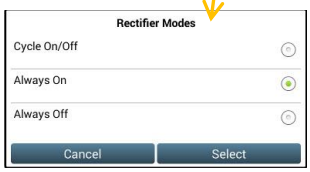
To further understand ***Surface Potential*** survey ***Physical Principles*** and ***Survey Methods,*** it is recommended that reader refer to the **Surface Potential Surveys Training Manual - Gx Version.pdf** document.

- **Surface Potential Survey Setup Screens**



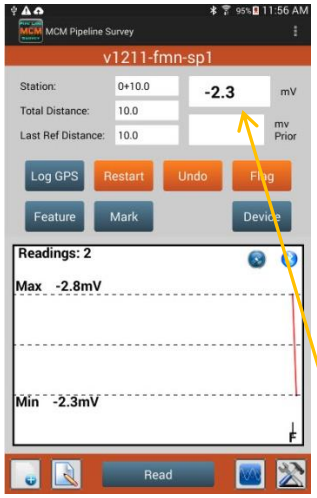


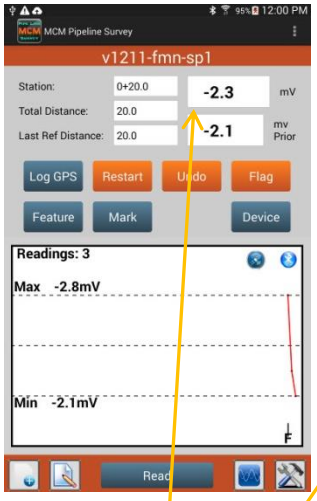




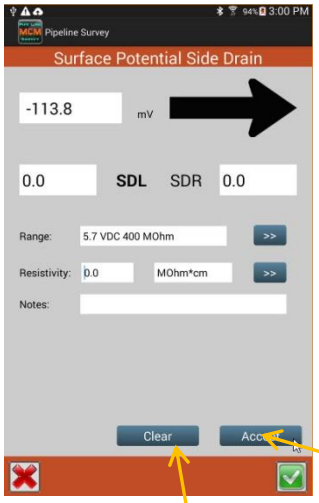
- Setting-up for a ***NEW*** Surface Potential type survey, setup screens 1, 2 and 5, *note* selectable fields, are normally defaulted.
  - You can select either, **Always On**, if the rectifiers influencing the pipe are **ON**, or, **Always Off**, if the pipe is unprotected or is temporarily depolarized. Note: The **Cycle On/Off** option is ***not available for Surface Potential surveys*** as the process involves cell-to-cell potential difference **single** readings.
  - To calculate a ***Corrosion Factor*** value in **ProActive**, the units **Ω.cm** or **Ω.m** for soil resistivity that will appear on the SP anomaly ***marking*** screen, for your manual data entry, will depend on your selection here in the **Soil Resistivity Distance Units** field (**CM** or **M**)
  - If this box is checked, GPS data will be logged automatically when Surface Potential anomalies are ***marked.***
  - The **Single Read** voltmeter reading mode is appropriate for ***cell-to-cell*** potential difference single readings, which are the basis of Surface Potential surveys.

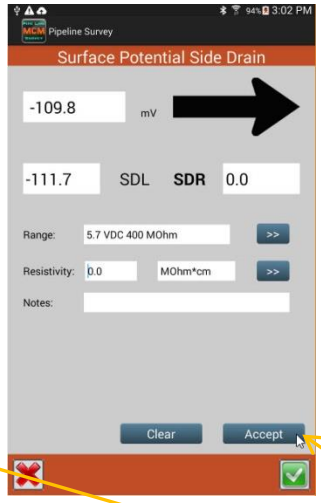
- **Surface Potential Survey *In Process* Screens**

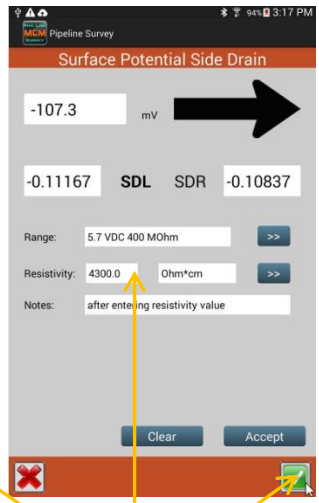




- The ***First*** tap of the **Read** button (or ***cane*** button) will log an initial displayed value in the ***top* mV field.** At this point the ***bottom* mV Prior field will be blank.**
- As successive readings are logged, the last logged reading (***the prior reading***) is displayed in the bottom **Prior mV** field and the ***current reading*** is displayed in the top **mV** field.
- On the above example screen, the prior reading was 40.2 mV and the current reading is negative mV. In this example, a ***positive-to-negative*** polarity switch has been detected, which means that an ***anodic area*** has been detected. This possible anomaly can then be ***marked*** by taking side drain readings on both sides of the pipe at the epicenter location. Tapping on the **Mark** button on the Survey screen will bring-up the ***Side Drain*** screen.





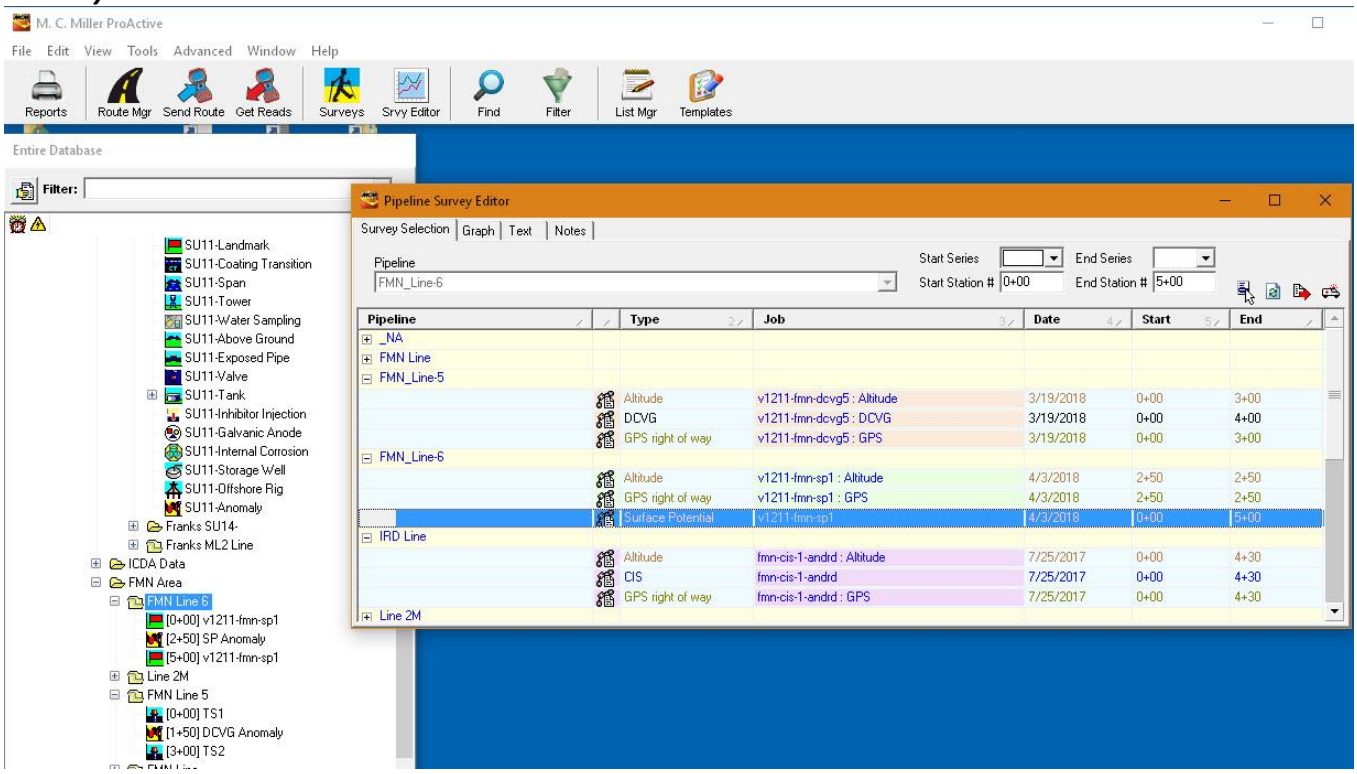


- By placing the negative data-probe over the pipe (at the epicenter spot) and the positive data-probe off to the ***left-hand side of the pipe***, you can ***accept*** the Side Drain Left (**SDL**) reading by tapping on the **Accept** button.
- Next, you would keep the negative data-probe over the pipe and you would swing the positive data-probe to the opposite side of the pipe (***the right hand side***) to take the Side Drain Right (**SDR**) reading.
- Next, you can manually enter a value for the ***soil resistivity measured in the vicinity of the anomaly***.
- At this point, you should tap on the **Save** button which will save all of the data associated with the anomaly.
- The **Clear** button will clear the logged data for the active reading.

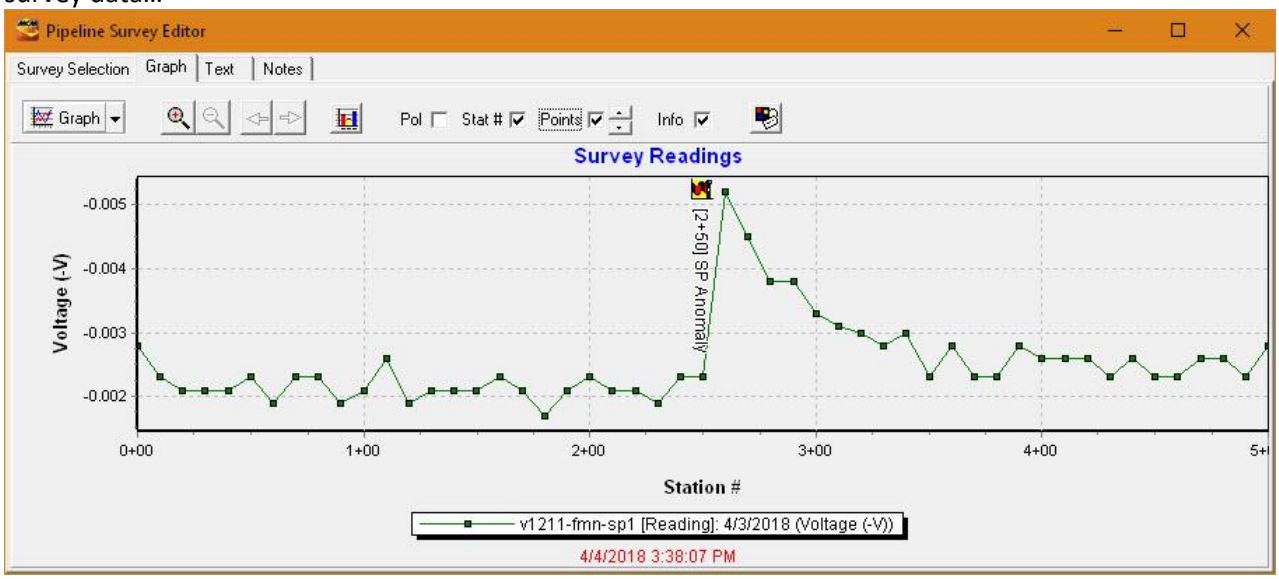
- **Surface Potential Survey Transfer to ProActive**

  As mentioned in PLS_Survey_Transfer_to_ProActive all PLS ***raw*** data resides in the ***pipelinesurvey*** folder on your Android tablet.

  - A successful '***Surveys***' function will update the ProActive ***database tree*** to reflect any ***Devices*** and/or ***Anomalies*** that were found during the survey. The ProActive '***Srvy Editor***' function can then be used to review survey data. The below picture shows the results of the transfer of a Surface Potential survey example to ProActive. The **Entire Database** window shows the database tree updated and the **Pipeline Survey Editor** window showing the survey data ***key*** elements.



  - Selecting the **Graph** type in the ***FMN_Line-6*** **Pipeline** and then clicking the **Graph *tab*** will show the transferred survey data…



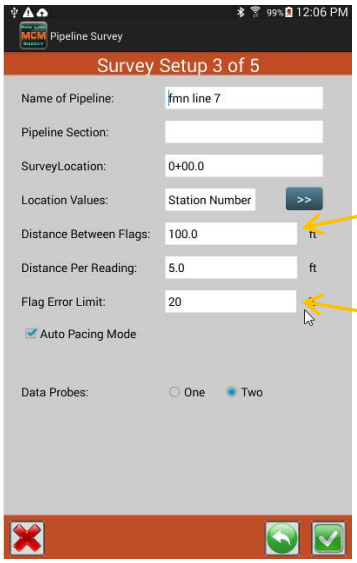
Note: checking the **Info** and **Points** checkboxes shows an additional level of detail for the transferred survey.

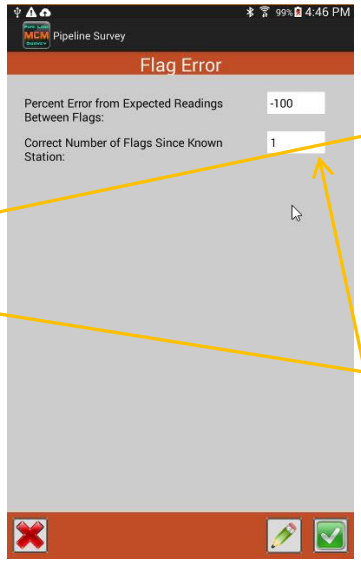
Android PLS Exception Screens

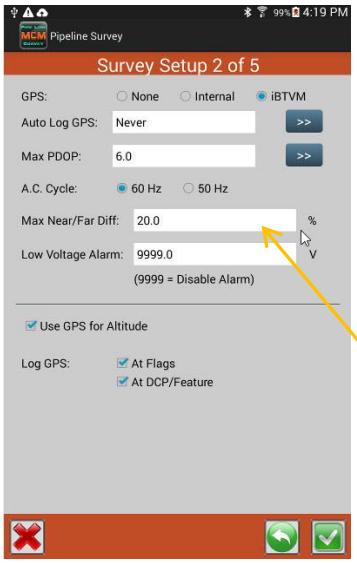
When setting-up PLS surveys where a ***difference***

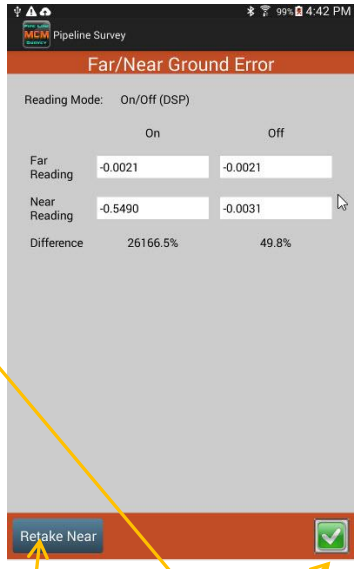
- with respect to ***Flag separation distance*** and/or
- between ***Far Ground*** and ***Near Ground*** P/S readings at a ***reconnect*** Test Station

do not meet specified survey setup criteria, an ***exception*** screen will be presented for the user to take action.









- In the field labeled, **Distance Between Flags**, you can type in the survey flag interval (***distance between survey flags***) for the section of pipeline being measured, assuming that survey flags have been laid out. Typically, survey flags are located at 100 feet intervals. In such a case, you would have a new reference (a stationing correction) every 100 feet. ***Note***: If survey flags are not in use, enter zero in this field. In this case, tapping accidentally on the Flag button will not adversely impact your stationing.
- **Flag Error Limit** specifies the maximum permissible error between the actual number of readings logged between 2 survey flags and the expected number of readings.
  By setting the field labeled, **Flag Error Limit** you can type in the maximum permissible error. For example, the maximum permissible error is indicated as ***20%*** on the **Survey Setup 3 of 5** screen. If the reading interval is expected to be ***5*** feet and the survey flag separation is ***100*** feet, this means that ***20*** readings are expected. If, however, only ***15*** readings are actually logged between survey flags, an error window will appear on the screen, since there is a ***25%*** difference between the expected and actual number of reading in this example. No error window will appear if the difference is less than ***20%***.
- On the **Flag Error** screen the user can specify the ***correct*** number of Flags since the last known station.

- On the **Survey Setup 2 of 5** screen, the **Max Near/Far Diff:** field will represent a threshold level with respect to the difference between a ***Far-Ground P/S reading and a Near Ground P/S reading*** (expressed as a percentage) recorded at a trail wire ***reconnect Test Station***. For differences above the entered threshold value, **Far/Near Ground Error** screen will be presented.
- The **Far/Near Ground Error** screen will present 2 options:
  - **Retake Near** 

  - ***Accept This Error*** 
- By selecting **Retake Near**, you are given the opportunity to retake the ***Near-Ground P/S reading*** (perhaps you need to re-do the connection). If the percentage difference is then below your threshold level, there will be no error screen.
- By selecting the ***checkmark***, you will be choosing to ignore the difference in the readings and move on with the survey (perhaps there is a significant current flowing in the pipe between the 2 test stations).

NOTES