

Gx PIPELINE SURVEY DATA-LOGGER
(Catalog # 11275)

USER'S MANUAL



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SECTION I

INTRODUCTION

The Gx Pipeline Survey Data-logger is an ultra-rugged handheld PC incorporating an integrated digital voltmeter, an integrated WAAS-enabled GPS receiver, an integrated 5MP digital camera and a custom-designed pipeline survey application. The unit also sports an independent (stand-alone) GPS position display application.

The operating system of the handheld PC is Windows CE 5.0 and MCM has designed a proprietary application program, known as Gx_PLS, in order that the handheld unit can be employed to collect “over-the-pipe” survey data (CIS, DCVG and Surface Potential (Cell-to-Cell) data), in association with appropriate accessory equipment.

The Gx Pipeline Survey Data-logger is shipped from MCM with the Windows operating system and the MCM applications pre-installed. The application programs remain installed (in RAM) unless the twin battery packs in the unit are allowed to fully-discharge or the unit is powered down to conserve battery power (see Section II.4). Collected pipeline survey data, however, will always be safe, regardless of battery status, as these data are stored on a non-volatile Flash memory. Also, a copy of each application program is maintained on the Flash memory and the programs are automatically re-installed whenever a “warm boot” or a “cold boot” process is performed (see Section II.5). [A “cold boot” process is performed automatically when the unit is powered on for the first time]

Pipeline survey data collected on the Gx Data-logger can be downloaded to either ProActive or to the Gx-ESD application.

As mentioned above, in addition to an integrated voltmeter, the Gx Pipeline Survey Data-logger has an integrated GPS receiver and an integrated digital camera.

The internal WAAS-enabled GPS receiver is a u-blox NEO-5 unit. A WAAS-enabled receiver provides position accuracy of around 3 meters (95% of the time), assuming that the WAAS differential correction message signal is received.

WAAS corrects for GPS signal errors caused by ionospheric disturbances, timing, and satellite orbit errors. This system, which was developed by the FAA and the DOT, consists of approximately 25 ground reference stations positioned across the United States (hence the “Wide Area” designation) that monitor GPS satellite data (there are also ground reference stations located in Canada and Mexico). Two master stations, located on either coast, collect data from the reference stations and create a GPS correction message. This correction accounts for GPS satellite orbit and clock drift as well as signal delays caused by the atmosphere and ionosphere. The correction message is broadcast through one of two geostationary satellites positioned over the equator and is picked up by a WAAS-enabled receiver.

In addition to processing WAAS correction message signals, the NEO GPS receiver also processes EGNOS (Europe-based) and MSAS (Japan-based) correction message signals.

Should even higher position resolution be required, the Gx Data-logger can be integrated with NMEA-compatible external GPS receivers. Please see Appendices 1 and 2 for instructions on how to configure Trimble XR & XRS receivers and ProXT & ProXH receivers, respectively.

Finally, the integrated 5MP digital camera can be used to record photographic images during pipeline surveys. The recorded images are associated with the ProActive database during the process of downloading pipeline survey data to the ProActive application. Once downloaded, the images can be accessed in ProActive, either via graphical reports (camera icons are overlaid on graphical reports) or the “Notes” page in the Pipeline Survey Editor, once a particular pipeline survey has been highlighted.

SECTION II

OPERATIONAL ITEMS

II. 1 Battery-life and How to Check Battery Status

The Gx Data-logger is equipped with two 2500mAh rechargeable Lithium-ion batteries. The 5000mAh total capacity should result in approximately 16 hours of surveying time, with the voltmeter and internal GPS unit active.

Note: The 16 hours battery lifetime estimate is based on setting the backlight intensity to 50% while on battery power (the battery lifetime will drop to around 12 hours with the backlight intensity set at 100%).

It is recommended that the batteries be recharged overnight when the data-logger is being used on a frequent basis. You might also wish to carry two spare batteries for switch-out – please see Section II. 3 for information on how to replace the batteries). If the data-logger will not be used for an extended period of time, it is recommended that the batteries be removed and stored in a cool, dry place – please see Section II.3 for details on battery removal).

How to Check Battery Status

The remaining charge on the batteries in the Gx Data-logger can be checked using the following procedure:

- > Tap on the “Start” button located in the bottom left hand corner of the desktop screen
- > Tap on “Settings” on the main menu
- > Tap on “Control Panel” on the Setting menu
- > Double Tap on the “Battery Status” icon
- > View battery status

How to Charge the Lithium-ion Batteries

Charging is accomplished using either the AC Adapter supplied with the data-logger or the DC vehicle charger unit that is also included with the package.

The charger unit is connected to the charging port located under the flap on the bottom right-hand side of the data-logger. When the batteries are charging, the (CHG) LED located at the top left hand corner of the keypad will blink ON and OFF (green colored) and when the batteries are fully-charged, the LED will turn solid ON (green). The LED will blink RED, once per second, when there is approximately 30 minutes of remaining battery power and will turn solid RED when there is approximately 10 minutes of battery life remaining.

Note: The batteries will not charge when the unit is below 0°C or above 40°C

Note: Operation of the unit below -20°C may cause damage to the Li-ion cell structure which is not covered under warranty

Note: The batteries will fully-discharge (from a fully-charged state) in about a 3 week period of time, with the unit in **Suspend Mode**, as opposed to the **Powered Off Mode** – please see Section II. 4 for details.

II. 2 Battery Care and Maintenance

DO:

- Charge often. Frequent full discharges add strain to the battery pack. Several partial discharges (regular use) with frequent recharges are better for lithium-ion batteries than one total discharge.
- Use the right charger. Each type of battery has its own technology, its own rate of charge and so on. The AC power supply adapter and the 12VDC auto adapter supplied with the unit are designed specifically for the Gx Data-logger lithium-ion batteries. Use of other adapters will void the warranty.
- Keep the lithium-ion batteries as cool as possible. Avoid heat. Short battery life is more likely to be caused by heat rather than charge/discharge patterns. Avoid exposure to direct sunlight or a hot car, for example.
 - If the batteries will not be used for a month or longer, they should be removed from the Gx Data-logger and store it in a cool, clean place (see Section II. 3).
- Expect to replace batteries periodically. The life span of batteries is highly dependent upon many factors including charge/discharge cycles, storage times, and operating and storage temperatures.

- Dispose of batteries in accordance with local municipality guidelines.

DO NOT:

- Never short-circuit the battery pack. Short-circuiting a Li-ion battery can cause it to ignite or explode, and as such, any attempt to open or modify a Li-ion battery's casing or circuitry is dangerous.
- Do not expose the Li-ion battery pack to high temperature environments. This can cause the battery to rupture, ignite, or explode.
- Do not drop, hit or modify the battery in any way.
- Do not expose the battery directly to moisture or rain. Opening the battery door on the Gx Data-logger negates the IP rating while it is open. Change batteries in a protected location (see Section II. 3).
- Do not discard batteries in the trash.
- Do not incinerate the batteries.

II. 3 How to Remove and Replace the Batteries

CAUTION!

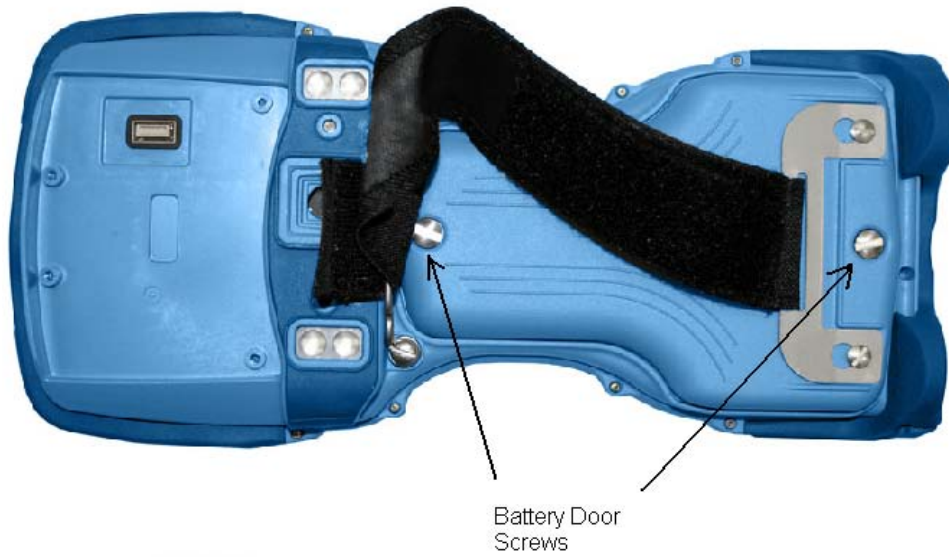
There is a risk of rupture, ignition, or explosion if you replace a Li-ion battery with an incorrect battery type. Only use Li-ion batteries supplied with your Gx Data-logger unit or replacement Li-ion batteries supplied, recommended, or approved by the M. C. Miller Company.

Note: When the battery door is open, the unit is not sealed. When replacing batteries, you should do so in a clean dry area, away from sunlight. Due to the high capacity of the battery, replacement should not be necessary in the field if your unit was properly-charged prior to a day's work.

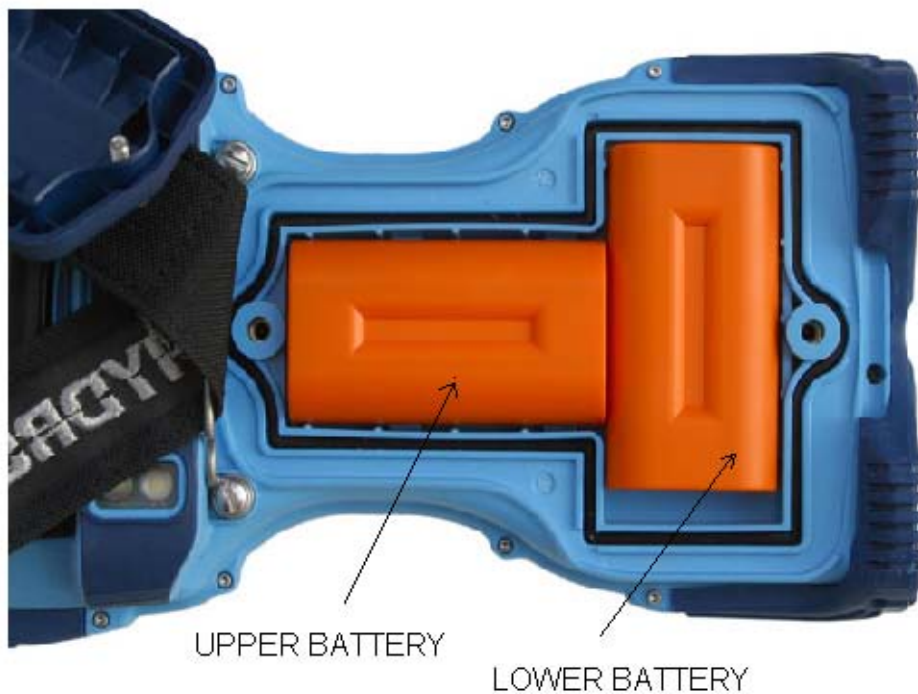
Remove the batteries from the Gx Data-logger when not using the device for extended periods. Store the batteries in a cool, dry, dark location at normal room temperature.

To remove/replace the rechargeable batteries:

1. Power down (Power Off) the unit (please see Section II. 4 regarding the difference between a Power Off action and a Suspend action)
2. With the unit face down, unscrew the battery door screws identified below:



3. Unscrew both screws and remove the battery door. Both lithium-ion batteries will be revealed as shown below.



4. Remove the lower battery first, by sliding it to the left, at which point it should lift out easily. To remove the upper battery, slide it down

- until it unlocks and then lift it out.
5. When inserting new batteries or when re-installing stored batteries, make sure that the battery contacts line up with the case contacts.
 6. Insert the upper battery first; make sure that it locks into place. Then insert the lower battery, this will simply slide into place, but make sure it is flat against the inside of the battery compartment.
 7. Replace the battery door using the two screws.

Warning! -20°C is the absolute lowest temperature for operating the device or for storing the batteries.

Note: The batteries will not charge when the unit is below 0°C (32°F) or above 40°C (104°F).

Note: Higher temperatures cause faster discharge of the batteries

II. 4 The Suspend Key/Power Key

The “Suspend/Resume” key, which also doubles as the “Power” key, is located at the bottom left hand corner of the keyboard as highlighted below.



Suspend/Resume

When using the Gx Data-logger on a daily (or quite frequent) basis, you can suspend the unit, to save battery power when not in use, by momentarily depressing the “Power” key. You can resume unit operation from the suspended state by momentarily depressing the “Power” key again (after a minimum of 3 seconds have elapsed since the suspend action).

Alternatively, if you will not be using the Gx Data-logger for extended periods of time, or, if you are going to remove the batteries for storage purposes, or, if you are going to replace the batteries, you should power down the unit completely, which is different from suspending the unit (please see below for the differences between the “Suspend” and “Power

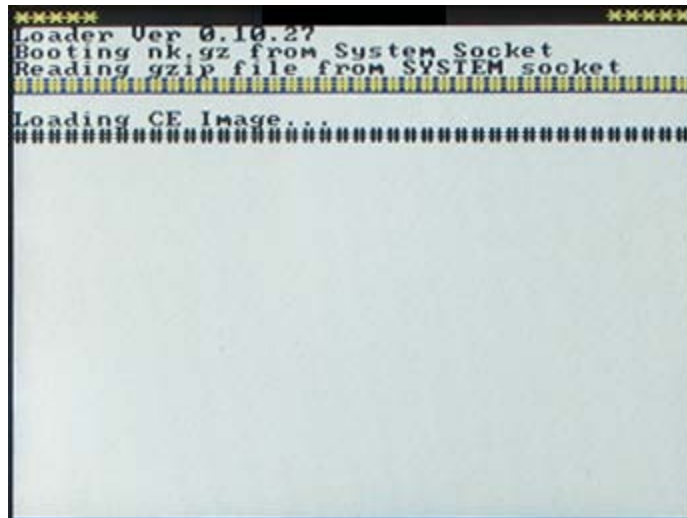
Off' states).

To power down the unit, you would depress (and hold) the “Power” key for around 3 seconds at which point the Power popup menu will be displayed as indicated below.



By tapping on the “Power Off” option on the above screen, the unit will go through its power down process.

To power the unit back on from a “Power Off” state, you would momentarily depress the “Power” key to initiated a “cold boot” process (please see Section II. 5 for information on the cold boot process). The screen shown below will be displayed as the cold boot process is initiated.



SUSPEND VS. POWER OFF STATES

There are some significant differences between the suspend state and the power off state. While the unit is in the power off state, programs in memory and files in the volatile storage area are lost and most system circuits are shutdown so that virtually no battery power is used. Upon power up, the operating system is reloaded and applications must be restarted.

While in the suspend state, peripherals are shut down and program execution is halted, but the unit remains ready. Applications and data in memory are preserved, as are files in the volatile storage area. Upon resuming, the peripherals are powered up and their drivers are initialized. Applications continue execution from where they left off and need not be aware of the unit being suspended. However, applications using remote connections, such as Bluetooth and WLAN, will need to re-establish these connections.

II. 5 How to Reset the Gx Data-logger

Should the Gx data-logger lock up (freeze up), or fail to operate, the unit can be reset in a number of different ways. The various reset processes are listed below in order of preference.

Note: The M. C. Miller applications will be automatically re-installed into RAM (from a back-up copy on the Flash memory) whenever a “warm boot” or a “cold boot” is performed (see below).

1) Warm Boot Process # 1

- Tap in the “Start” button (if responsive)
- Tap on “Programs”
- Tap on “Tools”
- Tap on “Warm Boot”

2) Warm Boot Process # 2

- Press and hold down the red “Power” key on the keyboard until a menu appears (in about a few seconds)
- When the menu appears, tap on “Warm Boot”

3) Cold Boot Process # 1

- Press and hold down the red “Power” key on the keyboard until a menu appears (in about a few seconds)

- When the menu appears, tap on “Cold Boot”
- 4) Cold Boot Process # 2 (use only if the operating system is un-responsive)
- Press and hold down both the “Power” and “Shift” keys until the CHG LED (top left hand corner of the keypad) lights up RED (approximately 10 seconds)
 - Release the Power and Shift keys – the LED will turn GREEN
 - Press and hold down both the “y” and the “z” keys until the CHG LED turns RED again
 - When the LED turns RED, release both keys - the data-logger will power down
 - Press the “Power” key to initiate the Cold Boot process

Following any of the above reset processes, the “Version” screen will be displayed. An example “Version” screen is shown below.



Please see Section II. 4 below for more information on the “Version” application.

Invalid Date:

If the data-logger determines an invalid date following a “warm boot” or a “cold boot” process, the message shown below will be displayed.



By clicking on the “OK” button on the above message screen, the window shown below will be displayed.



After selecting the correct date, the current time and your correct Time Zone, click on the “Apply” button on the “Date/Time Properties” window.

At this point, the “Version” screen will be displayed, which you can exit by tapping on the “OK” button (top right hand corner).

II. 6 How to Connect the Gx Data-logger to a PC

Gx Data-loggers can be connected to a PC using the USB cable supplied with the unit.

Connection via the USB Cable:

The requirements and procedures with regard to Gx Data-logger/PC connectivity depend on the operating system of the PC.

Case 1: Windows XP (or earlier) PC Operating System

The Microsoft “ActiveSync” communication program is required on the PC. If not currently installed, the application can be installed from the CD provided with the Gx Data-logger. Once installed, make sure that the “Allow USB Connections” option is selected in the “Connection Settings” window of the ActiveSync application.

Next, connect the USB cable from the Gx Data-logger to the PC and switch ON the Gx (via the RED power button). The connection should be automatic and you will be asked if you’d like to set up a partnership or not between the Gx and the PC. Answer NO to this question, as the ability to transfer file data is all that is required, as opposed to a synchronized partnership. You can then exit the Activesync application.

If the connection is not established automatically, make sure that the connection option on the Gx is “USB_Serial”, which it should be by default. To do so, tap on the “Start” button on the Gx screen, tap, on “Settings”, tap on “Control Panel” and double-tap on “PC Connection”. If “USB_Serial” is not indicated, tap on the “Change Connection” button and select “USB_Serial” from the drop down menu. Repeat the connection process.

Case 2: Windows Vista or Newer (such as Windows 7) PC Operating System

The Gx Data-logger connects to these systems via the “Mobile Device Center” which replaces the Activesync program on the PC side.

Make sure that the USB connection option is set up via the Mobile Device Center. Connect the USB cable between the Gx Data-logger and the PC and switch ON the Gx. The connection should be established automatically.

If the connection is not established automatically, make sure that the connection option on the Gx is “USB_Serial”, which it should be by default. To do so, tap on the “Start” button on the Gx screen, tap, on “Settings”, tap on “Control Panel” and double-tap on “PC Connection”. If “USB_Serial” is not indicated, tap on the “Change Connection” button and select “USB_Serial” from the drop down menu. Repeat the connection process.

II. 7 How to Check the Software Version Numbers and the Software Support Expiration Date(s)

To view the version number of each (installed) M. C. Miller software application, the support expiration date of each purchased application and the serial number of the voltmeter in your Gx Data-logger, double-click on the Gx_VER icon.

An example “Version” screen is displayed below.



The above example screen indicates that the Gx_PLS (Pipeline Survey) application has been purchased and that the expiration date for its support is 12/5/2010.

The other applications (Gx_SS and Gx_SDL) have been installed but have not been purchased (and, therefore cannot be run). The Gx_GPS and the MCMVoltmeter applications do not require separate purchase.

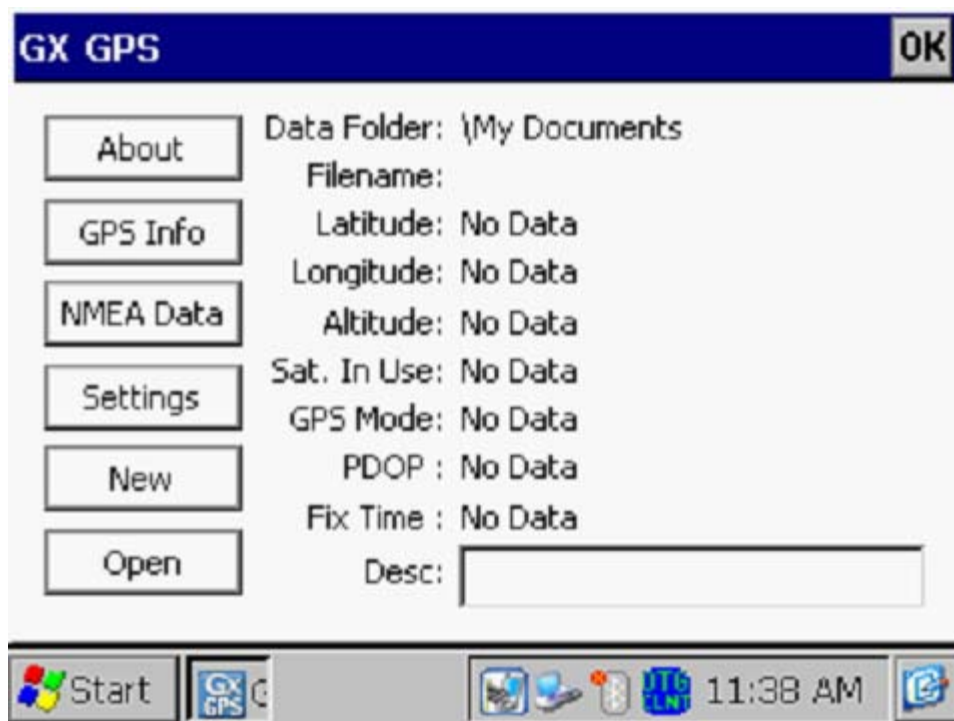
SECTION III

HOW TO RUN THE STAND-ALONE GPS POSITION DISPLAY APPLICATION

The stand-alone GPS Position Display application (Gx_GPS) can be used to view GPS position data on the Gx Data-logger screen at a given location, and, the data can also be saved (logged), if required. Logged position data are stored in a text file on your Gx that can be copied to a PC.

Switch ON (via the red power button) the Gx Data-logger and double-tap on the “Gx_GPS icon on the desktop screen to open the GPS Position Display application.

The screen shown below will be displayed.



Next, tap on the “Settings” button, which will pull up the screen shown below.



By tapping on the menu button in the GPS field, you can select the type of GPS receiver you are using. You can select either the “MCM Internal” receiver (if you plan to use the built-in GPS receiver on the Gx) or, an external “NMEA” compatible receiver (if you plan to use an externally-connected GPS receiver).

If you select to use the MCM Internal receiver, COM 4 will automatically be selected.

If you select “NMEA”, you can select the COM Port by tapping on the menu button in the COM field. If you are connecting your GPS receiver to the Gx Data-logger via a serial cable, select COM 1, which is the built-in serial port located under the flap on the bottom left hand side of the Gx data-logger.

Creating a Target Folder for Saving GPS Position Data:

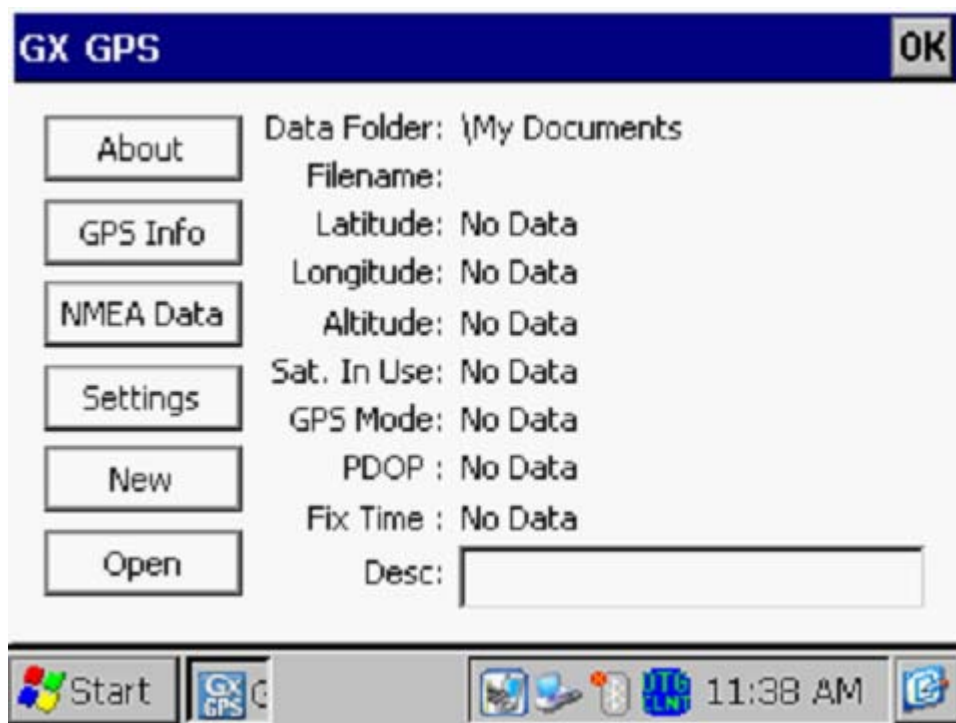
If saving position data is required, as opposed to simply viewing the position data, a folder can be established inside the “My Documents” folder on the Gx Data-logger to house the GPS data files. Alternatively, by default, the “My Documents” folder will be the target folder for GPS data files.

A sub-folder (inside the “My Documents” folder) can be created as the target folder via the above “Settings” screen by entering a backward slash (\)

[hold down the function (FUNC) key and press the “f” key] followed by a folder name in the “Data Folder” field.

Note: The GPS application stores GPS data files in both the “My Documents” folder inside the Flash memory folder (“SystemCF” folder) and the “My Documents” folder in the main memory.

By tapping on the “Save” button on the above Settings screen, you will be returned to the GPS data screen shown below.



The data parameters are self-explanatory with the exception of the PDOP parameter. This acronym stands for, Position Dilution of Precision. These data provide position accuracy information.

Creating a File in which to Store GPS Data:

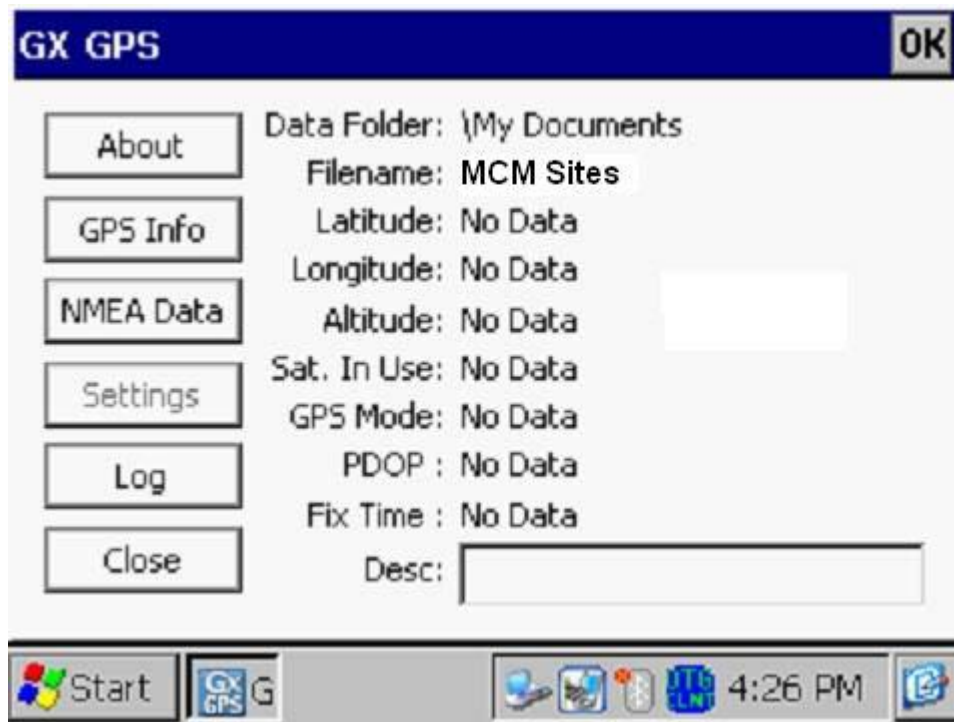
If you plan to save GPS position data, as oppose to simply viewing the position data, you can set up a file in which to store the logged data (the file will be created inside of your previously created target folder (see above)).

Tapping on the “New” button on the above screen will pull up the screen shown below.



In the “Enter New GPS Data Filename” field, you can enter a name for the file in which the GPS position data will be stored.

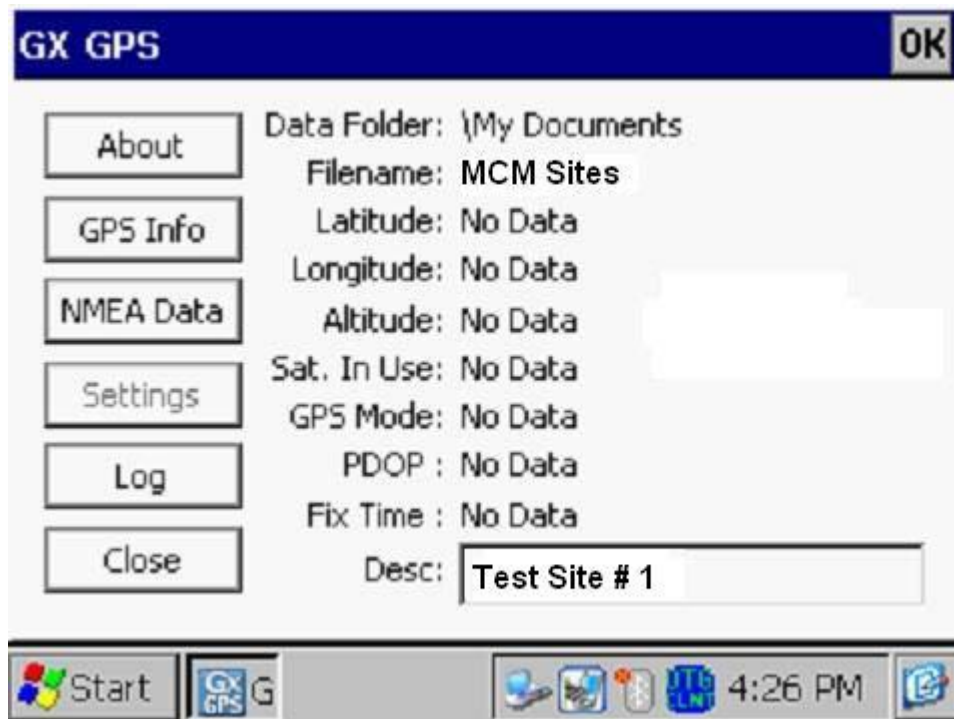
By tapping on the OK button, the screen shown below will appear, for the case of an example GPS Data file named “MCM Sites”.



Description Field:

You can provide a description of the location for which you are planning to log position data by tapping in the field labeled, “Desc:” and entering a description.

For example, the screen shown below indicates an example location description of “Test Site # 1”



Alternatively, you could open a previously saved GPS Data file by tapping on the “Open” survey button, as opposed to tapping on the “New” survey button.

By selecting a previously-saved file, you could, for example, continue to add GPS position data to an existing file that you had set up previously.

Logging GPS Position Data:

GPS data associated with your current position are logged by tapping on the “Log” button on the above screen.

Once you’ve finished logging data into a particular GPS Data file, you would tap on the “Close” button which would close the file. As indicated above, you can continue adding data to a GPS Data file by tapping on the “Open” button and selecting the file in question,

How to view saved GPS data:

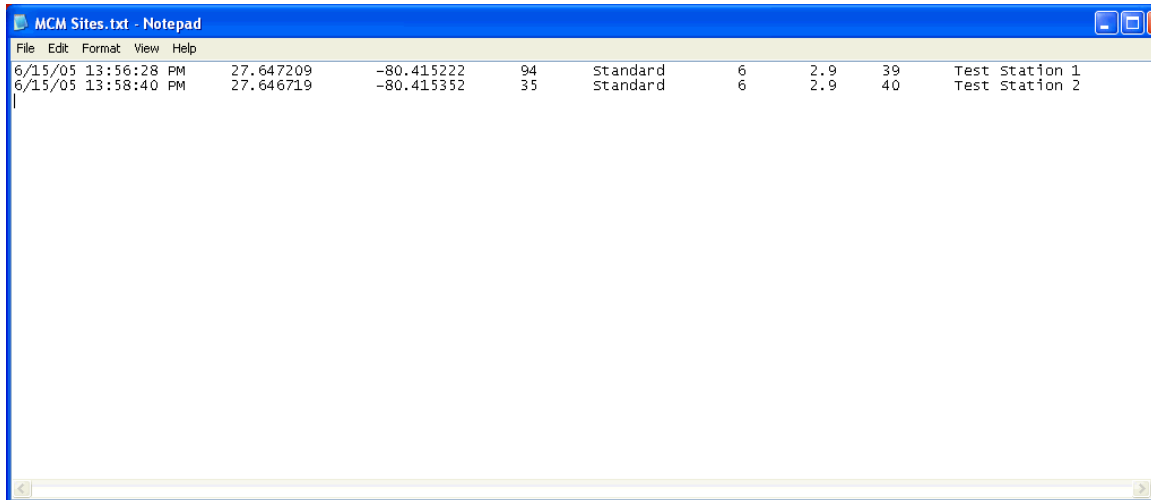
If you set up a file, as described above, and you logged GPS position data at one location or multiple locations, you can view the saved data by accessing the text file set up to store the data.

To do so, you would establish a connection between your Gx Data-logger and your PC using one of the methods described in Section II.6.

Having established a connection, click on the “Start” button on your PC, click on “My Computer”, double-click on “Mobile Device” and double-click on “My Documents”.

Next, locate the text file having the filename that you set up for storage of these data and copy and paste the file (your filename.txt) into a folder on your PC. You can then open the file to view the saved GPS position data.

For example, the window shown below illustrates example GPS position data logged at two locations (“Test Station 1” and “Test Station 2”). The data were saved in a file named “MCM Sites”.



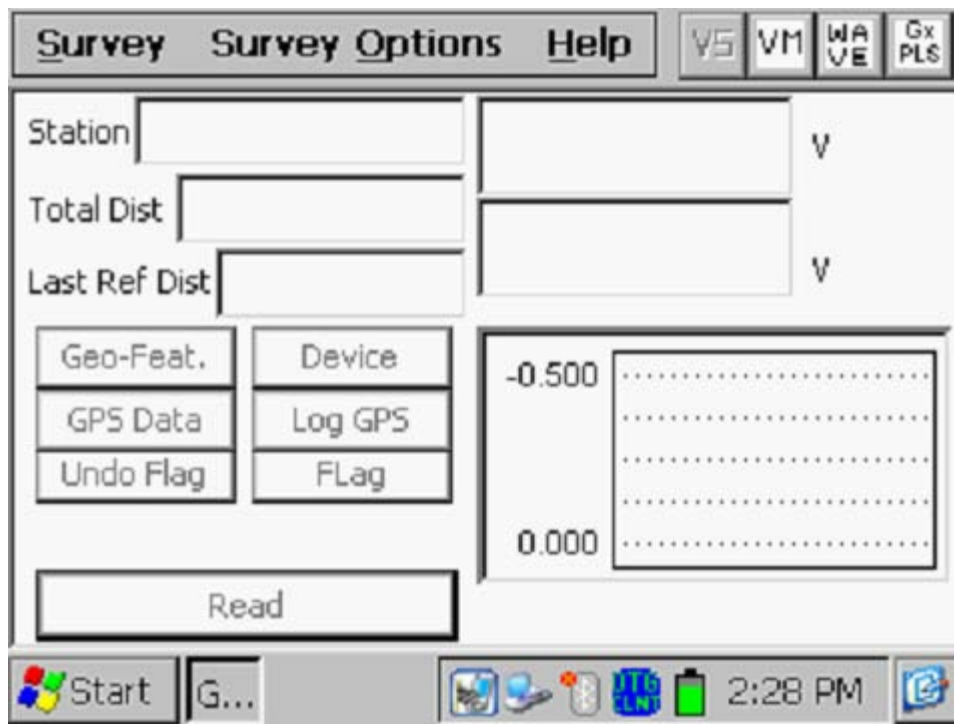
From left to right, the data displayed are: date, time of position fix, latitude, longitude, altitude, GPS status (standard or differentially-corrected), number of satellites in use, the PDOP and, finally, the description of the location (provided by you).

SECTION IV

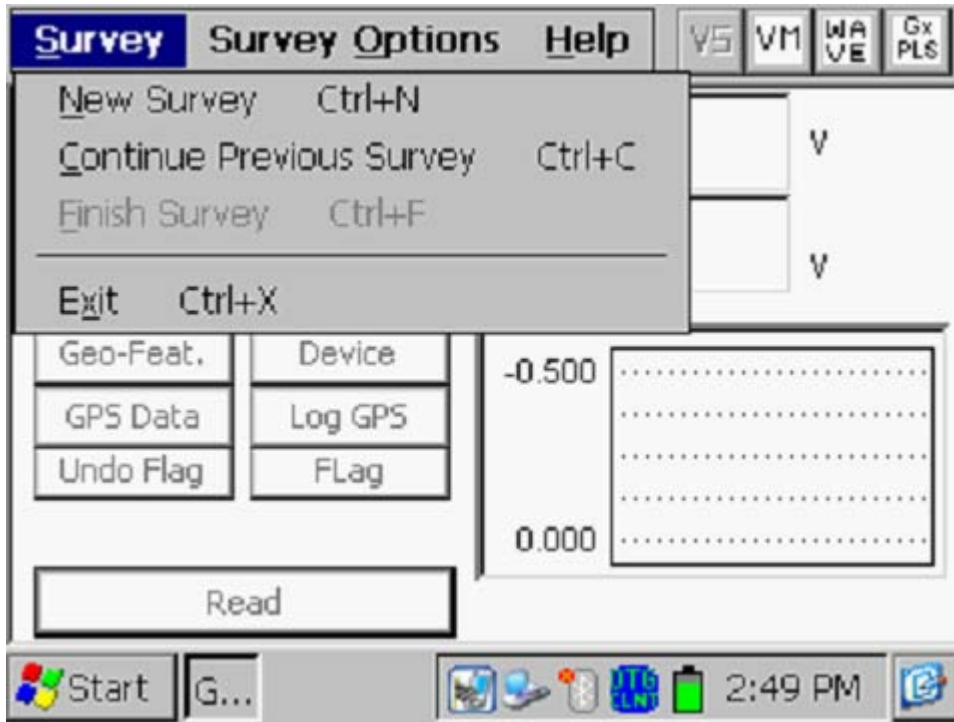
HOW TO SETUP THE Gx DATA-LOGGER FOR “OVER-THE-PIPE” SURVEYS

IV. 1 Setup for CIS

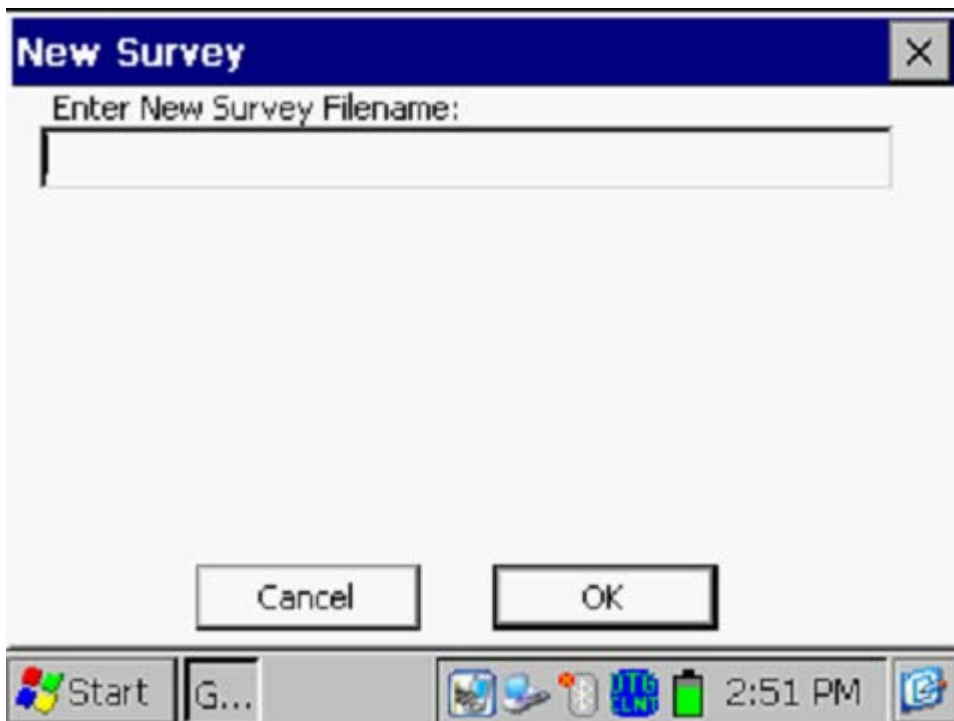
Step 1: Double-tap on the Gx_PLS icon on the Gx desktop. The screen shown below will be displayed.



Step 2: Tap on the “Survey” button located on the menu bar. The screen shown below will be displayed.



Under “Survey” there are several options. If this is a new survey (not a continuation of a previous survey) tap on “New Survey”. The screen shown below will be displayed.



Step 3: Enter a “filename” for the Survey.

This should be a descriptive name that will help you identify the survey at a later stage. Perhaps the name of the section of pipe you are surveying could be part of the filename. “CIS” and the survey date do not have to be part of the filename as these tags are incorporated with the survey on the ProActive side (assuming that you will be downloading the survey data to the ProActive application).

Note: You will not be permitted to use invalid characters, such as slashes (/ or \), as part of a filename. You will be alerted if you try to use any invalid characters.

Step 4: Once you have entered a filename, tap the OK button on the above screen. The screen shown below will be displayed. The specific selections indicated on the screen will reflect the selections made for the previous survey.

Setup 1 Of 5

Survey: Trigger CIS

Rect Mode: Cycle ON/OFF

Cane Button(s) Allowed To:

D.C.P.: None Save

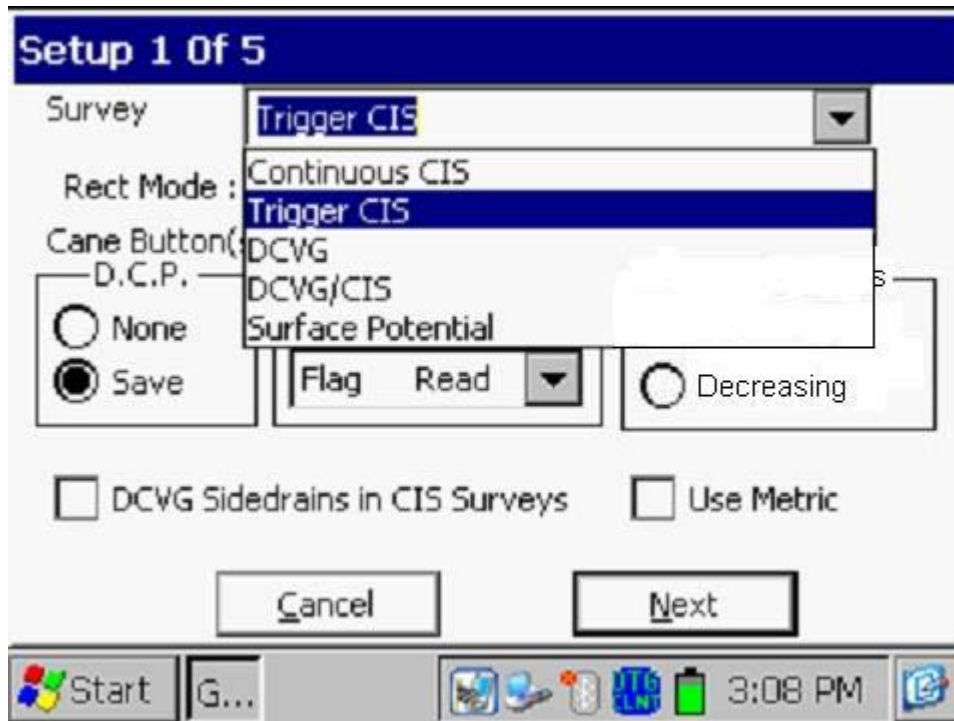
Survey: Left Right Flag Read

Survey Locations: Increasing Decreasing

DCVG Sidedrains in CIS Surveys Use Metric

Cancel Next

Step 5: Select the survey type by tapping on the menu button in the “**Survey Type**” field and highlighting the survey type of your choice.



For Close Interval (Potential) Surveys there are 2 options for “type of survey”: Trigger CIS and Continuous CIS.

“**Trigger CIS**” should be selected if you plan to either manually trigger readings (using the push-button data-probes), or, you plan to use an automatic triggering cable in conjunction with a trail wire measure/counter system.

“**Continuous CIS**” should be selected if you do not plan on either manually-triggering readings or having the readings triggered automatically using a triggering cable.

In the 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, 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”, 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 (see Setup screen 3 of 5 for the options available if the “Continuous CIS” mode is selected).

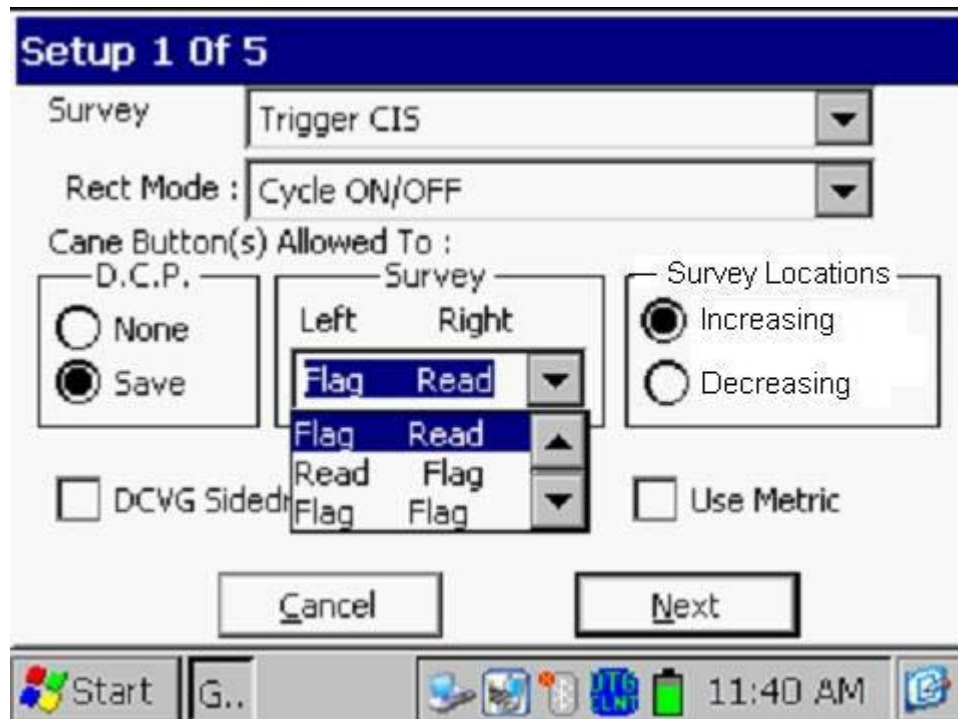
An advantage of Continuous CIS over Trigger CIS is that manual triggering of readings (using push buttons) is not required nor is an automatic triggering cable with associated trail wire measure/counter system. However, pre-measured (equally-spaced) survey flags are required for Continuous CIS and, if the pipeline does not run through an open area, extensive pausing may be required.

Step 6: Select the function (operating mode) of the push button switches associated with the data probes, during the survey itself and at test stations (data collection points (D.C.P.s))

Survey

The functionality available for the data probe switches depends on the survey mode selected in Step 5 [Trigger CIS or Continuous CIS].

For the Trigger CIS selection, the options will be as displayed on the screen shown below for the left-hand data probe (red-handled data probe) and the right-hand data-probe (green-handled data-probe).



Manual Triggering of Readings:

When the data probe switches are used to trigger readings, as opposed to an automatic triggering cable, there are 4 combinations possible for selection for the left and right switches, as indicated by tapping on the menu button in the “Survey” field on the above screen.

“**Read Read**” means that both switches can be used to trigger readings

“**Flag Read**” means that the left hand switch will designate the location of a survey flag and the right hand switch will be used to trigger readings

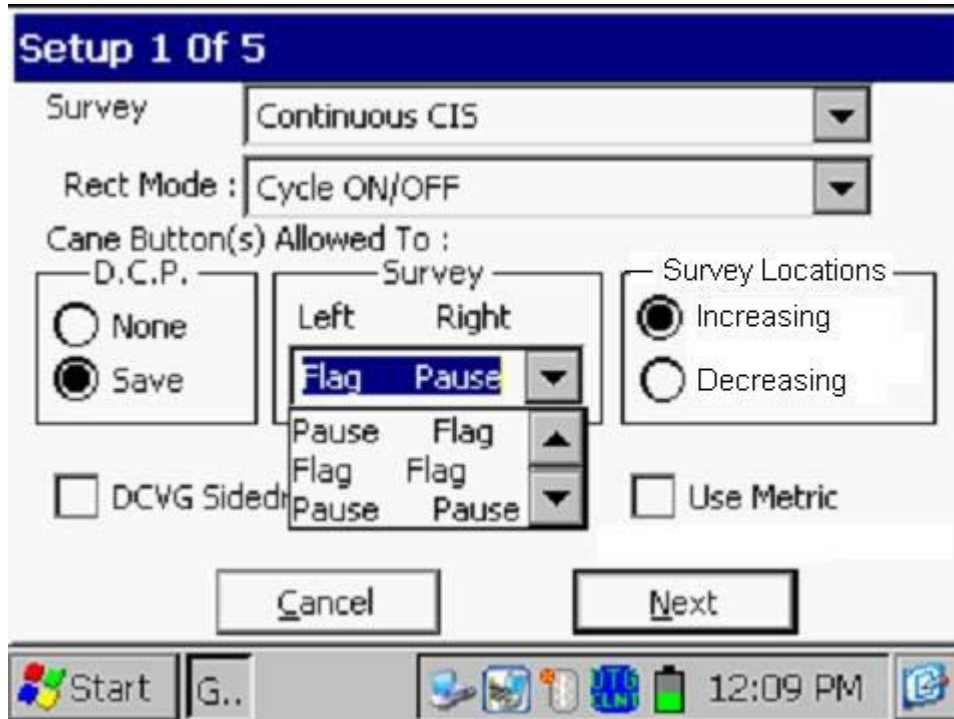
“**Read Flag**” means that the left hand switch will be used to trigger readings and the right hand switch will designate the location of a survey flag

“**Flag Flag**” means that both switches can be used to designate survey flags (and neither switch can be used to trigger readings).

Automatic Triggering of Readings:

The selection in this case should be “Read Read” only, since the readings are triggered by an automatic triggering cable. In this case, the data probe switches have no function, since the data probes are connected to the Gx Data-logger via the banana plugs, rather than via the 5-pin terminal.

For the Continuous CIS selection, the options will be as displayed on the screen shown below for the left-hand data probe (red-handled data probe) and the right-hand data-probe (green-handled data-probe).



In this case, the 4 combinations possible for selection for the left-hand and right-hand switches are as follows:

“**Flag Pause**” means that the left-hand switch will designate a survey flag and the right-hand switch will be used to interrupt (pause) readings and to re-start readings

“**Pause Flag**” means that the left-hand switch will be used to interrupt (pause) readings and to re-start readings and the right-hand switch will designate a survey flag

“**Flag Flag**” means that both switches can be used to designate survey flags (and neither switch can be used to interrupt (pause) readings).

“**Pause Pause**” means that both switches can be used to interrupt (pause) readings and to re-start readings.

D.C.P.

D.C.P. stands for Data Collection Point and on a CIS usually would represent a test station (either the initial hook up station or a reconnect test station where the trail wire is broken and reconnected to the pipe).

The data probe switches can have no functionality at these “devices” (the “**none**” selection) or they can be used to save the D.C.P. readings, such as Near-Ground P/S or Far-Ground P/S readings at a reconnect test station (the “**Save**” selection).

Step 7: Make “**Survey Locations**” selection

Once a value has been entered for the “Distance between Readings” (see the Setup 3 of 5 screen), that distance, for example 2.5 feet, can be added to each successive station number each time a reading is triggered, or, it can be subtracted from each successive station number each time a reading is triggered.

Your 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.

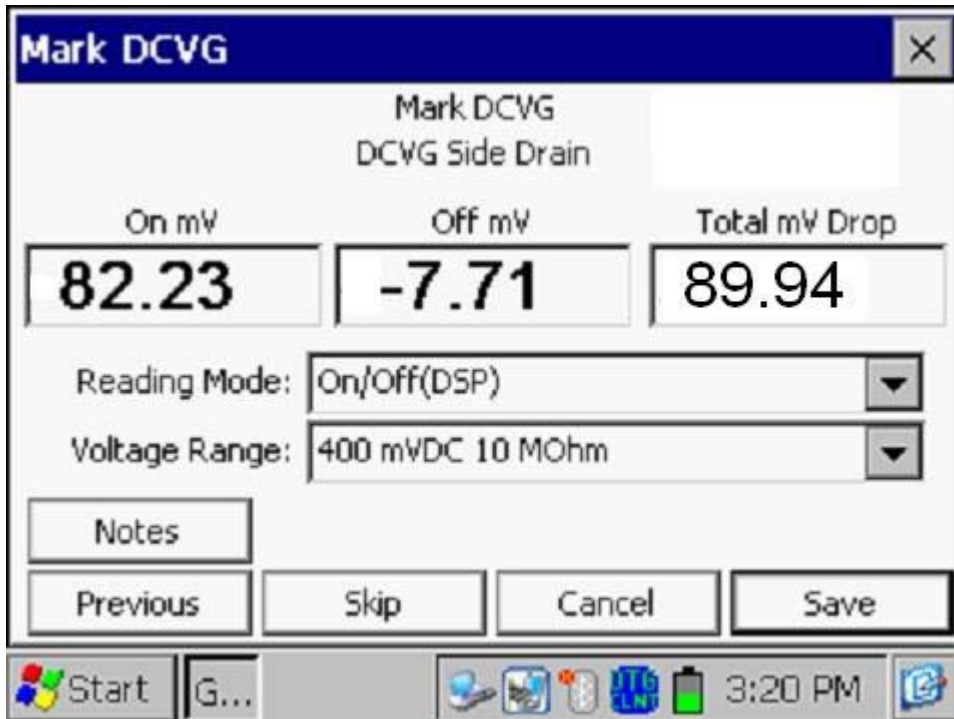
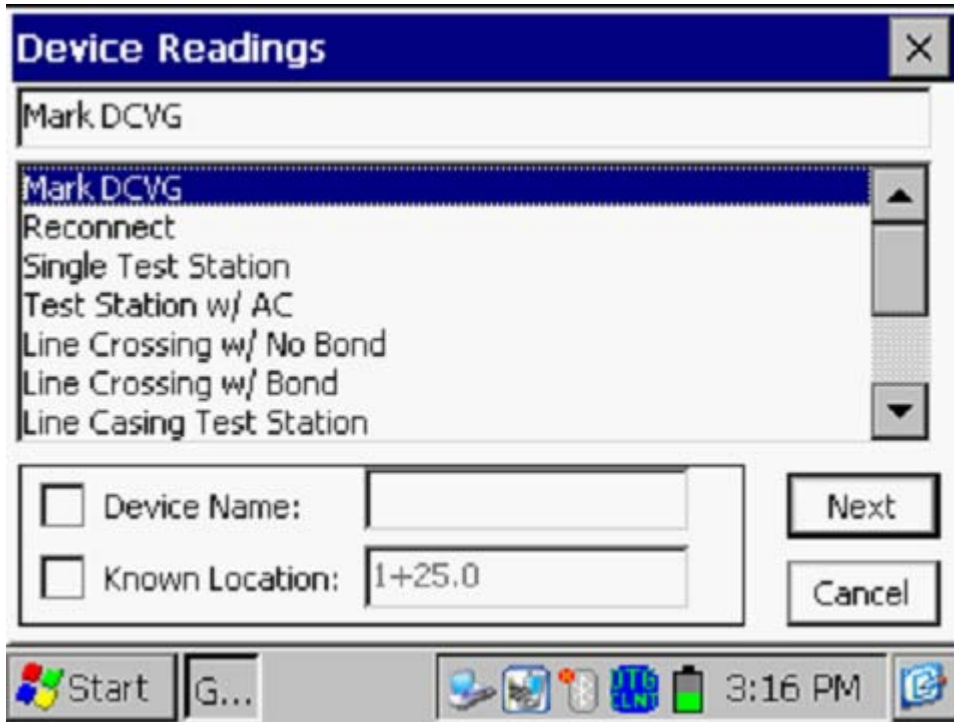
Step 8: Make selection of “Metric” units, if required.

By checking off the box labeled “**Metric**”, the reading interval (distance between triggered readings) and the flag interval (survey flag spacing) will be displayed on the Setup 3 of 5 screen in meters, as opposed to feet.

Step 9: Check-off the box labeled, “DCVG Sidedrains in CIS Survey” if you plan to log DCVG sidedrain readings at previously located anomalies, during the course of your CIS.

Note: This is a special case that would only apply if a DCVG survey had been performed in advance of your CIS and it was specified that you should have the anomaly locations determined by the DCVG survey integrated with your CIS file.

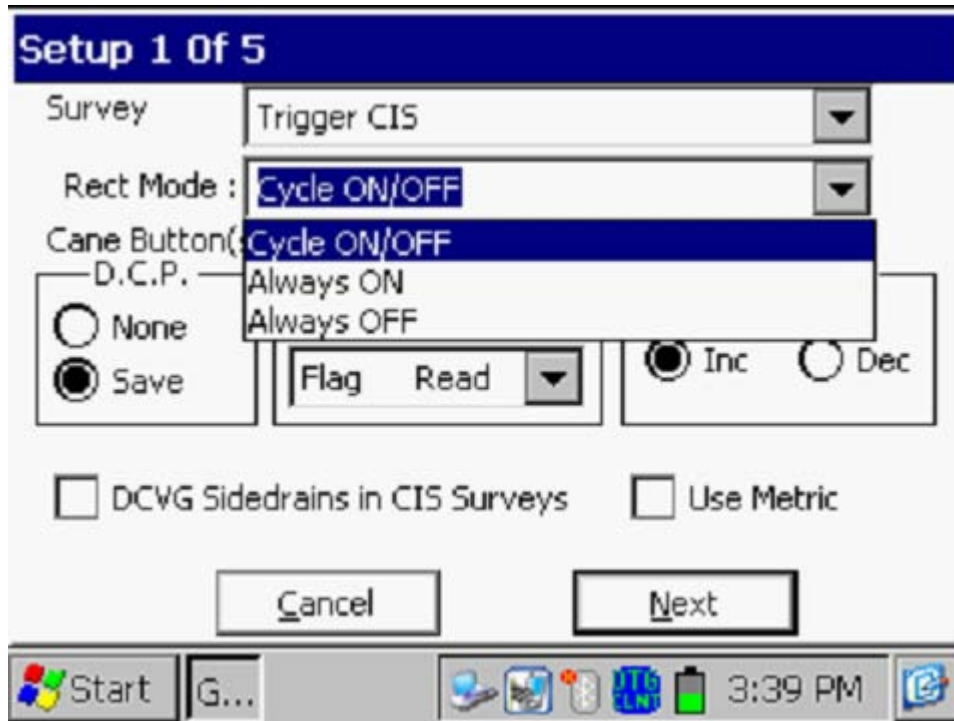
By checking this box, an additional “Device”, named “Mark DCVG” will be made available in the “Device” list, which has a sidedrain prompt associated with it, as indicated in the screens shown below.



The “Mark DCVG” device will not appear in the Device list if this box is not checked, which would be the case if you were conducting a regular CIS.

Step 10: Make “**Rectifier Mode**” selection.

By tapping on the menu button in the “Rectifier Mode” field on the above screen, the screen shown below will be displayed.



As can be seen from the above screen, there are 3 choices for “Rectifier Mode” as follows:

Cycle ON/OFF: Select this option if the DC current flowing (in the soil) to the pipe will be interrupted (switched ON and OFF) in a cyclic fashion during the CIS

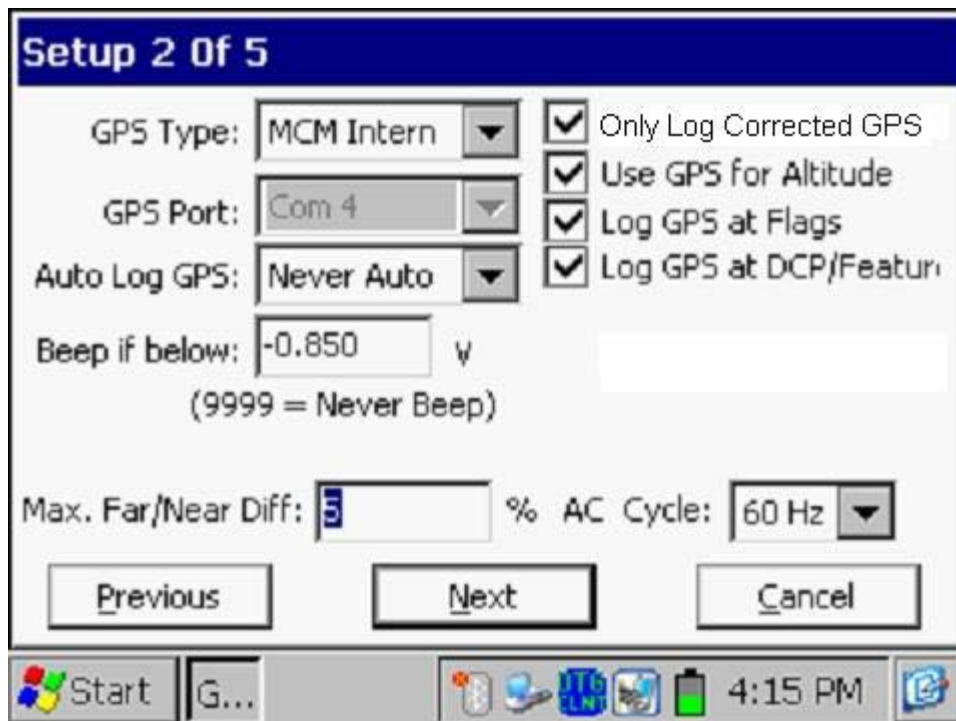
Always ON: Select this option if all rectifiers (or other DC voltage sources) having an affect on the line will be permanently ON (at least for the duration of the CIS).

Always OFF. Select this option if all rectifiers (or other DC voltage sources) having an affect on the line will be permanently OFF (at least for the duration of the CIS).

Note: The selection you make for the Rectifier Mode should relate to the Reading Mode selection you make on Setup screen 5 of 5.

Step 11: Tap on the “**Next**” button following your selection of “Rectifier Mode”.

The screen shown below will be displayed. Note: The specific selections shown on the screen will depend on the selections made for the previous survey.



Step 12: Make Selection of “**Max Far/Near Diff**” value.

The value entered in this 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, an alarm message will be displayed on the Gx survey screen.

For example, if the number (5) is entered in this field, the maximum allowable difference between FAR- and NEAR-GROUND P/S readings will be 5%, otherwise an error window will be displayed on the screen.

The error window will present 2 options:

Option 1: Retake Near Reading

Option 2: Accept This Error

By selecting Option 1, 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 message.

By selecting Option 2, 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).

Step 13: Select Local Electricity AC Frequency

By tapping on the menu button in the “**AC Cycle**” field on the screen shown above, you will have the choice of 60Hz or 50Hz AC. Select 60Hz for all U.S. applications. This is an important select with regard to the AC filtering system that’s applied to all of the DC voltage channels.

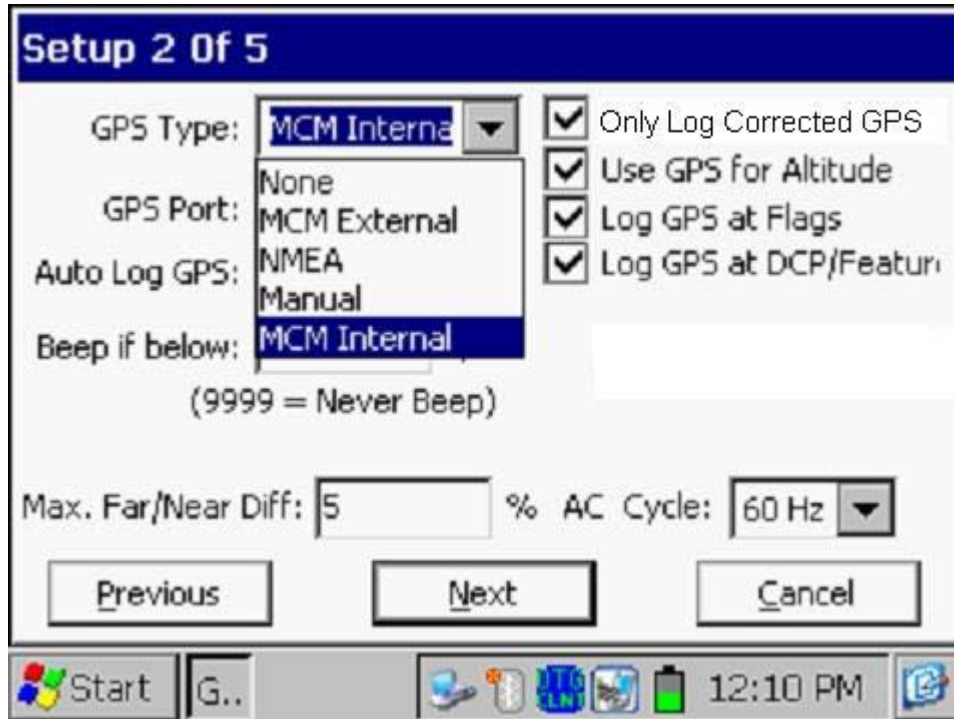
Step 14: Select the “**Beep if below**” value

This gives you the opportunity to receive an alarm (a beep sound) if the reading is below an entered threshold level. The entered value should be in volts and should be a negative value if you are measuring negative pipe-to-soil readings. One option is to set a low threshold value, for example, -0.2 (for -0.2 volts) since any readings below this value (say, zero volts) would be indicative of a trail wire break, for example, which is useful information.

If you not wish to hear any alarm sounds, enter 9999.

Step 15: Select the Type of GPS Receiver Being Used (If Any).

By tapping on the menu button in the “**GPS Type**” field on the above screen, the screen shown below will be displayed.



As can be seen from the above screen, there are 5 choices for “GPS Type”:

- None: This means that a GPS receiver is not being used
- MCM External: This means that an external MCM GPS Accessory is being used (currently not available)
- NMEA: This means that an external NMEA-compatible GPS receiver is being used (such as a Trimble unit)
- Manual: This means that location data will be entered manually when the GPS button is tapped on the survey screen during a CIS
- MCM Internal: This means that the Gx’s internal GPS unit will be used (a u-blox NEO, WAAS-enabled, receiver)

Select the appropriate choice by tapping on your selection.

Com Ports

When using an external GPS unit (NMEA option) connected via a serial cable, select the COM 1 option, which represents the built-in serial port located under the flap on the bottom left-hand side of the Gx data-logger. The COM 4 option will be automatically selected when the MCM Internal GPS receiver option is selected.

Step 16: Select GPS Data Logging Options.

Only Log Corrected GPS:

This box should be checked if you only want differentially-corrected GPS data to be logged by the Gx data-logger on the survey. Leaving this box unchecked will result in standard GPS data being logged in cases where differentially-corrected data are not available.

Note: If this box is checked and the unit is not receiving a differential correction message, no GPS data will be logged.

Use GPS Altitude:

If this box is checked, altitude data will be logged, in addition to the Lat/Long data whenever GPS data are logged. (Note: Altitude data on some GPS units are not particularly accurate).

Log GPS at Flags:

If this box is checked, GPS data will be logged automatically at survey flags when either the flag button is tapped (directly on the Survey screen) or when the push-button switch on the designated “flag cane” is pressed.

Log GPS at DCP/Feature:

If this box is checked, GPS data will be logged automatically at “Devices” or “Geo-Features” when either the “Device” button is tapped on the Survey screen and a “Device” reading is logged or when the “Geo-Feat.” button is tapped on the Survey screen and a geo-feature is registered.

Auto Log GPS:

By tapping on the menu button in the “Auto Log GPS” field, the selections available will be displayed.

By selecting one of these options, you can elect to have GPS data logged automatically at every CIS reading, at every second CIS reading, at every fifth CIS reading, at every tenth CIS reading, or not at all (never) at CIS readings.

Step 17: Tap on the “**Next**” button on the above screen

The specific screen that will be displayed will depend on if you selected “**Trigger CIS**” or “**Continuous CIS**” on the first screen.

Screen for “Trigger CIS” Case

Setup 3 of 5

Name of P/L:

Valve Segment:

Starting Location: Station Number

Flag Dist Error Limit % : %

Dist Per Reading : ft

Distance Between Flags : ft

Number of Data Probes
 One Two

Auto Pacing Mode:

Start G... 2:30 PM

Screen for “Continuous CIS” Case

Setup 3 of 5

Name of P/L:

Valve Segment:

Starting Location: Station Number

Flag Dist Error Limit % : %

Dist Per Reading : ft

Distance Between Flags : ft

Time to walk between flags: Sec.

Auto Learn Read Rate: Auto Pacing Mode:

Start G... 2:34 PM

Dist Per Reading

By tapping in the field on the above screen labeled, “Dist Per Reading” you can type in the interval distance, in feet (or meters for the metric case), expected between reading. 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 “Dist Per Reading” when readings are to be triggered using an automatic triggering cable, since the counter is calibrated for this distance.

Distance Between Flags

By tapping 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 Dist Error Limit %

Select the maximum permissible error between the **actual** number of readings logged between 2 survey flags and the **expected** number of readings.

By tapping in the field labeled, “Flag Dist Error Limit %” you can type in the maximum permissible error. For example, the maximum permissible error is indicated as 20% on the above screen. If the reading interval is expected to be 2.5 feet and the survey flag separation 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 reading 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 (optional):

Select whether or not 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.

Auto Learn Read Rate (optional)

Finally, in the case of the “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, 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.

Number of 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.

Note: Two data-probes are required for a Continuous CIS

Name of P/L (optional)

By tapping in the field labeled, “Name of P/L”, you can enter the pipeline name. Note: This is **not** necessarily the same name as the filename for the CIS that you used to setup the survey file.

Valve Segment (optional)

By tapping in the field labeled, “Valve Segment”, you can enter the name or number of the valve segment to be surveyed, if known.

Starting Location (very important)

Provide the Starting Location for the survey by tapping in the field labeled, “Starting Location” and entering the location.

You can select to have location information displayed on the survey screen as station number, feet or milepost (station number, meters or kilometer post for the metric case).

Whichever selection you make here will determine how you enter your starting location information.

For example, if your pipeline locations are represented by station numbers, you would select “Station Number” from the menu list and you would enter a starting location for the survey in the form of a station number. [If you do not know the station number associated with the beginning your survey, enter 0+0.0].

Step 18: Tap on the “**Next**” button on the above screen.

A version of the screen shown below will be displayed, depending on the current Date & Time and also the filename entered for your survey.

Set up 4 of 5

Work Order #:

Technician Name:

Comments / Description:

Survey Date: 7/6/2010 15:27:23

Survey Name: \\SystemCF\GX_Data\rp4\rp4.mcm

Work Order # (optional)

By tapping in the field labeled, “Work Order #”, you can enter the work order number associated with the survey, if known.

Technician Name (optional)

By tapping in the field labeled, “Technician Name”, you can enter the name of the surveyor.

Comments/Descriptions

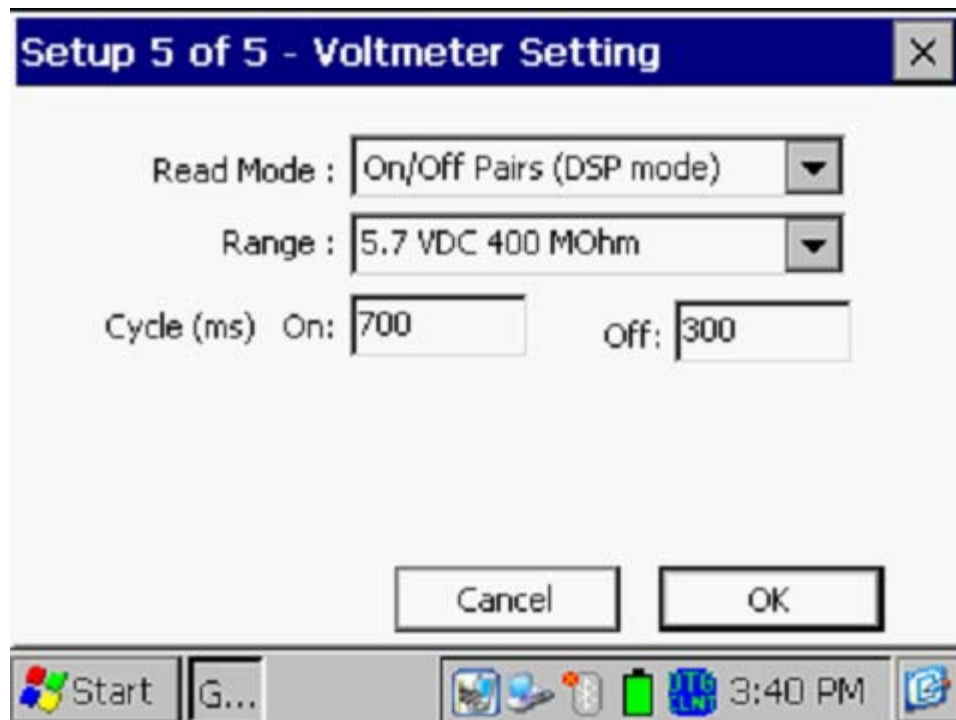
By tapping in the field labeled, “Comments/Descriptions”, you can enter any general comments you might have regarding the survey (perhaps weather conditions, soil conditions etc.).

Also shown on the above screen are the survey filename (“Survey Name” field) and the Start Date and Start Time for the survey (“Survey Date” field).

Note: The survey files are stored in the Gx_Data folder on the Gx data-logger’s CompactFlash memory (SystemCF) – a non-volatile memory.

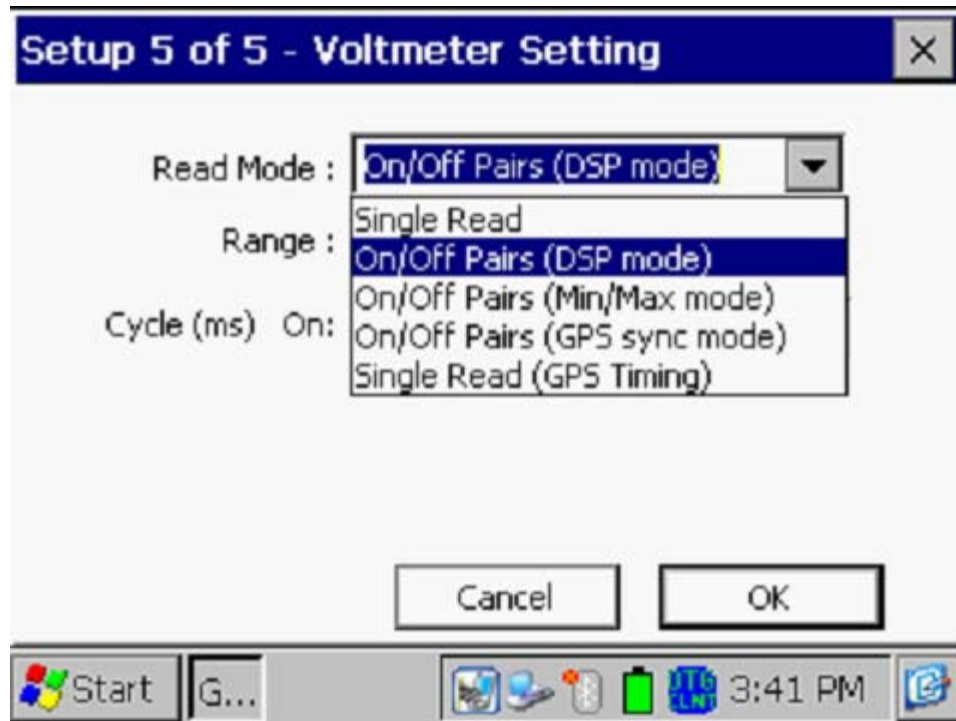
Note: These data cannot be changed manually.

Step 19: Tap on the “Next” button on the above screen. A version of the screen shown below will be displayed, depending on the settings selected for the previous survey.



Read Mode:

The 5 choices available for the voltmeter's reading mode are displayed by tapping on the menu button in the "Read Mode" field on the above screen. The new screen will be displayed as shown below.



Note: Your selection of voltmeter reading mode should be made with reference to your previous selections of "Rectifier Mode" and GPS Receiver Type.

Single Read:

This voltmeter 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 Pairs (DSP mode):

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.

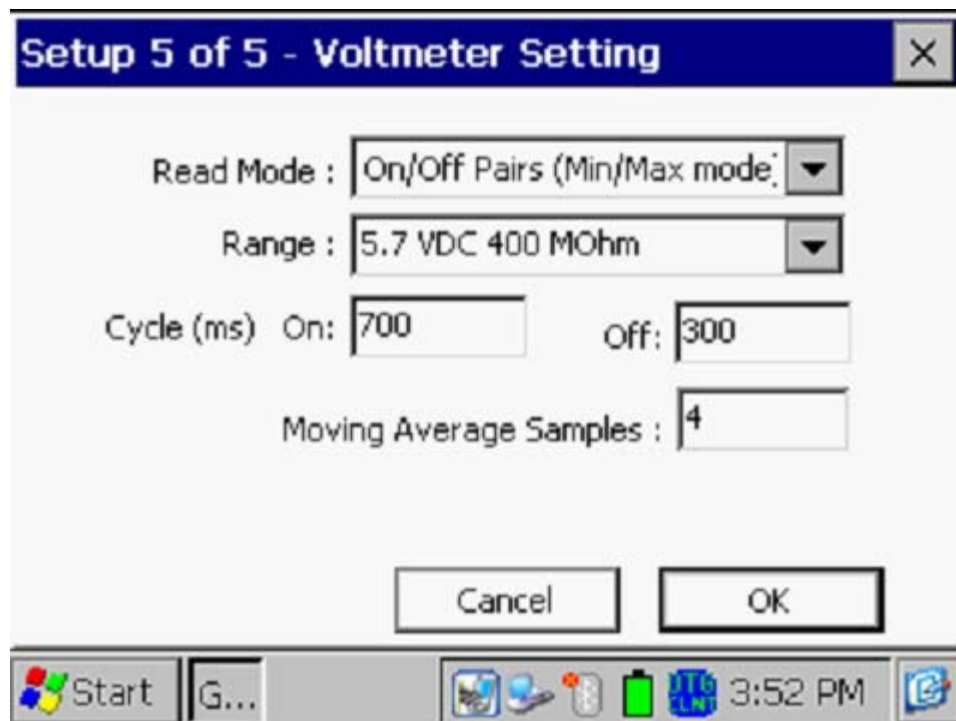
Note: A measurable difference between the ON and the OFF voltage readings is required for this reading mode, ie, a measurable IR drop is required.

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 Pairs (Min/Max mode)

This voltmeter 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.

With this voltmeter reading mode selected, an addition field (“Moving Average Samples”) will be displayed, as indicated on the screen shown below.



Moving Average Samples

The default value for “Moving Average Samples” is 4. In this case, 4 sample readings would be used to compute an average value for the Minimum (Min) voltage reading during each OFF portion of the cyclic waveform and, also, 4 readings would be used to compute an average value for the Maximum (Max) voltage reading during each ON portion of the waveform. Different values can be entered for this parameter in order to try to “optimize” the On/Off readings, depending on the nature of the interference occurring.

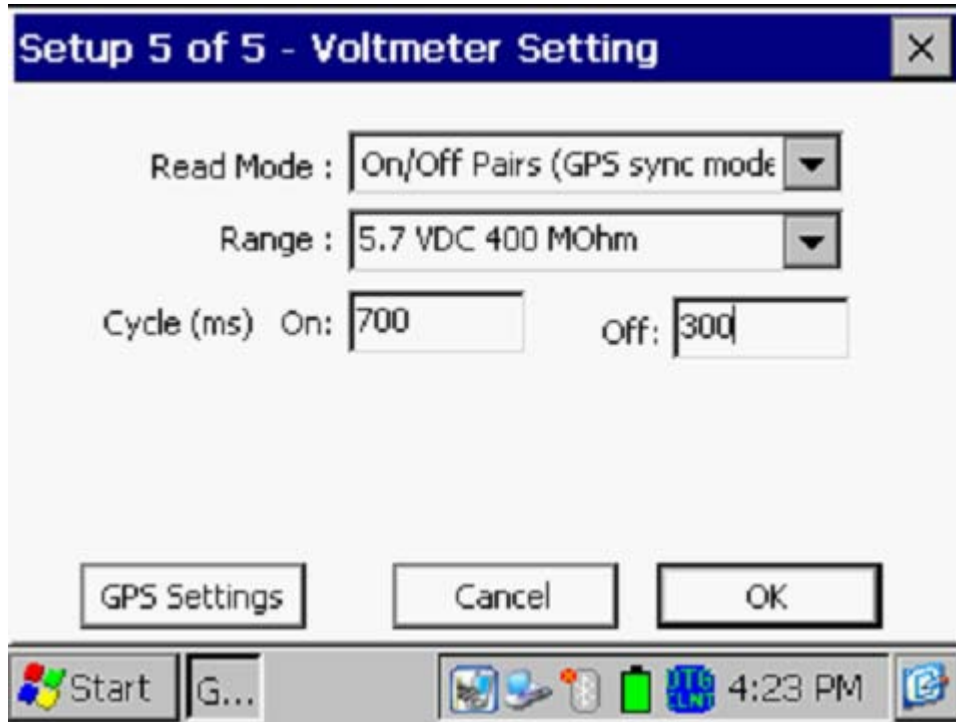
On/Off Pairs (GPS Sync):

This voltmeter reading mode can only be selected if you are using the built-in “MCM Internal” GPS receiver **AND** GPS current-interrupters.

Note: A primary feature of this reading mode is that the readings data are GPS time-stamped. Consequently, applications such as telluric current compensation tools can be applied to such data.

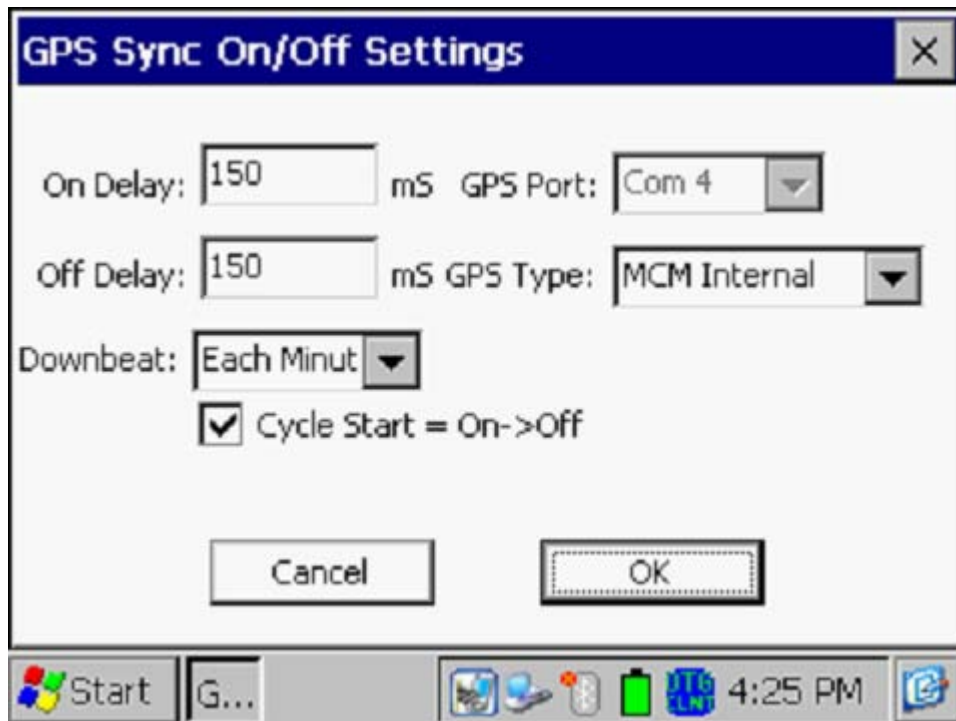
With this reading mode elected, you can select the recording times on the waveform for both the On and Off readings, with respect to the On-to-Off transitions and the Off-to-On transitions of the waveform, as opposed to the software determining appropriate locations on the waveform for you (as in the case of the On/Off Pairs D.S.P. reading mode – see above).

With this voltmeter reading mode selected, the screen shown below will be displayed revealing an additional button (“GPS Settings”)



GPS Settings

By tapping on the “GPS Settings” button, the screen shown below will be displayed, depending on the previous settings.



GPS Type

Select the type of GPS receiver being used. Currently, only the MCM Internal GPS Receiver can be used with the GPS Sync reading mode.

On Delay & Off Delay

By tapping in the fields labeled, “On Delay” and “Off Delay”, you can enter specific times (in milli-seconds) for these parameters.

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 delay times selected should be based on knowledge of the waveform, particularly in terms of any transition spiking. The idea is to select sampling times that will avoid any spiking.

Downbeat

By tapping on the menu button in the “Downbeat” field, you can select the downbeat schedule associated with the particular current interrupters you are using for the survey. The three options are: Each Minute, Each Hour and Midnight.

For example, if “Each Minute” is applicable to your interrupters, and you select this option for the Downbeat schedule, you are indicating to the data-logger software that at the top of each minute, there will be an On to Off transition (the rectifier current will switch from On to Off at the top of each minute). This would mean, in this example, that the software would only have to count back to the top of the last (previous) minute to have a timing reference.

Cycle Start

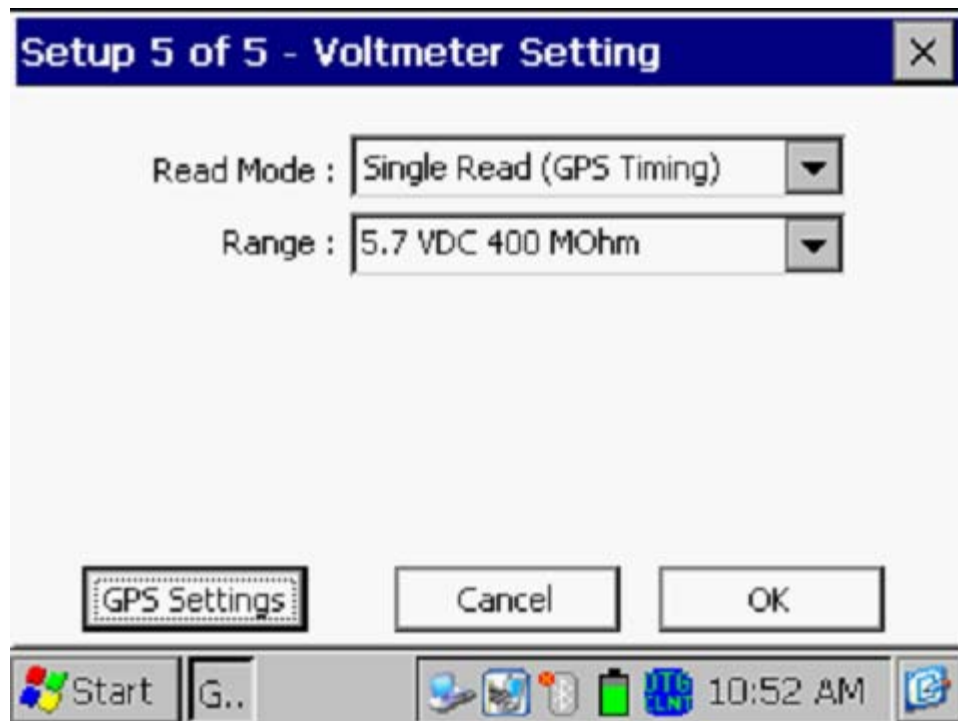
Finally, if your interruption cycle starts with the current in the ON state (the first transition is from ON to OFF), check off the box labeled, “Start Cycle” (un-check this box if the opposite is true).

Click on the “OK” button on the “GPS Settings” screen in order to return to the Voltmeter Settings screen (Screen 5 of 5).

Single Read (GPS Timing)

This voltmeter 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.

When the “Single Read (GPS Timing)” mode is selected, the screen shown below will be displayed.



The only additional information that needs to be supplied here is the type of GPS receiver you will be using, via the “GPS Settings” button.

Note: Currently, only the MCM Internal GPS Receiver can be selected for this voltmeter reading mode.

Note: A primary feature of this reading mode is that the readings data are GPS time-stamped. Consequently, applications such as telluric current compensation tools can be applied to such data.

Click on the “OK” button on the “GPS Settings” screen in order to return to the Voltmeter Settings screen (Screen 5 of 5).

Cycle On & Off (Times)

The specific On and Off times setup on the current interrupters should be entered in the “On” and “Off” fields, respectively, on the Setup 5 of 5 Screen.

Note: The On and the Off times should be entered in milli-seconds.

Note: Ideally, the interruption period (On time plus Off time) should be less than the time between triggered readings on a CIS. 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 of greater than 1 second.

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).

Range:

By tapping on the menu button in the “Range” field, you can select the voltmeter range and associated input impedance setting for your application from the full list of available options.

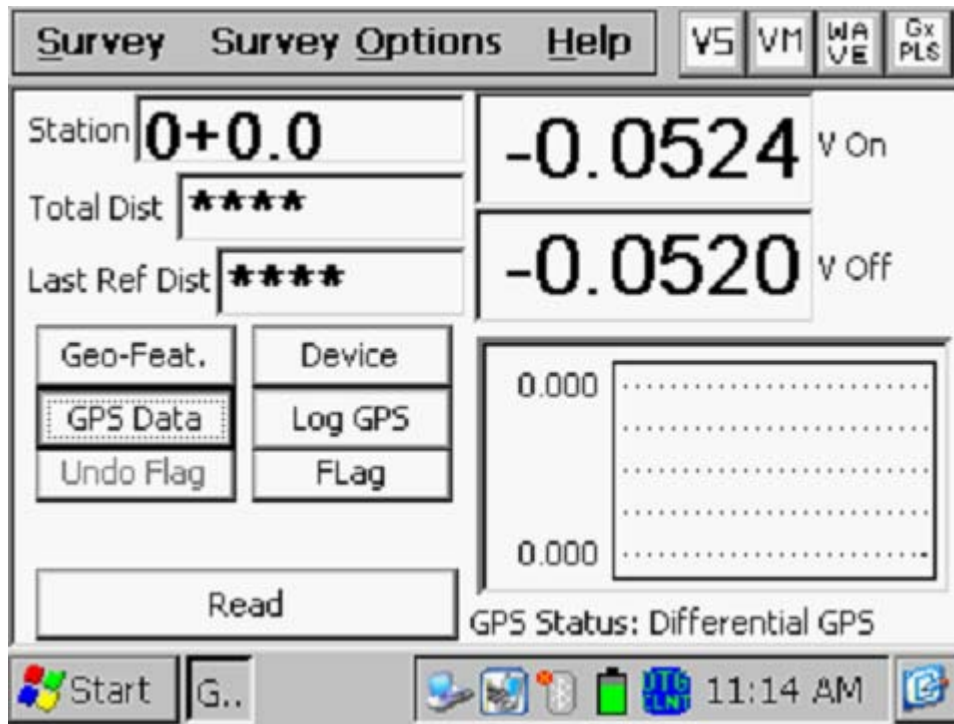
Note: Use the scroll bar to view all options.

The recommended setting for the “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.

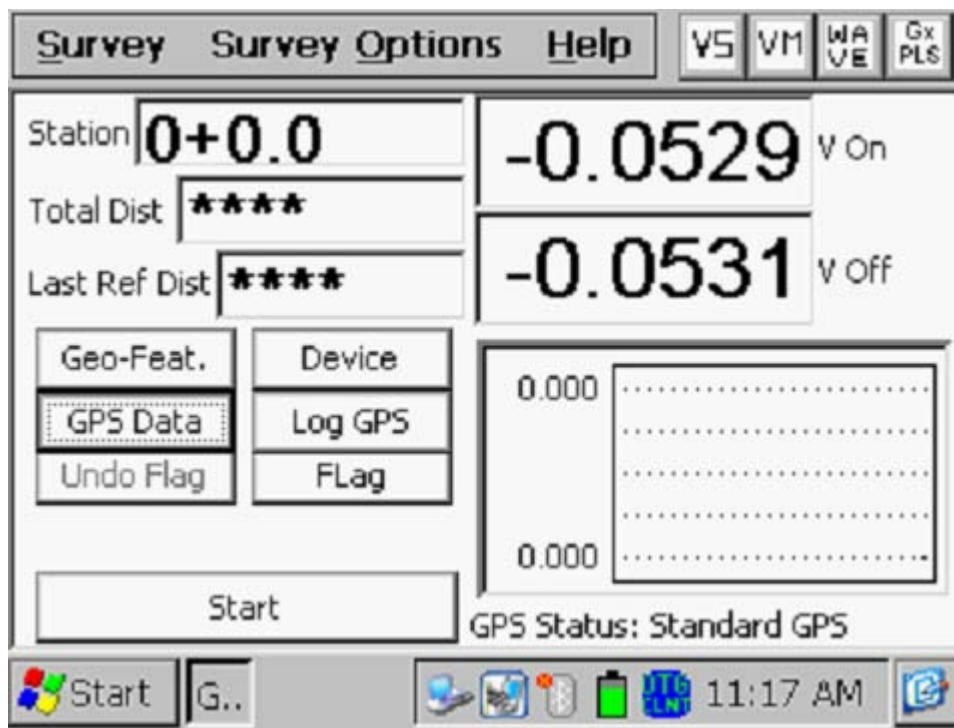
Step 20: Tap on the “OK” button on the “Setup 5 of 5” screen.

Versions of the screens shown below will be displayed, for the “Trigger CIS” and the “Continuous CIS” modes, depending on the start location entered previously and the location type entered previously (station number, feet or milepost (or station number, meters or kilometer post, for the metric option)).

Survey Screen for the “Trigger CIS” Mode



Survey Screen for the “Continuous CIS” Mode

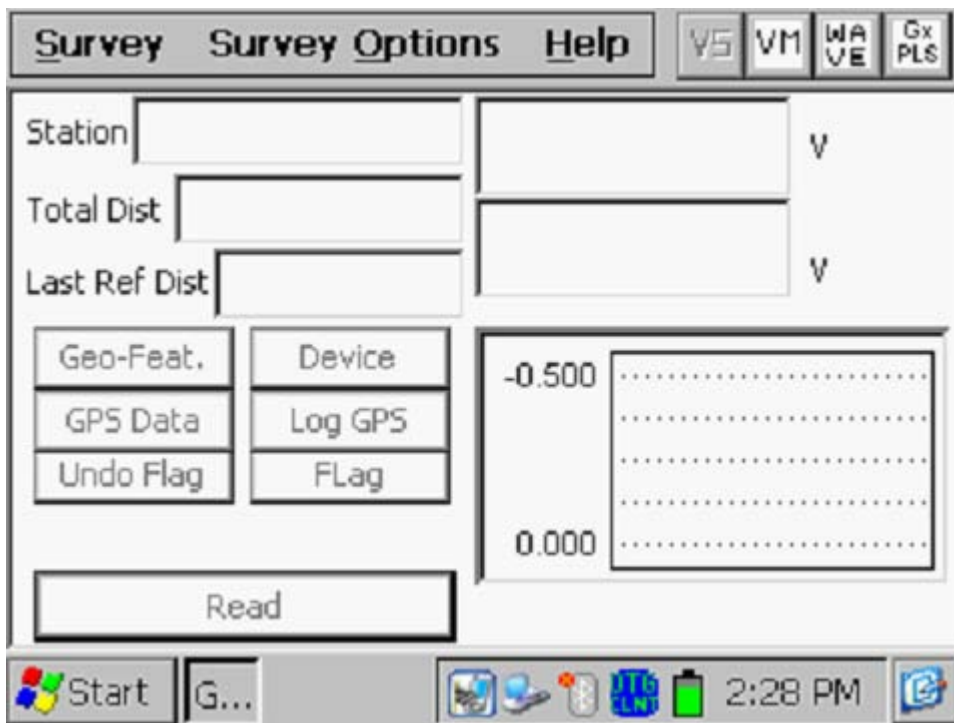


You are now ready to perform a close interval survey using the Gx data-logger and associated pipeline survey equipment.

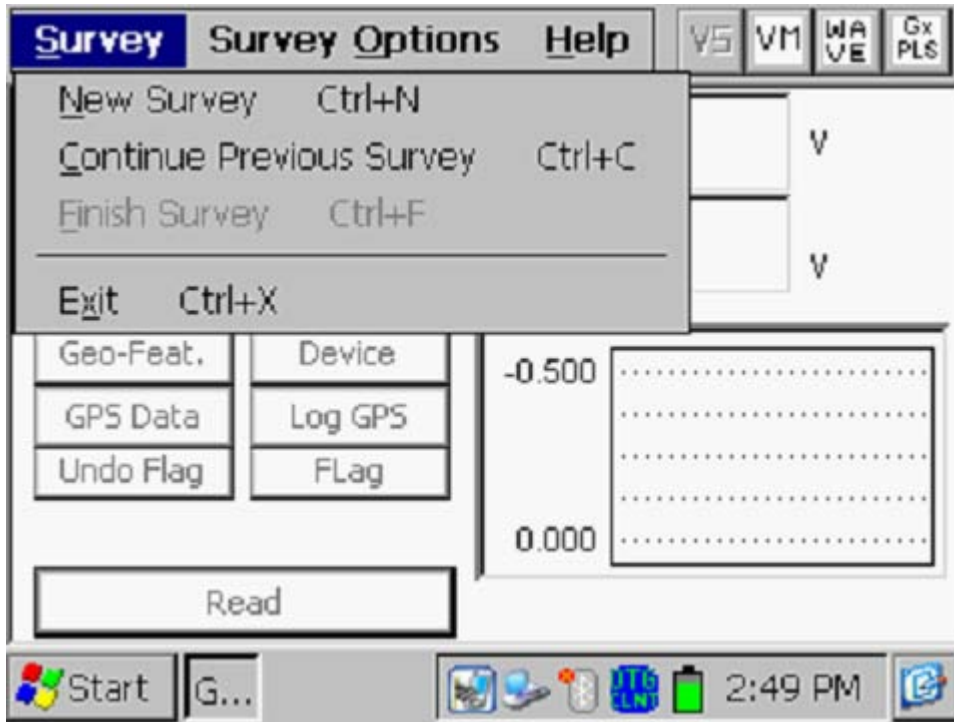
You are referred to our **CIS Training Manual – Gx Version** for information and recommendations on how to actually perform a CIS using the Gx. The Training Manual also provides information on the use of our Reference Electrode Data Probes and gives an overview of the physical principles associated with a CIS.

IV. 1 Setup for DCVG Surveys

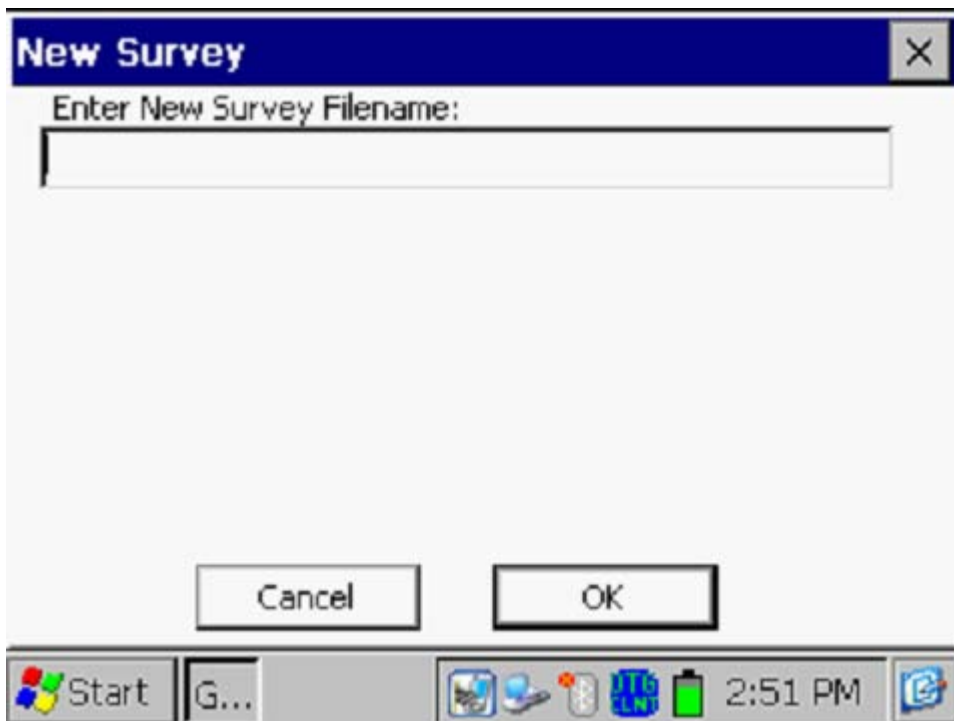
Step 1: Double-tap on the Gx_PLS icon on the Gx desktop. The screen shown below will be displayed.



Step 2: Tap on the “Survey” button located on the menu bar. The screen shown below will be displayed.



Under “Survey” there are several options. If this is a new survey (not a continuation of a previous survey) tap on “New Survey”. The screen shown below will be displayed.



Step 3: Enter a “filename” for the Survey.

This should be a descriptive name that will help you identify the survey at a later stage. Perhaps the name of the section of pipe you are surveying could be part of the filename. “DCVG” and the survey date do not have to be part of the filename as these tags are incorporated with the survey on the ProActive side (assuming that you will be downloading the survey data to the ProActive application).

Note: You will not be permitted to use invalid characters, such as slashes (/ or \), as part of a filename. You will be alerted if you try to use any invalid characters.

Step 4: Once you have entered a filename, tap the OK button on the above screen. The screen shown below will be displayed. The specific selections indicated on the screen will reflect the selections made for the previous survey.

Setup 1 Of 5

Survey: Trigger CIS

Rect Mode: Cycle ON/OFF

Cane Button(s) Allowed To:

D.C.P. None Save

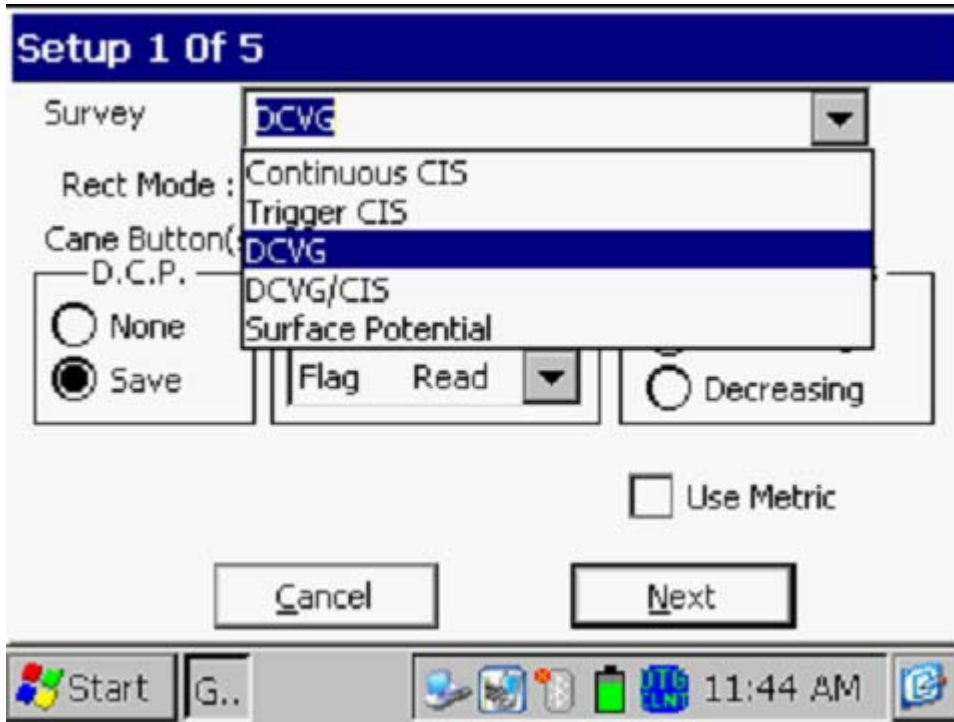
Survey Left Right Flag Read

Survey Locations Increasing Decreasing

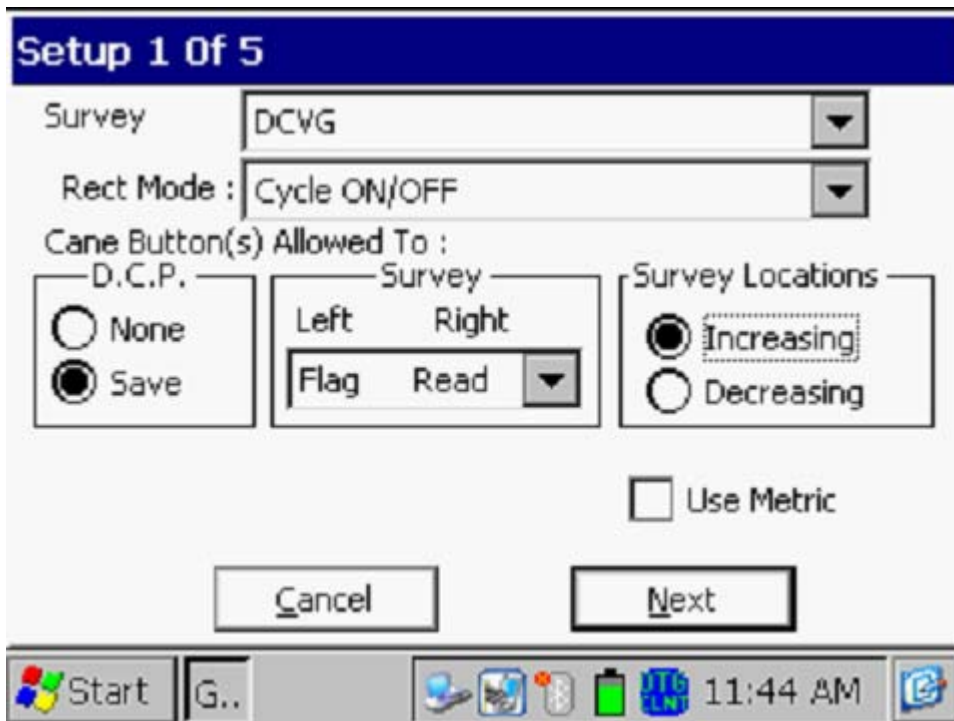
DCVG Sidedrains in CIS Surveys Use Metric

Cancel Next

Step 5: Select the survey type by tapping on the menu button in the “**Survey Type**” field and highlighting the survey type of your choice.



By tapping on the “DCVG” option, the screen shown below will be displayed, depending on the previous survey selections



Survey

The functionality of the data-probe push-button switches during a survey is selected by tapping on the menu button in the “Survey” field.

“**Read Read**” means that both switches can be used to trigger readings

“**Flag Read**” means that the left hand switch will designate the location of a survey flag and the right hand switch will be used to trigger readings

“**Read Flag**” means that the left hand switch will be used to trigger readings and the right hand switch will designate the location of a survey flag

“**Flag Flag**” means that both switches can be used to designate survey flags (and neither switch can be used to trigger readings).

D.C.P.

D.C.P. stands for Data Collection Point and on a DCVG survey usually would represent a test station where the IR drop is determined by connecting the voltmeter temporarily for pipe-to-soil readings.

The data probe switches can have no functionality at these “devices” (the “**none**” selection) or they can be used to save the D.C.P. readings, such as Pipe-to-Soil (On/Off) readings at a test station (the “**Save**” selection).

Note: When “Marking” DCVG anomalies (see the DCVG Training Manual – Gx Version), the data-probe switch functionality becomes “accept”, regardless of whether “save” or “none” is selected here.

Step 7: Make “**Survey Locations**” selection

Once a value has been entered for the “Distance between Readings” (see the Setup 3 of 5 screen), that distance, for example 5.0 feet, can be added to each successive station number each time a reading is triggered, or, it can be subtracted from each successive station number each time a reading is triggered.

Your selection of “Increasing” or “Decreasing” will depend on your walking direction over the pipe with respect to the pipe’s stationing.

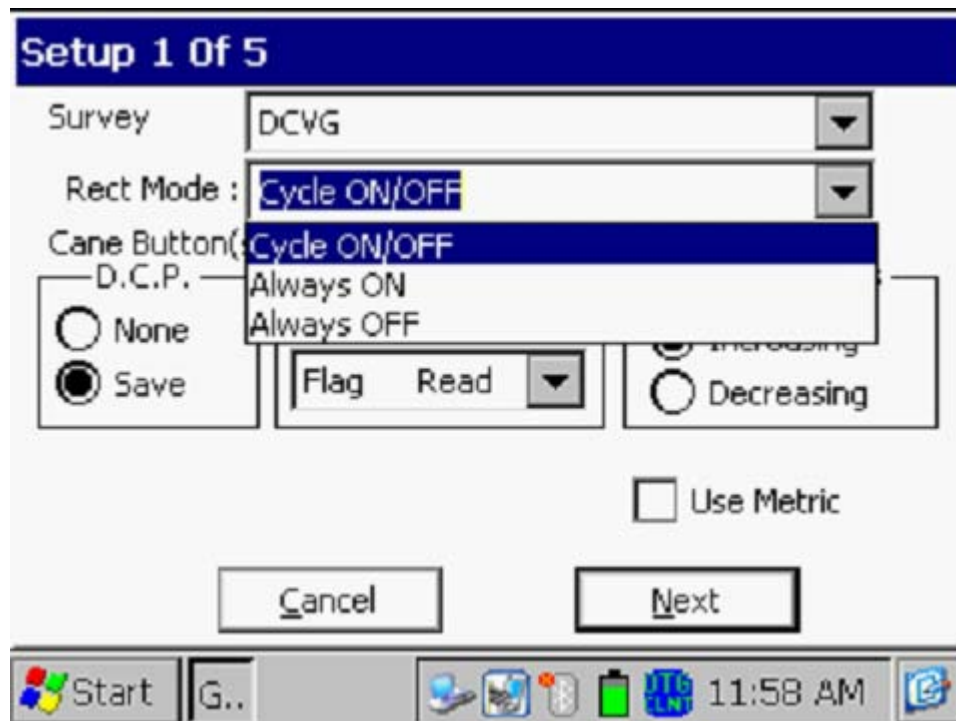
You would select “**Increasing**” if the station number will be increasing as you perform the survey and you would select “**Decreasing**” if the station number will be decreasing as you perform the survey.

Step 8: Make selection of “Metric” units, if required.

By checking off the box labeled “**Metric**”, the reading interval (distance between triggered readings) and the flag interval (survey flag spacing) will be displayed on the Setup 3 of 5 screen in meters, as opposed to feet.

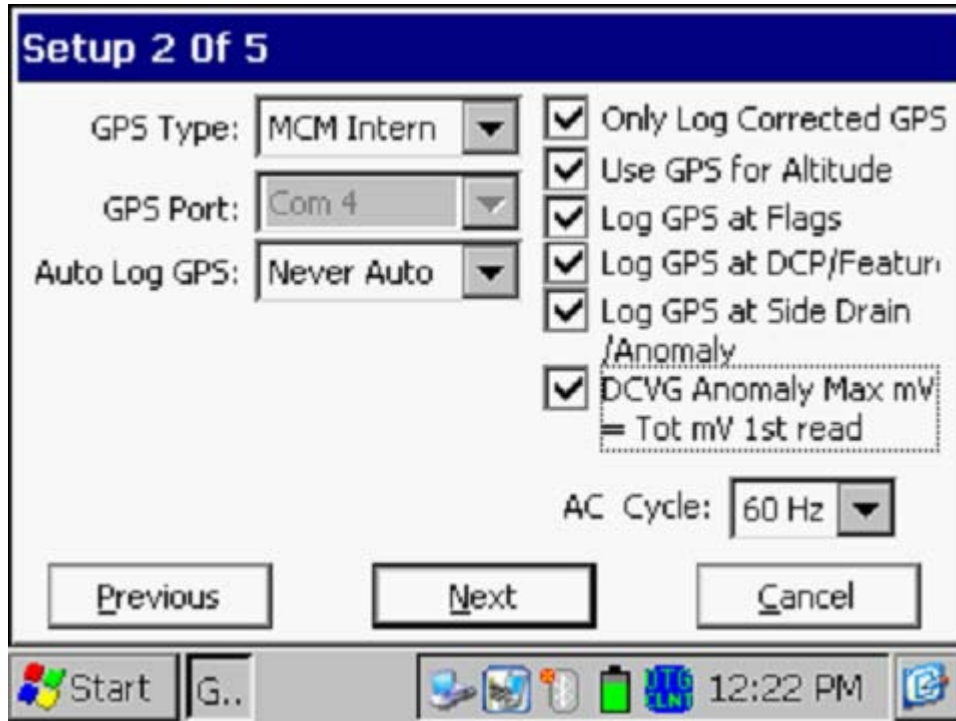
Step 9: Make “**Rectifier Mode**” selection.

By tapping on the menu button in the “Rectifier Mode” field on the above screen, the screen shown below will be displayed.



As can be seen from the above screen, there are 3 choices for “Rectifier Mode”. However, only the “Cycle On/Off” option should be selected for DCVG surveys, as rectifier current interruption is a requirement for this survey type.

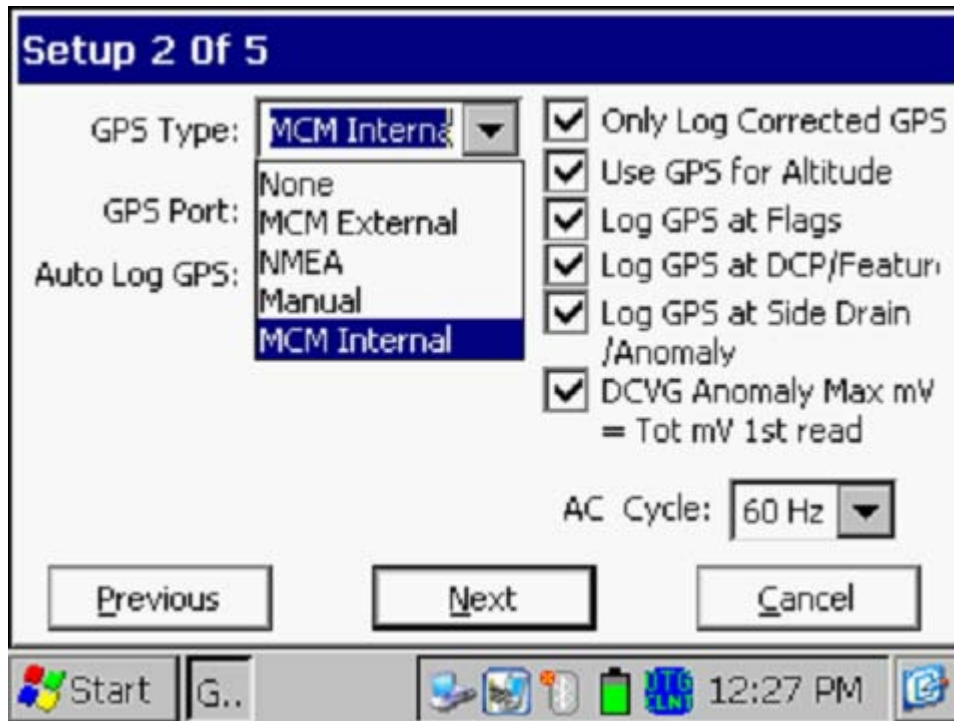
Step 10: Tap on the “Next” button on the above screen. The screen shown below will be displayed, depending on the selections made for the previous survey.



Step 11: Select Local Electricity AC Frequency
By tapping on the menu button in the “**AC Cycle**” field on the screen shown above, you will have the choice of 60Hz or 50Hz AC. Select 60Hz for all U.S. applications. This is an important select with regard to the AC filtering system that’s applied to all of the DC voltage channels.

Step 12: Select the Type of GPS Receiver Being Used (If Any).

By tapping on the menu button in the “**GPS Type**” field on the above screen, the screen shown below will be displayed.



As can be seen from the above screen, there are 5 choices for “GPS Type”:

- None: This means that a GPS receiver is not being used
- MCM External: This means that an external MCM GPS Accessory is being used (currently not available)
- NMEA: This means that an external NMEA-compatible GPS receiver is being used (such as a Trimble unit)
- Manual: This means that location data will be entered manually when the GPS button is tapped on the survey screen during a CIS
- MCM Internal: This means that the Gx’s internal GPS unit will be used (a u-blox NEO, WAAS-enabled, receiver)

Select the appropriate choice by tapping on your selection.

Com Ports

When using an external GPS unit (NMEA option) connected via a serial cable, select the COM 1 option, which represents the built-in serial port located under the flap on the bottom left-hand side of the Gx data-logger. The COM 4 option will be automatically selected when the MCM Internal GPS receiver option is selected.

Step 13: Select GPS Data Logging Options.

Only Log Corrected GPS

This box should be checked if you only want differentially-corrected GPS data to be logged by the Gx data-logger on the survey. Leaving this box unchecked will result in standard GPS data being logged in cases where differentially-corrected data are not available.

Note: If this box is checked and the unit is not receiving a differential correction message, no GPS data will be logged.

Use GPS Altitude

If this box is checked, altitude data will be logged, in addition to the Lat/Long data whenever GPS data are logged. (Note: Altitude data on some GPS units are not particularly accurate).

Log GPS at Flags

If this box is checked, GPS data will be logged automatically at survey flags when either the flag button is tapped (directly on the Survey screen) or when the push-button switch on the designated “flag cane” is pressed.

Log GPS at DCP/Features

If this box is checked, GPS data will be logged automatically at “Devices” or “Geo-Features” when either the “Device” button is tapped on the Survey screen and a “Device” reading is logged or when the “Geo-Feat.” button is tapped on the Survey screen and a geo-feature is registered.

Log GPS at Sidedrain/Anomaly

If this box is checked, GPS data will be logged automatically when DCVG anomalies are “marked”, as described in our DCVG Training Manual – Gx Version.

Auto Log GPS

By tapping on the menu button in the “Auto Log GPS” field, the selections available will be displayed.

By selecting one of these options, you can elect to have GPS data logged automatically at every DCVG reading, at every second DCVG reading, at every fifth DCVG reading, at every tenth DCVG reading, or not at all (never) at DCVG readings.

DCVG Anomaly Max mV = Total mV 1st Reading

The last check box on the above screen is actually not related to GPS Options.

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. (See our DCVG Training Manual – Gx Version).

Step 14: Tap on the “Next” button on the above screen. The screen shown below will be displayed, depending on the selections made on the previous survey.

Dist Per Reading

By tapping in the field on the above screen labeled, “Dist Per Reading” you can type in the interval distance, in feet (or meters for the metric case), expected between reading. Typically, in DCVG work this expected interval distance is 5.0 feet (or 2 meter in the metric case).

Distance Between Flags

By tapping 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 Dist Error Limit %

Select the maximum permissible error between the **actual** number of readings logged between 2 survey flags and the **expected** number of readings.

By tapping in the field labeled, “Flag Dist Error Limit %” you can type in the maximum permissible error. For example, the maximum permissible error is indicated as 20% on the above screen. If the reading interval is expected to be 2.5 feet and the survey flag separation 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 reading 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 (optional):

Select whether or not 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.

Name of P/L (optional)

By tapping in the field labeled, “Name of P/L”, you can enter the pipeline name.

Note: This is **not** necessarily the same name as the filename for the DCVG survey that you used to setup the survey file.

Valve Segment (optional)

By tapping in the field labeled, “Valve Segment”, you can enter the name or number of the valve segment to be surveyed, if known.

Starting Location (very important)

Provide the Starting Location for the survey by tapping in the field labeled, “Starting Location” and entering the location.

You can select to have location information displayed on the survey screen as station number, feet or milepost (station number, meters or kilometer post for the metric case).

Whichever selection you make here will determine how you enter your starting location information.

For example, if your pipeline locations are represented by station numbers, you would select “Station Number” from the menu list and you would enter a starting location for the survey in the form of a station number. [If you do not know the station number associated with the beginning your survey, enter 0+0.0].

Step 15: Tap on the **Next** button on the above screen. A version of the screen shown below will be displayed, depending on the current Date & Time and also the filename entered for your survey.

Set up 4 of 5

Work Order #:

Technician Name:

Comments / Description:

Survey Date: 7/8/2010 6:42:30

Survey Name: \\SystemCF\GX_Data\jk\jk.mcm

Previous Next Cancel

Start G... 6:43 AM

Work Order # (optional)

By tapping in the field labeled, “Work Order #”, you can enter the work order number associated with the survey, if known.

Technician Name (optional)

By tapping in the field labeled, “Technician Name”, you can enter the name of the surveyor.

Comments/Descriptions

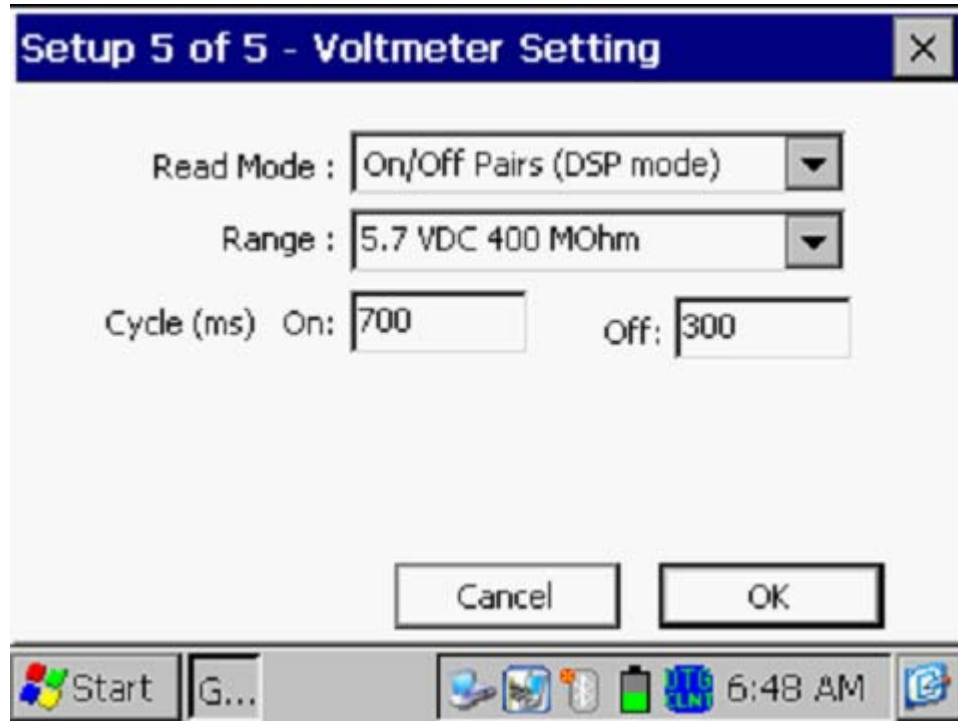
By tapping in the field labeled, “Comments/Descriptions”, you can enter any general comments you might have regarding the survey (perhaps weather conditions, soil conditions etc.).

Also shown on the above screen are the survey filename (“Survey Name” field) and the Start Date and Start Time for the survey (“Survey Date” field).

Note: The survey files are stored in the Gx_Data folder on the Gx data-logger’s CompactFlash memory (SystemCF) – a non-volatile memory.

Note: These data cannot be changed manually.

Step 16: Tap on the “Next” button on the above screen. A version of the screen shown below will be displayed, depending on the settings selected for the previous survey.



Read Mode

DCVG surveys are performed with the rectifier-current switched ON and OFF in a cyclic fashion and, as can be seen by tapping on the menu button in the field labeled, “Read Mode”, there are only two choices available for the reading mode of the voltmeter. The choices are “On/Off Pairs (DSP mode)” and “On/Off Pairs (GPS Sync)”.

Note: On/Off Pairs (Min/Max) is not a option here since DCVG surveys require a measurable difference between On and Off voltages, ie, they require a significant IR drop.

On/Off Pairs (DSP mode):

In this mode, the voltmeter uses digital signal processing techniques to determine the “flat” portions of the waveform for both the On and Off parts of the cycle. ΔV values (please see the DCVG Training Manual – Gx Version) are then determined for the On and the Off portions of the cycle from which the DCVG voltage is calculated [$\Delta V(\text{On})$ minus $\Delta V(\text{Off})$].

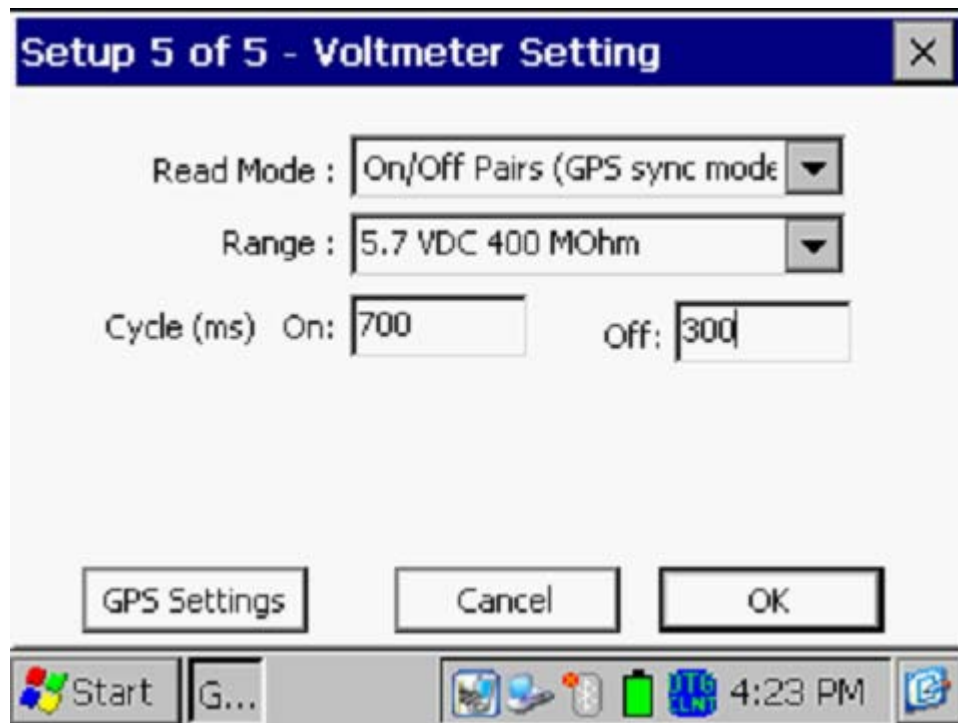
For these measurements to be successful, the data probes must remain in good electrical contact with the soil for at least one full waveform period following the initial contact of the probes with the soil, for a stable DCVG voltage value to be displayed.

On/Off Pairs (GPS Sync)

This voltmeter reading mode can only be selected if you are using the built-in “MCM Internal” GPS receiver **AND** GPS current-interrupters.

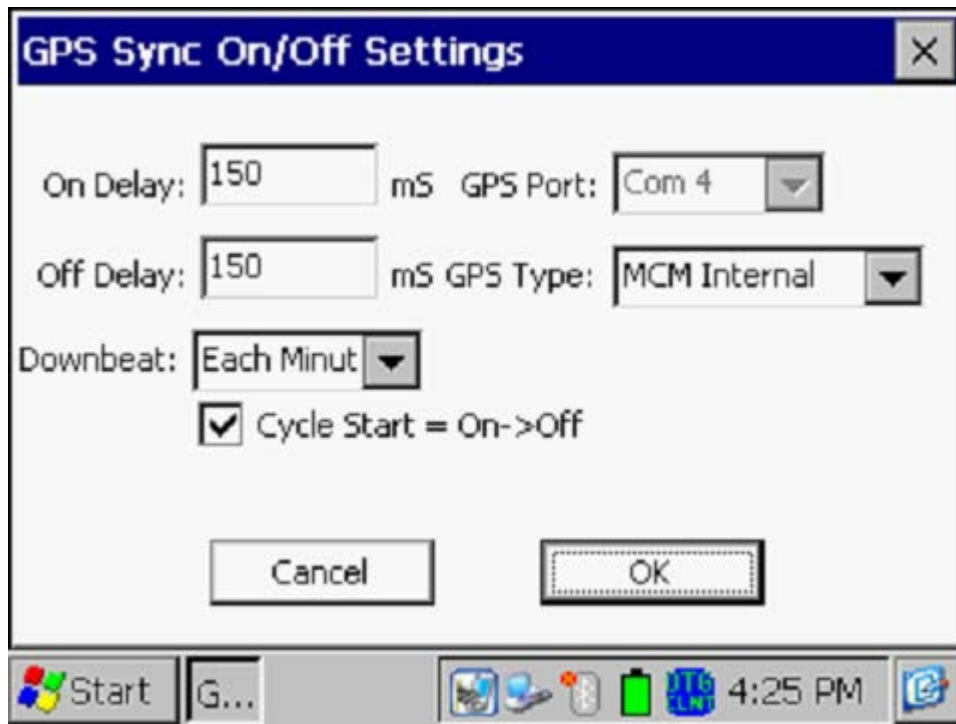
With this reading mode elected, you can select the recording times on the waveform for both the On and Off readings, with respect to the On-to-Off transitions and the Off-to-On transitions of the waveform, as opposed to the software determining appropriate locations on the waveform for you (as in the case of the On/Off Pairs D.S.P. reading mode – see above).

With this voltmeter reading mode selected, the screen shown below will be displayed revealing an additional button (“GPS Settings”)



GPS Settings

By tapping on the “GPS Settings” button, the screen shown below will be displayed, depending on the previous settings.



GPS Type

Select the type of GPS receiver being used. Currently, only the MCM Internal GPS Receiver can be used with the GPS Sync reading mode.

On Delay & Off Delay

By tapping in the fields labeled, “On Delay” and “Off Delay”, you can enter specific times (in milli-seconds) for these parameters.

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 delay times selected should be based on knowledge of the waveform, particularly in terms of any transition spiking. The idea is to select sampling times that will avoid any spiking.

Downbeat

By tapping on the menu button in the “Downbeat” field, you can select the downbeat schedule associated with the particular current interrupters you are using for the survey. The three options are: Each Minute, Each Hour and Midnight.

For example, if “Each Minute” is applicable to your interrupters, and you select this option for the Downbeat schedule, you are indicating to the data-logger software that at the top of each minute, there will be an On to Off transition (the rectifier current will switch from On to Off at the top of each minute). This would mean, in this example, that the software would only have to count back to the top of the last (previous) minute to have a timing reference.

Cycle Start

Finally, if your interruption cycle starts with the current in the ON state (the first transition is from ON to OFF), check off the box labeled, “Start Cycle” (un-check this box if the opposite is true).

Click on the “OK” button on the “GPS Settings” screen in order to return to the Voltmeter Settings screen (Screen 5 of 5).

Cycle On & Off (Times)

The specific On and Off times setup on the current interrupters should be entered in the “On” and “Off” fields, respectively, on the Setup 5 of 5 Screen.

Note: The On and the Off times should be entered in milli-seconds.

Note: Consequently, the rate at which DCVG voltages can be captured and saved depends critically on the interruption waveform period. This is a particularly important issue in the case of larger waveform periods. For example, if a 10 second On/2 second Off waveform is employed (12 second waveform period), stabilization times between 12 and 24 seconds could be possible (at each measurement location) before each DCVG voltage reading can be made. In contrast, the stabilization period would be only on the order of 1 to 2 seconds for a 700ms On, 300ms Off interruption cycle.

Range:

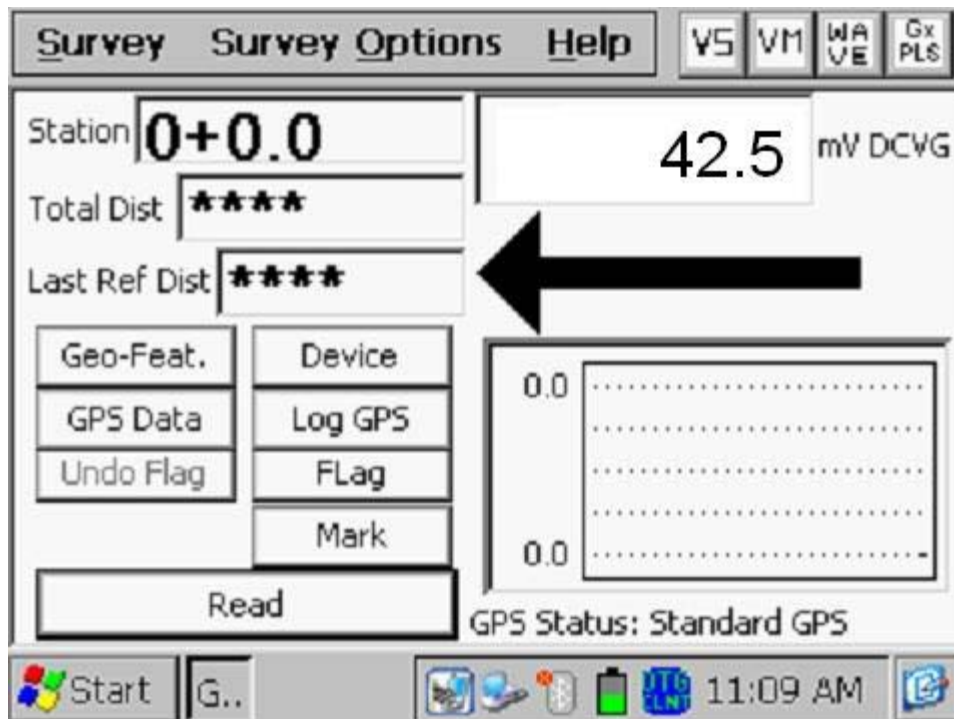
By tapping on the menu button in the “Range” field, you can select the voltmeter range and associated input impedance setting for your application from the full list of available options.

Note: Use the scroll bar to view all options.

Note: Since all of the voltmeter DC ranges (DC channels) on the Gx data-logger are “fast response” channels, each DC range is an option for DCVG surveys. However, since DCVG survey readings are typically small (either tens of mV or hundreds of mV only), with respect to sensitivity, the most appropriate DC ranges are the 5.7V, 400mV and 40mV ranges, depending on the size of the gradient fields that you encounter. Another issue is the signal-to-noise ratio with respect to being able to “find” and “mark” anomalies. For small signals (small gradient fields), the voltmeter’s noise level is the limiting factor. The noise levels associated with the 5.7V, the 400mV and the 40mV ranges are approximately as follows: $\pm 5\text{mV}$, $\pm 1\text{mV}$ and $\pm 0.5\text{mV}$, respectively.

Step 17: Tap on the “OK” button on the “Setup 5 of 5” screen.

A version of the screen shown below will be displayed, depending on the start location entered previously and the location type entered previously (station number, feet or milepost (or station number, meters or kilometer post, for the metric option)).



In the above “active” DCVG survey screen, the direction of the arrow (pointing to the left or pointing to the right) depends on the polarity of the DCVG voltage being measured. In the above case, the voltage being measured was positive which produced an arrow pointing to the left. The opposite would be true if the DCVG voltage reading had been negative (ie, the arrow would point to the right).

Note: With the reference electrodes (data-probes) properly positioned, the polarity of the DCVG voltage will always be positive (above the noise level) in the case of perpendicular DCVG surveys (please see our DCVG Training Manual – Gx Version). In this case, the arrow on the survey screen will always point to the pipe.

However, a change in arrow direction will be evident when performing parallel, or in-line, measurements in the vicinity of a DCVG anomaly (coating defect). In this case, the arrow will always point in the direction of the defect location on the pipe with respect to where you are currently standing. As you approach the defect, the arrow will point towards the upcoming defect location and when you are past the defect, the arrow will point back to the defect location. Consequently, performing in-line measurements in the vicinity of a defect can be a good way to pin-point its precise location, by monitoring the arrow’s polarity switches. When you are actually straddling a defect location (with the reference electrodes in-line with the pipe), the DCVG voltage will be zero (although, a true zero is not possible with a digital voltmeter) [please see our DCVG Training Manual – Gx Version].

You are now ready to perform a DCVG Survey.

You are referred to our **DCVG Training Manual – Gx Version** for information and recommendations on how to actually perform DCVG Surveys using the Gx data-logger. The Training Manual also provides an overview of the physical principles associated with DCVG Surveys.

IV. 3 Setup for Combined DCVG/CIS Surveys

Introduction:

It is possible to collect both DCVG survey data and CIS data on a single pass by using the MCM Switch Box in conjunction with the Gx data-logger.

In this combined survey mode, at each measurement location, the DCVG data are first recorded and then the Switch Box performs a switching operation that allows the CIS pipe-to-soil voltages to be recorded. When the CIS data have been recorded, the G1 will “beep”, which is the signal that you can move the data-probes to the next measurement location. Since, as discussed below, you will be effectively only using one data probe to collect the CIS data (the left-hand (red-handled) data-probe that will be positioned over the pipe), the CIS data will be determined from the cycle of the pipe-to-soil waveform that is sampled immediately after the trigger event. This explains why it is imperative that the data-probes remain in contact with the soil for at least one cycle after the trigger. Again, the data-logger will “beep” to advise you that the CIS data have been recorded and that you can proceed to the next measurement location. In contrast, the DCVG data are determined from the cycle of the waveform occurring just in front of the trigger event. Consequently, it will take at least two waveform periods (two On plus Off times) to record both sets of data, from the time at which the data-probes make good electrical contact with the soil at each measurement location.

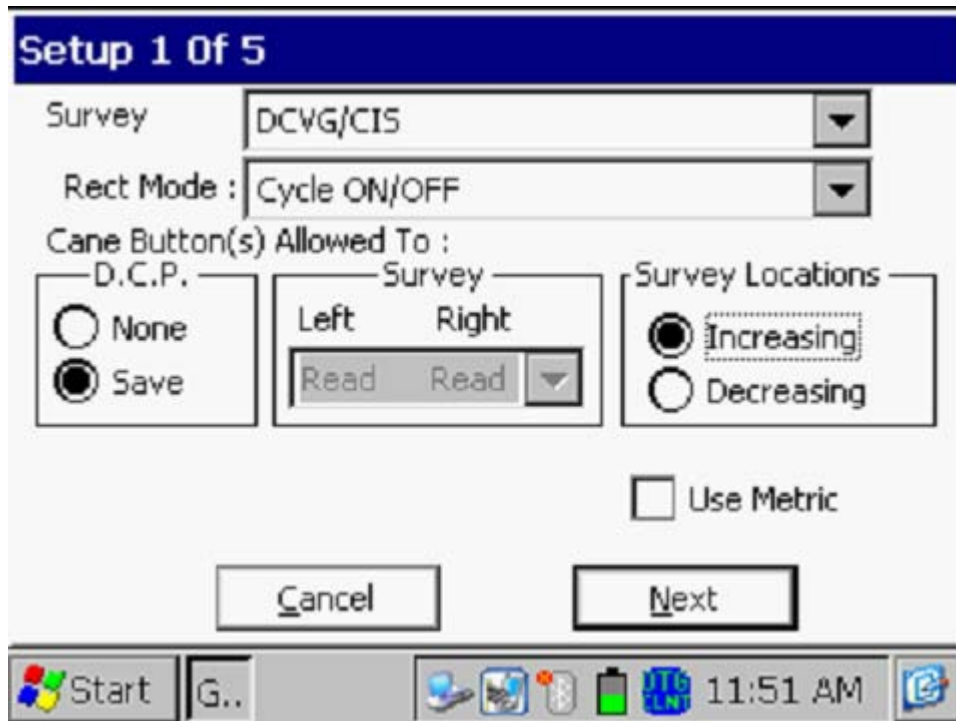
Another major difference between Combined DCVG/CIS applications and independent DCVG and CIS applications is that, in the Combined DCVG/CIS case, only the push-button switch on the left-hand cane (red-handled cane) is enabled (the push-button switch on the right-hand cane (green-handled cane) is disabled). This means that the event that will initiate the recording of, first, the DCVG data and, second, the CIS data, will be triggered by pressing the push-button switch on the red-handled data-probe. This also means that survey flags, if used, will have to be designated by tapping on the “Flag” button on the Survey screen.

Prior to performing Combined DCVG/CIS applications, it is recommended that you first use the Gx data-logger to perform independent DCVG and CIS surveys, as described in the preceding sections, in order to become familiar with the test apparatus (including the Gx) and the measurement procedures for both survey types.

You are also referred to our DCVG and CIS Training Manuals (Gx Versions) which are companion manuals to the Gx User's Manual for specific instructions on how to perform these survey types.

Setting Up Combined Surveys:

The setup procedures for Combined DCVG/CIS applications, as far as the Gx is concerned, are very similar to those detailed above for DCVG surveys. You are referred to Section IV.2 for specific information on screen selections.



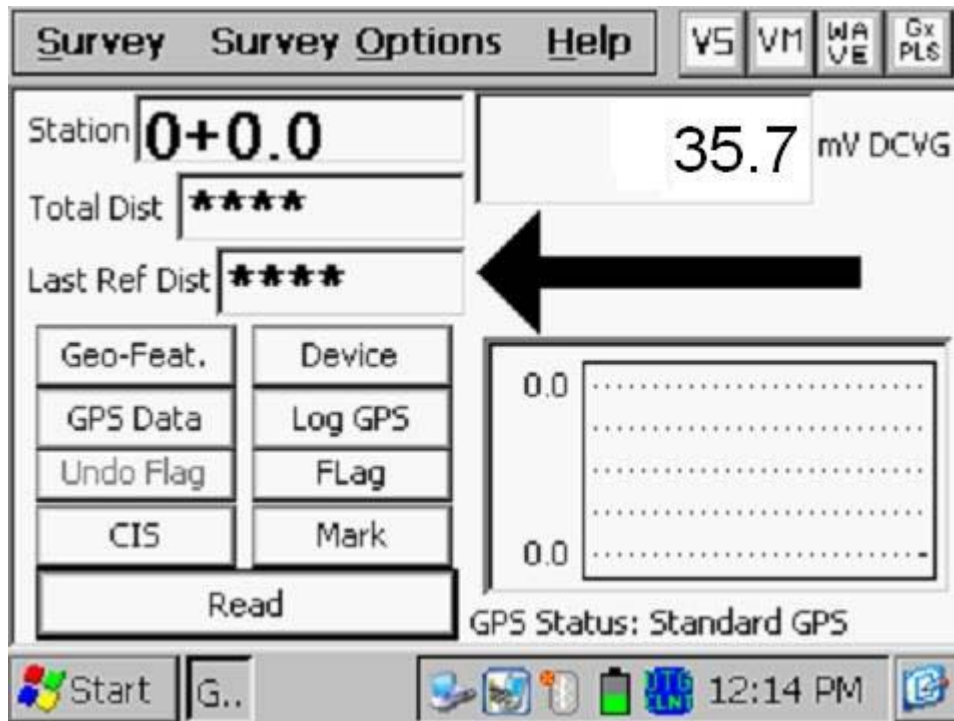
The first step is to select “DCVG/CIS” for the “Survey Type” by tapping on the menu button in the “Survey Type” box on the above screen.

You will notice that you are not able to select the functionality for the left- and right-hand data-probes in this survey type, since, as discussed above, the push-button switch on the right-hand cane (green-handled cane) is disabled. You will initiate the recording of, first, the DCVG data and, second, the CIS data, by pressing push-button switch on left-hand (red-handled) data-probe at each measurement location.

You can, however, select the functionality you desire for the left-hand push-button switch during “Device” measurements, i.e., measurements at data-collection points (D.C.P.’s). As before, you can select “None” which will mean that pressing the push-button at Devices will do nothing, or you can select “Save”, which means that the data at D.C.P.’s will be saved when you press the push-button. Alternatively, you can tap on “Device” on the Survey screen and proceed to save data as described in previous sections.

You should then proceed through the various setup screens, making your selections as before. Since this is a Combined DCVG and CIS application, you will only have two choices regarding Voltmeter Read Mode (since the DCVG part requires current-interruption and measurable differences between ON and OFF pipe-to-soil voltages (ie, measurable IR drops, which rules out the Min/Max reading mode). The two options are On/Off Pairs (DSP mode) and On/Off Pairs (GPS Sync. mode). Again, the GPS Sync. mode can only be selected if you are using the MCM Internal GPS receiver **and** GPS current interrupters.

Once you have gone through the setup screens, a version of the screen shown below will be displayed, depending on the start location entered and the location type entered (station number, feet or milepost (or station number, meters or kilometer post, for the metric option)).



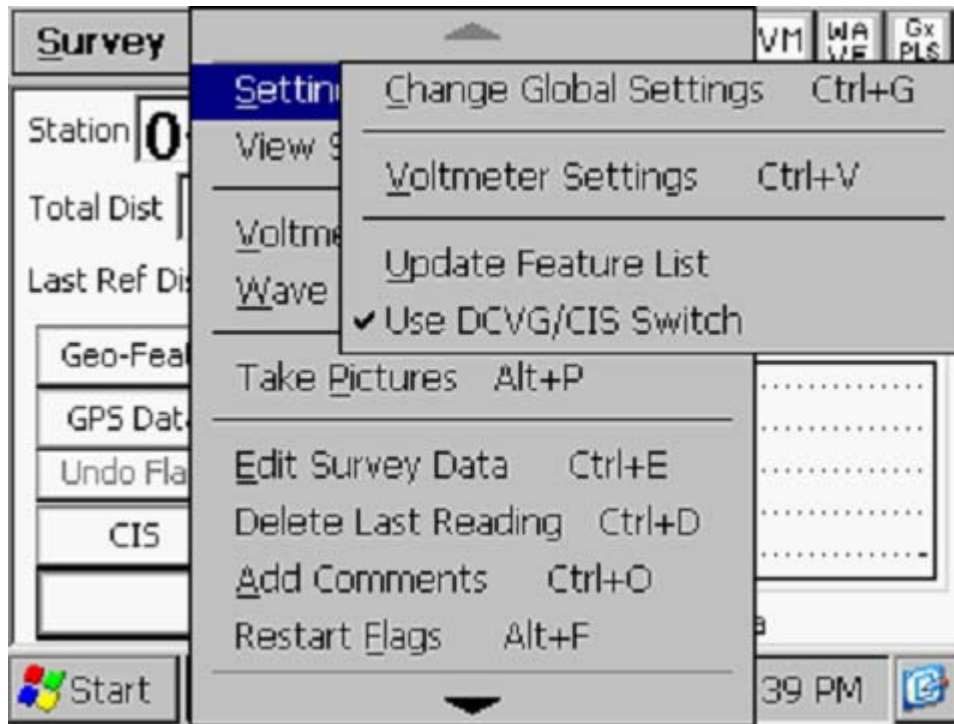
As can be seen from the above screen, the Combined DCVG/CIS Survey screen looks very similar to the DCVG survey screen (see Section IV.2).

The major difference here, however, is the presence of the “**CIS**” button. You can, at anytime during the Combined Survey, tap on the “**CIS**” button to view the CIS data that has been recorded. The data will be displayed on the graph.

After viewing the CIS graph, you can return to the above screen by tapping on the “**DCVG**” button which will have replaced the “**CIS** button”.

As mentioned in the “Introduction” to this section, DCVG and CIS data can be collected at each measurement location by virtue of using an MCM Switch Box. When you select the “DCVG/CIS” Survey Type, the Gx will enable the “DCVG/CIS Switch” option.

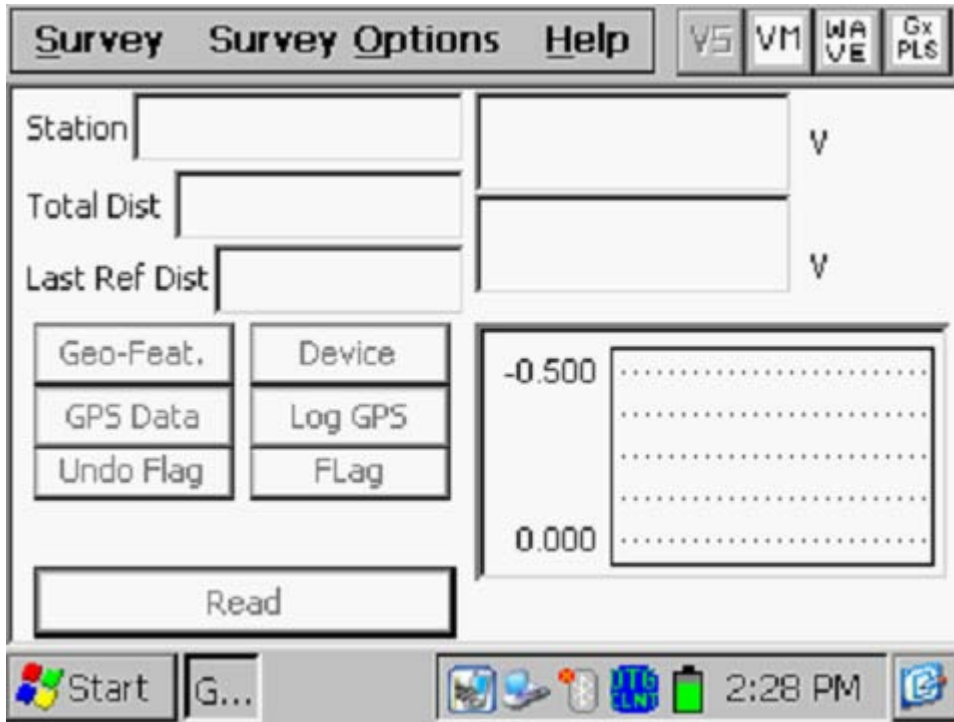
You can check to make sure that this Switch option has been enabled by tapping on “Options” and then tapping on “Settings” which will pull up the screen shown below.



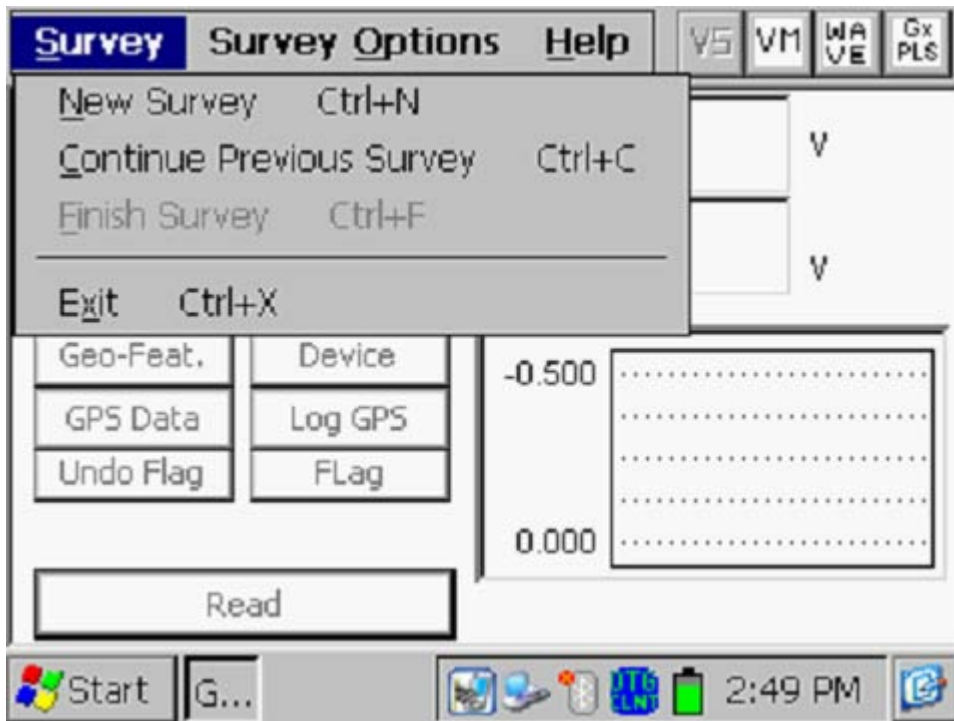
The check mark beside the “Use DCVG/CIS Switch” option indicates that this option has been enabled.

IV. 4 Setup for Surface Potential Surveys

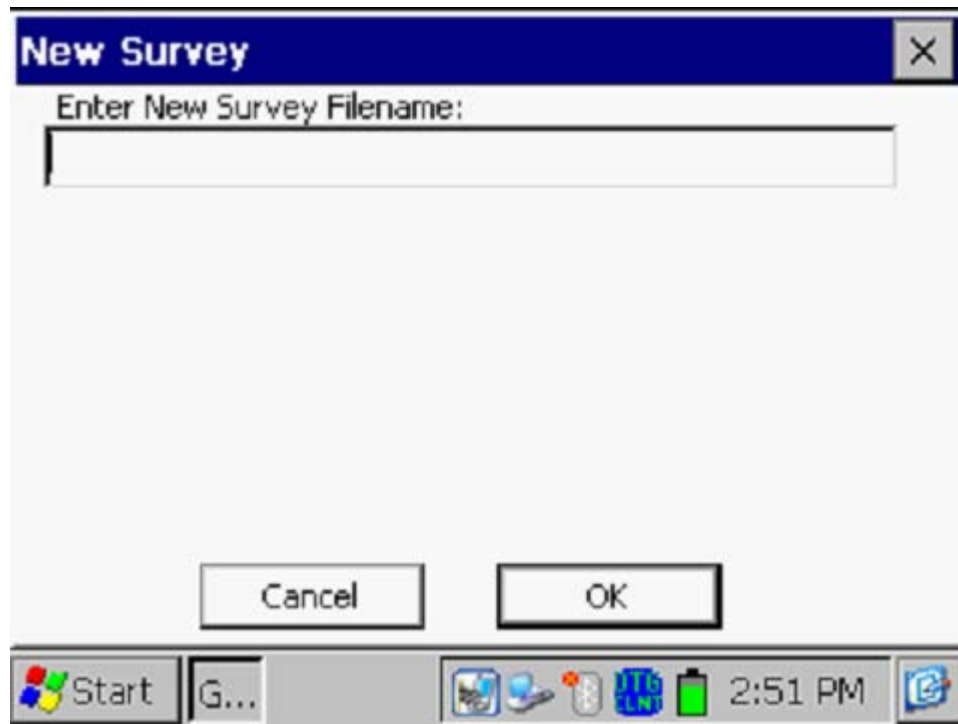
Step 1: Double-tap on the Gx_PLS icon on the Gx desktop. The screen shown below will be displayed.



Step 2: Tap on the “Survey” button located on the menu bar. The screen shown below will be displayed.



Under “Survey” there are several options. If this is a new survey (not a continuation of a previous survey) tap on “New Survey”. The screen shown below will be displayed.

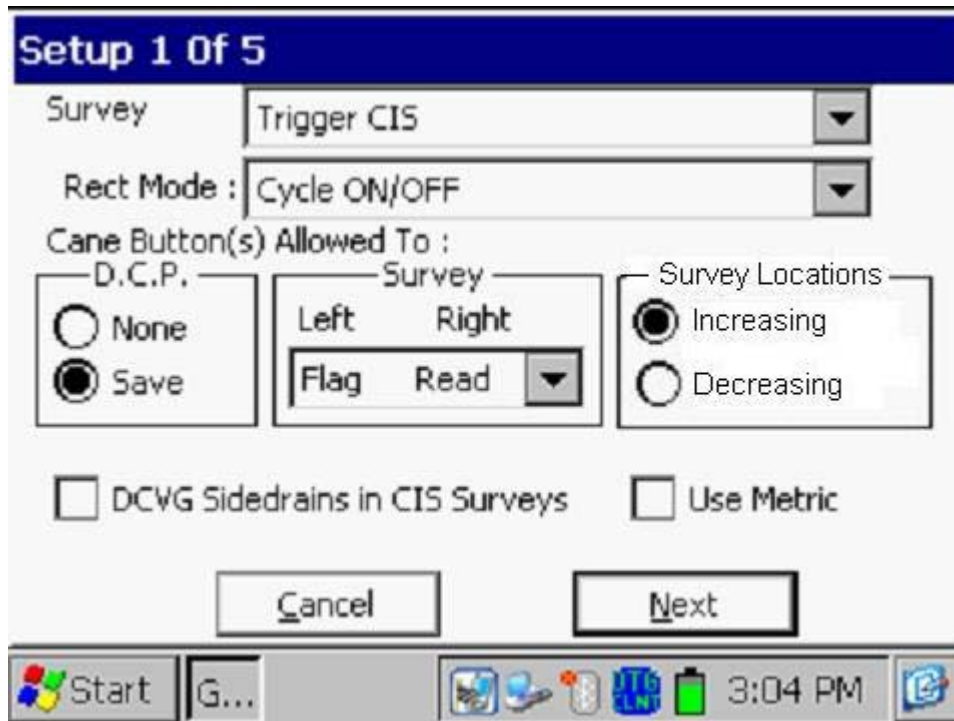


Step 3: Enter a “filename” for the Survey.

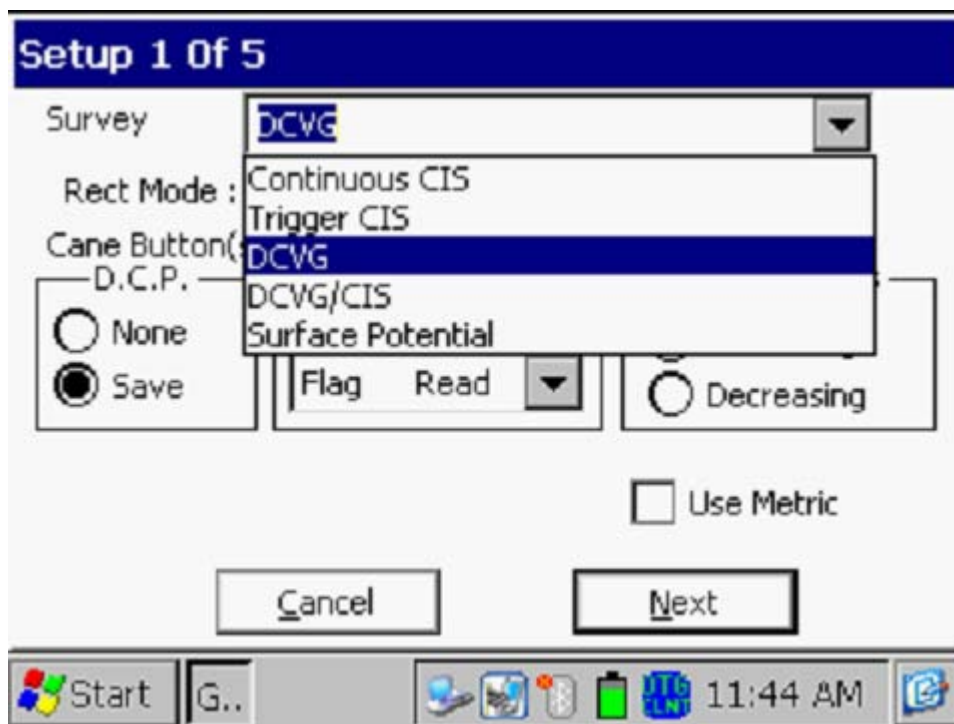
This should be a descriptive name that will help you identify the survey at a later stage. Perhaps the name of the section of pipe you are surveying could be part of the filename. “Surface Potential” and the survey date do not have to be part of the filename as these tags are incorporated with the survey on the ProActive side (assuming that you will be downloading the survey data to the ProActive application).

Note: You will not be permitted to use invalid characters, such as slashes (/ or \), as part of a filename. You will be alerted if you try to use any invalid characters.

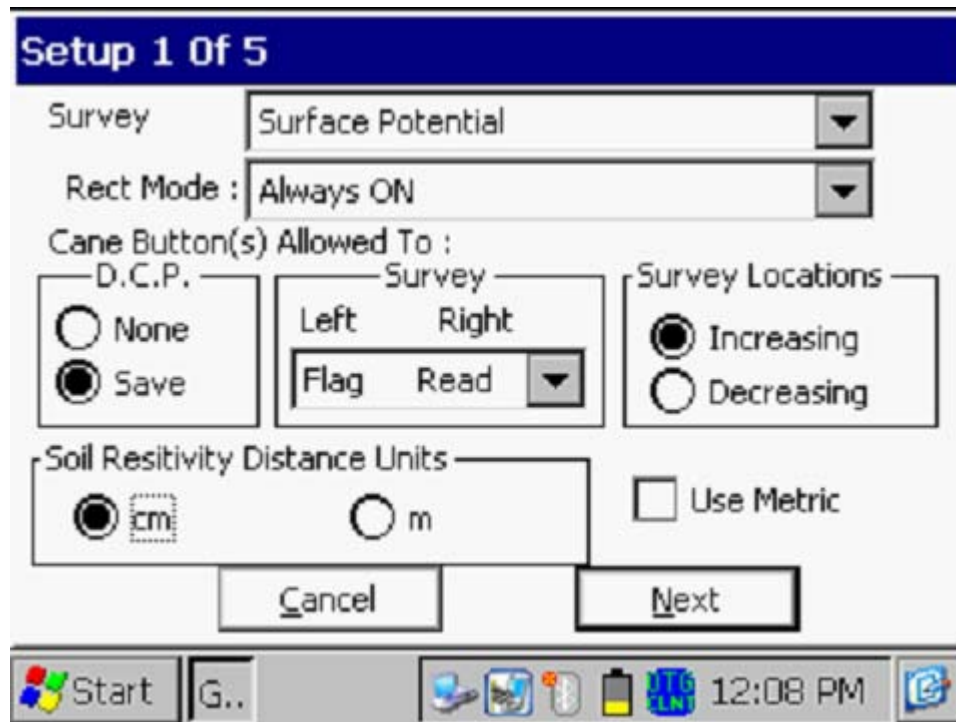
Step 4: Once you have entered a filename, tap the OK button on the above screen. The screen shown below will be displayed. The specific selections indicated on the screen will reflect the selections made for the previous survey.



Step 5: Select the survey type by tapping on the menu button in the “**Survey Type**” field and highlighting the survey type of your choice.



By tapping on the “Surface Potential” option, the screen shown below will be displayed, depending on the previous survey selections



Rectifier Mode

By tapping on the menu button in the “Rect Mode” field, 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.

Survey

Typically, for Surface Potential surveys, you would “trigger” readings using either the positive (green-handled) data-probe or the negative (red-handled) data-probe. In the case where an “in-line” survey is to be performed by two crew members (one holding the positive data-probe, the other holding the negative data-probe, the choice of which push-button switch to designate as the “trigger” for readings will depend on which data-probe the crew member operating the Gx is holding. If the Gx operator holds the red-handled (negative) data-probe, the selection should be “read flag” in the “Survey” category and, if the Gx operator is holding the green-handled (positive) data-

probe, the selection should be “flag read”. In either case, the crew member who is not the Gx operator could use his push-button switch to designate the location of survey flags.

D.C. P.

You can also use the push-button switches when recording voltages at D.C.P.’s (data collection points (devices)) to “save” a device reading, as opposed to tapping on the “save” button on the survey screen, if you wish. To do so, you would select the “Save” radio button on the above screen. If the “None” option is selected, the push-button switches will have no functionality at D.C.P.s

Note: When “Marking” SP anomalies (see the Surface Potential Training Manual – Gx Data-logger Version), the push-button switch functionality becomes “accept”, regardless of whether “save” or “none” is selected here.

Survey Locations:

Once a value has been entered for the “Distance between Readings” (see the Setup 3 of 5 screen), that distance, for example 5.0 feet, can be added to each successive station number each time a reading is triggered, or, it can be subtracted from each successive station number each time a reading is triggered.

Your 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.

Use Metric

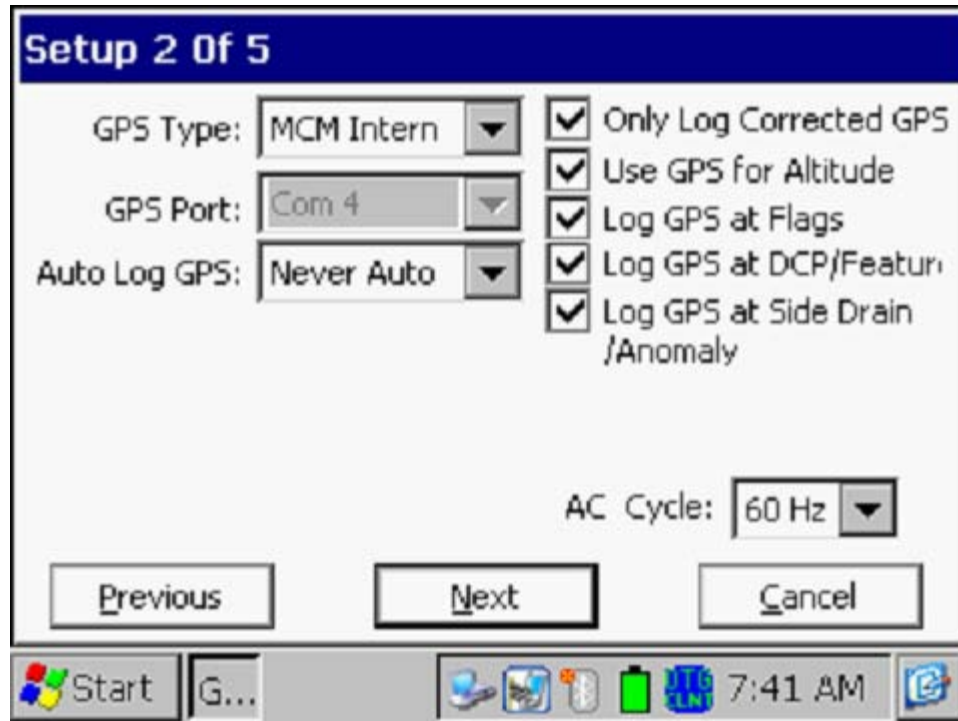
By checking off the box labeled “**Use Metric**”, the reading interval (distance between triggered readings) and the flag interval (survey flag spacing) will be displayed on the Setup 3 of 5 screen in meters, as opposed to feet.

Soil Resistivity Distance Units

As indicated in the Surface Potential Survey Training Manual - Gx version, you 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)

Step 6: Tap on the “Next” button on the above screen which will result in the screen shown below being displayed, depending on the settings used on the previous survey.

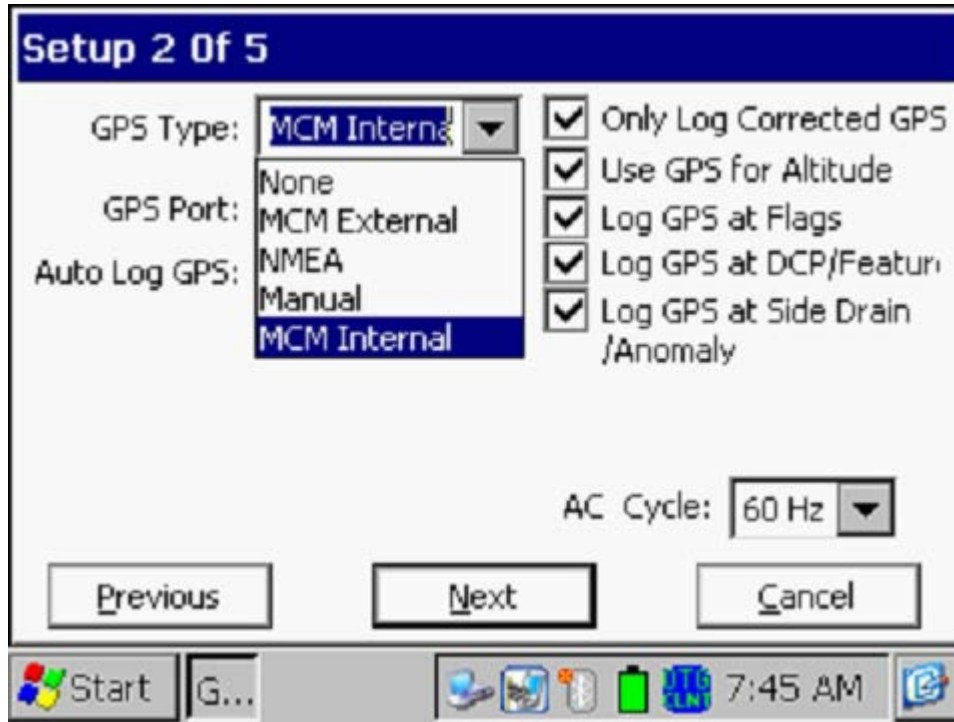


AC Cycle

By tapping on the menu button in the “**AC Cycle**” field on the screen shown above, you will have the choice of 60Hz or 50Hz AC. Select 60Hz for all U.S. applications. This is an important select with regard to the AC filtering system that’s applied to all of the DC voltage channels.

GPS Type

By tapping on the menu button in the “**GPS Type**” field on the above screen, the screen shown below will be displayed.



As can be seen from the above screen, there are 5 choices for “GPS Type”:

- None: This means that a GPS receiver is not being used
- MCM External: This means that an external MCM GPS Accessory is being used (currently not available)
- NMEA: This means that an external NMEA-compatible GPS receiver is being used (such as a Trimble unit)
- Manual: This means that location data will be entered manually when the GPS button is tapped on the survey screen during a CIS
- MCM Internal: This means that the Gx’s internal GPS unit will be used (a u-blox NEO, WAAS-enabled, receiver)

Select the appropriate choice by tapping on your selection.

Com Ports

When using an external GPS unit (NMEA option) connected via a serial cable, select the COM 1 option, which represents the built-in serial port located under the flap on the bottom left-hand side of the Gx data-logger. The COM 4 option will be automatically selected when the MCM Internal GPS receiver option is selected.

Only Log Corrected GPS

This box should be checked if you only want differentially-corrected GPS data to be logged by the Gx data-logger on the survey. Leaving this box unchecked will result in standard GPS data being logged in cases where differentially-corrected data are not available.

Note: If this box is checked and the unit is not receiving a differential correction message, no GPS data will be logged.

Use GPS Altitude

If this box is checked, altitude data will be logged, in addition to the Lat/Long data whenever GPS data are logged. (*Note:* Altitude data on some GPS units are not particularly accurate).

Log GPS at Flags

If this box is checked, GPS data will be logged automatically at survey flags when either the flag button is tapped (directly on the Survey screen) or when the push-button switch on the designated “flag cane” is pressed.

Log GPS at DCP/Features

If this box is checked, GPS data will be logged automatically at “Devices” or “Geo-Features” when either the “Device” button is tapped on the Survey screen and a “Device” reading is logged or when the “Geo-Feat.” button is tapped on the Survey screen and a geo-feature is registered.

Log GPS at Sidedrain/Anomaly

If this box is checked, GPS data will be logged automatically when SP anomalies are “marked”, as described in our DCVG Training Manual – Gx Version.

Auto Log GPS

By tapping on the menu button in the “Auto Log GPS” field, the selections available will be displayed.

By selecting one of these options, you can elect to have GPS data logged automatically at every SP reading, at every second SP reading, at every fifth SP reading, at every tenth SP reading, or not at all (never) at SP readings.

Step 7: Tap on the “Next” button on the above screen which will result in the screen shown below being displayed, depending on the settings used on the previous survey.

Setup 3 of 5

Name of P/L:

Valve Segment:

Starting Location: Station Number

Flag Dist Error Limit % : %

Dist Per Reading : ft

Distance Between Flags : ft

Auto Pacing Mode:

Previous Next Cancel

Dist Per Reading

By tapping in the field on the above screen labeled, “Dist Per Reading” you can type in the interval distance, in feet (or meters for the metric case), expected between reading. Typically, in Surface Potential work this expected interval distance is 5.0 feet (or 2 meter in the metric case).

Distance Between Flags

By tapping 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 Dist Error Limit %

Select the maximum permissible error between the **actual** number of readings logged between 2 survey flags and the **expected** number of readings.

By tapping in the field labeled, “Flag Dist Error Limit %” you can type in the maximum permissible error. For example, the maximum permissible error is indicated as 20% on the above screen. If the reading interval is expected to be 2.5 feet and the survey flag separation 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 reading 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 (optional):

Select whether or not 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.

Name of P/L (optional)

By tapping in the field labeled, “Name of P/L”, you can enter the pipeline name.

Note: This is **not** necessarily the same name as the filename for the SP survey that you used to setup the survey file.

Valve Segment (optional)

By tapping in the field labeled, “Valve Segment”, you can enter the name or number of the valve segment to be surveyed, if known.

Starting Location (very important)

Provide the Starting Location for the survey by tapping in the field labeled, “Starting Location” and entering the location.

You can select to have location information displayed on the survey screen as station number, feet or milepost (station number, meters or kilometer post for the metric case).

Whichever selection you make here will determine how you enter your starting location information.

For example, if your pipeline locations are represented by station numbers, you would select “Station Number” from the menu list and you would enter a starting location for the survey in the form of a station number. [If you do not know the station number associated with the beginning your survey, enter 0+0.0].

Step 8: Tap on the **Next** button on the above screen. A version of the screen shown below will be displayed, depending on the current Date & Time and also the filename entered for your survey.

Set up 4 of 5

Work Order #:

Technician Name:

Comments / Description:

Survey Date: 7/12/2010 8:2:14

Survey Name: \\SystemCF\GX_Data\bcd\bcd.mcm

Work Order # (optional)

By tapping in the field labeled, “Work Order #”, you can enter the work order number associated with the survey, if known.

Technician Name (optional)

By tapping in the field labeled, “Technician Name”, you can enter the name of the surveyor.

Comments/Descriptions

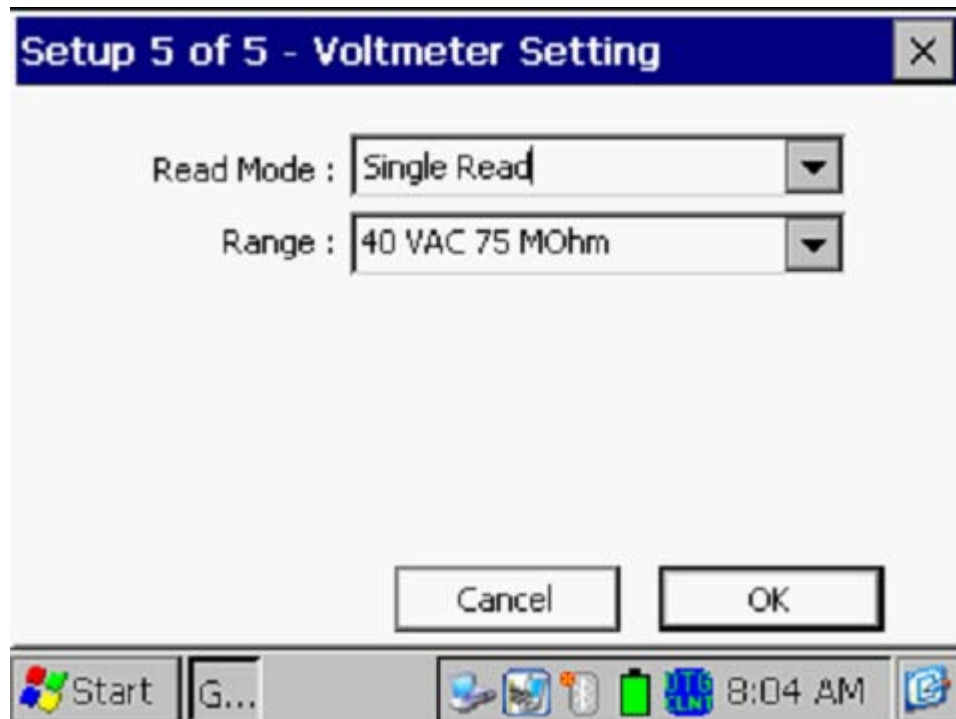
By tapping in the field labeled, “Comments/Descriptions”, you can enter any general comments you might have regarding the survey (perhaps weather conditions, soil conditions etc.).

Also shown on the above screen are the survey filename (“Survey Name” field) and the Start Date and Start Time for the survey (“Survey Date” field).

Note: The survey files are stored in the Gx_Data folder on the Gx data-logger’s CompactFlash memory (SystemCF) – a non-volatile memory.

Note: These data cannot be changed manually.

Step 9: Tap on the “Next” button on the above screen. A version of the screen shown below will be displayed, depending on the settings selected for the previous survey.



Read Mode:

By tapping on the menu button in the “Read Mode” field, you will see that there are two options available for selection as follows:

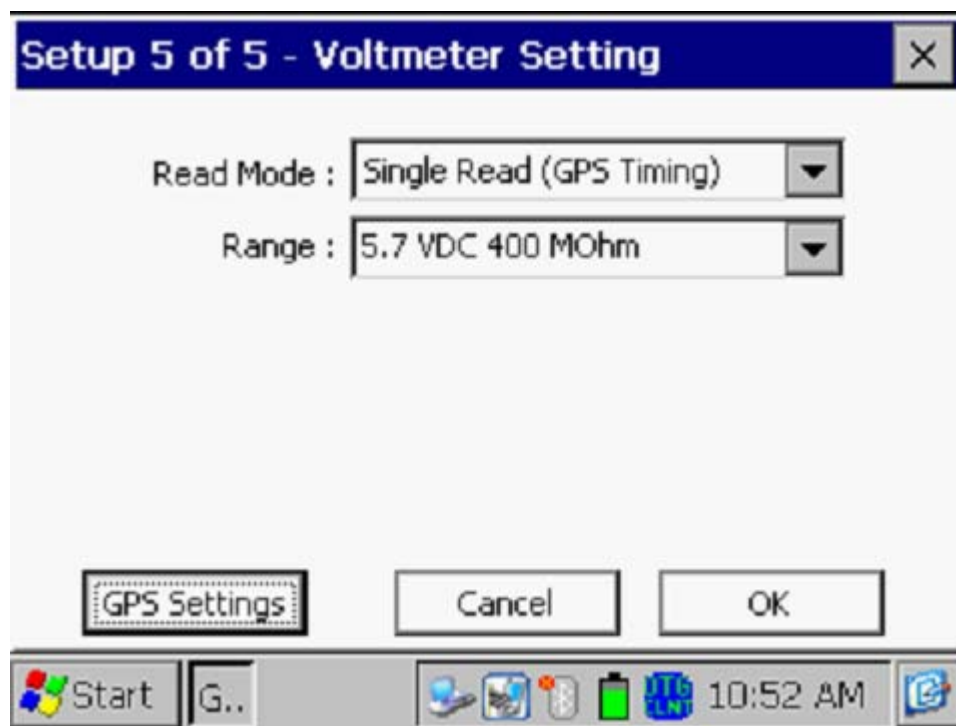
Single Read

This voltmeter reading mode is appropriate for “cell-to-cell” potential difference single readings, which are the basis of Surface Potential surveys.

Single Read (GPS Timing)

This voltmeter 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.

When the “Single Read (GPS Timing)” mode is selected, the screen shown below will be displayed.



The only addition information that needs to be supplied here is the type of GPS receiver you will be using, via the “GPS Settings” button.

Note: Currently, only the MCM Internal GPS Receiver can be selected for this voltmeter reading mode.

Range:

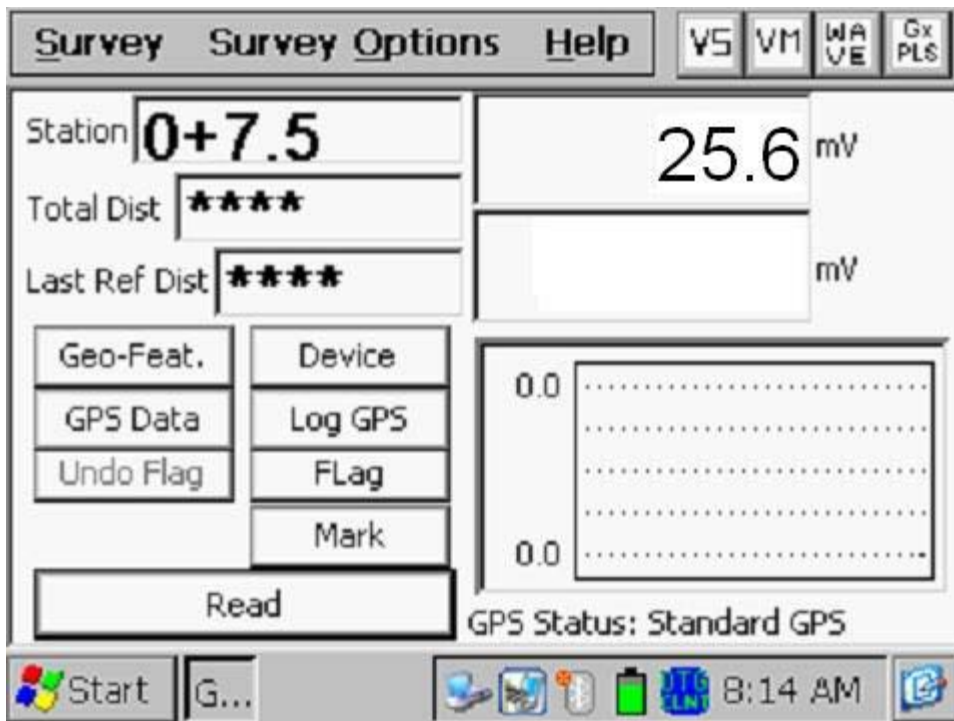
By tapping on the menu button in the “Range” field, you can select the voltmeter range and associated input impedance setting for your application from the full list of available options.

Note: Use the scroll bar to view all options.

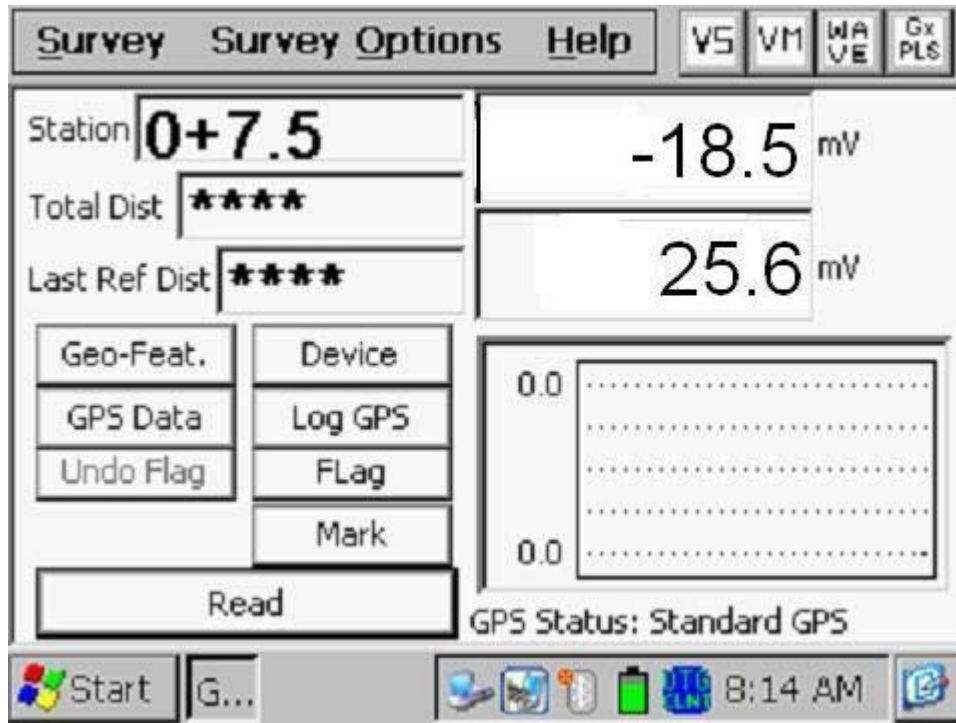
Note: Since SP survey readings are typically small (either tens of mV or hundreds of mV only), with respect to sensitivity, the most appropriate DC ranges are the 5.7V, 400mV and 40mV ranges, depending on the size of the gradient fields that you encounter. Another issue is the signal-to-noise ratio with respect to being able to “find” and “mark” anomalies. For small signals (small gradient fields), the voltmeter’s noise level is the limiting factor. The noise levels associated with the 5.7V, the 400mV and the 40mV ranges are approximately as follows: $\pm 5\text{mV}$, $\pm 1\text{mV}$ and $\pm 0.5\text{mV}$, respectively.

Step 10: Tap on the “OK” button on the “Setup 5 of 5” screen.

A version of the screen shown below will be displayed, depending on the start location entered previously and the location type entered previously (station number, feet or milepost (or station number, meters or kilometer post, for the metric option)).



Note: When readings are logged, the latest logged reading (the prior reading) is displayed in the bottom mV field on the above screen and the current reading is displayed in the top mV field (see the screen below for an example).

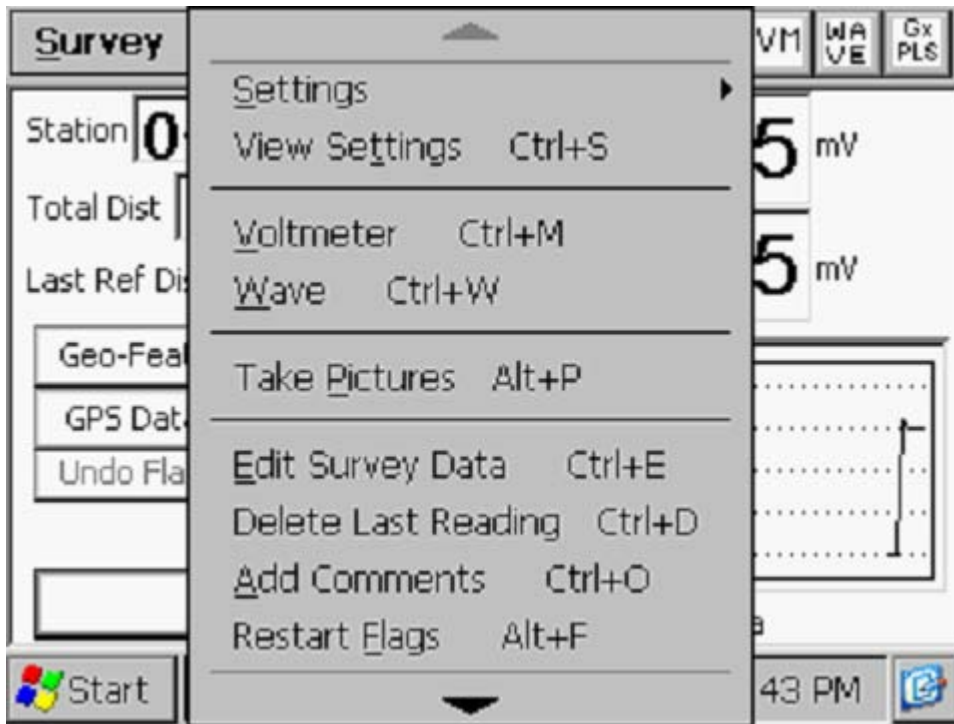


On the above example screen, the prior reading was 25.6mV and the current reading is -18.5mV. In this example, a polarity switch has been detected, which means that a gradient field has been detected.

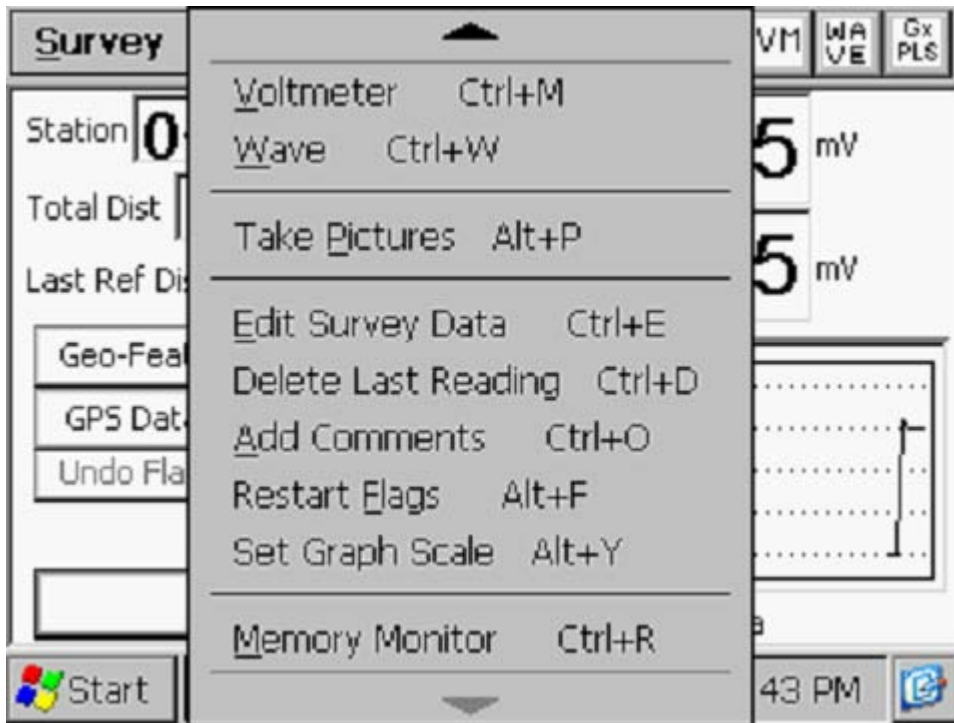
You are referred to our **Surface Potential Training Manual – Gx Data-logger Version** for information and recommendations on how to actually perform SP Surveys using the Gx data-logger. This Training Manual also provides an overview of the physical principles associated with SP Surveys.

IV. 4 “Survey Options” Menu including Picture Taking Option and Editing Option

By tapping on the “Survey Options” button on the Survey screen, the Survey Options menu will be displayed as indicated below.



Tapping on the down arrow on the above menu will reveal additional options, as illustrated in the screen shown below.



Settings

Once you've set up the Gx data-logger for a particular pipeline survey, you can make changes to your setup selections with the exception of your "Survey Type" selection and the currently indicated "Station". If you have selected a Trigger Mode CIS, for example, you cannot change to a Continuous Mode CIS, without setting up a new survey.

You can, however, make other selection changes. For example, if you examine the pipe-to-soil voltage waveform prior to beginning a CIS survey (highly recommended) and discover that there is considerable noise on the waveform, you might decide to switch the voltmeter reading mode from On/Off Pairs (DSP) to On/Off Pairs (Min/Max). Or, in another case, you might decide to change the "Distance Per Readings" interval from 2.5 feet to 5.0 feet, for example.

To change survey settings, tap on "Settings" and tap on "Change Global Settings".

View Settings

To simply view your setup selections, you can tap on "View Settings" on the above menu. Alternatively, you can use the Ctrl and S keys.

Voltmeter

To run the stand-alone voltmeter, either tap on the "Voltmeter" option on the menu or use the Ctrl and M keys. Please see section IV.6 below for more information on running the stand-alone voltmeter.

Wave

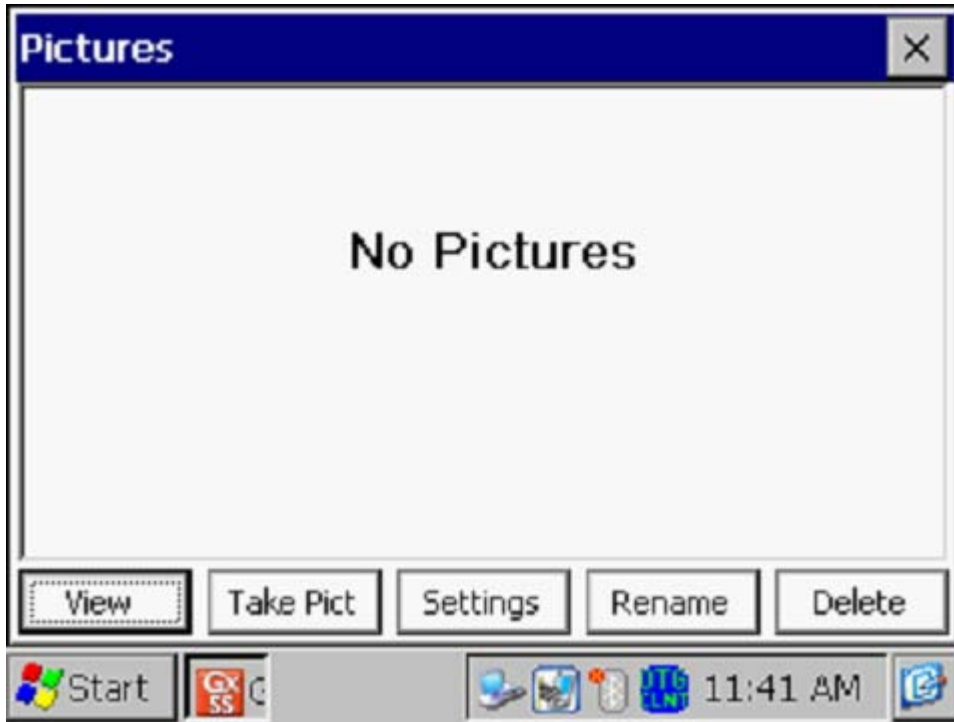
To run the stand-alone waveprint generator, either tap on the "Wave" option on the menu or use the Ctrl and W keys. Please see section IV.6 below for more information on running the stand-alone voltmeter.

Take Pictures

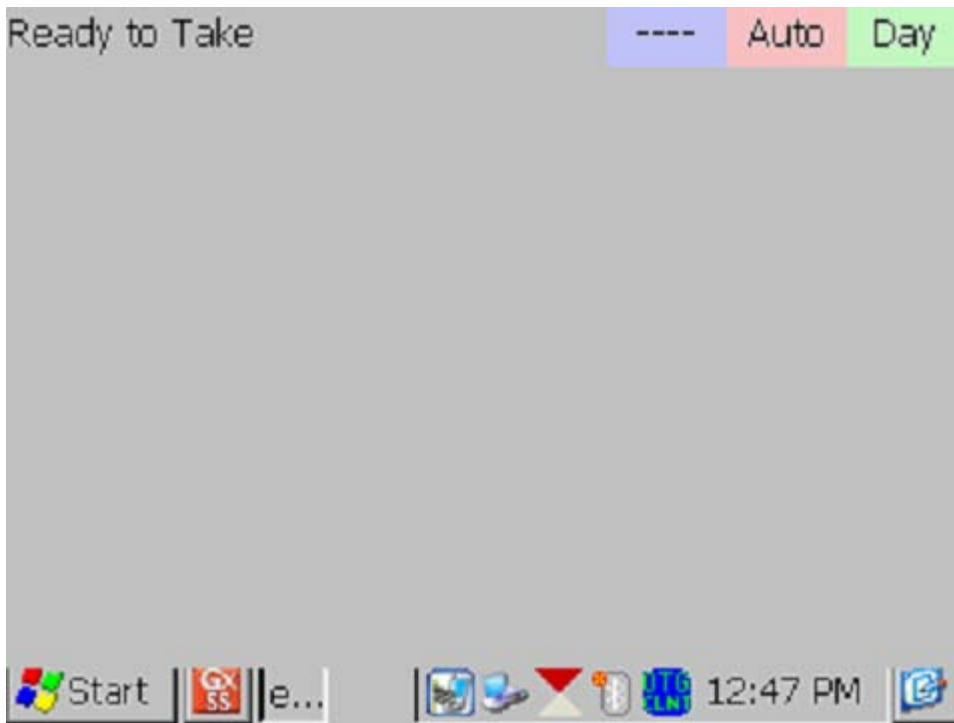
You can run the integrated camera program by either tapping on the "Take Pictures" option on the menu or by using the Ctrl and A keys.

Note: Several seconds are required to open and close the camera program.

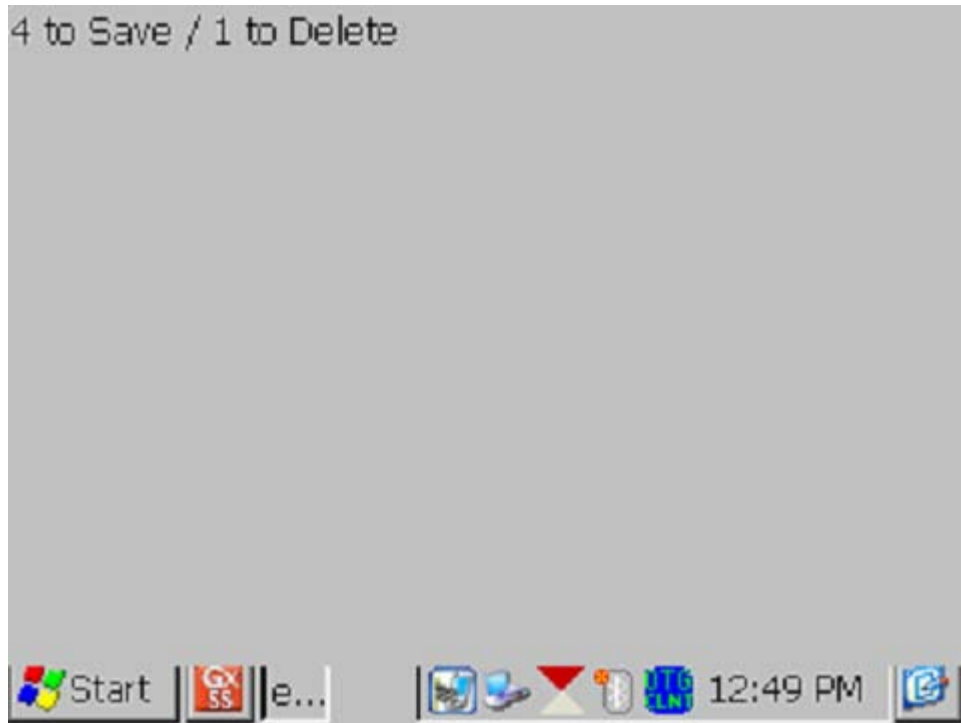
The "Pictures" screen shown below will be displayed.



To take a photograph, tap on the “Take Pict” button. The camera will go through a focusing process and you will see a “Ready to Take” indication at the top of the screen when you can take a picture, as indicated below.



At this point, press (and release) the camera button located at the top right hand corner of the keypad. You will have the choice of saving the picture or deleting it, as indicated by the “4 to Save/1 to Delete” indication on the screen below. To save the picture, press (and release) the #4 key.



An example of a saved image is shown below on the Picture screen.



As indicated in the above screen, the image is given a filename, by default, which represents the date/time stamp for the image. The above image, for example, was recorded on July 13, 2010 at 8:27am.

You can rename the image, if you prefer, by highlighting the image (tapping on the image) and tapping on the “**Rename**” button. You can then enter a new name for the image. For example, the image above has been renamed, “Office Desk” on the screen shown below.



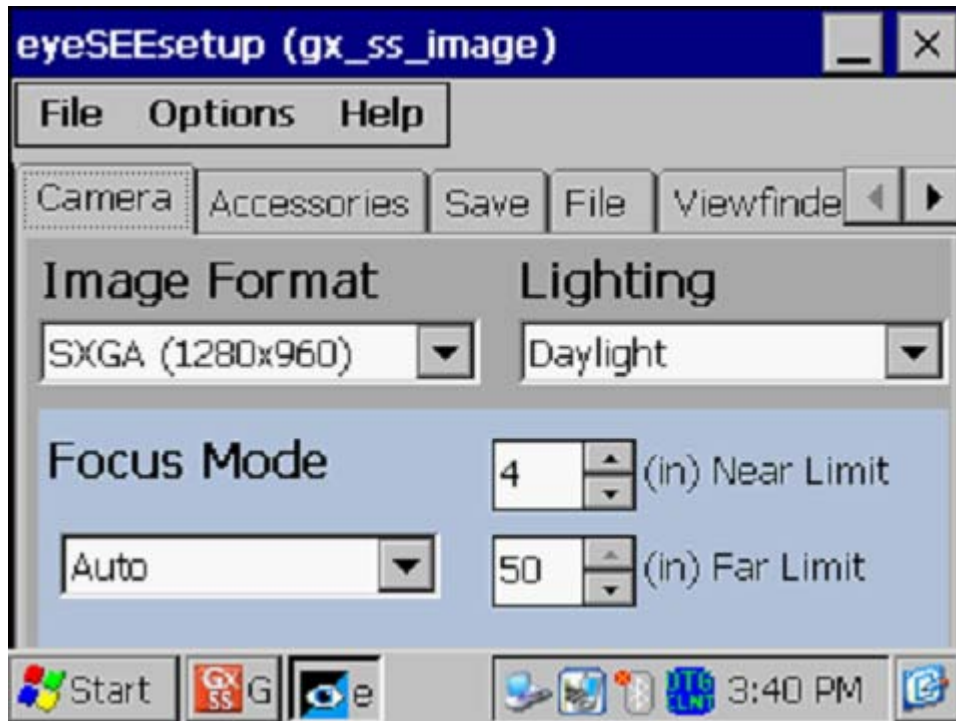
You can view a larger version of the image by highlighting the image (tapping on the image) and tapping on the “**View**” button.

You can take multiple photographs at a test site by repeating the process outlined above. For example, the Picture screen shown below shows two (renamed) images.



If you would like to adjust the camera settings from their default settings you can do so via the “**Settings**” button on the Pictures screen. For example, you can change the size and resolution of the image to be captured, the lighting conditions under which the image will be captured and the focusing method to be used, for example.

By tapping on the settings button, the screen shown below will be displayed.



As indicated on the above screen, there are a number of page tabs labeled, “Camera”, “Accessories”, “Save” etc. For information on the selections available via the various tabs, please see **Appendix 3 (Camera Settings)**.

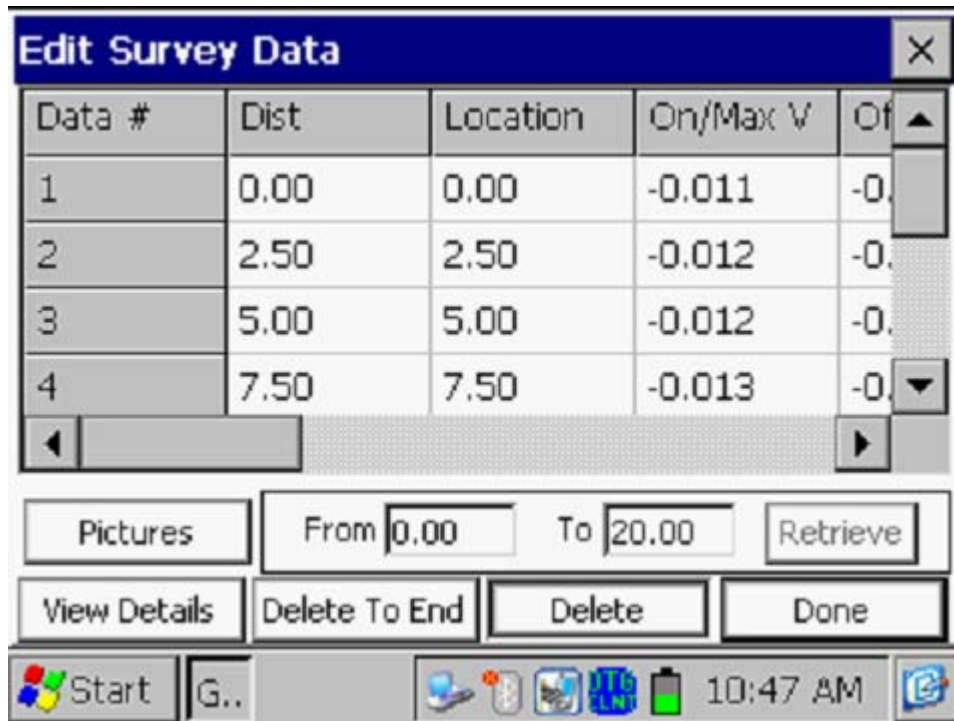
Note: For the default picture size (SXGA (1280x960)), the Flash light is not available. However, you can turn on the LED Lamp (which is turned OFF by default), if direct light is required. You can do so via the “Accessories” tab on the above screen. Also, please note that the Flash light is available for the largest picture size (highest resolution) setting (QSXGA 2048x1944).

You can return to the “Survey” screen (after the picture taking process) by tapping on the “X” button on the Picture screen.

Edit Survey Data

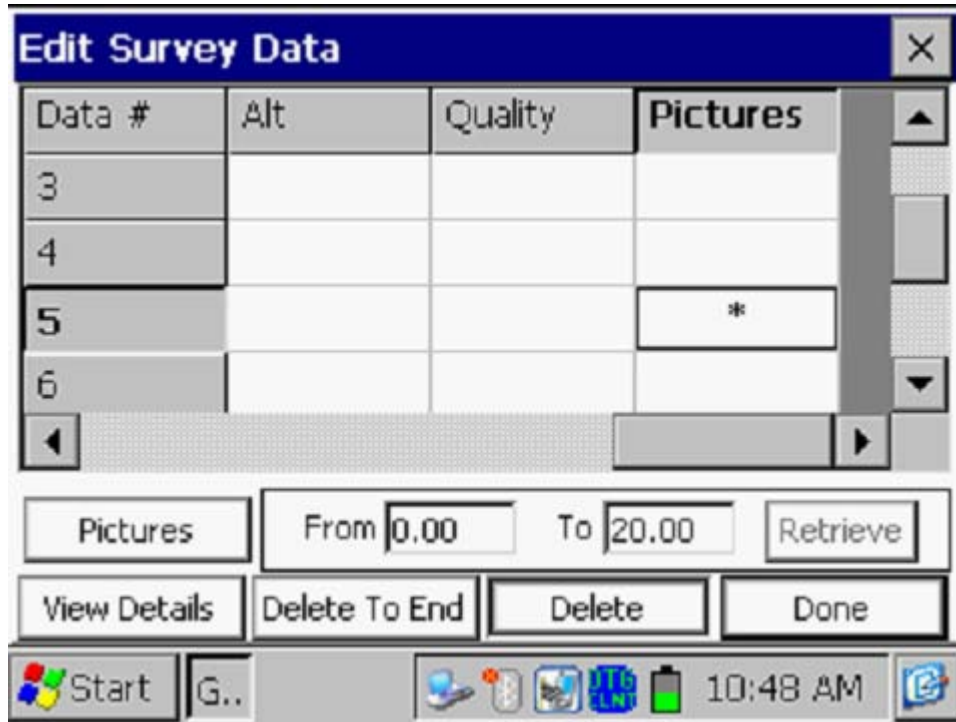
Collected survey data can be edited by tapping on the “Edit Survey Data” button or by using the Ctrl and E keys.

The screen shown below will be displayed, depending on the readings values and reading interval etc.



The data to be viewed can be selected by entering values in the “From” and “To” fields and tapping on the “**Retrieve**” button. Using the horizontal and vertical scroll bars, you can scroll through the collected data. A row of data can be deleted by highlighting the row and tapping on the “**Delete**” button. Multiple rows can also be deleted at the same time.

Pictures can be viewed and/or deleted by first highlighting the location (see screen below) and tapping on the “Pictures” button.



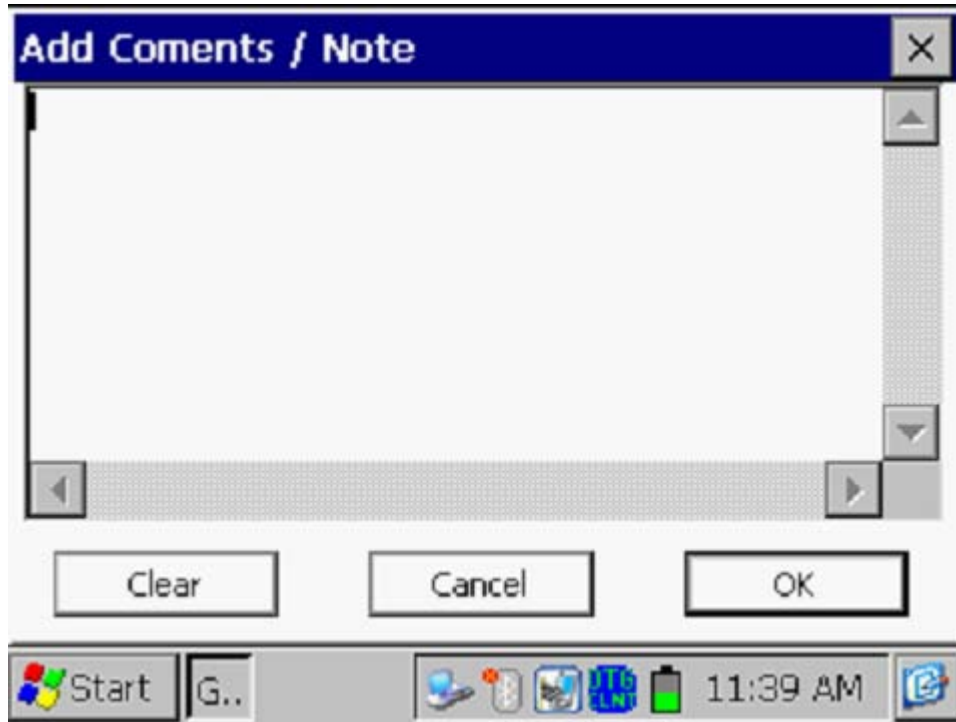
Once highlighted, the picture can be deleted by tapping on the “Delete” button, or viewed by tapping on the “Pictures” button.

Delete Last Reading

By selecting the “**Delete Last Reading**” option from the menu, you can have your last reading deleted, without having to go through the “Edit Survey Data” option. Alternatively, you can use the Ctrl and D keys to access the function.

Add Comments

You can add remarks (comments) at anytime on your survey by selecting the “Add Comments” option and manually entering data on the screen shown below.



Alternatively, you can use the Ctrl and O keys to access the function.

Tap on the “OK button on the above screen to return to the Survey screen after entering your comments.

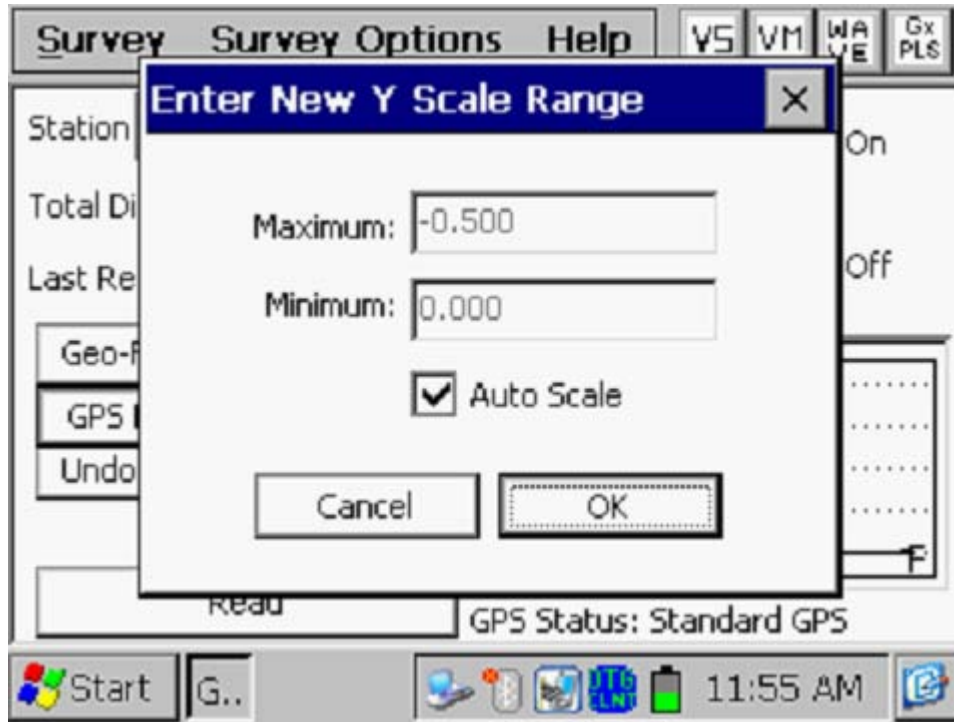
Restart Flags

You can reset survey flags by selecting the “Restart Flags” option from the menu. This action will establish your current location as the new zero reference, as far as flagging is concerned, and “zero” should be entered automatically in the “Last Reference Distance” field on the Survey screen.

Set Graph Scale

Rather than having the software auto scale the graph on the Survey screen to accommodate the actual data values logged, you can establish the maximum and minimum values for the graph scale in order to restrict the data values to be displayed on the graph.

To do so, you would un-check the box labeled, “Auto Scale” on the window shown below and enter specific values for “maximum” and “minimum”.



Tapping on the “OK” button will return you to the Survey screen.

IV. 6 How to Use the Gx as a “Stand-Alone” Voltmeter/ Waveprint Generator

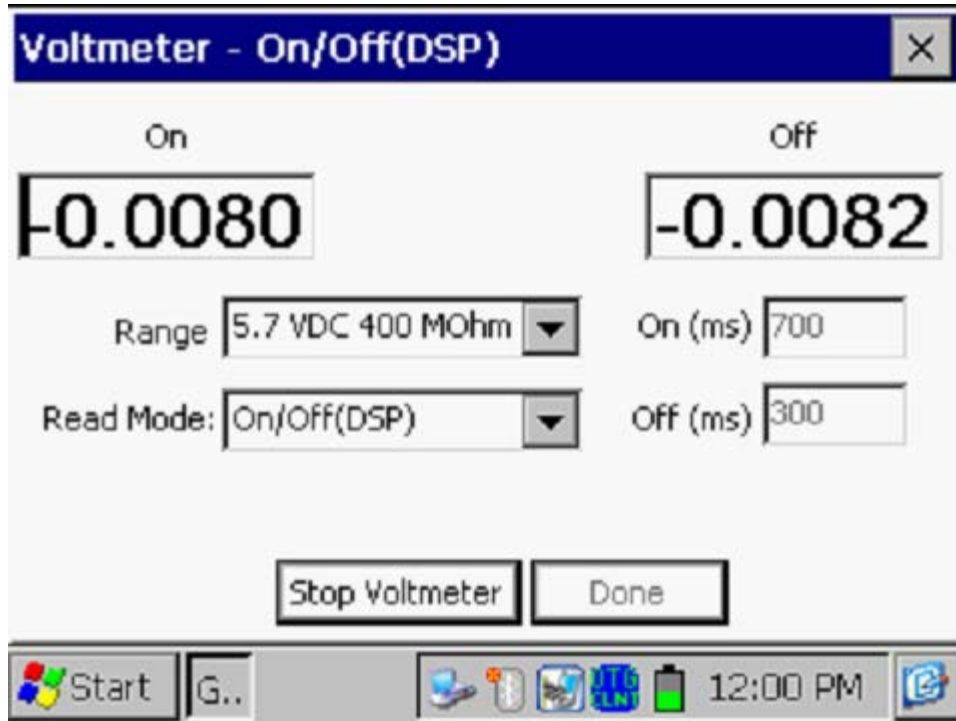
The Gx data-logger can be used as a “stand-alone” voltmeter or waveprint generator in situations where such applications may be warranted in association with the performance of a pipeline survey.

For example, at “devices” on your pipeline survey where you can make electrical contact with the pipe, you might want to make sure that all of the rectifiers having an affect on the pipeline are being switched On and Off in a synchronized fashion. Or, you might want to check certain readings that are not an integral part of the survey itself. Or, you might to examine the IR drop at a particular location etc., etc.

You can use the Gx as a “stand-alone” voltmeter by tapping on the “**Voltmeter**” button (“VM” button) at the top of the Survey screen or by tapping on “Survey Options” and then tapping on “Voltmeter”.

The “stand-alone” term arises due to the fact that, in this mode, the voltmeter is operating outside of the pipeline survey parameters and is being used in an independent (non-data-logging) capacity.

The screen shown below will be displayed, depending on previous settings.



The Red and the Black banana plug terminals on the top side of the Gx can be used to read voltages, via test leads or, alternatively, if an MCM data-probe is being used, the data-probe will be connected to the 5-pin connector on the top side of the Gx (connecting the reference electrode to the negative side of the voltmeter, if a black-band cable is used), and, the Red banana plug terminal can be used to connect to the positive side of the voltmeter.

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.

Following the reading process, tap on the “**Stop Voltmeter**” button and tap on the “**Done**” button, which will return you to the Survey screen.

By tapping on the menu button in the “**Read Mode**” field, you can select from the following voltmeter reading mode options:

Single Read: This is a single read mode, where either the rectifier current is permanently ON or the rectifier current is OFF for the duration of the reading.

On/Off (DSP mode):

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.

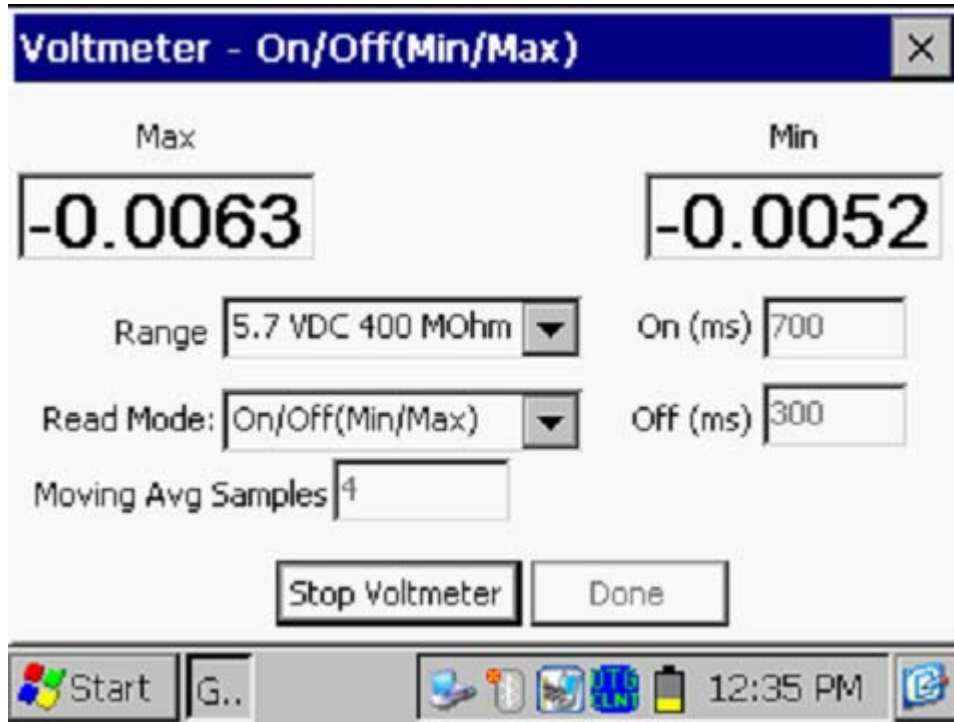
Note: A measurable difference between the ON and the OFF voltage readings is required for this reading mode, i.e., a measurable IR drop is required.

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 mode)

This voltmeter reading mode should be selected if there is 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.

With this voltmeter reading mode selected, an addition field (“Moving Average Samples”) will be displayed, as indicated on the screen shown below.



Moving Average Samples

The default value for “Moving Average Samples” is 4. In this case, 4 sample readings would be used to compute an average value for the Minimum (Min) voltage reading during each OFF portion of the cyclic waveform and, also, 4 readings would be used to compute an average value for the Maximum (Max) voltage reading during each ON portion of the waveform.

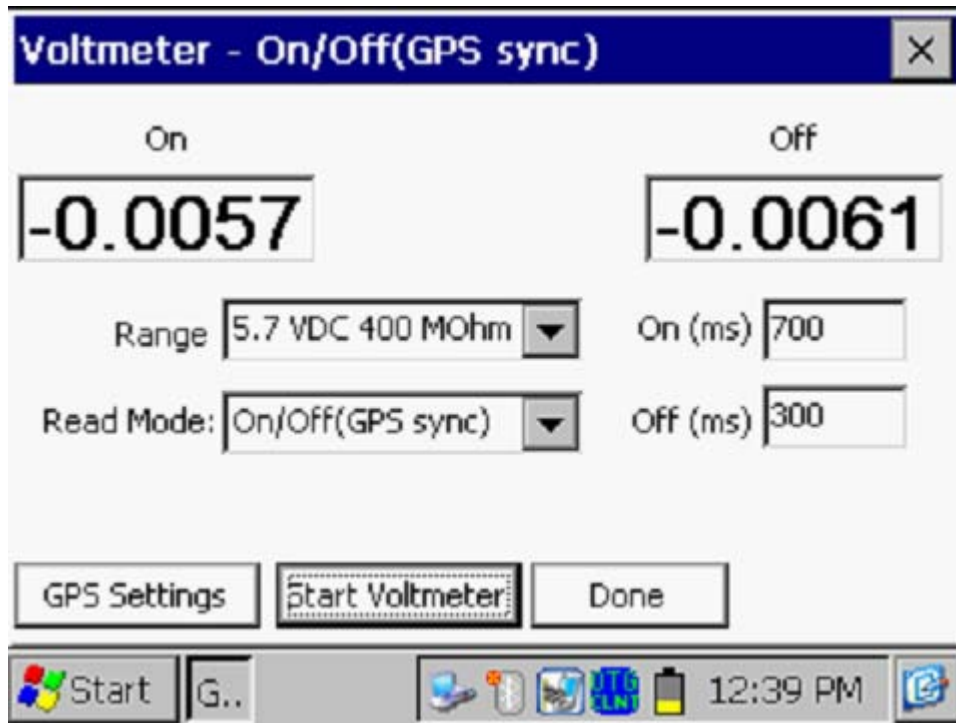
Different values can be entered for this parameter in order to try to “optimize” the On/Off readings, depending on the nature of the interference occurring.

On/Off (GPS Sync):

This voltmeter reading mode can only be selected if you are using the built-in “MCM Internal” GPS receiver **AND** GPS current-interrupters.

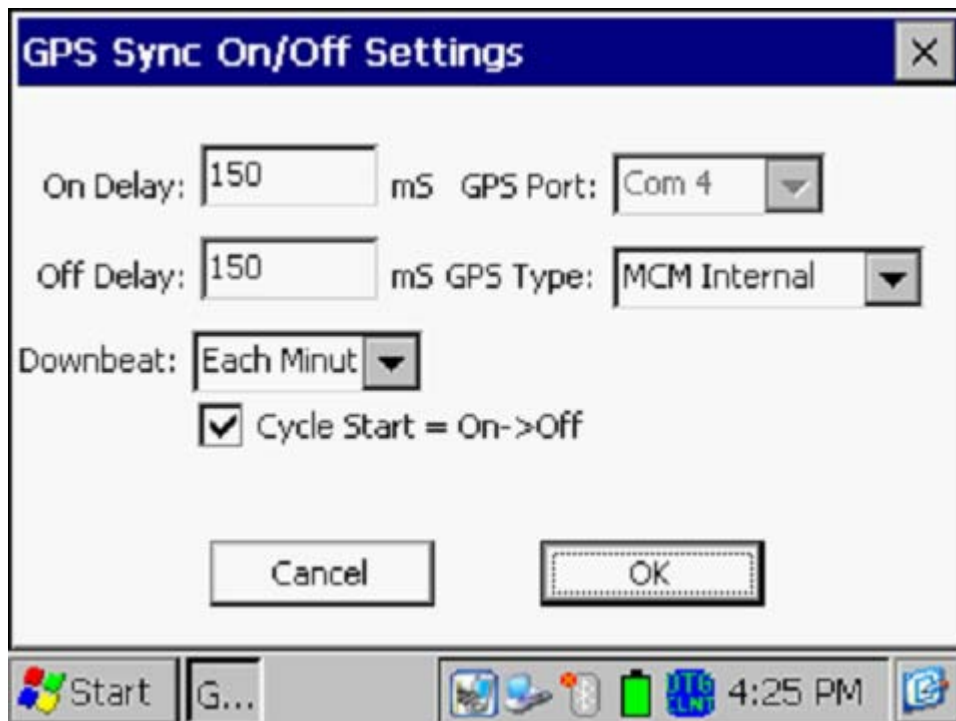
With this reading mode elected, you can select the recording times on the waveform for both the On and Off readings, with respect to the On-to-Off transitions and the Off-to-On transitions of the waveform, as opposed to the software determining appropriate locations on the waveform for you (as in the case of the On/Off Pairs D.S.P. reading mode – see above).

With this voltmeter reading mode selected, the screen shown below will be displayed revealing an additional button (“GPS Settings”)



GPS Settings

By tapping on the “GPS Settings” button, the screen shown below will be displayed, depending on the previous settings.



GPS Type

Select the type of GPS receiver being used. Currently, only the MCM Internal GPS Receiver can be used with the GPS Sync reading mode.

On Delay & Off Delay

By tapping in the fields labeled, “On Delay” and “Off Delay”, you can enter specific times (in milli-seconds) for these parameters.

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 delay times selected should be based on knowledge of the waveform, particularly in terms of any transition spiking. The idea is to select sampling times that will avoid any spiking.

Downbeat

By tapping on the menu button in the “Downbeat” field, you can select the downbeat schedule associated with the particular current interrupters you are using for the survey. The three options are: Each Minute, Each Hour and Midnight.

For example, if “Each Minute” is applicable to your interrupters, and you select this option for the Downbeat schedule, you are indicating to the data-logger software that at the top of each minute, there will be an On to Off transition (the rectifier current will switch from On to Off at the top of each minute). This would mean, in this example, that the software would only have to count back to the top of the last (previous) minute to have a timing reference.

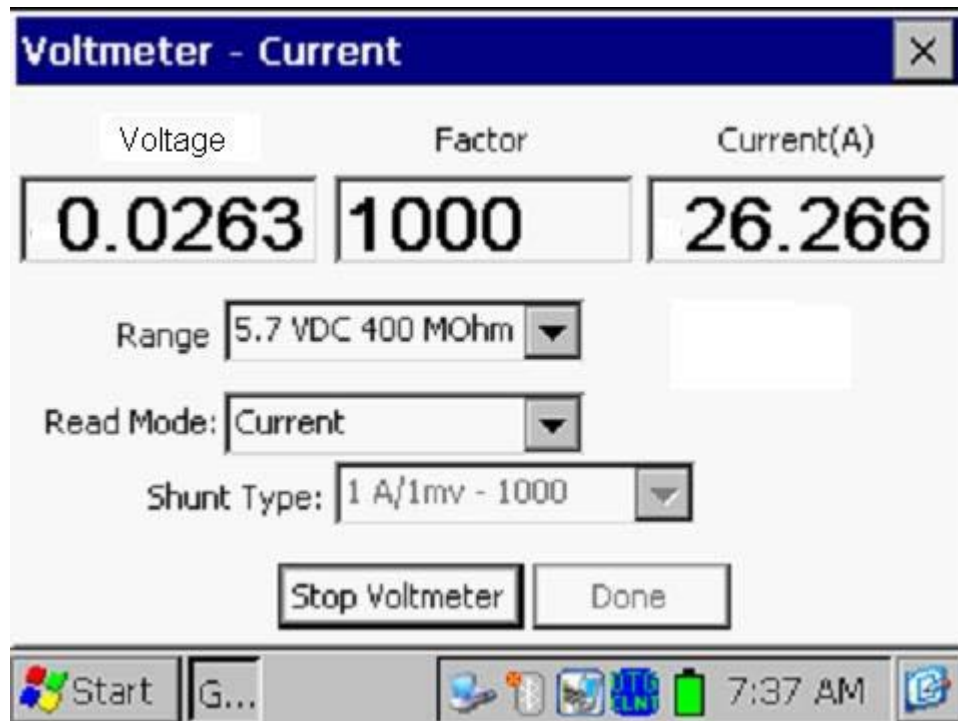
Cycle Start

Finally, if your interruption cycle starts with the current in the ON state (the first transition is from ON to OFF), check off the box labeled, “Start Cycle” (un-check this box if the opposite is true).

Tapping on the “OK” button on the “GPS Settings” screen will return you to the Voltmeter screen.

CURRENT (shunt voltage):

This mode would be selected if you were using the Gx to measure current via a shunt. By selecting this mode, the screen shown below will appear.



A number of industry standard shunts can be selected by tapping on the menu button in the “**Shunt Type**” field, after tapping on the “Stop Voltmeter” button to make any desired settings changes. You can also select “other” and enter your own shunt factor in the “Factor” field.

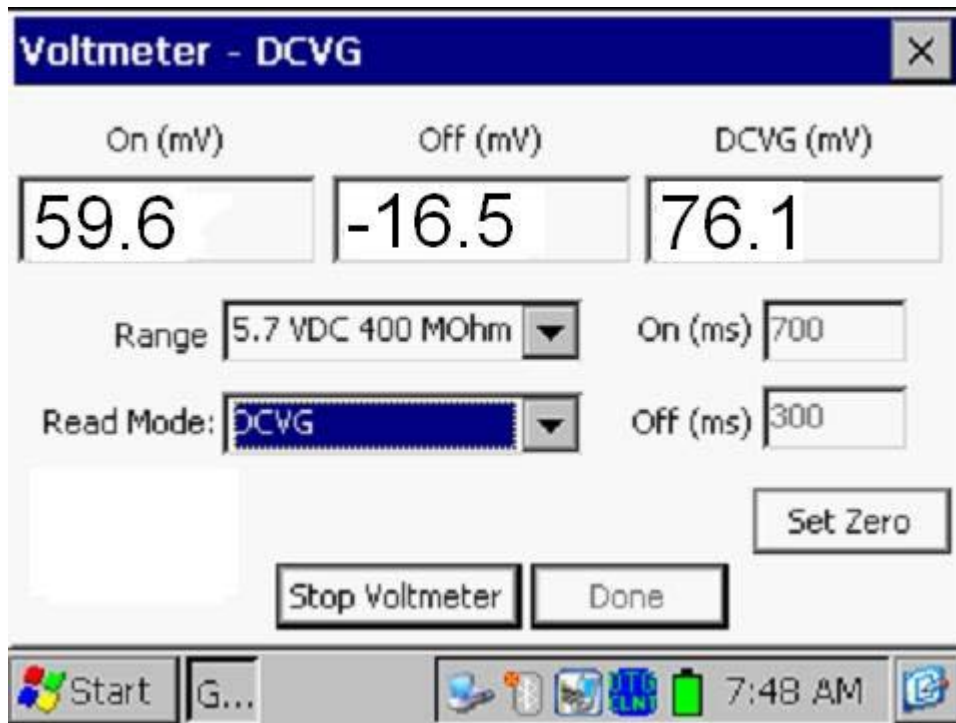
Note: The units of the displayed “Voltage” (Volts or milli-Volts) will depend on the settings selected in the “Range” field. Current is always displayed in Amps.

DCVG:

This voltmeter reading mode would be appropriate if you were set up to perform a DCVG survey (please see our DCVG Surveys Training Manual – Gx Version)

By running the “stand-alone” voltmeter, you can view the delta V(ON) and delta V(OFF) readings as well as the calculated (by the G1 software) value for the DCVG voltage [$\Delta V(\text{ON}) - \Delta V(\text{OFF})$].

The screen shown below is an example screen for operation in the DCVG reading mode.



As can be seen from the above screen, the delta V(ON) reading is +59.6mV and the delta V(OFF) reading is -16.5mV. Consequently, the DCVG voltage is 76.1mV.

This is an example of a cathodic/anodic anomaly, in which case current is flowing **away** from the pipe, at the defect location, into the soil during the OFF part of the current-cycle, but the defect is cathodically-protected when the impressed CP current is ON (current is flowing **to** the defect location).

This is important information that can be obtained with the Gx in this DCVG voltmeter reading mode without having to go through the process of “marking” a defect, as is the case when you are performing an actual DCVG survey (see our DCVG Training Manual – Gx Version).

The “**Set Zero**” button on the above screen also represents a useful feature. By placing the reference electrodes on the ground (close together) away from any voltage gradient fields, and tapping on the “**Set Zero**” button, the voltmeter will eliminate any offset that might exist between the two reference electrodes, which is important when measuring potential differences between two electrodes, as is the case in DCVG surveys.

DCVG GPS Sync.:

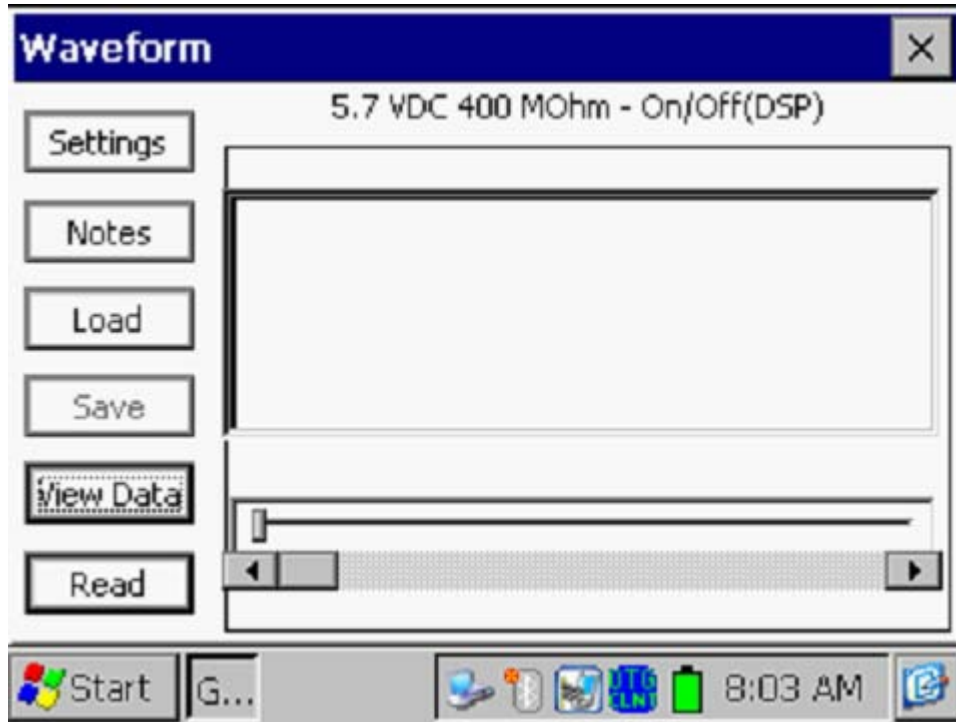
This voltmeter reading mode is similar to the DCVG reading mode described above except that, in this case, the On and Off voltages are sampled each cycle at precise times selected by the user.

Again, as was the case with the “ON/OFF GPS Sync” reading mode, this mode can only be selected if you are using the MCM Internal GPS receiver on the Gx **AND** you are using GPS current interrupters.

If this mode is selected, the “GPS Settings” button will again appear, as was discussed for the case of the “ON/OFF GPS Sync mode”. The GPS Settings selections will have to be made as described above for the ON/OFF GPS Sync mode option.

Waveprint Generator

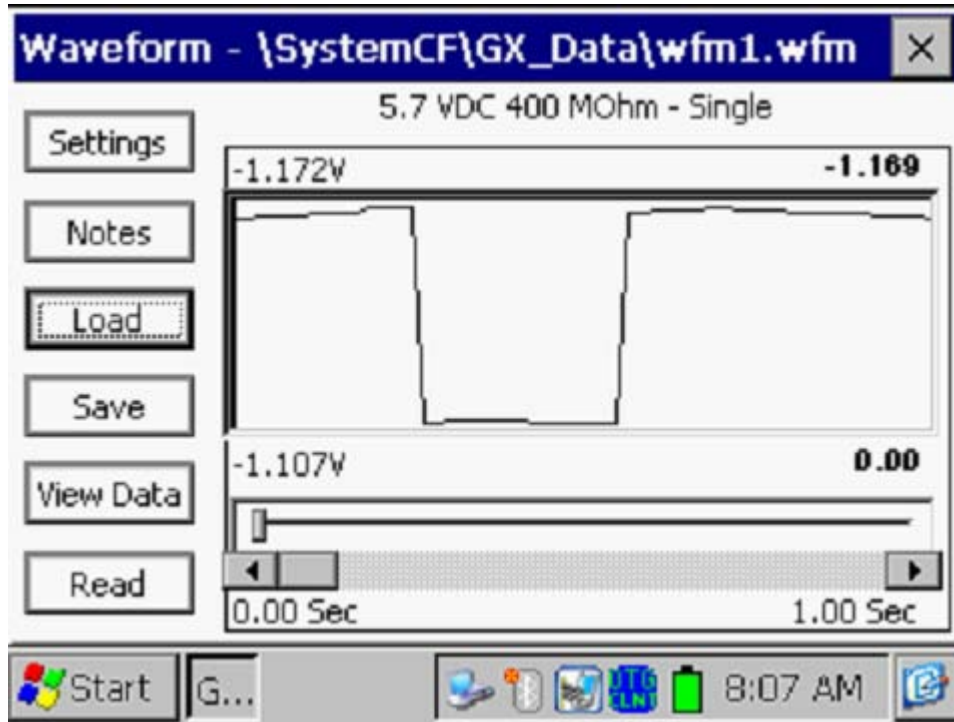
To use this feature, either tap on the “WAVE” button located at the top of the Survey screen or, when a survey has been setup, tap on “Survey Options” and then tap on “Wave”. The screen shown below will be displayed, depending on the previous settings.



Read:

By tapping on the “**Read**” button on the above Waveform screen, you can view, for example, the pipe-to-soil voltage waveform at a test site, assuming that you have the appropriate cable connections made to the Gx.

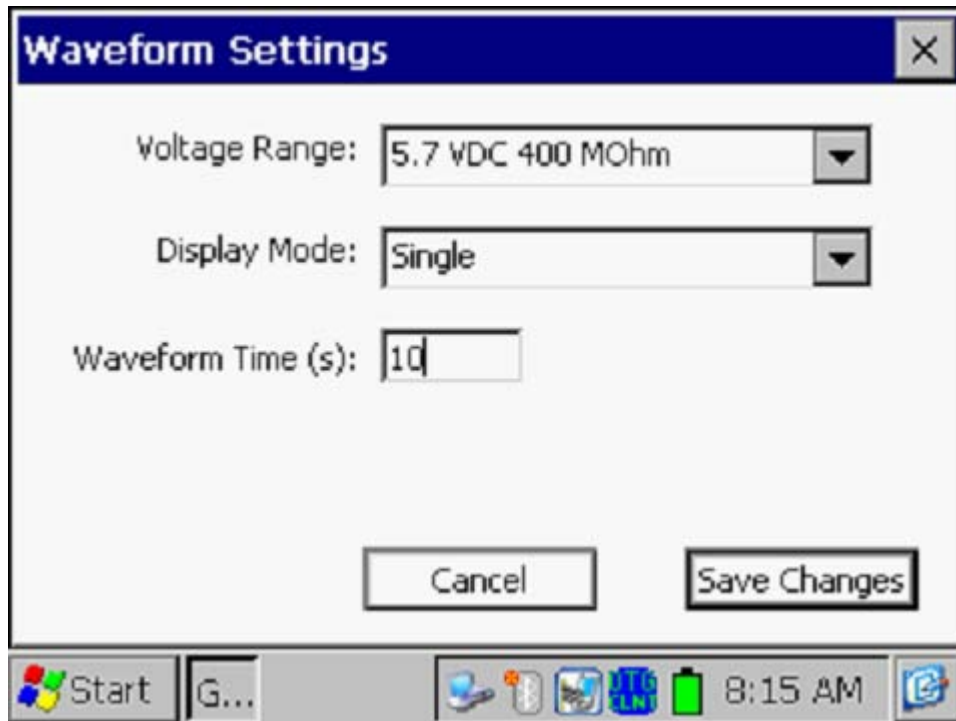
A typical waveform would be as shown in the screen below. *Note:* The example waveprint shown is not a “real” waveprint .. it is only presented for illustrative puposes.



Waveprints are very useful with regard to confirming switching synchronization of current interrupters, for example, and with regard to checking for On-to-Off and Off-to-On transition spikes.

Settings

By tapping on the “Settings” button on the Waveform screen, the screen shown below will be displayed, depending on the previous settings.



Since all of the DC channels on the Gx data-logger are fast response channels, you can select any “Voltage Range” setting amongst the DC options, regardless of the interruption cycle rate. The main issue with regard to optimum Range selection is sensitivity, in terms of the magnitude of the voltages being measured.

You can also change the “Display Mode” selection, by tapping on the menu button in the “Display Mode” field. In the case of the “Single” reading mode option, you can select the number of waveform periods to be displayed (viewable via the horizontal scroll bar), by tapping inside the “Waveform Time” box and entering a value manually for number of seconds. For example, if the interruption cycle period is 5 seconds (4 seconds On/1 second Off) and you entered 10 (seconds), you would have 2 waveform cycles displayed.

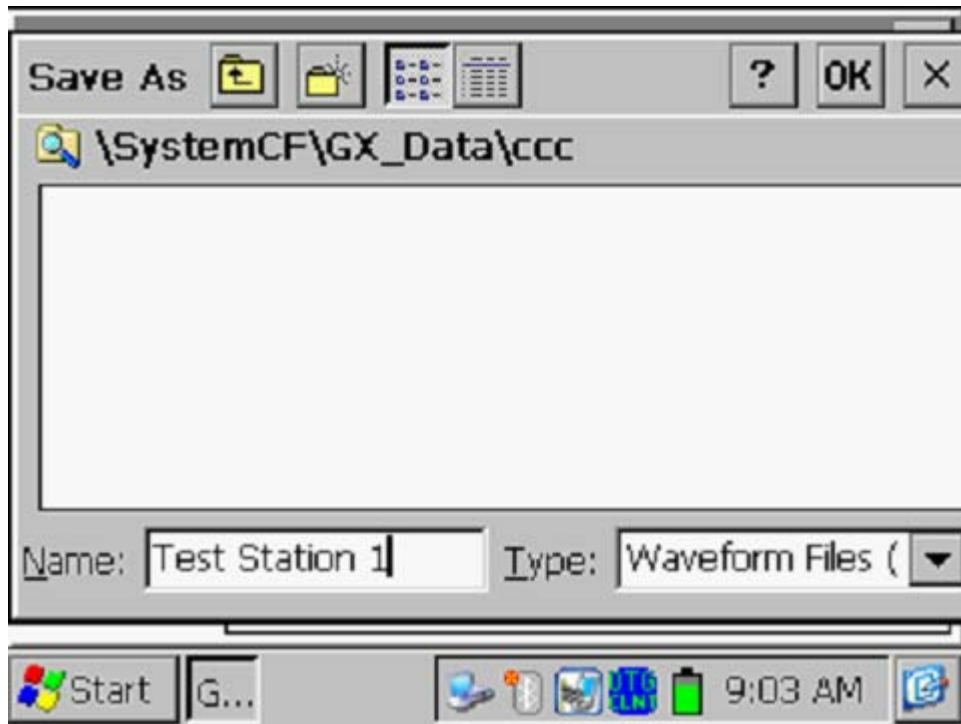
Save

To record a waveprint, tap on the “**Save**” button on the Waveform screen. The screen shown below will be displayed. *Note:* The specific folders presented on the screen will reflect the contents of the Gx_Data folder on your Flash memory card (SystemCF). The Gx_Data folder is used to store all of your survey files.



You have a number of options regarding saving the waveform data.

The recommended option, if you are recording waveform data in the context of a pipeline survey, is to save the waveform data file inside the actual pipeline survey file. To do so, you would double-tap on the survey file (folder) and enter a descriptive name for the waveform data file in the “Name” field. For example, the screen shown below would be displayed for the case of selecting the “ccc” survey file for storage of the waveform data file named, “Test Station 1”.



Alternatively, you could just enter a name of the waveform data file in the “Name” field and tap on the “OK” button. In this case, the waveform data file will be saved directly to the Gx_Data folder.

In addition, you could open a new folder in which to store the waveform data file, if you were collecting waveform data independent of a particular pipeline survey, for example.

Regardless of your target folder, you should tap on the “OK” button to save the waveform data file.

Load:

Finally, by tapping on the “**Load**” button on the Waveform screen, and highlighting a particular waveform data file displayed, you can have the previously-saved waveprint displayed by tapping on the “OK” button on the screen

APPENDIX 1

HOW TO CONFIGURE TRIMBLE XR, XRS, Power and Pocket GPS RECEIVERS FOR USE WITH THE Gx DATA-LOGGER

a) Introduction

Although standard (uncorrected) GPS data only provides a position accuracy of around 15 meters, real-time corrected GPS data can result in a position accuracy of better than 1 meter, making real-time corrected GPS data more suitable for pipeline survey applications.

In order to output real-time corrected GPS position data, a GPS receiver has to be coupled with a “correction message” receiver which receives a correction message transmitted by one of three major systems, namely, the WAAS, Satellite and Beacon correction message generating systems. (In most cases, the correction message receiver is integrated with the GPS receiver in one unit, although external correction message receivers are also used).

For example, our internal MCM GPS receivers (which have integrated correction message receivers) make use of correction messages transmitted by the WAAS system. The WAAS system works well in open areas (throughout North America), however, in some locations, such as heavily-wooded or mountainous areas, it is difficult to receive a correction message from the WAAS system, due to the present positioning, directly over the equator, of the only two (geo-synchronous) re-broadcast satellites currently in the WAAS system.

Consequently, until additional re-broadcast satellites are added to the WAAS system, making it equally effective in all regions of North America, it may be necessary for you to use another type of GPS receiver (other than the internal MCM GPS receiver) in order to access the correction message transmitted from either the Satellite system or the Beacon system, depending on your particular location.

For instance, Trimble GPS Pathfinder receivers are commonly used to access correction messages available via commercial (subscriber) satellite systems such as OmniSTAR and LandStar or via a system of ground-based beacons (Coast Guard system).

If you plan to use a Trimble “GPS Pathfinder” receiver unit in conjunction with your Gx data-logger, there is a configuration process that you need to perform, in order to set up the GPS unit so that appropriate data will be delivered to the Gx data-logger from the receiver.

A “GPS Pathfinder” receiver is capable of outputting NMEA data, when appropriately configured, which is the required output data type for a GPS receiver to work in conjunction with the Gx.

There are four types of Trimble “GPS Pathfinder” receiver units that can be configured to be compatible with the Gx using a software program called “GPS Pathfinder Controller”. The 4 receiver models are:

- GPS Pathfinder Pro XR
- GPS Pathfinder Pro XRS
- GPS Pathfinder Power
- GPS Pathfinder Pocket

The “GPS Pathfinder Controller” program is available from Trimble.

Your Trimble receiver unit will first have to be connected to the computer (your PC) onto which you have installed the GPS Pathfinder Controller program in order that the GPS receiver can be configured with the settings outlined below to be compatible with the Gx Data-logger.

b) How to Configure “GPS Pathfinder” Receivers to Output NMEA Data Suitable for use by the Gx Data-Logger:

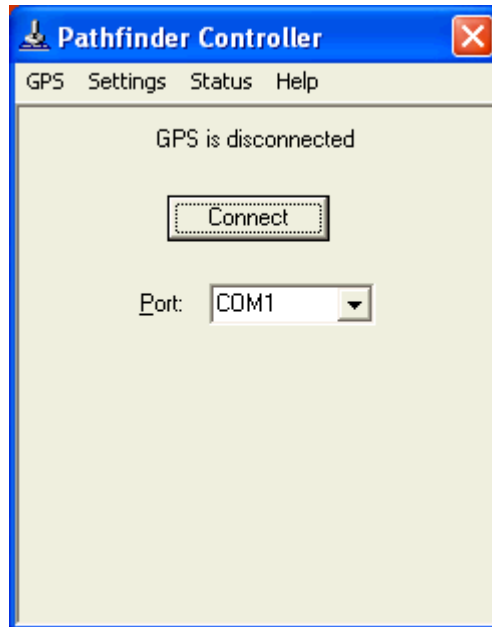
Step 1:

The first step in the configuration process is to connect the Trimble GPS receiver to your PC using the COM 1 Port on the Gx (built-in serial port) if using a serial cable.

Make sure that the battery pack is connected and that battery power is being applied to your receiver unit.

Step 2:

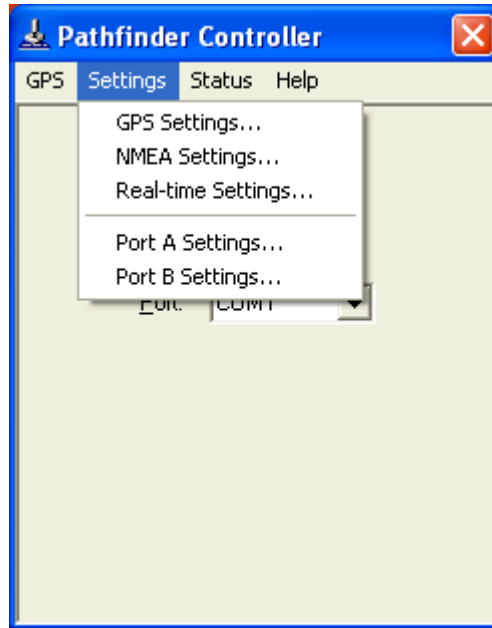
Double-click on the “GPS Pathfinder Controller” icon located on your PC’s desktop. The window shown below (or a version thereof) will be displayed.



You should then select the appropriate COM port (COM 1 if using the serial cable).

Step 3:

Click (or tap) on “Settings” on the above window. This will pull up the window shown below.



Step 4:

Click (or tap) on “Port A Settings” or “Port B Settings”. This will allow you to configure either Port A or Port B for NMEA data output.

The specific port that you’ll configure to output NMEA data (Port A or Port B) will depend on which of the Pathfinder receiver units you are configuring for application with the Gx and whether or not you would like to have the Gx unit signal the receiver to perform GPS tracking only when a survey application requires GPS data, as opposed to the receiver continuously-tracking the GPS signals even when not required to do so by the Gx.

For both the **XR and XRS receivers**, you can select to configure either Port A or Port B for NMEA data output.

The important issue with regard to the XR and XRS receivers is the connection cable itself.

If you would like the Gx unit to signal the GPS receiver when GPS tracking is required by the Gx, during particular survey applications, you would select cable number 30231-00 to connect the receiver to the Gx.

This is a power-saving mode of operation for the GPS receiver, since, when GPS tracking is not required by the Gx, the GPS receiver will be in “sleep” mode, which is a low-battery-power consumption mode. Conversely, if you’d like the GPS receiver to be continuously tracking the GPS signals at all times, you would select cable number 30945. With this cable, the Gx does not control when the receiver is in GPS tracking mode, but rather, the receiver will begin tracking as soon as battery power is applied and will continue to track until the battery power is switched off. This would represent the maximum battery power consumption mode for the receiver.

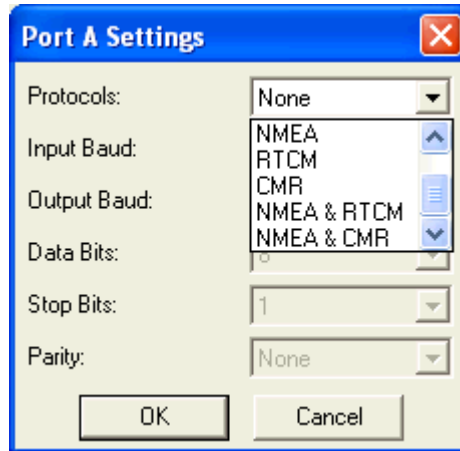
With regard to the **Power** receiver (which only has one physical terminal but you can connect to either Port A or Port B internally, depending on which cable you select), you would configure Port B for NMEA data output by selecting cable number 40492, assuming that you wanted to have the Gx signal the receiver to perform GPS tracking only when GPS data are required by a survey application. Alternatively, you would configure Port A, using cable number 30945, if you wanted to have the receiver to always be tracking the GPS signals when battery power is applied, even when GPS data are not required by the Gx.

Finally, for the **Pocket** receiver you must configure Port B for NMEA data output and you must connect to the Gx using the standard Pocket receiver cable supplied by Trimble. The Pocket receiver can only track the GPS signals when prompted to do so by the Gx unit. In other words, the Pocket receiver needs a control signal from an external unit (in our case the Gx) to be turned on.

Example:

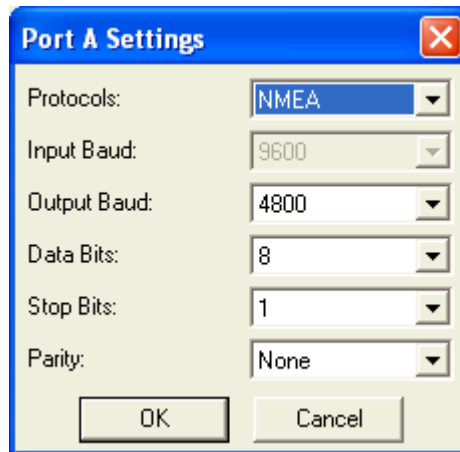
The following is an example of how you would configure Port A on the receiver unit for NMEA output.

If you select to configure Port A, by clicking or tapping on “Port A Settings”, the window shown below will appear.



Step 5:

Click (or tap) on the menu button in the field labeled, “Protocols” on the above window and select “NMEA”. The window shown below will appear.



Select the output baud rate for the receiver and the other communications settings required to match the Gx’s requirements.

The settings on the “Port A Settings” window shown above should be as follows:

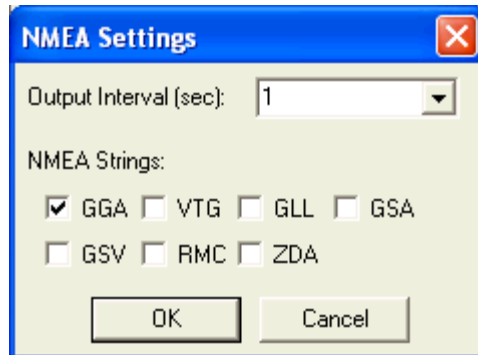
Output Baud Rate: 4800
Data Bits: 8
Stop Bits: 1
Parity: None

Step 6:

Click (or tap) on the “OK” button on the above “Port A Settings” window which will save these communications settings.

Step 7:

Click (or tap) on “Settings”, again, and then click (or tap) on “NMEA Settings” this time. By doing so, the window shown below will appear.



The NMEA data string format labeled as, “GGA” should be selected (box checked). All other boxes should be left unchecked.

The “GGA” data string contains position data (latitude, longitude and altitude) as well as the time (UTC) that each position was fixed. In addition, the “GGA” string contains data that indicate whether or not real-time correction was applied and how many satellites were involved for each position fix.

The “Output Interval” refers to the interval of time between the output of one string of NMEA data and the output of the next string of NMEA data, by the receiver.

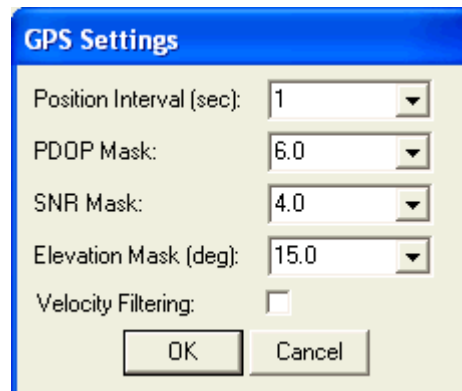
For application with the Gx, an “Output Interval” of 1 second should be selected by clicking (or tapping) on the menu button in the box labeled, “Output Interval” and selecting “1”.

Since our data strings contain position data (GGA format) and since we are requesting a new data string to be output by the receiver each second, this means that the receiver has to be generating position data at least every second. This issue brings us to the “GPS Settings” selection step (step 8).

Step 8:

After clicking (or tapping) on the “OK” button on the “NMEA Settings” window, click (or tap) on “Settings” again, and this time click (or tap) on “GPS Settings”.

This will pull up the window shown below.



Based on the discussion in Step 7, we require position data to be output every second and so, your selection of “Position Interval” on the above window should be 1 second.

We recommend that the other settings on this window be left at their default values, which are the values shown in the above window. These additional settings pertain to maintaining a minimum “quality” of GPS data, based on the receiver only processing data from satellites that are well positioned (relative to one another) and that are producing good signal strength. Please refer to the Trimble Pathfinder manual for more details on these parameters.

Step 9:

If you require real-time corrected GPS data and you plan to employ a particular system, Satellite (subscriber service), Beacon or WAAS, you would make any necessary selections in this regard by clicking (or tapping) on “Settings” and this time clicking (or tapping) on “Real-time Settings”. In the case of both the Satellite and Beacon systems, you would be required to make additional selections to suit your needs. Please refer to the Trimble Pathfinder manual for additional details.

Step 10:

Connect the “GPS Pathfinder Controller” software to the receiver unit by

clicking (or tapping) on “GPS” and selecting “Connect”. **By doing so, your settings will be sent to your GPS receiver unit to configure its operation.**

Step 11:

Disconnect the “GPS Pathfinder Controller” software from the receiver unit by clicking (or tapping) on “GPS” and selecting “Disconnect”.

Your “GPS Pathfinder” receiver will save your settings in its memory until you decide to re-configure the unit. You are now in a position to connect a suitably-configured receiver to the Gx unit and to perform surveys involving logging GPS position data associated with each site.

c) How to Connect a Configured GPS Pathfinder Receiver to the Gx

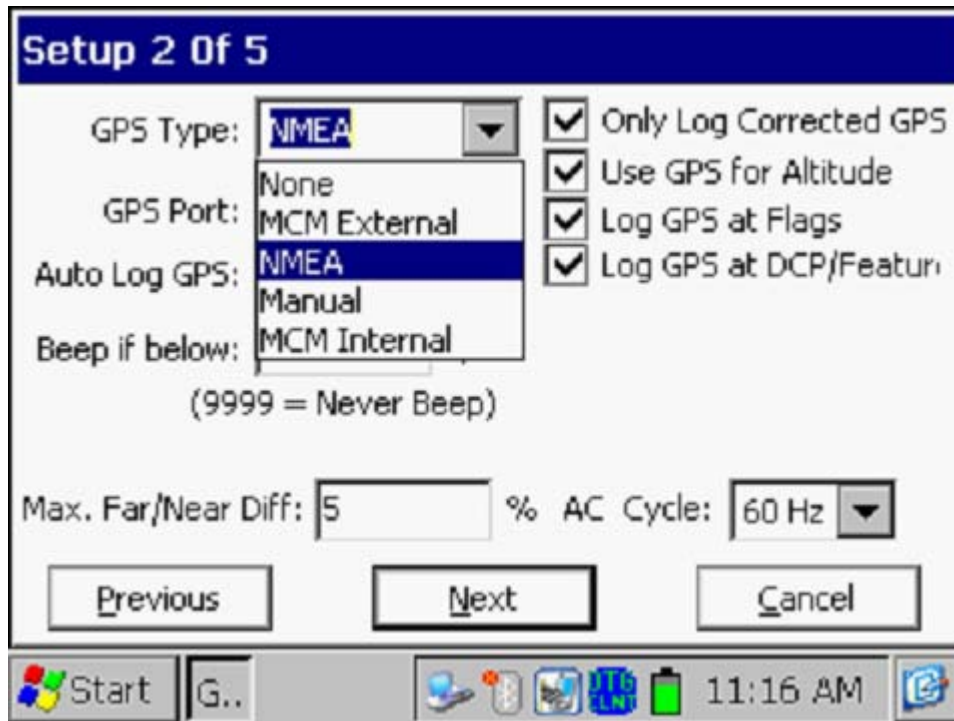
When you’ve configured your GPS receiver (either via your PC or via your Gx) and are ready to conduct a test site survey, you would connect your receiver to the Gx Data-logger via the COM 1 port (built-in serial port on the Gx), if you are using a serial cable.

Note: You will require a special cable (Gx Data-logger/Trimble GPS Connection Cable), which is MCM part number 11283, to connect the receiver to the Gx. This special cable is used in conjunction with your selection of Trimble cable (see section d (step 4) above).

d) How to Setup the Gx for a Pipeline Survey Application with an integrated GPS Pathfinder Receiver

The critical step here is to select NMEA, for the GPS Type, on the “Setup 2 of 5” screen during the process of setting up a survey file (see Sections IV. 1 through IV.4).

An example “Setup 2 of 5” screen is shown below.



Select the “**NMEA**” option from the “GPS Type” menu on the above screen.

Also, if you are connecting your receiver to the Gx data-logger via a serial cable, select “**Com 1**” from the “GPS Port” menu.

After setting up a survey file, connect your GPS receiver to the Gx data-logger via the Com 1 Port on the Gx data-logger, which is the built-in serial port located under the flap on the bottom left hand side of the logger.

Note: You will require a special cable (Gx Data-logger/Trimble GPS Connection Cable), which is MCM part number 11283, to connect the receiver to the Gx. This special cable is used in conjunction with your selection of Trimble cable (see section b (step 4) above).

APPENDIX 2

HOW TO CONFIGURE TRIMBLE ProXT and ProXH GPS RECEIVERS FOR USE WITH THE Gx DATA-LOGGER

SECTION 1

How to Configure the GPS Receiver for use with the Gx

Step 1: Insert the Trimble “GPS Pathfinder Pro Series” CD into the CD Drive of your PC and click on the “GPS Controller Software” option on the main menu.

Step 2: Click on the “Install on this PC” option and run through the Installation Wizard for the GPS Controller software for the desktop.

Step 3: Exit the CD image

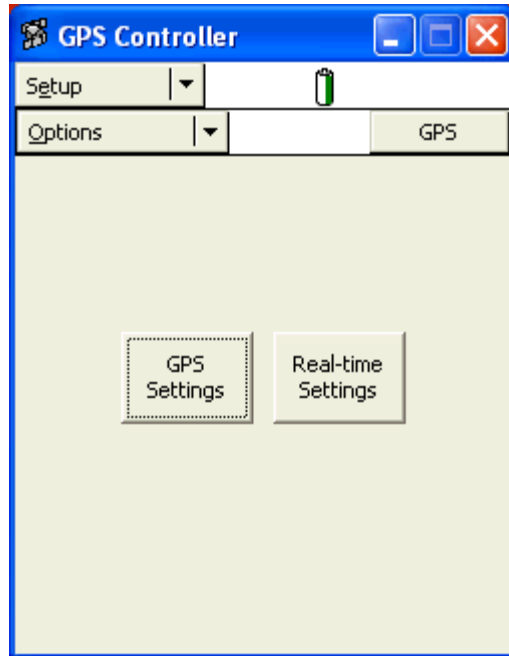
Step 4: Press and release the power button on the GPS receiver unit. The battery indicator on the GPS receiver should glow green (permanently ON) and the satellite indicator should flash (green) ON and OFF. The Bluetooth indicator should be OFF. If the Bluetooth indicator flashes (blue), press and hold the power button until the flashing stops permanently and then release the hold.

Step 5: Connect the serial cable that came with the Trimble unit (black cable with 9-pin female terminals at both ends) between the GPS receiver and your PC.

Note: If you use the ActiveSync program on your PC, ActiveSync has to be temporarily disconnected to allow the GPS receiver to connect to the PC, since ActiveSync ties up the serial port. Disallow the ActiveSync connection via the serial port while configuring the settings on the GPS receiver.

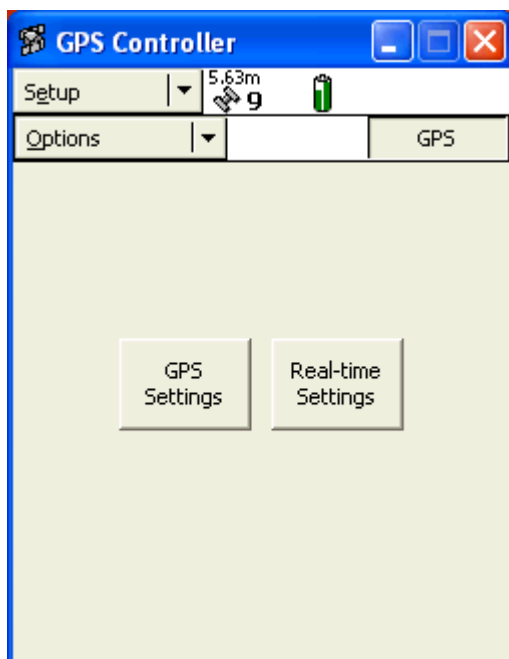
Step 6: Double click on the icon labeled “GPS Controller” that will have been automatically-created on your desktop during the software installation.

Next, click on the menu button at the top of the screen and select the “Setup” option, which will pull up the screen shown below.

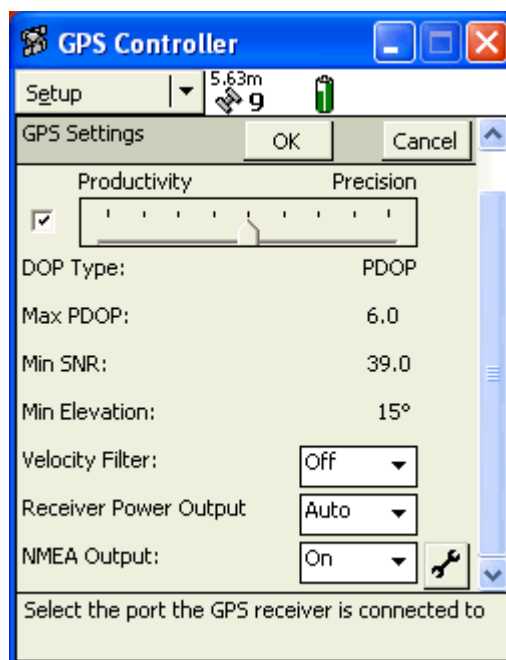
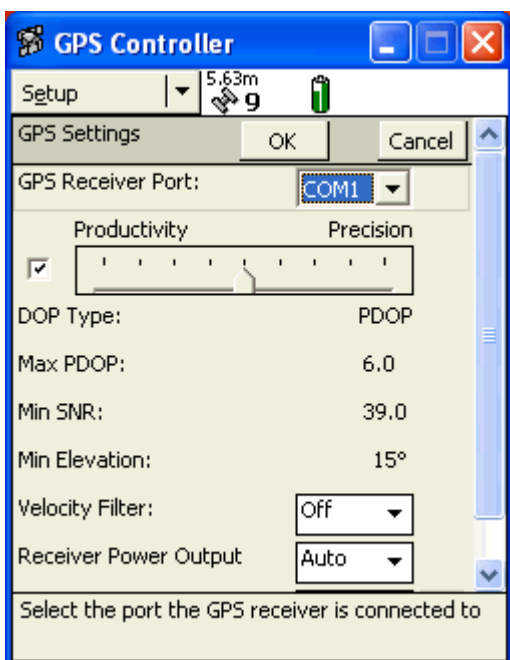


Step 7: Click on the “Options” menu and select “Connect to GPS”. This will pull up the window shown below.

Note: Typically several seconds (10 to 20 seconds) are required for the connection to be made



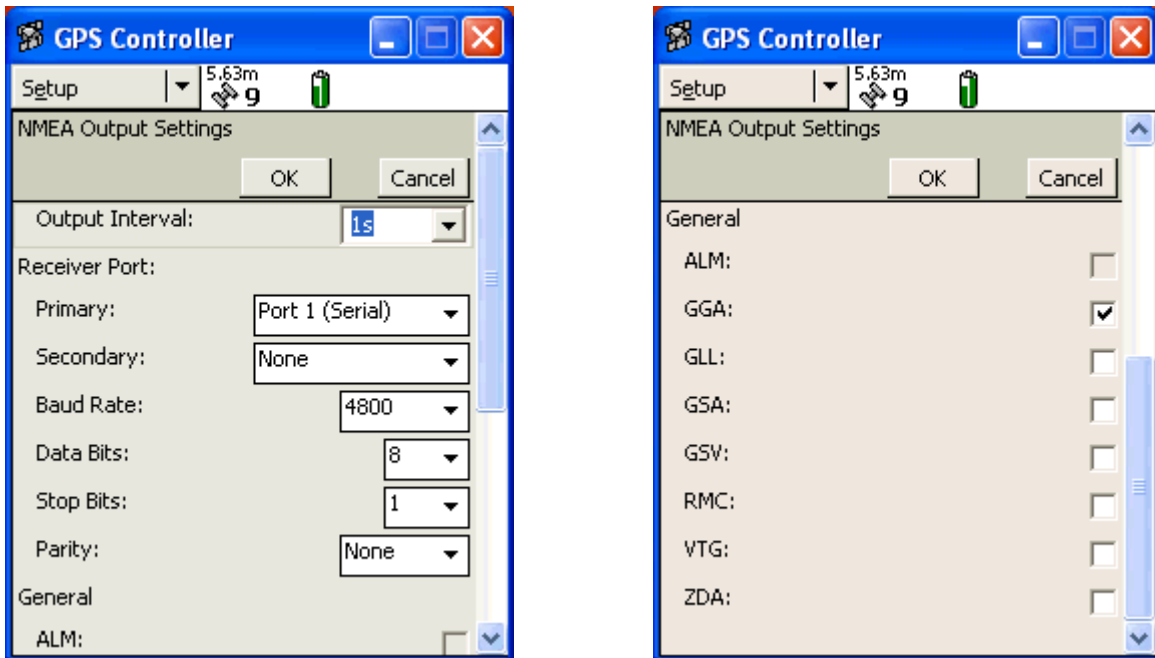
Step 8: Click on the “GPS Settings” button on the above screen, which will pull up the screen shown below (left-hand side screen).



Select the COM1 port for the “GPS Receiver Port” and leave the Productivity check box checked.

Next, use the scroll bar to reveal the “NMEA Output” field and select “On” for this option.

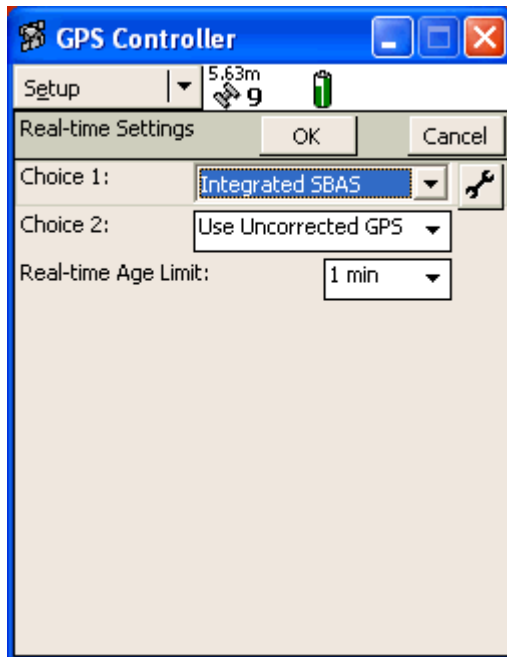
Step 9: Click on the “wrench” button on the above screen (right-hand side screen, bottom right) which will pull up the screen shown below (left-hand side screen).



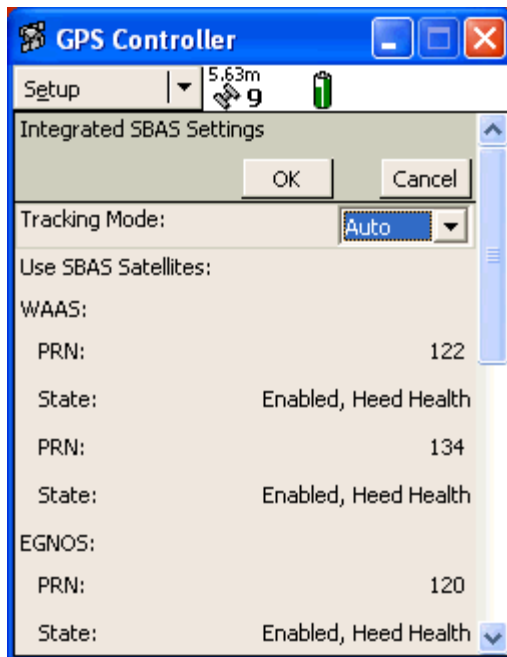
Next, make the selections indicated on the screen above (left-hand side screen). Next, use the scroll bar to scroll down to reveal the screen shown above (right-hand side screen) and select GGA only as the NMEA string type.

Next, click on the OK button on the “NMEA Output Settings” screen and then click on the OK button on the “GPS Settings” screen, which will return you to the Setup screen.

Step 10: Click on the “Real-time Settings” button on the Setup screen, which will pull up the screen shown below.

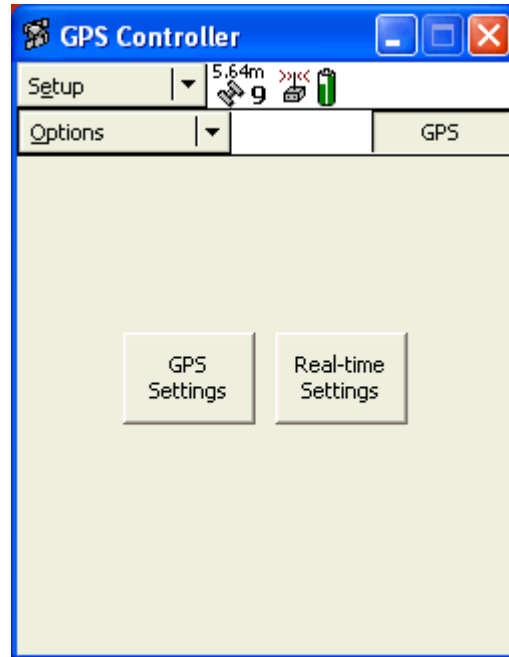


Next, under “Choice 1”, select “Integrated SBAS” (which is WAAS differential correction) and click on the “wrench” button, which will pull up the screen shown below.



Next, on the above screen, select “Auto” for the Tracking Mode.

Next, click on the OK button on the “Integrated SBAS Settings” screen and then click on the OK button on the “Real-time Settings” screen, which will bring you back to the Setup screen as shown below.



Step 11: Click on the “Options” drop-down on the above screen and select “Disconnect from GPS”. Your NMEA settings will be transmitted to the GPS receiver upon disconnecting. The GPS receiver is now configured for use with the Gx data-logger

SECTION 2

How to Test the GPS Receiver/Gx Connection

Note: To test the connection, the GPS receiver will require an unobstructed view of the satellites in an outside location.

To test that the Gx is receiving the NMEA output of the GPS receiver, perform the following steps:

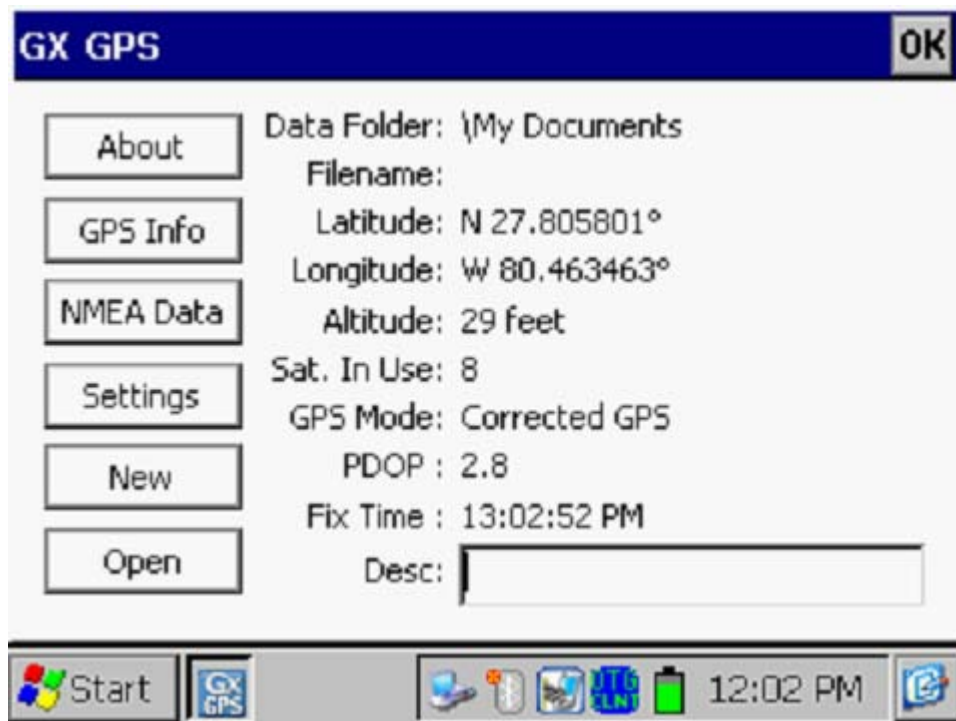
Step 1: Switch ON the GPS receiver. The battery indicator on the GPS receiver should glow green (permanently ON) and the satellite indicator

should flash ON (green) once per second when a stable NMEA output has been established. The Bluetooth indicator should be OFF.

Step 2: Switch ON the Gx and open the Gx_GPS program to run the Gx's GPS utility application. Tap on the "Settings" button and select "NMEA" via the menu button in the "GPS" field. Also, select "COM 1" from the adjacent menu, assuming that you'll be using a serial cable connection. Next, tap on the "Save" button.

Step 3: Connect the GPS receiver to the Gx data-logger via the serial cable that came with the Gx (9-pin female plugs on the both ends). Connect the serial cable to the built-in serial port on the Gx.

Step 4: View the GPS data on the Gx screen. An example GPS Data screen is shown below.



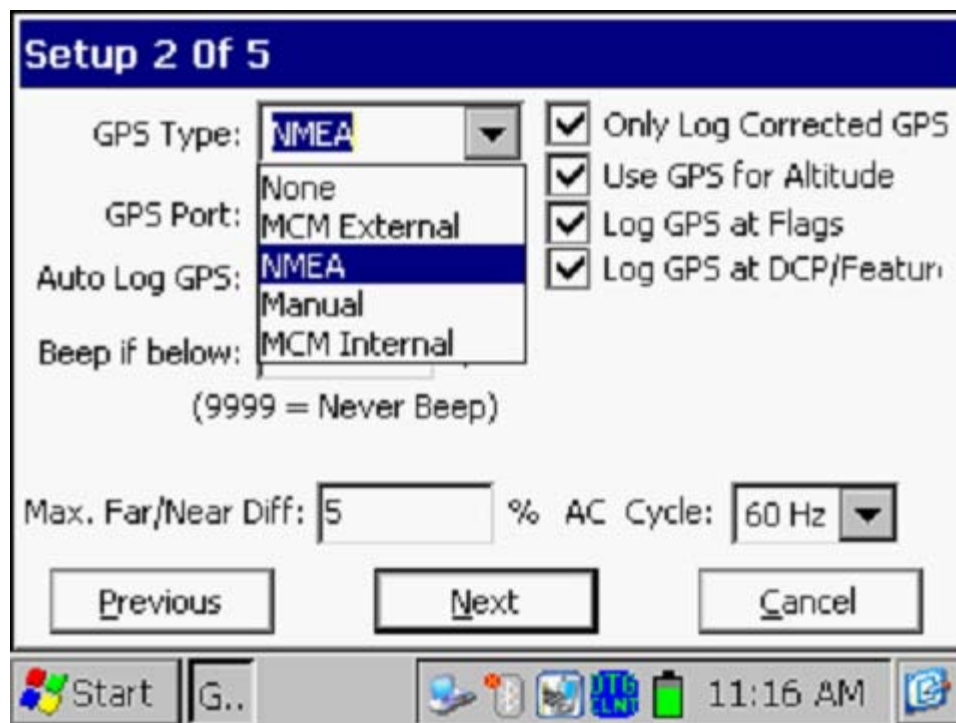
Step 5: Assuming that GPS data are displayed, exit the Gx_GPS program by tapping on the "OK" button on the above screen.

SECTION 3

How to Setup the Gx for a Pipeline Survey Application with an Integrated Pro Series Receiver

The critical step here is to select NMEA, for the GPS Type, on the “Setup 2 of 5” screen during the process of setting up a survey file (see Sections IV. 1 through IV.4).

An example “Setup 2 of 5” screen is shown below.



Select the “**NMEA**” option from the “GPS Type” menu on the above screen.

Also, if you are connecting your receiver to the Gx data-logger via a serial cable, select “**Com 1**” from the “GPS Port” menu.

After setting up a survey file, connect your GPS receiver to the Gx data-logger via the Com 1 Port on the Gx data-logger, which is the built-in serial port located under the flap on the bottom left hand side of the logger.

APPENDIX 3

Gx Camera Settings

Note 1: The Camera settings are available via the “Settings” button on the “Pictures” screen.

Note 2: For the default picture size (SXGA (1280x960)) established for the Gx Data-logger, the Flash light is not available. However, you can turn on the LED Lamp (which is turned OFF by default), if direct light is required. You can do so via the “Accessories” tab (please see the following Appendix). Also, please note that the Flash light is available for the largest picture size (highest resolution) setting (QSXGA 2048x1944).

CAMERA TAB

The **Camera** tab allows you to select settings that control the size and resolution of the image to be captured, the lighting conditions under which the image will be captured and the focusing method to be used.

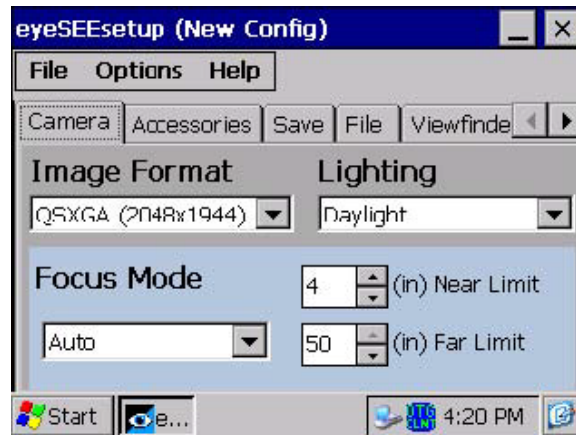


Image Format – The image format determines the size and resolution of the image. The available selections are: *QSXGA (2048x1944)*, *SXGA (1280x960)*, *VGA (640x480)*, and *HF (300x200)* where the numbers in parentheses are the size of the image in pixels.

Lighting – The lighting conditions under which an image is captured affect

its color (white) balance. This setting allows eye•WARE to correct for the color balance (also known as white balance) so that the colors in the image are closer to the true colors of the subject. The available selections are: *Daylight* (outdoors), *Fluorescent* (office) and *Tungsten* (house).

Note: You can also allow the user the switch between these selections on-the-fly. (See Display under Viewfinder Tab later in this chapter)

Continued Overleaf/

Focus Mode – The focus mode selects the method that eye•WARE uses to determine the image focus. The available selections are: *Auto*, *Laser*, *Macro*, *4 inches (10cm)*, *8 inches (20cm)*, *12 inches (30cm)*, *18 inches (45cm)* and *Infinity*. The *Auto* mode determines when the image is in focus by the sharpness of lines and edges in the image. The *Laser* mode utilizes the lasers to measure the distance to the subject and sets the focus distance accordingly. *Laser* mode is best for near range two dimensional subjects. The fixed focus modes set the focus distance at 4, 8, 12 and 18 inches respectively. These modes provide the fastest focusing when the approximate focus distance is known. The *Macro* mode sets the imager focus to the closest possible distance. *Macro* mode is useful for very small subjects or subjects with fine detail. Use the *Infinity* mode to focus at distances greater than 24 inches (61cm). *Infinity* mode provides the maximum depth of field while maintaining focus at infinity.

Note: You can also allow the user to switch between these selections on-the-fly. (See Key Control Tab later in this chapter)

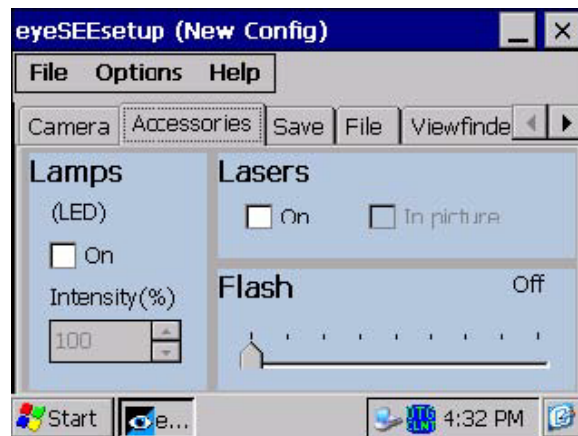
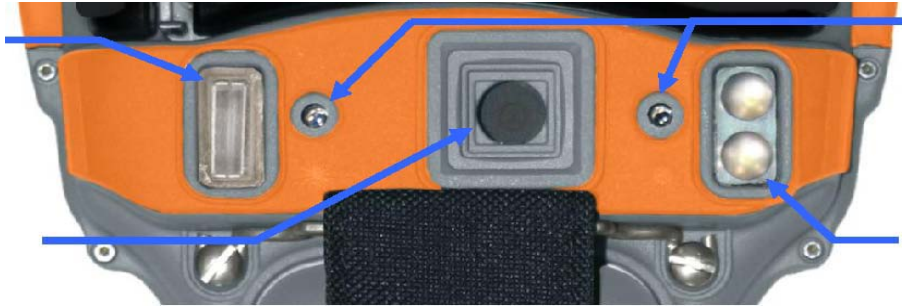
Near Limit – When using either the *Auto* or *Laser* focus modes this setting limits the closest focus distance allowed. If the focus distance is determined to be closer than this limit focus is set to the limit.

Far Limit – When using either the *Auto* or *Laser* focus modes this setting limits the farthest focus distance allowed. If the focus distance is determined to be farther than this limit focus is set to infinity.

Note: If you exceed the Near Limit or Far Limit when capturing an image, the image may appear out of focus.

ACCESSORIES TAB

The **Accessories** tab allows you to select settings that control how the lamps, lasers and flash are used.



LAMPS

The lamps are the LED illuminators located next to the imager lens. The lamps can be useful for providing extra illumination when capturing images of close subjects where the flash may be too powerful.

Lamps On – When checked, the lamps will be on during the viewfinder and image capture.

Intensity – Lamp illumination as a percent of full brightness.

LASERS

The lasers are used for the *Laser* focus mode and may be used as a marker or pointer when composing an image. Usually, the lasers are turned off prior to

capturing an image but if desired, the laser spots can be made to appear in the final image.

Lasers On – When checked the lasers will be on during the viewfinder operation.

In Picture – When checked the lasers will appear in the captured image.

FLASH

The flash is a Xenon photoflash located adjacent to the imager lens. The flash can be used to illuminate a dark scene or to provide fill lighting. There are nine settings; *Off*, *Lvl-1* through *Lvl-7* and *Max*. The flash level is selected by moving the slider to the desired flash level.

When the flash is first enabled and following each flash image capture, there is a short delay while the flash unit recharges.

Note: You can also allow the user to change the flash intensity on-the-fly. (See Key Control Tab later in this chapter)

SAVE TAB

The image **Save** tab allows you to select how image capture, evaluation and saving are performed.



KEY PRESS MODE

The key press mode determines how the capture processing sequence

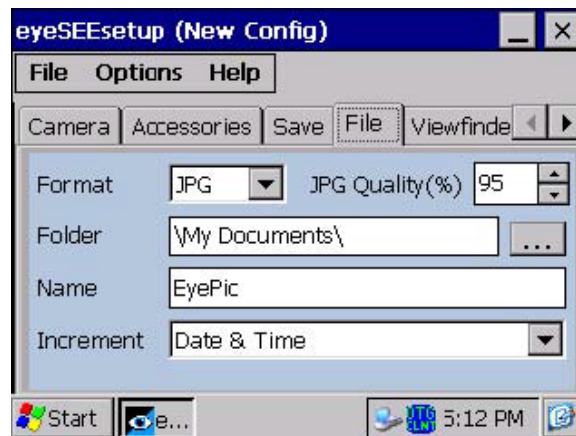
proceeds. If **Single** is selected, one press of the **Camera** button will start the viewfinder, allow the focus and exposure processing to complete and then automatically capture the image without further action by the user. If **Double** is selected, the first press of the **Camera** button brings up the viewfinder and runs the focus and exposure processing. The user must then press the **Camera** button a second time to capture the image.

AUTO SAVE

After capturing an image, the user is presented with a preview of the image before it is saved. If **Auto Save** is off, eye•WARE waits for the user to choose to save or discard the image. If **Auto Save** is on, eye•WARE automatically saves the image once it is captured. With **Auto Save** on, the **Preview** allows you to specify how long the preview image will remain on the display before it is saved. If **Preview** is set to 0, the preview image will not be shown to the user.

FILE TAB

The **File** tab allows you to select how image files are named and saved.



Format – Selects the image file format. The available selections are: BMP or JPG. BMP files contain uncompressed pixel data. The image data in a JPG file is compressed according to the JPEG standard. The file name is automatically given an extension based on the file format.

JPG Quality – When file format is set to JPG, this setting allows you to select how heavily the image data will be compressed. Compression allows the image file to be smaller at the expense of image quality. Higher quality values result in larger image files and better image appearance. Lower quality settings result in smaller image files with poorer image appearance.

Folder – Specifies the folder into which the image files will be saved. The folder may be located anywhere in the file system including \My Documents, \SystemCF and \USB Drive. You can use the browse button to target a folder.

Note: Images saved to the volatile portion of the file system, such as \My Documents will be lost on a cold reboot or if battery power is entirely depleted.

Name – Specifies the base name for image files. The base name can be appended by one of the file increment methods and will be given a file extension based on the file format.

Increment – Specifies how successive file names are created. The available selections are; *None*, *Counter* and *Date & Time*. If *None* is selected, the file name will remain constant and each saved image will overwrite the previous. If *Counter* is selected, the base file name will be appended with a count value. The *Counter* method will not create a file name that already exists in the folder. If the file name is already used, the count value will be advanced until an unused file name is created. If *Date & Time* is selected, the date and time at which the image file is saved is appended to the base file name. The date and time format is the same as that selected for the **Date/Time** text stamp described in the following sections except that colons (“:”), slashes (“/”) and spaces are replaced by an underbar (“_”).

Note: If you stop and restart eye•WARE, the counter will be set back to 0.

VIEWFINDER TAB

The **Viewfinder** tab allows you to select the viewfinder behavior.



DISPLAY

These items control the displaying of the viewfinder. If **Show Viewfinder** is not checked, the viewfinder image will not be displayed. If **Show Viewfinder** is checked, the viewfinder will be shown while exposure and focus are determined. Checking **Show Overlay** allows the graphical exposure, focus and target box to be drawn over the image. Otherwise, only the viewfinder image is shown.

TIMEOUT

When viewfinder timeout is not enabled, the viewfinder will remain visible until an image is captured or the viewfinder is aborted by the user. When viewfinder timeout is enabled, you can select the number of seconds that the viewfinder will remain active before automatically terminating. Pressing any key while the viewfinder is shown will restart the timeout period.

Note: Viewfinder timeout applies even when the viewfinder is not shown.

CONTROL KEY TAB

The **Key Control** tab allows you to select which of the on-the-fly keypad functions are available to the user.



White Balance – (numeric “2”) cycles through the color (white) balance modes advancing one selection with each key press.

Flash Level – (numeric “3”) cycles through the flash levels advancing one level from *Off* to *Max* with each key press. When the flash level is set at *Max*, the next key press changes the level to *Off*.

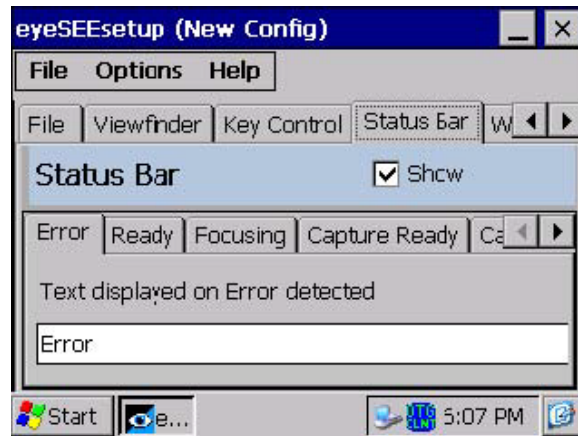
Note: Flash level control is only available when QSXGA resolution is selected.

Refocus – (numeric “6”) causes the focus processing to be repeated regardless of focus mode.

Focus Mode – (numeric “7”) cycles through the focus modes, advances one selection with each key press.

STATUS BAR TAB

The **Status Bar** tab controls whether the status bar is shown at the top of the display and allows you to customize the status messages.



SHOW/HIDE THE STATUS BAR

When **Show** is checked the status bar is displayed while eye•WARE is active, otherwise the status bar is not displayed.

CUSTOM STATUS MESSAGES

The sub-tabs allow you to customize the messages displayed in the status bar.

Error – Shown when an error condition is detected by eye•WARE.

Ready – Shown when eye•WARE is ready to begin an image capture sequence.

Focusing – Shown during focus processing.

Capture Ready – Shown when exposure and focus have been determined and eye•WARE is ready to capture an image.

Capturing – Shown while eye•WARE is acquiring an image.

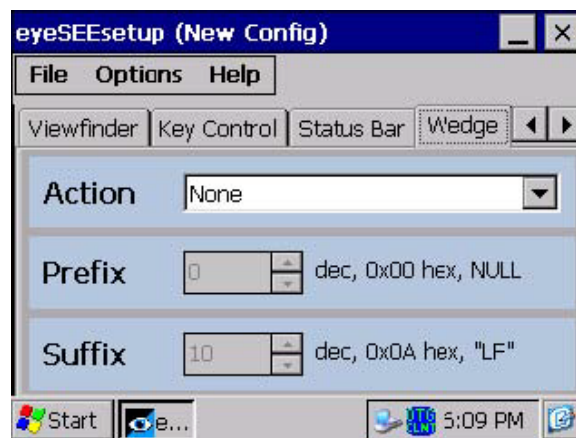
Save Ready – Shown when eye•WARE is ready to save the image.

Saving – Shown while eye•WARE saves the image to a file. The file name is automatically appended to the message text string.

Note: Some states may be too fast to be observed during normal eye•WARE operation.

WEDGE TAB

The **Wedge** tab allows you to configure the imager wedge action. When enabled, the wedge action sends a text string to the active Windows form following the saving of an image.



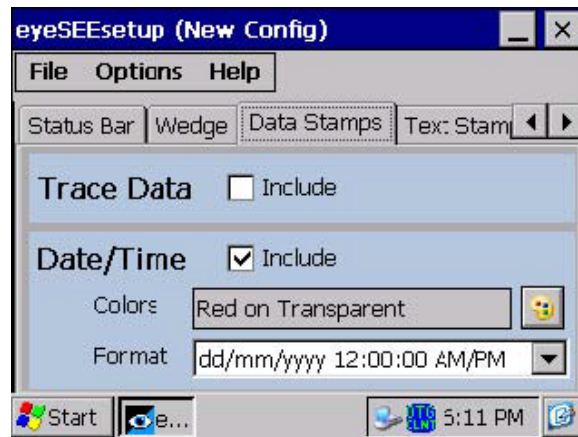
Action – Selects the wedge action to perform. Available selections are; *None*, *Send file name*, and *Send file path and name*. Selecting *None*, disables all wedge action. Selecting *Send file name*, causes the image file name to be sent to the active form. Selecting *Send file path and name*, causes the full file path to be sent to the active form.

Prefix – The prefix is a single 8-bit character value that is sent prior to the main text string. Any value between 0 and 255 may be selected. The value in the prefix box is shown in decimal and the equivalent hexadecimal and ASCII representations are shown beside the box. Select the prefix value by using the up ▲ and down ▼ buttons or by pressing a text character button on the keypad. Pressing a keypad button causes the prefix to be set to the value of the character for the key.

Suffix – The suffix is a single 8-bit character value that is sent following the main text string. Any value between 0 and 255 may be selected. The value in the suffix box is shown in decimal and the equivalent hexadecimal and ASCII representations are shown beside the box. Select the suffix value by using the up ▲ and down ▼ buttons or by pressing a text character button on the keypad. Pressing a keypad button causes the suffix to be set to the value of the character for the key.

DATA STAMPS TAB

The **Data Stamps** tab allows application of **Trace Data** and **Date/Time** text information into the image.



TRACE DATA

When **Include** is checked, data about the image capture conditions will be inserted into the image in the form of a block of text written over the image. Trace data may be useful for analyzing image quality issues but is rarely desirable for a final image. The trace data text always appears in the upper left hand corner of the image as red text on a white field. Trace data is applied during image saving and is not visible in the viewfinder or capture preview.

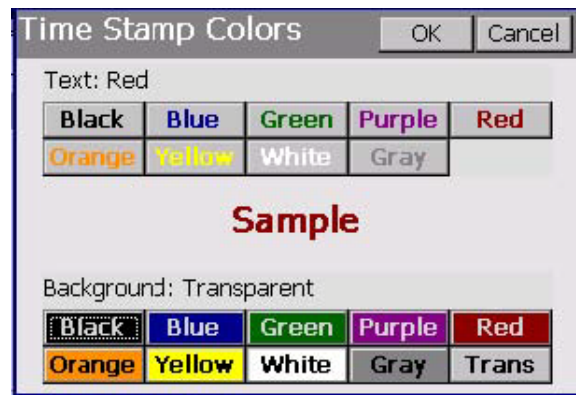
DATE/TIME TEXT

The date and time of the image capture may be applied to the final image as text. When enabled, the date and time text appears in the lower left corner of the image. You can select the date and time format and the text colors.

Date and time text is applied during image saving and is not visible in the viewfinder or capture preview.

Include – When checked, the date and time text will be included in the final image

Colors – You can select both the text color and the color of the background field on which the text is displayed. Tap the color button

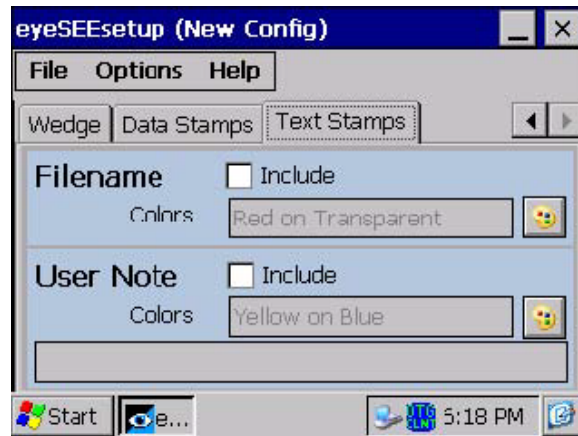


Format – Allows you to select the date and time format. Both European and USA date formats are available as are both 12 and 24 hour formats.

Note: The date/time format is also used for file name generation. When saving images, eye•WARE will replace conventional date and time separators (back slashes and colons) with underscores.

TEXT STAMPS TAB

The **Text Stamps** tab allows you to configure the application of **Filename** and **User Note** text information into the final image.



FILENAME

When **Include** is checked, the image file name is written in the lower right hand corner of the image. The text and background field colors are selected using the *Color Selection* dialog (See Date/Time Text above). File name text is applied during image saving and is not visible in the viewfinder or capture preview.

USER NOTE

When **Include** is checked, a custom text string is written in the upper right hand corner of the image. The text and background field colors are selected using the *Color Selection* dialog (See Date/Time Text above). Use the text box to specify your desired text. The user text is applied during image saving and is not visible in the viewfinder or capture preview.