CHC® i80

with Internal Satel 1-Watt Radios

RTK GNSS Receiver User Manual

This manual is for use with i80 CHC receivers sold by iGage Mapping Corporation.
Receivers purchased from other sources (other dealers or the factory) with similar model numbers/names will not match devices provisioned by iGage.

The 'X9 Download Tool' supplied with iGage receivers and available for download via the internet, only works with receivers purchased from iGage. This tool is not sold separately.

10 June 2016

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Copyright and Safety

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All product and brand names mentioned in this publication are trademarks of their respective holders.

GNSS Safety Warning

The i80 GNSS receiver tracks and utilizes signals from many space based satellite navigation systems:

The Global Positioning System (GPS) is operated by the US Government which is solely responsible for the accuracy and maintenance of the GPS network. Accuracy can also be affected by bad satellite geometry and obstructions including buildings and tree canopy.

The GLONASS (GLObal NAvigation Satellite System), is a satellite navigation system operated by the Russian Aerospace Defense Forces.

The Galileo System is the global navigation satellite system (GNSS) that is operated by the European Union (EU) and European Space Agency (ESA)

BeiDou Navigation Satellite System (BDS) (also known as COMPASS or BeiDou-2) is operated by CNSA (China National Space Administration.)

SBAS (Satellite Based Augmentation Services) including WAAS (USA), MSAS (Japan), EGNOS (Europe), QZSS (Asia), and GAGAN (India) may also be utilized by the i80 for carrier-phase corrections, in addition to differential corrections.

Neither iGage Mapping Corporation nor CHC are responsible for, nor warrant the viability of the space segment portion of the GNSS system. The user is cautioned that they alone are responsible for determining the application of the i80 to their task at hand.

Any of the GNSS system components can fail at any time. Be prepared for down time and failures.

FCC Compliance:

FCC Notice: CHC i80 receivers comply with the limits for a Class B digital device, pursuant to the Part 15 of the FCC rules when it is used in the Portable Mode.

Operation is subject to the following two conditions:

(1) This device may not cause harmful interference
(2) This device must accept any interference received, including interference that may cause undesired operation

See the section '*Radio Notices*' on page 12.

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Introduction

Thank you very much for choosing to purchase and use an i80 GNSS receiver from iGage Mapping Corporation!

With a ground-breaking price, outstanding performance, field ready carry case and easy-to-use features, we know that the CHC i80 GNSS receiver will be a valuable tool that will quickly pay for itself.

This guide is designed to help you familiarize yourself with your new equipment and successfully use it in the field.

If you have questions or suggestions, don't hesitate to contact us:

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Salt Lake City UT 84105 USA

+1-801-412-0011
email: i80@igage.com

Your input is extremely valuable to us and we will listen to your suggestions!

Software updates and news are available from:

www.x9gps.com

Click on 'Tools' then the 'i80' link for firmware, FAQs and other i80 information.

Training Videos

If you are not familiar with these subjects:

US Survey Feet vs. International Feet (Video #1)
Grid vs. Ground Distance Measurements (Video #2)
Ellipsoid vs. Orthometric Heights (Video #3)
Setting up a Tripod/Tribrach (Video #66)

Check out the videos at www.igage.com/v

In addition, there are Carlson SurvCE specific videos that address scale factors and aligning measured and record data.

SurvCE Manual

If you did not receive a copy of the SurvCE User Manual, an electronic copy of the manual for SurvCE can be found on the Carlson website:

www.survce.com

Click on 'Software Download', then choose the version number of the software loaded on your data collector, then click on 'Show Files'. A link to the latest manual version will be shown:

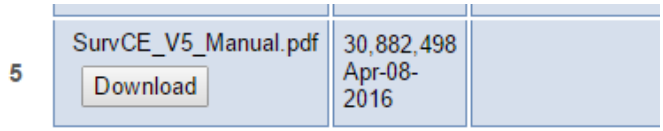


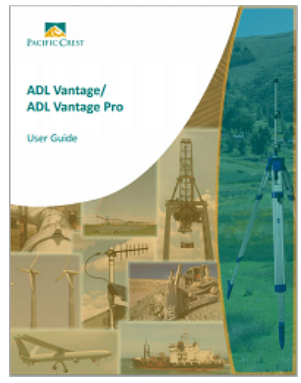
Figure 1 downloading the latest SurvCE Manual as a PDF file.

In addition there are a variety of excellent SurvCE training videos available at the Carlson Software website:

www.carlsonsw.com

Click on the 'Videos' link on the right side of the page.

ADL Vantage Pro UHF Radio Manual



Your CHC receiver package may contain a high powered Pacific Crest ADL Vantage Pro radio or repeater.

The manual for Pacific Crest ADL Vantage Pro radios can be found online:

http://www.pacificcrest.com/library/User_Guide_ADL_VantagePro.pdf

LT30 Data Collector

Your kit may contain a LT30 data collector or a data collector from a different manufacturer. You can download the Getting Started Guide from

www.x9gps.com

On the LT30 linked page.

Please note that iGage preloads all software, activates SurvCE and your LT30 will be ready to use, out of the box.

Please don't reload software, it should already be loaded. Call us if you have questions!

Important things to remember:

- Set the data collector to turn off the *backlight* after 30-seconds of inactivity.
- Set the data collector to NEVER automatically power off, it disrupts the Bluetooth connection.
- Tapping the ON/OFF key puts the data collector in Standby
- Push and hold the ON/OFF key for two seconds to turn the data collector OFF

WARNING: Be careful when charging the LT30 in your vehicle. It is possible to snap the USB mini connector if you sit on the data collector with the charging cable connected. This is not covered by warranty.

A software patch has been installed on your LT30 which allows the "F2" key to be used as an enter key, this allows for single button shots in SurvCE.

About the i80 GNSS Receiver

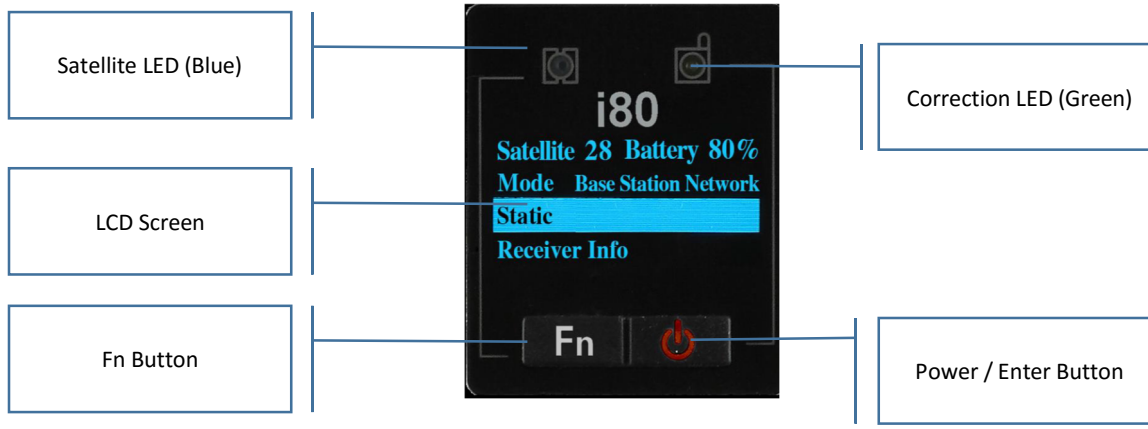
The i80 GNSS receiver incorporates a GNSS engine, GNSS antenna, internal Satel radio, 4G cellular modem, Bluetooth, Wi-Fi, and dual-batteries in a ruggedized and miniature unit that is easy to use. All-in-One i80 Base Rover kits include two, identical receivers for use as Base and Rover.

The bright LCD panel enables you to check satellite-tracking, internal battery charge status, Wi-Fi, working mode, data logging status and basic receiver information. Bluetooth and Wi-Fi technology provide cable-free communication between the receiver and a data collector / controller.

You can change the basic settings of the receiver with the LCD panel. Additional configuration settings can be made via the web interface using Wi-Fi or with a Bluetooth connected data collector.

Front Panel

The Front Panel has a bright LCD screen, two indicator LED's and two pushbuttons.

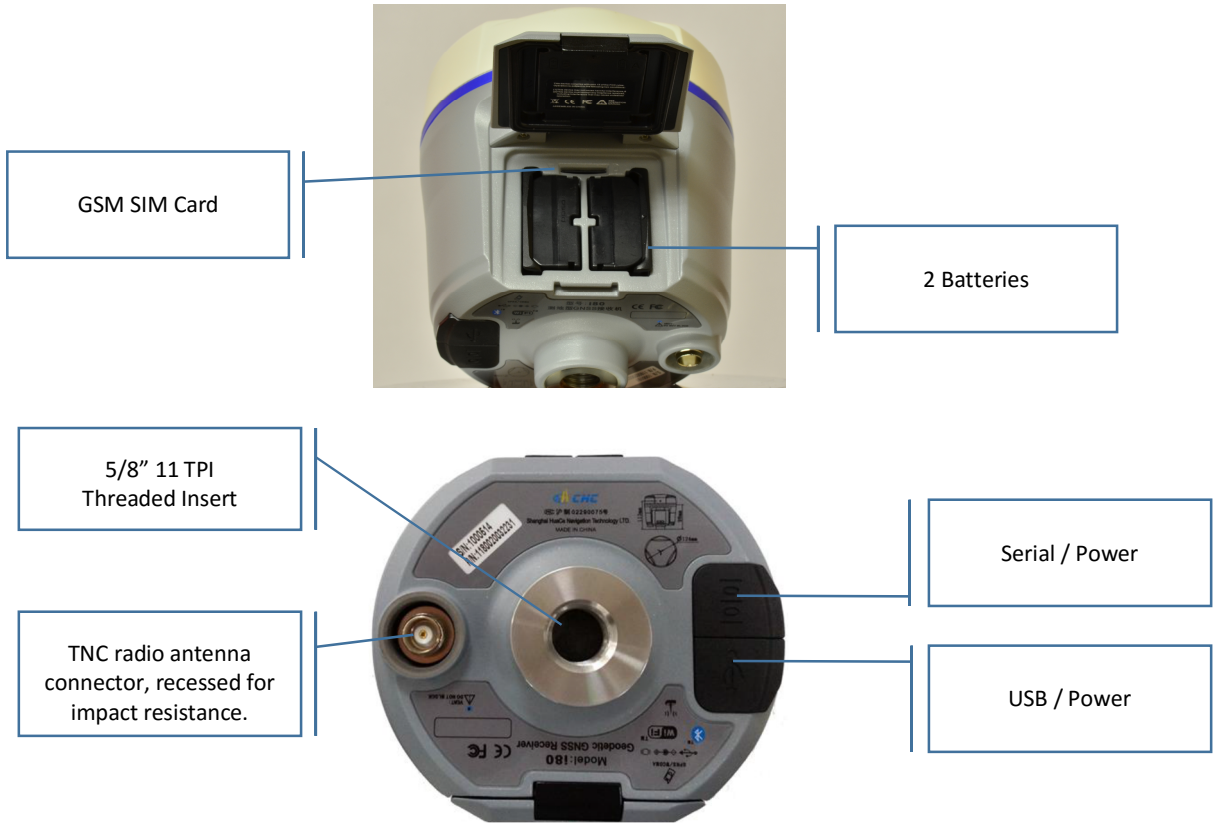


Satellite LED	Indicates the number of satellites that the receiver is tracking: • When the receiver is searching, blinks once every 5 seconds. • When the receiver is tracking and has a position, blinks once for each tracked satellite.
Correction LED	Blinks when correction data is transmitted (during BASE operation) or received (during ROVER operation.)
LCD Screen	Displays status and configuration options, controlled by the two pushbuttons.
Fn Button	Move to the next line of the current menu Move to the next character of a setting Changes a setting or character after being selected by Enter
Power / Enter Button	Power • Press and Hold for 3-seconds to turn the receiver ON or OFF

Enter

- Advance to next screen
- Accept a modified value

Receiver Back and Bottom



GSM SIM Card — Card slot for GSM SIM Card. Insert with gold contacts up and notch leading.

Batteries — There are slots for two batteries. Push the retaining bars to the side to release batteries, they will spring out. The batteries are hot-swappable. The battery with the higher charge is always used. (So both batteries will run down simultaneously.)

Serial + Power

7-pin LEMO connector that supports RS-232 communication and external power input.

Use the GNSS to PC Data Cable to control the i80 from a PC.

USB + Power

7-pin Lemo connector that supports USB connection to computer and external power input.

When connected to a computer using the supplied ‘long’ USB cable, the i80 will mount as an external disk drive on the attached computer (no drivers required.)

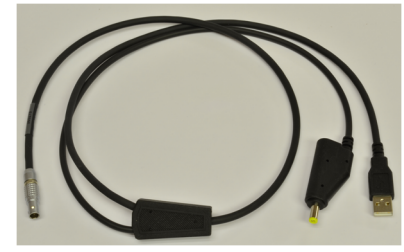
When connected to an external flash drive using the supplied ‘short’ USB cable, the i80 can log observation data directly to the flash drive

What's in the Box

Depending on your purchased configuration you will receive different accessories with your All-in-One GPS receiver heads. Typically the receiver heads and accessories will be delivered in a single case.

Figure 2 i80 All-in-One carry case with accessories

In addition to the i80 GNSS receivers you may also receive several accessories:

UHF Antenna PN: 0402 000 006 5/8 λend-fed-dipole Antennas with TNC Connector, one for each receiver.	
Battery Charger PN: 0505 990 001 (Includes Power Adapter and cord) The Power Adapter can be used for the battery charger and as an external power source for i80 base.	
Lithium-Ion Batteries PN: 0405 000 007	
OTG USB Cable (the Short USB Cable) PN: 403000098 Used for Flash Memory Expansion. May be required for firmware update.	
USB-IO and Power Cable (Long USB Cable) PN: 403000097 Connects GNSS head to computer, GNSS head mounts as an external disk drive. Can be used for external power to the head.	

SERIAL IO and Power Cable PN: 403000040 Connects the GNSS head to a computer serial port or an external UHF radio. Can be used for external power to the head.	
Extension Pole PN: 0404 000 021 Raises the base i80 GNSS head above a tribrach high enough to allow the UHF antenna to be connected to the receiver.	
TNC Extension Cable Allows you to elevate the UHF radio antenna further above the ground, greatly enhancing the radio range.	

Safety Information

Before you use your receiver, please make sure that you have read and understand the following warnings and safety requirements.

An absence of specific alerts does not mean that there are no safety risks involved. Warning and Caution information is intended to minimize the risk of personal injury and/or damage to the equipment.

Use and Care

The i80 GNSS receiver is a field ready instrument; however they are also delicate electronic instruments. Take suitable care to avoid damage to the instrument.

Avoid dropping the receiver as it can change the phase center of the antenna.

The display glass is 'Gorilla Glass' and is scratch resistant, however it is brittle. Do not place the receiver on its window.

Avoid storing the receiver at excessive temperatures (hot or cold) as it will damage the internal batteries.

Avoid storing the batteries at temperatures less than -40° F (-40° C) and temperatures higher than 160°F (70°C) as it will permanently reduce the battery capacity and life

DO NOT leave the receivers or accessories inside a vehicle in the summer. Temperatures higher than 160°F will permanently reduce battery capacity and battery life.

Battery Warnings, Safety and Disposal

The batteries are Lithium-Ion type cells.

WARNING - Do not damage the rechargeable Lithium-ion battery. A damaged battery can cause an explosion or fire, and can result in personal injury and property damage.

To prevent injury or damage:

Do not use or charge the battery if it appears to be discolored, warped, the case is bulging, or leaking battery fluid.

Do not expose the battery to fire, high temperature, or direct sunlight.

Do not immerse the battery in water.

Do not store the battery inside a vehicle during hot weather.

Do not drop or puncture the battery.

Do not open the battery or short-circuit its contacts.

Do not charge the batteries in chargers other than the supplied charger or a direct replacement.

Do not charge similar batteries in the supplied charger, even if they fit well.

WARNING - Avoid contact with the rechargeable Lithium-ion battery if it appears to be leaking. The battery fluid is extremely corrosive, and contact with it will result in personal injury and/or property damage.

If battery fluid gets into your eyes, immediately rinse your eyes with clean water and seek medical attention. Do not rub your eyes!

If battery fluid gets onto your skin or clothing, immediately use clean water to wash off the battery fluid.

Batteries

Lithium-Ion batteries are supplied with your receiver.

Figure 3 Lithium-Ion Batteries for i80 receivers

If you plan on running a base receiver for an extended period, it is suggested that you use a Battery Clip Cable to connect the auxiliary power connector to an external 12 volt battery.

If you are using a base receiver with an external radio, the radio cable supplies power to both the radio and the head. A base transmitting corrections at high power uses substantially more power than a rover.

Fully charge the batteries using the supplied charger before first use.

Battery Charger

Plug the charger into the supplied wall transformer or use the supplied alligator clip cable to connect to a 12 Volt battery.

Figure 4 The Dual Battery charger LEDs

It is okay to leave charged batteries in the charger for extended periods of time.

TOO COLD: Do not leave charged or uncharged batteries in your vehicle at night if the temperature will be less than 20 F. Extreme cold battery storage will permanently reduce the capacity and lifetime of the batteries.

TOO HOT: Do not leave charged or uncharged batteries in your vehicle on hot days with the windows rolled up when temperature will be higher than 90° F. Hot temperatures will permanently reduce the capacity and lifetime of the batteries.

Radio Notices

FCC Notice: CHC i80+ GNSS receivers comply with the limits for a Class B digital device, pursuant to the Part 15 of the FCC rules when it is used in the Portable Mode.

Operation is subject to the following two conditions:

- This device may not cause harmful interference
- this device must accept any interference received, including interference that may cause undesired operation

FCC Compliance:

Function	FCC-ID	Module Type
i80 Device	SY4-A01004	
Bluetooth	RFR-B2029	Stollman BlueMod+B20/AI/AP
3.75G WCDMA module	RI7HE910	Telit HE910-D
Satel TR-Radio	MRBSATEL-TA13G	Satel SATELLINE-M3-TR3

Figure 5 FCC ID's for i80 receiver's internal radios.

Bluetooth Radio

Radiated output power from the internal Bluetooth radio is far below FCC radio frequency exposure limits. The Bluetooth radio operates within guidelines for radio frequency safety standards and recommendations, which reflect the consensus of the scientific community.

The level of energy emitted is far less than the electromagnetic energy emitted by wireless devices such as mobile phones. However, the use of wireless radios may be restricted in some situations or environments, such as on aircraft or near blasting areas.

UHF Radios

Every i80 GNSS receiver includes a Satel UHF radio capable of broadcasting 1-watt UHF radio transmissions.

Satel UHF Safety and General Information

When used in the transmitting mode, even though the broadcast power is relatively low, you should take these additional precautions:

Medical Devices - Hearing Aids

Some digital wireless radios may interfere with some hearing aids. In the event of such interference, you may want to consult your hearing aid manufacturer to discuss alternatives.

Medical Devices - Pacemakers

The Advanced Medical Technology Association recommends that a minimum separation of 6 inches (15 cm) be maintained between a handheld wireless radio and a pacemaker. These recommendations are consistent with the independent research by, and recommendations of the U.S. Food and Drug Administration.

Persons with pacemakers should:

- ALWAYS keep the radio more than 6 inches (15 cm) from their pacemaker when the radio is turned ON.
- Not carry the radio in the breast pocket.
- Turn the device OFF immediately if you have any reason to suspect that interference is taking place.

Other Medical Devices

If you use any other personal medical device, consult the manufacturer of your device to determine if it is adequately shielded from RF energy. Your physician may be able to assist you in obtaining this information.

Blasting Caps and Areas

To avoid possible interference with blasting operations, turn off your radio when you are near electrical blasting caps, in a blasting area, or in areas posted: “Turn off two-way radio.” Obey all signs and instructions.

FCC Licensing Information

The i80 includes transmit – receive UHF radios and require FCC licensure for operation in the United States. It is illegal to operate these devices in Transmit mode without a valid FCC license.

This link describes the pitfalls of broadcasting without a license:

http://www.amerisurv.com/PDF/TheAmericanSurveyor_Silver-PirateSurveyors_Jan2014.pdf

This link describes exactly how to obtain an FCC License:

http://ashgps.wordpress.com/2014/01/08/exactly-how-do-i-get-a-fcc-license-for-my-rtk-radio/

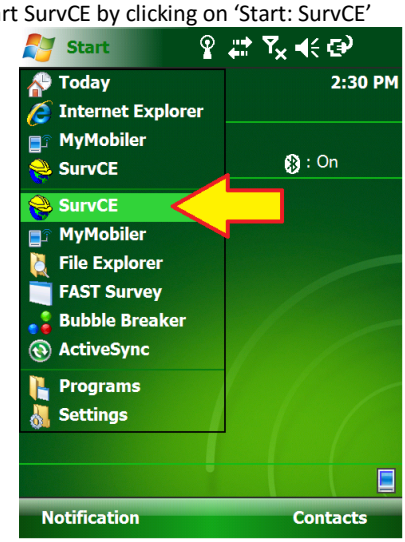
Starting a New SurvCE Job

i80 GNSS Receivers are typically sold with Carlson SurvCE field data collection software.

Throughout this manual, it is assumed that you have a SurvCE job open on your data collector when you begin setting up Base and Rover configurations.

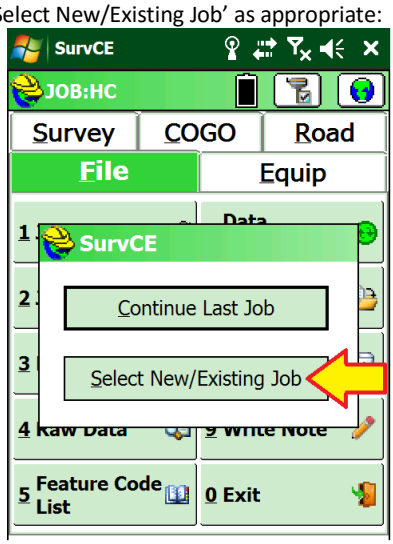
This section describes in detail how to setup a new SurvCE job.

1. Turn on the Data Collector, wait for it to boot.
2. Start SurvCE by clicking on 'Start: SurvCE'



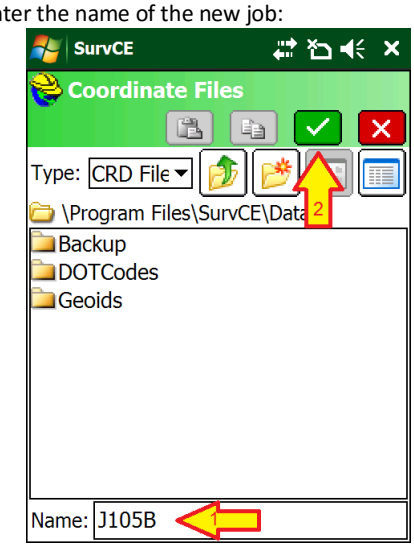
Note: the 'Start' icon is the windows flag in the upper left or lower right corner of the screen.

3. The opening screen will be shown, click on 'Continue' or 'Select New/Existing Job' as appropriate:



For this example, choose a 'Select New/Existing Job'.

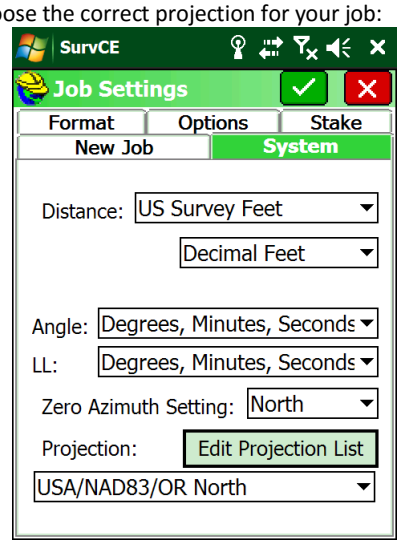
4. Enter the name of the new job:



Then click the green check mark.

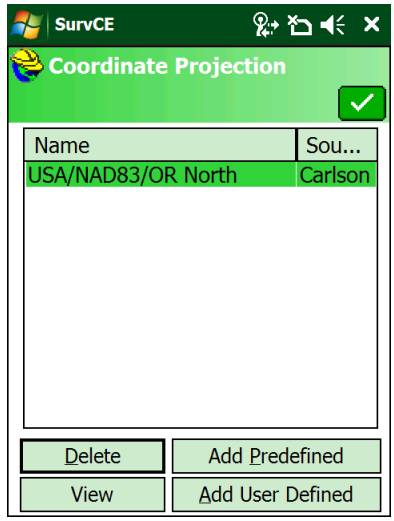
SurvCE jobs are stored in 'Card Files' with .CRD file extensions. When you create a new job, several supporting files are created in the same folder as the .CRD file. Some users prefer to keep jobs in separate folders, which you can manage from the 'Coordinate File' menu.

5. Choose the correct projection for your job:

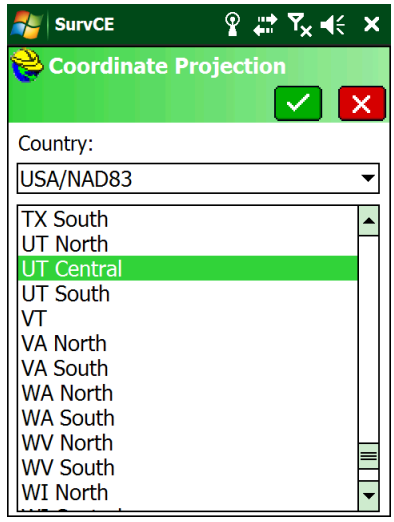


Choose 'Distance' units from 'Metric', 'US Survey Feet' or 'International Feet'.
The projection drop box displays a list of often used projections.

If the projection you need is not listed in the drop-down list click on 'Edit Projection List':

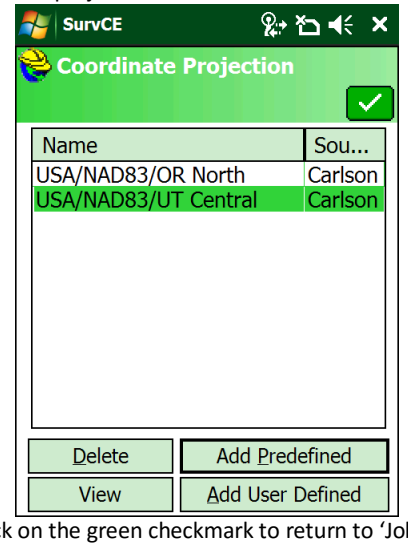


Then click on 'Add Predefined':



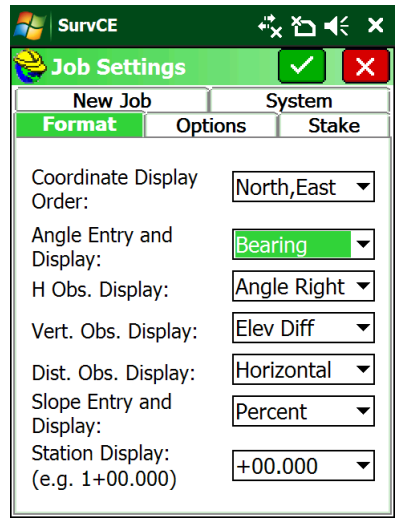
Select the correct projection for your location from the list, then click the green check mark. Under the 'Country' drop down box you can also find special county projections and standard UTM projections.

6. The coordinate projection list will now include your selected projection.



Click on the green checkmark to return to 'Job Settings'.

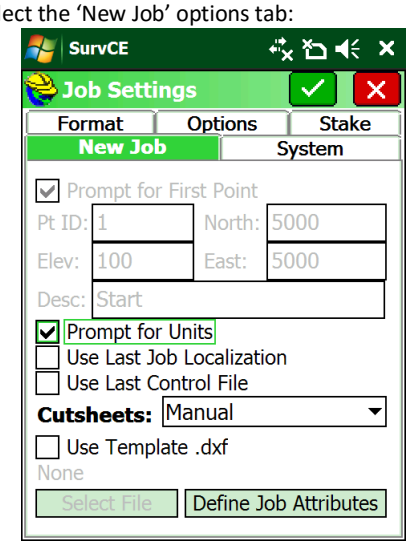
7. Select the 'Format' tab:



Most defaults will be fine. You may want to change 'Angle Entry and Display':

Bearing "N 45 12 52 W"
Azimuth "315 12 52"

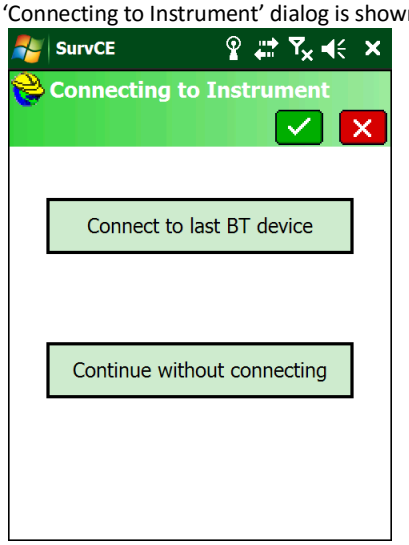
8. Select the 'New Job' options tab:



Unless you setup at the same location for every job (like a mine site) you will want to have 'Prompt for Units' checked and 'Use Last Job Localization' and 'Use Last Control File' unchecked as shown.

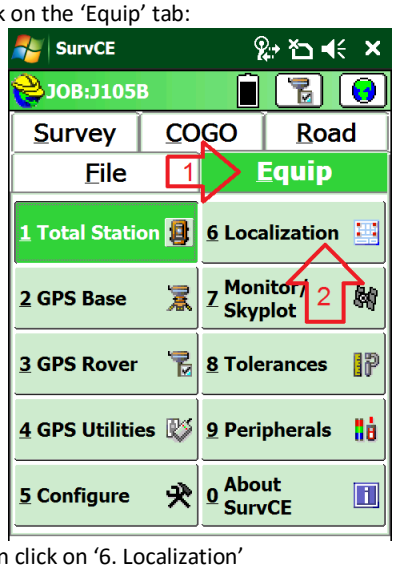
9. Click the green check mark again to get to the 'Main Menu'.

The 'Connecting to Instrument' dialog is shown:



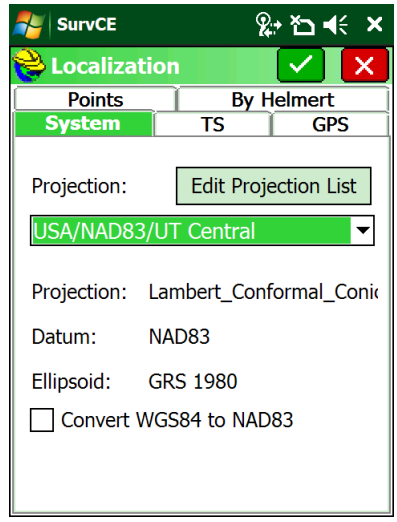
10. Click on 'Continue without connecting' to reach the main menu without connecting to an instrument.

11. Load a GEOID file.
Click on the 'Equip' tab:

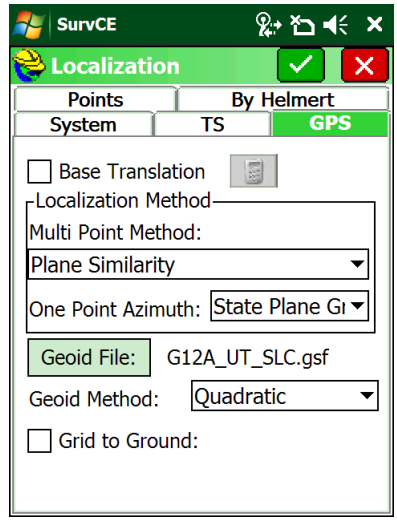


Then click on '6. Localization'

12. While you are at the 'System' tab, make sure that 'Convert WGS84 to NAD83' is unchecked:



13. Click on the 'GPS' tab:

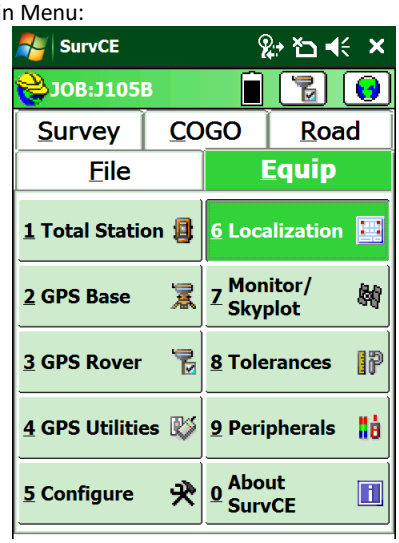


Make sure that an appropriate Geoid file is listed to the right of the 'Geoid File:' button.

If a GEOID file is not listed, click on the 'Geoid File:' button and browse for the proper Geoid file. If you don't have a geoid file that covers your survey area, read section '*Building, Loading and Using a GSF (GEOID Separation File) for SurvCE*' on Page 66.

Since you are not yet connected to a GNSS receiver, you can't check the 'Grid to Ground' checkbox and automatically compute a scale factor so it is best to leave this checkbox unchecked until after you have configured either the base or rover.

14. Finally click the green check mark to return to the Main Menu:



You are now ready to configure a Base or a Rover.

This manual contains several i80 step-by-step configuration guides:

Configuring the i80 UHF Base Page 18

Configuring an i80 UHF Rover Page 25

Configuring an i80 Network Rover with DCI Page 36

Configuring an i80 Network Rover with Internal GSM Page 46

Setting up a i80 UHF Base Rover Pair

The 'All-in-One' system includes Tx/Rx radios in both the Base and Rover. The Base and Rover are interchangeable.

The Base receiver is typically configured to automatically open an observation file every time the receiver is turned on and begins tracking satellites. This way you do not need to worry about not having occupation data for your base.

The only reason that the heads are stickered as 'Base' and 'Rover' is to automate configuration and save setup time. They can be interchanged at any time.

Configuring the i80 UHF Base

Choose a Great Location for the Base

The location of your base greatly impacts the success of your survey. There are two primary concerns:

1. Minimizing multipath and obstructions between the base and the sky
2. Maximizing the effective range of the UHF radio which is broadcasting corrections to the rover

The base does not need to be located at a control point or parcel corner. You can locate the Base at an optimum location for tracking GNSS signals and broadcasting corrections, then perform a single (or multiple) point Rover localization. It is better to localize your rover than to use a base that is under canopy or in a deep canyon.

Any multipath or obstructions at your base will affect every single shot at your rover, just as if the multipath existed at the rover. Your primary concern should be finding an open location for the base that minimizes multipath (via GNSS signal reflections on hard surfaces.)

A clear view of the sky above a 10 degree mask is also important. Partially obstructed/masked satellites (through tree branches) are worse than fully obstructed satellites. Clearance to the South, East and West is most important. Obstructions directly to the North have the least effect on your RTK and static solutions.

When using a UHF radio, your ability to place the UHF antenna in a high location with the minimum of obstructions to your working area is also important.

Base Radio Battery

iGage does not provide an external battery for use with the Base as they are difficult to safely ship and easily procured locally.

The internal batteries will run the i80 Base for approximately 6 to 8 hours depending on the configured UHF output power.

For extended operation, a 12-Volt battery is suggested. A motorcycle sized Sealed Lead-Acid battery will suffice for a day's work.

Figure 6 12V, 18 amp hour sealed lead acid battery with nut/bolt connections

You can use either the USB or Serial cable that are supplied with the i80, combined with the supplied battery clip cable to provide external power.

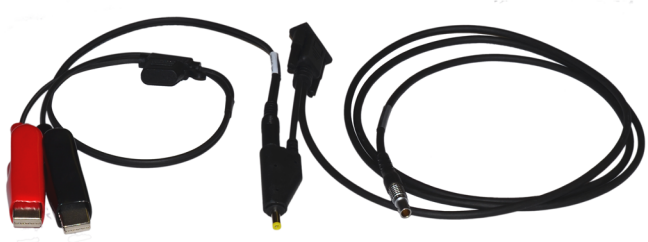


Figure 7External Power Cable for i80 Base

i80 Base Configuration: Step by Step Setup

1. Setup the Base:

    a. Choose a suitable location for the base. A clear view of the sky and satellites is most important. If the location is not high enough, a repeater may be required to propagate UHF radio corrections to the rover.

    b. Put freshly charged batteries in the head.

    c. Connect the UHF radio antenna to the bottom of the receiver.

    If you are going to be working more than ½ mile from the base, use the included TNC extension cable to move the UHF antenna to the top of a mast placed to the North of the receiver.
    The higher the antenna, the better.

    Please make sure that you are not placing the antenna near power lines!

Figure 8Raising the UHF antenna for additional range.

    d. If you are going to be working longer than 3 hours attach the external power connector and connect an external battery source.

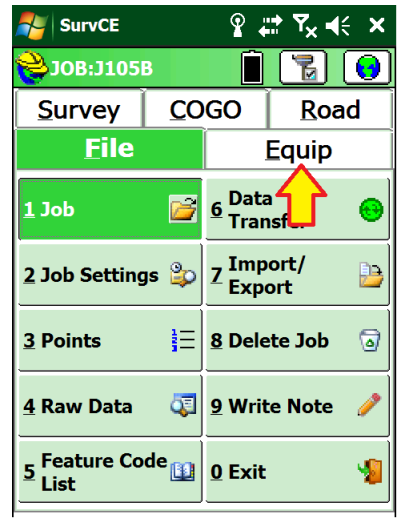
    e. Attach the receiver to a tripod or pole as appropriate.

    f. Rotate the receiver so the buttons face North

    g. Turn on the base, it will begin to track Satellites.

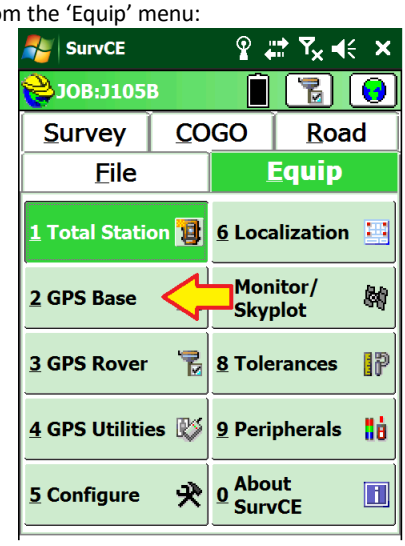
2. Refer to the section '*Starting a New SurvCE Job*' on Page 14 to start and configure a new job.

3. From the Main Menu:



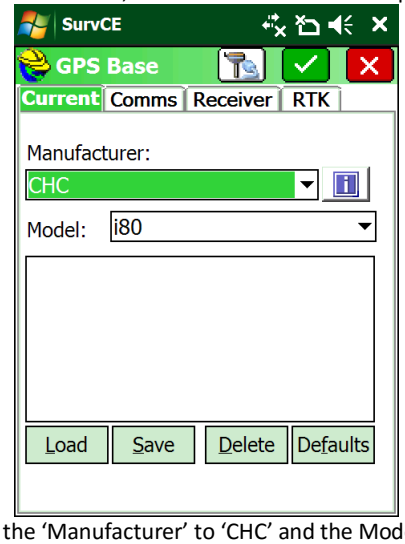
Click on the 'Equip' tab.

4. From the 'Equip' menu:



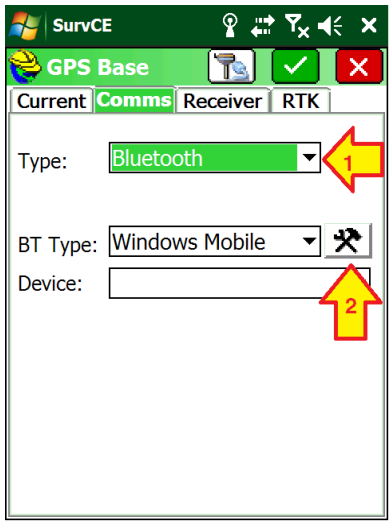
Click on the 'GPS Base' button.

5. After a moment, the 'Current' tab will be displayed:



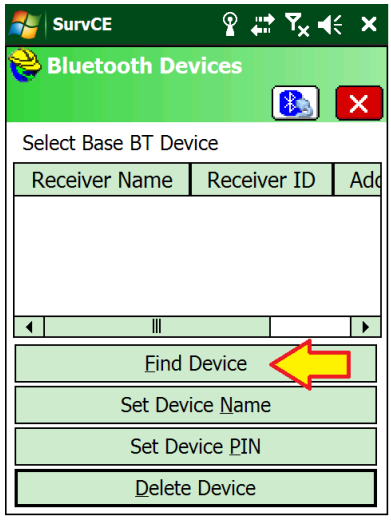
Set the 'Manufacturer' to 'CHC' and the Model to 'i80'as shown.

6. Click on the 'Comms' tab:

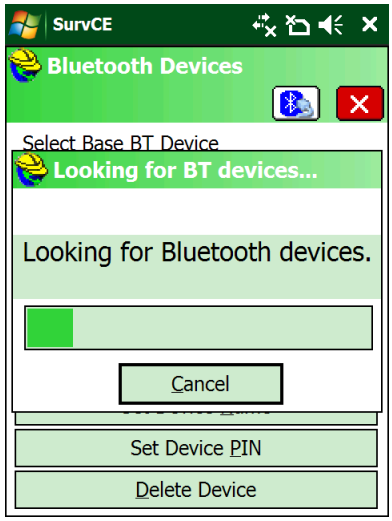


Set the 'Type' to 'Bluetooth',
Set the 'BT Type:' to 'Windows Mobile',
then click the configuration button (the 'hammer / wrench' icon) to the right of the 'BT Type'.

7. If your Base receiver is not shown, click the 'Find Device' button:

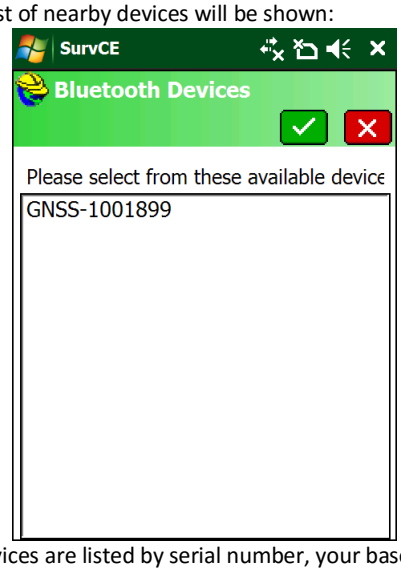


Wait up to 30-seconds while the data collector searches

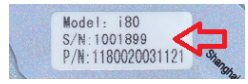


for nearby Bluetooth enabled devices.

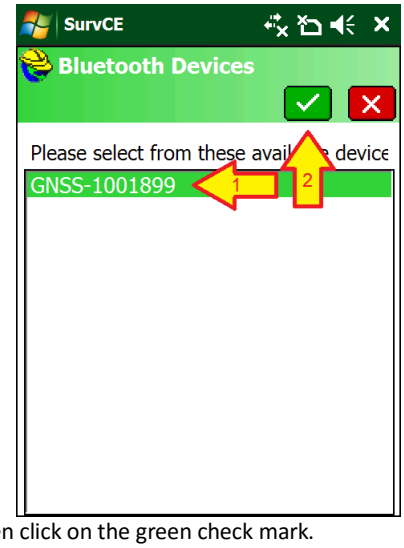
8. A list of nearby devices will be shown:



Devices are listed by serial number, your base serial number can be found on the bottom of the receiver:

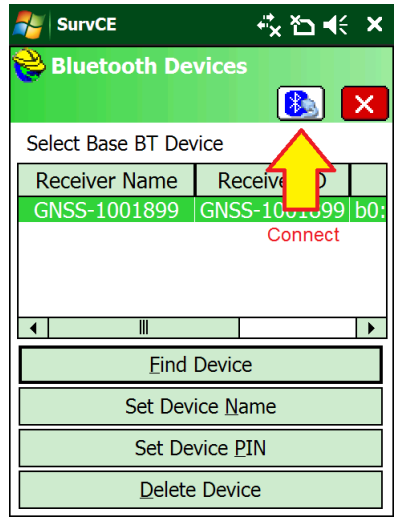


Click the correct device:



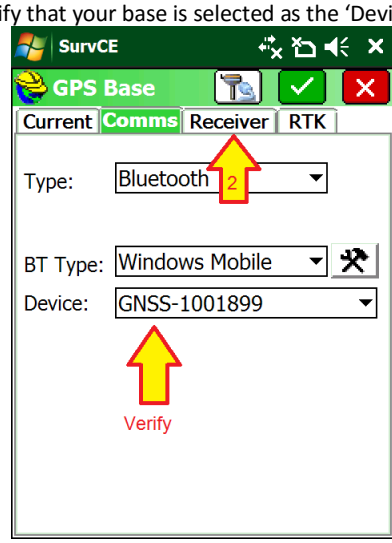
then click on the green check mark.

9. Your device should now be selected and highlighted on the device list:



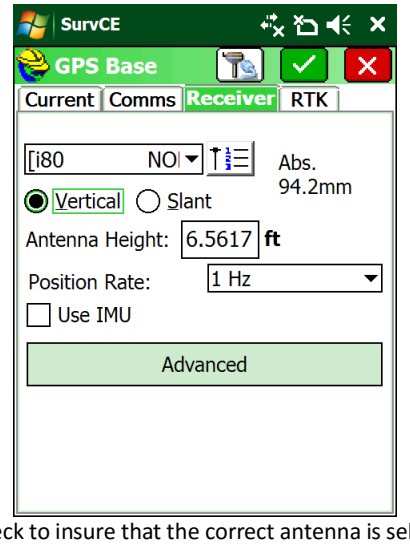
Click on the Bluetooth Connect button (it looks like a Bluetooth symbol with a cable.)

10. Verify that your base is selected as the 'Device':



then click on the 'Receiver' tab.

11. The GPS Base Receiver configuration tab will be shown:



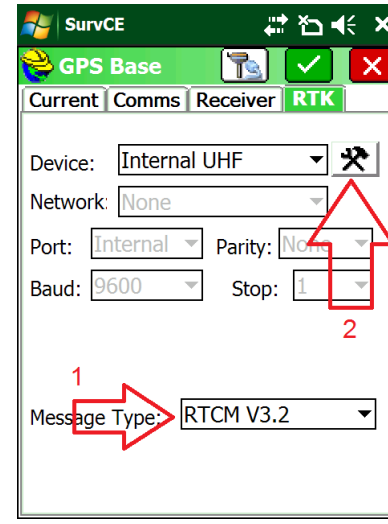
Check to insure that the correct antenna is selected. Both absolute and relative calibrations can be selected by clicking the '123' button. Absolute is typically correct for all applications.:

Set the Position Rate at 1 Hz.
Uncheck the 'Use IMU' (Tilt / Heading Compensation) as this is a 'Base' receiver and you should carefully level the head in all applications.

If the Base receiver is mounted on a fixed height pole, select 'Vertical' and enter the Antenna Height as the true pole height.

If the Base receiver is mounted on a tripod, select 'Slant' and enter the slanted tape distance from the ground mark to the bottom of the blue band that separates the white top from the gray bottom:

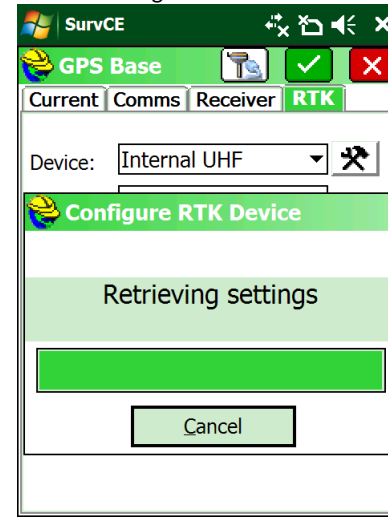
12. Click on the 'RTK' tab:



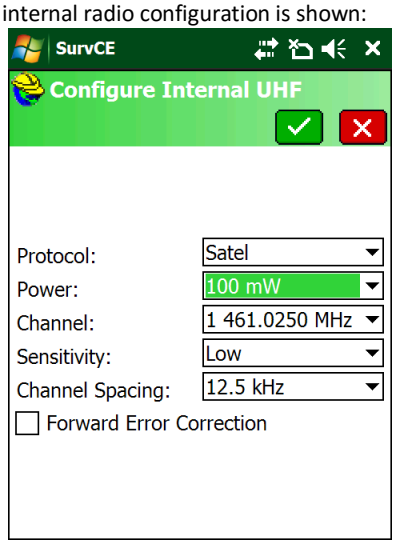
Set the 'Message Type' to 'RTCM V3.2' or 'sCMRx' While other messages are available, these two choices provide full corrections for all tracked satellites and signals.

Set the Device to 'Internal UHF'.

13. Click the settings button to the right of the Device. Wait a moment while the data collector retrieves the current radio configuration from the Base:



14. The internal radio configuration is shown:



i80 pairs work great with the settings shown above.

The Base and the Rover MUST have matching Protocol, Channel, Over the Air Baud, Forward Error Correction [and scrambling.]

The 'Satel' protocol has excellent range and low overhead. Other protocols may be required for interoperation with other brands of equipment.

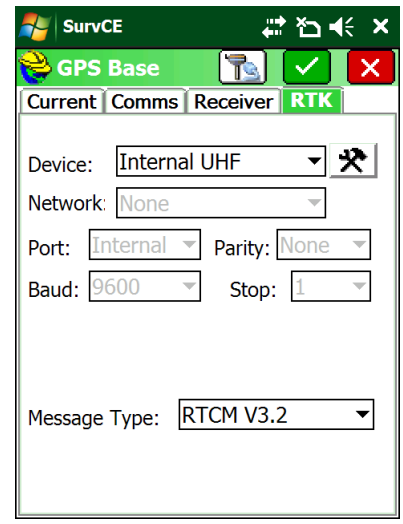
Use a handheld UHF radio to check the selected frequency for other users (Voice or Data.) It is best to use frequencies with no other users. (You must have a FCC license to transmit on the selected frequency.)

Always set the 'Sensitivity' to 'Low' on the Base, this reduces the suppression of Base transmissions when someone else is using the same frequency.

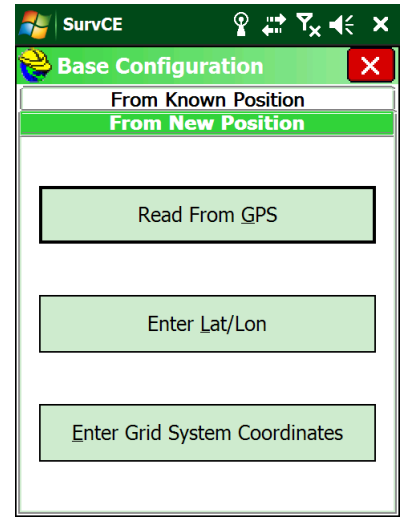
For operation in the United States the 'Channel Spacing' must be 12.5 kHz (unless you have a very special FCC License.)

Choose the lowest Power that allows you to move around the job without a loss of radio corrections. If you have a handheld UHF receiver, you can use the handheld to prevue the selected channel to insure it is not already in use by another user.

15. Click on the green check mark to return to the RTK tab:

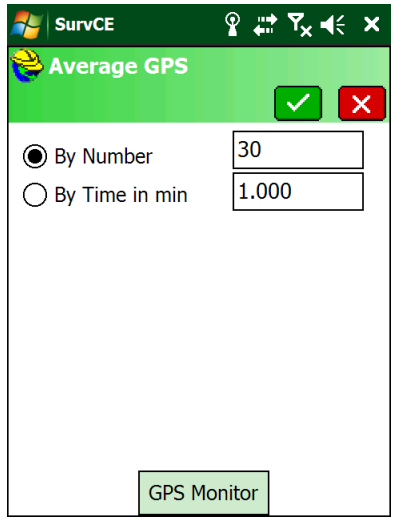


16. Click on the green check mark to advance to the Base Position screen:



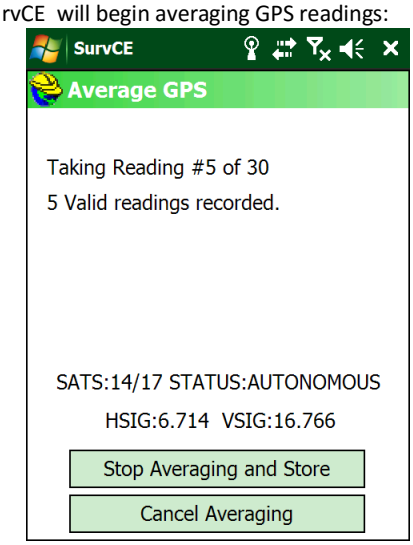
If you don't know the position of the base, click on 'Read From GPS'. If you have a geographic coordinate (Latitude / Longitude), then you can hand enter the position using either 'Enter Lat/Lon'. Use 'Enter Grid System Coordinates' if you know the Grid Coordinates for the base position or if they are an existing point in your job. If you have previously setup on the point, you can use the 'From Known Position' tab.

17. In this example, we will read an autonomous position from the GNSS receiver by clicking the 'Read from GPS' button. A 30-second average is usually sufficient to get a reasonable averaged position for the base:

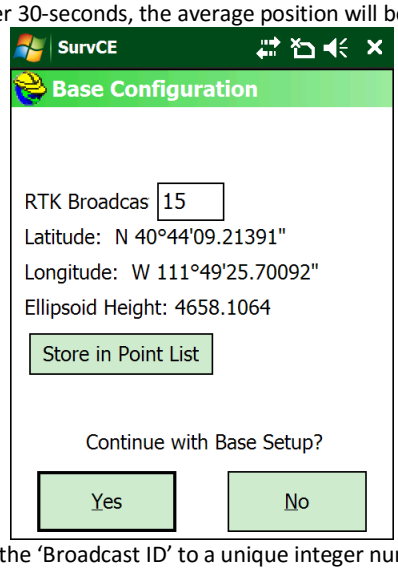


Click the green check mark.

18. SurvCE will begin averaging GPS readings:

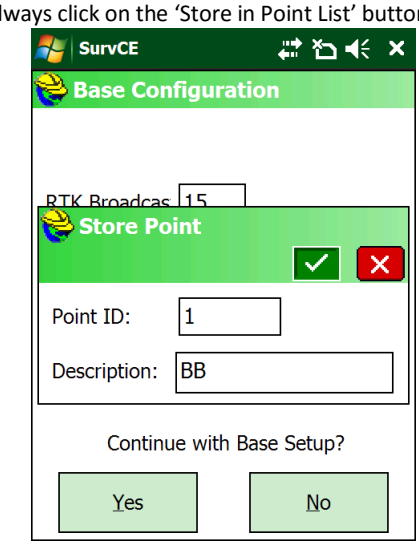


19. After 30-seconds, the average position will be shown:



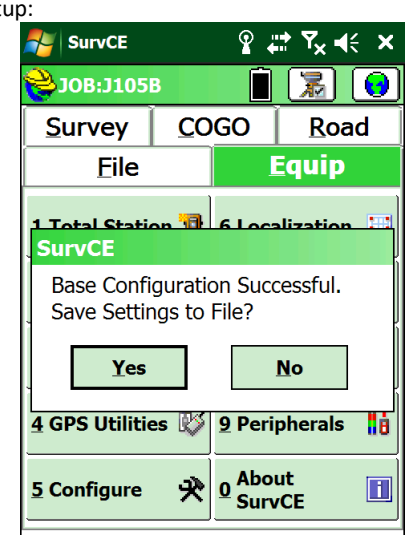
Set the 'Broadcast ID' to a unique integer number. This ID can be used to require the rover to only listen to your base in the event there are multiple bases on the same UHF frequency.

20. Always click on the 'Store in Point List' button:



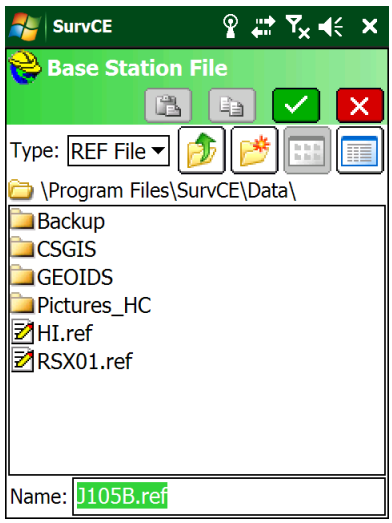
A 'Point ID' of '1' and a 'Description' of 'BB' (Broadcast Base) is reasonable.
This stores the Orthometric Height (if a GEOID is defined) for the base point in the current job file. This base location can be handy for setting a scale factor as raw data will exist for the base point.

21. Click the green check mark to continue with the base setup:



Click 'Yes' to store the base location to a file.

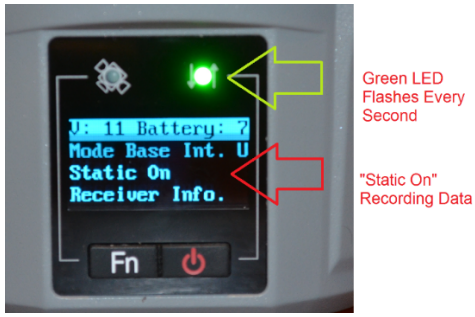
22. A file with the job's name and the extension .REF will be suggested:



Click the green check mark to accept.

23. Your base is now configured and should be broadcasting corrections.

24. Check to insure that the green LED is flashing once each second.
Check to insure that the status 'Static On' is shown.



25. **If 'Static On' is not shown, then the receiver is NOT storing observation data**. You can turn it on from the data collector or from the front panel.

From the data collector, click on 'Survey" tab, then click on "Log Raw Data':

26. The "Log GNSS" dialog is shown

Click on the 'Start File' button, then click on the red 'back' button.
The i80 display will now show "Static On"

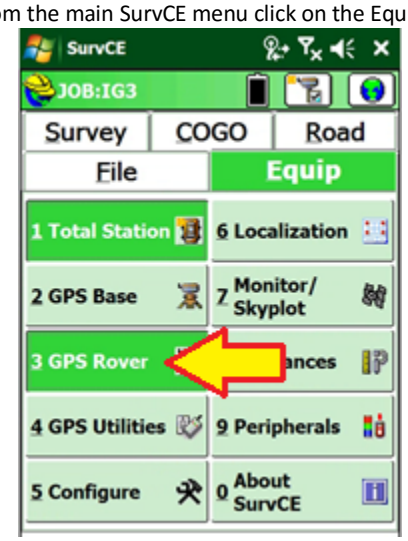
Your i80 Base should now be broadcasting corrections via the UHF radio. You can use your handheld receiver to listen to the corrections.

Configuring an i80 UHF Rover

1. Setup the Rover:
   a. Attach the UHF antenna to the head.
   b. Put one or two freshly charged batteries into the head.
   c. Attach the rover to the range pole.
   d. Attach the Data Collector bracket to the range pole.
   e. Turn on the Rover receiver.

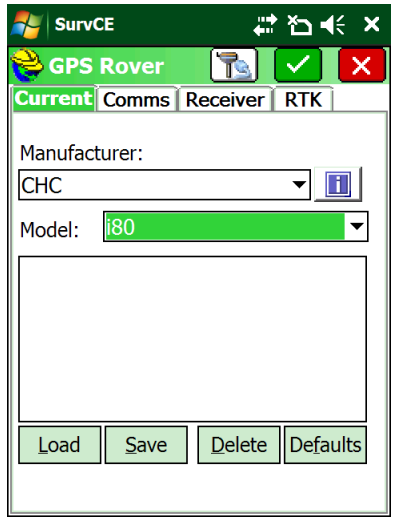
2. If you have not already started a new job, refer to the section '*Starting a New SurvCE Job*' on Page 14 to start and configure a new job.

3. From the main SurvCE menu click on the Equip tab:



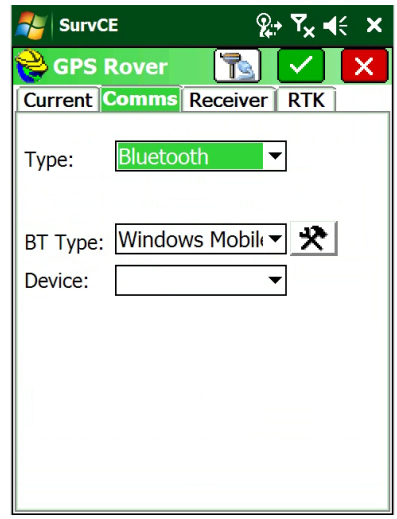
Then click on '3 GPS Rover'

4. Choose the correct manufacturer and device type:



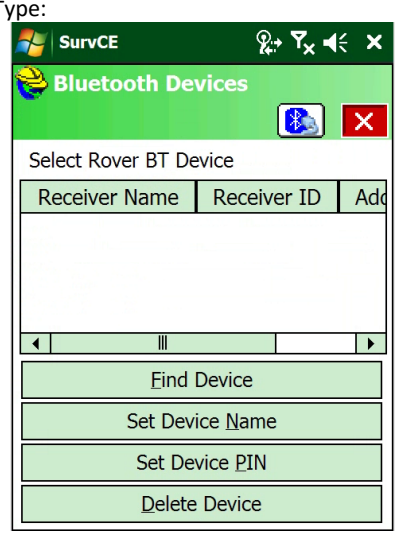
Choose 'CHC' and 'i80'.

5. Select the Comms tab:

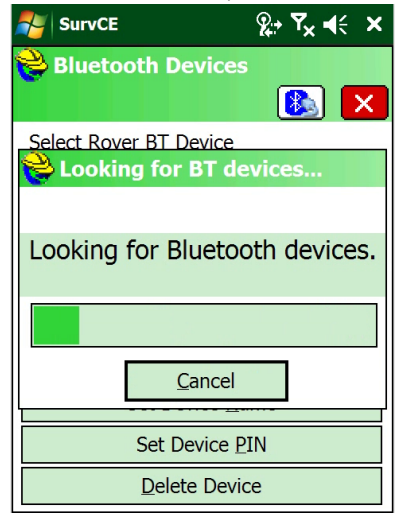


Choose 'BT Type' = 'Windows Mobile'.

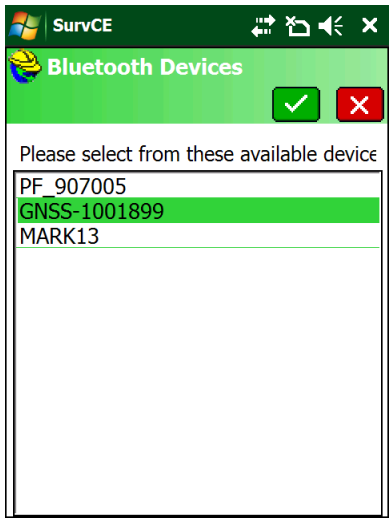
6. Click on the 'hammer/wrench' button to the right of BT Type:



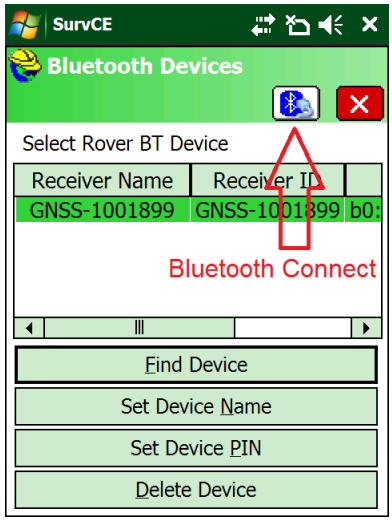
7. If your receiver is not listed, click on 'Find Device'



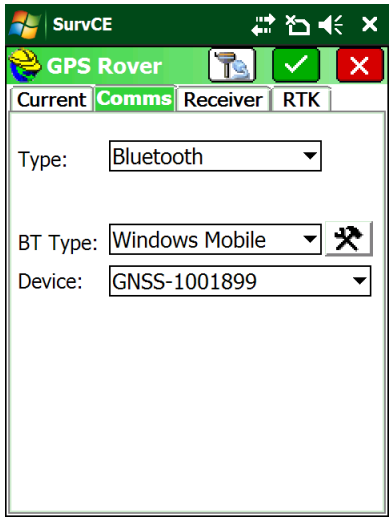
…



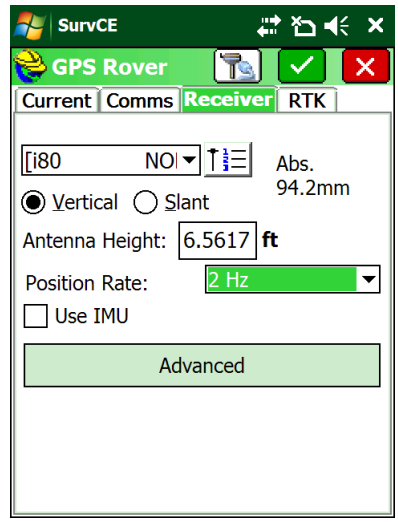
8. Highlight the correct receiver (the number is the serial number of the device, if you have your Base AND Rover powered up, make sure you are connecting to the Rover!)
9. Click on the Bluetooth button, just to the left of the red X:



SurvCE should now show the selected device:



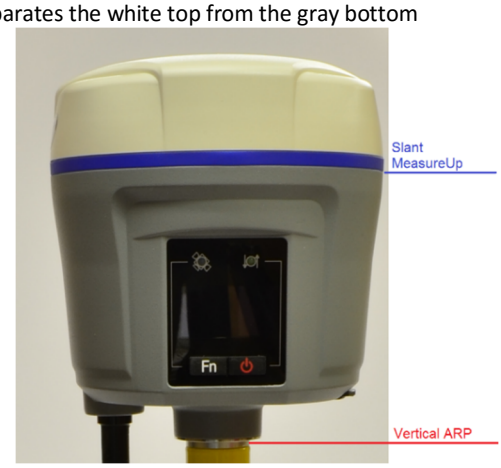
10. Click on the Receiver tab:



Check to insure that the correct antenna is selected: Absolute antenna models typically should be used.

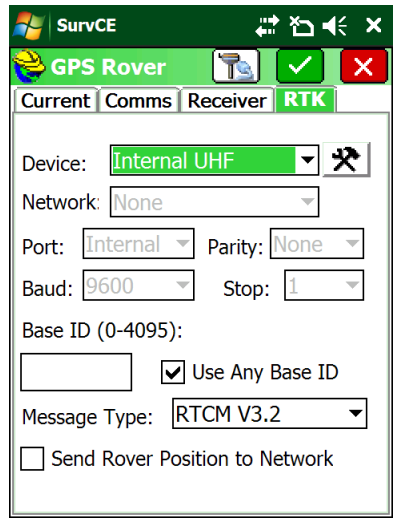
If the Rover receiver is mounted on a fixed height pole, select 'Vertical' and enter the Antenna Height as the pole height. (Hint, you can type "2M" and SurvCE will automatically convert 2 Meters to feet.

If the Rover receiver is mounted on a tripod, select 'Slant' and enter the slanted tape distance from the ground mark to the bottom of the blue band that separates the white top from the gray bottom



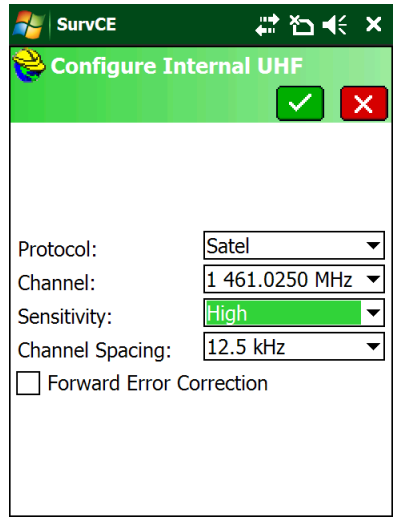
Set the 'Elevation Mask' to an appropriate elevation for the conditions at the Rover, typically 5 to 10 degrees.

11. Click on the RTK tab:



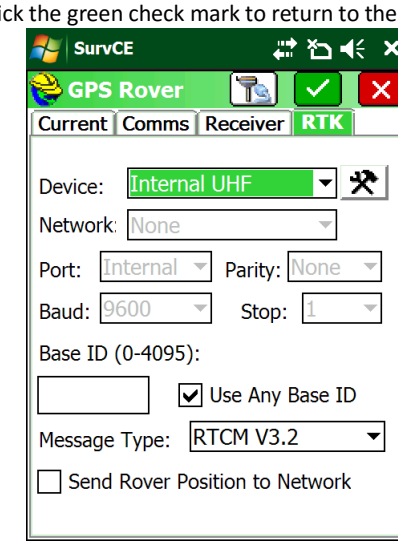
Select 'Device' = 'Internal UHF'.
The 'Message Type' should match the selection on the base, typically 'RTCM V3.2' or 'sCMRx'.
If you uncheck 'Use Any Base ID' then the entered base ID must EXACTLY match the ID configured on the base.

12. Click on the settings button (hammer / wrench) to the right of the 'Device':



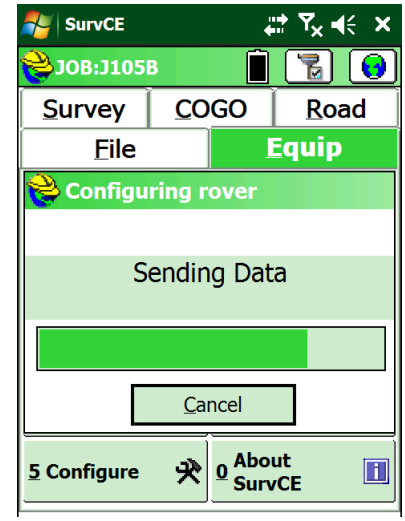
Always set 'Sensitivity' to 'High' on the Rover. (High sensitivity results in the longest radio range.)
The 'Protocol', frequency, 'Forward Error Correction' [and 'Scrambling'] must match the base.

13. Click the green check mark to return to the RTK tab:



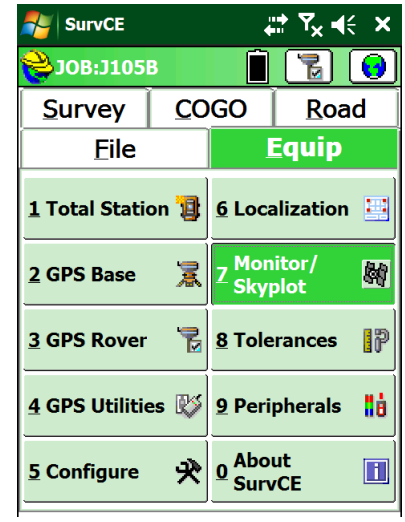
Click on the green check mark to configure the Rover.

14. After a few moments:



the receiver will be configured…

15. You will be returned to the main menu:



16. Continue to the next section to verify operation.

Troubleshooting a UHF Base / Rover Pair

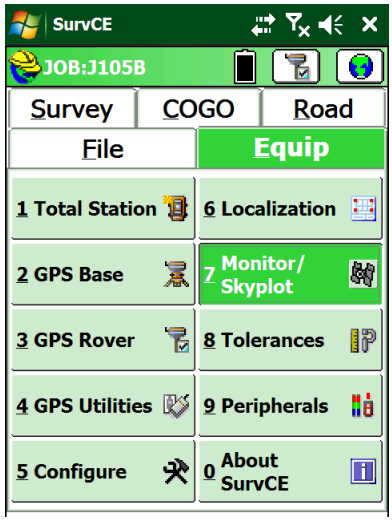
Base Too Close to Rover

If the rover is very near the Base (less than 20 feet), the receiver in the Rover may not be able to understand the Base. The Base will be TOO LOUD for the Rover to understand.

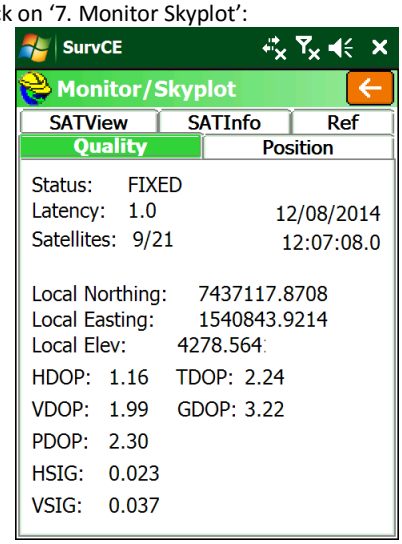
Either move the Rover further from the Base or remove the UHF antenna from rover (never remove the UHF antenna from a transmitting Base.)

Debugging with the 'Monitor Skyplot' screen on the Rover

On the Rover, from the main menu click on the 'Equip' tab:



Click on '7. Monitor Skyplot':



What is the displayed 'Status'?

Status = 'FIXED':

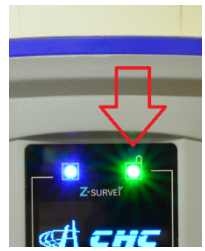
If the Base and Rover are properly configured and running, the 'Status' will be FIXED as shown above. Your Rover is ready to begin surveying.

Status = 'AUTONOMOUS' or 'DGPS':

The Rover is NOT receiving Base corrections or the Rover is indoors or under very heavy canopy.

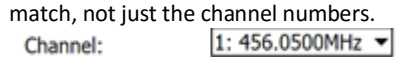
1. Is a UHF antenna connected to both the Base and Rover?

2. Is the Base broadcasting corrections? Check the green LED on the base:



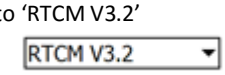
It should blink once each second.

3. If you have a handheld radio, turn it to the matching frequency and listen for corrections.
4. Is the Rover receiving the base corrections? The green LED on the Rover should blink once each second. If the Rover green LED is not flashing, check these items:
   a. Do the frequencies match on the base and rover? The frequencies must match, not just the channel numbers.



   b. Does the radio protocol match? Typically 'SATEL' on both Base and Rover.

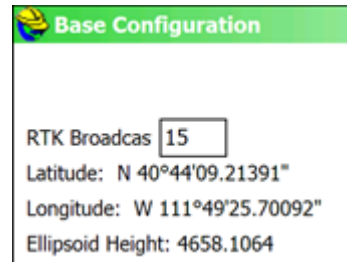
   c. Does the 'Message Type' match on the Base and Rover? Typically they are set to 'RTCM V3.2'



   d. Is the Rover's 'Base ID' set to 'Use Any Base ID'?

If it is unchecked, then the Base ID must

match the broadcast Base ID:

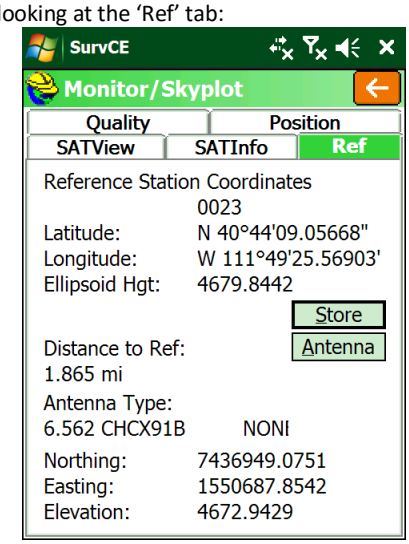


e. Is there someone else using the same frequency? Both Voice and Data in use by others on the same frequency will block your receivers.

Status = 'FLOAT':

If the Rover reports 'Float' then the UHF radios are properly configured and working. Corrections are being received however the GNSS engine cannot resolve ambiguities to fix the solution.

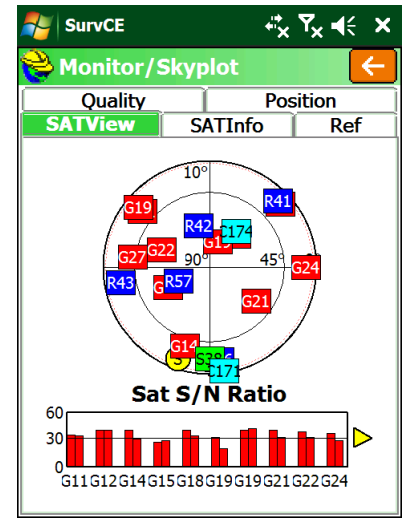
1. Is the Base within 30 miles of the Rover position? Extremely long baseline distances will keep the Rover from Fixing.
2. Is the HSIG continuously decreasing? If so, it may fix. If it drops and then jumps back up, something may be wrong.
3. Is the receiver's view of the sky open and unimpeded? Heavy canopy or extremely bad multipath will keep the receiver from Fixing.
4. Is there a chance that the rover is receiving corrections from someone else's? You can debug this by looking at the 'Ref' tab:



Is the 'Distance to Ref' correct for your base? Is the reference station number ('0023' above) correct for your base?

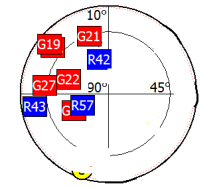
5. If the Rover is FLOAT, but never fixes, the programmed base position could be 100 meters from the actual base location.
6. If the Rover is FLOAT, but never fixes, there could be high multipath or canopy at the base or rover.
7. Is the Latency less than 4 seconds? If the Latency builds up to values larger than 5 seconds there is probably someone else on the same UHF radio frequency or the UHF radio signal is not strong enough to reach the rover dependably.

f. Check the 'SATView' under 'Monitor/Skyplot'. A satellite distribution like this:



is good and the receiver should FIX within 30 seconds if in open sky.

However a sky-plot like this:



where all of the satellites are in one quadrant, or the satellite count is very low, just won't be sufficient to get a FIXED solution.

Setting Up the Optional ADL Vantage Pro Repeater Kit

All-in-One RTK pairs include 1-watt internal Transmit / Receive radios in both the Base and Rover. For many jobs, 1-watt will be sufficient power to blanket the survey area with UHF corrections. To cover larger areas, an optional repeater can be used to extend surveying range.

Typically the repeater will receive a full correction message from the base and immediately retransmit the corrections at a higher power on the same channel as it is received. It is also possible to receive corrections on one frequency and transmit on another.

The repeater need not be located near the base, it only needs to be able to dependably listen to the base signal. This is great for applications where it is convenient to place the base on a job corner or control point, and then place the repeater on a nearby hill that has excellent radio coverage.

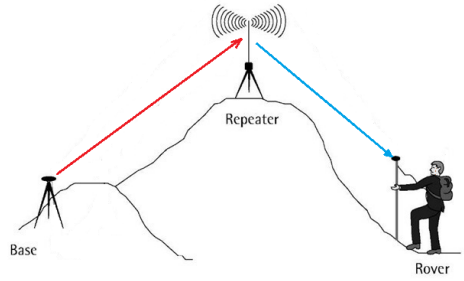


Figure 9 Using a Repeater to extend UHF correction range.

Repeater Radio Battery

The duty cycle of the radio in normal operation is about 50% and the radio draws about 8 amps at full output power. So a 9-hour day requires about 40 amp hours. However the battery requirement is greatly increased for operation in cold weather and the battery's capacity is reduced after several discharge cycles. The less the battery is discharged as a function of its maximum capacity, the more charge cycles the battery will accept. For these reasons, when purchasing a battery for the base: **big**-is-certainly-better.

Large deep cycle marine batteries with screw terminals that will directly accept the lug connectors of the supplied cables are available at reasonable cost from many local sources. iGage typically does not provide an external battery for use with the repeater.

There may be some advantage to a closed cell marine battery like the Optima series:

Figure 10 Optima Closed Cell Deep Cycle battery vs. Standard Deep Cycle Battery

However at three times the price of a standard marine deep cycle battery the Optima may difficult to justify.

Before plugging in the UHF radio, always insure that the UHF antenna has been connected. Double check that the polarity (RED = +; BLACK = -) is correct before attaching the power connector:

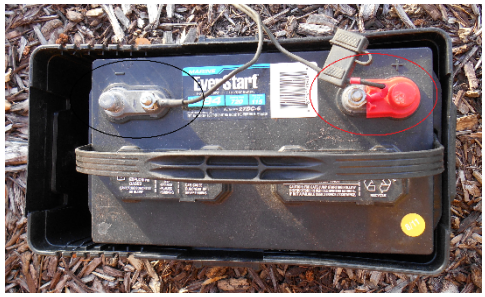


Figure 11 check the polarity of the connections to the battery before use.

You may receive alligator clip connectors with your repeater or RTK heads:

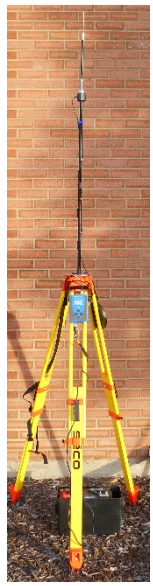
Figure 12 Alligator-clip connections won't support full output power!

These temporary **connectors will not provide** sufficient power to run the repeater at full power. If you plan on using output powers higher than 8-watts, use the spade connectors.

Setting up the Repeater

Place the repeater and antenna on a tripod or other suitable mount. If the base is nearby, set the UHF radio antenna to the North of the GNSS receiver so that the UHF antenna does not block the GNSS receiver's view of the southern sky.

This picture shows the antenna mounted on an extension on top of a tripod. An adjustable prism pole through the center of a tripod is also an excellent alternative.



Repeater

Extension on plate

or

Prism pole through tripod head

Figure 13 UHF Repeater Configuration

Mounting the antenna as high as possible will result in better radio range. Doubling the height of the antenna is much more effective than quadrupling the output power.

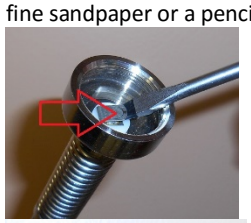
NOTE: The radio automatically drops the output power as required to keep the case at a reasonable temperature. In hot weather, it usually is sufficient to put a piece of cardboard over the top of the radio to keep direct sunlight from heating the case.

For operation in extreme heat, a fan cage is available to force cool the fins on the radio back. Alternatively you can use an inexpensive 12 volt fan:

Figure 14 Fan options for use at very high ambient temperatures.

1. Check the spring clip on the bottom of the antenna, if it is smashed down too far pry it back up so that it will make good contact. Check both the spring clip and the contact on the pole mount to insure they make a clean

connection, if they are corroded clean them lightly with fine sandpaper or a pencil eraser:



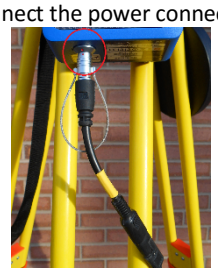
2. Connect the UHF Radio antenna to the radio mast, connect the TNC cable end to the ADL Vantage Pro.

DO NOT plug power into the ADL radio until the UHF antenna has been connected and placed on the mast.

DO NOT hold the antenna or touch the antenna when the ADL power is on. The radio will output sufficient power to burn you.

DO NOT place the UHF antenna to the South of the receiver. The UHF antenna will block the GNSS antenna's view of satellites to the South. Place the UHF antenna to the North of the GNSS base. (There are very few SV's to the North of your GNSS receiver so the impact is minimized.)

3. Connect the power connector to the radio:



4. The radio will turn on when power is applied. IMPORTANT: Before you remove power from the radio, ALWAYS turn the radio off with the power switch. Push and hold the Power ON/OFF button for five seconds, then wait for the radio to power down:

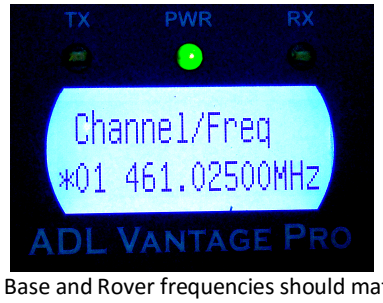
Alternatively you can disconnect power at the SAE (the flat two-pin connector.)

5. After 5 minutes, the LCD display is placed in sleep mode. Press and hold the ON/OFF button for 1-second to turn the LCD display back on.
6. If your Base is already configured and broadcasting corrections, the repeater should begin operation within 30-seconds of being turned on. You should see the RX LED blink, then the TX LED will immediately blink. This pattern should repeat every second.
7. If the repeater does not start working, verify that the base is transmitting, then check the repeater settings as shown below.

NOTE**: If you change a value, be sure to press the center Enter button to store the change.**

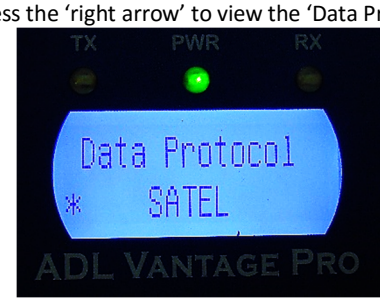
8. When you turn on the receiver, the device status will be shown. The status should be 'Battery: Normal'

9. Press the 'right-arrow' to move the next screen. The current channel will be shown



The Base and Rover frequencies should match this setting. Note that the channel number may be different, only the frequency must match.

10. Press the ‘right arrow’ to view the ‘Data Protocol’

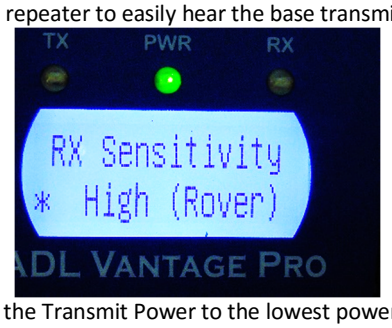


“SATEL” is the correct setting corresponding to the ‘SATEL’ setting on the Base and Rover.

11. The Radio Link Rate is the ‘over the air’ baud rate. The correct value is 9600.

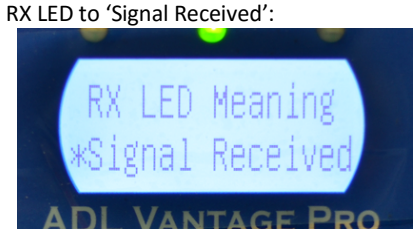
12. Set the Repeater Mode to ‘ON’:

13. Set the RX Sensitivity (for the base) to High. This allows the repeater to easily hear the base transmissions:



14. Set the Transmit Power to the lowest power that will cover your job.
Use the up and down arrow keys to select, press enter when the proper selection is made.

15. Set RX LED to ‘Signal Received’:



The RX LED will blink when any signal (voice or data) is present on the selected frequency.

16. The Serial Baud is the baud rate over the serial cable to the GNSS receiver. For a repeater, which does not have a serial cable, this has no effect:

17. Press the ‘right-arrow’ to skip Signal Strength:

18. Set ‘Advanced Menus’ to ‘Show’:

19. CSMA (Collision Sense Multiple Avoidance) must be left ON in the USA to meet FCC requirements:

When CSMA is turned ON, the radio will listen for other data or voice users on the programmed frequency, the radio will wait until other users stop broadcasting before transmitting. **FCC rules require CSMA to be ON for operation in the United States**.

20. Set 'Edit Config' to 'Enabled':

21. Set Scrambling to 'OFF' (this setting must match the setting on the Base and Rover):

Enabling Scrambling lengthens each data packet.

22. Set FEC (Forward Error Correction) to 'OFF' (this setting must match the setting on the Base and Rover):

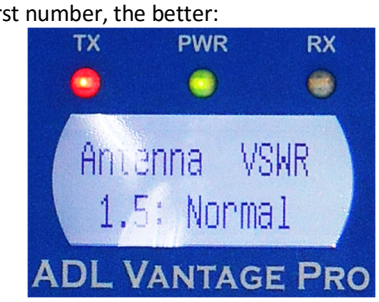
Turning FEC ON lengthens each data packet.

23. Choose the appropriate language

24. Leave 'Antenna Detect' set to 'Disabled'.
If you have concerns about your antenna or antenna cable, set 'Antenna Detect' to 'Enabled'. This will allow the radio to detect the antenna and cable efficiency and automatically reduce the output power to 2-watts when issues are found:

There is a slight chance that a good antenna will be detected as bad, which will result in inadvertent lower output power and reduced rover range.
If you know your antenna and cable are in good condition leave 'Antenna Detect' set to 'Disabled' to insure continuous high output power.

25. The Antenna VSWR displays the Standing Wave Ratio. Any value less than 10:1 is reasonable. The lower the first number, the better:

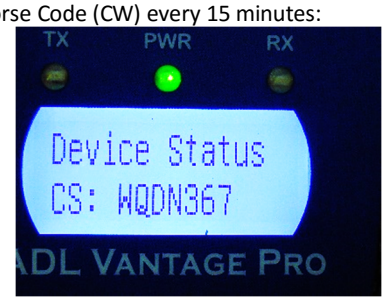


Values higher than 8:1 result in a 'no antenna connected message.'
Note: if 'Antenna Detect' is 'Disabled' this screen will not be shown.

26. One last right click and you are back to the Device Status:

27. Clicking the 'down-arrow' will display the owner's name or telephone number:

28. Down arrow to the FCC ID which is transmitted in Morse Code (CW) every 15 minutes:

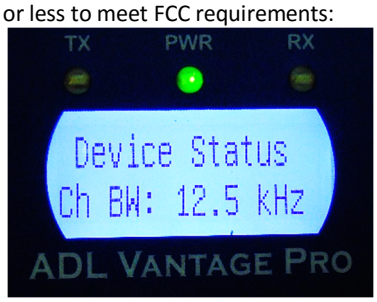


A valid FCC license is required for operation in the United States and the FCC assigned ID must be transmitted by continuous wave (CW) Morse Code every 15-minutes.

29. Press the down arrow to view the current modulation type:

The modulation type will change based on the selected protocol.

30. In almost all cases for all current FCC licenses in the United States, the channel bandwidth must be 12.5 KHz or less to meet FCC requirements:



31. This screen indicates if the transmitter is enabled and what the output power is:

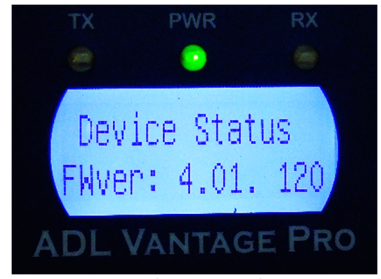
On hot days, it is possible that the radio power setting is higher than the enabled value. Power will also be reduced if Antenna Detect is enabled and a fault is detected.

32. This is the internal temperature of the receiver:

Automatic power management becomes active when this temperature is higher than 85 C.

33. 15-seconds after you switch to the Duty Cycle screen, the transmit duty cycle of the receiver is shown:

34. This is the firmware revision currently running in the radio:



NOTE: **The current (May 2016) firmware version is 4.20.** You can check for updated firmware online at www.pacificcrest.com

35. Finally the regulatory region code is displayed:

Always leave this setting as shown.
Always leave this setting as shown. Do not be concerned that it lists countries that do not include the USA.

Configuring an i80 Network Rover with DCI

There are many variants of network corrections: Single Base Line, VRS (Virtual Reference Server), FKP and SpiderNet MAX (Master Auxiliary.) The most common network transport is NTRIP using a data collector which is connected to the internet via a Wi-Fi Hotspot (preferred) or an internal GSM SIM card. It is also possible to use the GSM modem in the receiver head directly. These connection methods are covered in this User Manual:

Connecting your Data Collector to a Wi-Fi Hotspot Page 36

Provisioning a GSM SIM Card in your Data Collector Page 38

Once you configure your data collector to have Internet Connectivity, you will want to check that the connection is valid. The section:

Check the Internet Connection Page 41

Finally the steps required to configure a network rover using are shown:

NTRIP Rover Configuration Page 42

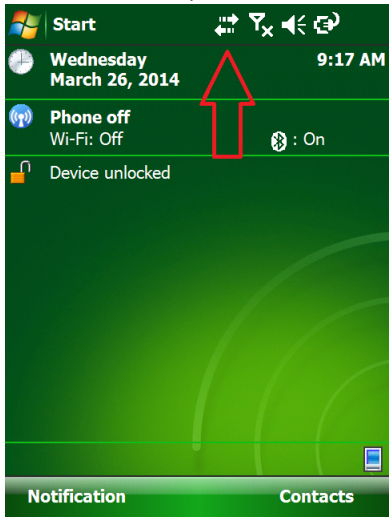
A Direct IP (DIP) connection is very similar to the NTRIP connection, however it is not covered in detail in this User Manual.

In addition, it is possible to use a SIM card directly in an i80 Network Rover, detailed configuration information can be found on Page 46.

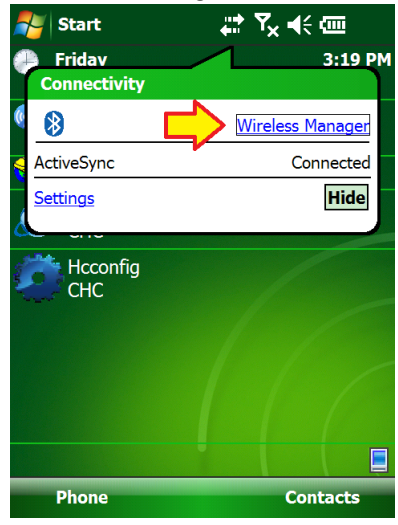
Connecting your Data Collector to a Wi-Fi Hotspot

The first time your data collector is connected to a Wi-Fi Hotspot you will need to configure the Wi-Fi access point and password.

1. First insure that the data collector is connected to the Wi-Fi Hotspot.
   Click on the Connectivity Button:



2. Click on 'Wireless Manager':

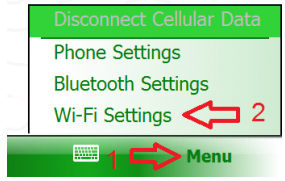


3. Enable (Turn ON, OPEN) the Wi-Fi connection by clicking on the slider to the right of Wi-Fi:

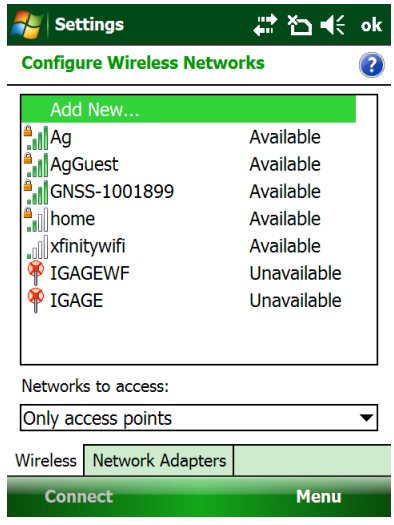
4. If you have connected to the hotspot before, wait 30 seconds to allow the data collector to automatically reconnect. If the antenna icon has a complete circle around it:

then your data collector is already connected to the internet. **Skip to section 'Check the Internet Connection' on Page 41**.

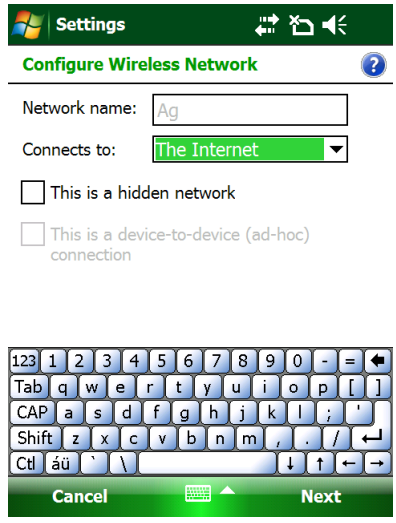
5. From the Wireless Manager, click on Menu: Wi-Fi Settings:



6. A list of available Wi-Fi Hotspots will be shown:



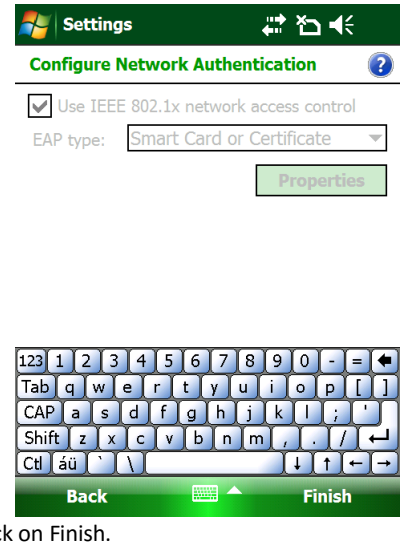
7. Click on your Wi-Fi Hotspot's name ('Ag' in this example):



8. Click on 'Next':

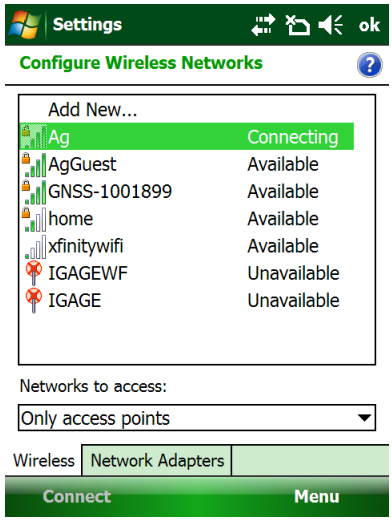
Enter your 'Network Key' (the Wi-Fi Password).

9. Click 'Next'

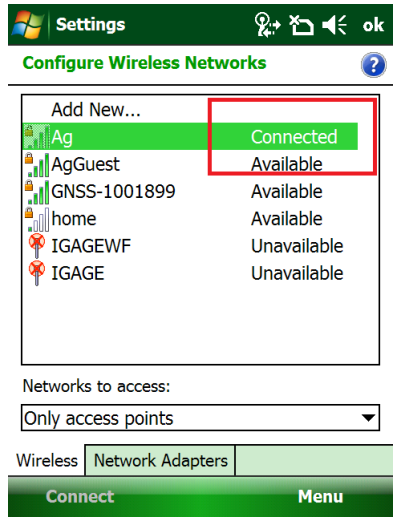


Click on Finish.

10. Watch the status of your Hotspot:



11. After a few seconds you will see 'Connected'



12. Finally click on 'ok' to return to the main menu.

13. **Continue to "Check the Internet Connection" on Page 41**

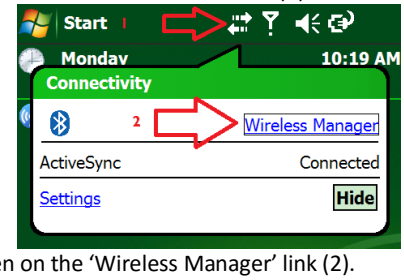
Provisioning a GSM SIM Card in your Data Collector

If you choose to install the SIM card in the data collector, you will need to do the following one-time provisioning to get the data collector 'on the internet.'

1. Procure a 'data' activated GSM SIM card.
2. Turn off the data collector, remove the battery and insert your SIM card:

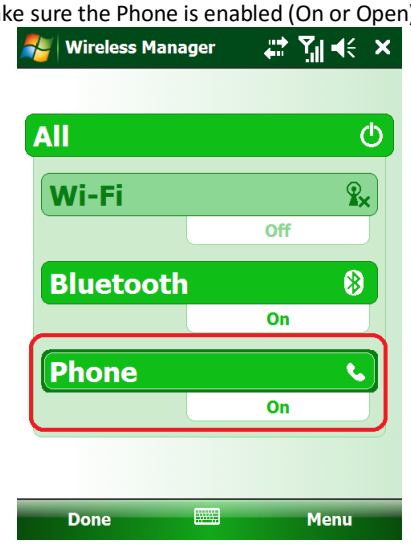
Note the gold contacts are down and the clipped edge goes in last on the LT30. Other data collectors may have a different card orientation.

3. Click on the 'Connections' icon (1):

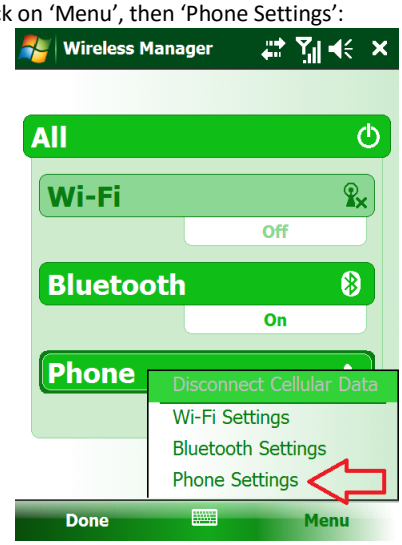


then on the 'Wireless Manager' link (2).

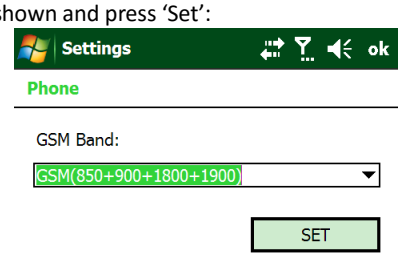
4. Make sure the Phone is enabled (On or Open):

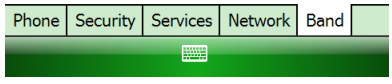


5. Click on ‘Menu’, then ‘Phone Settings’:

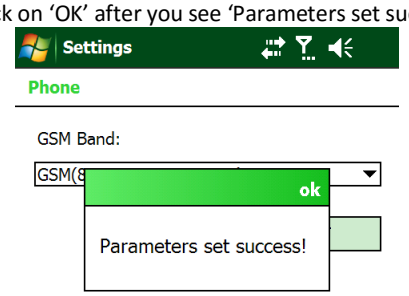


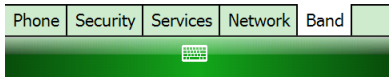
6. Optional: if your data collector has a ‘Band’ tab at the bottom, click on the ‘Band’ tab then set the GSM band as shown and press ‘Set’:





Click on ‘OK’ after you see ‘Parameters set success!’:

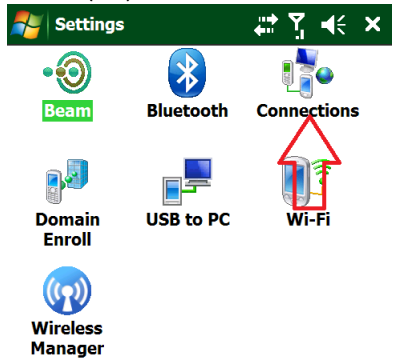




7. Wait (for up to 1-minute) for cell connectivity:

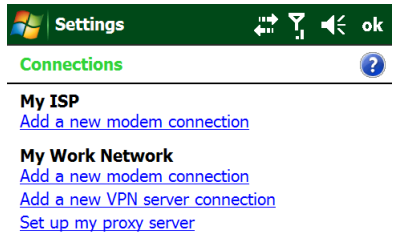
Click on the ‘X’ in the upper right hand corner to close the ‘Wireless Manager’

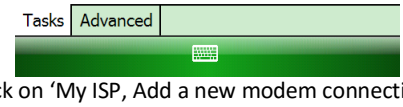
8. From the main menu click on ‘Start: Settings: Connections (tab)’:



Click on the ‘Connections’ icon.

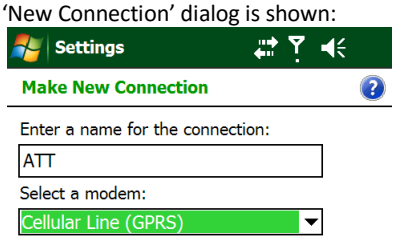
9. The Connections screen will be shown:





Click on ‘My ISP, Add a new modem connection’

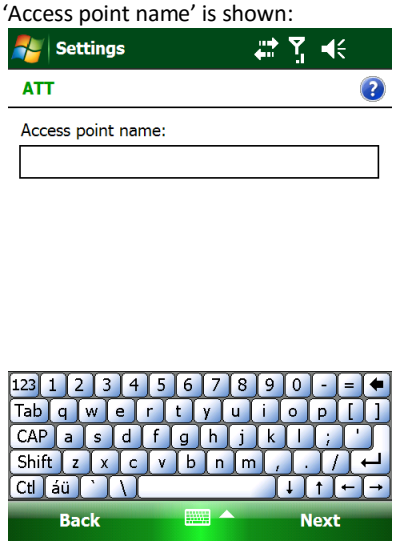
10. The ‘New Connection’ dialog is shown:



Set the connection name to roughly match your carrier

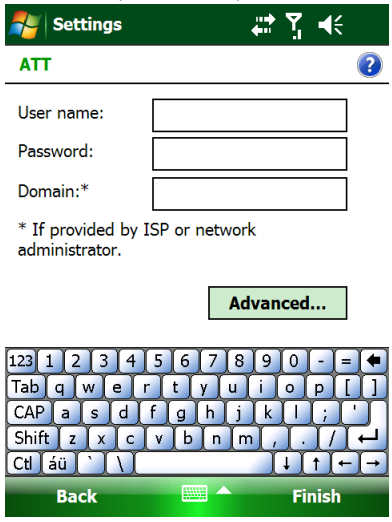
('ATT' in this case), set the modem to 'Cellular Line (GPRS)' as shown. Then click on Next.

11. The 'Access point name' is shown:



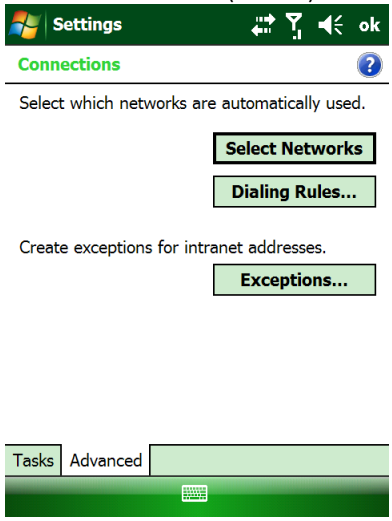
Leave 'Access point name:' blank and click on 'Next'. (Sometimes setting the 'Access point name' to 'broadband' may be required, however try the blank setting first.)

12. The 'User Name', 'Password', 'Domain' are shown:

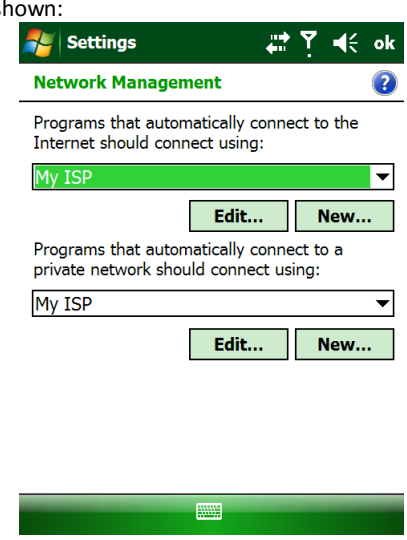


Leave them all blank and click on 'Finish'.

13. Click on the 'Advanced' tab (bottom):

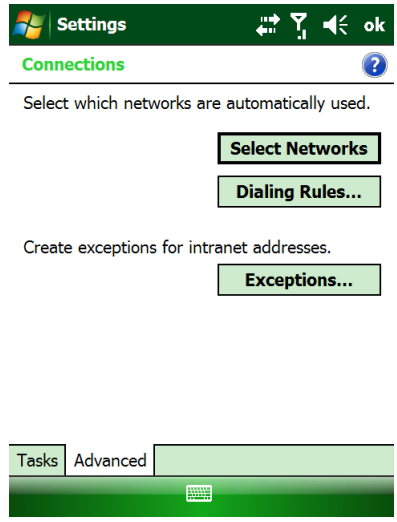


14. Click on 'Select Networks', and the management screen is shown:



Set both drop-down boxes to 'My ISP'. Click on OK.

15. From the Connections screen:



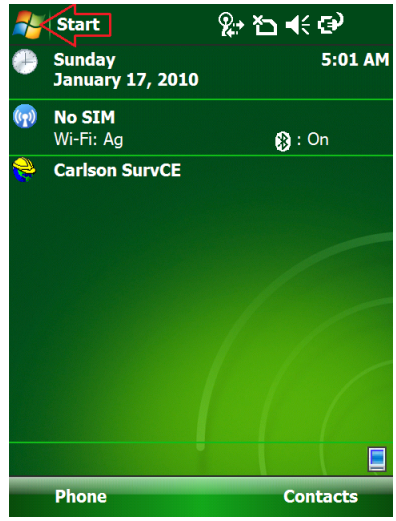
click on 'ok' to return to 'Settings', then 'X' to return to the main menu.
Your data collector should be connected to the internet.

16. Continue to the next section 'Check the Internet Connection' to verify that you have successfully connected to the cellular data network.

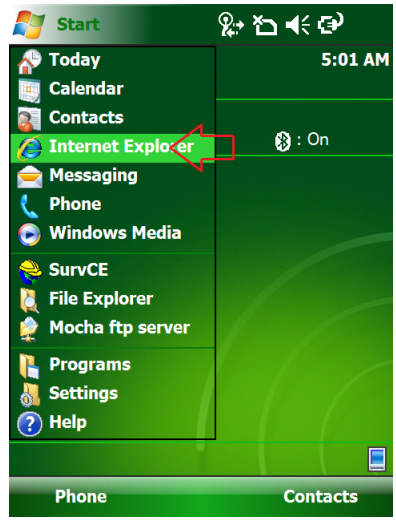
Check the Internet Connection

You can save a lot of time troubleshooting NTRIP and DIP connections by verifying that your data collector is 'really' connected to the internet. The easiest way to do this is by browsing to an internet location using the built-in 'Internet Explorer'.

1. From the main screen off the data collector, click on the 'Start' icon:

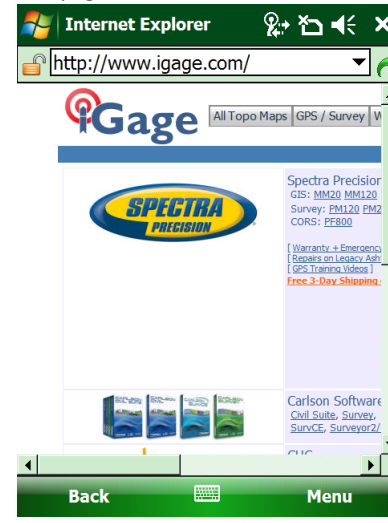


2. Click on 'Internet Explorer':



3. Click in the address bar, turn on the keyboard and enter a web address like 'www.igage.com':

4. If you are connected to the internet, you will see the browsed page:



5. Click the X to close the Internet Explorer. Your data collector has successfully connected to the internet.

Network (NTRIP) Rover Configuration

First you need to connect your data collector to the internet--You can use Wi-Fi to connect to a Mi-Fi (wireless access point or cell-phone hotspot) or if your data collector has an internal modem, you can use the internal modem. These connection methods are described in the previous chapters.

With Internet connectivity verified, we are ready to connect to the NTRIP server.

Connect your data collector to the internet one of these two methods:

- *Connecting your Data Collector to a Wi-Fi Hotspot* Page 36
- *Provisioning a GSM SIM Card in your Data Collector* Page 38

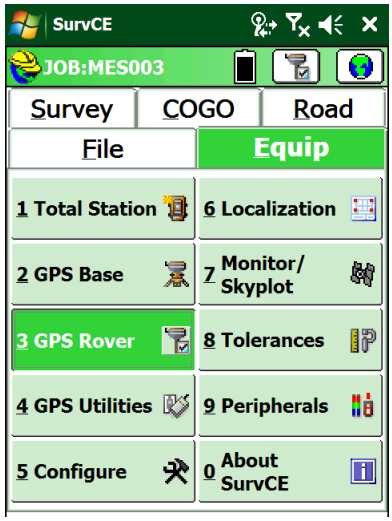
Next verify that the internet connection is working:

- *Check the Internet Connection* Page 41

Start a new job:

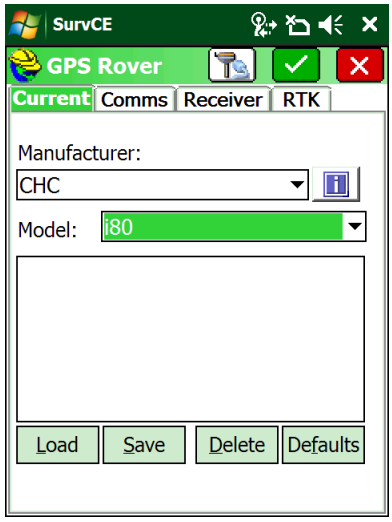
- *'Starting a New SurvCE Job'* Page 14

1. After starting a new job:



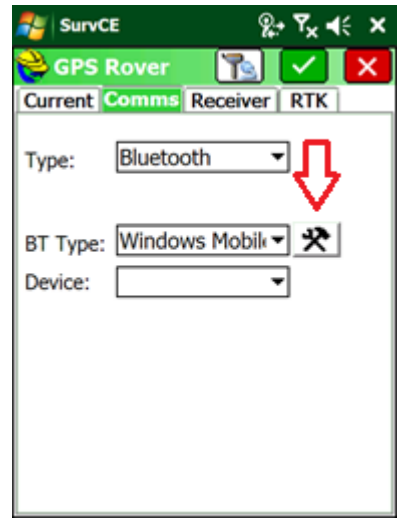
Click on "Equip: 3 GPS Rover"

2. On the 'Current' tab:



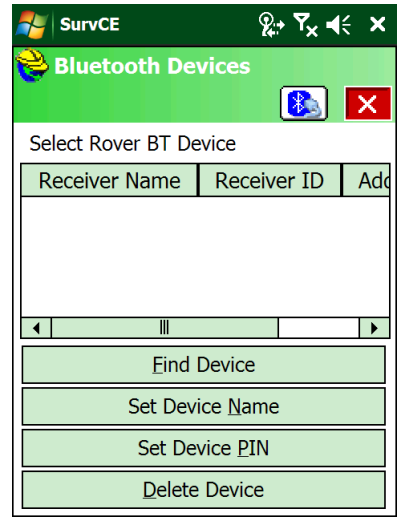
Select Manufacturer 'CHC' and Model 'i80'.

3. Click on the 'Comms' tab:

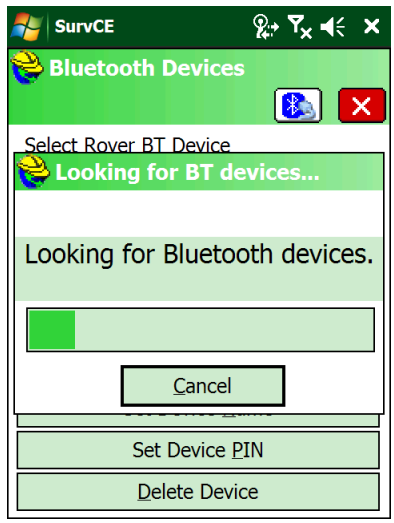


Choose Type = Bluetooth, BT Type = Windows Mobile as shown, then click on the Bluetooth settings (hammer / wrench icon) to the right of 'BT Type'

4. If your i80 Rover is not listed in the known device list:

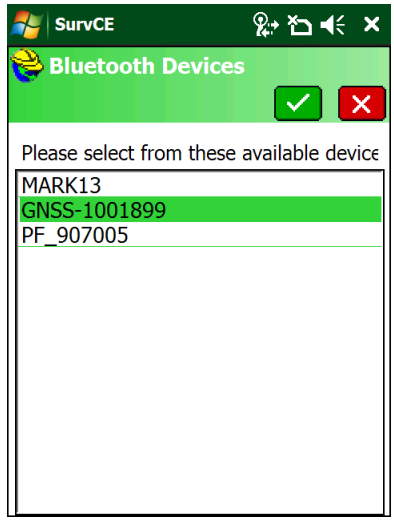


Click on 'Find Device'
Continue to wait



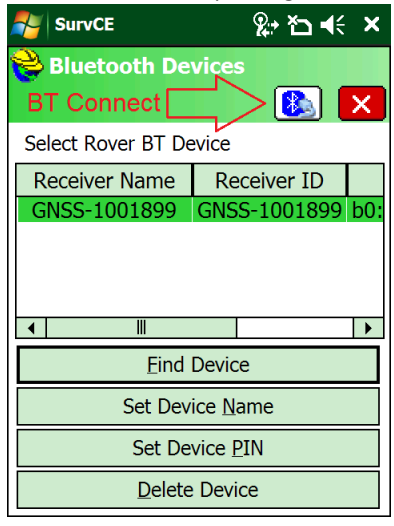
until the data collector stops looking.

5. Select the correct device:

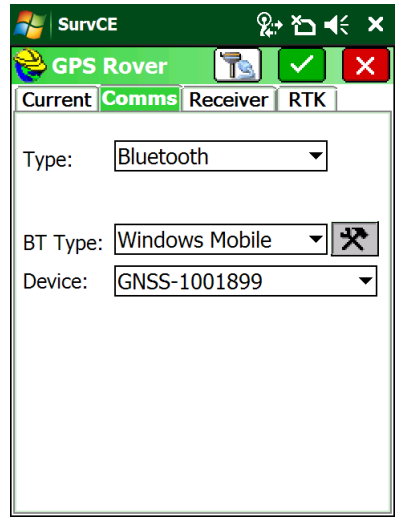


Click on the Green check mark

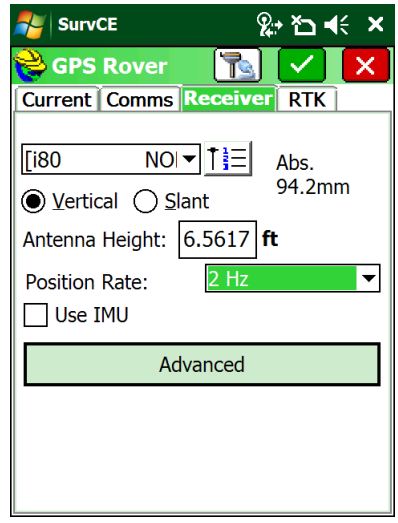
6. Click on the 'Bluetooth Connect' button (looks like Bluetooth icon with cable pointing towards it':



7. You will return to the 'Comms' menu:



8. Click on the 'Receiver' tab:



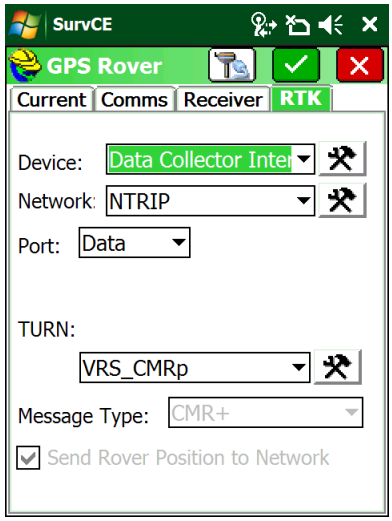
Check to insure that the correct antenna is selected, 'i80 NONE' absolute should typically be used.

Make sure the antenna height is correct. If you are using a 2 meter rod, you can enter "2M" for the 'Antenna Height', even if your projection is feet or survey feet.

2 Hz Position update Rate is good for stakeout.

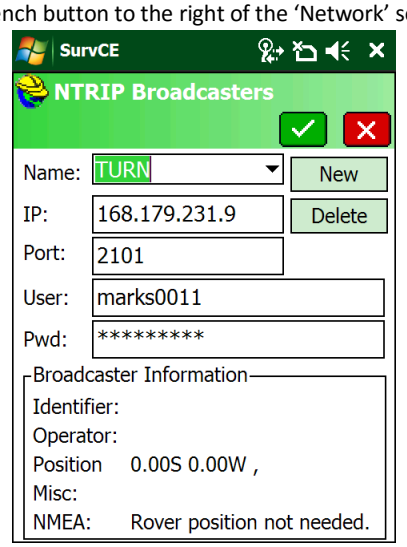
Check 'Use IMU' if you want to use the internal Tilt and Direction sensors.

9. Click on the 'RTK' tab:



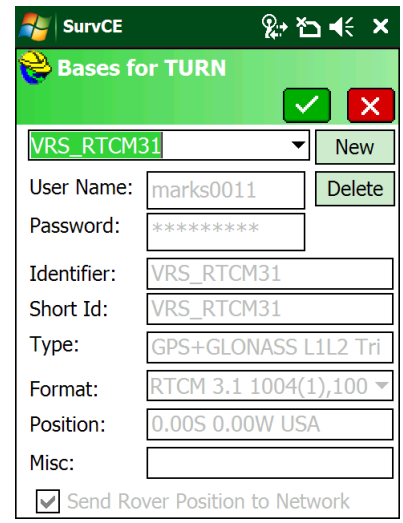
Configure as shown. Device should be 'Data Collector Internet'.
The Network should be NTRIP (unless you are connecting to a DIP server).
The Port should be 'Data'
Don't worry about the mount point yet.

10. Click on the Network Settings button (hammer / wrench button to the right of the 'Network' setting):



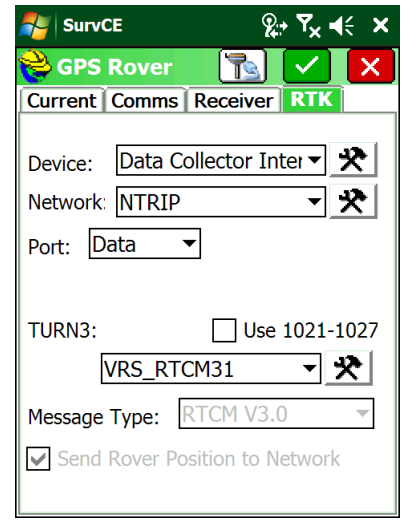
Enter the correct service Name, IP Address, Port, User Name and Password for your network. (The example above shows 'The Utah Reference Network' or TURN. Both the 'User Name' and Password are case sensitive and must match your network credentials exactly. Double-check your settings and then click on the Green Checkmark.

11. The data collector will load the mount table via the internet and display the list of bases:



Choose the correct mount point for your area. Usually you will want to choose either the 'RTCM 3 VRS' or 'CMR+ VRS' mount.
Do not chose the 'CMRx' protocol, the i80 only understands the 'sCMRx' protocol.

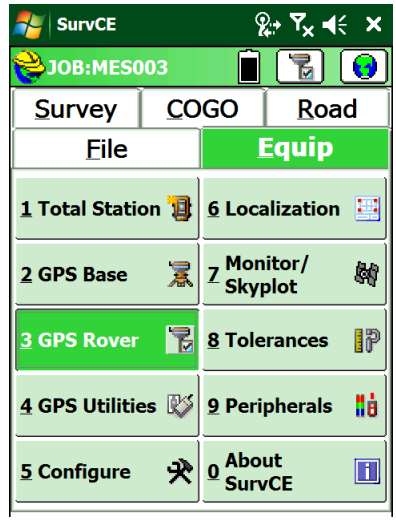
12. After selecting the correct base, click the Green checkmark to return to the RTK tab:



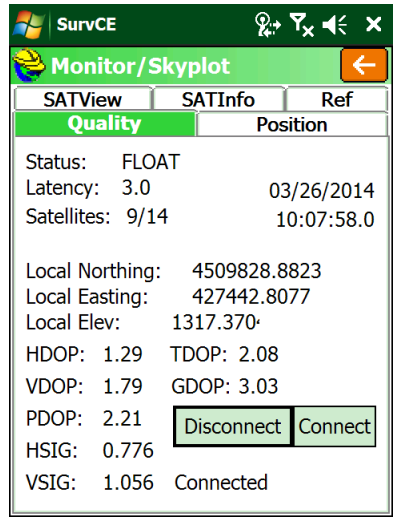
DO NOT check the 'Use 1021-1027' check box!

13. Click the Green checkmark.
After a short setup sequence, you will return to the

main menu:



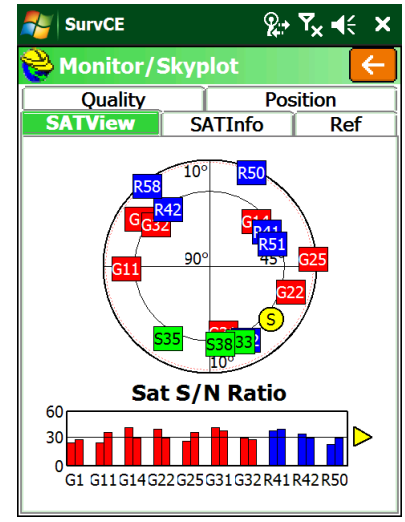
14. You can check your configuration using "Equip: 7 Monitor Skyplot":



within 20 seconds after the receiver makes a network connection, it should show "Status: Float."
The Latency should be less than 5 seconds.
The Satellite count should be reasonable.
The 'HSig' should be dropping.

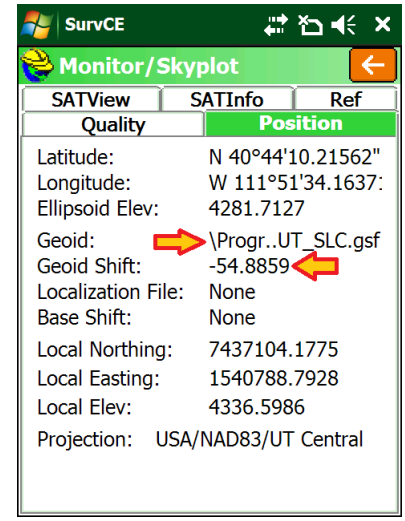
After some period of time, the status will change to FIXED.

15. If fixing is difficult, check the SAT View screen:



There should be a US SV (red) in every quadrant; there should be a GLONASS SV (blue) someplace.

16. You can verify that the GEOID is loaded and in use on the Position tab:



The Geoid Shift should be negative and the Local (orthometric) elevation should be above the Ellipsoid elevation as shown above.

Troubleshooting a Network Rover

1. Are corrections being received by the rover? Check the green LED on the rover:

It should blink once each second.

2. There is no warning if the Username or Password is wrong. Double check these values and the IP/PORT if the connection is not successful!

3. Is the internet connection still working? You can check it by using the Internet Explorer to browse to a web page.
4. If the Rover reports 'Float' then corrections are being received. It can take up to 1-minute after connecting for the rover to receive a base location and switch from AUTONOMOUS to FLOAT.
5. Are the HRMS and VRMS on the 'Equip: Monitor Skyplot' screen dropping?
6. If the Rover is FLOAT, but never fixes, and the latency is 5 seconds or less, check the effective baseline from your rover to the virtual base. On the 'Equip: Monitor Skyplot' screen, choose the 'REF' tab. Check the distance to base. Is it what you expect (less than 25 miles?)

Using the Internal GSM Modem in the i80

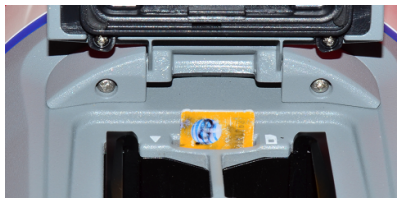
It is possible to use the internal GSM modem in the i80 GNSS receiver to connect to NTRIP correction sources.

Once configured, the head will automatically make the connection when it is turned on and the data collector will only need to reconnect to the head.

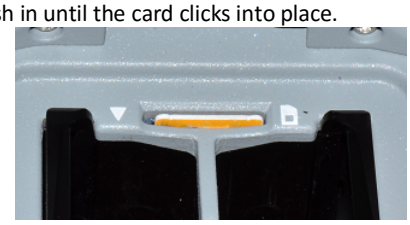
Note: This method only works with NTRIP connections. Direct IP (DIP) connections are supported by the head, but Carlson SurvCE does not support DIP service use.

It can be difficult to obtain a correctly provisioned SIM card and there is very little feedback if there are any issues when using the internal GSM modem. iGage strongly recommends that you use an external Mi-Fi adapter with Data Collector Internet (DCI).

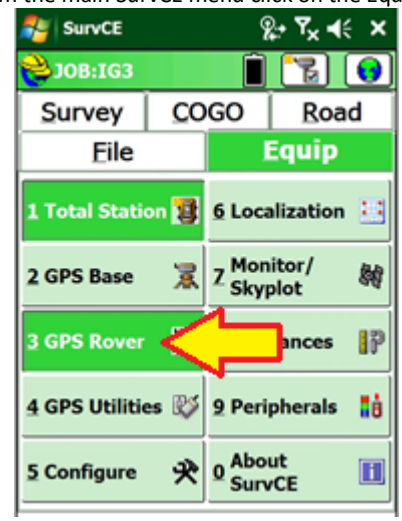
1. Turn off the i80 Rover and open the battery compartment door.
2. Insert your GSM (typically ATT or T-Mobile) data activated SIM card into the i80 receiver, the gold contacts should be 'UP' with the notched edge of the card inserted first:



Push in until the card clicks into place.

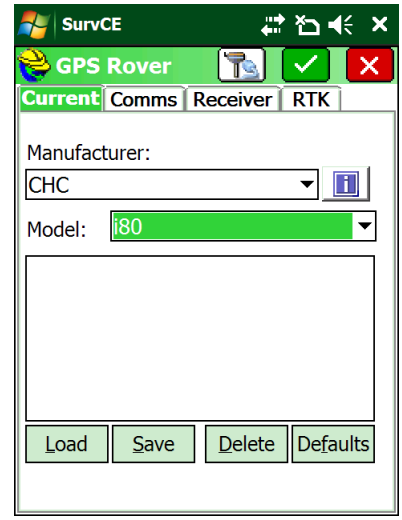


3. Setup the Rover:
   a. You do NOT need to attach the UHF antenna to the head.
   b. Put freshly charged batteries into the head.
   c. Attach the rover to the range pole.
   d. Attach the Data Collector bracket to the range pole.
   e. Turn on the Rover receiver.
4. Refer to the section '*Starting a New SurvCE Job*' on Page 14 to start and configure a new job.
5. From the main SurvCE menu click on the Equip tab:

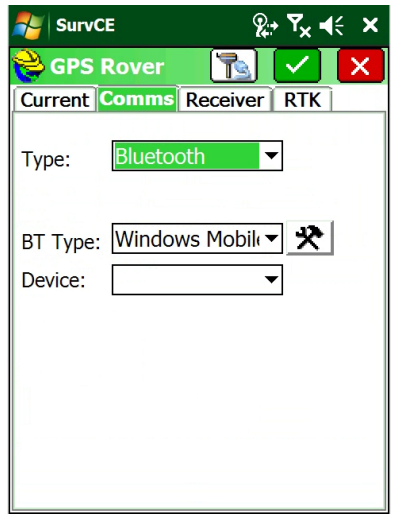


Then click on '3 GPS Rover'

6. Choose the correct manufacturer 'CHC' and device type 'i80':

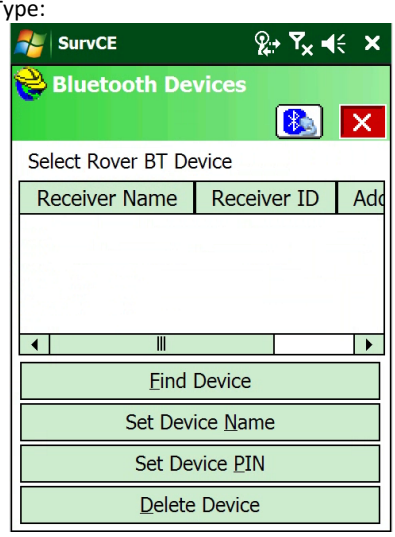


7. Select the 'Comms' tab:

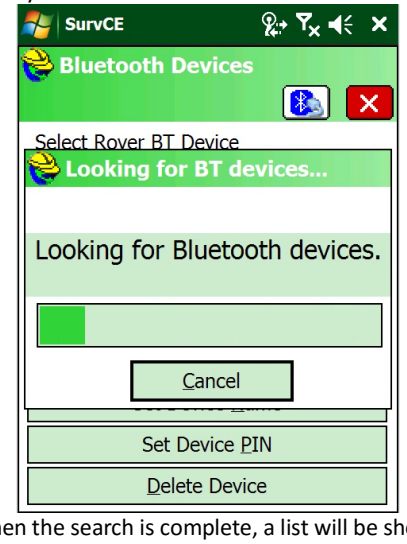


If your Rover is already listed in the Device drop-down box select it and skip to step 12.

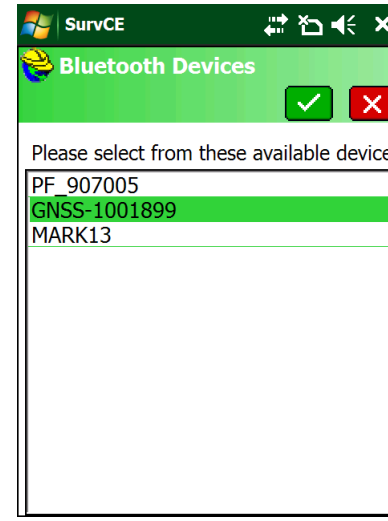
8. Click on the 'hammer/wrench' button to the right of BT Type:



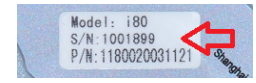
9. Click on 'Find Device' button, SurvCE will search for nearby Bluetooth devices:



When the search is complete, a list will be shown:

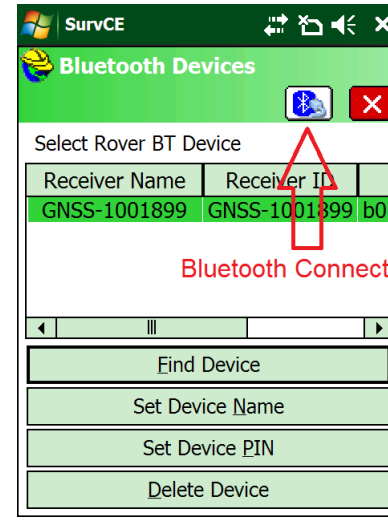


Devices are listed by serial number, your base serial number can be found on the bottom of the receiver:

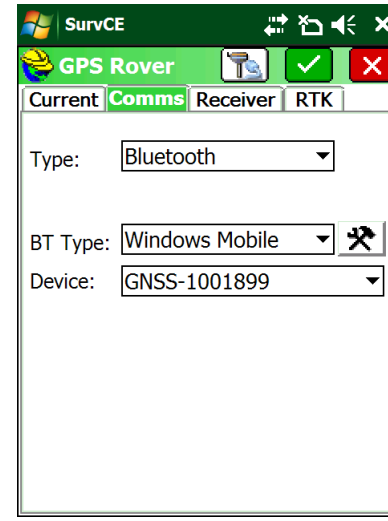


Click the correct device, then click the green checkmark.

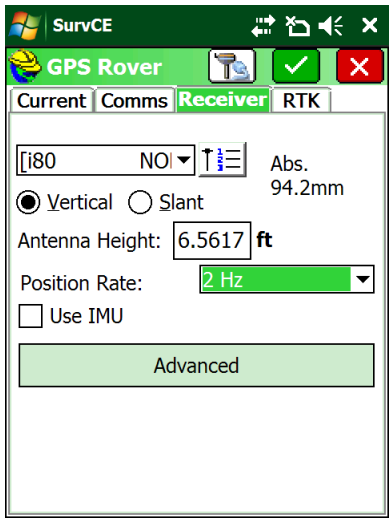
10. Verify that the correct receiver is highlighted, then click on the Bluetooth connect button:



11. SurvCE should now show the correct Device:



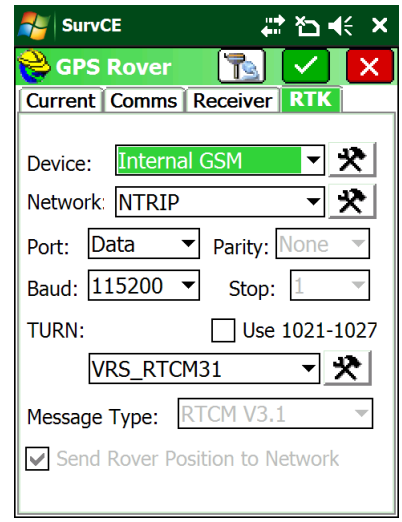
12. Click on the Receiver tab:



Check to insure that the correct antenna is selected:
"i80 NONE"
Set the Position Rate at 1 Hz.
Uncheck the 'Use IMU' (Tilt / Heading Compensation)

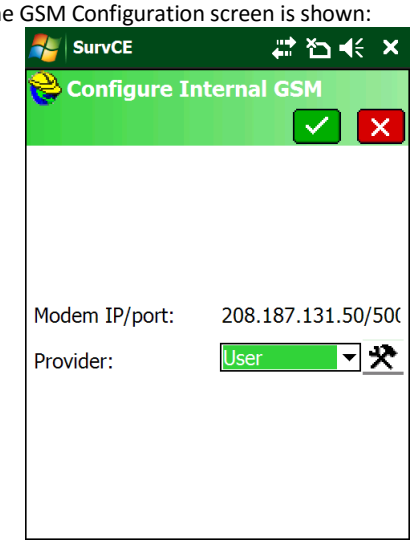
If the Base receiver is mounted on a fixed height pole, select 'Vertical' and enter the Antenna Height as the true pole height.
If the Base receiver is mounted on a tripod, select 'Slant' and enter the slanted tape distance from the ground mark to the bottom of the blue band that separates the white top from the gray bottom:

13. Click on the RTK tab:



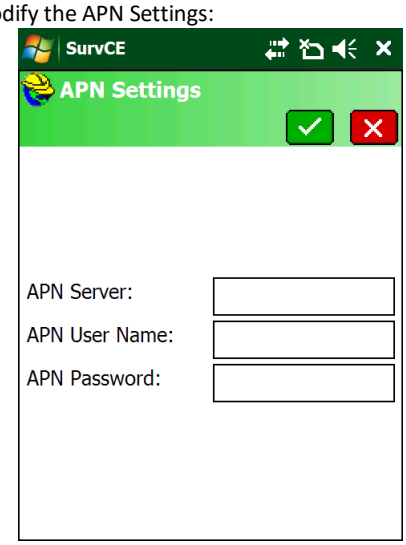
Select 'Device' = 'Internal GSM'.
Click on the settings button (hammer/wrench icon) to the right of the 'Device: Internal GSM'.

14. The GSM Configuration screen is shown:



Set 'Provider' = 'User'.

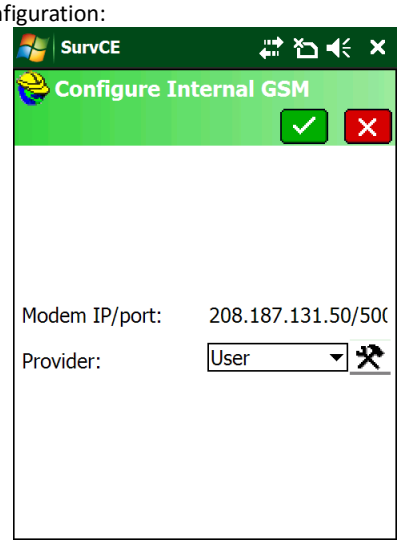
15. Click on the settings button (hammer / wrench icon) to modify the APN Settings:



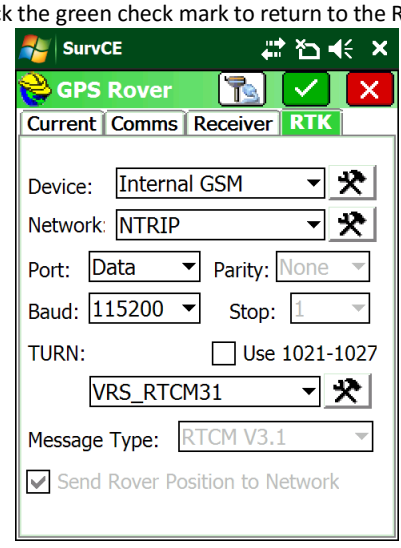
In most USA cellular markets, leaving the Server, User Name and Password blank (as shown) works great.

You may need to set the 'APN Server' name to 'broadband'.

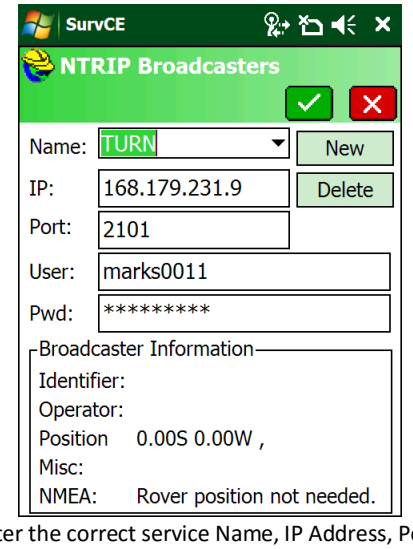
16. Click the green check mark to return to the GSM Configuration:



17. Click the green check mark to return to the RTK tab:



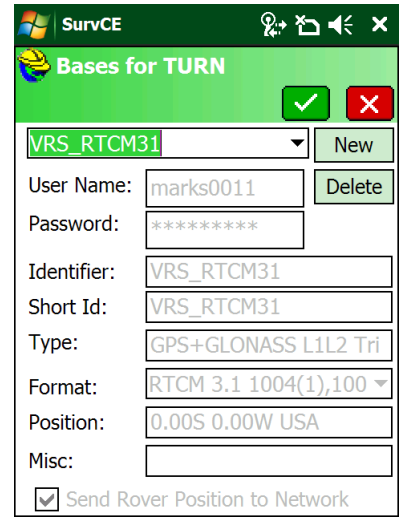
18. Click on the Hammer/Wrench button to the right of the 'Network':



Enter the correct service Name, IP Address, Port, User Name and Password for your network. (The example above shows 'The Utah Reference Network' or TURN.

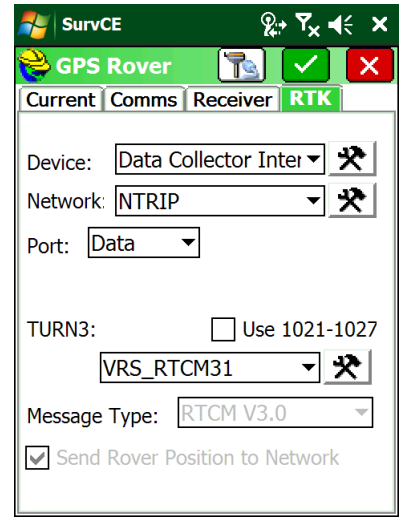
Both the 'User Name' and Password are **case sensitive** and must match your network credentials exactly. Click on green checkmark.

19. The data collector will load the mount table via the internet and display the list of bases:



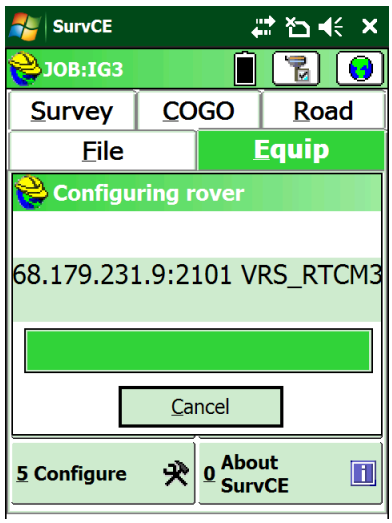
Choose the correct mount point for your area. Usually you will want to choose either the 'RTCM 3 VRS' or 'CMR+ VRS' mount…

20. Click the green checkmark to return to the RTK tab:



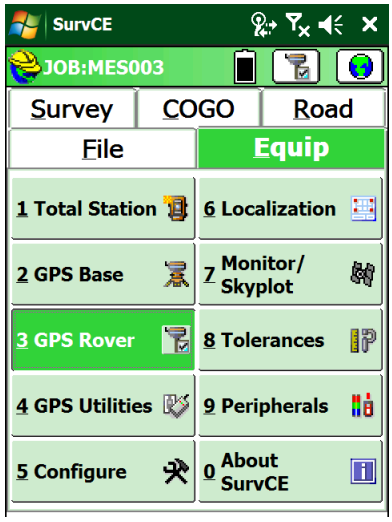
DO NOT click the 'Use 1021-1027' check box!
Click the Green checkmark again to configure the rover and connect to the network.

21. Wait while the cell modem in the head is initialized, and the server session is started:

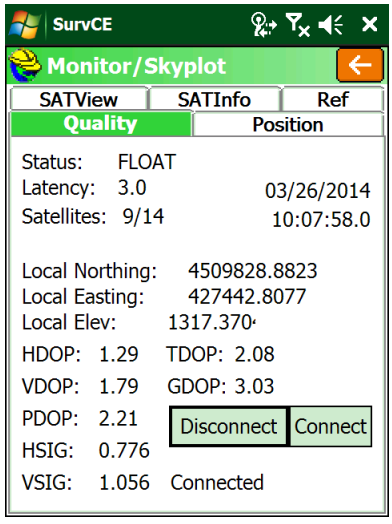


You will see "Waiting for Reading, Initialize Modem, and Connect to Network".

22. Finally you will return to the main menu:

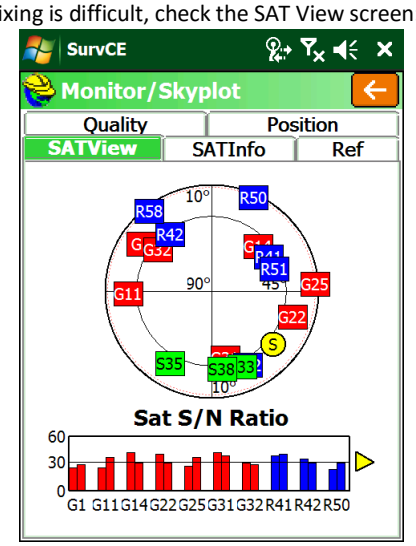


23. You can verify the connection using "Equip: 7 Monitor Skyplot":



within 20 seconds after the receiver makes a network connection, it should show "Status: Float."
The Latency should be less than 5 seconds.
The Satellite count should be reasonable.
The HSig should be dropping.
After some period of time, the status will change to FIXED.

24. If fixing is difficult, check the SAT View screen:



There should be a US SV (red) in every quadrant; there should be a GLONASS SV (blue) someplace.

25. You can verify that the GEOID is loaded and in use on the Position tab:

The Geoid Shift should be negative and the Local (orthometric) elevation should be above the Ellipsoid elevation as shown above.

Backing up Carlson Jobs: Never Loose Data in SurvCE

There is, a risk of losing data that you collect in any field program.

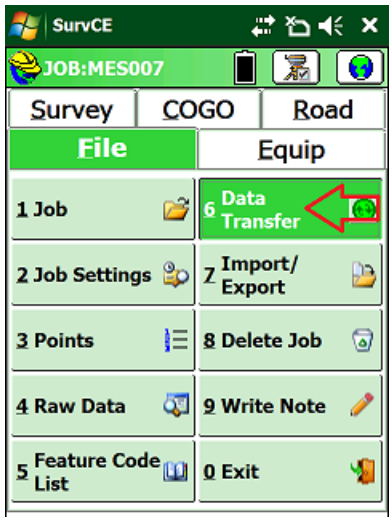
If anything goes wrong with the system, you must reinstall the operating system from scratch. This wipes out your program installations and it may wipe out all of the data that is stored on the device memory. (However, data on the internal SD Card should be safe.)

Luckily SurvCE has a simple mechanism that allows you to continuously back-up your work during the day.

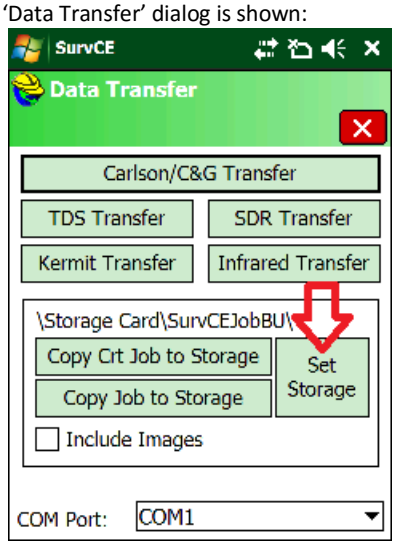
First make sure that your data collector has a SD or micro-SD card installed. These usually are placed in the battery compartment.

When you start a new job put it in the main memory. The default location in SurvCE is "/Device/Program Files/ SurvCE/Data/".

After you start a job, from the main menu go to 'Equip: 6: Data Transfer':



The 'Data Transfer' dialog is shown:



Click on the 'Set Storage' button, navigate to the SD card (often called 'Storage Card' or 'MMC Data Card") and configure the destination to be a new folder. Once the folder is named, click on the 'Copy Crt (current) Job to Storage'. It will take about 1/2 second to replicate all of the current job's files in the backup location.

Throughout the day return to this menu and click the 'Copy Crt…' button again to freshen your backup data copy.

Downloading, Processing and Archiving Static Data

Your i80 GNSS receiver includes a download, preprocessing and archive tool called

X9x Download

for use with the NGS OPUS, RTX, AUSPOS and IBGE online products.

Installing the Download Tool

Insert the provided disk in the DVD ROM drive of your computer and the installation tool should automatically run. Follow the on-screen instructions to install the download tool and the X9x-OPUS support tools on your computer.

You can always get the latest version of the X9x-OPUS Downloader from the internet and install it directly:

http://www.x90gps.com

Look for the 'UPDATES' button on the top of the page:

Downloading Data from i80 GNSS Receiver

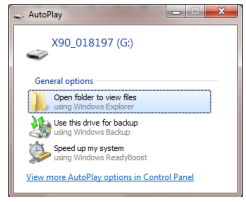
Summary: Turn on the receiver, wait for 10-seconds; plug in the USB Cable to your computer.

The i80 receiver mounts just like a USB thumb drive (flash drive) on your Windows computer. No special drivers are required.

To download data from your receiver:

1. Turn on the GNSS receiver
2. Wait 10 seconds for the power LED (Red) to blink 3 times.
3. Plug the USB connector into the USB hole on your GNSS receiver:

   and a USB port on your computer
4. Wait for the Windows disk mount screen to appear

When/if you see this 'AutoPlay' dialog, close it by clicking on the red 'X' in the upper-right corner.

The first time you attach a receiver, you may need to wait up to 2-minutes for standard device drivers to be downloaded / installed.

The drivers are built into Windows XP, Windows Vista, Windows 7, Windows 8 and Windows 10. The drivers are not distributed with the GNSS receiver.

If your receiver does not mount or an error message is displayed, you can usually unplug the receiver, wait a moment and plug it back in.

If you continue to have problems check the 'Troubleshooting…' section at the end of this manual.

Starting the Download Tool

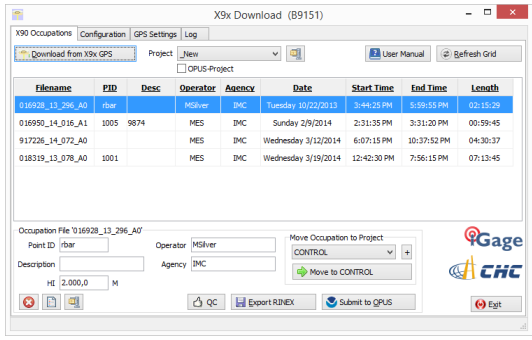
You can start the download tool by clicking on the Download shortcut on your desktop:

Using the Download Tool

Assuming the i80 GNSS receiver is plugged in and has mounted as a drive letter, just press the 'Download from X9x, i80 GPS' button:

The program will automatically switch to the '_New' project and download every new file from your receiver.

As the .HCN binary files are downloaded from the receiver they are automatically converted to RINEX and added to the '_New' project and finally displayed in the occupation grid.



You can sort the grid by Filename, PID, Description, Operation, Agency, Start Date/Time, End Date/Time and Length by clicking on the column header. Clicking twice on the header will reverse order the grid.

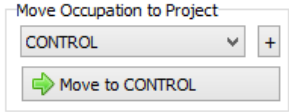
If you have any really short or unneeded occupations, you can select and delete them:

<- the 'Delete Occupation' button

For the remaining observations, enter the values you recorded in your field book:

1. **PID** (Point ID) A unique short identifier for each marker (usually a 4 digit integer.) Only letters, numbers and the underscore are allowed in the PID.
2. **Description** A longer description of the point. Note that quotes "" and "" are not allowed in the description.
3. **HI** The Instrument Height which is the distance from the ground mark to the bottom of the receiver
   add '**F**' to enter feet
   add '**S**' to enter slant height
   add '**SF**' or '**FS**' to enter slant feet height
4. **Operator** This value gets placed in exported RINEX files
5. **Agency** This value gets placed in exported RINEX files

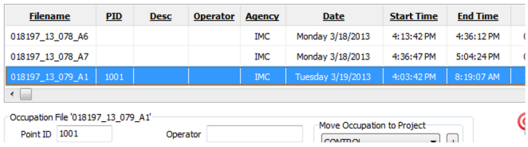
If the '_New' folder gets too full, you can make a new project folder (with the "+" button) and move occupations to the project:



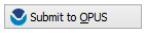
Submitting an Occupation to OPUS

Once all of the new occupations have been deleted or assigned to a project you can submit an occupation to NGS OPUS, NGS OPUS-RS, RTX, and AUSPOS. IBGE or post-process them using other software / services.

Click on an occupation to select it:



Click on the 'Submit for OPUS' button:



U.S. National Geodetic Survey

Note, you may select an alternative PPP Service provider (on the configuration tab.) Some of the alternative providers are:

Trimble's RTX Service

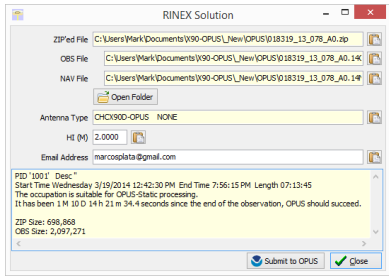
AUSPOS

Brazilian Institute of
Geography and Statistics

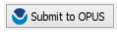
The currently selected occupation will be processed and prepared for upload to OPUS:

1. the file is decimated to 15-second epochs, header information is stuffed
2. the file is run through TEQC to insure it will be acceptable to OPUS
3. an Observation file and a Navigation file are generated
4. the Observation file is compressed into a ZIP file

If the 'Show Advanced Settings' is set to "Simple" then the program will skip directly to the '**Verify Filename to Upload'** screen (shown below.) If 'Show Advanced Settings' is set to "Normal", "Support OPUS-Projects" or "Advanced" then this 'RINEX Solution' helper screen is shown:

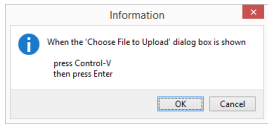


The program will suggest which service (OPUS-Static or OPUS-RS) and list the time since the end of the occupation. You can click the 'Submit to OPUS' button:

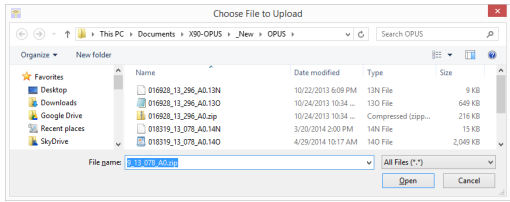


to automatically open an internet browser at the NGS OPUS Submission form. When the web page has loaded, the program will automatically fill in the 'Antenna Type', the 'Antenna Height' and the 'Email address.'

Verify Filename to Upload: The program will prompt you:

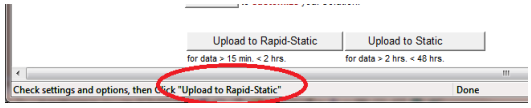


Click OK and then 'Choose File to Upload' will be displayed:



Press Control-V, then the 'Enter' key on your keyboard. You may also press Control-V, then click the 'Open' button with your mouse.

The NGS OPUS Submission form will be ready to submit, check the entries and any extended options that you might want to use. The status bar will prompt you with the correct submission button:



Press either the 'Upload to Rapid-Static' or 'Upload to Static' button as directed and your occupation will be uploaded to OPUS for processing.

Setting the Receiver Type

(Hidden when Simple)

When files are downloaded from the receiver, the receiver type is associated with the .HCN file. The 'Receiver Model' shows an occupation's associated hardware type:

If this is consistently incorrect, you can modify the device type while it is connected on the 'Configuration' tab.

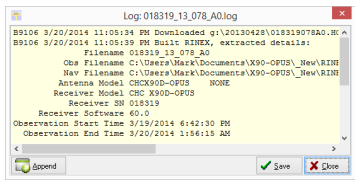
Viewing the Observation Log

(Hidden when Simple)

A detailed log is automatically kept for the files that you download and submit for processing.

Pressing the 'Log'

button shows the log file for the currently selected observation:



Pressing the 'Append'

button adds a date/time stamp and opens the log for user editing.

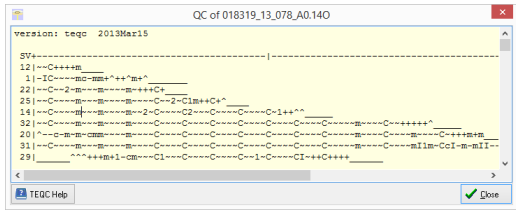
Press 'Save' to store your changes or 'Close' to close without saving.

Performing Quality Control Checks

(Hidden when Simple)

Pressing the

button will launch the UNAVCO TEQC tool and run a standard RINEX QC run on the currently selected observation file. When the run is complete, the results will be shown in a window:



You can press the 'TEQC Help' button to download the User Guide for TEQC from the UNAVCO web site.

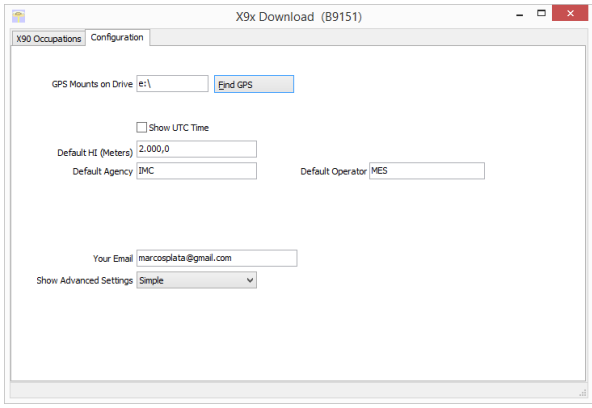
TEQC is a great tool for evaluating both the receiver's performance and the site suitability for collected data.

We use it to verify receiver operation in our hardware validation process.

Advanced Download Settings

Configuring the Download Tool

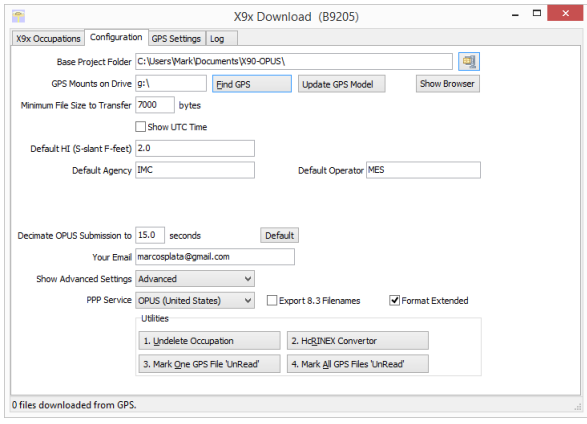
Click on the 'Configuration':



At a minimum enter these values:

Agency	your company name
Operator	the name of the default operator
Email	your email address

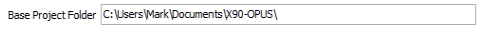
If you change 'Show Advanced Settings' from 'Simple' to 'Normal', 'Support OPUS Projects' or 'Advanced' additional setup values are shown:



You can change the rest of the configuration values as needed. Here are detailed descriptions for each of them:

'Base Project Folder'

(Hidden when Simple)



This is the full Window's path to the base folder where all of the data is stored. The default location is in your 'Documents' folder in a folder named 'X90-OPUS'.

Double-click over the current path to change the folder location.

The download tool will create a sub-folder for each Project that you add. In addition there are always three special folders:

_New	new occupation files downloaded from the receiver are placed here first
_Deleted	if you delete an occupation, it is not really deleted, just moved to the _Deleted folder. An undelete function is included in Utilities.
_Error	sometimes short occupations won't include navigation records, these short files end up here.

'Archive All Projects'

(Hidden when Simple)

Pressing the 'Archive' button to the right of the Base Project Folder entry will back up every occupation in every project to a single ZIP file.

This is handy if you want to move all of your data to another computer or make regular disaster backups.

There are similar Archive buttons on the main page: one archives the current occupation and the other archives the current project.

The download tool does not provide a method to restore these backups, however they are standard ZIP files and the Windows operating system does include a tool to decompress them.

'GPS Mounts on Drive'

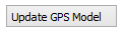
This is the drive letter that the GPS receiver was last found on. Don't worry if the drive letter changes, the program will automatically find the receiver when you download data.

If you want to verify that the GPS receiver is connected and has successfully mounted as a drive, press 'Find GPS'.

> Note: If you manually delete every single file and folder from the GPS receiver, the program won't be able to automatically find the receiver until after the GPS has recorded at least one file.

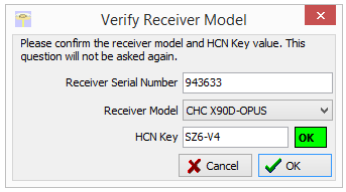
'Update GPS Model'

(Shown only when Advanced selected.)



The GPS Model is written into the receiver at the factory. If you delete ALL of the files on the receiver or format the receiver (it is a standard flash drive) it is possible that it will lose its receiver type.

With the receiver attached to your computer with the USB cable, click on the 'Update GPS Model' button to display this dialog:

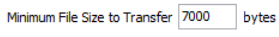


Use the drop down 'Receiver Model' to change the receiver type. If the HCN Key has been lost, it is written on a white sticker inside the battery compartment. You cannot edit the 'Receiver Serial Number'.

If the HCN Key has been correctly entered, the 'OK' will be shown in a green box, otherwise it will display '????' in a red box. The correct HCN key will be printed on a white label inside the battery compartment.

'Minimum File Size to Transfer'

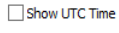
(Hidden when Simple)



Every time you turn on the GPS receiver, it will attempt to track satellites and open a new occupation file. Often several small junk files will be created that don't have any meaningful data and are of no value.

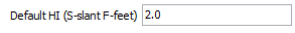
The download tool will automatically ignore files smaller than this minimum value. This keeps useless files from cluttering your computer.

'Show UTC Time'



When unchecked (the default,) the download tool will show the observation start and end times in your local time zone. If you check 'Show UTC Time', then the times are displayed in UTC time.

'Default HI'



When you download an occupation from the receiver, this HI will be the default associated with every occupation. You can change the HI for each individual occupation later, this is just the default.

If you ALWAYS use a 2-meter range pole, then this value will always be 2.000 and you won't have to worry about HI blunders.

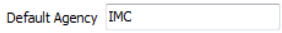
FEET: If you measure up in feet, you can enter the height in decimal feet and put an 'F' after the measurement. The program will automatically convert to Meters for you.

SLANT HEIGHT in Meters: If you measure a slant height, enter an 'S' after the measurement and the program will compute the vertical height for you.

SLANT HEIGHT in FEET: If you measure a slant height in feet, enter 'SF' or 'FS' after the measurement and the program will compute the vertical height in Meters for you.

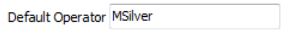
Note: if you use the 'PPP Service' = 'RTX (CenterPoint)' the submitted RINEX file spoofs an 'UNKNOWN EXT NONE' and adjusts your actual HI to reflect the generic antenna L1 offset.

'Default Agency'



Enter your company name here. This value is placed into every RINEX file that is exported. You can override this value on a file-by-file basis.

'Default Operator'



Enter the default name of the operator here. This value is placed into every RINEX file that is exported. You can override this value on a file-by-file basis.

'Decimate OPUS Submission to ...'

(Hidden when Simple)

When you submit a file to OPUS, it is always decimated at the NGS server to 15-second epochs (recording interval = 1 point every 15 seconds.) The default recording interval for the X9x-OPUS is 5-seconds.

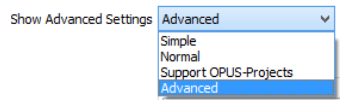
By pre-decimating the RINEX file before upload, it is reduced to 1/6th the size. This makes the upload process much faster while having no impact on the resulting solution.

Observations submitted to RTX are not decimated, AUSPOS submissions are decimated to 15 seconds. Observations exported directly to RINEX are not decimated.

'Your Email'

When you submit a file to OPUS, you need to provide your Email address so the OPUS processor can return a solution to you. The email address that you enter here will be used for all automatic submissions...

'Show Advanced Settings'



This setting determines the complexity of the X9x-Download program.

Simple: *(the Default setting)*
Hides archive functions, Minimum File size, Receiver Model, Antenna Name Decimate setting, QC function, Export to RINEX button, OPUS-Projects, the GPS Settings tab and the Log tab.

Normal:

Shows everything except for OPUS-Projects, the GPS Settings and Log tab.

OPUS-Projects:

Displays the OPUS-Projects checkbox which allows automatic submission to a NGS registered project.

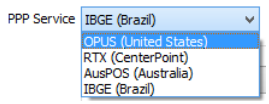
Advanced:

Displays the GPS Settings and Log tabs.

Typically you will never need to use the 'Advanced' functions.

'PPP Service'

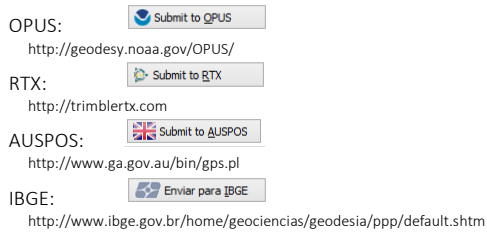
(Hidden when Simple)



The Download tool supports several PPP (Precise Point Positioning) services.

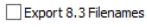
The submit button on the main page tracks this setting and the upload strategy is adjusted to each available service.

Additional Information is available on each service on the web:



Export 8.3 Filename

(Hidden when Simple)



Normally, the Download program submits files using filenames like this:

917226_14_072_A0.OBS

The device serial number, the year, the Julian day of year and the observation number. Some services and programs prefer names in an 8.3 (xxxxxxxx.xxx) format.

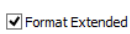
Checking this box results in exported filenames like:

10050720.14O

Where 1005 is the Point ID, 072 is the Julian date, 0 is the observation number, 14 is the year and O indicates an observation file.

Format Extended

(Only shown when PPP Service = OPUS)



The NGS returns three styles of reports:

Standard: Single Page Report
Extended: Standard + baseline details + State Plane in US Survey Feet or International Feet as appropriate
Standard + XML: Single Page + XML

For new OPUS users, the 'Format Extended' includes one important addition: State Plane coordinates are shown in both Meters and US Survey Feet (or International Feet) at the bottom of the report. We keep 'Extended' checked by default for this reason.

Prior to submitting an OPUS report, you can modify any of the Option settings, however checking this box results in the extended output always being checked.

Utilities

(Hidden when Simple)

Additional utilities for working with observations are included.

"1. Undelete Occupations"

When you delete an observation, it is actually moved to a special "_Deleted" folder.

Clicking the **Undelete Occupation** button allows you to specify a deleted observation to restore. When an occupation is undeleted, it is always returned to the _New project.

"2. HcRINEX Convertor"

Files are stored on the receiver in an '.HCN' binary file. When the tool downloads a file, it is automatically converted to standard RINEX using the HxRINEX tool.

Clicking this button runs the HcRINEX tool in manual mode. You can browse for HCN files and manually convert them to standard RINEX files. Results are always placed in a subfolder named 'RINEX' under the file to be converted.

"3. Mark One File Unread"

When files are downloaded from the receiver, they are not deleted from the receiver. The filename on the receiver is modified to begin with an underscore '_'.

This function allows you to specify a single file to mark as 'unread.' Once a file is unread the next download action will re-download and convert the file.

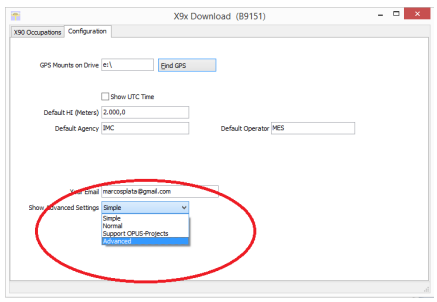
"4. Mark All GPS Files Unread"

This function marks EVERY observation file on the receiver as unread. The next download will read every single file on the receiver. (This will take quite a bit of time if your receiver had hundreds of files.)

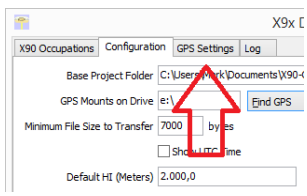
GPS Settings

(Hidden when Simple)

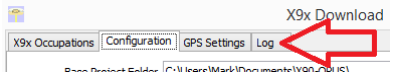
To modify the 'GPS Settings' or view the log, select the 'Configuration' tab, then choose 'Show Advanced Settings = Advanced.'



When 'Advanced' is selected, two additional tabs will be displayed:



The 'Log' Tab



The 'Log' tab shows detailed results of the current program operation. It may be useful to debug some aspect of file processing.

GPS 'Settings' Tab

The GPS Settings options on the download tool are not compatible with the i80. You can use the front panel controls or the Wi-Fi connection to make interval changes to the i80.

OPUS: What is it?

OPUS (Online Positioning User Service) is a free service provided by the NGS (National Geodetic Survey.)

From the NGS Website:

> "This Online Positioning User Service (OPUS) provides simplified access to high-accuracy National Spatial Reference System (NSRS) coordinates. Upload a GPS data file collected with a survey-grade receiver and obtain an NSRS position via email.
> OPUS requires minimal user input and uses software which computes coordinates for NGS' Continuously Operating Reference Station (CORS) network. The resulting positions are accurate and consistent with other National Spatial Reference System users."

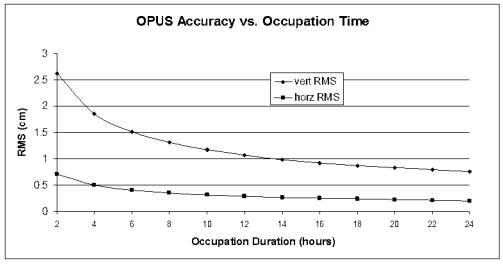
Here are direct links to more detailed information:

> http://geodesy.noaa.gov/INFO/OnePagers/OPUSOnePager.pdf
> http://geodesy.noaa.gov/OPUS/about.jsp

One of the most important contributors to vertical accuracy computed by OPUS-Static is the length of occupation. Longer times are better.

If you are concerned about elevation, please remember that a 2 hour OPUS static observation has an expected height accuracy of 2.5 cm. A 6-hour occupation has an expected accuracy of 1.5 cm.

Again, longer times are better. Your expectations should be tempered by this NGS graph:



OPUS-RS (Rapid Static)

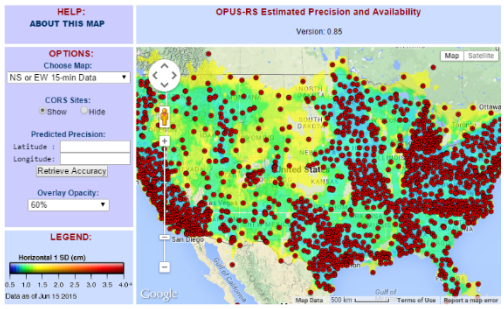
Standard OPUS-Static sessions require 2-hour observations. OPUS-RS sessions can be as short as 15-minutes.

However, OPUS-RS solutions are not available universally. In general, OPUS-RS requires:

> 3 (or more) CORS within 250 km of your site
> your site must be within 50 km of the polygon formed
> by the CORS sites

If you are working in Southwest Nevada, along the highline of Montana or in North or South Dakota, OPUS-RS probably will not work and you will have to collect more than 2 hours of data for submission to OPUS-STATIC!

Prior to collecting data for OPUS-RS check the latest status map to insure that OPUS-RS will work. The online OPUS-RS resource
http://geodesy.noaa.gov/OPUSI/Plots/Gmap/OPUSRS_sigmap.shtml
is updated routinely and reflects the probability that an occupation at a given location will be successful and the expected accuracy for a 15-minute and 1-hour occupation.



In some areas there is a risk that if a single CORS site is unavailable, your OPUS-RS job will not be processed. Caution and planning are suggested for OPUS-RS jobs.

OPUS-Projects

OPUS Projects is a relatively new online tool. Its use requires taking a NGS training class, but the invested time is well worth it as OPUS-Projects will allow you to combine the observation files from multiple receivers and multiple sessions.

There is an excellent article and video describing OPUS Projects in the October 2013 'American Surveyor' magazine. Search for "OPUS-Projects: The Next Revolution in GPS" to find a full resolution PDF.

OPUS Error Messages and Failures

There are lots of possible error messages when processing OPUS solutions. It is our experience that almost all errors fall into a single category:

> "There is not enough nearby CORS data to effectively process your occupation…**yet**."

In general, the solution is nearly always the same:

> "Wait until more data becomes available and resubmit your job."

If you are processing OPUS-RS jobs in an area with very few CORS stations, and one CORS station was offline, waiting will not help. OPUS-Static is the solution for locations where OPUS-RS is not dependable.

CORS stations can report observations hourly or daily. In some areas (typically UNAVCO PBO sites) most of the sites report once at the end of each day (GMT.) So data that is needed to process your job is not available until 4:00 am GMT on the day after you collect data.

The Download tool allows you to submit jobs to alternative services like AUSPOS and RTX. Typically these alternative services closely match OPUS.

If you submit an observation to OPUS and nothing comes back, check your SPAM folder. OPUS solutions are regularly misidentified as spam.

OPUS is sometimes unavailable or takes longer than other times.

Interpreting OPUS Results

When you receive an OPUS solution by email from the NGS, it will look something like this:

```
      USER: ms@igage.com                          DATE: May 06, 2014
RINEX FILE: p4490900.14o                          TIME: 16:08:35 UTC

  SOFTWARE: page5  1209.04 master93.pl 022814   START: 2014/03/31 00:00:00
EPHEMERIS: igs17861.eph [precise]               STOP: 2014/03/31 23:59:00
  NAV FILE: brdc0900.14n                    OBS USED: 45735 / 47174   :97%
  ANT NAME: TRM29659.00     SCIT          # FIXED AMB:   162 /   171   :95%
ARP HEIGHT: 0.0083                        OVERALL RMS: 0.011(m)

 REF FRAME: NAD_83(2011)(EPOCH:2010.0000)            IGS08(EPOCH:2014.2452)

        X:     -2184137.494(m)   0.003(m)          -2184138.362(m) 0.003(m)
        Y:     -3839941.381(m)   0.001(m)          -3839940.177(m) 0.001(m)
        Z:      4585410.516(m)   0.005(m)           4585410.529(m) 0.005(m)

      LAT:   46 15 35.23578      0.005(m)           46 15 35.25052 0.005(m)
    E LON:  240 22  8.47069      0.002(m)          240 22  8.40767 0.002(m)
    W LON:  119 37 51.52931      0.002(m)          119 37 51.59233 0.002(m)
   EL HGT:          208.861(m)   0.003(m)              208.444(m) 0.003(m)
 ORTHO HGT:         230.163(m)   0.018(m) [NAVD88 (Computed using GEOID12A)]

                    UTM COORDINATES    STATE PLANE COORDINATES
                     UTM (Zone 11)         SPC (4602 WA S)
Northing (Y) [meters]     5126276.950          103343.987
Easting (X)  [meters]      297235.684          566995.383
Convergence  [degrees]    -1.90148112          0.63125220
Point Scale                1.00010542          0.99993063
Combined Factor            1.00007268          0.99989789
```

Here are some general rules to help judge the quality of a solution:

The orbit [precise] should be precise or rapid (not-ultra rapid.)
> 90% observations used or > 80% # Fixed Ambiguities
> 50% Fixed Ambiguities or > 95% observations used
Overall RMS < 0.030(m)
Lat / Lon RMS < 0.030(m)

If you collect data under canopy or in an area where there are buildings or trees that obstruct the view above 10° elevation, the number of observations used will be lower.

Make sure you use the left-hand column (NAD_83) results, not the right-hand column (IGS08.)

Be careful with heights. Both ellipsoid and orthometric heights are listed. The orthometric height is NAVD88 GPS derived and typically is the elevation you need.

The RMS error estimate for the orthometric height includes an error estimate for the GEOID in addition to the RMS value for the ellipsoid height.

US Survey Feet vs. International Feet, Scale Factors

The state plane coordinates are listed at the bottom in the right-hand column. They are in Meters. If you need Feet, you can convert them, however be careful to convert to International Feet or U.S. Survey Feet as required by your State and application:

US Survey Feet = Meters * (3937/1200)
International Feet = Meters / 0.3048

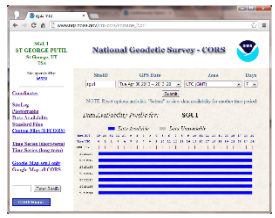
The misapplication of Ft/M scale factor can result in a 30 foot coordinate blunder! If you request an 'Extended Format' OPUS results, the state plane coordinates are computed and returned at the bottom of the report.

If your survey is at a significant elevation (> 100 feet) you may need to apply the Combined Factor (listed on the OPUS report for both UTM and State Plane Coordinates) to inversed distances to match optical shots made at ground level.

Getting ready to use OPUS

OPUS is a great tool for grounding your survey. But OPUS is part of a larger toolset. Before you begin a project take a moment to think about the 'Big Picture':

A. What are your GOALS?
   a. Required accuracy
   b. Horizontal and Vertical Datum; Geoid model choice
   c. Survey style: OPUS-Static, OPUS-Rapid Static, OPUS-Projects
   d. Consider FGDC Standards:
      http://www.fgdc.gov/standards/projects/FGDC-standards-projects/accuracy
B. Are there passive marks available for control?
   a. Will CORS, passive or a combination control the survey?
   b. Are local passive marks recoverable, undisturbed, sufficient quality, stable and GPS friendly?
   c. Where are the nearby NGS CORS (active) marks? This will determine 'Rapid Static' or 'Static' availability.
C. OPUS-Rapid Static Requirements
   a. Find the closest 9 CORS sites with available observations
   b. A minimum of 3 CORS stations within 250 KM are required.
   c. Your site must be within 50 km of a polygon created by the remaining available CORS.
   d. If the eligible CORS count is low, check the past reliability of recent observations to insure that there is a high probability of sufficient sites for OPUS-RS to compute a solution. Use the CORS 'Data Availability' to check for recent observations:

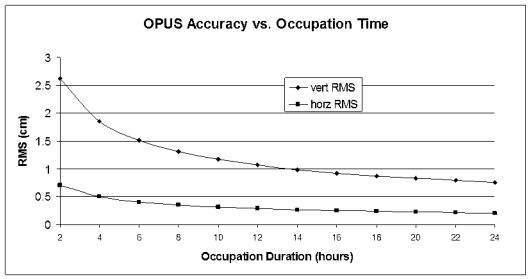


D. Mission Planning: Satellite Availability and Network Planning

a. How many receivers will you use for simultaneous observations? If you are using OPUS-Projects then More = More-Better.

b. Checkout online 'Mission Planning' tools for U.S. satellite availability using reasonable masks (>15 degrees) during collection periods. If there are any periods with fewer than 6 SV's or PDOPS higher than 3, plan on occupying points longer.

E. How long will you observe a site? Again:



F. Are your sites GPS compatible? Are there obstructions higher than 10 degrees?

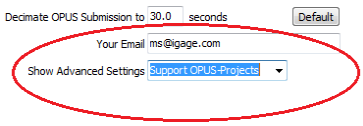
G. Field Checklist:

- Maps, aerial photography, ingress/egress plans
- Receiver with memory available
- Batteries fully charged plus battery-to-receiver cables with 12V external battery
- Compass for orienting receiver to North, current declination adjusted
- Fixed Height Tripods: Bubbles calibrated? Height verified?
- Tripods / Bipods / Tribrach / Tribrach adaptors: tribrach calibrated?
- Tools for adjusting bubbles (the correct Allen wrenches)
- Measure tape for slant measurements
- Digital Camera, batteries, memory: take close ups of cap and 4 horizon shots w/ receiver
- Station information observation log sheets
- Inclinometer for checking and documenting horizon obstructions
- Field Book, Observation Schedule, pencils
- Cell phone
- Flagging, paint, PK nails, hubs, rebar, caps, hammer
- Fluorescent vest, hat, bug dope, sunscreen, lunch, water, traffic control equipment
- Names, addresses, telephone numbers of property owners
- Gate keys / combinations

Using OPUS-Projects

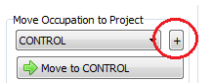
If you are contributing occupations to a registered OPUS-Project (note that NGS Training and authorization is required to use 'OPUS-Projects'), the Download tool can assist you when uploading files:

1. Turn ON OPUS-Projects support. On the 'Configuration' tab, set 'Show Advanced Settings' to "Support OPUS-Projects":

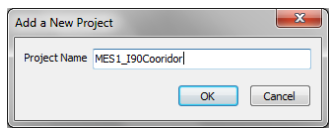


2. Add the NGS registered OPUS-Projects 'Project Identifier' supplied by your project administrator:

Click the "+" button

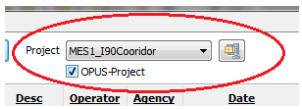


Enter the exact identifier



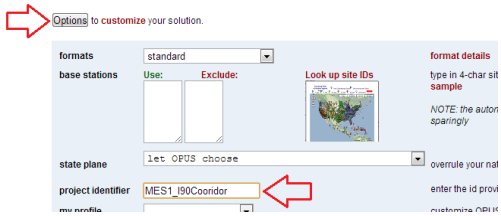
as the new project name.

Select the new Project



and check the newly displayed 'OPUS-Project' checkbox.

3. Now, when you submit an occupation that has been moved to the project, the upload tool will automatically press the 'OPTIONS' button on the OPUS submission form and fill in the project identifier:



Building, Loading and Using a GSF (GEOID Separation File)

GNSS receivers measure Ellipsoid Height. Users typically need Orthometric Heights.

The GEOID Separation File (GSF) is a file organized as a grid of height differences. Field data collection tools like SurvCE use the GSF file to derive an orthometric height at a Latitude - Longitude - Ellipsoid height from the ellipsoid.

It is very important that you survey with a GSF loaded for moderate sized jobs. If you don't, water will not necessarily flow downhill and fields will not be leveled for irrigation purposes.

Every three to five years, the National Geodetic Survey (NGS) produces a new GEOID realization for the United States. The most recent GEOID is Geoid12A.

The GEOID file (actually it is not a single file, but a group of files) for the United States is too large to load into data collector memory (when using SurvCE and FAST Survey) at once, so it is necessary to extract a portion of the GEOID for field use. A typical maximum file size is 400 Kbytes, while the full GEOID model is typically 40 megabytes for the United States.

GEOID Tools

Carlson SurvCE includes a Carlson XPort license number. You can download the latest XPort tool here:
http://www.carlsonsw.com/support/software-downloads/?product=SurvCE

Typically the XPortSetup tool is button number 1:

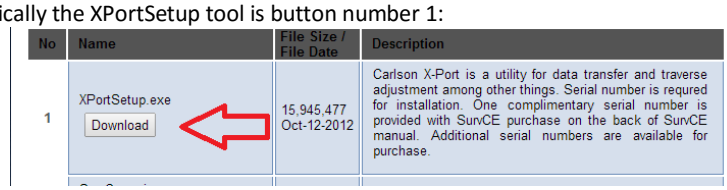


Figure 15 Downloading Carlson XPort from the web.

The Carlson XPort tool automatically downloads needed grid files from the internet as needed. Thus it is important to have internet access when building GEOID files in an area for the first time.

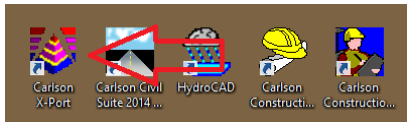
If you are using Spectra Precision FAST Survey, or your computer is not online, you can use the Ashtech Geoid Extraction tool. In addition, the Ashtech tool can be used to visualize the GEOID subsets that you create:

The Ashtech Geoid Extraction tool can be downloaded with this link:
http://ashgps.com/mirror/master/GEOIDS/Install_Geoids.exe

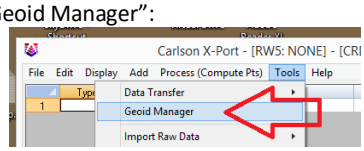
The full Geoid12A for use with the Ashtech tool can be downloaded with this link:
http://ashgps.com/mirror/master/GEOIDS/Install_GEOID12A_RevC.exe

Building a GSF file for a Project:

1. Start the Carlson XPort tool using the desktop icon:

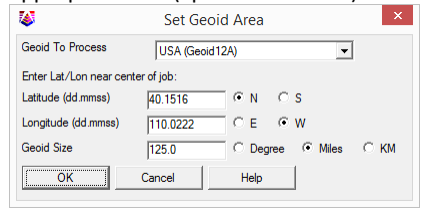


2. From the main menu of the X-Port tool, select "Tools: Geoid Manager":



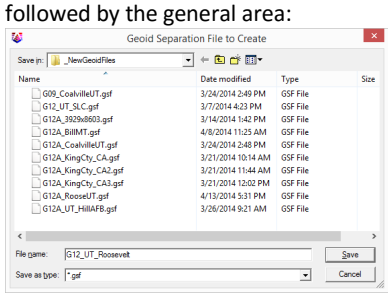
3. Choose the correct Geoid. If you are in the United States, the current correct GEOID is 'USA (Geoid 12A)', however other geoids are available for use if you need to match an older job.

4. Enter the center of job in Dd.MmSsss; select an appropriate size (I prefer 125 miles):

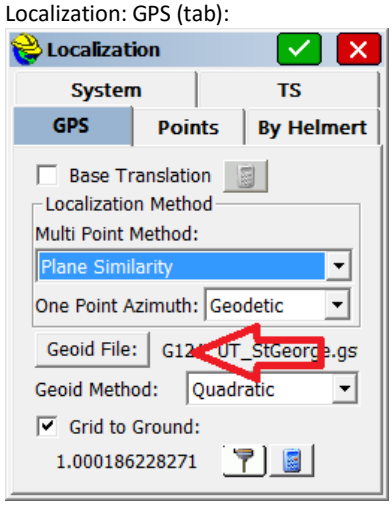


5. Click OK, the tool may need to go online to download the base geoid files, then choose an appropriate location for the output file. I prefer to use the Geoid name, followed by the State,

followed by the general area:

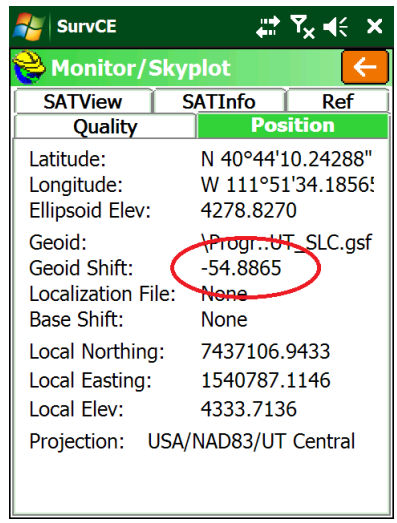


6. Click on “Save”.
7. Next transfer the GSF file to your data collector using ActiveSync or by mounting the device as a Flash Drive to your computer.
8. In SurvCE, you load the GEOID from: “Equip: 6 Localization: GPS (tab):



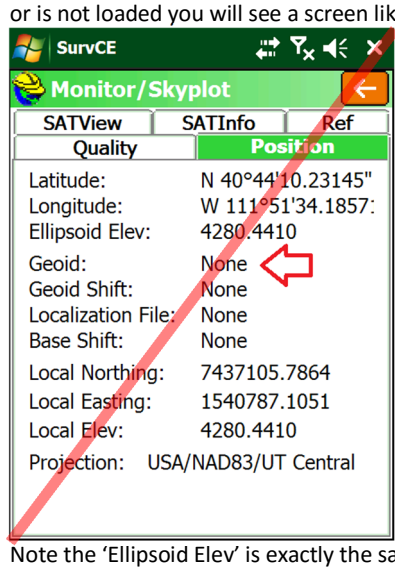
Click the ‘Geoid File:’ button, then browse to find the new GSF file.

9. You can verify that a GEOID file is loaded and in-use by going to “Equip: Monitor Skyplot: Position (tab)” where you will see the ellipsoid height, and the GEOID separation listed:



Notice that the GEOID Shift is negative. It is subtracted from the Ellipsoid elevation and causes the Local (orthometric) height to be higher than the ellipsoid. (This is true for most of the planet.)

If the GEOID file does not cover your survey area, or is not loaded you will see a screen like this:



Note the ‘Ellipsoid Elev’ is exactly the same as the ‘Local Elev

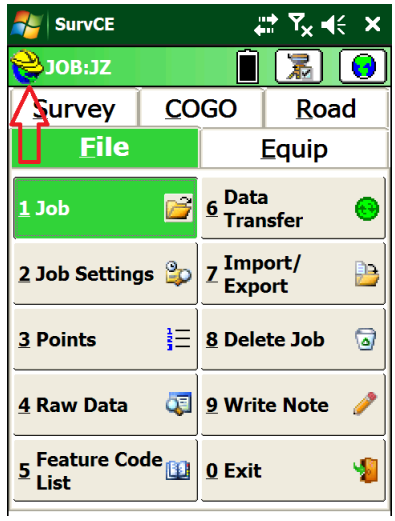
Data Collectors Should NEVER Standby & Manually Reconnecting

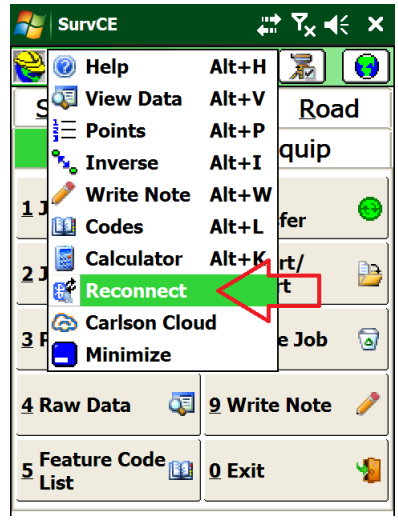
Your data collector is connected to the RTK head by Bluetooth. When/if the data collector goes into Standby, this communication link is shutdown.

When the data collector is brought out of Standby (typically by briefly pressing the power key,) it is supposed to automatically reconnect to the head. Depending on the state of communication before the data collector disconnects this reconnection procedure may be troublesome.

Manually Reconnecting Bluetooth

If the automatic reconnect does not work (and this can happen often), you can manually ask SurvCE to reconnect to the RTK head. This is very useful after changing the battery mid-day. From the main SurvCE menu click on the 'Hard Hat' in the upper left corner, then click on 'Reconnect':



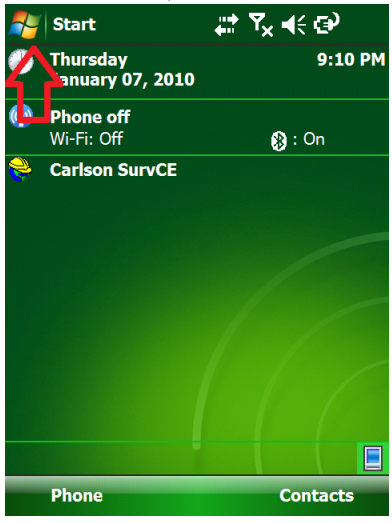


SurvCE will re-initialize the Bluetooth communication link between the data collector and the RTK head. If the Reconnect selection fails to reestablish the connection, reconfigure the rover from 'Equip: GPS Rover'.

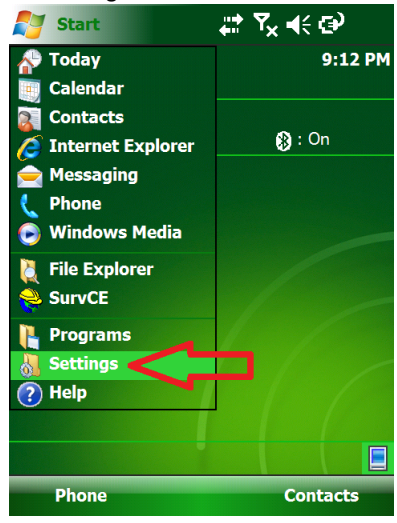
Never Standby

The best solution to this problem is to NOT ALLOW the data collector to enter standby. Turning off the backlight is okay, but you should configure the data collector to NEVER enter standby. Here is how:

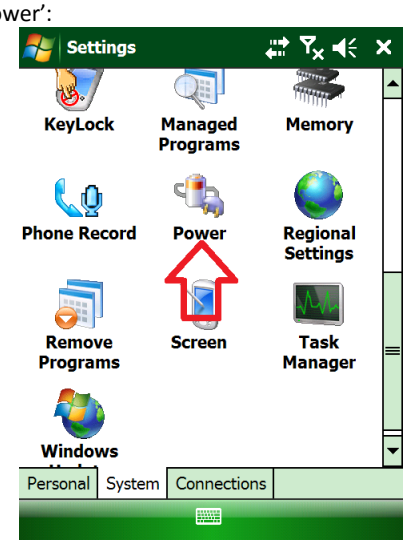
1. On the Data Collector, click on 'Start':



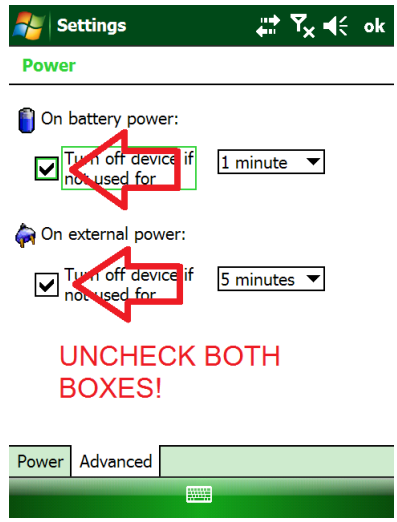
2. Click on 'Settings':



3. Select the 'System' tab, then drag down and click on 'Power':



4. Uncheck both boxes:



Then click 'ok' in the upper right corner.

Connect to Every Wi-Fi Access Point, NOT!

Before you use your i80 GNSS receiver in a network environment with a Wi-Fi based source of corrections, take a moment to disable automatic hotspot tracking.

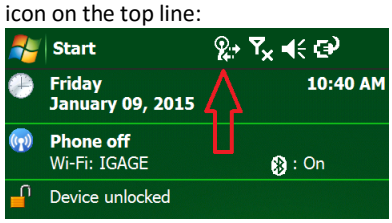
One of the annoying features of Windows CE and Windows Embedded is the automatic suggestion that you connect to every Wi-Fi hotspot that you pass by while surveying.

Even if you are already connected to your own Wi-Fi hotspot, the data collector by default continuously suggest that you connect to new ones as you pass them.

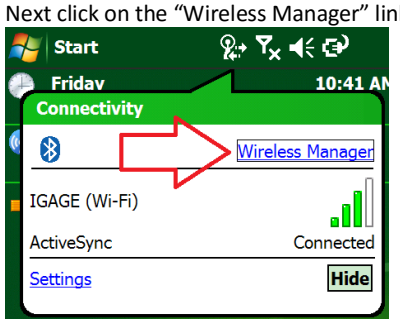
Not only is it annoying, but it can interfere with a network correction source and result in needless receiver loss of FIX.

Luckily there is a simple solution:

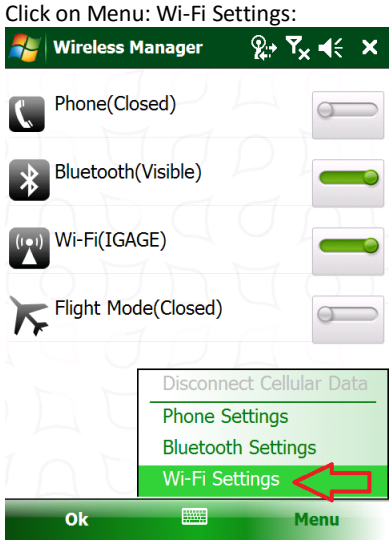
1. From the main screen, click on the 'Wireless Manger' icon on the top line:



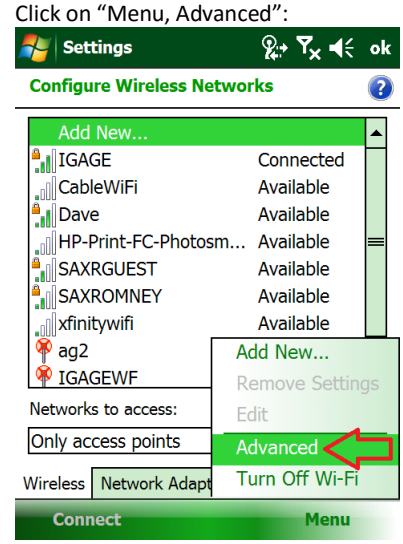
2. Next click on the "Wireless Manager" link:



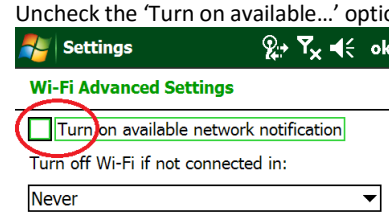
3. Click on Menu: Wi-Fi Settings:



4. Click on "Menu, Advanced":



5. Uncheck the 'Turn on available…' option:



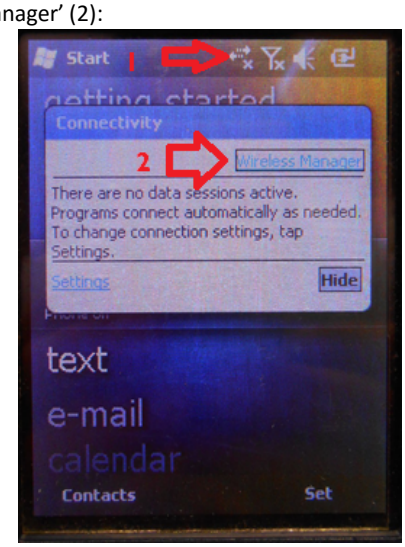
6. Click OK. Your data collector should now ignore hotspots, unless you manually attempt to connect to them.

Connecting Data Collector by Bluetooth to PC 'Windows Mobile Device Center'

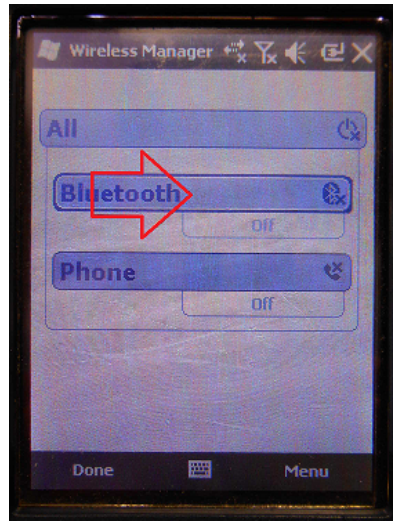
It is easy to plug your data collector into your PC with the USB connector and use Windows Mobile Device Center (under Windows XP the sync center is called 'ActiveSync'). But it is also easy to connect to your data collector with Bluetooth.

Here are the instructions for configuring a Bluetooth connection:

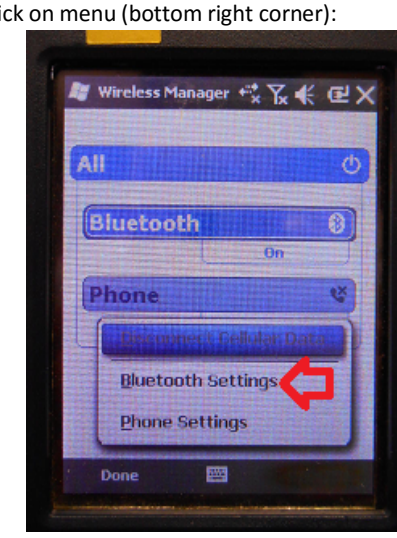
1. On the mobile device, first click on the 'connectivity' icon (1) on the top bar, then click on 'Wireless Manager' (2):



2. The Wireless Manger is shown, if Bluetooth is off click on the big blue Bluetooth bar to toggle Bluetooth on:

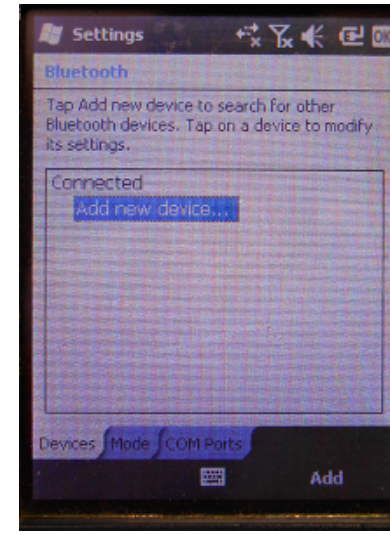


3. Click on menu (bottom right corner):

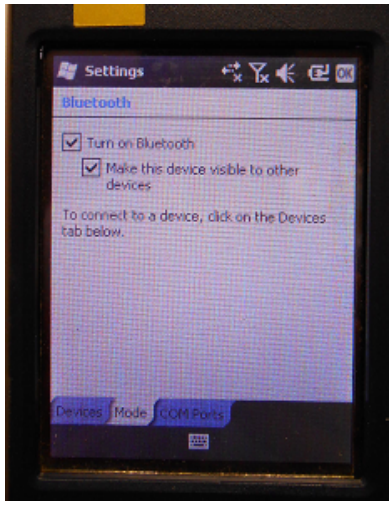


then 'Bluetooth Settings'

4. The Bluetooth Settings screen will be shown:

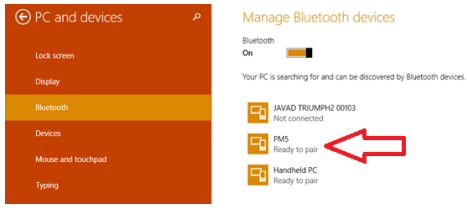


5. Click on the ‘Mode’ tab:



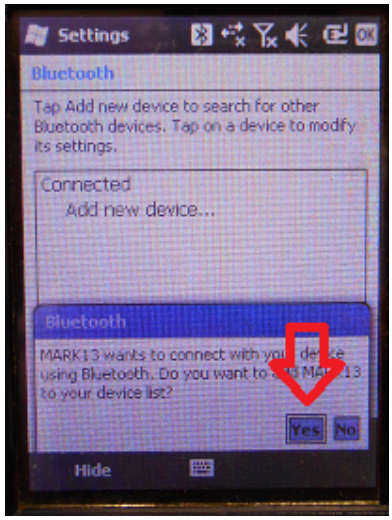
Then check the ‘Make the device visible to other devices’.

6. Back on your PC:



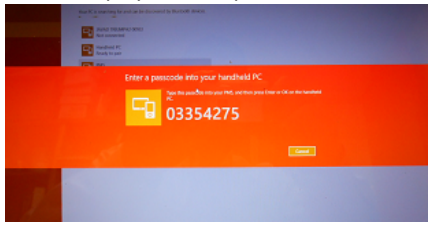
You should be able to see the device, shown as ‘Ready to pair’. (Wait 20 seconds if needed.)
Click on the device, and then click on the ‘Pair’ button.

7. On the mobile device, you will be prompted to pair:

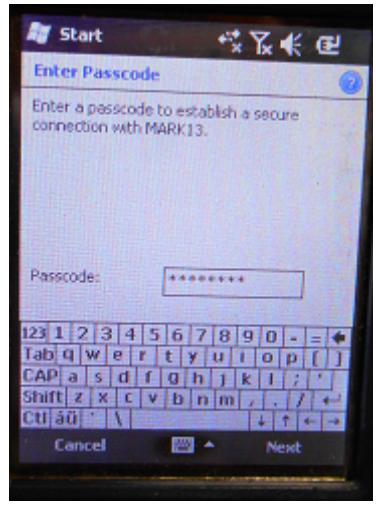


Click on ‘Yes’.

8. Your PC will display a secret passcode:

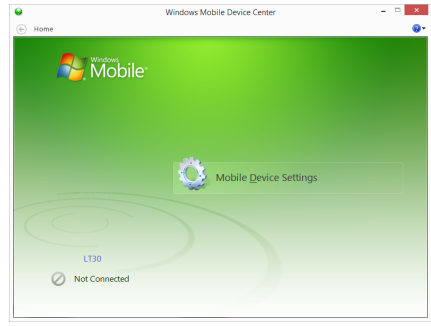


9. Quickly enter this number on your mobile device:



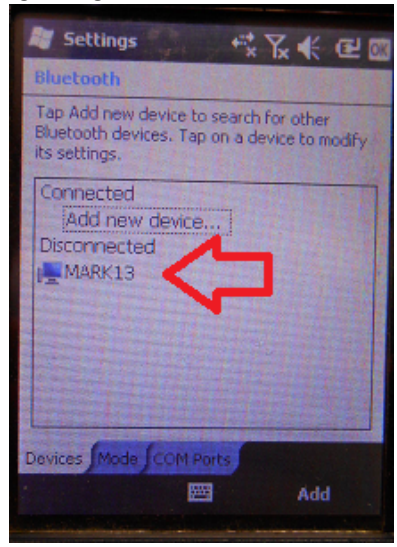
and then click ‘Next’.

10. Start Windows Mobile Device Center



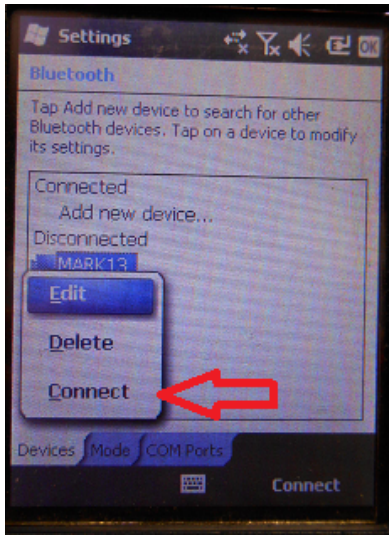
You will be ‘Not Connected’.

11. On the mobile device, navigate to the Bluetooth Settings dialog:



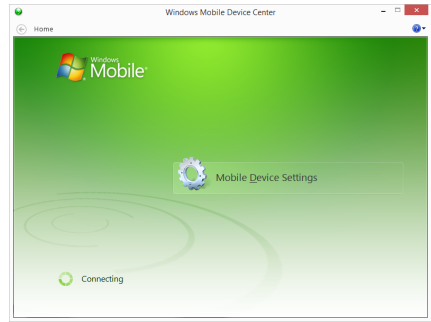
Click-and-hold on your computer name (my computer’s name is ‘MARK13’)

12. A pop-up dialog will be shown:



Click on Connect.

13. Now, on your PC you will see 'connecting':



After 30 seconds your device will be active-synced to your PC. The connection is fast and it will be remembered, so it will be easy to setup in the future.

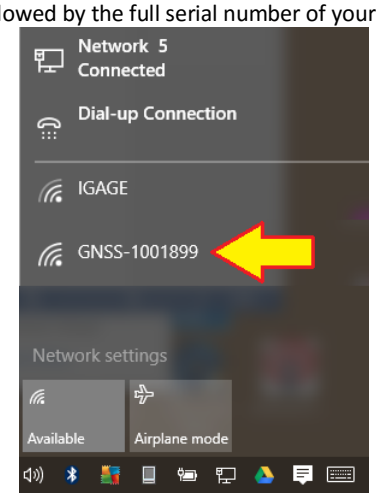
Connecting the i80 to a PC with Wi-Fi

The i80 receiver has an internal Wi-Fi Access Point which can be used in conjunction with a PC or smartphone to setup and control every feature of the receiver.

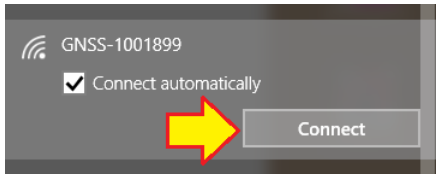
1. To connect the i80, on your PC:

   Click on the Network icon in the System Tray

2. Find the i80 receiver which will be named 'GNSS-' followed by the full serial number of your device:



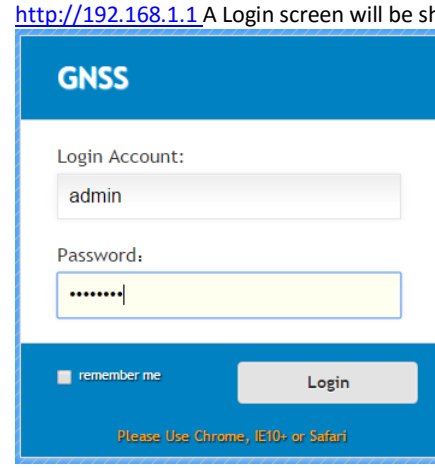
3. Click on 'Connect':



4. Enter the default Wi-Fi password "12345678"

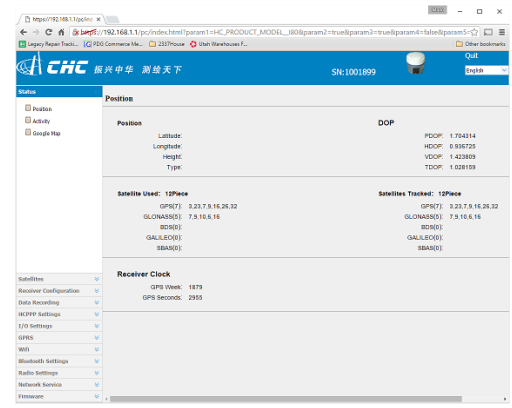
5. Click on 'Next' to connect by Wi-Fi to the GPS head.

6. Open a browser window on your PC and type in the GPS IP address:
   http://192.168.1.1 A Login screen will be shown:



   The 'Login Account' is '**admin**' and the 'Password' is '**password**'.

7. Click the 'Login' button, you will be at the 'Home Screen' of the GPS receiver:



   From the main screen, you can configure nearly every aspect of the receiver's operation.

Using HcConfig via Wi-Fi or Serial Port

HcConfig can be used to configure many of the receiver's settings via Wi-Fi or by direct connection to a serial port.

You can download the latest version of HcConfig from this web folder:

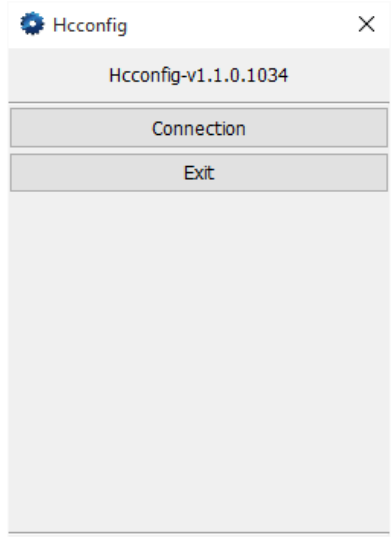
http://x9gps.com/Tools/Utilities/HCConfig/index.html

Download the latest build (the version with the highest ending number.) Build 1034 or higher is required for the i80.

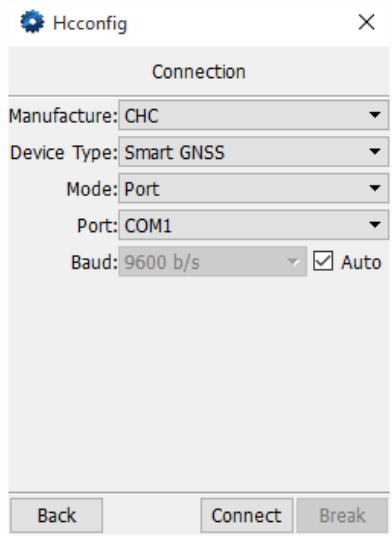
HcConfig by Serial Port

Connect your computer's serial port to the 9-pin serial cable connected to the serial port on the i80:

1. Run HcConfig:

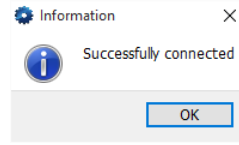


2. Click on the 'Connection' button:

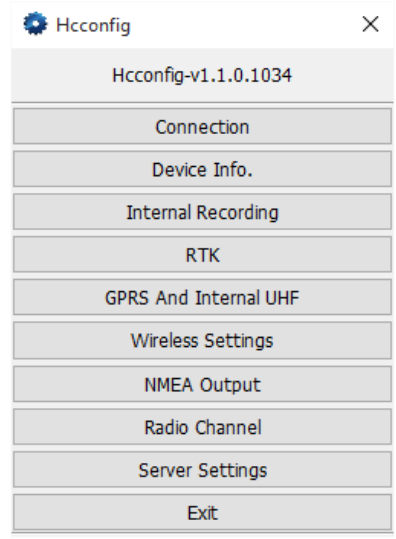


Configure as shown, but be sure to choose the correct COM Port for your connection.

3. Click the 'Connect' button:



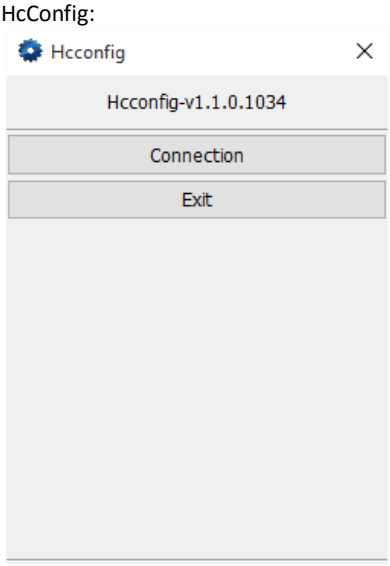
4. Many of the receiver settings can be configured from the Main Menu:



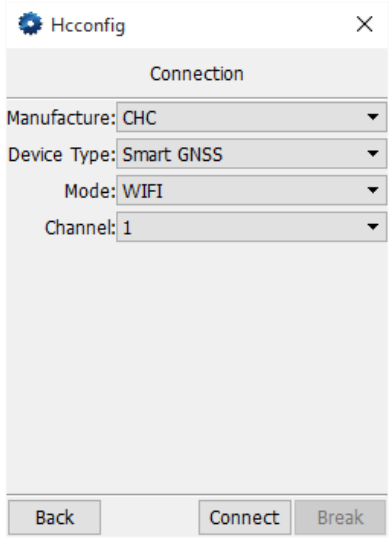
HcConfig by Wi-Fi

First create a Wi-Fi connection to the GPS receiver using the instructions ‘Connecting the i80 to a PC with Wi-Fi’ found on Page 74.

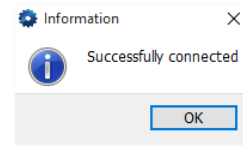
1. Run HcConfig:



2. Click on ‘Connection’:

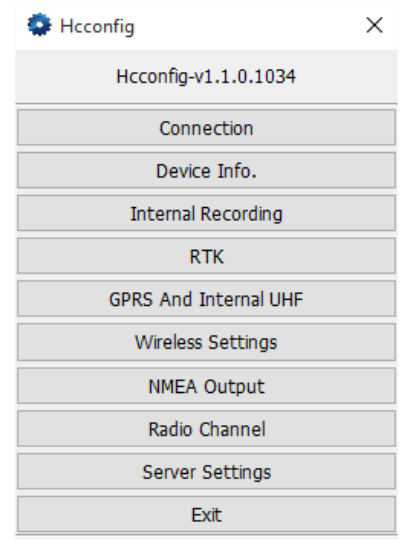


3. Click on ‘Connect’:



Click on ‘OK’.

4. Many of the receiver settings can be configured from the Main Menu:



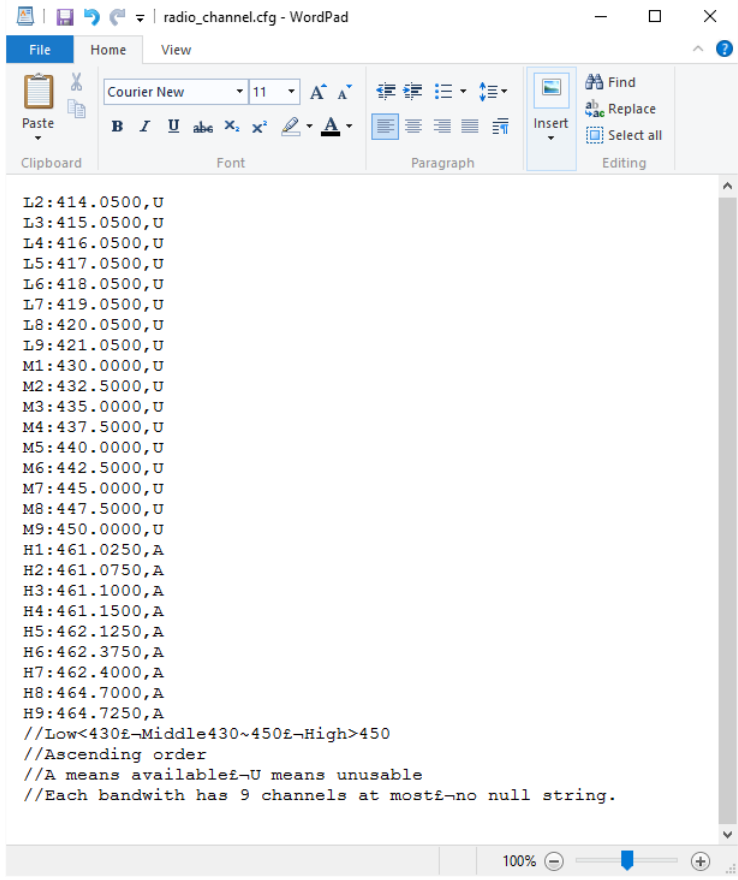
Setting the Radio Frequencies and FCC ID

In the United States a FCC license is required to operate the UHF radio at any power, on any frequency. Your FCC license will specify a 'Call Sign' which must be broadcast at least once every 10-minutes. Violating these requirements may result in large daily fines.

To set the radio frequency list and FCC ID, login to the GPS receiver using the instructions 'Connecting the i80 to a PC with Wi-Fi' found on Page 74.

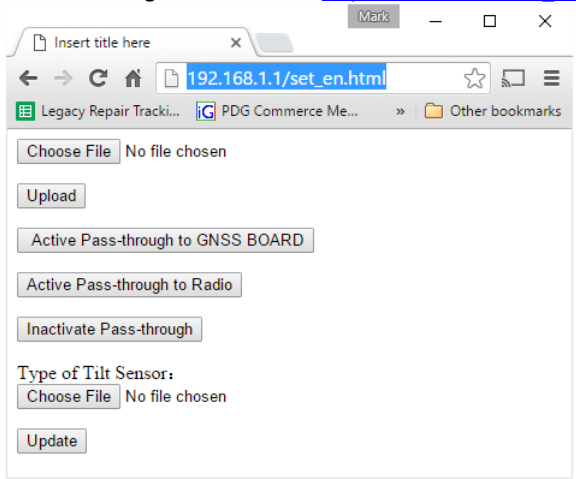
Download the Radio Control File from: http://x9gps.com/Tools/i80/Radio/radio_channel.cfg

Edit the template file with WordPad entering the desired frequencies in the H1 through H9 entries at the bottom of the file:

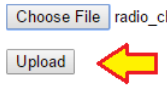


Only 9 frequencies can be set H1 through H9 (the Lower and Middle bands are used for government frequencies.) Save the file after changing the frequencies.

Use a browser and go to this address http://192.168.1.1/set_en.html :

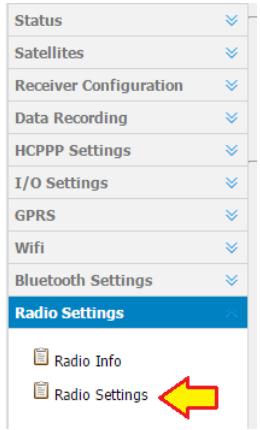


Click on ‘Choose File’ and browse to the settings file.

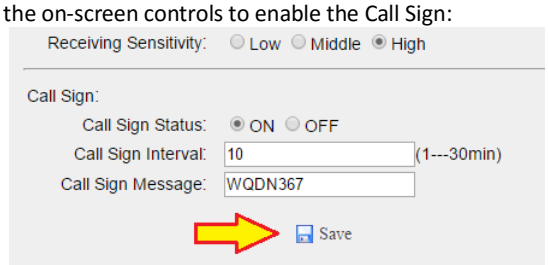


Click on the ‘Upload’ button to commit the radio channel table.

To set the broadcast FCC Call Sign (HcConfig can also be used to set the Call Sign), click on “Radio Settings: Radio Settings”:



Use the on-screen controls to enable the Call Sign:



The ‘Call Sign Status’ should be set to ‘ON’, the Interval should be 10 minutes or less, the message should be your FCC Assigned Call Sign.

Using the IMU (Tilt and Direction) Sensors

The i80 receiver has an internal IMU: tilt sensors (an electronic bubble) and an electronic compass. The IMU can be used to check the pole level, store the pole level in the RAW file and optionally correct for pole tilt (Tilt Compensated Shots.)

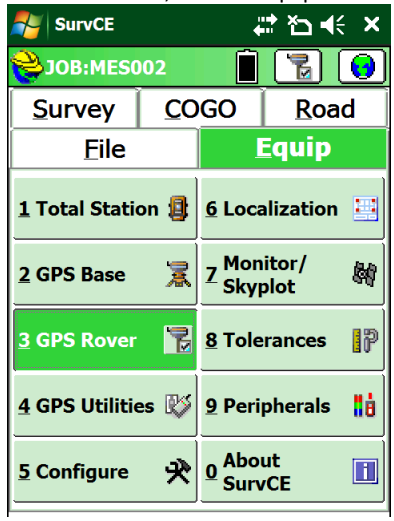
Calibrating the Tilt Sensor

Before using the IMU, you need to calibrate the tilt sensor. Since you are only going to use the IMU on the Rover, you do not need to calibrate the Base.

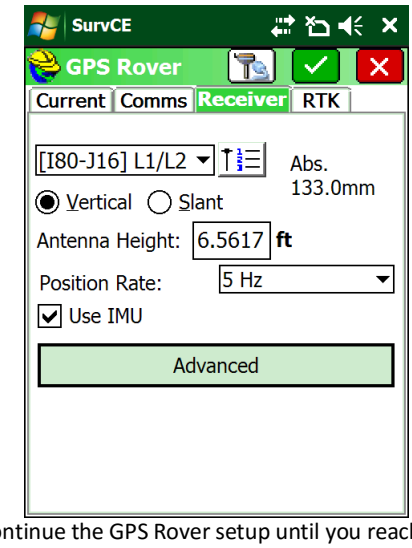
1. Place the receiver on a calibrated tribrach.

2. Adjust the tribrach to insure that it is level.

3. From the main menu, click on 'Equip: GPS Rover':

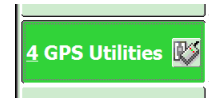


4. Make sure the correct device is selected on the 'Current' tab, select the correct device on the 'Comms' tab. On the 'Receiver' tab check the 'Use IMU' checkbox:

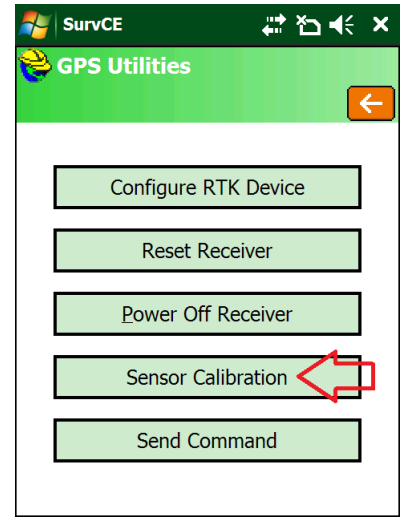


Continue the GPS Rover setup until you reach the main menu.

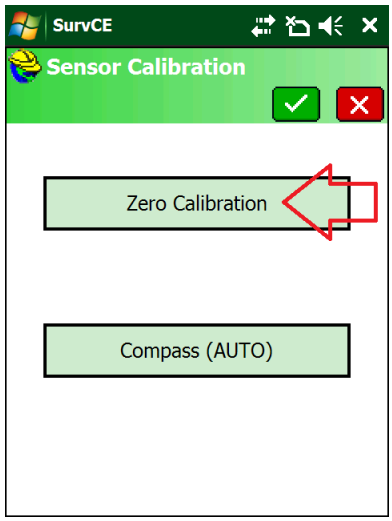
5. Click on GPS Utilities:



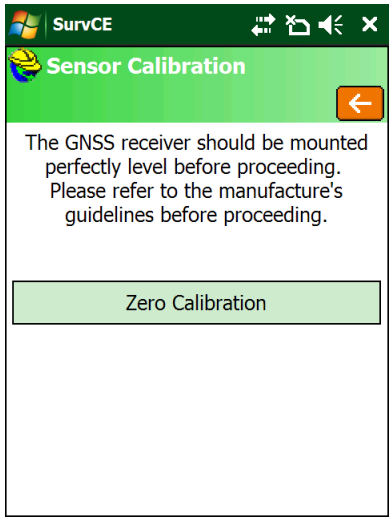
6. Click on 'Sensor Calibration':



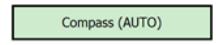
7. Click on ‘Zero Calibration’:



8. Double check that the receiver is level, then click on ‘Zero Calibration’:



9. The eBubble ‘Zero Calibration’ will take 15-seconds to complete.
10. Next click on ‘Sensor Calibration’ again, then click on ‘Compass (AUTO)’:



11. The Compass should be calibrated outside, away from local sources of magnetism.
12. Follow the instructions on the data collector. When asked to ‘Slowly rotate receiver according to manufacturer instructions’, hold the receiver in your hands with the display facing you, then rotate the receiver bottom-over-top while slowly rotating your body in circles.

NOTE: The Compass can be used to ‘compensate’ tilted measurements. Typically electronic compass based tilt compensation has disappointing results. **Compensated shots are currently not supported by iGage, the accuracy and suitability for any purpose is not warranted.**

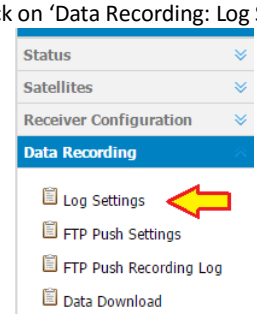
Setting i80 to Automatically Record Raw Observation Data

The i80 has 14 Giga Bytes of internal flash memory available where observation files can be stored.

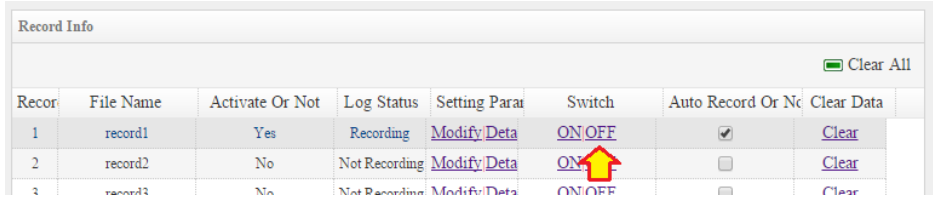
It is possible to configure the receiver so that it always opens an observation file when the receiver is turned on and after it has established a GPS Position. Typically Base receivers are set to automatically record files.

To configure a head, login to the GNSS receiver using the instructions 'Connecting the i80 to a PC with Wi-Fi' found on Page 74.

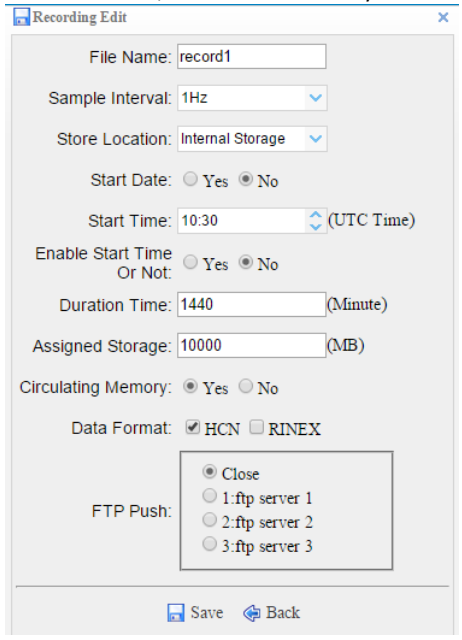
Click on 'Data Recording: Log Settings':



The current recording status will be shown:



Click on 'Switch OFF', then click on 'Modify' for the first recording bin:



The filename is the directory name for the base storage folder.

The Sample Interval sets the recording epoch spacing.

It is possible to extend the storage to an external Flash drive connected to the USB port with the supplied cable. The 'Storage Location' chooses between 'Internal' and 'External' memory.

If you set a 'Start Date' the file will begin only on the configured date (a time-picking window opens when 'Start Date' is set to 'Yes'.)

If you set a 'Start Time' and 'Enable Start Time' then the file will not begin recording until the configured Time is reached.

File durations are limited to 1,440 minutes (24 hours.) You can set a shorter 'Duration Time' in minutes.

'Assigned Storage' is the maximum memory that will be allocated to the selected recording bin. Enabling 'Circulating Memory' allows the receiver to delete the earliest files so that it can continue to record data when the 'Assigned Storage' limit is reached. If you set 'Circulating Memory' to No, then recording stops when the 'Assigned Storage' limit is reached.

The i80 can store files as compressed HCN files, as standard RINEX files or both. The iGage Download tool only looks for .HCN files. HCN files are much smaller than RINEX files, so if you are collecting long files it is probably best to only record .HCN files.

When you have completed modifying the settings, click on 'Save' to commit them.

If you want recording to begin automatically, check the 'Auto Record' checkbox, then click on 'ON' to restart recording.

Troubleshooting the i80 Receiver

1. Receiver won't turn on:

Battery is fully discharged: Charge battery or use external power.

Contacts on battery are dirty: Clean battery and receiver contacts with a soft cloth or soft eraser.

Battery is bad: Try another battery.

2. Is the receiver tracking satellites?

The BLUE LED flashes once for each SV (satellite vehicle) that is currently tracked.

If you are indoors, the LED will flash **once** every 5-seconds. However no SV's will be tracked.

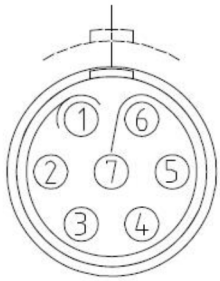
The receiver should begin tracking within 30-seconds after a warm start. After a cold start (off for more than 1 week) it may take 90-seconds for the receiver to begin tracking.

5. The GPS receiver won't mount as a Disk Drive.

1. Before plugging GPS cable into your PC, did you wait for the power LED to blink 3 times?
2. Unplug, wait 15-seconds, try again
3. Try another USB port.
4. Use an external USB Hub (this fixes intermittent disk mounts)
5. Try other computers.
6. Try turning off your PC, wait a minute and then turn on again. Reinsert the USB cable.
7. Get the DevView tool from http://www.nirsoft.net/utils/usb_devices_view.html and use it to uninstall the errant device driver for the GPS receiver.
    a. Download the USBDeview tool, there is a 32-bit and a 64-bit version, choose the correct version for your computer.
    b. Unzip the distribution ZIP file, run the "USBDeview" tool as an administrator.
    c. Unplug the GPS receiver.
    d. Look for the entry "OLIMEX LPC1766 Storage USB Device", right-click it and "Uninstall Selected Devices", answer yes to 'Do you want to uninstall?" wait 10-seconds and then plug the GPS receiver back in.

i80 Serial and USB IO Port Definitions

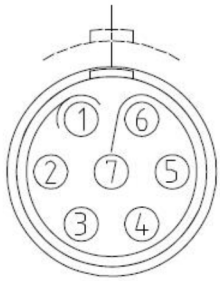
Serial IO Port Definition



PIN	FUNCTION
1	Ground (-)
2	Ground (-)
3	RS232-TX (Output)
4	Not Used
5	Not Used
6	VIN
7	RS232-RX (Input)

Figure 16 i80 7-Pin Serial IO Lemo Connection Information

USB IO Port Definition



PIN	FUNCTION
1	Ground (-)
2	Ground (-)
3	VBUS
4	DM
5	DP
6	VIN
7	ID

Figure 17 i80 7-Pin USB IO Lemo Connection Information

Upgrading Firmware with the OTG Cable

Note: You can also upgrade the device using a Wi-Fi connection using a web browser.

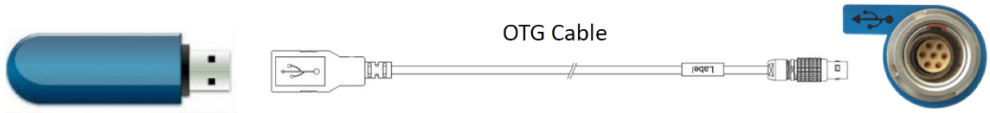


Figure 18 updating the i80 Firmware with the OTG Cable

1. Copy the firmware file (xxx.bin file) to the root directory of an external storage device such as USB drive or portable hard drive.
2. Turn off the receiver.
3. Connect the external storage device with receiver through USB port using the OTG cable.

4. Restart the receiver by pressing the power button for three seconds. After 15-seconds the LCD screen will prompt to upgrade the firmware.

5. Press 'Fn' button to upgrade the firmware.
6. When the firmware upgrade is complete, the receiver will be restarted and the LCD screen will again prompt to upgrade the firmware again.
7. Press the Enter button to quit the upgrade process and then remove the OTG cable.

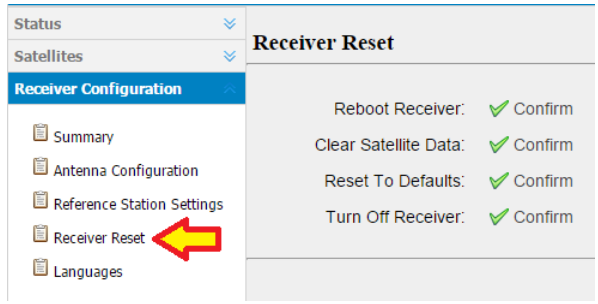
GNSS Reset

It is possible to reset the i80 from the Front Panel and from the web interface. This procedure should not be required for normal operation.

Web Interface Reset

Connect your PC or smartphone to the i80 receiver as shown in 'Connecting the i80 to a PC with Wi-Fi' on page 74.

From the Main Menu,



Click on 'Receiver Configuration: Receiver Reset'. You can reboot the entire receiver, clear the satellite ephemeris data, and reset the i80 head back to factory defaults or turn off the head programmatically.

Front Panel Reset

To reset the system from the Front Panel:

From the main menu:

Push and hold the 'Fn' key, then quickly click (press-release) the power key five times.

Watch the display and you will see:

The SV count changes to 'Getting' as the GNSS engine re-initializes.

Warranty

Before you get hung-up with hardware and software problems, please give us (iGage Mapping Corporation) a call:

+1-801-412-0011

Our goal is to take great care of our customers and be reasonable with everyone. Our response to issues may exceed your expectations and our written warranty.

IMC is “iGage Mapping Corporation” of Salt Lake City Utah USA.

IMC warrants the CHC X90, X900S, X900+, X91+ and i80 receivers, which we sell, to be free of defects in material and workmanship and will conform to our published specifications for these periods:

GPS receivers:	2-years
Cables and accessories:	1-year
Batteries:	90-days

This warranty applies only to the original purchaser of the product.

In addition, the CHC factory offers similar warranties and maintains a dedicated repair depot in the United States.

Hardware: Purchaser's exclusive remedy under this warranty shall be limited to the repair or replacement, at IMC's option, of any defective part of the receiver or accessories which are covered by this warranty. Repairs under this warranty shall only be made by IMC at an IMC service center. Any repairs by a service center not authorized by IMC will void this warranty.

In the event of a defect, IMC will at its option, repair or replace the hardware product with no charge to the purchaser for parts or labor. The repaired or replaced product will be warranted for 30-days from the date of return shipment, or for the balance of the original warranty, whichever is longer.

Software: IMC warrants that software products included with hardware products will be free from media defects for a period of 30-days from the date of shipment and will substantially conform to the then-current user documentation provided with the software. IMC's sole obligation shall be the correction or replacement of the media so that it will substantially conform to the then-current user documentation. IMC does not warrant the software will meet purchaser's requirements or that its operation will be uninterrupted, error-free or virus-free. Purchaser assumes the entire risk of using the software.

Exclusions

The following are excluded from the warranty coverage:

Periodic maintenance and repair or replacement of parts due to normal wear and tear.

Product Finishes.

Batteries exposed to heat, cold; or batteries opened or physically damaged.

Installations or defects resulting from installation.

Any damage caused by (i) shipping, misuse, abuse, negligence, tampering, or improper use; (ii) disasters such as fire, flood, wind, and lightning; (iii) unauthorized attachments or modification.

Service performed or attempted by anyone other than an authorized CHC or IMC service center.

That the receiver will be free from any claim for infringement of any patent, trademark, copyright or other proprietary right, including trade secrets.

Any damage due to accident, resulting from inaccurate satellite transmissions. Inaccurate transmissions can occur due to changes in the position, health or geometry of a satellite or modifications to the receiver that may be required due to any change in the GPS. IMC GPS receivers use GPS satellites to obtain position, velocity and time information. GPS is operated by the US government, which is solely responsible for the accuracy and maintenance of the GPS system. OPUS and OPUS-RS is a service of the NGS and IMC shall not be responsible for issues with NGS provided services.

Except as set forth in this limited warranty, all other expressed or implied fitness for any particular purpose, merchantability or non-infringement, are hereby disclaimed.

IMC shall not be liable to the purchaser or any other person for any incidental or consequential damages whatsoever, including but not limited to lost profits, damages resulting from delay or loss of use, loss of or damages arising out of breach of this warranty or any implied warranty even though caused by negligence or other fault of IMC or negligent usage of the product.

In no event will IMC be responsible for such damages, even if IMC has been advised of the possibility of such damages.

This written warranty is the complete, final and exclusive agreement between IMC and the Purchaser.

RMA

To obtain warranty service from iGage Mapping Corporation the purchaser must obtain a return materials authorization (RMA) number prior to shipping by calling

+1-801-412-0011

Or by email:

info@igage.com

To obtain warranty service from CHC (the Factory) send email to

support@chcnav.com

Purchaser's return address and the RMA number must be clearly printed on the outside of the package. IMC reserves the right to refuse to provide free-of-charge service if the date of sale cannot be determined or if the serial number is altered or removed. IMC will not be responsible for any losses or damage to the product incurred while the product is in transit or is being shipped for repair. Insurance is recommended. IMC suggests using a traceable shipping method such as UPS, FedEx or USPS with signature tracking when returning a product for service.

The Purchaser shall always pay shipping to IMC, **IMC will return warranty repairs by UPS ground**, unless the Purchaser agrees to prepay expedited service costs. IMC will not pay for warranty returns to destination outside of the contiguous 48-states. The purchaser shall always pay any associated duty associated with warranty repairs.

CHC (the Factory) has a separate warranty and RMA process.