



UtilityScan[®] DF

MN72-489 Rev H

Geophysical Survey Systems, Inc.

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UtilityScan[®] DF Quick Start Guide

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Regulatory Information

Please see the GSSI Manual CD or our website, www.geophysical.com/regulatoryinformation.htm, for current information and FCC Registration Form, including:

- FCC Notice for U.S. Customer
- Canadian Requirements for RSS-220
- Declaration of CE Conformance

UtilityScan® DF



- 1 Control Unit (Panasonic Toughpad FZ-G2)
- 2 Ethernet Cable
- 3 Dual Frequency Antenna with battery
- 4 3 Wheel Cart with front antenna mount,
Or
- 5 4 Wheel Cart with capsule and foam insert
for antenna

Section 1: Getting Started

Thank you for purchasing a UtilityScan DF from GSSI! The UtilityScan DF incorporates our innovative dual-frequency digital antenna (300 and 800 MHz) and an easy-to-use touchscreen interface to view shallow and deep targets simultaneously in a single scan. You can also take advantage of GSSI's world-renowned versatility and use our excellent 350 MHz HyperStacking antenna with the same control tablet and cart.

GSSI application support and training services are also at your disposal. Simply call (603) 893-1109 or email training@geophysical.com with questions. We'd love to hear from you!

Keyboard and Snipping Capability

The Panasonic FZ-G2 Toughpad® is designed to be used as a touch screen. You may use your fingers to tap on an icon or menu option, or you may use the attached stylus pen.

Snipping Tool: Press the A2 button once to open the Windows® Snipping Tool.

Keyboard: Press the A3 button on the right side of the tablet to launch the keyboard. You may exit the keyboard by tapping on the "X" located on the upper right-hand corner of the keyboard.



Toughpad Information

Power Indicator

- **Green:** Power is on.
- **Blinking Green:** Sleep Mode.
- **Blinking Green and Orange:** Cannot power on or resume due to low temperature.







Battery Indicator: A fully charged battery should last approximately 4 hours. Charging the battery takes approximately 3 hours.


- **Not lit:** Battery is not being charged.
- **Orange:** Charging.
- **Green:** Fully charged.
- **Red:** Remaining power is 9% or less.
- **Blinking Orange:** Battery can temporarily not be charged because the internal temperature is too high.


Note: If the Toughpad battery dies and the system shuts down during data collection you will need to recharge the battery. All of the data collected to the point of the system shutting down was saved and can be retrieved from the project folder.

Standard Icons

There are icons that will perform the same function throughout the system. They are as follows:

-  Change values up or down, or highlight menu options or files.
-  Accept the value.
-  Test the value.
-  Cancel.

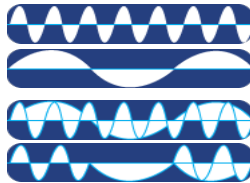
 The icons will display as red or white, depending upon whether or not it was the most recent selected option.

 An icon will appear blue if it is hovered over with the stylus pen.

Display Channel (Frequency) Icons

These icons will indicate what type of display is on the screen. Also, by tapping on them, the display will change according to which one is selected.

- High Frequency (800 MHz)
- Low Frequency (300 MHz)
- Blend
- All Three



Powering and Booting Up

- 1 Assemble the cart as shown in the Resource Guide: Cart Assembly Instructions. You can find the guide on the GSSI Tech Support website: <https://support.geophysical.com>.

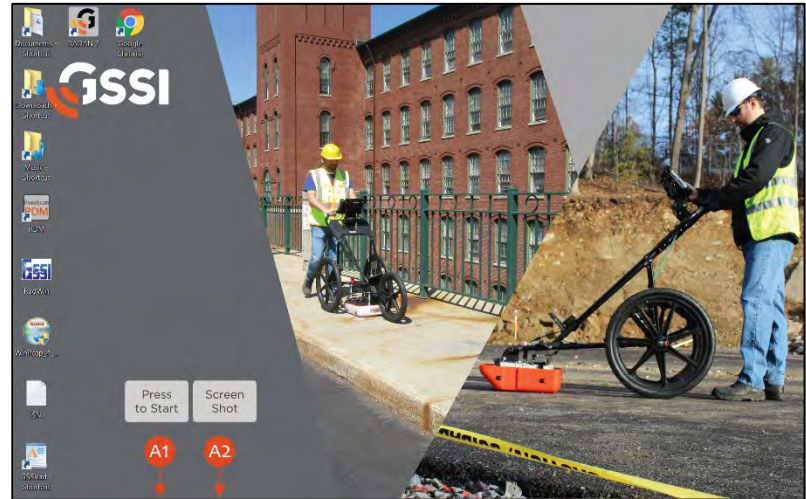
Important: Antenna battery must be attached to the antenna before continuing to Step 2.

- 2 To power up the system:

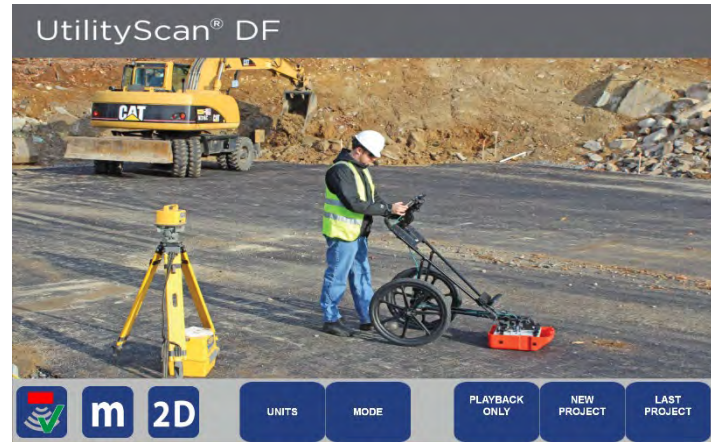
- a) Press and hold the power button on the Toughpad for about 2 seconds until a green light illuminates beside the power button. The COMM light will illuminate green and the PWR light will illuminate red. The PWR light will turn blue once the antenna has finished starting up.

- b) After a few seconds, when the system boot up is complete, the UtilityScan DF Start Screen is displayed.

- 3 Press the **A1** button to start.



- 4 Select how the data will be displayed and collected. Press the Units icon to toggle between Metric or English units.
- 5 Select between 2D or 3D Data Collection Mode by pressing the Mode button.
- 6 Select whether to collect or playback data:
 - **Playback Only:** To playback data previously collected and saved.
 - **New Project:** To configure and collect data for a new project.
 - **Last Project:** Collect data using the same configuration as the last project.



Communication Established with Antenna

- 7 If there is no communication between the Toughpad and the antenna, or there is no antenna attached to the Toughpad, “New Project” and “Last Project” will display as “No Antenna Found” and a red “X” will appear over the antenna icon. The green light on the antenna in the capsule will illuminate if communication is established.

No Communication Established with Antenna



Powering Down

It is essential that these steps are followed in order when powering down the system. Failure to do so may result in boot-up issues.

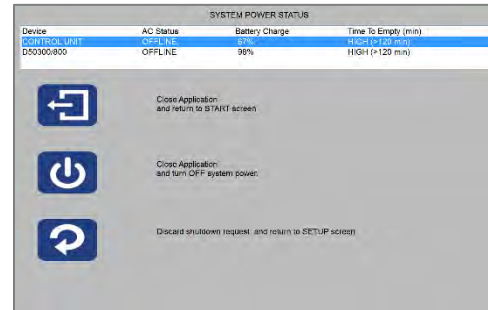
- 1 From the Setup Screen tap on System Options.
- 2 Tap on System Shutdown.
- 3 Tap either:



Exit: Close Application to return to start screen. At this point, press and hold the power button for about 3 seconds. The system will shut down properly.



Power Off: Close Application and turn OFF System power. The system will automatically shut down. (Recommended)



Note: If the system was not powered down properly and before the next time you power up, you must disconnect the battery on the antenna and then re-connect it. This will turn the antenna off, then back on. You can now power up normally.

Section 2: 2D Data Collection and Playback

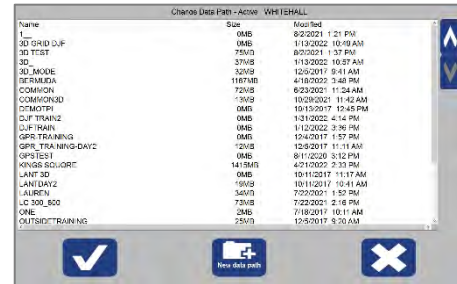
New Project Mode and Last Project Mode

New Project Mode: Configure the system as desired. This opens the Change Data Path screen and allows for the selection or creation of a project folder.

After selecting New Project, select which folder you would like to save your data to, or create a new folder for a new project.

- 1 Tap on the arrows and select a folder (project). All files will be saved to this folder and the name of the files will be folder name + a sequential number. Tap on Accept to continue.
- 2 Tap on New Data Path to create a new folder (project).
 - Enter and save the new folder (project) name.
 - Highlight the new folder (project) by tapping on the arrows.
 - Tap on Accept to continue.
- 3 Tap on Cancel. The files will be saved to the last folder that was used.

Last Project Mode: Bypass the Change Data Path screen and continue with the last project and all of its settings.



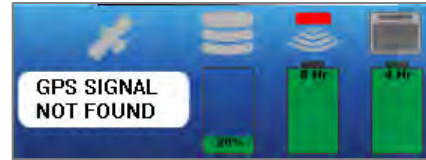
In either mode, the Setup options are the same. The following screen is displayed once a folder is created or Last Project Mode is selected:







The Screen is divided into three sections: Data View (Linescan and O-Scope), Main Menu located at the right pane of the screen, and the Sub-Menu located at the bottom of the screen.

Status screen located at the lower left corner of the screen.

- GPS Status
- Disk Space Used (storage space)
- Battery Power remaining for the antenna
- Battery Power remaining for the Toughpad



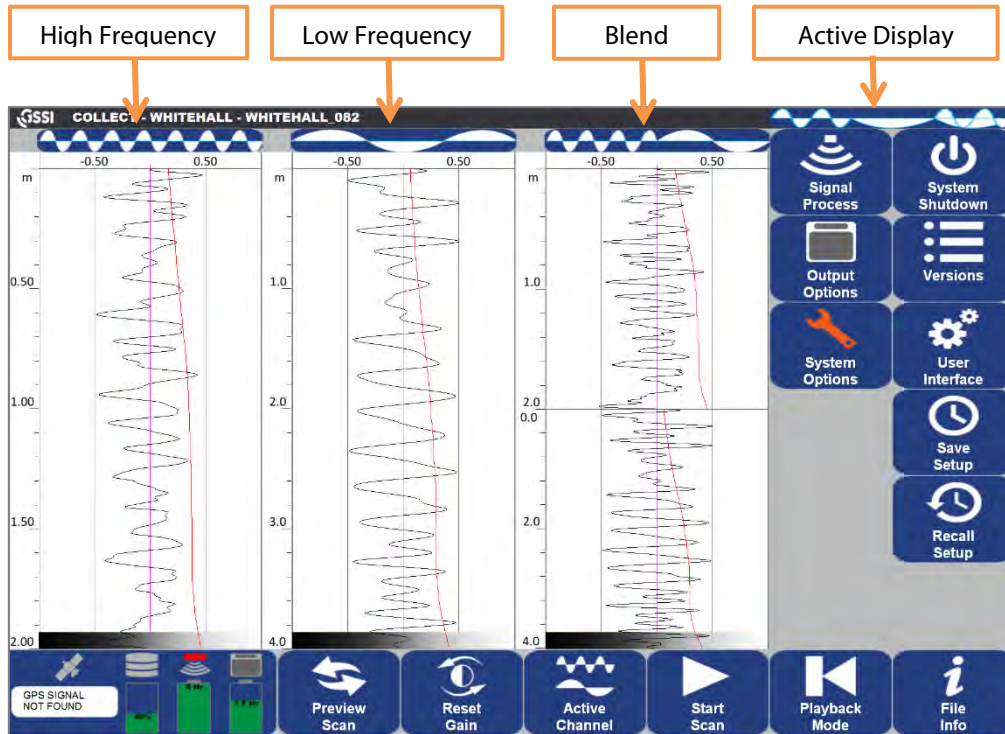
The Data View screen will display data in any one of the follow views:

- High Frequency 
- Low Frequency 
- Blend 
- All Three (Default) 

Switching between Data View screens and frequencies.

- Display just one frequency at a time by tapping the icon at the top of the O-Scope.
- Tapping the frequency icon again will display all three modes.

High, Low, Blend, and Active Frequency Symbols



Configuring the Main Menu Options (Right Pane of the Screen)

Signal Process Menu

Scan

- **Depth Range:** Choose an investigation depth. Preset depth options are available and paired for each antenna frequency.
- **Dielectric Constant:** Enter the Dielectric of the soil if known (See Appendix C for more Dielectric information).
- **Soil Type:** Choose a basic soil type from a menu of preset types. Each of these has an associated dielectric value.
- **Scan Density:** Possible choices are: Normal (18/ft or 50/m) and High (36/ft or 100/m).
- **Autosave:** The system will automatically save each file if this is turned on. When off, the system will prompt you to save/discard.

Gain Settings

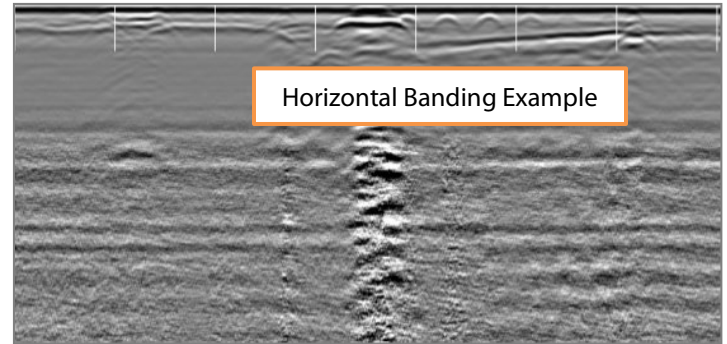
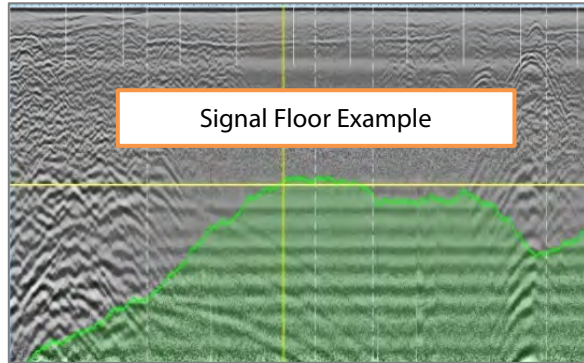
- Gain Mode
 - Auto: Allows the system to adjust the Gain Curve (red line seen in the O-Scope view) automatically based on the quality of the GPR signal.
 - Manual: Allows you to adjust the Gain Curve.
- Number of Points
 - Number of Gain Points or “Individual Sections” to adjust the Gain Curve.
 - Ranges for 1 point to 8 points.
- GP 1-8 (dB)
 - If Manual Gain Mode is selection, adjust each Gain Point accordingly.
 - Values range from -42 to 126.

Note: Tap on the double arrows (up or down) to display the appropriate gain points.



Filters (See Appendix C for more information)

- **Stacking (scans):** To reduce random or high frequency noise (static or fuzz) in your data. This value should be set low (3-5). The system will average together that number of scans and output the average value.
- **Background Removal (scans):** Remove horizontal banding in your data. This value should be set very high. The system will remove flat bands in the data of that many scans or higher.
- **Signal Floor:** Shows a visual indicator of noise levels. The shaded green area indicates an area of degraded signal in which some target types (weak reflectors) may not be readily visible.



- **Migration:** Allows the computer to estimate a dielectric constant by examining the shape of the hyperbolas.
- **Hilbert Transformation:** Change all migrated targets from having a negative and positive polarity to just positive polarity. Good for giving an idea of the strength of the reflection.



LineTrac (Optional Accessory)

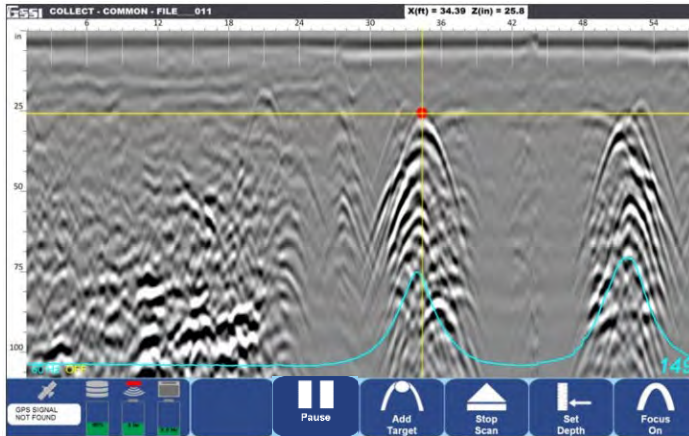
LineTrac employs a three-axis 50/60 Hz magnetometer that is used to locate powered and non-powered utilities.

LineTrac can be run in two ways:

- **Power Mode:** This sensor detection the electromagnetic field generated by flowing AC current. You will need to set LineTrac to detect either 50 Hz or 60 Hz. Note that Power mode will only detect flowing current, so make sure that the device attached to the line you are tracking is switched on and drawing current. The Power mode signal will be displayed in blue. The peak of the curve indicates the utility's position.
- **Frequency Mode:** This mode detects a line with a given radio frequency signal “piggybacked” on them. It is designed to work with common, widely available transmitters (not included). Clip the transmitter to the metallic utility, the utility's tracer wire, or non-contact induce the signal as you would with a standard line locator. Select the matching frequency from the LineTrac menu. The Frequency mode will be displayed in yellow. The detected target's position will be in the valley between the two peaks (see images on the following page).

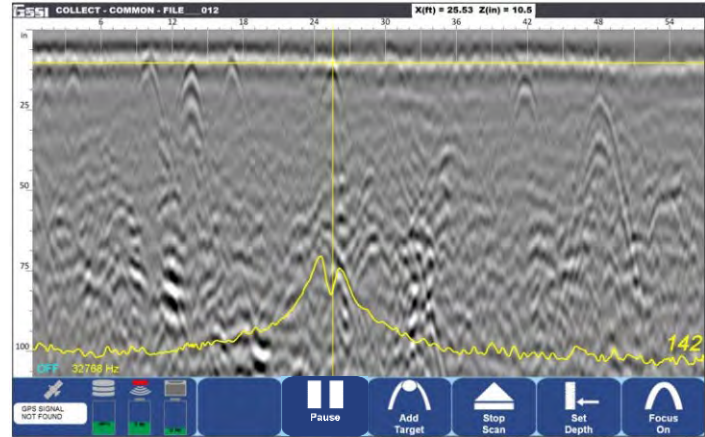
Note that the LineTrac sensor is positioned slightly forward of the GPR antenna's center position so the target's signal in LineTrac will be slightly offset with the GPR's detected location.

Power Mode



Data illustrates two power lines entering a large commercial building.

Frequency Mode



Data illustrates a small electrical conduit buried among multiple tree roots. Crosshairs indicates conduit position

 **Maintenance**

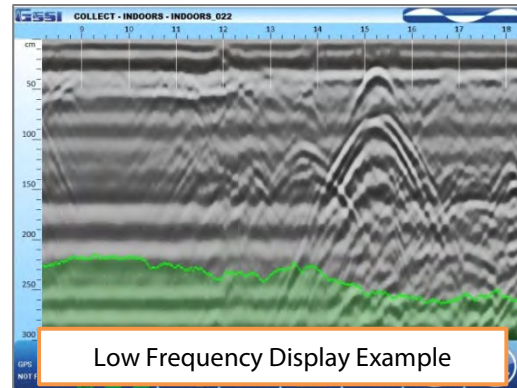
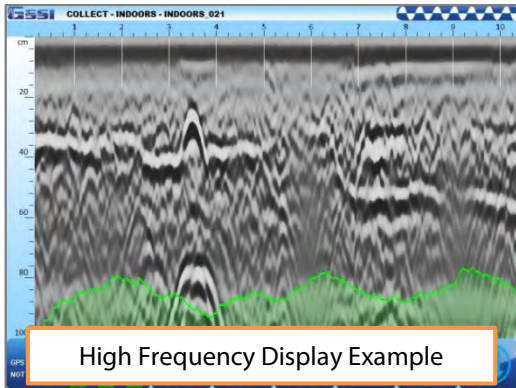
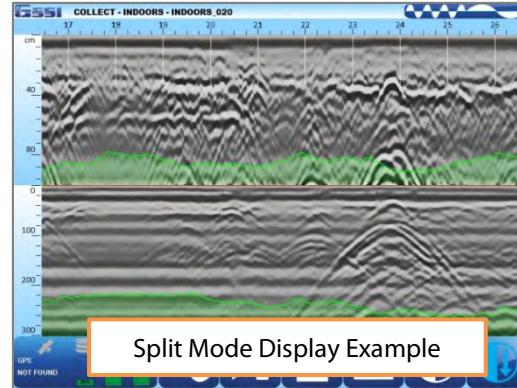
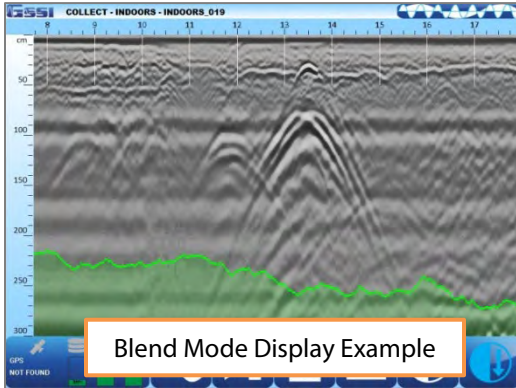
- Calibrate Survey Wheel (SW): Selecting this option will bring up the survey wheel calibration window. GSSI recommends calibrating the survey wheel before performing a survey.
- 1** Select calibration distance using the up/down arrow buttons.
 - 2** Position Antenna on the Start Mark.
 - 3** Click START button
 - 4** Move Antenna to Stop Mark. Take care to ensure that the portion of the antenna which began at the start mark is the same portion which ends at the stop mark. Press the Stop button.
 - 5** You will see the new calibration value displayed at the bottom of the screen. It will be negative for the 3-wheeled cart and positive for the 4-wheeled cart. Tap on Accept.
- Configure GPS: Select this option to configure this system with your GPS. See Appendix D for GPS configuration instructions.
 - Set Time: Select this option to set the system Date and Time.

Output Options Menu



Display:

- Color Table: Select from one of ten available color schemes.
- Color Stretch: This feature changes the distribution of the color values along the amplitude scale, yet still preserves the color of zero amplitude in the middle of the color bar. Positive values are good for accentuating weaker targets while negative values will accentuate strong targets.
- Color Slide: This feature shifts the color value distribution along the amplitude scan and changes the location of the color associated with zero amplitude. Positive values shift the distribution to the right (more positive), negative values to the left (more negative).
- Dual Channel
 - Split: Both channels to be displayed separately with individual scales.
 - Blend: Both channels are blended together. The high frequency data is displayed at the top and the lower frequency data is on the bottom.
- Blend Mode
 - Manual: Select from a shallow, medium, or deep location to blend the high and low frequency data.
 - Auto: Blending is automatically set based on the amount of noise and varies as the data quality varies.
- Vertical Scale
 - Equal: Scales are equal and split the Data View in half.
 - Real: Scales are set based on the antennas selected depth range.





Manage Files:

- Data Path: Change the Data Path where you would like the data to be saved or opened for Playback Mode. This will also allow you to create a new data path.
- Copy to USB Device: Copies the data from the Data Path to the USB device.
 - Opens a File Explorer to choose which files to copy to a USB drive.
 - Select files to copy and press the Check icon to copy. The File Explorer will close and a grey bar will appear at the top of the screen. When the copy is complete the grey bar will disappear and the Folder Name and File Name will reappear.
- Move to USB Device: Copies the data from the Data Path **AND DELETES** those files from the Toughpad.
 - Opens a File Explorer to choose which files to move to a USB drive.
 - Select files to remove from the Toughpad and place on the USB drive. Press the Check icon to move. The File Explorer will close and a grey bar will appear at the top of the screen. When the move is complete the grey bar will disappear and the Folder Name and File Name will reappear.
- Delete Files: Delete files from the Toughpad.
 - Opens a File Explorer to choose which files to delete from the Toughpad.
 - Select files to remove from the Toughpad and press the Check icon. The File Explorer will close and a grey bar will appear at the top of the screen. When finished deleting the files the grey bar will disappear and the Folder Name and File Name will reappear.

**Units/Scale:**

- Depth Scale
 - Depth: Display the vertical scale in distance units.
 - Time: Display the vertical scale in time units.
- Depth Units: Select the unit of measurement for Depth or the vertical scale.
- H-Scale Density: Select whether to display the horizontal scale during data collection with either Low, Medium, or High density of minor ticks.

System Options Menu



System Shut Down

- Exit: Close Application and return to Start Screen.
- Power Off: Close Application and Shut Down the System (power off). This will power off the antenna as well.
- Return to Application: Discard Shutdown Request and return to Setup Screen.



Versions: Displays Version information for the software and firmware.



User Interface

- Language: Set Language.
- Button Design: Label, Symbol, or Combo
- Brightness Up or Down: Set contrast up or down.



Save Setup: Save a current configuration for future use.



Recall Setup: Recall a saved configuration.

Sub Menu Options (Bottom Pane of the Screen)



Stop/Preview Scan: This will turn the antenna off and on.
When on, test data will continuously scroll across the screen.



Reset Gain: Reset the display gain for optimal viewing.



Active Channel: Toggle between the following modes.

- High Frequency
- Low Frequency
- Split/Blend: Based on which display is selected under Output Options – Display



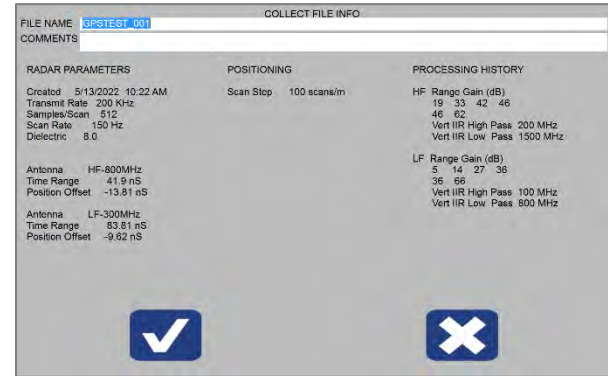
Start Scan: Begin to collect data.



Playback Mode: This will take you to playback mode if you wish to view saved data.



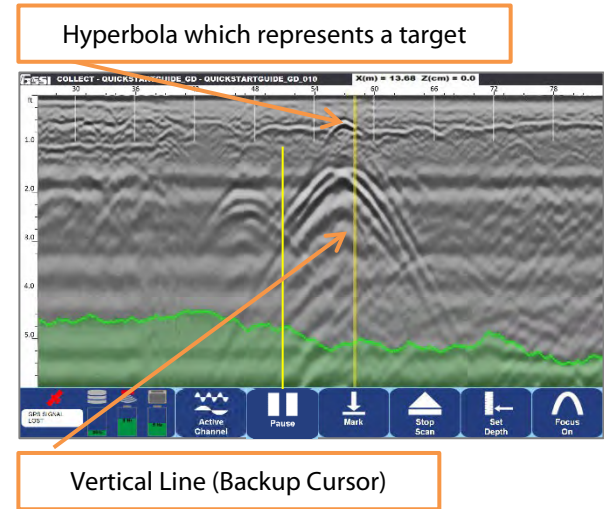
File Info: Information about the file. File names can be changed here as well.
All files will have a sequential number added to the end of the name.



File Information Window

Collecting 2D Data

- 1** Begin data collection by pressing Start Scan and moving the cart forward.
Data gets collected only when the cart is moving forward.
- 2** Data will fill the screen from left to right and begin scrolling.
- 3** After a feature is visible on the screen, pull the system straight back along your survey line. A vertical line (the backup cursor) will appear on the screen that corresponds with the center of the antenna. When the vertical line is over the top of a feature, the center of the antenna is also over the feature.
- 4** Using the two marks on the side of the cart or the antenna as reference points, mark the ground at each side of your cart. Then move the cart out of the way and place an “X” between the two marks.
- 5** After backing up new data will not be collected until the cart is moved past the spot where you began to reverse.



While the cart is moving forward and adding new data, the bottom menu bar will appear as:



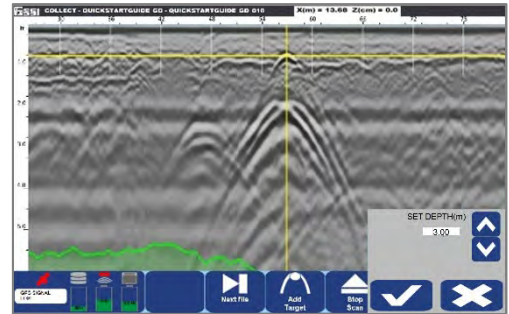
- Active Channel: Toggle between High, Low, Split, and Blend frequency displays
- Pause/Resume: Pauses or resumes data collection in the current file.
- Mark: Adds a user mark (vertical, dashed line) at the current location.
- Stop Scan: Stops collecting the current file.
- Gain Up/Down: Changes the display gain (screen contrast).


Set Depth, Focus Data, and Add Target



Enter a known depth or perform a velocity test on the data to estimate a dielectric value and get more accurate depth estimates. Also, add a color-coded icon to a hyperbola to identify a known target. The icons for Set Depth, Focus On, and Add Target appear at the bottom when the system is backed up.


Set Depth: Can be used with Migration turned on or off from the Signal Process – Filters Menu.

- 1 Using the stylus pen, place the horizontal line at the top of a feature at a known depth.
- 2 Tap Set Depth.
- 3 Input the correct depth and accept. This will change the dielectric value and update the vertical scale.

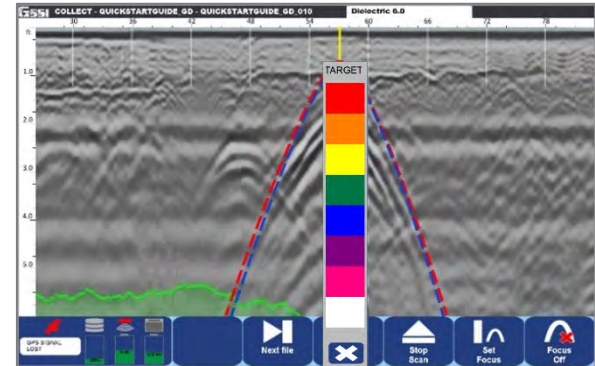
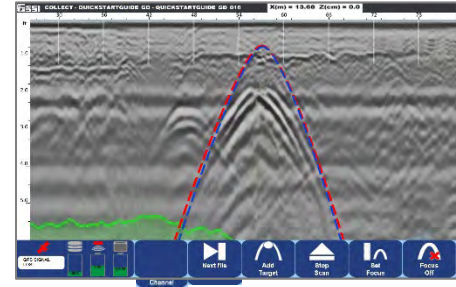


 **Focus On:** Only available when Migration is turned off.

- 1 Using the stylus pen, place the cross-hair on a hyperbola.
- 2 Tap Focus On. A vertical slider will appear to the right of the data.
- 3 Using the stylus pen and the vertical slider, match the Focus On hyperbola with a hyperbola on the screen.
- 4 Select either Set Focus or Focus Off:
 -  Set Focus to accept the hyperbola. This will change the dielectric value.
 -  Focus Off to cancel this process.

 **Add Target:** Only available when both horizontal and vertical cursors are visible.

- 1 Using the stylus pen, place the cross-hair on a hyperbola.
- 2 Tap Add Target. A vertical color tablet will appear.
- 3 Select the desired color that matches the known or potential use of the target.

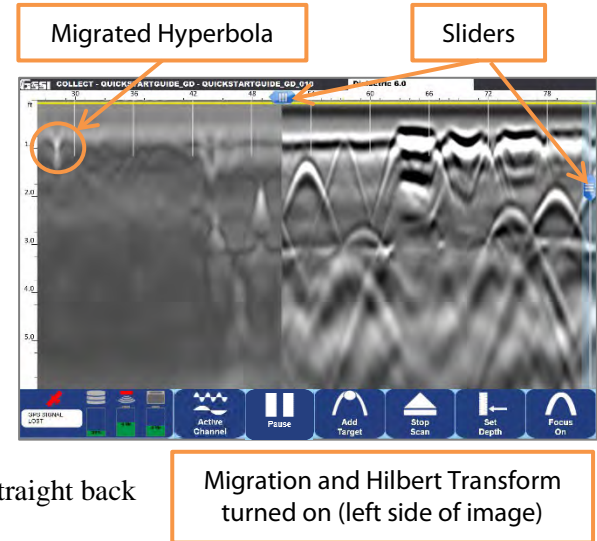


Migration & Hilbert Transform (Focus)

Use Migration during Collect or Playback Mode to estimate a dielectric value. When Migration is turned on two sliders appear on the right and top of the screen and a Migration window is placed over the data.

Turning on Hilbert Transform will change the migrated data so that all the reflections have a positive polarity and may be easier to identify. Migration can still be performed without turning Hilbert Transform on.

- 1 Turn Migration or Hilbert Transform On from the Signal Process – Filters Menu.
- 2 Start Scan to begin collecting data.
- 3 Once hyperbolic reflections appear on the screen, pull the system straight back along your survey line.
- 4 When the system is backed up two sliders appear on the screen.
 - Move the top slider to the left or right to change where real time migration window appears on the screen.
 - Move the right cursor up or down to adjust the dielectric value.
- 5 Begin pushing the system forward again to collect data with the new dielectric value and migration view.



2D Data Playback Mode

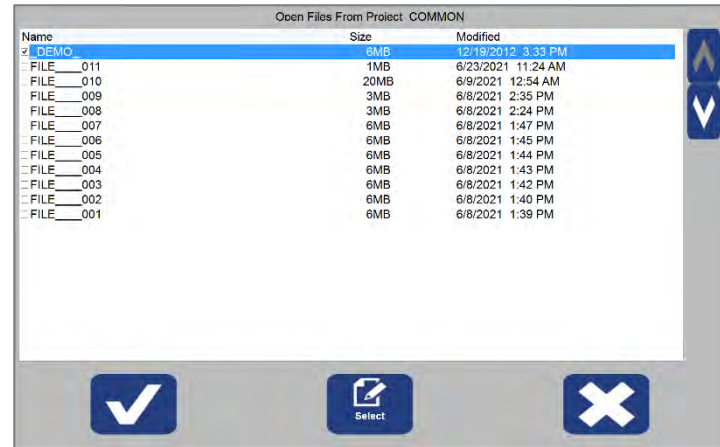
You can access the Playback Mode by selecting Playback from the bottom menu bar or selecting Playback Only from the intro screen. The Playback Only Mode allows you to view and edit data previously collected and saved. The antenna does not need to be connected to run this mode.

After selecting Playback Only, choose which file to review.

- Tap on the arrows and select a file or files.
- Tap on Accept to continue to the Playback Setup screen.

During playback you can perform all the following functions:

- Pause, move Backward, move Forward, select Next File (if multiple files were originally selected), or Stop Playback.
- Add vertical User Marks.
- Set Depth or turn Focus On to estimate the dielectric value.
- Adjust Display Gain.
- Select Active Channel or which frequency to display.



Sub Menu Options (Bottom Pane of the Setup Screen)



Preview File/Stop: Preview file. This will toggle between Preview File and Stop.



Reset Gain: Reset the display gain for optimal viewing.



Select File: Select another file to playback.



Playback File(s): Displays the data in whichever display is currently selected (High, Low, Split, or Blend). See next section for options during Playback.





Collect Mode: This will take you to collect mode if you wish to collect data.



File Info: Information about the file.

PLAYBACK FILE INFO		
FILE NAME: _DEMO_		
COMMENTS		
RADAR PARAMETERS	POSITIONING	PROCESSING HISTORY
Created: 12/19/2012 12:32 PM	GPS Type: CUSTOM	HF Range Gain (dB): -11 23 35 38
Samples/Scan: 512	Scan Step: 100 scans/m	42 52 68
Scan Rate: 150 Hz		Vert IIR High Pass: 200 MHz
Dielectric: 4.0		Vert IIR Low Pass: 1500 MHz
Antenna: HF-800MHz		LF Range Gain (dB): 9 21 21 31
Time Range: 44.44 nS		33 52 66
Position Offset: -10.31 nS		Vert IIR High Pass: 200 MHz
		Vert IIR Low Pass: 1500 MHz
Antenna: LF-300MHz		
Time Range: 74.07 nS		
Position Offset: -9.29 nS		

Playback File(s) Options

Depending upon the type of display you selected under Output Options, the data will initially display in the same mode (High, Low, Split, or Blend).

Displayed at the top of the screen:

- The current mode, Collect or Playback.
- The name of the folder and file.
- The location of the cross hair (X for distance, Z for depth). Place the stylus pen on the screen to move the cross hair to the desired position.

Menu Options at the Bottom of the Screen



Backward: Scroll the data towards the beginning of the file.

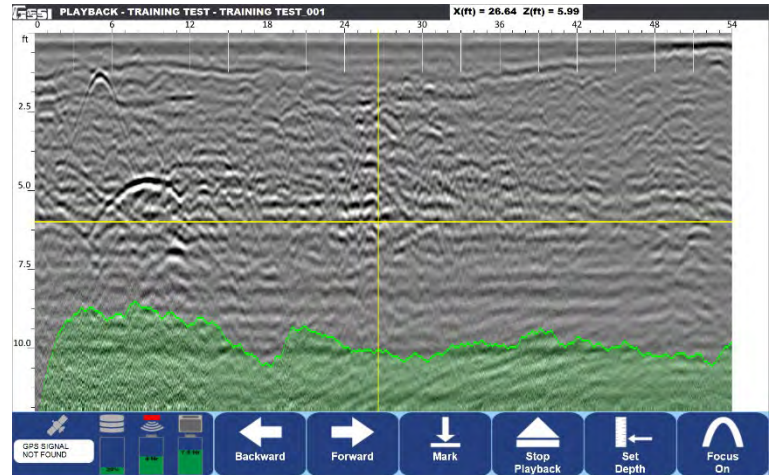


Forward: Scroll the data towards the end of the file.



Mark: Mark the data for reference points.

- 1 Place the stylus pen on the screen.
- 2 Move the pen around and place the vertical line where you would like the mark to be placed.
- 3 Tap the Mark Icon.



In this example, the Noise Indicator is turned on, as indicated by the green shaded area.



Stop Playback: Return to the Playback Setup Screen.



Set Depth: Input a known depth to the data. This will update the dielectric value accordingly.

- 1 Place the stylus pen on the screen.
- 2 Move the pen around and place the horizontal line at the known depth.
- 3 Tap the Set Depth Icon.
- 4 Enter and accept the known depth.



Focus On: Turns on Focus Mode to adjust the Dielectric Constant and get more accurate depth estimates.



Pause: Pauses playback.



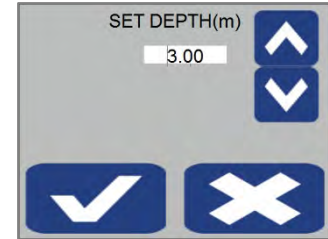
Next File: If multiple files were selected for playback this will advance through them in sequence.



Active Channel: Toggles between the High Frequency, Low Frequency, or Split/Blend data.



Gain Up/Down: Adjusts the Display Gain.



Section 3: 3D Data Collection and Playback

Select 3D Mode from the Introduction Screen. You can do this by clicking the mode button.

New Project Mode will allow you to configure the system as desired for a new project or continue with an old project.

Last Project Mode will bypass the Folder selection screen and continue with the last project with all its settings from the last project. In this mode, you still can make changes to the settings.

In either mode, the options are the same.

After selecting New Project, select which folder you would like to save your data to, or create a new folder for a new project.



Setting up 3D Collection

Signal Process, Output Options, and System Options

Go through the regular steps for 2D data collection as described in the previous section.

3D Mode - Config Grid

Begin by configuring the size of the grid and separation of transects.

X – Start: Grid coordinate where data collection will begin in the X-Axis.

X – End: Grid coordinate where data collection will end in the X-Axis.

Y – Start: Grid coordinate where data collection will begin in the Y-Axis.

Y – End: Grid coordinate where data collection will end in the Y-Axis.

X – Line Spacing: Separation between transects collected in the X-Direction.

Y – Line Spacing: Separation between transects collected in the Y-Direction.

Collection Method (Bottom Pane)

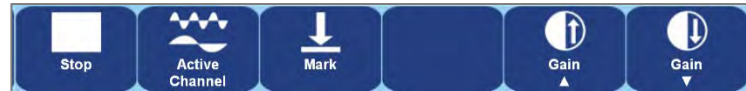
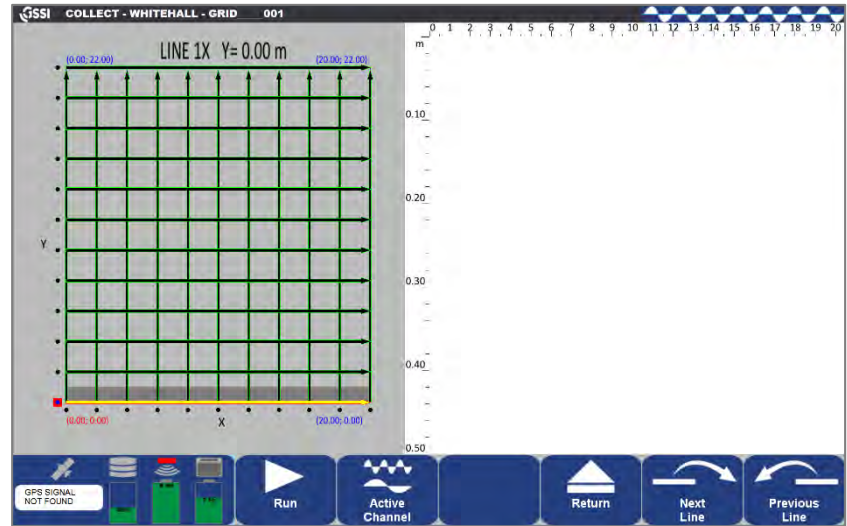
Toggle between Normal and Zig-Zag data collection for the X and Y directions.



The screenshot displays the UtilityScan DF software interface. At the top, the title bar reads "GSSI COLLECT - WHITEHALL - GRID 001". The main display area shows a grid with the text "SET GRID GEOMETRY (TOTAL LINES: 23 - MAXIMUM: 152)". The grid's top-left corner is labeled "(0.00, 22.00)" and the top-right corner is labeled "(20.00, 22.00)". The bottom-left corner is labeled "(0.00, 0.00)" and the bottom-right corner is labeled "(20.00, 0.00)". A red square is visible in the bottom-left corner of the grid. The interface includes a right-hand sidebar with several control buttons: "Signal Process" (0.00), "Output Options" (20.00), "3D Mode" (0.00), "System Options" (22.00), "X - START" (0.00), "X - END" (20.00), "Y - START" (0.00), "Y - END" (22.00), "X - LINE SPACING" (2.00), and "Y - LINE SPACING" (2.00). At the bottom, there is a row of buttons: "GPS SIGNAL NOT FOUND" (with a satellite icon), "Bottom Left" (with a grid icon), "Normal Scan" (with a horizontal arrow icon), "Normal Scan" (with a vertical arrow icon), "Start Scan" (with a play button icon), and "Return" (with a return key icon).

Collecting 3D Data

- 1** Once finished setting up the 3D grid press Start Scan. This opens the 3D collection screen.
- 2** Ensure that the cart is located so that the center of the antenna is over the starting corner and headed in the direction of the yellow arrow shown on the 3D collection screen.
 - The center of the antenna corresponds with the raised marks on the sides of the cart.
- 3** By default, the system starts in the X-direction when collecting data in both the X and Y Directions.
- 4** With the cart in position press the Run button.
- 5** Move the cart forward to the other end of the grid. The bottom pane will change offering different options.
- 6** When the cart travels the distance of the line specified during setup collection will automatically end.



- 7** Position the cart at the start of the next line. Press the Run button and move the cart to the end of the line where it will again end data collection automatically.
- 8** Continue Steps 4-7 until you've finished collecting in the first direction.
- 9** If collecting in two directions, then position the cart back at the starting corner and pointed up the Y-Axis. Repeat Steps 4-7.
- 10** Once finished collecting both directions of data press 3D Playback Mode. This will process the current data and return to the Playback Setup Screen.

Options during 3D Data Collection

Ending a Profile Early

During data collection a line can be ended early if there is an obstacle than can't be maneuvered around.

- 1 Move the cart forward as far as it will go along the line.
- 2 Press Stop to end data collection.
- 3 Press Next Line to advance to the next profile in the grid.

Collecting Around an Obstacle

If an obstacle is in the middle of a line data can be collected on either side of it. This only works with one obstacle per profile.

- 1 Move the cart forward as far as it will go along the line.
- 2 Press Stop to end data collection.
- 3 Move the cart to the other side of the obstacle.
- 4 Press Add Segment to restart the profile.
- 5 Move cart to the end of the grid and stop when the antenna is centered over the end of the grid.
- 6 Press Stop to end data collection. The second half of the file will automatically be repositioned so that the end of the profile corresponds to the edge of the grid.



Skipping a Profile(s)

An entire profile, or profiles, can be skipped during data collection by pressing Next Line once or repeatedly.

Adding a User Mark

A User Mark can be added to the data during data collection.

- Begin collecting a profile.
- Back up the cart to position the vertical cursor over a hyperbola you want to mark. Drag the horizontal cursor to form a cross-hair over the hyperbola.



Adding a Target

A color-coded target can be added to the data during data collection.

- Begin collecting a profile.
- Back up the cart to position the vertical cursor over a hyperbola of known quantity. Drag the horizontal cursor to form a cross-hair over the hyperbola.
- Press Add Target and select the color of the target you would like to add to your data.



Recollecting a Profile(s)

If an error was made during data collection and you know where it occurred that data can be recollected.

- Use Next Line or Previous Line to move around the 3D grid until located at the profile(s) to be recollected.
- Line up the antenna and press Run to recollect the profile.
- The new profile will replace the earlier profile automatically.



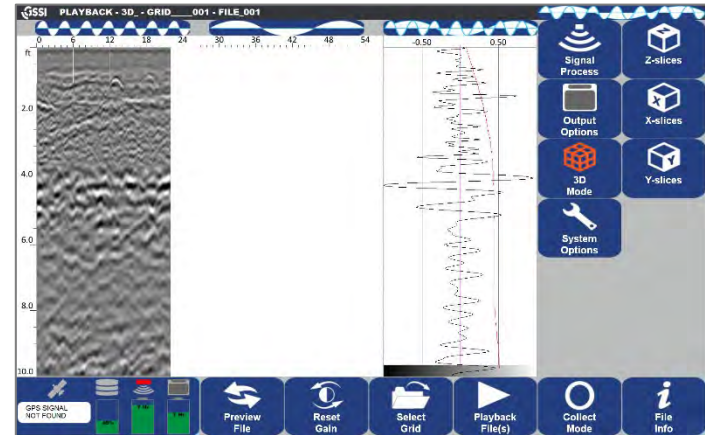
Changing the Data Display (Active Channel)

During data collection press Active Channel to toggle between frequencies and Split/Blend data views.

Playback 3D Data

The Playback Only Mode allows you to view and edit data previously collected and saved. The antenna does not need to be connected to run this mode.

- 1 After selecting Playback Only from the intro screen, choose which 3D Grid from the last selected project to review.
 - Tap on the Arrows and select a grid.
 - Tap on the Check to select the grid and continue to the Playback Setup screen.
- 2 During playback you can perform all the following functions:
 - Slice in the X, Y, or Z (depth) axis and adjust thickness.
 - Perform a Migration and Hilbert Transform.
 - Change the Dielectric Constant, Soil Type, and Display Gain.
 - Set Depth or turn Focus On to estimate the dielectric value.
 - Select Active Channel or which frequency to display.
 - Add vertical user Marks.
 - Pause, move Backward, move Forward, select Next File (if multiple files were originally selected), or Stop Playback.



Main Menu Options (Right Pane of the Screen)

The Signal Process, Output Options, and System Options work the same way in 3D mode as in 2D mode. Please review Section 2 for details.

3D Mode Menu

Z – Slice: Processes the current grid and displays a top down view of the area surveyed.

- **Start and End Position:** This is the range between which the slices will scroll automatically when Animate is turned on from the bottom pane.

When Z-Slice is selected two sliders appear above and to the right of the data.

- **Slice Thickness:** Slider to the right of the data. By moving the slider up and down the slice thickness changes. This will show you a greater thickness of the data in one image and may result in targets of different depths showing on the same image.
- **Slice Position:** This is the depth of the current slice and corresponds with the slider at the top of the data. Move the slider from left to right to look for deeper features.
- **Animate:** When turned On this will automatically moves through the Z-slices starting from the current location and moving shallower.



X – Slice: Processes the current grid and displays profiles sliced in the X direction that were collected in the Y direction.

- **Start and End Position:** This is the range between which the slices will scroll automatically when Animate is turned on from the bottom pane.
- **Slice Position:** This is the location of the current slice and is adjusted by moving the slider at the top of the data.

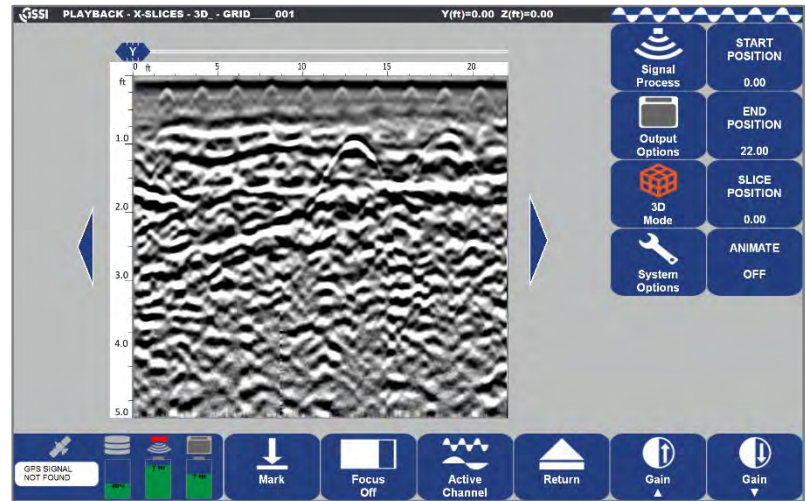
Y – Slice: Processes the current grid and displays profiles sliced in the Y direction that were collected in the X direction.

- **Start and End Position:** This is the range between which the slices will scroll automatically when Animate is turned on from the bottom pane.
- **Slice Position:** This is the location of the current slice and is adjusted by moving the slider at the top of the data.







Cube View: Displays a cube in the top left corner of the data showing the current slice position and thickness. Once turned on it will appear in either the Z-, X-, or Y-slices.

- This option is only accessible once the 3D data are displayed in either the Z-, X-, or Y-slices.



Grid Info: Displays information about the 3D file including Grid Parameters.



Sub Menu Options (Bottom Pane of the Setup Screen)

-  **Preview File/Stop:** Preview individual profiles. Data will begin scrolling through of each profile collected in the 3D grid. Use Stop to end the current scroll and begin back at the first profile.
-  **Reset Gain:** Reset the display gain for optimal viewing.
-  **Select Grid:** Select another grid from the current project file to playback.
-  **Playback File(s):** Displays the data in whichever display is currently selected (High, Low, Split, or Blend). See next section for options during Playback.
-  **Collect Mode:** This will take you to collect mode if you wish to collect data.
-  **File Info:** Information about the file.

FILE NAME FILE_001		PLAYBACK FILE INFO	
COMMENTS			
RADAR PARAMETERS		POSITIONING	PROCESSING HISTORY
Created	10/29/2021 11:44 AM	Scan Step	18 scans/ft
Samples/Scan	512		HF Range Gain (dB)
Scan Rate	150 Hz		1 36 53 60
Dielectric	14.0		65 66 66 66
			Vert IIR High Pass 200 MHz
			Vert IIR Low Pass 1500 MHz
			Horz IIR Stacking TC = 3
Antenna	HF-800MHz		LF Range Gain (dB)
Time Range	42.24 nS		8 95 52 55
Position Offset	-10.28 nS		55 55 64 66
			Vert IIR High Pass 100 MHz
			Vert IIR Low Pass 800 MHz
			Horz IIR Stacking TC = 3
Antenna	LF-300MHz		
Time Range	84.48 nS		
Position Offset	-10.28 nS		

Playback File(s) Options

Depending upon the type of display you selected under Output Options, the data will initially display in the same mode (High, Low, Split, or Blend).

Displayed at the top of the screen:

- The current mode, Collect or Playback.
- The name of the folder and file.
- The location of the cross hair (X for distance, Z for depth). Place the stylus pen on the screen to move the cross hair to the desired position.

Menu Options at the Bottom of the Screen



Backward: Scroll the data towards the beginning of the file.

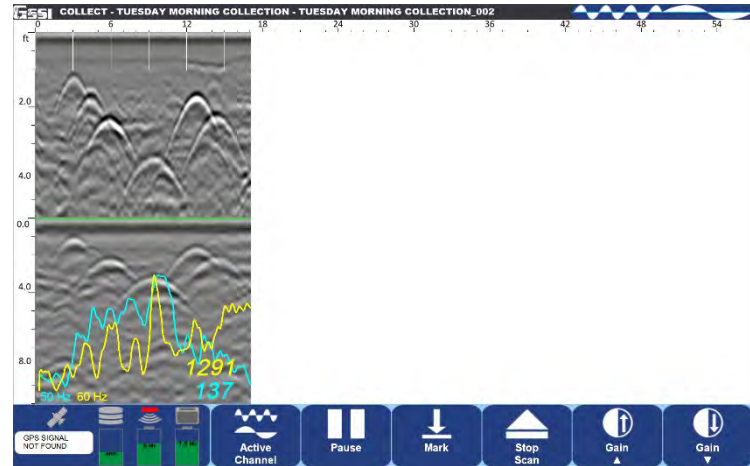


Forward: Scroll the data towards the end of the file.



Mark: Mark the data for reference points.

- 1 Place the stylus pen on the screen.
- 2 Move the pen around and place the vertical line where you would like the mark to be placed.
- 3 Tap the Mark Icon.



In this Split example, LineTrac is turned on, as indicated by the blue and yellow lines.

Focus: Use Focus during Playback Mode to estimate a dielectric value. This option is only available when displaying the X- or Y-slices. This turns on the Migration and Hilbert Filters from the Signal Process menu.

- 1 Turn Focus On and adjust the percent of coverage. You can either Focus 24%, 50%, 75%, or 100% of the X- or Y-slices.
- 2 Move the Dielectric slider to the right of the data up or down to adjust the Dielectric Constant. You will see the value change at the very top of the screen.
- 3 Obtaining a better Dielectric Constant is done by moving the vertical slider until the hyperbolic reflections become dots or vertical bars. See Appendix C for more information.
- 4 The new Dielectric Constant is automatically applied to all of the profiles in the 3D grid.



Stop Playback: Return to the Playback Setup Screen.



Set Depth: Input a known depth to the data. This will update the dielectric value accordingly.

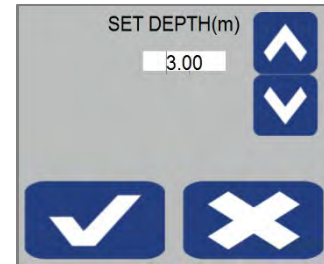
- 1 Place the stylus pen on the screen.
- 2 Move the pen around and place the horizontal line at the known depth.
- 3 Tap the Set Depth Icon.
- 4 Enter and accept the known depth.




Focus On: Turns on Focus Mode to adjust the Dielectric Constant and get more accurate depth estimates.



Pause: Pauses playback.



 **Next File:** If multiple files were selected for playback this will advance through them in sequence.

 **Active Channel:** Toggles between the High Frequency, Low Frequency, or Split/Blend data.

 **Gain Up/Down:** Adjusts the Display Gain.

Appendix A: Dielectrics of Common Materials (Soil Conditions)

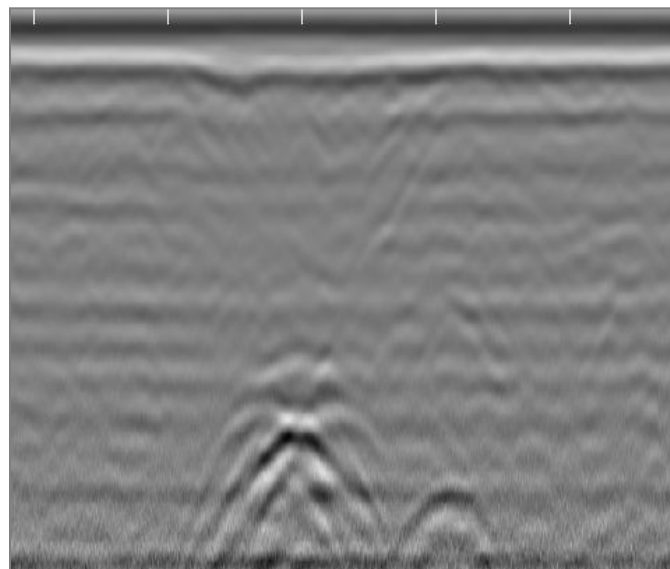
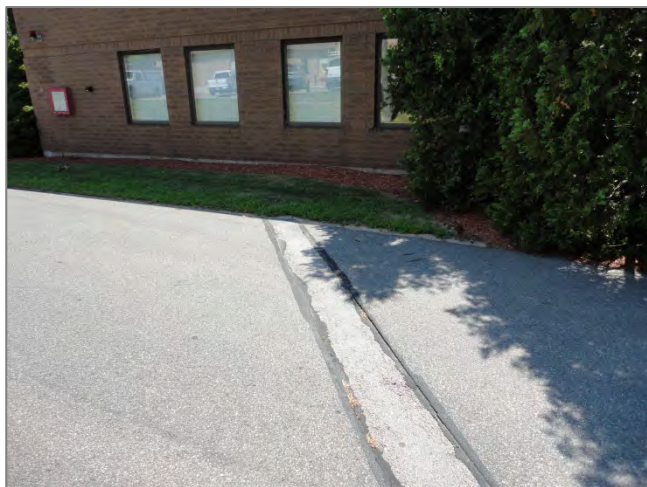
Material	Dielectric Constant	Material	Dielectric Constant
Air	1	Wet Granite	6.5
Snow Firn	1.5	Travertine	8
Dry Loamy/Clayey Soils	2.5	Wet Limestone	8
Dry Clay	4	Wet Basalt	8.5
Dry Sands	4	Tills	11
Ice	4	Wet Concrete	12.5
Coal	4.5	Volcanic Ash	13
Asphalt	5	Wet Sands	15
Dry Granite	5	Wet Sandy Soils	23.5
Frozen Sand & Gravel	5	Dry Bauxite	25
Dry Concrete	5.5	Saturated Sands	25
Dry Limestone	5.5	Wet Clay	27
Dry Sand & Gravel	5.5	Peats (saturated)	61.5
Potash Ore	5.5	Organic Soils (saturated)	64
Dry Mineral/Sandy Soils	6	Sea Water	81
Dry Salt	6	Water	81
Frozen Soil/Permafrost	6		
Syenite Porphyry	6		
Wet Sandstone	6		

Appendix B: Examples of Some Common Objects

These examples are presented for informational use only. The images that you see on your own site conditions may vary.

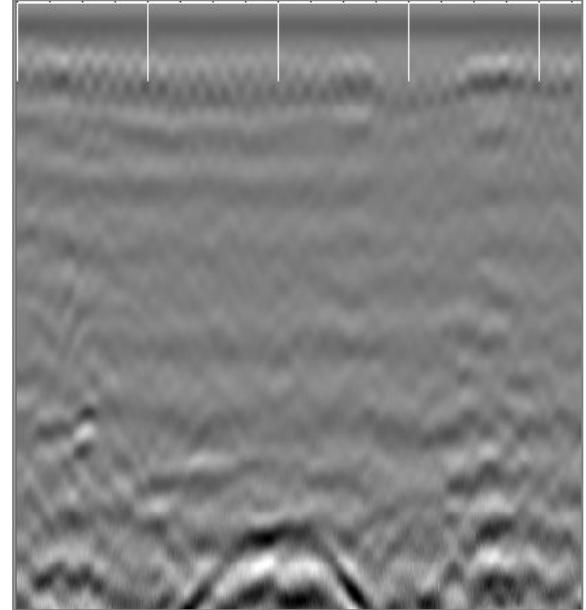
Example 1

This data shows a bank of conduits feeding into an industrial building. Note the dipping edge of a trench cut to the upper left of the conduits.



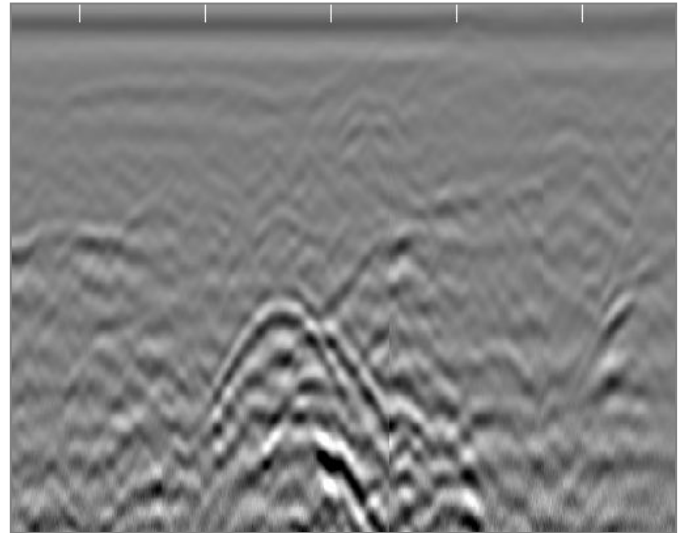
Example 2

This image shows a drain line coming out of a restroom. Also note the mesh at the top of the screen.



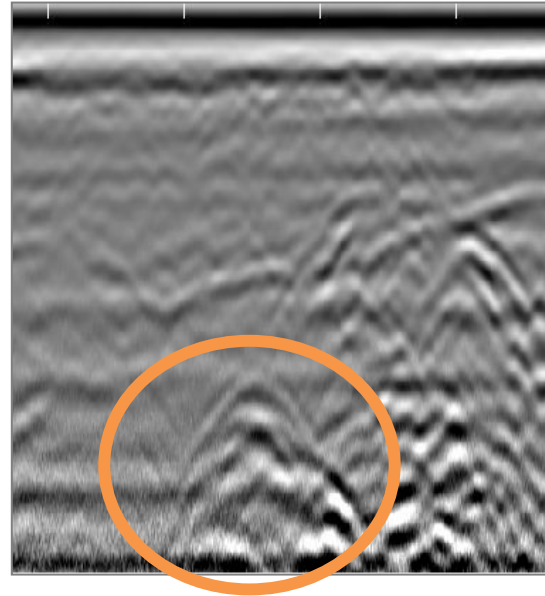
Example 3

This image shows data collected across a driveway, and the location of a conduit from the telephone pole to an industrial building.



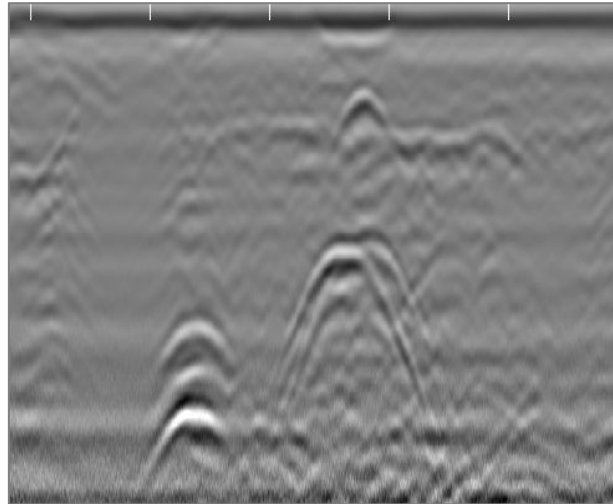
Example 4

This image shows data collected along a driveway next to a business. This shows a concrete culvert with a cable running through it.



Example 5

This image shows a gas line and communication cables (Fiber Optic) going across a driveway.

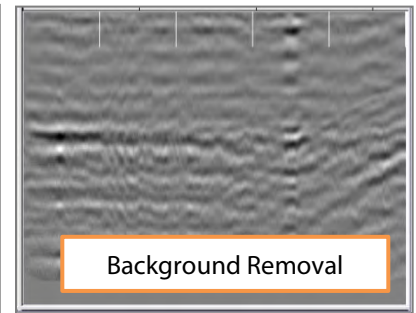
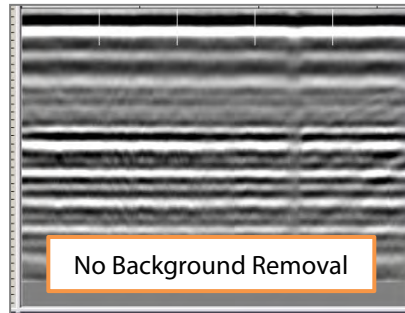


Appendix C: Glossary of Terms

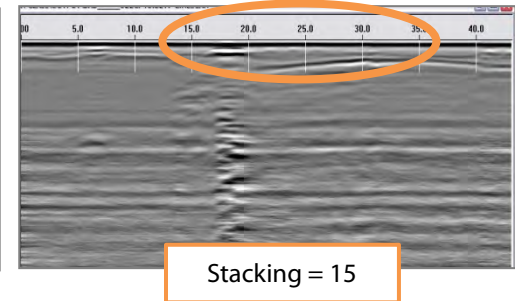
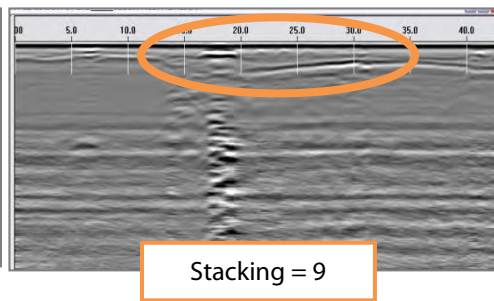
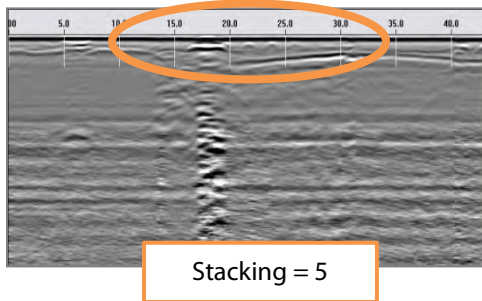
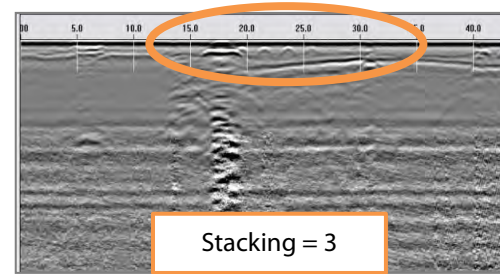
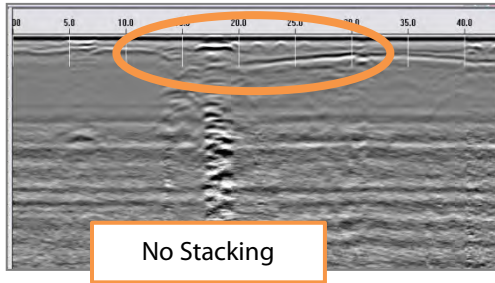
Dielectric: A value assigned to materials and is used to calculate the velocity of RADAR in that material. RADAR will travel at different speeds depending upon the material and/or soil condition. RADAR travels fastest in air (dielectric = 1) and slowest in water (dielectric = 81). Everything else falls somewhere in between. It is important to know the dielectric value of a material so that the depth of a target can be calculated. Since determining dielectric is a best guess estimate, the depth of a target will never be an exact measurement. As a safety feature, you will always give about a 1 foot (or about 1/3 meter) margin of error when estimating the depth of a target.

Filter: A process to remove unwanted noise in the data so that targets can be seen more clearly. Filtering is a trial and error process; therefore, trial runs are necessary using different filtering values to determine the best configuration for a job site. There are two types of filtering:

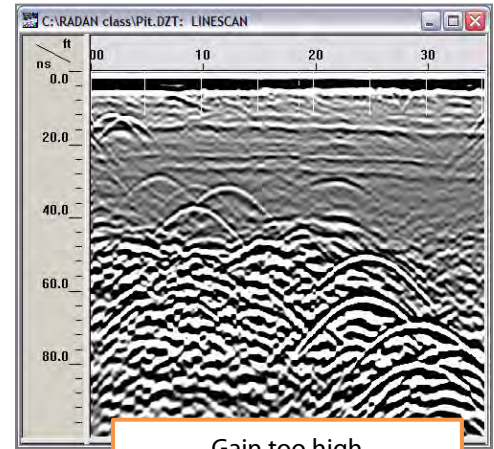
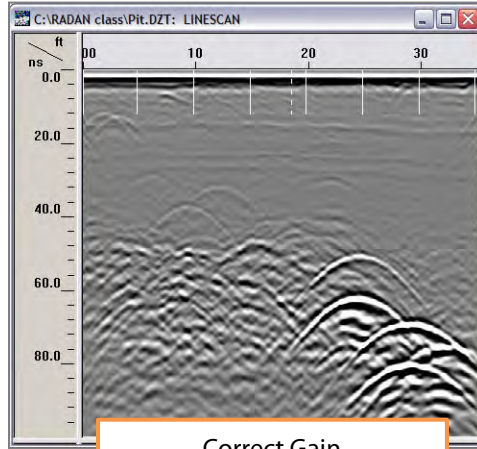
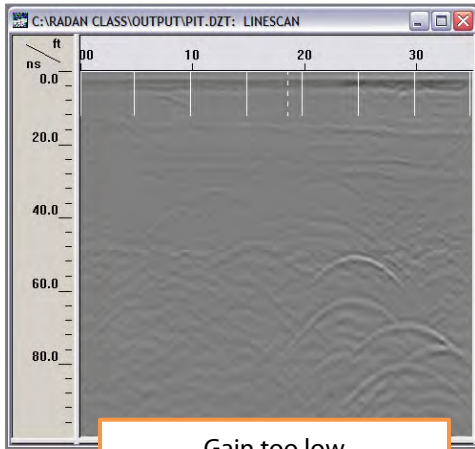
- **Background Removal:** This filter will remove unwanted noise that looks like horizontal banding across your data. Using this process, this will remove data that is consistent throughout your data. To avoid removing horizontal features of interest this filter should be set higher than the target feature length times the number of scans/unit.



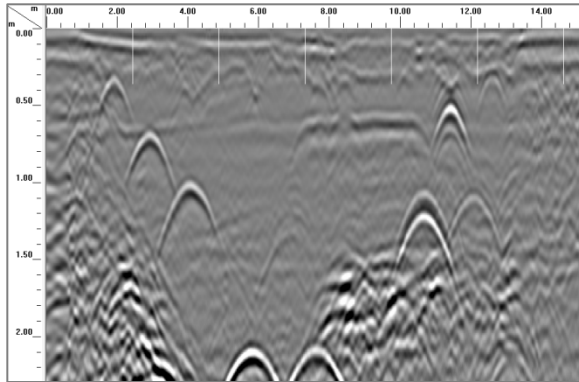
- **Stacking:** This filter will remove unwanted noise that looks like fuzziness in your data. By selecting a value of 3, 5, 9, or 15, the process will take each scan and replace that scan with the average values of the surrounding scans. Be aware that too much stacking can filter out real targets. In this example, stacking of 3 is the best result. Targets at the top begin to disappear with higher scans to average.



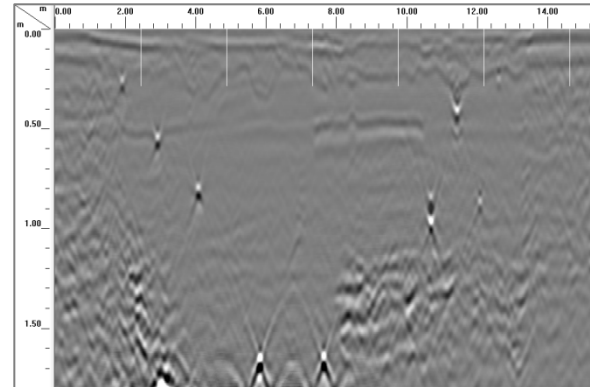
Gain: Adding or subtracting Gain from data will amplify or lower the image of the RADAR signals. It is advised that you use the lowest gain that will show targets.



Migration: Migration is a processing procedure that reduces or eliminates hyperbolic diffraction patterns in the data. It removed the tails of the hyperbolas to more accurately represent the location, and in some cases, the size of the target. This makes the recognition of point reflectors much easier, especially in 3D surveys in which the goal of the survey is to locate linear features such as pipes or rebar. Migration also offers a simple and accurate way of calculating the radar velocity (and thus dielectric) of the material your target is in from the shape of the hyperbolas.



Before Migration



After Migration

Appendix D: Connect and Configure GPS

The UtilityScan DF is designed to work with a wide variety of GPS units. In order to operate with the UtilityScan DF, your GPS must be able to output the NMEA GGA string through a 9-pin serial port. The GPS data are saved in a separate file with the same root name as your GPR data file. A profile collected with GPS will thus have three files associated with it: FILE_001.DZT (RADAR data), FILE_001.DZX (filter and gain settings for the raw data), and FILE_001.DZG (GPS location info).

Hardware Setup

- 5 Attach the GPS receiver securely to the UtilityScan DF system.
- 6 Measure and make note of the offset of the GPS receiver from the GPR antenna.
- 7 Plug the serial port from your GPS into the GPS port on the top of the dual frequency antenna.

Configure GPS

- 1 Select Signal Process – Maintenance.
- 2 Select Configure GPS. Five options will appear on the screen. Change these settings to match the settings on your GPS.
- 3 Click Accept or check.

GPS SERIAL PORT CONFIG	
BAUDRATE	9600
DATA BITS	8
PARITY	NONE
STOP BITS	1
HANDSHAKING	NONE



Check GPS Data Integrity

The UtilityScan DF performs a constant quality check on the incoming GPS stream. This is visible at the lower left-hand corner of the screen. The UtilityScan DF checks the HDOP once per second. A high quality HDOP, 2 or less, is required for the system to record GPS data.



HDOP \leq 2

- Latitude and Longitude are displayed.
- Data is being collected.



HDOP $>$ 2

- Data is being collected, but the accuracy is low.



Lost connection.



Connection was never established.

Transferring GPS files

A third file type (File_001.dzg) will be collected with each GPR data file. All of the files will be stored in the same project folder. Transferring the GPS files is automatically done at the same time as transferring the GPR data files.



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