ULTRA-TRAC® APL

ACOUSTIC PIPE LOCATOR

INSTRUCTION MANUAL

READ AND UNDERSTAND INSTRUCTIONS BEFORE USE

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Instruction Manual

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General Description

The Ultra-Trac® APL is an acoustic pipe locator designed to locate piping systems constructed of any material including (but not limited to): plastic, metal, clay, concrete, fiberglass, cast and ductile iron. The piping systems can also be located regardless of the type of surface above the pipe such as gravel, soil, grass, concrete or asphalt.

The Ultra-Trac® APL uses a highly specialized acoustic transducer (actuator) technology that requires coupling with the ground surface to send signals into the ground. Highly sensitive accelerometers sense the reflected energy. The data is processed and converted into easy to understand results on the display. There is no connection to the piping system required with the Ultra-Trac® APL.

The Ultra-Trac® APL is not affected by electrical fields or overhead power systems. The system incorporates noise filtering technology that eliminates false readings due to traffic or equipment that may be operating in the area of the test.

Safety and Care

- Follow your company and other applicable safety procedures when operating this device.
- Do not place this instrument in areas where live electrical power may be present.
- Do not open the housings at any time unless factory authorized to perform service.
- Do not use in the presence of hazardous gases or chemicals.
- Follow Federal, State and local regulations when disposing of any batteries.
- Do not immerse this product in water.
- Keep in the provided case when not in use or during shipping to reduce the chance of damage.

What is included:

- Ultra-Trac® APL with carrying case (926-00000-01)
- Recharging adapter (871-00029)
- Measuring tape (360-00342)
- Instruction Manual (750-00072)
- Quick Start Guide (750-00073)

Replacement Parts:

- Actuator plate (360-00326)
- Accelerometer housing (360-00320)
- Carrying Case (872-00016)
- APL Charger (871-00029)
- Tablet (360-00487)
- Dampening Pads (310-00061)
- Tablet Support Bracket Assembly (870-00087)
- USB Cable (360-00500)

Specifications:

- Size (inches): Handle 48; Base 20" X 10" X 10" (L x W x H)
- Weight: 26 LBS
- Operational Temp: -4°F to 122°F (-20°C to 50°C)
- Storage Temp: -20°F to 140°F (-29°C to 60°C)
- Battery life
    - Base: 25 hours
    - Tablet: 6 hours
- Battery type
    - Base: 16vdc Lithium-ion
    - Tablet: 7.4vdc Lithium-ion
- Recharge time
    - Base: 10 hours
    - Tablet: 3 hour
- Time per slice: <2 seconds
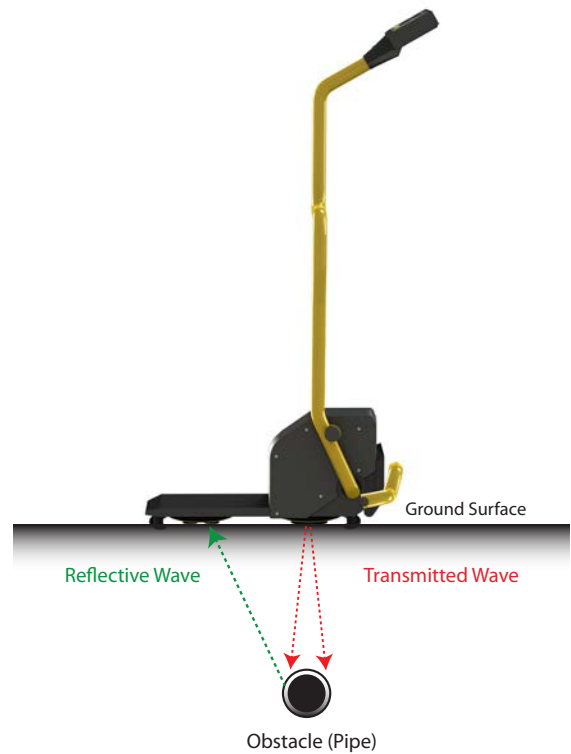- Time per 20 slice scan: <2 minutes

Detection Specifications:

- Time per 10x10 foot grid with 6-inch slice distance time = 10 minutes
- 1/2" ID pipe ≤30" depth
- 2" ID pipe ≤ 48" depth
- 4" ID pipe ≤96" depth
- Accuracy: better than ±18" from edge of pipe.
- Time Conversion Chart is used to estimate relative depth based on site conditions
- Detects any pipe material regardless of soil type

Principle of Operation

The Ultra-Trac® APL locates pipe through acoustic impedance mismatch. The speed of sound through ground materials differs from pipe material. This makes the pipe detectable using the Ultra-Trac® APL. The acoustic wave pattern of specific timing and frequency is monitored and processed using the device's accelerometers. Based on the return signature the instrument will determine if a pipe is present within the minimum requirements as set in the software.

The Ultra-Trac® APL is set on the ground. The manner in which the operator uses the device is critical to create proper coupling with the ground. The scan button is pushed to send a signal (set of pings) into the ground. The pings last approximately 2 seconds. This is called a slice. The operator then moves the APL 6" or 12" either to the right or left so another slice can be performed. After taking a minimum of 5 slices, a button on the tablet is pressed to plot results of the scan. Multiple scans create a survey (the final result for locating the piping system). By comparing all the scan data from the survey, the user can then determine a best fit line and locate the pipe in question. A pattern indicates likely target line location.

Ground Surface

Reflective Wave

Transmitted Wave

Obstacle (Pipe)

Summary of Operation:

Example Grid Plan:
9 Scan Rows
9 Slices Per Row

⬛ = 1 Slice
⬙ = Pipe Found (Marked)

1. The APL is placed on the ground such that scans will be taken at a 90-degree angle to the believed path of the target line.
2. Proper ground contact (coupling) is established.
3. With each push of the scan button, the actuator sends a set of "pings" into the ground
4. Receiver (Accelerometers) listens for reflected ping.
5. Strength, speed and duration of the reflected pings are monitored.
6. Each activation of the transmitter and receiver device is called a "slice".
7. A series of at least 5 slices, followed by plotting creates a display result called a scan.
8. A single scan row is not a full search. A minimum of 3 scan rows are required before a plot can be rendered that shows enough information to determine pipe locations.

Control Tablet and Mount Features

The control tablet is mounted at the end of the handle and is positioned so the display, on/off button, speaker, charging indicator and scan button are directed toward the user.

Display

Speaker

On/Off Button

Charging Indicator

Scan Button
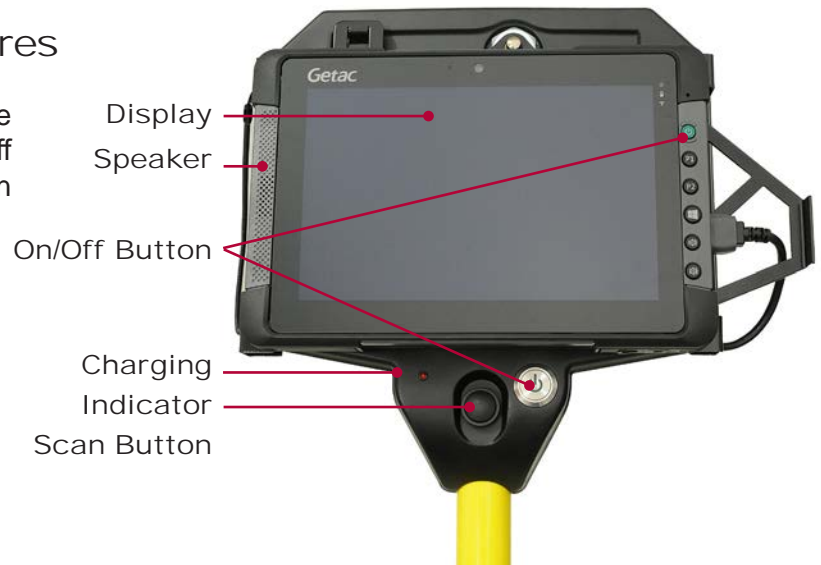
Chassis Features

The bottom of the instrument is referred to as the chassis. The chassis houses a battery, the components and electronics to operate, the actuator and accelerometers, the battery charging port, the handle connection, locking mechanism, and the kickstand.

Battery Charging (Chassis)

1. Open the box containing the charger and the assortment of wall plug adapters. Install the proper adapter for your global requirement.
2. With the instrument off remove the cover from the battery charge port located on the left side of the chassis.
3. Insert the charge adapter and secure by rotating the locking ring clockwise to prevent accidental disconnection. Do not over tighten.
4. The green light on the power switch will illuminate indicating there is a connection.
5. The red light will begin flashing within 60 seconds indicating charging is in progress.
6. A solid red light indicates charge is complete.

Battery Charging (Tablet)

1. Open the box containing the charger and the assortment of wall plug adapters. Install the proper adapter for your global requirement. (Note: Only a U.S. wall plug is included with the tablet. An additional wall plug adaptor for your specific geographical location may be required.)
2. With the instrument off remove the cover from the battery charge port located on the bottom left of the tablet.
3. Insert the charge adapter.
4. The battery charge indicator on the right side of the screen glows yellow while the battery is charging. It glows green when the battery is fully charged.

WARNING: Do not attempt to service this battery unless authorized by the factory. Doing so may void the warranty.

Operation of Instrument – Out of the Box

Refer to the "Performing a Locate" section for details of suggested site preparation prior to starting measurements.

1. **Unfold the Handle**

   Unfold and lock the handle in the upright position using the locking pin. The locking pin is held in place using a ¼ turn action.

2. **Extend the Kickstand**

   Extend the kickstand downward from the front to support the instrument.

3. **Power ON**

   Note: The tablet and Chassis have separate power sources. Both need to be turned on before the APL will be able to function properly.

   Chassis
   Press the power button until a beep is heard and release. A green light will flash 30 – 45 seconds. Once the green LED is solid the chassis is ready for use.
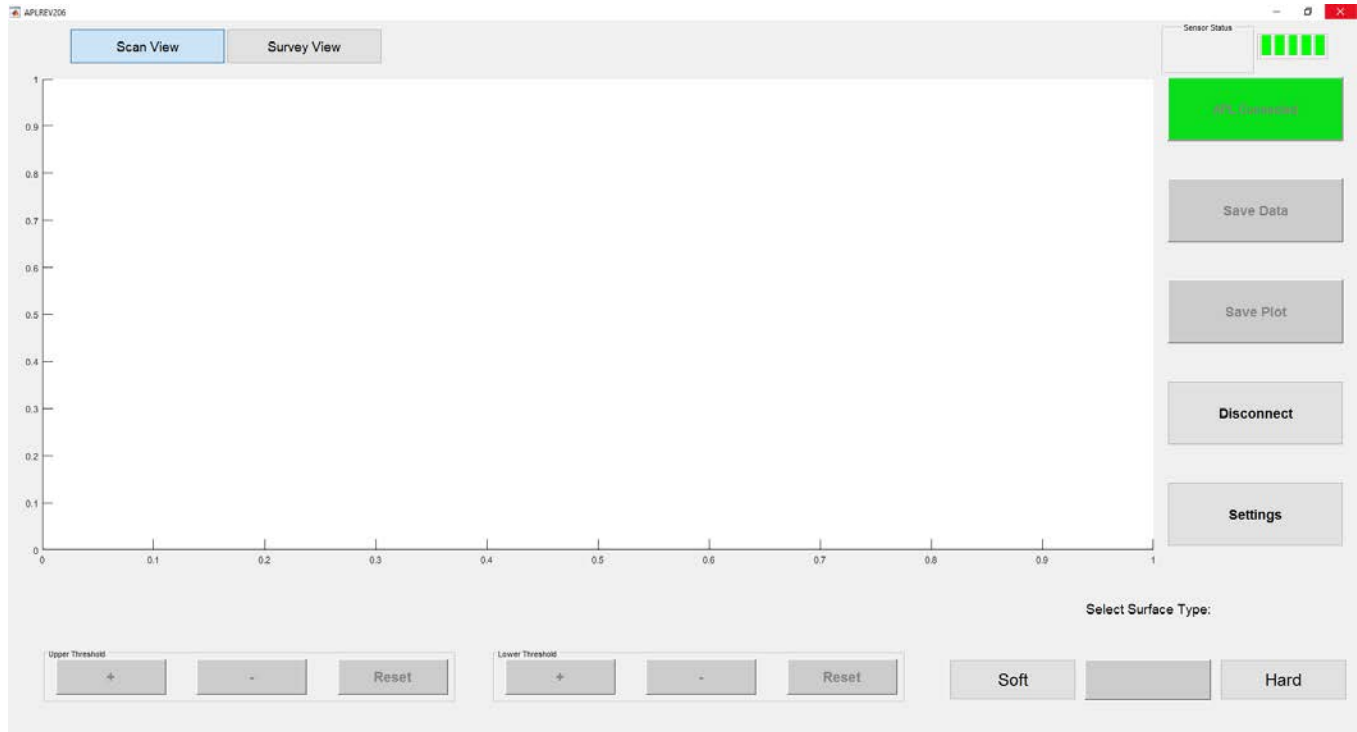

   Tablet
   Press the green power switch. The small blue LED in the upper left of the display will immediately illuminate followed by full display graphics within 30 sections. The APL application should automatically start.

Operation of Instrument

4. Prepare to take measurements (Scan View)

Once both the chassis and tablet are on and the tablet has the APL application displayed, press the soft button "Connect to APL". The tablet will take a moment to connect, when the connection is established the button will turn green and display the message "APL Connected".

5. Initial Scan Settings

The APL will automatically step the user through Scan Settings when the device is first powered on.

A. Select a Surface
Select the surface type by choosing Soft or Hard in the lower right of the tablet display.
Soft is for grassy or loose surfaces. Hard is for concrete, hard soil, rock and asphalt.

B. Select a Depth
Select depth by choosing Deep or Normal.
Normal is used for up to 5 ft (1.5m) depths. Deep is used for depths greater than 5 ft (1.5m) or for pipes greater than 2" (5cm) in diameter.

C. Select Step Direction
Select the desired direction of travel you wish to perform slices by choosing the left or right arrow.

D. Select Distance
Select the desired distance per slice. Six inch slices are recommended for most applications as they provide for a high-resolution scan. All readings are to the nearest slice width plus or minus ±18 inches from the outer edge of the utility line.

Operation of Instrument

6. Prepare to Take First Reading

Observe the sensor status in the upper right corner of the display. This indicates the accelerometers are ready for a reading. The sensor status should read "OK, OK" indicating that both accelerometers are functioning properly. A "plus sign (+)" indicates overvoltage and a "minus sign (-)" indicates an under voltage at the accelerometer. Call Sensit if you persistently get "+" or "- "indications.

The top line will also indicate all user selectable parameters.

Press down on the handle and foot platform. Press the scan button to start the process of collecting data for a slice. If the unit beeps three times the coupling to the ground is not good. Reposition the device a bit and ensure you are pressing with sufficient pressure on both the handle and foot platform. Repeat pressing the scan button.

Push Handle Forward

Step On Foot Pad

7. Plotting a Scan

After taking at least 5 slices press the button containing the word "Plot" in the lower right of the tablet screen. This will generate a display of the processed data on the axes in the center of the display. A maximum of 26 slices can be taken per scan. Pressing the button containing the word "New" will prepare the APL for beginning a new scan.

8. Saving a Scan
After plotting the data, the user has the options to save the raw data as well as the plot as two separate files. The plot can be saved by pressing the button containing the words "Save Plot" on the right of the screen. This will create a jpeg image (screengrab) of the current data for use in a report and client deliverables. To save the raw data, press the button containing the words "Save Data". This will save the raw data in a format that can be plotted in a volumetric cube in the Survey View mode of the application. NOTE: RAW DATA MUST BE SAVED IN ORDER TO USE SURVEY VIEW MODE.

Scan Results are displayed in the Cartesian plane (axes) in the center of the display. The color scale corresponds to the signal intensity (signal strength) displayed in the plot. A bright yellow color indicates a high signal return, while a dark blue color indicates little or no signal returned. The x-axis corresponds to slice number, or distance from starting point. The y-axis corresponds to the two-way travel time of the signals being displayed. This time is directly proportional to the depth of the object causing the reflected signal.

Scan View Feature Details
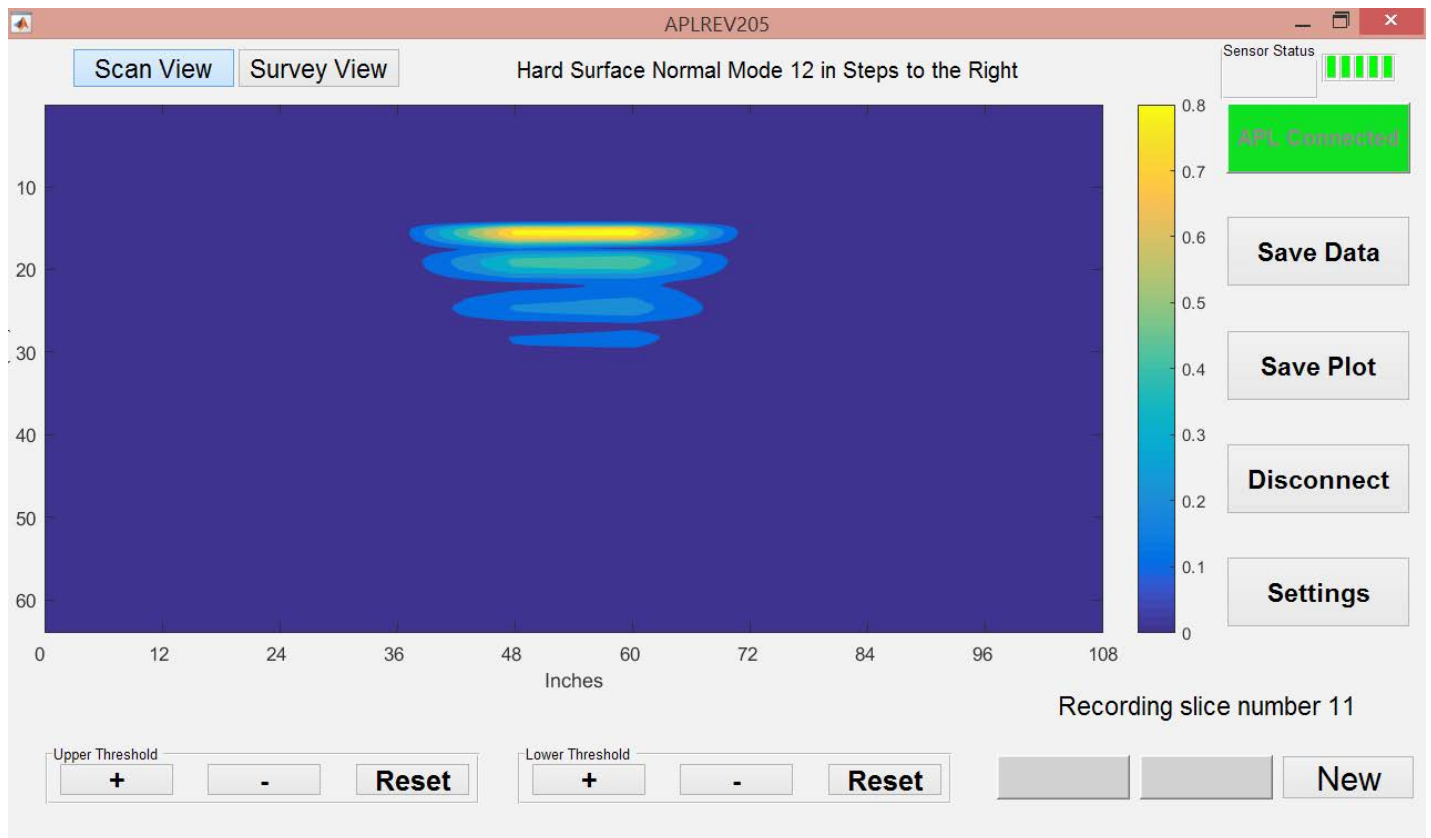
Scan View
Scan view is the default operating mode and is useful for collecting and viewing raw data in real time, and is used to mark locations in the field.

Connect to APL/APL Connected
Same button depending on the state of the APL. Connect to APL: Establishes communication between tablet application and the APL base. APL Connected: Indicates status of APL communication between tablet and base. Button has green background.

Disconnect
Press the disconnect button to terminate communication between the APL and the tablet.

Settings
Press the "Settings" button to access the APL Settings Menu. From this menu the user can change the units between "in" and "cm" and access the password protected Supervisor Menu.

Upper Threshold
Adjusts the upper limit of the color scale to filter out unwanted noise and comparing signal strengths in different areas.
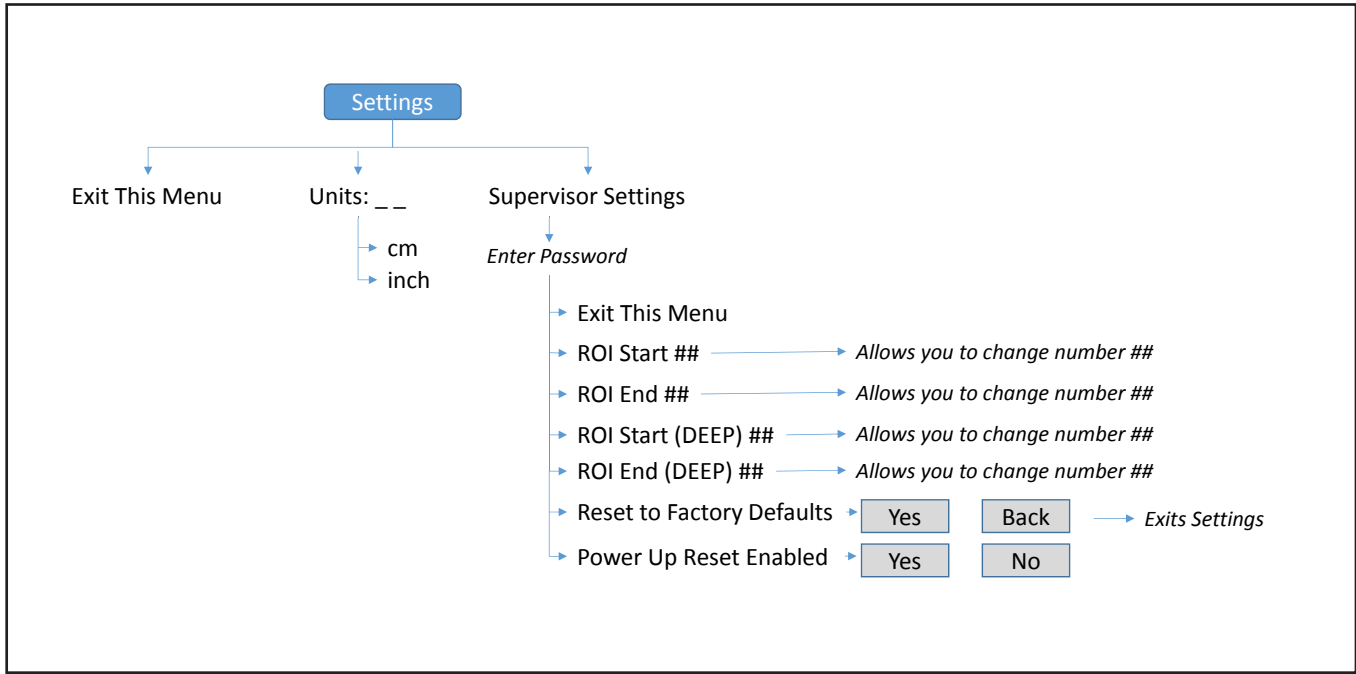
Lower Threshold
Adjusts the lower limit of the color scale to filter out unwanted noise and comparing signal strengths in different areas.

Menu
Allows the operator to adjust user parameters based on site conditions.

Menu Tree

Plot Menu Tree

Save Data

Press the "Save Data" button in order to save the raw data required to utilize Survey View. File names will have the default value of "YYYYMMDD_hhmmss.mat" where Y represents the year, M represents the month, D represents the day, h represents the hour (24-hour clock), m represents the minute, and s represents the second that the data file was created. This file name can be changed to any alphanumerical value. For example: "Water Line 1".

Save Plot

Press the "Save Plot" button in order to save a screenshot of the current data as it is displayed in the axes. This will only save an image file, and will not save the data required to operate Survey View. Any changes made to the upper or lower threshold values will be reflected in the saved image file. This is useful for incorporating in a report as a client deliverable or job file.

Menu Tree

Settings Menu Tree

Options
(*while in scan mode*)

→ Continue Scan ———————→ *Exits from options menu*

→ Switch Scan Direction

→ Restart Scan

→ New Settings

→ Redo Last Reading (*only available during a scan*) ——→ *Repeats the last slice*

Options
(*while in scan mode*)

→ Connect to APL ——→ *Establishes communication between tablet app to APL base*

→ APL Connected *Indicates status of APL communication between tablet and base. Button has green background. Does not respond to user button presses*

Disconnect ——————→ *Disconnects communication of APL tablet from APL Base*

Units - Change slice unit of measure (in or cm)

Supervisor Settings Menu

The Supervisor Settings should not be changed without first consulting the manufacturer. The Supervisor Settings Menu contains adjustments for how the APL analyzes the received signals. Supervisor Menu is password protected.

Region of Interest (ROI)
First, there is the Region of Interest (ROI). This adjustment consists of four settings, ROI Start and ROI End, ROI Start (Deep), and ROI End (Deep).

The first pair of ROI settings correspond to the Normal Depth mode, while the second pair of ROI settings correspond to the Deep Depth mode. These settings adjust the time frame of the signal that the APL will include in the detection algorithm.

For instance, If the ROI start is set to 18ms and the ROI end is set to 42 ms, only the signal received between 18 and 42 ms after each ping will be processed. This adjustment plays a role in how deep in the ground the APL will look for a pipe. The deeper a pipe is located, the longer it will take for a signal to return to the accelerometers. Therefore, by adjusting the time frame in the ROI, one can effectively change how deep the APL is scanning for buried pipe. One must be reminded that a later ROI start time value will result in lower returned signal strength due to signal attenuation in the soil.

Region of Interest (ROI) - Normal Depth Mode Settings
Adjustment for ROI is for the experienced user looking for piping that may be outside the default depth range established during development. The ROI for Normal Mode corresponds to the 900hz transmit frequency.
Start is 15ms
End is 39ms

Region of Interest (ROI) - Deep Depth Mode Settings
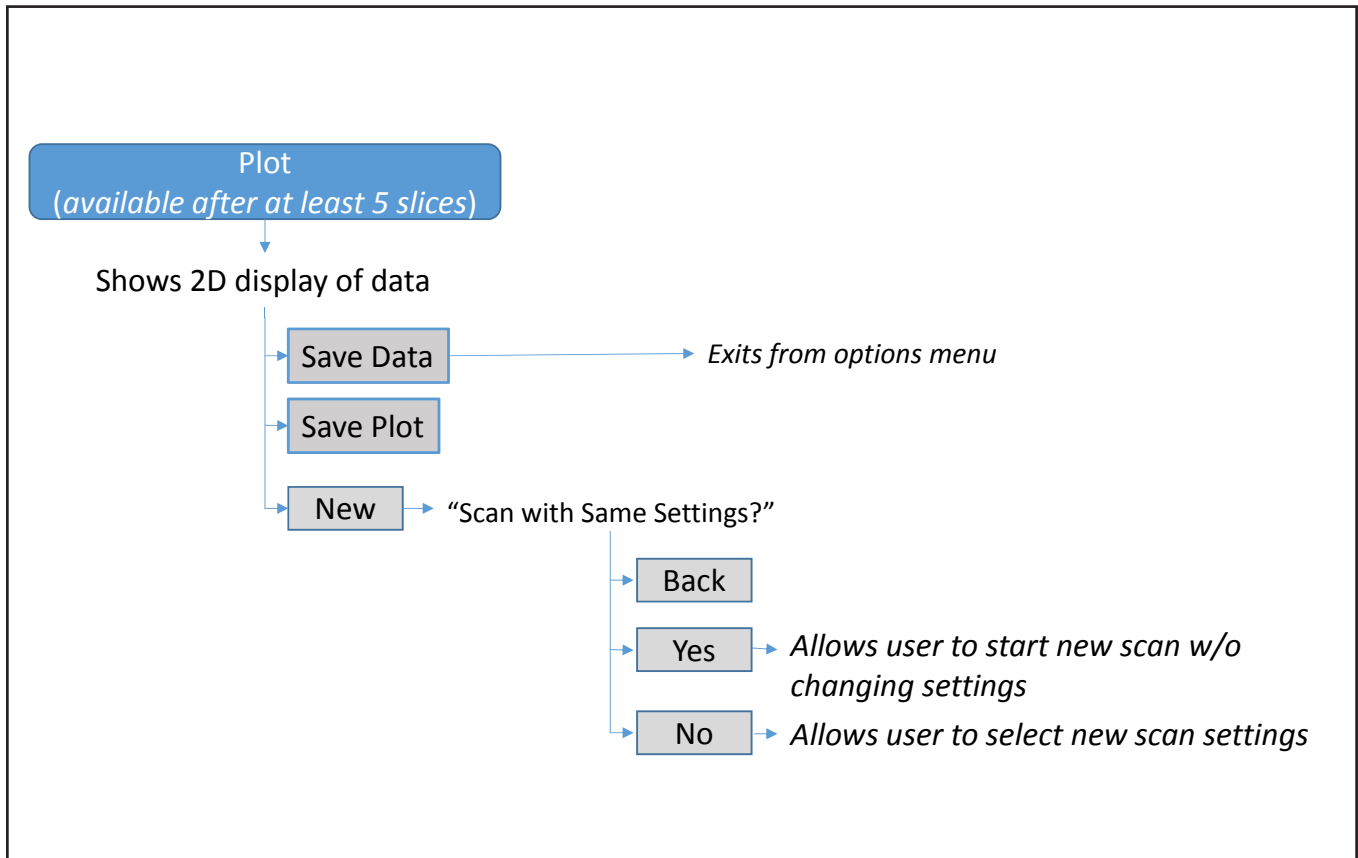The ROI for Deep Mode corresponds to the 500hz transmit frequency.
Start is 18ms
End is 60ms

Reset to Factory Defaults
Also included in the supervisor settings are the "Reset to Factory Defaults" and the "Power up Reset Enable" options. By selecting "Reset to Factory Defaults" the APL will be returned to the original settings and any adjustments made by the user will be overwritten.

Power up Reset Enabled
If the Power up Reset is set to enable, the user will be prompted to either keep or discard any custom settings upon each initialization of the unit. If Power Up reset is disabled, any changes will be kept until further changes are made or a factory reset is performed.

Scan Options (while in scan mode)

Plot
(*available after at least 5 slices*)

Shows 2D display of data

Save Data → *Exits from options menu*

Save Plot

New → "Scan with Same Settings?"

Back

Yes → *Allows user to start new scan w/o changing settings*

No → *Allows user to select new scan settings*

Survey View
After completing a number of scans at a common location, Survey View Mode can be used to view all similar 2D scans (same scan direction, depth mode, and step distance) scans in a three-dimensional space, displayed in a volumetric cube. After a number of scans have been saved to the tablet, they can quickly be compared using the Survey View mode of the application. With Survey View, the user is able to generate a simulated three-dimensional model of the survey using the data collected by the APL. This feature of the application does require that the scans be taken from the same reference line, and in the same distance intervals in order to properly correlate the slices of each scan.

Upon pressing the "Survey Mode" button at the top of the screen, a set of axes and a new set of controls will appear.

Survey View is selectable by pressing the button containing the words "Survey View" in the top-left corner of the display. Survey View is useful for comparing a number of scans collected in a common location using common parameters. Using Survey View it is possible to construct a three-dimensional image of the raw data.

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Survey View
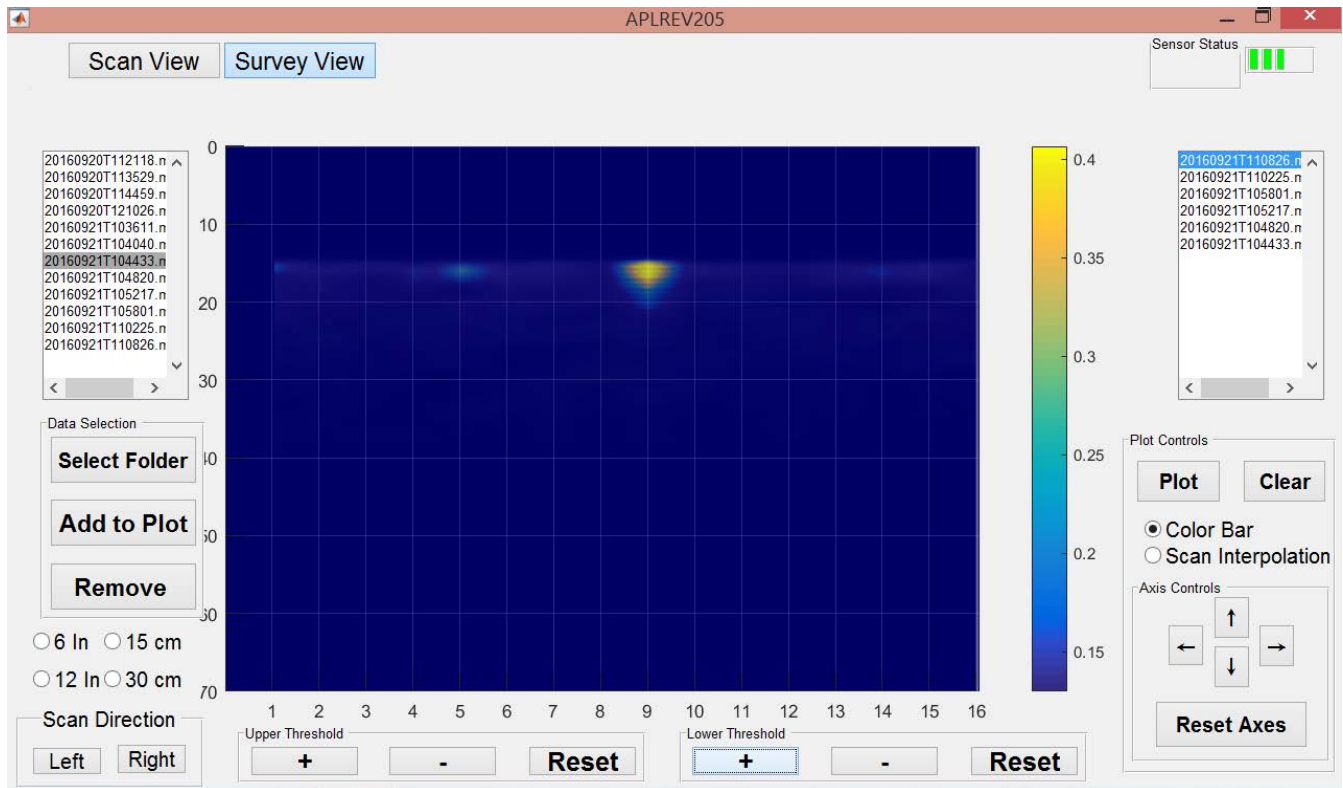
Press the "Select Folder" button and navigate to the directory containing the APL data collected during the survey (Defaults to /Program Files/APL/data/). After selecting the proper folder, the list box on the left will be populated with the list of .mat files containing the data collected during the survey. Note that the file data field will appear blank until a folder is selected.

In order to add data to the plot, highlight the .mat file and press the "Add to Plot" button. As files are added, they will appear in the list box on the right.

After all of the desired files have been added, press the "Plot Survey" button to plot a scan by scan representation of the survey. The plot will start off in a view of the X-Y plane or scan number vs time plane. Use the arrows in the axis controls box to change the view angle.

The entire survey has now been adjusted to one color scale. This color scale can be visualized by selecting the "Color Bar" radio button. The lower and upper thresholds of this color scale can be adjusted using the +/- buttons in the lower and upper threshold adjustment panels. The reset buttons will reset each respective threshold to its original value.

It is also possible to generate interpolated data in order to help visualize how each scan relates to the next by selecting the "Scan Interpolation" radio button and pressing "Plot Survey" again

Individual scans can be made invisible/visible by selecting the corresponding file name in the list box on the right

The scan direction and distance can be changed using the appropriate buttons at the bottom of the screen.

Depth Chart

A time measurement (in milliseconds) is displayed on the 'Y' axis of the display. The APL measures the time it takes for the acoustic signal to travel from the APL actuator to the underground object and back. This will assist in identifying objects at similar depth. Consult the APL Time Conversion Chart (below) for approximate depths.

Caution: Soil type, porosity, moisture content and other characteristics will determine the rate of return for the acoustic reflection. Depth is relative due to many factors and may vary based on these and other factors. The term "depth" is relative and true depth is not guaranteed when using electronic equipment to estimate the depth to a target utility line. The only way to ensure accurate depth information is to expose the utility line and measure the depth.

APL Time Conversion Chart

	Soil Condition								
	H/Dry	H/Moist	H/Wet	F/Dry	F/Moist	F/Wet	S/Dry	S/Moist	S/Wet
Factor m/s	215	200	160	195	155	110	95	75	65
ms reading	Depth formula (m/s)*ms*1.5 (1.5 is derived by divide ms reading in half and mult by 3ft/m)								
9	2.9	2.7	2.2	2.6	2.1	1.5	1.3	1.0	0.9
10	3.2	3.0	2.4	2.9	2.3	1.7	1.4	1.1	1.0
15	4.8	4.5	3.6	4.4	3.5	2.5	2.1	1.7	1.5
20	6.5	6.0	4.8	5.9	4.7	3.3	2.9	2.3	2.0
25	8.1	7.5	6.0	7.3	5.8	4.1	3.6	2.8	2.4
30	9.7	9.0	7.2	8.8	7.0	5.0	4.3	3.4	2.9
35	11.3	10.5	8.4	10.2	8.1	5.8	5.0	3.9	3.4
40	12.9	12.0	9.6	11.7	9.3	6.6	5.7	4.5	3.9
45	14.5	13.5	10.8	13.2	10.5	7.4	6.4	5.1	4.4
50	16.1	15.0	12.0	14.6	11.6	8.3	7.1	5.6	4.9
55	17.7	16.5	13.2	16.1	12.8	9.1	7.8	6.2	5.4
60	19.4	18.0	14.4	17.6	14.0	9.9	8.6	6.8	5.9
65	21.0	19.5	15.6	19.0	15.1	10.7	9.3	7.3	6.3

Yellow denotes potential need for deep mode.

Use green area to update vertical speed of sound.

Use deep mode setting for anything greater than 5 feet.

Use deep mode setting for pipes greater than 2" in diameter.

"H" represents a hard surface, that when stepped on, leaves no mark on the ground.

"F" represents a firm surface that leaves a small mark when stepped upon.

"S" represents a soft surface, that when stepped on, leaves an obvious depression on the ground.

A dry surface has little or no moisture in it.

A moist surface is damp to the touch.

A wet surface is one where water has puddled or the ground is muddy.

When considering a surface type, consider the consistency of the surface throughout the depth being tested.

What to avoid

When testing, always perform a scan on surfaces of like material. A scan requires a minimum of 5 slices on pavement, gravel, grass or dirt.

Do not perform 12" scans on loose or freshly excavated soil. Soft soil requires narrow slices.

Do not mix surface types in a single scan.

Do not perform a slice on large cracks or expansion joints.

How to turn off

- Press the "Disconnect" button on the tablet Display.
- Press and hold the silver on/off button until the green light goes out. The unit will beep 5 times.
- Shut down the tablet
  - o Make sure any data you've collected has been properly saved.
  - o Press on the Windows icon in the lower left.
  - o Press the (Power) symbol at the upper right and choose "shut down" from the drop down menu.

Performing a Locate

Example Grid Plan:
9 Scan Rows
9 Slices Per Row

= 1 Slice
= Pipe Found (Marked)

a. Determine the area to grid.
Plan to perform enough scans in such a manner the area is covered. In areas with multiple systems to identify, use six inch slices and a maximum of 26 slices per scan (approx. 12 ft (4m)).

b. Set the Measuring Tape
Place the measuring tape on the ground in the area to be tested at a 90-degree angle to the believed path of the target line. Align the housing of the APL with the beginning point of the measuring tape. With the instrument powered on and displaying "Ready for Reading":

c. Place the kickstand in the up position. A magnet on the front of the chassis housing will keep it in place.

d. Place foot on the foot pad

e. Push forward on the handle creating good coupling to the ground. The actuator is spring loaded so tension will be noticeable.

f. Press and release the scan button. When the slice is completed a beep will be heard and the display will show it is ready for the next slice.
Three beeps indicates improper force was applied to the handle or poor ground contact. The unit will prompt the operator to retake that slice.

HINT: If required to 'retake' several times, move the instrument 1-2" in any direction and retry.

Performing a Locate

g. Move the selected direction and distance corresponding to the measuring tape on the ground (6 or 12 inches).

h. Continue to perform the desired number of slices to perform the scan.
A minimum of 5 slices is required. There is a maximum of 26 slices per scan.
When completed, press the "Plot" button to display the pipe map results. At this point you can save the plot and/or the data from the scan you just completed.
The display will show where a pipe was found corresponding to the measuring tape reference.
Mark the corresponding location on the ground.

i. Move the measuring tape 5 to 15 feet to the next position, parallel to the previous scan row and repeat the scan procedure. Dependent on site conditions and survey requirements, a maximum of 25 feet between scans may be utilized in certain situations, such as a lone pipe in a right-of-way with a long search area. Press "New" button to begin a new scan using the same settings.

j. If new settings are desired, press the "No" button to create new settings.
Repeat the scan procedure. The display will show where a pipe was found corresponding to the measuring tape reference.
Mark the corresponding location on the ground with reference to the tape measure. A patter will emerge, indicating likely target line location.

k. During every investigation, always make some scans perpendicular to make certain there are no pipes parallel to your scans. The APL will only detect a pipe if it crosses it.

l. Review the results and align the marks to follow the piping system. A mark on its own may indicate a single anomaly in the ground. Here is a representation of marks created in a grid area.
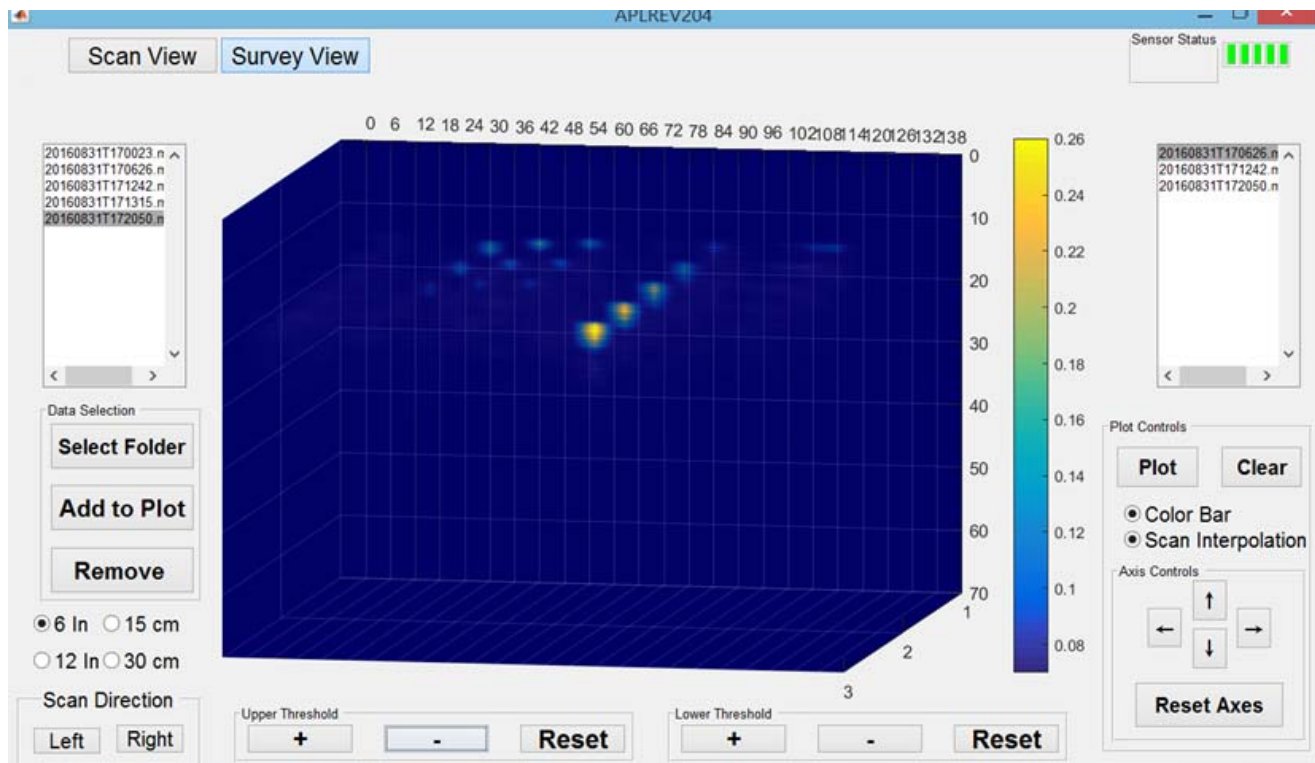
Maintenance

The Ultra-Trac® APL is designed to be relatively maintenance free. It is important to keep the actuator and accelerometers clean of mud and debris. **Good results are the result of good coupling with the ground and using consistent procedures. In the field it is important to**:

- Keep the instrument clean from dirt/debris build up on the bottom of the chassis

- Do not submerge this instrument in water.

- Do not operate in wet weather if the housing is damaged or the cover is missing for the SD card on the control box housing.

- Check for damaged bellows or cracked components on the actuator and accelerometers. Repairs are required if these are damaged or badly worn.

- Only factory authorized repair personnel can perform repairs to this product.

Warranty

Your Ultra-Trac® APL is warranted to be free from defects in materials and workmanship for a period of two years after purchase. The actuator and accelerometers are warranted for one year. The accelerometer housing assembly and the actuator foot (both continuously contacting the ground) are considered replacement items with a 90 day warranty. If within the warranty period the instrument should become inoperative from such defects, the instrument will be repaired or replaced at our option. This warranty covers normal use and does not cover damage which occurs in shipment or failure which results from alteration, tampering, accident, misuse, abuse, neglect or improper maintenance. Proof of purchase may be required before warranty is rendered. Units out of warranty will be repaired for a service charge. Internal repair or maintenance must be performed by a Sensit Technologies authorized technician. Violation will void the warranty. Units must be returned postpaid, insured and to the attention of the service department for warranty or repair.

This warranty gives you specific legal rights and you may have other rights which vary from state to state.

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MADE IN THE USA
WITH GLOBALLY SOURCED COMPONENTS