MultiWave Sensors

AZIMUTH POINTING SYSTEM (APS)

USER'S MANUAL

1st Edition Version 1.2

July 2009

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Declaration of Conformity

We declare that this product has been tested to and meet the requirements of:

FCC Part 15 Subpart B: 2008

&

ICES-003:2004

Testing Body responsible for issuing certificate of compliance:

Global EMC Inc.
180 Brodie Dr, Unit #2
Richmond Hill, Ontario
L4B 3K8
Canada

This product may also contain a certified Bluetooth module with an FCC ID as below:

For Class 1 Bluetooth- FCC ID: S7APAPRANIESD110
For Class 2 Bluetooth- FCC ID: VMTZBA-BT44

The product will be labeled showing which Bluetooth device is being used.

The system may also contain a TruPulse Laser Rangefinder from Laser Technology Inc. The TruPulse is a Class 1 Laser Product according to FDA (CFR 21).

RoHS and WEEE Compliance

The European Union has legislated to enforce the RoHS and WEEE directives.

RoHS : **R**estriction **o**f certain **H**azardous **S**ubstances in electronic equipment.
WEEE: **W**aste **E**lectrical and **E**lectronic **E**quipment.

Multiwave Sensors Inc. can confirm to the best of our knowledge that the APS is compliant with the above directives.

In the event that the APS battery does not charge properly, call Multiwave Sensors Inc., and if required the APS should be sent back to Multiwave Sensors Inc. for repair and proper disposal of the battery.

1.0 Introduction

The Azimuth Pointing System (APS) is a GPS based compass that provides a True North Azimuth measurement and position all in one device. Add a TruPulse Laser Rangefinder from Laser Technology Inc. (www.lasertech.com) and the APS becomes a powerful all in one total station for remote GPS measurements or commonly known as Laser Offset or GPS Offset. Since the APS is not using the earth's magnetic field to determine the azimuth, it is not affected by ferrous anomalies (metal) from the ground or surrounding structures.

The APS uses two antennas to calculate an azimuth solution. As with any GPS device, access to the horizon (to see GPS satellites) is important. Also, the APS should not be positioned to close to a vertical wall or under a tree, which would cut down the sightlines to GPS satellites and potentially cause multipath interference, although the APS has excellent multipath rejection capabilities.

2.0 Features

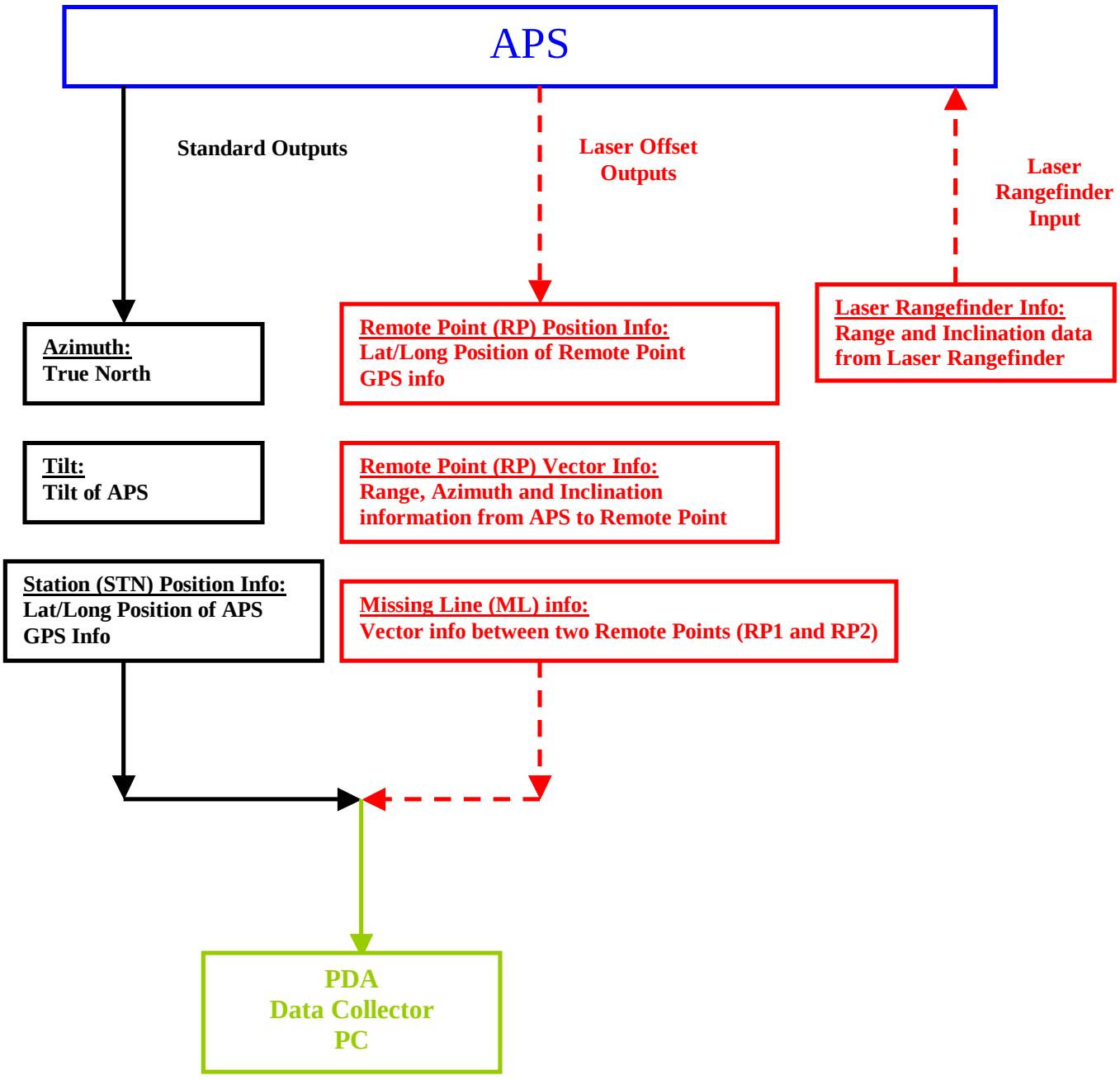
Accurate (0.5°) True North Azimuth measurement
No declination correction required
Optional Bluetooth or cable to PDA
Long Battery Life (6.5 hrs max.)
Sub-meter GPS Position Accuracy
Performs without being affected by local magnetic anomalies
Integrated GPS Integrity Parameter to qualify azimuth accuracy
Measures the distance and azimuth between two targets using the built in "Missing Line" function
Graphical satellite signal display on custom backlit LCD

3.0 On-Board Sensors

The APS produces an azimuth relative to True North (no declination required) and GPS position. In addition, there is an on-board inclinometer to provide an accurate tilt angle. When the optional Laser Rangefinder is attached (TruPulse manufactured by Laser Technology http://www.lasertech.com/ , the APS can also determine the position and range to a remote point. With the range and inclination information from the rangefinder, the APS becomes a completely mobile total station with no need for setups and backsights, which is ideal for Laser Offset mapping.

4.0 System Overview

Figure 1: System Overview



5.0 Modes of Use

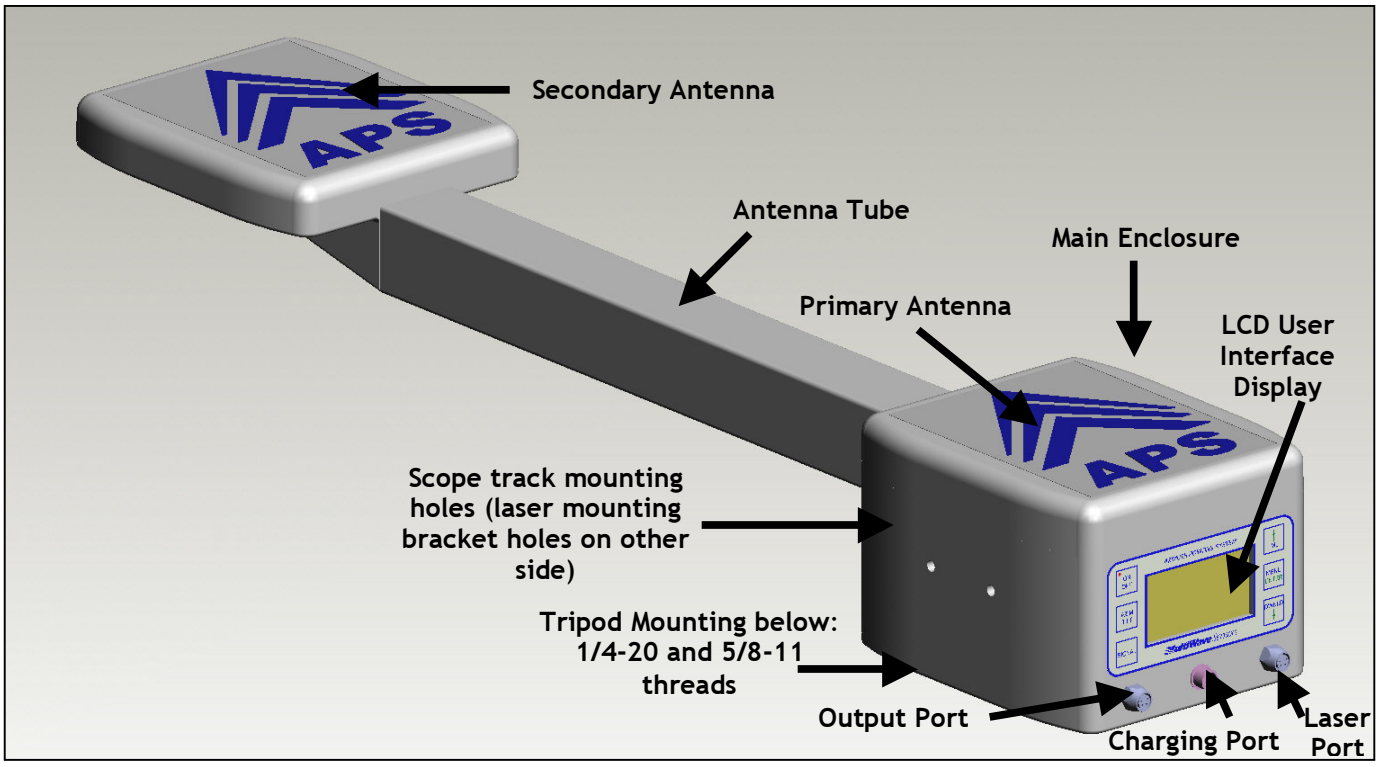
There are three operational modes for the APS.

- **Azimuth/Tilt Mode:** Default mode at start. Provides Azimuth, Tilt, and Location of the APS (Lat, Long, Elevation).
- **Laser Offset Mode:** Optional Laser Rangefinder is required. When the Laser Rangefinder is attached and fired the APS automatically transitions to this mode. Provides Position and/or Vector Information of the Remote Point.
- **Missing Line Mode:** Optional Laser Rangefinder is required. Provides Vector Information between two Remote Points (RP1 and RP2).

6.0 Hardware Description of the APS

- **Primary and Secondary Antennas:** Used to calculate the Azimuth and provide Latitude and Longitude information of APS.
- **Antenna Tube:** Connects Secondary Antenna to Main Enclosure electronics.
- **LCD User Interface Display:** Consists of a display and membrane panel with Hotkeys for various functions and information.
- **Output Port:** This port connects to a Data Collector, PDA or PC. Provides RS232 ouput data.
- **Laser Port:** The optional Laser Rangefinder is connected to this port.
- **Charging Port:** To charge the internal battery.
- **Scope and Laser track mounting holes:** For optional Sighting Scope and Laser Rangefinder mounting brackets.
- **Tripod Mounting:** For mounting of APS to camera or survey tripod

Figure 2: APS Diagram



7.0 Getting Started with the APS

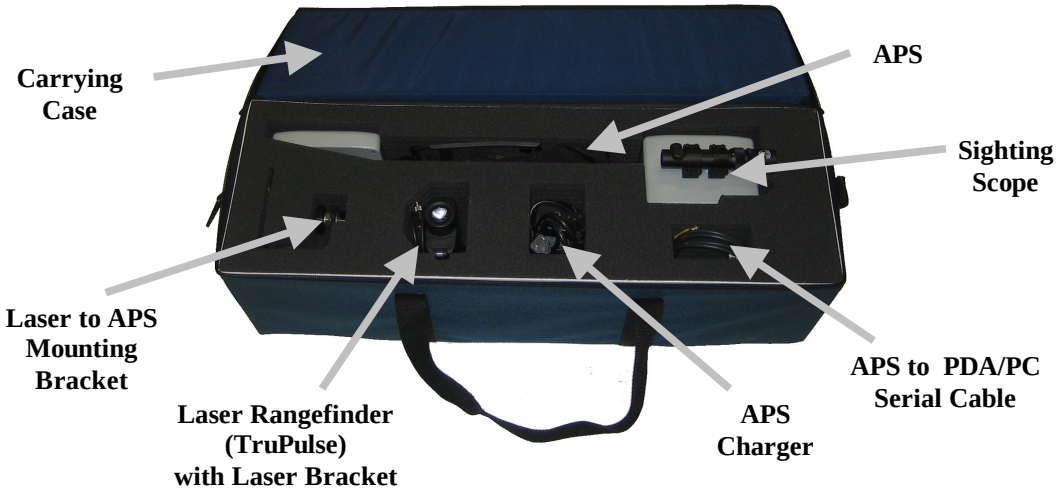
7.1 Unpacking the APS

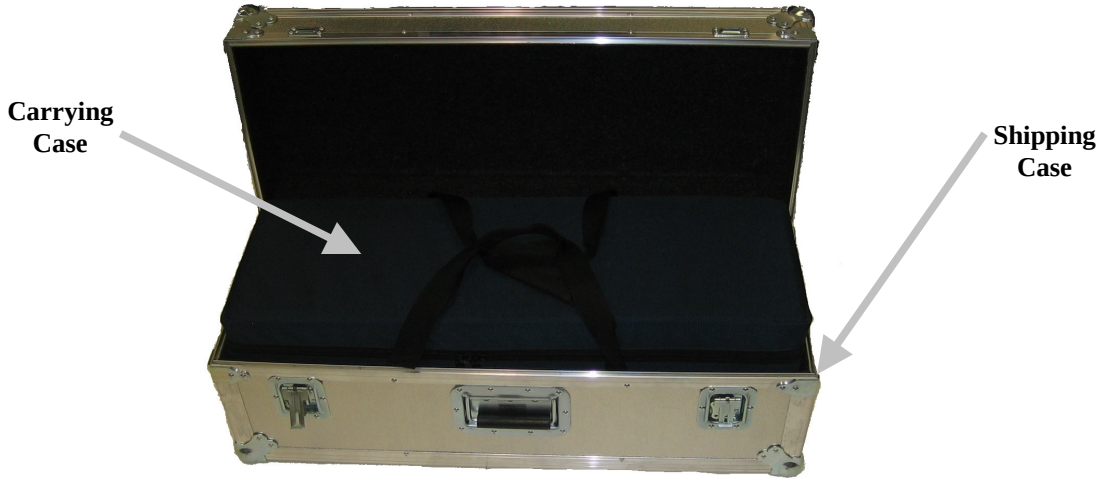
When you unpack your APS, check to make sure that you have received everything you ordered, and that it arrived undamaged.

APS Full Package:

- APS
- Sighting Scope (optional)
- APS to PDA/PC Serial Cable
- APS Charger
- Laser Rangefinder (TruPulse) with Laser Bracket (optional)
- Laser to APS Mounting Bracket (optional)
- Soft Carrying Case (optional)
- Hard Shipping Case (optional)
- Manual

Figure 3: APS in Carrying Case and Shipping Case





7.2 Charging the Battery of the APS

The APS is shipped fully charged. It is recommended to charge the APS prior to it's first use, charge as needed from that point on. The battery status of the APS, in time remaining, can be seen on the LCD User Interface Display in the right top corner. The charging light on the APS Charger will turn from green to red when it starts charging. When it is fully charged, the charging light will turn green again.

7.3 Mounting the APS

The APS can be mounted on a camera tripod using the ¼-20 thread (camera standard) or a surveyor tripod using the 5/8-11 thread. In either case, please ensure that the tripod is sturdy and well balanced as the APS can be rotated to different orientations.

It is also recommended to raise the APS up so that the display screen is at eye level. This makes the display easy to read and also ensures that the users head does not interfere with any GPS signals. It is not recommended to position the APS close to a vertical wall or under trees as this will limit GPS signal and potentially cause multipath interference resulting in a poor azimuth solution.

7.4 Starting the APS

Press the ON/OFF Button

You will hear two beeps.
ON/OFF LED illuminates.
Multiwave logo will briefly be displayed.

APS begins Initialization Processs.

Typically takes less than 1 minute. May take up to 2 minutes.

Signal Intensity Mode will be displayed. (see Section 8.5)

Bar graph displaying the satellites in view and their individual signal strength.

Azimuth/Tilt Mode is displayed. (See Section 8.2)

Battery Life and GPS Integrity are also displayed.
The GPS Integrity is a single number that determines the accuracy of the Azimuth solution. See Section 8.6 for further explanation.

At this point you are ready to use the APS for Azimuth, Tilt and GPS position measurements. You can also attach the optional Laser Rangefinder for Laser Offset and Missing Line measurements (see Sections 8.3 and 8.4).

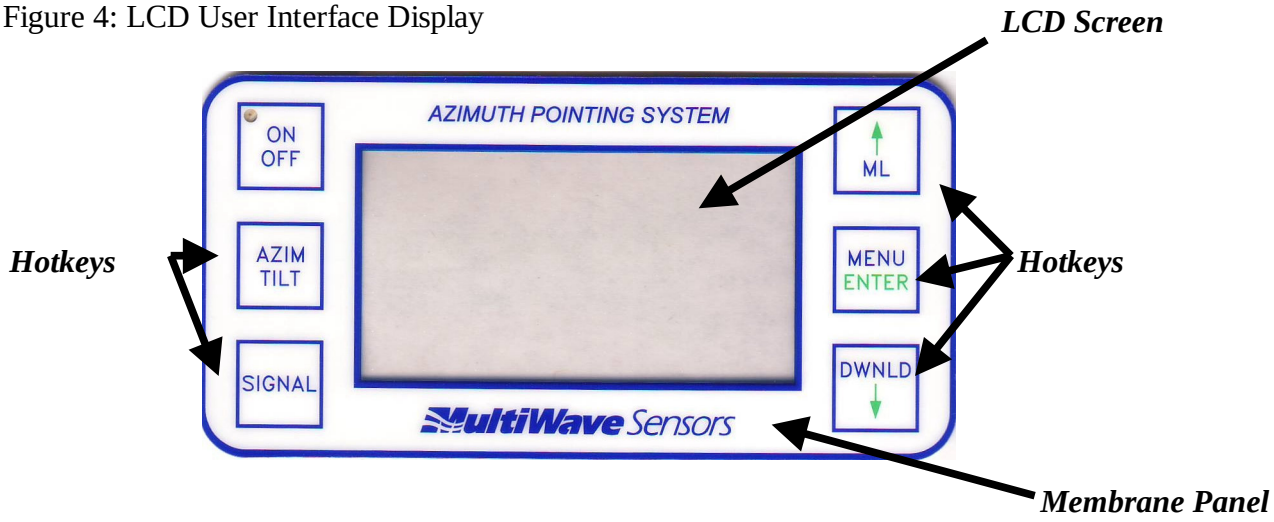
WARNING: If APS is turned on indoors always turn off the APS before performing an alignment. The APS internal algorithms need to re-initialize due to the absence of signal while indoors.

8.0 Detailed Operation

8.1 Modes of Use

The user can select any mode by pressing the hotkeys on the membrane panel except Laser Offset mode. This mode automatically transitions when the APS receives a string of data from the laser after a laser measurement.

Figure 4: LCD User Interface Display



8.2 Azimuth/Tilt Mode

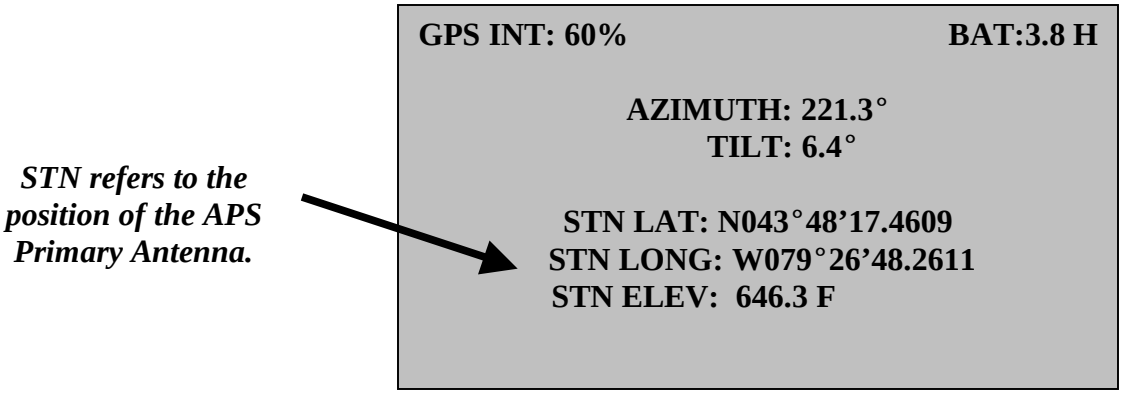
This is the most basic mode of use for the APS. As described in Section 7.4, the unit will power up into this mode. Applications for this mode include establishing an azimuth for line cutting, mounting the APS to an antenna or satellite dish for alignment, establishing a position and orientation of a drilling rig (core samples, raisebore, oil rig) and providing heading information for vehicles or aircraft.

All of the orientation and positional data is displayed on the screen and is output via RS-232 serial communication. The user can choose whether to have the data automatically stream out the port and at what rate, or the data can be sent on demand by pushing the download button. Details on how to output data can be seen in Section 8.13.

If the application requires the user to visually align to a target or track a moving target, it is recommended that the optional Sighting Scope be used.

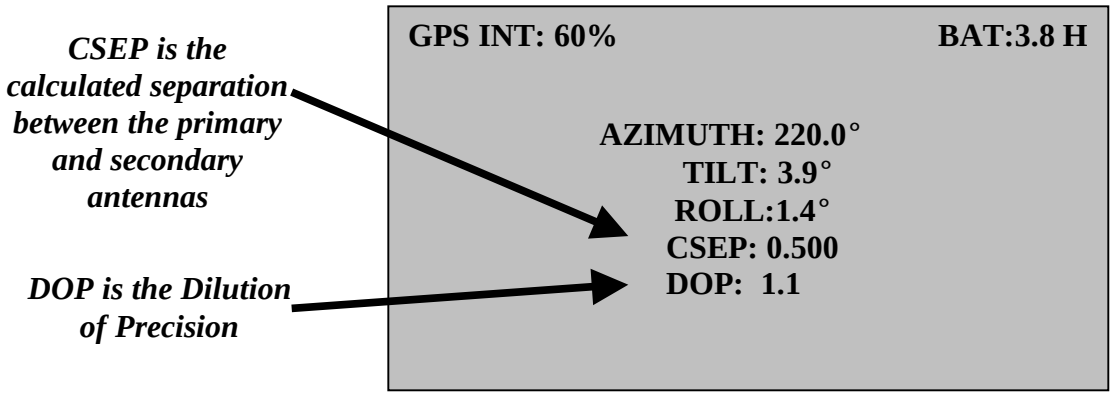
For clarity in terminology, Azimuth/Tilt is the mode of use and the term Heading is simply referring to Azimuth and Tilt information. Heading Rate is found in the menu system as it relates to the internal update rate of Azimuth/Tilt information and Head is short form for Heading output format (see Section 8.13).

Figure 5: Data displayed on LCD Screen for AZIM/TILT Mode (example)



If you are in any other mode or menu selection you can go directly to this mode by pressing the AZIM/TILT hotkey as seen on the membrane panel. Pressing the AZM/TILT Hotkey a second time will bring up another screen with other diagnostic information.

Figure 6: Data displayed on LCD Screen after double press of AZM/TILT



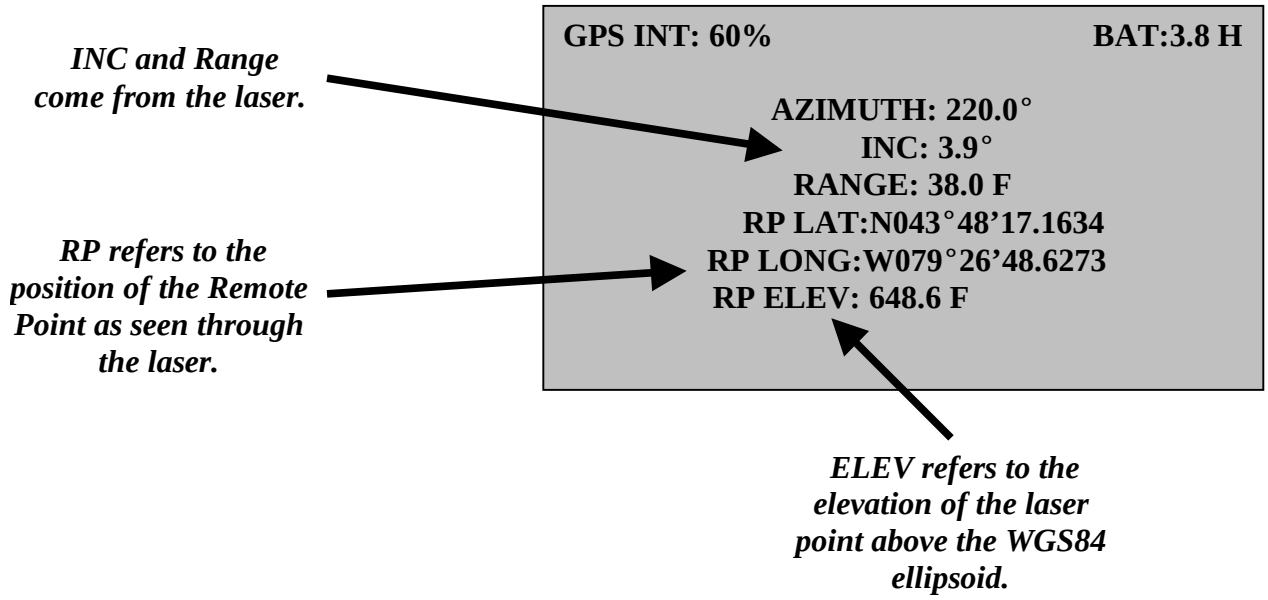
8.3 Laser Offset Mode

The APS cannot power up into this mode; however, the first measurement from the laser will automatically transition the APS into Laser Offset mode. The prime use for this mode is to determine the position of a remote target or point. Applications for this mode include GPS Offset Mapping, Stockpile Measurement, Mobile Mapping and Marine Mapping. In this configuration, the APS is a very powerful total station requiring no positional or orientation referencing.

The optional Laser to APS Mounting Bracket will allow the TruPulse to be connected to the APS. Typically, when the laser option is used, the optional Sighting Scope is used as well. The reason is that the Sighting Scope is permanently attached and aligned to the Primary and Secondary antennas. When the laser is installed for the first time, it needs to be aligned to the Primary and Secondary Antennas. Once the laser and APS Mounting Bracket is aligned, it can be removed for storage into the carrying case. The Sighting Scope is very useful for aligning the laser for the first time and checking the alignment after each setup prior to use. Details on how to align the optical accessories with the APS can be found in Sections 9 and 10.

When the APS takes a Laser Offset measurement, the APS displays the Azimuth and Inclination (inclination of the laser not the APS) to the remote point as well and the GPS position of that remote point. To prevent any confusion, GPS coordinates of remote points always have an RP in front of the coordinate. Also, the azimuth value of the last measurement is frozen on the screen until the next laser shot is taken. Similar to Azimuth/Tilt mode, the data output can be automatic or initiated by the DWNLD (Download) button. Details on data output can be found in Section 8.13.

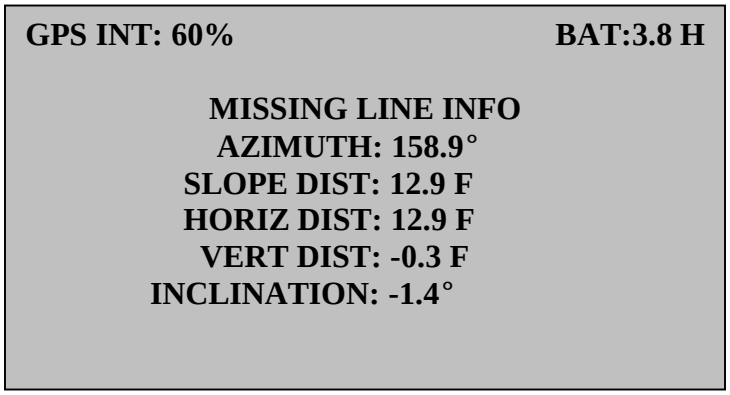
Figure 8: Data displayed on LCD Screen for Laser Offset Mode (example)



8.4 Missing Line Mode

This mode is a variation of Laser Offset mode in that the user can calculate the azimuth, distance and inclination between two remote points. When the Missing Line (ML) hotkey is pressed, the user will be prompted to take a laser measurement to the first remote point. After that measurement, the APS will prompt for the laser measurement to the second point. The APS will then calculate and display the Azimuth, Inclination and Distance from the first remote point to the second remote point. This is very useful for taking measurements is areas that the surveyor cannot physically occupy. Similar to Azimuth/Tilt mode, the data output can be automatic or initiated by the DWNLD button. Details on data output can be found in Section 8.13.

Figure 9: Data displayed on LCD Screen for Missing Line (ML) Mode

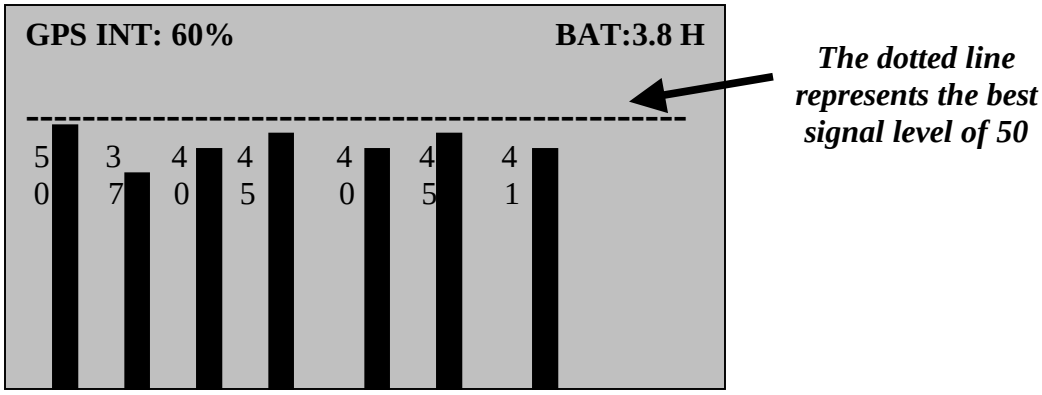


8.5 Signal Intensity Mode

This mode allows the user to view the number of satellites being used as well as their associated signal strength. As described in Section 7.4, Signal Intensity mode is automatically displayed while the APS is calculating a solution at start-up. When a solution is achieved, the APS reverts to the default Azimuth/Tilt display screen. At any time, the user can view the Signal Intensity screen using the hotkey SIGNAL.

If the size of the signal bar for each satellite is equal to or greater than the upper line, then that is an indication that that satellite has very good strength. Three satellites above that threshold is an excellent condition; however, the APS can still generate accurate azimuth results with no satellites above the threshold. The number of satellites in view and signal strength are variables for calculating the GPS Integrity. For details on how the GPS integrity relates to the accuracy, refer to the next section.

Figure 10: Data displayed on LCD Screen for Signal Intensity Mode



8.6 GPS Integrity

As described in earlier sections, the GPS integrity is a number, expressed as a percentage, which indicates the quality of the azimuth solution. It summarizes the satellites in view (SIV), significant satellite strengths, dilution of precision (DOP) and some internal indicators (proprietary) to produce this confidence factor. As the APS develops the azimuth solution from start-up, "NO HEADING" is display in place of the GPS integrity number. Once the azimuth solution is complete, the GPS Integrity number is then displayed.

After extensive testing the following accuracy guidelines based on GPS Integrity have been determined.

GPS Integrity (%)	Azimuth Accuracy (º)
< 30	> ± 1.0
30 – 50	< ± 1.0
50 – 80	< ± 0.5 (nominal)
> 80	<± 0.2

8.7 Battery Operation/Power Management System

The remaining battery life is displayed at all times in the upper right corner of the display screen. When the APS is turned on, the power management system interrogates the battery level and monitors it over a brief period (30 seconds) and estimates the remaining battery life until the APS will need charging again. If the APS is turned on right after charging, it may take up to 10 minutes for the power management system to re-establish the battery drain hysteresis. The time remaining is measured in 0.1 of an hour (six minutes) increments. When the APS is fully charged, there is approximately 6.5 hours of working life in the field. The smart charger can fully charge the APS in 90 minutes.

When charging the system, plug the smart charger into an outlet. The light on the charger should be green, indicating that it is not charging. Then plug the charger into the APS charging port. The light should turn to red while it is charging. When the internal lithium ion battery is fully charged, the charge light will turn green again.

8.8 Menus

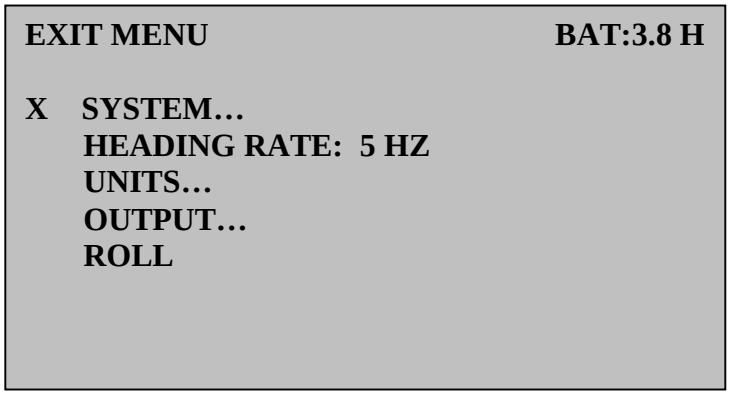
All the menu function buttons are coloured green on the membrane panel. All other hotkeys are in blue. To access the menu, press the MENU key. This activates the menu functions in green (Up Arrow, ENTER, Down Arrow), which are the three buttons on the right side.

When the MENU key is pressed the menu items (as described below) will be displayed. You will see an “x” beside one of the menu items. Pressing the ENTER key will cause the “x” to change to an “up down arrow” that corresponds to the green “UP and Down Arrows” on the membrane panels. You can now use these arrows to navigate through the submenu. Pressing ENTER will accept the setting and return to the Main Menu. You can now use the “UP and Down Arrows” on the membrane panel to navigate to the other menu items.

8.9 MAIN menu

When the MENU button is pressed, the following menu appears:

Figure 11: Data displayed on LCD Screen for Main Menu



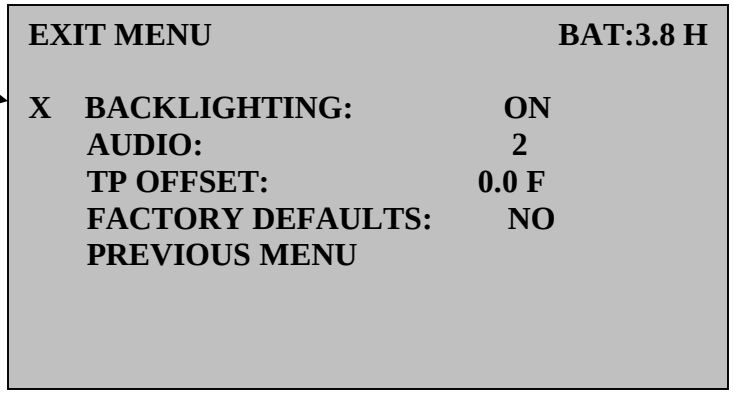
Pressing the ENTER button will take you to the SYSTEM submenu.

8.10 SYSTEM Submenu

When the SYSTEM item is pressed the following screen appears.

Figure 12: Data displayed on LCD Screen for System Submenu

Pressing the ENTER key will cause the "x" to change to an "up down arrow". Using the "UP and Down Arrows" on the membrane panel will allow for navigating through the submenu.



The options available for each of the above items is shown:

BACKLIGHTING:	ON, OFF
AUDIO:	1, 2, 3, OFF
TP OFFSET:	+/- N.n Units
FACTORY DEFAULTS:	NO, YES

The BACKLIGHTING is useful for operation after sunset and when you have shade on the screen on a bright day. There is only a marginal power saving for the battery when the backlight is turned off. It is recommended to leave it on.

The AUDIO parameter allows you to set the length of the beep, which is generated when a button is pushed or data is received from the laser. The maximum beep length is 3. The user can also turn off the audio.

The TP Offset refers to the horizontal offset distance of the TruPulse Laser Rangefinder from the Primary Antenna GPS location of the APS. This feature is most useful for those applications where the TruPulse may be further away from the APS Primary Antenna, such as in Mobile Mapping where the APS is on the roof and the TruPulse may be off to the side near the vehicle of the window. Pressing Enter once will toggle the +/- , twice will allow adjusting the first digit (1 to 9) and a third press will allow adjusting the second digit (0.1 to 0.9). So the offset is from –9.9 to 9.9 in meters or feet.

FACTORY DEFAULTS allows you to reset the APS to the settings that it had arriving from the factory.

8.11 HEADING RATE

This is the only choice on the main menu that is not a sub menu. Heading rate refers to how fast the APS updates the Azimuth and Tilt information. When selected, you can scroll through values of 1, 2, 5, or 10. This is the rate at which the APS is updating the Azimuth and Tilt. If you are in a fairly dynamic application, a faster heading rate is desirable, but if the application is more static (measuring from a tripod), a lower rate will be more stable.

8.12 UNITS Submenu

This menu allows you to set the appropriate units for you application. The options available for this menu item are:

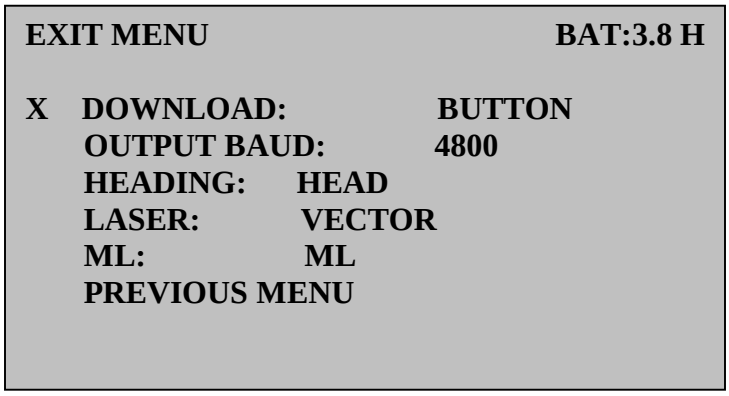
DISTANCE:	FEET, METERS
TILT:	º, %

DISTANCE refers to Range (from the laser) and Elevation (from the GPS Primary Antenna) measurements. The TILT default is displayed in degrees. Changing to % will display the angles in percent grade.

8.13 OUTPUT Submenu

When the OUTPUT item is pressed the following screen appears:

Figure 13: Data displayed on LCD Screen for Output Submenu



This submenu allows you to customize the data output for the APS. Here are the options available:

DOWNLOAD:	BUTTON, AUTO, TEST
OUTPUT BAUD:	4800, 9600, 19200, 38400, 57600, 115200
HEADING:	HEAD, HEAD + STN
LASER:	RP, RP + STN, STN + VECTOR, VECTOR
ML:	ML, ML + RP1 + RP2

The DOWNLOAD parameter allows you to specify how you want the data to be sent out the Data Port. You have a choice to review the data on the screen and then press the DWNLD (download) key or have it sent out automatically (AUTO). The TEST option is a factory-testing mode for debugging and should not be used unless MultiWave is providing support in the debugging process.

The OUTPUT BAUD rate is used to match the APS baud rate with your PC or data recorder. If you are using LTI's MapSmart program on the TDS Recon, select 4800.

The next three choices (HEADING, LASER and ML) send out data that follows the proprietary format guidelines of the NMEA 0183 Standard for Integrating Marine Electronic Navigational Devices, Revision 2.0 or know as NMEA format.

For:	RP, RP1, RP2 and STN:	$GPGGA (GPS format)
For:	HEAD:	$PLTIT (LTI Horizontal Vector format)
For:	ML	$PLTIT (LTI Missing Line format)

$GPGGA format example is as follows:

$GPGGA,213814.97,4343.41145,N,7941.64181,W,2,08,1.3,193.5,M,-35.5,M,,STN*1E

Name	**Example**	**Units**	**Description**
Message ID	**$GPGGA**		GGA header
UTC Time	**213814.97**		hhmmss.ss
Latitude	**4343.41145**		43º 43.41145’
N/S Indicator	**N**		N=North S=South
Longitude	**7941.64181**		79º 41.64181’
E/W Indicator	**W**		E=East W=West
Fix Indicator	**2**		0, 1 or 2
Satellites in view	**08**		0 to 12
HDOP	**1.3**		Horizontal Dilution of Precision
MSL Altitude	**193.5**	meters	Mean Sea Level Altitude
Units	**M**	meters	
Geoid Separation	**-35.5**	meters	Height above WGS84 ellipsoid
Units	**M**	meters	
Age of Diff. Corr.	**Null field**	second	
Dif. Ref. Station ID	**Null field**		
Checksum	**STN*1E**		STN*checksum or RP*checksum or RP1*checksum or RP2*checksum.
<CR><LF>			End of message termination.

LTI $PLTIT Horizontal Vector format example is as follows:

$PLTIT,HV,210.5,F,329.8,D,7.9,D,212.5,F*6B

Name	**Example**	**Units**	**Description**
Message ID	**$PLTIT**		LTI Header
Horizontal Vector	**HV**		Identifies as Criterion 400 Horizontal Vector format
Horizontal Distance	**210.5**		
Units of Horizontal Distance	**F**	Feet or Meters	
Azimuth	**329.8**	Degrees	For the APS this is True North.
Units of Azimuth	**D**	Degrees or Grads	
Inclination Angle	**7.9**	Degrees	
Units of Inclination Angle	**D**	Degrees or Grads	
Slope Distance	**212.5**		
Units of Slope Distance	**F**	Feet or Meters	
Checksum	***6B**		
<CR><LF>			End of message termination

LTI's $PLTIT Missing Line format example is as follows:

$PLTIT,ML,240.6,F,134.8,D,0.5,D,240.7,F*72

Name	**Example**	**Units**	**Description**
Message ID	**$PLTIT**		LTI Header
Horizontal Vector	**ML**		Identifies as Criterion 400 Missing Line format
Horizontal Distance	**240.6**		
Units of Horizontal Distance	**F**	Feet or Meters	
Relative Azimuth	**134.8**	Degrees	Azimuth between the two remote points.
Units of Azimuth	**D**	Degrees or Grads	
Vertical Angle	**0.5**	Degrees	
Units of Vertical Angle	**D**	Degrees or Grads	
Slope Distance	**240.7**		
Units of Slope Distance	**F**	Feet or Meters	
Checksum	***72**		
<CR><LF>			End of message termination

8.14 OUTPUT Examples

HEADING:

HEAD:
$PLTIT,HV,,,210.5,D,4.1,D,,*64

HEAD + STN:
$PLTIT,HV,,,210.1,D,4.2,D,,*63
$GPGGA,212910.99,4343.41145,N,7941.64181,W,2,09,1.0,193.3,M,-35.5,M,,STN*10

LASER:

RP:
$GPGGA,213300.99,4343.26839,N,7941.75863,W,2,10,0.9,198.6,M,-35.5,M,,RP*59

RP + STN:
$GPGGA,213459.01,4343.26887,N,7941.76197,W,2,09,1.2,199.1,M,-35.5,M,,RP*53
$GPGGA,213501.02,4343.41145,N,7941.64181,W,2,09,1.2,193.2,M,-35.5,M,,STN*1C

STN + VECTOR:
$GPGGA,213814.97,4343.41145,N,7941.64181,W,2,08,1.3,193.5,M,-35.5,M,,STN*1E
$PLTIT,HV,210.0,F,329.7,D,7.9,D,212.0,F*64

VECTOR:
$PLTIT,HV,209.5,F,329.6,D,7.8,D,211.5,F*6F

ML

ML:
$PLTIT,ML,240.6,F,134.8,D,0.5,D,240.7,F*72

ML + RP1 + RP2:
$PLTIT,ML,233.6,F,135.3,D,-0.0,D,233.6,F*51
$GPGGA,215247.01,4343.43100,N,7941.65659,W,2,08,1.3,198.2,M,-35.5,M,,RP1*6D
$GPGGA,215304.99,4343.40382,N,7941.61892,W,2,09,1.2,198.3,M,-35.5,M,,RP2*6E

8.15 ROLL

The ROLL of the APS will be displayed on the AZIM/TILT second menu as described in Section 8.2.

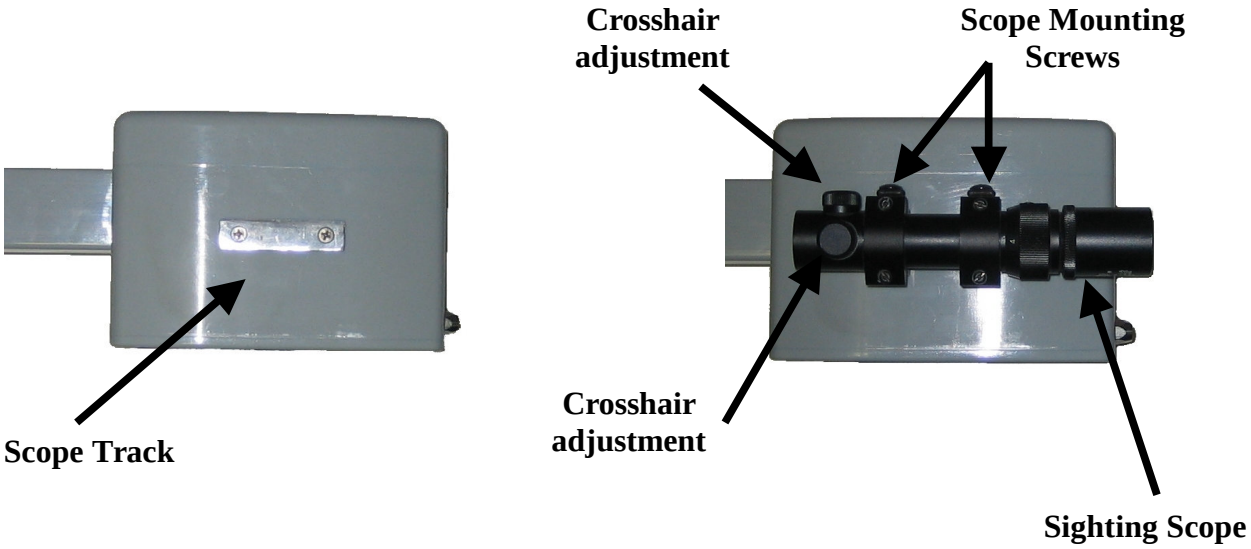
The options available for this menu are:

ROLL: ENABLED/DISABLED

9.0 Aligning the Sighting Scope

If you ordered the Sighting Scope with your APS, the Sighting Scope comes pre-aligned to the APS antennas. If you decide to order the Sighting Scope after you have received the APS, or it has been removed for some reason then follow these steps to re-attach and align:

Figure 14: Scope Track and Sighting Scope



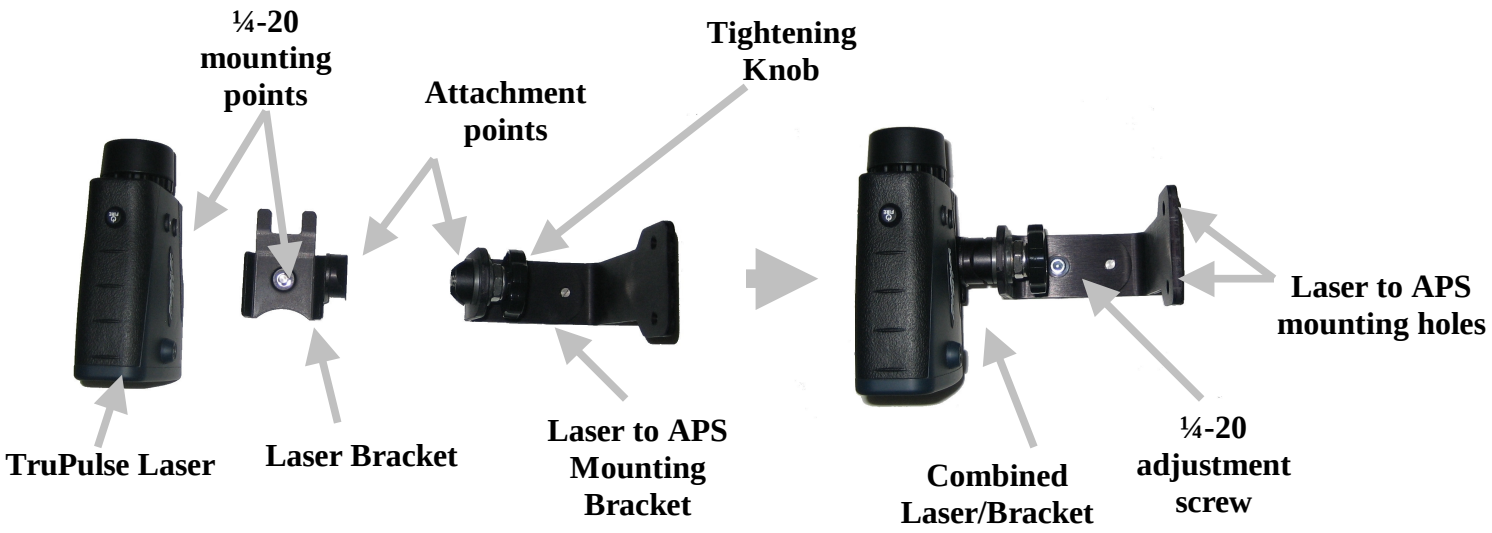
1) Attach the Scope Track to the left side of the APS using the screws provided.
2) Loosen the Mounting Screws on the Sighting Scope and slide over the Scope Track.
3) Tighten the Mounting Screws to secure the scope to the track.
4) Place the APS on a stable tripod.
5) Take outside and identify a target at least 1 km away.
6) Aim the APS at the target by sighting down the sides and tops of the antenna covers.
7) Remove the crosshair adjustment covers.
8) Using a screwdriver, adjust the crosshairs to the target.
9) Replace the crosshair adjustment covers.

10.0 Aligning the Laser

If you ordered the laser option with the APS, the associated brackets (Laser Bracket and Laser to APS Mounting Bracket) will be factory aligned. You need to follow the following steps if you ordered the laser option after receiving the APS or if the laser and Sighting Scope alignment has been compromised. It is however advisable to check the alignment if you have removed the Laser to APS Mounting Bracket.

The laser has a custom bracket (Laser Bracket), made by LTI, which is attached to the bottom of the laser through the ¼-20 mounting points. The Laser to APS Mounting Bracket attaches to the Laser Bracket by lining up the attachment points and tightening the Tightening Knob. The combined Laser/Bracket is then attached to the APS.

Figure 15: Top view of Laser, Laser Bracket, and Laser to APS Mounting Bracket



The laser only needs to be aligned with the APS in the horizontal direction since the laser can incline up and down. Follow steps 4-6 above and then follow these steps:

1) Follow steps 4-6 in Section 9.0 (Aligning the Sighting Scope) if required.
2) Attach the Laser Bracket to the laser.
3) Attach the APS Mounting Bracket to the APS using the screws provided.
4) Check the alignment by viewing a distant target, at least 1km away, with the Sighting Scope. Look through the laser and see if the vertical crosshair is on the target. If yes, then leave it as is. If not then proceed to 5.
5) Loosen the ¼-20 adjustment screw on the Laser to APS Mounting Bracket using the 3/16 Allen key provided.
6) Aim to a distant target at least 1km away through the Sighting Scope.
7) Swivel the laser until the vertical crosshair is on the target.
8) Tighten the adjustment screw using the Allen key.
9) Check the alignment.

11.0 Specifications

Performance	
Azimuth Accuracy:	<0.2° if GPS integrity is 80% or better 0.2° to 0.5° if GPS integrity is 50% to 80% 0.5° to 1.0° if GPS integrity is 30% to 50% 1.0° to 2.0° if GPS integrity is 30% or below
Tilt Accuracy:	± 0.2° (±0.1° typical)
GPS Positional Accuracy:	Sub meter (with WAAS) 2.5 m when WAAS not available
Physical	
Dimensions:	4" high x 26" long x 5" wide (no attached options)
Weight:	3.5 lbs without options (laser and sighting scope)
Enclosure:	Polycarbonate
APS Mounting:	1/4-20 and 5/8-11 threads for camera or survey tripod
Mounting for options:	Sighting Scope track and laser bracket attach to sides
LCD:	128 X 64 Graphic Transreflective with backlighting
Sound:	Programmable duration for button push tones
Membrane panel:	Custom panel with application hotkeys and menu system
Charging port:	Located on back panel between Output Port and Laser Port
Operational	
Display Modes on LCD:	Basic Heading (Azimuth, Tilt and GPS coordinates) Signal Intensity (bar chart of signal strength) Laser Offset (Remote Point Lat, Long, Elev.) Missing Line (Remote Vector and Coordinates)
Power	
Internal Battery:	Internal rechargeable lithium ion batteries
Operation time:	6.5 hours of use from full charge
Battery Monitor:	Displays remaining usage time in 0.1 hour increments
Battery Charger:	Lithium Ion smart charger (1.5 hours max charge time)
On/Off button:	Membrane panel button with LED indicator
Communications	
Output Port:	For downloading data to PC, PDA or Data Collector
Protocol:	Programmable baud, 8 data bits, no parity, 1 stop bit
Download cable:	Connects Output Port to computer (DB9)
Bluetooth:	Optional Class 1 Bluetooth
Format:	Standard NMEA formats ($GPGGA and $PLTIT)
Laser Port:	For Laser Offset and Missing Line modes
Environmental	
Operational Temperature:	-30º C to +60º C
Sealing:	NEMA 4, IP65

12.0 Troubleshooting

- APS won't get a solution (No Heading displayed on APS LCD User Interface Display).

This could be a result of poor satellite coverage, multipath effects, blockage from a building or large structure nearby, or severe RF interference in the vicinity.

Make sure that there is no object that is very close to the APS and above the antennas. For example if you stand right next to a truck with the APS below the body you may introduce multipath effects.

To mitigate the poor satellite coverage issue there is "GPS Planning Software" that can be used to determine the best time to use the APS. The most important factor to be aware of is the DOP charts. PDOP's, VDOP's, and HDOP's below 2 are excellent and are acceptable up to 3

- The Azimuth Measurement is fluctuating a lot.

This could be as a result of multipath effects (see above) or bad satellite geometry. Check the GPS Integrity value that it is at least above 30.

- APS won't turn on.

Most likely the battery requires charging. If the APS has been charged and still does not turn on then contact Multiwave.

- Data being output to the PC or PDA through the APS data port does not look right.

Check the baud rate of the APS and the PC/PDA.

Contact and Warranty Information

Contact Information

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Warranty Information

MultiWave Sensors Inc. (MWS) warrants the Azimuth Pointing System (APS) to be in good working order for a period of one year from the date of purchase. Should the product fail to be in good working order at any time during the warranty period, MWS will, at its option, repair or replace the product at no additional charge, except as set forth below. This limited warranty does not include service or repair of damage to the product resulting from accident, disaster, misuse, abuse, or non-MWS modification of the product.

If this product is not in good working order are warranted above, your sole remedy shall be repair or replacement as provided above. In no event will MWS be liable to you for any damages arising for your damages, including any lost profits, lost savings, or other incidental or consequential damages arising from the use or inability to use such product. Futhermore, MWS shall not be responsible if any MWS authorized dealer has been advised of the possibility of such damages, or for any claim by another party.

The APS is sealed for waterproofing and RF shielding at the factory. Any attempt to open the APS enclosure will immediately void the warranty unless there is written permission from MWS.