

Smart Aligner

USERS GUIDE

V1.1

January 2015



MultiWave *Sensors*

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1 Introduction

The Smart Aligner System is a GPS-based compass designed to effectively and efficiently align antennas in real time. The Smart Aligner Tool provides a True North or Grid North Azimuth measurement, Tilt, Roll and Position. Once the Tool is mounted to the antenna using the Universal Mounting Bracket, the Tool is simply turned on. From there the user interface is the full feature App on any iOS or Android smart device. Reporting is as simple as a few clicks with the report being able to be emailed directly from the App. The Tool can be mounted in eighteen different configurations for the most demanding spatial and RF conditions. For transport and storage the Tool folds to within 19" in length.

DOWNLOAD THE iOS Smart Aligner App from the App Store by searching for "Smart Aligner Multiwave"
DOWNLOAD the Android Smart Aligner App from Google Play by searching for "Smart Aligner Multiwave"

2 Safety

WARNING



When transporting/carrying the Smart Aligner System up a tower follow all relevant safety procedures and requirements. Always use the tether lines as described in this manual.

Use supplied or approved chargers (12VDC – 1.5A) to charge the battery.

3 Approvals



Declaration of Conformity

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

EMC
FCC Part 15 Subpart B: 2008
EN 61326-1
ICES-003:2004

Safety
EN 61010-1

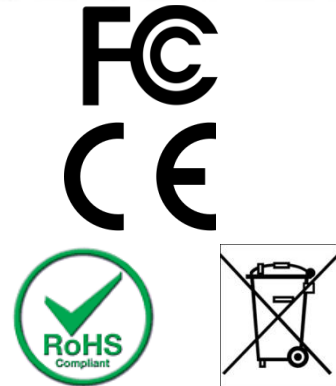
RoHS and WEEE Compliance

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

RoHS : **R**estriction of 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 Smart Aligner System is compliant with the above directives.

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





Ruggedized Carrying Case: All components fit in the case. The case is carry on baggage acceptable.

Backpack: To carry the Smart Aligner Tool and Brackets. Two separate compartments within.

Smart Aligner Tool: For measuring Azimuth, Tilt, Roll and Position of Antenna.

Slot for Options : Laser Rangefinder for measuring AGL, AIR21 Mounting Bracket, Custom Brackets

Universal Mounting Bracket: Bracket that attaches to Antenna. Smart Aligner Tool attaches to Bracket. Combined Bracket and Tool to align the antenna.

Smart Phone slot: For iPhone or Android based Smart Phone.

Wall Charger: For charging the Smart Aligner Tool.

Car Charger: For charging the Smart Aligner Tool.

NOTE: Throughout this Guide the “Smart Aligner Tool” will be referred to as the “**Tool**”
The “Universal Mounting Bracket” will be referred to as the “**Bracket**”



Short Arm: Contains first GPS antenna. From stored position: Rotates to $+90^\circ$ and 180° OR -90° and 180°

Long Arm: Contains Second GPS antenna. From stored position: Stored position to $+90^\circ$ OR Stored Position to -90°

Charging Port: Port for Wall or Car Charger

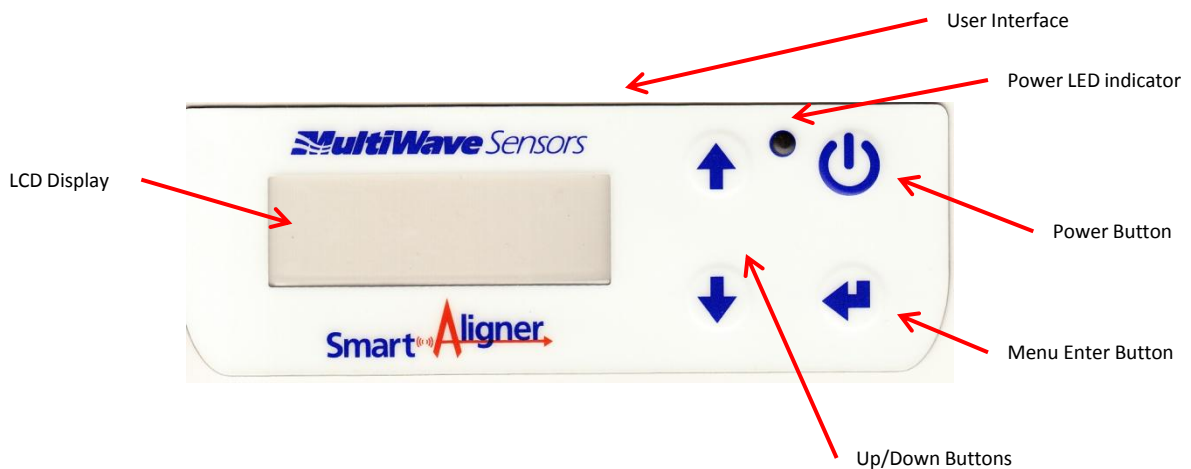
User Interface : LCD Screen, Menu Buttons and Power Button

Tether Line/Pin: Attaches to Bracket

Mounting Screw Knob: Attaches to Mounting Screw Knob receptacle on Bracket

Mounting Dowel Pins: Attaches to Dowel Pin Receptacles on Bracket

Data/Laser Port: Used with Laser Rangefinder option for AGL measurement



6

Arm Positions

The Long Arm and Short Arm each contain a GPS antenna. The arms can be rotated to three different fixed baseline positions. Each position sets the two GPS antennas at a separation of 0.5m for optimum accuracy. The "T" positions also extend the baseline away from the antenna that is being aligned to minimize or eliminate GPS multipath errors. For each of the positions the Tool compensates the Azimuth measurement so that the Azimuth is always calculated based on the Forward position. For example: If the Forward azimuth is 0° then moving the arms to the Left T position would point the arms at 270° . Sensors in the arms detect the rotation and compensate the azimuth $+90^\circ$ back to 0° (or $270^\circ + 90^\circ = 360^\circ = 0^\circ$). In the Right T position the arms would point at 90° . Sensors in the arms detect the rotation and compensate the azimuth -90° back to 0° (or $90^\circ - 90^\circ = 0^\circ$). When the Tool is mounted on the Bracket there are sensors that compensate the Azimuth based on how the Tool is mounted. Tilt and Roll are also compensated in all configurations.

Forward



Left T



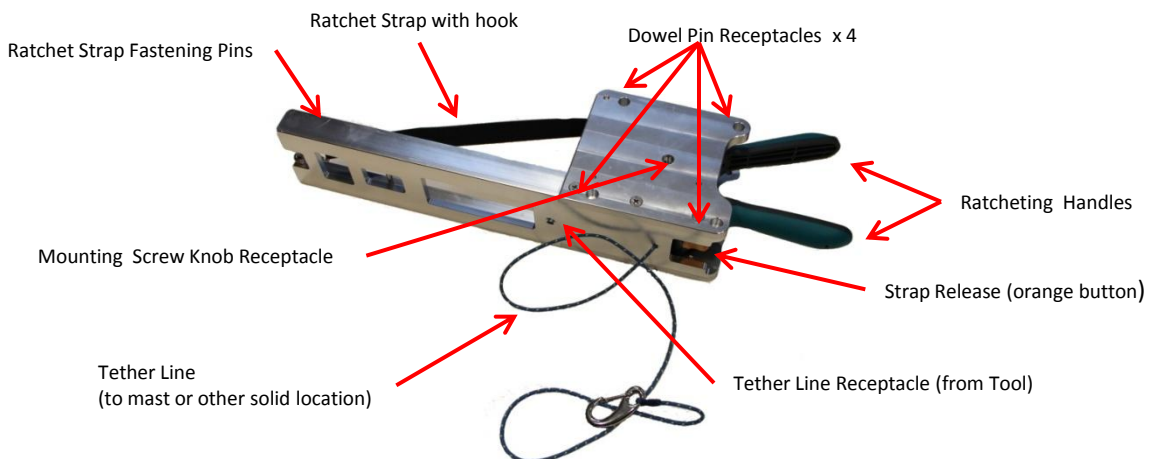
Right T



7

Bracket Description

The Bracket attaches to the antenna to be aligned. The Tool attaches to the Bracket by mating the Mounting Dowel Pins on the Tool to the Dowel Pin Receptacles on the Bracket. The Bracket can be attached to the left or right side of the antenna (right side position is shown). The Tool can be attached in three different positions on the Bracket. Sensors in the Bracket compensate the Azimuth based on the three different positions.



Ratchet Strap Fastening Pins: Ratchet Strap hook attaches to Pin.

Ratchet Strap with hook: Strap goes around the front of the antenna and hook is attached to the Fastening Pins

Dowel Pin Receptacles: The two Mounting Dowel Pins on the Smart Aligner Tool mate to two Dowel Pin Receptacles on the Bracket. The Tool can be attached Front or Back or Right/Left.

Mounting Screw Knob Receptacle: Mounting Screw Knob on Smart Aligner Tool is secured here.

Ratcheting Handles: When handles are ratcheted the strap is tightened around the antenna to be aligned.

Strap Release: Releases tension on Strap.

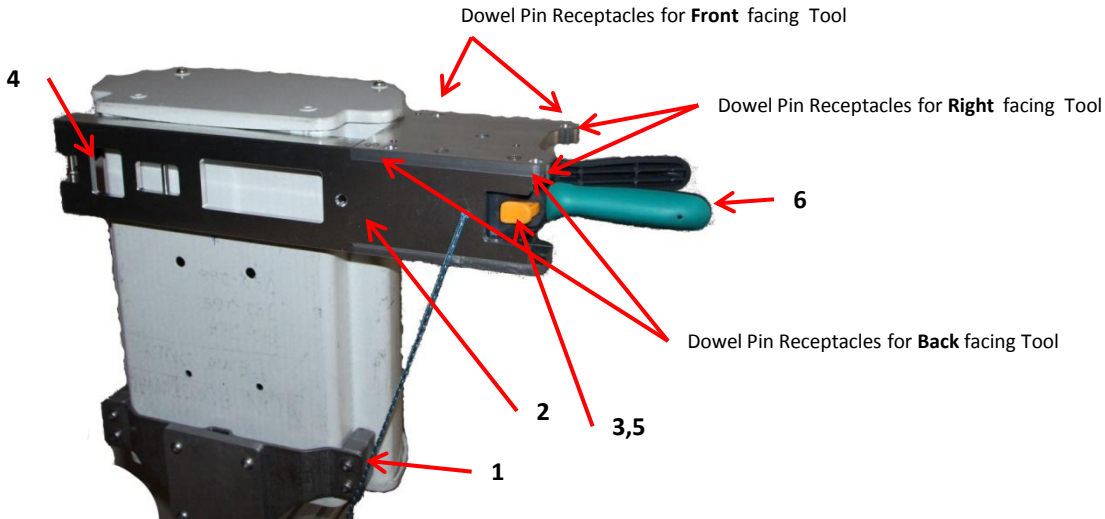
Tether Line Receptacle (from Tool): Tether Line from Smart Aligner Tool is secured here.

Tether Line (to mast or solid location): Tether Line is secured to the mast or any solid location

8

Bracket Attached to the Antenna

The Bracket is shown mounted on the right side of the antenna to be aligned. The Bracket can also be mounted on the left side of the antenna. The four Dowel Pin Receptacles on the Bracket allow for attaching the Tool facing Front, Back or Right. If the Bracket was mounted on the left side of the antenna then the Tool can face Front, Back or Left. Sensors in the Bracket compensate for the Azimuth due to the different positions of the Tool.



8.1

Procedure to Attach the Bracket to the Antenna to be Aligned

1. Tether the *Bracket* to a solid location.
2. Set the *Bracket* on the backplane of the antenna as shown. Keep the *Bracket* in place by holding on to the handle.
3. Depress the orange *Strap Release* button with your thumb and hold it
4. With your other hand attach the hook of the *Ratchet Strap* to the appropriate *Ratchet Strap Fastening Pin*
5. Release the orange *Strap Release* button but still hold the *Bracket*
6. Squeeze the *Ratcheting Handles* until the *Bracket* is tight to the antenna
7. You are now ready to attach the Tool to the Bracket

The Tool and Bracket can be attached to the antenna in 18 different configurations.

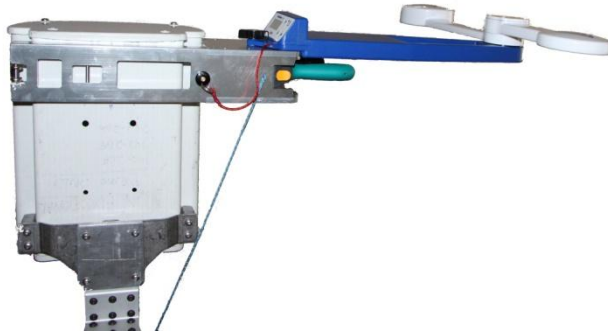
The 18 configurations are:

- 1-2** Right or Left side of antenna: Tool facing Front on Bracket, Arms Forward
- 3-4** Right or Left side of antenna: Tool facing Front on Bracket, Arms Left T (shown below)
- 5-6** Right or Left side of antenna: Tool facing Front on Bracket, Arms Right T
- 7-8** Right or Left side of antenna: Tool facing Right on Bracket, Arms Forward
- 9-10** Right or Left side of antenna: Tool facing Right on Bracket, Arms Left T
- 11-12** Right or Left Side of antenna: Tool facing Right on Bracket, Arms Right T (shown below)
- 13-14** Right or Left side of antenna: Tool facing Back on Bracket, Arms Forward
- 15-16** Right or Left side of antenna: Tool facing Back on Bracket, Arms Left T
- 17-18** Right or Left Side of antenna: Tool facing Back on Bracket, Arms Right T (shown below)

Right side of antenna: Tool facing Front, Arms Left T



Right side of antenna: Tool facing Right, Arms Right T

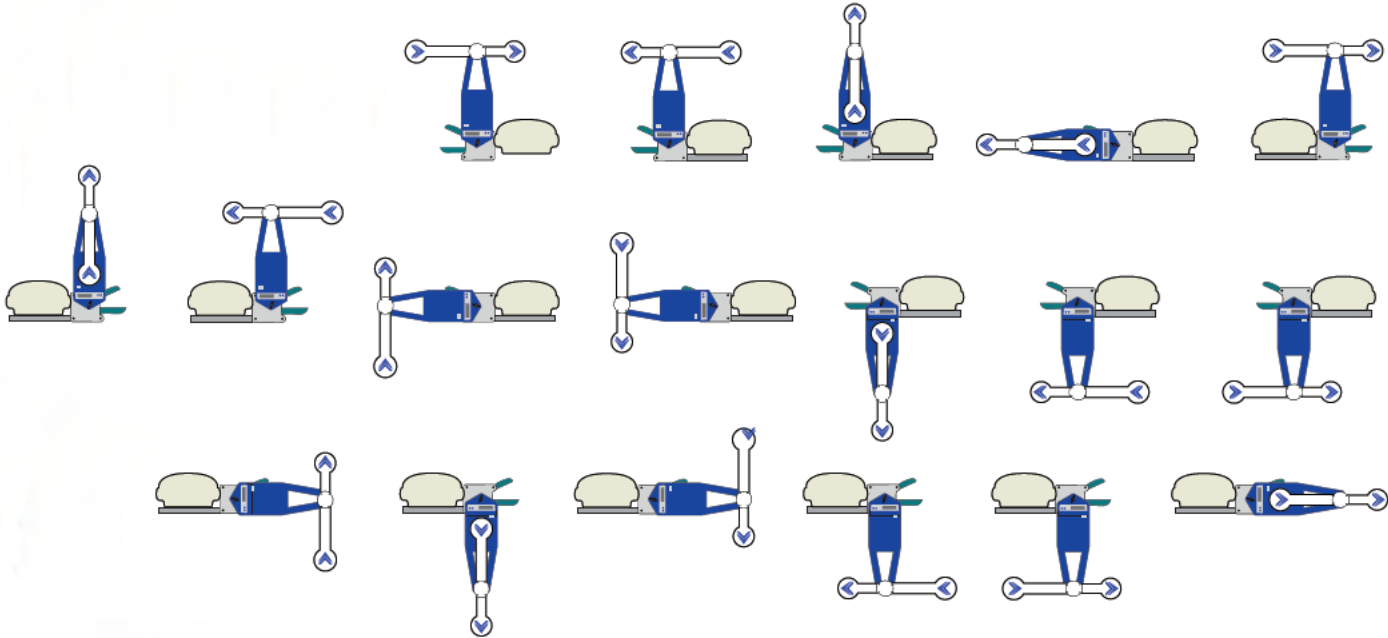
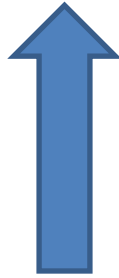


Right side of antenna: Tool facing Back, Arms Right T



No matter which configuration the Tool and Bracket are mounted to the antenna the **Antenna Azimuth** will be compensated. The user does not need to set any offsets. Sensors in the Bracket and Tool detect the configuration and automatically compensate the Azimuth, Tilt and Roll of the antenna. The different configurations are useful when there are mechanical constraints or excessive RF radiation from a live antenna. The T positions allow for extension of the two GPS antenna elements away from the antenna to mitigate any GPS multi-path effects which will degrade accuracy.


Antenna Azimuth

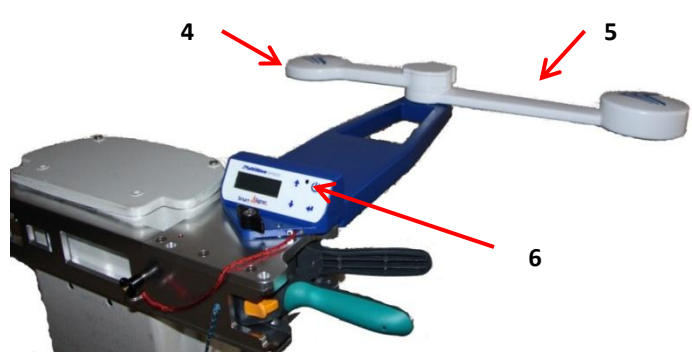
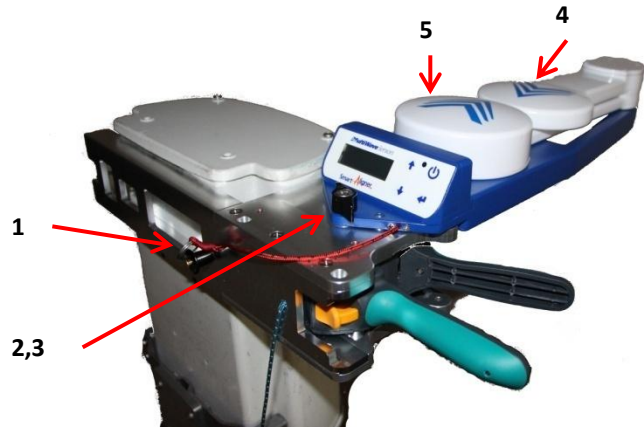


9.2

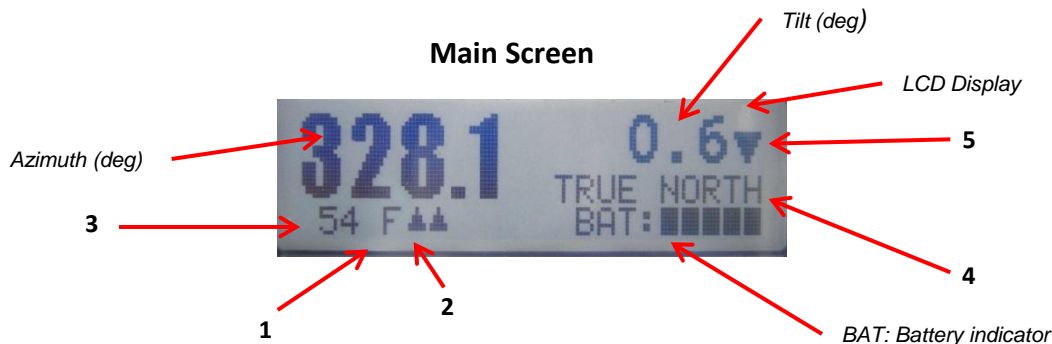
Procedure to attach the Tool to the Bracket

Example is for Right side of antenna: Tool facing Front, Arms Left T

1. Tether the *Tool* to the *Bracket*
2. Line up the *Mounting Dowel Pins* (underside of *Tool*) to the *Dowel Pin Receptacles* on the *Bracket*
3. Tighten the *Mounting Screw Knob* on the *Tool*
4. Rotate *Short Arm* clockwise till you feel/hear it click in and engage
5. Rotate the *Long Arm* counter-clockwise till you feel/hear it click in and engage
6. Press the POWER  button on the *User Interface* and wait for an azimuth solution
7. See next section for description of what you will see on the LCD *User Interface Screen* and how to navigate the menu items



When the Tool is turned on in the folded position it starts with the message **“Position Arms”** that indicates that the arms need to be deployed to one of the arm positions. Once the arms are deployed the message **“Starting Solution”** appears and an azimuth solution is being calculated. Once calculated the Azimuth, Azimuth Type, Tilt, Tilt Direction, GPS Integrity, Battery and Bracket/Arms position is displayed on the main screen. The secondary screen (displayed by pressing the down arrow on the User Interface) displays the GPS coordinates, Elevation, Tilt, Tilt Direction, Roll, Roll Direction, and AGL.



1. Tool on Bracket Position: Front (shown), Right, Left, Back

2. Arm Positions

Forward: Small Arm Forward: Long Arm Forward (shown)

Left T: Small Arm Left: Long Arm Left

Right T: Small Arm Right: Long Arm Right

Folded: Small Arm Folded: Long Arm Forward



3. GPS Integrity: Value from 0 to 100 to determine the quality of the azimuth measurement. It is a proprietary algorithm based on GPS Satellite and calculated diagnostics.

GPS Integrity > 70: Excellent

GPS Integrity > 60: Very Good

GPS Integrity > 30: Good

4. Azimuth Type:

TRUE NORTH is used throughout most of the world for aligning antennas. NO MAGNETIC DECLINATION IS REQUIRED

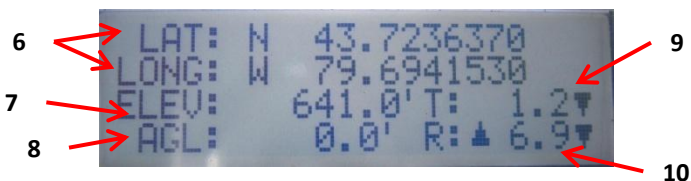
GRID NORTH: Some areas in the UK and other European countries

5. Tilt Direction: Downtilt

Uptilt



Secondary Screen



6. LAT, LONG: Latitude and Longitude

7. ELEV: Elevation from the GPS

8. AGL: From Laser Rangefinder

9. Tilt: “T” for Tilt. The arrow shows the Tilt Direction

10. Roll: “R” for Roll. The two arrows show the Roll Direction. The example ▲6.9 ▼ shows the tool Rolled to the right side

11

User Menu

To view the User Interface Menu press the Menu Enter button

Scroll through the menu using the Up/Down buttons

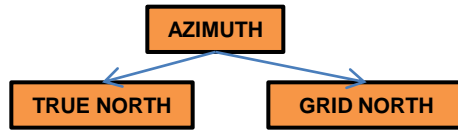
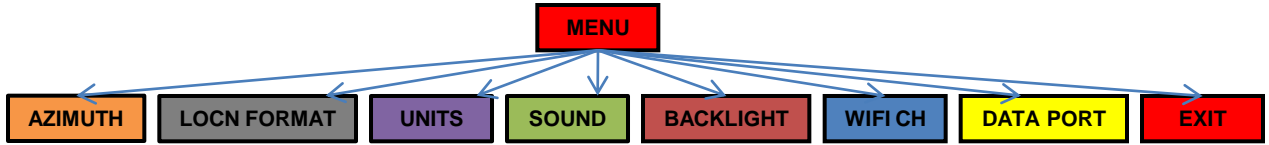
There will be a > next to the selected menu item.

Press the Menu Enter button to toggle the selection.

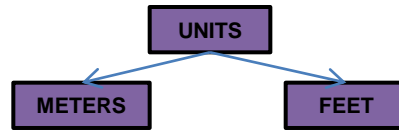
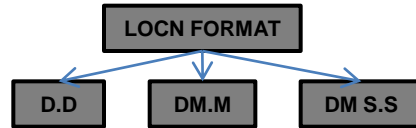
Use the Up/Down buttons to continue through the menu.

When finished go to EXIT and press the Menu Enter button

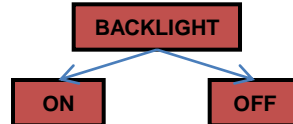
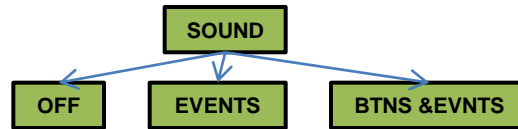
The item(s) selected will be saved.



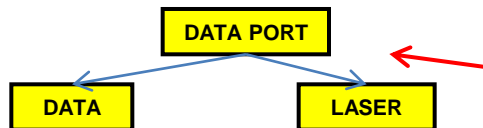
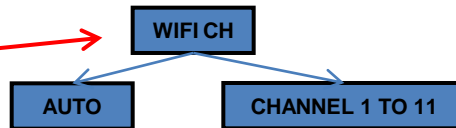
LOCN = LOCATION (Latitude & Longitude)
D.D: Decimal Degrees
DM.M: DegreesMinutes.DecimalMinutes
DM.S.S: Degrees Minutes Seconds



EVENTS: Such as when a solution is calculated there will be a beep.
BTNS: When a button is pressed there will be a beep.



If you are having problems connecting to WiFi you can select a specific channel.
AUTO: Selects the best available channel automatically.



Laser: TruPulse 200 Laser Rangefinder. Used for Laser AGL measurement.

12

Viewing the Diagnostic and Information Menu

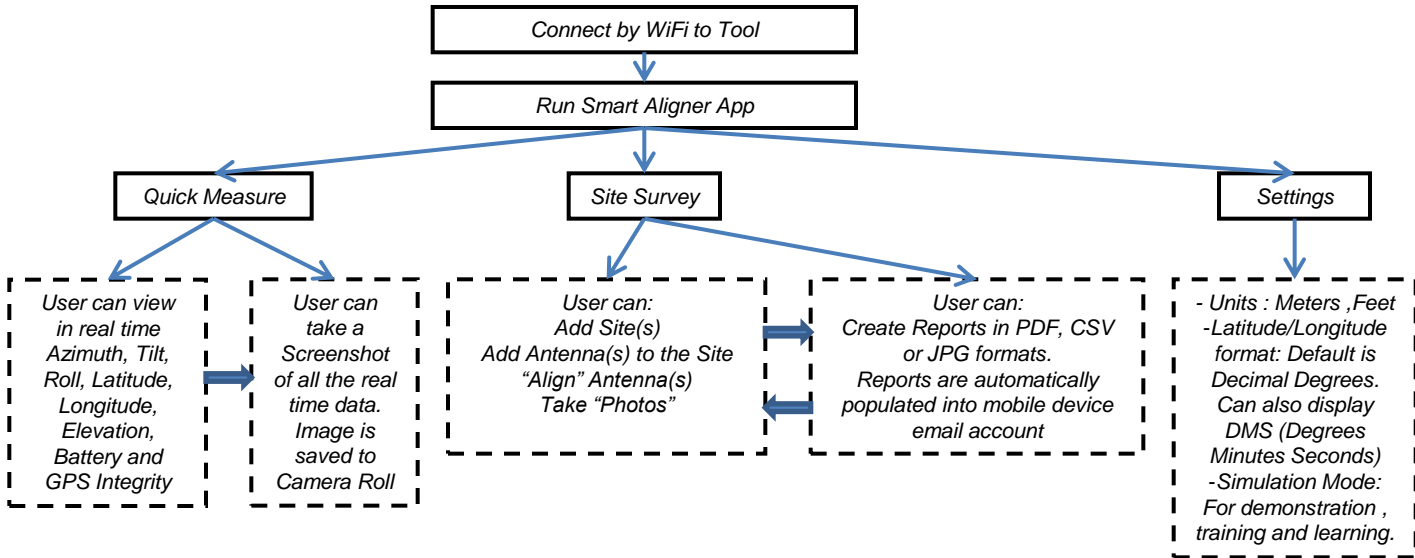
Diagnostic and other Information can be viewed by pressing the Up/Down buttons from the main screen

- Latitude, Longitude, Elevation, AGL, Tilt, Roll (Information)
- Firmware version, Serial Number, WiFi channel (Information)
- GLN and GPS Satellite information (Diagnostic)
- CSEP, HDOP, GPS>50, GLN>50 (Diagnostic)



A full feature App (for iOS 7.0 or greater and Android 4.1 or greater) is used for real time measuring and to create Antenna Alignment closeout reports. The user installs the App from either the App Store or Google Play by searching for “smart aligner multiwave”. The App is free. Described here is the iOS App. The Android and iOS Apps are identical in operation and look but may be different with respect to the gestures offered by the different operating systems. There will be a note describing the differences for each of the cases.

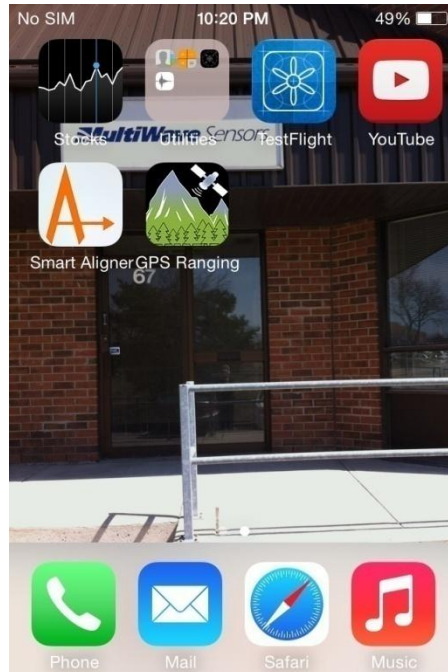
13.1 Smart Aligner App flow



Connection to WiFi



App on iPhone



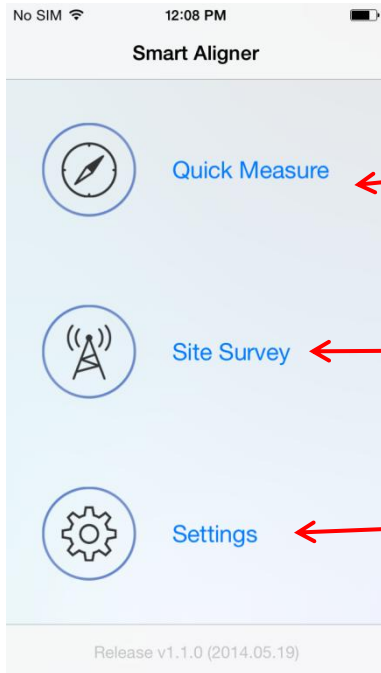
Initial Splash Screen



13.2 App Detailed Description

This section will describe the different screens and features available on the App. After the end of this section there will be a step by step guide for the user to follow to get familiar with the App. There are some advanced features in the App that will be described in the Advanced Features section.

Main Screen



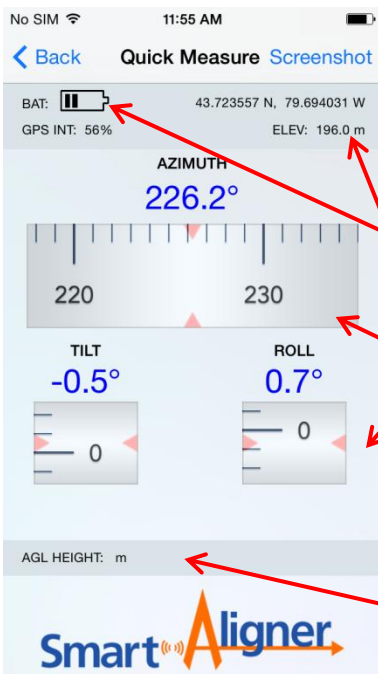
Quick Measure displays all the relevant alignment data without having to create a Site. The user has the option of taking a screenshot of the alignment data and add notes to the image.

Site Survey is used to add/edit a site, perform an alignment, verify the alignment and create a closeout report. Pictures can also be taken which are then added to the report.

User Settings: Units, Location format, and Simulation Mode

13.3 Quick Measure

Screen 1



When "Screenshot" is selected an "Image Notes" screen is displayed with the keyboard. The user can then add text such as Site or other information. The text and time/date will be annotated to the image and copied to the Camera Roll directory.

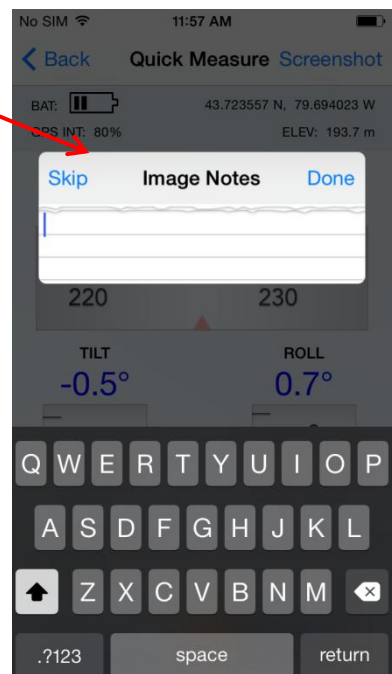
BAT: Tool battery life. Five bars represent around 10hrs of battery life.

Relevant antenna alignment data is shown: Azimuth, Tilt, Roll, Latitude, Longitude and GPS Elevation.

AGL HEIGHT: The Laser can be used to measure AGL HEIGHT and will be displayed here.

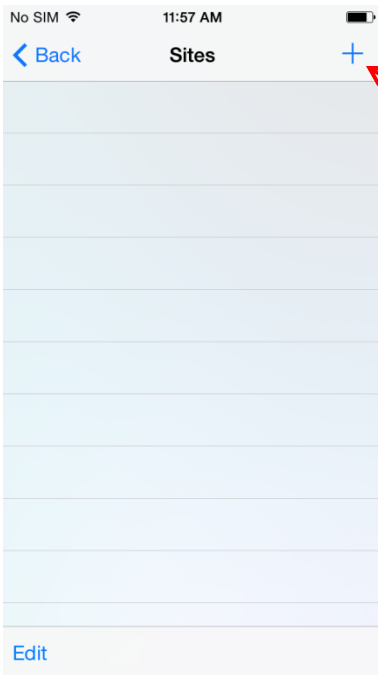
Screen 2

After Pressing "Screenshot" in Screen 1



Screen 1

After Pressing "Site Survey" in Main Screen



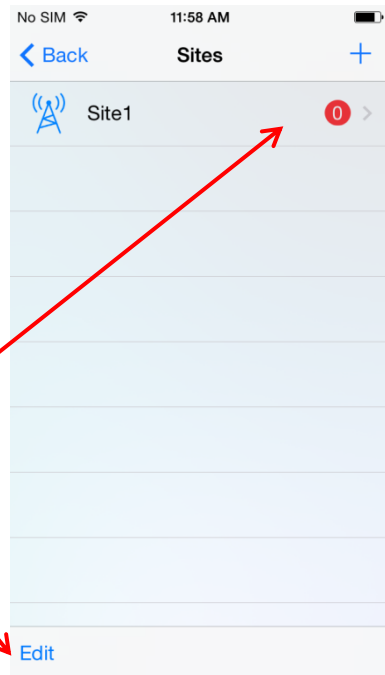
Create/Add a Site.
A screen and keyboard will be displayed to enter the Site name

Refers to the number of antennas within the Site. Shown here is "0" because no antennas have been created yet. When antennas are created the number of antennas will be displayed and the background will turn from red to blue.

For deleting Sites

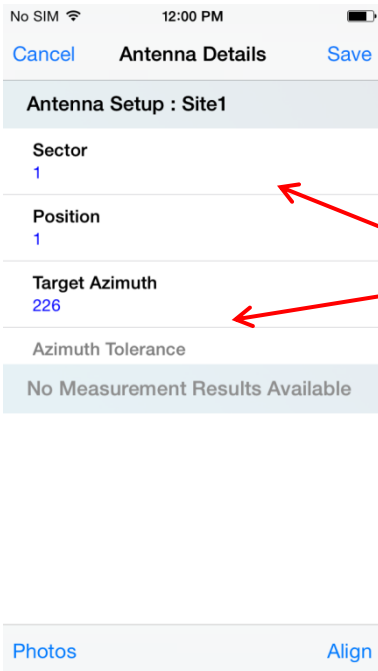
Screen 2

After Pressing "+" in Screen 1



Screen 3

After Pressing Site ("Site 1" shown)



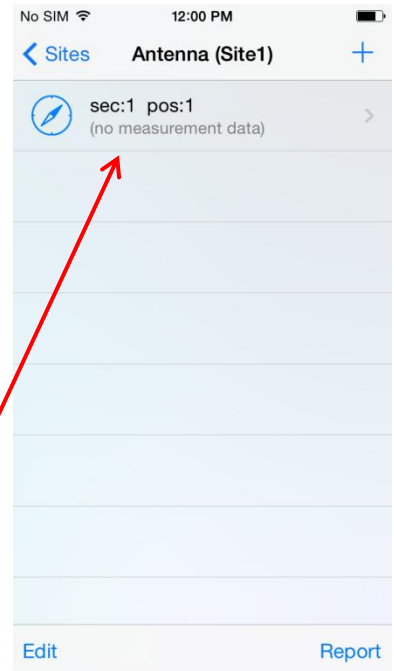
Antenna Information to be entered:
When each item is selected a keyboard will be displayed. Information is added or viewed by scrolling.

- Sector**
- Position**
- Target Azimuth**
- Azimuth Tolerance (See Advanced section)**
- Target Mechanical Tilt**
- Target Mechanical Roll**
- Electrical Tilt**
- Carrier**
- Contractor**
- Antenna Type**
- Serial Number**
- User Input 1 to 5**

Antenna is identified by the Sector and Position. Since the antenna was not aligned and verified there is no measurement data.

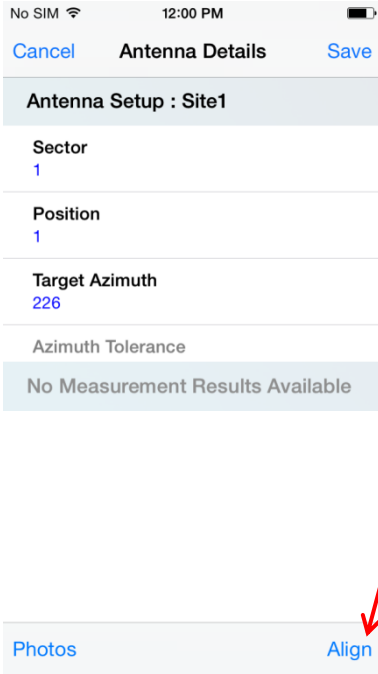
Screen 4

After Pressing "Save" in Screen 3



Screen 5

After Pressing the sec:1 pos:1 Antenna



Press "Align"
The "Align Antenna" screen will be displayed. The user aligns the antenna based on the target information entered. Once the user has aligned the antenna to the Carrier accuracy required the user is now ready for verification.

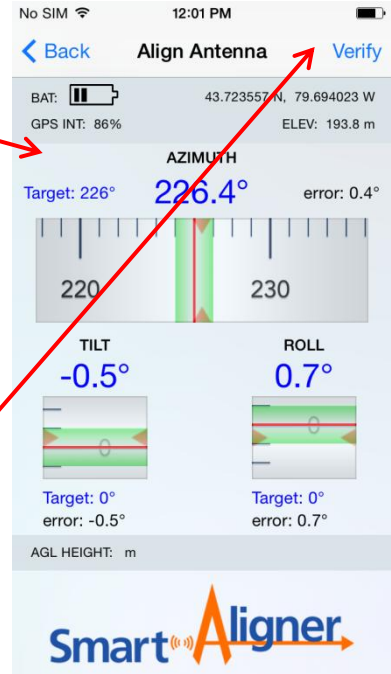
Press "Verify"
During verification the Tool is calculating the average Azimuth. The following message will be displayed while calculating



Verifying alignment...

Screen 6

After Pressing "Align" in Screen 5



Screen 7

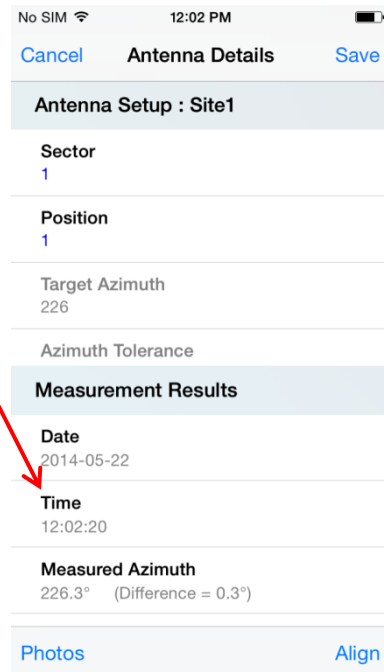
After "Verifying alignment" is completed



"Measurement Results" are saved and displayed after accepting the alignment. You can scroll down to see all the results.

Screen 8

After pressing "Accept"



Screen 8-Scroll Down

No SIM 12:02 PM

Cancel Antenna Details Save

Antenna Setup : Site1

Sector
1

Position
1

Target Azimuth
226

Azimuth Tolerance

Measurement Results

Elevation
194.0 m

AGL Height
m (LASER)

GPS Integrity
77

Photos Align

Screen 9

After tapping "AGL Height"

No SIM 12:02 PM

Cancel Update AGL Height Save

user laser

New height m

1 2 3
4 ABC DEF
5 GHI JKL MNO
6 PQRS TUV WXYZ
7 8 9
0

The "AGL Height" can be entered manually here.

If using the optional Laser Rangefinder then tap "Laser". The keyboard will disappear. Connect the Laser Rangefinder, aim to the ground and take a shot. The Tool will automatically calculate the AGL and will be displayed.

Screen 10

After entering an "AGL" from Screen 9

No SIM 12:03 PM

Cancel Antenna Details Save

Antenna Setup : Site1

Sector
1

Position
1

Target Azimuth
226

Azimuth Tolerance

Measurement Results

Elevation
194.0 m

AGL Height
75 m (USER)

GPS Integrity
77

Photos Align

"AGL Height" displayed here. In this example it was a manual entry and therefore it is shown as "USER". If a "Laser" shot was taken it would display "LASER"

Tap the camera icon and the phone camera will be activated to take an image

Screen 11

After tapping "Photo" in Screen 10

No SIM 12:03 PM

Back Antenna Photos

Camera icon

Screen 12
After tapping the Camera icon



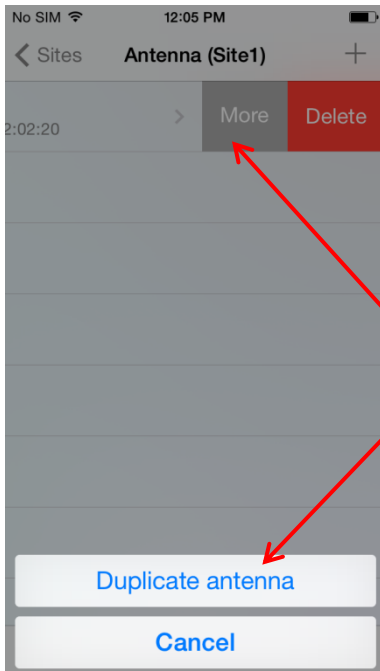
Take a picture and to store the image tap "Use"

Scroll through the images that have been taken. Up to four pictures can be taken and saved to the report.

Screen 13
Up to four pictures can be taken



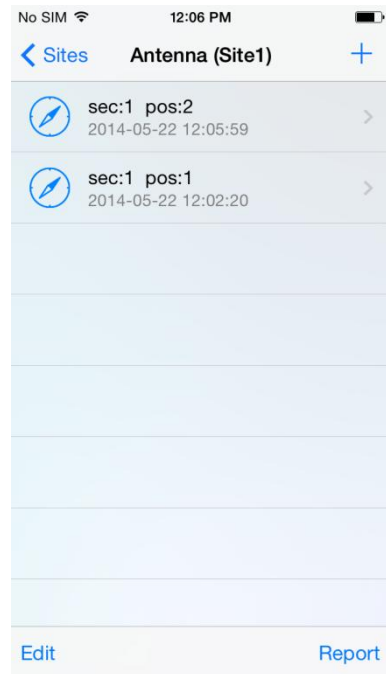
Screen 14
Back to the Antenna (Site) list and swiping left from the ">"



Tapping on "More" and then "Duplicate antenna" will allow the user to create a new antenna with the identical information as the chosen antenna. The user can then edit the information. For example the only different information for each antenna may be the Sector and Position. These values can be easily edited and saved.

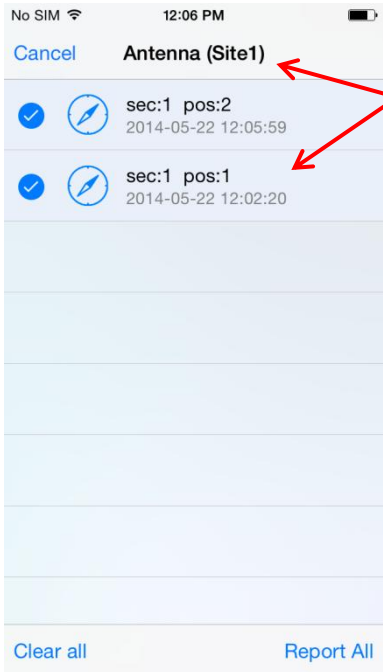
Screen 15

After duplicating an antenna, changing Position to 2, aligning and verifying the antenna. Ready for Report



Screen 16

After tapping "Report", "Select all" in the Antenna list

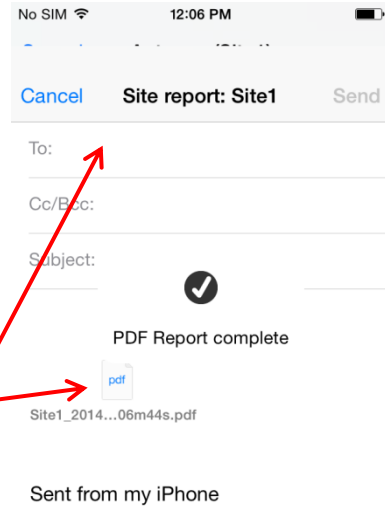


The following antennas within "Site1" (example) will be included in the report.

The report can now be emailed
See next page for an example of a report

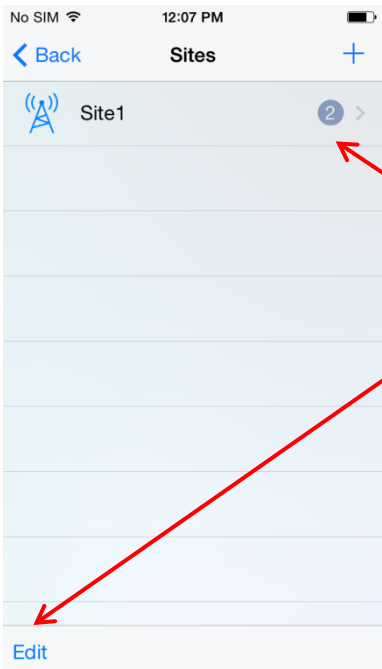
Screen 17

After tapping "Report All" in Screen 16



Screen 18

Go back to Sites list



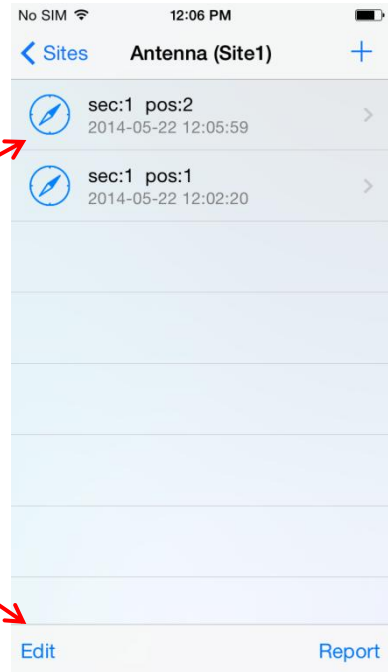
There are 2 antennas within Site1

For deleting Sites.
"Select All" or delete individually

For deleting Antennas.
"Select All" or delete individually

Screen 19

Tap on "Site1" example.



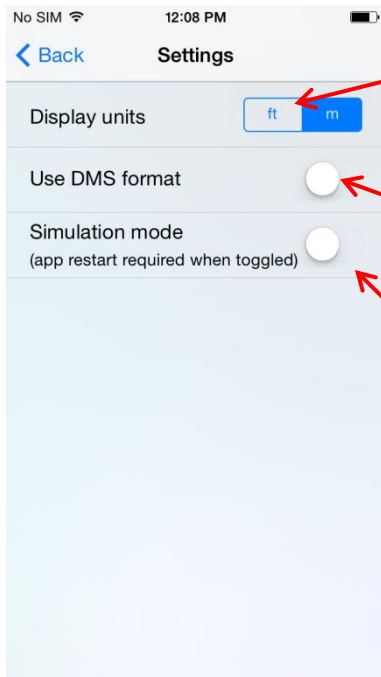
Site Alignment Results

Site Name: Buckingham circle
Report Date: 2014-09-10 @ 18:59:07

Sector:	beta	Position: b3	Antenna Type:	Amphenol/bxa-700800-6cf-edin	Serial Number:
Alignment Date:	29/08/2014	Contractor:	hts	Carrier:	Verizon
Alignment Time:	8:09:49	Latitude:	38°1'14.881" N	Target Mechanical Tilt:	0
Target Azimuth:	90°	Longitude:	78°31'48.996" W	Measured Mechanical Tilt:	-0.3
Measured Azimuth:	91.3°	Elevation:	609.69 ft	Difference:	0.3
Difference:	1.3°	GPS Integrity:	86	Electrical Tilt:	0
Azimuth Tolerance:	°	AGL Height:	102 ft (user)	Target Mechanical Roll:	0
Azimuth Type:	True North			Measured Mechanical Roll:	-4.8
UserInput1:	6'X8"X6"			Difference:	4.8
UserInput2:	3'6"				
UserInput3:	n/a				
UserInput4:	ldf4-50a/4'				
UserInput5:	n/a				



Screen 1



Units will be converted for:
Elevation
AGL Height

DMS : Degrees Minutes Seconds
for Latitude and Longitude.
Decimal Degrees is default

When Simulation mode is on this
will be red.
App must be RESTARTED when
toggling Simulation Mode

SIMULATION will be displayed
across the Quick Measure screen
and the Align antenna screen

Simulation Mode

Functional Differences**Report**

The main functional difference between the iOS and Android App is the Report format. The iOS operating system has always included PDF generation while any Android version below 4.4 (KitKat) has not. Therefore for any Android phone that does not have 4.4 or greater the Report generated will be in JPG format. For 4.4 and greater the user will have the option to choose JPG but the default Report will be PDF. When a JPG Report is generated each antenna will have its own separate file while a PDF Report will contain all the antennas in a multiple page file.

Camera

The differences are how a picture is taken. Different Android phones may all not be the same.

Display Differences

The iOS app displays "Save" and "Cancel". Android app displays ✓ or X .

Operating System Differences

Swiping vs Touch and Hold: To create a Duplicate Antenna in iOS you need to swipe as described in Screen 14. For Android you need to Touch and Hold and the Duplicate Antenna will be displayed. Same process for Deleting a Site or Exporting (Advanced section).

14

Advanced App Features

The App contains several advanced features that may not be used that often or not required by the Carriers. The advanced features are: Import/Export of a csv file, Azimuth Tolerance, and Laser Rangefinder measurements.

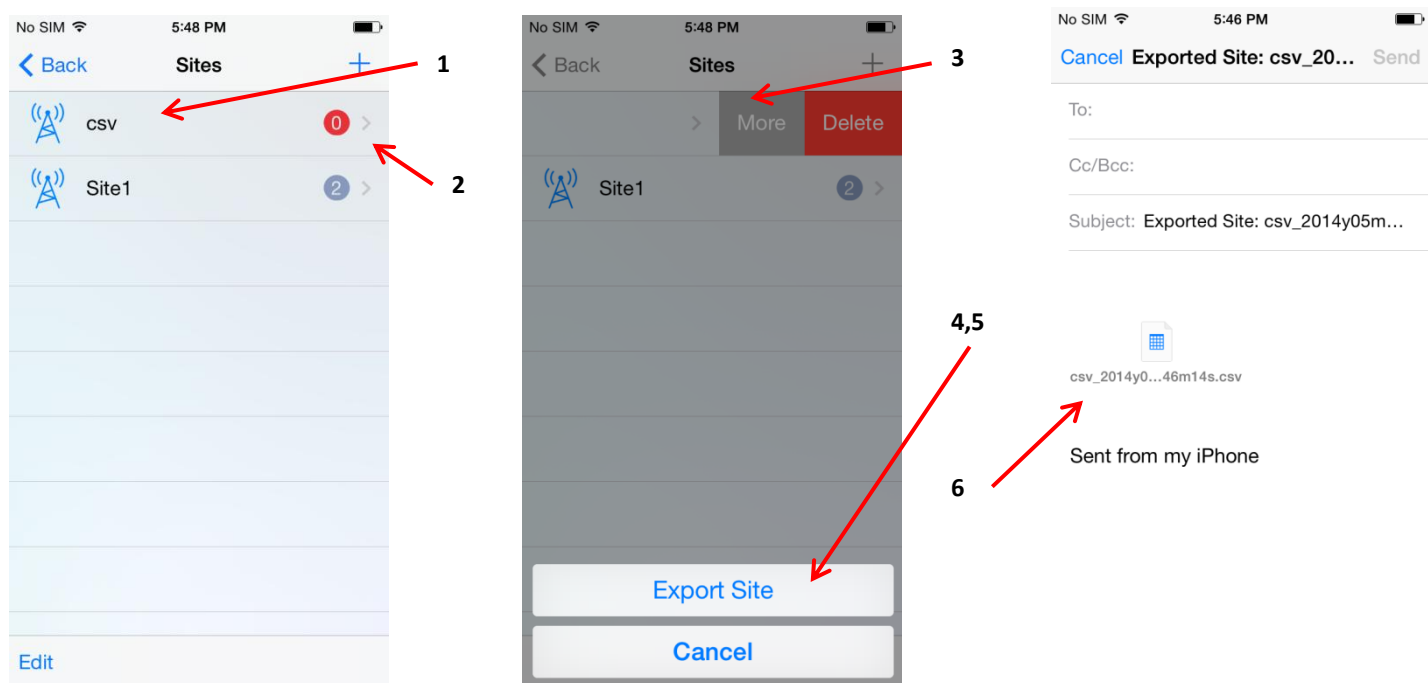
14.1 Import/Export of a csv Site File

This option allows the user or RF engineer to enter the antenna information into a csv file. The csv file can then be emailed and directly imported into the Smart Aligner App. The user imports the file and the Antenna Setup information is populated. Multiple antennas can be listed. It is best to create a blank/generic csv file with the App and then modifying it for import into the App. Once imported and used to align the antennas a csv file can be exported with all the alignment measurement data.

14.2 Create a Blank/Generic csv File

Run Smart Aligner App

1. Create a "New Site". For example call it "csv"
2. Swipe left from the ">" and
3. Tap "More"
4. Tap "Export Site"
5. Tap "Yes"
6. The csv file is attached to your email client. The file can now be emailed.



14.3**csv File Description**

The csv has eighteen (18) User entered fields and twenty one (21) Measurement fields. The User fields are entered by the User and the Measurement fields are automatically populated after an alignment and verification.

14.4**USER Entered Values**

<u>FIELD</u>	<u>FORMAT</u>
#	Integer
Site ID	All characters
Sector	All characters
Position	All characters
Target Azimuth	Decimal degrees (0 to 360)
Azimuth Tolerance	Decimal degrees (>0)
Target Mechanical Tilt	Decimal degrees (-90 to 90)
Target Mechanical Roll	Decimal degrees (-90 to 90)
Electrical Tilt	Decimal degrees (-90 to 90)
Carrier	All characters
Contractor	All characters
Antenna Type	All characters
Serial Number	All characters
User Input 1	All characters
User Input 2	All characters
User Input 3	All characters
User Input 4	All characters
User Input 5	All characters

<u>FIELD</u>	<u>FORMAT</u>
Date	D/M/Y
Time	h:m:s
Measured Azimuth	Decimal degrees (0 to 360)
Azimuth Type	T (True North) or G (Grid North)
Measured Mechanical Tilt	Decimal degrees (-90 to 90)
Measured Mechanical Roll	Decimal degrees (-90 to 90)
Latitude	Decimal degrees or DMS
Direction	N or S
Longitude	Decimal degrees or DMS
Direction	W or E
Elevation	Decimal degrees
Elevation Units	m or ft
AGL Height	Decimal degrees
AGL Height Units	m or ft
AGL Height Source	User or Laser
GPS Integrity	Integer
Photo ID 1	y:m:d-h:m:s.jpg
Photo ID 2	y:m:d-h:m:s.jpg
Photo ID 3	y:m:d-h:m:s.jpg
Photo ID 4	y:m:d-h:m:s.jpg

14.6 Import a csv Site File

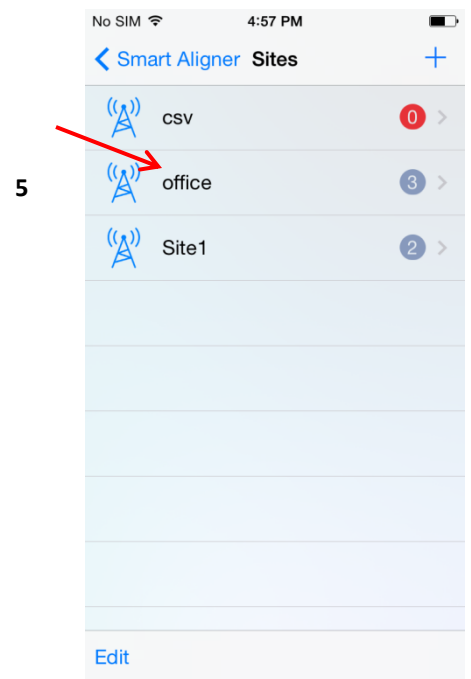
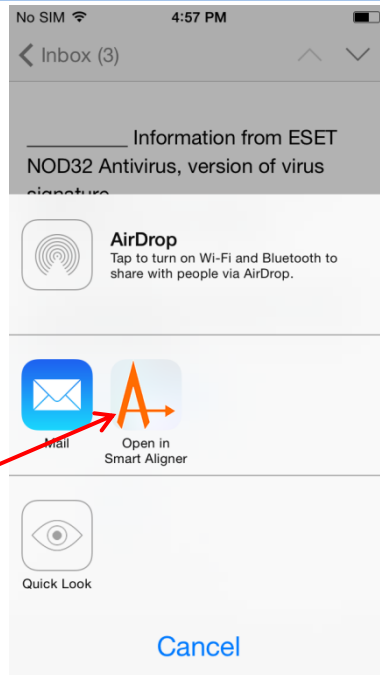
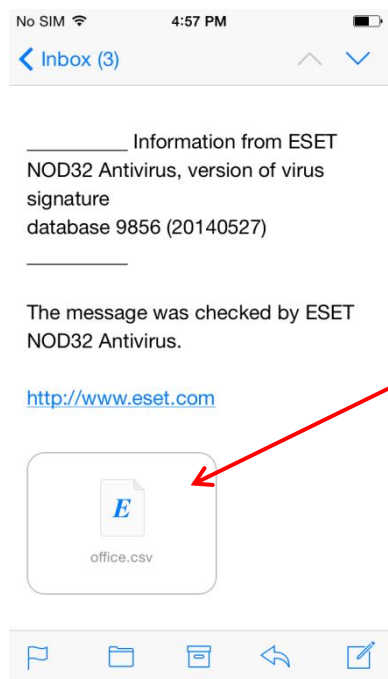
Open the blank/generic csv file. Name the file according to the Site name. Example: office.csv

NOTE: MUST be saved as a csv file. In Excel go to "Other Formats" and it will default to the csv format.

1. Enter data into the User Fields. Site ID for all antennas should be "office". Save "office.csv". Be sure that it is saved as a csv file and not an xls file. For example see entered data example as below.
2. Email "office.csv" to your phone.
3. Tap and hold "office.csv" in the attachment and there will be an option to "Open in Smart Aligner"
4. Tap "Open in Smart Aligner"
5. The Site "office" has been added with three (3) antennas as per the example.

1

#	SiteID	Sector	Position	TargetAzimuth	AzimuthTolerance	TargetMechanicalTilt	TargetMechanicalRoll	ElectricalTilt	Carrier	Contractor	AntennaType	SerialNum	UserInput1	UserInput2	UserInput3
2	1	office ALPHA	1	60		-1	0	0	ATT	Align Inc	Panel	123			
3	2	office BETA	1	180		-1	0	0	ATT	Align Inc	Panel	456			
4	3	office GAMMA	1	300		-1	0	0	ATT	Align Inc	Panel	789			



14.7 Export a csv Site File

Follow steps 2 to 6 in Create a blank/generic csv file (Section 14.1) for the selected site.

14.8 Azimuth Tolerance

The Azimuth Tolerance is the Carrier specified tolerance that their antennas need to be aligned to. It is a useful reminder to the user if the antenna aligned did not meet the tolerance. The App will alert the user if the alignment is not in tolerance. The user can re-align the antenna to tolerance. The tolerance can only be entered in the csv file.

Using the Azimuth Tolerance

Open the blank/generic csv file. Name the file according to the Site name. Example: ATT-Azimuth-Tolerance.csv

NOTE: MUST be saved as a csv file. In Excel go to "Other Formats" and it will default to the csv format.

1. Enter Site ID as Tolerance (as an example).
2. Enter a Target Azimuth of 220 (as an example).
3. Enter an Azimuth Tolerance of 3 (as an example).
4. Enter the remaining data (not required)
5. Save the file. See **NOTE** above.
6. Import the csv file to Smart Aligner. See **Import a csv Site file** (section 14.1)
7. Set the Tool so that it is pointing at 213 degrees (as an example) and tap "Verify"
8. The standard message will be shown with the added message "NOT IN TOLERANCE"
9. Make a Duplicate Antenna (see **Site Survey, Screen 14**)
10. Set the Tool so that it is pointing at near 220 degrees (less than 3 degrees error)
11. Tap "Verify". The standard message will be displayed.

#	SiteID	Sector	Position	TargetAzimuth	AzimuthTolerance	TargetMechanicalTilt	TargetMechanicalRoll	ElectricalTilt	Carrier	Contractor	AntennaType	SerialNum	UserInput1	UserInput2	UserInput3
2	Tolerance	1	1	220	3	0	0	0	ATT	Align Inc	Panel	1234			

1. **Align Antenna** screen: Target: 220°, Measured: 213.4°, error: 6.6°. Buttons: Back, Align Antenna, Verify.


2. **Measured Azimuth** dialog: Antenna Alignment difference is 6.7°. Specified Tolerance is 3°. NOT IN TOLERANCE. Do you want to accept this alignment or Re-Align the antenna? Buttons: Re-Align, Accept.

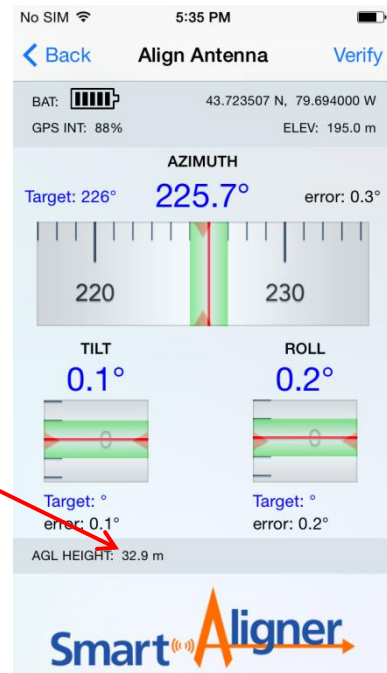
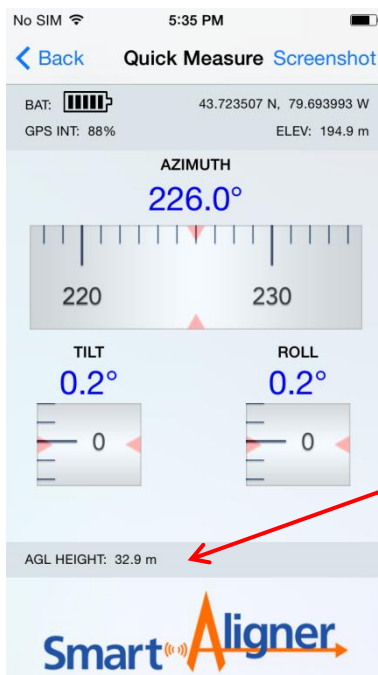
3. **Align Antenna** screen: Target: 220°, Measured: 220.4°, error: 0.4°. Buttons: Back, Align Antenna, Cancel.

4. **Measured Azimuth** dialog: Antenna Alignment difference is 0.4°. Do you want to accept this alignment or Re-Align the antenna? Buttons: Re-Align, Accept.

14.9 Laser Rangefinder Measurements for AGL (Option)

The AGL of the antenna can be measured using Laser Rangefinder and this measurement can flow directly through the Tool. The Tool will automatically determine the Vertical Distance (VD) and display the value on the App and on the Tool. An optional cable and Laser Rangefinder (TruPulse series from Laser Technology Inc. www.lasertech.com) can be purchased. The user can also enter the AGL value (use the VD setting) manually without the laser measurement flowing through the Tool or use another type of measurement device and enter the value.

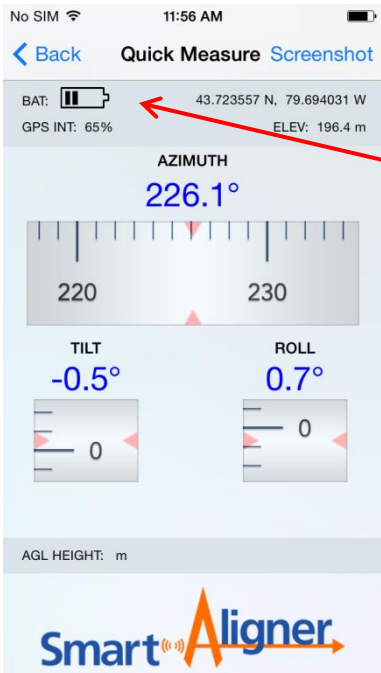
1. Connect the Laser Rangefinder Cable to the Tool.
2. Connect the Laser Rangefinder to the other end of the cable.
3. Press the  and select Data Port \rightarrow Laser.
4. Using the $\uparrow\downarrow$ scroll back to the main screen.
5. Press the Fire button on the Laser Rangefinder to turn it on.
6. Look through the eyepiece on the TruPulse.
7. Use the up/down arrows on the TruPulse 200 till you see VD in the Heads Up Display (HUD).
8. Use the Fire button on the TruPulse 200 to take a laser measurement.
9. The measurement will be displayed in the App on the Quick Measure and Align screens.
10. The measurement will also be displayed on the Tool (see section 12) and in the Report



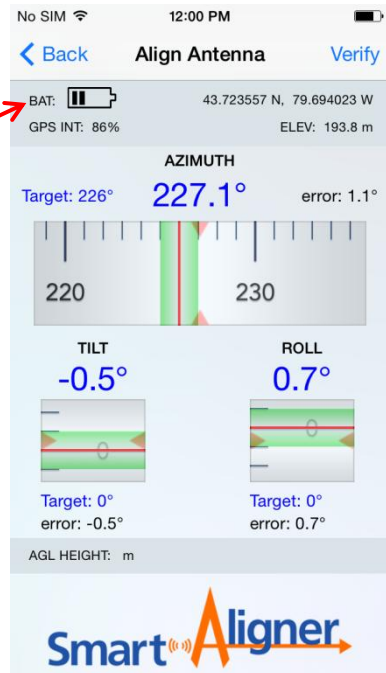
15

Charging the Tool

The Tool is equipped with a lithium ion rechargeable battery. On a single charge the battery can last up to ten hours. An indication of the battery lifetime can be seen on the Tool User Interface Screen and on the App while in operation. When charging, the User Interface Screen displays the progress of the bars. When the battery is finished charging the Tool will shut off. There are five indicator bars that each represent two hours of operation. When there is just one bar left the App will show it in red. Only use the supplied chargers or those recommended by Multiwave Sensors. A wall and car charger are included with the system.



Bars displayed during operation (not charging) in Quick Measure and Align Antenna Screen
Note: When there is only one bar it will be displayed in red



16

Optional Brackets

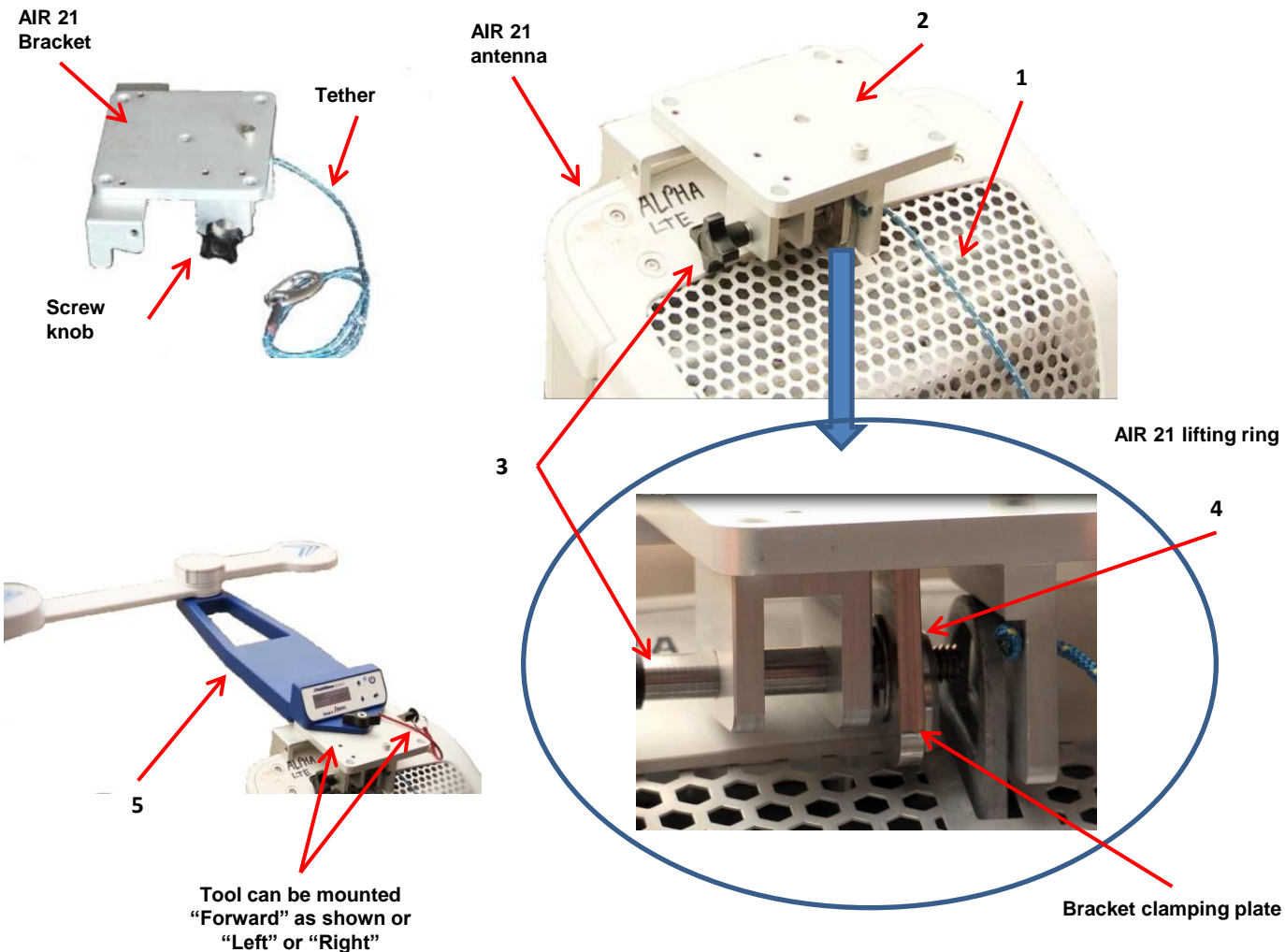
There are some antennas that the Bracket is not suited for. Those antennas either have non-flat backplanes, are odd shapes or have flanges that could interfere with the bracket. We have therefore designed several brackets and adapters so as to easily mount to these type of antennas.

16.1 Ericsson AIR 21 Bracket

The Ericsson AIR 21 antennas shape and form factor require a custom bracket to be used with the Tool to ensure accurate results. For this antenna, we have produced an optional bracket that attaches to the top of the AIR21 antenna. It is used instead of the Bracket. The AIR21 Bracket can be stored in the accessory bay in the case.

To attach the AIR 21 Bracket:

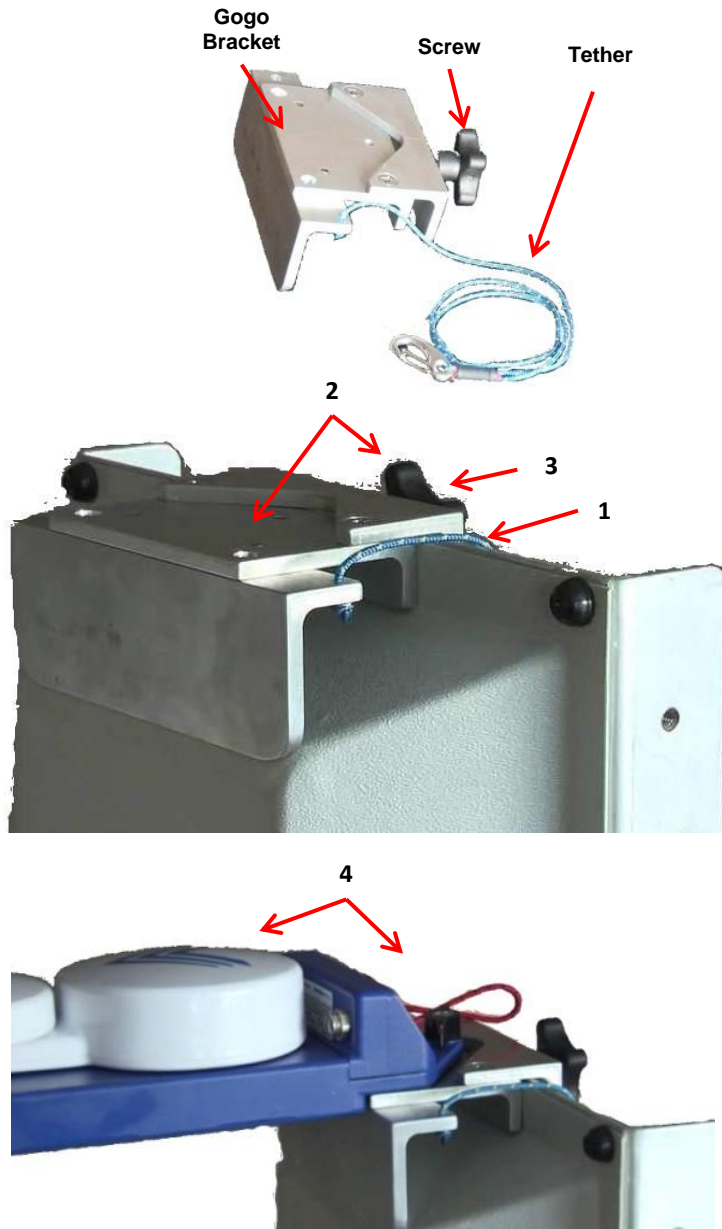
1. First attach the AIR 21 Bracket tether to the structure.
2. Place the AIR 21 Bracket over the top the antenna.
3. Open the screw knob so that the antenna lifting ring can be clamped.
4. Once the AIR 21 Bracket is seated squarely on the antenna, start screwing the bolt in until the bracket clamping plate is tight. The AIR 21 Bracket should be firmly attached to the antenna.
5. The Tool can then be mounted to the top of the mounting plate. Make sure the Tool is tethered to the AIR 21 Bracket. Please note that you can mount the Tool forward, left or right, but not backwards. The AIR21 Bracket is similar to the Bracket in that the tool will automatically sense what position it is in relative to the antenna. The Tool is now used in the exact same way to perform an alignment and verification.



The Gogo network utilizes an antenna with side fins that do not work well with the flexible strap. We have design a specific Gogo Bracket for that antenna, which is to be used instead of the Bracket. The Gogo Bracket can be stored in the accessory bay in the case.

To attach the Gogo Bracket:

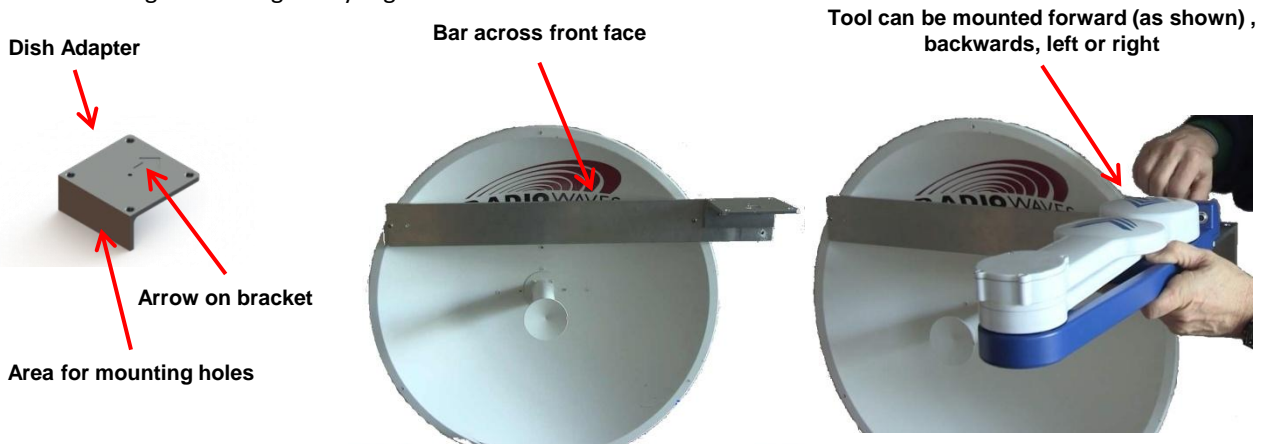
1. First attach the GOGO Bracket tether to the structure.
2. Place the GOGO Bracket over the top the antenna and open the screw knob so that the clamp fits over the vertical fin.
3. Once the GOGO Bracket is seated squarely on the antenna, start fastening the screw until the bracket is firmly attached to the antenna.
4. The Tool can then be mounted to the top of the mounting plate. Attach the Tool tether. Note that you can only mount the Tool in the forward position. The Tool is now used in the exact same way to perform an alignment and verification.



16.3 Dish Adapter

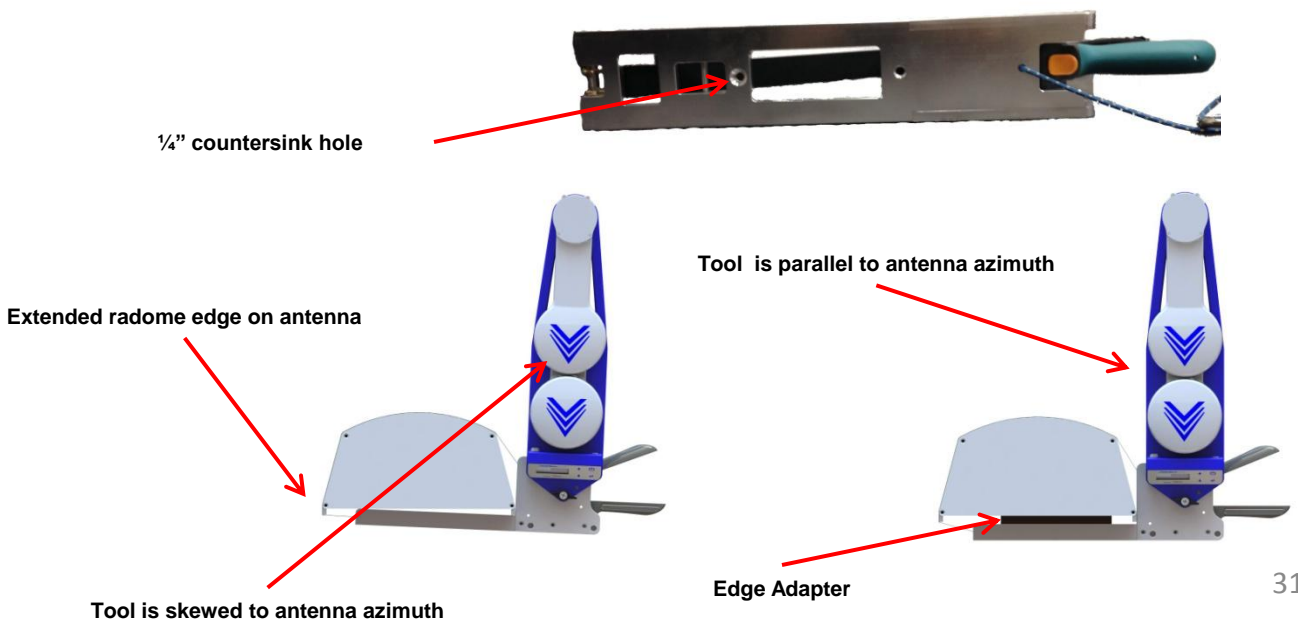
Microwave Dishes come in all shapes and sizes. It would be impossible to make one bracket that would address every dish on the market. Since each job usually has a similar dish, we recommend that you fabricate a bar that spans the front face of the dish and then mount the Dish Adapter on one end. It is important to mount the adapter in such a way that the arrow is pointing in the same direction as the dish so that the Tool can properly detect its position relative to the dish. The tool can be mounted forward (as shown), backwards, left or right like the Bracket.

You can then screw or clamp the bar across the dish face. Try to keep the bar as level as possible to keep your tilt reading as accurate as possible. Please ensure that you are properly tethering the bar according to climbing safety regulations.



16.4 Edge Adapter

The Edge Adapter can be used if your antenna has an extended radome edge or mounting grooves on the back plane of the antenna and the Bracket does not span either both edges or grooves. This can cause the Tool to be skewed in azimuth as seen below. The Edge Adapter corrects the skew. Simply attach the Edge Adapter to the inside of the channel of the Universal Mounting Bracket and attach it in place. If you have an earlier version of the bracket that does not have this mounting hole, you can either put a $\frac{1}{4}$ " hole with a countersink in the center of the web as shown or return it to MultiWave for this service to be done free of charge.



Performance

Azimuth accuracy:	0.5°
Tilt and roll accuracy:	0.2°
Position accuracy:	60 cm with SBAS
Start up time:	< 30 seconds

Power

Internal battery:	Rechargeable lithium ion
Operation time:	10 hrs (over 100 alignments)
Battery charger:	A C wall charger and DC car charger

Physical**Smart Aligner Tool (patent pending)**

Dimensions:	19" x 4.5" x 3" (48.3 cm x 11.4 cm x 7.6 cm)
Weight:	4 lb (1.8 kg)

Universal Mounting Bracket (patented)

Dimensions:	19" x 5" x 3" (48.3 cm x 12.7 cm x 7.6 cm)
Weight:	4lb (1.8 kg)

Carrying Case (contains all components)

Dimensions:	21" x 16" x 8.5" (53.3 cm x 40.6 cm x 21.6 cm)
Weight:	12 lb (5.4 kg)

TOTAL WEIGHT : 20 lb (9.1 kg)**Communication Ports**

LED backlit display:	User interface and display
Wi-Fi:	Smart Aligner to user's mobile device
Connectivity:	Smartphone/Tablet – iOS or Android
Cable interface:	Serial RS-232

Reporting

Report formats:	JPEG (screenshot), PDF or CSV
Photos:	Embedded in PDF report.
Optional JPEG Report format (recommended for Android if high resolution images are required. <i>Photos can also be used as a backup, by taking a picture of the User Display.</i>)	

Environmental

Operational temp:	-22° F to +158° F (-30° C to + 70° C)
Sealing:	NEMA 4X, IP67
Shock/vibration:	IEC 68-2-27 / IEC 68-2-6
EMI:	FCC Part 15 Subpart B: 2008 and ICES-003:2004

Mounting Configurations to Antenna**Multiple offset positions from bracket:** forward, side, backwards on left or right side of antenna**Multiple arm positions:** user can orientate the arms according to physical limitations**Offset and arm position tracking:** sensors track tool configuration and adjust the azimuth and tilt relative to antenna**Number of mounting configurations:** 18**Modes of Use (Smart Aligner App)****Quick measure:** real time display of antenna orientation information with option to save a screenshot of the data**Site survey:** set up of site and antenna information**Align antenna:** real time display of antenna orientation information with option to verify the alignment**Verify:** verify the alignment - ability to "Save" the alignment information after verification**Report mode:** create PDF reports from verified alignments or historically saved sites - automatic attachment to email message**Import profiles:** import CSV file with site and antenna information**Export profiles:** export completed CSV file with appended measured alignment information - automatic attachment to email message**Options**

- TruPulse Laser Rangefinder for AGL Height measurement
- GOGO antenna mounting bracket interface
- AIR 21 antenna mounting bracket interface
- Microwave dish antenna mounting bracket interface
- Edge Adapter for antennas with extended radome edges



PROBLEM: Tool is not getting an azimuth solution

There are a few factors that can be causing the Tool to have difficulty getting an azimuth solution:

1. Live antenna: The Tool has been designed for maximum immunity to RF interference however if there are frequency harmonics that are within the GPS frequencies then this could cause a difficulty in getting an azimuth solution.

SOLUTION: Try moving the Tool to the left or right position. This will move the GPS antenna elements (under blue chevrons) away from the source of the antenna to be aligned. Cycle power on the Tool and the solution should come up within 2 minutes or less.

2. No clear view of the sky: Since the tool is a GPS based device it needs to see at least four satellites. If the GPS antenna elements are getting blocked then viewing satellites may be difficult. Satellites may come in view at some point.

SOLUTION: Try moving the Tool to any of the other positions (front, back, left, right) and deploy the arms in either the T or straight position to give the GPS antenna elements the best view of the sky. Cycle power on the Tool and the solution should come up within 2 minutes or less.

3. The Bracket and Tool are mounted low down on the antenna to be aligned: By being mounted low down on the antenna to be aligned GPS multipath effects may be occurring. Multipath occurs when the GPS signal from the satellite is being reflected off the antenna to be aligned and causing an increased distance. Multipath can not only affect acquisition time but also accuracy.

SOLUTION: Try moving the Tool to the left or right side and deploy the arms in the T position. This will extend the GPS antenna elements away from the antenna to be aligned and minimizing multipath.

PROBLEM: Tool is always displaying "Position Arms" even when the arms are deployed to a valid position.

The arms may look like they are in a valid position but they may not be fully locked into position.

SOLUTION: Check the arms that, when deployed, they click into place. In order to be in a valid position the blue chevrons on the Tool must line up. The arms may be locked into place but if the chevrons are not lined the message "Position Arms" will always be displayed.

PROBLEM: Cannot see Smart Aligner in the list of WiFi networks

There may be numerous WiFi networks in the area and the Tool selected channel is overwhelmed.

SOLUTION: Try changing to a different WiFi channel on the Tool. This can be done on the main menu.

PROBLEM: App message displays "Seeking Connection"

The App has been started but does not have a WiFi connection.

SOLUTION: Check Settings on your smartphone to determine if you are connected by WiFi to the Tool. If you are not then connect to the network SmartAligner-XXXX (Serial #).

PROBLEM: App message displays "Waiting for data stream"

The App has been started, is connected by WiFi, but has not yet received any data from the Tool.

This message will appear and stay displayed under the following conditions:

The User Display message: "Position Arms" will be displayed. This message is displayed when the arms are not in a valid position.

SOLUTION: Deploy the arms to a valid position. The message "Starting Solution" on the Tool will appear until an azimuth solution is reached. During this time Tilt, Roll and Position data will be displayed on the Tool and the App.

PROBLEM: Smart AlignerApp crashes

There were some earlier bugs that caused crashes. The most common one was using extended characters or a Comma in the "Antenna Setup" fields.

SOLUTION: Update and install the newest Smart Aligner App version. Do not use extended characters or Commas in the Antenna Setup fields.

PROBLEM: The Bracket does not fit on the antenna

The Antenna may be one of those that requires an optional adapter bracket or different bracket.

SOLUTION: Check the Options section

PROBLEM: The Tool is not properly tracking the Azimuth when moved on the Bracket.

One of the sensors on the Bracket may be defective.

SOLUTION: Use only the Front position on the Bracket. Contact Multiwave as the Bracket may need to be returned to Multiwave for service.

PROBLEM: The Tool is not properly tracking the Azimuth when the arms are moved to a different position.

One of the arm sensors may be defective

SOLUTION: Use only the Forward position for the arms. Contact Multiwave as the Tool may need to be returned to Multiwave for service.

Contact Information

Multiwave Sensors Inc.
8510 Torbram Road
Unit #67
Brampton, Ontario
L6T 5C7

Phone: 905 458 9060
Fax: 905 458 3079

Email: info@multiwavesensors.com

Warranty Information

MultiWave Sensors Inc. (MWS) warrants the Smart Aligner System 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, dropping or non-MWS modification of the product. The Smart Aligner System is equipped with a 75g shock sensor to determine shock impact. In the event that the shock sensor is tripped the warranty is void.

If this product is not in good working order as 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 from your damages, including any lost profits, lost savings, or other incidental or consequential damages arising from the use or inability to use such product. Furthermore, 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 Smart Aligner System 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.

Extended warranties are available. Contact MWS or one of MWS's authorized distributors for more information.

Repair and Return Information

If the Smart Aligner System needs to be returned to MWS for any repair you will need to request an RMA #. Please email the following information to info@multiwavesensors.com or call us at 905 458 9060.

Company Name
Contact Name
Contact Telephone #
Smart Aligner System Serial #
Description of Problem
Method of shipping (FEDEX, UPS, Courier etc...)

We will send you an RMA# with instruction for shipping. If the Smart Aligner System is being shipped internationally (any country other than Canada) then the commercial invoice needs to include the following:

Harmonization Code: 9813.00.00.95

Smart Aligner System is being returned back to Canada for repairs. These are Canadian goods being returned for repairs. After repairs are completed the Smart Aligner System will be returned to purchaser. Not for sale or resale.