

# HyperTrack™

## Graphical User Interface (GUI)

### Software Instruction Manual



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# 1 Introduction

This Software Manual provides high-level instruction to safely operate the Quasonix HyperTrack™ precision PD Series positioner. This manual should be fully read and understood before beginning antenna operations. Safety is paramount to operations of any equipment. This manual focuses on the User Interface for operating the antenna system locally or remotely.

The manual is as critical as any component of the system. It is expected that every user (operator) has reviewed this manual and the drawing package before any operations have begun. The safety of the personnel and equipment is the single most important part of a successful mission. It is also critical to keeping your warranty up to date. The drawing pack is included as a separate deliverable, as it is program specific.

Please do not hesitate to contact Quasonix with any questions, concerns, maintenance scheduling, or upgrades.

## 1.1 Description

The PD Series of HyperTrack™ positioners are Elevation-over-Azimuth precision positioning assemblies comprised primarily of Commercially available Off The Shelf (COTS) sub-assemblies proven in the industrial robotics world with duty cycles and availability times much greater than our applications. The PD Series positioners design is a scalable architecture across the family of the positioners, keeping a common design and as many common components as possible.

Positioners are comprised of:

- Aluminum Housings
- Harmonic Gearboxes
- Brushless Servo Motors
- Data Packages w/limits
- Slipping Assembly (Standard)
- Rotary Joint (Standard)
- Cable Wrap (Optional)
- Drive Yoke
- Idle Yoke
- Idle Bearing Assembly
- Internal Cabling
- Access Hatches
- Connector Plates
- Mounting Flange

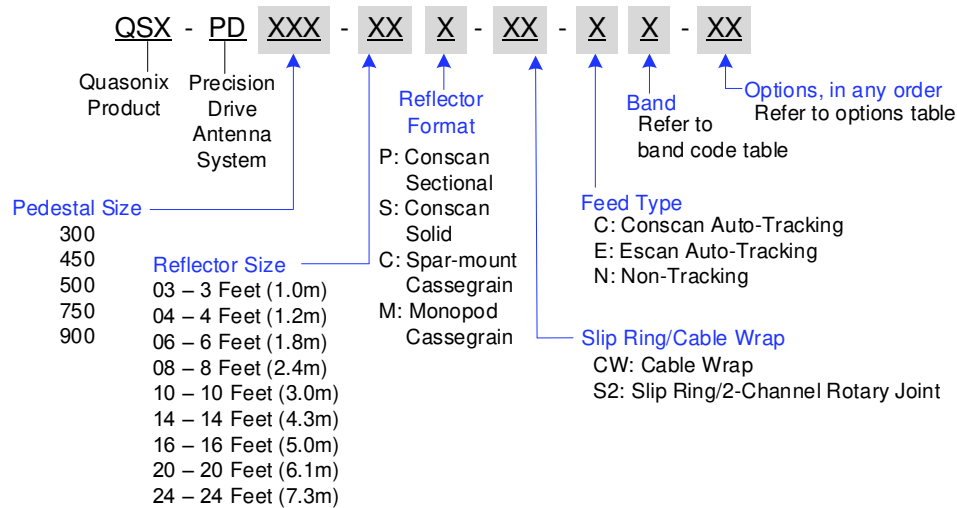
The PD series precision positioner assembly is one component of the Quasonix family of products. The positioner will work as a standalone assembly, although when paired with the entire family of Quasonix components, the full feature set and tracking capabilities can be achieved.

HyperTrack™ is manufactured by:

**Quasonix, Inc.**  
**6025 Schumacher Park Drive**  
**West Chester, OH 45069**  
**CAGE code: 3CJA9**

## 1.2 Nomenclature

HyperTrack™ is available in many variations based on the pedestal and reflector size, frequency bands, etc. The features and modes installed in each unit are identified in the model number, as depicted in Figure 1.



**Figure 1: HyperTrack™ Part Number Construction**

Specifications are subject to change. Contact Quasonix for questions regarding your specific HyperTrack™.

### 1.2.1 Options

The available options are listed below. Refer to section 1.2.2 for detailed descriptions of each option. Please contact Quasonix for assistance ordering HyperTrack™ options.

- AS Auto Stow
- CA Ethernet Camera
- FC Fiber Optic System Control
- FR Fiber Optic RF
- GP Differential GPS
- GY Gyroscope/IMU
- PS Pedestal Spacer

- RB Reinforced Backup Structure
- TR Tripod
- TX Uplink Transmitter

For example, a model QSX-PD450-08P-S2-C-S-CA is configured as shown in Table 1:

**Table 1: Model Configuration Example**

Identifiers	Description
Q SX	Quasonix product
P D	Precision Drive Antenna System
450	Pedestal Size
06	6 foot reflector (1.8m)
P	Conscan feed, sectional reflector format
S2	Slip Ring/2-Channel Rotary Joint
C	Conscan Auto-tracking Feed
S	S band (2200.0 MHz to 2400.0 MHz)
CA	Ethernet Camera

## 1.2.2 Detailed Option Descriptions

### 1.2.2.1 Auto Stow – AS

The Auto Stow option provides a remotely actuated stow pin for store and safety (PD450-PD900).

### 1.2.2.2 Ethernet Camera – CA

The Ethernet Camera option includes a 1080p, 30 fps, Power-Over-Ethernet coaxial camera. It has 30X optical zoom, 4.3 to 128 mm focal length, auto-focus, and auto-exposure. An h.264 to HDMI hardware decoder is included.

### 1.2.2.3 Fiber Optic System Control – FC

The Fiber Optic System Control option includes Ethernet Control lines and Feed Sync lines over dual-simplex fiber optic connections. These are MIL-STD-D38999 to LC simplex connectors.

### 1.2.2.4 Fiber Optic RF – FR

This option provides RF to fiber optic, multimode fiber connection. (Dynamic range is reduced compared to copper RF connections.)

### 1.2.2.5 Differential GPS – GP

The Differential GPS option provides an Ethernet-based position and heading GPS processor.

**1.2.2.6 Gyroscope/IMU – GY**

The Gyroscope/IMU option provides a MEMS-based Inertial Measurement/GPS receiver unit for auto position, heading, and stabilization.

**1.2.2.7 Pedestal Spacer – PS**

The Pedestal Spacer option provides a high strength riser extension. Contact the Quasonix factory to determine the correct length.

**1.2.2.8 Reinforced Backup Structure – RB**

The Reinforced Backup Structure option provides reinforced reflector and spar structure for higher wind loads or heavier feed requirements.

**1.2.2.9 Tripod – TR**

This option provides a temporary installation tripod (PD300 and PD450).

**1.2.2.10 Uplink Transmitter – TX**

This option provides an integrated uplink transmitter. Consult Quasonix for specific information.

## 2 Specifications

	PD300		PD450		PD500		PD750		PD900	
Antenna Capability	Up to 4 feet (1.2M)		Up to 6 feet (1.8M)		Up to 10 feet* (2.44M)		Up to 16 feet (5M)		Up to 24 feet (7.3M)	
Typical Conscan Performance	4' / 1.2 Meter <b>G/T - Beamwidth</b>		6' / 1.8 Meter <b>G/T - Beamwidth</b>		8' / 2.44 Meter <b>G/T - Beamwidth</b>		16' / 5 Meter <b>G/T - Beamwidth</b>		23' / 7.3 Meter <b>G/T - Beamwidth</b>	
1500 MHz	-0.5	11.2°	3.5	7.5°	6.3	5.5°	12.7	2.7°	14.5	2.2°
2300 MHz	3.0	7.3°	7.0	4.9°	9.8	3.6°	16.2	1.7°	18.0	1.4°
4400 MHz	5.5	4.0°	9.0	2.5°	11.0	1.9°	17.0	0.9°	21.5	0.65°
Compliance (radians/ft lb)	1.75 x 10 <sup>-5</sup>		2.3 x 10 <sup>-5</sup>		2.0 x 10 <sup>-5</sup>		4.0 x 10 <sup>-7</sup>		2.0 x 10 <sup>-7</sup>	
Pedestal Wgt	175 lbs		400 lbs		800 lbs		2400 lbs		3950 lbs	
Wind Operating	50 MPH		50 MPH		45 MPH – 10 feet*		50 MPH		50 MPH	
Gusting	65 MPH		65 MPH		50 MPH – 8 feet		65 MPH		65 MPH	
Survival	120 MPH		120 MPH		65 MPH		120 MPH		120 MPH	
Power Requirements	1.5 KW 115/230 VAC 50-60 Hz, 1Ø		2.5 KW 115/230 VAC 50-60 Hz, 1Ø		3.0 KW 115/230 VAC 50-60 Hz, 1Ø		4.0 KW 208/400 VAC 50-60 Hz, 3Ø		5.0 KW 208/400 VAC 50-60 Hz, 3Ø	
Torque	Cont-125 ft-lbs Peak-250 ft-lbs		Cont-235 ft-lbs Peak-400 ft-lbs		Cont-900 ft-lbs Peak-1800 ft-lbs		Cont-3600 ft-lbs Peak-7200 ft-lbs		Cont-5800 ft-lbs Peak-12000 ft-lbs	
Velocity	30°/sec		30°/sec		30°/sec		20°/sec		15°/sec	
Acceleration	40°/sec <sup>2</sup>		40°/sec <sup>2</sup>		40°/sec <sup>2</sup>		20°/sec <sup>2</sup>		20°/sec <sup>2</sup>	

Backlash	0.016 degrees typical
VSWR	2:0:1 maximum
Axial Ratio	<2.0 dB maximum
Polarization	Simultaneous dual or single, all variants of Circular or Linear polarization
Travel	Azimuth: Continuous, Optional up to ± 420° with pre-limits Elevation: -8° to +188° (Software), -10° to +190° (Electrical), -12° to +192° (Mechanical)

<b>Environmental</b>	
Operating Temperature	-30°C to +52°C
Storage Temperature	-54°C to +71°C
Relative Humidity	Up to 100%, including condensation
Rain	Up to 4 inches per hour
Ice	1/2 inch, Radial

## 3 Safety

This section should be read and fully understand to operate the positioner for the safety of the personnel and equipment.

The purpose of this section is to introduce the system user to general safety practices and specific hazard statements. Proper electrical and mechanical safety practices should always be observed when operating this equipment. Warning and Caution statements shall precede procedural data whenever a Hazard or a Potential Hazard exists to the operator or the equipment.

Personnel should use the following concepts:

- Read the safety summary before operation or maintenance of the system.
- Obey proper general electrical and mechanical safety practices and guidelines.
- Become properly trained on the system.
- Do not use unauthorized procedures that could contribute to a hazard.
- Pay close attention to the warning and caution statements.

### 3.1 Warning and Caution Statements

#### 3.1.1 Warning

Warning statements are used when an operation or maintenance procedure presents the most severe hazard to the user. Failure to obey warning statements could result in destruction of equipment, and/or loss of life. Warning statements display in red, as shown in Figure 2.

**!WARNING!**  
**Always ensure there are no persons servicing the positioner prior to applying power to the system. A visual check or headphone communications to someone close to the positioner is essential. OBEY ALL WARNING LIGHTS and BUZZERS.**

Figure 2: Example Warning Statement

#### 3.1.2 Caution

Caution statements are used when an operation or maintenance procedure, if not properly followed, could result in a loss of mission effectiveness. Failure to obey caution statements could result in severe damage to equipment, and/or severe injury to personnel. Caution statements display as shown in Figure 3.

**!CAUTION!**  
**When using the Velocity parameters and commanding the EL axis to drive at a large velocity into the Up or Down limits, the elevation axis components can be mechanically damaged. The Stop Movement button, in the Misc. column, should ALWAYS be used to stop EL axis motion, NOT the system limits.**

Figure 3: Example Caution Statement

### **3.2 Electromagnetic Radiation Hazards and Precautions**

**!CAUTION!**

Always remove power to the system prior to any servicing that involves removing a hatch or cover plate. Shut off all RF signal transmitters connected to the system before trying any system service or repairs.

**!WARNING!**

A control circuit failure could cause operation of the positioner with the antenna control unit turned off. To stop positioner operation under this condition, immediately disconnect the AC input power to the Servo Amplifier unit.

### **3.3 Operational Safety Summary**

### **3.4 Maintenance Operations Safety Summary**

The following procedures must be observed during maintenance in order to ensure personal safety:

**!WARNING!**

Disconnect power to the positioner mounted or remote located Servo Amplifier, assembly, and the Antenna Control Unit before removing or installing components.

### **3.5 Hazardous Components**

There are no hazardous components in the antenna system, however, high voltage AC is present at the positioner heater assemblies and in the feed assembly. High Voltage AC is also present within the Servo Amplifier Assembly, when in operation or when the servo is first connected to an external power source. The system itself can be hazardous during operation, so warning lights and/or buzzers should be obeyed.

### **3.6 Safety Summary**

The following are general safety precautions. They are recommended precautions that personnel must understand and apply during many phases of operation and maintenance.

**!WARNING!**

**Keep Away from Active Circuits!  
Dangerous AC Voltages May Be Present!**

Operating personnel must always observe safety regulations. Do not replace components or attempt adjustments inside the equipment with the primary power turned on. Under certain conditions, potential dangers may exist when the power control is in the OFF position, due to charges retained by capacitors. To avoid potential injuries, always remove power, and discharge and ground a circuit before touching it. When in doubt, contact a Quasonix factory representative before opening any system access hatches or covers.



**!WARNING!**

**Always align the positioner such that there are no mechanical obstructions throughout the entire range of movement in Azimuth and Elevation. Maintenance personnel must obey safety lights and buzzers which indicate immediate movement of the system.**

**!Warning!**

**Always ensure there are no persons servicing the positioner prior to applying power to the system. A visual check, or headphone communications to someone close to the positioner, is essential. Obey all warning lights and buzzers.**

**!Caution!**

**Do not service or adjust alone!**

**Under no circumstances should any person reach into, or enter, the enclosure(s) for the purpose of servicing or adjusting the equipment except in the presence of someone who is capable of rendering aid.**

**!Resuscitation!**

**Personnel working with, or near, high voltages should be familiar with modern methods of resuscitation. Such information may be obtained from the U.S. Bureau of Medicine and Surgery.**

## 4 Software Overview

HyperTrack™ operating software, is based on the integration of two (2) separate hardware boxes. The HyperTrack™ Antenna Control Unit (HTAC) includes factory installed firmware and a Windows based, client computer (PC) running the Windows 10 Pro operating system. The HTAC operates as the server in the system architecture, while the Windows PC, provides the client software (GUI), which communicates with the HTAC via an Ethernet link. The HTAC server, as well as the local pedestal feed control box assembly, has separate firmware installed for command and control, and for interfacing with the HTAC and the Telemetry Tracking System.

The Windows 10 Pro system About page, shown in Figure 4, outlines the HyperTrack™ PC hardware supplied with the Windows client PC. Note, the installed RAM was upgraded to 32 GB in all client computers.

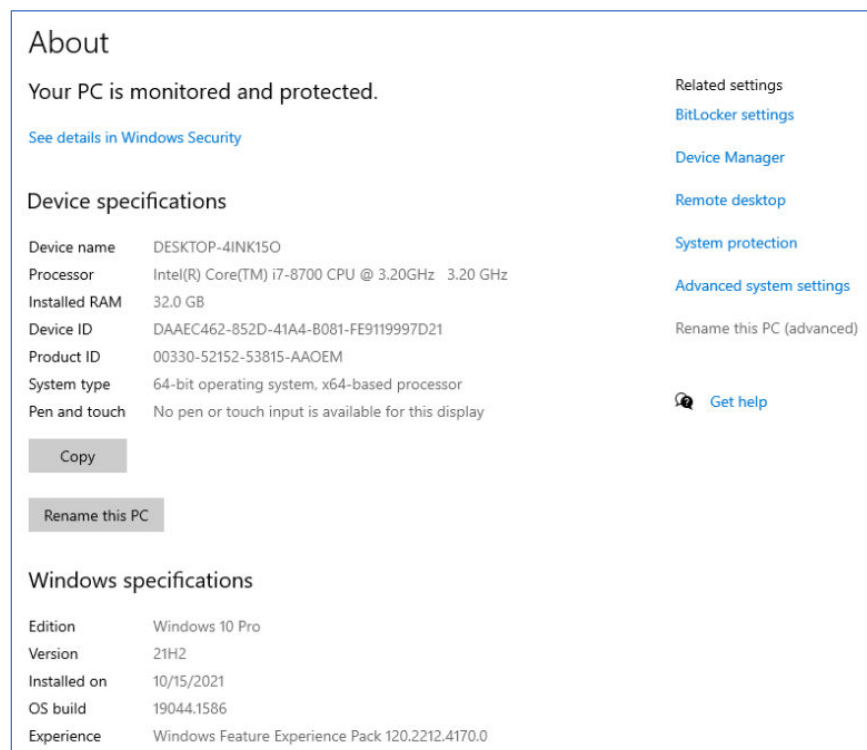


Figure 4: Windows 10 Pro System About Page

### 4.1 HyperTrack™ Antenna Control Unit

The HTAC is the assembly which maintains the direct Ethernet connection to the antenna system, as well as the client PC and system receivers. The HTAC is provided with a unique IP address, which secures the LAN connections to all networked devices. The HTAC IP address is set via the small front panel touchscreen interface window, as shown in Figure 5. The front panel touchscreen provides the user with a direct interface to the HTAC.

The HTAC operating firmware is factory preinstalled, however, it can be updated by accessing the Firmware Update Tab, (select the HELP icon, from the upper tool bar in the Standard View GUI).



Figure 5: HyperTrack™ Antenna Control Unit, Front Panel

The HTAC front panel has a lighted input power On/Off switch, as well as a touchscreen that provides access to: About (Help), Network, Boot, Tools, and Power. It also has two USB ports for factory use only.

All connections to the system servo assembly, receiver(s), and other devices are via HTAC ports on the back panel, as shown in Figure 6. The HTAC back panel, provides eight (8) tracking channel inputs (AGC and AM), as well as LAN/WAN, Servo, Slave, COM, Data, Clock, and additional USB and video Ports.

The HTAC back panel shows the typically available ports for receiver interface (AM/HT and AGC), network connections, power, COM, and video.



Figure 6: HyperTrack™ Antenna Control Unit, Back Panel

#### 4.1.1 HTAC Touch Screen Display

The following Touchscreen controls are available to the user:

**About** - Opens the HTAC box product information page, including the Hardware IP, Firmware, and Software builds

**Network** - Opens the Ethernet Information page; Sets the HTAC IP address and other LAN parameters; These parameters are typically factory set and will not need adjustment

**Boot** - Contains the HTAC boot up options, including the Auto and Remote Boot parameters

**Tools** - Opens the Touch Screen Calibration window; the touchscreen panel is calibrated by following the on-screen guide

**Power** - Opens the Power Selections window; The HTAC can be shut down by selecting the Power button followed by the Shutdown button. The HTAC can also be rebooted from this screen, if desired.

#### 4.1.2 HTAC Communications Architecture

The typical Ethernet communication layout scheme, for the HyperTrack™ Antenna Controller (HTAC), as well as the connected Windows Client (PC) computer, the managed switch (control room), and the external System Servo Assembly, is shown Figure 7. All connections are CAT 5/6. The communication lines between the switch and the Servo Assembly can be either Fiber Optic (FO) or Wired (RJ45), depending on the tracking system selected and the distance between the control room (HTAC) and the Servo Assembly.

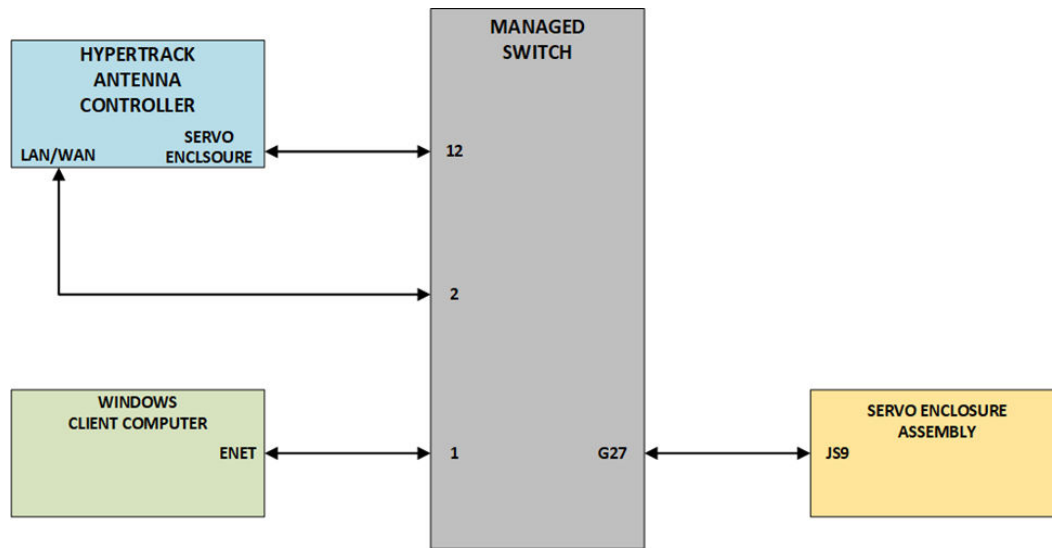


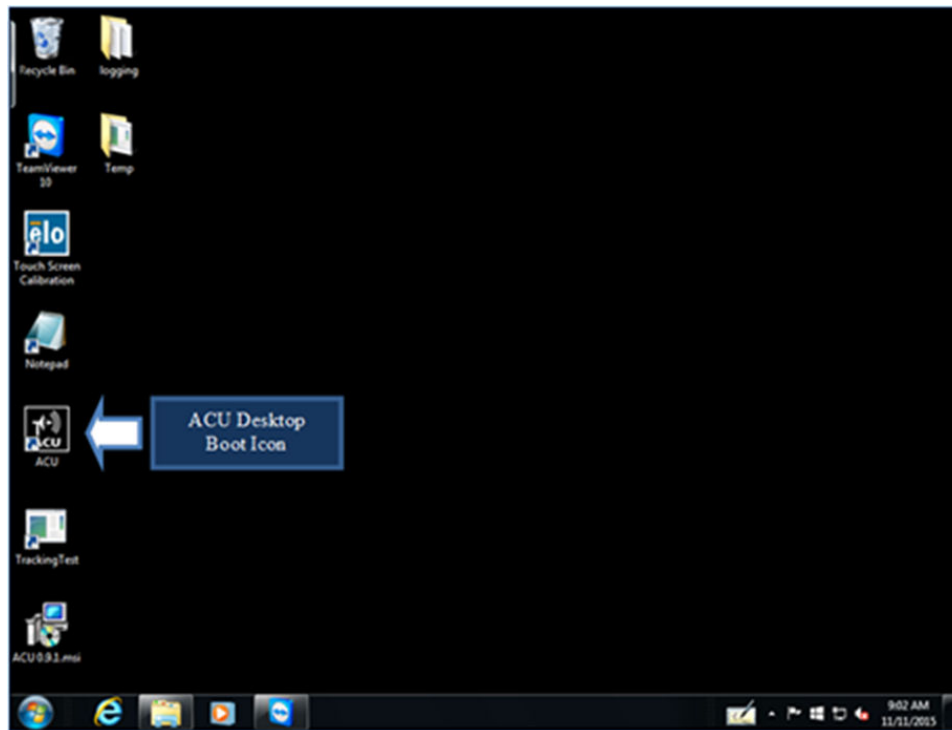
Figure 7: HTAC Communications Block Diagram

#### 4.1.3 Client Computer Graphical User Interface (GUI)

The client software Graphical User Interface (GUI) is located on the Windows 10 PC and is installed via a standard windows installer, typically from a USB flash drive or similar portable storage device.

The GUI does NOT start automatically upon computer boot up.

To start the GUI, select the Controller icon (small antenna ACU) located on the left-hand side of the Windows desktop, as shown in Figure 8.



**Figure 8: Windows Desktop, User Interface Icon**

The Server Selection screen displays, as shown in Figure 9. It contains the following parameters and buttons.

- Saved Controllers - Displays the unit Name and unique IP address (URI)
- Detected Controllers - Provides the Name, Hardware ID, and URI of automatically detected controllers on the network
- Add button - Allows unique controller addresses to be saved for access at a later time
- Connect button – Displays when either section is selected

In this example, two HyperTrack™ Antenna Controllers are available, one saved, and one detected on the network.

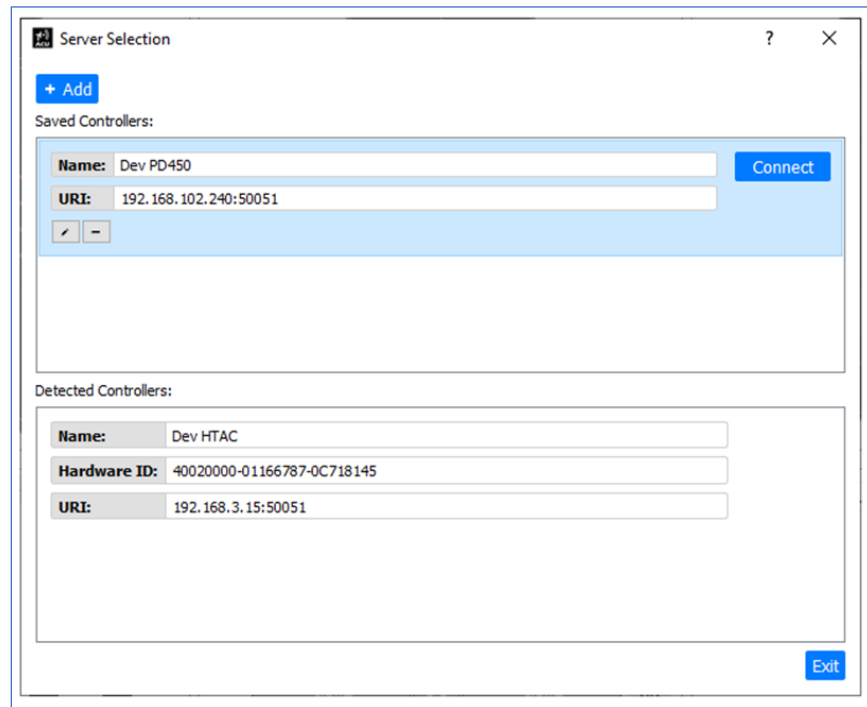


Figure 9: Server Selection Screen

When the Connect button is selected, a Login window displays, as shown in Figure 10. A Username and Password must be entered for the connection to be completed. Refer to section 4.1.4 for more information.

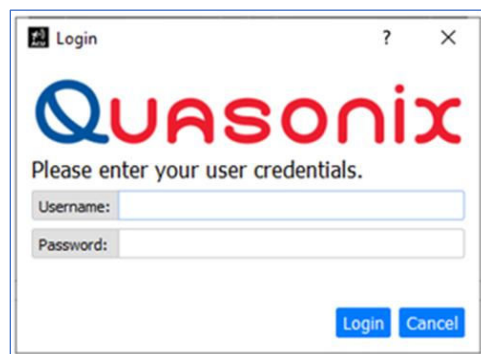
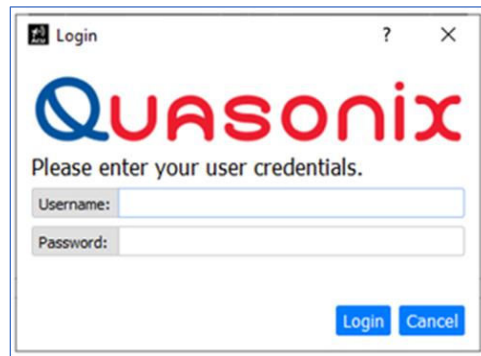


Figure 10: Login Screen

#### 4.1.4 HTAC Security

The General User password of (admin, admin) can be entered into the Login screen, shown in Figure 11, to open the Standard View GUI. This allows the user to access the GUI controls and settings menus. With it, the user can control all of the motion and tracking functions.



**Figure 11: Login Screen, Used for General and Advanced Access**

**Note of Caution:** From the System Settings control parameters the user can make changes that may cause system damage or function loss if changed. These menus are protected by an Advanced User password. If it becomes necessary to gain access to these hardware settings, the Quasonix factory must be contacted for a single use, temporary password. After the password is obtained from Quasonix, and entered in the HTAC, all of the restricted hardware settings menu becomes available. This single use password expires 24 hours from issue. If additional time is needed, a new password must be obtained from Quasonix.

The same password Login window is used for the General User password and the Advanced User password. The only difference between the two passwords, is that the Advanced User password is obtained from Quasonix and expires in 24 hours.

#### 4.1.5 Graphical User Interface (GUI) Overview

The Standard GUI display is composed of separate feedback and control widgets separated into specific operational areas on the display. The GUI provides the user with the basic control and feedback functions for the operation of the Quasonix HyperTrack™. Basic functions include, all axis control, system axis, angle feedback, receiver signal level displays (AGCs), and tracking information. The HyperTrack™ GUI is shown in Figure 12. The numbered labels in the figure are described in Table 2.

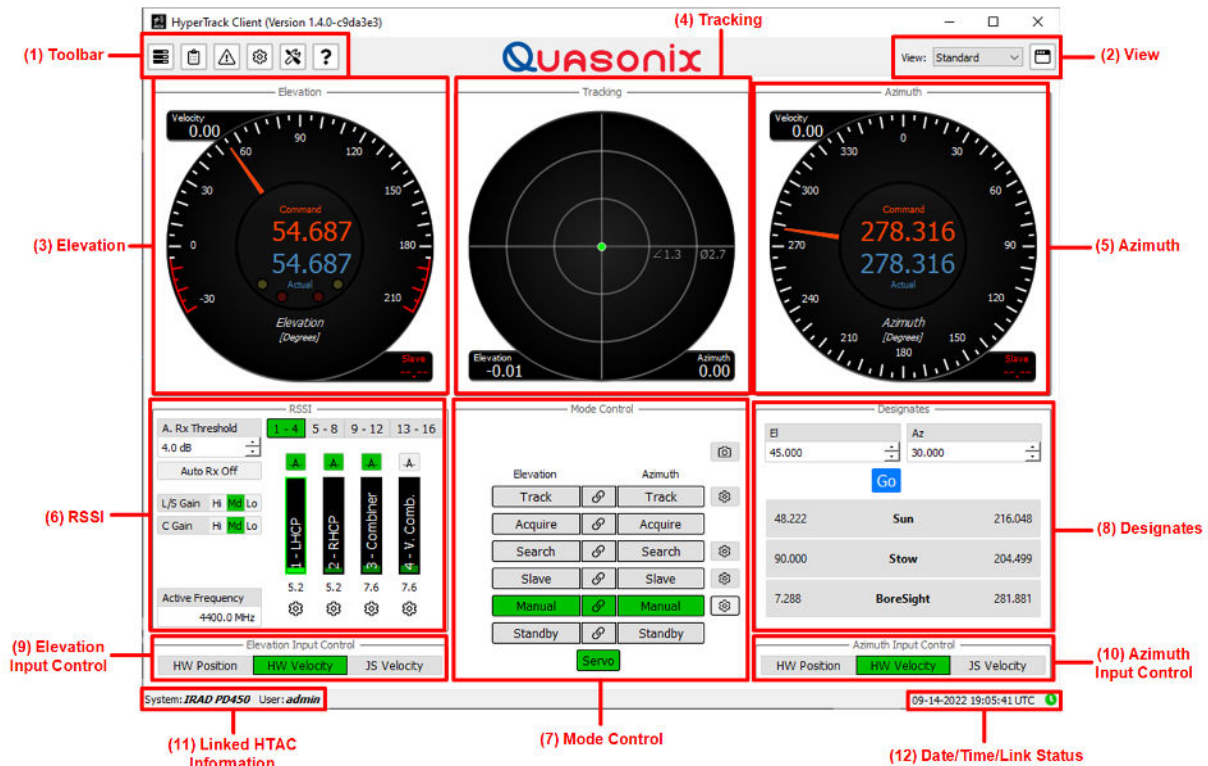


Figure 12: HyperTrack™ Graphical User Interface (GUI), Main Screen

Table 2: GUI Main Screen, Function Overview

Item #	Window Name	Description
1	Tool Bar	Upper Tool Bar - Left Side icons for Network Connections, Logging, Warning and Notification Indicators, Set Up Menus, Tool Menus, Help Menu, and the Date and Time Display; Selecting any icon opens a separate window
2	View	View drop down menu, with the Standard View button to the right - All available settings windows can be selected and opened from this panel display, with all of the user available angle feedback and system control buttons.



Item #	Window Name	Description
3	Elevation	Elevation Axis Position Meter - The Commanded digital angle readout and pointer are shown in orange (central meter orange numeric display); The Actual digital position readout with pointer are displayed in blue (central meter blue numeric display); The Elevation Slave pointer is green; The small digital displays (top right and bottom left) report the computed axis velocity and the EL axis slave angle, if slave angles are received.
4	Tracking	Track Error Meter is shown with a green meatball, indicating that the tracking feed is operational and the feed modulation signals are present; The two AZ and EL digital error value readouts are also shown below the meter; The meter displays the relative location of the radiating target (where the antenna is pointing); The antenna is pointing directly at the target when the meatball is in the center of the crosshairs; The computed AZ (X) and EL (Y) values are displayed in the small display boxes attached to the bottom of the meter.
5	Azimuth	Azimuth Axis Position Display Meter - The Commanded digital angle readout and pointer are shown in orange (central meter orange numeric display); The Actual digital position readout with pointer are displayed in blue (central meter blue numeric display); The Azimuth Slave pointer is green; The small digital displays (top right and bottom left) report the computed axis velocity and the AZ axis slave angle, if slave angles are received.
6	RSSI	<p>The RSSI window displays the four (4), user selected, tracking channels along with their AGC, signal level meters (out of the 16 available channels); Typically LHCP, RHCP, and Combined channels are used, with a fourth channel also available.</p> <p>The Client GUI provides 16 tracking channels, in total, with four groups of four channels each (Channels 1-4, 5-8, 9-12 and 13-16); These additional channels are viewed by selecting each set of four channels from the sets shown above the AGC meters; When a set is selected, the four (new) tracking channels (meters) display in the corresponding columns. Note, only one set of four tracking channel meters can be displayed at a time.</p> <p>Also, available in this area, is the Auto Receiver (Auto RX ON-OFF) button, along with the Auto Receiver channel selection buttons, located directly above each AGC meter.</p> <p>When the selection button is green, and the AUTO RX button is selected and highlighted (green), only the tracking channels that are selected (green) will be automatically switched. In Figure 12, all four tracking channels are selected, which means that the system will switch among all four channels, and will track on the channel with the highest signal level. In this example, the selected tracking channel is Channel 1 – R1 - LH which now displays a green border around the signal level meter. The selected tracking channel always has a green box around the selected channel's AGC meter.</p>

Item #	Window Name	Description
		<p>The A. Rx Threshold drop down menu provides the operator with a choice of Auto Receiver gain selection points, where the tracking channel switches from a lower to a higher received signal level at the selected point. In Figure 12, the tracking channel switching level is set to 3.0 dB. There must be a 3 dB difference between any tracking channel, before a channel switch will take place.</p> <p>The RSSI window also contains the L, S, and C Band (LNA) amplification selection buttons. The selections are Hi, Md, and Lo amplification for all available frequency bands. The gear buttons below each tracking channel opens the track settings for that channel.</p>
7	Mode Control	Elevation and Azimuth axes Mode Control window - Within this section, the EL and AZ servos can be enabled and disabled; In addition, the six (6) axis control modes of: Standby, Manual, Slave, Search, Acquire, and Track are located here; When in AZ or EL Manual Mode, this section contains the Camera Control button and the gear buttons which open the multi-function Camera Control window; the camera enable (ON-OFF) button and all of the other control functions associated with the mode control are located there.
8	Designates or Track	Multi-function display area - When a Gear button, next to any axis mode button is selected, the settings, displays or parameter input windows, associated with that mode button, are displayed; Designates are located within this window and are accessed by selecting the gear button next to the Manual button.
9	Elevation Input Control	The Elevation Axis, Input Mode, Control buttons are located within this narrow window; The Handwheel Position, Handwheel Velocity, and the Joystick button, for control of the Elevation axis, display here.
10	Azimuth Input Control	The Azimuth Axis, Input Mode, and Control buttons are located in this narrow window; The Handwheel Position, Handwheel Velocity, and the Joystick button, for control of the Azimuth axis, display here.
11	System	Lower Tool Bar - Contains the linked HTAC controller information and the User login
12	Date/Time	Date and time information including the Time Input Link (small Clock icon); The icon changes color depending on link status. Clicking on the Clock icon opens the Time Synchronization status and sources information page.

## 4.2 Graphical User Interface (GUI) Overview

The HyperTrack™ GUI Main screen provides the operator command and status of the antenna tracking system. The main display automatically opens after completing the Ethernet link to the HyperTrack™ controller (HTAC). This section describes the command and status functions available from the Main screen.

#### 4.2.1 Main Screen, Tool Bar

Tool Bar at the top of the Main GUI screen shows the HyperTrack™ Client Version number, and provides access to additional information through tabs and a drop down menu. The additional options provide the user with system setup, command, and status of the antenna system.

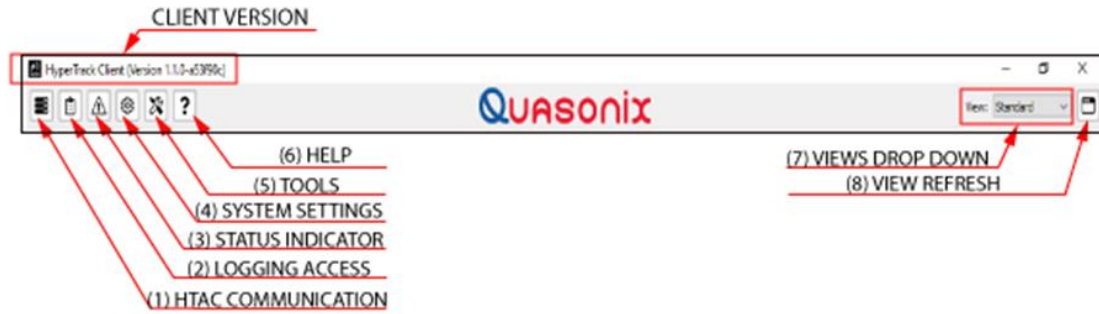


Figure 13: GUI Main Screen, Tool Bar

##### 4.2.1.1 HyperTrack™ Client Version

The Client Software Version is located in the upper left corner of the Main Screen Tool Bar, above the user option icons.

##### 4.2.1.2 HTAC Communications Status

The HyperTrack™ Controller (HTAC) link, re-link tab connects/disconnects the Ethernet link to the HTAC, and opens the Server Selection menu. This is used to choose between additional HTACs on the network via the Server Selection Menu – Detected Controllers.

In Figure 14, the user has selected the saved controller in the upper pane to connect. Selecting the Connect button, reestablishes an Ethernet link to that (saved) and highlighted HTAC controller. Additional HTAC controllers that are detected on the network, are displayed in the lower Detected Controllers pane. The operator can choose any displayed HTAC shown in the Server Selection window to re-link to, if desired.

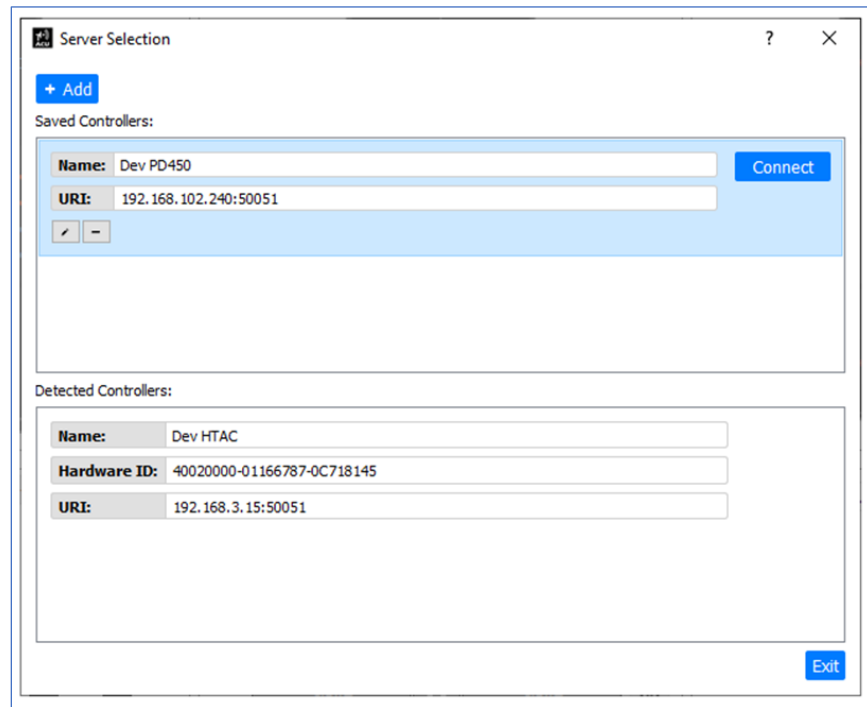


Figure 14: Server Selection Window

### 4.2.1.3 HTAC Logging Function

The HTAC GUI has logging functionality that allows the user to select the various parameters for data capture and archive.

#### 4.2.1.3.1 Logging Enable

The Clipboard icon, as shown in Figure 15, is used to access the Logging feature. This drop down menu allows the user to enable the feature and configure the settings and file management for data logging.

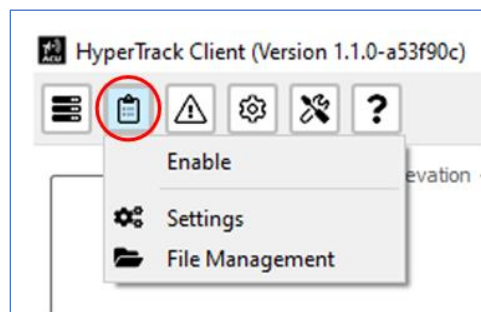


Figure 15: Tool Bar, Clipboard Icon

Selecting the Enable option activates the logging process (a check mark displays next to Enable). The logger continues to log the selected parameters, if Enable is active. The log file is saved to the HTAC's internal flash memory (not to the Windows client PC) where it can be moved to the Windows client PC, if desired.

Downloading the log file(s) to the PC uses the file management selections listed within the logger drop down menu. When the logger is enabled, a Start Logging window opens, as shown in Figure 16. This allows the operator to give each log file a unique name and description, as well as the default automatic time and date stamp—all before the logger starts logging. Selecting the Start button begins the logging function.

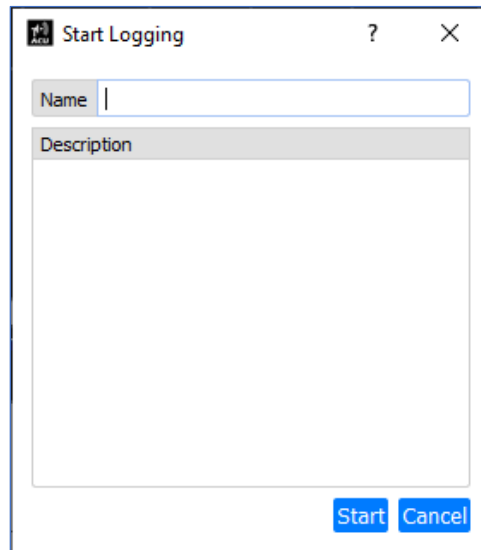


Figure 16: Start Logging Window

#### 4.2.1.3.2 Log Settings

The Log Settings window is accessed from the Clipboard icon, as shown in Figure 17.

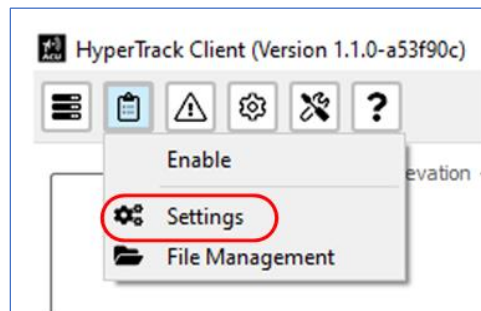
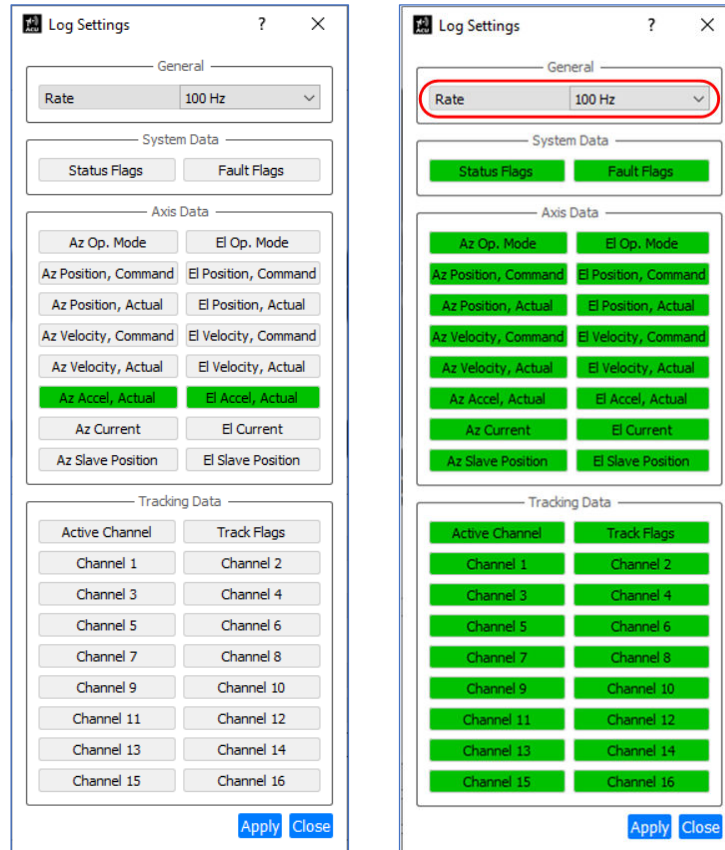


Figure 17: Tool Bar, Clipboard Icon, Settings Selection

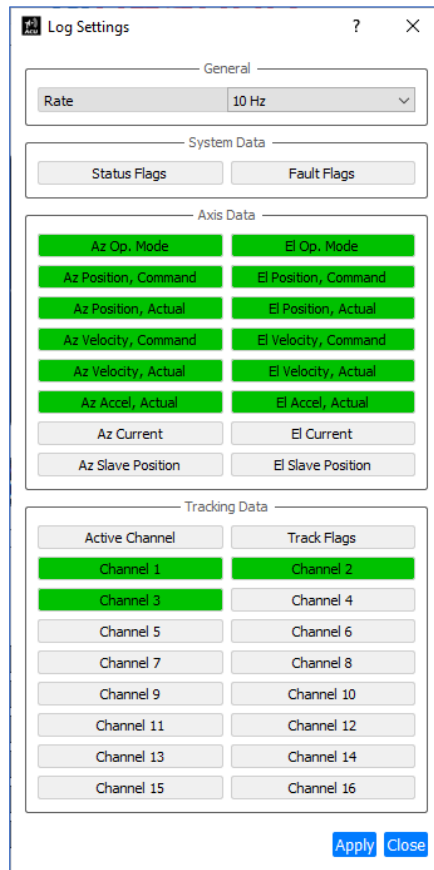
Log Settings allows the user to select what parameters the logger will record by selecting and highlighting each data box parameter to be recorded. The Data box turns green when selected, as shown in Figure 18. Unselecting a data box, changes the color from green back to gray, and that parameter will not be recorded. All parameters listed in the Log Settings window are recorded when highlighted green.

The data recording frequency is set via the Rate drop down menu, located in the General window, circled in Figure 18. The rate is adjustable between 1 Hz and 100 Hz. In the example on the left figure, all parameters highlighted green are recorded at the selected rate of 100 Hz. All gray parameters are not logged.



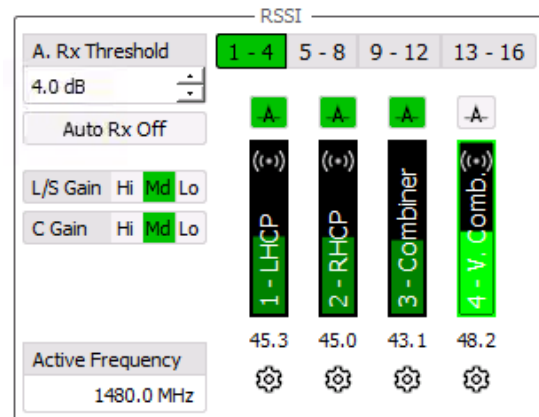
**Figure 18: Log Settings—Two Examples with Different Settings Selected**

The selected logging parameters in Figure 19 are continuously collected for all sixteen (16) channels, but recorded for only the selected (green) active tracking channels. If Auto Receive (Auto Rx) is selected and the Active Channel parameter is green, only the channel which is actively tracking the target (LHCP or RHCP, for example) will be recorded. If the tracking channel auto switches to a new channel, the logged data switches to the new tracking channel and is recorded for that channel.



In the example in Figure 19, the Active Channel is not selected, so the logger only records the selected tracking channels highlighted green.

In this example, the green channels are Channel 1-LHCP, Channel 2-RHCP, and Channel 3-COMB. Selected data for these three channels is recorded. Tracking data is always present on all track channels, even if they are not in use for tracking a target (there must be an AM / AGC connection to a receiver for each channel).



**Figure 19: Log Settings—Three Channels Selected**

When selected, the logger feature also captures the following parameters: Status Flags, Fault Flags, and Track Flags. Selectable parameter abbreviations are listed in Table 3 and Table. If a fault condition appears, while the logger is enabled and the fault is present in the Fault Flags list, the abbreviated flag is recorded and displays in the resulting saved log file, as long as a flag(s) parameter is selected and is highlighted green.

**Table 3: System General Fault Tags**

SFE	Safe Switch is enabled
STW	Stow Pin not in sensor receptacle
SHT	Shorting Plug is not installed
EIF	External Interlock Fault (Interlock Box is unplugged or active)
SCF	Safety Controller Fault ( Safety Controller in the servo assembly is faulting)
ECF	EtherCAT disabled fault ( EtherCat line is unplugged or switch has failed)
FCF	Feed Controller Fault (fault within the yoke arm mounted feed control box)

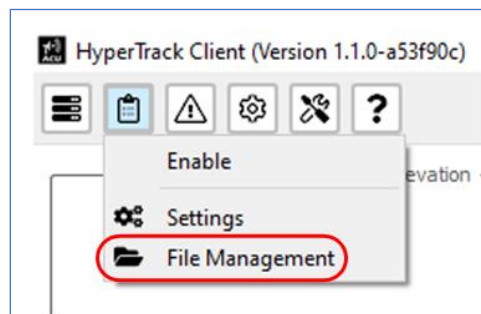
SBO	Servo Box Open (Servo Assembly lid is opened, lid sensor is not connected)
ASF	Azimuth Servo Fault (AZ axis servo has generated a fault condition)
ESF	Azimuth Servo Fault (AZ axis servo has generated a fault condition)

**Table 4: Tracking Status Flags**

MPCE	Multi-path Clipping is enabled (MPC button has been selected and active)
MPCA	Multi-path clip is active (MPC lower limit has been reached)
RME	Rate Memory Enabled ( RME button is selected and enabled)
RMA	Rate memory Active (Rate memory is active during the track)
PME	Position Memory Enabled (Position Memory is selected and enabled)
PMA	Position Memory is active (Position Memory is active during the track)
OHPE	Overhead Pass Enabled (Overhead pass has been selected)
OPHA	Overhead Pass Active (Overhead pass is selected and active)

#### 4.2.1.3.3 Log File Management

The Log File Management window is accessed from the Clipboard icon, as shown in Figure 20.



**Figure 20: Tool Bar, Clipboard Icon, File Management Selection**

The Log File management window, shown in Figure 21, displays the name and file size of all log files. Log files are saved to the HTAC and are not linked to the Windows Client PC.

Select the Download button to move the log file from the HTAC to the Windows Client PC (or selected destination). The Download button must be selected to open the Log File Management window. The menu allows the operator to select a new file destination.

Saved log files on the HTAC can be removed by selecting/highlighting the file name(s) and selecting the Delete button to remove them.



The File Management Window displays only the log files saved on the HTAC. This does not include the files moved to the Windows Client PC.

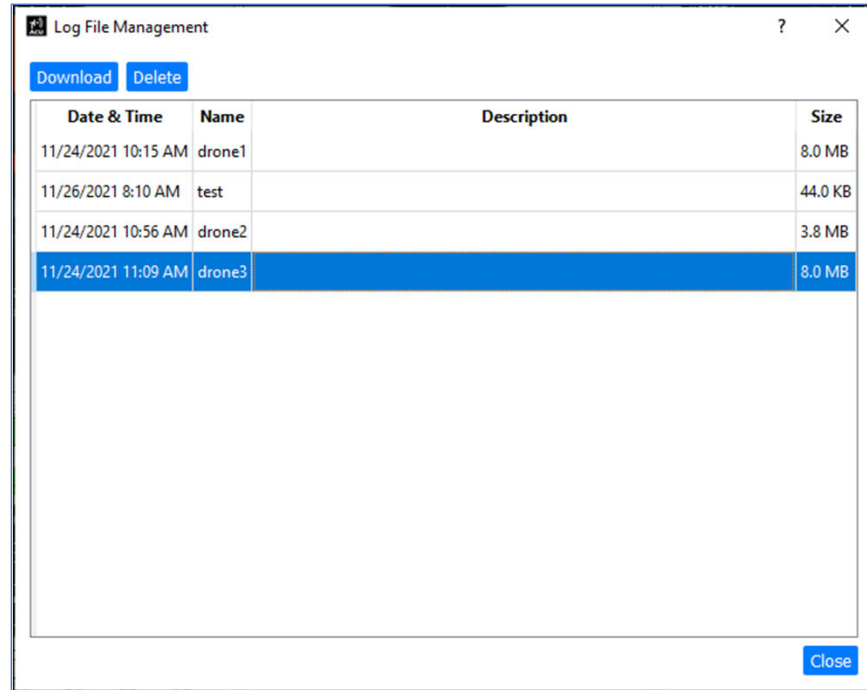


Figure 21: Log File Management Window

#### 4.2.1.4 Status and Indicator Window

Select the Status icon from the Main Tool Bar, as shown in Figure 22, to access the Status and Indicator window.

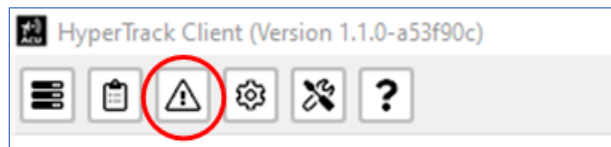


Figure 22: Tool Bar, Status Icon

The Status and Indicator Window, shown in Figure 23, is broken into four blocks listed from left to right: System, Elevation, Azimuth and Dehydrator. Status indicators illuminate green for Operational and red for Fault. A blank (uncolored) box indicates a state where no fault or indicator is required until a condition is met. For example, the Elevation Up and Down limit indicator boxes, are blank until a limit is reached.

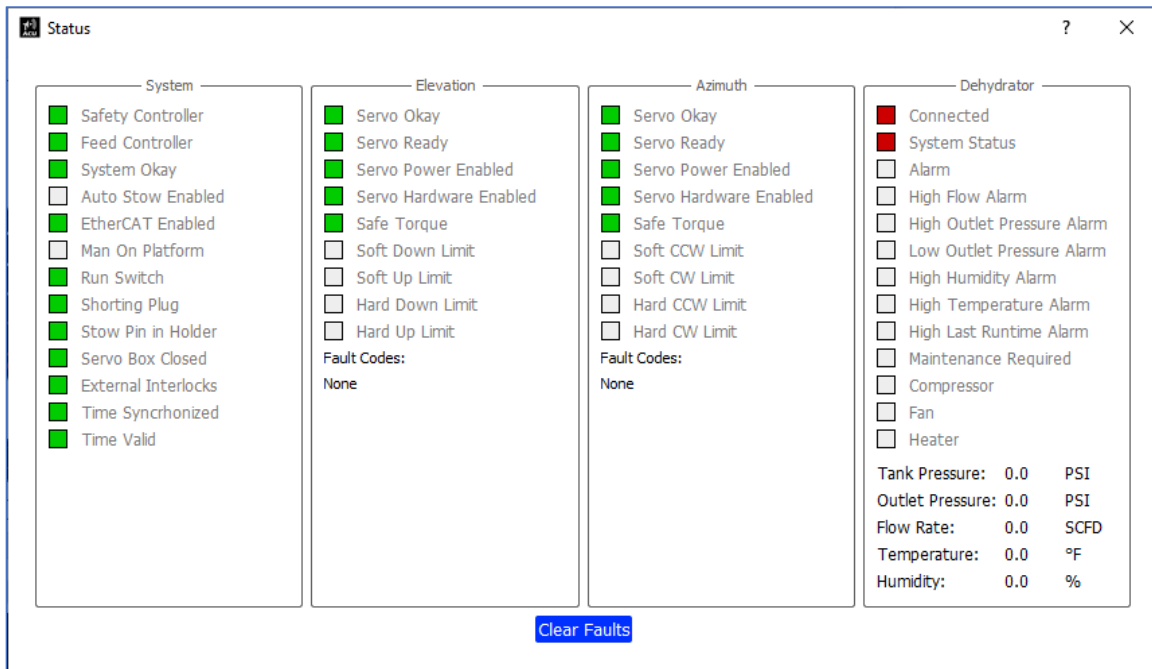


Figure 23: Status Window

Fault Codes in the Elevation and Azimuth Axis are displayed in their representative blocks. The Azimuth and Elevation Servo fault codes, generated by the system servos, are transmitted to the HTAC and displayed in each axis directly under the Fault Codes: space. In Figure 23, both axis Fault Codes are None.

The Air Dehydrator Status block displays the basic dehydrator faults and certain dehydrator system parameters.

The Clear Faults button at the bottom of the window can be used to clear minor fault conditions. If the faulted condition remains red or in a fault condition after selecting the Clear Faults button, this requires additional system analysis to resolve the fault.

The Status window System section provides overall system health indicators, which include:

- Safety Controller
- Feed Controller
- System Okay
- Auto Stow Enabled
- EtherCAT Enabled
- Man On Platform
- Run Switch
- Shorting Plug
- Stow Pin in Holder
- Servo Box Closed
- External Interlocks

The Elevation section provides overall system health indicators including:

- Servo Okay
- Servo Ready
- Soft Down Limit
- Soft Up Limit

- Servo Power Enabled
- Servo Hardware Enabled
- Safe Torque Off
- Hard Down Limit
- Hard Up Limit
- Fault Codes

The Azimuth section provides overall system health indicators including:

- Servo Okay
- Servo Ready
- Servo Power Enabled
- Servo Hardware Enabled
- Safe Torque Off
- Soft CCW Limit
- Soft CW Limit
- Hard CCW Limit
- Hard CW Limit
- Fault Codes

The Dehydrator section provides overall system health indicators including:

- Connected
- System Status
- Alarm
- High Flow Alarm
- High Outlet Pressure Alarm
- Low Outlet Pressure Alarm
- High Humidity Alarm
- High Temperature Alarm
- High Last Runtime Alarm
- Maintenance Required
- Compressor
- Fan
- Heater
- Tank Pressure
- Outlet Pressure
- Flow Rate
- Temperature
- Humidity

#### 4.2.1.5 Settings Window

Select the Settings icon from the Main Tool Bar, as shown in Figure 24, to access the Settings window.

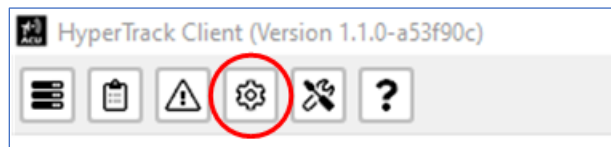


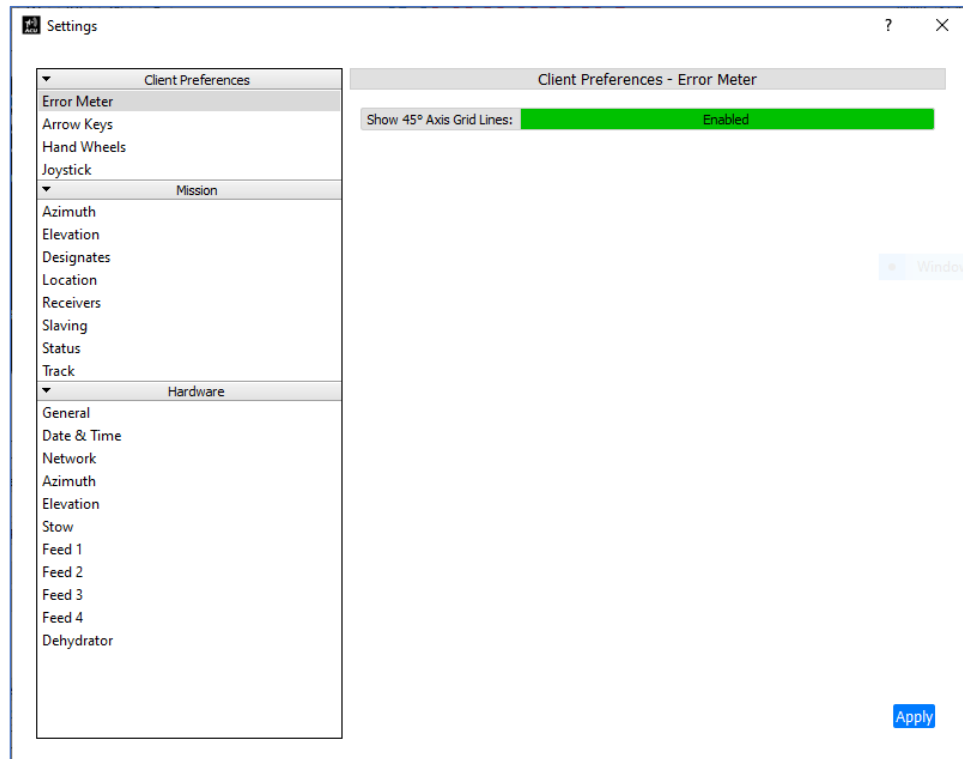
Figure 24: Tool Bar, Settings Icon

From within this window system operational parameters can be accessed, viewed, and updated as desired. The Settings window is divided into three areas Client Preferences, Mission, and Hardware, as shown in Figure 25.

Note: The grid lines only display in green when the SCM feed is scanning, or the Conscan feed is powered up and spinning. If the feed(s) are not powered up or connected, the grid lines remain red.

**WARNING!**

**Many Settings parameters contained in these areas are factory set and can be critical to the Quasonix Telemetry Tracking system operation. If you are unsure of what a certain parameter can, or should, be set to, contact Quasonix for more detailed information *before* making changes. Many windows within the hardware section are password protected. They require an Advanced Use password that is active for a limited time, and must be requested from Quasonix.**



**Figure 25: Settings Window**

The Client Preferences section provides access to user selectable parameters for system motion control and visual feedback. (Standard login required for access.) These parameters include an Error Meter, shown in Figure 25, Arrow Keys, Hand Wheels, and Joystick.

The Mission section provides user selected, variable parameters for typical system operations and/or tracking missions. (Standard log in required for access.) These parameters include Azimuth, Elevation, Designates, Location, Receivers, Slaving, Status, and Track.

The Hardware section includes critical hardware parameters required for normal system operation. (Various windows require the Advanced Use password for access.) Hardware parameters include General, Date and Time, Azimuth, Elevation, Stow, Feed 1, Feed 2, Feed 3, Feed 4, and Dehydrator.

When selecting Client Preferences, Mission, or Hardware, a second parameter entry menu opens to the right-hand side of the list. This is where parameters can be selected, changed, entered, and stored for each section. The Apply

button saves/applies the settings. To close any settings window, select the close window (X) located at the top right corner of the open window.

Figure 26 shows the Track parameter selected in the Mission section. The up and down arrows may be used to adjust settings, or values can be typed directly into the tracking parameters.

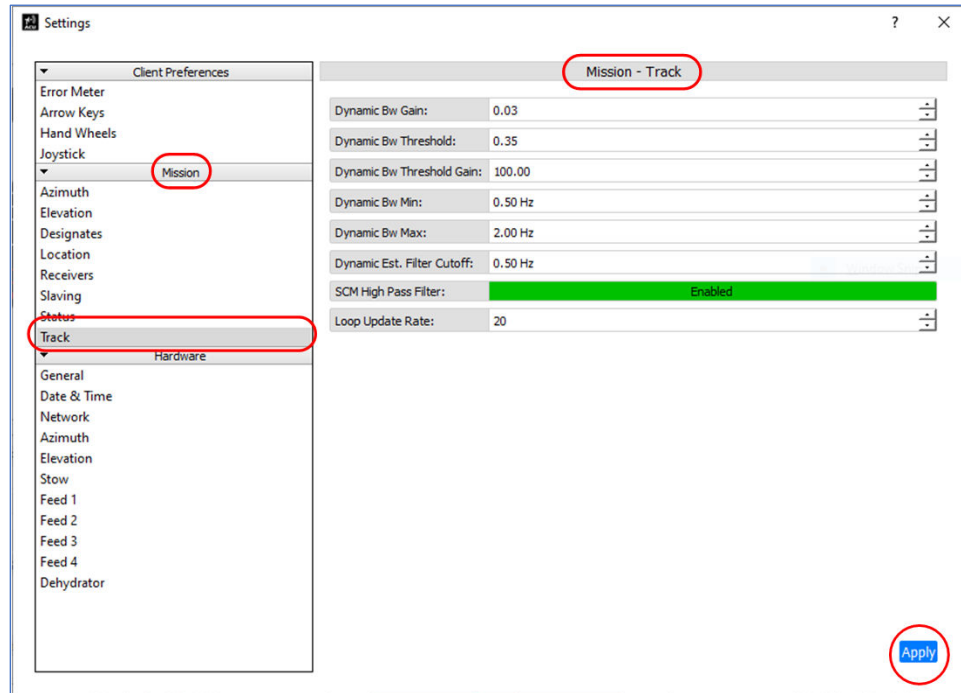


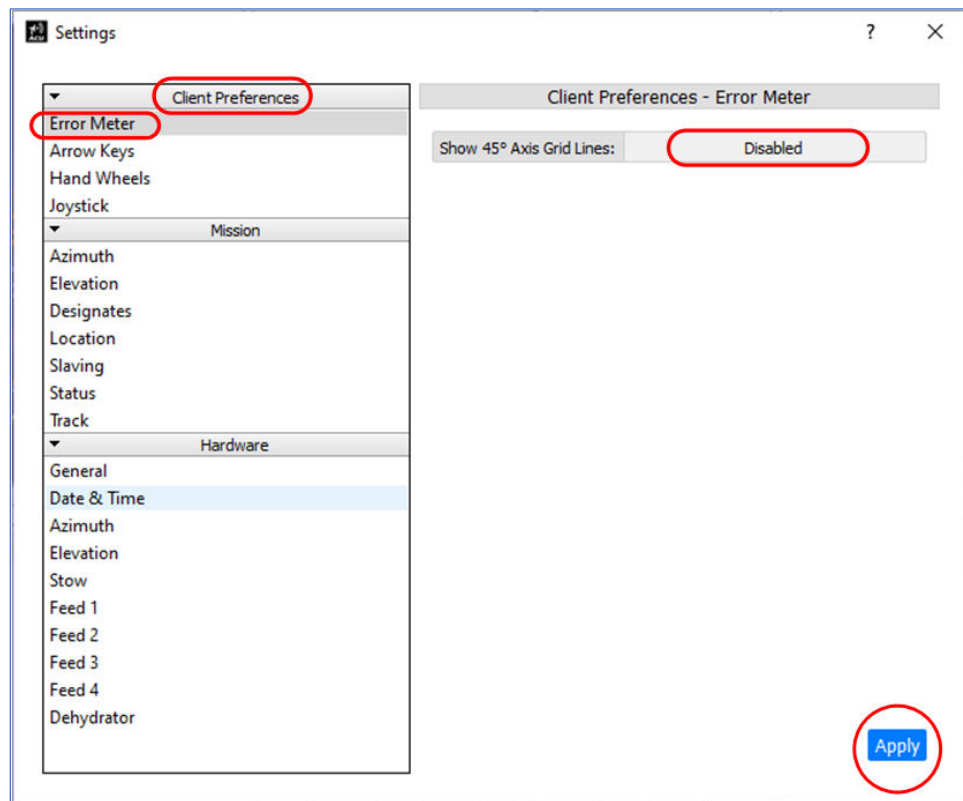
Figure 26: Mission Section, Track Parameter Selected and Settings Displayed

#### 4.2.1.5.1 Client Preferences

##### 4.2.1.5.1.1 Error Meter

Within the Client Preferences section, the user has the option to enable the Error Meter's 45° Grid Lines. This grid line function places diagonal (45°) lines in the Error Meter. These lines are typically used for verifying the off-axis Elevation and Azimuth tracking (pull into center) functions.

To enable the 45° grid lines, select the Disabled button next to Show 45° Axis Grid Lines, as shown in Figure 27.



**Figure 27: Client Preferences, Error Meter—Disabled/Enabled Button**

The button changes to Enabled and is highlighted in green, as shown in Figure 28. Select the Apply button to save the setting.

To disable this feature, select the Enabled button. The button changes to Disabled and the color returns to gray.

To close the window, select the close window (X) located at the top right corner.

The grid lines are only green when the SCM feed is scanning, or the Conscan feed is powered up and spinning, as shown in Figure 29. If the feed(s) are not powered up or connected, the grid lines remain red.

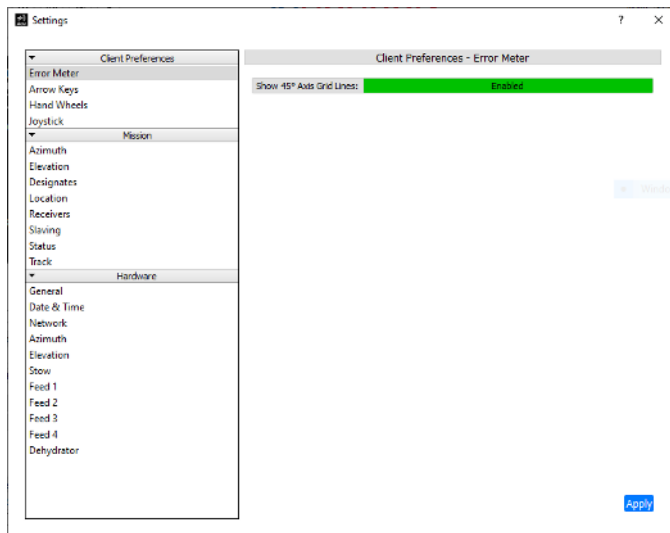


Figure 28: Client Preferences, Error Meter Enabled

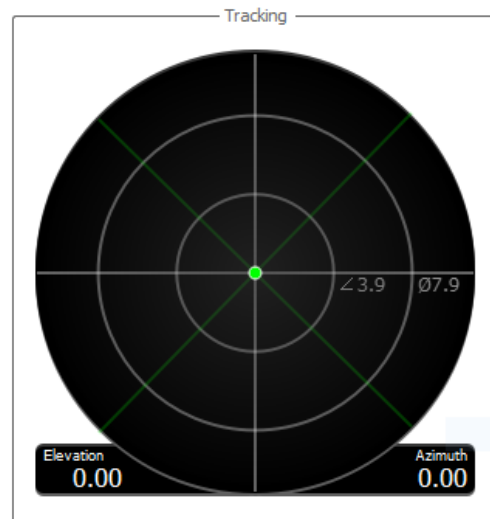


Figure 29: Error Meter, Green Grid Lines

#### 4.2.1.5.1.2 Arrow Keys

Within Client Preferences, the user has the option to enable the Arrow Keys functionality. When enabled, this function allows the user to control the velocity and movement of the Elevation and Azimuth Axes from a connected keyboard.

When enabled, the keyboard arrow keys are available to the user even if the system's hand wheels or joystick are connected and enabled.

The feature also allows the user to independently set the Elevation and Azimuth velocity. The axis moves when any arrow key is continuously held down.

- Tapping any arrow key moves the axis in small steps in the direction indicated by the keyboard arrow key.
- Holding any arrow key down drives the axis at rate the user has set for the Arrow Keys in Client Preferences.
- The Up/Down arrow keys control the Elevation axis Up/Down directions.
- The Left/Right arrow keys control the Azimuth axis CW and CCW motion.

Always select the Apply button to save the selections.

To close the window, select the close window (X) located at the top right corner.

#### 4.2.1.5.1.3 Hand Wheels

Within Client Preferences, the user has the option to set the Elevation and Azimuth Hand Wheel movement dynamics. The Hand Wheels and Hand Wheels Velocity Mode can be enabled and disabled by selecting the button to the right of the parameter. When enabled, the button is highlighted in green.

The user can set the antenna positioner movement using handwheels for the following movement dynamics.

- Az Degrees per turn
- El Degrees per turn
- Az Acceleration
- El Acceleration
- Az Deceleration
- El Deceleration
- Az Velocity per turn
- El Velocity per turn
- Az Max Velocity
- El Max Velocity

In the example in Figure 30, each full turn of the AZ hand wheel, in Velocity mode, drives the axis at 10° per second - per turn up to a maximum of 30° per second. In Position mode, one turn of the AZ hand wheel moves the axis 10° CW or CCW in position.

Selecting the Apply button saves all parameter selections. To close the window, select the close window (X) located at the top right corner.

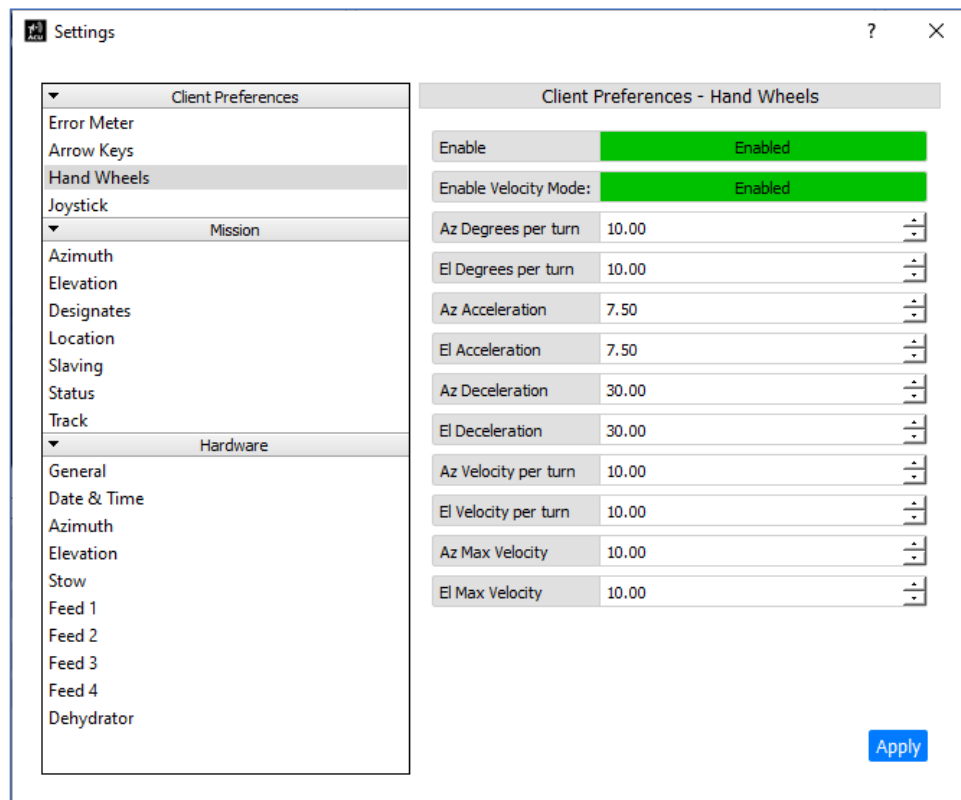


Figure 30: Client Preferences, Hand Wheels

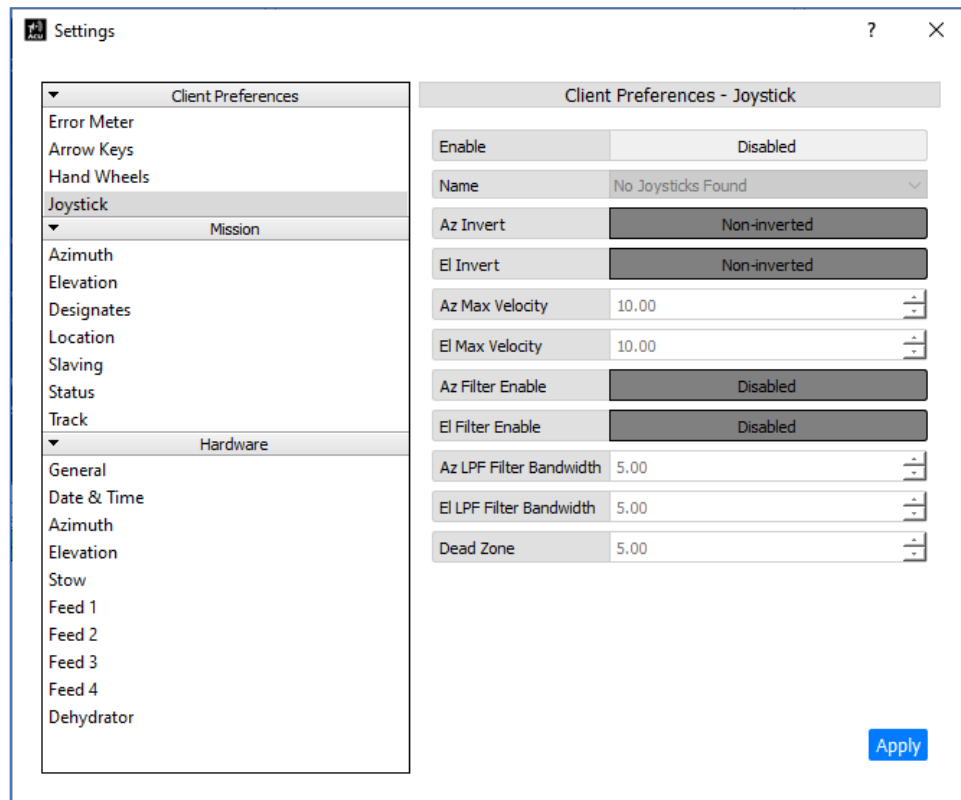
#### 4.2.1.5.1.4 Joystick

Within Client Preferences, the user has the option to select a joystick, its type, Enable/Disable functions, and its calibration parameters, as shown in Figure 31. When enabled, the button is highlighted green, and the detected joystick displays in the Name field. If multiple joysticks have been connected, select the one that corresponds to the joystick currently connected.



The user can set the antenna positioner movement by joystick for the following movement dynamics.

- Az Invert
  - El Invert
  - Az Max Velocity
  - El Max Velocity
  - El Max Velocity
- El Max Velocity
  - El Filter Enable
  - AZ LPF Filter Bandwidth
  - El LPF Bandwidth
  - Dead Zone



**Figure 31: Client Preferences, Joystick Parameters**

#### 4.2.1.5.2 Mission

#### 4.2.1.5.2.1 Azimuth

The Mission - Azimuth window contains the critical Azimuth Axis motion and limit parameters, as shown in Figure 32. The soft limit locations (if used) are set here. To enable, select Disabled next to the Enable Soft Limits? field. When enabled, the field is highlighted green.

When a Slipring/Rotary joint assembly option is installed in the Azimuth Axis, the Azimuth Axis has continuous motion in both the CW and CCW directions. When this option is installed, the Soft Limits are set to Disabled.

The axis Velocity, Acceleration, and Deceleration parameters are set up in this section. The AZ axis offset angle also displays here. The offset angle is typically generated by the True North Tool, which is used to correct the AZ axis to 0.0° North position (refer to the True North Tool section). Changing the AZ offset angle here, changes the systems north pointing position.

Selecting the Apply button saves all parameter selections. To close the window, select the close window (X) located at the top right corner.

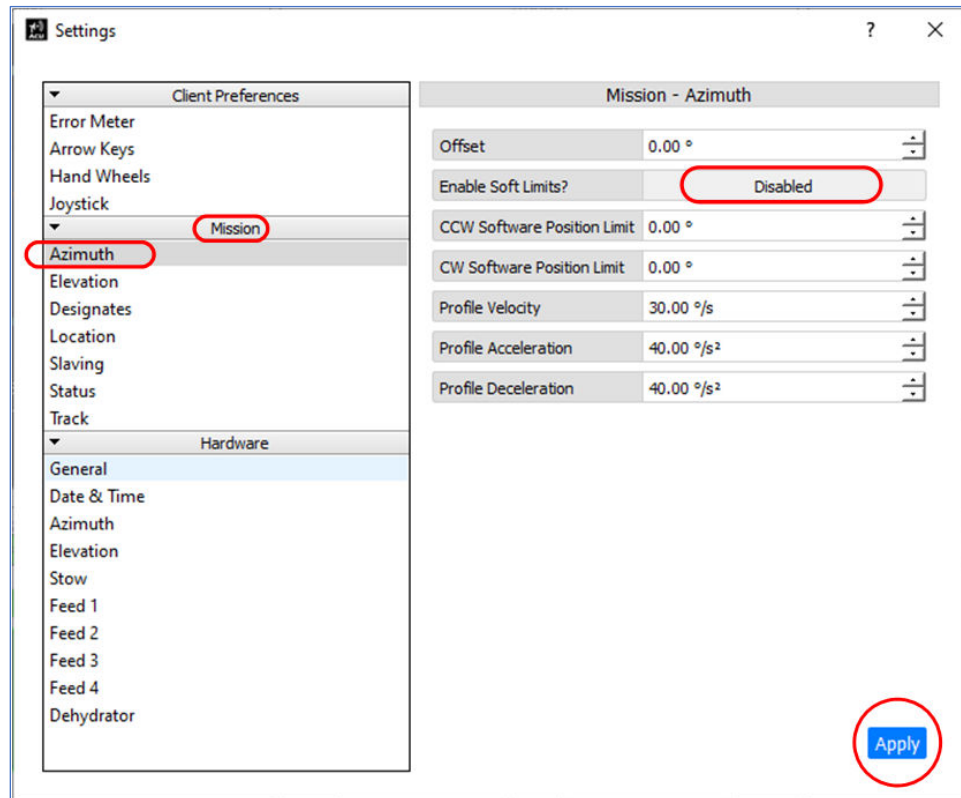


Figure 32: Mission, Azimuth

#### 4.2.1.5.2.2 Elevation

The Mission - Elevation window contains the critical Elevation Axis motion and limit parameters, as shown in Figure 33. The soft limit locations (if used) are set here. To enable, select Disabled next to the Enable Soft Limits? field. When enabled, the field is highlighted green.

This enables the limits in the Up/Down directions in Elevation. The axis Velocity, Acceleration, and Deceleration parameters are also set up in this area.

The EL axis Offset angle displays here. The offset angle is typically generated set.

Selecting the Apply button saves all parameter selections. To close the window, select the close window (X) located at the top right corner.

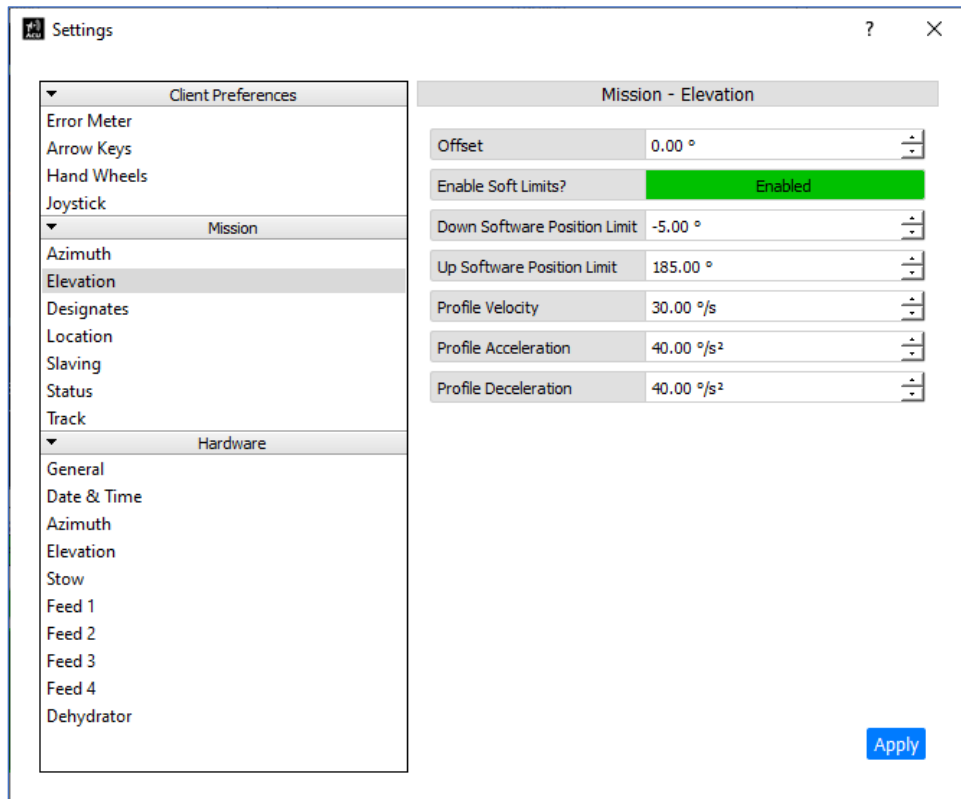


Figure 33: Mission, Elevation

#### 4.2.1.5.2.3 Program Designates

The Mission - Designates window contains the user entered, pre-programmed and named Elevation and Azimuth position locations, as shown in Figure 34. This allows the user to store antenna positions that are repetitively used such as: Boresight, Runway, and Stow. The system is configured at the factor for Sun Designate and is fixed. Sun Designates accuracy is dependent on correct set up at install.

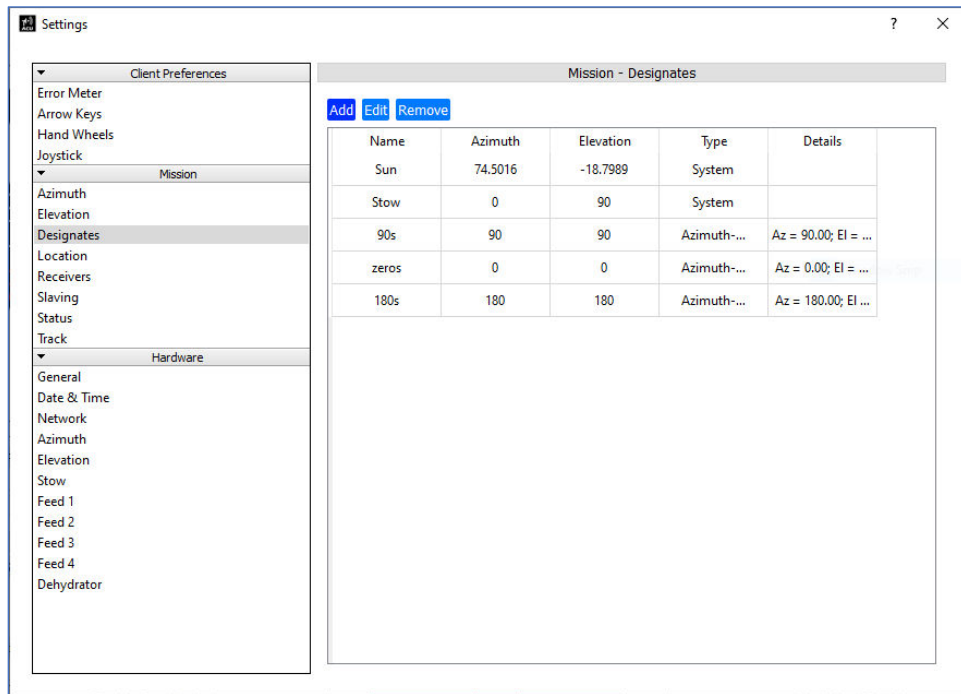


Figure 34: Mission, Designates

#### 4.2.1.5.2.3.1 Add Designate

To program coordinates, select the Add button at the top of the Mission Designates window. In the Add Designate window, shown in Figure 35, type or select the Azimuth and Elevation coordinates for each axis. After entering the coordinates, add a name for recall, then select the Save button. The new Designate displays in the Mission Designates window.

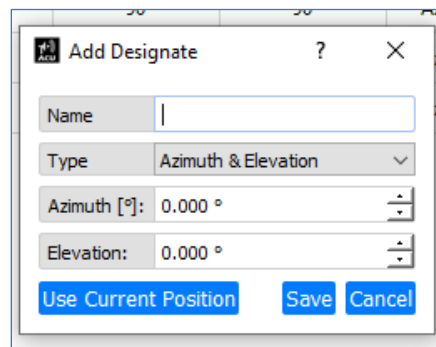


Figure 35: Mission, Designate—Add Designate

#### 4.2.1.5.2.3.2 Edit Designate

To change program coordinates, select the Edit button at the top of the Mission Designates window. In the Edit Designates window, enter the Azimuth and Elevation coordinates for each axis, as shown in Figure 36. After

entering the coordinates, add a name for recall, then select the Save button. The updated Designate displays in the Mission Designates window.

Figure 36: Mission, Designate—Edit Designate

#### 4.2.1.5.2.3.3 Remove Designate

To delete program coordinates, select the saved designate in the Mission Designates window. The designate to delete is highlighted in blue, as shown in Figure 37. Select the Remove button, and the coordinate entry is removed.

Name	Azimuth	Elevation	Type	Details
Sun	74.9406	-18.278	System	
Stow	0	90	System	
90s	90	90	Azimuth-...	Az = 90.00; El = ...
zeros	0	0	Azimuth-...	Az = 0.00; El = ...

Figure 37: Mission, Designate—Remove Designate

#### 4.2.1.5.2.4 Immediate Designates

The Immediate Designate feature is accessed by selecting the Gear button directly to the right of the AZ and EL Manual buttons in the Main screen, Mode Control window. When selected, the icon is outlined in black, and the Designates window opens to the right in the Multifunction Display area, as shown in Figure 38. The programmed and saved Designates display in this window, as well as the immediate designates entry fields for EL and AZ.

To drive the system to a saved, programmed, or immediate designated pointing location, both AZ and EL Manual buttons must be selected (highlighted in green). This indicates that the system is ready drive. Selecting a saved or programmed designate places the AZ and EL pointing positions into the immediate Designate entry fields. Selecting the Go button drives the system to the selected pointing location. Since the Sun Designate pointing position was selected in Figure 38, the system drives to the Sun pointing location.

Note: If only one axis is enabled (Manual button is green) and the other is disabled (manual button is red) when the Designates Go button is selected, only the enabled (green) axis will move.

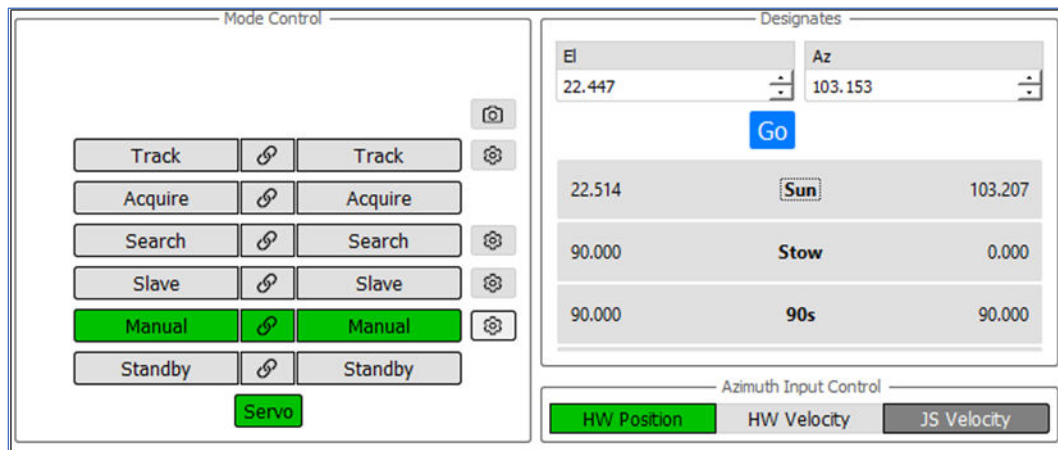


Figure 38: Mode Control Selection and Designates Window

#### 4.2.1.5.2.5 Location

The Mission - Location window allows the user to enter the Earth positions of the Antenna Tracking System. The Earth coordinates consist of: Latitude, Longitude, and Altitude of the antenna system's location on earth, as shown in Figure 39. These coordinates are entered in decimal format into each entry field and are saved by selecting the Apply button. These coordinates are critical for correct sun tracking and satellite slaving applications.

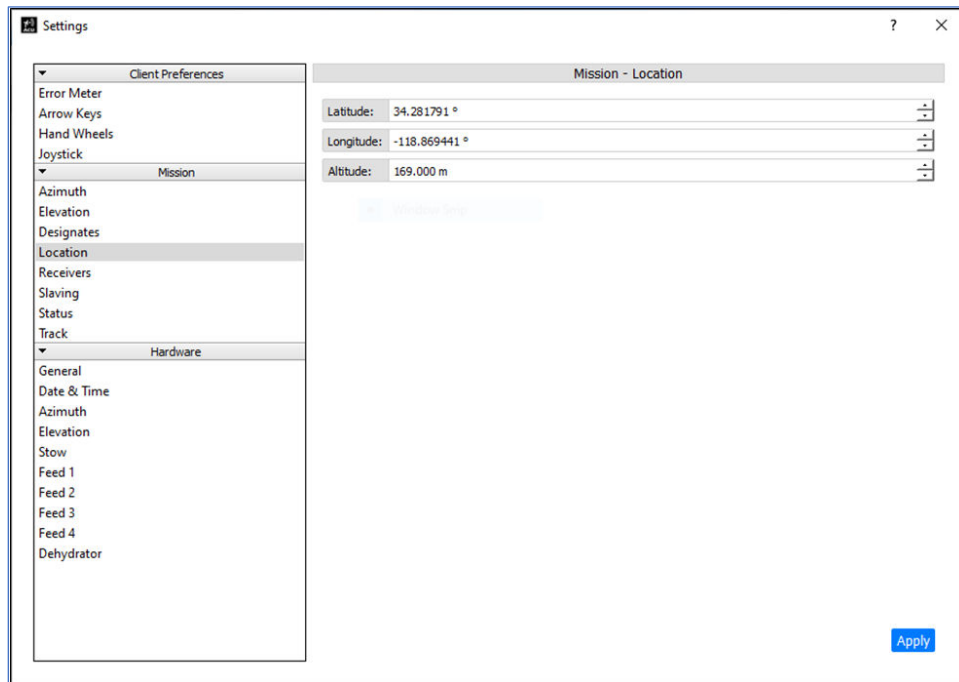


Figure 39: Mission, Location

#### 4.2.1.5.2.6 Receivers

The Mission – Receivers window is used to direct communication between the systems fixed receivers, the HTAC, and the connected Windows Client PC. In this way, changes in the parameter settings at the RDMS™ receiver itself are displayed on the Client GUI. Likewise, receiver parameter changes made within the GUI, are communicated to the linked RDMS™ receiver. This window is available with the Standard Login.

The Mission - Receivers window provides the user a means of adding, editing, or deleting Quasonix receiver(s). The system operates with other manufacturer's receivers, but the full system functionality will not be available.

The Mission - Receivers window shown in Figure 40 has three receivers saved in the window.

##### 4.2.1.5.2.6.1 Add Receiver

When the Add Receiver button is selected, it allows the user to enter a unique name and IP Address for a Quasonix receiver into a separate Add Receiver window. This enables remote control of the receiver through the GUI. After the parameters are entered, then select the Add button.

##### 4.2.1.5.2.6.2 Edit Receiver

The Edit Receiver button operates similarly to Add Receiver. The Edit Receiver window allows the user to change the parameters entered for an existing receiver already saved in the list.

##### 4.2.1.5.2.6.3 Delete Receiver

The Delete Receiver button is used to delete an existing receiver saved in the list.

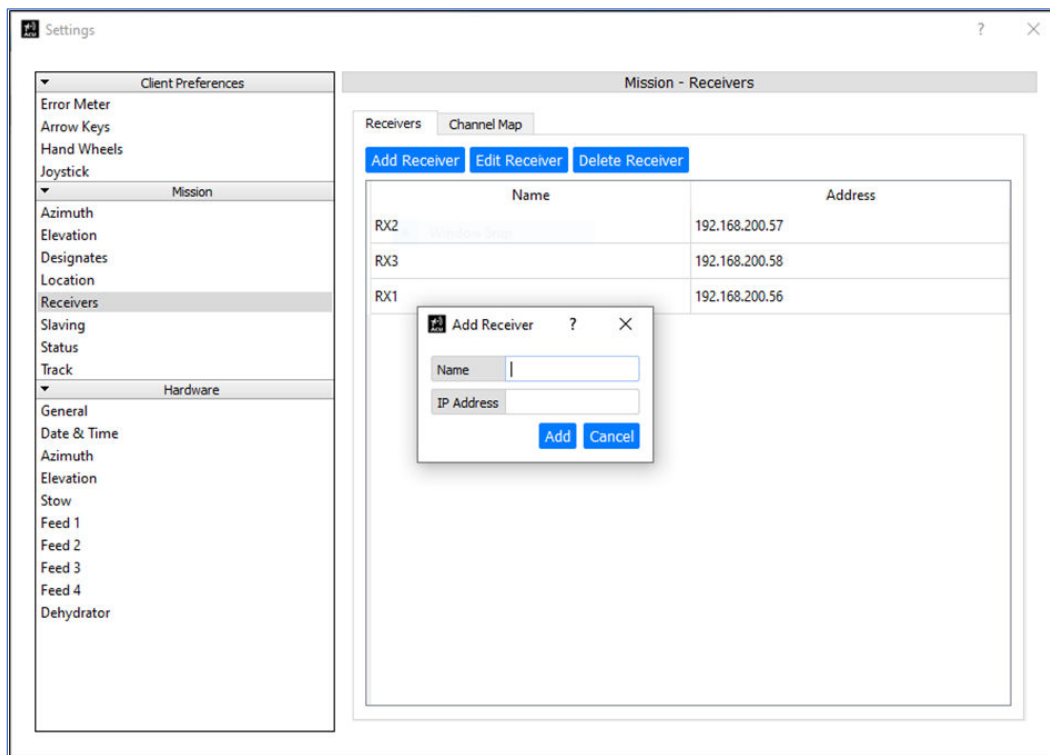


Figure 40: Mission, Receivers—Add Receiver

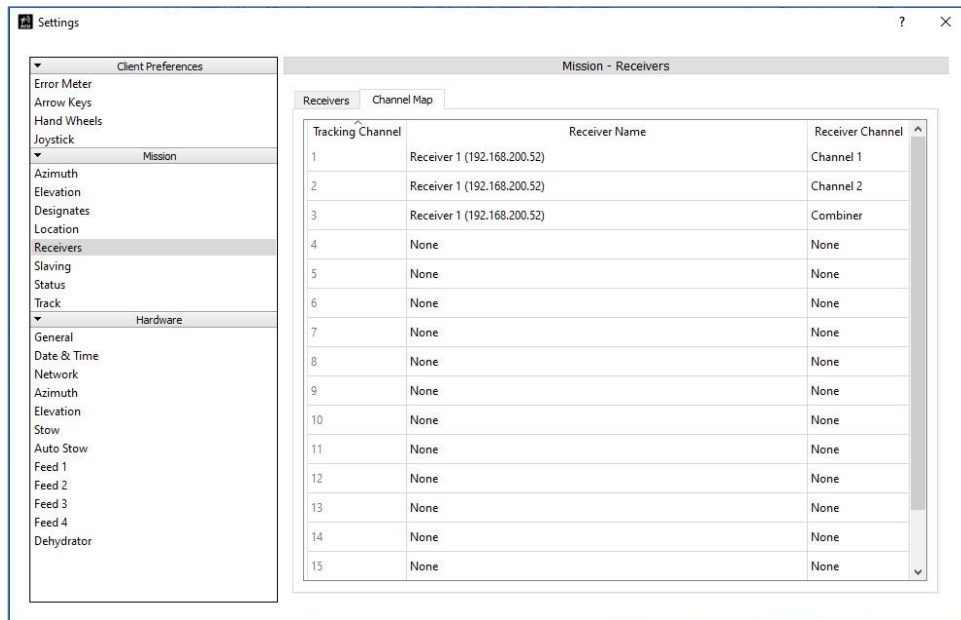
#### 4.2.1.5.2.7 Channel Map

The Channel Map window, shown in Figure 41, only applies to Quasonix RDMS™ receivers. This window lists the unique names and IP addresses of each Quasonix RDMS. The Channel Map window enables linking to the Quasonix HTAC. All tracking channels for each receiver are entered in this window.

For example, in Figure 41, receiver #1 (IP 192.168.200.52) has three tracking channels entered as: Channel 1 (LHCP), Channel 2 (RHCP) and Channel 3 (Combiner). In this example, the tracking system is supplied with only one RDMS™ receiver.

From the Client GUI on the Windows PC, the operator can select certain parameters to change, such as the tracking frequency and bit rate, and each linked Quasonix receiver receives the information and updates its current settings. Certain parameters selected at the receiver itself, such as frequency and bit rate, are transmitted to the HTAC for updating on the Client PC GUI.





**Figure 41: Mission, Receivers—Channel Map**

Within the Channel Map window, the tracking channel IP address for each receiver is added using these steps:

After adding Receiver #1's Tracking Channel IP addresses in the Receivers window, the receiver's three tracking channels (1, 2, and 3) must be selected by double clicking the Receiver Channel field.

A channel name is selected from the drop down menu for each of the receiver's three tracking channels, as shown in Figure 42. In this example, Channel 1, Channel 2 and Combiner are selected.

If a second receiver is entered, it displays in the Tracking Channel column, lines of 4, 5, and 6. Receiver #2, Tracking Channel 4 could also be named Receiver Channel 1 (from the drop down menu), Tracking Channel 5 would be named Receiver Channel 2, and Tracking Channel 6 would be named Receiver Channel Combiner.

This pattern of entering and naming receivers would continue for any additional receivers added.

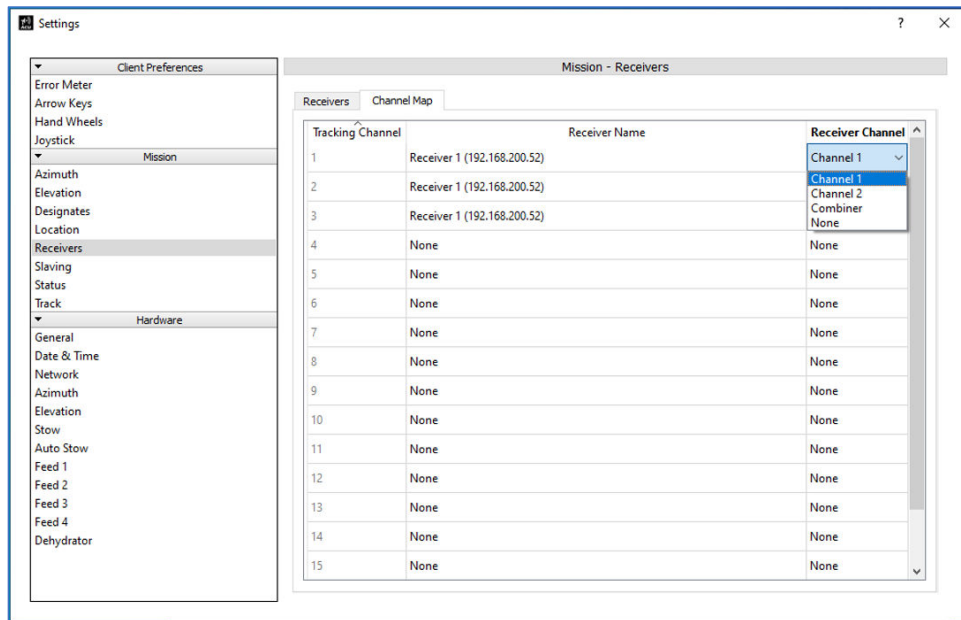


Figure 42: Channel Map, Receiver Channel Drop Down Menu

#### 4.2.1.5.2.8 Slaving

The Mission – Slaving window provides a means of adding, editing, or deleting slaving sources for antenna pointing purposes. This location is where the source parameters such as, Name, Description, and Source IP address are entered and stored. The only slave source provider available is the Standard Ethernet.

##### 4.2.1.5.2.8.1 Add Slave Source

Select the Add Source button. When the Add Slave Source window displays, as shown in Figure, type the source Name, Description, and IP address for recall. The only slave source input available (in the Provider field) is a Standard Ethernet. This is selected from the drop down menu. Select the Save button to add the slave source.

##### 4.2.1.5.2.8.2 Edit Slave Source

Select the Edit Source button to make changes to any listed slave source. Type updates in the Edit Source window (similar to the Add Slave Source window) to make changes to any listed slave source(s). Select the Save button to save the changes.

##### 4.2.1.5.2.8.3 Delete Slave Source

Select the source line entry to delete. Select the Delete Source button to remove the highlighted line from the available saved sources.

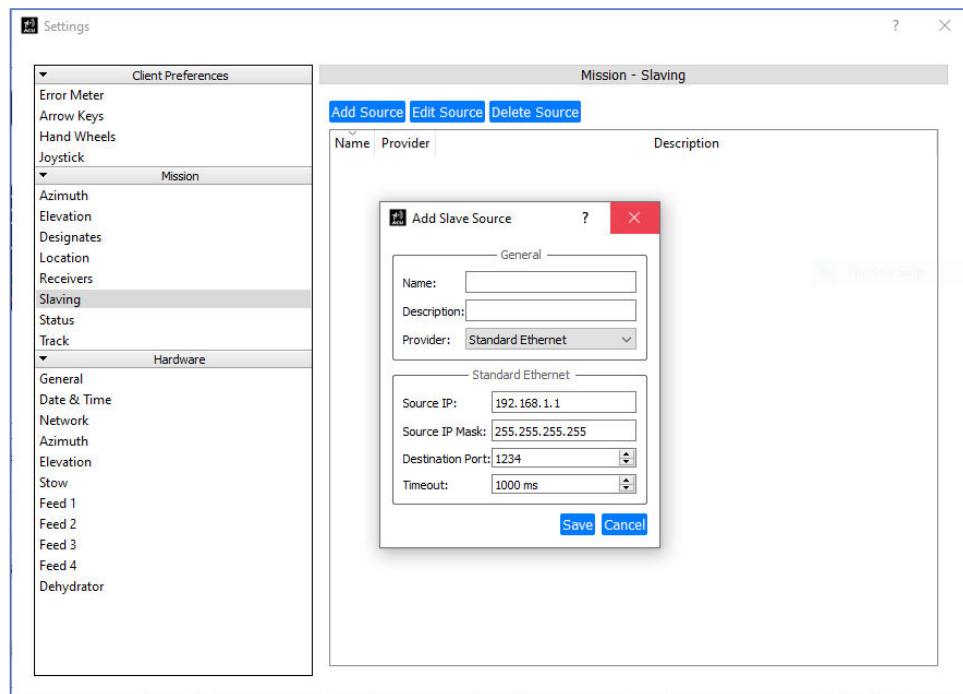


Figure 43: Mission, Slaving—Add Slave Source

#### 4.2.1.5.2.9 Status

The Mission - Status window provides the user a location where Status Messages are configured, enabled (highlighted in green), or disabled (highlighted in gray), as shown in Figure 44. This window is available with the Standard Login.

The message type is set by selecting from the drop down menu at the end of the Message Type field.

Type the Destination IP Address (Dst. IP Address) and Destination Port (Dst. Port) into the appropriate fields.

The Message Rate must be a value between 1 Hz and 100 Hz. Select the desired value from the drop down menu.

The message protocol (Endian field) can be switched between Big Endian and Little Endian.

All parameters are saved by selecting the Apply button.

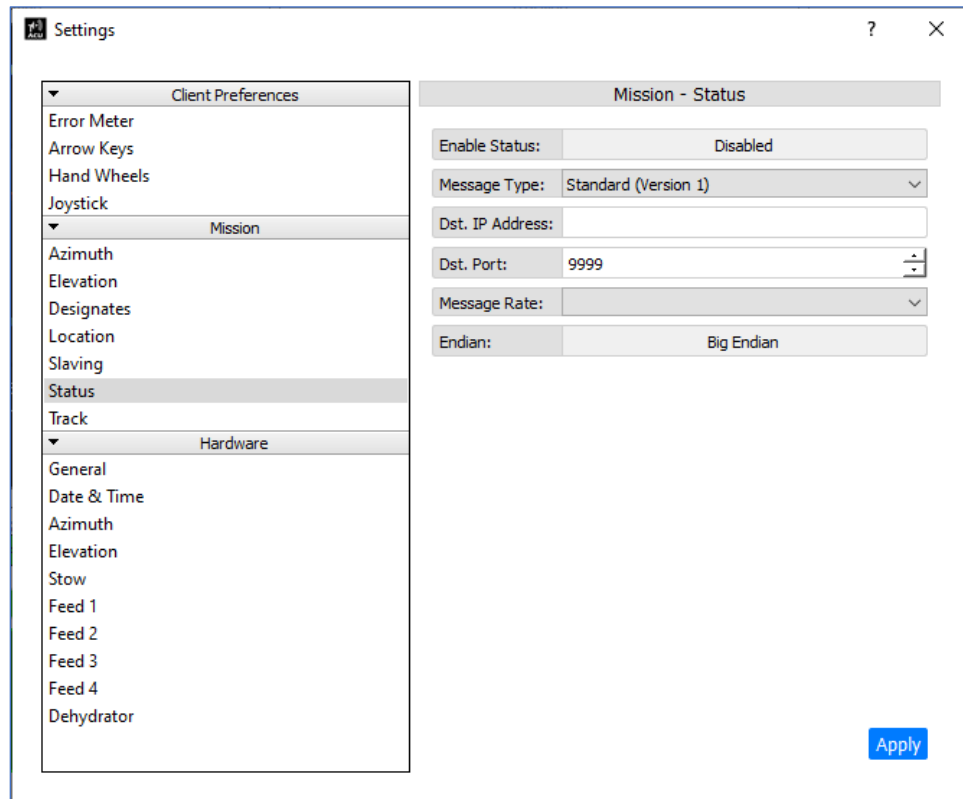


Figure 44: Mission, Status

#### 4.2.1.5.2.10 Track

The Mission -Track window, shown in Figure 45, provides a location to configure the parameters that define the target tracking motion of the antenna tracking system, as it follows the radiating target across the sky. The parameters found in this menu are factory adjusted to the type of feed, such as Conscan or SCM, and the reflector size of the deliverable. Note, these parameters are typically factory set for each deliverable and should not need adjustment.

The Dynamic Bw Min and Dynamic Bw Max parameters can be fine-tuned to achieve smoother system target tracking. These changes should be made in small increments and verified by checking the tracking motion of the system after each adjustment. Make sure to note starting parameters and any changes before adjustment through this process.

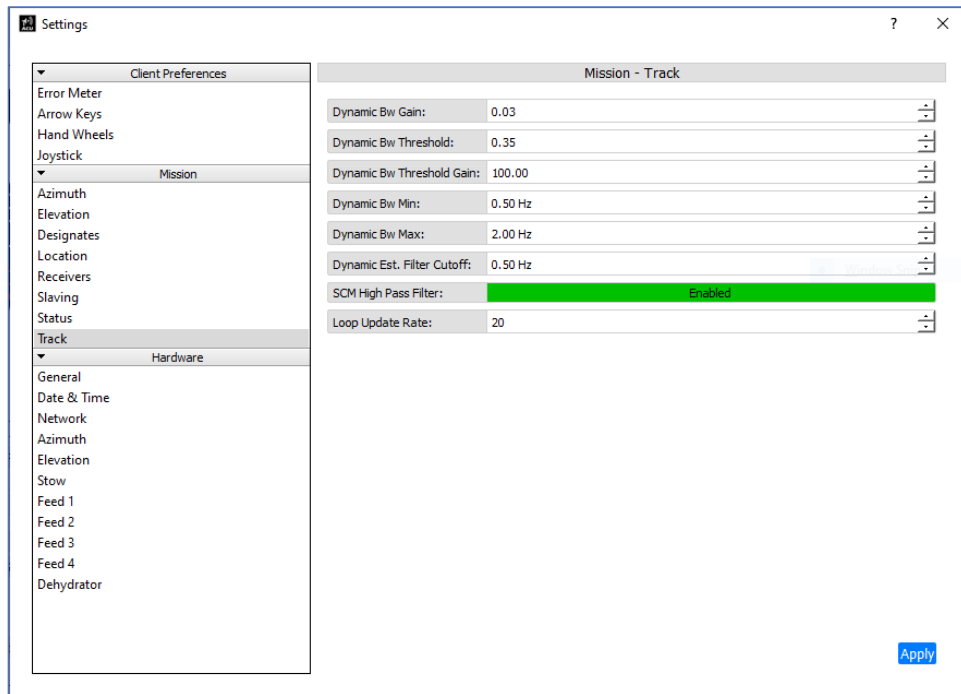


Figure 45: Mission, Track

### 4.2.1.5.3 Hardware

#### 4.2.1.5.3.1 General

The Hardware – General window, shown in Figure 46, provides the user a location to the basic system hardware parameters for the overall tracking system. Parameters include: tracking System Name, Reflector Diameter (in meters), and the ACQ AID aperture (in meters). This information is factory installed and should not be changed.

This window is NOT available to the standard user. An Advanced Use Password must be received from the Quasonix factory to access this window.

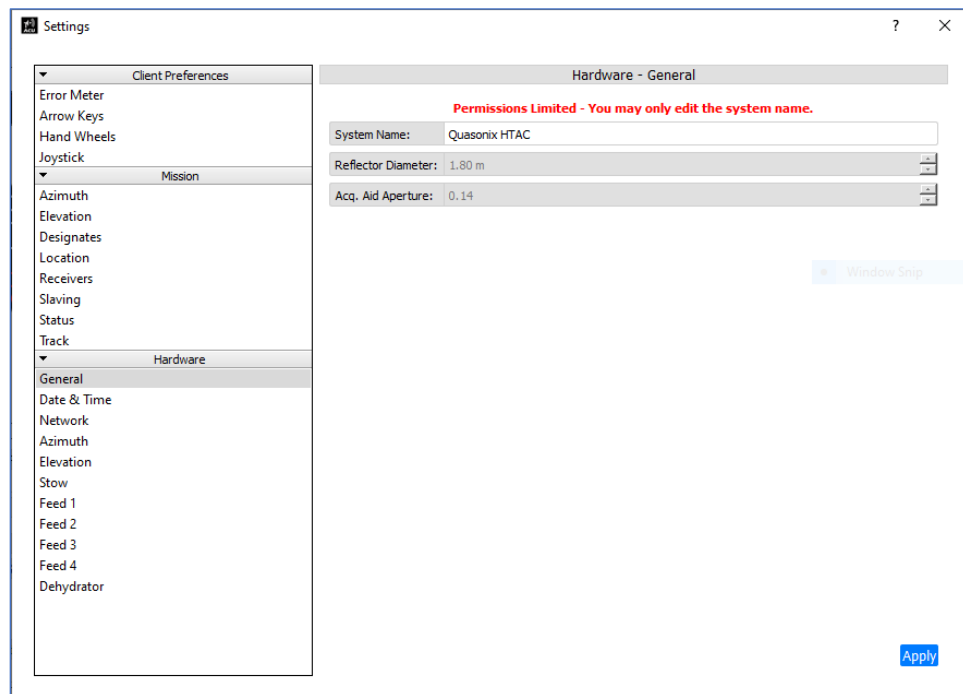


Figure 46: Hardware, General

#### 4.2.1.5.3.2 Date and Time

The Hardware - Date & Time window, shown in Figure 47, provides access to the current system date and time protocol information. The up/down arrows allows for the manual entry of the date and time information, if desired. Select the Set Date & Time button to save any changes.

In addition, a PTP 1588 time server can be employed to provide the IRIG B time data, if available. The PTP domain number can be changed, using the up/down arrows, to match the available PTP device to receive time data. The system always selects the best available server. Select the Set PTP Domain button to save any changes.

If an NTP time server is available, the Network Time Protocol information can be obtained by adding the time server's IP address to the NTP servers list. Multiple servers can be added, with the system automatically selecting the best choice server. The default servers shown in the NTP list are Internet Time Protocol Servers and can be removed if desired. Use the Add NTP Server button to add a server to the list, or the Delete NTP Server button to delete a server from the list.

The parameters in this window are available to all users with the Standard Login.

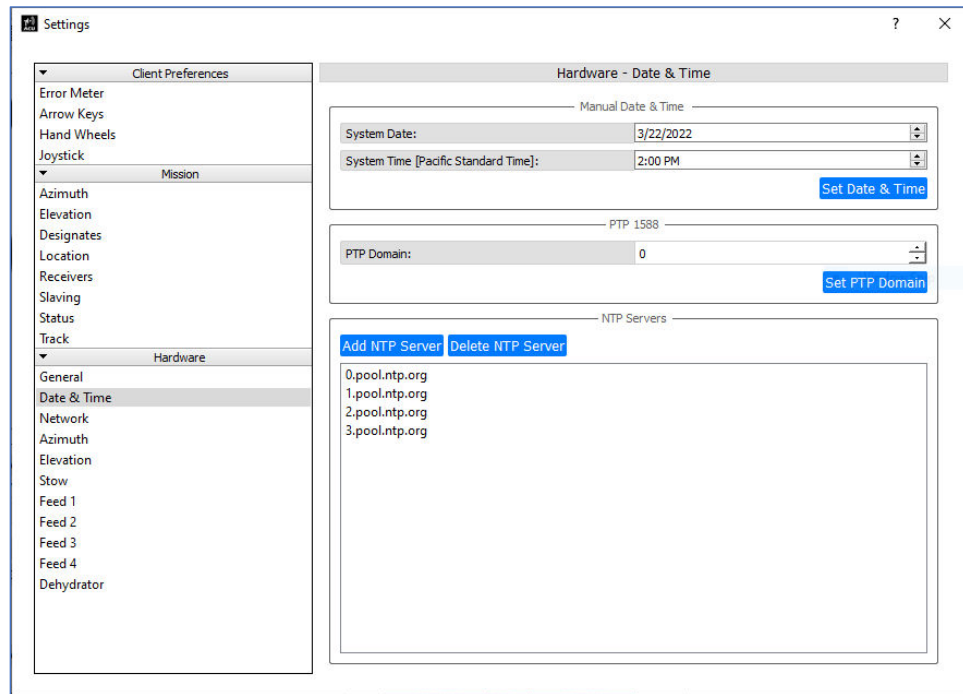


Figure 47: Hardware, Date and Time

#### 4.2.1.5.3.3 Network

The Hardware - Network window, shown in Figure 48, provides access to the factory set Ether-Cat, Vlan Protocol Number. This is a factory software setting, which controls EtherCat communication between the servo controllers and the managed switch, within the external servo assembly, and should not be changed.

Changing this setting may shut off the servo controller's internal EtherCat links.

An Advanced Use Password must be received from the Quasonix factory to access this window.

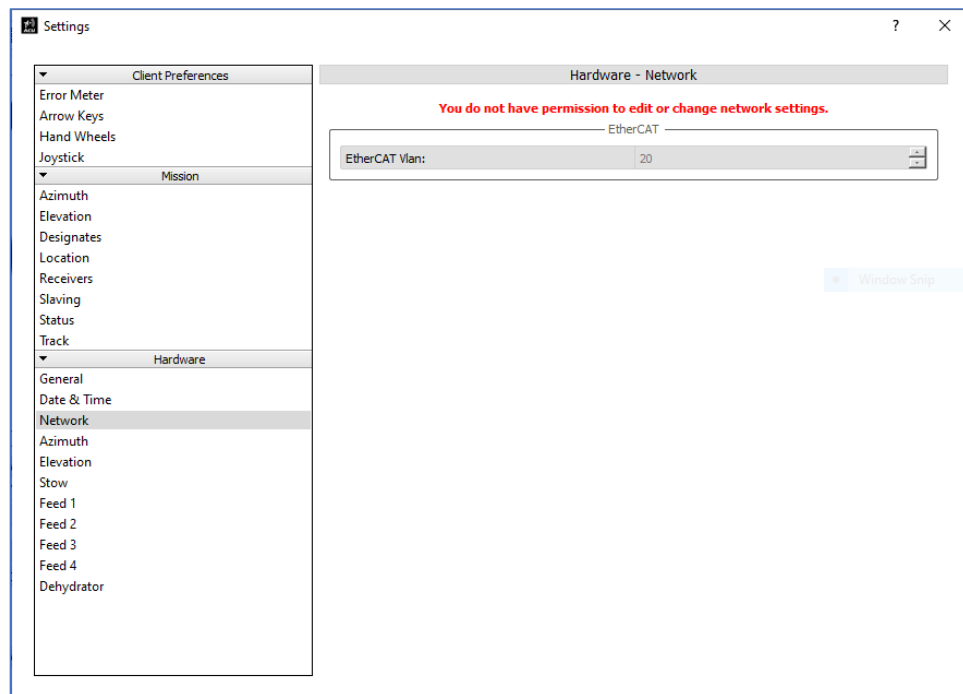


Figure 48: Hardware, Network

#### 4.2.1.5.3.4 Azimuth

The Hardware - Azimuth window, shown in Figure 49, provides access to the basic parameters for the correct operation of the Azimuth Axis. The parameters entered, saved, and displayed here are for Gear Ratio Input Revs, Gear Ratio Output Revs, Maximum Velocity, Maximum Acceleration, and Maximum Deceleration.

These are parameters set at the factory and are password protected to prevent damage to the system or personnel.

An Advanced Use Password must be received from the Quasonix factory to access this window.



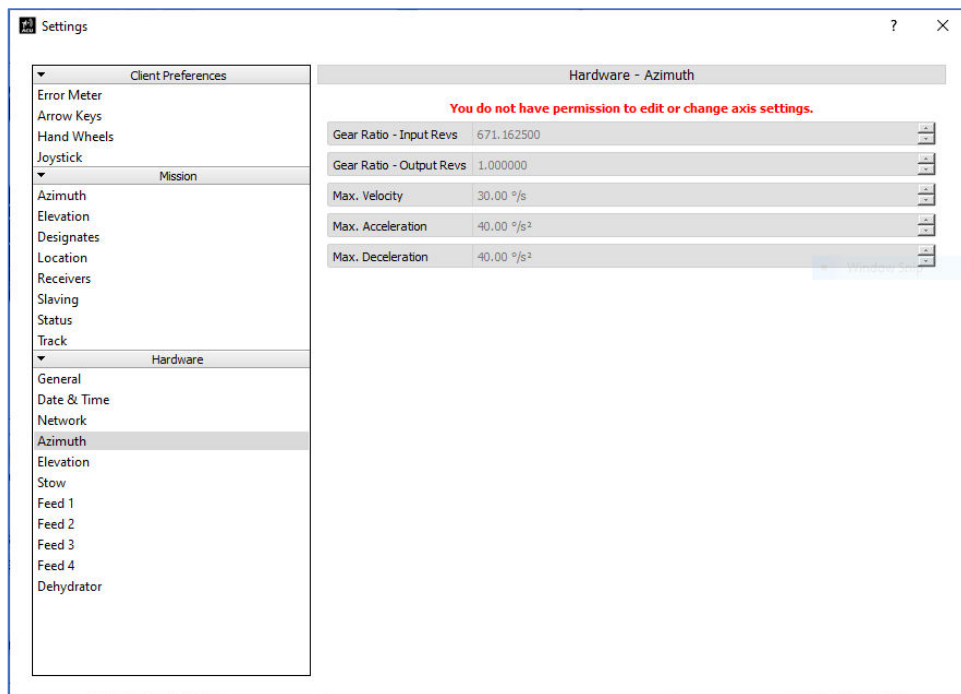


Figure 49: Hardware, Azimuth

#### 4.2.1.5.3.5 Elevation

The Hardware - Elevation window, shown in Figure 50, provides access to the basic parameters for the correct operation of the Elevation Axis. The parameters entered, saved, and displayed here are for Gear Ration Input Revs, Gear Ration Output Revs, Maximum Velocity, Maximum Acceleration, and Maximum Deceleration.

These parameters are set at the factory and are password protected to prevent damage to the system or personnel.

An Advanced Use Password must be received from the Quasonix factory to access this window.

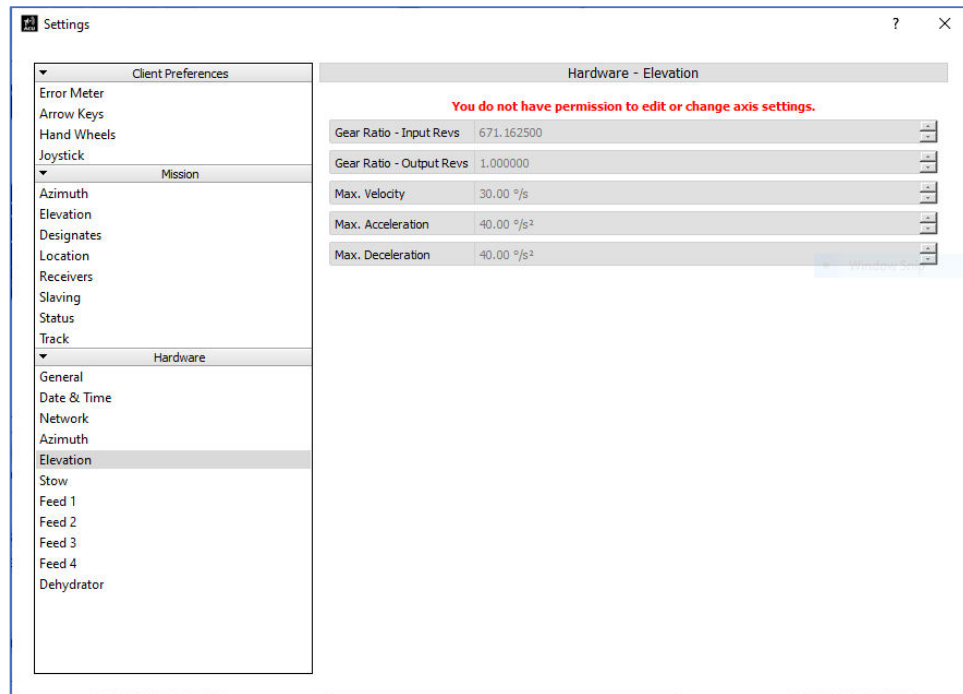


Figure 50: Hardware, Elevation

#### 4.2.1.5.3.6 Stow

The Hardware - Stow window, shown in Figure 51, records and saves the AZ and EL axes stow location.

This position is critical for systems with a supplied Auto Stow option. The typical stow position locates the drive side yoke arm where the manual stow pin, yoke arm pass through, and receptacle are located. At this exact location, the manual stow pin should easily mate into the receptacle, holding the yoke arm in place.

These are parameters set at the factory and are password protected to prevent damaged to the system or personnel.

An Advanced Use Password must be received from the Quasonix factory to access this window.

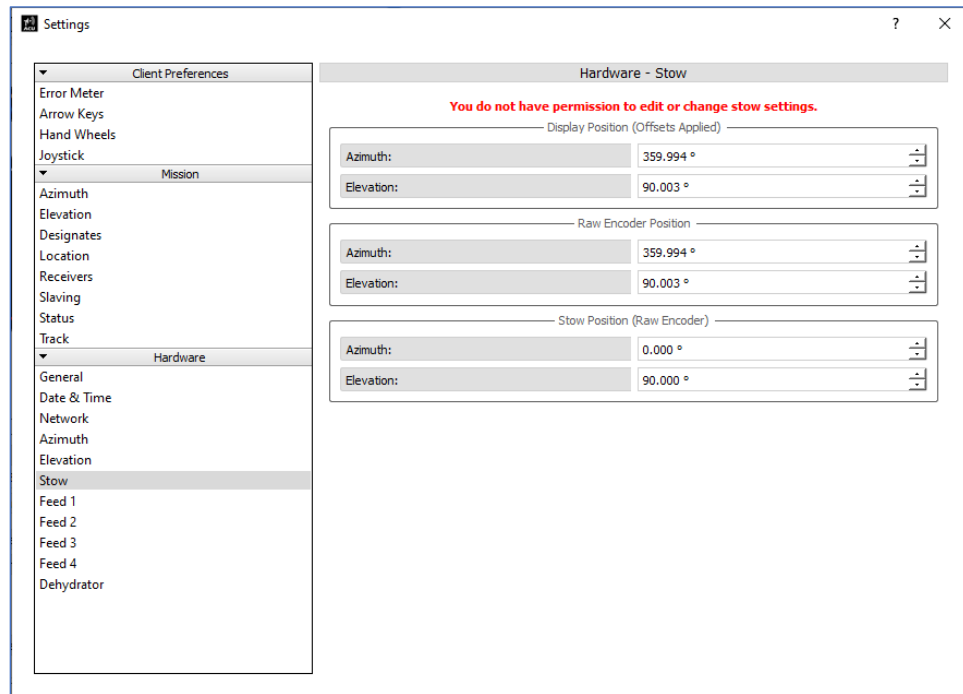


Figure 51: Hardware, Stow

#### 4.2.1.5.3.7 Feed 1

The Hardware - Feed 1 window provides access to the basic parameters the factory configured for the first feed (in multiple feed configurations).

In the example shown in Figure 52, the Quasonix standard Single Channel Monopulse (SCM) electronically scanning multiband (L, S, and C) Tracking Feed parameters have been configured.

This window contains four (4) available configurable Feed types (Feed 1 through Feed 4). This allows for the system to be configured for up to four (4) feeds in a single Quasonix HyperTrack™.

For example, Feed 1 would save the parameters for the provided, typical SCM feed assembly (as shown in Figure 52), while Feed 2 would contain the parameters for an additional feed, such as an offset, dish mounted, ACQ-AID.

Different types of feeds can be selected and configured within this window, such as combinations of Conical Scanning Feeds, SCM, or Monopod with Acquisition Aid Feeds.

This window is not available to all users. Users with limited access (ADMIN), however, can modify the Scan Frequency and the Band Detector Gains (Det.Gain °/V) only. An Advanced Password must be entered to access any other Feed 1 parameters.

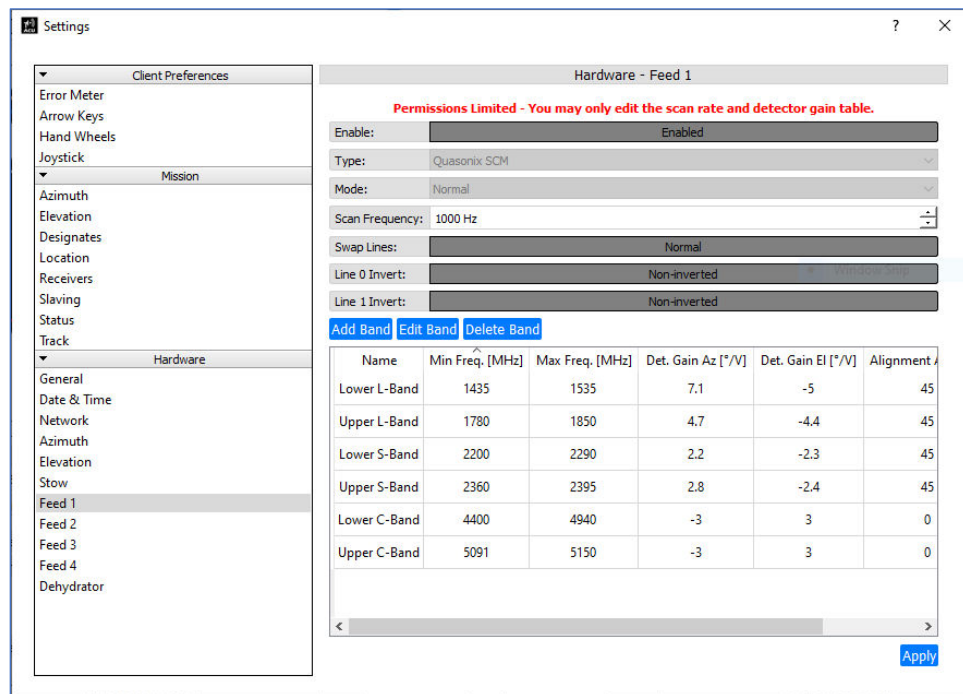


Figure 52: Hardware, Feed 1

In Figure 52, the settings were selected and set for a standard Quasonix tri-band feed (L/S/C bands). The Quasonix SCM feed was selected from the Feed (1) Type, drop down menu. The (feed modulation) Mode is set to Normal, and the feed Scan Frequency was set to 1000 Hz (typical factory scan rate setting). The scanning frequency can be adjusted from 100 Hz to 2000 Hz using the up/down arrows.

The Swap Lines and the Line (0 and 1) Invert modulation parameters are factory set for proper SCM feed modulation and should not be modified. These parameters are provided for factory test and troubleshooting purposes only.

The frequency bands shown within the table are typical for the Quasonix SCM Tri-Band Tracking Feed Assembly. Additional frequency bands can be added, removed, or modified by selecting the Add Band, Edit Band, or Delete Band button(s). The frequency bands must be compatible with the feed(s) installed, and cannot overlap the provided bands shown within the table.

Note: The Hardware - Feeds 2, 3, and 4 windows are identical to the Feed 1 window, but do not have the saved feed parameters settings, as shown in Figure 53. Only one feed is typically supplied, so all other feed windows are empty. If a system is supplied with two feeds, for example, the second feed's parameters would be saved under the Feed 2 heading.

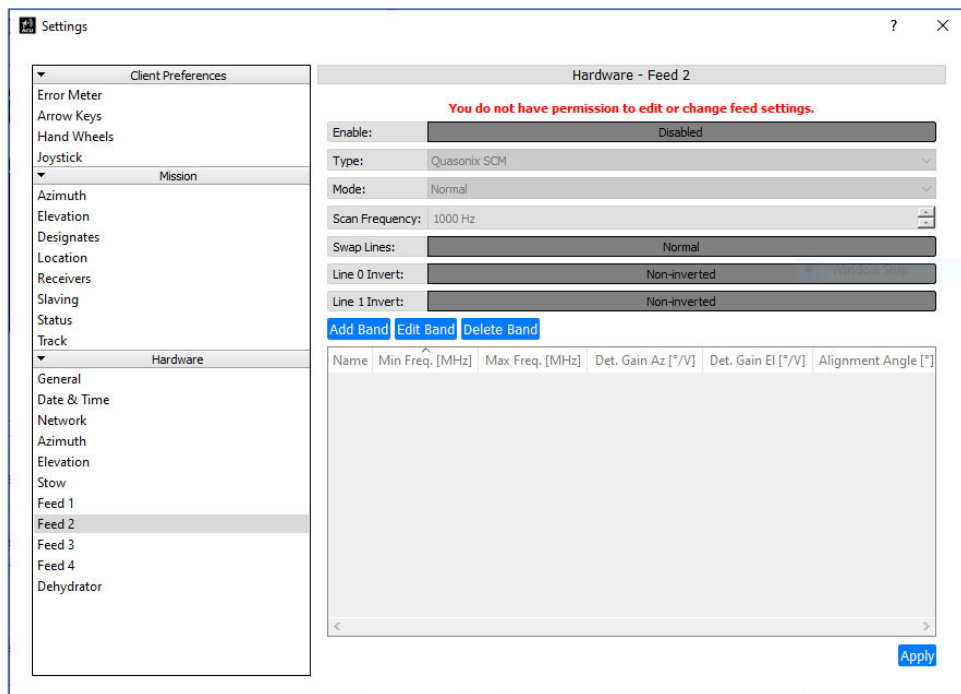


Figure 53: Hardware, Feed 2

#### 4.2.1.5.3.8 Dehydrator

The Hardware – Dehydrator window, shown in Figure 54, provides access to the dehydrator communication parameters. The dehydrator’s IP Address, SNMP Community setting, and Polling Rate are entered and stored here.

To allow the HTAC to communicate with the dehydrator, the Enable parameter must be selected, and highlighted in green. After communication is established, the basic dehydrator data and faults can be received by the HTAC and displayed with in the Status and Indicators.

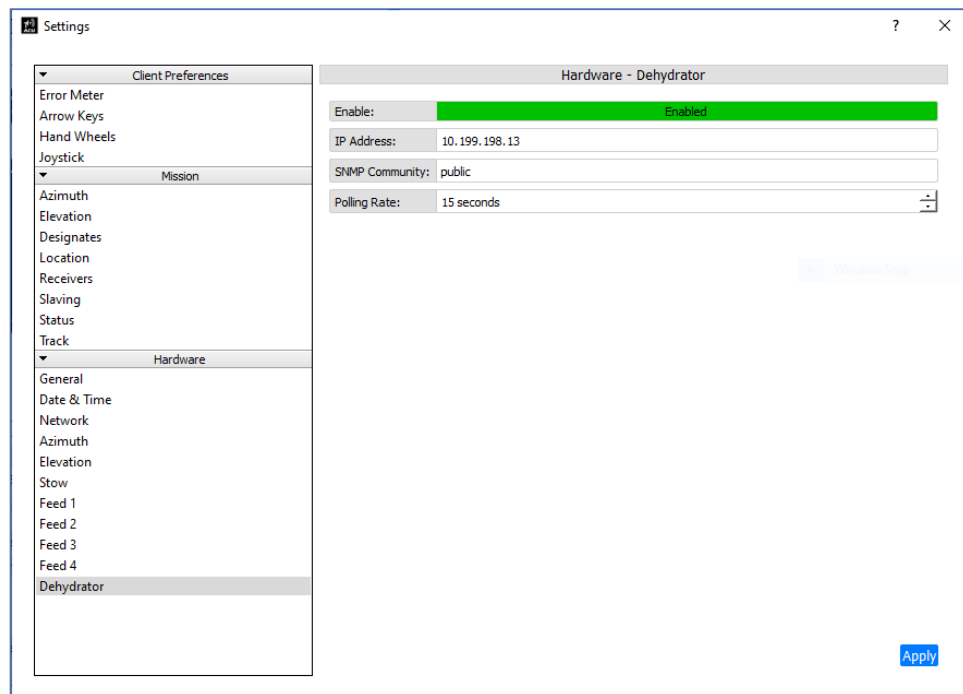


Figure 54: Hardware, Dehydrator

#### 4.2.1.6 Tools

A drop down menu displaying configurable features is accessed via the Tools icon on the Main Tool Bar, as shown in Figure 55. The features include:

- True North
- Handwheel Test
- Joystick Test
- Scope Recorder
- Change Password Window
- Manage Users Window
- Restart HTAC
- Shutdown HTAC

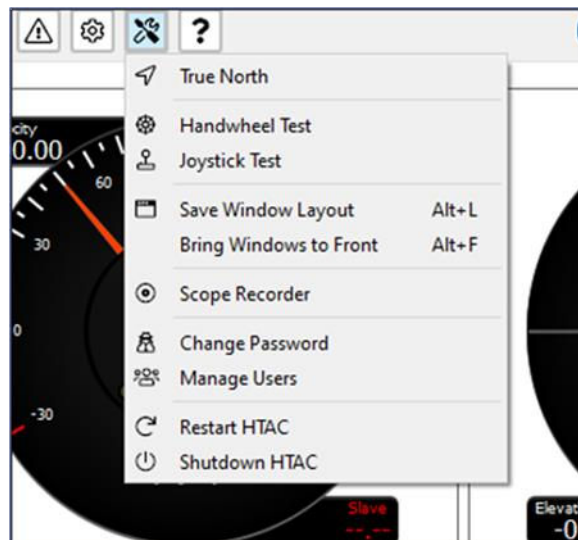


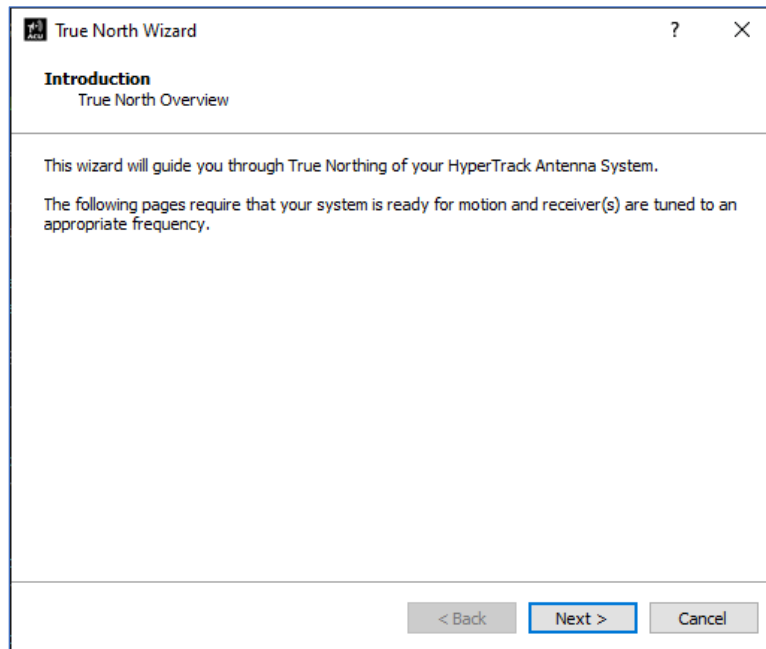
Figure 55: Main Screen Tools Icon and Configurable Features List

#### 4.2.1.6.1 True North

The True North feature in the Tools drop down menu aligns the HyperTrack™ with the Azimuth Axis True 0° pointing position. This provides the user with three methods of aligning the system to 0° North. Each method involves a series of steps the user can follow to align the Azimuth axis. The three alignment methods are provided with built-in Wizard to assist the user in configuring each alignment method, and are nearly identical.

- Sun Calibration
- Boresight Calibration
- Landmark Calibration

1. In the True North Wizard, Introduction screen, select the Next button.



**Figure 56: True North Wizard, Introduction**

2. The True North Wizard, Select Method screen, shown in Figure 57, is used to select the desired option for aligning the antenna: Sun, Boresight, or Landmark. Each method of alignment uses the same setup and Wizard. The most common is the Sun method, which is described in this manual.

The sun calibration method is selected by selecting the Sun parameter in the True North Wizard, as shown in Figure 57. Then, select the Next button to continue.

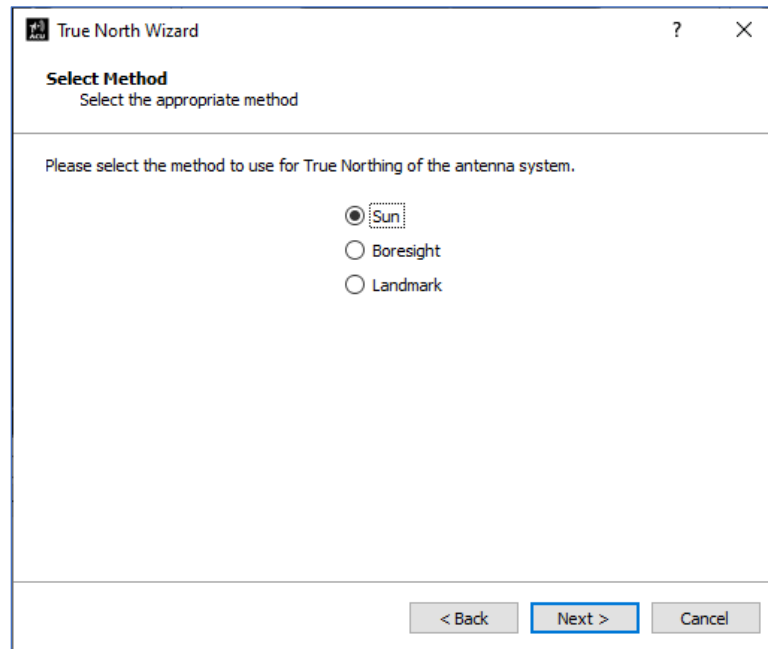


Figure 57: True North Wizard, Select Method

3. Sun Calibration - Verify system location and the correct Date and Time

Verify the system location in the True North Wizard, System Settings screen, as shown in Figure 58. Select the Next button to continue.

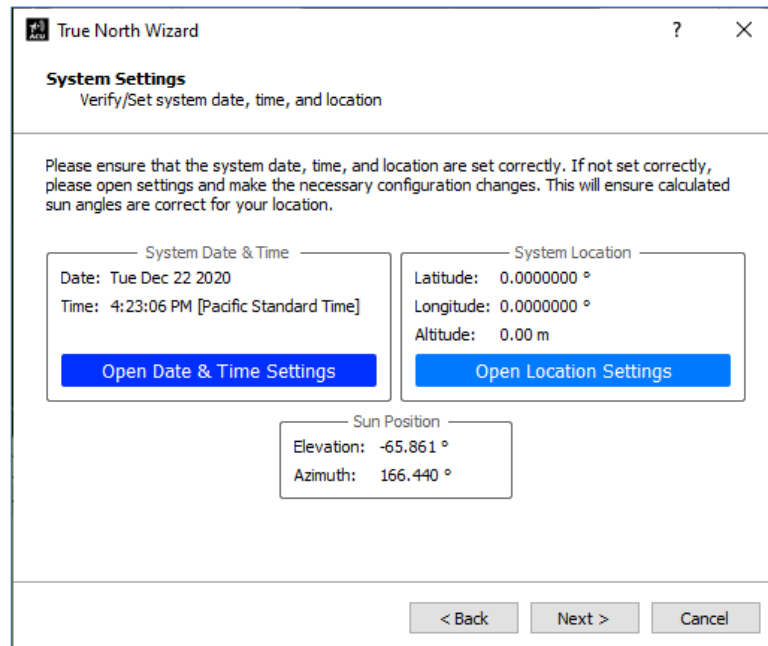


Figure 58: True North Wizard, System Settings



4. Set the tracking channel (LHCP) signal strength (Hi), and check the attached receiver settings and tracking frequency, in the True North Wizard, Channel Configuration, as shown in Figure 59. Select the Next button to continue.

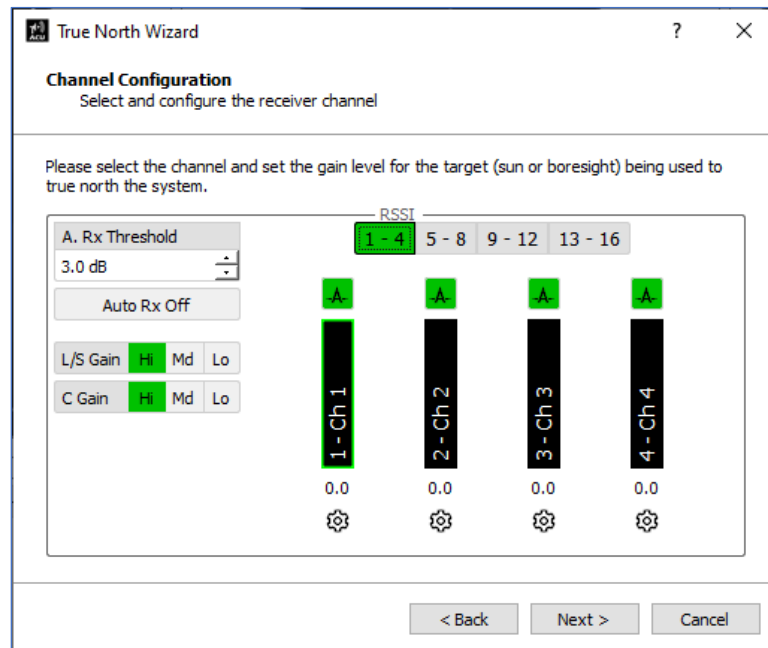


Figure 59: True North Wizard, Channel Configuration

5. In the True North Wizard, Enable Manual Mode screen, enable Manual Mode axes control, as shown in Figure 60. The AZ and EL axes are ready to move. Select the Next button to continue.

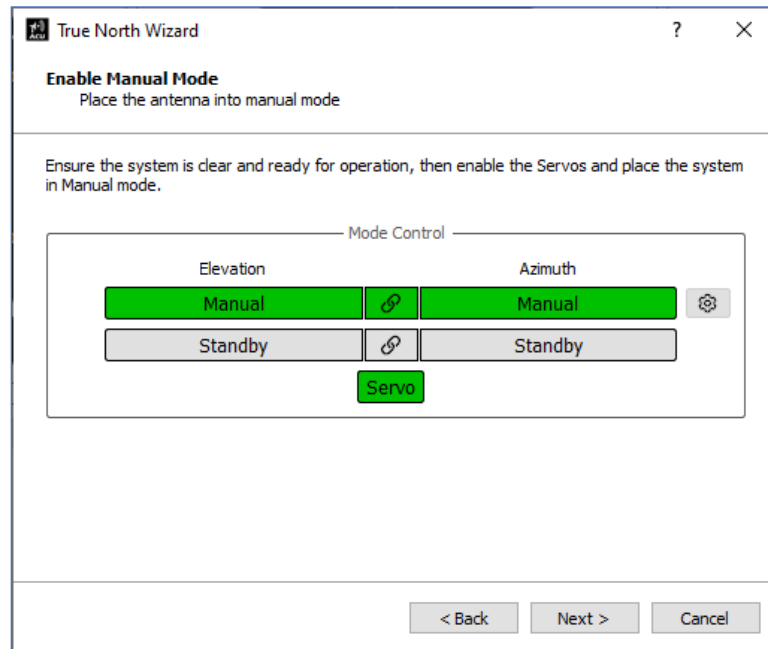


Figure 60: True North Wizard, Enable Manual Mode

6. On the True North Wizard, Find Sun window, shown in Figure 61, point the antenna at the sun by selecting the Move to Sun button, or by manually moving the HyperTrack™, as shown in Figure 62.

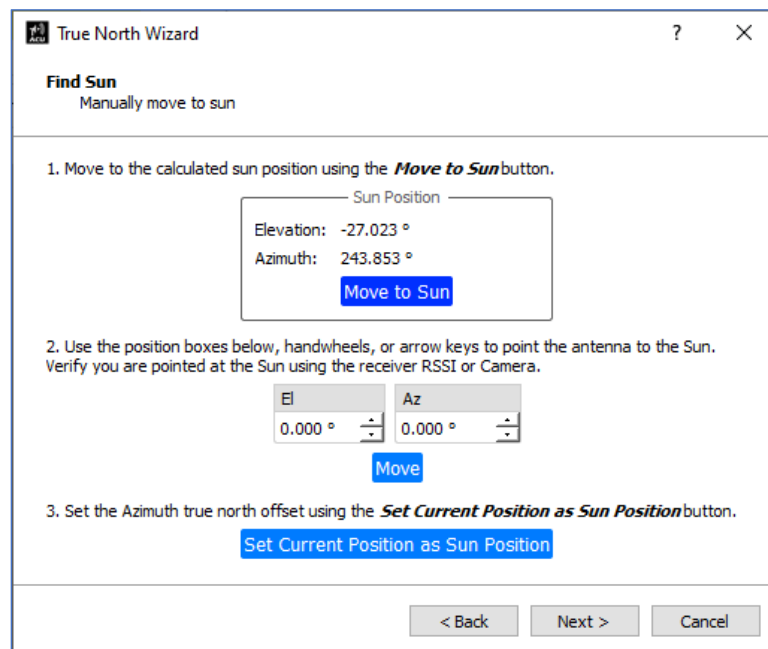


Figure 61: True North Wizard, Find Sun

Using a manual method, such as with handwheels, joystick, remote box, etc., move the antenna so the shadow of the prime focus feed is centered at the vertex of the reflector. If using a vertex mounted feed, Cassegrain, position the sun centered over the Cassegrain Feed Assembly.

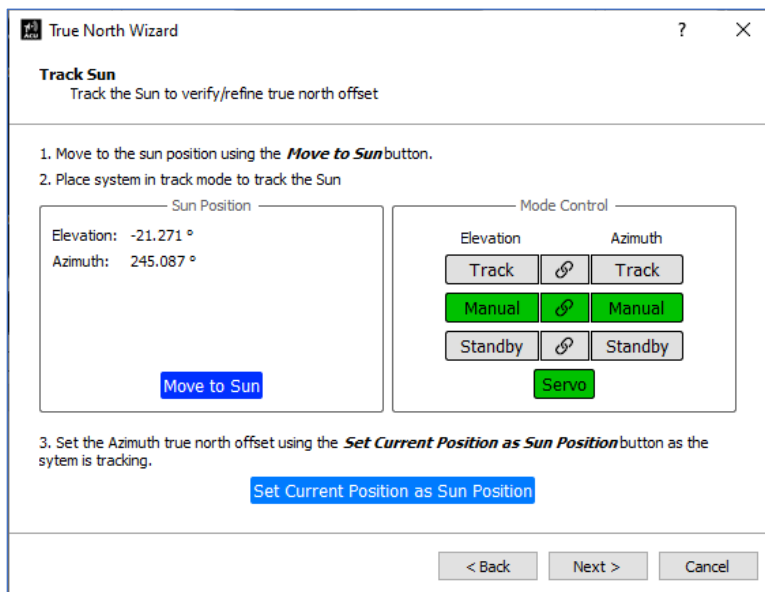


Figure 62: True North Wizard, Track Sun

7. After the antenna is positioned to sun, select the Set Current Position as Sun Position button.  
Select the Next button to continue.
8. This completes the True North wizard setup. The True North AZ Offset has been calculated, as shown in Figure 63. When the AZ Axis position dial reads 0.0°, the Antenna Azimuth Axis is pointed to calibrate to North.  
Select the Finish button to save the North Pointing position.

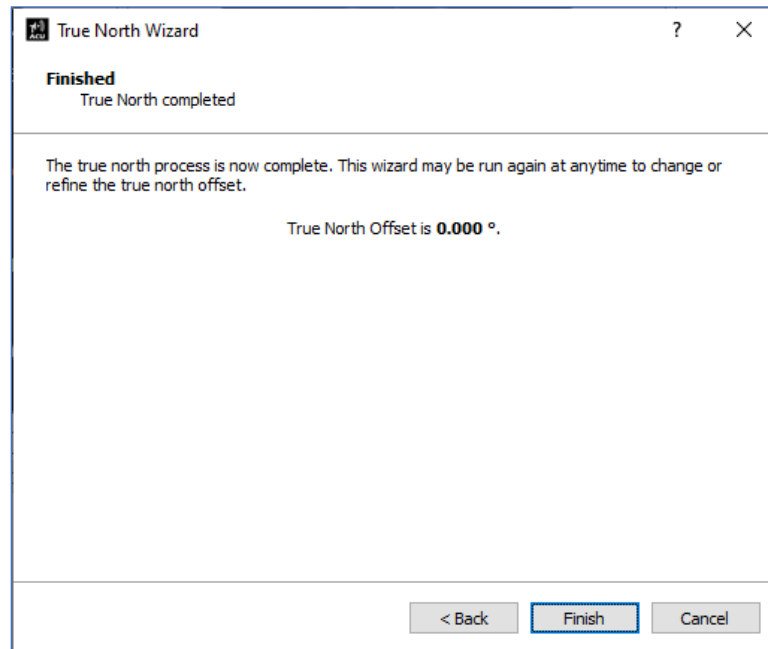


Figure 63: True North Wizard, Finished

Note: To accurately point to the sun, the following system settings must be correct: date and time and the system ground location (Latitude, Longitude, and height above sea level).

After the wizard is complete, select Sun Designate. The antenna should slew to the correct sky location. To check the position, the sun image should be located in the center of the camera view monitor. If a receiver is attached, the system can be selected to track the sun, and a comparison of the calculated (designated sun AZ/EL angles) to the actual sun tracking angles can be made. They should be almost identical.

The Wizard just described covers the Sun Pointing method for True Northing the tracking system. The other two methods, Boresight and Landmark, are nearly identical to the solar calibration method. Both have easy to follow wizards and are not covered here. The sun calibration is the most used method, as pointing the antenna to the sun, using Sun Designate, is typically used to verify the correct AZ North (0.0°) pointing position.

The True North calibration Wizard(s) are available with the Standard Login.

#### 4.2.1.6.2 Handwheel Test

The Handwheel Test feature in the Tools drop down menu is used to verify the hand wheel encoders and their connection to the internal resolver card PCB. This features displays the action of each hand wheel on screen with a hand wheel test feedback dial, as shown in Figure 64. Rotating the ACU's AZ hand wheel moves the AZ dial's pointer CW and CCW in line with the motion of the hand wheel. Rotating the ACU's EL hand wheel moves the EL dial's pointer Up/Down in line with the motion of the hand wheel.

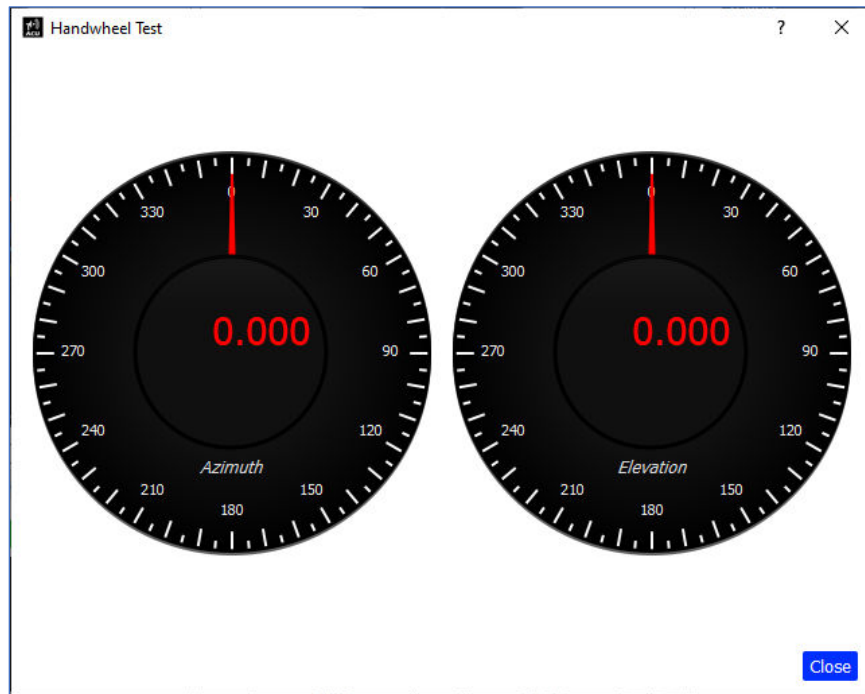


Figure 64: Hand Wheel Test Feedback Dial

#### 4.2.1.6.3 Joystick Test

The Joystick Test feature in the Tools drop down menu is used to verify the Joystick's calibration. By moving the joystick from left to right, and up and down, the Joystick Test window verifies the correct movement. When the joystick is released, the joystick is at center. The red dot on the test window should be at the center of the crosshairs, as shown in Figure 65. This indicates that the Client PC is reading the joystick inputs.

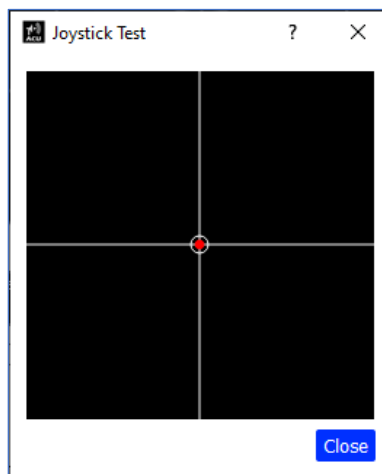


Figure 65: Joystick Test, Red Dot in Center of Crosshairs

#### 4.2.1.6.4 Scope Recorder

The Scope Recorder feature in the Tools drop down menu is used to record a group of pre-set system parameters for future analysis. It is designed as a testing tool for capturing a file for saving and sending to Quasonix benchmark system health, or to review performance for preventive and diagnostic purposes. Parameters that can be recorded and saved are:

- AM
- AGC
- DQM
- Strobing Signal 1
- Strobing Signal 2

The Scope Recorder window, shown in Figure 66, displays the Scope Recorder enabled. After the Trigger button is selected, the recorder saves the listed parameters in 10 seconds (in the example) pre-trigger selection and 10 seconds post-trigger selection, for a total of 20 seconds of data saved. The file is automatically named as shown in the window.

The data file collected should be shared with Quasonix for review, and archived for preventive and diagnostic purposes.

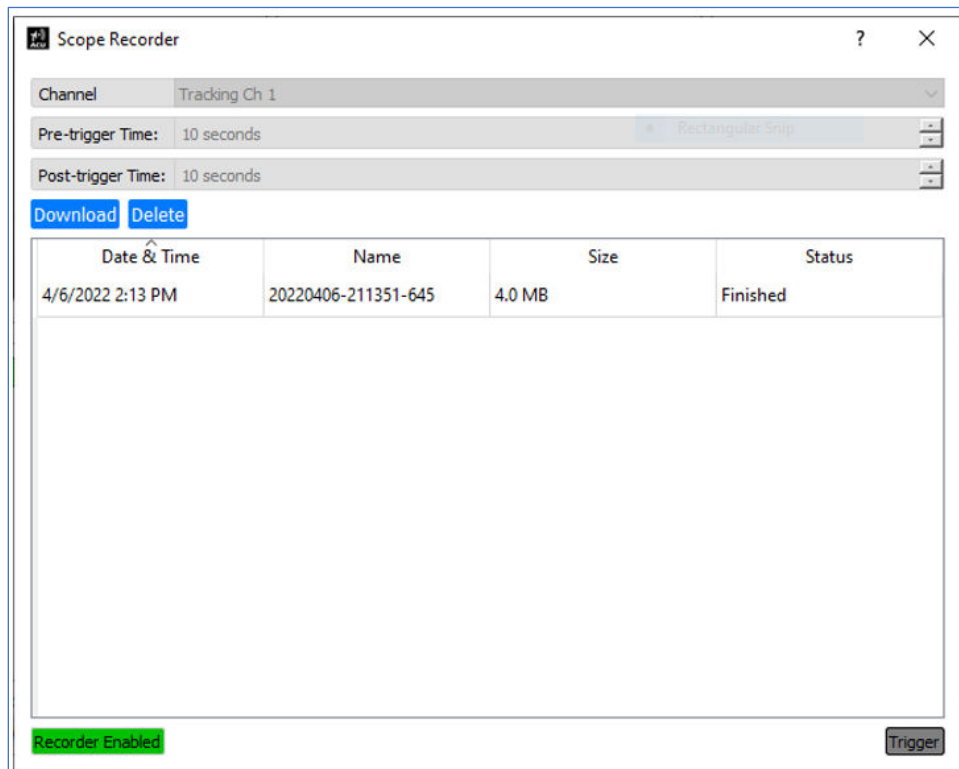


Figure 66: Tools, Scope Recorder

#### 4.2.1.6.5 Change Password

The Change Password feature in the Tools drop down menu is used to change the default password (Admin) to a user specific password for access to available features and parameters.

Advanced and factory settings are protected. To safeguard the antenna and personnel, access to these settings is only available from Quasonix. The Advanced Use password expires after 24 hours.

In the Change Password window, shown in Figure 67, type the current password and new password in the appropriate fields. Confirm the new password by typing it into the Confirm New Password field. Select the Apply button to change the password.

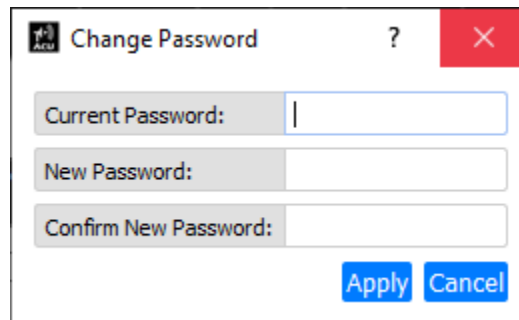
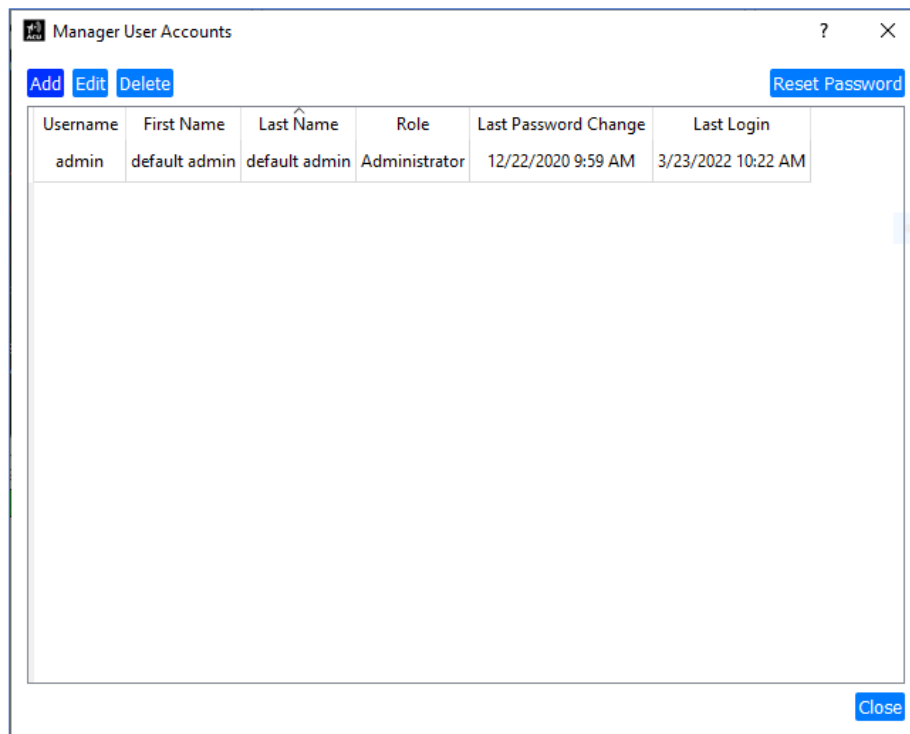


Figure 67: Change Password

#### 4.2.1.6.6 Manage Users (Administrators Only)

The Manage Users feature in the Tools drop down menu provides Administrator access to the Manage User Accounts window, shown in Figure 68. From here, the Administrator can manage access to the antenna system.



**Figure 68: Manage User Accounts**

To add users, select the Add button. In the Add User window, shown in Figure 69, the following parameters must be entered:

- Username – The name used to identify the account
- First Name – First name of the user
- Last Name – Last name of the user
- Role – The role assigned to the user may limit access to some user interface functionality; Use the drop down menu to select Viewer, Administrator, or Operator.
- Password – For the specific user being added
- Confirm Password – Re-enter the user password

Select the Create button to add the user.



**Figure 69: Manage User Accounts, Add User**

To edit an existing user account, highlight one of the users in the list, then select the Edit button. In the Edit User window, shown in Figure 70, change the desired parameters. Select the Update button to save the changes.

**Figure 70: Manage User Accounts, Edit User**

To delete an existing user account, highlight one of the users in the list, then select the Delete button.

The Reset Password button is only available to Administrator user accounts. It allows an Administrator to reset any other user's account password without the Administrator actually knowing the current password, as shown in Figure 71.

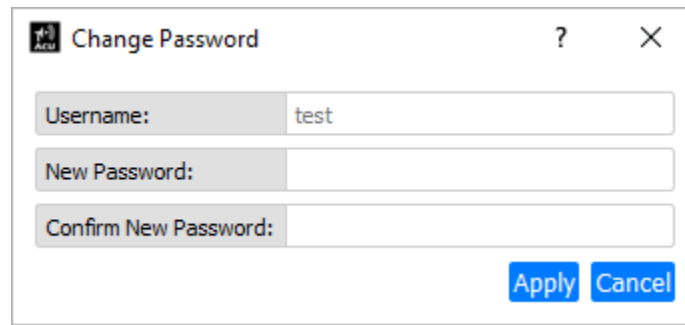


Figure 71: Manage User Accounts, Reset Password

#### 4.2.1.6.7 Restart HTAC

The Restart HTAC option in the Tools drop down menu is used to restart the software on the HTAC. When selected, a HyperTrack™ window displays, as shown in Figure 72.

Note: Doing this when target tracking, ends the tracking operation as the HTAC shuts down to reboot. During the restart, communication with the GUI stops, and the front panel Manual control buttons turn gray.

If Yes is selected, manual control is lost and the Server Log In screen opens, requiring a new login to reconnect with any listed HTAC.

To continue the restart, select the Yes button. To cancel the restart, select the No button.

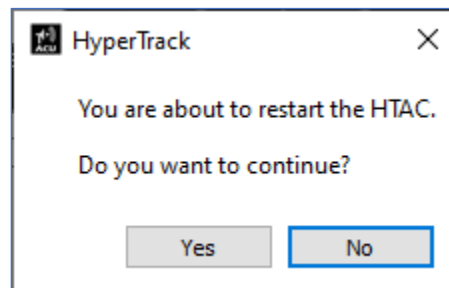


Figure 72: HyperTrack™ Restart Window

#### 4.2.1.6.8 Shutdown HTAC

The Shutdown HTAC option in the Tools drop down menu is used to shut down the HTAC. When selected, a HyperTrack™ window displays, as shown in Figure 73.

To continue the shutdown, select the Yes button. To cancel the shutdown, select the No button.

When finished, the controller power can be switched off.

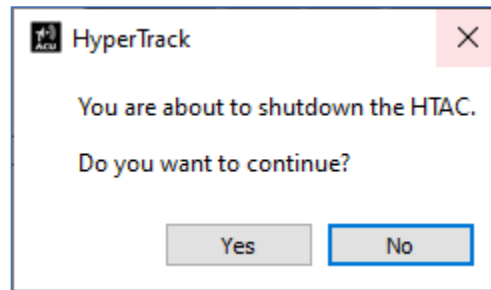


Figure 73: HyperTrack™ Shut Down Window

#### 4.2.1.7 Help Window

Select the Help icon from the Main Tool Bar, as shown in Figure 74, to access the Help window, shown in Figure 75.

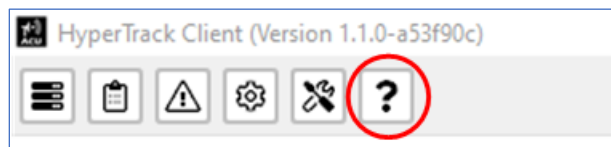


Figure 74: Tool Bar, Status Icon

The Help window provides access to three features:

- Contact
- Version
- Firmware Update

##### 4.2.1.7.1 Contact

The Contact tab displays Quasonix contact information, as shown in Figure 75.

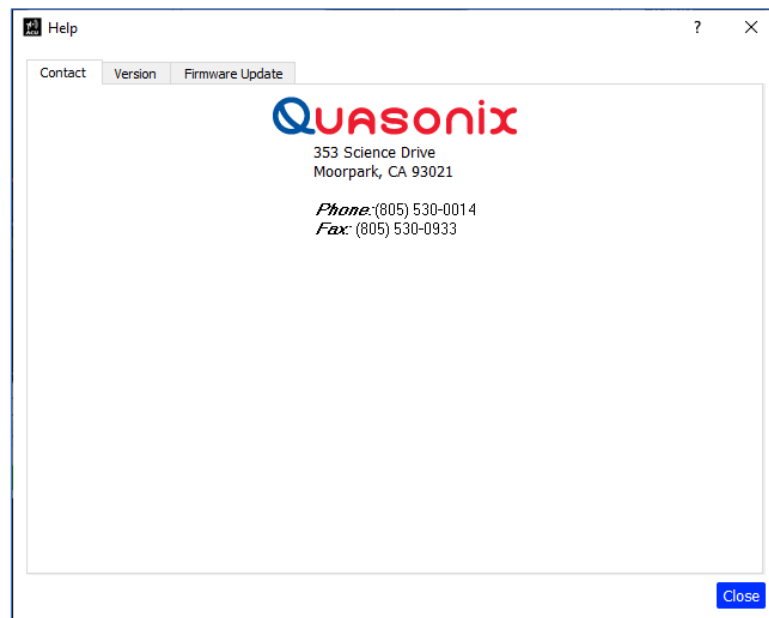


Figure 75: Help, Contact Tab

#### 4.2.1.7.2 Version

The Version tab displays the system software versions for the Client and the Server software, as shown in Figure 76.

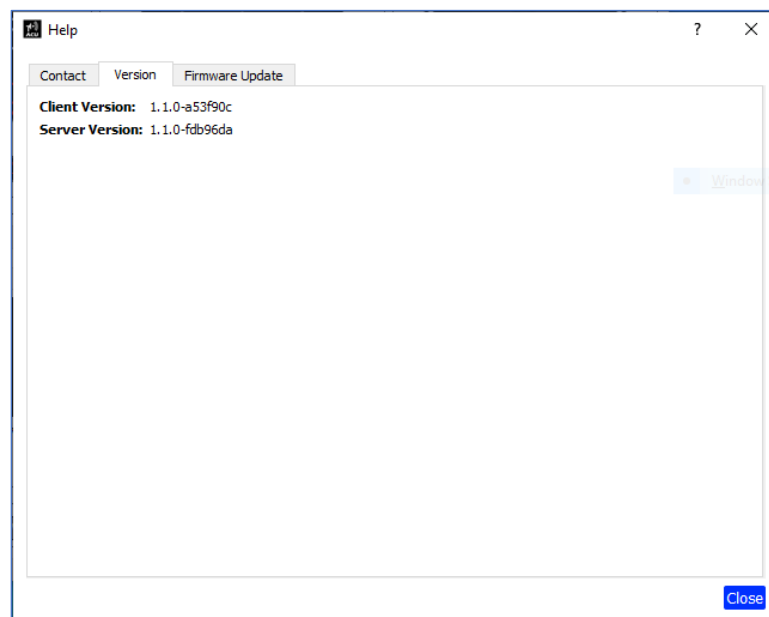
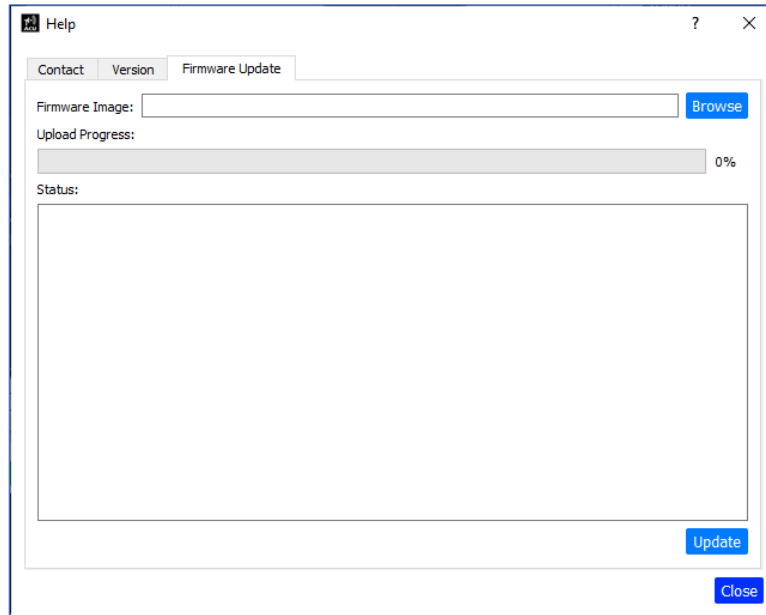


Figure 76: Help, Version Tab

#### 4.2.1.7.3 Firmware Update

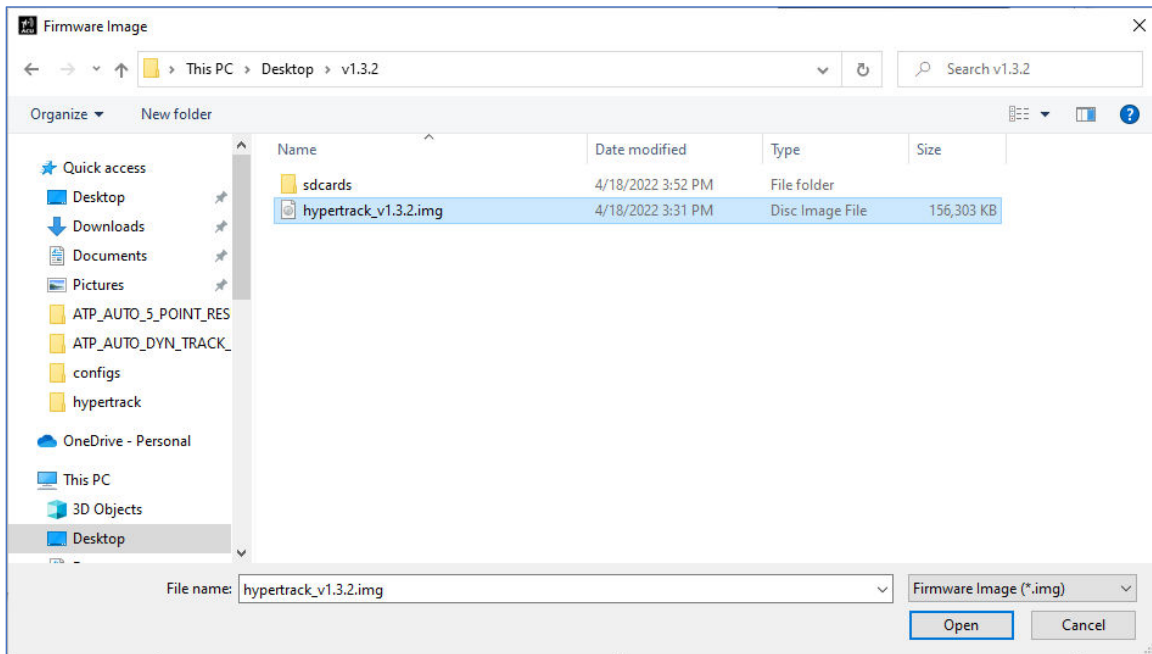
The Firmware Update tab, shown in Figure 77, provides a way to install the latest firmware versions for the HTAC and Feed Control Box. Contact Quasonix for access to firmware.



**Figure 77: Help, Firmware Update Tab**

1. After the firmware has been obtained from the factory and saved locally, the files can be accessed by selecting the Browse button, then searching for the Quasonix (update) firmware (Firmware Image \*.img file), as shown in Figure 78. This process is used to update the Server (HTAC) Firmware only. The firmware located in the Feed Control Box is updated simultaneously.

**Note:** The system Feed Control Box must be attached and connected by its system interface cable for the firmware update install to take place. If the Feed Control Box is not connected, the firmware update will not complete.



**Figure 78: Windows Explorer with File Highlighted**

2. After the new HTAC Server Firmware is highlighted, select the Open button. The file is copied to the HTAC and displays in the Firmware Image field in the Firmware Update tab.
3. To start the install, select the Update button.

The Upload Progress bar shows loading process until it is 100% complete. The Status window displays the firmware file elements as they process, as shown in Figure 79. If the firmware install fails, the progress bar does not reach 100%, and the factory should be contacted to resolve the install failure.

4. Note: Verify the system Feed Control Box is installed, powered, and connected correctly. In the example shown in Figure 79, the Feed Control Box was not connected, so the associated firmware update was aborted.

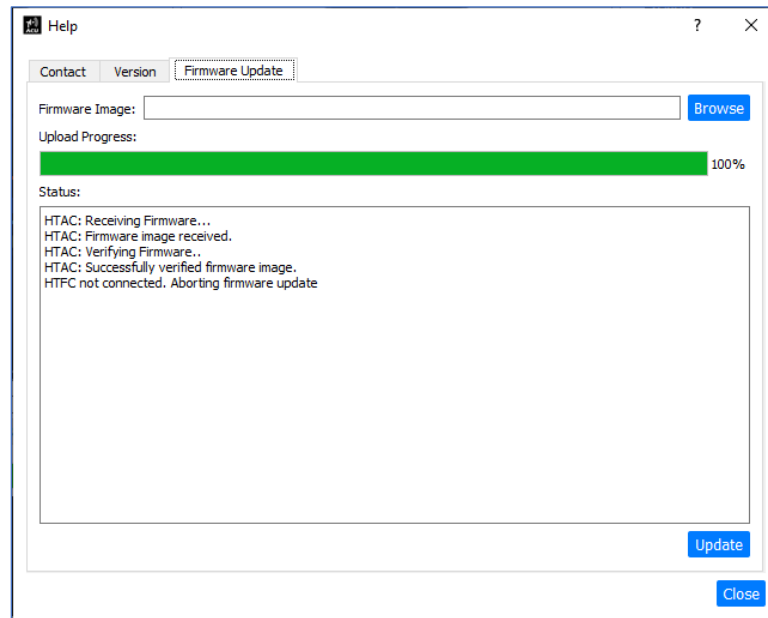


Figure 79: Firmware Update Status

#### 4.2.1.7.4 Client Software (GUI) Update

When updating the Windows Client Software (GUI) (not firmware!), located on the connected, Windows PC, the Firmware Update tab described in section 4.2.1.7.3 is NOT used.

Instead, a windows installer with the executable file is placed on a flash drive which is inserted into any available USB port on the client PC. The new software is then installed (like any, typical windows executable file) by selecting the file and completing the install.

#### 4.2.1.8 View

The View drop down menu is accessed via the Main Tool Bar, as shown in Figure 80. The features include multiple views or windows which can be independently opened and placed on the Windows Desktop. These windows contain tools for calibrating, checking, and operating the tracking system parameters. These parameters include: feed operation, motion tuning capability, testing, and tracking functions. The functional scope for showing various signals generated by the system (such as the generated AM) is accessed through these features as well. Their functionality is described in the following sections.

- Standard
- Tracking
- Motion Tuning
- Scope
- Motion Test

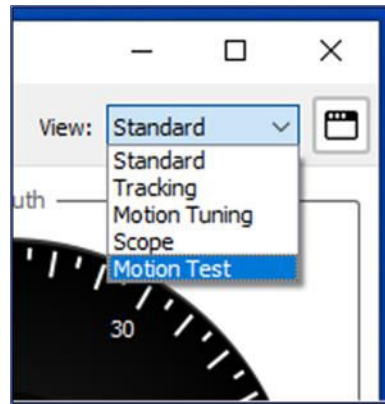


Figure 80: Main Screen, View Drop Down Menu

#### 4.2.1.8.1 Standard

The Standard view opens the Client GUI front panel, as shown in Figure 81, which is the main display for operations of the antenna system. This is the same screen that opens when the ACU icon is selected from the Windows PC Desktop.

Note: Multiple Standard View windows can be opened at the same time, if needed.

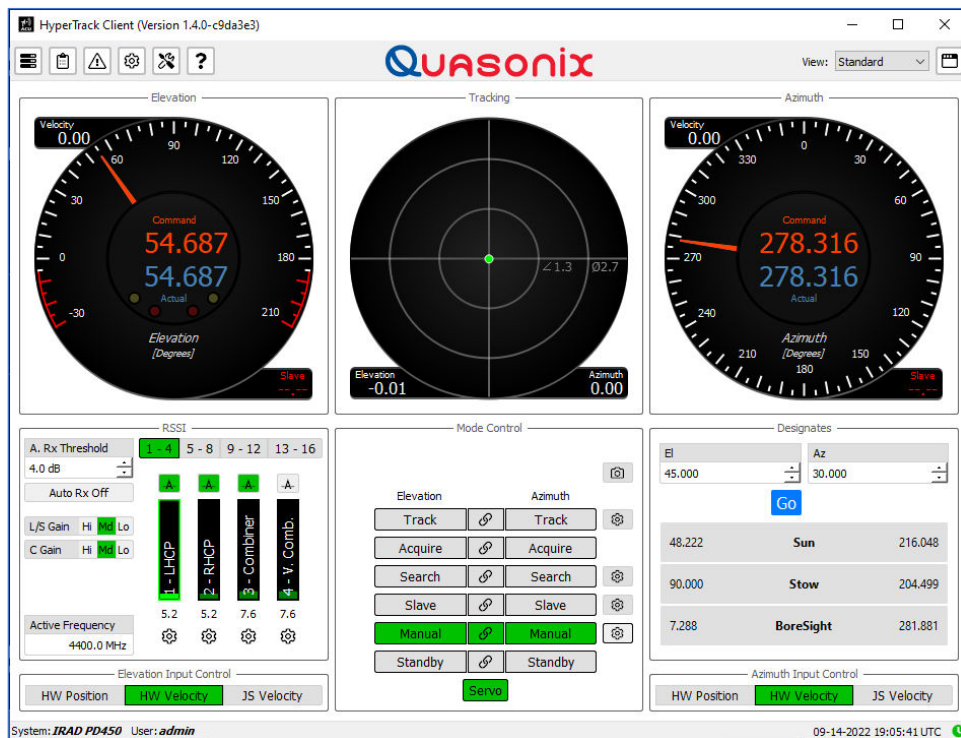


Figure 81: HyperTrack™ Graphical User Interface (GUI), Main Screen



#### 4.2.1.8.2 Tracking

Tracking view opens three (3) tracking history charting tools, as shown in Figure 82. The available charting tools are:

- Tracking Error History Chart
- Tracking RSSI History Chart
- Dynamic Bandwidth History Chart

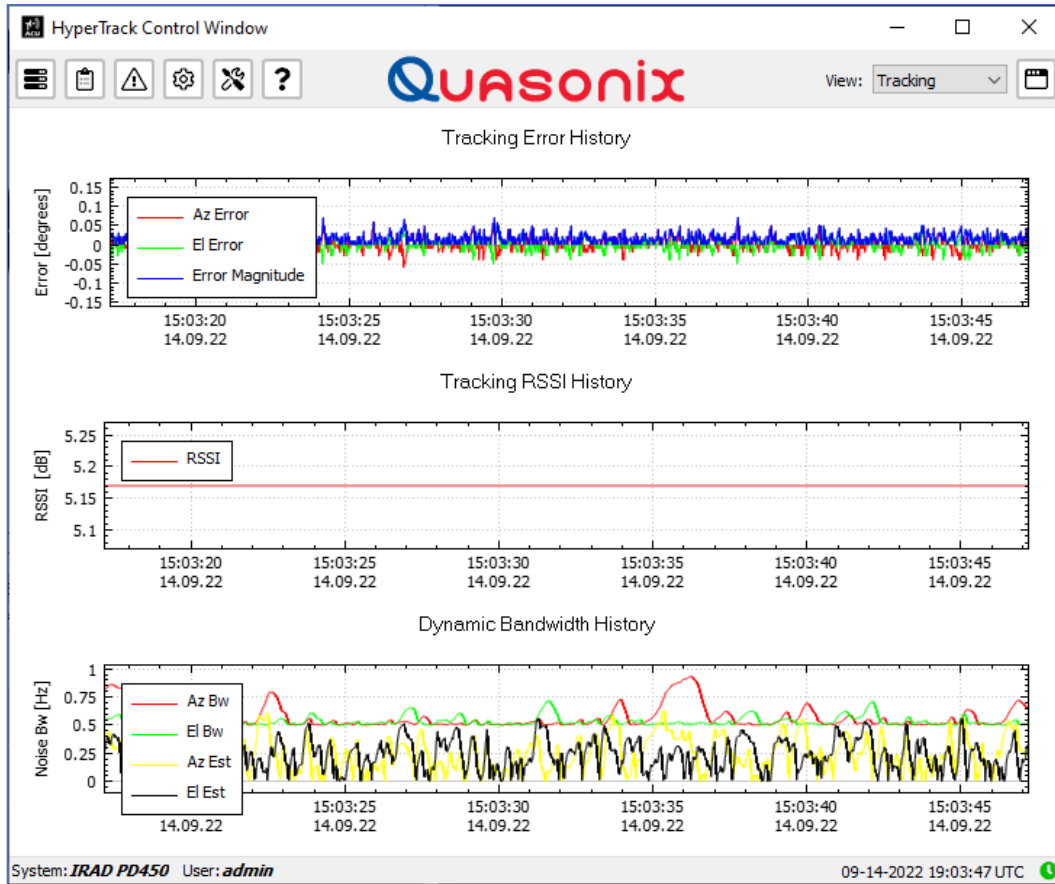


Figure 82: Tracking History Charts

Tracking data available to the client software automatically displays in the three charts shown. When the Tracking window is opened, the charts immediately display data. There is no start or stop chart button.

Tracking Error History records the AZ and EL errors in degrees over time—approximately 30 seconds—as the system is tracking the target. This is a graphic representation of what the Error Meter displays during a target track.

Tracking RSSI History displays the signal level history of the tracking channel in dBs used during a target track. This chart automatically displays data from the selected tracking channel during a tracking for LHCP, RHCP, or Combined.

Dynamic Bandwidth History scroll plots show a 30 second history of the tracking loop bandwidth for each axis.

#### 4.2.1.8.3 Motion Tuning

Motion Tuning view, shown in Figure 83, contains 30 second scroll plots of position, velocity, and current usage of each axis. The six Motion Tuning rolling charts for the AZ and EL axes showing the AZ and EL motion feedback when running a simple search pattern are shown in Figure 83.

The EL and AZ Position charts display a scrolling line showing Commanded vs Actual position of the axes, in degrees, over a 30 second repeating time.

The EL and AZ Velocity charts display the Commanded vs Actual velocities in degrees per second over a repeating 30 second time.

The EL and AZ Current charts display the measured current in amps delivered by each servo amplifier to the EL and AZ motors over 30 seconds.



Figure 83: Motion Tuning Charts

#### 4.2.1.8.4 Scope

Scope view, shown in Figure 84, opens a virtual oscilloscope with typical channel scaling functions. The Scope window displays the two strobing signals (square waves) which modulate the Quasonix SCM feed, as well as the resulting AM signal needed for tracking a radiating target.

The scope provides visible feedback information on how well the system is tracking the target. In Figure 84, the AZ axis is a few degrees off boresight.

Note: The Scope shows the feed strobing signals in yellow-pink, and the AM in green just offset from boresight.

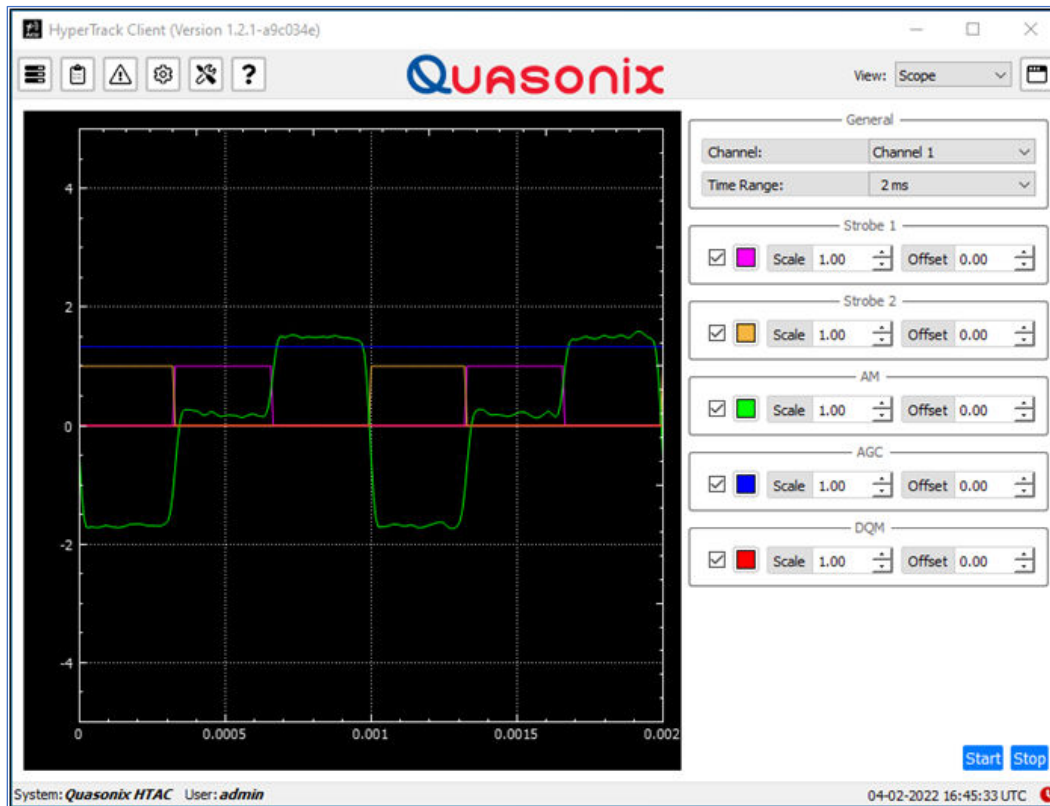


Figure 84: Scope View

#### 4.2.1.8.5 Motion Test

The Motion Test view accesses the Motion Testing window parameters, as shown in Figure 85. This window is composed of four parameter entry columns. Each column has axis specific parameters.

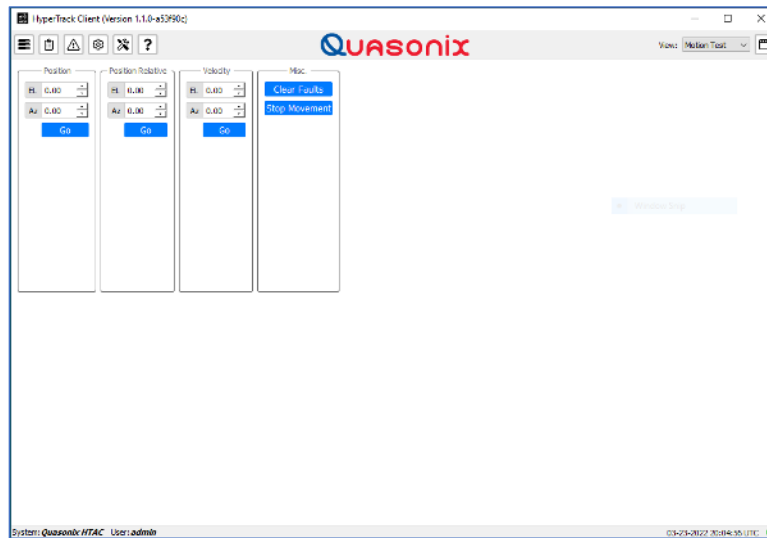


Figure 85: Motion Test

The four motion control entry parameters are:

- Position
  - EL Position
  - AZ Position
- Position Relative
  - EL Position Relative
  - Az Position Relative
- Velocity
  - EL Velocity
  - AZ Velocity
- Misc.
  - Clear Faults button
  - Stop Movement button

Position	Position Relative	Velocity	Misc.
EL 0.00	EL 0.00	EL 0.00	Clear Faults Stop Movement
Az 0.00	Az 0.00	Az 0.00	
Go	Go	Go	

Figure 86: Motion Test Entry Parameters

#### 4.2.1.8.5.1 Position

The Position parameters, shown in Figure 86, command the antenna to the AZ and EL angles. Type or use the Up/Down arrows to set the axis and elevation values. In this example, the antenna slews to 0.0 Azimuth and 0.0 Elevation when the Go button is selected.

#### 4.2.1.8.5.2 Position Relative

The Position Relative parameters command the antenna to the AZ and EL positions relative to their start positions. Type or use the Up/Down arrows to set the axis and elevation positions. In this example, assume the antenna was at

0 degrees AZ and 0 degrees EL, and 2.0 is entered into the AZ and EL boxes. When the Go button is selected, the antenna slews to +2.0 degrees Azimuth and + 2.0 degrees Elevation.

#### 4.2.1.8.5.3 Velocity

The Velocity parameters command the AZ and EL axes at the velocity entered each axis field. In this example, assume each parameter was set to 0.0. When the Go button is selected, the antenna does not move from its present position.

If each parameter was set to 5.0, the antenna slews in both axes at a constant 5 degrees/second velocity. Negative velocities command each axis to drive the antenna at the desired velocity, in the opposite direction. When commanded, the Elevation axis slews at constant velocity until the axis reaches the Up or Down limits.

#### !CAUTION!

**When using the Velocity parameters and commanding the EL axis to drive at a large velocity into the Up or Down limits, the elevation axis components can be mechanically damaged. The Stop Movement button, in the Misc. column, should ALWAYS be used to stop EL axis motion, NOT the system limits.**

#### 4.2.1.8.5.4 Misc.

The Misc. column contains two buttons, Clear Faults and Stop Movement. When the antenna is commanded to drive at a constant velocity, selecting the Stop Movement button stops all AZ and EL motion. This button should be used to stop the Elevation Axis before it reaches the Up or Down limits, especially if a large velocity is entered into the Velocity parameters.

#### 4.2.2 Graphical User Interface (GUI), Front Panel Quick Open

The Screen icon, shown in Figure 87, is used to quickly open multiple front panel/main screen displays. When the Screen icon is selected, it instantly duplicates the front panel as many times as it is selected, as shown in Figure 88. This enables monitoring of the front panel while simultaneously using other features and views described in this manual. For example, the user can be monitoring the Front Panel and the Fault windows at the same time.

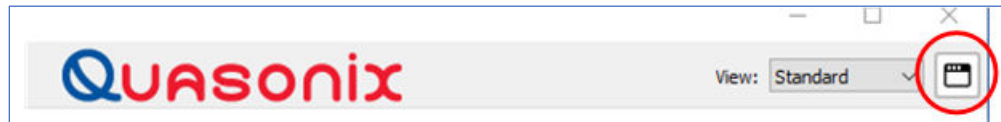


Figure 87: GUI Quick Open Icon

THE "SCREEN" ICON WILL CREATE DUPLICATE FRONT PANELS FOR THE USER TO UTILIZE FOR VISIBILITY OF OTHER FEATURES AND FUNCTIONS TO BE DISPLAYED SIMULTANEOUSLY

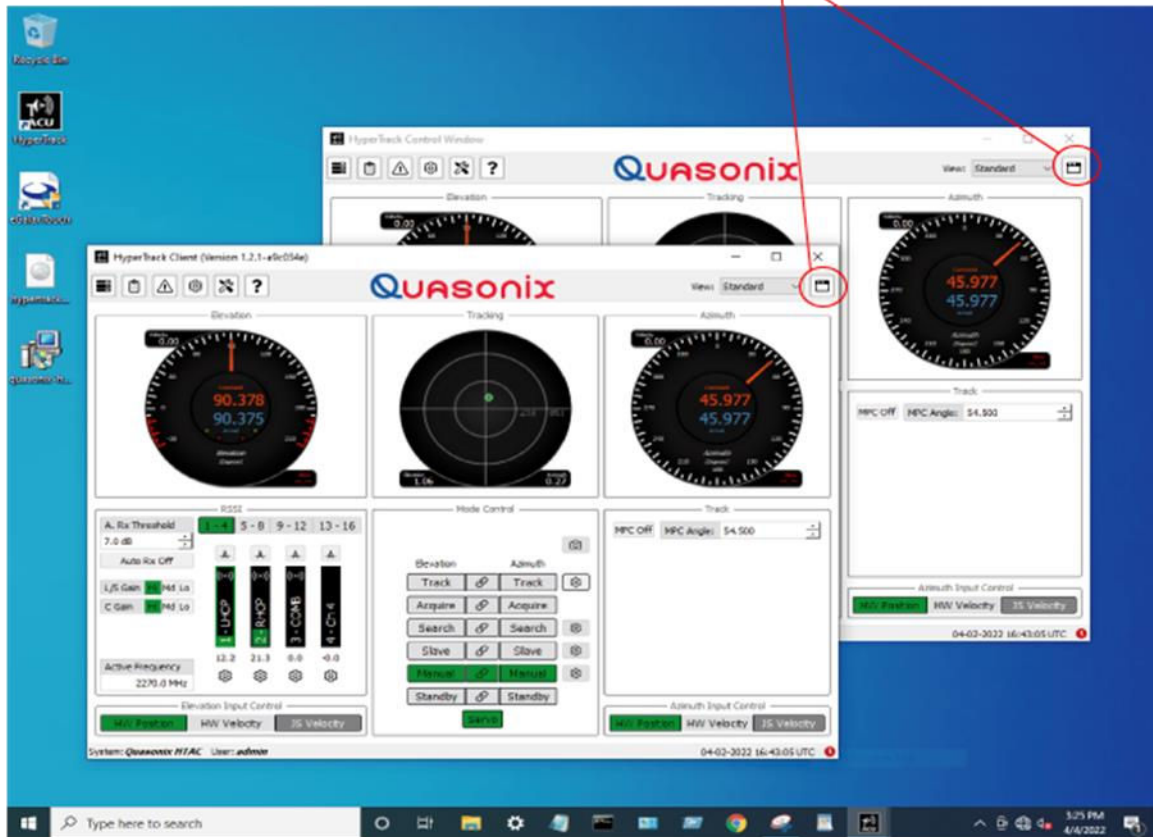


Figure 88: GUI Quick Open Icon, Multiple Windows Open

#### 4.2.3 Graphical User Interface (GUI), Front Panel Detail

The Front panel is the main GUI screen displayed upon launching the ACU HyperTrack™ application software, as shown in Figure 89.

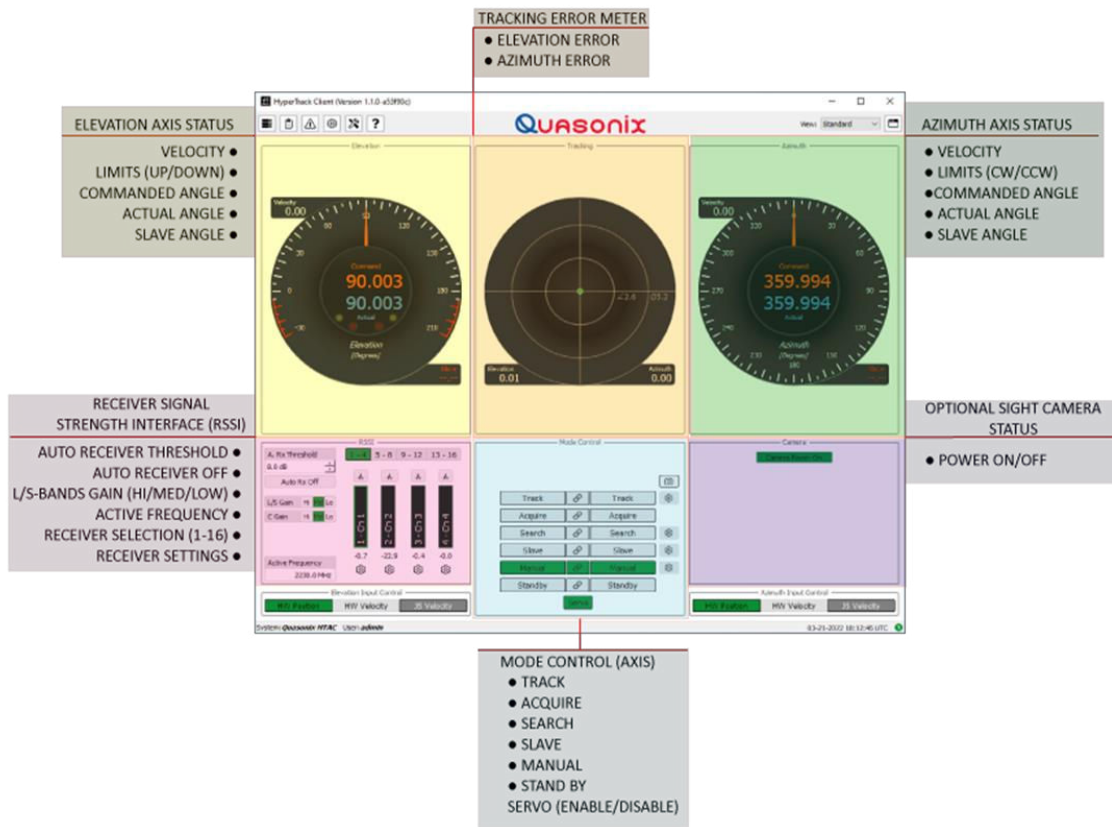


Figure 89: HyperTrack™ Client GUI, Main Screen

#### 4.2.3.1 Axis Status

The Elevation (EL) and Azimuth (AZ) axes analog / digital position feedback indicators show the pointing position of the axis with a two-color pointer and digital numerical readout (to XX.000°). The Commanded Position, blue pointer with blue digital display, indicates the position the axis was instructed to slew to represented by the lower digital readout. The actual position of the axis is indicated by the Orange pointer represented by the upper digital readout. Examples are shown in Figure 90.

If a slave position is detected, a green pointer shows the slave pointing angle to the axis. A separate slave digital numerical readout also displays the slave angle (not shown). The Elevation Up and Down limits for electromechanical and software indicator lights are located within the center dial, just under the digital displays. The AZ axis display is identical except for the limit indicators.

Note: A cable wrap system, where AZ motion is not continuous, will have AZ hard and Soft limits and indicators.



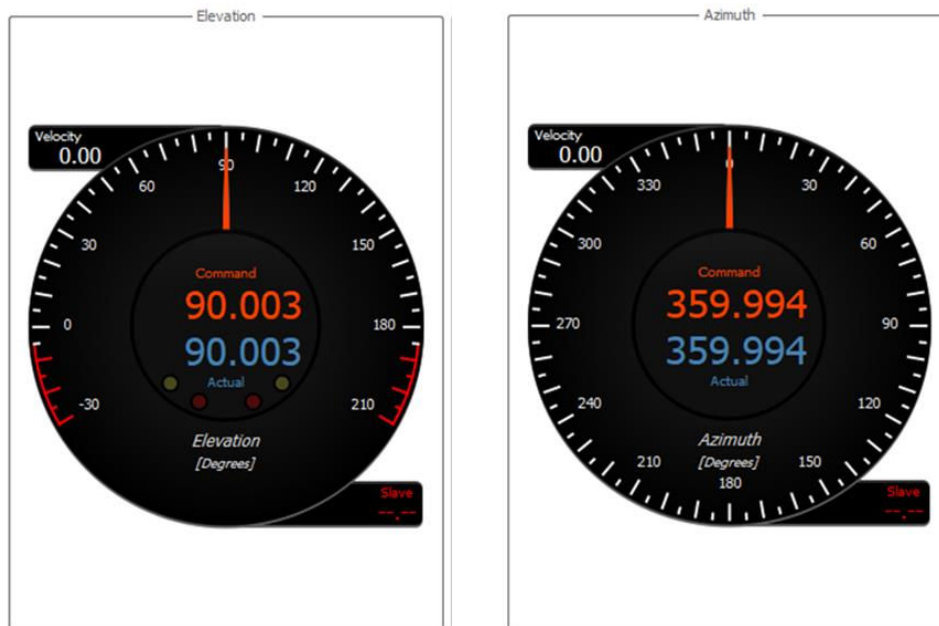


Figure 90: Axes Analog / Digital Position Feedback Indicators

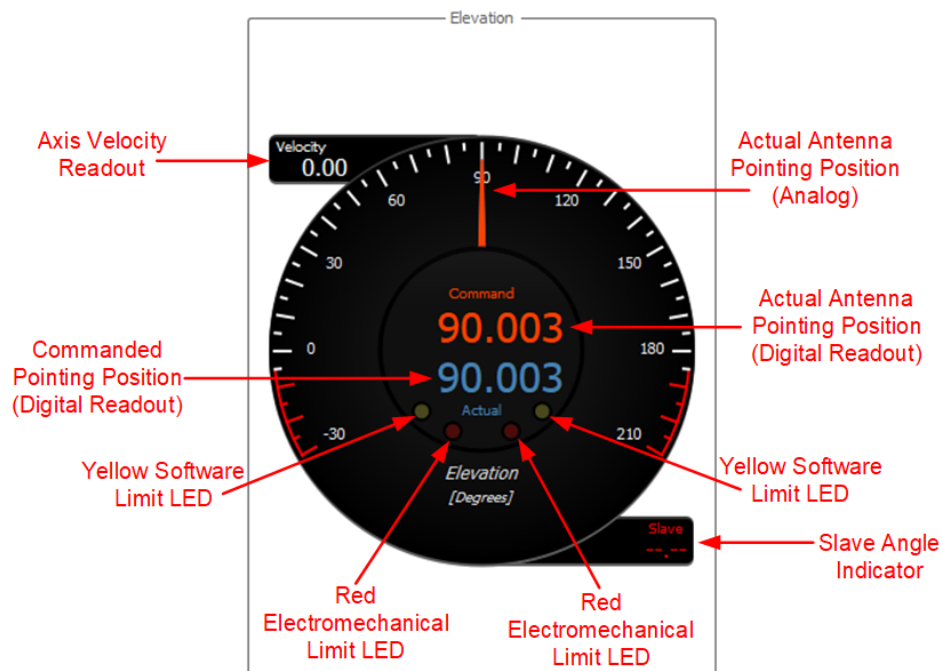


Figure 91: Axes Analog / Digital Position Feedback Indicators, Labeled



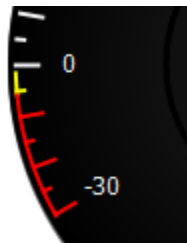
The Azimuth and Elevation axis position display meter breakdown:

- AZ Axis Velocity readout
- Actual antenna pointing position – Orange Pointer, in this case (359.994°)
- Commanded antenna pointing position – Blue pointer (under orange pointer)
- The central, digital, numerical readout for the Commanded and Actual antenna pointing position (both indicating 359.994°)
- CCW and CW limit indicator location – Not present is a slip ring system (no AZ limits). The EL position feedback dial always displays the Up and Down hard (electrical) and soft limits.
- Slave position digital readout – Green numerals indicate slave angle(s) are present. Red blanks (- - -) indicate NO slave angles are present.
- Analog dial divisions graduated to every 5 degrees (0 to 355.500 degrees)

The Elevation Status Display includes four LEDs for limits. The user configurable software limits are indicated by yellow LEDs and the electromechanical limits by red LEDs that illuminate when reached. The range of the user configurable limits are indicated by the red tick marks on the degrees indicator, as shown in Figure 92. After the software limits are set, the non-reachable degrees tick marks are blocked in red.

When the user configurable Multi-Path Clipping (MPC) is enabled, the antenna will not go below lines on the degree indicator marked in yellow. In Figure 92, the MPC is set for 0.0°. During a target track, the EL axis will not track below 0° when MPC is enabled.

**Note:** MPC only applies to the Elevation “down” direction.



**Figure 92: Multi-Path Clipping Limit in Yellow**

#### 4.2.3.2 Tracking Error Meter

The Tracking (Error Meter) is located between the EL and AZ Axis status windows. It provides a visual representation of the radiating targets location within the tracking antenna’s beamwidth.

The green indicator, shown in the middle of the meter, represents the radiating target relative to the antenna RF field of view. This indicator is commonly referred to as the “Meatball.”

The crosshairs represent the Cartesian Coordinate System. This divides the antenna tracking view into four quadrants, as shown in Figure 93. When the green dot/Meatball, is at center or origin of the planes, the target is being tracked at optimum.

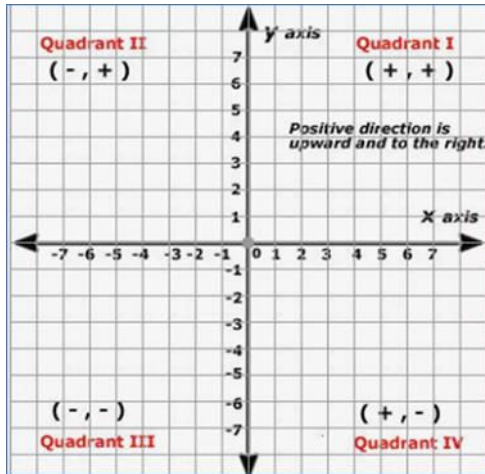


Figure 93: Example Cartesian Coordinate System Antenna Tracking View

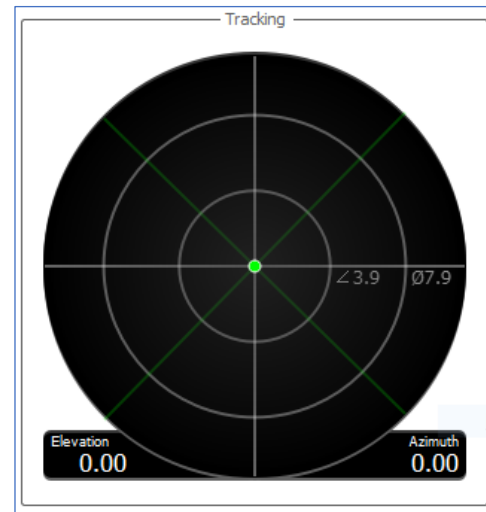


Figure 94: Tracking Error Meter

As the antenna slews towards the radiating target, the Meatball moves toward the center (cross hair) position of the Error dial, in both X and Y axes, (provided that the meter is calibrated correctly). As the antenna slews away from the target, the Meatball moves away from the central crosshair position on the error meter. If the tracking antenna is slewed in Azimuth CW and CCW (only) across the radiating target, the Meatball should move along the X axis of the error meter, with little to no deflection in the Elevation up and down (Elevation) deflection.

The Tracking error meter provides the operator with digital readouts of the Azimuth and Elevation track errors, in numeric format, located in the two small displays fixed to the bottom of the meter, as shown in Figure 94. When the system is auto tracking a radiating target, in both Azimuth and Elevation (both TRACK buttons are green) the Meatball should be centered at or near the central cross hairs location within the Tracking error meter. This indicates the antenna is pointed at the radiating target and is well within the antenna's beamwidth.

The user has the option of enabling and disabling two additional lines on the meter. The lines are 45° from the X and Y planes. These aid in where AZ and EL errors are approximately equal, and display green when feed is On and modulated, and red when feed is Off with no modulation signals present, as shown in Figure 95.

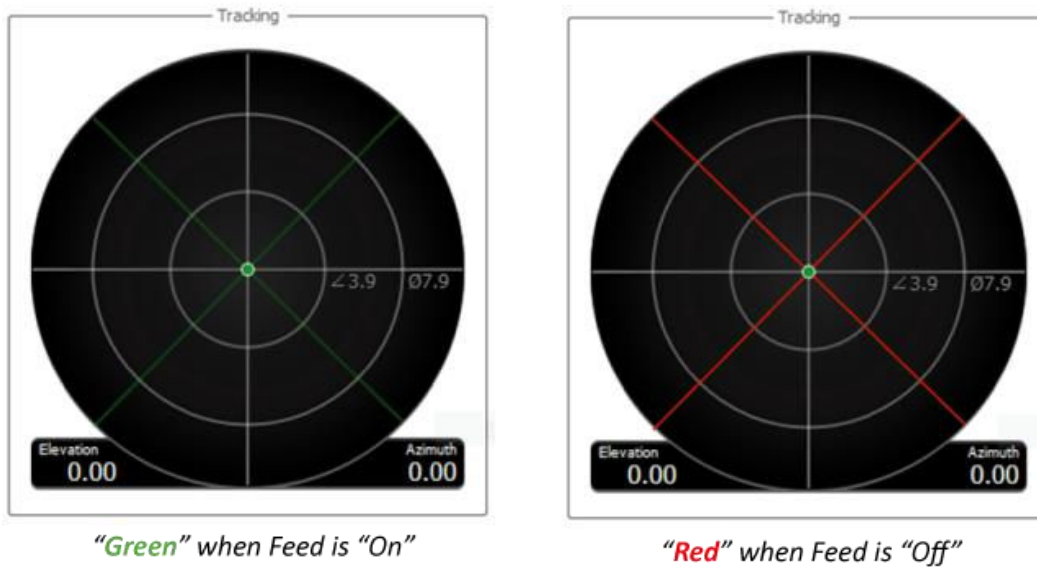


Figure 95: Tracking Error Meter Feed Indicators

#### 4.2.3.3 RSSI

The Receiver Settings and Selection Interface (RSSI), located in the lower left quadrant of the GUI main screen, is used to configure and switch between tracking receivers.

The RSSI window displays the Signal Level Meters (AGC Levels), the manual and automatic selection of the tracking channels, the Auto Rx button, the Rx Threshold setting tool, and the Receiver Settings buttons (Gear buttons) for configuring channel parameters. The multiple tracking channels are available to the user and can be displayed, 4 (four) at a time, up to the maximum of 16 tracking channels. The user selected, 4 tracking channels to be displayed, are highlighted in green. In the example in Figure 96, channels 1-4 are selected and are highlighted.

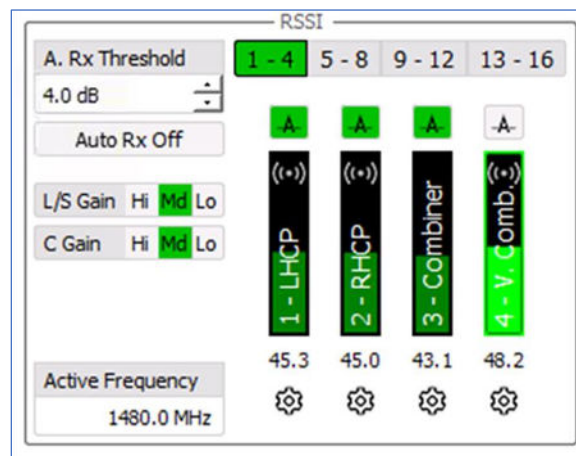


Figure 96: Main Screen, RSSI Window

#### 4.2.3.3.1 RSSI A. Rx Threshold

The A. Rx Threshold parameter is an Auto-Receiver Threshold setting tool used to enable and set the dB level between channels for switching tracking channels automatically. When enabled (On), the RSSI/AGC meters (vertical bars) turn yellow when the target has been acquired (signal level was at some point above the acquisition threshold) but the RSSI/AGC level is below the acquire threshold. When set to the desired signal level difference between channels, tracking automatically switches to the channel with the higher signal level. Above the AGC is set to switch when > 4.0 dB.

#### 4.2.3.3.2 RSSI Auto Rx Off

The Auto Rx Off enables/disables the auto receiver tracking channel switching function. When enabled, the RSSI/AGC signal meters are yellow. When disabled, the signal meters have no color.

#### 4.2.3.3.3 Gain

The Gain feature provides the user with High (Hi), Medium (Md), and Low (Lo) amplifier gain settings. In Figure 96, all three bands are set to the medium power amplification setting (Md). The gain difference between each setting is approximately 10 dB.

#### 4.2.3.3.4 RSSI Active Frequency

The Active Frequency feature displays the frequency the receiver is currently tuned to, as shown in Figure 97. This display only works if the receiver has been linked to the RSSI GUI by entering the receiver's IP address in the settings in the Add Receiver Parameters window. The window only displays the active frequency set at the receiver.

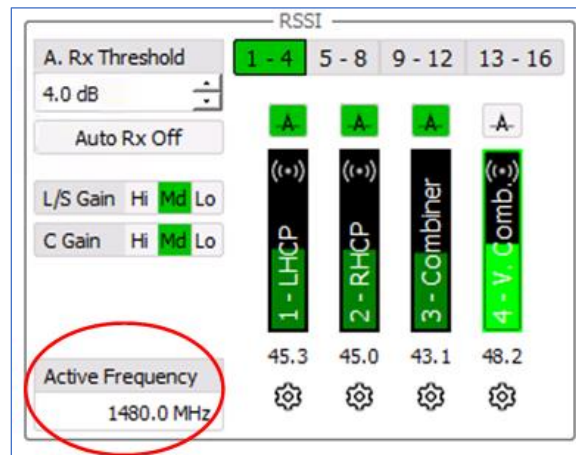


Figure 97: Main Screen, RSSI—Active Frequency Parameter

#### 4.2.3.3.5 RSSI Receivers

The Active Frequency feature displays the available receiver(s) (up to 16 total available receiver channels). Each button selection displays a group of four receiver channels / AGC signal level meters (1-4), (5-8), (9-12), and (13-16) below the selection buttons. Only four (4) receiver channels can be displayed at a time in the RSSI area. The channel designator is labeled within each meter, as shown in Figure 98.

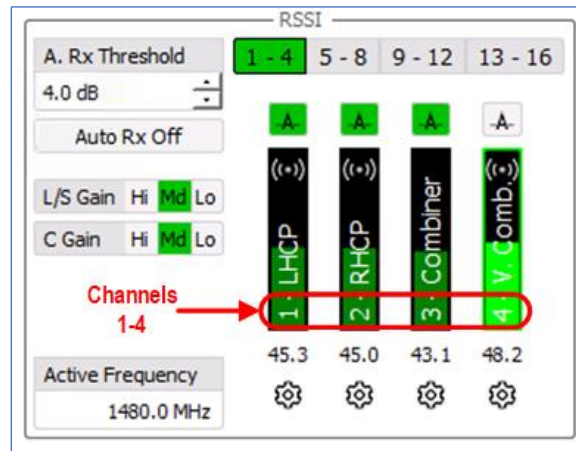


Figure 98: Main Screen, RSSI—Signal Meter Channels

#### 4.2.3.3.5.1 RSSI Receivers Auto Rx

The Auto Rx feature is activated by the button above each receiver signal level display (4). The button enables the Auto Rx for the channel below the button. The button illuminates green when enabled. In Figure, the buttons above channels 1, 2, and 3 are selected and illuminate green. Those channels automatically switch to the receiver channel with the highest displayed signal level. The auto receiver Auto Rx Off button must be enabled and illuminate yellow for auto channel switching to take place. An example is shown in Figure 99.

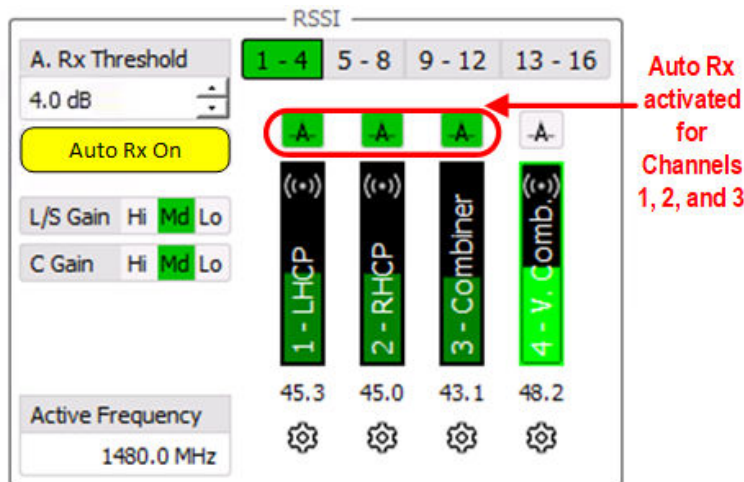


Figure 99: Main Screen, RSSI—Activated Auto Rx Channels

#### 4.2.3.3.5.2 RSSI Receivers Signal Level

The Auto Rx feature displays the active/selected AGC level for each tracking channel. The level is represented by the illuminated green bar in the display scale. In Figure 100, the selected tracking channel is channel four V COMB, indicated by a green border around the channel meter. The signal strength of the radiated target is also displayed numerically underneath each meter provided that the AGC BNC cables for each channel from the back of the Receiver AGC outputs are connected to the correct HTAC AGC inputs.

Choose the desired tracking channel by selecting a AGC meter channel. When the channel is selected, the green border displays, indicating that the system will track on the highlighted AGC meter. By selecting Auto Rx, the tracking channel is automatically selected by the software based only on received signal level.

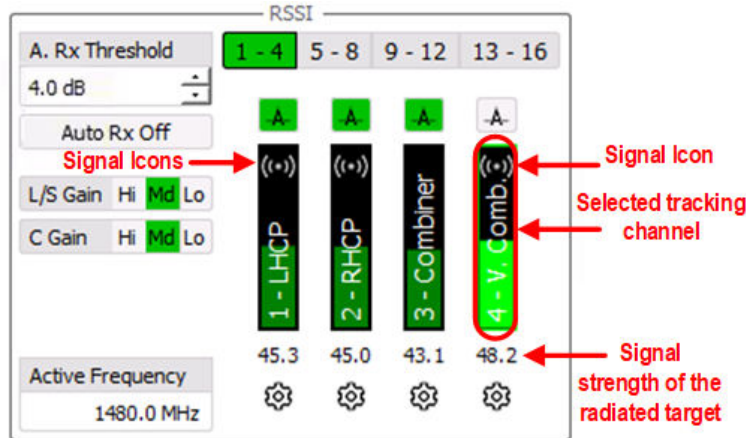


Figure 100: Main Screen, RSSI—Selected Tracking Channel/Signal Strength

The Signal icons, visible just below the borders on receiver signal displays 1, 2, and 4 indicate that the installed Quasonix RDMS receiver's IP address has been entered into the Settings – Hardware – Receivers panel, and that the receiver tracking channels have been mapped to specific IP addresses. This also indicates that STRICI is active.

#### 4.2.3.3.5.3 RSSI Receivers Settings

The Settings icon, just below the signal strength numerical display, allows access to receiver configuration parameters, as shown in Figure 101.

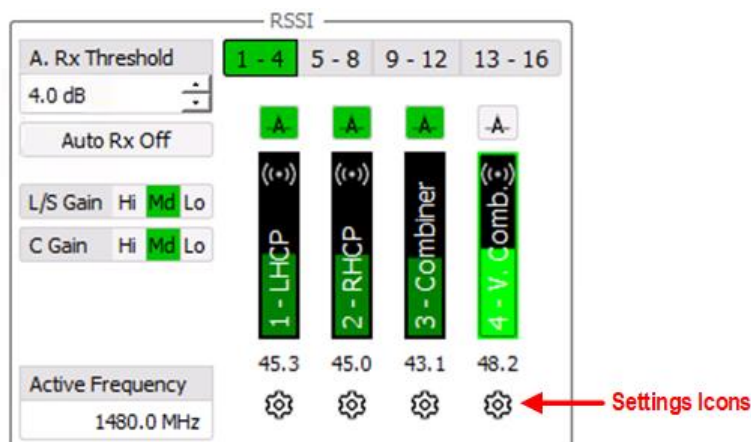


Figure 101: Main Screen, RSSI—Settings Icons

Each tracking channel has its own unique settings page. There can be up to 16 individual pages, one for each possible tracking channel. In Figure 102, the window is the set up for tracking channel 1 (LHCP RF input into the system receiver). The menu is divided into four sections: General, Thresholds, Tracking, and Receiver.

Figure 102: Channel 1 Settings

- General – Used to enter the Channel Name which will appear in the signal strength meter display in the RSSI window
- Thresholds
  - Saturation – User configurable parameter for the saturation level of the AGC Meter. The meter bar turns red upon reaching the set Saturation Threshold level (in this example 100.0 dB)
  - Acquire – User configurable parameter that determines where the tracking system switches from Manual mode to Track Mode; above the threshold is 50 dB. The signal strength meter display changes from orange to green when the acquire threshold level is reached.
  - Hysteresis – User configurable parameter that sets the point where the system drops out of Track, as the signal drops below the Acquire Threshold. In Figure 102, it is set to 3 dB. The system switches from Auto-Track, back to Acquire at about 47 dB. The hysteresis setting is used to keep the tracking



channel from constantly switching in and out of Track, to Acquire, and back due to small changes in the received signal level.

- Tracking
  - Dynamic Band Width Enable/Disable – This setting allows the software to automatically adjust the AZ and EL noise bandwidths for best tracking of the target. When enabled, the tracking algorithm uses the Settings – Mission – Track Dynamic Bandwidth MIN and MAX parameters. It is recommended to keep this setting enabled. Unchecking (disabling) this function, stops the automatic adjusting of the Dynamic (tracking) bandwidth, relies upon the manually entered settings (below the Dynamic BW Enable box) and allows the user to manually adjust the AZ and EL Noise bandwidths (default settings of 1.0 Hz). Manually adjusting these bandwidths can cause the Antenna Tracking System to track poorly, or cause large oscillations of the antenna during target tracking. In most cases, the automatic adjustment of the Dynamic Tracking BW provides the best target tracking capability of the tracking system. In limited cases where automatic BW adjustments do not provide good target tracking, the user can disable the Dynamic BW and manually enter the AZ and EL Noise Bandwidths to improve system tracking.
  - Noise Bandwidth Azimuth – The default is 1.0 Hz. The AZ noise bandwidth is manually entered in this field when the Dynamic BW Enable is not active (turned off).
  - Noise Bandwidth Elevation – The default is 1.0 Hz. The EL noise bandwidth is manually entered in this field when the Dynamic BW Enable is not active (turned off).

**Note:** The Noise Bandwidth parameter essentially adjusts the AZ and EL tracking gain, which can cause poor tracking if set too high or low. This parameter is factory adjusted and set for best tracking (when Dynamic BW Enable is On) for the system feed and antenna size.
- Receiver
  - Input Type – Sets receiver input to HyperTrack™ (digital) or Analog; the default is analog
  - Input Source – When in digital mode (HyperTrack™ selected), any source or combination of sources can be mapped to any channel. For example, if the drop down menu of Virtual HT Combiner 1+2 is selected, then Channel 1 is mapped to be a virtual combined channel of Channel 1 + Channel 2. Analog is the default setting, where each channel is 1 to 1.
  - Strobe Delay – Accounts for filtering and other delays through the receiver; factory adjusted and set (in this example 65 usec)
  - Sample Discard – Typically, used with the Quasonix SCM feed; sets the percentage of tracking feed modulation signal (AM), which is discarded due to signal changes at higher modulation rates; factory adjusted and set (in this example 25%)
  - Am Source Impedance – Selects and sets the AM source impedance from the attached receiver; typically set to 50 Ohms, but may vary by receiver type
  - AM Offset – Used for receiver compensation when installing a receiver which is NOT a Quasonix RDMS receiver
  - AGC Scale – User adjusted for AGC meter scaling; settings available are 5 dB/div, 10 dB/div, and 20 dB/div (in Figure 102, 20.0 dB/div)
  - AGC Zero – User adjustable AGC zero level; typically matched to receiver AGC zeroing, calibration (in this example 0.0 dBm)
  - AGC Source Impedance -- Selects the AGC source impedance of the attached receiver, typically 50 Ohms, but may vary by receiver type
  - AGC Offset – For receiver compensation when installing another receiver which is NOT a Quasonix RDMS receiver



- Open RX Control Button – Located on the bottom left of the Channel Settings window; opens Channel (x) Receiver Settings window, shown in Figure 104

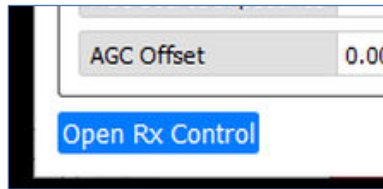


Figure 103: Open Rx Control Button

This screen is used to choose some key receiver settings, which are then transmitted over an Ethernet link to the connected Quasonix RDMS Receiver.

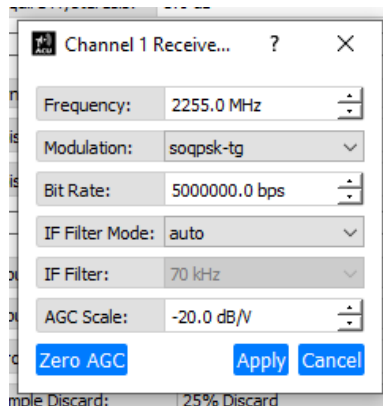


Figure 104: Channel (x) Receiver Settings

The Channel (x) Receiver Settings screen can be used to change the following parameters:

- Frequency
- Modulation
- Bit Rate
- IF Filter Mode
- IF Filter
- AGC Scale

The parameter settings shown in Figure 104 are transmitted to the connected Quasonix receiver when the Apply button is selected. All 16 available tracking channels contain this Settings screen, which opens when the Open Rx Control button is selected. Changes made in this screen are displayed in the Quasonix RDMS receiver setup window.

#### 4.2.3.4 Mode Control

The Mode Control window on the main GUI screen, shown in Figure 105, is used to manually configure and control the Azimuth and Elevation axes. It shows the independent AZ and EL axis control modes, Combined axis control buttons, Camera control button, Servo On/Off button, and the settings access (Gear button) for corresponding mode. When the Gear button is selected, an additional settings configuration window displays to the right of Mode Control window. An Auto Stow button may display if this option is installed and enabled.

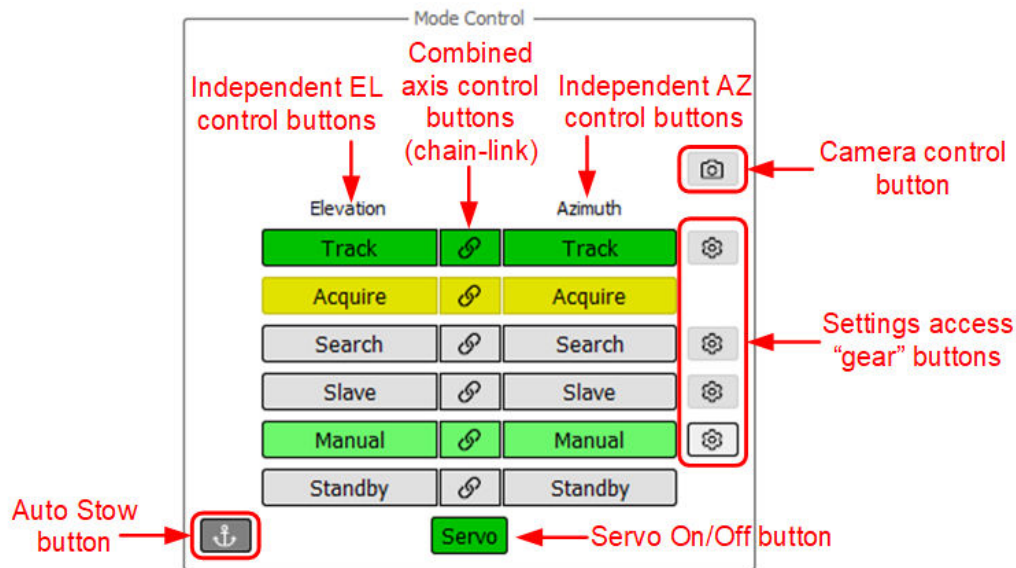


Figure 105: Main Screen, Mode Control Window

The Mode Control window includes the following functions: Track, Acquire, Search, Slave, Manual, Standby, and Servo.

##### 4.2.3.4.1 Servo

The Servo power button is located at the bottom center of the Mode Control window. Selecting the Servo button provides (AC) power to the Azimuth and Elevation Axes servo amplifiers, located within the servo power assembly. When the Servo button displays red, the servos are Off/Disabled.

When the Servo button is selected, it changes color to yellow and a timed audible warning indicator sounds. This is the transition alarm period. When the alarm ends, the Servo button changes to green. This indicates that both the Azimuth and Elevation servos are powered (On/Enabled) and ready to be commanded.

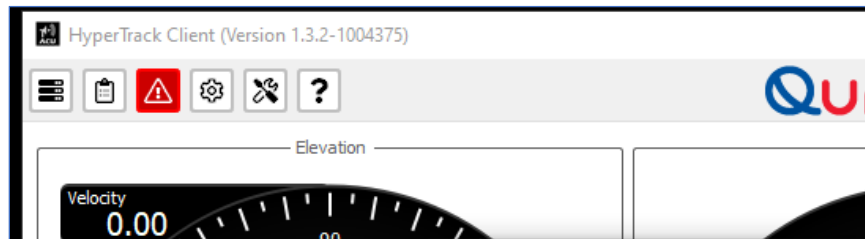
However, both axes are not enabled until the Manual buttons are selected and display in green. If a system interlock is present, the servo cannot be powered on and the Servo button will stay disabled (gray) until the interlock is cleared.

When the Servo button is gray, it indicates a fault or safe condition has rendered the Servo button unavailable to the user.

**!WARNING!**

**Always ensure there are no persons servicing the positioner prior to applying power to the system. A visual check or headphone communications to someone close to the positioner is essential. OBEY ALL WARNING LIGHTS and BUZZERS.**

When an interlock or fault is present, the Status icon, located on the Tool Bar at the top of the screen, flashes red indicating that an interlock or fault condition has occurred, as shown in Figure 106. The Servo button is disabled and displays gray until the interlock or fault is cleared. The servo power to the positioner is not available until the critical fault or interlock is removed and the Status Indicator is clear.



**Figure 106: Main Screen, Tool Bar—Red Status Icon**

The system interlocks include:

- Run/Safe Switch
- Stow Pin
- Local Control (Hand-Held)
- Shorting Plug (located at the servo amplifier assembly box)
- Man on Platform Interlock (2 - minute wait state)
- External Interlock (Optional and specific to the system)

The external interlock is used for customer specific requirements or specific types of installs, such as trailer systems. On a trailer, an interlock connect would be added to the tool box lid, so the system won't hit the tool box.

When no interlocks are present, the servos may be energized by selecting the red Servo button. The servos are powered On only after a fixed transition time with audible alarm. The alarm at the positioner alerts any personnel working on, or close to, the positioner that the system is operation and capable of movement. During the transition time, the Servo button illuminates yellow until the axes are enabled and warning alarm completes. The transition alarm time is not configurable in HyperTrack™ systems. It is a fixed, 30 second timeout.

After the transition time, the power is applied to the servos and the Servo button changes to green. The user now has access to the Azimuth and Elevation axis mode control buttons.

The servos in any other state will not allow access to the Mode Control buttons. The Mode Control buttons are disabled (gray).

#### **4.2.3.4.2 Modes of Operation**

There are six (6) standard modes of Azimuth and Elevation axes control. The Manual mode allows user input from the graphical user interface (GUI), handwheels, a joystick, or keyboard arrow keys. Those modes include:

- Track
- Acquire
- Search
- Slave
- Manual
- Standby

The system can utilize any of these modes/axes independently or simultaneously. For example, the Azimuth axis can be in Slave mode while the Elevation axis is in Search (or Manual mode). The user has the option of changing the mode of operation for an individual axis, or both axes simultaneously, by selecting the center command buttons, denoted by the chain-link.

#### 4.2.3.4.2.1 Track

When the Track mode is selected, the axes are forced into Auto-Track mode and will track the received signal without regard to quality or signal level (chain-link button selects both axes at the same time). The Track button illuminates green when enabled. If tracking is lost, the Track buttons revert to gray and the Acquire buttons remain yellow.

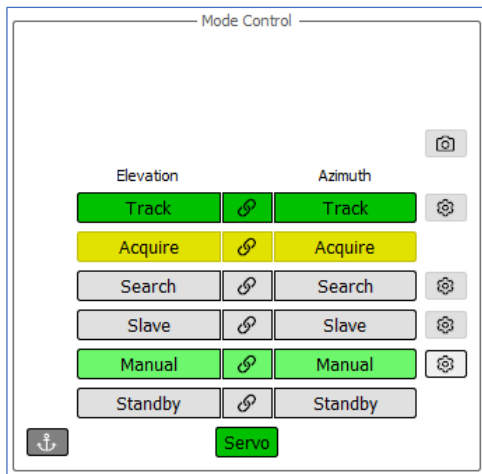


Figure 107: Mode Control Window

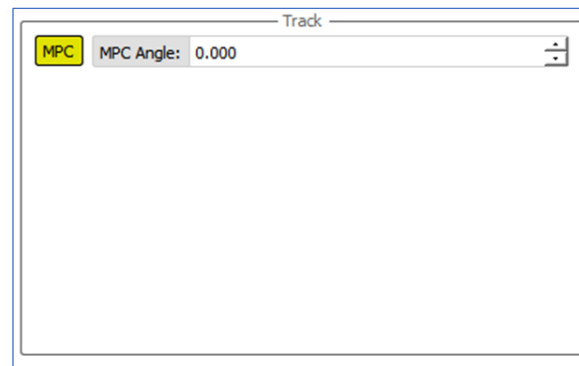


Figure 108: Track Window

To access the user configurable parameters, such as Multi-Path Clipping (MPC), select the Gear button to the right of the Track mode control buttons.

From the Track window, shown in Figure 108, the user can set the desired MPC angle, which will be activated when the MPC button is selected. When selected, the MPC button turns yellow. The MPC is a down limit that is only active during a target track (when Track buttons are active and green). It prevents the antenna from slewing down (in Elevation) below the MPC angle. This usually occurs when the antenna is pointing low and tracking a target moving out over the horizon, where the antenna may be responding to multi-path signals reflecting off the ground and may lose track. The MPC limit attempts to keep the antenna above the ground reflections and on the target.

#### 4.2.3.4.2.2 Acquire

When the Acquire mode is selected, the Azimuth and Elevation axes automatically switch to Track, based on a user configurable acquisition threshold. The acquisition threshold is independently configurable for each tracking channel (RSSI/AGC meter) displayed in the RSSI (AGC) window. When the Acquire button is gray, it indicates the mode is Off/Disabled. When Acquire mode is selected, the button illuminates yellow indicating that Acquire is Active.

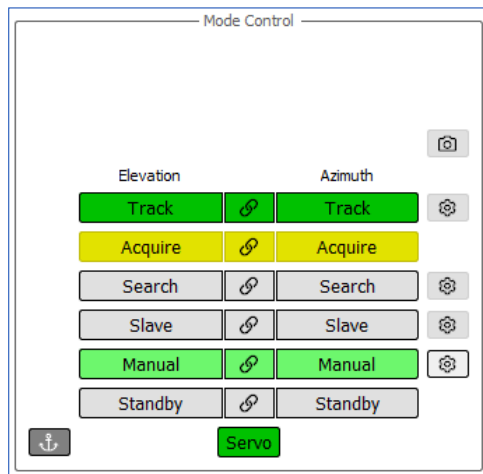


Figure 109: Mode Control, Manual Acquire

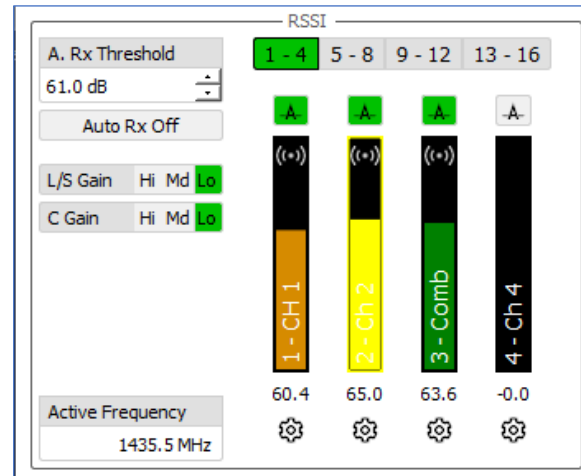


Figure 110: RSSI, Channel 1 Received Signal, Acquire Orange

Acquire settings are accessed by selecting the Gear button below each AGC meter/tracking channel in the RSSI window. The AGC meters display the signal received as an orange, yellow, or green bar when in Acquire, as shown in Figure 110. When the acquire threshold is achieved, the AGC bar turns green indicating the signal level is above the acquire threshold. If an acquired channel's signal level drops below the acquire threshold, and remains above the hysteresis level, the AGC bar turns yellow to indicate the target is about to be lost. The AGC bar turns orange when the signal is not acquired. If the received signal is above the user configurable saturation level, the bar turns red.

#### 4.2.3.4.2.3 Search

When an axis is placed in Search mode, the antenna slews in a pre-configured pattern per the user parameters.

To access the configurable search parameters, select the Gear button to the right of the Search axis button. The Search window, shown in Figure 111, provides access to the Azimuth and Elevation radius and velocity parameters. Select the type of search by using the down arrow in the Search field. Type or use the Up/Down arrows to assign values to the Elevation and Azimuth Radius and Velocity fields.

After these parameters are configured and stored, select the Search button in the Mode Control window (Figure 112) for either axis, or both, to start the search. The Search button illuminates green and the antenna begins to slew. This function can be used in combination with auto-track feature to search, acquire, and track a target within that search area.

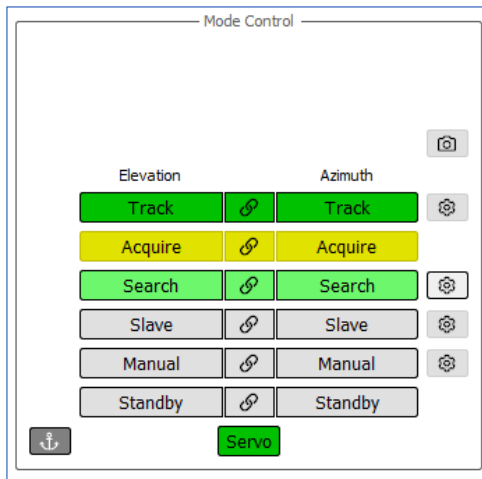


Figure 111: Mode Control Window

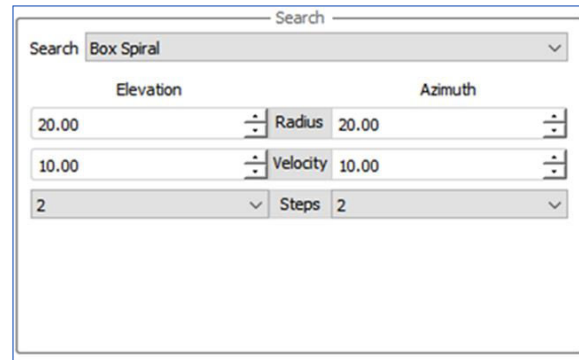


Figure 112: Search Window

When the AZ Search button is selected, the antenna only searches in Azimuth. In Figure 111, the Azimuth moves 20 degrees to each side of the starting pointing position, at a rate of 10 degrees/sec. Elevation parameter settings are identical. When both the AZ and EL Search buttons are selected, the antenna performs a Box Spiral or Raster search, depending on the Search parameter selected in the Search window. The antenna continues to follow the search routine, until Manual mode is selected again in both axes.

#### 4.2.3.4.2.4 Slave

When an axis is placed in Slave mode, the Slave button illuminates green, indicating that the axis is ready for manual input commands (chain-link button selects both axes at the same time). That axis takes command angles from a slave source from an outside source (typically Ethernet). The axis Status meter displays the numerical slave inputs as the antenna slews to the slave source commands.

The Gear button to the right of the Slave axis buttons provides access to the Slave parameters control window, shown in Figure 114. Use the drop down arrow in the Slave Source field to select from available sources. Currently the only slave source is the Ethernet source.

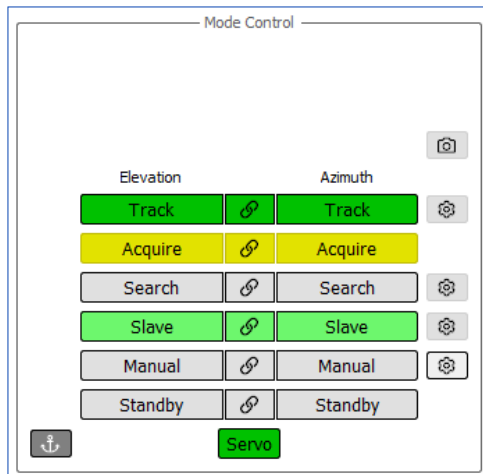


Figure 113: Mode Control Window

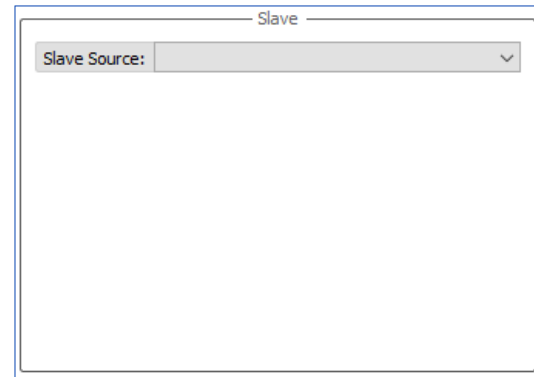


Figure 114: Slave Window

#### 4.2.3.4.2.5 Manual

When an axis is placed in Manual mode, the button illuminates green indicating that the axis is ready for manual input commands, as shown in Figure 115 (chain-link button selects both axes at the same time).

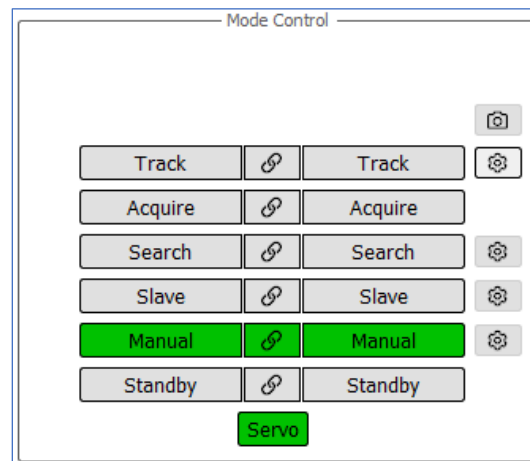


Figure 115: Mode Control, Manual Enabled

Each axis is independent from each other. The EL axis can be in Standby while the AZ axis is in Manual, for example.

The system designates are accessed by selecting the Gear button to the right of the Manual buttons. This opens the Designates window which allows the user to select pre-saved pointing locations, such as the antenna stow position and the sun tracking/pointing location. In addition to the pre-saved designate pointing locations, Immediate Designate pointing may be used. Refer to section 4.2.1.5.2.4 for details about Immediate Designates.

#### 4.2.3.4.2.6 Standby

Standby mode allows the Azimuth and Elevation Axes to independently be placed in Standby. When a Standby button illuminates red, the corresponding axis motor brakes are engaged, and the axis servo amplifier is disabled, as shown in Figure 116.

When the axis Manual button is selected and illuminates green, the axis Standby button changes to gray. The AZ and EL axes motor brakes are released, and the axis servo is enabled and waiting for manual control input (chain-link button selects both axes at the same time).

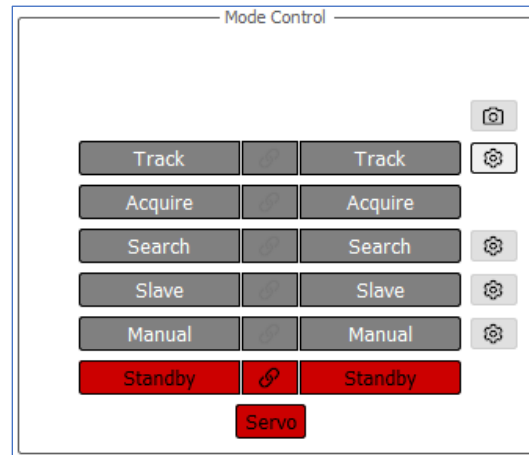


Figure 116: Mode Control, Standby

#### 4.2.3.4.3 Camera Icon

The Camera icon, shown in Figure 117, allows access to the Camera parameters menu. This allows the user to turn the camera On and Off, and provides access to the available camera control selections (depending on GUI Client software version).

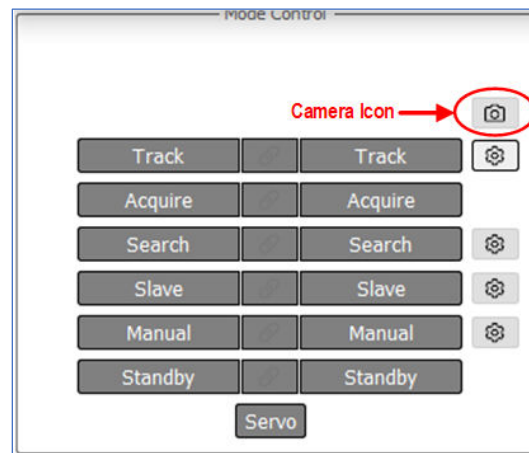


Figure 117: Mode Control, Camera Icon



#### 4.2.3.5 Azimuth and Elevation Input Control Windows

The Input Control windows, shown in Figure 118, allow the modes of manual antenna movement, either Position or Velocity, for each axis independently. The Input Control windows are located at the lower left (Azimuth) and right (Elevation) on the Main GUI screen.

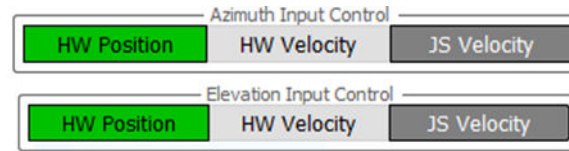


Figure 118: Azimuth and Elevation Input Control Windows

Both inputs operate identically. The windows consist of three (3) buttons: HW (Handwheel) Position, HW (Handwheel) Velocity, and JS (Joy Stick) Velocity. Before the handwheel and/or joystick can be used, the Handwheel and Joystick settings windows must be configured and enabled for both devices (typically factory set).

##### 4.2.3.5.1 HW (Handwheel) Position

This button selects the Handwheel Position mode, which drives the antenna CW and CCW or Up and Down as each handwheel CW and CCW are rotated. When the rotation of the handwheel stops, the antenna also stops. This mode is used to accurately drive or point the antenna to a desired location manually.

##### 4.2.3.5.2 HW (Handwheel) Velocity

This button selects the Handwheel Velocity mode, which drives the antenna CW and CCW or Up and Down continuously as the handwheel CW and CCW is moved. More rotational turns of the handwheel increases the antenna speed up to its maximum AZ and EL speed limit (typically 30 degrees/sec). If the handwheel is released (no longer turning), the antenna continues to move until the handwheel rotation is reversed. This slows down the angular speed of the antenna until it stops. Continuing to rotate the handwheel in the reverse direction begins to drive the antenna in the opposite direction, up to maximum velocity again. Driving the antenna in HW Velocity mode in the Elevation axis eventually drives the EL axis into the system Up or Down limits.

##### 4.2.3.5.3 JS (Joystick) Velocity

This button selects the joystick and places it in Velocity mode. If both axes are enabled, the joystick drives the antenna in both Azimuth and Elevation, depending on the user input into the attached joystick. The joystick is typically attached to the Client Windows PC via any available USB port. The Joystick settings window is then accessed to select and enable the displayed joystick types.

#### 4.2.3.6 Lower Tool Bar

The Lower Tool Bar contains two reference areas, as shown in Figure 119. The left side of the bar displays the System connection information and the User login status. The right side of the bar contains the Time, Date, and Link status.

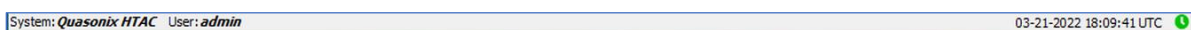


Figure 119: Lower Tool Bar

#### 4.2.3.6.1 Time Synchronization Status

Date and time display is in the right hand corner of the Lower Tool Bar. The Clock icon glows green when time code information is present, and red when time code information is missing. Selecting the green Clock icon opens the Time Synchronization Status window, as shown in Figure 120. This window contains three (3) sub window tabs:

- Tracking
- Source Statistics
- Sources

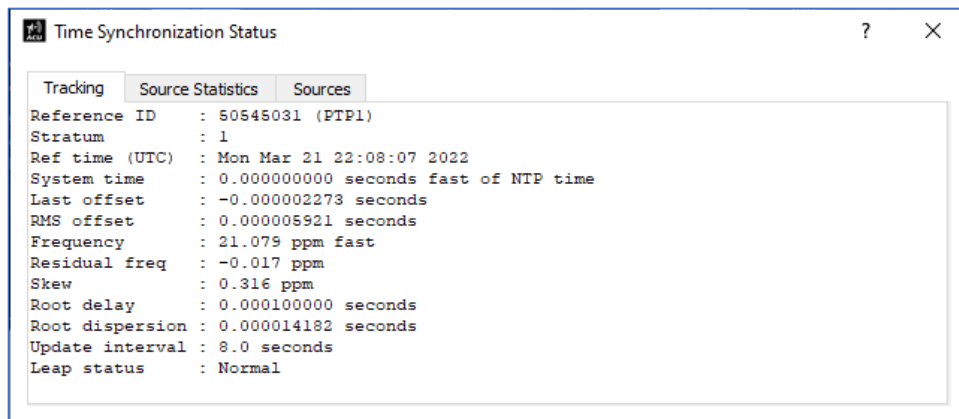


Figure 120: Time Synchronization Status, Tracking Tab

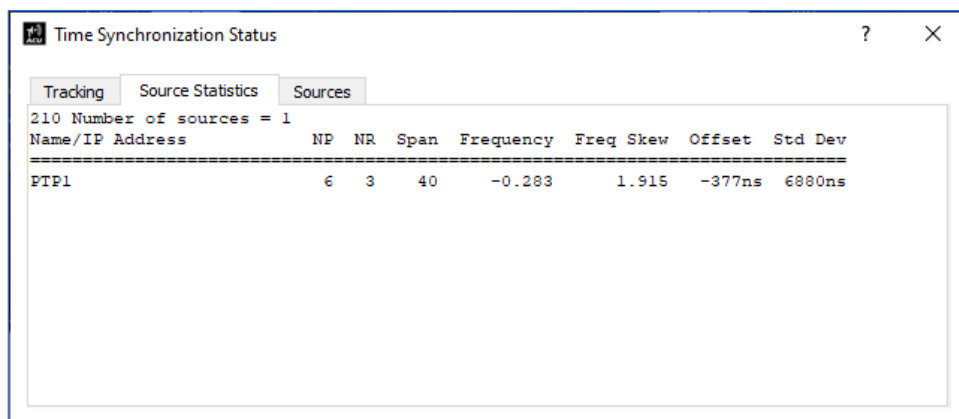


Figure 121: Time Synchronization Status, Source Statistics Tab

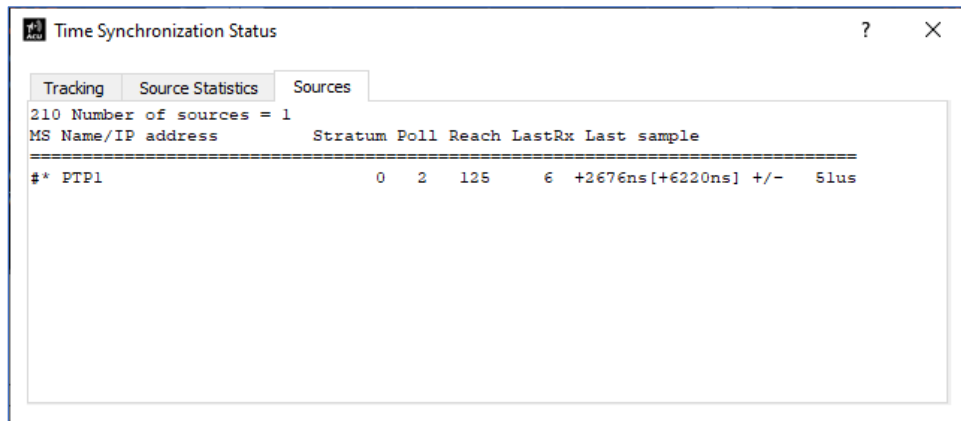


Figure 122: Time Synchronization Status, Sources Tab

#### 4.2.4 Optional Equipment—Auto Stow Assembly

The optional Auto Stow Assembly must be enabled from the Settings – Hardware - Auto Stow window. If the tracker was not supplied with the Auto Stow Assembly option, the page displays a Not Installed message, as shown in Figure 123. If the system was ordered with the Auto Stow Assemble option, the Enable button is selected and displays green.

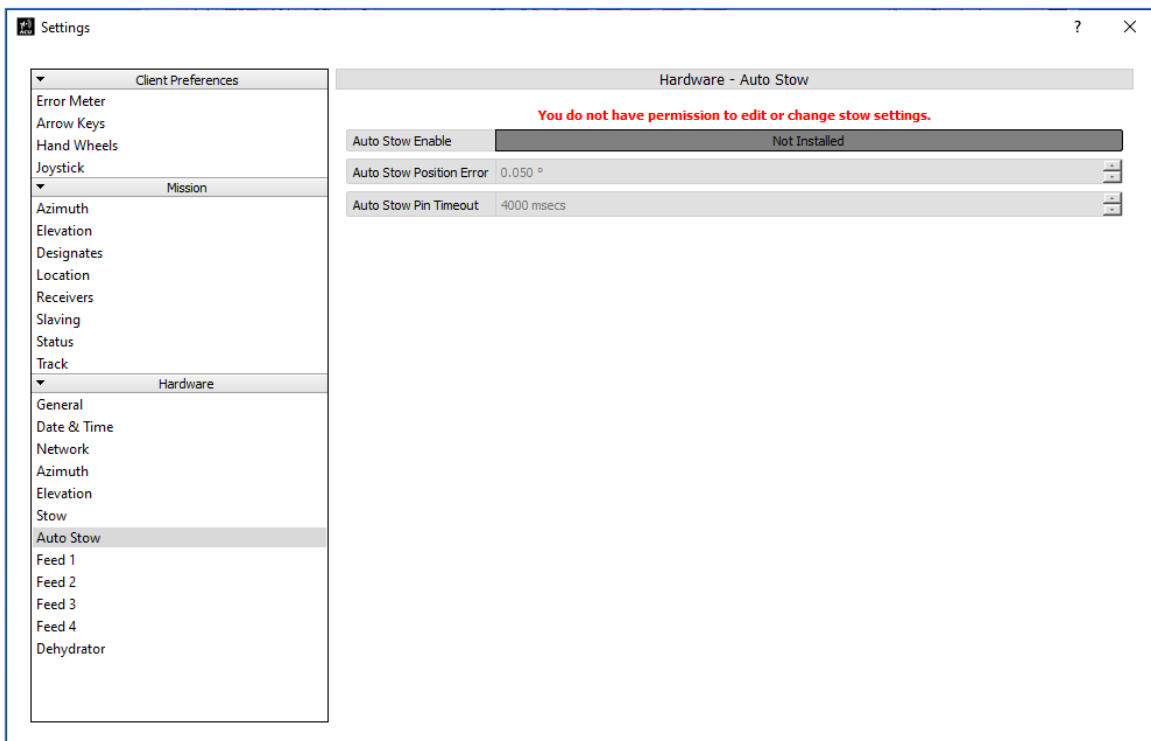


Figure 123: Settings, Hardware – Auto Stow Not Installed

When Enabled, the following GUI examples apply.

- The Main Screen (GUI), now includes a small Anchor icon located in the lower left hand corner of the Mode Control Area, as shown in Figure 124. Selecting the Anchor icon enables the Auto Stow system.

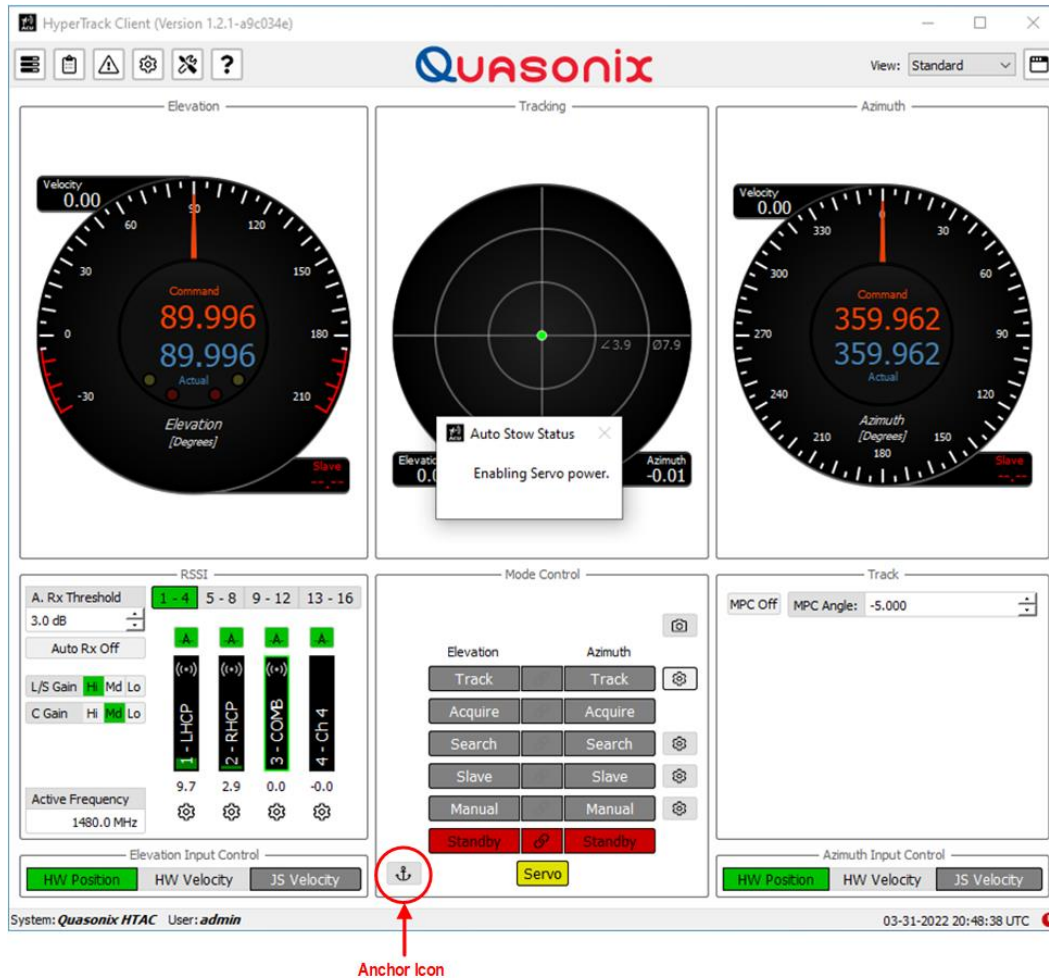


Figure 124: Auto Stow Status Message, Enabling Servo Power

- The Servo button automatically activates and powers On both servos.
- Both Manual buttons enable (green) and the system drives to the (saved) stow position, as shown in Figure 125.
- When at the stow position the Auto Stow pin drives into the stow receptacle. As it moves into the stow receptacle, the Anchor icon blinks green (Figure 125)

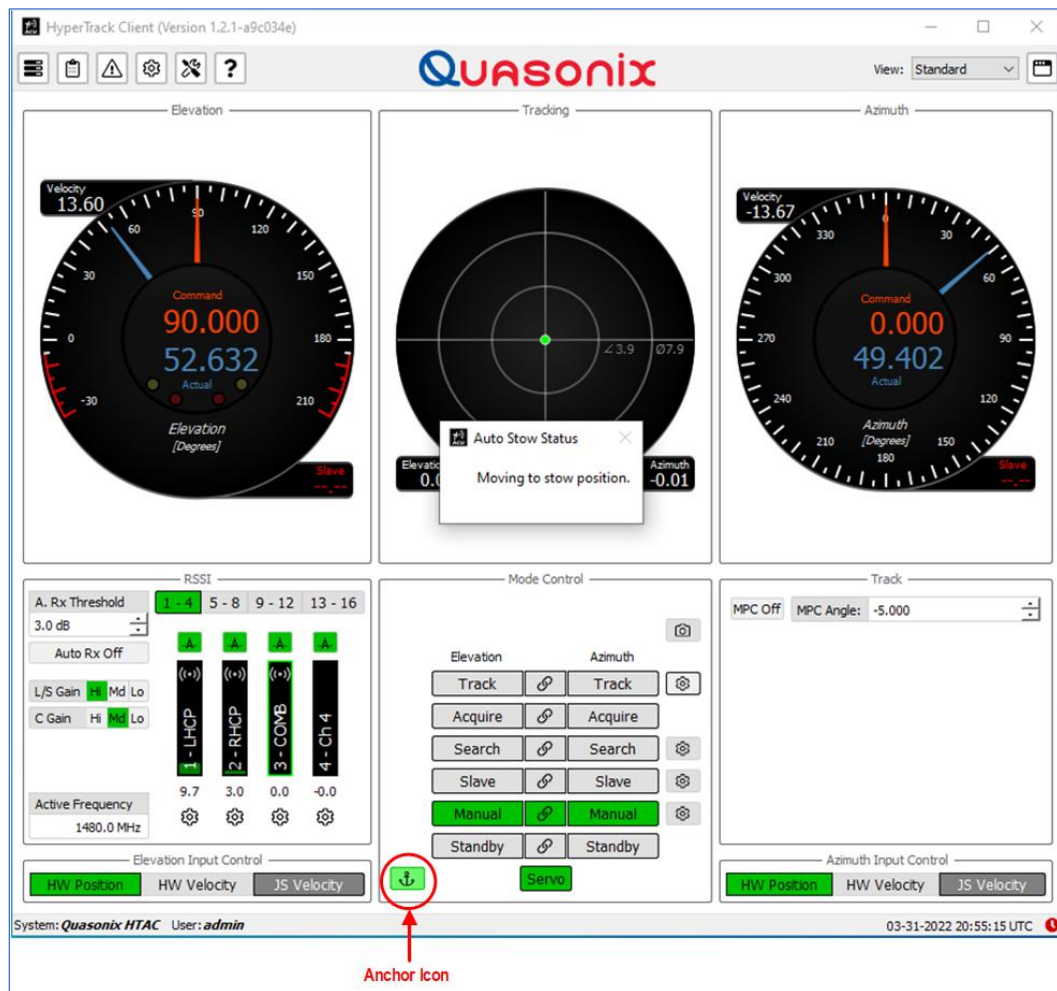


Figure 125: Auto Stow Status Message, Moving to Stow Position

- Auto Stow is enabled, and the system drives to the stored stow position.

After the stow pin has been completely inserted into the receptacle, the Auto Stow icon stops blinking. The AZ and EL Manual buttons turn red as the axes are disabled, and the stow Servo button disables the servos and turns red.

If during the stowing process the final stow position is not reached or the stow pin fails to activate, the process times out and a Stow Pin Fail Message displays, as shown in Figure 126.

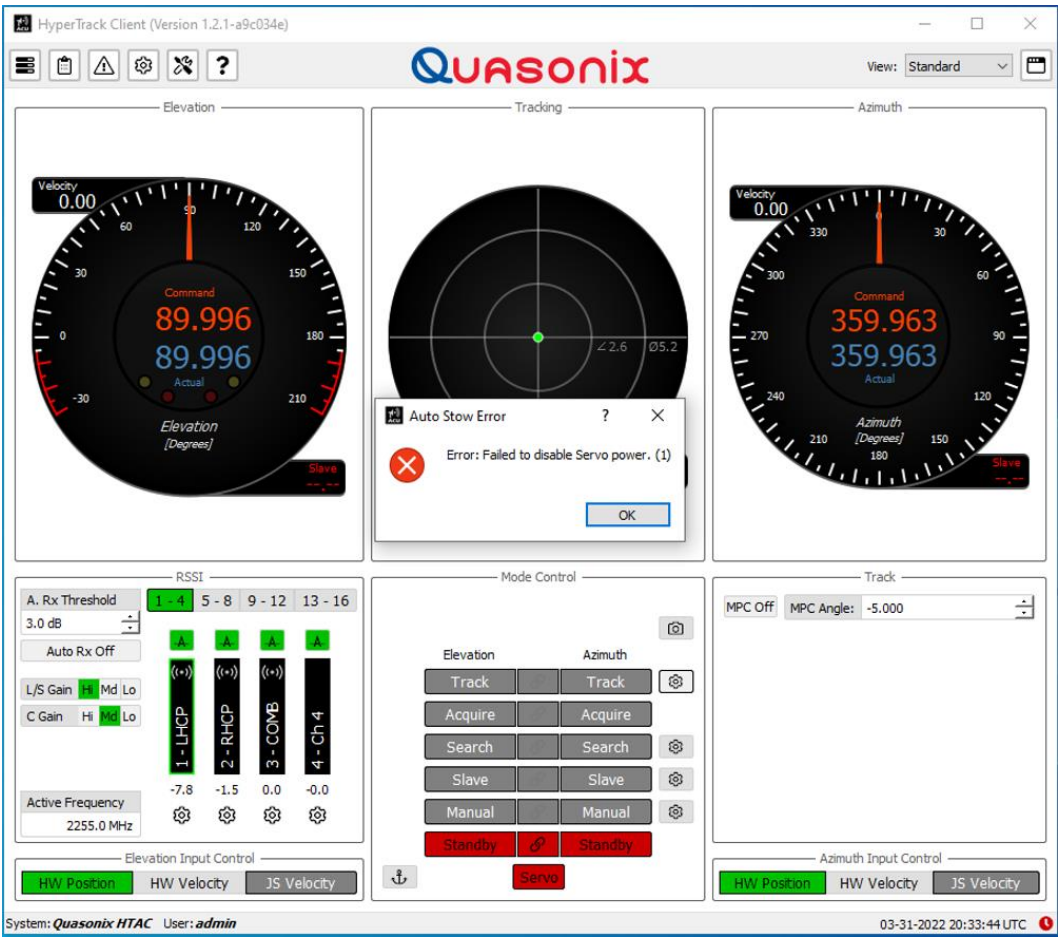


Figure 126: Auto Stow Error Message

## **5 Maintenance Instructions**

HyperTrack™ requires no regular maintenance, and there are no user-serviceable parts inside.

## 6 Product Warranty

HyperTrack™ carries a standard parts and labor warranty of one (1) year from the date of delivery.

### 6.1 Quasonix Limited Warranty Statement

This Limited Warranty Statement (this “Limited Warranty”) applies to all hardware and software products and internal components of such products (the “Products”) sold by Quasonix, or its representatives, authorized resellers, or country distributors (collectively referred to herein as “Quasonix”). EXCEPT AS EXPRESSLY SET FORTH IN THIS LIMITED WARRANTY, QUASONIX MAKES NO OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO ANY PRODUCTS SOLD BY IT. Quasonix expressly disclaims all warranties and conditions not stated in this limited warranty. There are no warranties which extend beyond the description on the face hereof. Capitalized terms not otherwise defined herein shall have the meaning set forth in those certain General Terms and Conditions of Sale for Standard Product, as amended from time to time.

Quasonix warrants to customer that for one (1) year from the date of shipment of the Products by Quasonix (the “Warranty Period”), such Products purchased from Quasonix or its authorized affiliate will materially conform to the specifications set forth in the applicable Quasonix Specifications, if any, and are free from defects in materials and workmanship under normal use during the Warranty Period. As used herein, “normal use” means the intended use of the Products for which it was designed by Quasonix.

This Limited Warranty extends only to the original purchaser of the Products and is not transferable to anyone who obtains ownership of the Products from the original purchaser.

Quasonix’ software, whether incorporated into the Products or sold separately, is warranted solely to the extent that problems or “bugs” are found in the software and affect the functional operation of the Products. At no time shall requests for changes in the software architecture or visual esthetics be considered a warranty item.

The Products are manufactured using new materials only. Replacement parts may be new or equivalent to new. Replacement parts are warranted to be free from defects in material or workmanship for thirty (30) days or for the remainder of the Warranty Period of the Products in which they are installed, whichever is longer.

During the Warranty Period, Quasonix will repair or replace the defective Products. All components or hardware products removed from the Products under this Limited Warranty become the property of Quasonix. All warranties are limited to the repair or replacement of the Products.

In no event shall Quasonix be liable for any special, consequential, incidental or indirect damages of any kind, including, without limitation, loss of profits, loss of data, “down-time,” loss of use or damage to other equipment, or personal injury or death, whether or not Quasonix has been advised of the possibility of such loss.

Notwithstanding anything to the contrary herein, Quasonix’s entire liability hereunder from any cause whatsoever and regardless of the form of action shall be limited to the amount actually received by Quasonix.

Quasonix shall not be liable for a breach of the warranty set forth in this Limited Warranty unless: (i) the customer gives written notice of the defect, reasonably described, to Quasonix’s Contracts Administrator within thirty (30) days of the time when customer discovers or ought to have discovered the defect and obtains a Return Materials Authorizations (“RMA”) number; (ii) Quasonix is given a reasonable opportunity after receiving the notice to examine such Products and customer (if requested to do so by Quasonix) returns such Products to Quasonix’s facility in Moorpark, CA, unless otherwise approved by Quasonix; and (iii) Quasonix reasonably verifies customer’s claim that the Products are defective.

Subject to the foregoing, with respect to any such Products during the Warranty Period, Quasonix shall, in its sole discretion, either: (i) repair or replace such Products (or the defective part) or (ii) credit or refund the price of such



Products at the pro rata contract rate provided that, if Quasonix so requests, customer shall, at Quasonix's expense, return such Products to Quasonix.

The customer is responsible for all costs associated with packaging and shipping of the defective Products to Quasonix's facility and clearly marking or affixing the given RMA number on the shipping label. Quasonix is not responsible for any loss or damage during shipment to Quasonix's facility. Following repair or replacement of covered Products, Quasonix will assume responsibility for the costs associated with the return of the material to the customer to an address provided by the customer. Notwithstanding the foregoing, items returned to Quasonix's facility and found to be operational or otherwise not covered by this Limited Warranty shall be returned to the customer at the customer's expense.

This Limited Warranty does not apply to expendable parts, such as cables, lamps, fuses, connectors, etc. This Limited Warranty does not extend to any Products which have been damaged or rendered defective (a) as a result of accident, misuse, abuse, or external causes; (b) by operation outside the usage parameters stated in the user documentation that shipped with the Products; (c) as a result of a failure to follow the instructions in the Operations & Maintenance Manual (d) by the use of parts not manufactured or sold by Quasonix; or (e) by modification or service by anyone other than (i) Quasonix, (ii) an Quasonix authorized service provider, or (iii) your own installation of end-user replaceable Quasonix or Quasonix approved parts if available for the Products in the servicing country.

THE TERMS OF THE WARRANTIES CONTAINED HEREIN DO NOT IN ANY WAY EXTEND TO ANY PRODUCT OR PART THEREOF OR SOFTWARE MATERIALS WHICH WERE NOT MANUFACTURED BY SELLER OR PREPARED BY SELLER OR ANY OF ITS AFFILIATES.

These terms and conditions constitute the complete and exclusive warranty agreement between the customer and Quasonix regarding the Products purchased. This Limited Warranty is applicable in all countries and may be enforced in any country where Quasonix or its authorized affiliates offer warranty service subject to the terms and conditions set forth in this Limited Warranty.

These terms and conditions supersede any prior agreements or representations (including representations made in Quasonix sales literature or advice given to the customer by Quasonix or an agent or employee of Quasonix) that may have been made in connection with the purchase of the Products. No change to the conditions of this Limited Warranty is valid unless it is made in writing and signed by an authorized representative of Quasonix.

#### **6.1.1 Extended Warranties**

Extended warranties or extra coverage are available upon request. Please contact Quasonix for details and pricing.

**THE REMEDIES SET FORTH IN THIS LIMITED WARRANTY STATEMENT SHALL BE THE BUYER'S SOLE AND EXCLUSIVE REMEDY AND SELLER'S ENTIRE LIABILITY FOR ANY BREACH OF THE LIMITED WARRANTY SET FORTH HEREIN.**

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## **7 Technical Support and RMA Requests**

In the event of a product issue, customers should contact Quasonix via phone (1-513-942-1287) or e-mail (support@quasonix.com) to seek technical support. If the Quasonix representative determines that the product issue must be addressed at Quasonix, a returned materials authorization (RMA) number will be provided for return shipment.

Authorized return shipments must be addressed in the following manner:

**Quasonix, Inc.  
ATTN: Repair, RMA #  
6025 Schumacher Park Drive  
West Chester, OH 45069**

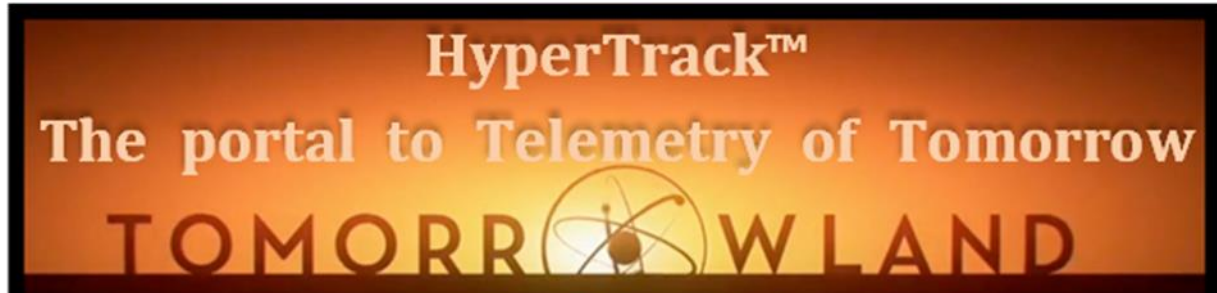
**To ensure that your shipment is processed most efficiently, please include the following information with your product return:**

- Ship To – Company name, address, zip code, and internal mail-drop, if applicable
- Attention/Contact person – Name, Title, Department, Phone number, email address
- Purchase Order Number – If applicable
- RMA Number – provided by the Quasonix representative

Please note that Quasonix reserves the right to refuse shipments that arrive without RMA numbers.

## 8 Appendix A - HyperTrack™ Control System

Auto-tracking antennas have operated by the same basic principle since the 1960s: design the antenna to scan a small area around the target and use the amplitude modulation (AM) thereby induced to steer the antenna toward the target. The specific implementations of this scheme have improved over the years, but there has been no fundamental change to the basic control mechanism – until now.



Starting in early 2017, Quasonix began shipping all 3rd Generation RDMS™ telemetry receivers with the HyperTrack™ control interface, which is revolutionizing the way auto-tracking antennas function.

Latency in the antenna tracking control loop leads to jitter in the antenna position. HyperTrack™ replaces the traditional AM and AGC analog signals with a single high-speed serial digital interface. Furthermore, all real time processing is done in FPGAs, where signal timing is precisely controlled and completely deterministic. This reduced latency and smaller latency variation ultimately results in faster, more accurate tracking. This is particularly important at C band, where the antenna beamwidth is smaller than it has ever been at L or S band. A functional flow diagram of a HyperTrack™ system is shown in Figure 127.

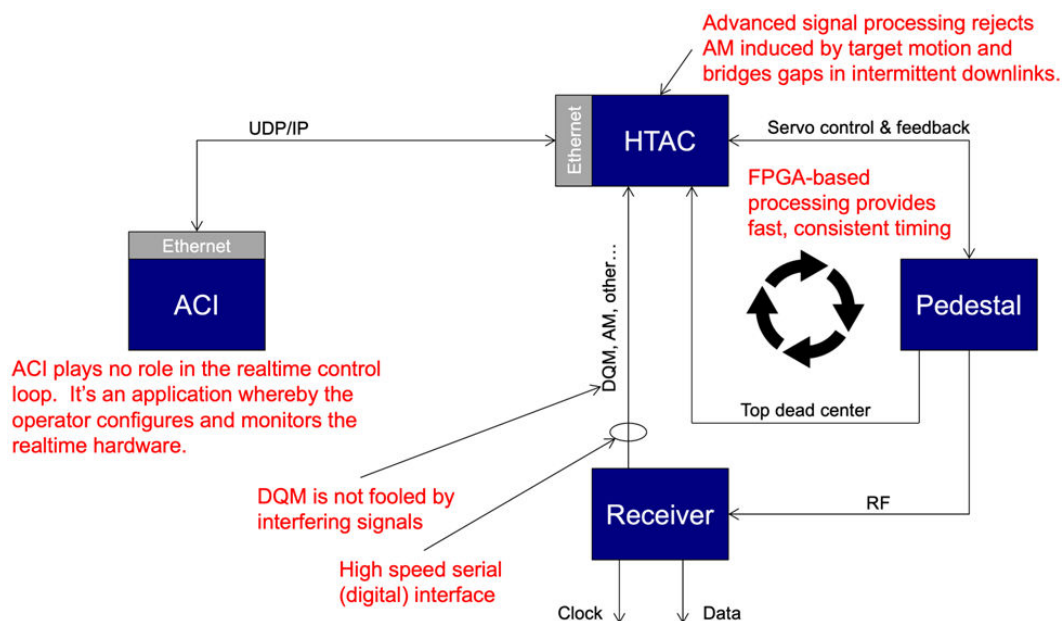


Figure 127: Functional Flow in HyperTrack™ Ground Station

A HyperTrack™ Ground Station exploits information from the TM receiver to improve the overall receive system performance, and it includes the capability to perform RF-level end-to-end antenna system testing that was previously impossible or extremely difficult to achieve.

## 8.1 HyperTrack™ Hardware

The HyperTrack™ Antenna Controller (HTAC) is implemented in a standard 2U rack chassis, with sufficient connections to support up to 8 receivers on one HTAC.



Figure 128: 2U HyperTrack™ Antenna Controller (HTAC), Front Panel



Figure 129: 2U HyperTrack™ Antenna Controller (HTAC), Back Panel

## 8.2 HyperTrack™ User Interface

HyperTrack™ brings revolutionary new features and employs advanced signal processing algorithms to achieve tracking performance beyond what has ever been achieved. Despite the sophistication of the machinery under the hood, the user interface is immediately familiar to anyone who has used auto-tracking antennas before.

The Standard Main Display (GUI) is composed of separate feedback and control widgets separated into specific operational areas on the display. The GUI provides the user with the basic control and feedback functions for the operation of the HyperTrack™ Antenna Controller. Basic functions include all axis control and angle feedback, signal level displays (AGCs), and tracking information. The main screen in the user interface is shown in Figure 130.

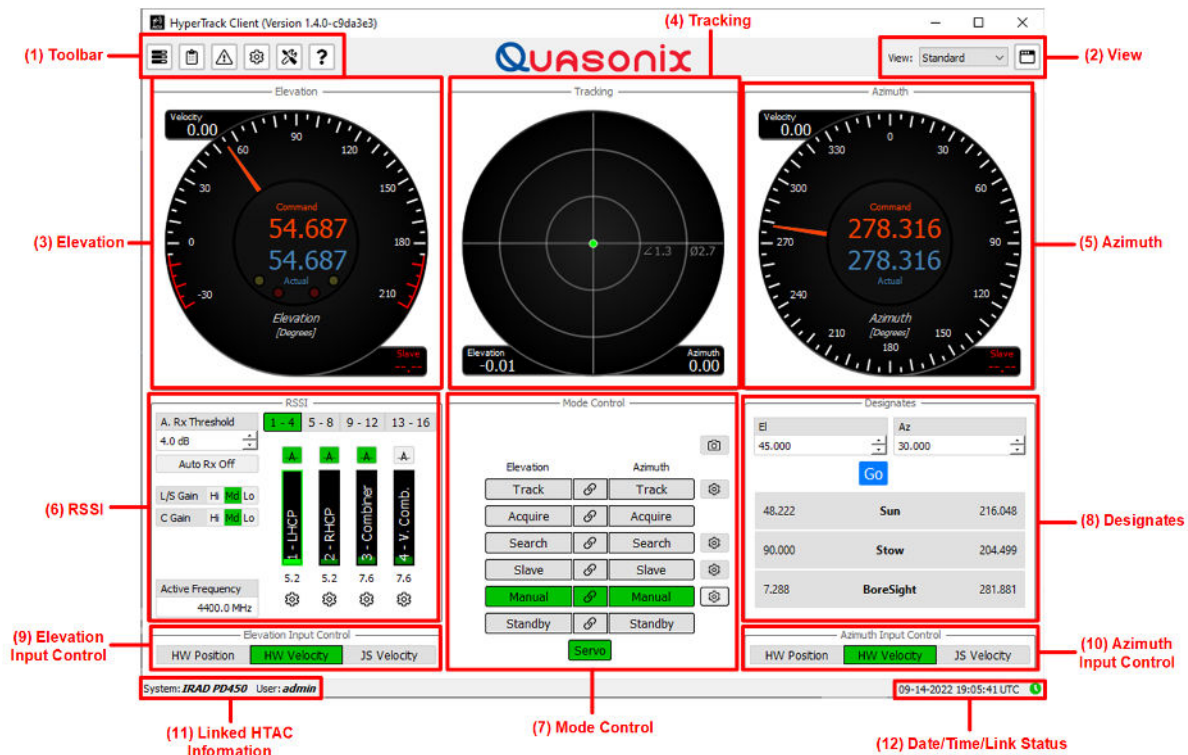


Figure 130: HyperTrack™ GUI Main Screen

### 8.3 Standard Controller Features

The HyperTrack™ Antenna Controller (HTAC) supports all of the “standard” ACU features, and provides support for the standard AM and AGC interfaces. In the interest of brevity, we simply list a few of those features here:

- Manual Mode
- Hand Wheel Control
- Joystick Control
- Keyboard Control
- Slave Mode
- Search Mode
- Acquire Mode
- Track Mode
- Automatic Receiver Selection
- Common GUI for Local and Remote connections
- Multi-Path Clipping
- Access Control List
- User-Configurable Designates
- IMU Stabilization
- Time code synchronization support
- GPS support
- Compass support
- Manual and/or automatic stow pins
- Network status protocol
- ACU data logging to file

- Support for AM and AGC interfaces
- Automatic Diagnostics and Test

## 8.4 HyperTrack™ Advanced Features

The elementary HyperTrack™ features listed above are important, but they are not unique to HyperTrack™. Every modern antenna controller supports these functions.

However, for customers with Quasonix RDMS™ receivers, the antenna systems described here can be complete HyperTrack™ Ground Stations. The HyperTrack™ Ground Station consists of four major components:

- A high-performance L/S-band Single Channel Monopulse (SCM) antenna
- A FPGA-based HyperTrack™ Antenna Controller
- Ground Station Analyzer
- A 3rd Generation Quasonix RDMS™ receiver with HyperTrack™ enabled

The HyperTrack™ interface between the receiver and the antenna controller is a critical element in the HyperTrack™ Ground Station. Quasonix published the HyperTrack™ antenna control protocol at the International Telemetry Conference (ITC) in 2019. Despite this, no other antenna vendor or receiver vendor has announced a HyperTrack™ capability in their products. Without this Quasonix-only feature, the advanced features described here would be impossible.

The following sections describe the advanced features of the HyperTrack™ Ground Stations that are really “The Portal to the Telemetry of Tomorrow.” These are features that truly revolutionize auto-tracking antenna systems, and are only available in a Quasonix HyperTrack™ Ground Station.

### 8.4.1 Interference Recognition

A conventional ACU accepts multiple receiver AGC voltages as inputs. The AGC voltages are used to control the ACU’s automatic switching to the receiver with the highest signal level. Thereby it is always using the receiver with the best signal for the AM signal used to track of the target.

Unfortunately, AGC is a very primitive measure of signal quality, and is not necessarily the best choice. It is particularly misleading in the presence of interference. AGC responds only to signal strength. A strong interferer can produce lots of signal strength. This leads to the antenna tracking loop “sticking” to the interfering signal and abandoning the signal from the test article. Additionally, transient in-band signals not detectable in normal signal strength measurements can severely impact the received data quality.

Starting in 2015, Quasonix introduced calibrated data quality metrics (DQM) in our 3rd Generation RDMS™ telemetry receivers. Recognizing the value of this feature, the Range Commanders Council adopted DQM as part of IRIG 106-17, and the ability to generate and output DQM is now a requirement for all receivers being delivered to DoD customers. DQM is a calibrated value, directly proportional to the log of the instantaneous bit error probability. In effect, it reports the true data quality of the demodulated RF signal, even if it is randomized or encrypted; it is not simply the RF signal strength. This difference is crucial.

Because DQM is a measure of the demodulated data quality, interference will drive the DQM value down, not up. Recognizing this, the HyperTrack™ Ground Station™ can detect the difference between interference and the signal from the real target. Only a complete HyperTrack™ Ground Station offers this groundbreaking feature.

### 8.4.2 Intelligent Gain Control (IGC)

Every telemetry receiver uses automatic gain control (AGC) to ensure that the demodulator is driven at the “right” level to recover the data from the modulated waveform. The HyperTrack™ Antenna Controller (HTAC) extends this



same concept to the gain upstream of the receiver. This dramatically improves the performance of the HyperTrack™ Ground Station in environments with nearby interfering signals.

For many years, the telemetry frequency bands were largely free of interfering signals. This led to a design philosophy of using very high gain amplifiers early in the RF path, most often in the feed itself. With high gain early in the RF path, the system noise temperature was very low, and the system sensitivity was very high. If there were no interfering signals, the system performance was good.

Today, however, interfering signals are ubiquitous and operate at extremely high power. Filters can decrease the level of these interferers, but high gain amplifiers in the antenna front end can still be driven into compression. Amplifiers in compression will create intermodulation products that no filtering can ever remove. For this reason, the HTAC employs Intelligent Gain Control (IGC) in the SCM feed.

The SCM feed has three gain settings (high, medium, and low). The IGC ensures that the feed uses no more gain than needed to achieve error-free performance. This works as follows:

At installation, before each mission, or whenever commanded by the operator, the antenna is first pointed to “cold sky” to determine the absolute lowest noise level achievable. The noise level is recorded for all three gain settings. Then, the antenna is rotated through 360° of azimuth at zero degrees elevation (where interference is always worst). Using the Ground Station Analyzer (refer to section 8.4.7) as a simulated signal source during this sweep, the HTAC records the “noise floor” (including interference) at the frequency (or frequencies) of interest, and in the full 360° of azimuth. Some azimuths are likely to be marked as “interference-free.” The use of the GSA as a signal source ensures that any intermodulation products caused by the mixing of the interferers with the desired signal will be detected.

This azimuth sweep is automatically repeated for each of the three gain settings, and then the three sets of noise floor results are stored in the HTAC. This baseline data (measured and stored in half-beamwidth increments) allows the HTAC to compute the true signal-to-noise ratio (SNR) at that frequency (or frequencies) while tracking the test article.

While in track mode, the HTAC knows its azimuth and the current feed gain setting (and therefore the noise floor). It also knows the received RF signal level (embedded in the HyperTrack™ control stream from the receiver). The HTAC then continuously calculates the SNR. If the current DQM (also embedded in the HyperTrack™ control stream) is high and the computed SNR is above a pre-defined threshold (typically about 30 dB), then the feed is using more gain than is necessary to yield error-free telemetry data and the HTAC will lower the gain in the feed. This dramatically decreases the risk of compression and intermodulation in the feed.

The IGC is not fooled by the high-level interference because, although the interferers can create very high SNR, they will also create a very low DQM. Using the pre-mission survey of noise floor together with the real-time signal strength and DQM, the IGC can adjust the front-end gain to maintain error-free performance while reducing susceptibility to interference.

IGC cannot entirely eliminate telemetry dropouts due to interfering signal, but it does significantly reduce their likelihood. Only a HyperTrack™ Ground Station offers this feature.

### **8.4.3 Incidental AM Rejection**

Because every target vehicle has an irregular antenna pattern, target motion imposes amplitude modulation on the RF signal, and the frequency range of this AM generally increases as the target velocity increases. In certain instances (spinning missiles, for example), the frequency of the AM induced by the target can overlap with the AM induced by the antenna scanning action. Conventional ACUs can be severely degraded by this incidental AM.

Through the HyperTrack™ protocol, however, the receiver and the HTAC share common knowledge of the scanning signal, which allows the HTAC to perform the equivalent of matched filter detection of the AM signal. This vastly improves the rejection of incidental AM from target motion and improves tracking performance on targets that induce significant AM on the RF signal.

#### 8.4.4 “Prop Chop” Filtering

A specific form of incidental AM is caused by rotating surfaces on the aircraft. These can be either the rotors on a helicopter or the propeller blades on a propeller-driven airplane. When the telemetry signal either passes through or reflects from these rotating elements, a highly periodic form of incidental AM is imposed on the RF signal. A screenshot from the built-in oscilloscope that is part of the HTAC is shown in Figure 131. This view shows 62 ms of data that was captured during recent testing at the US Army Yuma Proving Ground, operating at 4500 MHz.

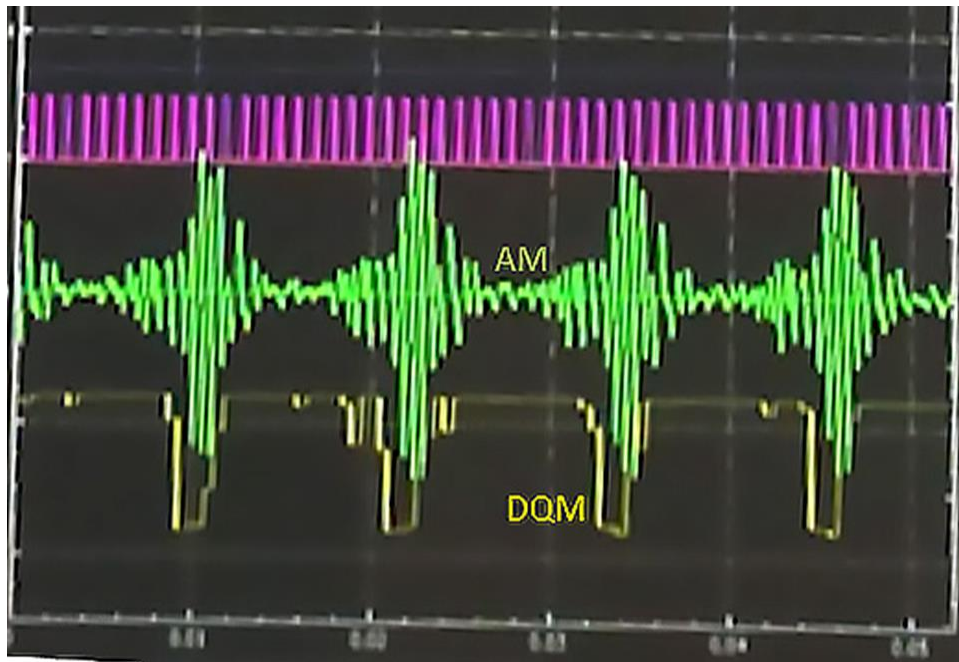
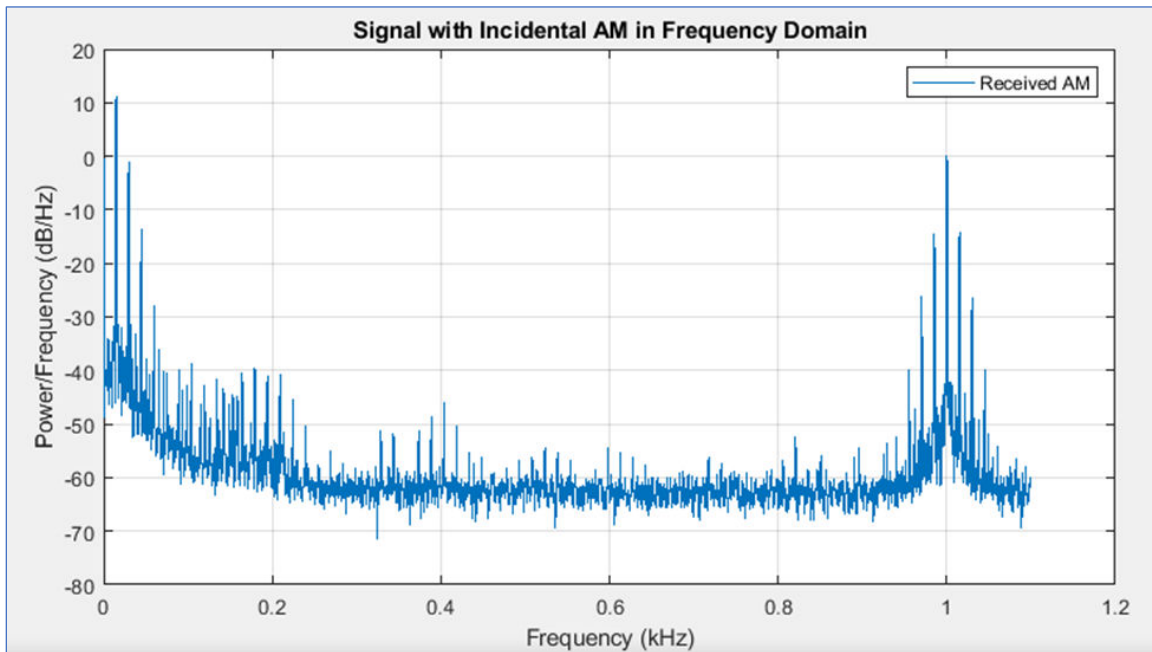


Figure 131: Prop-chop Displayed On the HyperTrack™ Antenna Controller (HTAC)

This periodic disturbance in the detected AM results in rotor-rate sidebands appearing on the SCM scanning signal, as shown in Figure 132. These sidebands can severely disrupt the detection of the SCM feed scanning signal and cause antenna mis-tracking.





**Figure 132: Rotor-rate Sidebands Before HTAC Processing**

The HTAC includes a powerful signal processing algorithm to remove these rotor-rate sidebands, as shown in Figure 133. Only the HyperTrack™ Antenna Controller offers this powerful signal processing algorithm. This feature has been proven to deliver dramatic improvements in the tracking of helicopter and propeller aircraft on several US test ranges.

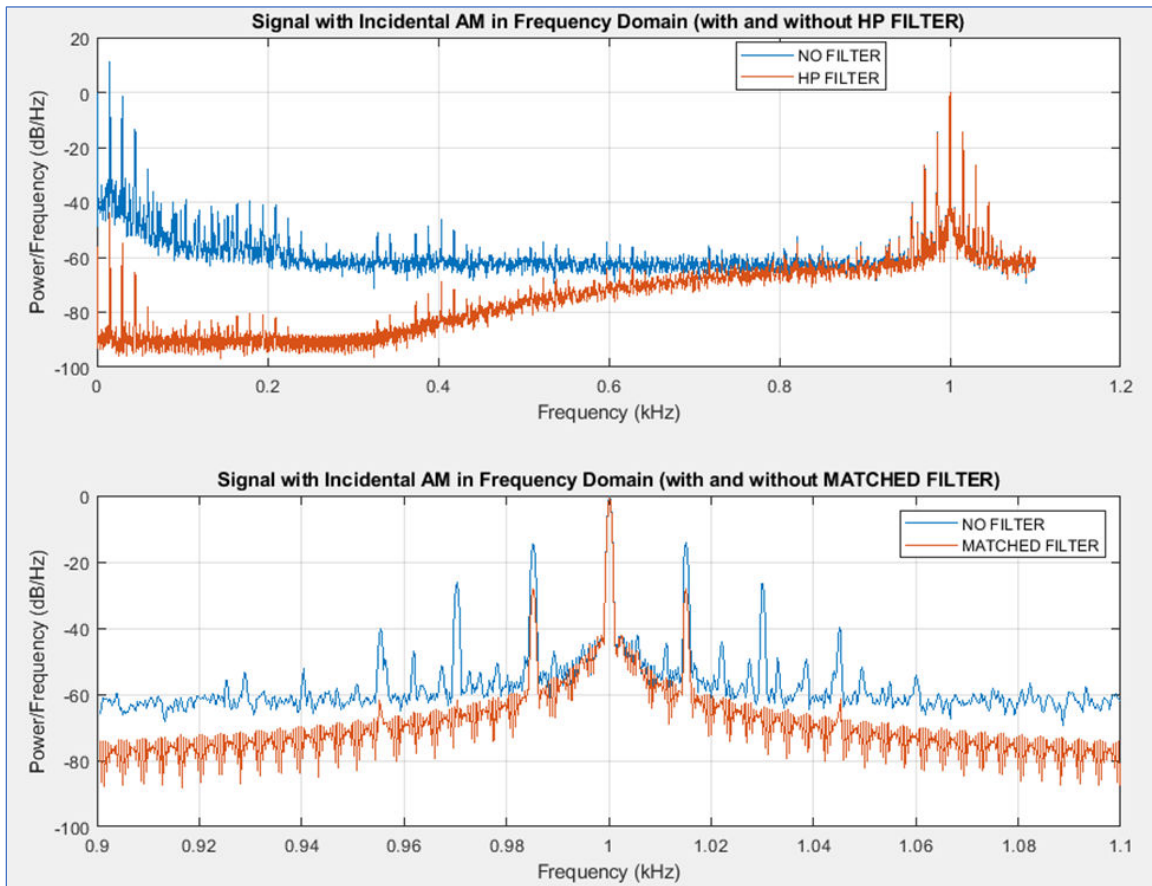


Figure 133: Rotor-rate Sidebands After HTAC Processing

#### 8.4.5 Dynamic Tracking Loop Bandwidth Control

Every auto-tracking antenna is driven by a feedback loop. The AM imposed on the signal by the scanning feed is used to steer the antenna toward the target. In the HyperTrack™ system, however, the bandwidth of this tracking loop is automatically adjusted to provide an ideal balance between aggressive, high acceleration when needed, and much smoother, more relaxed tracking when the test article motion is less dynamic. This all happens with no intervention by the operator and the reduction in unnecessary tracking “jitter” is remarkable.

The tracking loop is continually estimating target statistics to determine the dynamics as well as the target noise. Figure 134 illustrates how these estimates are used to create a loop bandwidth control surface that allows HyperTrack™ to handle a wide range of tracking situations automatically. When the target is moving fast and the noise is low, the algorithm adapts by increasing the loop bandwidth. Similarly, if the tracking noise is high or the target is moving slowly, the gain will be reduced. Generally, under low noise conditions, the loop is confident in the tracking error estimates and the gain is increased. When the dynamics of the target increase, the trend is to increase the gain to allow the system to keep up with the target. These actions exactly mimic how an operator would react to the situation.

The shape of the surface is designed to provide good responsiveness and operational stability. This adaptive approach to target tracking allows the system to cover a much wider range of conditions than traditional fixed gain approaches and significantly reduces the amount of operator intervention required.

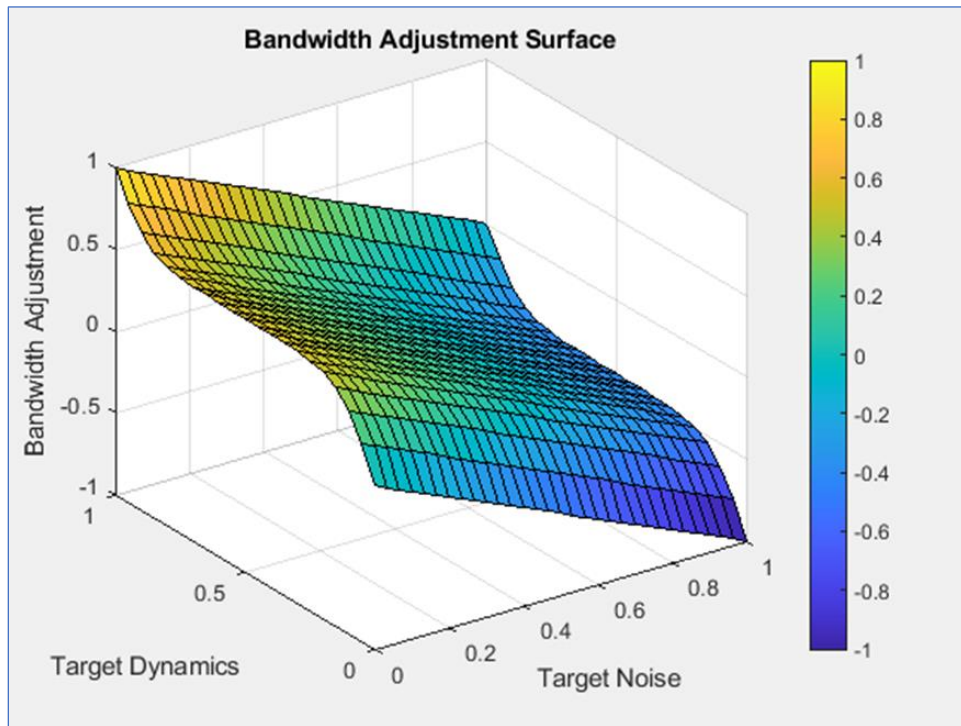


Figure 134: Dynamic Tracking Loop Bandwidth Surface

#### 8.4.6 Automatic Setup

Configuration and maintenance of a conventional auto-tracking antenna system requires test equipment and specialized operator training. With the HyperTrack™ Antenna Controller and a STRCI-enabled receiver, however, the process is highly automated. The key features of this automation are highlighted below:

- No need to set the AGC scaling – Because HyperTrack™ carries all of the tracking signal information in digital form (including AM and DQM values), the AGC signal has limited utility in tracking. The function previously performed by the AGC signal is now handled – much more reliably – by the DQM value. The receiver still reports signal strength to the user, but the ACU does not utilize this for control of the antenna.
- No need to set the AM bandwidth – In a conventional tracking loop, the AM bandwidth and AGC time constant are set to provide a crude bandpass characteristic that is intended to pass the scanning frequency and reject other signals. In HyperTrack™ mode, the receiver passes the complete receiver status to the HTAC, and the “signal conditioning” (including matched filter detection of the scanning signal) is done entirely in the HTAC – using settings that are automatically set by the HTAC. Never again endure poor tracking performance because the receiver was set up incorrectly.
- Automate delay calibrations – In a conventional tracking loop, the delays in the receiver (particularly the AM filtering delay) have to be calibrated out during system setup. With HyperTrack™, the signal processing is done in the HTAC, and it already knows its own signal latency.
- Automate complete ground station system test – By combining the features of HyperTrack™ with the GSA described below, Quasonix can offer a complete ground station analyzer capability.

#### 8.4.7 Ground Station Analyzer (GSA)

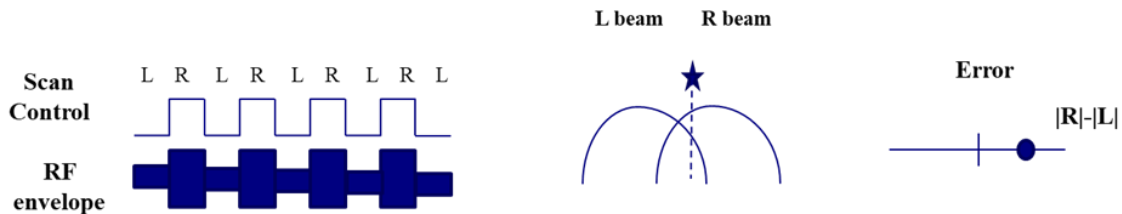
The Ground Station Analyzer (GSA) is a revolutionary technology that not only provides basic RF end-to-end HGS checkout, but it includes the capability to manipulate an RF signal such that it appears as a live virtual target to the

TM and ground station equipment. This RF signal is radiated from the subreflector to the feed. Unlike “test signal injection” schemes, where the AM signal is inserted somewhere downstream of the feed, the GSA exercises every single component in the RF path. No defect or failure can be overlooked.

The hardware to support the GSA is mounted on the antenna, above the azimuth rotary joint. The key components of the GSA are a custom Quasonix transmitter (capable of functions not supported by our standard transmitters, such as amplitude modulation) and a small L/S/C band button antenna mounted to the exterior of the feed at the vertex of the reflector.

When driven by the GSA, the antenna follows the synthetic target across the synthetic sky, and the receivers demodulate the ARTM waveforms for downstream processing by the decommutators. If there are dropouts caused by any signal characteristics or limitations in the ground station, including tracking errors, the GSA will produce them.

To illustrate how the GSA source creates RF signals that look like a real target, a simple two-state SCM example is shown in Figure 135. By increasing the amplitude of the transmission in conjunction with the right beam SCM scanning, it can cause the HTAC to estimate the target being to the right and therefore cause antenna to actually move in that direction. By monitoring the actual position of the antenna, the GSA can continually synthesize the RF response as if an actual target was present.



**Figure 135: GSA Generates the Actual RF Signal with Correct AM**

Since the GSA and GSA transmitter synthesize RF, it truly checks the entire RF and TM system. The GSA can also accept an external TM test stream to also exercise downstream ground station processing if desired. This capability provides for end-to-end total ground station checkout without a traditional boresight. A block diagram showing the GSA architecture is shown in Figure 136.

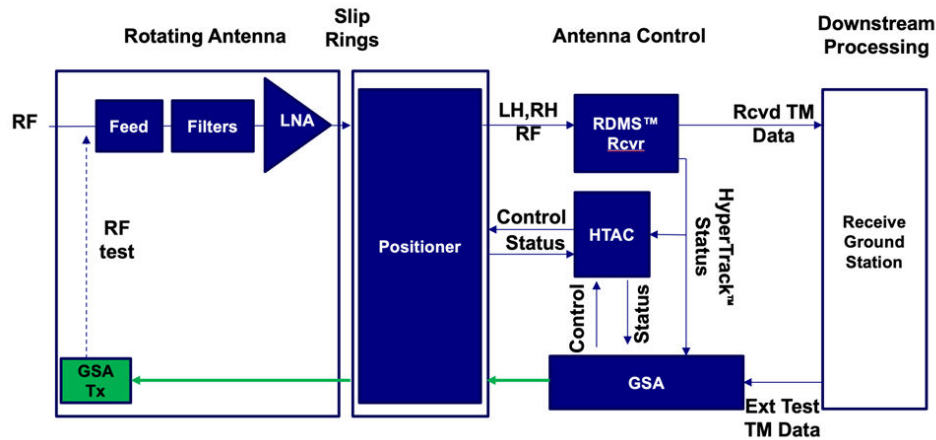


Figure 136: GSA—An Integral Part of each HyperTrack™ Ground Station

#### 8.4.7.1 Go/No-Go

The Go/No-Go feature of HyperTrack™ allows for the operator to automatically perform any or all of the Ground Station Analyzer functions. The tests to be performed can be selected from a drop down menu. Then, at any time, these tests can be run to verify that the ground station is operating properly. For instance, you may want to run the Interference survey on the channel that you are operating, then an End-to-End RF Verification followed by an Antenna Dynamic Response. All of the selected tests will be run in order, and the performance will be compared to the “normal” data to achieve a Go/No-Go indication.

#### 8.4.7.2 Automatic G/T Measurement

The HyperTrack™ serial protocol includes the received signal strength. This allows G/T measurements to be done automatically, by simply selecting G/T on the antenna control GUI. Then, in the span of about 20 seconds...

1. The HTAC points the antenna toward the sun (using the HTAC’s Sun Designate function).
2. The receiver reports the sun signal strength to the HTAC via the HyperTrack™ digital interface.
3. The HTAC then steers the antenna to a series of locations expected to be “cold sky.”
4. The receiver reports the cold sky signal strengths to the HTAC.
5. The HTAC uses the lowest cold sky signal strength and the sun signal strength to compute G/T.

#### 8.4.7.3 Antenna Dynamic Response

In contrast to a static boresight checkout, the GSA can create a virtual RF-based target to track with internally or externally supplied TM data. This allows the operator to perform realistic HGS testing that ranges from testing the HGS step response to full realistic flight scenarios. By comparing the results to previous testing and standard factory measurements, abnormalities in the HGS can be detected and corrected prior to experiencing costly antenna or telemetry failures.

#### 8.4.7.4 Calibration

The HyperTrack™ Antenna Control System with integrated GSA performs automatic calibrations and system checks to reduce operator workload and system configuration errors. These features include Automatic Phasing, End-to-end RF Verification, and Interference Surveys.

### 8.4.7.4.1 Auto-Phasing

Like any auto-tracking antenna system, time alignment of the SCM strobe signal and AM Error signal is required to maintain optimal system tracking. In HyperTrack™ mode, this time alignment is precise, automatic, repeatable, and permanent.

The control loop delay is inversely proportional to the AM filter bandwidth which is proportional to the scan rate. Since this system is totally digital, all of these parameters are set in the HyperTrack™ Antenna Controller (HTAC). Additionally, the receive tracking frequency is set in the HTAC. Knowing all of these parameters, the HTAC automatically adjusts all of the tracking parameters for optimal operation. No operator involvement is ever required.

### 8.4.7.4.2 End-to-end RF Verification

Ensuring all RF paths are performing correctly can become a difficult and time-consuming process. HyperTrack™ reduces system down time and streamlines trouble shooting by automatic End-to-end RF path verification. This is accomplished by using the integrated test transmitter and iterating through all channels. The channel under test is tuned to the test frequency and all other channels are tuned off frequency. The test signal contains a PN test pattern which is verified by each HyperTrack™ system component. Since all HyperTrack™ components support detection of all input signals, it is possible to determine system and hardware configuration errors, such as crossed or missing cable connections.

### 8.4.7.4.3 Interference Survey

HyperTrack™ can perform automated interference surveys using the STRCI communication protocol. This allows the operator to understand and gain a clear picture of interferers on the range. An interference survey can be performed at a single point or swept across a range of angles. At each test point, the system sweeps each channel's receiver frequency across supported frequencies bands. During the scan, the system records the pointing angle, frequency, and AGC data. When finished, plots and logs with survey information are provided for viewing and export.

## 9 Appendix B – Acronym List

Acronym	Description
AGC	Automatic Gain Control
AM	Amplitude Modulation
AQPSK	Variant of Quadrature Phase Shift Keying
ARTM	Advanced Range Telemetry
AUQPSK	Variant of Quadrature Phase Shift Keying
BER	Bit Error Rate
BNC	Bayonet Neill-Concelman Connector (RF Connector)
BPSK	Binary Phase Shift Keying
CPM	Continuous Phase Modulation
DB-9	D-subminiature 9 pin Serial Connector
DC	Diversity Combiner
DHCP	Dynamic Host Configuration Protocol
DPM	Digital Phase Modulation
DQ	Data Quality
DQM	Data Quality Metric
FPGA	Field Programmable Gate Array
IF	Intermediate Frequency
IP	Internet Protocol
kbps	Kilobits per second
KHz	Kilohertz
LCD	Liquid Crystal Display
mbps	Megabits per second
MCX	Snap on subminiature connector
MHCPM	multi-h Continuous Phase Modulation
MHz	Megahertz
N	(connector type) Threaded RF connector
OQPSK	Offset Quadrature Phase Shift Keying

Acronym	Description
PCMFM	Pulse Code Modulation/Frequency Modulation
PM	Phase Modulation
PSK	Phase Shift Keying
QPSK	Quadrature Phase Shift Keying
RDMS	Receiver DeModulator Synchronizer
RF	Radio Frequency
RJ-45	Ethernet Connection Jack
RM	Rack Mount
RRC	Remote RDMS Client
RS-232	Recommended Standard 232 (Serial Communications)
SAW	Surface Acoustic Wave
SDI	System Degradation Indication
SOQPSK	Shaped Offset Quadrature Phase Shift Keying
SOQPSK-TG	Shaped Offset Quadrature Phase Shift Keying –Telemetry Group
TRL	Tracking Loop
TTL	Transistor Logic
UDP	User Datagram Protocol
UQPSK	Unbalanced Quadrature Phase Shift Keying
USB	Universal Serial Bus
VAC	Voltage Alternating Current
VDC	Voltage Direct Current
WAN	Wide Area Network